FLUKE®

i1000s

AC Current Probe for Oscilloscopes

Calibration Manual

PN 1574933
May 2001

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Table of Contents

List of Tables

List of Figures

i1000s

AC Current Probe for Oscilloscopes

Introduction

⚠ Warning

To avoid shock or injury, do not perform the verification tests or calibration procedures described in this manual unless you are qualified to do so.

The information provided in this document is for the use of qualified personnel only.

Caution

The i1000s AC Current Probe contains parts that can be damaged by static discharge.

Follow the standard practices for handling static sensitive devices.

The information in this manual deals with the Fluke i1000s AC Current Probe for oscilloscopes, (hereafter referred to as "the Current Probe"). Information provided includes:

- Precautions and safety information
- Specifications
- Basic maintenance
- Performance test procedures
- Calibration adjustment procedures

For complete operating instructions, refer to the *i1000s Users Manual*.

Contacting Fluke

To order accessories, receive assistance, or locate the nearest Fluke distributor or Service Center, call:

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
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Precautions and Safety Information

⚠Warning

If the Current Probe is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

Read the "Safety Information" page before servicing or using this product.

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 or the test instruments. 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 overvoltage category III (CAT III). Use extreme caution when clamping around uninsulated conductors or bus bars.**
- **Overvoltage (Installation) Category III, or CAT III, refers to distribution level and fixed installation circuits inside a building electrical service entrance.**
- **Keep your fingers behind the finger-guard.**
- **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.**
- **Use of this equipment in a manner not specified herein may impair the protection provided by the equipment.**

Table 1. International Electrical Symbols

~	Alternating Current	⚠	Warning. Refer to the manual for explanation.
⏚	Earth (Ground)	⧈	Equipment protected throughout by double insulation or reinforced insulation.
CE	Conforms to EU directives		

The i1000s has been tested according to IEC Publication 61010-2-032-94. Follow all warnings to ensure safe operation.

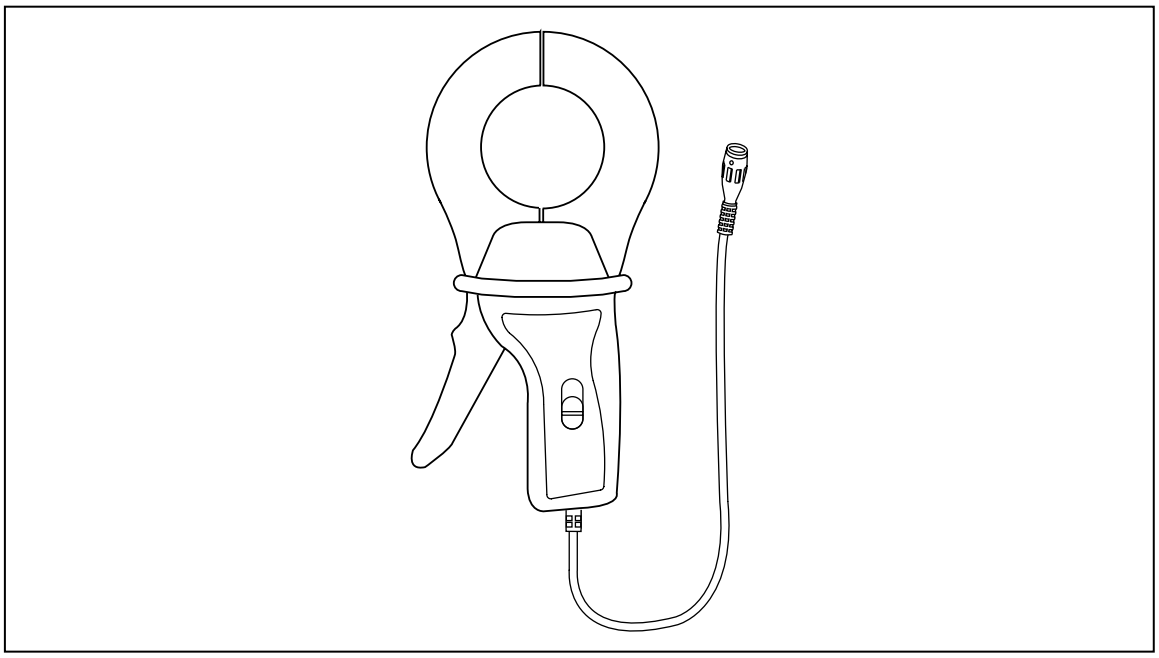

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Figure 1. Fluke i1000s AC Current Probe

Specifications

Safety Specifications

- Rated for 600 V ac circuits of Overvoltage Category III (CAT III) per IEC 61010-1-95 and IEC 61010-2-032-94.

  CAT III- Equipment that 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.

- Designed to Protection Class II, double or reinforced insulation requirements of UL 3111, ANSI/ISA-S82.01-1994, CAN/CSAC22.2 No.1010.1-92, IEC 61010-1-95/IEC 61010-2-03-94, and EN 61010-1: 1993.

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 AC Current Probe 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 °C to 50 °C (86 °F 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 °C to 18 °C and from 28 °C to 50 °C
Usable Frequency Range: 5 Hz to 100 kHz
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.

Table 2. Input Ranges and Accuracy

Switch Position	Input Range	Accuracy*
10 A (100 mV/A)	100 mA to 10 A (20 A instantaneous peak)	3 % of reading ± 10 mV
100 A (10 mV/A)	100 mA to 100 A (200 A instantaneous peak)	2 % of reading ± 5 mV
1000 A (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 A to 0.5 A	NA	0.1 A to 5 A	N/A	1 A to 50 A	N/A
0.5 A to 2 A	NA	5 A to 20 A	15 °C	50 A to 200 A	3 °C
2 A to 10 A	15 °C	20 A to 100 A	10 °C	200 A to 1000 A	2 °C
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, 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 Overvoltage Category III circuits per IEC 61010-1-95, IEC 61010-2-032-94, and IEC 61010-2-031.

Float Voltage (output cable and connector to ground):

600 V ac rms on Overvoltage Category III circuits per IEC 61010-1-95 and IEC 1010-2-032-94.

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 kHz to 40 kHz

< 10.0 % of reading from 40 kHz to 100 kHz.

Operating Temperature:

-10 °C to 50 °C (14 °F to 122 °F); 100 mA to 800 A ac rms continuous, 800 A 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)

Mechanical Specifications

Maximum Cable Diameter:

2.13 inches (54 mm)

Dimensions:

4.37 inches x 8.50 inches x 1.77 inches (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

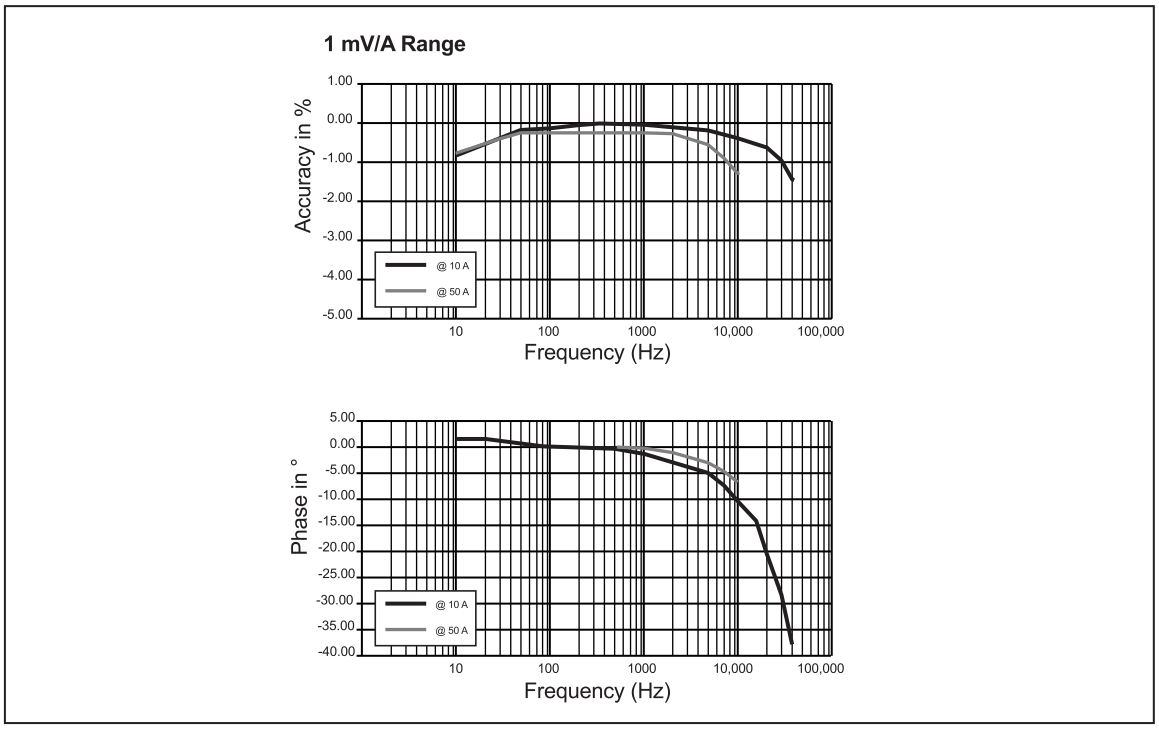

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Figure 2. Typical Response Curves

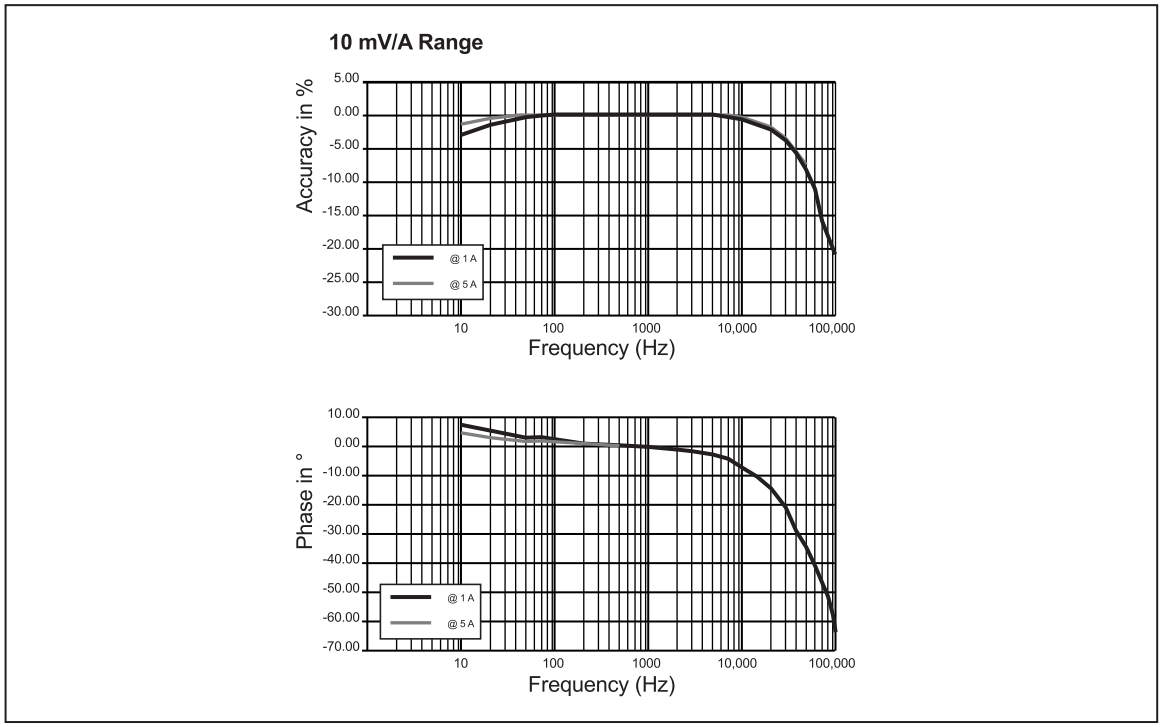

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Figure 2. Typical Response Curves (cont)

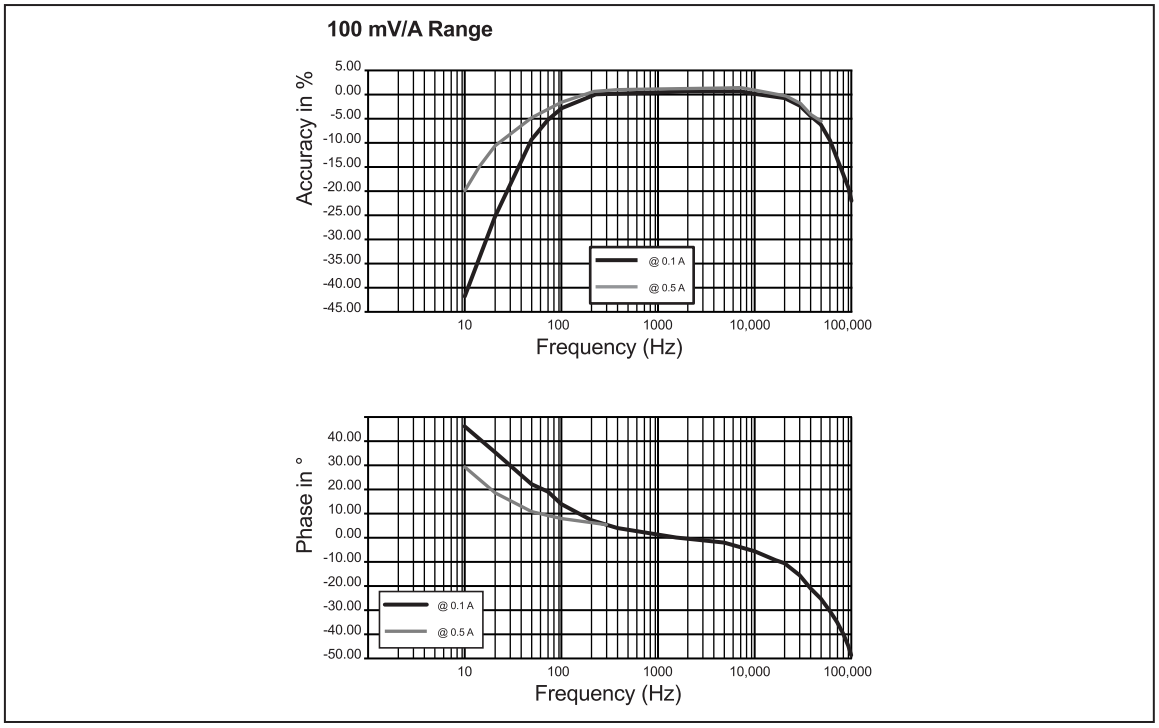

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Figure 2. Typical Response Curves (cont)

Performance Tests

⚠ Warning

To avoid electric shock or personal injury:

- **Do not perform the following procedures unless qualified to do so. Some procedures involve the use of high current.**
- **Before handling the test connections and between tests, make sure the calibrator is in standby mode (STBY).**
- **Review the "Precautions and Safety Information" section before performing the performance tests or calibration.**

The following performance tests verify the Current Clamp's specifications and verify its operation. If the Current Clamp fails any part of the performance test, calibration adjustment and/or repair is indicated.

Repairs or servicing not explained in this manual should be performed only at a Fluke Service Center. A Current Probe under warranty will be promptly repaired or replaced (at Fluke's discretion) and returned at no charge. See the registration card for warranty terms. If the warranty has lapsed, the meter will be repaired and returned for a fixed fee. To locate a Fluke service center, refer to the "Contacting Fluke" section.

Required Equipment

To execute the performance tests and/or adjust the calibration, the following test equipment will be necessary. If the recommended model is not available, use test equipment that meets the same specifications.

Table 4. Required Equipment

Instrument Type	Recommended Model	Required Characteristics
DC/AC Voltage Calibrator	Fluke Model 5520A Calibrator or equivalent	Specifications: 0.33 A to 1.09999 A 0.05 % + 100 µA 1.1 A to 2.99999 A 0.06 % + 100 µA 3 A to 10.9999 A 0.06 % + 2000 µA 11A to 20.5 A 0.12 % + 5000 µA
Digital Multimeter	HP 3458A or equivalent	DC voltage range: 10 V dc 14 ppm
Phasemeter	Clark-Hess instrument model 6000 or equivalent	Accuracy ± 50 m °
50-turn Current Coil	Fluke Model 5500A/COIL	45 Hz - 65 Hz 0.28% + 0.09 A
AC/DC Shunt	IET Labs-DCCS-200	0.1 Ω - 0.1% non-inductive
Magnet Wire Coil 1 turn of #10 single film coated wire	–	–
Small insulated Phillips screwdriver	–	–
BNC to banana plug adapter	–	–

Phase Shift

To check the performance of the Current Probe (refer to Figure 3):

1. Center the Current Probe around the coil.
2. Compare the values to those in the Table 5.

Table 5. Verification Table

Coil	Range	5520A Output	5500A Coil I. Prim.	Freq.	i1000s mV Output Min.	i1000s mV Output Max.	Phase in Deg. Min.	Phase in Deg. Max.
50 turn	1 mV/A	1 A	50.0 A	50 Hz	48.5	51.5	-3.0	3.0
50 turn	1 mV/A	2 A	100 A	400 Hz	98.0	102.0	N/A	N/A
50 turn	1 mV/A	4 A	200 A	60 Hz	197.0	203.0	-2.0	2.0
50 turn*	1 mV/A	14 A	700 A	50 Hz	692.0	708.0	-2.0	2.0
1 turn	10 mV/A	0.1 A	5 A	50 Hz	44.0	56.0	-15.0	15.0
50 turn	10 mV/A	0.4 A	20 A	50 Hz	191.0	209.0	-10.0	10.0
50 turn	10 mV/A	2 A	100 A	50 Hz	975.0	1025.0	-10.0	10.0
1 turn	100 mV/A	0.01 A	0.50 A	50 Hz	38.5	61.5	N/A	N/A
1 turn	100 mV/A	0.04 A	2.00 A	50 Hz	184.0	216.0	-15.0	15.0
1 turn	100 mV/A	0.2 A	10 A	50 Hz	960.0	1040.0	-15.0	15.0
* 700 A/ 50 Hz in 1 mV/A range has a TUR of 3.3								

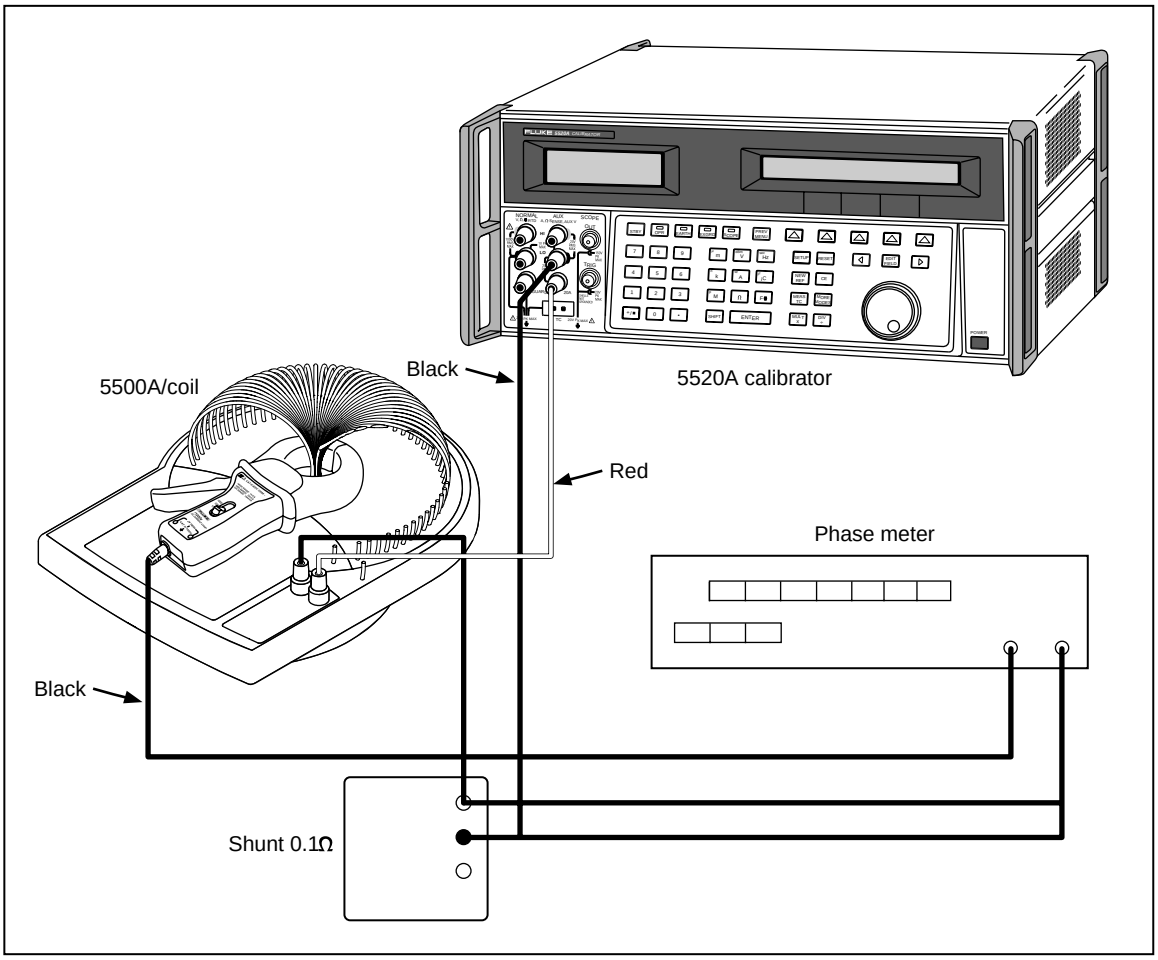

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Figure 3. Performance Test and Phase Check Setup

Calibration Adjustment

⚠ Warning

To avoid electric shock or personal injury:

- **Do not perform the following procedures unless qualified to do so. Some procedures involve the use of high current.**
- **Before handling the test connections and between tests, make sure the calibrator is in standby mode (STBY).**
- **Review the "Precautions and Safety Information" section before performing the performance tests or calibration.**

Calibration Adjustment Procedure

If the Current Probe fails any of the performance tests, a qualified technician should adjust the probe's calibration. The recommended calibration cycle is 1 year.

To adjust the Current Probe, it is necessary to access a potentiometer located inside.

To access the calibration potentiometer (refer to Figure 4):

1. Remove the two screws located on the back side of the of the Current Probe using a Phillips screwdriver.
2. Separate the two halves of the handle.

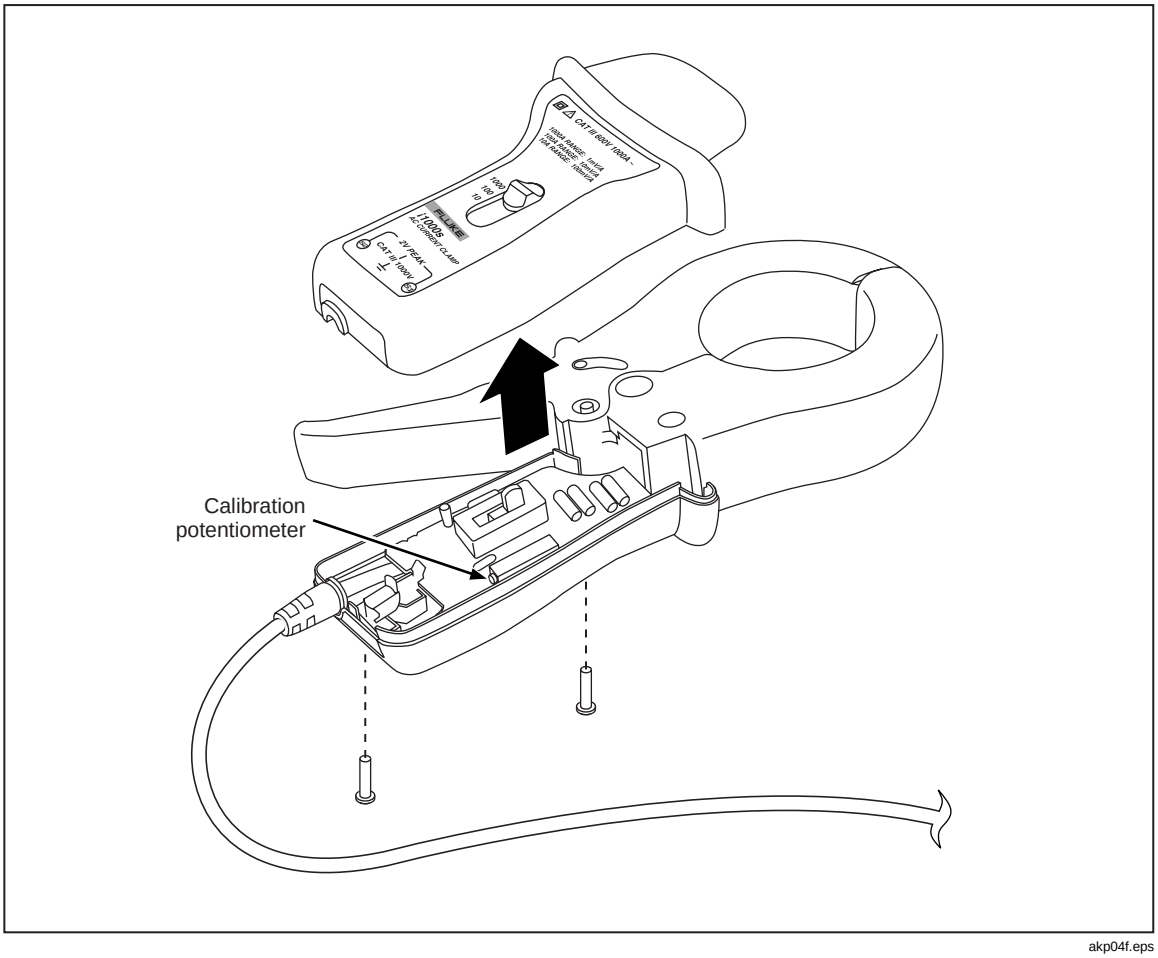

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Figure 4. i1000s Disassembly and Calibration Adjustment

To adjust the calibration of the AC Current Probe (refer to Figure 4 and 5):

1. Connect the AC Current output of the calibrator to the 50-turn coil.
2. Turn the instruments on and allow a 30-minute warm up period.
3. Connect the Current Probe to the digital multimeter (DMM) input via the BNC adapter.
4. Select the 1 V AC range on the DMM.
5. Select the 1000 A range on the Current Probe.
6. Set the Calibrator to output 10 A @ 50 Hz into the 50 turn coil, thus producing 500 A turns.
7. With the DMM in the 1 V AC range and the Current Probe centered on the coil, adjust the potentiometer to read 0.500V +/- 1 mV.
8. Put the calibrator into standby mode.

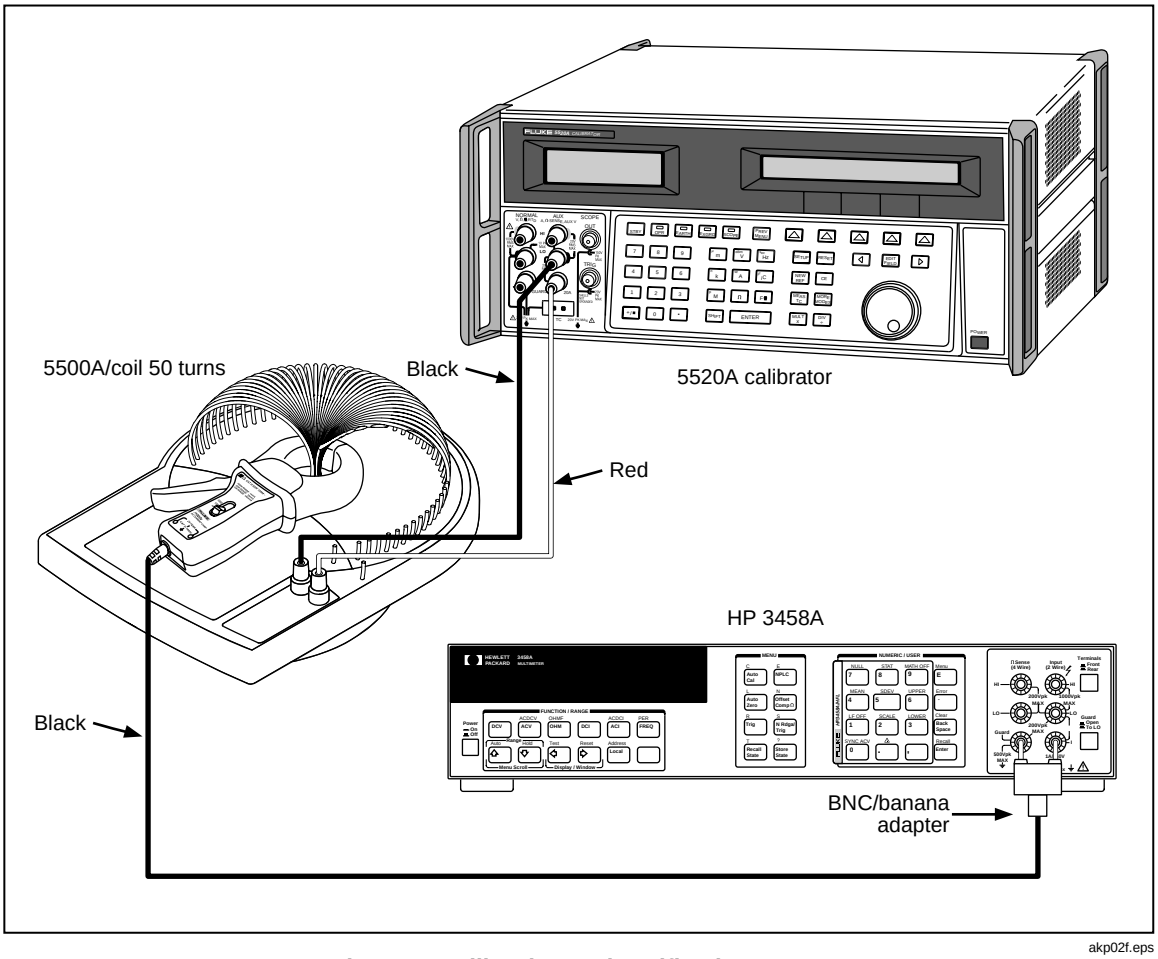

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Figure 5. Calibration and Verification Setup