

**WVR4000 and WVR5000  
Waveform Rasterizers  
Service Manual**



077-2449-01



# **WVR4000 and WVR5000 Waveform Rasterizers Service Manual**

## **Revision B**

### **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](http://www.tektronix.com)

077-2449-01

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- In North America, call 1-800-833-9200.
- Worldwide, visit [www.tektronix.com](http://www.tektronix.com) to find contacts in your area.

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## General Safety Summary

Review the following safety precautions to avoid injury and prevent damage to this product or any products connected to it.

To avoid potential hazards, use this product only as specified.

*Only qualified personnel should perform service procedures.*

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.

### To Avoid Fire or Personal Injury

**Use proper power cord.** Use only the power cord specified for this product and certified for the country of use.

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

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

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

**Power disconnect.** The power cord disconnects the product from the power source. Do not block the power cord; it must remain accessible to the user at all times.

**Do not operate without covers.** Do not operate this product with covers or panels removed.

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

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

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

**Do not operate in wet/damp conditions.**

**Do not operate in an explosive atmosphere.**

**Keep product surfaces clean and dry.**

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

**Terms in This Manual**    These terms may appear in this manual:



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

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

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**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.

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



CAUTION  
Refer to Manual

## Service Safety Summary

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

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

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

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

To avoid electric shock, do not touch exposed connections.

---

# Preface

This manual supports servicing to the module level of the WVR4000 and WVR5000 Waveform Rasterizers, which process video signals for display on an external XGA monitor. These instruments are used in video and television broadcasting, production, and post-production environments.

This manual explains how to troubleshoot and service the rasterizer 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 WVR4000 and WVR5000 Series Waveform Rasterizers modules.
- *Maintenance* tells you how to troubleshoot the product to the module level, remove the modules, and provides lists of replaceable modules and mechanical parts, and replacement part numbers.

## Manual Conventions

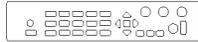
The following terms and conventions are used throughout this manual:

- The term “rasterizer” is used interchangeably with the more formal term “WVR4000 and WVR5000 Series Waveform Rasterizers.”
- The term “instrument” is used interchangeably with the term “rasterizer.”
- The term “module” refers to a collection of parts.

## Related Manuals

This manual requires you to have access to the following manuals and documentation when servicing this product. The manuals ship with the product on the Product Documentation CD and are also downloadable from the Tektronix Web site. The online help comes installed on the instrument.

**Table i: Related documentation**

Item	Purpose	Location
<i>WVR4000 and WVR5000 Waveform Rasterizers User Manual</i>	Installation and high-level operational overview	   WWW.Tektronix.com
<i>WVR4000 and WVR5000 Online Help</i>	In-depth operation and UI help	
<i>WVR4000 and WVR5000 Waveform Rasterizers Specifications and Performance Verification</i>	Instrument specifications and procedure for checking instrument performance to those specifications	   WWW.Tektronix.com

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# Introduction

The WVR4000 and WVR5000 Waveform Rasterizers provide a powerful and portable monitoring solution for broadcast, production, and post-production environments.

## Service Strategy

The WVR4000 and WVR5000 Series Waveform Rasterizers will be repaired to the module level at selected Tektronix service centers. Repair includes functional verification of the product. Component level repair by the customer is not supported.

## Specifications

The specifications for this product are found on the *WVR4000 and WVR5000 Product Documentation CD* that ships with the product. (See page viii, *Related Manuals*.)

## Performance Verification

The Performance Verification procedures for this product are found on the *WVR4000 and WVR5000 Product Documentation CD* that ships with the product. (See page viii, *Related Manuals*.)

## Options and Accessories

The lists of options and accessories for this product are found on the *WVR4000 and WVR5000 Waveform Rasterizers User Manual* provided in the *WVR4000 and WVR5000 Product Documentation CD* that ships with the product. (See page viii, *Related Manuals*.)

## Configurations

The WVR4000 Waveform Rasterizer has SD SDI inputs. The WVR5000 Waveform Rasterizer has dual mode SD/HD SDI inputs. No other configurations are available with these instruments.

## Hardware Installation

The waveform rasterizer can be used as-is or installed into a rack mount or cabinet. For instructions for installing the rasterizer into a rack mount or cabinet, refer to the *WFM4000 and WFM5000 Waveform Monitors and WVR4000 and WVR5000 Waveform Rasterizers System Integration Technical Reference*.

## Product Upgrade

No field upgrades are available for the WVR4000 or WVR5000 Waveform Rasterizers. When software updates become available, you can access them from the Tektronix Web site: [www.tek.com/software](http://www.tek.com/software). The *WVR4000 and WVR5000 Waveform Rasterizers User Manual* includes instructions for updating product software.

## Operating Information

For basic operating instructions, refer to the *WVR4000 and WVR5000 Waveform Rasterizers User Manual* that can be found on the *WVR4000 and WVR5000 Product Documentation CD* that shipped with this product. For more detailed reference information, refer to the *Waveform Rasterizer Online Help*. (Press the **Help** button on the instrument and then use the **General** knob, up/down arrow keys, and **SEL** button to navigate through the topics.)

In addition, there is context sensitive help to identify the buttons, knobs, and soft keys. Press the **Help** button to enable the context sensitive help. Press it again to turn off the context sensitive help.

### Power-On Procedure

1. Connect the power cord to the AC adapter.
2. Connect the AC adapter to the rear panel of the instrument and the power cord to an AC line frequency of 50 or 60 Hz within the range of 100 to 240 volts.
3. Press the Power button.
4. Wait for the system to complete its power-on self-tests.

### Power-Down Procedure

There are two methods to power down the instrument:

**Power Button** – Press the Power button to turn off the instrument.

**Power Supply** – Unplug the instrument from the power source to turn off the instrument.

---

## Theory of Operation

The WVR4000 and WVR5000 are modular waveform rasterizers. They are configured to accept serial SD digital or HD digital inputs, and digital audio inputs.

All models use an external XGA monitor for the display.

This theory of operation is mainly based on the High-level Block diagram. (See Figure 1.)

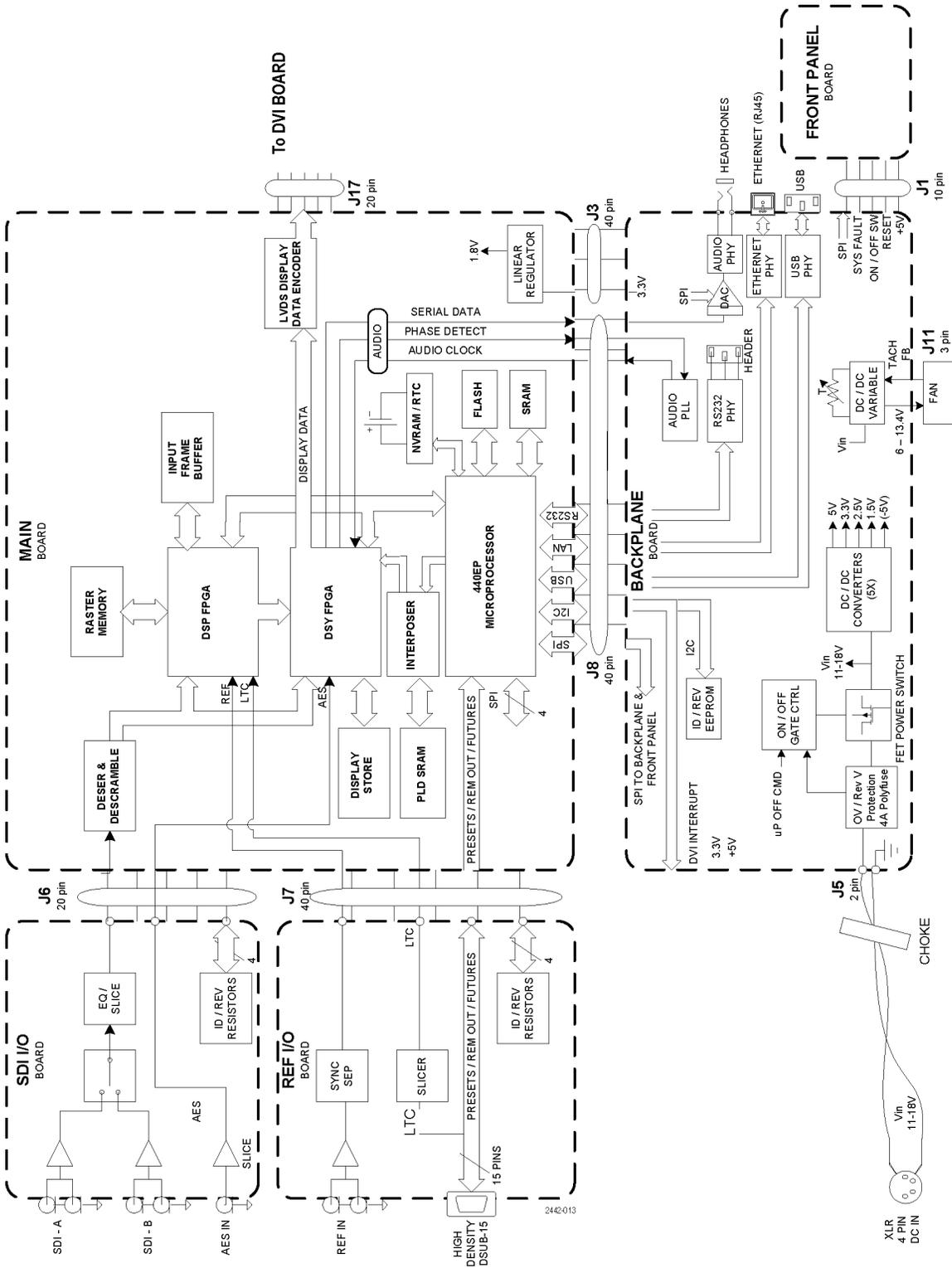


Figure 1: Block diagram

## SDI I/O Board

### Serial Digital Input Processing

The serial digital inputs are AC coupled and buffered passive loopthroughs. The signal passes through an amplifier while traveling to the channel selection switch. Only the amplifier corresponding to the selected channel is “on” (meaning that only the selected amp gets DC power). The selected signal passes through an equalizer whose digital differential pair output is sent over the ribbon cable to the Main board.

### AES Audio Input Processing

The AES digital audio input is AC coupled and bit sliced by a comparator, the single ended digital output of which is sent over the ribbon cable to the Main board.

## Reference I/O Board

### Reference Input

The Reference input is an AC coupled and buffered passive loopthrough. The reference signal is applied to a sync separator, the single ended digital output of which is sent over the ribbon cable to the Main board.

### LTC Input

The LTC input is a differential pair that is bit sliced by a comparator, the single ended digital output of which is sent over the ribbon cable to the Main board.

### Ground Closure Interface Signals

The ground closure interface (GCI) signals are heavily filtered and protected against adverse customer connections. Inputs (except Future 3 and 4) are buffered and the digital outputs are sent over the ribbon cable to the Main board. Future 3 and 4, since they have no directional circuitry, could be used as outputs in the future.

## DVI I/O Board

### DVI Output

The DVI output is known as DVI-I, which means that it has both an analog output (XGA) and a digital output (DVI). Both outputs are available simultaneously. A failure of one output does not necessarily interfere with the other, nor does one working output guarantee that both work.

### Monitor Resolution

The digital side of DVI is designed to auto-negotiate the best display resolution possible with the monitor (once it senses that one is connected). However, the instrument outputs are fixed XGA format, so if the monitor cannot support it, then it is not going to work. Therefore, be certain your monitor works with a known good WVR4000 or WVR5000 before suspecting a failure on the DVI board.

**XGA to DVI Adapter** The white adapter supplied with the unit converts the DVI output to a standard XGA connector, typical of most analog monitors. No adapter is normally required to connect the DVI output directly to a DVI display.

## Main Board

**Reference Input** The Reference input is a passive loophrough, 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.

**Digital Waveform Processing Engine** The data stream from the SDI video input is applied to the waveform processing FPGA. This block deformats, up-samples, interpolates, demodulates, 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 FPGA. 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 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 rasterizer 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 the input rate to 59.94 Hz frame rate to work with the XGA monitor. The picture and waveform data combine with the graphics and audio bar information from the control processor, and then output to the XGA display drive. Note that the parallel data from the serial digital input connect directly to this FPGA to provide the picture display functionality, bypassing the waveform processing engine, which is the DSP FPGA.

**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 through SPI signaling, and controls most other internal devices though either the SPI or the I<sup>2</sup>C serial buses.

The control processor interfaces to the Ethernet through a dual rate connection. This allows the network connection to run at 10 or 100 MB/s. The control processor has an internal USB 1.1 port that it uses to interface to the USB.

**LTC** LTC inputs come from the remote connector on the REF I/O board where it is converted from differential to single-ended. The LTC signal is applied to the waveform processing FPGA, which decodes the time code information.

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**NOTE.** *The FPGAs decode VITC signals digitally.*

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## Front Panel

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

## Audio

The audio capabilities reside on the main board and the backplane board. Audio supports digital embedded and AES/EBU monitoring.

### Audio Processing

The audio processing engine uses the DSY FPGA, whose main function is to calculate 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 sent to the control processor which then plots the bar display. 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.

### Audio Inputs

There are two basic audio input paths: AES and embedded. AES inputs are accepted at rates up to 192 kHz.

The embedded audio path starts at the waveform processing engine. First the audio samples are extracted from the serial digital video data and then multiplexed into the AES decoder. They then follow the same path as the AES data.

## Fan Control

There is a temperature sensor on the Backplane board. The control circuits use the temperature data to adjust the target speed for the fan. The fan circuit holds the fan speed at the target by measuring the fan tachometer output, allowing reliable operation at low speed. If the fan is not turning, the circuit senses the stall and turns on a red LED (DS170 on the Backplane board).

## Power Supply and Distribution

The Backplane board provides adverse input protection, on/off switching, and transient/EMC conditioning for the DC power input. The Backplane board also hosts all of the DC/DC converters for the various voltages used within the unit. In some cases, additional local linear regulators are used on other boards.

A 4 A Polyswitch (self resetting thermal fuse) provides input overcurrent fault protection. Failure of this fuse usually indicates a serious fault within the instrument.

The secondary supplies, their tolerances and locations are specified in the *Maintenance* section.

---

# 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 instrument diagnostic routines and troubleshooting trees. Most of the trees make use of the internal diagnostic routines to speed fault isolation to a module.

## 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 waveform rasterizer. Inspection and cleaning are done as preventive maintenance. Preventive maintenance, when done regularly, can 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 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 of the instrument and should normally be in place during instrument operation.



**WARNING.** *To prevent injury or loss of life, power down 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, non-static-producing brush for cleaning around components. If you must use a liquid for minor interior cleaning, use a 75% isopropyl alcohol solution and rinse with deionized water.

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



**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. For the rest of the instrument, 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.*

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**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	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.
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 will need to remove the top cover.

Inspect the internal portions of the instrument for damage and wear. Defects found should be repaired immediately.

If any circuit board is repaired or replaced, see if it is necessary to adjust the instrument. (See Table 1.)



**CAUTION.** To prevent damage from electrical arcing, ensure 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.
Capacitors	Damaged or leaking cases. Corroded solder on leads or terminals.	Remove and replace damaged circuit board.

**Table 2: Internal inspection checklist (cont.)**

Item	Inspect for	Repair action
Wiring and cables	Loose plugs or connectors. Burned, broken, or frayed wiring.	Firmly seat connectors. Repair or replace modules with defective wires or cables.
Chassis	Dents, deformations, and damaged hardware.	Straighten, repair, or replace defective hardware.

**Cleaning Procedure – Interior.** To clean the instrument interior, 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 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 components, refer to Preventing ESD. (See page 9.)

---

## Getting Started

To properly test an instrument you must have appropriate signal sources. Depending on what portion of the instrument you are testing, this might include Serial Digital Video or Digital Audio. In some cases, you may also need receivers or an oscilloscope to check outputs.

These instruments consist 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:

- Main board
- Ref I/O board
- SDI I/O board
- DVI I/O board
- Backplane board
- Front panel board

**Table 3: Required test equipment**

Test equipment	Requirements	Example
SDI serial digital video test generator with embedded audio. Varies with instrument model: WVR4000 (need SD SDI source), WVR5000 (need HD SDI source).	1080i 59.94 HD signals required for WVR5000: <ul style="list-style-type: none"> <li>■ 100% color bars</li> <li>■ 10 bit shallow ramp</li> <li>■ SDI Matrix Split Field Pathological Signal</li> <li>■ 100% sweep</li> </ul>	Tektronix TG2000 with HDVG1 module for TG2000 (Embedded audio needed)
	525/270 SD signals required for WVR4000: <ul style="list-style-type: none"> <li>■ 100% color bars</li> <li>■ 10 bit shallow ramp</li> <li>■ SDI Matrix Pathological Signal</li> <li>■ H 100% sweep</li> </ul>	DVG1 with option S1 module for TG2000 (Embedded audio needed)
AES Audio Signal Generator	48 kHz, 24 bit word length signals	Rohde & Schwarz UPL06, Tektronix AM700 and AM70.
Voltmeter		Fluke 87 or equivalent
DC Ammeter with Clamp on pickup	20 Amp DC capable	Fluke 336 or equivalent
Oscilloscope	Video trigger capability	Tektronix TDS3000B Series

**Table 4: Symptoms and causes**

<b>Symptom</b>	<b>Possible Sources or Recommended Detailed Troubleshooting Procedure</b>
No LEDs lit	Perform general checks Perform power supply checks Replace the front panel board as indicated by the test results from the above tests
Inconsistent or partial hardware failures	Perform power supply checks Examine Power On Self Tests (POST) results in the Diagnostic Log Replace main board
Fails any of these Power On Self Tests (POST):	Review messages in diagnostic log Perform power supply checks Replace the main board
<ul style="list-style-type: none"> <li>■ Timecode Decoder Comm</li> <li>■ SDI Deserializer Comm</li> <li>■ DSP FPGA A Comm</li> <li>■ DSP FPGA A Program</li> <li>■ Display FPGA Comm</li> <li>■ Display FPGA Program</li> </ul>	
Functional Test Failures PVD Test Failures	<p>In case of failure on either Functional or the Performance tests, the board at fault is generally obvious. Before replacing a board:</p> <ol style="list-style-type: none"> <li>1. Perform the power supply check.</li> <li>2. Check the diagnostic log for help in isolating the fault.</li> </ol> <p>If those do not isolate the problem, then replace the main board if the test is in one of the following areas:</p> <ul style="list-style-type: none"> <li>■ SDI</li> <li>■ REF</li> <li>■ DVI</li> <li>■ LTC</li> </ul> <p>If the problem is only the SDI input, first replace the SDI I/O board. If that does not fix the problem, replace the main board.</p> <p>If the problem is only the reference input, replace the Ref I/O board. If the problem persists, then replace the main board.</p> <p>If there is no XGA output, replace the DVI I/O board. If that does not fix the problem, replace the main board.</p> <p>If the problem is in audio, perform the steps in the Audio Troubleshooting section.</p>
Unknown Problems Often an instrument will come into service with vague or intermittent symptoms. In cases like these, the following set of tests may help find the problem or the marginal condition.	<ol style="list-style-type: none"> <li>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 currently happening.</li> <li>2. Check the power supply by performing the Power Supply check. A marginal supply can lead to intermittent operation if it is near the acceptable threshold.</li> <li>3. Run the functional test. This will exercise a majority of the functions in the instrument and includes the diagnostics. Some parts of the test may not be necessary for all problem areas.</li> </ol>

## Detailed Troubleshooting Procedures

The following tests should be run as indicated in the *Symptom and Causes*. (See Table 4 on page 14.) 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.

List of detailed troubleshooting procedures:

- General Checks
- Fan Failures
- Power Up/Power Down Troubleshooting
- Secondary Power Supply Check
- Front Panel Button Troubleshooting
- Isolating Audio Problems
- Examining Power On Self Test Results
- Running Diagnostics

### General Checks

1. Verify that the power cord is connected.
2. Remove the cover and check that all (visible) internal cables are correctly connected and seated.
3. Check for any (visible) discolored or burned components.

### Fan Failures

There is a temperature sensor on the Backplane board. The control circuits use the temperature data to adjust the target speed for the fan. The fan circuit holds the fan speed at the target by measuring the fan tachometer output, allowing reliable operation at low speed.

Since the fan speed is sensed through tachometer feedback, a fault will be asserted if the fan is not connected, is stalled, or if the tachometer feedback line is not working correctly. If the fan tachometer feedback stops (for whatever reason), then the red LED DS170 on the Backplane board will be lit, the front panel fault light will be lit, and the control circuit voltage at TP10 will drop to near zero volts (normally close to 5 V).

To continue diagnosis requires differentiating between the power supply to the fan and the fan itself. The most direct measurement point is the fan connector, J11 pin 1 (typically red wire), but to measure this while the connector is seated requires a probe with a very fine tip that can slip into the connector housing alongside of the wire itself. If the voltage on the fan connector J11 pin 1 is near 13 V (normal operating is close to 6 V), then replace the fan. If the voltage is not above 10 V, then replace the Backplane board. If equipment precludes measuring the connector pin directly, an alternate measurement node is F70, on the side closest to the outside wall of the instrument.

If the fan is spinning, but LED DS170 is lit, the problem is probably the tachometer feedback line on pin 3 of the fan. Inspect the fan wiring and check the J11 connector seating. If a sufficiently fine probe tip is available, use the oscilloscope to look for a square wave (about 4.75 V, 50 – 200 Hz) on the tachometer feedback line at J11 pin 3.

If J11 pin 3 is static 5 V, replace the fan.

If J11 pin 3 is static 0 V, unplug the fan connector and measure J11 pin 3 on the board (without any fan connection). If the voltage is now 5 V, replace the fan.

If available probe tips preclude direct measurement of J11 pin 3, start by replacing the fan. If that does not fix the problem, replace the Backplane board.

If you measured a square wave on J11 pin 3 (while the fan was running), replace the Backplane board.

### Power Up/Power Down Troubleshooting

If you push the power button and nothing happens, perform the following steps:

1. Verify that the cabling from the Front Panel board to the Backplane board (10 wire cable J1) is seated and that none of the pins of the connector have pulled out.
2. If the cabling is solid and the unit will not turn on, replace the Backplane board (where all the hardware that controls power up resides).
3. If the cabling is solid and the unit will not turn off, then the Main board software is “lost”. Reload the system software. If the problem persists, replace the Main board.

### Power Supply Test

The DC input is processed through a series of protection circuits before being supplied as VBULK to several DC to DC converters. If any of the following checks fail, replace the Backplane board. Use the provided picture to locate Backplane board test points. (See Figure 2.)

The test points are available, with the Backplane board installed, at the location specified. (See Table 5.)

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**NOTE.** All test points have a silk-screened box around them for easy identification.

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1. Check the VBULK test point and verify that it is approximately the same as the input voltage. Input voltage is about 12 V with the supplied AC converter.
2. Check the following test points for the individual supplies. (See Table 5.)

**Table 5: Backplane board secondary supplies**

Nominal (V)	Allowed range (V)	Measure at
VBULK	Input V (anywhere in 10 V to 18 V range) with up to 0.2 V drop	TP20
Fan	5 to 13.5	TP11 <sup>1</sup>
+5	4.75 to 5.25	TP3 <sup>1</sup>
3.3	3.2 to 3.4	TP4 <sup>2</sup>
2.5	2.4 to 2.6	TP5 <sup>2</sup>
1.5	1.4 to 1.6	TP6 <sup>2</sup>
-5	-4.75 to -5.25	TP7 <sup>2</sup>

<sup>1</sup> Near the fan circuits.

<sup>2</sup> Near the central mounting hole in the middle of the Backplane board. You may have to gently press the J3 and J8 ribbon cables out of the way to access it.

Check the Audio supplies on the Audio board (if an Audio board is installed). The test points are available, with the board installed, at the location specified. (See Figure 2.)

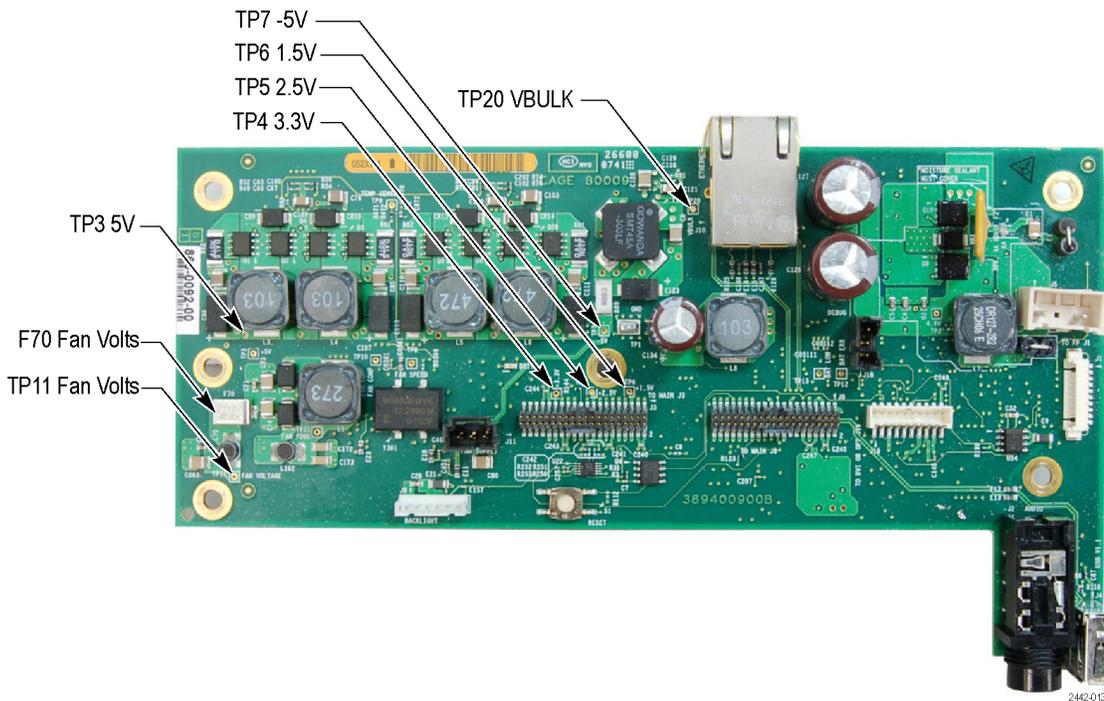


Figure 2: Backplane board power supply test points

### Front Panel Button Troubleshooting

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

1. Cycle the power to the unit. Immediately after power up, three buttons (GAIN, SWEEP, and MAG) should be lit continuously for about a second. Another button or two will begin to light briefly and one at a time before all buttons go out for a number of seconds while the display prints out a couple lines of text. Normal boot time is approximately 30 seconds. The initial sequence of lights, just before they all go out, indicates that the front panel processor is booting normally.
2. If the buttons are not lit, check the 10 pin cable from the keypad to the main board J1. If the cable is connected and good, then replace the front panel assembly.
3. If the buttons do not go out after a second or so, and continue to blink in a walking sequence, this indicates that the front panel processor has not received any communications from the Main board host processor. Check the 10 pin cable from the keypad to the main board J1 for proper seating and that none of the pins in the connector are pulled out. If the connector/cable looks okay, using a known good Front Panel is the next best troubleshooting tactic to isolate which board (Front Panel or Main) is at fault.
4. If the buttons light as expected and the unit appears to complete booting, but the keys are nonresponsive, check to see if the fault light is on (red LED

behind the power button). If so, the front panel processor is likely “lost”. Replace the Front Panel board.

5. If the buttons do not light in the expected sequence and the screen comes up a solid white, wait at least five minutes before disconnecting power and rebooting. If the unit boots normally after this, the original problem was that the Main board processor and the PLD (on the Main board) needed to be programmed. This is possible of a new Main board that has never been powered up. Otherwise, it is likely the result of a fault condition on the Main board.

### Audio Troubleshooting

Perform this test if there are problems with the audio display.

1. If embedded audio is not working, make sure that it still fails when the factory default preset is loaded. If it still fails, replace the Main board.
2. If AES audio is not working, there is some chance that it is not getting through the SDI I/O board. First make sure that the ribbon cable between the SDI I/O board and the Main board is seated and in good condition. If this does not resolve the problem, follow step 1 for embedded audio.

### Examine Power On Self Tests (POST) Results in the Diagnostic Log

To examine the POST results, press the **CONFIG** button, then select **Utilities > View Diagnostic Log**, and then press the **SEL** button.

Each power up is indicated by a boot time stamp, followed by a list of power on tests. If any failures are indicated, reload the unit software. If that does not resolve the problem, replace the Main board.

### Run Power On Diagnostics

To run the Power On Diagnostics, press the **CONFIG** button, and then select **Utilities > Run Power Up Diags** and press the **SEL** button. Press **SEL** again to run the diagnostic tests.

A series of Pass/Fail tests will be run. There are four types of tests performed: SDI diagnostics, FPGA diagnostics, Timecode diagnostics, and Power Up diagnostics, although only the first three are listed in the Run Diagnostics screen. The results are shown on screen and also saved to the Diagnostics Log, where they can viewed at a later time.

If any failures are indicted, reload the unit software. If that does not resolve the problem, replace the Main board.

## Repackaging Instructions

This section contains the information needed to repack the waveform rasterizer 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 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.

# Removal and Replacement Procedures

This section contains procedures for the removal and replacement of all replaceable modules in the instrument.

## Preparation



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**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 *Preventing ESD*. (See page 9.)

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This subsection contains the following items:

- 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 of the modules.



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**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.

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**NOTE.** Read *Equipment Required* for a list of the tools needed to remove and install modules in this instrument. (See Table 7 on page 23.) Read the cleaning procedure before disassembling the instrument for cleaning.

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## Lead Free Soldering

Lead-free manufacturing processes and components were used to make this product. The Tektronix Worldwide Service Organization uses lead-free solder in all repairs. Lead-free solder joints have a satin finish and are not shiny like lead-based solder joints.

This manual does not support component-level repairs. However, if you do make any component-level repairs, the following equipment is recommended:

- Industry-acceptable lead-free solder or solder paste. (See Table 6.)

**Table 6: Lead-free solder and paste**

<b>Material</b>	<b>Alloy</b>	<b>Vendor</b>	<b>Detail</b>
Wire Core Solder	SAC305	Kester	275 w/Pb-free alloy
Syringe Paste	SAC305	Kester R	276SR w/Pb-free alloy

- Soldering iron (and tip) that provides a higher temperature (700 °F) for proper melting of the lead-free solder.
- If you are using syringe paste, a hot air gun capable of providing temperatures slightly higher than 700 °F.

**Preparation for Module Removal**

**Equipment Required.** Most modules in the instrument can be removed with a screwdriver handle mounted with a size T-10 or T-15 Torx® screwdriver tip. All equipment required to remove and reinstall the modules is listed. (See Table 7 on page 23.)

**Table 7: Tools required for module removal**

Item no.	Name	Description
1	Screwdriver handle	Accepts Torx-driver bits
2	T-8 Torx tip	Used for removing the screws that hold the power connector to the I/O bracket. Torx-driver bit for T-8 size screw heads
3	T-10 Torx tip	Used for removing instrument screws. Torx-driver bit for T-10 size screw heads
4	T-15 Torx tip	Used for removing most instrument screws on boards. Torx-driver bit for T-15 size screw heads
5	1/8 inch flat-bladed screwdriver	Screwdriver for unlocking cable connectors
6	Phillips head screwdriver	Used for removing instrument Phillips head screws
7	Angle-Tip Tweezers	Used to remove front panel knobs
8	3/16 inch nut driver	Used to remove jack screws and front panel standoffs
9	MA-800G Soldering Aid (spudger)	Used to remove the front panel trim
10	Bomar DB36400	Special BNC socket wrench with Controlled Torque. Used to remove BNCs
11	Soldering iron (15 W)	Used for replacing Main board fuses
12	Long nose pliers	Used to compress EMI clips

## Module Removal

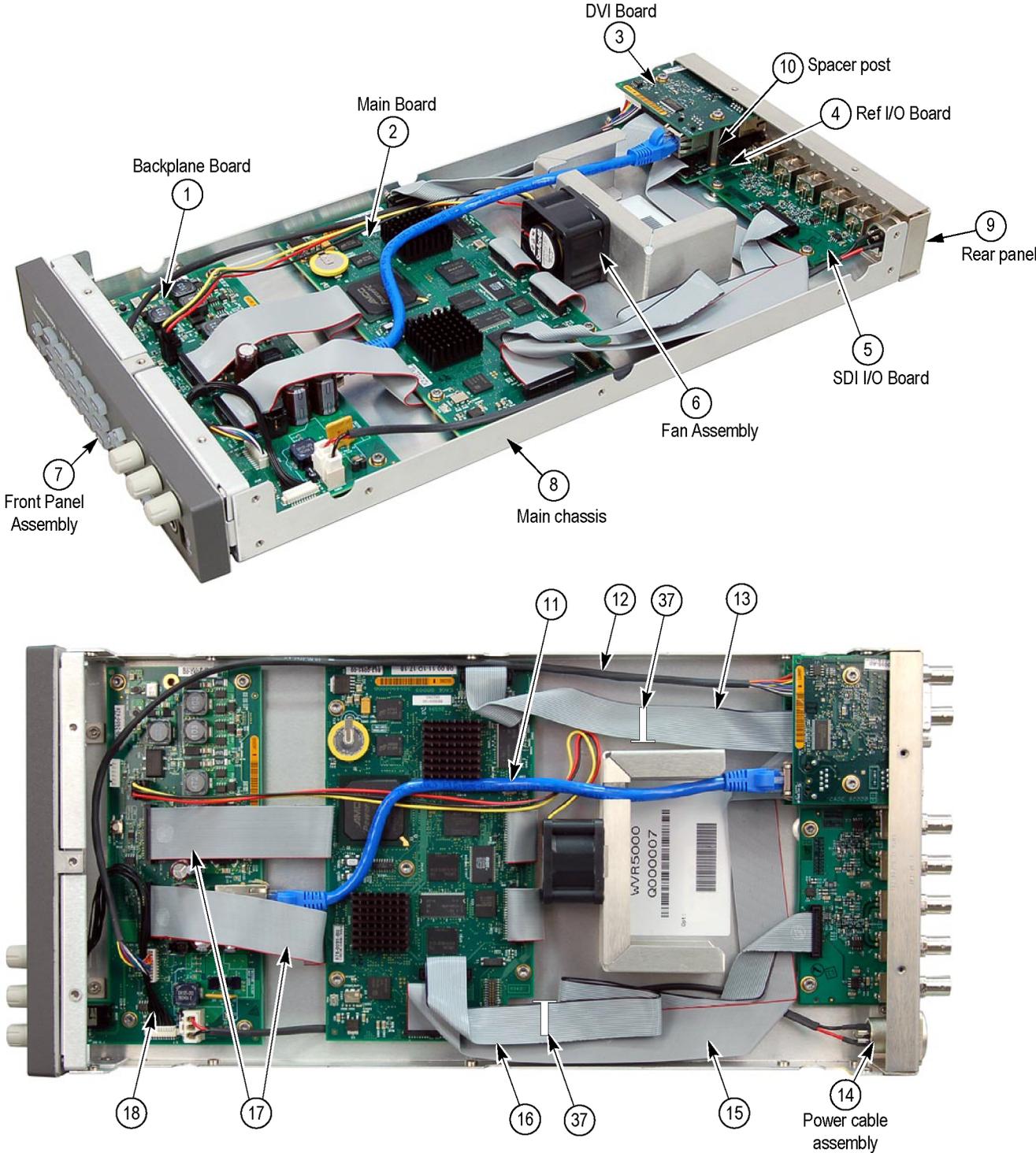
Remove a module by following the procedures provided. Use the photographs to see how to remove any module. The WVR Overview photograph provides a quick way to determine where modules are located. (See Figure 3.)

The Module Removal table describes how the modules are layered and in which order they need to be removed. (See Table 8.)

The Replaceable Parts list follows the Module Removal section and corresponds to the numbers in the photographs. (See Table 10.)

**Table 8: Module removal**

You must first remove	To remove							
	Front panel assembly	Main board	Front panel board	SDI board	Ref board	Backplane board	DVI board	Main chassis
Cover	X	X	X	X	X	X	X	X
Fan assembly								
Main board								
Front panel board	X							
Backplane board								
DVI board								
Main chassis	X	X	X	X	X	X	X	
Rear panel				X	X		X	X

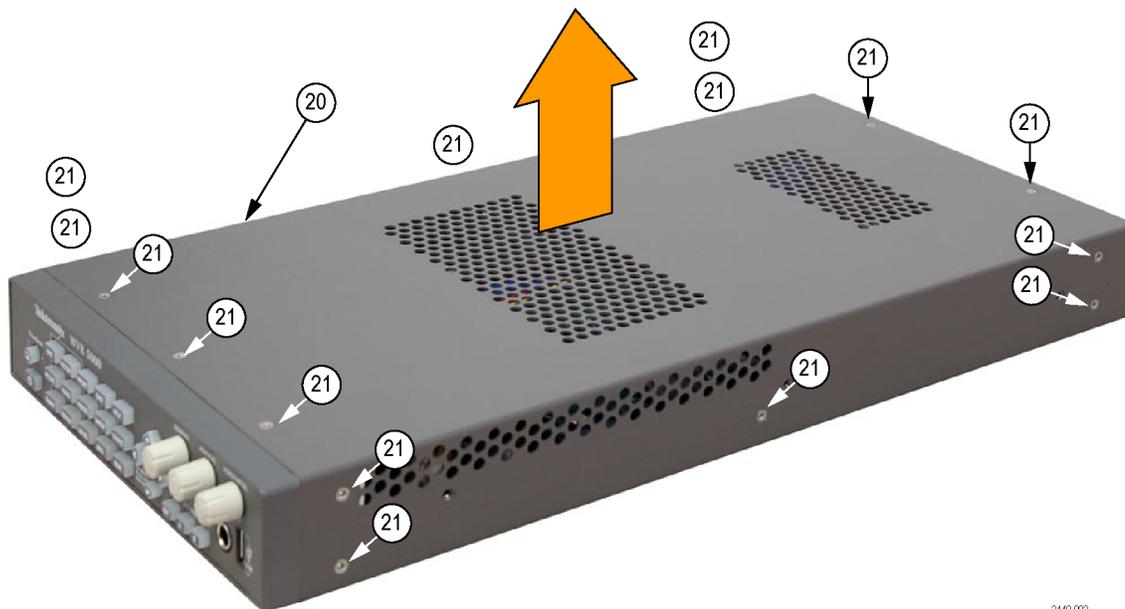


2449-001

Figure 3: WVR overview

**Cover** To remove the cover, perform the following procedure. (See Figure 4.)

1. Remove the 15 Phillips head screws from the sides, top, and rear of the cover.
2. Lift the cover straight up and remove.



2449-002

Figure 4: Cover removal

**Main Board**

The main board is attached to the main chassis. To remove the main board, perform the following procedure. (See Figure 5.) (See Figure 6.)

1. Remove the cover.
2. Detach the blue cable that runs from the DVI board to the backplane board, and then detach the J3, J8, J9, J6, J7, and J17 connectors from the main board.
3. Remove the five Torx-15 screws that secure the main board to the main chassis.
4. Remove the main board.

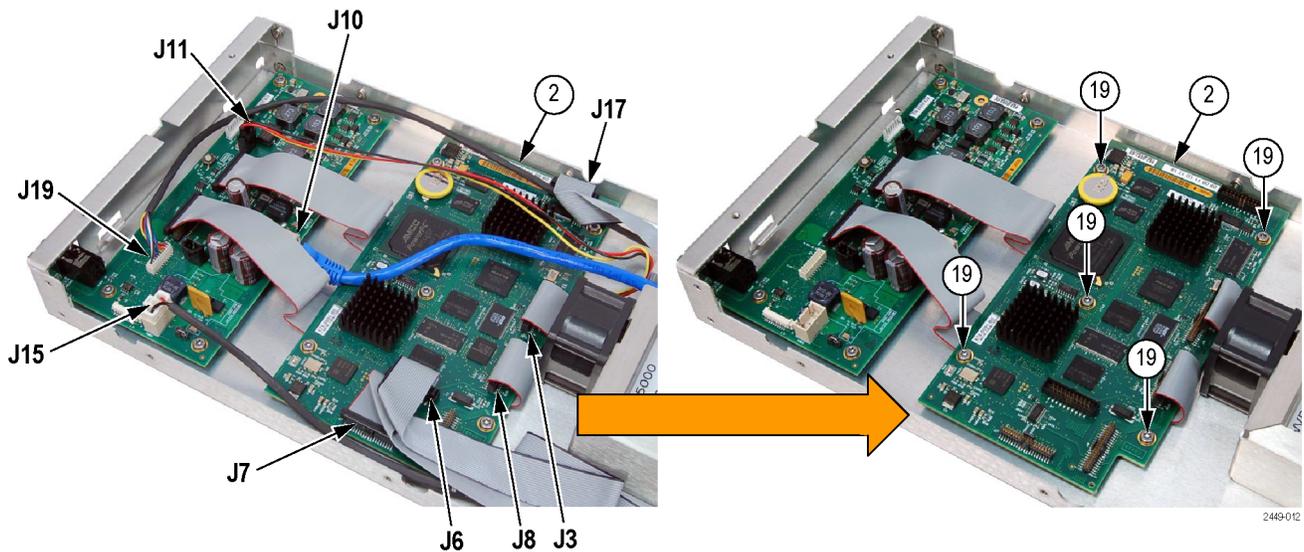


Figure 5: Main board removal

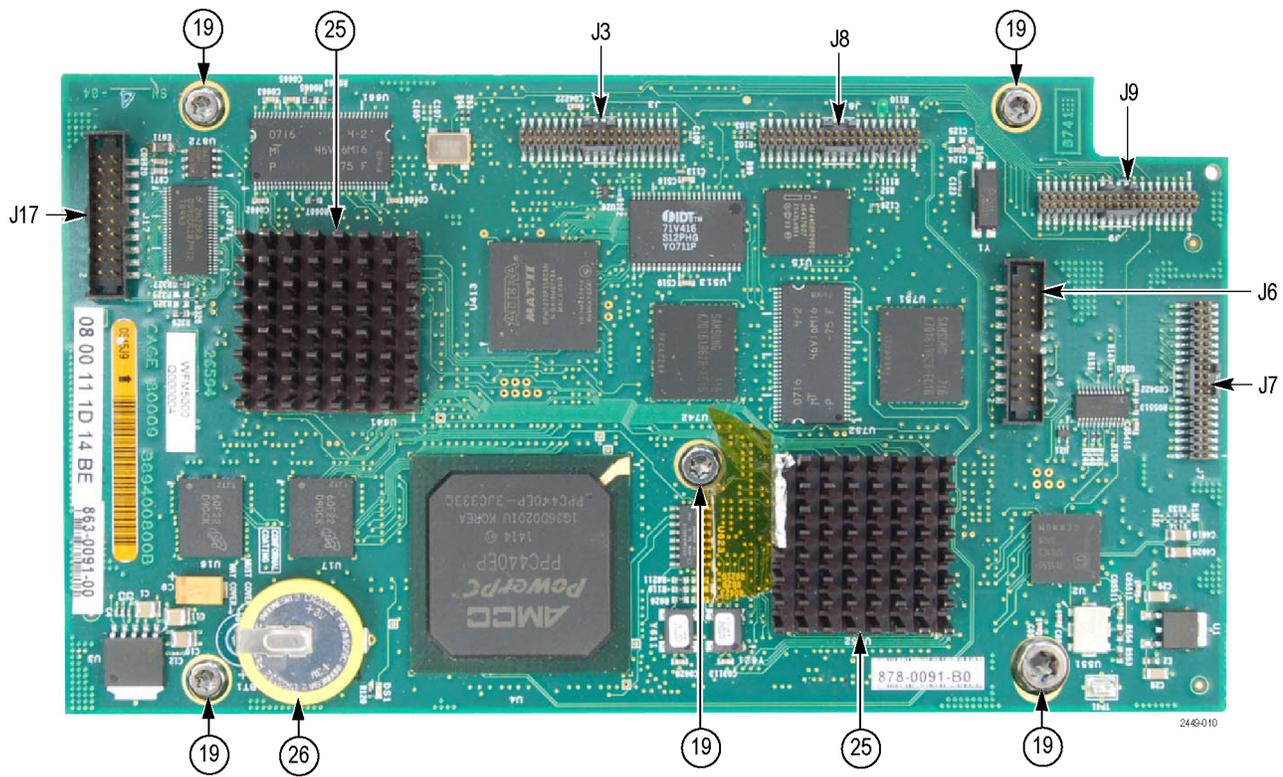
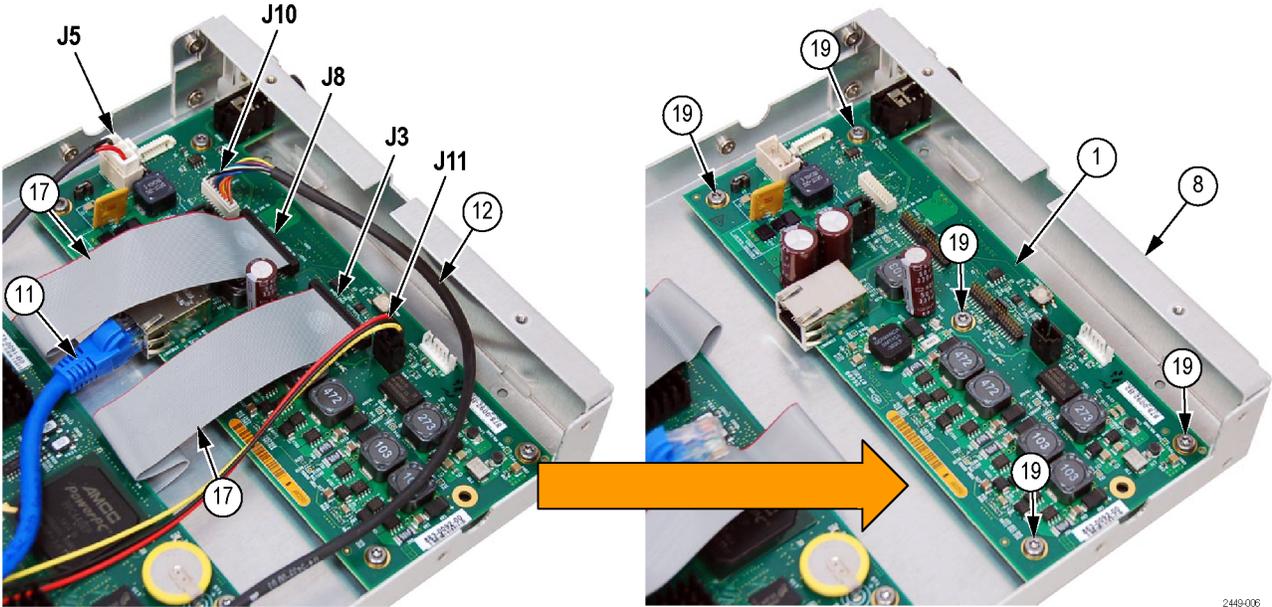


Figure 6: Main board

**Backplane Board**

The backplane board is attached to the main chassis. To remove the backplane board, perform the following procedure. (See Figure 7.) (See Figure 8.)

- 1. Remove the cover.
- 2. Detach the blue cable that runs from the DVI board to the backplane board from the backplane board.
- 3. Detach the cables from the J8, J3, J19, J11, J5, and J1 connectors.
- 4. Remove the six T-15 screws that attach the board to the main chassis.
- 5. Remove the backplane board.



249-006

Figure 7: Backplane board removal

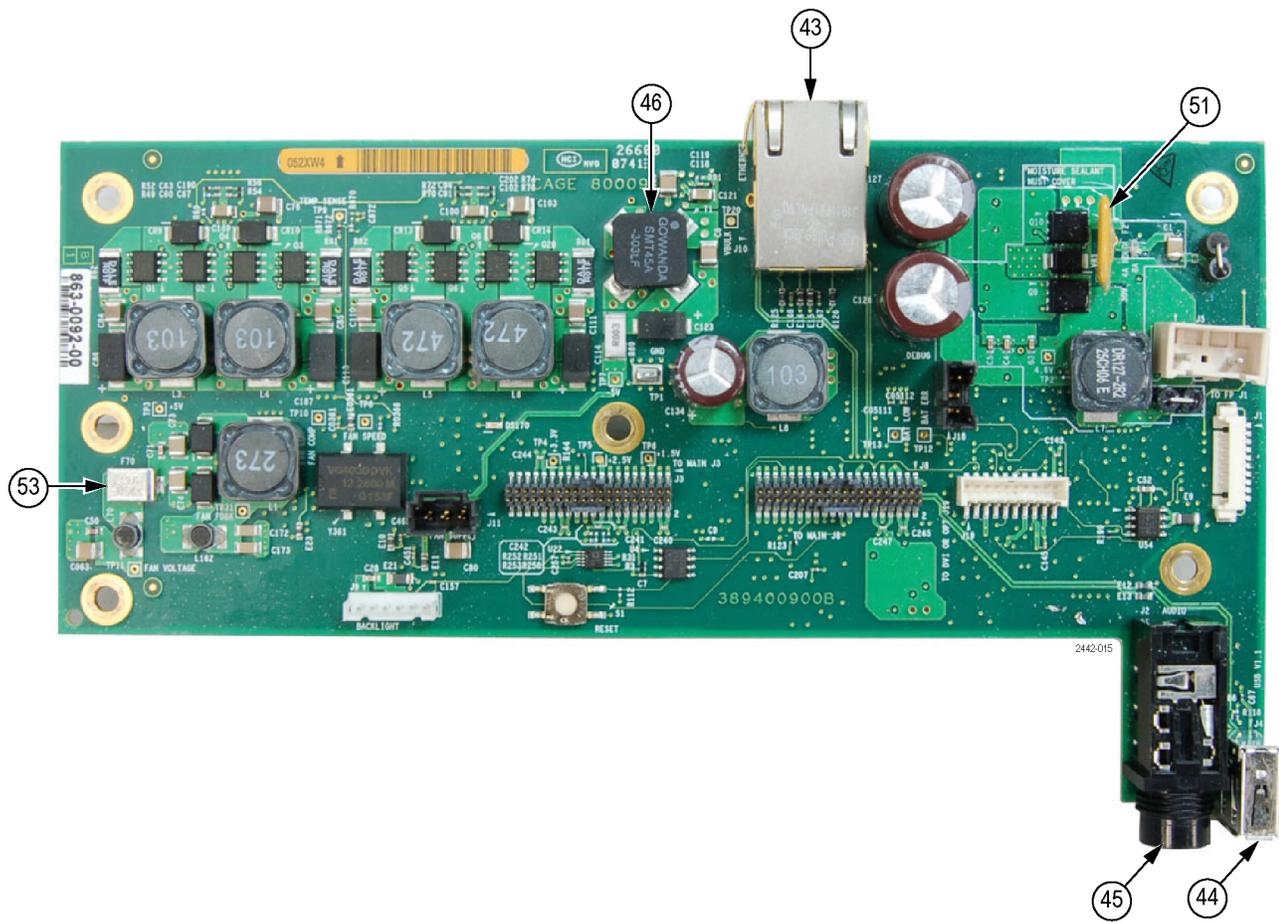
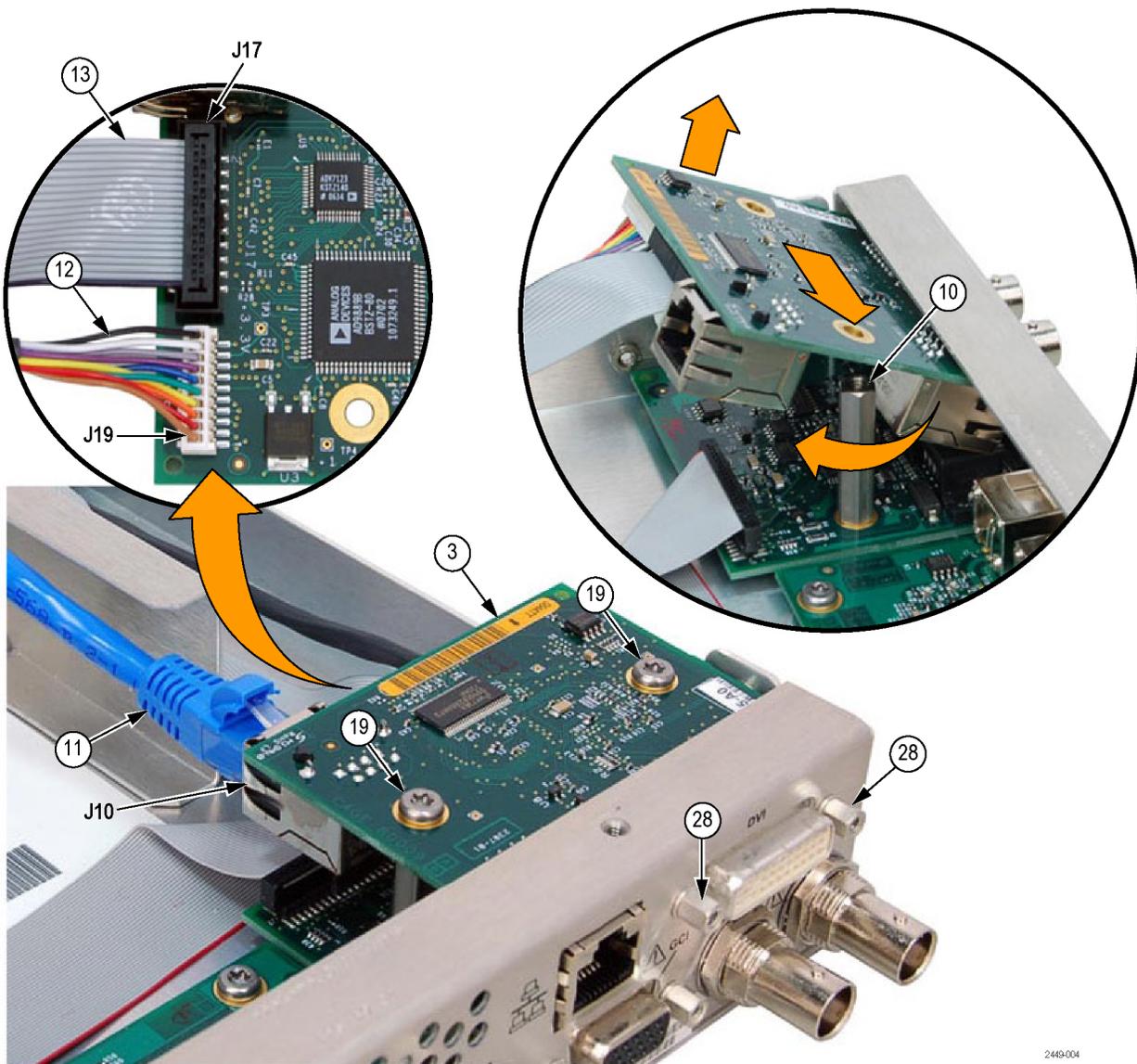


Figure 8: Backplane board

- DVI I/O Board** To remove the DVI I/O board, perform the following procedure. (See Figure 9.)
1. Remove the cover.
  2. Remove the two screws that secure the DVI connector to the rear panel.
  3. Remove the cables from the following connectors found on the bottom of the DVI board: J17, J19, and the Ethernet jack.
  4. Remove the two Torx-15 screws from the DVI board.
  5. Grasp the DVI board from the two corners farthest from the rear panel and tilt it approximately 45° upwards and then lift it towards you and away from the Remove the DVI board.

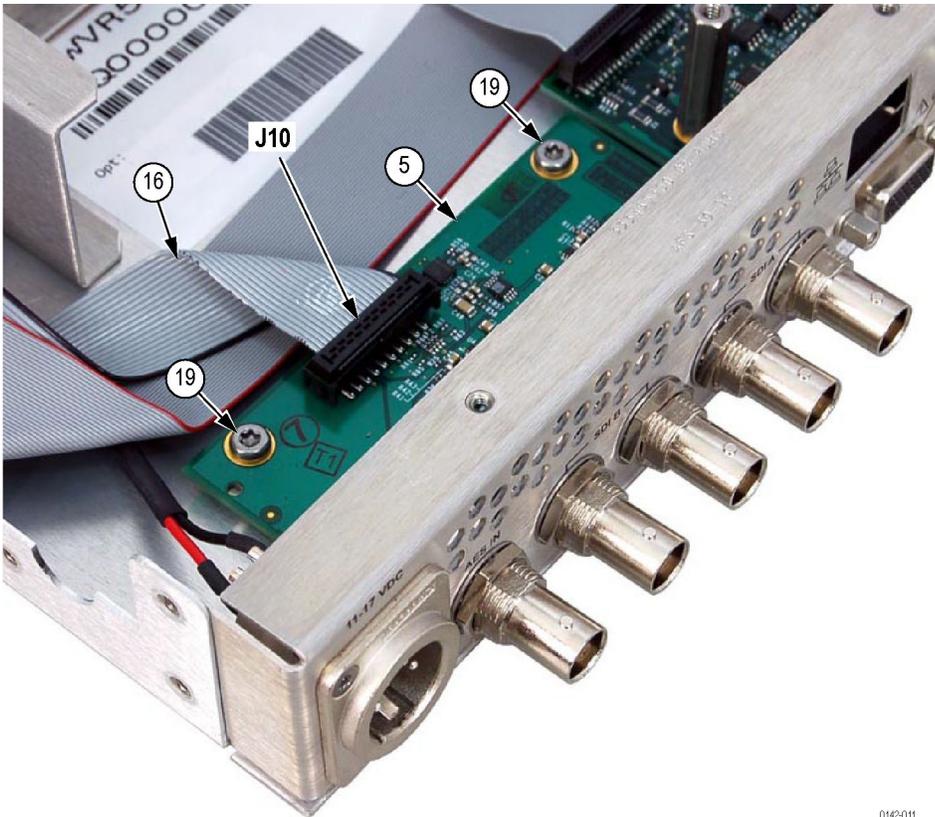


249-004

Figure 9: DVI board removal

**SDI I/O Board** To remove the SDI I/O board, perform the following procedure. (See Figure 10.)

1. Remove the cover.
2. Remove the cable from the J10 connector.
3. Remove the five washers and five nuts from the SDI BNCs in the rear panel.
4. Remove the two T-15 screws from the SDI board.
5. Remove the SDI board.

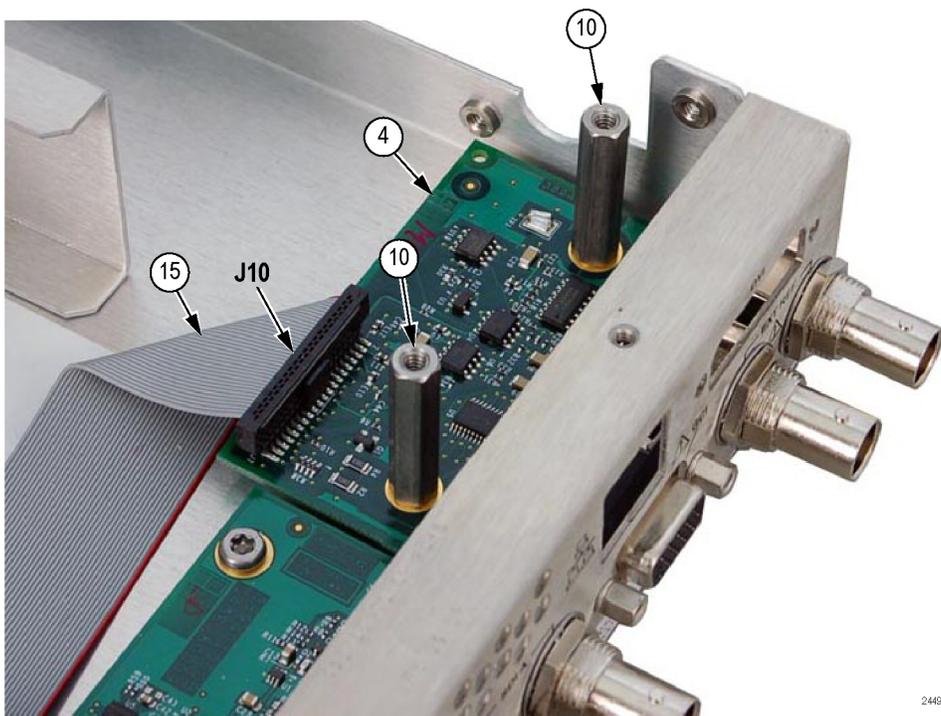


0142-011

Figure 10: SDI board removal

**REF I/O Board** To remove the REF I/O board, perform the following procedure. (See Figure 11.)

1. Remove the cover and the DVI board.
2. Remove the cable from the J10 connector.
3. Remove the two screws that attach the GCI connector to the rear panel.
4. Remove the two washers and two nuts from the REF BNCs in the rear panel.
5. Remove the two spacer posts from the REF board.
6. Remove the REF board.



2449-005

Figure 11: REF board removal

- Rear Panel** To remove the rear panel, perform the following procedure. (See Figure 12.)
1. Remove the cover.
  2. Remove the three Phillips screws from the bottom of the rear panel.
  3. Remove the two T-8 screws and two nuts from the power connector.
  4. Remove the seven nuts and seven washers from the BNC connectors.
  5. Remove the two nuts from the GCI connector and the two nuts from DVI connector.
  6. Remove the rear panel.

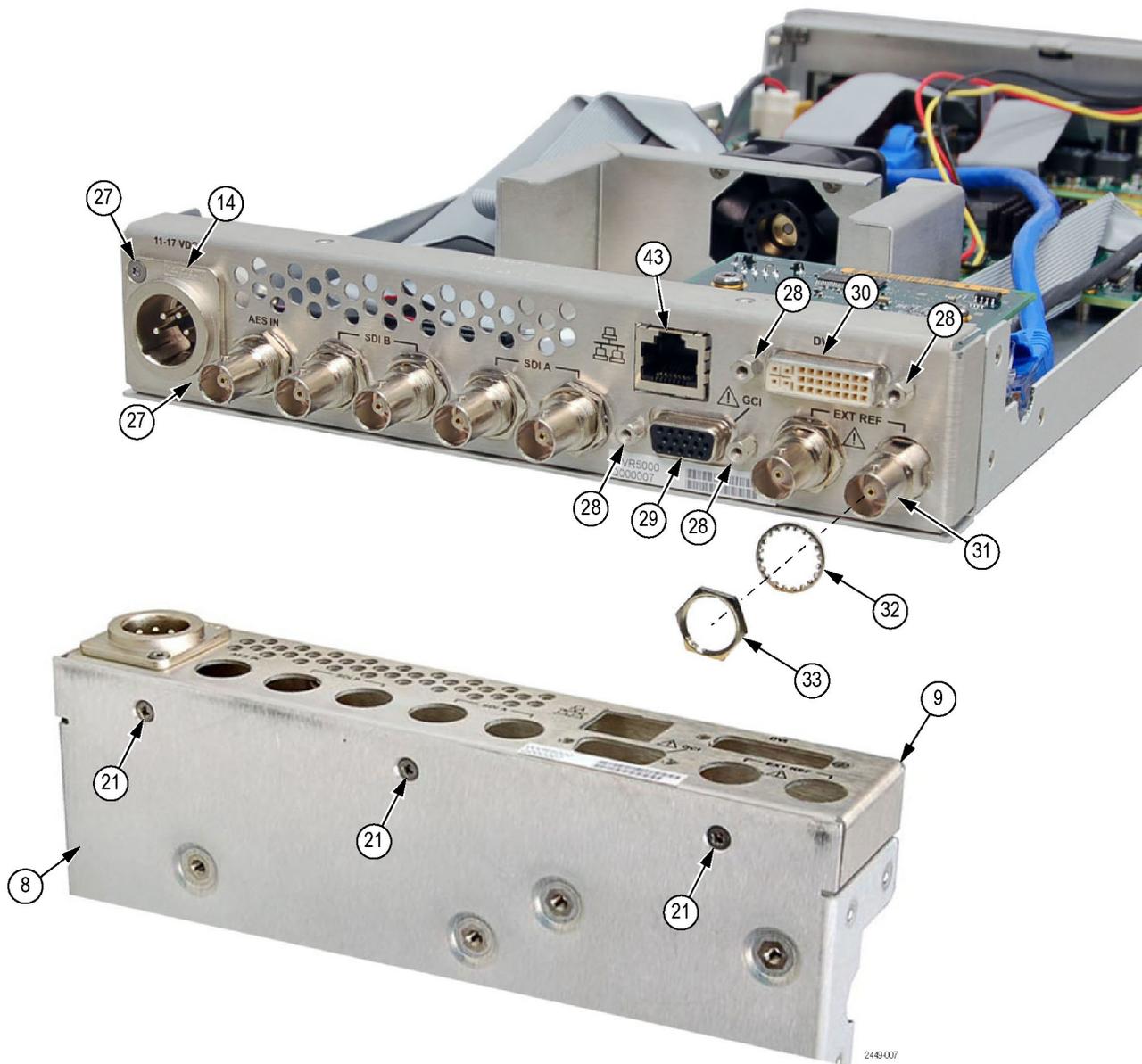
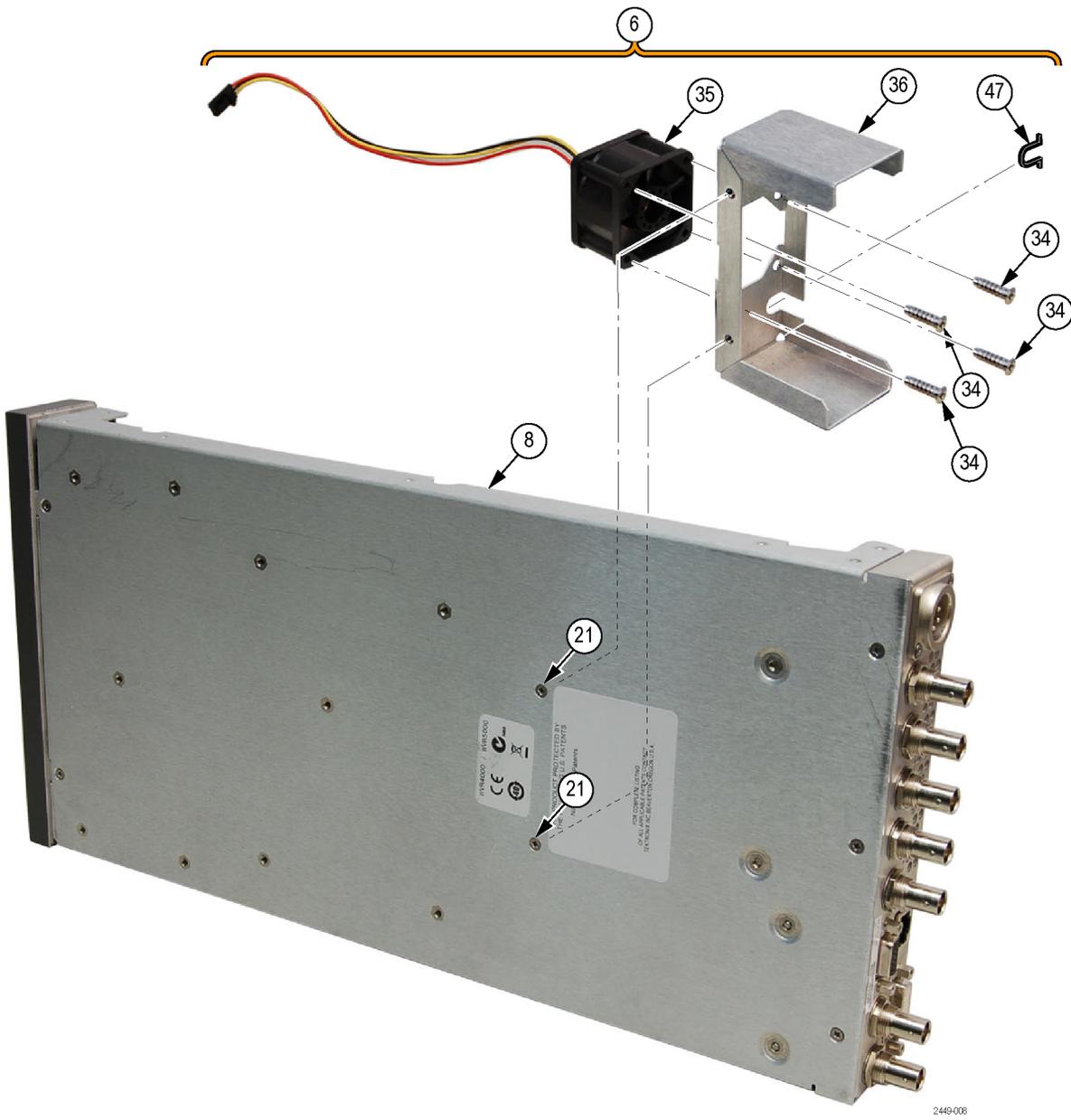


Figure 12: Rear panel removal

### **Fan Assembly**

Remove the fan assembly by performing the following procedures. (See Figure 13.)

1. Remove the cover.
2. Remove the two screws from the back center of the main chassis.
3. Detach the fan cable from J11 on the backplane board.
4. Lift the fan assembly away from the instrument.
5. If you want to take the fan assembly apart, remove the four Phillips screws that hold the fan to the fan bracket.
6. If you need to replace the grommet (attached to the fan bracket), do so now.



2449-008

Figure 13: Fan assembly removal



### Front Panel Board

Remove the Front Panel board by performing the following procedure. (See Figure 15.)

1. Remove the Front Panel assembly.
2. Remove the four Torx-10 screws that hold the frame to the Front Panel lexan.
3. Remove the four Torx-15 screws from the Front Panel board.
4. Remove the Front Panel board.

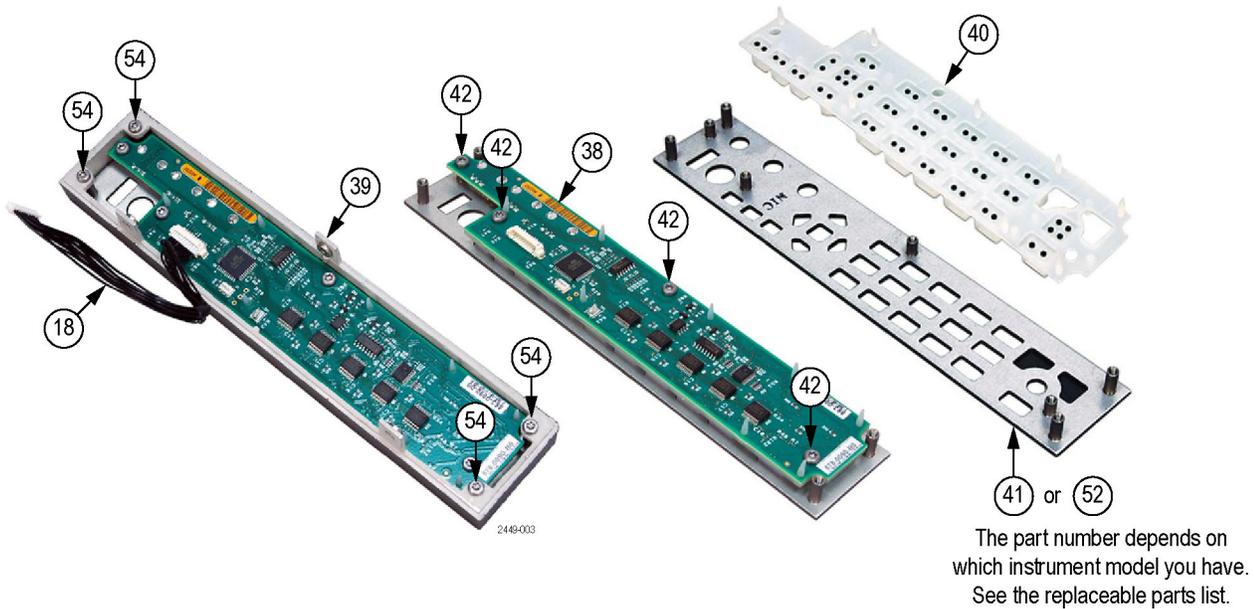


Figure 15: Front Panel board removal

## Replaceable Parts

This section contains a list of the replaceable modules for the WVR4000 and WVR5000 Waveform Rasterizers. Use the following list to identify and order replacement parts. Note that not all parts listed in this section are present on every model. The index numbers correspond to the numbers in the photographs in the Module Removal section. (See page 23, *Module Removal*.)

### Parts Ordering Information

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

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

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

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

### Module Servicing

Modules can be serviced 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](http://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 the WVR4000 and WVR5000 Waveform Rasterizers. Use this list to identify and order replacement parts. The following table describes each column in the parts list.

**Table 9: Parts list column descriptions**

Column	Column name	Description
1	Index number	Items in this section are referenced by index number to the photographs in the Module Removal section.
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.

**Table 10: Replaceable parts list**

Index number	Tektronix part number	Serial no. effective	Serial no. discont'd	Qty	Name & description
-1	870-0092-00			1	CIRCUIT BD SUBASSY;BACKPLANE; 389400900, TESTED
-2	870-0091-00			1	CIRCUIT BD SUBASSY;MAIN; 389400800, ROHS COMPLIANT; TESTED
-3	863-0095-00			1	CIRCUIT BOARD SUBASSY; DVI I/O, 389-4012-00; ROHS COMPLIAN
-4	863-0094-00			1	CIRCUIT BD SUBASSY; REF I/O; 389401100;TESTED
-5	863-0093-00			1	CIRCUIT BD SUBASSY; SDI I/O; 389401000;TESTED
-6	436-0434-00			1	ASSY,FAN TRAY; WITH FAN MOUNTED; WVR; SAFETY CONTROLLED
-7	333-4557-00			1	FRONT PANEL ASSY W/LEXAN; WVR5000; SAFETY CONTROLLED
-8	441-2505-00			1	CHASSIS,MAIN; 0.050 AL,SAFETY CONTROLLED
-9	333-4553-00			1	PANEL,REAR; WVR5000, WVR4000; SAFETY CONTROLLED
-10	129-1658-00			2	SPACER POST: 6-32M/F,1.125L, 1/4HEX,THREADS
-11	174-5442-00			1	CABLE ASSEMBLY;ETHERNET, MAIN BRD TO DVI I/O,WVR5000/WVR4000
-12	174-5439-00			1	CABLE, ASSEMBLY;DVI POWER 10 PIN, POWER CABLE BP PCB TO DVI PCB WVR J19
-13	174-5491-00			1	CABLE ASSEMBLY;20 PIN, MAIN TO DVI, WVR4000, WVR5000
-14	174-5446-00			1	CABLE ASSEMBLY;POWER 2 PIN, CABLE, PWR XLR RPAN TO BP PCB 2PIN WVR 8.5, J5
-15	174-5444-00			1	CABLE ASSEMBLY;40 PIN, MAIN PCB TO REF I/O PCB WVR J7

Table 10: Replaceable parts list (cont.)

Index number	Tektronix part number	Serial no. effective	Serial no. discont'd	Qty	Name & description
-16	174-5443-00			1	CABLE ASSEMBLY;20 PIN, MAIN PCB TO SDI PCB WVR J6
-17	174-5440-00			2	CABLE;MAIN TO BP 40 PIN, X.XLG MAIN TO BACKPLANE WVR J3 J8
-18	174-5492-00			1	CABLE ASSEMBLY, 10 PIN; FP TO MAIN
-19	211-0722-00			14	SCREW, MACHINE; 6-32 X 0.250, PNH, 410 SS PASSIVATED, T-15 TORX DR
-20	200-5051-00			1	COVER, TOP; WVR4000, WVR5000; SAFETY CONTROLLED
-21	211-0105-00			22	SCREW, MACHINE; 4-40 X 0.188, FLH, 100 DEG, 410 SS PASSIVATED, POZ
-22	311-2607-00			1	ENCODER; DIGITAL CONTACTING ENCODER, 24 CPR, 24 DETENTS, 6 MM DIA SHAFT, 17.5 MM LENGTH SHAFT, 12 MM BODY SIZE, TOP MOUNT; RE0123
-23	311-2580-00			2	ENCODER; DIGITAL CONTACTING ENCODER, 24 CPR, NON-DETENTED, 6 MM DIA SHAFT, 17.5 MM LENGTH SHAFT, 12 MM BODY SIZE, TOP MOUNT; RE0123
-24	366-0859-01			3	ASSEMBLY, KNOB; .470 DIAMETER, SOFT TOUCH
-25	214-4747-00			2	HEAT SINK, SEMIC; IC, PGA 11X11/MQUAD/27MM BGA; 1.1 IN X 1.1 IN X 0.45 IN H, PIN FIN, ALUMINUM, BLACK ANODIZE; 658-45AB
-26	146-0109-00			1	BATTERY, DRY; 3.0V, LITHIUM MANGANESE DIOXIDE, 210MAH, 20 X 3.22MM COIN CELL WITH SOLDER TABS, GR2032-1HF1
-27	211-0380-00			2	SCREW, MACHINE; 4-40 X 0.375, FLH, 410 SS PASSIVATED, T8
-28	214-3903-00			4	*VENDOR: LYNTRON...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, SN PLATED
-29	131-5450-00			1	CONN, DSUB; PCB, HIGH DENSITY; FEMALE, RTANG, 15 POS, 0.078 CTR, 0.350 MLG X 0.125 TAIL, 4-40 THD INSERT, BD RETENTION, 30 GOLD, SAFETY CONTROLLED
-30	131-8098-00			1	CONN, DVI-I, FEMALE, RTANG, PANEL MOUNT
-31	131-7270-00			7	CONN, RF, PLUG; BNC, PCB, PNL MNT, FEMALE, RTANG, 75 OHM, 0.510 H X 0.169 TAIL, LOW PROFILE ZINC DIE CAST HOUSING
-32	210-1039-00			7	WASHER, LOCK; 0.521 ID, INT, 0.025 THK, 410 SS, PASSIVATED
-33	220-0497-00			7	NUT, PLAIN, HEX; .5-28 X .562 HEX, BRS, NI (NICKEL) PLATED
-34	211-1266-00			4	SCREW, METRIC 4-1.4 X 12MM, FAN, FLATHEAD, STL, NICKEL PLATE, PHILLIPS
-35	119-7441-00			1	FAN ASSEMBLY; DC, 12V; 0.105A, 8.6 CFM, 30DBA, 3 LEAD, TACH OUTPUT, WITH CONN & HOUSING, SAFETY CONTROLLED
-36	407-5306-00			1	BRACKET, FAN MOUNT
-37	343-1701-00			2	CLAMP, CABLE; WITH ADHESIVE BACK
-38	870-0090-00			1	CIRCUIT BD SUBASSY; WVR FP; 389400700, ROHS COMPLIAN
-39	426-2420-01			1	FRAME, FRONT; ALUMINUM, SAFETY CONTROLLED
-40	260-2871-00			1	SWITCH, KEYPAD; ELASTOMERIC, SILICONE RUBBER; FRONT PANEL WVR4000, WVR5000
-41	333-4557-00			1	FRONT PANEL ASSY W/LEXAN; WVR5000; SAFETY CONTROLLED

**NOTE.** This item is for the WVR5000 only. If you have a WVR4000, see item number -52.

**Table 10: Replaceable parts list (cont.)**

Index number	Tektronix part number	Serial no. effective	Serial no. discont'd	Qty	Name & description
-42	211-1117-00			4	SCREW, MACHINE; 4-40 X 0.187, PAN HEAD, 410 SS PASSIVATED, T-10, TORX DR
-43	120-2048-00			1	TRANSFORMER,SIG;MODULE,LAN/ETHERNET;10/100 BASE-T SINGLE PORT,W/RJ45 CONNECTOR, W/LEDS,SHIELDED,EMI FINGERS,TX 1CT:1CT,RX 1CT:1,1500V ISOL;J1011F21P,THRU-HOLE
-44	131-7881-00			1	CONN,IO; PCB,USB,SERIES A;FEMALE,RTANG ON EDGE,1 X 4, 2.5MM CTR,13.90 H X 2.0 TAIL,30 GOLD,W/BOARD RETENTION
-45	131-7717-00			1	CONN,JACK PHONE; PCB/PNL;FEMALE,RTANG,3 POS,4 TERM
-46	120-5069-00			1	INDUCTOR,FXD; COUPLED INDUCTOR; PARALLEL RATING:300UH 25%,0.75A,0.675 OHM, SERIES RATING:1200UH 25%,0.37A,2.70 OHM,2 WINDINGS,TOROID CORE;SMT45A-303,SMD
-47	348-0171-00			1	GROMMET,PLASTIC; BLACK,U-SHAPED,0.276 ID
-51	159-0450-00			1	FUSE, THERMAL; 4.0A HOLD, 8.0A TRIP, 30V MAX, SELF RESETTING, UL REC; RUE400, RADIAL LEAD, SAFETY CONTROLLED
-52	333-4558-00			1	FRONT PANEL ASSY W/LEXAN; WVR4000; SAFETY CONTROLLED  <b>NOTE.</b> This is item is for the WVR4000 only. If you have a WVR5000, see item number -41.
-53	159-0412-00			1	FUSE, THRM,CHIP; SELF RESETTING FUSE,0.5A HOLD,1.0A TRIP,60V MAX,SMD050,T,SAFETY CONTROLLED
-54	211-0373-00			4	SCREW, MACHINE; 4-40 X 0.250, PNH, STEEL, ZINC FINISH, T10

**Table 11: Accessories**

Tektronix part number	Serial no. effective	Serial no. discont'd	Qty	Name & description
<b>Standard Accessories</b>				
071-2474-xx			1	MANUAL,TECH;QUICK START REFERENCE, WVR4000 & WVR5000  <b>NOTE.</b> This document is packaged with the Product Documentation CD as part number 020-2921-xx.
071-2451-xx			1	MANUAL,TECH;RELEASE NOTES WVR4000 WVR5000
063-4117-xx			1	DOCUMENTATION;PRODUCT CD, WVR4000 & WVR5000  <b>NOTE.</b> This document is packaged with the Quick Start Reference as part number 020-2921-xx.
The following documents are included as PDFs on the WVR4000 and WVR5000 Product Documentation CD:				
077-2445-xx				MANUAL,TECH; USER,ENGLISH, NOT PRINTED, PDF ONLY;WVR4000,WVR5000
077-2446-xx				MANUAL, TECH; USER, JAPANESE, NOT PRINTED, PDF ONLY, WVR4000, WVR5000
077-2447-xx				MANUAL,TECH; USER,SIMPLIFIED CHINESE,NOT PRINTED, PDF ONLY,WVR4000,WVR5000
077-2448-xx				MANUAL,TECH;SPECIFICATION AND PERFORMANCE VERIFICATION, NOT PRINTED, PDF ONLY, WVR4000/WVR5000
077-2450-xx				MANUAL,TECH;SECURITY AND DECLASSIFICATION INSTRUCTIONS,NOT PRINTED, PDF ONLY, WVR4000, WVR5000

**Table 11: Accessories (cont.)**

Tektronix part number	Serial no. effective	Serial no. discount'd	Qty	Name & description
077-2506-xx				SYSTEM INTEGRATOR, NOT PRINTED, PDF ONLY, WFM5000,WFM4000,WVR5000,WVR4000
See Description			1	CABLE ASSY, POWER:
				<i>Option</i> <i>Country</i> <i>P/N</i>
				A0                              North America                      161-0066-00
				A1                              Universal EURO                      161-0066-09
				A2                              United Kingdom                      161-0066-10
				A3                              Australia                      161-0066-13
				A5                              Switzerland                      161-0154-00
				A6                              Japan                      161-0298-00
				A10                              China                      161-0304-00
				A11                              India                      161-0400-00

**Optional Accessories**

071-2185-xx				MANUAL,TECH; ND-NC; TEKTRONIX SUPPLEMENTAL INFORMATION SHEET FOR THE PEOPLES REPUBLIC OF CHINA; CHINA ROHS
077-2449-xx				MANUAL,TECH;SERVICE MANUAL, WVR4000/WVR5000, PDF ONLY
011-0163-00				TERM,COAXIAL; BNC, TERMINATION SINGLE ENDED;75 OHM,26DB TO 2GHZ,50 OHM INTERMATABLE
013-0347-00				ADAPTER, CONN; VGA FEMALE TO DVI MALE DISPLAY
119-7532-00				AC/DC POWER SUPPLY; SAFETY CONTROLLED