Service Manual

WFM 1125

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

071-0455-04

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

Copyright © Sony/Tektronix Corporation. All rights reserved.

Copyright © Tektronix, Inc.. All rights reserved

Tektronix products are covered by U.S. and foreign patents, issued and pending. Information in this publication supercedes that in all previously published material. Specifications and price change privileges reserved.

Printed in Japan

Sony/Tektronix Corporation, P.O. Box 5209, Tokyo Int'l, Tokyo 100–31 Japan

Tektronix, Inc., P.O. Box 1000, Wilsonville, OR 97070–1000

TEKTRONIX and TEK are registered trademarks of Tektronix, Inc.

WARRANTY

Tektronix warrants that the products that it manufactures and sells will be free from defects in materials and workmanship for a period of one (1) year from the date of shipment. If a product proves defective during this warranty 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 warranty period and make suitable arrangements for the performance of service. 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.

THIS WARRANTY IS GIVEN BY TEKTRONIX IN LIEU OF ANY OTHER WARRANTIES, EXPRESS OR IMPLIED. TEKTRONIX AND ITS VENDORS DISCLAIM ANY IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. TEKTRONIX' RESPONSIBILITY TO REPAIR OR REPLACE DEFECTIVE PRODUCTS IS THE SOLE AND EXCLUSIVE REMEDY PROVIDED TO THE CUSTOMER FOR BREACH OF THIS WARRANTY. TEKTRONIX AND ITS VENDORS WILL NOT BE LIABLE FOR ANY INDIRECT, SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES IRRESPECTIVE OF WHETHER TEKTRONIX OR THE VENDOR HAS ADVANCE NOTICE OF THE POSSIBILITY OF SUCH DAMAGES.

Service Assurance

If you have not already purchased Service Assurance for this product, you may do so at any time during the product's warranty period. Service Assurance provides Repair Protection and Calibration Services to meet your needs.

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

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

Service Assurance Advantages

- Priced well below the cost of a single repair or calibration
- Avoid delays for service by eliminating the need for separate purchase authorizations from your company
- Eliminates unexpected service expenses

For Information and Ordering

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

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

Table of Contents

Specifications

Operating Information

Theory of Operation

Performance Verification

Adjustment Procedure

Maintenance

Options

Electrical Parts List

Diagrams

Mechanical Parts List

List of Figures

List of Tables

General Safety Summary

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

Only qualified personnel should perform service procedures.

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

To Avoid Fire or Personal Injury

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

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

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

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

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

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

Do Not Operate in Wet/Damp Conditions.

Do Not Operate in an Explosive Atmosphere.

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

Symbols and Terms

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

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

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

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

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

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

CAUTION indicates a hazard to property including the product.

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

WARNING
High Voltage

Protective Ground
(Earth) Terminal

CAUTION
Refer to Manual

Double
Insulated

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, disconnect the mains power by means of the power cord or, if provided, the power switch.

Use Caution When Servicing the CRT. To avoid electric shock or injury, use extreme caution when handling the CRT. Only qualified personnel familiar with CRT servicing procedures and precautions should remove or install the CRT.

CRTs retain hazardous voltages for long periods of time after power is turned off. Before attempting any servicing, discharge the CRT by shorting the anode to chassis ground. When discharging the CRT, connect the discharge path to ground and then the anode. Rough handling may cause the CRT to implode. Do not nick or scratch the glass or subject it to undue pressure when removing or installing it. When handling the CRT, wear safety goggles and heavy gloves for protection.

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.

X-Radiation. To avoid x-radiation exposure, do not modify or otherwise alter the high-voltage circuitry or the CRT enclosure. X-ray emissions generated within this product have been sufficiently shielded.

Preface

This document supports serial number J310000 and above.

This preface contains information needed to properly use this document to service the WFM 1125 Digital Television Waveform Monitor Option 0A/0B/0C/0D, as well as general information critical to safe and effective servicing of this waveform monitor. This manual applies to any instrument with serial number J310101 and above.

Document Structure

This document is divided into sections, such as *Specification and Theory of Operation*. Further, it is divided into subsections, such as *Product Description* and *Removal and Installation Procedures.*

Sections containing procedures also contain introductions to those procedures. Be sure to read these introductions because they provide information needed to do the service correctly and efficiently. The following is a brief description of each document section.

- *Specification* contains a product description of the WFM 1125 Digital Television Waveform Monitor Option 0A/0B/0C/0D and tables of the characteristics and descriptions that apply to it.
- *Operating Information* includes general information and operating instructions at the level needed to safely power on and service this waveform monitor. A statement of the service strategy that this document supports, and instructions for shipment of the waveform monitor are found in this section.
- *Theory of Operation* contains circuit descriptions that support general service and fault isolation down to the module level.
- *Performance Verification* contains a collection of procedures for confirming that these waveform monitor function properly and meet warranted limits.
- *Adjustment Procedures* contains a collection of procedures for adjusting these waveform monitor to meet warranted limits.
- *Maintenance* contains information and procedures for doing preventive and corrective maintenance of these waveform monitor. Instructions for cleaning, for firmware updates, and for fault isolation to a module are found here.
- *Options* contains information on servicing any of the factory-installed options that may be present in your waveform monitor.

- *Electrical Parts List* contains a statement referring you to *Mechanical Replaceable Parts,* where both electrical and mechanical modules are listed.
- *Diagrams* contains a block diagram and an interconnection diagram useful for isolating failed modules.
- *Mechanical Parts List* includes a table of all replaceable modules, their descriptions, and their Tektronix part numbers, as well as the exploded view.

Document Conventions

This document uses certain conventions which you should become familiar with before doing service.

Modules

Throughout this manual, any replaceable component, assembly, or part of these waveform monitor is referred to generically as a module. In general, a module is an assembly, like a circuit board, rather than a component, like a resistor or an integrated circuit. Sometimes a single component is a module; for example, each chassis part of the waveform monitor is a module.

Safety

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

Symbols

Besides the symbols related to safety, this document uses the following symbols:

STOP*. The stop labels information which must be read in order to correctly do service and to avoid incorrectly using or applying service procedures.*

Related Manual

The WFM 1125 Digital Television Waveform Monitor Option 0A/0B/0C/0D come with the following manual:

WFM 1125 Option 0A/0B/0C User Manual (Tektronix part number 071-0260-XX) contains information for operation the WFM 1125 Digital Television Waveform Monitor Option 0A/0B/0C/0D.

Introduction

Service Strategy

STOP*. Throughout this document, any field-replaceable component, assembly, or part of this waveform monitor is referred to generically as a module.*

This document contains all the information needed for periodic maintenance of the WFM 1125 Digital Television Waveform Monitor Option 0A/0B/0C/0D. (Examples of such information are procedures for checking performance and for readjustment.) Further, it contains all information for corrective maintenance down to the module level. This means that the procedures, diagrams, and other troubleshooting aids help isolate failures to a specific module, rather than to components of that module. Once a failure is isolated, replace the module with a fresh unit obtained from the factory.

All modules are listed in *Mechanical Parts List*. To isolate a failure to a module, use the fault isolation procedures found in Section 6, *Maintenance*.

Service Offerings

Tektronix provides service to cover repair under warranty as well as other services that may provide a cost-effective answer to your service needs.

Whether providing warranty repair service or any of the other services listed below, Tektronix service technicians, trained on Tektronix products, are best equipped to service your WFM 1125 Digital Television Waveform Monitor Option 0A/0B/0C/0D. Tektronix technicians are appraised of the latest information on improvements to the product as well as the latest new options to the product.

Warranty Repair Service

Tektronix warrants this product for one year from date of purchase. Tektronix technicians provide warranty service at most Tektronix service locations worldwide. Your Tektronix product catalog lists all service locations worldwide.

Repair or Calibration Service

The following services may be purchased to tailor repair and/or calibration of your WFM 1125 Digital Television Waveform Monitor Option 0A/0B/0C/0D to fit your requirements.

At-Depot Service. Tektronix offers several standard-priced adjustment (calibration) and repair services:

- A single repair and/or adjustment.
- Calibrations using equipment and procedures that meet the traceability standards specific to the local area.
- Annual maintenance agreements that provide for either calibration and repair or calibration only of the waveform monitor.

Of these services, the annual maintenance agreement offers a particularly cost-effective approach to service for many owners of the WFM 1125 Digital Television Waveform Monitor Option 0A/0B/0C/0D. Such agreements can be purchased to span several years.

On-Site Service. The annual maintenance agreement can be purchased with on-site service, with repair and calibration done at your facility. This service reduces the time your waveform monitor is out of service when calibration or repair is required.

Self Service

Tektronix supports repair to the module level by providing *Module Exchange* and *Module Repair and Return*.

Module Exchange. This service reduces down time for repair by allowing you to exchange most modules for remanufactured ones. Tektronix ships you an updated and tested exchange module from the Beaverton, Oregon service center, typically within 24 hours. Each module comes with a 90-day service warranty.

Module Repair and Return. This service returns to you within 10 days the same module that you shipped to Tektronix. The module shipped is repaired, tested, and returned to you from the Beaverton, Oregon service center. It is *not* updated to match current modules of the same type. Again, each module comes with a 90-day service warranty.

For More Information. Contact your local Tektronix service center or sales engineer for more information on any of the repair or adjustment services just described.

Before You Begin

This document is for servicing the WFM 1125 Digital Television Waveform Monitor Option 0A/0B/0C/0D. To prevent injury to yourself or damage to the waveform monitor, do the following tasks before you attempt service:

- Be sure you are a qualified service person.
- Read the Safety Summary found at the beginning of this document.
- Read *Service Strategy* in this section and *Supplying Operating Power* in section 2.

When using this document for servicing, be sure to heed all warnings, cautions, and notes.

Specifications

Product Description

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

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

Features

The waveform monitor offers the following features:

- Supports the following system formats:
  - Option 0A: 1035/60i, 1035/59.94i, 1080/60i, and 1080/59.94i
  - Option 0B: 720/60p and 720/59.94p
  - Option 0C: 1035/60i, 1035/59.94i, 1080/60i, 1080/59.94i, 720/60p, and 720/59.94p
  - Option 0D: 1035/60i, 1035/59.94i, 1080/60i, 1080/59.94i, 1080/50i, 720/60p, 720/59.94p, 1080/30sF, 1080/29.97sF, 1080/25sF, 1080/24sF, 1080/23.98sF, 1080/24p, and 1080/23.98p
- Digital component video signal displays, parade and vector modes
- Save and Display feature that saves and recalls the currently displayed signal
- CRC error detection
- Gamut error detection
- Infinite mode in persistence display that retains the image of transient signals
- Overlay and Parade displays
- Diamond, Lightning, and Bowtie displays
- Four graticules for waveform display
- Serial digital monitor output and CRC error monitor output
- Analog external reference input with passive loop through, bi-level or tri-level sync

- AES/EBU digital audio output (except for 720/60p, 720/59.94p, 1080/24p, and 1080/23.98p)
- Y, P_b, P_r picture monitor analog output from selected serial digital signal input

Specifications

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

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

Electrical Specifications

Table 1–1: Vertical deflection system

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

Table 1–2: Horizontal deflection system

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

Table 1–2: Horizontal deflection system (Cont.)

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

Table 1–2: Horizontal deflection system (Cont.)

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

Table 1–3: Serial digital video interface

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

Table 1–4: Analog Output

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

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

Characteristic	Performance requirements	Reference information
Format		ANSI S4.40
Impedance		75 Ω Unbalanced
Return Loss		> 25 dB at 0.1 MHz to 6 MHz
Amplitude	1.0 V ± 10 %	
DC Offset	0.0 V ± 50 mV	
Rise/Fall Time	30 ns to 44 ns	
Sampling Rate		48 kHz (locked to video signal)
Phase Lock Time		< 15 s

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

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

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

Table 1–6: External reference input

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

Table 1–7: Format display

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

Table 1–8: Field rate display

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

Table 1–9: RBG transcoder

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

Table 1–10: Component vector mode

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

Table 1–11: Lightning and diamond mode

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

Table 1–12: Bowtie mode

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

Table 1–13: Status display mode

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

Table 1–14: Save and display mode

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

Table 1–15: Warning display

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

Table 1–16: Calculation dynamic range

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

Table 1–17: Setup memory

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

Table 1–18: CRT display

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

Table 1–19: AC power source

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

Table 1–19: AC power source (Cont.)

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

2 Per EN 55103-1 Annex B

Table 1–20: Installation requirements

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

Environmental Characteristics

Table 1–21: Environmental characteristics

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

Physical Characteristics

Table 1–22: Physical characteristics

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

Safety and EMI

Table 1–23: Certifications and compliances[3]

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

Table 1–23: Certifications and compliances[3] (Cont.)

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

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

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

Operating Information

Operating Information

This section is divided into the following three subsections:

- Preparation for Use. Describes the installation, environmental requirements, information of how to power on or off, etc.
- Using the Menu. Describes the general menu operating information and DIAG/CAL menu structure.
- Remote Control. Describes the remote interfaces for servicing.

Preparation for Use

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

- Installation.
- Operating Environment.
- Applying and Interrupting Power.
- Repacking.

Installation

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

Included Accessories

The waveform monitor is shipped with several accessory items which may be required for normal use. For more information on accessories, refer to page 7–1.

Hardware Installation

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

Cabinet Options. The cabinets offered for the waveform monitor provide EMI shielding, protect against electrical shock, and protect against the accumulation of dust. Figure 2–1 shows the plain cabinet, option 1700F00. A rear panel fan supplies filtered, cooling air which exits through the cabinet vent holes. Restricting the air flow through the vents or the rear fan can lead to an excessive internal temperature.

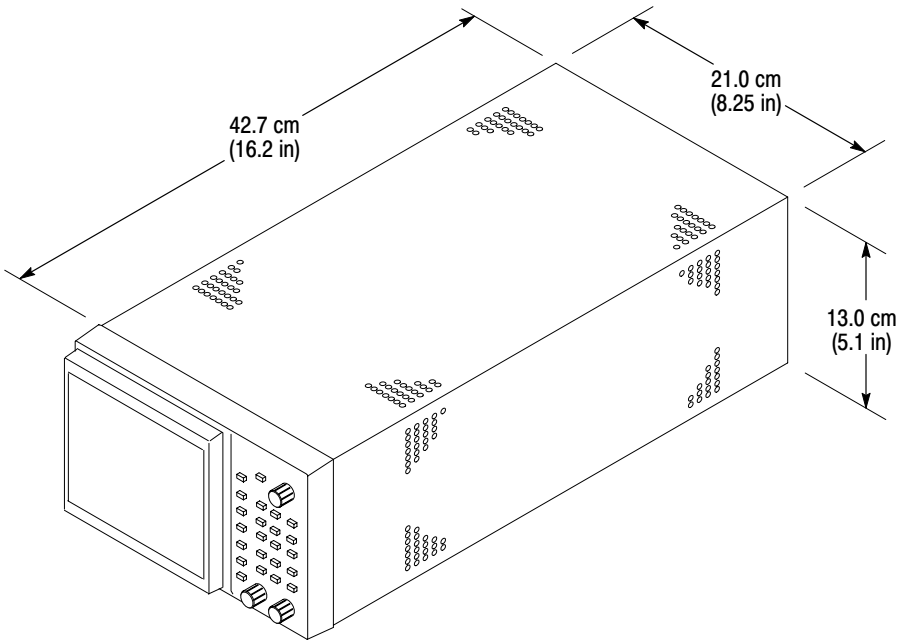


Figure 2–1: Dimensions of the 1700F00 plain cabinet

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

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

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

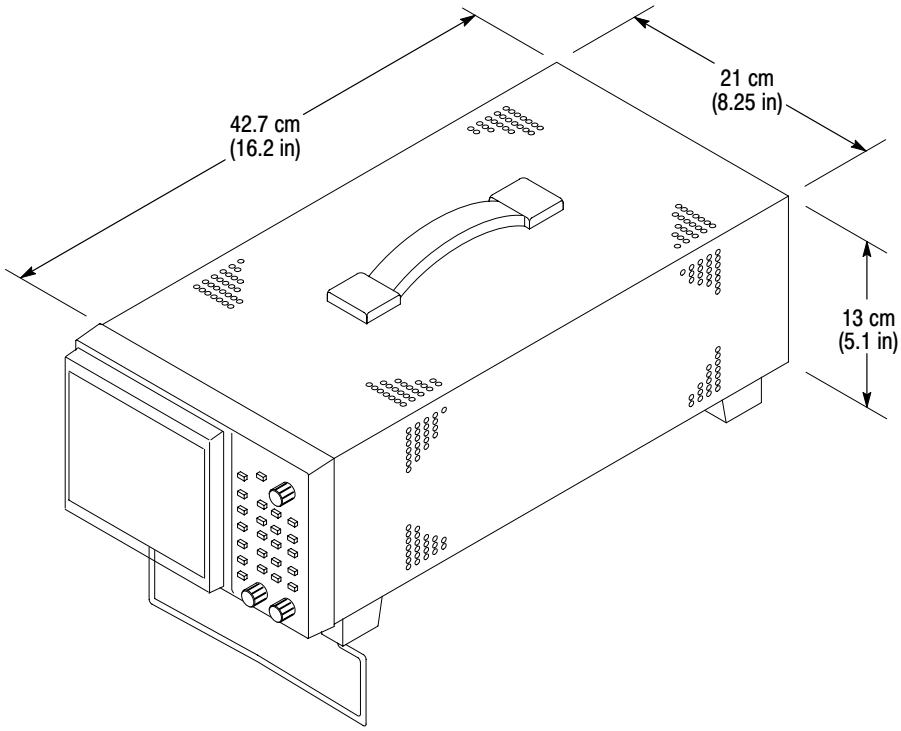


Figure 2–2: 1700F02 portable cabinet

Cabinet Installation. Secure the waveform monitor in a cabinet using two Trox T-15 screws. Figure 2–3 shows the location of these screws on the rear panel.

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

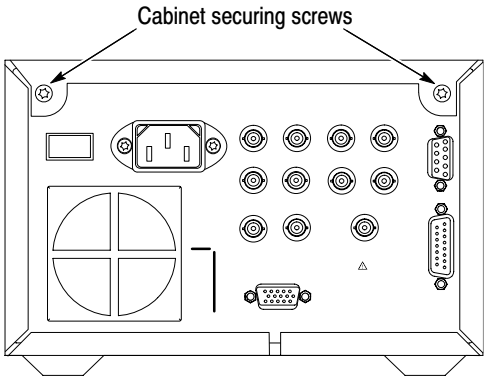


Figure 2–3: Rear view of the waveform monitor in a 1700F02 cabinet

Rack Adapter Installation. The optional 1700F05 side-by-side rack adapter, shown in Figure 2–4, consists of two attached cabinets. Use it to mount the waveform monitor and another half-rack width instrument, such as an analog component monitor, in a standard 19-inch rack.

You can adjust the rack adapter so that the waveform monitor is aligned with other equipment in the rack. See Figure 2–4.

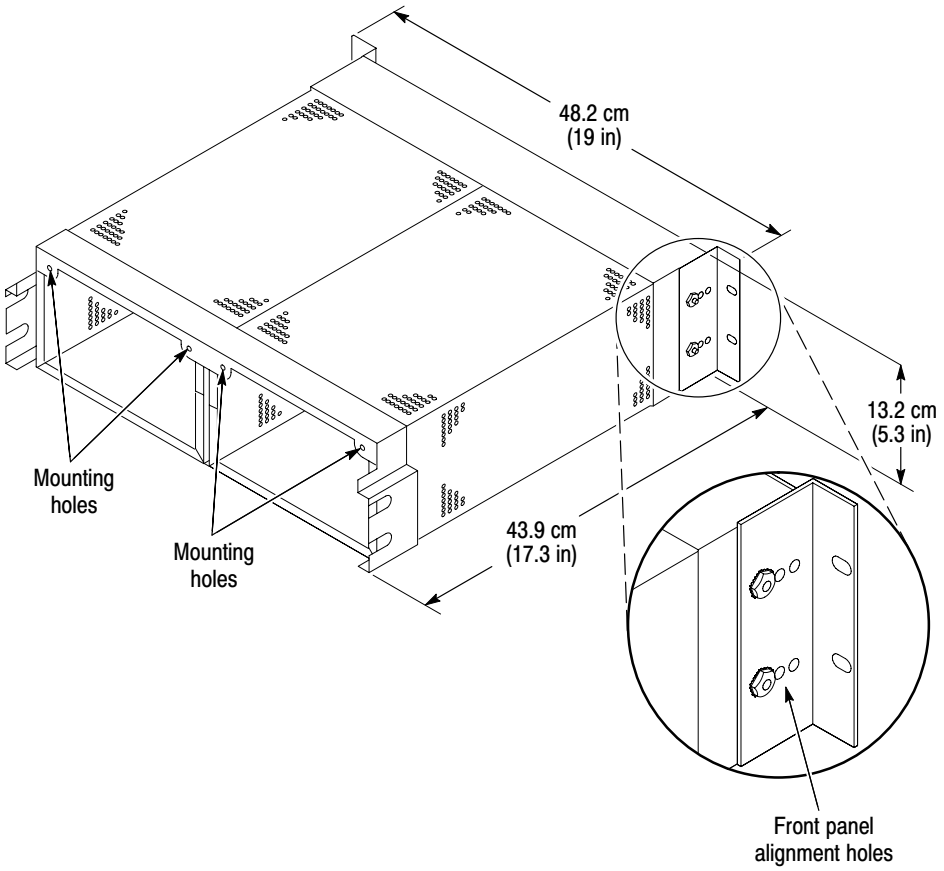


Figure 2–4: The 1700F05 rack cabinet holds two instruments

If you are using only one side of the rack adapter, insert a blank panel (1700F06) or an accessory drawer (1700F07) in the unused section to improve airflow and appearance. Figure 2–5 shows the blank panel and drawer.

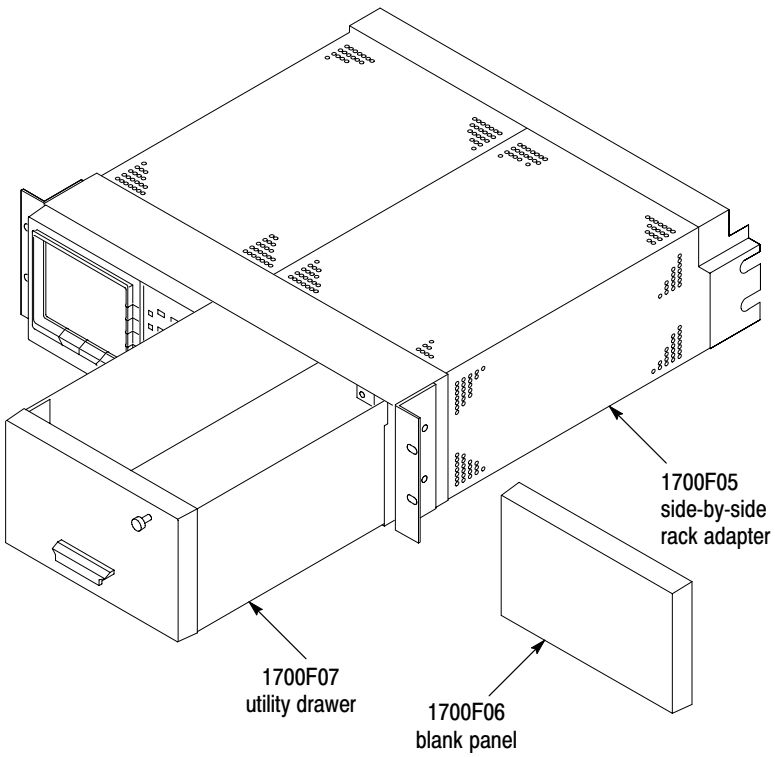


Figure 2–5: 1700F05 cabinet showing utility drawer and blank panel

Supplying Operating Power

***NOTE**. Read all information and heed all warnings in this subsection before connecting the waveform monitor to a power source.*

***WARNING.** AC POWER SOURCE AND CONNECTION. The waveform monitor operates from a single-phase power source. It has a three-wire power cord and two-pole, three-terminal grounding type plug. The voltage to ground (earth) from either pole of the power source must not exceed the maximum rated operating voltage, 240 volts.*

Before making connection to the power source, be sure the waveform monitor has a suitable two-pole, three-terminal grounding-type plug.

GROUNDING. This instrument is safety Class 1 equipment (IEC designation). All accessible conductive parts are directly connected through the grounding conductor of the power cord to the grounded (earthing) contact of the power plug.

***WARNING.** The power input plug must be inserted only in a mating receptacle with a grounding contact where earth ground has been verified by a qualified service person. Do not defeat the grounding connection. Any interruption of the grounding connection can create an electric shock hazard.*

For electric shock protection, the grounding connection must be made before making connection to the instrument's input or output terminals.

Power Cord Information

A power cord with the appropriate plug is supplied with each waveform monitor. Table 2–1 gives the color-coding of the conductors in the power cord.

Table 2–1: Power-cord conductor identification

Conductor	Color	Alternate color
Ungrounded (Line)	Brown	Black
Grounded (Neutral)	Light Blue	White
Grounded (Earthing)	Green/Yellow	Green

Operating Voltage

This waveform monitor operates with any line voltage from 90 to 240 VAC_{RMS} with any line frequency from 48 to 63 Hz. No fuse is provided with this waveform monitor.

Memory Backup Power

The CPU module with on-board battery allows the WFM 1125 Digital Television Waveform Monitor Option 0A/0B/0C/0D to retain some types of data upon loss of the AC power source. The stored adjustment constants, saved front-panel settings, current front-panel settings (instrument status), and waveforms saved in memory are retained.

The on-board battery of the CPU module has a shelf life of about five years. Partial or total loss of stored settings upon power on may indicate that the battery needs to be replaced.

Operating Environment

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

Operating Temperature

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

Ventilation Requirements

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

Applying and Interrupting Power

Consider the following information when you power on or power off the instrument, or when power is interrupted due to an external power failure.

Power On

At power on, the waveform monitor does not run the self check.

The waveform monitor has the internal diagnostic routines to allow you to isolate faulty modules. If needed, run the internal diagnostics manually.

Refer to Section 6, *Maintenance*, for information on diagnostics and fault isolation.

CRT Blinking

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

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

Power Off

CAUTION. *DO NOT power off the waveform monitor when doing any of the adjustments described in Section 5,* Adjustment Procedures. *To do so might result in the loss of internally stored adjustment constants.*

In general, do not power off the instrument when doing operations. Wait for the instrument to finish the operation when doing adjustments, or saving setups.

Improper power off or unexpected loss of power to the waveform monitor may result in the following corruptions of nonvolatile RAM (NVRAM). The following table describes the messages displayed when power is restored after an abnormal power off.

Table 2–2: Effects of corrupted data

Corrupted data type	Results
Saved Setups	Setup Lost

Repackaging Instructions

Use a corrugated cardboard shipping carton having a test strength of at least 275 pounds and with an inside dimension at least six inches greater than the instrument dimensions.

If the instrument is being shipped to a Tektronix Service Center, enclose the following information: the owner's address, name and phone number of a contact person, type and serial number of the instrument, reason for returning, and a complete description of the service required.

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

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

Installed Options

All options and optional accessories are listed and described in Section 7, *Options*. For further information and prices of instrument options, contact your Tektronix Field Office.

Using the Menus

You can set most functions with either context sensitive bezel button menus or general configuration menus. The following subsections outline and describe how to make selections from these menus. Figure 2–6 shows the buttons and knob used for menu selection.

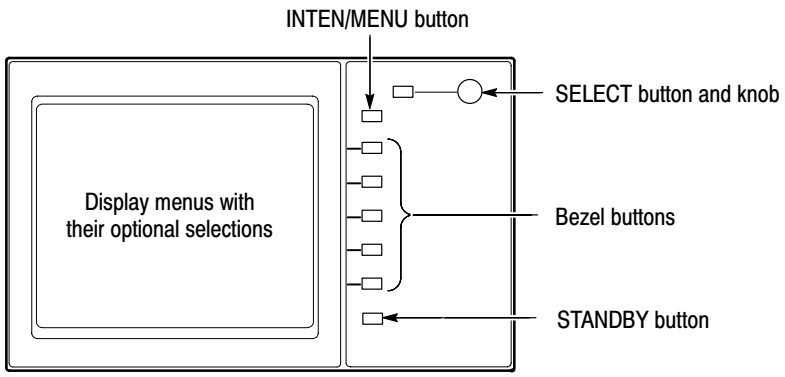


Figure 2–6: Elements of the WFM 1125 menu controls

Bezel Menu

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

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

Configure Menu

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

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

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

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

For example, turn the GAMUT on by stepping through the menus as follows:

1. Press and hold the INTEN/MENU button to display the Configure menu.
2. Turn the SELECT knob until GAMUT highlights.
3. Push the SELECT button to ON.
4. Push the INTEN/MENU button again to turn off the menu readout without losing your selections.

For additional information on this menu, refer to the *WFM1125 Option 0A/0B/0C User Manual*.

DIAG/CAL Menu

There are following three ways to enter into the DIAG/CAL mode:

- Turn on the Power switch on the rear panel while holding down the STANDBY button on the front panel.
- Press the INTEN/MENU button while holding down the 5-th bezel button, and then press the EXECUTE bezel button when the DIAG/CAL menu appears.
- Turn on the Power switch on the rear panel when the firmwares have not been downloaded yet to the internal modules.

NOTE. *If you enter into the DIAG/CAL mode through the first or third ways, the waveform monitor is not configured correctly. So, the I/O test in the MEMORY test will report a FAIL even if the H/W is correct.*

When you enter into the DIAG/CAL mode, the DIAG/CAL menu appears at the far right of the screen (VGA monitor).

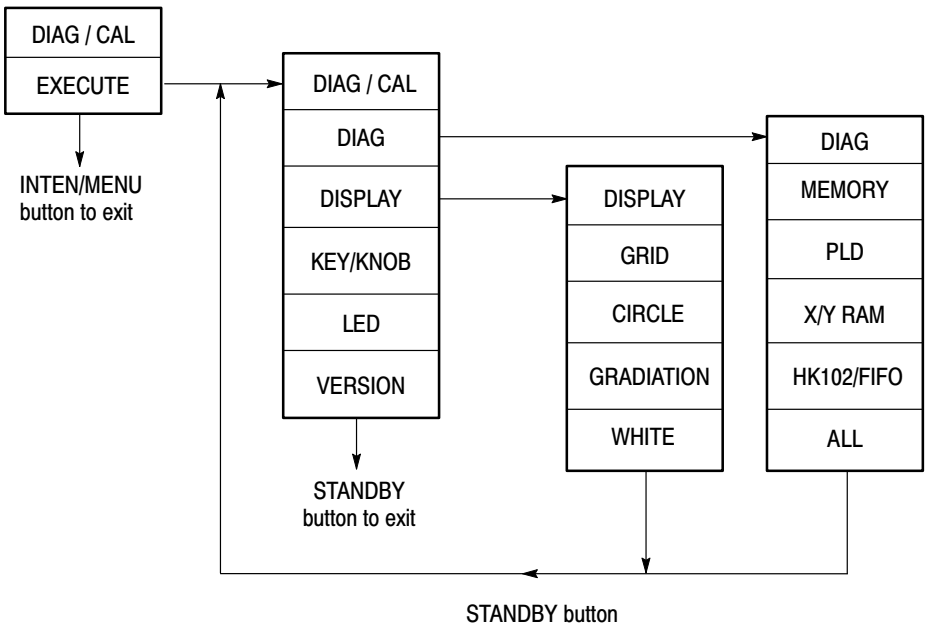


Figure 2–7: DIAG/CAL menu structure

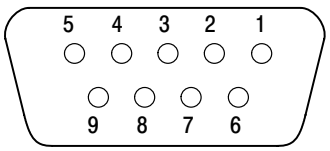
To select DIAG/CAL menu item, press the corresponding bezel button, and press the STANDBY button to go back to the previous menu. When you select a menu item to run the diagnostic or calibration routine, the menu disappears and corresponding screes appears. Press the STANDBY button to exit that screen and to restore the menu.

Remote Operation

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

RS–232C Connector

The RS-232C connector is a 9-pin D-type connector that provides a status data output and a remote verification interface. Figure 2–8 shows the pin assignments and the communication parameters for the RS-232C interface.



Communication parameters

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

Data bits: 8 (unselectable)

Stop bits: 1 (unselectable)

Parity: None (unselectable)

Flow control: Hard flagging (unselectable)

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

Figure 2–8: Pin assignments for the RS-232C connector

RS-232C Remote Command

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

```
DUMP
```

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

The following is an output example:

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

```
SAVE #
```

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

```
RECALL #
```

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

Remote Connector

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

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

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

Pin assignments for the REMOTE connector are shown in Figure 2–9 and described in Table 2–3. You enable functions by ground closures (TTL lows) on specified pins. Functions with "overbars" indicate an active low state.

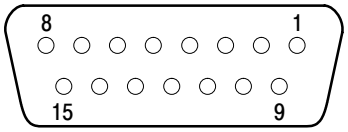


Figure 2–9: Pin assignments for the REMOTE connector

Table 2–3: Remote connector pin assignments and functions

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

Table 2–3: Remote connector pin assignments and functions (cont.)

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

Theory of Operation

Theory of Operation

This section describes the electrical operation of the WFM 1125 Digital Television Waveform Monitor Option 0A/0B/0C/0D using the major circuit blocks or modules.

A15 Relay & Sync board

CHANNEL SELECTOR After input through CH A or CH B, the 1.48 Gbps serial signal is input to K200 through A15 Relay & Sync board J240 or J230. After either one is selected, the serial signal input to the HK-102/HK-202 serial parallel conversion module on the A10 INPUT board through J210.

SYNC SEPARATOR The EXT REF signal is input the U130 buffer amplifier through J220 or J250. The buffered signal is input the U100 and the U200 through two different low pass filters. Although the U100 and the U200 are the NS (National Semiconductor) LM1881 which is sync separator, the functions of V-sync and the odd-even are not used in this instrument. The U100 generates the composite NTSC sync and the U200 generates the composite HDTV sync. The composite sync signals are input to A10 U200 through the W100.

A10 Input board

HK-102/HK-202 The input 1.48 Gbps serial data is converted into the Y signal (10-bit wide data) and the Pb/Pr multiplex signal (10-bit wide) at a data rate of 74.25 MHz. The module also generates the 74.25 MHz clock and the FRAME and CRCE signals. The FRAME signal indicates distinction between the HD (horizontal synchronization) and VD (vertical synchronization) numbers. The CRCE signal indicates occurrence of a CRC error.

This module has a CPU interface attached, which enables the operator to make various settings. Using this interface, this device turns on/off the unsurely data mask.

The 74.25 MHz clock, Y, Pb/Pr, and FRAME signals are input to the DEMUX circuit. The CRCE signal is buffered, resulting in output from the CRCE connector (BNC) through J290. (This output signal can be monitored on the oscilloscope etc.) The CRCE signal is input to the A20 MAIN board through W110 in order to indicate CRCE errors.

DEMUX After output from HK-102/HK-202 at a data rate of 74.25 MHz, the signal is input to the DEMUX circuit, resulting in drop to a data rate of 37.125 MHz. The output signals are: Y_EVEN (10-bit wide), Y_ODD (10-bit wide), Pb (10-bit wide), Pr (10-bit wide), 37.125 MHz consecutive clocks, STOP_CLK (controlled by signal STOP from the A20 MAIN board), and LINE_NUMN, which indicates the start of the frame.

The Y_EVEN<9..0>, Y_ODD<9..0>, Pb<9..0>, and Pr<9..0> signals are buffered by U200, U210, U220, U230, and U240, respectively. They are input to the A20 MAIN board through W100 and W110.

A20 Main board

LINE SELECT LINE SELECT consists of two major components. One is a counter used to count the lines up to the current line number from the LINE_NUMN signal, which indicates the start of the frame generated in the A10 INPUT board. The other is a register that holds the line number to be displayed.

When the line numbers match, LINE SELECT permits the FIFO to write approximately 1- or 2-line data.

LINE SELECT may be used in Line Select or Lines mode, the latter of which cannot display all the liens, thus neglecting some of them. For this reason, the circuit contains a sequencer that automatically updates the line number to be displayed.

FIFO FIFO is a 16-bit wide, 2K-word FIFO circuit. The Y_EVEN<9..0>, Y_ODD<9..0>, Pb<9..0>, Pr<9..0>, LINE_NUM<11..0>, and LAST_LINE signals are written into FIFO. LAST_LINE indicates the last line of the current frame.

DOUBLER DOUBLER is the data output from FIFO. The rate of Pb/Pr is one-half of that of Y. This circuit doubles the quantity of Pb/Pr data by interpolation.

TRANSCODER TRANSCODER calculates G, B, and R using Y and the doubly interpolated Pb/Pr data. It can also output Y, Pb, and/or Pr as they are.

INTERPOLATE This circuit consists of three GF9101's manufactured by GENUM.

U260 processes G or Y; U270 processes B or Pb; U270 processes R or Pr. Each of the ICs shape a 24-tap FIR filter, and can vary up to 54 coefficients in real time. For this device, any data rate up to 18.6 MHz (37.25 MHz/2) is considered to be the real time.

With the above features, this device performs interpolation by a factor of 53, that by a factor of 23, and sampling by a factor of 52/53.

OFFSET OFFSET operates the UP/DOWN counter through the pulse that is output from the rotary encode (V-POS knob on front panel). The increase or decrease in the UP/DOWN counter is read by the CPU. The vertical position is changed by increasing or decreasing the selected GF9101's digital offset.

ADDRESS GENERATOR The vertical data is obtained by selecting the data to be output, out of the output data from the GF9101.

Each time effective data is output from the GF9101, the horizontal data is obtained by incrementing the internal counter. Digital sweep is implemented as follows: each time one-line display ends, it is loaded to the value preset for the counter.

X-RAM and Y-RAM X-RAM and Y-RAM linearly convert the 15-bit wide data from ADDRESS GENERATOR into 9-bit data. Each of them is a 9-bit wide, 32K-word RAM. X-RAM is for horizontal conversion, and Y-RAM for vertical conversion.

HISTOGRAM HISTOGRAM uses the X-RAM and Y-RAM outputs as the addresses. It reads the data that indicated when the control signal indicating the effective data is enabled. After adding 1 to that data, HISTOGRAM writes the sum into the same address.

U450 and U460 constitute one pair, and U480 and U490 the other. Each of these RAMs can address a data rate against up to once for 4 clocks (37.125 MHz). While one pair is in Addition mode, the other is in Read mode. The results are sent to the VARIABLE PERSISTENCE circuit. Mode switching takes place when the last piece of data of a frame has been written.

VARIABLE PERSISTENCE The results of HISTOGRAM is written into U510 and U520. VARIABLE PERSISTENCE reads the results from these two RAMs simultaneously. It then adds the sum of the two results to the value obtained by multiplying the values stored in U510 and U520 by a constant. VARIABLE PERSISTENCE writes the result into the same address as the HISTOGRAM read-out address, again.

If the above constant is 0, VARIABLE PERSISTENCE is set off. If it is 1, the infinite state is entered.

VRAM U555 and U550, used for overlay, display characters and/or divisions in the whole area (480 x 640) of the VGA display.

U565, U570, and U575 constitute a triple buffer. The data from VARIABLE PERSISTENCE can be written into the RAM without dead time.

U585 is a SAVE&DISP RAM. While SAVE&DISP is not in execution, U585 is continuously writing the data into the VRAM from the inside of VARIABLE PERSISTENCE running cycle. When the front panel's SAVE&DISP button is pressed, U585 stops the write operation, and enters the read mode in which data is read through the triple buffer's serial port. The data is transferred to ADDER (U600) in synchronization with one of the triple buffer RAMs.

U580 is controlling the above RAMs, and is generating the horizontal and vertical synchronous pulses of VGA.

ADDER When SAVE&DISP is not working, ADDER selects the RAM the contents of which are being read through the serial port of the triple buffer (VRAM). It then sends the data of this RAM to RAM DAC.

When the front panel's SAVE&DISP button is pressed, ADDER adds the U585 serial data to the selected data above before sending the result to RAM DAC.

RAM DAC RAM DAC produces the intensity signal based on the data used in ADDER. INTENSITY can be updated by rewriting the data within the internal palette of RAM DAC.

CONTROLLER The main functions are (1) generating the address used to switch the coefficient of the GF9101 within INTERPOLATE, (2) controlling the clock that will be added to the DOUBLER controller, and (3) generating the strobe of the effective data.

This control starts when EMPTY FLAG is negated after the data enters the FIFO.

Others Since this board uses reconfigurable FPGA 10K10 and 10K30, the contents of FPGA vary with the mode.

This rule applies also to X-RAM and Y-RAM.

A40 CPU board

The A40 CPU board consists of the 68303 CPU, 128K-byte ROM, 256K-byte RAM (with battery backup), and 8M-byte FLASH ROM.

This board has an RS-232C port, which facilitates program modification.

A30 Front Panel board

The A30 Front Panel board drives the buttons, knobs and LEDs. User selections from the front panel are sent to the A20 Main board, and the commands from the A20 Main board control the LEDs on the front panel.

A60 DC-DC board

The A60 DC-DC board generates the -2, -5, +1.2, +3.3, and +12.5 V power supply voltages from the +5 V power supplied from Power Supply, and sends them to the other boards.

Power Supply

The Power Supply generates the +5 V power supply voltage from the AC line, and sends it to the A60 DC-DC board and A20 Main board.

The principal **Power** switch, located on the rear panel, controls all power to the waveform monitor including the Power Supply.

A5 DISPLAY board

The A5 DISPLAY board is a VGA driver that drives the VGA monitor. The VGA signal is supplied through the A20 MAIN board's J390 connector.

Fan

The fan provides forced air cooling for the waveform monitor. It connects to +12.5 V from the A60 DC-DC board.

Performance Verification

Performance Verification

This section describes the operation tests for the WFM 1125 Digital Television Waveform Monitor Option 0A/0B/0C/0D, and the procedures for those tests. The operation tests can be divided into two categories.

- Diagnostics.

  The waveform monitor incorporates a diagnostic routines that performs comprehensive instrument testing. This routine confirms that the waveform monitor is operating correctly. Refer to *Diagnostics* on page 6–19 for the diagnostic procedures.

- Performance tests.

  These tests confirm the operation of the items that are marked with an asterisk (*) in the guaranteed items in the operating specifications listed in Section 1, *Specifications*. The equipment listed in Table 4–1 is required to perform these performance tests.

Before Running the Performance Tests

Perform the following before running the Operation Tests.

Warm up A 20 minute warm up period is required for the all instruments (except for PC) prior to running the operation tests.

Required Equipments

Table 4–1 lists the equipment required for the performance tests.

Table 4–1: Required equipment

Item	Qty.	Required precision	Recommended equipment	Purpose
HDTV signal generator	1	Latest modification must be installed.	Tektronix TSG1001 and PSC1125 (Upgraded by 040-1649-00 upgrade kit)	Signal source
Sampling oscilloscope	1		Tektronix 11801C or equivalent, sampling head (SD-24 or SD-26)	To observe and measure the voltage from the MONITOR OUT
Oscilloscope	1		Tektronix TDS540B or equivalent	To observe and measure many output signals.
Digital Audio Monitor	1		Tektronix 764 or equivalent	To observe audio signal from the AUDIO output.
NTSC TV Generator	1		Tektronix TSG170A or equivalent	To provide NTSC test signal source.
RS-232C cable with 25-pin, D-type connectors	2	Male	Tektronix part no. 174–3882–00 (provided with the PSC1125)	Signal interconnections between the TSG1001 and PSC1125.
50/75Ω attenuator	2	Minimum loss	Tektronix part no. 011-0057-01	Signal interconnection
75Ω terminator	2		Tektronix part no. 011-0102-00	Signal interconnection
BNC-to-BNC adaptor	2	Female-to-female	Tektronix part no. 103-0028-00	Signal interconnection
BNC-to-BNC adaptor	2	Male-to-male	Tektronix part no. 103-0029-00	Signal interconnection
BNC-to-SMA adaptor	2	Female-to-male	Tektronix part no. 015-1018-00	Signal interconnection
BNC T connector	2		Tektronix part no. 103-0030-00	Signal interconnection
BNC cable	3	Impedance: 75 Ω		Signal interconnection
BNC cable	1	Impedance: 50 Ω		Signal interconnection
VGA monitor	1			VGA OUTPUT signal test
VGA video cable	1			Connection between a VGA monitor and the VGA OUTPUT.
Ground closer (loopback cable) with 15-pin, D-type connector	1		Custom, see Figure 4–1	Remote function tests.

Table 4–1: Required equipment (Cont.)

Item	Qty.	Required precision	Recommended equipment	Purpose
PC	1	IBM PC compatible		For downloading the signal set data to the TSG1001
Parallel interface cable	1		Tektronix part no. 174-2344-00, Supplied with the TSG1001	Connection between a PC and the TSG1001.
Signal set floppy disk	1	TSG1001 Signal Library The multi.dnl signal set file is included.	Tektronix part no. 063-2986-xx (provided with the PSC1125)	Signal set data to be down-loaded to the TSG1001 for tests
	1	TSG1001 Signal Library The multall.dnl signal set file is included.	Tektronix part no. 063-3286-xx (provided with the PSC1125-MF1 or 040-1649-00 upgrade kit for PSC1125)	Signal set data to be down-loaded to the TSG1001 for the format mode test of option 0D.

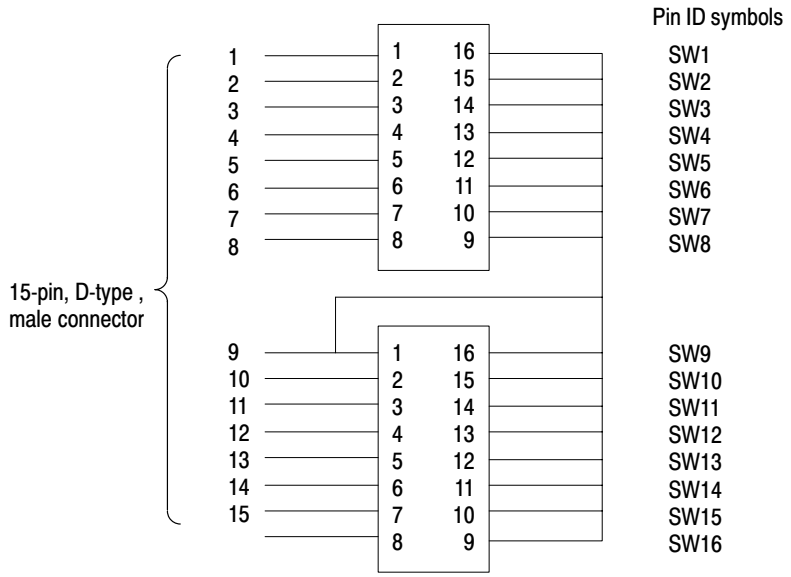


Figure 4–1: Ground closer with 15-pin D-type connector

Performance Tests

The performance test for thewaveform monitor must be performed in the following order.

- Frequency response
- Low pass filter
- Front panel controls
- Format modes (option 0D only)
- Analog output
- Audio output
- External reference
- Remote functions
- MONITOR out
- VGA output

***NOTE**. When you do the performance procedures in this section after the A40 CPU and/or A20 Main board have/has been replaced, you must download the firmware data to those modules first. Refer to* Firmware Updates *on page 6–9 for the firmware updating procedures.*

Preparations

To perform tests, download the signal set data: multi.dnl supplied with the floppy disk to the TSG1001 in advance.

Downloading to the TSG1001.

To load the signal set data into the TSG1001, you should install the SDP1000 communication utility: COM1000 into a PC. The procedures described below supposes that the necessary utility is already stored in the directory sdp1000.

***NOTE**. For the details on installation the COM1000, the SDP1000 communication utility, and downloading the signal set data to the TSG1001, refer to the manuals supplied with the TSG1001 and SDP1000.*

1. Connect the TSG1001 and PC with a parallel interface cable. And in the PC, type:

   ```
   cd sdp1000 <Return>
   com1000 <Return>
   <Return>
   ```

   DOWNLOAD screen appears.

2. Insert the signal set floppy disk (Multi.dnl signal set file stored) into the floppy disk driver on the PC. And type:

   ```
   a: <Return>
   ```

   The screen for the download files appears.

3. Select the Multi signal set file. Then press:

   ```
   <Return>
   ```

   Wait until the PC indicates that the download process has completed successfully.

Frequency response

This test confirms the frequency response.

The following equipment is required.

Equipment Required	HDTV signal generator (TSG1001 and PSC1125)
	Oscilloscope
	Two parallel signal cables
	Two 75 Ω BNC cables
	50 Ω BNC cable

Connections. Refer to Figure 4–2 for connections.

Using the parallel signal cables supplied with the PSC1125, connect between the G/Y on the TSG1001 and Y on the PSC1125, and between the B/Pb on the TSG1001 and P_B/P_R on the PSC1125.

Using the 75 Ω BNC cable, connect the OUT1 connector on the PSC1125 rear panel to the CH A connector on the waveform monitor rear panel.

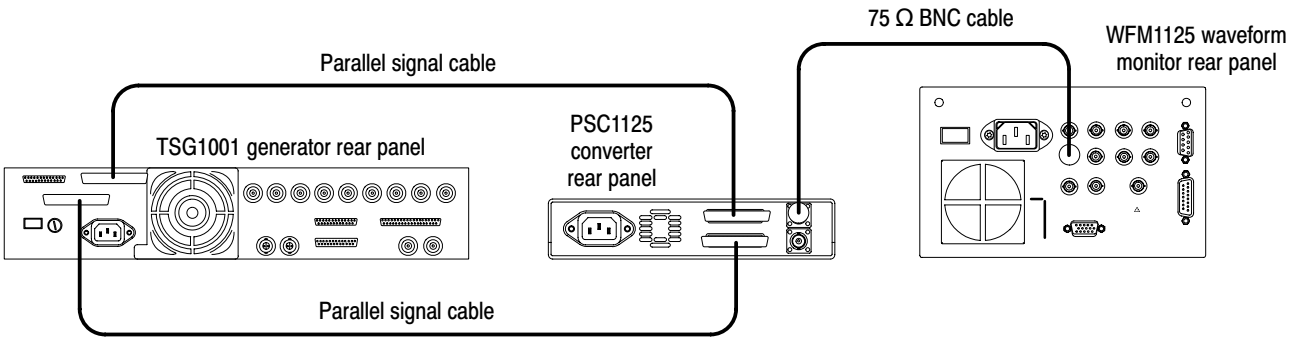


Figure 4–2: Performance test initial hookup

Initial Setups.

- TSG1001**:**

  FORMAT: . . . . . SMPTE 274M 60Hz (for Option 0A)
  SMPTE 296M (for Option 0B)

  SWEEP: . . . . . 100 %

  For Option 0C and Option 0D, perform the following procedure using the format setting for Option 0A and Option 0B respectively.

- The Waveform Monitor**:**

  INPUT: . . . . . CH A

Procedure.

1. Press and hold the **INTEN/MENU** button and select **FACTORY : EXECUTE → OK**.
2. Press the **DISPLAY : CH 1** button and **GAIN : ON** button, and then × 10 bezel button align the sweep waveform with the graticule.
3. Confirm that the amplitude of the sweep waveform is in the range from 696.5 to 703.5 mV and that the accuracy falls within the ± 0.5 %.
4. Press × 1 bezel button.
5. Press the **DISPLAY : CH 2** button and × 10 bezel button align the marker of the sweep waveform with the graticule.
6. Confirm that the amplitude of the sweep waveform is in the range from 695.1 to 704.9 mV and that the accuracy falls within the ± 0.7 %.
7. Press × 1 bezel button.

8. Press the **DISPLAY : CH 3** button and ×10 bezel button align the marker of the sweep waveform with the graticule.
9. Press ×1 bezel button.
10. Confirm that the amplitude of the sweep waveform is in the range from 695.1 to 704.9 mV and that the accuracy falls within the ± 0.7 %.
11. Press ×1 bezel button.

Low pass filter

This test confirms that the low pass filter operation is functioning correctly.

Use the test hookup and equipment controls from the previous test.

1. Press and hold the **INTEN/MENU** button and select **FILTER : LPF**.
2. Press the **INTEN/MENU** button again to clear the menu from the screen.
3. Press the **DISPLAY: CH1** and confirm the 4-th marker amplitude is equal to or less than 221 mV.
4. Press the **DISPLAY: CH2** and confirm the 7-th marker amplitude is equal to or less than 221 mV.
5. Press the **DISPLAY: CH3** and confirm the 7-th marker amplitude is equal to or less than 221 mV.
6. Press and hold the **INTEN/MENU** button on the front panel and select **FILTER : FLAT**, and then press the **INTEN/MENU** button again.

Front panel controls

This test confirms that the front panel controls are functioning correctly.

Use the test hookup and equipment controls from the previous test.

1. On the TSG1001 front panel, press the **COLOR BARS** button to set the COLOR BARS to 75 %.
2. Press the **DISPLAY : CH1** and confirm:
   - The CH1 LED lights.
   - Y signal is currently displayed.
3. Press the **DISPLAY : CH2** and confirm:
   - The CH2 LED lights.
   - P_b signal is currently displayed.
4. Press the **DISPLAY : CH3** and confirm:
   - The CH3 LED lights.

- P_r signal is currently displayed.

5. Press the **DISPLAY : OVERLAY/PARADE** button and confirm:
   - The LEDs of the PARADE, CH1, CH2 and CH3 light.
   - Y, P_b and P_r signals are being displayed in that order.
6. Press the **DISPLAY : OVERLAY/PARADE** button and confirm:
   - The LEDs of the OVERLAY, CH1, CH2 and CH3 light.
   - Y, P_b and P_r signals are being overlapped on the screen.
7. Press the **DISPLAY : BOWTIE/VECTOR** button and confirm:
   - The LEDs of the VECTOR lights.
   - Vector display is being made.

   a. Press the **LIGHTNING** bezel button and confirm:
   - Lightning display is being made.

   b. Press the **DIAMOND** bezel button and confirm:
   - Diamond display is being made.
8. On the TSG1001 front panel, press the **TIMING SIGNALS** button to set the TIMING SIGNAL to BOWTIE.
9. Press the **DISPLAY : BOWTIE/VECTOR** button and confirm:
   - The LEDs BOWTIE lights.
   - Bowtie waveform is displayed on the screen.
10. Press the **DISPLAY : STATUS** button and confirm:
    - The STATUS LED lights.
    - Status display is in progress.
11. Press the **DISPLAY: OVERLAY/PARADE** button and then the **VERTICAL OFFSET** button, and confirm:
    - The OFFSET menu appears at the far right part of the screen.
    - Each of CH1, CH2, CH3 and ALL can be selected by pressing the corresponding bezel button, and turning the **V POS** knob causes only the trace(s) for the selected channel(s) to move vertically.
12. Select **RESET** from the menu.
13. Press the **INTEN/MENU** button.

14. Press the **GAIN : ON** button and press the **X5** bezel button, and then confirm:
    - The GAIN: ON LED lights.
15. Press the **X1** bezel button to set the vertical gain to off.
16. Press the **LINE SEL : ON** button and confirm:
    - The VBLANK part disappears from the trace.
    - The LINE SEL: ON LED lights.
    - A line number is displayed at the upper left part of the screen.
17. Press the **DISPLAY : CH1** button and then press the **SWEEP** button, and confirm:
    - The SWEEP menu appears at the far right part of the screen.
    - Pressing each of the bezel buttons causes to change the display.
18. Select **1 LINE** from the menu and press the **INTEN/MENU** button.
19. Press the **HORIZONTAL : MAG** button to set it to on and confirm:
    - The waveform is enlarged laterally.
    - The HORIZONTAL: MAG LED lights.
20. Press the **HORIZONTAL : MAG** button to set it to off.
21. Press the **CURSOR : ON** button on the front panel and confirm:
    - The CURSOR menu appears at the far right part of the screen.
    - When a cursor is selected, the CURSOR: ON LED goes on, and the LED goes off when the **OFF** is selected.
22. Select **OFF** from the menu and then press the **INTEN/MENU** button.
23. Press **INPUT : A/B** button to select the CH B connector on the rear panel for input signal and confirm:
    - The INPUT: B LED lights.
    - The message *NO SIGNAL* is displayed at the lower part of the screen and the waveform disappears.

For the instrument with serial number J340101 and above,

- The INPUT: B LED light.
- Waveform changes a line.

24. Switch the PSC1125 cable connection from the CH A to the CH B on the waveform monitor, and confirm:

- The waveform appears on the screen again.

25. On the TSG1001 front panel, press the **SIGNAL SET** button twice.

26. On the TSG1001 front panel, press the **COLOR BARS** button and use the knob to lower the CIRCLE FREQ.

27. Press the **SAVE&DISP : ON** button and confirm:

- The SAVE&DISP : ON LED lights.
- The stationary and moving waveforms overlap.

28. Press the **SAVE&DISP : ON** button and confirm:

- The stationary waveform disappears.
- The SAVE&DISP: ON LED goes off.

29. On the TSG1001 front panel, press the **SIGNAL SET** button twice.

30. Press and hold the **INTEN/MENU** button and confirm:

- The **MENU** can be selected by turning the **SELECT** knob.

31. Press the **INTEN/MENU** button again. Then confirm:

- The menu disappears.
- The trace moves left and right by turning **H POS** knob.

32. Press the **HORIZONTAL : MAG** button to set it to on and confirm:

- The trace moves to left and right by turning **H POS** knob.

33. Press the **HORIZONTAL: MAG** to set it to off.

34. Press and hold the **INTEN/MENU** button, select **CRC LED : ON** and then **GAMUT : ON**.

35. With another 75 Ω cable, connect the OUT 2 on the PSC1125 rear panel and the CH A on the waveform monitor rear panel.

36. With a 50 Ω cable, connect the oscilloscope input and the CRCE OUT on the waveform monitor. Set the input impedance of the oscilloscope to 1 M Ω. Confirm:

- The CRC LED momentarily lights each time the **INPUT : A/B** button is pressed.
- Concurrently, a positive TTL–level pulse (2 to 5 V) is being output from the CRCE OUT.

37. On the TSG1001 front panel, press the **SWEEP** button to set the SWEEP to 100 %, and confirm:

- The GAMUT LED goes on.

38. On the TSG1001 front panel, press the **COLOR BARS** button to set the COLOR BAR to 100 %, and confirm:

- The GAMUT LED goes out.

Format modes (Option 0D only)

This test confirms that the format modes of Option 0D are functioning correctly .

Use the test hookup and equipment controls from the previous test.

1. Download the “multall.dnl” signal set file supplied on the TG1001 Signal Library floppy disk with part number 063–3286–xx to the TSG1001. Refer to *Downloading to the TSG1001* on page 4–4 for instructions.

1. On the TSG1001 front panel, press the **COLOR BARS** button to set the COLOR BARS to 75 %.

2. Set the format mode to “i” (interlace) .

3. Press the **SWEEP** button to select 2LINE display.

4. On the TSG1001 front panel, press the **FORMAT** button repeatedly to set the FORMAT to 274M 50Hz, and confirm:

- The field rate display at the upper right of the screen changes to 50i.

5. Set the format mode to “p” (progressive).

6. Press the **SWEEP** button to select 2LINE display.

7. On the TSG1001 front panel, press the **FORMAT** button repeatedly to set the FORMAT to 296M 60Hz, and confirm:

- The field rate display at the upper right of the screen changes to 60p.

8. On the TSG1001 front panel, press the **FORMAT** button repeatedly to set the FORMAT to 274M 24p, and confirm:
   - The field rate display at the upper right of the screen changes to 24p.
9. Set the format mode to "p(sF)" (segment frame).
10. On the TSG1001 front panel, press the **FORMAT** button repeatedly to set the FORMAT to 274M 24sF, and confirm:
    - The field rate display at the upper right of the screen changes to 24sF.
11. Re-download the "multi.dnl" signal set file for the following tests.

Analog output

This test confirms the amplitude and interchannel delay of the ANALOG OUT output.

The following equipment is required.

Equipment Required	HDTV Signal Generator (TSG1001 and PSC1125)
	Oscilloscope
	Two parallel signal cables
	Three 75 Ω BNC cables
	Two BNC T connectors
	Two 75 Ω terminators

Connections. Refer to Figure 4–3 for connections.

Using the parallel signal cables supplied with the PSC1125, connect between the G/Y on the TSG1001 and Y on the PSC1125, and between the B/Pb on the TSG1001 and P_B/P_R on the PSC1125.

Using the 75 Ω BNC cable, connect the OUT1 connector on the PSC1125 rear panel to the CH A connector on the waveform monitor rear panel.

Connect ANALOG OUT Y and ANALOG OUT P_b connector on the waveform monitor rear panel to the oscilloscope CH1 and CH2 input respectively, using the 75 Ω BNC cables and the BNC T connectors.

Terminate the other side of the BNC T connectors with the 75 Ω terminators.

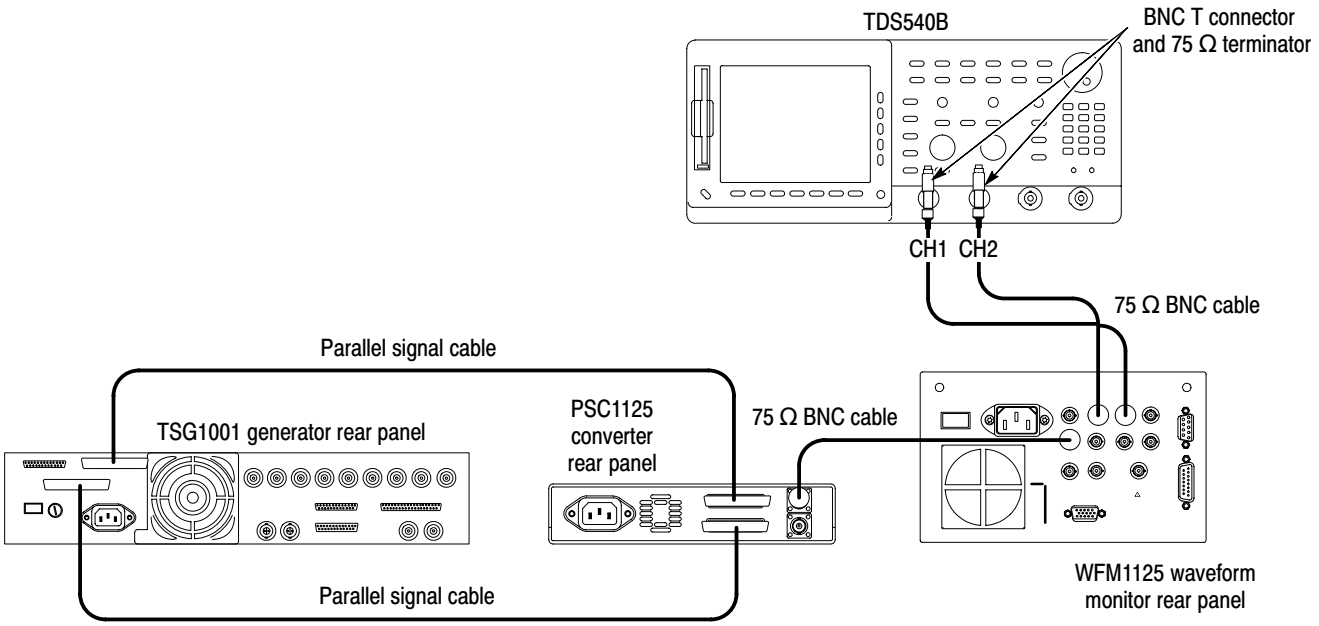


Figure 4–3: Analog output test initial hookup

Initial Setups.

- TSG1001**:**

  FORMAT: . . . . . SMPTE 274M 60Hz (for Option 0A)
  SMPTE 296M (for Option 0B)

  COLOR BARS: . . . . . 100 % COLOR BARS

- The Waveform Monitor**:**

  INPUT: . . . . . CH A

- Oscilloscope:

  Waveform: CH1

  Vertical scale: . . . . . 10 mV/div

  Vertical offset: . . . . . 0 V

  Vertical position: . . . . . Center

  Horizontal scale: . . . . . 10 μs/div

  Trigger mode: . . . . . EDGE

  Trigger source: CH1

Trigger level: . . . . . –140 mV

Procedure.

1. Align the 0 mV level of the signal with the center graticule on the oscilloscope.
2. Change the oscilloscope vertical offset to 700mV.
3. Confirm the signal level is 700 mV ± 7 mV.
4. Change the oscilloscope waveform to CH1 off, waveform to CH2, and vertical offset to –350 mV.
5. Align the –350 mV level of the signal with the center graticule on the oscilloscope.
6. Change the oscilloscope vertical offset to 350 mV.
7. Confirm the signal level is 350 mV ± 7 mV.
8. Press the **TIMING SIGNALS** button on the TSG1001 front panel to set the TIMING SIGNALS to BOWTIE.
9. Change the oscilloscope settings to:

   Waveform: . . . . . CH1 and CH2

   Vertical scale: . . . . . 100 mV/div for CH1
100 mV/div for CH2

   Vertical offset: . . . . . 0 V for CH1 and CH2

   Horizontal scale: . . . . . 1 µs/div

   Record length : . . . . . 5000 points

10. Press the MATH REF button on the oscilloscope front panel, and then press the main and side menu buttons in the following order to create a Math waveform:
    Change Math waveform definition → Dual Wfm Math → Set 1st Source to [Ch1] → Set operator to [–] → Set 2nd Source to [Ch2]
11. Change the oscilloscope settings to:

    Waveform: . . . . . CH1 and CH2 to Off

    Zoom: . . . . . On

    Vertical scale: . . . . . 100 mV/div (5.0 X Vert) for Math1

    Horizontal scale: . . . . . 5 µs/div (0.2X Horz)

12. Observe the Bowtie display on the oscilloscope and confirm the skew is within 3 ns (the marker on the display indicates 1 ns).

13. Change the oscilloscope zoom setting to off.

14. On the TSG1001 front panel press the **COLOR BARS** button to set the COLOR BAR to 100 %.

15. Change the BNC cable from ANALOG OUT P_b connector to ANALOG OUT P_r connector.

16. Change the oscilloscope settings to:

    Waveform: . . . . . MATH1 to off and CH2 to on

    Vertical scale: . . . . . 10 mV/div

    Vertical offset: . . . . . –350 mV

17. Repeat steps from 5 to 12.

Audio output

This test confirms the amplitude, rise time and fall time of the AUDIO output. This test can be skipped in case of Option 0B or 296M format mode of Option 0C.

The following equipment is required.

Equipment Required	HDTV Signal Generator (TSG1001 and PSC1125)
	Oscilloscope
	Digital Audio Monitor
	Two parallel signal cables
	Three 75 Ω BNC cables
	BNC T connector
	Two 75 Ω terminators

Connections. Refer to Figure 4–4 for connections..

Using the parallel signal cables supplied with the PSC1125, connect between the G/Y on the TSG1001 and Y on the PSC1125, and between the B/Pb on the TSG1001 and P_B/P_R on the PSC1125.

Using the 75 Ω BNC cable, connect the OUT1 connector on the PSC1125 rear panel to the CH A connector on the waveform monitor rear panel.

Connect AUDIO CHA connector on the waveform monitor rear panel to the oscilloscope CH1 input using the 75 Ω BNC cable and the BNC T connector.

Terminate the other side of the BNC T connector with the 75 Ω terminator.

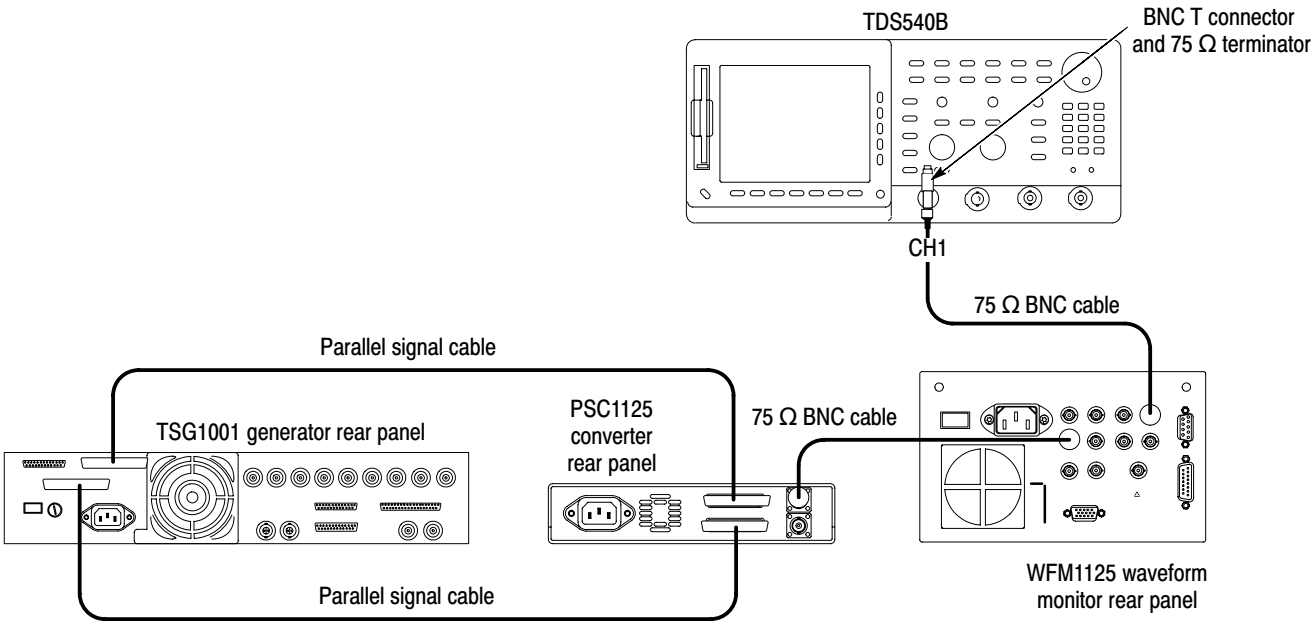


Figure 4–4: Audio output test initial hookup

Initial Setups.

- TSG1001**:**

  FORMAT: . . . . . SMPTE 274M 60Hz (for Option 0A)
  SMPTE 296M (for Option 0B)

  SWEEP: . . . . . 100 %

- The Waveform Monitor**:**

  INPUT: . . . . . CH A

- Oscilloscope**:**

  Waveform: CH1

  Vertical scale: . . . . . 200 mV/div

  Vertical offset: . . . . . 0 V

  Vertical position: . . . . . Center

  Horizontal scale: . . . . . 100 ns/div

  Trigger mode: . . . . . EDGE

Trigger source: CH1

Trigger level: . . . . . –140 mV

Procedure.

1. Align the 0 mV level of the displayed signal with the center graticule on the oscilloscope.
2. Using the oscilloscope measurement function, perform the amplitude measurement, and confirm that the amplitude is 1000 mV ± 100 mV.
3. Using the oscilloscope measurement function, perform the rise and fall time measurements, confirm that the rise and fall times are within the range from 30 ns to 44 ns.
4. Change the BNC cable from the AUDIO CHA connector to the AUDIO CHB connector.
5. Repeat steps from 1 to 3.
6. Disconnect the BNC cable, the BNC T connector, and the 75 Ω terminator from the AUDIO CHB connector on the waveform monitor and CH1 connector on the oscilloscope.
7. Change the connections to as follows:
   a. Connect the AUDIO CHA and AUDIO CHB outputs from the waveform monitor rear panel to the digital audio monitor CH1–2 AUDIO and CH3-4 AUDIO BNC inputs, respectively, using the 75 Ω BNC cables.
   b. Terminate the other side of the loop–through to the CH1-2 AUDIO and CH3–4 AUDIO input with the 75 Ω terminators.
8. On the digital audio monitor front panel, press **MENU** button to display the menu.
9. Select Inputs items from the menu, and select “CH1–2 input: BNC–unbalanced” and “CH3–4 input:BNC–unbalanced” items from the submenu.
10. On the digital audio monitor front panel, press the **CLEAR MENU** button to clear the menu.
11. On the digital audio monitor front panel, press the **VIEW AUDIO** button and **SESSION** button to display AUDIO/SESSION view.
12. In the view, confirm Highest true peaks are –20 dBFS, Sample rates are 48.00 kHz, and Active Bits are 20.
13. On the digital audio monitor, press the **CH STATUS** button to display CHANNEL STATUS view.

14. In the view, confirm CRC errors are not displayed.

External reference

This test confirms that the external reference input operation is functioning correctly.

The following equipment is required.

Equipment Required	HDTV signal generator (TSG1001 and PSC1125)
	NTSC TV signal generator
	Two parallel signal cables
	Two 75 Ω BNC cables
	75 Ω terminator

Connections. Refer to Figure 4–5 for connections.

Using the cables supplied with the PSC1125, connect between the G/Y on the TSG1001 and Y on the PSC1125, and between the B/Pb on the TSG1001 and P_B/P_R on the PSC1125.

Using the 75 Ω BNC cable, connect the OUT1 connector on the PSC1125 rear panel to the CH A connector on the waveform monitor rear panel.

Connect the ANALOG OUT Y output on the waveform monitor rear panel to one side of the EXT REF input on the waveform monitor rear panel using the 75 Ω BNC cable.

Terminate the other side of the loop–through to the EXT REF input with the 75 Ω terminator.

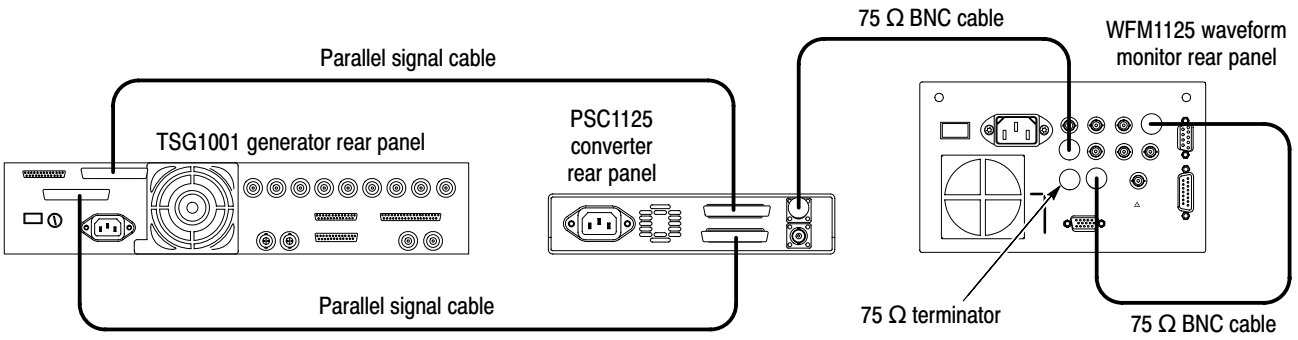


Figure 4–5: External reference test initial hookup

Initial Setups.

- TSG1001**:**

  FORMAT: . . . . . SMPTE 274M 60Hz (for Option 0A)
  SMPTE 296M (for Option 0B)

  SWEEP: . . . . . 100 %

- The Waveform Monitor**:**

  INPUT: . . . . . CH A

1. Press the **REF EXT** button on the waveform monitor front panel to set the reference mode to external.
2. Confirm that the field rate readout at the right upper corner on the screen indicates 60.00 Hz.
3. Disconnect the BNC cable from the ANALOG OUT Y output on the waveform monitor rear panel, and then connect it to the BLACK output on the NTSC TV generator rear panel.
4. Press and hold the **INTEN/MENU** button on the waveform monitor front panel to display the Configure menu, and then select EXT REFERENCE : NTSC from the menu.
5. Confirm that the field rate readout at the right upper corner on the screen indicates 59.94 Hz and the waveform is not locked.

Remote functions

This test confirms that the remote operation is functioning correctly.

The following equipment is required.

Equipment Required	HDTV signal generator (TSG1001 and PSC1125)
	Two parallel signal cables
	75 Ω BNC cable
	Ground closer with 15-pin, D-type connector

Connections. Refer to Figure 4–6 for connections.

Using the cables supplied with the PSC1125, connect between the G/Y on the TSG1001 and Y on the PSC1125, and between the B/Pb on the TSG1001 and P_B/P_R on the PSC1125.

Using the 75 Ω BNC cable, connect the OUT1 connector on the PSC1125 rear panel to the CH A connector on the waveform monitor rear panel.

Connect the 15-pin, D-type ground closure to the REMOTE connector on the rear panel. See Figure 4–1 for the switch ID symbols: SWxx, on the ground closure.

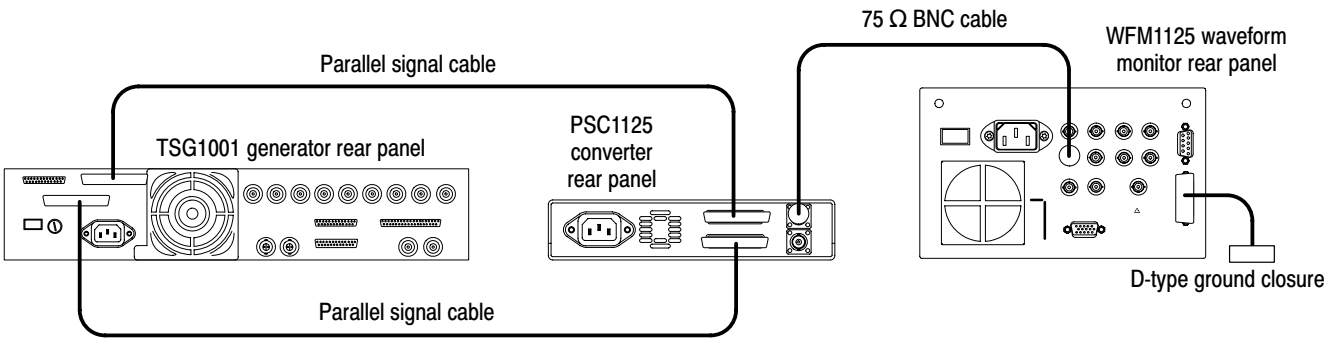


Figure 4–6: External reference test initial hookup

Initial Setups.

- TSG1001**:**

  FORMAT: . . . . . SMPTE 274M 60Hz (for Option 0A)
  SMPTE 296M (for Option 0B)

  SWEEP: . . . . . 100 %

- The Waveform Monitor**:**

  INPUT: . . . . . CH A

1. Open all dip switches on the ground closure.
2. Close SW15 and confirm:
   - The INPUT B LED lights.
3. Open SW15.
   - The INPUT A LED lights.
4. Close SW15.
   - The INPUT B LED lights.
5. Close SW11.
   - The display changes to STATUS.

6. Close SW14.

7. Open SW11.

8. Close SW11.

- The display changes to VECTOR.

9. Close SW13.

10. Open SW11.

11. Close SW11.

- The display changes to PARADE.

12. Close SW12.

13. Open SW11.

14. Close pin 11.

- The display changes to CH1.

15. Close SW10.

- The SAVE&DISP LED lights.

16. Open SW10.

- The SAVE&DISP LED goes out.

17. Close SW1.

- The display changes to 1FIELD.

18. Close SW3.

- The display changes to 2FIELD.

19. Open SW3.

20. Open SW1.

- The display changes to 1LINE, resulting in the Y signal being displayed.

21. Close SW2.

- The display changes to the green display.

22. Press and hold the **INTEN/MENU** button and then select **SAVE PRESET: 1 → OK**.

23. Press the **CH2** button, and select **SAVE PRESET: 2 → OK**.

24. Press the **CH3** button, and select **SAVE PRESET: 3 → OK**.

25. Press the **OVERLAY/PARADE** button, and select **SAVE PRESET: 4 → OK**.

26. Close SW5.

- The CH2 LED lights.

27. Close SW7.

- The CH1 LED lights.

28. Open pin 5 of D-type.

- The CH3 LED lights.

29. Open SW7.

- The CH1, CH2, CH3, and PARADE LED light.

30. Close SW6.

31. Open SW6.

32. Close SW7.

- The CH3 LED lights.

33. Open SW7.

- The CH1 LED lights.

The following procedures are only needed for checking the format mode of Option 0D.

34. Close SW4.

- The display changes to Progressive format mode.

35. Close SW8.

- The display changes to SegmentFframe format mode.

36. Open SW4.

- The display changes to Interlace format mode.

MONITOR output

This test confirms the signal level of the MONITOR output.

The following equipment is required.

Equipment Required	HDTV signal generator (TSG1001 and PSC1125)
	Sampling oscilloscope
	Two parallel signal cables
	75 Ω BNC cable
	Two 50 Ω BNC cables
	Two 75-to-50 Ω minimum-loss pads
	Two SMA-to-BNC adapters

Connections. Refer to Figure 4–7 for connections.

Using the cables supplied with the PSC1125, connect between the G/Y on the TSG1001 and Y on the PSC1125, and between the B/Pb on the TSG1001 and P_B/P_R on the PSC1125.

Using the 75 Ω BNC cable, connect the OUT1 connector on the PSC1125 rear panel to the CH A connector on the waveform monitor rear panel.

Attach the SMA-to-BNC adapters to the CH1 connector and TRIGGER DIRECT INPUT connector on the oscilloscope.

Attach the 75-to-50 Ω minimum-loss pads to OUT2 connector on the PSC1125 rear panel and MONITOR connector on the waveform monitor rear panel.

Using one of the 50 Ω BNC cable, connect the OUT2 attenuator on the PSC1125 to the TRIGGER DIRECT INPUT adapter on the oscilloscope.

Using the other 50 Ω BNC cable, connect the MONITOR attenuator on the waveform monitor to the CH1 adapter on the oscilloscope.

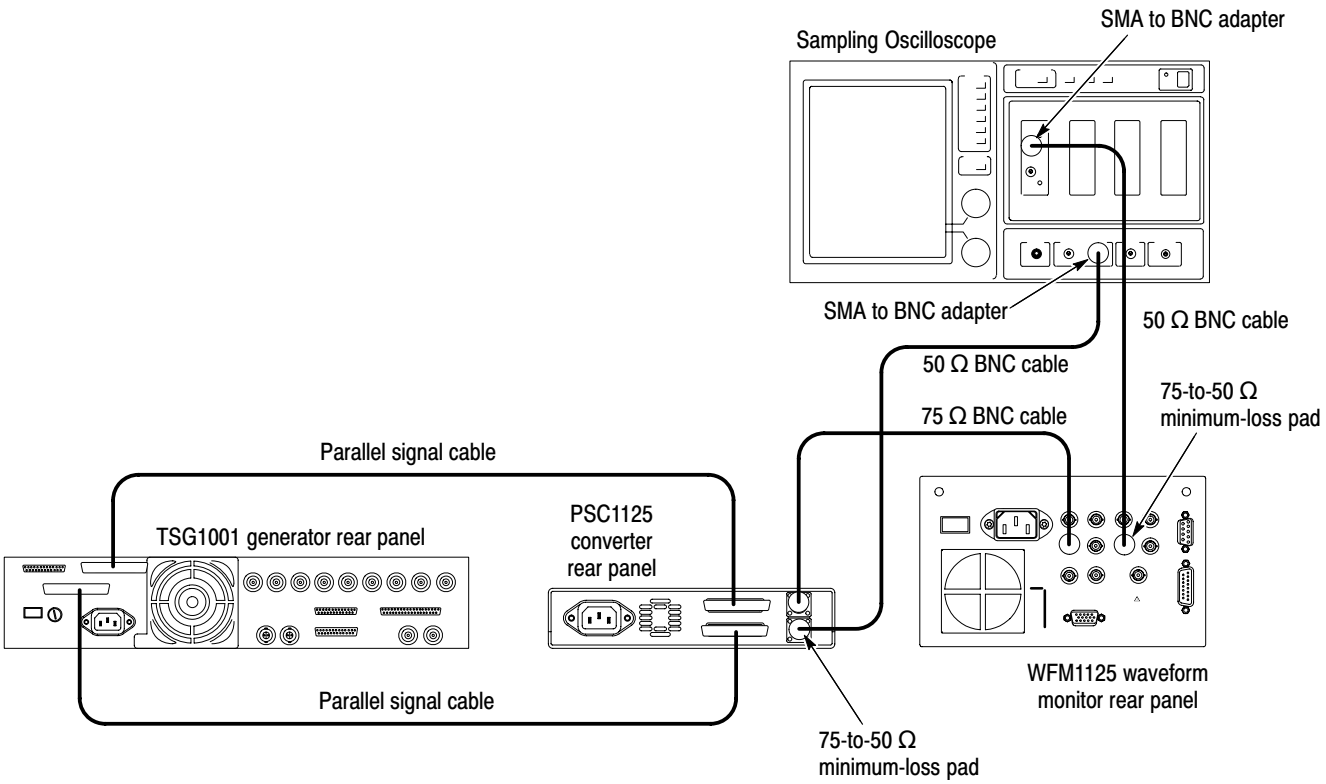


Figure 4–7: Monitor output test initial hookup

Initial Setups.

- TSG1001**:**

  FORMAT: . . . . . SMPTE 274M 60Hz (for Option 0A)
  SMPTE 296M (for Option 0B)

  SWEEP: . . . . . 100 %

- The Waveform Monitor**:**

  INPUT: . . . . . CH A

- Oscilloscope**:**

  Vertical: CH1

  Vertical scale: . . . . . 100 mV/div

  Vertical coupling: . . . . . AC

  Vertical offset: . . . . . 0 V

  Vertical position: . . . . . Center

Horizontal sweep: . . . . . 200 ps/div

Trigger mode: . . . . . Auto

Trigger coupling: . . . . . AC

Trigger level: . . . . . 0 V

Trigger slope: . . . . . Positive

Display mode: . . . . . Color Grading or Infinite

Procedure.

1. Confirm the output voltage from MONITOR connector is 800 mV ± 10%.

VGA output

This test confirms that the VGA signal is output correctly.

The following equipment is required.

Equipment Required	VGA monitor
	VGA video cable

1. Connect the VGA monitor to the VGA OUTPUT on the waveform monitor rear panel using the VGA video cable.
2. Confirm the same view as waveform monitor is displayed on the monitor.

Finish

1. Press and hold the **INTEN/MENU** button and select **FACTORY : EXECUTE → OK**.

Adjustment Procedure

Adjustment Procedures

This section contains information needed to adjust the WFM 1125 Digital Television Waveform Monitor Option 0A/0B/0C/0D.

Adjustment in the waveform monitor are limited to the visual characteristics (linearity, size, focus, contrast and brightness) of the display, analog output level, and the power supply voltage.

Requirements for Performance

Before you do this procedure, you need to address the following requirements.

Personnel This procedure is only to be performed by trained service technicians.

Warm-Up Period This waveform monitor requires a 20 minute warm-up time in a +20° C to +30° C environment before it is adjusted.

Access When adjusting the display, output level, and the power supply voltage, you need to remove the cabinet.

Equipment Required

Table 5–1 lists the equipment required to adjust the output level and power supply voltage. No equipment is required for the display adjustment.

Table 5–1: Required equipment

Item	Qty.	Required precision	Recommended equipment	Purpose
HDTV signal generator	1	Latest modification must be installed.	Tektronix TSG1001 and PSC1125 (Upgraded by 040-1649-00 upgrade kit)	Signal source
Oscilloscope	1		Tektronix TDS540A with P6139A probe or equivalent	To observe and measure many output signals.
RS-232C cable with 25-pin, D-type connectors	2	Male	Tektronix part no. 174–3882–00 (provided with the PSC1125)	Signal interconnections between the TSG1001 and PSC1125.
75Ω terminator	2		Tektronix part no. 011-0102-00	Signal interconnection
BNC T connector	2		Tektronix part no. 103-0030-00	Signal interconnection

Table 5–1: Required equipment (Cont.)

Item	Qty.	Required precision	Recommended equipment	Purpose
BNC cable	3	Impedance: 75 Ω		Signal interconnection
PC	1	IBM PC compatible		For downloading the signal set data to the TSG1001

Display Adjustment

Adjustment timing

After the removal and replacement of a display module due to electrical failure, you must adjust the timing.

If brightness and contrast have become unsatisfactory, you must adjust the timing.

Preparation

To perform the display adjustments, you must first remove the enclosure (cabinet).

1. Disconnect all cables from the waveform monitor and remove the two cabinet mounting screws shown in Figure 5–1. Slide the instrument forward out of the enclosure.
2. Place all the variable resistors of the A5 display board at the middle. See Figure 5–2 for the variable resistors.

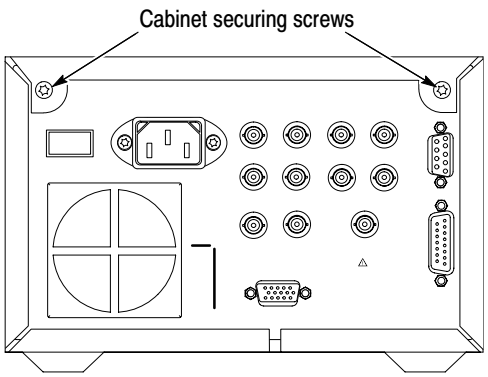


Figure 5–1: Rear view of the waveform monitor in an enclosure

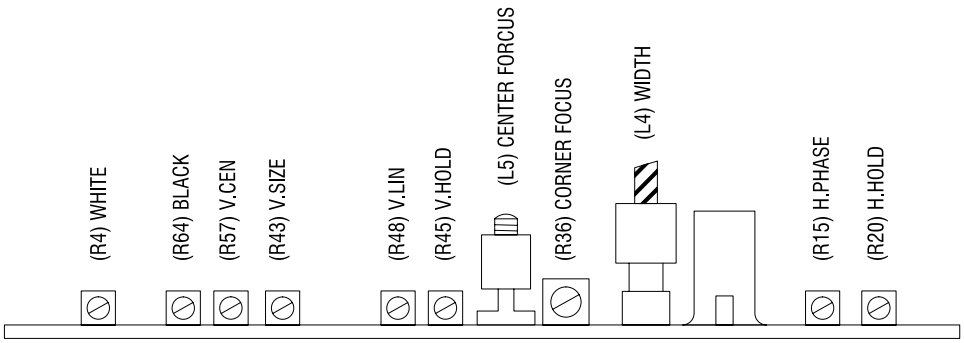


Figure 5–2: A5 display board view from top of the waveform monitor

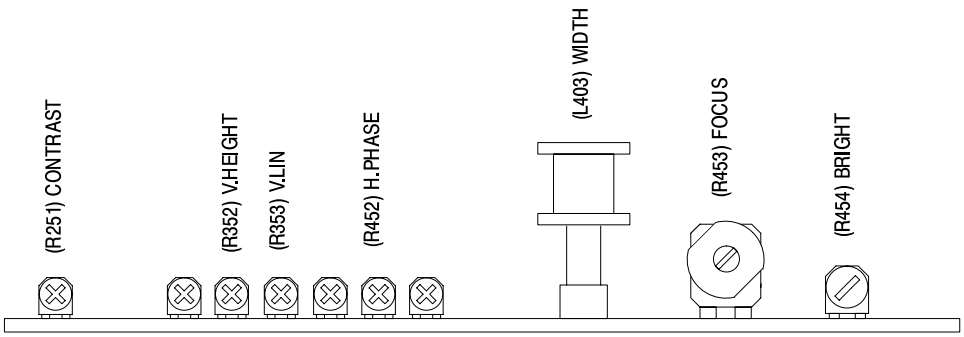


Figure 5–3: A5 display board view from top of the waveform monitor (J310171 and above)

Adjustment

WARNING. *To avoid serious injury, do not touch exposed connections or components when operating the instrument with the protective enclosure removed. Dangerous potentials exist at several points within the waveform monitor.*

***NOTE**. Use the variable resistors described in the parenthesis for the instrument with serial number J310171 and above.*

3. Connect the power cord, and turn on the power switch on the rear panel.

- When R64 : BLACK (R454 : BRIGHT) is turned clockwise to brighten the whole area of the CRT, confirm that there are no chips or unevenness on the phosphor.

4. Press the **INTEN/MENU** button while holding down the lowest bezel button to enter into the DIAG/CAL menu.

Yoke Alignment.

5. Select **EXECUTE → DISPLAY → WHITE** from the menu.

a. Adjust R15 : H.PHASE (R452 : H.PHASE) to center the bright video area in the background area.

b. Loosen the screw retaining the deflecting yoke to place the CRT display horizontally. This adjustment is not available for instruments with serial number J310171 and above.

Size And Linearity.

6. Press the **MENU** button and then select **GRID** from the menu.

The grid pattern (crosshatch pattern) appears on the screen.

- Check the distortion of the external frame and the declination from the CRT face, and the inclination about the grid pattern. No specifications are required.

a. Align the horizontal and vertical positions in place using the centering ring behind the deflecting yoke.

b. With R43 : V.SIZE (R352 : V.HEIGHT), set the vertical size to 71 mm.

c. With R48 : V.LIN (R353 : V.LIN), adjust the linearity on the top and bottom area on the CRT face. If necessary, use R43 and the centering rings for readjustment.

d. With L4 : WIDTH (L403 : WIDTH), set the horizontal size to 95 mm. If necessary, use R43 (R353) and the centering ring for readjustment.

***NOTE**. The centering rings may cause some distortion to the display. Adjust the centering rings for the least amount of distortion and the best centering.*

Black And White Levels.

7. Adjust R64 : BLACK (R454 : BRIGHT) to make the background disappear.
8. Press the **INTEN/MENU** button and then select **GRADATION** from the menu.
   a. Regulate R4 : WHITE (R251 : CONTRAST) so that the leftmost column is visible faintly and the two leftmost columns are discriminated.

Focus.

9. Press the **INTEN/MENU** button and then select **GRID** from the menu.
   a. With R36 : CORNER FOCUS (R453 : FOCUS), adjust the peripheral focus.
   b. With L5 : CENTER FOCUS, adjust the center focus.
   c. Check the whole. If necessary, repeat the above adjustments.
10. Press the **INTEN/MENU** button, and then **STANDBY** button twice to exit from the DIAG/CAL menu.

Output Adjustment

Preparations

To perform the output adjustments, you must first remove the enclosure (cabinet). For removing the enclosure, refer to *Preparation* on page 5–2.

To perform the output adjustments, you also must download the signal set data supplied with the floppy disk to the TSG1001 and make connections between the HDTV signal generator and the waveform monitor in advance. For downloading the signal set data and making connections, refer to *Downloading to the TSG1001* on page 4–4 and *Connections* on page 4–5.

After you have made connections, find the variable resister on the A10 input board. See figure 5–4.

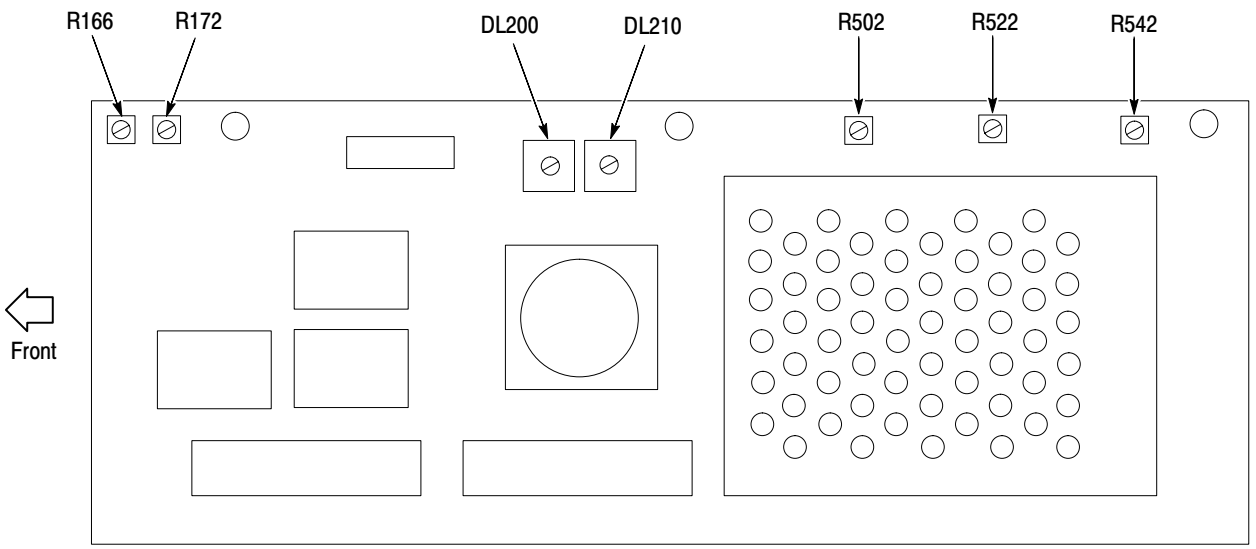


Figure 5–4: A10 input board view

Analog Output Adjustment

WARNING. *To avoid serious injury, do not touch exposed connections or components when operating the instrument with the protective enclosure removed. Dangerous potentials exist at several points within the waveform monitor.*

Connections.

Connect ANALOG OUT Y connector on the waveform monitor rear panel to the oscilloscope CH1 input using the 75 Ω BNC cable and the BNC T connector.

Connect ANALOG OUT P_b connector on the waveform monitor rear panel to the oscilloscope CH2 input using the other 75 Ω BNC cable and the other BNC T connector.

Terminate the other end of the BNC T connectors with the 75 Ω terminators.

Initial Setups.

TSG1001**:**

COLOR BARS: . . . . . 100 % COLOR BARS

Oscilloscope**:**

Waveform: CH1

Vertical scale: . . . . . 10 mV/div

Vertical offset: . . . . . 0 V

Vertical position: . . . . . Center

Horizontal scale: . . . . . 10 μs/div

Trigger mode: . . . . . EDGE

Trigger source: CH1

Trigger level: . . . . . –140 mV

Procedure.

1. Align the 0 mV level of the signal with the center graticule on the oscilloscope.
2. Change the oscilloscope vertical offset to 700mV.
3. Verify and adjust the A10 R502 to align the 700 mV level with the center graticule on the oscilloscope.
4. Change the oscilloscope vertical offset to 0 V.
5. If the 0 mV level is within ± 0.5 divisions from the center graticule, go to the next step. If not so, go back step 1.
6. Change the oscilloscope waveform to CH1 off, waveform to CH2, and vertical offset to –350 mV.
7. Align the –350 mV level of the signal with the center graticule on the oscilloscope.
8. Change the oscilloscope CH2 vertical offset to 350 mV.
9. Verify and adjust the A10 R522 to align the 350 mV level with the center graticule on the oscilloscope.
10. Change the oscilloscope CH1 vertical offset to –350 mV.

11. If the –350 mV level is within ± 0.5 division from the center graticule, go to the next step. If not so, go back step 7.

12. Press the **TIMING SIGNALS** button on the TSG1001 front panel to set the TIMING SIGNALS to BOWTIE.

13. Change the oscilloscope settings to:

Waveform:	CH1 and CH2
Vertical scale:	100 mV/div for CH1 100 mV/div for CH2
Vertical offset:	0 V for CH1 and CH2
Horizontal scale:	1 μs/div
Record length :	5000 points

14. Press the MATH REF button on the oscilloscope front panel, and then press the main and side menu buttons in the following order to create a Math waveform:
Change Math waveform definition → Dual Wfm Math → Set 1st Source to [Ch1] → Set operator to [–] → Set 2nd Source to [Ch2]

15. Change the oscilloscope settings to:

Waveform:	CH1 and CH2 to Off
Zoom:	On
Vertical scale:	100 mV/div (5.0 X Vert) for Math1
Horizontal scale:	5 μs/div (0.2X Horz)

16. Observe the Bowtie display on the oscilloscope and verify and adjust the A10 DL200 so that the skew is within 1 ns (the marker on the display indicates 1 ns).

17. Change the oscilloscope zoom setting to off.

18. On the TSG1001 front panel press the **COLOR BARS** button to set the COLOR BAR to 100 %.

19. Change the BNC cable from ANALOG OUT P_b connector to ANALOG OUT P_r connector.

20. Change the oscilloscope settings to:

Waveform:	MATH1 to off and CH2 to on
Vertical scale:	10 mV/div

Vertical offset: . . . . . –350 mV

21. Align the –350 mV level of the signal with the center graticule on the oscilloscope.

22. Change the oscilloscope CH2 vertical offset to 350 mV.

23. Verify and adjust the A10 R542 to align the 350 mV level with the center graticule on the oscilloscope.

24. Change the oscilloscope CH1 vertical offset to –350 mV.

25. If the –350 mV level is within ± 0.5 division from the center graticule, go to next step. If not, go back to step 21.

26. Press the **TIMING SIGNALS** button on the TSG1001 front panel to set the TIMING SIGNALS to BOWTIE.

27. Change the oscilloscope settings to:

Waveform: . . . . . CH1 and CH2

Vertical scale: . . . . . 100 mV/div for CH1
100 mV/div for CH2

Vertical offset: . . . . . 0 V for CH1 and CH2

Horizontal scale: . . . . . 1 μs/div

Record length : . . . . . 5000 points

28. Press the MATH REF button on the oscilloscope front panel, and then press the main and side menu buttons in the following order to create a Math waveform:
Change Math waveform definition → Dual Wfm Math → Set 1st Source to [Ch1] → Set operator to [–] → Set 2nd Source to [Ch2]

29. Change the oscilloscope settings to:

Waveform: . . . . . CH1 and CH2 to Off

Zoom: . . . . . On

Vertical scale: . . . . . 100 mV/div (5.0 X Vert) for Math1

Horizontal Scale: . . . . . 5 μs/div (0.2X Horz)

30. Observe the Bowtie display on the oscilloscope and verify and adjust the A10 DL210 so that the skew is within 1 ns (the marker on the display indicates 1 ns).

Audio Output Adjustment

Connections.

Connect AUDIO CHA connector from the waveform monitor rear panel to the oscilloscope CH1 input using the 75 Ω BNC cable and the BNC T connector.

Terminate the other side of the BNC T connector with the 75 Ω terminator.

Initial Setups.

Oscilloscope:

Waveform: CH1

Vertical scale: . . . . . 200 mV/div

Vertical Offset: . . . . . 0 V

Vertical Position: . . . . . Center

Horizontal Scale: . . . . . 100 ns/div

Trigger mode: . . . . . EDGE

Trigger Source: CH1

Trigger Level: . . . . . –140 mV

Procedure.

1. Align the 0 mV level of the displayed signal with the center graticule on the oscilloscope.
2. Using the oscilloscope measurement function, perform the amplitude measurement.
3. Verify and adjust the A10 R166 so that the amplitude is 1.00 V
4. Change the BNC cable from the AUDIO CHA connector to the AUDIO CHB connector.
5. Align the 0 mV level of the displayed signal with the center graticule on the oscilloscope.
6. Using the oscilloscope measurement function, perform the amplitude measurement.
7. Verify and adjust the A10 R172 so that the amplitude is 1.00 V

Voltage Adjustment

Preparations

To perform the output adjustments, you must first remove the enclosure (cabinet). For removing the enclosure, refer to *Preparation* on page 5–2.

After you have remove the enclosure (cabinet), find the test points on the A40 CPU board and the variable resistor on the Power Supply module. See Figures 5–5 and 5–6.

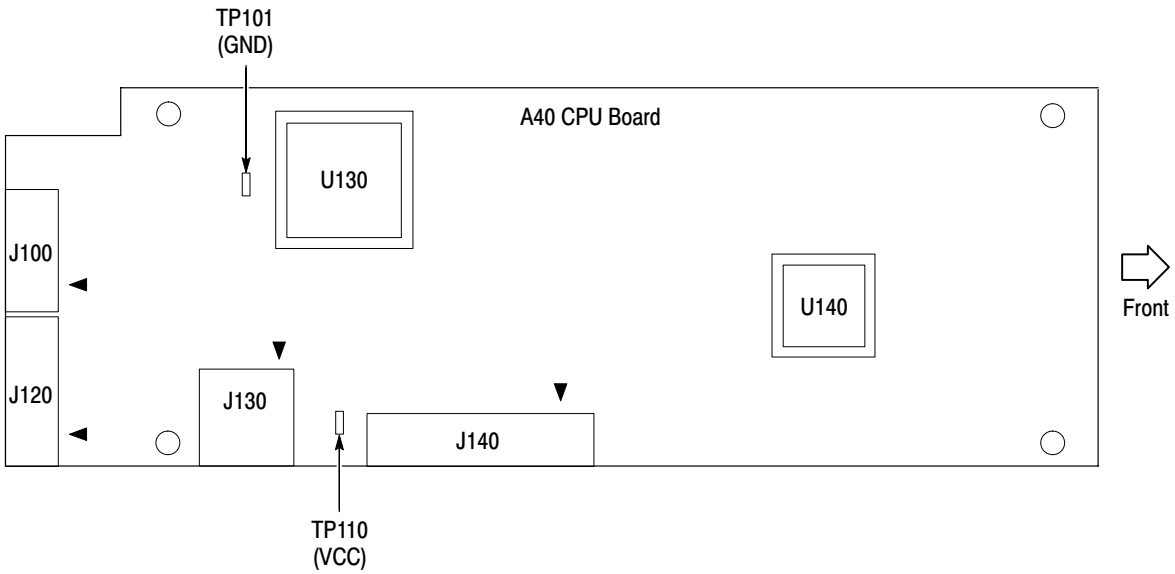


Figure 5–5: A40 CPU board view and test points

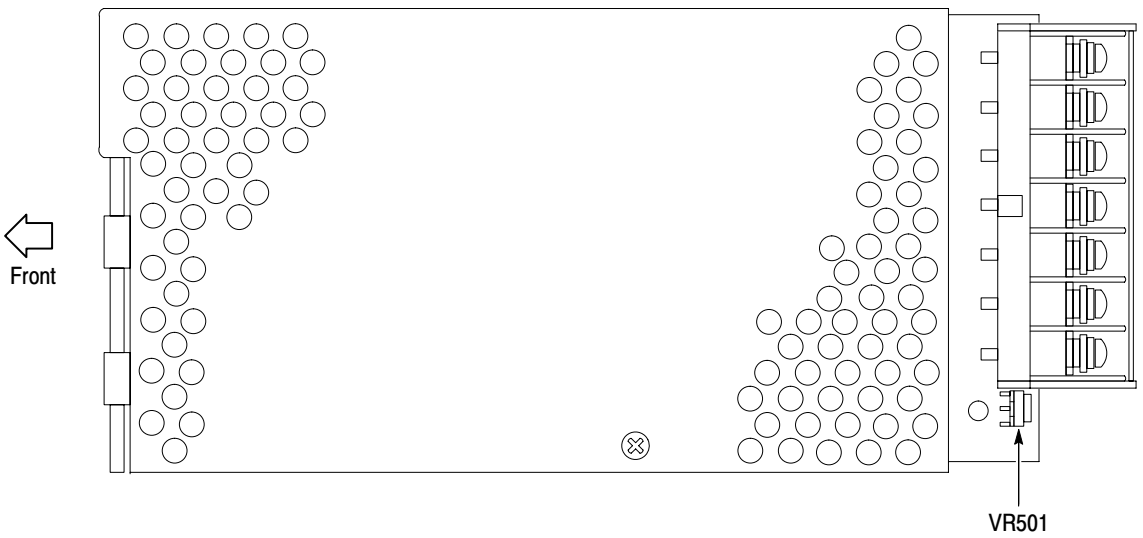


Figure 5–6: Power supply module view and VR501

Adjustment

WARNING. *To avoid serious injury, do not touch exposed connections or components when operating the instrument with the protective enclosure removed. Dangerous potentials exist at several points within the waveform monitor.*

Initial Setups.

Oscilloscope:

Waveform: CH1

Vertical scale: . . . . . 200 mV/div

Vertical Offset: . . . . . + 5 V

Vertical Position: . . . . . Center

Horizontal Scale: . . . . . 1 μs/div

Bandwidth : . . . . . 20 MHz

Procedure.

1. Remove the power supply module:
   a. Remove the three screws securing the power supply module to the instrument chassis.
   b. Slide the power supply module off of the chassis.
2. Connect the power cord to the waveform monitor, and turn on the power switch on the rear panel.
3. Attach the P6139A probe to the oscilloscope CH1 input.
4. Locate the test points TP101 and TP110 on the A40 CPU board. See Figure 5–5.
5. Locate the variable resistor VR501 on the Power Supply module. See Figure 5–6.
6. Adjust the voltage:
   a. Connect the grand lead of the probe to the TP101 (GND) and the probe tip to the TP110 (VCC).
   b. Turn the VR501 clockwise or counterclockwise to align the trace with the center graticule on the oscilloscope. If necessary, change the vertical scale setting up to 20 mV/div.
7. Install the power supply module:
   a. Position the power supply module on the chassis.
   b. Install the three screws securing the power supply module to the instrument chassis.

Maintenance

Maintenance

This section contains the information needed to do corrective maintenance on the WFM 1125 Digital Television Waveform Monitor Option 0A/0B/0C/0D. The following subsections are included:

- *Preparation* — Introduction plus general information on preventing damage to internal modules when doing maintenance.
- *Inspection and Cleaning* — Information and procedures for inspecting the waveform monitor and cleaning its external and internal modules.
- *Removal and Installation Procedures* — are not provided in this manual.
- *Firmware Updates* — The firmware of this instrument can be downloaded from a PC. This section describes the contents of the firmware floppy disk and procedures for downloading.
- *Troubleshooting* — Information for isolating and troubleshooting failed modules. Included is diagnostics and troubleshooting trees. Use troubleshooting trees if the faulty module could not be isolated in the diagnostic procedures.

Related Maintenance Procedures

The following sections contain information and procedures related to maintenance.

- Section 2, *Operating Information*, covers instructions useful when operating the waveform monitor in order to troubleshoot it.
- Section 3, *Theory of Operation*, contains a circuit description at the module, or block, level.
- Section 4, *Performance Verification*, contains procedures that may be useful in isolating problems to modules by testing instrument performance.
- Section 5, *Adjustment Procedures*, addresses after repair adjustment. It contains a procedure for adjusting the display circuit module of the waveform monitor.
- Section 9, *Diagrams*, contains a block diagram using individual modules as blocks and an interconnection diagram showing connections between the modules.
- Section 10, *Mechanical Parts List*, lists all field replaceable modules by part number.

Preparation

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

WARNING. *To avoid electrical shock, disconnect the instrument from the AC power supply before removing the cabinet or replacing any components.*

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

Preventing ESD

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

1. Minimize handling of static-sensitive modules.
2. Transport and store static-sensitive modules in their static protected containers or on a metal rail. Label any package that contains static-sensitive modules.
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 modules over any surface.
7. Avoid handling modules in areas that have a floor or work-surface covering capable of generating a static charge.

Susceptibility to ESD

Table 6–1 lists the relative susceptibility of various classes of semiconductors. Static voltages of 1 kV to 30 kV are common in unprotected environments.

Table 6–1: Relative susceptibility to static-discharge damage

Semiconductor classes	Relative susceptibility levels[1]
MOS or CMOS microcircuits or discrete circuits, or linear microcircuits with MOS inputs (most sensitive)	1
ECL	2
Schottky signal diodes	3
Schottky TTL	4
High-frequency bipolar transistors	5
JFET	6
Linear microcircuits	7
Low-power Schottky TTL	8
TTL (least sensitive)	9

[1] **Voltage equivalent for levels (voltage discharged from a 100 pF capacitor through resistance of 100 ohms**):

1 = 100 to 500 V
2 = 200 to 500 V
3 = 250 V
4 = 500 V
5 = 400 to 600 V
6 = 600 to 800 V
7 = 400 to 1000 V (est.)
8 = 900 V
9 = 1200 V

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 WFM 1125 Digital Television Waveform Monitor Option 0A/0B/0C/0D. 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 waveform monitor is used. A proper time to perform preventive maintenance is just before adjustment.

General Care

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

Inspection and Cleaning Procedures

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

CAUTION. *Avoid the use of chemical cleaning agents which might damage the plastics used in this waveform monitor. 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 waveform monitor for damage, wear, and missing parts, using Table 6–2 as a guide. The waveform monitor that appears to have been dropped or otherwise abused should be checked thoroughly to verify correct operation and performance. Immediately repair defects that could cause personal injury or lead to further damage to the instrument.

Table 6–2: External inspection check list

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

Cleaning Procedure — Exterior. To clean the instrument exterior, do the following steps:

1. Remove loose dust on the outside of the waveform monitor with a lint free cloth.
2. Remove remaining dirt with a lint free cloth dampened in a general purpose detergent-and-water solution. Do not use abrasive cleaners.

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

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

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

Inspect the internal portions of the waveform monitor for damage and wear, using Table 6–3 as a guide. Defects found should be repaired immediately.

If any electrical module is repaired or replaced, refer to Section 5 to see if it is necessary to adjust the waveform monitor.

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

Table 6–3: 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 failed module and replace with a fresh module.
Resistors	Burned, cracked, broken, blistered condition.	Remove failed module and replace with a fresh module.
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 damaged module and replace with a fresh module from the factory.
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 6–3: 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 waveform monitor 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.
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.

Lubrication. There is no periodic lubrication required for this waveform monitor.

Removal and Installation Procedures

The procedures for removal and installation are not provided in this manual.

Firmware Updates

WFM 1125 Digital Television Waveform Monitor Option 0A/0B/0C/0D firmware may be downloaded when the trouble shooting is needed or when the firmware has been updated. This must be done when the internal module: A40 CPU board has been replaced.

This subsection explains the file contents in the firmware floppy disks and how to uncompress and download the firmware.

Preparation

The equipments listed in Table 6–4 are required.

Table 6–4: Required equipment

Item	Qty.	Required precision	Recommended equipment	Purpose
Cable with 9-pin, D-type connector	1	9-pin, Dtype (male) –to– 9-pin, Dtype (female)	Custom, see Figure 6–1	Downloading the firmware
PC	1	IBM PC compatible with MS-DOS 3.1 or above		
Firmware floppy disks	2		Tektronix part no. 063-3174-XX (Option 0A, 0B, and 0C)	
	2		Tektronix part no. 063-3250-XX (Option 0D)	

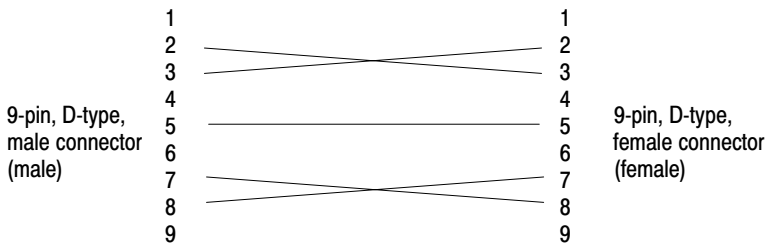


Figure 6–1: RS-232C cable with 9-pin, D-type connectors

Floppy disks

The 3.5-inch MS-DOS format firmware floppy disks include the files listed in Table 6–5.

Table 6–5: Floppy disk's file list

Type / File name	Descriptions
063–3174–XX	
Codes	
APPLI.HEX	68K code
Utilities	
TERM.EXE	TERMINAL EMULATION PC software
LOAD0A.EXE	PC software for Option 0A
LOAD0B.EXE	PC software for Option 0B
LOAD0C.EXE	PC software for Option 0C
8K config files	Used to configure A20U600 (i.e., to program FPGA).
ADDER.TTF	Resident
10K30 config files	Used to configure A20U200 and A10U200 (i.e., to program FPGA).
TRANCE.TTF	When color = SMPTE 240M and resol/d rng = RESOLUTION
TRANCE9.TTF	When color = SMPTE 240M and resol/d rng = D RANGE
CCIR.TTF	When color = SMPTE 274M and resol/d rng = RESOLUTION
CCIR9.TTF	When color = SMPTE 274M and resol/d rng = D RANGE
10K10 config files	Used to configure A20U100, A20U250, A20U350, A20U430, A20U470, A20U500, and A20U580 (i.e., to program FPGA).
LINES1.TTF	For LINES 1LINE or FIELD display
LINES2.TTF	For LINES 2LINE display
LINES3.TTF	For LINES parade or overlay display
3FIELD.TTF	For parade display (Field)
LINESEL1.TTF	For LINE SELECT 1LINE display
LINESEL2.TTF	For LINE SELECT 2LINE display
LINESEL3.TTF	For SELECT parade or overlay display
STATUS.TTF	When STATUS is displayed
BOWTIE.TTF	For Bowtie display

Table 6–5: Floppy disk's file list (Cont.)

Type / File name	Descriptions
DIAMOND.TTF	For Diamond display
LIGHTEN.TTF	For Lightning display
X table	Loaded to A20U425.
1LINES	Lines display
3LINES	Parade display
3LINES1	Parade display (Line Select)
3FIELDS	Parade display (Field)
FIELD	Field display
HMAG	Horizontally enlarged display by a factor of 25
LINES	lines display (Line Select)
LINESH	lines display (Line Select and Hmag)
VEC100X1	Vector display, 100%Color bar
VEC100X5	Vector display, 100%Color bar with 5x Gain
VEC100XA	Vector display, 100%Color bar with 10x Gain
VEC75X1	Vector display, 75%Color bar
VEC75X5	Vector display, 75%Color bar with 5x Gain
VEC75XA	Vector display, 75%Color bar with 10x Gain
Y table	Loaded to A20U410.
NORM1	Normal scale
NORM5	Normal scale with 5x Gain
NORM10	Normal scale with 10x Gain
WIDE1	Wide scale
WIDE5	Wide scale with 5x Gain
WIDE10	Wide scale with 10x Gain
VEC100Y1	Vector display, 100%Color bar
VEC100Y5	Vector display, 100%Color bar with 5x Gain
VEC100YA	Vector display, 100%Color bar with 10x Gain
VEC75Y1	Vector display, 75%Color bar
VEC75Y5	Vector display, 75%Color bar with 5x Gain
VEC75YA	Vector display, 75%Color bar with 10x Gain

Table 6–5: Floppy disk's file list (Cont.)

Type / File name	Descriptions
GF9101 coefficient files	A20U260, A20U270, and A20U280 digital filter coefficients. For every mode, there are two types of files available: files for Y and those for Pb/Pr. Examples: FLY_Y_RE.TXT FL_C_RE.TXT Note that, if MENU –> WFM/VECT –> wfm as –> RGB or GBR has been selected, files for Y are used for the three GF9101's.
	MENU –> Interpo –> ON MENU –> Filter –> Flat
FL_*_LI.TXT	Non–field mode in Line Select mode
FL_*_HM.TXT	When HMag is displayed in response to the pressing of the Horizontal Mag button (except in the Line Select mode)
FL_*_RE.TXT	Other than above
	MENU –> Interpo –> ON MENU –> Filter –> LPF.
LP_*_LI.TXT	Non–field mode in Line Select mode
LP_*_HM.TXT	When HMag is displayed in response to the pressing of the Horizontal Mag button (except in the Line Select mode)
LP_*_RE.TXT	Other than above.
ULP_Y_RE.TXT	For Diamond display.
063–3250–XX	
Codes	
APPLI.HEX	68K code
Utilities	
LOAD0D.EXE	PC software for Option 0D
8K config files	Used to configure A20U600 (i.e., to program FPGA).
ADDER.TTF	Resident
10K30 config files	Used to configure A20U200 and A10U200 (i.e., to program FPGA).
TRANCE.TTF	When color = SMPTE 240M and resol/d rng = RESOLUTION
TRANCE9.TTF	When color = SMPTE 240M and resol/d rng = D RANGE
CCIR.TTF	When color = SMPTE 274M and resol/d rng = RESOLUTION

Table 6–5: Floppy disk's file list (Cont.)

Type / File name	Descriptions
CCIR9.TTF	When color = SMPTE 274M and resol/d rng = D RANGE
10K10 config files	Used to configure A20U100, A20U250, A20U350, A20U430, A20U470, A20U500, and A20U580 (i.e., to program FPGA).
LINES1.TTF	For LINES 1LINE or FIELD display
LINES2.TTF	For LINES 2LINE display
LINES3.TTF	For LINES parade or overlay display
3FIELD.TTF	For parade display (Field)
LINESEL1.TTF	For LINE SELECT 1LINE display
LINESEL2.TTF	For LINE SELECT 2LINE display
LINESEL3.TTF	For SELECT parade or overlay display
STATUS.TTF	When STATUS is displayed
BOWTIE.TTF	For Bowtie display
DIAMOND.TTF	For Diamond display
LIGHTEN.TTF	For Lightning display
X table	Loaded to A20U425.
1F_1125	1 field display (1125 lines)
1F_750	1 field display (750 lines)
1L_1125	1 line display (1125 lines)
1L_750	1 line display (750 lines)
1LH	1 line display and H mag
1LS_1125	1 line select display (1125 lines)
1LS_750	1 line select display (750 lines)
1LSH	1 line display (line select and H mag)
2LH_24	2 line display and H mag (24 Hz field rate)
2LH_50	2 line display and H mag (50 Hz field rate)
2LH_60	2 line display and H mag (60 Hz field rate)
2LH_750	2 line display and H mag (750 lines)
2LSH_24	2 line display (line select and H mag, 24 Hz field rate)
2LSH_50	2 line display (line select and H mag, 50 Hz field rate)
2LSH_60	2 line display (line select and H mag, 60 Hz field rate)
2LSH_750	2 line display (line select and H mag, 750 lines)
3F_1125	3 field display (1125 lines)

Table 6–5: Floppy disk's file list (Cont.)

Type / File name	Descriptions
3F_750	3 fields disply (750 lines)
3L_1125	3 lines display (1125 lines)
3L_750	3 lines display (750 lines)
3LS_1125	3 lines select display (1125 lines)
3LS_750	3 lines display (line select, 750 lines)
VEC100X1	Vector display, 100%Color bar
VEC100X5	Vector display, 100%Color bar with 5x Gain
VEC100XA	Vector display, 100%Color bar with 10x Gain
VEC75X1	Vector display, 75%Color bar
VEC75X5	Vector display, 75%Color bar with 5x Gain
VEC75XA	Vector display, 75%Color bar with 10x Gain
Y table	Loaded to A20U410.
NORM1	Normal scale
NORM5	Normal scale with 5x Gain
NORM10	Normal scale with 10x Gain
WIDE1	Wide scale
WIDE5	Wide scale with 5x Gain
WIDE10	Wide scale with 10x Gain
VEC100Y1	Vector display, 100%Color bar
VEC100Y5	Vector display, 100%Color bar with 5x Gain
VEC100YA	Vector display, 100%Color bar with 10x Gain
VEC75Y1	Vector display, 75%Color bar
VEC75Y5	Vector display, 75%Color bar with 5x Gain
VEC75YA	Vector display, 75%Color bar with 10x Gain
GF9101 coefficient files	A20U260, A20U270, and A20U280 digital filter coefficients. For every mode, there are two types of files available: files for Y and those for Pb/Pr. Examples: FLY_Y_RE.TXT FL_C_RE.TXT Note that, if MENU –> WFM/VECT –> wfm as –> RGB or GBR has been selected, files for Y are used for the three GF9101's.
	MENU –> Interpo –> ON MENU –> Filter –> Flat

Table 6–5: Floppy disk's file list (Cont.)

Type / File name	Descriptions
FL_*_LI.TXT	Non–field mode in Line Select mode
FL_*_HM.TXT	When HMag is displayed in response to the pressing of the Horizontal Mag button (except in the Line Select mode)
FL_*_RE.TXT	Other than above
	MENU –> Interpo –> ON MENU –> Filter –> LPF.
LP_*_LI.TXT	Non–field mode in Line Select mode
LP_*_HM.TXT	When HMag is displayed in response to the pressing of the Horizontal Mag button (except in the Line Select mode)
LP_*_RE.TXT	Other than above.
ULP_Y_RE.TXT	For Diamond display.

Update Procedure

Update procedures compose of four main processes:

- Uncompressing the download files
- Downloading the files to the Waveform Monitor
- Resetting the Waveform Monitor
- Performance Verification

Uncompressing the download files

Do the following steps to uncompress the download files.

1. Power up the PC.
2. If you use a Windows machine, enter into the MS-DOS prompt mode.
3. Select a destination directory. If you want to install the files at a new directory, create it.
4. Insert WFM1125 op.0C (or op.0D) Disk1 into the floppy disk drive on the PC.
5. Type `A: INST` and then press Return key. Doing so displays various messages and the uncompressing condition.
6. When the messages *Please insert WFM1125 op.0C (or op.0D) Disk2* and *Press any key to continue* are displayed, according to the messages, insert the disk and press any key.

   When the uncompressing process completes, MS-DOS prompt is displayed.
7. Remove WFM1125 op.0C (or op.0D) Disk 2 from the floppy disk drive on the PC.

Downloading the files to the Waveform Monitor

Do the following steps to download the uncompressed files to the waveform monitor.

1. Connect the RS-232C connector on the waveform monitor and the RS-232C connector on the PC using the RS-232C cable.

In the Waveform Monitor:

2. Turn on power switch on the rear panel while holding down the **STANDBY** button on the front panel.

In the PC:

3. Change directory where files were uncompressed if necessary.

   Case 0: Option 0D

   Type:

   ```
   load0D <Return>
   ```

   Case 1: Option 0C

   Type:

   ```
   load0C <Return>
   ```

Case 2: Option 0A

Type:

```
cd 1125 <Return>
load0A <Return>
```

Case 3: Option 0B

Type:

```
cd 750 <Return>
load0B <Return>
```

Following menu appears on the screen:

```
Select Download item:
0: ALL
1: Firmware
2: TTF Files
3: GF Files
4: XY files
5: Graticule Data

Q: quit

Item Number  ?
```

Type:

```
0 <Return>
```

The download is completed in about 20 min for Option 0A and Option 0B, or 30 min for Option 0C and Option 0D. After the download has been finished, the download program exit automatically.

Resetting the waveform Monitor

Press and hold the **INTEN/MENU** button on the front panel to the Configure menu. Turn the **SELECT** knob to select the **FACTORY : EXECUTE** and press **OK** bezel button to reset factory settings.

***NOTE**. Be sure to reset the waveform monitor to factory settings after the download process is completed. If you skip this procedure, the waveform monitor may not perform correctly.*

Performance Verification

After you download the firmware, perform the performance verification procedures described in Section 4, *Performance Verification*.

Troubleshooting

This subsection contains diagnostic procedures and troubleshooting trees designed to help you isolate faulty modules in the waveform monitor.

Diagnostics

The WFM 1125 Digital Television Waveform Monitor Option 0A/0B/0C/0D has internal diagnostics that focus on verifying, adjusting, and if need be, isolating faulty modules.

Preparation

Display DIAG/CAL menu on the screen. Refer to *DIAG/CAL Menu* on page 2–14 for the DIAG/CAL menu structure and those operation information.

1. Turn on the power switch on the rear panel.
2. Press the **INTEN/MENU** button while holding down the lowest bezel button to enter into the DIAG/CAL menu.
3. Press **DIAG/CAL** bezel button.

Front panel buttons, knobs and LEDs

Check the front panel buttons, knobs and LEDs.

Buttons and knobs.

4. Select **KEY/KNOB** from the menu.
   a. When you press a button on the front panel except for the third bezel button, the name associated with the button is displayed on lower part of the CRT. Press all the front panel buttons except for the third bezel button, and confirm that all the buttons operate properly.
   b. Turn the knob clockwise and anticlockwise to confirm that the name of the corresponding knob followed by INC or DEC is displayed on the lower part of the screen. Do this procedures for all the knobs on the front panel.
5. Select **KEY/KNOB** from the menu.

LEDs.

6. Select **LED** from the menu and confirm that all the LEDs on the front panel light.

7. Select **LED** again and confirm that all the LEDs go off.

Memories

8. Press the **DIAG** bezel button.
9. Select **MEMORY** from the menu to run the following memory tests.
   - ROM checksum
   - RAM R/W test
   - FLASH MEMORY R/W test (this takes about 6 minutes)

***NOTE**. Do not power off the waveform monitor until this test is complete. Doing so would lost the files in the memory and you have to reload them again.*

   - IO register R/W test.

   Confirm that the PASS is displayed in all the memory tests. If error is detected, the FAIL is displayed together with error information on the screen.

10. Press **INTEN/MENU** button on the front panel.

PLDs

11. Select **PLD** from the menu to run the following PLD tests.
    - 10K30 configuration test
    - 10K10 configuration test
    - 8K configuration test

    Confirm that the PASS is displayed in all the PLD tests. If error is detected, the FAIL is displayed together with error information on the screen.

12. Press **INTEN/MENU** button on the front panel.

X-RAM and Y-RAM

13. Select **X/Y RAM** from the menu to run the following tests.
    - Overlay RAM R/W test
    - X/Y RAM data bus test
    - X/Y RAM memory cell test
    - X/Y RAM address bus test

    Confirm that the PASS is displayed in all the tests. If error is detected, the FAIL is displayed together with error information on the screen.

14. Press **INTEN/MENU** button on the front panel.

HK-102/HK-202 and FIFO

To execute the following test, you must input any signal that includes EAV and SAV into those module through the CH A or CH B connector on the rear panel.

15. Connect a signal to the CH A or CH B connector on the rear panel.

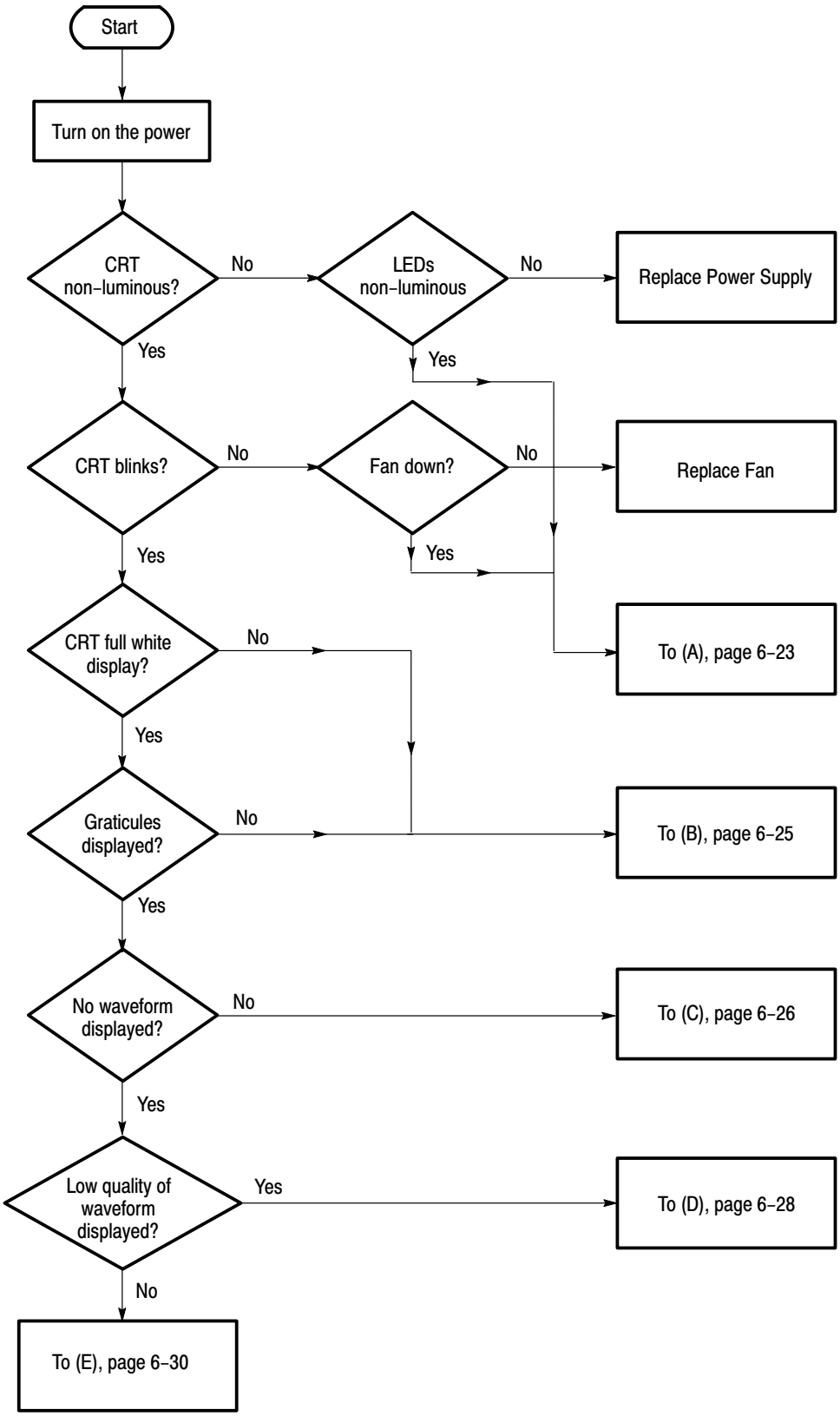
16. Select **HK102/HK202/FIFO** from the menu to run the following test.

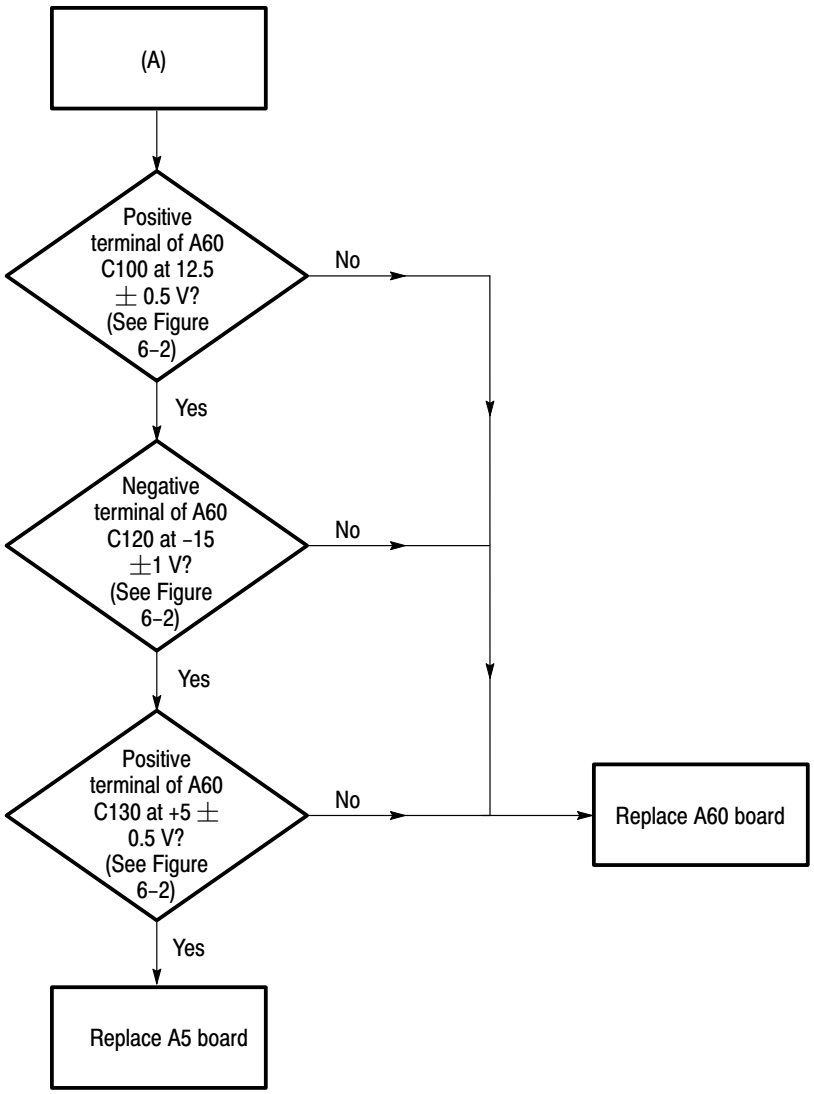
- HK-102/HK-202 and FIFO functional test.

Confirm that the PASS is displayed in this test. If error is detected, the FAIL is displayed together with error information on the screen.

17. Press **INTEN/MENU** button on the front panel.

18. Press **STANDBY** button twice to exit from the DIAG/CAL menu.


Start
Turn on the power
CRT non-luminous?
No
LEDs non-luminous
No
Replace Power Supply
Yes
Yes
CRT blinks?
No
Fan down?
No
Replace Fan
Yes
Yes
CRT full white display?
No
To (A), page 6-23
Yes
Graticules displayed?
No
To (B), page 6-25
Yes
No waveform displayed?
No
To (C), page 6-26
Yes
Low quality of waveform displayed?
Yes
To (D), page 6-28
No
To (E), page 6-30


(A)
Positive terminal of A60 C100 at 12.5 ± 0.5 V? (See Figure 6–2)
No
Yes
Negative terminal of A60 C120 at –15 ±1 V? (See Figure 6–2)
No
Yes
Positive terminal of A60 C130 at +5 ± 0.5 V? (See Figure 6–2)
No
Replace A60 board
Yes
Replace A5 board

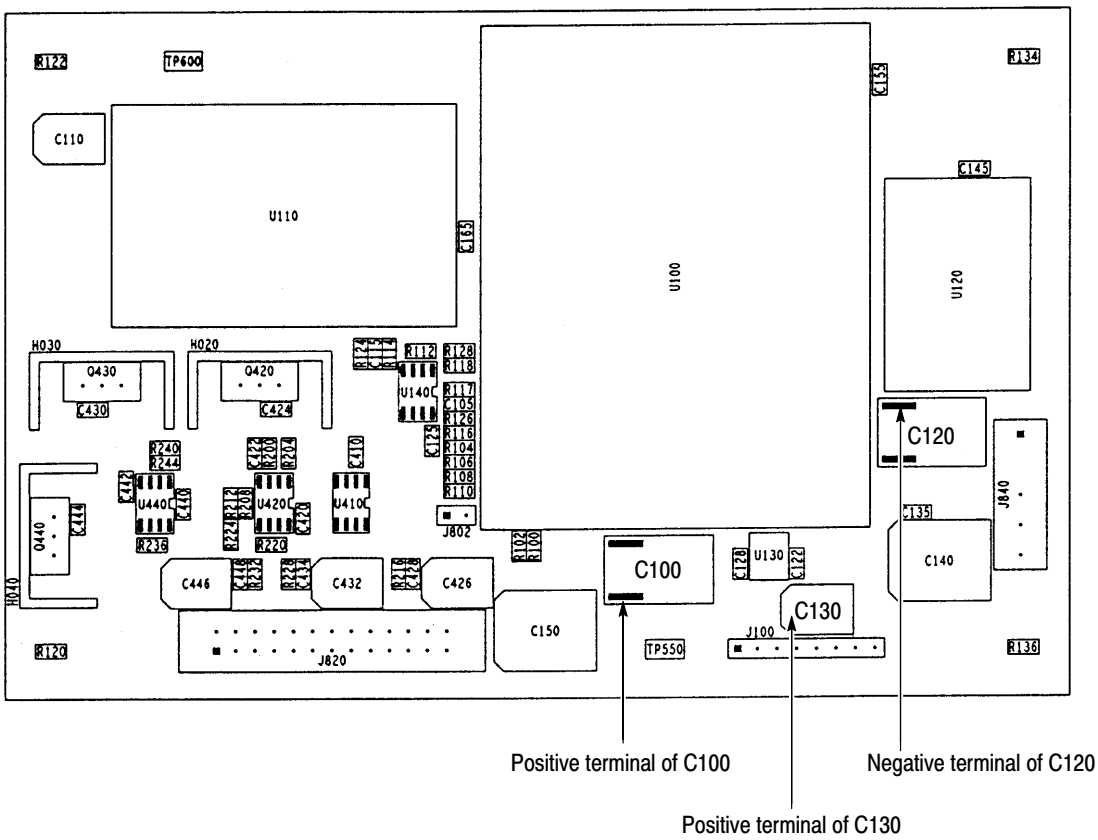
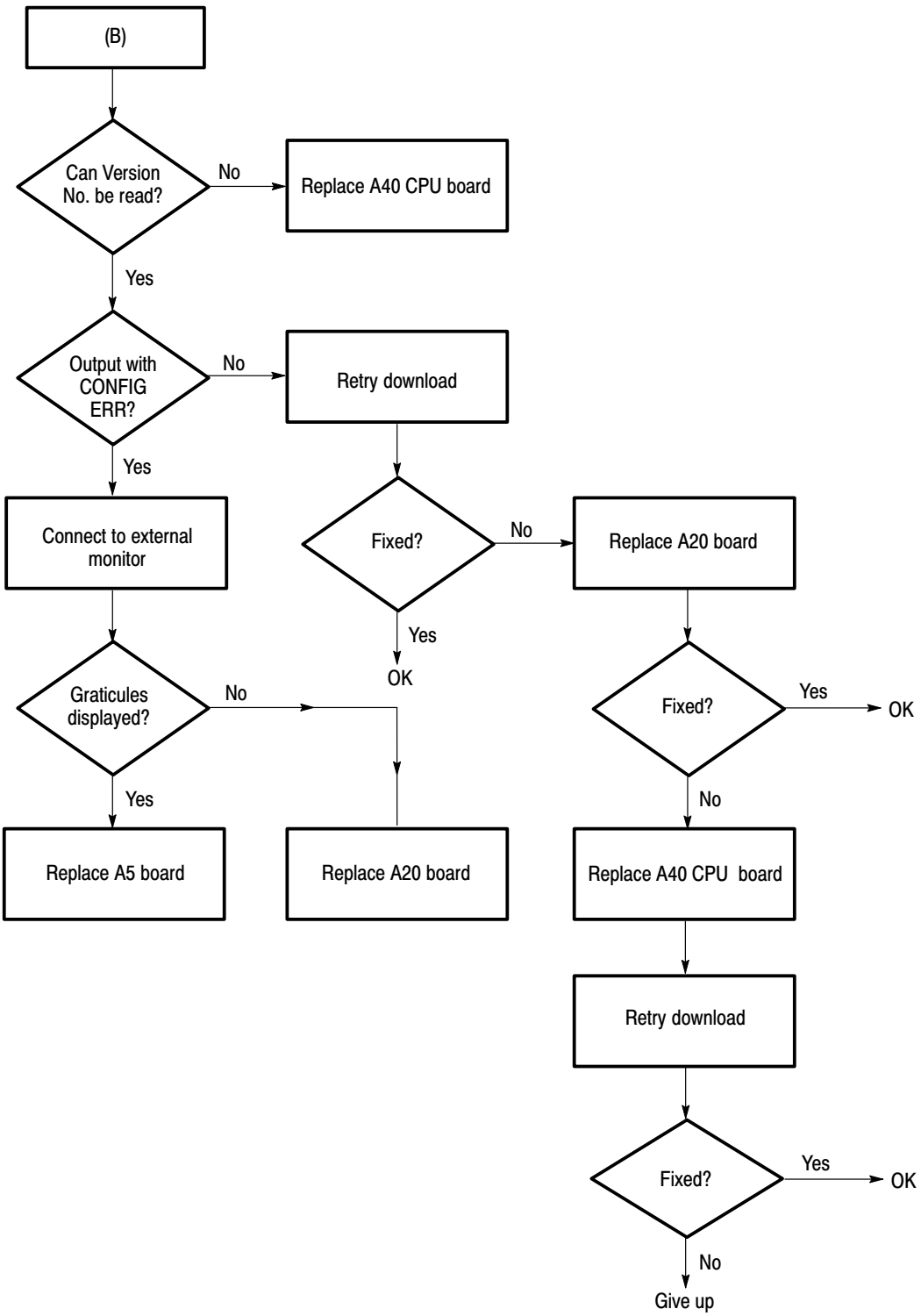
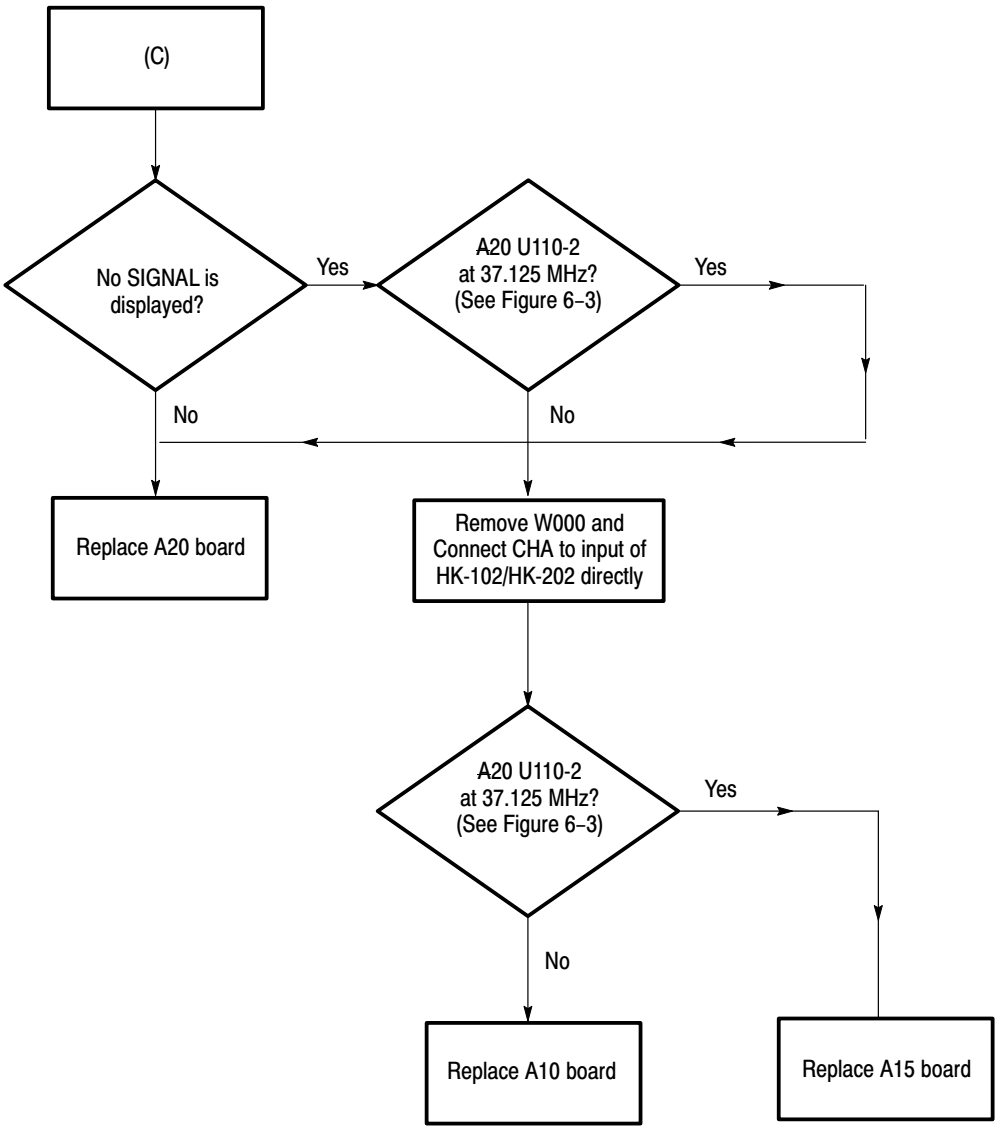


Figure 6–2: A60 DC-DC board (view from top)


(B)
Can Version No. be read?
No
Replace A40 CPU board
Yes
Output with CONFIG ERR?
No
Retry download
Yes
Connect to external monitor
Fixed?
No
Replace A20 board
Yes
OK
Graticules displayed?
No
Fixed?
Yes
OK
Yes
No
Replace A5 board
Replace A20 board
Replace A40 CPU board
Retry download
Fixed?
Yes
OK
No
Give up


(C)
No SIGNAL is displayed?
Yes
A20 U110-2 at 37.125 MHz? (See Figure 6–3)
Yes
No
No
Replace A20 board
Remove W000 and Connect CHA to input of HK-102/HK-202 directly
A20 U110-2 at 37.125 MHz? (See Figure 6–3)
Yes
No
Replace A10 board
Replace A15 board

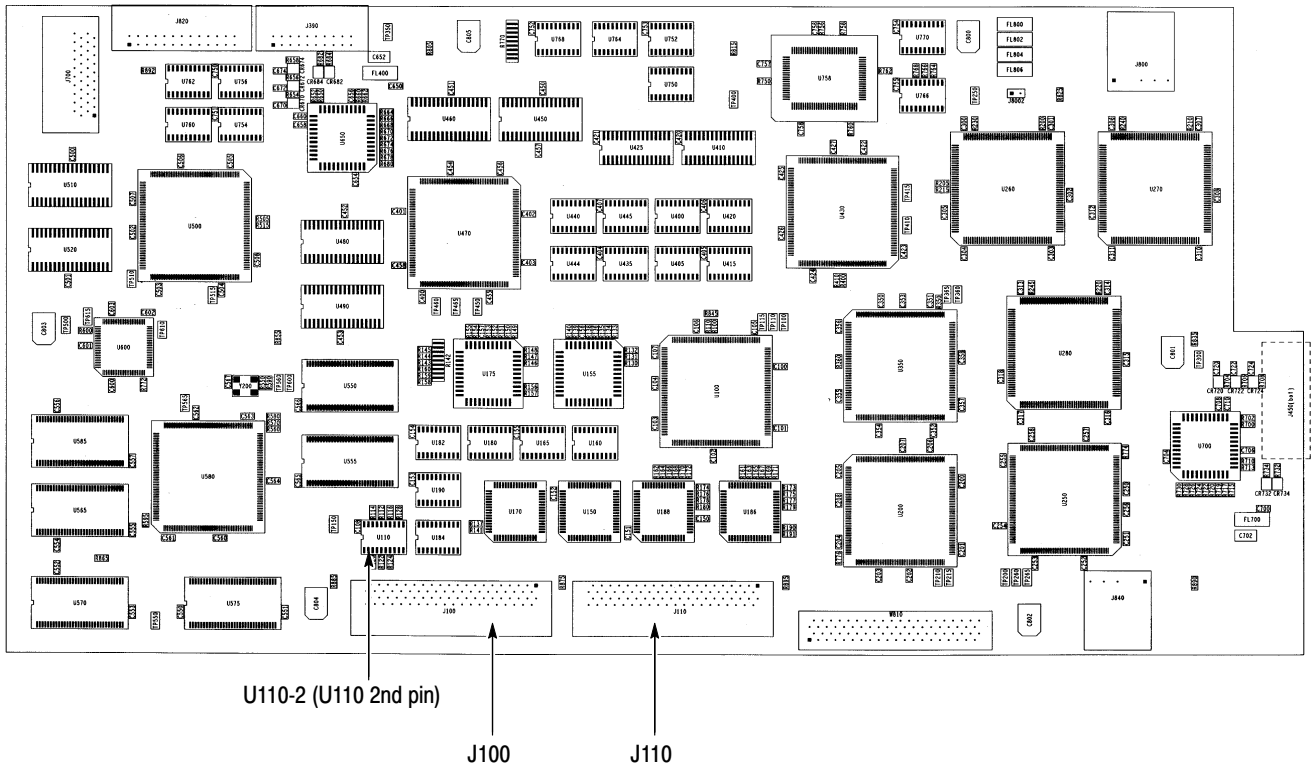
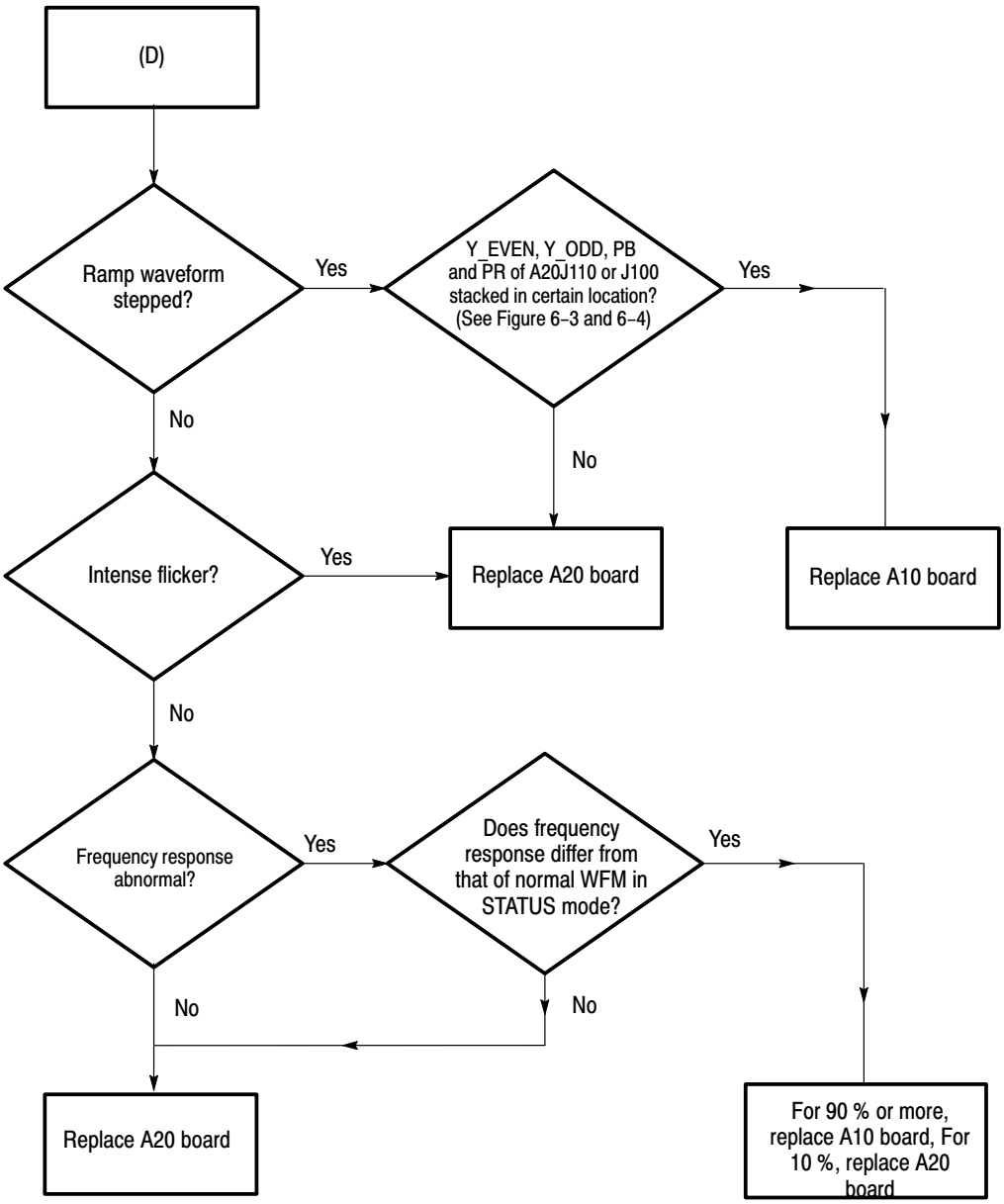


Figure 6–3: A20 Main board (view from top)


(D)
Ramp waveform stepped?
Yes
Y_EVEN, Y_ODD, PB and PR of A20J110 or J100 stacked in certain location? (See Figure 6–3 and 6–4)
Yes
No
No
Intense flicker?
Yes
Replace A20 board
Replace A10 board
No
Frequency response abnormal?
Yes
Does frequency response differ from that of normal WFM in STATUS mode?
Yes
No
No
Replace A20 board
For 90 % or more, replace A10 board, For 10 %, replace A20 board

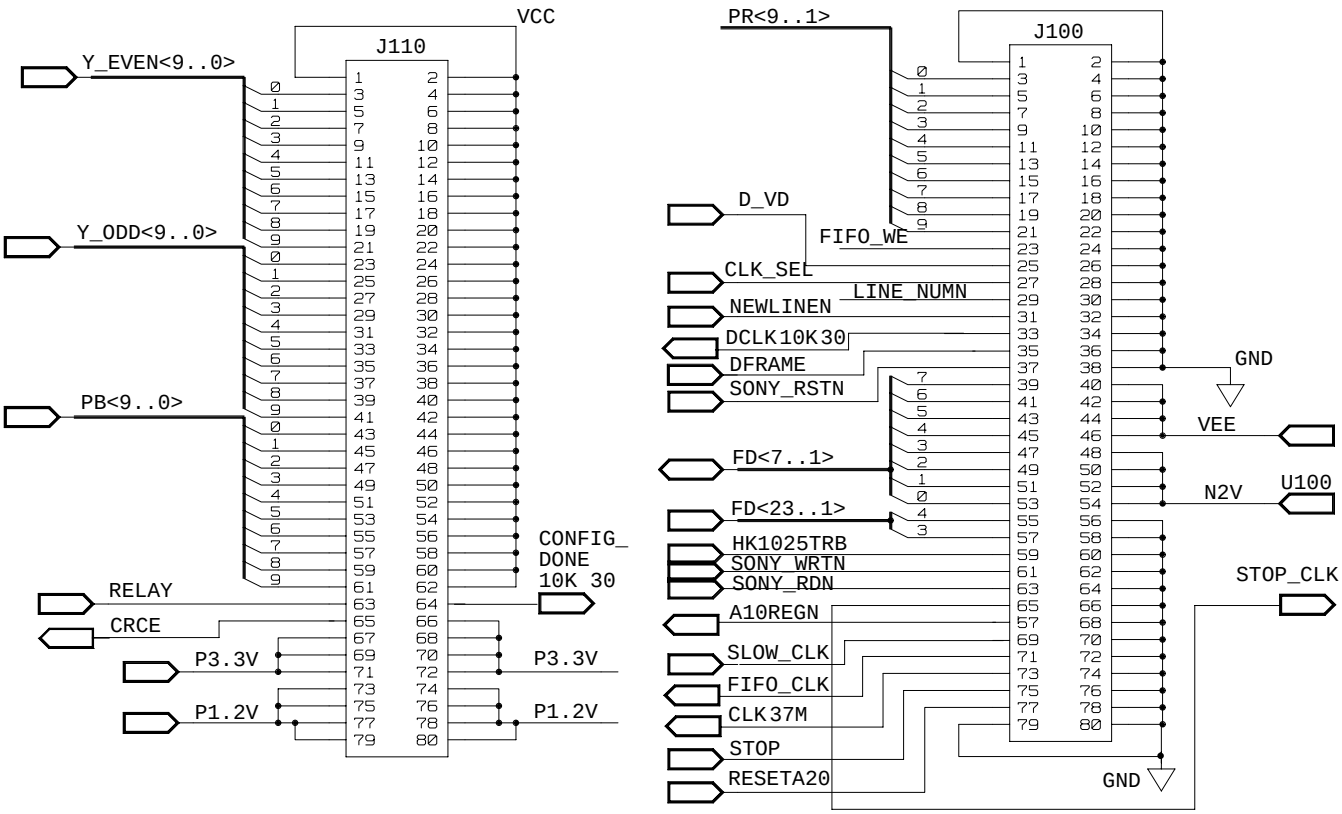
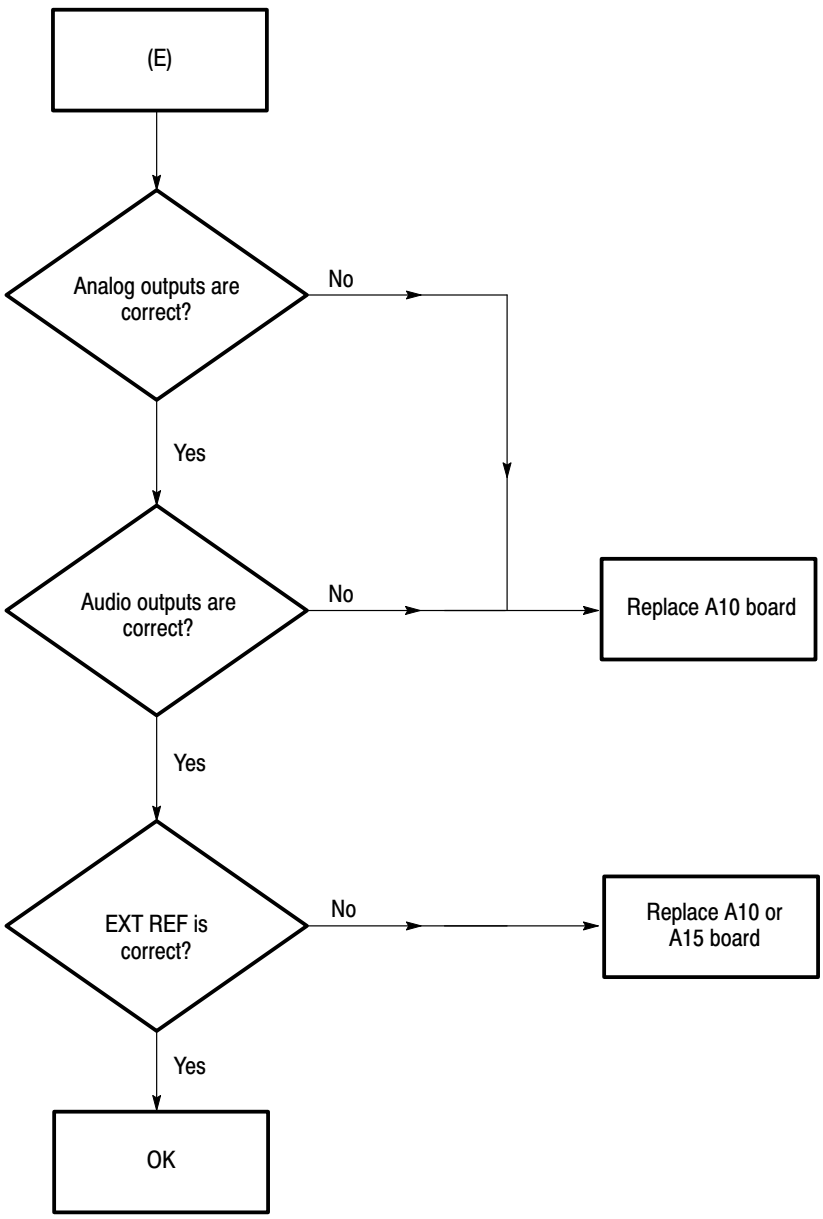


Figure 6–4: J100 and J110 connector pin configurations


(E)
Analog outputs are correct?
No
Yes
Audio outputs are correct?
No
Replace A10 board
Yes
EXT REF is correct?
No
Replace A10 or A15 board
Yes
OK

Options

Options and Accessories

This section describes the options as well as the standard and optional accessories that are available for the waveform monitor.

Option 0A Description

This option supports the following system formats:
1035/60i, 1035/59.94i, 1080/60i, and 1080/59.94i

Option 0B Description

This option supports the following system formats:
720/60p and 720/59.94p

Option 0C Description

This option supports the following system formats:
1035/60i, 1035/59.94i, 1080/60i, 1080/59.94i, 720/60p, and 720/59.94p

Option 0D Description

This option supports the following system formats:
1035/60i, 1035/59.94i, 1080/60i, 1080/59.94i, 1080/50i, 720/60p, 720/59.94p, 1080/30sF, 1080/29.97sF, 1080/25sF, 1080/24sF, 1080/23.98sF, 1080/24p, and 1080/23.98p

Accessories

Standard Accessories

The waveform monitor comes standard with the accessories listed in Table 7–1.

Table 7–1: Standard accessories

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

Optional Accessories

The following optional accessories listed in Table 7–2 can be ordered with the monitor or purchased through a Tektronix field office or distributor. When ordering, include both the name and part number (if available) of the option.

Table 7–2: Optional accessories

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

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

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

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

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

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

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

Electrical Parts List

Electrical Parts List

The modules that make up this instrument are often a combination of mechanical and electrical subparts. Therefore, all replaceable modules are listed in Section 10, *Mechanical Parts List.* Refer to that section for part numbers when using this manual.

Diagrams

Diagrams

This contains the block diagram and the interconnection diagram for the WFM 1125 Digital Television Waveform Monitor Option 0A/0B/0C/0D.

Symbols

Graphic symbols and class designation letters are based on ANSI Standard Y32.2–1975. Abbreviations are based on ANSI Y1.1–1972.

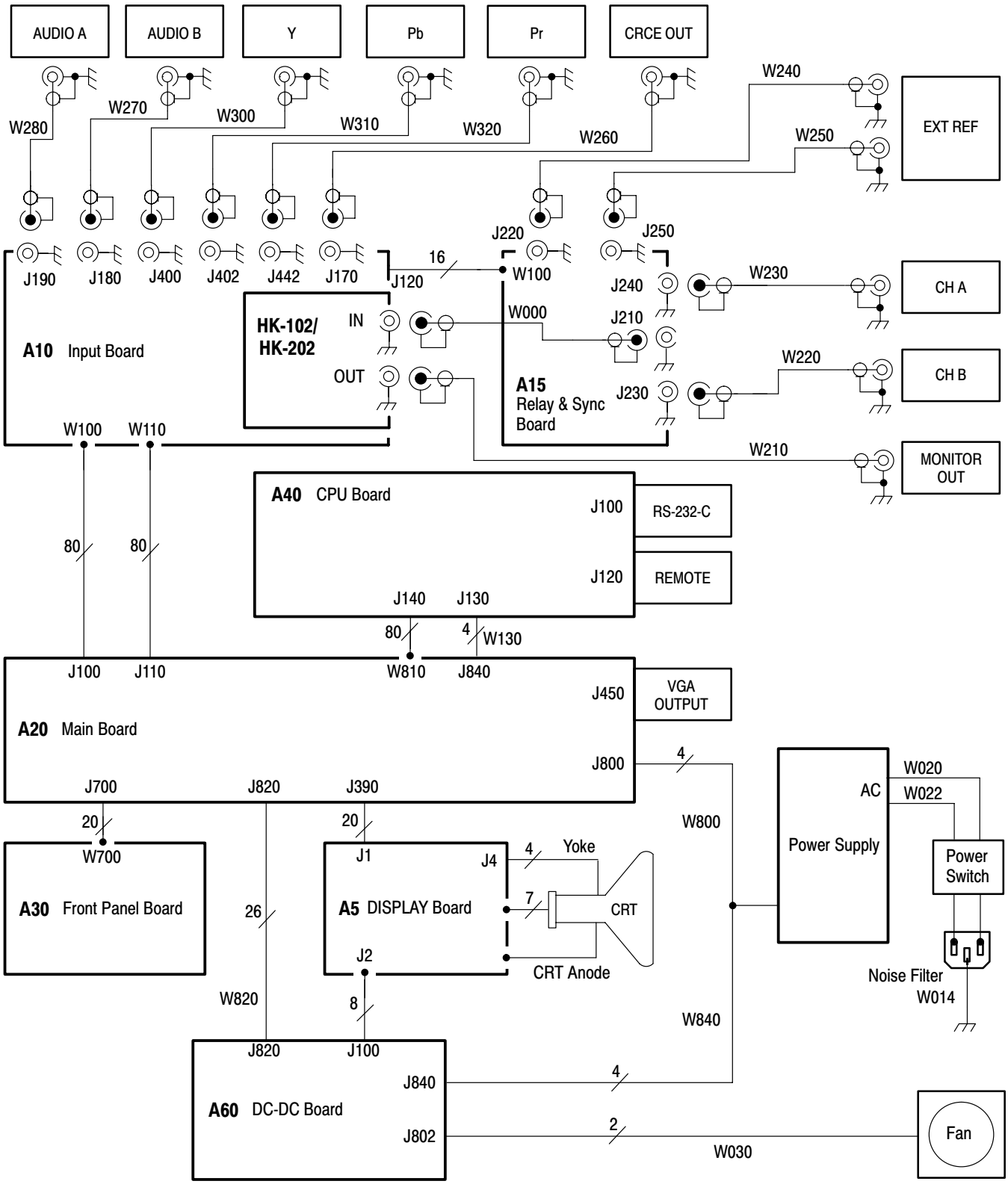


Figure 9–1: Interconnections

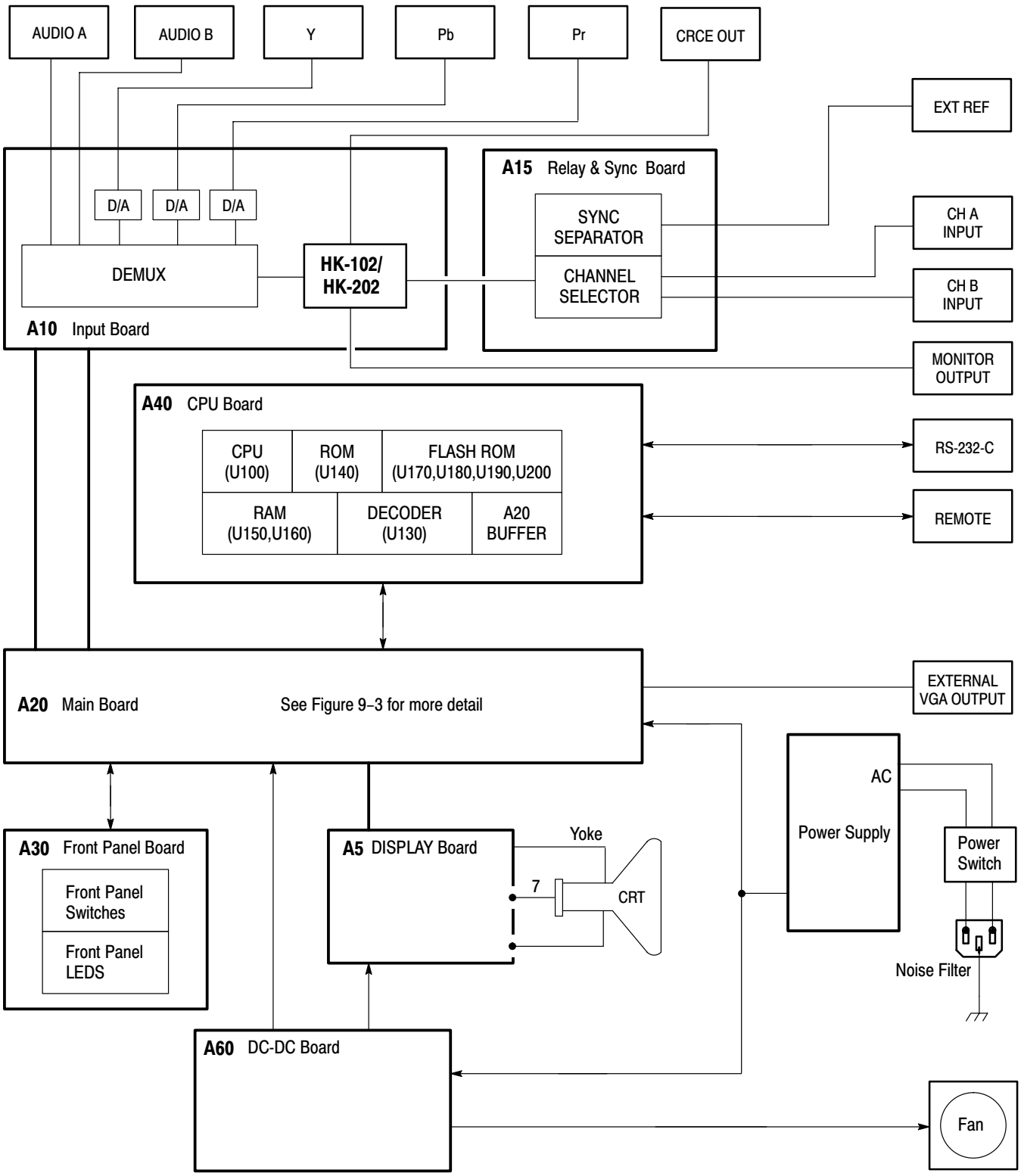


Figure 9–2: Block diagram

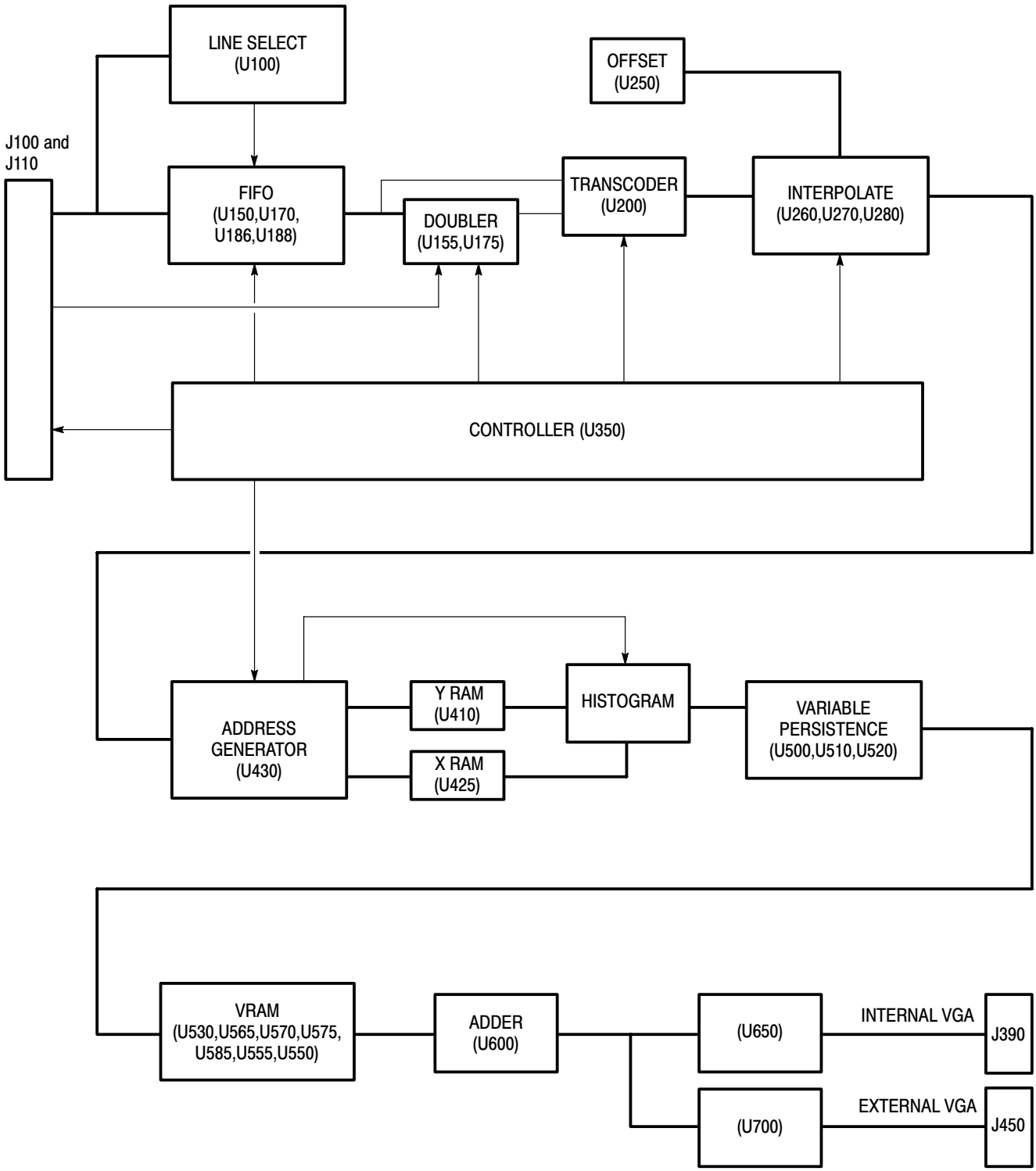


Figure 9–3: A20 Main board block diagram

Mechanical Parts List

Mechanical Parts List

This section contains a list of the replaceable modules for the WFM 1125 Digital Television Waveform Monitor Option 0A/0B/0C/0D. 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 instruments are sometimes made to accommodate improved components as they become available and to give you the benefit of the latest circuit 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 by selecting 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–TEK–WIDE, extension 6630.

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 the waveform monitor. 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 component number.
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. (Code to name and address cross reference is located after this page.)
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 following table cross indexes 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
0D1M6	NMB TECHNOLOGIES INC	9730 INDEPENDENCE AVE	CHATSWORTH, CA 91311
0GV52	SCHAFFNER EMC INC	9–B FADEM ROAD	SPRINGFIELD, NJ 07081
0JR05	TRIQUEST PRECISION PLASTICS	3000 LEWIS & CLARK HWY PO BOX 66008	VANCOUVER, WA 98666–6008
0KB01	STAUFFER SUPPLY	810 SE SHERMAN	PORTLAND OR 97214
0KB05	NORTH STAR NAMEPLATE	5750 NE MOORE COURT	HILLSBORO OR 97124–6474
05791	LYN–TRON INC	3150 DAMON WAY	BURBANK CA 91505–1015
50783	WINTRON INC (FORMERLY: PENN–TRAN CORP)	250 RUNVILLE ROAD	BELLEFONTE, PA 16823
32997	BOURNS INC	TRIMPOT DIVISION 1200 COLUMBIA AVE	RIVERSIDE, CA 92507–2114
54186	MICRO POWER SYSTEMS INC	3151 JAY ST	SANTA CLARA CA 95054
54972	CLINTON ELECTRONICS CORP	6701 CLINTON RD	ROCKFORD IL 61111–3863
73743	FISCHER SPECIAL MFG CO	111 INDUSTRIAL RD	COLD SPRING KY 41076–9749
7X318	KASO PLASTICS INC	11013 A NE 39TH	VANCOUVER, WA 98662
80009	TEKTRONIX INC	14150 SW KARL BRAUN DR PO BOX 500	BEAVERTON OR 97077–0001
80126	PACIFIC ELECTRICORD CO	747 W REDONDO BEACH PO BOX 10	GARDENA CA 90247–4203
86928	SEASTROM MFG CO INC	456 SEASTROM STREET	TWIN FALLS, ID 83301
S3109	FELLER U.S. CORPORATION	72 VERONICA AVE UNIT 4	SUMMERSET NJ 08873
TK0435	LEWIS SCREW CO	4300 S RACINE AVE	CHICAGO IL 60609–3320
TK2469	UNITREK CORPORATION	3000 LEWIS & CLARK HWY SUITE 2	VANCOUVER, WA 98661
TK2541	AMERICOR ELECTRONICS LTD	2682 W COYLE AVENUE	ELK GROVE VILLAGE IL 60007
TK2548	XEROX BUSINESS SERVICES DIV OF XEROX CORPORATION	14181 SW MILLIKAN WAY	BEAVERTON OR 97077
TK2640	STERLING ELECTRONICS	6160 SW ARTIC DRIVE	BEAVERTON, OR 97005

Replaceable Parts List

Fig. & Index Number	Tektronix Part Number	Serial No. Effective	Serial No. Discont'd	Qty	Name & Description	Mfr. Code	Mfr. Part Number
10–1–1	200–4018–XX			1	GUARD,FAN:STL,NI PL	80009	2004018XX
–2	366–1591–XX			23	PUSH BUTTON:DOVE GRAY,ABS	80009	3661591XX
–3	211–0720–XX			2	SCREW,MACHINE:6–32 X 0.50,PNH,STL,TORX T–15 WITH SLOT	OKB01	2110720XX
–4	129–1490–XX			2	SPACER,POST:12.0MM L,M3 THRU,STL,ZN–C PL,5.5MM HEX	80009	1291490XX
–5	211–0941–XX			4	SCREW,MACHINE:M3X6MM L,FLH,STL,MFZN–C,CROSS REC W/WASHER	80009	2110941XX
–6	211–0960–XX			3	SCREW,MACHINE:M4X10MM L,FLH,STL ZN PL,CROSS REC	80009	2110960XX
–7	211–0829–XX			2	SCREW,MACHINE:M3X10MM L,PNH,STL MFZN–C,CROSS REC	80009	2110829XX
–8	213–1108–XX			4	SCREW,MACHINE:M4X35MM L,PNH,STL,NI PL,CROSS REC	80009	2131108XX
–9	211–0871–XX			2	SCREW,MACHINE:M3X6MM L,PNH,STL,MFZN–C,CROSS REC W/FLAT & LOCK WASHER	80009	2110871XX
–10	211–0871–XX			41	SCREW,MACHINE:M3X6MM L,PNH,STL,MFZN–C,CROSS REC W/FLAT & LOCK WASHER	80009	2110871XX
–11	211–0941–XX			2	SCREW,MACHINE:M3X6MM L,FLH,STL,MFZN–C,CROSS REC W/WASHER	80009	2110941XX
–12	220–0208–XX			2	NUT,PLAIN,HEX:M3 X 7MM HEX,SST,3–SHU	80009	2200208XX
–13	220–0209–XX			4	NUT,PLAIN,HEX:M4,ASSEM WA	80009	2200209XX
–14	334–3379–XX			1	MARKER,IDENT:MARKED GROUND SYMBOLSAFETY CONTROLLED	22670	ORDER BY DESC
–							
–							
–17	342-A139–XX			1	INSULATOR.PLATE,POLYCARBONATE	80009	342A139XX
–18	333–4293–XX			1	PANEL,REAR:WFM1125,AL	80009	3334293XX
–19	386–7107–XX			1	SUBPANEL,FRONT:AL	80009	3867107XX
–20	441–2164–XX			1	CHASSIS,ASSY:WFM1125,AL	80009	4412164XX
–21	407–4537–XX			1	BRACKET,FRAME:STL	80009	4074537XX
–22	407–4538–XX			2	BRACKET,CRT:STL	80009	4074538XX
–23	407–4539–XX			1	BRACKET,PANEL:STL	80009	4074539XX
–24	426–2569–XX			1	FRAME,FRONT:WFM1125,POLYURETHANE	80009	4262569XX
–25	343-1569-XX			2	CLAMP	80009	3431569XX
–26	214–4796–XX			2	PIN,LOCATING:CKT BD,BRASS	80009	2144796XX
–27	342–1036–XX			1	INSULATOR,PLATE:CRT BD,PC	80009	3421036XX
–28	380–1119–XX			1	HOUSING,FAN:AL	80009	3801119XX
–29	260–2701–XX			3	SWITCH,ROTARY:ENCODER,5VDC,INCREMENTAL,W/CONN	80009	2602701XX
–30	200–4396–XX			1	COVER,CHASSIS:AIR FLOW,PC	80009	2004396XX
–31	333–4294–XX			1	PANEL,FRONT:WFM1125,PC	80009	3334294XX
–32	378–0447–XX			1	FILTER,CRT:ACRYLIC	80009	3780447XX

Replaceable Parts List (Cont.)

Fig. & Index Number	Tektronix Part Number	Serial No. Effective	Serial No. Discont'd	Qty	Name & Description	Mfr. Code	Mfr. Part Number
–33	129–1250–XX			4	SPACER,POST:12.5MM L,M2.6,STL,4.8MM HEX	S5403	CL211–0172–6
–34	129–1051–XX			2	SPACER,POST:4.8MM L,4–40INT/4–40EXT,STL 4.8MM HEX W/WASHER	80009	1291051XX
–35	346–0289–XX		J330XXX	1	STRAP,TIEDOWN:4.8 MM X 292 MM L,66–NYLON	80009	3460289XX
–36	348–1048–XX			1	PAD,CUSHIONING:150MM X 12MM X 13MM,SYNTH RBR	TKOAU	ORDER BY DESC
–37	343–0549–XX			2	STRAP,TIEDOWN:1.6–19MM DIA,66NYLON	TK1499	HW–047
–38	200–4397–XX			3	CAP:GRAY, 15MM, CAP	80009	2004397XX
–39	366–0792–XX			3	KNOB:GRAY, 15MM/6MM	80009	3660792XX
–40	348–A134–XX			43.5 CM	GASKET,SHIELD	80009	348A134XX
–41	220–0209–XX			1	NUT,PLAIN,HEX:M4,ASSEM WA	80009	2200209XX
–42	671–4602–XX 671–B100–XX	J340101	J330XXX	1	CIRCUIT BD ASSY A10 INPUT/DAC,389–A845–XX WIRED	80009	6714602XX
–43	671–4605–XX			1	CIRCUIT BD ASSY A20 MAIN,389–A900–XX WIRED	80009	6714605XX
–44	671–4603–XX			1	CIRCUIT BD ASSY A30 FRONT PANEL,389–A857–XX WIRED	80009	6714603XX
–45	671–4604–XX			1	CIRCUIT BD ASSY A40 CPU 389–A848–XX, OPTION 0A	80009	6714604XX
	671–4754–XX			1	CIRCUIT BD ASSY A40 CPU 389–A848–XX, OPTION 0B	80009	6714754XX
	671–4755–XX			1	CIRCUIT BD ASSY A40 CPU 389–A848–XX, OPTION 0C	80009	6714755XX
	671–5008–XX			1	CIRCUIT BD ASSY A40 CPU 389–A848–XX, OPTION 0D	80009	6715008XX
–46	671–4292–XX			1	CIRCUIT BD ASSY A60 DC–DC,389–A697–XX WIRED	80009	6714292XX
–47	671–4601–XX			1	CIRCUIT BD ASSY A15 RELAY & SYNC, 389–A847–XX WIRED	80009	6714601XX
–48	119–5744–XX 119–B073–XX	J340101	J330XXX	1	CONVERTER HYBRID HD SDI RX MODULE,I/O LV–CMOS	80009	1195744XX
–49	146–0093–XX			1	BATTERY,DRY LITHIUM,3V,650MAH	80009	1460093XX
–50	119–5745–XX			1	POWER SUPPLY INPUT 85–264VAC,OUTPUT 5VDC,20A	80009	1195745XX
–51	119–1536–XX			1	FILTER,RFI 3A,250VAC,50/60HZSAFETY CONTROLLED	54583	ZUB2203–00
–52	119–4361–XX			1	FAN,TUBE AXIAL 12VDC,0.16A,1.92W,4610RPM,200MM L	80009	1194361XX
–53	260–2700–XX			1	SWITCH,ROCKER DPST,250VAC,3A W/I–O MKD	80009	2602700XX
–54	131–6383–XX			1	CONN,RF JACK BNC,50OHM,FEMALE,STR,SNAP IN/PNL MTG,12.5MM MLG (CRCE)	80009	1316383XX
–55	348–1302–XX			1	GASKET,SHIELD,42CM L	80009	3481302XX
–56	348–1626–XX			1	GASKET,SHIELD	80009	3481626XX
–57	131–4131–XX			1	CONN,PLUG,ELEC:MALE W/LOCKING ADAPTER MTG	80009	1314131XX
–58	348–A134–XX			43.5 CM	GASKET,SHIELD	80009	348A134XX

Replaceable Parts List (Cont.)

Fig. & Index Number	Tektronix Part Number	Serial No. Effective	Serial No. Discont'd	Qty	Name & Description	Mfr. Code	Mfr. Part Number
–59	119–5994–XX				CRT Unit:	80009	1195994XX
	----------			1	CIRCUIT BD ASSY,A5 DISPLAY		
	----------			1	CRT		
	----------			1	DEFLECTION YOKE		
–60	276–A017–XX			1	CORE,EM FERRITE	80009	276A017XX
–61	348–A116–XX			68 CM	GASKET,SHIELD	80009	348A116XX

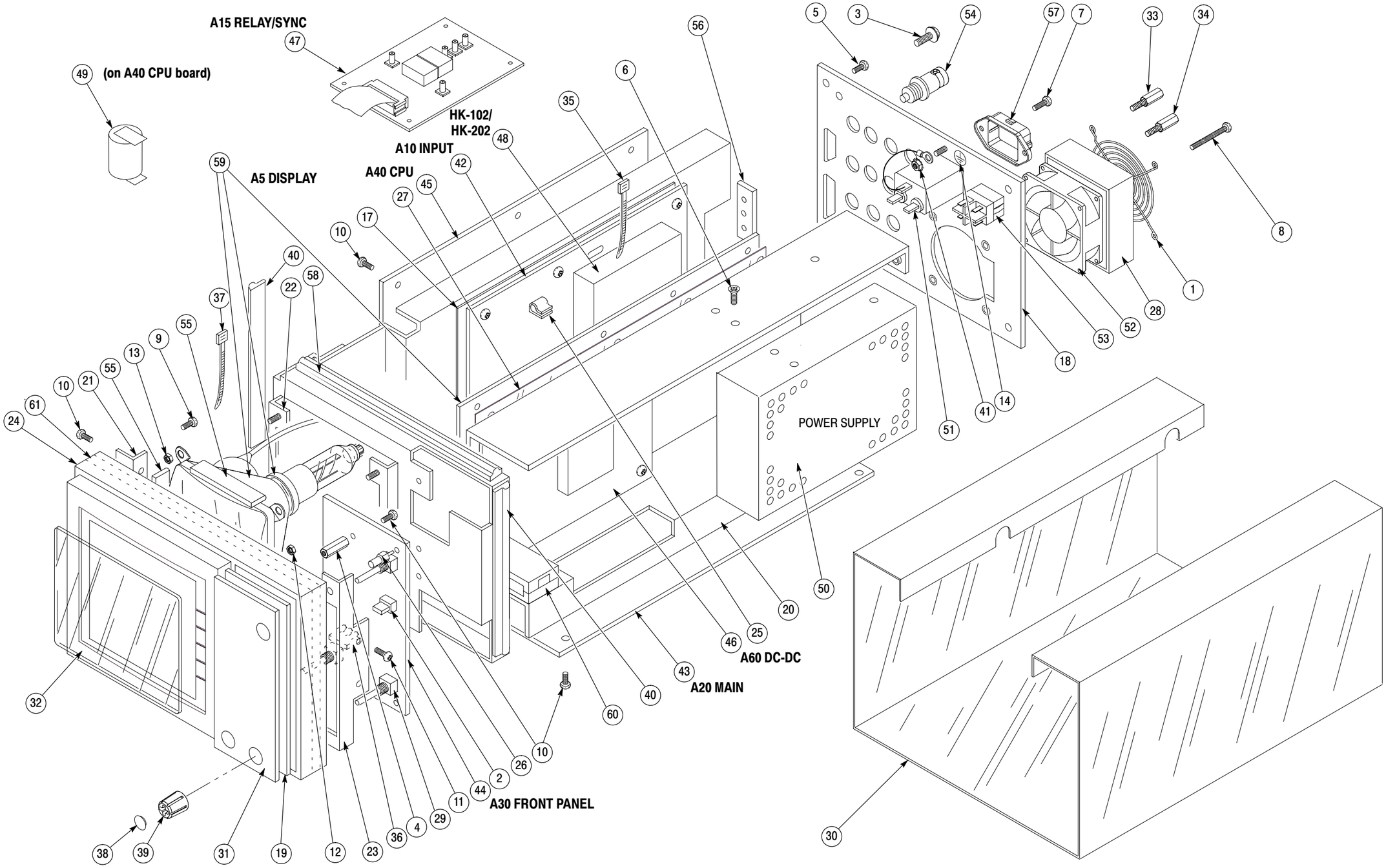


Figure 10–1: WFM 1125 Digital Television Waveform Monitor Option 0A/0B/0C/0D exploded view

Please cut away this area below the lines

Please cut away this area below the lines

Component Number	Tektronix Part No.	Serial No. Effective Dscont	Name & Description	Mfr. Code	Mfr. Part No.
			CABLE ASSEMBLIES **		
W000	174–4026–XX		CABLE ASSY,RF:75 OHM COAX,RG179,10CM L	80009	1744026XX
W210	174–4025–XX		CABLE ASSY,RF:75 OHM COAX,RG179,10CM L,BNC	80009	1744025XX
W220	174–4029–XX		CABLE ASSY,RF:75 OHM COAX,RG179,10CM L,BNC	80009	1744029XX
W230	174–4029–XX		CABLE ASSY,RF:75 OHM COAX,RG179,10CM L,BNC	80009	1744029XX
W240	174–4029–XX		CABLE ASSY,RF:75 OHM COAX,RG179,10CM L,BNC	80009	1744029XX
W250	174–4029–XX		CABLE ASSY,RF:75 OHM COAX,RG179,10CM L,BNC	80009	1744029XX
W260	174–3852–XX		CA ASSY,RF:50 OHM COAX,300MM L,GRAY	80009	1743852XX
W270	174–4027–XX		CABLE ASSY,RF:75 OHM COAX,20CM L,BLACK	80009	1744027XX
W280	174–4027–XX		CABLE ASSY,RF:75 OHM COAX,20CM L,BLACK	80009	1744027XX
W300	174–4028–XX		CABLE ASSY,RF:75 OHM COAX,20CM L,BLACK	80009	1744028XX
W310	174–4028–XX		CABLE ASSY,RF:75 OHM COAX,20CM L,BLACK	80009	1744028XX
W320	174–4028–XX		CABLE ASSY,RF:75 OHM COAX,20CM L,BLACK	80009	1744028XX
W820	174–3858–XX		CA ASSY,SP,ELEC:26,28AWG,10CM L,FLAT	80009	1743858XX

**** For cable interconnections, see Figure 9–1.**

Fig. & Index No.	Tektronix Part No.	Serial No. Effective Dscont	Qty	12345 Name & Description	Mfr. Code	Mfr. Part No.
				STANDARD ACCESSORIES		
	071–0260–XX		1	MANUAL,TECH:USER	80009	0710260XX
	161–0216–XX		1	CABLE ASSY,PWR,:3,18 AWG,2.5M L,BLACK (STANDARD ONLY)	80126	C7120–25M–BL
				OPTIONAL ACCESSORIES		
	200–3897–XX		1	FRONT PANEL COVER	80009	2003897XX
			1	PLAIN,CASE:1700F00		
			1	PTD CASE ASSY:1700F02		
			1	RACK ADAPTER,SIDE–BY–SIDE:1700F05		
			1	FILLER PANEL:1700F06		
			1	DRAWER,UTILITY:1700F07		
				FOR JUST SERVICING		
	071–0455–XX		1	MANUAL,TECH:SERVICE	80009	0710455XX
	063–3174–XX		A	3.5",DISK,WFM1125 LOAD MODULE ARCHIVES, FOR OPTION 0A/0B/0C)	80009	0633174XX
	063–3250–XX		A	3.5",DISK,WFM1125 LOAD MODULE ARCHIVES, FOR OPTION 0D	80009	0633250XX