80i-1000s

AC CURRENT PROBE FOR OSCILLOSCOPES

USERS MANUAL
MANUEL D'UTILISATION
BEDIENERHANDBUCH
MANUAL DEL USUARIO

PN 935044
APRIL 1993 Rev. 3, 9/95

FLUKE®

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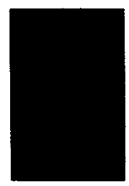
80i-1000s

AC CURRENT PROBE FOR OSCILLOSCOPES

USERS MANUAL



FLUKE®

INTRODUCTION

The Fluke 80i-1000s 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 1000A 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 600V ac circuits of Overvoltage Category III. (See Safety Information for definitions.)

WARNING

READ "SAFETY INFORMATION" BEFORE USING THE PROBE.

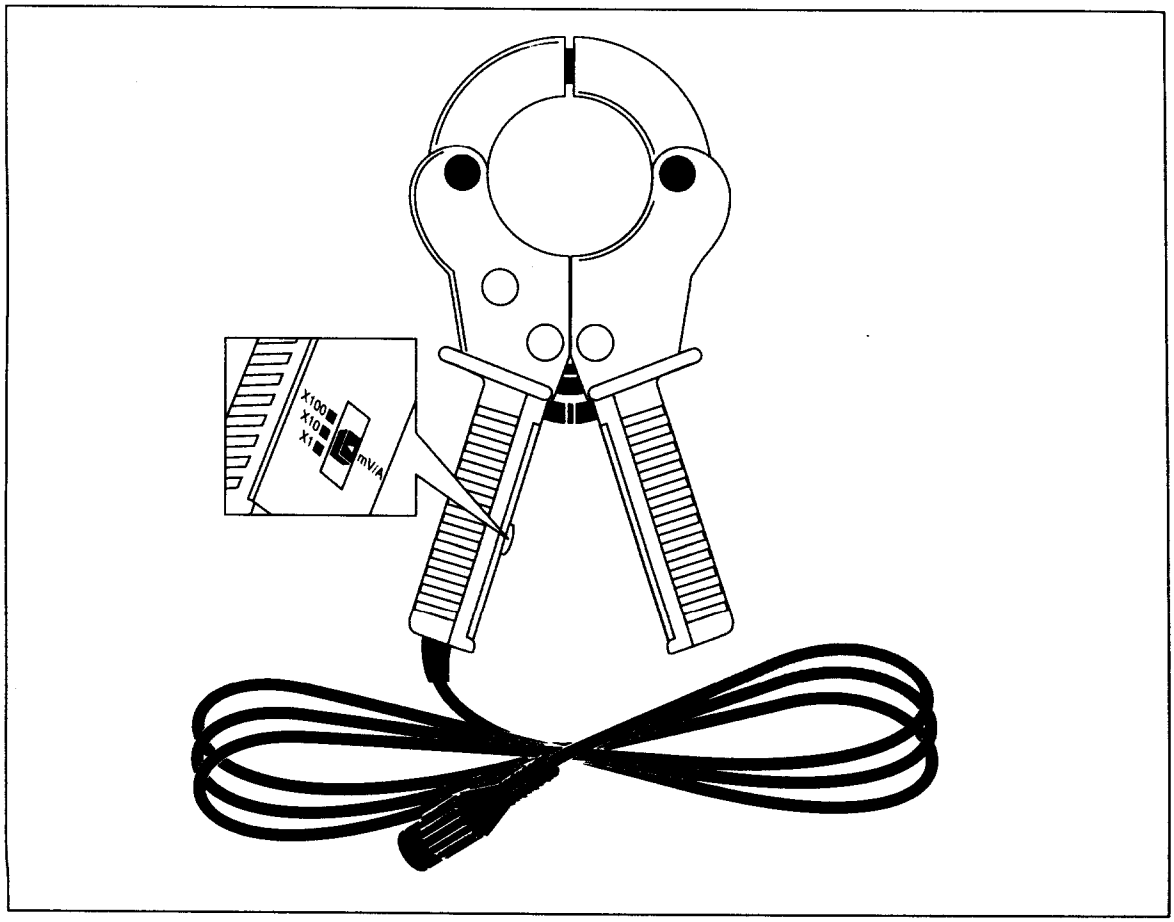


Figure 1. 80i-1000s AC Current Probe

BOX CONTENTS

The shipping container includes the probe, this instruction 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.

⚠ • Never use the probe on circuits rated higher than 600V 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.

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 Figure 2.

~	AC-ALTERNATING CURRENT	⚠	CAUTION see explanation in manual
⎓	Either DC or AC	⧈	Equipment protected throughout by DOUBLE INSULATION or REINFORCED INSULATION
⏚	EARTH		

Figure 2. International Electrical Symbols

The 80i-1000s has been tested according to IEC Publication 1010-1 and other safety standards (see "Specifications"). 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 600V ac circuits of Overvoltage Category III per IEC 1010-1: 1990 and IEC 1010-2-032.
- Designed to Protection Class II, double or reinforced insulation requirements of UL 3111, ANSI/ISA-S82.01-1994, CAN/CSA C22.2 No.1010.1-92, IEC 1010-1: 1990/IEC 1010-2-032, and EN 61010-1: 1993.

INSTRUMENT COMPATIBILITY

The 80i-1000s is compatible with any oscilloscope that accepts a standard BNC connector and has an input impedance of greater than or equal to 1MΩ in parallel with a maximum of 47 pF. To achieve the stated accuracy, use the 80i-1000s with an oscilloscope having an accuracy of ±2% or better. The 80i-1000s may be used with digital multimeters (DMMs) if a BNC to banana jack adapter is used.

ELECTRICAL SPECIFICATIONS

Current Range: 100 mA to 1000A ac rms (2000A instantaneous peak). (See Operating Temperature for limits)

WARNING

TO AVOID POTENTIAL THERMAL BURNS FROM THE JAWS WHEN MEASURING CURRENTS EQUAL TO OR GREATER THAN 800A AC RMS IN THE AMBIENT TEMPERATURE RANGE OF 30 TO 55°C (86 TO 131°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 (2V 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 55°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: 10A/µs

Ampere Second Product: 0.1

(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 0.1 Ampere Second Product, the probe output will be linear and specified accuracies will apply.)

Rise or fall time: < 40 µs

Table 1. Input Ranges and Accuracy

SWITCH POSITION	INPUT RANGE	ACCURACY*
100 mV/A	100 mA to 10A (20A instantaneous peak)	3% of reading ± 100 mA
10 mV/A	500 mA to 100A (200A instantaneous peak)	2% of reading
1 mV/A	5A to 1000A (2000A instantaneous peak)	2% of reading

Table 2. Maximum Phase Shift

SWITCH POSITION	PHASE SHIFT*		
100 mV/A	25° @ 0.5A	15° @ 2A	10° @ 10A
10 mV/A	4° @ 5A	3° @ 20A	2° @ 100A
1 mV/A	2° @ 50A	2° @ 200A	1° @ 1000A

** Accuracies and Phase Shifts are given for 45 Hz to 1 kHz, 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.*

Insertion Impedance (50/60 Hz):

- 100 mV / A : 0.1Ω
- 10 mV / A : 0.02Ω
- 1 mV / A : 0.01Ω

⚠ Working Voltage (Clamp jaws to Ground):
600V ac rms on Overvoltage Category III circuits per IEC 1010-1 : 1990 and IEC 1010-2-032.

⚠ Float Voltage (Output cable and connector to Ground):

600V ac rms on Overvoltage Category III circuits per IEC 1010-1 : 1990 and IEC 1010-2-032.

Influence of Adjacent Conductor: < 0.2 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 to 55°C (14 to 131°F); 100 mA to 800A ac rms continuous, 800 to 1000A ac rms for 5 minutes On, 15 minutes Off.

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

Storage Temperature: –40 to 71°C (–40 to 160°F)

Relative Humidity: 0 to 85% (10 to 30°C); 0 to 75% (30 to 40°C); 0 to 45% (40 to 50°C); 0 to 35% (50 to 55°C)

MECHANICAL SPECIFICATIONS

Maximum Cable Diameter: 2.13 inches (54 mm)

Dimensions: 4.1 x 8.1 x 1.6 inches (105 x 206 x 48 mm)

Weight: 1.43 lbs (650 g)

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

Enclosure Protection: IP 20 (IEC 529)

Drop Test: 1 meter per IEC 68-2-32

Mechanical Shock: 100G per IEC 68-2-27.

Vibration:
- 5/55/5 Hz, no less than 0.25 mm per IEC 68-2-6.
- Meets MIL-T-28800E Class 3.

TYPICAL RESPONSE CURVES

Typical response curves are shown in Appendix A.

OPERATION

Use the following procedure to make a measurement:

1. Connect the 80i-1000s 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.
4. Use a 1:1 probe setting.
5. Clamp the probe around the conductor to be measured, and observe the current waveform on your oscilloscope display.
6. Calculate the Amps-per-division on your oscilloscope by dividing the vertical scale (mV or V per division) by the 80i-1000s 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.

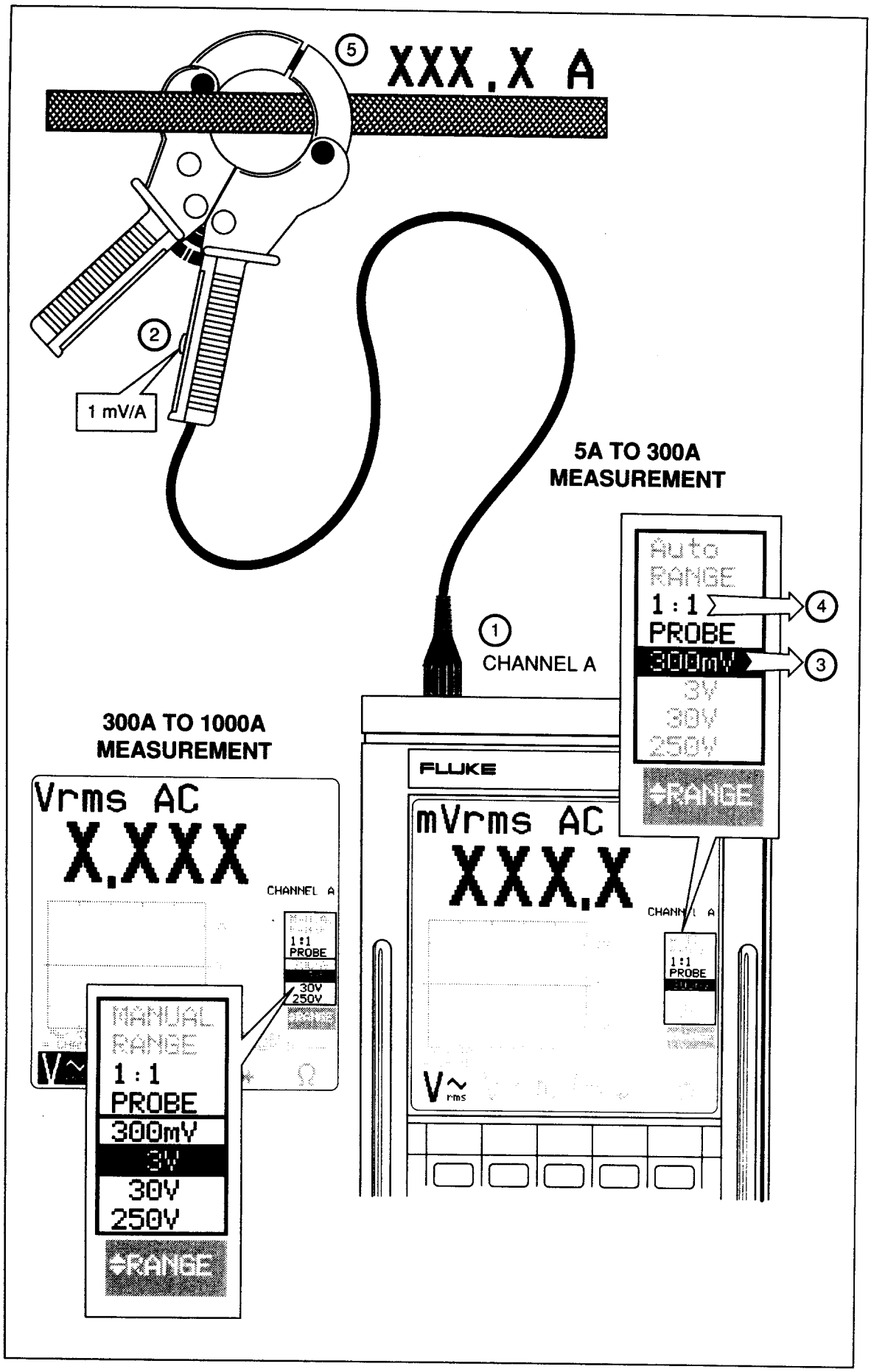


Figure 3. ScopeMeter Setups

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: 20A peak @ 100 mV/A, 200A peak @ 10 mV/A and 2000A 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. To check probe performance, complete the "Performance Test" procedure.

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.

WARNING

THESE SERVICING INSTRUCTIONS ARE FOR USE BY QUALIFIED PERSONNEL ONLY. TO AVOID ELECTRIC SHOCK, DO NOT PERFORM ANY SERVICING PROCEDURES UNLESS YOU ARE QUALIFIED TO DO SO. READ THE INFORMATION TITLED "SAFETY" AT THE BEGINNING OF THIS MANUAL BEFORE PROCEEDING.

Repairs or servicing not covered in this manual should be performed only at a Fluke Service Center. A 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. A list of service centers is at the back of this manual.

PERFORMANCE TEST

Probe accuracy is verified with the test setup shown in Figure 4. Required test equipment is defined in Table 3. Toroid coil construction is illustrated in figure 5.

Referring to Table 4, set the 5500A Calibrator controls as shown, and verify that the DMM readings are between the specified values. If any ampere measurement is out of specification, the probe may require calibration or factory repair.

CALIBRATION

If the performance test fails, a qualified technician should conduct the calibration procedure. The 80i-1000s can be returned to a Fluke Service Center for calibration, or it can be calibrated using the procedure below.

Equipment required for calibration is defined in Table 3.

Complete calibration is done by adjusting a potentiometer in one of the probe handles. Refer to Figure 6 for potentiometer access instructions.

Complete the following procedure to calibrate the probe.

1. Connect the equipment as shown in Figure 4. Allow 30 minutes for stabilization.

2. Set the 5500A output to 16 volts at 50 Hz. Enable the 5220A transconductance amplifier to operate. This produces 800 amp-turns in the center conductor bundle of the toroid coil (16A x 50 turns).

3. Set the DMM function and range to accommodate a display of 1.0V ac. Make sure the 80i-1000s switch is set to 1 mV/A.

4. Connect the probe to the DMM (using the BNC-to-banana adapter) and clamp the probe around the toroid coil center conductor bundle.

NOTE

The probe jaws must be centered around the center conductor bundle of the toroid coil.

5. Adjust the calibration potentiometer to read 0.800V ±0.001V on the DMM, then remove the adjustment tool.

6. Complete the Performance Test shown in Table 4.
7. Power down the test equipment.
8. Unclamp the probe and reinstall the handle cover.

This completes the probe calibration.

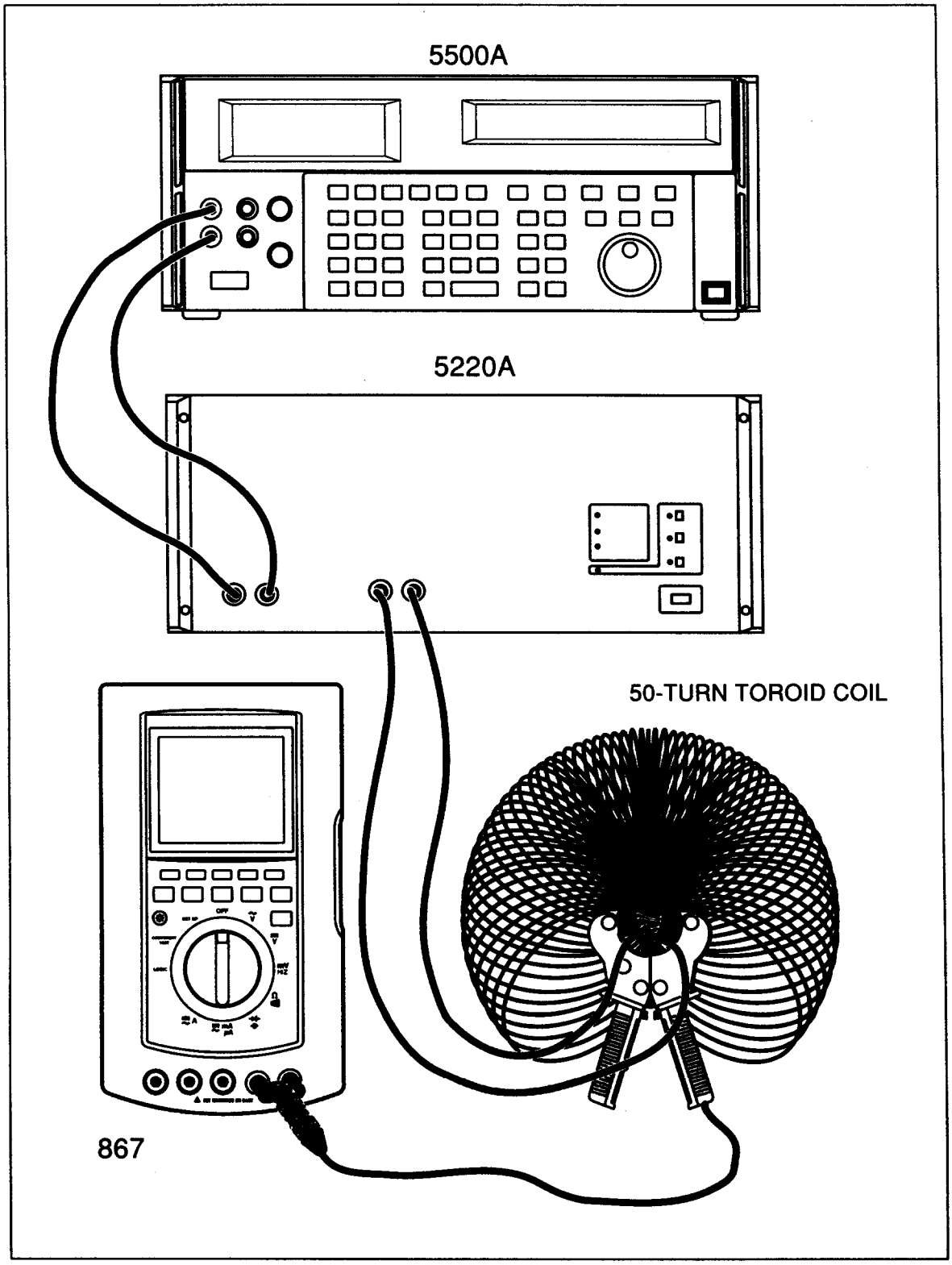


Figure 4. Performance Test and Calibration Setup

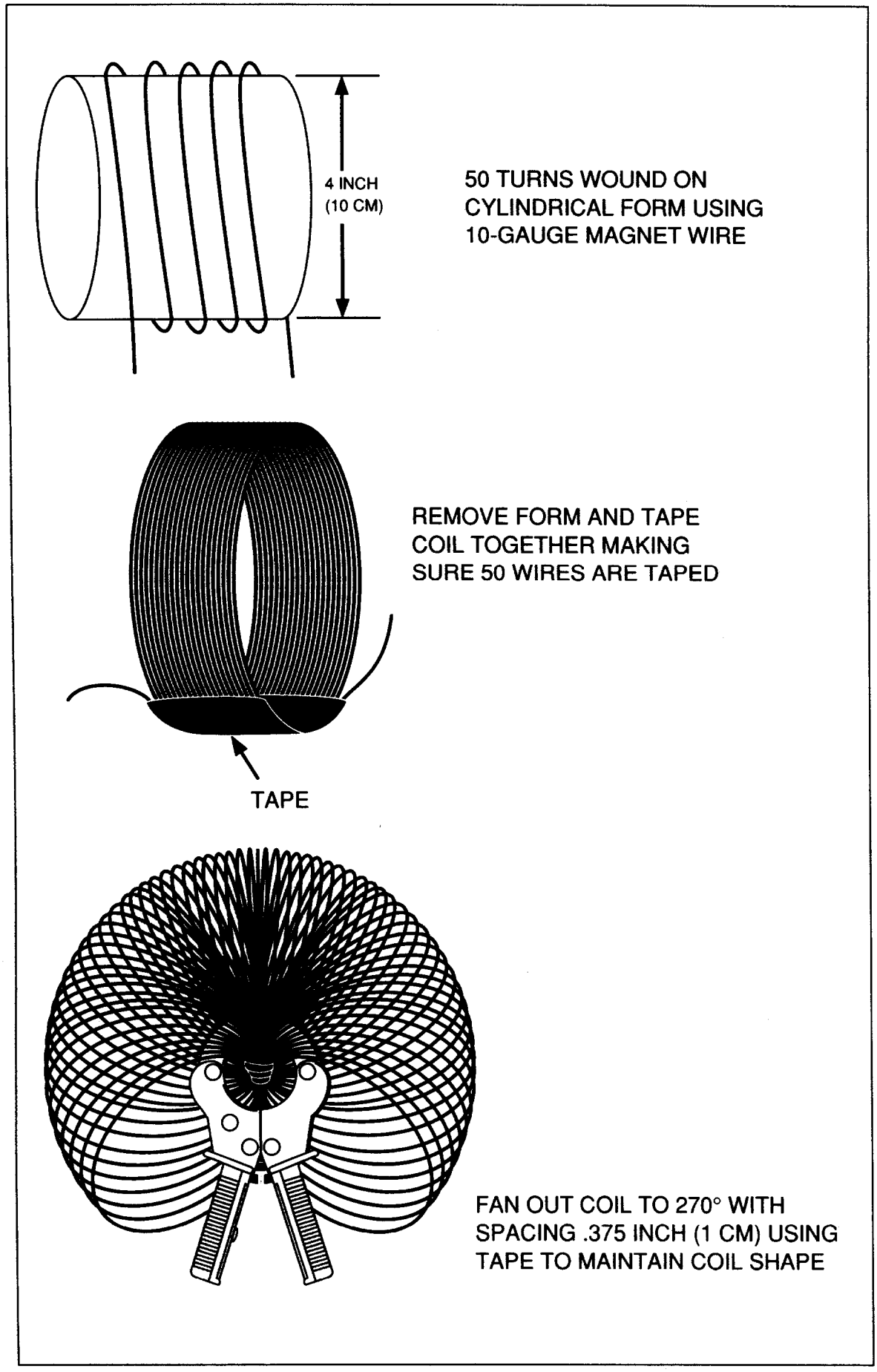


Figure 5. 50-Turn Toroid Coil

Table 3. Equipment Required for Performance Test and Calibration

INSTRUMENT TYPE	RECOMMENDED MODEL
Calibrator	Fluke Model 5500A
Transconductance Amplifier	Fluke Model 5220A
Digital Multimeter	Fluke Model 867
Small Insulated Screwdriver	Spectrol
Banana to BNC Connector	Fluke P/N PM9081/001
Magnet Wire Coil:	(50-turn toroid coil) 50 turns of #10 single conductor copper magnet wire, 4 inch diameter wound in a 270 degree toroid configuration. (See Figure 5.)

Table 4. Performance Test Points

5500A SETTINGS VOLTS AC		RMS AMPS MEASURED	LOW LIMIT OUTPUT (mV)	HIGH LIMIT OUTPUT (mV)
1V	50 or 60 Hz	50A	49.0	51.0
1V	400 Hz	50A	49.0	51.0
1V	1 kHz	50A	49.0	51.0
2V	1 kHz	100A	98.0	102.0
4V	50 or 60 Hz	200A	196.0	204.0
10V	50 or 60 Hz	500A	490.0	510.0

Note: All readings taken with probe range switch set to 1 mV/A.

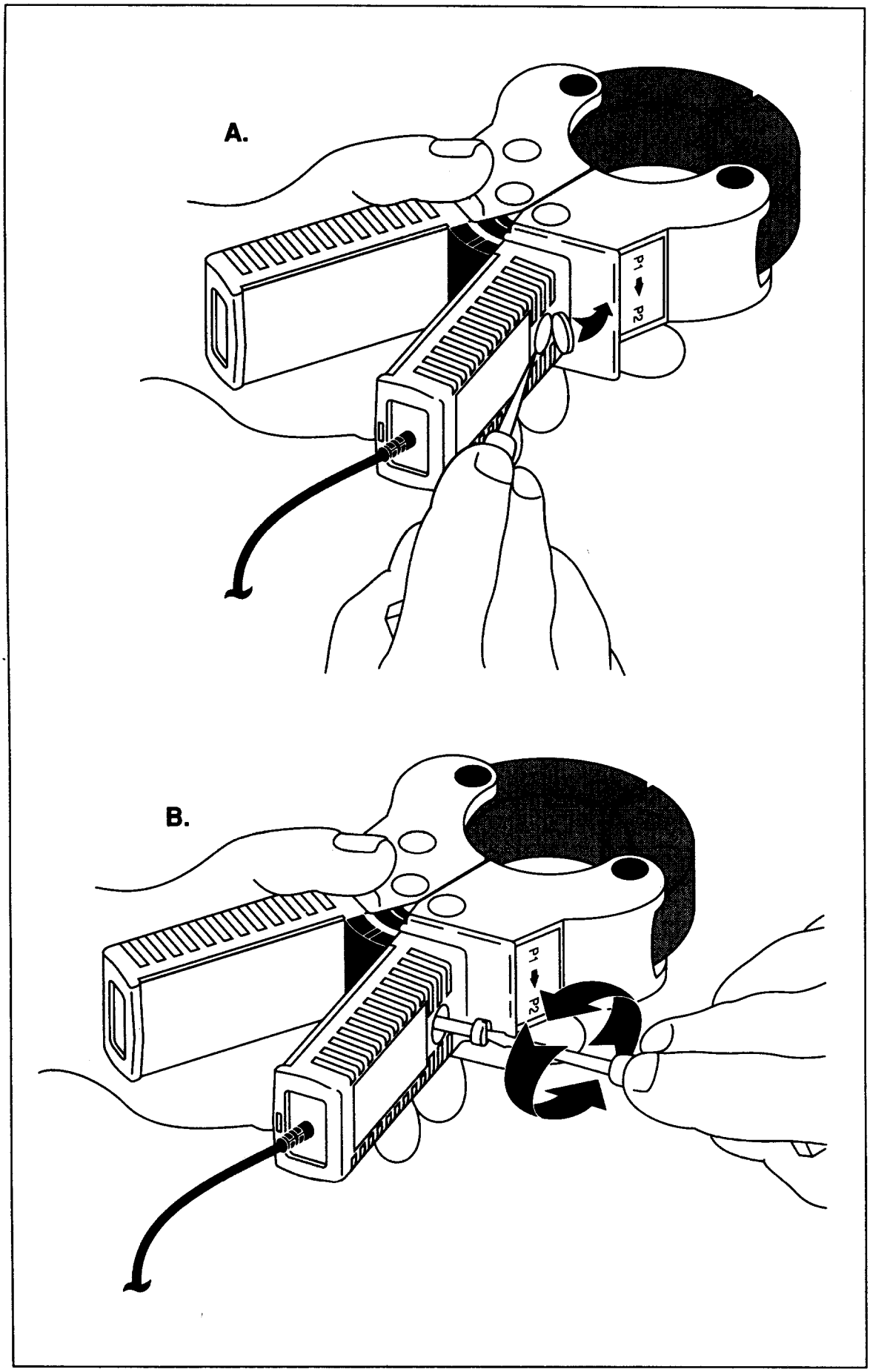


Figure 6. Calibration Potentiometer Access

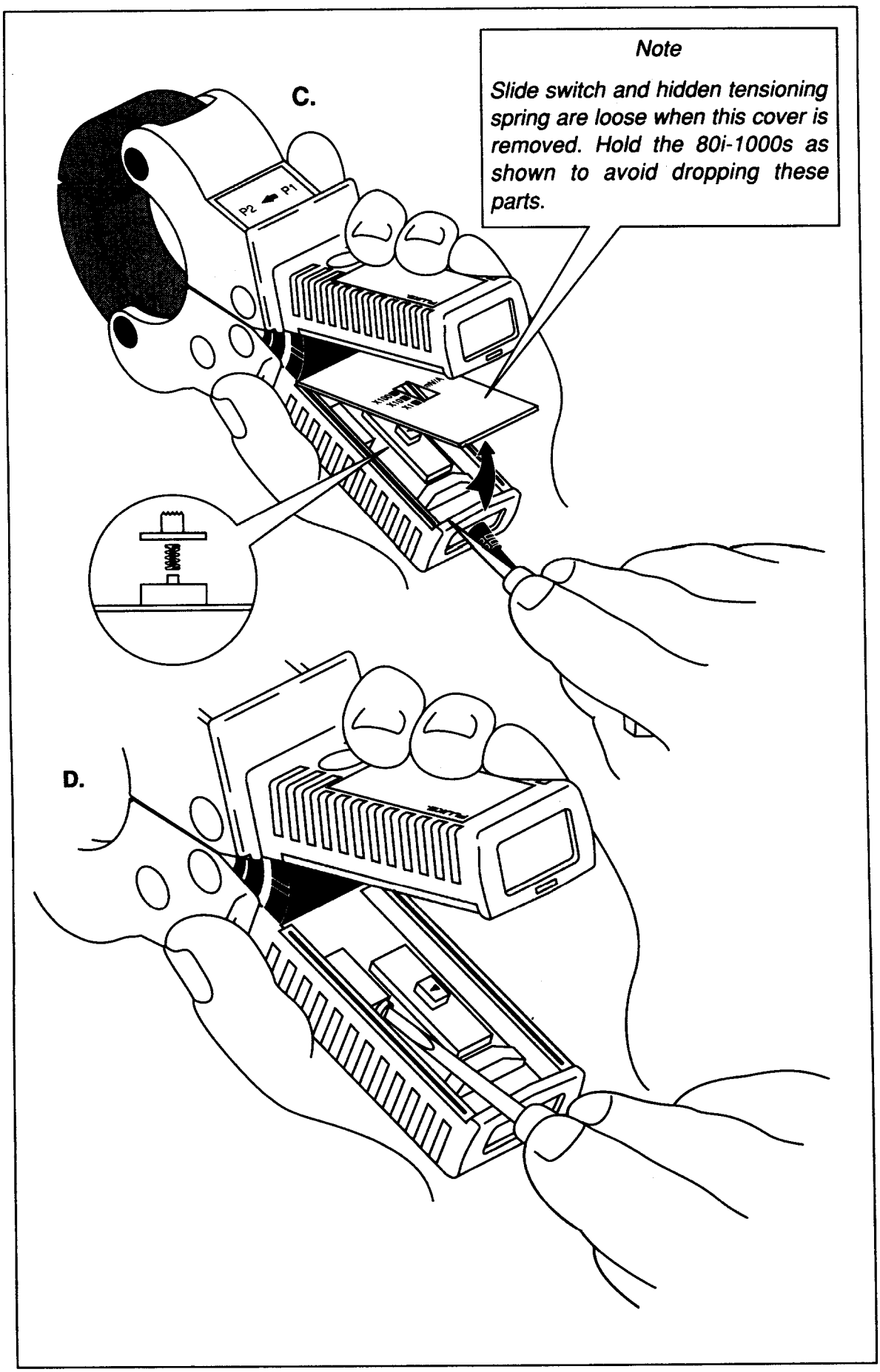


Figure 6. Calibration Potentiometer Access (cont)

REPLACEMENT PARTS

To order replacement parts in the USA, call 1-800-526-4731. To order outside the USA, contact the nearest Service Center. Use the following part numbers:

- Cable, 600V rms, Safety Insulated: 935036
- Quick Reference Card: 935122

Other replacement parts can be procured from generic sources with the information in Table 5.

SERIAL NUMBER LOCATION

Table 5. Replacement Parts

REF DES	DESCRIPTION	QTY
C1	CAP, CER, 330 pF ±10%, 50V, COG	1
C2, C3	CAP, CER, 2.2 nF ±10%, 50V, X7R	2
CR1 - CR10	DIODE, RM4004G	10
R1	RES, 92, ±0.5%, 1/4W, 50 ppm	1
R2, R3	RES, 18.2, ±0.5%, 1/4W, 50 ppm	2
R4	RES, 1.96K, ±1%, 1/8W, 50 ppm	1
R5 - R8	RES, 4.12, ±1%, 1/4W, 50 ppm	4
R9	RES, 15, ±1%, 1/8W, 50 ppm	1
R10	POT, 100, ±10%, 1/2W, 100 ppm	1
R11, 13	RES, 100, ±1%, 1/4W, 50 ppm	2
R12	RES, 220, ±5%, 1/4W, 200 ppm	1

The serial number date code is located on the handle. The serial number should be used when ordering parts or requesting service/calibration information.

SERVICE

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

SCHEMATIC DIAGRAM

Refer to Figure 7 for a schematic diagram and parts location information.

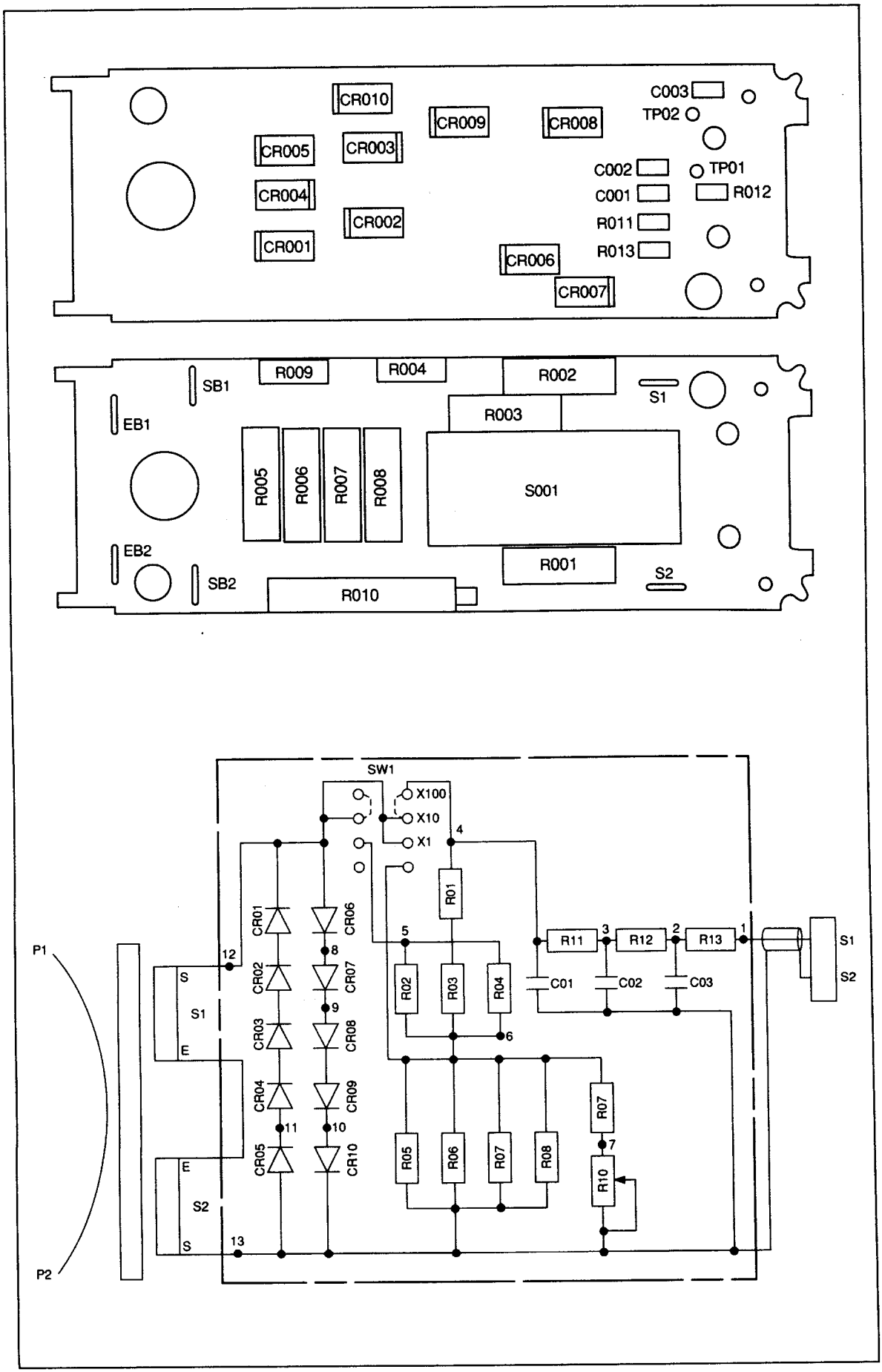
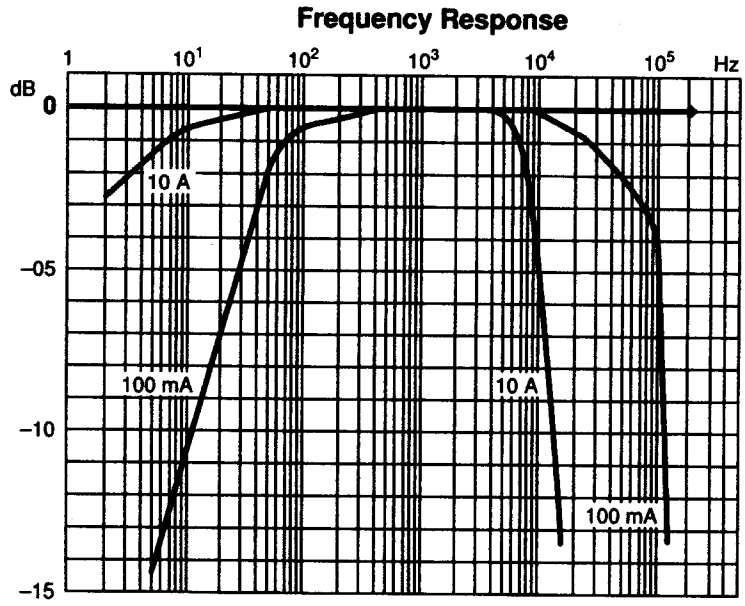


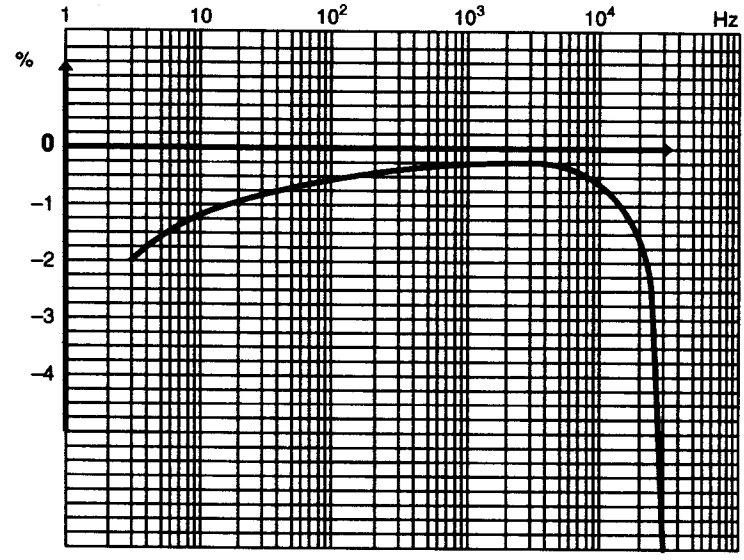
Figure 7. Schematic Diagram and Parts Locator

APPENDIX A.
TYPICAL RESPONSE CURVES

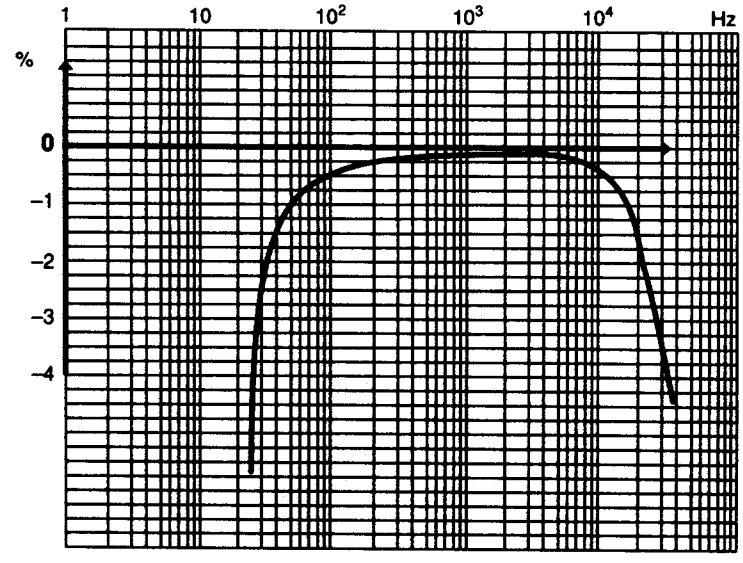
100 mV/A Range @ 10A/100 mA:
Frequency Response



10 mV/A Range @ 10 A:
Frequency Response

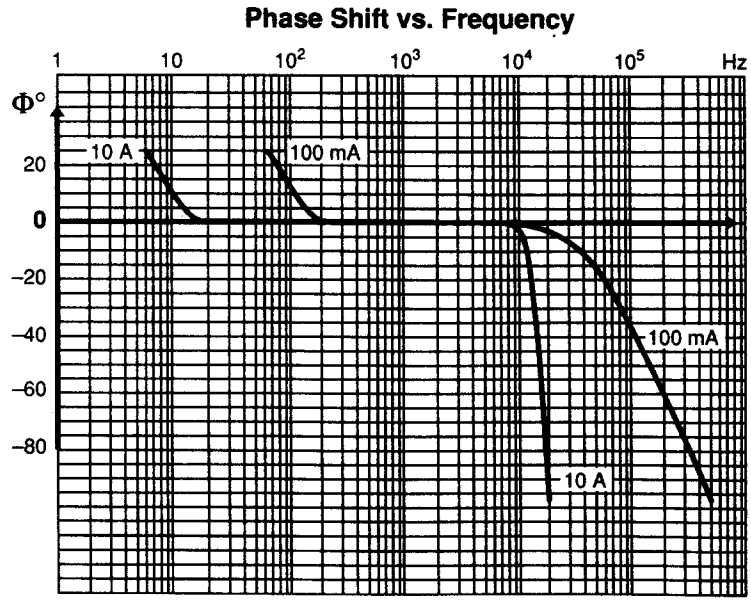


1 mV/A Range @ 5 A:
Frequency Response

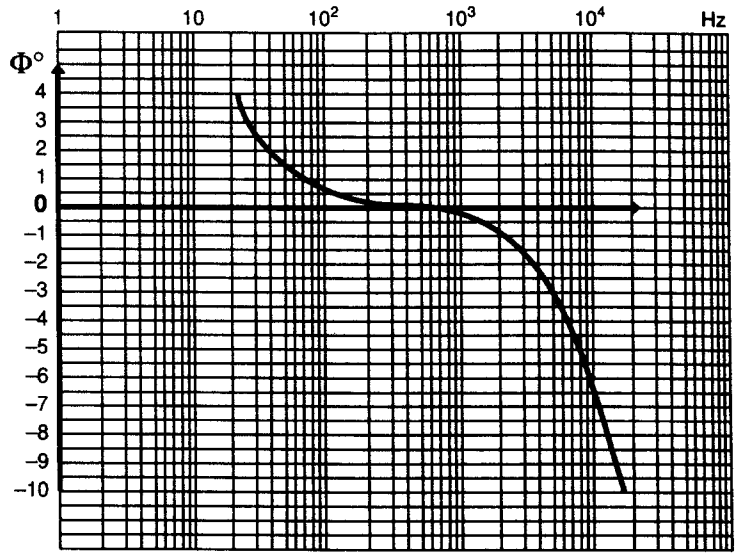


TYPICAL RESPONSE CURVES (cont)

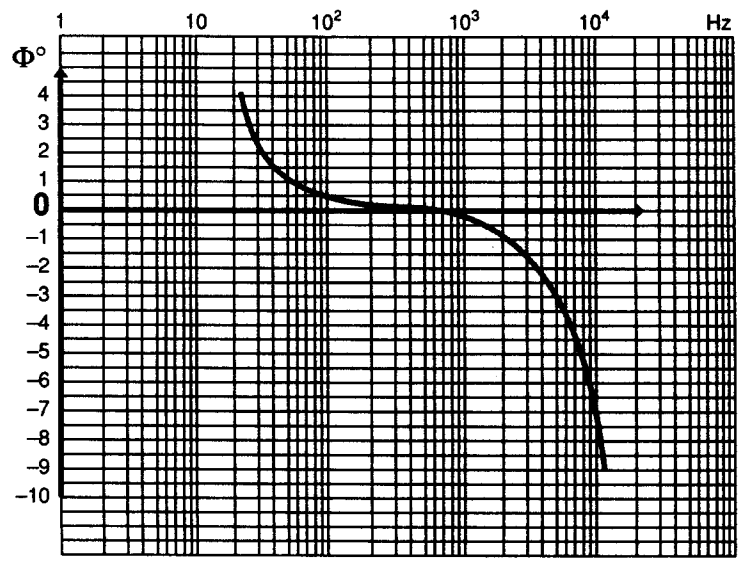
100 mV/A Range @10 A/100 mA:
Phase Shift vs. Frequency



10 mV/A Range @ 10 A:
Phase Shift vs. Frequency



1 mV/A Range @ 5 A:
Phase Shift vs. Frequency



For application or operation assistance or information on Fluke products, call:

- 800-443-5853 in USA and Canada
- 31 40 723-220 in Europe
- 206-356-5500 from other countries

The phone number for replacement parts is: 1-800-526-4731

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