TELEDYNE LECROY
Everywhereyoulook™

User Manual

DL-ISO High Voltage Optically Isolated Probes

DL03-ISO, DL07-ISO, DL10-ISO

DL-ISO High Voltage Optically Isolated Probes User Manual
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November, 2024

Contents

Safety

Follow these instructions to keep the probe operating in a correct and safe condition. Observe generally accepted safety procedures in addition to the precautions specified here. The overall safety of any system incorporating this accessory is the responsibility of the system owner.

Symbols

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

	**DANGER, HIGH VOLTAGE.** Risk of electric shock or burn.
	**CAUTION** of damage to probe or 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.
	**ESD CAUTION.** Risk of Electrostatic Discharge (ESD) that can damage the probe or instrument if anti-static measures are not taken.
	Laser Safety **WARNING.**

Terms

The terms *isolated* and *electrically floating* are used in documentation to indicate measurements where there is no direct conduction path to earth ground.

General Safety Precautions

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

For use only by trained personnel. Not for use in households or by children.

Use only as specified. Using the probe and/or the equipment it is connected to in a manner other than specified may impair the protection mechanisms.

Before use, test the probe with a known source to ensure it is operating correctly.

Do not overload; observe all terminal ratings. Do not connect the probe to any circuit that exceeds the CAT, voltage or current ratings of the oscilloscope terminal, probe or probe-accessory combination.

Use only accessories compatible with the probe and rated for the application. Using acssories 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 circuit under test before connecting probe tips.

Keep the probe head and fiber-optic cable away from the circuits being measured. Only tips are intended for contact with electrical sources.

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 use damaged cables. Before each use, check cables for damage to the protective insulation.

Do not operate with suspected failures. Before each use, inspect the probe and accessories. If any part is damaged, cease operation immediately and secure the probe from inadvertent use.

High Voltage Safety

Not rated for hand-held use. Do not handle probe tip connectors, cables or any part of the probe head at any time if there is any possibility >60 Vdc/30 Vrms is present in the circuit. The plastic case of the probe head and tip shields do not provide safe isolation.

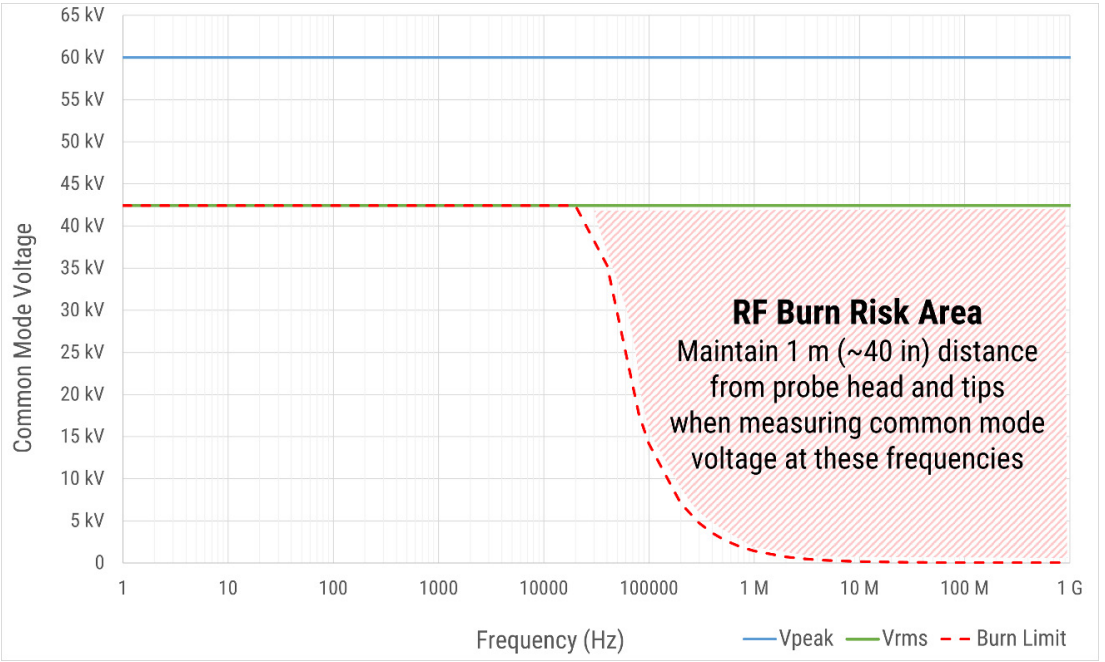
Do not connect tips to an energized circuit. Always de-energize the circuit under test before installing or removing tips.

Beware when using with high-voltage or high-frequency signals. Read the manual thoroughly before use to understand how the probe and accessories are derated depending on use. Refer to the tip derating and RF burn limit graphs.

Clearance Requirements

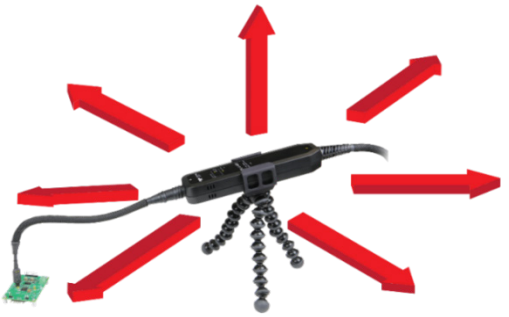
The unique common mode voltage range of the probe system allows it to be used in the presence of high-frequency/high-voltage common mode signals, but it is important to observe all precautions while using it.

WARNING: RF burns or electric shock can occur when using the DL-ISO probes. The plastic case of the probe head and tip shields do not provide safe isolation from hazardous common mode voltages. Do not access the probe while measuring signals in the RF burn risk area.



Maximum safe handling limits for common mode voltages between the probe head and tips with respect to earth ground.

WARNING: Maintain 1 m (~40 in) safe clearance of the probe head and tip in all directions when connected to an energized circuit. Place the oscilloscope and any equipment you need to access at least 1 m from the circuit and probe head.



Laser Safety

CLASS 1 LASER PRODUCT

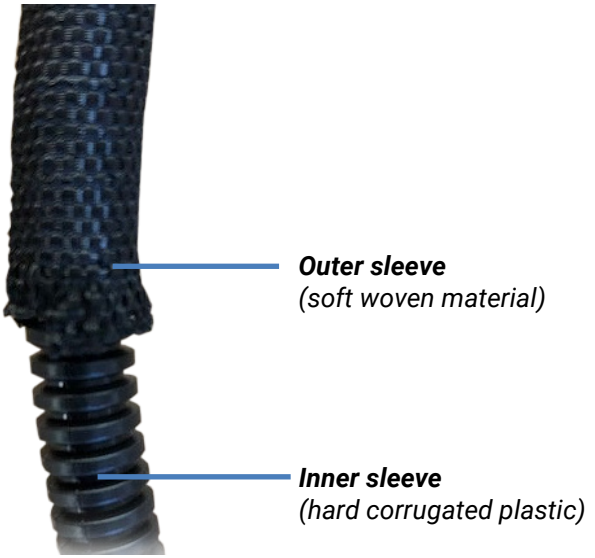
WARNING: The DL-ISO probes contain multiple lasers, exposing which may cause laser burns. Do not remove any plastic or metal covers or otherwise attempt to disassemble the probe.

Using controls, adjustments or procedures other than those specified in this manual may result in exposure to hazardous levels of invisible radiation.

The probe uses optical fibers within a single cable between the probe head and control module. Therefore, standard optical fiber handling practices are required. Avoid tight radius bends, crushing, crimping, twisting or otherwise stressing the fiber-optic cable.

Minimum cable radius bend is 2 in (5.1 cm); avoid making loops smaller than 4 in (10.2 cm).

Before each use, inspect the fiber-optic cable for damage such as tears or other defects. If the inner corrugated plastic sleeve is visible or punctured, cease operation immediately and secure the probe from inadvertent use.



Safe Operating Environment

Temperature, Operating, Probe Head	5 °C to 40 °C
Temperature, Operating, Control Module	10 °C to 35 °C
Temperature, Non-operating	-20 °C to 70 °C
Relative Humidity	5% to 95% RH (non-condensing) 75% RH above 30 °C 45% RH above 50 °C
Altitude, Operating	3000 m (9842 ft.) maximum
Altitude, Non-Operating	10,000 m (32,807 ft.) maximum
Usage	Indoor Use Only
Pollution Degree*	2, an operating environment where normally only dry, non-conductive pollution occurs. Conductivity caused by temporary condensation should be expected.

* Per IEC/EN 61010-1:2010.

The soft storage case and packaging materials shipped with the probe may not be suitable for certain ESD sensitive areas, such as EPAs (ESD Protected Areas). If this is a concern for your application, please take the necessary steps required for your test environment.

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Introduction

The DL-ISO probes enable the highest confidence in GaN and SiC device characterization with highest accuracy, best signal fidelity and comprehensive connectivity for testing servers, motherboards, mobiles, lighting and building automation, residential inverters, UPS, switch mode power supplies and motors. With up to 1 GHz bandwidth, 2500 V differential input range and 60 kV common mode range, they provide an industry-leading 1.5% system accuracy when used with 12-bit High Definition Oscilloscopes (HDOs).

Key Features

- 1 GHz bandwidth
- Ideal for GaN and SiC devices
- 1.5% system accuracy (probe plus oscilloscope)
- 435 ps rise time
- High CMRR—160 dB
- Flexible connectivity options
- Auto Zero without disconnection

Compatibility

DL-ISO probes are compatible with a wide range of Teledyne LeCroy oscilloscopes equipped with the ProBus interface. To confirm compatibility with your oscilloscope model, visit: https://teledynelecroy.com/probes/probemodel.aspx?modelid=11667&categoryid=3&mseries=537

Required Firmware Versions

Correct operation of the DL-ISO probes with MMCX tips, HV square-pin tips, or tip accessories requires that the oscilloscope be installed with MAUI® firmware version 10.1.x.x. or higher.

DL-ISO Probe System

Standard Parts

DL-ISO Probe

The probe head contains a frequency modulating optical transmitter and receiver integrated with a high-performance electrical amplifier. It is connected to the control module by an integrated fiber-optic cable. The control module utilizes the ProBus interface to communicate tip attenuation value and proper voltage scaling to the oscilloscope. When connected to a ProBus interface, the DL-ISO probe becomes an integral part of the measuring instrument, able to be controlled through the oscilloscope application or front panel.

DL-ISO probe head with tip (left) and control module with connector box (right)

External AC to DC Adapter

The probe is powered by an external AC to DC adapter that is connected to the control module. Connect to standard AC power outlets.

CAUTION: Use only the adapter shipped with the probe. To prevent damage, the probe must be powered from a supply that provides appropriately isolated and floating output voltage (i.e., no Earth connection). Extra adapters can be ordered from CUI, Inc., Part Number: SMI36-24.

Tripod Probe Mount

Non-conductive tripod secures probe and tip above the circuit in a stationary test setup.

Soft Storage Case

Soft case with a custom foam insert for storing probe and tips.

Probe Tips (at least one required)

Probe tips are sold separately from the probe itself, but at least one tip is required for proper functioning. Tips can be stored in a compartment in the soft carrying case.

All probe tips are high-quality coaxial attenuating tips that reject unwanted noise.

Probe tip measurement capability ranges from 2 Vpp to 2500 Vpp. The interface is MMCX or square pins depending on how large the voltage to be measured is.

MMCX Tip

MMCX tips connect directly to an MMCX connector on customer's circuit board. HV square-pin tips connect to differential +ve and -ve signals on circuits. On the tip, you will see a red + and a white - indicating which side connects to signal and which to reference.

HV Square Pin Tip

Description	Part Number	Quantity
2 Vpp MMCX Tip	DL-ISO-2V-TIP	1
10 Vpp MMCX Tip	DL-ISO-10V-TIP	1
40 Vpp MMCX Tip	DL-ISO-40V-TIP	1
200 Vpp MMCX Tip	DL-ISO-200V-TIP	1
1 kVpp HV Square Pin Tip	DL-ISO-1000V-TIP	1
2.5 kVpp HV Square Pin Tip	DL-ISO-2500V-TIP	1

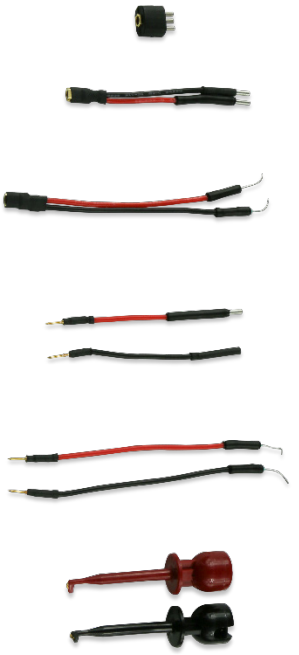
Each tip communicates identifying information to the probe. The tip rating determines the peak-to-peak voltage level that can be measured.

Note: Tip selection is important to optimize for best noise performance. Using a tip with a wider dynamic voltage range than necessary will result in more noise.

All tips are interchangeable with any DL-ISO probe and do not require specialized calibration with a specific DL-ISO probe. Simply insert the correctly rated tip into the connector on the probe head.

Optional Tip Accessories

All tip accessories shown below are sold as a kit, part number DL-ISO-ACC-KIT.



DL-ISO probe tip accessories

Item	Description	QTY
MMCX to Square-pin Adapter	This adapter can be used to connect 2 V to 200 V MMCX tips to square-pin headers. Mating pins must measure 25 mil/0.025” or 0.06 mm x 0.06 mm with a pitch of 0.1” between pins.	1
2" MMCX to Y-lead Socket	Intended for 2 V to 200 V MMCX tips, the Y-lead sockets can be used to probe differential signals that are far apart on the board.	1
3" MMCX to Y- lead Solder-in	Intended for 2 V to 200 V MMCX tips, the Y-lead solder-ins can be soldered directly to the test points for a secure probe connection.	1
2" Socket	Intended for 1000/2500 V tips, the sockets help extend the connection to the DUT.	2
3" Solder-in	Intended for 1000/2500 V tips, the solder-ins help extend the connection to the DUT.	2
Grabbers	Can be used to connect directly to IC legs or pins on a PCB. The 2” sockets will plug into the Grabbers.	2

DL-ISO Probe Specifications

For complete specifications, see the product datasheet. Specifications are subject to change without notice.

Electrical Characteristics

	DL03-ISO	DL07-ISO	DL10-ISO
Bandwidth	350 MHz	700 MHz	1 GHz
Risetime (10-90%)	1.1 ns	575 ps	435 ps
Input Dynamic Voltage Range			
DL-ISO-2V-TIP		2 Vpp	
DL-ISO-10V-TIP		10 Vpp	
DL-ISO-40V-TIP		40 Vpp	
DL-ISO-200V-TIP		200 Vpp	
DL-ISO-1000V-TIP		1000 Vpp	
DL-ISO-2500V-TIP		2500 Vpp	
Common Mode Voltage Range		+/- 60 kV (DC + peak AC)	
Maximum Input Voltage to Earth		+/- 60 kV (DC + peak AC)	
Maximum Operating Voltage (DC+Peak AC)			
DL-ISO-2V-TIP		26 V	
DL-ISO-10V-TIP		55 V	
DL-ISO-40V-TIP		170 V	
DL-ISO-200V-TIP		250 V	
DL-ISO-1000V-TIP		1000 V	
DL-ISO-2500V-TIP		2500 V	
Maximum Non-destruct Voltage (DC+Peak AC)			
DL-ISO-2V-TIP		50 V	
DL-ISO-10V-TIP		100 V	
DL-ISO-40V-TIP		250 V	
DL-ISO-200V-TIP		300 V	
DL-ISO-1000V-TIP		1250 V	
DL-ISO-2500V-TIP		3300 V	
Sensitivity			
DL-ISO-2V-TIP		20 mV/div to 250 mV/div	
DL-ISO-10V-TIP		100 mV/div to 1.3 V/div	
DL-ISO-40V-TIP		400 mV/div to 5 V/div	
DL-ISO-200V-TIP		2 V/div to 25 V/div	
DL-ISO-1000V-TIP		10 V/div to 125 V/div	
DL-ISO-2500V-TIP		25 V/div to 320 V/div	
DC Gain Accuracy (probe + oscilloscope)		1.5% after Precision Gain Calibration	
DC Gain Drift		<1% / °C	

	DL03-ISO	DL07-ISO	DL10-ISO
Offset			
DL-ISO-2V-TIP		±25 V	
DL-ISO-10V-TIP		±50 V	
DL-ISO-40V-TIP		±150 V	
DL-ISO-200V-TIP		±150 V	
DL-ISO-1000V-TIP		±1000 V	
DL-ISO-2500V-TIP		±2500 V	
Input Impedance			
DL-ISO-2V-TIP		200 kΩ || 3.6 pF	
DL-ISO-10V-TIP		1 MΩ || 2.1 pF	
DL-ISO-40V-TIP		1 MΩ || 2.1 pF	
DL-ISO-200V-TIP		7.5 MΩ || 2.0 pF	
DL-ISO-1000V-TIP		8 MΩ || 1.5 pF	
DL-ISO-2500V-TIP		15 MΩ || 2.1 pF	
Output Termination		50 Ω	
Input/Output Coupling		DC only	
Interface		ProBus	

Noise and Electromagnetic Compatibility (EMC)

	DL03-ISO	DL07-ISO	DL10-ISO
Noise (typical)			
DL-ISO-2V-TIP (100 mV/div)	2.3 mVrms	3.0 mVrms	3.4 mVrms
DL-ISO-10V-TIP (500 mV/div)	11.5 mVrms	15.0 mVrms	17.0 mVrms
DL-ISO-40V-TIP (2 V/div)	46.0 mVrms	60.0 mVrms	68.0 mVrms
DL-ISO-200V-TIP (10 V/div)	230.0 mVrms	300.0 mVrms	340.0 mVrms
DL-ISO-1000V-TIP (50 V/div)	1.2 Vrms	1.5 Vrms	1.7 Vrms
DL-ISO-2500V-TIP (125 V/div)	2.9 Vrms	3.8 Vrms	4.3 Vrms
Electrostatic Discharge (ESD) Immunity	8 kV contact discharge, 10 kV air discharge per IEC61000-4-2, criteria A		
Radiated RF Electromagnetic Field Immunity	Probe Tip and Probe Head Up to 25 V/m (80 MHz to 2.7 GHz) per IEC61000-4-3, criteria A when operating in standard configuration* Control Module Up to 3 V/m (80 MHz to 2.7 GHz) per IEC61000-4-3, criteria A when operating in standard configuration*		

	DL03-ISO	DL07-ISO	DL10-ISO
Immunity to Conducted Disturbance Induced by RF Fields	Probe Tip and Probe Head Up to 10 V (150 kHz to 80 MHz) per IEC61000-4-6, criteria A when operating in standard configuration* Control Module Up to 3 V (150 kHz to 80 MHz) per IEC61000-4-6, criteria A when operating in standard configuration*		

* Standard configuration is a test setup with probe head positioned close to DUT and at least 1 m from control module, oscilloscope near control module, and all laboratory conditions within environmental range listed on page 5.

Dimensions

Probe Head	Width 58 mm Length 220.7 mm (not including strain relief) Height 32 mm
Fiber-optic Cable Length (tip to oscilloscope input)	3.375 m (11 ft.)
Control Module	Width 106.1 mm Length 229.8 mm (not including strain relief) Height 57.8 mm

Tip-Accessory Derating

Tips are derated according to the following table when used with the accessory listed.

WARNING: Tips and accessories are classified No Rated Measurement Category per IEC/EN 61010-2-030:2021 definitions. No Rated Measurement Category applies to circuits not directly connected to the mains supply. The measurement terminals of the probe as well as all accessories are to be used only for measurements on circuits not directly connected to the mains. The probe and accessories are not rated for CAT II, III or IV measurements.

WARNING: The Measurement Category and voltage rating is the lower of the probe tip or accessory used. Do not exceed the CAT, voltage or current rating of the lowest rated individual component.

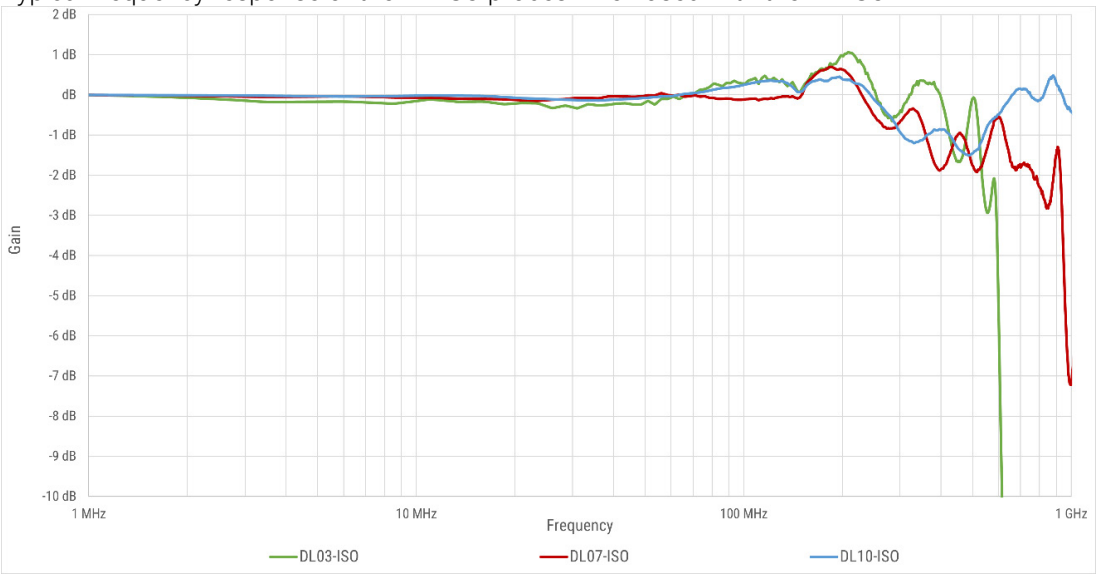
WARNING: The probe is not intended for hand-held use. Always maintain adequate spacing between floating probe components and earth ground when measuring high voltages in a stationary test setup.

Part	Input Dynamic Range	Max. Operating Voltage* (DC+Peak AC)	Max. Non-destruct Voltage* (DC+Peak AC)
DL-ISO-ACC-KIT			
MMCX to Square-pin Adapter	*Tip dependent*	250 V	300 V
2" MMCX to Y-lead Socket	*Tip dependent*		
3" MMCX to Y- lead Solder-in	*Tip dependent*		
2" Socket	*Tip dependent*	2,500 V	3,300 V
3" Solder-in	*Tip dependent*		
Grabbers	*Tip dependent*		

* Accessories derate the same as the tip used. Refer to the Non-destruct Input Voltage (tip derating) graph.

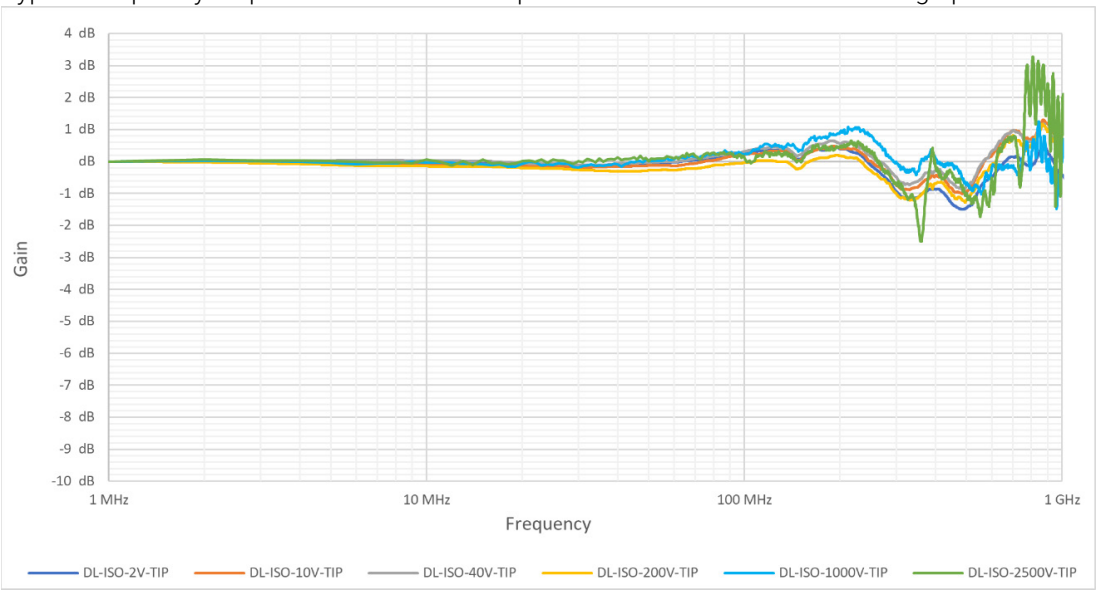
Bandwidth by Model

Typical frequency response of the DL-ISO probes when used with the DL-ISO-2V-TIP:

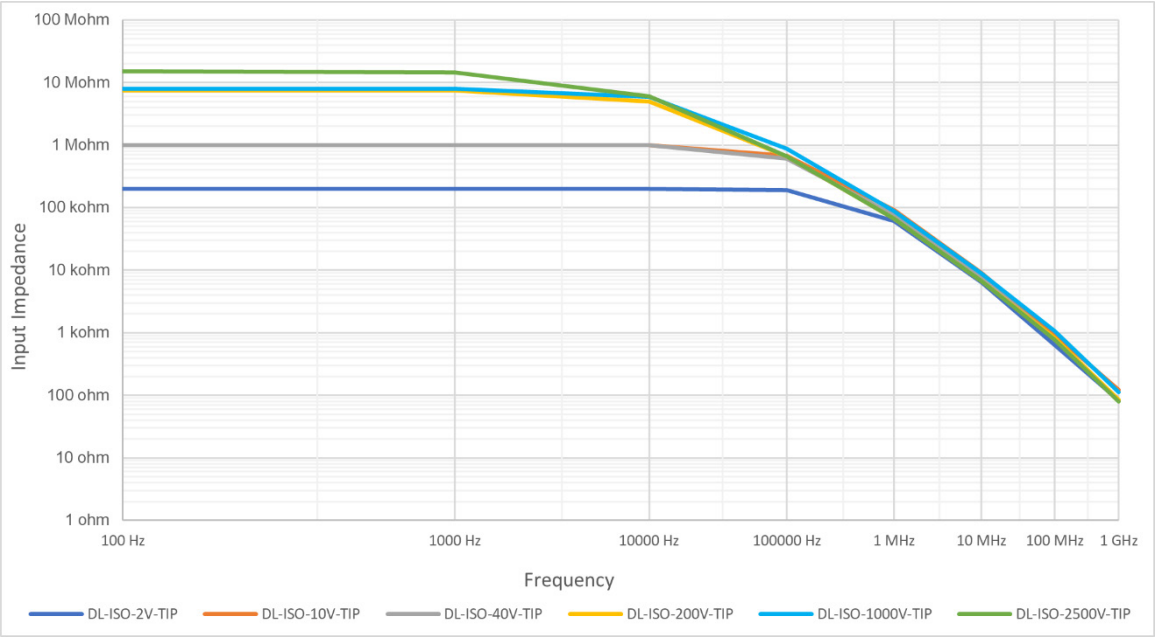


Bandwidth by Tip

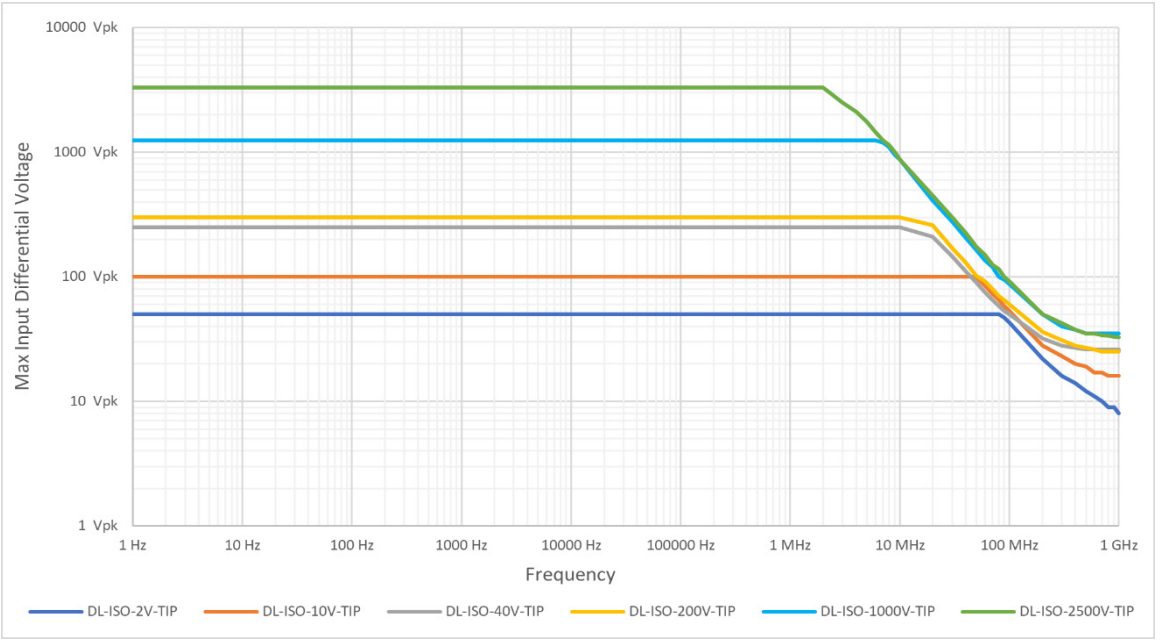
Typical frequency response of the DL10-ISO probe when used with the following tips:



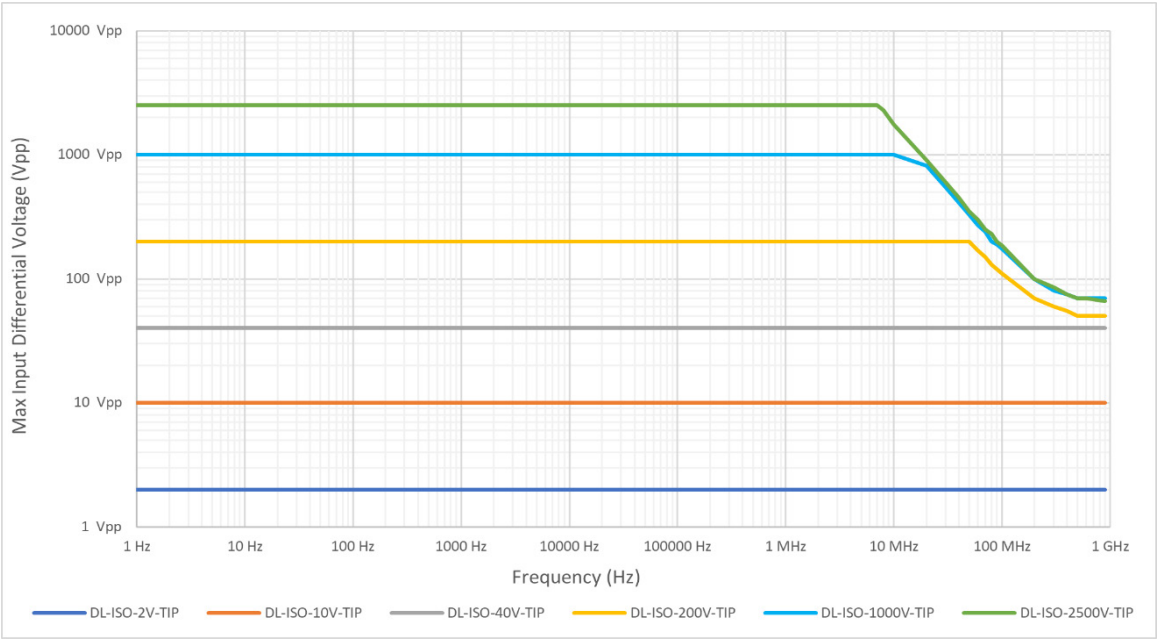
Input Impedance vs. Frequency



Max. Non-destruct Voltage (tip derating)



Max. Operating Voltage (tip derating)

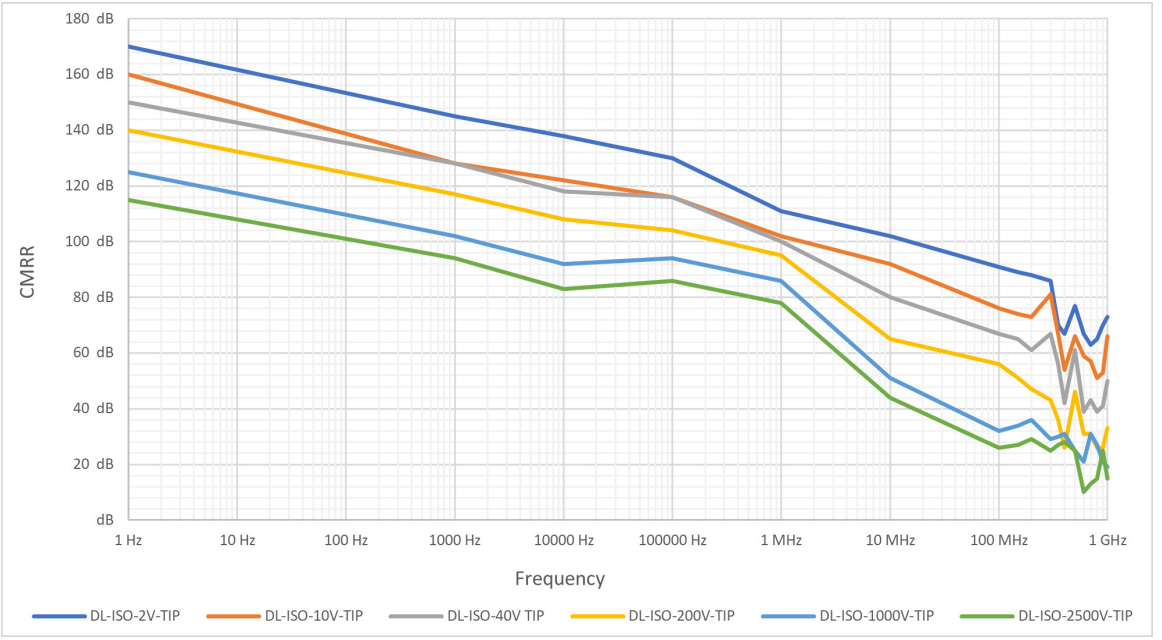


Common Mode Rejection Ratio (CMRR)

CMRR varies by tip and measurement frequency. The table below shows typical values.

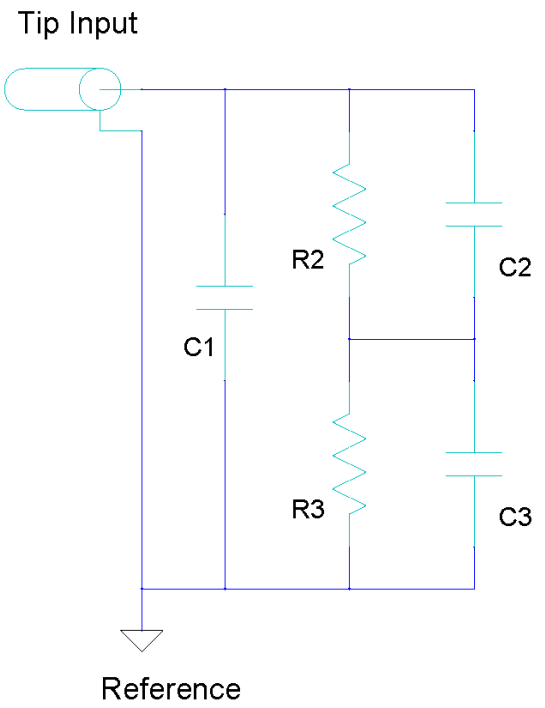
Probe Tip	DC	1 MHz	100 MHz	200 MHz	500 MHz	1 GHz
DL-ISO-2V-TIP	160 dB	110 dB	90 dB	90 dB	80 dB	75 dB
DL-ISO-10V-TIP	160 dB	100 dB	75 dB	75 dB	65 dB	65 dB
DL-ISO-40V-TIP	150 dB	100 dB	70 dB	60 dB	60 dB	50 dB
DL-ISO-200V-TIP	140 dB	95 dB	55 dB	50 dB	45 dB	35 dB
DL-ISO-1000V-TIP	125 dB	85 dB	30 dB	35 dB	25 dB	20 dB
DL-ISO-2500V-TIP	115 dB	80 dB	25 dB	30 dB	25 dB	15 dB

CMRR in decibels (dB) is shown in the plot below. All discontinuities are due to a combination of noise floor limitations of the measurement device and amplification capabilities of the generators.



Equivalent Circuit

Probe Tip	C1	C2	C3	R2	R3
DL-ISO-2V-TIP	1.2 pF	1.3 pF	0.01 pF	200 kΩ	125 Ω
DL-ISO-10V-TIP	1.2 pF	0.55 pF	0.05 pF	1.0 MΩ	700 Ω
DL-ISO-40V-TIP	1.6 pF	0.5 pF	1.5 pF	1.0 MΩ	3.0 kΩ
DL-ISO-200V-TIP	1.4 pF	1.0 pF	1.0 pF	7.5 MΩ	2.5 kΩ
DL-ISO-1000V-TIP	1.5 pF	0.5 pF	0.15 pF	8.0 MΩ	5.4 kΩ
DL-ISO-2500V-TIP	1.9 pF	0.5 pF	0.15 pF	15.0 MΩ	5.7 kΩ



Operation

Note: Operating the probe requires MAUI firmware version 10.1.x.x or higher. To confirm the version, choose Utilities > Utilities Setup from the oscilloscope menu bar, then open the Status tab.

Connecting the Probe to the Test Instrument

Connect the probe to the oscilloscope through the ProBus input.

Connect the AC-to-DC adapter to the DC inlet on the probe control module, then connect to AC power. The colored LED will turn green, indicating functional status.

For optimal accuracy, allow the system to warm up powered on for at least 20 minutes, then Perform a Precision Gain Calibration prior to taking measurements (see p.23).

Attaching and Removing Tips

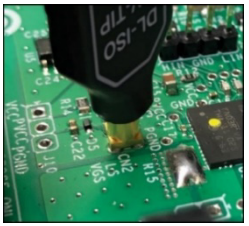
Insert the desired tip into the connector on the probe head. Be sure the arrows on both connectors are aligned.

To remove tips from the probe head, gently pull back on the LEMO plug to unlock it before pulling the tip from the probe. Do not squeeze the LEMO plug when removing the tip.

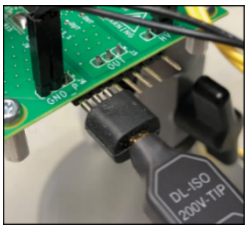
Connecting Tips to the Test Circuit

De-energize the circuit under test before connecting tips.

WARNING: The DL-ISO uses fiber-optic isolation to permit the probe to float above ground without damaging the oscilloscope or harming the operator. DO NOT touch the probe head, tip or tip cable while connected to a live circuit. The probe is not rated for hand-held use and serious harm will result if you touch these components while they are floating.

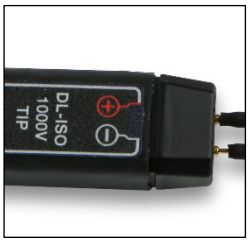


Seat MMCX tips directly into MMCX connectors.



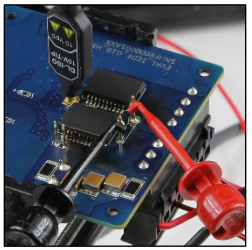
To connect MMCX tips to square-pin headers, attach the MMCX to square-pin adapter to the tip before pressing it onto the pins.

Note: The adapter connects to square-pin headers with mating pins measuring 25 mil/0.025” or 0.635 mm x 0.635 mm and a pitch of 0.1” between pins. The order of the three pins in the adapter is Reference-Signal-Reference. Connect the Reference pin to the lower impedance node of the circuit.



HV square-pin tips connect to differential +ve and -ve signals on circuits. On the tip, you will see a red + and a white - indicating which side connects to signal and which to reference.

The pitch between pins is 0.2” (5.08 mm). The mating pins should be 0.025” x 0.025” (0.635 mm x 0.635 mm). Alternately, round pins could be used whose diameter varies from 0.026” to 0.033” (0.66 mm to 0.84 mm).



Most tip accessories have a red and a black interface. Red connects to signal and black connects to reference.

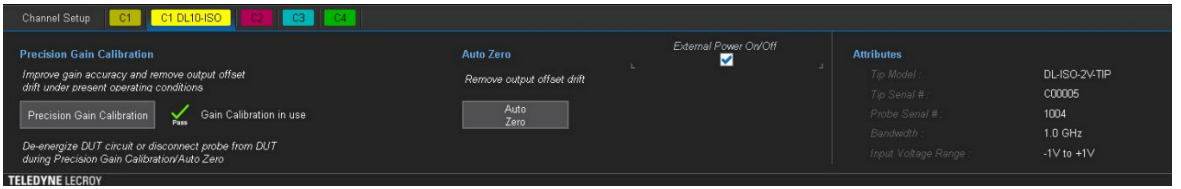
Operating with an Oscilloscope

When the entire DL-ISO, including the attenuating tip, is connected to a Teledyne LeCroy oscilloscope, the displayed scale factor and measurement values are adjusted to account for the effective gain of the probe. The oscilloscope will set the proper probe attenuation according to the information received from the tip, while the oscilloscope probe control functions are activated, and probe gain and offset can be controlled through the oscilloscope.

The C*n*DL-ISO dialog appears behind the C*n* dialog of the probe input channel. The probe's tip model, serial number, bandwidth and input voltage range are all shown on the DL-ISO probe dialog.

The probe dialog can be used to:

- Initiate a Precision Gain Calibration or Auto Zero procedure
- Turn External Power On/Off without having to physically disconnect the probe
- Update probe firmware, when required



DL-ISO probe dialog.

Probe Volts/Div and Attenuation

The oscilloscope's scale factor is controlled through the front panel Volts/Div knob or input channel dialog (C*n*). When the probe is connected, the oscilloscope voltage per division settings will be limited to a minimum sensitivity setting based on the attached tip.

Offset

Offset allows you to remove a DC bias voltage from the input signal while maintaining DC coupling. This ensures that the probe will never be overdriven while a signal is displayed on screen and prevents inaccurate measurements.

Offset can also be used to adjust the input voltage range that can be measured. For example, the 40 Vpp tip measures -20 V to +20 V with 0 V offset. If the offset is changed to +10 V, the range of signal that can be measured now changes to -10 to +30 V. This is especially useful when measuring gate drives with asymmetrical voltage ranges or viewing the full swing of Vds voltages. When offset is changed, the Attributes section of the probe dialog provides real-time guidance on what Input Voltage Range is valid (based on the offset setting and probe tip that is connected).

Auto Zero

The Auto Zero procedure corrects for DC offset drifts that naturally occur from thermal effects in the probe system. DC offset drift is independent of probe tip connected, but it is affected by oscilloscope gain setting and ambient temperature.

DL-ISO Full Scale Range (FSR) is calculated as:

$$8 \times \text{Vertical Gain Sensitivity}$$

For example, at 100 mV/div, FSR = 100 mV/div x 8 = 800 mV.

DL-ISO DC Offset Drift is calculated as:

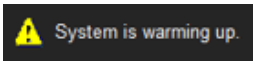
$$\text{DC Offset Drift} \leq [0.05\% \times \text{FSR} \times \text{temperature change}]$$

For example, if there is a 10 °C change at 100 mV/div, the DC Offset Drift will be:

[(0.05/100) x 800 mV x 10] = 4 mV

To perform an Auto Zero:

1. De-energize the circuit under test (the probe may remain physically connected).
2. Warm up the system (oscilloscope and probe) until the “warming up” indicator on the probe dialog disappears:



3. Touch the Auto Zero button on the DL-ISO dialog.

Precision Gain Calibration

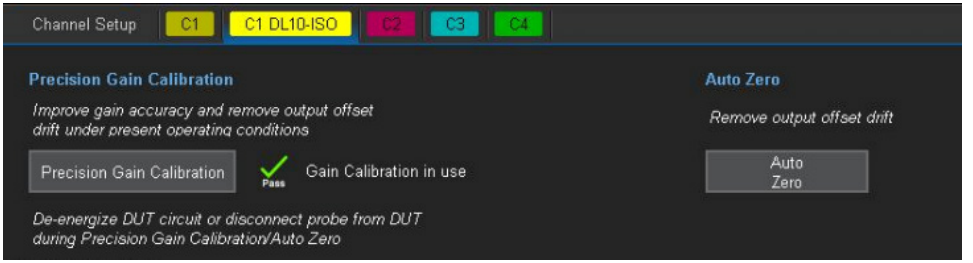
Precision Gain Calibration should be performed prior to each use to ensure that gain accuracy for the current measurement configuration meets the specifications. Depending on the accuracy desired and/or change in ambient temperature, it may be necessary to calibrate more often. Precision Gain Calibration includes an Auto Zero procedure.

To perform a Precision Gain Calibration:

1. De-energize the circuit under test (the probe may remain physically connected).
2. Warm up the system (oscilloscope and probe) until the “warming up” indicator on the probe dialog disappears.
3. Touch the Precision Gain Calibration button on the probe dialog.

Each calibration is valid for the temperature (±5 °C) at which it was performed. The temperature is polled to determine whether the probe is still in the valid temperature range.

The probe dialog will indicate when the probe has a valid calibration (green "√ Pass"):



Calibrations are not cached. If the probe was previously calibrated at one temperature then re-calibrated at another before returning to the first temperature, the Precision Gain Calibration will have to be repeated. The probe dialog will show that a calibration is needed by placing a red "X Fail" next to the Precision Gain Calibration button.

If the probe is disconnected then re-connected, repeat Precision Gain Calibration.

Probe Firmware Update

If an Update Firmware button appears on the probe dialog, the probe firmware requires an update for proper functioning. With the probe connected to any channel of the oscilloscope, touch the button to begin the update. The probe will appear to temporarily disconnect (there will be no DLxx-ISO dialog), and the oscilloscope message bar will say "Updating Firmware". The update takes approximately two minutes. When the update is complete, the probe will automatically reconnect and be usable.

Note: This procedure does not update the oscilloscope firmware, only the probe firmware. The probe must be connected to the oscilloscope throughout this process. Additionally, the DC power supply must remain plugged in, and no connection should be removed during update.

Performance Verification

DL-ISO probes shipped from Teledyne LeCroy are tested and adjusted to meet the Gain Accuracy specification. This procedure can be used to verify the performance of an DL-ISO.

Some of the test equipment used to verify the performance may have environmental limitations required to meet the accuracy needed for the procedure. Make sure that the ambient conditions meet the requirements of all the test instruments used in the procedure.

Required Test Equipment

The following equipment (or its equivalent) is required for performance verification of the DL-ISO probe. As input/output connector types vary on different brands of instruments, additional adapters or cables may be required.

Description	Minimum Requirements	Example Equipment
Oscilloscope	ProBus interface equipped 12-bit resolution	Teledyne LeCroy HDO4000, HDO6000, WaveRunner 8000HD
Digital Multimeter (DMM)	DC: 0.1% accuracy AC: 0.1% accuracy 5.5 digit resolution	Keysight Technologies 34401A Fluke 8842A-09
Function Generator	Sine Wave output amplitude adjustable to 6.0 Vpp (2.12 Vrms) into 50Ω at 60 Hz	Teledyne LeCroy WaveStation 3082 Keysight Technologies 33120A Stanford Research Model DS340 Teledyne Test Tools T3AFG120
High Voltage Amplifier (needed for 200, 1000 and 2500 V tips)	Output amplitude of at least 300 Vpp (106.06 Vrms)	TEGAM 2340 or similar
BNC Coaxial Cable (2)	Male to Male, 50Ω, 36"	Pomona 2249-C-36 Pomona 5697-36
Banana Plug Adapter	Female BNC to Dual Banana Plug	Pomona 1269
BNC to SMA Adapter	BNC (f) to SMA (f)	Pomona 4291 Amphenol RF 242123
BNC to SMA Adapter	BNC (f) to SMA (m)	Pomona 4290
Probe Calibration Fixture	SMA to square pin adapter	Teledyne LeCroy PCF200
MMCX to 0.1" Square Pin Adapter 2" MMCX to Y-lead Socket 3" MMCX to Y-lead Solder-in 2" Socket 3" Solder-in Grabbers		DL-ISO-ACC-KIT

Before You Begin

1. Turn on the oscilloscope and allow it to warm up for at least 20 minutes.
2. Connect the probe connector box to the oscilloscope C1 input. Verify that the C1DL-ISO tab appears behind the C1 setup dialog. This confirms that the probe is sensed.
3. Fully assemble the probe—tip connected to probe head and control module connected to power—and allow it to warm up for 20 minutes. The LED on the control module should turn green.
4. Meanwhile, turn on the other test equipment (i.e., DMM and function generator) and allow these to warm up for the time recommended by the manufacturer.
5. Make a photocopy of the Test Record (page 30) and fill in the necessary data.

Functional Check

The functional check will verify the basic operation of the probe functions. It is recommended to perform the functional check prior to any other test procedures.

1. Return to the oscilloscope to the factory default settings:
    a. Select File > Recall Setup from the menu bar.
    b. Touch the Recall Default button
2. If the update firmware button is present, update the firmware
3. Open the C1DL-ISO dialog and touch Auto Zero, then OK.
4. Confirm that the message "Performing AutoZero on DL-ISO...." is displayed in the message bar and that no error messages are displayed.

RMS Noise Check

The sensitivity range and RMS noise is dependent on which lead you have available. RMS Noise check can be performed for any or all the leads shown below and verify the test result meets the test limit in the Test Record page.

1. Set C1 Vertical Scale to:
    a. DL-ISO-2V-TIP: 100 mV/div
    b. DL-ISO-10V-TIP: 500 mV/div
    c. DL-ISO-40V-TIP: 2 V/div
    d. DL-ISO-200V-TIP: 10 V/div
    e. DL-ISO-1000V-TIP: 50 V/div

f. DL-ISO-2500V-TIP: 100V/div

2. Touch Precision Gain Calibration on the C1DL-ISO dialog. Wait while calibration completes.
3. Turn on P1 and set it to measure the standard deviation (sdev) of C1. Turn on statistics.
4. Clear Sweeps, wait 10 seconds, then record the mean value shown for measurement P1:sdev(C1) on the test record and compare it to the test limit for the corresponding tip voltage and DL-ISO model number.

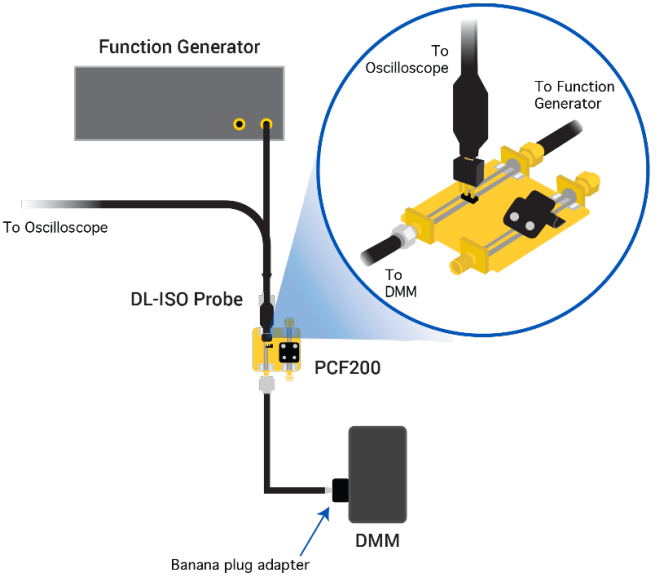
Gain Accuracy Check

1. Using a BNC-to-BNC coaxial cable and BNC (f) to SMA (m) adapter, connect the function generator to the PCF200.

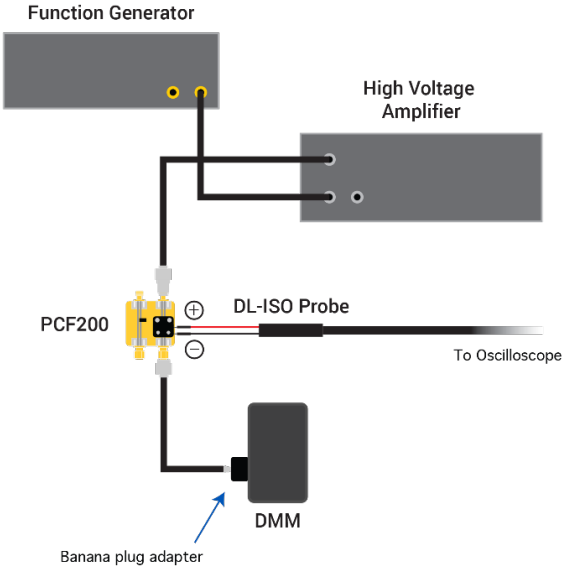
   NOTE: For 200 V, 1000 V and 2500 V tips, connect the output of the function generator to the input of the amplifier with a BNC to BNC cable. Connect the output of the amplifier to the PCF200 with a BNC cable and BNC (f) to SMA (m) adaptor.

2. Using a banana plug adapter, BNC-to-BNC coaxial cable and BNC (f) to SMA (f) adapter, connect the DMM to the PCF200.
3. Touch Precision Gain Calibration on the C1DL-ISO dialog. Wait while calibration completes.
4. Connect the probe tip to the PCF200:
   a. For 2 V, 10 V, 40 V and 200 V MMCX tips:
      i. Connect the MMCX-to-square-pin adapter to the probe tip.
      ii. Connect the probe tip to the square pin header on the PCF200.
   b. For 1000 V and 2500 V square-pin tips:
      i. Connect Red pin to socket adaptor to (+) terminal of the tip and black pin to socket adaptor to the (-) terminal of the tip.
      ii. Connect sockets to the square pin header on the PCF200, Red lead should connect to the transmission line and black lead should connect to ground.

   The test setup should look like the images below.



Set up for 2 V, 10 V, 40 V, and 200 V tips



Set up for 1 kV and 2.5 kV tips

5. Set the DMM to measure V_{AC}.
6. Set the oscilloscope timebase to 10 ms/div.
7. Set the function generator output to 1 MΩ termination, and the output waveform to a sine wave with a frequency of 60 Hz.
8. Set both the function generator amplitude and oscilloscope C1 vertical scale as follows:

   NOTE: For 2 V, 10 V and 40 V tips, set the function generator load to 1MΩ. For 200 V, 1000 V and 2500 V tips, set the function generator load to 50Ω.

   a. DL-ISO-2V-TIP: 600 mV_{PK-PK} and 100 mV/div
   b. DL-ISO-10V-TIP: 3 V_{PK-PK}.and 500 mV/div
   c. DL-ISO-40V-TIP: 6 V_{PK-PK}.and 1 V/div
   d. DL-ISO-200V-TIP: 600 mV_{PK-PK}.(30 V_{PK-PK} at output of amplifier) and 5 V/div
   e. DL-ISO-1000V-TIP: 2.4 V_{PK-PK}.(120 V_{PK-PK} at output of amplifier) and 20 V/div
   f. DL-ISO-2500V-TIP: 6 V_{PK-PK}.(300 V_{PK-PK} at output of amplifier) and 50 V/div
9. Turn on measurement P1 and set it to measure the standard deviation (sdev) of C1.
10. Record the P1:sdev(C1) measurement value on the test record.
11. Record the VAC measurement of the DMM on the test record.
12. Calculate the gain accuracy (%) using the equation:

$$\left(\frac{Probe\ Measured\ Voltage\ -\ DMM\ Measured\ Voltage}{DMM\ Measured\ Voltage}\right) * 100$$

13. Compare calculated gain accuracy to the limit on the test record.

DL-ISO Performance Verification Test Record

Probe Model and Serial Number: _____

Tip Model and Serial Number: _____

Asset/Tracking Number: _____

Date: _____

Technician: _____

Equipment	Model	Serial Number	Calibration Due Date
Digital Multimeter			
Oscilloscope			
Function Generator*			N/A

* The function generator is used for making relative measurements. The output of the generator is measured with a DMM or oscilloscope. Thus, the generator is not required to be calibrated.

RMS Noise

Step	Description	Test Limit (mVrms)			Test Result
	Probe Model Number	DL03-ISO	DL07-ISO	DL10-ISO	
4	Mean sdev(C1) – DL-ISO-2V-TIP	4.6	6	6.8	
4	Mean sdev(C1) – DL-ISO-10V-TIP	23	30	34	
4	Mean sdev(C1) – DL-ISO-40V-TIP	92	120	136	
4	Mean sdev(C1) – DL-ISO-200V-TIP	460	600	680	
4	Mean sdev(C1) – DL-ISO-1000V-TIP	2300	3000	3400	
5	Mean sdev(C1) – DL-ISO-2500V-TIP	5750	7500	8500	

Gain Accuracy

Step	Description	Intermediate Data	Test Result
11	DL-ISO Measured Voltage	V_{AC}	
12	DMM Measured Voltage	V_{AC}	
13	Gain Error (< ± 2.5%)		%

Permission is granted to photocopy this page to record the results of the Performance Verification procedure. File the completed record as required by applicable internal quality procedures. Results recorded under "Test Result" are the actual specification limit check. The test limits are included in each step. Record other measurements and intermediate calculations that support the limit check under "Intermediate Data".

Care and Maintenance

Checking Probe Cable

Before each use, check the fiber-optic cable for tears in the soft outer sleeve. If the corrugated sleeve beneath is visible at any point, stop using the probe and secure it from inadvertent use.

Cleaning the Probe Body

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

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

Calibration Interval

The recommended calibration interval is one year. A performance verification procedure is included in this manual. The complete performance verification should be performed as the first step of annual calibration.

Service Strategy

The DL-ISO probe utilizes fine-pitch surface mount devices. Defective probes must be returned to a Teledyne LeCroy service facility for diagnosis and exchange.

CAUTION: Refer all servicing to qualified personnel. A defective probe under warranty will be replaced with a factory refurbished probe.

Probes not under warranty can be exchanged for a factory refurbished probe for a modest fee. Replacement probes are factory repaired, inspected, and calibrated to the same standards as a new product. You must return the defective probe in order to receive credit for the probe core.

Reference

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 probe.
2. Pack the probe in its case. If possible, include all tips. Do not include the manual.
3. Pack the case in its original shipping box, or an equivalent carton with adequate padding to avoid damage in transit.
4. 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

5. If returning a probe to a different country: contact Teledyne LeCroy Service for instructions on completing your import/export documents.

Extended warranty, calibration and upgrade plans are available for purchase. Contact your Teledyne LeCroy sales representative to purchase a service plan.

Technical Support

For a complete list of offices by country, including our sales & distribution partners, visit:
teledynelecroy.com/support/contact

Teledyne LeCroy
700 Chestnut Ridge Road
Chestnut Ridge, NY, 10977, USA

US Service and Support:
Ph: 800-553-2769 / 845-425-2000
FAX: 845-578-5985
customersupport@teledynelecroy.com

Warranty

THE WARRANTY BELOW REPLACES ALL OTHER WARRANTIES, EXPRESSED OR IMPLIED, INCLUDING BUT NOT LIMITED TO ANY IMPLIED WARRANTY OF MERCHANTABILITY, FITNESS, OR ADEQUACY FOR ANY PARTICULAR PURPOSE OR USE. TELEDYNE LECROY SHALL NOT BE LIABLE FOR ANY SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES, WHETHER IN CONTRACT OR OTHERWISE. THE CUSTOMER IS 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 TRANSPORT PREPAID.

The product is warranted for normal use and operation, within specifications, for a period of one year from shipment. Teledyne LeCroy will either repair or, at our option, replace any product returned to one of our authorized service centers within this period. However, in order to do this we must first examine the product and find that it is defective due to workmanship or materials and not due to misuse, neglect, accident, or abnormal conditions or operation.

Teledyne LeCroy shall not be responsible for any defect, damage, or failure caused by any of the following: a) attempted repairs or installations by personnel other than Teledyne LeCroy representatives, or b) improper connection to incompatible equipment, or c) for any damage or malfunction caused by the use of non-Teledyne LeCroy supplies. Furthermore, Teledyne LeCroy shall not be obligated to service a product that has been modified or integrated where the modification or integration increases the task duration or difficulty of servicing the oscilloscope. Spare and replacement parts, and repairs, all have a 90-day warranty.

Products not made by Teledyne LeCroy are covered solely by the warranty of the original equipment manufacturer.

Certifications

DL-ISO probes conform to the following standards:

IEC/EN 61010-1:2010/A1:2019 - Safety Requirements for Electrical Equipment for Measurement, Control and Laboratory Use, Part 1: General Requirements

IEC/EN 61010-2-30:2021 - Particular Requirements for Equipment Having Testing or Measuring Circuits

IEC/EN 60825-1 - Safety of Laser Products, Part 1: Equipment Classification and Requirements - Edition 3 (2014)

US 21CFR Part 1010 Performance Standards for Electronic Products: General

US 21CFR Part 1040 Performance Standards for Light-Emitting Products

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

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

For more 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.

dl-iso-user-manual.pdf
November, 2024

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Chestnut Ridge, NY 10977
USA

teledynelecroy.com