
User's Guide

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Agilent 1146A AC/DC Oscilloscope Current Probe

Receiving Your Shipment

Upon receiving your shipment, check that the contents agree with the packing slip. If anything is missing, contact your nearest Agilent Technologies Sales Office. If the shipment was damaged, contact the carrier, then contact the nearest Agilent Technologies Sales Office.

Packaging

The 1146A AC/DC Current Oscilloscope Probe is shipped with a separate battery (not installed) and a User's Guide.

WARNING



- Connect the probe to the oscilloscope or voltage measuring instrument before clamping the probe around a conductor.
 - Never use the probe on circuits rated higher than 600 V or with float voltage greater than 600 V.
 - Never leave the probe clamped around a conductor while it is not connected to an oscilloscope or voltage measuring instrument.
 - Carefully center the conductor inside the probe jaws and ascertain that the probe is perpendicular to the conductor before closing the jaws.
 - Avoid, if possible, the proximity of other conductors which may create noise.
 - Check the magnetic mating surfaces of the probe jaws; these should be free of dirt, rust, or other foreign matter
 - Do not use a probe which is cracked, damaged or has defective leads.
-



This symbol signifies that the 1146A AC/DC Oscilloscope Current Probe is protected by double or reinforced insulation. Only use specified replacement parts when servicing the instrument.



This symbol signifies CAUTION! and requests that the user refer to the user manual before using the instrument.

Description

The 1146A AC/DC Current Oscilloscope Probe expands oscilloscope applications in industrial, automotive or power environments, and is ideal for analysis and measurement of distorted current waveforms and harmonics. The probe permits accurate display and measurement of currents from 100 mA to 100A rms, DC to 100 kHz without breaking into the circuit. The probe uses Hall effect technology to measure AC and DC signals. The probe connects directly to an oscilloscope through a 2 meter coaxial cable with an insulated BNC.

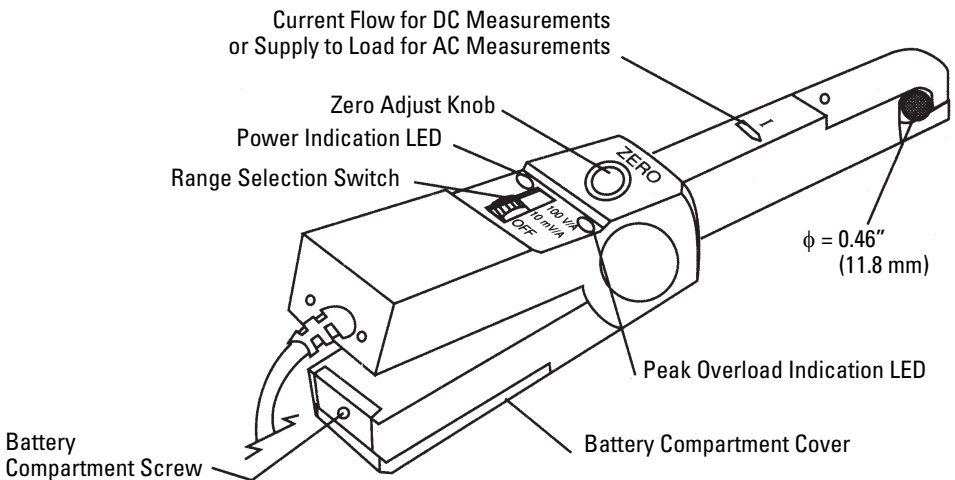
Compatibility

The 1146A AC/DC Current Oscilloscope Probe is compatible with any analog or digital oscilloscope or other voltage measuring instrument which has the following features:

- BNC input connector.
- Range capable of displaying 0.2 to 0.5 V per division.
- Minimum input impedance of 1 M Ω .

Control and Connector Identification

Figure 1



Control and Connector Identification

Specifications

Specifications

Electrical Specifications

Current Range 100 mV/A: 100 mA to 10 A peak
10 mV/A: 1 to 100 A peak

Output Signal 1000 mV peak max

AC current accuracy (After calibration and for one year)
(zero probe before making measurement)

Range	Accuracy
100 mV/A (50 mA to 10 A peak)	3% of reading ± 50 mA
10 mV/A (500 mA to 40 A peak)	4% of reading ± 50 mA
10 mV/A (40 A to 100 A peak)	15% max at ± 100 A

Phase Shift¹ < 1° from dc to 65 Hz on 10 mV/A
< 1.5° from dc to 65 Hz on 100 mV/A

Frequency Range DC to 100 kHz (-3dB with current derating)

Noise Range 10 mV/A: 480 μ V
Range 100 mV/A: 3 mV

Slew Rate Range 10 mV/A: 20 mV/ μ s
Range 100 mV/A: 0.3 V/ μ s

Load Impedance >1 M Ω / 100 pF

Insertion Impedance (50/60 Hz) 100 mV/A: 0.01 Ω
10 mV/A: 0.01 Ω

Rise or Fall time Range 100 mV/A: 3 μ s
Range 10 mV/A: 4 μ s

Working Voltage 600 Vrms max.

Common mode voltage 600 Vrms max.

Influence of adjacent conductor <0.2 mA/A AC

Influence of conductor position in jaw 0.5% of reading at 1 kHz

Battery 9 V alkaline (NEDA 1604A, IEC 6LR61)

Low battery green LED when ≥ 6.5 V

Overload indication red LED indicates input greater than the selected range.

Typical Consumption 8.6 mA

Battery Life 55 hours typical

¹ **Reference conditions** 23 °C ± 5 °C, 20 to 75% relative humidity, DC to 1kHz, probe zeroed, 1 minute warmup, batteries at 9 V ± 0.1 V, external magnetic field <40 A/m, no DC component, no external current carrying conductor, 1 M Ω / 100 pF load, conductor centered in jaw.



Environmental Specifications

Operating Temperature 0° to 50 °C

Storage Temperature -30° to 80 °C

Temperature Influence <0.2% per °C

Operating Relative Humidity

10° to 30 °C: 85 5% RH (without condensation)

40° to 50 °C: 45 5% RH (without condensation)

Altitude Operating: 0 to 2000 m

Non operating: 0 to 12,000 m

Mechanical Specifications

Zero Adjustment 20 turn potentiometer

Maximum cable diameter 11.8 mm

Case Protection IP20 per IEC 529

Drop Test 1.0 m on 38 mm of oak on concrete; test according to IEC 1010

Mechanical Shock 100 G; test per IEC 68-2-27

Vibration Test per IEC 68-2-6, frequency range 10 Hz to 55 Hz, amplitude 0.15 mm

Handle Lexan 920A, UL 94 V2

Dimensions 231 x 36 x 67mm

Weight 330 g (11.6 oz) with battery

Color light gray

Output lead insulated coaxial cable with insulated BNC connector

Cable length 2 m

Safety Specifications

- Double insulation or reinforced insulation between primary or secondary and outer case of the handle, per IEC 1010.
- 600 V category III, Pollution: 2.
- 300 V category IV, Pollution: 2.
- 5550 V 50/60 Hz between primary or secondary and the outer case of the handle.
- 3250V 50/60 Hz between primary and secondary.

Electromagnetic compatibility

EN 50081-1 Class B

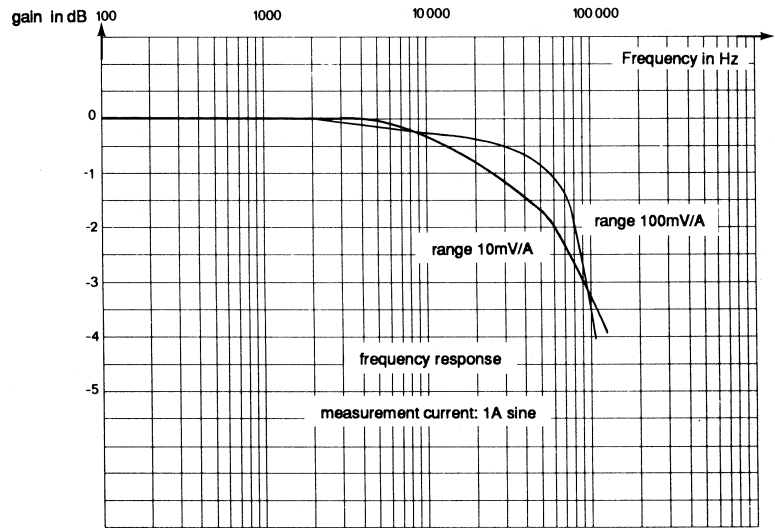
EN 50082-2 Electrostatic discharge IEC 1000-4-2

Radiated Field IEC 1000-4-3

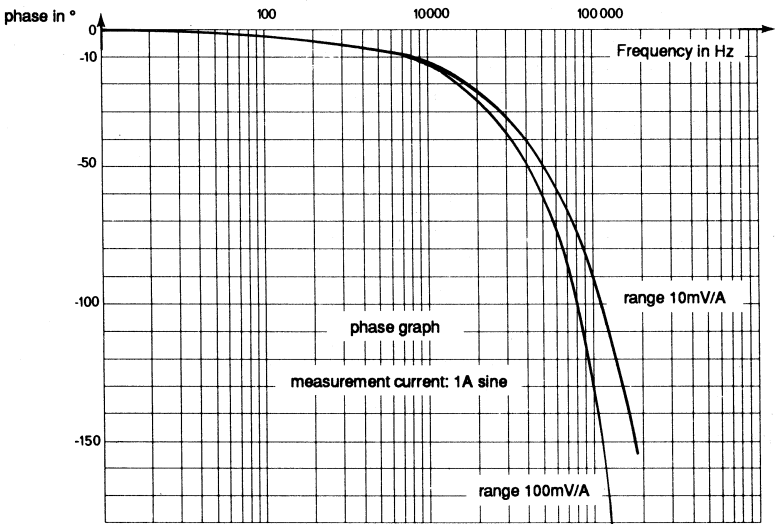
Fast transients IEC 1000-4-4

Magnetic Field at 50/60 Hz IEC 1000-4-8

Typical Response Curves

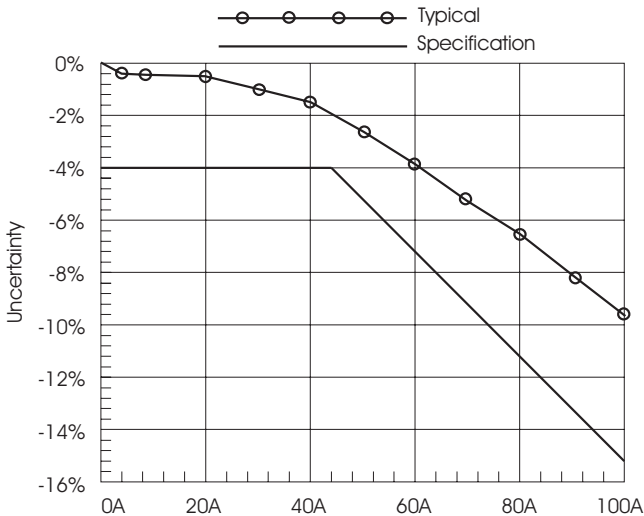


Frequency



Phase Shift

Linearity for a DC signal Range 10 mV/A



Accuracy

Operation

Zero Adjustment

The probe has a zero adjustment which should be adjusted before measurement. Alternatively, you may "zero" with the oscilloscope instead.

Current Measurement

Connect the current probe to the proper input channel on the oscilloscope. Begin with the least sensitive range on the current probe (10 mV/A). Select the 0.5 V/Division range on your oscilloscope. Clamp the probe on the conductor to be measured and read the current flowing directly on your oscilloscope.

You may also use your oscilloscope to amplify the signal while using the 100 mV/A probe range (which offers the best accuracy and least phase shift).

Important

It is possible to change the range on the current probe without removing the probe from the current carrying conductor, but it is important to remember not to exceed the permissible peak ratings of 1000 mV peak or 2000 mV peak to peak maximum. The peak ratings by range are: 10 A peak on the 100 mV/A range, 100 A peak on the 10 mV/A range.

Maintenance

Battery Indication (Green LED)

The probe has a battery condition LED. To ensure proper readings with your current probe, be sure that the green LED is lit during measurement. If not, replace the 9 V battery.

Peak Overload (OL) Indication (Red LED)

The 1146A offers an overload indicator. If the red LED illuminates during measurement, this indicates that the peak value exceeds the instrument response level and that the output is distorted. Switch the probe to a higher range if possible.

Maintenance

Be sure that mating surfaces of the jaw are free of dirt or foreign matter. If they are rusted, gently clean with a soft, lightly oiled cloth. Do not leave excessive oil residue.

Battery Replacement

When the probe is turned on, the green battery indication LED should light up. If not, replace the 9 V battery (see Figure 1). To replace the battery, disconnect the probe from the circuit and the oscilloscope. Turn the probe "OFF". Unscrew the battery compartment screw and pull out the battery compartment cover. Replace the battery and put the cover back on. Do not replace the battery while probe is in use.

Calibration

Repair and Calibration

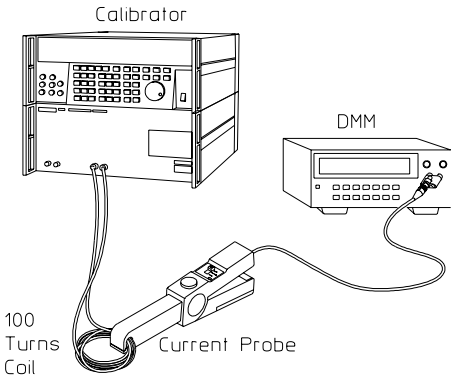
To guarantee that your instrument complies with the factory specifications, we recommend that the 1146A AC/DC Oscilloscope Current Probe be submitted to our factory service center at one year intervals for recalibration, or as required by other standards.

Equipment Required

Required Equipment	Critical Specificaitons	Recommended Model
DC/AC Voltage Calibrator		Fluke Model 5500A or equivalent
2 Digital Multimeters	1 A range, 1 V AC band with 100 KHz accuracy 1% or better. 0.1% equivalent DC accuracy	Agilent 34401A or equivalent.
Magnet wire coil	100 Turns	None
Small insulated screwdriver	None	None
BNC to banana plug adapter	None	None
Function Generator	50-100 KHz	Agilent 33120A or equivalent

To calibrate the 1146A, carefully pop out the plastic dot located on the left side of the probe, to access the potentiometer.
Turn the calibrator on and allow 15-30 minutes for it to warm up.

Figure 2



Accuracy Calibration Test

Calibration**Accuracy Calibration Test**

- 1 Connect the equipment.
 - a Connect the 100 turns coil to the output of the calibrator.
 - b Connect the 1146A output (BNC side) to the Digital Multimeter input using the BNC adapter.
- 2 Select the 200 mV DC range on the multimeter and 100m V/A range on the probe.
- 3 Adjust the zero adjust knob to read ± 0.5 mV on the multimeter.
- 4 Set the calibrator to provide 60 mA at 50 MHz in the 100 turns coil, this produces 6A turns.
- 5 Clamp on the 1146A probe to the coil.
- 6 With the multimeter set to AC (1V range) adjust R17 (resistor 17 pot 470 ohm 20% 1/2 W 100 ppm MULTI-CE 525121B00) to 602 mV ± 2 mV.
- 7 Set the amplifier to standby, then select 10m V/A range on the 1146A probe.
- 8 Set the calibrator source to 600 mA at 50 Hz in the 100 turns coil, this produces 60 A turns.
- 9 With the multimeter in AC function and the probe clamped onto the coil, verify that the reading is 600 mV ± 24 mV.
- 10 Set the calibrator to source 60 mA at 50 Hz in the 100 turns coil. Verify that the reading on the multimeter is 60 mV ± 2.4 mV.
- 11 After calibration, verify the 1146A on the chart below. If some points are out of accuracy, re-adjust R17 to balance the reading.

DC Range 10 mV/A

Positive			Negative		
Measure	Minimum	Maximum	Measure	Minimum	Maximum
10 A	98 mV	102 mV	-10 A	-98 mV	-102 mV
30 A	294 mV	306 mV	-30 A	-294 mV	-306 mV
60 A	576 mV	624 mV	-60 A	-576 mV	-624 mV
90 A	837 mV	963 mV	-90 A	-837 mV	-963 mV
100 A	910 mV	1.09 V	-100 A	-910 mV	-1.09 V

DC Range 100 mV/A

Positive			Negative		
Measure	Minimum	Maximum	Measure	Minimum	Maximum
1 A	98 mV	102 mV	-1 A	-98 mV	-102 mV
3 A	294 mV	306 mV	-3 A	-294 mV	-306 mV

Positive			Negative		
6 A	588 mV	614 mV	-6 A	-588 mV	-612 mV
10 A	980 mV	1.02 V	-10 A	-980 mV	-1.02 V

Overload LED Verification

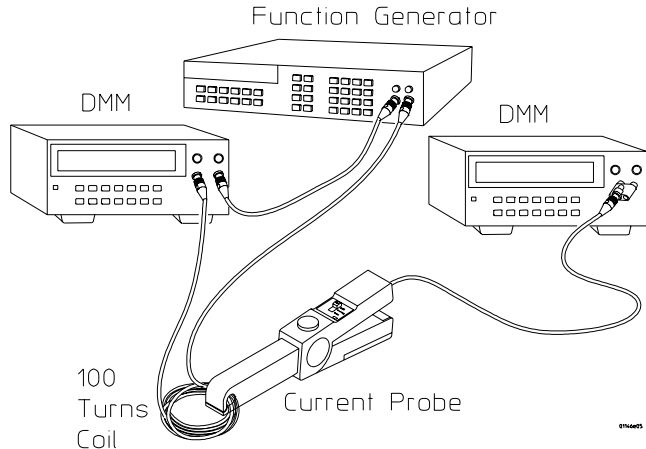
Use the same setup as done in the calibration.
The red LED must be lit when the current measured is greater than the value of the chart below.

Measure	Range
+10 A \pm 2%	100 mV/A
+120 A	10 mV/A
-120 A	10 mV/A

Probe Output Voltage

- 1 Connect a 100 turns coil to the output of the function generator and monitor the current with an ammeter (100 KHz bandwidth) in series.
- 2 Adjust the current to 19 mA AC at 100 KHz.
- 3 The probe output should be between 130.15 mV and 193.8 mV on the 100m V/A range and 13.02 to 19.4 mV on the 10m V/A range.

Figure 3



Probe Output Voltage

DECLARATION OF CONFORMITY

According to ISO/IEC Guide 22 and CEN/CENELEC EN 45014

Manufacturer's Name: Agilent Technologies, Inc
Manufacturer's Address: 1900 Garden of the Gods Road
Colorado Springs, CO
80907, U.S.A.

Declares, that the product

Product Name: Oscilloscope Current Probe
Model Number(s): 1146A
Product Option(s): This declaration covers all options of the above products(s)

Conforms to the following product standards:

EMC	Standard	Limit
	IEC 61326-1:1997+A1:1998 / EN 61326-1:1997+A1:1998	
	CISPR 11:1990 / EN 55011:1991	Group 1, Class A ^[1]
	IEC 61000-4-2:1995+A1:1998 / EN 61000-4-2:1995	4 kV CD, 8 kV AD
	IEC 61000-4-3:1995 / EN 61000-4-3:1995	3 V/m, 80-1000 MHz
	IEC 61000-4-4:1995 / EN 61000-4-4:1995	0.5 kV signal lines, 1 kV power Lines
	IEC 61000-4-5:1995 / EN 61000-4-5:1995	0.5 kV line-line, 1 kV line-ground
	IEC 61000-4-6:1996 / EN 61000-4-6:1996	3 V, 0.15-80 MHz
	IEC 61000-4-11:1994 / EN 61000-4-11:1994	1 cycle, 100%
	Canada: ICES-001:1998	
	Australia/New Zealand: AS/NZS 2064.1	

Safety IEC 61010-1:1990+A1:1992+A2:1995 / EN 61010-1:1993+A2:1995

Conformity / Supplementary Information:

The product herewith complies with the requirements of the Low Voltage Directive 73/23/EEC and the EMC Directive 89/336/EEC (including 93/68/EEC) and carries the CE-marking accordingly (European Union)

^[1] The product was tested in a typical configuration with Agilent Technologies test systems.

Date: 06/28/2000


Name

Ken Wyatt, Product Regulations Manager

For further information, please contact your local Agilent Technologies sales office, agent, or distributor.

Product Regulations

EMC	IEC 61326-1:1997+A1:1998 / EN 61326-1:1997+A1:1998	
	CISPR 11:1990 / EN 55011:1991	
	IEC 61000-4-2:1995+A1:1998 / EN61000-4-2:1995	A
	IEC 61000-4-3:1995 / EN 61000-4-3:1995	B
	IEC 61000-4-4:1995 / EN 61000-4-4:1995	A
	IEC 61000-4-5:1995 / EN 61000-4-5:1995	A
	IEC 61000-4-6:1996 / EN 61000-4-6:1996	A
	IEC 61000-4-11:1994 / EN 61000-4-11:1994	A
	Canada: ICES-001:1998	
	Australia/New Zealand: AS/NZS 2064.1	

Safety	IEC 348:1978 / HD 401 S1:1981
	UL1244
	CSA-C22.2 No. 231 (Series M-89)

Performance Codes:
A PASS - Normal operation, no effect.
B PASS - Temporary degradation, self recoverable.
C PASS - Temporary degradation, operator intervention required.
D FAIL - Not recoverable, component damage.

Notes: (none)

Sound Pressure Level	N/A
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Regulatory Information for Canada

ICES/NMB-001

This ISM device complies with Canadian ICES-001.
Cet appareil ISM est conforme à la norme NMB-001 du Canada.

Regulatory Information for Australia/New Zealand

This ISM device complies with Australian/New Zealand AS/NZS 2064.1



Safety Notices

This apparatus has been designed and tested in accordance with IEC Publication 1010, Safety Requirements for Measuring Apparatus, and has been supplied in a safe condition. This is a Safety Class I instrument (provided with terminal for protective earthing). Before applying power, verify that the correct safety precautions are taken (see the following warnings). In addition, note the external markings on the instrument that are described under "Safety Symbols."

Warnings

- Before turning on the instrument, you must connect the protective earth terminal of the instrument to the protective conductor of the (mains) power cord. The mains plug shall only be inserted in a socket outlet provided with a protective earth contact. You must not negate the protective action by using an extension cord (power cable) without a protective conductor (grounding). Grounding one conductor of a two-conductor outlet is not sufficient protection.
- Only fuses with the required rated current, voltage, and specified type (normal blow, time delay, etc.) should be used. Do not use repaired fuses or short-circuited fuse-holders. To do so could cause a shock or fire hazard.
- If you energize this instrument by an auto transformer (for voltage reduction or mains isolation), the common terminal must be connected to the earth terminal of the power source.
- Whenever it is likely that the ground protection is impaired, you must make the instrument inoperative and secure it against any unintended operation.
- Service instructions are for trained service personnel. To avoid dangerous electric shock, do not perform any service unless qualified to do so. Do not attempt internal service or adjustment unless another person, capable of

rendering first aid and resuscitation, is present.

- Do not install substitute parts or perform any unauthorized modification to the instrument.
- Capacitors inside the instrument may retain a charge even if the instrument is disconnected from its source of supply.
- Do not operate the instrument in the presence of flammable gasses or fumes. Operation of any electrical instrument in such an environment constitutes a definite safety hazard.
- Do not use the instrument in a manner not specified by the manufacturer.

To clean the instrument

If the instrument requires cleaning: (1) Remove power from the instrument. (2) Clean the external surfaces of the instrument with a soft cloth dampened with a mixture of mild detergent and water. (3) Make sure that the instrument is completely dry before reconnecting it to a power source.

Safety Symbols



Instruction manual symbol: the product is marked with this symbol when it is necessary for you to refer to the instruction manual in order to protect against damage to the product..



Hazardous voltage symbol.



Earth terminal symbol: Used to indicate a circuit common connected to grounded chassis.

Notices

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USA

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A CAUTION notice denotes a hazard. It calls attention to an operating procedure, practice, or the like that, if not correctly performed or adhered to, could result in damage to the product or loss of important data. Do not proceed beyond a CAUTION notice until the indicated conditions are fully understood and met.



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