



# Operator's Manual

ADP300/305  
Active Differential Probe



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### **Warranty**

Teledyne LeCroy warrants this oscilloscope accessory for normal use and operation within specification for a period of one year from the date of shipment. Spare parts, replacement parts and repairs are warranted for 90 days.

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

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## **Safety Instructions**

This section contains instructions that must be observed to keep this oscilloscope accessory operating in a correct and safe condition. You are required to follow generally accepted safety procedures in addition to the precautions specified in this section. **The overall safety of any system incorporating this accessory is the responsibility of the assembler of the system.**

## **Symbols**

These symbols may appear on the ADP30x probe body or probe accessories or in this manual to alert you to important safety considerations.



**WARNING.** High Voltage, risk of electric shock.



**CAUTION.** Potential for damage to probe or instrument it is connected to.

Attend to the accompanying information to protect against personal injury or damage. Do not proceed until conditions are fully understood and met.



**ELECTROSTATIC DISCHARGE (ESD) HAZARD.** The probe is susceptible to damage if anti-static measures are not taken.



**DOUBLE INSULATION**



**PROTECTIVE (EARTH) TERMINAL**

## ADP30x Probe

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### Precautions

To avoid personal injury or damage to property, review and comply with the following safety precautions.

**Use product only as specified.**

**Do not overload.** To avoid electric shock or fire hazard, do not apply any potential that exceeds the maximum rating of the probe and/or the probe accessory, whichever is less.

**Connect and disconnect properly.** To avoid electric shock or fire hazard, 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 or disconnect accessories to a voltage source unless they are first connected to the probe input leads.

**Use only accessories compatible with the probe.** Use only accessories that are rated for the application. Substituting other accessories may create a potential shock or burn hazard. Ensure connections between probe input leads and probe accessories are secure before connecting them to a voltage source.

**Comply with voltage derating curve.** When measuring higher frequency signals, comply with the Voltage vs. Frequency Derating Curve (see Page 6).

**Observe all terminal ratings.** To avoid electric shock or fire, do not use the probe above the input limits shown on the probe as well as all accessories.

**Do not remove probe casing.** Removing the probe's case or touching exposed connections may result in electric shock.

**Use only within operational environment listed.** Do not use in wet or explosive atmospheres. 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 ADP30x family of high voltage active differential probes is safe, easy-to-use, and ideally suited for power measurements.

The 20 MHz ADP300 is perfect for troubleshooting low frequency power circuits, and other circuits where the reference potential is elevated from ground or the location of ground is unknown.

The 100 MHz ADP305 is designed for measuring high-speed floating voltages found in today's power electronics, like switching power supplies.

With the ProBus interface, the ADP30x becomes an integral part of the oscilloscope. For the ADP305, the attenuation, offset, and bandwidth limit are all controlled from the oscilloscope's front panel or by means of remote control commands. This means that the complete measurement setup can be saved and recalled by the oscilloscope and all measurement values will be correct. The oscilloscope provides power to the probe, so there is no need to worry about a separate power supply or changing batteries.

The sensitivity of the ADP300 ranges from 1 V/div to 350 V/div; and the sensitivity for the ADP305 ranges from 200 mV/div to 350 V/div.

Attenuation is automatically selected by the oscilloscope to either  $\div 100$  or  $\div 1000$ .

### **Key Benefits**

- True Differential Measurements
- EN 61010-031 1000 V CAT III Safety Compliance (when used with correspondingly rated probe accessories)
- ProBus Interface with Automatic Scaling
- Auto-Zeroing

## Specifications

### Nominal Characteristics

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

Sensitivity:	
ADP300	1 V/div to 350 V/div
ADP305	200 mV/div to 350 V/div
Input Configuration	True Differential, + and – inputs
Maximum Input Voltage	1000 V rms, either input to ground, CAT III. 1400 Vp, between inputs
Output Configuration	Single ended, Ground referenced
Intended Output Load	1 MΩ
Output Connector	ProBus
Input Attenuation	÷100 or ÷1000
Bandwidth Limit Filter	20 MHz (ADP305 only)
Interface	ProBus
Oscilloscope Compatibility	Teledyne LeCroy LT or LC series oscilloscopes with firmware version 8.5 or higher; or X-Stream oscilloscopes. (Not available for 9300 series oscilloscopes)

### Warranted Characteristics

Warranted characteristics are parameters with guaranteed performance. Unless otherwise noted, tests are provided in the "Performance Verification Procedure" for all warranted specifications.

Low Frequency Accuracy (probe only)	±1% of reading (÷1000 Atten) ±2% of reading (÷100 Atten)
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### Typical Characteristics

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

Bandwidth:	
ADP300	20 MHz
ADP305	100 MHz
Rise Time:	
ADP300	< 17.5 ns
ADP305	< 3.5 ns
Slew Rate, referenced to input:	
ADP300	60 000 V/µs
ADP305	300 000 V/µs
AC Noise	< 50 mV rms
Common Mode Rejection:	
50 Hz / 60 Hz	80 dB (10 000:1)
100 kHz	50 dB (300:1)
Input Impedance	4 MΩ    8 pF either input to ground
Propagation Delay	20 ns

### Environmental Characteristics

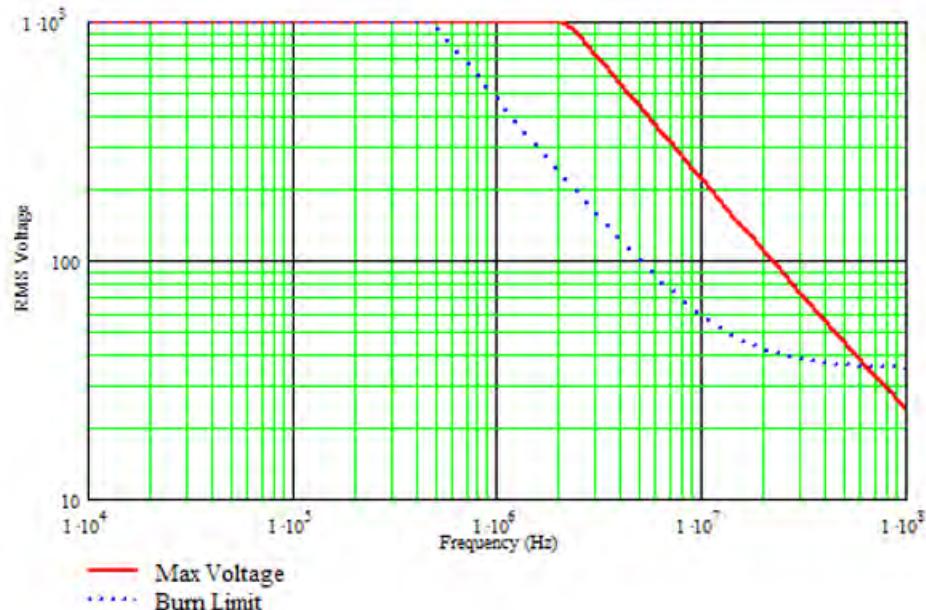
Temperature, operating	0 °C to 50 °C (32 to 122 °F)
Usage	Indoor
Relative Humidity	80% max. up to 31 °C, decreasing linearly to 40% max. at 50 °C
Altitude	3000 m (9842 ft) max. at 25 °C

### Physical Characteristics

Weight	300 g
Overall Length	2 m
Input Lead Length	40 cm

## ADP30x Probe

### Voltage vs Frequency Derating Curve



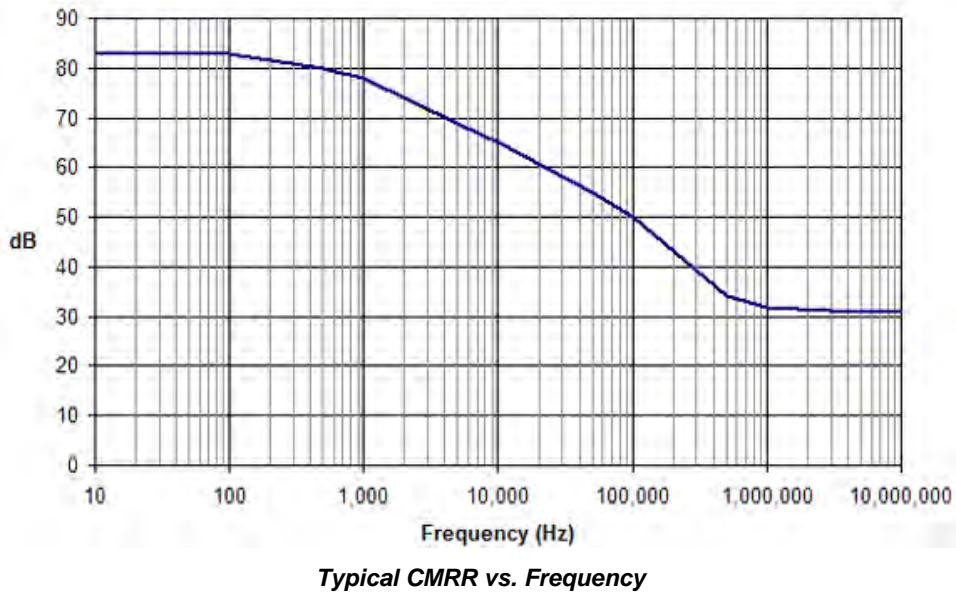
*Input Voltage and Burn Limit vs. Frequency*

**NOTE:** The voltage derating curve provides the maximum voltage that can be applied to the probe inputs without risking damage to the probe.

The Burn Limit is the voltage limit that should be used when the input leads are being hand-held. This limit is derived using the methodology described in EN 61010-031 section 6.3.1.2.



**WARNING.** To avoid risk of electric shock or burn, comply with the burn limits of the voltage vs. frequency derating curve when measuring high-frequency signals with hand-held accessories.



## Standard Accessories

The following accessories are included with each probe model:

	ADP300	ADP305
Instruction Manual	x	x
Certification of Compliance	x	x
Hook and Loop Strap for holding probe	x	x
Plunger Hook Tip	x	x
Safety Alligator Clip		x
Plunger Jaw Clip		x
Plunger Clamp Clip		x
Spade Terminal		x
Soft Accessory Case		x

## ADP30x Probe

### ***Voltage Derating for ADP30x Standard Accessories***

Accessory (Teledyne LeCroy P/N)	Combined Probe and Accessory Max Input Voltage (from either input to ground)
Plunger Hook Clips (PK30X-1)	1000V CAT II (600V CAT III)
Safety Alligator Clips (PK30X-2)	1000V CAT III
Plunger Jaw Clips (PK30X-3)	1000V CAT II (600V CAT III)
Plunger Clamp Clips (PK30X-4)	1000V CAT III
Safety Spade Terminals (PK30X-5)	1000V CAT II (600V CAT III)

**NOTE:** The operating altitude of ADP30x is derated to 2000 m (6560 ft) when used with these accessories. The voltage rating and CAT rating are de-rated to the voltage in the above table when used with these accessories.

 **WARNING.** To avoid risk of electric shock or fire, do not exceed either the voltage rating or category rating of the probe or the probe accessory, whichever is the lesser of the two.

 **WARNING.** To avoid risk of electric shock when using the probe or accessories, 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.

### Description of Accessories

#### Plunger Hook Clip (1 Red, 1 Blue)



Insulated, 1000 V, CAT II. Designed to attach to wire lead parts, the overall length is 158 mm (6.22 inches), and the hook extends 8 mm (0.31 inch) when the plunger is fully pressed.

#### Safety Alligator Clip (1 Red, 1 Blue)



Insulated, 1000 V, CAT III. Designed to attach to large components, such as busbars and large bolts, the overall length is 90 mm (3.54 inches) and the jaw opens to 22 mm (0.87 inch) max.

#### Plunger Jaw Clip (1 Red, 1 Blue)



Insulated, 1000 V, CAT II. The clip is designed to securely grasp thick wires, cables, ground leads, rails, and even screw heads. The overall length is 175 mm (6.89 inches). The steel jaw extends 12 mm (0.48 inch) and opens to 25 mm (1 inch).

## ADP30x Probe

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### Plunger Clamp Clip (1 Red, 1 Blue)



Insulated, 1000 V, CAT III. Designed for attaching to hard-to-reach test points, the entire body is fully insulated. The overall length is 160 mm (6.3 inch). The clamp can grab leads, pins and wires up to 5 mm (0.2 inch) in diameter.

### Spade Terminal



Insulated, 1000 V, CAT II. Designed to connect to terminal strips, posts, and screws, the overall length is 65 mm (2.55 inch).

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

### Soft Accessory Case

This can be used to carry probes and accessories. It can also be mounted on your oscilloscope for storing all your accessories and manuals. See Appendix B for installation instructions.

## **Operation**

### **Connecting the Probe to the Test Instrument**

The ADP30x series of probes has been designed for use with Teledyne LeCroy oscilloscopes equipped with the ProBus interface. When you attach the probe output connector to the scope's input connector, the scope will recognize the probe, set the scope input termination to  $1\text{ M}\Omega$ , and activate the probe control functions in the user interface.

### **Connecting the Probe to the Test Circuit**

The ADP30x series of probes is 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, the + and – inputs both must always be connected to the test circuit. Positive voltages applied to the + input (red) relative to the – input (blue) will deflect the oscilloscope trace toward the top of the screen.

To maintain the high performance capability of the probe in measurement applications, care must be exercised in connecting the probe to the test circuit. 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 greatly 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.

## ADP30x Probe

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### Operation with a Teledyne LeCroy Oscilloscope

When the ADP30x 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.

Through the oscilloscope software, the probe's internal attenuation and offset can be conveniently controlled through the oscilloscope's user interface.

Turning the VOLTS/DIV knob will control the oscilloscope's scale factor and the probe's internal attenuation to give full available dynamic range from 1 V/div to 350 V/div for the ADP300, and from 200 mV/div to 350 V/div for the ADP305. Some of the transition of the scale factor will result in a change of attenuation.

### Smart Offset

The ADP30x has offset capability. This allows you to remove a DC bias voltage from the differential input signal while maintaining DC coupling.

The offset range of the probe is a function of the oscilloscope's sensitivity and the probe's attenuation. This ensures that the probe will never be overdriven on screen. In addition, it will prevent the oscilloscope from being overdriven and getting inaccurate measurements.

### Bandwidth Limit (ADP305 only)

To comply with various test standards used for quantifying output noise of power supplies, the ADP305 is capable of switching the bandwidth limit from **Off** (maximum bandwidth) to **20 MHz** in the channel Vertical Adjust dialog.

### Auto Zero

The ADP30x incorporates an Auto Zero function to remove the DC offset from the Differential Amplifier's output. Auto Zero must be invoked by the user. You may do this even while the probe is connected to a live circuit.

After several minutes of warm-up, or when the probe is exposed to a large shift in ambient temperature, some DC offset drift may occur from thermal effects in the amplifier. To initiate an Auto Zero cycle, select "AUTO ZERO" in the oscilloscope's user interface. During an Auto Zero cycle the oscilloscope will automatically disconnect the ADP30x inputs from the circuit under test, perform the auto zero function, and reconnect the inputs.

## Remote Control Commands

When attached to a Teledyne LeCroy oscilloscope equipped with ProBus interface, the ADP30x Active Differential Probe can be remotely controlled, along with the other oscilloscope functions. The control interface can be either the RS-232 or IEE-488 (GPIB) buses. The commands that control the probe are described below. The text for the command description is formatted in a style consistent with the oscilloscope command description contained in the *Teledyne LeCroy Digital Oscilloscopes Remote Control Manual* supplied with the oscilloscope. Please refer to this manual for additional information on the remote control buses and the conventions used in the command descriptions.

The commands begin with the "PRx:" prefix, where "x" is the channel that the ADP30x is connected to. These commands are similar to the channel commands that use the prefix "Cx:". The difference is that the "PRx:" form refers to the probe tip, whereas the "Cx:" form refers to the oscilloscope input connector. For example, "PRx:VDIV" sets the Volts per division at the probe tip, while "Cx:VDIV" sets the Volts per division at the BNC input connector, without factoring the gain or attenuation factor of ADP30x probe. The "PRx:" form of these commands are only active when the ADP30x probe is connected to the selected channel. An error will result when an ADP30x specific command is sent to the oscilloscope without a differential probe connected to the selected channel.

### Command List

PRx:AUTOZERO	Initiates an auto zero cycle in the probe.
PRx:BWL	Selects the probe upper bandwidth limit.
PRx:COUPLING	Selects the input coupling of the probe.
PRx:OFFSET	Selects the probe offset voltage.
PRx:VDIV	Selects the vertical scale factor of the probe/oscilloscope system.

## ADP30x Probe

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### Probe Auto Zero

**PRx:AUTOZERO, PRx:AZ**  
*Command*

**Description** The PRx : AUTOZERO command initiates an auto zero cycle in the ADP30x probe to remove any offset drift. The probe input can remain connected to the test circuit during the auto zero cycle.

**Command Syntax** <channel>:AutoZero  
<channel>:= {PR1, PR2, PR3, PR4}

**Example** The following command initiates an auto zero in the ADP30x Differential Probe attached to channel 1:

```
CMD$="PR1:AZ":CALL IBWRT(SCOPE%,CMD$)
```

### Probe Bandwidth Limit

**PRx:BANDWIDTH\_LIMIT, PRx:BWL**  
*Command/Query*

**Description** The PRx : BANDWIDTH\_LIMIT command sets the upper (HF) -3 dB bandwidth limit of the ADP305 probe. The arguments are in Hz. The PRx : Bandwidth\_Limit query returns the upper bandwidth limit setting for the differential probe connected to the specified channel.

**Command Syntax** <channel>:BWL<upper bandwidth>  
<channel>:={PR1, PR2, PR3, PR4}  
<upper bandwidth>:={OFF, 20M}

**Query Syntax** <channel>:BWL?

**Response Format** <channel>:BWL <upper bandwidth>

**Example** The following command sets the upper bandwidth of the ADP305 connected to channel 1 to 20 MHz.

```
CMD$="PR1:BWL 20M": CALL IBWRT(SCOPE%,CMD$)
```

**NOTE:** The PRx:Bandwidth\_Limit command is not available with model ADP300.

## **Probe Coupling**

**PRx:COUPLING, PRx:CPL**

*Command/query*

**Description** The PRx:COUPLING command selects the coupling mode of the ADP30x probe.

The PRx:COUPLING? query returns the coupling mode of the selected channel.

**Command Syntax** <channel>:COUPLING<coupling> <channel>:={PR1, PR2, PR3, PR4} <coupling>:={DC, GND}

**Query Syntax** <channel>:COUPLING?

**Response Format** <channel>:CPL <coupling>

**Example** The following command sets the coupling to DC in the ADP30x differential probe connected to channel 2.

```
CMD$=:PR2:CPL DC": CALL IBWRT(SCOPE%,CMD$)
```

## ADP30x Probe

### Probe Offset

PRx:OFFSET, PRx:OFST

*Command/Query*

#### Description

When an ADP30x probe is connected to a channel, the OFFSET command sets the probe offset value.

The maximum range and resolution is determined by the V/DIV setting. If an out-of-range value is entered, the differential probe will set the offset to the closest valid value, and the VAB bit (bit 2) in the STB register will be set.

The OFFSET? query returns the offset voltage of the differential probe connected to the specified channel.

**Command Syntax** <channel>: OFFSeT<offset>  
<channel>:={PR1, PR2, PR3, PR4}

**ADP305:** <offset>={-40V to +40V} for 200-499 mV/div(LC series)  
= {-100V to +100V} for 200-499 mV/div (LT series)  
= {-100V to +100V} for 500 mV/div to 9.9 V/div  
= {-1000V to +1000V} for 10V/div to 99 V/div  
= {-(1400V-4(V/Div setting)) to (1400V-4(V/Div setting))} for 100 V/div to 350 V/div

**ADP300:** <offset>={-100V to +100V} for 1-9.9 V/div  
= {-1000V to +1000V} for 10-99 V/div  
= {-(1400V-4(V/Div setting)) to (1400V-4(V/Div setting))} for 100 V/div to 350 V/div

**Query Syntax** <channel>:OFFSeT?

**Response Format** <channel>:OFST <offset>

#### Example

The following command sets the offset at the probe tip of the ADP30x differential probe connected to 1 to 5 volts:

CMD\$="PR1:OFST 5": CALL IBWRT(SCOPE%,CMD\$)

**NOTE** The suffix V is optional

### Probe Volts/div

**PRx:VOLT\_DIV,PRx:VDIV**

*Command/Query*

<b>Description</b>	The PRx:VOLT_DIV command sets the vertical sensitivity at the ADP30x input. The effective gain of the differential probe is factored into the vertical sensitivity.  The valid range of arguments is fixed by the probe type. If an out-of-range value is entered, the oscilloscope will set the vertical sensitivity to the closest value and set the VAB bit (bit 2) in the STB register.  The PRx:VOLT_DIV? query returns the vertical sensitivity at the probe input of the specified channel.
<b>Command Syntax</b>	<channel>:Volt_DIV <sensitivity> <channel>:={PR1, PR2, PR3, PR4} <sensitivity>:={200 mV to 350 V} for ADP350 <sensitivity>:={1 V to 350 V} for ADP300
<b>Query Syntax</b>	<channel>:Volt_DIV?
<b>Response Format</b>	<channel>:VDIV <sensitivity>
<b>Example</b>	The following command sets the vertical sensitivity at the probe tip of the ADP30x probe connected to channel 3 to 2 Volts/div:  CMD\$="PR3:VDIV 2":CALL IBWRT(SCOPE%,CMD\$)

**NOTE:** The suffix V is optional

## **Maintenance**

### **Calibration Interval**

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

### **Cleaning**

Clean only the exterior surfaces of the probe using a soft cloth or swab dampened with 75% isopropyl alcohol. Do not use harsh chemicals or abrasive elements. Probe is not water proof. Under no circumstances submerge the probe or allow moisture to penetrate it.

### **Service Strategy**

The ADP30x series probes utilize 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. 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.



**WARNING** No user serviceable components inside. Do not remove covers. Refer servicing to qualified personnel.

## **Troubleshooting**

If the probe is not operating properly the problem may be the way in which it is used. Before assuming that the probe is defective, perform the following troubleshooting procedures:

1. For Teledyne LeCroy LT and LC series scopes, verify that the firmware version is 8.5 or higher.
2. Waveform is inverted. — Make sure that the + lead (Red) is connected to the proper test point.
3. No DC. — Make sure that the attachment accessory is completely plugged onto the lead.
4. No output signal. — Make sure that **DC** coupling is selected.

## **Returning a Defective Probe**

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.

## ADP30x Probe

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### Replacement Parts

The probe connection accessories and other common parts can be ordered through the regional customer care centers. Refer to the list below for Teledyne LeCroy part numbers. 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. The returned probe should be sent back to the regional customer care center without any accessories, manual, or case.

Item	Teledyne LeCroy P/N	Alternate P/N
ADP300 Exchange Unit	APD300-PROBE-FRU	
ADP305 Exchange Unit	APD305-PROBE-FRU	
Instruction Manual	ADP30x-OM-E	
Soft Carrying Case	SAC-01	
Plunger Hook Clips	PK30X-1	Mueller: BU-20431-2 (Red) Mueller: BU-20431-6 (Blue)
Safety Alligator Clips	PK30X-2	Mueller: BU-65-2 (Red) Mueller: BU-65-6 (Blue)
Plunger Jaw Clips	PK30X-3	Mueller: BU-20434-2 (Red) Mueller: BU-20434-6 (Blue)
Plunger Clamp Clips	PK30X-4	Mueller: BU-20433-2 (Red) Mueller: BU-20433-6 (Blue)
Safety Spade Terminals	PK30X-5	Mueller: BU-30214-2 (Red) Mueller: BU-30214-6 (Blue)

## **Functional Test**

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.

### **Test Equipment Required**

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

### **Test procedure**

1. Connect the ADP300 or ADP305 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 **Blue** 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 **AUTOSSETUP**.
7. Set the sensitivity of the probe to 1 V/div.
8. Set the CAL output to 1 V<sub>p-p</sub> square wave.
9. Verify that the displayed square wave is 1 V<sub>p-p</sub> 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.
13. Set the VOLTS/DIV to 100 V.
14. Verify that the probe attenuation now shows X1K.

## ADP30x Probe

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### Performance Verification

This procedure can be used to verify the warranted characteristics of the ADP30x series Active 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.

### Test Equipment Required

The following table lists the test equipment and accessories (or their equivalents) that are required for performance verification of the ADP30x Active Differential probe. 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	Test Equipment Examples
Digital Multimeter	<b>DC: 0.1% Accuracy</b> <b>AC: 0.2% accuracy</b> to measure 700 mV at 70 Hz	Agilent Technologies 34401A Fluke 8842A-09 Keithley 2001
Function Generator	Sine Wave output waveforms 20 Vp-p	Agilent Technologies 33120A Stanford Research Model DS340 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 or 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 (Red) Mueller BU-32601-6 (Blue)

### Preliminary Procedure

1. Connect the ADP30x under test to the female end of the ProBus Extension Cable. Connect the male end of the ProBus Extension Cable to any channel 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 (located in Appendix A), and fill in the necessary data.

### 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  $\pm 0.01$  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 under test 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 (**Blue**) to the negative or return output.
10. Set the oscilloscope scale factor to 20 V/div.

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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 1000 and 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:

$$\% \text{Error} = \left( \frac{1000 \times \text{MeasuredOutputVoltage}}{\text{InputVoltage}} - 1 \right) \times 100$$

13. Record the answer to two significant places ( $\pm x.x\%$ ) on line 13 in the Test Record.
14. Verify that the error  $\leq 1.00\%$ .
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 100 and 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.

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

18. Record the answer to two significant places ( $\pm x.x\%$ ) on line 18 in the Test Record.
19. Verify that the error is  $\leq 2.00\%$ .

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.

## **Performance Verification Test Record**

This record can be used to record the results of measurements made during the performance verification of the ADP300/ADP305 Active Differential Probe.

Photocopy this page and record the results on the copy. File the completed record, as required by applicable internal quality procedures.

The test record corresponds to the parameters tested in the performance verification procedure. The numbers preceding the individual data records correspond to the steps in the procedure that require the recording of data. Results to be recorded in the column labeled "Test Result" are the actual specification limit checks. Test limits are included in all of these steps.

Other measurements, and the results of intermediate calculations that support the limit check, are to be recorded in the column labeled "Intermediate Results".

Permission is granted to reproduce these pages for the purpose of recording test results.

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### ADP300/ADP305 Test Record

**Serial Number:** \_\_\_\_\_

**Asset or Tracking Number:** \_\_\_\_\_

**Date:** \_\_\_\_\_

**Technician:** \_\_\_\_\_

#### Equipment Used:

	MODEL	SERIAL NUMBER	CALIBRATION DUE DATE
OSCILLOSCOPE			
DIGITAL MULTIMETER			
FUNCTION GENERATOR <sup>1</sup>			

<sup>1</sup>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
<b>Gain Accuracy</b>			
5	Function Generator Output Voltage	_____ V	
11	Probe Output Voltage	_____ V	
13	÷1000 Gain Error (Test limit ±1%)	_____ %	
16	Probe Output Voltage	_____ V	
18	÷100 Gain Error (Test limit ±2%)	_____ %	

## **Reference Information**

### **Differential Mode and Common Mode**

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

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

### **Differential Mode Range and Common Mode Range**

Differential Mode range is the maximum signal that can be applied between the + and – inputs without overloading the amplifier, which otherwise would result in clipping or distorting 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, you need to be careful to avoid accidentally exceeding the common mode range.

### **Common Mode Rejection Ratio**

The ideal differential amplifier would amplify only the differential mode voltage component and reject all of the common mode voltage component. Real differential amplifiers are not perfect, so a small portion of the common mode voltage component appears at the output. Common Mode Rejection Ratio (CMRR) is the measure of how well the amplifier rejects the common mode voltage component. CMRR is equal to the differential mode gain (or normal gain) divided by the common mode gain. The 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., 10000:1) or implicitly in dB (e.g., 80 dB). The higher the number the greater the rejection the better the performance.

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The first order term that determines the CMRR is the relative gain matching between the + and – input paths. To obtain high CMRR values, the input attenuators in a differential amplifier are precisely matched to each other. This matching includes the DC attenuation as well as the capacitance that 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 becomes more pronounced. The CMRR becomes smaller as the frequency increases. Hence, 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. As such, it is 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 amplifiers.

## Certifications

This section certifies the ADP30x probe's Electromagnetic Compatibility (EMC), Safety and Environmental compliances.

### **EMC Compliance**

#### **EC DECLARATION OF CONFORMITY - EMC**

The probe meets 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 61326-1:2006, EN 61326-2-1:2006 EMC requirements for electrical equipment for measurement, control, and laboratory use.

#### **Electromagnetic Emissions:**

CISPR 11:2003, Radiated and Conducted Emissions Group 1, Class A<sup>12</sup>

#### **Electromagnetic Immunity:**

EN 61000-4-2:2001 Electrostatic Discharge, 4 kV contact, 8 kV air, 4 kV vertical/horizontal coupling planes<sup>3</sup>

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EN 61000-4-3:2006 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<sup>3</sup>

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.

3 Meets Performance Criteria "B" limits of the respective standard: during the disturbance, product undergoes a temporary degradation or loss of function or performance which is self-recoverable.

### **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):

CISPR 11:2003 Radiated and Conducted Emissions, Group 1, Class A, in accordance with EN61326-1:2006 and EN61326-2-1:2006.

### **Australia / New Zealand Contacts:**

Vicom Australia Ltd.	Vicom New Zealand Ltd.
1064 Centre Road	60 Grafton Road
Oakleigh, South Victoria 3167	Auckland
Australia	New Zealand

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### ***Safety Compliance***

#### **EC DECLARATION OF CONFORMITY – LOW VOLTAGE**

The probe meets 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 61010-1:2010 Safety requirements for electrical equipment for measurement, control, and laboratory use – Part 1: General requirements

EN 61010-2:030:2010 Safety requirements for electrical equipment for measurement, control, and laboratory use – Part 2-030: Particular requirements for testing and measuring circuits

EN 61010-031/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.
- Measurement Category II (CAT II), for measurements performed on circuits directly connected to the low-voltage installation.
- Pollution Degree 2, operating environment where normally only dry non-conductive pollution occurs. Conductivity caused by temporary condensation should be expected.

### ***Environmental Compliance***

#### **END-OF-LIFE HANDLING**



The probe is marked with this symbol to indicate that it complies with the applicable European Union requirements to Directives 2002/96/EC and 2006/66/EC on Waste Electrical and Electronic Equipment (WEEE) and Batteries.

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

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### **RESTRICTION OF HAZARDOUS SUBSTANCES (RoHS)**

This probe has been classified as Industrial Monitoring and Control Equipment, and is outside the scope of the 2011/65/EU RoHS Directive (Exempt until July 2017, per Article 4).

### ***ISO Certification***

Manufactured under an ISO 9000 Registered Quality Management System.