TELEDYNE LECROY
Everywhereyoulook™

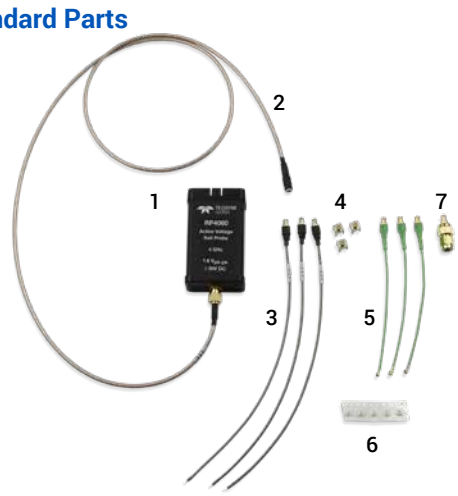
RP2060, RP4060
Active Voltage Rail Probes

935225-00 Rev A

The Teledyne LeCroy RP2060 and RP4060 Power Rail Probes meet the specific requirements of those who need to acquire a low-voltage DC signal for testing digital power management components (e.g., PMICs, VMRs, POL switching regulators). The rail probes will acquire a low-impedance, low-voltage DC bus signal without loading the device under test (DUT). They provide high sensitivity (gain) with low noise and high offset—allowing a DC bus signal to be displayed in the vertical center of the oscilloscope.

For the complete manual, visit:
teledynelecroy.com/probes/active-voltage-rail-probe

Standard Parts



1. RPxx60 Active Voltage Rail Probe
Low-loading, ±60 V offset rail probe available in 2 GHz and 4 GHz bandwidth models. Qty 1.

2. SMA-to-MCX Extension Cable
0.9 m cable attaches to solder-in leads/coaxial cables or mates directly with MCX PCB mounts. Qty 1.

3. MCX Solder-in (SI) Leads
4 GHz rated, 18 cm SI leads. Qty 3.

4. MCX PCB Mounts (Receptacles)
6mm x 6 mm PCB mounts accept the MCX extension cable for 4 GHz bandwidth connection. By TE Connectivity. Qty 3.

5. U.FL Ultra-miniature Coaxial Cables
3 GHz rated, U.FL ultra-miniature coaxial cables mate with U.FL PCB mounts. By Lighthorse. Qty 3.

6. U.FL PCB Mounts (Receptacles)
3 mm x 3 mm PCB mounts accept the U.FL ultra-miniature coaxial cables. By Hirose. Qty 5.

7. MCX-to-SMA Adapter
Attaches the probe to SMA connectors on DUT. Qty 1.

Soft Storage Case (not shown)
Protective case with custom foam insert. Qty 1.

Accessories

Additional/Replacement Parts
Additional quantities of the following can be ordered from Teledyne LeCroy.

Item	Part Number	QTY
MCX Solder-in Lead	RP4000-MCX-LEAD-SI	3

Consult the manufacturers for additional quantities of other parts.

Browser Tip Kit
A ÷1 high-frequency transmission line browser tip, it includes adapters and resistors that enable it to also be used as a ÷10 or ÷20 attenuation high-frequency transmission line probe. P/N RP4000-BROWSER.

Compatibility

Use only with compatible Teledyne LeCroy instruments running MAUI firmware versions:

- 10.1.x.x or higher for RP4060
- 10.2.x.x. or higher for RP2060

For a current list of compatible instruments, visit:
teledynelecroy.com/probes/active-voltage-rail-probe

Probe Assembly and Connection

1. Attach the SMA-to-MCX extension cable to the SMA connector on the bottom of the probe housing.
2. Press the probe housing onto the oscilloscope ProBus connector. A click confirms it is seated properly.
3. Attach the desired tip (if any) to the extension cable.
4. Allow the probe to warm up for at least 20 minutes after being connected to the oscilloscope before making measurements.

Connecting Tips to Circuit

To measure the AC fluctuation of a DC rail, you may make any of the following connections to the circuit.

Direct MCX Connection

1. Solder the MCX PCB mount to the board.
   - Solder the center pin to the signal.
   - Solder one or more of the four posts to ground.

⚠ **CAUTION:** Avoid excessive lateral or vertical force on the mount once it has been installed.

2. Mate the MCX extension cable to the mount by pressing the plug into the PCB receptacle.

For full instructions, see TE Connectivity, P/N 1061015-1.

Direct U.FL Connection

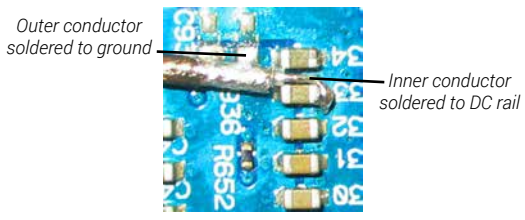
1. Solder the U.FL PCB mount to the board (maximum temperature 350 °C for five minutes).
2. Mate the U.FL coaxial cable to the PCB receptacle by aligning the connectors and pressing the cable plug into the receptacle. A click confirms proper mating.

⚠ **CAUTION:** Do not apply a load in excess of 2 N parallel to or 4 N perpendicular to the mating axis. Do not forcefully twist or deform the wires.

For full instructions, see Hirose, P/N U.FL-R-SMT-1. Also see Lighthorse, P/N CB1.32D-IPX-MXMGT-4In-X1.

Solder-in Connection

1. Solder the exposed ~3 mm inner conductor of the SI-lead to the DC rail.
2. Solder the exposed ~0.5 mm outer conductor to ground with as short of a lead as possible.

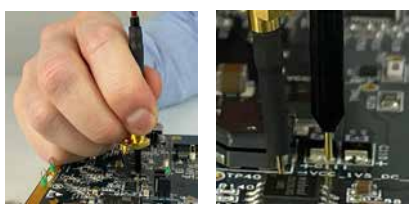


NOTE: SI-leads can be re-soldered multiple times. See the *User Manual* for instructions.

Browser Connection

⚠ **CAUTION:** Maximum Safe Input Voltage for hand-held use is 60 Vdc (referenced to ground) per IEC/EN 61010-031:2015. Bandwidth is limited to 500 MHz when using the browser tip.

1. Remove the MCX extension cable from the rail probe.
2. Attach the browser cable to the SMA connector on the probe housing.
3. Place the browser tip on the test point, keeping the body as perpendicular to the circuit as posible to minimize parasitic capacitance.
4. Place the adjacent ground tip on a nearby ground. The hinged ground can be gently pulled away from or toward the browser tip to fit it to the ground point.



See the *User Manual* for instructions on using the browser tip as a transmission line probe.

Operating from the Oscilloscope

When the probe is attached to the oscilloscope's input connector, the instrument will recognize the probe and:

- Set the input termination (coupling) to DC50Ω
- Set the probe attenuation to 1.2x

Attenuation and Coupling cannot be changed.

The probe's attributes are shown on the RPxx60 Probe dialog, which appears when a probe is detected.

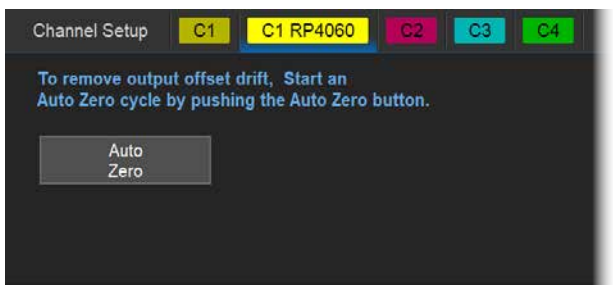
Vertical Scale (V/div)
The oscilloscope automatically factors in the nominal 1.2x attenuation and adjusts the Vertical Scale (gain) to reflect the attenuation value. No further adjustment is needed.

Offset
Probe offset is controlled using the front panel Vertical OFFSET knob. The amount of offset applied is displayed on the input channel descriptor box.

NOTE: On Teledyne LeCroy oscilloscopes, the input offset displayed is the amount of offset required to zero the applied voltage (e.g., a -1 V offset is required to vertically center a 1 V DC rail on the grid).

Bandwidth
Bandwidth is limited to the lower of the probe or tip rating. Use the Bandwidth control on the C*n* dialog to limit bandwidth to less than the rating of probe or tip.

Auto Zero
After 20 minutes of warm-up, or when the probe is exposed to a large shift in ambient temperature, some DC offset drift may occur. Open the RPxx60 dialog and touch Auto Zero to remove any DC offset drift.



RP4060 probe dialog.

Compliance

For the full list of current certifications, see the EC Declaration of Conformity shipped with your product.

RPxx60 probes conform to the following standards:

IEC/EN 61010-031:2015+A1:2018 - 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

IEC/EN 61326-1:2020 - EMC requirements for electrical equipment for measurement, control, and laboratory use

IEC/EN 61326-2-1:2021 - Particular requirements for sensitive test and measurement equipment for EMC unprotected applications

The RPxx60 rail probes comply with the applicable European Union requirements to Directives 2012/19/EU on Waste Electrical and Electronic Equipment (WEEE). For information about proper disposal and recycling of your Teledyne LeCroy product, visit:
teledynelecroy.com/recycle

Unless otherwise specified, all materials and processes are compliant with RoHS Directive 2011/65/EU in its entirety, inclusive of any further amendments or modifications of said Directive.

Warranty

For warranty information, visit our website at:
teledynelecroy.com/support/service.aspx

Factory Calibration

The recommended factory calibration interval is one year. For service, contact Teledyne LeCroy.

Environmental Specifications

Temperature, Operating	0 °C to 50 °C
Temperature, Non-Operating	-40 °C to 70 °C
Relative Humidity	5% to 80% RH (non-condensing) up to 30 °C, decreasing linearly to 45% RH at 50 °C
Altitude, Operating	3,000 m (9,842 ft.) maximum
Altitude, Non-Operating	10,000 m
Pollution Degree	2, indoor use only. Per IEC/EN 61010-31:2015, this is an operating environment where normally only dry, non-conductive pollution occurs. Conductivity caused by temporary condensation should be expected.

Cleaning

Clean only the exterior surfaces of the probe using a soft cloth dampened with water or 75% isopropyl alcohol solution. Do not use harsh chemicals or abrasive cleansers. Dry the probe and accessories thoroughly before making voltage measurements.

CAUTION: The probe casing is not waterproof. Under no circumstances submerge the probe in liquid or allow moisture to penetrate it.

Connecting to High Impedance Sources

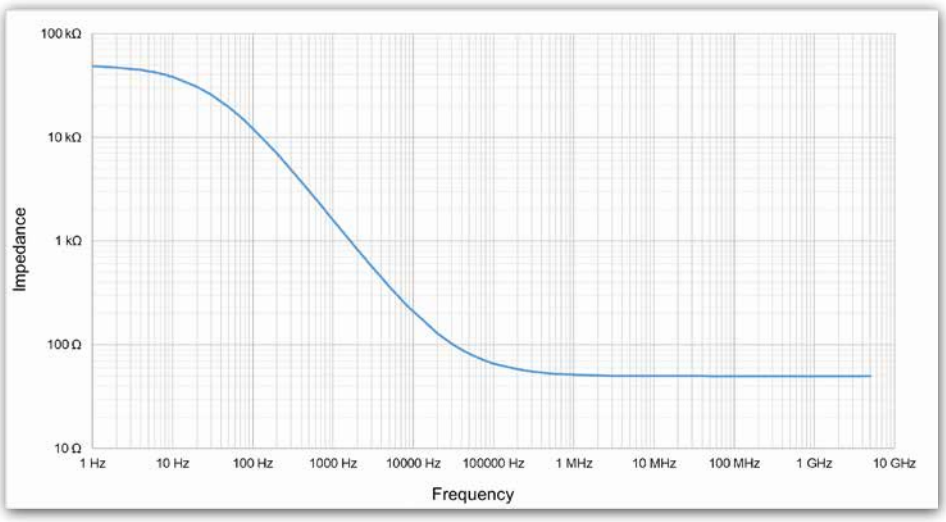
The frequency response plots describe probe performance with a 0 Ω load. See the *User Manual* for degradation of the frequency response when the source impedance is non-zero.

Electrical Specifications

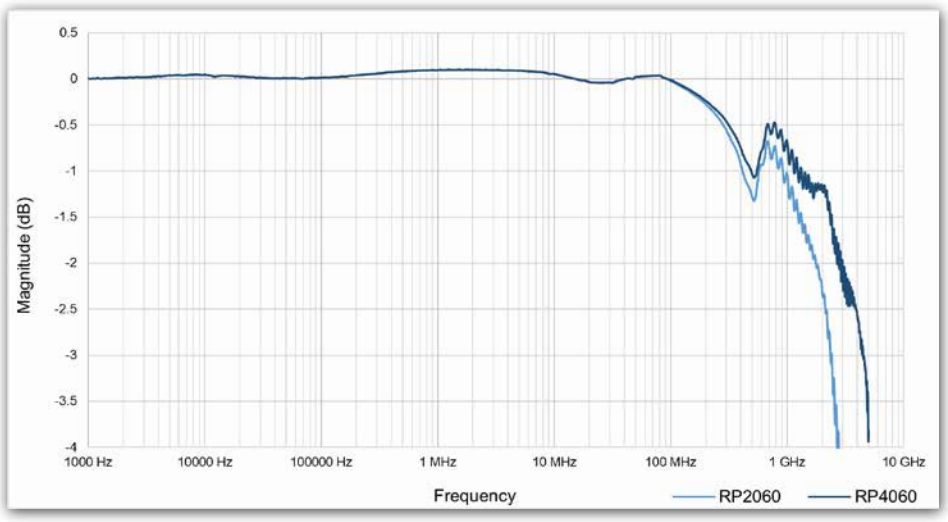
Warranted Characteristics	
Bandwidth (MCX Cable & PCB Mount)	RP4060: 4 GHz RP2060: 2 GHz
Attenuation Accuracy	1% into 50 Ω
Offset Accuracy	±0.1% ±3 mV
Nominal Characteristics	
Offset Range	±60 V
Attenuation	1.2x
DC Input Impedance	50 kΩ
Input Dynamic Range	±800 mV (single-ended)
Max. Non-destruct Input Voltage	100 V (DC + peak AC)
Max. Non-destruct AC Voltage	50 Ω oscilloscope input limit
Max. Safe Input Voltage (referenced to ground)	60 Vdc when hand-held per IEC/EN 61010-031:2015
Output Termination	50 Ω at oscilloscope input
Typical Characteristics	
Bandwidth* MCX Solder-in Lead U.FL Coax Cable & PCB Mount Browser Tip	 4 GHz 3 GHz 500 MHz
Rise Time (10%-90%)	RP4060: 110 ps RP2060: 220 ps

** Bandwidth is the lower of probe or tip rating. Maintain adequate spacing between probe components and earth ground.*

Input Impedance (RP2060 and RP4060)



Frequency Response



Safety and Best Practices

Safety Symbols

These symbols appear on the probe or in documentation.

	CAUTION of damage to equipment, or **WARNING** of hazard to health. Refer to the accompanying information in the product manual to protect against personal injury or damage. Do not proceed until conditions are fully understood and met.
	ESD CAUTION. Risk of Electrostatic Discharge (ESD) that can damage equipment if anti-static measures are not taken.

General Precautions

The overall safety of any system incorporating this probe is the responsibility of the system owner.

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

Use only accessories compatible with the probe. Use only accessories that are rated for the application. Using accessories other than those shipped with the probe may create an electrical hazard.

Connect and disconnect properly. Connect the probe to the oscilloscope before connecting to the circuit being measured. De-energize the test circuit before connecting/disconnecting probe tips (excluding browsers). Disconnect probe from circuit before disconnecting probe from oscilloscope.

Do not use for measurements on Mains circuits.

Do not overload; observe all terminal ratings. Comply with the frequency derating when measuring signals with a high frequency component.

Do not excessively bend cables. Avoid tight radius bends, crushing, crimping, twisting or otherwise stressing cables.

Do not remove the probe's casing. Touching exposed connections may result in electric shock.

Do not disassemble the probe or remove inside parts. Refer all service to Teledyne LeCroy personnel.

Use only indoors 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 damage. If any part is damaged, cease operation immediately and secure the probe from inadvertent use.

Avoiding Damage to DUT

CAUTION: Low voltage DC power rails carry large amounts of current, and if they are shorted to ground, large currents will flow, potentially damaging the DUT. To prevent this:

- Before energizing the DUT, inspect solders and PCB mounts carefully to ensure there is no inadvertent connection between the power rail and ground.
- Use insulating tapes or other materials around the connection points (especially when using the solder-in, which has an exposed cable ground).
- Tape solder-in leads and coaxial cables to the DUT to avoid stress on the connection points and/or accidental disconnection that could lead to short circuiting the rail voltage or other damage to the circuit.
- Exercise extreme caution when using the browser tip. Avoid inadvertent contact between the ground pin and the conductive browser tip assembly, or between the browser ground pin and the DC rail.

Probe Handling

Exercise care when handling and storing the probe. Avoid putting excessive strain on or exposing leads and cables to sharp bends.

ESD Sensitive: Avoid damaging the probe by always following anti-static procedures (wear wrist strap, etc.) when using or handling the probe.

CAUTION: Maximum Safe Input Voltage for hand-held use is 60 Vdc (referenced to ground) per IEC/EN 61010-031:2015.

Avoiding Parasitic Inductance

All ground connections provided with the rail probe are very short (browser) or coaxial in nature to ensure that any parasitic inductance added to the circuit when the probe connection is made remains low.

If the browser ground lead is increased in length, or if long ground leads are attached to the coaxial solder-ins, then the parasitic loop inductance of the probe will greatly increase and the signal fidelity performance will deteriorate. This is seen on the signal as a "ringing" or a slowing rise time of fast signals. Additionally, large loop areas will pick up any radiated electromagnetic field which passes through the loop and may induce noise into the probe input.

To verify that no ground loop is present:

1. Connect the ground and tip to the DUT ground.
2. Validate that a low noise 0 Vdc signal is measured.

Choosing Probing Location

Power planes will typically exhibit 2d standing waves. Place probe point land patterns as close to the area of interest as possible.

Contact

For assistance in the US, contact Technical Support at:

Ph: 800-553-2769 / 845-425-2000
Fax: 845-578-5985
support@teledynelecroy.com

A complete list of regional offices is available from:
teledynelecroy.com/support/contact