

**Tektronix BERTScope
Clock Recovery Instruments
Quick Start User Manual**



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This document supports BSA Software V10 and above.

www.tektronix.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.tektronix.com to find contacts in your area.

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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.

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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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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:



CAUTION
Refer to Manual



WARNING
High Voltage



Protective Ground
(Earth) Terminal



Chassis Ground



Standby

Compliance information

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

EMC compliance

EC Declaration of Conformity – EMC

Meets intent of Directive 2004/108/EC for Electromagnetic Compatibility. Compliance was demonstrated to the following specifications as listed in the Official Journal of the European Communities:

EN 61326-1 2006. EMC requirements for electrical equipment for measurement, control, and laboratory use.^{1 2 3}

- CISPR 11:2003. Radiated and conducted emissions, Group 1, Class A
- IEC 61000-4-2:2001. Electrostatic discharge immunity
- IEC 61000-4-3:2002. RF electromagnetic field immunity
- IEC 61000-4-4:2004. Electrical fast transient / burst immunity
- IEC 61000-4-5:2001. Power line surge immunity
- IEC 61000-4-6:2003. Conducted RF immunity
- IEC 61000-4-11:2004. Voltage dips and interruptions immunity

EN 61000-3-2:2006. AC power line harmonic emissions

EN 61000-3-3:1995. Voltage changes, fluctuations, and flicker

European contact.

Tektronix UK, Ltd.
Western Peninsula
Western Road
Bracknell, RG12 1RF
United Kingdom

- 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 should be used.

Australia / New Zealand Declaration of Conformity – EMC

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

- CISPR 11:2003. Radiated and Conducted Emissions, Group 1, Class A, in accordance with EN 61326-1:2006.

Australia / New Zealand contact.

Baker & McKenzie
Level 27, AMP Centre
50 Bridge Street

Sydney NSW 2000, Australia

Safety compliance

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

EU declaration of conformity – low voltage

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

Low Voltage Directive 2006/95/EC.

- 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 2002/96/EC and 2006/66/EC on waste electrical and electronic equipment (WEEE) and batteries. For information about recycling options, check the Support/Service section of the Tektronix Web site (www.tektronix.com).

Restriction of hazardous substances

This product is classified as an industrial monitoring and control instrument, and is not required to comply with the substance restrictions of the recast RoHS Directive 2011/65/EU until July 22, 2017.

Preface

This document supports the following Tektronix BERTScope Clock Recovery instruments:

- CR125A with a maximum bit rate of 12.5 Gb/s
- CR175A with a maximum bit rate of 17.5 Gb/s
- CR286A with a maximum bit rate of 28.6 Gb/s

NOTE. *Faster instruments have higher specifications. Please contact your local Tektronix representative for additional details not mentioned in this document.*

The software-based graphical user interface is accessed through the Tektronix BERTScope Analyzer top level View menu, listed as Clock Recovery Control. Detailed information on the operation of the control interface can be accessed at any time through the Help menus available in any of the control views.

BERTScopePC Standalone Software installs the Clock Recovery instrument control interface on a user-supplied PC. The BERTScopePC software is included on the CD-ROM shipped with the Clock Recovery instrument.

The instrument communicates with the Tektronix BERTScope Analyzer or Host PC through a USB interface. A USB interconnect cable is provided with the product.

Product description

The Tektronix BERTScope CR125A, CR175A, and CR286A are fully flexible clock recovery instruments designed to make compliance testing of today's communication designs easy and accurate. With jitter being such a complex and contentious parameter, the Tektronix Clock Recovery instrument is intended to make compliance testing simple, repeatable and accurate.

Many communication standards now specify that jitter testing must be carried out using a reference clock that has been derived from the data signal using clock recovery with well defined loop bandwidth characteristics. Typically these characteristics are specified in terms of the -3 dB bandwidth of the recovery loop, the rate of roll-off of the frequency response, and the degree of response peaking allowable. These effects will greatly dictate the amount of jitter that will be present on the reference clock, and therefore the amount of jitter ultimately measured by test instrumentation.

The Clock Recovery instrument has been designed from the ground up to provide flexibility and accuracy in compliance measurements. For easy verification of compliance, the correct characteristics are automatically set when a given standard is selected from a pull-down menu. However, for users wanting to explore the limits of their designs, full control of parameters is also easily available. A good example of this is for systems where restricting the buildup of jitter is critical. Clock recovery plays a crucial role in this, and the ability to emulate a clock recovery source with excessive peaking is a great way of understanding the system sensitivity to jitter gain.

The Tektronix BERTScope Clock Recovery instrument is the perfect companion to the Tektronix BERTScope Bit Error Rate Analyzer, sharing a common user interface. A single USB connection and high quality microwave coax cables connect the two units.

Table i: Features and benefits

Features	Benefits
Accurate, robust (including spread spectrum clocking) clock recovery	Recover clock when no device or system clock is available, jitter measurements cannot be any better than your clock reference.
Accurate, user-controllable PLL bandwidth and peaking	Compliant clock recovery for standards testing, measured DUT jitter is dependent on PLL bandwidth
Optional jitter spectrum analysis	Spectral view and measurement of jitter in signal, calibration of jitter components for PCIe 5 Gb/s receiver test
Optional 24 MHz loop bandwidth	For PCIe Gen 3 testing

Key specifications

Table ii: Key specifications

Characteristic	CR125A	CR175A	CR286A	CR175A Option HS	CR286A Option HS
Input sensitivity (typical)		100 mV single-ended 50 mV differential		40 mV single-ended 20 mV differential	
Input data rate coverage	150 Mb/s to 12.5 Gb/s	150 Mb/s to 17.5 Gb/s	150 Mb/s to 28.6 Gb/s	150 Mb/s to 17.5 Gb/s	150 Mb/s to 28.6 Gb/s
Data insertion loss	2 dB (min), 2.6 dB (typical), 3 dB (max), up to 12.5 Gb/s ¹			-	
Data input voltage range	-5 V (min), +5 V (max)			-5 V (min), +5 V (max) 1 V _{p-p} (max)	
Measured edge density accuracy	±1%, up to 14.3 Gb/s, ±3% >14.3 Gb/s				
Equalization range	0 to 10 dB				
Data output	Up to 12.5 Gb/s ¹			-	

¹ Data through path only recommended for use below 12.5 Gb/s. Use external pick-off tees and terminate output connector above 12.5 Gb/s.

The following table lists the clock and subrate clock output characteristics and specifications common to all instruments:

Table iii: Key specifications, clock and subrate clock outputs

Characteristic	Specifications
Loop bandwidth	100 kHz-12 MHz, 200 kHz to 12 MHz above 14.3 GHz up to 24 MHz with Option XLBW ext. loop BW
Peaking	0-6 dB, 500 kHz-12 MHz, 0-5 dB 12 MHz – 24 MHz with option XLBW
Intrinsic jitter (typical)	250 fs
Clock output range	Full-rate clock for input data rates to 14.3 Gb/s Half-rate clock for input data rates >14.3 Gb/s
Sub-rate divider ratios	For input data rate to 14.3 Gb/s: Full rate divided by 1, 2, 4, 5, 6, 7, 8, 9, 10, 12, 14, 16, 18, 20, 24, 25, 28, 30, 32, 35, 36, 40, 42, 45, 48, 49, 50, 54, 56, 60, 63, 64, 70, 72, 80, 81, 90, 100, 108, 112, 120, 126, 128, 140, 144, 160, 162, 168, 180, 192, 196, 200, 216, 224, 240, 252, 256, 280, 288, 320, 324, 336, 360, 384, 392, 432, 448, 504, 512, 576, 648 For input data rate >14.3 Gb/s: Full rate divided by 2, 4, 8, 10, 12, 14, 16, 18, 20, 24, 28, 32, 36, 40, 48, 50, 56, 60, 64, 70, 72, 80, 84, 90, 96, 98, 100, 108, 112, 120, 126, 128, 140, 144, 160, 162, 180, 200, 216, 224, 240, 252, 256, 280, 288, 320, 324, 336, 360, 384, 392, 400, 432, 448, 480, 504, 512, 560, 576, 640, 648, 672, 720, 768, 784, 864, 896, 1008, 1024, 1152, 1296

Documentation

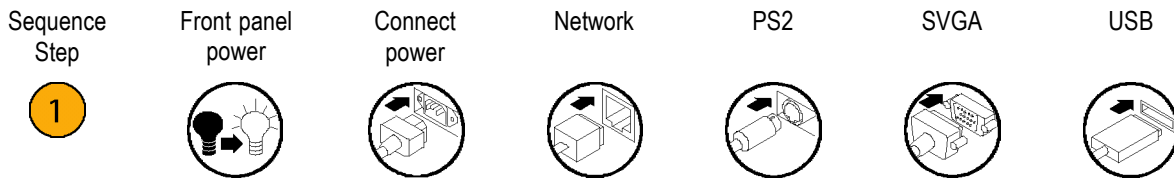
In addition to this document, the following documents are available:

- Online help, including remote control commands
- Online remote control guide (PDF)

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

Conventions used in this manual

The following icons are used throughout this manual.



NOTE. A Notice statement identifies conditions which can result in unintended operating modes, incorrect measurement results, or require resetting the operating software on a personal computer that interacts with the instrument.

Installation

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

The Tektronix Clock Recovery Instrument is intended to be operated in a controlled laboratory environment.

The instrument is intended to operate on a bench top, or on top of another instrument such as the Tektronix BERTScope Bit Error Rate Analyzer. There are four shock-absorbing feet 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.*

This instrument uses a low voltage soft power switch that activates the power supply. The primary power control circuitry is always live whenever the power cable is connected to the mains. The instrument is fuse-protected to reduce the risk of fire in the event of a power supply failure. Access to the power cable for disconnection from the mains in an emergency may be required by local codes.



CAUTION. *To prevent damage to the instrument when the data outputs are not in use, terminate the data outputs with the SMA terminations provided.*



CAUTION. *To prevent damage to the high sensitivity data circuitry, ensure that the input voltage does not exceed ± 5 V range, 3 V_{p-p} .*

Accessories

The instrument comes with the following standard accessories:

- Power cord
- USB interconnect cable
- Documents
- BERTScopePC Standalone Software CD-ROM (installs the CR's control interface on a user-supplied PC)

The following optional accessories are available for your product:

Accessory	Description
CR125ACBL	High-performance delay matched cable set (required for BERTScope Analyzer and Clock Recovery instrument in SSC applications)
100PSRTFILTER	100 ps rise time filter
BSA12500ISI	Differential ISI board
PMCABLE1M	Precision phase-matched cable pair, 1 m
SMAPOWERDIV	SMA power dividers
BSASATATEE	BSA-SATA-Tee for OOB Signaling
SATATESTSW	Serial ATA Interop Test Suite automation software
BSARACK	BSA rack mount kits

Options

The following options are available for your product.

Option	Description	CR125A	CR175A	CR286A
PCIE	PCIe PLL analysis (requires 12GJ, operates at 2.5 G and 5 G only)	X	X	X
PCIE8G	PCIe PLL analysis (requires 12GJ, operates at 2.5 G, 5 G, and 8 G only)	X	X	X
HS	Add high-sensitivity clock recovery		X	X
XLBW	Add extended loop bandwidth in the clock recovery	X	X	X
12GJ	Add jitter spectrum analysis from 1.2 to 11.2 Gb/s	X		
17GJ	Add jitter spectrum analysis from 1.2 to 11.2 Gb/s		X	
28GJ	Add jitter spectrum analysis from 1.2 to 11.2 Gb/s			X

Operating requirements

Place the instrument on a cart or bench on the bottom feet. Observe the following clearance requirements and dimensions:

Table 1: Operating requirements

Feature	Description
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)
Width	394 mm (15.5 in)
Height	220 mm (8.7 in)

Before operating the instrument, verify the ambient temperature: +10° C to +40 °C (+41 °F to +113 °F).

Preventing electrostatic discharge (ESD)



CAUTION. To prevent damaging internal circuit boards and their components due to electrostatic discharge (ESD), please read the following guidelines.

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 may damage the instrument.

To avoid damage to the instrument, use the following guidelines 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 one of several ways of connecting the clock recovery instrument to a Tektronix BERTScope Analyzer; your connections may vary depending on your applications.

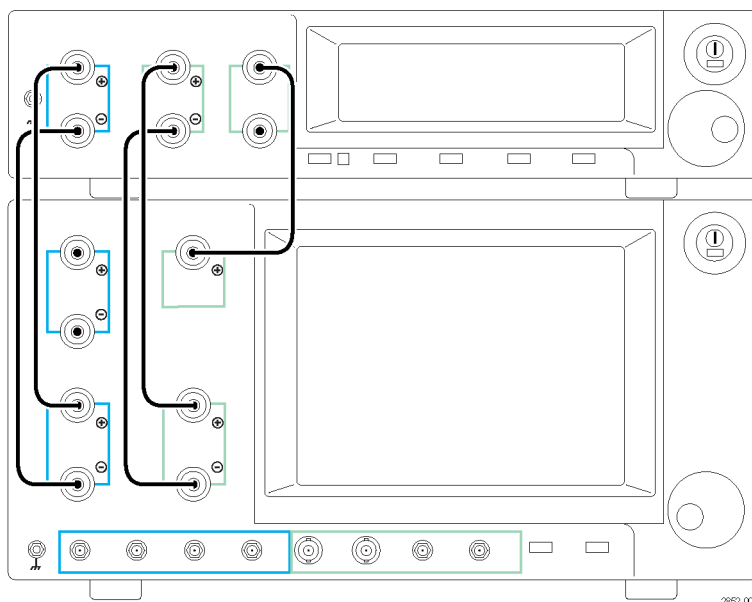
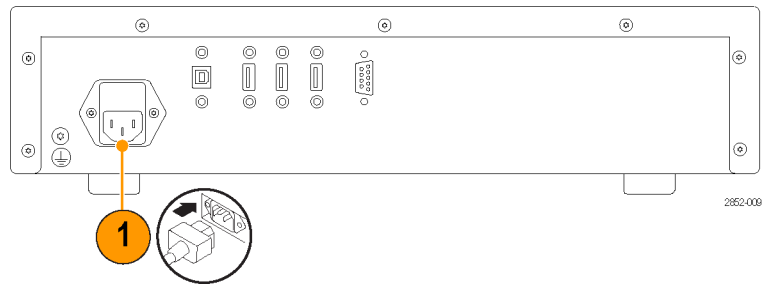


Figure 1: Clock Recovery and BERTScope Analyzer connections

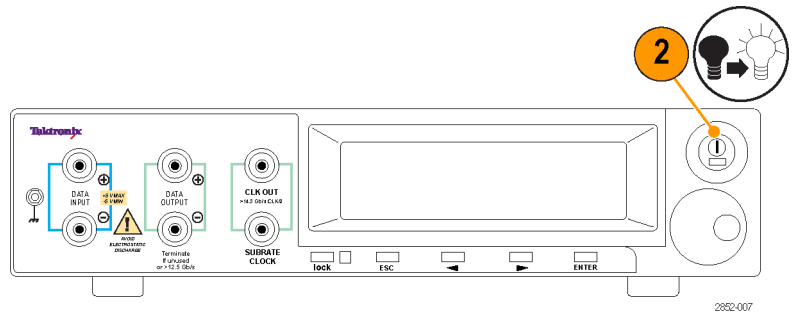
Power on the instrument

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.



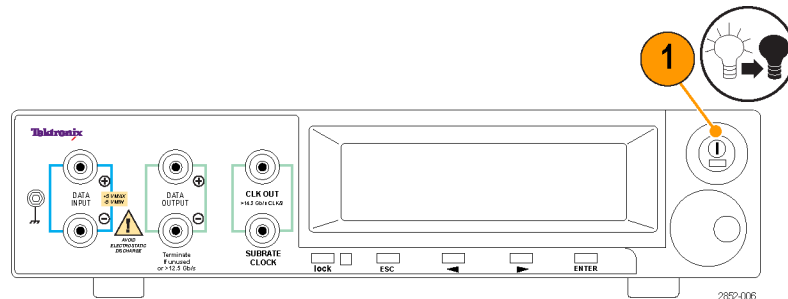
NOTE. The first time that the BERTScope Analyzer starts with the Clock Recovery instrument attached, the standard Microsoft Windows New Hardware Found message displays as the drivers automatically load.



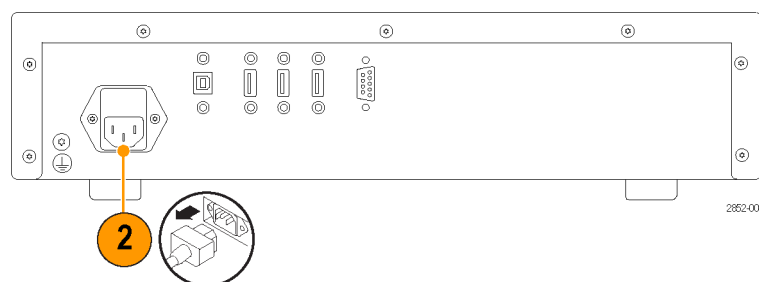
CAUTION. Static discharge can damage the instrument. To avoid static discharge while connecting cables to the front panel interface, always use the proper coaxial cables with APC-3.5, 2.92 mm, or SMA cables.

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 BERTScope PC software provides for PC control of BERTScope Clock Recovery instruments and the Digital Pre-Emphasis Processor (DPP) instruments that are being operated as stand-alone instruments (not connected directly to a BERTScope bit error rate tester).

With the BERTScopePC software installed on a Windows PC, and the stand-alone instrument connected to the PC via the standard USB interface, the BERTScopePC software initiates installation of the appropriate driver and provides a user interface allowing control of all DPP or CR functions. The user interface provided for each instrument is similar to the BERTScope bit error rate tester.

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

Insert the BERTScope PC 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 > BERTScope PC UI (or one of the other selections in the menu).

Operation

Front panel connectors and controls

Refer to the following illustration and table for information on the front panel connectors and controls.

Adjust the input settings after connecting the cables to the Data Input and Clock Output connectors and turning the instrument on.

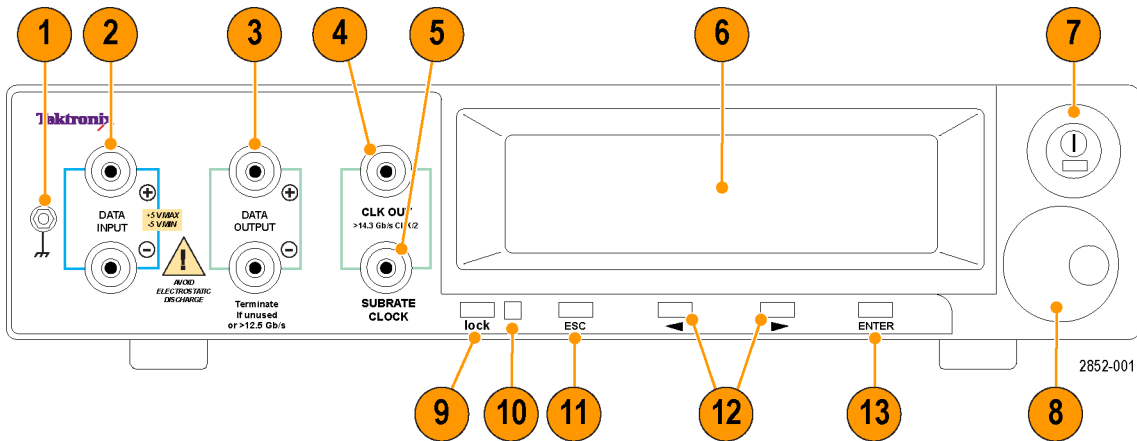


Figure 2: Front panel connectors and controls

Connectors/controls	Description
1 Chassis ground	Use this connector to connect a common ground to other instruments or to connect a ground strap with a banana connector to the instrument to reduce risk of static discharge while using the instrument.
2 DATA INPUT + and DATA INPUT -	Data input connectors. Connect a differential input from a signal source to these connectors. To prevent damage to the high sensitivity data circuitry, ensure that the input voltage does not exceed ± 5 V range, $3 V_{p-p}$.
3 DATA OUTPUT + and DATA OUTPUT -	Data output connectors. These are loop-through data differential data output connectors. Terminate any unused output connectors to avoid reflections that can severely degrade performance.
4 CLK OUT	Clock output connector. This is the recovered full rate clock connector.
5 SUBRATE CLOCK	Subrate clock connector. This is the recovered clock connector with programmable subrates. This signal can be connected to the trigger input of an oscilloscope.
6 Display	The display shows measured values on the left side of the display and the device settings on the right side. The device settings can be controlled by buttons beneath the display and the rotary knob.

Connectors/controls		Description
7	Power On/Off button	The power button activates the power supply to provide power to the primary circuits of the instrument. The switch has a green light when the instrument is powered 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.
8	Adjustment knob	The rotary knob adjusts the display settings and can scroll through the menu selections. It can also be used to zoom selections.
9	Lock button	Push this button to initiate manual locking.
10	Lock status indicator	The lock status indicator shows a different color for the status of the lock: Green, lock; Amber, locking; Red, unable to lock.
11	ESC button	Push this button exit the submenus in the display and revert to the previous values when editing settings.
12	Left and right cursor buttons	Push these buttons to navigate through the display settings. Use the buttons to move through and change individual digits; use the rotary knob to make larger changes.
13	Enter button	Push this button to scroll through menus or to change digits when editing the display. It also selects the setting for adjustment and confirms changes when editing settings.

Rear panel connectors

Refer to the following illustration and table for information on the rear panel connectors.

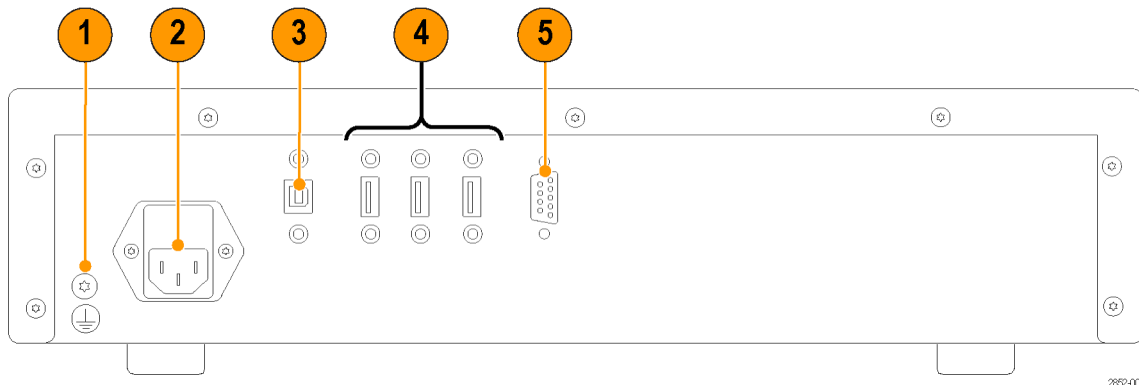


Figure 3: Rear panel connectors

Connectors/controls	Description
1 Chassis ground	Use this connector to connect a common ground to other instruments.
2 AC Power	Connect with a suitable power cable to match the local power outlet type.
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 instrument 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. The BERTScopePC software must be installed on the PC to support standalone operation.
4 USB HUB OUT	Use these USB connectors to connect to other instruments in the system with USB cables.
5 RS232	Miniature type D connector for standard RS232 communication

Interface and display information

Many industry standards are available from the front panel menu. The current settings appear on the right side of the display.

The following table shows settings that you can enter manually.

Table 2: Display settings

Item	Description
Nominal Data Rate	Nominal rate of the recovered clock
Lock Range	Frequency range around the nominal rate that will be scanned during locking
Bandwidth	Bandwidth of the recovery loop measured at -3 dB
Peaking	Peaking of the recovery loop. Also sets first or second order roll-off of untracked jitter
Nominal Edge Density	Expected edge density of incoming data. Required to set bandwidth correctly
Edge Density Mode	Sets bandwidth. Calculations are based on Nominal Edge Density or edge density measured during lock
Clock Amplitude	Output amplitude of the full rate clock
Subrate Amplitude	Output amplitude of the subrate clock
Subrate Division	Division ratio of the subrate clock

By default, all settings will be saved automatically when you power off the instrument will be restored when you turn the instrument on. You can save current settings to one of four setups to be recalled later.

Several continuously updated measurements are shown on the front panel display.

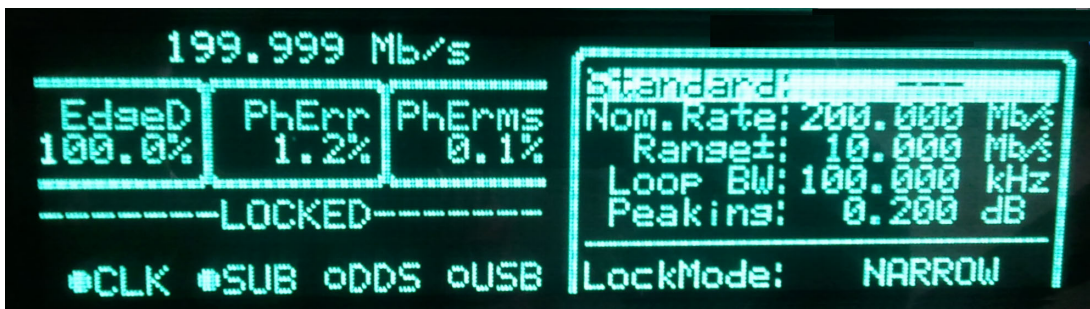


Figure 4: Measured values

The following table describes the displayed measurements.

Table 3: Displayed measurements

Item	Description
Data rate	The actual input data rate in Hertz. If the CR platform has DDR capability (such as the CR2500A), the CR Monitor data rate will be displayed in Gb/s or Mb/s.
Edge Density (EdgeD)	The measured edge density. A '1010' data pattern transmitted at the Nominal Data Rate would have 100% edge density.
Phase Error	The peak-to-peak phase error between the incoming data and the recovered clock. This measured value will increase if jitter is present on the input data that is not being tracked by the recovered clock.
Phase Error RMS (PhErms)	The RMS phase error between the incoming data and the recovered clock
Lock Status	Reports whether the CR is locked, unlocked, or in the process of locking.

By default, the instrument is configured in Auto Lock mode, where it automatically attempts to acquire lock if the detected Phase Error exceeds the Phase Error Limit setting, or if the recovered clock is unstable. Pressing the LOCK key on the CR front panel forces a relock.

Use the Clock Recovery instrument with a Tektronix BERTScope Analyzer

This section provides information on using the Clock Recovery instrument with a Tektronix BERTScope Analyzer.

The Clock Recovery instrument can be connected to a Tektronix BERTScope Analyzer through a USB cable, allowing full control of the instrument through the BERTScope Analyzer touchscreen user interface.

The following setup is one of many ways of connecting the instruments. Your system configuration will vary. The following steps are provided as guidelines for connecting the Clock Recovery instrument to a Tektronix BERTScope Analyzer. Refer to the connection diagram as needed.

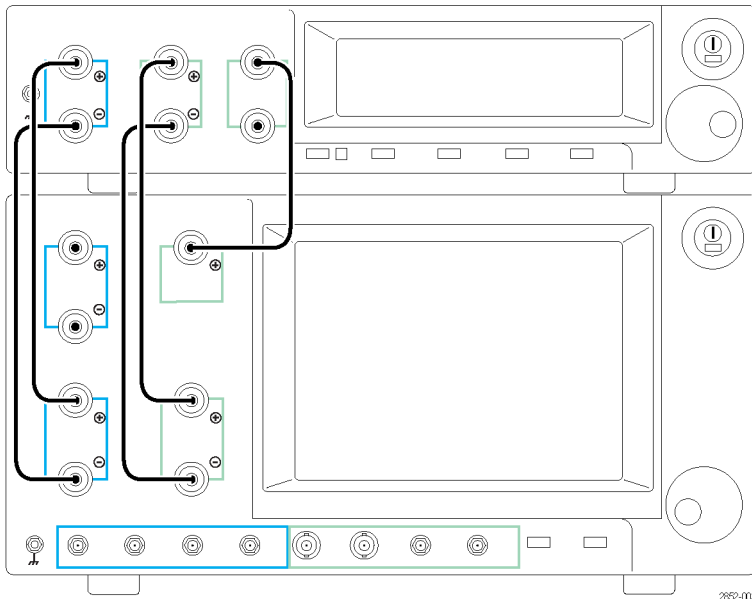


Figure 5: Connecting the Clock Recovery instrument to a Tektronix BERTScope Analyzer

1. Connect a USB cable from the rear of the Clock Recovery instrument to the BERTScope Analyzer.
2. Connect the Clock Recovery data input connectors to the BERTScope Analyzer Pattern Generator data output connectors.
3. Connect the Clock Recovery data output connectors to the BERTScope Analyzer data input connectors.
4. Connect the Clock Recovery clock output to the BERTScope Analyzer clock input.
5. Power on the BERTScope Analyzer and then the Clock Recovery instrument.

After the BERTScope Analyzer completes the start-up sequence, the Home view will appear.

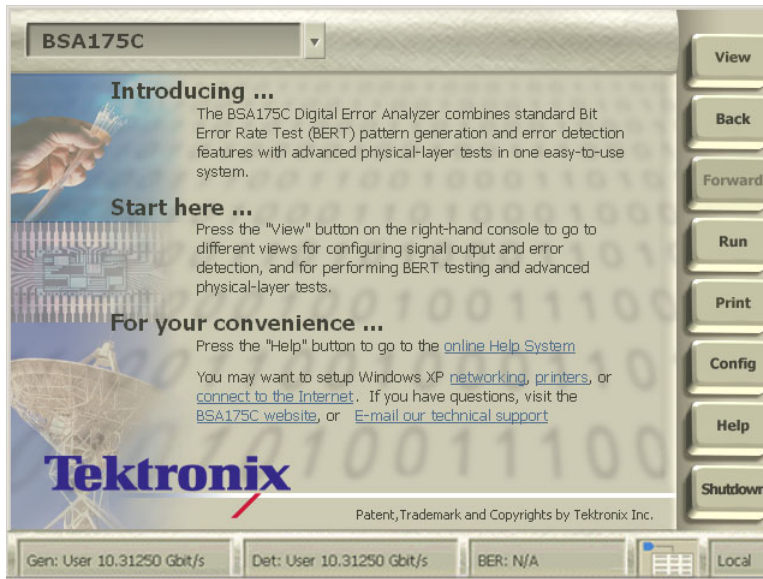


Figure 6: BERTScope Analyzer Home view

Press **View** on the BERTScope Analyzer, select **Clock Recovery** followed by **CR Control** to access the CR Control view.

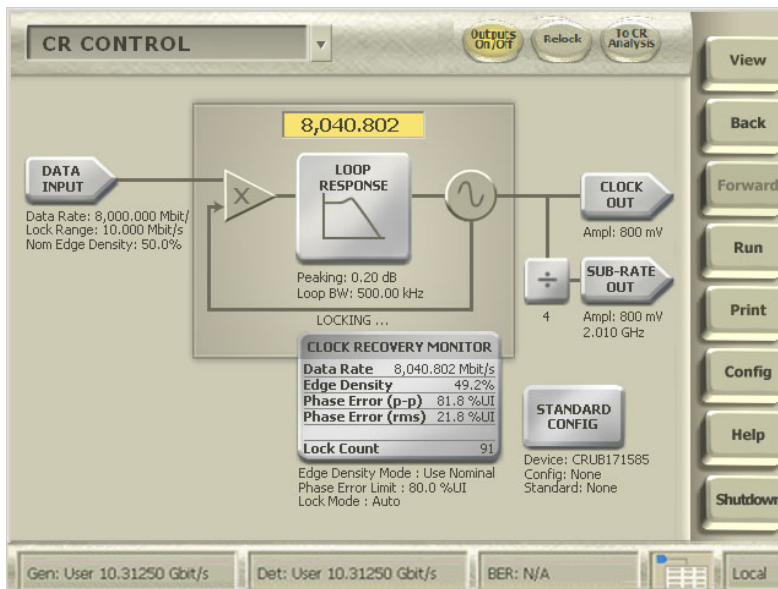


Figure 7: Clock Recovery CR Control view

Use the buttons on the touchscreen to access the device settings; all functionality is available through the user interface as well as the front panel controls of the Clock Recovery instrument. Graphing capability is available on the Tektronix BERTScope Analyzer by pressing the oval To CR Analysis button at the top of the BERTScope Analyzer Clock Recovery Control display (this Clock Recovery Analysis view can also be selected from the initial View menu).

Applications

To connect to another instrument, here are some simple configurations to get you started.

Connect the Clock Recovery instrument to a Tektronix sampling oscilloscope

Complete the following steps to connect the clock recovery instrument to a Tektronix sampling oscilloscope.

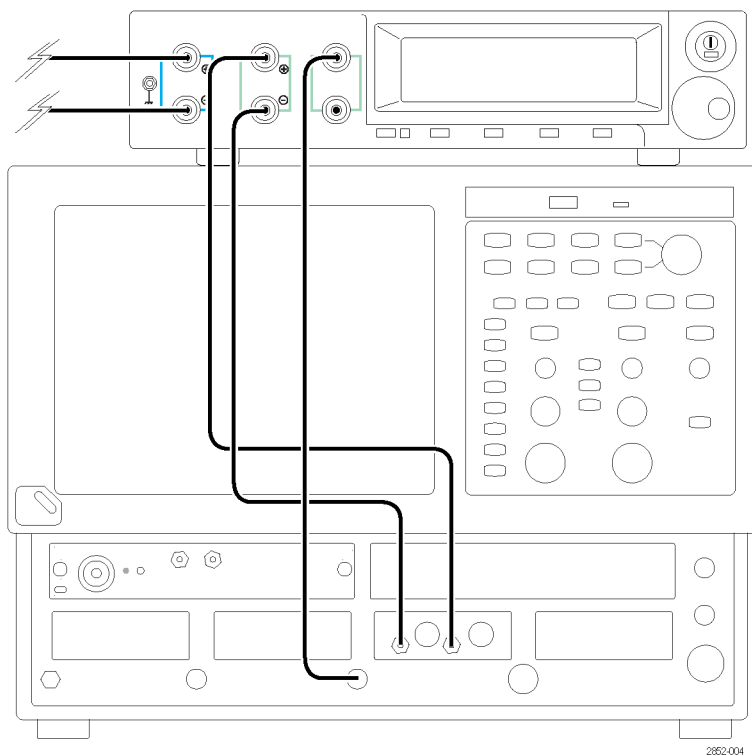


Figure 8: Connecting the Clock Recovery instrument to a Tektronix sampling oscilloscope

1. Connect the data input connections from the signal under test to the Data Input connectors on the Clock Recovery instrument.
2. Connect the Clock Recovery Data Output connectors to the data input connection on the sampling oscilloscope.
3. Connect the Clock Recovery Clock Output connectors to the trigger input connector of the sampling oscilloscope.

Connect the Clock Recovery instrument to another Bit Error Rate Tester (BERT)

Complete the following steps to connect the Clock Recovery instrument to another Bit Error Rate Tester. The actual connections depend on your instrument.

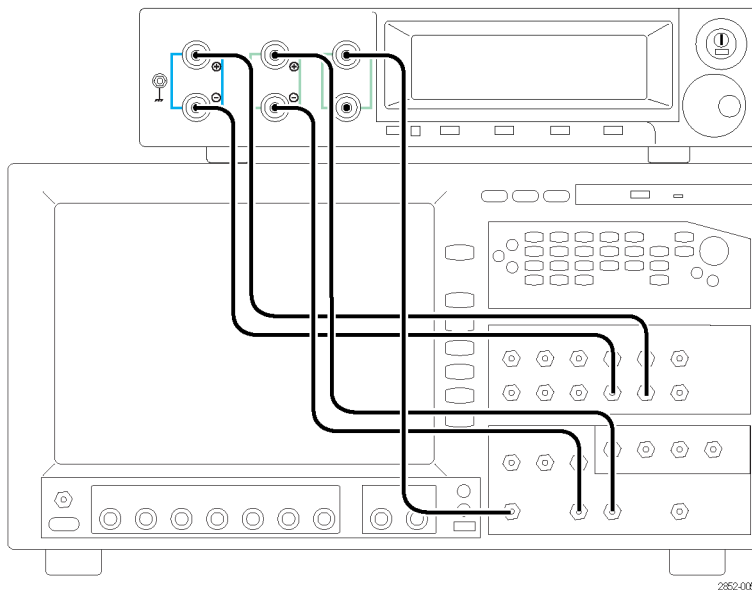


Figure 9: Connecting the Clock Recovery instrument to another BERT instrument

1. Connect the pattern generator data output connectors from the BERT instrument to the Clock Recovery Data Input connectors.
2. Connect the Error Detector data input connectors from the BERT instrument to the Clock Recovery Data Output connectors.
3. Connect the Clock Input connector from the BERT instrument to the Clock Recovery Clock Output connectors.

User service

This section describes high-level service and maintenance information 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 the instruments. 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. Do not store or leave the instrument where the display will be exposed to direct sunlight for long periods of time.



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

- 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 On/Standby 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.

Connector replacement

The DATA IN and DATA OUT connectors use Planar Crown® adapters. These facilitate user replacement of the adapter, should it become damaged. Replacement adapters can be ordered from Tektronix.

Replace the front panel connectors

The adapter is secured to the connector with a captive threaded mounting ring.

1. Remove a damaged connector by grasping the knurled outer portion of the ring with your fingers and turning counter-clockwise.

Do not allow foreign material to enter the connector body when replacing the adapter.

2. Position the two locating tabs in the corresponding slots of the instrument-mounted portion of the connector and seat the replacement adapter.
3. Align the retaining ring and tighten by rotating clockwise.

Tighten the connector finger-tight. To avoid over-tightening and possibly damaging the connector, do not use a tool to tighten it.

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 4: Data specifications

Characteristic	Description
Data interfaces	50 Ω differential or single-ended, DC-Coupled APC 3.5mm user-replaceable Planar Crown® adapters
Data rate coverage	
CR125A	150 Mb/s to 12.5 Gb/s
CR175A ¹	150 Mb/s to 17.5 Gb/s
CR286A ¹	150 Mb/s to 28.6 Gb/s
Data insertion loss	2 dB (min), 2.6 dB (typical), 3 dB (max) from data input to data output
Data input voltage range	-5 V (min), +5 V (max)
Input sensitivity	100 mV single ended (typical) 50 mV differential (typical)
Measured edge density resolution	$\pm 1\%$
Measured phase deviation	Displayed as % RMS and % peak-peak, 10-90% peak-peak available range

¹ Includes specifications for Option HS

Table 5: Clock specifications

Characteristic	Description
Clock interfaces	50 Ω single-ended, AC Coupled. APC 3.5 mm user-replaceable Planar Crown® adapters
Clock output range	150 MHz to 12.5 GHz (full rate clock output)
Loop bandwidth	2.5 kHz to 12 MHz variable
Loop bandwidth accuracy	$\pm 10\%$ (1100 pattern)
Locking range	50 MHz default, adjustable to 10 to 500 MHz
Peaking	0-6 dB from 500 kHz to 12 MHz 0 dB from 100 kHz to 500 kHz
Peaking accuracy	Greater of $\pm 10\%$ of setting, or 0.5 dB
Frequency response roll-off	-20 dB/ decade to -40 dB/decade
Intrinsic jitter (typical)	70 fs (typical), 250 fs _{RMS} (max), measured at 800 mV _{p-p} input amplitude, 10 Gb/s, 1010 pattern, 2 MHz loop bandwidth setting, and 0.5 dB peaking
Output frequency deviation tracking range (tracking 30 to 33 kHz triangle modulated SSC)	+500/-5500 ppm (+0.05/-0.55%)
Minimum input return loss	15 dB
Output waveform rise/fall times (20/80%)	25 ps (typical), 30 ps (max)
Clock output amplitude	250 mV _{p-p} (min) 900 mV _{p-p} (max) at clock rates ≤ 12.5 Gb/s 700 mV _{p-p} (max) at clock rates > 12.5 Gb/s
Output amplitude setting accuracy	Greater of 10% or 30 mV, > 50 MHz clock output frequency

Table 5: Clock specifications (cont.)

Characteristic	Description
Subrate clock output (as specified for clock output except for the following)	
Subrate divider ratios	Full rate divided by 1, 2, 4, 5, 6, 7, 8, 9, 10, 12, 14, 16, 18, 20, 24, 25, 28, 30, 32, 35, 36, 40, 42, 45, 48, 49, 50, 54, 56, 60, 63, 64, 70, 72, 80, 81, 90, 100, 108, 112, 120, 126, 128, 140, 144, 160, 162, 168, 180, 192, 196, 200, 216, 224, 240, 252, 256, 280, 288, 320, 324, 336, 360, 384, 392, 432, 448, 504, 512, 576, 648

Table 6: Trigger information (rear panel)

Characteristic	Description
Trigger output	
Interface type	SMA, 50 Ω , DC coupled
Latency	300 ms
Trigger input	
Interface type	SMA, 50 Ω , DC-coupled to 0 V
Threshold	1.5 V
Minimum pulse width	50 ns

Table 7: General specifications

Characteristic	Description
Device information	Serial number, revision codes available using front-panel
Control interface	USB cable (supplied). Unit also provides hub capability for 3 additional USB ports.

Table 8: Physical specifications

Characteristic	Description
Height	9.5 cm (3.75 in)
Width	39.4 cm (15.5 in)
Depth	33.6 cm (13.25 in)
Weight	9.1 kg (20 lbs)
Power	150 W maximum
Voltage	100 to 240 VAC, 50/60 Hz
Power fuse	3.15 A, 250 V, 5 mm x 20 mm, fast blow

Table 9: Environmental specifications

Characteristic	Description
Temperature	
Operating	+10 °C to +40 °C (+41 °F to +113 °F)
Non-operating	-20 °C to +60 °C
Humidity	
Operating	20 to 80% at or below 40 °C
Non-operating	5 to 90% at or below 60 °C
Altitude	
Operating	To 2000 m (6562 ft.)
Non-operating	To 12,000 m (39,370 ft.)

The performance of the BERTScope CR Series Option GJ Jitter Spectrum and DCD measurements are listed in the following tables. The performance of the clock recovery functionality remains identical as listed in the BERTScope CR series specifications.

Table 10: Jitter spectrum

Characteristic	Description
Minimum frequency	200 Hz
Maximum frequency	90 MHz
Minimum frequency resolution	200 Hz
Maximum jitter	Limited only by the ability of the clock recovery to lock with PLL BW at 0.5 MHz and 0.5 dB peaking
Vertical units	% UI or ps
Vertical scale	Log or linear
Frequency scale	Log or linear
Maximum number of integrated measurement frequency bands	3

Table 11: Duty cycle-dependent jitter

Characteristic	Description
Units	% UI or ps
Maximum range	50% UI

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