



**TELEDYNE LECROY**  
Everywhere you look™



# Operator's Manual

## AP031

### 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.

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

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

# 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 probe body or in this manual to alert you to important safety considerations.



**HIGH VOLTAGE**, risk of electric shock.



**CAUTION** of potential for damage to probe or instrument it is connected to or **WARNING** of potential bodily injury. 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.



**ON (POWER)**



**OFF (POWER)**



**DOUBLE INSULATION**



**MEASUREMENT GROUND TERMINAL**

## Precautions

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

**Use product only as specified.** The probe is designed to make differential voltage measurements. It is *not* to be used to insulate the circuit under test from the measuring instrument.

**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 (e.g. probe hooks), 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 hooks before making any connections to a voltage source. Do not connect or disconnect probe hooks to a voltage source unless they are first connected to the probe input leads. Ensure connections between probe input leads and probe hooks are secure before connecting them to a voltage source.

**Use only accessories compatible with the probe.** Use only accessories that are shipped with the product. Substitution of other accessories may create a potential shock hazard.

**Comply with voltage derating curve.** When measuring higher frequency signals, comply with the Voltage vs. Frequency Derating Curve (see Page 7).

**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.

## AP031 Probe

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**Avoid damage to cable through excessive bending.**

**Handle with care.** Tips of probe hooks are sharp. They puncture skin or cause other bodily injury if not handled properly.

**Keep fingers behind the finger guard of the probe hooks.**

**Do not operate with suspected failures.** Before each use, inspect the probe and probe hooks for any potential 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 AP031 is a fully differential active probe designed for applications where electrical signals must be measured relative to a floating voltage different to the oscilloscope ground potential.

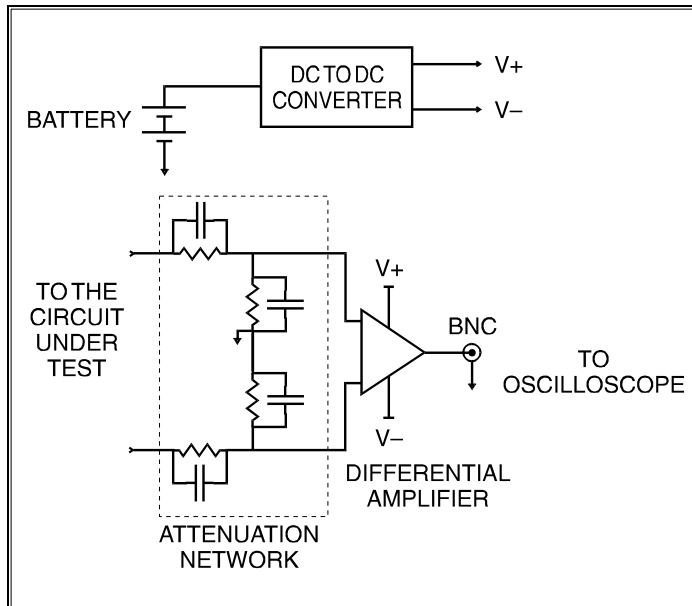
This probe is specifically designed for situations where:

- The reference voltage may be several hundreds volts above or below ground.
- Measurements require the rejection of common mode signals.
- Ground loops and currents produce to excessive signal interference.

The use of the probe ensures safe operation of the oscilloscope and maintains high signal fidelity with good common mode rejection and dynamic range.

The probe is a fully differential active device. The differential capability allows measurements to be made between two points in a circuit without reference to ground. The two input signals are processed inside the probe (see figure 1) and the resulting single-ended signal may be measured by any grounded oscilloscope. Because the differential

voltage is calculated within the probe, with only the resultant difference signal being passed to the oscilloscope, a large dynamic range can be achieved with excellent rejection of common mode signals.



**Figure 1**

# Specifications

## Electrical Characteristics

<b>Bandwidth</b>	25 MHz
<b>Rise Time</b>	14 ns
<b>Attenuation</b>	1:10 / 1:100
<b>Atten. Accuracy</b>	±2 %
<b>Input Resistance</b>	4 MΩ
<b>Input Capacitance</b>	5.5 pF each side to ground
<b>Input Configuration</b>	Differential
<b>Input Voltage</b>	<p><b>Max. Differential 1:100 Range</b> ±700 V (DC + AC pk) and 700 V r.m.s.</p> <p><b>Max. Differential 1:10 Range</b> ±70 V (DC + AC pk) and 70 V r.m.s.</p> <p><b>Max. Common Mode</b> ±700 V ( DC + AC pk) and 700 V r.m.s.</p> <p><b>Max. Absolute</b> ±1400 V ( DC + AC pk) and 1000 V r.m.s.</p>
<b>CMRR</b>	<p><b>50 Hz</b> - 80 dB</p> <p><b>20 kHz</b> - 60 dB</p>
<b>Output Offset (Typical)</b>	<±5 mV
<b>Output Noise (Typical)</b>	0.7 mV r.m.s typical



## Electrical Ratings

<b>Maximum Input Voltage</b>	1000 V rms (1400 V DC + peak AC)
<b>Installation (Overvoltage) Category</b>	III
<b>Pollution Degree</b>	2

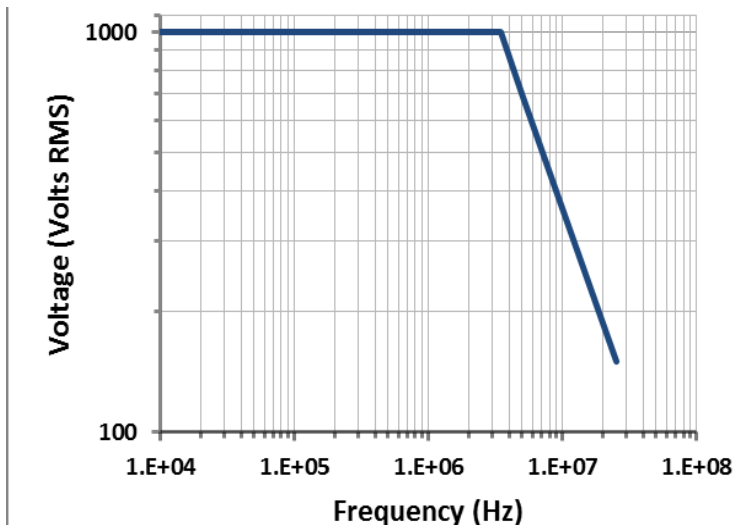
Measurement Category III (CAT III) is applicable for measurements performed in the building installation.

Pollution Degree 2 is applicable to an operating environment where normally only dry non-conductive pollution occurs. Occasionally a temporary conductivity caused by condensation must be expected.

## General Characteristics

<b>Operating Temperature</b>	-10° C to 40° C
<b>Storage Temperature</b>	-30° C to 70° C
<b>Altitude, Operating</b>	up to 2000 m (6560 ft)
<b>Cable Length</b>	1.3 m
<b>Weight (probe only)</b>	42 g
<b>Power requirement</b>	Four internal 1.5 V AA size batteries or 6 V d.c. / 60 mA mains adaptor (Not supplied )
<b>Dimensions</b>	6.6" (168 mm) x 2.4" (62 mm) x 0.79" (20 mm) (excluding casing )
<b>Cables</b>	BNC, 95 cm ( RG58 / U ), Input Lines: 45 cm (PVC, double insulation )
<b>Accessories</b>	2 x Safety Hooks, 4 mm compatible (1 red, 1 black)
<b>Weight</b>	9.35 oz ( 285 g ) excluding batteries and casing
<b>Safety Certification</b>	EN61010-1:2010 ; EN61010-031/A1:2008 1000V CAT III Approval

## Voltage vs. Frequency Derating



**NOTE:** The voltage vs frequency derating curve provides the maximum voltage that can be applied to the probe inputs without risking damage to the probe or injury to the user from possible burns at higher frequencies.



**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 hook, 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 hook.

## Making Measurements

Ensure the probe is fitted with four high-quality, AA cells. These should be cells that are protected from leakage which could damage the power supply contacts in the probes.

Before making any measurements or connections refer to the safety information contained in this document.

Connect the probe to one of the oscilloscope input channels ensuring the BNC connector is fully mated, and the safety ground lead to the oscilloscope CAL BNC connection.

Select the proper range setting on the probe using the slide-switch on the probe body.

Adjust the input coupling impedance and attenuation of the oscilloscope channel to which the probe is connected using the Probe tab of the Channel (Vertical) setup dialog.

Ensure 1 M $\Omega$  input impedance ( 'DC1M $\Omega$ ' or 'AC1M $\Omega$ ' ) is selected. The use of 50  $\Omega$  input impedance will unduly load the output of the differential probe resulting in reduced amplitude output and incorrect scaling.

To ensure the oscilloscope correctly interprets the vertical waveform scale be sure to adjust the probe attenuation setting using the 'Probe Atten' menu controls. The example shown, x100 probe attenuation, would achieve correct vertical scaling AP031 operating with a maximum range of  $\pm 700$  V.

Finally, adjust the vertical sensitivity and offset of the oscilloscope channel to which the probe is connected to achieve an optimum display.

Range Setting	Probe Operating Range (DC + Peak AC)
1/10	$\pm 70$ V
1/100	$\pm 700$ V

# Maintenance

## Cleaning

Clean the exterior of the probe only with a soft cloth moistened with either water or isopropyl alcohol.

## Service Strategy

The AP031 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.

## Certifications

This section certifies the AP031 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>1 2</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>

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.

## AP031 Probe

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### ***European Contact:***

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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:***

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Oakleigh, South Victoria 3167  
Australia

Vicom New Zealand Ltd.  
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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, please visit

[teledynelecroy.com/recycle](http://teledynelecroy.com/recycle).

### ***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 until 22 July 2017 (per Article 4, Paragraph 3).



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