

FLUKE®

i1000s
AC Current Probe for Oscilloscopes

Users Manual

(English)

LIMITED WARRANTY AND LIMITATION OF LIABILITY

Each Fluke product is warranted to be free from defects in material and workmanship under normal use and service. The warranty period is one year and begins on the date of shipment. Parts, product repairs, and services are warranted for 90 days. This warranty extends only to the original buyer or end-user customer of a Fluke authorized reseller, and does not apply to fuses, disposable batteries, or to any product which, in Fluke's opinion, has been misused, altered, neglected, contaminated, or damaged by accident or abnormal conditions of operation or handling. Fluke warrants that software will operate substantially in accordance with its functional specifications for 90 days and that it has been properly recorded on non-defective media. Fluke does not warrant that software will be error free or operate without interruption.

Fluke authorized resellers shall extend this warranty on new and unused products to end-user customers only but have no authority to extend a greater or different warranty on behalf of Fluke. Warranty support is available only if product is purchased through a Fluke authorized sales outlet or Buyer has paid the applicable international price. Fluke reserves the right to invoice Buyer for importation costs of repair/replacement parts when product purchased in one country is submitted for repair in another country.

Fluke's warranty obligation is limited, at Fluke's option, to refund of the purchase price, free of charge repair, or replacement of a defective product which is returned to a Fluke authorized service center within the warranty period.

To obtain warranty service, contact your nearest Fluke authorized service center to obtain return authorization information, then send the product to that service center, with a description of the difficulty, postage and insurance prepaid (FOB Destination). Fluke assumes no risk for damage in transit. Following warranty repair, the product will be returned to Buyer, transportation prepaid (FOB Destination). If Fluke determines that failure was caused by neglect, misuse, contamination, alteration, accident, or abnormal condition of operation or handling, including overvoltage failures caused by use outside the product's specified rating, or normal wear and tear of mechanical components, Fluke will provide an estimate of repair costs and obtain authorization before commencing the work. Following repair, the product will be returned to the Buyer transportation prepaid and the Buyer will be billed for the repair and return transportation charges (FOB Shipping Point).

THIS WARRANTY IS BUYER'S SOLE AND EXCLUSIVE REMEDY AND IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, INCLUDING BUT NOT LIMITED TO ANY IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. FLUKE SHALL NOT BE LIABLE FOR ANY SPECIAL, INDIRECT, INCIDENTAL, OR CONSEQUENTIAL DAMAGES OR LOSSES, INCLUDING LOSS OF DATA, ARISING FROM ANY CAUSE OR THEORY.

Since some countries or states do not allow limitation of the term of an implied warranty, or exclusion or limitation of incidental or consequential damages, the limitations and exclusions of this warranty may not apply to every buyer. If any provision of this Warranty is held invalid or unenforceable by a court or other decision-maker of competent jurisdiction, such holding will not affect the validity or enforceability of any other provision.

Fluke Corporation
P.O. Box 9090
Everett, WA 98206-9090
U.S.A.

Fluke Europe B.V.
P.O. Box 1186
5602 BD Eindhoven
The Netherlands

Table of Contents

Title	Page
Introduction	1
Box Contents	2
Safety Information	2
Safety Specifications	4
Instrument Compatibility	4
Electrical Specifications	5
Mechanical Specifications	7
Typical Response Curves	8
Operation	11
Measurement Considerations	13
Maintenance	13
Cleaning and Storage	13
Replacement Parts	14
Service	14
Contacting Fluke	14

List of Tables

Table	Title	Page
1.	Symbols	4
2.	Input Ranges and Accuracy	6
3.	Maximum Phase Shift	6

List of Figures

Figure	Title	Page
1.	i1000s AC Current Probe	2
2.	Typical Response Curves	8
3.	ScopeMeter Setups	12

Fluke i1000s AC Current Probe

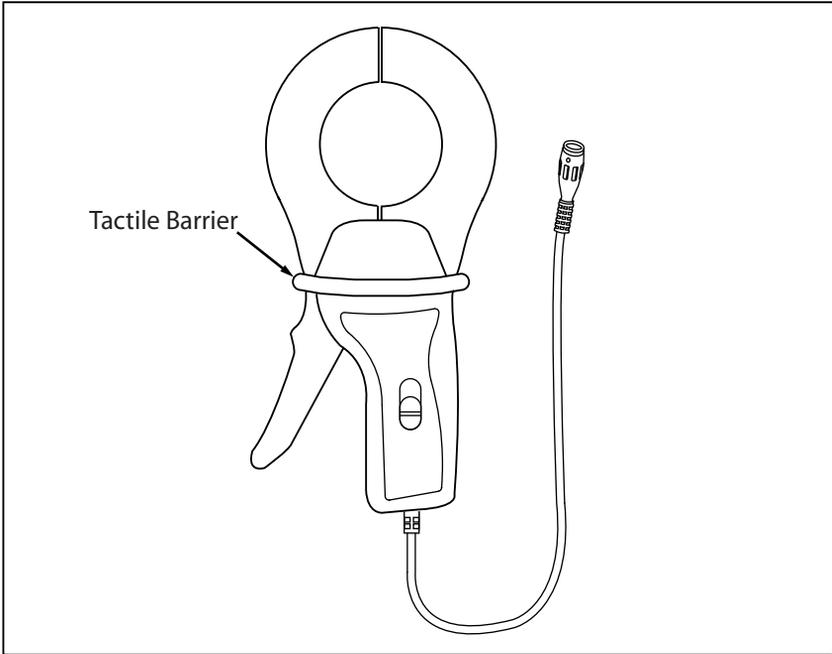
Introduction

The Fluke i1000s is a clamp-on ac current probe designed to expand oscilloscope applications in industrial and power environments. The Current Probe (shown in Figure 1) provides the following features:

- Ideal for measuring distorted current waveforms and harmonics.
- Allows accurate measurement of currents from 100 mA to 1000 A rms, 5 Hz to 100 kHz without breaking into the circuit.
- A passive filter eliminates noise and ring on rapidly rising di/dt waveform, ensuring accurate screen displays.
- Connects directly to an oscilloscope through a reinforced coaxial cable and an insulated BNC connector.
- Rated for 600 V ac circuits of Overvoltage Category III, Pollution Degree 2. (See "Safety Information" for definitions.)

⚠ Warning

Read "Safety Information" before using the probe.



aef01f.eps

Figure 1. i1000s AC Current Probe

Box Contents

The shipping container includes the probe, this users manual, a Quick Reference Card, and a product registration card.

Safety Information

Read the following safety information carefully before attempting to operate or service the Current Probe.

In this manual, a **⚠ Warning** identifies conditions and actions that pose hazard(s) to the user. A **⚠ Caution** identifies conditions and actions that may damage the Current Probe. International electrical symbols used are explained in Table 1.

⚠ Warning

- **To avoid injury and ensure safe operation of the probe, follow all safety precautions detailed in this manual.**
- **Never use the probe on circuits rated higher than 600 V in measurement category III (CAT III). Use extreme caution when clamping around uninsulated conductors or bus bars.**
- **CAT III equipment is designed to protect against transients in equipment in fixed equipment installations, such as distribution panels, feeders and short branch circuits, and lighting systems in large buildings.**
- **Do not hold the clamp anywhere beyond the tactile barrier. See Figure 1.**
- **Adhere to local and national safety codes. Individual protective equipment must be used to prevent shock and arc blast injury where hazardous live conductors are exposed.**
- **Use caution when working with voltages above 60 V dc, 30 V ac rms or 42 V ac peak. Such voltages pose a shock hazard.**
- **Check the magnetic mating surfaces of the probe jaws; these should be free of dirt, dust, rust, or other foreign matter.**
- **Do not use a probe which is cracked, damaged, or has a defective cable. Such probes should be made inoperative by taping the clamp shut to prevent operation.**

Table 1. Symbols

	May be used on HAZARDOUS LIVE conductors.
	Equipment protected by double or reinforced insulation.
	Risk of Danger. Important Information. See Users Manual.
	Risk of Electric Shock.
	Complies with EN/IEC 61010-1 2 nd Edition & EN/IEC 61010-02-032
	Earth Ground
	AC (Alternating Current)

The i1000s complies with IEC Publication 61010-2-032. Follow all warnings to ensure safe operation.

Use of this equipment in a manner not specified herein may impair the protection provided by the equipment.

Safety Specifications

- Rated for 600 V ac circuits of Measurement Category III, Pollution Degree 2, per EN/IEC 61010-1 and EN/IEC 61010-2-032.
- Complies with American industry standards UL61010B-1 and UL61010B-2-032 and European standards EN/IEC 61010-1 2nd Edition and EN/IEC 61010-02-032.

Instrument Compatibility

The i1000s is compatible with any oscilloscope that accepts a standard BNC connector and has an input impedance of greater than or equal to 1 M Ω in parallel with a maximum of 47 pF. To achieve the stated accuracy, use the i1000s with an oscilloscope having an accuracy of $\pm 2\%$ or better. The i1000s may be used with digital multimeters (DMMs) if a BNC to banana jack adapter is used.

Electrical Specifications

Current Range: 100 mA to 1000 A ac rms (2000 A instantaneous peak).

⚠ Warning

To avoid potential thermal burns from the jaws when measuring currents equal to or greater than 800 A ac rms in the ambient temperature range of 30 to 50° C (86 to 122° F), limit the measurement cycle to a measurement time of 5 minutes or less, followed by a cooling time of 15 minutes or more.

Output Signal: mV output signal (2 V peak max). 3 ranges, switch selectable on handle.

Influence of Temperature: < 0.1% per °C for temperatures from -10 to 18° C and from 28 to 50° C.

Usable Frequency Range: 5 Hz to 100 kHz. (See Appendix A for typical response curves.)

Load Impedance

Required instrument input impedance: > 1 MΩ in parallel with up to 47 pF

di/dt max: 10 A/μs

Ampere Second Product:¹ 1.0

Rise or fall time: < 40 μs

¹To avoid the inaccurate readings that result from core saturation, the Ampere Second Product should not be exceeded. If the average amplitude times the duration of a given current pulse does not exceed 1.0 Ampere Second Product, the probe will be linear and specified accuracies will apply.

Table 2. Input Ranges and Accuracy

Switch Position	Input Range	Accuracy*
100 mV/A	100 mA to 10 A (20 A instantaneous peak)	3% of reading \pm 10 mV
10 mV/A	100 mA to 100 A (200 A instantaneous peak)	2% of reading \pm 5 mV
1 mV/A	1 A to 1000 A (2000 A instantaneous peak)	1% of reading \pm 1 mV

*Accuracies and Phase Shifts are given for 48 Hz to 65 Hz; an ambient temperature of 23° C \pm 5° C, relative humidity of 20 to 75%, conductor centered in jaw window, no DC component, no external current carrying conductor, magnetic field < 40 A/m and 1 M Ω /47 pF oscilloscope or meter input impedance.

Table 3. Maximum Phase Shift

100 mV/A		10 mV/A		1 mV/A	
0.1 to 0.5 A	NA	0.1 to 5 A	N/A	1 to 50 A	N/A
0.5 to 2 A	NA	5 to 20 A	15°	50 to 200 A	3°
2 to 10 A	15°	20 to 100 A	10°	200 to 1000 A	2°

Accuracies and Phase Shifts are given for 48 Hz to 65 Hz; an ambient temperature of 23° C \pm 5° C, relative humidity of 20 to 75%, conductor centered in jaw window, no DC component, no external current carrying conductor, magnetic field < 40 A/m and 1 M Ω /47 pF oscilloscope or meter input impedance.

Working Voltage (Clamp jaws to Ground):

600 V ac rms on Measurement Category III, Pollution Degree 2 circuits per EN/IEC 61010-1 and EN/IEC 61010-2-032.

Float Voltage (Output cable and connector to Ground):

600 V ac rms on Measurement Category III, Pollution Degree 2 circuits per EN/IEC 61010-1 and EN/IEC 61010-2-032.

Influence of Adjacent Conductor:

< 1.0 mA/A ac

Influence of Conductor Position in Jaw Opening:

< 0.5 % of reading from 10 Hz to 5 kHz

< 4.0 % of reading from 5 to 40 kHz

< 10.0 % of reading from 40 to 100 kHz.

Operating Temperature:

-10 °C to +50 °C (14 °F to 122 °F); 100 mA to 800 A ac rms continuous, 800 to 1000 A ac rms for 5 minutes On, 15 minutes Off.

-10 °C to +30 °C (14 °F to 86 °F); 100 mA to 1000 A ac rms continuous

Storage Temperature:

-40 °C to +71 °C (-40 °F to +160 °F)

Relative Humidity:

0 % to 85 % (10 °C to 30 °C); 0 % to 75 % (30 °C to 40 °C); 0 % to 45 % (40 °C to 50 °C)

Altitude:

Operating: 2000 m

Mechanical Specifications

Maximum Cable Diameter:

2.13 inches (54 mm)

Dimensions:

4.37 in. x 8.50 in. x 1.77 in. (111 mm x 216 mm x 45 mm)

Weight:

1.21 lbs (550 g)

Output Cable:

63 inches (1.6 m) PVC-insulated lead with insulated BNC connector.

Enclosure Protection:

IP 40 (IEC 529)

Drop Test:

1 meter per IEC 68-2-32

Mechanical Shock:

100 G per IEC 68-2-27.

Vibration:

5/55/5 Hz, no less than 0.25 mm per IEC 68-2-6.

Typical Response Curves

Typical response curves are shown in Figure 2.

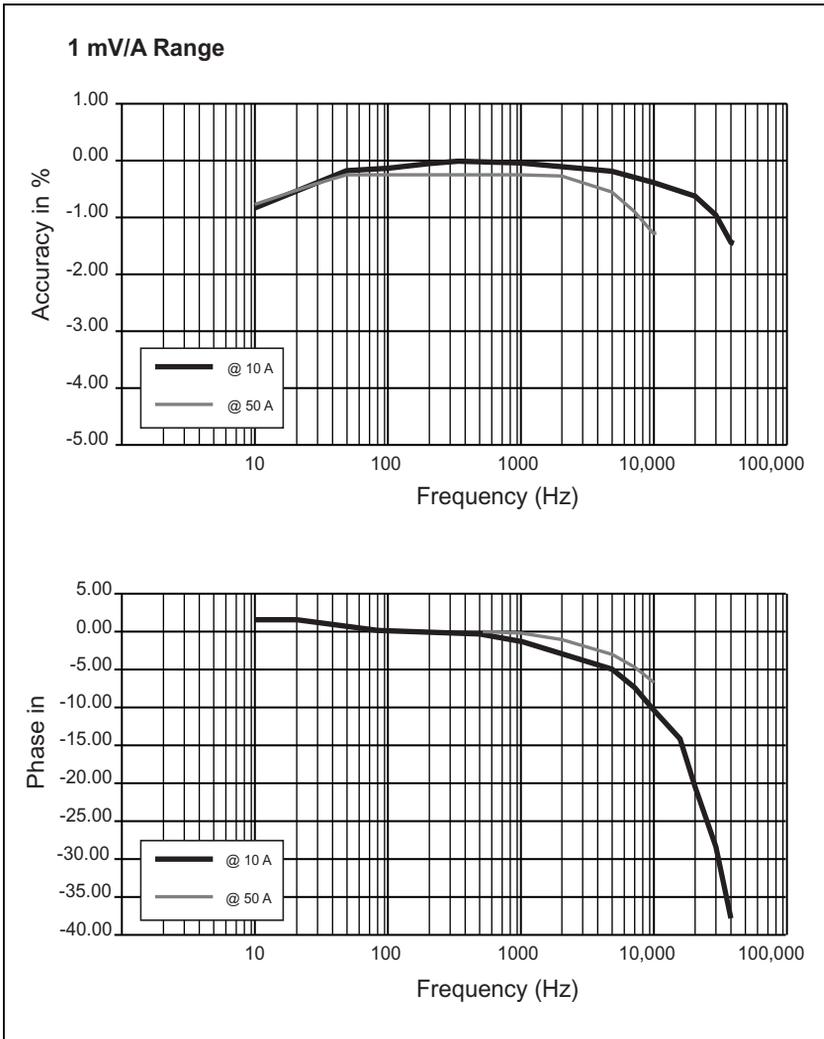


Figure 2. Typical Response Curves

ae107f.eps

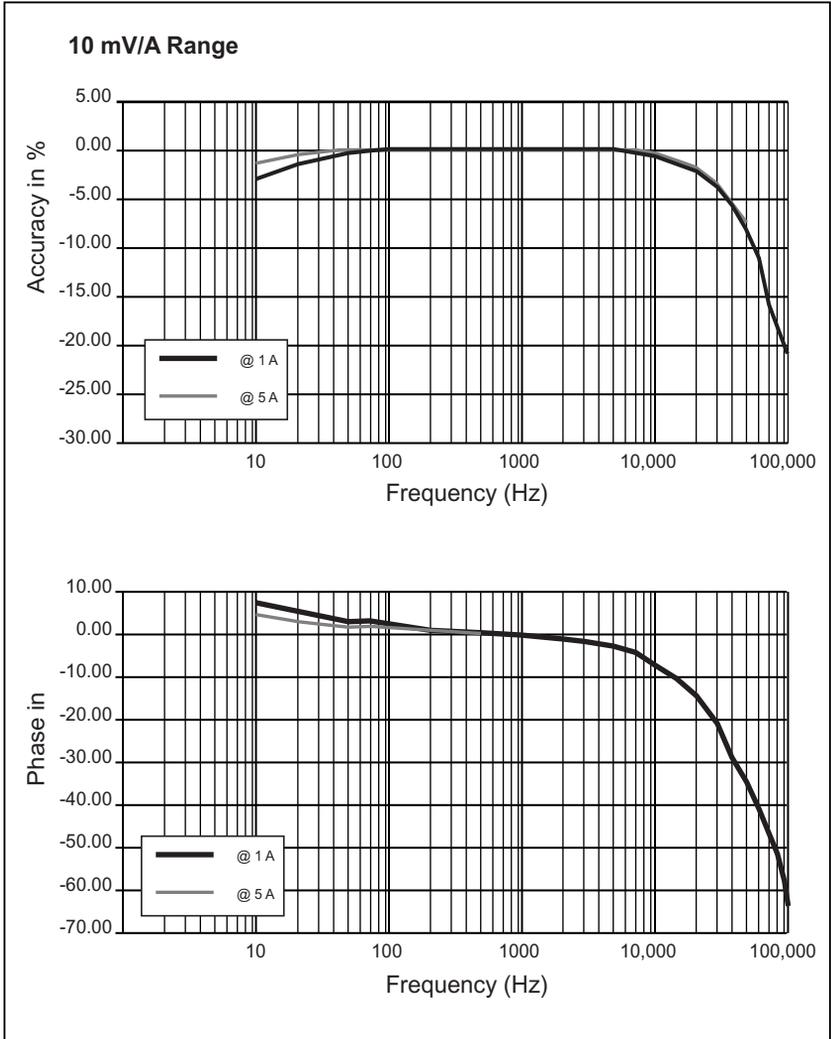


Figure 2. Typical Response Curves (cont)

aef08f.eps

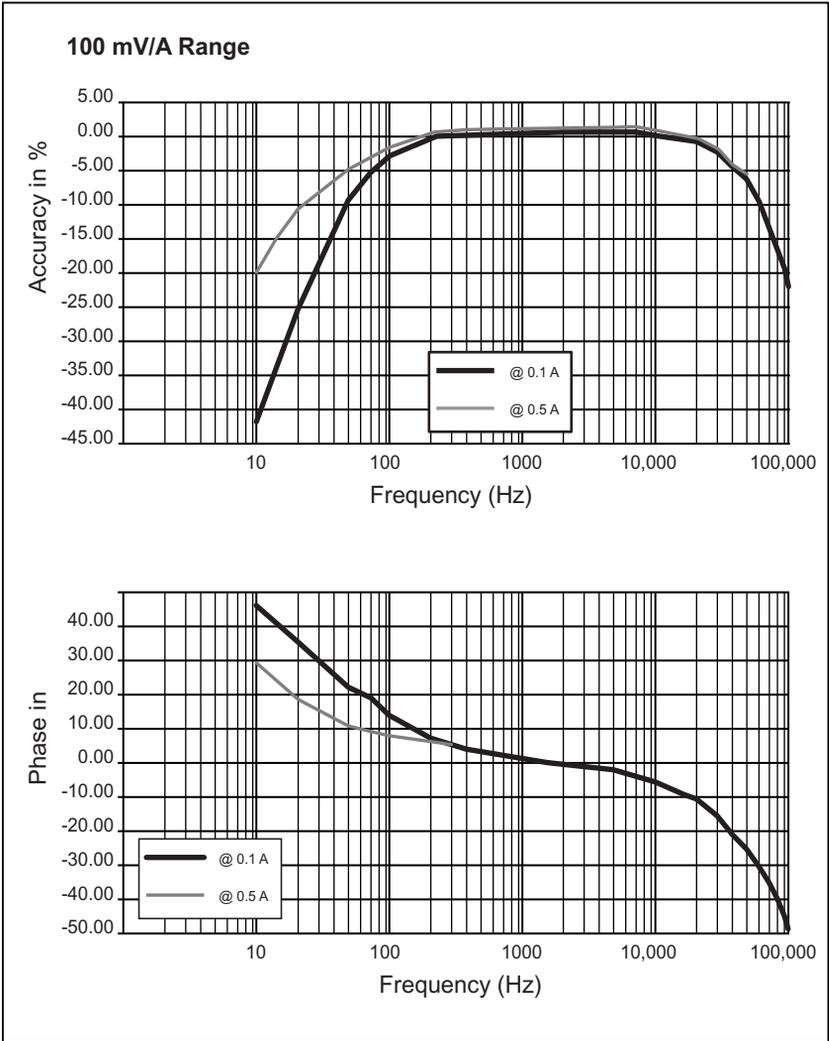


Figure 2. Typical Response Curves (cont)

aef09f.eps

Operation

Use the following procedure to make a measurement:

1. Connect the i1000s Current Probe to the desired input channel on the oscilloscope.
2. On the Current Probe, select the least sensitive range (1 mV/A). See Figure 1 for selector switch location.
3. On your oscilloscope, select an appropriate range. Use a 1:1 probe setting.

Note

If using the Fluke ScopeMeter 123, use this procedure for step 3:

1. Press  (shown in Figure 3).
 2. When the **MEASUREMENTS** screen appears, select **AMP...** and **ENTER**.
 3. When **ENTER** is pressed, the **AMPERE PROBE** screen appears.
 4. Select the appropriate range (i.e. 1 mV/A).
4. Clamp the probe around the conductor to be measured, and observe the current waveform on your oscilloscope display.

Note

If using the Fluke 123 ScopeMeter, disregard the next step.

5. Calculate the Amps-per-division on your oscilloscope by dividing the vertical scale (mV or V per division) by the i1000s switch position (1, 10, or 100 mV/A). For example:

$$\frac{20 \text{ mV per division}}{1 \text{ mV/A}} = 20 \text{ A per division}$$

Setups using the Current Probe and a ScopeMeter are shown in Figure 3.

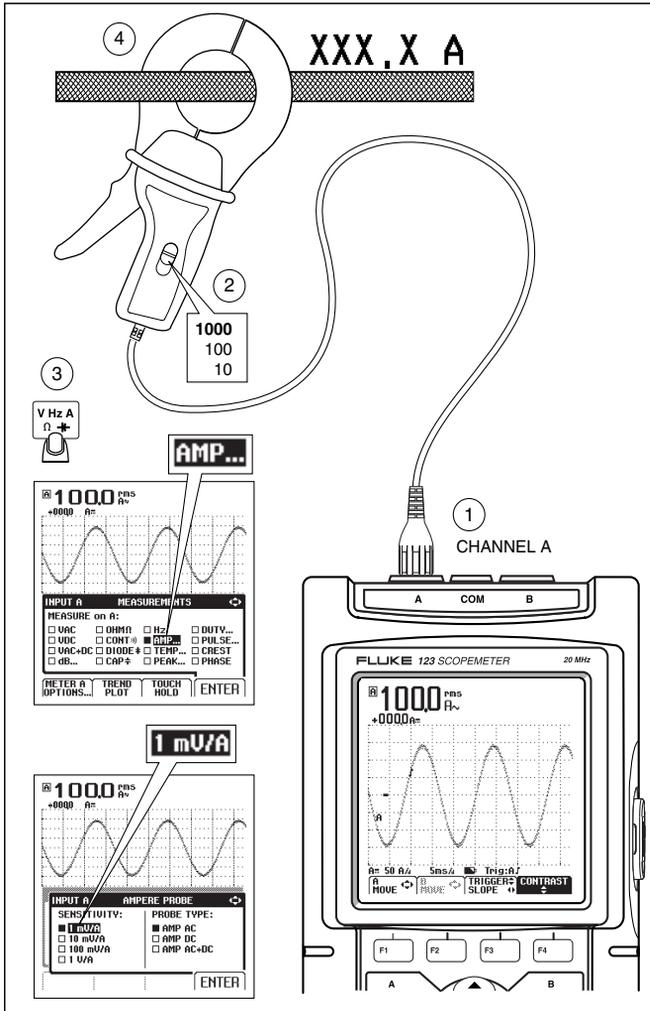


Figure 3. ScopeMeter Setups

aef02f.eps

Measurement Considerations

Observe the following guidelines for positioning the Current Probe jaws:

- Carefully move the probe to center the conductor inside the jaws.
- Make sure the probe is perpendicular to the conductor.
- If possible, avoid measurements close to other current-carrying conductors.

On the Current Probe, the 1 mV/A range offers the best accuracy and least phase shift. When using the 1 mV/A probe range, use the “volts per division” adjustment on your oscilloscope for best display results.

Note

Although it is possible to change the range on the current probe without removing the probe from the current carrying conductor, remember not to exceed the permissible peak ratings. The peak ratings by range are: 20 A peak @ 100 mV/A, 200 A peak @ 10 mV/A and 2000 A peak @ 1 mV/A.

Maintenance

Before each use, assure continued safety of the probe by inspecting it for cracks or missing portions of the insulating cover and for loose or weakened components. Pay particular attention to the insulation surrounding the probe jaws. Any probe that fails this inspection should be made inoperative by taping the probe shut to prevent unintended operation.

Cleaning and Storage

Periodically wipe the case with a damp cloth and detergent; do not use abrasives or solvents. Open the jaws and wipe the magnetic pole pieces with a lightly oiled cloth. Do not allow rust or corrosion to form on the magnetic core ends.

Replacement Parts

When requesting replacement parts, use the following part numbers.

- Cable, 600 V rms, Safety Insulated: 935036
- *Fluke i1000s Quick Reference Card*: 1575200
- *Fluke i1000s Calibration Manual*: 1574933

Service

For service, pack the Current Probe securely in its original shipping container and forward it, postage paid, to the nearest service. Include a description of the malfunction. Fluke assumes no responsibility for damage in transit.

Contacting Fluke

For application or operation assistance on Fluke products or to contact Fluke, call one of the following telephone numbers:

USA: 1-888-99-FLUKE (1-888-993-5853)

Canada: 1-800-36-FLUKE (1-800-363-5853)

Europe: +31 402-678-200

Japan: +81-3-3434-0181

Singapore: +65-738-5655

Anywhere in the world: +1-425-446-5500

Or, visit Fluke's Web site at www.fluke.com.