

BK PRECISION®

Differential Probe for
Oscilloscopes

PR-60

Features:

- 1000 Vrms input voltage max.
- 25 MHz Bandwidth
- x10 and x100 attenuation
- -80 dB CMRR (@ 60 Hz)
- Battery operated with external supply option

CE IEC 61010 CAT II

Contents

1. Safety precautions
2. Items supplied with the probe
3. Introductions to the differential probe
4. Specifications
5. Using the probe
6. Maintenance and repair
7. Examples of differential probe applications

Symbols used

The following safety signs are used on the probe and in these instructions:



Caution, dangerous voltages!



*Caution, danger!
Read instructions!*

1. Safety precautions

Prior to using the differential probe for the first time, read the following carefully:

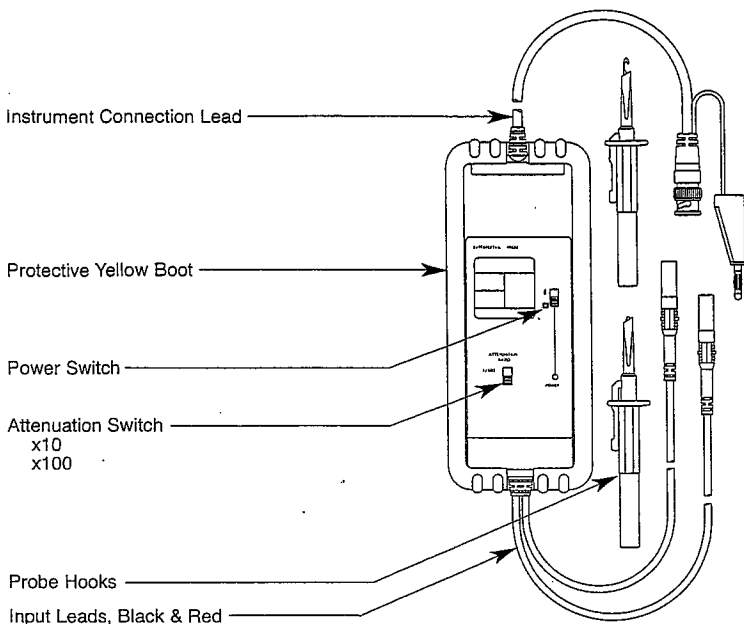
- The probe must only be used by qualified personnel.
- Earthing the probe: This probe is designed to be Class 1 (connected to a protective conductor) so, apply carefully the following connecting procedure: By means of the BNC output socket and auxiliary grounding terminal, connect the probe to the oscilloscope in order to earth it. It is therefore necessary to check that the oscilloscope itself is connected to earth via a lead which conforms to regulations. Connect the probe to the oscilloscope prior to connecting the leads to the item to be tested.
- It is imperative not to disconnect the probe from the oscilloscope until after the test leads have been disconnected.
- Use only high quality accessories which conform to safety standards.
- Never open the probe while the input leads are connected.
- Never exceed the maximum input voltage of $\pm 1400\text{V DC} + \text{peak AC}$ or 1000Vrms .
- Do not expose the probe to humidity, steam, or an aggressive or explosive environment.
- Keep the case and the connection leads in a clean condition and prevent humidity or liquid from being able to penetrate inside the probe or its component parts.
- Do not use the probe if there is any reason to suspect that it is not operating properly or that it is faulty.
- The mains-power supply must conform to the standards in force.
If the probe is not to be used for a prolonged period, remove the batteries, so that it will not damage the battery compartment.

2. Items supplied with the probe

The differential probe is supplied with the following:

- | | | | |
|---|--------------------|---|------------------------|
| 1 | Differential probe | 4 | AA 1.5V batteries |
| 2 | Probe Hooks | 1 | Operating instructions |

3. Introductions to the differential probe



4. Specifications

Bandwidth	DC to 25 MHz (-3dB)
Accuracy	$\pm 2\%$
Rise Time	< 20 nS
Input Impedance	$4\text{ M}\Omega / 10\text{ pF}$ each side to ground
Input Voltage:	
Max. Differential	$\pm 70\text{ V}$ (DC+Peak AC) or 50 Vrms for 1/10 ratio $\pm 700\text{ V}$ (DC+Peak AC) or 500 Vrms for 1/100 ratio
Max. Common Mode	$\pm 700\text{ V}$ (DC+Peak AC) or 500 Vrms for 1/10 or 1/100 ratio
Absolute Max. Voltage (Differential or Common Mode)	$\pm 1400\text{ V}$ (DC+Peak AC) or 1000 Vrms for 1/10 or 1/100 ratio
Output Voltage:	
Max. Amplitude	$\pm 7\text{ V}$ (into $1\text{ M}\Omega$ input)
Offset (Typical)	$< \pm 20\text{ mV}$ (Max.), -10°C to $+40^\circ\text{C}$
Noise (Typical)	0.6 mVrms
Source Impedance (Typical)	$1\text{ }\Omega$ @ 1 kHz , $8\text{ }\Omega$ @ 1 MHz
CMRR (Typical)	-80 dB @ 60 Hz ; -40 dB @ 1 MHz
Ambient Operating Temperature	-10°C to $+40^\circ\text{C}$
Ambient Storage Temperature	-30°C to $+70^\circ\text{C}$
Ambient Operating Humidity	25 to 85% RH at 25 to $+35^\circ\text{C}$
Ambient Storage Humidity	25 to 85% RH at 25 to $+65^\circ\text{C}$
Power Requirements	$4 \times \text{AA cells}$ or $6\text{ V DC}/60\text{ mA}$ mains adapter (not supplied)
Length of Input Lines	45 cm
Length of BNC Cable	95 cm (RG58/U)
Dimension (L x W x H)	$168 \times 62 \times 20\text{ mm}$ ($6.6 \times 2.4 \times 0.8''$)
Weight	285 g w/batteries (0.583 lbs)

5. Using the probe



Before using the differential probe for the first time, read carefully the section on the precautionary measures at the beginning of these instructions.

- *Inserting or replacing the batteries*

Before using the differential probe for the first time, the batteries supplied with the device must be inserted in the battery compartment.



At the time of inserting or replacing the batteries, the input leads must not be connected to an item to be tested! Never operate the probe with the case open.

To insert or replace the batteries, remove the yellow protective rubber boot by peeling it away from the case and then sliding back the battery cover. If necessary, the old AA Batteries can then be removed and the new ones inserted into the compartment. Always ensure the batteries are positioned for proper polarity. After inserting the batteries, close the case and replace the boot.

- *Using an external power supply*

Using the socket on the side of the probe, it is possible to connect the device to an external power supply. The internal batteries are then disconnected. A mains transformer, for example, can be used for the external power supply. The power supply voltage must be 6 V DC. The current consumption will be approximately 60 mA. Take into account the fact that the output voltage of some supplies considerably exceeds their nominal value! The connector plug is 2.1mm x 5.5mm, female center pin positive. Only use on external power supply that conforms with all safety standards in force.

- *Connecting the probe*

Prior to connecting the probe, read the section on the safety precautions at the beginning of these instructions! Connect the output of the probe to the input of the oscilloscope, with the coaxial lead inserted into the BNC socket. The input impedance of the oscilloscope must be 1M Ω . In view of the high impedance connection it is not advisable to extend the cable considerably. In the case of using an oscilloscope incorporation a 50 Ω input, the output voltage of the probe is reduced by half. It should also be noted that battery consumption may increase. In the case of a low impedance connection, it is possible to extend the cable without difficulty.

- *Test equipment risk assessment*

Users of this equipment and or their employers are reminded that Health and Safety Legislation require them to carry out a valid risk assessment of all electrical work so as to identify the potential sources of electrical danger or risk of

electrical injury such as from inadvertent short circuits. Where the assessment shows that the risk is significant then the use of fused test leads constructed in accordance to the HSE guidance note GS38 "Electrical Test Equipment for use by Electricians" should be used.

- *Switching the probe on and off*

The probe is switched on by sliding the power switch to the 1 position. The power condition is indicated by the LED lamp lighting up. The device can be switched off by sliding the switch to the 0 position.

- *Choice of attenuation*

The probe offers the choice of two attenuation factors: $\times 10$ and $\times 100$.

For an attenuation factor of $\times 10$, slide the selector switch to the 1/10 position. The voltage at the inputs is equal to the voltage displayed on the oscilloscope $\times 10$.

For an attenuation factor of $\times 100$, slide the selector switch to the 1/100 position. The voltage at the inputs is equal to the voltage displayed on the oscilloscope $\times 100$.

- *Procedure for using the differential probe*

- Check the mains earth connection to the oscilloscope
- Connect the probe to the oscilloscope.
- Adjust the vertical sensitivity on the oscilloscope (V/div.)
- Select the attenuation factor on the probe ($\times 10$ or $\times 100$)
- Switch the probe on (I).
- If necessary, adjust the reference line on the oscilloscope.
- Connect the test leads to the item to be tested.

6. Maintenance and repair

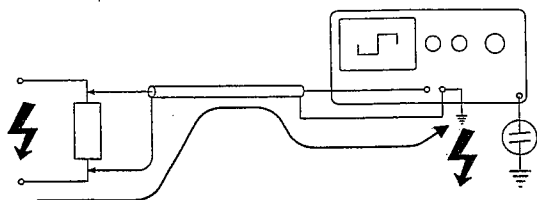
The differential probe does not require any special maintenance. If necessary, clean the case with a damp cloth. Ensure that no moisture enters inside the device. Do not use the probe if there is any reason to think that it is not operating properly or that it is faulty. In the case of repair, send the device to the distributor. Do not attempt to service or repair the probe yourself.

7. Examples of differential probe applications

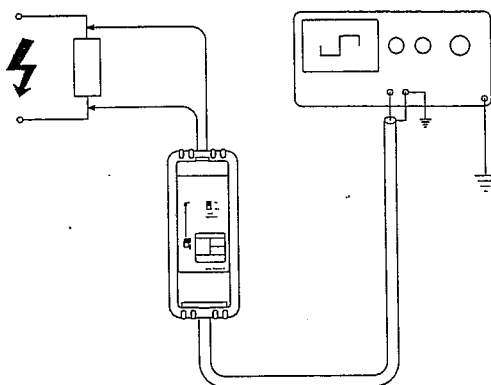
- *Reference potential and safety*

The measuring inputs of a normal mains-operated oscilloscope are referenced to mains-earth potential because they are connected, via the oscilloscope power cord, to the mains-earth. Also, other exposed metal parts of the oscilloscope are connected to earth. Therefore, if an oscilloscope is connected to measure live mains circuits such as switching controllers, thyristors or power

MOSFETs then this can cause short circuits damaging the system components and present an extreme user safety hazards.



The oscilloscope casing may carry lethal voltages when the ground lead is detached.



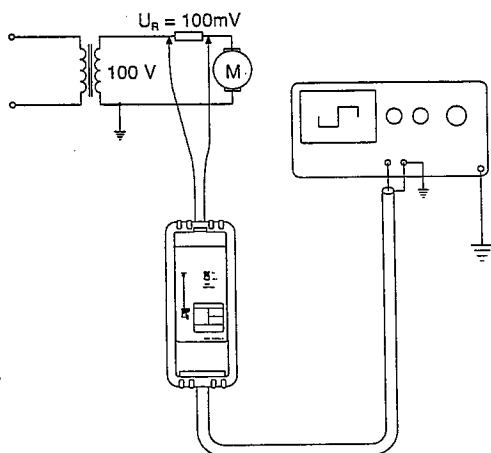
Differential probe for safe measurements

These safety hazards still exist if the oscilloscope earth is disconnected or if it is powered through a mains-isolating transformer because the oscilloscope input and other metal parts will be raised to the test circuit voltage.

However, the use of a differential probe provide safe single or multi-channel measuring connections.

Apart from the danger which exists when taking measure-

ments with floating potential, further problems arise in multi-channel measurements because ground connections still exist between the oscilloscope inputs. Using a differential probe ensures safety. The probe allows measurements between any two points of a circuit without a reference point. However, since the output is related to ground, it can be easily connected to the input of the earthed oscilloscope.



• Earth loop circuits and common mode voltages

While the ground potential can in principle be used as a

Example: Voltage at the motor series resistor is only a fraction of the common-mode voltage which is superimposed on the measuring voltage.

common reference point in many cases, it is often impossible to make reference connections to the same common point. This may create earth loops which means that a voltage may build up between the ground potential of the investigated circuit and the ground potential of the oscilloscope. The loop can be greater than the signal voltage and falsify the measuring result. The use of a differential probe is frequently the only solution in such cases or when a high common-mode voltage is present.

Highly accurate measurements largely unaffected by interference voltages can be made thanks to the high degree of common-mode rejection offered by the differential probe and the possibility of tapping the measuring voltage direct at the signal source. The differential probe expands each oscilloscope input to provide differential input connections for safe measuring on floating circuits. The probe also provides rejection of common mode signals.