



OMICRON

CMC 310

Reference Manual



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The user is responsible for every application that makes use of an OMICRON product.

OMICRON electronics translates this manual from the source language English into a number of other languages. Any translation of this manual is done for local requirements, and in the event of a dispute between the English and a non-English version, the English version of this manual shall govern.

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PREFACE

The purpose of this reference manual is to familiarize users with the *CMC 310* test set and to show how to properly use it in various application areas.

The manual contains important tips on how to use the *CMC 310* safely, properly, and efficiently. Its purpose is to help you avoid danger, repair costs, and down time as well as to help maintain the reliability and life of the *CMC 310*.

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

The reference manual should always be available at the site where the *CMC 310* is used. It should be read by all personnel operating the test set.

In addition to the reference manual and the applicable safety regulations in the country and at the site of operation, the usual technical procedures for safe and competent work should be heeded.

Note: This reference manual describes the *CMC 310* hardware - that is, the physical test set. In order to get familiar with the software for controlling and configuring the *CMC 310*, please refer to the related manuals.

For Your Safety Please Note

The *CMC 310* test set can output life-hazardous voltages and currents.



Throughout the manual, this symbol indicates special safety-relevant notes/directions linked to the possibility of touching live voltages and/or currents. Please thoroughly read and follow those directions to avoid life-hazardous situations.



This symbol indicates potential hazards by electrical voltages/currents caused by, for example, wrong connections, short-circuits, technically inadequate or faulty equipment or by disregarding the safety notes of the following sections.

SAFETY INSTRUCTIONS



Before operating the *CMC 310* test set, carefully read the following safety instructions.

Only operate (or even turn on) the *CMC 310* after you have read this reference manual and fully understood the instructions herein.

The *CMC 310* may only be operated by trained personnel. Any maloperation can result in damage to property or persons.

Rules for Use

- The *CMC 310* should only be used when in a technically sound condition. Its use should be in accordance with the safety regulations for the specific job site and application. Always be aware of the dangers of the high voltages and currents associated with this equipment. Pay attention to the information provided in the reference manual and the software documentation.
- The *CMC 310* is exclusively intended for the application areas specified in section 1, "Designated Use" on page 9. The manufacturer/distributors are not liable for damage resulting from unintended usage. The user alone assumes all responsibility and risk.
- The instructions provided in this reference manual and the associated software manuals are considered part of the rules governing proper usage.
- Do not open the *CMC 310* or remove any of its housing components.

Orderly Practices and Procedures

- The reference manual (or its PDF version) should always be available on site where the *CMC 310* is used.
- Personnel assigned to using the *CMC 310* must have read this reference manual and fully understood the instructions herein.
- Do not carry out any modifications, extensions or adaptations at the *CMC 310*.

Operator Qualifications

- Testing with the *CMC 310* should only be carried out by authorized and qualified personnel.

- Personnel receiving training, instruction, direction, or education on the *CMC 310* should remain under the constant supervision of an experienced operator while working with the equipment.

Safe Operation Procedures

- Follow the instructions in sections 3.2 and 3.4 that describe the safe use of the connecting cables and how to set the *CMC 310* into operation.
- The *CMC 310* must only be used from a power outlet that has a protective earth.
- The mains cable must be rated for the nominal voltage and current specified in Table 6-1, "Power supply data" on page 29. It is recommended to use the cable supplied with the test set.
- Do not block the access to safety-relevant test set components like the main power switch or the power cord. In cases of an emergency, these components need free and quick access.
- Do not connect any of the front panel VOLTAGE/CURRENT OUTPUTS 1 ... 3 to the protective earth. The N sockets, however, may be connected to protective earth.
- When connecting to the banana plug sockets, only use cables with 4 mm/0.16 " safety banana connectors and plastic housing. Always insert plugs completely.
- Before connecting and disconnecting test objects, verify that all outputs have been turned off. Never connect or disconnect a test object while the outputs are active.
- When disconnecting power supply cables or test leads, always start from the device feeding the power or signal.
- All sockets on the front panel are to be considered dangerous with working voltages up to 300 V_{rms}. Only use cables that meet these respective requirements to connect to the equipment.
- Red Signal Light :
If the voltage on any of the three voltage outputs or on the "AUX DC" output exceeds 42 V, the associated signal light lights up.
- Do not insert objects (e.g., screwdrivers, etc.) into the sockets or into the ventilation slots.
- Do not operate the *CMC 310* under wet or moist conditions (condensation).
- Do not operate the *CMC 310* when explosive gas or vapors are present.

- Connect only external devices to the *CMC 310* "ETH" interface that meet the requirements for SELV equipment (SELV = Safety Extra Low Voltage) according to EN 60950 or IEC 60950. The SELV hardware for Ext. Interface, LLO 1-6, ETH2, and USB is present, but not used in the *CMC 310*.
- For applications drawing DC current: The load may not exceed 3 mA because of dangerous feedback current.
- When setting up the *CMC 310*, make sure that the air slots on the back, top, and bottom of the test set remain unobstructed.
- Voltages up to 1 kV can be present inside the *CMC 310*! Therefore, opening the *CMC 310* is only permitted by qualified experts either at the factory or at certified external repair centers.
- If the *CMC 310* is opened by the customer, all guarantees are invalidated.
- *CMC 310* Ethernet functionality (see section 5.2.1, "Ethernet Port ETH1" on page 26):
 - Connect ETH1 **only** to Ethernet ports.
- If the *CMC 310* seems to be functioning improperly, please contact the OMICRON Technical Support (see section "OMICRON Service Centers" on page 55).

Changing the Power Fuse

- Unplug the power cord between the test set and the power source.
- The fuse is located at the back of the test set.
- Fuse type: **T12.5 AH 250 V** (wire fuse 5 × 20 mm).

For safety reasons please use only fuse types recommended by the manufacturer. Refer to 6.1, "Main Power Supply" on page 29 for more information.

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

Any other use of the *CMC 310* is considered improper and may result in damage to property or persons.

Features of the *CMC 310*:

- Output of test quantities:
 - 3 x voltage
 - 3 x current
- Supply of DC voltages to the test object
- Output of binary signals
- Capture of binary signals

2 INTRODUCTION

The *CMC 310* is a test set controlled by the *CMControl P* software.

This reference 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, please read the user manuals.

3 OPERATING THE CMC 310



Only operate (or even turn on) the *CMC 310* after you have read this reference manual and fully understood the instructions herein.

3.1 System Components

Before operating the *CMC 310* for the first time, use the packing list to verify that all components of the test system are available.

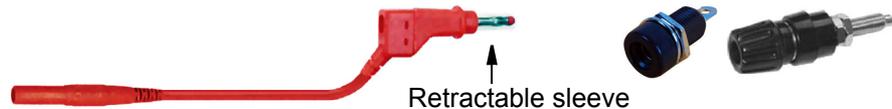
To set the *CMC 310* into operation you need the following components:

- *CMC 310* with (mains) power cable
- Connecting cable *CMC 310* ↔ *CMControl* unit or WiFi router for *CMControl P App*
- Connecting cable *CMC 310* ↔ test object
- *CMControl* unit with *CMControl P* software or tablet with *CMControl P App* and WiFi router

3.2 Safe Use of the Connecting Cables

3.2.1 Test Lead Adapter for Non-Safety Sockets

The optional CMC Wiring Accessory Package includes flexible test lead adapters of 5 cm/2 " length with a retractable sleeve (6 x black, 6 x red).

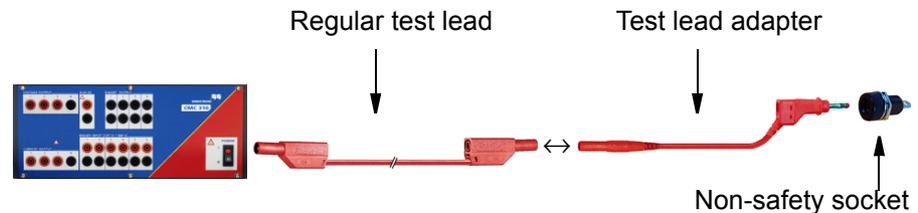


These test leads are to be used as **adapters**, only. They are intended to make the 4 mm/0.16 " banana plugs of the standard test leads fit into non-safety sockets (see illustration above).

Never directly insert one of these retractable sleeves into a CMC 310 output socket at the front of the test set. This does not comply with the designated purpose of these leads and is contrary to the safety regulations.

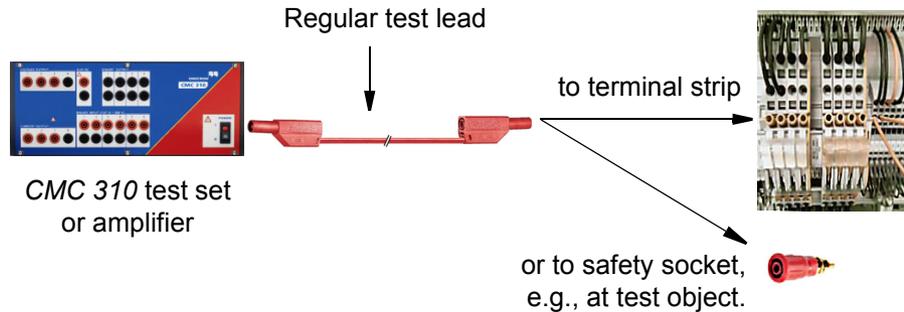


Plug **only the regular test leads** of 2.0 m/6 ft. length into the CMC 310 output safety sockets.



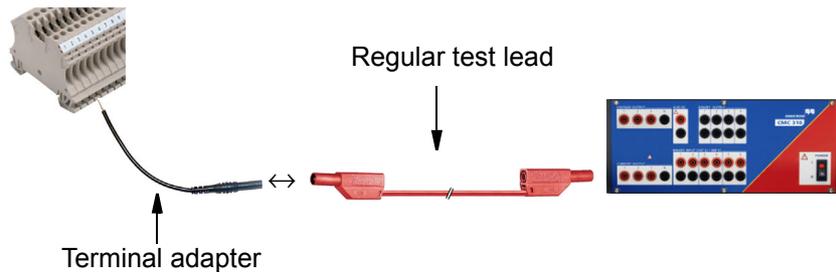
3.3 Regular Test Leads for Safety Sockets

Use the regular test leads of 2.0 m/6 ft. length to connect the *CMC 310* output to other safety sockets of, for example, amplifiers, test objects or to banana adapters in control cabinets.



3.3.1 Terminal adapters

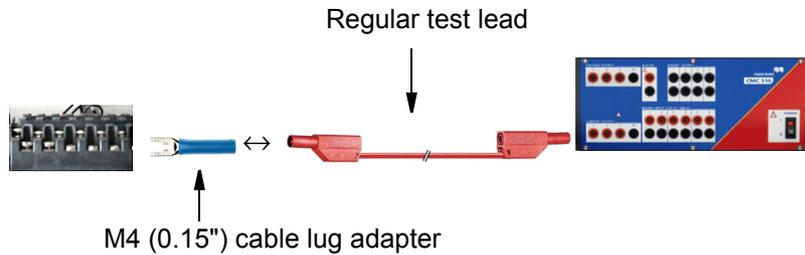
The optional CMC Wiring Accessory Package includes flexible terminal adapters to connect the regular test leads to screw-clamp terminals.



The terminal adapters have blank ends. Therefore, turn off the voltage before connecting these adapters. Always insert an adapter with its blank end into the terminal strip first, and fasten it before connecting it to a test lead.

3.3.2 M4 (0.15") Cable Lug Adapters

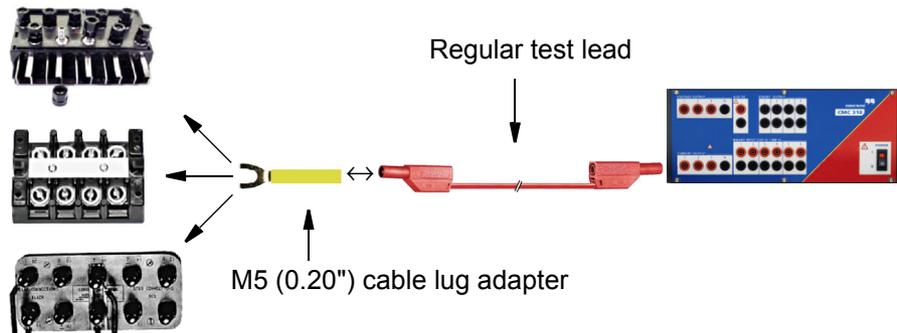
The optional CMC Wiring Accessory Package includes M4 (0.15") cable lug adapters to connect regular test leads to screw-clamp terminals of SEL/ABB/GE relays (and others).



The cable lugs have blank ends. Therefore, turn off the voltage before connecting such a lug. Always insert the cable lug with its blank end into the terminal strip first, and fasten it, before connecting it to a test lead.

3.3.3 M5 (0.20") Cable Lug Adapters

The optional CMC Wiring Accessory Package includes M5 (0.20") cable lug adapters to connect regular test leads to common and most widespread screw-clamp terminal types.



The cable lugs have blank ends. Therefore, turn off the voltage before connecting such a lug. Always insert the cable lug with its blank end into the terminal strip first, and fasten it, before connecting it to a test lead.

3.4 Starting the Test System

The following description assumes that either the *CMControl* unit or the *CMControl P App* (on a tablet) is running.



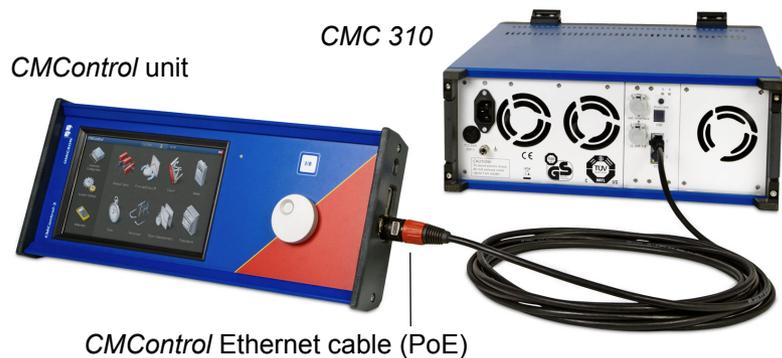
At this point of time, you may want to have a look at the *CMControl P* manual. This manual guides you through the first steps and actions with the *CMControl P* software. Learn how to output voltages and currents with your *CMControl* unit or *CMControl P App*.



When setting up the *CMC 310*, make sure not to obstruct the ventilation slots.

Connecting the system components¹:

Figure 3-1:
Connecting the *CMC 310*
to the *CMControl* unit.



1. Connect the *CMC 310* from the Ethernet connector ETH1 at the *CMC*'s rear side to your *CMControl* unit's Ethernet port or to a WiFi router (when using a tablet).
2. Connect the *CMC 310* test set to the mains.
3. Turn on the *CMC 310*. If a *CMControl* unit is connected to the *CMC 310*, the *CMControl* unit will turn on automatically. Otherwise, if a WiFi router is connected, then turn on the WiFi router and your tablet.
4. A comprehensive hardware test is carried out on the *CMC 310*. In the process, switching sounds from relays in the *CMC* test set can be heard. If any irregularities are determined during the course of this self-test, the software displays a corresponding error message.

¹ To ensure the required EMC compatibility, we strongly recommend to use the OMICRON-supplied cable, only.

4 SETUP AND FUNCTION

The OMICRON test system, controlled by the *CMControl P* software, employs the concept of a functional division between the software running on the *CMControl* unit and the *CMC 310* hardware connected to the test object.

The CMControl P software running on the CMControl unit or tablet

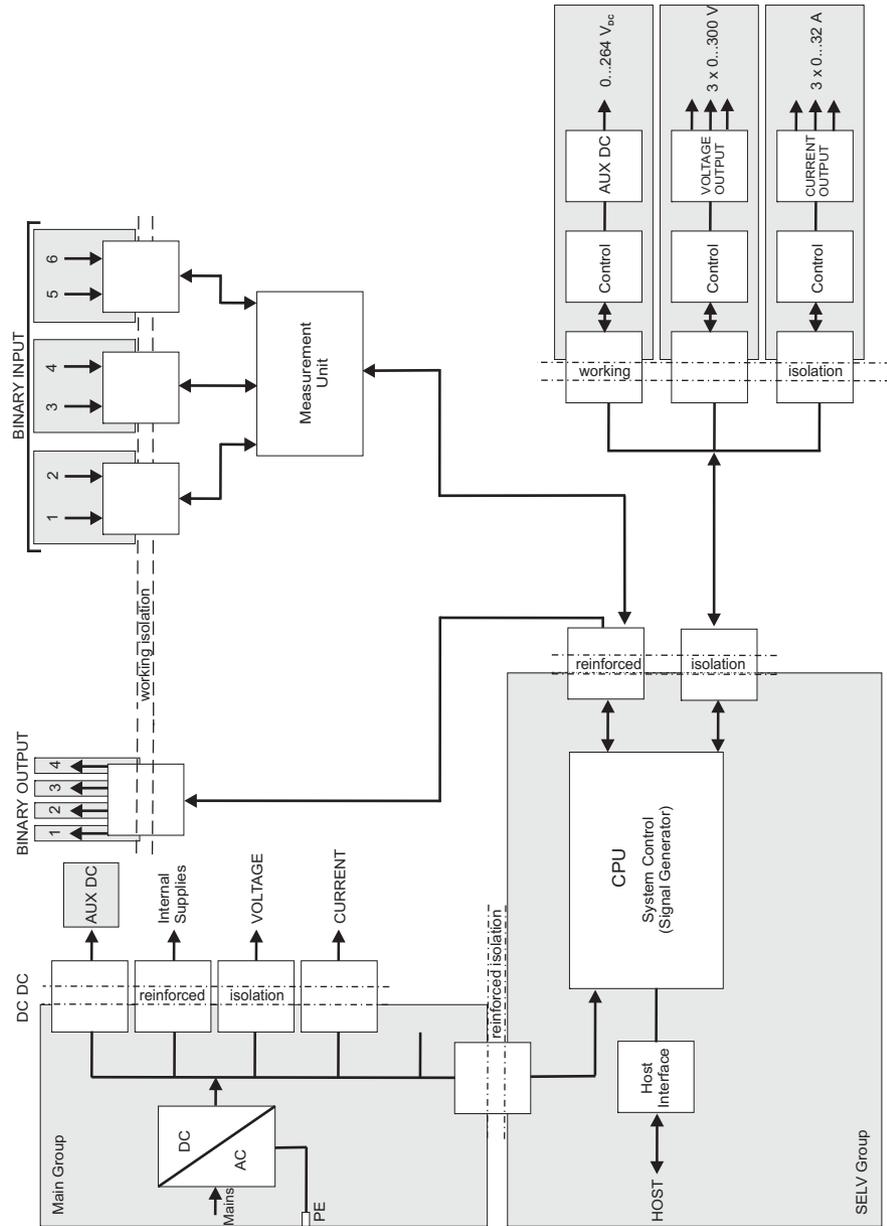
- controls the test signals
- processes measurement data
- creates reports
- generates data entries

The CMC 310 test set

- creates test signals (currents, voltages, binary signals)
- measures the reaction (analog and binary) from the test object
- supplies DC-current to test objects

4.1 Block Diagram

Figure 4-1:
Main block diagram of the
CMC 310

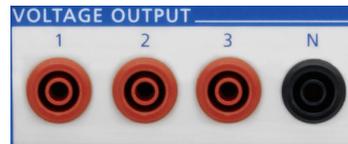


The block schematic diagram in figure 4-1 shows all externally accessible signals with gray shading. Every gray area represents a galvanic group that is isolated from all of the other galvanic groups.

The power connection ("power supply group") and the connections for "SELV group" (SELV = Safety Extra Low Voltage) are available on the back of the test set. All other gray shaded groups are available on the front of the test set. The safety relevant isolated circuits (power ↔ SELV, power ↔ front plate, and front plate ↔ SELV) are marked as "reinforced isolation" in the block diagram.

4.1.1 Voltage Output (Voltage Amplifier)

Figure 4-2:
Voltage amplifier
(voltage outputs)



The three voltage outputs have a common neutral N and are galvanically separated from all other outputs of the *CMC 310*.

The voltage amplifier and the current amplifiers are linear amplifiers with DC coupling. The voltage outputs work in two ranges:

- Range 1: 3 x 0 ... 150 V
- Range 2: 3 x 0 ... 300 V

Protecting the Voltage Outputs

All voltage outputs are protected for open circuits, L-N short-circuits, and overload. Should the heat sink overheat, a thermal switch turns off all outputs.

Overload Warning Flagged in the Software

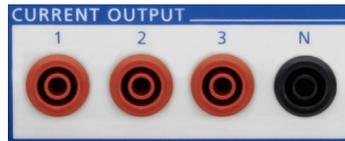
When a voltage output is overloaded, a corresponding warning is displayed in the user interface of the *CMControl P* software.



Do not connect any of the VOLTAGE OUTPUTS 1 ... 3 to protective earth. The N sockets, however, may be connected to protective earth.

4.1.2 Current Output (Current Amplifier)

Figure 4-3:
CMC 310 current outputs



The three current outputs have a common N and are galvanically separated from all other connections of the *CMC 310*.

The current amplifiers are implemented as switched mode amplifiers with DC coupling. With this technology it is possible to achieve high power density in a very compact structure. The DC coupling enables a precise reproduction of transients or DC offsets.

Protecting the Current Outputs

All current outputs are protected for open circuits, short-circuits, and overload. If the heat sink overheats, a thermo switch turns off all outputs. The output sockets are internally protected against currents if the current exceeds $30 A_{rms}$; the *CMC 310* switches off with the error message "current on neutral too high".

In non-operative state, relay contacts (as illustrated in figure 5-3) protect the current amplifier from external power by shortening the outputs to N.



Caution: If there is an in-feed from an external source, the current outputs can be damaged or destroyed.

Overload Warning Flagged in the Software

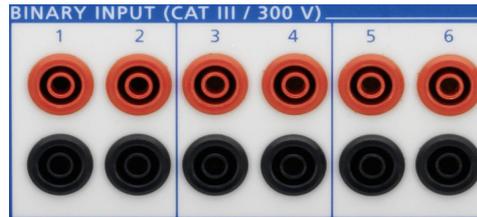
When a current output is overloaded, a corresponding warning is displayed in the user interface of the *CMControl P* software.



Please see also section 7.1, "Safety Instructions for High Current Output" on page 47.

4.1.3 Binary Inputs 1 - 6

Figure 4-4:
Binary inputs 1 - 6



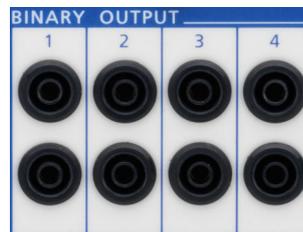
The six binary inputs are divided into three groups of two, each group galvanically separated from the others.

The input signals are monitored with a time resolution of 100 μ s and then evaluated in the CPU.

The binary inputs are configured from the Hardware Configuration module of the *CMControl P* software. When doing so, it can be specified whether the contacts are potential-sensitive or not. When the contacts are potential-sensitive, the expected nominal voltage and pick-up threshold can be set for each binary input.

4.1.4 Binary Output

Figure 4-5:
Binary outputs



Four binary outputs are available for use as potential-free relay contacts.

4.1.5 AUX DC (DC Power for Test Objects)

Figure 4-6:
DC power for test objects
(AUX DC)



Test objects that require an auxiliary DC voltage can be fed from the AUX DC output.

The DC voltage that is applied over the AUX DC output can vary from 0 to 264 Volts and is configured using the software.

The AUX DC output is galvanically separated from all other outputs.



Caution: The selected voltage can be life-threatening!

 If the voltage on the "AUX DC" output exceeds 42 V, the associated signal light lights up.

4.1.6 CPU

The *CMC 310* CPU (**C**entral **P**rocessing **U**nit) carries out the following tasks:

- Communication with the *CMControl* unit or a WiFi router via the network port "ETH1".
- Digital signal generation for all outputs of the test set.
- Generation of a high-accuracy central clock signal.
- Monitoring and control of all systems, including external amplifiers, if applicable.

4.1.7 Power Supplies (DC-DC)

An AC/DC converter generates the required DC voltage from 85 ... 264 V_{AC} supply voltage (see section 6.1) and ensures adequate EMC filtering.

The power supply to the different modules, that each are part of their own galvanic groups, are implemented using DC-DC converters with reinforced insulation.

4.2 Signal Generation

The generation of sine wave signals with high amplitude and phase accuracy is required in order to achieve output signals with the specified accuracy.

In order to fulfill the requirement for phase-coupled signal sources, signal generation is digitally implemented.

For this, the *CMC 310* employs a high-performance digital signal processor (DSP).

With digital signal generation the system is very flexible. An exact correction of the amplitude, offset, and phase can be carried out in a digital manner through the use of device-specific parameters (i.e., gain, offset, and null phase angle on every channel).

The digital correction assures the best possible long-term drift behavior.

In addition to sine waves, any other periodic or transient signal can be generated.

4.2.1 Accuracy and Signal Quality

The *CMC 310* is a very precise test set with excellent long-term and temperature drift behavior.

To achieve this accuracy, the philosophy was not only to solve signal generation digitally, but also to implement the distribution of signals to the various modules using digital methods. In doing so, the goal of galvanic separation of the individual generator groups was also achieved without loss of accuracy.

In achieving the amplitude accuracy, the drift behavior (temperature and long-term) is of major importance in the voltage references, the digital-analog converters (DAC), the accurate voltage dividers in the voltage amplifiers, and the current shunts in the current amplifiers.

The actual (typical) data is in general about a factor of 3 better than the guaranteed data.

The associated exact measurement media are required for the assurance of the accuracy in the production. The measurement media used by OMICRON are regularly calibrated by an accredited calibration institute so that tracing to international standards can be assured.

5 CONNECTIONS AND INTERFACES

5.1 Front Panel Connections

Figure 5-1:
Front view of the CMC 310

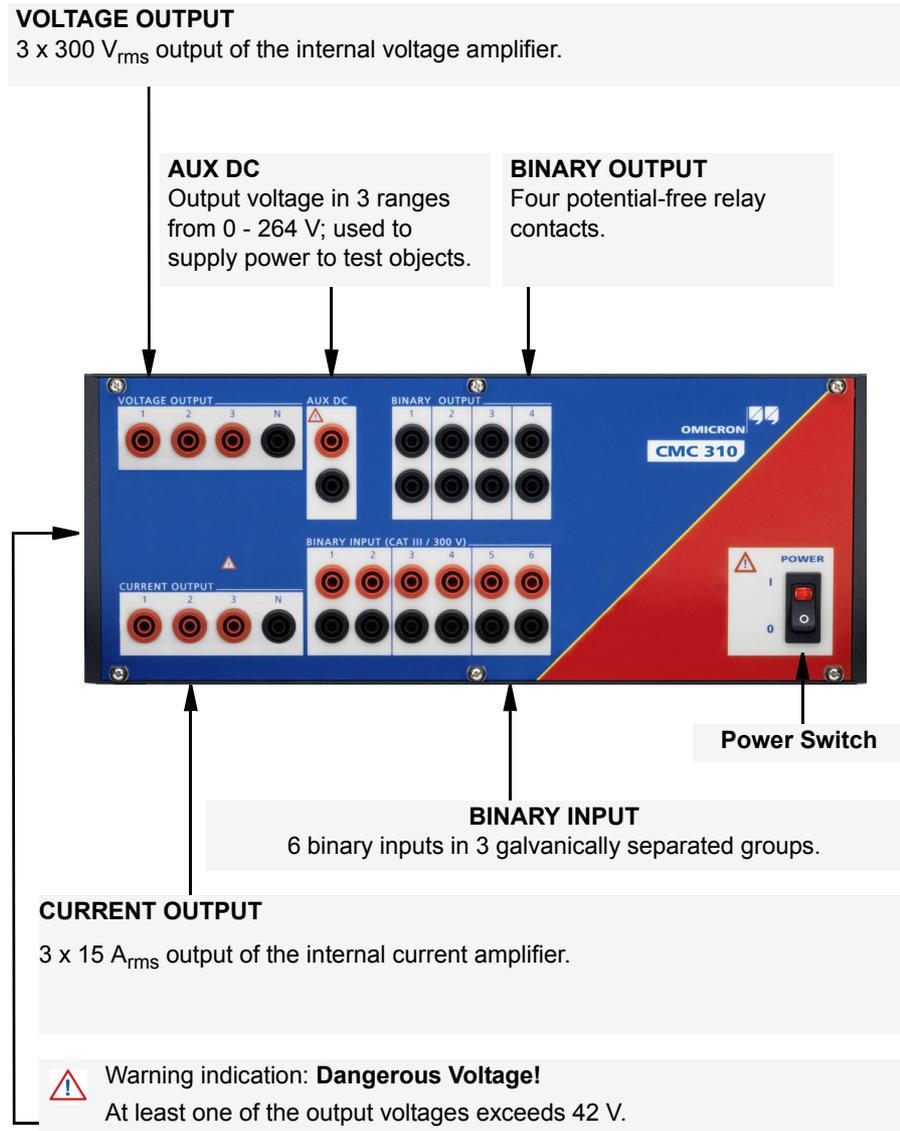
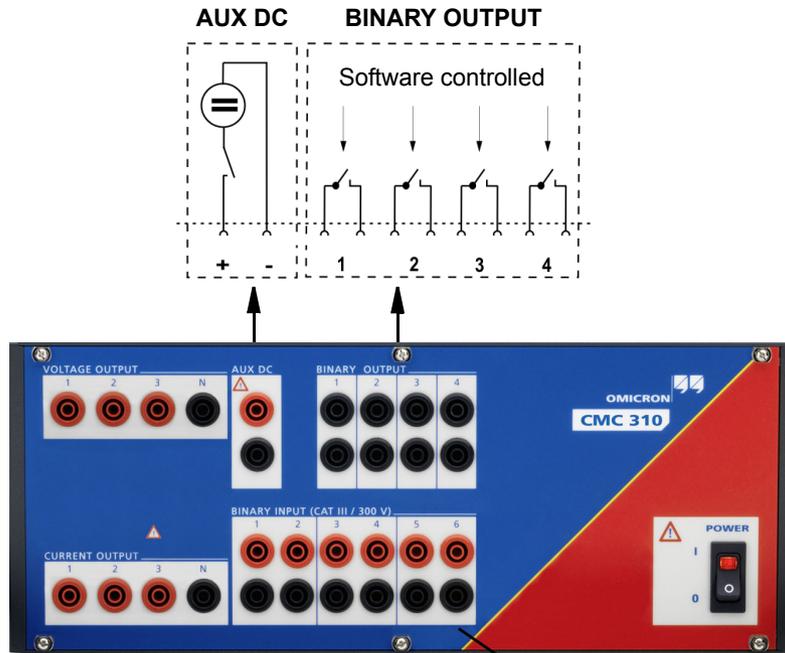


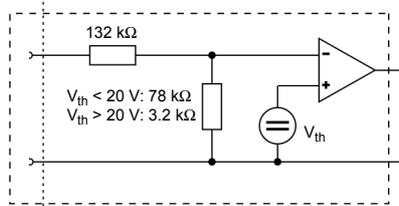
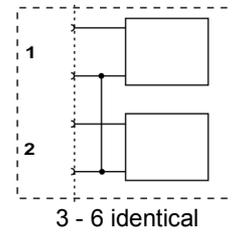
Figure 5-2:
Simplified circuit diagrams
of binary inputs and
outputs



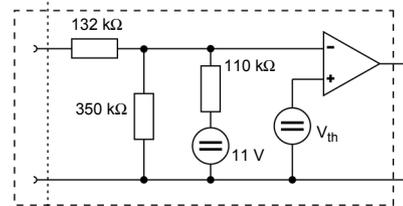
Each binary input can be configured individually for wet or dry operation.

Two inputs (1 + 2, 3 + 4, ...) are one potential group. The inputs grouped in one potential group share a common ground.

BINARY INPUT

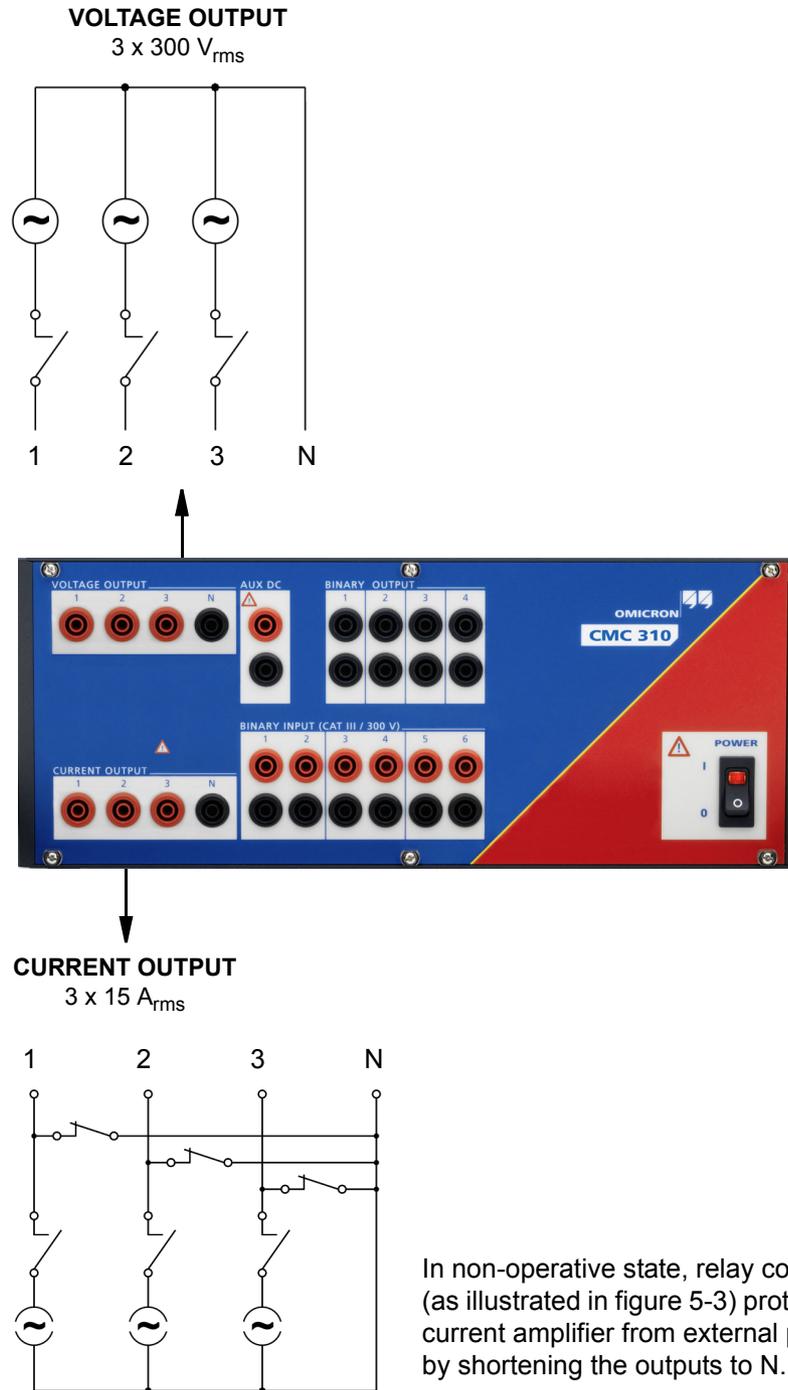


Circuit diagram of a binary input with programmable threshold voltage (wet operation)



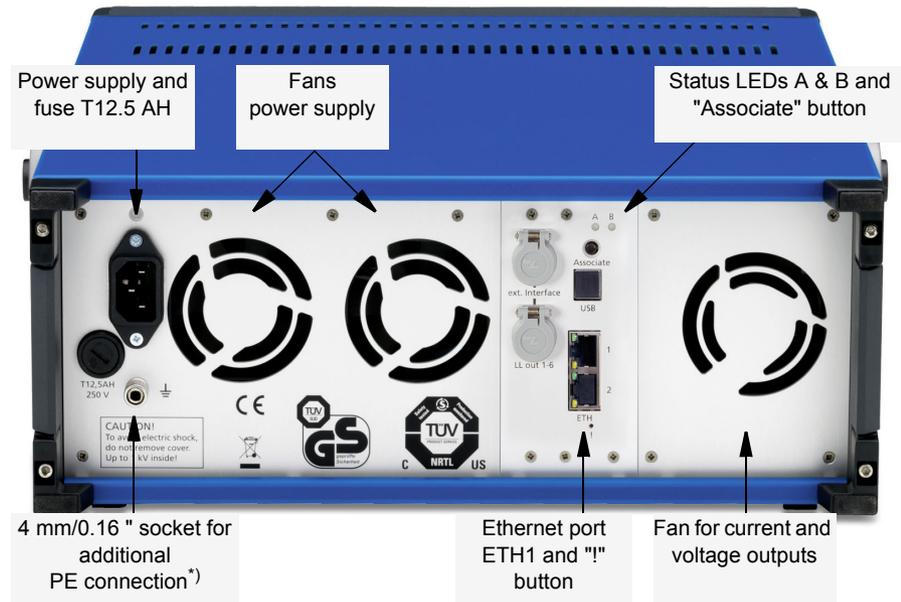
Circuit diagram of a binary input for potential-free operation (dry)

Figure 5-3:
Simplified diagrams of
current and voltage
outputs



5.2 Connections on the Back Panel

Figure 5-4:
Rear view of CMC 310



*) For example to connect to low resistance grounding bars.

5.2.1 Ethernet Port ETH1



The CMC 310 PoE (Power over Ethernet) port **ETH1** is a standard 10/100Base-TX (twisted pair) Ethernet port. It supports auto crossing (auto MDI/MDIX). This means you can use a standard cable or a cross-over Ethernet patch cable.

The green LED indicates a link connection to a *CMControl* unit or a network. The yellow LED indicates active traffic (receiving or transmitting) on the cable.

! Button



The ! button enables you to recover from unsuccessful software image downloads or other emergency situations. 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.



Associate Button and 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. It may be necessary to reset the IP configuration in this way to recover from settings with conflicting static IP addresses.

Status LED A, B



The status LED A and B are of interest in case of troubleshooting.

A: yellow status LED

- A lit yellow LED indicates that the test set is ready to be controlled by a computer. The hardware checks in the test set are finished, and the test set is properly connected to a computer or a network.
- The LED is off when the test set is waiting for an "emergency software image download". This is the case when pressing the ! button while powering-up the CMC test set.

B: green LED

If the yellow LED A is off, the green LED B signals the following conditions:

- LED B blinks slowly:
CMC test set waits for the TFTP download (**T**rivial **F**ile **T**ransfer **P**rotocol) of a software image.
- LED B is lit:
The TFTP download of the software image is in progress.
- LED B blinks quickly:
The computer writes, e.g., 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.

5.2.2 Ethernet / Network Settings

General

The *CMControl P* software communicates with the *CMC 310* via a network connection. Therefore it is possible to either have the *CMC 310* directly connected to the *CMControl* unit or using a WiFi router and the *CMControl P App* installed on a tablet.

The network port has one link LED (green) and one traffic LED (yellow flashing) to check the physical connectivity and proper cabling.

5.2.3 SELV Interfaces

All inputs and outputs to the SELV group (SELV = Safety Extra Low Voltage) reference to a common neutral that is internally connected to the protective earth (GND) of the housing.

Note: The hardware is present for Ext. Interface, LLO 1-6, ETH2, and USB, but not used in the *CMC 310*.

6 TECHNICAL DATA

Guaranteed Values:

- General:
The values are valid for the period of one year after factory calibration, within $23\text{ °C} \pm 5\text{ °C}$ at nominal value and after a warm-up time greater than 25 min.
- Guaranteed values from the generator outputs:
The values are valid in the frequency range from 10 ... 100 Hz unless specified otherwise. Given maximum phase errors are related to the voltage amplifier outputs.
- Accuracy data for analog outputs are valid in the frequency range from 0 ... 100 Hz unless specified otherwise.
- The given input/output accuracy values relate to the range limit value (% of range limit value).

6.1 Main Power Supply

Table 6-1:
Power supply data

Main Power Supply	
Connection	Connector according to IEC 60320-1 C14
Voltage, single phase nominal voltage operational range	100 ... 240 V _{AC} 85 ... 264 V _{AC}
Power fuse	T 12.5 AH 250 V (5 x 20 mm) "Schurter", order number 0001.2515
Nominal current	at < 170 V: 12 A max. at > 170 V: 10 A max.
Frequency nominal frequency operational range	50/60 Hz 45 ... 65 Hz
Overvoltage category	II

6.2 Insulation Coordination

Table 6-2:
Insulation coordination

Insulation Coordination	
Overvoltage category	II
Pollution degree	2 (except for Binary Inputs)
Insulation of function groups on front panel to ground (GND) ¹	<ul style="list-style-type: none"> - Basic insulation with maximum voltage of 600 V_{rms} to ground - Clearance: > 3 mm (0.12 ") - Creepage: > 6 mm (0.24 ") - Test voltage: 2200 V_{rms}
Insulation of functional groups on front panel from each other	<ul style="list-style-type: none"> - Working insulation - Clearance: > 1 mm (0.04 ") - Creepage: > 1 mm (0.04 ") - Test voltage: 1500 VDC
Measurement category (BINARY INPUT)	<ul style="list-style-type: none"> - CAT III / 300 V_{rms} - CAT IV / 150 V_{rms}

¹ Functional groups on CMC 310 front panel:
VOLTAGE OUTPUT, CURRENT OUTPUT, AUX DC, BINARY OUTPUT,
BINARY INPUT

6.3 Outputs

For block diagrams of the available generator outputs, please refer to section 4.1, "Block Diagram" on page 16.

Table 6-3:
Analog current and voltage
outputs.

General Generator Outputs Data (analog current and voltage outputs)	
Frequency ranges sinusoidal signals	10 ... 599 Hz
Frequency resolution	< 5 μ Hz
Frequency accuracy	\pm 0.5 ppm
Frequency drift	\pm 1 ppm
Phase range φ	- 360° ... + 360°
Phase resolution	0.001°
Temperature drift	0.0025 %/°C

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

All outputs are monitored. Overload conditions result in a message displayed on the *CMControl P* software.

6.3.1 Current Outputs

The data designated "guaranteed" apply to a mains power supply of 230 VAC and to ohm resistive load (load flow = 1). The data designated "typical" apply to inductive load.

Table 6-4:
Current outputs

Footnotes:

1. Data for three-phase systems are valid for symmetric conditions (0°, 120°, 240°) unless specified otherwise.
2. For wiring of single-phase modes see chapter 7, "Increasing the Output Power, Operating Modes" on page 47.
3. Single-phase mode (in phase opposition).
4. rd. = reading;
rg. = range, where at *n* % of rg. means: *n* % of upper range value.
5. Valid for sinusoidal signals at 50/60 Hz and $R_{load} \leq 0.5 \Omega$.
6. Values at 20 kHz measurement bandwidth, nominal value, and nominal load.
7. Guaranteed data at 230 V mains for ohmic loads (PF=1); typical data for inductive loads.

Current Outputs ¹		
Output currents		
3-phase AC (L-N)	3 x 0 ... 15 A	
1-phase AC (L-L) ^{2, 3}	1 x 0 ... 15 A	
1-phase AC (LL-LN) ²	1 x 0 ... 30 A	
DC (LL-LN) ²	1 x 0 ... ±30 A	
Power ⁷	Typical	Guaranteed
3-phase AC (L-N)	3 x 350 VA at 15 A	3 x 200 W at 15 A
1-phase AC (L-L) ^{2, 3}	1 x 780 VA at 15 A	1 x 440 W at 15 A
1-phase AC (LL-LN) ²	1 x 500 VA at 30 A	1 x 350 W at 30 A
Accuracy	Typical	Guaranteed
$R_{load} \leq 0.5 \Omega$	Error < 0.05 % rd. ⁴ + 0.05 % of rg.	Error < 0.15 % of rd. + 0.15 % of rg.
$R_{load} > 0.5 \Omega$	Error < 0.1 % of rg.	Error < 0.9 % of rg.
Harmonic distortion (THD+N) ^{5,6}	0.15 %	< 0.35 %
Phase error ⁵	0.05 °	< 0.2 °
DC offset current	< 3 mA	< 10 mA
Resolution	1 mA, 2 mA (2 phases parallel), ...	
Frequency range	0 ... 599 Hz	
Trigger on overload	Timer accuracy error < 1 ms	
Short-circuit protection	Unlimited	
Open-circuit protection	Open outputs (open-circuit) permitted	
Connection	4 mm/0.16 " banana connectors	
Insulation	Reinforced insulation of power supply and all SELV interfaces	

Figure 6-1:
Guaranteed output power per phase of a group (active power values in W are guaranteed; apparent power values in VA are typical values)

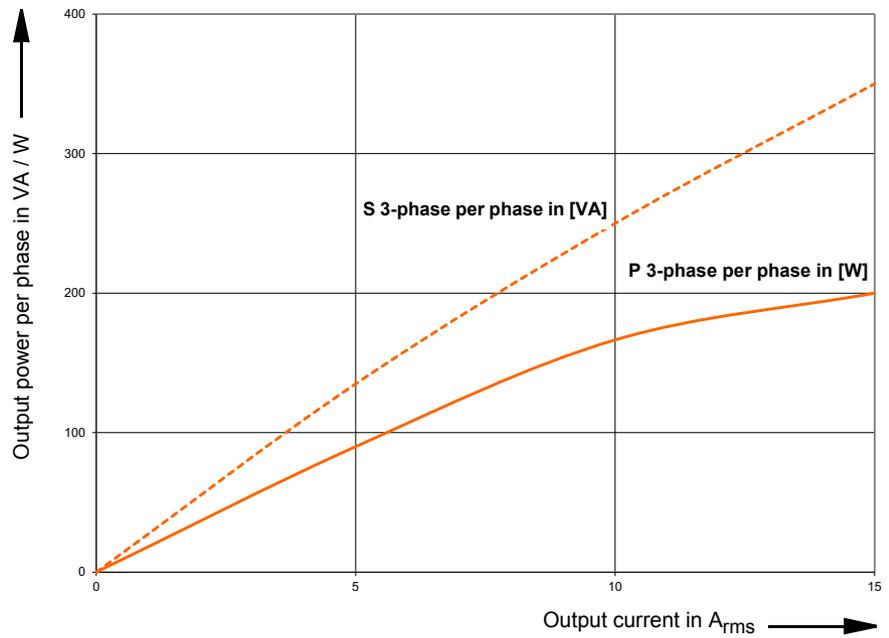
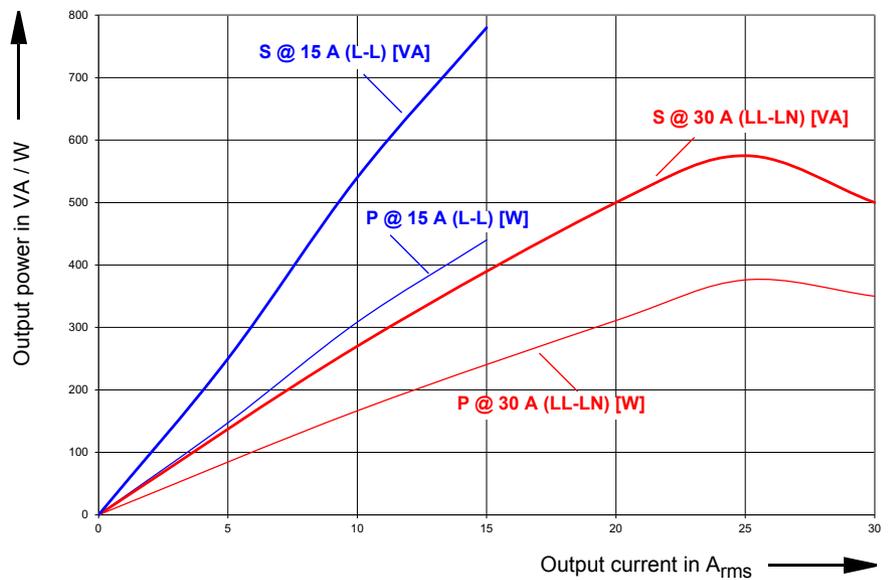
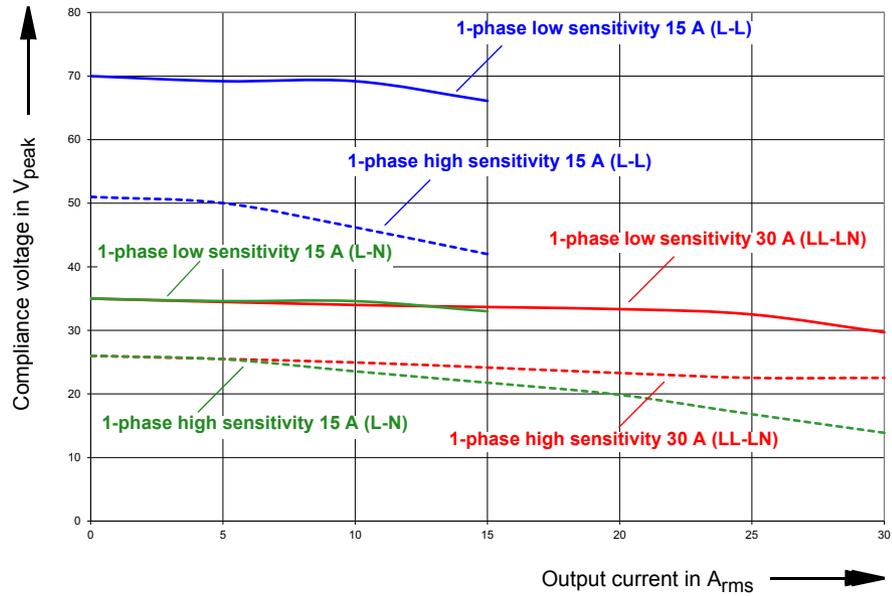


Figure 6-2:
Guaranteed single phase output power curves (active power values in W are guaranteed; apparent power values in VA are typical values)



For additional information refer to section 7.2, "Single-Phase Operation of the CMC 310" on page 48.

Figure 6-3:
Typical compliance
voltage (50/60 Hz)



The high (50 ms) and low (200 ms) sensitivity curves in figure 6-3 correspond to the overload detection time settings in the *CMControl P* software. The low sensitivity curves show the maximum available peak compliance voltage, which is mainly relevant for testing primary and electromechanical relays.

6.3.2 Voltage Outputs

Table 6-5:
CMC 310 voltage outputs

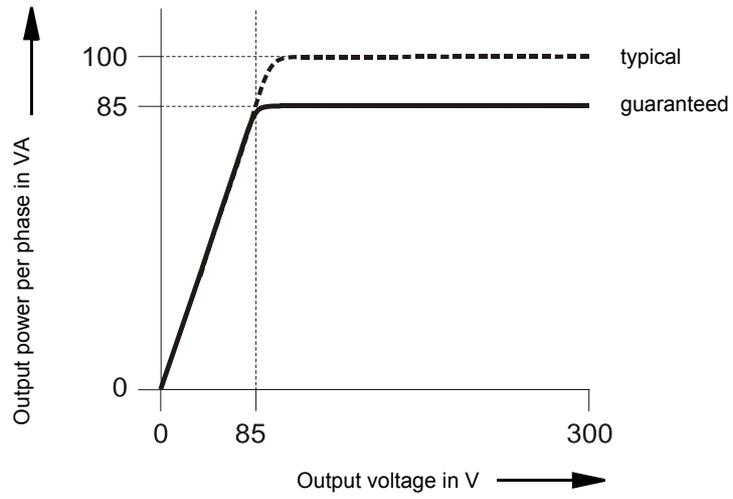
Footnotes:

1. Guaranteed data for ohmic loads, (PF=1). Refer to the accompanying figure of the output power curves.
2. Data for three-phase systems are valid for symmetric conditions (0°, 120°, 240°).
3. rd. = reading;
rg. = range, whereat
n % of rg. means: n % of upper range value.
4. Valid for sinusoidal signals at 50/60 Hz.
5. 20 kHz measurement bandwidth, nominal value, and nominal load.

4 Voltage Outputs		
Output voltages		
3-phase AC (L-N)	3 x 0 ... 300 V	
1-phase AC (L-N)	1 x 0 ... 300 V	
1-phase AC (L-L)	1 x 0 ... 600 V	
DC (L-N)	3 x 0 ... ± 300 V	
Output power ¹	Typical	Guaranteed
3-phase AC ²	3 x 100 VA at 100 ... 300 V	3 x 85 VA at 85 ... 300 V
1-phase AC (L-N)	1 x 200 VA at 100 ... 300 V	1 x 150 VA at 75 ... 300 V
1-phase AC (L-L)	1 x 275 VA at 200 ... 600 V	1 x 250 VA at 200 ... 600 V
DC (L-N)	1 x 420 W at 300 VDC	1 x 360 W at 300 VDC
Accuracy	Error < 0.03 % of rd. ³ + 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 ⁴	Typical 0.02 °	Guaranteed < 0.1 °
DC offset voltage	< 20 mV	< 100 mV
Voltage ranges	Range I: 0 ... 150 V Range II: 0 ... 300 V	
Resolution	Range I: 5 mV Range II: 10 mV	
Frequency range	10 ... 599 Hz	
Short-circuit protect.	Unlimited for L - N	
Connection	4 mm/0.16 " banana connectors	
Insulation	Reinforced insulation of power supply and all SELV interfaces	

6.3.2.1 Power Diagram for Three-Phase Operation

Figure 6-4:
Power diagram for
three-phase operation



6.3.2.2 Power Diagram for Single-Phase Operation

Also refer to section 7.2.3, "Single-Phase Voltage" on page 50.

Figure 6-5:
Single-phase operation
L-N

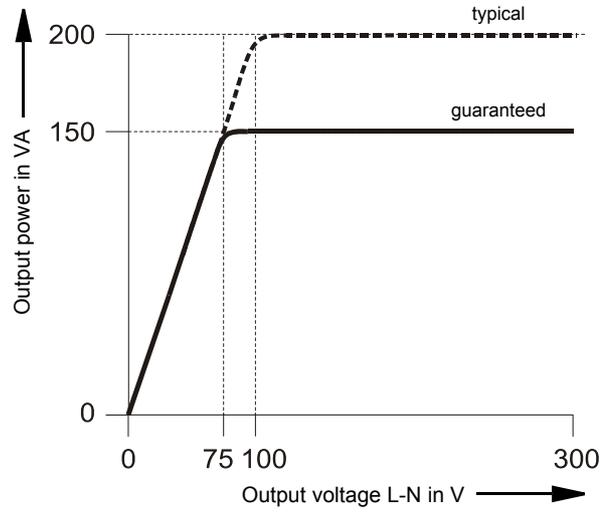
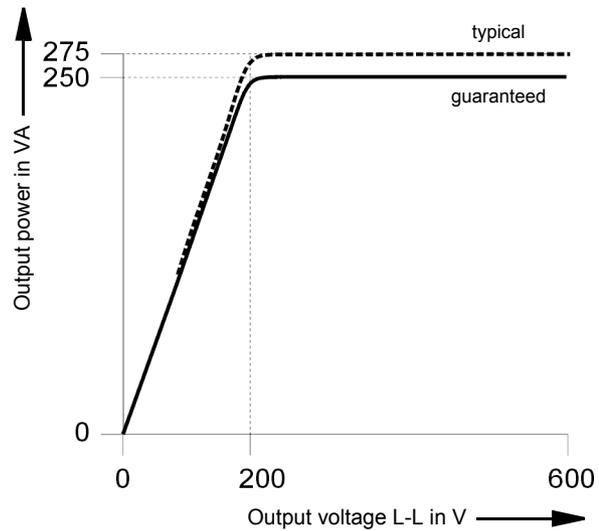


Figure 6-6:
Single-phase operation
L-L



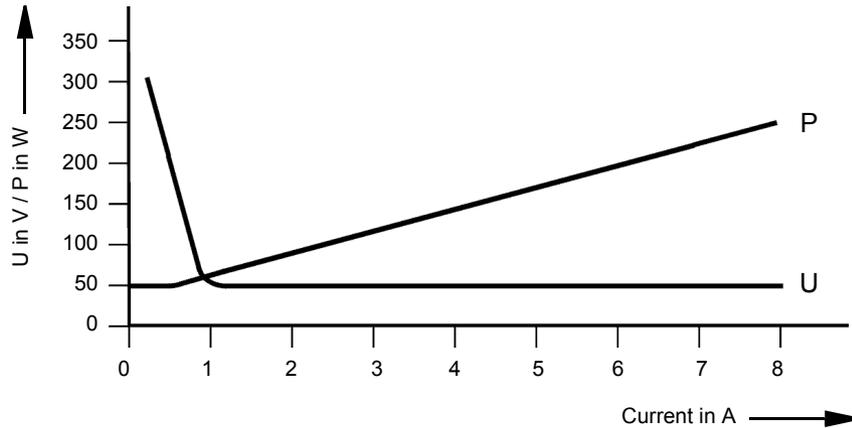
6.3.3 Binary Output Relays

Table 6-6:
Data of binary output
relays

4 Binary Output Relays (Binary Outputs 1-4)	
Type	Potential-free contacts; software-controlled
AC loading	V_{\max} 300 VAC; I_{\max} 8 A; P_{\max} 2000 VA
DC loading	V_{\max} 300 VDC; I_{\max} 8 A; P_{\max} 50 W (refer to load limit curve)
Switch-on current	15 A (max. 4 s at 10 % duty-cycle)
Electrical lifetime	100 000 switching cycles at 230 V _{AC} / 8 A and ohmic load
Pickup time	Approx. 6 ms
Fall back time	Approx. 3 ms
Bounce time	Approx. 0.5 ms
Connection	4 mm/0.16 " banana sockets
Insulation	Reinforced insulation from all SELV interfaces and from power supply.

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

Figure 6-7:
Load limit curve for relays
on the binary outputs with
DC voltages



6.3.4 DC Supply (AUX DC)

Table 6-7:
DC Voltage 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	Error: typical < 2 %, guaranteed < 5 %
Resolution	< 70 mV
Connection	4 mm/0.16 " banana 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.

6.4 Inputs

6.4.1 Binary Inputs

Table 6-8:
General data of
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 μ s
Sampling frequency	10 kHz
Time resolution	100 μ s
Max. measuring time	Unlimited
Debounce time	0 ... 25 ms (refer to page 42)
Deglintch time	0 ... 25 ms (refer to page 42)
Configuration	Binary inputs can be configured.
Connection	4 mm/0.16 " banana sockets on the front panel
Insulation	3 galvanic insulated binary groups with each 2 inputs having its own GND. Operation insulation to the power outputs, DC inputs and between galvanically separated groups. Reinforced insulation from all SELV interfaces and from power supply.

Table 6-9:
Data for potential-sensing
operation

Data for Potential-Sensing Operation		
Threshold voltage data per input range	Setting range	Resolution
Range I	0 ... 20 V	50 mV
Range II	>20 ... 300 V	500 mV
Max. input voltage	CAT III / 300 V _{rms} CAT IV / 150 V _{rms}	

Data for Potential-Sensing Operation	
Threshold voltage accuracy ¹	5% of rd. + 0.5% of rg.
Threshold voltage hysteresis	Range I: typ. 60 mV Range II: typ. 900 mV
Input impedance ² Threshold 0 ... 20V Threshold 20 ... 300V	210 kΩ 135 kΩ

¹ Applies to positive voltage signal edge; value shown in % of reading (rd.) + % of upper range value (rg.)

² Refer to figure 5-3, "Simplified diagrams of current and voltage outputs" on page 25.

Table 6-10:
Data for potential-free
operation

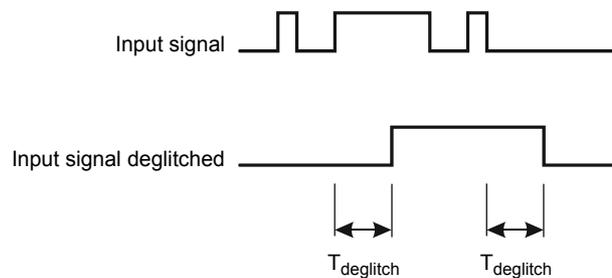
Data for Potential-Free Operation ¹	
Trigger criteria	Logical 0: R > 100 kΩ Logical 1: R < 10 kΩ
Input impedance	216 kΩ

¹ Refer to figure 5-2, "Simplified circuit diagrams of binary inputs and outputs" on page 24.

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.

Figure 6-8:
Signal curve, deglitching
input signals



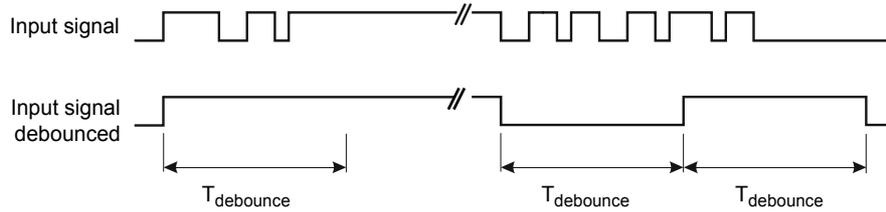
Debouncing input signals

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 low level until the expiry of another period $T_{debounce}$.

Figure 6-9:
Signal curve, debounce
input signals



6.5 Technical Data of the Ethernet Port

Table 6-11:
Technical data of the
Ethernet port

Ethernet port ETH1	
Type	10/100 Base-TX (10/100 Mbit, twisted pair, auto-MDI/MDIX or auto-crossover)
Connector	RJ45
Cable type	LAN cable of category 5 (CAT5) or better
Status indication	Green LED: physical link present Yellow LED: traffic on interface
Power over Ethernet (PoE)	IEEE 802.3af compliant. (Class 2, 6.49 W)

6.6 Environmental Conditions

6.6.1 Climate

Table 6-12:
Climate

Climate	
Operating temperature	0 ... +50 °C; above +30 °C a 50 % duty cycle may apply.
Storage and transportation	-25 ... +70 °C
Max. altitude	2000 m
Humidity	5 ... 95% relative humidity; no condensation
Climate	Tested according to IEC 60068-2-78

6.6.2 Shock and Vibration

Table 6-13:
Shock and vibration

Dynamics	
Vibration	Tested according to IEC 60068-2-6; frequency range 10 ... 150 Hz; acceleration 2 g continuous (20 m/s ²); 10 cycles per axis
Shock	Tested according to IEC 60068-2-27; 15 g / 11 ms, half-sinusoid, each axis

6.7 Mechanical Data

Table 6-14:
Data regarding size and
weight

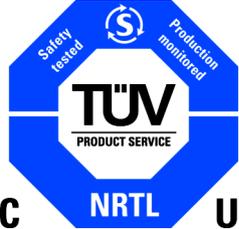
Size, Weight and Protection	
Weight	12.8 kg (28.2 lbs)
Dimensions W x H x D (without handle)	343 x 145 x 390 mm (13.5 x 5.7 x 15.4 ")
Housing	IP20 according to EN 60529

6.8 Cleaning

To clean the *CMC 310*, use a cloth dampened with isopropanol alcohol or water. Prior to cleaning, always switch off the power switch and unplug the power cord from the mains.

6.9 Safety Standards, Electromagnetic Compatibility (EMC) and Certificates

Table 6-15:
CE conformity, certified
Safety Standards and
EMC-compatibility

CE Conformity, Requirements	
The product adheres to the specifications of the guidelines of the council of the European Community for meeting the requirements of the member states regarding the electromagnetic compatibility (EMC) Directive 2004/108/EC and the low voltage Directive 2006/95/EC.	
EMC	
Emission	
Europe	EN 61326-1; EN 61000-6-4; EN 61000-3-2/3
International	IEC 61326-1; IEC 61000-6-4; IEC 61000-3-2/3
USA	FCC Subpart B of Part 15 Class A
Immunity	
Europe	EN 61326-1; EN 61000-6-2; EN 61000-4-2/3/4/5/6/11
International	IEC 61326-1; IEC 61000-6-2; IEC 61000-4-2/3/4/5/6/11
Certified Safety Standards	
Europe	EN 61010-1
International	IEC 61010-1
USA	UL 61010-1
Canada	CAN/CSA-C22.2 No 61010-1-04
Certificate	    <p>Manufactured under an ISO9001 registered system</p>

7 INCREASING THE OUTPUT POWER, OPERATING MODES

The *CMC 310* has a very large application diversity. The current outputs offer enough output power to test almost all electromechanical relays.

The *CMC 310* offers a variety of single-phase operation with which the output power from the units can be significantly increased.

The operating modes illustrated in the following sections can be set in the Hardware Configuration of the *CMControl P* software.

7.1 Safety Instructions for High Current Output



Observe the following safety instructions when using the operating modes and connection methods described in this chapter.

- When connecting current outputs in parallel, it has to be ensured that the test leads are only connected together immediately at the test object and that the test leads have sufficient diameter.
- For applications drawing DC current: The test object (load) should be exclusively non-inductive! Note that a load of, for example, 1 Henry can store 50 J (Joule) at 10 A DC for a long period of time. Electrical shocks with more than 350 mJ can be life-hazardous for the user.



7.2 Single-Phase Operation of the CMC 310

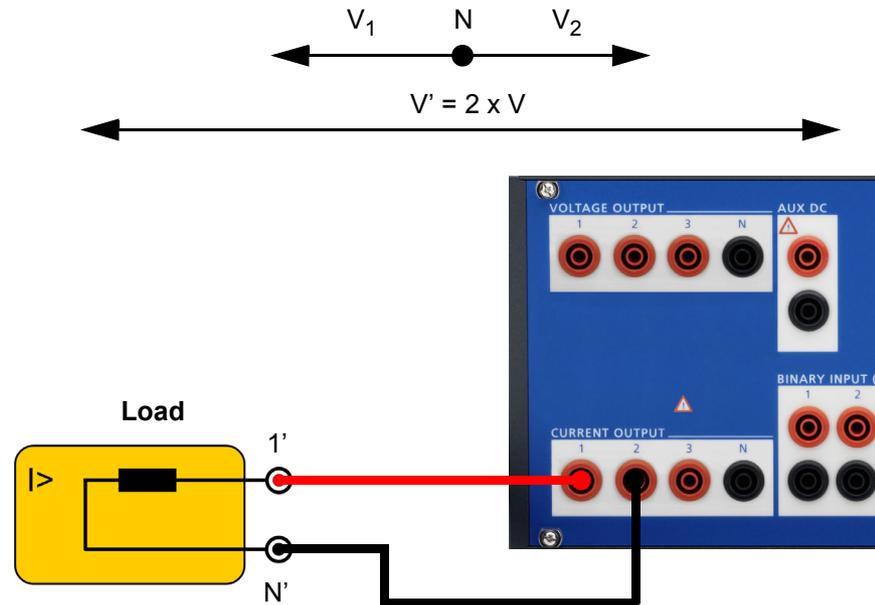
7.2.1 1 x 15 A High Burden Mode (L-L)

1 x 0 ... 15 A, max. 70 V_{peak}, 1 x 780 VA at 15 A

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

Observe the safety instructions given in Section 7.1 on page 47 when using this operating mode.

Figure 7-1:
Single-phase operation,
1 x 15 A high burden mode



Refer to the output curves shown in the figures 6-1 through 6-3 in section 6.3.1, "Current Outputs" on page 32.

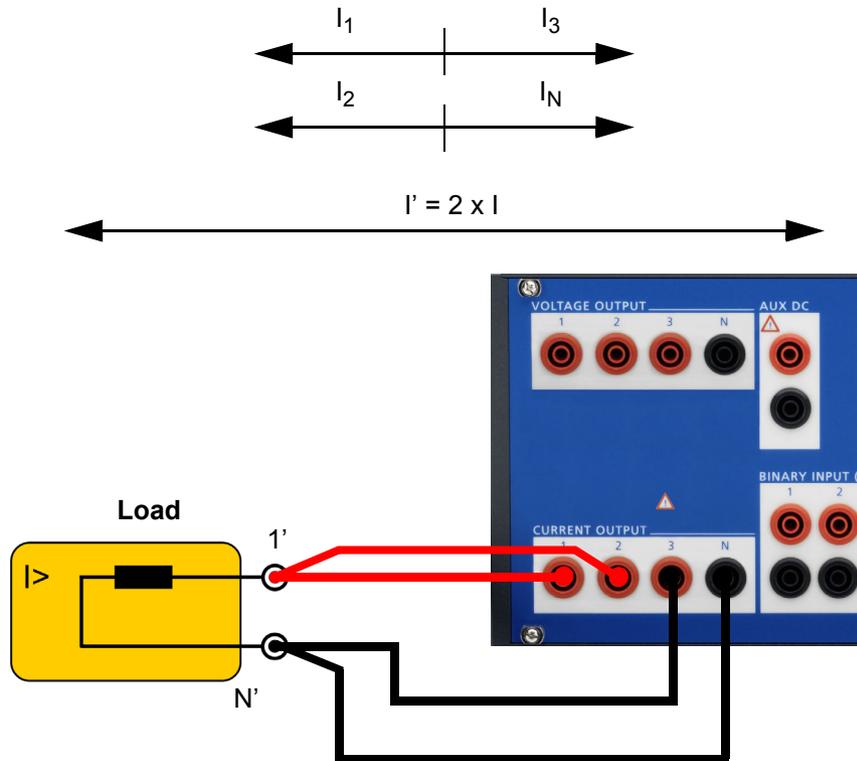
7.2.2 1 x 30 A High Current Mode (LL-LN)

1 x 0 ... 30 A, max. 35 V_{peak}, 1 x 700 VA at 30 A

The currents 1 and 2 are connected in parallel. The third phase is used to support the N socket.

Observe the safety instructions given in Section 7.1 on page 47 when using this operating mode.

Figure 7-2:
Single-phase operation,
1 x 30 A high current mode

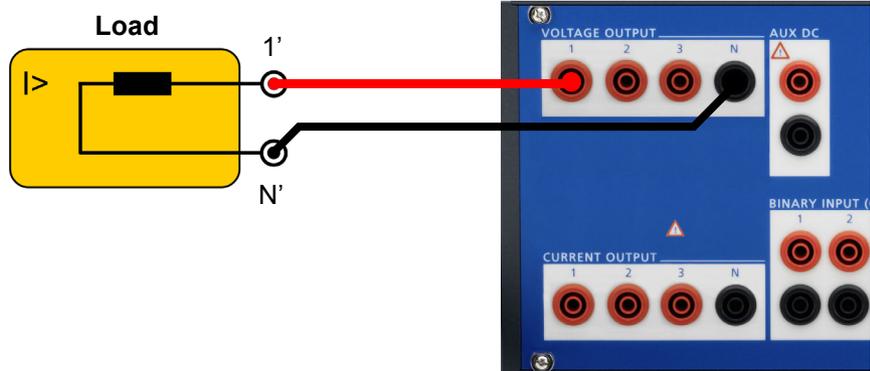


Refer to the output curves shown in the figures 6-1 through 6-3 in section 6.3.1, "Current Outputs" on page 32.

7.2.3 Single-Phase Voltage

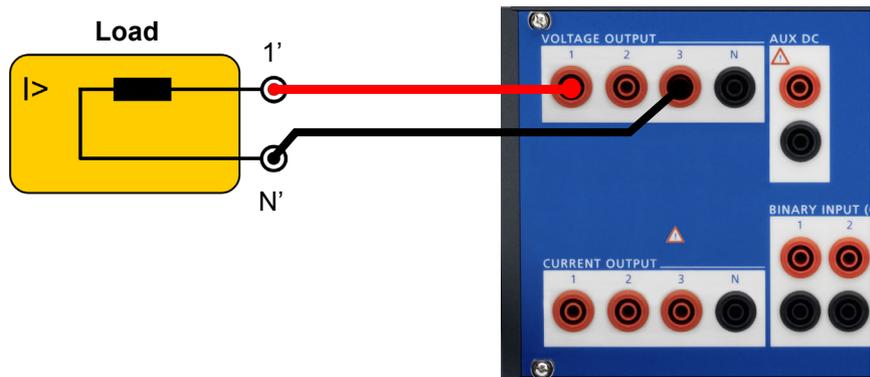
1 x 0 ... 300 V, 1 x 200 VA [100 ... 300 V] typical

Figure 7-3:
Single-phase operation of
the voltage system (L-N)



1 x 0 ... 600 V, 1 x 275 VA [200 ... 600 V] typical

Figure 7-4:
Single-phase operation of
the voltage system
(L-L phase opposition)



Refer to the output curves shown in the figures 6-5 through 6-6 in section 6.3.2, "Voltage Outputs" on page 35.



Note: Never connect N' or any other phase to GND (PE). This can cause life-hazardous situations to persons and damage to property.

8 TROUBLESHOOTING

8.1 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.

Table 8-1:
Troubleshooting the
CMC 310

Error	Possible causes	Remedies
Power switch does not light up after turning on the <i>CMC 310</i> test set.	<p>There is no power to the test set.</p> <p>The fuse of the test set is blown</p> <p>Malfunction of internal test set components</p>	<p>Check the power supply and assure that it supplies power to the test set.</p> <p>Unplug the power cord from the power source! Replace the fuse: T 12.5 AH 250 V (5 x 20 mm).</p> <p>Please contact the OMICRON technical support (refer to section "OMICRON Service Centers" on page 55).</p>
The following message appears: "WARNING: Broken ground connection! Immediately turn off the test set! Resuming the operation can result in hazard to life and is done at your own risk."	<p>Ground-wire connection to the <i>CMC 310</i> is broken or the test set is powered by an earth-free power supply.</p> <p>Note: Never connect the <i>CMC 310</i> to an isolating transformer.</p>	<p>Check the ground connection.</p> <p>Ground the housing of the test set separately using the PE connection socket (on the back panel of the test set).</p>

OPEN SOURCE LICENSE INFORMATION

Parts of the *CMC 310* software are under OMICRON license, other parts are under open source software licenses. Both the open source license texts and the source code are provided on the OMICRON CD/DVD.

Insert the CD/DVD into your drive. For the license texts, open Windows Explorer and navigate to your CD/DVD's subfolder *_Documentation*Common. The file that contains the license information is the *CMC license information.txt*.

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For address details of other OMICRON Service Centers in your area, please visit our website www.omicron.at or www.omicronusa.com.

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V

vibration44

W

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weight of CMC 31044

