CPOL3

User Manual

OMICRON

Table of contents

OMICRON

1   Introduction

1.1   About this document

This document provides information on how to use this product safely, properly and efficiently.

It contains important safety rules for working with this product and gets you familiar with operating this product. Following the instructions in this document will help you to prevent danger, repair costs, and avoid possible down time due to incorrect operation.

This document is to be supplemented by existing national safety standards for accident prevention and environmental protection.

1.2   Symbols and conventions

The following symbols indicate safety instructions for avoiding hazards.

⚠ **WARNING**

Death or severe injury may occur if the appropriate safety instructions are not observed.

⚠ **CAUTION**

Minor or moderate injury may occur if the appropriate safety instructions are not observed.

NOTICE

Equipment damage or loss of data possible

In this document, the following symbols and formatting styles are used:

Symbol/format	Description
✔	Conditions to be met before starting a task
▶	Instructions that can be carried out in any order
1.	Instructions that have to be carried out in the given order

2.	1. Step
	2. Step
	   2.1 Substep
	   2.2 Substep

→ / ➜	Expected outcome of a step/task
Text in bold	Text shown on a device, its display or in a software
Text in italics	OMICRON product name
🛈 / **Note:**	Additional information, explanations or tips

1.3   Compliance statements

In the following statement, the device is designated as "product", "equipment", or "apparatus".

The OMICRON contact address can be found on the last page (back page) of this document.

Declaration of conformity (EU)

The equipment adheres to the guidelines of the council of the European Community for meeting the requirements of the member states regarding the following directives:

- Electromagnetic compatibility (EMC) directive
- Low voltage directive (LVD)
- RoHS directive

Declaration of conformity (UK)

The equipment adheres to the regulations of the UK government for meeting the requirements regarding the following regulations:

- Electromagnetic Compatibility (EMC) Regulation
- Electrical Equipment Regulation (Safety)
- Regulation for Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment

FCC compliance (USA)

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment. If this equipment does cause harmful interference to radio or television reception, contact OMICRON Support.

Declaration of compliance (Canada)

This Class A digital apparatus complies with Canadian ICES-003.

Cet appareil numérique de la classe A est conforme à la norme NMB-003 du Canada.

1.4   Related documents

The documentation for the following products completes the information covered in this User Manual. It provides further safety instructions and information about the devices that can be used as a signal generator:

- CMC test sets
- *COMPANO 100*
- *CPC 100*
- *CT Analyzer*

Scan the QR code below for a digital version of the *CPOL3* User Manual:

1.5 Recycling

This device (including all accessories) is not intended for household use. At the end of its service life, do not dispose of the device with household waste.

EU countries (incl. European Economic Area)

OMICRON devices are subject to the EU Waste Electrical and Electronic Equipment Directive (WEEE directive). As part of our legal obligations under this legislation, OMICRON offers to take back the device and to ensure that it is disposed of by authorized recycling agents.

Outside the European Economic Area

For information on the environmental regulations relevant to your country, contact the responsible authorities. Dispose of the OMICRON device only in accordance with your local legal requirements.

1.5.1   Separate disposal of components

You can disassemble the device and dispose of the different components separately in accordance with your local legal regulations. This helps to reduce the amount of electronic waste and protect the environment.

ℹ️ Once the device has been opened, safety can no longer be guaranteed and the device must not be used again.

1. Disconnect all cables.
2. Open the battery cover, remove the batteries and dispose of them in accordance with your local legal regulations.
3. Remove the screws with a TX screwdriver to open the case of the device.
4. Remove the screws on the top and bottom circuit boards.
5. Dispose of the circuit boards and the display as electronic waste.
6. Dispose of the top and bottom parts of the plastic case as plastic waste.

2   Safety

2.1   Basic safety information

▶ Before operating the device, make sure that you have read this document
   and fully understood all instructions.

▶ Only install and operate the device and any accessories according to the
   instructions in the corresponding user documentation.

▶ Make sure that this document is available on the site where the device is
   operated, either digitally or in print.

▶ Contact OMICRON Support (page 45) if you do not understand any of the
   instructions in this document.

Using the device must comply with all applicable local and national safety
standards, regulations and safety-relevant documents.

Improper use may result in damage to persons or property and could invalidate
warranty claims.

2.2   Designated use

The *CPOL3* is no voltage detector as defined in "EN 61243-3 Live working –
Voltage detectors – Part 3: Two-pole low-voltage type". Therefore, the *CPOL3*
must not be used to check if voltage is present.

The *CPOL3* is designed to check a series of test points for correct polarity and
for wiring errors. The checks can be performed on current and voltage
transformers as well as on the connected cables and terminals. The *CPOL3*
shows the magnitude as well as the polarity of DC signals and the magnitude
of AC signals. To simplify error diagnostics, it supports an oscilloscope-like
view.

You can use the following OMICRON test sets to generate a CPOL sawtooth
test signal: CMC test sets, *COMPANO 100*, *CPC 100*, or *CT Analyzer*.

▶ Refer to the respective test set documentation for information about safe
   testing with the test set in use.

2.3　　Operator qualifications

Only authorized and qualified personnel who are regularly trained in electrical engineering and their specific tasks are permitted to operate the device and any accessories.

Operators must be familiar with the equipment and observe all applicable standards, local regulations, and safety-relevant documents, for example, the following standards or their equivalents:

- EN 50191 (VDE 0104) "Erection and Operation of Electrical Test Equipment"
- EN 50110-1 (VDE 0105 Part 100) "Operation of Electrical Installations"
- IEEE 510 "IEEE Recommended Practices for Safety in High-Voltage and High-Power Testing"

Personnel receiving training, instructions, directions, or education on the device must be under constant supervision of an experienced operator while working with the equipment.

▶ Before starting to work, clearly establish the responsibilities:

- Designated person in control of the electrical installation
- Designated person in control of the work activities

▶ Make sure that the designated person in control of the work activities coordinates the communication with all persons involved in work activities.

2.4　　Safety instructions

▶ Stay focused on your tasks to ensure safety.

▶ If the device or any accessory is damaged or does not seem to function properly, do not use it. If in doubt, contact OMICRON Support (page 45).

▶ Only use original cables provided by OMICRON.

▶ Only use original accessories provided by OMICRON.

The use of different cables and accessories is at the operator's own risk, considering the necessary high safety standards, the technical requirements, as well as relevant norms and certification standards. If in doubt, contact OMICRON Support (page 45).

2.4.1 Work environment

▶ Do not operate the device in a condensing environment.

▶ Do not operate the device in the presence of explosive gas or vapors.

▶ Do not operate the device under environmental conditions that exceed the temperature and humidity limits listed in the "Technical data" section.

▶ Before using any additional equipment, make sure that the environmental conditions are suitable for that equipment.

▶ Make sure that the device and all accessories are dry and clean. In dusty regions, use protective cable caps.

2.4.2 Personal safety

▶ Protect others from accessing the danger zone and accidentally touching live parts by setting up a suitable safety barrier and, if applicable, signal lamps.

▶ Warn other people prior to any operation to make them aware of any possible disturbances.

▶ If you have a cardiac pacemaker, do not use the device. If you have another type of electronic medical implant consult a medical professional before operating the device. Make sure there is no person with an electronic medical implant such as a cardiac pacemaker in the immediate vicinity.

2.4.3 Mechanical safety

▶ Do not open the device without authorization.

▶ Contact OMICRON Support (page 45) for maintenance and repair.

2.4.4 Product-specific instructions

▶ Do not use the *CPOL3* to check if voltage is present. The *CPOL3* is no voltage detector as defined in "EN 61243-3 Live working – Voltage detectors – Part 3: Two-pole low-voltage type".

▶ Always follow the local and national safety standards to check if the system is de-energized before starting to work.

▶ Do not use the *CPOL3* during rain.

▶ Never leave the *CPOL3* under direct sunlight as it might heat up quickly. Check the permissible temperature range of the batteries in use. Operate and store the *CPOL3* only within the temperature range of the batteries in use.

▶ Do not use the *CPOL3* if it is damaged. Before use, inspect the case. Look for cracks or missing plastic. Pay particular attention to the insulation surrounding the connectors.

▶ Check the test leads and measurement tips for damaged insulation, exposed metal or bare wires before connecting them to the *CPOL3*. Check the test leads for continuity. Replace damaged test leads immediately.

▶ If the test leads need to be replaced, only use test leads that meet the EN 61010-031 standard, rated at least for CAT II 1000 V, CAT III 600 V, CAT IV 300 V, or better.

▶ When using test probes, keep your fingers behind the finger guards of the test probes. When using the measurement tip, keep your fingers behind the finger guard of the *CPOL3*.

▶ Make sure that the battery compartment is closed and latched before operating the *CPOL3*. Never operate the *CPOL3* with an open battery compartment.

▶ To power the *CPOL3*, only use 2 AA cell batteries, properly installed in the battery compartment.

▶ Do not apply more than the rated voltage for the applicable measurement category between a terminal and earth ground (CAT II 1000 V, CAT III 600 V, or CAT IV 300 V). This also applies if test leads with a higher measurement category or voltage rating are used.

3 Description

3.1 Device overview

1	Connectors for test probes	6	Hold button
2	Display	7	Lanyard slot
3	Finger guard	8	Removable magnet
4	Mode button	9	Battery compartment
5	Select button		

3.2   Display
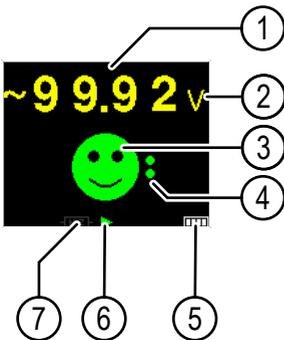
1	RMS value	5	Battery indicator
2	Unit	6	Status indicator
3	Polarity indicator	7	Input impedance
4	Phase indicator		

RMS value

Shows the measured RMS value:

• **~** symbol: measured True RMS value (including DC value)

• **+** or **–** symbols: measured DC value (RMS value is displayed below)

Unit

• **V**: measured voltage in volts

• **A**: measured current in amperes

Polarity indicator

Polarity is OK.
If the *CPOL3* detects a polarity check signal with the same polarity as the source signal, it shows a happy green face.

Polarity is not OK (inverted polarity).
If the *CPOL3* detects a polarity check signal that has an inverted polarity compared to the source signal, it shows a sad red face.

If the polarity check signal cannot be detected, no symbol is shown. In this case, you can do the following:

• Perform a functional check by measuring directly at the test set that is used as signal source.

• If the signal level is too low, you can increase the amplitude of the test signal (only if possible and only within the permissive range of the circuit under test).

Phase indicator

If the test set in use supports generating a polarity check signal with embedded phase ID information, the *CPOL3* will try to decode the phase ID and display a number of red or green dots, corresponding to the phase number.

Battery indicator

Shows the approximate charge level of the batteries. The indicator is designed for Alkaline batteries. It may diverge if other battery types are used.

▶ Replace the batteries if the indicator shows an empty battery symbol. See section Replacing the batteries (page 35).

Status indicator

The following symbols show the status of the display:

• ▶ Run: The display shows the live measurement.

• ⏸ Hold: The **Hold** mode is activated, and the display is frozen (not updated).

• ⏫ Peak hold: The display shows the peak value. It is updated when a higher RMS value (**Meter** test mode) or frequency component (**Spectrum** test mode) is measured.

Input impedance

The *CPOL3* has 2 input impedance modes: **HiZ** (high input impedance) and **LoZ** (low input impedance). See section Measuring settings (page 20) for more information.

3.3   Back panel elements

Removable magnet

With the removable magnet, you can attach the *CPOL3* to metallic surfaces.

▶ Turn the magnet counterclockwise to remove it from the *CPOL3*.

Battery compartment

The *CPOL3* uses 2 AA batteries. We recommend to use rechargeable AA batteries to reduce the amount of electronic waste.

▶ Remove the batteries if the *CPOL3* is not going to be used for an extended period of time. See section Replacing the batteries (page 35).

Tip: Adjust the automatic power-off time according to your needs. See section Settings menu (page 26). A shorter power-off time saves energy and increases the battery life.

3.4 Test probes

To take measurements with the *CPOL3*, use the following test probes that are included in the delivery:

1 × red	Direct connection (CAT II only)
1 × red, retractable	Connection via test lead
1 × black, retractable	Connection via test lead

Retracted probes

CAT IV or CAT III

Measurement category

Turn to extend test probe
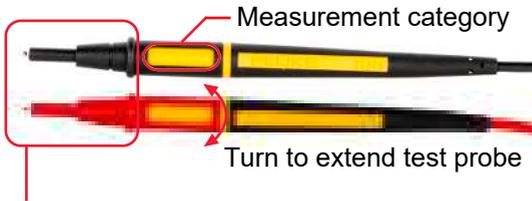
Do not touch during measurement

Probe for direct connection and extended probes

CAT II (1000 V)

Do not touch during measurement
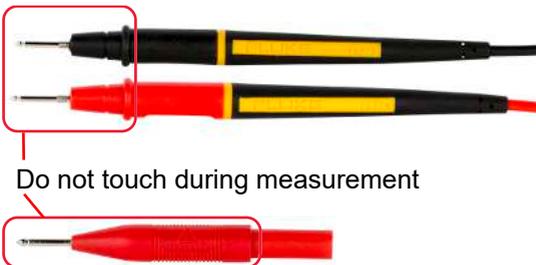
4 Operation

4.1 Buttons and their functions

Mode button

When the *CPOL3* is switched off:

▶ Press to switch on the *CPOL3* for a single measurement.

▶ Press and hold for a few seconds to switch on the *CPOL3* for an extended period. See section Settings menu (page 26) for the **Power Off** configuration.

When the *CPOL3* is switched on:

▶ Press to cycle through the test modes **Meter**, **Oscilloscope**, and **Spectrum** (if enabled).

▶ Press and hold for a few seconds to switch off the *CPOL3*.

Select button

▶ Press to switch between measuring voltage (HiZ), voltage (LoZ), and current. See section Measuring settings (page 20).

▶ Press and hold for a few seconds to configure additional functions of a test mode (for example, to change the axis).

Hold button

During normal operation:

▶ Press to switch on the **Hold** mode and freeze the measurement result.

▶ Press and hold for a few seconds to switch on **Peak hold** and display the maximum value of the measured voltage or current.
Peak hold is not available in the **Oscilloscope** test mode.

When the **Hold** mode is switched on:

▶ Press to exit the **Hold** mode.

▶ Press and hold for a few seconds to display a QR code that contains the measurement result. You can scan it (for example, with a cell phone) and log the measurement result in a text editor.
You can enable and configure the QR code functionality in the settings menu. See section Settings menu (page 26).

4.2   Measuring settings

With the *CPOL3*, you can measure the following:

- Voltage with high input impedance (HiZ)
- Voltage with low input impedance (LoZ)
- Current with high input impedance (HiZ)[I]

▶ Press the **Select** button to cycle through the measuring settings.

Example:
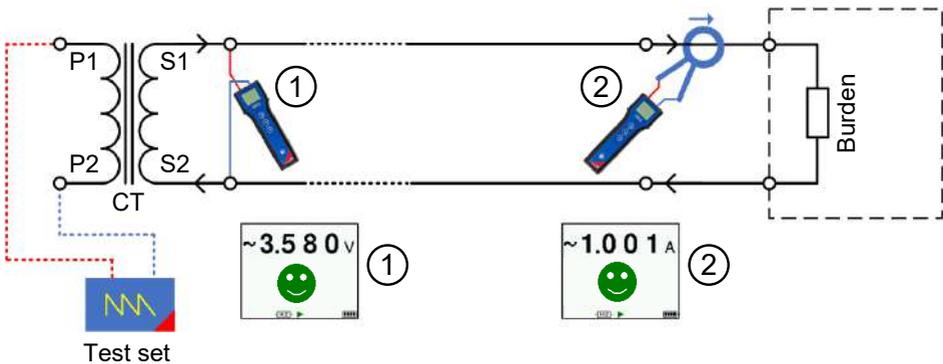
Basically, the *CPOL3* always measures the voltage on the terminal (1). To measure currents, you need to use a current-clamp (2) together with the *CPOL3*. Then, a configurable conversion factor is applied so that the *CPOL3* displays the result directly as current value in amperes.

Supported conversion factors are: 1 V/A, 100 mV/A, 10 mV/A, and 1 mV/A. See section Settings menu (page 26) for information on how to change the conversion factor.

[I]   The function to measure current is intended for the use with a current clamp. Therefore, it always uses the **HiZ** mode.

OMICRON

Measurement accuracy

The measurement accuracy when measuring currents significantly depends on the accuracy of the current clamp in use. Check the information for use of the current clamp for details.

Zeroing the current clamp

Some current clamps have a zero adjustment function. You need to perform the zero adjustment before using the current clamp with the *CPOL3*. Otherwise, the polarity may not be detected. For information on how to enable zero adjustment function, refer to the instructions for use of your current clamp.

Input impedance

The *CPOL3* has 2 input impedance modes: **HiZ** (high input impedance) and **LoZ** (low input impedance).

In the **LoZ** mode, the input impedance is ~3 kΩ instead of 1.8 MΩ in the regular **HiZ** mode. You can use the **LoZ** mode, for example, to efficiently suppress coupled ghost signals from parallel wires (as they might happen, for example, during wiring checks on VT circuits).

If used with higher input voltage, an integrated PTC resistor increases the input impedance to limit the internal power dissipation. If there is a low impedance source with higher voltage, the **LoZ** mode is automatically disabled after some time to protect the device. This can be an indication for a wiring problem, because coupled signals usually do not have sufficient power to trip this safety mechanism.

Measurement accuracy

If higher voltage is measured in the **LoZ** mode, the accuracy will be reduced due to the voltage drop on the test leads, caused by the higher input current. If high accuracy is required, use the **HiZ** mode.

Higher power consumption

In the **LoZ** mode, an internal relay is enabled that increases the power consumption. To increase the battery life, use the **LoZ** mode only when necessary.

4.3 Test modes

4.3.1 Meter

In the **Meter** test mode, the display shows the RMS or DC value of the measured signal. If the DC component is below 90% of the RMS value, the RMS value is displayed. Otherwise, the DC voltage and the corresponding polarity are displayed. In this case, the RMS voltage is displayed in a smaller size below the DC value.

▶ Press the **Hold** button to freeze the display.

▶ Press and hold the **Hold** button for a few seconds to enable **Peak hold**. The peak values are shown in a darker yellow color behind the live measurement.

Polarity detection

If the *CPOL3* detects a CPOL polarity check signal, it shows a green happy or red sad face to indicate the correct or wrong polarity.

If the phase ID information of the CPOL polarity check signal is detected, it is displayed next to the face as a number of dots. The number of dots shows the corresponding phase (for example, 2 dots for phase 2).

4.3.2   Oscilloscope

In the **Oscilloscope** test mode, the *CPOL3* displays the waveform of the measured signal. You can use it to check the signal waveform if no polarity signal can be detected in the **Meter** test mode.

1	RMS value	Shows the RMS value of the measured signal (True RMS, including DC component).
2	Time base	Shows the time per grid division. To change it, press and hold the **Select** button for a few seconds.
		For 0.1 s/div and 1 s/div, the Rolling RMS mode is activated and the displayed value equals the true RMS value instead of the instantaneous value. This is indicated by the text **RMS** in the upper left corner.
3	AC coupling	Shows if the integrated high-pass filter is active. If active, only the AC component will be displayed. See section Settings menu (page 26).
4	Scaling	Shows the voltage or current per grid division. The *CPOL3* uses auto-scaling only.

▶ Press the **Hold** button to freeze or unfreeze the display.

4.3.3 Spectrum

In the **Spectrum** test mode, the *CPOL3* displays the spectrum of the measured signal. This can be useful, for example, to check if the 52.6 Hz test signal is distorted by coupled 50 Hz or 60 Hz mains components.

> ℹ The **Spectrum** test mode is disabled per default. You need to enable it in the **Settings** menu. See section Settings menu (page 26).
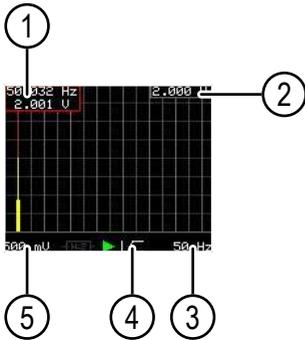
1	Main frequency	Shows the main frequency of the displayed signal and the corresponding amplitude. It is only shown for frequencies ≥10 Hz if a single frequency is dominant and has a higher amplitude than the others. The amplitude needs to be high enough for detection.
2	RMS value	Shows the RMS value of the measured signal (True RMS, including DC component).
3	Frequency base	Shows the frequency per grid division (dark lines). Press and hold the **Select** button for a few seconds to change it.
4	AC coupling	Shows if the integrated high-pass filter is active. If active, only the AC component will be displayed. See section Settings menu (page 26).
5	Scaling	Shows the voltage or current per grid division. The *CPOL3* uses auto-scaling only.

The horizontal grid consist of different line types:

Dark lines	Basic grid with the displayed frequency division.
Light lines	Fundamental and odd harmonics, based on the configured mains frequency.[1]
Light lines, dashed	Even harmonics, based on the configured mains frequency.[1]

[1]   Configure the mains frequency in the **Settings** menu.

The left column shows the DC component of the signal. If AC coupling is enabled, no DC component is shown.

▶   Press the **Hold** button to freeze the display.

▶   Press and hold the **Hold** button for a few seconds to enable **Peak hold**. The peak values are shown in a darker yellow color behind the live measurement.

4.4 Settings menu

▶ To open the **Settings** menu, together press and hold the **Select** and **Hold** buttons for a few seconds until the menu is displayed.

▶ Press the **Hold** button to cycle through different settings.

▶ Press the **Select** button to change a setting.

▶ Press the **Mode** button to leave the settings menu.

ⓘ If you change a setting, it is automatically saved and you do not need to reconfigure it after each activation of the *CPOL3*.

4.4.1 Ratio

You can select the conversion factor that is applied when measuring currents. See section Measuring settings (page 20).

The supported conversion factors are: 1 V/A, 100 mV/A, 10 mV/A, and 1 mV/A.

▶ Set this value to match the value on the current clamp you are using.

4.4.2 Coupling

You can choose whether AC or DC coupling is used. In case of AC coupling, a high-pass filter is applied in the **Oscilloscope** and **Spectrum** test modes. This is a digital filter. A high DC offset requires a higher input range and will reduce the accuracy of the measurement. This also affects the accuracy of the displayed AC signal component.

ⓘ AC coupling can help to check small signals coupled on a DC voltage, for example, the station battery.

4.4.3 Spectrum

• **Off**: Test mode is disabled.

• **50 Hz**: Test mode is enabled. Grid is displayed for 50 Hz mains frequency.

• **60 Hz**: Test mode is enabled. Grid is displayed for 60 Hz mains frequency.

4.4.4 PowerOff

The time until the *CPOL3* automatically switches off depends on how long you press the **Mode** button when switching on the *CPOL3*:

Option	Switch-off time	
	after short Mode button press	after long Mode button press
5 sec / 1 min	5 seconds	1 minute
15 sec / 1 min	15 seconds	1 minute
5 sec / 5 min	5 seconds	5 minutes
15 sec / 5 min	15 seconds	5 minutes

4.4.5 QRCode

The *CPOL3* allows you to export measurement data via a QR code. You can use this function to create an interface to your own or third-party documentation systems.

In the **Settings** menu, you can enable and configure the QR code. It is displayed in the **Hold** mode when you press the **Hold** button for a few seconds.

The following options are available:

- **Off**: Disable this function
- **Text**: Display a QR code that contains the measurement results in text format.
- **JSON**: Display a QR code that contains the measurement results in JSON format.

You can find some information on the export formats **Text** and **JSON** below. The full *CPOL3* QR code format specifications are available as Application Note in the knowledge library of the OMICRON Customer Portal, or you can request them from OMICRON Support (see section Support (page 45)).

Text format

When you select **Text**, the measurement data is exported as a one-line ASCII string with semicolons as field separators. Some mobile phones allow you to store the parsed QR code content in their integrated text editors. Then, you can export this text and import it into a spreadsheet application, for example.

The QR code in text format is available for all test modes:

Test mode	QR code content
Meter	Contains the RMS or DC value and the detected polarity.
Oscilloscope	Contains the RMS value (no polarity).
Spectrum	Contains the RMS value and, optionally, the detected dominant frequency and the corresponding amplitude (no polarity).

The ASCII string is structured as follows:
`[Value]; [Unit]; [Type]; [Polarity]; [Factor]; [LoZ]; [Freq]; [Amp]`

Example: `12.324; "V"; "RMS"; -3; 10; 0`

The following table describes the elements of the ASCII string:

Element	Type	Content		Example
Value	Float	Measured value		`12.324`
Unit	String	`"V"` or `"A"`		`"V"`
Type	String	`"RMS"` or `"DC"`		`"RMS"`
Polarity	Integer	Shows the detected CPOL polarity:[1]		`-3`
		`+`	Correct polarity	
		`-`	Wrong polarity	
		`0`	No CPOL signal found	
		`1`	CPOL signal found	
		`2`	CPOL signal + phase ID 1	
		`3`	CPOL signal + phase ID 2	
		`4`	CPOL signal + phase ID 3	
		`5`	CPOL signal + phase ID 4	

OMICRON

Element	Type	Content			Example
Factor	Integer	Conversion factor used when measuring currents:			10
		1	1 A/V	1 V/A	
		10	10 A/V	100 mV/A	
		100	100 A/V	10 mV/A	
		1000	1000 A/V	1 mV/A	
LoZ	Integer	**LoZ** mode:			0
		0	Disabled		
		1	Enabled		
Freq[2]	Float	Dominant frequency in Hz			50.021
Amp[2]	Float	Amplitude of the dominant frequency in V or A			2.3143
		Note: The accuracy is limited.			

[1]   Only available in the **Meter** test mode.

[2]   Optional. Only available in the **Spectrum** test mode if the amplitude is high enough.

JSON format

When you select **JSON** , the measurement data is exported in JSON format with additional metadata. This format also includes an ASCII string. If required for documentation purposes, you can use it to reconstruct the displayed measurement results in the **Oscilloscope** or **Spectrum** test modes.

4.4.6   Info

Shows information on the software version of the *CPOL3*.

4.5 Measuring with the CPOL3

4.5.1 Working principle

> ⚠ **WARNING**
>
> **Death or severe injury due to electrical shock possible**
>
> ▶ Before injecting current, make sure that the CT tabs on all cores are closed (either connected or short-circuited).
>
> ▶ To inject current, always follow all safety instructions in the information for use of the test set in use.

The example below shows how to find a wrong polarity in a typical CT circuit.
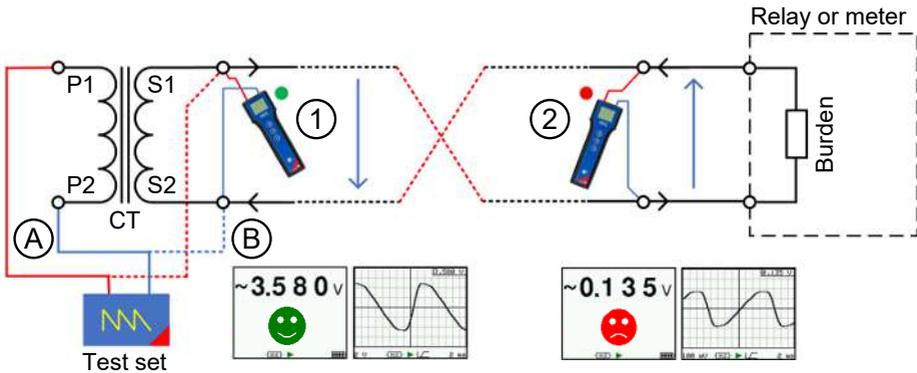
The *CPOL3* detects the polarity of a sawtooth waveform and measures the amplitude. You can generate the waveform with various OMICRON test sets (see section Designated use (page 10)). You can inject it either on the primary side (A, solid line) or the secondary side (B, dashed line) of the CT, depending on the test set in use.

If the *CPOL3* detects a steep rising slope followed by a slowly falling slope, it indicates a correct polarity with a happy green face (1). If the polarity is reversed, for example, due to a wiring error, the slope rises slowly and is followed by a fast falling slope. In this case, the *CPOL3* indicates a wrong polarity with a sad red face (2).

For more application examples, refer to the *CPOL3* Application Note.

4.5.2 Phase identification
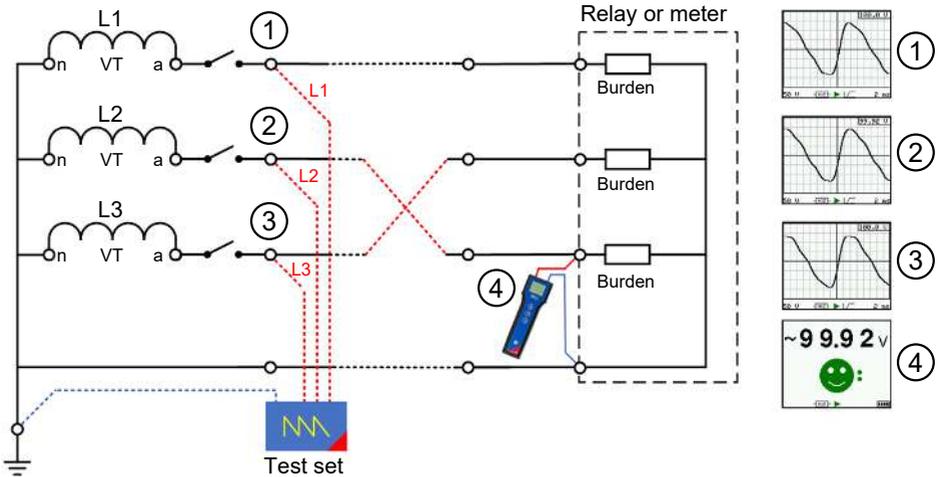
Test set

The *CPOL3* can decode phase identifications (phase IDs) if the OMICRON test set in use generates a CPOL polarity check signal with additional phase ID information. The phase ID information is encoded in the harmonics of the sawtooth signal (see 1, 2, and 3). Older versions of the *CPOL* device will still be able to detect the polarity correctly (based on the sawtooth waveform). But they but won't display a phase ID.

If the phase ID information is present and the amplitude of the signal is sufficient, the *CPOL3* can decode the phase ID. It displays the phase number as a number of dots next to the green or red face showing the polarity (4).

If the *CPOL3* cannot decode the phase ID information, it only shows the green or red face for positive or negative polarity.

Phase IDs in CT circuits with common return wire

On a multi-phase system with parallel injection, the voltage drop on the common return wire may distort the sawtooth signal so that the polarity cannot be detected correctly.
In this case, we recommend using a current clamp instead of directly measuring the voltage.

If a phase angle of 120° between the phases is used for the test, the currents on the common return wire will sum up and cancel each other. Therefore, you can measure no polarity and (almost) no current on the common return wire when using a current clamp.

In this case, we recommend using 0° between the phases for the injection. Then, the currents on the common return wire will sum up ,and you can measure them. The *CPOL3* will display a polarity check signal with the correct polarity but without phase ID on the common return wire.

4.5.3   Performing a measurement

> ⚠ **WARNING**
>
> **Death or severe injury due to electrical shock possible**
>
> The *CPOL3* is no voltage detector as defined in "EN 61243-3 Live working – Voltage detectors – Part 3: Two-pole low-voltage type".
>
> ▶ Do not use the *CPOL3* to check if voltage is present.
>
> ▶ Always follow the local and national safety standards to check if the system is de-energized before starting to work.

> ⚠ **WARNING**
>
> **Death or severe injury due to electrical shock possible**
>
> The measurement category stated as "CAT" on the test probes applies to the test probes only. If there are 2 devices or a device and an accessory with different measurement categories or voltages, the lowest category applies.
>
> ▶ Only use the *CPOL3* to measure voltages up to 300 V for CAT IV, 600 V for CAT III, and 1000 V for CAT II.

> ⚠ **WARNING**
>
> **Death or severe injury due to electrical shock possible**
>
> Dangerous voltages can occur due to a wiring error inside the cabinet.
>
> ▶ Always be aware that wiring errors inside the cabinet could lead to higher voltages than expected.
>
> ▶ Always observe the highest voltage and measurement category inside the cabinet before connecting the *CPOL3*.

1. **CAUTION! Scratch and puncture injuries. Handle test probes with care.**
   Connect the shorter red test probe directly to the *CPOL3*, or use the red cable to connect the retractable red test probe.

2. Use the black cable to connect the retractable black test probe.

3. Press the **Mode** button to switch on the *CPOL3*.

4. Press the **Mode** button again to cycle through the test modes (see section Test modes (page 22)) and select one.

5. Optional: Press the **Select** button to switch the measuring settings (see section Measuring settings (page 20)).

6. **WARNING! Electrical shock. Do not touch the test probe or the top part of the CPOL3 during measurement. Hold the CPOL3 below the finger guard.**
   Start measuring with the *CPOL3*.

   Unexpected measurement result

   If the measurement result does not match the expected result or if it indicates a wiring problem, observe the following:

   ▶ Clearly identify the cause of the problem by performing more measurements, for example.

   ▶ Only take further actions if you have clearly identified the problem.

5 Maintenance and calibration

5.1 Cleaning

Preconditions

✔ All connection cables are disconnected from the device.

▶ Clean the device with a cloth dampened with isopropanol alcohol.

5.2 Replacing the batteries

The *CPOL3* is operated with 2 AA batteries. See section Energy supply (page 41) for the supported battery types.

⚠ **WARNING**

Death or severe injury due to electrical shock possible

Dangerous voltage at the open battery contacts.

▶ Make sure the battery compartment is closed and latched before operating the *CPOL3*.

▶ Never operate the *CPOL3* with an open battery compartment.

▶ Before replacing the batteries, always disconnect the *CPOL3* from the measurement setup.

NOTICE

Equipment damage possible

▶ Do not mix old and new batteries.

▶ Make sure that both batteries are of the same type.

Preconditions

✔ All cables are removed.

1. Use a cross-head screwdriver to remove the screw from the cover of the battery compartment.
2. Remove the cover.
3. Replace the AA batteries observing the polarity indicated in the battery compartment.
4. Insert the cover.
5. Use a cross-head screwdriver to lock the cover with the screw.

🛈 Remove the batteries if the *CPOL3* is not going to be used for an extended period of time.

5.3 Calibration

The *CPOL3* is calibrated at the factory during production.

It can be calibrated by external calibration laboratories. The calibration instructions are available as Application Note in the knowledge library of the OMICRON Customer Portal, or you can request them from OMICRON Support (see section Support (page 45)).

6 Technical data

The listed data are guaranteed for an ambient temperature of 23 °C ± 5 °C (73 °F ± 9 °F).

6.1 Measurement categories

Depending on the accessories in use, the *CPOL3* is designed to comply with the IEC 61010-031 standard for the measurement categories CAT II (1000 V), CAT III (600 V) and CAT IV (300 V).[I] [II]

If you use 2 devices or a device and an accessory with different measurement categories, the lowest category applies.

6.2 Input characteristics

Characteristic	Rating
Maximum voltage between any terminal and earth ground	1000 V_{RMS} or 1000 VDC
Measuring range AC[1]	1 mV_{RMS} … 1000 V_{RMS}
Measuring range DC	1 mVDC … 1000 VDC
Ranges	Automatic ranging only

[1] Crest factor of ≤3 at a full-scale value of up to 500 V, decreasing linearly to crest factor ≤1.5 at 1 000 V.

[I]   For pollution degree 2.

[II] Valid until a maximum operation altitude of 2 000 m (6 550 ft).

6.2.1 Accuracy specifications

Range	Resolution	DC	AC[1]
1 V	0.001 V	$< 0.2\ \%$ rd $+ 0.2\ \%$ rg[2]	$< 0.3\ \%$ rd $+ 0.2\ \%$ rg[2]
10 V	0.001 V		
100 V	0.01 V		
1000 V	0.1 V		

[1] Unless otherwise noted, all specifications are valid for DC and/or 50/60 Hz.

[2] rd = reading, rg = range. Accuracy values indicate that the error is smaller than ± ((read value × reading error) + (full scale of the range × full scale error)).

6.3 Specifications of functions

6.3.1 Measuring settings

Setting	Input impedance
Voltage, standard mode (**HiZ**)	1.8 MΩ
Voltage, **LoZ** mode	2.7 kΩ
Current, **HiZ** mode[1]	1.8 MΩ

[1] Calculated from voltage by using a configurable conversion factor. Function is intended for use with a current clamp.

6.3.2   Meter test mode

Detectable signal types	Specification
Polarity test sawtooth signal	52.6 Hz nominal frequency (19 ms cycle duration)[1]
	Visualization of the Phase ID information that is encoded in signal (if available)
	Detects signals from > 100 μV up to 1000 V
DC signals	DC and True RMS values are shown
AC or mixed signals	True RMS value is shown

[1]   As generated by *CPC 100*, CMC test sets, *CT Analyzer*, and *COMPANO 100*.

The **Hold** and **Peak hold** modes are available.

6.3.3   Oscilloscope test mode

Characteristic	Specification
Amplitude	Linear
	±4 divisions
	Auto-scaling (1 mV/div … 500 V/div)
Time per division	Waveform display: 1 ms, 2 ms, 5 ms, 10 ms
	Rolling RMS: 100 ms, 1 s
Trigger	Automatic (rising edge)
Coupling	AC or DC (digital only, selectable in the **Settings** menu)

The **Hold** mode is available.

6.3.4 Spectrum test mode

Characteristic	Specification
Grid settings	50 Hz, 60 Hz, off (default)
Method	512 bin FFT with Hamming window, first 158 bins shown
Y-Axis	Amplitude
	Linear display
	8 divisions
	Auto-scaling (1 mV/div … 500 V/div)
Frequency per division	50/60 Hz per division (0 … 785 Hz range)
	20 Hz per division (0 … 314 Hz range)
	10 Hz per division (0 … 157 Hz range)
	5 Hz per division (0 … 78.5 Hz range)
Frequency accuracy	Typically < ±0.01 % of reading
Coupling	AC or DC (digital only, selectable in the **Settings** menu)
Peak frequency	Peak-based frequency detection between 10 Hz and maximum range

The **Hold** and **Peak hold** modes are available.

6.4 Energy supply

6.4.1 General

Characteristic	Specification
Power consumption	During measurement in the **HiZ** mode: < 150 mW
	During measurement in the **LoZ** mode: < 300 mW
	Standby: < 50 µW
Operation time	Standard (**HiZ**) mode: > 14 h[1]
	LoZ mode: > 10 h
Standby time	> 1 year

[1]   Using typical alkaline-manganese dioxide batteries.

6.4.2 Batteries

Characteristic	Specification
Type	2 × 1.5 V Mignon AA
Battery types	LR6 Alkaline-Manganese, 1.5 V
	FR6 LiFeS2, 1.5 V
	R6 Zinc-Carbon, 1.5 V
	HR6 NiMH rechargeable, 1.2 V

We recommend using rechargeable HR6 (NiMH) batteries for environmental reasons or FR6 (LiFeS2) batteries if a long operation time is required.

6.5 Mechanical data

Characteristic	Specification
Dimensions (W × H × D)	68 mm × 33 mm × 206 mm
	(2.7 in × 1.3 in × 8.2 in)
Weight[1]	245 g
	(8.6 oz)

[1]   With batteries, without accessories.

6.6 Environmental conditions

Characteristic	Specification
Operating temperature	−10 °C ... +50 °C
	(+14 °F... +122 °F)
Storage and transportation temperature[1]	−25 °C ... +70 °C
	(−13 °F ... +158 °F)
Max. altitude for operation[2]	Up to 1000 V_{rms}: 2 000 m (6 550 ft)
	Up to 600 V_{rms}: 4 000 m (13 100 ft)
Shock	15 g/11 ms
	Half-sinusoid
	3 shocks in each axis
Vibration	Frequency range: 10 Hz ... 50 Hz
	Acceleration: 2 g continuous
	20 cycles per axis
Humidity	5 % ... 95 % relative humidity (no condensation)

[1]   Depends on the specifications of the battery type in use. High storage temperatures reduce the battery lifetime.

[2]   Depends on the measurement category. The values listed in this table apply to measurement category CAT II.

6.7 Standards

Electromagnetic compatibility (EMC), Safety	
EMC	IEC/EN 61326-1 (industrial electromagnetic environment)
	47 CFR Part 15 Subpart B (Class A) of FCC
Safety	IEC/EN/UL 61010-31
	CAN/CSA-C22.2 No. 61010-031

Other standards	
Shock	IEC/EN 60068-2-27
Vibration	IEC/EN 60068-2-6
Humidity	IEC/EN 60068-2-78

7   Open-source license information

Parts of the *CPOL3* software are under OMICRON license, other parts under open-source software licenses.

The *CPOL3* software contains the following open-source components:

Open-source component	License type
Adafruit GFX	BSD
ARM CMSIS Library	Apache2
STM32 HAL	BSD
Nayuki QR Code generator library	MIT
GNU FreeFont	GPL3

To access the open-source license information including the necessary source code:

1. Go to www.omicronenergy.com/opensource.
2. Select **DOWNLOAD SOFTWARE**, and navigate to the corresponding folder.

Support

When you are working with our products, we want to provide you with the greatest possible benefits. If you need any support, we are here to assist you.

OMICRON Support – get in touch

omicronenergy.com/support

At our support hotline, you can reach well-educated technicians for all of your questions.

Make use of our 24/7 hotlines:

Americas: +1 713 830-4660 or +1 800-OMICRON

Asia-Pacific: +852 3767 5500

Europe / Middle East / Africa: +43 59495 4444

Additionally, you can find the service center or sales partner closest to you at omicronenergy.com.

OMICRON Customer Portal – stay informed

my.omicronenergy.com

Browse through the knowledge library and find manuals, application notes, conference papers, and much more.

Download the latest software updates and learn about upcoming events.

OMICRON Academy – learn more

omicronenergy.com/academy

Learn more about your product in one of the training courses offered by the OMICRON Academy.