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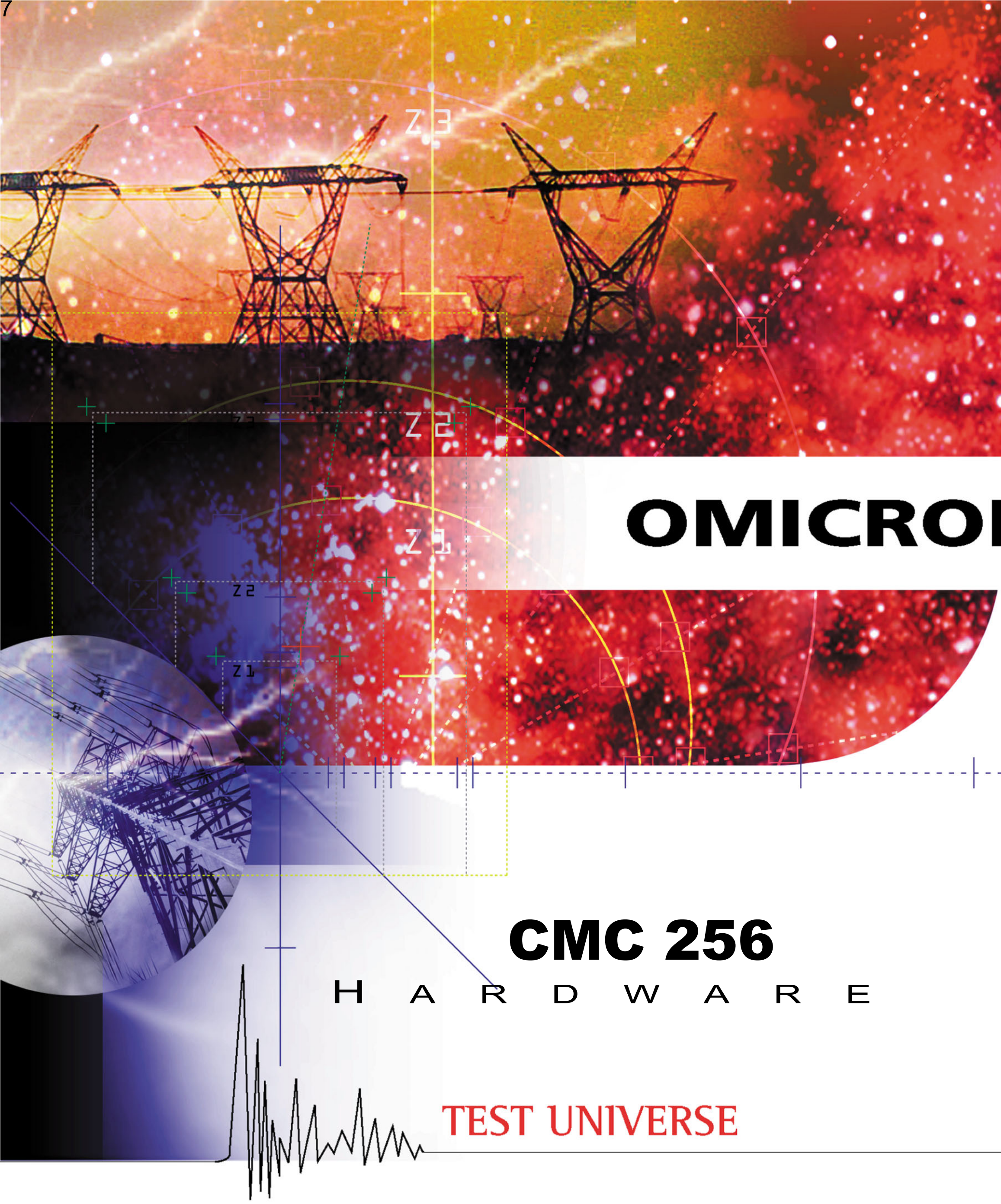

OMICRON

CMC 256

HARDWARE Reference Manual

TEST UNIVERSE

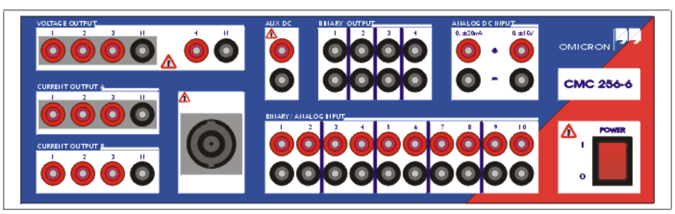

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TABLE OF CONTENTS

PREFACE

The purpose of this user manual is to familiarize users with the CMC 256 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 256 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 256.

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

The user manual should always be available at the site where the CMC 256 is used. It should be read by all personnel operating the CMC 256.

In addition to the user 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.

In this manual the product name CMC 256 is used for the test set CMC 256-6 with six current outputs.

Note:

This user manual describes only the hardware of the CMC 256. In order to learn more about the necessary software for controlling and configuring the CMC 256, please refer to the software manuals as well as the online help of the OMICRON Test Universe.

Glossary

Several different symbols are used in this manual in order to draw your attention to specific paragraphs.

The meaning of the symbols are:

Note

Indicates passages that have special meaning or provide more detailed information.

Warning

Indicates passages that have special meaning relevant to your personal safety.

Reference Information

Indicates that the source provides detailed information about the current topic.

SAFETY INSTRUCTIONS

Before operating the CMC 256, please carefully read the following safety instructions.

It is *not* recommended that the CMC 256 be used (or even turned on) without understanding the information in this manual.

CMC 256 should only be operated by trained personnel.

Rules for Use

- CMC 256 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 user manual and the software documentation.

- CMC 256 is exclusively intended for the application areas specified in Section 1, "Designated Use" on page 13. 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 user manual and the associated software manuals are considered part of the rules governing proper usage.

- CMC 256 should not be opened or have any of its panels removed.

Orderly Practices and Procedures

- The user manual should always be available on site where the CMC 256 is used.

- Before using the CMC 256, personnel assigned to the CMC 256 should read the user manual. This also applies to all personnel who only occasionally work with the CMC 256.

- Do not undertake any modifications, extensions, or adaptations to the CMC 256.

Operator Qualifications

- Testing with the CMC 256 should only be carried out by authorized and qualified personnel.
- Personnel receiving training, instruction, direction, or education on the CMC 256 should remain under the constant supervision of an experience operator while working with the equipment.

Safe Operation Procedures

- Follow the instructions in section 3.2 which describe bringing the CMC 256 into service.
- CMC 256 must only be used from a power outlet that has a protective ground.
- Do not plug any of the front panel connectors to protective ground.
- When connecting to the banana plug sockets, only use cables with 4 mm 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 cables, always start from the device feeding the power.
- 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 Warning Light ⚠:
  If a dangerous voltage (greater than 42V) is on one of the four voltage outputs or on the "AUX DC" output, the associated warning light is lit up.
- Do not insert objects (e.g., screwdrivers, etc.) into the sockets or into the ventilation slots.
- Do not operate the CMC 256 under wet or moist conditions (condensation).
- Do not operate the CMC 256 when explosive gas or vapors are present.
- The SELV-interface (Save Extra Low Voltage) of the CMC 256 - "Host Interf." or “ETH1”, "LL out 1-6" (Low Level Output), "ext. Interf." - should only have external devices connected that meet the requirements for SELV equipment according to EN 60950 or IEC 60950.

- When setting up the CMC 256, make sure that the air slots on the back, top, and bottom of the device remain unobstructed.

- Voltages up to 1 kV can be present inside the CMC 256! Therefore, opening the CMC 256 is only permitted by qualified experts at the factory.

- If the CMC 256 is opened by the customer, all guarantees are invalidated.

- CMC 256 with the NET-1 option (see Section 6.12, "The NET-1 Option (CMC 256 with Ethernet)" on page 83):
  - It is a product of laser class 1 (EN 60825, IEC 60825).
  - Connect ETH1 only to Ethernet based interfaces.
  - **Caution:** There is a danger of explosion if the battery (type CR2032) is incorrectly replaced. Replace only with the same or an equivalent type recommended by the manufacturer. Dispose of used batteries according to the manufacturer's instructions.

- If the CMC 256 seems to be functioning improperly, please call the OMICRON Hotline. (See "Contact Information / Technical Support" on page 109.)

Changing the Power Fuse

- Unplug the power cord between the device and the power source.

- Find the fuse at the back of the device.

- Fuse type: **T10 AH 250 V** (wire fuse 6.3×32 mm).

1 Designated Use

The CMC 256 is a PC-controlled test device intended for testing:

- protection relays
- transducers
- energy meters

In addition to the test functions, optional high-performance measurement functions [0 Hz (DC) ... 10 kHz] for ten analog inputs are available.

The CMC 256 is a part of the OMICRON Test Universe which, in addition to the test device, consists of a personal computer, the test software, and, when needed, external amplifiers.

The CMC 256 is independent from the corresponding test software.

Features of the CMC 256:

- Output of test quantities:
  - 4 × voltage
  - two galvanically separated current triples (each 3 ×12.5 A)
- Control of external amplifiers (up to six additional test signals) through the low-level interface.
- Supply of DC voltages to the test object.
- Output of binary signals.
- Capture of signals, counter impulses, and DC measured values.
- Option *EnerLyzer*: Measurement and analysis of DC and AC voltages, as well as DC and AC currents by means of a clip-on probe. Refer to Section 6.10, "The EnerLyzer Measurement Option" on page 63.

Any other use of the CMC 256 is considered improper.

2 Introduction

CMC 256 is part of a test system that consists not only of the test device itself, but also of a PC and the testing software OMICRON Test Universe.

External current and voltage amplifiers can be used as extension components to the test system. (Refer to Section 9, "CMC 256 Related Products and Accessories" on page 101.)

This user manual describes only the hardware of the CMC 256.

The configuration and control of the CMC 256 is performed through the test software of the OMICRON Test Universe. For more detailed information, please read the user manual and the online help accompanying the OMICRON Test Universe software.

The following options are available for the CMC 256 test set:

- *EnerLyzer*: software module for measurement and analysis of AC and DC voltages, see Section 6.10, "The EnerLyzer Measurement Option" on page 63
- EP (Extended Precision): the CMC 256 with extended output power accuracy e.g. for energy meter test applications, see Section 6.11, "The EP Option (Extended Precision)" on page 81
- NET-1: the CMC 256 with two Ethernet interfaces replacing the parallel port interface e.g. for test set control and substation communication according to IEC 61850, see Section 6.12, "The NET-1 Option (CMC 256 with Ethernet)" on page 83

3 Operating the CMC 256

3.1 System Components

Before operating the CMC 256 for the first time, verify that all components of the test system are available.[1]

You need the following components in order to bring the CMC 256 into operation:

- CMC 256 with (mains) power cable
- Connecting cable CMC 256 ↔ PC (provided)
- Connecting cable CMC 256 ↔ test object
- PC with installed test software and a parallel port or Ethernet (see option NET-1, chapter 6.11) interface[2]

3.2 Starting the Test System

The following description assumes that the PC has been set up and that the test software for the OMICRON Test Universe has been installed.

Detailed instructions for installing the software for the OMICRON Test Universe can be found in the user manual for the software.

This description refers both to the PC and to the CMC 256. It does not take into consideration any external devices.

If the system is driven by external amplifiers, follow the instructions in Section 7.2, "Operation with External Amplifiers" on page 96.

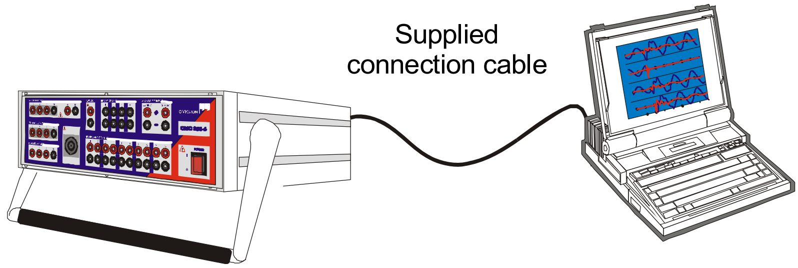
When setting up the CMC 256, it is most important to make sure that the ventilation slots remain unobstructed.

1 For deliverables refer to packing list.

2 The system requirements for the PC can be found in the installation description of the OMICRON Test Universe software.

Connecting the System Components:

Figure 3-1:Connecting the CMC 256 with the PC



1. Connect the CMC 256 to the PC with the supplied connection cable[1]:
    - CMC 256: to the connector (“Host Interf.” or ETH1) on the back of the device
    - PC: to the parallel interface port (labeled "PRT", "Printer" or "LPT1") or to the Ethernet interface (labeled “Ether” or “LAN”).
2. Plug CMC 256 and PC into power outlet.
3. Turn on both devices.
4. Start the OMICRON Test Universe software.
When starting the Test Universe software, a comprehensive hardware test is carried out on the CMC 256. When doing so, switching sounds from relays in the test device can be heard. If any irregularities are determined during the course of this self-test, the software displays a corresponding error message on the PC screen. Refer to Section 8, "Troubleshooting" on page 97.

[1] In order to ensure the required EMC compatibility of the connection cable, it is recommended that the supplied cable from OMICRON be used.

4 Setup and Function

The PC-controlled OMICRON test system employs the concept of a functional division between the software running on the PC and the CMC 256 hardware connected to the test object.

Test Software running on PC

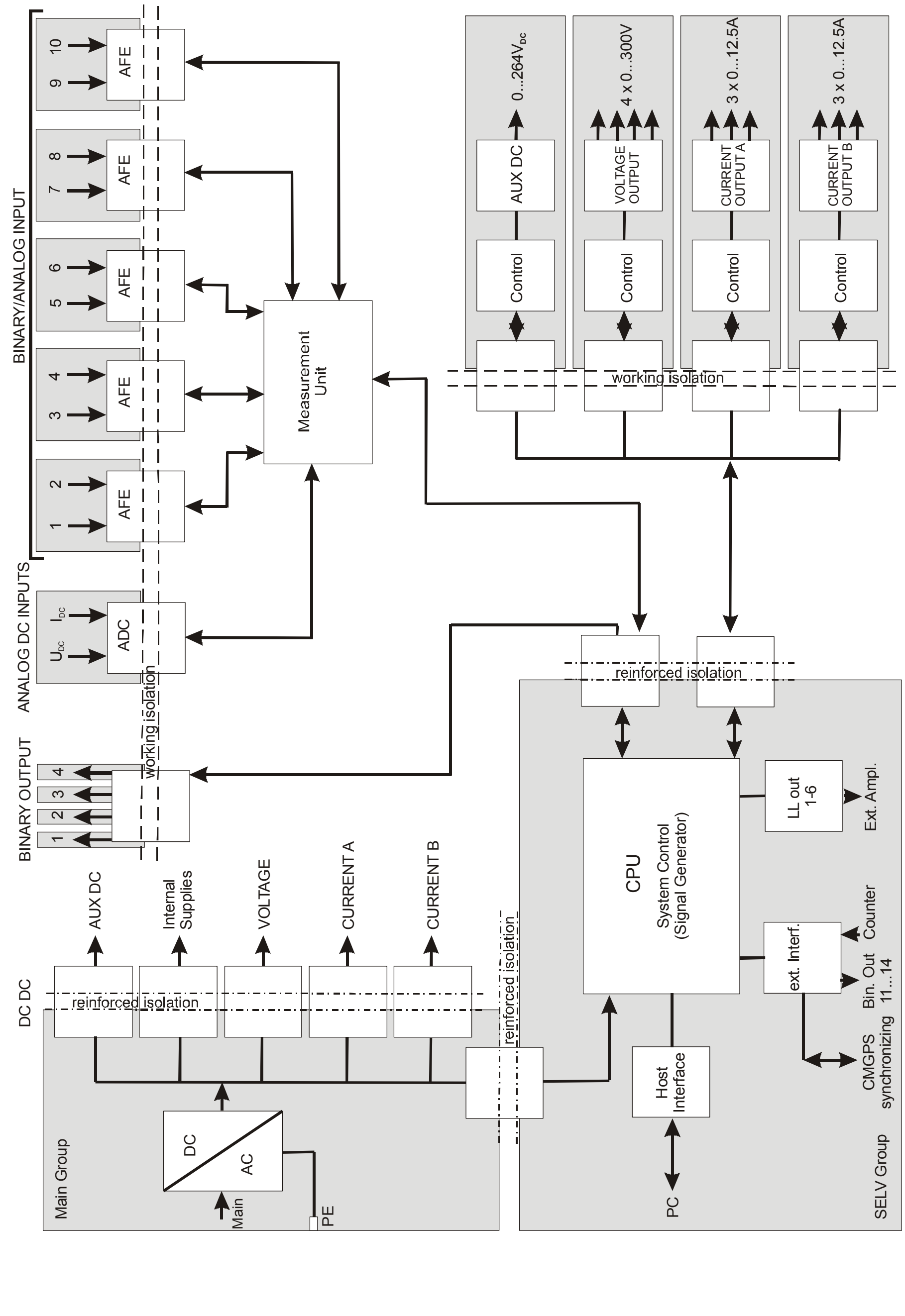
- controls the test signals
- processes measurement data
- creates reports
- generates data entries

CMC 256 test set

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

4.1 Block Diagram

Figure 4-1:
Main block diagram of the CMC 256



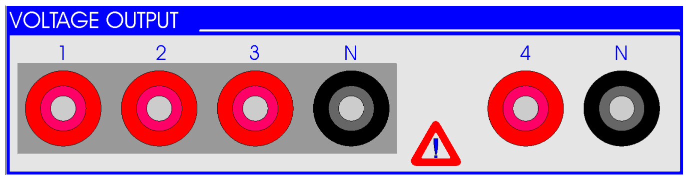
The block schematic diagram in Figure 4-1, “Main block diagram of the CMC 256” on page 20 shows all externally accessible signals with gray shading. Every grey area represents a galvanic group that is isolated from all of the other galvanic groups.

The power connection ("power supply group") and the connections for “SELV group” (SELV = **S**ave **E**xtra **L**ow **V**oltage) are available on the back of the device. All other gray shaded groups are available on the front of the device.

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 four voltage outputs reference a single, common neutral N and are galvanically separated from all other outputs of the CMC 256. The two black sockets labeled "N" are galvanically connected with one another.

The voltage amplifier and the current amplifiers are implemented as linear amplifiers with DC coupling.

The voltage outputs are implemented with two voltage ranges.

- Range 1: 4 x 0 ... 150 V
- Range 2: 4 x 0 ... 300 V

Protecting the Voltage Outputs

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

Overload Warning Flagged in the Software

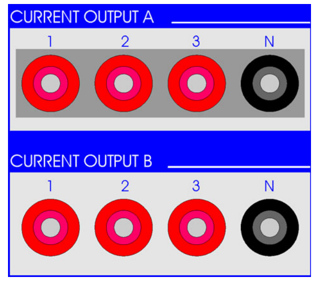
When a voltage output is overloaded, a corresponding warning is displayed in the user interface of the test software of the OMICRON Test Universe (e.g., Section 8.3, "Overheating" on page 99).

4.1.2 Current Output (Current Amplifier)

Figure 4-3:
CMC 256 current outputs

CURRENT OUTPUT A
CURRENT OUTPUT B

Two galvanically separated current triples, each with their own neutral (N).



The current triple is galvanically separated from all other connections of the CMC 256.

The current amplifiers are implemented as linear amplifiers with DC coupling. With this technology, exceptional harmonic distortions and frequency bandwidth specifications can be achieved in a very compact structure. Through the DC coupling, any transient or DC offset can be precisely reproduced.

All current outputs are equipped with two current ranges in order to increase their dynamic ranges:

- Range 1: 6 × 1.25 A
- Range 2: 6 × 12.5 A

Protecting the Current Outputs

All current outputs are protected for open circuits, short circuits, and overloads.

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

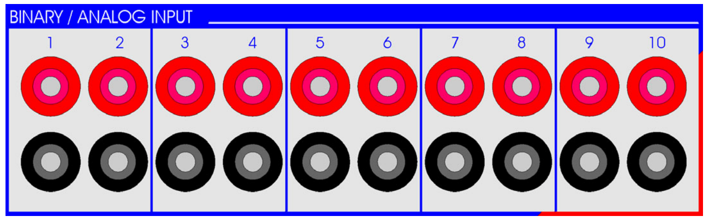
If the heat sink overheats, a thermal switch turns off all outputs.

Overload Warning Flagged in the Software

When a current output is overloaded, a corresponding warning is displayed in the user interface of the test software of the OMICRON Test Universe. Refer to Section 8.3, "Overheating" on page 99.

4.1.3 Binary / Analog Input (Binary Inputs 1 – 10)

Figure 4-4:
Binary inputs 1 – 10



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

The input signals are monitored using an isolation amplifier with a time resolution of 100 μs and are then evaluated in the measurement units.

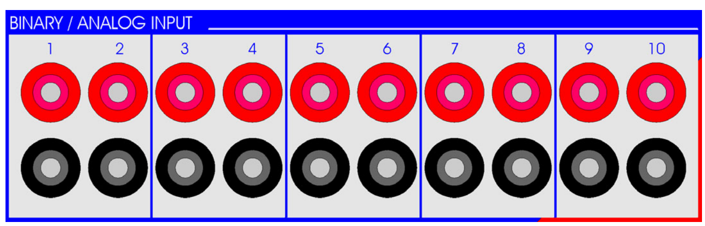
The binary inputs are configured from the hardware configuration module of the OMICRON Test Universe software. When doing so, it can be specified whether the contacts are potential sensitive or not. When the contacts are potential sensitive, the expected nominal voltage and pick-up threshold can be set for each binary input.

Moreover, the binary inputs 1 – 10 can be used as counter inputs for input frequencies up to 3 kHz.

More detailed information about the configuration of the binary inputs can be found in the online help for the OMICRON Test Universe.

4.1.4 Binary / Analog Input (Analog Inputs 1 – 10)

Figure 4-5:
Measurement unit
(analog inputs 1 – 10)



All ten of the binary inputs to the CMC 256 can be individually configured through the software as being binary or analog measurement inputs[1].

1 Up to three inputs can be used for measuring rms values without the *EnerLyzer* option.

Setting the inputs to be analog measurement inputs can be accomplished using the measurement option *EnerLyzer*. This *EnerLyzer* option can be upgraded at any later stage. Refer to Section 6.10, "The EnerLyzer Measurement Option" on page 63.

The capture of measurement values with range switching from each two channels occurs in an analog input stage AFE (**A**nalog **F**ront **E**nd), which is galvanically separated from the other input stages.

The input signals 1 - 10 can be captured in a frequency range from 0 Hz (DC) to approximately 10 kHz. The sampling rate can be switched between three predefined values. (Refer to Table 6-25, “Sampling rate 28.44 kHz, measurement range 600 V, 100 V, 10 V, 1 V” on page 65.)

The measured values are passed through an isolation amplifier to the "Measurement Unit" and are digitized with an A/D converter. Further processing occurs through a high-performance floating point digital signal processor (DSP).

As such, apparent power, reactive power, real power, etc., can be provided in real-time and transmitted to the PC.

The inputs are implemented as voltage inputs and have five measurement ranges: 100 mV, 1 V, 10 V, 100 V, and 600 V. The inputs are protected in each measurement range up to the input voltage of 600 V_{rms}.

For measuring current a current clamp is used, such as 10 mV/A for currents up to 80 A. (Refer to Section 9.4, "Current Clamp C-PROBE1" on page 105.)

When measuring with the current clamp, the current measurement channel is additionally galvanically separated from the adjacent measurement channel. The accuracy of the current measurement is mainly limited by the accuracy of the current clamp.

In addition to the synchronous capture of 10 measurement channels, the *EnerLyzer* option offers mathematically combining and evaluating of measurement channels in order to achieve:

- Evaluation of DC components (DC voltages or DC currents)
- Effective values (true RMS) of all measurement signals in real-time
- Peak values (U_{peak}, I_{peak},...)
- Phase angles with reference to a given input signal
- Calculation of apparent, reactive, and real power (in any configuration) in real-time
- Frequency and spectrum (harmonic diagrams) of periodic signals
- Capture of transient input signals at various sampling rates
- Different triggering options for the capture of transient signals

4.1.5 Analog DC Input (U_{DC}, I_{DC})

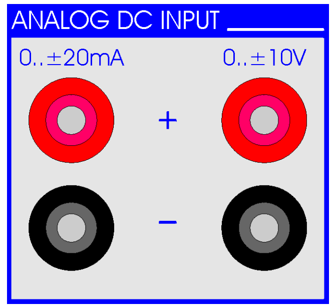


Figure 4-6:
Measurement unit DC
(analog inputs V_{DC}, I_{DC})

The measurement of analog DC signals is implemented for the testing of transducers and consists of:

- a high accuracy voltage reference
- an ADC (**A**nalog **D**igital **C**onverter) for each input
- the respective input circuits (i.e., accuracy voltage divider, shunt, filter) etc.

The input signals U_{DC} and I_{DC} are measured. The I_{DC} input has two ranges available: 0…±20 mA and 0…±1mA. A reversible input fuse is used as protection to the I_{DC} input.

The evaluation and forwarding of the measurement values takes place in the measurement unit. U_{DC} and I_{DC} inputs reference a common neutral N. The DC measurement unit is galvanically separated from all connections on the front panel.

4.1.6 Binary Output

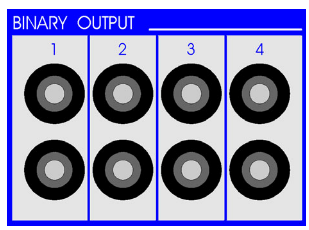


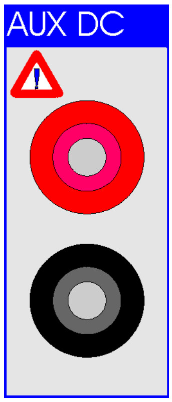
Figure 4-7:
Binary outputs

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

More detailed information about the configuration of the binary outputs can be found in the online help for the OMICRON Test Universe.

4.1.7 AUX DC (DC Power to test objects)

Figure 4-8:DC power for test objects (AUX DC)



Test objects (e.g. protection relays) requiring 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.

Using the AUX DC utility in the OMICRON Test Universe software, a voltage can be defined for the output of AUX DC whose value is stored in the CMC 256 non-volatile memory.

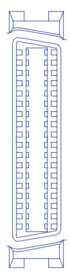
A few seconds after turning on the power supply to the CMC 256, the defined voltage is available at the AUX DC output.

⚠: Whenever the AUX DC supplies a dangerous voltage (greater than 42 V), the warning indicator LED lights up.

More detailed information about the configuration of the AUX DC supply can be found in the online help for the OMICRON Test Universe.

4.1.8 Host Interface (PC Interface Port, SELV)

Figure 4-9:
PC interface
host interface



The use of the parallel printer port as the connection between the PC and the CMC 256 permits a significantly higher data transfer rate as well as allowing any standard notebook computer to be used as control PC.

The system requirements for the PC can be found in the installation description of the OMICRON Test Universe software.

When the OMICRON Test Universe program is started, it automatically searches for the interface (LPT*x*) on the PC, to which the CMC 256 is connected.[1]

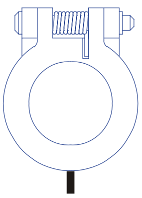
[1] For CMC 256 with the NET-1 option see Section 6.12, "The NET-1 Option (CMC 256 with Ethernet)" on page 83

4.1.9 Other SELV Interfaces

General

All inputs and outputs to the SELV Group reference a common neutral, which is also connected to the protective ground (GND) of the housing.

LL out 1-6 (Low Level output 1-6)



LL out 1-6

Six high accuracy analog signal sources are available that can be used, for example, to control external amplifiers.

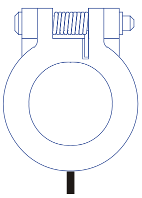
In addition, a serial digital interface is available that transmits control and monitor functions between the CMC 256 and the external amplifiers. Supported devices are the CMA 156, CMA 56, CMS 156, CMS 251 and CMS 252.

The low level signals have an output level from nominal 0 to ±10 V_{peak} (Refer to Section 5.2.1, "LL out 1-6" on page 36.). Every low level output is short-circuit protected and is continually monitored for overload.

Overload Warning Flagged in the Software

When a low level output is overloaded, a corresponding warning message appears on the user interface of the OMICRON Test Universe software.

ext. Interf. (External Interface)



ext. Interf.

Bin.out 11 - 14:

Four transistor outputs (open collector) are available for time critical, quick and bounce free binary outputs (small signals).

Counter:

For applications in energy meter testing, fast counter inputs of up to 100 kHz are occasionally needed. CMC 256 has two fast "low-level" counter inputs.

For energy meter test applications, the CMLIB B permits easy connectivity.

More information about the CMLIB can be found in Section 9.5, "CMLIB B – Option for the Meter Testing" on page 106.

Synchronization:

The GPS synchronization of the CMC 256 time base can be performed over the "ext. Interf." interface.

For this, the CMGPS synchronization device is an optional accessory. It communicates via the "ext. Interf." interface with the CMC 256. It also is powered from there with a DC supply.

More information about the CMGPS can be found in Section 9.3, "CMGPS" on page 104.

4.1.10 Central Processing Unit (CPU)

The CPU contains a digital signal processor (DSP) and carries out the following tasks:

- communication with the PC via the parallel interface ("Host Interf")
  CMC 256 with the NET-1 option additionally has its own 32-bit microprocessor to support the Ethernet (“ETH1“ and “ETH2”) interfaces to a PC or network.
- digital signal generation for all outputs of the device (including control signals for external amplifiers).
- generation of high accuracy central clock signal (with synchronization options using the CMGPS).
- monitor and control of all systems (including external amplifiers).

4.1.11 Power Supplies (DC-DC)

An AC/DC converter generates the required DC voltage (99 to 264 V_{AC}) 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 256 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., amplifier factor, 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 256 is a very precise test device with excellent long-term and temperature drift behavior. In addition to the high amplitude accuracy, the CMC 256 is especially noted for the phase accuracy.

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 accuracy 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 to 5 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 Connections on the Front Panel

Figure 5-1:
Front view of the CMC 256

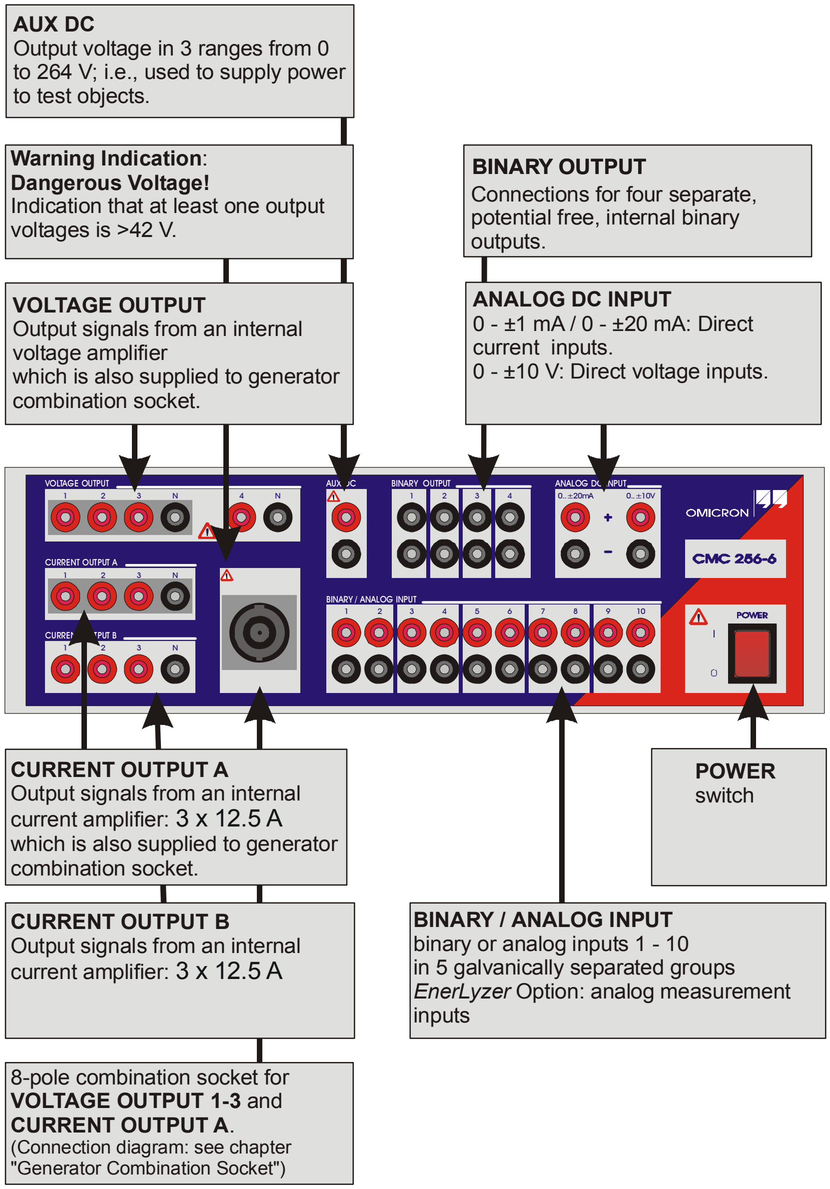
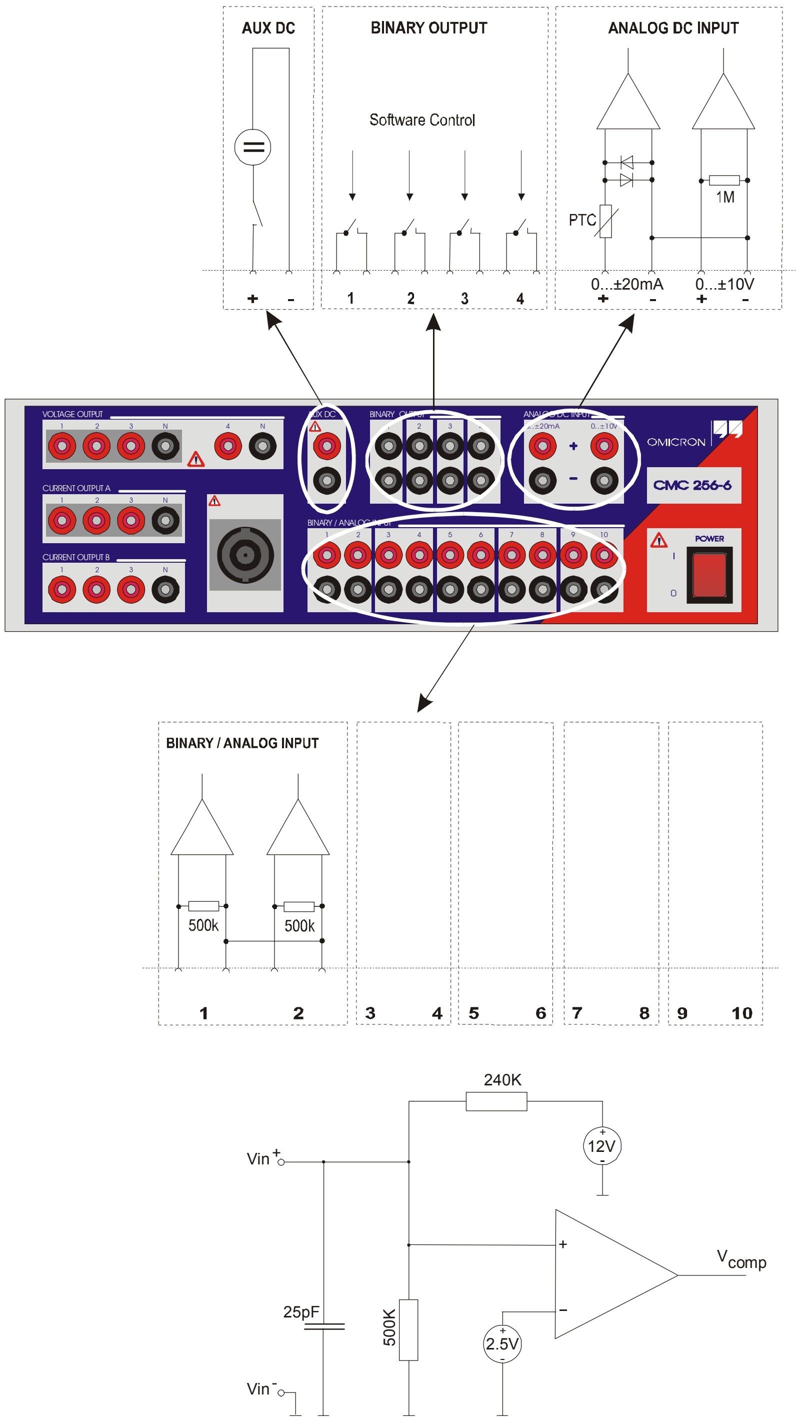


Figure 5-2:
Analog and binary inputs
and outputs

Analog
DC inputs and
outputs

Binary or
optional analog
inputs

Input circuit of a
binary input for
potential free
contacts



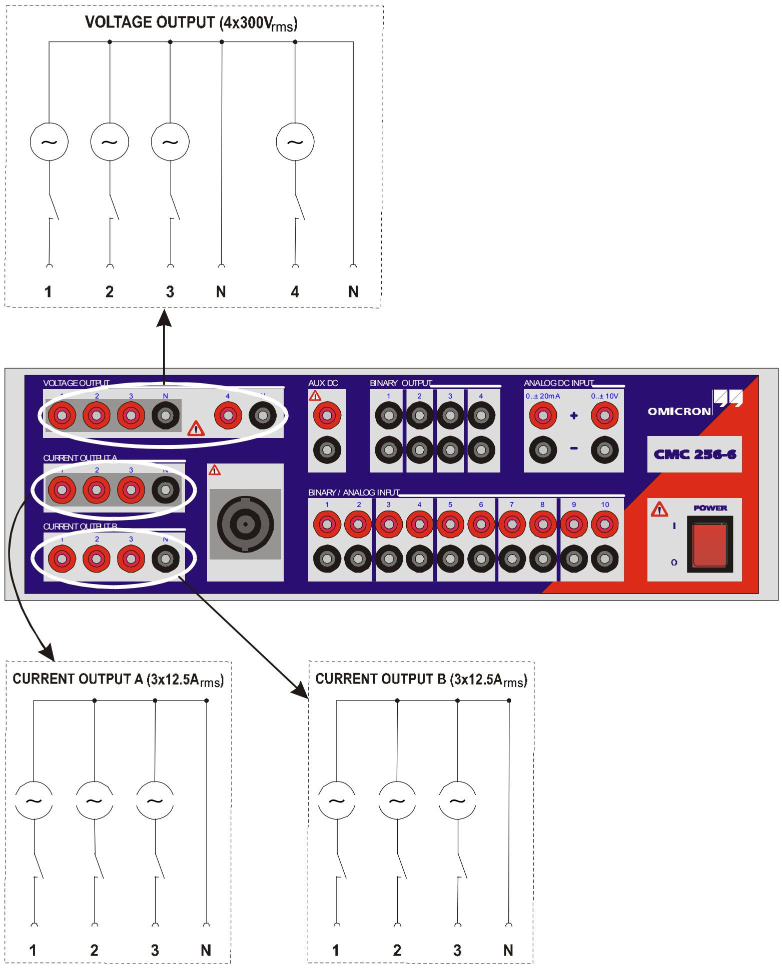


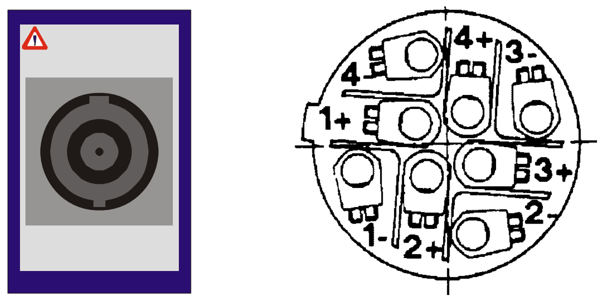
Figure 5-3:
Current and voltage outputs CMC 256

5.1.1 Generator Combination Socket for VOLTAGE OUTPUT, CURRENT OUTPUT

The combination socket CURRENT OUTPUT / VOLTAGE OUTPUT simplifies the connection of test objects to the CMC 256.

The three voltage outputs (VOLTAGE OUTPUT 1-3) as well as the CURRENT OUTPUT A are wired to this socket. Refer to Table 5-1, “Pin layout for the CMC 256” on page 35.

Figure 5-4:
Generator Combination socket



View of
the front side of the CMC 256

View of the connector from the
cable wiring side

WARNING:

The connections on the socket are dangerous when the device is turned on.

Follow the safety information provided at the beginning of this manual when connecting the generator combination sockets.

If a dangerous voltage (greater than 42 V) is present on the socket, a warning indicator lights above the socket.

For currents greater than 25 A, the test object (load) should be exclusively connected to the 4 mm banana sockets and not on the generator connection socket.

Table 5-1:
Pin layout for the CMC 256

Pin	Signal
1-	VOLTAGE N
2-	VOLTAGE 3
3-	VOLTAGE 2
4-	VOLTAGE 1
1+	CURRENT A 1
2+	CURRENT A N
3+	CURRENT A 3
4+	CURRENT A 2

Note: If using negative sequence phase rotation, swap the connectors VOLTAGE 2 and VOLTAGE 3 as well as CURRENT 2 and CURRENT 3.

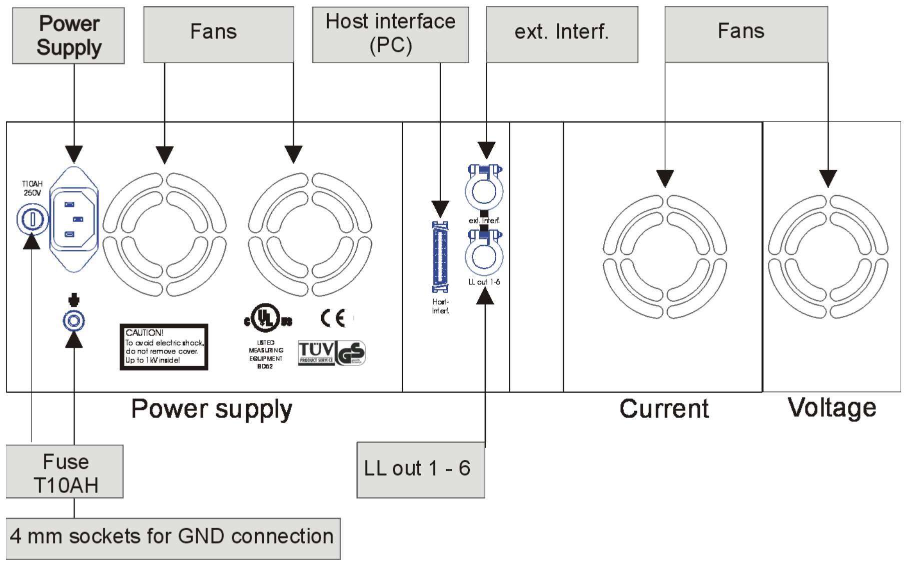
Table 5-2:
Manufacturer ordering information

Description of the generator combination socket	
Description	SPEAKON LINE 8-pole
Article Number	NL8FC
Manufacturer	Neutrik (www.neutrik.com)

You can order the plug for generator combination socket directly from OMICRON. For the part number refer to Section 9.6, "Ordering Information" on page 107.

5.2 Connections on the Back Panel

Figure 5-5:
Rear View CMC 256



For the rear view of CMC 256 with the NET-1 option, see Section 6.12, "The NET-1 Option (CMC 256 with Ethernet)" on page 83.

5.2.1 LL out 1-6

The connection sockets "LL out 1-6" are two generator triples completely independent from one another. These signals serve to control an external amplifier or to be used directly as a small signal output.

To connect to these sockets, use the supplied cable that comes with the external amplifier (connection cable CMC 256-amplifier).

The outputs are separated through reinforced insulation from the power input and from the load outputs (SELV interface). They deliver calibrated signals in the range from 0 to 7 V_{eff} nominal (0 to $\pm$10 V_{peak}).

The selection of the amplifier as well as the specification of the scale for the respective amplifiers to be connected is done through the software.

For more detailed information, please read the user's manual and the online help accompanying the OMICRON Test Universe software.

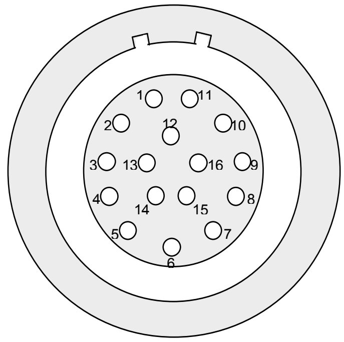


Figure 5-6:
Pins for the "LL out 1-6" interface (lower 16-pole Lemo socket) view from the wiring side

Table 5-3:
Combination socket layout for amplifier.

Pin	Function[1]
pin 1	LL out 1
pin 2	LL out 2
pin 3	LL out 3
pin 4	Neutral (N) connected with GND
pin 5	LL out 4
pin 6	LL out 5
pin 7	LL out 6
pin 8-16	for internal purposes
housing	screen connection

[1] "LL out 1-3" and "LL out 4-6" each make up a selectable triple (voltage or current system).

5.2.2 External Interface

On the "ext. Interf." connection sockets, two high frequency counter inputs (up to 100 kHz) are available for the testing of meters.

In addition, four transistor binary outputs 11-14 are available. These have the advantage over the relay outputs in that they have no bounce and have minimal reaction times.

Figure 5-7:
Pins for the interface "ext. Interf" (upper 16-pole Lemo-socket) View from cable connection

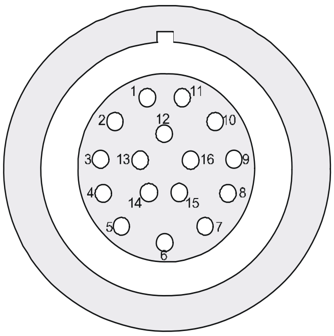


Table 5-4:
Combination socket layout to “ext. Interf.“

Pin	Function
pin 1	Counter input 1
pin 2	Counter input 2
pin 3	reserved
pin 4	Neutral (N) connected with 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

Figure 5-8:
Input circuit counter input 1 or 2

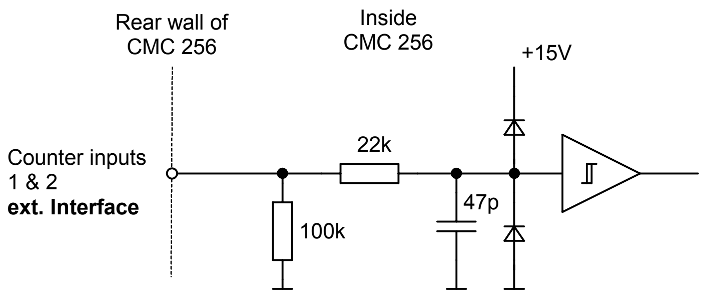


Figure 5-9:
Output circuit of the binary transistor outputs 11 - 14

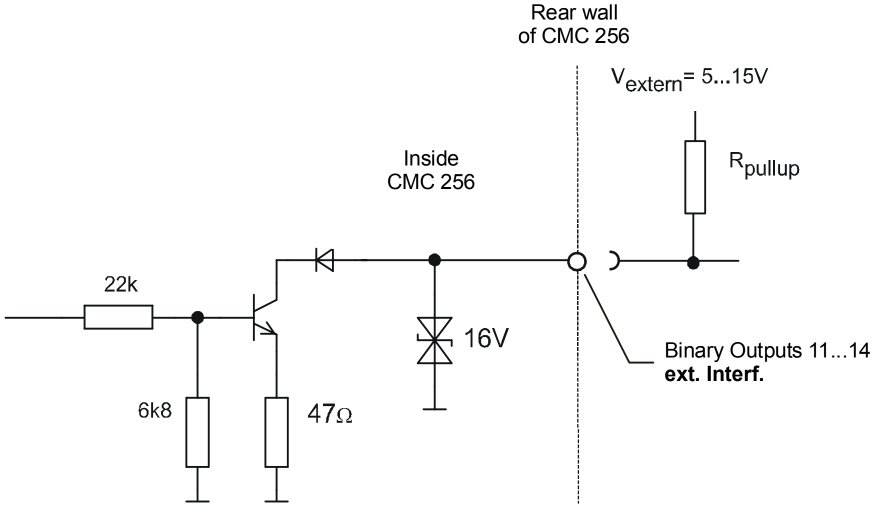


Table 5-5:
Ordering Information

Manufacturer description for the connection plug "LL out 1-6" and "ext. Interf." (see www.lemo.ch)	
connector for two guide notches and pull relief (for "LL out 1-6")	FGB.2B.316.CLAD 72Z
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

6 TECHNICAL DATA

Guaranteed Values:

- General:

  The values are valid for the period of one year after factory calibration, within 23°C ± 5°C at nominal value and after a warm-up phase greater than 25 min.

- Guaranteed values from the generator outputs:

  The values are valid in the frequency range from 10 to 100 Hz unless specified otherwise.

Accuracy Data:

Valid in the frequency range from 0 to 100 Hz unless specified otherwise.

6.1 Main Power Supply

Table 6-1:
Power supply data

Main Power Supply	
connection	Connector according to IEC 60320
voltage, single phase nominal voltage permitted range	 110-240 V_{AC} 99 ... 264 V_{AC}
power fuse	T 10 AH 250 V
power consumption[1]	1200 VA at 115 V 1600 VA at 230 V
frequency Nominal frequency permitted range	 50 / 60 Hz 45 ... 65 Hz
overvoltage category	II

[1] Refer to Section 6.3.6, "Output Power and Input Supply Voltage" on page 52.

The maximum output power of the CMC 256 is limited by the (mains) input supply voltage. If the input supply voltage is less than 150 V_{AC}, it is no longer possible to drive all outputs at full load (VOLTAGE OUTPUT, CURRENT OUTPUT, AUX DC) simultaneously.

6.2 Insulation Coordination

Table 6-2:
Insulation coordination

Insulation Coordination	
overvoltage category	II
pollution degree	II
insulation of function groups on front panel to ground (GND)[1]	- basic insulation with maximum working voltage 600 V_{rms} to ground - clearance: > 3mm - creepage: > 6mm - test voltage: 2200 V_{rms}
insulation of functional groups on front panel from each other	- working insulation - clearance: > 1 mm - creepage: > 1 mm - test voltage: 1500 VDC
measurement category (BINARY / ANALOG INPUT)	- CAT II

[1] Functional groups on front panel: VOLTAGE OUTPUT, CURRENT OUTPUT (A, B), AUX DC, BINARY OUTPUT, BINARY / ANALOG INPUT, ANALOG DC INPUT

6.3 Outputs

Block diagrams of the available generator outputs can be found in Section 4.1, "Block Diagram" on page 20.

Table 6-3:
Analog current, voltage, and LL outputs.

General Generator Outputs (Analog current and voltage outputs as well as LL out 1-6 outputs)		
frequency ranges sinusoidal signals transient signals	 10…1000 Hz 0 (DC)…3.1 kHz	
frequency resolution	<5 µHz	
frequency accuracy	±0.5 ppm	
frequency drift	±1 ppm	
bandwidth (–3 dB)	3.1 kHz	
phase range φ	-360° to +360°	
phase resolution	0.001°	
phase error[1]	typically 0.02°	guaranteed < 0.1°
synchronized operation	Generator outputs could be synchronized to a reference input signal on binary/analog input 10 (range: 40…70 Hz).	

[1] Valid for sinusoidal signals at 50 / 60 Hz.

All voltages and current generators are configurable independently with respect to amplitude, phase angle, and frequency.

All outputs are monitored. Overload conditions result in a message displayed on the PC.

6.3.1 CURRENT OUTPUT A

Table 6-4:
Current outputs of
CMC 256

3 Current outputs[1]		
output currents		
3-phase AC (L-N)	3 x 0 ... 12.5 A	
1-phase AC (L-N)[2]	1 x 0 ... 37.5 A	
DC (L-N)[2]	1 x 0 ... ±17.5 A	
DC (L-N)	1 x 0 ... ±12.5 A	
power (range II)	typical	guaranteed
3-phase AC (L-N)	3 x 80 VA at 8.5 A	3 x 70 VA at 7.5 A
1-phase AC (L-L)[3]	1 x 160 VA at 8.5 A	1 x 140 VA at 7.5 A
1-phase AC (L-N)[2]	1 x 240 VA at 25.5 A	1 x 210 VA at 22.5 A
DC (L-N)[2]	1 x 240 W at ±17.5 A	1 x 235 W at ±17.5 A
DC (L-N)	1 x 100 W at ±12.5 A	1 x 90 W at ±12.5 A
power (range I)		
3-phase AC (L-N)		3 x 12.5 VA at 1.25 A
accuracy[4]	error < 0.03%	error < 0.1%
harmonic distortion (THD+N)[5]	0.025%	< 0.07%
DC offset current		
range I	< 30 µA	< 300 µA
range II	< 300 µA	< 3 mA
current ranges	range I: 0 ... 1.25 A range II: 0 ... 12.5 A	
resolution	< 50 µA (in 1.25 A range) < 500 µA (in 12.5 A range)	
short-circuit protection	unlimited to N	
open-circuit protection	open outputs (open-circuit) permitted	
connection	4 mm banana connectors amplifier connection socket[6] (only CURRENT OUTPUT A)	
insulation	reinforced insulation from power supply and all SELV interfaces	

1 Data for three-phase systems are valid for symmetric conditions (0°, 120°, 240°). Refer to Section 6.3.6, "Output Power and Input Supply Voltage" on page 52.

2 Three-phase parallel switched

3 Single-phase model (in phase opposition): 2 currents in series

4 Percentage data references the full scale.

5 Values at 50/60 Hz, 20 kHz measurement bandwidth, nominal value, and nominal load

6 For currents > 25 A, the test object should only be connected to the 4 mm banana connections and not to the generator combination socket.

6.3.2 CURRENT OUTPUT B

The technical data is the same as in Section 6.3.1, "CURRENT OUTPUT A" on page 44.

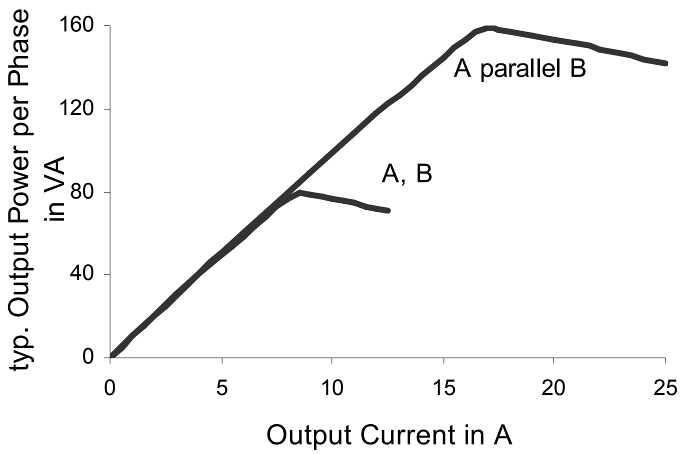
6.3.3 Parallel Switching of CURRENT OUTPUT A and B

Table 6-5:
Parallel switched current outputs A and B of CMC 256

Parallel Switched Current Outputs[1] A and B		
output currents 3-phase AC (L-N) 1-phase AC (L-N)[2] DC (L-N)[2] DC (L-N)	3 x 0 ... 25 A 1 x 0 ... 75 A 1 x 0 ... ±35 A 1 x 0 ... ±25 A	
power (range II)	typical	guaranteed
3-phase AC (L-N) 1-phase AC (L-N)[2] DC (L-N)[2] DC (L-N)	3 x 160 VA at 17 A 1 x 480 VA at 51 A 1 x 480 W at ±35 A 1 x 200 W at ±25 A	3 x 140 VA at 15 A 1 x 420 VA at 45 A 1 x 470 W at ±35 A 1 x 180 W at ±25 A
power (range I) three-phase AC (L-N)		3 x 25 VA at 2.5 A
accuracy[3]	error < 0.03%	error < 0.1%
harmonic distortion (THD+N)[4]	0.025%	< 0.07%
DC offset current range I range II	 < 60 μA < 600 μA	 < 600 μA < 6 mA
current ranges	range I: 0 ... 2.5 A range II: 0 ... 25 A	
resolution	< 100 μA (in range I) < 1 mA (in range II)	
connection	4 mm banana connectors/amplifier connection socket[5]	

1 Data for three-phase systems are valid for symmetric conditions (0°, 120°, 240°). Refer to Section 6.3.6.
2 Three-phase parallel switched (for connection diagram refer to Section 7.1.3)
3 Percentage data references the full scale.
4 Values at 50/60 Hz, 20 kHz measurement bandwidth, nominal value, and nominal load
5 For currents > 25 A, the test object should only be connected to the 4 mm banana connections and not to the generator combination socket.

Figure 6-1:
Typical output power per phase of a group and with parallel switching (A II B) of both groups

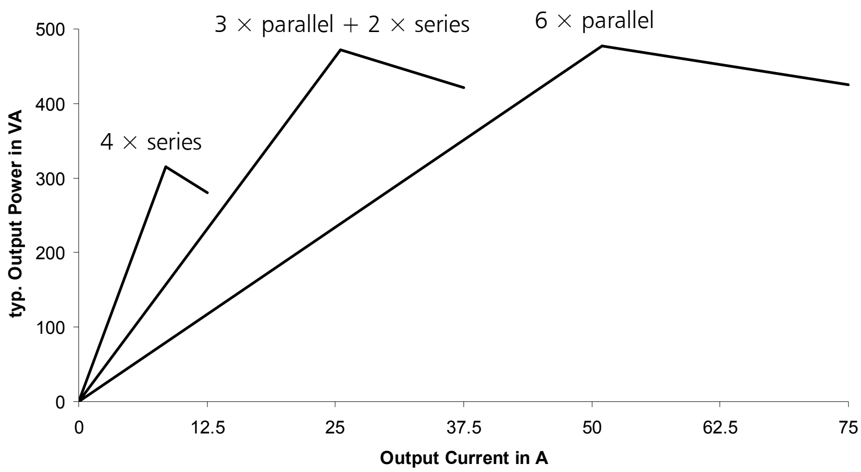


6.3.4 Single-phase Operation for Output Currents

Table 6-6:
Single-phase operation of the CMC 256

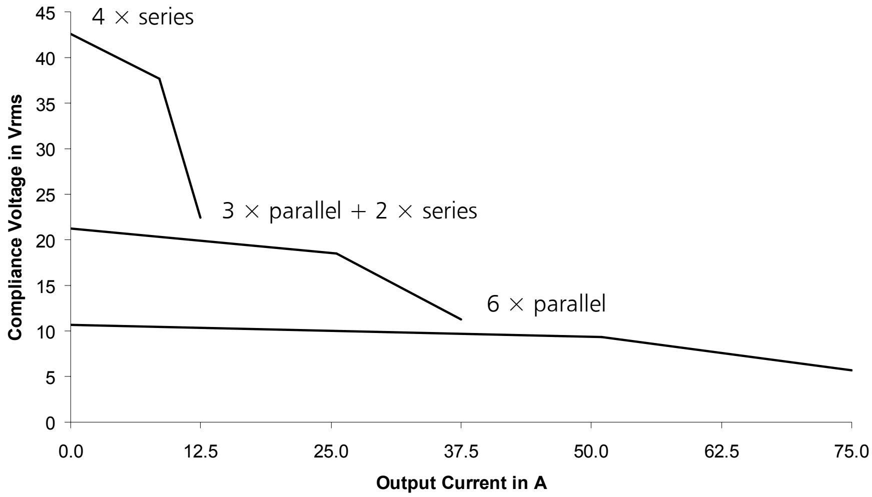
Single-Phase Operation	
output currents	
4 x series	1 x 0 ... 12.5 A, refer to Section 7.1.1.
3 x parallel + 2 x series	1 x 0 ... 37.5 A, refer to Section 7.1.2.
6 x parallel	1 x 0 ... 75 A, refer to Section 7.1.3.
power output	
4 x series	1 x 320 VA at 8.5 A
3 x parallel + 2 x series	1 x 480 VA at 25.5 A
6 x parallel	1 x 480 VA at 51 A

Figure 6-2:
Typical output power curves (50/60Hz)



For additional information see Section 7.1, "Single-Phase Operation of the CMC 256" on page 90.

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



6.3.5 Voltage Outputs

Table 6-7:
CMC 256 voltage outputs

4 Voltage Outputs		
output voltages		
4-phase AC (L-N)[1]	4 x 0 ... 300 V	
1-phase AC (L-L)	1 x 0 ... 600 V	
DC (L-N)	4 x 0 ... ±300 V	
output power[2]	typical	guaranteed
3-phase AC[3]	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 200 VA at 200 ... 600 V	1 x 150 VA at 150 ... 600 V
DC (L-N)	1 x 420 W	1 x 360 W at 300 VDC
accuracy[4]	error < 0.025%	error < 0.1%
harmonic distortion (THD+N)[5]	0.015%	< 0.05%
DC offset voltage	< 20 mV	< 100 mV
voltage ranges	range I: 0 ... 150 V range II: 0 ... 300 V	
resolution	5 mV in 150 V range 10 mV in 300 V range	
short-circuit protected	unlimited from L - N	
connection	4 mm banana connectors, amplifier connection socket V_{L1}-V_{L3}	
insulation	reinforced insulation from power supply and all SELV interfaces	

1 a) V_{L4} (t) automatically calculated: $V_{L4}=(V_{L1}+ V_{L2}+ V_{L3})*C$
C: configurable constant from –4 to +4.
b) V_{L4} freely configurable through software in frequency, phase, and amplitude.

2 Guaranteed data for ohmic loads, (PF=1).
Refer to the accompanying figure of the output power curves.
Refer to Section 6.3.6, "Output Power and Input Supply Voltage" on page 52.

3 Data for three-phase systems are valid for symmetric conditions (0°, 120°, 240°).

4 Percentage data references nominal voltages from 30 to 300 V.

5 Values at 50 / 60 Hz, 20 kHz measurement bandwidth, nominal value and nominal load.

6.3.5.1 Power Diagram for Three-Phase Operation

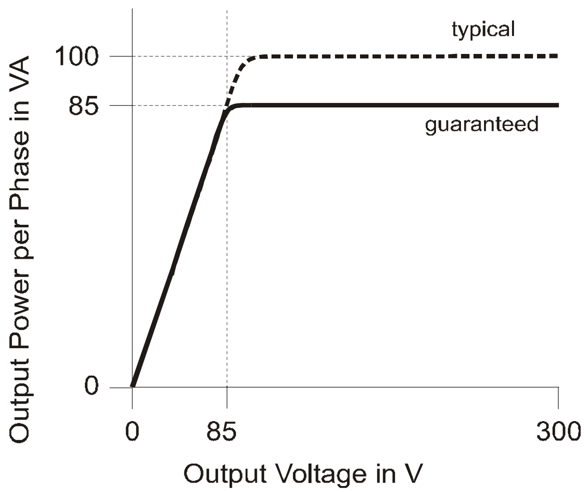


Figure 6-4:
Power diagram for three-phase operation

6.3.5.2 Power Diagram for Single-Phase Operation

See also Section 7.1.4, "Single-Phase Voltage" on page 95.

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

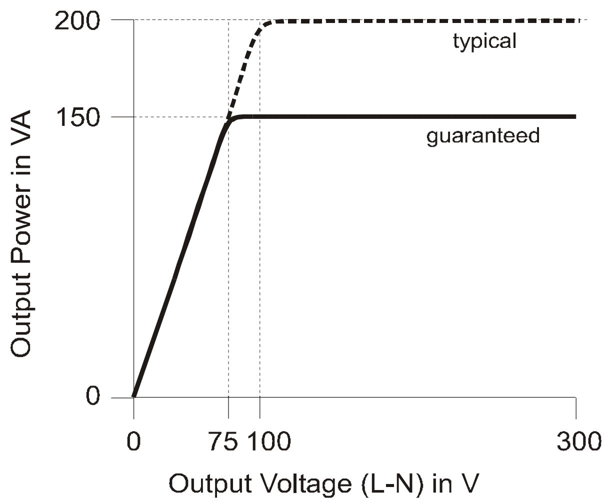
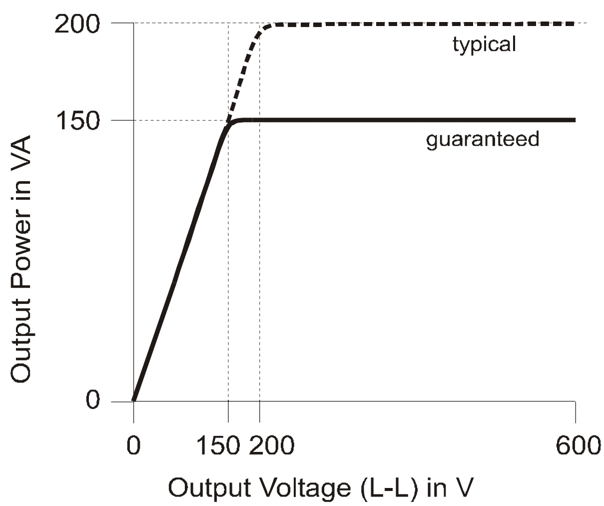


Figure 6-6:
Single-phase operation L-L

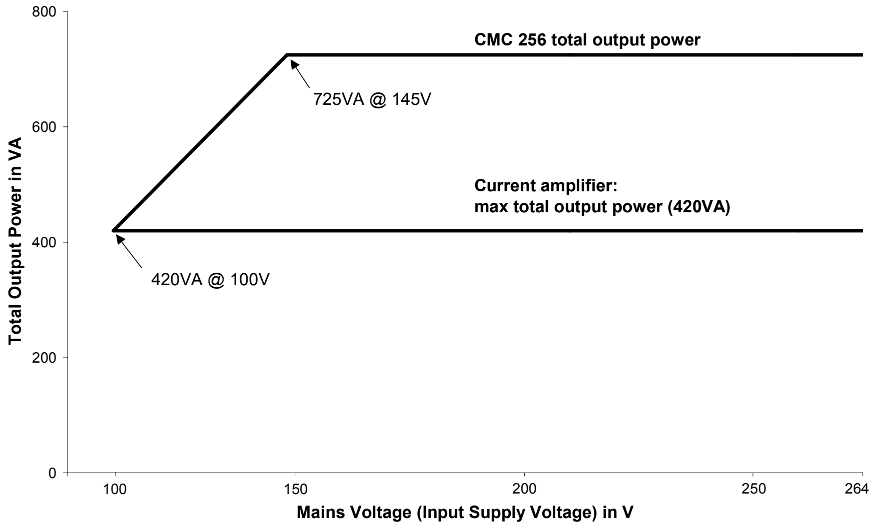


6.3.6 Output Power and Input Supply Voltage

The maximum output power of the CMC 256 is limited by the (mains) input supply voltage. If the input supply voltage is less than 150 V_{AC}, it is no longer possible to drive all outputs at full load (VOLTAGE OUTPUT, CURRENT OUTPUT, AUX DC) simultaneously.

If all of the voltage outputs, current outputs, as well as the AUX DC outputs are to be driven with the input supply voltage less than 150 V_{AC}, the maximum load of the current output has to be reduced. This is accomplished using the hardware configuration in the OMICRON Test Universe software.

Figure 6-7:
Output power in reference to the input supply voltage



Beside the reduction of the available total output power at low line voltages, no other degradation of the technical data of the CMC 256 occurs.

The full power output at the current outputs (and no load at the voltage outputs) sums up to a figure of 420 VA. This is an important configuration for testing high burden overcurrent relays and the condition can almost perfectly met at a line voltage of 100V (see also Table 6-8, “Output power versus the input supply voltage” on page 53).

The table below shows some selected load conditions for three-phase testing with the CMC 256. These specific conditions listed were tested at OMICRON, i.e. a CMC 256 was operated under the specified conditions and its proper function was verified. The results prove the general power curve shown in Figure 6-7, “Output power in reference to the input supply voltage” on page 52.

Table 6-8:
Output power versus the input supply voltage

Line Voltage	Outputs and Loads	Total Power
85V	3 x 85V, 52VA + 3 x 25A, 52VA	312VA
90V	3 x 85V, 56VA + 3 x 25A, 56VA	336VA
95V	3 x 85V, 63VA + 3 x 25A, 63VA	378VA
100V	3 x 85V, 70VA + 3 x 25A, 70VA	420VA
110V	3 x 85V, 80VA + 3 x 25A, 80VA	480VA
115V	3 x 85V, 85VA + 3 x 25A, 85VA	510VA
120V	3 x 85V, 85VA + 3 x 25A, 85VA	555VA
150V	3 x 85V, 85VA + 3 x 25A, 85VA	675VA

6.3.7 Interface for External Amplifier "LL out 1-6"

Table 6-9:
Data for interface "LL out 1-6"

6 Outputs		
setting range	0…±10 V_{peak}[1]	
output current	max. 1 mA	
resolution	< 250 µV	
accuracy (error in %)	typical < 0.025%	guaranteed < 0.07% for 1…10 V_{peak}
harmonic distortion (THD+N)[2]	typical < 0.015%	guaranteed < 0.05%
DC offset current	typical < 150 µV	guaranteed < 1.5 mV
unconventional CT/VT simulation	Linear or Rogowski[3] mode	
overload indication	yes	
short-circuit protection	unlimited to neutral	
insulation	SELV to all other potential groups of the test equipment. GND is connected to protective earth ground.	

1 Input OMICRON amplifier nominal: 0 ... 5 V_{rms}

2 Values at nominal voltage (10 V_{peak}), 50/60 Hz, and 20 kHz measurement bandwidth.

3 In Rogowski mode, the output signals are calculated in a differentiated way (d/dt). For more detailed information, please read the online help of the OMICRON Test Universe software.

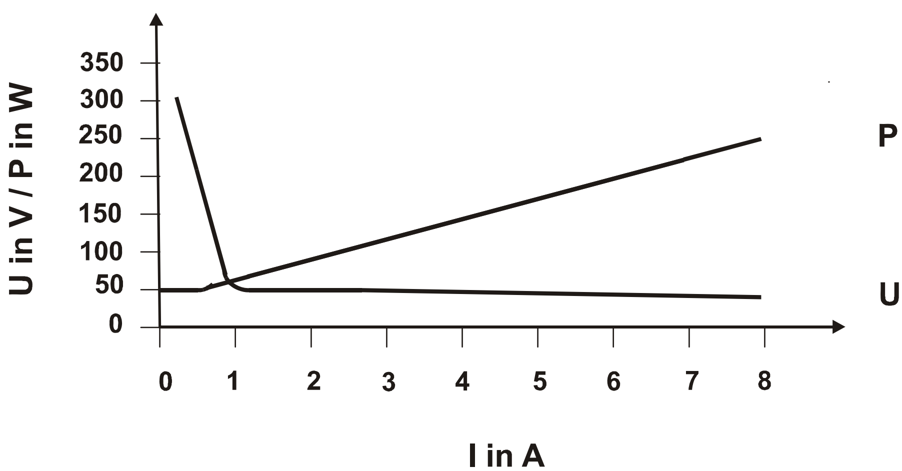
6.3.8 Binary Output Relays

Table 6-10:
Data to 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. 4s at 10% duty-cycle)
electrical lifetime	100,000 switching cycles at 230 V_{AC} / 8 A and ohm load
pickup time	approx. 6 ms
fall back time	approx. 3 ms
bounce time	approx. 0.5 ms
connection	4 mm banana sockets
insulation	operation insulation to power outputs 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 6-8:
Load limit curve for relays on the binary outputs with DC voltages



6.3.9 Low-Level Binary Outputs (ext. Interf.)

Table 6-11:
Data for the LL binary outputs 11-14

4 Low-Level Transistor Binary Output (Binary Outputs 11-14)	
type	Open Collector transistor outputs external pull-up resistor
switching voltage	max. 15 V
max. input voltage	±16 V
switch current	max. 5 mA (current limited) min. 100 μA
actualization time	100 μs
rise time	< 3 μs (V_{extern}=5 V, R_{pullup}=4.7 kΩ)
connection	socket "ext. Interf." (rear CMC 256)
insulation	SELV to all other potential groups of the test equipment. GND is connected to protective earth ground (GND)

Main schematic for the output stage of the binary transistor outputs 11-14. Refer to Figure 5-9, “Output circuit of the binary transistor outputs 11 - 14” on page 39.

6.3.10 DC Supply (AUX DC)

Table 6-12:
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. 50W
accuracy[1]	error: typical < 2%, guaranteed < 5%
resolution	< 70 mV
connection	4 mm banana sockets on the 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 6-13:
General data of binary inputs

General Data for Binary Inputs 1…10	
number of binary inputs	10
trigger criteria	potential free or DC-voltage compared to threshold voltage
reaction time	max. 220 μs
sampling frequency	10 kHz
time resolution	100 μs
max. measuring time	infinite
debounce time	0…25ms (see Page 58)
deglitch time	0…25ms (see Page 58)
counting function counter frequency pulse width	 3 kHz (per input) >150 μs (for high and low signals)
configuration	Binary inputs are configurable. Refer to the online help of the test software in the OMICRON Test Universe.
connection	4mm banana sockets on the front panel
insulation	5 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 6-14:
Data for potential sensing operation

Data for Potential Sensing Operation		
threshold voltage data for input range	setting range	resolution
100mV 1V 10V 100V 600V	± 140mV ± 1.4V ± 14V ± 140V ± 600V	2mV 20mV 200mV 2V 20V
max. input voltage	$600V_{rms}$ ($850V_{pk}$)	
threshold voltage accuracy[1] in range: 100 mV, 1 V, 10 V, 100 V 600 V	error: typical < 2%, guaranteed < 4% typical < 5%, guaranteed < 10%	
threshold voltage hysteresis	1…5% of the specified input to each range's full-scale	
input impedance[2]	500 kΩ (//50pF)	

1 Valid for positive voltage signal edge; percentage is shown in respect to each range's full-scale.
2 Refer to Figure 5-3 in Section 5-2, "Analog and binary inputs and outputs" on page 32.

Table 6-15:
Data for potential free operation

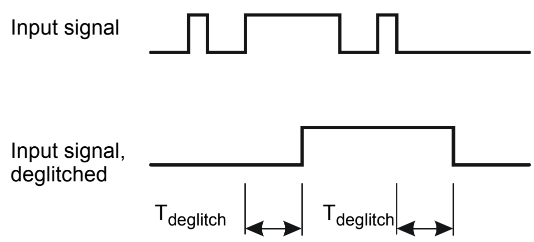
Data for Potential Free Operation[1]	
trigger criteria	Logical 0: R>80 kΩ Logical 1: R<40 kΩ
input impedance	162 kΩ (//50pF)

1 Refer to Figure 5-3 in Section 5-2, "Analog and binary inputs and outputs" on page 32.

Deglitch of 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 following figure explains the deglitch function.

Figure 6-9:
Signal curve, deglitch of input signals



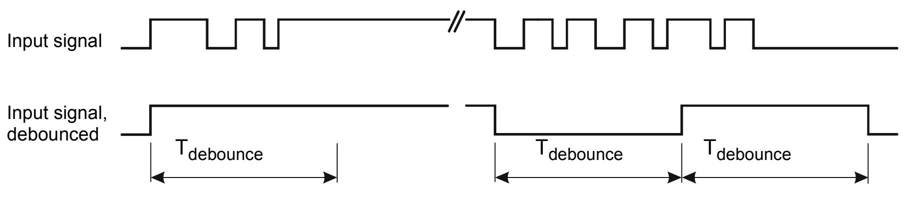
Debounce of input signals

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 256 and are calculated in real time.

The following figure explains 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 6-10:
Signal curve, debounce of input signals



6.4.2 Counter Inputs 100 kHz (Low Level)

Table 6-16:
Counter inputs 100 kHz

2 Counter Inputs	
max. 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 & fall times	< 1 ms
max. input voltage	±30 V
connection	socket "ext. Interf." (rear CMC 256)
insulation	SELV to all other potential groups of the test equipment. Galvanically connected with "LL out 1-6" and ground.

Main schematic of the input switch counter input 1 and 2, refer to Figure 5-8, “Input circuit counter input 1 or 2” on page 39.

6.4.3 DC Measurement Inputs (ANALOG DC INPUT)

Exceeding the specified input values can damage the measurement inputs!

Table 6-17:
DC measurement input

DC Measurement Input IDC		
measurement range	0 ... ±1 mA 0 ... ±20 mA	
max. input current	600 mA	
accuracy	typ. error < 0.003%	guar. error < 0.02%
input impedance	approx. 15 Ω	
connection	4 mm banana connectors	
insulation	insulation to all other front panel connections; reinforced insulation from all SELV interfaces and from power supply. Galvanically connected with V_{DC}.	

Table 6-18:
DC voltage measurement input

DC Voltage Measurement Input VDC		
measurement range	0…±10 V	
max. input voltage	±11 V	
input impedance	1 MΩ	
max. input current	±90 mA	
accuracy	typ. error < 0.003%	guar. error < 0.02%
connection	4 mm banana connectors	
insulation	galvanically connected with I_{DC}	

6.5 PC Interface (Host interf.)

Table 6-19:
PC interface

Host Interface[1]	
connector / socket	IEEE 1284-C (Parallel Port)
usage	The PC interface serves to connect the CMC 256 with the PC. It is recommended that the supplied connection cable be used.
insulation	SELV to all other potential groups. galvanically connected to ground (GND).

1 For CMC 256 with the NET-1 option see Section 6.12.

6.6 Environmental Conditions

6.6.1 Climate

Table 6-20:
Climate

Climate	
operating temperature[1]	0 ... +50°C
storage and transportation	-25…+70°C
humidity	5…95% relative humidity; no condensation
climate	tested according to IEC 68-2-3

[1] Above +30°C a 50% duty cycle may apply.

6.6.2 Shock and Vibration

Table 6-21:
Shock and vibration

Dynamics	
vibration	tested according to IEC 68-2-6 (operating mode) Frequency range 10 ... 150 Hz; acceleration 2 g continuous (20 m/s^2); 10 cycles per axis
shock	tested according to IEC 68-2-27 (operating mode) 15 g / 11 ms, half-sinusoid, each axis

6.6.3 Electromagnetic Compatibility (EMC)

Table 6-22:
Electromagnetic
compatibility

EMC	
CE conformity, requirements	The product adheres to the specifications from the guidelines of the council of the European community for meeting the requirements of the member states regarding the electromagnetic compatibility (EMC Standard 89/336/EEC). EN 61326-1
Emission Europe International	 EN 50081-2; EN 61000-3-2/3 FCC Subpart B of Part 15 Class A
Immunity Europe International	 EN 50082-2 IEC 61000-4-2/3/4/5/6/11

6.7 Safety Standards and Certificates

Table 6-23:
Fulfilled safety standards and certificates

CMC 256 certified safety standards	
European standards	EN 61010-1: 2001 EN 60950
international standards	IEC 61010-1 UL 3111-1 CAN/CSA-C22.2 No 1010.1-92
certificate	
	Manufactured under an ISO9001 registered system

6.8 Mechanical Data

Table 6-24:
Data regarding size and weight

Size, Weight and Protection	
weight	15.7 kg
dimensions W x H x D (without handle)	450 x 145 x 390 mm
housing	IP20 according to EN 60529

6.9 Cleaning

To clean the CMC 256, use a cloth dampened with isopropanol alcohol or water.

6.10 The *EnerLyzer* Measurement Option

Optionally, each of the ten binary inputs in the section BINARY / ANALOG INPUT can be configured as analog measurement inputs for DC and AC voltages up to 600 V[1].

As the analog inputs of the CMC 256 are voltage inputs, active current clamps with voltage outputs have to be used to measure currents.

OMICRON offers the C-PROBE1 as a suitable current clamp. (Refer to Section 9.4, "Current Clamp C-PROBE1" on page 105.) This current clamp is not included in the deliverables of the *EnerLyzer* measurement option and must be ordered separately.

The CMC 256 also supports other current clamps.

☞ Please note that all clamps must be active current clamps with voltage output or current clamps with a shunt.

For questions, please contact OMICRON (see "Contact Information / Technical Support" on page 109).

The *EnerLyzer* option contains:

- The *EnerLyzer* software module that can be started from within the OMICRON Test Universe.
- The "*EnerLyzer* Measurement Options" software manual in PDF format.

☞ The CMC 256 can be upgraded with the *EnerLyzer* option at any time.

[1] Up to three inputs can be used for measuring rms values without the *EnerLyzer* option.

6.10.1 General Data

The analog measurement inputs have five measurement ranges that can be individually configured in the test module *EnerLyzer*.

- 100 mV
- 1 V
- 10 V
- 100 V
- 600 V

These range limits refer to the respective rms values of the sinusoidal shaped input signals. The ranges 100mV, 1V, 10V and 100V could be overloaded approximately with 10%.

Input impedance: 500 kOhm // 50 pF for all measurement ranges.

Overload protection: 600 V_{rms} (±850 V_{peak}) from reference potential N, from another input, or protective ground (GND).

The sampling rate is configurable by the software:

- 28.44 kHz
- 9.48 kHz
- 3.16 kHz

Three different operating modes are possible:

- Multimeter Mode
- Harmonic Analyzer
- Transient Analyzer

6.10.2 Multimeter Mode

This operating mode is designed for measuring steady-state signals (e.g., also non-sinusoidal shaped). Measurements such as rms values, phase angle, frequency, etc. can be made.

The input signals are processed in real time without delay.

6.10.2.1 Accuracy AC Measurements

Conditions: integration time 1 s, measurement signal sinusoidal, excitation 10-100%, accuracy references the measurement full scale values.

Table 6-25:
Sampling rate 28.44 kHz, measurement range 600 V, 100 V, 10 V, 1 V

Frequency range	Accuracy	
	typical	guaranteed
DC	±0.15%	±0.40%
10 Hz ... 100 Hz	±0.06%	±0.15%
10 Hz ... 1 kHz	+ 0.06% / -0.11%	±0.25%
10 Hz ... 10 kHz	+ 0.06% / -0.7%	±1.1%

Table 6-26:
Sampling rate 28.44 kHz, measurement range 100 mV

Frequency range	Accuracy	
	typical	guaranteed
DC	±0.15%	±0.45%
10 Hz ... 100 Hz	±0.1%	±0.3%
10 Hz ... 1 kHz	+ 0.15% / -0.2%	±0.5%
10 Hz ... 10 kHz	+ 0.15% / -1.0%	±2%

Table 6-27:
Sampling rate
9.48 kHz
3.16 kHz
measurement range 600 V, 100 V, 10 V, 1 V

Frequency range	Accuracy	
	typical	guaranteed
DC	±0.15%	±0.45%
10 Hz ... 100 Hz	±0.08%	±0.2%
10 Hz ... 1 kHz	+ 0.1% / -0.3%	±0.5%
10 Hz ... 4 kHz (sampling rate 9.48 kHz)	+ 0.1% / -0.5%	±1.2%
10 Hz ... 1.4 kHz (sampling rate 3.16 kHz)	+ 0.1% / -0.5%	±1.0%

Table 6-28:
Sampling rate
9.48 kHz
3.16 kHz
measurement range
100 mV

Frequency range	Accuracy	
	typical	guaranteed
DC	±0.15%	±0.5%
10 Hz ... 100 Hz	±0.1%	±0.35%
10 Hz ... 1 kHz	+ 0.15% / -0.35%	±0.5%
10 Hz ... 4 kHz (sampling rate 9.48 kHz)	+ 0.15% / -0.6%	±1.2%
10 Hz ... 1.4 kHz (sampling rate 3.16 kHz)	+ 0.15%/ -0.6%	±1.2%

The accuracy data contains linearity, temperature, long-term drift, and frequency.

Figure 6-11:
Typical frequency response with a sampling rate of 28.44 kHz and an input voltage of 70 V[1]

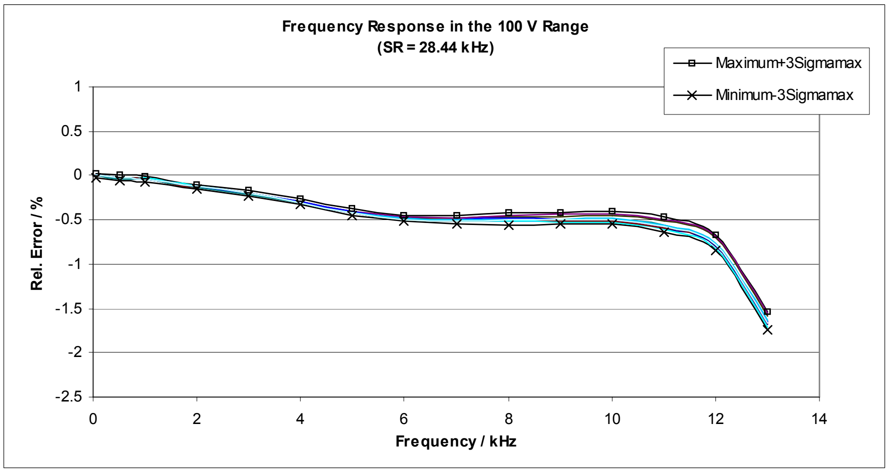
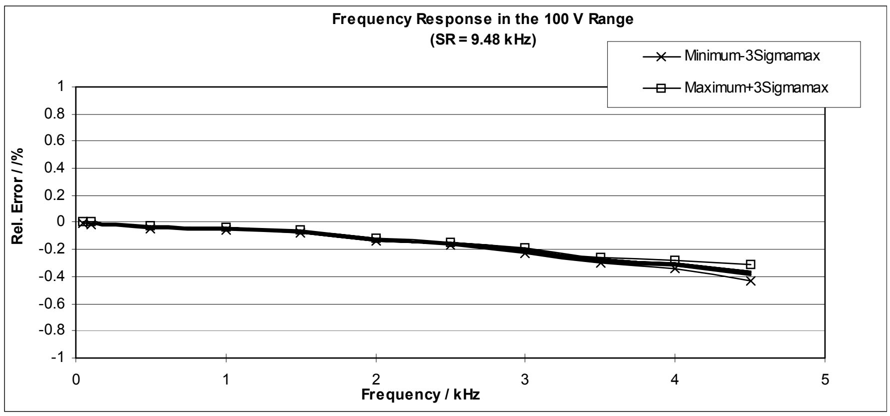


Figure 6-12:
Typical frequency response with a sampling rate of 9.48 kHz and an input voltage of 70 V[1]

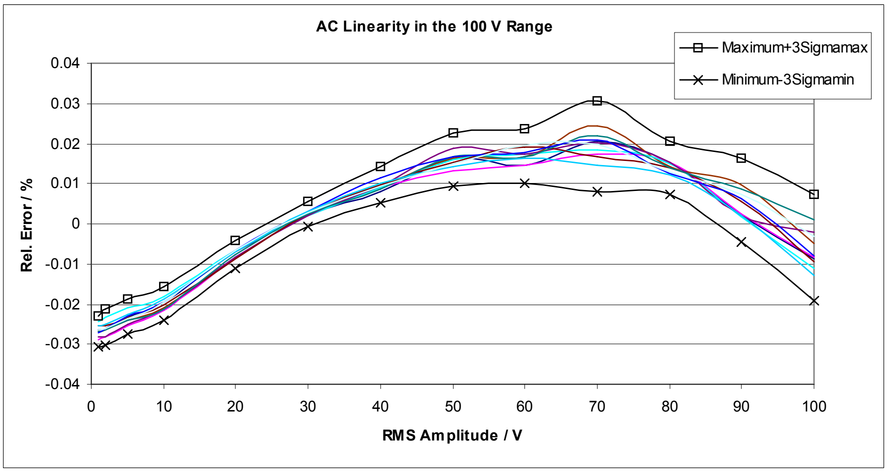


---

[1] a) Relative error: $\frac{\text{Actual - Expected}}{\text{Full Scale}} \cdot 100\%$

b) $3Sigma_{max}$ represents the maximum of the 3Sigma values of all 10 input channels. The $3Sigma_{max}$ value of an analog input are determined from 50 measurement values.

Figure 6-13:
Typical AC linear progression at 50 Hz and a sampling rate of 28.44 kHz[1]



6.10.2.2 Channel Cross-Talk

Conditions: sinusoidal form infeed on a channel without overload, AC measurement on neighboring channel, integration time 1 s.

Table 6-29:
Cross talk dampening on channels of the same potential groups in dB at f=50 Hz

Measurement range	600 V	100 V	10 V	1 V	100 mV
Dampening in dB	80	105	95	120	120

Table 6-30:
Cross talk dampening on channels of the same potential groups in dB at f=500 Hz

Measurement range	600 V	100 V	10 V	1 V	100 mV
Dampening in dB	65	80	75	95	95

The cross-talk dampening on a neighboring channel of an other potential group is greater than 120 dB in all measurement ranges (f=50 Hz or 500 Hz).

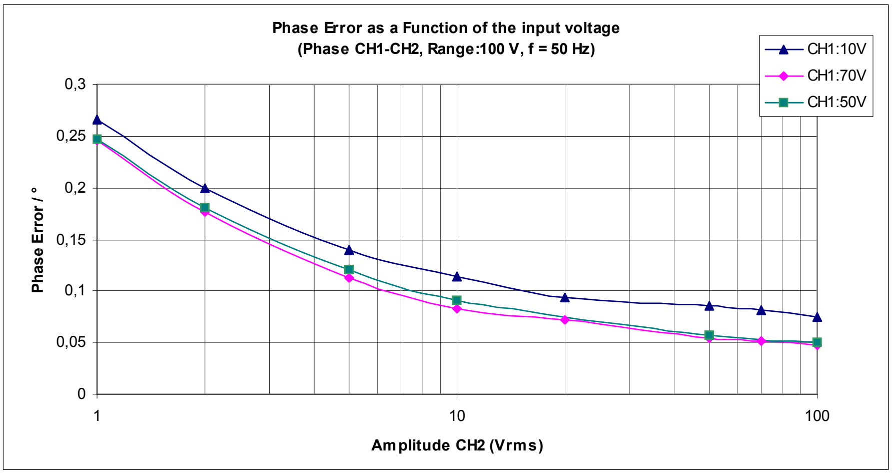
---

[1] a) Relative error: $\frac{\text{Actual - Expected}}{\text{Full Scale}} \cdot 100\%$

b) $3Sigma_{max}$ represents the maximum of the 3Sigma values of all 10 input channels. The $3Sigma_{max}$ value of an analog input are determined from 50 measurement values.

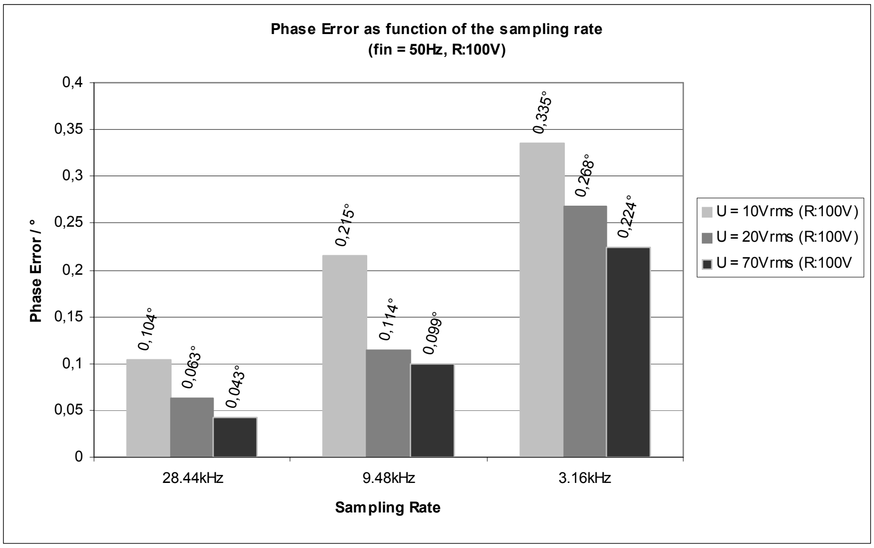
6.10.2.3 Accuracy Phase Measurement

Figure 6-14:
Phase error is a function of the input voltage



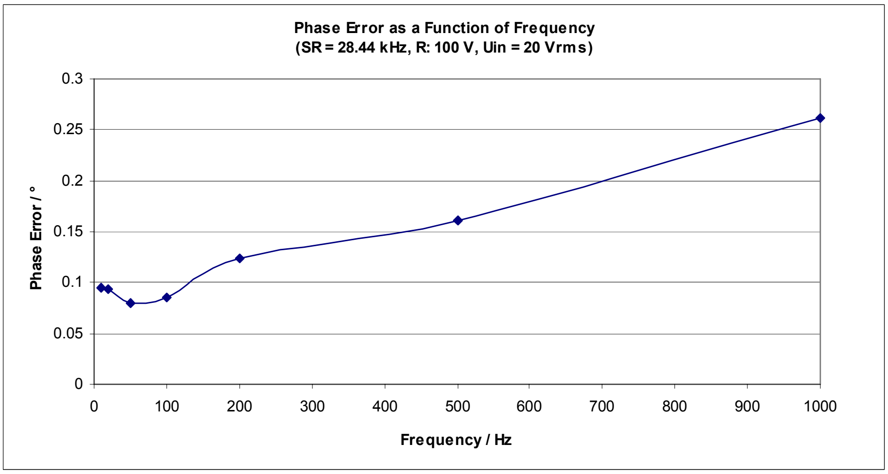
Conditions: integration time 1 s, measurement signal sinusoidal, measurement range 100 V, f=50 Hz, sampling rate 28.44 kHz.

Figure 6-15:
Phase error as a function of the sampling rate



Conditions: integration time 1 s, measurement signal sinusoidal, f=50 Hz, measurement range 100 V, both channels same excitation (20 V, 70 V).

Figure 6-16:
Typical phase error as a function of the input frequency



Conditions: integration time 1 s, measurement signal sinusoidal, sampling rate = 28.44 kHz, measurement range 100 V, excitation on both channels 20 V_{rms}.

The maximum input frequency for the phase measurement depends on the sampling rate.

Table 6-31:
Sampling rate and input frequency range

Sampling rate	Input frequency range
28.44 kHz	10 Hz ... 2.30 kHz
9.48 kHz	10 Hz ... 750 Hz
3.16 kHz	10 Hz ... 250 Hz

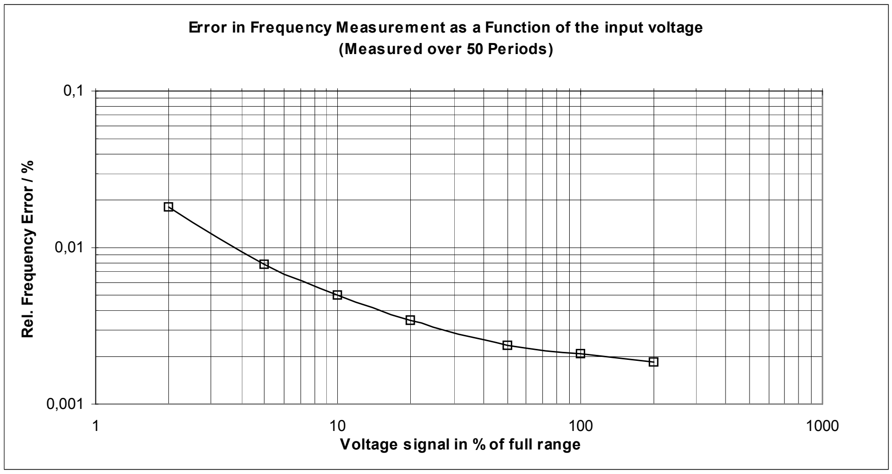
☞

Note:

1. The measurement accuracy of phase can be improved by:
   - increasing the integration time
   - enabling the recursive averaging function
2. When measuring very small phase shifts (less than 0.2°), the sign (positive or negative) of the measurement results can not be definitely determined. If this causes a problem, please refer to the phase measurement in the harmonic analysis.
3. For measuring phase, the input voltage should be greater than 5% of full scale. An overload of the measurement channel does not negatively affect the obtainable accuracy.

6.10.2.4 Accuracy of the Frequency Measurement

Figure 6-17:
Error in the frequency measurement as a function of the input voltage



Conditions: integration time 1 s, measurement signal sinusoid.

The maximum input frequency for the frequency measurement depends on the sampling rate.

Table 6-32:
Sampling rate and input frequency range.

Sampling rate	Input frequency range
28.44 kHz	10 Hz ... 1500 Hz
9.48 kHz	5 Hz ... 500 Hz
3.16 kHz	5 Hz ... 150 Hz

Conditions: Excitation greater than 10% from measurement full scale, duty cycle 50%.

Note:

With the harmonic analysis, input frequencies up to 3.4 kHz can be measured.

6.10.2.5 Accuracy Power Measurement

General

The power is calculated from one current channel and one voltage channel:

Real power: $P = \frac{1}{T} * \int_0^T u(t) * i(t) dt$ [W]

Apparent power: **S** = V_{rms} x I_{rms} [VA]

Reactive power: **Q** = $\sqrt{S^2 - P^2}$ *sign_Q [var]

$U_{rms} = \sqrt{\frac{1}{T} * \int_0^T u(t)^2 dt}$, $I_{rms} = \sqrt{\frac{1}{T} * \int_0^T i(t)^2 dt}$

Accuracies

Conditions: integration time 1s, measurement signal sinusoidal, excitation 10-100%, accuracy references the apparent power, error of the current clamp is not taken into consideration

Table 6-33: Sampling rates 28.44kHz 9.48kHz 3.16kHz

Frequency range	Power	Accuracy[1]	
AC		typical	guaranteed
10Hz ... 100Hz	S	±0.3%	±0.7%
	P	±0.3%	±0.7%
	Q	±0.8%	±2%

Table 6-34: Sampling rate 28.44kHz

Frequency range	Power	Accuracy[1]	
AC		typical	guaranteed
10Hz ... 2.2kHz	S	+0.3% / -1.2%	±2.5%
	P	+0.3% / -1,2%	±2.5%
	Q	+0.8% / -2.5%	±3.5%

1 Relative error: $\frac{\text{Actual - Expected}}{\text{Nominal value apparent power}} \cdot 100\%$
S = Apparent power
P = Real power
Q = Reactive power

Table 6-35:
Sampling rate
9.48kHz

Frequency range	Power	Accuracy[1]	
AC		typical	guaranteed
10Hz ... 750Hz	S	+0.3% / -0.7%	±1.8%
10Hz ... 750Hz	P	+0.3% / -0.7%	±1.8%
10Hz ... 750Hz	Q	+0.8% / -1.2%	±2.5%

Table 6-36:
Sampling rate
3.16kHz

Frequency range	Power	Accuracy[1]	
AC		typical	guaranteed
10Hz ... 250Hz	S	+0.3% / -0.5%	±1.3%
10Hz ... 250Hz	P	+0.3% / -0.5%	±1.3%
10Hz ... 250Hz	Q	+0.8% / -1%	±2.2%

Table 6-37:
DC accuracy

	Power	Accuracy[1]	
DC		typical	guaranteed
	P, S	±0.3%	±0.9%

[1] Relative error: $\frac{\text{Actual - Expected}}{\text{Nominal value apparent power}} \cdot 100\%$

S = Apparent power
P = Real power
Q = Reactive power

Note:

The accuracy specifications include linearity, temperature, ageing drift, frequency and phase response.

Typical relative error as a function of the excitation

Figure 6-18:
Typical error of the apparent power S as a function of the excitation, fs=28.44kHz, fin=50Hz

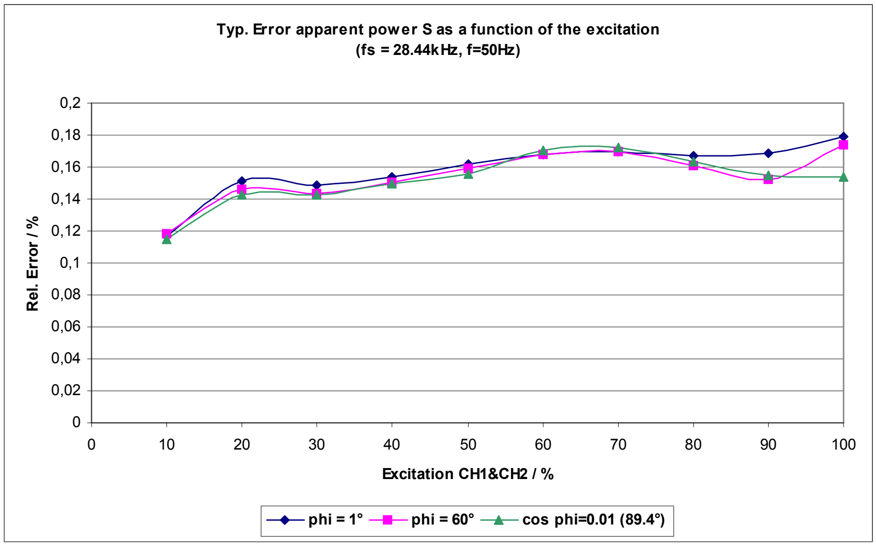


Figure 6-19:
Typical error of the real power P as a function of the excitation considering the apparent power, fs=28.44kHz, fin=50Hz

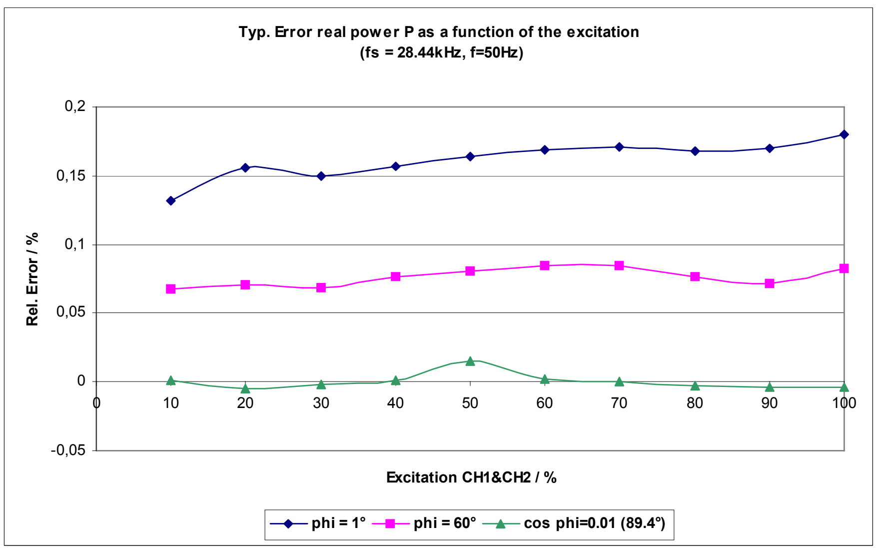
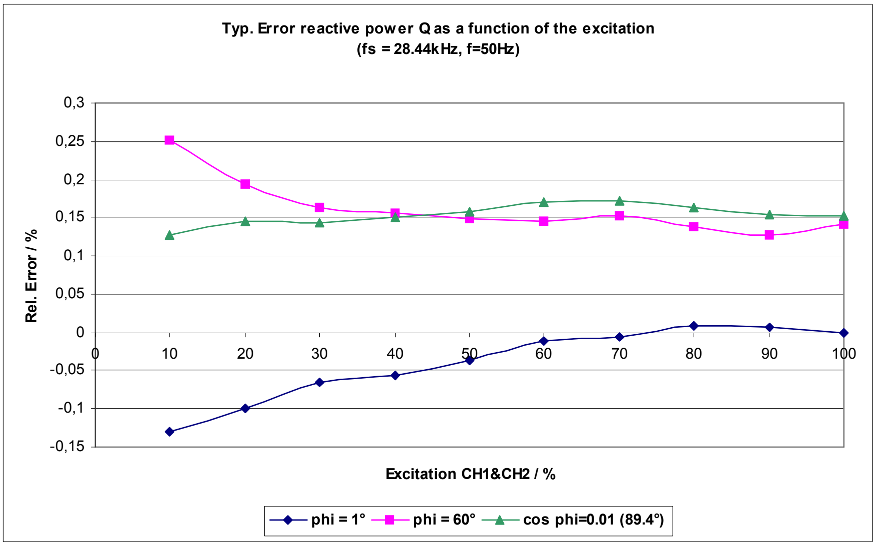
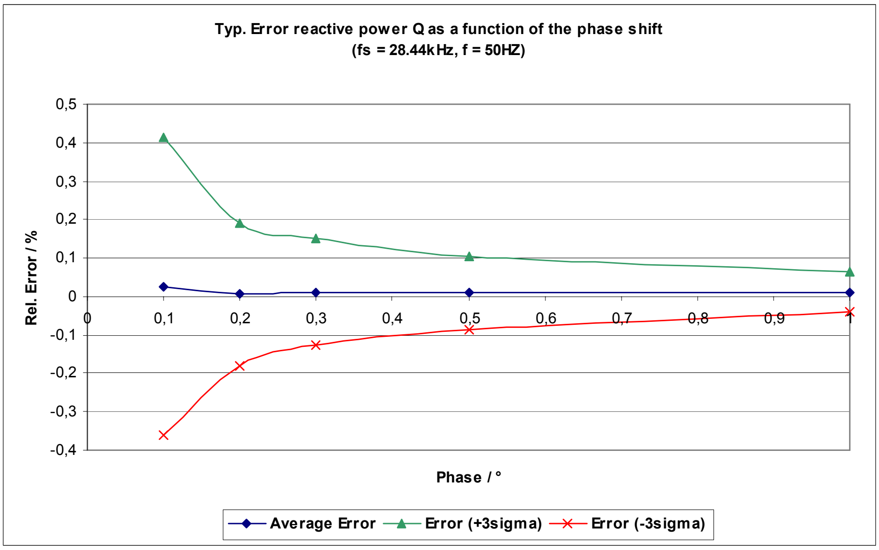


Figure 6-20:
Typical error of the reactive power Q as a function of the excitation,
fs=28.44kHz, fin=50Hz



Conditions:
integration time 1s, measurement signal sinusoid, sampling rate = 28.44kHz, fin = 50Hz

Figure 6-21:
Typical error[1] of the reactive power Q as a function of the phase shift considering the apparent power,
fs=28.44kHz, fin=50Hz,
excitation CH1 and CH2 = 70%.



[1] The 3Sigma values are determined from 50 measurement values.

Conditions:
integration time 1s, measurement signal sinusoidal, sampling rate = 28.44kHz, both channels with same excitation 70%

Note:

- For very small phase shifts (<0,3°) and small excitation (<10%), too small integration time (<1s) or sampling rate 3.16kHz, the sign of the reactive power can not be definitely determined.
- The accuracy of the power measurement depends primarily on the accuracy of the current clamp (refer to Section 9.4, "Current Clamp C-PROBE1" on page 105).

6.10.3 Harmonic Analyzer

This operating mode is designed for measuring stationary signals (e.g., not sinusoid shaped). The input signal is separated into fundamental and harmonic waves (Fourier Analysis).

The following items are measured:

- frequency of the fundamental wave
- amplitude of the fundamental and harmonic waves
- phase shifts between the fundamental and harmonic waves (also from the different channels)

The input signals are captured. Finally, the calculation of the measurement items is carried out. During this time, the input signal is not taken into consideration.

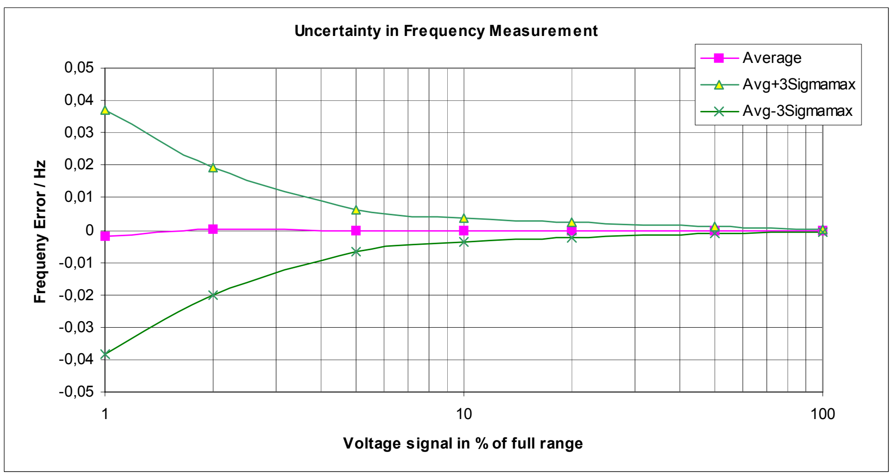
6.10.3.1 Accuracy of the Frequency Measurement

The permitted input frequency range depends on the specified sampling rate:

Table 6-38:
Sampling rate and input frequency range

Sampling rate	Input frequency range
28.44 kHz	49 Hz ... 3400 Hz
9.48 kHz	17 Hz ... 1100 Hz
3.16 kHz	5 Hz ... 380 Hz

Figure 6-22:
Error in the frequency measurement as a function of the voltage signal



Conditions: sampling rate 9.48 kHz, fin=20 Hz ... 1 kHz

Note:

Through recursive averaging, the measurement uncertainty can be reduced further.

6.10.3.2 Accuracy Amplitude Measurement

The measurement values are given as effective values (rms values).

The permitted input frequency range for the fundamental wave depends on the specified sampling rate:

Table 6-39:
Sampling rate and input frequency range

Sampling rate	Input frequency range
28.44 kHz	100 Hz(=fmin) ... 3200 Hz
9.48 kHz	30 Hz(=fmin) ... 1000 Hz
3.6 kHz	10 Hz (=fmin) ... 350 Hz

Valid for fundamental and harmonic waves in specified frequency range; accuracy refers to full scale.

Table 6-40:
Sampling rate 28.44 kHz, measurement range 600 V, 100 V, 10 V, 1 V

Frequency range	Accuracy	
	typical	guaranteed
fmin ... 1 kHz	±0.1%	±0.3%
fmin ... 10 kHz	+ 0.1% / -0.7%	±1.1%

Table 6-41:
Sampling rate 28.44 kHz, measurement range 100 mV

Frequency range	Accuracy	
	typical	guaranteed
fmin ... 1 kHz	±0.2%	±0.5%
fmin ... 10 kHz	+ 0.2% / -1.0%	±2.0%

Table 6-42:
Sampling rate
9.48 kHz
3.16 kHz
measurement range 600 V, 100 V, 10 V, 1 V.

Frequency range	Accuracy	
	typical	guaranteed
fmin ... 100 Hz	±0.1%	±0.3%
fmin ... 1 kHz	+ 0.1% / -0.5%	±0.8%
fmin ... 4 kHz (sampling rate = 9.48 kHz)	+ 0.1% / -0.8%	±1.2%
fmin ... 1.4 kHz (sampling rate = 3.16 kHz)	+ 0.1% / -0.8%	±1.2%

Table 6-43:
Sampling rate
9.48 kHz
3.16 kHz
measurement range
100 mV

Frequency range	Accuracy	
	typical	guaranteed
fmin ... 100 Hz	±0.15%	±0.4%
fmin ... 1 kHz	±0.2% / -0.5%	±0.8%
fmin ... 4 kHz (sampling rate = 9.48 kHz)	+ 0.2% / -1.0%	±1.5%
fmin ... 1.4 kHz (sampling rate = 3.16 kHz)	+ 0.25% / -1.0%	±2.0%

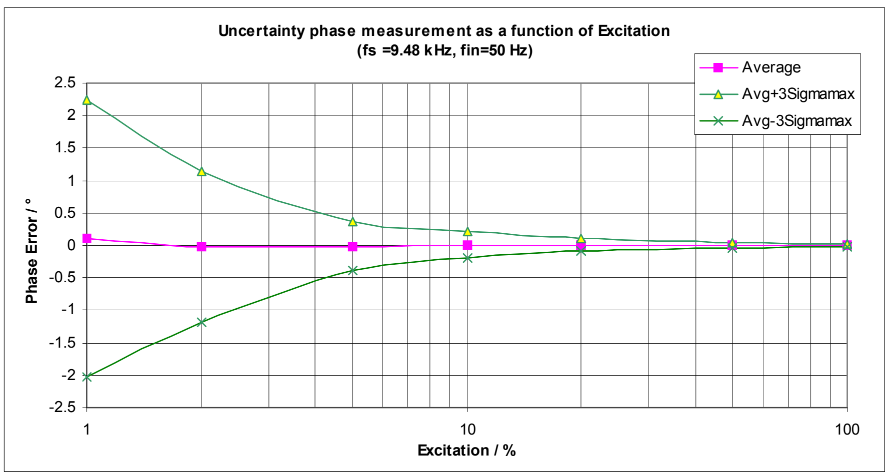
6.10.3.3 Accuracy of Phase Measurement

The permitted input frequency range for the fundamental wave depends on the specified sampling rate:

Table 6-44:
Sampling rate and input frequency range

Sampling rate	Input frequency range
28.44 kHz	100 Hz ... 3200 Hz
9.48 kHz	30 Hz ... 1000 Hz
3.16 kHz	10 Hz ... 350 Hz

Figure 6-23:
Phase error is a function of the excitation



Conditions: sampling rate 9.48 kHz, fin=50 Hz.

Note:
Through recursive averaging, the measurement uncertainty can be reduced further.

6.10.4 Transient Analyzer

In this operating mode, transient signals on up to 10 input channels can be synchronously recorded.

The recording starts whenever a pre-defined trigger condition is met. The selectable trigger conditions are:

- Trigger on threshold with positive or negative edge
- Combination of different power quality triggers (sag, swell, harmonic, frequency, frequency change, notch)

In addition, a time offset for the capture window relative to the trigger time point can be specified.

The trigger delay can be

- positive (recording begins after the trigger time point)
- or negative (recording begins already before the trigger time point).

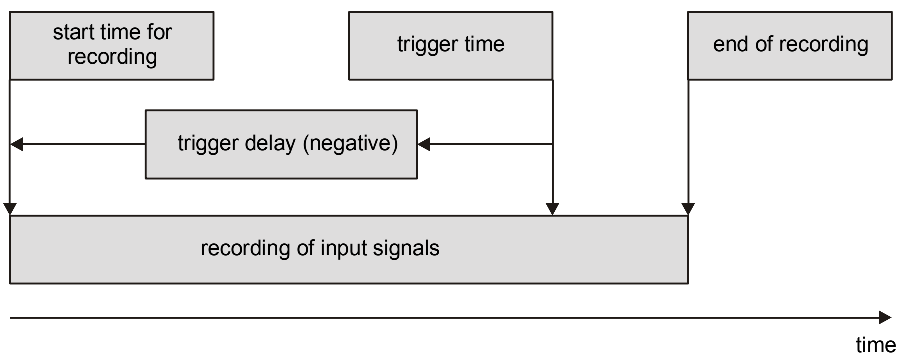


Figure 6-24: Illustration of the relationship between trigger time points, trigger delay, and recording time

Note:
More details about possibilities for triggering can be found in the online help delivered with the OMICRON Test Universe and in the practical examples in the option *EnerLyzer*.

The maximum length of the recording depends on the settings for the sample rate and the number of channels to be captured.

Table 6-45:
The maximum recording time is dependent on the number of active channels and the sampling frequency

Number of active channels	Maximum recording time [s] at fs = 28.4 kHz	Maximum recording time [s] at fs = 9.48 kHz	Maximum recording time [s] at fs = 3.16 kHz
1	35.16	105.47	316.41
2	17.58	52.73	158.20
3	11.72	35.16	105.47
4	8.79	26.37	79.10
5	7.03	21.09	63.28
6	5.86	17.58	52.73
7	5.02	15.07	45.20
8	4.40	13.18	39.55
9	3.91	11.72	35.15
10	3.52	10.55	31.64
11[1]	3.20	9.59	28.76

[1] all binary inputs are stored as **one** channel.

Accuracy of the sampling value:

- measurement range 600 V, 100 V, 10 V, 1 V: ±0.2% typical
±0.5% guaranteed
- measurement range 100 mV: ±0.3% typical
±0.6% guaranteed

The accuracy data are full scale errors.

6.11 The EP Option (Extended Precision)

The following specifications relate to a CMC 256 with EP (Extended Precision) option. Only the specification differences of a CMC 256 EP are mentioned here.

The EP option is characterized by:

- the specified accuracy of the output power
- the aptitude for testing meters of class 0.2 according to IEC 62053 (formerly IEC 60687)
- the higher accuracy of the power outputs (current and voltage amplifiers)

The expansion of a CMC 256 with the EP option is also subsequently possible.

6.11.1 Generator Outputs General

The standard specifications of the generator outputs can be found in Section 6.3, "Outputs" on page 43.

Table 6-46:
Analog current and voltage outputs

Analog current and voltage outputs (VOLTAGE OUTPUT, CURRENT OUTPUT)		
	typical	guaranteed
phase error	0.005°	< 0.02°
temperature drift	0.0025%/°C	

6.11.2 Current Outputs (CURRENT OUTPUT)

The standard specifications of the current outputs can be found in Section 6.3.1, "CURRENT OUTPUT A" on page 44.

The specification of the accuracy is valid for CURRENT OUTPUT A and B.

Table 6-47:
3 current outputs
CMC 256 EP

3 current outputs[1] CMC 256 EP		
	typical	guaranteed
accuracy[2]	error < 0.02%	error < 0.05%

1 Data for three-phase systems are valid for symmetric conditions (0°, 120°, 240°).
2 Percentage data references the full scale.

6.11.3 Voltage Outputs (VOLTAGE OUTPUT)

The standard specifications of the voltage outputs can be found in Section 6.3.5, "Voltage Outputs" on page 49.

Table 6-48:
4 voltage outputs
CMC 256 EP

4 voltage outputs[1] CMC 256 EP		
	typical	guaranteed
accuracy[2]	error < 0.02%	error < 0.05%

1 Data for three-phase systems are valid for symmetric conditions (0°, 120°, 240°).
2 Percentage data related to the set value in the voltage range 50…300V.

6.11.4 Output Power CMC 256 EP

Table 6-49:
Output power
CMC 256 EP

Output power CMC 256 EP		
	typical	guaranteed
accuracy[1]	error < 0.05%	error < 0.1%
output power temperature drift	0.001%/°C	< 0.005%/°C

1 Data are valid for set value (relative error) from 0.1 to 12.5A (current amplifier A or B) and 50 to 300V (voltage amplifier) at 50/60Hz.
Permissible load for current outputs:
Range 1.25A: 0 to 1Ω and 1VA max., cos φ = 0.5 to 1
Range 12.5A: 0 to 0.5Ω and 6VA max., cos φ = 0.5 to 1
Permissible load for voltage outputs:
10VA max. at 50 to 300V, cos φ = 0.5 to 1

6.12 The NET-1 Option (CMC 256 with Ethernet)

The NET-1 option consists mainly of an additional, high performance 32-bit RISC micro-processor with the following interfaces:

- ETH1: 10/100Base-TX (twisted pair) Ethernet interface (used as the control interface for the test set)
- ETH2: 100Base-FX (fiber) Fast Ethernet interface

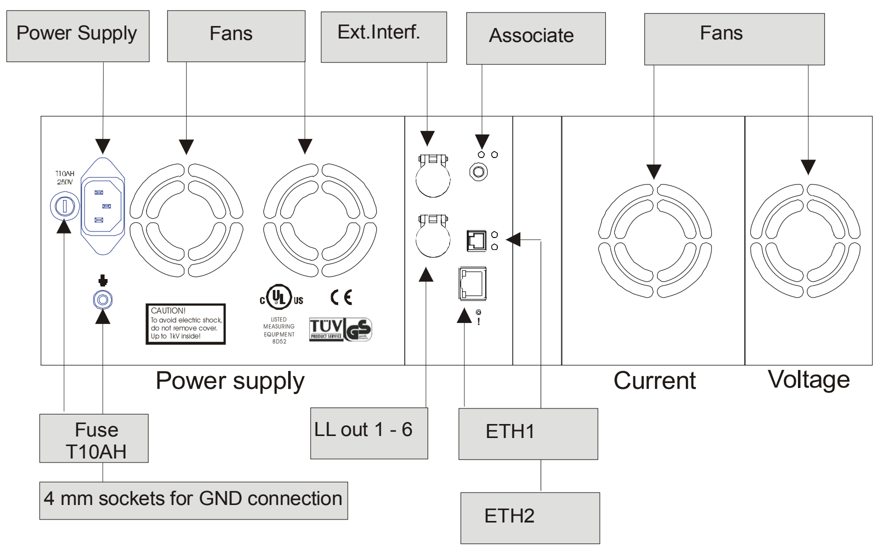
Since the test set can be controlled over a network, any distance between the controlling computer and the test set is possible. Due to this, the possibility for direct remote control of the test set (e.g. for end-to-end testing) is provided.

The NET-1 option also provides the basis for the processing of substation protocols according to the UCA 2.0 specification and the IEC 61850 standard. The two Ethernet interfaces allow flexible configurations, e.g. for separation of data traffic from different network segments or segregation of substation protocol data and test set control commands.

An upgrade of the standard CMC 256 with the NET-1 option is possible.

6.12.1 Connections and Interfaces

Figure 6-25:
Rear view of the CMC 256 with the NET-1 option



See description in Section 4.1.9, "Other SELV Interfaces" on page 27 and Section 5.2, "Connections on the Back Panel" on page 36.

ETH1 (10/100Base-TX, twisted pair)

ETH1 is a standard 10/100Mbit twisted pair Ethernet interface. It is normally used for the communication with the PC to control the test set.

The ETH1 interface supports auto crossing (auto MDI/MDIX). This means that a standard cable or a cross-over Ethernet patch cable can be used.

The lower green LED indicates a link connection to a PC or a network. The upper yellow LED indicates if a data traffic signal (receive or transmit) is active on the cable.

Connect ETH1 only to Ethernet based interfaces. Do not connect it to PSTN (Public Switched Telephone Networks).

ETH2 (100Base-FX, optical fiber)

ETH2 is a standard 100Mbit optical fiber interface, which has a small form factor MT-RJ fiber connector.

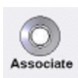
After disconnecting the fiber patch, please insert the dust cover on the fiber connector.

The lower green LED indicates a link connection to a PC or a network.

The upper yellow LED indicates when a data traffic signal (receive or transmit) is active on the cable.

Laser Class 1 Product (related to IEC 60825)

Associate Button



The Associate button has the following functions:

- **Associate with Controlling PC**
  Due to the Ethernet communication interface, it is possible to communicate to any CMC available on the network. This could 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 special mechanism is integrated into the CMC 256 with the NET-1 option that allows only “authorized” clients to control the test set. By using the Associate button, the test set is registered for use with a specific host PC. The test set will emit voltages and current only when it is associated to the client requesting this. This association will be stored in the test set and remembered until it is changed to a different host PC. The association process can only be initiated by a software component delivered with the OMICRON Test Universe software. For more details about this process, refer to the software’s online help.

  For the association the Ethernet hardware (MAC) address of the controlling PC is remembered. Consequently, if the network interface on the PC has changed or if multiple network cards are installed on the PC, the CMC 256 has to be associated whenever the MAC address changes.

- **Reset IP Configuration**
  The Associate button has an additional effect if pressed during power-up of the test set. If the button is pressed while powering up the CMC 256, the IP configuration of the network interfaces is reset to factory default which is DHCP/AutoIP for both network interfaces. It may be necessary to reset the IP configuration in this way to recover from settings with conflicting static IP addresses.

! 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 such as a paper clip during power-up of the test set. If you press the ! button while powering the CMC 256, the test set will not start as usual but wait for a new software image download.

Status LED A, B

The status LED’s A and B are only of interest in case of a troubleshoot condition.

A: yellow LED

The LED is on if the CMC 256 is ready for use and controlled by a PC.
The LED is off if the CMC 256 is waiting for an emergency software image download after pressing the ! button during power-up of the test set. For details, see "! Button" on page 85.

B: green LED

The LED is on while the flash memory of the CMC 256 is accessed.

6.12.2 Technical Data

Ethernet 1 (ETH1)	
type	10/100Base-TX (10/100Mbit, twisted pair, auto-MDI/MDIX or auto crossing)
connector	RJ45
cable type	LAN cable of category 5 (CAT5) has to be used
status indication	LED green: valid link exists LED yellow: traffic on interface

Ethernet 2 (ETH2)	
type	100Base-FX (100Mbit, fiber, duplex)
connector	MT-RJ
cable type	50/125 μm or 62.5/125 μm (duplex patch cable)
cable length	> 1 km possible
status indication	LED green: valid link exists LED yellow: traffic on interface
⚠	This is a product of Laser Class 1 (IEC 60825)

6.12.3 Ethernet / Network Settings

General

The OMICRON Test Universe software running on the PC communicates with the CMC 256 with the NET-1 option via a network connection. Therefore it is possible both to have the CMC 256 directly connected to the PC's network plug by a cable and to have the CMC 256 and the controlling PC connected to the same computer network.

Both network ports can be used interchangeably, but ETH1 is primarily used to connect to a PC to control the test set and ETH2 for substation communication. Both network ports have link LEDs (green) and traffic LEDs (yellow flashing) to check the physical connectivity and proper cabling.

IP Configuration

For communication of the CMC 256 NET-1 with the controlling PC the test set and the OMICRON Test Universe software use a DCOM connection over TCP/IP. The TCP/IP settings are done via the Test Set Association and Configuration component included in the Test Universe software. The CMC 256 NET-1 can either be set to static IP addresses or use DHCP (Dynamic Host Configuration Protocol) and AutoIP/APIPA (Automatic Private IP Addressing). Additionally there is a DHCP allocator (small DHCP server) integrated in the CMC 256 NET-1 to serve IP addresses for a directly connected PC, which is activated only if there is no network DCHP-server and only for the PC, where the OMICRON Test Universe software is running.

If the IP settings conflict with static IP addresses of other devices in the network, it is possible to reset the device to factory defaults (DHCP and AutoIP) by pressing the Associate button on the back of the test set while powering up the device (see "Associate Button" on page 84).

Security / Firewall Settings

To automatically detect and set the IP configuration of CMC 256 NET-1 test sets in the network and to set their IP configuration IP-multicasting is used by the Test Universe software. Therefore a firewall program has to be configured to allow for this communication in addition to allow for DCOM communication. For the Microsoft Windows Firewall in Windows XP SP2 the configuration of the firewall is done automatically during installation of the OMICRON Test Universe.

The software component on the PC which automatically detects test sets on the network (OMFind.exe) has to be allowed for an inbound connection on port 4987 for UDP. The software component on the PC which controls the test sets (CMEngAl.exe) has to be allowed for DCOM communication over TCP/IP.

Network Troubleshooting

For a detailed and up-to-date list of How-Tos and FAQs, see the OMICRON Networking FAQ document "Network-based test sets FAQ.pdf" included in the Test Universe Software documentation folder.

7 Increasing the Output Power, Operating Modes

CMC 256 has a very large application diversity. The current outputs offer enough output power that a variety of electromechanical relays can be tested.

In particular, the CMC 256 offers a variety of types of single-phase operation using its two galvanically separated current triples with which the output power from the units can be significantly increased.

In cases when the current or the output power – or even the number of independent voltages or currents – is insufficient, it is possible to switch individual amplifier groups of the CMC 256 in parallel or to connect external amplifiers (up to six independent additional channels) to the "LL out 1-6".

The following illustrated operating types can be set based on their corresponding types in the hardware configuration with the "OMICRON Test Universe."

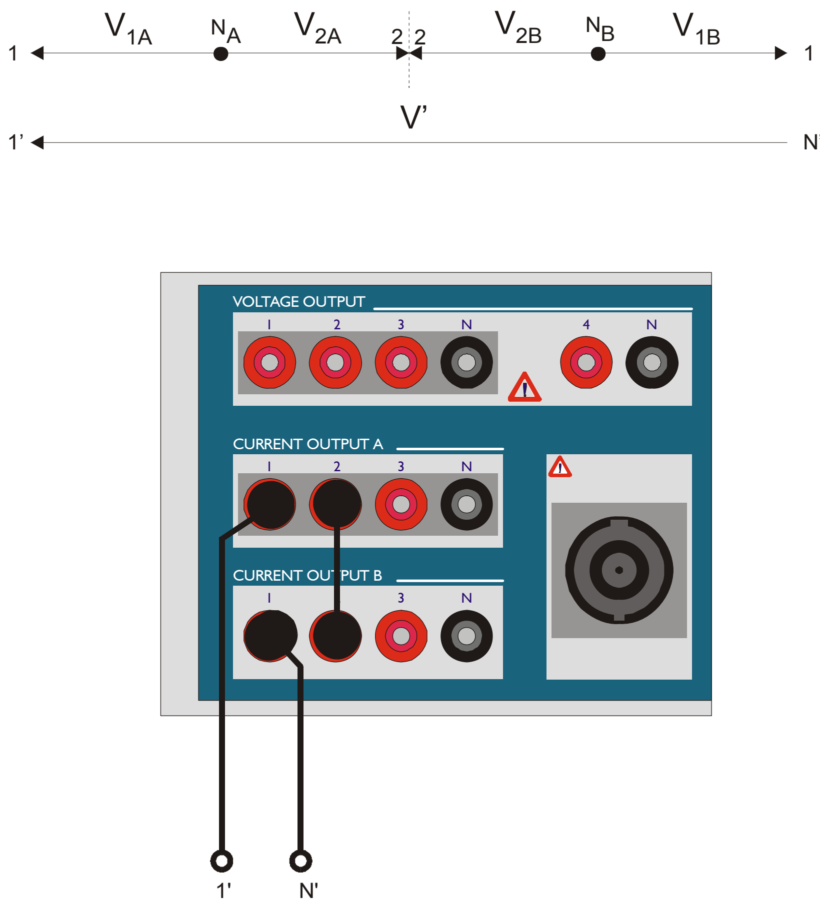
7.1 Single-Phase Operation of the CMC 256

7.1.1 Connecting CURRENT OUTPUT A and CURRENT OUTPUT B in Series

1 x 0 ... 12.5 A, max. 40 V_{rms}, 1 x 320 VA at 8.5 A

Both amplifier groups CURRENT OUTPUT A and CURRENT OUTPUT B can also be connected in series (as is shown in the picture.) The current 1 and 2 of a group are phase opposite.

Figure 7-1:
Single-phase operation 4 x series



Refer to the output curves in Section 6.3.4, "Single-phase Operation for Output Currents" on page 47.

7.1.2 Series Connection of Current A (1+ 2+ 3 parallel) and Current B (1+ 2+ 3 parallel)

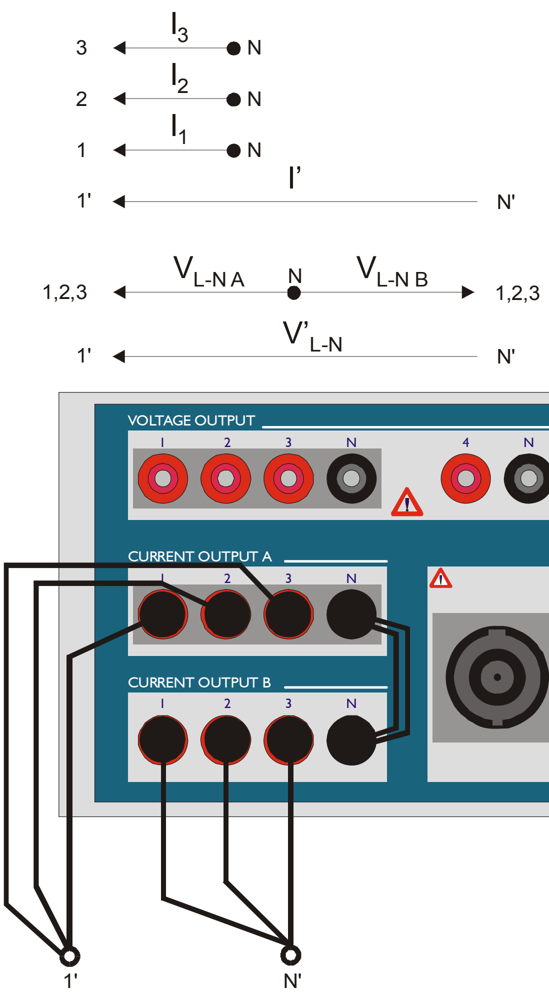
1 x 0 ... 37.5 A, max. 20 V_{rms}, 1 x 480 VA at 25.5 A

The currents 1, 2, and 3 of the groups A and B are switched in parallel (refer to Figure 7-2 below). In addition, the groups A and B are switched in series.

Note: Please verify that the test leads have sufficient diameter.

Every current socket can deliver up to 12.5 A_{rms} and the N-Socket up to 3 × 12.5 A_{rms} = 37.5 A_{rms}.

Figure 7-2:
Single-phase 3 x parallel /
2 x series



Refer to the output curves in Section 6.3.4, "Single-phase Operation for Output Currents" on page 47.

Note:

- The phase angles of all outputs of the group A must be identical.
- The phase angles of all outputs of group B must be identical plus in phase opposition to the phase angle of group A.
- The amplitude of all outputs for both groups must be set to the same value.

Because test leads (2 m length, 2.5 mm^2, 12.5 A) are subject to 2.5 W power loss, we recommend using the connection techniques from Figure 7-2, “Single-phase 3 x parallel / 2 x series” on page 91.[1]

WARNING:	
⚠	For currents greater than 25 A, the test object (load) should be exclusively connected to the 4 mm banana sockets and not on the generator connection socket.

[1] Double up the test leads for the N socket by using two test leads back to back. In addition ensure that the current outputs (1,2,3) are only connected together at the actual test object.

7.1.3 Parallel Switching CURRENT OUTPUT A with CURRENT OUTPUT B

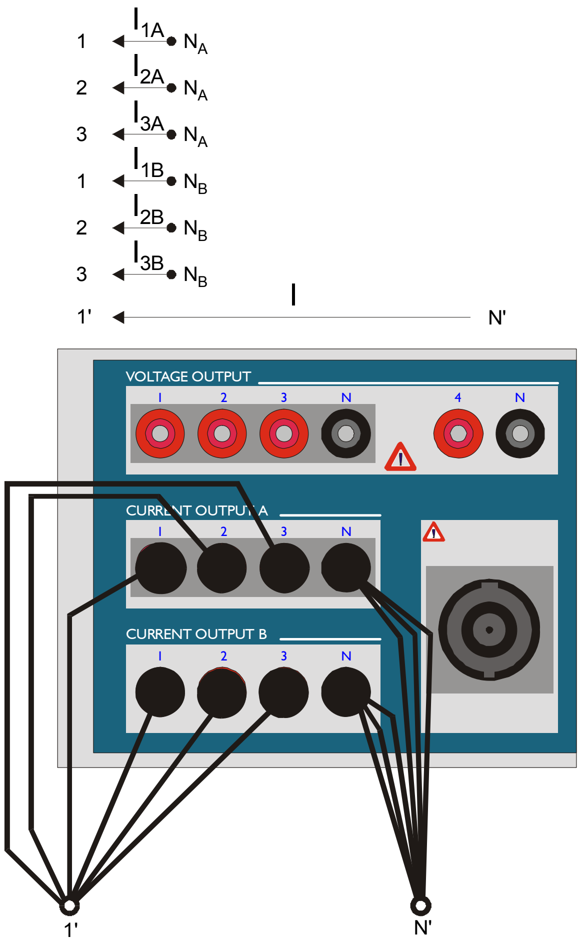
Parallel switching CURRENT OUTPUT A (1+ 2+ 3 parallel) with CURRENT OUTPUT B (1+ 2+ 3 parallel) [6 x parallel]

1 x 0 ... 75 A, max. 10 V_{rms}, 1 x 480 VA at 51 A

The currents 1, 2, and 3 of the Groups A and B are switched in parallel.

Please verify that the test leads have sufficient diameter.

Figure 7-3:
Single-phase operation
6 x parallel



Refer to the output curves in Section 6.3.4, "Single-phase Operation for Output Currents" on page 47.

All six current channels have to be set to the same phase and the same amplitude.

Because test leads (2 m length, 2.5 mm^2, 12.5 A) are subject up to 2.5 W power loss, we recommend using the connection techniques from Figure 7-3, “Single-phase operation 6 x parallel” on page 93.[1]

WARNING:

For currents greater than 25 A, the test object (load) should be exclusively connected to the 4 mm banana sockets and not on the generator connection socket.

[1] Triple up the test leads for the N socket by using two test leads back to back. In addition ensure that the current outputs (1,2,3) are only connected together at the actual test object.

7.1.4 Single-Phase Voltage

1 x 0 ... 300 V, 1 x 150 VA [75 ... 300 V] » typical 1 x 200 VA [100 ... 300 V]

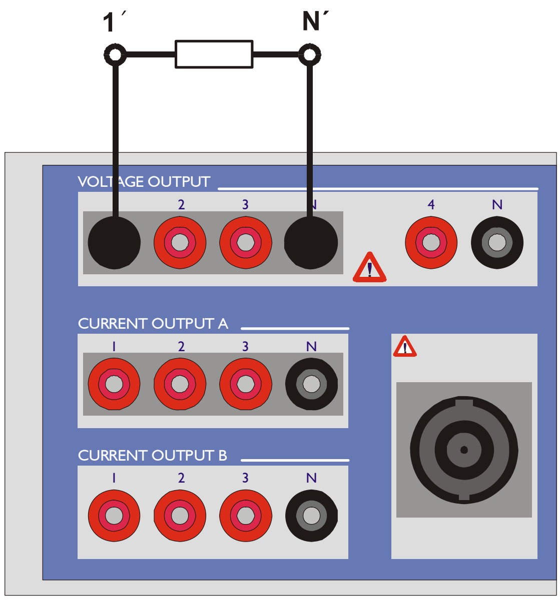


Figure 7-4:
Single-phase operation of the voltage system (L-N)

1 x 0 ... 600 V, 1 x 150 VA [150 ... 600 V] » typical 1 x 200 VA [200 ... 600 V]

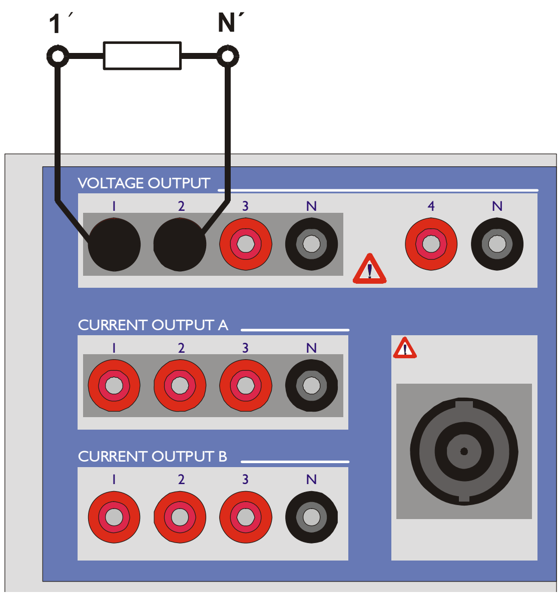


Figure 7-5:
Single-phase operation of the voltage system
(L-L phase opposition)

Refer to the output curves in Section 6.3.5, "Voltage Outputs" on page 49.

7.2 Operation with External Amplifiers

The connections "LL out 1-6" offers a large variety of extension possibilities through the connection of external amplifiers.

As such, higher currents and higher power outputs can be generated, or the number of independent voltage or current channels can be extended.

Applications which the CMC 256 alone cannot cover, thus become realizable.

Every output socket LL-out can be connect with up to four external amplifiers with six independent channels.

The following configurations are possible:

- 9 $\times$25 A_{rms} / 70 VA for differential relays in three galvanically separated current triples with CMC 256 + CMA 156
- 6 $\times$250 V / 75 VA for the synchronization in two galvanically separated voltage triples with CMC 256 + CMS 156

For a complete overview of the supported configurations of the CMC 256 and CMA/S amplifiers see the OMICRON Test Universe online help, topic Hardware Configuration.

8 TROUBLESHOOTING

This section provides general rules to be followed in case of a failure of the CMC 256 as well as a instructions how to eliminate some specific disruptions of the test set.

8.1 Troubleshooting Guide

In case of a disruption in operation of the CMC 256 proceed as follows:

1. Check the relevant software user manual or online help included in the Test Universe software for an immediate response.
2. Check whether the disruption is reproducible and document it.
3. Try to narrow the disruption by using another PC, test set or connection cable, if available.
4. Note the exact wording of any error message or unexpected conditions.
5. If you contact the OMICRON technical support, please attach:
    - Your company name as well as a phone number and e-mail address
    - The serial number of your test set
    - Information about your PC: Manufacturer, type, memory, installed printers, operating system (and language) as well as the installed version of the OMICRON PC software (and language)
    - Screenshots of the error messages
6. If you call the OMICRON hotline, please have your PC and test set available and be ready to repeat the steps that caused the disruption.

For speeding up the support process, please attach the following diagnostic log files:

- Communication log file
  This file records any communication between the CMC 256 and PC.
  To send the log file to the OMICRON technical support:
  1. Close all other applications.
  2. Choose **Calibration & Diagnosis…** > **Logfile** from the Test Universe start page.
  3. Select **Logging on (Detailed)** in the **Edit** menu and minimize the window.
  4. Start the test module and reproduce the disruption.
  5. Go back to the log file and select **Send** in the **File** menu to submit the log file via e-mail to the OMICRON technical support.
- Hardware check log file
  Each time a test module starts, an internal hardware self-check is performed. The results of this test are stored in the hwcheck.log file.
  To open the log file, choose **Calibration & Diagnosis…** > **Hardwarecheck** from the Test Universe start page.

8.2 Potential Disruptions, Possible Causes and Remedies

Some potential disruptions that may occur while operating the CMC 256 are listed below. Try to eliminate them by applying the remedies proposed here.

Table 8-1:Troubleshooting the CMC 256

Disruption	Possible causes	Remedies
Power switch does not light after turning on the test set.	There is no power to the test set.	Check the power supply and assure that it supplies power to the test set.
	The fuse of the test set has blown (e.g., is defective)	Unplug the power cord from the power source! Replace the fuse: Fuse T 10 AH 250 V (6.3x32 mm).
	Disruption of test set’s functions	Please contact the OMICRON technical support (see "Contact Information / Technical Support" on page 109).
The following message appears in the status line: “Ground-wire break!!! Ground-wire connection lost! The unit must not be operated further without an isolating transformer!”	Ground-wire connection to the CMC 256 t is broken or the test set is powered by an earth-free power supply (isolating transformer).	Ground the housing of the test set separately using the PE connection socket (on the back panel of the test set). If an earth-free operation is required, confirm the message and continue to work. **Note:** The housing of the test set is not grounded and this is not the designated operation mode.

8.3 Overheating

If a thermal shutdown occurs because of loading the voltage or current outputs a long time by high burden, the Test Universe displays the following messages respectively in the Status History window:

- "Voltage overtemperature: " followed by a list of the affected outputs
  "CMC switched off."
  "Test stopped with error."

- "Current overtemperature: " followed by a list of the affected outputs
  "CMC switched off."
  "Test stopped with error."

The thermal shutdown can be avoided by reducing the compliance voltage of the current amplifiers. For detailed information on the important operational messages, please refer to the user manual and the online help delivered with the OMICRON Test Universe software.

9 CMC 256 Related Products and Accessories

This chapter describes the optional equipment for the CMC 256 test set. In the following the amplifiers CMA 56, CMA 156, CMS 156, CMS 251 and CMS 252 are jointly named CMA/S. Please check the OMICRON website www.omicron.at for up-to-date information.

9.1 CMA/S Current/Voltage Amplifiers

The CMA/S external amplifiers are controlled by the CMC 256 via the "LL out 1-6" on the rear panel of the test set as shown in Figure 9-1 below.

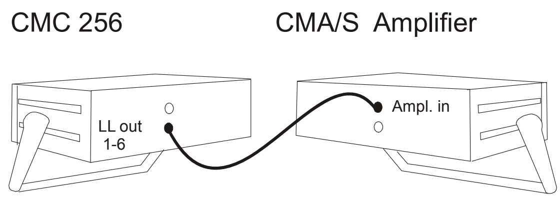


Figure 9-1: Connecting a CMA/S amplifier to the CMC 256

Table 9-1:Technical Data on CMA/S amplifiers

Amplifier	Output configurations	Output power	Miscellaneous
CMA 156	6-phase current amplifier (Group A, B) 6×25 A (L-N) 3×50 A (L-N) 2×75 A (3L-N) 1×150 A (3L-N)	6×70 VA at 7.5 A 3×140 VA at 15 A 2×225 VA at 22.5 A 1×420 VA at 45 A	Amplitude accuracy: error < 0.1% Weight: 15.4 kg
CMA 56	3-phase current amplifier 3×25 A (L-N) 1×150 A (3L-N)	3 ×140 VA at 15 A 1 ×420 VA at 45 A	Amplitude accuracy: error < 0.1% Weight: 14.9 kg
CMS 156	3-phase current / voltage amplifier (3×250V, 3×25A) 3×250 V (L-N) 1×500 V (L-L) 3×25 A (L-N) 1×75 A (3L-N)	3×75 VA 1×150 VA 3×70 VA at 7.5A 1×210 VA at 22.5A	Amplitude accuracy: error < 0.1% Weight: 14.7 kg
CMS 251	1-phase high power amplifier (1×125 V or 1×12.5 A) 1×125 V (L-N) or 1×12.5 A (L-N)	Up to 1400 VA	Output amplifier is configurable as voltage or current source Weight: 14.8 kg
CMS 252	2-phase high power amplifier 2×(125 V or 12.5 A) 2×125 V (L-N) or 2×12.5 A (L-N) 1×25 A (L-N)	Up to 1400 VA	Both output amplifiers are configurable as voltage or current source Weight: 18.4 kg

Detailed information about the CMA/S amplifiers can be found in the corresponding user manual, product catalog, or on the OMICRON website http://www.omicron.at.

9.2 CMB IO-7

The CMB IO-7 is a PC controlled test unit consisting of binary inputs and outputs. For that purpose the CMB IO-7 provides seven module plug-in slots which can be equipped with different input/output modules. Depending on the assembled modules the CMB IO-7 is capable to provide up to 144 (300 VDC) potential-sensing (wet) or potential-free (dry) input channels and/or up to 96 output channels.

The signals applied to the inputs of the CMB IO-7 are precisely time tagged. The desired timing characteristic of the corresponding output reactions can be specified in the controlling software of the OMICRON Test Universe by using freely programmable sequences.

The following IO modules are available:

- INP1-24: 24 binary inputs, 0…300 VDC, two galvanically separated groups 12+12
- OUT1-16: 16 binary relay outputs
- OUT2-16: 16 binary solid-sate outputs, high-side MOSFET outputs (fast, no bouncing)

The CMB IO-7 can be used together with the CMC 256 test set[1] (see Figure 9-2 below for a typical test set-up) or stand-alone.

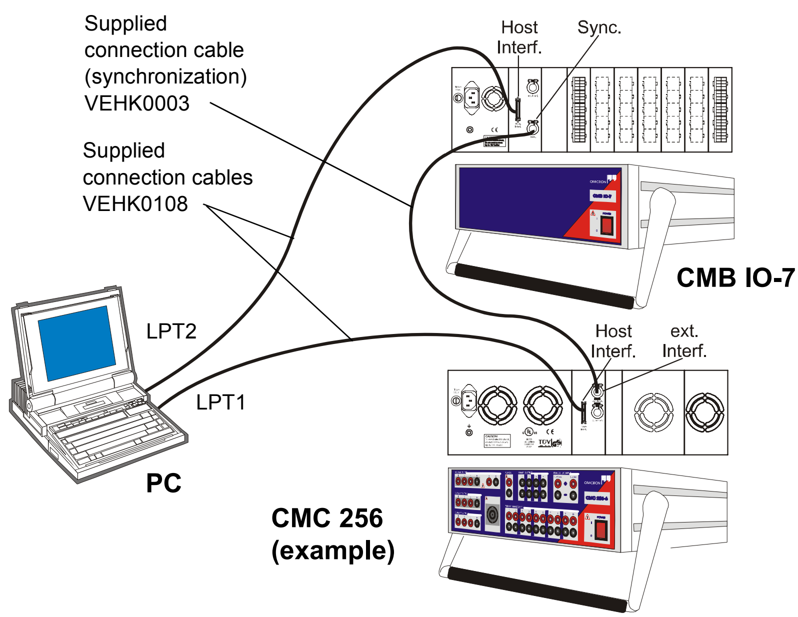


Figure 9-2:Connecting the CMB IO-7, CMC 256 and PC

[1] Second parallel port is required if the CMB IO-7 is used in conjunction with the CMC 256. For notebooks the SPP-100 PCMCIA card with parallel port is available from OMICRON. For the part number refer to Section 9.6, "Ordering Information" on page 107.

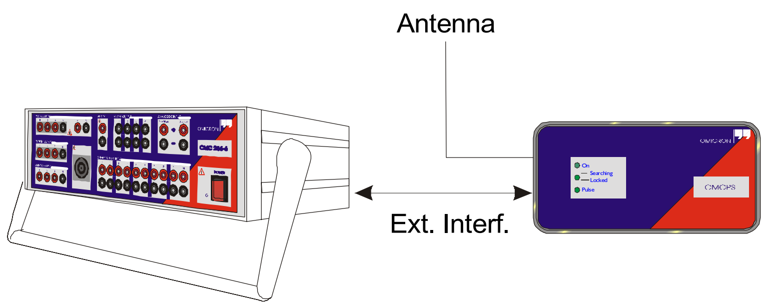
9.3 CMGPS

The CMGPS is a system extension that permits triggering a CMC test set at an exactly specified point in time using the world-wide reception of a GPS (Global Positioning System) satellite signal.

Using two or more CMGPS devices, the test procedure of two or more CMC test sets can be started simultaneously.

The power supply to the CMGPS comes from the CMC 256 test set.

Figure 9-3: Synchronization device CMGPS



Detailed information about the CMGPS can be found in the corresponding user manual, product catalog, or on the OMICRON website http://www.omicron.at.

Table 9-2:Basic technical data on CMGPS

Pulse outputs	2
Accuracy	Error < ±1 µs or ±5 µs
Synchronization of test sets[1]	Error < 100 µs / < 5 µs
Connection	Voltage supply from the CMC 256, configurable by the test software of the OMICRON Test Universe.
Weight	440 g
Dimensions W x H x D	140 x 70 x 40 mm

[1] Error corresponds to amplifier output signals (voltage/current) of CMGPS synchronized test sets at configured GPS trigger event
5 µs: enhanced mode (CMC 256 only + State Sequencer)

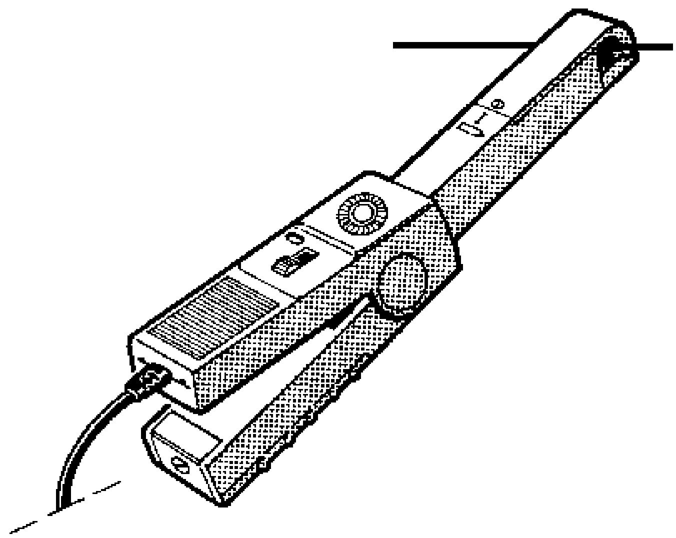
Optionally a 2×20m antenna cable to provide up to 40 m is available from OMICRON. For the part number refer to Section 9.6, "Ordering Information" on page 107.

9.4 Current Clamp C-PROBE1

Using the current clamp C-PROBE1 and the *EnerLyzer* measurement option, direct and alternating currents can be measured via the analog measurement inputs of the BINARY / ANALOG INPUT section. (Refer to Section 6.10, "The EnerLyzer Measurement Option" on page 63.)

C-PROBE1 is an active, DC-capable current probe and has two switchable measurement ranges.

Figure 9-4:
Current clamp C-PROBE 1



Detailed information about the C-PROBE1 and the *EnerLyzer* measurement option can be found in their respective user manuals, product catalogs, or on the OMICRON website http://www.omicron.at.

Table 9-3:Basic technical data on C-PROBE 1

Max. voltage of the leads	600 V_{rms} to GND	
Switch position	100 mV/A	10 m V/A
Measurement ranges	0…10 A AC/DC	0…80 A AC/DC
Frequency bandwidth	0 (DC)…10 kHz	

9.5 CMLIB B – Option for the Meter Testing

The CMLIB B permits all optional devices that are needed for meter testing to be easily connected to the CMC 256.

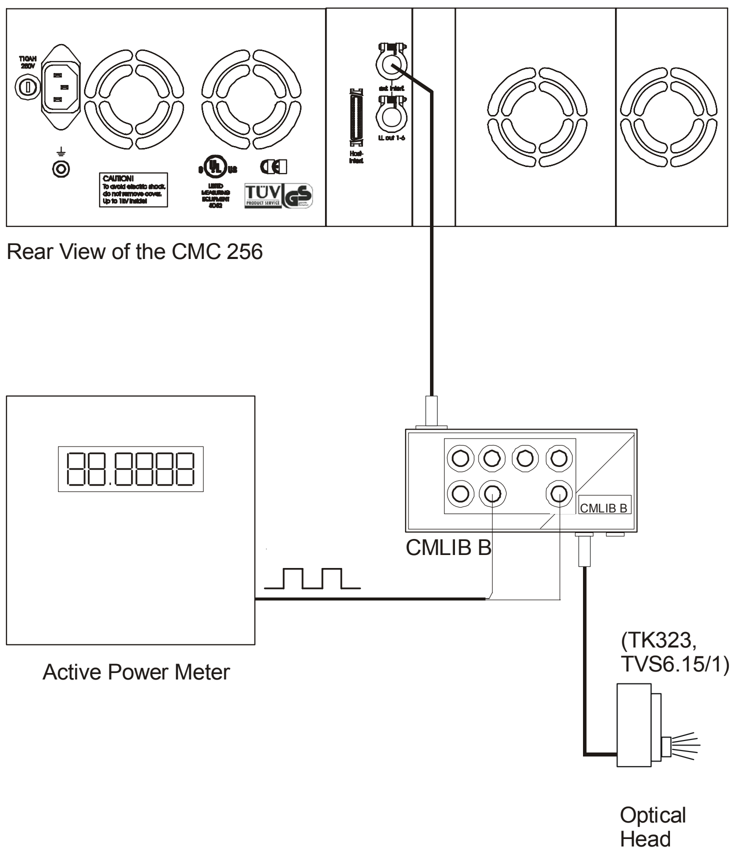
Among the optional devices are:

- meter under test
- reference meter
- optical scanning heads.

The CMLIB B is connected to the “ext. Interf.” socket on the rear panel of the CMC 256.

It requires a supply voltage of 12 ... 24 V_{DC}. A power supply is part of the deliverables.

Figure 9-5:
Main connection diagram
CMLIB B



Detailed information about the CMLIB B can be found in the corresponding user manual, product catalog, or on the OMICRON website http://www.omicron.at.

9.6 Ordering Information

In this section you'll find ordering information for the optional devices and components of the CMC 256.

For easier identification of the cable and plugs, they are depicted in the following illustrations.

Figure 9-6: Connection cable connector 1

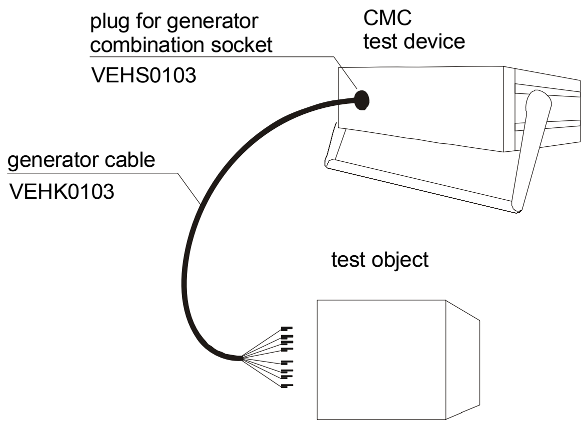


Figure 9-7: Connection cable connector II

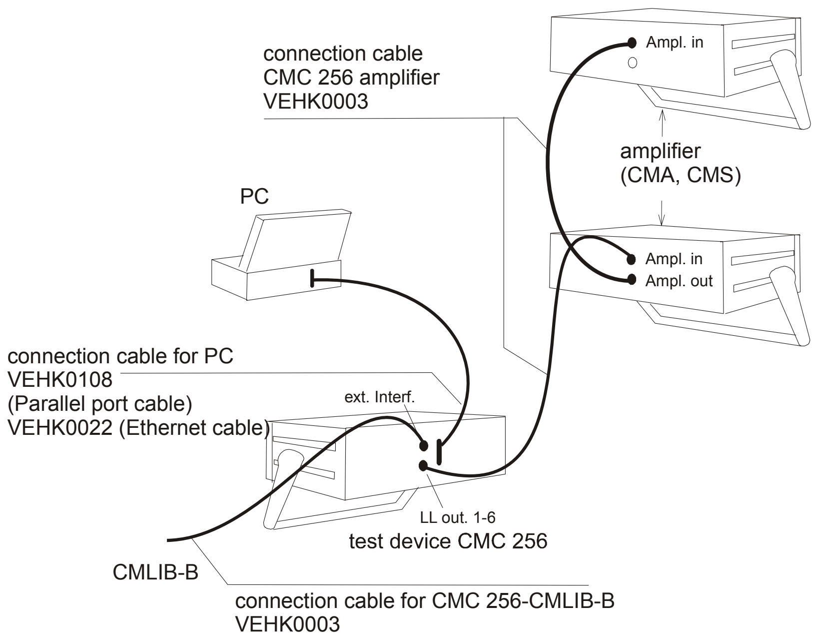


Table 9-4:
Ordering information

Ordering description		Part number
CMC 256 options		
EP	Extended Precision upgrade	VEHO0002
NET-1	Upgrade CMC 256 with Ethernet interface	VEHO1010
EnerLyzer	Software module providing *EnerLyzer* functionality	VESM2050
Amplifiers		
CMA 56	Current amplifier (3×50 A)	VEHV0010
CMA 156	Current amplifier (6×25 A)	VEHV1010
CMS 156	Voltage/current amplifier (3×250 V, 3×25 A)	VEHV1030
CMS 251	High power voltage/current amplifier (1×12.5 A or 1×125 V)	VEHV1050
CMS 252	High power voltage/current amplifier (2×12.5 A or 2×125 V)	VEHV1060
Binary input/output extensions		
CMB IO-7	Basic unit with 1×INP1-24, 1×OUT16-1	VE000700
INP1-24	Binary input module (24 inputs, 0…300 V)	VEHZ0710
OUT1-16	Binary output module (16 relay outputs)	VEHZ0720
OUT2-16	Binary solid state output module (16 MOSFET outputs)	VEHZ0750
SPP-100	Parallel port PCMCIA card	VEHZ0730
Module connector for CMB input/output modules		VEHZ0740
Synchronization device CMGPS		VEHZ3000
2×20 m antenna cable and SMA adapter		VEHZ3003
Current clamp C-PROBE 1 (10/80 A range, DC…10 kHz)		VEHZ4000
Meter test components		
CMLIB B	CMC 256-to-meter connection set	VEHZ1102
TK323	Photoelectric scanning head	VEHZ2005
TVS6.15/1	Magnetic scanning head	VEHZ2004
Cables		
Connection cable CMC 256-to-PC socket (parallel port interface) 1.5 m		VEHK0108
Connection cable CMC 256-to-amplifier, CMLIB A/B or CMGPS		VEHK0003
Generator combination cable		VEHK0103
Ethernet patch cable 1.5 m		VEHK0022
Fiber patch cable MTRJ–MTRJ 3 m		VEHK0021
Fiber patch cable MTRJ–ST 3 m		VEHK0020
Connector		
Plug for generator combination socket		VEHS0103
Transport cases for CMC 256, CMA/S		
Large-size case with casters for heavy transport stress		VEHP0015
Case for medium/light transport stress		VEHP0016

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