FLUKE®

i1000s

AC Current Probe for Oscilloscopes

Users Manual

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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 Measurement Category III, Pollution Degree 2. (See "Safety Information" for definitions.)

⚠Warning

Read "Safety Information" before using the probe.

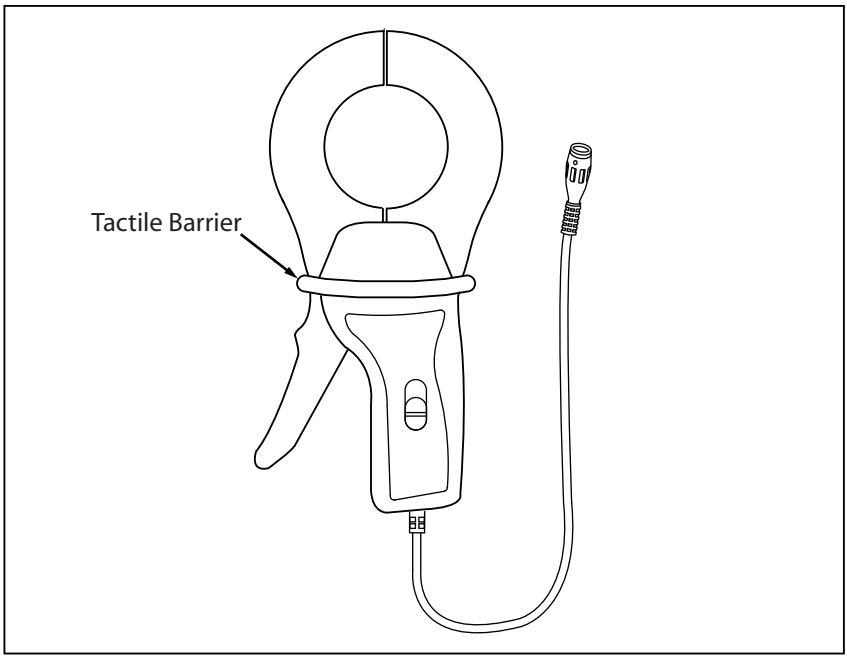

Figure 1. i1000s AC Current Probe

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.**
- **Do not alter the Product and use only as specified, or the protection supplied by the Product can be compromised.**

Table 1. Symbols

	WARNING. HAZARDOUS VOLTAGE. Risk of electric shock.
	WARNING - RISK OF DANGER. Consult user documentation.
	Application around and removal from uninsulated hazardous live conductors is permitted.
	Double Insulated
	Conforms to European Union directives.
	Certified by Underwriters Laboratories to North American safety standards.
CAT III	Measurement Category III is applicable to test and measuring circuits connected to the distribution part of the building's low-voltage MAINS installation.
	Earth
	AC (Alternating Current)
	This product complies with the WEEE Directive marking requirements. The affixed label indicates that you must not discard this electrical/electronic product in domestic household waste. Product Category: With reference to the equipment types in the WEEE Directive Annex I, this product is classed as category 9 "Monitoring and Control Instrumentation" product. Do not dispose of this product as unsorted municipal waste.

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.

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 MΩ in parallel with a maximum of 47 pF. To achieve the stated accuracy, use the i1000s with an oscilloscope having an accuracy of ± 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

[1] To 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.

Safety

General ..... IEC 61010-1: Pollution Degree 2

Measurement ..... IEC 61010-2-032 CAT III 600 V

Electromagnetic Compatibility (EMC)

International ..... IEC 61326-1: Portable Electromagnetic Environment
CISPR 11: Group 1, Class A

Group 1: Equipment has intentionally generated and/or uses conductively-coupled radio frequency energy that is necessary for the internal function of the equipment itself.

Class A: Equipment is suitable for use in all establishments other than domestic and those directly connected to a low-voltage power supply network that supplies buildings used for domestic purposes. There may be potential difficulties in ensuring electromagnetic compatibility in other environments due to conducted and radiated disturbances.

Caution: This equipment is not intended for use in residential environments and may not provide adequate protection to radio reception in such environments.

Emissions that exceed the levels required by CISPR 11 can occur when the equipment is connected to a test object.

Korea (KCC)..... Class A Equipment (Industrial Broadcasting & Communication Equipment)

Class A: Equipment meets requirements for industrial electromagnetic wave equipment and the seller or user should take notice of it. This equipment is intended for use in business environments and not to be used in homes.

USA (FCC) ..... 47 CFR 15 subpart B. This product is considered an exempt device per clause 15.103.

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 ± 10 mV
10 mV/A	100 mA to 100 A (200 A instantaneous peak)	2% of reading ± 5 mV
1 mV/A	1 A to 1000 A (2000 A instantaneous peak)	1% of reading ± 1 mV
*Accuracies and Phase Shifts are given for 48 Hz to 65 Hz; an ambient temperature of 23° C ± 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 MΩ/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 ± 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 MΩ/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.

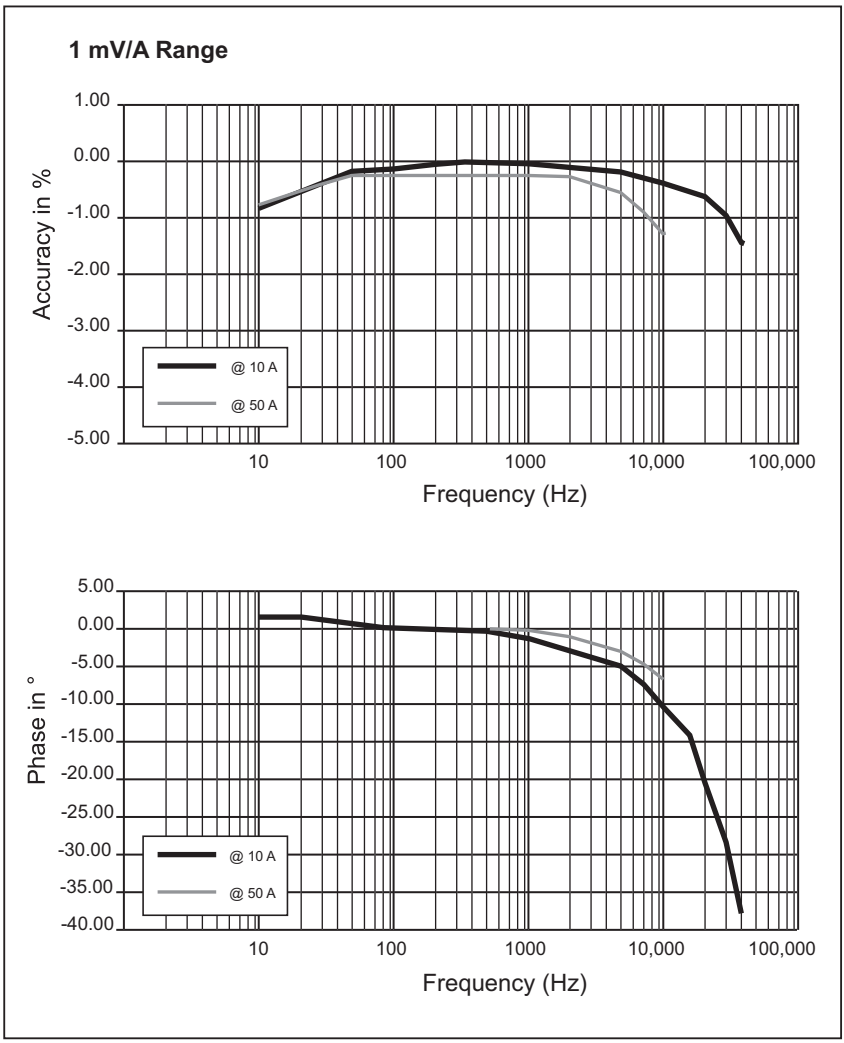

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Figure 2. Typical Response Curves

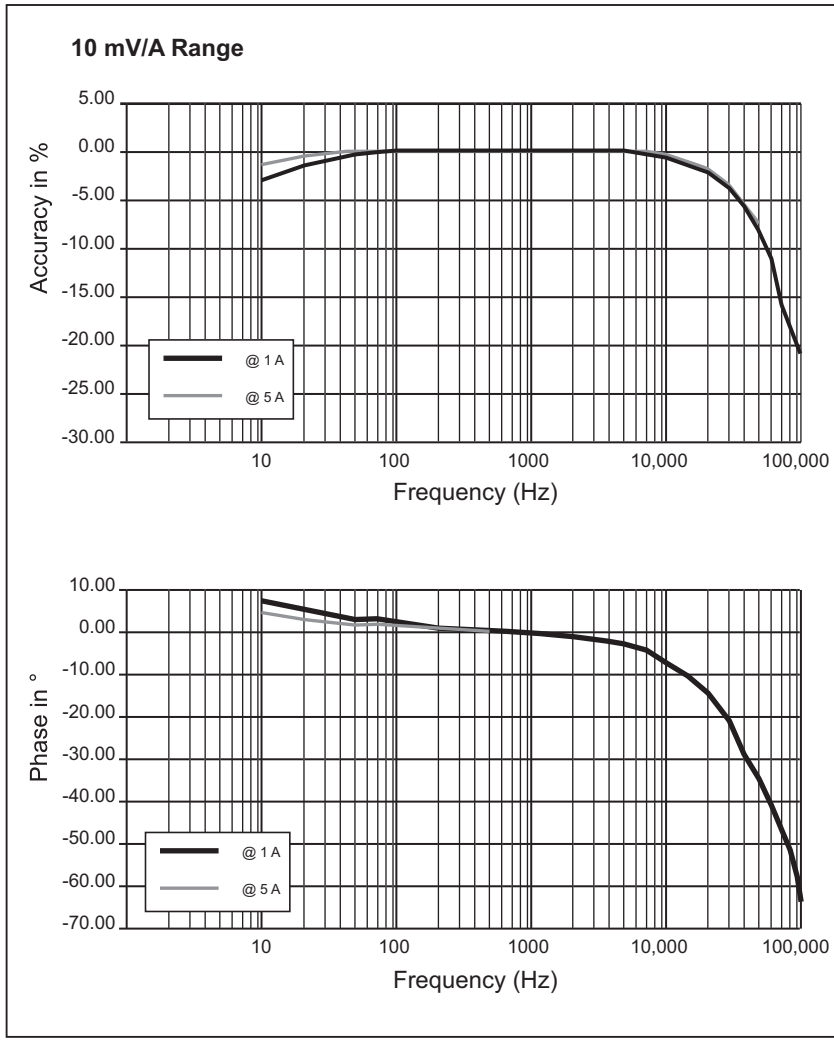

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Figure 2. Typical Response Curves (cont)

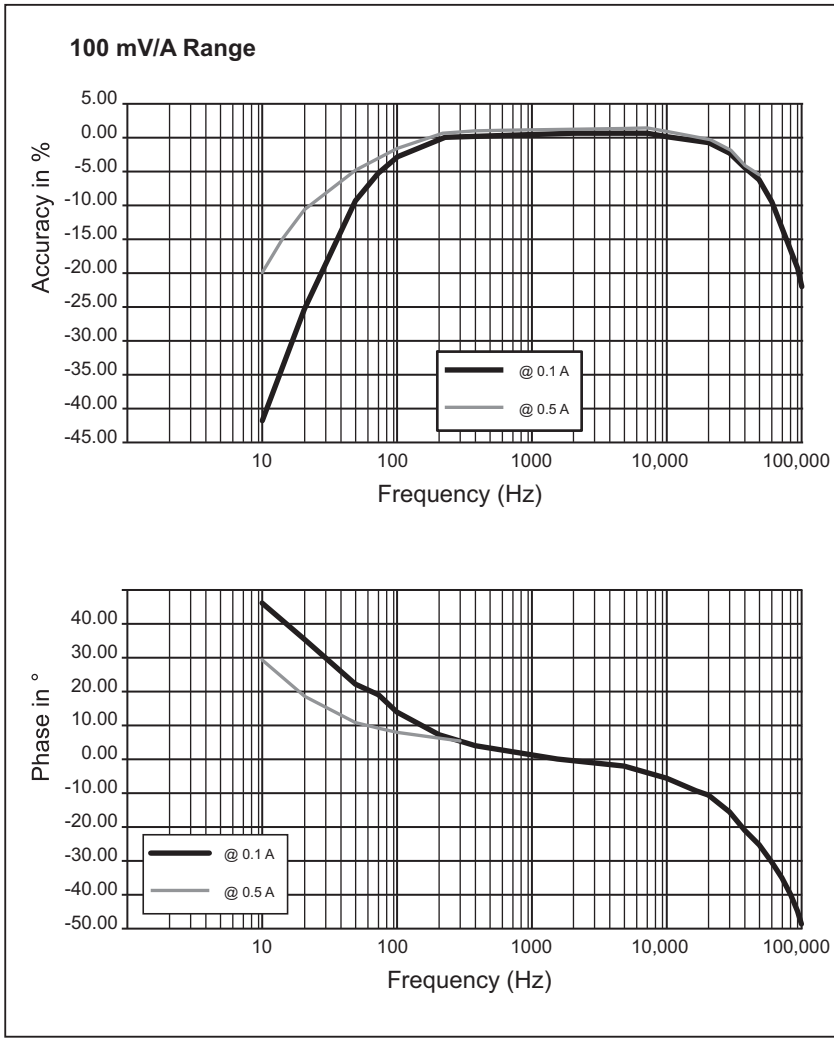

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Figure 2. Typical Response Curves (cont)

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* V Hz A Ω ⏚ *(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:

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

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

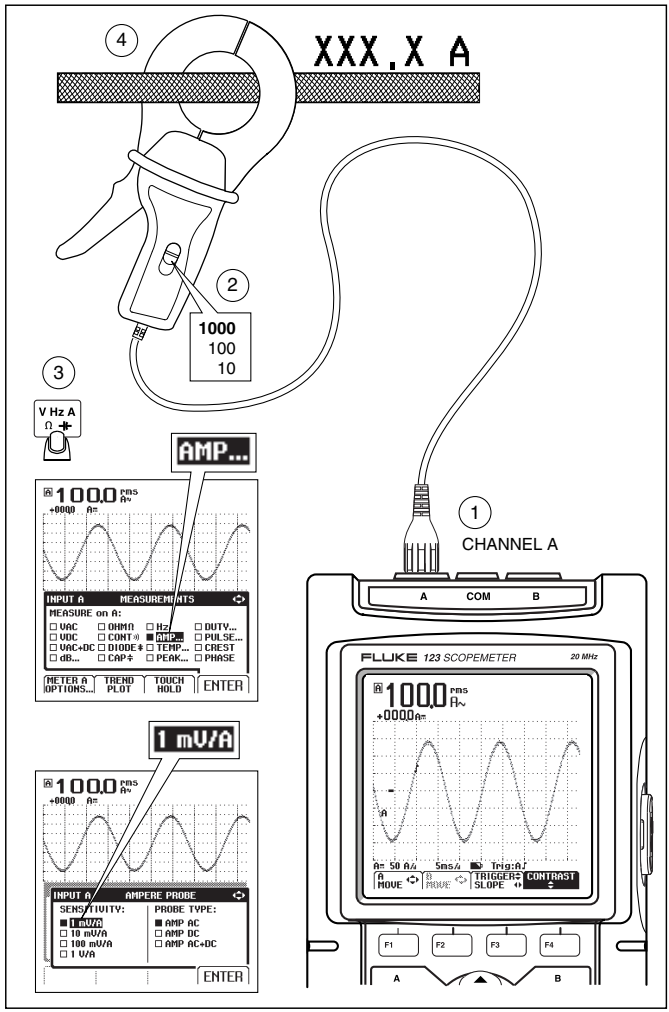

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Figure 3. ScopeMeter Setups

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.