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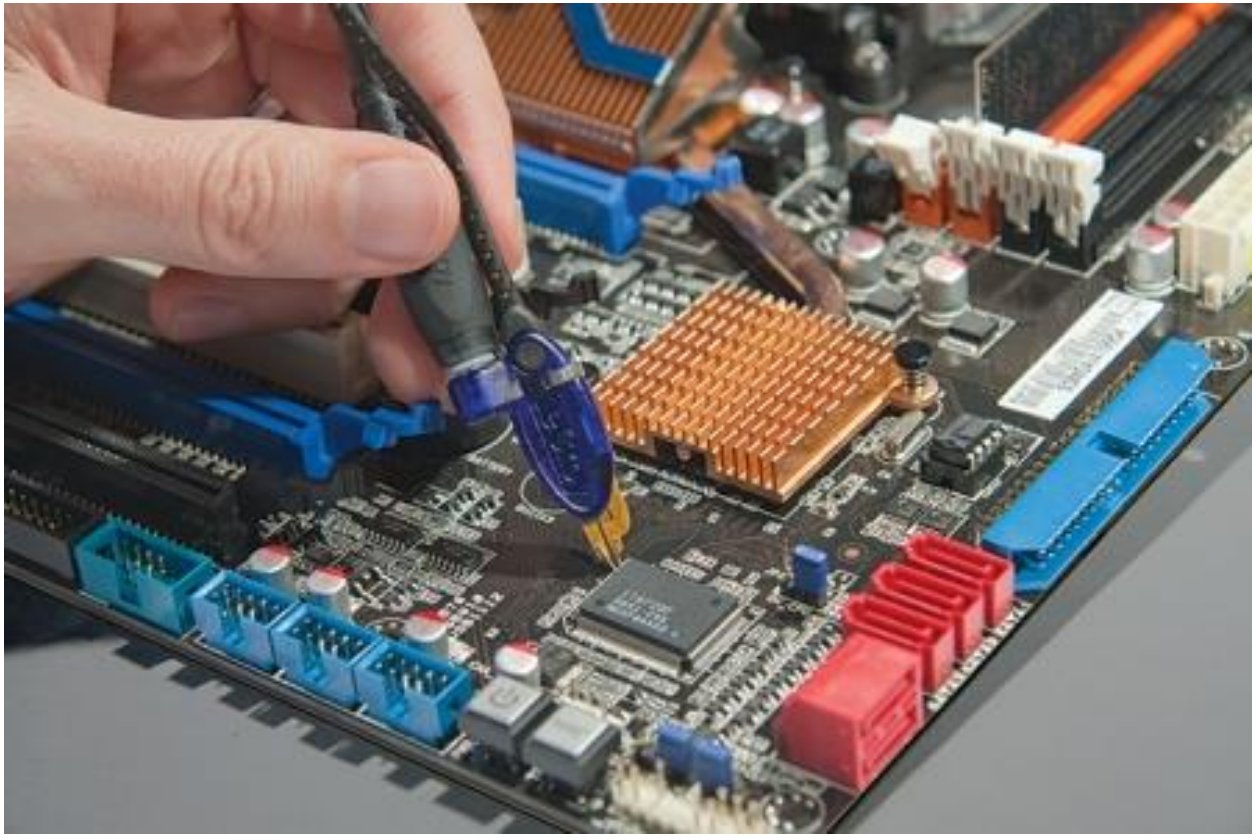

Operator's Manual

WaveLink Series Differential Probe (4, 6 GHz)

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November, 2013

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Introduction

WaveLink Series Differential Probes are very high-bandwidth, active differential probes. The probes feature low noise, very low input impedance and high common mode rejection, and are ideally suited for signal integrity measurements in high-speed digital systems.

The dynamic range, system attenuation, and input impedance were designed to optimize performance for use with these types of signals. The series is modular in concept, accepting several interchangeable Probe Tips and Leads with a common Differential Amplifier Small Tip Module and Platform/Cable Assembly allowing for flexibility in physical interconnect and optimizing bandwidth and electrical performance.

At time of initial shipment, each probe undergoes a rigorous calibration and performance verification process that results in a stored response file within the probe. When the probe is connected to a Teledyne LeCroy oscilloscope, the probe and oscilloscope responses are optimized to each other to provide a probe + oscilloscope response identical to that of the raw oscilloscope channel. Teledyne LeCroy has provided this capability since the introduction of the first WaveLink probes in 2003.

The following topics cover Platform/Cable Assembly models WL-PLINK and WL-PBUS, the Dx10 and Dx20 Differential Amplifier Small Tip Modules, and the Dxx0-SI, Dxx0-SQ, Dxx0-SP, and Dxx0-PT interchangeable leads and tips. Also covered are the integrated differential amplifier modules with adjustable/positioner tips (D600A-AT, D400A-AT).

PLEASE NOTE THE FOLLOWING:

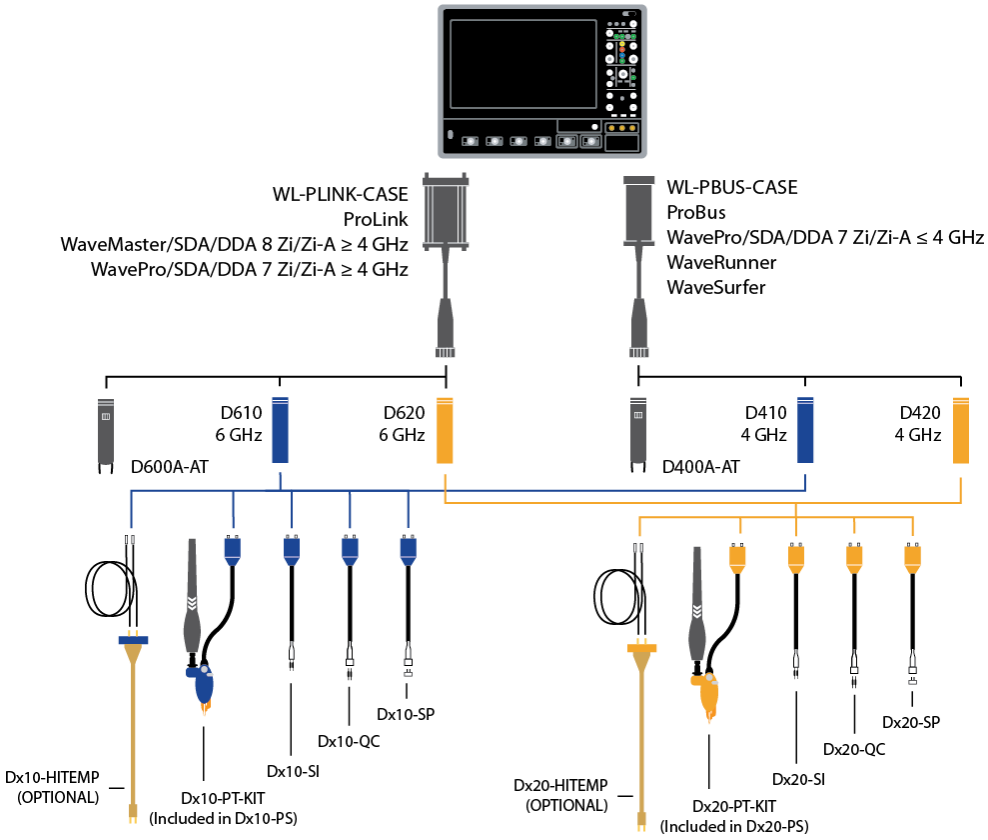
- A Certificate of Calibration is supplied with each probe indicating the system meets the specifications with those components listed in the Certificate.
- Download the latest version of X-Stream software to run your WaveLink probe with maximum performance.

ESD Sensitive: The tips of the WaveLink probes are sensitive to Electrostatic Discharge (ESD). Avoid causing damage to the probe by always following anti-static procedures (wear wrist strap, etc.) when using or handling the probe.

Modular Advantage

When wires are attached to a probe's tips or leads to make probing of the circuit under test easier to perform, additional inductance and/or capacitance is added to the input, lowering the resonance frequency of a series resonance circuit, which may cause oscillations with frequencies within the passband of the probe. These effects, or excessive ringing, degrade the performance of the probe, resulting in incorrect presentation of the input signal, reduced bandwidth, and changes in loading impedance.

The WaveLink differential probe series has been designed as a modular system with different interchangeable tips and leads, each with its own buffer amplifier and eliminates the addition of external wires or accessories. When using these tips or leads, no interconnects are necessary in the high-impedance path of the input signal, assuring proper transmission of the signals as it passes through the probe. Using these tips and leads guarantees the specified performance and input characteristics of the probe.



4, 6 GHz Probe Family

Standard Accessories Table

Standard Accessories	WL-PBUS-CASE WL-PLINK-CASE	Dx10/20	Dx10/20-PS	Dx10/20-PT-KIT	Dx10/20-SI-HiTemp	Dx00A-AT
Amplifier System						
Amplifier	-	1 each	1 each	-	-	-
Solder-in Lead Set	-	1 each	1 each	-	-	-
Spare Damping Resistors for SI Tip	-	1 set of 5	1 set of 5	-	-	-
Tip Retaining Clip for SI Leads	-	1 each	1 each	-	-	-
Adhesive Tape	-	1 set	1 set	-	-	-
Quick Connect Lead Set	-	1 each	1 each	-	-	-
Damping Resistors for QC Tip	-	2 sets of 10	2 sets of 10		-	-
Square Pin Lead Set	-	1 each	1 each	-	-	-
Ground Lead	-	1 each	1 each	-	-	-
Ground Clip	-	1 each	1 each	-	-	-
Instruction Manual	-	1 each	1 each	-	-	1 each
Accessory Info Sheet & Quick Start Guide	-	1 each	1 each	-	-	-
HiTemp SI Lead	-	-	-	-	1 each	-
HITemp Cable	-	-	-	-	1 matched set	-
Positioner Tip with Accessories	**-**		**-**	**-**	**-**	**-**
Positioner Tip (Browser)	-	-	1 each	1 each	-	-
Replacement Pogo Pins for Dx10-PT/Dx20-PT	-	-	1 set	1 set	-	-
Positioner Tip Probe Guides	-	-	1 each	1 each	-	-

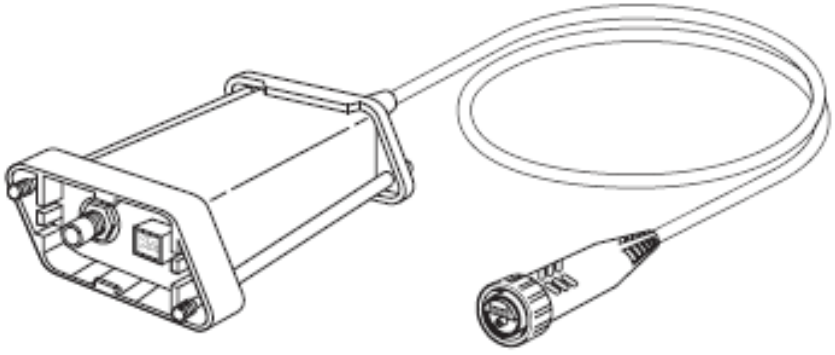
Standard Accessories	WL-PBUS-CASE WL-PLINK-CASE	Dx10/20	Dx10/20-PS	Dx10/20-PT-KIT	Dx10/20-SI-HiTemp	Dx00A-AT
XYZ Positioner	-	-	1 each	1 each	-	-
Adhesive Tape for XYZ Positioner	-	-	1 set	1 set	-	-
Browser Wand for PT Tip	-	-	1 each	1 each	-	-
Interlock Pieces for PT Tip	-	-	1 each	1 each	-	-
Swivel for PT Tip	-	-	1 each	1 each	-	-
Platform/Cable Assembly Kit						
Platform/Cable Assembly	1 each	-	1 each	-	-	-
Freehand Probe Holder	1 each	-	1 each	-	-	-
Probe Deskew Fixture	1 each	-	1 each	-	-	-
Platform/Cable Assembly Mounting Clip	1 each	-	1 each	-	1 each	1 each
Probe Cable Clamp	2 each	-	2 each	-	1 each	1 each
Deluxe Soft Carrying Case	1 each	-	1 each	-	-	-
Foam Insert for Carrying Case	1 each	-	1 each	-	-	-
Protective Storage Case	1 each	-	1 each	-	-	-
Plastic Tray for Storage Case	1 each	-	1 each	-	-	-

NOTE: While the amplifiers can be used with either platform/cable assembly, bandwidth is limited by the lowest bandwidth component. In addition, system calibration is required for all interconnected components to guarantee system performance. Typically, a customer purchases a single Platform/Cable Assembly that matches the Amplifier Module bandwidth rating.

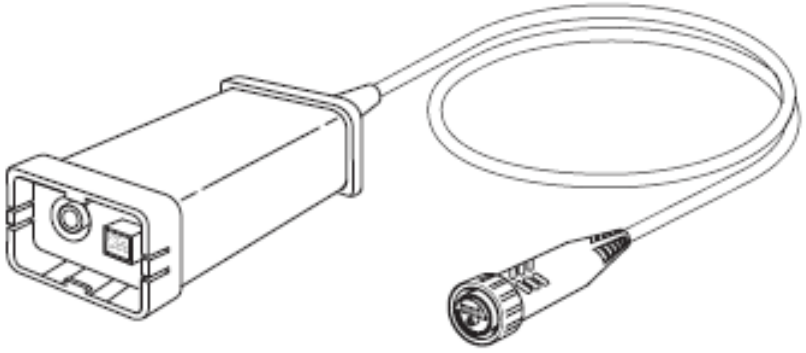
Modular Probe Components

Platform Cable Assembly

This piece forms the foundation of the probe and provides an attachment for the probe amplifier to the oscilloscope. There are two different platform/cable assemblies available depending on whether you are connecting to Teledyne LeCroy's ProLink inputs (currently used on on any ≥4 GHz Teledyne LeCroy WavePro 7 Zi/Zi-A, WaveMaster 8 Zi/Zi-A, and LabMaster 9 Zi-A oscilloscope) or Teledyne LeCroy's ProBus inputs.



Platform Cable Assembly provided in WL-PLINK-CASE



Platform Cable Assembly provided in WL-PBUS-CASE

NOTE: Throughout the manual, we will refer to either the WL-PLINK-CASE or WL-PBUS-CASE ordering numbers whenever referring to the complete orderable kit that includes the deluxe soft carrying case and associated accessories. We will refer to either the WL-PLINK or WL-PBUS when referring to the physical item that attaches on one end to the oscilloscope and attaches on the other end to the amplifier module.

The Platform/Cable Assembly performs the following important functions:

- It provides power to the probe amplifier from the oscilloscope.
- It communicates to the oscilloscope the identifying characteristics of the amplifier that is connected to the probe so that the oscilloscope channel can be set to the correct probe attenuation value automatically.
- It transmits the amplifier output signal along a well-defined low loss transmission line into the oscilloscope input, and terminates the probe appropriately at that point.

NOTE: WL-PLINK-A is compatible with D610/620, and D410/420.

Platform/Cable Assembly	Product Code
WaveLink ProLink Probe Platform/Cable Assembly	WL-PLINK-CASE
WaveLink ProBus Platform/Cable Assembly	WL-PBUS-CASE

The small, low mass WaveLink Series of Differential Probes is designed for ease of use and high frequency performance, and is supplied in two different configurations:

- WL-PLINK for use with ProLink interface (≥4 GHz)
- WL-PBUS for use with ProBus interface

Differential Amplifier Small Tip Modules

The Differential Amplifier Small Tip Modules contain the active amplifier circuitry. Different small tip modules have different electrical and physical interconnect characteristics, allowing the user to select the small tip module appropriate for the application.The Differential Amplifier Small Tip Module models D610, D620, D410, and D420 connect to any WaveLink probe platform/cable assembly and accepts differential interconnect Leads and Tips to provide the user with flexibility in connecting the probe to the circuit under test without degrading the electrical performance.

NOTE: The D6x0 small tip modules can be used with a WL-PBUS probe body. However, this combination would not deliver full system bandwidth with 4 or 6 GHz oscilloscopes.

Amplifier Modules (incl. Solder-in or Adjustable Tip)	Product Code
WaveLink D410 4 GHz/2.5Vp-p Differential Probe Amplifier with Dx10-SI Solder-In Tip (Qty. 1), Dx10-SP Square Pin (Qty. 1), and Dx10-QC Quick Connect (Qty. 1)	D410
WaveLink D420 4 GHz/5Vp-p Differential Probe Amplifier with Dx20-SI Solder-In Tip (Qty. 1), Dx20-SP Square Pin (Qty. 1), and Dx20-QC Quick Connect (Qty. 1)	D420
WaveLink D610 6 GHz/2.5Vp-p Differential Probe Amplifier with Dx10-SI Solder-In Tip (Qty. 1), Dx10-SP Square Pin (Qty. 1), and Dx10-QC Quick Connect (Qty. 1)	D610
WaveLink D620 6 GHz/5Vp-p Differential Probe Amplifier with Dx20-SI Solder-In Tip (Qty. 1), Dx20-SP Square Pin (Qty. 1), Dx20-QC Quick Connect (Qty. 1)	D620
WaveLink D400A-AT 4 GHz/4.8Vp-p Differential Amplifier Module with Adjustable Tip	D400A-AT
WaveLink D600A-AT 6 GHz/4.8Vp-p Differential Amplifier Module with Adjustable Tip	D600A-AT

Interconnect Leads

The following interconnect tip and lead assemblies are available. Tips and leads are interchangeable among compatible small tip modules (i.e. Dx10 small tip modules can be used with Dx10-xx tips).

SI - Solder-In interconnect lead assembly provides the highest level of electrical performance. It uses two small damping resistors in the input with flexible leads, allowing connection to a wide range of test point spacings. The leads are soldered directly into the connection points of the circuit under test, providing a reliable, intermittence-free connection. The SI interconnect lead assembly provides the highest possible performance at the expense of non-movable installation.

QC - Quick Connect interconnect lead assembly allows the probe to be moved quickly between different test points of the circuit. A pair of small damping resistors (supplied with the probe) is soldered to the circuit's test points, and the ends of the damping resistors plug into the small connector at the probe tip for a reliable quick connection. A set of 20 resistors are shipped with the probe. This lead assembly is limited to 4 GHz bandwidth.

SP - Square Pin interconnect lead assembly can be used on boards where standard 0.025" square pins are used for interconnect. The highly flexible, 145 mm (5.7") long Square Pin Interconnect lead connects directly with a pair of square pins mounted on standard 0.100" (2.54 mm) centers. Because of the parasitic inductance of the square pin to which the probe is connected, the system will not support maximum bandwidth or the minimum rise time when used with a 6 GHz oscilloscope. The added inductance of the square pins limits the measurements to signals of 3 GHz bandwidth. A low cost alternative is to provide vias in the circuit to be tested, and to insert the flexible tips of the very low loading Adjustable Tip module into these vias.

PT - The Positioner Browser tip can be hand-held or used as a browser like an Easy Probe positioner. The pogo pin tips are adjustable from 0 to 3.5 mm (0 to 0.14") and have 0.6 mm of Z-Axis compliance. Because of its thin form factor and spring-loaded tips, it is ideally suited for use with multiple probes in tight areas such as the back side of boards with ball-grid array packaged ICs.

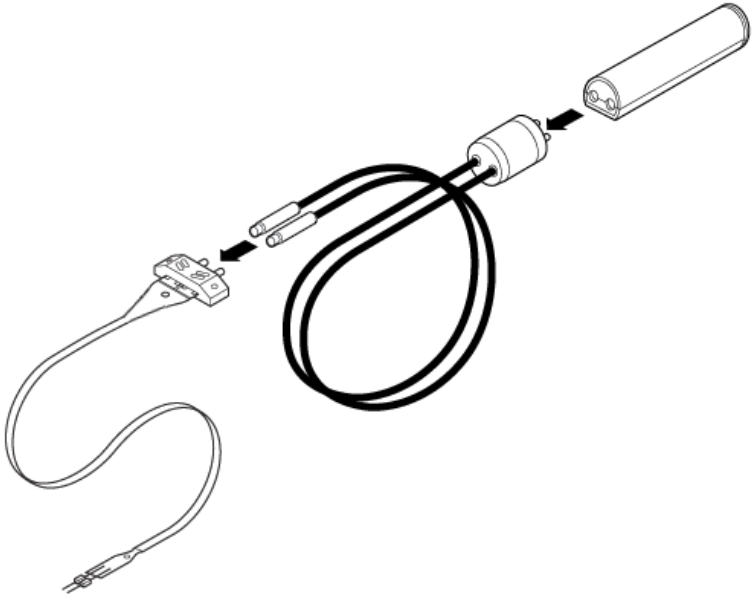
HiTemp - The HiTemp cable and SI lead are used for controlled situations where a differential amplifier module normally needs to be removed from the extreme temperature environment. Ideally suited for testing scenarios where the temperature can fluctuate from -40 °C to +105 °C, the 90 cm matched cable pair and Solder-In lead provides an easy and robust connection to the device under test while allowing access into environmental chambers. The HiTemp probe cables and SI lead is paired with the D6x0 and D4x0 differential amplifier small tip module for full-system bandwidth, excellent signal fidelity, and superior noise performance.

PLEASE NOTE THE FOLLOWING:

- All interconnect leads are colored to distinguish between Dx10 (Blue) and Dx20 (Orange.
- Although interconnect Leads for the D610, D620, D410, and D420 mechanically mate with any module, they are incompatible. No damage results; however, performance may be reduced when switching tips between modules, and the response is not calibrated.
- Do not confuse the Square Pin lead with the Quick Connect lead. The Quick Connect tip has been designed to accept only the wire diameter of the small damping resistors, not the 0.025' thickness of the square pin.
- Inserting square pins into the connector of the Quick Connect Lead could cause damage to the wire receptacle of the QC Lead.
- Receptacles are identified with **QC** or **SP** labeling to help avoid confusion.

Optional Accessories

High-Temperature SI Lead and Cables



NOTE: Amplifier shown in picture not included with the HiTemp SI Lead and Cables.

The High-Temperature SI Lead (Dxx0-SI-HiTemp), is ideally suited for extreme (both high and low) temperature controlled test setups.

Complete Probe System

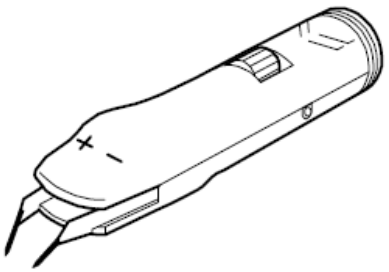
By design, the WaveLink probes are modular in nature. However, to make selection easy, a complete probe system (-PS) is available for purchase. These probe systems are all-inclusive and contain the following items:

- Platform/Cable Assembly
- Amplifier Module with Solder-in Interconnect Leads and Square Pin Lead
- Positioner Tip Browser Kit

Just choose the appropriate bandwidth (4 or 6 GHz) and the input differential range (2.5 Vpk-pk or 5 Vpk-pk) for the probe system.

Standard Accessories	D4x0-PS	D6x0-PS
WL-PBUS-Case Platform/Cable Assembly	1 Each	
WL-PLINK-Case Platform/Cable Assembly		1 Each
Dxx0 Amplifier Module with SI, SP, and QC Lead Sets	1 Each	1 Each
Dxx0-PT-KIT Positioner Tip (Browser) Kit	1 Each	1 Each

Adjustable Tip Module

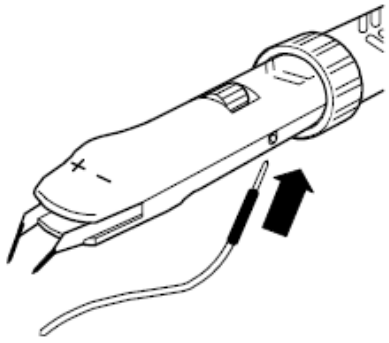


The Adjustable Tip Module, D600A-AT and D400A-AT, with two highly flexible NiTiNOL alloy tips, allow for easy probing of very dense circuitry.

By rotating the thumb wheel on top of the module you can change the spacing of the tips to accommodate any test point spacing from < 0.1 mm (0.004”) to 3 mm (0.12”).

The Adjustable Tip directly connects to the probe platform/cable assembly and can be used in hand-held applications for rapid test point browsing.

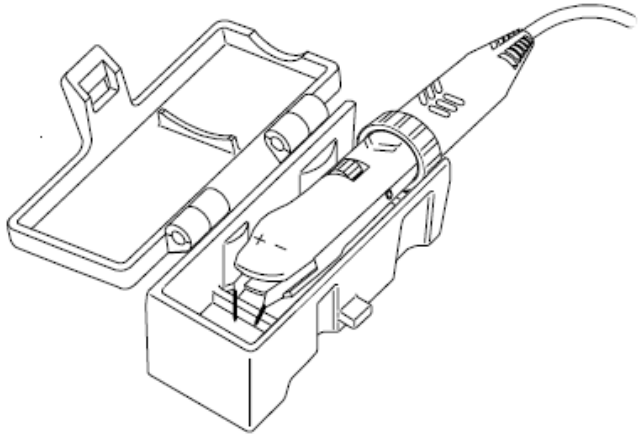
Ground Lead and Clip



This Ground Lead (PACC-LD005) and the Ground Clip (PK006-4) are provided as standard accessories to the WaveLink series probes and can be used to connect to ground of the circuit under test. The plug of the ground lead connects to the receptacle located on the side of the probe body.

The ground lead is not required to be used with high-frequency measurements, but to ground floating test circuits to keep the common mode within the maximum specified range.

Protective Cover



The protective cover is provided as a standard accessory on D600A-AT or D400A-AT probes to help prevent damage to the Adjustable Tip module. The flexible NiTiNOL-alloy tips of the module are very durable, but can be damaged when enough stress is applied (and result in erroneous measurements).

NOTE: Avoid tip damage and always attach the cover to the module when not in use.

Probe Operation

Handling the Probe

The WaveLink series probe is a precision test instrument. Exercise care when handling and storing the probe. Always handle the probe by the probe body or interface box. Avoid putting excessive strain on the cable or exposing the probe cable to sharp bends.

CAUTION

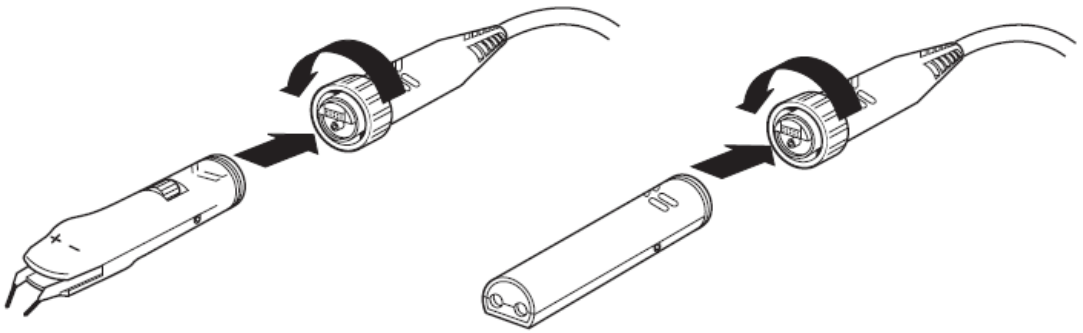
ESD Sensitive: The tips of the WaveLink probes are sensitive to Electrostatic Discharge (ESD). Avoid causing damage to the probe by always following anti-static procedures (wear wrist strap, etc.) when using or handling the probe.

CAUTION

CAUTION. Prevent damage to the flexible tips and always attach the Protective Cover to the Adjustable Tip module when not in use.

Connecting an Amplifier Module to a Probe Body

Attach an Adjustable Tip, Small Tip or Positioner Amplifier Module to the Platform/Cable Assembly by aligning the connectors of the module with the receptacles in the platform/cable assembly and pressing the two together. Finger-tighten the assembly by rotating the threaded collar onto the module.



Attaching Adjustable Tip or Small Tip Module

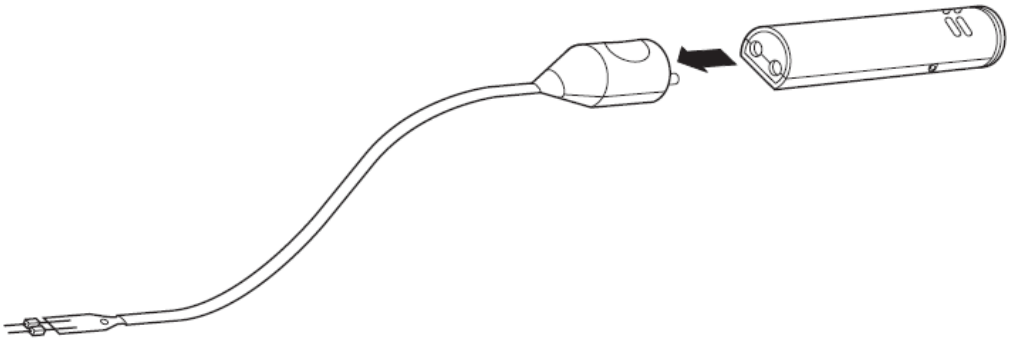
CAUTION

Do not use pliers to tighten the collar.

Remove the Differential Amplifier by loosening the threaded collar from the module and pulling the two assemblies apart.

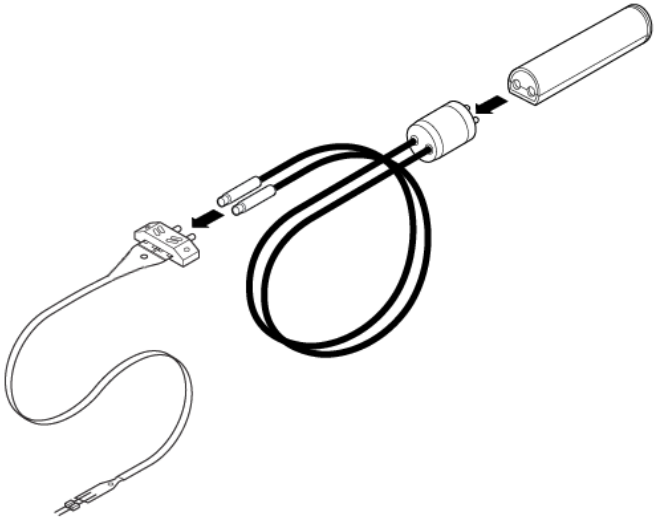
By design, amplifier module works with the WL-PLINK or WL-PBUS platform/cable assembly and the Dxx0-SI Lead, Dxx0-SP lead, Dxx0-QC lead or Dxx0-PT tip.

Connecting the Lead to the Amplifier



Align the flat side of the SI Interconnect Lead with the flat side of the Amplifier and press together.

Connecting the Hi-Temp SI Interconnect Lead to the Amplifier



PLEASE NOTE THE FOLLOWING:

- Although interconnect leads for the D610, D620, D410, and D420 mechanically mate with any amplifier, they are incompatible. No damage results; however, performance may be reduced when switching tips between amplifiers, and the response is not calibrated.
- Avoid accidental interchanging by matching the color coding of the interconnect lead connector housing with the color of the corresponding probe tip amplifier.

Interchangeability and Calibration

By design, the D610, D620, D600A-AT, D410, D420, and D400A-AT Amplifier Modules and Interconnect Leads deliver the specified performance when interchanged on a WL-PLINK- or WL-PBUS probe body.

Each configured probe is shipped with a Certificate of Calibration indicating that the system performance was validated and found to meet or exceed the warranted specifications with those models and accessories listed in the Certificate.

As only this configuration was validated, the certificate is only valid for the configuration indicated.

Compatibility

Several probe tip modules and probe bodies are available; however, not all of them may be compatible with one another.

Over time, Teledyne LeCroy may offer additional modules that mechanically mate with the probe body. However, not all modules are electrically compatible with all probe bodies. Connecting a non-compatible module to a probe body does not damage either the probe body or the module. This incompatibility, however, is detected by the probe body, and a warning is issued by the AutoColor ID LED.

Platform/Cable Assembly	Probe Tip Module	
	Adjustable and Small Tip Modules D410, D420, and D400A-AT	Adjustable and Small Tip Modules D610, D620, and D600A-AT
WL-PLINK	Allowed	Allowed
WL-PBUS	Allowed	Reduced BW

Connecting the Probe to a Teledyne LeCroy Oscilloscope

The WL-PLINK- Platform/Cable Assembly has been designed for use with the ProLink interface of the Teledyne LeCroy's WaveMaster 8 Zi and Zi-A, SDA, WavePro (4 and 6 GHz models) and DDA oscilloscopes; and the WL-PBUS- for use with the ProBus interface of the WaveMaster 8 Zi and Zi-A, WavePro, WaveRunner, and DDA oscilloscopes.

Attach the platform/cable assembly to the test instrument by aligning the interface connector with the input connector and pushing the interface toward the instrument.

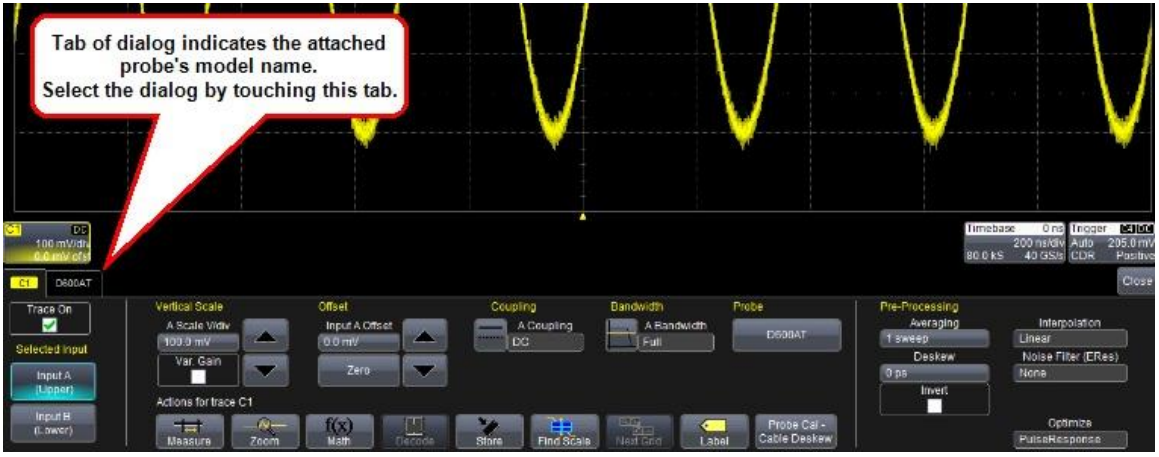
On the WL-PLINK- platform/cable assembly, a click sound is heard when the probe interface latches to the test instrument. The probe also uses thumbscrews to secure the interface to the instrument. **Do not overtighten the thumbscrews.**

Thumbscrews are not provided on the WL-PBUS- interface system.

Remove the WL-PLINK- platform/cable assembly from the instrument by unscrewing the thumbscrews and moving the interface up and down while pulling gently until a click is heard. This click indicates the platform/cable assembly is detached from the instrument.

For the WL-PBUS- platform/cable assembly, disconnect by pulling the interface box from the oscilloscope.

Operation with a Teledyne LeCroy Oscilloscope



Vertical dialog with labeled tab corresponding with attached probe.

When the probe's output connector is attached to an X-Stream oscilloscope's input connector, the oscilloscope recognizes the probe and activates the vertical channel functions in the user interface (shown previously). Refer to your oscilloscope's instruction manual for specific operation.

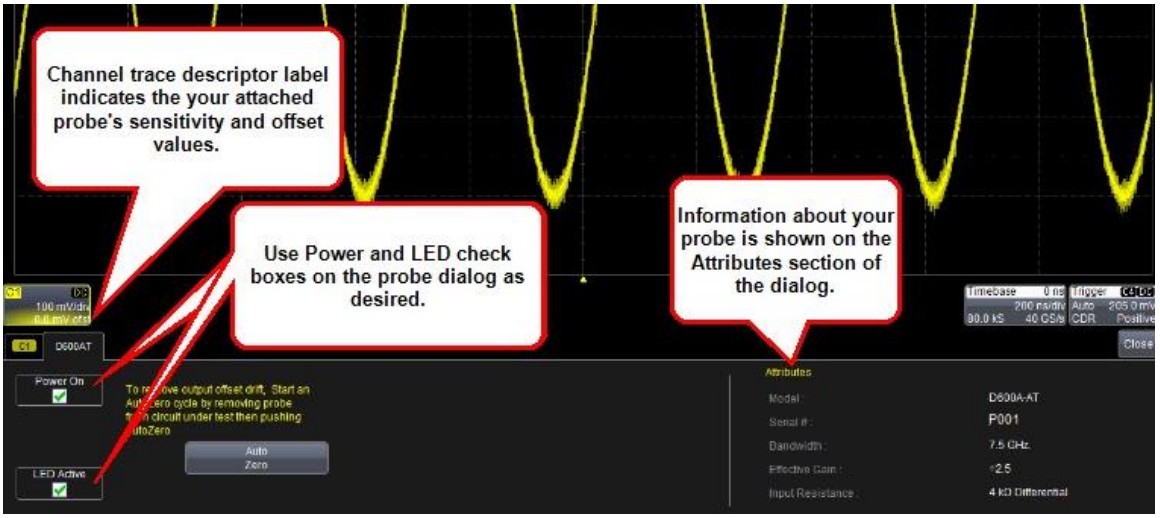
Control through the oscilloscope's interface can be found on the channel dialog that corresponds with the connected probe.

Touching the tab for the attached probe (varies based on the particular probe you have attached) activates the probe dialog as follows.

The probe information frame shows the characteristics of the probe only.

Touching the **Power On** checkbox turns the probe power on or off.

In some applications it may be desirable to turn the probe's AutoColor ID off or on by touching the **LED On** checkbox.

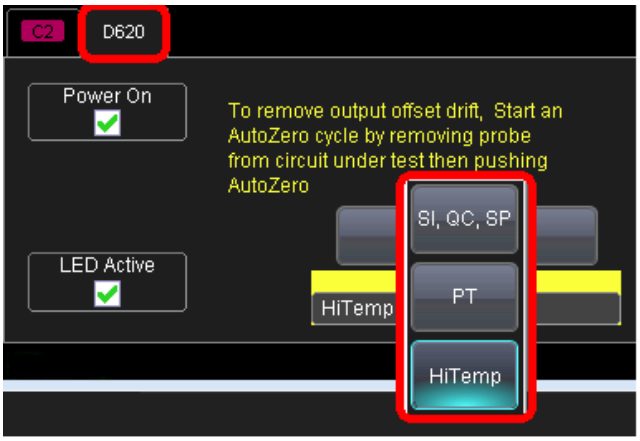


Channel trace descriptor label and Probe dialog contains data corresponding with attached probe.

Amplifier Dialog and Tip Select Field

When the Platform/Cable Assembly is first connected to the oscilloscope, a dialog is shown identifying the amplifier (D620 in the following screen-shots). The dialog also contains a **Tip Select** field.

SI, **QC**, and **SP** tips are selected by default (the following screen-shot at left). If using **PT** tips or HiTemp tips, change the Tip Select value accordingly by clicking inside the field (the following screen-shot at right). Use this field to choose the specific tip you are using before optimizing your signal.



PLEASE NOTE THE FOLLOWING:

- The Tip Select button is made available based on the date of your probe purchase. Contact Teledyne LeCroy for details.
- Firmware version 5.9.0.2 or greater is required when using PT tips.

Connecting the Probe to the Test Circuit

For all modules and interconnect leads/tips, positive voltages applied to the + input relative to the – input deflects the oscilloscope trace towards the top of the screen.

Exercise care when connecting the probe to the test circuit to maintain the high frequency capability of the probe in measurement applications. Increasing the parasitic capacitance or inductance in the input path may introduce a ring, or slow the rise time of fast-rising signals. Any extension of the signal path with extra wire leads, etc. adversely affects the probe's performance.

A ground connection is generally not required here. Refer to Probe Grounding (on page 24) for more details.

There are a variety of probe leads/tips that can be connected to a given differential amplifier small tip module. Some tips (e.g. the D600A-AT adjustable tip) are integrated with the amplifier. The Dx10 and Dx20 tips (-SI, -PT, -QC, and -SP) operate interchangeably with a matched amplifier. Each tip can be connected to the probe circuit as described in the following topics.

Solder-In Interconnect Lead

The Solder-In Interconnect Lead for the Small Tip module is supplied with two pre-installed resistors, which are intended to be soldered to the runs or pad test points on the board under test. Because the resistors and the leads are small, this interconnect lead provides the maximum signal fidelity at the highest frequency response.

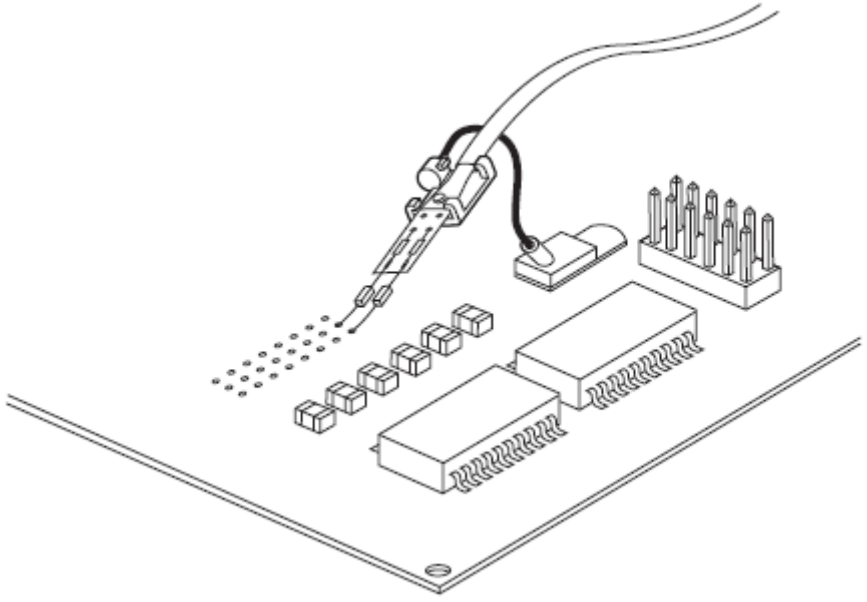
Using a small soldering iron, attach the free wires of the resistors to the appropriate test points (as follows).

PLEASE NOTE THE FOLLOWING:

- When using the Dxx0-SI-HiTemp lead in extreme conditions, the Tip Retaining Clip is rated to 100 °C and adhesives are rated to 90 °C.
- The primary function of the Probe Tip Retaining Clip is to position the resistor leads when soldering the resistors to the test points.

CAUTION

CAUTION. The resistors are small in order to maintain high-frequency performance. However, they are not sturdy enough to bear the weight of the probe module. It should be supported by other means. A positioning tool, such as the Board Clip, the Probe Tip Retaining Clip, or EZ Probe positioner can be used to support the probe.



Measuring with SI Interconnect Lead

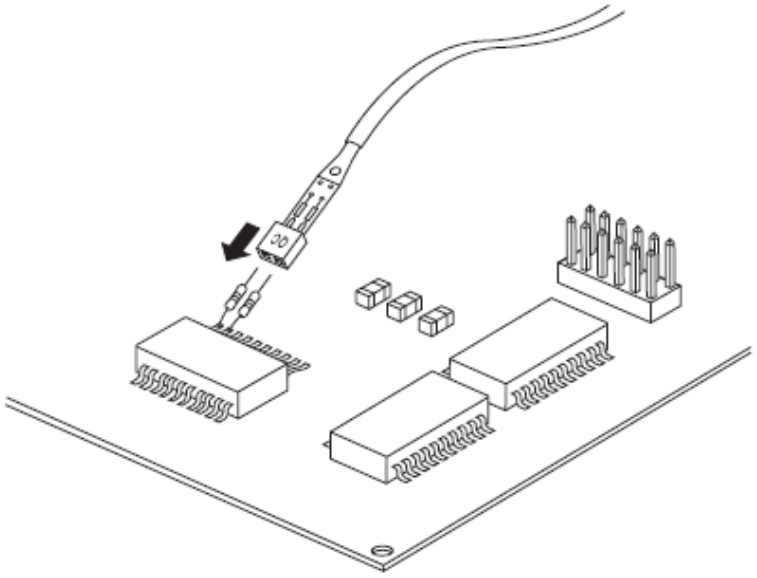
Quick Connect Lead

The Quick Connect lead can be used in applications requiring probe movement to multiple test points.

Solder one end of the damping resistors (provided) to the testing points while plugging the other end directly into the special connector mounted on the probe input board.

Accurately position the resistors for soldering by first inserting the resistor leads into the QC receptacle, positioning the tip, and then soldering the resistors in place. Repeat this process when installing resistors to other test points. A positioning tool like the Probe Tip Retaining Clip can be used to aid in holding the QC module and the resistor in place for soldering.

NOTE: Maintain maximum performance by not extending the resistor wires or using different resistors.



Measuring with the QC Interconnect Lead

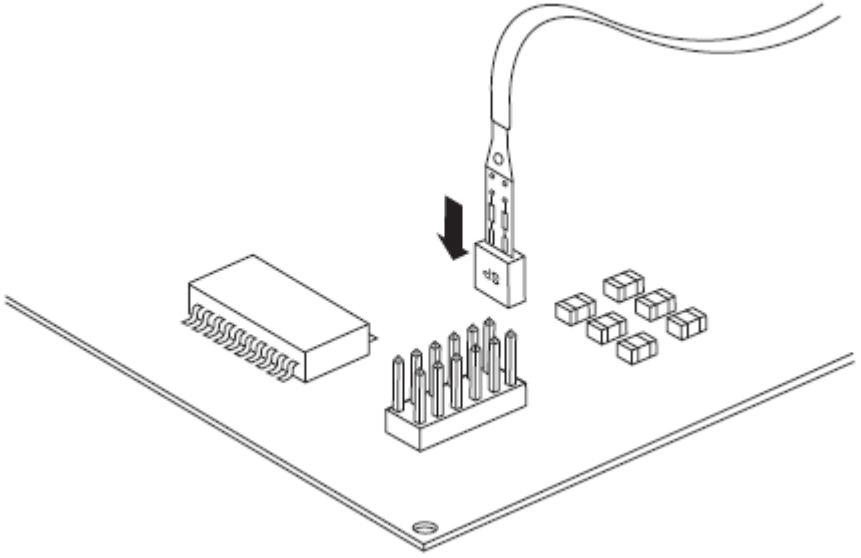
CAUTION

Inserting square pins or wires other than the ones provided with the QC lead may cause damage to the wire receptacle.

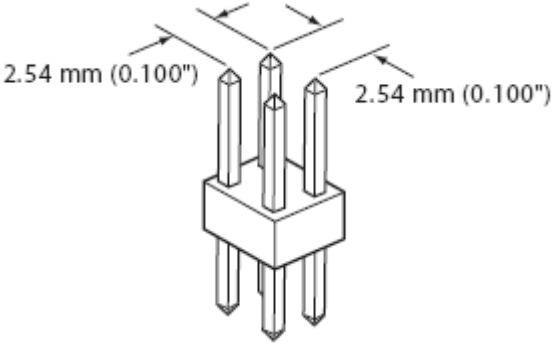
Square Pin Lead

The Square Pin lead allows the probe to be connected directly to standard 0.025" square pins mounted on 0.100" centers (as shown in the figures of this topic).

The system bandwidth and rise time are limited by the Square Pin lead because of the inherent inductance of the square pins themselves. The practical bandwidth is approximately 3 GHz.

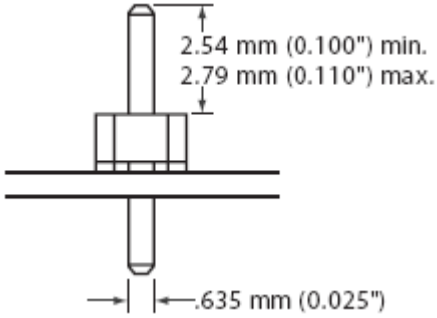


Measuring with the SP Interconnect Lead



Square Pin Header Dimensions

Keep the highest possible performance by keeping the parasitic inductance under control. Also, make good electrical connections by not using any square pins longer than 2.79 mm (0.110") or shorter than 2.54 mm (0.100").



Square Pin length

CAUTION

Do not confuse the Square Pin lead with the Quick Connect lead. The Quick Connect lead has been designed to accept only the wire diameter of the small damping resistors, not the 0.025" thickness of the square pin.

Inserting square pins into the connector of the Quick Connect Lead could cause damage to the wire receptacle of the Quick Connect Lead.

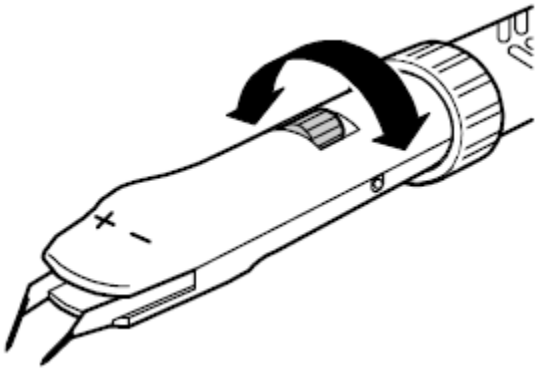
The lead is clearly labeled with the initials SP printed on the Square Pin receptacle housing.

Differential Amplifier Module with Adjustable Tip

The D600A-AT or D400A-AT Differential Amplifier with Adjustable Tip is ideally suited for hand-held browsing applications or for mounting in locations where circuitry is not dense.

The highly-flexible tips of the Adjustable Tip are made out of nickel-titanium alloy and are permanently attached to the module.

The spacing of the tips can be adjusted by rotating the knurled thumbscrew on the top of the module to accommodate different test point spacing from less than 0.1 mm to > 3 mm (shown as follows).



Adjusting the Tips

For accurate measurements, both the **+** and **–** inputs must always be connected to the test circuit.

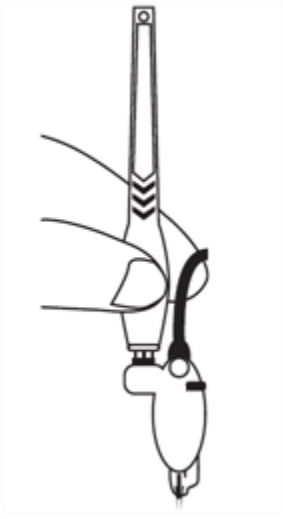
NOTE: When making differential measurements, both tips need to make good contact. The best way to accomplish this is to place one tip on one test point, apply a little pressure and by rotating the probe body slightly, place the other tip on the other test point. Assure good contact and apply enough pressure to bend the tips just a bit.

Excessive bending of these tips may damage the module beyond repair. However, the tips are flexible enough to allow both tips to make good contact with the circuit under test even when the probe is slightly rotated with respect to the circuit under test.

As indicated on the module, the left tip, looking from the top of the module, is connected to the **–** input and the right pin is connected to the **+** input of the differential probe.

NOTE: Always support the probe to prevent too much stress on the pins of the Adjustable Tip Module.

Dx10-PT and Dx20-PT



The Dx10 and Dx20-PT positioner tips have a very small form factor with very low mass. They are a good all-around browsing or mounted solution for probing in areas with a high concentration of test points or limited free space to fit a probe.

Various attachments and extenders are supplied with the -PT tip allowing it to be easily held while browsing or connected to a mounting device.

Rotating the thumbwheel adjusts the tip spacing from 0 to 3.5 mm (0 to 0.14") in a direction perpendicular to the thumbwheel rotation. There is a positive stop on the thumbwheel to prevent it from being rotated too far in either direction.

The tips are a pogo-pin assembly and are spring-mounted to accommodate 0.6mm of Z-Axis compliance. This aids in applications where more than one Dx10 or Dx20-PT tip is required to make measurements in a crowded area and the tips need to be mounted at an angle to the board under test.

Avoid applying excessive lateral pressure on the tip as breakage may result. Do not use the tip to scrape the circuit. If the tip does break, it may be replaced in the socket. If the socket also breaks, a new socket can be soldered onto the tip. Refer to Replacing Spring-Loaded Tips and Tip Sockets on Dx10-PT and Dx20-PT Positioner Tips (on page 43) for instructions on replacing tips and sockets.

Probe Grounding

In most cases, when the common mode portion of the signal consists mainly of lower frequencies, the probe does not need to be connected to the ground of the circuit under test. This minimizes the effects of ground loop currents. Any signal corruption caused by not having the probe connected to ground of the signal under test is common to both inputs and is rejected by the differential operation of the probe.

However, in an environment with high RF ambient noise, it may be better to connect the probe ground lead to a good RF ground near the point where the signal is being measured. Find out if a ground lead is necessary by making a measurement with and without a ground lead. Use the one that provides the least signal corruption.

Capacitive coupling from AC mains may cause truly floating devices (like battery operated devices) to exceed the common mode range. In such cases it is recommended to connect the probe ground to the device under test.

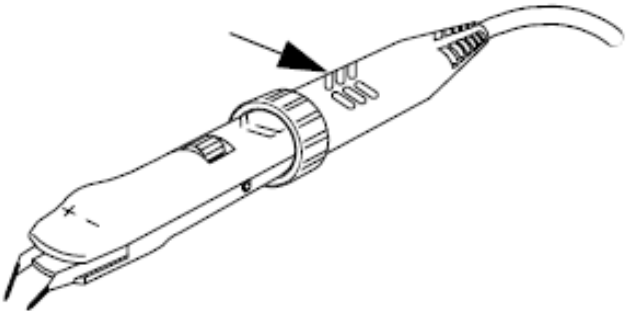
- Always use a ground lead when testing floating circuits.
- Floating circuitry may exceed the common mode input voltage causing damage to the probe.

Example: Circuits powered from laboratory bench power supplies which normally have floating outputs.

Positioning of the Input Leads

Normally the performance of the Solder In and Quick Connect leads is not affected by the position of the differential amplifier small tip module. They can be mounted straight upright or on an angle. However, when it is necessary to mount the module parallel to the board, the maximum performance is obtained when the '+' sign (printed near the positive input of the module) is facing up and the ground plane on the opposite side of the module's input is facing the board. The flexible cable connecting the input tip to the amplifier/small tip module is insensitive to placement.

Autocolor ID



The AutoColor ID LED, built into the platform/cable assembly, is designed to indicate three functions of the probe or probe/oscilloscope combinations:

AutoColor ID

When the probe is connected to a Teledyne LeCroy X-Stream oscilloscope, the LED illuminates in the default color of the channel to which the probe is connected.

Platform/Cable Assembly Compatibility

When the probe tip module is compatible with the probe body to which it is connected, the green LED illuminates for about one second after the probe is connected to the oscilloscope.

A solid red light indicates the probe is not compatible with the probe body to which it is connected.

Over-Temperature

A flashing red light indicates over-temperature of the probe. Power to the probe is automatically shut down when the light is flashing. The LED is OFF when probe power is OFF, unless the shut-down is caused by over-temperature.

Power Control

Power Control allows intermittent operation of a small tip modules and probe tip combinations during testing at elevated ambient temperatures to prevent overheating of the probe; as, for example, when testing the operation of test circuits in temperature chambers.

The intent of this feature is to keep the probe tip power off during the time when the chamber temperature is changing between tests. When the chamber temperature has stabilized and measurements are ready to be taken, the probe is powered on to facilitate measurements. The probe is then powered down while the chamber temperature is changing for the next test.

The time the probe can be operated at these elevated temperatures is a function of airflow, thermal conductivity of the probe in that environment, etc. For a starting estimate on time vs. temperature refer to the following table.

When the probe operates at an elevated ambient temperature, the wave shape is correct, but because it is outside the specified temperature range the amplitude may be uncalibrated.

Power Control is not supported on older non-X-Stream oscilloscopes.

When used with a Teledyne LeCroy X-Stream oscilloscope and over-temperature does occur, the probe automatically turns off the power applied to the probe and the AutoColor ID in the probe body flashes in red. In addition, a warning message appears on the oscilloscope's screen. When cooled down, the user must reset the power again.

Approximate Operating Time versus Temperature for the D400A-AT and D600A-AT.

Temperature °C	Time
Up to 40	Continuous
40 to 55	40 minutes
55 to 65	18 minutes
65 to 75	30 seconds
75 to 85	15 seconds

AutoZero

WaveLink probes incorporate an AutoZero function to remove any DC offset from the probe. This function is available when the probe is used with Teledyne LeCroy's X-Stream oscilloscopes, and must be invoked by the user.

After several minutes of warm-up, or when the probe is exposed to a large shift in ambient temperature, some DC offset may occur, and an AutoZero cycle should be initiated.

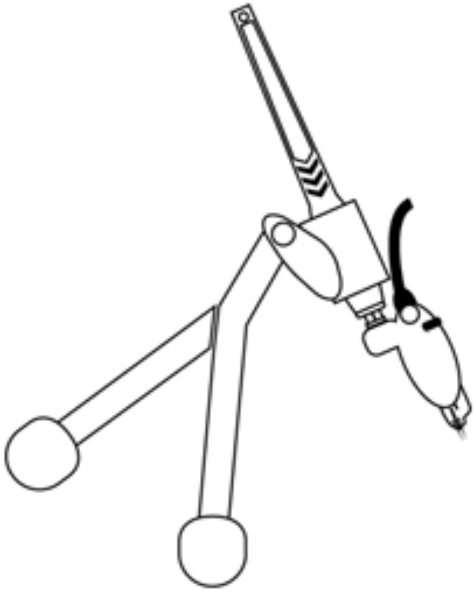
Start an AutoZero cycle by removing the probe from the circuit under test and touching the on-screen **AutoZero** button to remove output offset drift.

Accessory Use

Positioning tools support the platform/cable assembly and differential amplifier small tip module. They reduce the risk of damaging runs or pads on the board. Always use a positioning tool to support your probe.

Positioning Tools

FreeHand Probe Holder

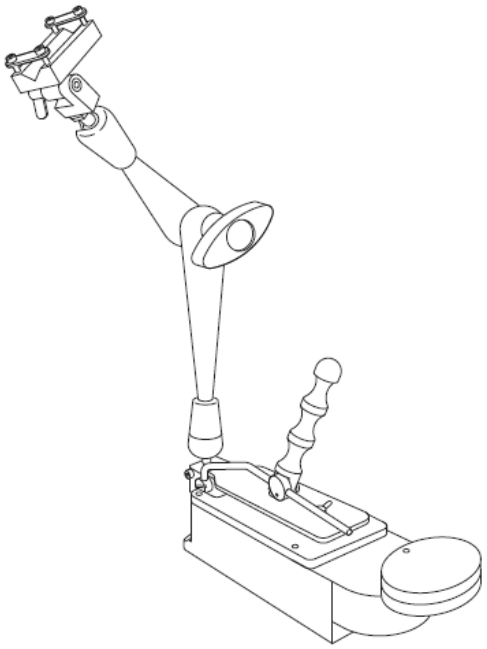


The FreeHand Probe holder (PACC-MS001) is provided as a standard accessory with the D610/620, D410/420, D600A-AT, and D400A-AT Probe Tip Modules.

The FreeHand holder is a quick, stable, easy-to-set-up probe positioner, improving concentration and focus on the measurement by not having to hold the probe.

The FreeHand holder is designed to keep most of the weight on the probe tip to prevent loss of contact with the circuit under test.

EZ Probe Positioner



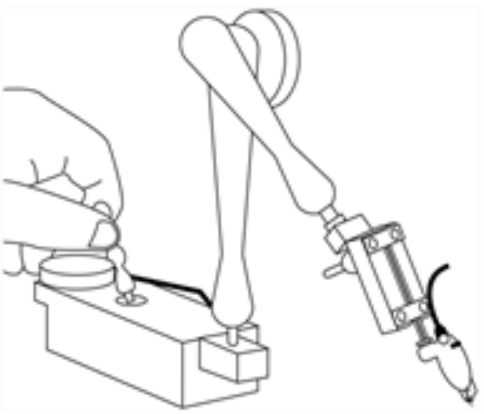
The EZ Probe Positioner is available as an optional accessory; please contact your local Teledyne LeCroy sales representative for details.

The EZ Probe Positioner provides stable, accurate positioning in the X-Y-Z axes. The unique 3:1 motion reduction joystick allows simple, precise positioning of the attached probe in both the horizontal and vertical measuring plane. The probe has a fully-articulating arm, providing 30 cm (12 inch) reach in virtually any direction.

The XYZ joystick has separate friction controls allowing independent X-Y plane or Z-Axis movement and is especially useful when combined with the PT module.

The EZ-Probe Positioner comes with a vacuum mounted base to keep the probe in place in any test environment. However, the solid base is heavy enough so the Positioner can be used without the vacuum.

EZ Probe Positioner Using Dx10-PT and Dx20-PT

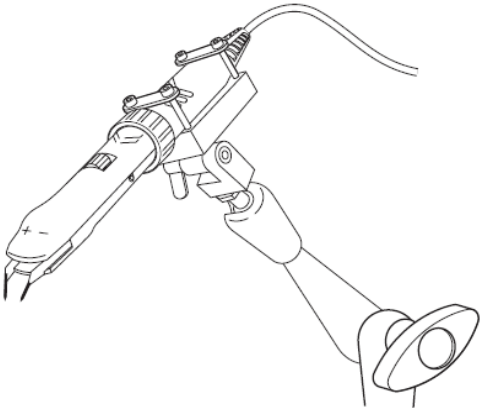


Attach the probe by first removing the screws holding the top plate to the V-shaped probe holder. Rest the Long Interconnect Extender in the V-shaped groove, and fasten the top plate to the holder, using the removed screws (as follows). Then, insert the Dx10 or Dx20-PT onto the Long Interconnect Extender.

NOTE: Do not over-tighten the screws.

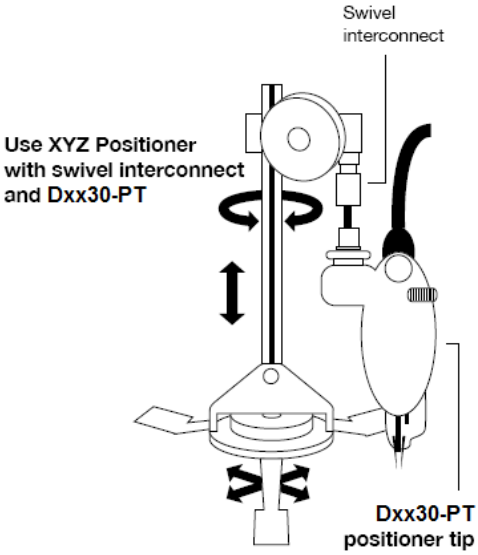
Once the probe has been attached, loosen the knob on the EZ Positioner arm and position the probe close to the test point. Tighten the knob and use the joystick to fine position the probe.

EZ Probe Positioner Using Dx00A-AT



Attach the probe by first removing the screws holding the top plate to the V-shaped probe holder. Insert the end of the platform/cable assembly and tighten the screws holding the top plate to secure the probe.

Dxx0-PT-XYZ-POSITIONER

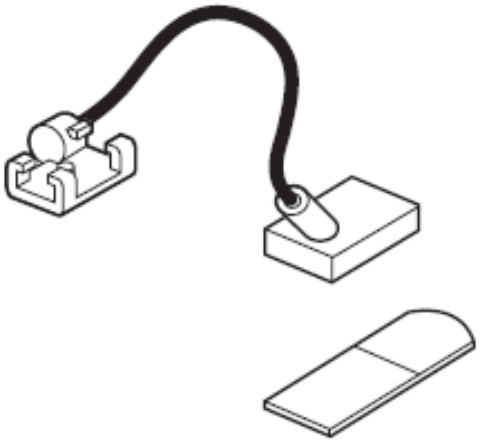


This positioner is a small, lightweight device that can be affixed to the printed circuit assembly using the included adhesive pads. The black adhesive pads are for more permanent attachment, whereas the white adhesive pads leave less residue when removed. The wide variety of short, long, swivel, and right angle interconnect parts can be connected to the top assembly, which can then be moved up and down along the Z-Axis to increase or release pressure on the probe points. The bottom assembly contains a tightening wheel which can be loosened to allow minor X-Y axis adjustments, and then tightened to fix the exact probing position.

Tip Retaining Clip

The Probe Tip Retaining Clip is designed to provide support to the probe when soldering the resistors of the Solder-In module to test points.

NOTE: When using the Dxx0-SI-HiTemp lead in extreme conditions, the Tip Retaining Clip is rated to 100 °C and adhesives are rated to 90 °C.



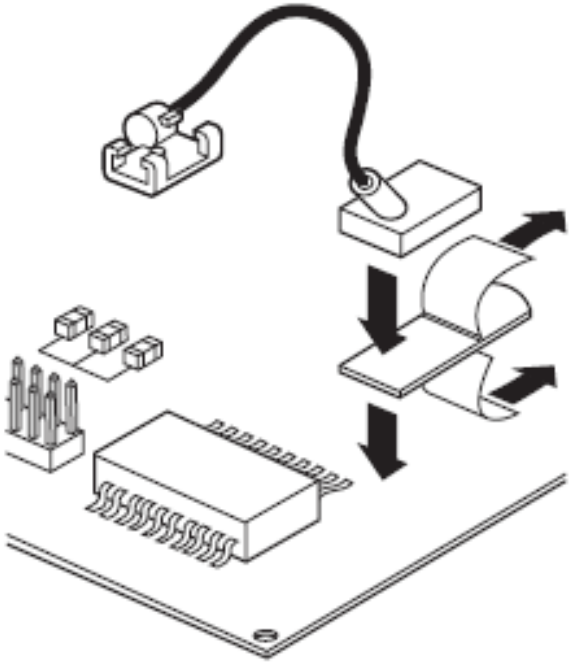
The Tip Retaining Clip (PK600ST-3) is an aid for holding the SI Interconnect Leads in place while making measurements or when soldering the damping resistors to the test points of the board under test.

The Clip comes standard with the Differential Amplifier Small Tip Modules (on page 7) along with a set of 10 white and 10 black Adhesive Pads (Dxx0-PT-TAPE) used for mounting the clip to the board.

The following section explains how to fasten the clip to the board, properly move and position the clip, attach the probe, and remove the clip.

Fastening the Clip to the Board

Fasten the clip to the board by removing the small piece of protection paper from one side of the adhesive pad and mount the pad to the underside of the clip. If necessary, use alcohol to clean the section of the board where the clip is mounted to remove any grease or flux residue.



Connecting the SI Module Using the Tip Retaining Clip

Remove the protective paper from the other side of the adhesive pad and mount the clip to the desired location on the board. Apply pressure to the clip for at least several seconds to assure proper adhesion (shown previous).

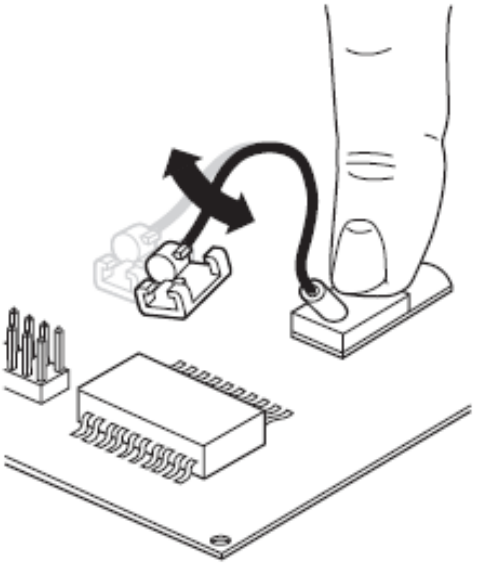
The adhesive pad with the tab is still be visible and stays attached to the adhesive pad. The tab is used to remove the clip from the board.

NOTE: Maximum strength of the adhesive pad is obtained after about 30 minutes.

Moving and Positioning the Clip

Always apply pressure to the pad (as follows) to prevent any shifting while bending the arms and/or moving the probe adapter portion of the clip (typically done while positioning or attaching the probe).

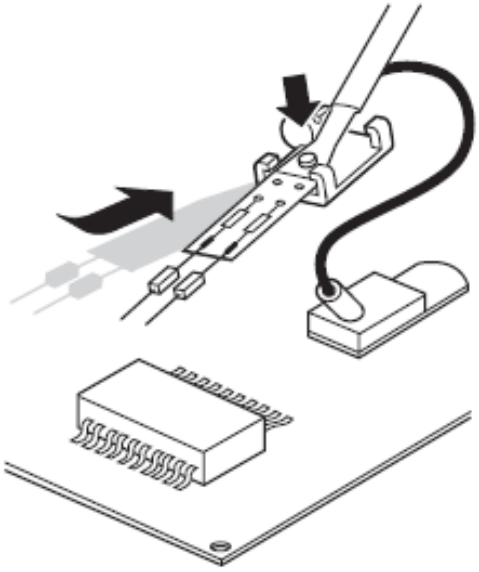
NOTE: This is especially important if moving and positioning before the adhesive pads have properly cured.



Applying pressure when adjusting the probe holder

ATTACHING THE PROBE

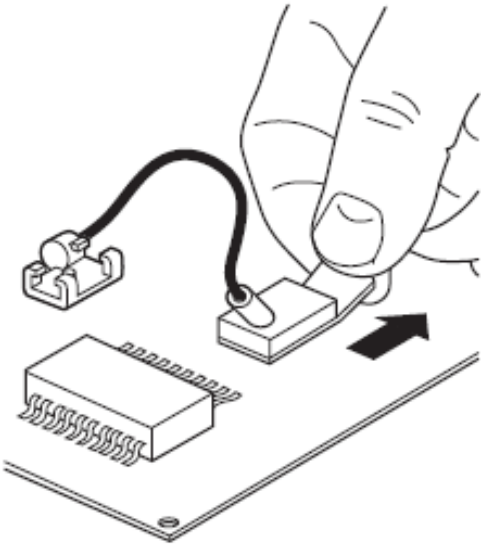
Attach the probe by positioning the cable of the module on top of the clip and sliding the input board of the module into the grooves. While moving the probe into position for measurement, apply pressure to the mounting pad to prevent the adhesive pad from moving and losing its adhesion.



Attaching the Probe

Removing the Tip Retaining Clip

Remove the Retaining Clip from the board by pulling on the tab of the adhesive pad. The clip can now be removed easily without leaving any adhesive residue and can be used in another application using a new adhesive pad.

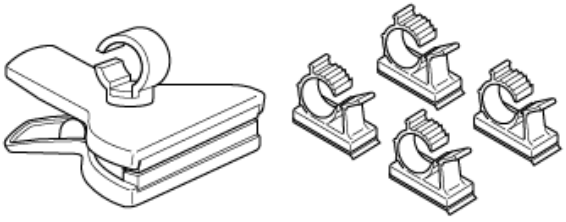


Removing the Retaining Clip

Platform/Cable Assembly Mounting Kit

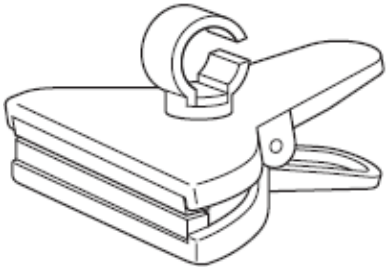
Platform/Cable Assembly Mounting Kit (PK600ST-4) can be used to support to the Platform/Cable Assembly and relieve stress on interconnect leads when the test points are located close to the edge of the board under test.

The PK600ST-4 includes one Board Edge Clip and four Adhesive Backed Platform/Cable Assembly Clamps explained in the following sections.

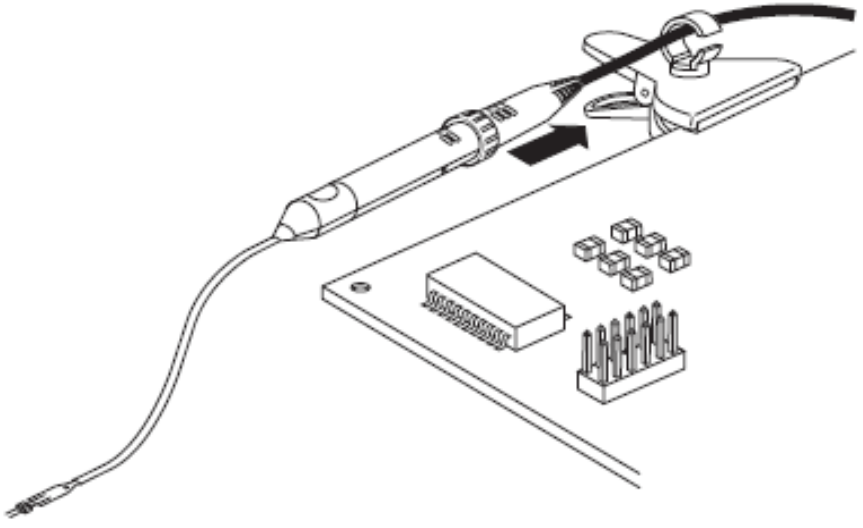


PLATFORM/CABLE ASSEMBLY BOARD EDGE CLIP

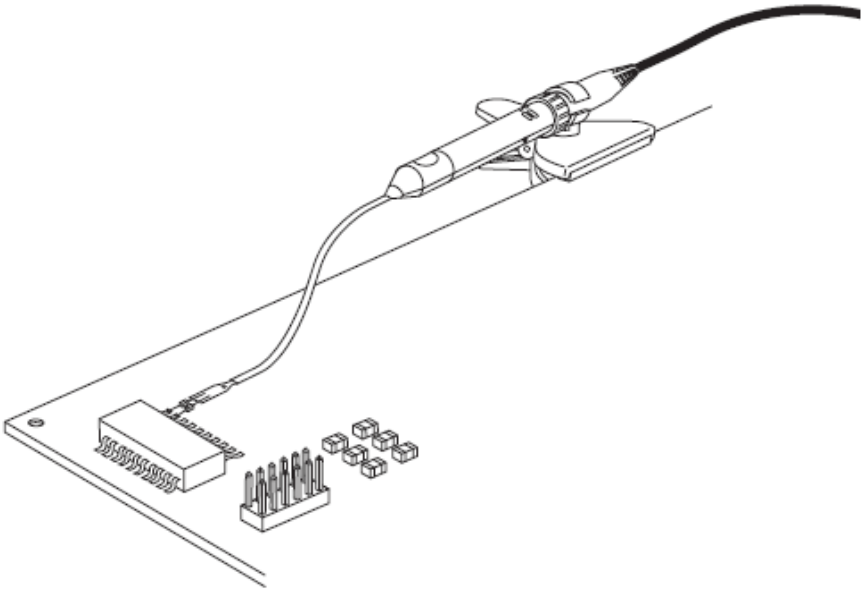
The Platform/Cable Assembly Location Clip can be used to give support to the probe and Interconnect Lead when the test points are located close to the edge of the board under test. It's also useful for holding the probe assembly while soldering the solder-in interconnect lead to your device under test.



Slide the probe cable into the clamp opening and move the probe so that the probe's strain relief is located in the opening. Close the clamp.



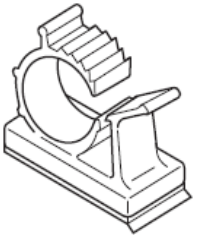
Slide the Probe into the Board Edge Clip



Insert the probe body into the board edge clip and position the clamp as desired.

ADHESIVE BACKED PLATFORM/CABLE ASSEMBLY CLAMPS (4)

The Adhesive Backed Probe Body Clamp provides additional support to the Platform/Cable Assembly and Interconnect Lead anywhere on the board under test.

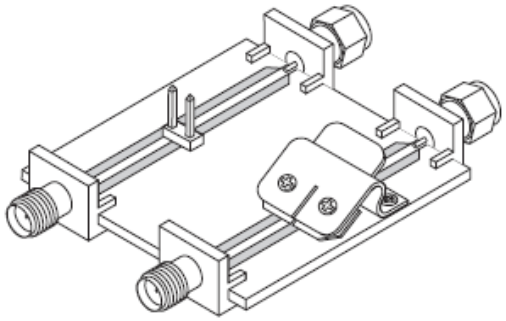


Connection Guides

Probe connection guides are designed to make it easy to electrically isolate the two probe tips when browsing. They also greatly reduce accidental and unwanted contact across probe points.

Before attaching connection guides, clean the PCA assembly area with IPA or another cleaner to remove oils. Then, apply with a light pressure, release, and let set for one hour.

Probe Deskew Fixture



The Probe Deskew Fixture (PCF200) is provided as a standard accessory with WaveLink series Platform/Cable Assemblies. The fixture can be used one of two ways:

- For lower bandwidth WaveLink probes (≤ 6 GHz), the fixture may be used to determine the effect of probe input loading on the circuit under test and the probe response to the signal being measured, using the D610, D620, D410, and D420 modules.
- For all WaveLink probes designed to accommodate all WaveLink tips (not at full bandwidth), the fixture may be used as a convenient way to deskew several probes/oscilloscope channels. This can be accomplished in the following ways:
    - Connect a fast edge to one or both inputs. Connect the probe tip(s) to the appropriate connection point. Solder-in probe tips and browser tips may be inserted under the clamping mechanism. Display the probe signals on the oscilloscope screen and use the channel deskew adjust to align them to a common point.
    - Connect the WavePro 7 Zi/Zi-A or WaveMaster 8 Zi/Zi-A fast edge output to one of the inputs. Set the Zi Series oscilloscope to trigger on the internal Fast Edge source. Set the trigger delay to zero. Now, on the vertical dialog, use the Probe Cal - Cable Deskew button to align one signal/channel at a time to the specified zero delay trigger point (center of screen). Repeat for as many probes as you have connected, each time aligning them to the common point.

NOTE: The Probe Deskew fixture has an inherent rise time limitation of ~70ps. Deskew of very high frequency signals using WaveLink High Bandwidth Differential Probes may require a faster rise time than this fixture can provide. In this case, utilize one of your signals as a reference point, and then deskew all additional signals to the reference signal.

A **TF-DSQ fixture** is available as a Teledyne LeCroy accessory. The product is used in conjunction with the oscilloscope software to perform probe deskew and DC calibration.

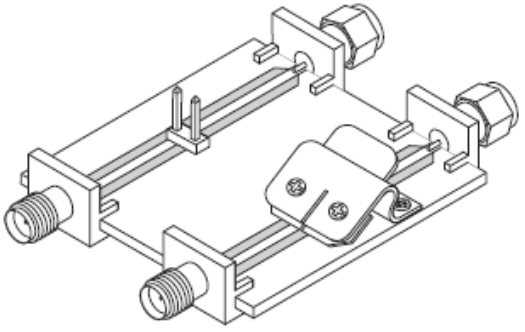
Probe Characterizing

For any measurement, it is important to know how the input impedance of the probe affects the signal to be measured and how well the output signal of the probe represents the input signal.

With transmission line topology, WaveLink probes provide relatively high impedance over the entire frequency range.

It may be desirable to accurately characterize the probe loading when correlating oscilloscope measurements to simulation results.

This test can be performed using the Characterization Fixture (as follows). This fixture has two 50 Ω microstrip transmission lines, one for testing the SP lead and one for testing the SI and QC lead. The AT module can be tested with either microstrip.



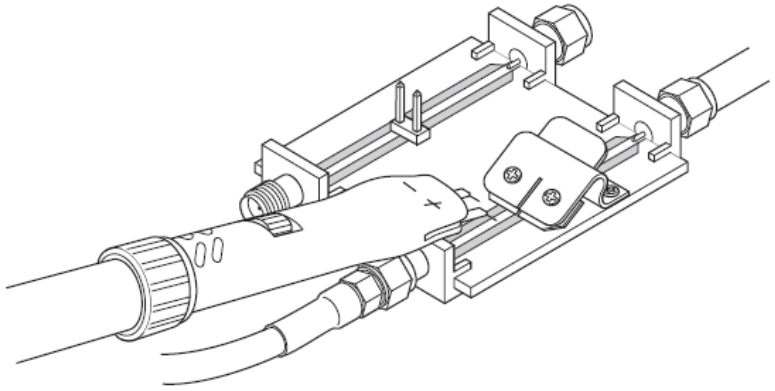
Characterization Fixture

In addition, a Teledyne LeCroy X-Stream oscilloscope and a signal source, such as a sine wave generator or a pulse generator with fast step output signal, is needed. Using this fixture, you can measure this signal with and without the probe attached to detect any change in shape or timing due to probe loading.

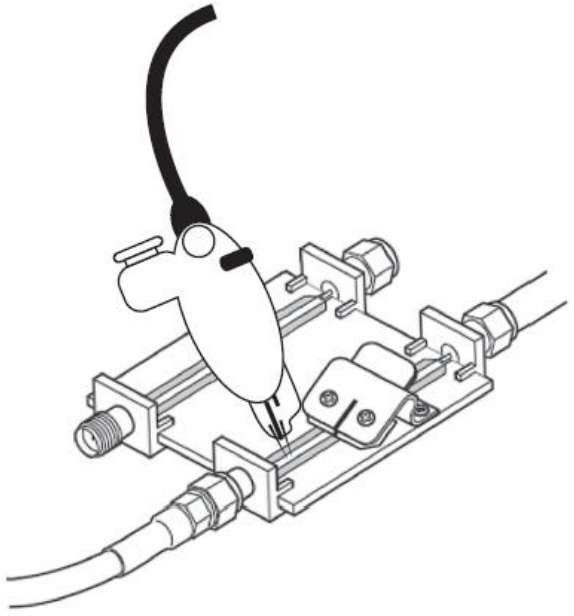
Perform the test by connecting one end of the characterization fixture (using a 50 Ω SMA cable) to the fast rising (50 Ω) output of a pulse generator and the output end of the fixture to an input of the oscilloscope. Verify the input impedance of the oscilloscope channel is set to 50 Ω.

The output of the probe is connected to another 50 Ω input, and the probe's input pins are adjusted to make contact with the run and ground plane of the 50 Ω characterization fixture.

The following four images show the correct way of connecting adjustable positioner tips or leads to the characterization fixture.

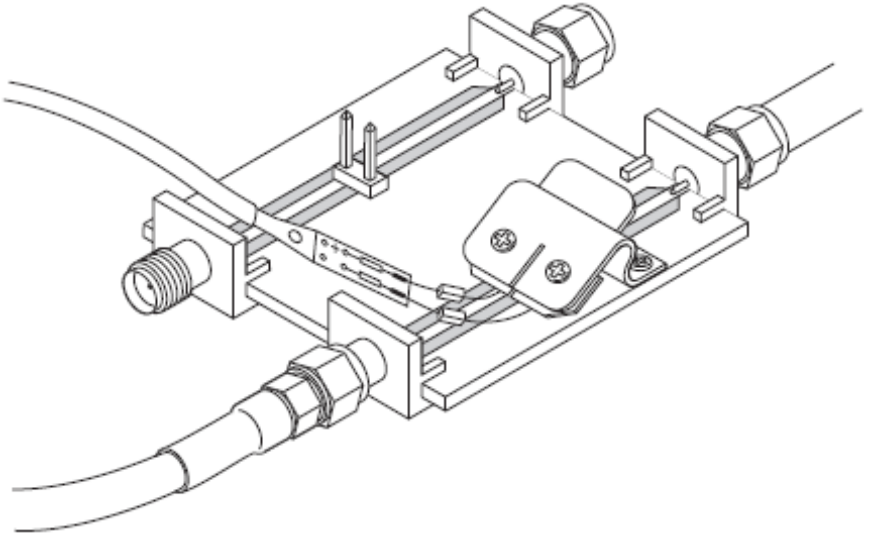


Measuring Response using the D600A-AT or D400A-AT Differential Amplifier Module with Adjustable Tip

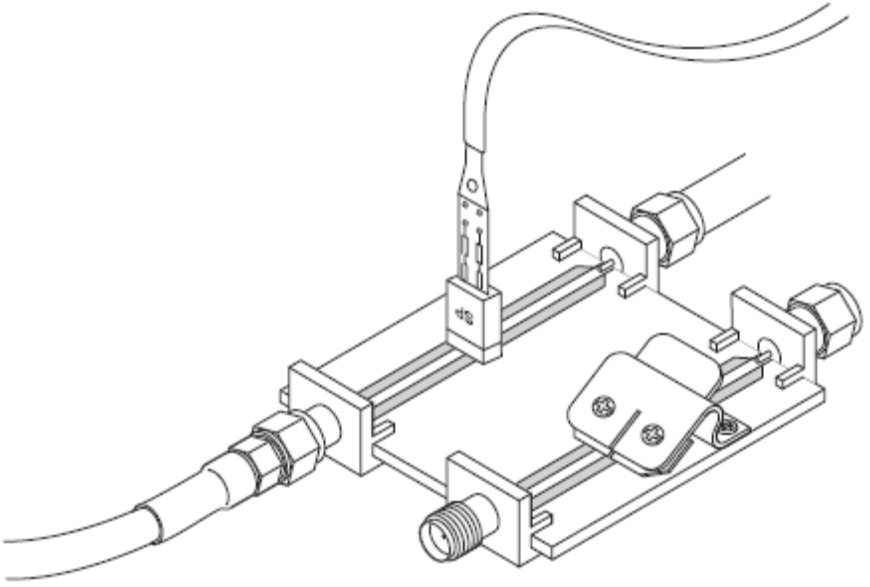


Characterization Fixture with Dx10-PT or Dx20-PT Positioner Tip

Use the SI Interconnect Lead with Characterization Fixture by pressing on the black plastic tab to open the clamp. Place the resistor leads under the clamp, assuring that the **+** lead is under the section making contact with the center microstrip and that the **–** lead is under the other section making contact with the ground plane. Release the clamp so it holds the wires securely in place as follows:



Characterization Fixture with SI Lead

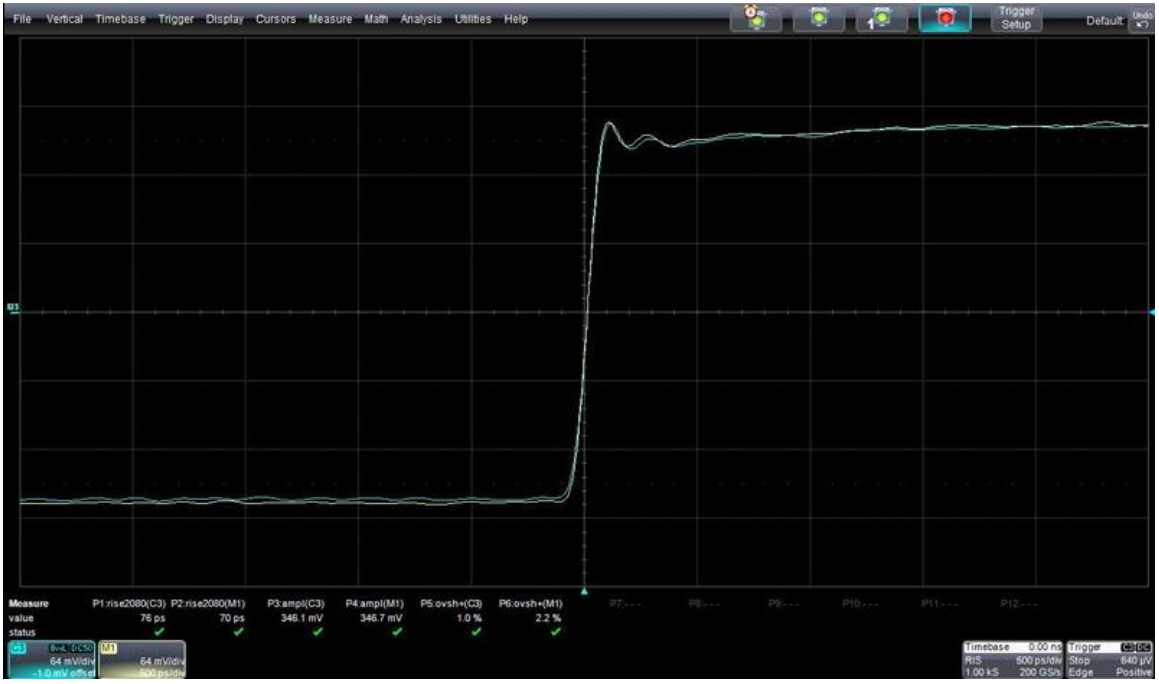


Characterization Fixture with SP Lead

NOTE: It is important to verify the positive input of the modules is connected to the positive signal on the center microstrip. All modules show the positive input with a **+** sign.

Determine the effect of delay due to loading by triggering the oscilloscope on an independent signal so that the trigger point does not shift when the probe is connected to the 50 Ω strip line.

1. First obtain a reference by displaying and storing the waveform of the pulse through the fixture without the probe touching the microstrip or ground plane around the strip.
2. Next, touch the **+** input of the probe tip to the center trace, and the **–** input to ground on either side of the microstrip. The output of the fixture represents the loading effect that the probe has on a signal in a 50 Ω transmission line environment.
3. Finally, to view the signal passing through the probe, turn ON the channel to which the probe's output is connected. (It may be necessary to deskew to remove the propagation delay of the probe).



Responses of probe input loading and probe output

The previous screen-shot shows the output of the Characterization Fixture with and without probe loading, and the probe output response, using a 35 ps, 340 mV Pk-Pk pulse.

As can be seen on the top part of the traces, the probe loading effect on the input signal is negligible. The small voltage difference between the responses prior to the fast rise step is due to the resistive loading of the probe.

Care and Maintenance

Care and Maintenance Overview

The following sections for Replacing Damping Resistors and Spring Loaded Tips explain user services required to properly care for your probe.

Replacing Damping Resistors on -SI Leads

A set of five replacement damping resistors have been supplied with the Solder-In Interconnect Lead.

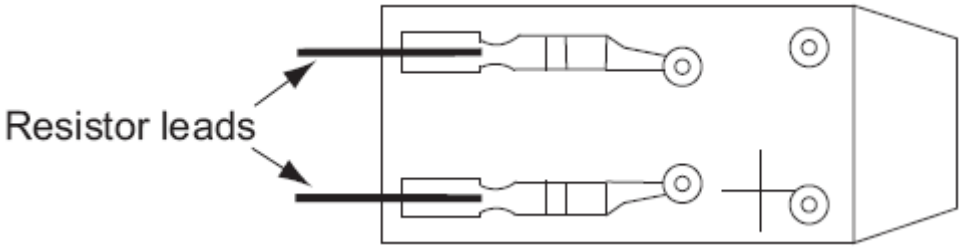
PLEASE NOTE THE FOLLOWING:

- Do not confuse the replacement SI module damping resistors for Quick Connect lead resistors. The SI replacement damping resistors are smaller than the Quick Connect resistors.
- Resistors used in the D610, D620, D410, and D420 have different values from those used in the older D350ST.

Because of the small mass of the SI Lead input board, be sure to support the unit using the Probe Tip Retaining Clip when removing the old resistors and adding the new ones. Refer to Positioning Tools (on page 30) for information about using the Retaining Clip.

With an appropriate soldering iron for these low mass resistors, remove the damaged resistor from the SI input board. Since the length of each wire is identical, align the wire of one end of the new resistor with the end of the pad on the input board and solder it in place.

Assure the highest performance by providing the correct parasitic inductance of the wire. Also, be sure to use the supplied damping resistors and verify the end of the resistor lead coincides with the end of the pad as follows:



Resistor Lead Placement

Replacing Tips and Sockets on Dx10-PT and Dx20-PT

The following topics for Replacing Spring-Loaded Tips and Replacing Tip Sockets explain user services required to properly care for your probe.

Replacing Spring-Loaded Tips

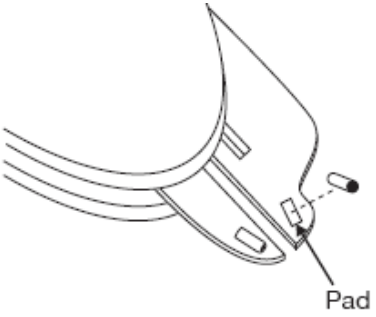
A set of 4 replacement spring-loaded tips have been supplied with the Dx10-PT and Dx20-PT Positioner Tips. Under normal usage, the tips should last a very long time. However, in the event of breakage or damage, they can be easily replaced.

First, adjust the tip spacing to its maximum open position. Then, remove the old tip from the socket and insert a new tip, taking care to orient it in the correct direction. While replacing tips, mount the Dx10/Dx20-PT in a clamp, taking care to not adjust too tightly.

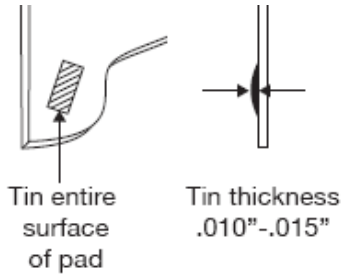
Replacing Tip Sockets

A set of 2 replacement tip sockets have been supplied with the Dx10-PT and Dx20-PT Positioner Tips. Under normal usage, the tip sockets should not need replacement. However, in the event of breakage or damage, new sockets can be soldered into place using the following steps:

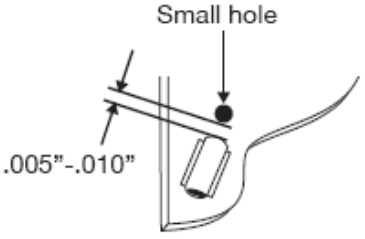
1. Secure the positioner tip in a clamp to immobilize it while working. Using an appropriate fine-tip soldering iron for low mass components, apply heat and remove the damaged socket from the positioner tip circuit board.
2. Clean off the pad using the soldering iron. Clean oils and dirt in the area using deionized or distilled water and isopropyl alcohol. Inspect the pad for damage - damaged or loose sockets do not adhere properly.



3. Tin the pad using a no clean solder (shown below). Tin thickness should be .010” to .015” (2.5 to 4 mm).



4. Locate the socket so the closed end is slightly overhanging the end of the pad. This prevents solder from flowing into the socket insert hole. Align the socket sides with the pad sides and solder as follows:



5. Finally, clean the newly soldered assembly with deionized or distilled water.

Service Strategy

Defective probes or probe tip modules must be returned to a Teledyne LeCroy service facility for diagnosis and repair or replacement. Defective products under warranty are repaired or replaced.

Refer to the Service Options (on page 54) for more details.

Returning a Probe for Calibration or Service

Return a product for calibration or service by contacting your local Teledyne LeCroy sales representative. They tell you where to return the product. All returned products should be identified by both model and serial number. Provide your name, a contact number, and a description of the defect or failure (if possible).

Products returned to the factory require a Return Material Authorization (RMA) acquired by contacting your nearest Teledyne LeCroy sales office, representative, or the North America Customer Care Center.

- Return shipments should be prepaid.
- Teledyne LeCroy cannot accept COD or Collect Return shipments.
- We recommend air-freighting.

NOTE: It is important that the RMA be clearly shown on the outside of the shipping package for prompt redirection to the appropriate department.

Use the following steps for a smooth product return.

1. Contact your local Teledyne LeCroy sales or service representative to obtain a Return Authorization Number.
2. Remove all accessories from the probe. Do not include the manual. If you need to return a D610, D620, D410, or D420 module, be sure to include all Interconnect Leads and Tips (SI, QC, SP, PT).
3. Pack the probe in its case, surrounded by the original packing material (or equivalent) and box.
4. Label the case with a tag containing:
   - The RMA
   - Name and address of the owner
   - Product model and serial number
   - Description of failure
5. Package the probe case in a cardboard shipping box with adequate padding to avoid damage in transit.
6. Mark the outside of the box with the shipping address given to you by the Teledyne LeCroy representative; be sure to add the following:
   - ATTN: <RMA assigned by the Teledyne LeCroy representative>
   - FRAGILE
7. Insure the item you're returning (for at least the replacement cost).
8. Ship the package to the appropriate address.

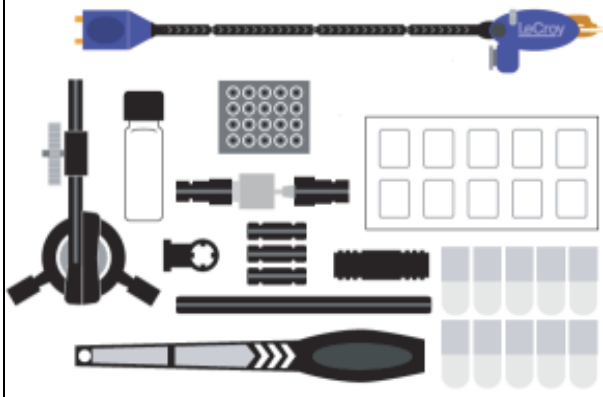
Returning a Probe to a Different Country

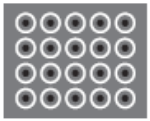
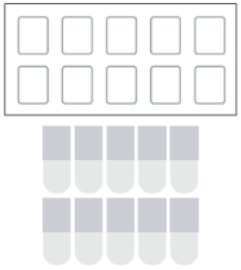
NOTE: Be sure to properly mark shipments returned for service from a different country to avoid customs duty for a full purchase price of a new probe or accessory.

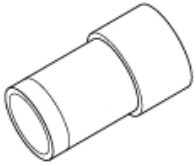
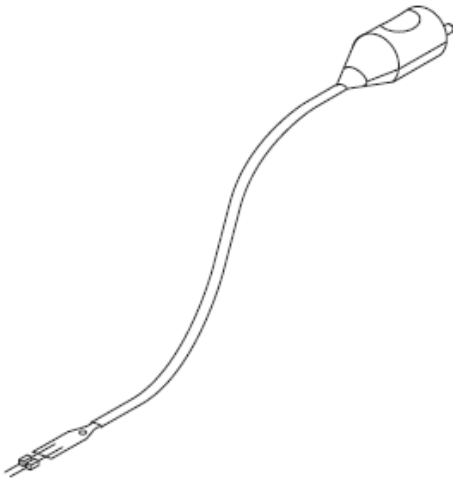
In addition to the items mentioned in the previous topic, mark shipments returned for service as a "Return of US manufactured goods for warranty repair/recalibration." If there is a cost involved in the service, put the cost of the service in the value column and the original value of the product at time of purchase in the body of the invoice marked "For insurance purposes only."

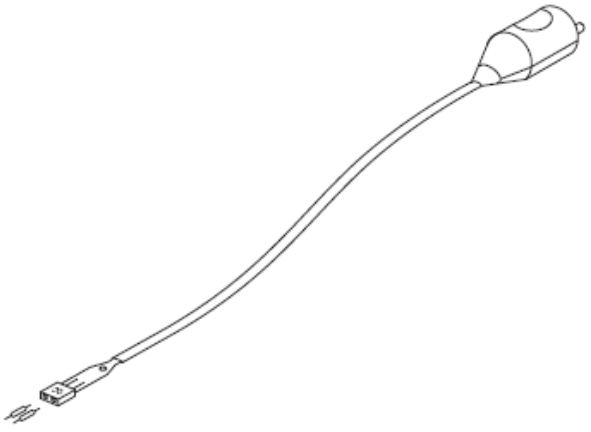
Be very specific as to the reason for shipment. Duties may have to be paid on the value of the service.

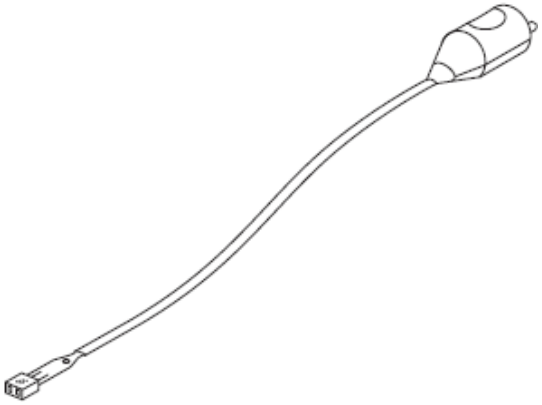
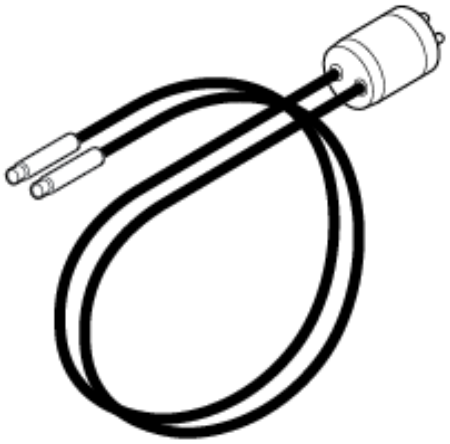
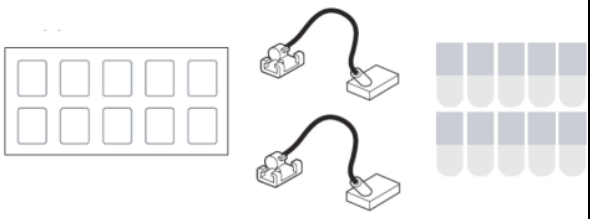
Consumables and Replacement Parts

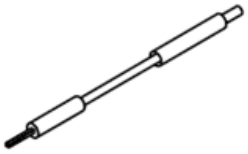
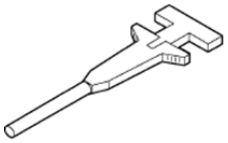
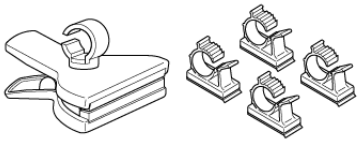
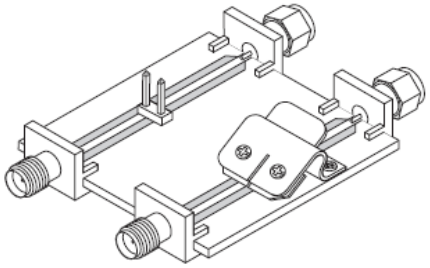
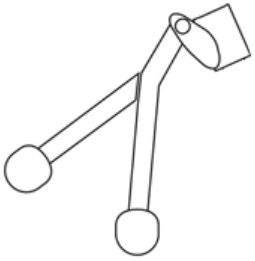
Description and Initial Product Code	Image	Replacement Product Code
Positioner Tip with Accessories Dx10-PT-Kit (D610/D410) Dx20-PT-Kit (D620/D420)		RK-Dx10-PT-Kit RK-Dx20-PT-Kit
Positioner Tip (Only ordered as a replacement.)		Dx10-PT (D610/D410) Dx20-PT (D620/D420)
Pogo Pin Tips (for PT Tip) (Only ordered as a replacement.)		Dxx0-PT-Tips (Included with D6x0-PT-Kit / D4x0-PT-Kit) (Qty. 4)

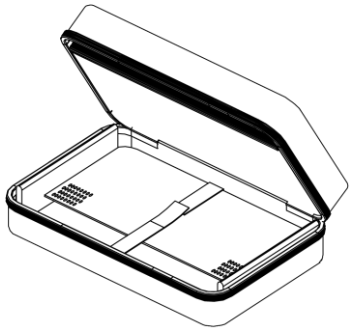
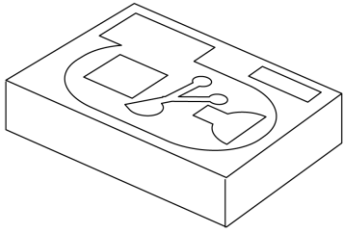
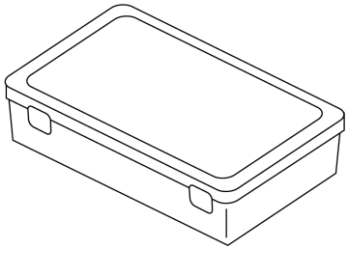
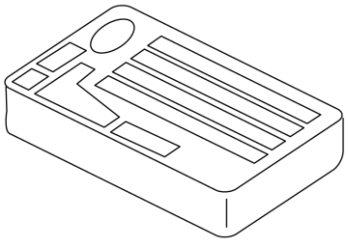
Description and Initial Product Code	Image	Replacement Product Code
Pogo Tip Connection Guides (Only ordered as a replacement.)		Dxx0-PT-Guides (Included with D6x0-PT-Kit / D4x0-PT-Kit)
XYZ Positioner (Only ordered as a replacement.)		Dxx0-PT-XYZ-Positioner (Included with D6x0-PT-Kit / D4x0-PT-Kit)
Adhesive Tape for XYZ Positioner (Only ordered as a replacement.)		Dxx0-PT-Tape (Included with D6x0-PT-Kit / D4x0-PT-Kit) (10 Pcs. Each)
Browser Wand for PT Tip (Only ordered as a replacement.)		Dxx0-PT-Wand (Included with D6x0-PT-Kit / D4x0-PT-Kit) (Qty. 1)

Description and Initial Product Code	Image	Replacement Product Code
Interlock Pieces for PT Tip (Only ordered as a replacement.)		Dxx0-PT-Interlock (Included with D6x0-PT-Kit / D4x0-PT-Kit) (6 Pcs.)
Swivel for PT Tip (Only ordered as a replacement.)		Dxx0-PT-Swivel (Included with D6x0-PT-Kit / D4x0-PT-Kit) (Qty. 1)
Solder-In Tips (Only ordered as a replacement.)		PKxx0-SI (D6x0/D4x0) (Qty. 5)
Solder-In Lead (Only ordered as a replacement. Also, includes PK600ST-3.)		Dx10-SI (D610/D410) Dx20-SI (D620/D420)

Description and Initial Product Code	Image	Replacement Product Code
Replacement HiTemp-SI Lead		Dx10-SI-HiTemp (D610/D410) Dx20-SI-HiTemp (D620/D420) With Spare Resistors (Qty. 10)
Replacement Quick Connect Lead		Dx10-QC (D610/D410) Dx20-QC (D620/D420) With Spare Resistors (Qty. 10)

Description and Initial Product Code	Image	Replacement Product Code
Replacement Square Pin Lead (Only ordered as a replacement.)		Dx10-SP (D610/D410) Dx20-SP (D620/D420) With Spare Resistors (Qty. 10)
Replacement HiTemp Cable (Only ordered as a replacement.)		Dxx0-Cable-HiTemp (1 Paired Cable Each)
Replacement Solder-In Probe Holder Kit (Only ordered as a replacement. Includes 2 tip retaining clips and 1 set of adhesive tape.)		PK600ST-3 (Included as part of D6x0/D4x0.)

Description and Initial Product Code	Image	Replacement Product Code
Ground Lead (Only ordered as a replacement. Includes 4 leads.)		PACC-LD005 (Included as part of D6x0/D4x0.)
Ground Clip (Only ordered as a replacement. Includes 2 clips.)		PK006-4 (Included as part of D6x0/D4x0.)
Platform/Cable Assembly Mounting Kit (Only ordered as a replacement.)		PK600ST-4 (Included as part of WL-PLINK-CASE and WL-PBUS-CASE).
Probe Deskew Fixture (Only ordered as a replacement.)		PCF200 (Included as part of WL-PLINK-CASE and WL-PBUS-CASE)
Freehand Probe Holder (Only ordered as a replacement.)		PACC-MS001 (Included as part of WL-PLINK-CASE and WL-PBUS-CASE)

Description and Initial Product Code	Image	Replacement Product Code
Deluxe Soft Carrying Case (Only ordered as a replacement)		SAC-03 (Included as part of WL-PBUS--CASE, WL-PLINK-CASE, Dx10-PS, Dx20-PS)
Foam Insert for SAC-03		921079-00 for WL-PBUS-CASE; 921081-00 for WL-PLINK-CASE
Protective Storage Case (Only ordered as a replacement)		921083-00 (Included as part of WP-PBUS-CASE, WL-PLINK-CASE, Dx10-PS, Dx20-PS)
Plastic Tray for Protective Storage Case (Only ordered as a replacement)		921078-00 (Included as part of WP-PBUS-CASE, WL-PLINK-CASE, Dx10-PS, Dx20-PS)

***For warranted accuracy, amplifiers must be returned to factory for calibration with leads.**

Service Options

Service Option	Product Code
Three-Year Warranty for D600A-AT	D600A-AT-W3
Three-Year Warranty for D400A-AT	D400A-AT-W3
Three-Year Warranty for D610	D610-W3
Three-Year Warranty for D620	D620-W3
Three-Year Warranty for D410	D410-W3
Three-Year Warranty for D420	D420-W3
Five-Year Warranty for D600A-AT	D600A-AT-W5
Five-Year Warranty for D400A-AT	D400-AT-W5
Five-Year Warranty for D610	D610-W5
Five-Year Warranty for D620	D620-W5
Five-Year Warranty for D410	D410-W5
Five-Year Warranty for D420	D420-W5
Three-Year Warranty and Annual NIST Calibration	D600A-AT-T3
Three-Year Warranty and Annual NIST Calibration	D400A-AT-T3
Three-Year Warranty and Annual NIST Calibration	D610-T3
Three-Year Warranty and Annual NIST Calibration	D620-T3
Three-Year Warranty and Annual NIST Calibration	D410-T3
Three-Year Warranty and Annual NIST Calibration	D420-T3
Five-Year Warranty and Annual NIST Calibration	D600A-AT-T5
Five-Year Warranty and Annual NIST Calibration	D400-A-AT-T5
Five-Year Warranty and Annual NIST Calibration	D610-T5
Five-Year Warranty and Annual NIST Calibration	D620-T5
Five-Year Warranty and Annual NIST Calibration	D410-T5
Five-Year Warranty and Annual NIST Calibration	D420-T5

Service Option	Product Code
Three-Year Annual NIST Calibration	D600A-AT-C3
Three-Year Annual NIST Calibration	D400A-AT-C3
Three-Year Annual NIST Calibration	D610-C3
Three-Year Annual NIST Calibration	D620-C3
Three-Year Annual NIST Calibration	D410-C3
Three-Year Annual NIST Calibration	D420-C3
Five-Year Annual NIST Calibration	D600A-AT-C5
Five-Year Annual NIST Calibration	D400A-AT-C5
Five-Year Annual NIST Calibration	D610-C5
Five-Year Annual NIST Calibration	D620-C5
Five-Year Annual NIST Calibration	D410-C5
Five-Year Annual NIST Calibration	D420-C5
NIST Traceable Calibration with Test Data* (one module)	D600A-AT-CCNIST
	D400A-AT-CCNIST
	D610-CCNIST
	D620-CCNIST
	D410-CCNIST
	D420-CCNIST

***CCNIST NIST traceable calibration with test data is an available option for D610, D620, D410, D420, D600A-AT,and D400A-AT differential amplifier modules only when ordered with either a WL-PLINK-CASE or WL-PBUS-CASE probe platform.**

Functional Test

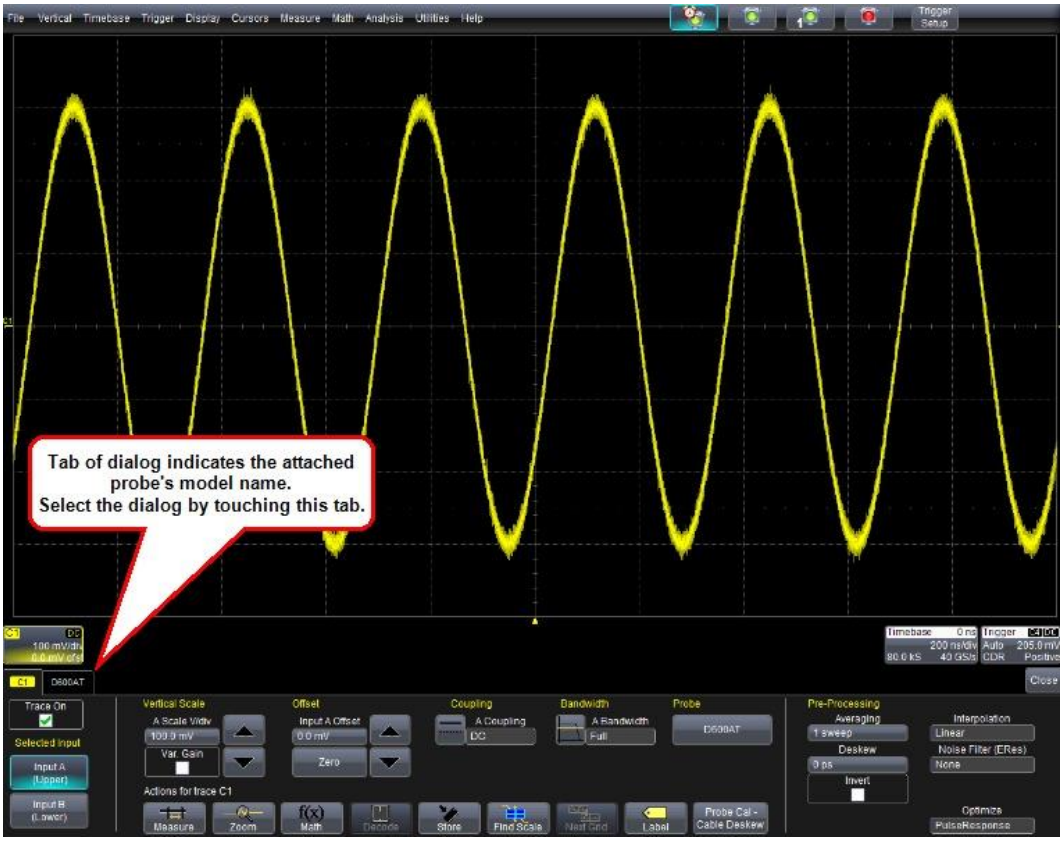
Functional Test Overview

The functional test can be used to verify the basic operation of the WaveLink Differential Probe functions, using a Teledyne LeCroy X-Stream oscilloscope. Refer to the oscilloscope's online help for proper use of the touch screen and controls.

Test Setup

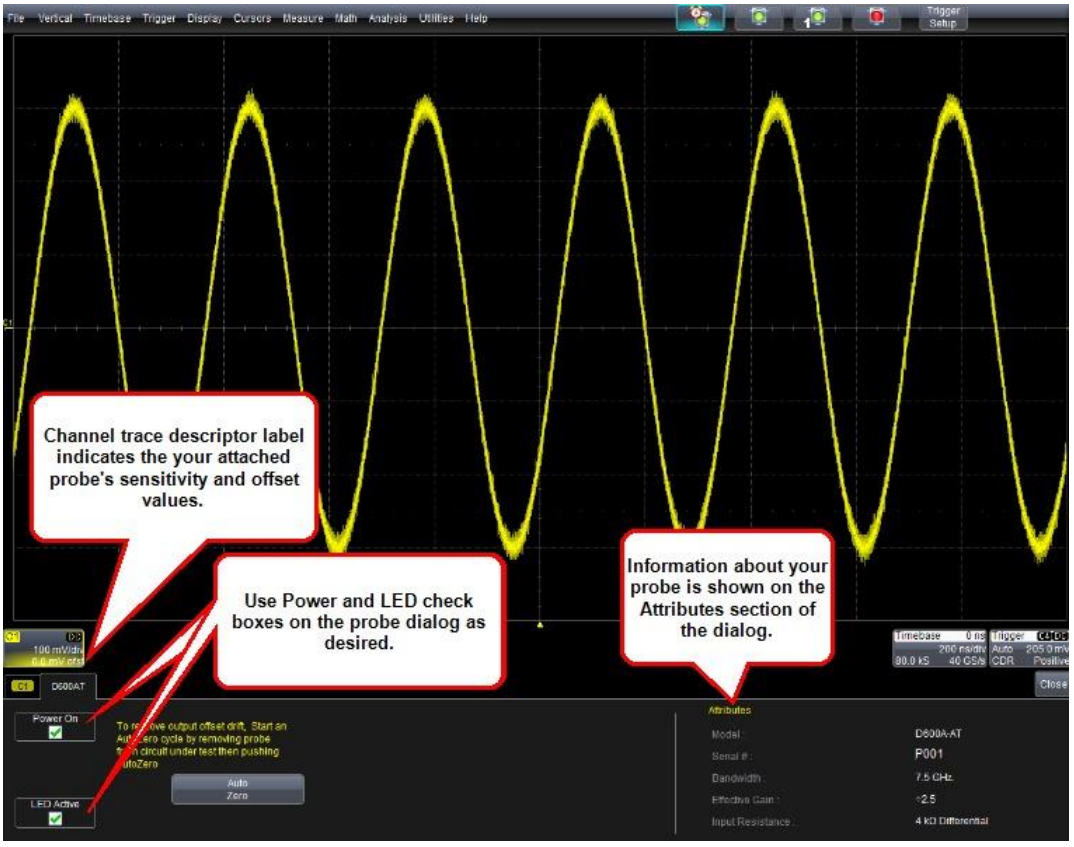
Use the following steps to set up the basic tests:

1. Connect a module to a probe body (for example, a WL-PLINK with a D600A-AT), and then connect the body to channel 1 of the oscilloscope. The instant the probe is connected to the oscilloscope, the AutoColor ID LEDs should illuminate GREEN for less than 1 second indicating the probe is compatible with the oscilloscope.
2. After the green LED indication, the Probe AutoColor ID indicators illuminate in the color of the channel to which the probe is connected. Verify the probe AutoColor ID indicates the proper corresponding channel color by disconnecting the probe and reconnecting to the other channels. Reconnect the probe to Channel 1.



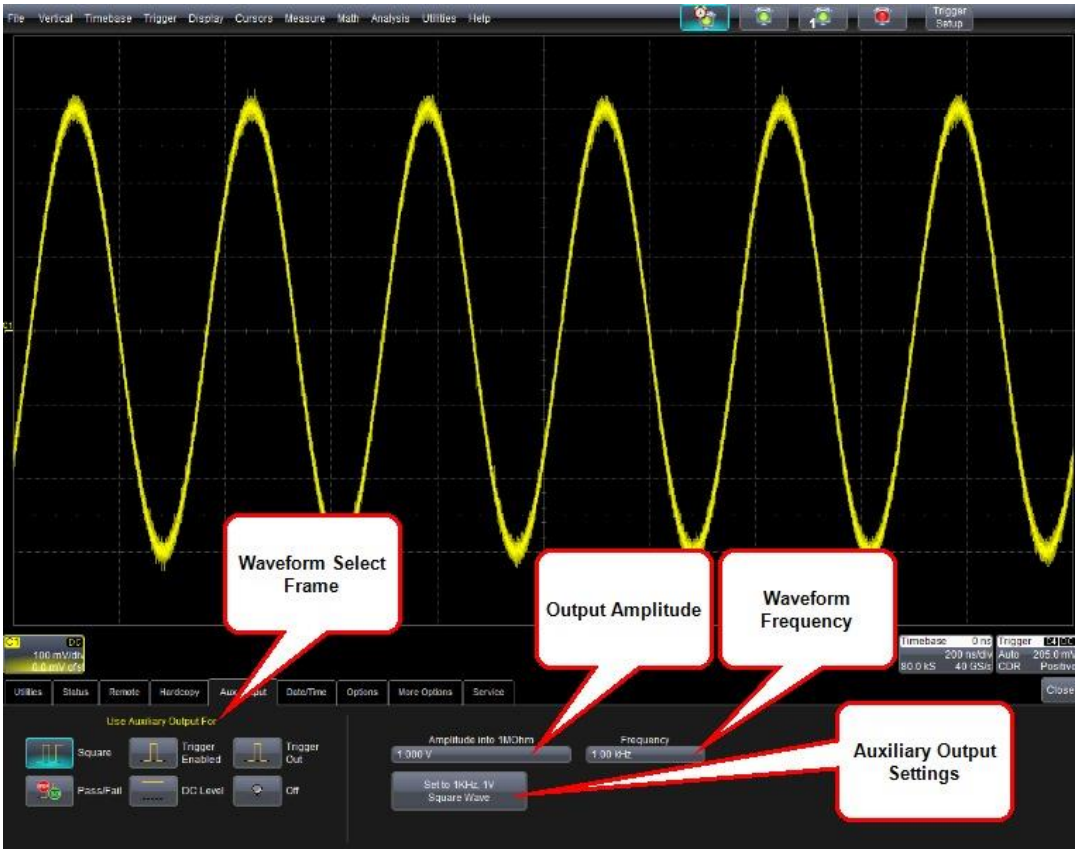
Vertical dialog with labeled tab corresponding with your attached probe.

3. Turn on the channel corresponding to the connected probe.
4. Touch the probe-connected channel's trace label. The Cx Vertical Adjust dialog is shown. Verify the probe model. The D600A-AT is shown (previous).
5. Touch the D600A-AT probe indicator tab to show the D600A-AT probe menu as follows:



6. Touch the Power On checkbox to verify the AutoColor ID LEDs on the probe is OFF (and probe power is OFF). Turn the power back ON by clicking the checkbox again.
7. Touch the Led On checkbox to verify the probe's AutoColor ID LEDs turn off (probe power is still ON). Turn LEDs back ON.
8. At this point, the Calibrator must be set up before performing the functional tests. Select Utilities → Utilities Setup... from the menu bar.

9. Touch the Aux Output tab.
10. Touch the Square button to obtain a square wave output signal.



NOTE: TTL is processed internally (and the Aux Output dialog shows a TTL checkbox) for the following oscilloscope models: WaveMaster 5000, 6000, SDA 40000, 5000, and 6000.

11. Set the amplitude to 1 Volt, Frequency to 1.00 kHz, Offset to 0 V.
12. Verify the screen indicates the proper settings in the Aux Output fields.
13. Set the probe sensitivity to 200 mV/div.
14. Connect the **+** tip of the Adjustable Tip module to the center connector of the calibrator output signal, and the **–** pin to the shell (ground) of the connector. If necessary, readjust the tip spacing.

15. Verify the screen shows a square wave centered on the middle graticule line (refer to the following screen-shot). If no square wave is shown, the + channel of the probe may be faulty.

16. Press AUTO SETUP on the oscilloscope's front panel to obtain a stable display.
17. Since we're using an A-AT tip for our example, adjust the tips so both touch or are almost touching.
18. Connect both tips to the calibrator output signal.
19. Verify a straight line is shown centered on the screen. There should be no vertical deflection, to indicate good CMRR.
20. One of the channels may be at fault if a square wave or part of a square wave is shown.

This concludes the functional tests of the WaveLink Differential Probe.

Performance Verification

Performance Verification Overview

This procedure can be used to verify the warranted characteristics of the WaveLink Differential Probe.

The recommended calibration interval for differential probes is one year. Test results can be recorded on a photocopy of Appendix A - Performance Verification Test Record (on page 98) provided at the end of this manual.

Performance Verification can be completed without removing the probe covers or exposing the user to hazardous voltages. No adjustments are provided.

In the unlikely event a probe fails performance verification, it can be sent back to the local service center or the factory. For information on returning the probe, refer to the Returning a Probe for Calibration or Service (on page 44) or Returning a Probe to a Different Country (on page 46) topics as needed.

This procedure tests the WL-PLINK with a D600A-ATand Dx60-SI. The WL-PBUS is then tested with a D400A-AT and D4x0 SI. Both probe setups are tested for the following warranted specifications:

- Output Zero
- Low frequency attenuation accuracy at low and high voltage range
- Rise time

The rise time specification has dependency on characteristics of the probe body. Therefore, traceable calibration requires verification with a specific probe body denoted by serial number. The rise time and attenuation accuracy parameters of probe tip modules utilizing detachable tips have similar dependencies on the individual tip, which is serialized. This applies to the D6x0, and D4x0 probe tip modules.

The rise time specification for the D600A-AT and D6x0 are only valid with a WL-PLINK probe body. Rise time for the D4x0, and D400A-AT can be measured with a WL-PBUS probe body. Output zero and LF attenuation accuracy can be measured with any probe body.

If the probe package includes more than one probe tip module, e.g., a D6x0 and a D600A-AT, the entire procedure needs to be completed for each probe tip module. If more than one module is being verified, copy and fill out a separate test record for each probe, probe tip module, and interconnect lead.

NOTE: It is recommended that the Functional Check be performed prior to the Performance Verification Procedure to assure all other non-warranted functions perform as specified. For the Functional Check, refer to the Functional Test Overview (on page 56).

Required Test Equipment

The following table lists the test equipment and accessories, or their equivalents, required for performance verification of the WaveLink Series of Differential Probes.

The procedure has been developed to minimize the number of parameters requiring calibration in the test instrumentation. Only the parameters listed in boldface in the Minimum Requirements column must be calibrated to the accuracy indicated.

Because the input and output connector types may vary on different brands and models of test instruments, additional adapters or cables may be required.

Description	Minimum Requirements	Example Test Equipment
Oscilloscope, High BW [1]	BW [3] 6 GHz	Teledyne LeCroy: WaveMaster 8600A, WavePro 760 Zi, WaveMaster 806 Zi/Zi-A
Oscilloscope, High BW [2]	BW [3] 4 GHz	Teledyne LeCroy: WaveMaster 804Zi-A, WavePro 740 Zi, WaveRunner 640 Zi
Oscilloscope, High Impedance	200 mV/div - 2 V/div scale factor 1 MΩ input impedance ProBus interface	Teledyne LeCroy: WavePro 7300 or WaveRunner 6200, WavePro 735 Zi-A, WaveRunner 6 Zi
Digital Multimeter	**AC: 0.2% accuracy** to measure 200 mV and 2 V_{rms} @ 1 kHz 6½ digit resolution	Agilent Technologies: 34401A, or Fluke: 8842A-09, or Keithley: 2001
Oscillator/Function Generator	Sine Wave output, adjustable from 500 mV to 4 Vp-p (357 mV to 2.83 V_{rms}) at 70 Hz	Stanford Research: Model DS340,or Agilent Technologies: 33120A, or Leader: LAG-120B
Pulse Generator	12 ps, -5 V_{out}, 2.4 mm output	Picosecond Pulse Labs: 4015D-215
Calibration Fixture [3]	See Preliminary Procedure	Teledyne LeCroy: ProLink-CF01
Calibration Fixture [4]	See Preliminary Procedure	Teledyne LeCroy: ProBus-CF01
Terminator, Precision, BNC	50 Ω ± 0.05%	Teledyne LeCroy: TERM-CF01
Characterization Fixture [5]		Teledyne LeCroy: PCF-200
SMA to BNC Adapter	Female SMA to male BNC	Pomona Electronics: 4289

Description	Minimum Requirements	Example Test Equipment
		Pasternack Enterprises: PE9073
SMA to BNC adapter	Male SMA to female BNC	Pomona Electronics: 4290 Pasternack Enterprises: PE9074
SMA to BNC Adapter	Female SMA to female BNC	Pomona Electronics: 4291 Pasternack Enterprises: PE9075
SMA to SMA Adapter [6]	Female SMA to female SMA	Pomona Electronics: 4284 Pasternack Enterprises: PE9070
Terminator, SMA	Female SMA, 50 Ω, ½ W	Pomona Electronics: 4287 Pasternack Enterprises: PE6003
Attenuator	Male 2.4 mm to male SMA, 50 Ω, 10 dB,12 GHz	Pasternack Enterprises: PE7045-10
BNC coaxial cable, (3 ea)	Male-male BNC, 50 Ω, 36”	Pomona Electronics: 2249-C-36 Pasternack Enterprises: PE3067-36
SMA coaxial cable, (2 ea) [6]	Male-male SMA, 50 Ω, 36”	Pomona Electronics: 4846-K-24 Pasternack Enterprises: PE3369-36
SMA coaxial cable, (1 ea) [5]	Male SMA to female SMA, 50 Ω, 36”	Pomona Electronics: 4528-K-24 Pasternack Enterprises: PE3078-36
BNC Tee connector, (2ea)	Male to dual female, BNC	Pomona Electronics: 3285 Pasternack Enterprises: PE9001
Banana Plug adapter	Female BNC to dual banana plug	Pomona Electronics: 1269 Pasternack Enterprises: PE9008
ProBus to ProLink adapter [7]		Teledyne LeCroy: LPA-BNC
Adapter	Female 2.4 mm to female SMA	Pasternack Enterprises: PE9656
1 MΩ adapter [3]		Teledyne LeCroy AP-1M
Torque Wrench	for SMA connectors	

PLEASE NOTE THE FOLLOWING:

[1] Only required for verification of the D600A-AT, or D6xx-SI rise time

[2] Only required for verification of the D400A-AT or D4x0 rise time

[3] Required for WL-PLINK verification

[4] Required for WL-PBUS verification

[5] Standard accessory included with probe

[6] Instead of using a male-to-male SMA cable with a SMA-to-SMA adapter to connect to the male end of the characterization fixture, you can use a male SMA-to-female SMA cable.

[7] Only needed when testing a WL-PBUS probe for rise time with a WaveMaster 8000 oscilloscope. Not needed when using any WavePro model oscilloscope. (Adapter supplied as a standard accessory with WaveMaster 8000 oscilloscopes.)

Preliminary Procedure

When testing using a WL-PBUS, any X-Stream oscilloscope with an input impedance of 1 MΩ can be used. Using a WL-PLINK requires a WaveMaster 8000 oscilloscope with an AP-1M Hi-Z adapter to convert the 50 Ω input impedance into 1 MΩ. No external power supply is required; the ProLink-CF01 or the ProBus-CF01 are used to power the probe. When testing with a WavePro/SDA/DDA 7 Zi, no AP-1M is required.

1. Connect the WL-PLINKto the input of ProLink-CF01 Calibration Fixture. When testing the WL-PBUS connect the probe to the ProBus-CF01 Calibration Fixture (shown in the following Output Zero Voltage figure).
2. Remove the captive screws from the ProLink-CF01, allowing the WL-Plink-Case Calibration Fixture connectivity.
3. When testing using a WL-PLINK, connect the output of the ProLink-CF01 Calibration Fixture to a free channel of the WavePro (any model) or WaveMaster (using the LPA-BNC adapter, or any model Zi or Zi-A) oscilloscope. When using a WL-PBUS, connect the ProBus-CF01 to a free Channel of the 1 MΩ oscilloscope.
4. Allow at least 20 minutes warm-up time for the WaveLink probe and test equipment before performing the Verification Procedure.
5. Turn on the other test equipment and allow them to warm up for the manufacturer's recommended timeframe.
6. While the instruments are reaching operating temperature, print a copy of Appendix A - Performance Verification Test Record (on page 98), and fill in the necessary data.

Most of the warranted characteristics of the WaveLink Differential Probe are valid at any temperature within the Environmental Characteristics portion of the Specification. Visit teledynelecroy.com for specification details. However, some of the other test equipment used to verify the performance may have environmental limitations required to meet the accuracy requirements needed for the procedure. Be sure that the ambient conditions meet the requirements of all the test instruments used in the procedure.

As specified, the low frequency attenuation accuracy is valid at a reduced temperature range from 20 to 30 °C; verification, therefore, must be done at an ambient temperature within that range.

Verification Procedure

This verification procedure describes the tests, using a probe with an AT module. The procedure for testing a PT module or a Small Tip module (including D610, D620, D410, and D420) with either an SI, QC, SP, or PT interconnect lead or a Tip is identical to testing an AT module. However, the connection to the Characterization Fixture may be different.

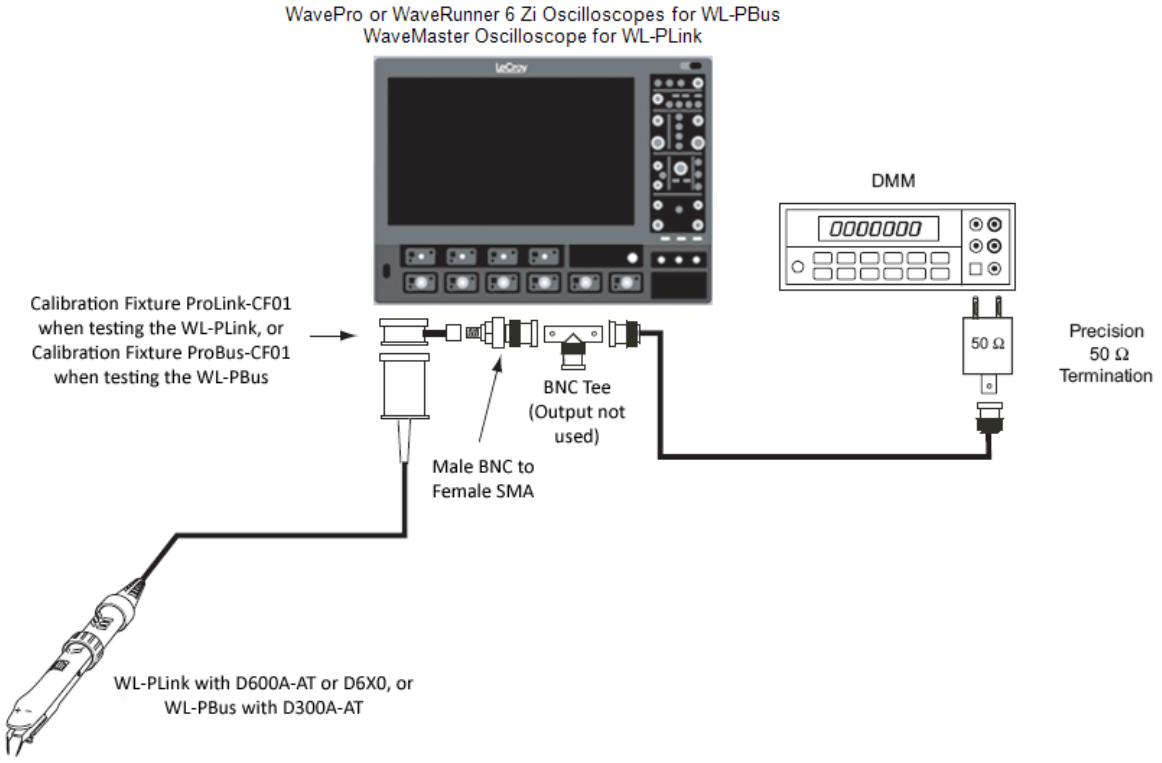
The setup and procedure for testing Output Zero and Attenuation Accuracy is the same for WL-PLINK as for WL-PBUS, except for a different oscilloscope.

Output Zero

1. Connect the appropriate calibration fixture to the output of the probe to be tested (shown in the following figure).

   NOTE: The output zero is not affected by the input leads, so any D6x0 or D4x0 interconnect lead may be used for this test.

2. Provide power to the probe by connecting the ProLink-CF01 to any input of a WavePro (any model) or WaveMaster (any model) oscilloscope.
3. No signal input connection to the oscilloscope is required for the Output Zero test.
4. For the WL-PLINK (or WL600), connect a BNC-to-SMA adapter to the SMA output connector of the ProLink-CF01 Calibration Fixture, and the BNC end to a BNC Tee (shown in the following figure). No adapter is needed for connecting the WL-PBUS (or WL300) ProBus-CF01 to a BNC TEE.
5. Connect the Precision 50 Ω Terminator, using another BNC cable, to the free end of the BNC Tee.
6. Set the DMM to DC volts.
7. Connect the Precision 50 Ω Terminator to the DMM input.
8. After a warm-up time of at least 20 minutes, measure the output voltage and record the result as Output Voltage on the Test Record.



Output Zero Voltage

9. Initiate an AutoZero
10. Wait an additional 15 minutes, then record the DMM reading to 1 mV resolution in the Test Record as Output Voltage after AutoZero.
11. Take the difference of the two readings recorded steps 8 and 10 (previous) and multiply by 2.5 when testing with a D600A-AT, D6x0, D4x0, or D400A-AT.
12. Record the result as Output Zero on the Test Record.
13. Verify the absolute value of Output Zero is less than 10 mV.

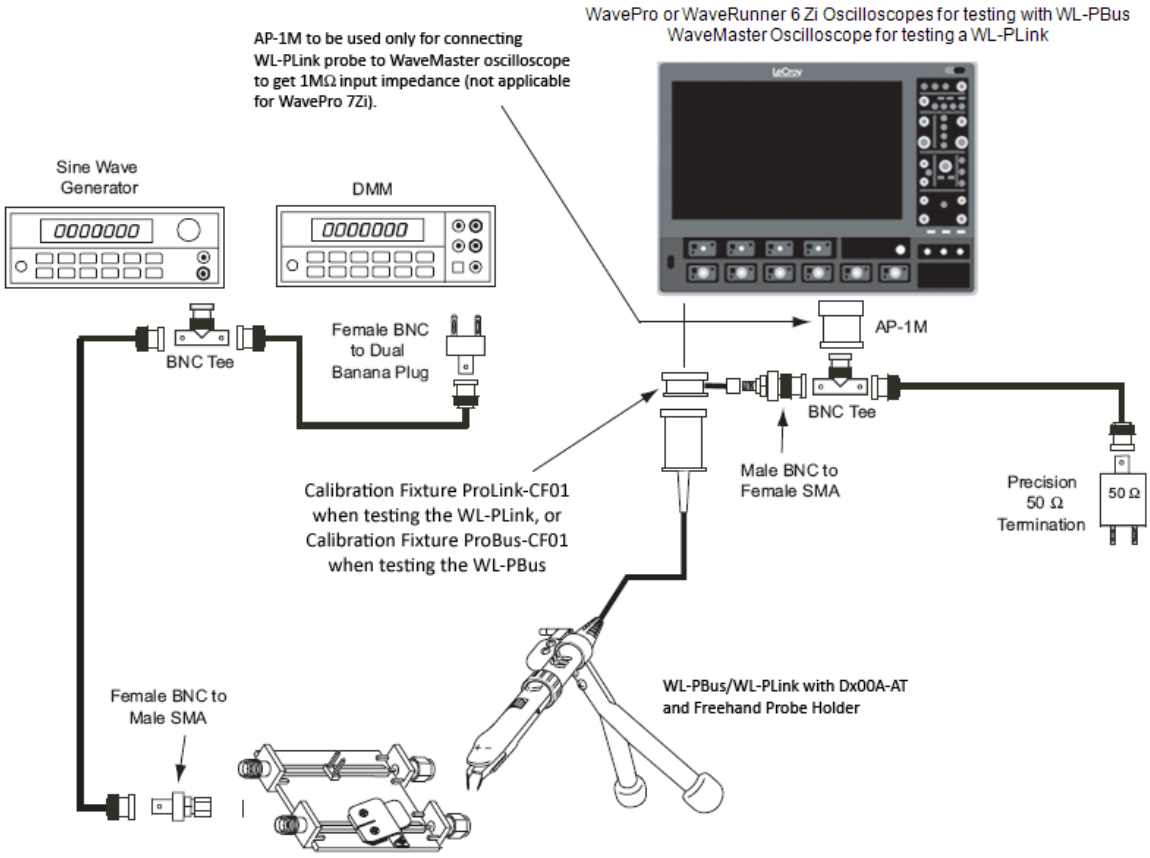
Low Voltage Low Range Attenuation Accuracy

NOTE: When verifying an ST module, the low-frequency attenuation accuracy at low and high voltage needs to be verified with each interconnect lead.

Because each PT and ST interconnect lead has its own serial number, it should be recorded **with the serial number of the probe tip module** on the Test Record.

1. Connect the male end of a BNC Tee to the Sine Wave Generator output (refer to the following figure for setup). Set the generator's output voltage to 0 Volts.
2. Connect one end of a BNC cable to the BNC Tee and the other end to a Female BNC-to-Male SMA adapter.
3. Connect the male side of the BNC-to-SMA adapter to a female end of the Characterization Fixture. Refer to the following figures to determine which side of the Characterization Fixture to use for the probe tip module and interconnect lead to be tested.
4. Connect another BNC cable to the free end of the BNC Tee and the other end of the cable to the Female BNC-to-Dual Banana Plug Adapter.
5. Connect the Banana Plug Adapter to the DMM input, verifying that the ground side of the adapter is connected to the low side of the DMM.
6. Attach a ProLink-CF01 Calibration Fixture to the WL-PLINK, or a ProBus-CF01 to the WL-PBUS probe.
7. Remove the captive screws from the ProLink-CF01 allowing the WL-PLINK Calibration Fixture connectivity.
8. Connect the Calibration Fixture to Channel 1 of the oscilloscope.
9. For the WL-PLINK connect a BNC-to-SMA adapter to the SMA output connector of the ProLink-CF01 Calibration Fixture, and the BNC end to a BNC Tee (as shown in the following figure). No adapter is needed when connecting the WL-PBUS ProBus-CF01 to the BNC TEE.
10. For WL-PLINK, to obtain 1 MΩ input impedance, connect the male side of the BNC Tee to an AP-1M Hi-Z adapter, and the adapter to a free channel of a WavePro 7 Zi and Zi-A or WaveMaster oscilloscope.
11. For a WL-PBUS, connect the male side of the BNC Tee to a free channel of the non-7 Zi WavePro oscilloscope.

12. This input is used to observe the probe's output signal in order to verify adequate Characterization Fixture contact.



WL-PBUS/WL-PLINK with a Dx00A-AT Measuring Input Voltage

13. Connect the Precision 50 Ω Terminator via another BNC cable to the free end of the BNC Tee.

14. Leave the unused end of the Precision Terminator floating for the time being.

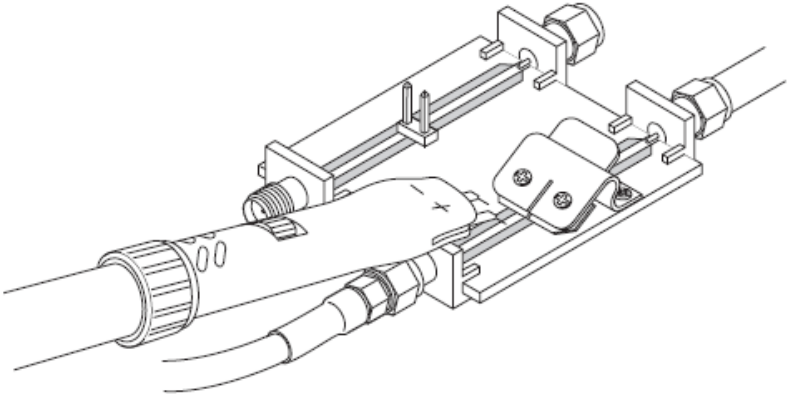
15. Select the channel to which the BNC tee is connected and set the channel's sensitivity to 0.1 V/DIV. Verify that the input coupling is set to DC and the input resistance to 1 MΩ. Do not terminate the BNC Tee adapter into 50 Ω.

NOTE: The following steps and figures show how to connect the different modules to the characterization fixture.

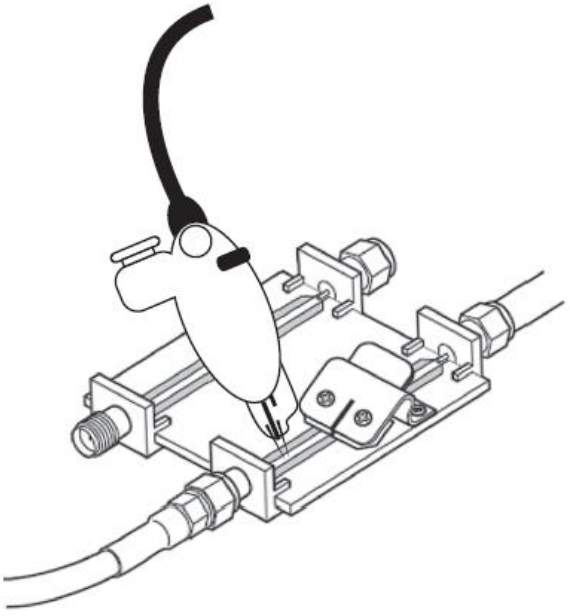
CONNECTING THE AT MODULE TO THE CHARACTERIZATION FIXTURE

Connect the AT module to the fixture. The following figure shows which side to use.

When testing the probe with an Adjustable Tip module, use the FreeHand Probe Holder for stability and easy measuring. Adjust the tips so one makes contact with the center strip of the Characterization Fixture, and the other tip with one of the side ground strips.



CONNECTING THE PT MODULE TO THE CHARACTERIZATION FIXTURE



CONNECTING SI, QC AND SP MODULES TO THE FIXTURE

1. The ST and QC leads should be connected with the ends of the damping resistors placed under the clip (as follows). Be sure to press down on the plastic tab to lift the clip and slide the wires under the clip, verifying the **+** side is located over the center strip and the **–** side over the ground plane on either side of the center strip. Release the tab.

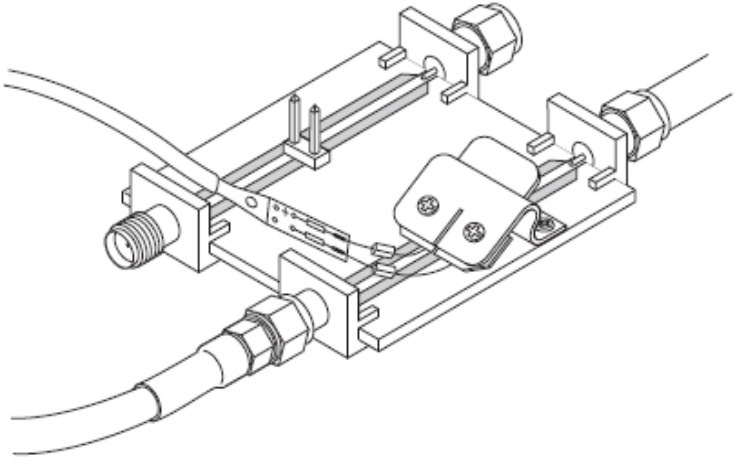
   The SP lead should plug onto the square pins located on the fixture as the following SP to Characterization Fixture Connection drawing shows.

2. Set the DMM to read AC.
3. Set the sine wave generator to about 70 Hz and the output when testing with a D600A-AT, D6x0, D4x0, and D400A-AT to 1.0 Vp-p (0.353 Vrms), as indicated on the DMM.
4. If necessary, move the AT module so the tips make good contact to get the proper amplitude (about 4 divisions) on the oscilloscope.
5. With good probe tip contacts verified, record the DMM reading to 1 mV resolution in the Test Record as Probe Low Range Input Voltage.
6. Unplug the BNC to Banana Plug Adapter from the DMM and connect the Precision 50 Ω Terminator to the DMM input (shown as follows).
7. After the DMM has stabilized, record the reading to 1 mV resolution in the Test Record as Probe Low Range Output Voltage.
8. Take the probe's attenuation into account by multiplying the reading recorded 3 steps prior (for Probe Low Range Input Voltage) for the D600A-AT, D6x0, D4x0, or D400A-AT modules by 2.5. Record the result as Corrected Low Range Output Voltage on the test record.
9. Divide the Output Voltage (obtained 2 steps prior) by the Input Voltage (obtained 4 steps prior). Subtract the ratio from 1.0 and multiply the result by 100% for the error percentage.

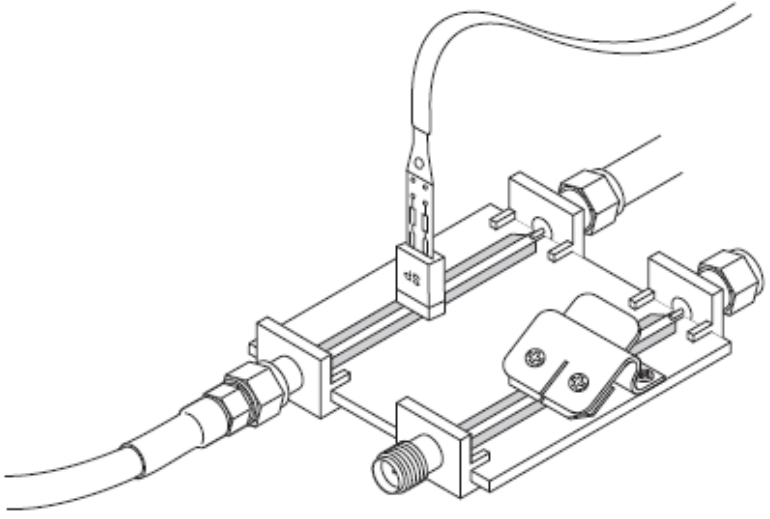
$$Error = \left(1 - \frac{Corrected\ Probe\ Output\ Voltage}{Probe\ Input\ Voltage}\right) x100\%$$

10. Record the result to two decimal places (±0.xx %) as Low Range Attenuation Error on the Test Record.
11. Ensure the calculated Low Voltage Attenuation Error is less than ±2%.
12. When testing an ST module, repeat these steps for the other interconnect leads. Use a new test record sheet for each probe.

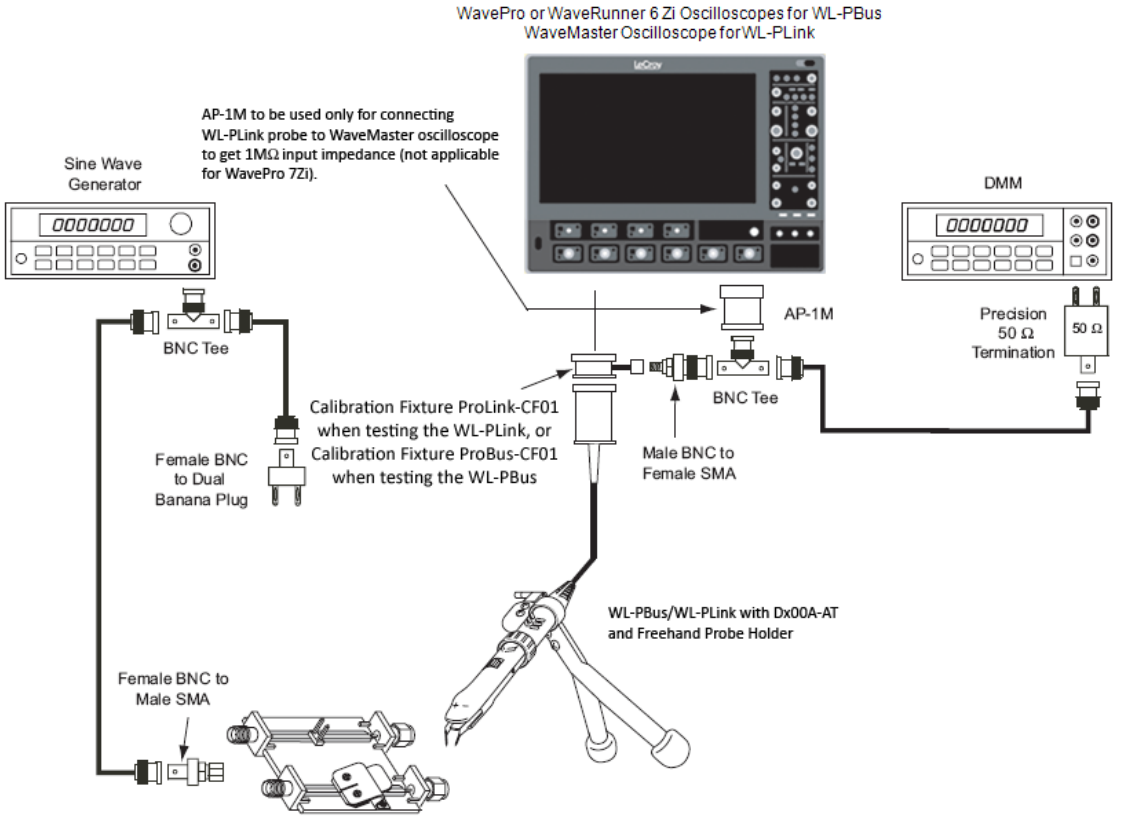
Use this same setup for the next procedure.



SI and QC to Characterization Fixture Connection



SP to Characterization Fixture Connection



WL-PBUS or WL-PLINK with a Dx00A-AT measuring Output Voltage.

High Range Attenuation Accuracy

NOTE: Similar to the Low Range Attenuation Accuracy section, the following steps are performed on all interconnect leads.

1. Unplug the Precision 50 Ω Terminator and BNC cable from the DMM, and reconnect the BNC cable with the BNC-to-Banana Plug Adapter to the DMM input (as the previous figure shows).
2. Set the oscilloscope scale factor to the maximum V/DIV. Verify the Coupling is set to 1 MΩ and DC.
3. Set the output voltage of the sine wave generator when testing the D600A-AT, D6x0, D4x0, D400A-AT to 4.0 Vp-p (1.414 Vrms) as indicated on the DMM. Leave the frequency at 70 Hz.

4. Observe the oscilloscope's display and verify the probe tips are making good contact with the Characterization Fixture.
5. Record the DMM reading to 1 mV resolution as Probe High Range Input Voltage on the Test Record.
6. Disconnect the BNC-to-Banana Plug Adapter from the DMM and reconnect the Precision 50 Ω Terminator to the DMM input (as the previous SP to Characterization Fixture Connection figure shows).
7. After the DMM has stabilized, record the reading to 1 mV resolution on the Test Record as Probe High Range Output Voltage.
8. Multiply the reading recorded in the previous step for the D600A-AT, D6x0, or D400A-AT modules by 2.5; and for the D4x0 module, by 5. Record the result as Corrected High Range Output Voltage on the Test record.
9. Divide the calculated output voltage obtained in the previous step by the input voltage obtained 4 steps prior. Subtract the ratio from 1.0 and multiply the result by 100% to get the error percentage.

$$Error = \left(1 - \frac{Corrected\ Probe\ Output\ Voltage}{Probe\ Input\ Voltage}\right) x100\%$$

10. Record the result to two decimal places (±0.xx %) as High Range Attenuation Error on the Test Record. Ensure that the calculated High Voltage Attenuation Error is less than ±5% Rise (Fall) Time (10% to 90%).

Rise Time

Measuring the probe's rise time cannot be done directly and must be done in an indirect manner. First, the rise time of the total system must be measured (meaning, the pulse generator, characterization fixture with probe connected, and the oscilloscope). Second, the rise time of the probe's output is measured. These two measurements determine the rise time of the probe.

When testing the WL-PLINK probe for rise time, use the very high bandwidth WavePro 7 Zi and Zi-A or WaveMaster 8 Zi and Zi-A oscilloscope. However, when using a WaveMaster oscilloscope with the WL-PBUS, you need to use the LPA-BNC ProBus-to-ProLink adapter to connect the WL-PBUS probe to the WaveMaster oscilloscope.

Refer to the Dx00A-AT to Characterization Fixture Connection and the SI and QC to Characterization Fixture Connection figures to properly connect the Dx00A-AT, D6x0-SI, or D4x0-SI Tips/Leads.

1. Connect a female 2.4 mm-to-female SMA adapter to the output of the pulse generator's pulse head; and one side of a male SMA-to-male SMA cable to the adapter and the other side to a 10 dB attenuator.

   NOTE: When fastening a SMA connector, always use the SMA Torque Wench to tighten the connector to 8 in-lbs.

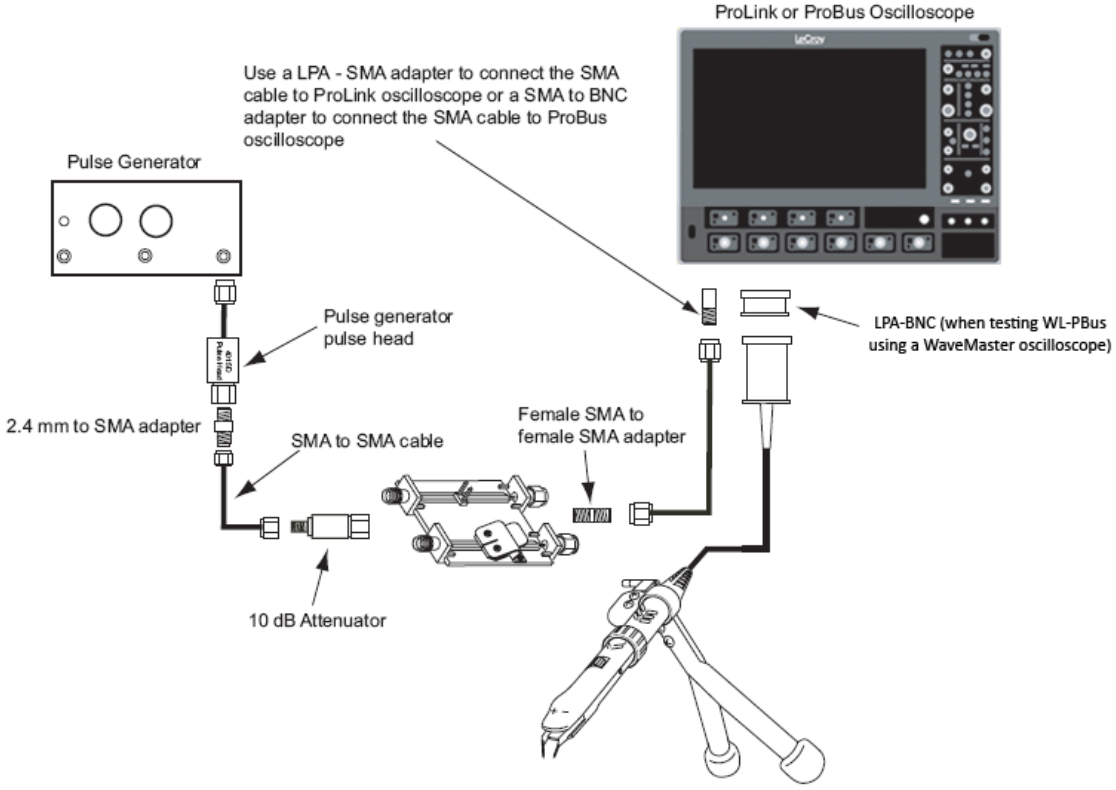
2. Connect the male side of the attenuator to one of the female sides of the Characterization Fixture (as follows).
3. Set the oscilloscope vertical to Channel 1, the input coupling to DC 50 Ω, the scale factor when testing a D600A-AT, D6x0-SI, D4x0-SI, or D400A-AT to 0.2 V/div.
4. On the oscilloscope, select Vertical → Invert.
5. Connect another SMA cable via a female-to-female SMA connector to the male output of the Fixture and the other end of the cable to an LPA-to-SMA adapter when connecting a WL-PLINKto a ProLink oscilloscope, or to a SMA-to-BNC adapter when connecting a WL-PBUS probe to a ProBus oscilloscope. Connect either adapter to Channel 1 of the oscilloscope.

   A female-to-male SMA cable, if available, can be used instead of a male-to-male SMA cable with a female-to-female SMA adapter to connect the Fixture to the oscilloscope.
6. Connect the probe tip to the Characterization Fixture, as shown in the previous Dx00A-AT to Characterization Fixture Connection, and Dx10/Dx20-PT Characterization Fixture Connection figures.

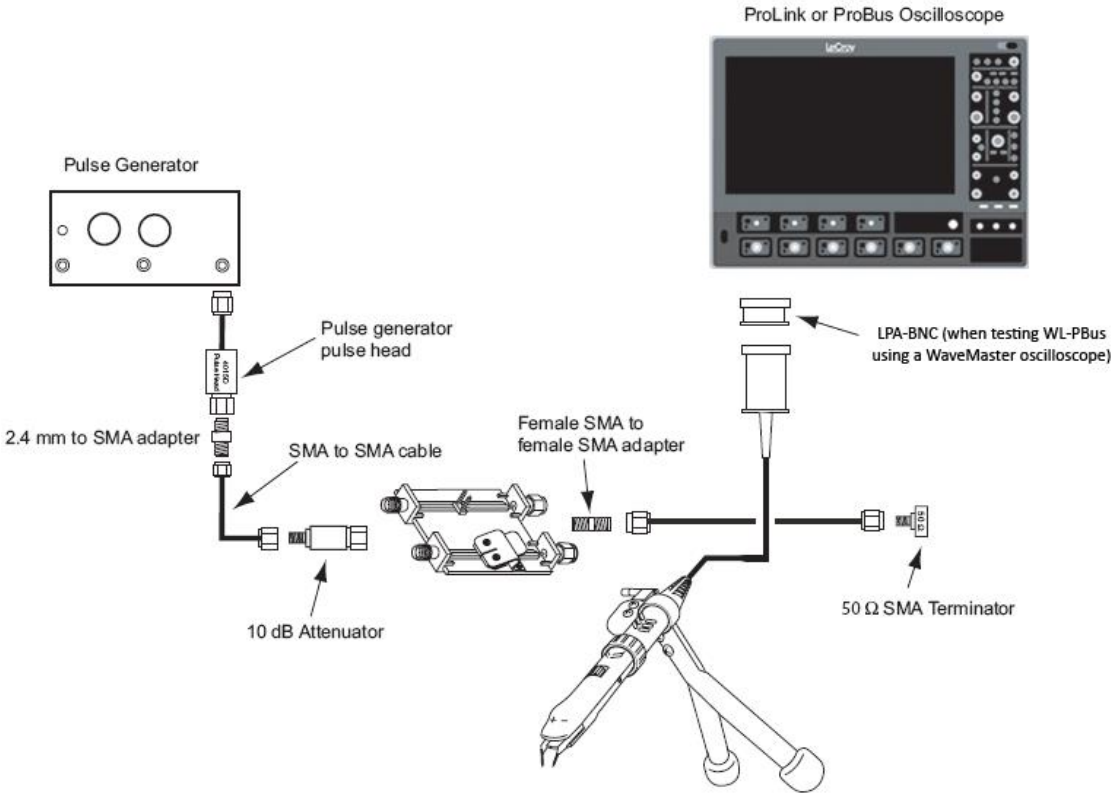
   TIP: When testing the probe with an adjustable tip module, use the FreeHand Probe Holder for stability and easy measuring. Adjust the tips of the Adjustable Tip Module so one tip makes contact with the center strip of the Characterization Fixture and the other with one of the side ground strips.

7. Verify a good contact is made between the adjustable tip and the Characterization Fixture by connecting the output of the probe to Channel 2 of the appropriate oscilloscope. Verify the vertical input is set to Channel 2, the input coupling to DC 50 Ω, and the scale factor to 0.2 V/div. The displayed signal should be a negative going pulse about 3 divisions high.

   TIP: When testing a WL-PBUS using a WaveMaster instead of a WavePro oscilloscope, connect the LPA-BNC to the WL-PBUS before connecting the probe to the oscilloscope.



Measuring System Rise Time



Measuring System Rise Time with Probe

8. Measure the system rise time by setting the oscilloscope to Channel 1 and adjusting the variable scale factor to obtain a pulse height of 6 divisions. Adjust the OFFSET to center the displayed pulse on the center graticule line.
9. Set the oscilloscope bandwidth to FULL, triggering from Channel 1, select the RIS method, set the timebase to 20 ps/div and adjust the trigger for a stable display.
10. Record the measured 10% to 90% rise time as System rise time (tsys) on the Test Record.
11. Measure the probe's rise time by disconnecting the SMA cable from either the LPA-to-BNC adapter or the SMA-to-BNC adapter, and connect it to the female SMA 50 Ω terminator (shown on the previous Measuring System Rise Time figure).
12. Remove the LPA-to-SMA or the SMA-to-BNC adapter from Channel 1. Set the Channel 1 scale factor to 0.1 V/div, the input coupling to DC 50 Ω and triggering from Channel 1.

13. Disconnect the probe output from Channel 2 and connect it to Channel 1, taking care not to disturb the Adjustable Tip module setup with the Characterization Fixture.
14. Use the variable scale factor to obtain a pulse height of about 6 divisions. Adjust the OFFSET to center the displayed pulse around the center graticule line.
15. Measure the 10% to 90% rise time and record the measurement as Rise time with probe (t2) on the Test Record.
16. Calculate the probe's rise time by taking the square root of the difference of $(t_{sys})^2$ and $(t_2)^2$.

$$Probe\ Rise\ Time\ =\ \sqrt{(t_2)^2 - (t_{sys})^2}$$

17. Record the calculated rise time as Probe Rise Time on the Test Record.

This concludes the Performance Verification Procedure.

Reference Material

Specifications

NOTE: Specifications are subject to change without notice.

Please refer to the Teledyne LeCroy website at teledynelecroy.com for detailed specification information.

Regional Service Centers

Contact Teledyne LeCroy for sales, support, and service at the location nearest you.

Teledyne LeCroy Service Centers World Wide	
United States and Canada - World Wide Corporate Office Teledyne LeCroy 700 Chestnut Ridge Road Chestnut Ridge, NY, 10977-6499 teledynelecroy.com Phone: 800-553-2769 or 845-425-2000 Fax: 845-578-5985 **Support:** contact.corp@teledynelecroy.com **Sales:** customersupport@teledynelecroy.com	***United States - Protocol Solutions Group*** Teledyne LeCroy 3385 Scott Boulevard Santa Clara, CA, 95054 teledynelecroy.com Fax: 408-727-0800 **Sales and Service:** Phone: 800-909-7211 or 408-727-6600 contact.corp@teledynelecroy.com **Support:** Phone: 800-909-7112 or 408-653-1260 psgsupport@teledynelecroy.com
European Headquarters Teledyne LeCroy SA 4, Rue Moïse Marcinhes Case postale 341 1217 Meyrin 1 Geneva, Switzerland teledynelecroy.com/europe Phone: + 41 22 719 2228 / 2323 / 2277 Fax: +41 22 719 2233 contact.sa@teledynelecroy.com applications.indirect@teledynelecroy.com **Protocol Analyzers:** +44 12 7650 3971	***Singapore*** **Oscilloscopes:** Teledyne LeCroy Singapore Pte Ltd. Blk 750C Chai Chee Road #02-08 Chai Chee @ Technopark Singapore 469003 Phone: ++ 65 64424880 Fax: ++ 65 64427811 **Protocol Analyzers:** Genetron Singapore Pte Ltd. 37 Kallang Pudding Road, #08-08 Tong Lee Building Block B Singapore 349315 Phone: ++ 65 9760-4682

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China Teledyne LeCroy Beijing Beijing Office and Service Center Rm. 2001 - Office; Rm. 2002 - Service Center Unit A, Horizon Plaza No. 6, Zhichun Road, Haidian District Beijing 100088, China **Sales:** ++86 10 8280 0318 / 0319 / 0320 **Service:** ++86 10 8280 0245 Fax: +86 10 8280 0316	***Taiwan*** Lecoln Technology Co Ltd. Far East Century Park, C3, 9F No. 2, Chien-8th Road Chung-Ho Dist., New Taipei City Taiwan Phone: ++ 886 2 8226 1366 Fax: ++ 886 2 8226 1368 sales_twn@teledynelecroy.com
Korea Teledyne LeCroy Korea 10th fl.Ildong Bldg. 968-5 Daechi-dong, Gangnam-gu Seoul 135-280, Korea Phone: ++ 82 2 3452 0400 Fax: ++ 82 2 3452 0490	***Japan*** Teledyne LeCroy Japan Hobunsya Funchu Bldg, 3F 3-11-5, Midori-cho, Fuchu-Shi Tokyo 183-0006, Japan Phone: ++ 81 4 2402 9400 Fax: ++ 81 4 2402 9586 teledynelecroy.com/japan

Warranty

Teledyne LeCroy warrants this oscilloscope accessory for normal use and operation within specification for a period of one year from the date of shipment. Spare parts, replacement parts and repairs are warranted for 90 days.

In exercising its warranty, Teledyne LeCroy, at its option, will either repair or replace any assembly returned within its warranty period to the Customer Service Department or an authorized service center. However, this will be done only if the product is determined by Teledyne LeCroy's examination to be defective due to workmanship or materials, and the defect is not caused by misuse, neglect, accident, abnormal conditions of operation, or damage resulting from attempted repair or modifications by a non-authorized service facility.

The customer will be responsible for the transportation and insurance charges for the return of products to the service facility. Teledyne LeCroy will return all products under warranty with transportation charges prepaid.

This warranty replaces all other warranties, expressed or implied, including but not limited to any implied warranty of merchantability, fitness or adequacy for any particular purposes or use. Teledyne LeCroy shall not be liable for any special, incidental, or consequential damages, whether in contract or otherwise.

Safety Instructions

This section contains instructions that must be observed to keep this oscilloscope accessory operating in a correct and safe condition. You are required to follow generally accepted safety procedures in addition to the precautions specified in this section**. The overall safety of any system incorporating this accessory is the responsibility of the assembler of the system.**

Symbols

These symbols appear on the probe body or in this manual to alert you to important safety considerations.

Potential for damage to probe or instrument it is connected to. Attend to the accompanying information to protect against personal injury or damage. Do not proceed until conditions are fully understood and met.

Potential Electrostatic Discharge (ESD) hazard. The probe is susceptible to damage if anti-static measures are not taken.

Precautions

Connect and disconnect properly. Connect probe to the measurement instrument before connecting the test leads to a circuit/signal being tested.

Use only within operational environment listed. Do not use in wet or explosive atmospheres.

Use indoors only.

Keep product surfaces clean and dry.

Be careful with sharp tips. The tips may cause bodily injury if not handled properly.

Use only accessories compatible with the probe. Use only accessories that are shipped with the product.

Observe all terminal ratings. To avoid electric shock or probe damage, do not use the probe above the input limits shown on the probe.

Avoid damaging the cable through excessive bending.

Do not operate with suspected failures. Do not use the probe if any part is damaged. Cease operation immediately and sequester the probe from inadvertent use.

Operating Environment

The accessory is intended for indoor use and should be operated in a clean, dry environment. Before using this product, ensure that its operating environment is maintained within these parameters:

Temperature: 5° to 40° C.

Humidity: Maximum relative humidity 90 % for temperatures up to 31° C decreasing linearly to 50 % relative humidity at 40° C.

Altitude: Up to 10,000 ft (3,048 m).

Certifications

This section contains the instrument's Electromagnetic Compatibility (EMC), Safety and Environmental certifications.

EMC Compliance

EC Declaration of Conformity - EMC

The probe meets intent of EC 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, EN 61326-2-1:2006 EMC requirements for electrical equipment for measurement, control, and laboratory use.

Electromagnetic Emissions:

CISPR 11:2003, Radiated and Conducted Emissions Group 1, Class A [1] [2]

Electromagnetic Immunity:

EN 61000-4-2:2001 Electrostatic Discharge, 4 kV contact, 8 kV air, 4 kV vertical/horizontal coupling planes [3]

EN 61000-4-3:2006 RF Radiated Electromagnetic Field, 3 V/m, 80-1000 MHz; 3 V/m, 1400 MHz - 2 GHz; 1 V/m, 2 GHz - 2.7 GHz [3]

1 Emissions which exceed the levels required by this standard may occur when the probe is connected to a test object.

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

3 Meets Performance Criteria "B" limits of the respective standard: during the disturbance, product undergoes a temporary degradation or loss of function or performance which is self-recoverable.

European Contact:

Teledyne LeCroy Europe GmbH
Waldhofer Str 104
D-69123 Heidelberg
Germany
Tel: (49) 6221 82700

AUSTRALIA & NEW ZEALAND DECLARATION OF CONFORMITY—EMC

Probe complies with the EMC provision of the Radio Communications Act per the following standards, in accordance with requirements imposed by Australian Communication and Media Authority (ACMA):

CISPR 11:2003 Radiated and Conducted Emissions, Group 1, Class A, in accordance with EN61326-1:2006 and EN61326-2-1:2006.

Australia / New Zealand Contacts:

Vicom Australia Ltd.
1064 Centre Road
Oakleigh, South Victoria 3167
Australia

Vicom New Zealand Ltd.
60 Grafton Road
Auckland
New Zealand

Safety Compliance

EC Declaration of Conformity – Low Voltage

The probe meets intent of EC Directive 2006/95/EC for Product Safety. Compliance was demonstrated to the following specifications as listed in the Official Journal of the European Communities:

EN 61010-1:2010 Safety requirements for electrical equipment for measurement, control, and laboratory use – Part 1: General requirements

EN 61010-031/A1:2008 Safety requirements for electrical equipment for measurement, control, and laboratory use – Part 031: Safety requirements for hand-held probe assemblies for electrical measurement and test.

Environmental Compliance

End-Of-Life Handling

The probe is marked with this symbol to indicate that it complies with the applicable European Union requirements to Directives 2002/96/EC and 2006/66/EC on Waste Electrical and Electronic Equipment (WEEE) and Batteries.

The probe is subject to disposal and recycling regulations that vary by country and region. Many countries prohibit the disposal of waste electronic equipment in standard waste receptacles. For more information about proper disposal and recycling of your Teledyne LeCroy product, please visit teledynelecroy.com/recycle.

Restriction of Hazardous Substances (RoHS)

The probe conforms to 2011/65/EU RoHS2 Directive based on the fact that it is classified as Industrial Monitoring and Control Instrument (per Article 3, Paragraph 24) and these product(s) & associated accessories are exempt from RoHS compliance until 22 July 2017 (per Article 4, Paragraph 3).

ISO Certification

Manufactured under an ISO 9000 Registered Quality Management System. Visit teledynelecroy.com to view the certificate.

Probe Input Loading

Attaching any probe to a test circuit adds some loading to the circuit under test. In most applications the high impedance of the probe, compared to the impedance of the circuit under test, imparts an insignificant load to the test circuit. However, at very high frequencies the capacitive reactance of the Probe Tip Module or Interconnect Lead may load the circuit enough

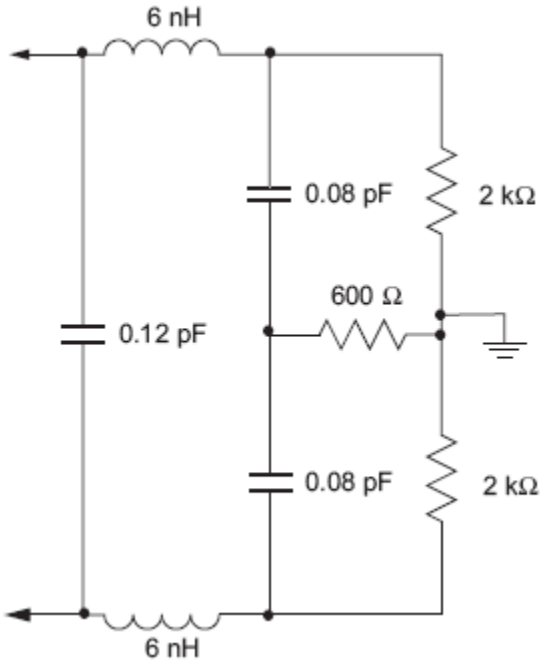
to affect the measurement. These probes are designed to minimize these effects at high frequencies. Refer to the figures in this topic for equivalent input circuit information.

These circuits represent the aggregate load placed on the test circuit, but not the actual input circuit of the probe. For critical applications, you can enter the information of your module or lead into SPICE to accurately represent the probe loading.

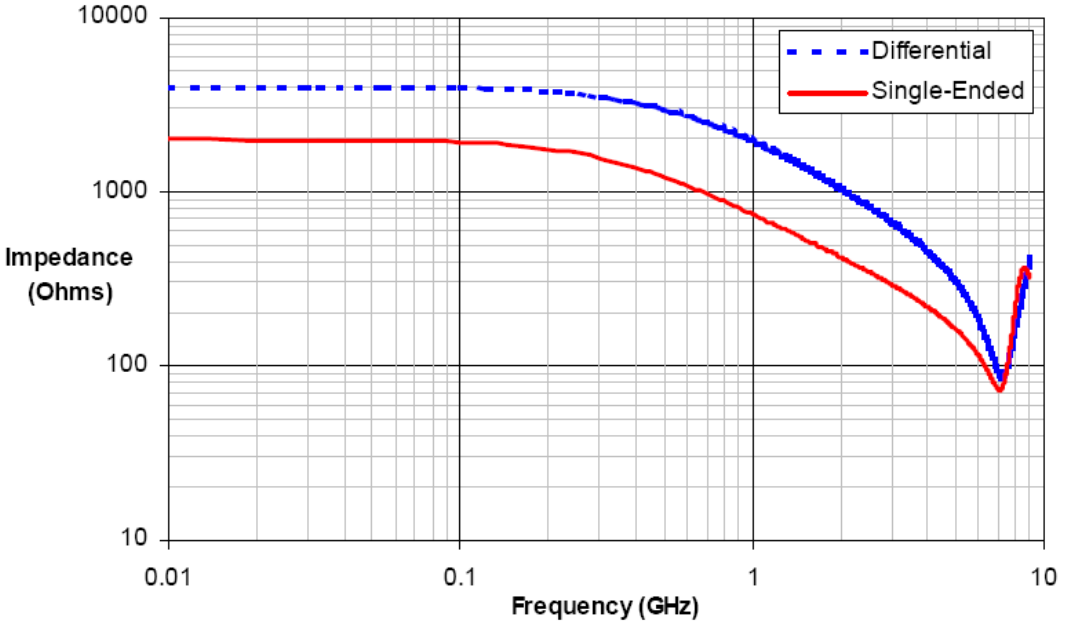
NOTE: Avoid degrading the high frequency performance of the probe and **do not** extend the input pins on the module.

To help determine the loading of the probe, some of the figures in this topic show loading impedance plots for the different modules and leads. For more information on probe loading, please refer to the **Probe Characterization** topic.

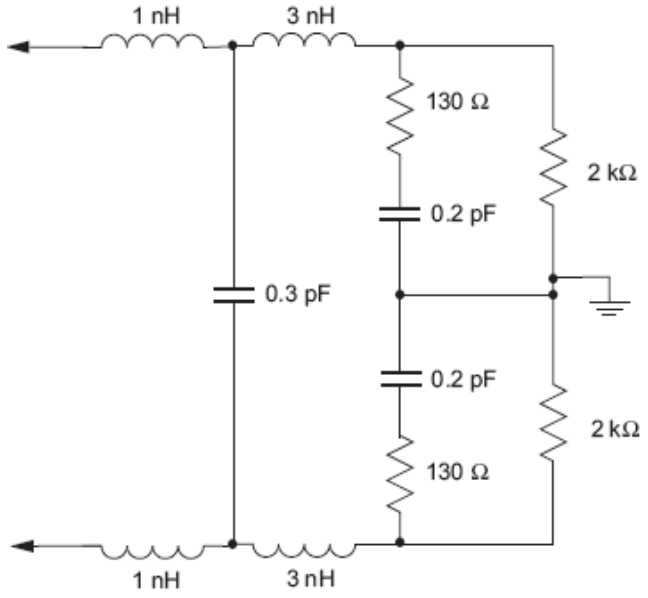
Input Loading on Dx00A-AT



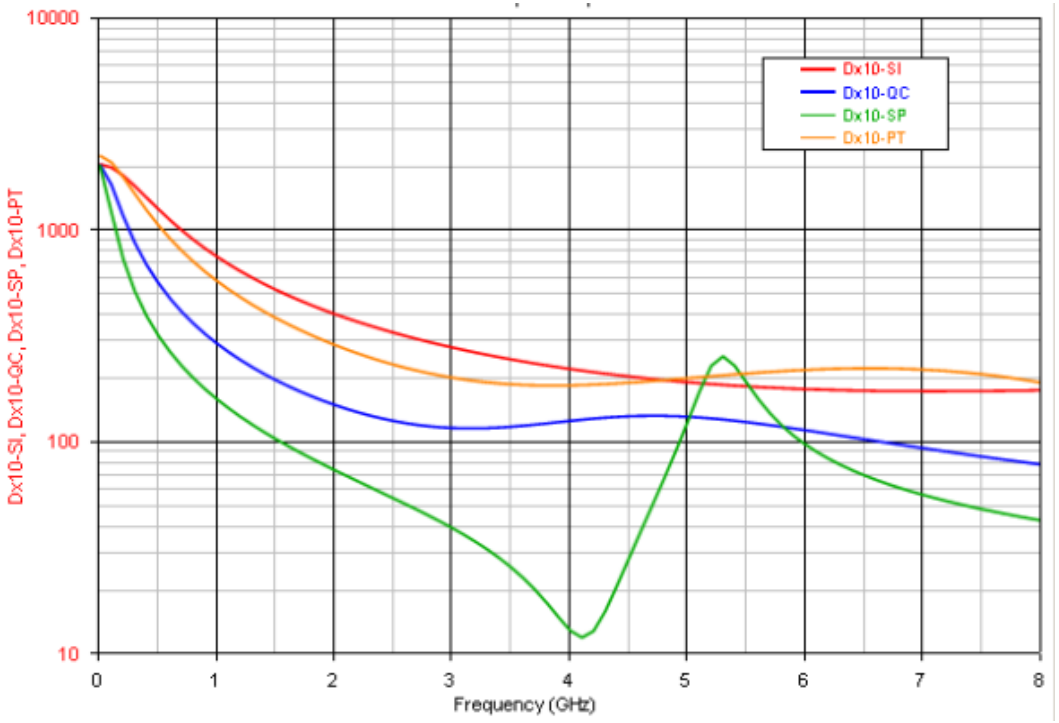
D600A-AT, D400A-AT Equivalent Input Circuit



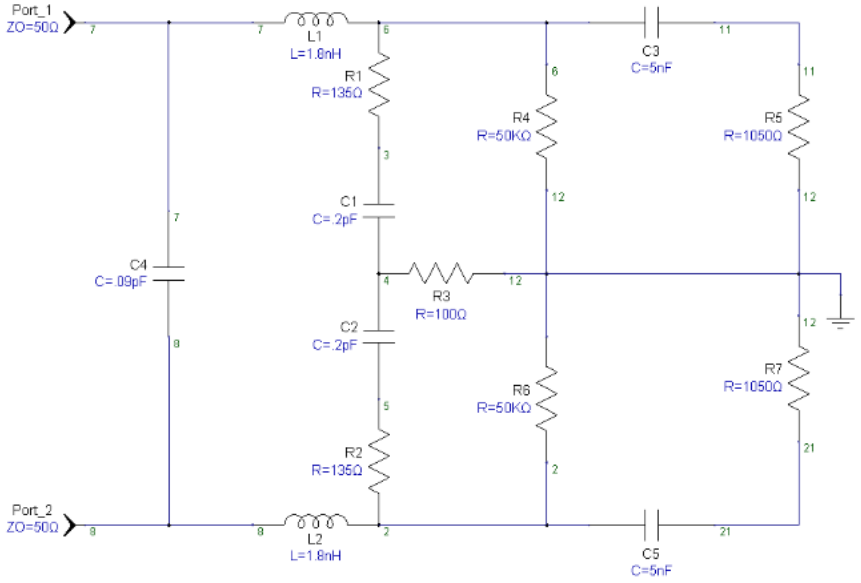
D600A-AT, D400A-AT Loading Impedance



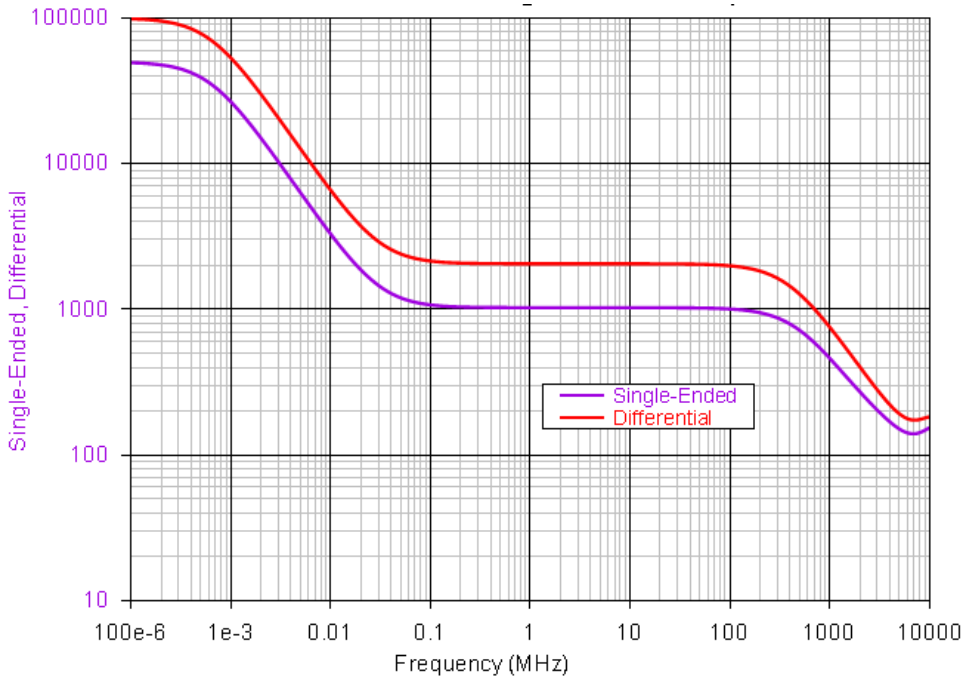
Input Loading on Dx10 Tips



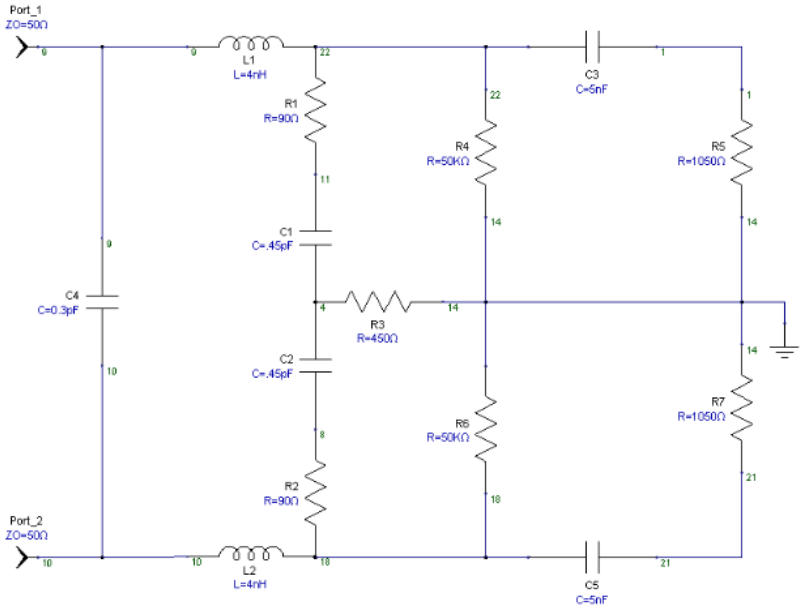
Dx10 SI/QC/SP/PT Input Impedance



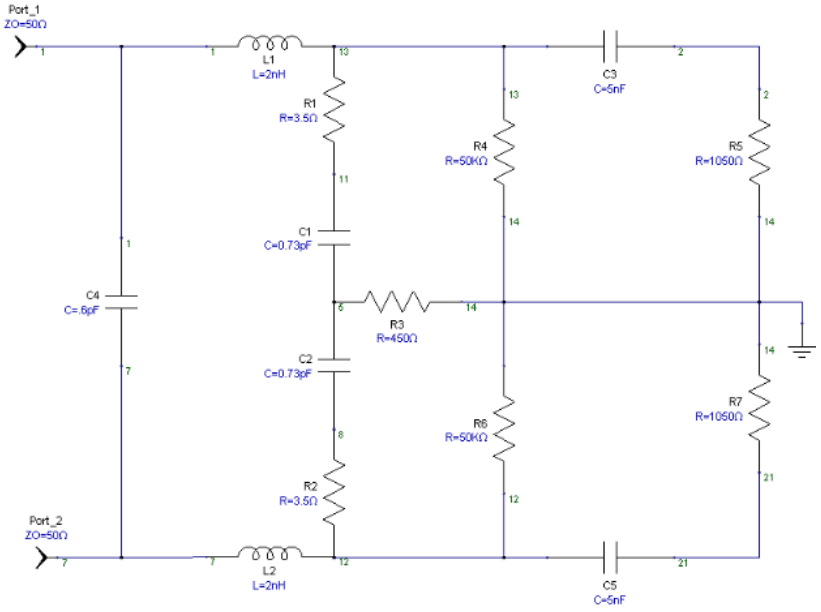
Dx10-SI Equivalent Input Circuit



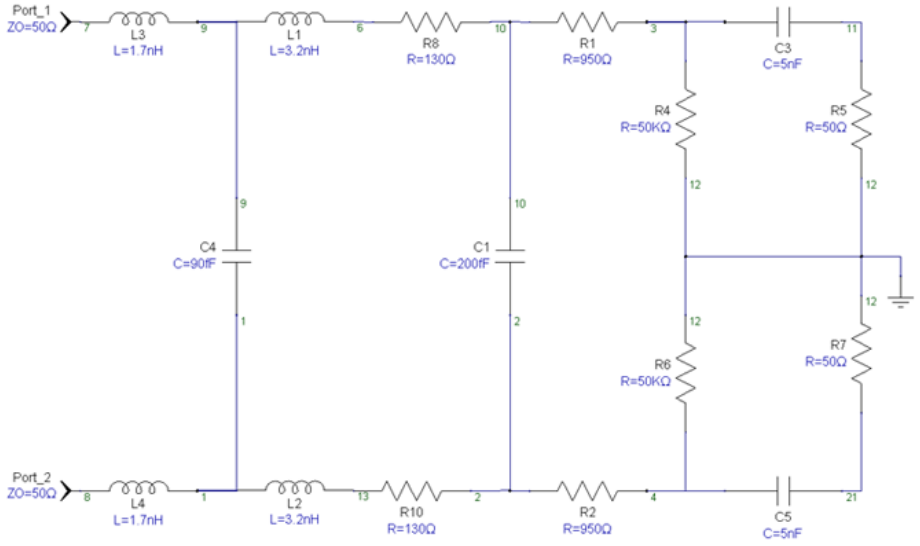
Dx10-SI Single-ended Impedance



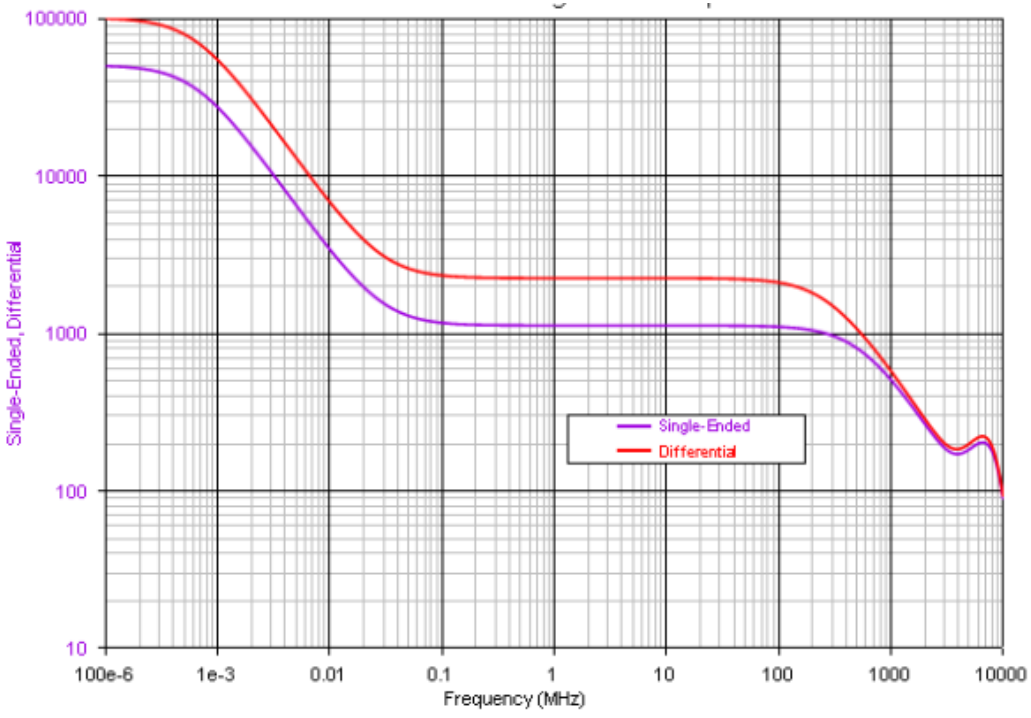
Dx10-QC Equivalent Input Circuit



Dx10-SP Equivalent Input Circuit

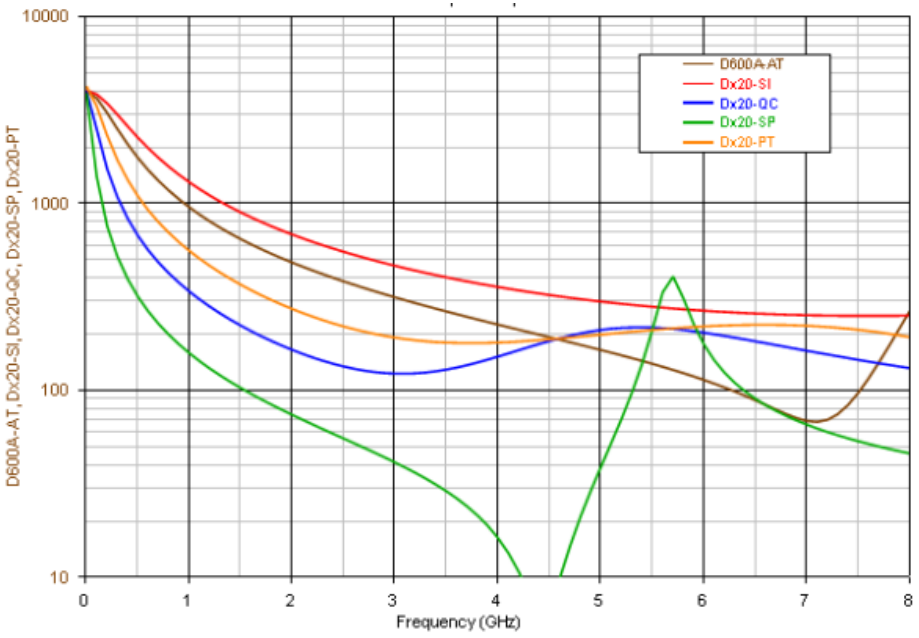


Dx10-PT Equivalent Input Circuit

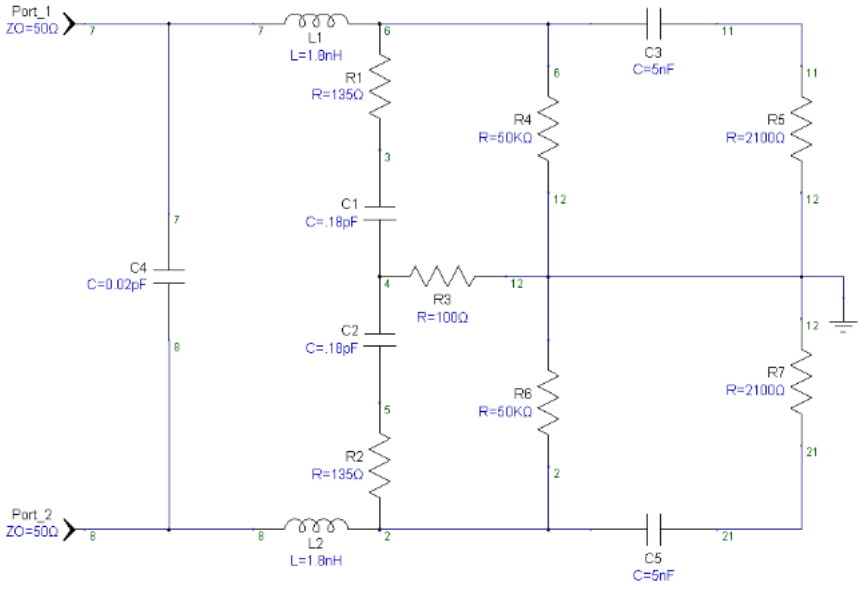


Dx10-PT Impedance Graph

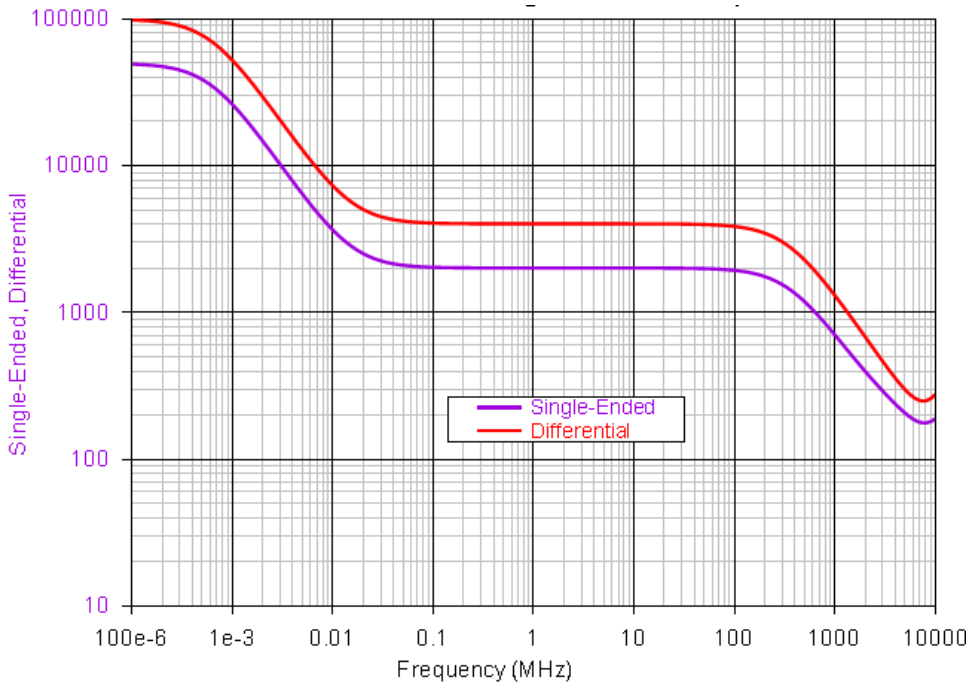
Input Loading on Dx20 Tips



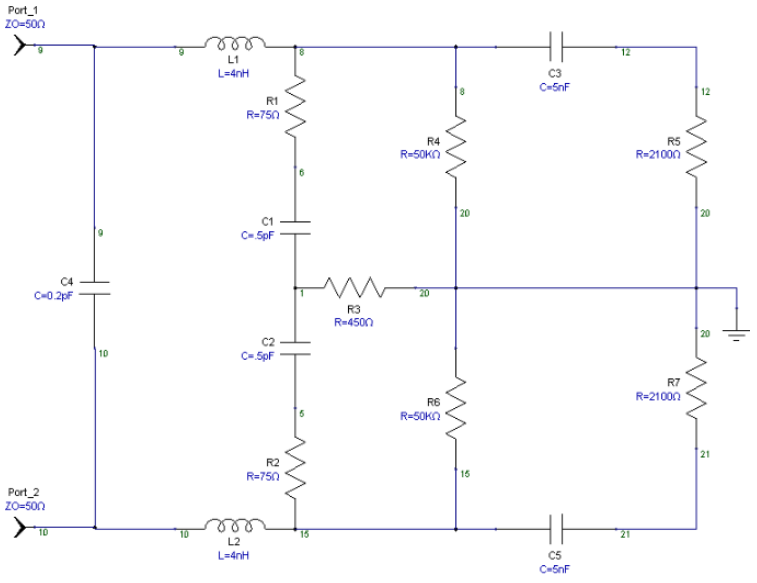
Dx20 SI/QC/SP/PT and D600A-AT Input Impedance



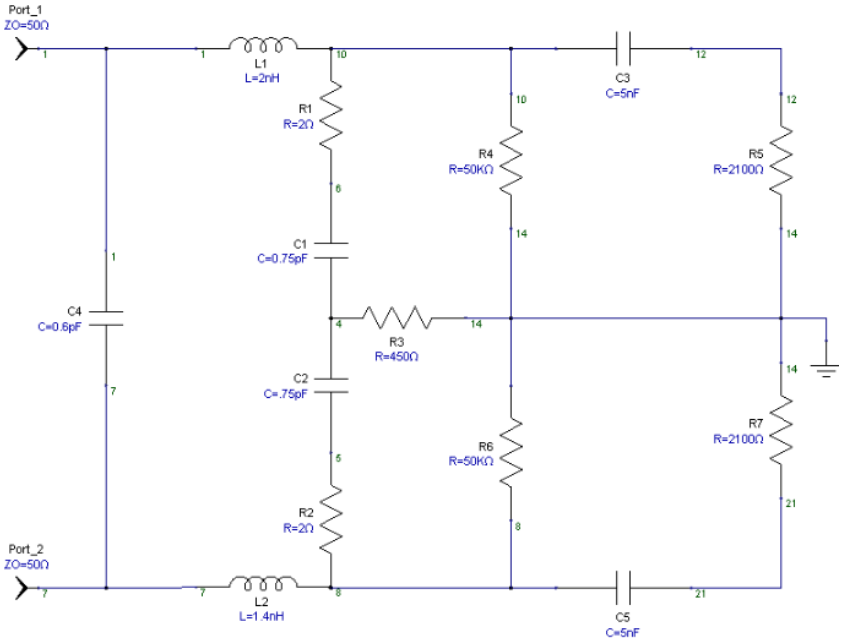
Dx20-SI Equivalent Input Circuit



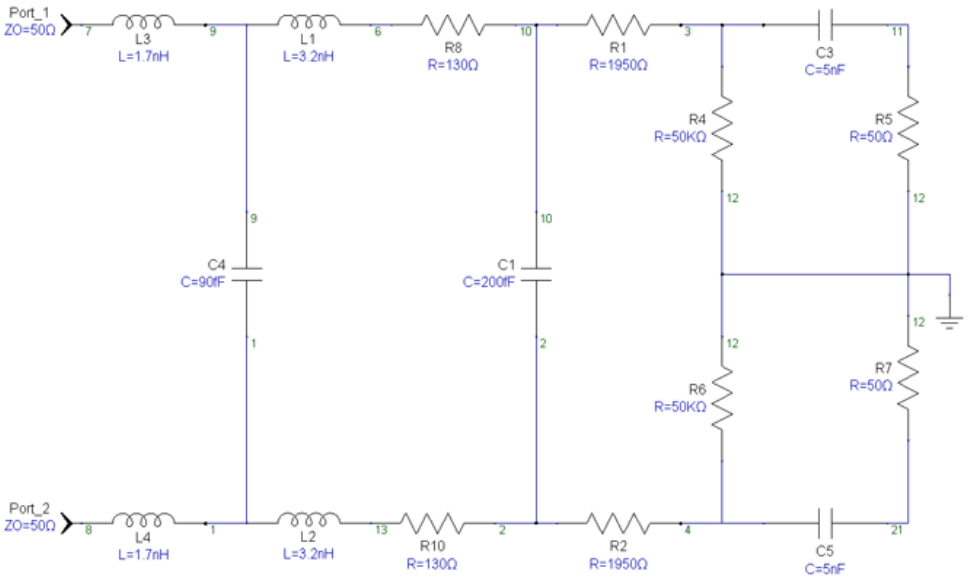
Dx20-SI Impedance Graph



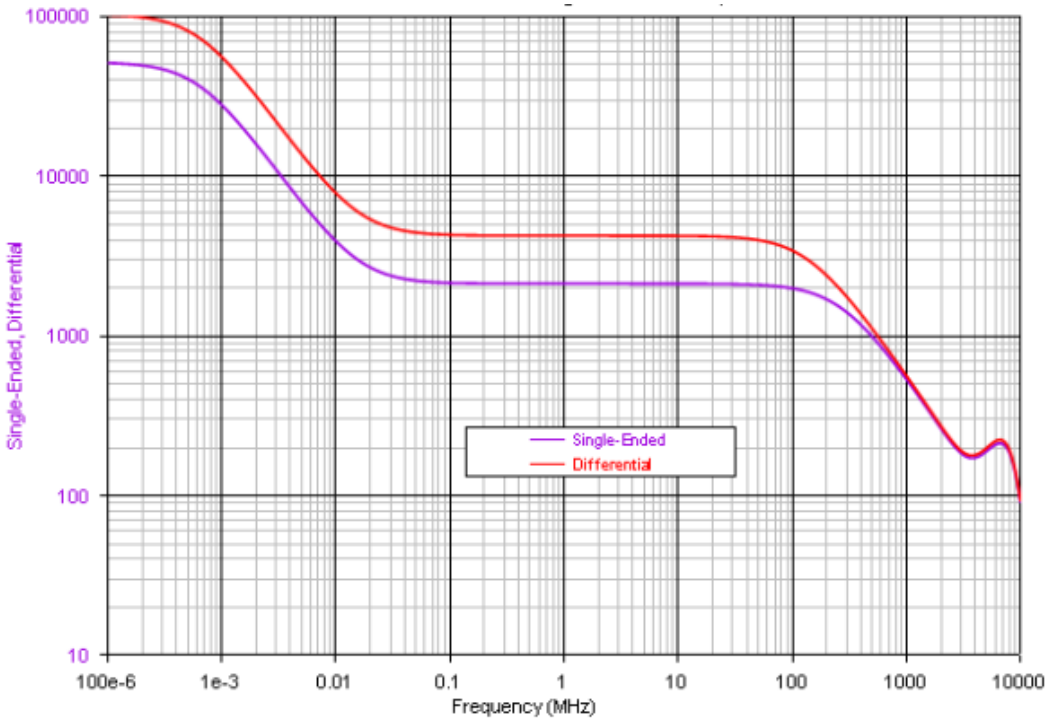
Dx20-QC Equivalent Input Circuit



Dx20-SP Equivalent Input Circuit



Dx20-PT Equivalent Input Circuit



Dx20-PT Impedance Graph

Differential Mode and Common Mode

Differential probes sense the voltage difference which appears between the **+** input and **–** input. This voltage is referred to as the Differential Mode or Normal Mode voltage. The voltage component which is referenced to earth and is identical on both inputs is rejected by the amplifier. This voltage is referred to as the Common Mode voltage and can be expressed as:

$$V_{CM} = \frac{V_{+input} + V_{-input}}{2}$$

Differential Mode Range and Common Mode Range

Differential Mode range is the maximum signal that can be applied between the **+** and **-** inputs without overloading the amplifier/amplifier, which otherwise would result in clipping or distorting of the waveform measured by the oscilloscope.

The Common Mode Range is the maximum voltage with respect to earth ground that can be applied to either input. Exceeding the common mode range can result in unpredictable measurements. Because the Common Mode signal is normally rejected, and not displayed on the oscilloscope, the user needs to be careful to avoid accidentally exceeding the common mode range.

Because the input signal of a differential amplifier is not referenced to ground, the concept of V_{peak} versus $V_{peak\text{-}peak}$ may be confusing.

With a ground referenced signal, V_{peak} is the maximum instantaneous voltage amplitude the signal will have with respect to ground. In a differential system, there is no ground reference. Therefore, the Differential Mode Range refers to the maximum instantaneous amplitude of the signal difference between the positive input and the negative input. Since most amplifiers have symmetrical bipolar inputs, the value is generally expressed as an absolute value, and can have either polarity.

For example, an amplifier with a differential mode rating of ±1 V can have a maximum voltage difference appearing at any instant in time of 1 V between the inputs. The polarity could be either positive or negative. This does not imply that the number can be doubled to 2 volts. For clarity, consider the following table of absolute voltages applied to the inputs of a differential amplifier that has a differential mode range or ±1 V and a common mode range of ±5 V:

Voltage on + input to ground	Voltage on – input to ground	Difference	Comment
+1.5 V	+0.8 V	+0.7 V	OK: within ±1 V range
-1.5 V	-0.8 V	-0.7 V	OK: within ±1 V range
+0.8 V	-0.1V	+0.9 V	OK: within ±1 V range
+1.0 V	-1.0 V	+2.0 V	Out of range: exceeds ±1 V
+6.5 V	+6.0 V	0.5 V	Exceeds ±5 V common mode range
1.5 Vpk-pk sine	Ground	0.75 Vpeak	OK: within ±1 V range

Some amplitude is specified as peak to peak. The differential amplifier peak-to-peak range is twice the peak differential mode range specification (at any instant in time) as the maximum voltage amplitude signal is one-half of the peak-to-peak value.

In a balanced differential system, the signal on each output is an inverted copy of the other input. For example, an LVDS system may have a pair of outputs, each of which has a voltage swing of 0 to +370 mV. A logic 1 would be represented when the **+** output is at +370 mV, while the **-** output is at 0 V. A logic zero is the opposite polarity: the **+** output at 0 V and the **-** output at +370 mV. Note that even though both outputs swing 370 mV, the maximum difference voltage between them at any instant is still within ±370 mV. So, this signal could be measured with a differential amplifier that has a differential mode range of ±400 mV.

Common Mode Rejection Ratio

The ideal differential probe/amplifier would sense and amplify only the differential mode voltage component and reject the entire common mode voltage component. Real differential amplifiers are not perfect, and a small portion of the common mode voltage component appears at the output. Common Mode Rejection Ratio (CMRR) is the measure of how much the amplifier rejects the common mode voltage component. CMRR is equal to the differential mode gain (or normal gain) divided by the common mode gain. Common mode gain is equal to the output voltage divided by the input voltage when both inputs are driven by only the common mode signal. CMRR can be expressed as a ratio (e.g., 10,000:1) or implicitly in dB (e.g., 80 dB). Higher numbers indicate greater rejection (better performance).

The first order term determining the CMRR is the relative gain matching between the **+** and **–** input paths. Obtain high CMRR values by precisely matching the input attenuators in a differential amplifier. The matching includes the DC attenuation and the capacitance which determines the AC attenuation. As the frequency of the common mode component increases, the effects of stray parasitic capacitance and inductance in determining the AC component become more pronounced. The CMRR becomes smaller as the frequency increases. Therefore, the CMRR is usually specified in a graph of CMRR versus common mode frequency.

The common mode frequency in these graphs is assumed to be sinusoidal. In real life applications, the common mode signal is seldom a pure sine wave. Signals with pulse wave shapes contain frequency components much higher than the repetition rate may suggest. This makes it very difficult to predict actual performance in the application for CMRR-versus-frequency graphs. The practical application of these graphs is to compare the relative common mode rejection performance between different probes and amplifiers.

Offset

Offset for D600A-AT, and D400A-AT Probes

Offset for the WaveLink Series probe is provided by Teledyne LeCroy's X-Stream based oscilloscopes. This allows you to remove a DC bias voltage from the input signal while maintaining DC coupling.

To prevent displaying a clipped waveform from overdriving the probe, the available offset changes as a function of the V/Div setting of the oscilloscope.

The following equation determines the available offset as a function of oscilloscope sensitivity:

$$MaximumOffset = \pm|V - 4x\ V/div|$$

where

V is the maximum range of the probe, and

V/div is the selected scale factor

V= 2.4 for the D600A-AT, or D400A-AT

As can be seen, the maximum offset for the probe with either the D600A-AT or D400A-AT is 2.4 V, while the minimum offset is 0 Volt at a scale factor of 0.6 V/div. (0.6 V/div is the minimum sensitivity available when using the D600A-AT or D400A-AT adjustable tip.

When the WaveLink series probe is used with a Teledyne LeCroy WaveMaster 8 Zi and Zi-A or WavePro 7 Zi and Zi-A (4 and 6 GHz models) oscilloscope equipped with ProLink interface, or with a WavePro oscilloscope with ProBus interface, the probe offset is controlled with the channel OFFSET knob.

Sometimes it may be desirable to display a waveform as a reference signal where a large display amplitude may not be necessary. Perhaps a timing reference when amplitude details are not needed. In such a case, the oscilloscope's zoom function can be used to reduce the displayed height of the reference signal. (Refer to your oscilloscope's online help for operation of the zoom function.)

Offset for D610, D620, D410, and D420 Probes

These probes all have full offset capability over their entire V/Div range.

Dynamic Range

WaveLink D600A-AT and D400A-AT probes have no gain or attenuation control. However, WL-PLINK (D610, D620 modules) and WL-PBUS (D410, D420 modules) do provide gain and attenuation controls.

The system attenuation is fixed at ÷2.5 when using an AT, PT, D610, or D620 modules; or at ÷5 for the D410 or D420.

The WaveLink series probes are always DC coupled (no AC coupling is provided). Therefore, care must be exercised to avoid exceeding the common mode range. Because the common mode signal is rejected by the probe and is not displayed, changes in the amplitude of the common mode component are not apparent to the user. Exceeding the common mode range may introduce distortion to the probe's output signal.

Specifications	D610, D410	D620, D420	D600A-AT, D400A-AT
Input Dynamic Range	±1.25 V	±2.5 V	±2.4 V
Input Common Mode Voltage	±4 V	±4 V	±2.4 V
Input Offset Voltage	±3 V	±3 V	0 V
Minimum Probe Attenuation	1.0X	1.9X	÷2.5

NOTE: Each probe has unique attenuation values programmed into memory. The value changes with your specific V/div setting. View your actual attenuation from the Probe dialog.

Appendix A - Performance Verification Test Record

This record can be used to record the results of measurements made during the performance verification of the WaveLink Series of Differential Probes. Photocopy this page and record the results on the copy. File the completed record as required by applicable internal quality procedures. The section in the test record corresponds to the parameters tested in the performance verification procedure. The numbers preceding the individual data records correspond to the steps in the procedure requiring the recording of data.

Results to be recorded in the column labeled Test Result are the actual specification limit check. The test limits are included in all of these steps. Other measurements and the results of intermediate calculations that support the limit check are to be recorded in the column labeled Intermediate Results.

Permission is granted to reproduce these pages for the purpose of recording test results.

NOTE: Use a new Test Record for each tested probe, probe tip module, and lead assembly.

Items Tested

Item	Serial Number	Item	Serial Number
WL-PLINK		D420	
WL-PBUS		D400A-AT	
D600A-AT		Dx10-SI	
D610		Dx10-QC	
D620		Dx10-SP	
D410		Dx20-SP	

Equipment Used

Instrument	Model	Serial Number	Calibration Due Date
Oscilloscope			
Digital Multimeter			
Sine Wave Generator			
Pulse Generator			

Test Record

Output Zero

Step	Description	Intermediate Data	Test Result
1.	Output Voltage	V	
2.	Output Voltage after AutoZero	V	
3.	**Output Zero** (Test limit ≤ 10 mV)		mV

Low Range Attenuation Accuracy

Step	Description	Intermediate Data	Test Result
4.	Probe Low Range Input Voltage	V	
5.	Probe Low Range Output Voltage	V	
6.	Corrected Low Range Output Voltage	V	
7.	**Low Range Attenuation Error** (Test limit ≤ 2%)		%

High Range Attenuation Accuracy

Step	Description	Intermediate Data	Test Result
8.	Probe High Range Input Voltage	V	
9.	Probe High Range Output Voltage	V	
10.	Corrected High Range Output Voltage	V	
11.	**High Range Attenuation Error** (Test limit ≤ ±5.0%)		%

Rise Time

Step	Description	Intermediate Data	Test Result
12.	System rise time	ps	
13.	Rise time with probe	ps	
14.	**Probe Rise Time**		psec

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Chestnut Ridge, NY 10977
USA

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