High Voltage Differential Probe user's manual

ADP1025	25MHz/700Vpk
ADP2025	25MHz/1400Vpk
ADP5025	25MHz/3500Vpk
ADP1100	100MHz/700Vpk
ADP2100	100MHz/1400Vpk
ADP5100	100MHz/3500Vpk

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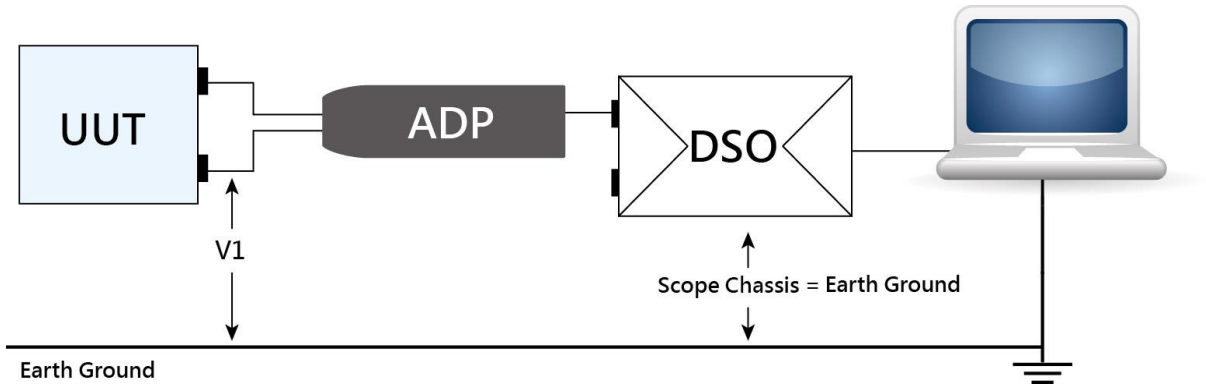
General Safety Summary

Safety Instructions

Read the safety instructions to avoid injury and prevent damage to this product or any products connected to it.

- **Ground the product.**

This probe is grounded with the shell of BNC connector, through the grounding conductor of the power cord of the measurement instrument.
To avoid electric shock, the grounding conductor must be connected to earth ground. Before making connections to the input leads of this probe, ensure that the output BNC connector is attached to the BNC connector of the measurement instrument, while the measurement instrument is properly grounded.



- **Observe all terminal ratings.**

To avoid shock hazard or fire, please note all ratings and markings on the product.

Check the product manual for further ratings information before making connections to the product.

Do not connect a potential to any terminal that exceeds the maximum rating of that terminal.

- **Connect and disconnect properly.**

Do not connect/disconnect probes and test leads while they are connected to a potential source.

Connect the probe output to the measurement instrument before connecting the probe to

the circuit under test.

Disconnect the probe input leads from the circuit under test before disconnecting the probe from the measurement instrument.

- **Do not operate in wet/damp conditions.**
- **Do not operate in an explosive atmosphere.**
- **Keep product surfaces clean and dry.**

Symbols and Terms

These symbols & terms may appear in this manual or on the product **to alert you to important safety considerations.**

DANGER indicates an injury hazard immediately accessible as you read the marking.

Danger statements identify conditions or practices that could result in injury or loss of life.

WARNING indicates an injury hazard not immediately accessible as you read the marking. ***Warning statements identify conditions or practices that could result in damage to this product or other property.***

Double insulation

Earth (ground) Terminal

Compliance & Certification

This section lists the EMC, safety, and environmental standards with which the probe complies.

- **EMC Compliance:**

EC Declaration of Conformity – EMC

Meets intent of Directive 2004/108/EC & 2014/30/EU for Electromagnetic Compatibility.

Compliance was demonstrated to the following specifications as listed in the Official Journal of the European Communities:

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

EN55011:2009/A1:2010. Radiated and conducted emissions, Group 1, Class B

IEC 61000-4-2:2008. Electrostatic discharge immunity (ESD)

IEC 61000-4-3:2008. RF electromagnetic field immunity (RS)

IEC 61000-4-4:2012. Electrical fast transient/burst immunity (EFT)

IEC 61000-4-5:2005. Power line surge immunity

IEC 61000-4-6:2008. Conducted RF immunity

IEC 61000-4-8:2009. Power frequency magnetic field immunity

IEC 61000-4-11:2004. Voltage dips and interruptions immunity

EN 61000-3-2:2006. AC power line harmonic emissions

EN 61000-3-3:2013. Voltage changes, fluctuations, and flicker

- **Safety Compliance:**

Equipment Type: Differential Voltage Probe

EC Declaration of Conformity – Low Voltage

Compliance was demonstrated to the following specification as listed in the Official Journal of the European Communities:

Low Voltage Directive 2006/95/EC.

EN 61010-031/A1:2008. Safety requirements for electrical equipment for measurement, control and laboratory use – Part

031: Safety requirements for handheld probe assemblies for electrical measurement and test.

- **Pollution Degree Description:**

A measure of the contaminants that could occur in the environment around and within a product. Typically the internal environment inside a product is considered to be the same as the external. Products should be used only in the environment for which they are rated.

Pollution Degree 1.

No pollution or only dry, nonconductive pollution occurs. Products in this category are generally encapsulated, hermetically sealed, or located in clean rooms.

Pollution Degree 2.

Normally only dry, nonconductive pollution occurs. Occasionally a temporary conductivity that is caused by condensation must be expected. This location is a typical office/home environment. Temporary condensation occurs only when the product is out of service.

Pollution Degree 3.

Conductive pollution, or dry, nonconductive pollution that becomes conductive due to condensation.

These are sheltered locations where neither temperature nor humidity is controlled. The area is protected from direct sunshine, rain, or direct wind.

Pollution Degree 4.

Pollution that generates persistent conductivity through conductive dust, rain, or snow. Typical outdoor locations.

- **Pollution Degree**

Pollution Degree 2 (as defined in IEC 61010-1). Note: Rated for indoor use only.

- **Installation & Measurement (Overvoltage) Category Descriptions**

Terminals on this product may have different installation or measurement (overvoltage)

category designations. The installation and measurement categories are:

Measurement Category IV. For measurements performed at the source of low-voltage installation.

Measurement Category III. For measurements performed in the building installation.

Measurement Category II. For measurements performed on circuits directly connected to the low-voltage installation.

Measurement Category I. For measurements performed on circuits not directly connected to MAINS.

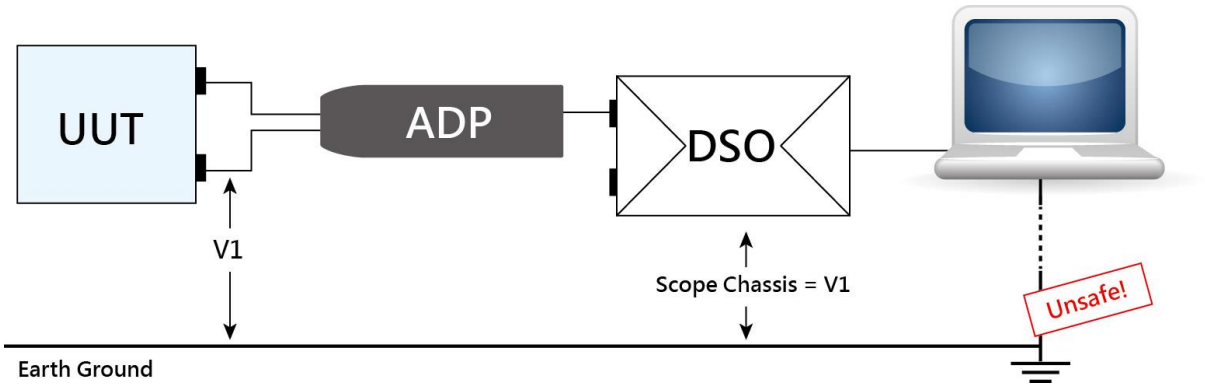
- **Overvoltage Category (AC Adapter)**

  Overvoltage Category II (as defined in IEC 61010-1)

Introduction

The ADP can be used with any oscilloscope and enables users to safely make measurements of floating circuits with their oscilloscope grounded. The ADP Active Differential Probe converts floating signals to low-voltage ground-referenced signals that can be displayed safely and easily on any ground-referenced oscilloscope.

⚠ WARNING: For safe operation, do not use the ADP High-voltage Differential Probe with oscilloscopes that have floating inputs (isolated inputs). The ADP High-voltage Differential Probe requires an oscilloscope or other measurement instrument with grounded inputs.



Application

Floating Measurements

Switching Power Supply Design

Motor Drive Design

Electronic Ballast Design

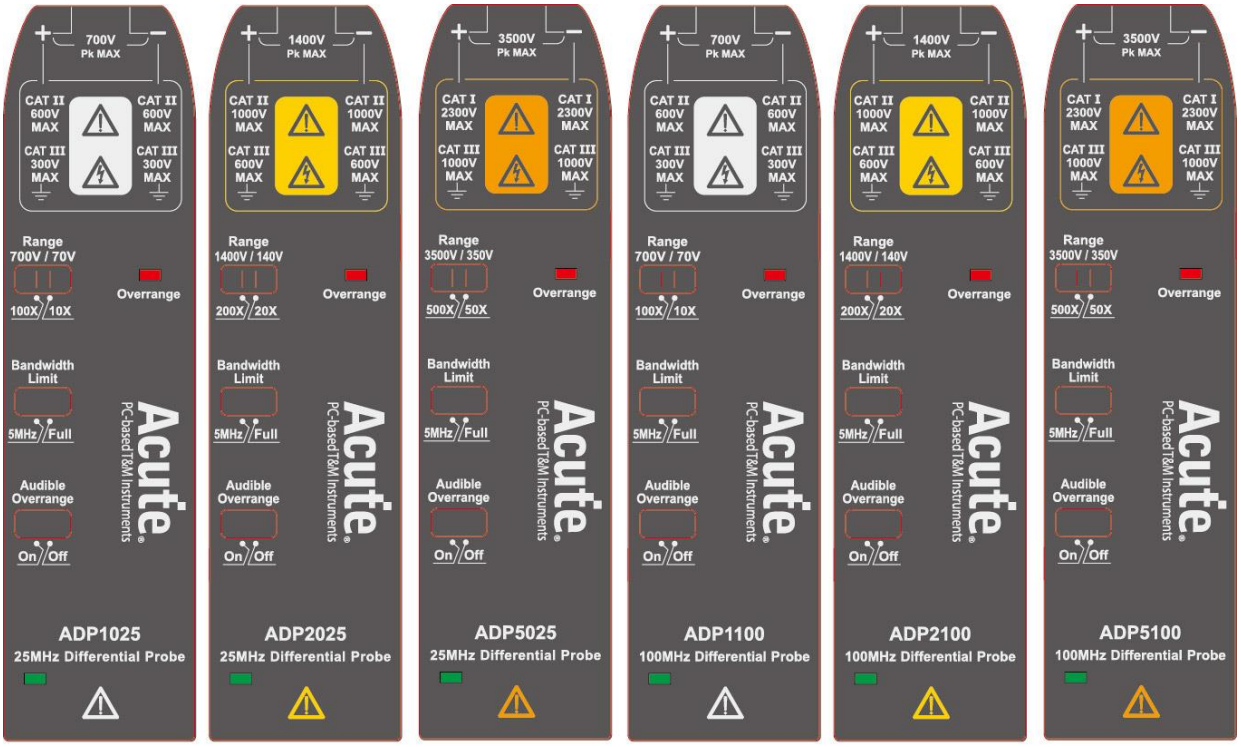
CRT Display Design

Power Converter Design and Service

Power Device Evaluation

Set each channel as Add A Signal.

Probe Appearance



DANGER. The rated working voltage with higher Measurement Category probably occurs a huge surge. **To avoid risk of electric shock or fire, do not exceed category rating of the probe.**

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: For safe operation, do not use the ADP High-voltage Differential Probe with oscilloscopes that have floating inputs.

- **Controls and Indicators**

  The probes have several features that make probing and measurement a simpler task.

  Depending on the probe model, your probe attenuation ranges may differ from those illustrated.

- **Overrange Indicator**

  The Overrange indicator lights red if the voltage of the input signal exceeds the linear range of the range setting.

  When this happens, the signal on the probe output does not accurately represent the signal on the probe input.

- **Range Switch (Attenuation Switch)**

  Switch the voltage range (attenuation) settings of the probe. The range should be adjusted on the oscilloscope.

  The Overrange LED lights if the applied voltage exceeds the selected range. To extinguish the LED, select a higher range.

  If a higher range is not available, do not attempt to take the measurement with the probe.

- **Bandwidth Limit Switch**

  Switch to 5MHz will limit the probe bandwidth below 5 MHz. 5 MHz is close to the switching frequency of most switching transistors (FETs) in switch mode power supplies (SMPS).

  The 5MHz filter assists in the characterization and testing of power supplies in switch mode by removing all high frequency content, noise and harmonics from the measurement.

- **Audible Overrange Switch**

  Switch on to enable an audible alarm that indicates when the measured signal exceeds the selected range.

- **Offset null trimmer (Offset cover on the bottom side)**

  There are 3 offset trimmers for nulling the DC-offset drift.

  1. 10X/100X Coarse trimmer for both 10X/100X (or 20X/200X, 50X/500X) offset nulling.
  2. 10X Fine-trimmer for 10X (or 20X, 50X) offset nulling.
  3. 100X Fine-trimmer for 100X (or 200X, 500X) offset nulling.

WARNING. To avoid risk of electric shock or fire, do not open the offset-cover as the probe connecting to any under testing circuit or signal.

Accessories

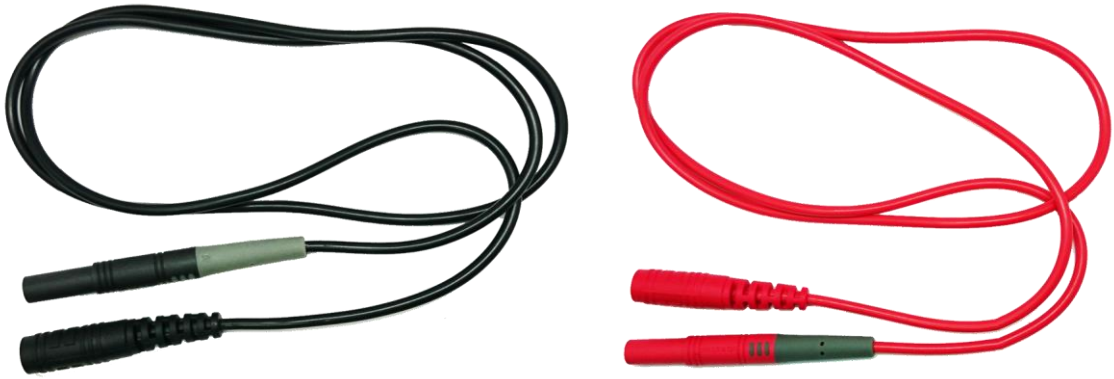
- **Integral Input Leads**

The integral input leads extend ~9 in (0.23 m) from the probe body. Connect the leads directly to your circuit, or use the extender leads and the accessories shown below.

- **Extender Leads**

These cables extend the reach of the probes by ~67 in (1.5 m). The banana ends connect to all of the clip accessories that are included with the probes. One pair of extender leads are included with the probes.

Maximum ratings: 2300 V CAT I * 1000 V CAT III



- **Hook Clips (AC280-FL)**

Plug the probe test leads into the banana plug connectors. Squeeze the grips to expose the hook clip and then clasp it around the circuit test point.

Maximum ratings: 1000 V CAT III, 600 V CAT IV One pair of hook clips is included with the probes.

- **Adjusting Tool (PF-903)**

  The screwdriver with Slot-end is for opening Offset-cover, and with Frierson-end is for adjusting trimmer.

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.

Specifications

Specification	ADP1025	ADP1100
Bandwidth (-3dB)	DC to 25MHz	DC to 100MHz
Attenuation	1:10/100	
Gain accuracy	±2%	
Offset zero (Scope gain=1X)	±10 mV	
Diff. Input Impedance	10Mohm, 1pF	
Rise time (small signal, 10-90%, 20-30℃)	14ns	≦3.7ns
Input voltage		
Diff. Vin	100X: ±700V (DC+ pk AC) 10X: ±70V (DC + pk AC)	
Comm. Vin	±700V	
Max. Vin to Earth	600V CAT-II ; 300V CAT-III	
Impulse withstand	2500V	
CMRR (typical)	60Hz: > 80dB	
	100kHz: > 60dB	
	3MHz: > 40dB	
	10MHz: > 35dB	
Output swing	±7V (to 1Mohm load)	
Offset adjusting range (Scope gain=1X)	Coarse: ±150mV Fine: ±30mV	
Bandwidth limit filters	-3dB @ ~5MHz	
Diff. overvoltage detection level	100X: > |±700| V 10X: > |±70| V	
Temperature		
Operating	0℃ to 40℃ (32℉ to 104℉)	
Storage	-30℃ to 70℃ (-22℉ to 158℉)	
Humidity		
Operating	0℃ to 35℃ (32℉ to 95℉), 0 to 85% RH	
Storage	-55℃ to 60℃ (-67℉ to 140℉), 0 to 90% RH	
Power requirement	USB (5V, < 250mA)	
Body dimension (L,W,H)mm^3	145,45,20	
Weight (Probe body only)	180g	
Length of BNC/USB-cable	90cm	
Length of Lead-cable	24cm	

Specification	ADP2025	ADP2100
Bandwidth (-3dB)	DC to 25MHz	DC to 100MHz
Attenuation	1:20/200	
Gain accuracy	±2%	
Offset zero (Scope gain=1X)	±10 mV	
Diff. Input Impedance	10Mohm, 1pF	
Rise time (small signal, 10-90%, 20-30℃)	14ns	≦3.7ns
Input voltage		
Diff. Vin	200X: ±1400V (DC + pk AC) 20X: ±140V (DC + pk AC)	
Comm. Vin	±1400V	
Max. Vin to Earth	1000V CAT-II ; 600V CAT-III	
Impulse withstand	4000V	
CMRR (typical)	60Hz: > 80dB	
	100kHz: > 60dB	
	3MHz: > 40dB	
	10MHz: > 35dB	
Output swing	±7V (to 1Mohm load)	
Offset adjusting range (Scope gain=1X)	Coarse: ±150mV Fine: ±30mV	
Bandwidth limit filters	-3dB @ ~5MHz	
Diff. overvoltage detection level	200X: > |±1400| V 20X: > |±140| V	
Temperature		
Operating	0℃ to 40℃ (32℉ to 104℉)	
Storage	-30℃ to 70℃ (-22℉ to 158℉)	
Humidity		
Operating	0℃ to 35℃ (32℉ to 95℉), 0 to 85% RH	
Storage	-55℃ to 60℃ (-67℉ to 140℉), 0 to 90% RH	
Power requirement	USB (5V, < 250mA)	
Body dimension (L,W,H)mm^3	145,45,20	
Weight (Probe body only)	180g	
Length of BNC/USB-cable	90cm	
Length of Lead-cable	24cm	

Specification	ADP5025	ADP5100
Bandwidth (-3dB)	DC to 25MHz	DC to 100MHz
Attenuation	1:50/500	
Gain accuracy	±2%	
Offset zero (Scope gain=1X)	±10 mV	
Diff. Input Impedance	10Mohm, 1pF	
Rise time (small signal, 10-90%, 20-30℃)	14ns	≦3.7ns
Input voltage		
Diff. Vin	500X: ±3500V (DC+ pk AC) 50X: ±350V (DC + pk AC)	
Comm. Vin	±3500V	
Max. Vin to Earth	2300V CAT-I ; 1000V CAT-III	
Impulse withstand	6000V	
CMRR (typical)	60Hz: > 80dB	
	100kHz: > 60dB	
	3MHz: > 40dB	
	10MHz: > 35dB	
Output swing	±7V (to 1Mohm load)	
Offset adjusting range (Scope gain=1X)	Coarse: ±150mV Fine: ±30mV	
Bandwidth limit filters	-3dB @ ~5MHz	
Diff. overvoltage detection level	500X: > |±3500| V 50X: > |±350| V	
Temperature		
Operating	0℃ to 40℃ (32℉ to 104℉)	
Storage	-30℃ to 70℃ (-22℉ to 158℉)	
Humidity		
Operating	0℃ to 35℃ (32℉ to 95℉), 0 to 85% RH	
Storage	-55℃ to 60℃ (-67℉ to 140℉), 0 to 90% RH	
Power requirement	USB (5V, < 250mA)	
Body dimension (L,W,H)mm^3	145,45,20	
Weight (Probe body only)	180g	
Length of BNC/USB-cable	90cm	
Length of Lead-cable	24cm	

Operation

- **Connecting the probe to the instrument with input impedance of 1 MΩ**

The probe requires an external 5Vdc power. Install the probe as follows:

1. Connect the output of the probe to the BNC input of the test instrument. The test instrument must be ground (not floating).
2. Connect the power cord to the USB power source.
3. The green LED of the probe light to confirm power-on.
4. Adjust the vertical offset (or position).
5. Select the proper range setting.

   ex, when using the ADP2025 probe, to achieve higher resolution and less noise when measuring signals below 140V pk, switch the attenuation to 20X. If the Overrange indicator lights or flashes, the output signal may not be accurate.

   Use the 200X setting instead.

   ⚠ **WARNING.** To avoid electrical shock, observe proper safety precautions when working with voltages above 60 VDC or 30 VACRMS.

   These voltage levels pose a shock hazard. Use only the accessories specified for the probe that you are using.

   Make sure that the accessories are fully mated before connecting or disconnecting.

   ⚠ **WARNING.** To avoid electrical shock or fire, make sure the test leads are in good condition.

   If the wire jacket becomes excessively worn, do not use the probe.
6. Using the appropriate probe accessories, connect the inputs of the probe to the circuit points to be measured.

   ⚠ **WARNING.** To avoid electrical shock or fire, keep the output cable of the probe away from the circuits being measured. The output cable is not intended to be in contact with the circuits being measured.

- **Connecting the probe to the test circuit**

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 (black) 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.

• Operation with Oscilloscope

When the probe is connected to a 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.

Some of the transition of the scale factor will result in a change of attenuation.

• Offset null adjusting

The probe 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 attenuation.

Some DC offset drift may occur from thermal effects and different power-ground loop.

The probe must have a warm-up period of at least 20 minutes and be in an environment that does not exceed the limits described.

There are 3 offset trimmers for nulling the offset drift:
1. 10X/100X Coarse trimmer for both 10X/100X (or 20X/200X, 50X/500X) offset null.
2. 10X Fine-trimmer for 10X (or 20X, 50X) offset null.
3. 100X Fine-trimmer for 100X (or 200X, 500X) offset null.

After 20 minutes warm-up, you may switch 10X/100X (or 20X/200X, 50X/500X) attenuation path to check their offset drift via oscilloscope.

If the offset drift exists on either attenuation path, you may open the Offset-cover by using the Slot-end of the adjusting tool(PF-903).

⚠ WARNING. **To avoid risk of electric shock or fire, do not open the offset-cover as the probe connecting to any under testing circuit or signal.**

Adjust the trimmers by using the Frierson-end of the adjusting tool(PF-903).

The skill of adjusting:

1. Make sure the probe already warm-up for over 20 minutes.
2. Disconnect the probe to any under testing circuit. Short the positive and negative input probes.
3. Place to the center position of both Fine-trimmers
4. If the DC-offset of both attenuation path all toward positive or negative position, adjust the Coarse-trimmer until either one is positive and another one is negative.
5. Adjust Fine-trimmer to null the DC offset of each attenuation path

• Bandwidth Limit

To comply with various test standards used for quantifying output noise of power supplies, the probe is capable of switching the bandwidth limit from full bandwidth to 5 MHz.

Operating Basics

- **Overrange Detection**

  Differential voltage outside the operating range will overdrive the circuitry of the probe and distort the output signal. When this differential Overrange occurs, the probe detects the condition and lights the Overrange indicator. With the Audible Overrange ON, the probe will also emit an audible alarm.

- **Common-Mode Rejection**

  The common-mode rejection ratio (CMRR) is the specified ability of a probe to reject signals that are common to both inputs.

  More precisely, CMRR is the ratio of the differential gain to the common-mode gain. The higher the ratio, the greater the ability of probe to reject common-mode signals.

  Common mode rejection decreases as the input frequency increases. For example, if you apply a 60 Hz line voltage of 500 Vp-p to both input leads of the probe, the probe rejects the signal by 80 dB (typical) and the signal appears as only a 50 mVp-p signal on the oscilloscope screen.

- **Twisting the Input Leads**

  Twisting the input leads helps to cancel noise that is induced into the input leads and to improve the high frequency response of the inputs.

- **Probe Loading**

  When you touch your probe tip to a circuit element, you are introducing a new resistance, capacitance, and inductance into the circuit. Frequency and impedance of the source determine how much the probe loads the circuit you are measuring. As the frequency of the source starts to increase beyond 1 kHz, the input impedance of the probe begins to decrease.

  The lower the impedance of the probe relative to that of the source, the more the probe loads the circuit under test. For a graph of frequency versus input impedance, refer to the Specifications section. As the graph shows, the probes have virtually no loading effect on sources with relatively low impedance and low frequency.

Functional Check

Using accessories that are shipped with your probe and a source that supplies AC line voltage, perform the following

⚠ ***WARNING.*** *To reduce risk of shock or fire, ensure that the accessories are fully mated before you connect to voltage sources above 42 Vpk.*

1. Connect the output of the probe to the oscilloscope input channel.

2. Connect the probe inputs to the AC voltage source.

3. Connect the inputs, set the voltage range, and perform the check as each row of the following table indicates.

Input 1	Input 2	Mode	Range setting	Check
Hot	Ground/Neutral	Differential	High (500/200/100x)	(A)
Hot	Ground/Neutral	Differential	Low (50/20/10x)	(B)
Hot	Hot	Common	High/Low	No

signal **11** If a DC offset voltage is present, null the DC-offset. (See *Offset Null adjusting section.*)

(A) Measurement instrument displays or indicates the line voltage

(B) Measurement instrument displays or indicates the line voltage. Overrange indicator lights if the input is ~20% over

Performance Verification

This procedure can be used to verify the warranted characteristics of the ADP series Active Differential Probes.

If the product does not meet specifications, it should be returned to a Acute service center.

There are no user accessible adjustments, so there is no adjustment procedure.

Acute Technology Inc.

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