

Service Manual



TDS3000C Series Digital Phosphor Oscilloscopes 071-2507-00

This document supports firmware version 4.00
and above for TDS3000C Series instruments only.

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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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.

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. Connect the probe output to the measurement instrument before connecting the probe to the circuit under test. Disconnect the probe input and the probe ground from the circuit under test before disconnecting the probe from the measurement instrument.

Ground the Product. When operating with AC power, 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.

When operating with battery power, this product must still be grounded. To prevent electric shock, always connect a grounding wire between the ground terminal on the rear panel and earth ground.

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.

Connect the ground lead of the probe to earth ground only.

Replace Batteries Properly. Replace batteries only with the proper type and rating specified.

Recharge Batteries Properly. Recharge batteries for the recommended charge cycle only.

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

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

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

Do Not Operate in Wet/Damp Conditions.

Do Not Operate in an Explosive Atmosphere.

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.

Safety Terms and Symbols

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



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



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

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

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

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

CAUTION indicates a hazard to property including the product.

Symbols on the Product. These symbols may appear on the product:



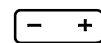
WARNING
High Voltage



Protective Ground
(Earth) Terminal



CAUTION
Refer to Manual



Battery
Information



Ethernet Port



Chassis Ground

Preventing Electrostatic Damage



CAUTION. *Electrostatic discharge (ESD) can damage components in the oscilloscope and its accessories. To prevent ESD, observe these precautions when directed to do so.*

Use a Ground Strap. Wear a grounded antistatic wrist strap to discharge the static voltage from your body while installing or removing sensitive components.

Use a Safe Work Area. Do not use any devices capable of generating or holding a static charge in the work area where you install or remove sensitive components. Avoid handling sensitive components in areas that have a floor or benchtop surface capable of generating a static charge.

Handle Components Carefully. Do not slide sensitive components over any surface. Do not touch exposed connector pins. Handle sensitive components as little as possible.

Transport and Store Carefully. Transport and store sensitive components in a static-protected bag or container.

Service Safety Summary

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

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

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

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

To avoid electric shock, do not touch exposed connections.

Preface

This Service manual provides information to troubleshoot, disassemble, and repair the following TDS3000C Series Digital Phosphor Oscilloscopes instrument to the module level:

- TDS3012C
- TDS3014C
- TDS3032C
- TDS3034C
- TDS3052C
- TDS3054C

Operating Information

This chapter provides an overview of the following topics:

- Connecting power and using the battery pack
- Installing an application module
- Installing a communication module
- Front-panel menus and controls
- Front- and rear-panel connectors
- Probe compensation
- Self calibration
- Transporting the oscilloscope

For details about operating information, see the *TDS3000C Series Digital Phosphor Oscilloscope User Manual*.

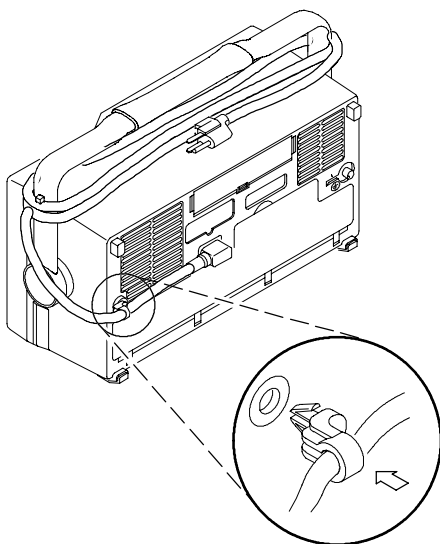
For information about unpacking and inspecting the instrument, see *Unpacking and Repacking Instructions* on page 4–39 of this manual.

Connecting Power

To connect a power cord, do these steps:

1. Open the strain relief clip and slip it onto the power cord.
2. Snap the strain relief into its hole in the rear panel of the oscilloscope.
3. Connect the power cord to the power input connector.

You can operate the oscilloscope from a grounded mains supply with line voltage between 90 V_{AC} and 250 V_{AC} and frequency between 47 Hz and 440 Hz. The oscilloscope is grounded through the power cord. The line fuse is internal and is not user replaceable.



Using Battery Power

You can operate the oscilloscope continuously for up to three hours from the TDS3BATC rechargeable battery pack. A triangle icon in the display () shows when the battery is in use, a power-plug icon () shows when line power is connected, and a gauge icon () shows the relative charge level in the battery. The oscilloscope turns off automatically when the battery runs low.

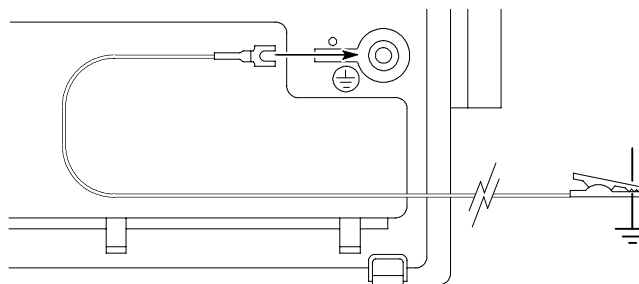
Refer to the *General Safety Summary* for information about proper rechargeable battery disposal.

Operating Safely with Battery Power



WARNING. To avoid electric shock, always connect the rear-panel ground terminal to earth ground when operating the instrument from battery power.

For safe operation, the oscilloscope chassis must remain at earth ground potential even when operating from battery power. Without a connection between the chassis and earth ground, you can receive a shock from exposed metal on the chassis if you connect an input to a hazardous voltage ($>30\text{ V}_{\text{RMS}}$, $>42\text{ V}_{\text{pk}}$). To protect against this condition, attach the Tektronix-supplied grounding wire from the terminal on the rear panel to earth ground. If you use a different grounding wire, it must be larger than 18 gauge (1 mm^2).

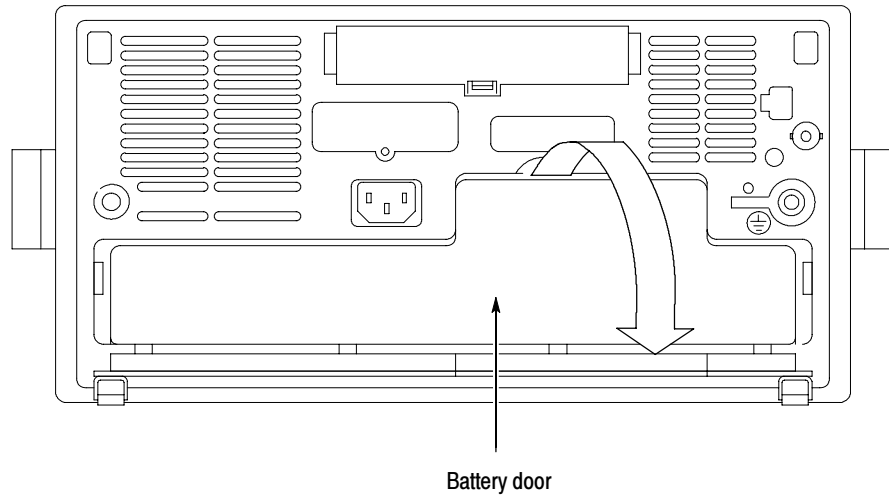


When you start to use the battery pack, an on-screen message reminds you to connect the grounding wire between the ground terminal on the rear panel and earth ground.

Installing and Removing the Battery

To install the optional battery pack, do these steps:

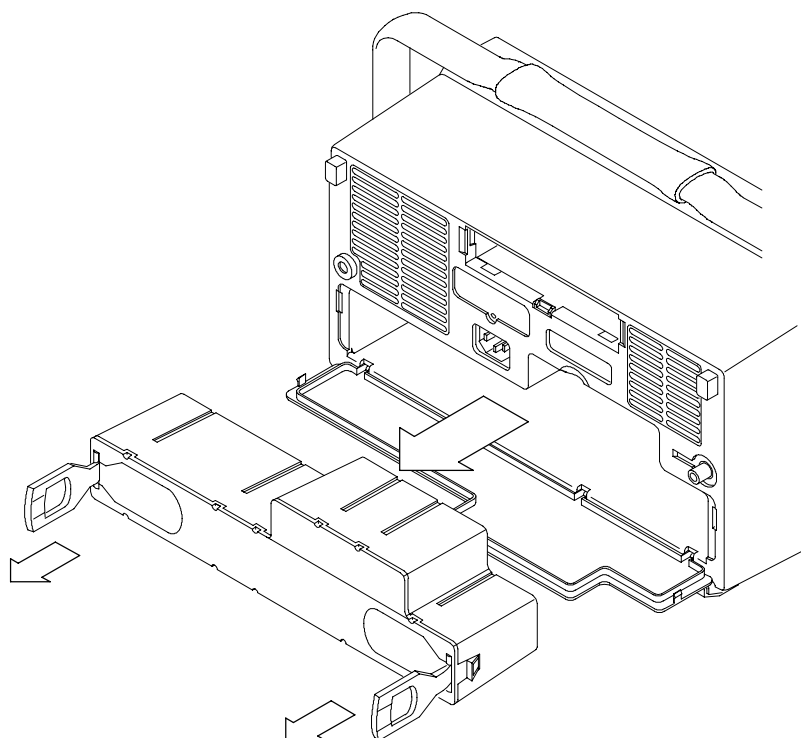
1. Open the battery compartment door on the rear panel and remove the accessory tray.



2. Slide the battery into the compartment and press it in from both sides until you hear the latches click.
3. Press on both sides of the battery compartment door to snap it closed.

To remove the battery, do these steps:

1. Open the battery compartment door.
2. Lift the battery handles and pull the battery out of the oscilloscope.

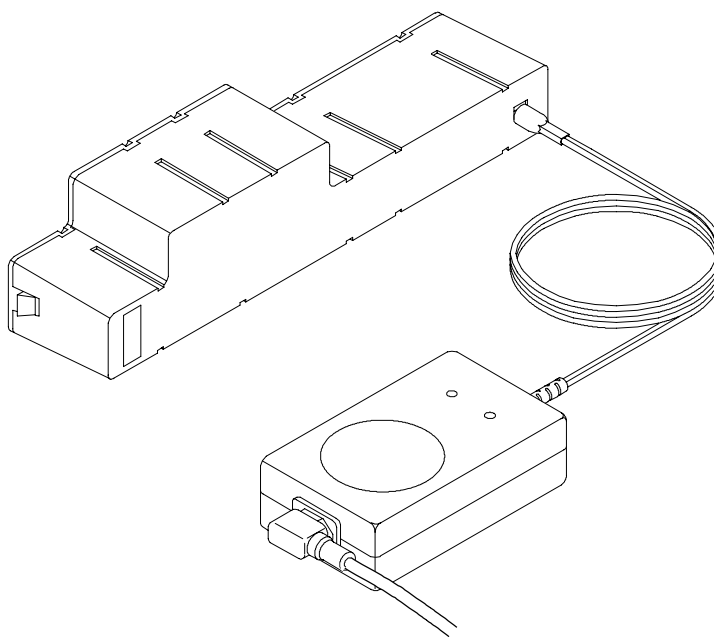


Charging the Battery

The battery charges automatically when the oscilloscope is connected to line power. You can also charge the battery with the optional external charger (TDS3CHG).

Configuration	Typical charging time
Battery charging in oscilloscope with oscilloscope turned on or off	32 hours
Battery charging with TDS3CHG external charger	6 hours

NOTE. Charge the battery before using it for the first time or after prolonged storage.

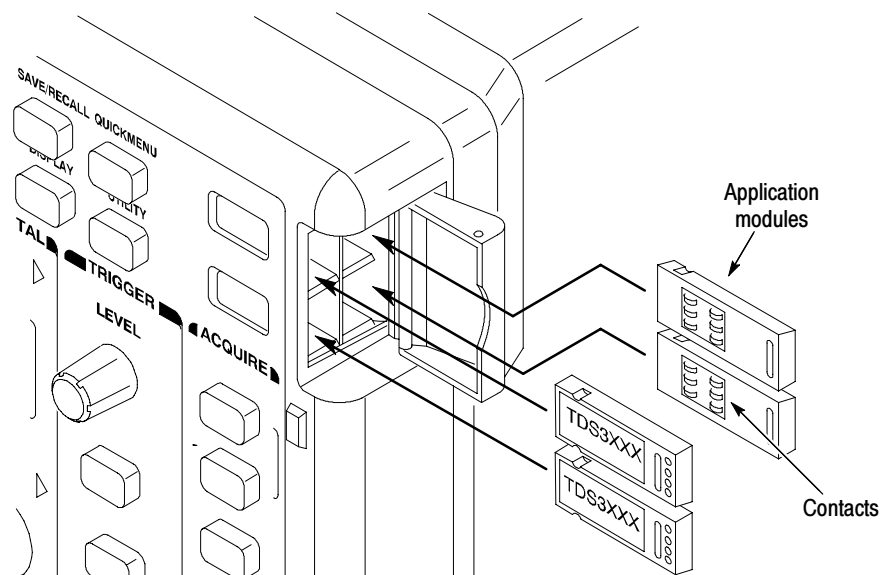


Installing an Application Module



CAUTION. To avoid damage to the oscilloscope or application module, observe the ESD precautions described on page vii.

Optional application packages are available to extend the capability of your oscilloscope. You can install up to four application modules at one time. Application modules can go into the two slots with windows in the upper right corner of the front panel. Two additional slots are directly behind the two you can see.



Refer to the *TDS3000, TDS3000B, and TDS3000C Series Application Module Installation* manual that came with your application module for instructions on installing and testing an application module.

NOTE. If you remove an application module, the functions provided by the application module become unavailable. You can reinstall the module to restore the functions.

Installing a Communication Module



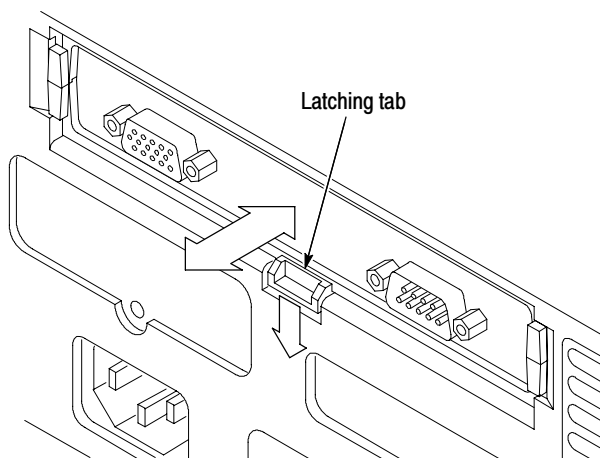
CAUTION. To avoid damage to the oscilloscope or communication module, observe the ESD precautions described on page vii.

To install the optional communication module, do these steps:

1. Turn the oscilloscope power off.
2. Press down on the latching tab to remove the blank cover.
3. Slide the communication module into the compartment until the internal connectors are seated and the latching tab locks.
4. Turn power on. The communication module is now ready for your use.

To remove a communication module, do these steps:

1. Turn the oscilloscope power off.
2. Press down on the latching tab and then use a small screwdriver to alternately pry out the sides of the communication module.
3. Slide out the communication module and store it in an ESD-shielded bag. Install the blank cover if no other communication module is to be installed.



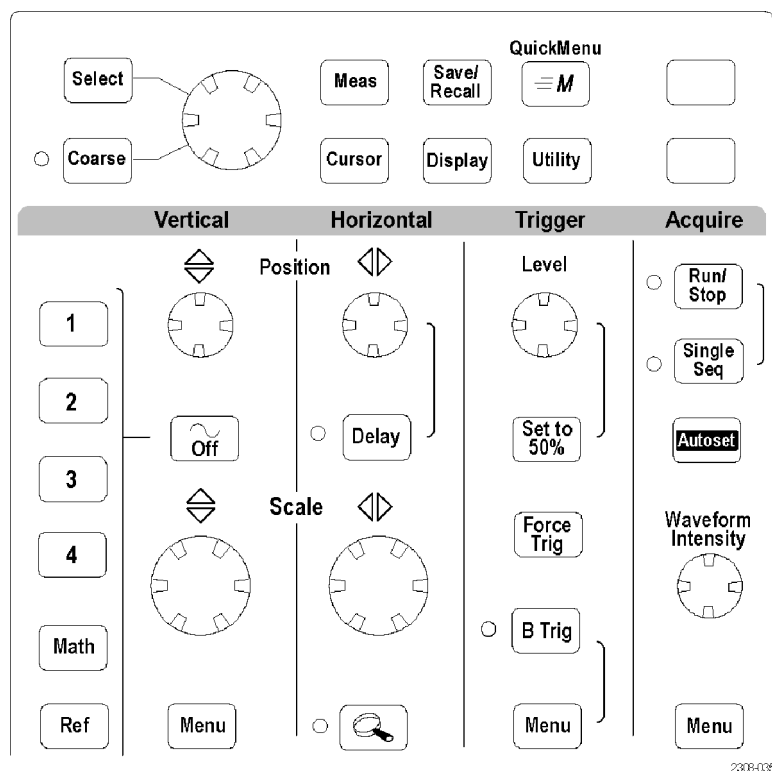
Front-Panel Menus and Controls

The front panel has buttons and controls for the functions you use most often. The front panel has menus to access more specialized functions.

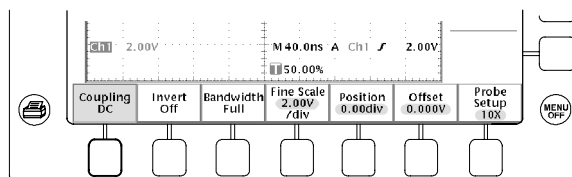
Using the Menu System

To use the menu system, follow the steps shown on the next two pages.

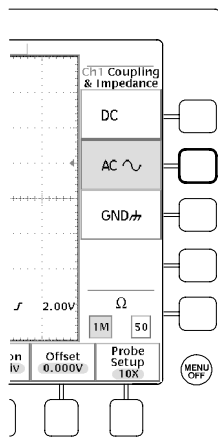
1. Push a front-panel menu button to display the menu you want to use.



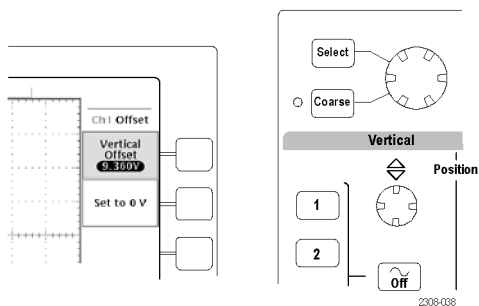
2. Push a bottom screen button to select a menu item. If a pop-up menu appears, continue to push the screen button to select an item from the pop-up menu.



3. Push a side screen button to choose a menu item. If the menu item contains more than one choice, push the side screen button again to make the choice.



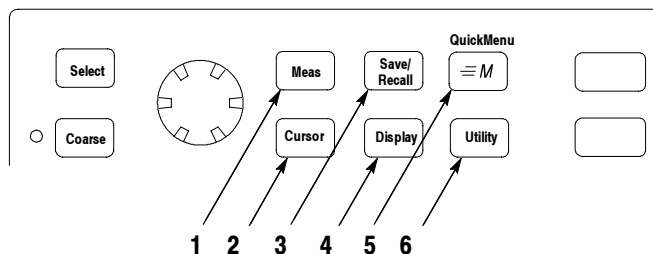
4. Certain menu choices require you to set a numerical value to complete the setup. Use the general purpose knob to adjust the parameter value. Push the **Coarse** button to make larger adjustments.



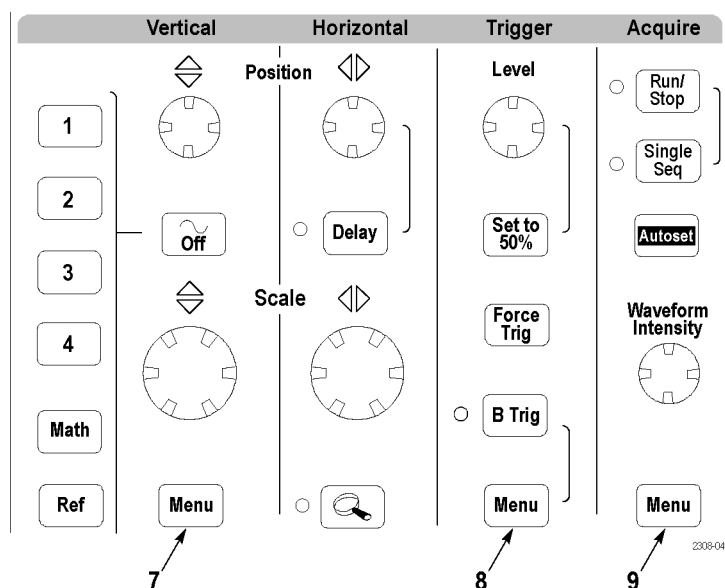
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Using the Menu Buttons

You can use the menu buttons to perform many functions in the oscilloscope.



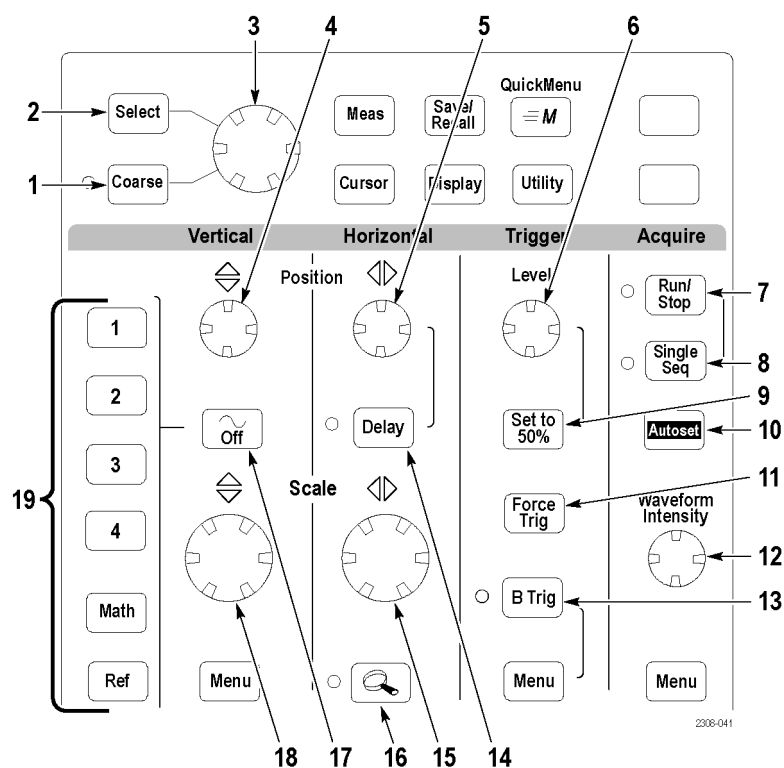
1. **Meas.** Performs automated measurements of waveforms.
2. **Cursor.** Activates the cursors.
3. **Save/Recall.** Saves and recalls setups and waveforms to memory or a USB flash drive.
4. **Display.** Changes the appearance of waveforms and the display screen.
5. **QuickMenu.** Activates QuickMenus such as the built-in Scope QuickMenu.
6. **Utility.** Activates the system utility functions, such as selecting a language.



7. **Vertical Menu.** Adjusts the scale, position, and offset of waveforms. Sets the input parameters.
8. **Trigger Menu.** Adjusts the trigger functions.
9. **Acquire Menu.** Sets the acquisition modes and horizontal resolution, resets the delay time, and accesses the WaveAlert™ menu.

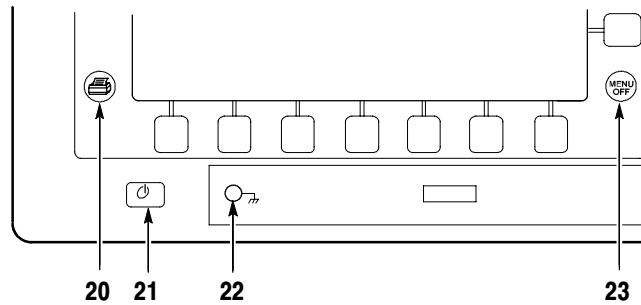
Using the Dedicated Controls

These dedicated buttons and controls generally control waveforms and cursors without the use of menus.



1. **Coarse.** Causes the general purpose knob and position knobs to make adjustments more quickly.
2. **Select.** Toggles between the two cursors to select the active cursor.
3. **General purpose knob.** Moves the cursors. Sets numerical parameter values for some menu items. Push **Coarse** to make adjustments quickly.
4. **Vertical Position.** Adjusts the vertical position of the selected waveform. Push **Coarse** to make adjustments more quickly.
5. **Horizontal Position.** Adjusts the trigger point location relative to the acquired waveforms. Push **Coarse** to make adjustments quickly.

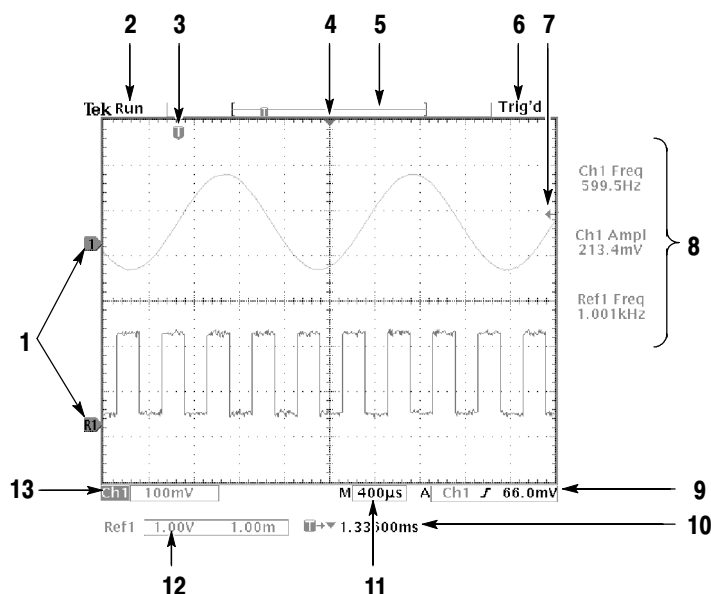
- 6. Trigger Level.** Adjusts the trigger level.
- 7. Run/Stop.** Stops and restarts acquisition.
- 8. Single Seq.** Sets acquisition, display, and trigger parameters for a single-shot (single-sequence) acquisition.
- 9. Set To 50%.** Sets the trigger level to the midpoint of the waveform.
- 10. Autoset.** Automatically sets the vertical, horizontal, and trigger controls for a usable display.
- 11. Force Trig.** Forces an immediate trigger event.
- 12. Waveform Intensity.** Controls waveform intensity.
- 13. B Trig.** Activates the B trigger. Changes the trigger menu to set the B-trigger parameters.
- 14. Delay.** Enables delayed acquisition relative to the trigger event. Use **Horizontal Position** to set the amount of delay.
- 15. Horizontal Scale.** Adjusts the horizontal scale factor.
- 16. Horizontal zoom.** Splits the screen and magnifies the current acquisition horizontally.
- 17. Waveform Off.** Removes the selected waveform from the display.
- 18. Vertical Scale.** Adjusts the vertical scale factor of the selected waveform.
- 19. CH1, CH2, (CH3, CH4,) Math.** Displays a waveform and chooses the selected waveform. **Ref** shows the reference waveform menu.



- 20. Hard copy.** Initiates a hard copy using the port selected in the Utility menu.
- 21. Power.** Turns power to on or standby.
- 22. Wrist-strap ground.** Use to connect a wrist strap when working with ESD-sensitive circuits. This connector is not a safety ground.
- 23. Menu Off.** Clears menu from the display.

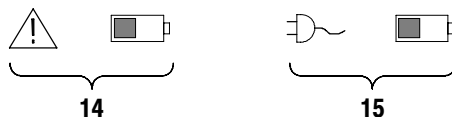
Identifying Items in the Display

The following items may appear in the display; not all items are visible at any given time. Some readouts move outside the graticule area when menus are turned off.



1. Waveform baseline icons show the zero-volt level of the waveforms (ignoring the effect of offset). The icon colors correspond to the waveform colors.
2. Acquisition readout shows when acquisition is running, stopped, or when acquisition preview is in effect.
3. Trigger position icon shows the trigger location in the waveforms.
4. Expansion point icon shows the point that the horizontal scale expands and compresses around.
5. Waveform record icon shows the trigger location relative to the waveform record. The line color corresponds to the selected waveform color.
6. Trigger status readout shows trigger status.
7. Trigger level icon shows the trigger level on the waveform. The icon color corresponds to the trigger source channel color.
8. Cursor and measurement readouts show results and messages.
9. Trigger readouts show the trigger sources, slopes, and levels, and position.
10. Readout shows the delay setting or the trigger location within the record.
11. Horizontal readout shows the main or zoom time/division.

12. Auxiliary waveform readouts show the vertical and horizontal scale factors of the math or reference waveforms.
13. Channel readouts show the channel scale factor, coupling, input resistance, bandwidth limit, and invert status.

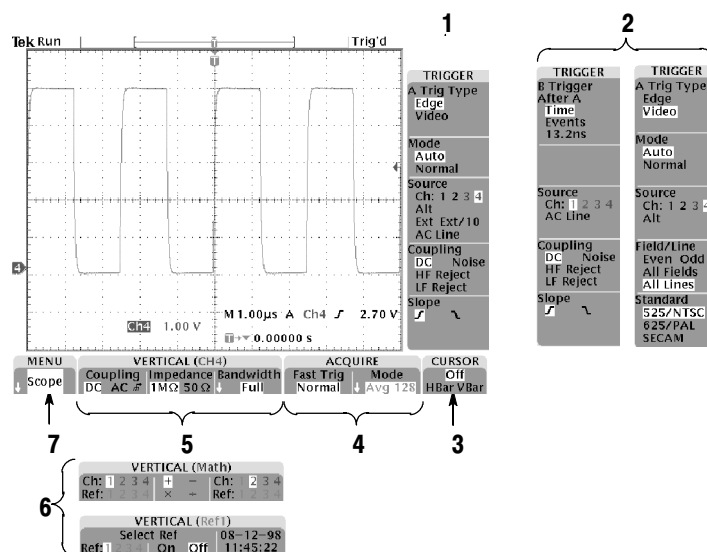


14. A triangle icon with the battery icon indicates that a battery is installed and battery power is in use. The battery icon shows the approximate charge level of the battery. See page 1-3 for important safety information.
15. A power-plug icon with the battery icon indicates that a battery is installed but line power is in use. The battery may be charging. The battery icon shows the approximate charge level.

Using Quick Menus

The QuickMenu feature simplifies the use of the oscilloscope. When you push the QuickMenu button, a set of frequently used menu functions show on the display. Then, push the screen buttons around the display to operate the QuickMenu.

Using the Scope QuickMenu. Scope is one type of QuickMenu that you can use to control the basic oscilloscope functions. You can perform many tasks without using the regular menu system. If you need to use a function that is not contained in the Scope QuickMenu, push the button you would normally push to access that function. For example, if you want to add an automatic measurement, push the Meas button to set up the measurement. Then, push the QuickMenu button to return to the Scope QuickMenu with the measurement also in the display.

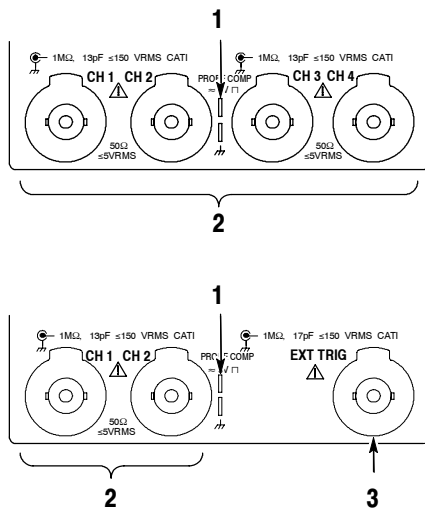


1. Edge Trigger controls. Push these screen buttons to set trigger parameters for edge trigger.
2. Trigger controls if either B trigger or video trigger is selected.
3. Cursor control. Push this screen button to turn on cursors and select the cursor type. Push the SELECT button to toggle between the two cursors to select the active cursor. Use the general purpose knob to move the active cursor.
4. Acquisition controls. Push these screen buttons to set acquisition parameters.
5. Channel vertical controls. Push these screen buttons to set vertical controls for the selected channel. Use the CH1, CH2, CH3, CH4, MATH, and REF buttons to select the channel you want to control.
6. Vertical controls if either the math waveform or a reference waveform is selected.
7. Menu. Push this screen button to select a specific QuickMenu display if more than one is available.

NOTE. Items in the Scope QuickMenu display not mentioned above are also contained in the regular display. Those items are described on page 1-15.

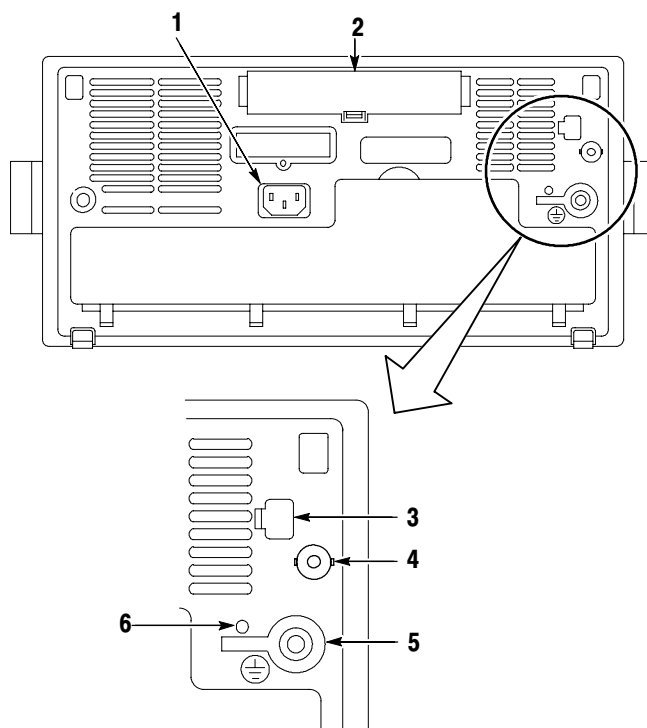
Other QuickMenus. Some optional application packages include a custom QuickMenu display. Those QuickMenus contain specific features that are important for the application.

Front-Panel Connectors



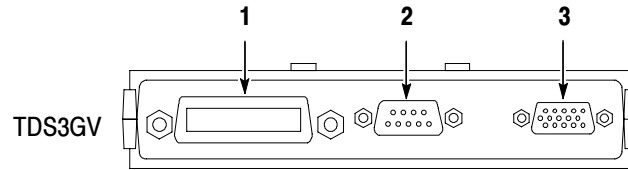
1. PROBE COMP. Square wave signal source to compensate probes.
2. CH1, CH 2, (CH3, CH4). Channel inputs with TekProbe interface.
3. EXT TRIG. External trigger input with TekProbe interface (two-channel models only). Four-channel models have an external trigger input on the rear of the oscilloscope.

Rear-Panel Connectors



1. Power input. Attach to an AC power line with integral safety ground.
2. Communication Module compartment. Install optional communication modules.
3. Ethernet port. Connects the oscilloscope to a 10BaseT local area network.
4. External Trigger input (four-channel models only). See the *Specifications* appendix for external trigger signal requirements.
5. Ground terminal. Connect to earth ground when using battery power. See page 1-3 for important safety information.
6. CAL switch. For use by authorized service personnel only.

Communication Module Connectors



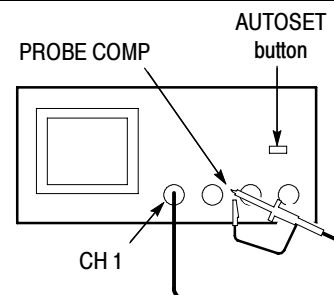
1. GPIB port. Connect to a controller for remote programmability.
2. RS-232 port. Connect to a controller or terminal for remote programmability or printing.
3. VGA port. Connect to a VGA monitor to display the screen image.

Probe Compensation

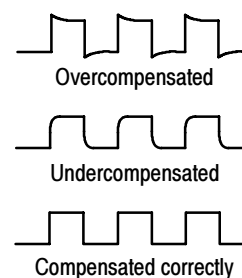
Perform this adjustment to match your probe to the input channel. This should be done whenever you attach a passive probe for the first time to any input channel.

1. Connect the oscilloscope probe to channel 1. Attach the probe tip and reference lead to the **PROBE COMP** connectors, then push **AUTOSET**.

If using the probe hook-tip, ensure a proper connection by firmly twisting the tip onto the probe.

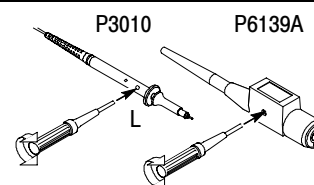


2. Check the shape of the displayed waveform.



3. If necessary, adjust your probe.

Repeat as necessary.



Self Calibration

The self calibration routine lets you quickly optimize the oscilloscope signal path for maximum measurement accuracy. You can run the routine anytime but you should always run the routine if the ambient temperature changes by 10° C or more.

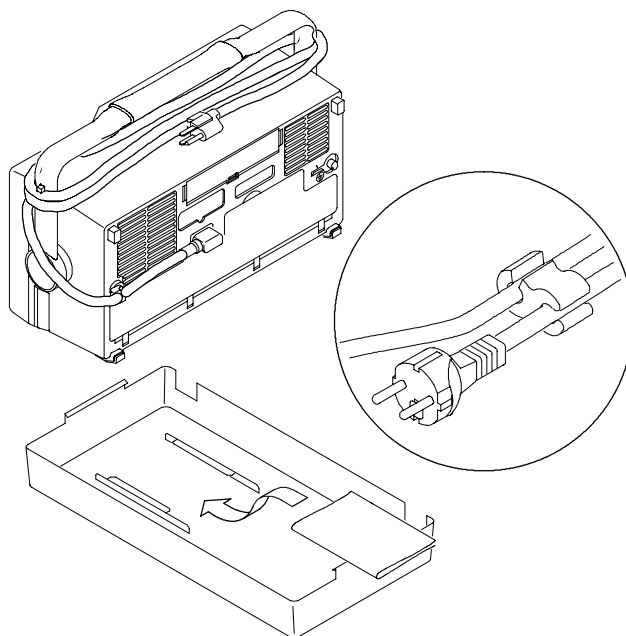
To compensate the signal path, do the following steps:

1. Disconnect any probes or cables from the channel input connectors.
2. Push the **UTILITY** button.
3. Push the **System** screen button to select **Cal**.
4. Push the **Signal Path** screen button.
5. Push **OK Compensate Signal Path**. This procedure takes several minutes to complete.

NOTE. *The signal path compensation does not include calibration to the probe tip.*

Transporting the Oscilloscope

When transporting the oscilloscope, wrap the cord around the handle as shown below. Use the supplied cord retainer if the power plug does not have a molded-in retainer. The oscilloscope front cover has a convenient place to store TDS3000C Series 1/4-size user and reference manuals.



If you are not using a battery, you can use the accessory tray in the battery compartment to store probes and other accessories.

Theory of Operation

This chapter describes the electrical operation of the oscilloscope to the module level. Figure 2-1 shows the oscilloscope module interconnections.

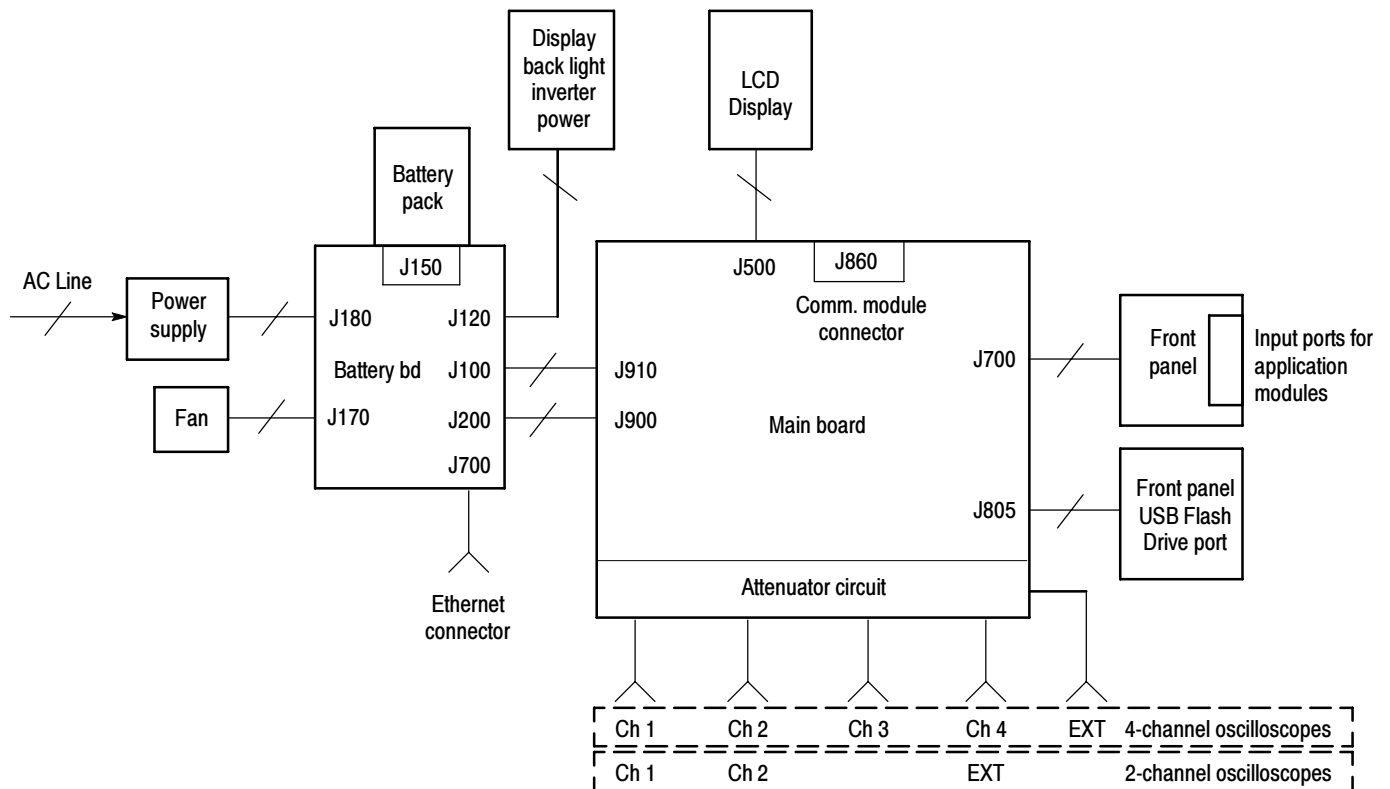


Figure 2-1: TDS3000C series block diagram

Power Supply

The power supply converts AC line voltage to 15 VDC to power all internal circuits. It also supplies power to charge the optional battery pack.

Battery Board

The battery board provides the following functions:

- Interfaces to the optional battery pack (powers the oscilloscope from the battery pack or charges the battery pack when the oscilloscope is connected to AC line).
- Turns on DC power to the oscilloscope.
- Converts 15 VDC from the power supply to 5 VDC for the main and front panel boards and ± 15 VDC for probe power.
- Powers the cooling fan.
- Provides power to the display backlight inverter board.
- Provides an Ethernet 10BaseT connector to connect the oscilloscope to a network.

Main Board

The Main Board module contains the following functions.

Acquisition System

The acquisition system begins with the analog signal path and ends with a digitized signal in memory. The signal enters a channel input and then passes through an attenuator and preamplifier. The analog signal from each preamplifier goes through a sampler and digitizer, a time base controller, and then into acquisition memory. The analog signal from each preamplifier is also distributed to a trigger circuit.

Trigger System

The trigger system processes the analog signals from the preamplifiers and sends trigger information to the time base controller. Advanced trigger functions are enabled only when the appropriate application modules and supporting software is installed.

Display System

The display system combines live waveform data from acquisition memory with menus and text and stores this information in display memory. It then uses this data to refresh the VGA display module (LCD).

Processor System

The processor system contains a MPC860 Power PC microprocessor that controls the entire instrument. The processor system also contains FLASH ROM, system RAM, and interfaces to communication modules and the front-panel USB Flash Drive port.

Power Converter

The power converter receives 15 VDC (or battery voltage) from the battery board and generates voltages for the analog and digital circuitry on the main board.

Display Module

The display module consists of a color liquid crystal display (LCD), a display driver, a pair of fluorescent back light tubes, and a high-voltage back light power supply.

Front-Panel Board

The front-panel board contains a microprocessor that reads the front-panel buttons and controls and then sends this information to the processor system. The front-panel board also generates the probe compensation output signal and provides an interface to the application modules.

USB Port

The front panel USB Flash Drive port is a host port. This port is only for use with a USB flash drive.

Adjustment Procedures

This chapter contains the factory adjustment procedures for the TDS3000C series oscilloscopes. Only qualified personnel should perform adjustment procedures. Read the *Service Safety Summary* and the *General Safety Summary* before performing any service procedures. Also refer to the chapter *Operating Information* for information about using the oscilloscope.

NOTE. *The voltage references inside the oscilloscope are very stable over time and should not require routine adjustment. Before performing any procedure in this chapter, do the Performance Verification procedures (found in the Specifications and Performance Verification technical reference, available on the Web at www.tektronix.com/manuals) to check whether or not the oscilloscope meets specifications.*

Successful completion of this adjustment procedure automatically updates the instrument Calibration Due date and time. Successful completion of the Performance Verification procedure does not update the instrument Calibration Due date and time.

Required Equipment

The following equipment, or a suitable equivalent, is required to complete these procedures.

Description	Minimum requirements	Example
DC voltage source	50 mV to 70 V, $\pm 0.1\%$ amplitude accuracy	Wavetek 9500 Oscilloscope Calibrator with one 9510 Output Module
Leveled sine wave generator	30 kHz to 80 MHz, 100 ppm frequency accuracy, 3% amplitude accuracy	
Fast-rise generator	100 Hz - 1 MHz repetition rate, 2.2 V Pk-Pk signal (~ 2.2 V to 0 V) unloaded signal, ≤ 1 ns rise time	
50 Ω BNC cable (five required ¹)	BNC male to BNC male, ≈ 10 in (25 cm.) long	Tektronix part number 012-0208-00
BNC T (three required ¹)	One male and two female BNC connectors	Tektronix part number 103-0030-00

Description	Minimum requirements	Example
BNC female-to-female adapter	Two female BNC connectors	Tektronix part number 103-0028-00
Adjustment tool	Non conducting shaft with diameter ≤ 2.5 mm (≤ 0.1 in)	Tektronix part number 003-1433-02

¹ The number required is reduced by two if you are adjusting a two-channel oscilloscope.

Overview of the Adjustment Process

The oscilloscope is protected from inadvertently changing factory adjustments by a rear-panel switch. To perform the factory adjustment, you must push and hold the switch while you power on the oscilloscope.

Before performing adjustment procedures, you must warm up the oscilloscope at least ten minutes in an ambient temperature between 20° C and 30° C. Adjustments performed prior to warm-up or outside this temperature range may result in poor performance. You must also recall the default factory settings before starting the factory adjustment procedure.

The factory adjustment procedure consists of a series of steps; as you move through these steps, the oscilloscope display provides instructions that describe the specific input signal requirements for each step. If the step passes, the oscilloscope moves on to the next step. If any step fails, you can repeat the step or choose to abort the procedure.

NOTE. Do not turn any knobs or push any front-panel buttons other than the Next Step or Previous Step buttons during the adjustment procedure. Doing so will cause the oscilloscope to abort the adjustment procedure. The oscilloscope uses the previous calibration constants if the adjustment procedure is aborted.

The screen does not display the actual oscilloscope settings (such as channel input impedance, vertical and horizontal settings, and so on) during the adjustment procedure. The oscilloscope automatically sets the instrument settings, but these settings may not read out correctly on the display.

During some steps, the instrument may appear to be idle for several minutes while it is processing information internally. Please have patience.

If all steps in the procedure are completed successfully, a “Pass” message is displayed and the new calibration constants take affect. If the procedure fails for any reason, the oscilloscope reverts to the previous calibration settings.

Signal Connections

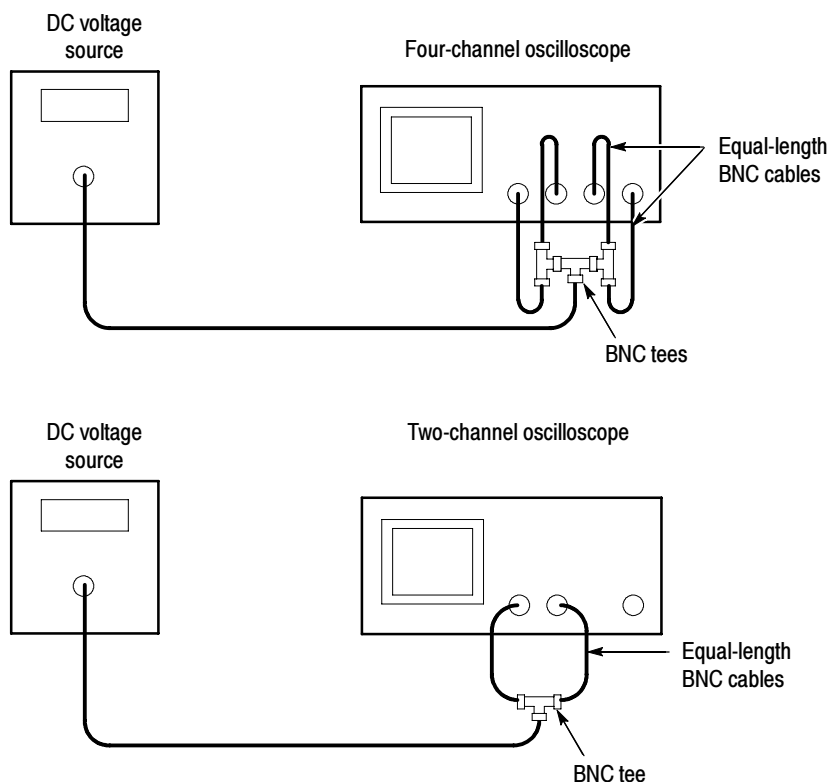
The adjustment procedure requires three types of equipment setups if you are adjusting a four-channel oscilloscope, or four types if you are adjusting a two-channel oscilloscope. For each step of the procedure, the oscilloscope display indicates which setup is the correct one to use. The equipment setups are described below.

Applying DC Voltage to Input Channels

The first adjustment procedures require a DC voltage (or zero volts) applied simultaneously to all instrument channels. A typical on-screen instruction might read:

Apply 0.0000 V DC signal to all channels.

When you see an instruction similar to this, connect the oscilloscope to the DC voltage source to all the channels as shown below and then set the DC voltage to the specified value.



NOTE. If the DC voltage source you are using has an output head, use a female-to-female BNC adapter and a short BNC cable to make the connection to the first BNC tee.

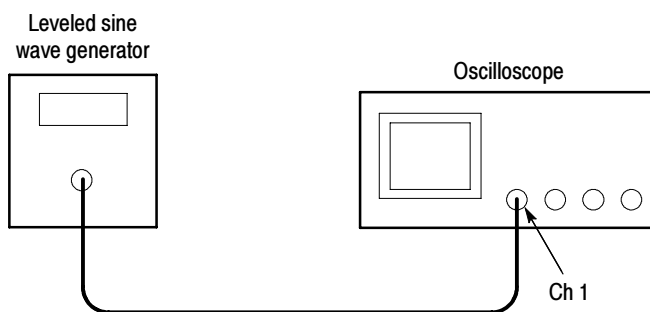
A number of steps require setting the input voltage to 0.0000 V. Some calibration equipment can inject a small amount of noise or have a very low-level AC signal near ground. This can result in failure of the performance verification procedure even though the instrument passes the factory adjustment procedure. If you think that your calibration equipment injects noise or AC at zero volts, make sure to disconnect signal cables from the oscilloscope for all steps that require 0.000 V input.

Applying AC Voltage to a Channel

Later in the procedure, a leveled sine wave needs to be applied to each channel, one channel at a time. A typical on-screen instruction might read:

Apply 400.00 mV Pk-Pk 80 MHz sine wave signal to channel 1 only.

When you see an instruction similar to this, connect the leveled sine wave generator to the specified channel and then set the amplitude and frequency to the specified values.



NOTE. If the leveled sine wave generator you are using has an output head, connect the head directly to the channel input.

Make sure that the AC generator output is set for a 50-ohm load for all AC-source steps.

Applying Fast Rise Step Signals to all Channels

During the procedure a fast rise step signal needs to be applied simultaneously to all channels. A typical on-screen instruction might read:

Apply -2.2 V to 0 V (unloaded), fast-rise signal (≤ 1 ns) to all channels.

Use the *Applying DC Voltage to Input Channels* equipment setup shown on page 3-3.

NOTE. Make sure to set the generator source impedance to 50 ohms.

Set the fast-rise signal repetition rate to anywhere between 100 Hz and 1 MHz, inclusive.

The fast-rise signal Pk-Pk range is -2.2 V to 0 V (unloaded). Measure the fast-rise signal, using an independent device with an input termination set to 1 M Ω or greater, to verify that the fast-rise signal does vary between -2.2 V and 0 V, regardless of the generator's programmed value. This ensures that there is enough signal range to adjust either 2-channel or 4-channel oscilloscopes.

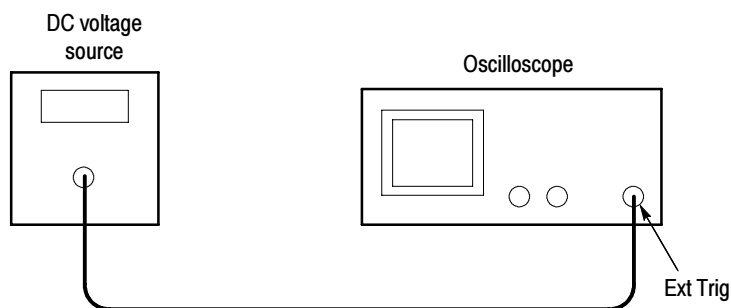
Make sure that the coax cable connection path length is the same for all channels.

Applying DC Voltage to the External Trigger

If you are adjusting a two-channel oscilloscope, a DC voltage needs to be applied to the external trigger input. A typical on-screen instruction might read:

Apply -5.00 V DC signal to external trigger input.

When you see an instruction similar to this, connect the oscilloscope to the DC voltage source and set the DC voltage to the specified value.



NOTE. If the DC voltage source you are using has an output head, connect the head directly to the external trigger input.

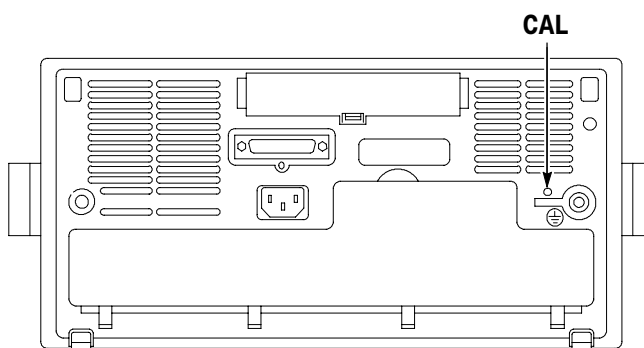
Factory Adjustment Procedure

To perform the factory adjustment procedure, do these steps:

1. Connect the oscilloscope to an AC power source.

NOTE. You must connect the oscilloscope and the test equipment to the same AC power circuit. Connect the oscilloscope and test instruments into a common power strip if you are unsure of the AC power circuit distribution. Connecting the oscilloscope and test instruments into separate AC power circuits can result in offset voltages between the equipment, which can invalidate the adjustment procedure.

2. Locate the hole that provides access to the CAL switch on the rear panel.



3. Put the adjustment tool into the CAL switch hole. Push and hold the CAL switch in while you power on the oscilloscope. Release the switch when the oscilloscope shows the power-on message with the oscilloscope graticule in the background.
4. Push the **SAVE/RECALL** button.
5. Push the **Recall Factory Setup** screen button.
6. Push the **OK Confirm Factory Init** screen button to restore factory settings prior to doing the factory calibration.

NOTE. Do not skip the Recall Factory Setup steps. You must recall the factory settings in order to correctly start the factory adjustment procedure.

7. Push the **MENU OFF** button.

8. Push the **UTILITY** button.
9. Push the **System** screen button to select **Cal**.
10. Push the **Factory** screen button.
11. Push the **OK Do Factory Calibration** screen button to start the adjustment process.
12. Connect signals from the DC voltage source, leveled sine wave, or fast-rise generator as instructed by the oscilloscope display. After you connect the correct signal, push the **OK Do Next Step** screen button to continue the process.

NOTE. *The oscilloscope adjusts itself automatically using the reference signal from the DC voltage source, leveled sine wave, or fast-rise generator. There are no manual oscilloscope adjustments that you need to make.*

*If you make an error, such as connecting the wrong input signal, you can repeat the last step by pushing the **Return to Previous Screen** screen button.*

13. Continue the adjustment process until it is complete. You can abort the process at any time by pushing the **MENU OFF** button or by changing to a different menu.
14. Do the performance verification tests (found in the *Specifications and Performance Verification* technical reference, available on the Web at www.tektronix.com/manuals) to verify that the adjustment procedure has correctly calibrated the oscilloscope. Incorrect use of calibration equipment can cause the oscilloscope to pass the adjustment procedure but fail performance verification. Refer to the note on page 3-4 regarding possible injected noise for 0.000V DC input levels.

Maintenance

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

- *Preparation* refers you to important information contained elsewhere in this manual.
- *Preventing ESD* provides general information on preventing damage to internal modules when doing maintenance.
- *Inspection and Cleaning* provides procedures for inspecting the oscilloscope and cleaning its external and internal modules.
- *Removal and Installation Procedures* provide procedures for the removal and installation of modules.
- *Troubleshooting* provides information for isolating failed modules.
- *Unpacking and Repacking Instructions* provides packaging information for shipment or storage.

Preparation

Only qualified personnel should perform service procedures. Read the *Service Safety Summary* and the *General Safety Summary* before performing any service procedures. Also refer to the chapter *Operating Information* for information about using the oscilloscope.

Preventing ESD

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).



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

1. Minimize handling of static-sensitive modules.
2. Transport and store static-sensitive modules in their static protected containers or on a metal rail. Label any package that contains static-sensitive modules.

3. Discharge the static voltage from your body by wearing a grounded antistatic wrist strap while handling these modules. Do service of static-sensitive modules only at a static-free work station.
4. Nothing capable of generating or holding a static charge should be allowed on the work station surface.
5. Handle circuit boards by the edges when possible.
6. Do not slide the modules over any surface.
7. Avoid handling modules in areas that have a floor or work-surface covering capable of generating a static charge.

Inspection and Cleaning

This section describes how to inspect for dirt and damage, and how to clean the oscilloscope. Inspection and cleaning are done as preventive maintenance. Preventive maintenance, when done regularly, may prevent malfunctions and enhance 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 adjustment of the oscilloscope.

General Care

Protect the oscilloscope from adverse weather conditions. The oscilloscope is not waterproof.

Do not store or leave the oscilloscope where the LCD display will be exposed to direct sunlight for long periods of time.



CAUTION. To avoid damage to the oscilloscope, do not expose it to any sprays, liquids, or solvents.

Inspection and Cleaning Procedures

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

Inspection — Exterior. Inspect the outside of the oscilloscope for damage, wear, and missing parts. An oscilloscope that appears to have been dropped or otherwise abused should be checked thoroughly to verify correct operation and performance. Immediately repair defects that could cause personal injury or lead to further damage to the oscilloscope.

Cleaning Procedure — Exterior. To clean the oscilloscope exterior, perform the following steps:

1. Remove loose dust on the outside of the oscilloscope with a lint free cloth. Use care to avoid scratching the clear plastic display filter.
2. Use a soft cloth or paper towel dampened with water to clean the oscilloscope. You can use a 75% isopropyl alcohol solution for more efficient cleaning.



CAUTION. *To avoid damage to the surface of the oscilloscope, do not use any abrasive or chemical cleaning agents.*

Inspection — Interior. During normal use, the oscilloscope case protects the internal components against common dust and dirt. However, if it appears that the oscilloscope may have been damaged or has been exposed to an unusually dirty or wet environment, you should inspect and clean the interior.

To inspect and clean the interior, disassemble the oscilloscope according to the procedure *Removal and Installation Procedures* on page 4-5.

Inspect the internal portions of the oscilloscope for damage and wear using Table 4-1 as a guide. Defects found should be repaired immediately.

Table 4-1: Internal inspection check list

Item	Inspect for	Repair action
Front and Rear Case Cover	Cracks or deformations. Broken doors or hinges. Loose labels.	Repair or replace defective hardware.
Metal chassis pieces	Bent, fractured, or broken pieces.	Repair or replace defective hardware.
Circuit boards	Loose, broken, or corroded solder connections. Burned circuit boards. Burned, broken, or cracked circuit-run plating.	Remove failed module and replace with a new module.

Table 4- 1: Internal inspection check list (Cont.)

Item	Inspect for	Repair action
Solder connections	Cold solder or rosin joints.	Resolder joint and clean with isopropyl alcohol.
Wiring and cables	Loose plugs or connectors. Burned, broken, or frayed wiring.	Firmly seat connectors. Repair or replace modules with defective wires or cables.

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

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

STOP. If, after performing steps 1 and 2, a module is clean upon inspection, skip steps 3 and 4. Proceed with step 5.

If steps 1 and 2 do not remove all the dust or dirt, all modules in the oscilloscope except the Display Module and the Fan may be spray washed using a solution of 75% isopropyl alcohol. Proceed with step 3.

3. Spray wash dirty parts with the 75% isopropyl alcohol solution and wait 60 seconds for the majority of the alcohol to evaporate.
4. Use hot (49° C to 60° C / 120° F to 140° F) deionized water to thoroughly rinse the parts.
5. Dry all parts with low-pressure, deionized air.
6. Dry all components and assemblies in an oven or drying compartment using low-temperature (52° C to 66° C / 125° F to 150° F) circulating air.

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

Removal and Installation Procedures

This section describes how to remove and install the major mechanical and electrical modules. It provides the following information:

- *List of Modules* on page 4-5 describes where to locate a list of replaceable modules.
- *Summary of Procedures* on page 4-6 lists the procedures for removal and installation of modules.
- *Tools Required* on page 4-7 describes the tools needed to perform the procedures.
- *Handle*, on page 4-8, begins a series of procedures that describe the removal and installation of modules.

Preparation

Please read the following warning statement. Then read the following general instructions before removing a module.



WARNING. Only qualified personnel should perform service procedures. Before doing this or any other procedure in this manual, read the General Safety Summary and Service Safety Summary located at the beginning of this manual. Also, to prevent possible injury to service personnel or damage to electrical components, read Preventing ESD on page vii.

1. Read the *Summary of Procedures* on page 4-6 to understand which procedure to use to access a given module. Then read *Tools Required* on page 4-7 for a list of tools needed to remove and install modules in the oscilloscope.
2. If you are disassembling the oscilloscope for cleaning, refer to the *Inspection and Cleaning* procedure on page 4-2 for cleaning instructions.
3. Remove the optional battery pack and/or communication module before disassembling the oscilloscope.

List of Modules

The *Mechanical Parts List* chapter provides a list of all replaceable modules. Any electrical or mechanical module, assembly, or part listed in the parts list is referred to as a module.

Summary of Procedures

Table 4-2 lists the removal and installation procedures in order of increasing complexity. Within each procedure, only perform the steps that are required to access the modules that need repair.

Table 4-2: Removal and installation procedures

Procedure	Modules accessed	Begins on page
Handle	Handle Hub cover Hub assembly	4-8
Rear case	Rear case Communication module cover Communication module guide Feet	4-12
Rear chassis	Rear chassis Battery board Power supply Power supply bracket Line filter DC power cable AC line power cable Fan	4-14
Main board	Main board Display cable USB cable	4-21
Front chassis and display Module	Front chassis Display module Front-panel USB port Inverter cable Inverter board Display module	4-26
Display Inverter board and backlights	Inverter board Backlight tubes	NO TAG
Front panel	Knobs Front-panel board Flex circuit keypad contacts Keypads	4-30

Tools Required

You will need the following tools to remove and replace all the modules in the oscilloscope.

- Torque-limiting screwdriver, 12 in/lb (1.3 N·m) range with TORX T-10 and T-15 tips (If you are using a magnetic screwdriver with interchangeable bits, the T-15 bit must be a long bit, at least 5 cm. (2 in) overall length).
- Screwdriver with $\frac{1}{8}$ inch flat blade
- Needle-nose pliers

Handle You will need a $\frac{1}{8}$ inch flat-bladed screwdriver and needle-nose pliers to remove the handle.

Removal. Use this procedure to remove the handle.

1. Use the $\frac{1}{8}$ inch flat-bladed screwdriver to pry the hub cover off of each side of the handle.
2. Rotate the handle to its full upright position.
3. Locate the handle hub on the display side of the oscilloscope.

NOTE. *Do not remove the screw at the center of the handle hub.*

4. See Figure 4-1. Use the needle-nose pliers to pull the metal pin in the display-side hub outward approximately 6 mm (0.25 in). If you accidentally pull the metal pin all the way out, reinsert it half way. The pin may be positioned at either the top or bottom of the hub assembly.

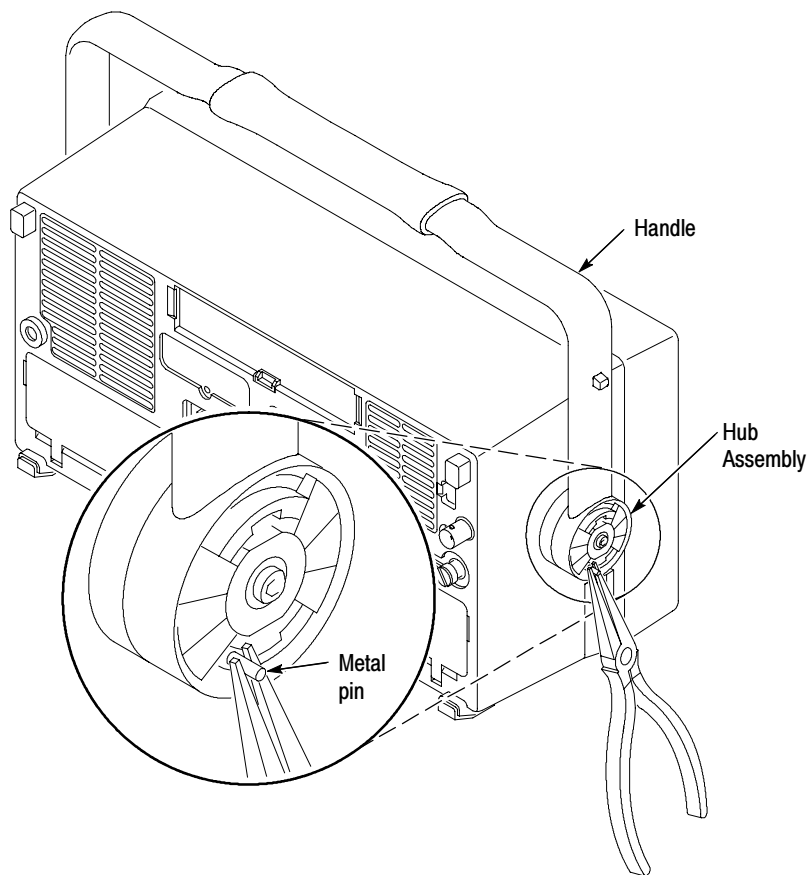


Figure 4-1: Pulling the hub pin

5. Place the oscilloscope on its feet on soft surface (such as an anti-static mat), with the display-side hub facing you.
6. Rotate the handle two detent positions toward the rear of the oscilloscope. The hub should rotate with the handle. If the hub does not rotate with the handle, return the handle to the upright position, pull the pin out a little farther, and then rotate the handle toward the rear of the oscilloscope.
7. Pull outward on the handle at the hub to release the display-side hub assembly. You may need to rotate the handle up and down slightly to help release the hub assembly. See Figure 4-2.

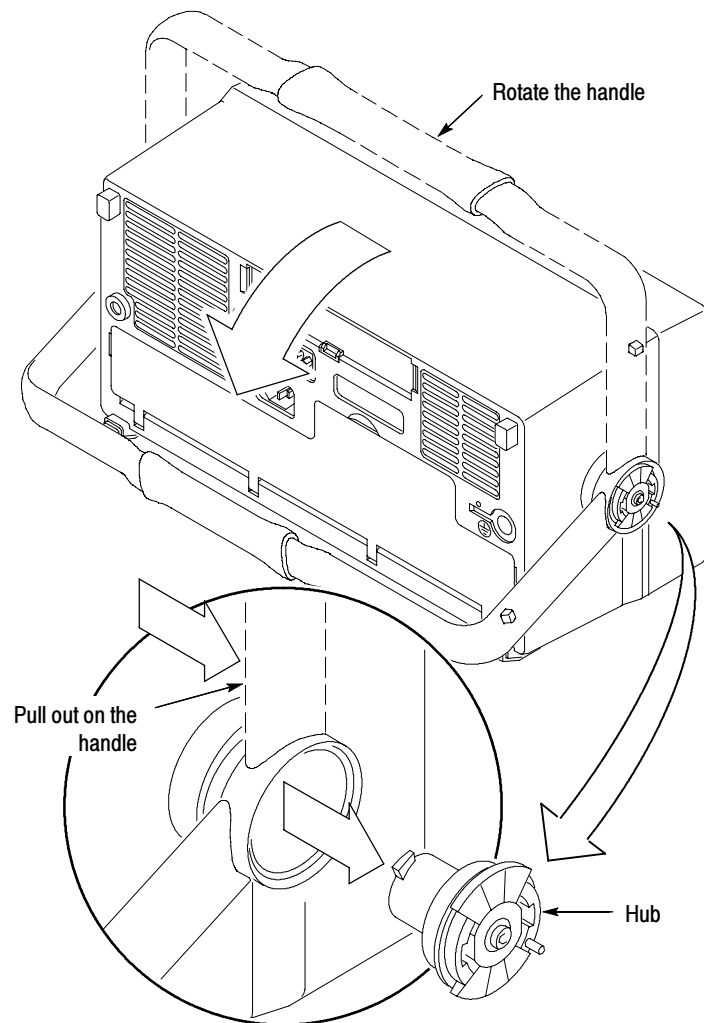


Figure 4-2: Releasing the hub assembly

8. Locate the remaining hub on the opposite side of the oscilloscope. Place the oscilloscope with the remaining hub facing you. Keep the handle at the same position used in step 6.
9. Use the needle-nose pliers to pull the metal pin in the remaining hub outward approximately 6 mm (0.25 in).
10. Raise the handle to its full upright position. The hub should rotate with the handle. If the hub does not rotate with the handle, return the handle to the down position, pull the pin out a little farther, and then rotate the handle toward the top of the oscilloscope.

11. Pull outward on the handle to release the remaining hub assembly. You may need to rotate the handle back and forth slightly to help release the hub assembly.
12. Grasp the handle on both sides and pull outwards to remove the handle from the oscilloscope.

Installation. Use this procedure to reinstall the handle.

1. Place the oscilloscope on its feet on soft surface (such as an anti-static mat), with the front facing you.
2. Verify that the front and rear cases fit together tightly.
3. Grasp the handle from both sides and stretch it over the top of the oscilloscope. Rotate the handle into its full upright position. The Tektronix logo should appear right-side up when looking down on the handle.
4. Insert one hub assembly into the handle on the right side (non display side) of the oscilloscope. The hub assembly can go in one of two ways, 180° apart; either way is ok.
5. While pressing in on the hub assembly with your fingers, rotate the handle away from you into its lowest position. The hub assembly should rotate with the handle.
6. Use the $\frac{1}{8}$ inch flat-bladed screwdriver to push the metal pin in to lock the hub assembly. Once locked, the hub assembly should not rotate when you rotate the handle.

NOTE. Do not push the metal pin completely into the hub assembly. Leave it out approximately 1.5 mm ($\frac{1}{16}$ inch).

7. With the handle in its lowest position, insert the remaining hub assembly into the handle on the display side of the oscilloscope.

8. While pressing in on the hub assembly with your fingers, rotate the handle to its full upright position. The hub assembly should rotate with the handle.
9. Use the $\frac{1}{8}$ inch flat-bladed screwdriver to push the metal pin in to lock the hub assembly.

NOTE. Do not push the metal pin completely into the hub assembly. Leave it out approximately 1.5 mm ($\frac{1}{16}$ inch).

10. Verify that neither hub assembly rotates when you rotate the handle.
11. Snap the hub covers into place over the hub assemblies. See Figure 4-3.

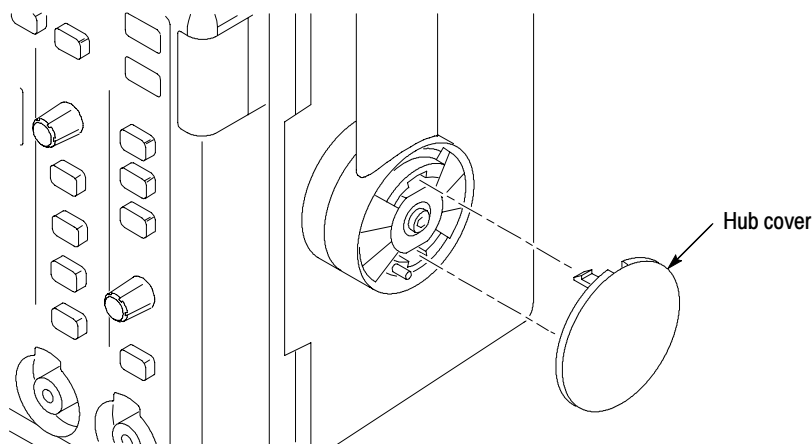


Figure 4-3: Reinstalling a hub cover

Rear Case

You will need a TORX T-15 screwdriver to remove the rear case.

Removal. Use this procedure to remove the rear case, feet, communication module cover, and communication module guide.

NOTE. You must remove the handle assembly before you can remove the rear case. Follow the procedure on page 4-8 to remove the handle.

1. Place the oscilloscope face down on soft surface (such as an anti-static mat), with the bottom facing you.
2. Remove the T-15 TORX screw just above the power plug.
3. Remove the communication module cover or any communication module that may be installed.

4. Lift the rear cover off of the oscilloscope chassis.
5. Remove both feet if necessary to replace them, otherwise leave the feet installed in the back cabinet.
6. To remove the communication module guide, gently lift the chassis to release the small communication module guide tab, move the module guide slightly away from the chassis, and then lift the module guide away from the oscilloscope. See Figure 4-4. Note that there are alignment pins along the front edge of the module guide that insert into the main board when you reinstall the module guide.

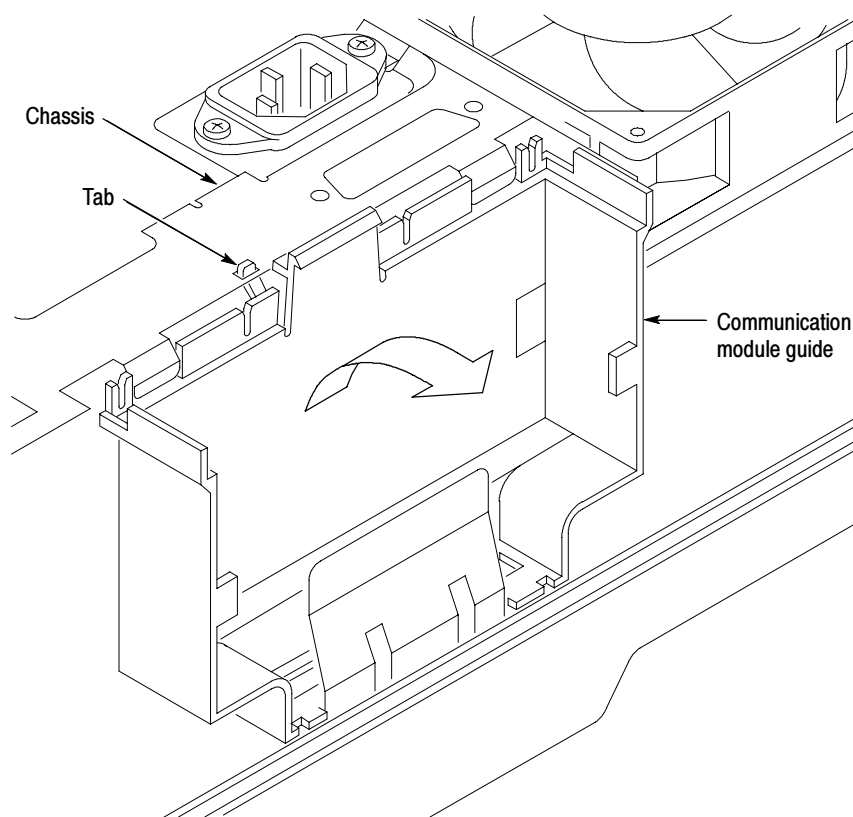


Figure 4-4: Communication module guide

Installation. Use this procedure to install the communication module guide, feet, rear case, and communication module cover.

1. Place the oscilloscope face down on soft surface (such as an anti-static mat), with the bottom facing you.

2. Install the communication module guide into the chassis. Make sure that the four pins on the module guide align with the four holes on the main board. Gently lift the rear chassis and insert the small tab in the chassis slot.
3. Install the feet into the front case if you removed them in a previous step.
4. Place the rear case over the oscilloscope chassis and lower it. The rear case should fit over and capture the feet.
5. Press the rear case downward so that it is seated completely.
6. Install the T-15 screw above the power connector.

NOTE. The screw installed above the power connector is 0.25 inches long. Make sure you use the correct-length screw when attaching the rear cabinet to the rear chassis.

7. Install the communication module cover or a communication module.

Rear Chassis

You will need a TORX T-15 screwdriver to remove the rear chassis.

NOTE. You must remove the handle assembly and the rear case before you can remove the rear chassis.

Removal. Use this procedure to remove the rear chassis, battery board, power supply, power supply bracket, line filter, fan, and rear USB cable.

1. Place the oscilloscope face down on soft surface (such as an anti-static mat), with the bottom facing you.
2. Disconnect the following cables (see Figure 4-5):
 - a. Line trigger cable from main board connector J980.
 - b. DC power cable from main board connector J900.
 - c. Display backlight power cable from the battery board.
3. Turn the oscilloscope around so the top is facing you, and disconnect the following cables (see Figure 4-5):
 - a. Rear USB cable from main board connector J815.
 - b. Ethernet cable from main board connector J920.

4. Remove the four screws that secure the rear chassis to the front chassis. Two screws are near the Ethernet connector, one screw is by the cooling fan, and one screw is on the AC line filter shield (see Figure 4-5).
5. Lift the rear chassis assembly partially away from the front chassis.
6. Unplug the braided cable from the rear chassis BNC connector (four-channel models only). Note how the cable is routed for when you reassemble the instrument.

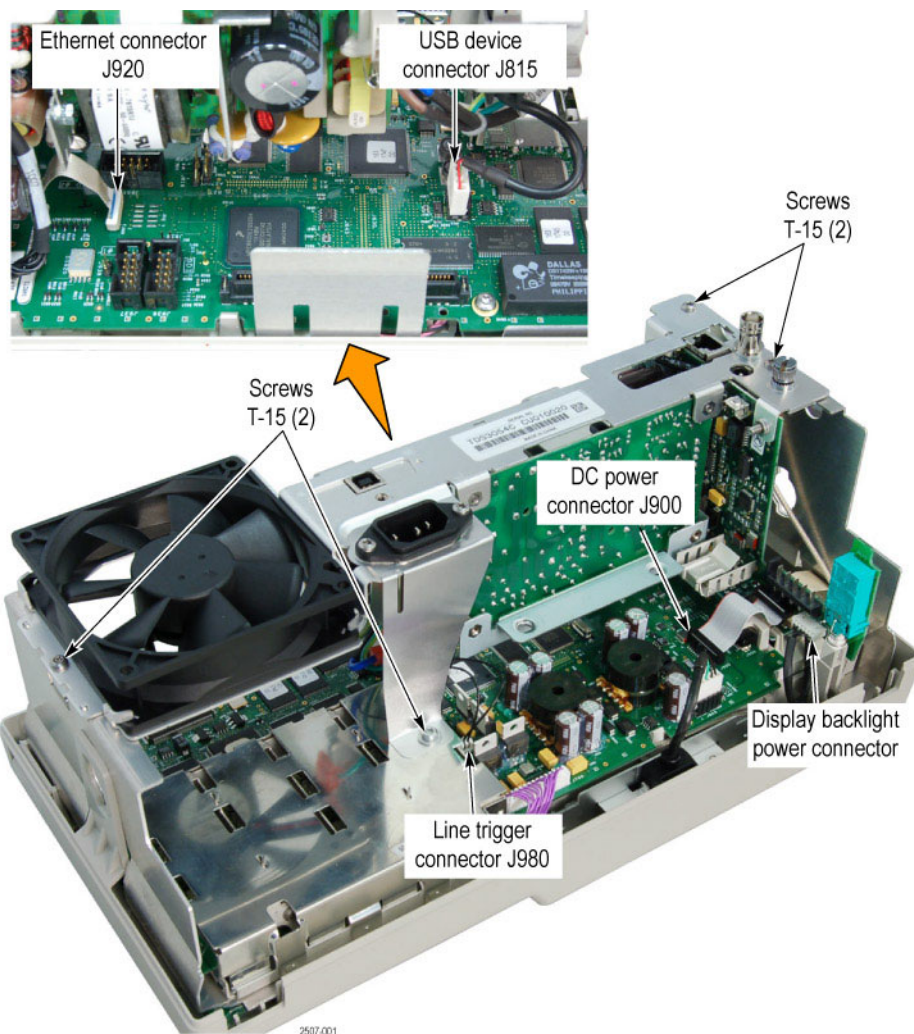


Figure 4-5: Rear chassis cables to the main board

STOP. *If you do not need to disassemble the rear chassis assembly, go to the Main Board procedure on page 4-21. The following instructions describe complete disassembly of the rear chassis assembly. However, you can just remove the modules from the rear chassis that appear to be in the way of the module you need to access.*

Battery Board Removal. Use the following steps to remove the battery board from the rear chassis.

1. Remove the plastic power switch extension from the power switch if necessary.
2. Remove the two screws that secure the battery board to the rear chassis.
3. Unsnap the battery board from the rear chassis. You can use the $\frac{1}{8}$ inch flat-bladed screwdriver to help release the board from the snap post.
4. Disconnect the fan cable from the battery board. You can use the $\frac{1}{8}$ inch flat-bladed screwdriver to help undo the connection.
5. Disconnect the six-wire connector from J180 on the battery board. The battery board is now completely disconnected from the rear chassis.

Power Supply Board Removal. Use the following steps to remove the power supply board from the rear chassis.

1. Disconnect the AC line power cable from the power supply.
2. Remove the two screws that secure the power supply to the rear chassis. The power supply board is now completely disconnected from the rear chassis.
3. If you are replacing the power supply board, remove the two screws that secure the power supply to the power supply bracket, and install the bracket on the new power supply board.

AC Filter and Fan Removal. Use the following steps to remove the AC filter and fan from the rear chassis.

1. Remove the AC line power cable from the line filter and from the tab on the chassis.
2. Remove the two screws that secure the line filter to the rear chassis.
3. Carefully bend the tabs that secure the fan to the rear chassis and remove the fan.

Installation. Use this procedure to install the fan, line filter, external power jack, power supply, battery board, and rear chassis. Skip the steps for modules that are already installed.

1. Insert the fan cable through the hole in the rear chassis and place the fan in its cavity. The fan label should face toward the rear chassis. See Figure 4-6.

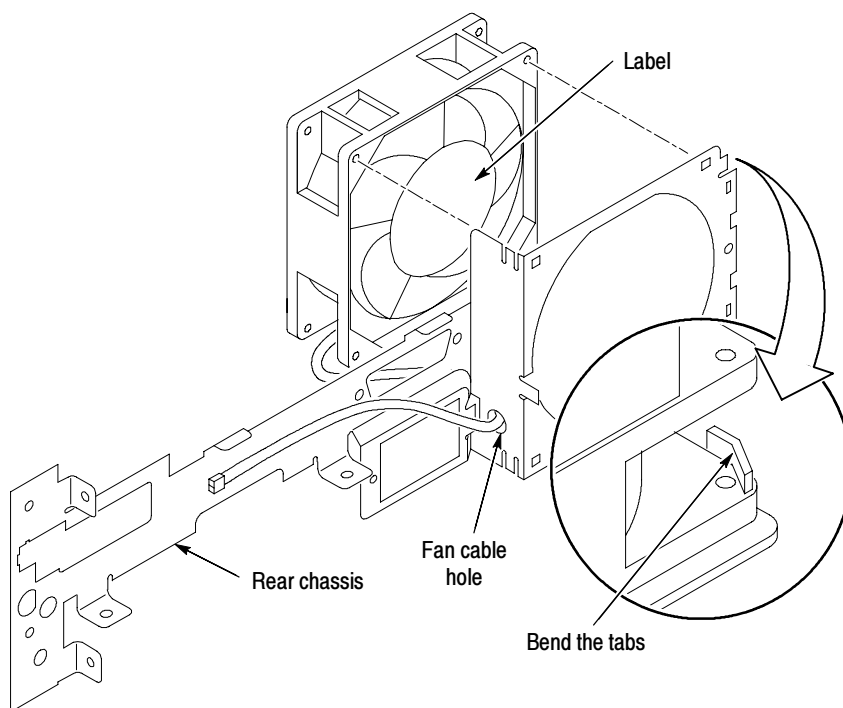


Figure 4-6: Installing the fan, line filter, and line power cable

2. Place the AC filter shield over the rear chassis AC line filter opening, and then insert the line filter into the rear chassis. Position the AC line filter so that the ground conductor tab faces toward the bottom of the instrument. Secure the AC shield/filter assembly with two screws. See Figure 4-7.

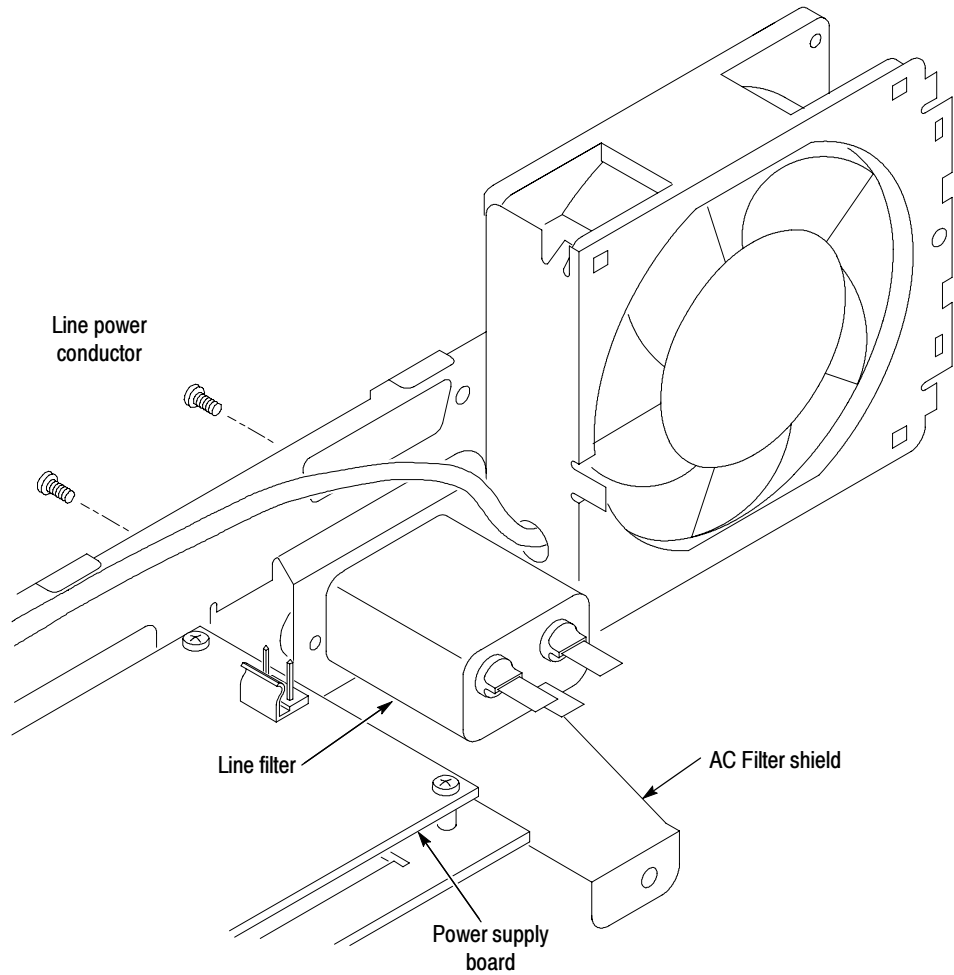


Figure 4-7: Installing the AC line filter and shield

3. Connect the line power cable connectors to the line filter and the tab on the rear chassis. See Figure 4-8.

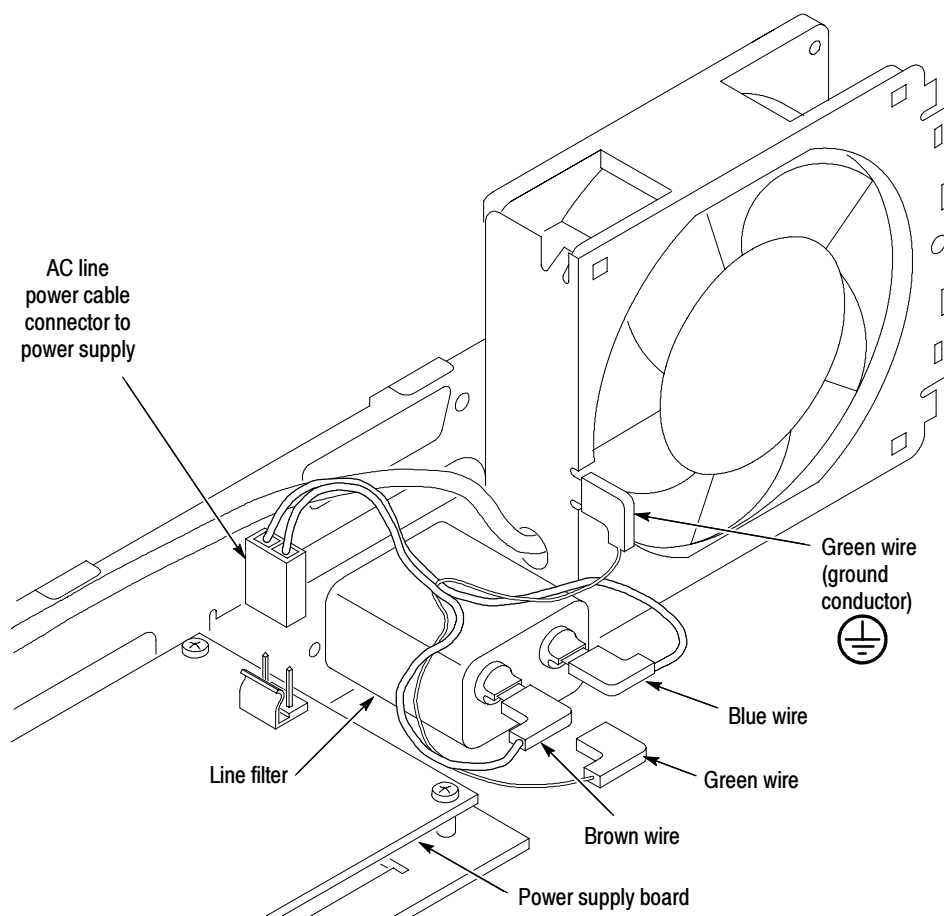


Figure 4-8: Installing the line filter and line power cable

4. Attach the power supply to the rear chassis with two screws. The fuse side of the power supply board should face the line filter.
5. If you installed a new power supply, attach the power supply bracket to the power supply with two screws. The snap post on the bracket should be on the side of the power supply that is opposite the fuse.
6. Attach the AC line power cable to the power supply.
7. Attach the DC power cable to the power supply.
8. Connect the fan power cable to the battery board at J170.
9. Connect the DC power cable to the battery board at J180.

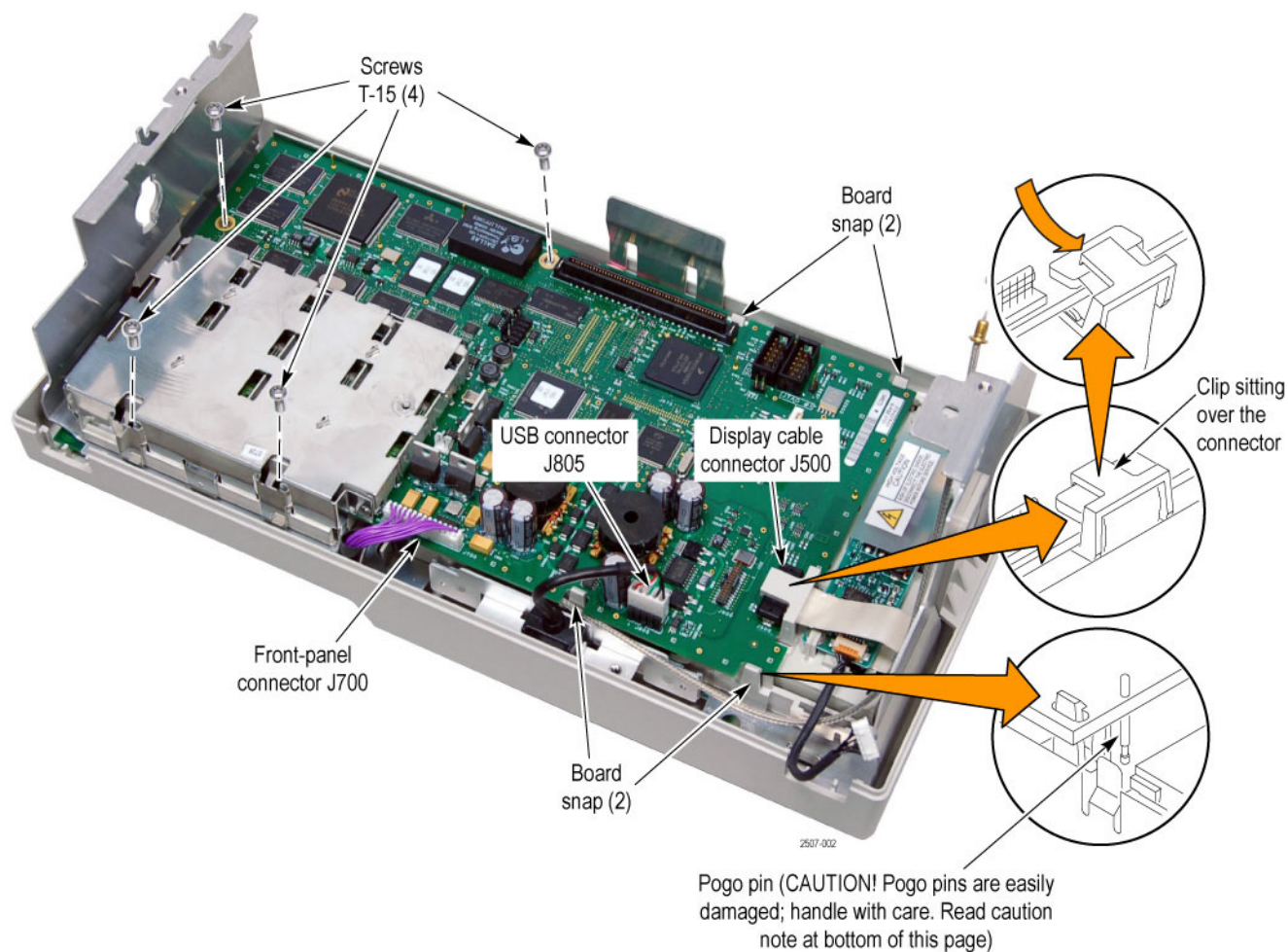
- 10.** Snap the battery board onto the post on the rear chassis.
- 11.** Install two screws to secure the battery board to the rear chassis.
- 12.** Install the power switch extension onto the power switch so that it angles outward and to the side of the rear chassis assembly.
- 13.** Place the oscilloscope assembly face down on soft surface (such as an anti-static mat), with the bottom facing you.
- 14.** Position the rear chassis assembly above the oscilloscope assembly.
- 15.** Dress the DC power cable under the power supply and toward you.
- 16.** Insert the braided external trigger cable into the BNC connector on the rear chassis (four-channel models only).
- 17.** Position the left side (fan end) of the rear chassis onto the two small tabs.
- 18.** Secure the rear chassis to the front chassis with four screws (two screws near the BNC connector, one screw on the fan end of the chassis, and one screw onto the AC filter shield). See Figure 4-5.
- 19.** Connect the following cables (see Figure 4-5):
 - a.** Line trigger cable to main board connector J980
 - b.** DC power cable to main board connector J900
 - c.** Display backlight power cable to the battery board
- 20.** Turn the oscilloscope around so the top is facing you, and connect the following cables (see Figure 4-5):
 - a.** Rear USB cable to main board connector J815
 - b.** Ethernet cable to main board connector J920

Main Board

You will need a $\frac{1}{8}$ inch flat-bladed screwdriver and a TORX T-15 screwdriver to remove the main board.

Removal. Use this procedure to remove the front panel cable, front USB cable, display cable, and main board. Refer to figure 4-9 for these procedures.

1. Place the oscilloscope assembly face down on a soft surface (such as an anti-static mat), with the bottom facing you.
2. Remove the front-panel cable from connector J700.
3. Remove the front-panel USB Host cable from connector J805.
4. If present, start to remove the clip from the display cable, at connector J500, to the position shown in the upper illustration in Figure 4-9. There is not sufficient clearance to completely remove the clip until the main board is loosened.
5. Use a magnetic TORX T-15 screwdriver (long bit) to remove the four screws that secure the main board to the front-panel assembly. See Figure 4-9.
6. Release the two snaps that hold the main board (see Figure 4-9). Lift the main board out of the front-panel assembly.
7. Use the $\frac{1}{8}$ inch flat-bladed screwdriver to carefully lift the display cable from connector J500 on the main board. See Figure 4-9.

**Figure 4-9: Main Board**

CAUTION. There are a number of small pogo-style pins that extend from the main board to contact the front chassis. These pins are easily damaged. Use the following guidelines whenever you handle the main board:

- Always place the main board on your work surface with the pogo pins facing up
- Do not apply any sideways force on the pogo pins, or slide any objects across the pogo pins, as they are easily bent
- If replacing the main board, place the old main board on the main board foam carrier that came with the new main board

- *If you are temporarily placing the main board in an anti-static bag for protection, use a bag that is large enough to prevent putting strain on the pogo pins*
 - *If you are temporarily placing the main board in an anti-static bag for protection, hold the bag open while inserting the main board; do not allow the bag to slide across the pogo pins*
-

Installation. Use this procedure to install the main board and reconnect cables.

1. Place the oscilloscope front-panel assembly face down on soft surface (such as an anti-static mat), with the bottom facing you.
2. With the front-panel cable dressed out of the way, lower the main board into the front chassis assembly. Be careful not to bend or damage any of the pogo pins while handling or installing the main board.
3. Insert the display cable into the J500 connector, support the main board, and push down firmly on the connector to seat it.



CAUTION. *Do not flex the main board while seating the display cable into main board connector J500. Board damage may result. Carefully support the area under J500 while seating the cable connector.*

4. If present, reinstall the J500 display cable connector clip. See Figure 4-10.



CAUTION. *Make sure that the lower legs of the connector clip are not in contact with any components on the bottom of the circuit board. Board damage may result.*

5. Push down on the two main board corners to engage the snaps.

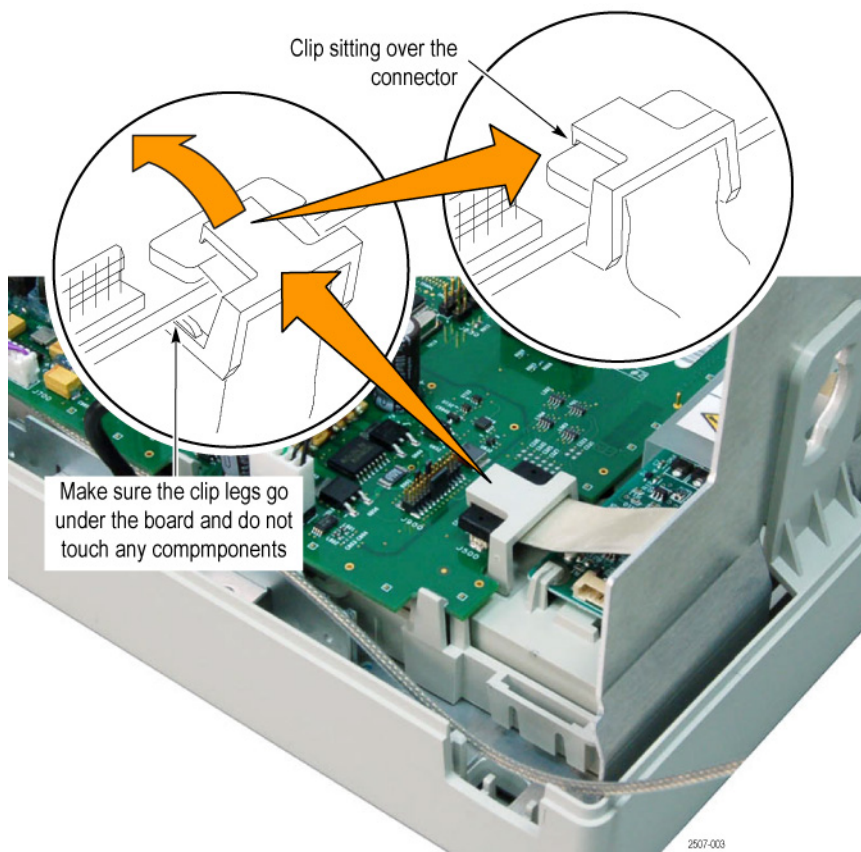


Figure 4-10: Install the J500 connector clip

6. Use a magnetic long-bit TORX T-15 screwdriver to install the four screws that secure the main board to the front-panel assembly.

NOTE. If after assembling the oscilloscope the display shows streaks, bars, garbled data, or no image, open the instrument case and make sure that the display cable is firmly and completely seated into connector J500.

7. Connect the front-panel cable to the main board at J700.
8. Connect the front-panel USB cable to the main board at J805.
9. Use Kapton tape to secure the display cable as shown in Figure 4-11. Cut the tape around the inverter power connector.
10. On four-channel models, use Kapton tape to secure the trigger cable to the side of the chassis. Arrange the cable for the most clearance between the trigger cable and the display cable.

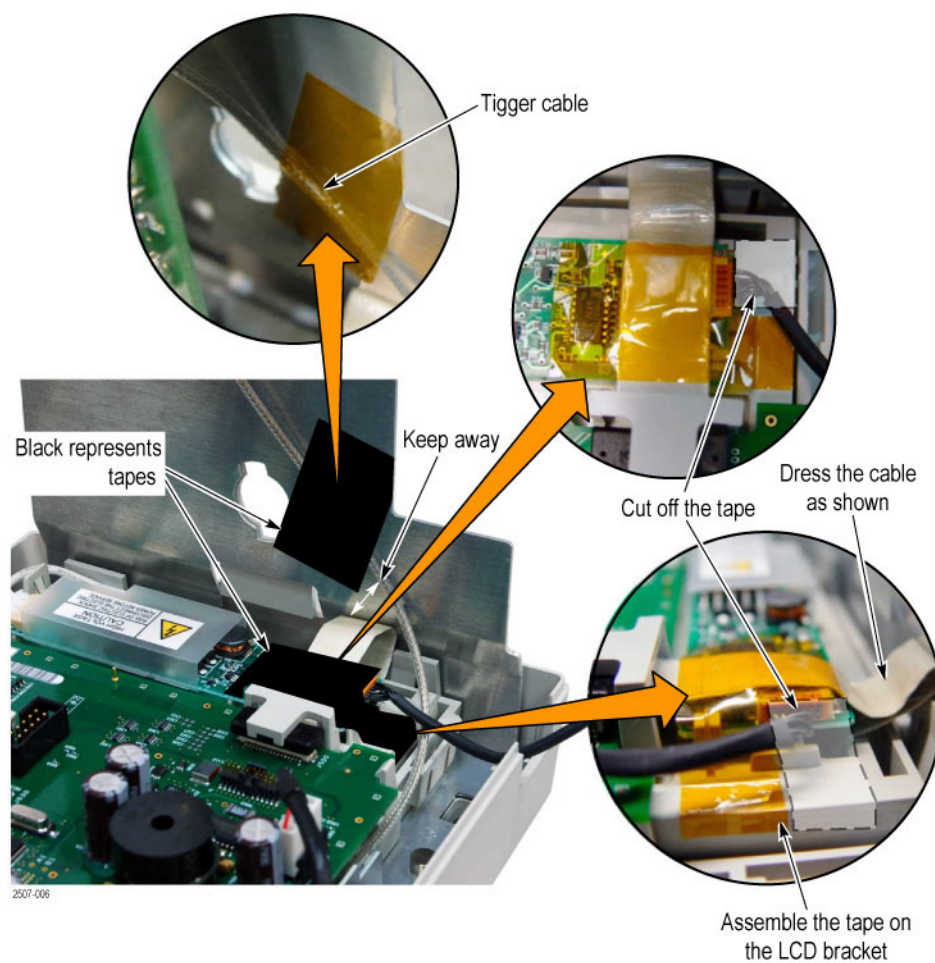


Figure 4-11: Taping trigger cable (four-channel models only) and display cable

Front Chassis and Display Module

You will need a long-bit TORX T-10 screwdriver to remove the front chassis.

Removal. Use this procedure to remove the front chassis and the display module.

1. Place the oscilloscope face down on a soft surface (such as an anti-static mat), with the bottom facing you.
2. Use the magnetic long-bit TORX T-10 screwdriver to remove the two screws that secure the front chassis to the front case. See Figure 4-12.

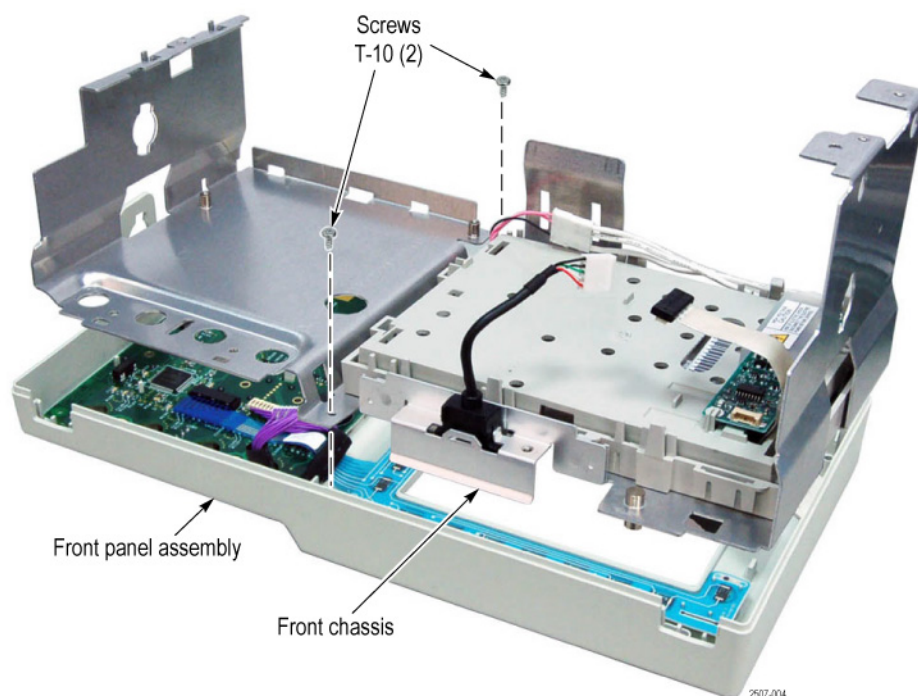


Figure 4-12: Front chassis

3. Lift the front chassis out of the front case. Lifting the left end of the chassis slightly ahead of the right end helps to clear a slight interference at the right end of the chassis.

NOTE. It is possible to remove the inverter board without removing the front chassis or display module. If this is the only thing you need to do, skip to step NO TAG on page NO TAG.

4. Place the front chassis with the display facing you. See Figure 4-13.
5. Use your thumbs to slide the top display module tabs up until the overhanging part of the tabs clear the chassis holes. See Figure 4-13.

6. Push the tabs through the chassis holes to remove the display module.

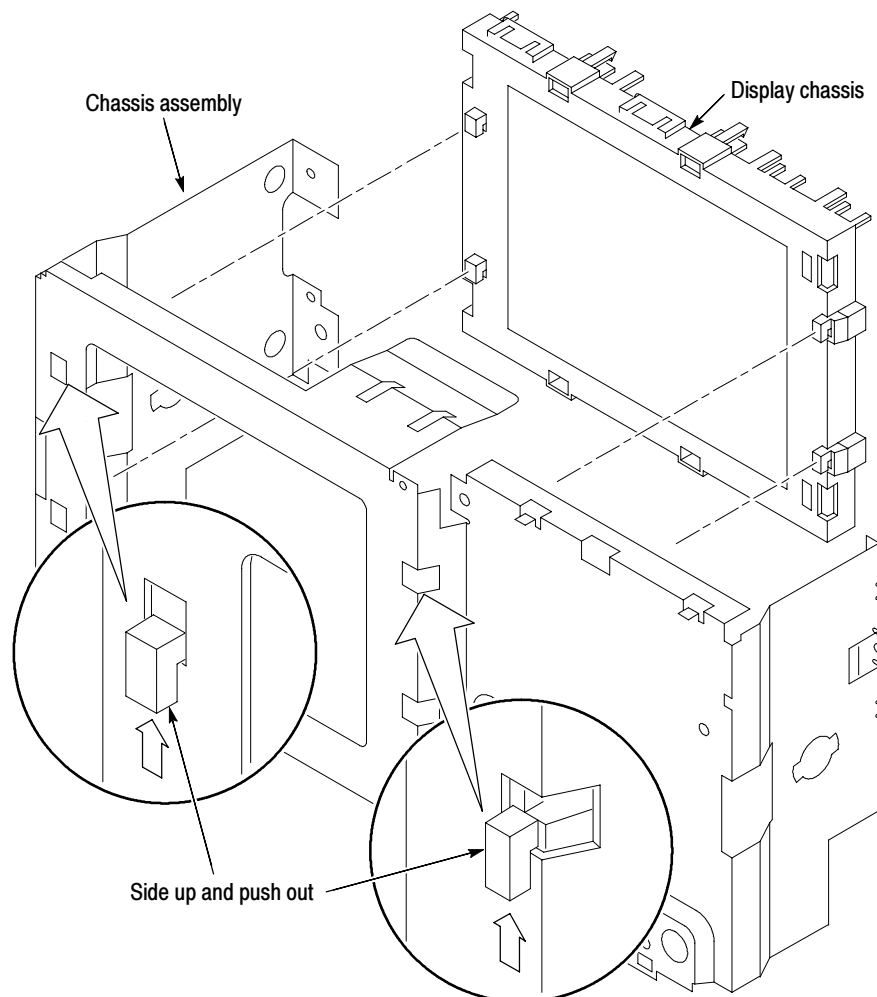


Figure 4-13: Display module

Installation. Use this procedure to install the display module into the front chassis and install the front chassis.

1. Place the front chassis with the display facing you. See Figure 4-13.
2. Push the display module tabs through the chassis holes.
3. Use your thumbs to slide all four display module tabs down as far as possible to lock the display module in place on the front chassis.
4. Place the oscilloscope face down on a soft surface (such as an anti-static mat), with the bottom facing you.

5. Route the front-panel cable so that it lies parallel to and along the top edge of the bezel button flex circuit. Position the black vinyl cable cover so that the wires are exposed from the front panel connector to just over the edge of the front panel board.
6. Route the front panel cable through the cable post on the front panel and tuck part of the cable just under the bottom corner of the front panel board. See Figure 4-14.

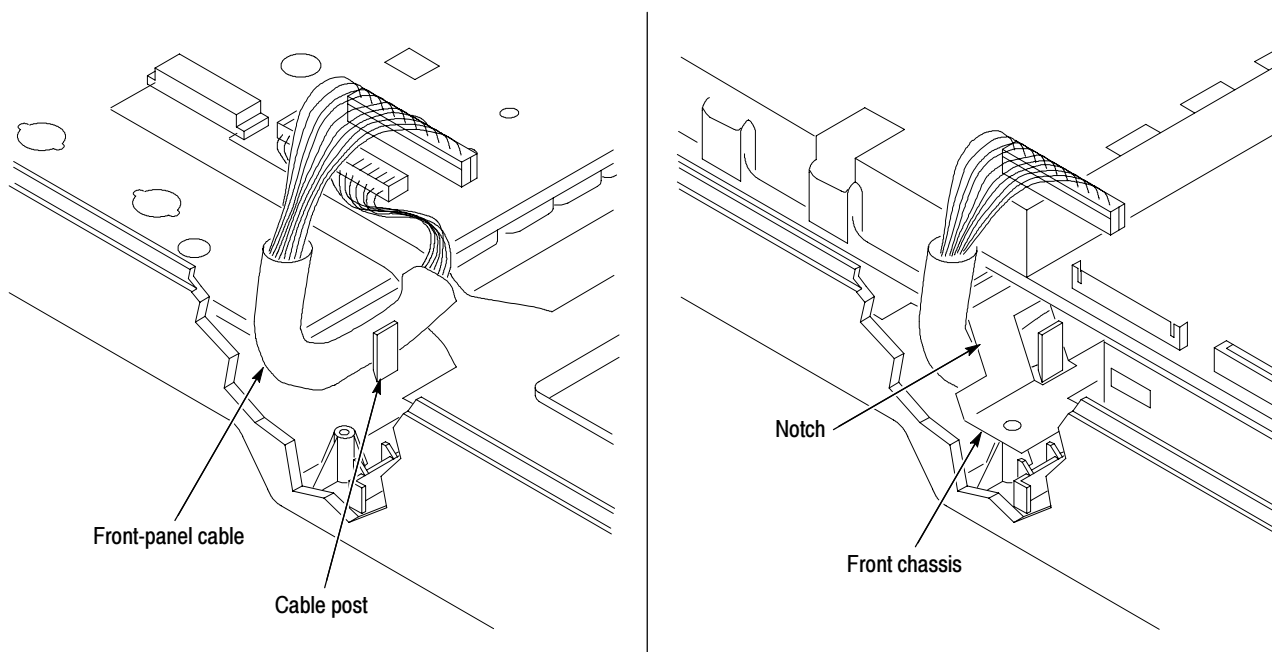


Figure 4-14: Front-panel cable routing

7. Insert the front chassis assembly into the oscilloscope. Insert the right end of the front chassis slightly ahead of the left end to clear a slight interference at the right end of the chassis.
8. Route the front-panel cable through the notch located on the bottom edge of the front chassis. See Figure 4-14.
9. Use the TORX T-10 screwdriver to insert the two screws that secure the front chassis to the front case.

Front-panel USB port

You will need a $\frac{1}{8}$ inch flat-bladed screwdriver and a pair of pliers to remove and reinstall the front-panel USB port.

Removal. Use this procedure to remove the front-panel USB port from the front chassis:

1. Use a screwdriver to bend the metal securing tabs slightly away from the USB connector, as shown in Figure 4-15.
2. Slide the USB connector and cable out toward the front of the front chassis.

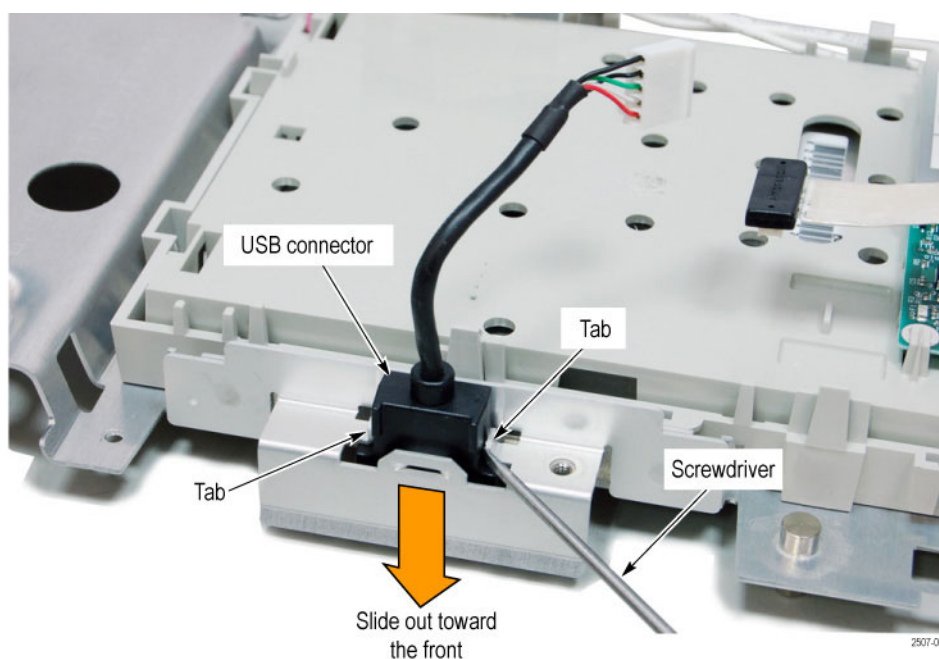


Figure 4-15: Front-panel USB port removal

Installation. Use this procedure to reinstall the front-panel USB port.

1. Use a pair of pliers to straighten the tabs on the front chassis, if needed.
2. Insert the USB cable through the front chassis, from the front.
3. Insert the USB connector into the front chassis. The connector will only fit into the chassis cutout when it is in the correct orientation. Push the connector in until it snaps into place.

Front Panel You do not need any tools to remove the front panel board.

Removal. Use this procedure to remove the front panel, front panel buttons, bezel button flex circuit, and bezel buttons.

1. Place the oscilloscope face up on a soft surface (such as an anti-static mat).
2. Remove the front-panel knobs by firmly pulling each knob away from the front panel. Careful prying with a small screwdriver or similar tool may be necessary. See Figure 4-16.

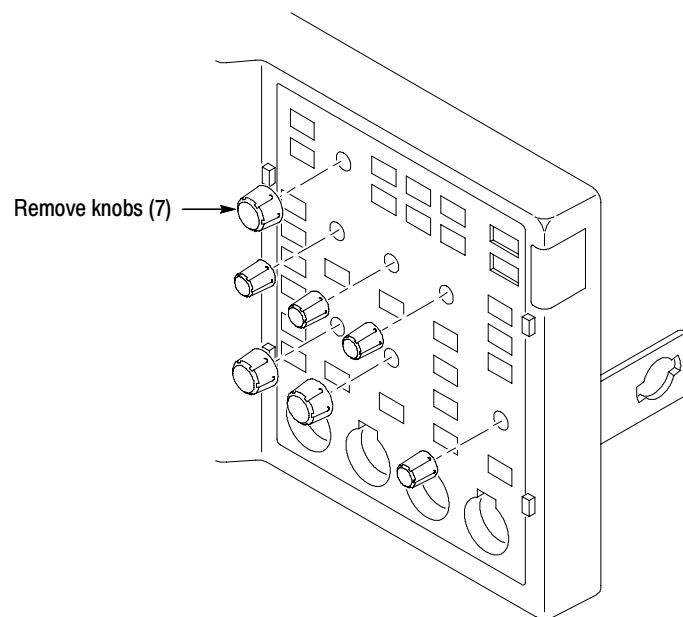


Figure 4-16: Remove front-panel knobs

3. Place the oscilloscope face down on a soft surface (such as an anti-static mat), with the bottom facing you.
4. Disconnect the bezel button flex circuit from J200 by gently pulling the flex circuit out of the connector. Gently remove the flex circuit from the front panel and place on a clean protected surface.
5. Remove the front-panel board by pulling back board snaps and lifting the lower right corner of the front-panel board. Pull back the board snaps in numeric order, starting with snap one, as shown in Figure 4-17.

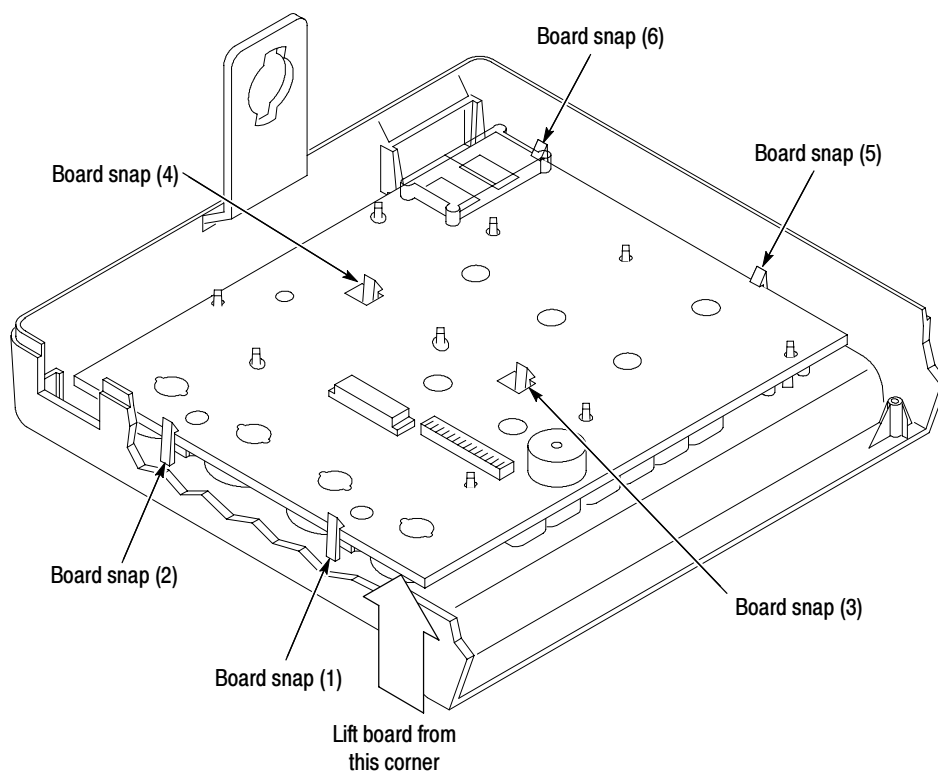


Figure 4-17: Remove front-panel board

6. Remove the front-panel and bezel button keypads by lifting them away from the front panel. Do not touch the keypad contacts or place them on a contaminated surface. See Figure 4-18.

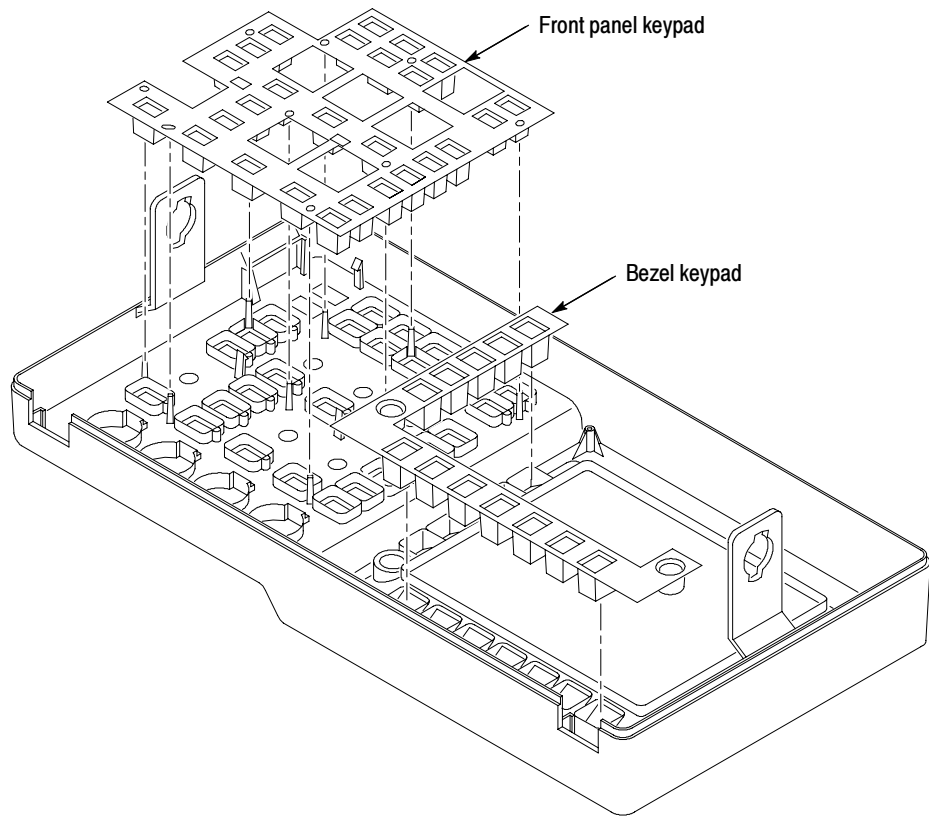


Figure 4- 18: Remove front-panel keypads

Installation. Use this procedure to reinstall the front-panel board.

1. Check that the front-panel lock nuts are still in the front panel before installing the front panel keypad and board. These nuts are pressure-fit and can come loose. See Figure 4-19.

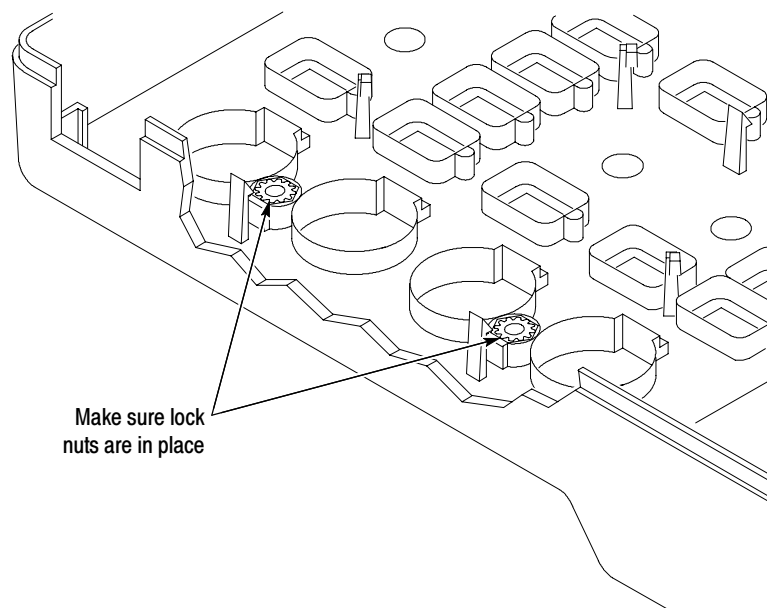


Figure 4-19: Checking front-panel lock nuts

2. Install the front-panel keypad into the front panel. Do not touch the keypad contacts. See Figure 4-18.
3. Insert the front-panel board by aligning the board with the alignment posts. Then press firmly on the board, starting at the top edge, to engage the board snaps.
4. Install the bezel button flex circuit; align the the flex circuit on the front-panel bezel button pins and gently press the flex circuit flat.
5. Connect the bezel button flex circuit to J200.
6. Route the front-panel cable as described in steps 5 and 6 on page 4-28.
7. Install the front-panel knobs by firmly pushing each knob onto the front panel knob shaft. Align the flat side of the knob shaft with the flat part of the knob hole.

Troubleshooting

This section contains information and procedures to help you isolate a defective module in a TDS3000C series oscilloscope.



WARNING. Before doing this or any other procedure in this manual, read the General Safety Summary and Service Safety Summary found at the beginning of this manual. Also, to prevent possible injury to service personnel or damage to electrical components, read Preventing ESD on page vii.

Adjustment After Repair

If you replace the main board, you must adjust the instrument after repair. Refer to the chapter *Adjustment Procedures* for information about adjustment.

Required Tools and Equipment

You need the the following equipment to troubleshoot the instrument.

Tools and Equipment	Example
DMM	3.5 or greater digit DMM

Troubleshooting Procedure

Figures 4-20 through 4-22 are troubleshooting procedure flowcharts. Use them to troubleshoot an instrument failure. Begin with Figure 4-20.

NOTE. Before performing the troubleshooting procedure, remove the instrument cabinet (see page 4-5).

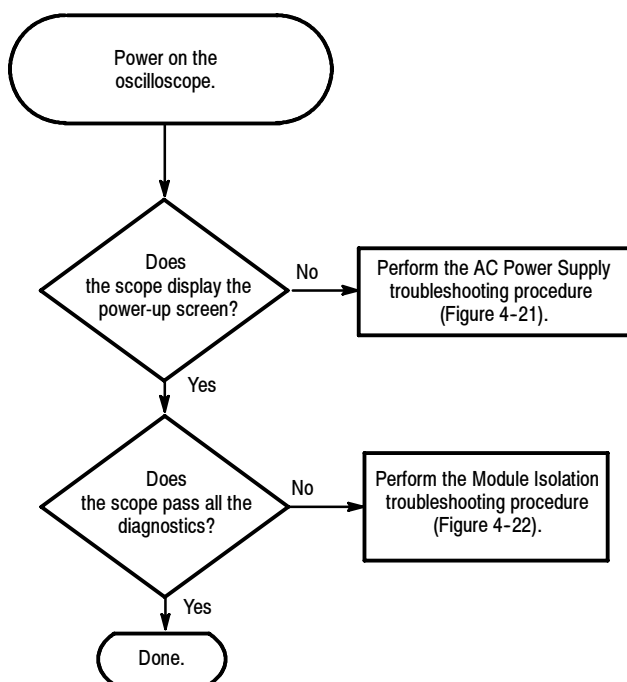


Figure 4-20: Primary troubleshooting procedure

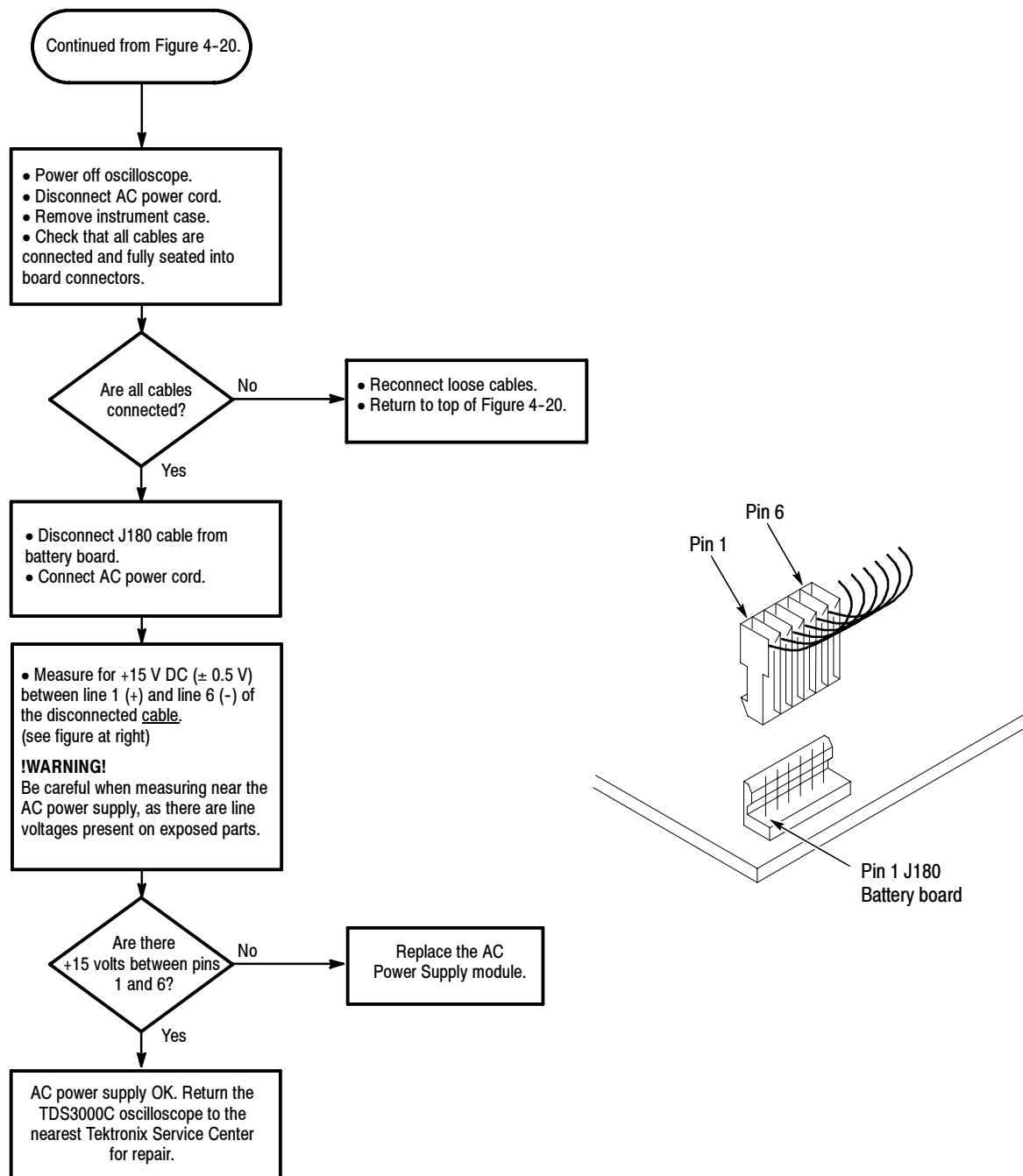
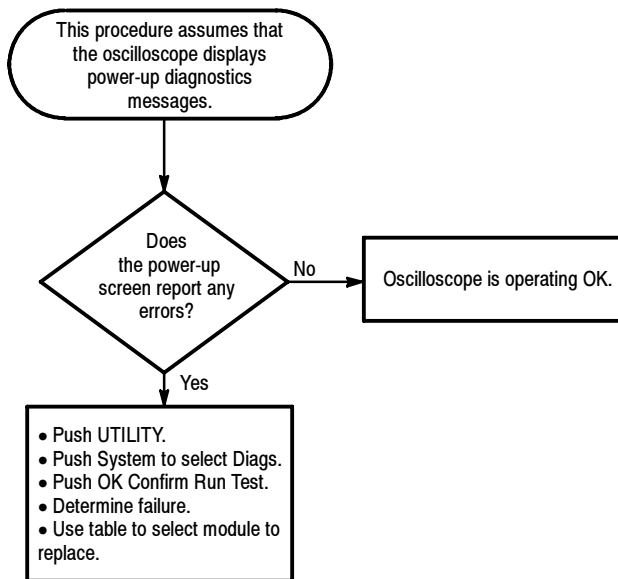


Figure 4-21: AC power supply troubleshooting procedure



<u>Failed Test</u>	<u>Most Likely Cause</u>
Acquisition	Main board
CPU	Main board
Display	Main board
Front Panel	Front Panel (or Main board)
I/O	Comm module (or Main board)
ROM	Main board
App Modules	Front Panel (or App keys)

Figure 4-22: Module isolation troubleshooting procedure

Unpacking and Repacking Instructions

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

Unpacking

The oscilloscope and its standard accessories are carefully packed at the factory in a shipping carton. If, upon receipt, damage to the shipping carton is evident, notify the shipper. Tektronix, Inc. is not responsible for damage caused during shipping.

If you have not already done so, carefully remove the oscilloscope and its accessories from the shipping carton and inspect them for damage. Save the shipping carton for repacking or storage.

Repacking

Use a corrugated cardboard shipping carton having a test strength of at least 275 pounds (125 kg) and with an inside dimension at least six inches (15.25 cm.) greater than the instrument dimensions.

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

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

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

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

Storage

The oscilloscope should be stored in a clean, dry environment.

See the *TDS3000C Specifications and Performance Verification* manual for a complete listing of the environmental characteristics.

Options

The TDS3000C series options, listed in Table 5-1, provide power cords and documentation packages for international customers.

Table 5-1: TDS3000C Series options

Option	Description
A0	North America power
A1	Universal EURO power
A2	United Kingdom power
A3	Australia power
A5	Switzerland power
A6	Japan power
A10	China power
A11	India power
A99	No power cord
L0	English documentation package
L1	French-language documentation package
L2	Italian-language documentation package
L3	German-language documentation package
L4	Spanish-language documentation package
L5	Japanese-language documentation package
L6	Portuguese-language documentation package
L7	Simplified Chinese-language documentation package
L8	Traditional Chinese-language documentation package
L9	Korean-language documentation package
L10	Russian-language documentation package
L99	No documentation package
E1	English-language documentation package plus Options A1, A2, A5, L1, and L3

Replaceable Parts List

This chapter contains a list of the replaceable modules for the TDS3000B series oscilloscope. 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 (see Part Number Revision Level below)
- 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.

Change information, if any, is located at the rear of this manual.

Part Number Revision Level

Tektronix part numbers contain two digits that show the revision level of the part. For some parts in this manual, you will find the letters XX in place of the revision level number.



When you order parts, Tektronix will provide you with the most current part for your product type, serial number, and modification (if applicable). At the time of your order, Tektronix will determine the part number revision level needed for your product, based on the information you provide.

Module Servicing

Modules can be serviced by selecting one of the following three options. Contact your local Tektronix service center or representative for repair assistance.

Module Exchange. In some cases you may exchange your module for a remanufactured module. These modules cost significantly less than new modules and meet the same factory specifications. For more information about the module exchange program, call 1-800-TEK-WIDE, extension 6630.

Module Repair and Return. You may ship your module to us for repair, after which we will return it to you.

New Modules. You may purchase replacement modules in the same way as other replacement parts.

Using the Replaceable Parts List

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

Parts list column descriptions

Column	Column name	Description
1	Figure & index number	Items in this section are referenced by figure and index numbers to the exploded view illustrations that precede the list
2	Tektronix part number	Use this part number when ordering replacement parts from Tektronix
3 and 4	Serial number	Column three indicates the serial number at which the part was first effective. Column four indicates the serial number at which the part was discontinued. No entries indicates the part is good for all serial numbers
5	Qty	This indicates the quantity of parts used
6	Name & description	An item name is separated from the description by a colon (:). Because of space limitations, an item name may sometimes appear as incomplete. Use the U.S. Federal Catalog handbook H6-1 for further item name identification

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

Exploded Views Figures 6-1 through 6-5 on the following pages show the module-level exploded views of the TDS3000B series oscilloscope. The adjacent page is the list of components for that exploded view, indexed by the numbers in the figure.

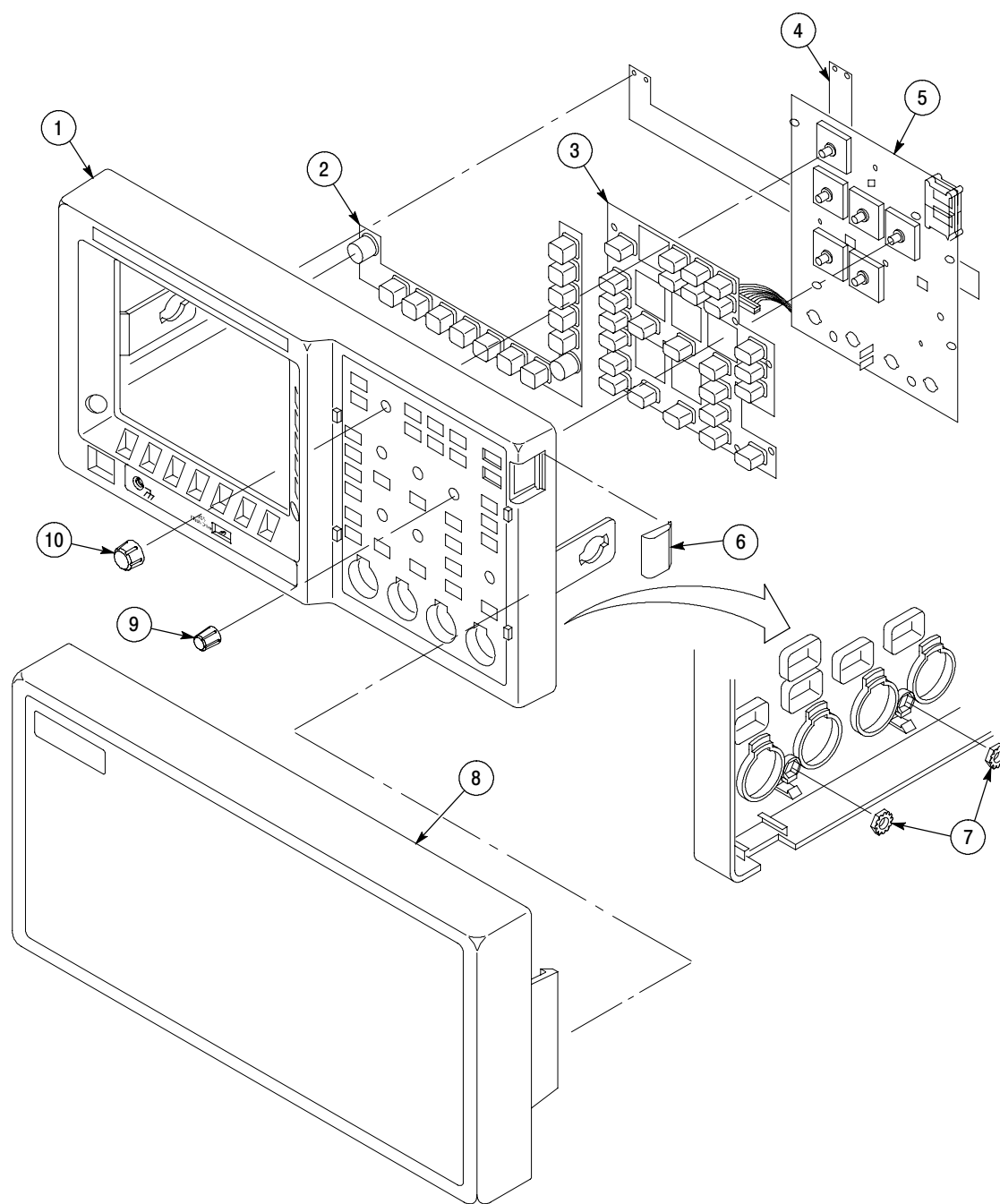


Figure 6- 1: Exploded view, front case half

Figure 6-1 Replaceable parts list

Fig. & index number	Tektronix part number	Serial no. effective	Serial no. discont'd	Qty	Name & description
6-1					Exploded view, front case half
-1	050-3698-00			1	PARTS REPL KIT; FRONT CASE ASSY, 2 CH, W/LABELS;TDS3012C, TDS3032C, TDS3052C
	050-3697-00			1	PARTS REPL KIT; FRONT CASE ASSY, 4 CH, W/LABELS;TDS3014C, TDS3034C, TDS3054C
-2	260-2878-00			1	SWITCH,KEYPAD:SILICONE RUBBER,EMAT SET,BEZEL
-3	260-2876-00			1	SWITCH,KEYPAD:ELASTOMERIC,FRONT PANEL,PUSHBUTTON, 2 CH
	260-2877-00			1	SWITCH,KEYPAD:ELASTOMERIC,FRONT PANEL,PUSHBUTTON, 4 CH
-4	259-0149-00			1	FLEX CIRCUIT:BEZEL BUTTONS,POLYESTER
-5	671-5370-01			1	CKT BD SUBASSY:OEM FRONT PANEL
-6	200-4418-00			1	COVER; OPTION KEY DOOR,0.7270 X 1.2250 X 0.310,PC/ABS,FR110,SILVER GRAY
-7	210-0457-00			2	NUT,PL,ASSEM WA:6-32 X 0.312,STL CD PL,W/LOCKWASHER
-8	200-4416-01			1	COVER:FRONT,PROTECTIVE,13.850 X 7.090 X 2.050,PC/ABS,FR110,BLUE
-9	366-0772-00			4	KNOB,CAP:PC/ABS BAYBLEND FR110,SIVER GRAY,0.425 DIA X 0.520 H
-10	366-0771-00			3	KNOB,CAP:PC/ABS BAYBLEND FR110,SILVER GRAY,0.650 DIA X 0.520 H

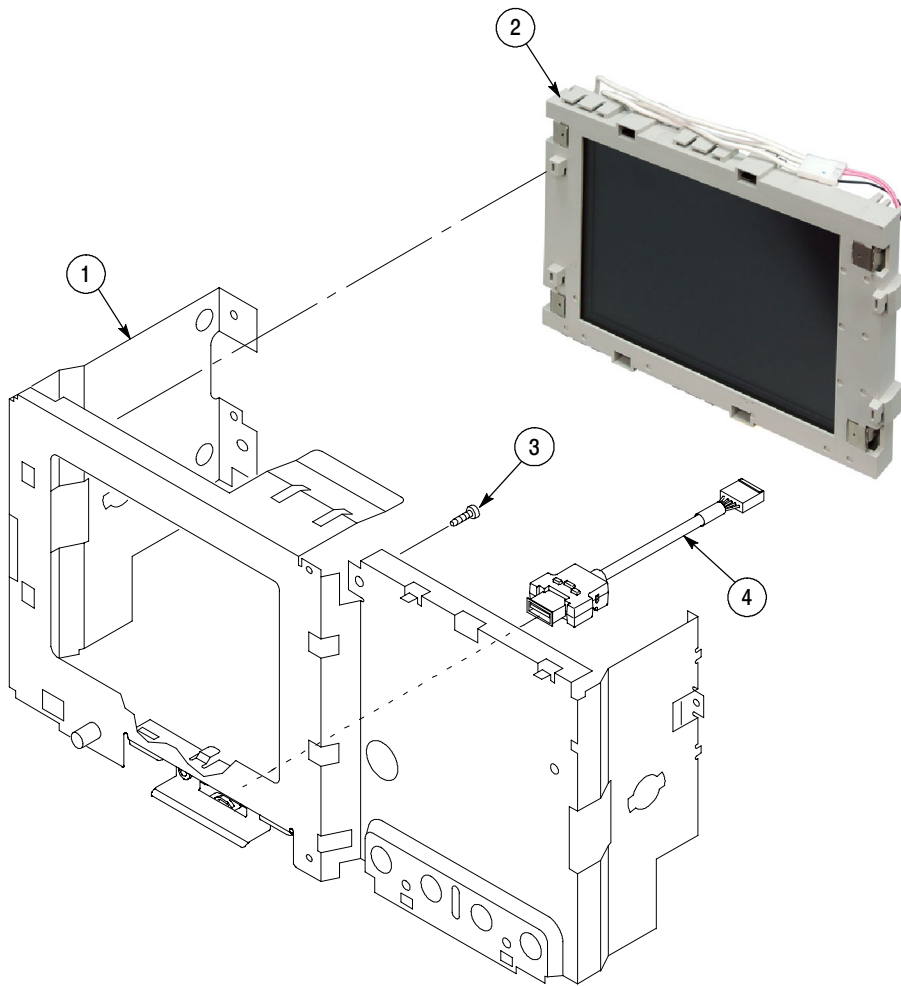


Figure 6-2: Exploded view, LCD display

Figure 6-2 Replaceable parts list

Fig. & index number	Tektronix part number	Serial no. effective	Serial no. discont'd	Qty	Name & description
6-2					Exploded view, LCD display
-1	441-2506-00			1	CHASSIS:FRONT,0.050 AL,13.020 X 2.860
-2	650-5119-00			1	LCD MODULE ASSY; TDS3000C SERIES
-3	211-0927-00			2	SCREW,PT:K35-1.57 X 10.0MM,T10,STL,BLACK
-4	174-5411-00			1	CABLE EXTENSION, USB-HOST
-5	131-6521-00			4	CONTACT,ELEC:EMI,CLIP-ON,0.38 L X 0.500 W (2 CONTACTS) X 0.45 HIGH,ELECTROLESS NICKEL PLATE

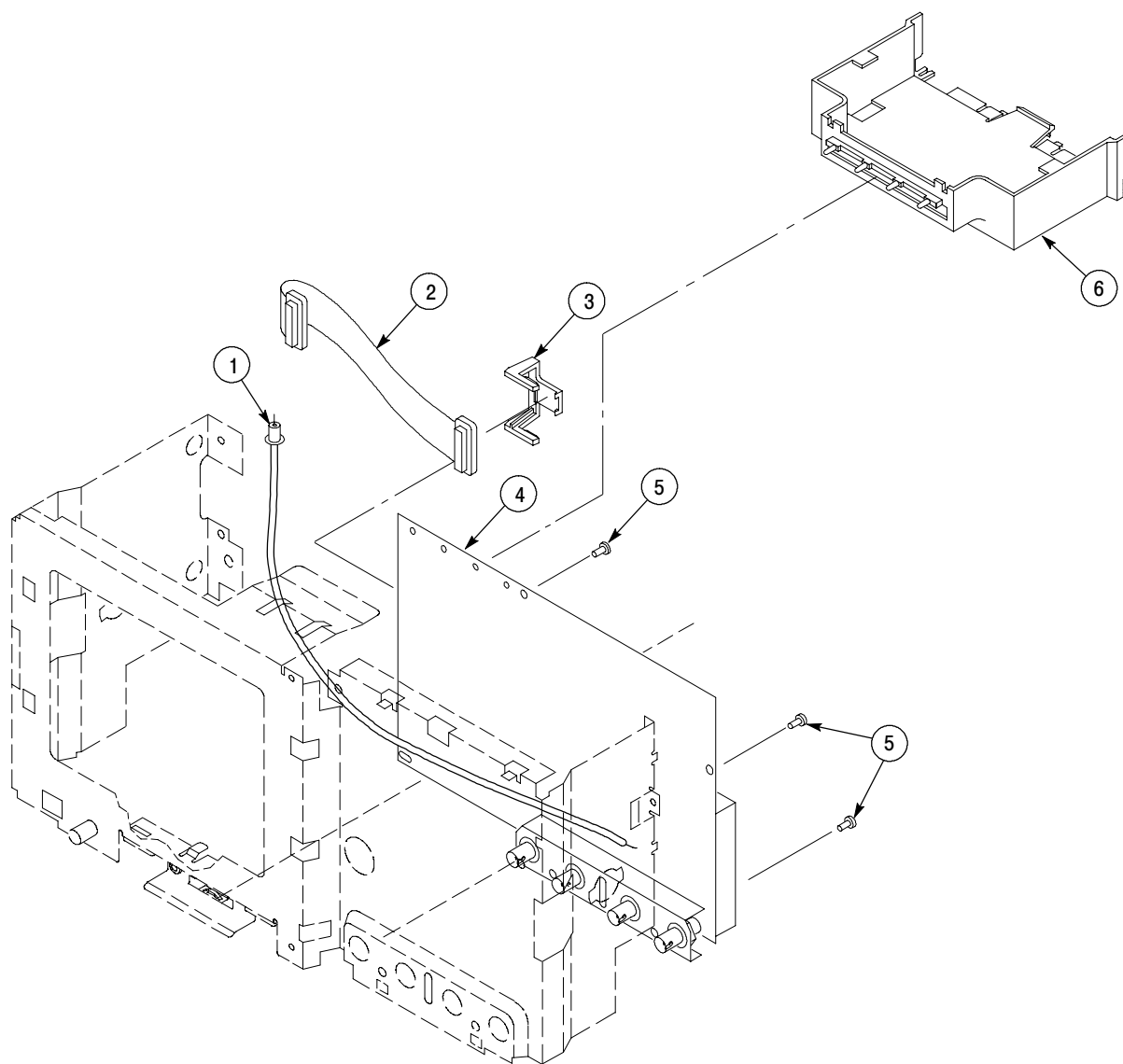


Figure 6-3: Exploded view, main board

Figure 6-3 Replaceable parts list

Fig. & index number	Tektronix part number	Serial no. effective	Serial no. discont'd	Qty	Name & description
6-3					Exploded view, main board
-1	174-5476-00			1	CA ASSY, EXTERNAL TRIGGER (4-channel models only)
-2	174-5424-00			1	CABLE ASSY, SP; FLAT FLEX, DISPLAY(LCD), 33 AWG, 0.5MM CTR, 31 POS, 2.0 L, TIN/LEAD PLATED CONDUCTORS
-3	343-1676-00			1	CLAMP, CABLE
-4	671-6425-00			1	CIRCUIT BD ASSY; MAIN, 2 CH, 100 MHZ, (TDS3012C ONLY)
	671-6426-00			1	CIRCUIT BD ASSY; MAIN, 2 CH, 300 MHZ, (TDS3032C ONLY)
	671-6427-00			1	CIRCUIT BD ASSY; MAIN, 2 CH, 500 MHZ, (TDS3052C ONLY)
	671-6428-00			1	CIRCUIT BD ASSY; MAIN, 4 CH, 100 MHZ, (TDS3014C ONLY)
	671-6429-00			1	CIRCUIT BD ASSY; MAIN, 4 CH, 300 MHZ, (TDS3034C ONLY)
	671-6430-00			1	CIRCUIT BD ASSY; MAIN, 4 CH, 500 MHZ, (TDS3054C ONLY)
-5	211-0721-00			4	SCREW,MACHINE:6-32 X 0.375,PNH,STL,CDPL,T-15 TORX DR
-6	351-1025-00			1	GUIDE:OPTION MODULE,POLY,ABS ALLY,BAYBLEND FR-110

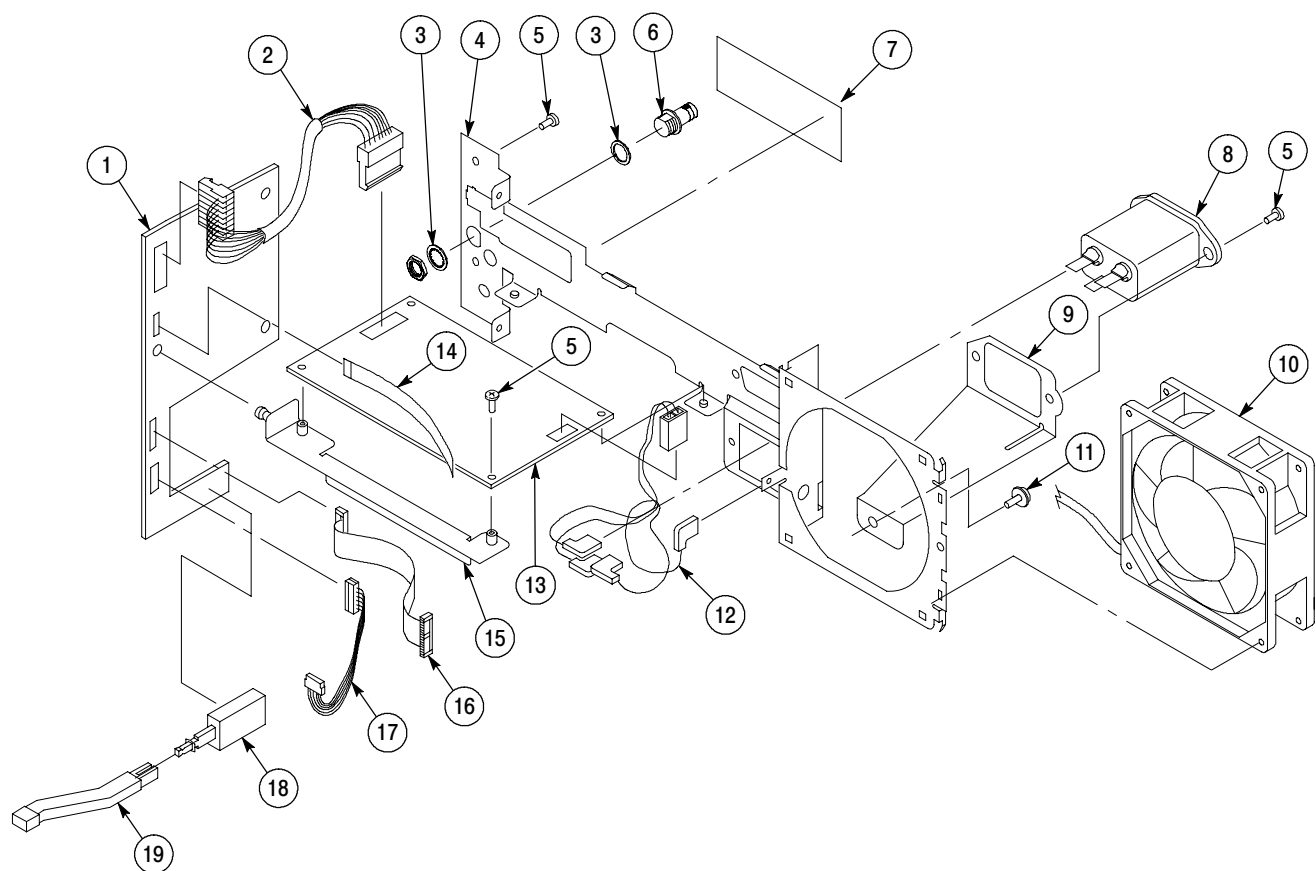


Figure 6-4: Exploded view, circuit board assembly and fan

Figure 6-4 Replaceable parts list

Fig. & index number	Tektronix part number	Serial no. effective	Serial no. discont'd	Qty	Name & description
6-4					Exploded view, circuit board assembly and fan
-1	870-0087-01				CKT BD ASSY: BATTERY
-2	174-4533-00			1	CABLE ASSY. SP; DISCRETE, POWER SUPPLY
-3	210-0978-00			2	WASHER, FLAT; 0.375 ID X 0.5 OD X 0.024, STL CD PL
-4	441-2507-00			1	CHASSIS:REAR,0.050 AL,12,795 X 3.620,CHROMATE
-5	211-0711-00			7	SCREW,MACHINE:6-32 X 0.250,PNH,STL,CDPL,T-15 TORX DR
-6	131-1315-01			1	CONN, RF JACK; BNC, PNL; 50 OHM, FEMALE
-7	335-0519-00			1	MARKER, IDENT; LABEL, COVERUP NO EXT TRIG
-8	119-0420-00			1	FILTER,RFI:6A,250VAC,400HZ
-9	337-4254-01			1	SHIELD, STRAP; FILTER TO ATTENUATOR SHIELD
-10	119-5848-00			1	FAN,DC:TUBEAXIAL,24V,2.09W,2450 RPM,41 CFM,92MM X 25MM,33 DBA,3610KL-05W-B30-P00,
-11	211-0967-00			1	SCREW:6-32X 0.25,PNH,STL,ZI PLT,T-15, W/CAPTIVE FLAT WASHER,
-12	174-3764-00			1	CABLE ASSEMBLY:DISCRETE,LINE INPUT SENSE,PSC,3,18 AWG,1,26 AWG,4.5 L,1X3
-13	119-7088-00			1	POWER SUPPLY:40W,AC-DC,90-264 VAC IN,15V 2.6A OR 3.3A,20 CFM,NAN40-7615
-14	174-5470-00			1	CABLE, 9 PIN FLAT FLEX ETHERNET
-15	407-4530-00			1	BRACKET:POWER SUPPLY SUPPORT,0.050 AL,5.150 X 0.785,CHROMATE
-16	174-5459-00			1	CABLE ASSEMBLY (2 X 13 POWER)
-17	174-3767-01			1	CA ASSY, SP; DISCRETE, BACKLIGHT, IDC
-18	260-2443-00			1	SWITCH,PWR:DPDT,PUSH PUSH ALT ACT,PC PINS
-19	384-1813-00			1	SHAFT:BAYBLEND FR110,SILVER GREY

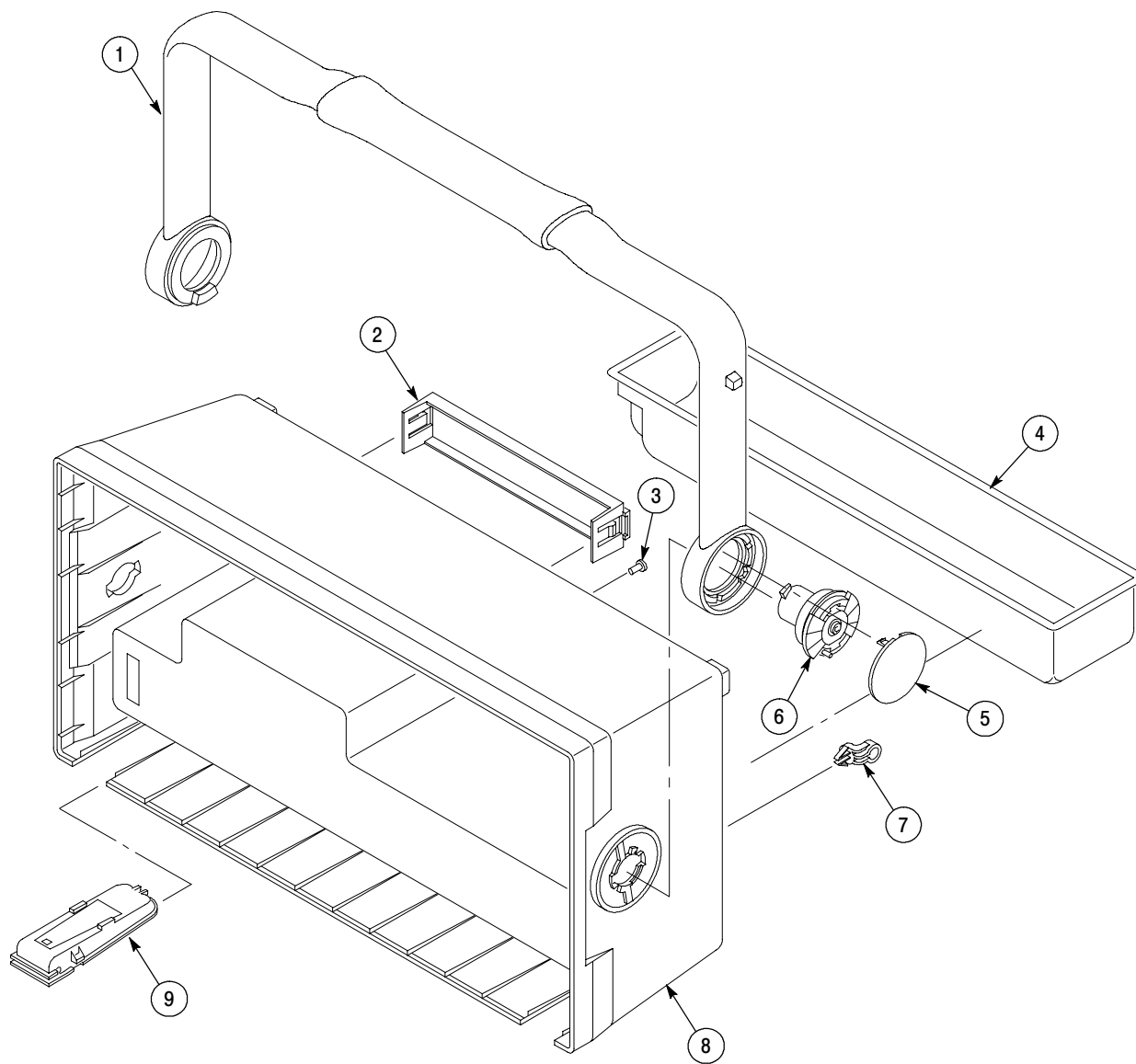


Figure 6-5: Exploded view, rear case half

Replaceable parts list

Fig. & index number	Tektronix part number	Serial no. effective	Serial no. discont'd	Qty	Name & description
6-5					Exploded view, rear case half
-1	367-0498-00			1	HANDLE,CARRYING:14.5740 X 6.3230
-2	200-4415-00			1	COVER:OPTION MODULE OPENING,5.1440 X 0.910 X 0.9950,PC/ABS,FR110,BLUE
-3	211-0722-00			1	SCREW,MACHINE:6-32 X 0.250,PNH,STL,CDPL,T-15 TORX DR
-4	436-0371-00			1	TRAY,ACCESSORY:BATTERY COMPARTMENT
-5	200-4394-00			2	COVER,HUB:POLY,1.60 DIAMETER
-6	401-0785-01			2	HUB ASSY:NYLON
-7	343-1213-00			1	CLAMP,PWR CORD:POLYIMIDE
-8	202-0455-00			1	CASE ASSEMBLY; CASE, W/REAR DOOR, REAR FOOT & CUSHION;TDS3000C, SAFETY CONTROLLED
-9	348-1582-00			2	FOOT ASSY:FRONT,HINGED,HOUSING 380-1118-00, FRONT FOOT 348-1557-00,

Accessories list

Fig. & index number	Tektronix part number	Serial no. effective	Serial no. discont'd	Qty	Name & description
	200-4416-01			1	COVER:FRONT,PROTECTIVE (SEE FIGURE 6-1-8)
	_____			2	P6139A PASSIVE PROBE, 10X, 300&500MHZ, W/ACCY
	436-0371-00			1	TRAY,ACCESSORY:BATTERY COMPARTMENT
	071-2308-XX			1	MANUAL TECH; ENGLISH ;TDS3000C SERIES
	071-2309-XX			1	MANUAL TECH; FRENCH ;TDS3000C SERIES
	071-2310-XX			1	MANUAL TECH; ITALIAN ;TDS3000C SERIES
	071-2311-XX			1	MANUAL TECH; GERMAN ;TDS3000C SERIES
	071-2312-XX			1	MANUAL TECH; SPANISH ;TDS3000C SERIES
	071-2313-XX			1	MANUAL TECH; JAPANESE ;TDS3000C SERIES
	071-2314-XX			1	MANUAL TECH; PORTUGUESE ;TDS3000C SERIES
	071-2315-XX			1	MANUAL TECH; SIMPLIFIED CHINESE;TDS3000C SERIES
	071-2316-XX			1	MANUAL TECH; TRADITIONAL CHINESE;TDS3000C SERIES
	071-2317-XX			1	MANUAL TECH; KOREAN;TDS3000C SERIES
	071-2318-XX			1	MANUAL TECH; RUSSIAN ;TDS3000C SERIES
	071-2507-XX			1	MANUAL,TECH: SERVICE,TDS3000C SERIES
	650-4285-XX			1	TDS3AAM ADVANCED ANALYSIS APP MODULE
	650-4286-XX			1	TDS3LIM LIMIT TEST APP MODULE
	650-4203-XX			1	TDS3SDI 601 DIGITAL VIDEO APP MODULE
	650-4125-XX			1	TDS3TMT TELECOM MASK TEST APP MODULE
	650-3899-XX			1	TDS3VID EXTENDED VIDEO APP MODULE
	650-4289-XX			1	TDS3GV GPIB/RS232/VGA COMM MODULE
	See Description			1	CABLE ASSY, POWER:
					OPTION COUNTRY P/N
					A0 NORTH AMERICA 161-0348-00
					A1 UNIVERSAL EURO 161-0343-00
					A2 UNITED KINGDOM 161-0344-00
					A3 AUSTRALIA 161-0346-00
					A5 SWITZERLAND 161-0347-00
					A6 JAPAN 161-0342-00
					A10 CHINA 161-0341-00
					A11 INDIA 161-0349-00
	_____			1	TDS3CHG EXTERNAL BATTERY CHARGER
	_____			1	TDS3BATC RECHARGEABLE BATTERY PACK
	_____			1	AC3000 OSC SOFT CARRY CASE
	_____			1	RM3000 RACK MOUNT KIT
	_____			1	NI LabVIEW SignalExpress Tektronix Edition software for OSC
	_____			1	OpenChoice® Desktop PC Communications software for OSC