

WVR5250
Waveform Rasterizer
Service Manual



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Important safety information

This manual contains information and warnings that must be followed by the user for safe operation and to keep the product in a safe condition.

To safely perform service on this product, additional information is provided at the end of this section. (See page vii, *Service safety summary*.)

General safety summary

Use the product only as specified. Review the following safety precautions to avoid injury and prevent damage to this product or any products connected to it. Carefully read all instructions. Retain these instructions for future reference.

Comply with local and national safety codes.

For correct and safe operation of the product, it is essential that you follow generally accepted safety procedures in addition to the safety precautions specified in this manual.

The product is designed to be used by trained personnel only.

Only qualified personnel who are aware of the hazards involved should remove the cover for repair, maintenance, or adjustment.

Before use, always check the product with a known source to be sure it is operating correctly.

This product is not intended for detection of hazardous voltages.

Use personal protective equipment to prevent shock and arc blast injury where hazardous live conductors are exposed.

While using this product, you may need to access other parts of a larger system. Read the safety sections of the other component manuals for warnings and cautions related to operating the system.

When incorporating this equipment into a system, the safety of that system is the responsibility of the assembler of 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.

Do not use the provided power cord for other products.

Ground the product. This product is indirectly grounded through the grounding conductor of the mainframe 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, make sure that the product is properly grounded.

Do not disable the power cord grounding connection.

Power disconnect. The power cord disconnects the product from the power source. See instructions for the location. Do not position the equipment so that it is difficult to operate the power cord; it must remain accessible to the user at all times to allow for quick disconnection if needed.

Use proper AC adapter. Use only the AC adapter specified for this product.

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

Do not apply a potential to any terminal, including the common terminal, that exceeds the maximum rating of that terminal.

Do not operate without covers. Do not operate this product with covers or panels removed, or with the case open. Hazardous voltage exposure is possible.

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

Do not operate with suspected failures. If you suspect that there is damage to this product, have it inspected by qualified service personnel.

Disable the product if it is damaged. Do not use the product if it is damaged or operates incorrectly. If in doubt about safety of the product, turn it off and disconnect the power cord. Clearly mark the product to prevent its further operation.

Before use, inspect voltage probes, test leads, and accessories for mechanical damage and replace when damaged. Do not use probes or test leads if they are damaged, if there is exposed metal, or if a wear indicator shows.

Examine the exterior of the product before you use it. Look for cracks or missing pieces.

Use only specified replacement parts.

Replace batteries properly. Replace batteries only with the specified type and rating.

Recharge batteries properly. Recharge batteries for the recommended charge cycle only.

Do not operate in wet/damp conditions. Be aware that condensation may occur if a unit is moved from a cold to a warm environment.

Do not operate in an explosive atmosphere.

Keep product surfaces clean and dry. Remove the input signals before you clean the product.

Provide proper ventilation. Refer to the installation instructions in the manual for details on installing the product so it has proper ventilation.

Slots and openings are provided for ventilation and should never be covered or otherwise obstructed. Do not push objects into any of the openings.

Provide a safe working environment. Always place the product in a location convenient for viewing the display and indicators.

Use only the Tektronix rackmount hardware specified for this product.

Service safety summary

The *Service safety summary* section contains additional information required to safely perform service on the product. Only qualified personnel should perform service procedures. Read this *Service safety summary* and the *General safety summary* before performing any service procedures.

To avoid electric shock. Do not touch exposed connections.

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

Disconnect power. To avoid electric shock, switch off the product power and disconnect the power cord from the mains power before removing any covers or panels, or opening the case for servicing.

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.

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.*

Symbols and 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.



When this symbol is marked on the product, be sure to consult the manual to find out the nature of the potential hazards and any actions which have to be taken to avoid them. (This symbol may also be used to refer the user to ratings in the manual.)

The following symbol(s) may appear on the product:



Preface

This manual supports servicing to the module level of the WVR5250 Waveform Rasterizer, which rasterizes video signals for XGA and HDMI displays. The instrument finds use as a monitor for broadcasting, production, and post-production environments.

This manual explains how to troubleshoot and service the instrument to the module level. The manual is divided into the following sections:

- *Introduction* provides a general product description and tells where to find product installation information.
- *Theory of Operation* provides descriptions of the instrument modules.
- *Maintenance* tells you how to troubleshoot the product to the module level and how to handle the modules.
- *Replaceable Parts* shows the replaceable modules and mechanical parts and provides replacement part numbers.

Manual Conventions

The following terms and conventions are used throughout this manual:

- The terms "rasterizer" and "instrument" are used interchangeably to refer to the WVR5250 Waveform Rasterizer.

Related Manuals

This manual assumes you have access to the following manuals when servicing this product.

Table i: Related documentation

Item	Purpose	Location(s)
Installation and Safety Instructions	Provides safety and compliance information and hardware installation instructions to present the associated safety warnings. This manual is available in English, Japanese, Russian, and Simplified Chinese	<ul style="list-style-type: none">■ Printed manual■ www.tektronix.com/downloads
Online Help	In-depth instrument operation and UI help.	<ul style="list-style-type: none">■ On the instrument
User Manual	Provides operation and application information	<ul style="list-style-type: none">■ Product Documentation CD■ www.tektronix.com/downloads

Table i: Related documentation (cont.)

Item	Purpose	Location(s)
Specifications and Performance Verification Technical Reference	Procedure for checking performance and list of specifications	<ul style="list-style-type: none">■ Product Documentation CD■ www.tektronix.com/downloads
System Integration Technical Reference	Provides information for system integrators who are designing systems where this product will be deployed.	<ul style="list-style-type: none">■ Product Documentation CD■ www.tektronix.com/downloads

Introduction

The WVR5250 Waveform Rasterizer rasterizes serial digital video signals for DVI-I and HDMI displays, providing a new standard of display quality and flexibility.

Service Strategy

These products are repaired to the module level at selected Tektronix service centers. Repair includes functional verification of the product.

Specifications

The specifications for this product are found in the Specifications and Performance Verification Technical Reference document. (See Table i.)

Performance Verification

The performance verification procedures for this product are found in the Specifications and Performance Verification Technical Reference document. (See Table i.)

Options and Accessories

The lists of options and accessories for this product are found in the user manual. (See Table i.)

Configurations

The base instrument has no hardware upgrade options. Software options are available to add capabilities such as audio and advanced gamut monitoring. For a complete list of options, refer to the user manual. (See Table i.)

Hardware Installation

This product is designed to be rack mounted. For installation instructions, refer to the Installation and Safety Instructions document. (See Table i.)

Product Upgrade

Software upgrades are available for all products as free software downloads from the Tektronix Web site. The user manual includes instructions for updating product software. If you would like to purchase additional features and capabilities for your instrument, contact Tektronix for more information on purchasable options. For a complete list of options, refer to the user manual. (See Table i.)

Operating Information

For basic operating instructions, refer to the user manual. For more detailed reference information, refer to the instrument online help. (Press the **Help** button on the instrument front panel and then use the **General** knob, up/down arrow keys, and **SEL** button to navigate through the topics.)

Power-On Procedure

1. Connect the supplied power cord to the external AC adapter, and connect its XLR output connector to the instrument.
2. Press the power button on the instrument front-panel and the instrument will turn on.
3. Wait for the system to complete its power-on self-tests.

Power-Down Procedure

1. Press the power button on the instrument front-panel to turn the instrument off.
2. To remove power completely, disconnect the power cord from the AC adapter.

NOTE. *The power button on the front-panel does not disconnect the mains power. Only the power cord at the AC adapter can disconnect the mains power.*

Theory of Operation

This instrument is modular. It includes extensive standard capabilities, which can be augmented by adding various options. This instrument has outputs to drive an external monitor as well as a serial digital picture monitor.

This theory of operation is based on the high-level block diagram. (See Figure 1.)

The block diagram reflects the physical arrangement of circuit boards with the CPU board at the bottom, the Video I/O board in the center, and the FPGA board at the top. Connectors to the External Reference and Front Panel boards are shown.

Power Distribution is not shown in the block diagram but is covered at the end of this section.

The primary functions on the CPU board are:

- Control processor kernel
- Front panel interface
- Fan controller
- Headphones output and control
- USB and network connections
- Various secondary power supplies

The primary functions on the Video I/O board are:

- SDI input signal conditioning
- HDMI input signal conditioning
- HDMI output (loopthrough of input signal)
- Input power conditioning and control

The primary functions on the FPGA board are:

- Serial digital input processing
- Waveform and picture processing for display
- DVI output
- Reference input data processing
- SDI output generation

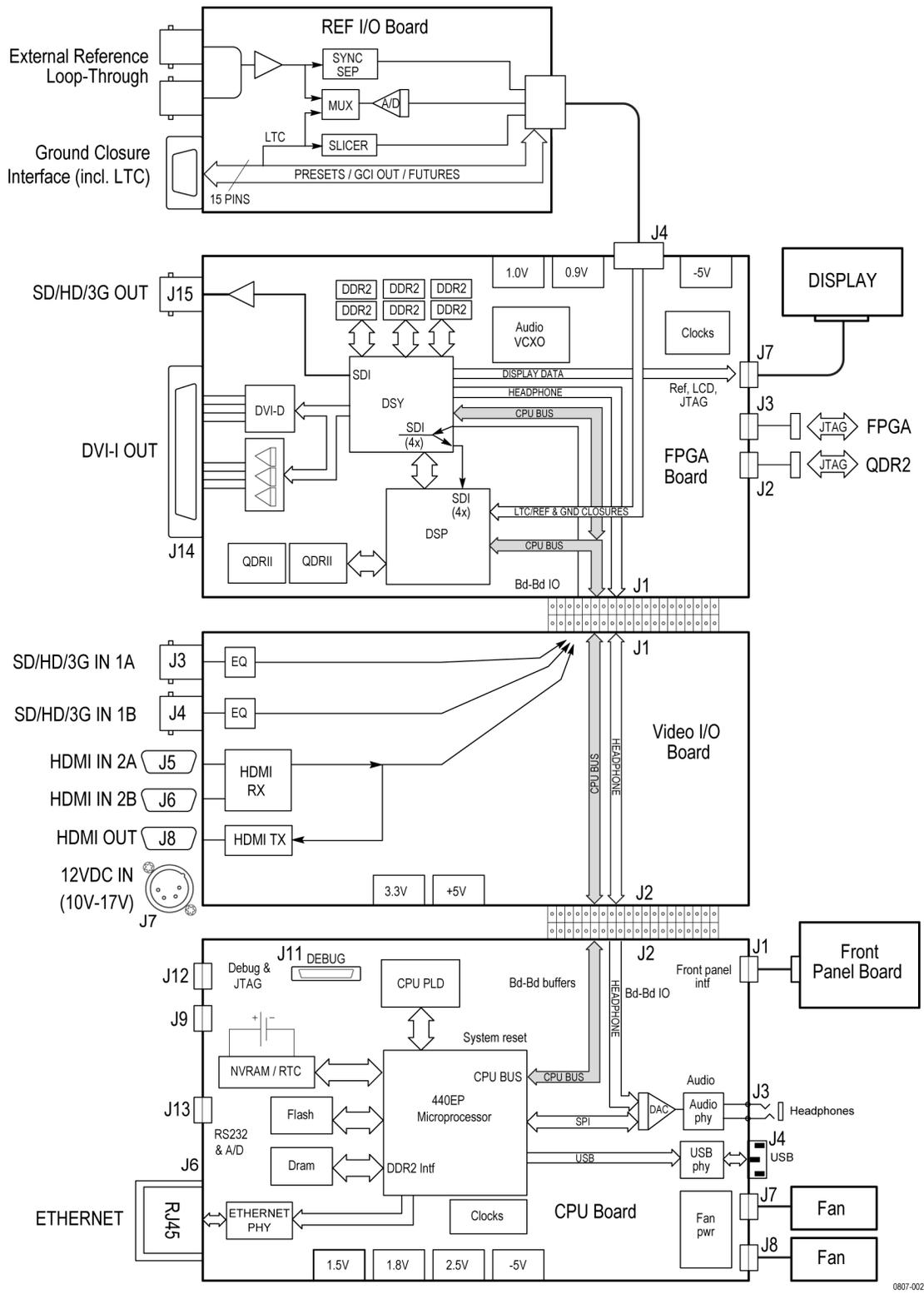


Figure 1: Block diagram

Video I/O Board

Serial Digital Input Processing

The serial digital circuitry receives the SDI input streams from the Video I/O board after they have been equalized. The SDI streams are passed to the DSP FPGAs where they undergo measurement and raster processing. The signal information is then passed to the DSY FPGA for picture processing, recursion, and display combining. The result is provided to the external DVI-I connector.

HDMI Input Processing

Both HDMI inputs (HDMI 2A and HDMI 2B) are routed to the input IC where one of the two inputs is decoded. The decoded video is then routed to both the HDMI output IC and the DSP FPGA on the FPGA board. On the FPGA board, the DSY and DSP FPGAs process the data in a similar manner to the SDI data.

REF I/O Board

Reference Input

The reference input is a passive loopthrough, which is AC coupled and buffered. The reference signal is applied to a sync separator whose output is supplied to the DSP FPGA, where the timing information is derived. The reference signal is also digitized for display as a waveform.

LTC

LTC inputs come from the remote connector. The LTC signal is applied to an A/D converter and then input to the waveform processing FPGA, which decodes the time code information.

NOTE. *The FPGAs decode VITC signals digitally.*

FPGA Board

Digital Waveform Processing Engine

The data streams from the video inputs are applied to the waveform processing FPGA. This block deformats, up-samples, interpolates, and otherwise processes the data to generate the signals needed to create the displays.

Rasterizing Engine

The rasterizer engine resides in the same DSP FPGA as the waveform processing engine. This block builds up the variable intensity images in the fast static RAM. For each pixel of the display, the rasterizer engine increments the intensity of that pixel every time the waveform hits its coordinates. As a result, the waveform areas that are hit more frequently are brighter. For any given frame, the intensity map is built up in one memory chip and read out of the other. The functions swap on the next field.

Recursion and Picture Processing Engine

The output of the rasterizing engine feeds the picture and recursive processing engine in the second large FPGA. This engine adds the previous frame to the present frame to reduce flicker and improve brightness. It also converts the picture and waveform signals from various input frame rates to 60 Hz frame rate to work with the DVI-I monitor. The picture and waveform data are then combined with the graphics and audio bar information from the control processor. The result is sent through the DVI connector to the external monitor.

CPU Board

CPU Board Control Processor

The control processor is in charge of all the operational modes in the instrument. It draws the audio bars, communicates with the front panel, and controls most other internal devices through either the SPI or the I²C bus.

The control processor interfaces to the Ethernet through a dual rate connection. This allows the network connection to run at 10 or 100 MBps.

Front Panel

The front panel contains a small processor which communicates with the control processor through SPI signaling. Reprogramming can be done through the SPI if the front panel processor flash code must be updated.

Audio (Option AUD)

The audio option enables display of levels and phase of embedded audio, and drives the headphones output.

SDI Audio Processing

The display FPGA extracts embedded audio data from the selected SDI data stream and sends it to the headphones output D/A converter on the CPU board. The FPGA also calculates the peak values for the selected meter ballistics (response characteristics).

The audio data has two paths to the display. On one path, peak values are read by the control processor, which then plots the bar and surround displays. On the second path, raw data samples are sent to the waveform processing engine, which interpolates and plots it to generate the Lissajous, or “phase,” display.

HDMI Audio Processing

HDMI audio is extracted from the HDMI stream by the HDMI input IC. It is then output through an I²S interface to the FPGA board, where it enters the DSP FPGA. Once on the FPGA board, the audio is processed in a manner similar to the SDI audio.

Fan Control

There are multiple temperature sensors in different locations in the instrument. The control processor reads the temperature sensors and sets a target speed for the fans. The fan circuit holds the fan speed at the target by measuring the fan tachometer output, allowing reliable operation at low speed. If a fan is not turning, the circuit senses the stall and turns on a red LED (DS2 or DS3 on the CPU board). The fans are tested at power on. If a fan fails, a message is shown on screen and also entered into the diagnostic log.

Power Supply and Distribution

External power may be supplied by either the provided power module or a customer-supplied 11-17 V DC power source. Protection circuits include a self-resetting fuse, transient filtering, and limiting, over- and under-voltage protection and current limiting. A latching relay controls standby mode. The nominal 12 V DC input powers 5 V and 3.3 V supplies. All three voltages are distributed to the CPU and FPGA boards to power circuits as well as lower voltage local regulators.

General Maintenance

This section contains the information needed to perform periodic and corrective maintenance on the instrument. The following subsections are included:

- *Preventing ESD* – General information on preventing damage by electrostatic discharge.
- *Inspection and Cleaning* – Information and procedures for inspecting and cleaning the instrument.
- *Troubleshooting* – Information for isolating and troubleshooting failed modules. Included are instructions for operating the diagnostic routines and troubleshooting trees. Most of the trees make use of the internal diagnostic routines to speed fault isolation to a module.
- *Removal and Replacement Procedures* – Information and procedures for removing and replacing modules in the instrument.
- *Repackaging Instructions* – Information on returning a instrument for service.

Preventing ESD

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



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

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

1. Minimize handling of static-sensitive circuit boards and components.
2. Transport and store static-sensitive modules in their static protected containers or on a metal rail. Label any package that contains static-sensitive boards.
3. Discharge the static voltage from your body by wearing a grounded antistatic wrist strap while handling these modules. Do service of static-sensitive modules only at a static-free work station.
4. Nothing capable of generating or holding a static charge should be allowed on the work station surface.
5. Handle circuit boards by the edges when possible.

6. Do not slide the circuit boards over any surface.
7. Avoid handling circuit boards in areas that have a floor or work-surface covering capable of generating a static charge.

Inspection and Cleaning

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

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

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

General Care The cabinet helps keep dust out and should normally be in place during operation.



WARNING. *To prevent injury or death, power off the instrument and disconnect it from line voltage before performing any procedure that follows.*

Interior Cleaning Use a dry, low-velocity stream of air to clean the interior of the chassis. Use a soft-bristle, nonstatic-producing brush for cleaning around components. If you must use a liquid for minor interior cleaning, use a 75% isopropyl alcohol solution and rinse with deionized water.

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



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

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

Table 1: External inspection checklist

Item	Inspect for	Repair action
Front panel and top cover	Cracks, scratches, deformations, damaged hardware	Repair or replace defective module
Front-panel knobs	Missing, damaged, or loose knobs	Repair or replace missing or defective knobs
Connectors	Broken shells, cracked insulation, and deformed contacts. Dirt in connectors	Repair or replace defective modules. Clear or wash out dirt
Rackmount slides	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

Inspection — Interior. To access the inside of the instrument for inspection and cleaning, you must remove the top cover.

Inspect the internal portions of the instrument for damage and wear, using the following table as a guide. Defects found should be repaired immediately.

If any circuit board is repaired or replaced, check the following table to see if it is necessary to adjust the instrument.



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

Table 2: Internal inspection checklist

Item	Inspect for	Repair action
Circuit boards	Loose, broken, or corroded solder connections. Burned circuit boards. Burned, broken, or cracked circuit-run plating.	Remove and replace damaged circuit board.
Resistors	Burned, cracked, broken, blistered condition.	Remove and replace damaged circuit board.
Solder connections	Cold solder or rosin joints.	Resolder joint and clean with isopropyl alcohol.

Table 2: Internal inspection checklist (cont.)

Item	Inspect for	Repair action
Capacitors	Damaged or leaking cases. Corroded solder on leads or terminals.	Remove and replace damaged circuit board.
Wiring and cables	Loose plugs or connectors. Burned, broken, or frayed wiring.	Firmly seat connectors. Repair or replace modules with defective wires or cables.
Chassis	Dents, deformations, and damaged hardware.	Straighten, repair, or replace defective hardware.

Cleaning Procedure – Interior. To clean the instrument interior, perform 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 6.
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. Dry all parts with low-pressure, deionized air.

Lubrication. There is no periodic lubrication required for the instrument.

Troubleshooting

The procedures in this section will help you trace the root cause of a problem back to one of the replaceable modules. In general, this is a board-level replacement, but there are a few components on some boards that are replaceable.



WARNING. *Before performing this or any other procedure in this manual, read the General Safety Summary and Service Safety Summary found at the beginning of this manual.*

To prevent possible injury to service personnel or damage to electrical component, refer on how to prevent ESD. (See page 9.)

Getting Started

This procedure consists of two main sections: the first section contains the *Symptoms and Causes* table, and the second section contains a set of *Detailed Troubleshooting Procedures*. The table lists common problems and should help you identify the problem or it may direct you to one of the detailed troubleshooting procedures in the second section. You should investigate and resolve the first symptom found, as the Symptoms and Causes table assumes that the functions covered earlier in the table are working correctly. If you do not find your problem in the table, or if no specific problem was reported by the user, then follow the steps in the *Unknown Problem* section in the Symptoms and Causes table.

The WVR5250 Waveform Rasterizer is highly configurable, and its behavior is sometimes complex. Before troubleshooting in-depth, verify that:

- The installed options are as expected. See CONFIG > Utilities > View Instrument Options
- The current settings support the expected behavior. A good first step is to recall the Factory Presets. To do this, press PRESET > Recall Preset > Recall Factory Preset.

To fully test this instrument, you must have an appropriate Serial Digital Video source and an HDMI signal source. In some cases, you may also need receivers or an oscilloscope to check outputs.

This instrument consists of several boards and major components. The objective of this troubleshooting guide is to isolate a problem to a module or board so it can be replaced. This guide does not provide information to troubleshoot to the component level.

Standard boards and modules:

- Power Supply (external)
- FPGA board
- CPU board
- Video I/O board
- External Reference I/O board

Table 3: Required test equipment

Test equipment	Requirements	Example
SDI serial digital video test generator with embedded audio. Instruments with option 3G require a 3 Gb/s SDI source.	1080p 59.94 3 Gb/s signals required: <ul style="list-style-type: none"> ■ 100% color bars ■ SDI Matrix Split Field Pathological Signal 	Tektronix TG700 with an HD3G7 module (Embedded audio needed for audio options)
	1080i 59.94 HD signals required: <ul style="list-style-type: none"> ■ 100% color bars ■ 10 bit shallow ramp ■ SDI Matrix Split Field Pathological Signal ■ 100% sweep 	
	525/270 SD signals required: <ul style="list-style-type: none"> ■ 100% color bars ■ 10 bit shallow ramp ■ SDI Matrix Pathological Signal ■ 100% sweep 	
XGA Monitor	Computer monitor capable of 1024 x 768 x 60 Hz scan rate	
HDMI signal source	Any HDMI signal	Simplay Labs IScan® Duo video processor/switcher
Monitor with an HDMI input	Supports standard HDMI formats	Tektronix WFM5250 SDI/HDMI Multifformat Compact Waveform Monitor
HDMI cable	Supports standard HDMI formats	Belkin HDMI High Speed Cable
Voltmeter		Fluke 87 or equivalent
Oscilloscope	Video trigger capability	Tektronix TDS3000C Series, Tektronix DPO70404

Table 4: Symptoms and causes

Symptom	Possible cause or detailed troubleshooting procedure to follow
No LEDs lit and no external display	Perform General Checks Perform Power Switch Checks Perform Basic Power Supply checks
Some LEDs lit, but no external display	Perform General Checks Verify external monitor functionality with another X VGA source Perform Basic Power Supply Fault Checks Perform CPU Boot Checks
External display does not function normally	Verify external monitor functionality with another X VGA source Replace FPGA board
The front panel buttons are all dark or inoperative	Check front panel cable Replace front panel assembly
Power Up Diagnostic failures:	
Faults referring to Main or CPU board	Replace CPU board
Faults referring to FPGA functions	Replace FPGA board
Fan faults	Perform Fan Checks
Advanced Diagnostics failures:	Replace FPGA board
Functional or Performance Verification Test Failures:	Perform Power Up Diagnostics Perform Advanced Diagnostics Perform Diagnostic Monitor Voltage Checks
SDI in, one channel bad	Replace Video I/O board
SDI in, both channels bad	Replace FPGA board
SDI out bad	Replace FPGA board
Waveform or graphic displays corrupted	Replace FPGA board
HDMI in, one channel bad	Replace Video I/O board
HDMI in, both channels bad	Perform HDMI input checks
HDMI OUT bad	Replace Video I/O board
Audio bars bad	Replace FPGA board
USB bad	Replace CPU board
Ethernet bad	Replace CPU board
Fans bad	Perform Fan checks
Headphones bad, audio bars OK	Replace CPU board
Reference or LTC waveform bad	Check Reference I/O cable Replace Reference I/O board

Table 4: Symptoms and causes (cont.)

Symptom	Possible cause or detailed troubleshooting procedure to follow
Ground closure input or Alarm output bad	Check Reference I/O cable Replace Reference I/O board
Unknown Problems	Use these steps to diagnose an instrument with vague or intermittent symptoms: <ol style="list-style-type: none"> <li data-bbox="487 443 1453 506">1. Check the diagnostic log. This log records a variety of problems and will enable you to see messages for an error that may not be happening now. <li data-bbox="487 512 1453 604">2. Check the power supplies by performing the Diagnostic Monitor Voltage Checks. A marginal supply can lead to intermittent operation if it is near the acceptable threshold. This includes the external power source and the secondary supplies on each board. <li data-bbox="487 611 1453 699">3. Perform the incoming inspection tests. This will exercise a majority of the functions in the unit and includes the Advanced Diagnostics. Some parts of the test may not be necessary for all problem areas.

Detailed Troubleshooting Procedures

The following tests should be run as indicated in the *Symptom and Causes* table. (See Table 4 on page 15.) The procedures check for specific problems or will help you isolate a problem to a board. You can run them at any time for informational purposes, but if you do not run the procedures in the correct context, then the final recommendation identifying a root cause might be suspect.

General Checks

1. Verify that the external power is connected, stable and between 10 and 19 V_{DC}.
2. Check that all internal cables are correctly connected and seated.
3. Check for any discolored or burned components.

Power Switch Checks

This procedure requires partial disassembly and should only be performed if the unit fails to show any indication of operation. This procedure may also be used to troubleshoot a unit that cannot be powered off from the front panel power button.

Remove the Reference I/O and FPGA boards to gain access to the Video I/O board test points. Connect power and measure the voltage at power connector J7 pin 4 with respect to chassis ground. The external power supply voltage (10 to 19 V_{DC}) should be present at this pin.

If no LEDs are lit on the front panel or CPU board, press the front panel power button to check that the initial problem is still present. If there is still no indication of power up, press button S1 on the Video I/O board. If S1 also has no effect, replace the Video I/O board.

If S1 causes normal power up (indicated by lit red and green LEDs on the CPU board), then the problem is in the connection from the front panel button to the Video I/O board. Disconnect power, disassemble as necessary, and check for continuity or low resistance of the following links:

- Button resistance: On the Front Panel board, resistance from J1 pin 2 to ground should be less than 1000 ohms when the power button pressed, greater than 20k ohms when released.
- Front panel cable continuity: Resistance from Front Panel board J1 pin 2 to CPU board J1 pin 2 should be less than 10 ohms.
- CPU board continuity: Resistance from J1 pin 2 to J2 pin 211 should be less than 10 ohms.
- Video I/O board continuity: Resistance from J2 pin 211 to switch S1 pins nearest the edge of the board should be less than 10 ohms.

Replace any cable or board that fails the resistance checks.

Basic Power Supply Checks

This section describes methods for verifying the proper operation of the basic power supplies on the Video I/O board. This procedure requires partial disassembly, and should only be performed if the unit fails to produce evidence of CPU boot up.



WARNING. *Internal power supplies are all low voltage so no safety shield is present.*

This instrument requires an external DC power source capable of providing 11 to 17 V_{DC} at 3A. The provided AC adapter accepts 90 to 264 V_{AC} and outputs around 12 V_{DC} with 4 A capability. This voltage passes through a power switch circuit on the Video I/O board, and is present at the "+12V" test point if instrument power is on.

The switched +12V powers +5V and +3.3V switching power supplies, also located on the Video I/O board. These three voltages are the basic power supplies distributed to the rest of the instrument.

Remove the Reference I/O and FPGA boards to gain access to the Video I/O board power test points. Locate the +12V, +5V and +3.3V test points on the Video I/O board. (See Figure 2.) Measure the voltages with a DVM and check against the allowable ranges. (See Table 5.) If the voltages are outside the allowed range, replace the Video I/O board. If voltages are within the allowed range, replace the CPU board.

Table 5: Video I/O board basic supplies

Nominal (+V)	Allowed range (+V)
+12V	11 to 17
+5V	4.85 to 5.15
+3.3V	3.2 to 3.4

HDMI Input Checks

This procedure requires disassembly. It should be performed only if the HDMI input fails to perform correctly.

1. Follow the steps to remove the FPGA board. (See page 27, *FPGA board*.)
2. With the FPGA board removed, power up the instrument.
3. Plug in an HDMI cable, driven by an HDMI signal, into input HDMI 2A.
4. Verify that the red LED labeled HDMI Input A turns on. If it does not turn on, replace the Video I/O board.
5. Move the HDMI cable to input HDMI 2B.
6. Verify that the red LED labeled HDMI Input B turns on. If it does not turn on, replace the Video I/O board.
7. If both LEDs function correctly when an input is plugged in, the failure is probably in the parallel video bus that connects the Video I/O board to the FPGA board. This could be on the FPGA board or the Video I/O board.

Basic Power Supply Fault Checks

This procedure requires disassembly. It should be performed only if the unit fails to operate to the point where diagnostics can be run, and if the power button is continuously lit red. The power button is normally red for about 2 seconds when the unit is first powered up. In addition, the power button may be red in the case of any detected hardware fault. To isolate the symptom to a power supply fault, it is necessary to view the fault LEDs on the Video I/O board.

Remove the top cover to gain viewing access to the Video I/O board fault LEDs DS2, DS3, DS4 and DS5, located on the right edge of the Video I/O board. These are visible from above. Connect power and press and hold the power button. If none of the four fault LEDs is red, then exit this procedure.

LEDs DS1, and DS3 indicate faults on the Video I/O board. If any one of them is red, replace the Video I/O board. If either DS4 or DS5 is lit, then isolate the faulty assembly by removing them one at a time in the order listed below. Disconnect the power before removing each assembly, and then reconnect power and press the power button to test. The first board or cable to be removed that causes a Video I/O board fault LED to stop lighting is probably faulty and should be replaced.

1. Reference I/O cable at FPGA board J4
2. FPGA board
3. Display backlight cable at CPU board J5 (remove Video I/O board to gain access, then reinstall Video I/O board)

For the next two steps, test by pressing Video I/O board switch S1 instead of the (disconnected) front panel power button:

4. Front panel cable at CPU board J1 (remove Video I/O board to gain access, then reinstall Video I/O board)
5. CPU board (remove Video I/O board from CPU and test Video I/O board in isolation)

If any Video I/O board fault LED, DS1 through DS5, is red when the board is tested in isolation, replace the Video I/O board.

CPU Boot Checks

The objective of this test is to determine whether the combination of the CPU board, the FPGA board, and the Video I/O board is booting correctly, in which case the missing external display is an FPGA board fault. If this combination of boards is not booting to completion, the Basic Power Supply Fault Checks decide whether Video I/O or CPU+FP is at fault. The primary indicator is the front panel behavior, which is presumed good based on single-fault assumption. Since a good unit boots completely with the front panel disconnected, an initial and final test are done to the front panel to guarantee that the front panel is not hanging boot.

This procedure requires disassembly, and should be performed only if some front panel buttons light, but the external display is not functional.

Observe the sequence of front panel button illumination at power on. Normal power up sequence has the following appearance. Time “T” is in seconds.

T=0: Press power button to power up

GAIN, SWEEP, MAG buttons light

Initial button lighting sequence starts with <, ^, >, V buttons on for about 1/2 second each

T=3: All buttons flash for fraction of a second, then all go out.

The button sequence changes to row-by-row starting with WFM row, then PICT row, then GAMUT row, then repeating.

T=10 to 20: Power button may turn red.

T=20: Button sequence stops.

T= 28: Brief changes, then all buttons dim (per backlight setting).

T= 32: Previous power off state is restored to buttons. Usually two or three become bright.

If the power up behavior is similar to that described, then the CPU is booting correctly and the display fault is likely to be on the FPGA board. Replace the FPGA board.

If the power up behavior differs from that described above, then perform the Basic Power Supply Fault Checks to further isolate the faulty module.

Fan Checks

This instrument contains two fans; they are controlled by both hardware and software. Hardware controls the fans to a certain speed, but software sets the speed target as a function of the temperature measured on a variety of temperature sensors.

If a fan fails, its corresponding LED lights up on the CPU board:

- Fan 1 fails: LED DS3 lights
- Fan 2 fails: LED DS2 lights

A fan failure is sensed through tachometer feedback; a fault is asserted if the fan is disconnected or stalled, or if the tachometer feedback line is not working correctly.

If one fan fails, the control circuit will increase the voltage to the 13.5 V max level, causing the remaining fan to run at maximum speed.

The normal voltage to drive the fans (pin 1) varies from about 6 V to 13.5 V depending on internal temperature.

If a fan is not spinning, measure the voltage on pin 1 of the connector on that fan. If the voltage is near 13 V, replace the fan. If the voltage is not above 10 V, replace the CPU board.

If both fans are spinning, but either LED DS2 or DS3 is lit, the problem is probably the tachometer feedback line on pin 3 of either fan. Inspect the wiring and resistors R201, R203, R202, and R204 on the CPU board, and use the oscilloscope to look for a 3.3 V square wave on the tachometer feedback line. If resistors are intact but there is no signal on the tachometer line, replace the affected fan.

Power-Up Diagnostics

To examine the Power-up Diagnostics results, press the **CONFIG** button, and then select **Utilities > View Diagnostic Log**.

Each power on is indicated by a boot time stamp, followed by a list of power on tests. If any failures are indicated, refer to the action as noted above.

Advanced Diagnostics

To run the Advanced Diagnostics, press the **CONFIG** button, and then select **Utilities > Run Advanced Diags**.

Advanced Diagnostics includes tests that check the interfaces between FPGAs and memory on the FPGA board. If the instrument fails any of these tests, replace the FPGA board.

Diagnostic Monitor Voltage Checks

This test uses the built-in voltage monitor to check many power supplies on the Video I/O, FPGA, and CPU boards. It requires successful boot up, display and front panel operation:

1. Press and hold OTHER, and then select Diag Monitor to display the diagnostic monitor screen.
2. Navigate to pages 2 and 3 to display the power supply voltages. If the “Last” value of any voltage is outside the allowable range, it is displayed in red. Voltage values are updated about every 10 seconds.
3. If any voltage is out of range, replace the faulty module as indicated by the first word of the displayed line. “Input” indicates the power supply is on the Video I/O board.

Front Panel Button Troubleshooting

Perform this test if the power supplies are good, but none of the buttons are lit or respond to presses:

1. Cycle the power to the unit. Immediately after power on, three buttons (GAIN, SWEEP, and MAG) should be lit continuously and the other buttons should be lit one at a time in a walking pattern.
2. If the buttons are not lit, check the 10 pin cable from the keypad to the main board J21. If the cable is connected and good, then replace the front panel assembly.

Removal and Replacement Procedures

This section contains information about removal and replacement of all modules in the instrument.

Preparation



WARNING. Before doing this or any other procedure in this manual, read the safety summaries found at the beginning of this manual. Also, to prevent possible injury to service personnel or damage to the instrument components, read Installation in Section 2, and Preventing ESD in this section.

This subsection contains the following items:

- This preparatory information that you need to properly do the procedures that follow.
- List of tools required to remove and disassemble all modules.
- Procedures for removal and reinstallation of the modules.



WARNING. Before doing any procedure in this subsection, disconnect the power cord from the line voltage source. Failure to do so could cause serious injury or death.

NOTE. Read Equipment Required for a list of the tools needed to remove and install modules in this instrument. (See Table 6 on page 25.) Read the cleaning procedure before disassembling the instrument for cleaning.

Equipment Required. Most modules in the instrument can be removed with a screwdriver handle mounted with a size T8 and T10 Torx screwdriver tips and a

3/16 nut driver. All equipment required to remove and reinstall the modules is listed in the following table. (See Table 6 on page 25.)

Table 6: Tools required for module removal

Item no.	Name	Description	General Tool number
1	Screwdriver handle	Accepts TORX-driver bits	620-440
2	T8 TORX tip	Used for removing screws that secure the top cover, rear panel, front panel, and XLR power connector.	Standard tool
3	T10 TORX tip	Used for removing most instrument screws. Torx-driver bit for T10 size screw heads	640-235
4	T15 TORX tip	Used for removing instrument screws. Torx-driver bit for T15 size screw heads	640-247
5	1/8 inch flat-bladed screwdriver	Screwdriver for unlocking cable connectors	Standard tool
6	Angle-Tip Tweezers	Used for removing front panel knobs	Standard tool
7	3/16 inch nut driver	Used for removing jack screws and front panel spacer posts	Standard tool
8	5/16 inch nut driver	Used for removing the nut on AC ground lug	Standard tool
9	9/16 inch nut driver	Used for removing the nuts from the rear-panel BNCs.	Standard tool
10	9/16 inch spanner socket	Used for removing the nuts from the rear-panel SDI connectors	Standard tool
11	MA-800G Soldering Aid (spudger)	Used for removing the front panel trim	Standard tool
12	Soldering iron (15 W)	Used for replacing CPU board fuses	Standard tool
13	Long nose pliers	Used to compress connector lock tabs	Standard tool

Module Removal

The removal of most of the modules is a straightforward process, and can be determined by a quick study of the exploded diagram in the *Replaceable Parts List*. (See Figure 5.) The boards need to be removed in the order listed here.

- Top cover**
1. Remove the five flat-head 40 X 0.188 T8 screws on the front edge of the top cover. When reinstalling, tighten these to 8 in/lb.
 2. Remove the four flat-head T8 screws on the left side of the top cover and the four flat-head T8 screws on the right side.
 3. Lift the top cover up off the instrument.

- Rear panel and Reference I/O board**
1. Turn the instrument over. On the bottom side of the main chassis, remove the three flat-head 40 X 0.188 T8 screws that attach the rear panel to the chassis. When reinstalling, tighten these to 8 in/lb.
 2. Turn the instrument right side up. Remove the two flat-head 40 X 0.375 T8 screws that attach the ground clip and the XLR connector to the rear panel. When reinstalling, install the ground clip as shown. (See Figure 3.) Tighten the screws to 5.5 in/lb.

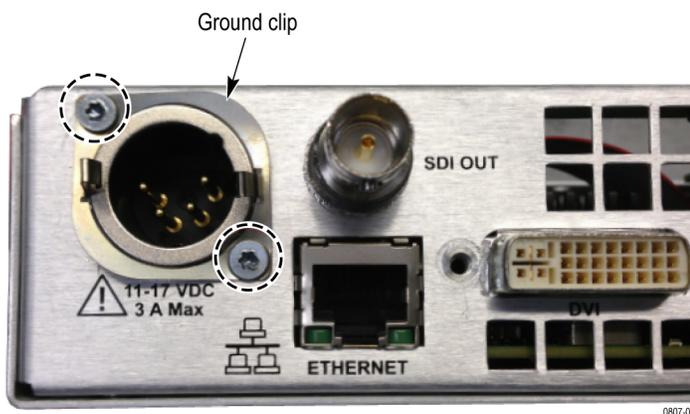


Figure 3: XLR connector ground clip

3. Using a 9/16 spanner socket, remove the nut and lock washers from the two SDI input connectors.
4. Using a 9/16 wrench, remove the nut and lock washers from the three remaining BNC connectors.
5. Using a 3/16 nut driver, remove the 2 DVI jack screws.

6. Carefully disconnect the cable that leads from the Reference I/O board to J4 on the FPGA board below.
7. Pull gently and separate the rear panel, with the Reference I/O board still attached, from the main chassis.

Reference I/O board.

1. Using a 3/16 nut driver, remove the two Remote connector jack screws that attach the Reference I/O board to the rear panel. When reassembling, tighten to 4 in/lbs.
2. Remove the nut and lock washers from the two Ref Loop female BNC connectors using a 9/16 wrench.
3. Pull the Reference board straight back away from the rear panel.
4. Place the Reference I/O board on a static-free work surface.

FPGA board

1. Remove the three pan-head 40 X 0.187 T10 screws that attach the FPGA board to the Video I/O board below it. When reassembling, tighten these screws to 5.5 in/lb.
2. Lift the FPGA board straight up, to disconnect the inter-board connector on the bottom of the FPGA board from the Video I/O board. When reinstalling, make sure that these connectors are aligned correctly before pushing the FPGA board down on the Video I/O board, and make sure that you do not clip the fan cable.
3. Place the FPGA board on a static-free work surface.

Video I/O board

1. Using a 3/16 nut driver, remove the three spacer posts. When reassembling, tighten the posts to 5.5 in/lbs.
2. Lift the Video I/O board straight up to disconnect the inter-board connector on the bottom of the Video I/O board from the CPU board. When reinstalling, make sure that these connectors are aligned correctly before pushing the Video I/O board down on the CPU board.
3. Place the Video I/O board on a static-free work surface.

CPU board

1. Remove the one pan-head 40 X 0.187 T10 screw that secures the CPU board to the chassis. When reinstalling, tighten this screw to 5.5 in/lb.
2. Using a 3/16 nut driver, remove the three spacer posts. When reassembling, tighten the posts to 5.5 in/lbs.
3. Gently disconnect the fan cables from J7 and J8 on the CPU board. These connectors lock in place. Push the release tab (in the middle) to unlatch the

connector. When reinstalling, make sure to push the plug into the connector until it snaps into place.

4. Gently disconnect the front panel cable from J1 on the CPU board. Pull this straight away from the connectors to prevent damage.
5. Tilt the CPU board up slightly and separate it from the main chassis.
6. Place the CPU board on a static-free work surface.

Front Panel

1. Turn the front panel assembly over. Remove the two flat-head 40 X 0.188 T-10 screws on the bottom that attach the front panel assembly to the main chassis.
2. Pull the front panel assembly forward. Gently pull the cable through the slot in the main chassis.
3. Gently disconnect the cable from the Front Panel board and set it aside.

Remove the Front Panel board. The Front Panel board can be removed from the front panel and replaced, as follows:

1. Remove the three knobs from the front panel.
2. Remove the four pan-head 40 X 0.187 T10 screws that attach the board to the front panel. When reinstalling, tighten to 5.5 in/lb.
3. Gently separate the board, with elastomer mat attached, from the front panel.
4. Pull off the elastomer mat.

Fan and Main Chassis

1. Remove the four pan-head 40 X 0.625 T10 screws that attach the two fans to the main chassis.
2. Remove the fans from the main chassis. When reassembling, put the fans inside the main chassis with the NMB-MAT labels facing toward the inside of the instrument. Make sure the fans are rotated so that the cables are located up against the main chassis bottom and on the outer corners. (See Figure 4.)

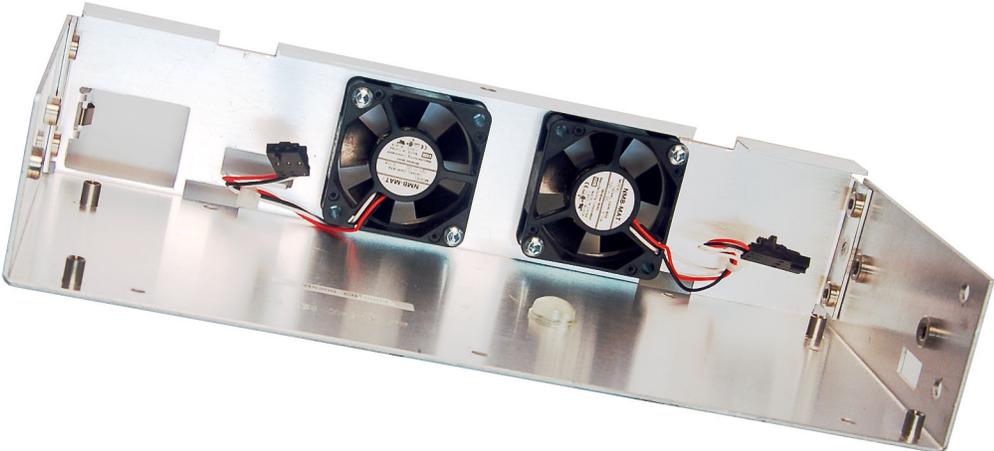


Figure 4: Fan and main chassis

Repackaging Instructions

This section contains the information needed to repack the instrument for shipment or storage.

Packaging

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

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

Shipping to the Service Center

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

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

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

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

Replaceable Parts

This section contains a list of the replaceable modules for your instrument. Use this list to identify and order replacement parts.

NOTE. *Not all parts listed in this section are present on every model. The parts present will depend on the model and options installed.*

Parts Ordering Information

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

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

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

If you order a part that was 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 1-800-833-9200. Outside North America, contact a Tektronix sales office or distributor; see the Tektronix Web site for a list of offices: www.tektronix.com.

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.

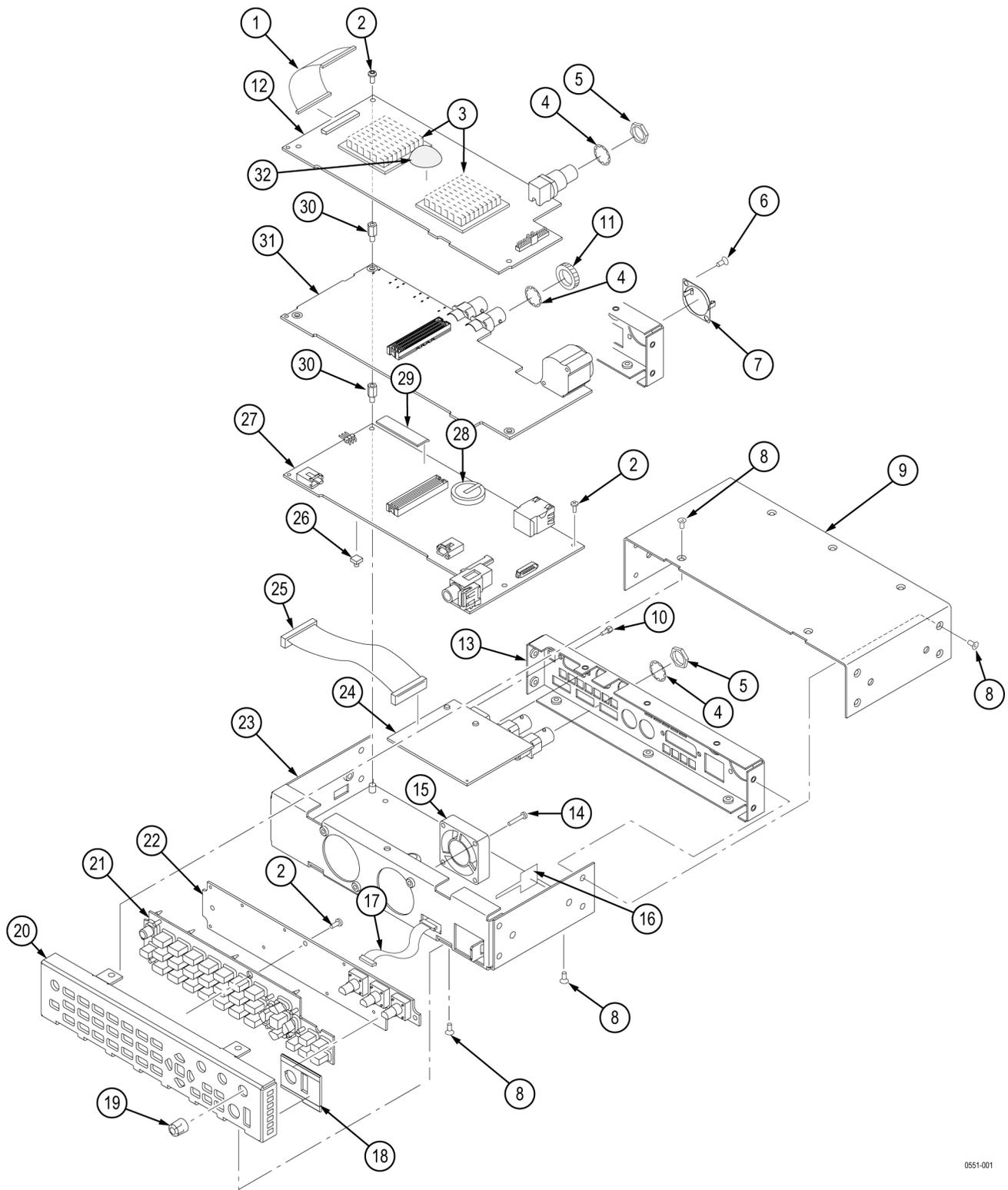
Using the Replaceable Parts Lists

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

Column	Column name	Description
1	Figure & index number	Items in this section are referenced by figure and index numbers to the exploded view illustrations that follow. Orderable modules show the figure number without an index 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 entry 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.

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

Fig. & index number	Tektronix part number	Qty	Name & description
5-1	174-5921-00	1	CABLE: FPGA TO REF I/O 40 PIN
-2	211-1117-00	8	SCREW, MACHINE; 4-40 X 0.187, PAN HEAD, STEEL, ZINC FINISH, T-10, TORX DR
-3	214-4748-00	2	HEAT SINK: IC, PGA 11X11/MQUAD/27MM BGA, 1.1 X 1.1 X 0.25 H, PIN FIN, AL, BLACK ANODIZE
-4	210-1039-00	5	WASHER, LOCK: 0.521 ID, INT, 0.025 THK, STEEL, ZINC FINISH
-5	220-0497-00	3	NUT, PLAIN, HEX: .5-28 X .562 HEX, BRS, NI (NICKEL) PLATED
-6	211-0101-00	2	SCREW, MACHINE: 4-40 X 0.25, FLH, 100 DEG, ZINC PLATED STEEL, T8
-7	344-0679-00	1	CLIP, GROUND: XLR POWER CONNECTOR
-8	211-0105-00	18	SCREW, MACHINE: 4-40 X 0.188, FLH, 100 DEG, ZINC PLATED STEEL, T8
-9	200-5191-00	1	TOP COVER: CHASSIS
-10	214-3903-00	4	SCREW, JACK: 4-40 X 0.312 LONG, 0.188 H HEX HEAD STAND OFF, 4-40 INT THD, X 0.312 THD EXT 4-40, STEEL, ZINC PLATED
-11	220-0271-01	3	SPANNER NUT
-12	863-0884-01	1	CIRCUIT BD ASSY: FPGA
-13	333-4705-00	1	PANEL, REAR
-14	211-0894-00	4	SCREW, MACHINE: 4-40 X 0.625, PNH, STEEL, ZINC FINISH, T-10, TORX DR
-15	119-7751-00	2	FAN, DC: TUBEAXIAL, 12V, 5.6 CFM
-16	343-1701-00	1	CLAMP, CABLE; WITH ADHESIVE BACK
-17	174-5492-00	1	CABLE ASSEMBLY, 10 PIN: FP TO MAIN
-18	348-2076-00	1	EMI GASKET: USB/HEADPHONE
-19	366-0851-00	3	KNOB: CAP 0.470 INCH DIAMETER, SOFT TOUCH
-20	333-4706-00	1	FRONT PANEL ASSY
-21	260-2923-00	1	SWITCH, KEYPAD: ELASTOMER MAT
-22	863-6505-01	1	CIRCUIT BD ASSY: FRONT PANEL
-23	441-2645-00	1	CHASSIS: MAIN
-24	878-6504-00	1	CIRCUIT BD ASSY: REF I/O
-25	174-5921-00	1	CABLE FPGA TO REF I/O 40 PIN
-26	260-5015-00	1	SWITCH, PUSH: SPST, TACT;50MA, 50V, MOMENTARY, SILVER CONTACTS
-27	863-0851-00	1	CIRCUIT BD ASSY: CPU
-28	146-0109-00	1	BATTERY, DRY: 3.0V, LITHIUM MANGANESE DIOXIDE, 210MAH, 20 X 3.22MM COIN CELL WITH SOLDER TABS, CR2032-1HF1
-29	348-2077-00	1	EMI GASKET: PROCESSOR, HDMI
-30	129-1713-00	6	SPACER POST: 0.276 L, 4-40 M/F 0.188 HEX
-31	863-0708-01	1	CIRCUIT BD ASSY: VIDEO I/O
-32	348-2003-00	1	BUMPER, RUBBER; CLEAR, 0.375 DIA X 0.200 H



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Figure 5: WVR5250 exploded view