

Service Manual



TDS5000B Series Digital Phosphor Oscilloscopes 071-1362-02

This document applies to firmware version 1.00 and above.

Warning

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

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Contacting Tektronix

Tektronix, Inc.
14200 SW Karl Braun Drive
P.O. Box 500
Beaverton, OR 97077
USA

For product information, sales, service, and technical support:

- In North America, call 1-800-833-9200.
- Worldwide, visit 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.

Connect and Disconnect Properly. Do not connect or disconnect probes or test leads while they are connected to a voltage source.

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.

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 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 Fuse. Use only the fuse type and rating 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:



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.

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



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.

Environmental Considerations

This section provides information about the environmental impact of the product.

Product End-of-Life Handling

Observe the following guidelines when recycling an instrument or component:

Equipment Recycling. Production of this equipment required the extraction and use of natural resources. The equipment may contain substances that could be harmful to the environment or human health if improperly handled at the product's end of life. In order to avoid release of such substances into the environment and to reduce the use of natural resources, we encourage you to recycle this product in an appropriate system that will ensure that most of the materials are reused or recycled appropriately.



The symbol shown to the left indicates that this product complies with the European Union's requirements according to Directive 2002/96/EC on waste electrical and electronic equipment (WEEE). For information about recycling options, check the Support/Service section of the Tektronix Web site (www.tektronix.com).

Mercury Notification. This product uses an LCD backlight lamp that contains mercury. Disposal may be regulated due to environmental considerations. Please contact your local authorities or, within the United States, the Electronics Industries Alliance (www.eiae.org) for disposal or recycling information.

Restriction of Hazardous Substances

This product has been classified as Monitoring and Control equipment, and is outside the scope of the 2002/95/EC RoHS Directive. This product is known to contain lead, cadmium, mercury, and hexavalent chromium.

Preface

This manual contains service information for TDS5000B Series Digital Phosphor Oscilloscopes. Read this preface to learn how this manual is structured, the conventions it uses, and where to find additional supplemental information related to servicing this product.

You should also read the General and Service safety summaries before servicing the product.

Manual Structure

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

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

Manual Conventions

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

Modules

Throughout this manual, any replaceable component, assembly, or part is referred to by the term *module*. A module is composed of electrical and mechanical assemblies, circuit cards, interconnecting cables, and user-accessible controls.

Replaceable Parts

This manual refers to any field-replaceable assembly or mechanical part specifically by its name or generically as a replaceable part. In general, a replaceable part is any circuit board or assembly, such as the hard disk drive, or a mechanical part, such as the I/O port connectors, that is listed in the replaceable parts list of Chapter 10.

Safety

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

Related Documentation

TDS5000B Series Digital Phosphor Oscilloscopes ship with the following additional manuals and CD-ROMs:

- TDS5000B Series Digital Phosphor Oscilloscopes Quick Start User Manual
- Getting Started with OpenChoice Solutions Manual with CD
- TDS5000B Series Product Software CD. Includes: application, online help, TDS5000B Series Programmer Online Guide (GPIB online help and PDF), Performance Verification PDF, release notes, VISA information.
- TDS5000B Series Elo Touchscreen Switcher Software CD. Refer to the instructions in the CD booklet that came with the Touch Screen Switcher Tool CD.
- TDS5000B Series Operating System Restore CD
- Optional Applications Software for Windows-Based Oscilloscopes



Specifications

Specifications

The specifications for this instrument are now available on the TDS5000B Series Product Software CD-ROM that shipped with your product.

Look for the *TDS5000B Series Digital Phosphor Oscilloscopes Specifications and Performance Verification Technical Reference PDF*, available on this disk.



Operating Information

Operating Information

This chapter covers installation information and basic operation instructions.

Installation

The basic operating software is already installed on the hard disk. Refer to *Software Installation* on page 2-5 for instructions on reinstalling the software.

NOTE. *To avoid rebuilding your hard disk, be sure to create an emergency startup disk. You will need this disk if you ever have to reinstall the Windows operating system. Refer to Create an Emergency Startup Disk on page 2-4.*

Before You Start

Verify that all parts and accessories for the oscilloscope are available. Use the graphical packing list that came with the oscilloscope to determine the necessary parts and accessories. You should also verify that the following items are available:

- The correct power cords
- The product-software CD set that includes installation copies of the software installed on the oscilloscope
- All the accessories necessary to operate the oscilloscope

Environmental Considerations

The oscilloscope is designed to operate on a bench or on a cart in the normal position (on the bottom feet). For proper cooling, at least three inches (7.62 cm) of clearance is required on the left side of the oscilloscope. If you operate the oscilloscope while it is resting on the rear feet, make sure that you properly route any cables coming out of the rear of the oscilloscope to avoid damaging them.



CAUTION. *To prevent overheating the oscilloscope, keep the bottom and sides of the oscilloscope clear of obstructions to ensure proper cooling.*

NOTE. *The Power Source and Environmental specifications tables list the operating requirements for the oscilloscope. Power source, temperature, humidity, and altitude are listed.*

These tables are part of the TDS5000B Series Digital Phosphor Oscilloscopes Specifications and Performance Verification Technical Reference PDF, available on the TDS5000B Series Product Software CD-ROM (Tektronix part number 063-3692-xx).

Connect the Peripherals

The peripheral connections are the same as those you would make on a personal computer. The connection points are shown in Figure 2-1 on page 2-3. See Table 2-1 for additional connection information.

Table 2-1: Additional accessory connection information

Item	Description
Monitor	If you use a non-standard monitor, you may need to change the the display settings to achieve the proper resolution for your monitor.
External Printer	Connect the printer to the EPP (enhanced parallel port) connector directly. If your printer has a DB-25 connector, use the adapter cable that came with your printer to connect to the EPP connector. For information on printer usage, see <i>Printing Waveforms</i> in your user oscilloscope manual.
Rackmount	Refer to the <i>TDS5000B Rackmount Installation Instructions</i> for information on installing the rackmount kit.
Other	Refer to the Application release notes on your product CD set for possible additional accessory installation information not covered in this manual.

NOTE. *We recommend that you plug USB devices directly into the USB connectors on the oscilloscope chassis for improved reliability rather than connecting the devices serially in a chain. If your mouse locks up, disconnect and reconnect the USB connector to restore normal operation. If the oscilloscope front panel and/or touch screen do not respond, press the On/Standby switch for at least 5 seconds to cycle power.*



WARNING. *To prevent injury to yourself or the oscilloscope, power off the oscilloscope before installing accessories (such as the mouse and keyboard) to connectors. See Powering Off the Oscilloscope on page 2-4.*

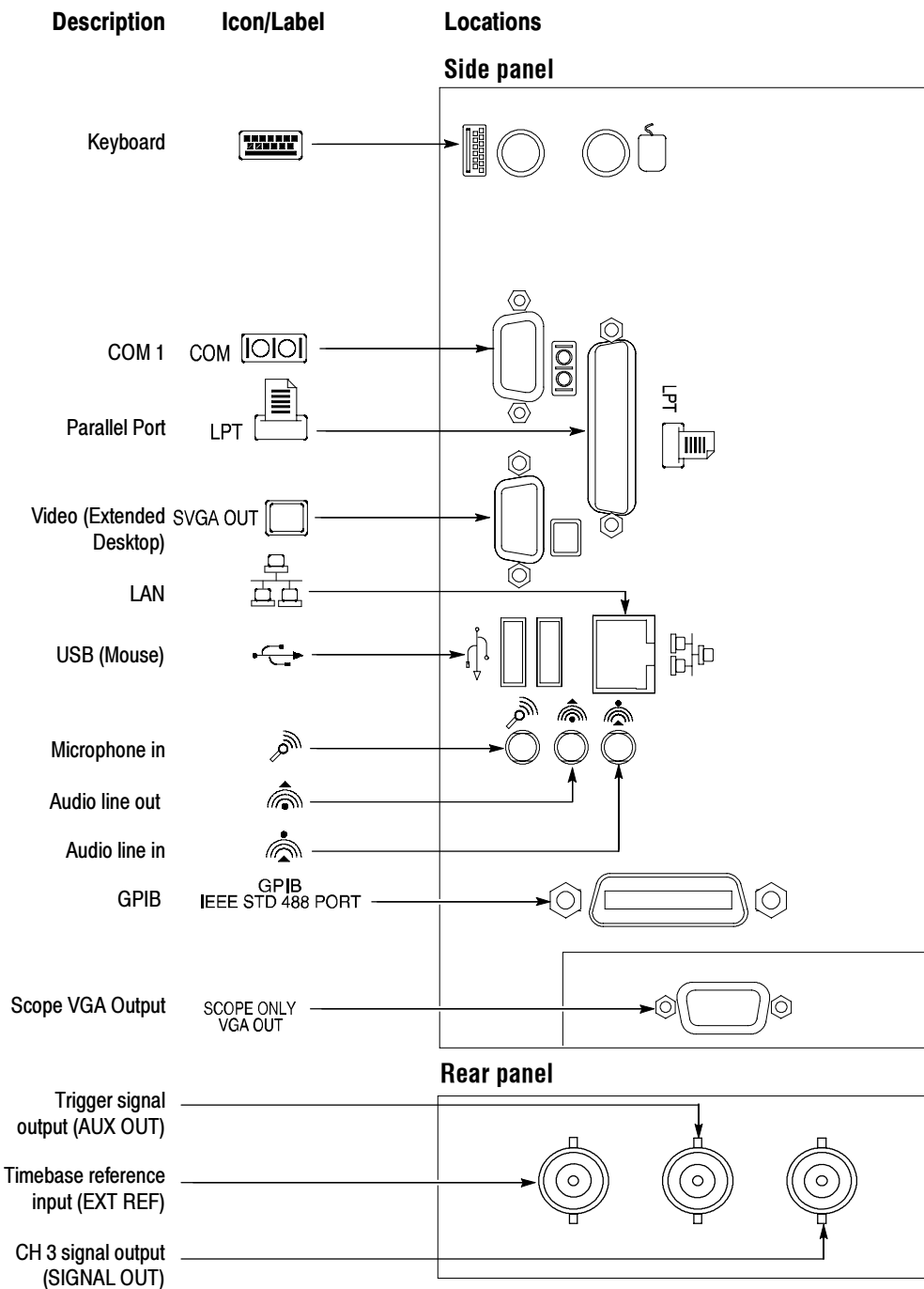


Figure 2-1: Locations of peripheral connectors on the side panel

Power On the Instrument

Follow these steps to power on the instrument.



CAUTION. To prevent damage to the oscilloscope, connect the keyboard, mouse, and other accessories before applying power to the product.

1. Connect the power cord.
2. If you have an external monitor, connect the power cord and power on the monitor.
3. Press the On/Standby switch to power on the instrument (see Figure 2-2 for the switch location).
4. Wait for the boot routine and low-level self test to complete.

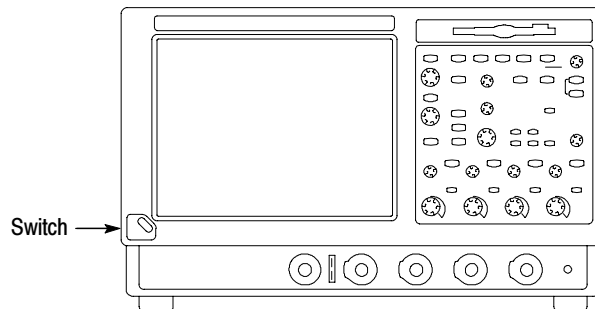


Figure 2-2: On/Standby switch location

Powering Off the Oscilloscope

The oscilloscope has a built-in soft power-off function that safely powers off the oscilloscope when you press the On/Standby switch.

To completely remove power to the instrument, press the On/Standby switch, and then remove the power cord from the rear panel.

Create an Emergency Startup Disk

Now that you have completed the basic installation process, you should create an emergency startup disk that you can use to restart your instrument in case of a major hardware or software failure. You should create this disk, and then store it in a safe place.



CAUTION. To prevent rebuilding the entire instrument hard disk, create an emergency startup disk and store it in a safe place. This disk may allow you to recover your Windows installation.

The emergency startup disk contains basic files to restart your instrument. It also contains files to check and format the hard disk.

Follow these steps to create the emergency startup disk:

1. Minimize the oscilloscope application: select Minimize from the File menu.
2. Select the Windows Start button, point to Programs > Accessories > System Tools > Backup.
3. Select Emergency Repair Disk.
4. Insert a floppy disk into the disk drive and follow the on-screen instructions to create the startup disk.

Software Installation

This section describes how to install the system software found on the product-software CD that accompanies this product. The instrument ships with the product software installed, so only perform these procedures if reinstallation becomes necessary.

Software Release Notes. Read the software release notes README.TXT ASCII file on the product-software CD before performing installation procedures. This file contains additional installation and operation information that supersedes other product documentation.

To view the README.TXT file, open the Notepad Windows accessory and open the file on the product-software CD. After installation, you can also read the copy from a directory on the product:

```
C:\Program Files\Tektronix\TekScope\readme.txt
```

Operating System Restoration. Use the procedure that accompanies your *Operating System Restore* CD should reinstalling system software become necessary.

The compact disc contains the files necessary to restore the Windows operating system and necessary drivers for the oscilloscope.

The Windows operating system and drivers are factory installed on the oscilloscope hard disk. The compact disc serves as a backup in the event that you have to rebuild the hard drive. You must restore the Windows operating system before you can install the oscilloscope firmware and other product software.

Application Installation. Use the procedures that accompany your *Product Software* CD should reinstalling the oscilloscope application software become necessary.

The compact disc contains the files necessary to restore the oscilloscope application and other software for the oscilloscope.

Software Lock for Upgrades. You can use the LockUpgrades utility to prevent users from installing unauthorized firmware upgrades on the instrument. This utility requires that a user enter a password before an upgrade can be installed. To use the utility, run the LockUpgrades .exe file, and follow the on-screen instructions. The LockUpgrades.exe file is in the following directory:

C:\Program Files\Tektronix\TekScope

NOTE. *Using the Operating System Restore CD to reinstall the operating system resets the LockUpgrades utility to the default setting and allows firmware upgrades without password protection.*

Operating Information

This section covers basic operation information so that you can operate and prepare to service the instrument.

Back Up User Files

You should always back up your user files on a regular basis. Use the Microsoft Backup tool to back up files stored on the hard disk. The Backup tool is located in the System Tools folder in the Accessories folder.

1. Minimize the oscilloscope application by selecting Minimize from the File menu.
2. Select the Windows Start button, point to Programs, Accessories, System Tools, and then click Backup.
3. Use the Microsoft Backup tool to select your backup media and to select the files and folders that you want to back up. Use the online help for information on using the Backup tool. You can back up to the floppy drive, CDRW drive, or to your network storage.

User Interface Map

This section shows the main parts of the user interface.

Figure 2-3 shows the oscilloscope in the Menu bar mode. All features of the oscilloscope can be accessed through the menus using a mouse or the optional touch screen.

When the oscilloscope is in the Toolbar mode, most of the control windows can be accessed by touching buttons at the top of the display.

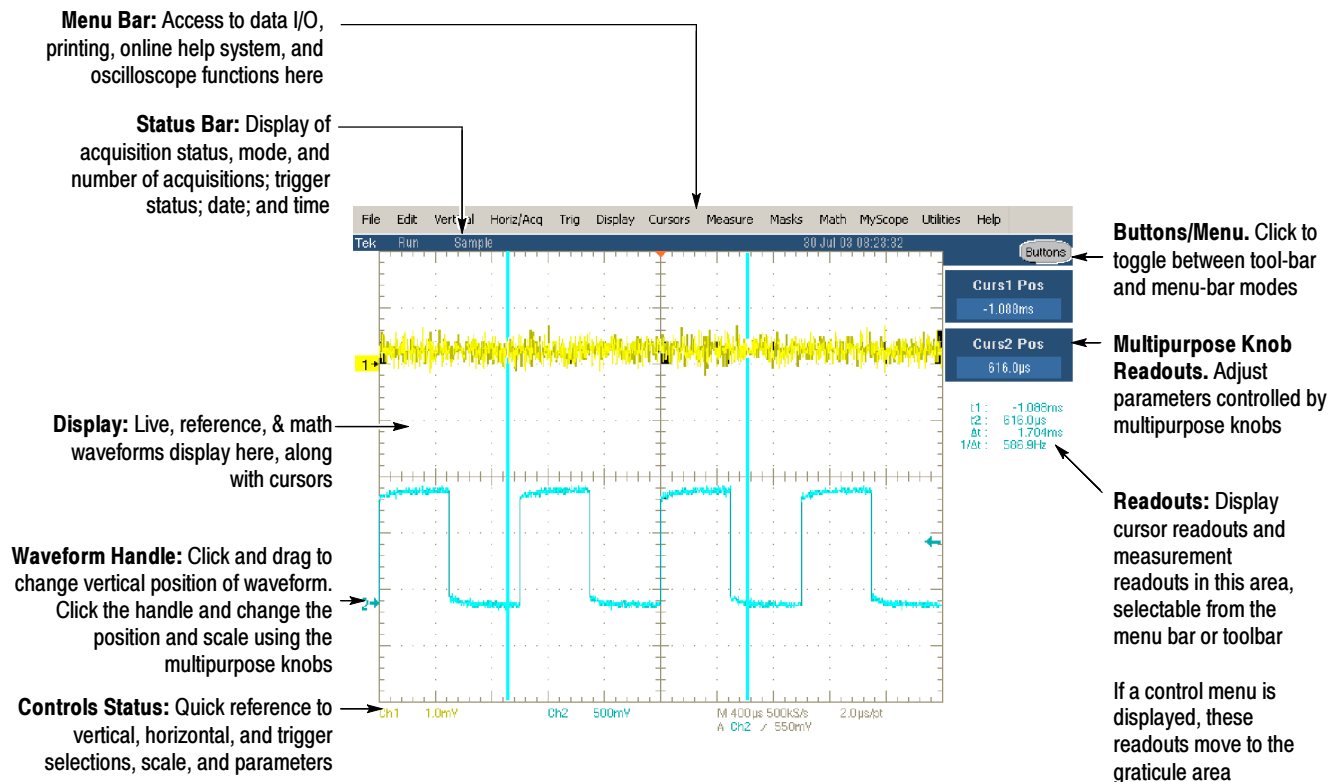


Figure 2-3: User interface

Front Panel I/O Map

Figure 2-4 shows the input/output connectors and floppy disk drive location.

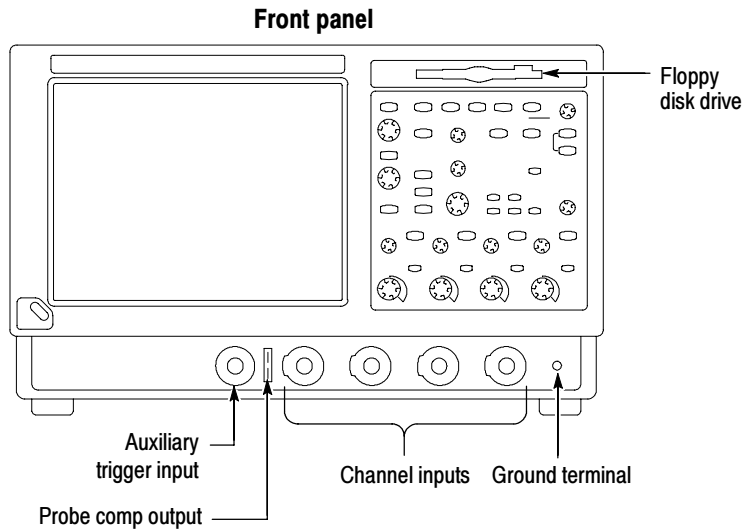


Figure 2-4: Locations of input/output connectors on the front panel

Rear Panel I/O Map

Figure 2-5 shows the input/output connectors on the rear panel.

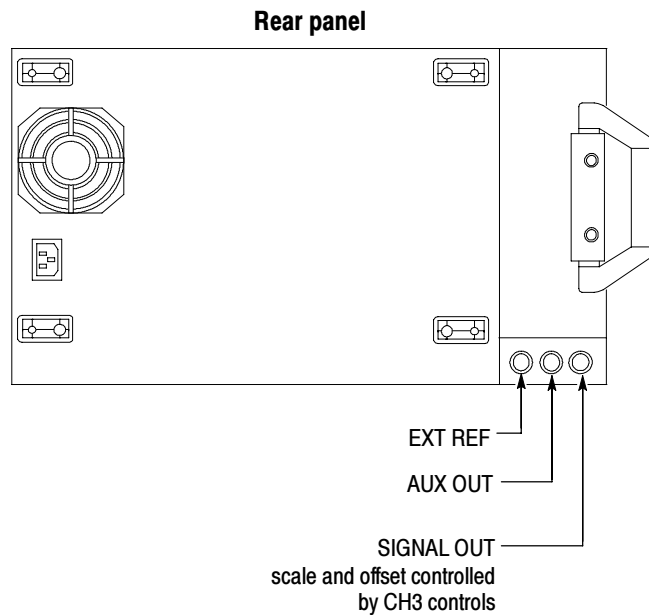


Figure 2-5: Locations of connectors on the rear panel

Front Panel Controls Map Many of the oscilloscope functions can be controlled directly from the front panel controls or in conjunction with the screen interface.

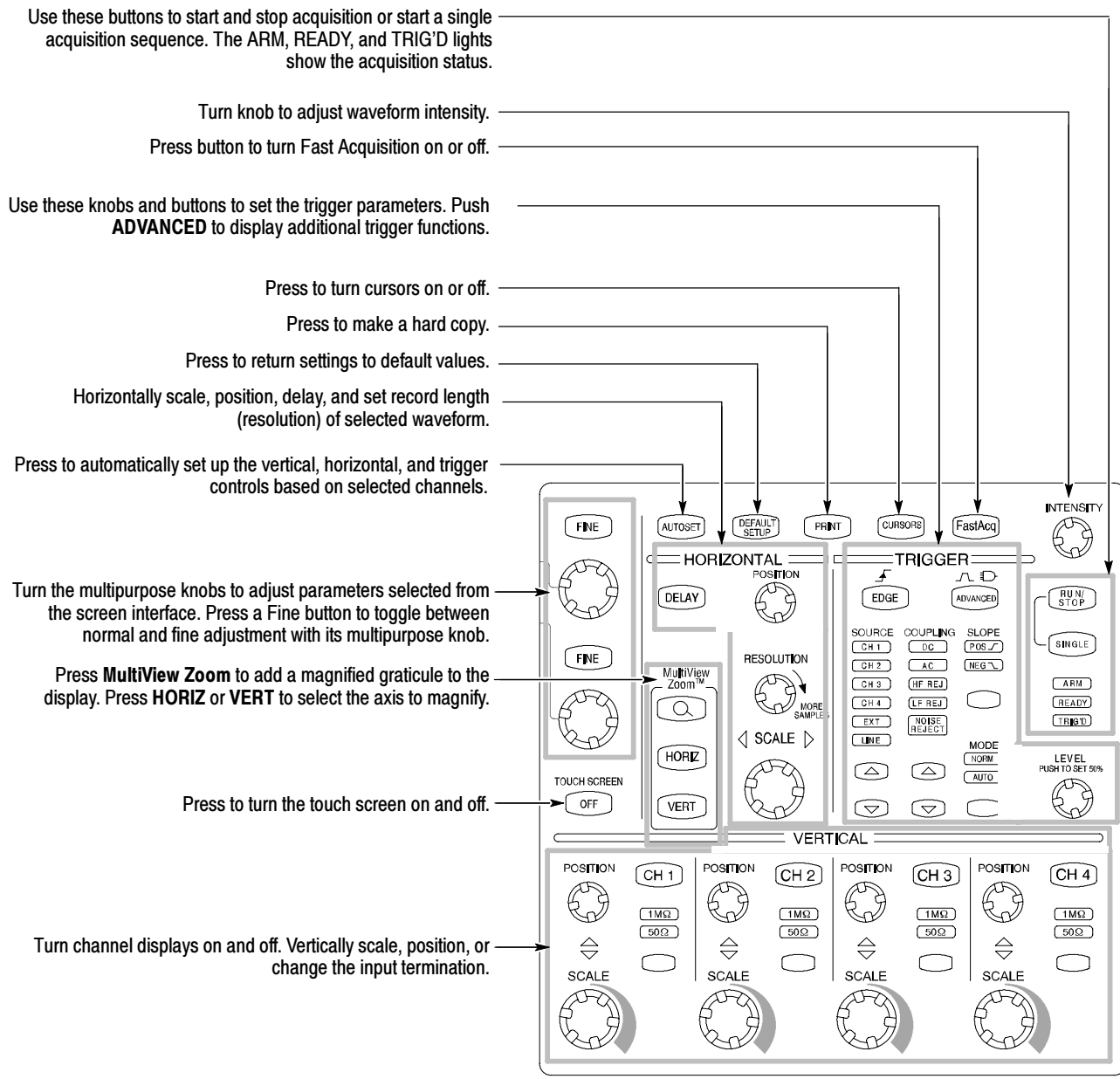


Figure 2-6: Front panel controls

Instrument Diagnostics

Do the following steps to verify the instrument passes the internal diagnostics.

1. Display the diagnostics menu:
 - If the oscilloscope is in toolbar mode, click the **MENU** button to put the oscilloscope into the menu bar mode.
 - Select **Instrument Diagnostics . . .** from the **Utility** menu.
2. Run the diagnostics.
 - First disconnect any input signals from all four channels.
 - Click the **Run** button in the diagnostics control window.
3. Wait for the diagnostics to complete.

The internal diagnostics do an exhaustive verification of proper oscilloscope function. This verification may take several minutes to complete. When the verification is finished, the resulting status appears in the diagnostics control window.
4. Verify that no failures are found. If any failures occur, use the “DIAG:RESULTS:VERBOSE?” query for details on the errors.

Signal Path Compensation

Run the Signal Path Compensation.

NOTE. *The oscilloscope must be warmed up to operating temperature. Signal Path Compensation is not valid until the oscilloscope Calibration Status reaches Temp status.*

1. Select **Instrument Calibration . . .** from the **Utility** menu.
2. Verify that the instrument has had a twenty-minute warm-up before continuing.
3. Click the **Calibrate** button to start the routine.
4. Wait for the test to complete (the test may take several minutes to complete).
5. Verify that the word **Pass** appears under the Status label in the control window.

Using the Online Help

The user manual represents only part of the assistance available to you — the online help system, integrated as part of the oscilloscope user interface, provides quick-to-access support for operating this oscilloscope.

Two types of online help are available, the oscilloscope online help and the GPIB online programmer's help. The oscilloscope online help provides information on all of the oscilloscope controls and procedures for doing typical tasks. The GPIB online programmer's help is normally installed on a remote PC and provides information for controlling the oscilloscope via the GPIB. This section mainly discusses the online help for the oscilloscope.

Accessing Help in the Toolbar Mode. When the oscilloscope is in the toolbar mode, click the Help button in the upper right corner of the screen to display help on whatever control window is displayed. From within the Help window, you can access other help through tabs, links, or buttons. You can also click the Help Topics button to display the standard Windows Contents, Index, and Find tabs.

Accessing Help in the Menu Bar Mode. When the oscilloscope is in the menu bar mode, you can access the help system from the drop-down help menu. Select Help on Window to display help on the current control window. Select Contents and Index to display the standard Windows Contents, Index, and Find tabs. You can also select other topics from the Help menu such as information on Technical Support or product specifications.

Moving the Help Topics to View the Oscilloscope Display. You may temporarily move any displayed help out of the way while you change control window settings. Click the Minimize button in the help window to shrink the help window to a button that displays in the upper right corner of the display (with the label Restore Help). Click the Restore Help button to restore the help window to its normal size.



Theory of Operation

Theory of Operation

This section describes the electrical operation of the oscilloscope. Figure 9-1 on page 9-2 shows the module interconnections.

Logic Conventions

The oscilloscope contains many digital logic circuits. This manual refers to these circuits with standard logic symbols and terms. Unless otherwise stated, all logic functions are described using the positive-logic convention: the more positive of the two logic levels is the high (1) state, and the more negative level is the low (0) state. Signal states may also be described as “true” meaning their active state or “false” meaning their nonactive state. The specific voltages that constitute a high or low state vary among the electronic devices.

Module Overviews

Module overviews describe the basic operation of each functional circuit block as shown in Figure 9-1 on page 9-2.

General

A PC motherboard and microprocessor system controls the oscilloscope. The oscilloscope features a VGA resolution flat-panel display, an optional transparent touch screen, and a front-panel with direct access to commonly used oscilloscope functions. You can also use the oscilloscope with a mouse pointing device or keyboard.

Input Signal Path

A signal enters the oscilloscope through a direct coaxial connection to the input connector, or a probe connected to the front panel.

Acquisition Board. The acquisition board conditions the input signals, samples them, converts them to digital signals, and controls the acquisition process under direction of the processor system. The acquisition system includes the multi-source trigger, acquisition timebase, and acquisition-mode generation and control circuitry. The acquisition board is located in the bottom compartment of the oscilloscope. Two or four vertical channels are accommodated. All channels feature a Tekprobe Level 2 interface for additional front-end signal conditioning functions like high input-impedance real-time probes.

Display Panel

Waveforms and menus are displayed on a 10.4 inch, color, active-matrix LCD (liquid crystal display) with an optional integral touch panel.

Display System. Text and waveforms are processed by different parts of the display circuitry. The display system (display adapter board and inverter board) sends the text and waveform information to the display panel.

Touch Panel (Optional). The display board sends information from the touch panel to the processor. Any changes in settings are reported to the processor system.

Front Panel

The software that operates on the PC motherboard reads the front-panel switches and encoders. Any changes in their settings are reported to the processor system. The software also turns the LEDs on and off.

Menu Switches. Front-panel menu switches are also read by the software. The touch screen processor sends any changes in menu selections to the processor system. The **ON/STBY** switch passes through the PC Interface board to the PC motherboard. The PC motherboard creates the signal sent to the power supply to toggle power.

Processor System. The processor system is a collection of hardware, software, and the Windows operating system. The processor system provides a CPU for performing calculations on data, floppy and CDRW disk drives for data storage, and I/O for interacting with data. The disk drives, the PC interface board, the motherboard, and any peripherals are all components of the processor system.

Floppy Drive. The floppy drive provides access to stored waveform data and software to customize your oscilloscope.

PC Interface Board. The PC Interface board provides a data path between to the Acquisition board and the display system. The PC Interface board provides a GPIB interface through a side panel connector.

PC Motherboard. The PC motherboard provides standard Windows functionality and I/O port interfaces to the rear panel. The PC motherboard also reads the front-panel switches and encoders and implements any changes requested by their settings.

Side Panels

The hard drive and CD-ROM provide access to stored waveform data and software to customize your oscilloscope with your measurement needs. The GPIB port allows for external control of the oscilloscope.

You can make hardcopies on the GPIB, RS-232, and Centronics ports. The PC Interface board includes a VGA connector for an external monitor to display the oscilloscope screen.

The PC motherboard has two USB ports and one serial port on the side panel. A microphone input and earphone output exist on the PC motherboard. The Ethernet connector is RJ-45. Keyboard and mouse are both PS/2.

Power Supply

The power supply is a switching power converter with active power factor control. It supplies power to all of the circuitry in the oscilloscope.

The **ON/STBY** switch, located on the front panel, controls all of the power to the oscilloscope except for part of the circuitry in the standby power supply.

The power supply sends a **Good** signal to the processor system when the power supply voltages are within specifications.

Power is distributed through the PC Interface board and the Disk Drive Adapter board connectors.

Fans

The fan assembly provides forced air cooling for the oscilloscope. The fans are controlled by the microprocessor.

Printer

The optional internal thermal printer allows for quick hard copies of the screen display. The printer receives power and USB signals from the PC Interface board.



Performance Verification

Performance Verification

The performance verification procedures for this instrument are now available on the TDS5000B Series Product Software CD-ROM (Tektronix part number 063-3692-xx) that shipped with your product.

Look for the *TDS5000B Series Digital Phosphor Oscilloscopes Specifications and Performance Verification Technical Reference PDF*, available on this disk.



Calibration Procedure

Calibration Procedure

This chapter describes a sample automatic calibration procedure for your oscilloscope. The purpose of this procedure is to make internal configuration adjustments in the oscilloscope to help ensure its accuracy.

Calibration Interval

The voltage and timing references inside the oscilloscope are very stable over time and should not need routine calibration/adjustment. Before performing the procedures in this chapter, first verify that the oscilloscope does not meet specifications. Refer to *Performance Tests* for a procedure to verify the specifications. These tests are part of the *TDS5000B Series Digital Phosphor Oscilloscopes Specifications and Performance Verification Technical Reference PDF*, available on the *TDS5000B Series Product Software CD-ROM*.

If periodic calibration is one of your requirements, a general rule is to verify performance and perform calibration (only if needed) every 2000 hours of operation or once a year if the oscilloscope is used infrequently.

Calibration Environment

The oscilloscope must be calibrated in a 20 °C to 30 °C ambient temperature environment. The oscilloscope and signal source must warm up at least 20 minutes in this environment before you begin the calibration procedure.

Calibration Dependencies

Some calibration tests may be dependent upon others. The automatic calibration procedure performs the tests in an appropriate sequence to eliminate dependency problems. Always execute the complete automatic calibration procedure. The total time to execute the procedure is approximately 45 minutes (depending somewhat on the processor speed of the controller and the type of GPIB controller — USB is much slower).

Calibration After Repair

After removal and replacement of a module due to electrical failure, you may need to perform the calibration procedure, depending on the module replaced. See Table 5-1.

Table 5-1: Calibration required for module replaced

Module replaced	Calibration required
Front panel assembly	No
Acquisition board	Yes
Processor board	Yes

Table 5- 1: Calibration required for module replaced (Cont.)

Module replaced	Calibration required
Micro ATX processor assembly	No
Display panel or display system	No
Power supply	No
Interconnect boards	No
Fans	No

Required Equipment

The sample calibration procedure requires the specific test equipment and materials listed in Table 5-2.

Table 5- 2: Required equipment and materials

Category	Specific equipment required	Quantity
Signal source	Wavetek 9500 Oscilloscope Calibrator, with Option 100 (high-stability time base)	1 ea
	Wavetek 9520 or 9530 Standard Output Module	4 ea
Instrument controller	PC-compatible computer with National Instruments GPIB Controller card and National Instruments NI-488.2 for Windows software, running Windows 95 or later. The PC must support Visual Basic win32 applications and be able to provide a TekVisa supported GPIB connection to the Wavetek 9500 as well as to the TDS5000B oscilloscope	1 ea
Test software	Calibration software such as the sample Visual Basic 6 program listed later in this chapter	1 ea
	TekVisa drivers. These are available on the TDS5000B Application CD	1 ea
GPIB cables	GPIB cable, 1 m minimum length, Tektronix part number 002-0991-01 or similar	2 ea

Overview of the Procedure

To execute the sample calibration program listed at the end of this chapter, you must have the specific equipment listed in Table 5-2. You must use a separate computer as the instrument controller.

The sample program allows the user to control both the Wavetek 9500 and the TDS5000B oscilloscope to achieve “Factory Calibration” of the TDS5000B. There is no validation of the accuracy of the calibration performed. That is, there is no performance validation within this sample calibration program.

After the controller is set up, you need to install the TekVisa drivers from a CD-ROM that was shipped with the oscilloscope. You also need to input and compile your calibration software, such as the sample program listed later in this chapter.

The sample procedure listed is fully automated. Once the program is started, all of the steps will run without manual intervention.

Instrumentation Setup

Before you can execute the sample calibration program, you need to set up and configure the instrumentation. Make connections according to Figure 5-1.

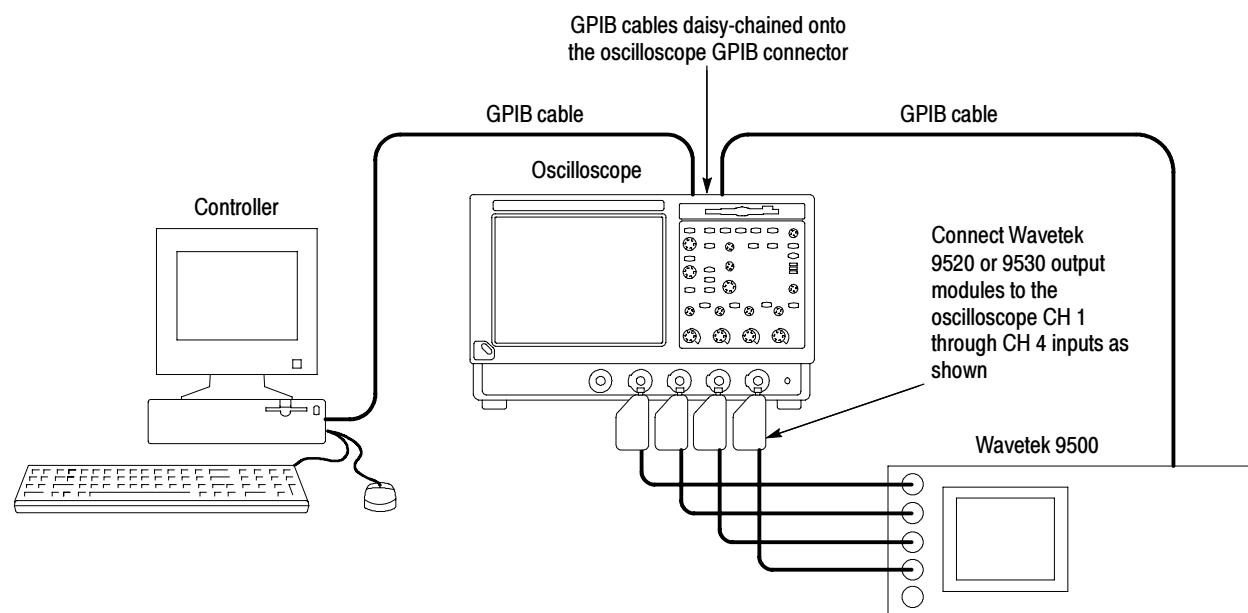


Figure 5-1: Calibration setup

Once the connections have been made, follow these steps:

NOTE. *If you have just completed the performance verification procedure, you can skip all the following steps in this setup procedure.*

1. *Power on the instruments:* Turn power on for the controller, oscilloscope, and signal source. The oscilloscope and the signal source must warm up for 20 minutes before you can begin to execute the test. However, while you are waiting you can continue with the next steps in this procedure.
2. Ensure that the Wavetek output modules are aligned in time with each other. To do this, perform the Wavetek 95000 precision alignment 9500 channel outputs, zero skew operation. Refer to the Wavetek 9500 documentation for information about doing this procedure.
3. *Check the Wavetek 9500 GPIB address:* Refer to the Wavetek 9500 documentation for information about setting the GPIB address. If the address is set to 0 or 1, change it to an address between 2 and 30 (inclusive). Make a note of the address setting for use later in this procedure.
4. *Set the GPIB address of the oscilloscope.*
 - a. If the oscilloscope powered on in the toolbar mode (the default mode), click the **Menu** button (upper right corner of the display) to put the oscilloscope in menu-bar mode. In menu-bar mode, you should then see a PC-style menu bar across the top of the display.
 - b. Pull down the **Utility** menu and then select **GPIB Configuration . . .**. This command will display the GPIB Configuration control window.
 - c. In the GPIB Configuration control window, click the **Talk/Listen** button to select Talk/Listen mode.
 - d. Click the **Address** readout and then click the up and down arrows or the upper multipurpose knob to set the GPIB address to 1.
 - e. Click the **Close** button to close the control window.
5. *Configure the PC controller:* Use the GPIB software and hardware on the controller as necessary to make the following settings:
 - a. Set the controller GPIB address to **0**.
 - b. Define GPIB devices and their addresses for compatibility with the test program as shown in Table 5-3.

Table 5-3: GPIB devices required by test program

Device name	GPIB address
<controller>	0
DUT1	1

Calibration Program Installation and Execution

Follow these steps to install the calibration program on the instrument controller.

1. *Locate the test program:* Locate your calibration program. You can adapt the sample program listed later in this chapter. Put the program in an appropriate location such a folder labelled `c:\programfiles\tds5000b`.
2. Once the instrumentation is connected and configured, allow it to warm up for at least 20 minutes.
3. *Start the program 1:* Select **Run. . .** in the **Start** menu and then enter `c:\programfiles\tds5000b\calibrate.exe` (or other appropriate designation for the disk drive, path and program name used if it is not `c:\programfiles\tds5000b\calibrate.exe`). (Some PCs and controllers require quotes around the path.)
4. *Start the program 2:* Alternatively, open the directory used and then locate the your calibration program. This is the file you will double click to execute the calibration procedure.
5. For the sample program, program execution is a matter of pressing the “start calibration” button.

Calibration Program Operation

The sample calibration application has two buttons. One starts the calibration process, and one exits the application.

There are two text output windows. The first supports a scrolling step/status list. The second has an update of the current status including a display of a simple progress bar during the calibration.

Press the “Start Calibration” button: After pressing this button, all buttons become inactive until calibration is complete.

The application checks GPIB communication with the TDS5000B oscilloscope and the Wavetek 9500 to insure that it can control these devices and reports in

the output window the response of these devices. As each step is performed, the output window will have test signal requirements display and, after the TDS5000B has completed that calibration step, the results will be displayed. That is a scrolling history window and the results from the complete calibration can be reviewed.

The status window will display a rough progress bar during calibration. Some calibration steps can take more than 11 minutes and the status window is only updated between steps, so be patient.

Locate your calibration program. You can adapt the sample program listed on page 5-37. Put the program in an appropriate location such as a folder labeled `c:\programfiles\tds5000b`.

Commands

This section supports the GPIB commands with command definitions, syntax, return messages, and examples. The commands are divided into two groups - CALibrate and DIAGnostic.

Calibration Command Group

The calibration commands provide information about the current state of calibration. Table 5-4 lists the CALibrate commands, and descriptions and examples follow the table.

Table 5-4: CALibrate commands

Command	Description
*CAL?	Instructs the instrument to perform self-calibration
CAL?	Returns the internal and factory calibration status and the calibration due date
CALibrate:CALProbe:CH<x>?	Instructs the instrument to perform a probe calibration
CALibrate:FACTory	Start the factory calibration
CALibrate:FACTory:ABOrt	Stop the factory calibration without changing the cal file
CALibrate:FACTory:CONTInue	Do the next step in the calibration procedure
CALibrate:FACTory:NOTify:DUE?	Return whether the factory calibration is due
CALibrate:FACTory:NOTify:HOuRs	Set or return the number of hours until the user is notified that the instrument is due for factory calibration
CALibrate:FACTory:NOTify:YEARs	Set or return the number of years until the user is notified that the instrument is due for factory calibration
CALibrate:FACTory:PREVious	Backup to the previous step/group but don't go until a CONTINUE command is sent
CALibrate:FACTory:STARt	Start the factory calibration
CALibrate:FACTory:STATus?	Return the factory calibration status
CALibrate:FACTory:STEPSTATus?	Return the status of the current calibration step
CALibrate:FACTory:STEPSTIMulus?	Return the required stimulus for this calibration step
CALibrate:INTERNAI	Starts the internal signal path calibration
CALibrate:INTERNAI:STARt	Starts the internal signal path calibration

Table 5- 4: CALibrate commands (Cont.)

Command	Description
CALibrate:INTERNAL:STATUS?	Returns the current status of the internal signal path calibration
CALibrate:PROBEstate:CH<x>	Returns the calibration status of the attached probe
CALibrate:RESults?	Returns the status of all calibration subsystems without performing an SPC operation
CALibrate:RESults SPC?	Returns the results of the last SPC operation

***CAL?**

This query-only command instructs the digitizing oscilloscope to perform a signal path compensation and return its calibration status. This command is equivalent to selecting Instrument Calibration from the Utilities menu and then clicking the Calibrate button.

NOTE. *The self-calibration can take several minutes to respond. No other commands will be executed until calibration is complete.*

Related Commands

CALibrate:RESults:SPC?

Syntax

*CAL?

Returns

0 <NR1> indicating that the calibration did not complete successfully
 1 (or any non-zero value) <NR1> indicating that the calibration completed without errors

Example

*CAL?
 might return
 1
 indicating that the calibration was successful.

CAL?

This query-only command instructs the instrument to return the internal and factory calibration status and the calibration due status.

Related Commands CALibrate:RESults:SPC?

Syntax CAL?

Returns 0 <NR1> indicating that the calibration did not complete successfully
1 (or any non-zero value) <NR1> indicating that the calibration completed without errors

Example *CAL?

might return

```
*CALIBRATE:INTERNAL:STATUS PASS;:CALIBRATE:FACTORY:STATUS
PASS;NOTIFY:HOURS 2000;YEARS 1.0E0;DUE 0
```

indicating the internal and factory calibration status and the calibration due status.

CALibrate:CALProbe:CH<x>?

This query-only command instructs the instrument to perform a probe calibration for the selected channel and returns the calibration status. The Channel <x> range is 1-4. This command is equivalent to selecting Probe Cal from the Vertical menu. You must warm up the instrument for at least 20 minutes before running this command.

A probe query takes approximately 30 seconds to complete. No other commands will be executed until calibration is complete.

Related Commands CH<x>:PROBECal?, CALibrate:PRObestate:CH<x>?

Syntax CALibrate:CALProbe:CH<x>?

Returns -1 indicating that the probe calibration failed for the selected channel
0 indicating that the probe calibration passed for the selected channel
1 indicating that the probe calibration is initialized for the selected channel

Examples CALibrate:CALProbe:CH2?
might return
:CALIBRATE:CALPROBE:CH2 0
indicating that the probe calibration passed for Channel 2.

CALibrate:FACTory

This command starts the factory calibration. This command functions the same as the CALibrate:FACTory:START command.

Syntax CALibrate:FACTory

Example CALIBRATE:FACTORY
starts the factory calibration

CALibrate:FACTory:ABOrt

This command stops the factory calibration, resets to the initialization state, and exits without changing the calibration data.

Related Commands CALibrate:FACTory:START

Syntax CALibrate:FACTory:ABOrt

Example CALIBRATE:FACTORY:ABORT
stops the factory calibration

CALibrate:FACTory:CONTInue

This command does the next step in the calibration procedure. The calibration step number is increased on successful completion of this step. If the calibration step fails, the step number is not increased. You can use CALibrate:FACTory:CONTInue, to repeat a factory calibration step that failed.

Follow this command with CALibrate:FACTory:STEPstatus? to determine execution status.

If the current step is the last step and the calibration succeeds, new calibration data and pass status is saved to non-volatile memory and the oscilloscope returns to normal operation in the same state it was in before beginning factory calibration.

If the current step is the last step and any factory calibration step has failed, without a successful pass for repeated steps, a fail status will be saved to non-volatile memory. Factory calibration data will not be saved to non-volatile memory if the factory status is FAIL.

Related Commands CALibrate:FACTory:STARt

Syntax CALibrate:FACTory:CONTInue

Example CALIBRATE:FACTORY:CONTINUE

causes the instrument to execute the next step in the calibration procedure.

CALibrate:FACTory:FANcontrol

This command sets or returns the status of the fan control.

Syntax 1 CALibrate:FACTory:FANcontrol <NR3> [, <NR3>]

Arguments <NR3> sets the temperature in degrees Celsius
<NR3> sets the mean sea level specified in feet; this command is optional and if not specified, it defaults to 0.0 (sea level)

Syntax 2 CALibrate:FACTory:FANcontrol?

Returns 0 means that the fan was never calibrated
1 means that calibration is in process
2 means that the fan has been calibrated

Example 1 CALibrate:FACTory:FANcontrol 20

This sets the fan control calibration temperature to 20 degrees Celsius at sea level.

Example 2 CALibrate:FACTory:FANcontrol?

This query might return

```
:CALIBRATE:FACTORY:FANCONTROL 1
```

indicating that calibration is in process.

CALibrate:FACTory:NOTify:DUE?

This command returns whether the factory calibration is due.

Syntax CALibrate:FACTory:NOTify:DUE?

Returns 0 <NR1> means that the oscilloscope is not due for factory calibration.

1 <NR1> means that the oscilloscope is due for factory calibration.

Example CALIBRATE:NOTIFY:DUE?

might return

```
:CALIBRATE:FACTORY:NOTIFY:DUE 0
```

signifying that factory calibration is not due.

CALibrate:FACTory:NOTify:HOURS

This command sets or returns the number of hours until the user is notified that the instrument is due for factory calibration.

Syntax CALibrate:FACTory:NOTify:HOURS {INFIinite|<NR1>}

Argument INFIinite means whatever the specified maximum is for the instrument.

<NR1> set to an integer value.

Example 1 CALIBRATE:NOTIFY:HOURS 1500

sets the calibration notification time to 1,500 hours.

Example 2 CALIBRATE:FACTORY:NOTIFY:HOURS?

might return

```
:CALIBRATE:FACTORY:NOTIFY:HOURS 2000
```

signifying that the calibration due notifier will be displayed 2000 hours after the last calibration.

CALibrate:FACTory:NOTify:YEARS

This command sets or returns the number of years until the user is notified that the instrument is due for factory calibration.

Syntax CALibrate:FACTory:NOTify:YEARS {INFInite|<NR3>}

Argument INFInite means whatever the specified maximum is for the instrument.
<NR1> set to a floating point value.

Example 1 CALIBRATE:FACTORY:NOTIFY:HOURS 1.5e0
sets the calibration notification time to 1.5 years.

Example 2 CALIBRATE:FACTORY:NOTIFY:HOURS?
might return
:CALIBRATE:FACTORY:NOTIFY:HOURS 1.5e0
signifying that the calibration due notifier will be displayed 1.5 years after the last calibration.

CALibrate:FACTory:PREVIOUS

This command backs up the calibration steps one step so that the next CALibrate:FACTory:CONTInue command will repeat the factory calibration step that just finished. Repeated CALibrate:FACTory:PREVIOUS commands can back up as many calibration steps as desired, at least until step one is reached. The appropriate notifier, with signal source information, is displayed after the factory calibration step is adjusted.

Syntax CALibrate:FACTory:PREVIOUS

Example CALIBRATE:FACTORY:PREVIOUS
backs up the calibration steps one step.

CALibrate:FACTory:START

This command starts the factory calibration. The factory calibration process consists of a series of steps. Do not send any other commands that change the state of the oscilloscope until the calibration process is complete.

Related Commands CALibrate:FACTory:ABOrt

Syntax CALibrate:FACTory:START

Example CALIBRATE:FACTORY:START
starts the factory calibration.

CALibrate:FACTory:STATus?

This command returns the factory calibration status.

Syntax CALibrate:FACTory:STATus?

Returns FAIL if the factory calibration failed
PASS if the factory calibration passed
UNCAL if the factory calibration has not been run

Example CALIBRATE:FACTORY:STATUS
might return
:CALIBRATE:FACTORY:STATUS PASS
indicating the factory calibration passed

CALibrate:FACTory:STEPSTATus

This command returns the status of the current calibration step.

It returns pass during oscilloscope power on without regard to actual calibration status. It returns pass or fail for the factory calibration step that most recently executed when factory calibration is in progress. Use this query to synchronize programmed factory calibration steps.

Syntax	CALibrate:FACTory:STEPSTATUS
Returns	FAIL if the factory calibration failed PASS if the factory calibration passed
Example	CALIBRATE:FACTORY:STEPSTATUS might return :CALIBRATE:FACTORY:STEPSTATUS FAIL indicating the last oscilloscope calibration step did not pass

CALibrate:FACTory:STEPSTIMulus

This command returns the required stimulus for this calibration.

Syntax	CALibrate:FACTory:STEPSTIMulus
Returns	Using the format: <Volts>, <Freq>, <Chan>, <Term>, <Token> Volts <NR3> is a floating point number representing DC volts if the value for <Freq> is 0 or representing $V_{\text{peak-to-peak}}$ if the value for <Freq> is non-zero. Freq <NR1> is the frequency in Hz of the applied waveform.

NOTE. This command typically returns the frequency of the signal in hertz. However, if it returns a frequency value of “4” then that means apply the deskew function of the Wavetek 9500 calibrator to all input channels. If it returns a “0” then apply a DC voltage.

Chan <NR1> stands for the channel.

Term <NR1> stands for the ohms of termination. For example,

8.0E-03, 0, 1, 50, C01

means apply 800 mV DC to Channel 1 with 50 ohm termination. If the query is sent before FACTORY CAL has been initialized, the returned string will be:

0.0, 0, 0, 0, END

Token is a unique string identifying the step to be done next.

CALibrate:INTERNAL

This command starts the internal signal path calibration (SPC) of the instrument. You can use the CALibrate:INTERNAL:STATUS? query to return the current status of the internal signal path calibration of the instrument.

Syntax CALibrate:INTERNAL

Example CALIBRATE:INTERNAL

This command starts the internal signal path calibration of the instrument.

CALibrate:INTERNAL:START

This command starts the internal signal path calibration (SPC) of the instrument. This command is the same as the CALibrate:INTERNAL command. You can use the CALibrate:INTERNAL:STATUS? query to return the current status of the internal signal path calibration of the instrument.

Syntax CALibrate:INTERNAL:START

Example CALIBRATE:INTERNAL:START

This command starts the internal signal path calibration of the instrument.

CALibrate:INTERNAL:STATUS?

This query-only command returns the current status of the instrument internal signal path calibration for the last SPC operation.

Syntax CALibrate:INTERNAL:STATUS?

Returns This query will return one of the following:

- INIT indicating that the instrument has not had the internal signal path calibration run
- PASS indicating that the signal path calibration completed successfully
- FAIL indicating that the signal path calibration did not complete successfully
- WARMUP indicating that the instrument has not warmed up for the required time to perform signal path calibration

- TEMPDRIFT indicating that the instrument has not reached a state of stable temperature adequate for performing signal path calibration
- RUNNING indicating that the signal path calibration is currently running

Example CALIBRATE:INTERNaL:STATus?

This query might return INIT, indicating that the internal signal path calibration has not been run.

CALibrate:PRObestate:CH<x>?

This query-only command returns the status of the probe calibration for a probe attached to a given channel.

Related Commands CH<x>:PROBECa1?

Syntax CALibrate:PROBEstate:CH<x>?

Arguments <x> is the channel number the probe is attached to

Returns

- 1 indicating that the probe calibration failed for the selected channel
- 0 indicating that the probe calibration passed for the selected channel
- 1 indicating that the probe calibration is initialized for the selected channel
- 2 indicating that probe calibration is running for the selected channel

Example CALIBRATE:PROBESTATE:CH1?

This query returns the status of the probe calibration for a probe attached to CH1. A query might return

```
:CALIBRATE:PROBESTATE:CH1 0
```

indicating that the probe calibration for channel 1 passed.

CALibrate:RESults?

This query-only command returns the status of internal and factory calibration without performing calibration operations. The returned results do not include the calibration status of attached probes. The CALibration:RESults? query is intended to support GO/NoGO testing of the instrument calibration readiness: all returned results should indicate PASS status if the instrument is fit for duty. It is

quite common, however, to use uncalibrated probes (particularly when the instrument inputs are connected into a test system with coax cables).

This command is equivalent to selecting Instrument Calibration from the Utilities menu, and then viewing the contents of the Status field.

Syntax CALibrate:RESults?

Example CALIBRATE:RESULTS?

This query returns the status of all the calibration subsystems. It might return:

```
:CALIBRATE:RESULTS:SPC PASS;FACTORY PASS;FACTORY:VOLTAGE  
PASS;FREQUENCY PASS;TRIGGER PASS
```

CALibrate:RESults:SPC?

This query-only command returns the results of the last SPC operation: either PASS or FAIL.

Related Commands *CAL?

Syntax CALibrate:RESults:SPC?

Example CALIBRATE:RESULTS:SPC?

Returns the results of the last SPC operation.

CALibrate:TEMPerature?

The query returns the air temperature inside the case in degrees Celsius.

Syntax CALibrate:TEMPerature?

Example CALIBRATE:TEMPerature?

This query might return

```
:CALIBRATE:TEMPERATURE 20
```

indicating that the air temperature inside the case is 20 degrees Celsius.

Diagnostics Command Group

The diagnostic commands control the selection and execution of diagnostic tests. Table 5-5 lists the DIAGnostic commands. Descriptions and examples follow the table.

Table 5-5: DIAGnostic Commands

Command	Description
DIAG:CONTROL:HALT	Enables or disables halting on first diagnostic failure
DIAG:CONTROL:LOOP	Enables or disables looping of diagnostics
DIAG:EXECUTE	Executes currently selected set of diagnostics
DIAG:ITEM?	Returns all data associated with a selected menu item
DIAG:ITEM:FAILURES?	Returns the total number of failures that occurred
DIAG:ITEM:NAME?	Returns the name of the selected menu item
DIAG:ITEM:RESULT?	Returns the result of the last test executed on this item
DIAG:ITEM:SUBITEMS?	Returns the number of subitems associated with this item
DIAG:LEVEL	Sets the current level of diagnostic test hierarchy
DIAG:LOOPS?	Returns the number of times the diagnostics were completed during the last execution
DIAG:NAME?	Returns the subsystem name, area and test name of the current diagnostic test
DIAG:NAME:AREA?	Returns the selected area of the current diagnostic test
DIAG:NAME:SUBSYS?	Returns the subsystem of the current diagnostic test
DIAG:NAME:TEST?	Returns the name of the current diagnostic test
DIAG:NUMITEMS?	Returns the number of items on the currently selected level of test hierarchy
DIAG:RESults?	Returns a brief pass or fail status of the last test execution
DIAG:RESults:VERBose?	Returns a more explanatory message about the results of the last diagnostic execution
DIAG:SElect:ALL	Selects all available diagnostics
DIAG:SElect:AREA	Selects one of the available diagnostic areas
DIAG:SElect:LAST	Sets the last item of a group of items from the same level of test hierarchy
DIAG:SElect:SUBSYS	Selects one of the available diagnostic subsystems
DIAG:SElect:TEST	Selects one of the available diagnostic tests
DIAG:STATE	Sets the instrument operating state

Table 5-5: DIAGnostic Commands

Command	Description
DIAG:STOP	Terminates the execution of diagnostics
TEST	Selects and executes any item at any level of the test hierarchy
TEST:RESults?	Returns a brief pass or fail status of the last test execution
TEST:RESults:VERBose?	Returns a more explanatory message about the results of the last test execution
TEST:STOP	Terminates the execution of the test

DIAG:CONTROL:HALT

This command (no query form) determines whether the next execution of diagnostics will stop on the first diagnostic failure that occurs or will execute the selected set of diagnostic functions. This command is equivalent to selecting Instrument Diagnostics from the Utilities menu and then enabling Halt on Fail.

Related Commands DIAG:CONTROL:LOOP

Syntax DIAG:CONTROL:HALT (ON|OFF|<NR1>)

Arguments ON enables the halt function, causing the execution of diagnostics to halt at the first diagnostic failure that occurs.

OFF disables the halt function, allowing the instrument to execute the entire set of diagnostics before halting, even if a diagnostic failure occurs.

<NR1> A 0 enables the halt function; any other number disables the halt function.

Example DIAG:CONTROL:HALT ON

This command enables the halt function, causing the execution of diagnostics to halt at the first diagnostic failure that occurs.

DIAg:CONTROL:LOOP

This command (no query form) determines whether the next execution of diagnostics executes once or continuously loops on the selected set of diagnostics (assuming the halt control is set to off using the DIAg:CONTROL:HALT command or that the halt control is set to ON but no failures occur). This command is equivalent to selecting Instrument Diagnostics from the Utilities menu and then enabling Loop Control.

Related Commands DIAg:CONTROL:HALT, DIAg:STOP

Syntax DIAg:CONTROL:LOOP (ON|OFF|<NR1>)

Arguments ON enables the loop function, causing the execution of diagnostics to continuously loop.

OFF disables the loop function, causing the oscilloscope to execute the entire set of diagnostics once and then halt.

<NR1>-A 0 enables the loop function; any other number disables the loop function.

Examples DIAg:CONTROL:LOOP ON

This command enables the loop function.

DIAg:EXECUTE

This command (no query form) starts the execution of the currently selected set of diagnostics. This command is equivalent to selecting Instrument Diagnostics from the Utilities menu and then pressing Run.

Related Commands DIAg:STATE

Syntax DIAg:EXECUTE

Example DIAg:EXECUTE

This command starts the execution of the selected set of diagnostics.

DIAG:ITEM?

This query-only command returns all the data associated with a particular menu item. This command is equivalent to selecting Instrument Diagnostics from the Utilities menu and then reviewing the diagnostics settings.

This query can be issued while diagnostics are still in progress.

Related Commands DIAG:ITEM:FAILURES?, DIAG:ITEM:NAME?, DIAG:ITEM:RESULT?,
DIAG:ITEM:SUBITEMS?

Syntax DIAG:ITEM? <NR1>

Arguments <NR1> sets the index item about which data will be returned, which ranges from 0 through 15.

Example DIAG:ITEM? 2

This query might return:

```
:DIAG:ITEM 2,"Acquisition","Pass",0,8
```

This indicates that the acquisition test passed and that there were 0 failures of the 8 subitems for that test.

DIAG:ITEM:FAILURES?

This query-only command returns the total number of failures. This command is equivalent to selecting Instrument Diagnostics from the Utilities menu and then reviewing the Diagnostic Status.

This query can be issued while diagnostics are still in progress.

Related Commands DIAG:ITEM?, DIAG:ITEM:NAME?, DIAG:ITEM:RESULT?, DIAG:ITEM:SUB-
ITEMS?

Syntax DIAG:ITEM:FAILURES? <NR1>

Arguments <NR1> sets the index item about which data will be returned, which ranges from 0 through 15.

Example DIAG:ITEM:FAILURES? 2

This query might return

```
:DIAG:ITEM:FAILURES 2,0
```

This indicates there were 0 failures for item 2.

DIAG:ITEM:NAME?

This query-only command returns the name of the selected menu item. This command is equivalent to selecting Instrument Diagnostics from the Utilities menu and then reviewing the Subsystem, Area and Test settings.

This query can be issued while diagnostics are still in progress.

Related Commands DIAG:ITEM?, DIAG:ITEM:FAILURES?, DIAG:ITEM:RESULT?,
DIAG:ITEM:SUBITEMS?

Syntax DIAG:ITEM:NAME? <NR1>

Arguments <NR1> sets the index item about which data will be returned, which ranges from 0 through 15.

Example DIAG:ITEM:NAME? 2

This query might return

```
:DIAG:ITEM:NAME 2,"Acquisition"
```

This indicates that the selected menu item (2) is Acquisition.

DIAG:ITEM:RESULT?

This query-only command returns the result from the last execution of the item. This command is equivalent to selecting Instrument Diagnostics from the Utilities menu and then reviewing the Diagnostic Status.

This query can be issued while diagnostics are still in progress.

Related Commands DIAG:ITEM?, DIAG:ITEM:NAME?, DIAG:ITEM:FAILURES?,
DIAG:ITEM:SUBITEMS?

Syntax DIAG:ITEM:RESULT? <NR1>

Arguments <NR1> sets the index item about which data will be returned, which ranges from 0 through 15.

Example 1 DIAG:ITEM:RESULT? 2
This query might return
:DIAG:ITEM:RESULT 2,"Pass"
indicating that the item passed during the last execution.

Example 2 DIAG:ITEM:RESULT? 2
This query might return
:DIAG:ITEM:RESULT 2,"Fail"
indicating that the item failed during the last execution.

Example 3 DIAG:ITEM:RESULT? 2
This query might return
:DIAG:ITEM:RESULT 2,""
indicating that the item was not run.

DIAG:ITEM:SUBITEMS?

This query-only command returns the number of sub-items associated with the item. This command is equivalent to selecting Instrument Diagnostics from the Utilities menu, choosing the Subsystem, Area or Test setting, and then reviewing the resulting sub-items.

This query can be issued while diagnostics are still in progress.

Related Commands DIAG:ITEM?, DIAG:ITEM:NAME?, DIAG:ITEM:FAILURES?,
DIAG:ITEM:RESULT?

Syntax DIAG:ITEM:SUBITEMS? <NR1>

Arguments <NR1> sets the index item about which data will be returned, which ranges from 0 through 15.

Example DIAg:ITEM:SUBITEMS? 2

This query might return

```
:DIAG:ITEM:SUBITEMS 2,8
```

This indicates that there are 8 sub-items associated with the selected item (2).

DIAg:LEVEL

This command sets or returns the currently selected level of diagnostic test hierarchy. This command is equivalent to selecting Instrument Diagnostics from the Utilities menu and then reviewing the Diagnostic Status.

Syntax 1 DIAg:LEVEL (SUBSYS|AREA|TEST)

Syntax 2 DIAg:LEVEL?

This query form of the command can be issued while diagnostics are still in progress.

Arguments SUBSYS sets diagnostic testing to the subsystem level.

AREA sets diagnostic testing to the area level.

TEST sets diagnostic testing to the test level.

Example 1 DIAg:LEVEL AREA

sets the diagnostic testing to the area level.

Example 2 DIAg:LEVEL?

This query might return

```
:DIAG:LEVEL SUBSYS
```

indicating that the current level of diagnostic test hierarchy is Subsys.

DIAG:LOOPS?

This query-only command returns the number of times that the selected diagnostics set was completed during the last diagnostic execution. This command is equivalent to selecting Instrument Diagnostics from the Utilities menu and then reviewing the Elapsed Count.

This command can be issued while diagnostics are still in progress.

Syntax DIAG:LOOPS?

Example DIAG:LOOPS?

This query might return

```
:DIAG:LOOPS 5
```

indicating that the selected set of diagnostics was completed 5 times during the last diagnostic execution.

DIAG:NAME?

This query-only command returns the names of the subsystem, area and test of the current diagnostic test.

This query can be issued while diagnostics are still in progress.

Related Commands DIAG:NAME:AREA?, DIAG:NAME:SUBSYS?, DIAG:NAME:TEST?

Syntax DIAG:NAME?

Example DIAG:NAME:?

This query might return

```
:DIAG:NAME:SUBSYS "Processor";AREA "Memory";TEST "DRAMWalk1 "
```

This indicates the subsystem name, area name, and test name of the currently selected diagnostic test.

DIAG:NAME:AREA?

This query-only command returns the selected area of the current diagnostic test. There are three levels of diagnostic test hierarchy: subsystem, area and test. This command is equivalent to selecting Instrument Diagnostics from the Utilities menu, and then reviewing the Diagnostic Status.

This query can be issued while diagnostics are still in progress.

Related Commands DIAG:NAME?, DIAG:NAME:SUBSYS?, DIAG:NAME:TEST?

Syntax DIAG:NAME:AREA?

Example DIAG:NAME:AREA?

This query might return

```
:DIAG:NAME:AREA "Memory"
```

indicating the selected area name of the currently selected diagnostic test.

DIAG:NAME:SUBSYS?

This query-only command returns the subsystem of the current diagnostic test. This command is equivalent to selecting Instrument Diagnostics from the Utilities menu, and then reviewing the Diagnostic Status.

This query can be issued while diagnostics are still in progress.

Related Commands DIAG:NAME?, DIAG:NAME:AREA?, DIAG:NAME:TEST?

Syntax DIAG:NAME:SUBSYS?

Example DIAG:NAME:SUBSYS?

This query might return

```
:DIAG:NAME:SUBSYS "Acquisition"
```

indicating the subsystem name of the current diagnostic test.

DIAG:NAME:TEST?

This query-only command returns the name of the current diagnostic test. This command is equivalent to selecting Instrument Diagnostics from the Utilities menu, and then reviewing the Diagnostic Status.

This query can be issued while diagnostics are still in progress.

Related Commands DIAG:NAME?, DIAG:NAME:AREA?, DIAG:NAME:SUBSYS?

Syntax DIAG:NAME:TEST?

Example DIAG:NAME:TEST?

This query might return

```
:DIAG:NAME:TEST "diagDataFormatConf"
```

indicating the test name of the current diagnostic test.

DIAG:NUMITEMS?

This query-only command returns the number of items on the currently selected level of test hierarchy, which ranges from 1 through 15. This command is equivalent to selecting Instrument Diagnostics from the Utilities menu, and then reviewing the Diagnostic Status.

This query can be issued while diagnostics are still in progress.

Syntax DIAG:NUMITEMS?

Example DIAG:NUMITEMS?

This query might return

```
:DIAG:NUMITEMS 7
```

indicating the number of items on the currently selected level of test hierarchy.

DIAG:RESults?

This query-only command returns an abbreviated status about the results of the last diagnostic (or test) execution. For a more explanatory status message, use the DIAG:RESults:VERBose query. This command is equivalent to selecting Instrument Diagnostics from the Utilities menu, and then reviewing the Diagnostic Status.

This query can be issued while diagnostics are still in progress.

Related Commands DIAG:RESults:VERBose?

Syntax DIAG:RESults?

Example 1 DIAG:RESults?

This query might return

```
:DIAG:RESULTS "135"
```

indicating the specific failure code of the first test failure that occurred.

Example 2 DIAG:RESults?

This query might return

```
:DIAG:RESULTS "Pass"
```

indicating the specific failure code of the first test failure that occurred.

Example 3 DIAG:RESults?

This query might return

```
:DIAG:RESults "*****"
```

indicating the diagnostic test was not run.

DIAG:RESults:VERBose?

This query-only command returns a more explanatory message about the results of the last diagnostic (or test) execution than the DIAG:RESults? query. This command is equivalent to selecting Instrument Diagnostics from the Utilities menu, and then reviewing the Diagnostic Status.

This query can be issued while diagnostics are still in progress.

Related Commands DIAg:RESults?

Syntax DIAg:RESults:VERBose?

Example DIAg:RESults:VERBose?

This query might return

:DIAG:RESULTS:VERBOSE "DIAG ABORTED, ERROR 15 in A2D-Dmux 1 interconnects"

DIAg:SElect:ALL

This command (no query form) selects all available diagnostics. This command is equivalent to selecting Instrument Diagnostics from the Utilities menu, and then choosing ALL from the Subsystem, Area and Test pull-down lists.

Related Commands DIAg:NAME:AREA?, DIAg:NAME:SUBSYS?, DIAg:NAME:TEST?,
DIAg:EXECUTE

Syntax DIAg:SElect:ALL ALL

Example DIAg:SElect:ALL ALL

This command selects all available diagnostics.

DIAg:SElect:AREA

This command (no query form) selects one of the available areas. This command is equivalent to selecting Instrument Diagnostics from the Utilities menu, and then choosing an Area from the pull-down lists.

NOTE. *This command should only be executed if DIAg:LEVEL is set to AREA.*

Related Commands DIAg:SElect:SUBSYS?, DIAg:SElect:TEST?, DIAg:SElect:LAST

Syntax DIAg:SElect:AREA <NR1>

Arguments <NR1> selects an area by number, which can range from 0 (zero selects all) through 15 (as specified by DIAg:NUMITEMS).

Example DIAg:SElect:AREA 1
This command selects Area 1 as the area to be diagnosed.

DIAg:SElect:LAST

This command (no query form) selects one or more diagnostic menu items to be executed via the DIAg:EXECUTE command. If you specify DIAg:LEVEL:SUBSYS, then menu items come from this diagnostic level and are limited to the value returned by the DIAg:NUMITEMS? query. For example, specifying DIAg:SELECT:SUBSYS 2 and DIAg:NUMITEMS 5 indicates that diagnostics will start from subsystem 2 and that you can specify a range from 2 through 5 for DIAg:SElect:LAST.

If you enter:
DIAg:SElect:LAST 2, only subsystem 2 will be executed.
DIAg:SElect:LAST 4, subsystems 2 *through* 4 will be executed.

Related Commands DIAg:EXECUTE, DIAg:LEVEL, DIAg:NAME:AREA?, DIAg:NAME:SUBSYS?, DIAg:NAME:TEST?, DIAg:NUMITEMS?, DIAg:SElect:SUBSYS

Syntax DIAg:SElect:LAST <NR1>

Arguments <NR1> selects an integer that identifies the number of the last item that will be executed when the DIAg:EXECUTE command is run.

Example DIAg:SElect:LAST 2
specifies that (based on the previous example, only subsystem 2 will be executed.

DIAg:SElect:SUBSYS

This command (no query form) selects one of the available subsystems. This command is equivalent to selecting Instrument Diagnostics from the Utilities menu and then choosing a Subsystem from the drop-down list.

NOTE. This command should be executed only if *DIAG:LEVEL* is currently set to *SUBSYS*.

Related Commands *DIAG:SElect:AREA*, *DIAG:SElect:TEST*, *DIAG:SElect:LAST*

Syntax *DIAG:SElect:SUBSYS* <NR1>

Arguments <NR1> selects a subsystem by number, which can range from 0 (zero selects ALL) through 15 (as specified by *Diag:NUMITEMS*).

Example *DIAG:SElect:SUBSYS*
selects Subsystem 1 as the subsystem to be diagnosed.

DIAG:SElect:TEST

This command (no query form) selects one of the available tests. This command is equivalent to selecting Instrument Diagnostics from the Utilities menu and then choosing a Test from the drop down list.

NOTE. This command should be executed only if *DIAG:LEVEL* is currently set to *TEST*.

Related Commands *DIAG:SElect:AREA*, *DIAG:SElect:SUBSYS*, *DIAG:SElect:LAST*

Syntax *DIAG:SElect:TEST* <NR1>

Arguments <NR1> selects a test by number, which can range from 0 (zero selects ALL) through 15 (as specified by *DIAG:NUMITEMS*).

Example *DIAG:SElect:TEST* 1
selects Test 1 as the test to be executed.

DIAg:STATE

This command (no query form) changes the oscilloscope operating state. Depending on the argument, diagnostics capabilities are either turned on or off. This command is equivalent to opening the DIAg:STATE dialog (ON) or closing it (OFF).

Related Commands TEST:STOP

Syntax DIAg:STATE {ON|OFF}

Arguments ON puts the instrument into the state in which diagnostics can be run. This argument is used automatically if either DIAg:EXECUTE or DIAg:TEST commands are executed.

OFF disables diagnostics capabilities and returns the oscilloscope to a normal operating state.

Example DIAg:STATE OFF

turns off diagnostics capabilities and returns the instrument to a normal operating state.

DIAg:STOP

This command (no query form) causes diagnostics (or test) execution to terminate at the end of the next low-level test. This command is equivalent to selecting Instrument Diagnostics from the Utilities menu and then clicking Abort.

Related Commands TEST:STOP

Syntax DIAg:STOP

Example DIAg:STOP

terminates diagnostics (or test) execution at the end of the next low-level test.

TEST

This command (no query form) provides the ability to select and execute an item at any level of the test hierarchy (Test, Area or Subsystem). This command is equivalent to selecting Instrument Diagnostics from the Utilities menu, choosing a test and then pressing Run.

NOTE. *Turning off both DIAg:CONTROL:HALT and DIAg:CONTROL:LOOP before executing the TEST command is recommended.*

Syntax TEST <NR3>

Arguments <NR3> sets the test ID, which ranges from 0 through 3 characters. If no test ID is specified, all available diagnostics are executed.

Example 1 TEST "1"
executes all Acquisition tests (Subsystem: Acquisition)

Example 2 TEST "11"
executes all Acquisition Memory tests (Subsystem: Acquisition, Area:Memory)

Example 3 TEST "113"
executes a specific Acquisition Memory test (Subsystem: Acquisition, Area: Memory, Test: Address Lines).

TEST:RESuLts?

This query-only command returns an abbreviated status about the results of the last TEST execution. This command is equivalent to selecting Instrument Diagnostics from the Utilities menu and then reviewing the Diagnostic Status.

Related Commands TEST, TEST:RESuLts:VERBoSe?

Syntax TEST:RESuLts?

Example 1 TEST:RESuLts?

might return

```
:TEST:RESULTS "135"
```

indicating the specific failure code of the first test failure.

Example 2 TEST:RESults?

might return

```
:TEST:RESULTS "PASS"
```

indicating the previously executed test passed

Example 3 TEST:RESults?

might return

```
:TEST:RESULTS "*****"
```

indicating the test was not run.

TEST:RESults:VERBose?

This query-only command returns a more explanatory message about the results of the last TEST execution than the TEST:RESults query.

Related Commands TEST, TEST:RESults?

Syntax TEST:RESults:VERBose?

Example TEST:RESults:VERBose?

might return

```
:TEST:RESULTS:VERBOSE DIAG ABORTED, ERROR 15 in A2D-Dmux 1  
interconnects"
```

TEST:STOP

This command (no query form) causes test (or diagnostics) execution to terminate at the end of the next low-level test. This command is equivalent to selecting Instrument Diagnostics from the Utilities menu and then clicking Abort.

Related Commands DIAg:STOP

Syntax TEST:STOP

Example TEST:STOP

Sample Calibration Program

This section includes a listing of a sample calibration program. It is written in Microsoft Visual Basic 6.

Tektronix provides this listing as is with no warranties of any kind, specifically excluding warranties of merchantability and fitness for a particular purpose. Tektronix, Inc. assumes no liability of any kind for your use of this software.

Overview

```
Find and initialize TDS5000B instrument
Find and initialize CALIBRATOR instrument
Wait required warmup time
Setup SRQ TDS5000B: OPC
Sent TDS5000B: CALibrate:FACTory:START
While ( CalibratorArgs = Query TDS5000B: :CALibrate:FACTory:STEPSTIMulus? .ne.
"0.0,0,0,0,END" )
Do
{
    Program Calibrator(CALibratorArgs)
    Send TDS5000B: :CALibrate:FACTory Continue
    Wait SRQ TDS5000B
    if ( (No SRQ) .or. (Query TDS5000B: :CALibrate:FACTory:STEPSTATUS? .ne. PASS) )
    {
        Send TDS5000B: CALibrate:FACTory ABOrt
        Abort Calibration Procedure
    }
}
if (Query TDS5000B: :CALibrate:FACTory:STATUs? .ne. PASS)
{
    Notify operator of FAILURE
}
else
{
    Notify operator of SUCCESS
}
```

Listing

```

VERSION 5.00
Object = "{DFEB0DA3-D648-11D4-9C5F-EA48B7E9393D}#1.0#0"; "tvc.ocx"
Begin VB.Form frmMain
    AutoRedraw      = -1 'True
    Caption         = "Calibrator for TDS5000B"
    ClientHeight    = 4884
    ClientLeft      = 48
    ClientTop       = 324
    ClientWidth     = 8184
    LinkTopic       = "Form1"
    ScaleHeight     = 4884
    ScaleWidth      = 8184
    StartupPosition = 3 'Windows Default
Begin TVCLib.Tvc TvcWaveTek
    Left           = 3600
    Top            = 2760
    _Version       = 65536
    _ExtentX       = 847
    _ExtentY       = 847
    _StockProps    = 0
    VisaDescriptor = "GPIB0::1::INSTR"
    Timeout        = 10000
End
Begin TVCLib.Tvc TvcScope
    Left           = 2400
    Top            = 2760
    _Version       = 65536
    _ExtentX       = 847
    _ExtentY       = 847
    _StockProps    = 0
    VisaDescriptor = "GPIB0::1::INSTR"
    Timeout        = 10000
End
Begin VB.CommandButton cmdPlay
    Caption         = "Start Calibration"
    Enabled         = 0 'False
    Height          = 492
    Left            = 600
    TabIndex        = 5
    ToolTipText     = "Start Calibration"
    Top             = 4080
    Width           = 1572
End

```

```
Begin VB.TextBox txtSignal
  BeginProperty Font
    Name           = "Lucida Console"
    Size           = 7.8
    Charset        = 0
    Weight         = 400
    Underline      = 0 'False
    Italic         = 0 'False
    Strikethrough  = 0 'False
  EndProperty
  Height          = 372
  Left            = 600
  Locked          = -1 'True
  TabIndex        = 4
  ToolTipText     = "Provide this signal to the TDS5000B"
  Top             = 3360
  Width           = 7092
End
Begin VB.ListBox lstOutput
  Height          = 2160
  Left            = 480
  TabIndex        = 1
  Top             = 480
  Width           = 7212
End
Begin VB.CommandButton cmdExit
  Cancel          = -1 'True
  Caption         = "E&xit"
  Height          = 492
  Left            = 6120
  TabIndex        = 0
  ToolTipText     = "Stop calibrator program"
  Top             = 4080
  Width           = 1572
End
Begin VB.Label lblSignal
  Caption         = "Status"
  Height          = 252
  Left            = 600
  TabIndex        = 3
  Top             = 3000
  Width           = 1572
End
Begin VB.Label lblOutput
  Caption         = "Output from TDS5000B"
  Height          = 252
  Left            = 480
```

Sample Calibration Program

```
        TabIndex      = 2
        Top           = 120
        Width         = 2052
    End
End
Attribute VB_Name = "frmMain"
Attribute VB_GlobalNameSpace = False
Attribute VB_Creatable = False
Attribute VB_PredeclaredId = True
Attribute VB_Exposed = False
' $Header: $
'
' DESCRIPTION:
' The Calibrator is an application that runs on a PC. The PC must support
' visual basic win32 application and provide a TekVisa supported GPIB connection
' to the WaveTek 9500 as well as the TDS5000B instrument. The Calibrator will allow
' the user to control both of these devices to achieve "Factory Calibration" of the
' TDS5000B. There will be no validation of the accuracy of the calibration preformed
' (no PV). The GPIB interface hardware in the PC has to be able to act as a GPIB
' controller.
'
'
' Original Author:      Tektronix, Inc.
Option Explicit
Dim strEndOfCal As String      ' The token string produced by tekScope when
                              ' calibration is finished
Dim devFound As Boolean       ' Has the GPIB devices been found before?
Dim calInitDone As Boolean    ' Has the tekScope been told that we are going
                              ' to do factory calibration?
Dim calPassedLastStep As Boolean ' use to allow one retry on a cal step
Dim srcGrounded As Boolean    ' tracks if the WaveTek is set in Ground mode
Dim reqVolts As Double        ' voltage needed for the next step
Dim reqChannel As Integer     ' channel needed for the next step
Dim reqFreq As Double         ' frequency needed for the next step
Dim reqTermination As Double  ' termination in Ohms needed for the next step
Dim reqStepName As String     ' name of the next step
Dim stepNumber As Integer     ' cal step number
Dim calFailed As Boolean      ' did calibration fail?
' Subroutine to scan for the devices needed.
' tekScope and waveTek devices should be found or we won't be able to complete
' calibration of the oscilloscope.
Private Sub findDevices()
    Dim i As Integer
    Dim dev As Variant
    Dim strResult As String
    Dim strGPIBtekscope As String ' name of tekScope GPIB connection
    Dim strGPIBwavetek As String ' name of WaveTek GPIB connection
```



```

If devFound = False Then ' only need to find the device names once.
    strGPIBwavetek = ""
    strGPIBtekscope = ""
    txtSignal.Text = "Please wait:  Initializing"

    TvcScope.SearchCriterion = 0 ' search all devices
                                ' get detected VISA devices
    dev = TvcScope.FindList
                                ' populate devices listbox
    If IsArray(dev) Then
        For i = LBound(dev) To UBound(dev)
            If Left(dev(i), 4) = "GPIB" Then
                lstOutput.AddItem dev(i)
            End If
        Next
    End If
' Set to first GPIB device since no internal device found
For i = 0 To lstOutput.ListCount - 1
    If Left(lstOutput.List(i), 4) = "GPIB" Then
        lstOutput.ListIndex = i
        TvcScope.Descriptor = lstOutput.Text
        strResult = TvcScope.Query("*IDN?")
        Debug.Print strResult
        If Left(strResult, 14) = "TEKTRONIX,TDS5" Then
            strGPIBtekscope = lstOutput.Text
            lstOutput.AddItem "tekScope is " & strResult
        End If
        If Left(strResult, 16) = "Wavetek Ltd,9500" Then
            strGPIBwavetek = lstOutput.Text
            lstOutput.AddItem "Wavetek is " & strResult
        End If
    End If
Next
If strGPIBtekscope = "" Then
    MsgBox "failed to find TekScope"
End If
TvcScope.Descriptor = strGPIBtekscope
If strGPIBwavetek = "" Then
    MsgBox "failed to find WaveTek 9500"
End If
End If
TvcWaveTek.Descriptor = strGPIBwavetek
txtSignal.Text = "TekScope Ready"
devFound = True
lstOutput.ListIndex = lstOutput.ListCount - 1

```

```

    End If
End Sub
' Function to wait for Operation Complete to happen
' from the tekScope.
Private Function tekScopeOPC() As Boolean
    Dim opc As Integer
    Dim strOPC As String
    Dim count As Integer

    On Error Resume Next

    opc = 0
    count = 0
    While (opc <> 1) And (count < 1000)
        Sleep 1000
        strOPC = ""
        strOPC = TvcScope.Query("*OPC?")
        If Len(strOPC) > 0 Then
            opc = Asc(strOPC) - Asc("0")
        Else
            opc = 0
        End If
        count = count + 1
    Wend
    If count > 10 Then
        Debug.Print "OPC happened after " & count & " seconds."
    End If
    If opc <> 1 Then
        Debug.Print "Timed out trying to get OPC on tekScope."
        tekScopeOPC = False
    Else
        tekScopeOPC = True
    End If
End Function
' Resets the WaveTek 9500 to default mode.
Private Sub resetWaveTek()
    Dim count As Integer
    Dim opc As Integer
    Dim strOPC As String
    Dim esr As Integer
    TvcWaveTek.WriteString "*CLS"
    TvcWaveTek.WriteString "*RST"
    count = 0
    strOPC = TvcWaveTek.Query("*OPC?")
    If Len(strOPC) > 0 Then
        opc = Asc(strOPC) - Asc("0")
    Else
        opc = 0
    End If
End Sub

```

```

End If
While (opc <> 1) And (count < 20)
  Sleep 1000
  strOPC = TvcWaveTek.Query("*OPC?")
  If Len(strOPC) > 0 Then
    opc = Asc(strOPC) - Asc("0")
  Else
    opc = 0
  End If
  count = count + 1
Wend
If opc <> 1 Then
  Debug.Print "Unable to reset calibrator."
  Exit Sub
Else
  Sleep 1000
  esr = TvcWaveTek.Query("*ESR?")
  If esr <> 0 Then
    Debug.Print "Non-zero event status after *RST from waveTek 9500. " & _
      "*ESR? returned: " & esr
  End If
End If
srcGrounded = False
End Sub
' Sets the WaveTek 9500 signal to the needed value for the next cal step
Private Sub setWaveTek()
  Dim strCommand As String

  TvcWaveTek.WriteString "OUTPUT OFF"
  If reqVolts > 2.9 Then ' make sure we won't get an overload error
    TvcWaveTek.WriteString "ROUTE:SIGNAL:IMPEDANCE 1000000"
  End If
  Select Case reqFreq
    Case 0
      Debug.Print "use " & reqVolts & " DC signal on channel " & reqChannel & _
        " term: " & reqTermination & " ohms"
      TvcWaveTek.WriteString "SOUR:FUNC:SHAPE DC"
      If reqVolts = 0 Then
        strCommand = "SOUR:PAR:DC:GROUND ON"
        srcGrounded = True
      Else
        If srcGrounded = True Then
          srcGrounded = False
          strCommand = "SOUR:PAR:DC:GROUND OFF"
          TvcWaveTek.WriteString strCommand
        End If
        strCommand = "SOUR:VOLTAGE " & reqVolts
      End If
    End Select

```

```

    End If
    TvcWaveTek.WriteString strCommand
    strCommand = "ROUTE:SIGNAL:PATH CH" & reqChannel
    TvcWaveTek.WriteString strCommand
    strCommand = "ROUTE:SIGNAL:IMPEDANCE " & reqTermination
    TvcWaveTek.WriteString strCommand
Case 4
    Debug.Print "use deskew signal"
    TvcWaveTek.WriteString "SOUR:FUNC:SHAPE SKEW"
    TvcWaveTek.WriteString "SOUR:PAR:SKEW:ALIG PREC"
    TvcWaveTek.WriteString "SOUR:FREQ:FIX 1000000"
    TvcWaveTek.WriteString "ROUT:SIGN:SKEW CH1, ON"
    TvcWaveTek.WriteString "ROUT:SIGN:SKEW CH2, ON"
    TvcWaveTek.WriteString "ROUT:SIGN:SKEW CH3, ON"
    TvcWaveTek.WriteString "ROUT:SIGN:SKEW CH4, ON"
    TvcWaveTek.WriteString "ROUT:SIGN:SKEW CH5, ON"
Case Else
    Debug.Print "use AC signal"
    TvcWaveTek.WriteString "SOUR:FUNC:SHAPE SIN"
    strCommand = "SOURCE:FREQ " & reqFreq
    TvcWaveTek.WriteString strCommand
    strCommand = "SOUR:VOLT " & reqVolts
    TvcWaveTek.WriteString strCommand
    strCommand = "ROUTE:SIGNAL:PATH CH" & reqChannel
    TvcWaveTek.WriteString strCommand
    strCommand = "ROUTE:SIGNAL:IMPEDANCE " & reqTermination
    TvcWaveTek.WriteString strCommand
End Select
TvcWaveTek.WriteString "OUTPUT ON"
Sleep 1000
End Sub
' Subroutine parses the information from the TDS5000B as to the required signal
' for the next calibration step.
Private Sub updateSignal(strRequired As String)
    Dim strSignal() As String
    Dim strMessage As String
    Dim stepStrLen As Integer
    Dim stepStr As String      ' text progress bar

    If strRequired = strEndOfCal Then
        lstOutput.AddItem "Calibration complete"
        calInitDone = False
        Exit Sub
    End If
    strSignal = Split(strRequired, ",")
    reqVolts = Mid(strSignal(0), 2)
    reqFreq = strSignal(1)

```

```

reqChannel = strSignal(2)
reqTermination = strSignal(3)
reqStepName = strSignal(4)

strMessage = reqVolts & " volts "
If reqFreq = 0 Then
    strMessage = strMessage & " DC "
Else
    strMessage = strMessage & reqFreq & " AC "
End If
strMessage = strMessage & "channel " & reqChannel & " "
If reqTermination = 1000000 Then
    strMessage = strMessage & "1 Meg Ohms"
Else
    strMessage = strMessage & reqTermination & " Ohms"
End If

stepStrLen = 2
stepStr = "[]"
If Left(reqStepName, 3) = "S01" Then
    stepStrLen = 24
    stepStr = "[    long operation    ]"
End If
If Left(reqStepName, 3) = "D01" Then
    stepStrLen = 10
    stepStr = "[  wait  ]"
End If
txtSignal.Text = "[" & String(stepNumber, "+") & stepStr & String(110 - (stepNumber + step-
StrLen), ".") & "]"
txtSignal.Refresh
stepNumber = stepNumber + 1
If Left(reqStepName, 3) = "S01" Then
    stepNumber = stepNumber + 23
End If
If Left(reqStepName, 3) = "D01" Then
    stepNumber = stepNumber + 9
End If
lstOutput.AddItem "Provide the following signal: " & strMessage
lstOutput.ListIndex = lstOutput.ListCount - 1
lstOutput.Refresh
End Sub
' Subroutine turns on the correct buttons for the current mode of operation at
' the end of the calibration step.
Private Sub turnOnButtons()
    cmdPlay.Enabled = True
    cmdExit.Enabled = True
End Sub

```

```
' Subroutine to turn off the buttons that will not work during the current
' calibration step.
Private Sub turnOffButtons()
    cmdPlay.Enabled = False
    cmdExit.Enabled = False
End Sub
' Subroutine to handle the Exit button.
' This button is only available during single step mode or before calibration
' has started.
Private Sub cmdExit_Click()
    End
End Sub
' Subroutine to handle the Next step.
Private Sub cmdNextStep()
    Dim strResult As String

    turnOffButtons
    setWaveTek
    TvcScope.WriteString ":CALIBRATE:FACTORY CONTINUE"
    If tekScopeOPC = False Then
        Debug.Print "factory calibration step did not complete"
        Exit Sub
    End If
    Sleep 1000
    strResult = TvcScope.Query(":CALIBRATE:FACTORY:STEPSTATUS?")
    If Left(strResult, 4) = "PASS" Then
        lstOutput.AddItem "Passed step " + reqStepName
        calPassedLastStep = True
        Sleep 1000
        strResult = TvcScope.Query("CALIBRATE:FACTORY:STEPSTIMULUS?")
        updateSignal (strResult)
        Debug.Print strResult
    Else
        If calPassedLastStep = False Then
            calFailed = True
            calInitDone = False
        Else
            Debug.Print "Will retry last step"
        End If
        lstOutput.AddItem "Failed step " + reqStepName
        calPassedLastStep = False
    End If
    lstOutput.ListIndex = lstOutput.ListCount - 1
    turnOnButtons
End Sub
' Subroutine to handle the Play button.
' This will place the TDS5000B in factory calibration mode and if single step
' mode is not active repeatedly do next step until calibration is complete.
```

```

Private Sub cmdPlay_Click()
    Dim strResult As String
    Dim str20Blanks

    turnOffButtons
    findDevices
    calPassedLastStep = True
    calFailed = False
    stepNumber = 0
    txtSignal.Text = "Starting Calibration"
    txtSignal.Refresh
    resetWaveTek
    TvcScope.WriteString ":CALIBRATE:FACTORY ABORT"
    If tekScopeOPC = False Then
        Debug.Print "factory calibration abort command did not complete"
        turnOnButtons
        Exit Sub
    End If
    strEndOfCal = TvcScope.Query("CALIBRATE:FACTORY:STEPSTIMULUS?")
    txtSignal.Text = strEndOfCal
    lstOutput.AddItem "Ending string will be " & strEndOfCal
    Debug.Print strEndOfCal
    TvcScope.WriteString "CALIBRATE:FACTORY START"
    txtSignal.Text = "TekScope Reset"
    If tekScopeOPC = False Then
        Debug.Print "factory calibration start did not complete"
        Exit Sub
    End If
    Sleep 1000
    strResult = TvcScope.Query("CALIBRATE:FACTORY:STEPSTIMULUS?")
    txtSignal.FontSize = 5
    updateSignal (strResult)
    Debug.Print strResult
    calInitDone = True
    While calInitDone = True
        cmdNextStep
    Wend
    txtSignal.FontSize = 8
    strResult = TvcScope.Query(":CALIBRATE:FACTORY:STATUS?")
    If strResult = "PASS" Then
    ' If calFailed = False Then
        lstOutput.AddItem "Calibration of TDS5000B succeeded"
        txtSignal.Text = "Calibration of TDS5000B succeeded"
    Else
        lstOutput.AddItem "Calibration of TDS5000B failed"
        txtSignal.Text = "Calibration of TDS5000B failed"
    End If

```

Sample Calibration Program

```
    turnOnButtons
End Sub
Private Sub Form_Activate()
    txtSignal.Text = "Calibrator is Ready"
    turnOnButtons
End Sub
Private Sub Form_Load()
    devFound = False
    calInitDone = False
End Sub
```




Maintenance

Maintenance

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

- **Preventing ESD** — General information on preventing damage by electrostatic discharge.
- *Inspection and Cleaning* — Information and procedures for inspecting the oscilloscope and cleaning its external and internal modules.
- *Removal and Installation Procedures* — Procedures for the removal of defective modules and replacement of new or repaired modules. Also included is a procedure for disassembly of the oscilloscope for cleaning.
- *Troubleshooting* — Information for isolating and troubleshooting failed modules. Included are instructions for operating the oscilloscope diagnostic routines and troubleshooting trees. Most of the trees make use of the internal diagnostic routines to speed fault isolation to a module.
- **Repackaging Instructions** — Information on returning an oscilloscope 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. *To prevent damaging from static discharge to the semiconductor components in this oscilloscope, read the following steps.*

When performing any service which requires internal access to the oscilloscope, 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 oscilloscope. Inspection and cleaning are done as preventive maintenance. Preventive maintenance, when done regularly, may prevent oscilloscope malfunction and enhance its reliability.

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

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

General Care

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

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.



WARNING. *To prevent harm to yourself, power off the instrument and disconnect it from line voltage before performing any of the following procedures.*

Exterior Cleaning

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

Clean the On/Standby switch using a dampened cleaning towel. Do not spray or wet the switch directly.



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

Inspection — Exterior. Inspect the outside of the oscilloscope for damage, wear, and missing parts, using Table 6-1 as a guide. Immediately repair defects that could cause personal injury or lead to further damage to the oscilloscope.

Table 6-1: External inspection check list

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

Flat Panel Display Cleaning

The display is a soft plastic display and must be treated with care during cleaning.



CAUTION. To avoid damage to the flat panel display, do not use improper cleaning agents or methods.

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

Avoid spraying liquids directly on the display surface.

Avoid scrubbing the display with excessive force.

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

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



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

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

Inspect the internal portions of the oscilloscope for damage and wear, using Table 6-2 as a guide. Defects found should be repaired immediately.

If any circuit board is repaired or replaced, check Table 6-2 in Section 5 to see if it is necessary to adjust the oscilloscope.



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

Table 6-2: Internal inspection check list

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

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

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

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

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

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

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

Lubrication. There is no periodic lubrication required for this oscilloscope.

Removal and Installation Procedures

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

Preparation



WARNING. *To prevent possible injury to service personnel or damage to the oscilloscope components, read the Safety Summary found at the beginning of this manual, Installation in Section 2, and Preventing ESD in this section before starting any procedure in this manual.*

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 electrical and mechanical modules.
- A disassembly procedure for removal of all the major modules from the oscilloscope at one time and for reassembly of those modules into the oscilloscope. Instructions for doing the actual cleaning are found under *Inspection and Cleaning* at the beginning of this section.



WARNING. *To prevent serious injury or death to your self, disconnect the power cord from the line voltage source before doing any procedure in this subsection.*

NOTE. *Read Equipment Required for a list of the tools needed to remove and install modules in this oscilloscope. See Table 6-3, page 6-8. Read the cleaning procedure before disassembling the oscilloscope for cleaning.*

Equipment Required. Most modules in the TDS5000B Digital Oscilloscope can be removed with a screwdriver handle mounted with a size T-15, TORX screwdriver tip. *Use this tool whenever a procedure step instructs you to remove or install a screw unless a different size screwdriver is specified in that step.* All equipment required to remove and reinstall each module is listed in the first step of the procedure.

Table 6-3: Tools required for module removal

Item no.	Name	Description	General tool number
1	Screwdriver handle	Accepts TORX-driver bits	620-440
2	T-10 TORX tip	Used for removing the electrical or optical module chassis. TORX-driver bit for T-10 size screw heads	640-235
3	T-15 TORX tip	Used for removing most oscilloscope screws. TORX-driver bit for T-15 size screw heads	640-247
4	1/8 inch flat-bladed screwdriver	Screwdriver for unlocking cable connectors	Standard tool
5	#0 Phillips screwdriver	Screwdriver for removing small Phillips screws, CD, floppy & hard drive	Standard tool
6	Angle-Tip Tweezers	Used to remove front panel knobs	Standard tool
7	3/16 inch open-end wrench	Used to remove the rear panel nut posts	Standard tool
8	5/16 inch open-end wrench	Used to remove the rear panel nut posts	Standard tool
9	MA-800G Soldering Aid	Used to remove the front panel trim	Standard tool

Procedures for External Modules

The following procedures are found here and are listed in order presented.

- Line Cord
- Front Panel Knobs
- Trim (all)
- Bottom cover
- Left and Right covers

Line cord

1. *Orient the oscilloscope:* Set the oscilloscope so the bottom is down on the work surface and the back is facing you.
2. *Remove the line cord:* Pull the line cord away from the AC power connector.

Front-Panel Knobs

1. *Assemble equipment and locate modules to be removed:*
2. *Orient the oscilloscope:* Set the oscilloscope so the bottom is down on the work surface and the front is facing you.
3. *Remove the knob(s):* Grasp the knob you want to remove and pull it straight out from the front panel $\frac{1}{4}$ inch to create some clearance between the base of the knob and the front panel. Insert the angled-tip tweezers between the knob and front panel and use them to remove the knob. See Figure 6-1 on page 6-10.
4. *Reinstallation:* To reinstall, align knob to shaft and push it in until it snaps.



CAUTION. To prevent damage to the encoders located on the circuit board, apply pressure to the encoders while pushing the knob on the shaft.

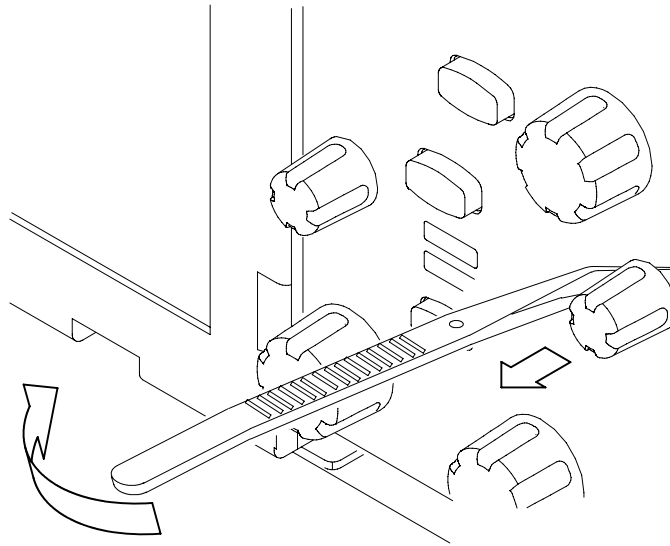


Figure 6-1: Knob removal

Trim and Carrying Handle

1. *Locate module to be removed:* Locate the Trim in the locator diagram. See Figure 6-2, page 6-13.
2. *Remove the carrying handle and the left side panel:* Use Figure 6-2, page 6-13 as a guide.
 - a. Remove the two T-15 TORX drive screws that secure the handle to the oscilloscope. Remove the handle from the oscilloscope.
 - b. Remove the two T-15 TORX drive screws from the bottom of the left side panel.
 - c. Slide the left side panel towards the rear of the oscilloscope allowing the tabs to clear the cover openings, then pull out to remove the panel from the oscilloscope.

NOTE. For many service operations you do not need to remove the left panel.

3. *Remove the right side panel:* Use Figure 6-2, page 6-13 as a guide.
 - a. Remove the CDRW Drive trim by inserting a flat blade screwdriver in the bottom slot of the CDRW trim and gently prying the trim piece out of the side panel. Pull the trim up and out from the oscilloscope.
 - b. Remove the two T-15 TORX drive screws from the bottom of the oscilloscope that secure the right side panel.

- 8.** *Remove the acquisition trim:* Use Figure 6-2, page 6-13 as a guide.
 - a.** Remove the acquisition trim from the oscilloscope.
- 9.** *Reinstallation:* Do in reverse steps 2 through 4 to reinstall the appropriate trim.

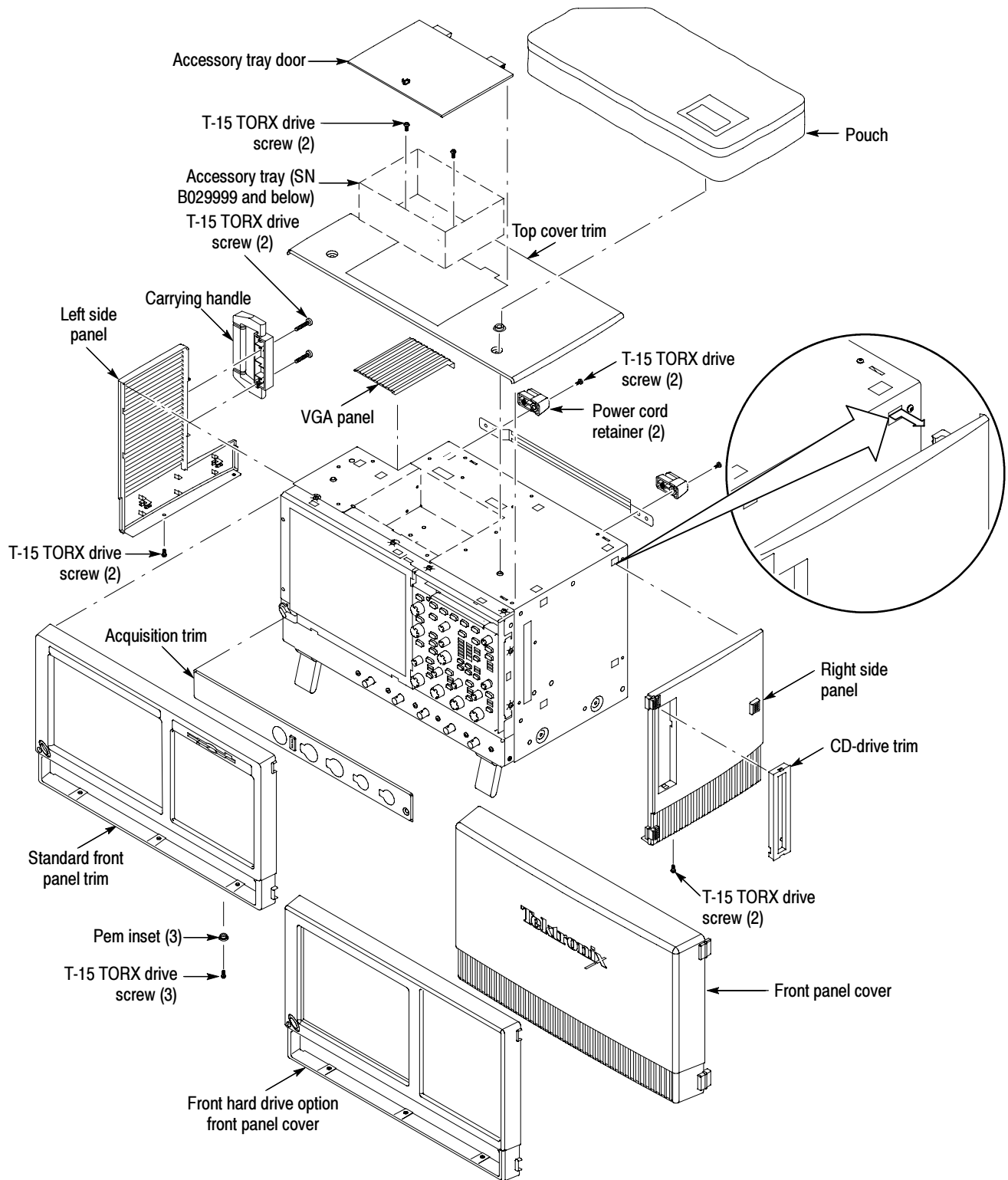


Figure 6-2: Trim removal

Bottom Covers

1. *Remove the bottom covers:* See Figure 6-3.
2. *Orient the oscilloscope:* Set the oscilloscope so the top is down on the work surface and the bottom is facing you.
 - a. Remove the two T-15 TORX drive screws that secure the bottom cosmetic cover to the oscilloscope, and remove the cover.
 - b. Remove the seven T-15 TORX drive screws that secure the bottom metal cover to the oscilloscope, and remove the cover.
3. *Reinstallation:* Do in reverse steps a through b to reinstall the bottom covers. Be sure to properly locate the 5 black screws (if present; see Figure 6-3).

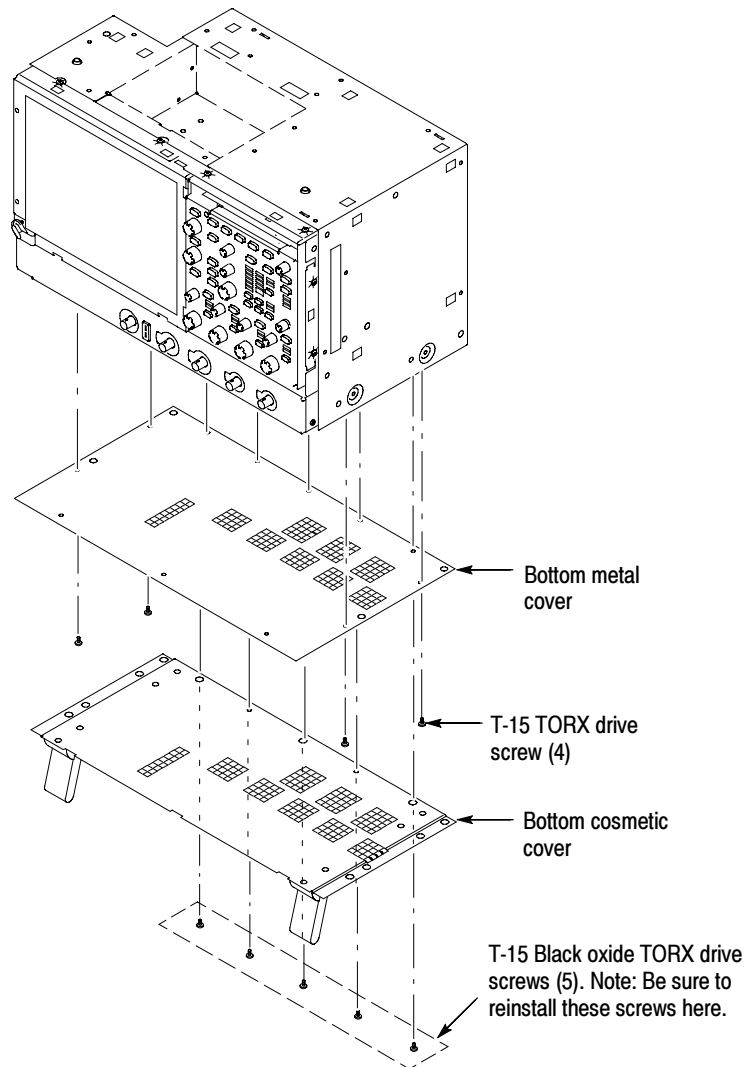


Figure 6-3: Bottom cover removal

Right Side Cover

1. *Remove the right side cover:* See Figure 6-4.
 - Trim (all)
 - Bottom cover
2. *Orient the oscilloscope:* Set the oscilloscope so the rear is on the work surface and the front of the oscilloscope is facing you.

NOTE. *All mounting screw holes are indicated by a star etched around the mounting hole. Be sure to properly locate these screws to reinstall the right side cover.*

- a. Remove the fifteen T-15 TORX drive screws that secure the right-side cover to the top and right sides of the chassis.
- b. Remove the right-side cover.



CAUTION. *To prevent damage to the oscilloscope internal cabling, take care not to bind or snag the covers on this cabling as you remove or install the components.*



CAUTION. *To prevent damage to instruments for SN B029999 and below, be sure to properly locate the shorter screw to reinstall the right-side cover.*

3. *Reinstallation:* Do in reverse steps a through b to reinstall the right-side cover. Be sure to properly locate the shorter screw (if present; see Figure 6-5).

NOTE. *If you do not have an internal printer or accessory tray installed in your oscilloscope, skip the Printer Frame procedure on page 6-17.*

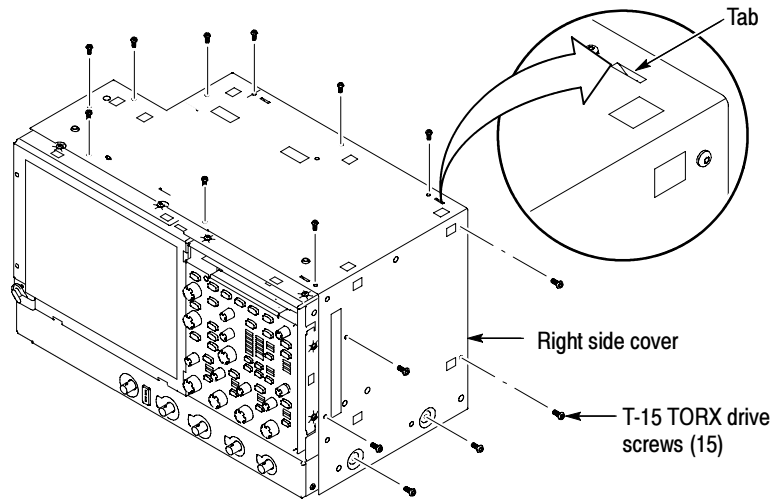


Figure 6-4: Right-side cover removal (SN B030000 and above)

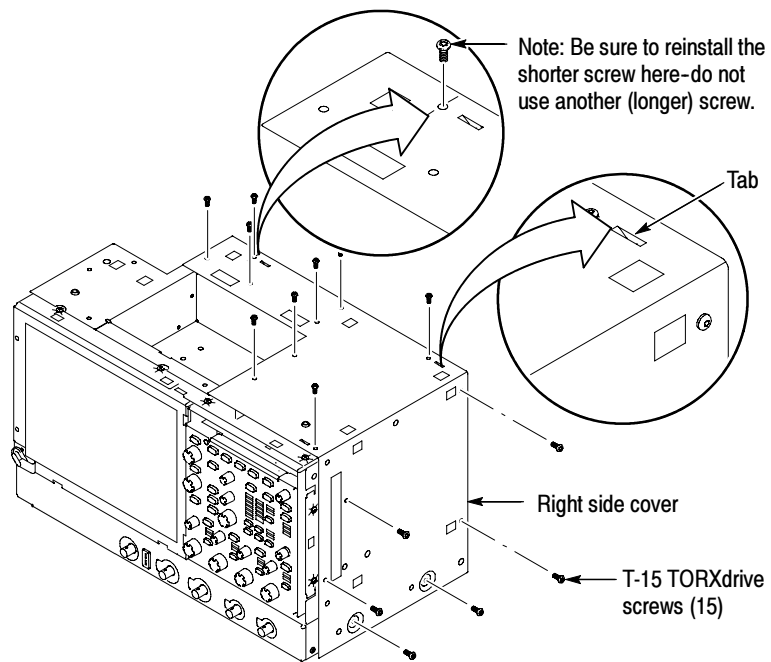


Figure 6-5: Right-side cover removal (SN B029999 and below)

**Printer Frame
(SN B029999 and below)**

1. *Remove the printer frame if installed:* See Figure 6-6.
 - CD-Rom Trim
 - Right-side panel
 - Printer or accessory tray
 - Top cover trim
 - Top two rear feet
 - Pouch
 - Right-side cover
2. *Orient the oscilloscope:* Set the oscilloscope so the rear is on the work surface and the front of the oscilloscope is facing you.
 - a. Remove the four T-15 TORX drive screws that secure the printer frame to the chassis.
 - b. Remove the two T-15 TORX drive screws that secure the cable restraint to the printer frame.
 - c. Remove the printer frame from the chassis.



CAUTION. *Take care not to bind or snag the covers on the oscilloscope internal cabling as you remove or install components.*

3. *Reinstallation:* Do in reverse steps a through c to reinstall the cabinet covers.

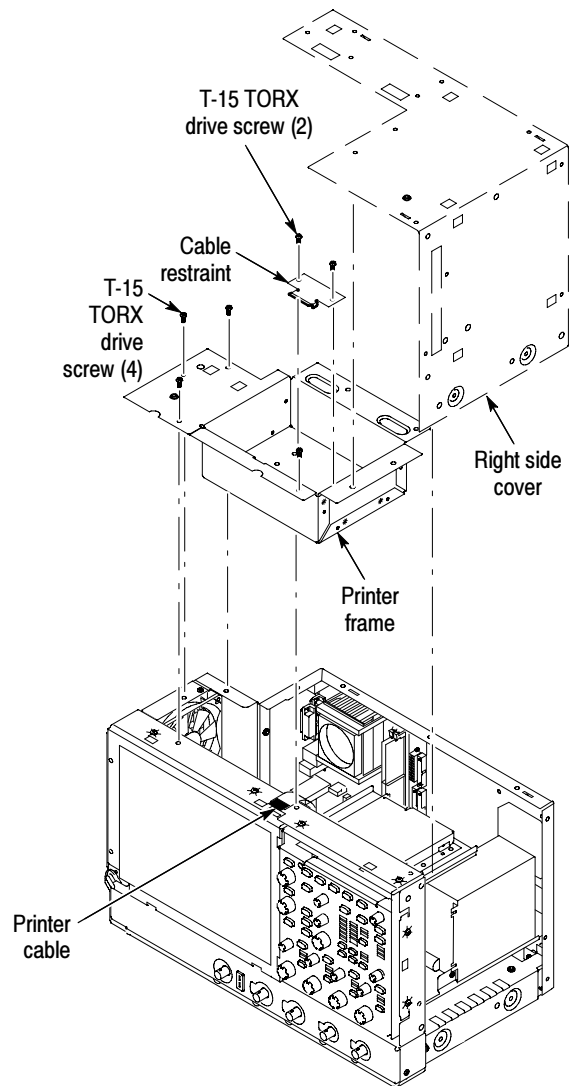


Figure 6-6: Printer frame removal

4. Reverse the procedure to reinstall.

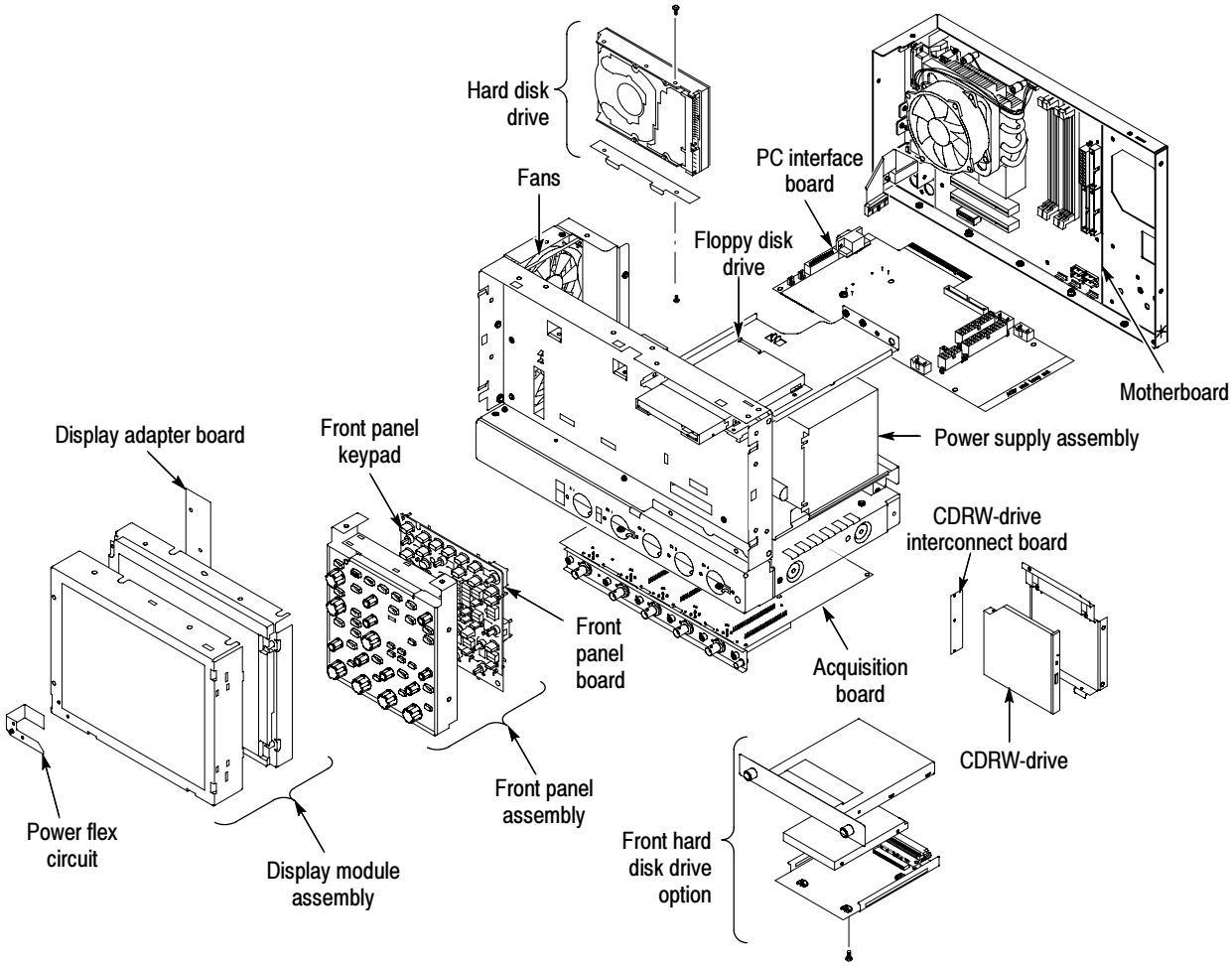


Figure 6-7: Internal modules

Procedures for Modules

You should have completed the *Procedures For External Modules* before doing many of the procedures in this collection. The procedures found here are listed in disassembly order:

- Front Panel assembly
- Front Panel Board
- Front Panel Keypad
- Display assembly
- Display Adapter Board
- On/Standby Switch Flex Circuit
- Floppy Disk Drive
- Hard Disk Drive
- CDRW Drive
- Fan assembly
- Power Supply
- Motherboard
- PC Interface Board
- Acquisition Board

Front Panel Assembly

1. *Locate module to be removed:* Locate the Front Panel assembly in Figure 6-8, on page 6-22. Additional modules to be removed:
 - Trim (Front-Panel)
2. *Remove the Front Panel assembly:* See Figure 6-8, page 6-22.
3. *Orient the oscilloscope:* Set the oscilloscope so the bottom is down on the work surface and the front panel is facing you.
 - a. Remove the six T-15 TORX drive screws that secure the Front Panel assembly to the front chassis.
 - b. Grasp the top of Front Panel assembly and pull forward to allow access to the ribbon-cable connector on the Front-Panel Board.
 - c. Use the $\frac{1}{8}$ inch flat-bladed screwdriver to carefully lift the J1 cable connector lock up to disconnect J1 flex cable from the display module

assembly. See Figure 6-9, page 6-23. Note the pin 1 index mark on the connector and the black stripe on the cable for later reassembly.

d. Pull the Front Panel assembly forward and remove from the oscilloscope.

4. *Reinstallation:* Do in reverse steps a through d to reinstall the Front Panel assembly.

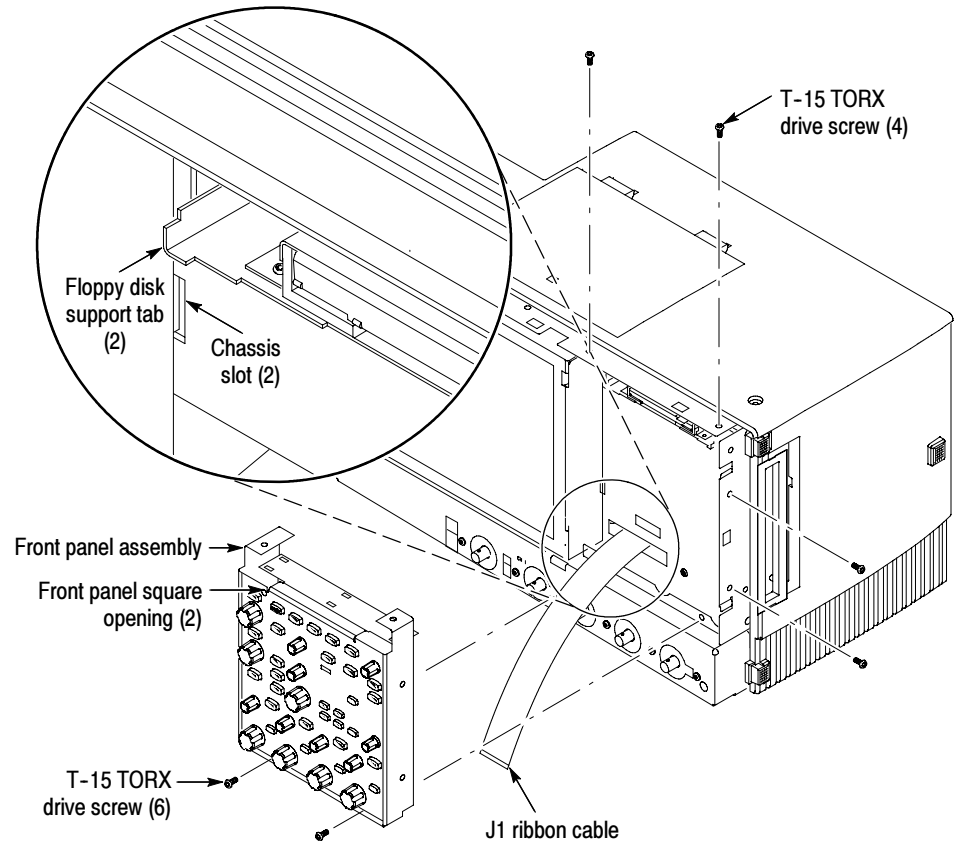


Figure 6-8: Front panel assembly removal

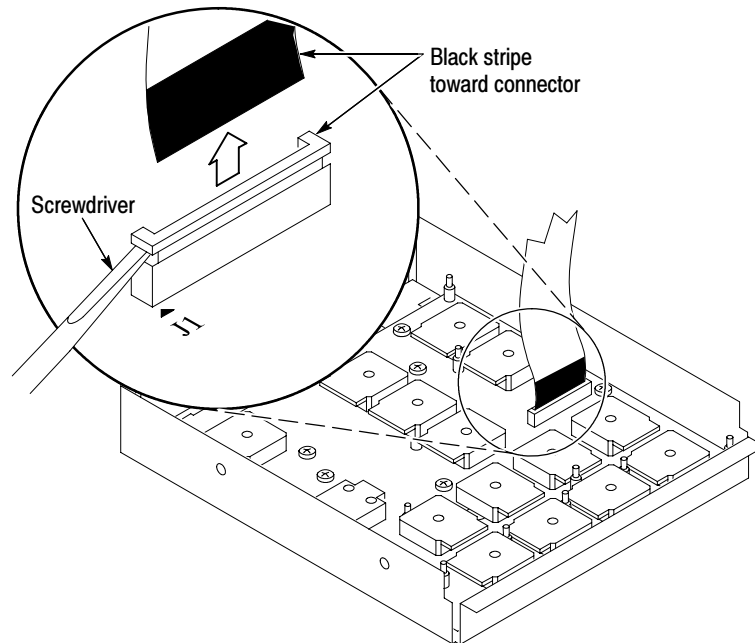


Figure 6-9: J1 flex cable connector removal

Front Panel Board

1. *Locate module to be removed:* Locate the Front Panel assembly Figure 6-8, page 6-22. Additional modules to be removed:
 - Front Panel Knobs
 - Trim (front panel)
 - Front Panel assembly
2. *Remove the Front Panel board:* See Figure 6-10, page 6-24.
 - a. Remove the eight T-15 TORX drive screws that secure the Front Panel board to the Front Panel assembly.
 - b. Pry the board up off the alignment studs. Place a flat-bladed screwdriver in the pry-point access holes to pry the board up from the assembly.
 - c. Remove the board from the assembly.
3. *Reinstallation:* Do in reverse steps a through c to reinstall the Front Panel board.

Front Panel Keypad

1. *Locate module to be removed:* Locate the Front Panel assembly in Figure 6-8, on page 6-22. Additional modules to be removed:
 - Front Panel Knobs
 - Trim (front panel)
 - Front Panel assembly
 - Front Panel Board
2. *Remove the Front Panel keypad:* See Figure 6-10.
 - a. Pull on each of the keypad support guides to separate the keypad from the Front Panel board. Use a pair of tweezers or equivalent tool to pull the twelve keypad support guides.
 - b. Remove the keypad from the Front Panel board.

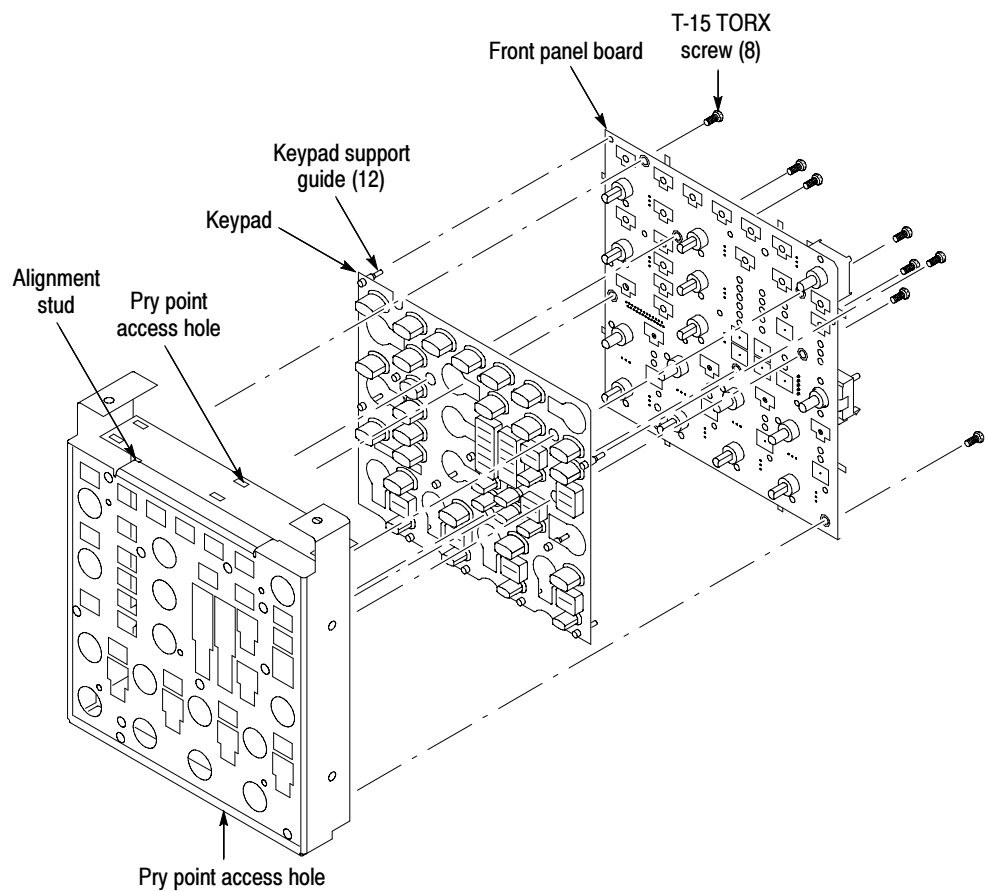


Figure 6-10: Front panel board and keyboard removal



CAUTION. When removing or installing the keypad, make sure you do not touch the switch contacts with your fingers. The oils in your fingers will degrade or damage the switch contacts. To help prevent damage to the keypad use cotton gloves when removing or installing the keyboard pad.

3. *Reinstallation:* Do in reverse step 2 to reinstall the keypad, front panel board, and the front panel assembly. Then see the following instructions:
 - a. Make sure the keypad is aligned properly on the Front Panel board.
 - b. Make sure the ribbon cable is routed correctly when installing the Front Panel into the chassis.
 - c. Insert the two floppy disk support tabs into the front panel square openings. Both left front panel tabs must go into the chassis slots. See Figure 6-8, page 6-22.

Display Assembly

1. *Locate module to be removed:* Locate the Display assembly, Figure 6-11, page 6-26. Additional modules to be removed:
 - Trim (front panel & top)
2. *Orient the oscilloscope:* Set the oscilloscope so the bottom is down on the work surface and the front panel is facing you.



CAUTION. To avoid damage to the front panel Standby/On switch assembly, do not set the Display module assembly on a work surface. Sliding the oscilloscope over the edge of the work surface could break off the On/Standby switch assembly.

3. *Remove the Display assembly:* See Figure 6-11, page 6-26.
 - a. Remove the four T-15 TORX drive screws that secure the display assembly to the chassis.
 - b. Grasp the display assembly at the finger reliefs located at the top-right and bottom-left corners of the display assembly and pull forward far enough to allow access to the flex cable connector.
 - c. Disconnect J5 flex cable from the display assembly. Remove the display module assembly from the oscilloscope. See Figure 6-11, page 6-26.

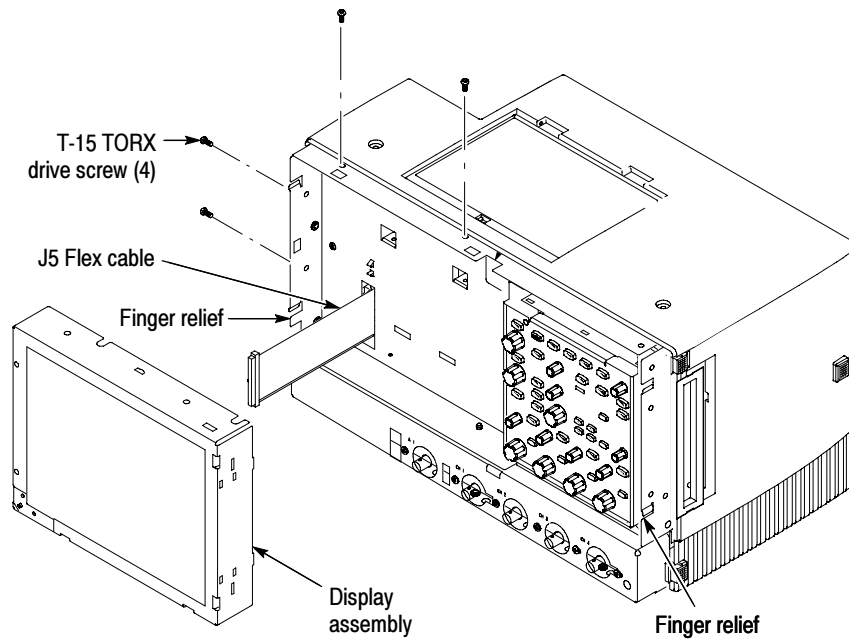


Figure 6-11: Display removal

4. Remove the Touch panel from the Display assembly: See figures 6-12 and 6-13, on pages 6-27 and 6-28.



CAUTION. To prevent degradation of the display sharpness, this procedure must be performed in a dust free environment. Wear cotton gloves to prevent finger oils from contaminating any surfaces of the display glass.

- a. Disconnect cables J1 and J7 from the Display Adapter circuit board.
- b. Separate the assembly by carefully prying the (outer) Touch panel assembly from the (inner) Display assembly. Insert a flat-bladed screwdriver in the access notches to push out on the Touch panel assembly.

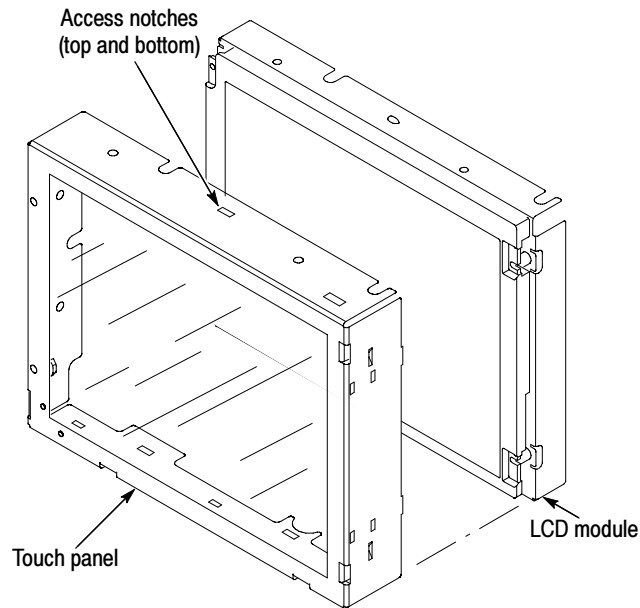


Figure 6-12: Touch panel and Display assembly removal

5. *Reinstallation:* Do in reverse steps 1 through 5 to reinstall the Display assembly.

Display Adapter Board

1. *Locate module to be removed:* Locate the display adapter board in the locator diagram *Internal Modules*, Figure 6-7, on page 6-19. Additional modules to be Removed:
 - Trim (front panel & top)
 - Display assembly
2. *Remove the Display Adapter Board:* See Figure 6-13, pages 6-28.
 - a. Disconnect cables J1, J6, J5, and J7 from the Display Adapter board.
 - b. Slide the connector clip, if present, off of J4.
 - c. Disconnect cable J4 from the Display Adapter board.
 - d. Remove the three T-15 TORX drive screws that secure the Display Adapter circuit board to the Display assembly. Remove the Display Adapter from the assembly.
3. *Reinstallation:* Do in reverse steps a through d to reinstall the board.

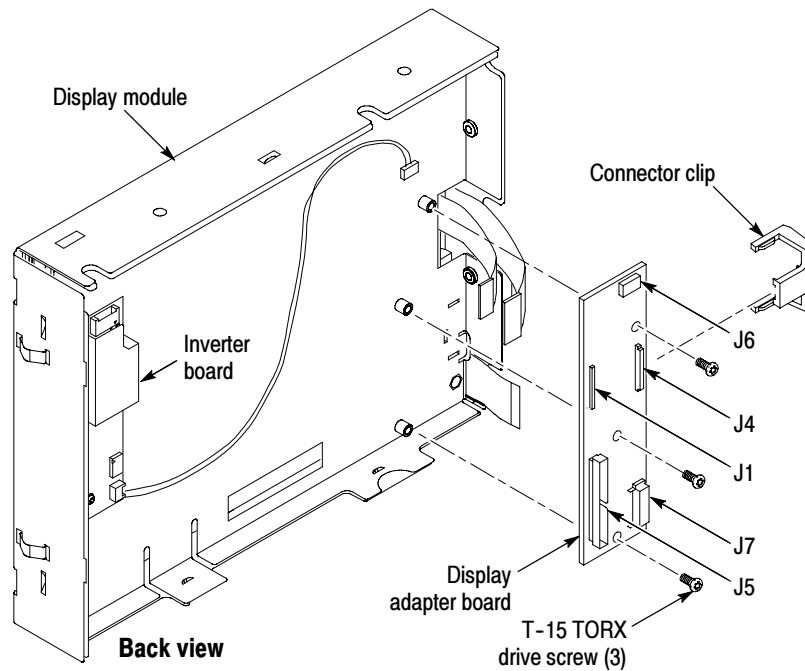


Figure 6-13: Display adapter board removal

On/Standby Switch Power Flex Circuit Removal

1. *Locate module to be removed:* Locate the On/Standby Switch power flex circuit in the locator diagram *Internal Modules*, Figure 6-7, page 6-19. Additional modules to be removed:
 - Trim (front panel)
 - Display assembly
2. *Orient the assembly:* Set the display adapter so the back is down on the work surface and the front is facing you.
3. *Remove the On/Standby Switch power flex circuit:* See Figure 6-14, on page 6-29.
 - a. Peel the On/Standby switch power flex circuit away from the front of the display assembly.
 - b. Disconnect the flex circuit from J7 on the Display Adapter circuit board.
 - c. Grasp the flex circuit and pull it out of the Display assembly.
4. *Reinstallation:* Do the following procedure to reinstall the On/Standby Switch.
 - a. Remove the protective backing on the power flex circuit.

- b. Slide the connector end of the power flex circuit through the slot in the Display assembly. Make sure the flex circuit connector aligns with J7 on the Display Adapter circuit board.
- c. Align the holes in the power flex circuit to the two index posts on the front side of the Display assembly.
- d. Firmly press the flex circuit to the Display assembly chassis surface.

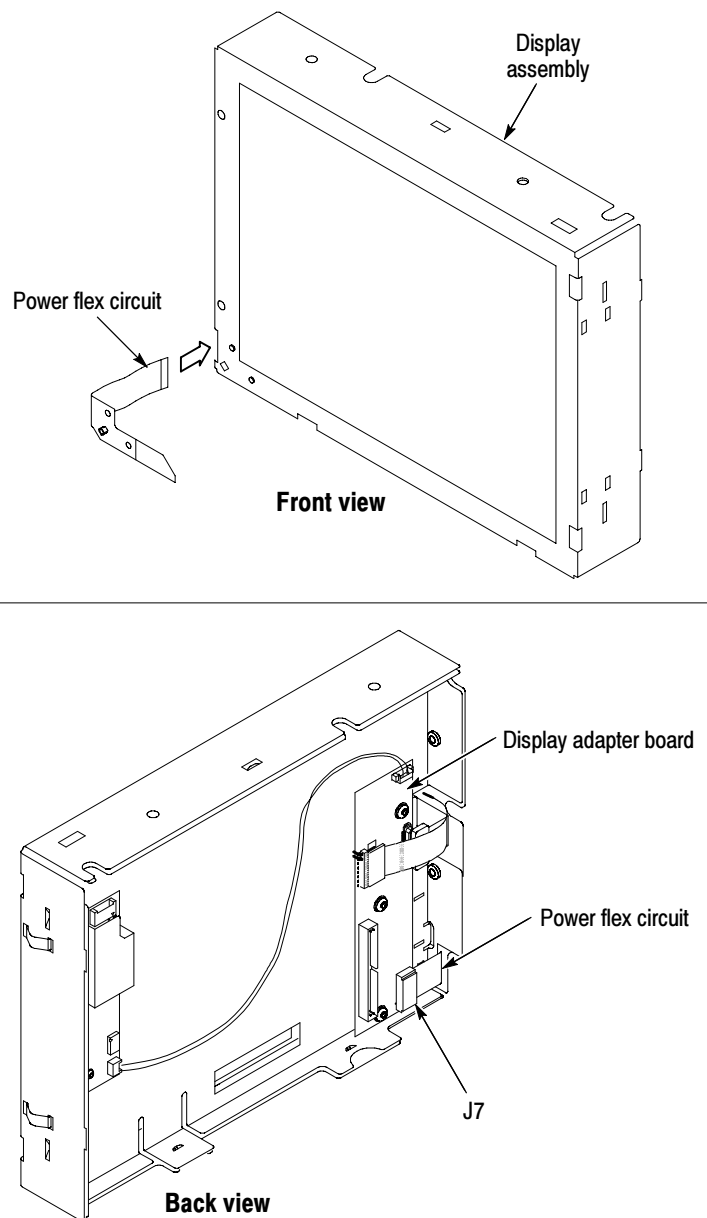


Figure 6-14: Power flex circuit removal

Floppy Disk Drive

1. *Locate modules to be removed:* Locate the Floppy Disk Drive in the locator diagram *Internal Modules*, Figure 6-7, page 6-19. Additional modules to be removed:
 - Trim (front panel)
 - Cover (top)
2. *Orient the oscilloscope:* Set the oscilloscope so the bottom is down on the work surface and the front panel is facing you.
3. *Remove the floppy disk drive:* Use Figure 6-15 as a guide. A #0 Phillips screwdriver is required for this procedure.
 - a. Remove the cable from the back of the floppy disk drive.
 - b. Remove the two T-15 TORX drive screws that secure the floppy disk drive assembly to the chassis.

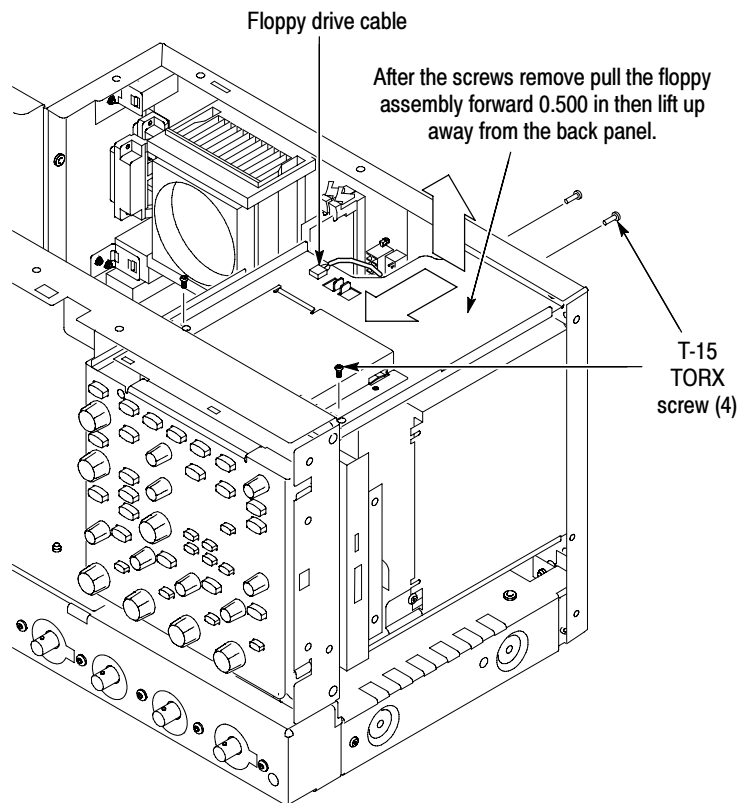


Figure 6-15: Floppy disk drive assembly removal

- c. Remove the two small Phillips screws that secure the floppy disk drive assembly to the bracket.

- d. Remove the floppy drive from the bracket.

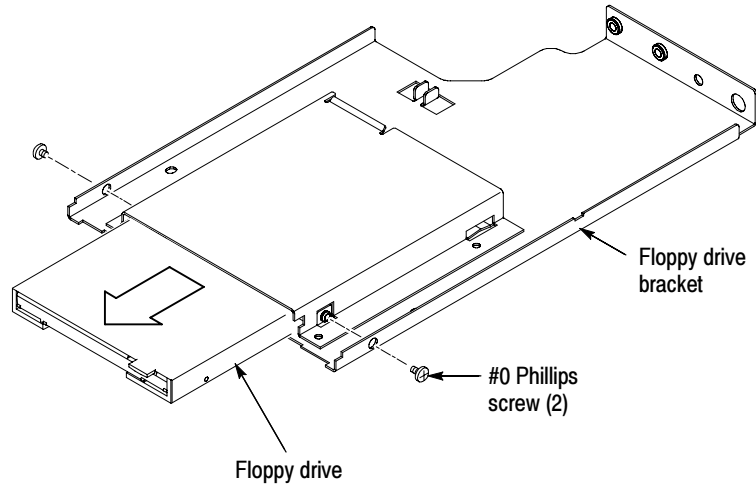


Figure 6-16: Floppy disk drive removal

- 4. *Reinstallation:* Do in reverse steps a through d to reinstall the floppy disk drive.

PC Interface Board and Motherboard Cable Connections

Figure 6-17 shows the location of cables and cable connectors for the PC interface board and the motherboard. Pay close attention to this diagram and the cable connections when you disassemble and reassemble the instrument.

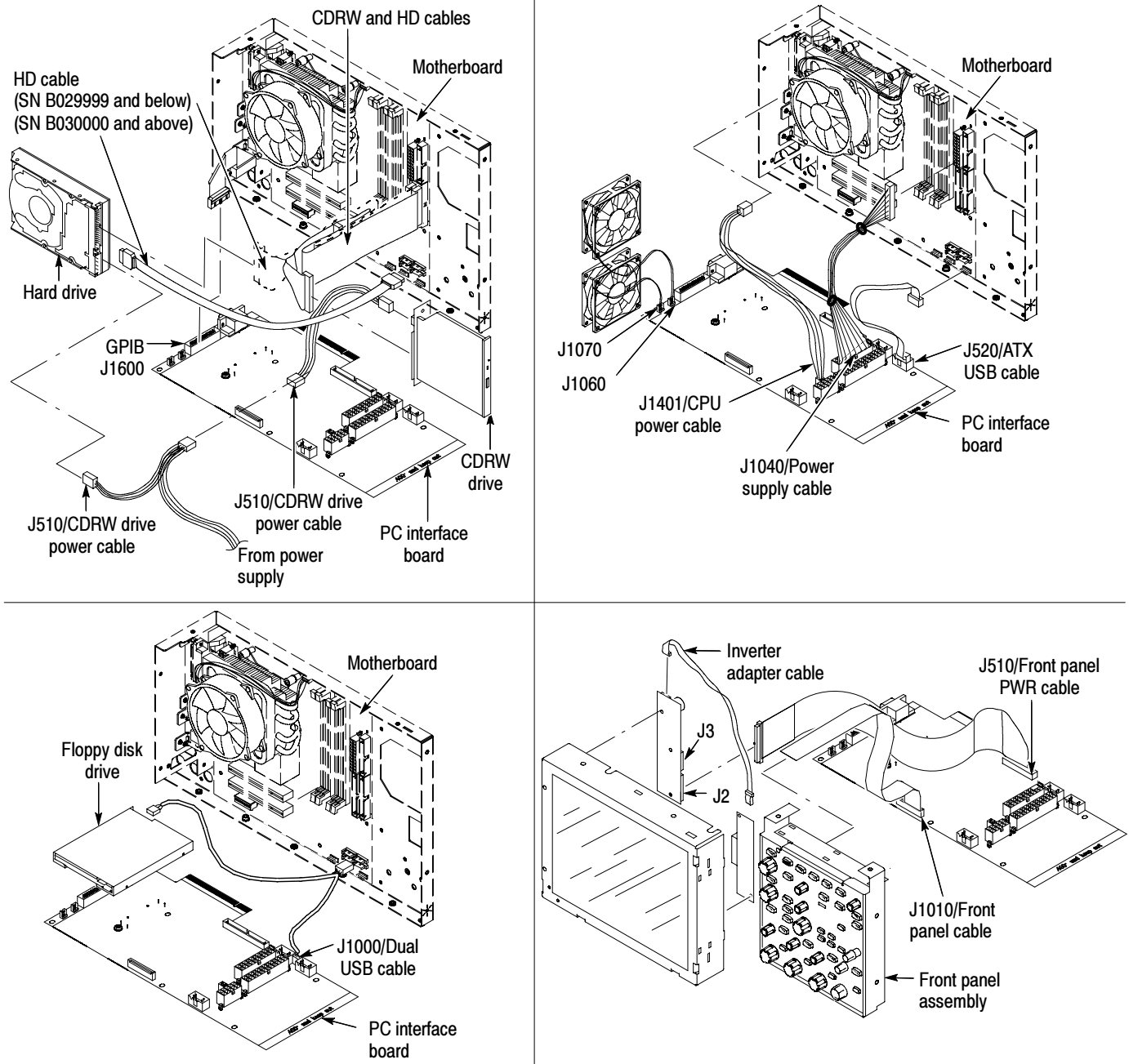


Figure 6-17: PC Interface board and motherboard cable connections

Hard Disk Drive

1. *Locate module to be removed:* Locate the Hard Disk Drive assembly in the locator diagram *Internal Modules*, Figure 6-7, page 6-19. Note the location of cables and cable connectors see Figure 6-17 on page 6-32. Additional modules to be removed:
 - Trim (all except front panel and acquisition)
 - Right side cover
 - Printer frame (SN B029999 and Below)



CAUTION. *To prevent permanent damage to the hard disk drive, do not remove the hard drive when the oscilloscope is powered on.*

Always power off the oscilloscope before removing the hard disk drive.

2. *Orient the oscilloscope:* Set the oscilloscope so the bottom is down on the work surface and the right side panel is facing you.
3. *Remove the Hard Disk Drive assembly:* See Figure 6-18, on page 6-34.
 - a. Verify that the oscilloscope is powered off.
 - b. Remove the 2 T-15 TORX screws that secure the Hard Disk Drive assembly to the chassis.
 - c. Pull the Hard Disk Drive assembly away from the chassis far enough to access the cables.
 - d. Disconnect the 2 cables from the Hard Disk Drive assembly. See Figure 6-18 on page 6-34.
 - e. Remove the 2 T-15 TORX drive screws that secure the hard drive bracket to the the hard drive.
4. *Reinstallation:* Do in reverse steps a through e to reinstall the hard disk drive.

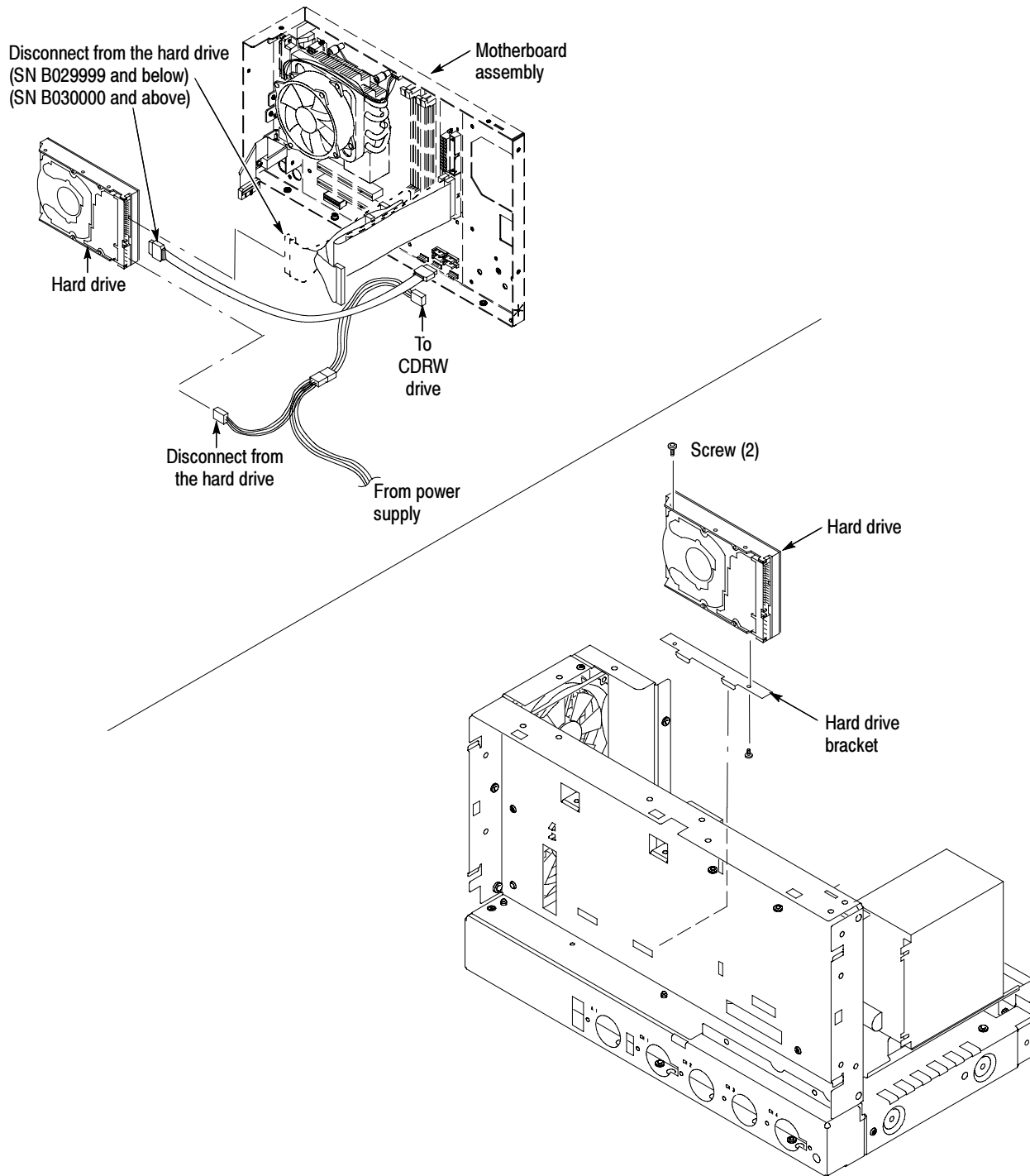


Figure 6-18: Desktop hard drive removal

CDRW Disk Drive

1. *Locate module to be removed:* Locate the CDRW assembly in the locator diagram *Internal Modules*, Figure 6-7, on page 6-19. Note the location of cables and cable connectors see Figure 6-17 on page 6-32. Additional modules to be removed:
 - Trim (all except front panel and acquisition)
 - Right side cover
 - Printer frame (SN B029999 and below)
 - Floppy disk drive
2. *Orient the oscilloscope:* Set the oscilloscope so the bottom is down on the work surface and the right side panel is facing you.
3. *Remove the CDRW Disk Drive assembly:* See Figure 6-20, on page 6-37.
 - a. Verify that the oscilloscope is powered off.
 - b. Remove the T-15 TORX drive screw that secures the CDRW Disk Drive assembly to the chassis.
 - c. Pull the CDRW Disk Drive assembly away from the chassis far enough to disconnect the cables See Figure 6-20.
4. *Remove the CDRW Drive from the assembly:* See Figure 6-19 .
 - a. Remove the four Phillips screws that secure the drive to the bracket.
 - b. Gently pull the drive away from the connector and remove the drive from the bracket.

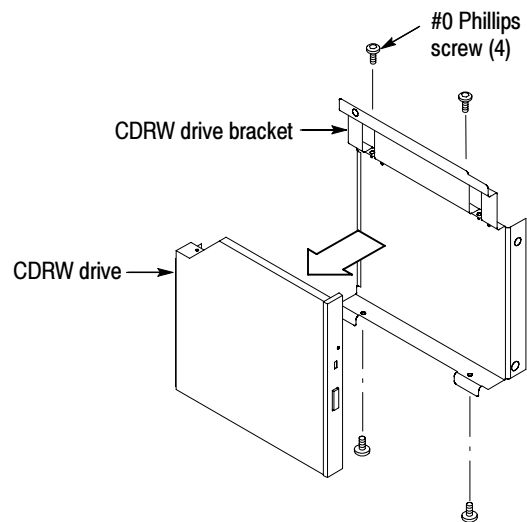


Figure 6-19: Removing the CDRW drive from the bracket

5. *Reinstallation:* Do in reverse steps 3 and 4 to reinstall the CDRW drive.

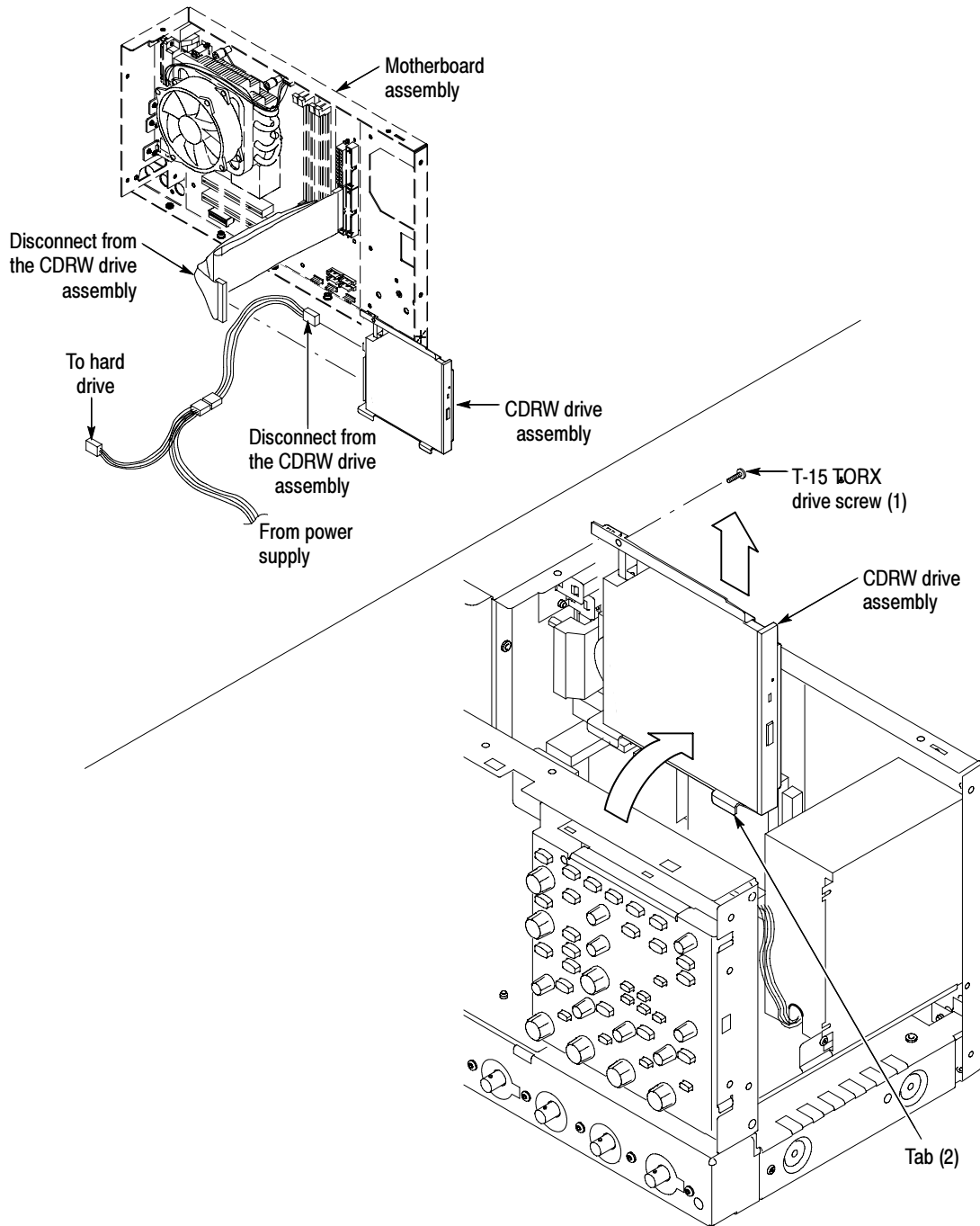


Figure 6-20: CDRW drive assembly removal

Fan Removal

1. *Locate module to be removed:* Locate the fans in the locator diagram *Internal Modules*, Figure 6-7, page 6-19. Additional modules to be removed:
 - Trim (all except front panel and acquisition)

2. *Orient the oscilloscope:* Set the oscilloscope so the bottom is down on the work surface and the left side is facing you.
3. *Remove the fans:* See Figure 6-21, on page 6-39.
 - a. Remove the four plastic fasteners that secure each of the fans to the chassis. See Figure 6-21.

NOTE. *A wire cutter can help you remove each fastener. First, use the cutter to pry up and retract the fastener head. Then use it to remove the fastener body. Be careful to only pry with the wire cutters and NOT to cut!*

- b. Lift the fan cable up and out from the cable clamp.

NOTE. *Needle-nose pliers can serve as an effective tool to remove the cable clamp if you use it to carefully squeeze the clamp's top and bottom latches.*

- c. Disconnect the fan cable from the PC interface board. See Figure 6-22 on page 6-40.
 - d. Lift the fan assembly up and out from the chassis.
4. *Reinstallation:* Do in reverse steps a through d to reinstall the fan assembly.



CAUTION. *Take care when handling the fans; the fan blades are brittle and can be easily damaged.*

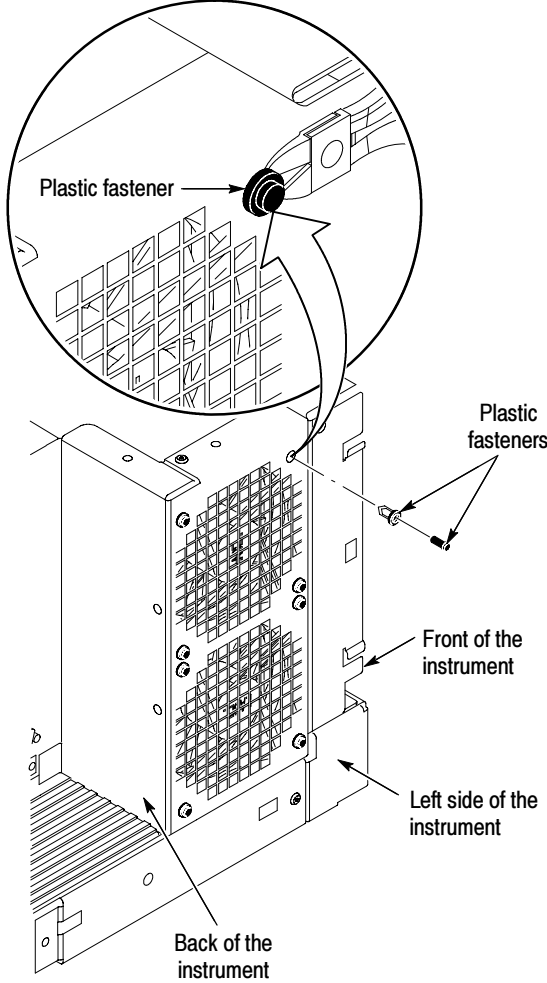


Figure 6-21: Fan fastener removal

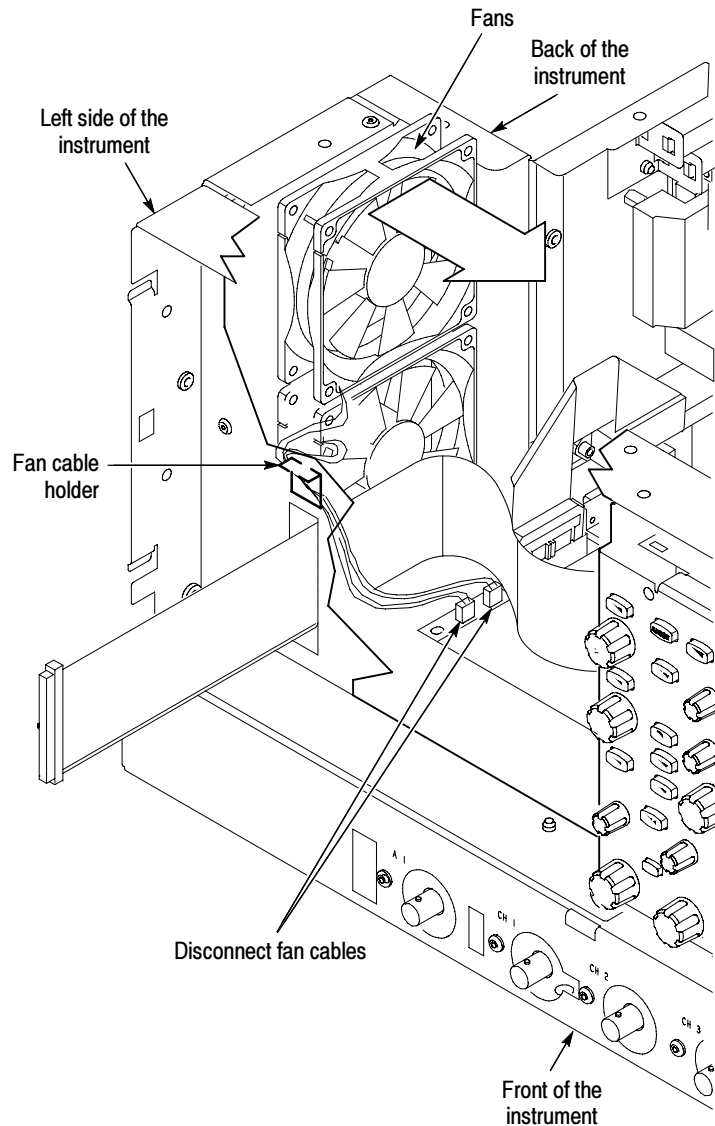


Figure 6-22: Disconnecting the fan cables

Power Supply

1. *Assemble equipment and locate modules to be removed:* Locate the modules to be removed in the locator diagram *Internal Modules*, Figure 6-7, on page 6-19. Additional modules to be removed:
 - Trim (all)
 - Right side cover
2. *Orient the oscilloscope:* Set the oscilloscope so the bottom is down on the work surface and the back is facing you.

3. *Remove the power supply:* See Figure 6-23, on page 6-41.
 - a. Remove the four T-15 TORX drive screws that secure the power supply to the back of the chassis.
 - b. Remove the T-15 TORX drive screw that secures the power supply to the right side of the chassis.
 - c. Move the power supply towards the back of the instrument to access the cables and unplug the two power supply cables from the PC interface board.
 - d. Lift the power supply away from the chassis and guide the cables out.
4. *Reinstallation:* Do in reverse steps a through d to reinstall the power supply.

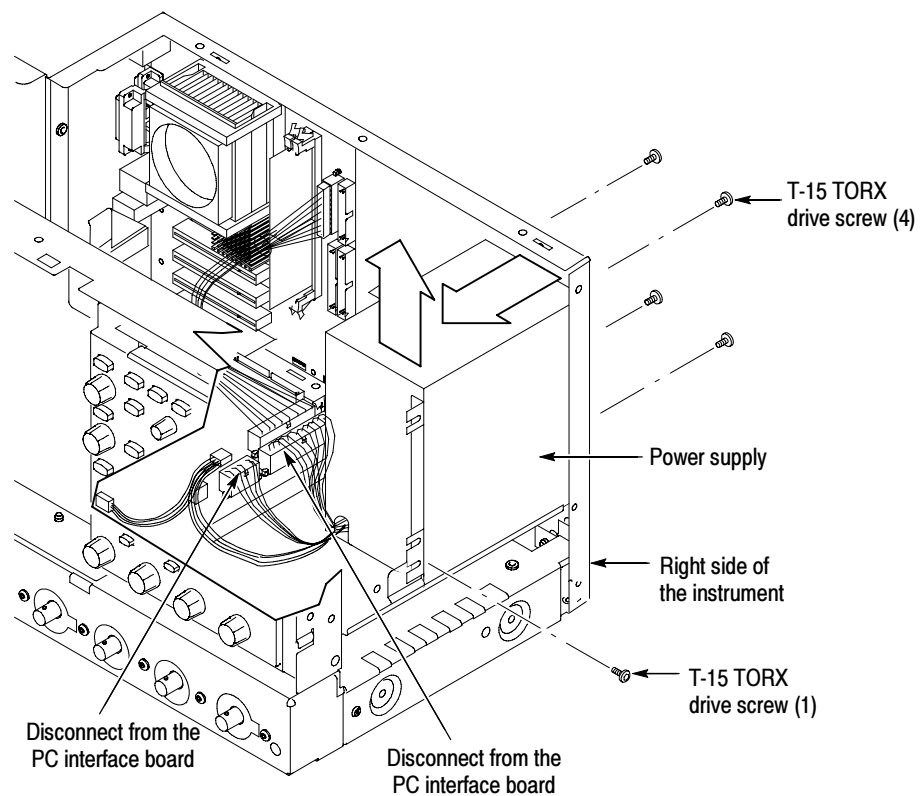


Figure 6-23: Power supply removal

Motherboard

1. *Locate module to be removed:* Locate the motherboard in the locator diagram *Internal Modules*, Figure 6-7, on page 6-19. Note the location of cables and cable connectors see Figure 6-17 on page 6-32. Additional modules to be removed:
 - Trim (all)
 - Bottom cover
 - Left and Right covers
 - Power Supply
2. *Orient the oscilloscope:* Set the oscilloscope so the bottom is down on the work surface and the top panel is facing you.
3. *Remove the motherboard assembly:* See Figure 6-24, on page 6-44.

NOTE. *The motherboard and rear chassis is removed as one assembly.*

- a. Remove the four T-15 TORX drive screws that secure the power cord retainers, the pouch bracket, and motherboard assembly to the side of the chassis.
- b. Remove the two bottom feet from the chassis of the motherboard assembly.

NOTE. *You only need to separately remove the two bottom feet if you plan to replace the sheet metal and reuse the feet. Also, if you do plan to replace the sheet metal, then remember that it has stickers with important information on it such as the serial #, option label and safety data.*

- c. Remove the two jack screws that secure the VGA connector to the bracket.
 - d. Disconnect the three cables from the motherboard assembly.
 - e. Disconnect the GPIB cable from the PC interface board.
 - f. Carefully lift the assembly out of the chassis.
4. *Orient the motherboard assembly:* Set the motherboard assembly so the bottom is down on the work surface and the connector panel is facing you.
 5. *Remove the motherboard from the rear chassis:*
 - a. Remove the six jack screws that secure the motherboard connectors to the connector panel of the rear chassis.

- b. Remove the six T-15 TORX drive screws that secure the motherboard to the rear chassis.
 - c. Carefully lift the motherboard out of the rear chassis.
6. *Reinstallation:* Do in reverse steps 3 through 5 to reinstall the motherboard assembly.

Heatsink Fan and Microprocessor. *Locate module to be removed:* Locate the heatsink fan in the locator diagram *Internal Modules*, Figure 6-24, on page 6-44. Note the location of cables and cable connectors, see Figure 6-17 on page 6-32. Additional modules to be removed:

- Trim (all)
 - Bottom cover
 - Left and Right covers
 - Power supply
 - Motherboard
1. Disconnect the J1F1 power cable from the motherboard. See Figure 6-25 on page 6-45.
 2. Remove the four heatsink retaining screws that secure the fan, heatsink, and mounting bracket to the motherboard assembly.
 3. Raise the locking lever, open the cover, and remove the microprocessor.
 4. *Reinstallation:* Do in reverse steps 1 through 3 to reinstall the heatsink fan and microprocessor.

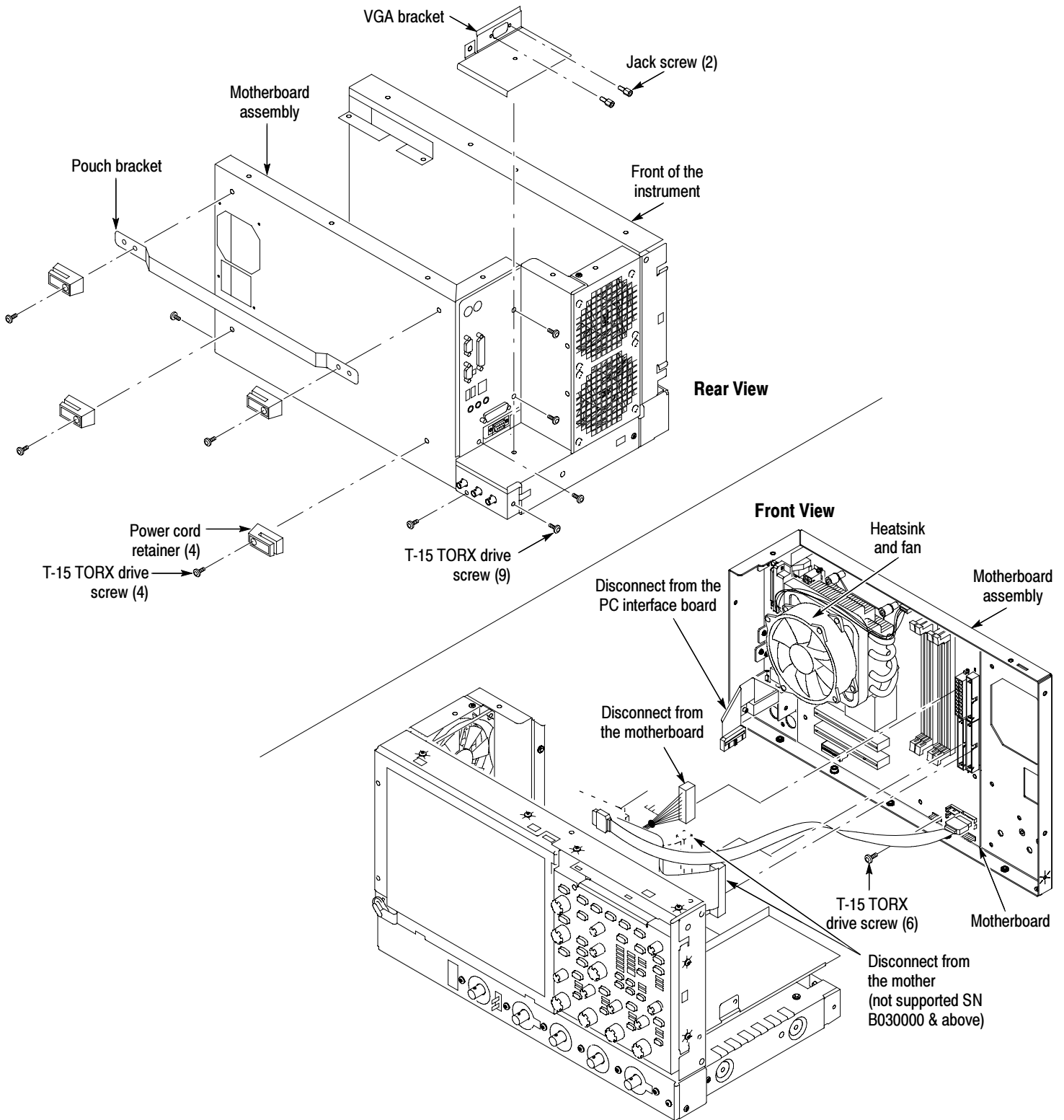


Figure 6-24: Motherboard removal

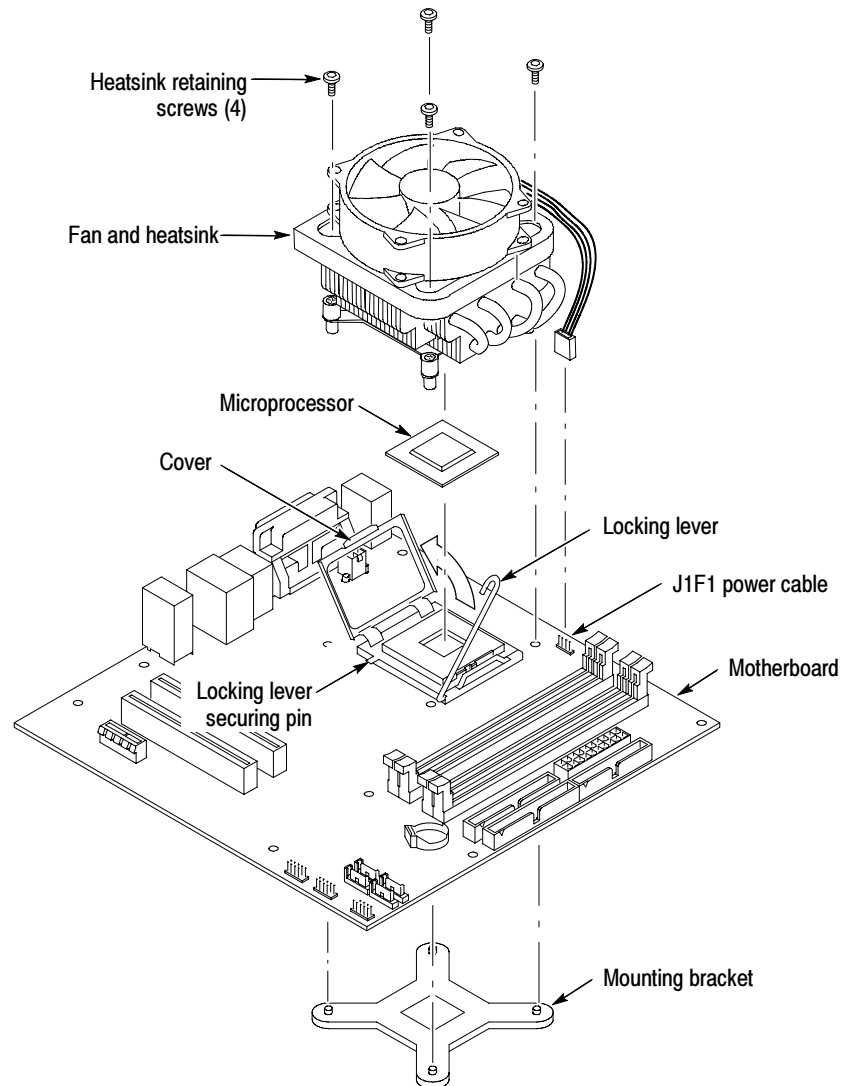


Figure 6-25: Heatsink fan and microprocessor removal

PC Interface Board

1. *Locate module to be removed:* Locate the PC interface board in the locator diagram *Internal Modules*, Figure 6-7, on page 6-19. Note the location of cables and cable connectors see Figure 6-17 on page 6-32.



CAUTION. Before installing the PC interface board, fully install the acquisition board. Doing this helps ensure correct alignment of the 125-pin connector between the acquisition board and the PC interface board.

Additional modules to be removed:

- Trim (all)
 - Right-side cover
 - Hard drive assembly
 - Floppy disk drive
 - CDRW drive assembly
 - Power supply
 - Motherboard assembly
2. *Orient the oscilloscope:* Set the oscilloscope so the bottom is down on the work surface and the top panel is facing you.
 3. *Remove the PC interface board:* See Figure 6-26 on page 6-47.
 - a. Disconnect the two cables from the PC interface board.
 - b. Remove the six T-15 TORX drive screws that secure the PC interface board to the chassis.



CAUTION. Do not remove the screw next to J1800 (See Figure 6-26 on page 6-47). The screw secures an indexing pin used to align the J1800 connectors together.

- c. Grasp the PC interface board near J1800 (see Figure 6-26) and carefully pull the board up to disconnect J1800. Once you have cleared the connector, remove the board from the chassis.
4. *Reinstallation:*
 - a. When installing the PC interface board, set the board in place and align the J1800 halves using the guide pin. Gently press the board into place to seat the connector between the PC interface board and the acquisition board.
 - b. Install the six T-15 TORX drive screws that secure the PC interface board to the chassis.
 - c. Connect the two cables to the PC interface board.

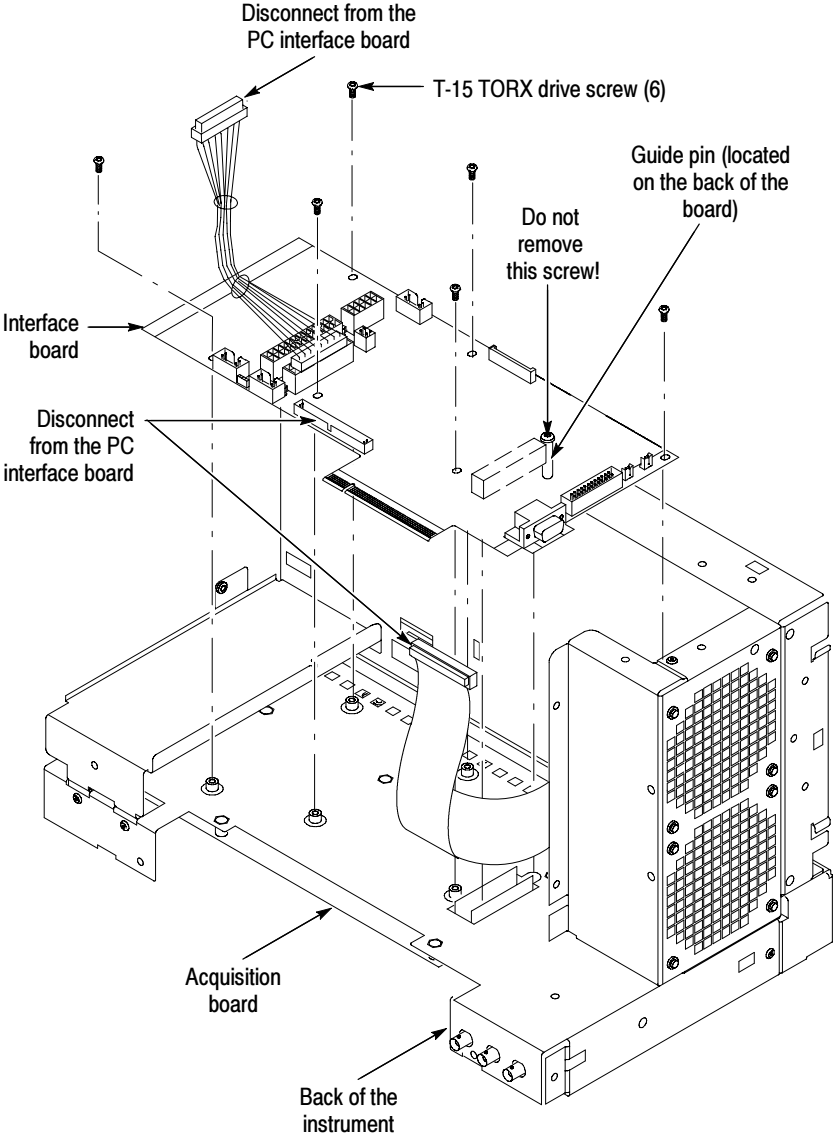


Figure 6-26: PC interface board removal

Acquisition Board

1. *Locate module to be removed:* Locate the Acquisition board in the locator diagram, Figure 6-7, on page 6-19. Additional modules to be removed:
 - Trim (all)
 - Bottom cover
2. *Orient the oscilloscope:* Set the oscilloscope so the top is down on the work surface and the bottom is facing up.
3. *Remove the Acquisition board:* See Figure 6-27, page 6-49.
 - a. Remove the seven T-15 TORX drive screws that secure the bottom panel to the chassis.
 - b. Disconnect the three coaxial cables from the Acquisition board.
 - c. Disconnect the ribbon cable from the Acquisition board.
 - d. Remove the six T-15 TORX drive screws that secure the board to the chassis.
 - e. Remove the six T-15 TORX drive screws that secure the board to the front panel.
 - f. Grasp the Acquisition board on the edge near J1800 (see Figure 6-27) and carefully pull the board up to disconnect J1800. Once you have cleared the connector, remove the board from the chassis.
4. *Reinstallation:*
 - a. When installing the Acquisition board, set the board in place and align the J1800 halves using the guide pin. Gently press the board into place to seat the connector between the PC interface board and the Acquisition board.
 - b. Install the six T-15 TORX drive screws that secure the Acquisition board to the front panel.
 - c. Install the six T-15 TORX drive screws that secure the Acquisition board to the chassis.
 - d. Connect the three coaxial cables to the Acquisition board.

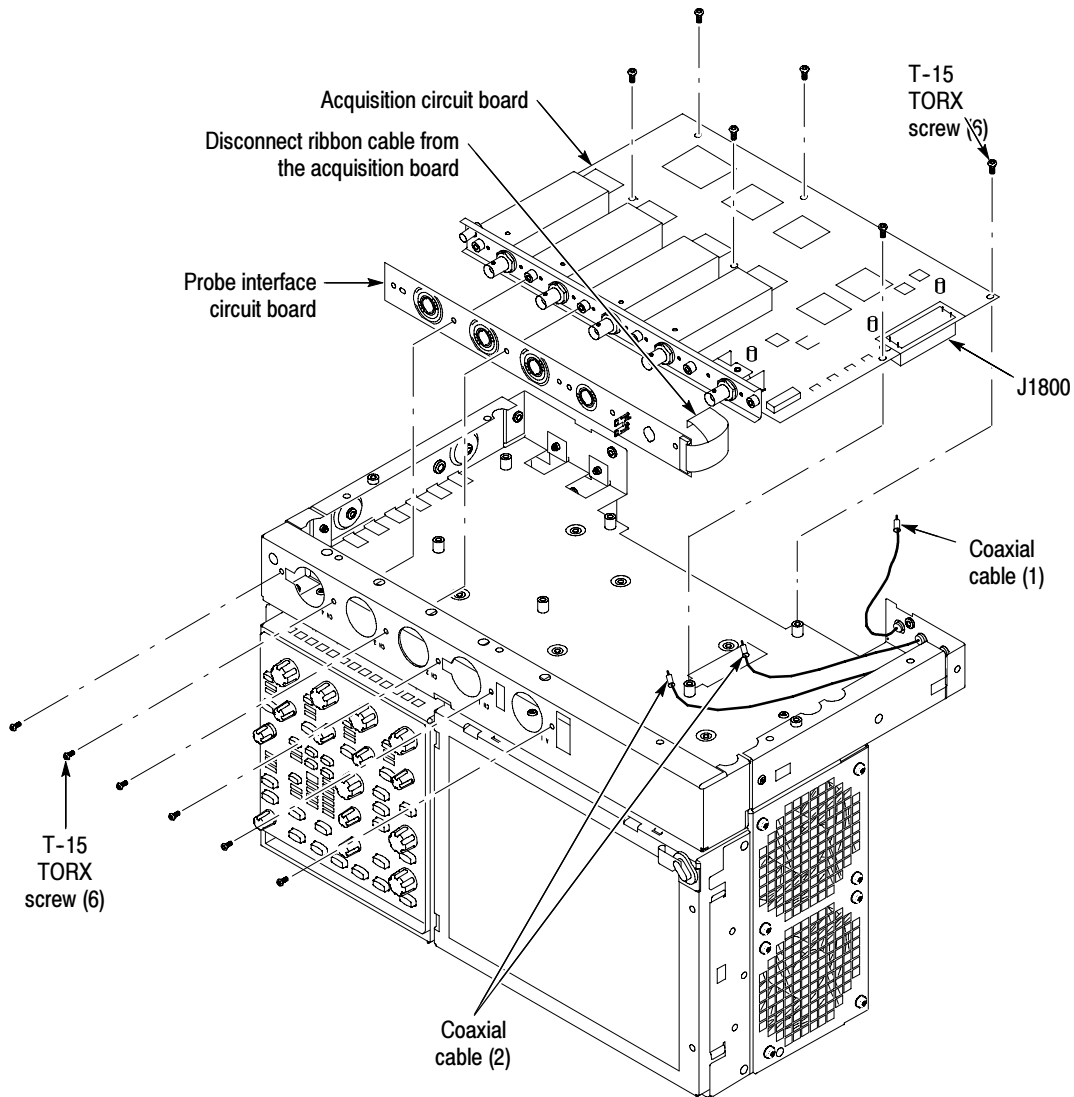


Figure 6-27: Acquisition circuit board removal

Troubleshooting



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, please read Preventing ESD on page 6-1.

This section contains information and procedures designed to help you isolate faults to a module.

This section assumes that service personnel have the prerequisite skills required to work on this oscilloscope, including PC troubleshooting and Windows 2000 skills. Details of PC and Windows 2000 operation and service are not in this manual.

For assistance, contact your local Tektronix Service Center.

Service Level

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

Check for Common Problems

Use Table 6-4 to quickly isolate possible failures. The table lists problems and possible causes. The list is not exhaustive, but it may help you eliminate a problem that is quick to fix, such as a blown fuse or loose cable.

Table 6-4: Failure symptoms and possible causes

Symptom	Possible cause(s)
Oscilloscope will not power on	<ul style="list-style-type: none">■ Power cord not plugged in■ Faulty power supply
Front panel light comes on (oscilloscope powers on), but one or more fans will not operate	<ul style="list-style-type: none">■ Faulty fan cable■ Defective fan assembly■ Faulty power supply

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

Symptom	Possible cause(s)
PC motherboard appears “dead”; power light comes on, but monitor screen(s) is (are) blank, oscilloscope emits no beeps	<ul style="list-style-type: none"> ■ DIMM memory module incorrectly installed or missing. Missing DIMMs will cause a POST fault and PC motherboard will beep ■ Defective PC motherboard ■ Hold down on-standby button on the PC Interface board , if system boots, replace the power supply
Hard disk drive related symptoms	<ul style="list-style-type: none"> ■ Defective hard disk drive ■ Incorrect hard disk type selected in the BIOS setup ■ Replaceable hard disk drive not installed ■ Power supply failure ■ Corrupted BIOS module firmware, reinstall firmware ■ Hard disk drive not configured as bootable (slave) master hard disk drive ■ Loose cable ■ Faulty PC motherboard
CD-ROM related symptoms	<ul style="list-style-type: none"> ■ Defective CD-ROM ■ Defective disk drive adapter board ■ Defective cable from PC Interface board to display adapter board ■ Defective PC Interface board ■ Incorrect CD-ROM configuration in the BIOS setup
Flat panel display blank	<ul style="list-style-type: none"> ■ Display selection jumper set incorrectly on front panel board (there are no jumpers on the board when the oscilloscope is shipped from the factory; this is the correct default setting) ■ Video adapter set to AGP (connect monitor to VGA port, enter BIOS, set Video Adapter = PCI) ■ BIOS setting not Advance > Video Configuration > Primary Video Adapter = PCI ■ Defective cable from front panel board to display adapter board ■ Defective cable from inverter board to display adapter board ■ Defective cable from inverter board to backlighting display lamp ■ Defective backlighting display lamp ■ Faulty display ■ Faulty controller board ■ Faulty inverter board ■ Faulty display adapter board
BIOS error messages	<ul style="list-style-type: none"> ■ Refer to the BIOS error message table on page 6-62

Equipment Required

You will need a digital multimeter to take measurements and to check power supply voltages, as described on page 6-56.

Testing might also be required to correct some faults. Under those circumstances, you will need the test equipment listed in the *Specifications and Performance Verification Technical Reference (Tektronix part number 071-1420-xx)*. See www.tektronix.com for the latest version of this manual.

Fault Isolation Procedure

Follow the primary troubleshooting tree in Figure 6-28 on page 6-54 for fault isolation. This tree calls for you to run the diagnostics programs, and check for BIOS errors.

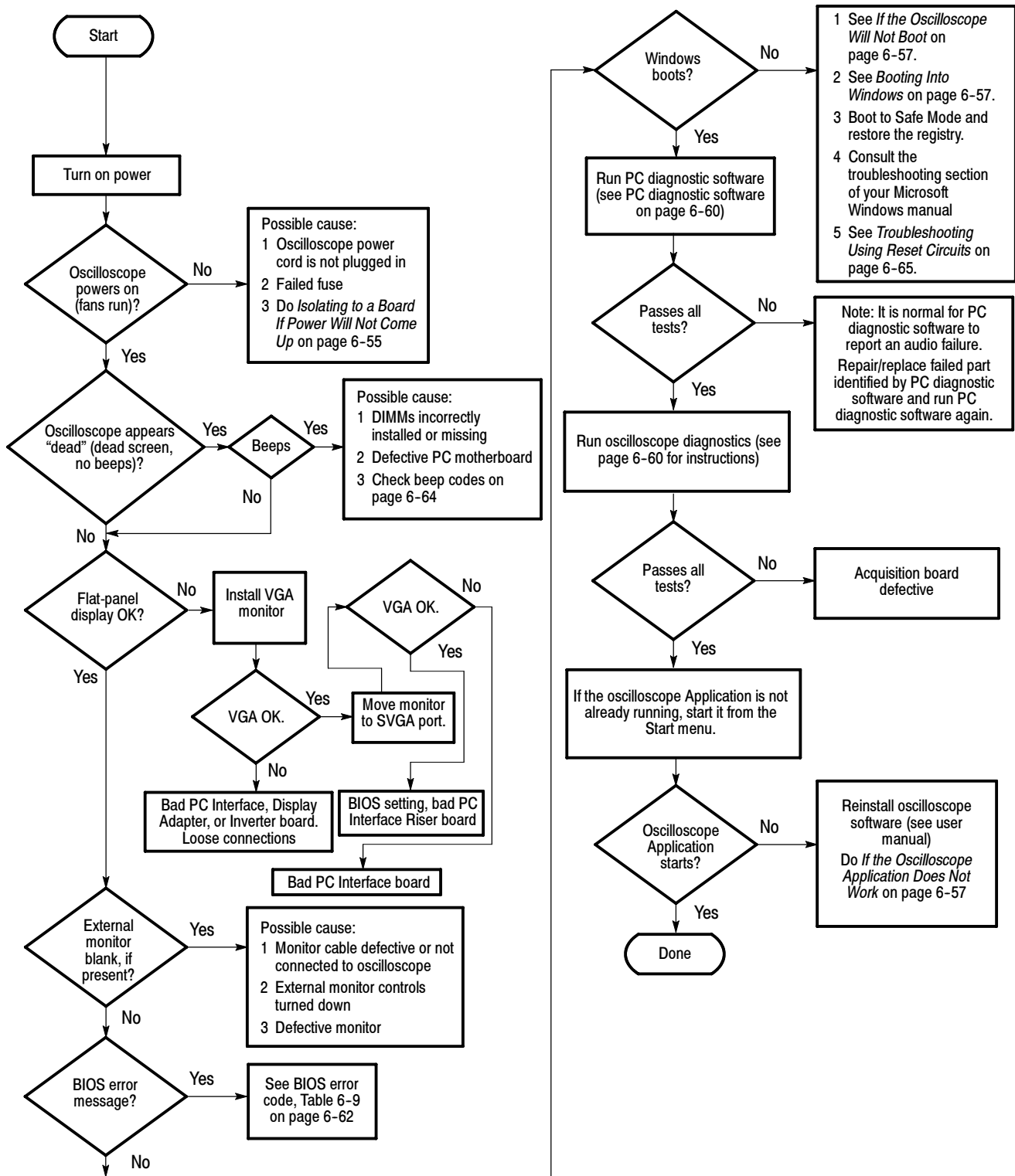


Figure 6-28: Primary troubleshooting tree

Isolating to a Board if Power Will Not Come Up

If the instrument will not power on, you can isolate the problem by observing the specific symptoms and comparing them to those listed below.

If the mains power cord is connected and the oscilloscope is not on, (power supply is in standby mode), +5 V will be present on pin 9 of P1, the power supply connector. If +5 V is not present, replace the power supply.

If the PSON signal on J1100, pin 2 is low, the oscilloscope interprets this signal as an indication that the power is on. If the PSON signal is high, measure the resistance from J510, pin 50 to ground, and J520, pin 6 to ground, while depressing the ON/STBY button on the front panel. If the resistance measures less than 500 ohms in either test, replace the PC motherboard.

If the oscilloscope powers on momentarily, an over current condition exists. Remove boards one at a time to locate a fault (the display, disk drive adapter board, acquisition board, and the PC motherboard). If you remove the PC motherboard, you must jumper the forced power-on pins (see Figure 6-29). The PC Interface board is required for power to come up.

If removing the boards did not find the problem, replace the power supply.

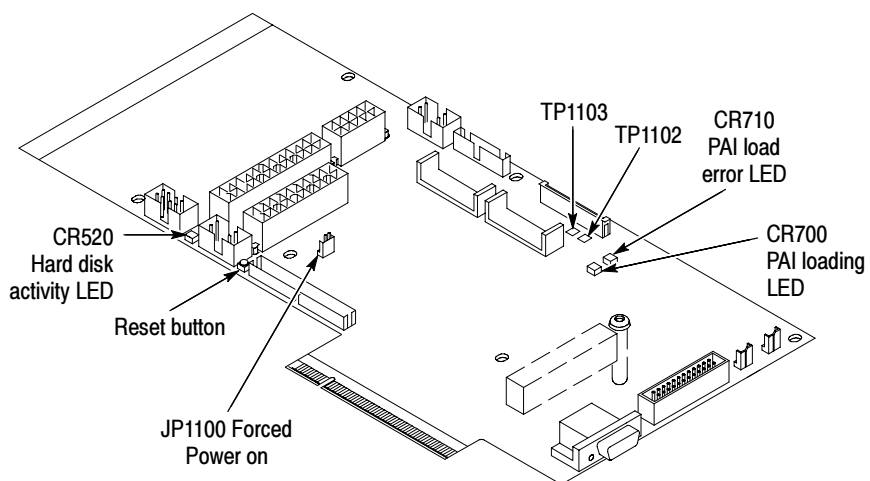


Figure 6-29: Location of jumpers and reset button

Checking the Power Supply Voltages

To check the power supply voltages, power on the oscilloscope and connect the reference lead of a digital voltmeter to chassis ground. Measure the power supply voltages with the voltmeter and compare each reading to the values listed in the tables. If the voltages are within about 5% of the nominal voltages, your power supply is functional.

The pins that carry power supply voltages are listed in Table 6-5.

Table 6-5: Power supply voltages

Power supply cable/pin #	Voltage
P1, Pins 1, 2, 12, 13 (orange)	+3.3 V
P1, Pins 4, 6, 21, 22, 23 (red)	+5.1 V
P1, Pin 8 (grey)	+5.1 V
P1, Pin 9 (violet, +5VSB)	+5.1 V
P1, Pins 10, 11 (yellow)	+11.6 V
P1, Pin 14 (blue)	-11.8 V
P2/P3, Pin 1 (yellow)	+11.6 V
P2/P3, Pin 4 (red)	+5.1 V
P13, Pin 2 (green)	+2.7 V
P13, Pin 3 (orange)	+3.3 V
P13, Pin 5 to Pin 10 (blue, tan)	+7 mV rms

After you check the voltages on the power supply connector, check the voltages on the acquisition board, at J1800. The pins that carry voltages are listed in Table 6-6.

Table 6-6: Acquisition board voltages

J1800 pin number	Voltage
Pins A1, A4, A8, A12, A16, A20, A24, A25	+3.3 V
Pin B23	+11.6 V
Pin B25	-11.8 V
Pins C20, C21, C22, C23, C24, C25	+5.1 V
Pin E12	+16.3 V
Pins E13, E14, E15, E16, E17, E18	+5.5 V
Pins E19, E20, E21, E22, E23, E24	-5.4 V
Pin E25	-16.4 V

If the Oscilloscope Will Not Boot

If there is a display on the VGA port, but not on the LCD, replace the display assembly (LCD, lamps, and cable).

If the display adapter is bad, the BIOS should report it using beep codes (see Table 6-11, on page 6-64).

If nothing is displayed, is the display turned on? At boot time and while using an external monitor connected to the PC motherboard external video port, press F2 to enter the BIOS setup. The Advanced Video Configuration menu lets you select PCI (LCD) or AGP (the PC motherboard port on the upper-side panel). The lower VGA port on the side panel is the PCI video port (driven by the same video controller as the LCD).

Booting Into Windows

If the oscilloscope will not boot, press F8 to enter the start up menu, and boot to the command prompt. If you can boot to the command prompt, use the MSDOS Edit program to edit the autoexec.bat file to run the CMOS restore utility (see *Update/Restore the PC Motherboard CMOS* on page 6-69).

If booting starts, finds the hard disk, but hangs at the Windows splash screen:

1. Select the AGP video port using the setup menu.
2. Disconnect the PC motherboard from the PC Interface board.
3. If the system boots (It will only boot to Windows; the oscilloscope application will not run) to the external PC motherboard video port, replace the PC Interface board.

If the Oscilloscope Application Does Not Work

If the oscilloscope boots into Windows, but the oscilloscope application does not work (the DPO Man graphic is displayed), check the following:

1. The application software.
2. The Acquisition board.
3. The PC Interface board.
4. Did someone exit the application using the Task Manager and then try to reenter the application without rebooting?
5. If the relays click, the acquisition is running.
6. Check the desktop properties (right click on the desktop and select Properties). On the Settings tab, 16 bit is required. Video merge will not work with other settings. If you change the setting, reboot.
7. On the Settings tab of the desktop properties, select Advanced and then the Performance tab. Hardware Acceleration must be set to Full for video merge to work. If you change the setting, reboot.

PC Interface and PC Motherboard Diagnostics

The primary diagnostics for the oscilloscope are the power-on diagnostics, the PC diagnostic software, and the oscilloscope diagnostics. Procedures for running these diagnostics are described below.

Power-On Diagnostics

The power-on diagnostics check the basic functionality of the oscilloscope at every power on. If any failures occur at power on, the screen displays the calibration and diagnostics property page. Table 6-7 lists a subset of the power on tests. Use the results of the tests to help you isolate problems to system modules.

The power on tests ensure that hardware is installed and can be accessed by the software. The tests provide limited diagnostic information, but do not provide any performance information. The oscilloscope diagnostics provide more extensive tests than the power-on diagnostics.

The power on tests check the generic hardware including the keyboard, mouse, memory, CPU, and associated peripherals. The interrupt lines and trigger lines are also checked.

If there are no failures, you can view the results of the tests in the Instrument Diagnostics page under the Utilities menu.

Table 6-7: Power-on diagnostic tests

Component	Group & test	Power on	Extended
Processor	Memory DRAM Walk1	✓	✓
	Memory DRAM Cell	✓	✓
	Memory DRAM March	✓	✓
	Memory NVRAM		✓
	PCI Bus Scan		✓
	Registers PAI	✓	✓
Display	Registers Display	✓	✓
Acquisition	Registers DAC	✓	✓
	Registers Demux	✓	✓
	Registers Preamp	✓	✓
	Registers PLL	✓	✓
	Registers ADC	✓	✓
	Memory MemData	✓	✓
	Memory MemAddr	✓	✓
	Memory DataFormat	✓	✓
	Memory MemSpeed		✓

Table 6-7: Power-on diagnostic tests (Cont.)

Component	Group & test	Power on	Extended
	Acq Modes SubSample	✓	✓
	Acq Modes PeakDetect	✓	✓
	Acq Modes HiRes	✓	✓
	Interrupt Bit Tests	✓	✓
	HF Step PhaseCal		✓
	Demuxes InstaVuXY		✓
	Vertical 50OhmOvld	✓	✓
	Vertical ADC Connects	✓	✓
	PLL Clock Freq	✓	✓
Trigger	Registers GTL	✓	✓
	Registers HITL	✓	✓
	Registers ExtTvTrg	✓	✓
	TrgLvlComp LogicComp1	✓	✓
	TrgLvlComp LogicComp2	✓	✓
	TrgLvlComp LogicComp3	✓	✓
	TrgLvlComp LogicComp4	✓	✓
	GTL TICounters	✓	✓
	GTL GTLBigCntrs	✓	✓
	HITL Ch1Edge	✓	✓
	HITL AfterDBE	✓	✓
	HITL AfterDBT	✓	✓
	HITL Slewrate	✓	✓
	HITL LineTrig	✓	✓
	HITL HITL	✓	✓
	Extended Glitch	✓	✓
	Extended PulseWidth	✓	✓
	Nibble Bus	✓	✓
Misc	GPIB Interface	✓	✓

PC Diagnostic Software

If the oscilloscope passes all the BIOS tests and Windows boots, the primary tree calls for you to run PC diagnostic software (such as QAPlus/Win).

Use a comprehensive diagnostic software application to check and verify the operation of the PC hardware in the oscilloscope.

To run the diagnostic software, you must have a working keyboard (a working mouse or other pointing device is optional) and have the Windows operating system running. Repair or replace any failed component identified by the diagnostic software.

NOTE. *To run PC diagnostic software, you must have either a working keyboard or a working mouse (or other pointing device) and Windows running.*

To run the PC diagnostic software, do the following steps:

1. From the File menu select **Exit**.
2. Exit all other applications and exit all windows.
3. Install and start the PC diagnostic software.
4. Click **OK** and select the tests you want to perform.
5. To restore the oscilloscope to normal operating condition, reboot the oscilloscope after the diagnostic tests are complete.

Oscilloscope Diagnostics. If the oscilloscope passes all the tests, the primary tree calls for you to run the oscilloscope Diagnostics. The oscilloscope Diagnostics are a comprehensive software test that checks the functionality of the oscilloscope. If the oscilloscope Diagnostics test fails, the oscilloscope is defective.

To run the oscilloscope Diagnostics, do the following steps:

1. Turn off all other applications.
2. From the menu bar, click **Utilities** and then select **Instrument Diagnostics**.

Diagnostics The oscilloscope has two levels of internal diagnostics that focus on verifying, adjusting, and if need be, isolating faulty modules.

Both levels of internal diagnostics report any bad modules. If a bad module is found, replace the module.

The two levels of diagnostics are the short confidence set and the extended set that tests the oscilloscope circuitry in depth and takes more time. At power on, the oscilloscope automatically executes the short set. The extended set is optional and is executed by using the following procedure:

1. *Display the System diagnostics menu:*
 - a. From the menu bar, click **Utilities** and then select **Instrument Diagnostics**.

Firmware Updates

Firmware updates are easy to do. Simply install the firmware CD in your oscilloscope and follow the displayed instructions or the instructions that accompany the CD.

If you want to order a firmware update, contact your Tektronix service center.

After Repair

After removal and replacement of a module due to electrical failure, you must perform the calibration or software update as indicated in Table 6-8.

Table 6-8: Action required for module replaced

Module replaced	Calibration required	Software update required
Front panel assembly	No	None
Acquisition board	Yes	Boot ROM and authorization code
PC Interface board	No	Boot ROM and authorization code
PC motherboard assembly	No	Windows, oscilloscope application
Display panel or display system	No	None
Power supply	No	None
Interconnect boards	No	None
Fans	No	None

BIOS Error Messages

Table 6-9 lists error messages displayed by the BIOS.

Table 6-9: BIOS Error messages

Error message	Explanation
GA20 Error	An error occurred with Gate-A20 when switching to protected mode during the memory test.
Pri Master HDD Error Pri Slave HDD Error Sec Master HDD Error Sec Slave HDD Error	Could not read sector from corresponding drive.
Pri Master Drive - ATAPI Incompatible Pri Slave Drive - ATAPI Incompatible Sec Master Drive - ATAPI Incompatible Sec Slave Drive - ATAPI Incompatible	Could not read sector from corresponding drive.
Cache Memory Bad	An error occurred while testing L2 cache. Memory may be bad.
CMOS Battery Low	The battery may be losing power. Replace the battery soon.
CMOS Display Type Wrong	The display type is different than what has been stored in CMOS. Check Setup to make sure type is correct.
CMOS Check Sum Bad	The CMOS checksum is incorrect. CMOS memory may have been corrupted. Run Setup to reset values.
CMOS Settings Wrong	CMOS values are not the same as the last boot. These values have either been corrupted or the battery has failed.
CMOS Date/Time Not Set	The time and/or date values stored in CMOS are invalid. Run Setup to set correct values.
DMA Error	Error during read/write test of DMA controller.
HDC Failure	Error while trying to access hard disk controller.
Checking NVRAM...	NVRAM is being checked to see if it is valid.
Update OK!	NVRAM was invalid and has been updated.
Update Failed	NVRAM was invalid but was unable to be updated.
Keyboard is locked	The system keyboard lock is engaged. The system must be unlocked to continue to boot.
Keyboard Error	Error in the keyboard connection. Make sure keyboard is connected properly.
KB/Interface Error	Keyboard interface test failed.
Memory Size Decreased	Memory size has decreased since the last boot. If no memory was removed, then memory may be bad.

Table 6-9: BIOS Error messages (Cont.)

Error message	Explanation
Memory Size Increased	Memory size has increased since the last boot. If no memory was added, then memory may be bad.
Memory Size Changed	Memory size has changed since the last boot. If no memory was added or removed, then memory may be bad.
No Boot Device Available	System did not find a boot device.
Off Board Parity Error	A parity error occurred on an off-board card. This error is followed by an address.
On Board Parity Error	A parity error occurred in onboard memory. This error is followed by an address.
Parity Error	A parity error occurred in onboard memory at an unknown address.
NVRAM/CMOS/PASSWORD cleared by Jumper	NVRAM, CMOS, and passwords have been cleared. The system should be powered off and the jumper removed.
<CTRL_N> Pressed	CMOS is ignored and NVRAM is cleared. User must enter Setup.

BIOS Beep Codes

When an error occurs during the power on self test (POST), the BIOS displays an error message describing the problem. The BIOS also issues a beep code (one long tone followed by two short tones) during POST if the video configuration fails (a faulty video card or no card installed) or if an external ROM module does not properly checksum to zero.

An external ROM module (for example, a video BIOS) can also issue audible errors, usually consisting of one long tone followed by a series of short tones. For more information on the beep codes, check the documentation for the device.

There are several POST routines that issue a POST terminal error and shut down the system if they fail. Before shutting down the system, the terminal-error handler issues a beep code (see Table 6-11) signifying the test point error, writes the error to I/O port 80h, attempts to initialize the video, and writes the error in the upper left corner of the screen (using both monochrome and color adapters).

If the POST completes normally, the BIOS issues one short beep before passing control to the operating system.

Table 6-10: Beep codes (SN B030000 and above)

Beeps	Description
3 long	Memory error
4 alternating (high-low-high-low)	Thermal warning

Table 6-11: Beep codes (SN B029999 and below)

Beeps	Description
1	Refresh failure
2	Parity cannot be reset
3	First 64 K memory failure
4	Timer not operational
5	Not used
6	8042 Gate A20 cannot be toggled
7	Exception interrupt error
8	Display memory R/W error
9	Not used
10	CMOS shutdown register test error
11	Invalid BIOS (for example, POST module not found, etc.)

PC Interface LEDs

When the oscilloscope is powered on, the PAI Loading and the Load Error LEDs (CR700 and CR710) will turn on momentarily, and then turn off. The hard disk activity can be monitored by observing the status of CR520.

Troubleshooting Using Reset Circuits

The PC Interface board uses a combination of removable jumpers and test points to manipulate circuit reset for troubleshooting.

There are two PCI busses on the PC Interface board; the PC motherboard primary PCI bus, and the L2 PCI bus. A hardware fault on any of these busses can prevent Windows from starting properly.

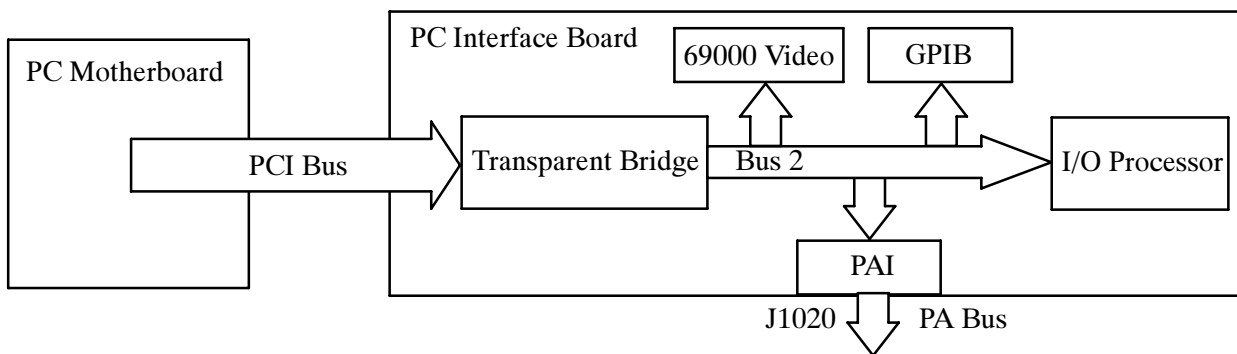


Figure 6-30: The PCI busses (SN B030000 and above)

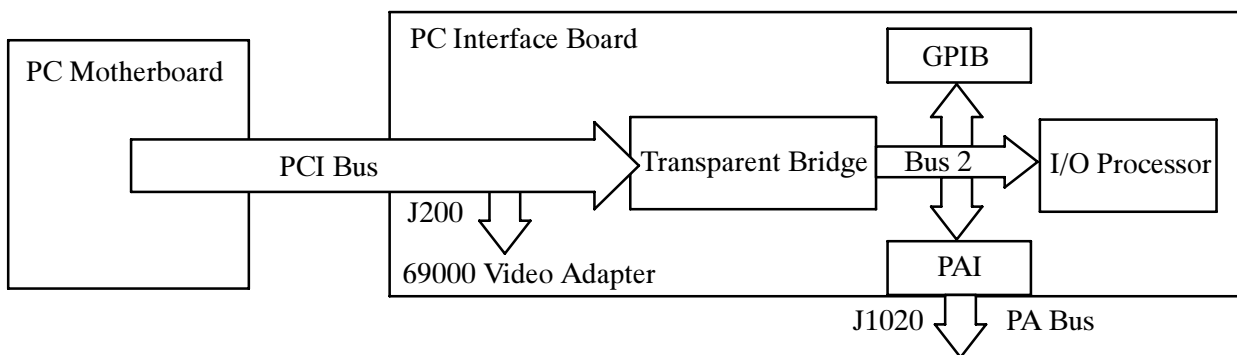


Figure 6-31: The PCI busses (SN B029999 and below)

By grounding test points TP1102 or TP1103 (see Figure 6-32) you can selectively remove components from the PC motherboard primary PCI bus. This is useful

when Windows will not start. The PC Interface board components on the PC motherboard primary PCI bus are the 21152 transparent bridge, and the 69000 video adapter.

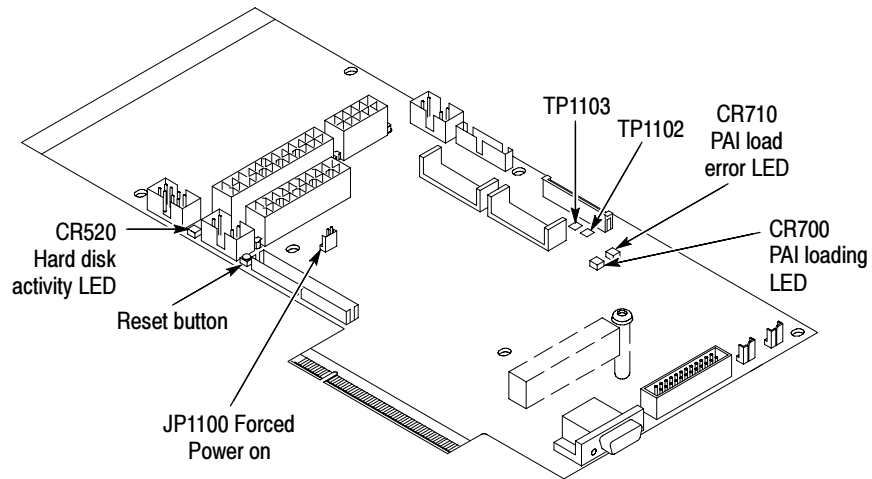


Figure 6-32: Location of jumpers and reset button

Grounding TP1103 forces the transparent bridge and all components on the L2 PCI bus into reset. Ground TP1103 to determine if the instrument will boot to Windows.

If Windows forces a safe boot mode, be sure to keep TP1103 grounded until Windows is fixed in safe mode and can be booted up into normal mode. Once Windows can be booted into normal mode, unground TP1103 and reset the unit. This will enable the bus line previously grounded by TP1103.

Grounding TP1102 resets the 69000 video adapter. Note, neither the PC Interface board VGA port or the LCD will function if TP1102 is grounded. Use the PC motherboard SVGA port (see Figure 6-33 on page 6-68). This requires a configuration change in the BIOS.

To enter the BIOS setup utility, do the following:

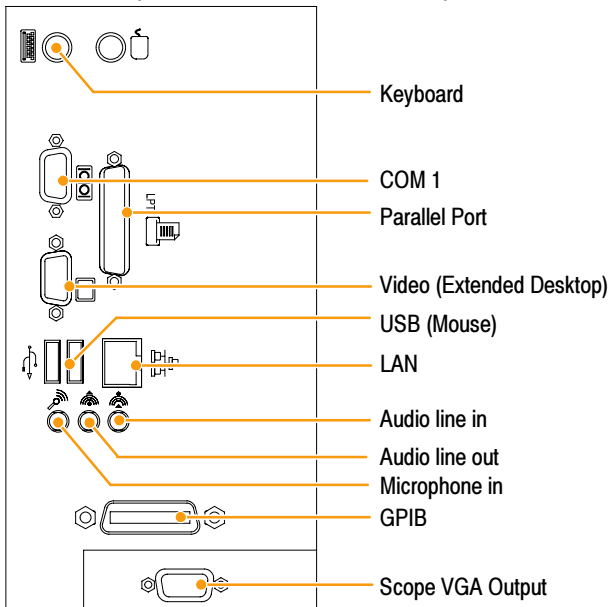
1. Restart Windows while holding down the F2 key.
2. Select Video Configuration from the Advanced Menu.
3. Set the Primary video adapter to AGP.
4. Exit the BIOS setup and save the changes.

If TP1102 is grounded before the video configuration is changed to AGP, reset the screen by hitting CTRL-ALT-DEL twice. This resets Windows and TP1102.

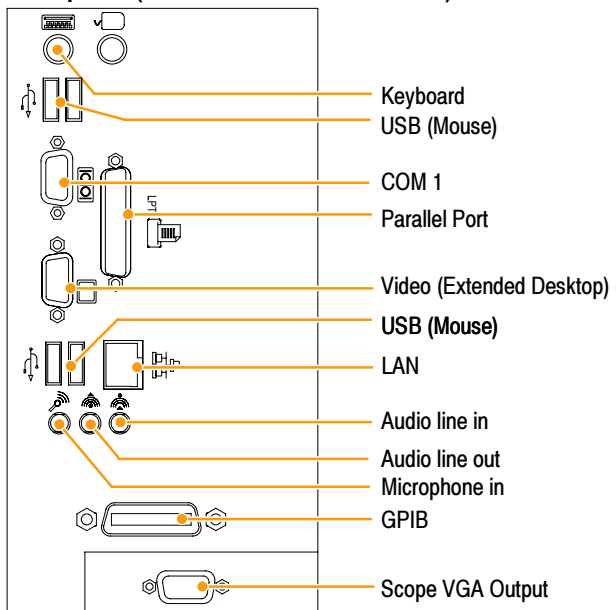
5. When you are done troubleshooting, change the BIOS setting back to PCI.

NOTE. *The 69000 video adapter located on the Tektronix PC Interface board is the primary video adapter. A second video adapter is located on the PC motherboard. The PC motherboard has an AGP video adapter and the 69000 is a PCI bus video adapter. The 69000 is made the primary video adapter because it can drive LCD panels. Tektronix forces the 69000 to be the primary video adapter via BIOS setting Advance→ Video Configuration→ Primary Video Adapter = PCI.*

Side panel (SN B010100 to SN B019999)



Side panel (SN B020000 to SN B029999)



Side panel (SN B030000 and Above)

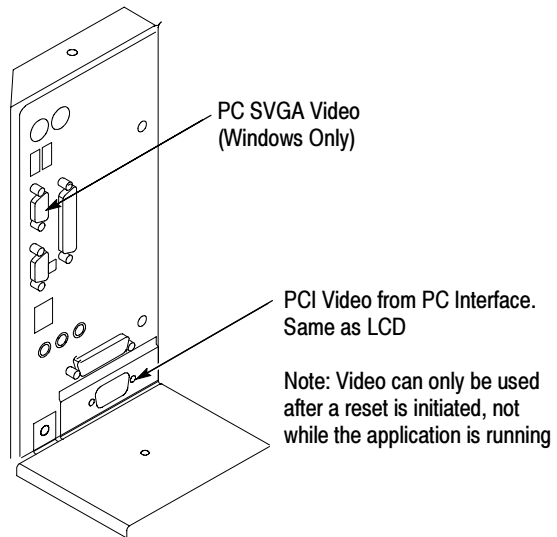
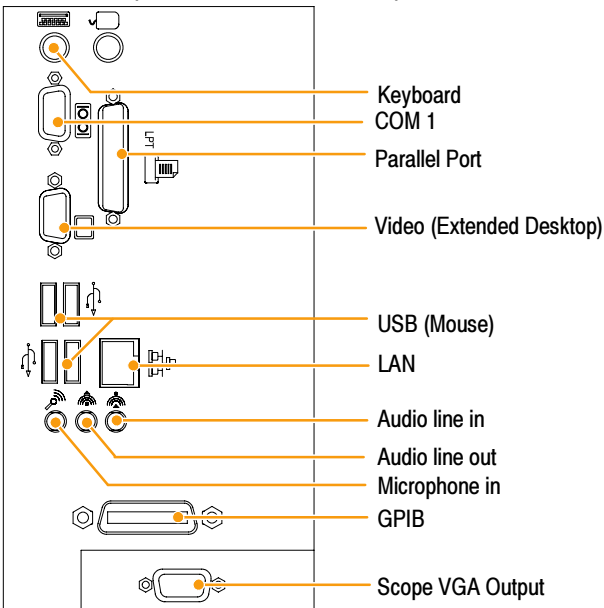


Figure 6-33: PCI and AGP video connectors

Installing the PC Motherboard Serial Number

To install a serial number into the oscilloscope do the following steps:

1. Connect a PC with a GPIB interface to the GPIB interface of the oscilloscope.



WARNING. Make sure the unique identifier does not end in all zeros before generating or setting the key.

2. Use the following command to install the serial number (the actual serial number should be in single quotes):

```
:HWAccountant:SERIAL 'serialNumber'
```

3. After sending this command, reboot the instrument. After rebooting, a valid unique ID (UID) is available.

Update/Restore the PC Motherboard CMOS

If the CMOS parameters become corrupted, restore the CMOS memory using the following procedure:



CAUTION. Only install CMOS parameters from Tektronix. CMOS parameters from other manufacturers may make your oscilloscope inoperable.

1. Edit the autoexec.bat file.
2. Remove comments CMOS restore parameters.
3. Boot the instrument.
4. Reedit the autoexec.bat file to re-comment the CMOS restore parameters.

If you cannot restore the CMOS memory, replace the battery.

Installing an Authorization Key

If you replace your PC Interface board or add a new option, you must install a new authorization key, using the following procedure:

1. From the oscilloscope menu bar, click the **Utilities** menu, select **Option Installation**, and then click **Continue**.
2. Enter the new key using an attached keyboard.
3. Click **Continue**.

Hard Disk Drive Maintenance

Use the same procedures to maintain the oscilloscope hard disk drive that you use to maintain a hard disk drive in a personal computer.

Using ScanDisk, attempt to fix the disk without destroying data on the disk. To use ScanDisk, perform the following steps:

1. Power on the oscilloscope and run ScanDisk. Set ScanDisk to perform a thorough surface scan and to automatically fix errors.
 - Using Microsoft Windows 2000 select Start\Programs\Accessories\System Tools\ScanDisk
 - Using Microsoft MSDOS: enter SCANDISK *drive:* /SURFACE /AUTOFIX
2. If ScanDisk will not repair the disk, format the hard disk drive using the File Utilities Format command. Format will destroy all data currently on the disk.
3. If reformatting the hard disk and reloading the software will not repair the disk, install a new hard disk drive.

Repackaging Instructions

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

Packaging

When repacking the oscilloscope for shipment, use the original packaging. If the packaging is unavailable or unfit for use, contact your local Tektronix representative to obtain new packaging.

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 oscilloscope 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 oscilloscope.
- 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.



Options and Accessories

Options and Accessories

This section lists the standard and optional accessories available for the TDS5000B Series oscilloscopes, as well as the product options.

Options

You can order the options shown in Table 7-1 with the oscilloscope.

Table 7-1: Instrument options

Hardware options	
18	Touch-screen interface
1P	Built-in thermal printer (option not available for instruments SN B030000 & above)
FHD	Front panel removable hard drive
SM	Serial communications mask testing
Acquisition memory options	
3M	16M/8M/4M on 1/2/4 channels
Mounting options	
1K	K420 oscilloscope cart with mouse accessory tray
1R	Rackmount kit
Software options	
DVD	TDSDVD—Optical storage analysis software
J2	TDSDDM2—Disk drive measurements software
J3E	TDSJIT3E—Jitter and timing analysis software essentials
JT3	TDSJIT3—Jitter & timing analysis with Rj/Dj and BER estimation
PW3	TDSPWR3—Power measurement software
USB	TDSUSBS—USB2.0 compliance test software only
CP2	TDSCPM2—ANSI/ITU telecom pulse compliance software
ET3	TDSET3—Ethernet compliance test software
Power cord options	
A0	North American
A1	Universal European power cord (220 V, 50 Hz)

Table 7-1: Instrument options (Cont.)

Power cord options	
A2	UK power cord (240 V, 50 Hz)
A3	Australia power cord (240 V, 50 Hz)
A4	240 V North America
A5	Switzerland power cord (220 V, 50 Hz)
A6	Japan power cord
A10	China power cord (240 V, 50 Hz)
A99	No power cord
Service options	
D1	Calibration data report
C3	Additional 2 years of calibration
D3	Calibration data report for Option C3
R3	Additional 2 years of repair
C5	Additional 4 years of calibration
D5	Calibration data report for Option C5
R5	Additional 4 years of repair

You can order the upgrade kits shown in Table 7-2 to extend the performance of your instrument after its initial purchase. Contact your local Tektronix representative for details and the most current information.

Table 7-2: Instrument upgrades

TDS5UP upgrade*	Description
Option 18	Touch-screen interface
Option 1K	Scope cart
Option M03	Upgrade acquisition memory depth from standard to option 3M
Option 1P	Built-in thermal printer (not supported for instruments SN B030000 and above)
Option 1R	Rackmount kit
Option SM	Serial communications mask testing
Option CP2	TDSCPM2—ANSI/ITU telecom pulse compliance software
Option DVD	TDSDVD—Optical storage analysis software
Option J2	TDSDDM2—Disk drive measurements software
Option J3E	TDSJIT3E—Jitter and timing analysis software essentials
Option JT3	TDSJIT3—Jitter & timing analysis with Rj/Dj and BER estimation

Table 7-2: Instrument upgrades (Cont.)

TDS5UP upgrade*	Description
Option PW3	TDSPWR3—Power analysis software
Option USB	TDSUSBS—USB2.0 compliance test software only
Option IF	Service installation of selected options

***When ordering a TDS5Up upgrade kit, you must order at least one option.**

Accessories

This section lists the standard and optional accessories available for this oscilloscope.

Standard

The accessories shown in Table 7-3 are shipped with the oscilloscope.

Table 7-3: Standard accessories

Accessory	Part number
<i>The TDS5000B Series Digital Phosphor Oscilloscopes Quick Start User Manual</i>	
<i>English (Option L0)</i>	071-1355-xx
<i>French (Option L1)</i>	071-1357-xx
<i>German (Option L3)</i>	071-1358-xx
<i>Japanese (Option L5)</i>	071-1356-xx
<i>Korean (Option L9)</i>	071-1359-xx
<i>Simplified Chinese (Option L7)</i>	071-1360-xx
<i>Traditional Chinese (Option L8)</i>	071-1361-xx
<i>Russian (Option L10)</i>	071-1404-xx
<i>Getting Started with OpenChoice Solutions Manual with CD</i>	020-2513-xx
<i>TDS5000B Series Product Software CD-ROM (includes application, online help, TDS5000B Series Online Programmer Guide (GPIB online help and PDF), Performance Verification PDF, release notes, VISA information)</i>	063-3692-xx
<i>TDS5000B Series Operating System Restore CD-ROM</i>	
SN B010100 to SN B019999	063-3693-xx
SN B020000 to SN B029999	063-3739-xx
SN B030000 and above	063-3985-xx
<i>Optional Applications Software for Tektronix Windows-Based TDS Instruments CD-ROM and manuals</i>	020-2450-xx

Table 7-3: Standard accessories (cont.)

Accessory	Part number
<i>The TDS5000B Series Digital Phosphor Oscilloscopes Specifications and Performance Verification</i> (a PDF file on the <i>TDS5000B series Product Software CD</i>)	071-1420-xx
<i>The TDS5000B Programmer Online Guide</i> (files on the <i>TDS5000B series Product Software CD</i>)	— —
<i>The TDS5000B Online Help</i> (part of the application software)	— —
Calibration Certificate documenting NIST traceability, Z540-1 compliance, and ISO9001 registration	— —
Power Cord	
North America (Option A0)	161-0104-00
Universal Euro (Option A1)	161-0104-06
United Kingdom (Option A2)	161-0104-07
Australia (Option A3)	161-0104-05
240V North America (Option A4)	161-0104-08
Switzerland (Option A5)	161-0167-00
Japan (Option A6)	161-A005-00
China (Option A10)	161-0306-00
No power cord or AC adapter (Option A99)	—
Mouse	119-6936-00
Front cover	200-4651-00
One 500 MHz, 10x passive probe per channel	P5050
Snap-on Accessory Pouch	016-1935-xx
30 day evaluation copy of LabVIEW	020-2476-xx

Optional The accessories in Table 7-4 are orderable for use with the oscilloscope at the time this manual was published. Consult a current Tektronix catalog for additions, changes, and details.

Table 7-4: Optional accessories

Accessory	Part number
<i>TDS5000B Series Digital Phosphor Oscilloscopes Service Manual</i>	071-1362-xx
Keyboard	118-9402-xx
Transit case	016-1937-xx
Thermal printer paper (one roll)—not supported for instruments SN B030000 and above	016-1897-xx
Probe calibration, compensation, and deskew adapter (requires a separate pulse generator)	067-0405-02

Table 7-4: Optional accessories (cont.)

Accessory	Part number
Video display clamp	013-0278-00
Power deskew fixture	067-1478-00
Extra front removable hard drive	065-0692-xx
P5050 500 MHz 10x passive probe	P5050
P6101B 15 MHz 1X passive probe	P6101B
P6158 20x low-capacitance probe	P6158
P6247 1 GHz differential probe	P6247
P6243 1 GHz high speed active probe	P6243
P6245 1.5 GHz high speed active probe	P6245
P6248 1.7 GHz differential probe	P6248
P6246 400 MHz differential probe	P6246
TCP202 current probe	TCP202
TCPA300, TCPA400 series current measurement systems	TCPA300/TCPA400
CT1, CT2, and CT-6 high speed AC current probe	CT-1/CT-2/CT-6
CT4 AC current probe 20 kA	CT-4
AM5030S DC/AC current measurement system	AM5030S
P6021 AC current measurement probe	P6021
P6022 AC current measurement probe	P6022
AMT75 1 GHz 75 Ω adapter	AMT75
P5200 high voltage differential probe	P5200
P5205 high voltage differential probe	P5205
P5210 high voltage differential probe	P5210
P5100 high voltage probe	P5100
P6015A high voltage probe	P6015A
P6158 3 GHz, 20X low C probe	P6158
P6243 1 GHz active probe	P6243
P6245 1.5 GHz active probe	P6245
P6247 1 GHz differential probe	P6247
P6248 1.5 GHz differential probe	P6248
P6246 400 MHz differential probe	P6246
ADA400A differential preamplifier	ADA400A
P6701B optical/electrical converter (multimode)	P6701B
P6703B optical/electrical converter (single mode)	P6703B
AFTDS differential signal adapter	AFTDS



Electrical Parts List

Electrical Parts List

The modules in this instrument are made up of mechanical and electrical subparts. All replaceable modules are listed in Section 10, *Mechanical Parts List*.

Refer to this section for a list of the replaceable parts.



Diagrams

Diagrams

This section describes the electrical operation of the TDS5000B Digital Oscilloscope using the major circuit blocks. Figure 9-1 on page 9-2 shows the oscilloscope module interconnections.

Symbols

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

Logic symbology is based on ANSI/IEEE Std 91-1984 in terms of positive logic. Logic symbols depict the logic function performed and can differ from the manufacturer's data.

The tilde (~) preceding a signal name indicates that the signal performs its intended function when in the low state.

Other standards used in the preparation of diagrams by Tektronix, Inc. are:

- Tektronix Standard 062-2476 Symbols and Practices for Schematic Drafting
- ANSI Y14.159-1971 Interconnection Diagrams
- ANSI Y32.16-1975 Reference Designations for Electronic Equipment
- MIL-HDBK-63038-1A Military Standard Technical Manual Writing Handbook

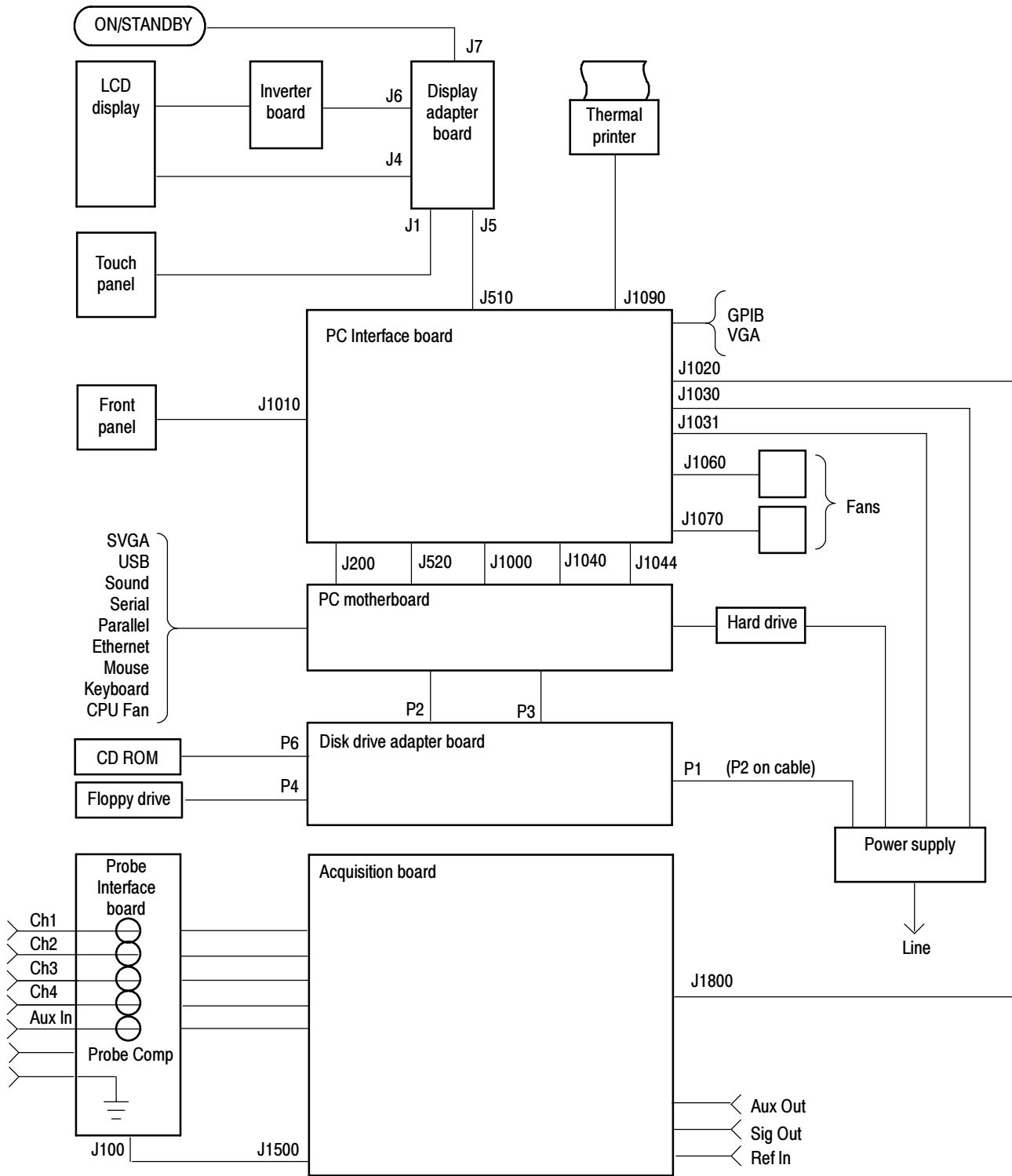


Figure 9- 1: TDS5000B series block diagram



Mechanical Parts List

Mechanical Parts List

This section contains a list of the replaceable mechanical components for the TDS5000B Series instruments. Use this list to identify and order replacement parts.

Parts Ordering Information

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

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

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

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

Using the Replaceable Mechanical Parts List

The tabular information in the Replaceable Mechanical Parts List is arranged for quick retrieval. Understanding the structure and features of the list will help you find all of the information you need for ordering replacement parts. The following table describes the content of each column in the parts list.

Parts list column descriptions

Column	Column name	Description
1	Figure & index number	Items in this section are referenced by figure and index numbers to the exploded view illustrations that follow.
2	Tektronix part number	Use this part number when ordering replacement parts from Tektronix.
3 and 4	Serial number	Column three indicates the serial number at which the part was first effective. Column four indicates the serial number at which the part was discontinued. No 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.

Chassis Parts Chassis-mounted parts and cable assemblies are located at the end of the Replaceable Electrical Parts List.

External Parts

Fig. & index number	Tektronix part number	Serial no. effective	Serial no. discount'd	Qty	Name & description
10-1-1	200-4669-XX			1	DOOR:ACCESSORY TRAY,0.050 AL
	200-4668-XX			1	CABINET,TOP:PRINTER TRAY,0.050 AL, Opt. 1P
-2	436-0408-XX	B010100	B029999	1	TRAY,:ACCESSORY
-3	016-1935-XX			1	POUCH; ACCESSORIES,BLACK,SNAP-ON
-4	200-4832-XX			1	TOP:PLASTIC
-5	355-0303-XX			2	MARKER,IDENT; LABEL,PRINT UNIT ID,BLACK
-6	211-0722-XX			2	SCREW,MACHINE; 6-32 X 0.250,PNH,STL,CDPL,T-15 TORX DR
-7	348-1685-XX			4	FOOT:REAR,PC/ABS
-8	407-4961-XX			1	BRACKET; MOUNTING,POUCH,0.050 AL
-9	200-4639-XX			1	COVER,SIDE:RIGHT,FR110
-10	200-4652-XX			1	COVER:CDROM,PC/ABS
-11	211-1050-XX	B010100	B029999	8	SCREW,MACHINE:6-32 X 0.312 L,PNH,STL CAD,T15
-12	333-4388-XX			1	PANEL ASSEMBLY:FRONT,LOWER,2 CH
	333-4363-XX			1	PANEL ASSEMBLY:FRONT,LOWER,4 CH
-13	101-0158-XX			1	TRIM RING:FR110 (PC/ABS)
	101-0163-XX			1	TRIM RING; FR110,PC/ABS,OPTION FHD
-14	--- --- ---			1	PEM
-15	200-4651-XX			1	COVER,FRONT:PC/ABS ALLOY BAYBLEND,FR110,TEK BLUE
-16	260-2746-XX			1	SWITCH,KEYPAD:ELASTOMERIC,ON/STANBY,PUSHBUTTON
-17	200-4640-XX			1	COVER,SIDE:LEFT,FR110
-18	367-0528-XX			1	HANDLE,CARRYING:DUAL DUROMETER MOLDED,POLYPROPYLENE,VINYL GRIP SECTION,
-19	407-4838-XX			1	BRACKET:HANDLE BASE,PC/ABS ALLOY,BAYER BAYBLEND FR-110,TEK BLUE
-20	212-0213-XX			1	SCREW,MACHINE:8-32 X 0.75 L,PNH,STL, BLACK OXIDE PL,TORX
-21	200-4667-XX			1	COVER:VGA PANEL,PC/ABS ALLOY,BAYER,BAYBLEND FR,TEK BLUE
-22	214-5003-XX			1	FASTENER,LATCHG:PUSH LOCK,1V60-3-9-999-9
-23	211-0738-XX	B010100	B029999	2	SCREW,MACHINE:6-32 X 0.625,PNH,STL BLK ZI,TORX

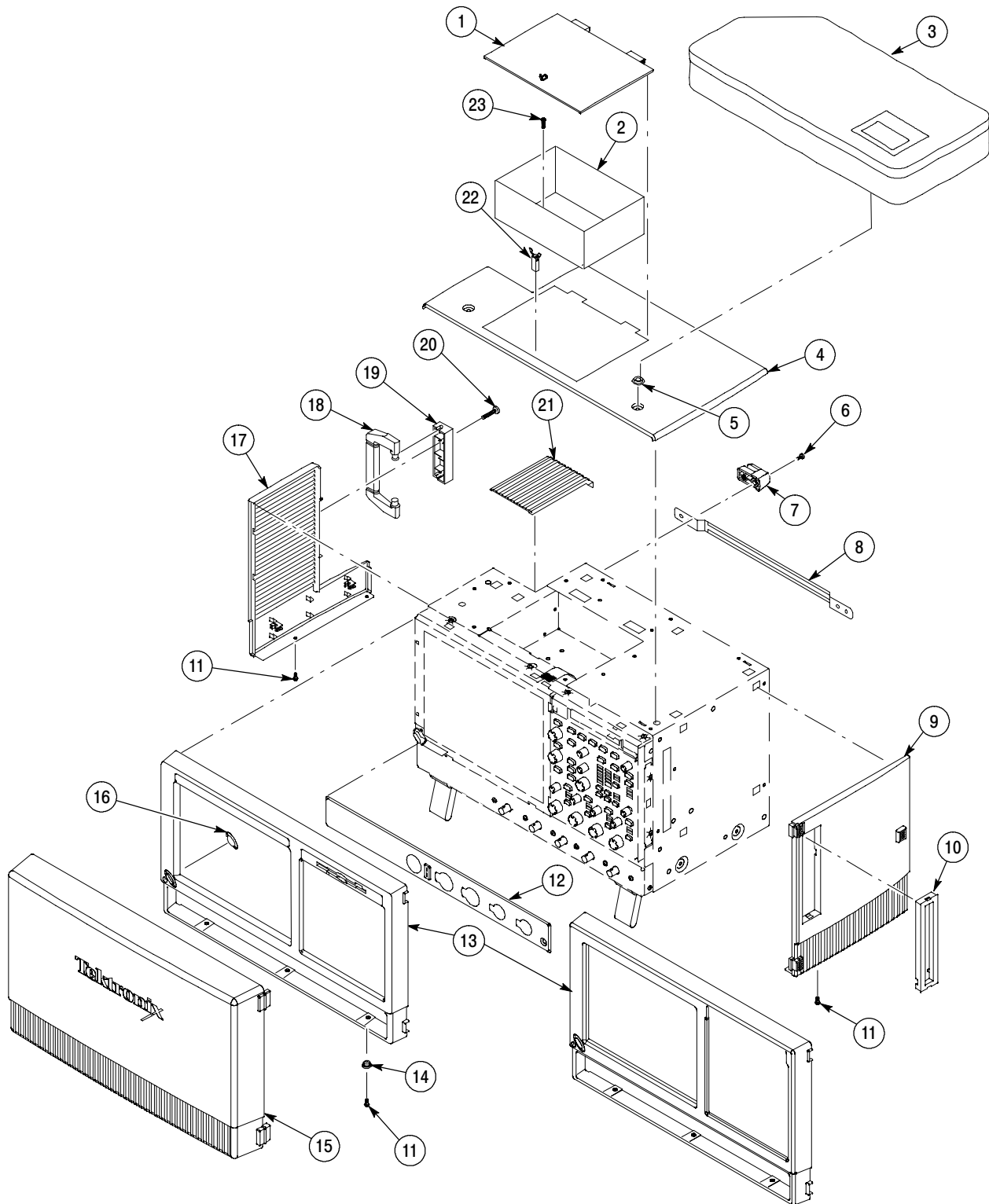


Figure 10-1: External parts

Inner Panels

Fig. & index number	Tektronix part number	Serial no. effective	Serial no. discontinued	Qty	Name & description
10-2-1	407-4822-XX			1	BRACKET:VGA
-2	211-1050-XX	B010100	B029999	8	SCREW,MACHINE:6-32 X 0.312 L,PNH,STL CAD,T15
-3	344-0591-XX	B010100	B029999	1	CLIP,CABLE:0.050 AL,
-4	200-4865-XX	B010100	B029999	1	COVER, TOP:PRINTER TRAY,0.050 AL
-5	211-0747-XX			1	SCREW,MACHINE; 6-32 X 0.188,PNH,STL,CDPL,T-15 TORX DR
-6	390-1217-XX	B010100	B029999	1	CABINET, TOP:0.05 ALUMINUM
-6a	200-5037-XX	B030000			COVER, TOP; 0.05 ALUMINUM
-7	211-1164-XX			6	SCREW,MACHINE:6-32 X 0.25 L,PNH,T15,BLACK OXIDE
-8	200-4641-XX			1	COVER:BOTTOM,AL
-9	200-4661-XX			1	COVER:BOTTOM,COSMETIC,0.040 AL,W/BLACK VINYL ONE SIDE
10	441-2226-XX	B010100	B019999		CHASSIS ASSY; FOR ASHLAND MOTHER BOARD,0.050 AL W/BRACKETS & HARDWARE
	441-2376-XX	B020000	B029999	1	CHASSIS ASSY; FOR LACROSSE MOTHER BOARD,0.050 AL W/BRACKETS & HARDWARE
	441-2491-XX	B030000		1	CHASSIS ASSY; FOR TAPPEN MOTHER BOARD,0.050 AL W/BRACKETS & HARDWARE

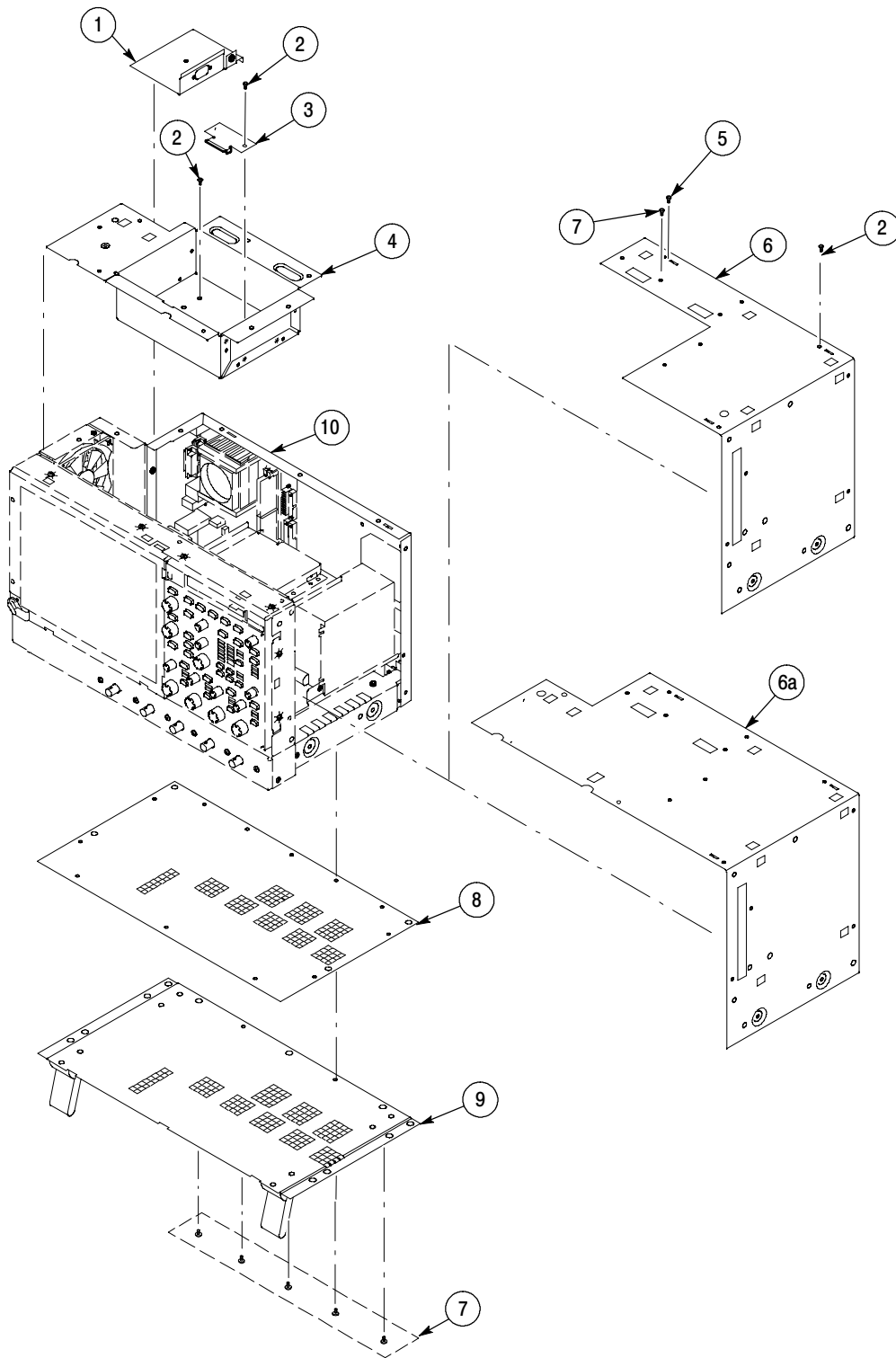


Figure 10-2: Inner panels

Modules

Fig. & index number	Tektronix part number	Serial no. effective	Serial no. discont'd	Qty	Name & description
10-3-1	650-4317-XX			1	PRINTER,THERMAL:TDS5000 SERIES PRINTER
-2	211-0738-XX	B010100	B029999	2	SCREW,MACHINE:6-32 X 0.625,PNH,STL BLK ZI,TORX
-3	174-4427-XX			1	CA ASSY, SP:DESCRETE,CPD,20, 18 AWG, 8.0L, 2 X 10,RCPT,STR,2X10 BOTH ENDS
-4	174-4514-XX			1	CA ASSY,SP:GPIB,RIBBON
-5	039-0154-XX	B010100	B019999	1	MOTHER BOARD ASSY;PENTIUM 4/CELERON BD,UATX,ASHLAND 2.1,W/O PROC-ESSOR,D845GVAD2L
	039-0159-XX	B020000	B029999	1	MOTHER BOARD ASSY;PENTIUM 4/CELERON BD,UATX,LA CROSSE,W/O PROC-ESSOR,BLKD865GLCLK INTEL P/N,SAFETY CONTROLLED
	039-0173-XX	B030000		1	MOTHER BOARD ASSY;PENTIUM 4,UATX,TAPPEN BD,GIG E, PROCSSOR LGA775,DDR2 667MHZ,TOTAL 4 GIG;BLKD945GTPLKR,SAFETY CONTROLLED
-6	156-9442-XX	B010100	B029999	1	IC,MEMORY; 64M X 64,512M, 266MHZ,CL=2.5,PC2100; MT16VDDT6464A,DIMM184
	167-0428-XX	B030000		1	IC,MEMORY; 64M X 64,512 MB DDR2,1.8V, 3-3-3;MT16HTF6464AY-40E,DIMM240,DS1
-7	211-1050-XX	B010100	B029999	16	SCREW,MACHINE:6-32 X 0.312 L,PNH,STL CAD,T15
-8	174-4894-XX	B010100	B019999	1	CABLE ASSY; 4 PIN P4 POWER,9.5 L,MOTHER BOARD TO INTERFACE BOARD
	174-4865-XX	B020000	B029999		CABLE ASSY; 4 PIN P4 POWER,9.5 L,MOTHER BOARD TO INTERFACE BOARD
	174-5351-XX	B030000			CABLE ASSY; 4 PIN P4 POWER,12 L,MOTHER BOARD TO INTERFACE BOARD
-9	174-4807-XX			1	CA ASSY; ATX USB, PLUS MISC. TO DISPLAY
-10	671-5737-XX			1	CIRCUIT BD ASSY; PC INTERFACE
-11	119-6480-XX			1	POWER SUPPLY:300W,AC-DC,STANDARD,ATX PC SUPPLY,90-132 180-264VAC 50-60 HZ IN,+3.3V 16A +5V 26
		B010000	B010004		TDS5032B
		B010000	B010005		TDS5032B
		B010000	B010020		TDS5034B
		B010000	B010005		TDS5052B
		B010000	B010029		TDS5054B
		B010000	B010152		TDS5104B
					<i>All military and commercial products released with 119-6969-xx, except for a limited number of products listed above .</i>
	119-6969-XX				POWER SUPPLY; 300W, AC-DC, ATX POWER SUPPLY, 100-240 VAC 50-60 HZ, 115 VAC 400 HZ IN,
-12	614-1023-XX			1	PANEL ASSEMBLY:FRONT,4 CH-NO TS
	614-1024-XX			1	PANEL ASSEMBLY:FRONT,2 CH
	614-1025-XX			1	PANEL ASSEMBLY:FRONT,2 CH-NO TS
	614-1026-XX			1	PANEL ASSEMBLY:FRONT
-13	366-0837-XX			7	KNOB,CAP; 0.650 D,SOFT FEEL COATING,PC/ABS BAYBLEND,FR110,TEK SILVER GRAY
-14	366-0836-XX			7	KNOB,CAP; 0.425 DIA,SOFT FEEL COATING,PC/ABS,BAYBLEND,FR110,TEK SILVER GRAY
-15	366-0835-XX			1	KNOB,EPS; PUSH BUTTON ENCODER,SOFT FEEL COATING,PC/ABS BAY- BLEND,FR110,TEK SILVER GRAY
-16	174-4321-XX			1	CABLE ASSY:FLAT FLEX,26POS,10.4L,FRONT PANEL
-17	259-0155-XX			1	FLEX CIRCUIT; POWER SWITCH,W/LED
-18	650-4633-XX			1	MODULE ASSEMBLY; TOUCH PANEL;TDS5000B SERIES
-19	650-4586-XX	B010100	B0299999	1	COMPONENT KIT:DISPLAY MODULE ONLY
	650-4999-XX	B030000		1	COMPONENT KIT:DISPLAY MODULE ONLY
-20	343-1676-XX			1	CLAMP,CABLE; PC/ABS ALLOY,SILVER GREY

Modules (Cont.)

Fig. & index number	Tektronix part number	Serial no. effective	Serial no. discont'd	Qty	Name & description
-21	671-5279-XX 671-5244-XX 671-6299-XX	B010100 B030000	B029999	1	CKT BD SUBASSY:DISPLAY INTERFACE ONLY CKT BD SUBASSY:DISPLAY INTERFACE ONLY CKT BD SUBASSY;DISPLAY ,INTERFACE, TOUCH SCREEN
-22	119-6260-XX 119-6806-XX	B010100 B020000	B019999	1 1	POWER SUPPLY:INVERTER BOARD,FOR NEC 10.4 IN LCD POWER SUPPLY;INVERTER BOARD,FOR NEC 10.4 IN LCD
-23	174-3618-XX 174-5278-XX 174-4794-XX	B010100 B020000 B030000	B019999 B029999	1 1	CABLE ASSY SP:RIBBON,CPR,28 AWG,9.5 L,1X5,0.049CTR, LZ SERIES,MOLEX 50058 S CABLE ASSY SP; RIBBON,;CPR,28 AWG,9.5 L,1X5,0.049CTR,LZ SERIES JAE X 1X5 TO 1X8,0.049CTR,MOLEX 50058 SERIES CA ASSY; DISPLAY ADAPTER TO INVERTOR,SAFETY CONTROLLED
-24	174-4892-XX			1	CA ASSY,SP; RIBBON,IDC,50,28 AWG,13.0L,2 X 25,0.039 CTR BOX MTE 30 GOLD X 2 X 25 0.039 CTR BOX MTE 30 GOLD
-25	210-0164-XX			8	RIVET,SOLID:0.163 OD X 0.415 L,PANEL RANGE HEAD STYLE,NYLON
-26	119-6441-XX			2	FAN,TUBEAXIAL:12VDC,0.15A,1.8W,48CFM,2450RPM,30DBA,92MM X 92MM X 26MM, W/ 7IN LEADS & CONNECTO
-27	174-4531-XX	B010100	B029999	1	CABLE:PRINTER
-28	214-5119-XX 214-5064-XX	B010100 B020000	B019999 B029999	1	HEAT SINK,SEMIC; IC,PROCESSOR;ALUMINUM WITH 12V FAN FOR INTEL PENTIUM 4 PROCESSOR,FOR LGA775 PACKAGE USE;COOLER MASTER S3N-9IWLS-06-GP,SAFETY CONTROLLED HEAT SINK,SEMIC; IC,PROCESSOR;ALUMINUM WITH 12V FAN FOR INTEL PENTIUM 4 PROCESSOR,W/ THERMAL CONDUCTIVITY GREASE,0.42 DEG C/W;COOLER MASTER E2U-N73EC-03,SAFETY CONTROLLED
-29	119-7333-XX	B030000		1	P4 LGA775 FAN-SINK-BRACKET FROM AVC.

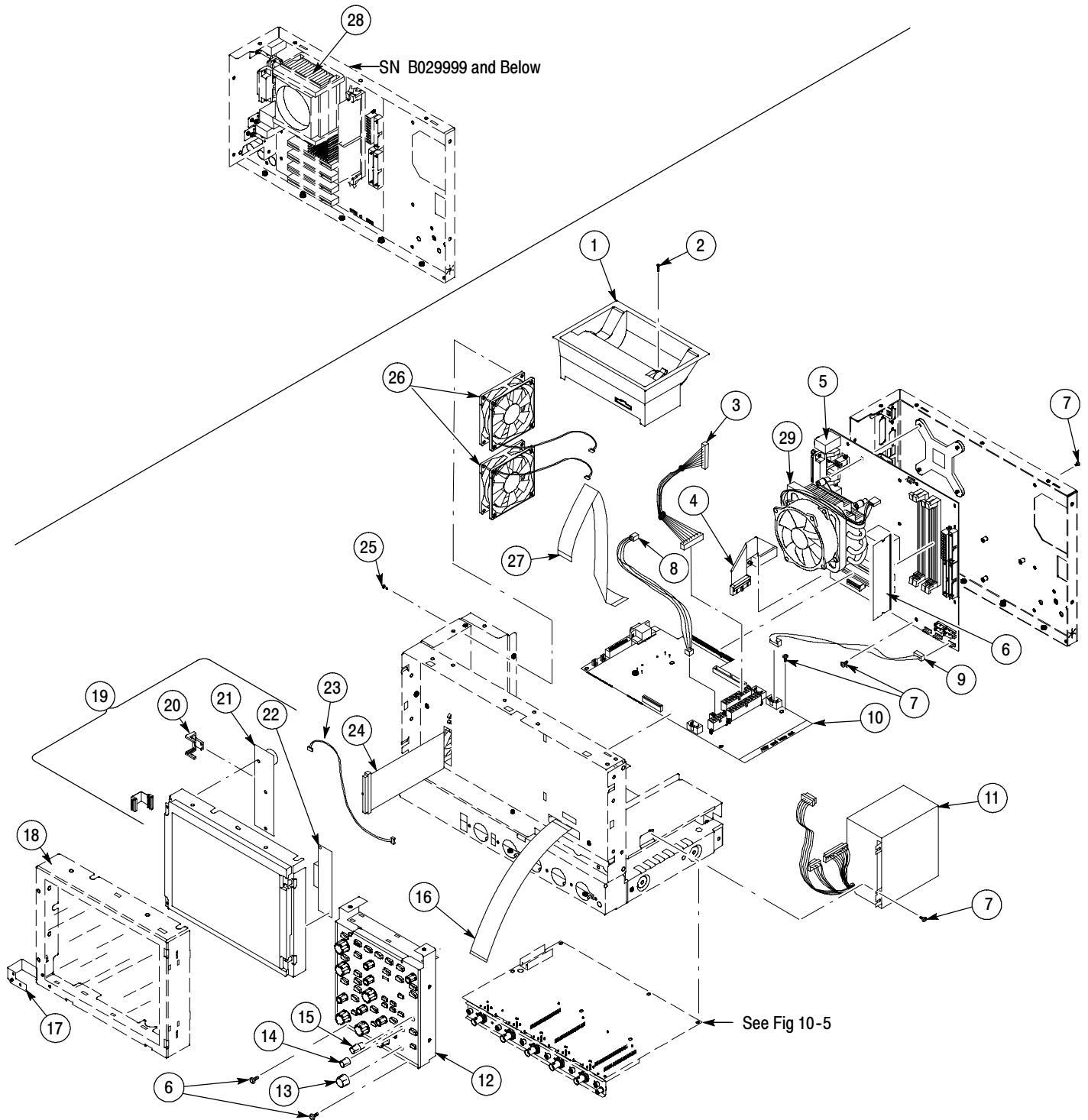


Figure 10-3: Modules

Drives

Fig. & index number	Tektronix part number	Serial no. effective	Serial no. discont'd	Qty	Name & description
10-4-1	119-6873-XX			1	DISK DRIVE; WINCHESTER,3.5 IN,80GB,180GXP FAMILY,IDE,SINGLE PLATTER UDMA100,7200RPM;07N9685,SAFETY CONTROLLED
-2	174-0747-XX			4	SCREW,MACHINE; 6-32 X 0.188,PNH,STL,CDPL,T-15 TORX DR
-3	407-4951-XX			1	BRKT,MOUNTING; HARD DISK DRIVE, .050 ALUM
-4	174-4671-XX	B010100	B029999	2	CA ASSY,SP; ULTRA DMA/ATA HARD DISK DRIVE,IDE,18.0 L
4a	174-5273-XX	B030000		2	CA ASSY; HARD DISK DATA CABLE, SATA, STRAIGHT, 0.5M LONG
-5	119-6833-XX			1	DISK DRIVE; USB FLOPPY,3.5 INCH;1.44MB,0.5 INCH,TWO SIDED,DOUBLE DENSITY
-6	407-4706-XX	B010100	B029999	1	BRACKET:FLOPPY DRIVE,6.064 X 5.075,ALUMINUM
6a	407-5236-XX	B030000		1	BRACKET ASSY; FLOPPY DRIVE,GAL-XC STEEL;TDS5034B
-7	211-1079-XX			2	SCREW,MACHINE:2.6 X 0.45 MM,3.0L,PNH,STL,PHILLIPS
-8	174-4808-XX			1	CA ASSY; USB 2.0,DUAL HEAD,16.0 L
-9	174-4881-XX			1	CABLE ASSY; 4 PIN P4 POWER,7.5 L,MOTHER BOARD TO INTERFACE
-10	211-1050-XX	B010100	B029999	2	SCREW,MACHINE:6-32 X 0.312 L,PNH,STL CAD,T15
-11	211-1081-XX			1	SCREW,MACHINE; M3 X 0.5 X 3.5MM,FLAT WAFER HD W/SERRATIONS STRESS RELIEVED,PHL,0.0002 STL ZI PLT
-12	407-4964-XX			1	BRACKET ASSY; CD-RW DISK DRIVE,0.050 AL
-13	119-6839-XX			1	DISK DRIVE; OPTICAL,CD-RW,5.25 SLIM,IDE,24X,24X,10X,650/700MB,110MS;CD-W224E-A93
-14	103-0443-XX			1	ADAPTER; FOR CD-ROM DRIVE,SLIMLINE,IDE INTERFACE CONNECTOR,FOX CONN HL149207 OR EQUILIADAPTER; FOR CD-ROM DRIVE,SLIMLINE,IDE INTERFACE CONNECTOR,FOX CONN HL149207 OR
-15	174-7671-XX			1	CA ASSY,SP; ULTRA DMA/ATA HARD DISK DRIVE,IDE,18.0 L
-16	441-2350-XX			1	BRACKET; REMOVABLE HD BOTTOM; GAL-XC; STEEL
-17	679-5705-XX			1	IDE1 ADAPTER BOARD
-18	065-0740-XX 065-0764-XX	B010100 B030000	B029999	1	MASTER DRIVE ASSEMBLY KIT; REMOVEABLE HARD DISK DRIVE DRIVE ASSEMBLY; REMOVEABLE HARD DISK DRIVE
-19	211-1081-XX			1	SCREW,MACHINE; M3 X 0.5 X 3.5MM,FLAT WAFER HD W/SERRATIONS STRESS RELIEVED,PHL,0.0002 STL ZI PLT
-20	407-4944-XX			1	BRACKET; REMOVABLE HD BOTTOM; GAL-XC; STEEL
-21	119-6832-XX			1	DISK DRIVE; WINCHESTER,2.5 IN,40 GB, IDE/ATAPI-6,4200 RPM,9.5MM,SINGLE PLATER
-22	211-1177-XX			2	SCREW, THUMB, CAPTIVE; 6-32X.750 STAINLESS STEEL
-23	200-4848-XX			1	COVER; FHD,REMOVEABLE
-24	407-4945-XX			1	BRKT SUPPORT,REMOVABLE HD: TOP,GAL-XC;STEEL
-25	679-5654-XX	B010100	B029999	1	HDD ADAPTER; PTTHON

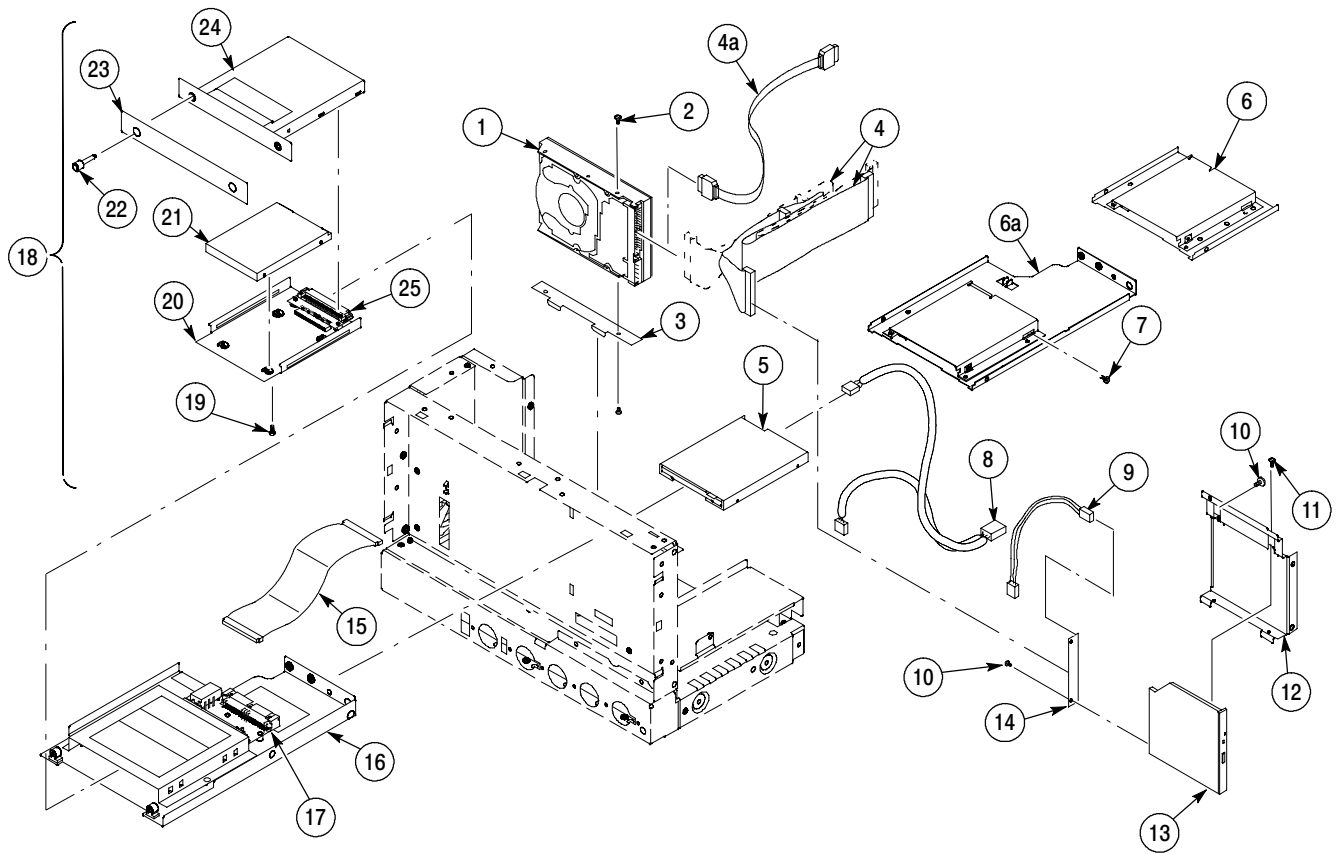


Figure 10-4: Drives

Acquisition assembly

Fig. & index number	Tektronix part number	Serial no. effective	Serial no. discont'd	Qty	Name & description
10-5-1	671-5738-XX			1	CKT BD SUBASSY:ACQUISITION, TDS5104
	671-5739-XX			1	CKT BD SUBASSY:ACQUISITION, TDS5054, TDS5034B, TDS5054BE
	671-5740-XX			1	CKT BD SUBASSY:ACQUISITION, TDS5052, TDS5032B
-2	211-1050-XX			6	SCREW,MACHINE:6-32 X 0.312 L,PNH,STL CAD,T15
-3	174-2729-XX			1	CABLE ASSY:COAX,RFP,50 OHM,5.5 L,PELTOLA BOTH ENDS
-4	174-2637-XX			1	CABLE ASSY:,RF,50 OHM COAX,7.0 L,,PELTOLA BOTH ENDS
-5	175-8029-XX			1	CABLE ASSY,RF:50 OHM COAX,12.0 L,PELTOLA X PELTOLA
-6	131-1315-XX			3	CONN,RF JACK:BNC/PNL,50 OHM PELTOLA/REAR PNL, WITH HARDWARE
-7	174-4483-XX			1	CABLE ASSY:FLEX,20 COND,PROBE INTERFACE
-8	679-5209-XX			1	CKT BD SUBASSY:PROBE INTERFACE

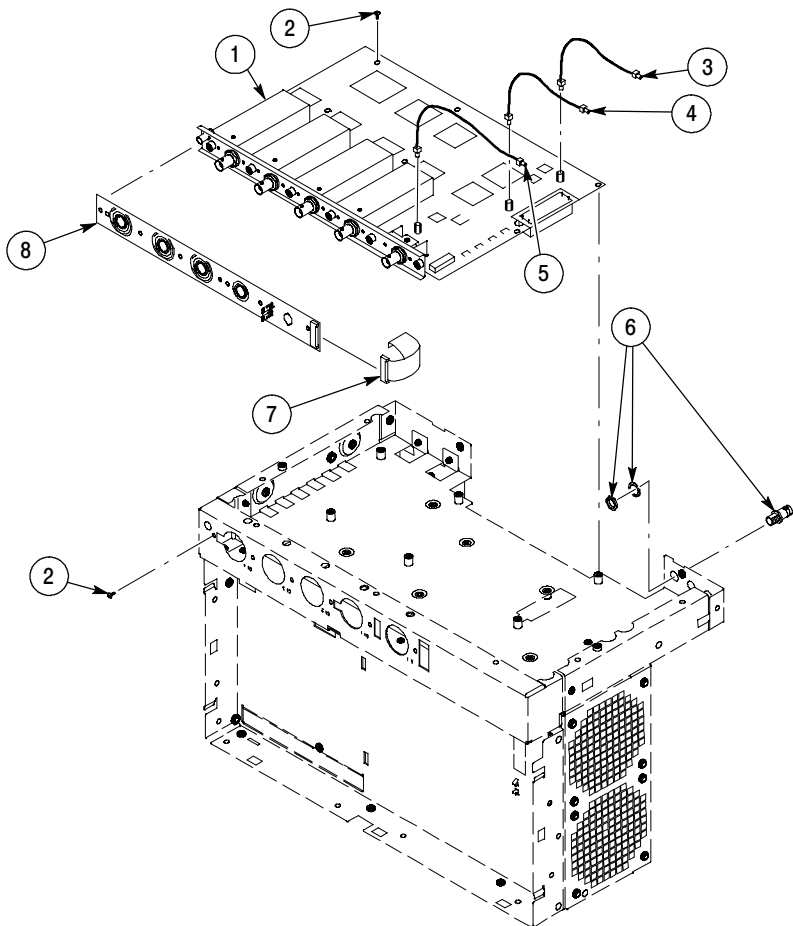


Figure 10-5: Acquisition assembly

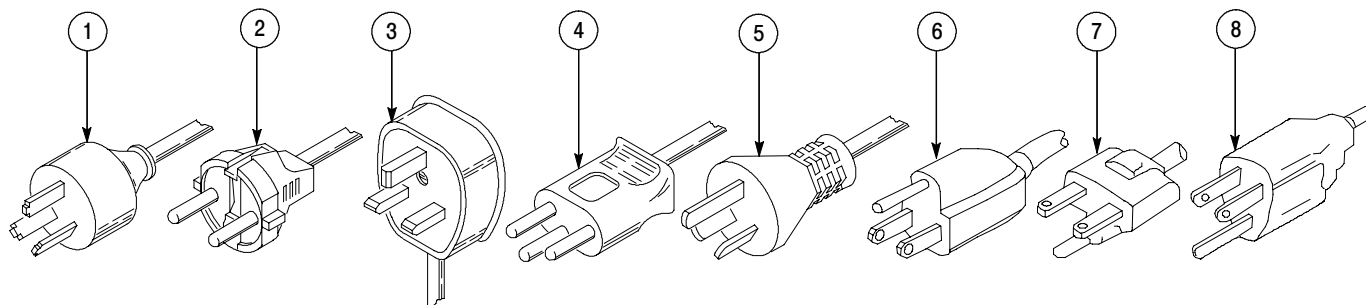


Figure 10-6: Accessories

Accessories

Fig. & index number	Tektronix part number	Serial no. effective	Serial no. discont'd	Qty	Name & description
STANDARD ACCESSORIES					
10-6-1	161-0104-05			1	CA ASSY,PWR:3,1.0MM SQ,250V/10A,2.5 METER, (OPTION A3 - AUSTRALIA)
-2	161-0104-06			1	CA ASSY,PWR:3,1.0MM SQ,250V/10A,2.5 METER, (OPTION A1 - EUROPEAN)
-3	161-0104-07			1	CA ASSY,PWR:3,1.0MM SQ,240V/10A,2.5 METER,FUSED, (13A FUSE) (OPTION A2 - UNITED KINGDOM)
-4	161-0167-00			1	CA ASSY,PWR:3,0.75MM SQ,250V/10A,2.5 METER, (OPTION A5 - SWITZERLAND)
-5	161-0306-00			1	CA ASSY,PWR:3,1.0MM SQ,250V/10A,2.5 M (OPTION AC - CHINA)
-6	161-0104-00			1	CABLE ASSY,PWER,;3,18 AWG,92 L (STANDARD CABLE - NORTH AMERICA)
-7	161-0104-08			1	CABLE ASSY,PWR; 3,18 AWG,250/10A,98.0 L,RTANG,IEC320,RCPT X STR,NEMA 6-15P,US, (NORTH AMERICA 240V)
-8	161-A005-XX			1	CABLE ASSY,PWR; JAPANESE T MARK,
	200-4651-XX			1	COVER,FRONT; PC/ABS ALLOY BAYBLEND,FR110,TEK BLUE
	020-2434-XX			1	ACCESSORY KIT; DUAL JEWEL CASE,W/BLANK CD-R,CD-RW
	020-2450-XX			1	ACCESSORY KIT; OPTIONAL APPLICATIONS SOFTWARE
	020-2476-XX			1	30 DAY EVALUATION COPY OF LABVIEW
	063-3609-XX				30 DAY EVALUATION COPY OF MATLAB
	020-2513-XX			1	ACCESSORY KIT; BASIC CONCEPTS MANUAL & SOFTWARE DEVELOPMENT KIT; OPEN CHOICE SOLUTIONS
	063-3692-XX				TDS5000B Series Product Software CD
	063-4049-XX	SN B030000			TDS5000B Series Elo Touchscreen Switcher Software CD
	063-3693-XX	SN B010100	SN B019999		TDS5000B Series Operating System Restore CD
	063-3759-XX	SN B020000	SN B029999		TDS5000B Series Operating System Restore CD
	063-3985-XX	SN B030000			TDS5000B Series Operating System Restore CD

Accessories (Cont.)

Fig. & index number	Tektronix part number	Serial no. effective	Serial no. discont'd	Qty	Name & description
	071-1355-XX			1	MANUAL,TECH;QUICK START REFERENCE,ENGLISH,TDS5000B SERIES
	071-1356-XX			1	MANUAL,TECH;QUICK START REFERENCE,JAPANESE,TDS5000B SERIES
	071-1357-XX			1	MANUAL,TECH;QUICK START REFERENCE,FRENCH,TDS5000B SERIES
	071-1358-XX			1	MANUAL,TECH;QUICK START REFERENCE,GERMAN,TDS5000B SERIES
	071-1359-XX			1	MANUAL,TECH;QUICK START REFERENCE,KOREAN,TDS5000B SERIES
	071-1360-XX			1	MANUAL,TECH;QUICK START REFERENCE,SIMPLIFIED CHINESE,TDS5000B SERIES
	071-1361-XX			1	MANUAL,TECH;QUICK START REFERENCE,TRADITIONAL CHINESE,TDS5000B SERIES
	071-1401-XX			1	MANUAL,TECH;QUICK START REFERENCE,RUSSIAN,TDS5000B SERIES
	119-6936-XX			1	POINTER ASSY,MOUSE; USB,WHITE,OPTICAL THREE BUTTON WHEELED,W/USB TO PS2 ADAPTER,ABS
OPTIONAL ACCESSORIES					
	118-9402-XX			1	KEYBOARD ASSY; 83 KEY NOTEBOOK KEYBOARD,IBM AT OR PS/2 COMPATIBLE,GRAY
	071-1362-XX			1	MANUAL,TECH:SERVICE TDS5000B
	016-1946-XX			1	Kit:RACKMOUNT (OPTION 1R)
	655-4920-XX			1	MODULAR KIT:PRINTER,STAND ALONE