TELEDYNE LECROY
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Operator's Manual

HVD3102 and HVD3106
High Voltage
Differential Probes

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June 2014

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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 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 or in documentation 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.

HIGH VOLTAGE WARNING. Risk of electric shock.

CAUTION

ESD CAUTION. Risk of electrostatic discharge (ESD) that can damage the instrument if anti-static measures are not taken.

Double Insulation

Measurement Ground

Precautions

Avoid personal injury or damage to your equipment by complying with the following safety precautions:

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 overload; observe all ratings. To avoid electric shock or fire, do not apply any potential that exceeds the maximum rating of the probe and/or the probe accessory, whichever is less. Observe all terminal ratings.

Connect and disconnect properly. Always make the connections from the probe input leads to the probe accessory that you intend to use before making any connections to a voltage source. Do not connect accessories to (or disconnect from) a voltage source unless they are first connected to the probe input leads. Avoid damaging cables through excessive bending.

Use only accessories compatible with the probe. Use only accessories that are rated for the application. Substituting other accessories (except those specified in this manual) may create a shock or burn hazard. Ensure the connections between probe input leads and probe accessories are secure before connecting them to a voltage source.

Comply with the voltage derating curve. When measuring higher frequency signals, comply with the Voltage vs. Frequency Derating Curve.

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

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

Keep product surfaces clean and dry.

Handle with care. Probe accessory tips are sharp. They can puncture skin or cause other bodily injury if not handled properly.

Keep fingers behind the finger guard of the probe accessories.

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 sequester the probe from inadvertent use.

Introduction

The HVD3102 and 3106 high-voltage active differential probes are safe, easy-to-use, and ideally suited for power electronics measurements. The probes feature:

- Differential voltage measurement capability in high common-mode (up to 1000Vrms) environments.
- Exceptional common-mode rejection ratio (CMRR) across a broad frequency range
- Wide differential voltage range – 1500Vpeak rated and 2000Vpeak before amplifier saturation to permit capture of short duration overshoots
- High offset capability at both 50x and 500x attenuation settings provides maximum flexibility for capturing gate drive and control signals floating on a 1000Vdc bus
- 1% DC and low frequency gain accuracy
- ProBus interface with automatic scaling
- Auto Zero capabilities

The HVD3102 probe (25 MHz, 1000Vrms) and HVD3106 probe (120 MHz, 1000Vrms) are ideal for power electronics applications, where the reference potential is elevated from ground. Each probe is supplied with a complete set of lead accessories and a soft accessory case. The main differences between the two probes is the probe bandwidth (25 MHz vs. 120 MHz).

The CMRR for the probes is exceptional out to very high frequencies. This greatly assists in measurement of signals in the noisy, high common-mode environments common to power electronics. The high CMRR combined with low probe noise and high offset capability makes the probes capable of measuring very small control signals floating on high common-mode voltages.

Probe specifications are provided for using the probe within a 1500Vpeak differential voltage range. However, the probe can be safely operated above this range. Up to 2000Vpeak, the probe will display the signal, but the probe specifications cannot be guaranteed. However, in this range, the probe is operating below the saturation point of the amplifier, and very reasonable results can be expected. The V/div range for each probe can be set up to 400V/div (3200Vp-p displayed over all 8 vertical oscilloscope grid divisions).

The probe is calibrated for high precision measurements to within 1% at DC to low frequency (~10 kHz). This provides for high accuracy of top and base voltage levels of pulse-width modulated signals. The AutoZero capability permits further measurement precision by allowing small offset drifts to be calibrated out of the measurement.

With the ProBus interface, the HVD310x becomes an integral part of the oscilloscope. Power is provided to the probe through the ProBus interface, so there is no need for a separate power supply or batteries. Attenuation (50x or 500x) is automatically selected based on oscilloscope gain range (V/div) setting and the offset adjust is unified with that of the oscilloscope. The sensitivity of the HVD31xx ranges from 100 mV/Div to 400 V/Div, with the maximum available offset dependent on the V/div setting and the oscilloscope model. In general, Teledyne LeCroy 12-bit High Resolution Oscilloscopes (HRO) and HD4096 High Definition Oscilloscopes (HDO) provide the most offset capability over the widest range of V/div settings.

Requirements

The HVD3102 and HVD3106 probes are compatible with any Teledyne LeCroy oscilloscope equipped with the ProBus interface and XStream software version 7.4 or greater.

Probe Kit

The HVD3102 and HVD3106 probes are delivered in a soft accessory case (SAC-01A) with an Operator's Manual, Certificate of Calibration, and all standard accessories described below.

HVD3102 and HVD3106 Probe Kit

See Replacement Parts for information about ordering replacement accessories.

Adobe portable document format (PDF) copies of this manual are available for free download from teledynelecroy.com/support/techlib.

Standard Accessories

All accessories feature a 4 mm Banana (female) connector to accept most Banana plugs.

Spade Terminals, PK-HVA-05, QTY 2 (1 ea. red/black). Designed to connect to terminal strips, posts and screws, the overall length is 63 mm (2.48 inches). Insulated, 1000 V, CAT III.

WARNING. To avoid injury or death due to electric shock, do not handle probe input leads connected to the Spade Terminals while they are connected to a voltage source. Do not use Spade Terminals as hand-held accessories; they are meant to be used as a permanent installation in a test set up.

Safety Alligator Clips, PK-HVA-01, QTY 2 (1 ea. red/black). Designed to reliably grip large components, such as bus bars and large bolts, the overall length is 92.8 mm (3.65 inches) and the jaw opens to 32 mm (1.26 inch). Only the lower jaw is conducive; the top jaw is insulating plastic. Insulated, 1000 V, CAT III.

Plunger Hook Clips, PK-HVA-03, QTY 2 (1 ea. red/black). Designed with a flexible stem to access deep targets in dense environments and a 4.5 mm (0.177 inch) hook to attach to wire leaded parts. The overall length is 157.6 mm (6.20 inches). Insulated, 1000 V, CAT II.

Plunger Pincer Clips, PK-HVA-02, QTY 2 (1 ea. red/black). Designed with a long, thin, flexible stem for attaching to hard-to-reach test points, the entire body is fully insulated. The overall length is 161.6 mm (6.36 inch). The pincers can grab leads, pins and wires up to 4 mm (0.157 inch) in diameter. Insulated, 1000 V, CAT II.

Plunger Alligator Clips, PK-HVA-04, QTY 2 (1 ea. red/black). The clip is designed to securely grasp thick wires, cables, ground leads, rails, and screw heads. The overall length is 153 mm (6.02 inches); the jaw opens to 23 mm (0.905 inch) max. Insulated, 1000 V, CAT III.

Voltage Derating for Standard Accessories

Accessory	Part Number	Derated Max. Input Voltage for Combined Probe and Accessory (from either input to ground)
Safety Alligator Clips	PK-HVA-01	1000V CAT III
Plunger Pincer Clips	PK-HVA-02	1000V CAT II
Plunger Hook Clips	PK-HVA-03	1000V CAT II
Plunger Alligator Clips	PK-HVA-04	1000V CAT III
Spade Terminals	PK-HVA-05	1000V CAT III

CAUTION. The operating altitude of the HVD3102 and HVD3106 is derated to 2000 m (6560 ft) when used with the accessories above.

WARNING. The voltage and CAT rating of the probe are derated to the values in the table above when used with the corresponding accessory.

WARNING. To avoid risk of electric shock or fire, do not exceed either the voltage rating or category rating. Keep your fingers behind the finger guard of the probe. Keep the output cable away from the circuits being measured. Use only these specified accessories.

Specifications

For the current specifications, see the HVD3102 and HVD3106 product pages at teledynelecroy.com. Below are some key product specifications.

Specifications are subject to change without notice.

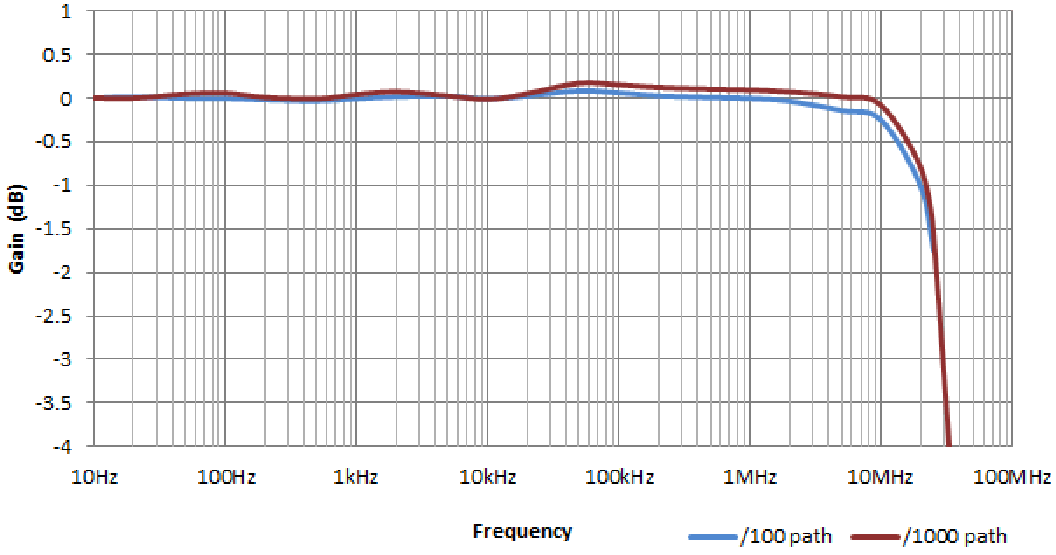
Guaranteed Specifications

	HVD3102	HVD3106
Bandwidth (probe only)	25 MHz	120 MHz
Risetime 10-90 %	14 ns	2.9 ns
CMRR Test Limits, 23 C	80 db @ 50 Hz 60 db @ 1 MHz	80 db @ 50 Hz 60 db @ 1 MHz

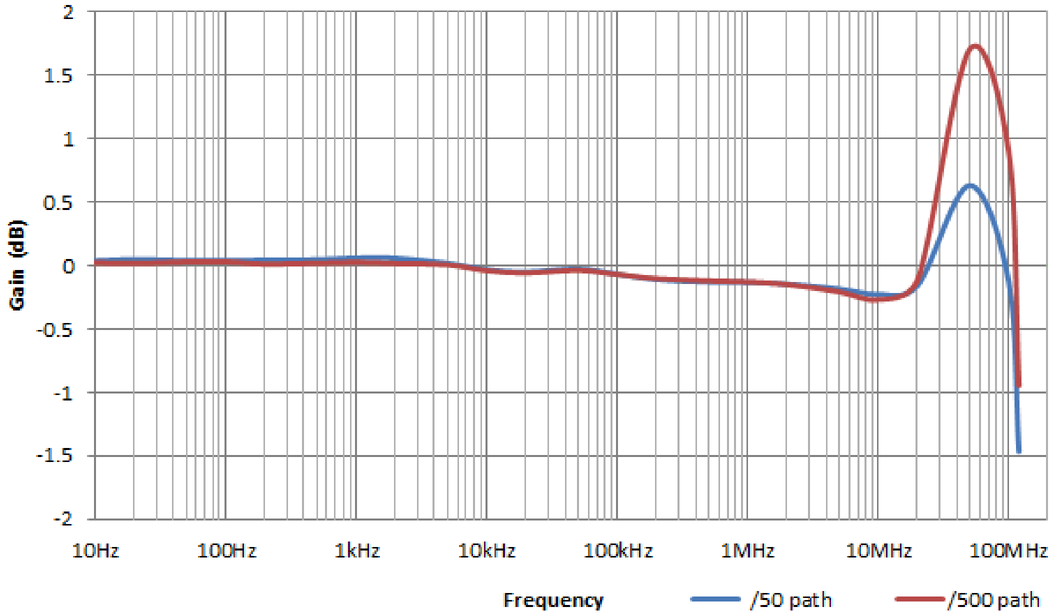
Environmental Characteristics

Temperature, Operating	0 C to 50 C
Temperature, Non-operating	- 40 C to 70 C
Relative Humidity, Operating	5% to 80% RH (Non-Condensing) 50% RH above 30 C
Relative Humidity, Non-operating	5% to 95% RH (Non-Condensing) 75% RH above 30 C 45% RH above 40 C
Altitude	3000 m (9842 ft) max. at 25 C
Usage	Indoors

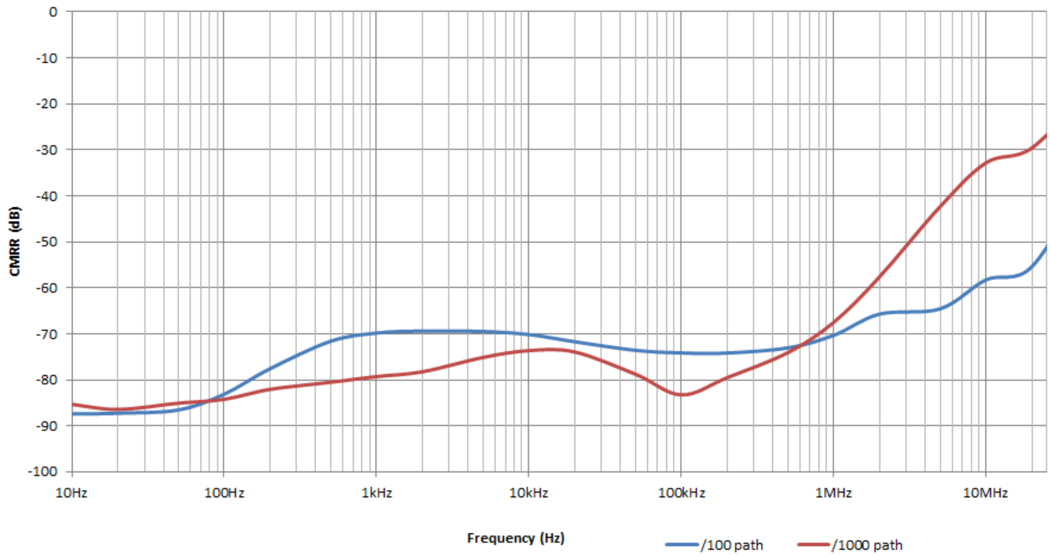
HVD3102 Typical Bandwidth



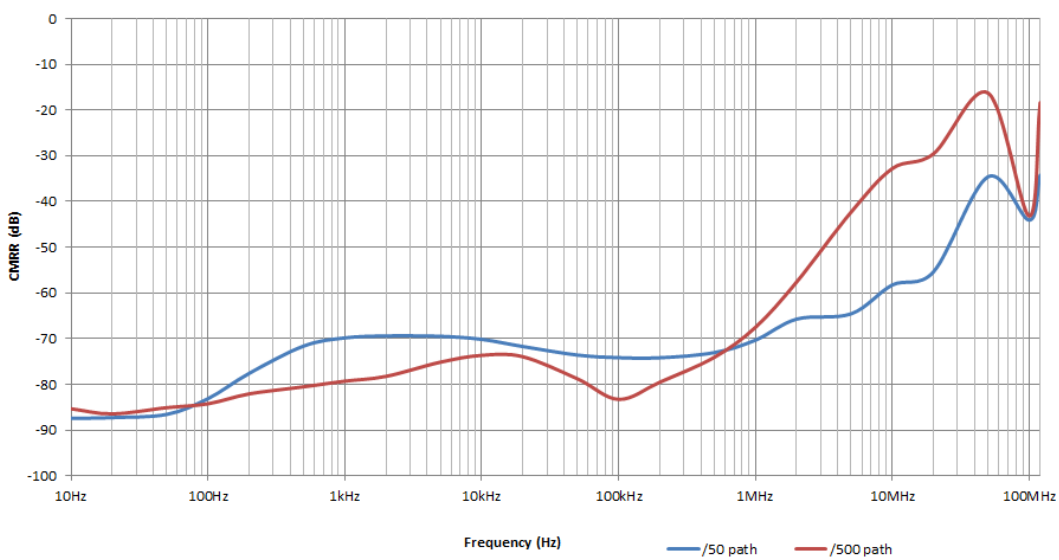
HVD3106 Typical Bandwidth



HVD3102 Typical CMRR Performance



HVD3106 Typical CMRR Performance



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 that appears at the output. 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).

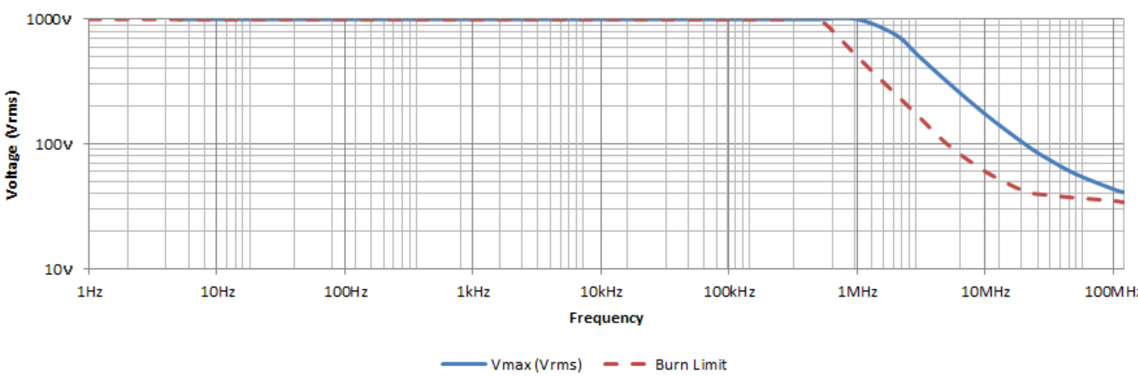
The first order term determining the CMRR is the relative gain matching between the **+** and **–** input paths. Obtain high CMRR values by precisely matching the input attenuators in a differential amplifier. The matching includes the DC attenuation and the capacitance which determines the AC attenuation. 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.

Input Voltage vs. Frequency and Burn Limit

The Maximum Input Voltage curve (solid line on graph) shows the maximum voltage that can be applied to the probe inputs without risking damage to the probe. The lower Burn Limit curve (dashed line on graph) shows the maximum voltage that can be applied to the probe inputs while the operator is handling the inputs. Handling the inputs while connecting the probe to active signals above this burn limit could result in injury to the operator.

WARNING. To avoid risk of electric shock or fire, comply with the burn limits of the derating curve when measuring high-frequency signals with hand-held accessories. Do not exceed the voltage or category rating of the probe or accessories (whichever is less). Keep your fingers behind the finger guard of the probe. Keep the output cable away from the circuits being measured. Use only the specified accessories.



Differential Mode and Common Mode

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

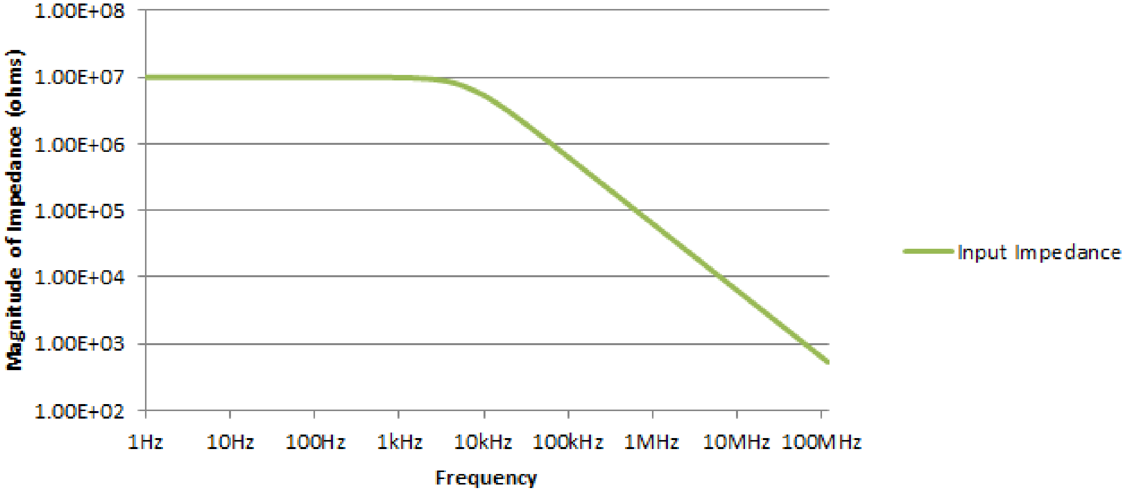
$$V_{CM} = \frac{V_{+input} + V_{-input}}{2}$$

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, 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.

Differential Input Impedance



Operation

Connecting to the Test Instrument

The HVD3102 and HVD3106probes have been designed for use with Teledyne LeCroy oscilloscopes equipped with the ProBus interface. When you attach the probe output connector to the oscilloscope's input connector, the instrument will:

- Recognize the probe
- Set the oscilloscope input termination to 1 MΩ
- Activate the probe control functions in the oscilloscope user interface.

NOTE: To ensure accurate measurements, connect the probe to the oscilloscope and allow to warm up for at least 20 minutes. Then, perform an Auto Zero prior to connecting the probe to the device under test.

Connecting to the Test Circuit

The HVD3102 and HVD3106 probes are ideally suited for applications where no ground is available or where the location of a ground connection is unknown.

Two inputs are available at the probe tip to connect the probe to a circuit under test. For accurate measurements, both the + and – inputs must be connected to the test circuit. Positive voltages applied to the + input (red) relative to the – input (black) will deflect the oscilloscope trace toward the top of the screen.

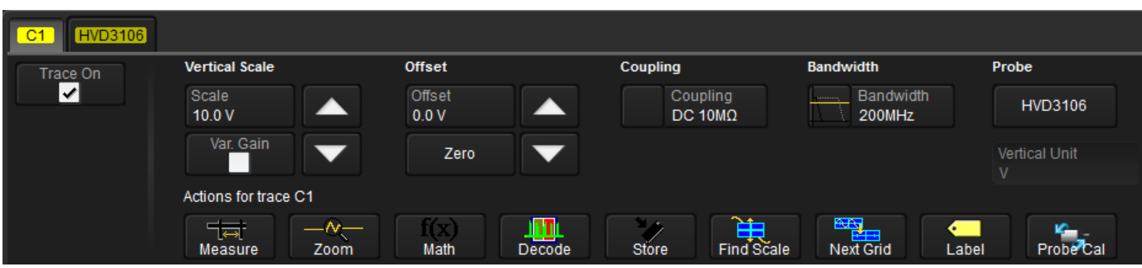
To maintain the high performance capability of the probe in measurement applications, exercise care when connecting the probe. Increasing the parasitic capacitance or inductance in the input paths may introduce a “ring” or may slow the rise time of fast signals. Input leads that form a large loop area will pick up any radiated electromagnetic field that passes through the loop and may induce noise into the probe inputs. Because this signal will appear as a differential mode signal, the probe's common mode rejection will not remove it. This effect can be reduced by twisting the input leads together to minimize the loop area.

High common mode rejection requires precise matching of the relative gain or attenuation in the + and – input signal paths. Mismatches in additional parasitic capacitance, inductance, delay, and a source impedance difference between the + and – signals will lower the common mode rejection ratio. Therefore, it is desirable to use the same length and type of wire and connectors for both input connections. When possible, try to connect the inputs to points in the circuit with approximately the same source impedance.

To minimize the amount of bench space occupied, the probes may be stacked on one top of another during usage. Since the probe body generates heat, and the stacking reduces cooling, it is recommended that ambient temperatures not exceed 30 degrees C while the probes are stacked and in operation. The exceptional CMRR performance of the probe should prevent interference between probes when they are stacked, but care should be taken to separate the probe leads during operation.

Operating with an Oscilloscope

When the probe is connected to a Teledyne LeCroy oscilloscope, the displayed scale factor and measurement values will be adjusted to account for the effective gain of the probe. The probe's internal attenuation and offset can be conveniently controlled through the Probe dialog, which is added to the oscilloscope's Channel setup dialogs when a probe is detected.



Probe Volts/Div and Attenuation

The Volts/Div knob controls the oscilloscope's scale factor and the probe's internal attenuation to give full available dynamic range from 100 mV/Div to 400 V/Div. Some transition of the scale factor will result in a change of attenuation.

Probe Offset

The offset range of the probe allows you to remove a DC bias voltage from the differential input signal while maintaining DC coupling. This ensures that the probe will never be overdriven while a signal is displayed on screen. In addition, it will prevent the oscilloscope from being overdriven and getting inaccurate measurements.

The total usable offset of the oscilloscope and probe system is a function of the oscilloscope V/div setting, oscilloscope offset at that V/div setting, probe attenuation, and probe offset at that attenuation setting, and this total maximum offset may be calculated.

First, it is necessary to know the oscilloscope front end V/div setting with the probe connected. This may be calculated as follows:

$$\text{Oscilloscope Front End V/Div} = \text{(Probe and Oscilloscope) V/Div} \div \text{Probe\_Attenuation}$$

Once the Oscilloscope Front End V/div value is known, then it is possible to know the maximum offset available in the oscilloscope at this V/div setting either by referencing the oscilloscope specifications or setting the maximum offset value on the oscilloscope for that V/div setting.

Then, the maximum offset available with the probe and oscilloscope combination can be calculated as follows:

Max Positive Offset Available

$$\text{Max Positive Offset (Probe and Oscilloscope together)} = \\ \text{Oscilloscope Positive Offset (at Oscilloscope Front End V/div)} * \text{Probe Attenuation} - 10V$$

Max Negative Offset Available

$$\text{Max Negative Offset (Probe and Oscilloscope together)} = \\ \text{Oscilloscope Negative Offset (at Oscilloscope Front End V/div)} * \text{Probe Attenuation} + 10V$$

In both cases, the maximum offset available cannot exceed the HVD3102 maximum offsets of ±150V at 100x attenuation and ±1500V at 1000x attenuation or the HVD3106 maximum offsets of ±150V at 50x attenuation and ±1500V at 500x attenuation.

NOTE: The offset values reported in the oscilloscope's channel descriptor box may deviate slightly from expected values, based on calculations per the formulas above. The reported probe attenuation is a "nominal" value and can deviate slightly from the actual value measured during calibration and stored with the probe. The actual offset value reported uses the actual "as measured" probe attenuation value. This provides for higher DC and low frequency gain accuracy than would otherwise be possible.

Bandwidth Limiting

To comply with various test standards used for quantifying output noise of power supplies, the probe is capable of switching the bandwidth limit from Off (maximum bandwidth) to 20 MHz in the channel Vertical Adjust dialog.

Auto Zero

Auto Zero corrects for DC offset drifts that naturally occur from thermal effects in the amplifier. The probe incorporates Auto Zero capability to remove the DC offset from the probe's differential amplifier output to improve the measurement accuracy. Auto Zero is invoked manually from the Probe dialog that appears behind the Channel setup dialog when the probe is connected to the oscilloscope.

NOTE: Remove the probe from the test circuit before performing Auto Zero.

Always perform Auto Zero after probe warm-up (recommended warm-up time is 20 minutes). Depending on the measurement accuracy desired and/or the change in the 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 re-connected, repeat Auto Zero after a suitable warm-up time.

For example, the DC offset drift of the probe is 70 µV/°C (worst-case) referred to the output. If the probe is set to 50x attenuation and the ambient temperature changes by 10°C, then the DC offset drive could be as high as (70 µV/°C)(50)(10°C) = 35mV (referenced to the probe tip). If the probe is being used to measure a 3Vp-p signal, then the DC offset drift in this case could be a little more than 1%. If the signal measured was 1400Vp-p in 500x attenuation mode, then the DC offset (in the same ambient temperature condition) could be as high as (70 µV/°C)(500)(10°C) = 350 mV due to the probe tip, but any offset accuracy error from the oscilloscope itself would likely dominate the measurement.

Maintenance

Cleaning

Clean only the exterior surfaces of the probe using a soft cloth or swab dampened with water or 75% isopropyl alcohol solution. Do not use harsh chemicals or abrasive cleansers.

CAUTION. The probe is not water proof. Under no circumstances submerge the probe or allow moisture to penetrate it.

Calibration Interval

This probe has no adjustments. The recommended calibration interval is one year. A Performance Verification Procedure is included in this manual.

Service Strategy

The HVD3102/HVD3106 probe utilizes fine-pitch surface mount devices. It is, therefore, impractical to attempt repair in the field. Defective probes must be returned to a Teledyne LeCroy service facility for diagnosis and exchange.

CAUTION. Do not remove the covers. Refer all servicing to qualified personnel.

A defective probe under warranty will be replaced with a factory refurbished probe. A probe that is not under warranty can be exchanged for a factory refurbished probe for a modest fee. You must return the defective probe in order to receive credit for the probe core.

Replacement Parts

The probe accessories can be ordered as a replacement kit, PK-HV-0001, through your local sales office, and individual probe accessory tips (pair 1 ea. red/black) can be purchased through the regional customer care centers listed at the back of this manual.Defective probes can be replaced on an exchange basis. Replacement probes are factory repaired, inspected, and calibrated to the same standards as a new product. In order to obtain a replacement probe, you must return the defective probe. Return the probe to your regional customer care center.

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. Do not include the manual.
2. Pack the product in its case, surrounded by the original packing material (or equivalent).
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.

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

Functional Test Procedure

This procedure should be performed to confirm the basic operation of the probe, or to aid in determining the source of a problem, rather than to verify the accuracy of the probe. You can perform the Functional Test without removing the probe covers.

Required Equipment

Other than a Teledyne LeCroy oscilloscope, no special test equipment is required for the functional test.

Test Procedure

1. Connect the HVD3102/HVD3106 to any vertical channel on the oscilloscope.
2. Select the channel to which the probe is connected.
3. Press the **AUTO ZERO** button in the user interface menu.
4. If necessary, adjust the **OFFSET** to 0.000 V.
5. Using accessory clips, attach the red clip to the + CAL out and the black clip to the ground post of the CAL out signal. For oscilloscopes with the CAL signal on a BNC connector, a BNC-to-Banana adapter (e.g., Pomona model 1296) may be used.
6. Press **AUTOSETUP**.
7. Set the sensitivity of the probe to 1 V/Div.
8. Set the CAL output to 1 Vp-p square wave.
9. Verify that the displayed square wave is 1 Vp-p centered at +0.5 V.
10. Reverse the accessory leads on CAL out and verify that the displayed square wave is still 1 V, but is now centered at –0.5 V.
11. Change the **COUPLING** on the user interface menu to **Grounded** to verify that the signal disappears and that the trace is still centered on the screen.
12. Verify that the probe attenuation shows x100 for HVD3102 or x50 for HVD3106.
13. Set the VOLTS/DIV to 100 V.
14. Verify that the probe attenuation now shows x1K for HVD3102 or x500 for HVD3106.

Performance Verification

This procedure can be used to verify the warranted characteristics of the HVD3102/HVD3106 High-Voltage Differential Probes. If the product does not meet specifications, it should be returned to a Teledyne LeCroy service center. There are no user accessible adjustments, so there is no adjustment procedure.

Required Equipment

The following table lists the test equipment and accessories (or their equivalents) that are required for performance verification of the HVD3102/HVD3106 High-Voltage Differential Probes. This procedure is designed to minimize the number of calibrated test instruments required. Because the input and output connector types may vary on different brands and models of test instruments, additional adapters or cables may be required.

Only the parameters listed in boldface in the "Minimum requirements" column must be calibrated to the accuracy indicated.

Description	Minimum Requirements	Example Equipment
Digital Multimeter	**DC: 0.1% accuracy** **AC: 0.2% accuracy** to measure 7 mVrms to 7 Vrms at 70 Hz	Agilent 34401A Fluke 8842A-09 Keithley 2001
Function Generator	Output sine wave of 20 Vpp	Agilent 33120A Stanford Research DS34 Leader LAG-120B
BNC Coaxial Cable	Male-to-Male 50 Ω Cable	Pomona 5697-36
Calibration Fixture	ProBus Extender Cable	Teledyne LeCroy PROBUS-CF01
Banana Plug Adapter	Female BNC-to-Dual Banana Plug	Pomona 1269 Mueller BU-00260
Insulated Banana Plug Insulated Banana Couplers (2)	Insulated BNC-to-Shrouded Banana Plug	Mueller BU-5671-B-12-0 Mueller BU-32601-2 (R) Mueller BU-32601-6 (B)

Preliminary Procedure

1. Connect the HVD3102/HVD3106 under test to the female end of the ProBus Extension Cable. Connect the male end of the ProBus Extension Cable to channel 1 (C1) of the oscilloscope.
2. Turn the oscilloscope on and allow at least 30 minutes warm-up time before performing the Certification Procedure.
3. Turn on the other test equipment and allow these to warm up for the time recommended by the manufacturer.
4. While the instruments are reaching operating temperature, make a photocopy of the Performance Verification Test Record (following this topic), and fill in the necessary data.

Certification Procedure

1. Set the function generator to sine wave, 70 Hz, and an output voltage of approximately 7.00 V rms (into a high impedance output).
2. Set the DMM to measure AC Volts.
3. Connect the function generator output to the DMM, using a BNC cable and a female BNC to dual banana plug adapter.
4. Adjust the function generator output voltage until the DMM reads 7.000 V ±0.01 V.
5. Record the DMM reading to 1 mV resolution in the Test Record.
6. Disconnect the BNC cable from the function generator and from the BNC-to-banana plug adapter on the DMM. (Leave the banana plug adapter connected to the DMM).
7. Connect the BNC connector from the probe extender cable to the BNC-to-banana plug adapter on the DMM.
8. Connect the insulated banana plug adapter to the function generator.
9. Using the insulated banana couplers, connect the positive lead (red) of the probe under test to the positive output of the BNC-to-banana plug adapter and the negative lead (black) to the negative or return output.
10. Set the oscilloscope scale factor to 20 V/Div.
11. Record the DMM reading to 0.01 mV resolution in the Test Record.

12. Multiply the measured output voltage recorded in step 11 by the actual probe attenuation factor, then divide this number by the function generator output voltage (probe input voltage) recorded in step 5. Subtract 1 from this number and multiply the result by 100 to get the error in percent:

$$\%Error = \left(\frac{PrAttenuation \ x \ MeasuredOutputVoltage}{InputVoltage} - 1\right) x \ 100$$

NOTE: The actual probe attentuation can be found by using the XStream Browser. Choose File > Exit to show the oscilloscope desktop, then double-click the XStream Browser icon. In the locator field, enter the path "app.Acquisition.C1.InputB.HVD310*x*" (where *x* is your probe model number). The value is shown next to PrAttenuation.

13. Record the answer to two significant places (± x.xx%) on line 13 in the Test Record.
14. Verify that the error ≤ 1.00%.
15. Decrease the oscilloscope scale factor to 5 V/Div.
16. Record the DMM reading to 0.01 mV resolution in the Test Record.
17. Multiply the measured output voltage recorded in step 16 by the actual probe attenuation factor, then divide this number by the function generator output voltage (probe input voltage) recorded in step 5. Subtract 1 from this number and multiply the result by 100 to get the error in percent.

$$\%Error = \left(\frac{PrAttenuation \ x \ MeasuredOutputVoltage}{InputVoltage} - 1\right) x \ 100$$

NOTE: Recheck the actual probe attentuation in the XStream Browser, as it will now be a different value than in step 12.

18. Record the answer to two significant places (±x.xx%) on line 18 in the Test Record.
19. Verify that the error is ≤ 1.00%.

This completes the Performance Verification Procedure. Complete and file the Test Record, as required to support your internal calibration procedure. If the criteria in steps 14 or 19 are not met, contact your local Teledyne LeCroy service center.

HVD3102/HVD3106 Test Record

Permission is granted to photocopy this page and record the results of the Performance Verfication procedure on the copy. File the completed record as required by applicable internal quality procedures.

The numbers preceding the individual data records correspond to steps in the procedure requiring the recording of data. Results recorded under "Test Result" are the actual specification limit check. The test limits are included in all of these steps. Record other measurements and intermediate calculations that support the limit check under "Intermediate Results".

Serial Number: ______________________

Asset / Tracking Number: ______________________

Date: ______________________

Technician: ______________________

Equipment	Model	Serial Number	Calibration Due Date
Oscilloscope			
Digital Multimeter			
Function Generator[1]			

1 The function generator used in this Performance Verification Procedure is used for making relative measurements. The output of the generator is measured with a DMM or oscilloscope in this procedure. Thus, the generator is not required to be calibrated

Step	Description	Intermediate Data	Test Result
5	Function Generator Output Voltage	V	
11	Probe Output Voltage	V	
13	÷500 / ÷1000 Gain Error (test limit ± 1 %)		%
16	Probe Output Voltage	V	
18	÷50 / ÷100 Gain Error (test limit ± 1 %)		%

Reference

Certifications

This section certifies the probe's EMC, Safety, and Environmental compliance.

EMC Compliance

EC Declaration Of Conformity - EMC

The probe meets the intent of EC Directive 2004/108/EC for Electromagnetic Compatibility. Compliance was demonstrated to the following specifications as listed in the Official Journal of the European Communities:

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

Electromagnetic Emissions:

EN 55011/A1:2010, Radiated and Conducted Emissions Group 1, Class A [1, 2]

Electromagnetic Immunity:

EN 61000-4-2:2009 Electrostatic Discharge, 4 kV contact, 8 kV air, 4 kV vertical/horizontal coupling planes

EN 61000-4-3/A2:2010 RF Radiated Electromagnetic Field, 3 V/m, 80-1000 MHz; 3 V/m, 1400 MHz - 2 GHz; 1 V/m, 2 GHz - 2.7 GHz

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

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

European Contact:

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

Australia & New Zealand Declaration Of Conformity—EMC

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

E55011/A1:2010 Radiated and Conducted Emissions, Group 1, Class A, in accordance with EN61326-1:2013 and EN61326-2-1:2013.

Australia / New Zealand Contacts:

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

Vicom New Zealand Ltd.
60 Grafton Road
Auckland
New Zealand

Safety Compliance

EC Declaration Of Conformity - Low-Voltage

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

EN 61010-031:2002/A1:2008 Safety requirements for electrical equipment for measurement, control, and laboratory use – Part 031: Safety requirements for hand-held probe assemblies for electrical measurement and test.

- Measurement Category III (CAT III), for measurements performed in the building installation.
- Pollution Degree 2, operating environment where normally only dry non-conductive pollution occurs. Conductivity caused by temporary condensation should be expected.

U.S. Nationally Recognized Agency Certification

The Probe has been certified by Underwriters Laboratories (UL) to conform to the following safety standard and bears UL Listing Mark:

UL 61010-031-2007 - 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.

Canadian Certification

The probe has been certified by Underwriters Laboratories (UL) to conform to the following safety standard and bears cUL Listing Mark:

CAN/CSA-C22.2 No. 61010-031-07 (R2012) - 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 product is marked with this symbol to indicate that it complies with the applicable European Union requirements to Directives 2002/96/EC and 2006/66/EC on Waste Electrical and Electronic Equipment (WEEE) and Batteries.

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

Restriction Of Hazardous Substances (RoHS)

The product and its accessories conform to the 2011/65/EU RoHS2 Directive, as they have been classified as Industrial Monitoring and Control Equipment (per Article 3, Paragraph 24) and are exempt from RoHS compliance until 22 July 2017 (per Article 4, Paragraph 3).

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 three years 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.

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