# Terminology

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## *Oscilloscope / Differential Probe Terminology*

**>> Attenuation:** Ratio of the output signal to the input signal. Attenuation should remain constant decreasing by 3dB only as the frequency increases to the maximum bandwidth.

**>> Bandwidth:** The maximum -3dB frequency that can be expected.

**>> Cable Length**: Length of the cable from the end of the probe to the end of the connector. It is important to use a probe with just enough cable length for your needs. Long cables increase the capacitance and propagation delay of the probe.

**>> Compensation Range**: The range a probe can be compensated to match the input capacitance of the test equipment it is being used with.

**>> IEC 1010**: Probes with the IEC 1010 category rating have been designed for safety.

**>> Input Impedance**: The total resistance and capacitance as measured at the tip of the probe. This specification is used to define the loading effect of a probe. At frequencies under 1MHz the input resistance of the probe will have the most influence. At higher frequencies the input capacitance will have the most influence.

**>> Max Input Voltage**: The maximum voltage the probe can be used at.

**>> Max Differential Voltage:** The maximum differential voltage that can be measured by a differential probe

**>> Readout**: Probes with this capability are compatible with readout function oscilloscopes that automatically detect and display the attenuation factor of the probe.

**>> Rise Time**: The time required for the leading edge of a pulse to rise from 10% to 90% of its final value.

**>> CMRR:** Common Mode Rejection Ratio. A measure of a differential probes ability to reject any signals common to both test points in a differential measurement

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# Oscilloscope / Differential Probes

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***MARKETS***
*Electronic*
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***APPLICATIONS***
*Logic signal and waveform tests*
*Measure voice / data signals*
*Analyze power quality*
*Test motor control circuits*

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*Refer to pages 2-3 for specifications.*


## Oscilloscope / Differential Probe Selection

Selecting the correct oscilloscope probe ensures accuracy and can improve the performance of your test instrument. TPI offers a wide range of high quality oscilloscope probes designed to meet the most demanding applications.

The IP series monolithic probes have switchable attenuation and are available in 60 and 250MHz. These probes are ideal for technicians that need a basic oscilloscope probe.

The slimline design P and SP series probes are available in fixed or switchable attenuation. These series of probes are perfect for the technician needing additional features such as replaceable cable and interchangeable probe tip. The compensation adjustment for these probes is located in the BNC to eliminate noise pickup.

TPI also offers three models of high voltage differential probes all with high common mode rejection, wide bandwidth, and fast rise times. Differential probes enable the viewing of signals not referenced to earth ground and provide better performance than a matched pair of single ended oscilloscope probes when measuring these types of signals.

Several important factors must be taken into account when selecting the proper probe.

- The probe should have sufficient bandwidth and rise time for the test instrument and application. Choose a probe with at least an equal bandwidth as the scope it will be used with. For best performance a probe with twice the bandwidth as the scope should be selected.

- For oscilloscope probes, the input capacitance of your oscilloscope should be within the compensation range specification of the probe. In addition, if your oscilloscope has readout function, select a probe with this capability.

- For differential probes, make sure the maximum differential voltage is adequate for your application and the common mode rejection specification meets the requirements of the tests being performed.

Refer to the oscilloscope and differential probe specification tables to select the correct probe for your application.

# Oscilloscope Probe Specifications

## SPECIFICATIONS

| Model | Bandwidth | Attenuation | Cable Length | Input Impedance R | Input Impedance L | Max Input V DC + peak AC | Rise Time | Compensation Range | Readout | IEC1010 |
|---|---|---|---|---|---|---|---|---|---|---|
| **IP SERIES, SWITCHABLE** | | | | | | | | | | |
| IP060 | 60MHz | x1<br>x10 | 1.5M | 1Meg<br>10Meg | 200pF<br>22pF | 600V | 6ns | 20 ~ 45 pF | NA | CAT II |
| IP250 | 250MHz | x1<br>x10 | 1.5M | 1Meg<br>10Meg | 200pF<br>22pF | 600V | 1.5ns | 10 ~ 60pF | NA | CAT II |
| **SP SERIES, SWITCHABLE** | | | | | | | | | | |
| SP 60B | 60MHz | x1<br>x10 | 1.2M | 1Meg<br>10Meg | 47pF<br>18pF | 600V | 5.8ns | 10 ~ 30pF | NA | CAT II |
| SP 100B | 100MHz | x1<br>x10 | 1.2M | 1Meg<br>10Meg | 47pF<br>16pF | 600V | 3.5ns | 10 ~ 35pF | NA | CAT II |
| SP150B | 150MHz | x1<br>x10 | 1.2M | 1Meg<br>10Meg | 47pF<br>15pF | 600V | 2.3ns | 10 ~ 35pF | NA | CAT II |
| SP 200B | 200MHz | x1<br>x10 | 1.2M | 1Meg<br>10Meg | 47pF<br>15pF | 600V | 1.8ns | 10 ~ 35pF | NA | CAT II |
| SP 250B | 250MHz | x1<br>x10 | 1.2M | 1Meg<br>10Meg | 47pF<br>14pF | 600V | 1.4ns | 10 ~ 35pF | NA | CAT II |
| SP 300B | 300MHz | x1 | 1.2M | 1Meg | 47pF | 600V | 1.1ns | 10 ~ 35pF | NA | CAT II |
| **NON-SWITCHABLE** | | | | | | | | | | |
| 1P20B | 15MHz | x1 | 1.2M | 1Meg | 47pF | 600V | 23ns | | NA | |
| P100B | 100MHz | x10 | 1.2M | 10Meg | 16pF | 600V | 3.5ns | 10 ~ 35pF | NA | CAT II |
| P100BR | 100MHz | x10 | 1.2M | 10Meg | 16pF | 600V | 3.5ns | 10 ~ 35pF | Yes | CAT II |
| P200B | 200MHz | x10 | 1.2M | 10Meg | 15pF | 600V | 1.8ns | 10 ~ 35pF | NA | CAT II |
| P250 | 250MHz | x100 | 1.2M | 100Meg | 6.5pF | 1,200V | 1.4ns | 10 ~ 35pF | NA | |
| P250R | 250MHz | x100 | 1.2M | 100Meg | 6.5pF | 1,200V | 1.4ns | 10 ~ 35pF | Yes | |
| P250B | 250MHz | x10 | 1.2M | 10Meg | 14pF | 600V | 1.4ns | 10 ~ 35pF | NA | CAT II |
| P250BR | 250MHz | x10 | 1.2M | 10Meg | 14pF | 600V | 1.4ns | 10 ~ 35pF | Yes | CAT II |
| P1,000B | 1GHz | x10 | 1.0M | 500Ω | 3pF | 600V | NA | NA | Yes | CAT II |

## FAQ OSCILLOSCOPE PROBES

**Can TPI oscilloscope probes be used with Tektronix and Hewlett Packard scopes?**
Yes, TPI oscilloscope probes can be used with most major brands of scopes.

**Why is selecting a probe with the correct bandwidth important?**
Choosing a probe with the correct bandwidth enables you to use your scope to its full potential.

**Why do TPI oscilloscope probes have a compensation range and compensation adjustment?**
Since the input of every oscilloscope is different our probes have a compensation adjustment so the capacitance of the probe can be adjusted to match the capacitance of the scope input. The compensation range is the range of adjustment available. Matching probe and scope capacitance is important to prevent waveform distortion.

**What is the benefit of a probe with X1 and X10 switchable attenuation?**
Passive X10 probes allow you to read a signal 10 times the amplitude of that viewed with a X1 probe. Example: an eight-division graticule on 5V/Div setting would display a 40 volt peak-to-peak signal using the X1 setting. You can view a 400 volt signal using the X10 setting.

**What is readout?**
Readout is an activator pin that protrudes out of the BNC connector of an X10 or X100 probe that completes a circuit. There are contacts around the BNC connector on the front of the oscilloscope and the attenuation is automatically set. If your scope does not have contacts around the BNC connector, it does not need this feature.

**What probe should I buy?**
Select a probe that is at least the same bandwidth as the oscilloscope you intend to use; however, for optimum performance, select a probe with two times the bandwidth of your test instrument.

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# Differential Probe Specifications

## SPECIFICATIONS

| FUNCTION | ADF25 | ADF25A | ADF25C |
|---|---|---|---|
| Bandwidth | DC -25 MHz (-3dB) | DC -25 MHz (-3dB) | DC -70 MHz (-3dB) |
| Accuracy | ± 2% | ± 2% | ± 2% |
| Risetime | 14nS | 14nS | 14nS |
| CMRR (Typical) | | | |
| 50Hz | -80dB | -86dB | -80dB |
| 20kHz | -60dB | -66dB | -60dB |
| 200kHz | -50dB | -56dB | -50dB |
| Input Impedance | 4M/10pf each side to ground 8M/5pF between inputs | 4M/10pf each side to ground 8M/5pF between inputs | 10M/10pf each side to ground 20M/5pF between inputs |
| Input Voltage | ±140V DC Inc.Pk AC@ 20:1 or 100V RMS | ±170V DC Inc.Pk AC@ 10:1 or 50V RMS | ±700V DC Inc.Pk AC@ 100:1 or 400V RMS |
| Maximum Differential | ± 1,400VDC Inc. Pk AC 200:1 or 1,000V RMS | ± 1,400VDC Inc. Pk AC 100:1 or 500V RMS | ± 7,000VDC Inc. Pk AC 1,000:1 or 5,000V RMS |
| Output Voltage | ± 7V minimum 2KΩ load | ± 7V minimum 2KΩ load | ± 7V minimum 50KΩ load |
| Offset (typical) | | <± 5mV -10° C to + 40° C | |
| Common Mode | ± 1,400V DC Inc. Pk AC or 1,000V RMS | ± 1,400V DC Inc. Pk AC or 1,000V RMS | ± 7,000V DC Inc. Pk AC or 2,500V RMS |
| Noise (typical) | 0.7mV RMS | 0.7mV RMS | 0.9mV RMS |
| Output Source Impedance | 1Ω @ 1kHz. 8Ω @1 MHz | 1Ω @ 1kHz. 8Ω @1 MHz | 50Ω |
| Operating Temperature | -10° C to + 40° C (14°F to 104°F) | | |
| Power Requirements | 4 AA cell or 6V main adapters: DC/600mA or DC/800mA | | |
| Power Supply | Not included | | |
| Input Leads | 45 cm double insulated PVC terminated in 44 mm safety plugs | 45 cm double insulated PVC terminated in 44 mm safety plugs | 60 cm double insulated Rubber terminated in sprung hooks |
| IEC1010 | CAT III | CATIII | CATII |

## FAQ DIFFERENTIAL PROBES

**What can you measure with a differential probe?**
With 20 MHz bandwidth, a switchable attenuation of 20:1, and 200:1 (part no. ADF25), you can measure high-voltage circuits, motor speed controls, power supply design, and high-power electronic converters.

**What comes in the probe set?**
You will receive one differential probe, 2 probe tips, and 2 retractable sprung probes for accessing small wires for measurements.

**Why is common rejection ratio (CMMR) important for differential probes?**
CMMR is a measure of how well a differential probe will reject signals common to both test points, leaving the desired signal to be displayed by the scope

**What does the maximum differential voltage specification tell me?**
This specification provides you with the maximum voltage between the inputs the differential probe can be subjected to. This is important because the maximum voltage should never be exceeded.

**What is input impedance?**
Impedance is a measure of how much a signal will be restricted. In general, it is best to have high resistance and low capacitance to ensure signal quality, accuracy of tests, and to ensure the probe doesn't load down the circuit under test.