Tektronix®

Tektronix BERTScope Digital Pre-Emphasis Processor

Quick Start User Manual

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Tektronix BERTScope
Digital Pre-Emphasis Processor

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www.tek.com

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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.tek.com to find contacts in your area.

Warranty

Tektronix warrants that this product will be free from defects in materials and workmanship for a period of one (1) year from the date of shipment. If any such product proves defective during this warranty period, Tektronix, at its option, either will repair the defective product without charge for parts and labor, or will provide a replacement in exchange for the defective product. Parts, modules and replacement products used by Tektronix for warranty work may be new or reconditioned to like new performance. All replaced parts, modules and products become the property of Tektronix.

In order to obtain service under this warranty, Customer must notify Tektronix of the defect before the expiration of the warranty period and make suitable arrangements for the performance of service. Customer shall be responsible for packaging and shipping the defective product to the service center designated by Tektronix, with shipping charges prepaid. Tektronix shall pay for the return of the product to Customer if the shipment is to a location within the country in which the Tektronix service center is located. Customer shall be responsible for paying all shipping charges, duties, taxes, and any other charges for products returned to any other locations.

This warranty shall not apply to any defect, failure or damage caused by improper use or improper or inadequate maintenance and care. Tektronix shall not be obligated to furnish service under this warranty a) to repair damage resulting from attempts by personnel other than Tektronix representatives to install, repair or service the product; b) to repair damage resulting from improper use or connection to incompatible equipment; c) to repair any damage or malfunction caused by the use of non-Tektronix supplies; or d) to service a product that has been modified or integrated with other products when the effect of such modification or integration increases the time or difficulty of servicing the product.

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Table of Contents

Important safety information

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

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

General safety summary

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

Comply with local and national safety codes.

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

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

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

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

This product is not intended for detection of hazardous voltages.

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

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

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

To avoid fire or personal injury

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

Do not use the provided power cord for other products.

Ground the product. This product is 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, make sure that the product is properly grounded.

Do not disable the power cord grounding connection.

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

Observe all terminal ratings. To avoid fire or shock hazard, observe all ratings and markings on the product. Consult the product manual for further ratings information before making connections to the product. Do not exceed the Measurement Category (CAT) rating and voltage or current rating of the lowest rated individual component of a product, probe, or accessory. Use caution when using 1:1 test leads because the probe tip voltage is directly transmitted to the product.

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

Do not float the common terminal above the rated voltage for that terminal.

The measuring terminals on this product are not rated for connection to mains or Category II, III, or IV circuits.

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

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

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

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

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

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

Use only specified replacement parts.

Use proper fuse. Use only the fuse type and rating specified for this product.

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

Do not operate in an explosive atmosphere.

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

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

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

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

Avoid improper or prolonged use of keyboards, pointers, and button pads. Improper or prolonged keyboard or pointer use may result in serious injury.

Be sure your work area meets applicable ergonomic standards. Consult with an ergonomics professional to avoid stress injuries.

Use care when lifting and carrying the product.

Use only the Tektronix rackmount hardware specified for this product.

Service safety summary

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

To avoid electric shock. Do not touch exposed connections.

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

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

Use care when servicing with power on. Dangerous voltages or currents may exist in this product. Disconnect power, remove battery (if applicable), and disconnect test leads before removing protective panels, soldering, or replacing components.

Verify safety after repair. Always recheck ground continuity and mains dielectric strength after performing a repair.

Terms in this manual

These terms may appear in this manual:

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

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

Symbols and terms on the product

These terms may appear on the product:

- DANGER indicates an injury hazard immediately accessible as you read the marking.
- WARNING indicates an injury hazard not immediately accessible as you read the marking.
- CAUTION indicates a hazard to property including the product.

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

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

Compliance information

This section lists the EMC (electromagnetic compliance), safety, and environmental standards with which the instrument complies.

EMC compliance

EU EMC Directive

Meets intent of Directive 2014/30/EU for Electromagnetic Compatibility. Compliance was demonstrated to the following specifications as listed in the Official Journal of the European Communities:

EN 61326-1. EMC requirements for electrical equipment for measurement, control, and laboratory use. [1] [2] [3]

- CISPR 11. Radiated and conducted emissions, Group 1, Class A
- IEC 61000-4-2. Electrostatic discharge immunity
- IEC 61000-4-3. RF electromagnetic field immunity
- IEC 61000-4-4. Electrical fast transient / burst immunity
- IEC 61000-4-5. Power line surge immunity
- IEC 61000-4-6. Conducted RF immunity
- IEC 61000-4-11. Voltage dips and interruptions immunity

EN 61000-3-2. AC power line harmonic emissions

EN 61000-3-3. Voltage changes, fluctuations, and flicker

European contact.

Mfr. Compliance Contact
Tektronix, Inc. PO Box 500, MS 19-045
Beaverton, OR 97077, USA
www.tek.com

1 **This product is intended for use in nonresidential areas only. Use in residential areas may cause electromagnetic interference.**

2 **Emissions which exceed the levels required by this standard may occur when this equipment is connected to a test object.**

3 **For compliance with the EMC standards listed here, high quality shielded interface cables that incorporate low impedance connection between the cable shield and the connector shell should be used.**

Australia / New Zealand EMC

Complies with the EMC provision of the Radiocommunications Act per the following standard, in accordance with ACMA:

- EN 61326-1. Radiated and Conducted Emissions, Group 1, Class A.

Safety compliance

This section lists the safety standards with which the product complies and other safety compliance information.

EU low voltage directive

Compliance was demonstrated to the following specification as listed in the Official Journal of the European Union:

Low Voltage Directive 2014/35/EU.

- EN 61010-1. Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use – Part 1: General Requirements.

U.S. nationally recognized testing laboratory listing

- UL 61010-1. Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use – Part 1: General Requirements.

Canadian certification

- CAN/CSA-C22.2 No. 61010-1. Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use – Part 1: General Requirements.

Additional compliances

- IEC 61010-1. Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use – Part 1: General Requirements.

Equipment type

Test and measuring equipment.

Safety class

Class 1 – grounded product.

Pollution degree descriptions

A measure of the contaminants that could occur in the environment around and within a product. Typically the internal environment inside a product is considered to be the same as the external. Products should be used only in the environment for which they are rated.

- Pollution degree 1. No pollution or only dry, nonconductive pollution occurs. Products in this category are generally encapsulated, hermetically sealed, or located in clean rooms.
- Pollution degree 2. Normally only dry, nonconductive pollution occurs. Occasionally a temporary conductivity that is caused by condensation must be expected. This location is a typical office/home environment. Temporary condensation occurs only when the product is out of service.
- Pollution degree 3. Conductive pollution, or dry, nonconductive pollution that becomes conductive due to condensation. These are sheltered locations where neither temperature nor humidity is controlled. The area is protected from direct sunshine, rain, or direct wind.
- Pollution degree 4. Pollution that generates persistent conductivity through conductive dust, rain, or snow. Typical outdoor locations.

Pollution degree rating

Pollution degree 2 (as defined in IEC 61010-1). Rated for indoor, dry location use only.

Measurement and overvoltage category descriptions

Measurement terminals on this product may be rated for measuring mains voltages from one or more of the following categories (see specific ratings marked on the product and in the manual).

- Category II. Circuits directly connected to the building wiring at utilization points (socket outlets and similar points).
- Category III. In the building wiring and distribution system.
- Category IV. At the source of the electrical supply to the building.

NOTE. *Only mains power supply circuits have an overvoltage category rating. Only measurement circuits have a measurement category rating. Other circuits within the product do not have either rating.*

Mains overvoltage category rating

Overvoltage category II (as defined in IEC 61010-1).

Environmental considerations

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

Product end-of-life handling

Observe the following guidelines when recycling an instrument or component:

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

This symbol indicates that this product complies with the applicable European Union requirements according to Directives 2012/19/EU and 2006/66/EC on waste electrical and electronic equipment (WEEE) and batteries. For information about recycling options, check the Tektronix Web site (www.tek.com/productrecycling).

Preface

Features and benefits

- 1 to 12.5 Gb/s for support of hardware-based equalization of 2nd- and 3rd-generation serial standards
- 3- or 4-tap for full support of compliance testing for 802.3ap, serial attached SCSI, 10GBASE-KR backplanes, DisplayPort™, USB 3.0, and PCI Express® Gen3
- Pre-cursor or post-cursor adjustment for optimizing compensation for ISI and loss
- Easy setup with concurrent multiple domain views ideal for operation as a standalone instrument controlled by a remote PC, or with a BERTScope analyzer for complete software integration
- Precise control to correct for effects such as backplane ISI or optical effects with adjustability through tap weights or step response provides the flexibility needed for complete design characterization
- Design characterization for high-speed, sophisticated designs
- Certification testing of serial data streams for industry standards
- Design verification of high-speed I/O components and systems

Features	Benefits
Controllable pre-emphasis	Required for compliance testing of newer standards including PCIe®, 10GBASE-KR, 40GBASE-KR-4, 100GBASE-CAUI, 40GBASE-XLAUI, SAS
De-embed channel between stress source and DUT	Calibrated stress testing at the DUT pin

Documentation

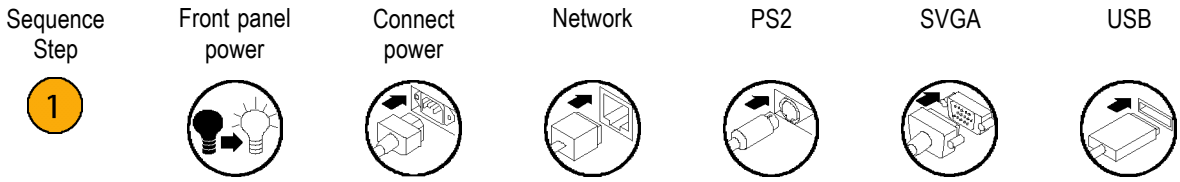
In addition to this Quick Start Guide, the following documents are available:

- Online help, including remote control commands
- Remote control programmer guide (PDF)
- DPPRACK rack mount instructions, available as an option

Check the Tektronix Web site for additional documentation at www.tek.com/manuals.

Conventions used in this manual

The following icons are used throughout this manual.



NOTE. *A Notice statement identifies conditions which may result in unintended operating modes, incorrect measurement results, or require resetting the instrument or personal computers operating software interacting with it.*

Introduction

This Quick Start User Manual supports the Tektronix BERTScope DPP125C Digital Pre-Emphasis Processor. The DPP is a non-linear signal conditioning processor intended to add precision calibrated pre-emphasis to a serial data waveform, generally supplied by the Pattern Generator of the Tektronix BERTScope analyzer.

The Pre-Emphasis Processor reclocks the data, and passes through any calibrated stress (jitter) which appears on the clock input signal. The output signal is buffered through a calibrated output stage, providing user control of the amplitude and offset.

With the exception of the power switch, all control is through the software-based graphical user interface. When used with a BERTScope analyzer, the interface is found in the DPP Control view. The DPP can also be operated standalone, using the BERTScopePC standalone software supplied with the product and available at www.Tek.com. The BERTScopePC software must be installed to support standalone operation.

Full descriptions of the operating controls are given in the Online Help, included in both the BERTScope analyzer and BERTScopePC applications. Detailed information on operation of the control interface can be accessed at any time through the Help menus included in any control view.

The instrument communicates with its control host via USB 2.0. When used with a BERTScope analyzer, connect the included USB cable between the Type B connector on the rear panel of the DPP and an available Type A connector on the rear panel of the analyzer. If a BERTScope Clock Recovery instrument is also being used with the analyzer, connect the DPP through an available USB connector on the rear panel of the Clock Recovery instrument. When used standalone, first install the BERTScopePC software and driver into the host PC. Then connect the USB cable to any available USB connector on the host computer.

Product description

The BERTScope DPP Digital Pre-Emphasis Processor provides programmable three-tap or optional four tap pre-emphasis for compliance testing to standards such as 802.3ap, Serial Attached SCSI, 10GBASE-KR backplanes, DisplayPort™, and USB 3.0 — and flexible enough for the 8 GT/s PCI-Express® standard.

Boosting the amplitude of the transition bits in a digital signal in relation to non-transition bits, or pre-emphasis, is an increasingly common method used in systems to overcome the frequency dependent loss of low cost circuit boards to allow the passage of Gb/s data. The DPP covers the requirements for high data rate test, allowing the flexibility to evaluate compliance to multiple standards and to explore the limits of device performance.

A key benefit of the DPP is the ease with which an engineer can adjust the precise characteristics of the pre-emphasis signal being applied to the test device. This is achieved through a highly intuitive control interface that simultaneously shows the step response, tap weightings, and frequency response of the signal, in keeping with the BERTScope philosophy of multi-domain insight.

Options

The following table lists the options available for the DPP125C Digital Pre-emphasis Processor.

Table i: DPP125C options

Item	Description
ECM	Adds PCI Express eye opener (equalizer), FIR clock doubler, and PCI Express 100 MHz reference clock multiplier functions
4T	Adds 4-Tap Digital Pre-emphasis Processor

Installation

Unpack the instrument and check that you have received all items listed as Standard Accessories. Check the Tektronix Web site (www.tek.com) for the most current information.

The DPP is intended to be operated in a controlled laboratory environment. It is intended to operate on a bench top, on top of or underneath another instrument such as the BERTScope analyzer, or in an instrument rack. Four feet are located on the bottom of the instrument. Operate the instrument only when positioned with the feet facing downward. Do not operate the instrument with the long axis vertical, standing on its side, as this will block the path of air required for cooling.

CAUTION. *Operating the instrument while it is standing on the side can damage and overheat the instrument. To avoid damaging the instrument or to avoid overheating the instrument, do not block any of the air vents to allow proper cooling during normal operation.*

Standard accessories

The instrument comes with the following accessories:

- Documentation, including this Quick Start User Manual
- Power cord
- Two (2) 12-inch SMA low-loss cables
- 2 m USB interconnect cable
- 5 ft RS-232 null modem cable
- BERTScopePC Standalone Software CD-ROM (installs the DPP control interface on a user-supplied PC)

Optional accessories

Table 1: DPP125C optional accessories

Accessory	Description
DPPRACK	Rackmount kit with instructions
100PSRTFILTER	100-picosecond rise time filter
PMCABLE1M	Precision-phase matched cable pair, 1 meter
SMAPOWERDIV	SMA power divider
BSASATATEE	SATA-Tee for SATA OOB signaling

Site considerations

Read this section before installing the instrument. This section describes operating considerations and power requirements.

Table 2: Environmental specifications

Characteristic	Description
Temperature	
Operating	10 °C to +40 °C (50 °F to 104 °F)
Non-operating	–40 °C to +71 °C (–40 °F to 160 °F)
Humidity	
Operating	5% to 95% relative humidity at up to 30 °C (86 °F) 5% to 45% relative humidity above 30 °C up to 40 °C (86 °F to 104 °F) non-condensing
Non-operating	5% to 95% relative humidity at up to 30 °C (86 °F) 5% to 45% relative humidity above 30 °C up to 50 °C (86 °F to 122 °F) non-condensing
Altitude	
Operating	Up to 2000 meters (6562 ft)
Non-operating	To 12,000 m (39,370 ft.)

Operating requirements

Place the instrument on a cart or bench. The instrument should rest on its bottom feet. Observe the following clearance requirements:

Table 3: Clearance requirements

Characteristic	Dimensions
Top	0 mm (0 in)
Left and right sides	76 mm (3 in)
Bottom	0 mm (0 in) standing on feet
Rear	0 mm (0 in)

Before operating the instrument, verify the ambient temperature: +10° C to +40 °C (+50 °F to +104 °F).

CAUTION. *To ensure proper cooling, keep the sides of the instrument clear of obstructions.*

Table 4: Instrument power considerations

Feature	Description
Voltage range	100 to 240 VAC_{RMS}
Frequency	50/60 Hz
Power	100 W maximum
Fuse	3.15 A, 250 V, 5 x 20 mm, 50 ms

Preventing electrostatic discharge (ESD)

CAUTION. *A direct electrostatic discharge can damage the instrument input. To learn how to avoid this damage, read the following information.*

Electrostatic discharge (ESD) is a concern when handling any electronic equipment. The instrument is designed with robust ESD protection; however it is still possible that large discharges of static electricity directly into the signal input or output may damage the instrument. To avoid damage to the instrument, use the following techniques to prevent electrostatic discharge to the instrument.

- Discharge the static voltage from your body by wearing a grounded antistatic wrist strap while connecting and disconnecting cables and adapters. The instrument provides a front panel connection for this purpose.
- Discharge any static voltage from all cables before connecting them to the instrument or device under test by momentarily grounding the center conductor of the cable, or by connecting a 50 Ω termination to one end, prior to attaching the cable to the instrument.

  A cable that is left unconnected on a bench can develop a large static charge.
- Nothing capable of generating or holding a static charge should be allowed on the work station surface.

Instrument connection information

The following diagram shows an example of a high-level view of instrument connections. In this case the DPP inputs are connected to outputs of a BERTScope analyzer; other variations are possible depending on your setups and configuration.

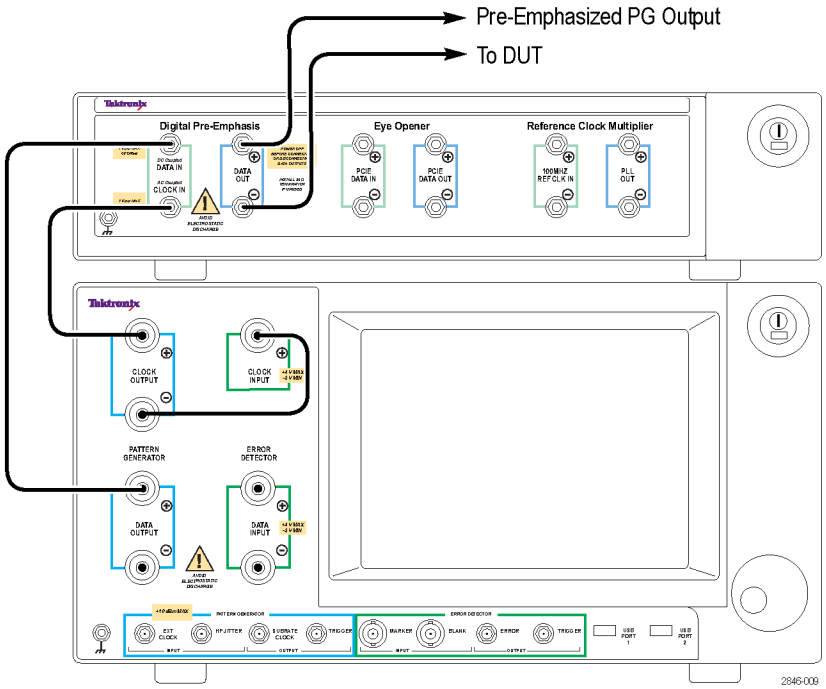
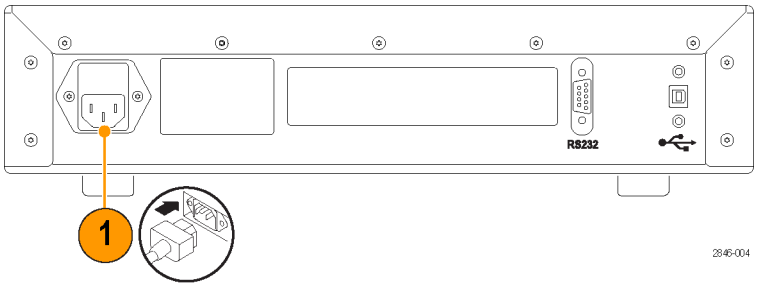


Figure 1: DPP and BERTScope setup

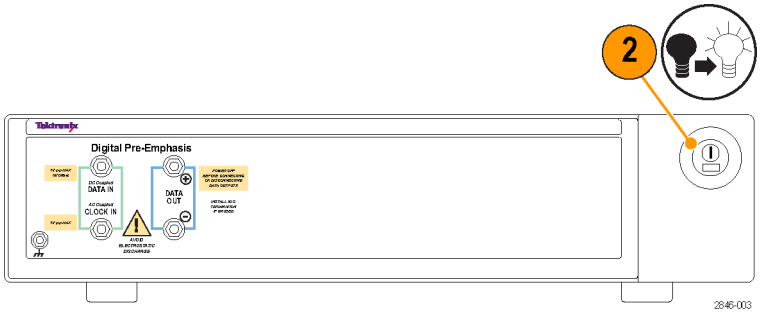
Power on the instrument

1. Connect the AC power cord to the rear of the instrument and to a properly grounded power source.



2. Push the front-panel power button to turn the instrument on.

   The green power indicator on the button will turn on.



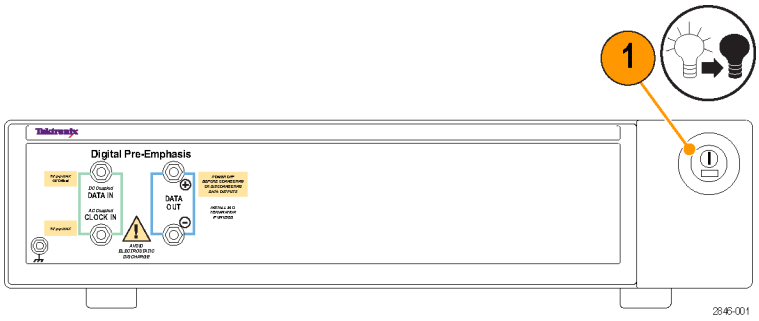
NOTE. *The first time that the BERTScope analyzer starts with the DPP attached, the standard Microsoft Windows New Hardware Found message displays as the drivers automatically load.*

CAUTION. *Static discharge can damage the instrument. To avoid static discharge while connecting cables to the front panel interface, always use the proper coaxial cables with APC-3.5, 2.92 mm, or SMA connectors.*

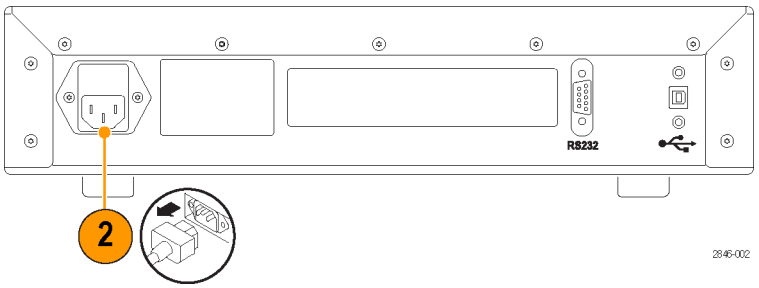
Power off the instrument

1. Press the front panel power button to turn the instrument off.

   The green power indicator on the button will turn off.



2. Disconnect the power cord from the rear of the instrument to completely remove power from the instrument after it shuts down.



BERTScopePC Software

The BERTScopePC software provides for PC control of BERTScope instruments that are being operated as standalone instruments (not connected directly to a BERTScope analyzer).

With the BERTScopePC software installed on a Windows PC, and the standalone instrument connected to the PC via the USB interface, the BERTScopePC software initiates installation of the appropriate driver and provides a user interface allowing control of all instrument functions. The user interface provided for each instrument is similar to the BERTScope analyzer.

Included in the installation is the BERTScope Remote Client application which provides for remote access to the BERTScopePC application. This software must be installed on a PC running the Microsoft Windows operating system.

Insert the BERTScopePC disk in the disc drive of the PC and follow the on-screen instructions to install the software.

After the software is installed, start the software from the Start menu by selecting Start > BERTScope > BERTScopePC UI (or one of the other selections in the menu).

Clock and data input skew

The DPP125C is a nonlinear processor that re-clocks the input data. Any skew between the Data In and Clock In signals will move the sample point in time, appearing as a reduction in eye opening. If the input signal has sufficient jitter, bit errors can appear in the DPP output when excessive clock/data delay is present.

Applications that require processing of stressed data use the BERTScope analyzer Subrate Clock output, with the Stressed Clock output selected. In this setup, the Subrate Clock output leads the data output signal by several nanoseconds. The DPP125C compensates for this delay difference internally; external subrate clock and data cabling between a BERTScope analyzer and the DPP125C should be nominally length-matched. If you use an instrument besides a BERTScope analyzer as an input to the DPP125C (an instrument that provides stressed data and clock to the DPP125C) and that instrument provides phase-matched clock and data outputs, you will need to use an external data cable approximately 1.5 m (59 in) longer than the external clock cable for correct phase matching within the DPP125C instrument. This cable compensation is not required if the source instrument does not apply stress to the input clock and data of the DPP125C.

Calibrate the instrument to fine-tune the delay match

Use the following calibration method to fine tune the clock and data delay match.

1. Connect the DPP to the BERTScope analyzer:
   a. Connect the positive data output from the BERTScope Generator to the DPP Data Input.
   b. Connect the Subrate Clock Out from the BERTScope Generator to the DPP Clock.
   c. Loop the DPP outputs back to the BERTScope Error Detector inputs.
   d. Go to the Stressed Eye view and set the Sine Jitter to 30% UI.

      The particular SJ frequency is not crucial, but should be set to a frequency that will be used during testing.
   e. Enable the Random Jitter, and set the amplitude to the intrinsic value.
2. Calibrate to remove the Clock-to-Data delay:
   a. Set the Generator Delay to 1 UI.
   b. Run the Detector to check for error free operation.
   c. If there are any errors, advance the Generator delay by another ½ UI.

      The Detector should be operating error free at this point.
   d. Record the Generator Delay.
3. After you have obtained error-free operation, find the boundary between error free operation and error operation by decreasing the Generator Delay and using a binary search method shown in the following illustration.

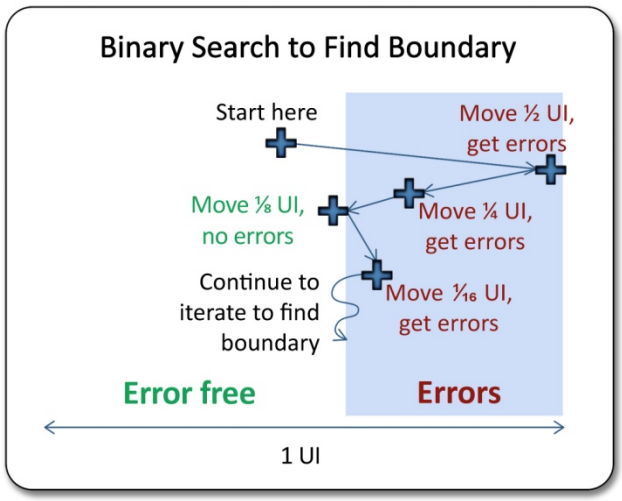


Figure 2: Binary search method to fine-tune the Clock-to-Data delay match

4. Record the Generator Delay.
5. Return the Generator Delay to the error-free point found in Step 2.
6. Find the boundary between the error-free operation and the error operation by increasing the Generator Delay and using a binary search shown in the previous illustration. Record the Generator Delay.
7. Set the Generator Delay to the average of the two delay values.

   This is an approximate calibration point.
8. Increase the Sine Jitter and Random Jitter amplitudes to be larger than the amplitudes you plan to use for testing (but not so high as to close the eye completely).
9. Repeat the previous steps, starting at the initial calibration point found in Step 7.

   Use this point as the calibrated Generator Delay. Use this delay value as long as the cabling setup remains the same.

Operation

Typical configuration

One configuration with the BERTScope analyzer is shown below.

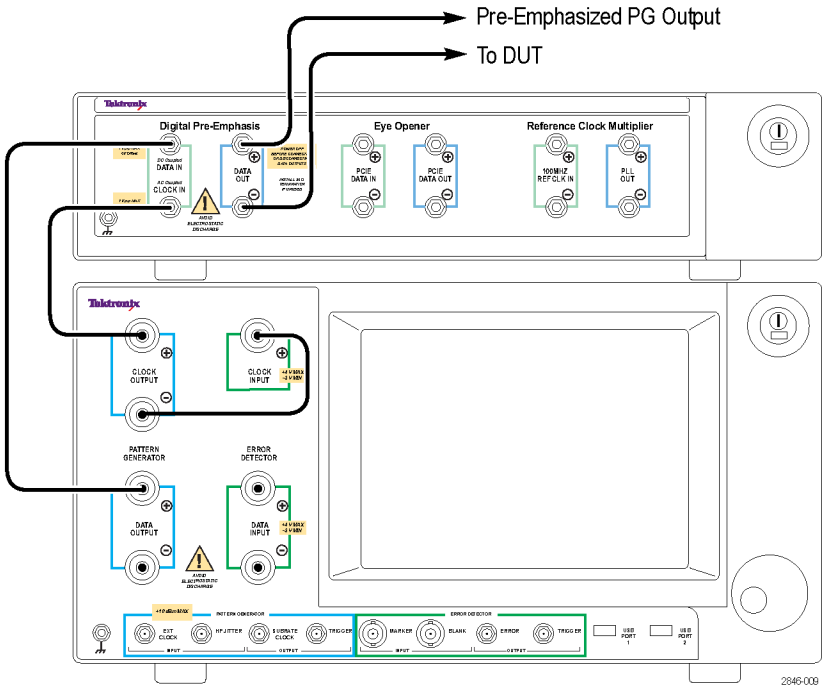


Figure 3: DPP and BERTScope typical setup

The DPP data output signal is differential, while the input data and clock are single-ended. Because the output signal is reclocked and buffered, low loss cables are not required for the input signals. However, to maintain amplitude calibration and minimize inter-symbol interference (ISI), use high performance cables to connect the DPP output to the DUT.

In the configuration shown above, the BERTScope analyzer is clocked directly from the negative clock output of the pattern generator. The inverted phase, along with any phase delay in the cables or DUT, is corrected by the Auto Align process in the Detector. Other setup configurations can source the Error Detector clock from a clock recovery source, or the DUT itself.

NOTE. *To enable the BERScope clock and data outputs to be used with the DPP, go to the DPP Control view and touch the PG Clock button. Then select* ***Set Gen. Outputs for DPP*** *from the menu.*

For an alternate way of connecting the BERTScope analyzer to the DPP use the SUBRATE CLOCK output at the bottom of the BERTScope (next to the TRIGGER connector). The Subrate Clock output can be used as subrate clock or as a stressed clock output signal depending on the settings in the user interface. When you use the subrate clock to clock the DPP, you may want to use the stressed clock to provide the clock for the DPP. If so, make sure that you select the stressed clock output mode of the Subrate Clock output in the user interface.

Front panel connectors

The following sections describe the DPP controls and connectors. For information on the on-screen buttons, refer to the online help.

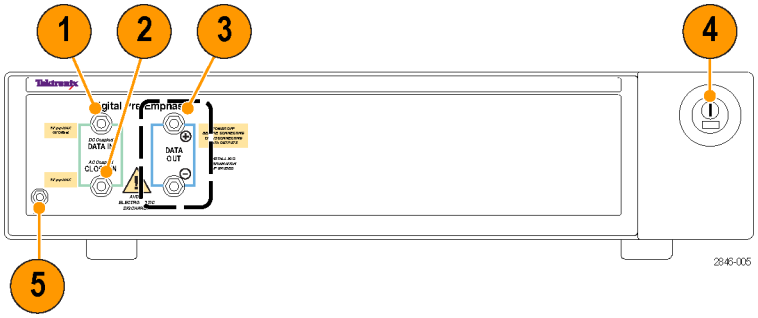


Figure 4: DPP125C front panel controls and connectors

Table 5: Front panel connectors, standard instrument

Connector		Description
1	DATA IN	Single-ended data signal input to processing FIR filter. Input is AC-coupled, terminated into 50 Ω within the operating frequency range of the instrument. Normally connected to the BERTScope analyzer Pattern Generator DATA+ output.
2	CLOCK IN	Single-ended clock input used to clock the FIR filter. Input is AC-coupled, terminated into 50 Ω within the operating frequency range of the instrument. Normally connected to the BERTScope analyzer Pattern Generator CLOCK+ output.
3	DATA OUT+ and DATA OUT–	Plus and minus differential data outputs from the FIR processor filter. Output is 50 Ω from the buffer amplifier. Signal amplitudes and offsets are controlled through the user interface. Normally connected to the DUT. Terminate unused outputs into 50 Ω if driving a single-ended load.
4	Power switch	Activates the power supply to provide power to the primary circuits in the instrument. The switch has a green light when power is turned on. The primary power control circuitry is always live whenever the power cord is connected to the instrument. To completely disconnect power from the instrument, disconnect the power cord at the rear of the instrument.
5	Ground connector	Use this connector to connect a common ground to other instruments

Option ECM connectors

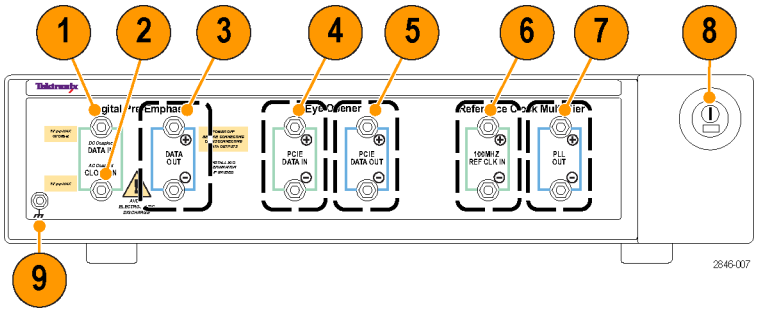


Figure 5: DPP125C Option ECM front panel controls and connectors

Table 6: Front panel connectors, DPP125C Option ECM

Connector		Description
1	DATA IN	Single-ended data signal input to processing FIR filter. Input is DC-coupled, terminated into 50 Ω within the operating frequency range of the instrument. Normally connected to the BERTScope analyzer Pattern Generator DATA+ output.
2	CLOCK IN	Single-ended clock input used to clock the FIR filter. Input is AC-coupled, terminated into 50 Ω within the operating frequency range of the instrument. Normally connected to the BERTScope analyzer Pattern Generator CLOCK+ output.
3	DATA OUT+ and DATA OUT–	Plus and minus differential data outputs from the FIR processor filter. Outputs are 50 Ω from the buffer amplifier. Signal amplitudes and offsets are controlled through the user interface. Normally connected to the DUT. Terminate unused outputs into 50 Ω if driving a single-ended load.
4	PCIE DATA IN+ and DATA IN–	Plus and minus differential Eye Opener PCIE data input connectors. These AC-coupled inputs connect to the output of the DUT.
5	PCIE DATA OUT+ and DATA OUT–	Plus and minus differential Eye Opener PCIE data output connectors with applied equalization, normally connected to the BERTScope Error Detector DATA+ and DATA- inputs.
6	100 MHZ REF CLK IN + and –	100 MHz reference clock plus and minus input connectors. The signals applied to these input connectors are normally from the DUT. The reference clock can be multiplied from 100 MHz to 2.5, 5, or 8 GHz and supplied to a BERTScope analyzer to meet the required PCIe data rate.
7	PLL OUT + and –	Multiplier PLL plus and minus output connectors for 2.5 GHz, 5.0 GHz, and 8.0 GHz clock rates.
8	Power switch	Activates the power supply to provide power to the primary circuits in the instrument. The switch has a green light when power is turned on. The primary power control circuitry is always live whenever the power cord is connected to the instrument. To completely disconnect power from the instrument, disconnect the power cord at the rear of the instrument.
9	Ground	Use this connector to connect a common ground to other instruments

Rear panel information

Standard instrument controls and connectors

The following section describes the DPP rear panel controls and connectors.

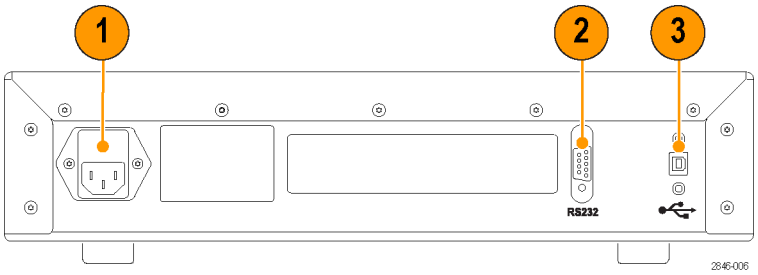


Figure 6: DPP rear panel connectors

Table 7: Rear panel connectors, standard instrument

Connector		Description
1	AC Power	Connect with a suitable power cable to match the local power outlet type.
2	RS232	Miniature type D connector for standard RS-232 communication.
3	USB IN	USB 2.0 type B connector used to interface the instrument for control. When used with a BERTScope analyzer, connect to any available USB connector. The DPP125C can also be operated standalone with an external PC. When operated in this mode, connect the USB connector to an available USB connector in the PC. BERTScopePC software must be installed to support standalone operation.

Option ECM controls and connectors

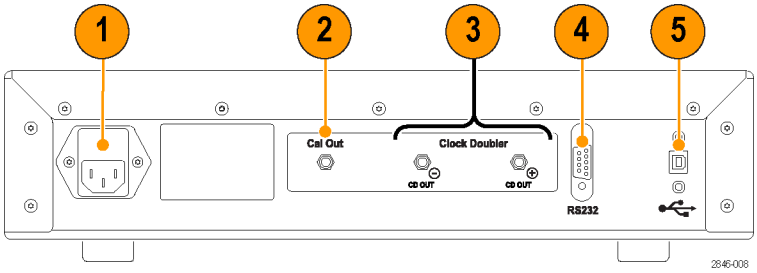


Figure 7: DPP125C ECM rear panel controls and connectors

Table 8: Rear panel connectors, DPP125C ECM

Connector		Description
1	AC Power	Connect with a suitable power cable to match the local power outlet type.
2	Cal Out	The Cal Out connector provides a single-ended copy of the Reference Clock Multiplier PLL output, optionally divided by a ratio of 1, 2, 4, or 8.
3	Clock Doubler: CD OUT– and CD OUT+	For data rates between 8.0 and 12.5 Gb/s, the clock doubler optionally generates a full rate clock from a half rate clock provided on the CLOCK IN front panel connector. This feature is intended for support of higher data rate serial interfaces when used with the stress capabilities of a BERTScope analyzer. When the clock doubler is enabled, the CD OUT+ and CD OUT- connectors provide a differential copy of the frequency doubled clock provided to the DPP125C FIR.
4	RS232	Provides standard RS-232 communication including FIR (finite impulse response) tap settings for PCIe receiver equalization tuning (auto-negotiation)
5	USB	USB 2.0 type B connector used to interface the instrument for control. When used with a BERTScope analyzer, connect to any available USB connector. The DPP125C can also be operated standalone with an external PC. When operated in this mode, connect the USB connector to an available USB connector in the PC. BERTScopePC software must be installed to support standalone operation.

Procedures

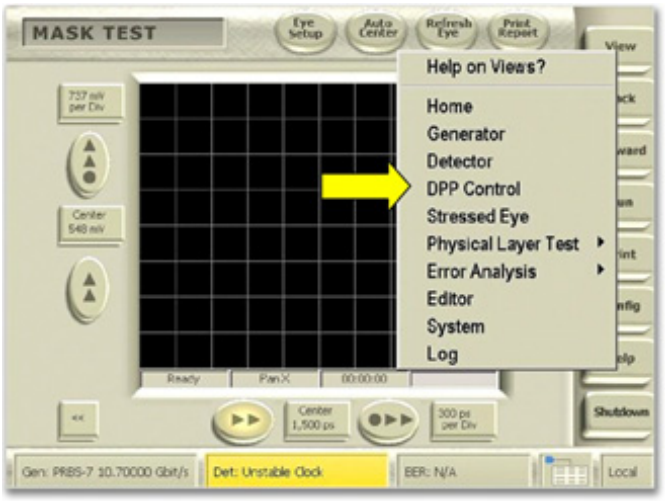
Complete the following procedures after properly connecting the DPP to your system or to your host PC.

System setup

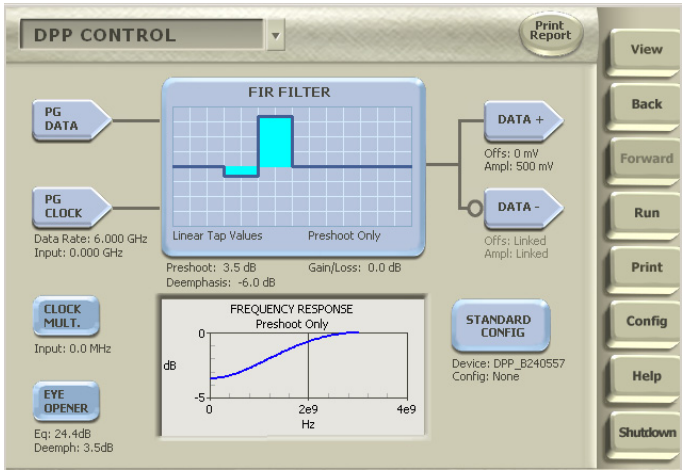
When you first start the BERTScope analyzer with the DPP attached to your system, the standard Microsoft Windows New Hardware Found message displays as the drivers automatically load. Follow the online instructions, if needed.

NOTE. *The contents of the starting window depend on whether the DPP is connected as part of the overall system or used with a standalone host computer.*

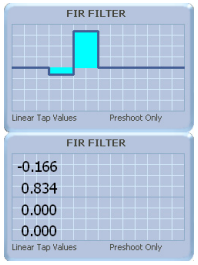
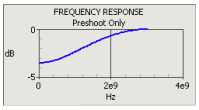
Click the View button and then select **DPP Control** to open the interface.



The single view provides a complete control interface for the DPP instrument.



The following table describes the key features in the control interface.

Item	Description
	The PG DATA button represents the data input connector on the front panel. Click the button to display the current data input properties and status values.
	The PG CLOCK button represents the Clock input connector on the front panel. Click the button to display the current clock input properties and status values. Clicking the button also displays a list of items that can be changed for your application. The DPP Mode selection is unavailable for earlier DPP125 models.
	The CLOCK MULT. button displays the current property and status settings of the Reference Clock Multiplier. Click the button to select the PCIe frequency or to set the phase-locked loop mode for your application. This button only appears when the BERTScope Generator hardware is present or simulated. This feature is available with DPP125C OPT ECM.
	The EYE OPENER button displays the current property and status settings for the DPP Eye Opener. The DPP Eye opener provides a means of opening the eye for BER testing. Click the button to select the Equalization and De-emphasis values. The Equalization values will vary depending on the operating frequency selection. This feature is available with DPP125C OPT ECM.
	The FIR (Finite Impulse Response) filter in the center of the view represents a graphical step response display or it shows the current TAP settings depending on the selection of the DPP FIR Format. In the Step Response graph, each vertical line denotes a bit boundary. Each horizontal grid line in the center graph represents an equal division of the maximum-to-minimum value range. For the Step Response graphic, the top edge is +100%, the middle blue line is 0%, and the bottom edge is –100%. Each grid line is 25%. For the Taps, the top edge is +1, the middle blue line is 0, and the bottom edge is –1. Each horizontal grid line is 0.25. In the Tap graph, the width of the bars is not significant. Click the FIR filter button to display a list of menus to further configure the DPP setup.
	The Frequency Response graph at the bottom of the view shows the equivalent frequency domain response of the selected configuration.
	The DATA+ or DATA– icon set the output amplitude and offset voltages, similar to the corresponding function in the BERTScope Pattern Generator.
	The STANDARD CONFIG button provides a means to connect to or disconnect from a DPP device. Click the button to select the DPP device or to save or restore a DPP configuration file..

Refer the online help for additional information on the controls in the DPP Control view.

Applications

Using the DPP with other instruments

The DPP125C instruments can be used with other vendor's Bit Error Rate testers, other instruments, or in standalone configurations. All of the instrument functionality is accessible through the user interface provided by the BERTScopePC standalone software.

The control communication is through the USB 2.0 connection to the host computer rather than to a BERTScope analyzer. The software should be installed on the host PC before connecting the USB cable.

User service procedures

This section provides high-level service information and procedures for your instrument.

Service offerings

Tektronix provides service to cover repair under warranty as well as other services that are designed to meet your specific service needs.

Whether providing warranty repair service or any of the other services listed below, Tektronix service technicians are well equipped to service your instrument. Services are provided at Tektronix Service Centers and on-site at your facility, depending on your location.

Warranty repair service

Tektronix warrants this product as described in the warranty statements at the front of this manual. Tektronix technicians provide warranty service at most Tektronix service locations worldwide. The Tektronix product catalog lists all service locations worldwide.

Calibration and repair service

In addition to warranty repair, Tektronix Service offers calibration and other services that provide cost-effective solutions to your service needs and quality standards compliance requirements. Our instruments are supported worldwide by the leading-edge design, manufacturing, and service resources of Tektronix to provide the best possible service.

General care

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

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

Preventive maintenance

Preventive maintenance mainly consists of periodic cleaning. Periodic cleaning reduces instrument breakdown and increases reliability. Clean the instrument as needed, based on the operating environment. Dirty conditions may require more frequent cleaning than computer room conditions.

Exterior cleaning

Clean the exterior surfaces with a dry, lint-free cloth or a soft-bristle brush. If dirt remains, use a cloth or swab dampened with a 75% isopropyl alcohol solution. A swab is useful for cleaning in narrow spaces around the controls and connectors. Do not use abrasive compounds on any part of the instrument.

Cleaning guidelines

To avoid damaging the instrument follow these precautions:

- Avoid getting moisture inside the instrument during external cleaning and use only enough solution to dampen the cloth or swab.
- Do not wash the front-panel power switch. Cover the switch while washing the instrument.
- Use only deionized water when cleaning. Use a 75% isopropyl alcohol solution as a cleanser and rinse with deionized water.
- Do not use chemical cleaning agents; they may damage the instrument. Avoid chemicals that contain benzene, toluene, xylene, acetone, or similar solvents.

Fuse replacement

The instrument is protected by a fuse placed in series with the power line input. The fuse is conservatively rated and should never open through the life of the instrument. A blown fuse would generally indicate a problem with the instrument which requires factory service. It is recommended that you arrange to have the instrument serviced if you experience a blown fuse.

Instrument calibration

The instrument uses digital calibration of the output buffers. To maintain the accuracy of the output amplitude and offset, annual calibration is recommended. Contact Tektronix to schedule instrument calibration.

Repack the instrument for shipment

If the instrument is to be shipped to a Tektronix service center for repair, attach a tag showing the following information:

- Name of the product owner
- Address of the owner
- Instrument serial number
- A description of the problems encountered and/or service required.

When packing an instrument for shipment, use the original packaging. If it is unavailable or not fit for use, contact your Tektronix representative to obtain new packaging.

Specifications

Table 9: System specifications

Characteristic	Description
Data rate	1 to 12.5 Gb/s
Filter function	FIR
Taps	3 [1]
Tap spacing	1 UI [2]
Tap Weight range	−100% – +100%, including 0
Tap weight resolution	1% or 0.1 dB
Control interface	USB 2.0

[1] An optional 4-tap configuration is available

[2] When clocked at the data rate.

Table 10: Clock input specifications

Characteristic	Description
Configuration	Single ended
Sensitivity (Typical)	250 mV_{p-p}
Termination	50 Ω, AC-Coupled
Connector	SMA, female
Maximum jitter transfer function	1:1, Clock input to Data output

Table 11: Data input specifications

Characteristic	Description
Sensitivity (Typical)	250 mV_{p-p}, PRBS31 pattern
Termination	50 Ω, DC-Coupled
Connector	SMA, female

Table 12: Data output specifications

Characteristic	Description
Configuration	Differential, independent amplitude control
Coupling	AC-coupled with DC-coupled output offset
Connector	SMA, female
Amplitude (Typical)	200 mV to 900 mv single-ended (0.4 V to 1.8 V differential)
Offset Range (Typical)	-500 mV 0 to +500 mV
Skew (Typical)	< 2 ps
Transition time	< 40 ps
Intrinsic jitter (Typical)	< 350 fs rms, additive, 1010 pattern

Table 13: Physical specifications

Characteristic	Description
Dimensions	
Width	39.4 cm (15.5 in)
Height	10.4 cm (4.1 in) with feet
Depth	53.3 cm (21 in)
Weight	
DPP125C	5.0 kg (11.0 lb)
DPP125C Opt. ECM	5.2 kg (11.5 lb.)
Power consumption	100 W, maximum
Power requirements	100 to 240 VAC, 50/60 Hz
Power fuse	3.15 A, 250 V, 5 mm x 20 mm, fast blow

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Symbols and Numbers

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