RIGOL

PCA1000B/2000B Series

Current Probe

User Guide

Apr. 2025

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Website: *http://www.rigol.com*

Section	Description	Page

List of Figures

1 Safety Requirement

1.1 Safety Notices and Symbols

Safety Notices in this Manual:

DANGER

Indicates that incorrect operation presents an extreme hazard that could result in serious injury or death to the user.

WARNING

Indicates that incorrect operation presents a significant hazard that could result in serious injury or death to the user.

CAUTION

Indicates that incorrect operation presents a possibility of injury to the user or damage to the device.

NOTE

Indicates suggestions related to the performance of the device or correct operation.

Safety Notices on the Product:

- **DANGER**

  It calls attention to an operation, if not correctly performed, could result in injury or hazard immediately.

- **WARNING**

  It calls attention to an operation, if not correctly performed, could result in potential injury or hazard.

- **CAUTION**

  It calls attention to an operation, if not correctly performed, could result in damage to the product or other devices connected to the product.

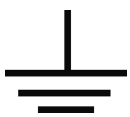
Safety Symbols on the Product:

Hazardous Voltage

Safety Warning

Protective Earth Terminal

Chassis Ground



Test Ground

1.2 Safety Precautions

To use this device in a safe manner, please strictly observe the following safety precautions. Failure to operate the device as instructed may impair the protection function provided by the device. The company declaims no responsibility for any damage resulting from failure to follow the instructions.

DANGER

- **To avoid short circuit and personal injury, the circuit under test is limited to 300 V.**
- **Do not measure around a bare conductor. Doing so may result in short-circuit or electric shock. Take measurements at a location on an insulated wire where there is sufficient insulation for the circuit voltage.**
- **Refer to *Electrical Specifications* when measuring current that includes a high-frequency component. Never measure any current that exceeds the rated current.**
- **Using the device in high-frequency or strong magnetic field may cause the device to become abnormally hot, resulting in fire, equipment damage, or burns.**
- **Do not touch the measured conductor and sensor head when measuring.**
- **When connecting a waveform measurement instrument to the BNC output connector of this device, please ensure that the instrument is double-insulated and equipped with protective grounding.**
- **Observe the following to avoid electric shock and short circuit.**
  - **Connect the probe to the waveform measurement instrument first, and then connect the probe to the active cable to be measured.**
  - **When the sensor is turned on, do not short circuit the conductor under test.**
  - **Do not damage the insulation surface while taking measurements.**
  - **Before clamping the conductor under test, make sure that the insulation on the conductor is undamaged. Also, take care not to damage the insulation when clamping the conductor. Any damage to the insulation could cause an electric shock.**
  - **To prevent fire, burns, or damage of the DUT, pay attention to the following items when measuring high-frequency current or current that has high-frequency components:**
    - **Eddy current loss may cause heating of the sensor head.**
    - **Dielectric heating may cause heating of cord insulation and other materials.**
  - **This device should only be connected to the secondary side of a breaker, so the breaker can prevent an accident if a short circuit occurs. Connections should never be made to the primary side of a breaker, because unrestricted current flow could cause a serious accident if a short circuit occurs.**
  - **Be sure to observe all operating precautions for the waveform measurement instrument and other measurement instruments to which this device is connected.**

- **When using a measurement instrument that does not provide isolation between its input terminals, chassis, or other input terminals, please pay attention to the following points. As shown in the following figure, if a signal is applied to an input terminal other than that to which this device is connected, do not connect the ground terminal of the signal to any non-ground potential. Otherwise, short-circuit current will flow through the current probe from the ground terminal, which could cause an electrical accident or damage.**

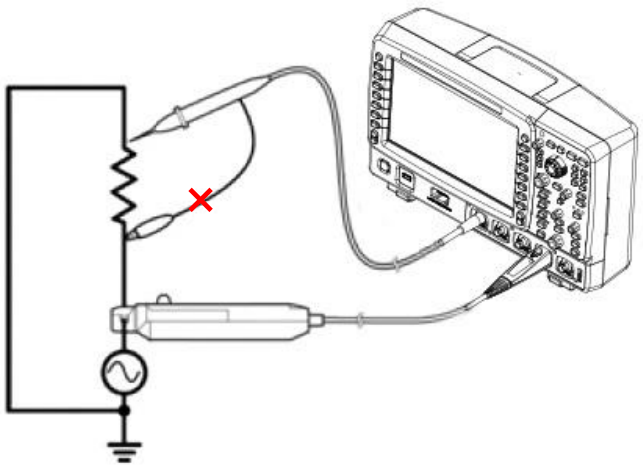


Figure 1.1 PCA1030B/2030B

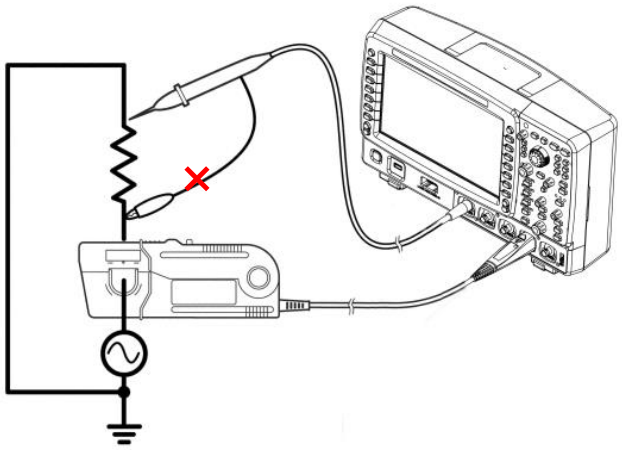


Figure 1.2 PCA1150B/1500B

WARNING

- **Keep the device dry and keep your hands dry while measuring to avoid electric shock.**
- **Do not perform the demagnetization operation on the waveform measurement instrument while the conductor under test is clamped onto the probe. Doing so could damage the circuitry or cause an accident that might result in injury or death.**

- **Ensure that the input does not exceed the maximum rated current to avoid device damage, short-circuiting, and electric shock resulting from overheating.**
- **To avoid electric shock when measuring live lines, wear appropriate protective gear, such as insulated rubber gloves, boots, and a safety helmet.**

CAUTION

- **To avoid damage to the device, protect it from vibration or shock during transport and handling, and be especially careful to avoid dropping it.**
- **Do not store or use the device in a place where it could be exposed to direct sunlight, high temperature, humidity, or condensation. Under such conditions, the device may be damaged and insulation may deteriorate so that it no longer meets its specifications.**
- **Before use, inspect the product for any damage that may have occurred due to harsh storage conditions or transportation. If any damage is found, please contact your local distributor or representative.**
- **This device is not designed to be entirely water-proof or dust-proof. To avoid damage, do not use it in a wet or dusty environment.**
- **The sensor head is a precision assembly which includes a shield case, a ferrite core, and a Hall effect element. It may be damaged if subjected to sudden changes in ambient temperature, or mechanical strain or shock, and therefore great care should be exercised in handling it.**
- **The gear mating surfaces of the sensor head are precision ground, and should be treated with care. If the surface is scratched, performance may be impaired.**
- **Measurements may be degraded by dust on the gear mating surface of the sensor head. Keep the mating surfaces clean by gently wiping with a soft and anti-static cloth.**
- **Foreign substances on the mating surfaces of the sensor head can cause resonant sound and degraded measurements. Therefore, keep these mating surfaces clean by gently wiping with a soft cloth.**
- **Do not bend or pull the cables to avoid damaging them.**
- **Do not apply a static electricity or other source of high voltage to the sensor. Doing so may damage its internal Hall elements and circuitry.**
- **To clean the device, wipe it gently with a soft cloth moistened with water or mild detergent. Never use solvents such as benzene, alcohol, acetone, ether, ketones, thinners or gasoline, as they can deform and discolor the case.**
- **When the power is on, keep the sensor closed, except when clamping it onto the conductor under test. Otherwise, the gear mating surface of the magnetic core section can be scratched.**
- **Keep the sensor head closed when not in use, to avoid accumulating dust or dirt on the gear mating surface, which could affect its clamp performance.**
- **Avoid stepping on or pinching the cable, which could damage the cable insulation.**
- **Keep the cables away from heat sources, as bare conductors could be exposed if the insulation melts.**

NOTE

Accurate measurement may be impossible in the presence of strong magnetic fields, such as transformers and high-current conductors, or in the presence of strong electromagnetic fields such as radio transmitters.

2 Service

When sending the device for repair, pack it carefully to prevent damage in transit. Package the device with the cushioning materials to avoid causing damage to the probe. Be sure to attach the detailed failure descriptions about the product. RIGOL shall not be responsible for any damage of the probe that occurs during shipment.

A regular calibration is necessary in order to ensure that the current probe can provide correct measurement results with expected accuracy. If you need to calibrate the current probe, contact RIGOL.

3 Document Overview

This manual gives you a quick overview of the functions, operation methods, and precautions of the PCA1000B/PCA2000B Series Current Probe.

TIP

For the latest version of this manual, download it from RIGOL official website (*http://www.rigol.com*).

Publication Number

UGE35100-1110

Content Conventions in this Manual

The PCA1000B/PCA2000B Series Current Probe includes the following models.

Model	Maximum Continuous Current[1]	Bandwidth	Range	Current Transfer Ratio
PCA1030B	30 A	50 MHz	30 A	0.1 V/A
PCA2030B	30 A	100 MHz	30 A	0.1 V/A
PCA1150B	150 A	12 MHz	150 A	0.01 V/A
PCA1500B	500 A	5 MHz	500 A	0.01 V/A

NOTE

[1]: The maximum continuous current decreases as the frequency increases. Refer to the maximum measurable current vs. frequency curve graphs for each model.

4 Product Overview

The PCA1000B/PCA2000B Series Current Probe is a high-frequency current probe with AC/DC measurement capability. Its key features include: high bandwidth, capturing current waveforms quickly and accurately; high accuracy, up to 1% accuracy within the current measurement range, meeting the requirements of most test areas.

Key Features

- **PCA1030B/PCA2030B** has a compact and lightweight form factor, making it easy to use on today' s densely populated circuit boards. The small clamp allows current measurement in tight spaces while still accommodating conductors up to 5 mm in diameter. It can measure 30 A continuous current and 50 A peak current. PCA1030B provides 50 MHz bandwidth, and PCA2030B provides 100 MHz bandwidth.
- The **PCA1150B** jaw can clamp conductors up to 20 mm in diameter, making it suitable for high-current applications. It can measure 150 A continuous current and 300 A peak current, and provides a bandwidth of 12 MHz.
- The **PCA1500B** jaw can clamp conductors up to 20 mm in diameter, making it suitable for high-current applications. It can measure 500 A continuous current and 750 A peak current, and provides a bandwidth of 5 MHz.

Applications

- Power supply (switching and linear) design
- LED lighting design
- Electric vehicle design
- New energy
- Variable frequency household appliance
- Experiment of electrical engineering
- Semiconductor device design
- Inverter/transformer design
- Electronic ballast design
- Industrial/consumer electronics design
- Engine drive design
- Power electronics and power transmission experiments
- Design of transportation systems (electric vehicles, locomotives, avionics)

5 Probe Parts Overview

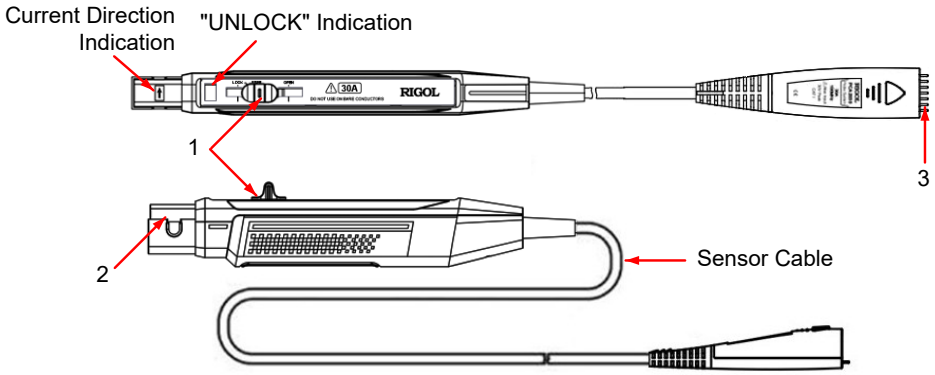


Figure 5.1 PCA1030B/PCA2030B Parts

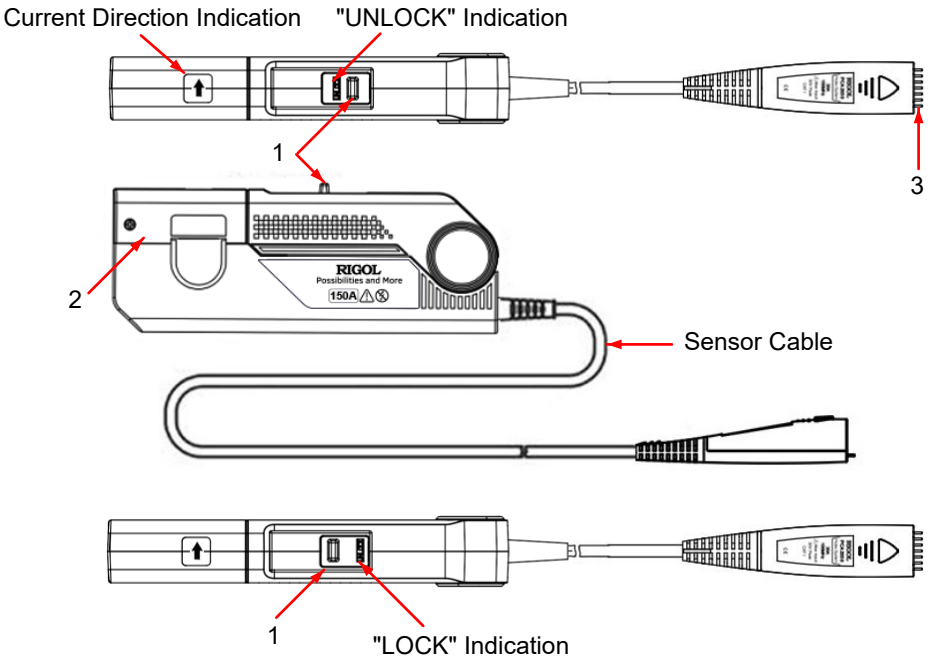


Figure 5.2 PCA1150B/PCA1500B Parts

1. Opening Lever

It is used to release and lock the current sensor. You are recommended to lock the current sensor when measuring the conductor to avoid danger.

For PCA1030B/PCA2030B, there are OPEN, FREE, and LOCK indications on one side of the opening lever. The on/off status of the current sensor is related to the position of the opening lever.

- When the opening lever is in the OPEN position, the current sensor is released and the conductor under test can be connected to the current sensor;
- When the opening lever is in the FREE position, the current sensor is closed but not locked;
- When the opening lever is in the LOCK position, the current sensor is locked and the UNLOCK indication is covered (cannot be seen).

For PCA1150B/PCA1500B, there are LOCK and UNLOCK indications on the opening lever. The current sensor is locked when the LOCK indication is displayed on the opening lever (the UNLOCK indication disappears).

2. Sensor

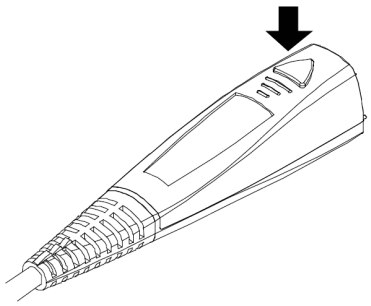
It is used to clamp the conductor under test to carry out the actual current measurement. It is a core element for detecting conductor current. It is a precision assembly that includes a molded component, a ferrite core, and a Hall-effect element. It may be damaged if subjected to sudden changes in ambient temperature, or mechanical strain or shock, and therefore great care should be exercised in handling it.

3. Output Connector

The current waveform of the conductor under test is output at a constant gain via this connector to the waveform measurement instrument. This connector can be connected to the BNC input connector of the waveform measurement instrument.

TIP

- The current probe must be connected to a waveform measurement instrument that has an input impedance of at least 1 MΩ. Accurate measurement is not possible with waveform measurement instrument that has an input impedance of 50 Ω.
- If using BNC-banana plug adapters or similar connectors to connect to input terminals other than BNC connectors, make sure the polarity is correct in connection.
- Before disconnecting the output connector from the waveform measurement instrument, first press the button on the probe and then pull out the connector, as shown in the figure below. Pulling or dragging the cable without pressing the button may damage the terminator.



6 To Use the Current Probe

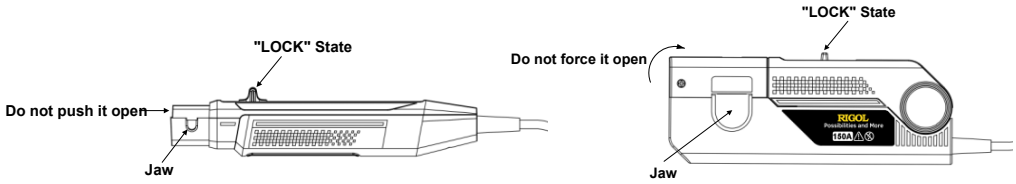
Before using the current probe, read *Safety Precautions* and *Precautions for Measurement* carefully.

6.1 Precautions for Measurement

CAUTION

- **When removing the connector, press the button on the probe to unlock the connector before pulling it out. Dragging or pulling the cable without unlocking may damage the output terminal.**
- **Note the polarity of the input terminal when using an input terminal other than the BNC terminals.**
- **The maximum continuous input range is based on the heat that is internally generated during the measurement. Note that the input current cannot exceed the range, or it may damage the current probe.**
- **The maximum rated current is a recommended value that assumes sine-wave input under standard conditions. Self-heating may increase if the ambient temperature increases or the measurement current waveform contains other frequency components. The device may sustain damage from self-heating even at current levels that are lower than the maximum current value defined by the maximum rated current.**
- **If excess current is input, generated heat activates a built-in safety function that blocks normal output. If this happens, remove the input immediately (remove the sensor from the conductor under test or reduce the input current to zero). Wait until the sensor has had sufficient time to cool before resuming operation.**
- **Heating generated during measurement of current with a frequency of 1 kHz or higher is mainly attributed to the self-heating of the sensor head. In this case, the built-in safety function will not be activated. Be careful to avoid accidents, such as a burn by heat, short-circuit, and damage to the sensor.**
- **Even if the input current does not exceed the rated continuous maximum, continuous input for an extended period of time may activate the safety circuit to prevent damage resulting from heating of the sensor.**
- **At a high ambient temperature, the built-in safety circuit may be activated even if the input current is below the rated continuous maximum.**
- **Continuous input of current exceeding the rated maximum input range or repeated activation of the safety function may result in damage to the device.**
- **Do not place any unclamped conductor with a current of a frequency of 10 kHz or higher near the sensor head, as current flow in the conductor nearby may cause the temperature increase of the sensor head, leading to damage to the sensor.**
- **Use the opening lever to open the sensor head. If an upper core is forced to open when the sensor head is locked, the open-close mechanism can be damaged. When**

it is in the LOCK position, please do not apply pressure to the overall part in the direction shown below.

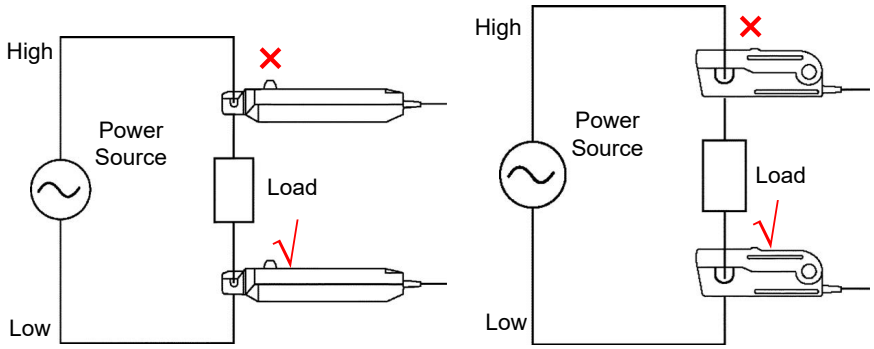


NOTE

- The output terminal of this device is internally configured. When using a waveform measurement instrument, please select the high input impedance (1 MΩ). If the input impedance is 50 Ω, accurate measurement is not possible.
- Ensure that the measured current does not exceed the maximum value. Exceeding this rated value may cause core saturation. Core saturation can result in waveform clipping during saturation, excessive impulse current, and may even prevent proper degaussing of the core, requiring re-zeroing.
- Immediately after powering on, this device may be subject to an appreciable offset drift due to the effect of self-heating. To counteract this, allow the device to warm up for at least 30 minutes before carrying out measurements.
- When performing continuous measurements, it is necessary to be aware that the zero offset voltage will drift due to the impact of some factors such as the changes of the ambient temperature.
- Under certain circumstances, oscillation may occur if the output connector is connected to the waveform measurement instrument that has been powered on. This does not indicate a malfunction. Oscillation can be stopped and operation can be restored to normal by opening and closing the sensor clamp.
- Depending on the amplitude and frequency of the current being measured, the sensor head may emit a resonant sound. This sound may also occur during demagnetizing operation, but it does not represent a malfunction.
- If foreign matter becomes adhered to the gear mating surface of the sensor head, a slight gap will appear between its upper and lower layer. In this case, a resonant sound will be produced from the sensor head. Therefore, any foreign matter on the gear mating surface of the sensor head should be removed by using the cleaning method described in this manual.
- An increase in the volume of the resonant sound during use may indicate that the gap between the upper and lower layers has increased. Since the sensor characteristics may change, it is recommended to calibrate the device.
- Performing the demagnetization operation on the waveform measurement instrument will generate a demagnetized waveform. Although the waveform may be asymmetry with respect to the zero-volt line, it does not indicate a malfunction.
- The reading may be affected by the position within the clamp aperture of the conductor being measured. The conductor should be in the center of the clamp aperture.
- When carrying out measurements,make sure that the sensor head is locked (for PCA1030B/PCA2030B, the opening lever should be in the LOCK position; for PCA1150B/

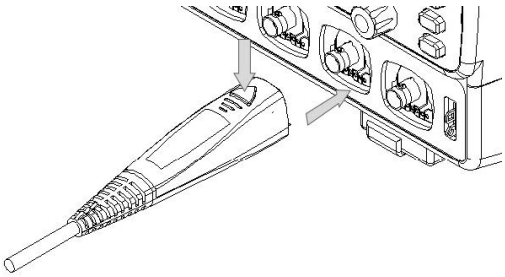
PCA1500B, first press down the probe to close the sensor head and then slide the opening lever until LOCK is displayed and UNLOCK disappears). If the sensor head is not properly closed, accurate measurements will not be possible.

- Accurate measurement may be impossible in the presence of strong magnetic fields, such as transformers and high-current conductors, or in the presence of strong electromagnetic fields such as radio transmitters.
- At high frequencies, common mode noise may affect measurements taken on the high voltage side of the circuit. If this occurs, reduce the frequency range of the waveform measurement instrument or clamp onto the low-voltage side of the circuit, as appropriate.



6.2 Preparations before Measurement

1. Prepare a high-frequency current probe and a waveform measurement instrument.
2. Connect the output connector of the current probe to the input terminal of the waveform measurement instrument.



3. Power on the waveform measurement instrument, and check whether the power indicator lights up.
4. Turn on the current probe and wait at least 30 minutes. Immediately after it is powered on, zero drift occurs obviously due to the warm-up and other factors. To ensure the accurate measurement, wait for at least a 30-minute warm-up after turning on the current probe before performing the measurement.

6.3 Demagnetizing and Zero Adjustment

1. With the waveform measurement instrument input at ground, adjust the trace to the zero position.
2. Set the input coupling of the waveform measurement instrument to DC.

CAUTION

- **If using BNC-banana plug adapters or similar connectors to connect to input terminals other than BNC connectors, make sure the polarity is correct in connection.**
- **Do not demagnetize while the sensor of the current probe is clamping the conductor under test. Demagnetizing causes current to flow into the conductor, which may damage components of the circuit under test.**
- **With the above considerations, as the demagnetized waveform will be generated when the current probe is energized, ensure that no conductor under test is clamped to the current probe before providing power to the current probe.**

3. Make sure the current sensor is locked (for PCA1030B/PCA2030B, the opening lever should be in the LOCK position; for PCA1150B/PCA1500B, LOCK should be displayed on the opening lever and UNLOCK should disappear).
4. Perform the demagnetization operation on the waveform measurement instrument.
5. Perform the zero adjustment operation on the waveform measurement instrument to adjust the trace to the zero position.

6.4 Measurement Procedure

1. Check and ensure that the system is safe and the preparations described in the preceding section have been ready.
2. Slide the lever to unlock the current sensor (for PCA1030B/PCA2030B, the opening lever should be in the OPEN position; for PCA1150B/PCA1500B, UNLOCK should be displayed on the opening lever and LOCK should disappear).
3. Adjust the current sensor to make its current direction indicator align with the actual current direction in the conductor. Clamp the sensor head around the conductor under test and put the conductor in the center of the sensor head.
4. Make sure the probe is locked by pushing the opening lever until UNLOCK disappears (for PCA1030B/PCA2030B, the opening lever should be in the LOCK position; for PCA1150B/PCA1500B, push the opening lever until LOCK is displayed and UNLOCK disappears).
5. It is now possible to monitor the current waveform. The output gain is 0.1V/A for PCA1030B/PCA2030B and 0.01V/A for PCA1150B/PCA1500B. You can use this output gain to derive the current sensitivity from the voltage sensitivity of the

waveform observing instrument. For example, if the voltage sensitivity is 10 mV/div, then the current sensitivity is (10 mV/div)/(0.1V/A) = 100 mA/div.

7 Specifications

7.1 Electrical Specifications

Model		PCA1030B	PCA2030B	PCA1150B	PCA1500B
Bandwidth (-3 dB)		DC~50 MHz (*Figure 7.1*)	DC~100 MHz (*Figure 7.2*)	DC~10 MHz (*Figure 7.3*)	DC~2 MHz (*Figure 7.4*)
Rise Time		≤7 ns	≤3.5 ns	≤35 ns	≤175 ns
Maximum Continuous Current		30 Arms (*Figure 7.5*)	30 Arms (*Figure 7.6*)	150 Arms (*Figure 7.7*)	500 Arms (*Figure 7.8*)
Peak Current		50 Apk	50 Apk	300 Apk	750 Apk
Range		30 A, 10X attenuation	30 A, 10X attenuation	150 A, 100X attenuation	500 A, 100X attenuation
Overcurrent Alarm Threshold		≥50 A	≥50 A	≥300 A	≥750 A
Current Transfer Ratio		0.1 V/A	0.1 V/A	0.01 V/A	0.01 V/A
Resolution		10 mA	10 mA	100 mA	100 mA
Accuracy (DC, 45~66 HZ Maximum Continuous Current)		±1%±10 mA	±1%±10 mA	±1%±100 mA	±1%±100 mA
Input Impedance		Refer to *Figure 7.9*	Refer to *Figure 7.10*	Refer to *Figure 7.11*	Refer to *Figure 7.12*
Delay	Probe	14 ns	14 ns	36 ns	42 ns
	BNC (1 m)	5 ns			
Termination Load		≥100 kΩ			

Model	PCA1030B	PCA2030B	PCA1150B	PCA1500B
Voltage on Insulated Wire	300 V CATI		600 V CATII 300 V CATIII	
Safety Compliance	EN61010-1: 2010+A1:2019 EN 61010 61010-2-032:2019			
EMC	EN61326-1:2013 EN61000 EN61000-3-2:2014 EN61000 EN61000-3-3:2013			

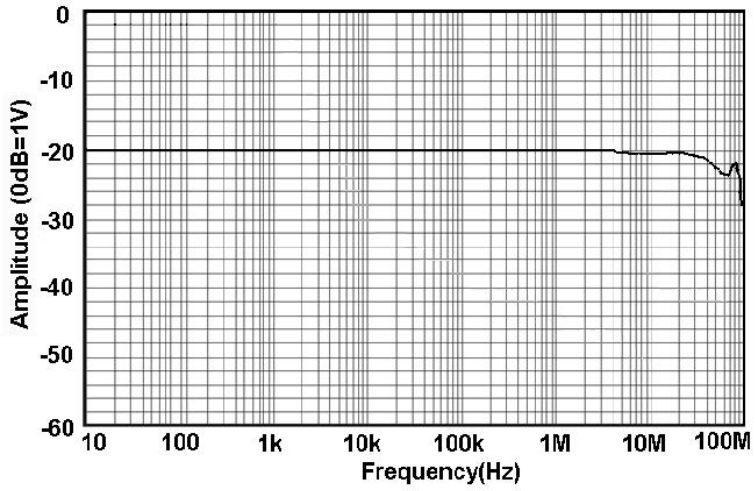


Figure 7.1 PCA1030B Amplitude-Frequency Characteristics

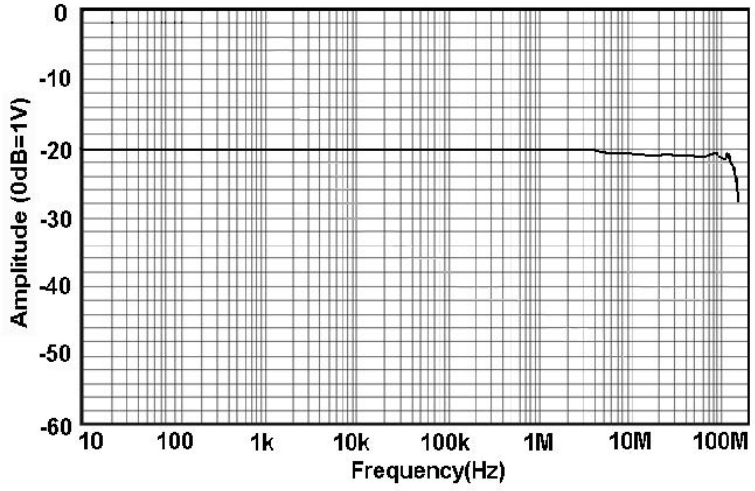


Figure 7.2 PCA2030B Amplitude-Frequency Characteristics

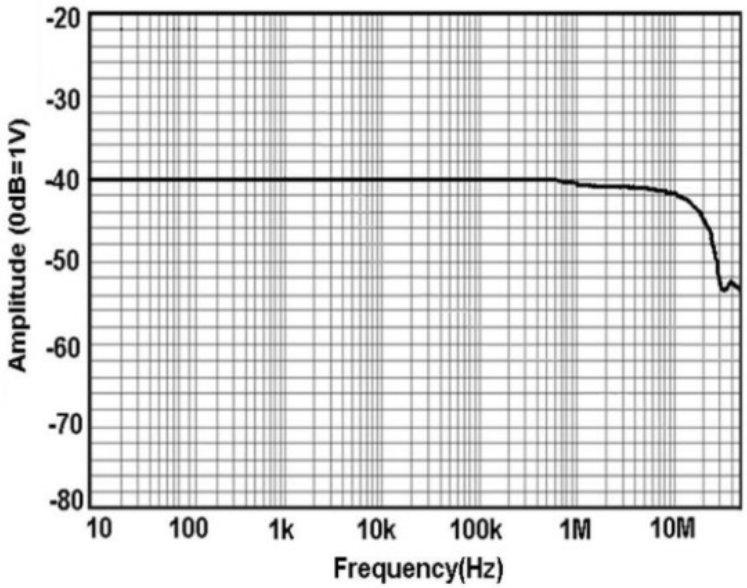


Figure 7.3 PCA1150B Amplitude-Frequency Curve

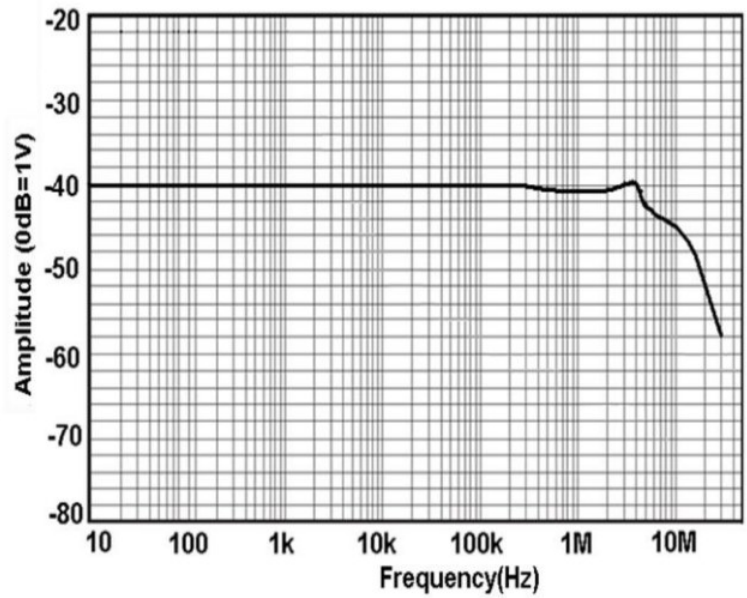


Figure 7.4 PCA1500B Amplitude-Frequency Curve

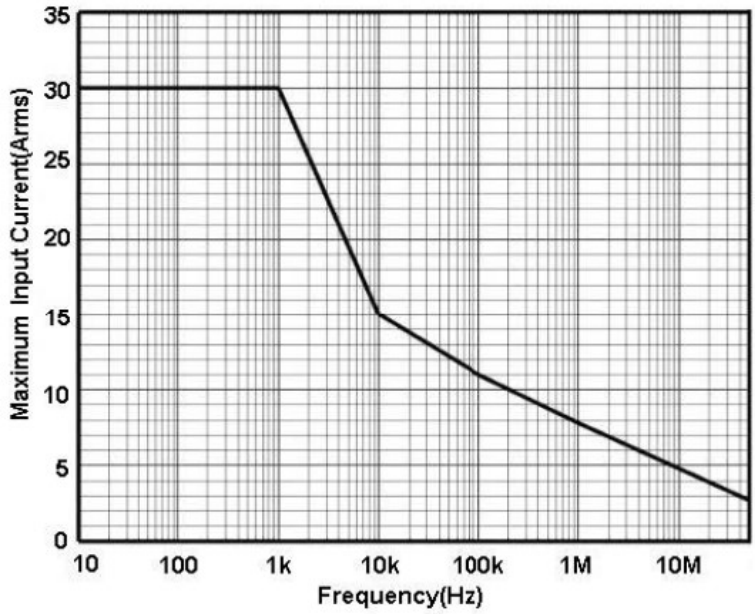


Figure 7.5 PCA1030B Maximum Measurable Current vs. Frequency Curve

(Continuous use beyond the maximum current indicated by the curve may result in probe burnout)

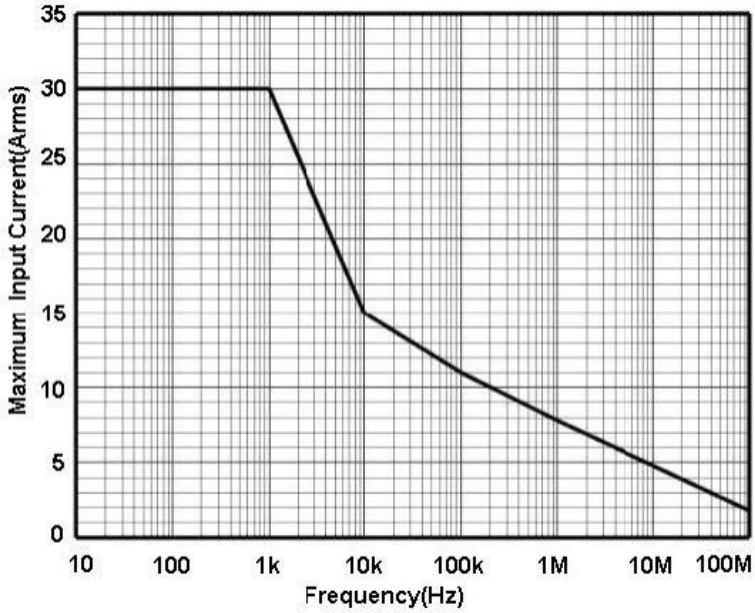


Figure 7.6 PCA2030B Maximum Measurable Current vs. Frequency Curve

(Continuous use beyond the maximum current indicated by the curve may result in probe burnout)

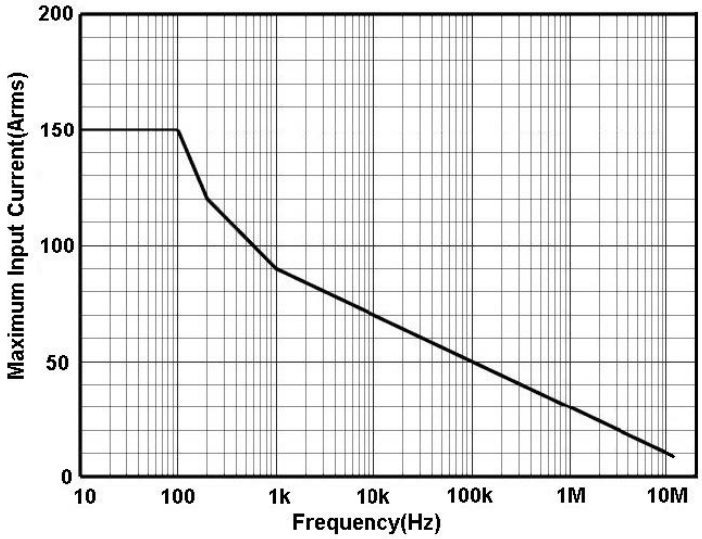


Figure 7.7 PCA1150B Maximum Measurable Current vs. Frequency Curve

(Continuous use beyond the maximum current indicated by the curve may result in probe burnout)

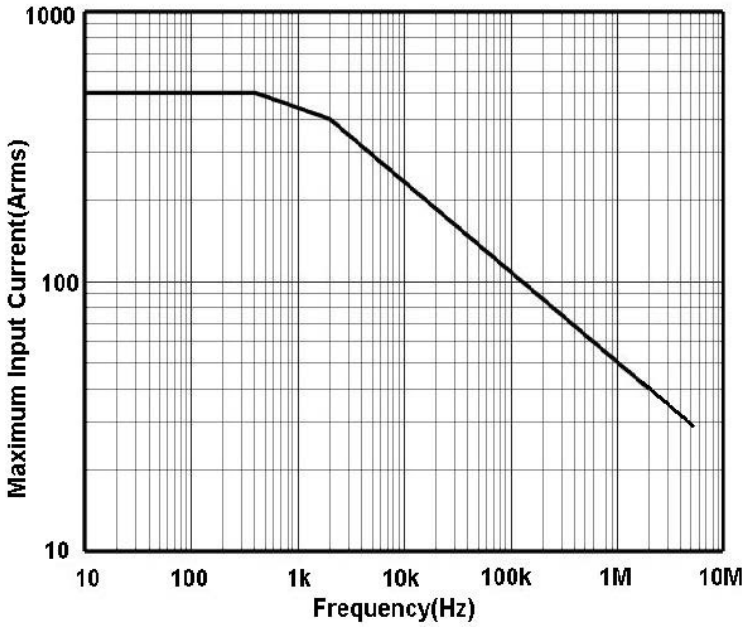


Figure 7.8 PCA1500B Maximum Measurable Current vs. Frequency Curve

(Continuous use beyond the maximum current indicated by the curve may result in probe burnout)

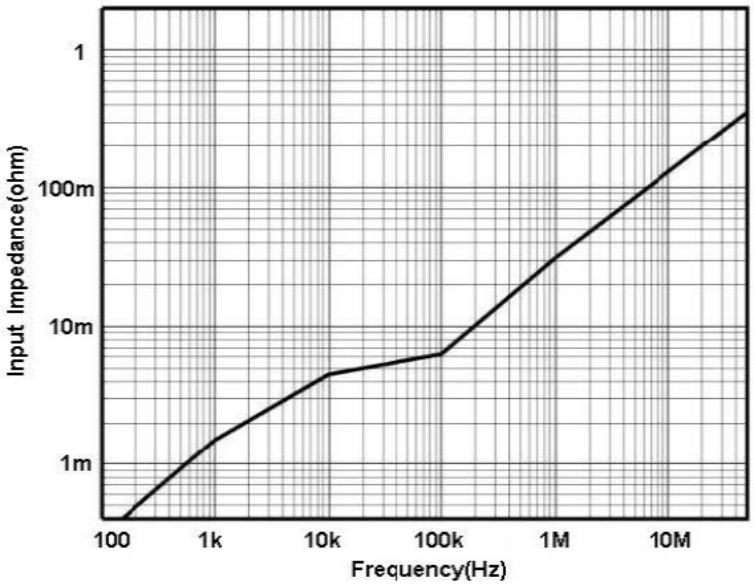


Figure 7.9 PCA1030B Input Impedance vs. Frequency Curve

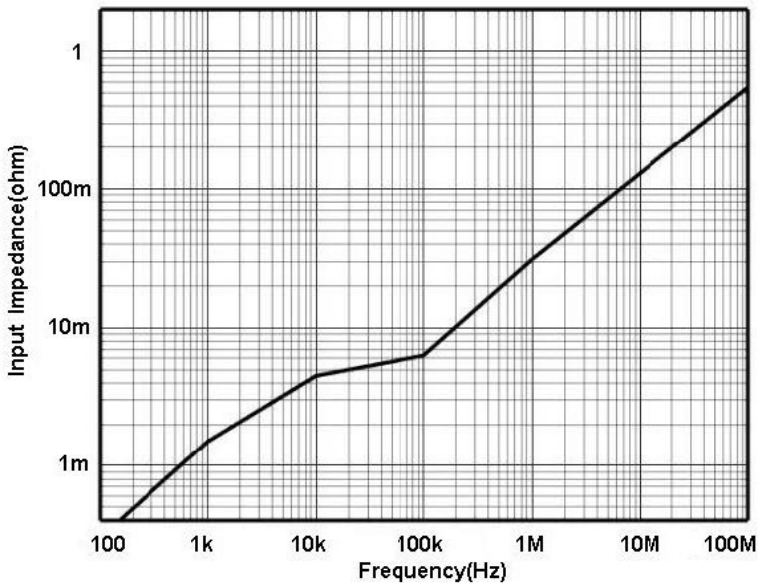


Figure 7.10 PCA2030B Input Impedance vs. Frequency Curve

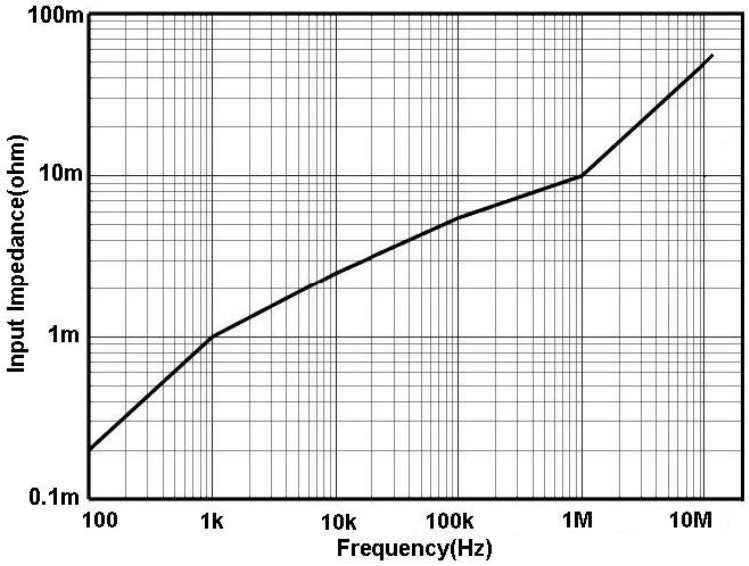


Figure 7.11 PCA1150B Input Impedance vs. Frequency Curve

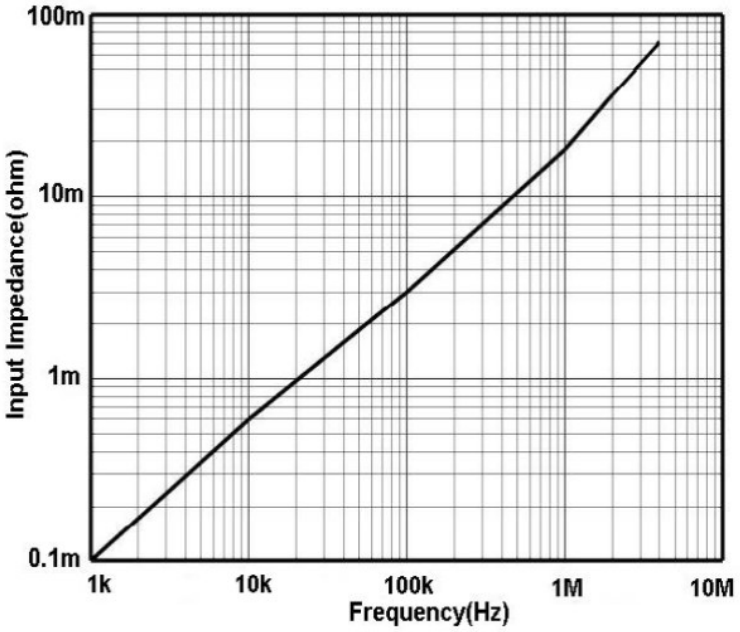


Figure 7.12 PCA1500B Input Impedance vs. Frequency Curve

7.2 Mechanical Characteristics

Model	PCA1030B	PCA2030B	PCA1150B	PCA1500B
Jaw Diameter	5 mm		20 mm	
Data Cable Length	1.5 m			

Model	PCA1030B	PCA2030B	PCA1150B	PCA1500B
Current Clamp Handle Size (W*H*D)	176 mm*39.5 mm*18 mm		174 mm*67.5 mm*30 mm	
Terminator (W*H*D)	122.3 mm*24 mm*25.5 mm			
Probe Weight	225 g		430 g	445 g

7.3 Environmental Characteristics

Environmental Characteristics	
Operating Temperature and Humidity	0 to 40℃, ≤80% RH (without condensation)
Storage Temperature and Humidity	-10℃ to 50℃, ≤80% RH (without condensation)
Operating Altitude	≤2,000 m
Storage Altitude	≤12,000 m

8 Troubleshooting

Problem	Possible Causes	Solutions
DC cannot be measured, or measurements are lower than expected within a specific frequency range	The power is not turned on	Turn on the power
	The coupling mode of the the waveform measurement instrument is set to AC coupling	Set the coupling mode to DC coupling
	The sensor is not locked	Lock the sensor
The amplitude is lower than expected across the full frequency range	The input impedance of the waveform measurement instrument is 50 Ω	Set the impedance to 1 MΩ or higher

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