DPO2000 and MSO2000 Series Oscilloscopes

Service Manual

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Tektronix

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Service Manual

Revision B

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Tektronix

Contacting Tektronix

Tektronix, Inc.
14150 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.

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.

Connect the probe reference lead to earth ground only.

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

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

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

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

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

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.

Preface

This service manual provides information that you need to troubleshoot, disassemble, and replace parts on the Tektronix DPO2000 and MSO2000 Series Oscilloscopes.

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*.

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 power supply, or a mechanical part, such as the I/O port connectors, that is listed in the replaceable parts list.

Safety

Symbols and terms related to safety appear in the *General Safety Summary*

Related Documentation

Table i: Related documentation

To read about	Use these documents
Installation and Operation	*DPO2000 and MSO2000 Series Digital Phosphor Oscilloscopes User Manual* (available in 11 languages)
Specifications and Performance	*DPO2000 and MSO2000 Series Specifications and Performance Verification Technical Reference* (PDF only)
Programmer Commands	*DPO2000 and MSO2000 Series Programmer Manual* (PDF only)
Analysis and Connectivity Tools	*Getting Started with OpenChoice® Solutions Manual*
Installing and testing applications modules	*DPO2000 and MSO2000 Series Application Modules Installation Instructions Manual*
Oscilloscope calibrator	*Fluke Oscilloscope Calibrator Manual* at http://us.fluke.com

The Tektronix manuals are available on the Web, at www.tektronix.com/manuals.

Operating Information

For information on installing and operating your DPO2000 or your MSO2000 Series Oscilloscope, refer to the *DPO2000 and MSO2000 Series Oscilloscopes User Manual*.

The User manual is available, in 11 languages, on the Web at www.tektronix.com.

Theory of Operation

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

Block Diagram

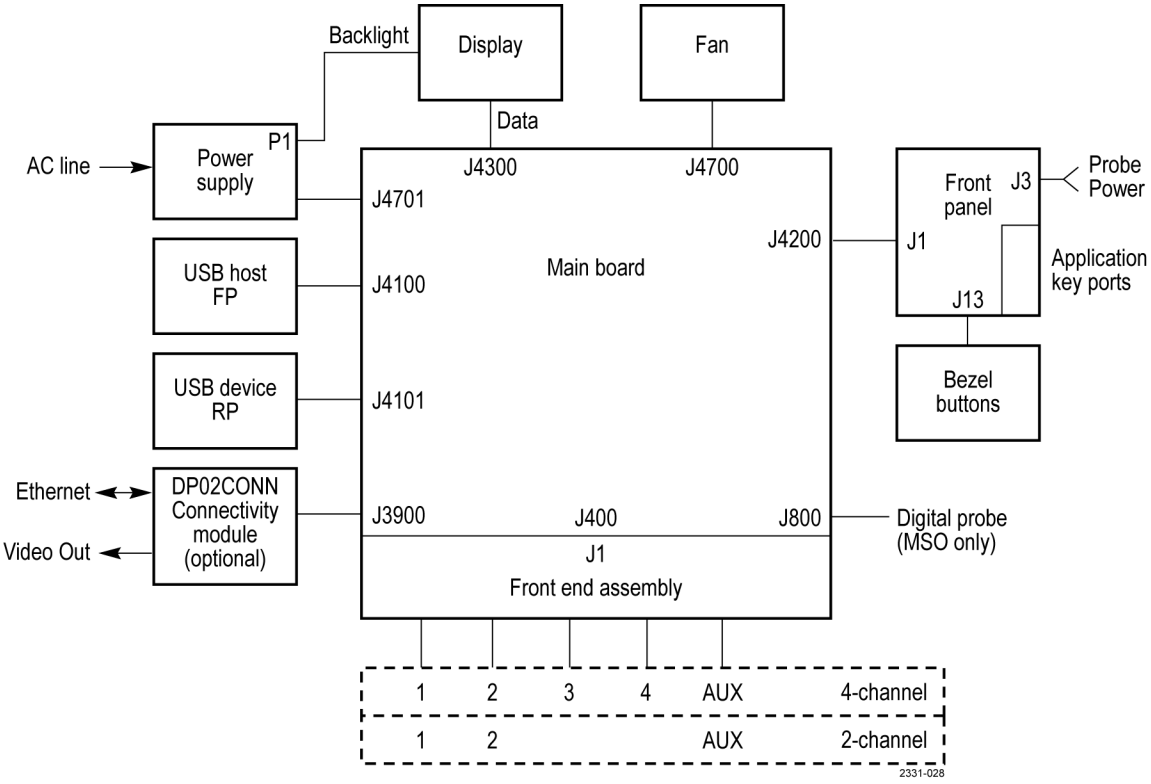


Figure 1: Oscilloscope module interconnections

Power Supply

The Power Supply board converts AC line voltage to +3.3 V, +5 V, –5 V, and +13 V to power all internal circuits. The Power Supply board also supplies power to the display backlight.

Front End Assembly

The Front End assembly begins with the analog signal path and ends with differential mode channel signals which are passed to the Main board. The analog inputs, attenuators, and preamps are contained in this assembly.

Main Board

The Main board module contains the following functions:

Acquisition System

The Acquisition system begins by accepting the differential mode channel signals from the Front End assembly, which are routed to the A/D inputs, and ends with a digitized signal in memory.

Trigger System

The Trigger system processes the digitized signal stored in memory. Advanced trigger functions are enabled only when the appropriate application modules and supporting software are 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 WQVGA display module (LCD).

Processor System

The Processor system contains a Power PC microprocessor that controls the entire instrument. The processor system also contains FLASH ROM, system RAM, and interfaces to Ethernet and to the USB ports.

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 on the Main board. The Front Panel board also generates the probe compensation output signal and provides an interface to the application modules.

Adjustment Procedures

This chapter contains the factory adjustment procedure for the DPO2000 Series and the MSO2000 Series oscilloscopes. Only qualified personnel should perform adjustment procedures. Read the *Service Safety Summary* and the *General Safety Summary* before performing any service procedures.

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 to check whether the oscilloscope meets specifications. See the DPO2000 and MSO2000 Series Specification and Performance Verification Technical Reference.*

Successful completion of this adjustment procedure automatically updates the stored time and date of the latest successful adjustment. Completion of the Performance Verification procedure does not update this date and time. If no adjustment is needed, there is also no need to update the time and date of the adjustment.

Required Equipment

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

The following table specifies required equipment for the MSO2000 Series oscilloscope.

Description	Minimum requirements	Example
DC voltage source	5 mV to 25 V, ±0.1% amplitude accuracy	Fluke or Wavetek 9500 Oscilloscope Calibrator with five 9530 active heads.
Digital calibrator probe	Precision test probe, 16 digital channels	Tektronix Part Number 067-6316-00
BNC to square pin adapter	Connects signal from BNC to 16 square pins	Tektronix Part Number 878-0219-00

The following table specifies required equipment for the DPO2000 Series oscilloscope.

Description	Minimum requirements	Example
DC voltage source	5 mV to 25 V, ±0.1% amplitude accuracy	Fluke or Wavetek 9500 Oscilloscope Calibrator with 9530 active heads
Sine Generator	1 kHz to 200 MHz	Wavetek 9500 Oscilloscope Calibrator with one 9510 Output Module
Edge Generator	1 kHz with < 50 ps ch-ch skew	
50 Ω BNC cable	BNC male to BNC male, about 10 in (25 cm) long	Tektronix part number 012-0208-00

Overview of the Adjustment Process

Before performing adjustment procedures, you must warm up the oscilloscope for at least 20 minutes in an ambient temperature between 20 °C and 30 °C. Adjustments performed before warm-up or outside this temperature range may result in poor performance or calibration failure.

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 oscilloscope passes the step, it moves on to the next step. If the oscilloscope fails, you can repeat the step or choose to abort the procedure.

If you have difficulty completing the steps, refer to the *Completing the Procedure* section for specific instructions and troubleshooting information.

To complete the calibration procedure, you must know how to operate the oscilloscope calibrator. Please refer to the user manual, which can be found at http://us.fluke.com.

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 or fails.*

The screen does not display the signal traces or actual oscilloscope settings (such as channel input impedance, or vertical and horizontal settings) 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.

If the oscilloscope completes all steps in the procedure successfully, a "Pass" message is displayed and the new calibration constants take effect. If the oscilloscope does not pass a step, you can repeat the step. To cancel the calibration procedure, press the **Menu Off** front panel button on the oscilloscope. This reverts the oscilloscope to the old calibration constants.

Factory Adjustment Procedure

To perform the factory adjustment procedure, complete these steps:

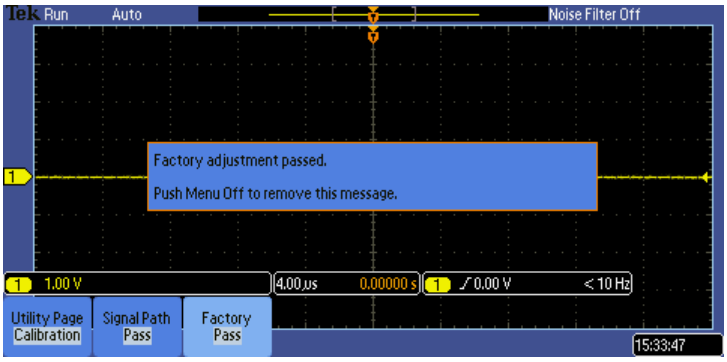
1. Connect the oscilloscope to an AC power source.

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

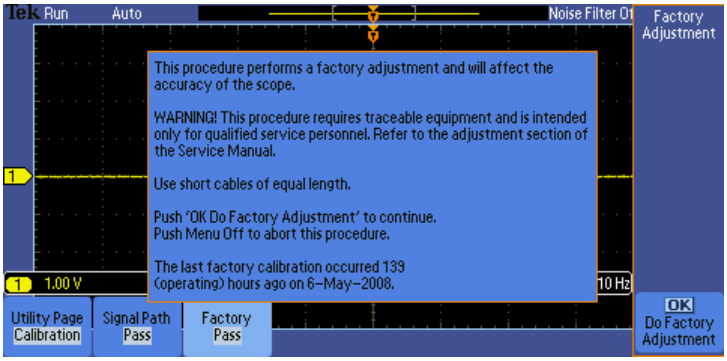
2. Power on the oscilloscope and warm it up for 20 minutes.
3. Power on the oscilloscope calibrator and warm it up for 20 minutes.
4. Connect the active heads from the calibrator to the oscilloscope, ensuring that Channel 1 on the calibrator connects to Channel 1 on the oscilloscope, and so on.

NOTE. *For the DPO2000, there will be either 2 or 4 channels to connect. For the MSO2000, there will be either 2 or 4 channels to connect, plus an additional channel connection for the digital probe. Plug the digital probe into the Channel 5 active head on the calibrator, using the BNC to square pin adapter, but do not plug the probe into the oscilloscope until you are directed to by the calibration process. Once you do plug the digital probe into the oscilloscope, do not unplug it until the adjustment procedure is completed.*

5. Access the Factory Adjustment menu:
   a. Press the front-panel **Utility** button, and then press the bottom-bezel **Utility Page** button.
   b. Use Multipurpose knob **a** to select **Calibration**, and then press the bottom-bezel **Factory** button. The Factory adjustment passed dialog will appear, as shown below.



c. While the dialog window is open, press and hold the top side-bezel button (below the **Waveform Only** button) for approximately five seconds. The Factory Adjustment description and menu will appear, as shown here.



d. Push the **OK Do Factory Adjustment** side-bezel button to start the adjustment process. Prompts appear on the oscilloscope screen to indicate the signal type and the channels to which it should be connected.

NOTE. *The oscilloscope adjusts itself automatically using the calibrator signal as a reference. You do not need to make any adjustments.*

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** side bezel button.

6. For each step, refer to the following table to identify the signal type, and then carefully follow the instructions for that signal type on the specified page.

Signal type	Example prompt	Refer to	Parameters to set
DC Voltage	Apply 0 V DC 50 Ω termination signal to 3.	(See page 10.)	Waveform type, voltage, termination, channel
Sine Signal	Apply 2.0 V Pk-Pk 1 MHz 50 Ω termination sine signal to 3.	(See page 11.)	Waveform type, voltage, frequency, termination, channel

NOTE. *The oscilloscope screen will not provide you with all of the information that you need to complete the steps successfully, so it is critical that you follow the steps outlined in the Completing the Procedure section. Each time a new prompt appears, refer to the table above to identify the signal type, and then ensure that you are following every step that is outlined for that specific signal type.*

7. Continue with the adjustment process until it is complete and you receive the **Pass** notification. You can cancel the process at any time by pushing the **MENU OFF** button.
8. Complete the performance verification tests to verify that the adjustment procedure has correctly calibrated the oscilloscope. (Refer to the *DPO2000 and MSO2000 Series Specifications and Performance Verification Technical Reference*.) Incorrect use of calibration equipment can cause the oscilloscope to pass the Calibration Procedure but fail Performance Verification.

Completing the Procedure

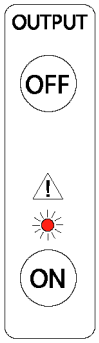
Instructions for completing the DC Voltage, Deskew, and Sine Signal tests are below. For each step in the calibration procedure, start at the beginning of the numbered instructions for the specific test type, and carefully complete each step.

If the oscilloscope fails a step, consult the *Troubleshooting* section at the end of this chapter, revert to the previous step and try again. If the step fails again, return to the first step in the calibration procedure and try the entire procedure again. If the procedure fails, there could be problem with the oscilloscope. Consider seeking customer support.

DC Voltage

The DC Voltage test is the first test to appear on the prompts, and it usually makes up the majority of the calibration procedure tests. For each DC Voltage test, complete all 8 steps listed below to best ensure that the test will pass.

1. Push the **DC/Square**  button.
2. Push the **WAVEFORM** lower-bezel button, and then push the **DC Positive**  right-bezel button.
3. Push the **CHANNEL SELECT** lower-bezel button.
4. Push the **LOAD** lower-bezel button to highlight either **1M Ω** or **50 M Ω** .
5. **EXIT lower** bezel button.
6. If the amplitude field is not selected, use the front panel scroll buttons. Type the specified voltage, and then push the appropriate unit in the right-bezel menu.
   - **For 0 V:** ground the signal by pushing the grounding  lower-bezel button. When this is active, you will not be able to make a channel selection, so in some cases you might need to temporarily deselect the grounding option while you make a channel selection. If the prompt requires all channels and the signal is grounded, The calibrator screen will default to Channel 1.
   - **For any nonzero voltage:** Before you select the voltage, you must first ensure that the calibrator is in direct mode. Push the  lower-bezel button until 1.0 is selected.
7. Ensure that the red light is illuminated to indicate that the output is on. If not, push the **ON** button, as shown below:



8. On the oscilloscope, push the **OK Do Next Step** side-bezel button.

Sine Signal

When a Sine Signal prompt appears, complete the following steps:

1. Push the **Sine**  front panel button.
2. To ensure that the voltage is in direct mode, push the  lower-bezel button and select **1.0**.
3. Push the **CHANNEL SELECT** lower-bezel button, and then ensure that Channel 5 is selected.
4. Ensure that the red light is illuminated to indicate that the output is on. If not, push the **ON** button.
5. On the oscilloscope, push the **OK Do Next Step** right-bezel button.

Troubleshooting

Refer to the following table for common issues encountered during the calibration procedure.

Problem	Things to try
The instrument fails a test	Are the channels hooked up properly, routed to the right channels, and turned on Is the signal set to the correct waveform, frequency, and termination (if applicable to the test) Is the output set to **ON** (the red light will be illuminated) If you make a correction or find that everything appears to be correct, click the **Go back a step** button to try the test again.
I can't set the amplitude to 0 V, as specified in the prompt	Ground the signal by pushing the  lower-bezel button.
I can't find the parameters that I need to set	Is the waveform set correctly Is the grounding button on? When this is active, you will not be able to make a channel selection, so in some cases you might need to temporarily deselect the grounding option while you make a channel selection. If you can find the termination settings, click the **CHANNEL SELECT** lower-bezel button.
I can't set the signal to all channels	If you are unable to set the signal to all channels, try setting the signal to Channel 1.
The Sine Signal test failed	If the prompt specified Channel 4, try setting the signal to Channel 5, instead.

Maintenance

This section contains the information needed to do periodic and corrective maintenance on the oscilloscope, as well as repackaging instructions if you need to return the oscilloscope to Tektronix for service.

Preventing ESD

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

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

When performing any service that requires internal access to the oscilloscope, adhere to the following precautions to avoid damaging internal modules and their components due to electrostatic discharge.

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. Service static-sensitive modules only at a static-free work station.
4. Do not place anything capable of generating or holding a static charge 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 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 you 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 is essential for proper cooling. The cabinet needs to be in place when operating the oscilloscope.

LCD Display Cleaning

The LCD should be treated with care during cleaning.

CAUTION. *Improper cleaning agents or methods can damage the flat panel display.*

Avoid using abrasive cleaners to clean the display surface.

Avoid spraying liquids directly on the display surface.

Avoid scrubbing the display with excessive force.

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

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 avoid injury or death, power down the instrument and disconnect it from line voltage before performing any procedure that follows.*

Exterior Cleaning

Clean the exterior surfaces 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.

CAUTION. *Avoid the use of chemical cleaning agents, which might damage the plastics used in this oscilloscope. 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.*

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

Exterior Inspection

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

Table 1: External inspection check list

Item	Inspect for	Repair action
Case, 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.

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 display surface.

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

Interior Inspection

To access the inside of the oscilloscope for inspection and cleaning, refer to the Removal Procedures in this section.

Inspect the internal portions of the oscilloscope for damage and wear, using the following table as a guide. Repair any defects immediately.

If you replace the Main board or the Front End assembly, you must adjust the instrument after repair. Refer to the *Adjustment Procedures*.

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

Table 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.
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 rinsed 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 following steps.

If there is still dust or dirt on the module, the oscilloscope may be spray washed using a solution of 75% isopropyl alcohol by doing the following steps:

1. Gain access to the parts to be cleaned by removing easily accessible shields and panels. (See page 18.)
2. Spray wash dirty parts with the isopropyl alcohol and wait 60 seconds for the majority of the alcohol to evaporate.
3. Use hot (120 °F to 140 °F) deionized water to thoroughly rinse them.
4. Dry all parts with low-pressure, deionized air.
5. Dry all components and assemblies in an oven or drying compartment using low-temperature (125 °F to 150 °F) circulating air.

Overview of Removal Procedures

Refer to the *Trim, Cabinet, and Module Removal* for the location of modules that you are removing or installing. If you are disassembling the instrument for cleaning, refer to the *Inspection and Cleaning* procedure for instructions.

List of Modules

The *Replaceable Parts List* chapter provides a list of all replaceable modules. Any replaceable component, assembly, or part is referred to as 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.*

Tools Required

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

- Torque-limiting screwdriver, 12 in-lb (1.3 N-m) range with TORX T15 and small Phillips bits. If you are using a magnetic screwdriver with interchangeable bits, the T15 bit must be a long bit, at least 5 cm (2 in) overall length.

Trim, Case, and Module Removal

Use the following procedures to remove the trim, case, and internal modules. Refer to the illustrations in Section 5, *Replaceable Parts*, for additional detail.

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

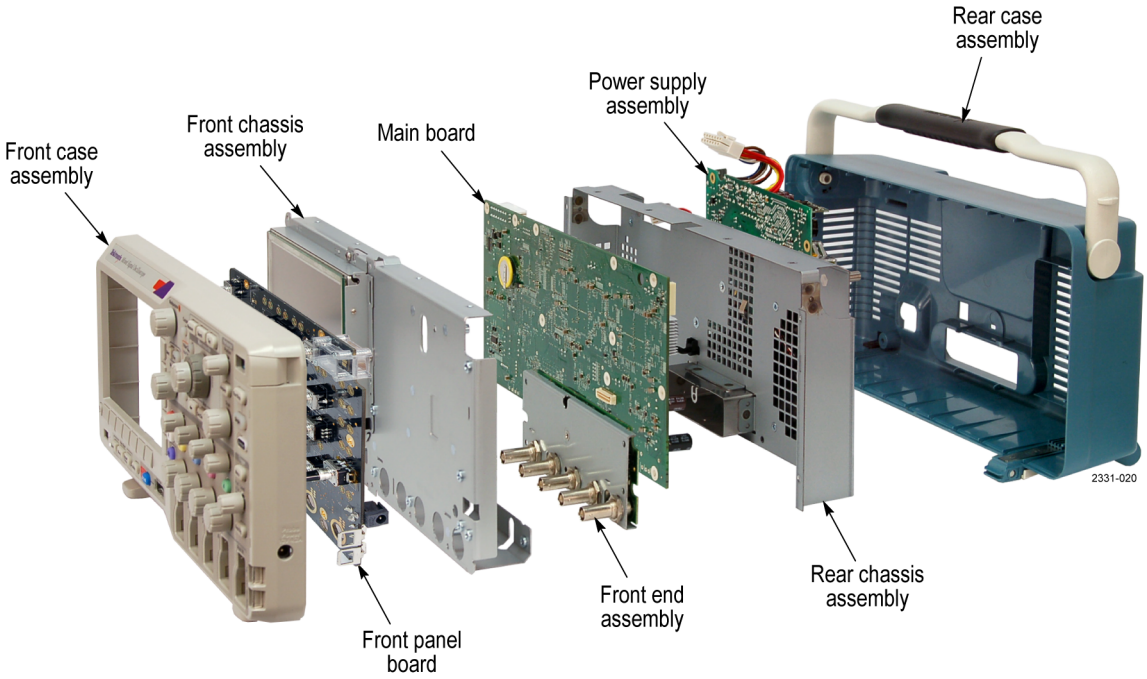


Figure 2: Locator for internal modules

Removal Procedures

Refer to the *Exploded Views* and/or the *Internal Module* locator before you follow any removal procedures for any modules. These procedures require that you have access to the module that you are removing. Unless directed otherwise, replacement is the reverse of removal.

CAUTION. *When removing or installing the Front Panel board or flexible keypad, do not touch the switch contacts with your fingers. The oils on 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.*

Rear Case

Follow these steps to remove the Rear Case assembly. Use a TORX T15 screwdriver tip. (See Figure 8.)

1. Remove the four screws from the back of the Rear Case assembly. When reinstalling, tighten these screws to 8 in/lb.
2. Grasp the case and pull outwards to remove it.

Power Supply Module

Follow these steps to remove the Power Supply module. You need to have previously removed the Rear Case assembly. Use a TORX T15 screwdriver tip. (See Figure 9.)

1. Disconnect the power supply cable from J4701 on the Main board.
2. Disconnect the backlight cable from P1 on the power supply.
3. Disconnect the Green/Yellow ground cable from the chassis tab.
4. Remove the two screws that attach the power cord connector to the rear chassis. When reinstalling, tighten these screws to 8 in/lb.
5. Remove the 3 screws that attach the Power Supply module to the rear chassis. When reinstalling, tighten these screws to 8 in/lb.
6. Lift the Power Supply module off the chassis.

Rear Chassis

Follow these steps to remove the rear chassis. You need to have previously removed the Rear Case assembly. Use a TORX T15 screwdriver tip. (See Figure 10.)

1. If not already disconnected, disconnect the power supply cable from J4701 on the Main board, disconnect the backlight cable from P1 on the power supply.
2. Disconnect the fan cable from J4700 on the Main board.
3. Remove the 14 T15 screws that attach the rear chassis to the front chassis. When reinstalling, tighten these screws to 8 in/lb.
4. Lift the rear chassis slightly, and then disconnect the rear USB port cable from J4101 on the Main board.
5. Remove the rear chassis and place it on the work surface with the fan up.

Fan

NOTE. *Do not remove the fan from the rear chassis unless you are replacing the fan.*

Follow these steps to remove the fan. You need to have previously removed the Rear Case assembly and the rear chassis. (See Figure 11.)

1. Lift the tape holding the fan cable to the rear chassis, so that the cable is free.
2. Turn the rear chassis over on the work surface so that the fan is on the bottom.
3. Remove the four T15 flat-head screws that attach the fan to the rear chassis.
4. Separate the fan and the rear chassis.

Main Board

Follow these steps to remove the Main board. You need to have previously removed the rear case assembly and the rear chassis. Use a TORX T15 screwdriver tip. (See Figure 12.)

1. Disconnect the display cable from J4300 on the Main board.
2. Disconnect the Front Panel cable from J4200 on the Main board.
3. Disconnect the front USB port cable from J4100 on the Main board
4. Remove the 11 remaining T15 screws that connect the Main board to the chassis. When reinstalling, tighten these screws to 8 in/lb.
5. Lift the Main board up and set it on a static-free work surface.
6. When reinstalling, use care to align J400, on the back of the Main board, with J1 on the Front End assembly. You can use the mounting holes as an alignment aid. Apply slight pressure to seat the connector. Also, make sure to route the Front Panel cable above the Main board standoff.

Front End Assembly

Follow these steps to remove the Front End Assembly. You need to have previously removed the rear case, the rear chassis, and the Main board. (See Figure 13.)

1. Remove the five T15 screws that attach the Front End assembly to the front chassis. When reinstalling, tighten these screws to 8 in/lb.
2. Lift the Front End assembly up from the front chassis. Be careful of the BNC connectors until they clear the front chassis.
3. Place the Front End assembly on a static-free work surface.

Front Chassis

Follow these steps to remove the Front Chassis. You must have previously removed the rear case assembly and the rear chassis. (See Figure 14.)

1. Remove the seven T15 screws that connect the front chassis to the front panel assembly.
2. MSO2000 Series only – remove the digital probe guide.
3. Lift the main chassis from the oscilloscope slightly, and then disconnect the Front Panel cable from the front panel. Set the main chassis aside with the display module up.
4. When reinstalling, be careful with the screws. These are self-tapping screws, and you want to avoid cutting new threads. One way to do this is to rotate the screw counterclockwise until the threads drop into the grooves, then rotate the screw clockwise until it is seated. Tighten these screws to 8 in/lb.

Display Module

Follow these steps to remove the display module. You need to have previously removed rear case, rear chassis, and front chassis. Use a TORX T15 screwdriver tip. (See Figure 15.)

1. Place the front chassis on the work surface with the display module up.
2. Remove the four T15 screws that secure the display module to the front chassis.
3. Gently lift the display up and off of the chassis, threading the backlight and data cables through their respective holes in the chassis.

CAUTION. *Be careful when removing and reinstalling the Display module cables. If the connectors have bent pins or are installed incorrectly, the Display may be destroyed.*

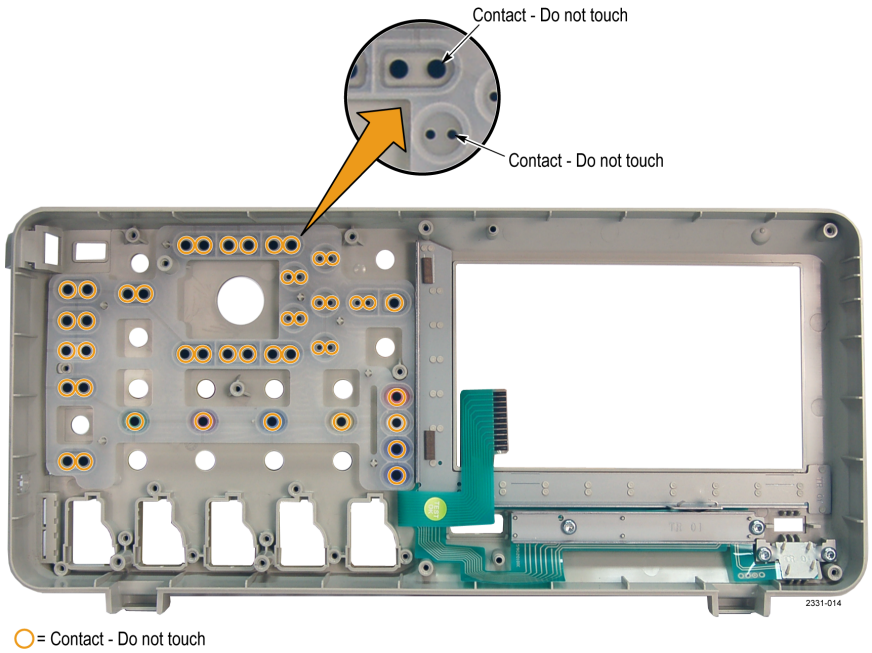
Front Panel board

Follow these steps to remove the Front Panel board. You need to have previously removed the rear case, rear chassis, Main board, and front chassis. Use a TORX T15 screwdriver tip. (See Figure 16.)

1. Remove all of the front-panel knobs, and then place the Front Panel assembly face down on the work surface.
2. Disconnect the bezel button flex-cable from J13 on the Front Panel board.

3. Remove the 12 T15 screws that attach the Front Panel board to the front frame. Note that five of these screws have ground clips. Make sure to place the ground clips on the correct screws when reinstalling. Note the ground clip detail in Figure 5-11. When reinstalling, tighten these screws to 8 in/lb.
4. Lift the Front Panel board off of the chassis, and place it on a static-free surface.

CAUTION. *While the Front Panel board is out of the instrument, do not touch the switch contacts on the board or on the flexible mat with your fingers. The oils on your fingers will degrade or damage the switch contacts.*



5. When reinstalling, be careful with the screws. These are self-tapping screws; avoid cutting new threads by slowly rotating the screw counterclockwise until the threads drop into the grooves, then rotate the screw clockwise until seated.

Application Key Guides

Follow these steps to replace the Application Key guides. You need to have previously removed the rear case, rear chassis, Main board, front chassis, and Front Panel board. Use a Phillips screwdriver tip. (See Figure 17.)

NOTE. *Do not remove the Application Key guides from the Front Panel board unless you are replacing them due to damage.*

1. Remove the two flat-head Phillips screws from the back side of the Front Panel assembly. These screws go completely through the guides on both sides of the circuit board.
2. Turn the Front Panel assembly over and remove the two flat-head Phillips screws from the front side of the Front Panel assembly.
3. When reinstalling these screws, tighten them to only 2 in/lb.

CAUTION. *Do not overtighten the screws in the Application Key guides. Overtightening these screws will destroy the guide.*

Troubleshooting

This section contains information and procedures to help you isolate a defective module in the DPO2000 series or the MSO2000 series oscilloscopes.

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.*

Adjustment After Repair

If you replace the Main board or the Front End assembly, you must adjust the instrument after repair. Refer to the *Adjustment Procedures*.

Required Tools and Equipment

You need the following equipment to troubleshoot the instrument.

Tools and equipment	Example
DMM	3.5 digit or better DMM; Fluke 80 Series or equivalent

Troubleshooting Procedure

The following figures are troubleshooting procedure flowcharts. Use them to troubleshoot an instrument failure.

WARNING. *Before removing the rear case, disconnect the power cord from the line voltage source. Failure to do so could cause serious injury or death.*

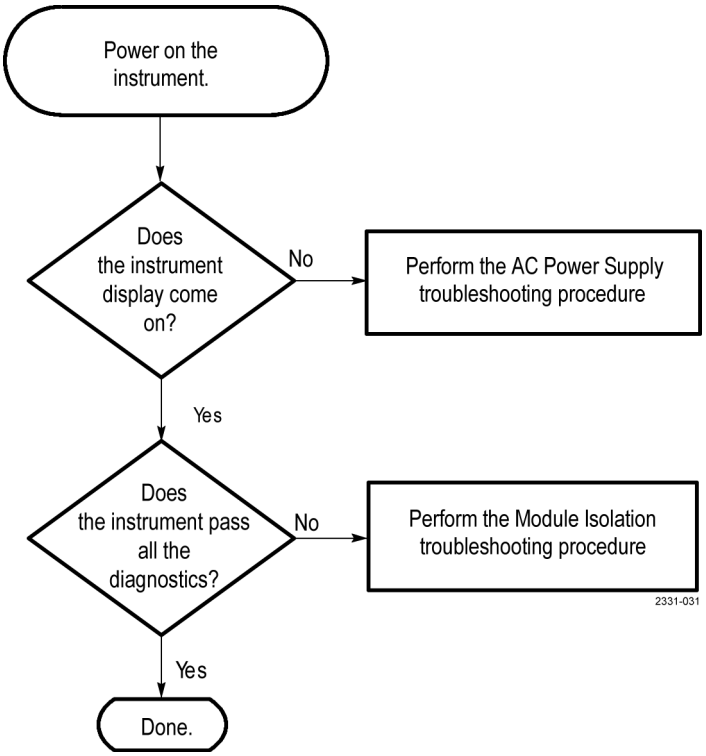


Figure 3: Primary troubleshooting procedure

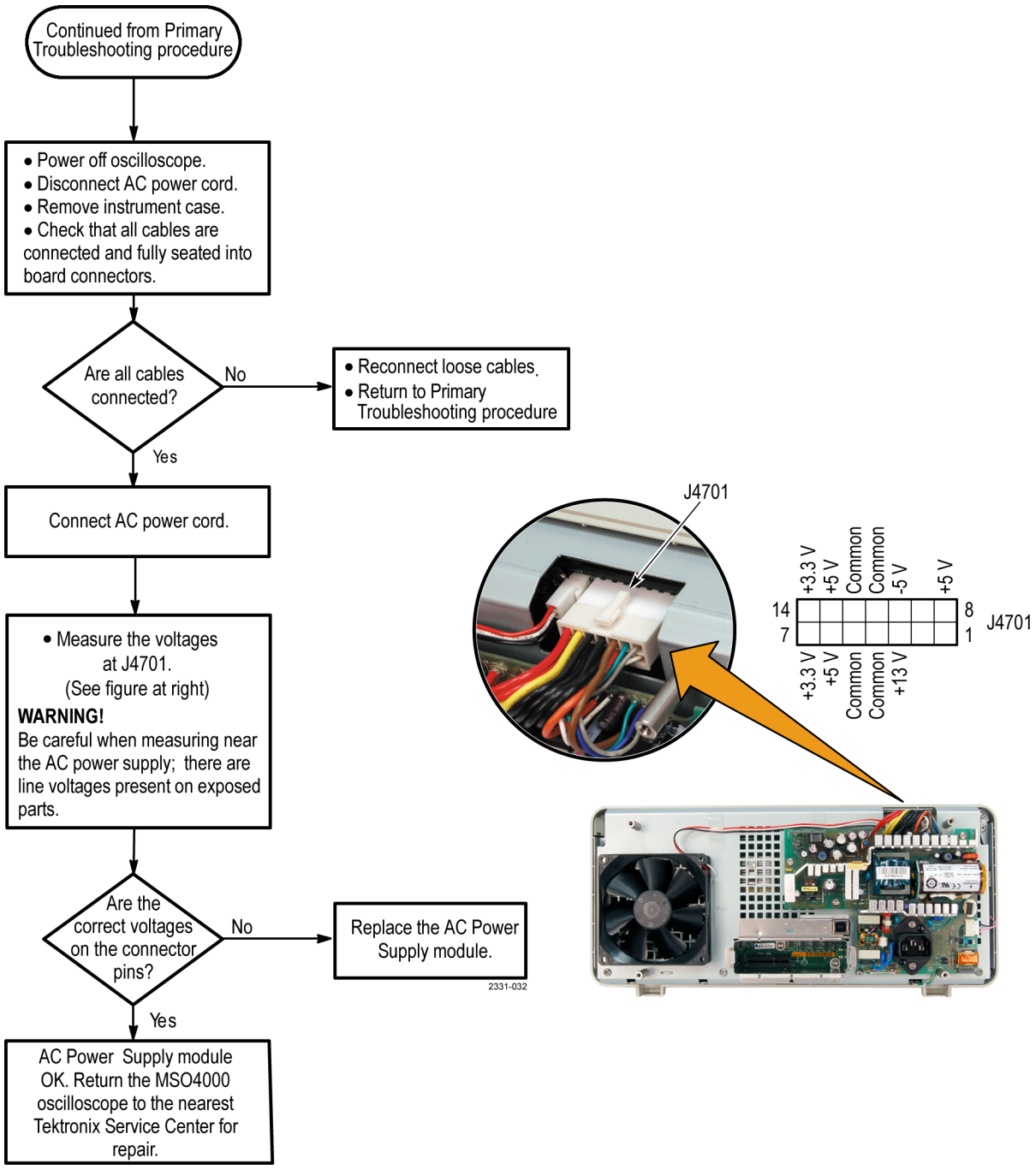
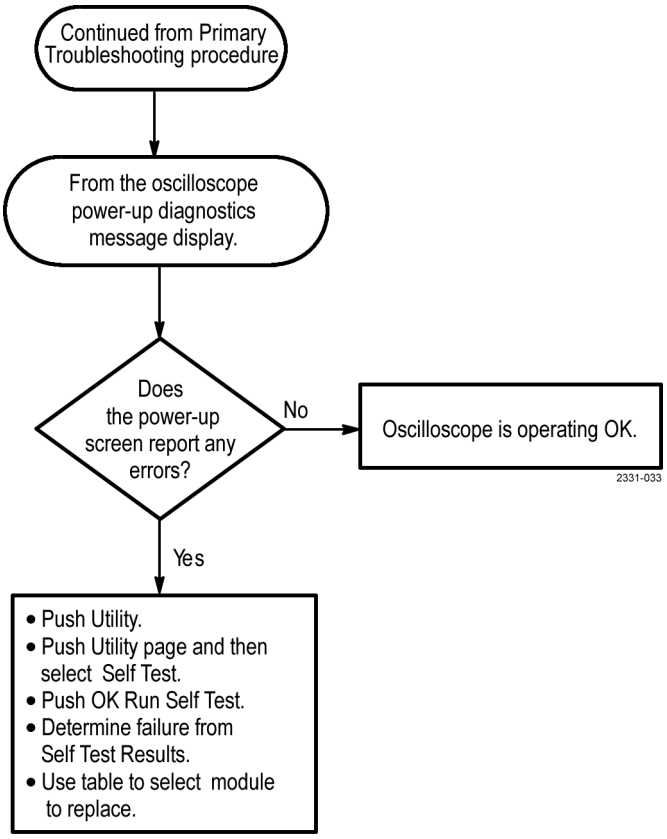


Figure 4: AC power supply troubleshooting procedure



Failed Test	Most Likely Cause
Acquisition	Main board (or Front End assembly)
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 5: 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. See www.tektronix.com/service to find a service center near you.

Storage

The oscilloscope should be stored in a clean, dry environment. The following environmental characteristics apply for both shipping and storage:

- Temperature range: -20 °C to +60 °C
- Altitude: To 15,000 m

See the *DPO2000 and MSO2000 Series Specifications and Performance Verification Technical Reference* for a complete listing of the environmental characteristics.

Replaceable Parts List

This chapter contains a list of the replaceable modules for the DPO2000 and MSO2000 Series Oscilloscopes. 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.

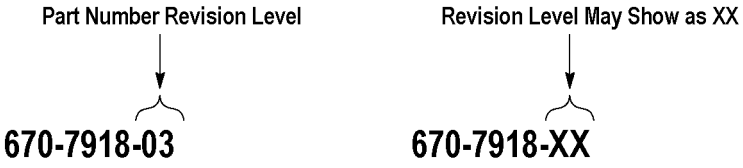
- Part number (See page 29.)
- Instrument type or model number
- Instrument serial number
- Instrument modification number, if applicable

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 next three options. Contact your local Tektronix service center or representative for repair assistance.

Module Exchange. In some cases you may exchange your module for a remanufactured module. These modules cost significantly less than new modules and meet the same factory specifications. For more information about the module exchange program, call 1-800-833-9200, extension 2.

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 instrument. Use this list to identify and order replacement parts. The following table describes each column in the parts list.

Column	Column name	Description
1	Figure & Index Number	Items in this section are referenced by figure and index numbers to the exploded view illustrations that 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

The following diagrams show the module-level exploded views of the DPO2000 and MSO2000 Series oscilloscopes. Each exploded view is indexed by the numbers in the figure.

Table 3: Front trim

Fig. & index number	Tektronix part number	Serial no. effective	Serial no. discont'd	Qty	Name & description
5-1					**Front trim**
-1	366-0863-00			7 [1]	ASSEMBLY, KNOB; .685 DIAMETER
-2	366-0862-00			6 [1]	ASSEMBLY, KNOB; .470 DIAMETER
-3	366-0877-00			1	KNOB; LARGE, WSP, JOG, SHUTTLE, FSN.ASM
-4	358-0890-00			1	BUSHING, SPACER, RING JOG-SHUTTLE
-5	366-0876-00			1	KNOB; SMALL, WSP, JOG - SHUTTLE, FSN.ASM
-6	800-0038-00			1	FINAL ASSEMBLY; MECHANICAL; DPO2EMBD
	800-0039-00			1	FINAL ASSEMBLY; MECHANICAL; DPO2AUTO
	800-0040-00			1	FINAL ASSEMBLY; MECHANICAL; DPO2COMP
-7	200-5039-00			1	COVER, DOOR OPTION KEYS

[1] Number will vary depending on oscilloscope model.

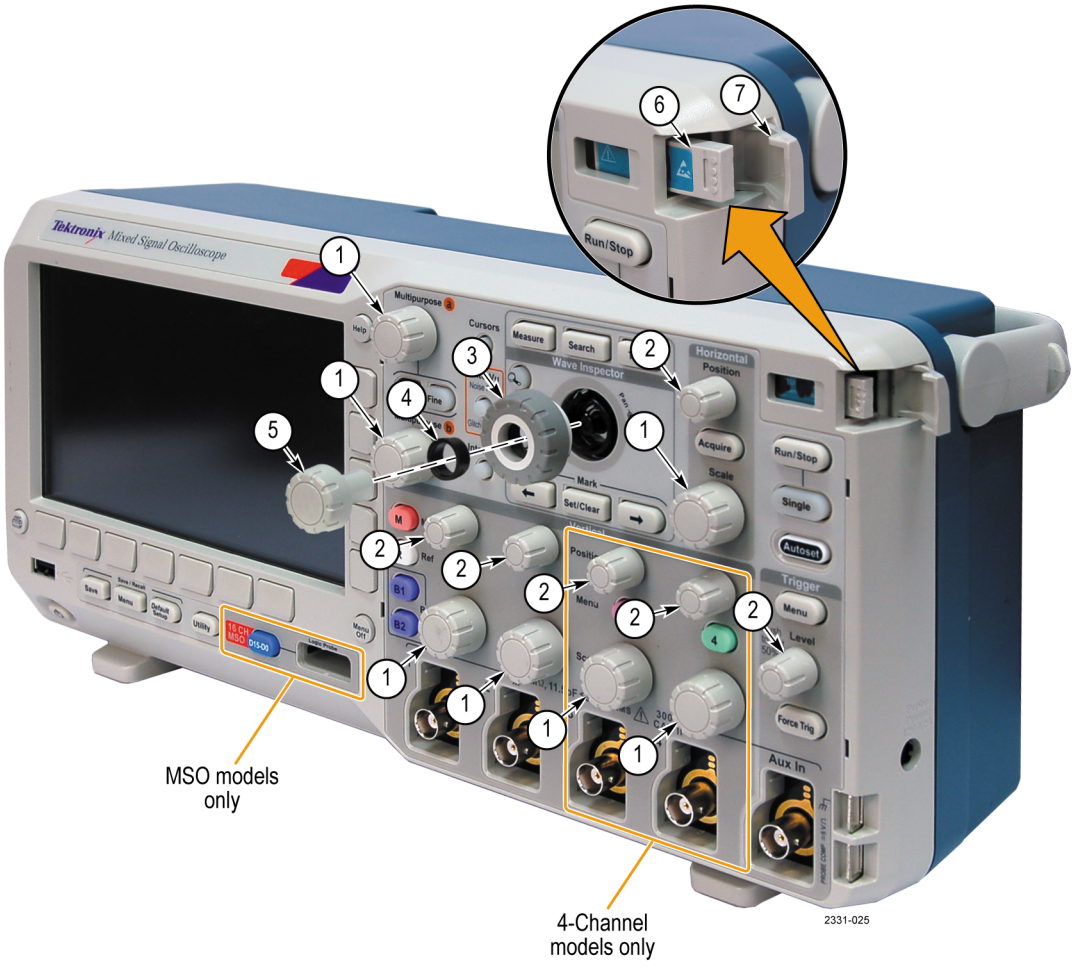


Figure 6: Front trim

Table 4: Rear trim

Fig. & index number	Tektronix part number	Serial no. effective	Serial no. discont'd	Qty	Name & description
5-2					Rear trim
-1	650-5016-00			1	REAR CASE SUB ASSEMBLY; MSO/DPO2000
					ATTACHED PARTS
-2	348-1910-00			2	FOOT, FRONT CABINET, HINGED
-3	214-5148-00			2	SPRING FRONT FOOT
-4	105-1170-00			2	ACTUATOR, CAM FOLLOWER HANDLE SLIPRING
	367-0547-00			1	HANDLE, CARRYING BASE
					END ATTACHED PARTS

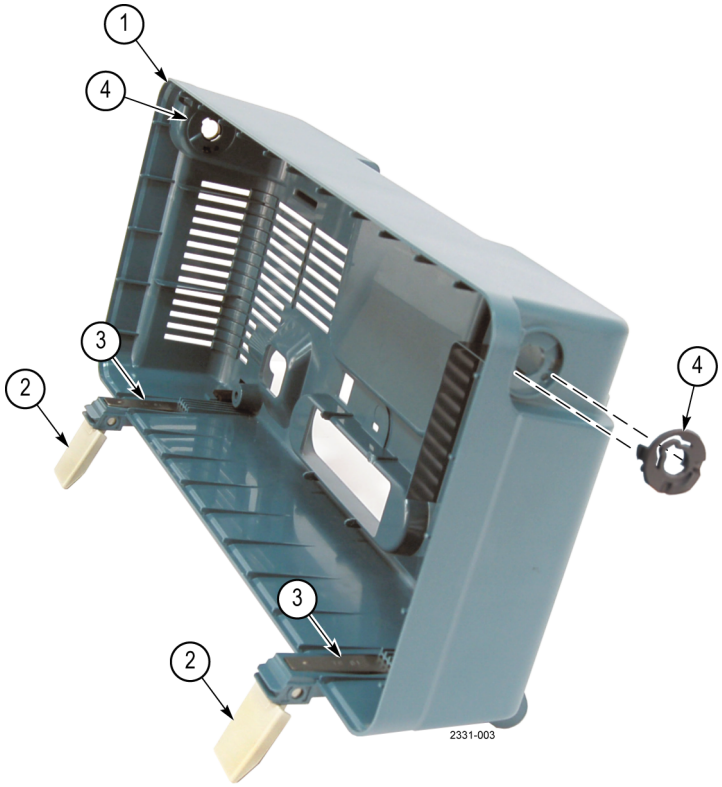


Figure 7: Rear trim

Table 5: Rear case

Fig. & index number	Tektronix part number	Serial no. effective	Serial no. discont'd	Qty	Name & description
5-3					**Rear case**
-1	367-0547-00			1	HANDLE, (PART OF 650-5016-00_
-2	211-1272-00			4	SCREW, MACHINE; 6-32 X 0.250, PNH, STEEL, ZINC FINISH, T-15 TORX DR
-3	650-5016-00			1	REAR CASE SUB ASSEMBLY; MSO/DPO2000
-4	348-1909-00			2	FOOT REAR; SAFETY CONTROLLED, PART OF 650-5016-00 REAR CASE SUB ASSEMBLY
-5	200-5046-00			1	COVER, BLANK OPTION MODULE
-6	— — — — —			1	ETHERNET AND EXTERNAL MONITOR OUT CONNECTIVITY MODULE FOR DPO/MSO2000 SERIES: DPO2CONN

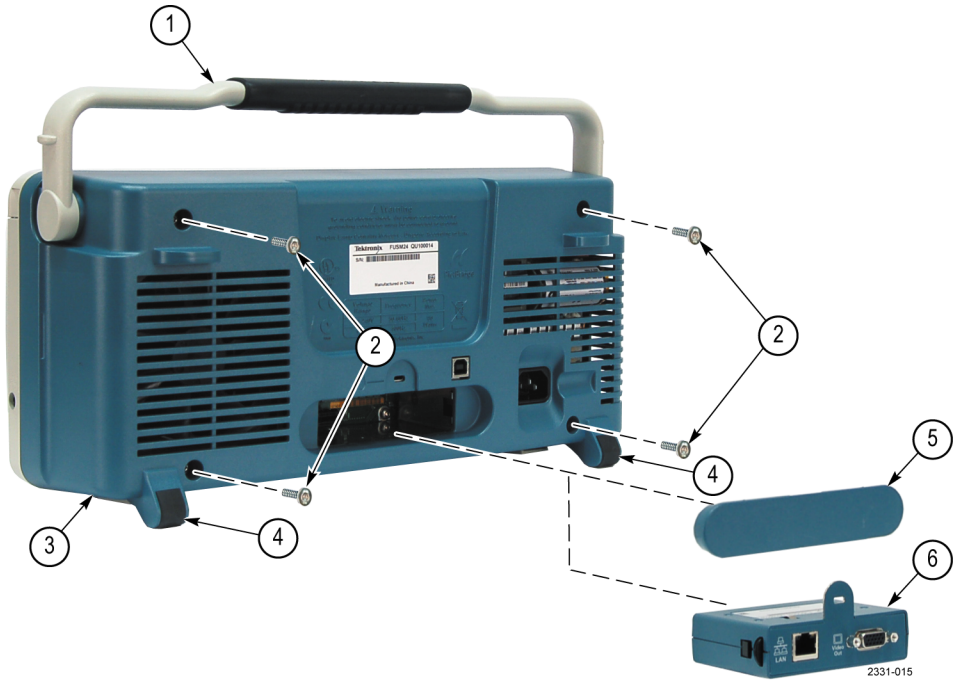


Figure 8: Rear case

Table 6: Power supply

Fig. & index number	Tektronix part number	Serial no. effective	Serial no. discont'd	Qty	Name & description
5-4					**Power supply**
-1	119-7038-00			1	FAN,TUBEAXIAL; 12VDC,0.21A,2.52W, 1.45M^3/MIN, 3150RPM,33DBA,92MM X 92MM X 25MM; SAFETY CONTROLLED
-2	119-7266-00			1	POWER SUPPLY: CUSTOM AC-DC, 85-264 VAC 45-440HZ IN, +5 V 9 A, +3.3 V 4.5 A, -5 V 0.5 A, +13 V 0.3 A OUT, CCFL BACKLIGHT INVERTER, LINE TRIGGER SIGNAL, SAFETY CONTROLLED
-3	211-1272-00			3	SCREW,MACHINE; 6-32 X 0.250,PNH,STL,ZNPL,T-15 TORX DR
-4	211-1275-00			2	SCREW, MACHINE; W/HEAVY PATCH THREADLOCKING MATERIAL; 6-32 X 0.312 L, PNH,STL,ZNPL, T15

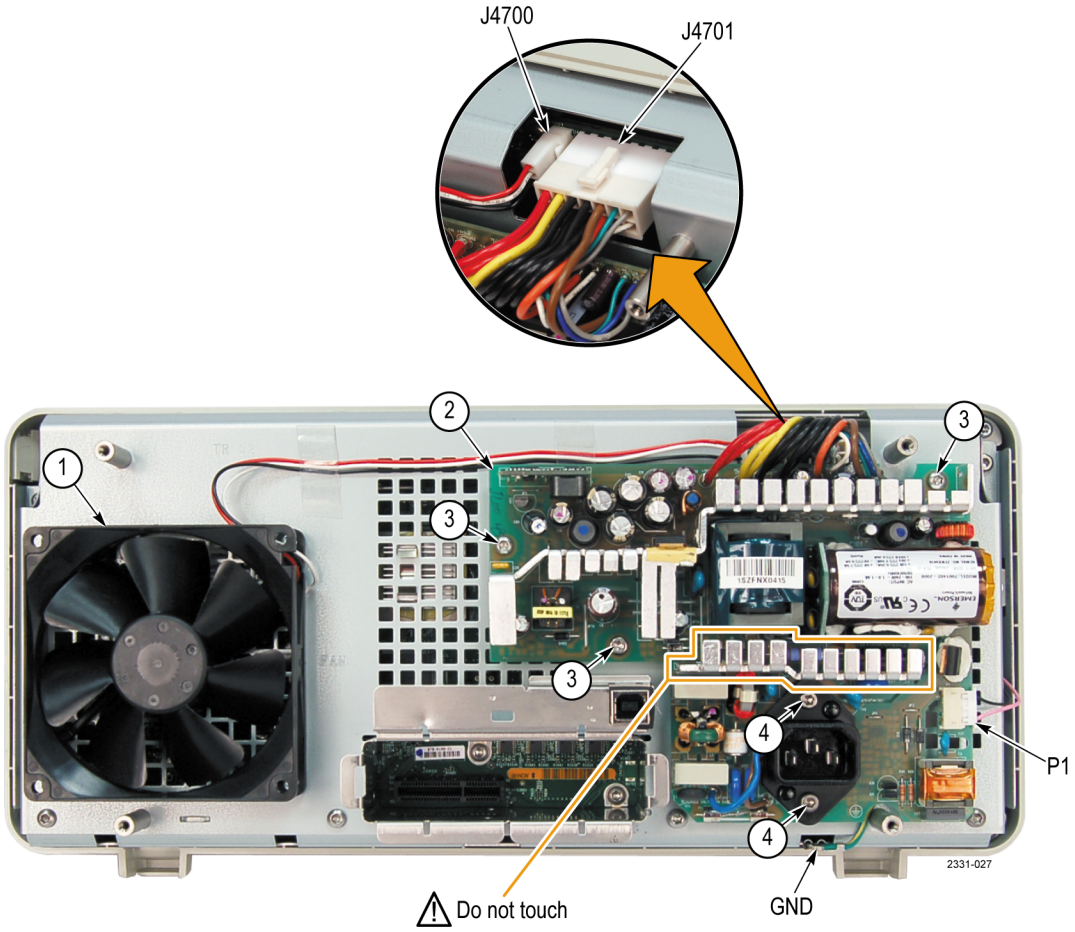


Figure 9: Power supply

Table 7: Rear chassis

Fig. & index number	Tektronix part number	Serial no. effective	Serial no. discont'd	Qty	Name & description
5-5					**Rear chassis**
-1	441-2503-00			1	CHASSIS, ASSEMBLY REAR
-2	211-1272-00			14	SCREW, MACHINE; 6-32 X 0.250, PNH, STEEL, ZINC FINISH, T-15 TORX DR

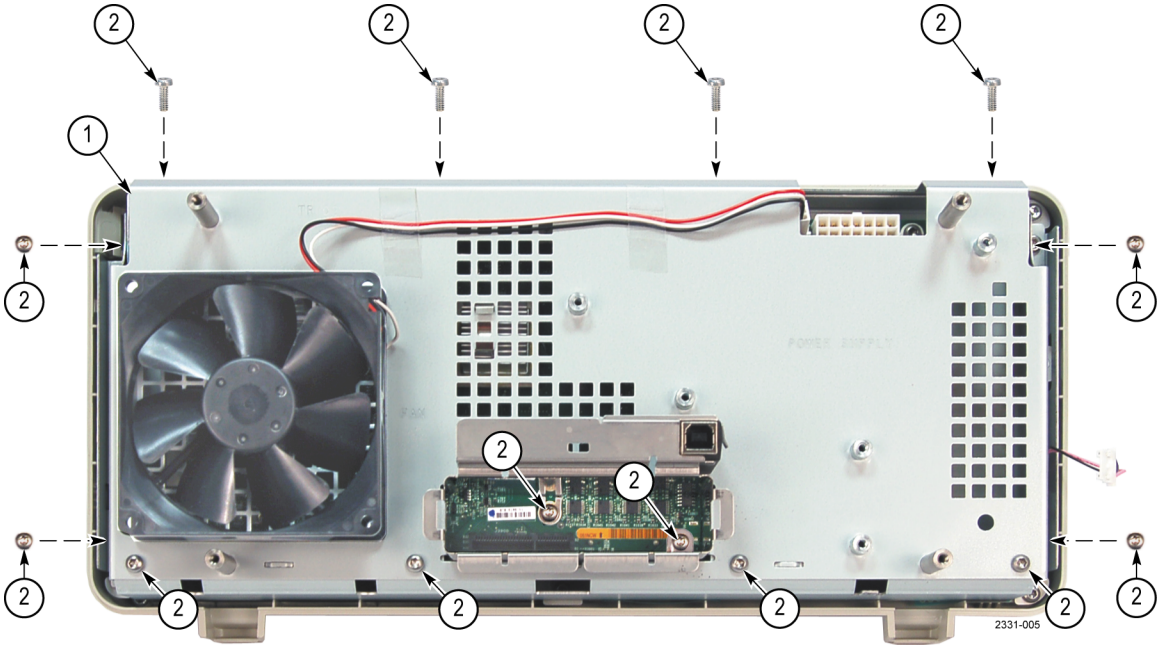


Figure 10: Rear chassis

Table 8: Fan

Fig. & index number	Tektronix part number	Serial no. effective	Serial no. discont'd	Qty	Name & description
5-6					Fan
-1				1	CHASSIS, ASSEMBLY REAR. (See Table 7.)
-2	213-1150-00			4	SCREW, FLAT HEAD, T15 FAN SCREW, M5X10

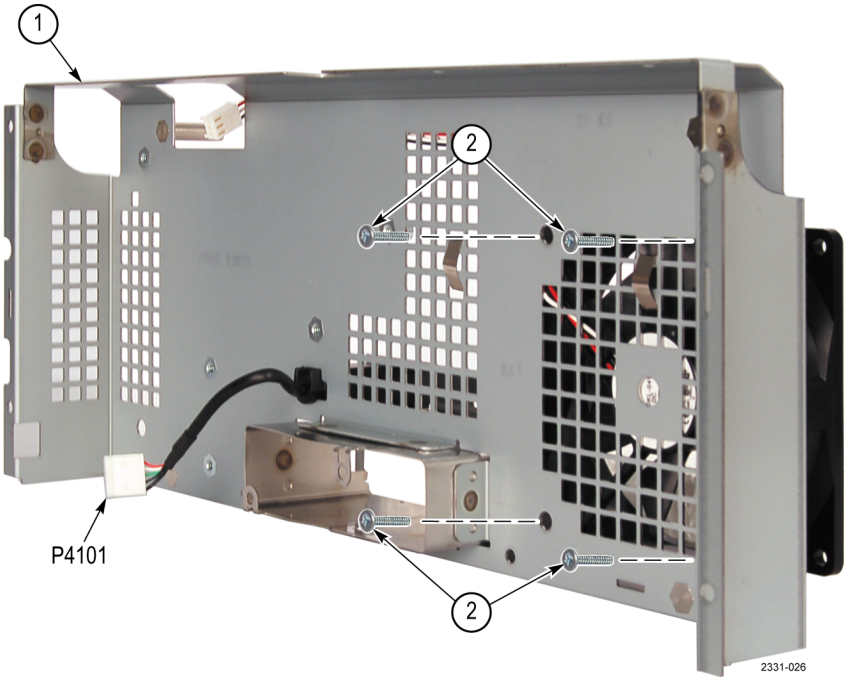


Figure 11: Fan

Table 9: Main board

Fig. & index number	Tektronix part number	Serial no. effective	Serial no. discont'd	Qty	Name & description
5-7					Main board
-1	870-0318-00			1	CIRCUIT BD ASSY; MAIN; TESTED;389386100; MSO2024 ONLY
	870-6186-00			1	CIRCUIT BD ASSY; MAIN 4 CHN TESTED; 389386100; MSO2014 ONLY
	870-0024-00			1	CIRCUIT BD ASSY; MAIN 2 CHN TESTED;389386100; MSO2012 ONLY
	870-0319-00			1	CIRCUIT BD ASSY; MAIN; CH TESTED; 389386100; DPO2024 ONLY
	870-0026-00			1	CIRCUIT BD ASSY; MAIN 4 CHN TESTED; 389386100; DPO2014 ONLY
	870-0025-00			1	CIRCUIT BD ASSY; MAIN 2 CHN TESTED; 389386100; DPO2012 ONLY
-2	211-1272-00			11	SCREW,MACHINE; 6-32 X 0.250,PNH,STL,ZNPL,T-15 TORX DR

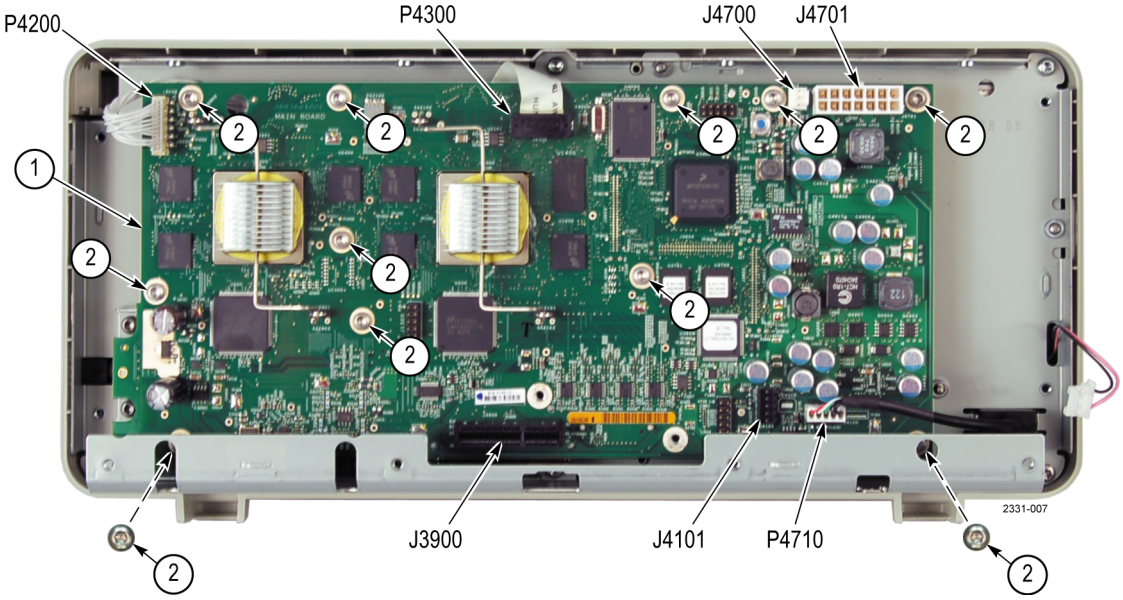


Figure 12: Main board

Table 10: Front end board

Fig. & index number	Tektronix part number	Serial no. effective	Serial no. discont'd	Qty	Name & description
5-8					Front end board
-1	441-2502-00			1	CHASSIS, ASSEMBLY MAIN
-2	870-6261-00			1	CIRCUIT BD ASSY;FRONT END 4 CH BRD; 389391100; TESTED; DPO2014, DPO2024, MSO2014, and MSO2024
	870-0020-00			1	CIRCUIT BD ASSY;FRONT END 2 CH BRD DPO2012, MSO2012
-3	211-1272-00			5	SCREW,MACHINE; 6-32 X 0.250,PNH,STL,ZNPL,T-15 TORX DR
-4	351-1124-00			1	GUIDE, MSO PROBE MSO MODELS ONLY

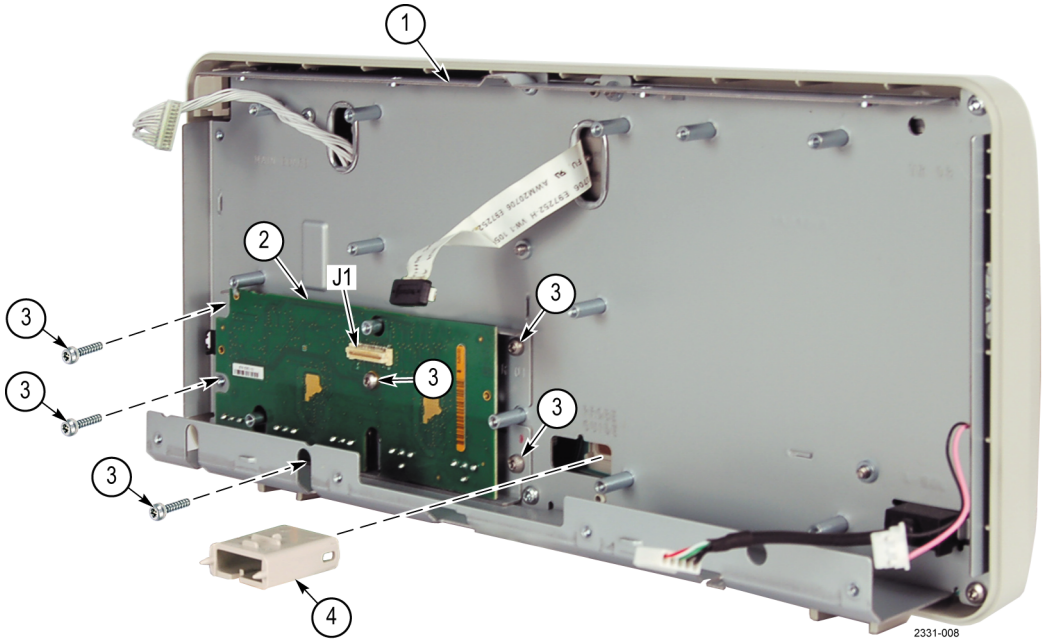


Figure 13: Front end assembly

Table 11: Main chassis

Fig. & index number	Tektronix part number	Serial no. effective	Serial no. discont'd	Qty	Name & description
5-9					**Main chassis**
-1					CHASSIS, ASSEMBLY MAIN. (See Table 10.)
-2	211-1273-00			7	SCREW, PT; K35-1.57, PAN HEAD, STL, ZNPL, T-15

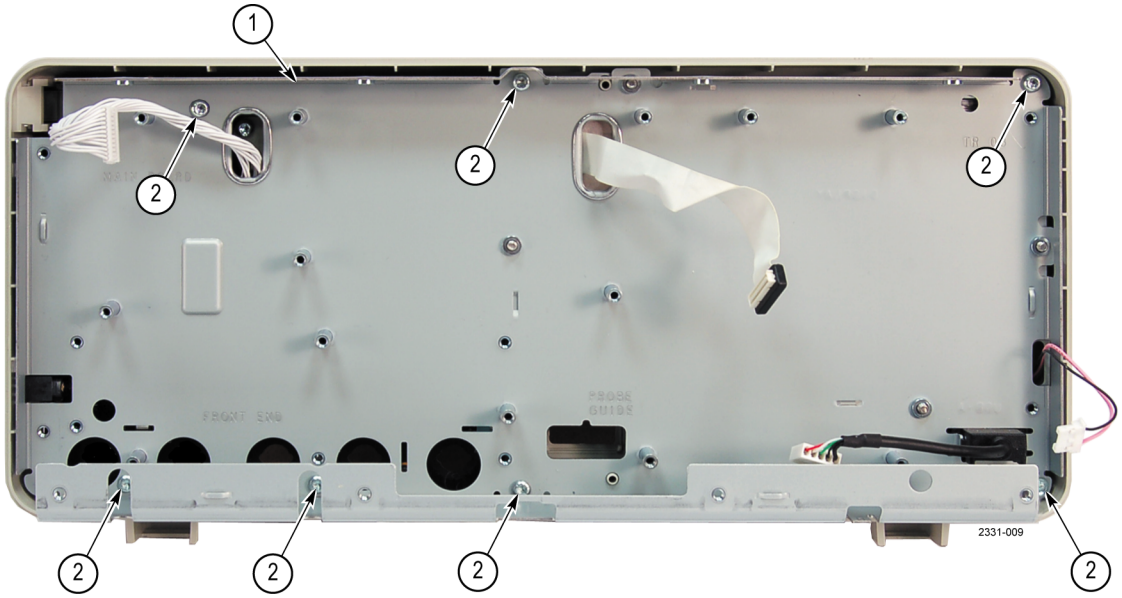


Figure 14: Main chassis

Table 12: Display

Fig. & index number	Tektronix part number	Serial no. effective	Serial no. discont'd	Qty	Name & description
5-10					Display
-1					CHASSIS, ASSEMBLY MAIN. (See Table 10.)
-2	850-0057-00			1	FINAL ASSEMBLY;LCD DISPLAY COLOR
-3	211-1272-00			4	SCREW,MACHINE; 6-32 X 0.250,PNH,STL,ZNPL,T-15 TORX DR

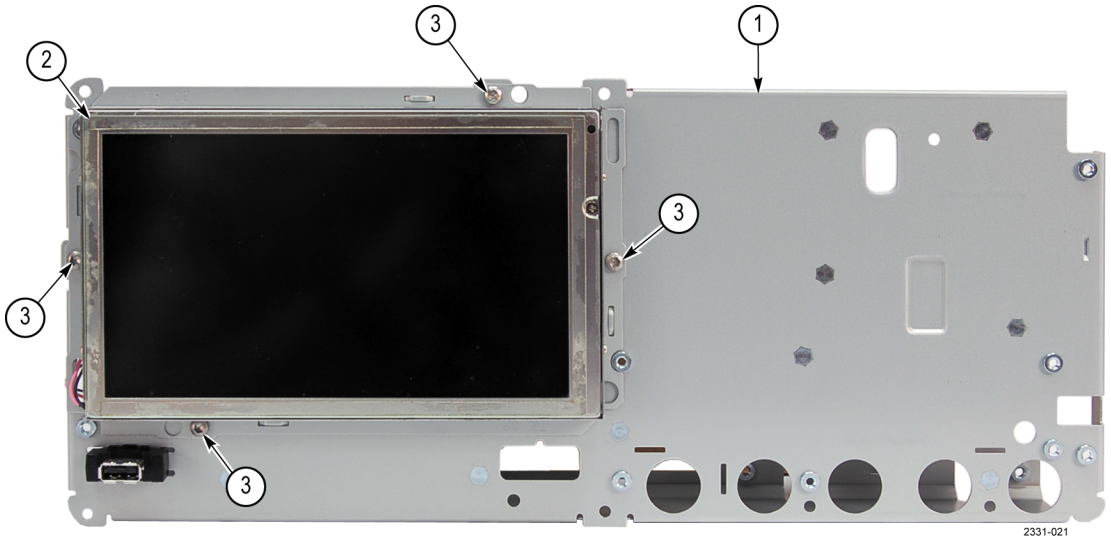


Figure 15: Display

Table 13: Front panel board

Fig. & index number	Tektronix part number	Serial no. effective	Serial no. discont'd	Qty	Name & description
5-11					Front panel board
-1	879-0102-01			1	CIRCUIT BD SUBASSY; FRONT PANEL BD 2CH;389390300 MSO2012, DPO2012
	878-0027-01			1	CIRCUIT BD SUBASSY;FRONT PANEL 4 CH; 389390300 MSO2014, MSO2024, DPO2014, DPO2024
-2	650-5027-00			1	FRONT CASE SUB ASSEMBLY; 4 CH MSO2014 & MSO2024
	650-5026-00			1	FRONT CASE SUB ASSEMBLY; 2 CH MSO2012
	650-5018-00			1	FRONT CASE SUB ASSEMBLY; 4 CH DPO2014 & DPO2024
	650-5017-00			1	FRONT CASE SUB ASSEMBLY; 2CH DPO2012
-3	211-1273-00			13	SCREW, PT; K35-1.57, PAN HEAD, STL, ZNPL, T-15
-4	131-8139-00			5	CONTACT, SPRING; FRONT PANEL ELEC
-5	174-5373-00			1	CABLE ASSEMBLY, FRONT PANEL

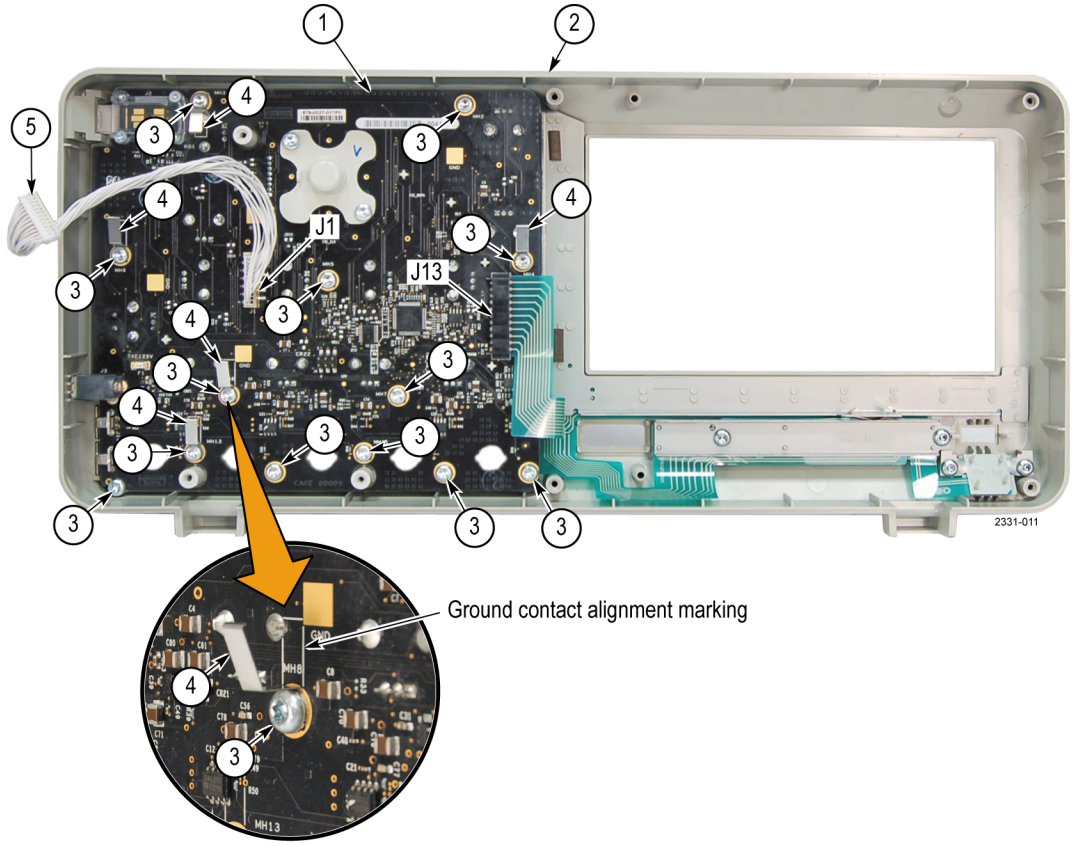


Figure 16: Front panel board

Table 14: Option key guides

Fig. & index number	Tektronix part number	Serial no. effective	Serial no. discont'd	Qty	Name & description
5-12					Option key guides
-1	— — — —			1	CIRCUIT BD SUBASSY; FRONT PANEL BD. (See Table 13.)
-2	351-1109-00			2	GUIDE,KEY; OPTIONAL SW
-3	213-1149-00			4	SCREW,TPG,TF; 2-28 X.5,PLASTITE, FLAT HEAD,PHILLIPS,STL,ZNPL

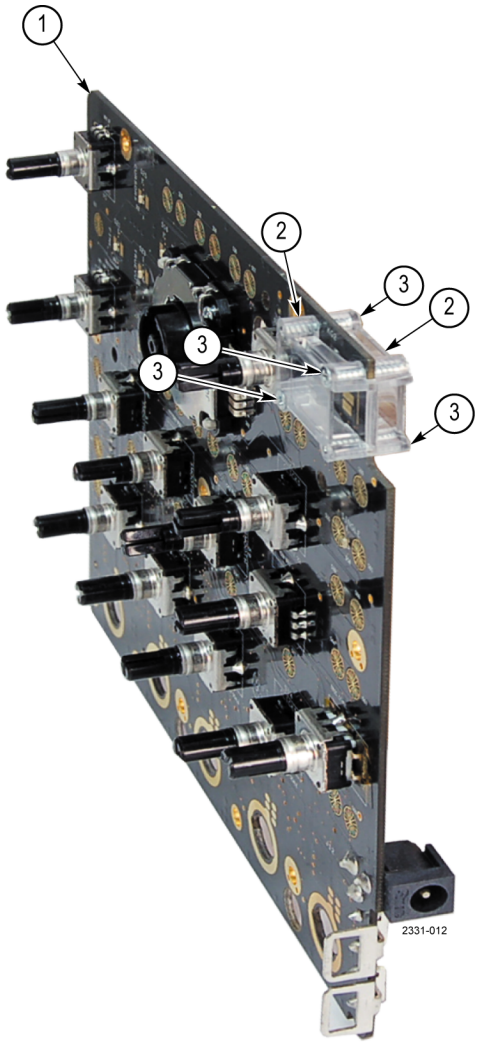


Figure 17: Option key guides

Table 15: Replaceable parts list: DPO2000 and MSO2000 Accessories

Fig. & index number	Tektronix part number	Serial no. effective	Serial no. discont'd	Qty	Name & description
No Image					***STANDARD ACCESSORIES***
	See Description			1	CABLE ASSY, POWER; ONE OF:
					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
	See Description			1	MANUAL, TECH, USER, DPO/MSO2000 Series
					Option / **Language** / **P/N**
					L0 / English / 071-2319-00
					L1 / French / 071-2320-00
					L2 / Italian / 071-2321-00
					L3 / German / 071-2322-00
					L4 / Spanish / 071-2323-00
					L5 / Japanese / 071-2324-00
					L6 / Portugese / 071-2325-00
					L7 / Sim. Chinese / 071-2326-00
					L8 / Trad. Chinese / 071-2327-00
					L9 / Korean / 071-2328-00
					L10 / Russian / 071-2329-00
	See Description			1	LABEL, FRONT PANEL, LANGUAGE OVERLAY, DPO/MSO2000 Series
					Option / **Language** / **P/N**
					L1 / French / 335-2020-00
					L2 / Italian / 335-2021-00
					L3 / German / 335-2022-00
					L4 / Spanish / 335-2023-00
					L5 / Japanese / 335-2024-00
					L6 / Portugese / 335-2025-00
					L7 / Sim. Chinese / 335-2026-00
					L8 / Trad. Chinese / 335-2027-00
					L9 / Korean / 335-2028-00
					L10 / Russian / 335-2029-00
	063-4118-xx			1	DPO/MSO2000 SERIES DOCUMENTATION CD
	010-0784-01			1	PROBE ASSEMBLY; SERVICE REPLACEMENT;P2221; EXPORT
	010-6316-00			1	16 CHANNEL DIGITAL PROBE, GENERAL PURPOSE
	196-3508-00			2	LEADSET, GENERAL PURPOSE; 8 CHANNEL DIGITAL PROBE (FLYING LEADS)
					OPTIONAL ACCESSORIES
	071-2331-00			1	MANUAL, TECH: SERVICE, ENGLISH; DPO/MSO2000 SERIES
	119-7465-00			1	POWER SUPPLY; EXTERNAL, DESKTOP (W/SPECIAL 2.1MM ID BARREL CONNECTOR; 50W, 12VDC 4.2A OUT, 90 - 264VAC 47 - 440 HZ IN; 78% EFF, UL, CSA, PSE, CCC ,SAFETY CONTROLLED
	020-2924-01			1	DEMO KIT: ED DEMO BOARD 2, TECH MANUAL TRAINING AID
	067-1686-00			1	POWER DESKEW/CALIBRATION FIXTURE;DPO7XXX
	016-2010-00			1	SOFTCASE, ACD2000
					INCLUDED PARTS
	200-5045-00			1	COVER, FRONT PROTECTIVE
					END INCLUDED PARTS