LeCroy

WaveLink

Differential Probe Series

Operator's Manual

October, 2008

LeCroy Corporation
700 Chestnut Ridge Road
Chestnut Ridge, NY, 10977-6499
Tel: (845) 578-6020, Fax: (845) 578 5985

Warranty

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, 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 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. 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. LeCroy shall not be liable for any special, incidental, or consequential damages, whether in contract or otherwise.

Internet: www.lecroy.com

Manufactured under an ISO 9000 Registered Quality Management System. Visit www.lecroy.com to view the certificate.		This electronic product 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 LeCroy product, please visit www.lecroy.com/recycle.

WL-OM-E-RevE

916621 RevA

TABLE OF CONTENTS

Introduction

The WaveLink Differential Probe series is a very high bandwidth active differential probe. The probe features low noise, very low input impedance and high common mode rejection, and is 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 Tip Modules to allow for flexibility in physical interconnect, and optimizes bandwidth and electrical performance.

This manual covers body models WL-PLink and WL-PBus (WL600 and WL300 for legacy probes) and all interchangeable probe tip modules. The following diagrams illustrate the various parts of the different probe families.

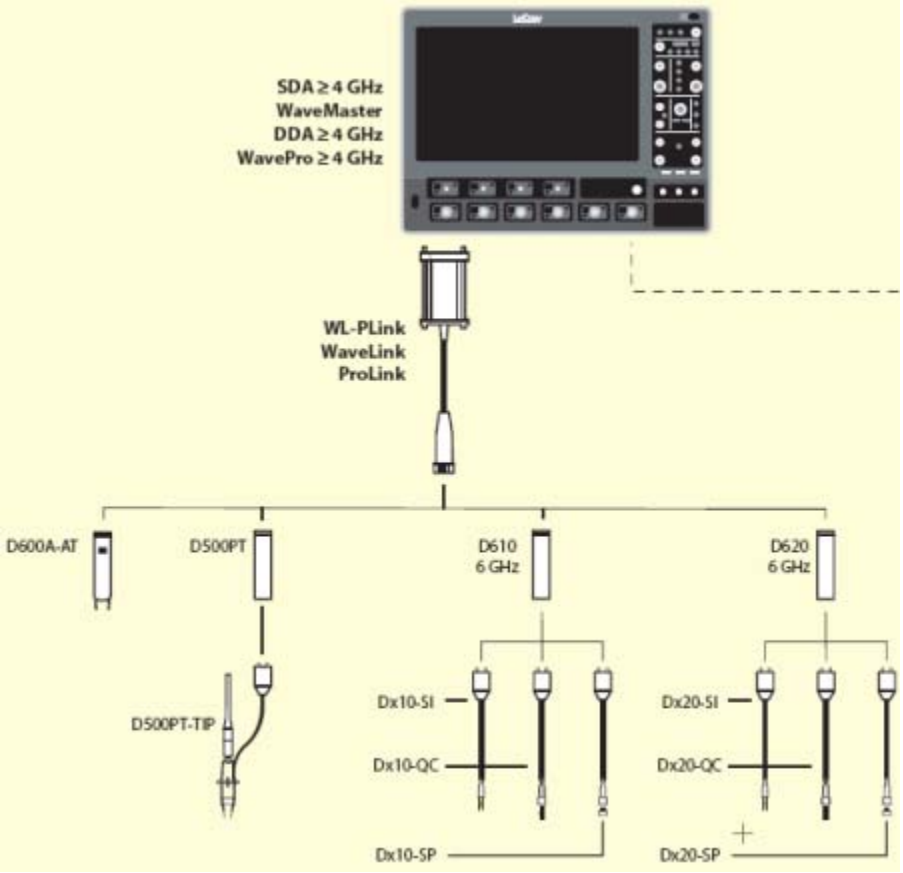
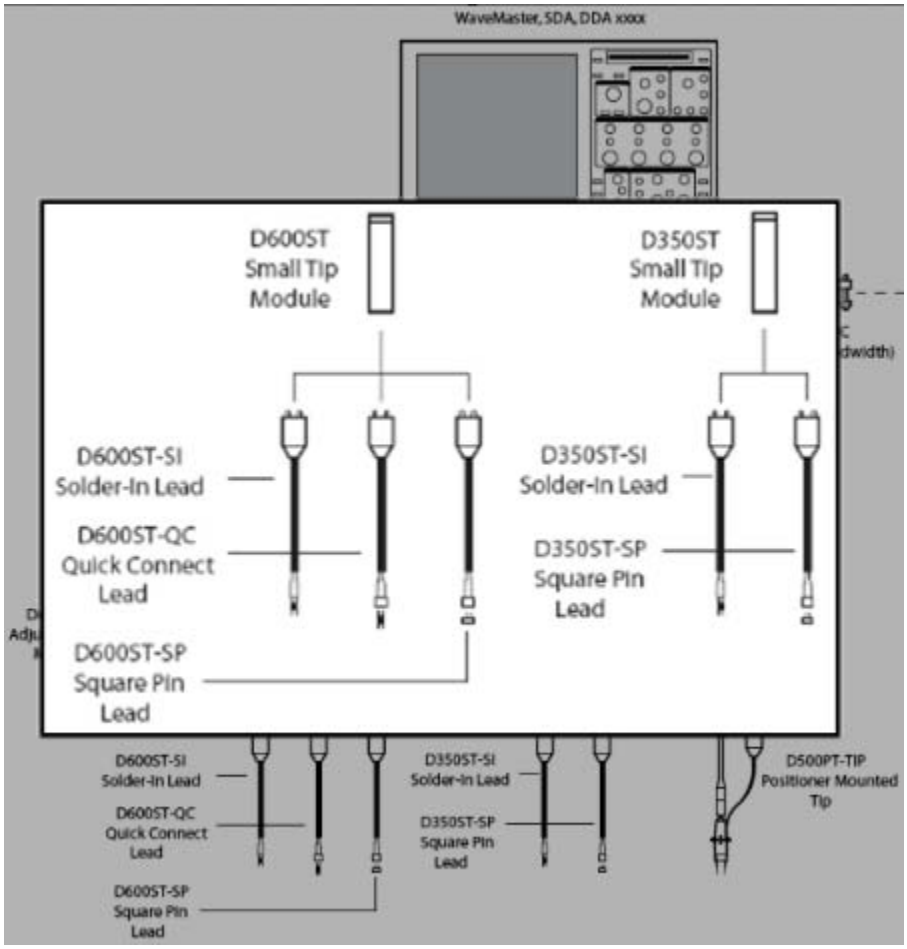


Figure 1-1. WL-PLink Probe Family

The WL600's amplifiers and tips (as follows) are still supported with a limited supply. Please contact your LeCroy sales representative for more information.



Note: WL600's amps and tips are still supported with a limited supply.

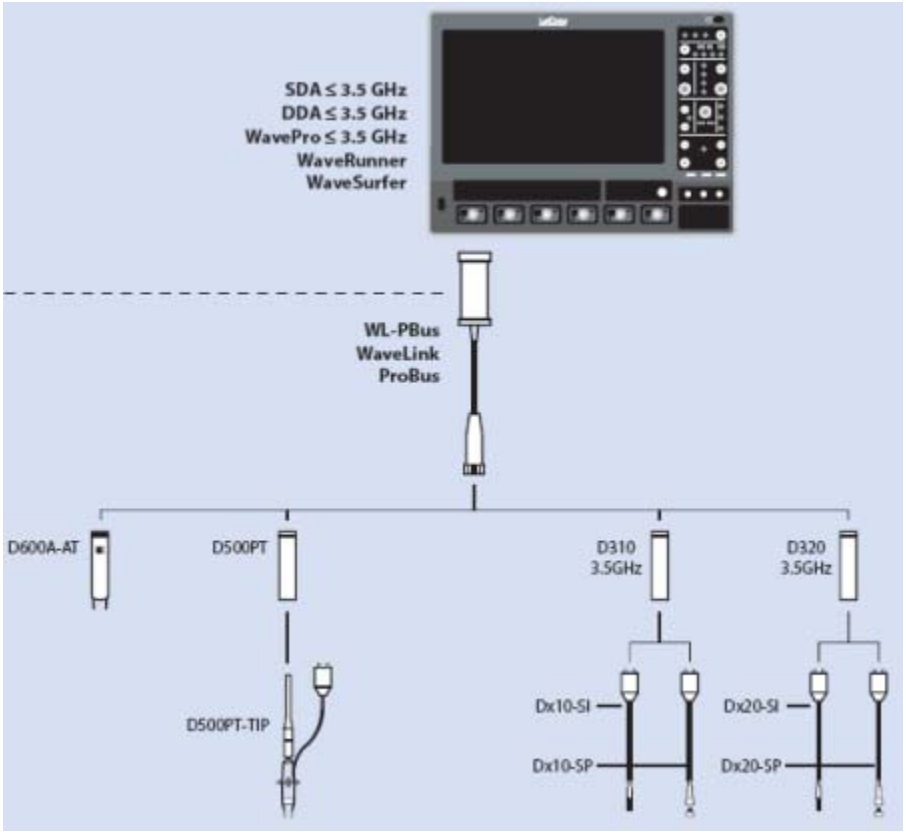
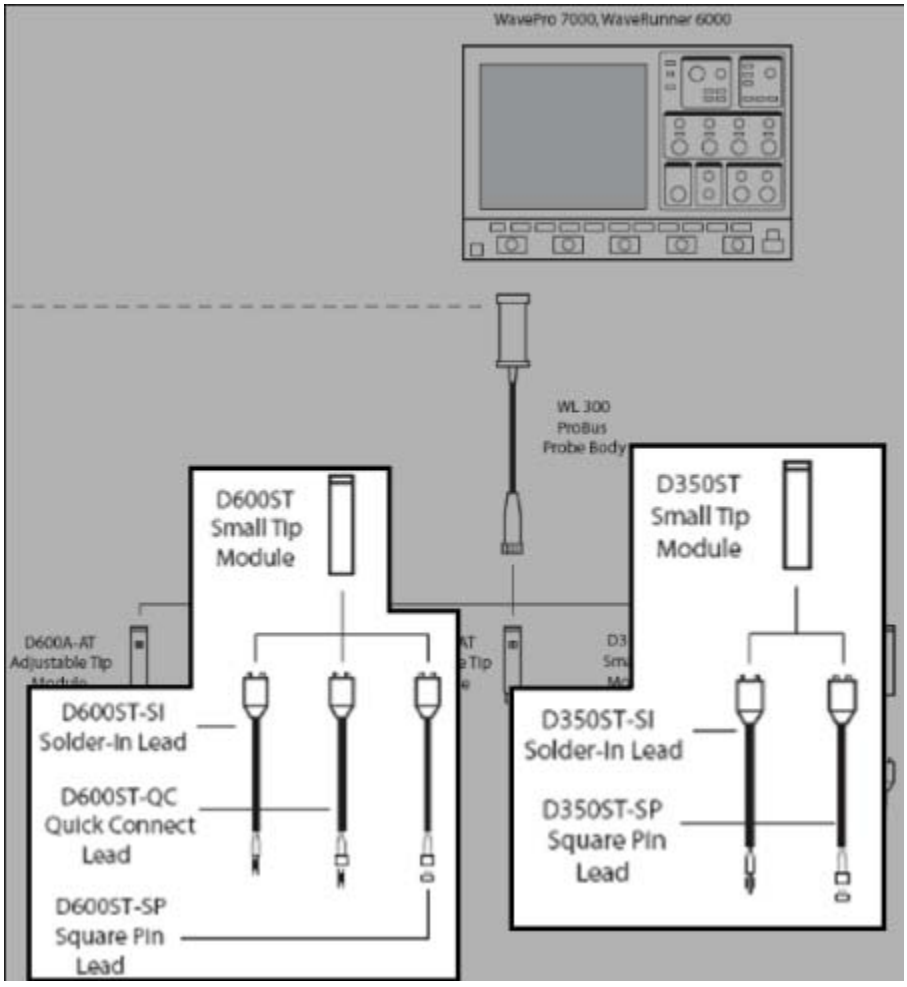


Figure 1-2. WL-PBus Probe Family

Note: While the amplifiers can be used with with either cable assembly, the user is limited by the lower bandwidth of the BNC connector.

The WL300's amplifiers and tips (as follows) are still supported with a limited supply. Please contact your LeCroy sales representative for more information.



Note: WL300's amps and tips are still supported with a limited supply.

The WaveLink probe consists of the **Probe Tip Module** and the **Probe Body**.

Probe Body Updates

Previous probe body models (WL600 and WL300) are fully-functional and continue to work with LeCroy probe amplifiers and tips. However, the new **WL-PLink** and **WL-PBus** respective models provide improved oscilloscope input connection and compatibility for future models.

Probe Tip Modules

The Probe Tip Modules contain the active amplifier circuitry. Different modules have different electrical and physical interconnect characteristics, allowing the user to select the module appropriate for the application.

Small Tip Module

The Differential Small Tip Module D610, D620, D310, and D320 (also D600ST and D350ST for legacy probes) connects to any WaveLink probe body and accepts differential Probe Tip Modules to provide the user with flexibility in connecting the probe to the circuit under test without degrading the electrical performance.

Three interconnect lead assemblies, which are interchangeable between the probe bodies, are provided:

- **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. The QC interconnect lead assembly is available for the D610and D620 (also, D600ST for legacy probes) only. This lead assembly is limited to 4GHz 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 risetime 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.

Positioner Mounted Module

The Positioner Mounted Module, D500PT, with the Positioner Mounted Tip, D500PT-TIP, can be used as a browser for use in a positioner such as Easy Probe positioner. 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.

Differential Adjustable Tip Modules

Differential Adjustable Tip Modules, D600A–AT and D300A-AT, with adjustable pin spacing are suitable for probing traces and components on circuit boards. The Adjustable Tip Module connects directly to the WaveLink probe body.

Note: The D6x0, D600xx and D500PT probe tip modules can be used with a WL-PBus (also WL300 for legacy probes) probe body. However, they do not deliver full system bandwidth with 4 or 6 GHz oscilloscopes.

Probe Body

The probe body contains common circuitry such as power supply, communication and control and AutoColor ID. The series consists of:

- WL-PLink probe body (WL600 for legacy probes) for ProLink instruments
- WL-PBus probe body (WL300 for legacy probes) for ProBus instruments

The WaveLink series probes utilize digital filtering to improve the system frequency response. The response is corrected through the use of digital filters, which are specifically tailored through calibration to optimize the frequency flatness of each individual probe. This, combined with the exceptional probe loading characteristics, provides the highest fidelity in eye pattern measurement.

Note: Download the latest version of X-Stream software to run your WaveLink probe with maximum performance.

- Any probe tip or amplifier connected to WL-PLink or WL-PBus (or WL600, 300 for legacy probes) are powered directly from LeCroy's WaveSurfer, WaveRunner 6000 and Xi, WavePro, WaveMaster, Serial Data Analyzer (SDA), or Disk Drive Analyzer (DDA) oscilloscopes through the ProLink interface. D6xxx and D500PT modules support full bandwidth at the probe tip with oscilloscopes up to 6 GHz (5 GHz for the D500PT).
- All Probe Tip modules are interchangeable with probe bodies, for example the D310, D320, or D300A-AT (also, D350ST for legacy probes) can also be operated with a WL-PLink (also, WL600 for legacy probes) probe body for use with oscilloscopes equipped with ProLink interface with reduction in overall bandwidth.
- The D6x0, D600xx series and D500PT can be used with the WL-PBus (also WL300 for legacy probes) probe body for use with LeCroy WaveSurfer, WaveRunner 6000 and Xi, WavePro, DDA3000, DDA735Zi, and SDA725Zi and 735Zi series oscilloscopes. Keep in mind that in this configuration, the system bandwidth is limited to the oscilloscope bandwidth.
- The WaveLink, ProLink, and ProBus interfaces can control the probe through the oscilloscope user interface.
- A Certificate of Calibration is supplied with each probe indicating that the system will meet the specifications with those components listed in the Certificate.

ESD Sensitive: The tips of the WaveLink probe 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 input 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 series differential probe has been designed as a modular system with different probe tip Modules, each with its own buffer amplifier and eliminates the addition of external wires or accessories. When using these modules, 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 Probe Tip Modules guarantees the specified performance and input characteristics of the probe.

Applications

The WaveLink Probe series is ideally suited for acquiring differential signals like ones found in disk drive read channels and applications with fine pitch IC's and high lead count where high speed, minimal loading, and accurate jitter measurement are required.

System Designers

Probes are used when designing systems using standard and ASIC components use simulators and correlate with lab measurements

IC Designers

Probes are used when characterizing new chip designs.

They're also used by manufacturers of servers, PC Motherboards, Data routers, and Disk drives.

Accessory Package Contents

The following accessory products come with these additionally listed items.

D600A-AT and D300A-AT Adjustable Tip Modules Include:

- Ground lead and clip
- Protective storage case
- WaveLink Series Instruction Manual
- Quick Start Guide
- Calibration certificate

D610, D620, D310, D320, (Also D600ST and D350ST for Legacy) Modules Include:

- Solder-In interconnect lead set with replacement resistors (10)
- Quick Connect interconnect lead set with additional damping resistors (20). (D610, D620, and D600ST only)
- Square Pin interconnect lead set
- Ground lead and clip
- Probe tip mounting kit
- WaveLink Series Instruction Manual
- Quick Start Guide
- Calibration certificate

D500PT Positioner Mounted Tip Includes:

- Positioned tip assembly
- Probe tip module
- Module mounting clamp
- Ground lead and clip
- WaveLink Series Instruction Manual
- Quick Start Guide
- Calibration certificate
- FreeHand probe stand
- Tip repair tool
- Replacement tips (2)

WL-PLink and WL-PBus (Also WL600 and WL300 for Legacy) Probe Bodies Include:

- Soft accessory case with WaveLink series insert
- Probe characterization fixture
- Probe body mounting clip
- Probe cable clamp (2)
- Small accessory case

D610, D620, D310, D320, D600A-AT, D300A-AT, D600ST, D500PT and D350ST Tip Modules, when ordered with WL-PLink, WL-PBus, (WL600 or WL300) Also Substitute:

- Certificate of NIST traceable calibration in place of calibration certificate

Also, Available as an Optional Accessory...

- EZ Probe positioner

Features and Accessory Descriptions

Standard Feature Descriptions

Probe

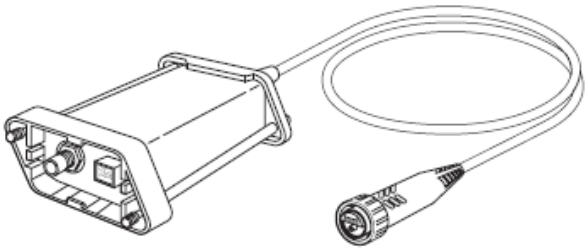


Figure 2-1. WL-PLink and WL600

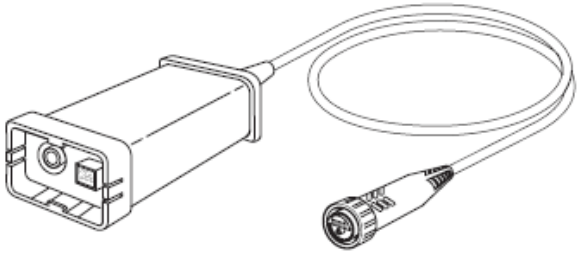


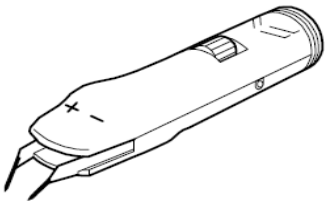
Figure 2-2. WL-PBus and WL300

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

1. WL-PLink (WL600 for legacy probes) for use with ProLink interface
2. WL-PBus (WL300 for legacy probes) for use with ProBus interface

The remainder of this topic explains parts of the Tip Module and Body (the probes two different components).

Adjustable Tip Module

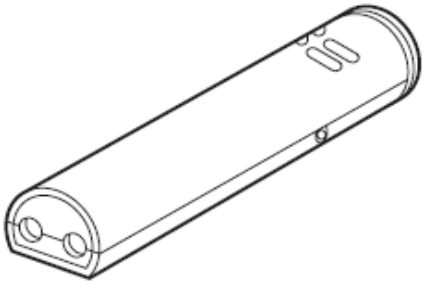


The Adjustable Tip Module, D600A-AT and D300A-AT, with two highly flexible NiTiNOL alloy tips, allow for easy probing of very dense circuitry.

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 AT tip can be used in hand-held applications for rapid test point browsing.

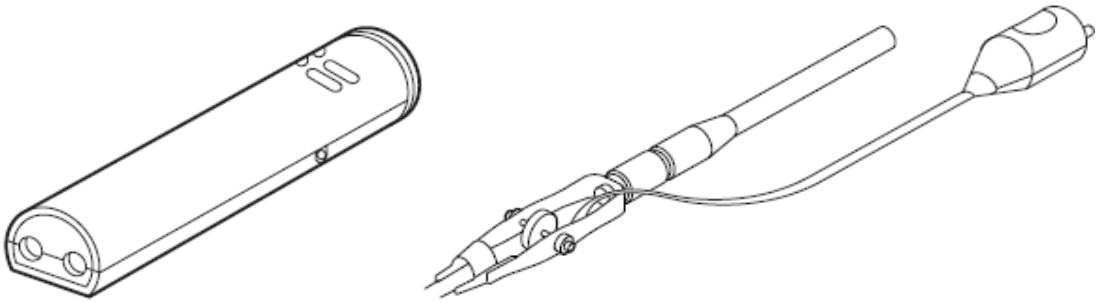
Small Tip Module



The Small Tip Module, D610, D620, D310, and D320 (D600ST and D350ST for legacy probes) extend the measuring capabilities of the AT Module which have physical interconnect constraints not addressable with the AT Module.

- ST Module D610 and D620 allow Solder-In, Quick Connect, and Square Pin interconnect leads. D600ST also allows all three leads in legacy probe systems.
- ST Module D310 and D320 allow Solder-In and Square Pin interconnect leads. D300ST also allows SI and SP leads in legacy probe systems.

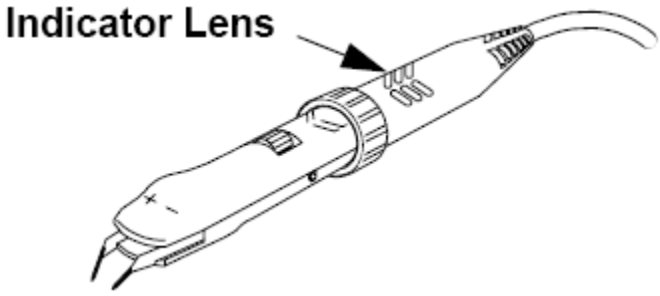
Positioner Mounted Module



The Positioner Mounted Module, D500PT, accepts the D500PT-TIP, designed specially to facilitate browsing in areas where many test points are located in a small area.

The module is calibrated for use with the D500PT-TIP tip only. The tip is included with the purchase of the module.

AutoColor ID and Power Control Indicators



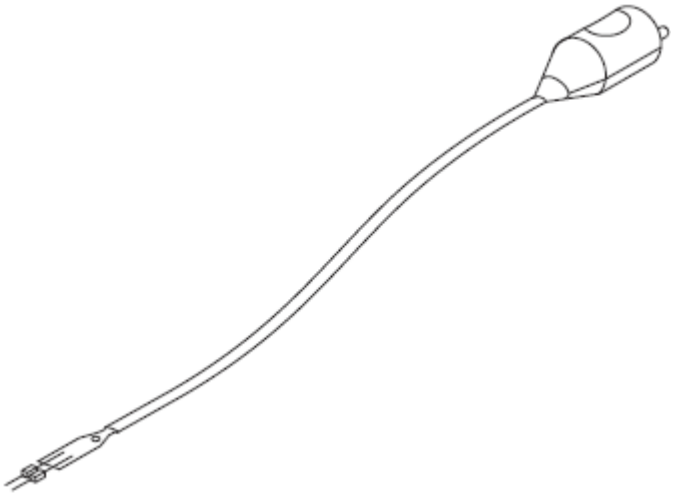
AutoColor ID LED, located in the probe body, illuminates in the default color of the channel to which the probe is connected.

It also is used for warnings.

The WaveLink series probe is provided with several standard and optional accessories to make probing and connecting to different test points easier than ever.

Standard Accessory Descriptions

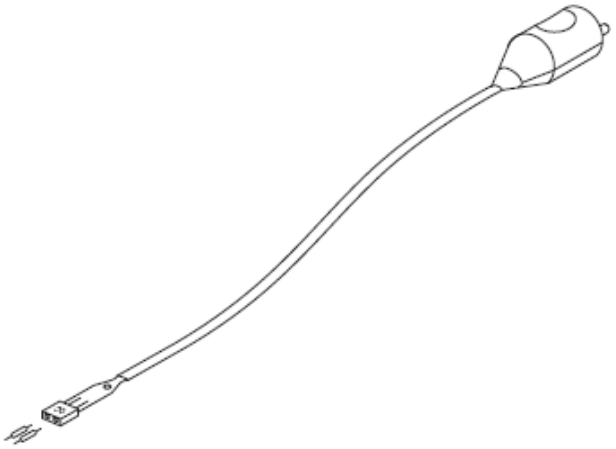
Solder-In Interconnect Lead



- The Dx10-SI and Dx20-SI Solder-In Interconnect Leads (D600ST-SI and D350ST-SI for legacy probes) are supplied with two pre-installed damping resistors. Solder the free end of the damping resistors directly to the pads or runs in the circuit under test.
- Because resistors and lead lengths are small, this Interconnect Lead provides the maximum signal fidelity at the highest frequencies.
- Ten replacement damping resistors are provided with the Interconnect Lead.
- The Dx10-SI and Dx20-SI (also D600ST-SI and D350ST-SI for legacy probes) are of different designs and not interchangeable.

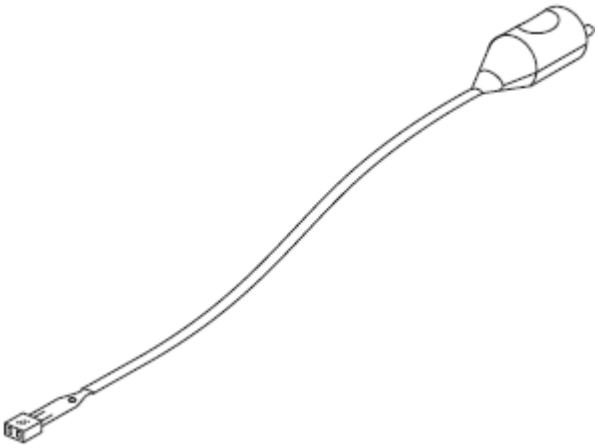
Note: Refer to the Care and Maintenance topic for damping resistor replacement information.

Quick Connect Interconnect Lead



- The Dx10-QC and Dx20-QC Quick Connect Interconnect Lead (WL-PLink only and D600ST-QC for legacy probes) is ideally suited for applications where the probe needs to be moved frequently between different test points.
- Solders the somewhat larger damping resistors to the points in the circuit to be probed. The free end of the damping resistors plug into a special connector mounted directly on the probe input board.
- 20 solder-In resistors are supplied with the Quick Connect Interconnect Lead.

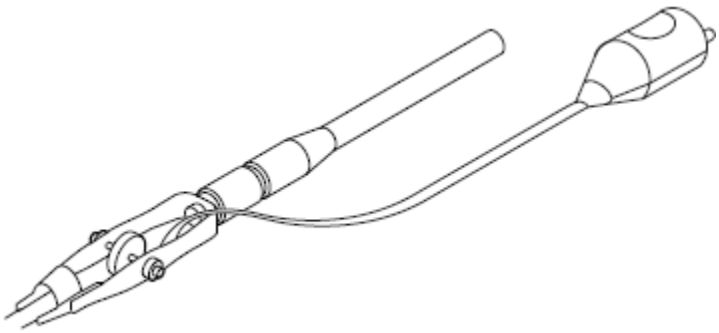
Square Pin Interconnect Lead



- The Dx10-SP and Dx20-SP Square Pin Interconnect Leads (D600ST-SP and D350ST-SP for legacy probes) allow the probe to connect directly to the standard 0.025” square pins mounted on 0.100” centers.
- The system bandwidth and rise time are limited when a Square Pin interconnect lead is used, due to the inherent inductance of the square pins themselves.
- The practical BW limit is approximately 4 GHz.

Note: The Dx10-SP and Dx20-SP (also D600ST-SP and D350ST-SP for legacy probes) are of different designs and not interchangeable.

Positioner Mounted Tip



The Positioner Mounted Tip (D500PT-TIP), with its adjustable tip spacing and spring loaded tips, is ideally suited for browsing many test points in small areas. For example, you can connect multiple PM tips to the back side of boards with ball grid arrays.

Because of the telescoping tips, the probe can be angled while still making good contact with the test points.

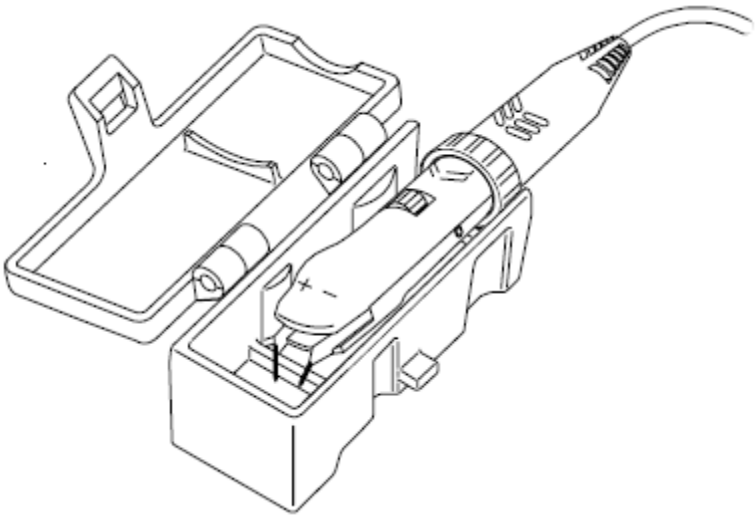
The adjustable tip section is ball mounted in the holder for easy adjustment

PLEASE NOTE THE FOLLOWING:

- All interconnect leads are colored to distinguish between Dx10 (Blue), Dx20 (Orange), D600ST (Grey), D500PT (Green) and D350ST (Red).
- Although interconnect Leads for the D610, D620, D310, D320, and D500PT (also D600ST, and D350ST for legacy probes) 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.

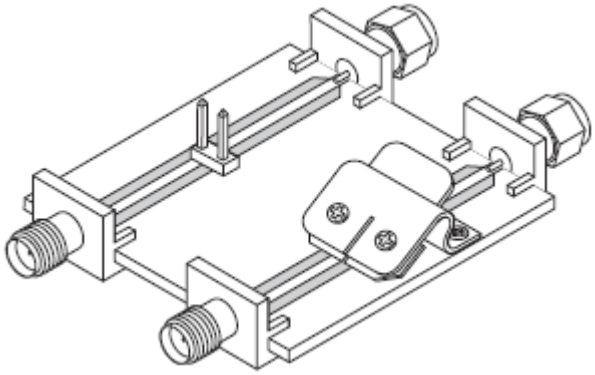
Protective Cover



The protective cover is provided as a standard accessory on D600A-AT or D300A-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).

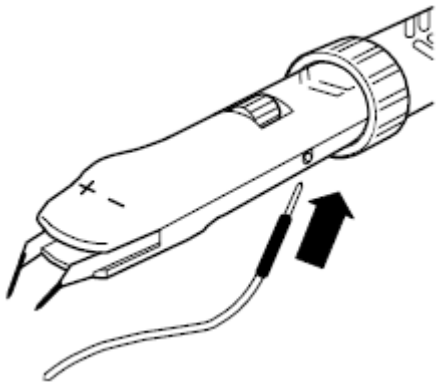
Note: Avoid tip damage and always attach the cover to the module when not in use.

Characterization Fixture



The Characterization Fixture (PCF200) is provided as a standard accessory with WaveLink series probes. The fixture determines the effect of probe input loading on the circuit under test and the probe response to the signal being measured, using the AT, ST, Dx10, and Dx20 modules with SI, or SP, or QC (QC for WL-PLink only)interconnect leads.

Ground Lead and Clip



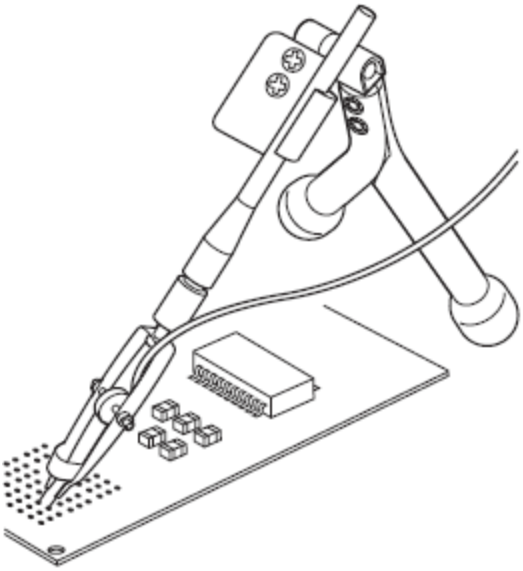
This Ground Lead (PACC-LD005) and the Ground Clip (PK006-4) are provided as standard accessories to the WaveLink series probes and can be used to connect to ground of the circuit under test. The plug of the ground lead connects to the receptacle located on the side of the probe body.

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

Related Products and Replacement Components

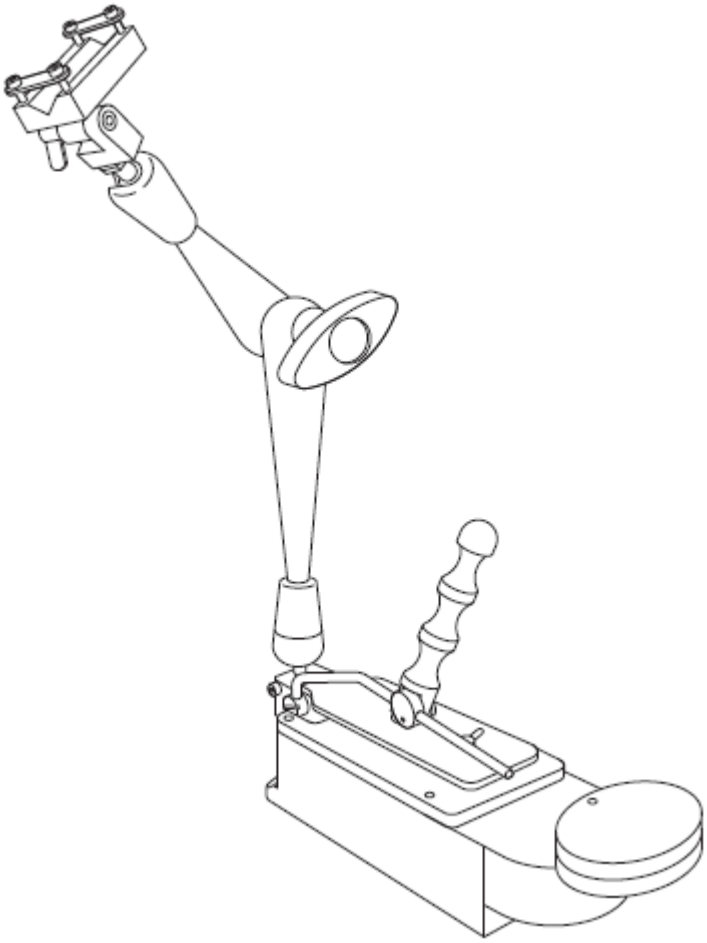
Positioning Aids and Retaining Devices

FREEHAND PROBE HOLDER



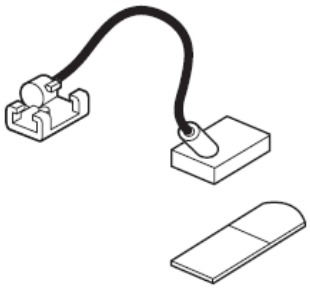
- The FreeHand Probe holder (PACC-MS001) is provided as a standard accessory with the D500PT Probe Tip Module.
- The FreeHand holder is a quick, stable, easy-to-set-up probe positioner, improving concentration and focus on the measurement by not having to hold the probe.
- The FreeHand holder is designed 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 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.

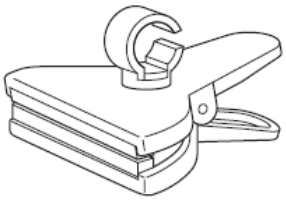
TIP RETAINING CLIP



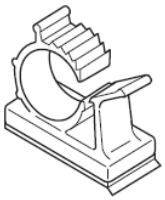
- The Tip Retaining Clip (PK600ST-3) is an aid for holding SI and QC Interconnect Leads in place while making measurements or when soldering the damping resistors to the test points of the board under test.
- The Clip is supplied as a standard accessory with the D610, D620, D310, and D320, and D500PT (also D600ST and D350ST for legacy probes) and comes with a package of 20 adhesive pads for mounting the clip to the board.

PROBE BODY CLAMP SET

The Probe Body Clamp Set (PK600ST-4) can be used to support to the probe and Interconnect Lead when the test points are located close to the edge of the board under test.

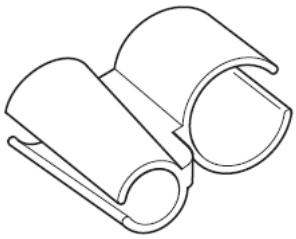


The PK600ST-4 includes one Board Edge Clip and four Adhesive Backed Probe Body Clamps.



The Adhesive Backed Probe Body Clamp can be used to give support to the probe body and Interconnect Lead anywhere on the board under test.

MODULE MOUNTING CLAMP



The Probe Module Clip should be used to attach the D500PT to the arm of the EZ Probe Positioner. Refer to the Positioning Tools topic for attachment instructions.

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.

ESD Sensitive: The tips of the WaveLink probe 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.

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

Connecting a Module to a Probe Body

Attach an Adjustable Tip, Small Tip or Positioner Tip Module to the probe body by aligning the connectors of the module with the receptacles in the probe body and pressing the two together. Finger-tighten the assembly by rotating the threaded collar onto the module.

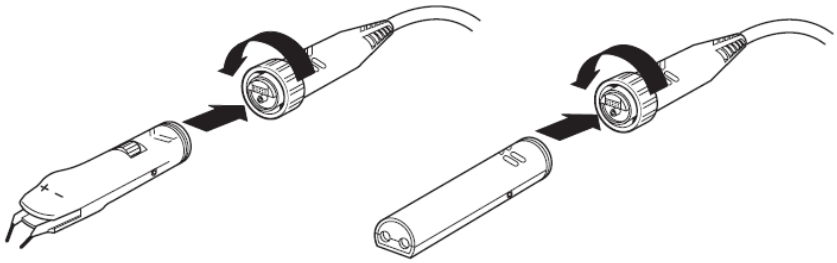


Figure 2-3. Attaching Adjustable Tip or Small Tip Module

Do not use pliers to tighten the collar.

Remove the Probe Tip Module by loosening the threaded collar from the module and pulling the two assemblies apart.

By design, the PT, AT, and ST modules can be interchanged with any Probe Body; and any Interconnect Lead fits into the ST module.

Connecting the SI, QC, SP, or TIP to a Module

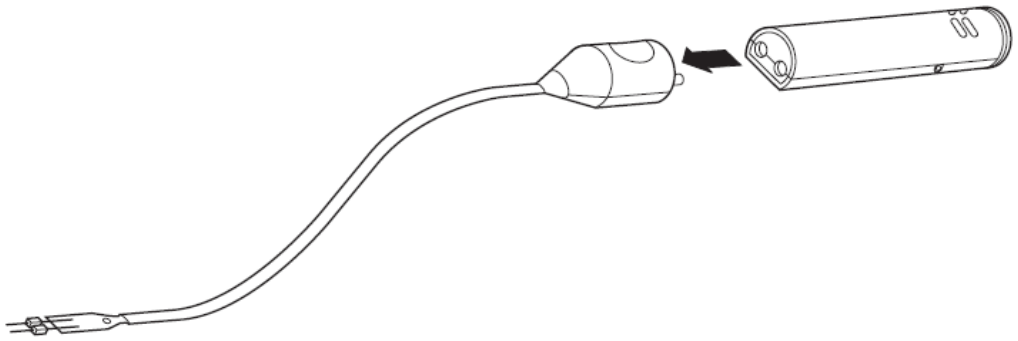


Figure 2-4. Attaching an Interconnect Lead

Align the flat side of the Interconnect Lead Module with the flat side of the Small Tip Module and press together.

PLEASE NOTE THE FOLLOWING:

- Although interconnect leads for the D610, D620, D310, D320, and D500PT (also D600ST, and D350ST for legacy probes) 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.
- Avoid accidental interchanging by matching the color coding of the interconnect lead connector housing with the color of the corresponding probe tip module.

Interchangeability and Calibration

By design, the D610, D620, D600A-AT, D310, D320, D300A-AT, and D500PT, Amplifier Modules and Interconnect Leads deliver the specified performance when interchanged on a WL-PLink or WL-PBus probe body (also on legacy WL600 or WL300 probes).

Note: Legacy Amplifier models D600ST, D350ST and Interconnect Leads also deliver the specified performance when interchanged on a WL300 or WL600 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, 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.

Probe Body	Probe Tip Module	
	Adjustable and Regular Tip Modules D310, D320, and D300A-AT (D350ST for legacy probes)	D610, D620, D600A-AT, and D500PT (also D600-ST for legacy probes)
WL-PBus	Allowed	Allowed
WL600*	Allowed	Reduced BW
WL300*	Allowed	Allowed
WL-PBus	Allowed	Reduced BW

Table 2-1.Probe Body-Tip Compatibility

* Legacy probe body. Supported with a limited supply.

Connecting the Probe to a LeCroy Oscilloscope

The WL-PLink (WL600 legacy) probe has been designed for use with the ProLink interface of the LeCroy's WaveMaster, SDA, WavePro (4 and 6 GHz models) and DDA oscilloscopes; and the WL-PBus (WL300 legacy) for use with the ProBus interface of the WavePro, WaveRunner, and DDA oscilloscopes.

Attach the probe to the test instrument by aligning the interface connector with the input connector and pushing the interface toward the instrument.

On the WL-PLink (or WL600) probe body, 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 (or WL300) interface system.

Remove the WL-PLink (or WL600) probe 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 probe is detached from the instrument.

For the WL-PBus (or WL300) probe, disconnect by pulling the interface box from the oscilloscope.

Autocolor ID

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

1. **AutoColor ID**

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

2. **Probe Body 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.

3. **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.

AutoZero

The WaveLink probes incorporate an AutoZero function to remove any DC offset from the probe. This function is available when the probe is used with 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.

Power Control

Power Control allows intermittent operation of the probe during testing at elevated ambient temperatures to prevent overheating of the probe; as, for example, 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 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.

Note: The D610, D620, D310, D320, D600ST, D500PT, and D350ST do not operate from +40 °C to +85 °C and do not shut down.

However, no probe should be operated with the power for more than 2 hours at any temperature exceeding the value given in the **Environmental Characteristics**.

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.

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

Table 2-2.Approximate Operating Time versus Temperature for the D300A-AT and D600A-AT.

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

When used with a 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.

Operation with a LeCroy Oscilloscope

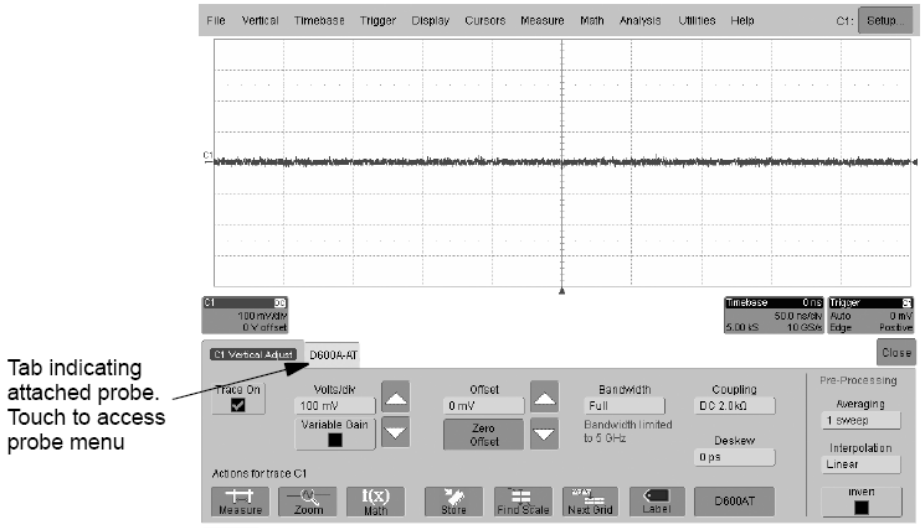


Figure 2-5. Vertical Menu

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 previous). Refer to your oscilloscope's instruction manual for specific operation.

Control through the oscilloscope's interface can be found in the screen menu of the channel to which the probe is connected.

Touching the tab indicating the attached probe (in this case D600ST) activates the probe menu screen 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.

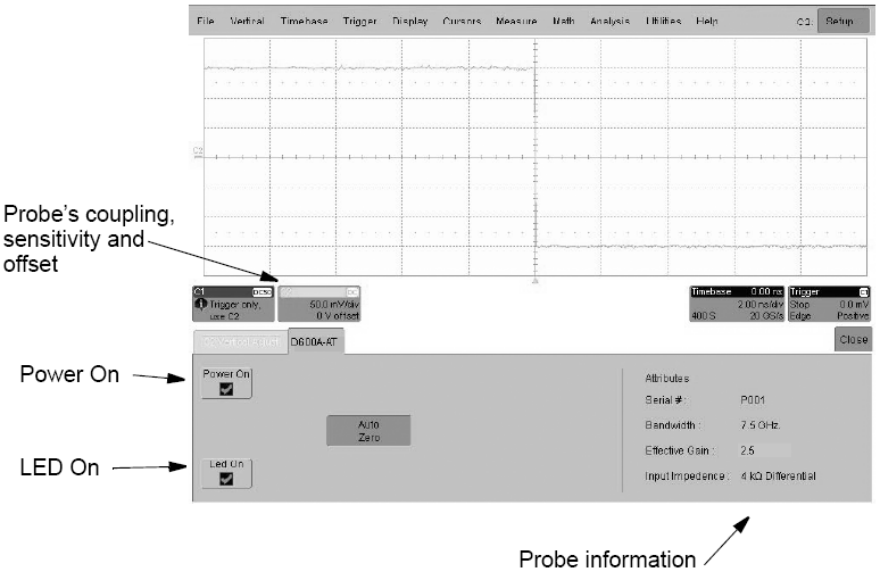


Figure 2-6. Probe menu

Connecting the Probe to the Test Circuit

Connecting the Probe to the Test Circuit Overview

For all modules and interconnect leads, 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 affect the probe's performance.

A ground connection is generally not required here. Refer to the **Probe Grounding** topic for more details.

Adjustable Tip Module

The WL-PLink and WL-PBus probes (WL600 and WL300 for legacy probes) with their small profile, low mass head and the D600A-AT or D300A-AT Adjustable Tip Module are ideally suited for hand-held browsing applications in dense circuitry.

The highly flexible tips of the Adjustable Tip Module 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).

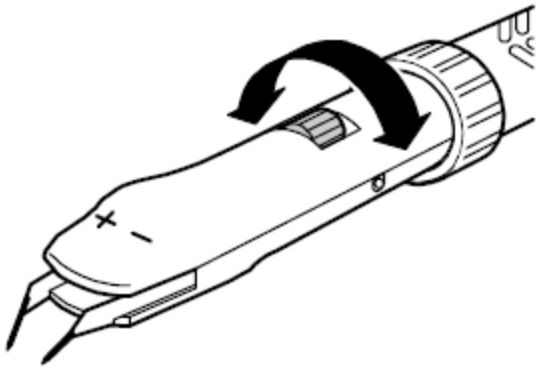


Figure 2-7. Adjusting the Tips

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 Pin Module.

Positioner Mounted Tip

The Positioner Mounted Tip, with its small form factor and low mass, is specifically designed to be used in areas with a high concentration of test points; for example, testing ball grid arrays on the back side of an etched circuit board.

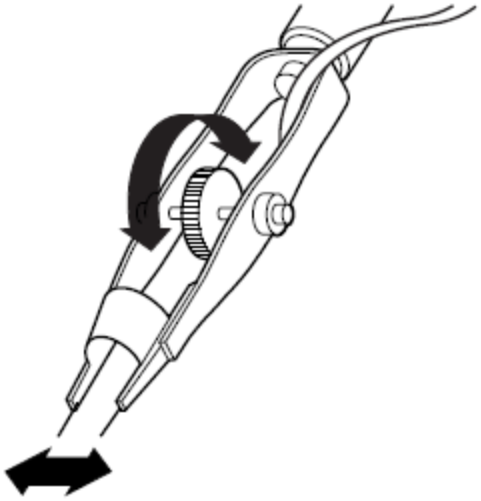


Figure 2-8. Adjusting the spacing of the TIP

Accommodate different test point distances by adjusting the spacing (from 0.5 mm to 4 mm) by rotating the knurled knob of the assembly (previous). In addition, the tip assembly is ball mounted to the holder for increased flexibility in mounting the probe tips. Adjust the tip assembly without moving the whole probe assembly by loosening the nut, moving the tip assembly to the desired location, and then tightening the nut (as follows).

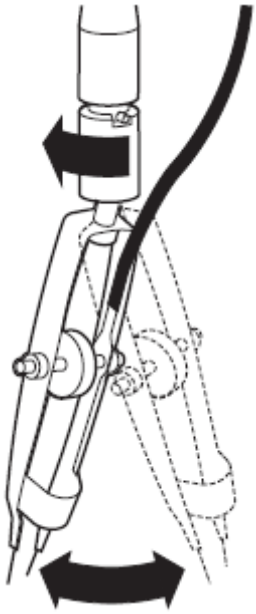


Figure 2-9. Ball Mounted Probe Tip

The spring mounted assembly accommodates a certain amount Z-axis compliance. This aids in applications where additional tips are required to make measurements and the tips need to be mounted at an angle to the board under test.

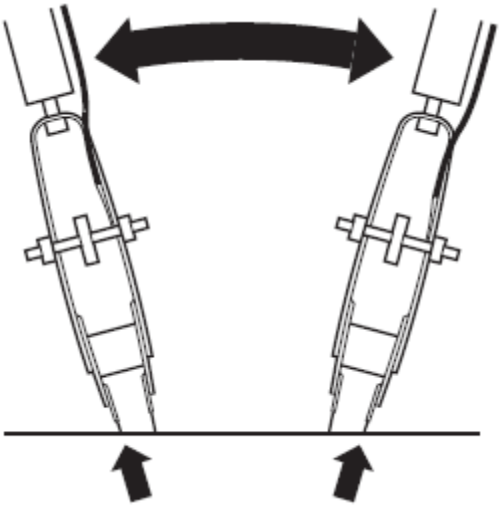


Figure 2-10. Z-axis compliance

Because of its small size, more than one positioner mounted tip can be used in tight areas for testing several test points at the same time. The tips are easily positioned on the test points through the use of an EZ positioner, its ball joint mounting of the probe tips, and the adjustable spacing of the probe tips (as all four figures in this topic illustrate).

PLEASE NOTE THE FOLLOWING:

- As with any differential probe testing, accurate measurements are best obtained with both the **+** and **–** inputs connected to the test points. All interconnect leads and tips have positive inputs marked with a **+** sign.
- Obtain maximum response by compressing the PT tips between their half and full amounts. The probe performs well with less compression, except for optimum flatness in the transient response.

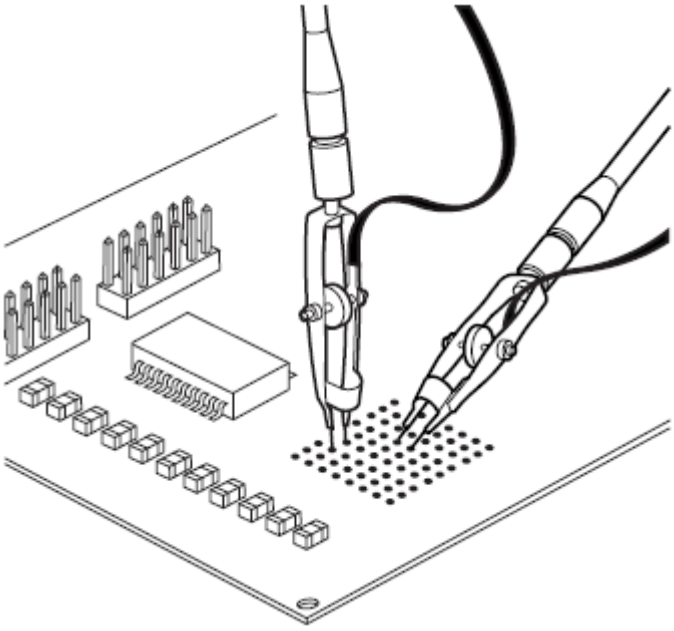


Figure 2-11. Measuring with Dual Positioner Mounted Tip

The Positioner Mounted Tip is designed to be used with the EZ Positioner for ease of measurement and to prevent excessive stress on the test points.

Solder-In Lead

The Solder-In Lead for the ST 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).

Note: The primary function of the Probe Tip Retaining Clip is to position the resistor leads when soldering the resistors to the test points.

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.

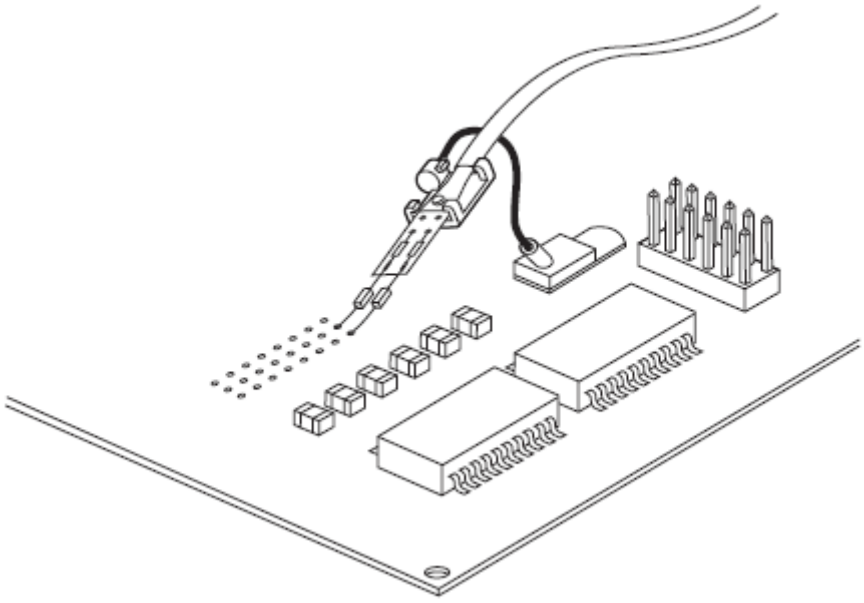


Figure 2-12. Measuring with SI Interconnect Lead

Quick Connect Lead (D610/D620 Only)

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.

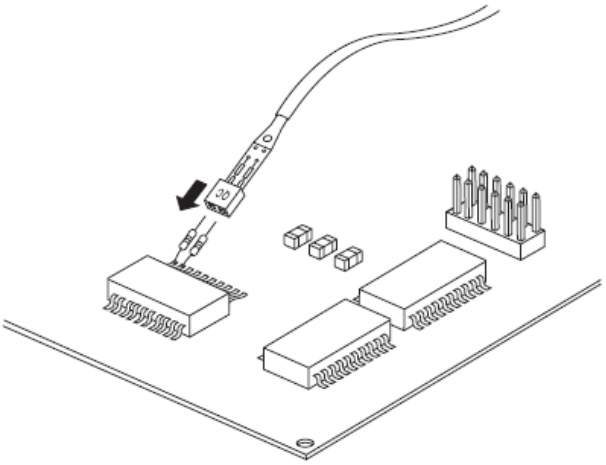


Figure 2-13. Measuring with the QC Interconnect Lead

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 4 GHz.

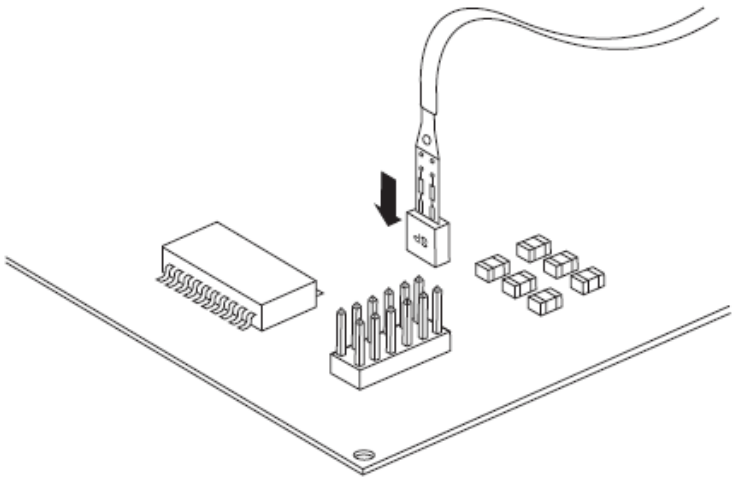


Figure 2-14. Measuring with the SP Interconnect Lead

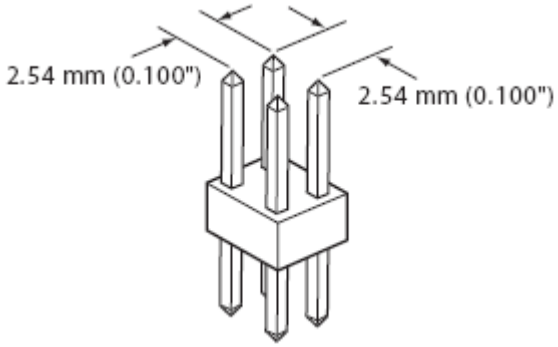


Figure 2-15. Square Pin Header Dimensions

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”).

A square pin meeting these dimensional requirements is available from Samtec (www.samtec.com) in the TLW-1xx-06 series.

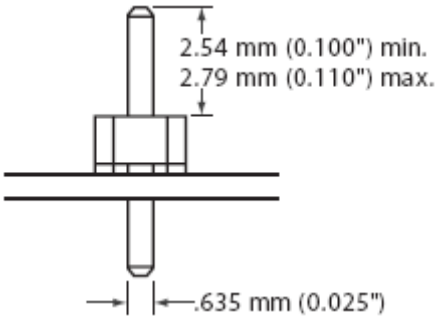


Figure 2-16. Square Pin length

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.

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

Positioning of the Input Leads

Normally the performance of the Solder In and Quick Connect modules is not affected by the position of the modules. 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 module is insensitive to placement.

Positioning Tools

Positioning Tools Overview

Positioning tools support the probe and module and reduce the risk of damaging runs or pads on the board. Always use a positioning tool to support your probe.

EZ Probe Positioner

The EZ Positioner provides stable, accurate positioning in the X-Y-Z axes. It is ideally suited for use with the D500PT-TIP, D600A-AT, and D300A-AT browsing tips. The vacuum-mount base keeps the EZ Positioner in place in any test environment. The solid brass base is heavy enough that it can be used without vacuum. The 3:1 motion reduction joystick pivots in the X-Y direction and moves up and down for Z-axis positioning.

D500PT

To connect the probe to the EZ Positioner, slide the large opening of the tapered section of the Module Mouting Clamp on the narrow section of the positioner's arm, and slide the clamp towards the positioner while pushing down on the clamp as follows:

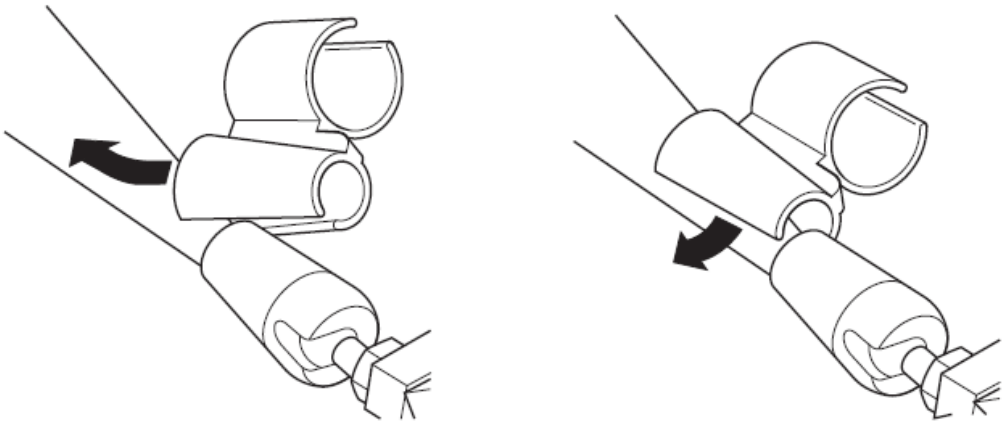


Figure 2-17. Attaching the Clamp to the EZ Positioner

Slide the probe cable through the slot on the other section of the clamp and slide the probe into the clamp until it hits the locking nut as follows:

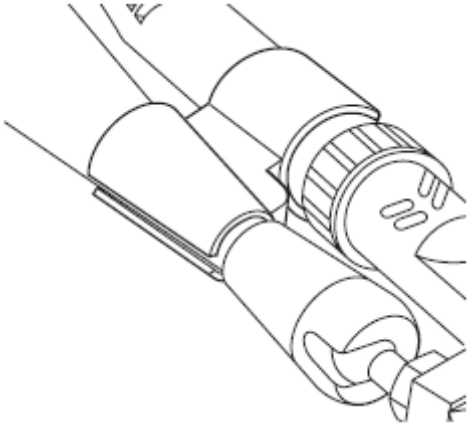


Figure 2-18. Module Mounting Clamp

Loosen the screws of the V-shaped probe holder, slide the shaft of the probe tip module into the positioner's probe holder, and tighten the screws as follows:

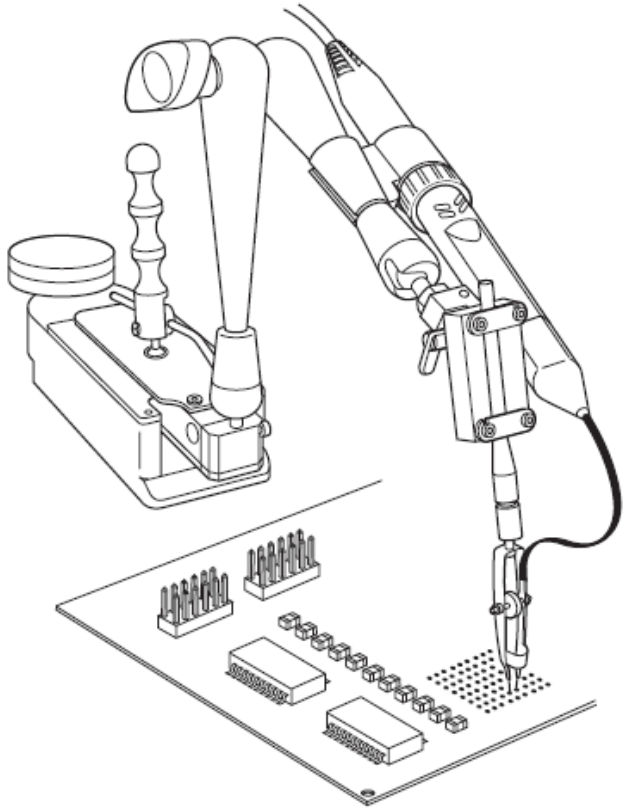


Figure 2-19. PT Probe mounting to EZ Positioner

The connection to the test points is greatly simplified using the joystick, ball joint of the positioner, the ball joint of the probe, and the spring mounted probe tips.

OPTIONAL ACCESSORY CLAMP

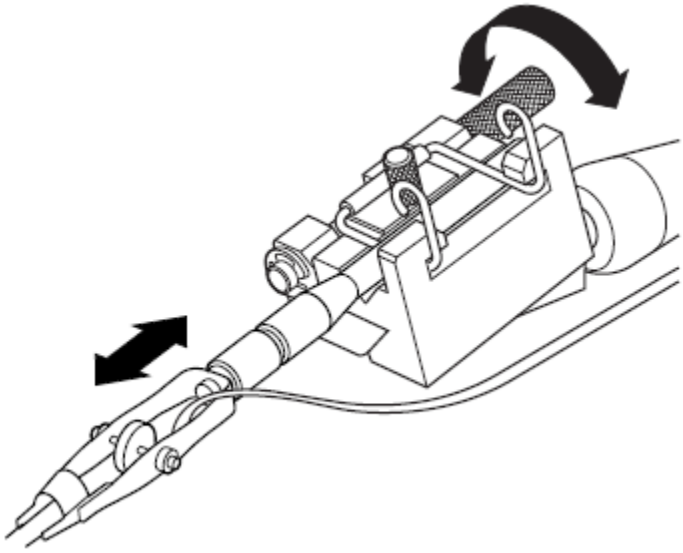


Figure 2-20. Optional Accessory Clamp with Z-axis adjustment

The optional accessory clamp replaces the probe clamp provided with the EZ positioner and allows easy Z-axis adjustment of the probe. The Z-axis can be adjusted by rotating the knurled knob located on top of the clamp (shown previous).

DX00A-AT

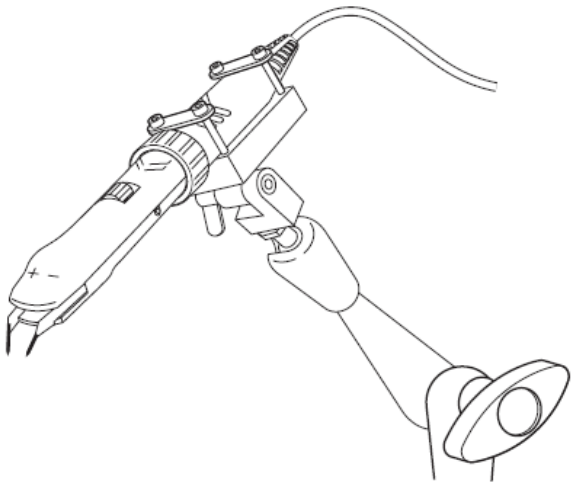


Figure 2-21. AT Probe mounted to EZ Positioner

Attach the probe by removing the screws holding the top plate to the V-shaped probe holder. Rest the probe body (not the AT or ST module) in the V-shaped groove, and fasten the top plate to the holder, using the removed screws (shown previous).

Note: Do not overtighten 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.

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.

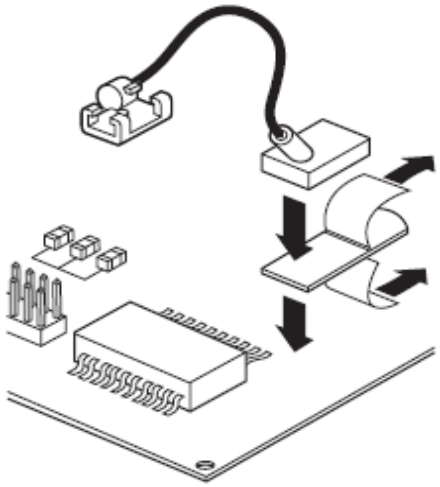


Figure 2-22. Connecting the SI Module Using the Tip Retaining Clip

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.

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.

If you have to bend the arms to move the probe adapter part of the clip for positioning or attaching the probe before the adhesive has cured properly, always apply pressure to the pad to prevent the pad from shifting as follows:

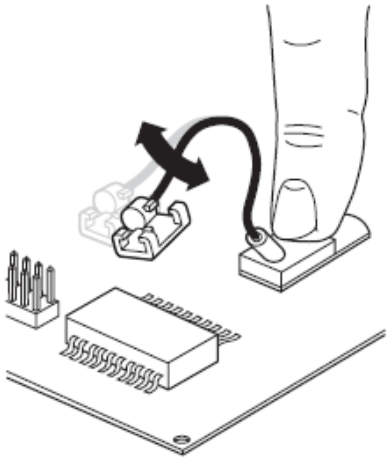


Figure 2-23. Applying pressure when adjusting the probe holder

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.

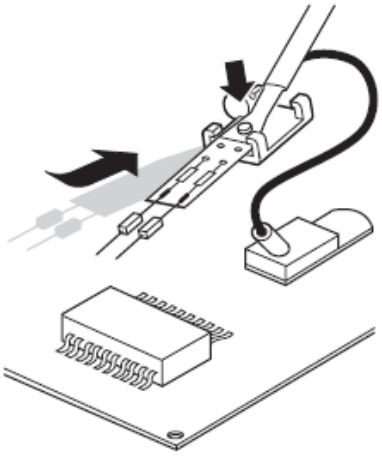


Figure 2-24. Attaching the Probe

TIP RETAINING CLIP REMOVAL

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.

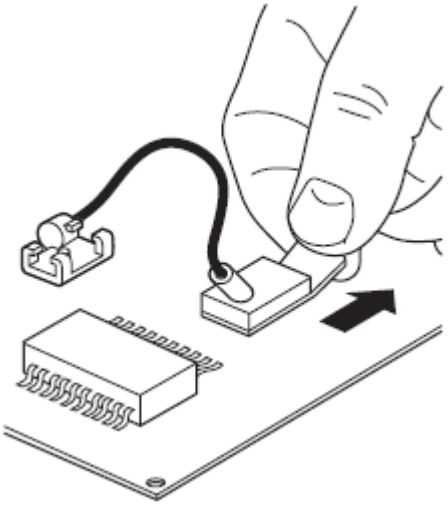


Figure 2-25. Removing the Retaining Clip

PROBE BODY LOCATION CLIP

The Probe Body 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. 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.

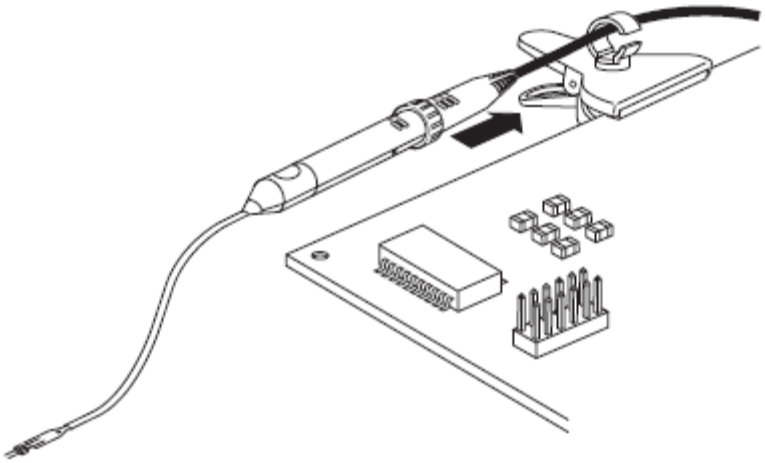


Figure 2-26. Slide Probe into Board Clip

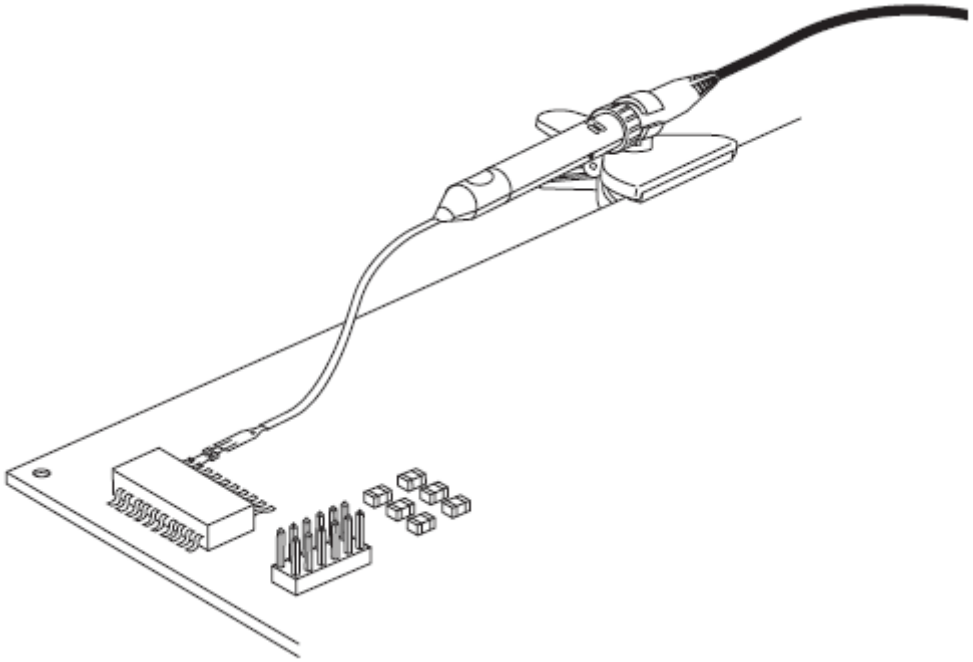


Figure 2-27. Probe Body Location Clip

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.

Offset

OFFSET FOR D600ST, D350ST, D500PT, D600A-AT, AND D300A-AT PROBES

Offset for the WaveLink Series probe is provided by 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 = ±|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, D500PT, D600ST or D300A-AT

V= 5 for the D350ST

As can be seen, the maximum offset for the probe with either the D600A-AT or D300A-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 D300A-AT adjustable tip.

When the WaveLink series probe is used with a LeCroy WaveMaster or WavePro 7Zi (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, D310, AND D320 PROBES

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

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.

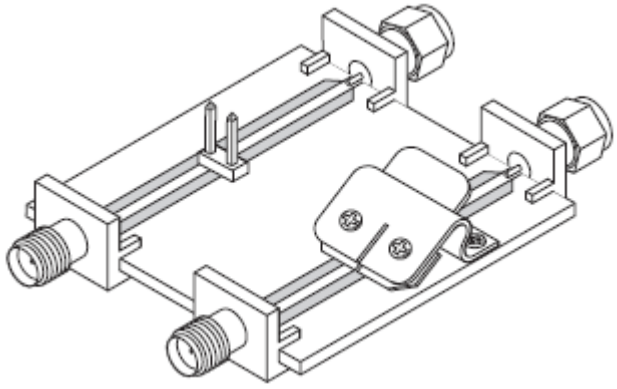


Figure 2-28. Characterization Fixture

In addition, a 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 the modules to the characterization fixture.

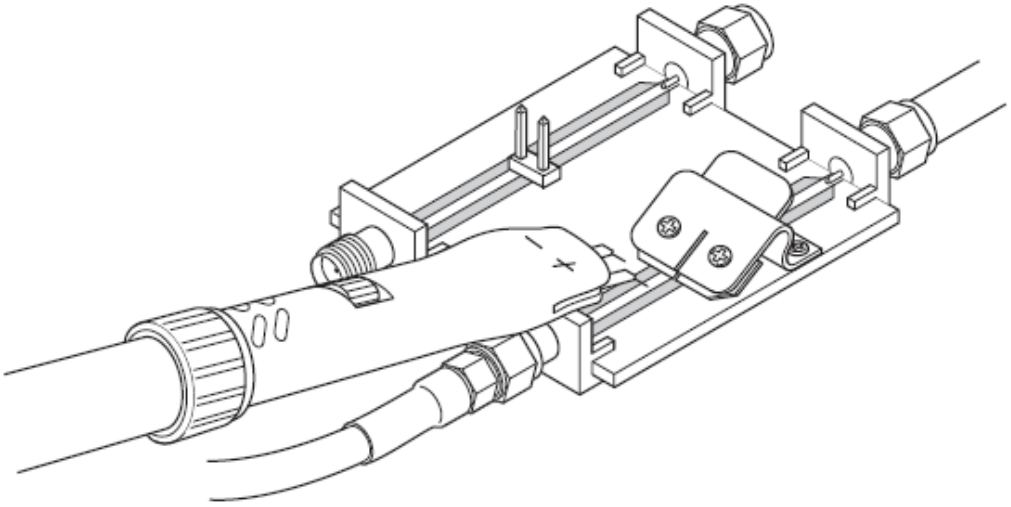


Figure 2-29. Measuring Response using the AT module

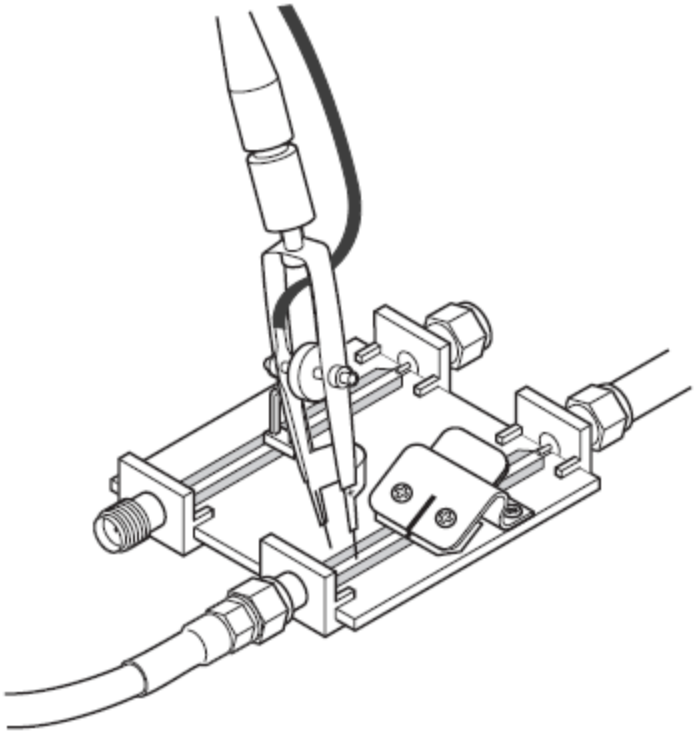


Figure 2-30. Characterization Fixture with PT module

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:

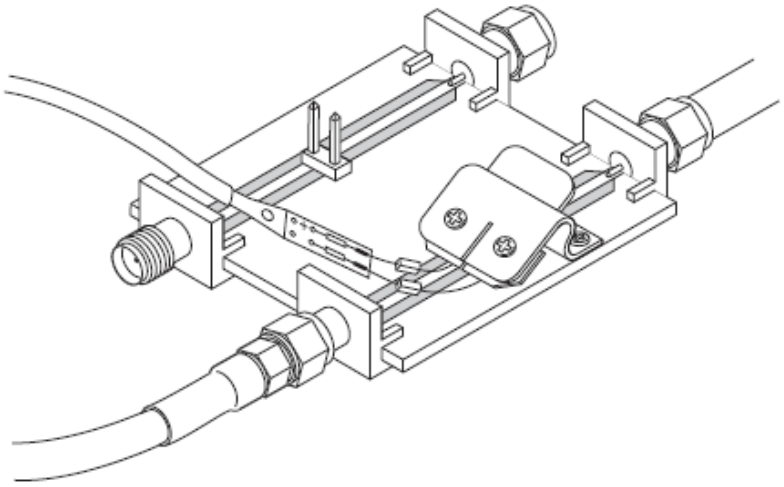


Figure 2-31. Characterization Fixture with SI Lead

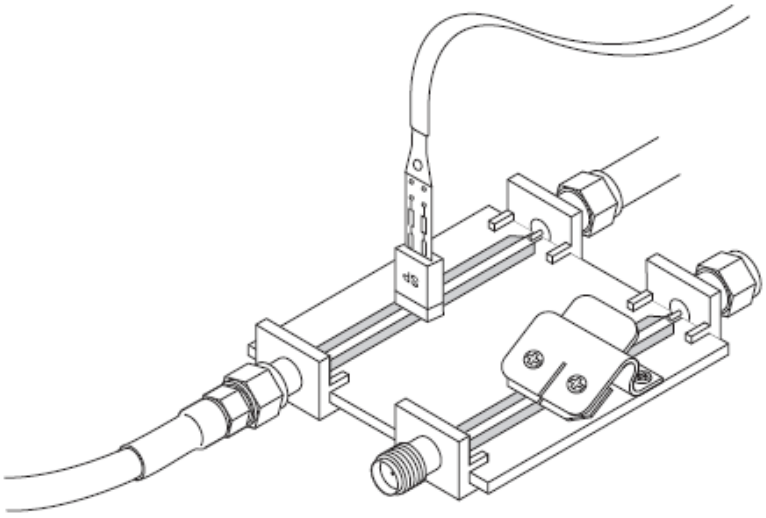


Figure 2-32. Characterization Fixture with SP Lead

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).

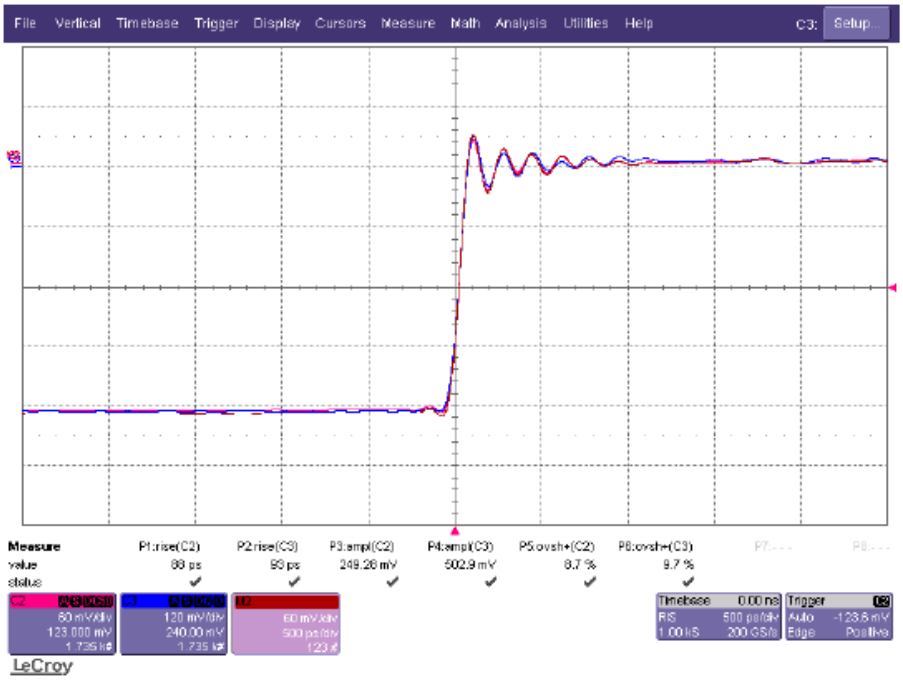


Figure 2-33. Responses of probe input loading and probe output

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, –0.25 to 0 V 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.

Dynamic Range

WaveLink legacy probes (D600ST, D600A-AT, D300A-AT, D500PT, D350ST) have no gain or attenuation control. However, WL-PLink (D610, D620 modules) and WL-PBus (D310, D320 modules) do provide gain and attenuation controls.

The system attenuation is fixed at ÷2.5 when using either an AT, PT, D610, or D620 modules, (or a D600ST module for legacy probes); or at ÷5 for the D310 or D320 (D350ST for legacy probes).

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, D310	D620, D320	D600ST, D600A-AT, D300A-AT, D500PT	D350ST
Input Dynamic Range	±1.25 V	±2.5 V	±2.4 V	±5 V
Input Common Mode Voltage	±4 V	±4 V	±2.4 V	±5 V
Input Offset Voltage	±3 V	±3 V	0 V	0 V
Probe Attenuation	1.5X	2.5X	÷2.5	÷2.5

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

A set of 10 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, D310, D320, and D600ST have different values from those used in the 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 the **Tip Retaining Clip** section of this manual (previous) 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:

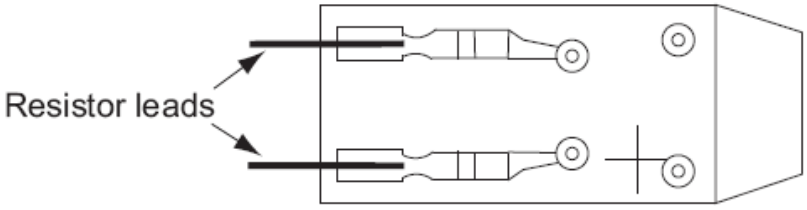


Figure 3-1. Resistor Lead Placement

Replacing Spring Loaded Tips

If the spring-loaded tip fails to perform properly, the tips can be replaced. A special Spring Holder Tool is provided to hold the spring-loaded tip during the replacement process.

Prevent damaging the flex circuit and always use a small, low-temperature soldering iron when replacing the spring-loaded tips.

Replace a tip by positioning the movable tip of the spring-loaded tip in the hole of the Spring Holder Tool (as follows). Mount the Positioner Mounted Tip in a clamp to prevent applying too much strain on the flex circuit.

Apply heat and remove the spring-loaded tip.

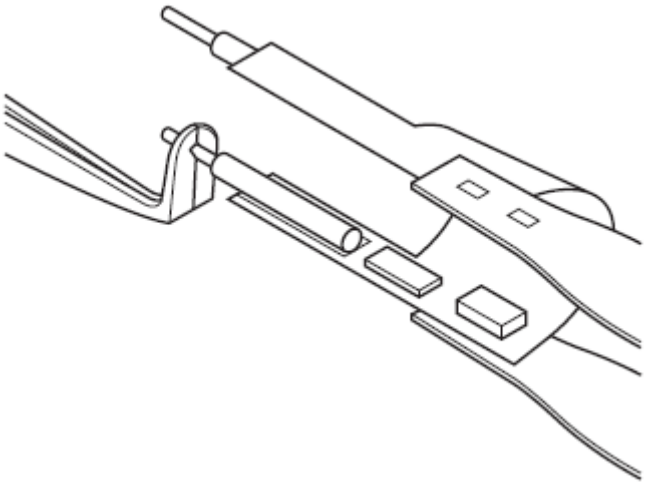


Figure 3-2. Spring Loaded Tip Removal

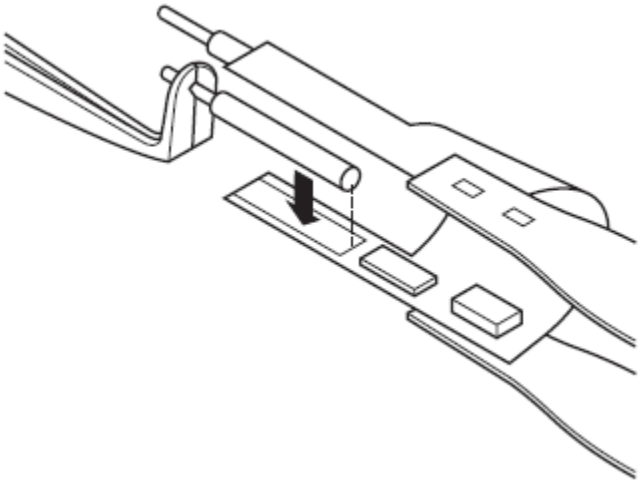


Figure 3-3. Spring Loaded Tip Replacement

Add a new tip by positioning the new tip in the hole of the Spring Holder Tool and position the new tip on the flex circuit of the Positioner Mounted Tip so the end of the new tip aligns with the end of the pad on the Positioner Mounted Tip (previous).

Avoid damaging the flex circuit and do not apply too much heat or solder to the spring-loaded tip.

Cleaning

The exterior of the probe and cable should be cleaned, using a soft cloth moistened with water or isopropyl alcohol only. The use of abrasive agents, strong detergents, or other solvents may damage the exterior of the probe.

The probe case is not sealed and should never be immersed in any fluid.

Service Strategy

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

Returning a Probe for Calibration or Service

Return a product for calibration or service by contacting your local 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 LeCroy sales office, representative, or the North America Customer Care Center.

- Return shipments should be prepaid.
- 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 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, D600ST or D310, D320, D350ST module, do include all Interconnect Leads.
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 LeCroy representative; be sure to add the following:
    - ATTN: <RMA assigned by the 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.

Replacement Parts

The probe accessories and other common parts can be ordered through the regional customer care centers. Use the following table to reference LeCroy part numbers for your probe.

Probe Bodies, Holders, Clips, and Accessories

Note: WL600 and 300 items are still supported with a limited supply.

Item	LeCroy P/N	Replacement Quantity
ProLink Probe Body	WL-PLink	1
ProLink Probe Body	WL600 (Legacy)	1
ProBus Probe Body	WL-PBus	1
ProBus Probe Body	WL300 (Legacy)	1
Ground Lead	PACC-LD005	1
Ground Clip	PK006-4	1
FreeHand Probe Holder	PACC-MS001	1
Characterization Fixture	PCF200	1
Soft Case	SAC-01	1
Probe Tip holder kit	PK600ST-3	1 (incl. 20 pads)
Probe Body mounting kit	PK600ST-4	Includes: 1Board Edge Clip and 4 Adhesive Backed Probe Body Clamps
Instruction Manual	WL-OM-E	1

A-AT and PT Modules and Tips

Item	LeCroy P/N	Replacement Quantity
D300 Adjustable Tip Module	D300A-AT	1
D600 Adjustable Tip Module	D600A-AT	1
D500 Positioner Tip Module	D500PT	1
Positioner Mounted Tip	D500PT-TIP	1
Replacement tips for D500PT	PK500PT-1	2

D310, D320, D610, and D620 Modules and Tips (Sets and Replacements)

Item	LeCroy P/N	Replacement Quantity
D310 Small Tip Module	D310	1
D310 Solder-In Tip	Dx10-SI	1
D310 Square Pin Tip	Dx10-SP	1
D320 Small Tip Module	D320	1

Item	LeCroy P/N	Replacement Quantity
D320 Solder-In Tip	Dx20-SI	1
D320 Square Pin Tip	Dx20-SP	1
D610 Small Tip Module	D610	1
D610 Solder-In Tip	Dx10-SI	1
D610 Quick Connect Tip	Dx10-QC	1
D610 Square Pin Tip	Dx10-SP	1
D620 Small Tip Module	D620	1
D620 Solder-In Tip	Dx20-SI	1
D620 Quick Connect Tip	Dx20-QC	1
D620 Square Pin Tip	Dx20-SP	1
Replacement SI Resistor Kit	PKxx0-SI	10
Replacement QC Resistor Kit	PKxx0-QC	20

D300 and D600 Modules and Tips (Sets and Replacements)

Note: WL600 and 300 modules and tips are still supported with a limited supply.

Item	LeCroy P/N	Replacement Quantity
D350 Small Tip Module	D300ST	1
Solder In Lead Set for D350ST	D350ST-SI	1
Square Pin Lead Set for D350ST	D350ST-SP	1
Resistor kit for D350ST-SI	PK350ST-1	10
D600 Small Tip Module	D600ST	1
Solder In Lead Set for D600ST	D600ST-SI	1
Resistor kit for D600ST-SI	PK600ST-1	10
Quick Connect Lead Set for D600 ST	D600ST-QC	1
Resistor kit for D600ST-QC	PK600ST-2	20
Square Pin Lead Set for D600ST	D600ST-SP	1

Optional Accessories Parts List

Item	LeCroy P/N	Replacement Quantity
EZ Probe positioner	EZ Probe	1

Reference

Safety Information

Symbols

The following symbols appear on the WaveLink Differential Probe or in this manual and indicate important safety considerations.

Refer to information near this symbol to protect against personal injury or damage to the instrument.

The CAUTION sign indicates a potential hazard. It calls attention to a procedure, practice or condition, which, if not followed, could possibly cause damage to the equipment. If a CAUTION is indicated, do not proceed until its conditions are fully understood and met.

The WARNING sign indicates a potential hazard. It calls attention to a procedure, practice or condition which, if not followed, could possibly cause bodily injury or death. If a WARNING is indicated, do not proceed until its conditions are fully understood and met.

The ESD sign indicates a potential hazard. It calls attention to the susceptibility of the equipment to Electrostatic Discharge (ESD) induced damage if anti-static measures are not taken.

Operator Safety

Review the following safety precautions to avoid personal injury and to prevent damage to the probe or any connected products. Avoid potential hazards and use the probe only as specified.

It is advised to comply with the following:

ESD Sensitive: The tips of the WaveLink probe 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

- Connect probe to the measurement instrument before connecting the probe test leads to a circuit/signal being tested.
- Using the probe and/or the oscilloscope it is connected to in a manner other than that specified may impair their protection mechanisms.
- Do not use the probe if any part is damaged. All maintenance should be referred to qualified service personnel.

WARNING

- Do not apply a voltage to any input that exceeds the maximum rating of that input. Refer to the Specifications topic for details.
- Handle the probe with care as it has sharp tips that may cause bodily injury if not handled properly.
- Do not use the probe in wet or explosive atmospheres.

Operating Environment

The WaveLink Differential Probe is intended for indoor use and should be operated in a clean, dry environment.

The design of the differential probe has been verified to conform to EN 61010-031 safety standard per the following limits:

- Installation (Overvoltage) Category I: Refers to signal level which is applicable for equipment measuring terminals that are connected to source circuits in which measures are taken to limit transient voltages to an appropriate low level.
- Pollution Degree 2: Refers to an operating environment where normally only dry non-conductive pollution occurs. Occasionally a temporary conductivity caused by condensation must be expected.

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 a 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 Adjustable and Positioner Tips

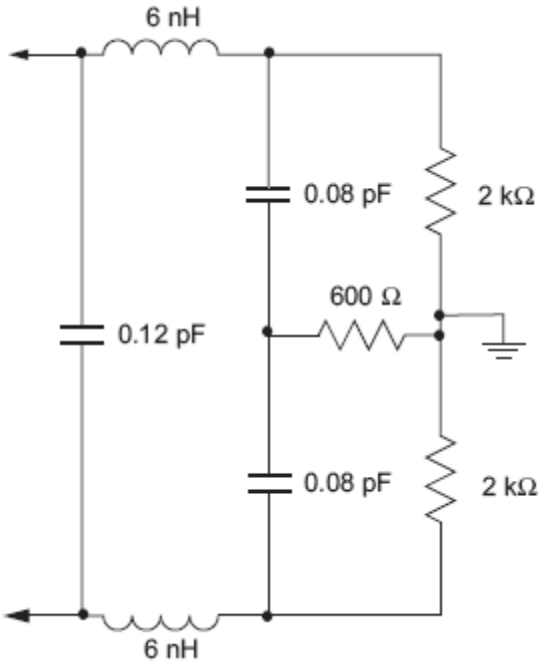


Figure 4-1. D600A-AT, D300A-AT Equivalent Input Circuit

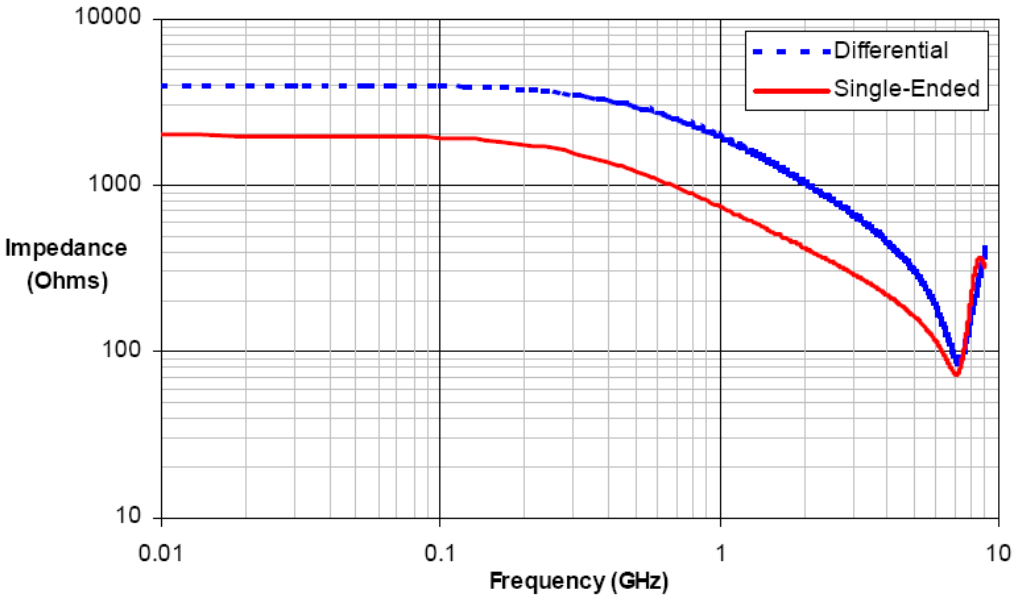


Figure 4-2. D600A-AT, D300A-AT Loading Impedance

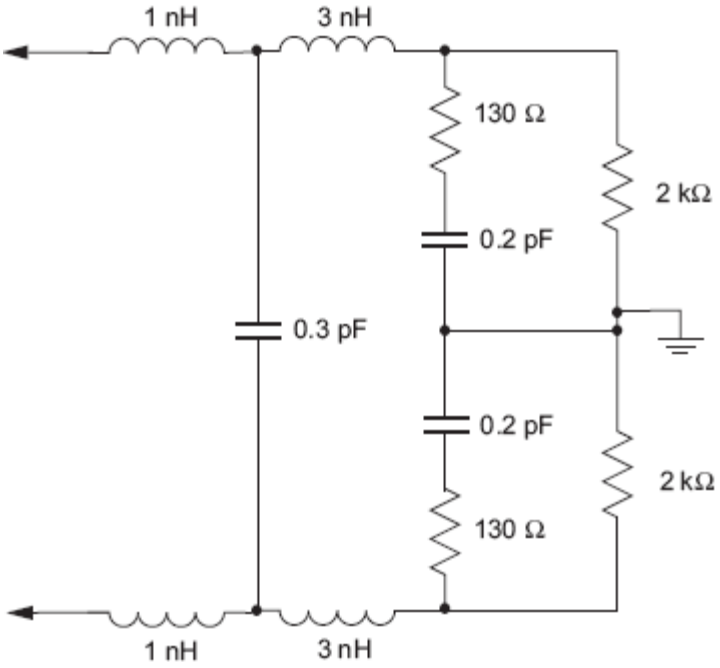


Figure 4-4. D500PT Equivalent Input Circuit

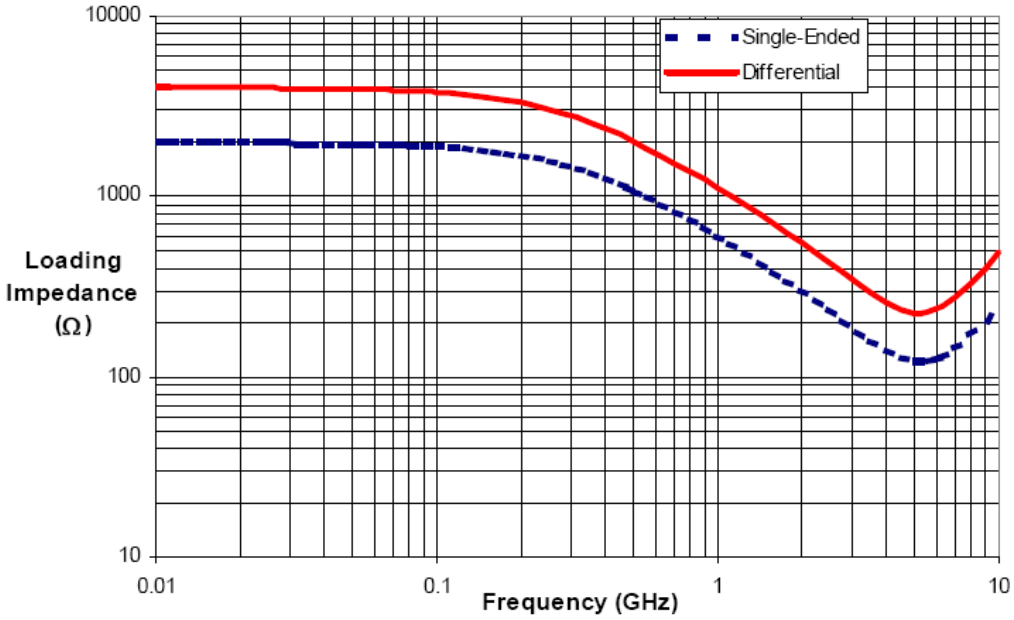


Figure 4-5. D500PT Loading Impedance

Input Loading on Dx10 Tips

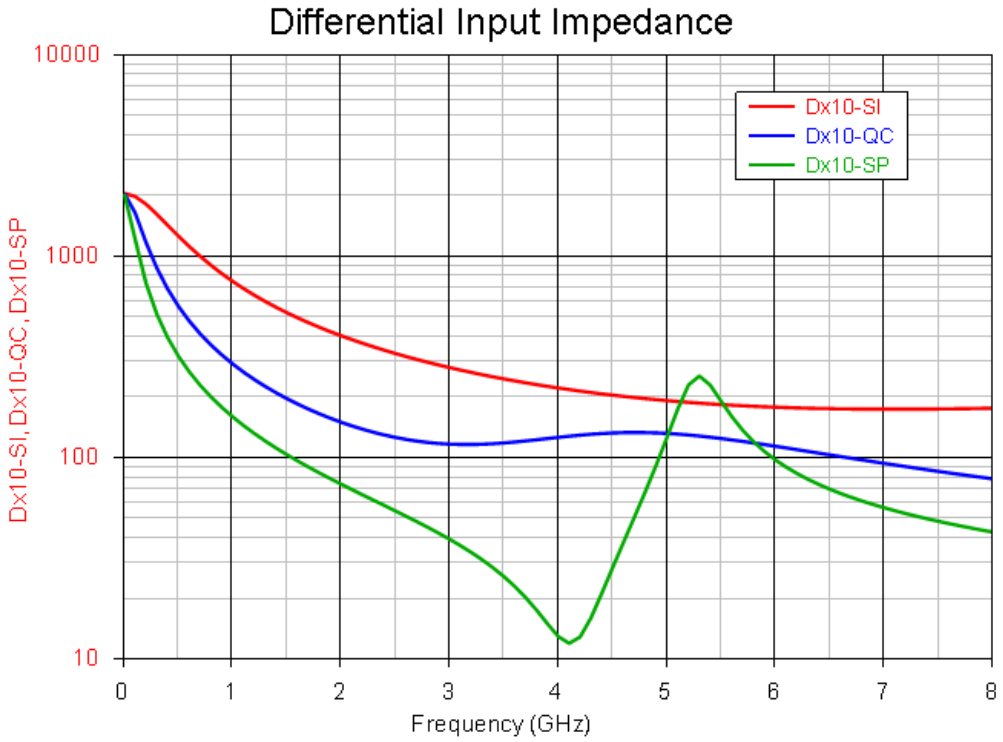


Figure 4-6. Dx10 SI/QC/SP Input Impedance

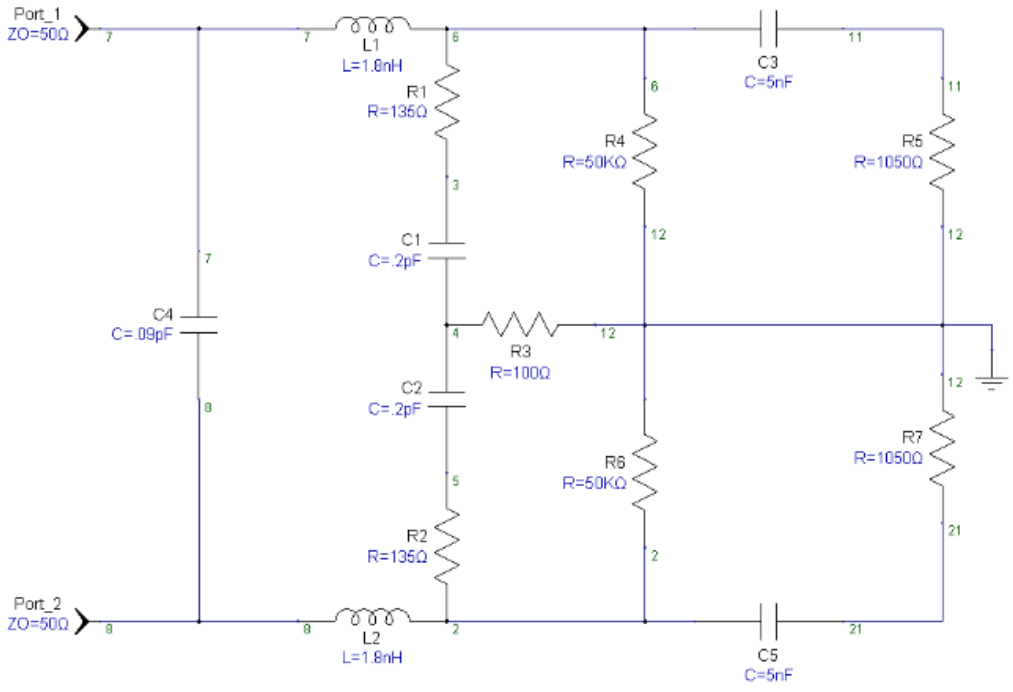


Figure 4-7. Dx10-SI Equivalent Input Circuit

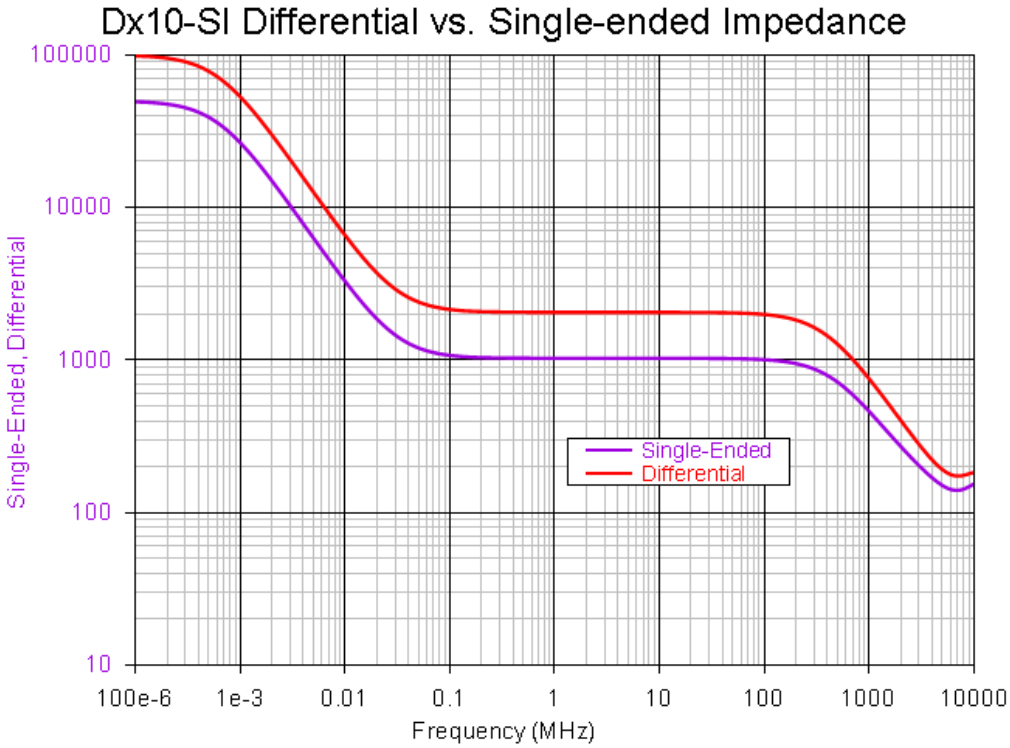


Figure 4-8. Dx10-SI Impedance Graph

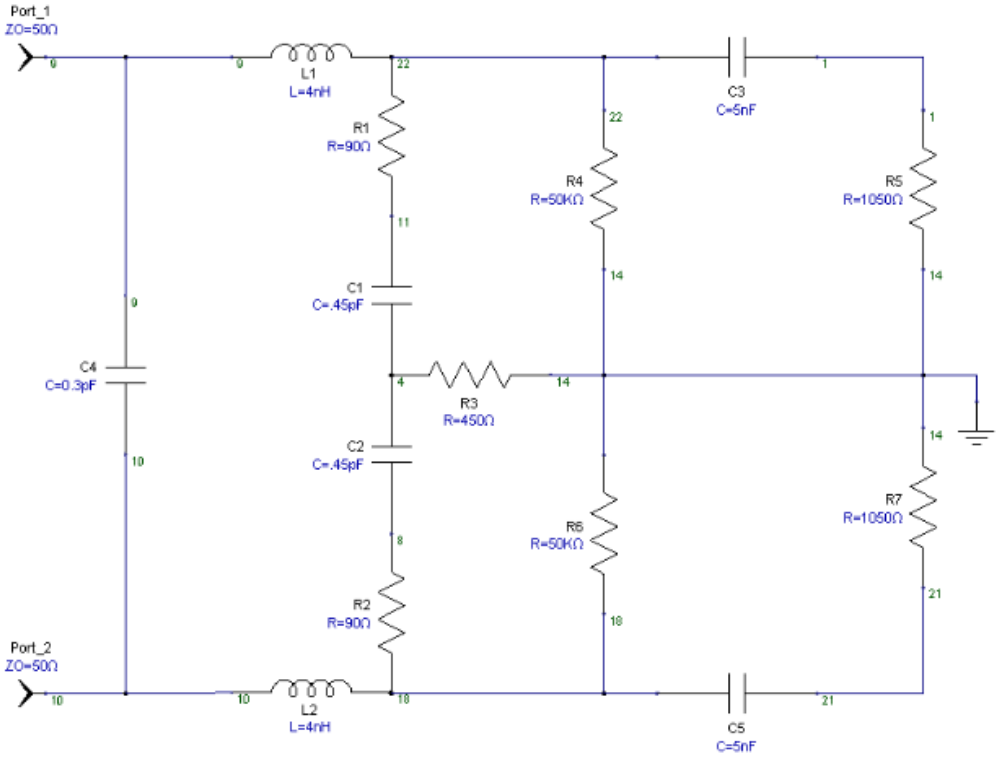


Figure 4-9. Dx10-QC Equivalent Input Circuit

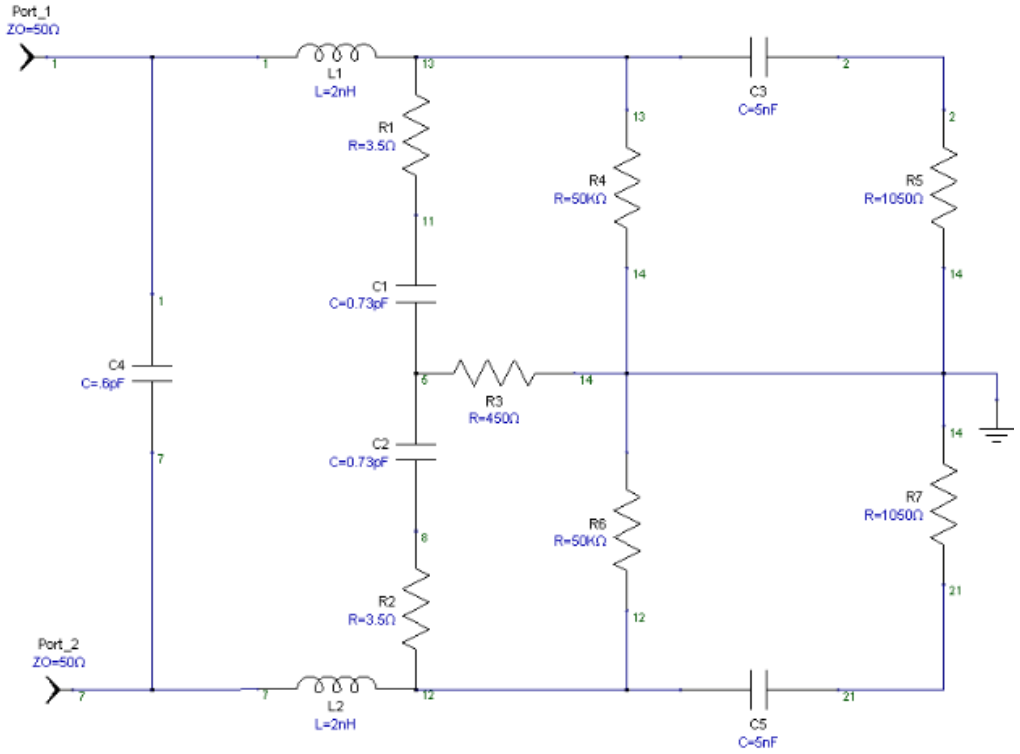


Figure 4-10. Dx10-SP Equivalent Input Circuit

Input Loading on Dx20 Tips

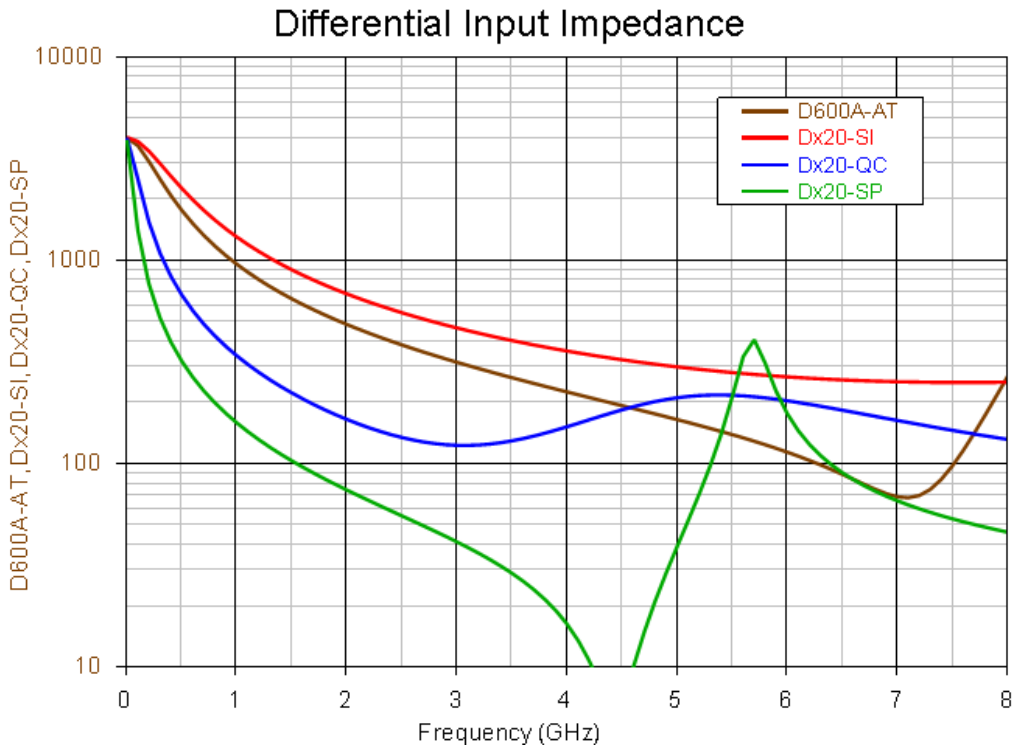


Figure 4-11. Dx20 SI/QC/SP Input Impedance

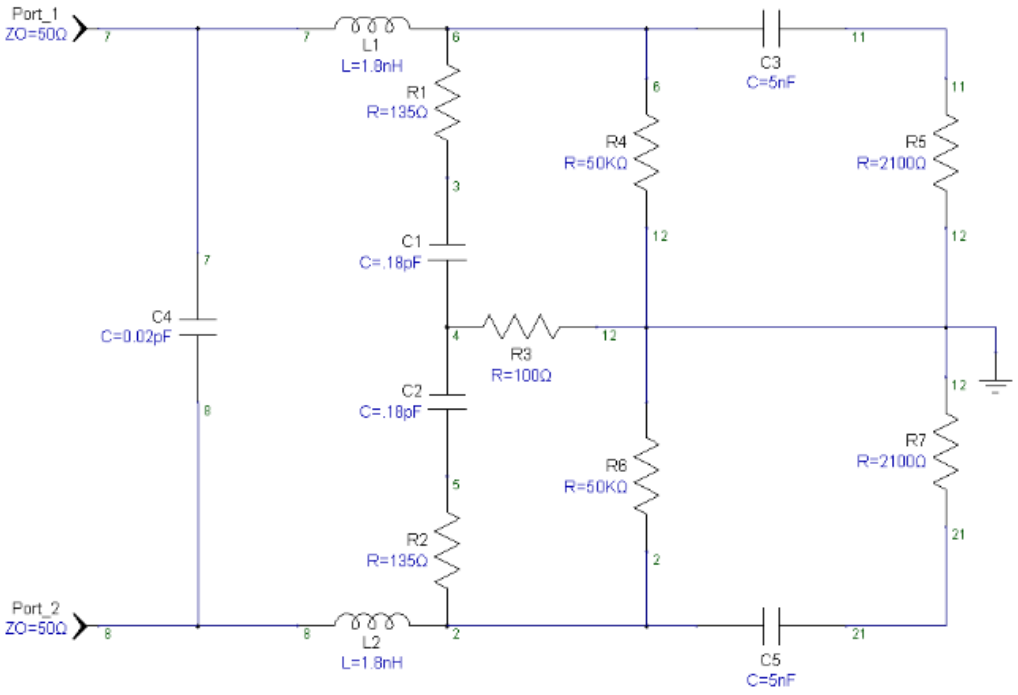


Figure 4-12. Dx20-SI Equivalent Input Circuit

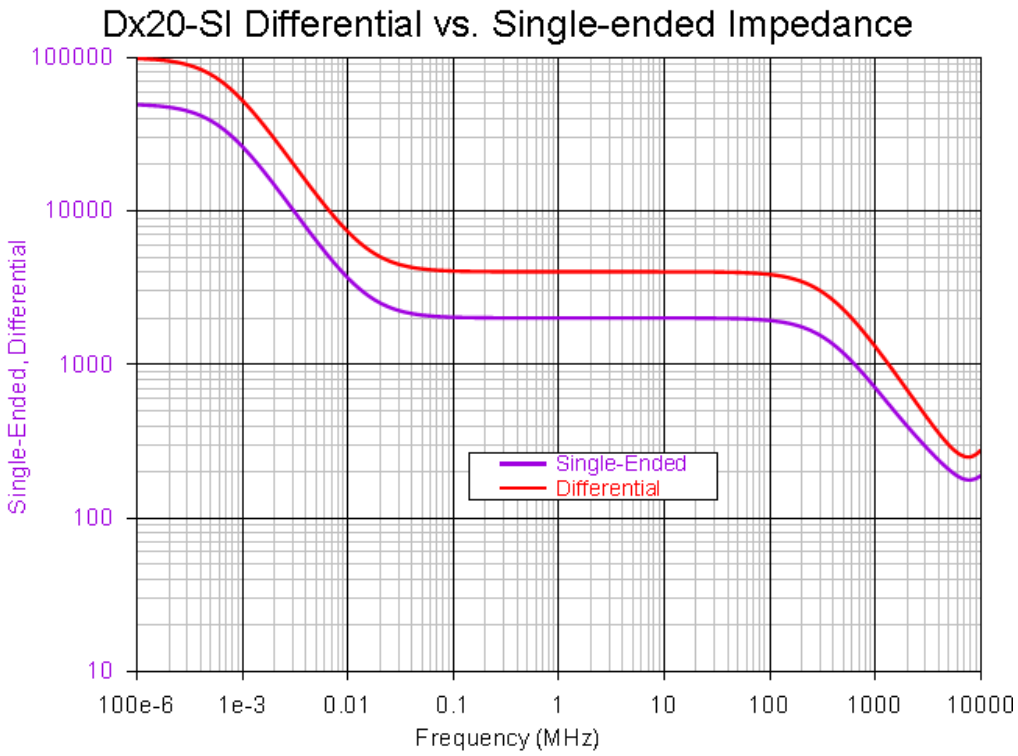


Figure 4-13. Dx20-SI Impedance Graph

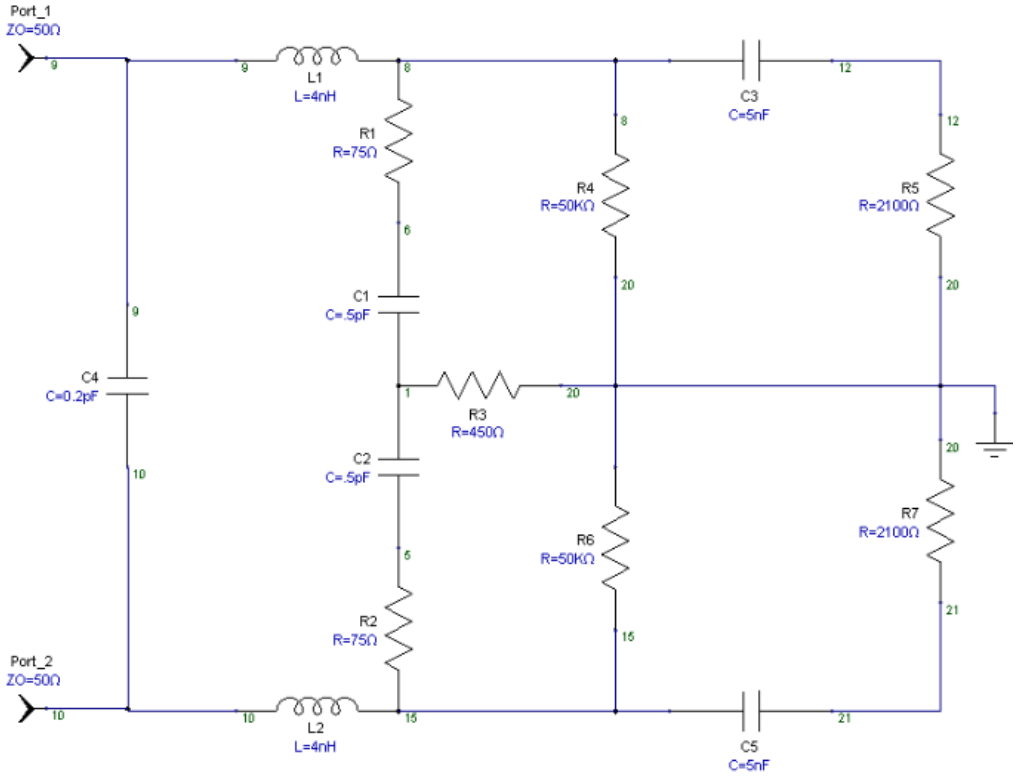


Figure 4-14. Dx20-QC Equivalent Input Circuit

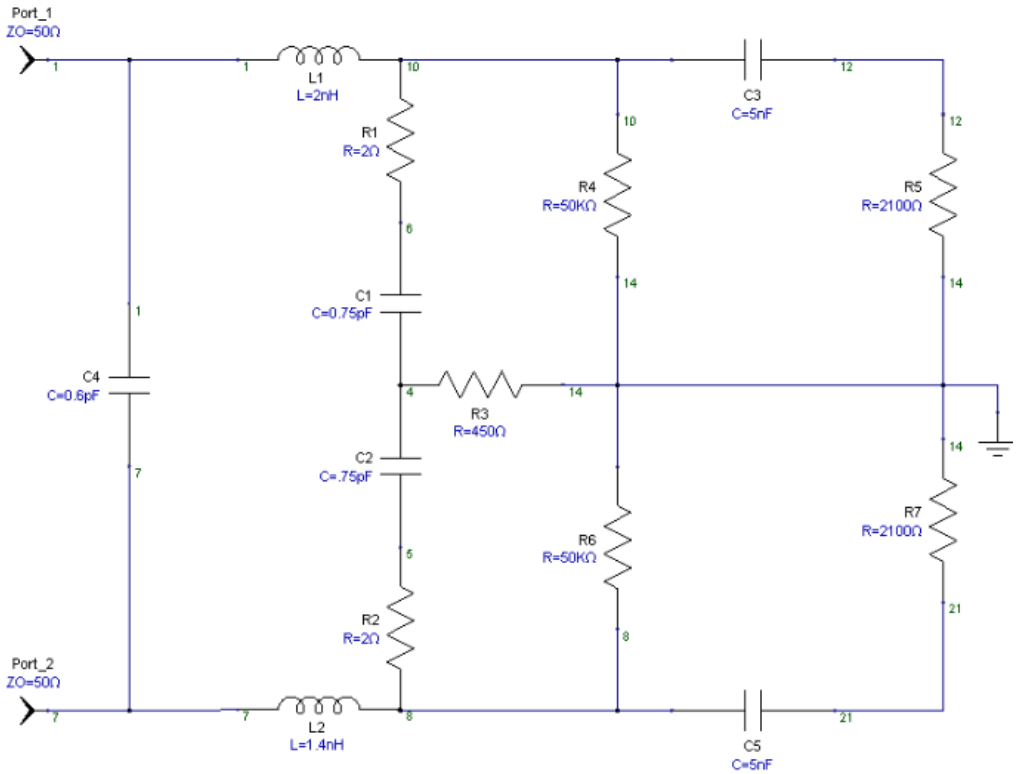


Figure 4-15. Dx20-SP Equivalent Input Circuit

Input Loading on Legacy Probes

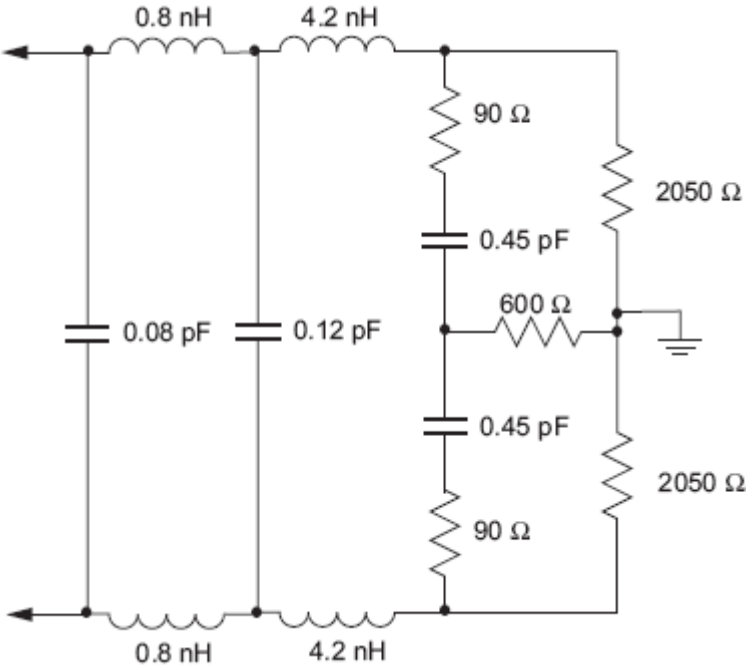


Figure 4-16. D600ST-QC Equivalent Input Circuit

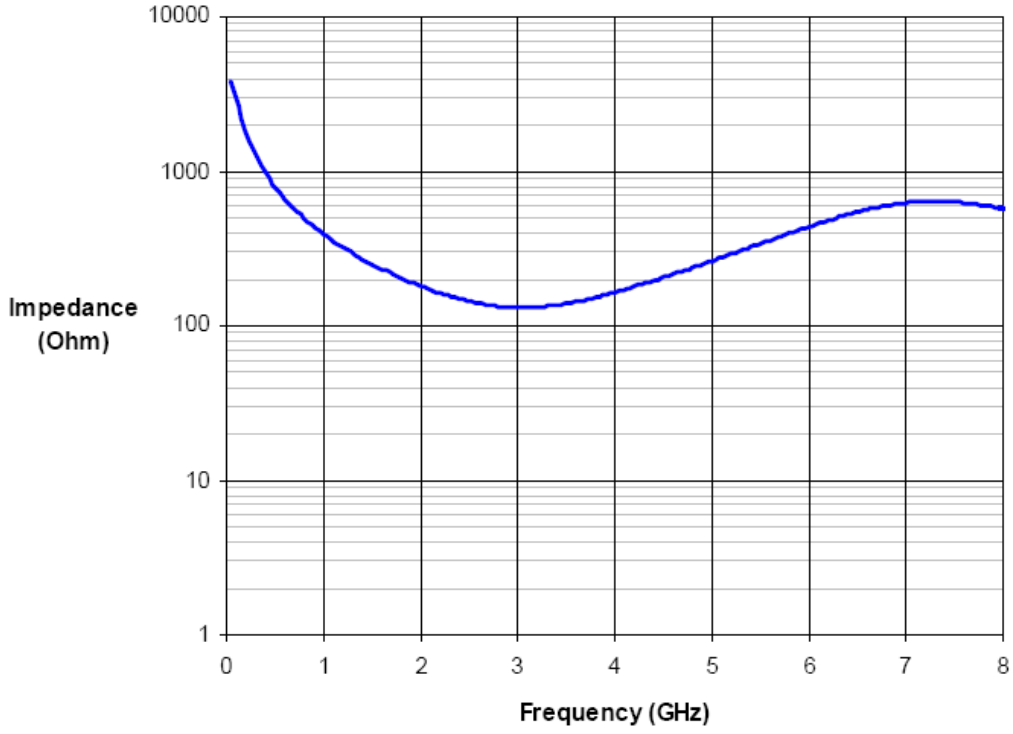


Figure 4-17. D600ST-QC Differential Loading Impedance

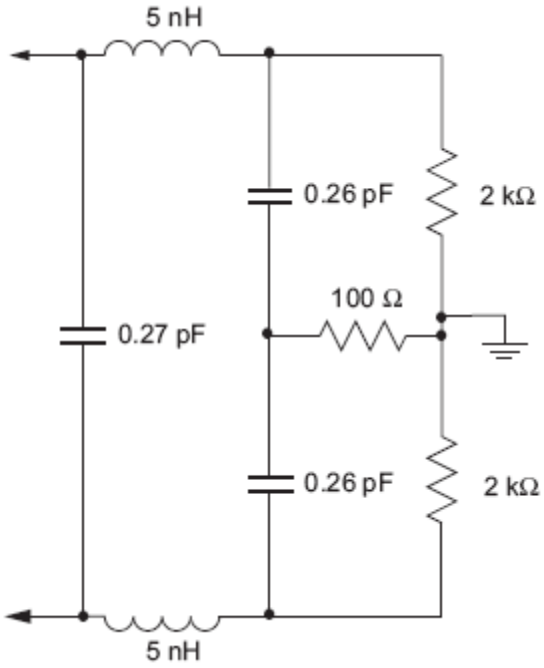


Figure 4-18. D600ST-SP Equivalent Input Circuit with 2.54 mm (0.100”) long square pins

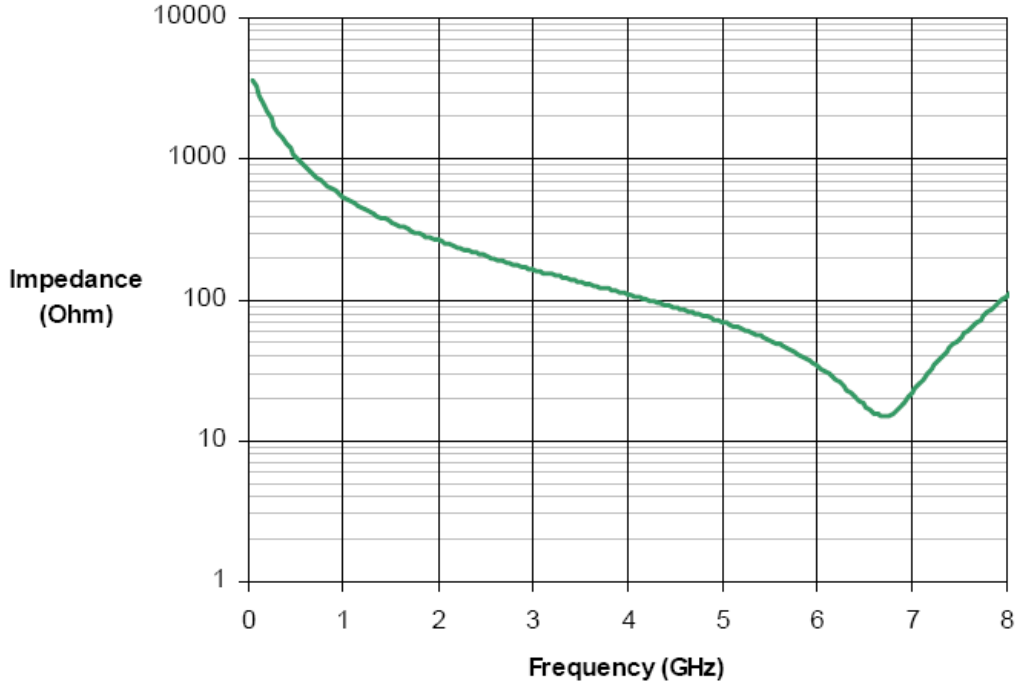


Figure 4-19. D600ST-SP Differential Loading Impedance with 2.54 mm (0.100") long square pins

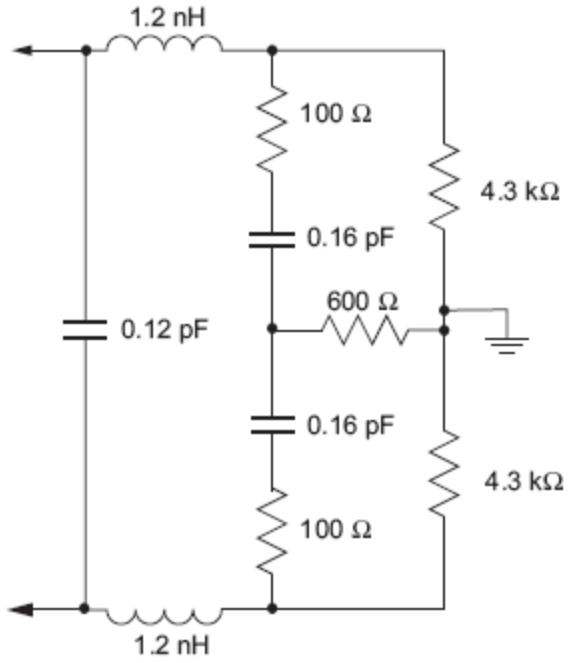


Figure 4-20. D350ST-SI Equivalent Input Circuit

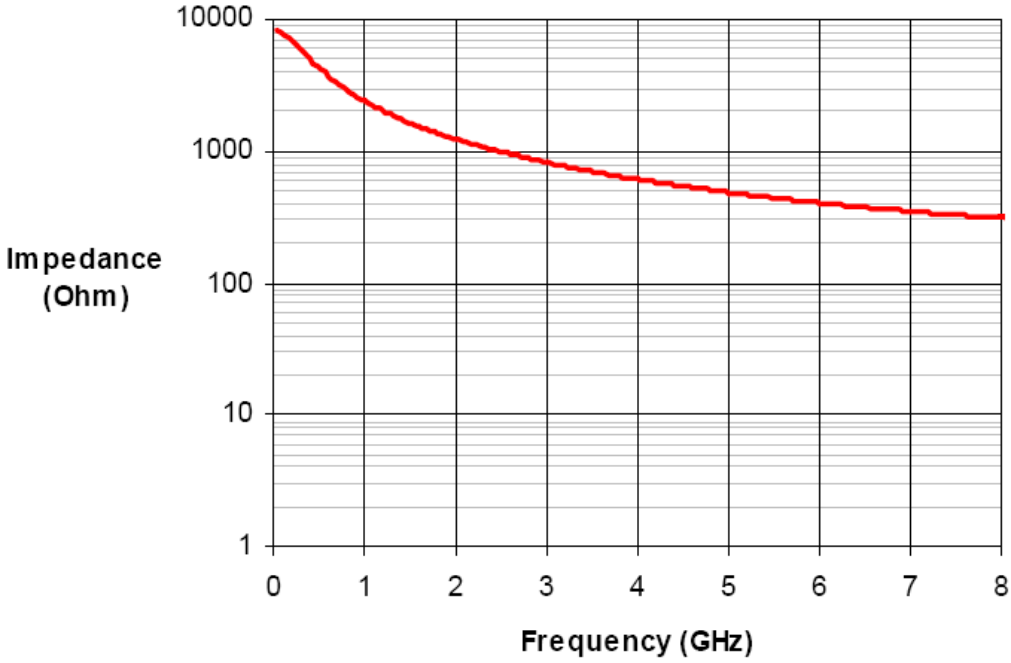


Figure 4-21. D350ST-SI Differential Loading Impedance

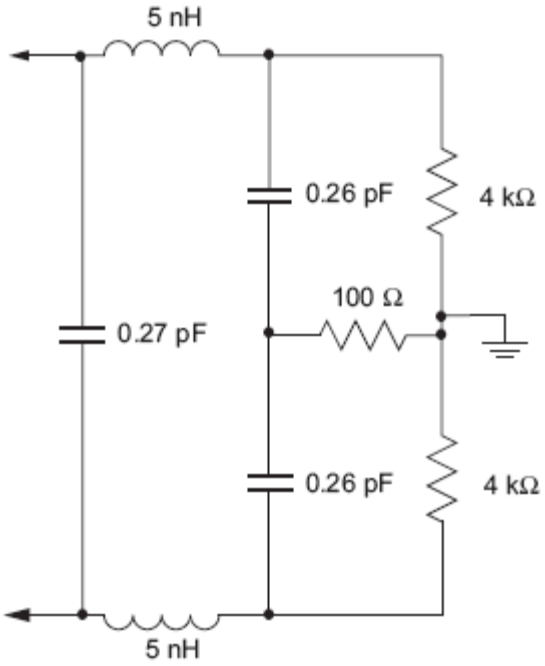


Figure 4-22. D350ST-SP Equivalent Input Circuit

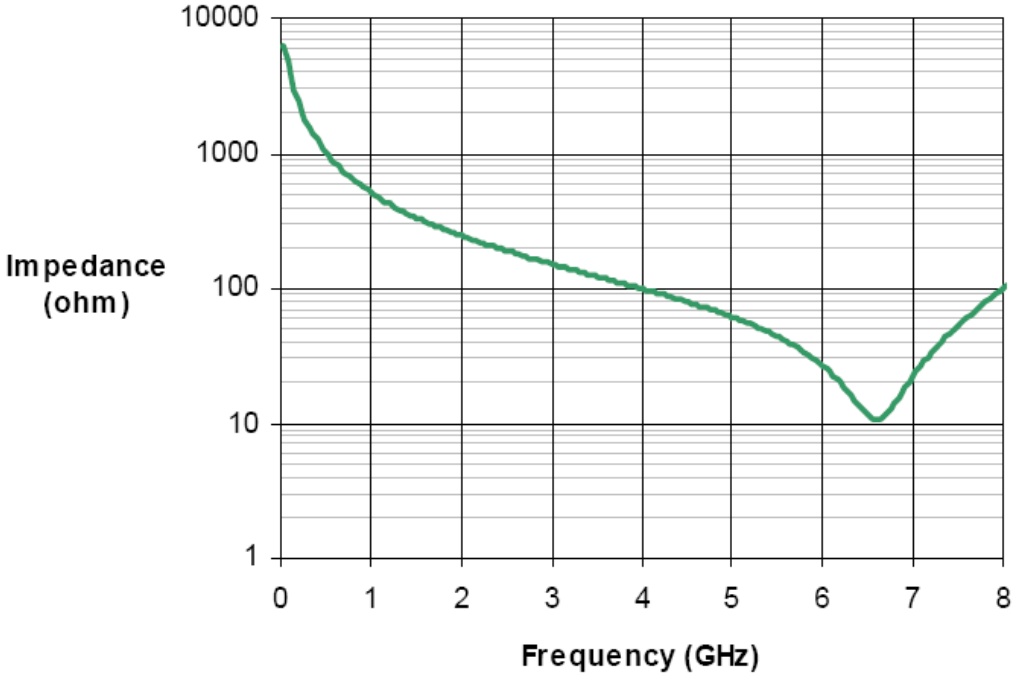


Figure 4-23. D350ST-SP Differential Loading Impedance

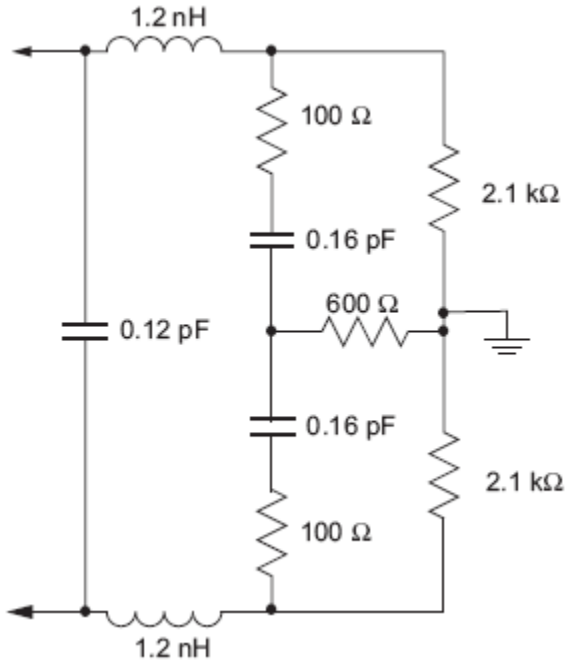


Figure 4-24. D600ST-SI Equivalent Input Circuit with 2.54 mm (0.100”) square pins

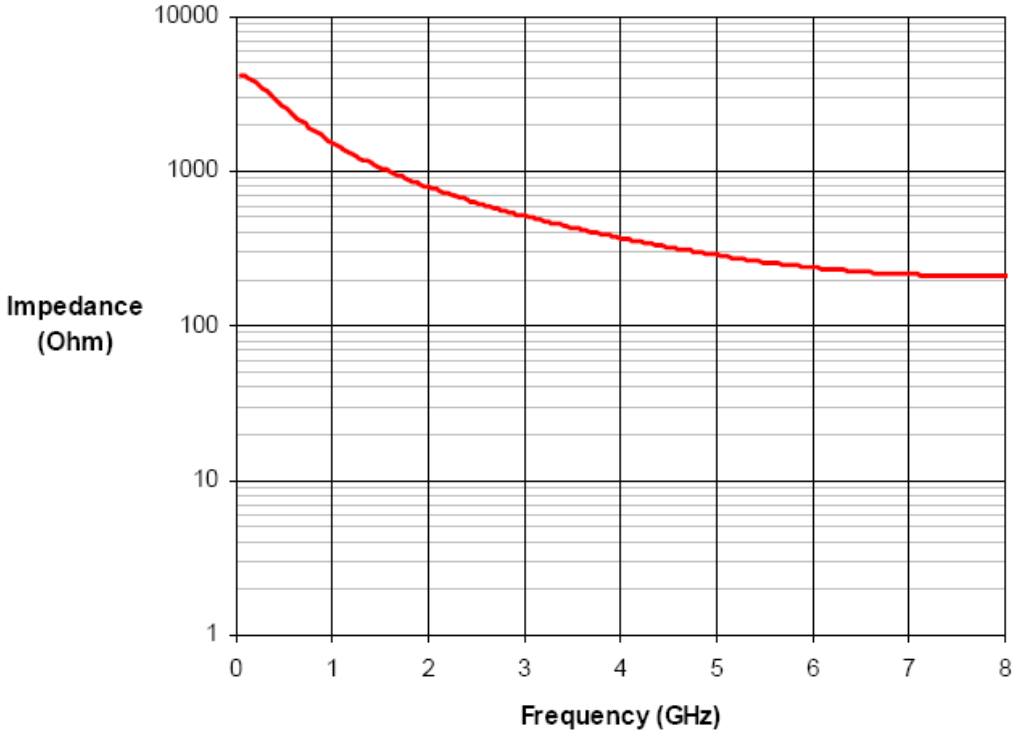


Figure 4-25. D600ST-SI Differential Loading Impedance (with 2.54mm (0.100") square pins)

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. However, 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 $V_{pk\text{-}pk}$ sine	Ground	0.75 V_{peak}	OK: within ±1 V range

Some amplitudes are 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.

Functional Test

Functional Test

The functional test can be used to verify the basic operation of the WaveLink Differential Probe functions, using a 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.

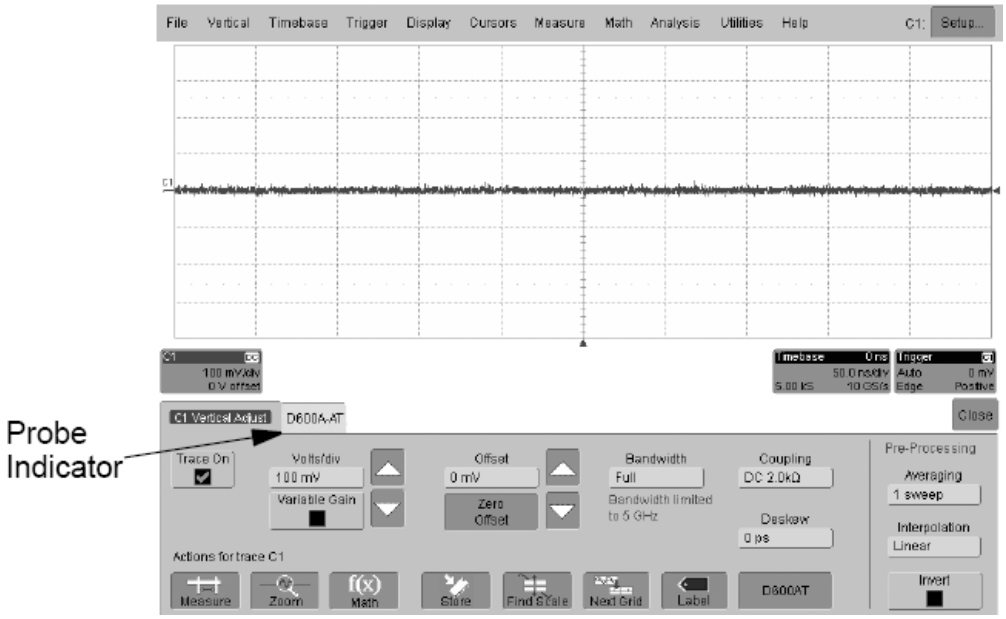


Figure 5-1. Vertical Channel setup

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:

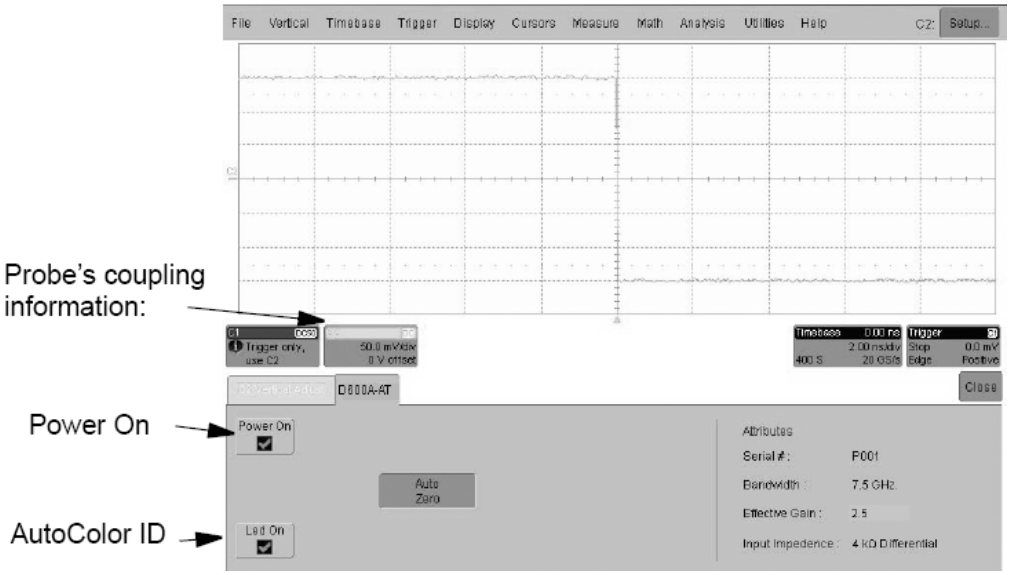


Figure 5-2. D600A-AT probe menu

6. Touch the **Power On** checkbox to verify the AutoColor ID LEDs on the probe are 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 as follows:
10. Touch the **Square** button to obtain a square wave output signal.

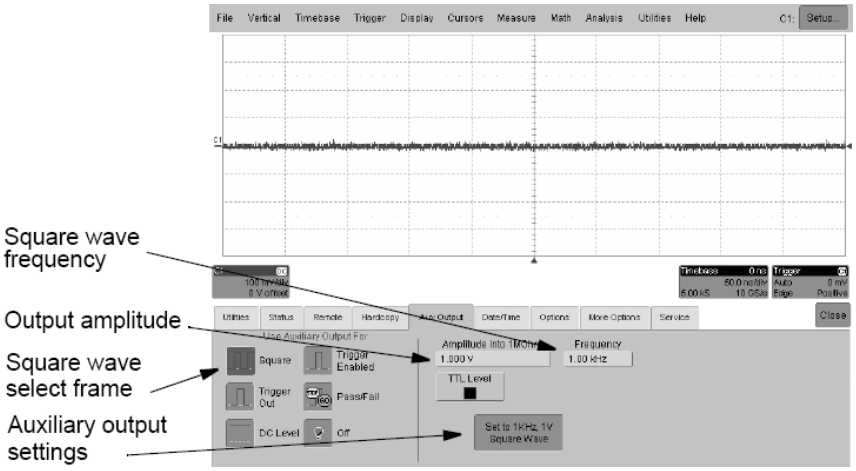


Figure 5-3. Auxiliary output setup

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 around the center graticule line (refer to the following screen-shot). If no square wave is shown, the **+** channel of the probe may be faulty.

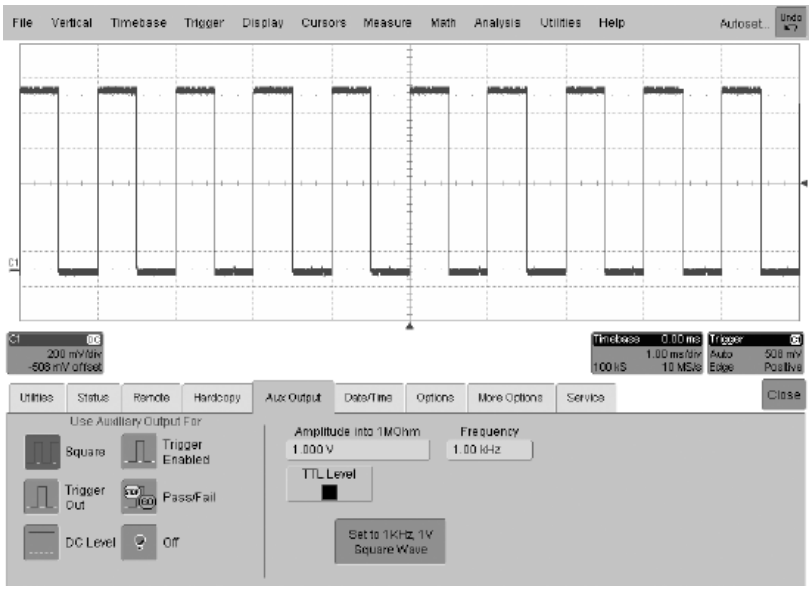


Figure 5-4. Square wave output signal

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** 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** or **Returning a Probe to a Different Country** topics as needed.

This procedure tests the WL-PLink with a D600A-AT, D600ST-SI, Dx10-SI, Dx20-SI, and the D500PT. The WL-PBus is then tested with a D300A-AT and D350ST-SP. 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 D600ST, D350ST, D6x0, D3x0, and D500PT probe tip modules.

The **rise time** specification for the D600A-AT, D600ST, D6x0, and D500PT are only valid with a WL-PLink probe body. Rise time for the D3x0, D300A-AT and D350ST 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 D600ST 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** topic (previous).

Required Test Equipment

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

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	Test Equipment Examples
Oscilloscope, High BW [1]	BW ³ 6 GHz	LeCroy: WaveMaster 8600A, WavePro 760Zi
Oscilloscope, High BW [2]	BW ³ 3 GHz	LeCroy: Wavemaster 8300A or WavePro 7300, WavePro 735Zi
Oscilloscope, High Impedance	200 mV/div - 2 V/div scale factor 1 MΩ input impedance ProBus interface	LeCroy: WavePro 7300 or WaveRunner 6200, WavePro 735Zi
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	LeCroy: ProLink-CF01

Description	Minimum Requirements	Test Equipment Examples
Calibration Fixture [4]	See Preliminary Procedure	LeCroy: ProBus-CF01
Terminator, Precision, BNC	50 W ± 0.05%	LeCroy: TERM-CF01
Characterization Fixture [5]		LeCroy: PCF-200
SMA to BNC Adapter	Female SMA to male BNC	Pomona Electronics: 4289 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: 4284Pasternack Enterprises: PE9070

Description	Minimum Requirements	Test Equipment Examples
Terminator, SMA	Female SMA, 50 W, ½ W	Pomona Electronics: 4287Pasternack Enterprises: PE6003
Attenuator	Male 2.4 mm to male SMA, 50 W, 10 dB,12 GHz	Pasternack Enterprises: PE7045-10
BNC coaxial cable, (3 ea)	Male-male BNC, 50 W, 36”	Pomona Electronics: 2249-C-36Pasternack Enterprises: PE3067-36
SMA coaxial cable, (2 ea) [6]	Male-male SMA, 50 W, 36”	Pomona Electronics: 4846-K-24 Pasternack Enterprises: PE3369-36
SMA coaxial cable, (1 ea) [5]	Male SMA to female SMA, 50 W, 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: 1269Pasternack Enterprises: PE9008

Description	Minimum Requirements	Test Equipment Examples
ProBus to ProLink adapter [7]		LeCroy: LPA-BNC
Adapter	Female 2.4 mm to female SMA	Pasternack Enterprises: PE9656
1 MW adapter [3]		LeCroy AP-1M
Torque Wrench	for SMA connectors	

PLEASE NOTE THE FOLLOWING:

[1] Only required for verification of the D600A-AT, D6xx-SI, or D500PT rise time

[2] Only required for verification of the D300A-AT or D3xx 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 oscilloscope. Not needed when using a WavePro oscilloscope. (Adapter supplied as a standard accessory with WaveMaster oscilloscopes.)

Preliminary Procedure

Different oscilloscopes are required when testing using a **WL-PLink** (**WL600** for legacy probes) or **WL-PBus** (**WL300** for legacy provbes) probe body.

When testing using a WL-PBus (or WL300), any X-Stream oscilloscope with an input impedance of 1 MΩ can be used. Using a WL-PLink (or WL600) requires a WavePro 7000 or 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 7Zi, no AP-1M is required.

1. Connect the WL-PLink (or WL600) to the input of ProLink-CF01 Calibration Fixture. When testing the WL-PBus (or WL300) 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 (or WL600) Calibration Fixture connectivity.
3. When testing using a WL-PLink (or WL600), connect the output of the ProLink-CF01 Calibration Fixture to a free channel of the WavePro 7000 or WaveMaster 8000 oscilloscope. When using a WL-PBus (or WL300), 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**, and fill in the necessary data.

Most of the warranted characteristics of the WaveLink Differential Probe are valid at any temperature within the following **Environmental Characteristics** portion of the Specifications section in this documentation. 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 an ST module (including D610, D620, D310, and D320) with either a SI, QC, or SP interconnect lead 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 (or WL600) as for WL-PBus (or WL300), 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 D600ST) or D3x0 (or D350ST) 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 or WaveMaster 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.

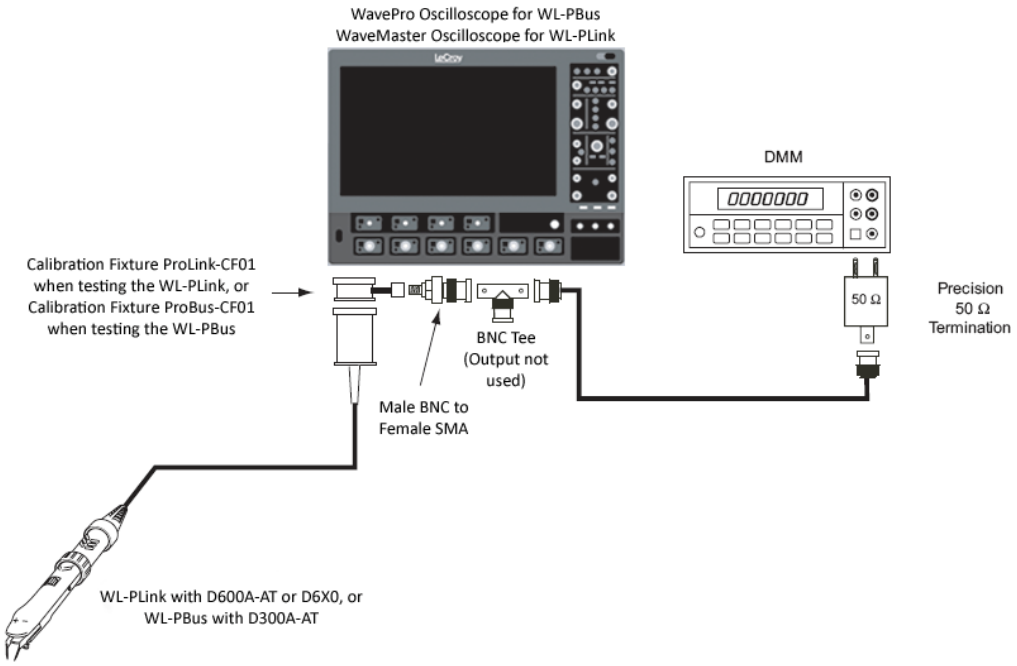


Figure 6-1. Output Zero Voltage

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 (or D600ST), D3x0, D500PT or D300A-AT. Multiply the result by 5 for the D350ST module.
12. Record the result as **Output Zero** on the Test Record.
13. Verify the absolute value of Output Zero is less than 10 mV. For the D350ST, Output Zero should be < 20 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 WL600), or a ProBus-CF01 to the WL-PBus (or WL300) probe.
7. Remove the captive screws from the ProLink-CF01 allowing the WL-PLink (or WL600) Calibration Fixture connectivity.
8. Connect the Calibration Fixture to Channel 1 of the oscilloscope.
9. 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 (as shown in the following figure). No adapter is needed when connecting the WL-PBus (or WL300) ProBus-CF01 to the BNC TEE.
10. For a WL-PLink (or WL600), 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 7Zi or WaveMaster oscilloscope.
11. For a WL-PBus (or WL300), connect the male side of the BNC Tee to a free channel of the non-7Zi WavePro oscilloscope.
12. This input is used to observe the probe's output signal in order to verify adequate Characterization Fixture contact.

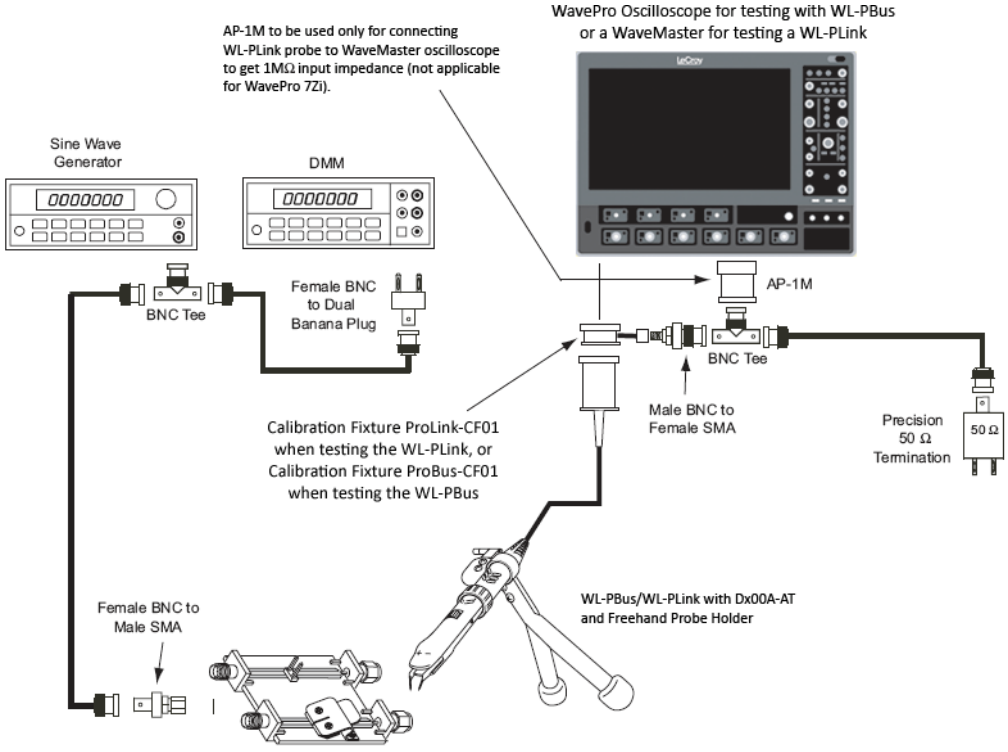


Figure 6-2. WL-PBus/WL-PLink with a Dx00A-AT Measuring Input Voltage

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.

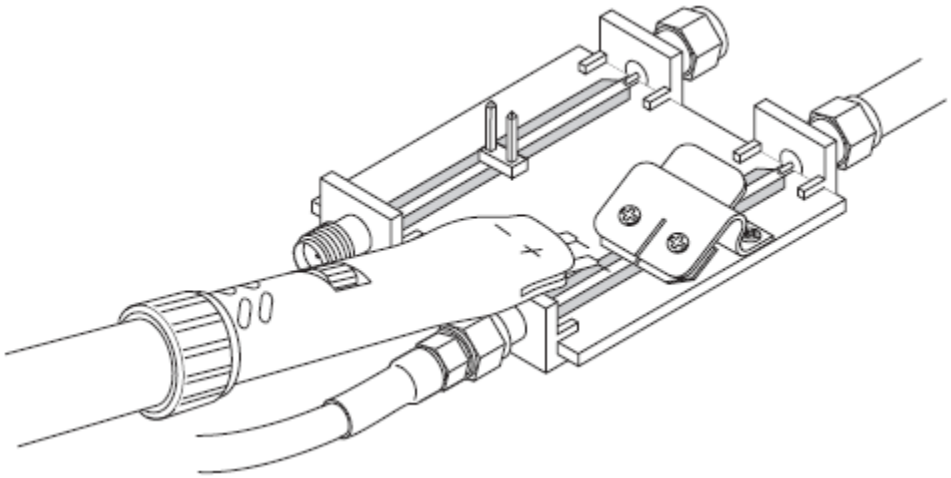


Figure 6-3. Dx00A-AT to Characterization Fixture Connection

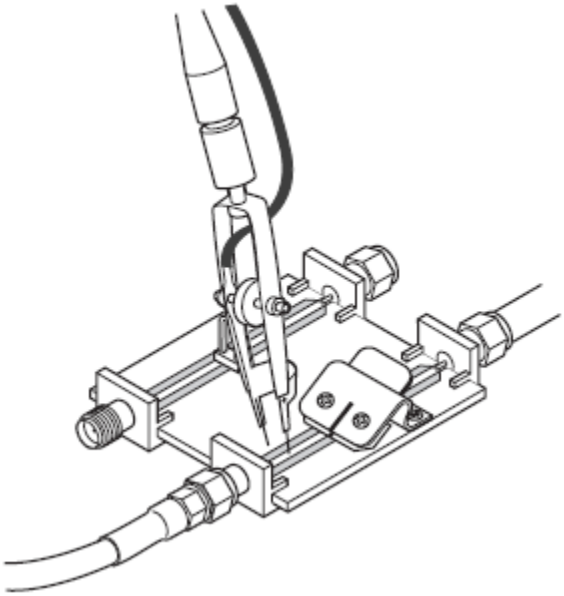


Figure 6-4. D500PT-TIP to Characterization Fixture Connection

- 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.

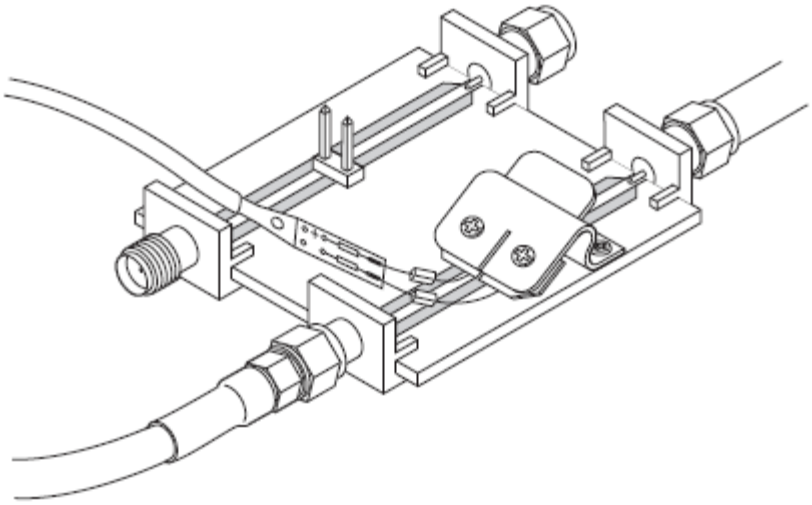


Figure 6-5. SI and QC to Characterization Fixture Connection

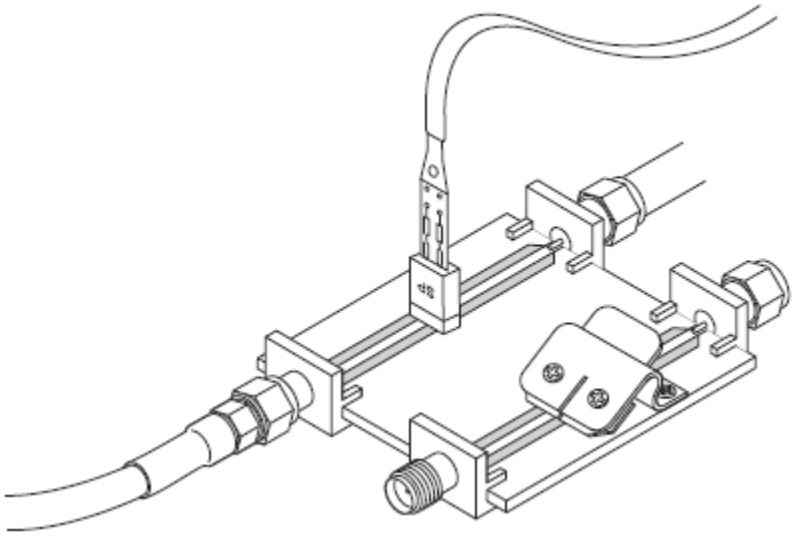


Figure 6-6. SP to Characterization Fixture Connection

- Set the DMM to read AC.
- Set the sine wave generator to about 70 Hz and the output when testing with a D600A-AT, D6x0 (or D600ST), D3x0, D500PT, and D300A-AT to 1.0 $V_{p\text{-}p}$ (0.353 V_{rms}), and the D350ST to 2.0 $V_{p\text{-}p}$ (0.707 V_{rms}) as indicated on the DMM.
- If necessary, move the AT module so the tips make good contact to get the proper amplitude (about 4 divisions) on the oscilloscope.

- With good probe tip contacts verified, record the DMM reading to 1 mV resolution in the Test Record as **Probe Low Range Input Voltage**.
- Unplug the BNC to Banana Plug Adapter from the DMM and connect the Precision 50 Ω Terminator to the DMM input (shown as follows).
- After the DMM has stabilized, record the reading to 1 mV resolution in the Test Record as **Probe Low Range Output Voltage**.
- 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 (or D600ST), D3x0, D500PT, or D300A-AT modules by 2.5; and for the D350ST module, by 5. Record the result as **Corrected Low Range Output Voltage** on the test record.

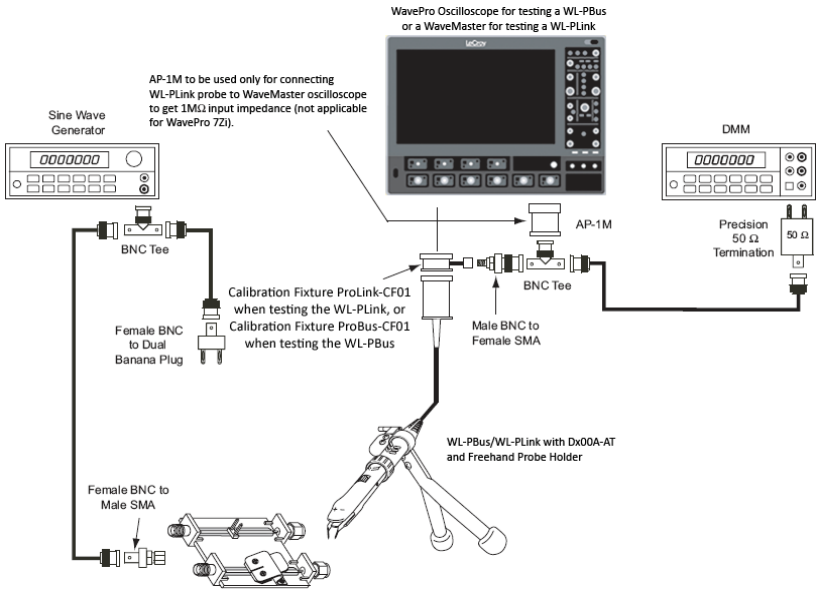


Figure 6-7. WLx00 with a Dx00A-AT measuring Output Voltage.

- 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.

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

- Record the result to two decimal places (±0.xx %) as **Low Range Attenuation Error** on the Test Record.
- Ensure the calculated **Low Voltage Attenuation Error** is less than ±2%.
- 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.

High Range Attenuation Accuracy

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

- 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 **WLx00 with a Dx00A-AT Measuring Input Voltage** figure shows).

- Set the oscilloscope scale factor to the maximum V/DIV. Verify the Coupling is set to **1 MΩ** and **DC**.
- Set the output voltage of the sine wave generator when testing the D600A-AT, D6x0 (or D600ST), D3x0, D500PT, D300A-AT to 4.0 V_{p-p} (1.414 V_{rms}), and the D350ST to 8.0 V_{p-p} (2.828 V_{rms}) as indicated on the DMM. Leave the frequency at 70 Hz.
- Observe the oscilloscope's display and verify the probe tips are making good contact with the Characterization Fixture.
- Record the DMM reading to 1 mV resolution as **Probe High Range Input Voltage** on the Test Record.
- 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).
- After the DMM has stabilized, record the reading to 1 mV resolution on the Test Record as **Probe High Range Output Voltage**.
- Multiply the reading recorded in the previous step for the D600A-AT, D6x0 (or D600ST), D500PT, or D300A-AT modules by 2.5; and for the D3x0 (or D350ST) module, by 5. Record the result as **Corrected High Range Output Voltage** on the Test record.
- 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.

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

- Record the result to two decimal places (±0.xx %) as **High Range Attenuation Error** on the Test Record.
- Ensure the calculated **High Voltage Attenuation Error** is less than ±5%.

Rise (Fall) Time (10% to 90%)

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 (or WL600) probe for rise time, use the very high bandwidth WavePro 7Zi or WaveMaster oscilloscope. However, when testing a WL300, you can use either a WaveMaster or a WavePro 7300 oscilloscope. When using a WaveMaster oscilloscope with the WL300, you need to use the LPA-BNC ProBus-to-ProLink adapter to connect the WL300 probe to the WaveMaster oscilloscope.

THIS SECTION TESTS THE RISE TIMES FOR:

- D600A-AT (75 ps), D6x0-SI or D600ST (75 psec) and D500PT (90 ps) using a WavePro 760Zi oscilloscope.
- D3x0-SI (128 ps) or D350ST-SP-SI (150 ps) and D300A-AT (95 ps) using a WavePro 735Zi 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, D3x0-SI, D600ST-SI, D500PT-TIP, or D350ST-SP tips.

- 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.

- Connect the male side of the attenuator to one of the female sides of the Characterization Fixture (as follows).

- Set the oscilloscope vertical to Channel 1, the input coupling to DC 50 Ω, the scale factor when testing a D600A-AT, D6x0-SI, D3x0-SI, D600ST-SI, D500PT-TIP, or D300A-AT to 0.2 V/div. When testing the D350ST-SP, set the scale factor to 0.1 V/div.
- On the oscilloscope, select **Vertical → Invert**.
- 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-PLink (or WL600) to a ProLink oscilloscope, or to a SMA-to-BNC adapter when connecting a WL-PBus (or WL300) 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.
- Connect the probe tip to the Characterization Fixture, as shown in the previous **Dx00A-AT to Characterization Fixture Connection** and **D500PT-TIP to Characterization Fixture Connection** figures.
- 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.

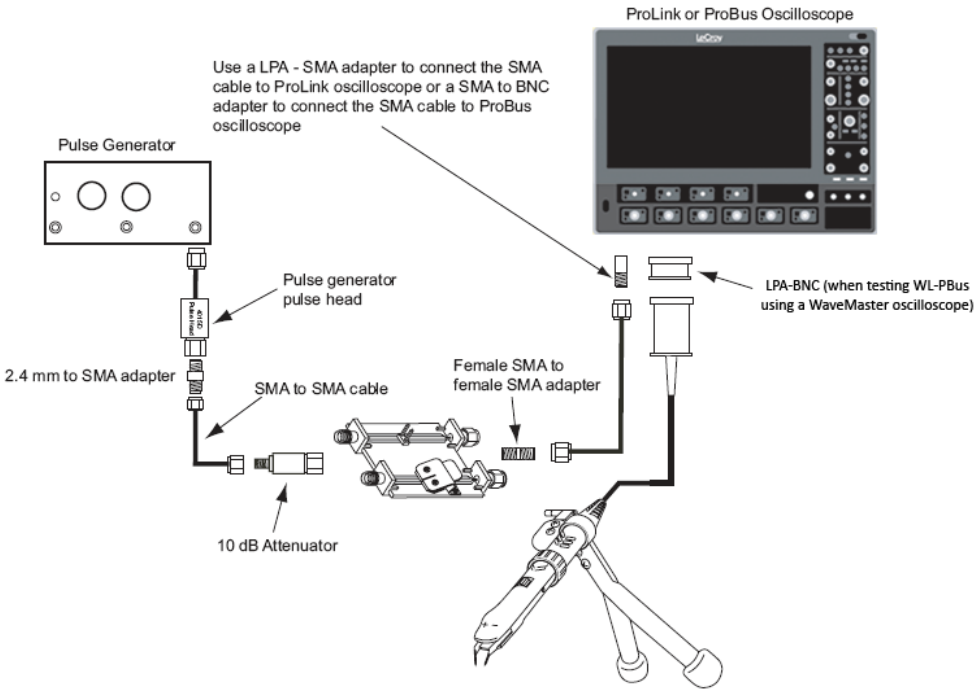


Figure 6-8. Measuring System Rise Time

- 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 (except for the D350ST-SP, where the scale factor should be set to 0.1 V/div). The displayed signal should be a negative going pulse about 3 divisions high.

  When testing a WL-PBus (or WL300) using a WaveMaster instead of a WavePro oscilloscope, connect the LPA-BNC to the WL-PBus (or WL300) before connecting the probe to the oscilloscope.

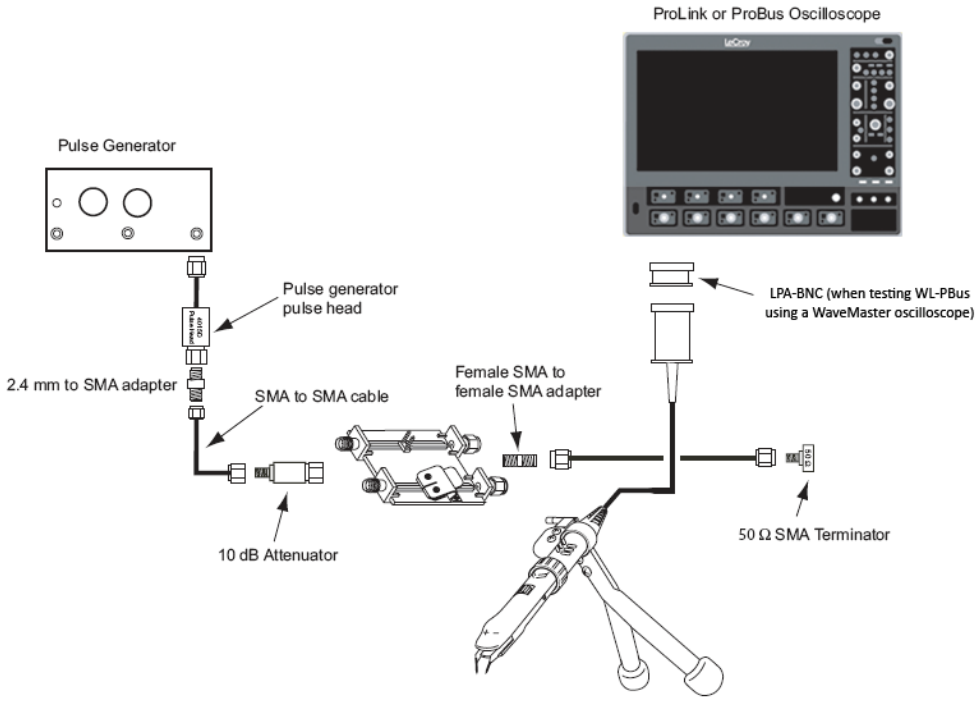


Figure 6-9. Measuring System Rise Time with Probe

- 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.
- 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.
- Record the measured 10% to 90% rise time as **System rise time** (t_{sys}) on the Test Record.
- 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).
- 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.
- 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.
- 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.
- Measure the 10% to 90% rise time and record the measurement as **Rise time with probe** (t_2) on the Test Record.
- Calculate the probe's rise time by taking the square root of the difference of $(t_{sys})^2$ and $(t_2)^2$.

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

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

This concludes the Performance Verification Procedure.

Specifications

Specification Overview

The specifications are valid for probes when the following conditions have been met:

- The probe has been operating for at least 30 minutes in an environment which is within the operating environmental specifications.
- The probe has been calibrated within the last 12 months. Calibration was performed in a controlled environment of 25 °C ±5 °C
- D600A-AT, D610, D620, D600ST, or D500PT operated with WL-PLink (or WL600 for legacy) probe body.
- D300A-AT, D310, D320, or D350ST operated with WL-PBus (or WL300 for legacy) probe body.

Nominal Characteristics

Nominal characteristics describe parameters and attributes that are guaranteed by design, but do not have associated tolerances.

General

- **Input Configuration** - True differential **+** and **–** Inputs with auxiliary ground connection.

INPUT CONNECTORS

- **AT** - Sharp probe tip; user adjustable spacing of the flexible tips to ensure contact on uneven surface.
- **PT** - Small format probe with sharp probe tip; user adjustable spacing is spring loaded to assure contact on uneven surface.
- **SI** - Solder-In; damping resistor leads can be soldered directly onto any test point on the board.
- **QC** - Quick Connect; connector at the end of the QC lead will connect to damping resistors soldered to circuit's test points.
- **SP** - Square Pin; connects to standard square pins test points.

	D600A-AT, D600ST, D500PT and D300A-AT, D350ST	D610, D620, D310, and D320
 **Maximum Non-Destruct Input Voltage, continuous**	Withstand up to ±18 Vp (±40 Vp for D350ST only)	±20
Probe Attenuation	÷2.5 ÷5 (D350ST)	3.2X / 1.9X (D620/D320) 1.7X / 1.0X (D610/D310)
Input Resistance	4 kΩ Differential, 2 kΩ each input to ground 8 kΩ Differential, 4 kΩ each input to ground (D350ST)	100 kΩ Differential, 43 kΩ each input to ground
Output Interface	WL600 ProLink WL300 ProBus	WL-PLink ProLink WL-PBus ProBus

Dynamic Ranges	D600A-AT, D600ST, D500PT and D300A-AT, D350ST	D610, D620, D310, and D320
Maximum Differential Linear Input	±2.4 V ±5.0 V (D350ST)	5 Vpp (±2.5 V, for D620/D320) 2.5 Vpp (±1.25 V, for D610/D310)
Maximum Common Mode Input	±2.4 V ±5.0 V (D350ST)	±4 V

Warranted Characteristics

Warranted characteristics describe parameters that have guaranteed performance. Unless otherwise noted, tests are provided in the **Performance Verification** topic for all warranted specifications.

LF Attenuation Accuracy (Probe only at +20 °C to +30 °C with 0 V common mode)	D600A-AT, D600ST	D500PT and D300A-AT	D350ST	D610, D620, D310, and D320
	2% (V_{in}:|0 to 1.2 V|)	5% (V_{in}:| 1.2 V to 2.4 V|)	2% (V_{in}:|0 to 1.2 V|) 5% (V_{in}:| 1.2 V to 2.4 V|)	2% +20 °C to +30 °C

Zero Offset Error (Referred to the input for at least 15 minutes after Auto Zero)	D600A-AT, D600ST	D500PT and D300A-AT	D350ST	D610, D620, D310, and D320
	<10 mV	<10 mV	<20 mV	5 mV (D620/D320) 2.5 mV (D610/D310)

Offset Gain Accuracy	
D610/D620/D600ST-SI	1% of Offset Value

Bandwidth (System)	
D610/D620	6 GHz[1]

Rise Time (Probe only 10% - 90%)	
D600A-AT[1]	< 70 psec
D600ST-SI[1]	< 65 psec
D500PT[2]	< 100 psec
D350ST-SI[3]	< 90 psec
D300A-AT[3]	< 95 psec

Typical Characteristics

Typical characteristics are parameters with no guaranteed performance. Tests for typical characteristics are not provided in the Performance Verification Procedure.

Bandwidth (System)	
D600A-AT	6 GHz[1]
D600ST-SI	6 GHz[1]
D610/D620/D600ST-QC	4 GHz[1]
D610/D620/D600ST-SP	3 GHz[1]
D500PT	5 GHz[1]
D310/D320-SI	3.5 GHz[1]
D310/D320-SP	3 GHz[1]
D350ST	4 GHz[3]
D300A-AT	3 GHz[3]

Rise Time (System) (10% - 90%)	
Dx10-SI (on D610)	75 ps[1]
Dx20-SI (on D620)	75 ps[1]
Dx10-QC (on D610)	112.5 ps[1]
Dx20-QC (on D620)	112.5 ps[1]
D600ST-QC	112.5 ps[1]
Dx10-SP (on D610)	150 ps[1]
Dx20-SP (on D620)	150 ps[1]
D600ST-SP	150 ps[1]
Dx10-SI (on D310)	128 ps[1]
Dx20-SI (on D320)	128 ps[1]
Dx10-SP (on D310)	150 ps[1]
Dx20-SP (on D320)	150 ps[1]

Noise (Referred to input, System)	
D610	2.8 mV rms
D620	4.8 mV rms
D310	2.0 mV rms
D320	3.6 mV rms
D600A-AT, D600A-AT, D600ST	5.8 mVrms[1]
D500PT	5.8 mVrms[1]
D350ST	9.5 mVrms[1]
D300A-AT	5.0 mVrms[1]

[1] Measured with 6 GHz instrument bandwidth

[2] Measured with 5 GHz instrument bandwidth

[3] Measured with 3 GHz instrument bandwidth

Common Mode Rejection Ratio

(See CMRR section of this manual for details)

D600A-AT	
DC to 1 GHz	> 40 dB
1 GHz to 3 GHz	> 30 dB
3 GHz to 7 GHz	> 20 dB

D610, D620, D310, and D320	
DC to 10 MHz	> 30 dB
10 MHz - Max Frequency	> 26 dB

D600ST	
DC to 1 GHz	> 30 dB
1 GHz to 3 GHz	> 25 dB
3 GHz to 7 GHz	> 20 dB

D500PT	
DC to 1 GHz	> 25 dB
1 GHz to 3 GHz	> 19 dB
3 GHz to 5 GHz	> 16 dB

D350ST	
DC to 1 GHz	> 30 dB
1 GHz to 3 GHz	> 25 dB

D300A-AT	
DC to 1 GHz	> 40 dB
1 GHz to 3 GHz	> 30 dB

Propagation Delay	
Dx20, Dx10, D600A-AT, D600ST, D500PT, D300A-AT, and D350ST	7 ns

Total Harmonic Distortion	
D610/D310	0.5%
D620/D320	0.5%
D600A-AT, D600ST, D500PT, D300A-AT	1.10% at 1 GHz, 0.8 Vp-p input
D350ST	0.66% at 1 GHz, 2 Vp-p input

2nd Order Intercept (Input)	
D610/D310	42 dBm
D620/D320	48 dBm
D600A-AT, D300A-AT	43 dBm
D600ST, D500PT	48 dBm

2nd Order Intercept (Input)	
D350ST	54 dBm

3rd Order Intercept (Input)	
D610/D310	32 dBm
D620/D320	38 dBm
D600A-AT, D300A-AT	33 dBm
D600ST, D500PT	30 dBm
D350ST	36 dBm

Gain / Temperature Coefficient	
D610/D310	0.01%/°C
D620/D320	0.01%/°C
D600ST, D500PT, D350ST	0.08%/°C

Environmental Characteristics

The Environmental Characteristics are tested to specification MIL-PRF-28800F Class 4.

Environmental Characteristics	
Temperature (Operating)	0 °C to 40 °C (Probe module can be operated intermittently at higher temperatures using the Power Control function)
Temperature (Non-Operating)	-40 °C to 71 °C
Humidity (Operating)	5% to 80% RH* (Non-Condensing) *50% RH above 30 °C
Humidity (Non-Operating)	5% to 95% RH* (Non-Condensing) *75% RH above 30 °C and 45% RH above 40 °C

* Measured with 6 GHz instrument bandwidth

* Measured with 3 GHz instrument bandwidth

Physical Characteristics

- **Adjustable Tip Spacing**: 0 to 3.0 mm (0 to 0.12")
- **Adjustable Tip Point Diameter**: 75 µm
- **Positioner Mounted Tip Spacing**: 0.5 to 4 mm
- **Positioner Mounted Tip Diameter**: 0.2 mm (0.008”)
- **Z-Axis Compliance**: 2 mm
- **SI and QC Resistor Tip Spread at Circuit Connection**: 0 to 11 mm (0 to 0.43 in.)
- **SP Insertion Depth**: 2.54 mm (0.100 in.) min. to 2.79 mm (0.110 in.) max.
- **Cable Length**: 1.3 m (4 ft. 3 in.)

Weight

Probe Only (Includes probe body with WL-PBus or WL300)	
D600A-AT, D300A-AT	146 g (5.1 oz.)
D600ST, D350ST, D6x0, and D3x0	152 g (5.3 oz.)
D500PT	170 g (6.0 oz.)

Probe Only (Includes probe body with WL-PLink or WL600)	
D600A-AT, D300A-AT	171 g (6.0 oz.)
D600ST, D350ST, D6x0, and D3x0	177 g (6.2 oz.)
D500PT	197 g (6.9 oz.)

Shipping	
D600A-AT, D300A-AT	0.45 kg (1 lb.)
D600ST, D350ST, D6x0, and D3x0	0.57 kg (1 lb. 4 oz.)
WL-PLink (or WL600) and WL-PBus (or WL300)	1.3 kg (2 lbs. 14 oz.)

Compliance and Certifications

CE Compliant

CE Declaration of Conformity

The Dx00 Differential Probe meets the intent of the European Council Directive 73/23/EEC for Product Safety and 89/336/EEC for Electromagnetic Compatibility. This declaration is based upon compliance of the product to the following standards:

- Low Voltage Directive - EN 61010-031:2002 Safety requirements for electrical equipment for measurement, control and laboratory use. Part 031: Safety requirements for hand-held probe assemblies for electrical measurements and test.
- EMC Directive - EN 61326/A3:2003 EMC requirements for electrical equipment for measurement, control and laboratory use.

  EN 55011/A2:2002 Radiated Emissions (Class A)

  EN 61000-4-2/A2:2001* Electrostatic Discharge Immunity (±4 kV contact discharge, ±8 kV air discharge)

  EN 61000-4-3/A1/2003* RF Radiated Electromagnetic Field Immunity (3 V/m, 30 MHz to 1 GHz, 80% amplitude modulated with 1 kHz sinewave)

* Meets Performance Criteria B limits – temporary, self-recoverable degradation or loss of performance is allowed, but no change of actual operating state or loss of stored data is allowed.

WARNING

This is a Class A product. In a domestic environment this product may cause radio interference, in which case the user may be required to take appropriate measures.

Common Mode Rejection Ratio (CMRR) Graphs

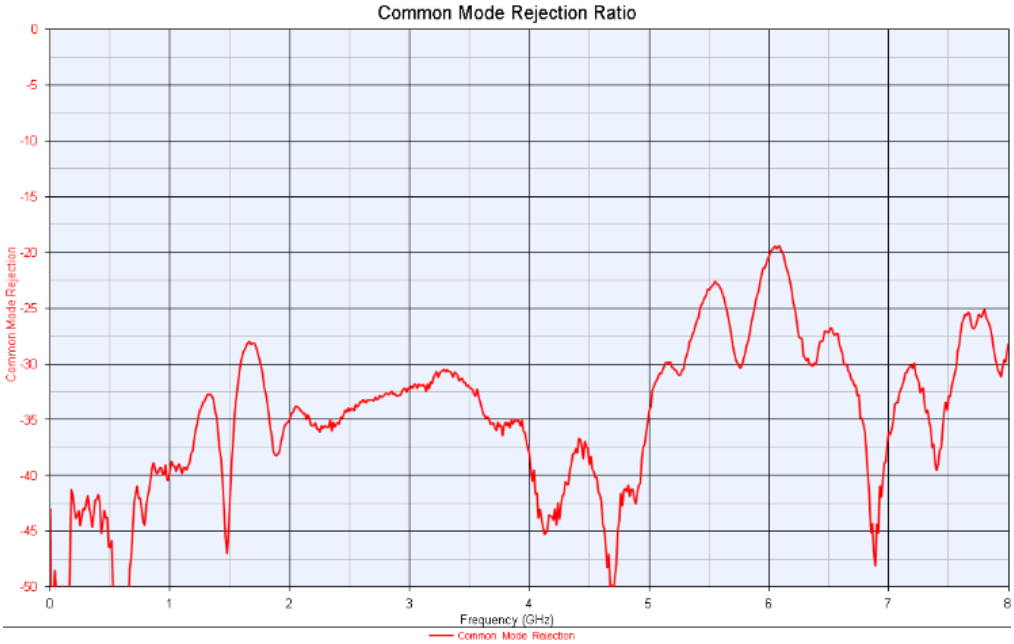


Figure 7-1. Typical D610, D620, D310, and D320

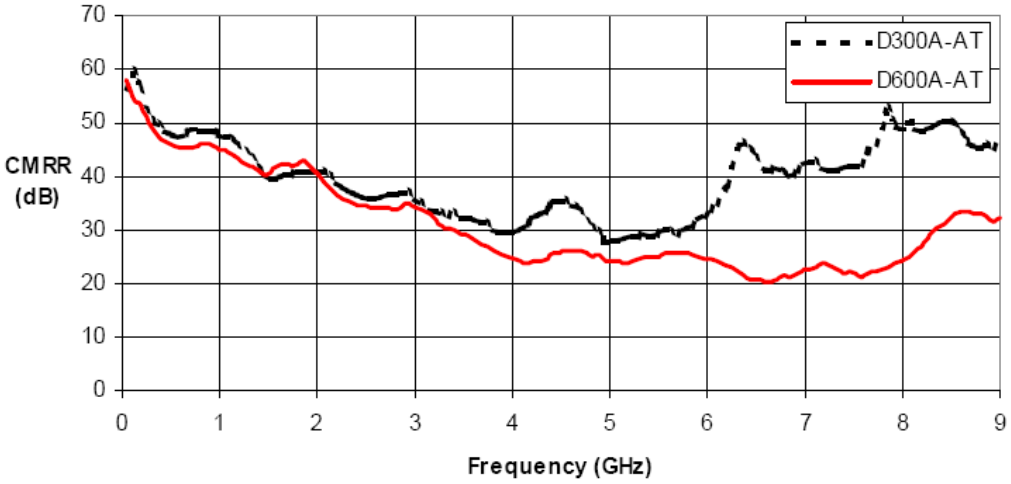


Figure 7-2. Typical D600A-AT / D300A-AT CMRR

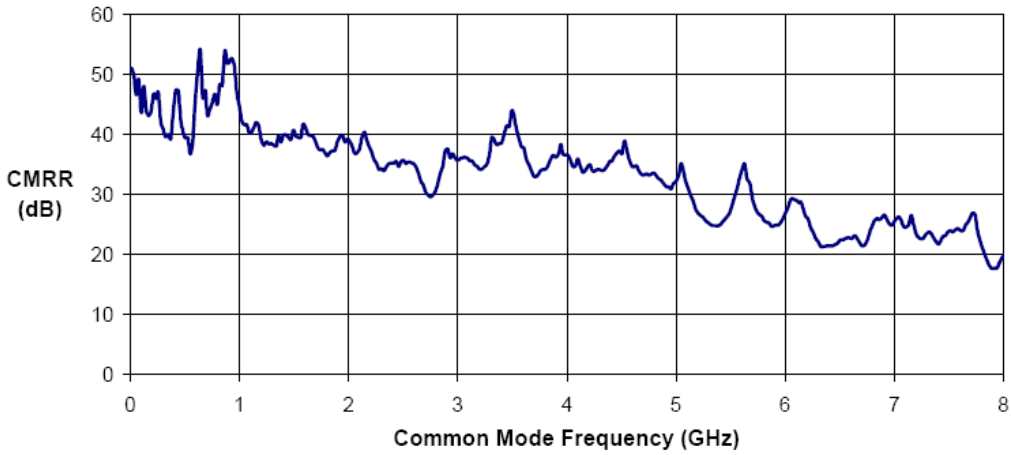


Figure 7-3. Typical D600ST CMRR

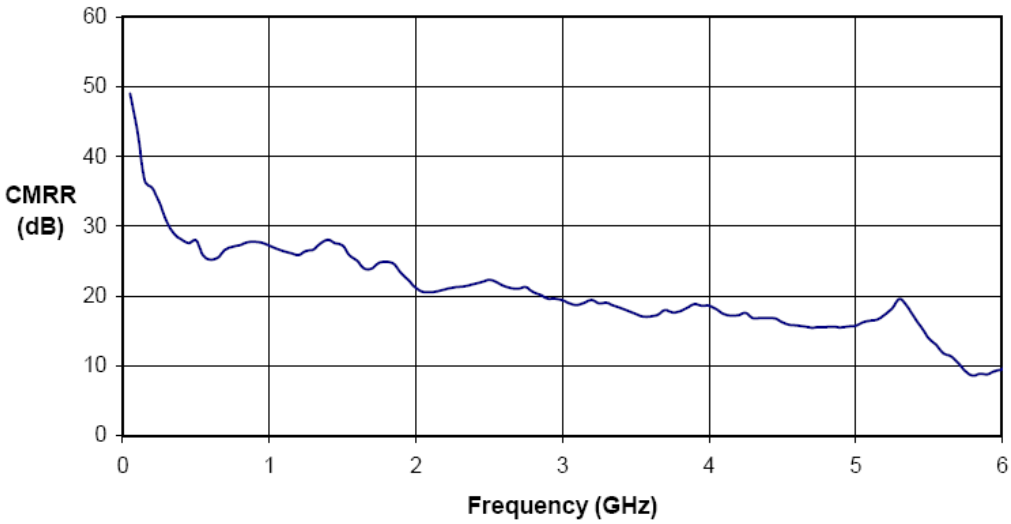


Figure 7-4. Typical D500PT CMRR

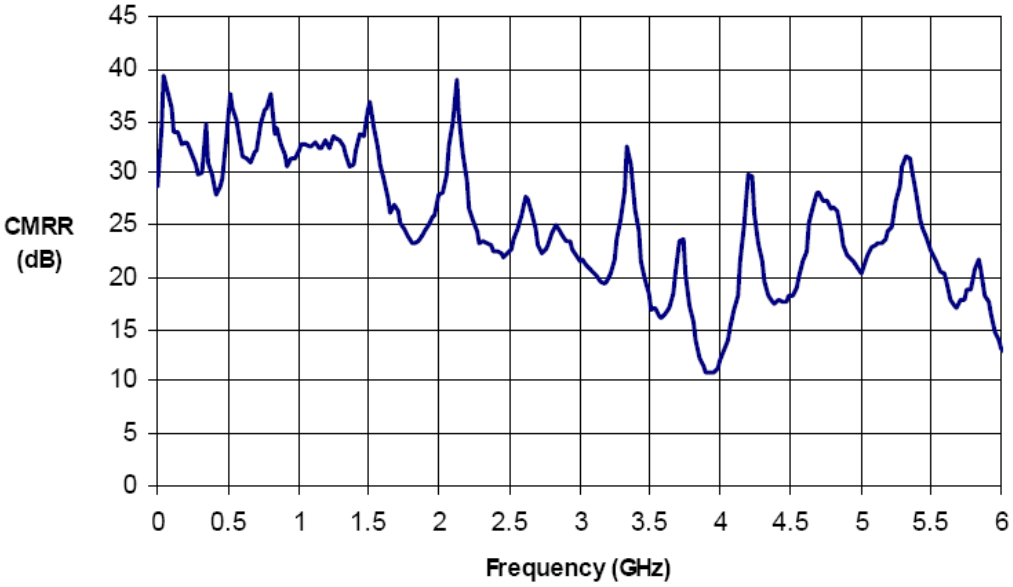


Figure 7-5. Typical D350ST-SI CMRR

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 Differential Probe series. 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		D500PT-TIP	
WL600		D350ST	
WL-PBus		D310	
WL300		D320	
D600A-AT		D350ST-SP	
D600ST		D300A-AT	
D610		Dx10-SI	
D620		Dx10-QC	
D600ST-SI		Dx10-SP	
D600ST-QC		Dx20-SI	
D600ST-SP		Dx20-QC	
D500PT		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, except D350ST < 20 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**		p sec

Index