OMICRON

CMC 310

User Manual

Manual version: ENU 1012 05 01

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1 Preface

The purpose of this User Manual is to familiarize users with the *CMC 310* test set hardware and its specifications.

This manual is supplemented by the Safe use of CMC test sets manual, on-site safety regulations and existing national safety standards for accident prevention and environmental protection.

The *CMC 310* test set requires a suitable control software or control device for operation.

► Consult the corresponding Getting Started manual or user documentation regarding the use of the control software or control device.

Note:

- The Safe use of CMC test sets manual and the software manuals are supplied on CD/DVD together with this User Manual.
- From time to time the manual is updated to reflect the actual development status or changes of the test set's functional range. See page 2 for this manual's version number.

WARNING

Death or severe injury caused by dangerous voltage possible

► Operate the *CMC 310* only after you have read and fully understood the Safe use of CMC test sets manual.

1.1 Web Interface

The *CMC 310* test set is additionally equipped with a Web Interface. The Web Interface enables you to view device-specific parameters, and – depending on the device type – even provides you with configuration features.

For more detailed information, see the according Web Interface help.

► Launch the Web Interface of that particular device, then click its help command. The Web Interface is launched from the OMICRON *Device Link* tool.

1.2 Open source license information

Parts of the *CMC 310* test set software are under OMICRON license, other parts are under open source software licenses. Both the open source license texts and the necessary source code are provided in the **OMICRON Open Source Download Area** at www.omicronenergy.com/opensource.

Open this address in your Internet browser, click the **Download Software** button, and navigate to the **CMC Embedded Image** directory.

► Look for the file containing your version in the file name (for example, **Open Source CMC embedded Image 2.59.zip** for version 2.59).

In addition to some open source code packages, the archive contains an overview of all license information of the *CMC* test set.

2 Safety

2.1 Designated use

The *CMC 310* is a test set controlled by the *CMControl P* software for the testing of protection relays, energy meters, SCADA systems and devices.

► Do not use *CMC* test sets in any other way than described in this document or in working environments that exceed the specifications given in section 4 "Technical data". Improper use may result in damage to persons or property.

2.2 Safety symbols used

In this document, the following symbols indicate safety instructions for avoiding hazards.

WARNING

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

NOTICE

Equipment damage or loss of data possible.

2.3 Safety instructions

► Before operating a *CMC* test set, carefully read the following safety instructions.

► Only operate (or even turn on) the *CMC* test set after you have read this manual including section 4 "Technical data" on page 18, and fully understood the instructions. We also recommend to read all other relevant documentation for your test set and control software.

For your safety

Only trained personnel may operate *CMC* test sets. Any maloperation can result in damage to property or persons.

You can remotely activate *CMC* test set outputs if the *CMC* is turned on and connected to a suitable control software or control device (via network, wireless or USB).

► Observe all necessary safety measures given below.

All 4 mm safety sockets on the front panel can carry signals at dangerous levels and can conduct dangerous voltages.

Rules for use

- ► Before operation, visually check for damages and make sure that the device and its accessories are in a technically sound condition.
- ► Use *CMC* test sets only in accordance with the safety regulations for the specific job site and application.
- ► Follow the instructions provided in the documentation.
- ► Testing with *CMC* test sets shall only be carried out by authorized and qualified personnel. Before starting to work, clearly establish the responsibilities of all personnel involved.
- ► Personnel operating *CMC* test sets must be familiar with all necessary personal safety equipment.
- ► Testing with *CMC* test sets must comply with all on-site procedures and methods for personal safety.
- ► Personnel receiving training, instruction, direction, or education on *CMC* test sets should remain under the constant supervision of an experienced operator while working with the equipment.
- ► Keep this document available on site where the *CMC* test sets are used.

Safe operation procedures

- ► Ensure proper grounding of the device and of the equipment under test.
- ► Use a power supply with protective earth.
- ► The power cable must be rated for the nominal voltage and current specified in section 4.2 "Main power supply" on page 19. We recommend to use the cable supplied with the test sets.
- ► Do not block the access to safety-relevant test set components like the power switch or the power cable.
- ► Operate *CMC* test sets only under the environmental conditions specified in section 4.7 "Environmental conditions" on page 35. Especially avoid a condensing environment.
- ► Do not operate *CMC* test sets when explosive gas or vapors are present.
- ► When setting up *CMC* test sets, make sure that the ventilation holes on the rear of the device remain unobstructed.
- ► The fuse (→ section 2.5 "Changing the power fuse" on page 8) is the only serviceable part in *CMC* test sets. Do not open *CMC* test sets or carry out any modifications, extensions, or adaptations.
- ► If *CMC* test sets seem to be functioning improperly, please contact OMICRON Support.
- ► Falling adapters or cables are a hazard. Test leads wired to tall test objects must be secured mechanically.
- ► Do not connect any of the front panel outputs of **VOLTAGE OUTPUT** or **CURRENT OUTPUT** to protective earth. The **N** sockets, however, may be connected to protective earth.
- ► Do not connect high inductive loads to *CMC* test sets.
- ► Observe the wiring instructions and safety precautions given in the Safe use of CMC test sets manual.

2.4 Cleaning

Cleaning procedure:

1. Switch off the power switch.
2. Unplug the power cable from the power outlet.
3. Clean the *CMC* test set with a cloth dampened with isopropanol alcohol.

2.5 Changing the power fuse

Proceed as follows to replace the power fuse on your *CMC* test set:

1. Unplug the power cable of the *CMC* test set from the power outlet.
2. Locate the fuse on the back of the *CMC* test set.
3. Replace the fuse by an identical fuse type: Schurter 0001.2515 (T12.5 AH 250 V).

3 Test set overview

3.1 Description

The *CMC 310* is a test set controlled by the *CMControl P* software. This User Manual describes the hardware of the *CMC 310*. The configuration and control of the *CMC 310* is carried out by the *CMControl P* software. For more detailed information, read the user documentation.

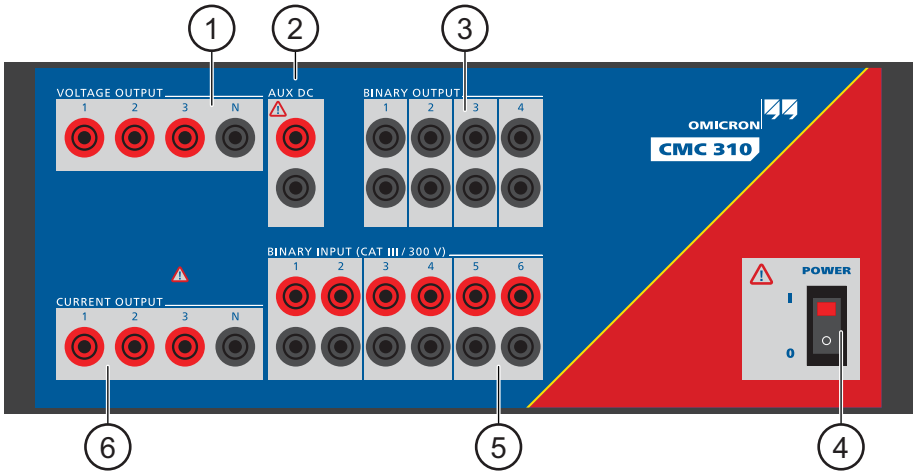
3.2 Front panel connections

WARNING

Death or severe injury caused by dangerous voltage possible

All outputs and inputs of *CMC* test sets that are not explicitly restricted to SELV can carry lethal voltage. The insulation between input and output groups on the front panel is only a functional insulation and not sufficient to prevent dangerous voltages from being bridged between ports. In case of an internal failure input ports can also be a source of dangerous voltages.

- ► Before working on test objects, connections or terminals connected to the *CMC* test set, make sure that the power supply of the *CMC* test set is switched off and that all parts in the working area are de-energized.
- ► Observe the correct wiring procedure.



1	**VOLTAGE OUTPUT**	3 × 300 V_{RMS} output of the internal voltage amplifier
2	**AUX DC**	Output voltage in 3 ranges from 0 to 264 V; used to supply power to test objects
3	**BINARY OUTPUT**	4 potential-free relay contacts
4	**POWER switch**	
5	**BINARY INPUT**	6 binary inputs in 3 galvanically separated groups
6	**CURRENT OUTPUT**	3 × 32 A_{RMS} output of the internal current amplifier

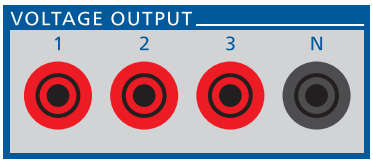
3.2.1 VOLTAGE OUTPUT

NOTICE

Equipment damage possible

An external infeed could damage the *CMC* test set.

► Make sure that there is no infeed from an external source.



The 3 voltage outputs have a common neutral (**N**) that can be connected to protective earth, if required.

→ Section 4.4.3 "Voltage outputs" on page 25.

The amplifier is galvanically separated from all other connectors of the *CMC 310.*

All voltage outputs are protected against open circuits, L-N short circuits, overload, and overtemperature.

► Do not connect any of the outputs of **VOLTAGE OUTPUT** to protective earth.

3.2.2 CURRENT OUTPUT

WARNING

Death or severe injury caused by dangerous inductive loads possible

If charged with current, inductive loads may store a dangerous amount of energy. For example, an energy of <350 mJ is considered safe according to the IEC 61010-1 safety standard.

► Make sure that the possibly stored energy of the inductive device under test is within safe limits.

► Do not use the *CMC* test set for the measurement on high inductances (power transformer, current transformer) due to the discharging processes.

► If in doubt, contact OMICRON Support for more information.

WARNING

Death or severe injury caused by dangerous voltage levels on conductive parts possible

Although the output voltages of the current generators are within touch-safe limits, the insulation to other input and output groups is implemented as functional insulation only. Therefore, the outputs can conduct dangerous voltages.

► Observe the wiring instructions and safety precautions given in section "Wiring" in the Safe use of CMC test sets manual.

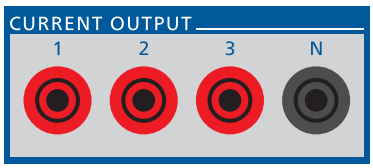
► Do not touch open conductive parts with live current signals (e.g. blank screw terminals) while the *CMC* test set is switched on.

NOTICE

Equipment damage possible

An external infeed could damage or destroy the current output. The outputs are protected in switched-off state by a short-circuit relay.

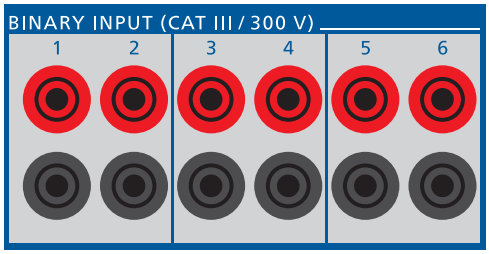
► Make sure that there is no infeed from an external source.



→ Section 4.4.2 "Current outputs" on page 22.

Each output is galvanically separated from all other connections of the *CMC 310*. All current outputs are protected against open circuits, short circuits, overload, and overtemperature.

3.2.3 BINARY INPUT

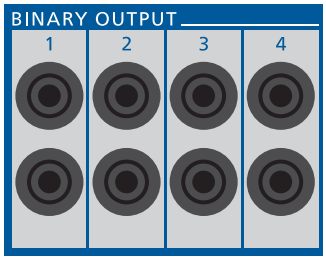


All 6 inputs of the *CMC 310* can be individually configured by the control software to be binary inputs (wet = potential-sensing or dry = potential-free). When the contacts are potential-sensing, the expected nominal voltage can be set for each binary input.

The 6 inputs are divided into 3 groups of 2 inputs, each group galvanically separated from the others.

Moreover, the binary inputs 1 to 6 can be used as counter inputs for input frequencies up to 3 kHz.

3.2.4 BINARY OUTPUT



The 4 potential-free normally open relay contacts can switch AC or DC currents of up to 8 A.

Technical data → Section 4.4.5 "Binary output relays" on page 28.

3.2.5 AUX DC (DC power for test objects)

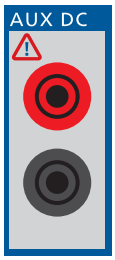
WARNING

Death or severe injury caused by dangerous voltage levels due to control by software possible

The **AUX DC** output can be programmed to output dangerous voltage. This may lead to damage to property or persons. Since the output is only controlled by software, a wrong **AUX DC** setting (e.g. set in software, software or hardware error) could lead to an unexpected value (up to 264 V).

► Make sure that the voltage applied at the **AUX DC** output of the *CMC* test set interface is safe before connecting any test leads to this output.

► Follow the wiring procedure described in section "Wiring" in the Safe use of CMC test sets manual.



The **AUX DC** output can be used to supply test objects with DC voltage. The output voltage can be configured to 0 … 264 V in the control software or control device.

► Refer to the documentation of the control software for more information.

The **AUX DC** output is galvanically separated from all other connections of the *CMC 310*.

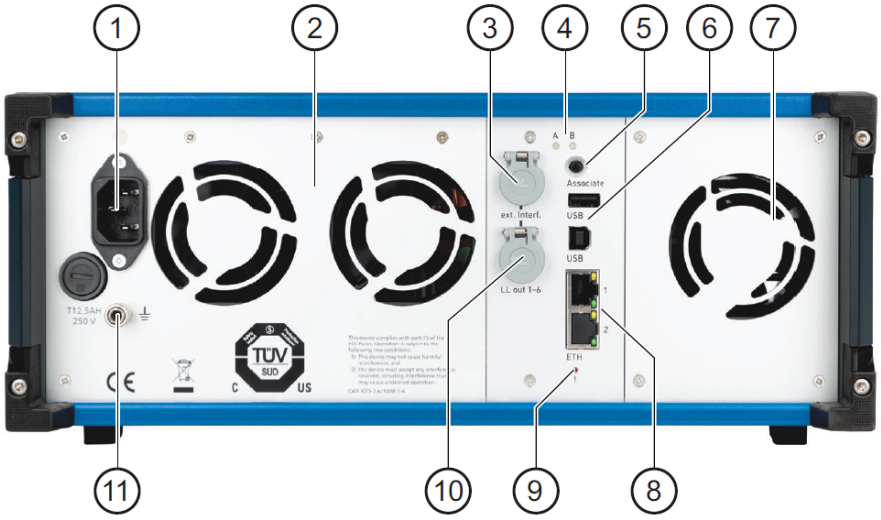
The output is protected against short-circuit, overload, and overtemperature.

An LED in the upper left corner indicates if the output is active.

LED status	Description
Red	Output is active
OFF	Output is inactive

3.3 Back panel connections

Rear view of the *CMC 310* with the NET-2 interface board:



1	Power supply, fuse T12.5 AH
2	Fans for power supply
3	External interface **ext. Interf.**
4	Status LEDs A and B
5	**Associate** button
6	**USB** ports type **A** and **B**
7	Fans for current and voltage outputs
8	Ethernet ports **ETH1** and **ETH2**[1]
9	**!** button
10	Interfaces **LL out 1– 6**[1]
11	Grounding socket Used to connect the CMC test set to protective earth using a grounding cable if grounding via the power outlet is insufficient (see section "Grounding" in the Safe use of CMC test sets manual).

1. The hardware for **LL out 1–6** and **ETH2** exists but is not used in the *CMC 310*.

3.3.1 USB ports

USB port type **A** is used to insert USB peripherals such as wireless USB adapters. Only OMICRON-supplied wireless USB adapters are supported.

USB port type **B** is used to connect the *CMC 310* to your computer.

► To improve electromagnetic compatibility, use the OMICRON-supplied cable.

For the technical data of the **USB** port see section 4.6 "Technical data of the communication ports" on page 34.

3.3.2 Ethernet port ETH1

Depending on the interface board of your *CMC* test set, the PoE Ethernet (**P**ower **o**ver **E**thernet) port **ETH1** is of one of the following types:

- 10/100Base-TX (twisted pair) Ethernet port (at **NET-1C** board)
- 10/100/1000Base-TX (twisted pair) Ethernet port (at **NET-2** board)

They support auto crossing (auto MDI/MDIX). This means you can use a standard cable or a cross-over Ethernet patch cable.

→ Section 4.6 "Technical data of the communication ports" on page 34.

The yellow and green LEDs at the **ETH** port reflect the port's operational status. Depending on your NET-x interface board, their behavior slightly varies.

→ Section 4.6 "Technical data of the communication ports" on page 34.

3.3.3 ! button

The **!** button enables you to recover from unsuccessful software image downloads or other issues. To start a new software image download, press the **!** button with a pointed tool or a paper clip while powering up the *CMC*. In that case, the test set will not start as usual but wait for a new software image download.

3.3.4 Associate button

The **Associate** button has the following functions:

- **Association with controlling computer**
  An Ethernet communication port enables you to communicate with any *CMC* available on the network. This may lead to dangerous situations where a user accidentally connects to a device located on a desk of somebody else, emitting unsafe voltages and endangering the person working there.
  To prevent such a situation, a mechanism is integrated into the *CMC* test set that allows only "authorized" clients to control the test set. If you use the **Associate** button, the test set is registered for use with a specific host computer.
  The association process can be initiated via the control software.

► For more details about this process, refer to the according help.
For the association, the *CMC* test set remembers the Ethernet hardware address (MAC) of the connected port of the controlling device. Should the port change, a re-association is necessary.

- **Reset IP configuration**
  If the **Associate** button is pressed while powering up the *CMC* test set, the IP configuration of the network interfaces is reset to factory default, which is DHCP/AutoIP for both network interfaces. This may be necessary to recover from settings with conflicting static IP addresses.

3.3.5 Status LED A and B

The status LEDs A and B above the **Associate** button are of interest in case of troubleshooting.

A: yellow status LED

- ON indicates that the test set is ready to be controlled by a computer. The hardware checks in the test set are finished.
- OFF indicates that the test set is waiting for a software image download. This is the case when the **!** button is pressed while powering up the *CMC* test set.

B: green status LED

- LED B blinks slowly: The *CMC* test set waits for the TFTP download (**t**rivial **f**ile **t**ransfer **p**rotocol) of a software image.
- LED B is ON: The TFTP download of the software image is in progress.
- LED B blinks quickly: The computer is writing, for example, the software to the flash memory of the *CMC* test set.

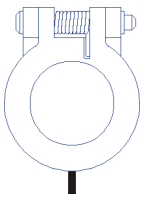
► Do not turn off the *CMC* test set as long as the writing is in progress.

3.3.6 SELV interfaces

All inputs and outputs of the SELV group (SELV = **s**afety **e**xtra **l**ow **v**oltage, defined in IEC 60950-1) reference to a common neutral (**N**) that is internally connected to the protective earth (GND) of the housing.

Note: The hardware for **LL out 1–6** and **ETH2** exists but is not used in the *CMC 310*.

External interface (ext. Interf.):



ext. Interf.

The SELV interface connector **ext. Interf.** holds 4 additional transistor binary outputs (**BINARY OUTPUT** 11–14). Unlike regular relay outputs, the outputs of **BINARY OUTPUT** 11–14 are bounce-free binary outputs and have a minimal reaction time.

In addition, 2 high frequency counter inputs for up to 100 kHz are available for the testing of energy meters.

LL out 1–6 (low-level outputs 1–6)

The hardware for **LL out 1–6** exists but is not used in the *CMC 310*.

4 Technical data

4.1 Calibration and guaranteed values

We recommend that you send in your test sets for calibration at least once a year.

The drift of test equipment, that is, the deterioration of accuracy over time, depends strongly on environmental conditions and the application field. Excessive use or mechanical and/or thermal stress may result in the need for shorter calibration intervals.

Moderate working environments, on the other hand, allow you to increase the calibration interval to once every 2 or even 3 years.

► Particularly in cases of extended calibration intervals, verify the accuracy of the test set by cross-referencing the measurement results with traceable reference equipment either on a regular basis or prior to use. You can, for example, use a typical, often-used device under test as a reference, or use measurement equipment with a certified high accuracy.

Should the test equipment fail, immediately contact OMICRON Support for calibration or repair. Do not try to use it anymore.

Guaranteed values

- The values apply at 23 °C ± 5 °C (73 °F ± 9 °F), and after a warm-up time greater than 25 minutes.
- Guaranteed values of the generator outputs:
  The values are valid in the frequency range from 10 to 100 Hz unless specified otherwise. Given maximum phase errors relate to the voltage amplifier outputs.
- Accuracy data for analog outputs are valid in the frequency range from 0 to 100 Hz unless specified otherwise.
- The given input/output accuracy values relate to the range limit value (% of range limit value).

4.2 Main power supply

Main power supply	
Connection	C14 connector according to IEC 60320-1
Voltage, single phase	
Nominal voltage	100 … 240 V_{AC}
Operational range	85 … 264 V_{AC}
Power fuse	T 12.5 AH 250 V (5 × 20 mm) Schurter ordering number 0001.2515 For more information, visit the website www.schurter.com.
Nominal supply current	Max. 12 A @ 110 V; max. 10 A @ 230 V
Frequency	
Nominal frequency	50/60 Hz
Operational range	45 ... 65 Hz
Overvoltage category	II

4.2.1 Operational limits in conjunction with a weak power supply input voltage

In general, the maximum output power of the *CMC 310* is limited by the power supply input voltage. If the power supply input voltage is less than 120 V_{AC}, it is possible to supply the *CMC 310* with 2 phases (L-L, for example with a NEMA 6 240 V U.S. Standard) instead of the normal phase-neutral (L-N) operation in order to increase the power supply input voltage.

In order to limit the internal losses and to maximize the output power of the voltage amplifier, always set the maximum test object voltage to the minimum value possible for the test.

Apart from the reduction of the available total output power, a weak power supply input does not further affect the technical data of the *CMC 310*.

Typical total output power at different power supply voltages

Power supply	Current amplifier	Voltage amplifier	AUX DC
230 V[1]	3 × 250 W at 20 A	3 × 85 W at 85 V	45 W at 110 V
115 V[1]	3 × 250 W at 20 A	3 × 85 W at 85 V	45 W at 110 V
100 V[1]	3 × 200 W at 20 A	3 × 85 W at 85 V	45 W at 110 V
90 V[1]	3 × 150 W at 20 A	3 × 85 W at 85 V	45 W at 110 V

1. After 10 min of continuous operation at full output power, a duty cycle of 10 min on/10 min off is required at an ambient temperature of 23 °C.

4.2.2 Operational limits with current and voltage amplifier in parallel

A parallel operation of current and voltage amplifier lowers the maximum output power of the *CMC 310*.

To limit the internal losses and to maximize the output power of the voltage amplifier, set the maximum test object voltage to the minimum value possible for the test.

Typical test set uptime for different power outputs

Current amplifier	Voltage amplifier	t1[1]
3 × 200 W at 20 A	3 × 60 W at 85 V	>1800 s[2]
3 × 250 W at 20 A	3 × 85 W at 85 V	600 s
3 × 430 W at 20 A	3 × 100 W at 85 V	500 s

1. t1 = maximum possible uptime for a cold *CMC 310* test set.
2. At an ambient temperature of 23 °C, when operating the *CMC 310* test set with a low power supply, allow a duty cycle of 10 min on/10 min off.

4.3 System clock accuracy

All signals generated or measured by the *CMC 310* refer to a common internal time base that is specified as follows:

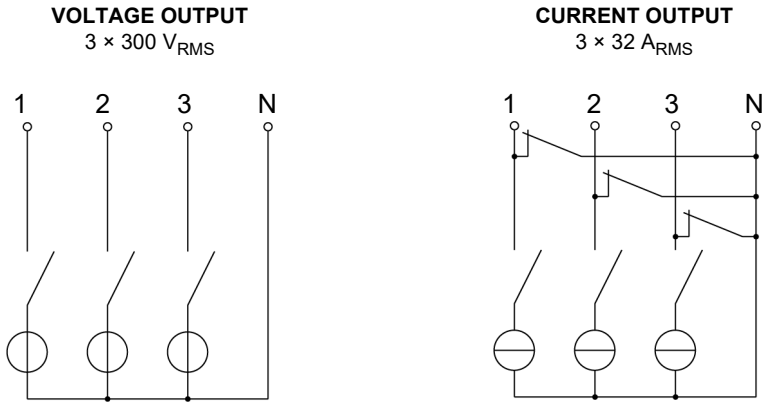
Characteristic	Specification
Clock performance	Stratum 3 (ANSI/T1.101-1987)
Frequency drift (over time)	
24 hours	<±0.37 ppm (±0.000037 %)
20 years	<±4.60 ppm (±0.00046 %)
Frequency drift (over temperature range)	<±0.28 ppm (±0.000028 %)

4.4 Outputs

4.4.1 General generator outputs

General generator outputs data (analog current and voltage outputs)	
Frequency ranges[1]	Sinusoidal signals[2] 10 … 599 Hz
Frequency resolution (signal generation)	<5 µHz
Phase range φ	–360° ... +360°
Phase resolution	0.001°
Phase error	→ section 4.4.2 "Current outputs" on page 22 → section 4.4.3 "Voltage outputs" on page 25
Amplitude temperature drift	0.0025 %/°C

1. For injections longer than 1 minute, the maximum fundamental frequency is limited to 587 Hz to comply with international trade restrictions for frequency-controlled signal generators. For other options, please contact OMICRON Support.
2. Amplitude derating for current outputs at frequencies above 380 Hz.



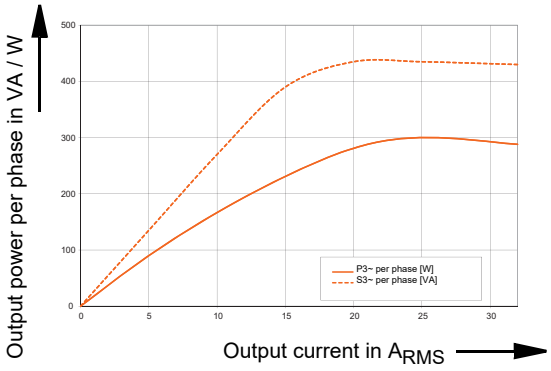
All voltages and current generators can independently be configured with respect to amplitude, phase angle, and frequency.

All outputs are monitored. Overload conditions prompt a notification in the control software.

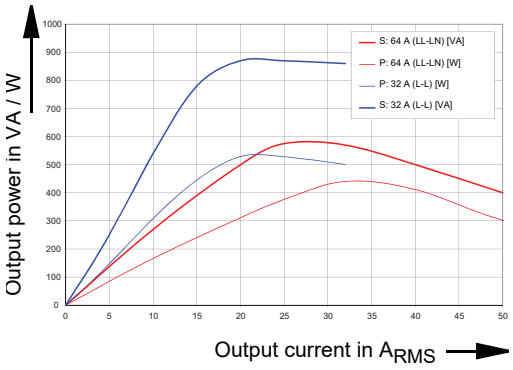
4.4.2 Current outputs

Current outputs[1]		
Output currents 3-phase AC (L-N) 1-phase AC (L-L)[2, 3] 1-phase AC (LL-LN)[2] DC (LL-LN)[2]	 3 × 0 ... 32 A 1 × 0 ... 32A 1 × 0 ... 64 A 1 × 0 ... ±90 A	
	Typical	Guaranteed
Output power[4] 3-phase AC (L-N) 1-phase AC (L-L)[2, 3] 1-phase AC (LL-LN)[2] DC (LL-LN)[2]	 3 × 430 VA at 25 A 1 × 870 VA at 25A 1 × 500 VA at 40A 1 × 700 W at ±40 A	 3 × 250 W at 20 A 1 × 530 W at 20 A 1 × 350 W at 40 A 1 × 500 W at ±40 A
Accuracy[5] $R_{load} \leq 0.5\ \Omega$	 Error <0.05 % of rd. + 0.02 % of rg.	 Error <0.15 % of rd. + 0.05 % of rg.
Harmonic distortion (THD+N)[6, 7]	0.05 %	<0.15 %
Phase error[6]	0.05°	<0.2°
DC offset current	<3 mA	<10 mA
Frequency range[8, 9]	Sinusoidal signals	0 (DC) … 599 Hz
Resolution	1 mA, 2 mA (2 phases in parallel), ...	
Trigger on overload	Timer accuracy error <1 ms	
Short-circuit protection	Unlimited	
Open-circuit protection	Open outputs (open-circuit) permitted	
Connection	4 mm socket	
Insulation	Reinforced insulation of power supply and all SELV interfaces	

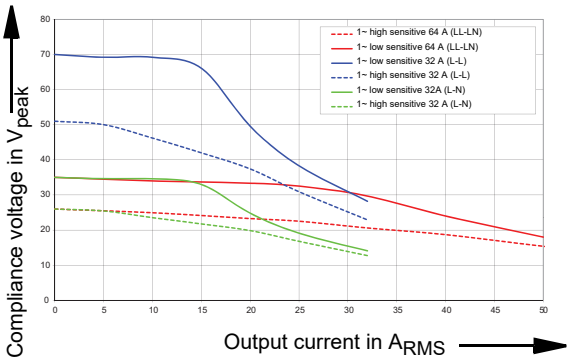
1. Data for 3-phase systems are valid for symmetric conditions (0°, 120°, 240°)
2. For wiring of single-phase modes → section 5 "Increasing the output power" on page 38.
3. Single-phase mode (in phase opposition).
4. Guaranteed data at 230 V power supply for ohmic loads (PF=1); typical data for inductive loads.
   → Section 4.2.1 "Operational limits in conjunction with a weak power supply input voltage" on page 19.
5. rd. = reading; rg. = range, whereas *n* % of rg. means: *n* % of upper range value
6. Valid for sinusoidal signals at 50/60 Hz and Rload ≤ 0.5 Ω.
7. Values at 20 kHz measurement bandwidth, nominal value, and nominal load.
8. For injections longer than 1 minute, the maximum fundamental frequency is limited to 587 Hz to comply with international trade restrictions for frequency-controlled signal generators. For other options, please contact OMICRON Support.
9. Amplitude derating at >380 Hz (→ "Current derating at high frequencies for sinusoidal signals" on page 23)



Guaranteed output power per phase of a group (active power values in W are guaranteed; apparent power values in VA are typical values)

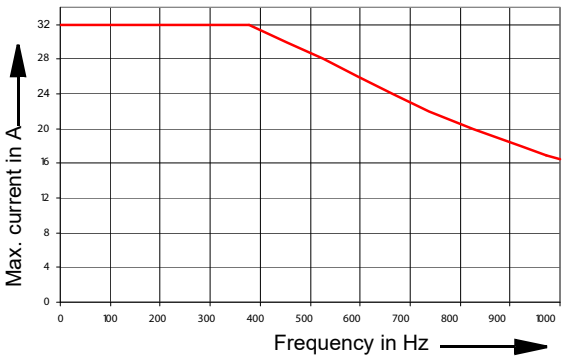


Guaranteed single phase output power curves (active power values in W are guaranteed; apparent power values in VA are typical values)

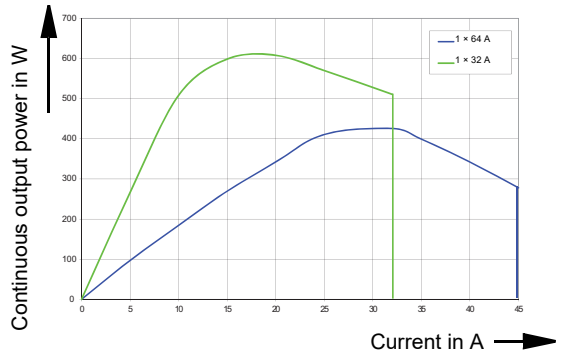


Typical compliance voltage (50/60 Hz)

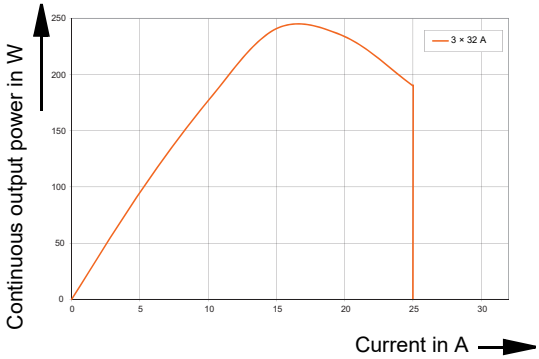
The low sensitive curves show the maximum available peak compliance voltage, which is mainly relevant for testing primary and electromechanical relays.



Current derating at high frequencies for sinusoidal signals



Typical continuous output current and output power at 23 °C; single-phase mode



Typical continuous output current and output power at 23 °C; 3- and 6-phase mode

The continuous operating range is given by the area below the curves in the figures above.

Due to the large number of operating modes, it is not possible to give universally applicable curves for the discontinuous mode. However, the examples given below can be used instead to gain feeling for the possible output durations (t1 is the possible duration of a cold device).

Typical duty cycles for operation at ambient temperature of 23 °C

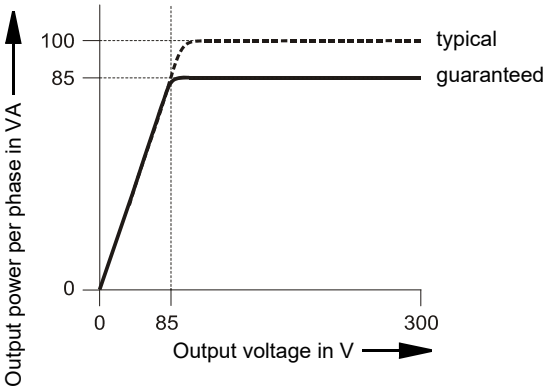
	I [A]	P [W]	Duty cycle	t_1 [min]	t_{on} [s]	t_{off} [s]
3 × 32 A (L–N)	0 ... 25	0 ... 600	100 %	>30	>1800	–
	26	700	80 %	7.5	80	20
	29	650	75 %	6.0	60	20
	32	600	71 %	3.5	50	20
1 × 64 A (LL–LN)	0 ... 40	0 ... 350	100 %	>30	>1800	–
	50	250	60 %	4.9	30	20
	60	150	43 %	2.6	15	20
	64	100	38 %	2.0	12	20

4.4.3 Voltage outputs

Voltage outputs		
Output voltages 3-phase AC (L-N) 1-phase AC (L-N) 1-phase AC (L-L) DC (L-N)	 3 × 0 ... 300 V 1 × 0 ... 300 V 1 × 0 ... 600 V 3 × 0 ... ±300 V	
	Typical	Guaranteed
Output power[1] 3-phase AC[2] 1-phase AC (L-N) 1-phase AC (L-L) DC (L-N)	 3 × 100 VA at 100 ... 300 V 1 × 200 VA at 100 ... 300 V 1 × 275 VA at 200 ... 600 V 1 × 420 W at 300 V_{DC}	 3 × 85 VA at 85 ... 300 V 1 × 150 VA at 75 ... 300 V 1 × 250 VA at 200 ... 600 V 1 × 360 W at 300 V_{DC}
Accuracy[3]	Error <0.03 % of rd. + 0.01 % of rg.	Error <0.08 % of rd. + 0.02 % of rg.
Harmonic distortion (THD+N)[4, 5]	0.015 %	<0.05 %
Phase error	0.02°	<0.1°
DC offset voltage	<20 mV	<100 mV
Voltage ranges	Range I: Range II:	0 ... 150 V 0 ... 300 V
Frequency ranges[6]	Sinusoidal signals	10 … 599 Hz
Resolution	Range I: Range II:	5 mV 10 mV
Short-circuit protection	Unlimited for L–N	
Connection	4 mm sockets	
Insulation	Reinforced insulation of power supply and all SELV interfaces.	

1. Guaranteed data for ohmic loads (PF = 1). Refer to the accompanying figures of the output power curves.
2. Data for 3-phase systems are valid for symmetric conditions (0°, 120°, 240°)
3. rd. = reading; rg. = range, whereas *n* % of rg. means: *n* % of upper range value
4. Valid for sinusoidal signals at 50/60 Hz.
5. Values at 20 kHz measurement bandwidth, nominal value, and nominal load
6. For injections longer than 1 minute, the maximum fundamental frequency is limited to 587 Hz to comply with international trade restrictions for frequency-controlled signal generators. For other options, please contact OMICRON Support.

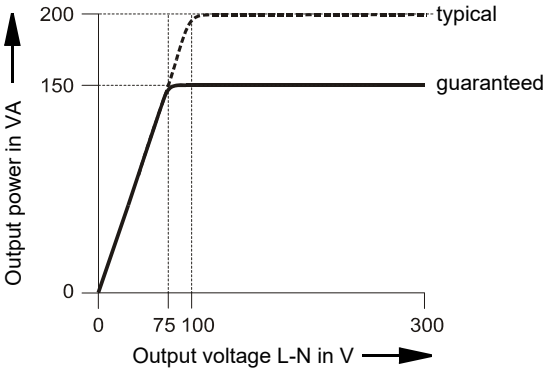
Power diagram for 3-phase operation



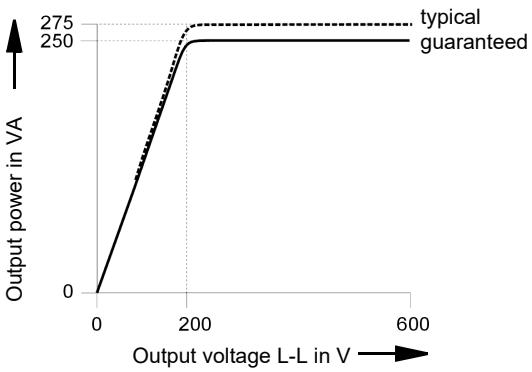
Power diagram for single-phase operation

Section 5.2 "Voltage outputs" on page 39

Single-phase operation L-N



Single-phase operation L-L

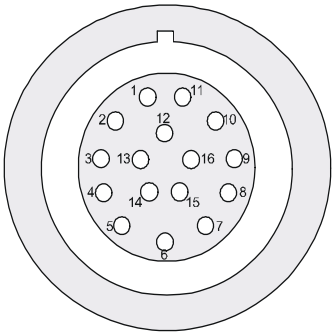


4.4.4 Low-level binary outputs (ext. Interf.)

The SELV interface connector **ext. Interf.** holds 4 additional transistor binary outputs (**BINARY OUTPUT** 11–14). Unlike regular relay outputs, **BINARY OUTPUT** 11–14 are bounce-free binary outputs and have a minimal reaction time.

In addition, 2 high-frequency counter inputs for up to 100 kHz are available for the testing of energy meters. They are described in section 4.5.2 "Counter inputs 100 kHz (low level)" on page 32.

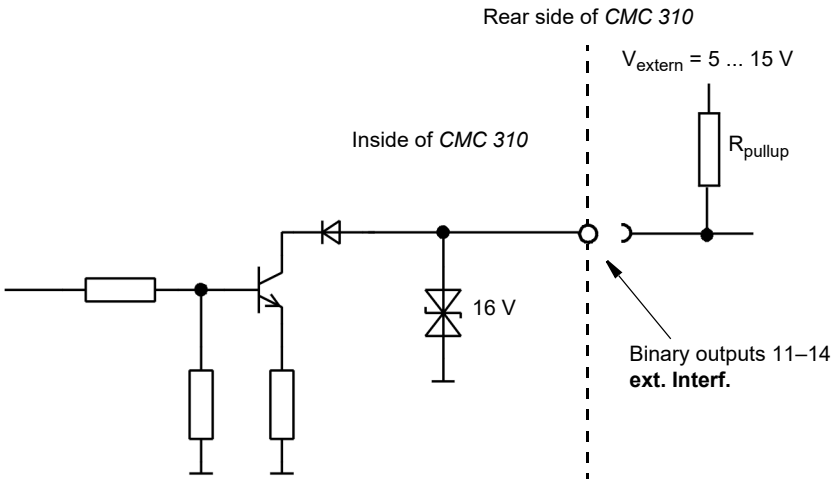
Pin assignment of the external interface **ext. Interf.** (upper 16-pole LEMO socket); view onto the connector from the cable wiring side:



Pin	Function
Pin 1	Counter input 1
Pin 2	Counter input 2
Pin 3	Reserved
Pin 4	Neutral (N) connected to GND
Pin 5	Binary output 11
Pin 6	Binary output 12
Pin 7	Binary output 13
Pin 8	Binary output 14
Pin 9–16	Reserved
Housing	Screen connection

4 low-level transistor binary outputs (BINARY OUTPUT 11–14)	
Type	Open-collector transistor outputs; external pull-up resistor
Rated voltage	Max. ±16 V
Rated current	Max. 5 mA (current limited); min. 100 µA
Update rate	10 kHz
Rise time	<3 µs (V_{extern} = 5 V, R_{pullup} = 4.7 kΩ)
Connection	Connector **ext. Interf.** (*CMC 310* rear side)
Insulation	Reinforced insulation to all other potential groups of the test equipment. GND is connected to protective earth (PE).

Circuit diagram of **ext. Interf.** binary transistor outputs 11–14:



Manufacturer ordering information	
Connector for one-guide notch and pull relief (for **ext. Interf.**).	FGG.2B.316.CLAD 72Z
Black anti-bend cable cover	GMA.2B.070 DN

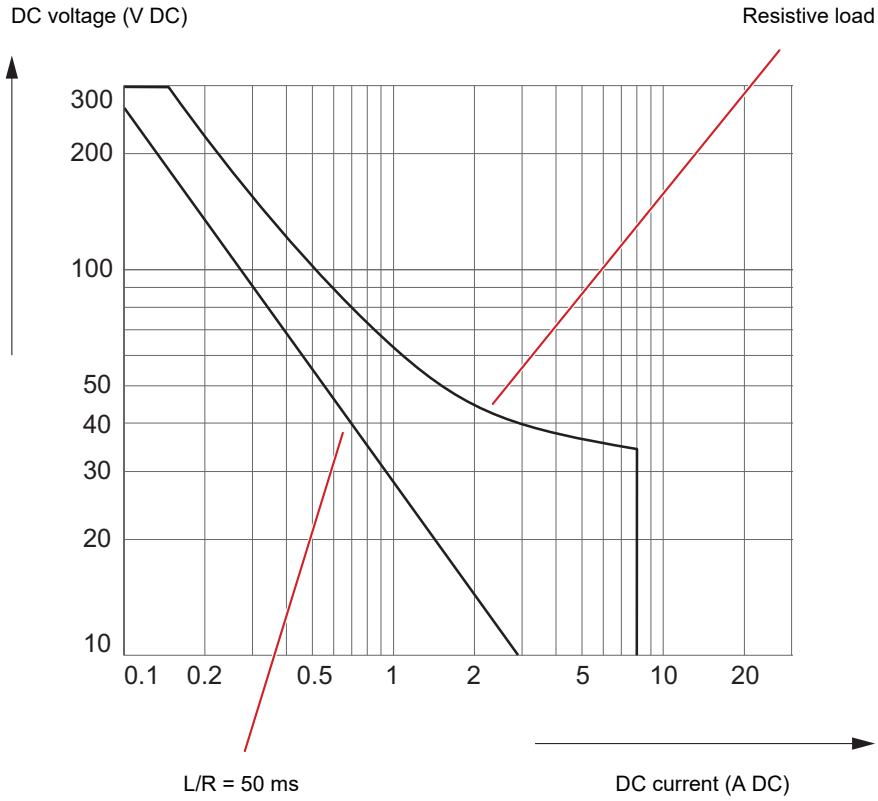
For a manufacturer description about the connection sockets **LL out** and the external interface **ext. Interf.**, visit the website www.lemo.com. You can order the LEMO cable directly from OMICRON.

4.4.5 Binary output relays

4 binary output relays (BINARY OUTPUT 1–4)	
Type	Potential-free contacts; software-controlled
Connection	4 mm sockets
AC loading capacity AC breaking capacity	V_{max} = 300 V, I_{max} = 8 A, P_{max} = 2000 VA
DC loading capacity DC breaking capacity	→ "Load limit breaking capacity curve for binary output relays with DC voltages" on page 29.
Inrush current	15 A (max. 4 s at 10 % duty cycle)
Carry capacity	5 A continuous at 60 °C (140 °F)
Electrical lifetime	100 000 switching cycles at 230 V_{AC}/8 A and ohmic load
Operate time	Max. 10 ms (no bouncing)
Release time	Max. 5 ms (no bouncing)
Overvoltage category	II, according to IEC 61010-1

The accompanying diagram shows the load limit curve for DC voltages. For AC voltages, a maximum power of 2000 VA is achieved.

Load limit breaking capacity curve for binary output relays with DC voltages



4.4.6 DC supply (AUX DC)

DC supply (AUX DC)		
Voltage ranges	0 ... 66 V_{DC} (max. 0.8 A) 0 ... 132 V_{DC} (max. 0.4 A) 0 ... 264 V_{DC} (max. 0.2 A)	
Power	Max. 50 W	
Accuracy[1]	Typical	Guaranteed
	Error <2 %	Error <5 %
Resolution	<70 mV	
Connection	4 mm sockets on front panel.	
Short-circuit protection	Yes	
Overload indication	Yes	
Insulation	Reinforced insulation from power supply and all SELV interfaces.	

1. Percentage is with respect to each range's full-scale.

4.5 Inputs

4.5.1 Binary inputs

General data of binary inputs 1…6	
Number of binary inputs	6
Trigger criteria	Potential-free or DC-voltage compared to threshold voltage.
Reaction time	Max. 220 µs
Sampling rate	10 kHz
Time resolution	100 µs
Maximum measuring time	Unlimited
Debounce/deglitch time	0 … 25 ms (→ page 31)
Counting function Counter frequency Pulse width	 <3 kHz (per input) >150 µs (for high and low signals)
Connection	4 mm sockets
Insulation	3 galvanically insulated binary groups with each 2 inputs having its own GND. Functional insulation to the power outputs, DC inputs and between galvanically separated groups. Reinforced insulation from all SELV interfaces and from power supply.

Data for potential-sensing operation		
Range/resolution	20 ... 300 V 0 ... 20 V	500 mV 50 mV
Maximum input voltage	CAT IV: 150 V CAT III: 300 V	
Threshold voltage accuracy[1]	5 % of rd. + 0.5 % of rg.	
Typical threshold voltage hysteresis	Range 20 ... 300 V: 900 mV Range 0 ... 20 V: 60 mV	
Input impedance	Threshold 20 ... 300 V: 135 kΩ Threshold 0 ... 20 V: 210 kΩ	

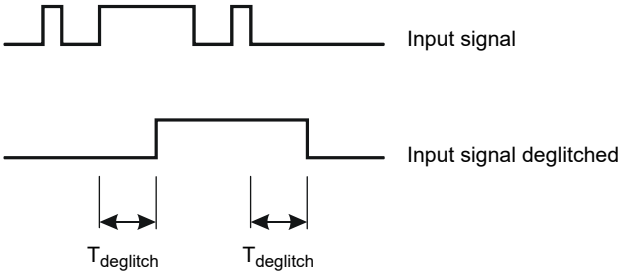
1. Valid for positive voltage signal edge; percentage is shown in respect to each range’s full-scale.

Data for potential-free operation	
Trigger criteria	
Logical 0	R >100 kΩ
Logical 1	R <10 kΩ
Input impedance	216 kΩ

Deglitching input signals

In order to suppress short spurious pulses, a deglitching algorithm could be configured. The deglitch process results in an additional dead time and introduces a signal delay. In order to be detected as a valid signal level, the level of an input signal must have a constant value at least during the deglitch time.

The figure below illustrates the deglitch function.



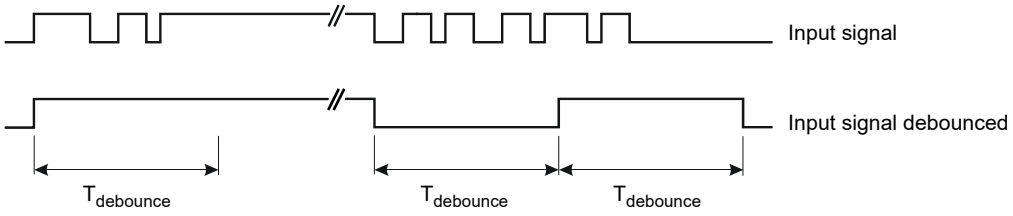
Debouncing input signals

For input signals with a bouncing characteristic, a debounce function can be configured. This means that the first change of the input signal causes the debounced input signal to be changed and then be kept on this signal value for the duration of the debounce time.

The debounce function is placed after the deglitch function described above and both are realized by the firmware of the *CMC 310* and are calculated in real time.

The figure below illustrates the debounce function. On the right-hand side of the figure, the debounce time is too short. As a result, the debounced signal rises to "high" once again, even while the input signal is still bouncing and does not drop to a low level until another $T_{debounce}$ period has expired.

The figure below illustrates the debounce function.

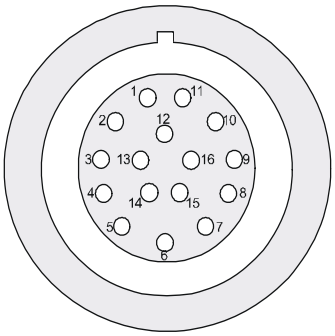


4.5.2 Counter inputs 100 kHz (low level)

The SELV interface connector **ext. Interf.** holds 2 high-frequency counter inputs for up to 100 kHz which are used for testing energy meters.

In addition, 4 additional transistor binary outputs (**BINARY OUTPUT 11–14**) are available. They are described in section 4.4.4 "Low-level binary outputs (ext. Interf.)" on page 26.

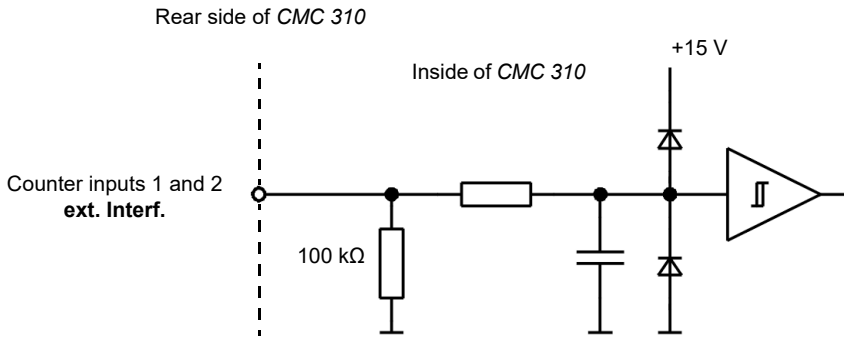
Pin assignment of the external interface **ext. Interf.** (upper 16-pole LEMO socket); view onto the connector from the cable wiring side:



Pin	Function
Pin 1	Counter input 1
Pin 2	Counter input 2
Pin 3	Reserved
Pin 4	Neutral (N) connected to GND
Pin 5	Binary output 11
Pin 6	Binary output 12
Pin 7	Binary output 13
Pin 8	Binary output 14
Pin 9–16	Reserved
Housing	Screen connection

2 counter inputs	
Maximum counter frequency	100 kHz
Pulse width	>3 µs (high and low signal)
Switch threshold Pos. edge Neg. edge	 Max. 8 V Min. 4 V
Hysteresis	Typ. 2 V
Rise and fall times	<1 ms
Maximum input voltage	±30 V
Connection	Socket **ext. Interf.** (rear side of *CMC 310*)
Insulation	Reinforced insulation to all other potential groups of the test equipment. GND is connected to protective earth (PE).

Circuit diagram of **ext. Interf.** counter inputs 1 and 2:



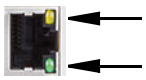
Manufacturer ordering information	
Connector for one-guide notch and pull relief (for **ext. Interf.**).	FGG.2B.316.CLAD 72Z
Black anti-bend cable cover.	GMA.2B.070 DN

For a manufacturer description about the connection sockets **LL out 1–6** and external interface **ext. Interf.**, visit the website www.lemo.com. You can order the LEMO cable directly from OMICRON.

4.6 Technical data of the communication ports

4.6.1 NET-2 board

The NET-2 board requires *CMControl* software version 2.30 (or later).

NET-2: 2 × USB port and Ethernet ports ETH1/ETH2		
	USB type	USB 2.0 high speed up to 480 Mbit/s
	USB connector	USB type A
	Output current	Max. 500 mA
	USB type	USB 2.0 high speed up to 480 Mbit/s; USB 1.1-compatible
	USB connector	USB type B (connect to computer)
	USB cable	USB 2.0 high speed type A-B, 2 m/6 ft
	ETH type	10/100/1000Base-TX[1] (twisted pair, auto-MDI/MDIX or auto-crossover)
	ETH connector	RJ45
	ETH cable type	Shielded LAN cable of category 5 (CAT5) or better
	ETH port status LED 	Depending on the ETH type of your NET-2 interface board's counterpart, the status LED's behavior varies. Physical link established, port active: Mbit/s — Active LED ON 10 — yellow 100 — green 1000 — yellow + green If there is traffic via an **ETH** port, the active LEDs start blinking.
	ETH **P**ower **o**ver **E**thernet (PoE)	IEEE 802.3af compliant Port capability limited to one Class 2 (6.49 W) power device

1. 10Base = 10 Mbit/s transfer rate
   100Base = 100 Mbit/s transfer rate
   1000Base = 1000 Mbit/s transfer rate

4.6.2 NET-1C board (legacy board)

NET-1C: USB port and Ethernet ports ETH1/ETH2		
	USB type	USB 2.0 full speed up to 12 Mbit/s
	USB connector	USB type B (connect to computer)
	USB cable	USB 2.0 high speed type A-B, 2 m/6 ft
	ETH type	10/100Base-TX (10/100Mbit, twisted pair, auto-MDI/MDIX or auto-crossover)
	ETH connector	RJ45
	ETH cable type	Shielded LAN cable of category 5 (CAT5) or better
	ETH port status LED 	• Physical link established, port active: green LED ON • Traffic via **ETH** port: yellow LED is blinking
	ETH **P**ower **o**ver **E**thernet (PoE)	IEEE 802.3af compliant Port capability limited to one Class 2 (6.49 W) power device

4.7 Environmental conditions

Climate	
Operating temperature	0 ... +50 °C (+32 ... +122 °F), a 50 % duty cycle may apply above +30 °C (+86 °F)
Storage	–25 … +70 °C (–13 … +158 °F)
Maximum altitude	2000 m (6560 ft)
Humidity	5 … 95 % relative humidity; no condensation
Climate	Tested according to IEC 60068-2-78

Shock and vibration	
Vibration	Tested according to IEC 60068-2-6; frequency range 10 ... 150 Hz; 2 g (20 sweeps)
Shock	Tested according to IEC 60068-2-27; 15 g/11 ms, half-sinusoid, each axis

4.8 Mechanical data

Size, weight and protection	
Weight	13.1 kg (28.9 lb)
Dimensions W × H × D (without handle)	343 × 145 × 390 mm (13.5 × 5.7 × 15.4")
Housing	IP20 according to IEC 60529

4.9 Safety standards, electromagnetic compatibility (EMC) and certificates

Electromagnetic interference (EMI)	
Europe	EN 61326-1; EN 61000-6-4; EN 61000-3-2/3; EN 55032 (Class A)
International	IEC 61326-1; IEC 61000-6-4; IEC 61000-3-2/3; CISPR 32 (Class A)
USA	47 CFR 15 Subpart B (Class A) of FCC
Electromagnetic susceptibility (EMS)	
Europe	EN 61326-1; EN 61000-6-2; EN 61000-4-2/3/4/5/6/8/11/16/18; EN 61000-6-5
International	IEC 61326-1; IEC 61000-6-2; IEC 61000-4-2/3/4/5/6/8/11/16/18; IEC 61000-6-5
Safety standards	
Europe	EN 61010-1; EN 61010-2-030
International	IEC 61010-1; IEC 61010-2-030
USA	UL 61010-1; UL 61010-2-030
Canada	CAN/CSA-C22.2 No 61010-1; CAN/CSA-C22.2 No 61010-2-030
Certificate	Safety tested Production monitored TÜV SÜD C US Manufactured under an ISO 9001 registered system.

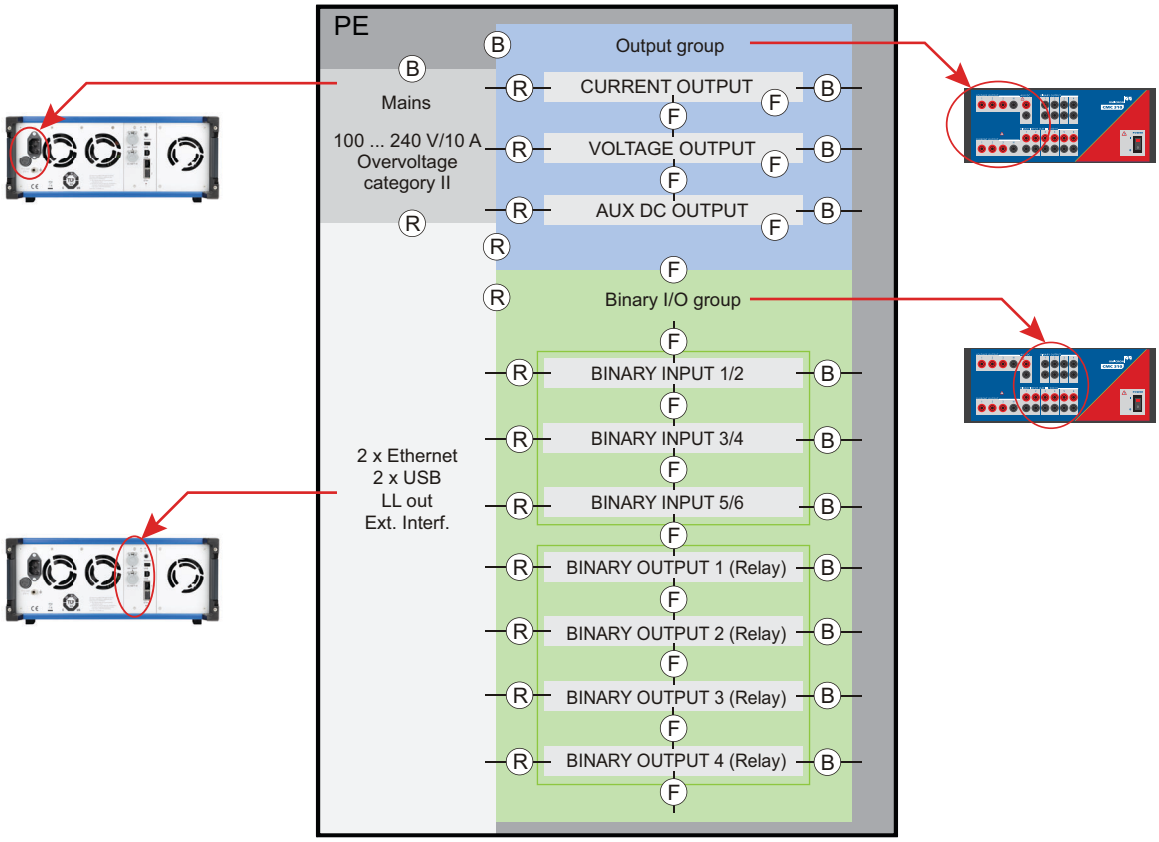
4.10 Electrical insulation groups

The following chapter shows how the inputs and outputs of *CMC* test sets are insulated against PE and each other.

B = Basic insulation

R = Reinforced insulation

F = Functional insulation



Insulation designed for pollution degree 2.

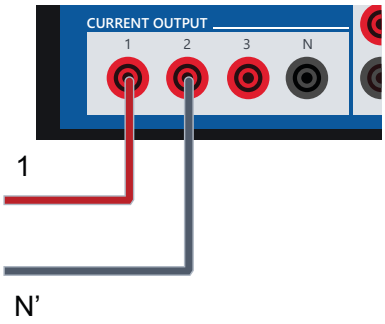
5 Increasing the output power

The possible output current and output voltage of the *CMC 310* can be increased by connecting amplifiers in parallel or in series. The following output configuration examples represent a selection of the possible configurations. For a complete list of possible configurations, check the hardware configuration of the control software or control device.

When using the *CMC 310* in an operational mode that parallels the output currents, make sure to use test leads of an appropriate diameter.

5.1 Current outputs

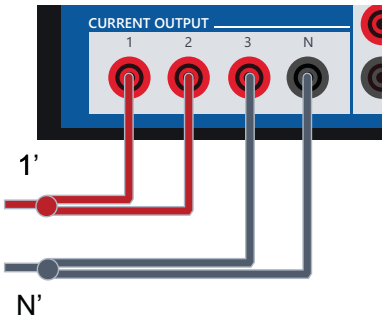
1 × 0 ... 32 A



The currents 1 and 2 of the current triple are phase-opposite. This doubles the compliance voltage of a single output.

1 × 0 ... 32 A (±45 A_{DC}), 870 VA at 25 A; max. 70 V_{peak}.

1 × 0 ... 64 A

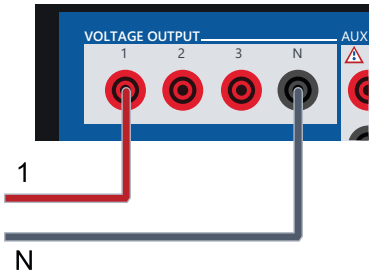


Since the current over the N socket is limited to 32 A_{RMS} (45 A_{DC}), the third phase is used to support the N socket. The currents 1 and 2 are connected in parallel.

1 × 0 ... 64 A (±90 A_{DC}), 500 VA at 40 A; max. 35 V_{peak}.

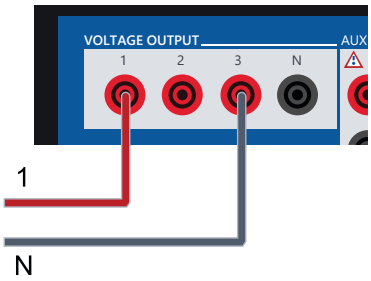
5.2 Voltage outputs

1 × 0 ... 300 V



Typical: 200 VA at 100 ... 300 V.

1 × 0 ... 600 V



Typical: 275 VA at 200 ... 600 V.

6 Troubleshooting

6.1 Troubleshooting guide

In case of operational problems with the *CMC 310*, and if you could not find a solution in this manual or the other accompanying documentation (of control software and device), proceed as follows:

1. Check whether the malfunction is reproducible and document it.
2. Try to isolate the malfunction by using another computer, control device, test set or connecting cable, if available.
3. Note the exact wording of any error message or unexpected conditions.
4. If you contact OMICRON Support, please supply the following:
   - Your company name as well as a phone number and email address.
   - The serial number of your test set.
   - Information about the control device or the computer running the control software: manufacturer, type, memory, operating system (and language), and the installed version and language of the control software.
   - Screenshots or the exact wording of possible error messages.
5. If you contact OMICRON Support, have your computer and test set available and be prepared to repeat the steps that caused the problem.

To speed up the process, please attach available diagnostic log files or a system snapshot file.

Proceed as follows in the *CMControl* software:

1. Connect to the *CMC 310* Web Interface (→ section 1.1 on page 5).
2. Navigate to the **System** page.
3. Download a **System snapshot**.

6.2 Potential errors, possible causes, remedies

Some potential disruptions that may occur while operating the *CMC 310* are listed below. Try to eliminate them by applying the remedies proposed here.

Error	Possible causes	Remedies
The power switch does not light up after turning on the *CMC 310* test set.	There is no power to the test set.	Check the power supply and make sure that it supplies power to the test set.
	The fuse of the test set is blown.	Unplug the power cord from the power source. Replace the fuse: T 12 AH 250 V (5 × 20 mm). → 2.5 "Changing the power fuse" on page 8.
	There is a malfunction of internal test set components.	Contact OMICRON Support → "Support" on page 43.
The following message appears in the status line: "Warning: broken or insufficient connection to protective earth. We recommend to switch off the device. Check the connection or, if necessary, install an additional PE connection.".	The ground-wire connection to the *CMC 310* is broken or the test set is powered by an earth-free power supply.	Switch off the *CMC 310* and disconnect it from power supply. Check the ground connection. Ground the housing of the test set separately using the grounding socket (on the back panel of the test set).

6.3 Overheating

Depending on the output current and the ambient temperature, a duty cycle smaller than 100 % has to be applied for the current outputs in order to prevent a protective shut-down of the current amplifier by the overtemperature protection function. If the *CMC 310* performed a protective shutdown of the current amplifier, a message is displayed in the control software or on the control device.

You can then try the following to avoid further protective shutdowns:

- Use shorter duty cycles, for example, 50 % instead of 75 %.
- Use the *CMC 310* at lower ambient temperatures.

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!

24/7 Technical support – get support

www.omicronenergy.com/support

At our technical support hotline, you can reach well-educated technicians for all of your questions. Around the clock – competent and free of charge.

Make use of our 24/7 technical support hotlines:

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OMICRON electronics GmbH, Oberes Ried 1, 6833 Klaus, Austria, +43 59495