Operator's Manual
WaveLink Medium-Bandwidth (8 GHz and 13 GHz) Differential Probe

TELEDYNE LECROY
Everywhere you look™
WaveLink Series
Medium Bandwidth Differential Probes
(8 GHz and 13 GHz)

Operator's Manual
May, 2018
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Safety
To maintain the probe in a correct and safe condition, observe generally accepted safety procedures in addition to the precautions specified in this section. The overall safety of any system incorporating this product is the responsibility of the assembler of the system.

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

- **CAUTION** of damage to instrument, or **WARNING** of hazard to health. Attend to the accompanying information to protect against personal injury or damage. Do not proceed until conditions are fully understood and met.

- **Hi Voltage WARNING**. Risk of electric shock or burn.

- **ESD CAUTION**. Risk of Electrostatic Discharge (ESD) that can damage the probe or instrument if anti-static measures are not taken.

Precautions

- **WARNING**. To avoid personal injury or damage due to electric shock or fire:
  - Do not overload; observe all terminal ratings. Do not apply any potential that exceeds the maximum rating of the probe and/or the probe accessory, whichever is less.
  - Comply with the Voltage vs Frequency derating curve when measuring higher frequency signals.
  - Connect and disconnect properly. Always connect the probe input leads to the probe accessory before connecting to a voltage source. Ensure connections are secure before applying voltage.
  - Keep the probe body and output cable away from the circuits being measured. Only accessory tips are intended for contact with electrical sources.
  - Use only accessories compatible with the probe. Use only accessories that are rated for the application.
**WaveLink Series Medium Bandwidth Differential Probes (8 GHz and 13 GHz)**

⚠️ **CAUTION.** To avoid damaging the equipment:

**Use only as specified.** The probe is intended to be used only with compatible Teledyne LeCroy instruments. Use of the probe and/or the equipment it is connected to in a manner other than specified may impair the protection mechanisms.

**Do not excessively bend cables.**

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

**Keep product surfaces clean and dry.**

**Do not operate with suspected failures.** Before each use, inspect the probe and accessories for any damage such as tears or other defects in the probe body, cable jacket, accessories, etc. If any part is damaged, cease operation immediately and secure the probe from inadvertent use.

**Operating Environment**

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

**Temperature:** 5° to 40° C.

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

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

**Specifications**

Full probe specifications are available from the WaveLink product page on our website at:

[teledynelecroy.com/probes](teledynelecroy.com/probes)

**NOTE:** Specifications are subject to change without notice.
Introduction

Teledyne LeCroy’s WaveLink 8 GHz and 13 GHz Differential Probes are a general purpose probing solution with high input dynamic range and offset range capability. The range of capabilities is ideal for a variety of high speed DDR signals where high dynamic range and large offset requirements are common.

The wide variety of tips offered with the Dxx30 provides confidence that the most challenging test points can be probed. The solder-in, positioner (browser) tip, square pin, Hi-Temp solder-in, QuickLink solder-in and SMA/SMP lead sets provide great flexibility when probing, while maintaining signal integrity. An assortment of hands-free probe holders eases the challenge of connecting multiple leads to a board.

WaveLink probes provide superior loading characteristics and are calibrated with a custom “fine-tuned” frequency response. The ultra-low loading coupled with a flat frequency response ensure accurate measurements.

The unique QuickLink architecture allows for probe tips to be quickly attached or removed to a WaveLink differential amplifier. Unlike other “consumable” probe tip solutions which rely on tiny, delicate tips located very close to the Device Under Test (DUT), the QuickLink Solder-In tip has an integral 9-inch lead. QuickLink Solder-In tips are low-cost, making it easy to equip multiple test points and DUTs and eliminating time-consuming resoldering of connectors.

NOTE: A Certificate of Calibration is supplied with each probe indicating the system meets the specifications when used with those components listed in the Certificate. Download the latest version of X-StreamDSO firmware to run your WaveLink probe with maximum performance.

NOTE: This manual serves as operating instructions for the legacy D1030 WaveLink probe.

ESD Sensitive: The tips of the WaveLink probes are sensitive to Electrostatic Discharge (ESD). Avoid causing damage to the probe by always following anti-static procedures when using or handling the probe.
WaveLink Series Medium Bandwidth Differential Probes (8 GHz and 13 GHz)

Modular Design

The WaveLink probe design consists of a **Platform/Cable Assembly** and a **Differential Amplifier** **Small Tip Module** supplied with interconnect leads. An optional **Positioner Tip (Browser)** and other leads may be purchased separately. The variety of interchangeable leads eliminates the need for external wires or other accessories in the high-impedance path of the input signal, assuring proper transmission of the signal as it passes through the probe.

WaveLink Dxx30 Probe Family

At time of shipment, Teledyne LeCroy serializes the individual components and calibrates them as a system. To achieve maximum performance and warranted specifications, the components should be used together, as serialized. If additional Interconnect Leads or other components are purchased, you may return the serialized system to Teledyne LeCroy for re-calibration to ensure performance.
# Probe Accessories

## Standard Accessories Table

<table>
<thead>
<tr>
<th>Accessories</th>
<th>D830-PL</th>
<th>D830-D1330</th>
<th>D830-PB2</th>
<th>D830</th>
</tr>
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<tbody>
<tr>
<td>Platform/Cable Assembly</td>
<td>WL-PLINK</td>
<td>D830</td>
<td>WL-PBUS2</td>
<td></td>
</tr>
<tr>
<td>Freehand Probe Holder</td>
<td>1 each</td>
<td>1 each</td>
<td>1 each</td>
<td></td>
</tr>
<tr>
<td>Probe Deskew Fixture</td>
<td>1 each</td>
<td>1 each</td>
<td>1 each</td>
<td></td>
</tr>
<tr>
<td>Platform/Cable Assembly Mounting Clip</td>
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<td>1 each</td>
<td>1 each</td>
<td></td>
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<tr>
<td>Probe Cable Clamp</td>
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<tr>
<td>Deluxe Soft Carrying Case</td>
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<td>1 each</td>
<td>1 each</td>
<td></td>
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<tr>
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<td>Plastic Tray for Storage Case</td>
<td>1 each</td>
<td>1 each</td>
<td>1 each</td>
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</tr>
<tr>
<td><strong>Differential Amplifier Small Tip Module</strong></td>
<td></td>
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<tr>
<td>Amplifier Module</td>
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<tr>
<td>Solder-In Lead Set</td>
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<td>Spare Damping Resistors</td>
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<tr>
<td>Tip Retaining Clips</td>
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<td>Adhesive Tape</td>
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<td>Square Pin Lead Set</td>
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<tr>
<td>Ground Lead</td>
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<td>1 each</td>
<td></td>
</tr>
<tr>
<td>Ground Clip</td>
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<td>Operator's Manual</td>
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<tr>
<td>Accessory Info Sheet</td>
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WaveLink Series Medium Bandwidth Differential Probes (8 GHz and 13 GHz)

## Optional Accessories Table

<table>
<thead>
<tr>
<th>Accessories</th>
<th>Dxx30-PT-KIT</th>
<th>Dxx30-SMA-SMP-Leads</th>
<th>Dxx30-HiTemp</th>
<th>Dxx30-QL</th>
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<tr>
<td>Positioner Tip Kit</td>
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<td>Positioner Tip (Browser)</td>
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<tr>
<td>Replacement Pogo Pins for Dxx30-PT</td>
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<tr>
<td>Positioner Tip Probe Guides</td>
<td>1 each</td>
<td></td>
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<tr>
<td>XYZ Positioner</td>
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<td>Adhesive Tape for XYZ Positioner</td>
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<td>Browser Wand for PT Tip</td>
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<tr>
<td>Interlock Pieces for PT Tip</td>
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<td></td>
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<td></td>
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<td>Swivel for PT Tip</td>
<td>1 each</td>
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<td><strong>SMA/SMP Lead Set</strong></td>
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<td></td>
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<td>SMA or SMP Input Cables</td>
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<tr>
<td>DC Blocking Adapter</td>
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<tr>
<td>Finger Wrench</td>
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<tr>
<td><strong>HiTemp Lead Set</strong></td>
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<td>HiTemp SI Lead</td>
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<tr>
<td>HiTemp Cable</td>
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<td></td>
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<tr>
<td><strong>QuickLink Adapter Pack</strong></td>
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<tr>
<td>QL-SI Tips</td>
<td></td>
<td></td>
<td>3 each</td>
<td></td>
</tr>
</tbody>
</table>

**NOTE**: While the amplifiers can be used with either platform/cable assembly, system bandwidth is limited to the lowest bandwidth component. System calibration is required for all interconnected components to guarantee system performance.
Probe Components

Platform/Cable Assembly
The platform/cable assembly forms the foundation of the probe, attaching the amplifier to the oscilloscope channel. It is supplied in two configurations.

The WL-PBUS2 platform is for use with either ProBus or ProBus2 oscilloscope interfaces. It is compatible with legacy WaveLink amplifiers originally supplied for use with WL-PBUS. The platform is fitted with a locking lever (not shown in the image below) that must be kept locked after connecting to the oscilloscope to ensure full bandwidth capabilities. See p.18.

Note: Although all amplifiers are physically interchangeable with any platform/cable assembly, bandwidth is limited to the lowest bandwidth component, and performance is only guaranteed for components that are calibrated and serialized together. The WL-PBUS2 platform is only rated to 8 GHz when used with D830 or higher bandwidth amplifiers.

WL-PLINK is for use with the ProLink interface.

WL-PBUS2 platform/cable assembly provided with D830-PB2 probes.

WL-PLINK platform/cable assembly provided with D830-PL and D1330-PL probes.
The platform/cable assembly:

- Provides power to the probe amplifier from the oscilloscope.
- Communicates to the oscilloscope the identifying characteristics of the amplifier that is connected to the probe so that the oscilloscope channel can be set to the correct probe attenuation value automatically. Software prompts you to specify the type of tip connected to the amplifier when this occurs.
- Transmits the amplifier output signal along a well-defined low loss transmission line into the oscilloscope input, and terminates the probe appropriately at that point.

WL-PLINK shown with accessories and case.
Differential Amplifier Small Tip Module
The amplifier modules contain the active, differential amplifier circuitry and perform the important task of amplifying the low-level signal at the probe tip for transmission via the platform/cable assembly. A selection of interconnect leads/tips with different electrical and physical characteristics allow you to choose the tip appropriate for the application.

Solder-In Lead
The Solder-In (SI) lead provides the highest possible performance in stationery installations. The design of the SI lead minimizes circuit AC loading by providing high probe AC loading over a wide frequency range. The SI lead is supplied with:

- Two pre-installed and pre-trimmed attenuating (damping) resistors connected to the flexible transmission line. The resistors are soldered directly into the connection points of the circuit under test, providing a reliable, intermittence-free connection.

- Five replacement damping resistors.

The pre-installed resistor design eliminates the need to custom cut and solder lengths of wire to the end of the lead and to the DUT. Damping resistors may be easily replaced in the field to provide maximum serviceability over the life of the SI lead.

The very small and precisely cut resistors have the advantage of locating the damping resistance of the probe tip as close to the DUT as possible, thereby eliminating the need for long lengths of wire which can impact loading and frequency response. The two resistors may be spaced as desired to connect to a wide variety of circuits.
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**Square Pin Lead**
The Square Pin (SP) lead can be used on boards where standard 0.025” square pins are used for interconnect. The highly flexible, 145 mm (5.7”) long SP 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 pins, the probe will not support maximum bandwidth or minimum risetime when used with an oscilloscope with bandwidth greater than 3 GHz. The added inductance of the square pins limits the measurements to signals of 3 GHz or lower bandwidth.

**Optional Accessories**
These special-use leads may be purchased to augment the performance of a WaveLink probe.

**Positioner Tip (Browser)**
The Positioner Tip (PT) provides the ability to access the signal on the DUT without permanently attaching a lead or other device. It combines high performance with quick access to a variety of probe points when used as a hand-held browser (with the wand attachment). When used with a positioner tool, it is a fast and convenient method to re-position a fixed test point.

The pogo pin tips are adjustable from 0 to 3.5 mm (0 to 0.14”) and have 0.6 mm (0.024”) of Z-Axis compliance. Because of its thin form factor and spring-loaded tips, it is ideally suited for use with multiple probes in tight areas such as the back side of boards with ball-grid array packaged ICs.

Two replacement resistive tips are provided with the positioner tip. These tips may be replaced in the field if damaged.
**SMA/SMP Lead Set**

The SMA interconnect system has been designed to connect the probe directly to female SMA connectors as well as to the higher performance 3.5 mm and 2.92 mm female connectors. The SMA/SMP interconnect has two parts:

- An interconnect “lead” which plugs into the amplifier module
- Two input cables (either SMA terminated or SMP terminated) which plug into the interconnect lead and connect to female SMA or SMP connectors

A network at the end of this interconnect lead, at the point where the SMA cables attach, attenuates the signal for the correct scale factor as well as provides some response compensation.

The SMA DC blocking adapters (supplied with the SMA interconnect lead) can be used to extend the common mode or differential mode range by removing any DC component which exceeds the range. This would most likely be a common mode component.
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_HiTemp SI Lead and Cable_
The HiTemp cable and SI lead are used for controlled situations where a differential amplifier module normally needs to be removed from the extreme temperature environment. Ideally suited for testing scenarios where the temperature can fluctuate from -40 °C to +105 °C, the 90 cm matched cable pair and Solder-In lead provides an easy and robust connection to the device under test while allowing access into environmental chambers. The HiTemp probe cables and SI lead pair with the Dxx30 differential amplifier module for full-system bandwidth, excellent signal fidelity, and superior noise performance.

QuickLink Adapter Pack
The QuickLink Probe Adapter enables you to connect QuickLink Solder-In (QL-SI) tips to WaveLink amplifier modules. QL-SI tips may be used with the HDA125 Digital Analyzer for digital signal input, or switched to a WaveLink amplifier for analog signal input of the same probing point. The adapter is purchased as a set with three QL-SI tips (Dxx30-QL-3SI). Replacement QL-SI tips are also available for purchase separately.
Probe Operation

Interchangeability and Calibration
Teledyne LeCroy WaveLink probes are factory calibrated and performance verified on shipment. Each configured probe is shipped with a Certificate of Calibration indicating that the system performance was found to meet or exceed the warranted specifications when using those components listed in the Certificate. As only this configuration was validated, the certificate is only valid for the configuration indicated. A serial number is affixed to each calibrated component; you must match the serial numbers on all components to ensure guaranteed performance.

Amplifier Modules
Although any amplifier module can mechanically mate with any platform/cable assembly, specifications are only guaranteed when the amplifier is used with the platform/cable assembly to which it has been calibrated and serialized (generally, the one with which it is delivered).

NOTE: System bandwidth is limited to the lowest bandwidth component. System calibration is required for all interconnected components to guarantee system performance. If incorrect or uncalibrated amplifier modules and platform/cable assemblies are connected, a warning is displayed on the oscilloscope touch screen.

Leads/Tips
Although all interconnect leads mechanically mate with any amplifier module, they are only compatible with the same-numbered amplifier (e.g., D830-SI with D830).

The interconnect tips are designed to keep response within a narrow range and so are interchangeable from amplifier to amplifier provided they are the same number, and interconnect leads manufactured at the same time have nearly identical performance. Likewise, if a damping resistor on the SI lead is replaced using the procedure for “Replacing Damping Resistors on the Solder-in Interconnect Lead” (on page 36), performance is still guaranteed. If an interconnect lead tip is damaged beyond field repair and requires factory replacement, Teledyne LeCroy recommends that you return it to the factory with the probe platform/cable assembly and amplifier module for a complete calibration and test to ensure guaranteed performance, because there may be small differences in performance of interconnect leads supplied at different times.

If an optional tip is purchased at time of original shipment, this is also calibrated and serialized with the other components. If it is purchased at a later date and you have provided Teledyne LeCroy with the serial number of the probe the tip is to be used with, Teledyne LeCroy calibrates the tip to your existing components and supplies a calibration file on a USB memory stick for installation on your oscilloscope. Follow the instructions provided with the file and memory stick in order to load this file and ensure proper calibrated performance with your existing probe components.
**Probe Loading and Frequency Response**

Teledyne LeCroy probes are factory calibrated using a Vector Network Analyzer (VNA) to measure a system (probe plus test fixture) frequency response. The test fixture is de-embedded from the measurement using Teledyne LeCroy’s Eye Doctor tools, so the remaining frequency response is due to the combination of the test signal and the probe loading on the test circuit. The system frequency response is then calculated for these remaining circuit elements.

During calibration, each probe amplifier has a response file created and stored on-board. When the probe is connected to your Teledyne LeCroy oscilloscope, the on-board response file is read by your oscilloscope, and a combined optimized probe + oscilloscope response is created for your particular oscilloscope and channel to which the probe is connected. The response is identical to that of the oscilloscope channel.

All that is left for the operator is to de-embed the probe loading from the circuit using Teledyne LeCroy’s Virtual Probe software option, if desired. Since the Teledyne LeCroy probe impedance is very high across the passband, this may not even be necessary.

To de-embed probe loading, use the appropriate equivalent circuit model in "Probe Input Impedance and Loading" on page 52 and Teledyne LeCroy’s Eye Doctor tools.

You can also use Teledyne LeCroy’s Virtual Probe option, which allows you to select the probe tip from a list of supported tips. Your selection applies a corresponding S-parameter file that is derived from the equivalent circuit model of the tip.

**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 platform/cable assembly. Avoid putting excessive strain on the cables or bending them sharply.

- **ESD Sensitive:** The tips of the probe are sensitive to Electrostatic Discharge (ESD). Always follow anti-static procedures (wear wrist strap, etc.) when using or handling the probe.
- **CAUTION:** Store tips in the plastic protective storage case when not in use.
- **CAUTION:** Positioner Tip tips are very small and are fragile. When not in use, store them in the provided case.
Connecting an Amplifier Module to a Platform/Cable Assembly
Attach the Amplifier Module to the Platform/Cable Assembly by aligning the connectors of the module with the receptacles in the platform/cable assembly and pressing the two together. Be sure to finger-tighten the assembly by rotating the threaded collar onto the module.

⚠️ **CAUTION:** Do not use pliers or any other tools to tighten the collar.

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

Connecting Interconnect Leads/Tips to the Amplifier
Align the flat side of the lead connector housing with the flat side of the amplifier and press together. Match the color-coding on the connector housing with the color-coding on the corresponding probe tip and press together.

*SI, SP, and PT Interconnect Lead*
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QuickLink Probe Adapter and QL-SI Tip

HiTemp Interconnect Lead
**SMA/SMP Lead**

Connect the interconnect lead to the amplifier module, and the matched pair of SMA/SMP input cables to the interconnect lead.

**NOTE:** The SMA/SMP input leads are supplied as a matched pair. Individual cables should not be interchanged between probes.

The SMA/SMP input cables must always be used with the interconnect lead. While the input cables use the same connectors as does the interconnect lead and will physically mate with the amplifier module, the system will not work properly in this configuration. No damage will occur to the lead or amplifier, but maximum input voltage will be much lower to prevent destruction and reduce susceptibility to ESD.

A finger wrench is supplied to aid in tightening the SMA/SMP connectors to a torque of 8 in-oz. This "finger tight" can be approximated when using the wrench.

The DC blocking adapter (included with the SMA/SMP leadset) should be used when the common mode voltage of the circuit under test is unknown or exceeds the maximum common mode voltage specified. When the adapter is used, the probe is AC coupled and the LF cut-off frequency is approximately 10 MHz.

Connect the each SMA input lead to a DC block and the male side of the DC block to the SMA connector of the circuit under test.

**NOTE:** When using the DC Blocking Adapter, set the Vertical Offset to 0.

**Positioning Interconnect Leads**

Normally, the performance of the interconnect leads is not affected by the position of the amplifier module. They can be mounted straight upright or on an angle.

However, when it is necessary to mount the module parallel to the board, the maximum performance is obtained when the "+" sign (printed near the positive input tip) is facing up.

The flexible cable connecting the tip of the lead to the amplifier module is reasonably insensitive to placement, but can be affected by large signal emitters on the device under test, so avoid placing it near these types of signals.
Connecting the Platform to a Teledyne LeCroy Oscilloscope

**WL-PLINK**
The WL-PLINK platform/cable assembly has been designed for use with the ProLink interface of Teledyne LeCroy oscilloscopes.

Attach the platform/cable assembly to the instrument by aligning the connector with the input and pushing the interface toward the instrument. You will hear a click when the connector latches to the test instrument. Tighten the thumbscrews to secure the assembly to the instrument. **Do not overtighten the thumbscrews.**

To remove the WL-PLINK assembly from the instrument, loosen the thumbscrews and move the connector up and down while gently pulling until a click is heard. This click indicates the assembly is detached from the instrument.

**WL-PBUS2**
The WL-PBUS2 is designed for use with the ProBus and ProBus2 interfaces of Teledyne LeCroy oscilloscopes.

Before connecting the platform to the oscilloscope, open the locking lever by switching it to the leftmost position (opposite facing arrows). Press the connector head onto the oscilloscope connector, then close the locking lever by the switching it to the rightmost position (closed lock).

**CAUTION.** Failing to close the locking lever will negatively impact probe performance. Full bandwidth is only guaranteed with the lock closed.

Thumbscrews are not provided on the WL-PBUS2 assembly. Disconnect the WL-PBUS2 assembly by opening the locking lever, then pulling the connector head from the interface.

**Connecting the Probe to the Test Circuit**
For all amplifier 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 affects the probe’s performance.

A ground connection is generally not required. Refer to “Probe Grounding” on page 23.
**Solder-In Lead**
The Solder-in Lead for the amplifier 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 tip, attach the free wires of the resistors to the appropriate test points by carefully following the directions in the following sections.

**NOTE:** The entire SI tip should be positioned with the resistor side upright facing (away from the PCB plane). Keep a 45 degree angle between the SI tip ends and the PCB plane. The SI lead provides better signal fidelity performance with high frequency signals if it is elevated in this manner. The tip clip also helps to secure and reinforce the SI resistive tips, and can be used to position the resistor leads when soldering the resistors to the test points.

**CAUTION:** The resistors are small in order to maintain high-frequency performance, but are not sturdy enough to bear the weight of the probe module. Use a positioning tool, such as the Platform/Cable Assembly Mounting Clamp, the Probe Tip Retaining Clip, or EZ Probe positioner to support the probe.
WaveLink Series Medium Bandwidth Differential Probes (8 GHz and 13 GHz)

Properly bending the SI Lead tips results in a more consistent response. Upon first receiving your SI Lead, the tips are not likely to be positioned for optimal performance when soldered to your trace. The goal is to get the resistor bodies to be parallel and the tips bent to sit on the test board traces.

1. Bend the resistor bodies to position them parallel.

2. Bend the tips in toward the center. Make the bend as close to the resistor body as possible. Bend them to about 60° from straight.

3. At this point, the leads can be bent from their midpoints so they are parallel to each other.

4. Perform a final check to ensure proper lead spacing and compare them to the trace spacing on the PCB.
**Square Pin Lead**

Insert the head of the Square Pin lead directly over standard 0.025” square pins mounted on 0.100” centers.

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

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”).
Positioner Tip (Browser)
The Positioner Tip (Browser) has a very small form factor with very low mass. It is a good all-around browsing or mounted solution for probing in areas with a high concentration of test points or limited free space to fit a probe.

Various attachments and extenders are supplied with the Positioner Tip (PT), allowing it to be easily held while browsing or connected to a mounting device. Using these attachments, the tip can be positioned in many different ways to make probing possible in tight geometries.

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

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

**NOTE:** Some mechanical positioners (such as the EZ probe) may exert excessive Z-Axis compliance during setup, so be extra careful with these types of mechanical positioners.

Avoid applying excessive lateral pressure on the tip as it may break. Do not use the tip to scrape the circuit. If the tip does break, it may be replaced in the socket. If the socket also breaks, a new socket can be soldered onto the tip.
**QL-SI Tips**

Attach QL-SI Tips as you would any solder-in lead tip. Once soldered to the board, the QL-SI tips can be switched from the WaveLink probe to an HDA125 High-speed Digital Analyzer by pulling the tip head from the amplifier and plugging it into the digital leadset pod, or vice versa.

**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.

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. Connect the plug of the ground lead to the receptacle on the side of the amplifier module body.

- In floating devices, connect the ground lead to the DUT’s reference or common voltage.
- In high RF ambient noise environments, connect the ground lead to a good RF ground near the point where the signal is being measured.

**CAUTION:** Always use a ground lead when testing floating circuits. Floating circuitry such as circuits powered from laboratory bench power supplies, which normally have floating outputs, may damage the probe by exceeding the common mode input voltage.
WaveLink Series Medium Bandwidth Differential Probes (8 GHz and 13 GHz)

**Positioning Input Leads**

Normally the performance of the Solder-In Lead and Positioner Tip Browser is not affected by the position of the amplifier module. They can be mounted straight upright or on an angle. However, when it is necessary to mount the module parallel to the board, the maximum performance is obtained when the + sign (printed near the positive input on both the SI Lead and the PT Tip) is upward facing.

**NOTE:** The flexible cable connecting the input tip to the amplifier module is reasonably insensitive to placement, but can be affected by large signal emitters on the device under test, so avoid placing it near these types of signals
Using Positioning Tools

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

**FreeHand Probe Holder**

The freehand probe holder (PACC-MS001) is provided as a standard accessory with the WL-PLINK. It is designed to keep most of the weight on the probe tip to prevent loss of contact with the circuit under test. The freehand is a stable, easy-to-use positioner, improving your ability to concentrate on the measurement by not having to hold the probe.

**Dxx0-PT-XYZ-Positioner**

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

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

**EZ Probe Positioner Using Dx30-PT**

Attach the probe by first removing the screws holding the top plate to the V-shaped probe holder. Rest the Long Interconnect Extender in the V-shaped groove, and fasten the top plate to the holder, using the removed screws (as follows). Then, insert the Dx30-PT onto the Long Interconnect Extender.

**NOTE:** Do not over-tighten the screws.

Once the probe has been attached, loosen the knob on the EZ-Probe Positioner arm and position the probe close to the test point. Tighten the knob and use the joystick to fine position the probe.
The Tip Retaining Clip (PK600ST-3) is an aid for holding the SI Interconnect Leads in place while making measurements or when soldering the damping resistors to the test points of the board under test. The Clip comes standard with Small Tip Amplifier Modules along with a set of 10 white and 10 black Adhesive Pads (Dx30-PT-TAPE) used for mounting the clip to the board.

**NOTE:** In extreme conditions, the Tip Retaining Clip is rated to 100 °C and adhesives are rated to 90 °C.

### Fastening the Clip to the Board

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

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

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

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

### Moving and Positioning Tip Retaining Clip

Always apply pressure to the pad (as follows) to prevent any shifting while bending the arms and/or moving the probe adapter portion of the clip (typically done while positioning or attaching the probe). This is especially important if moving and positioning before the adhesive pads have properly cured.
ATTACHING THE PROBE TO THE CLIP
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.

REMOVING THE TIP RETAINING CLIP
Remove the Retaining Clip from the board by pulling on the tab of the adhesive pad. The clip can now be removed easily without leaving any adhesive residue and can be used in another application using a new adhesive pad.
Platform/Cable Assembly Mounting Kit

The Platform/Cable Assembly Mounting Kit (PK600ST-4) can be used to support the platform/cable assembly and relieve stress on interconnect leads when the test points are located close to the edge of the board under test. The kit includes one Board Edge Clip and four Adhesive-backed Platform/Cable Assembly Clamps.

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

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

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

Connection Guides
Probe connection guides are designed to make it easy to electrically isolate the two probe tips when browsing. They also greatly reduce accidental and unwanted contact across probe points. Before attaching connection guides, clean the PCA assembly area with IPA or another cleaner to remove oils. Then, apply with a light pressure, release, and let set for one hour.
Controlling the Probe from the Oscilloscope

**NOTE:** Allow the probe to warm up for at least 20 minutes following set up. A properly warmed-up probe ensures optimal measurements.

**Before Using the Probe**
- Ensure the oscilloscope’s Windows updates are current.
- If using the probe with an SDA 9000, 11000, 13000, or 18000 oscilloscope, download and install the most recent version of the Microsoft Core XML Services (MSXML) Service Pack before using your probe. Other service packs may be required for MSXML to work properly.
- Install the latest version of X-StreamDSO oscilloscope firmware.

**Controlling Vertical Response**
When the fully assembled probe is connected to a MAUI oscilloscope, the oscilloscope recognizes the probe and opens the respective Channel (Cn) setup dialog. Refer to your oscilloscope’s Operator’s Manual for specific operation of the Vertical controls.

```
Channel dialog with tab corresponding to attached probe (amplifier) model
```

Behind the Cn dialog is a dialog of controls for the probe (the name varies based on the amplifier module you have attached).

- The **Attributes** frame shows the characteristics of the probe, such as Amplifier Bandwidth and Attenuation of probe signal.
- The **Power On** checkbox controls the operational state of the probe.
- The **LED Active** checkbox turnson/off AutoColor ID.
- **Auto Zero** initiates an Auto Zero cycle.
- **Tip Select** allows you to select the tip in use for proper calibrated response.
Probe dialog (following tip select) showing data corresponding to attached probe.

**AutoColor ID**

The AutoColor ID LEDs built into the platform/cable assembly immediately inform you of three conditions related to the probe:

- **Input channel** LED illuminates in the color of the channel to which the probe is connected.
- When the amplifier module is compatible with the platform/cable assembly to which it is connected, the green LED illuminates for about one second after the probe is connected to the oscilloscope. A continuous red light indicates the components are not compatible.
- If the probe is over-temperature, the red LED flashes. The probe is automatically shut down in this state (see Power Control). Unless the shut-down is caused by over-temperature, all LEDs are normally off when probe is powered down.

In some applications, it may be desirable to turn the probe’s AutoColor ID off by deselecting the LED Active checkbox on the Probe dialog.

**Tip Select**

Touch the Tip Select control and choose the lead/tip used. The symbols corresponding to the selected lead will then appear on the Probe dialog tab.

**CAUTION:** It is crucial to make the tip selection on this field as it results in the amplifier and tip combination having the response calibrated for at the factory. Failure to select the proper tip may result in inaccurate measurements. If you do not see the tip among the selections, return the probe to the Teledyne LeCroy factory for re-calibration.
Auto Zero
WaveLink probes incorporate an Auto Zero function to remove any DC offset from the probe. This function is available only when the probe is used with Teledyne LeCroy’s MAUI oscilloscopes and must be invoked by the user. Perform Auto Zero after several minutes of warm-up, or when the probe is exposed to a large shift in ambient temperature.

To invoke Auto Zero, touch the **Auto Zero** control on the Probe dialog.

**CAUTION:** Disconnect the probe from the circuit before Auto Zero, or any DC component that is part of the Signal to be measured will be zeroed out.

Depending on the measurement accuracy desired and/or changes in ambient temperature where the probe is located, it may be necessary to perform Auto Zero more often. If the probe is disconnected from the oscilloscope and reconnected, repeat Auto Zero after suitable warm-up.

Deskewing
The Probe Characterization Fixture (PCF200) is provided as a standard accessory with WaveLink series platform/cable assemblies. The fixture can be used as a convenient way to deskew probes/oscilloscope channels.

**REQUIRED EQUIPMENT**

- PCF200
- Square-Pin (SP) lead or additional Solder-In (SI) lead
- 50 Ω terminator

**NOTE:** Alternatively, an LPA-K-A adapter and an SMA cable can be used.
**CONNECTING TO THE PCF200**
Place leads so that the positive tip contacts the center microstrip and the negative tip contacts the ground plane. Leads show the positive tip with a “+” sign.

For solder-in leads, press the black plastic tab on the PCF200 to open the clamp, placing the resistor tips under the clamp so that the + tip contacts the center microstrip and the – tip contacts the ground plane. Release the clamp so it holds the wires securely in place.

Place the Square Pin lead over the pins on the second circuit.

---

*Positioner Tip connected to PCF200*

*SI or QL-SI tips connected to PCF200*

*SP Lead connected to PCF200*
WaveLink Series Medium Bandwidth Differential Probes (8 GHz and 13 GHz)

**DESKEW PROCEDURE**

1. Warm the oscilloscope for at least 20 minutes.

2. Connect the PCF200 to the oscilloscope’s Fast Edge output using the signal path indicated by the type of probe tip being used for the measurement:
   - The upper path (with the black clip) is for Solder-In (SI) and QuickLink Solder-In (QL-SI) probe tips.
   - The lower circuit is for Square-Pin (SP) probe tips.

   **TIP:** For ease of connectivity, we recommend using the SP tip. However, the tip does not matter as long as you use the same tip to deskew each probe. On some oscilloscope models, the Fast Edge signal is output over the Aux Out interface. Go to Utilities > Utilities Setup > Aux Output to configure the output for Fast Edge.

3. Connect probes electrically in a single-ended arrangement using their designated area on the fixture:
   - Connect the positive side, indicated by a plus sign on the probe tip, to the signal trace (between the two white strips).
   - Connect the negative side to the ground plane (outside the white strips).

4. In order to minimize reflection, apply a 50 Ω terminator to the end of the signal path in use. If a 50 Ω terminator is not available, an SMA cable can be used to terminate the PCF200 to one of the oscilloscope’s outputs.

5. Connect the probe cable to C1.

6. Set the oscilloscope trigger type to “Edge”, trigger source to “Fast Edge”, timebase to 10 ns/div, and delay to zero. Start acquisition.
Once everything is properly set up, the oscilloscope display should look similar to the figure below. If there is no propagation delay due to the probe, and no internal oscilloscope channel propagation delay, the 50% trigger level will appear exactly centered on the oscilloscope grid. Any visible delay represents the amount of skew to be corrected.

7. Adjust the C1 Deskew value so that the 50% rising edge point is centered on the grid.
   - From the C1 setup dialog, enable Sinx/x Interpolation and set Averaging to 50 sweeps.
   - Adjust the Deskew value to move the rising edge of the trace toward the center of the grid.
   - Decrease the timebase to around 20 ps/div, and adjust the Deskew value so that the 50% rising edge point is centered on the grid, as shown in the image below:

8. Repeat this procedure for each probe using the same probe tip.

**NOTE:** Before deskewing the next probe, reset Averaging to 1 sweep and turn off Sinx/x Interpolation.
Maintenance

Cleaning
The exterior of the probe and cable should be cleaned, using a soft cloth moistened with water. 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.

Replacing Damping Resistors on the SI Lead
The external damping resistors locate the tip resistance as close to the device under test as possible, which minimizes tip inductance and capacitance and provides very favorable loading characteristics. However, these resistors are subject to mechanical stress and may periodically need to be replaced even if proper stress-relief precautions are taken. Replacement damping resistors are included with the probe, and replacement of these resistors is simple. Resistors are pre-cut to the right lead lengths, so all that is required is removal and attachment of the new resistor.

Follow these steps to correctly remove the damaged damping resistors and to solder a new resistor to your tip. It is assumed that the person performing the resistor replacement is familiar with fine-pitch soldering techniques.

1. Remove the old resistor tip and any remaining solder from the long solder pad using a fine-tip soldering iron, taking care not to de-solder the SMT resistors.
2. Use a soldering iron to pre-tin the pad. Wash the area with isopropyl alcohol to remove any residual flux.

⚠️ **CAUTION:** Avoid using excessive amounts of solder. Use the photographs in this topic as a reference for the proper amount of solder.

3. Align the damping resistor lead with the end of the tin pad and solder in place running the lead along the pad and over the via. Avoid using excessive amounts of solder. Use the photographs in this topic as a reference for the proper amount of solder.

4. Verify the following dimensions for:

   **Resistor Lead Length**
   - 0.090 ±0.000 / -0.010 (inches)
   - 2.286 ±0.000 / -0.254 (millimeters)

   **Resistor Gap to PCB Edge**
   - 0.050 - 0.025 (inches)
   - 1.27 - 0.635 (millimeters)
Replacing Tip Sockets

Two replacement tip sockets are supplied with the Dxx30-PT positioner tip. Under normal usage, sockets should not need replacement, but new sockets can be soldered into place as follows:

1. Secure the positioner tip in a clamp to immobilize it while working. Using an appropriate fine-tip soldering iron for low mass components, apply heat and remove the damaged socket from the positioner tip circuit board.

2. Clean off the pad using the soldering iron. Clean oils and dirt in the area using deionized or distilled water or isopropyl alcohol. Inspect the pad for damage - damaged or loose sockets do not adhere properly.

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

4. Locate the socket so the closed end is slightly overhanging the end of the pad. This prevents solder from flowing into the socket insert hole. Align the socket sides with the pad sides and solder as shown. Leave proper clearance between the socket and pad sides when soldering.

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

Defective probes or probe tip modules must be returned to a Teledyne LeCroy service facility for diagnosis and repair or replacement. Defective products under warranty are repaired or replaced. Probes are warranted for a period of one year from shipment. The following extended warranty and service plans are available.

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

<table>
<thead>
<tr>
<th>Service Option</th>
<th>Product Code</th>
</tr>
</thead>
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<tr>
<td>Three-Year Warranty</td>
<td>D830-PB2-W3, D830-PL-W3, D1330-PL-W3</td>
</tr>
<tr>
<td>Five-Year Warranty</td>
<td>D830-PB2-W5, D830-PL-W5, D1330-PL-W5</td>
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<tr>
<td>Three-Year Annual NIST Calibration</td>
<td>D830-PB2-C3, D830-PL-C3, D1330-PL-C3</td>
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<tr>
<td>Five-Year Annual NIST Calibration</td>
<td>D830-PB2-C5, D830-PL-C5, D1330-PL-C5</td>
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<tr>
<td>Three-Year Warranty with Annual NIST Calibration</td>
<td>D830-PB2-T3, D830-PL-T3, D1330-PL-T3</td>
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<tr>
<td>Five-Year Warranty with Annual NIST Calibration</td>
<td>D830-PB2-T5, D830-PL-T5, D1330-PL-T5</td>
</tr>
<tr>
<td>NIST Traceable Calibration with Test Data* (for one amplifier module)</td>
<td>D830-PB2-CCNIST, D830-PL-CCNIST, D1330-PL-CCNIST</td>
</tr>
</tbody>
</table>

*CCNIST NIST traceable calibration with test data is available for D830 and D1330 differential amplifier modules only when serialized to a WL-PLINK or WL-PBUS2 platform/cable assembly.
Returning a Product for Service
Contact your local Teledyne LeCroy service center for calibration or other service. If the product cannot be serviced on location, the service center will give you a Return Material Authorization (RMA) code and instruct you where to ship the product. All products returned to the factory must have an RMA.

Return shipments must be prepaid. Teledyne LeCroy cannot accept COD or Collect shipments. We recommend air-freighting. Insure the item you’re returning for at least the replacement cost.

1. Remove all accessories from the device.
2. Pack the product in its case, surrounded by the original packing material (or equivalent). Be sure to include all Interconnect Leads and Tips. Do not include the manual.
3. Label the case with a tag containing:
   - The RMA
   - Name and address of the owner
   - Product model and serial number
   - Description of failure or requisite service
4. Pack the product case in a cardboard shipping box with adequate padding to avoid damage in transit.
5. Mark the outside of the box with the shipping address given to you by Teledyne LeCroy; be sure to add the following:
   - ATTN: <RMA code assigned by Teledyne LeCroy>
   - FRAGILE
6. If returning a product to a different country:
   - Mark the shipment as a "Return of US manufactured goods for warranty repair/recalibration."
   - If there is a cost for the service, list the cost in the Value column and the original purchase price "For insurance purposes only."
   - Be very specific about the reason for shipment. Duties may have to be paid on the value of the service.
### Consumables and Replacement Parts
The following parts may be ordered individually as replacements from your Teledyne LeCroy sales representative or Teledyne LeCroy Service Center.

**NOTE:** Equivalent parts may be ordered as replacements for legacy D1030 probes.

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<th>Item</th>
<th>Replacement Product Code</th>
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<td>RK-Dxx30-PT-Kit</td>
</tr>
<tr>
<td>Positioner Tip</td>
<td>Dxx30-PT</td>
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<tr>
<td>Pogo Pin Tips for PT Tip (Qty. 4)</td>
<td>Dxx30-PT-Tips</td>
</tr>
<tr>
<td>Pogo Tip Connection Guides</td>
<td>Dxx30-PT-Guides</td>
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<td>Item</td>
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<td>-----------------------------------------</td>
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<tr>
<td>XYZ Positioner</td>
<td>Dxx30-PT-XYZ-Positioner</td>
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<tr>
<td>Adhesive Tape for XYZ Positioner (10 Pcs. each)</td>
<td>Dxx30-PT-Tape</td>
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<tr>
<td>Browser Wand for PT Tip</td>
<td>Dxx30-PT-Wand</td>
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<td>Interlock Pieces for PT Tip (6 Pcs.)</td>
<td>Dxx30-PT-Interlock</td>
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<tr>
<td>Swivel for PT Tip</td>
<td>Dxx30-PT-Swivel</td>
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<td>Item</td>
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<tr>
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<td>Dxx30-SI-RESISTORS</td>
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<td>D1030-SI</td>
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<td>D1030-SP</td>
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<td>Ground Clip (Qty. 2)</td>
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<td>Solder-in Probe Holder Kit</td>
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<td>(2 tip-retaining clips and 1 set of adhesive tape)</td>
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### WaveLink Series Medium Bandwidth Differential Probes (8 GHz and 13 GHz)

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<td>Optional Tips</td>
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<td>QuickLink Adapter</td>
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<td>D1030-QL</td>
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<td>QL-SI Tips (1- or 9-tip pack)</td>
<td>D830-1QL-SI</td>
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<td>D830-9QL-SI</td>
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<td>D1030-1QL-SI</td>
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<td></td>
<td>D1030-9QL-SI</td>
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<td>HiTemp SI-Lead (includes spare resistors)</td>
<td>D830-SI-HiTemp</td>
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<td>D1030-SI-HiTemp</td>
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<td>HiTemp Cable</td>
<td>Dxx30-Cable-HiTemp</td>
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<td>SMA/SMP Leads (with DC blocking adapter and finger wrenches)</td>
<td>RK-D830-SMA-SMP-LEADS</td>
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<td>RK-D1030-SMA-SMP-LEADS</td>
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<tr>
<td><strong>Platform/Cable Assembly Parts</strong></td>
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<td>Platform/Cable Assembly Mounting Kit</td>
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<tr>
<td>Probe Deskew Fixture</td>
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</tr>
<tr>
<td>Freehand Probe Holder</td>
<td>PACC-MS001</td>
</tr>
<tr>
<td><strong>Deluxe Soft Carrying Case</strong></td>
<td></td>
</tr>
<tr>
<td>Deluxe Soft Carrying Case</td>
<td>SAC-03</td>
</tr>
<tr>
<td><strong>Foam Insert for SAC-03</strong></td>
<td>921081-00</td>
</tr>
<tr>
<td><strong>Protective Storage Case</strong></td>
<td></td>
</tr>
<tr>
<td>Protective Storage Case</td>
<td>921083-00</td>
</tr>
<tr>
<td><strong>Plastic Tray for Protective Storage Case</strong></td>
<td>921078-00</td>
</tr>
</tbody>
</table>
Performance Verification
The following procedures can be used to verify basic operation and some of the warranted characteristics of a WaveLink Differential Probe. Performance Verification can be completed without removing the probe covers or exposing the user to hazardous voltages. No adjustments are provided.

Performance verification should be performed as the first part of annual calibration. It is recommended that the Functional Test be performed prior to the Performance Verification Procedure to assure all other non-warranted functions perform as specified.

Test results can be recorded on a photocopy of the “WaveLink MBW Probe Test Record” (on page 51). In the unlikely event a probe fails performance verification, it can be sent back to the local service center or the factory. See “Returning a Product for Service” (page 40).

Best practice is to complete the entire procedure for each combination of platform/cable assembly, probe amplifier, and lead. If more than one interconnect lead is being verified, copy and fill out a separate test record for each platform/cable assembly, amplifier module, and interconnect lead.

**NOTE**: If the probe system includes interconnect leads that are *not* serialized to the amplifier module and platform/cable assembly, then performance may not be verifiable.

Functional Test
The functional test can be used to verify the basic operation of a WaveLink Differential Probe when used with a Teledyne LeCroy oscilloscope.

**NOTE**: It is recommended that the Functional Test be performed prior to the Performance Verification Procedure to assure all other non-warranted functions perform as specified.

1. Connect the amplifier module to the platform/cable assembly, then connect the interconnect lead to the amplifier module.

2. Connect the platform/cable assembly to C1 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.

3. After the green LED indication, the Probe AutoColor ID indicators illuminate in the color of the channel to which the probe is connected (amber for C1). Verify AutoColor ID indicates the proper channel by disconnecting the probe and reconnecting to the other channels.

4. Reconnect the probe to C1 and turn on the C1 trace.

5. Open the C1 setup dialog. Verify the correct amplifier model is shown on the Probe dialog tab following C1.
6. Open the Dxx30 Probe dialog. Note the probe model number and platform/amplifier serial number on the test record. Select the tip used and note this on the test record.

7. Turn OFF power by clearing the Power On checkbox. Verify the Power LED on the probe turns OFF. Turn the power back ON by selecting the checkbox again.

8. Clear the LED Active checkbox to verify the probe's AutoColor ID LEDs turn off (probe power should still be ON). Turn LEDs back ON.

9. Connect the oscilloscope Aux Out signal to C2 through the PCF200 fixture. Use the following elements in order: AuxOut > BNC(m) to SMA(f) adapter > SMA cable > PCF200 > ProLinkAdapter > C2.

10. Choose Utilities > Utilities Setup from the menu bar, then open the Aux Output dialog. Configure the Aux Output to a 1 kHz, 1 V square wave (there should be a button).

11. Set the oscilloscope to trigger on C2 Edge at 250 mV. Set the C1 and C2 Vertical Scale to 100 mV/div with -250 mV Offset. Set Horizontal Scale to 200 µS/div.

12. Connect the probe interconnect lead to the PCF200 (SI tip shown below):
    - PT leads can touch directly to the trace and ground.
    - SP leads should be connected to square pins (the AuxOut signal should be connected through the square pin path of the PCF200).
13. Verify the signal measured on C1 is the same as that being measured directly on C2.

**NOTE:** The 1 V AuxOut voltage will be 500 mV when driving the scope 50 Ω input.

![Waveform Image]

This concludes the functional test.
**Verification Procedure**

This procedure can be used to verify the low-frequency attenuation accuracy of a WaveLink Medium Bandwidth Differential Probe.

**NOTE:** If testing with probe interconnect leads that are not serialized to the amplifier module and platform/cable assembly, performance may not be verifiable.

**Required Test Equipment**

The following table lists the test equipment, or their equivalents, required for the performance verification test. 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.

<table>
<thead>
<tr>
<th>Test Equipment</th>
<th>Minimum Requirements</th>
<th>Example Equipment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oscilloscope</td>
<td>Instrument bandwidth greater than probe warranted bandwidth</td>
<td>Teledyne LeCroy WaveMaster 8 Zi</td>
</tr>
<tr>
<td></td>
<td>ProLink input</td>
<td></td>
</tr>
<tr>
<td>Digital Multimeter</td>
<td>AC: 0.2% accuracy to measure 200 mV and <strong>2 Vrms</strong> @ 1 kHz to 6½ digit resolution</td>
<td>Agilent Technologies 34401A</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Fluke 8842A-09</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Keithley 2001</td>
</tr>
<tr>
<td>Oscillator/Function Generator</td>
<td>Sine Wave output, adjustable from 500 mV to 4 Vp-p (357 mV to <strong>2.83 Vrms</strong>) @ 70 Hz</td>
<td>Stanford Research DS340</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Agilent Technologies 33120A</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Leader LAG-120B</td>
</tr>
<tr>
<td>Calibration Fixture *</td>
<td></td>
<td>Teledyne LeCroy PCF200</td>
</tr>
<tr>
<td>ProLink Adapter</td>
<td></td>
<td>Teledyne LeCroy LPA-2.92 or LPA-SMA</td>
</tr>
<tr>
<td>SMA to BNC Adapter</td>
<td></td>
<td>Pomona Electronics 4289</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Pasternack Enterprises PE9073</td>
</tr>
<tr>
<td>SMA Coaxial Cable</td>
<td></td>
<td>Pomona Electronics 4846-K-24</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Pasternack Enterprises PE3369-36</td>
</tr>
</tbody>
</table>
WaveLink Series Medium Bandwidth Differential Probes (8 GHz and 13 GHz)

**LF Attenuation Accuracy**
This procedure should be performed after the Functional Test. Warm up the probe for at least 20 minutes before starting.

1. Remove the probe test leads from the PCF200 fixture.
2. Set C1 and C2 Vertical Scale to 100 mV/Div with 0 V Offset. Set the trigger to C1 Edge 0V. Set the Horizontal Scale to 10 ms/div.
3. Turn on measurements and set P1 to measure the standard deviation of C1 \(\text{sdev}(C1)\) and P2 to measure the standard deviation of C2 \(\text{sdev}(C2)\).
4. Set the function generator to output a 50 Hz sine wave at 100 mVrms into 50 Ω.
5. Set the DMM to measure AC V and connect leads to the DMM.
6. Momentarily remove the probe under test from C1 and connect the function generator to C1 using the following accessories: Function Generator -> BNC (m) to SMA (f) adapter -> SMA cable -> PCF200 -> ProLink Adapter -> C1.
7. Touch the DMM leads to the PCF200 signal line and ground and record the measured voltage amplitude on the test record (line 7).
8. Remove the leads from the PCF200 and record the scope C1 standard deviation measurement on the test record (line 8).
9. Remove the function generator connection from C1 and install it on C2. Reconnect the probe under test to C1.
10. Press AutoZero on the probe dialog to remove any residual offset from the measurement.
11. Calculate the C1 error by subtracting the value recorded on line 8 by the value recorded on line 7 and dividing by the value on line 7. Record the value in percent (line 11).
12. Touch the DMM leads to the PCF200 signal line and ground and record the measured voltage amplitude on the test record (line 12).
13. Connect the leads of the probe/tip under test to the PCF200 and record the scope Channel 1 standard deviation measurement on the test record (line 13).
14. Calculate the Probe-Channel 1 error by subtracting the value recorded on line 13 by the value recorded on line 12 and dividing by the value on line 12. Record the value in percent on the test record (line 14).
15. Subtract the Channel 1 Error (line 11) from the Probe – Channel 1 Error (line 14) to get the Probe – only error (line 15).
WaveLink MBW Differential Probe Test Record

Technician____________________________________________________    Test Date__________________________

Items Tested

<table>
<thead>
<tr>
<th>Item</th>
<th>Model</th>
<th>Serial Number</th>
<th>Cal Due Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Platform/Cable Assembly</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Amplifier</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lead</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tip</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Oscilloscope</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Digital Multimeter</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sine Wave Generator</td>
<td></td>
<td></td>
<td></td>
</tr>
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</table>

LF Attenuation Accuracy

<table>
<thead>
<tr>
<th>Step</th>
<th>Description</th>
<th>Intermediate Data</th>
<th>Test Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>7</td>
<td>Output Voltage (DMM)</td>
<td></td>
<td>V</td>
</tr>
<tr>
<td>8</td>
<td>Output Voltage (C1)</td>
<td></td>
<td>V</td>
</tr>
<tr>
<td>11</td>
<td>C1 Error</td>
<td></td>
<td>%</td>
</tr>
<tr>
<td>12</td>
<td>Probe Input Voltage (DMM)</td>
<td></td>
<td>V</td>
</tr>
<tr>
<td>13</td>
<td>Probe Output Voltage (C1)</td>
<td></td>
<td>V</td>
</tr>
<tr>
<td>14</td>
<td>Probe/C1 Error</td>
<td></td>
<td>%</td>
</tr>
<tr>
<td>15</td>
<td><strong>Probe Error (Test limit ≤ 2%)</strong></td>
<td></td>
<td>%</td>
</tr>
</tbody>
</table>

Permission is granted to photocopy this page and use it to record measurements made during the performance verification of a WaveLink MBW probe. The numbers preceding each line correspond to steps in the procedure that require the recording of data.

The actual specification test limits are included in each step. Intermediate calculations that support the limit check are to be recorded in the column labeled Intermediate Data.

Use a new Test Record for each combination of platform/cable assembly, amplifier module, interconnect lead, and tip.
Reference Material

Probe Input Impedance and 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 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.

The SI Interconnect Lead tip uses a construction in which the tip termination consists of a damping resistor with very short lead length (to minimize inductance) that is soldered to the circuit. These damping resistors connect to a special distributed resistor on the lead. The distributed resistors compensate for the inherent transmission loss of the probe system. The result is very broad frequency response with relatively high impedance. 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 or some other simulator to accurately represent the probe loading.

**NOTE:** To avoid degrading the high frequency performance of the probe do not extend the input leads on the solder-in interconnect lead tip.
Dxx30Probe with Dxx30-SI, Dxx30-QL-SI, or Dxx30-HiTemp

Equivalent Circuit Model

[Diagram of Equivalent Circuit Model with components labeled]

- 120 ohm
- 2 nH
- 0.14 pF
- 0.02 pF
- 0.5 pF
- 10 nF
- 125 k
- 930 ohm

Operator's Manual
PROBE INPUT IMPEDANCE

**Typical probe input impedance magnitude as a function of frequency for differential and single-ended (one lead ground) configuration.**

**Typical probe input impedance magnitude as a function of log frequency for differential and single-ended (one lead ground) configuration.**
**Dxx30 Probe with Dxx30-PT**

**EQUIVALENT CIRCUIT MODEL**
**PROBE INPUT IMPEDANCE**

*Typical probe input impedance magnitude as a function of frequency for differential and single-ended (one lead ground) configuration.*

*Typical probe input impedance magnitude as a function of log frequency for differential and single-ended (one lead ground) configuration.*
**Dxx30 Probe with Dxx30-SP**

**Equivalent Circuit Model**
PROBE INPUT IMPEDANCE

Typical probe input impedance magnitude as a function of frequency for differential and single-ended (one lead ground) configuration.

Typical probe input impedance magnitude as a function of log frequency for differential and single-ended (one lead ground) configuration.
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.

Common Mode Rejection Ratio

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

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

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

**Offset**

The offset for the WaveLink probe is in the probe amplifier (D830, D1030, and D1330). Thus, these probes have full offset capability over their entire V/Div range.

When the WaveLink series probe is used with a Teledyne LeCroy oscilloscope equipped with a ProLink 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.)

**Dynamic Range**

WaveLink Medium Bandwidth probe amplifiers have no gain or attenuation control. However, the WL-PLINK platform/cable assembly does provide gain and attenuation controls.

The actual gain value for each probe is indicated in the probe dialog box, which is displayed when the probe is connected to the scope.

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.
Technical Support

*Live Support*
Registered users can contact their local Teledyne LeCroy service center at the number listed on our website. You can also request Technical Support via the website at:

teledynelecroy.com/support/techhelp

*Resources*
Teledyne LeCroy publishes a free Technical Library on its website. Manuals, tutorials, application notes, white papers, and videos are available to help you get the most out of your Teledyne LeCroy products. Visit:

teledynelecroy.com/support/techlib

*Service Centers*
For a complete list of offices by country, including our sales and distribution partners, visit:

teledynelecroy.com/support/contact

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*Sales and Service:*
FAX: 845-578-5985
contact.corp@teledynelecroy.com

*Support:*
Ph: 800-553-2769
customersupport@teledynelecroy.com
Certifications
Teledyne LeCroy certifies compliance to the following standards as of the time of publication. See the EC Declaration of Conformity certificate shipped with your product for the current certifications.

EMC Compliance

EC DECLARATION OF CONFORMITY - EMC
The product meets the intent of EC Directive 2014/30/EU for Electromagnetic Compatibility. Compliance was demonstrated to the following specifications as listed in the Official Journal of the European Communities:

EN 61326-1:2013, EMC requirements for electrical equipment for measurement, control, and laboratory use. ¹,²,³

1. Emissions which exceed the levels required by this standard may occur when the product is connected to a test object.
2. This product is intended for use in nonresidential areas only. Use in residential areas may cause electromagnetic interference.
3. To ensure compliance with the applicable EMC standards, use high-quality shielded interface cables.

European Contact:*
Teledyne LeCroy Europe GmbH
Im Breitspiel 11C
D-69126 Heidelberg
Germany
Tel: +49 6221 82700

AUSTRALIA & NEW ZEALAND DECLARATION OF CONFORMITY—EMC
The product complies with the EMC provision of the Radio Communications Act per the following standards, in accordance with requirements imposed by Australian Communication and Media Authority (ACMA):

AS/NZS CISPR 11:2011 Radiated and Conducted Emissions, Group 1, Class A

Australia / New Zealand Contacts:*
RS Components Pty Ltd.  RS Components Ltd.
Suite 326 The Parade West  Unit 30 & 31 Warehouse World
Kent Town, South Australia 5067  761 Great South Road
* Visit teledynelecroy.com/support/contact for the latest contact information.
**Safety Compliance**

**EC DECLARATION OF CONFORMITY – LOW VOLTAGE**

The product meets the intent of EC Directive 2014/35/EU for Product Safety. Compliance was demonstrated to the following specifications as listed in the Official Journal of the European Communities:

IEC/EN 61010-031:2015 Safety requirements for electrical equipment for measurement, control, and laboratory use – Part 031: Safety requirements for hand-held probe assemblies for electrical measurement and test.

**Environmental Compliance**

**END-OF-LIFE HANDLING**

The probe is marked with this symbol to indicate that it complies with the applicable European Union requirements to Directives 2012/19/EU and 2013/56/EU on Waste Electrical and Electronic Equipment (WEEE) and Batteries.

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

**RESTRICTION OF HAZARDOUS SUBSTANCES (RoHS)**

The probe and its accessories conform to the 2011/65/EU RoHS2 Directive.
Warranty
Teledyne LeCroy warrants this oscilloscope accessory for normal use and operation within specification for a period of one year from the date of shipment. Spare parts, replacement parts and repairs are warranted for 90 days.

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

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

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