OMICRON

CMC 353

Reference Manual

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PREFACE

The purpose of this reference manual is to familiarize users with the *CMC 353* 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 353* 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 353*.

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

The reference manual should always be available at the site where the *CMC 353* is used. It should be read by all personnel operating the test set.

Note: The OMICRON *Test Universe* software also installs a PDF version of this reference manual. It can directly be opened by a mouse-click from the help topic "User Manuals of OMICRON Test Universe".

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

Note: This reference manual describes the *CMC 353* hardware - that is, the physical test set. In order to get familiar with the software for controlling and configuring the *CMC 353*, please refer to the software manuals and/or the OMICRON *Test Universe* Help.

For Your Safety Please Note

The *CMC 353* test set can output life-hazardous voltages and currents.

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

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

SAFETY INSTRUCTIONS

Before operating the *CMC 353* test set, carefully read the following safety instructions.

Only operate (or even turn on) the *CMC 353* after you have read this reference manual and fully understood the instructions herein.

The *CMC 353* may only be operated by trained personnel. Any maloperation can result in damage to property or persons.

Rules for Use

- The *CMC 353* should only be used when in a technically sound condition. Its use should be in accordance with the safety regulations for the specific job site and application. Always be aware of the dangers of the high voltages and currents associated with this equipment. Pay attention to the information provided in the reference manual and the software documentation.
- The *CMC 353* is exclusively intended for the application areas specified in section 1, "Designated Use" on page 11. The manufacturer/ distributors are not liable for damage resulting from unintended usage. The user alone assumes all responsibility and risk.
- The instructions provided in this reference manual and the associated software manuals are considered part of the rules governing proper usage.
- Do not open the *CMC 353* or remove any of its housing components.

Orderly Practices and Procedures

- The reference manual (or its PDF version) should always be available on site where the *CMC 353* is used.

Note: The OMICRON *Test Universe* software installs a PDF version of this reference manual. To view the manual, start the *Test Universe* Help from the *Start Page* or any test module and navigate to the table of contents entry **User Manuals** (at the beginning of the table of contents). Click **Hardware Manuals**. In this topic you find a direct link to "*CMC 353*". To open the manual, click the link.

- Personnel assigned to using the *CMC 353* must have read this reference manual and fully understood the instructions herein.
- Do not carry out any modifications, extensions or adaptations at the *CMC 353*.

Operator Qualifications

- Testing with the *CMC 353* should only be carried out by authorized and qualified personnel.
- Personnel receiving training, instruction, direction, or education on the *CMC 353* should remain under the constant supervision of an experienced operator while working with the equipment.

Safe Operation Procedures

- Follow the instructions in sections 3.2 and 3.4 that describe the safe use of the connecting cables and how to set the *CMC 353* into operation.
- The *CMC 353* must only be used from a power outlet that has a protective earth.
- Do not block the access to safety-relevant test set components like the main power switch or the power cord. In cases of an emergency, these components need free and quick access.
- Do not connect any of the front panel VOLTAGE/CURRENT OUTPUTS 1 ... 3 or VOLTAGE OUTPUT 4, respectively, to protective earth. The N sockets, however, may be connected to protective earth.
- When connecting to the banana plug sockets, only use cables with 4 mm/0.16 " safety banana connectors and plastic housing. Always insert plugs completely.
- Before connecting and disconnecting test objects, verify that all outputs have been turned off. Never connect or disconnect a test object while the outputs are active.
- When disconnecting power supply cables or test leads, always start from the device feeding the power or signal.
- All sockets on the front panel are to be considered dangerous with working voltages up to 300 V_{rms}. Only use cables that meet these respective requirements to connect to the equipment.
- Red Signal Light ⚠:
  If the voltage on any of the four voltage outputs or on the "AUX DC" output exceeds 42 V, the associated signal light lights up.
- Do not insert objects (e.g., screwdrivers, etc.) into the sockets or into the ventilation slots.
- Do not operate the *CMC 353* under wet or moist conditions (condensation).
- Do not operate the *CMC 353* when explosive gas or vapors are present.

- The SELV interfaces (SELV = Safety Extra Low Voltage) of the *CMC 353* - "Host Interf.", “ETH1”, “ETH2”, "LL out" (Low Level Outputs) or "ext. Interf." - should only have external devices connected that meet the requirements for SELV equipment according to EN 60950 or IEC 60950.
- For applications drawing DC current: The load may not exceed 3 mH because of dangerous feedback current.
- When setting up the *CMC 353*, make sure that the air slots on the back, top, and bottom of the test set remain unobstructed.
- Voltages up to 1 kV can be present inside the *CMC 353*! Therefore, opening the *CMC 353* is only permitted by qualified experts either at the factory or at certified external repair centers.
- If the *CMC 353* is opened by the customer, all guarantees are invalidated.
- *CMC 353* Ethernet functionality (see section 5.2.1, "Ethernet Ports ETH1 and ETH2" on page 32):
  - Connect ETH1 and ETH2 **only** to Ethernet ports.
- If the *CMC 353* seems to be functioning improperly, please contact the OMICRON Tecnical Support (see section "Contact Information / Technical Support" on page 95).

Changing the Power Fuse

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

  For safety reasons please use only fuse types recommended by the manufacturer. Refer to 6.1, "Main Power Supply" on page 39 for more information.

1 DESIGNATED USE

The *CMC 353* is a computer-controlled test set for the testing of:

- protection relays
- transducers
- energy meters
- PQ (power quality) analyzers.

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

The *CMC 353* is part of the OMICRON *Test Universe* which, in addition to the physical test set, consists of a test software for a computer with Windows[1] operating system, and, when needed, external voltage and/or current amplifiers, GPS or IRIG-B synchronization units or other accessories.

Any other use of the *CMC 353* is considered improper and may result in damage to property or persons.

Features of the *CMC 353*:

- Output of test quantities:
  - 4 × voltage
  - 3 x current
- Capability of protection testing with IEC 61850 devices.
- Control of external amplifiers (up to 12 additional test signals) through the low-level interface.
- Supply of DC voltages to the test object.
- Output of binary signals.
- Capture of binary signals and counter impulses.

[1] Windows is a US registered trademark of Microsoft Corporation.

2 INTRODUCTION

The *CMC 353* is a part of the OMICRON *Test Universe* which, in addition to the physical test set, consists of a test software for a computer with Microsoft Windows operating system, and, when needed, external voltage and/or current amplifiers, GPS or IRIG-B synchronization units or other accessories (refer to section 9, "CMC 353-Related Products and Accessories" on page 75).

This reference manual describes the hardware of the *CMC 353*. The configuration and control of the *CMC 353* is carried out by the test software of the OMICRON *Test Universe*. For more detailed information, please read the user manuals and the OMICRON *Test Universe* Help.

Note: The OMICRON *Test Universe* software installs a PDF version of this reference manual. To view the manual, start the *Test Universe* Help from the *Start Page* or any test module and navigate to the table of contents entry **User Manuals** (at the beginning of the table of contents). Click **Hardware Manuals**. In this topic you find a direct link to "*CMC 353*". To open the manual, click the link.

3 OPERATING THE CMC 353

Only operate (or even turn on) the *CMC 353* after you have read this reference manual and fully understood the instructions herein.

3.1 System Components

Before operating the *CMC 353* for the first time, use the packing list to verify that all components of the test system are available.

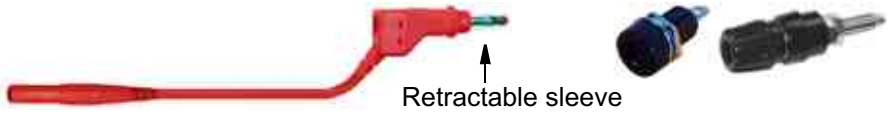
To set the *CMC 353* into operation you need the following components:

- *CMC 353* with (mains) power cable
- Connecting cable *CMC 353* ↔ PC
- Connecting cable *CMC 353* ↔ test object
- PC equipped with an Ethernet port and the OMICRON *Test Universe* software.

3.2 Safe Use of the Connecting Cables

3.2.1 Test Lead Adapter for Non-Safety Sockets

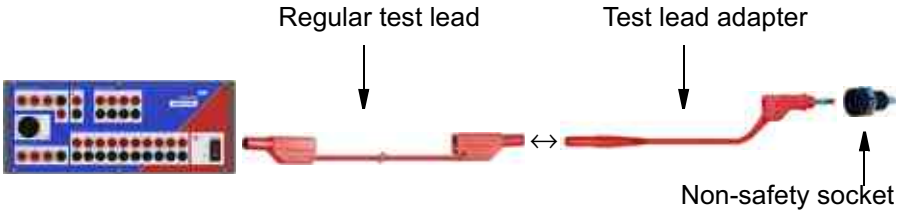
The optional CMC Wiring Accessory Package includes flexible test lead adapters of 5 cm/2 " length with a retractable sleeve (6 x black, 6 x red).



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

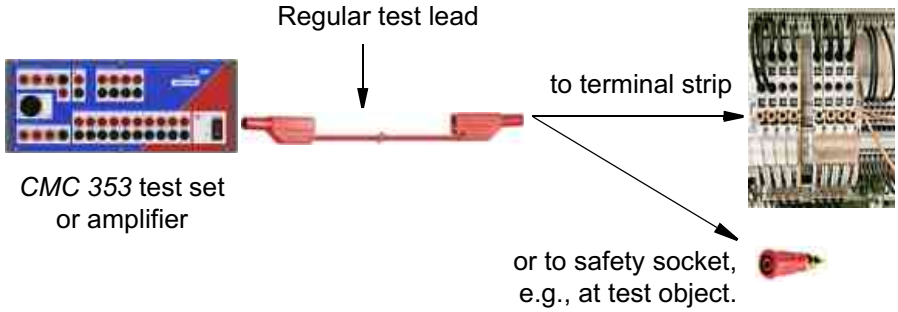
Never directly insert one of these retractable sleeves into a *CMC 353* output socket at the front of the test set. This does not comply with the designated purpose of these leads and is contrary to the safety regulations.

Plug **only the regular test leads** of 2.0 m/6 ft. length into the *CMC 353* output safety sockets.



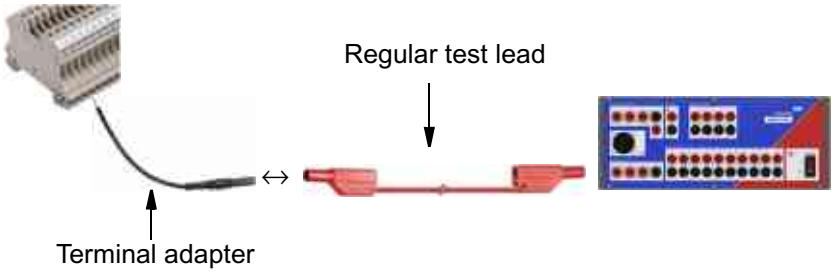
3.3 Regular Test Leads for Safety Sockets

Use the regular test leads of 2.0 m/6 ft. length to connect the *CMC 353* output to other safety sockets of, for example, amplifiers, test objects or to banana adapters in control cabinets.



3.3.1 Terminal adapters

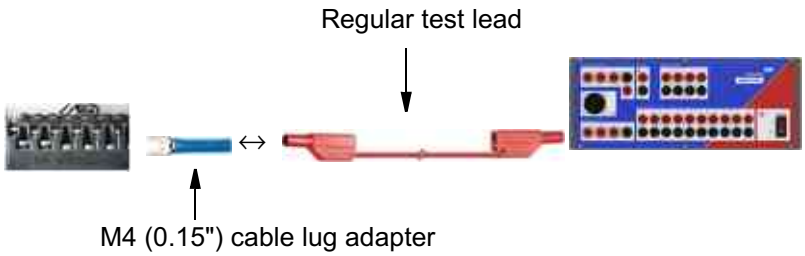
The optional CMC Wiring Accessory Package includes flexible terminal adapters to connect the regular test leads to screw-clamp terminals.



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

3.3.2 M4 (0.15") Cable Lug Adapters

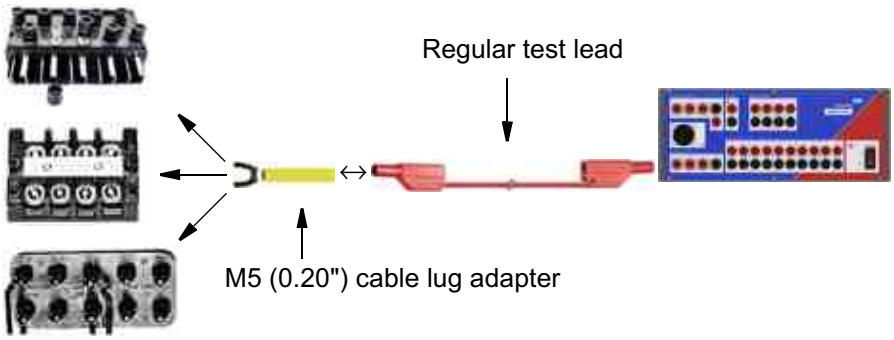
The optional CMC Wiring Accessory Package includes M4 (0.15") cable lug adapters to connect regular test leads to screw-clamp terminals of SEL/ABB/GE relays (and others).



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

3.3.3 M5 (0.20") Cable Lug Adapters

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



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

3.4 Starting the Test System

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

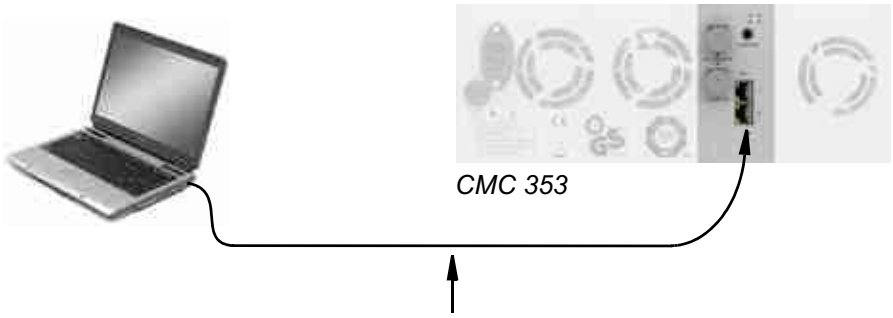
For detailed instructions about the OMICRON *Test Universe* software, refer to the manual "The Concept". This manual is provided in PDF format. It is available on your hard disk after the installation of OMICRON *Test Universe*. To view the manual, start the *Test Universe* Help from the *Start Page* or any test module and navigate to the table of contents entry **User Manuals** (at the beginning of the table of contents). Click **Software Manuals**. In this topic you find a direct link at "Getting Started with OMICRON *Test Universe* - The Concept". To open the manual, click the link.

This description refers both to the computer and to the *CMC 353*. It does not take into consideration any external devices. If the system is driven by external amplifiers, follow the instructions in section 7.3, "Operation with External Amplifiers" on page 69.

When setting up the *CMC 353*, it is important to make sure that the ventilation slots remain unobstructed.

Connecting the System Components:

Figure 3-1:
Connecting the *CMC 353* to the computer



1. Connect the *CMC 353* to the PC with the supplied connecting cable[1]:
   - *CMC 353*: Connector ETH1 or ETH2 at the rear side of the test set
   - PC: Ethernet port (labeled “EtherNET”, “LAN” or similar).

[1] To ensure the required EMC compatibility, we recommended to use the OMICRON-supplied cable, only.

For instructions to help you to incorporate network-capable CMC test sets into a computer network, please refer to the manual **Network-based CMC Test Sets**. This manual is provided in PDF format. It is available on your hard disk after the installation of OMICRON *Test Universe*. Its name is **Network-based test sets.pdf**.

To view the manual, start the *Test Universe* Help from the *Start Page* or any test module and navigate to the table of contents entry **User Manuals** (at the beginning of the table of contents). Click **Read Me First**. In this topic you find a direct link to "Network-based CMC Test Sets". To open the manual, click the link.

2. Connect the *CMC 353* test set to the mains.
3. Turn on both devices.
4. Start the OMICRON *Test Universe* software.

   A comprehensive hardware test is carried out on the *CMC 353*. In the process, switching sounds from relays in the CMC test set can be heard. If any irregularities are determined during the course of this self-test, the software displays a corresponding error message on the PC monitor (refer to section 8, "Troubleshooting" on page 71).

4 SETUP AND FUNCTION

The computer-controlled OMICRON test system employs the concept of a functional division between the software running on the computer and the *CMC 353* hardware connected to the test object.

OMICRON *Test Universe* test software running on the computer

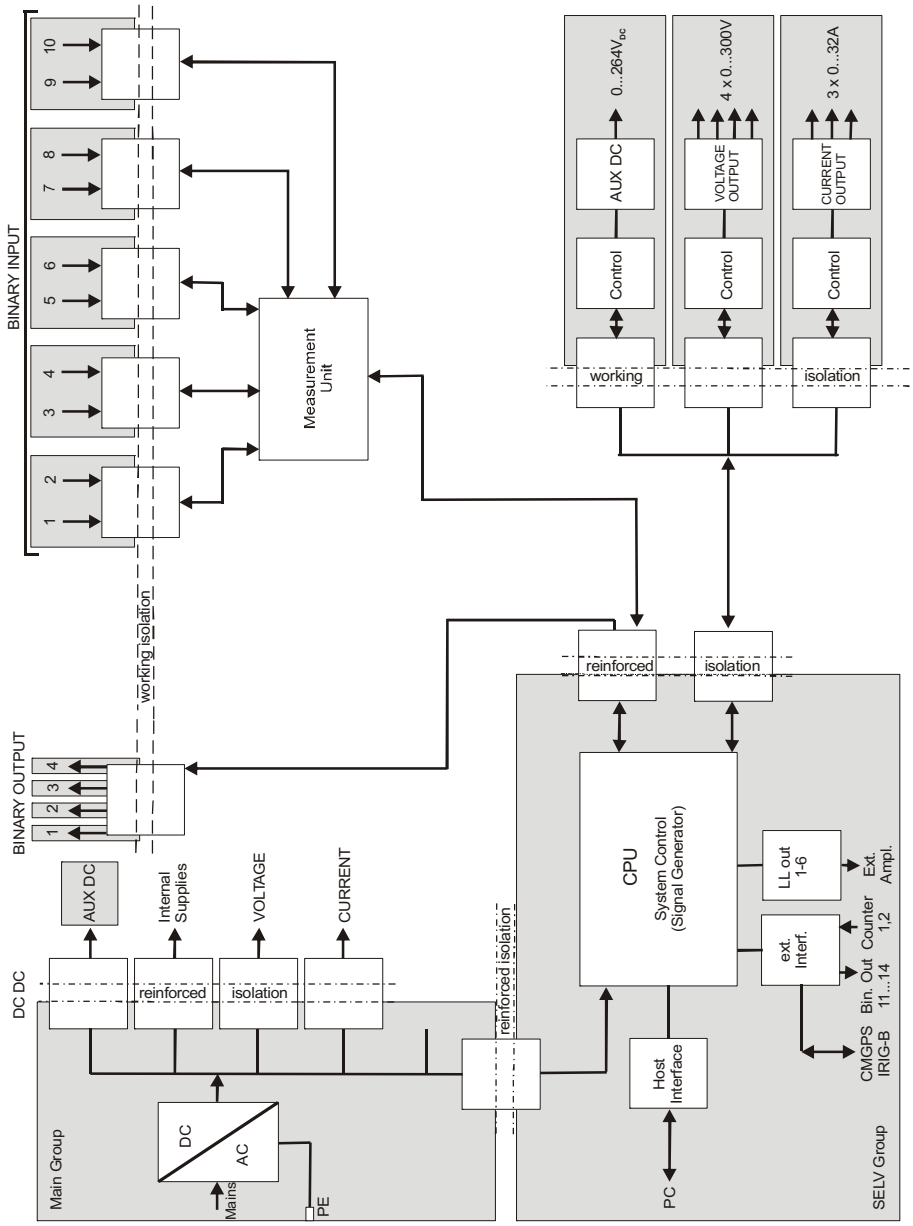
- controls the test signals
- processes measurement data
- creates reports
- generates data entries.

The *CMC 353* test set

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

4.1 Block Diagram

Figure 4-1:
Main block diagram of the *CMC 353*



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

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

4.1.1 Voltage Output (Voltage Amplifier)

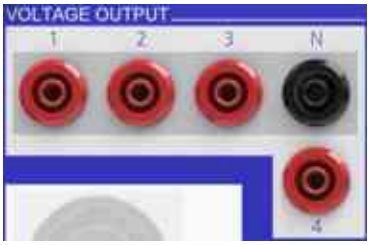


Figure 4-2: Voltage amplifier (voltage outputs)

The four voltage outputs have a common neutral N and are galvanically separated from all other outputs of the *CMC 353*.

The voltage amplifier and the current amplifiers are linear amplifiers with DC coupling. The voltage outputs work in two 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, L-N short-circuits, and overload. Should the heat sink overheat, a thermal switch turns off all outputs.

Overload Warning Flagged in the Software

When a voltage output is overloaded, a corresponding warning is displayed in the user interface of the test software of the OMICRON *Test Universe* (like described in, for example, section 8.3, "Overheating" on page 73).

Do not connect any of the VOLTAGE OUTPUTS 1 ... 3 or VOLTAGE OUTPUT 4, respectively, to protective earth. The N sockets, however, may be connected to protective earth.

4.1.2 Current Output (Current Amplifier)

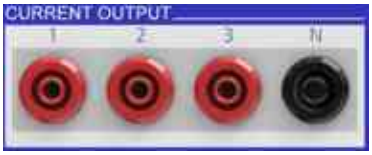


Figure 4-3:
CMC 353 current outputs

The three current outputs have a common N and are galvanically separated from all other connections of the *CMC 353*.

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

Protecting the Current Outputs

All current outputs are protected for open circuits, short-circuits, and overload. If the heat sink overheats, a thermo switch turns off all outputs. The output sockets are internally protected against currents > 45 A_{peak} (32 A_{rms}; the *CMC 353* switches off with the error message "current on neutral too high").

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

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

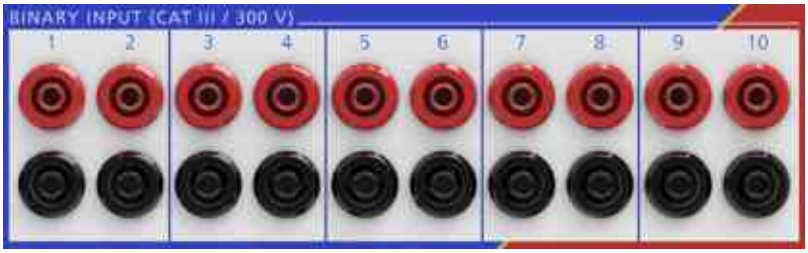
Overload Warning Flagged in the Software

When a current output is overloaded, a corresponding warning is displayed in the user interface of the test software of the OMICRON *Test Universe* (like described in, for example, section 8.3, "Overheating" on page 73).

Please see also section 7.1, "Safety Instructions for High Current Output" on page 65 about

4.1.3 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 with a time resolution of 100 µs and then evaluated in the CPU.

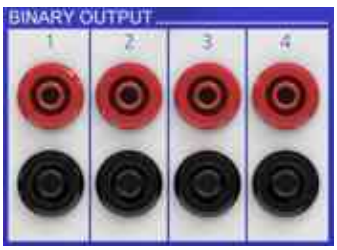
The binary inputs are configured from the Hardware Configuration module of the OMICRON *Test Universe* software. When doing so, it can be specified whether the contacts are potential-sensitive or not. When the contacts are potential-sensitive, the expected nominal voltage and pick-up threshold can be 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 OMICRON *Test Universe* Help.

4.1.4 Binary Output

Figure 4-5:
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 OMICRON *Test Universe* Help.

4.1.5 AUX DC (DC Power for Test Objects)

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

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

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

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

The power-up default

By means of the test tool *AuxDC* you can set a so-called power-up default. When the test set is powered-up the next time, the auxiliary DC output is automatically set to this default value. This default value applies until it is deliberately changed again.

Setting a power-up default value means, that immediately after the test set is switched on, this voltage is applied to the auxiliary DC voltage output, regardless whether a computer is connected to it or not.

Caution: The selected voltage can be life-threatening!

Consider storing a power-up default voltage of higher than 0 V a potential danger to future users that may connect other devices to this CMC test set.

We strongly recommend to always set the default value to 0 V before storing the device, or to otherwise attach a warning label to the device housing, such as "*This unit outputs an AuxDC voltage of ___V immediately after powering-up*".

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

More information about the configuration of the AUX DC supply can be found in the OMICRON *Test Universe AuxDC* Help.

4.1.6 CPU

The *CMC 353* CPU (**C**entral **P**rocessing **U**nit) carries out the following tasks:

- Communication with the computer or a network via the Ethernet ports “ETH1” and “ETH2”.
- Digital signal generation for all outputs of the test set (including control signals for external amplifiers).
- Generation of a high-accuracy central clock signal with synchronization options using the *CMGPS* synchronization unit or the *CMIRIG-B* interface box (refer to 9.3, "Time Synchronization Accessories" on page 77).
- Monitoring and control of all systems, including external amplifiers, if applicable.

4.1.7 Power Supplies (DC-DC)

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

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

4.2 Signal Generation

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

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

For this, the *CMC 353* employs a high-performance digital signal processor (DSP).

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

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

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

4.2.1 Accuracy and Signal Quality

The *CMC 353* is a very precise test set with excellent long-term and temperature drift behavior.

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

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

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

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

5 Connections and Interfaces

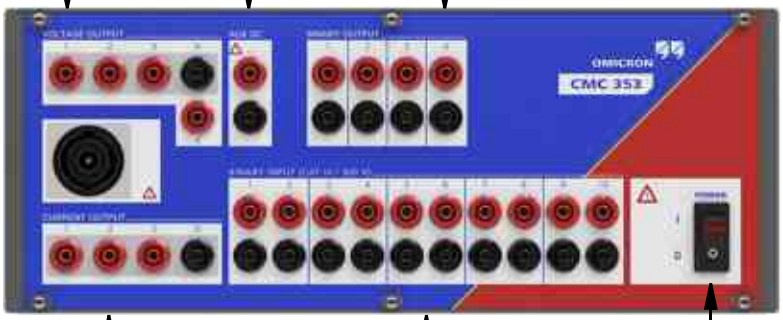
5.1 Front Panel Connections

Figure 5-1:
Front view of the *CMC 353*

VOLTAGE OUTPUT
4 x 300 V_{rms} output of the internal voltage amplifier; outputs 1 - 3 also applied to the generator combination socket.

AUX DC
Output voltage in 3 ranges from 0 - 264 V; used to supply power to test objects.

BINARY OUTPUT
Four potential-free relay contacts.



Power Switch

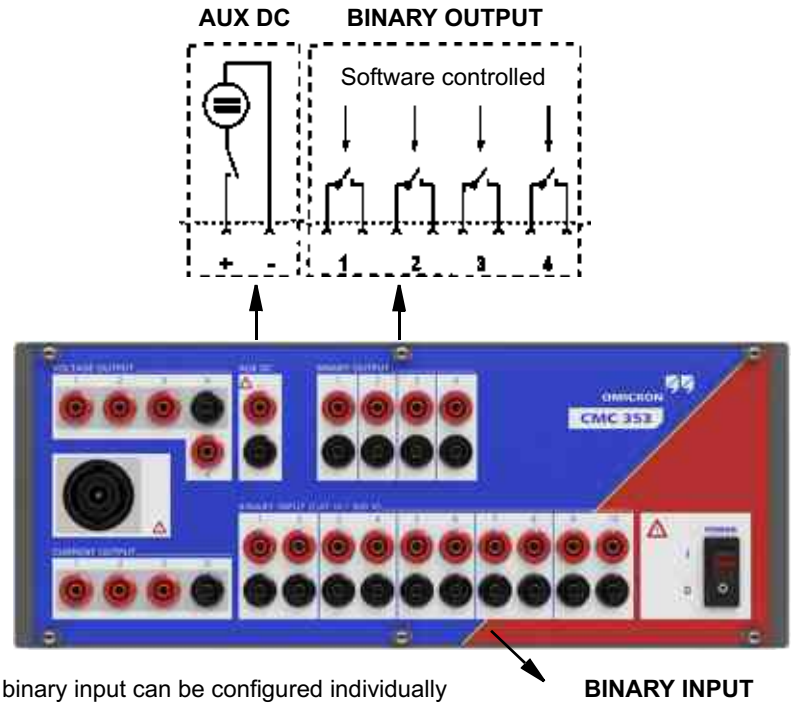
BINARY INPUT
10 binary inputs in 5 galvanically separated groups.

CURRENT OUTPUT
3 x 32 A_{rms} output of the internal current amplifier; also applied to the generator combination socket.

Generator combination socket
8-pole combination socket for VOLTAGE OUTPUT 1-3 and CURRENT OUTPUT (up to 3 × 25 A max.).

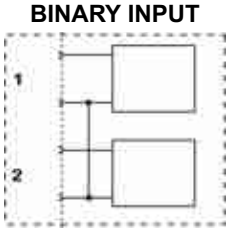
Warning indication: **Dangerous Voltage!**
At least one of the output voltages exceeds 42 V.

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

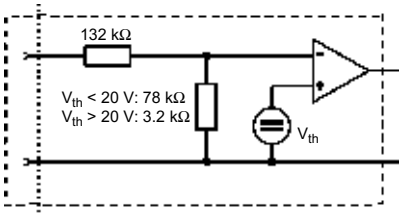


Each binary input can be configured individually for wet or dry operation.

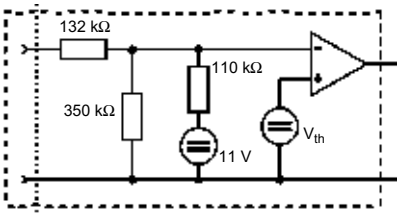
Two inputs (1 + 2, 3 + 4, ...) are one potential group. The inputs grouped in one potential group share a common ground.



3 - 10 identical

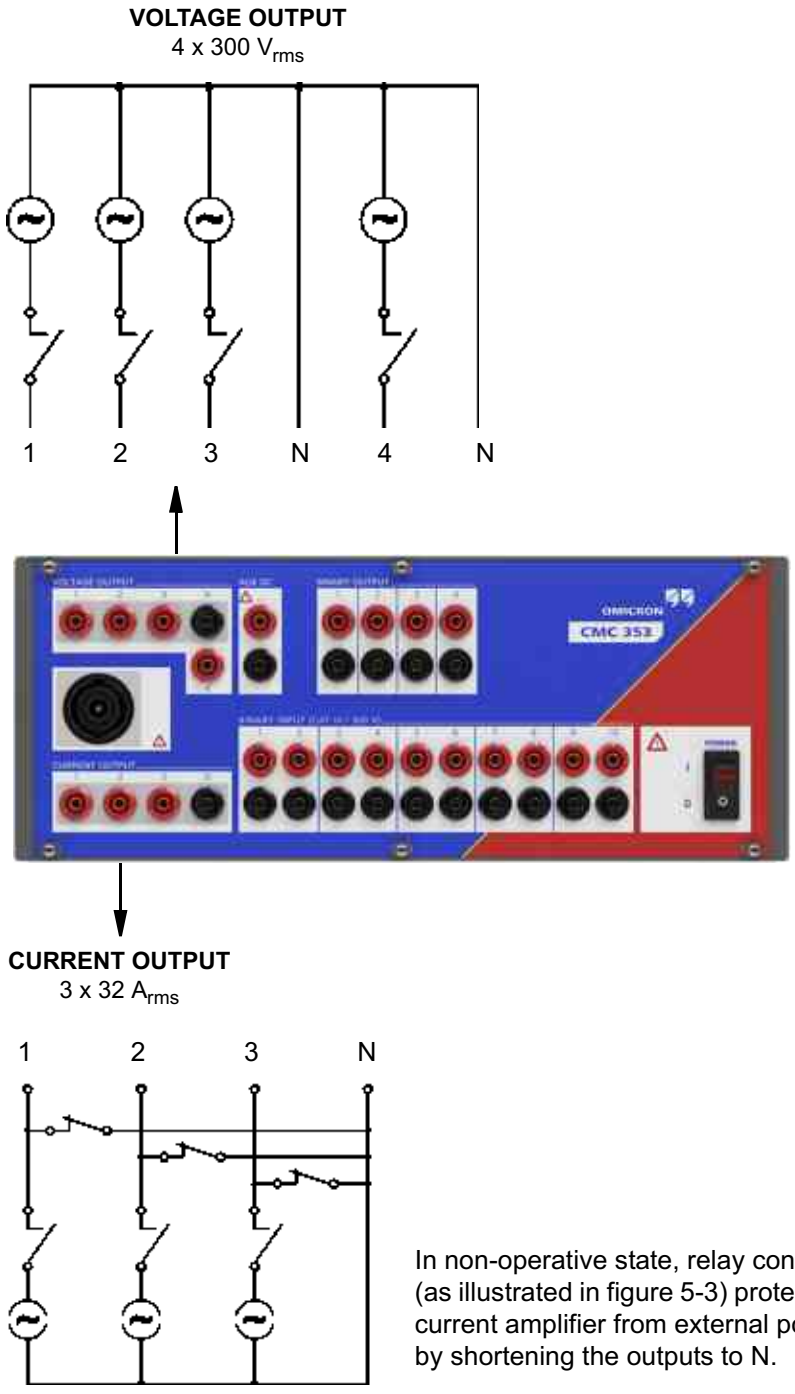


Circuit diagram of a binary input with programmable threshold voltage (wet operation)



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

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



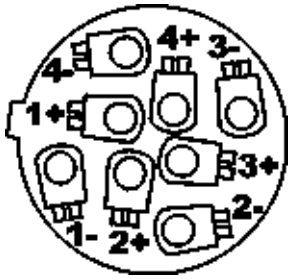
In non-operative state, relay contacts (as illustrated in figure 5-3) protect the current amplifier from external power by shortening the outputs to N.

5.1.1 Generator Combination Socket for VOLTAGE OUTPUT and CURRENT OUTPUT

The combination socket CURRENT OUTPUT / VOLTAGE OUTPUT simplifies the connection of test objects to the *CMC 353*. The three voltage outputs (VOLTAGE OUTPUT 1-3) as well as the CURRENT OUTPUT are wired to the combination socket (refer to table 5-1 on page 31).

Figure 5-4: Generator combination socket

Front view



View onto the connector from the cable wiring side

WARNING:

The connections on the socket are dangerous when the test set 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 applied to 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/0.16 " banana sockets and not on the generator connection socket.

Table 5-1: Pin layout

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

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

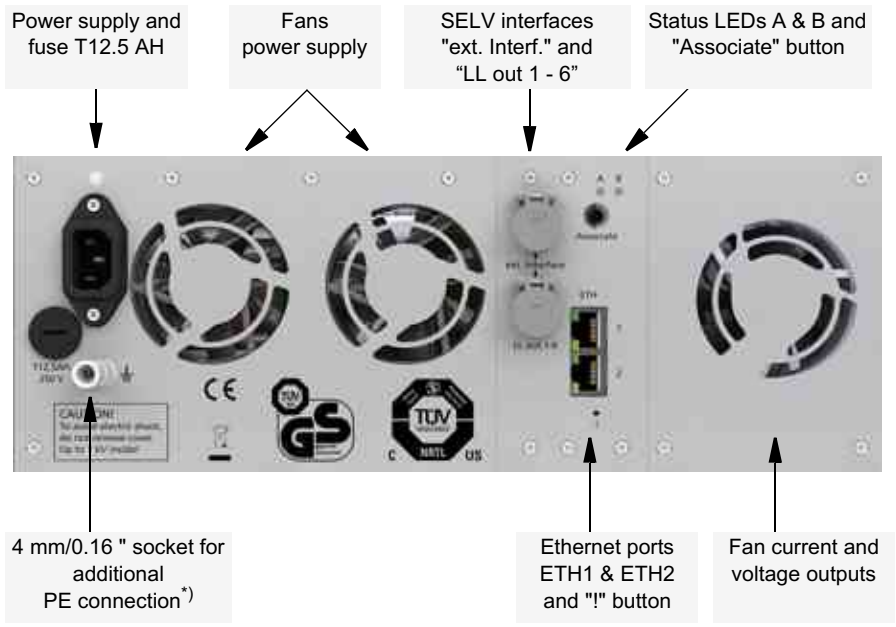
Table 5-2: Manufacturer ordering information

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 86.

5.2 Connections on the Back Panel

Figure 5-5:
Rear view of *CMC 353*



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

5.2.1 Ethernet Ports ETH1 and ETH2

The two *CMC 353* PoE (**P**ower **o**ver **E**thernet) ports ETH1 and ETH2 are standard 10/100Base-TX (twisted pair) Ethernet ports. They support auto crossing (auto MDI/MDIX). This means you can use a standard cable or a cross-over Ethernet patch cable.

Since the *CMC 353* can be controlled over a network, any distance between the controlling computer and the test set is possible. This enables direct remote control of the *CMC 353*, e.g., for end-to-end testing.

The Ethernet ports also provide the basis for the processing of substation protocols according to the IEC 61850 standard. They 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.

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

! Button

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

Associate Button

The Associate button has the following functions:

- **Associate with controlling computer**

  An Ethernet communication port enables you to communicate with any CMC available on the network. This may lead to dangerous situations where a user accidentally connects to a device located on a desk of somebody else, emitting unsafe voltages and endangering the person working there.

  To prevent such a situation, a special mechanism is integrated into the CMC test set 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 computer. The test set will issue voltages and currents only when it is associated to the client requesting this. The association process can be initiated by the *Test Set Association and Configuration* tool or by the OMICRON *Device Browser*. For more details about this process, refer to the Help of the according tool.

  For the association the Ethernet hardware address (MAC) of the controlling computer is remembered. Consequently, if the network interface on the computer has changed, the CMC test set has to be associated whenever the MAC address changes.

  Reset IP Configuration

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

Status LED A, B

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

A: yellow status LED

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

B: green LED

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

- LED B blinks slowly:

  CMC test set waits for the TFTP download (**T**rivial **F**ile **T**ransfer **P**rotocol) of a software image.
- LED B is lit:

  The TFTP download of the software image is in progress.
- LED B blinks quickly:

  The computer writes (e.g., the software image) to the flash memory of the CMC test set. Do not turn off the CMC test set as long as the writing is in progress.

5.2.2 Ethernet / Network Settings

General

The OMICRON *Test Universe* software running on the PC communicates with the *CMC 353* via a network connection. Therefore it is possible to either have the *CMC 353* directly connected to the computer's network plug by a cable or to have the *CMC 353* and the controlling computer connected to a 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 353* 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 353* can either be set to static IP addresses or use DHCP (**D**ynamic **H**ost **C**onfiguration **P**rotocol) and AutoIP/APIPA (**A**utomatic **P**rivate **I**P **A**ddressing).

Additionally there is a special DHCP server integrated in the *CMC 353* to serve IP addresses only for that computer the OMICRON *Test Universe* software is running on. Note that this will only take place when there is no DHCP server in the network. If there is DHCP server in the network, the DHCP feature of the *CMC 353* remains inactive.

If the IP settings conflict with IP settings of other devices in the network, it is possible to reset the test set to factory defaults (DHCP and AutoIP) by pressing the "Associate" button at the rear of the test set while powering up the test set (refer to "Associate Button" on page 33).

Security / Firewall Settings

To automatically detect and set the IP configuration of *CMC 353* test sets in the network, 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 (or later) 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

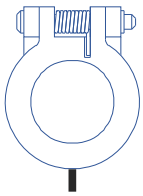
For instructions to help you to incorporate network-capable CMC test sets into a computer network, please refer to the manual "Network-based CMC Test Sets". This manual is provided in PDF format. It is available on your hard disk at *installation folder*\Test Universe\Doc\.

Alternatively, start the *Test Universe* Help from the OMICRON *Start Page* or any test module and navigate to the table of contents entry **User Manuals** (at the beginning of the table of contents). Click **Read Me First**. In this topic you find a direct link to "Network-based CMC Test Sets". To open the manual, just click the link.

5.2.3 SELV Interfaces

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

5.2.3.1 External Interface ("ext. Interf.")



ext. Interf.

The SELV interface connector "ext. Interf." holds four additional transistor **binary outputs** (Bin. out 11 - 14). Unlike regular relay outputs, Bin. out 11 - 14 are bounce-free binary outputs (small signals) and have a minimal reaction time.

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

For more detailed information please refer to the technical data section 6.3.7, "Low-Level Binary Outputs ("ext. Interf.")" on page 54.

Meter Testing

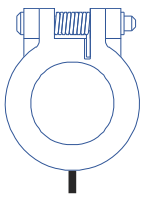
For energy meter test applications, the "ext. Interf." permits easy connectivity.

Synchronization

Via the "ext. Interf.", the *CMC 353* time base can be GPS- and IRIG-B-synchronized. Depending on the synchronization method of your choice, use either the *CMGPS* synchronization unit or the *CMIRIG-B* interface box.

Both synchronization accessories, the *CMGPS* and the *CMIRIG-B*, are optional and are described in more details in section 9.3, "Time Synchronization Accessories" on page 77.

5.2.3.2 LL out 1-6 (Low Level Outputs 1-6)



LL out 1 - 6

The SELV interface connector "LL out 1 - 6" holds two independent generator triples. These six high accuracy analog signal sources can serve to either control an external amplifier or to directly provide small signal outputs.

In addition, a serial digital interface is available that transmits control and monitor functions between the *CMC 353* and the external amplifiers.

Supported devices are *CMA 156*, *CMA 56*[1], *CMS 156*, *CMS 251*[1] and *CMS 252*.

[1] These products are not available anymore.

The low level outputs are short-circuit-proof and continually monitored for overload.

Connect the external amplifier to the *CMC 353* low level outputs. Use the connecting cable that was supplied with the amplifier.

For more detailed information please refer to the technical data section 6.3.6, "Low Level Outputs "LL out" for External Amplifiers" on page 52.

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 time 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. Given maximum phase errors are related to the voltage amplifier outputs.

- Accuracy data for analog outputs are valid in the frequency range from 0 to 100 Hz unless specified otherwise.
- The given input/output accuracy values relate to the range limit value (% of range limit value).

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 operational range	 100 - 240 V_{AC} 85 ... 264 V_{AC}
Power fuse	T 12.5 AH 250 V (5 x 20 mm) "Schurter", order number 0001.2515
Nominal current[1]	at < 170 V: 12 A max. at > 170 V: 10 A max.
Frequency nominal frequency operational range	 50/60 Hz 45 ... 65 Hz
Overvoltage category	II

[1] Refer to section 6.3.4, "Operational Limits in Conjunction with Mains Supply" on page 51.

6.2 Insulation Coordination

Table 6-2:
Insulation coordination

Insulation Coordination	
Overvoltage category	II
Pollution degree	2 (except for Binary Inputs)
Insulation of function groups on front panel to ground (GND)[1]	- Basic insulation with maximum voltage of 600 V_{rms} to ground - Clearance: > 3 mm (0.12 ") - Creepage: > 6 mm (0.24 ") - Test voltage: 2200 V_{rms}
Insulation of functional groups on front panel from each other	- Working insulation - Clearance: > 1 mm (0.04 ") - Creepage: > 1 mm (0.04 ") - Test voltage: 1500 VDC
Measurement category (BINARY INPUT)	- CAT III / 300 V_{rms} - CAT IV / 150 V_{rms}

[1] Functional groups on *CMC 353* front panel:
VOLTAGE OUTPUT, CURRENT OUTPUT, AUX DC, BINARY OUTPUT, BINARY INPUT

6.3 Outputs

For block diagrams of the available generator outputs, please refer to section 4.1, "Block Diagram" on page 20.

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

General Generator Outputs Data (analog current and voltage outputs, outputs "LL out")		
Frequency ranges sinusoidal signals[1] harmonics / interharmonics[2] transient signals	 10 … 1000 Hz 10 … 3000 Hz 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°	
Synchronized operation	Generator outputs can be synchronized to a reference input signal on binary input 10 (range: 40 … 70 Hz).	
Temperature drift	0.0025 %/°C	

[1] Amplitude derating for current outputs at frequencies above 380 Hz.

[2] Signals above 1 kHz are only supported in selected *Test Universe* modules and are only available on the voltage outputs and the low level outputs.

All voltages and current generators can independently be configured 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 Extended Frequency Range

In selected *Test Universe* modules (e.g., *Harmonics* and *PQ Signal Generator*) the *CMC 353* supports a mode for generating stationary signals up to 3 kHz on the voltage outputs and the low-level outputs. This mode corrects the phase and gain errors of the output filter. The 3 dB bandwidth of this filter limits the amplitude at 3 kHz to about 70 % of the maximum range value. The application of the extended frequency range is the generation of harmonics and interharmonics.

Table 6-4: Extended frequency range (1 - 3 kHz)

Extended Frequency Range (1 - 3 kHz)		
	Typical	Guaranteed
Low Level Outputs[1]		
Phase error	< 0.25 °	< 1 °
Amplitude error	< 0.25 %	< 1 %
Voltage Amplifier		
Phase error	< 0.25 °	< 1 °
Amplitude error	< 0.25 %	< 1 %

[1] No extended frequency range support for external amplifiers.

6.3.2 Current Outputs

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

For possible operational limits refer to sections 6.3.4, "Operational Limits in Conjunction with Mains Supply" and 6.3.5, "Operational Limits with Current and Voltage Amplifier in Parallel".

Table 6-5:
Current outputs

Current Outputs[1]		
Output currents		
3-phase AC (L-N)	3 x 0 ... 32 A	
1-phase AC (L-L)[2, 3]	1 x 0 ... 32 A	
1-phase AC (LL-LN)[2]	1 x 0 ... 64 A	
DC (LL-LN)[2]	1 x 0 ... ±90 A	
Power[7]	Typical	Guaranteed
3-phase AC (L-N)	3 x 430 VA at 25 A	3 x 250 W at 20 A
1-phase AC (L-L)[2, 3]	1 x 870 VA at 25 A	1 x 530 W at 20 A
1-phase AC (LL-LN)[2]	1 x 500 VA at 40 A	1 x 350 W at 40 A
DC (LL-LN)[2]	1 x 700 W at ±40 A	1 x 500 W at ±40 A
Accuracy	Typical	Guaranteed
$R_{load} \leq 0.5\ \Omega$	Error < 0.05 % rd.[4] + 0.02% of rg.	Error < 0.15 % of rd. + 0.05% of rg.
$R_{load} > 0.5\ \Omega$	Error < 0.1 % of rg.	Error < 0.3 % of rg.
Harmonic distortion (THD+N)[5,6]	0.05 %	< 0.15 %
Phase error[5]	0.05 °	< 0.2 °
DC offset current	< 3 mA	< 10 mA
Resolution	1 mA, 2 mA (2 phases parallel), ...	
Frequency range[9]	0 … 1000 Hz	
Trigger on overload	Timer accuracy error < 1 ms	
Short-circuit protection	Unlimited	
Open-circuit protection	Open outputs (open-circuit) permitted	
Connection	4 mm/0.16 " banana connectors, amplifier connection socket[8]	
Insulation	Reinforced insulation of power supply and all SELV interfaces	

Footnotes:

1. Data for three-phase systems are valid for symmetric conditions (0 °, 120 °, 240 °) unless specified otherwise.
2. For wiring of single-phase modes see chapter 7, "Increasing the Output Power, Operating Modes" on page 65.
3. Single-phase mode (in phase opposition).
4. rd. = reading; rg. = range, whereat *n* % of rg. means: *n* % of upper range value.
5. Valid for sinusoidal signals at 50/60 Hz and $R_{load} \leq 0.5\ \Omega$.
6. Values at 20 kHz measurement bandwidth, nominal value, and nominal load.
7. Guaranteed data at 230 V mains for ohmic loads (PF=1); typical data for inductive loads. Refer to the sections about operational lmits 6.3.4. and 6.3.5.
8. For currents > 25 A, connect test object only to the 4 mm/0.16 " banana connections and not to the generator combination socket.
9. Current amplitude derating at frequencies above 380 Hz (see Figure 6-4).

Figure 6-1:
Guaranteed output power per phase of a group and when groups A and B are connected in parallel (active power values in W are guaranteed; apparent power values in VA are typical values)

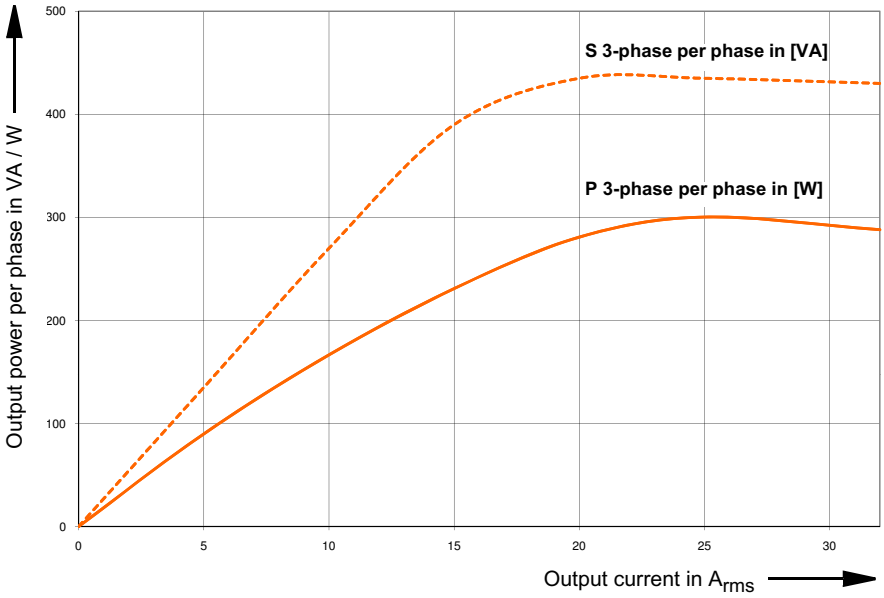
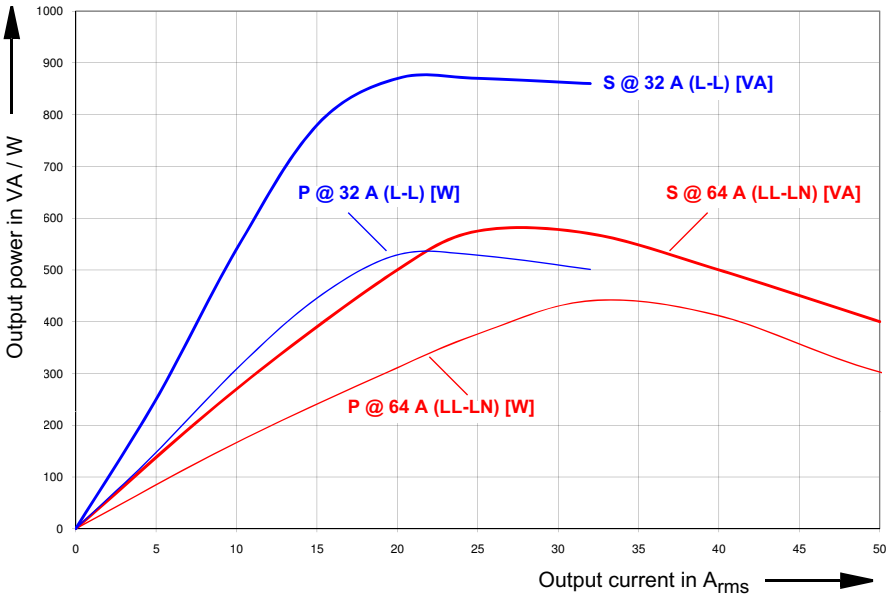
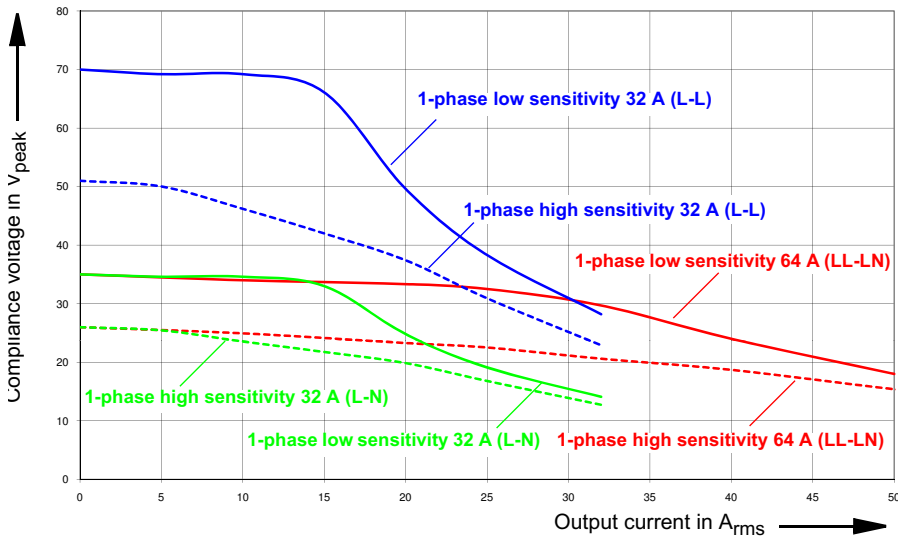


Figure 6-2:
Guaranteed single phase output power curves (active power values in W are guaranteed; apparent power values in VA are typical values)



For additional information refer to section 7.2, "Single-Phase Operation of the CMC 353" on page 66.

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



The high and low sensitivity curves in figure 6-3 correspond to the overload detection sensitivity settings in the *Test Universe* software. The low sensitivity curves show the maximum available peak compliance voltage, which is mainly relevant for testing primary and electromechanical relays.

Figure 6-4:
Current derating at high frequencies for sinusoidal signals

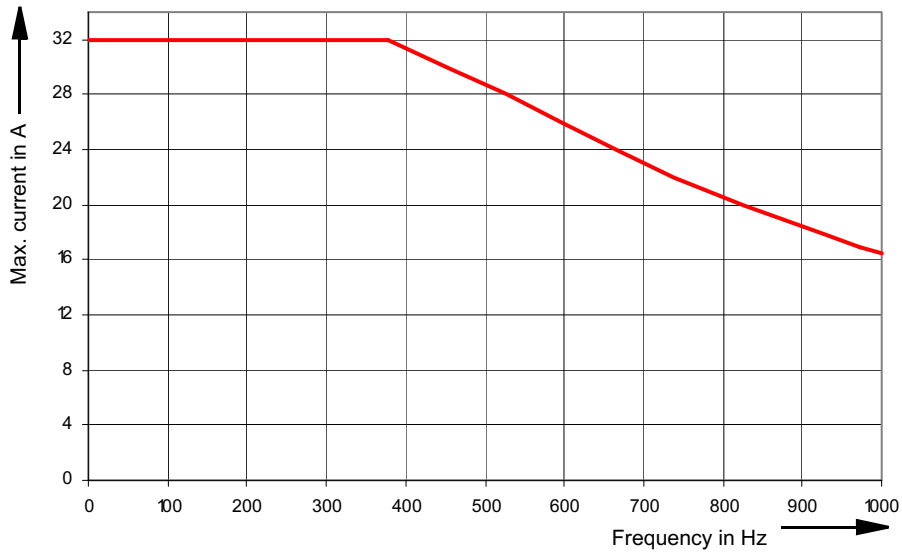


Figure 6-5:
Typical continuous output current and output power at 23 °C;
single-phase mode

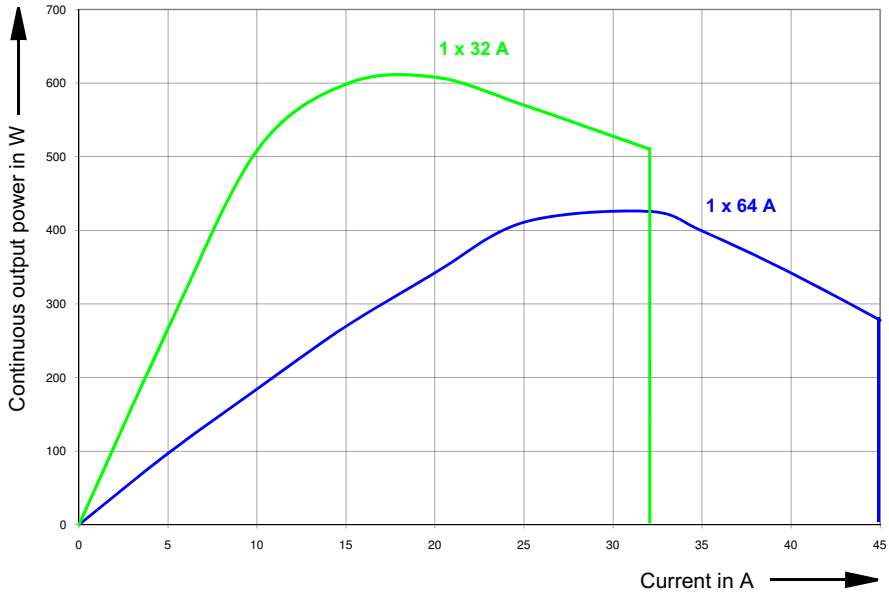
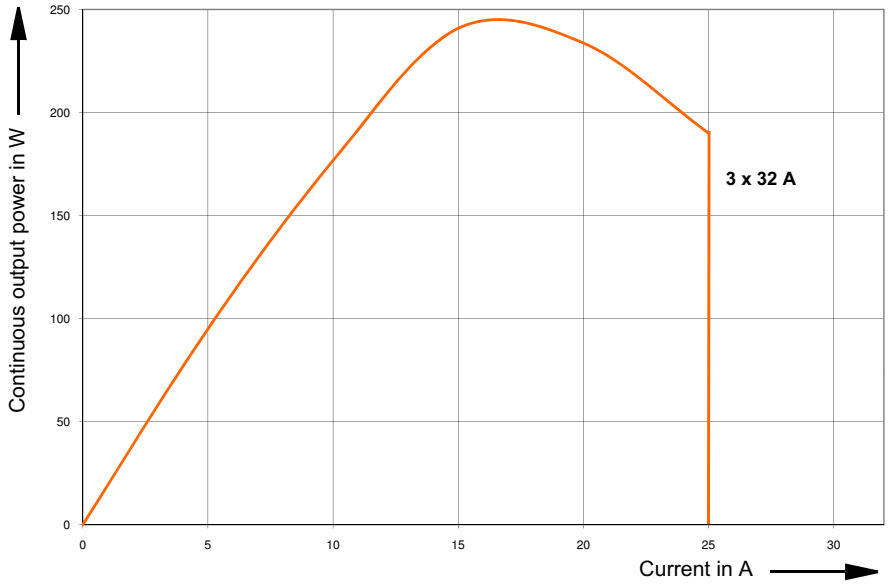


Figure 6-6:
Typical continuous output current and output power at 23 °C;
three- and six-phase mode



The continuous operating range is given by the area below the curves in the figure 6-5 and 6-6 above.

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

Table 6-6:
Typical duty cycles for operation at ambient temperature of 23 °C

3 x 32 A (L-N)					
I [A]	P [W]	Duty cycle	t1 [min]	ton [s]	toff [s]
0 ... 25	0 ... 600	100 %	> 30	> 1800	-
26	700	80 %	7.5	80	20
29	650	75 %	6.0	60	20
32	600	71 %	3.5	50	20

1 x 64 A (LL-LN)					
I [A]	P [W]	Duty cycle	t1 [min]	ton [s]	toff [s]
0 ... 40	0 ... 350	100 %	> 30	> 1800	-
50	250	60 %	4.9	30	20
60	150	43 %	2.6	15	20
64	100	38 %	2.0	12	20

6.3.3 Voltage Outputs

Table 6-7:
CMC 353 voltage outputs

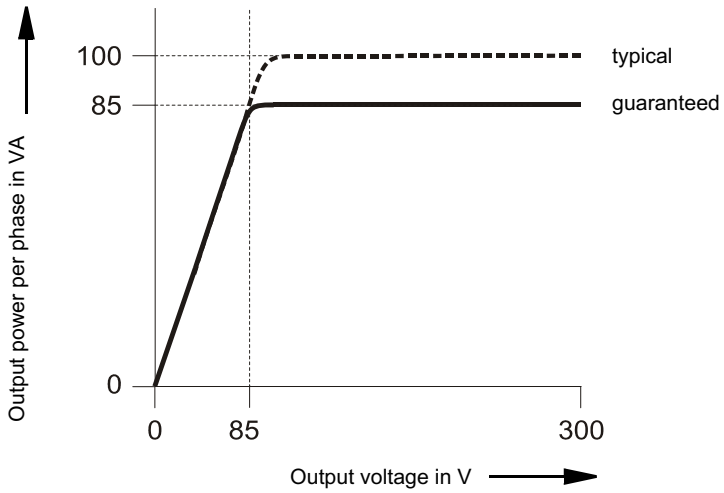
4 Voltage Outputs		
Output voltages 3-phase AC (L-N) 4-phase AC (L-N)[1] 1-phase AC (L-N) 1-phase AC (L-L) DC (L-N)	 3 x 0 ... 300 V 4 x 0 ... 300 V 1 x 0 ... 300 V 1 x 0 ... 600 V 4 x 0 ... ± 300 V	
Output power[2]	Typical	Guaranteed
3-phase AC[3] 4-phase AC[4] 1-phase AC (L-N) 1-phase AC (L-L) DC (L-N)	3 x 100 VA at 100 ... 300 V 4 x 75 VA at 100 ... 300 V 1 x 200 VA at 100 ... 300 V 1 x 275 VA at 200 ... 600 V 1 x 420 W at 300 VDC	3 x 85 VA at 85 ... 300 V 4 x 50 VA at 85 ... 300 V 1 x 150 VA at 75 ... 300 V 1 x 250 VA at 200... 600 V 1 x 360 W at 300 VDC
Accuracy	Error < 0.03 % of rd.[5] + 0.01 % of rg.	Error < 0.08 % of rd. + 0.02 % of rg.
Harmonic distortion (THD+N)[6, 7]	0.015 %	< 0.05 %
Phase error[6]	Typical 0.02 °	Guaranteed < 0.1 °
DC offset voltage	< 20 mV	< 100 mV
Voltage ranges	Range I: 0 ... 150 V Range II: 0 ... 300 V	
Resolution	Range I: 5 mV Range II: 10 mV	
Frequency ranges	sinusoidal signals 10 … 1000 Hz harmonics/interharm.[8] 10 … 3000 Hz transient signals DC … 3.1 kHz	
Short-circuit protect.	Unlimited for L - N	
Connection	4 mm/0.16 " banana connectors; amplifier connection socket V_{L1}-V_{L3}	
Insulation	Reinforced insulation of power supply and all SELV interfaces	

Footnotes:

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} can be configured by 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 6.3.4, "Operational Limits in Conjunction with Mains Supply" on page 51.
3. Data for three-phase systems are valid for symmetric conditions (0 °, 120 °, 240 °).
4. Data for four-phase systems are valid for symmetric conditions (0 °, 90 °, 180 °, 270 °).
5. rd. = reading;
   rg. = range, whereat *n* % of rg. means: *n* % of upper range value.
6. Valid for sinusoidal signals at 50/60 Hz.
7. 20 kHz measurement bandwidth, nominal value, and nominal load.
8. Signals above 1 kHz are only supported in selected software modules and are only available on the voltage outputs and the low level outputs.

6.3.3.1 Power Diagram for Three-Phase Operation

Figure 6-7:
Power diagram for
three-phase operation



6.3.3.2 Power Diagram for Single-Phase Operation

Also refer to section 7.2.3, "Single-Phase Voltage" on page 68.

Figure 6-8:
Single-phase operation
L-N

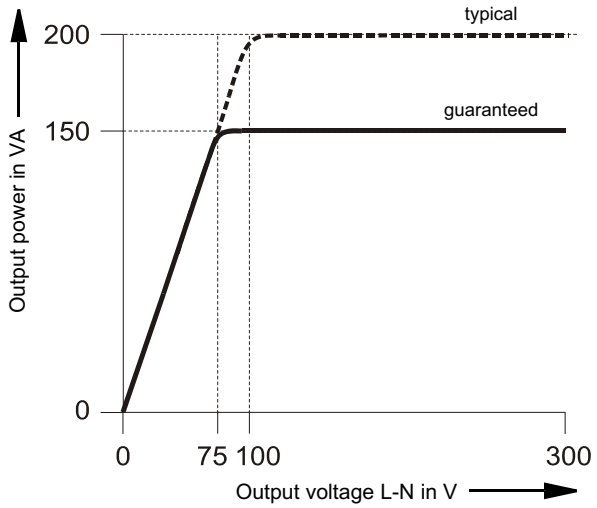
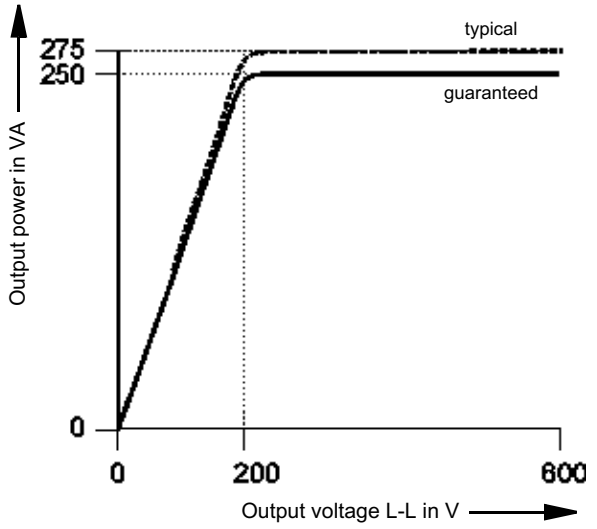


Figure 6-9:
Single-phase operation
L-L



6.3.4 Operational Limits in Conjunction with Mains Supply

A mains power supply voltage of 115 VAC or below limits the maximum possible output power of the *CMC 353*.

In order to increase the output power when operated with a mains power supply voltage of ≤ 115 VAC, you can supply the *CMC 353* from two phases (L-L) rather than from the normal one phase-neutral (L-N). This increases the power supply by the factor √3 (115 VAC * √3 = 200 V).

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

Table 6-8:
Typical total output power at low mains power supply voltages

Mains[1]	Current amplifier	Voltage Amplifier	AUX DC
115 V	3 x 250 W @ 20 A	3 x 85 W @ 85 V	45 W @ 110 V
100 V	3 x 200 W @ 20 A	3 x 85 W @ 85 V	45 W @ 110 V
90 V	3 x 150 W @ 20 A	3 x 85 W @ 85 V	45 W @ 110 V

[1] At an ambient temperature of 23 °C, after 10 min of continuous operation at full output power, allow a duty cycle of 10 min on/10 min off.

6.3.5 Operational Limits with Current and Voltage Amplifier in Parallel

A parallel operation of current and voltage amplifier lowers the maximum output power of the *CMC 353.*

To limit the internal losses and to maximize the output power of the voltage amplifier, set the maximum test object voltage to the minimum value possible for the test. To minimize no-load losses, do not route unused amplifiers in the **Hardware Configuration**.

Table 6-9:
Typical test set uptime for different output powers when operating at an ambient temperature of 23 °C

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

[1] t1 = maximum possible uptime for a cold *CMC 353* test set.

[2] At an ambient temperature of 23 °C, when operating the *CMC 353* test set with a low mains power supply, allow a duty cycle of 10 min on/10 min off.

6.3.6 Low Level Outputs "LL out" for External Amplifiers

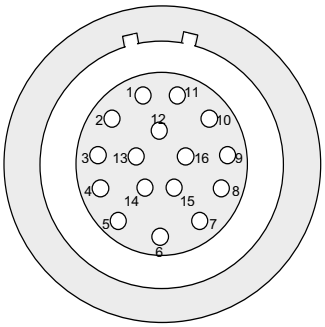
The SELV interface connector "LL out 1 - 6" holds two independent generator triples. These six high accuracy analog signal sources per connector can serve to either control an external amplifier or to directly provide small signal outputs.

In addition, the SELV interface connector provides a serial digital interface (pins 8-16; see below) that transmits control and monitor functions between the *CMC 353* and the external amplifiers. Supported devices are the *CMA 156*, *CMA 56*, *CMS 156*, *CMS 251* and *CMS 252*.

The low level outputs are short-circuit-proof and continually monitored for overload. They 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 ± 10 V_{peak}).

Both the selection of the particular amplifier as well as the specification of the range of the amplifier takes place in the *Test Universe* software.

Figure 6-10:
Pin assignment of "LL out"; view onto the connector from the cable wiring side.



Pin	Function
Pin 1	LL out 1
Pin 2	LL out 2
Pin 3	LL out 3
Pin 4	Neutral (N) connected to 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

"LL out 1-3" and "LL out 4-6" each make up a selectable voltage or current triple.

Table 6-10:
Data for SELV outputs "LL out"

"LL out" outputs		
Output voltage range	0…±10 V_{peak}[1]	
Frequency range	0 … 3000 Hz	
Output current	Max. 1 mA	
Resolution	< 250 µV	
Accuracy	Typical < 0.025 %	Guaranteed < 0.07 % for 1…10 V_{peak}
Harmonic distortion (THD+N)[2]	Typical < 0.015 %	Guaranteed < 0.05 %
Phase error[3]	Typical 0.02 °	Guaranteed < 0.1 °
DC offset voltage	Typical < 150 µV	Guaranteed < 1.5 mV
Unconventional CT/VT simulation	Linear or Rogowski[4] mode	
Overload indication	Yes	
Short-circuit protection	Unlimited to GND	
Insulation	Reinforced insulation to all other potential groups of the test equipment. GND is connected to protective earth (PE).	

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

[4] When simulating Rogowski sensors, the output voltage is proportional to the derivative of the current with respect to time (di(t)/dt).

Table 6-11:
Ordering Information

Ordering Information	
Connector for two guide notches and pull relief (for "LL out")	FGB.2B.316.CLAD 72Z
Black anti-bend cable cover	GMA.2B.070 DN

For a manufacturer description about the connection sockets "LL out" and "ext. Interf.", visit the Web site www.lemo.com.

6.3.7 Low-Level Binary Outputs ("ext. Interf.")

The SELV interface connector "ext. Interf." holds four additional transistor binary outputs (Bin. out 11 - 14). Unlike regular relay outputs, Bin. out 11 - 14 are bounce-free binary outputs (small signals) and have a minimal reaction time.

In addition, two high frequency counter inputs for up to 100 kHz are available for the testing of energy meters. They are described in section 6.4.2, "Counter Inputs 100 kHz (Low Level)" on page 61.

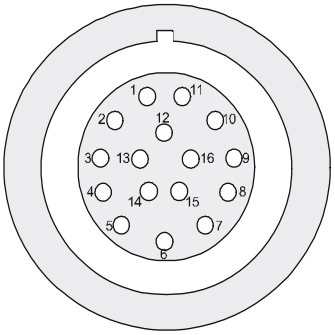


Figure 6-11:
Pin assignment of "ext. Interf." (upper 16-pole Lemo socket); view onto the connector from the cable wiring side

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

Table 6-12:
Data of the low-level binary outputs 11 - 14

4 Low-Level Transistor Binary Outputs (Bin. out 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	Connector "ext. Interf." (*CMC 353* rear side)
Insulation	Reinforced insulation to all other potential groups of the test equipment. GND is connected to protective earth (PE).

Figure 6-12:
Circuit diagram of "ext. Interf." binary transistor outputs 11 - 14

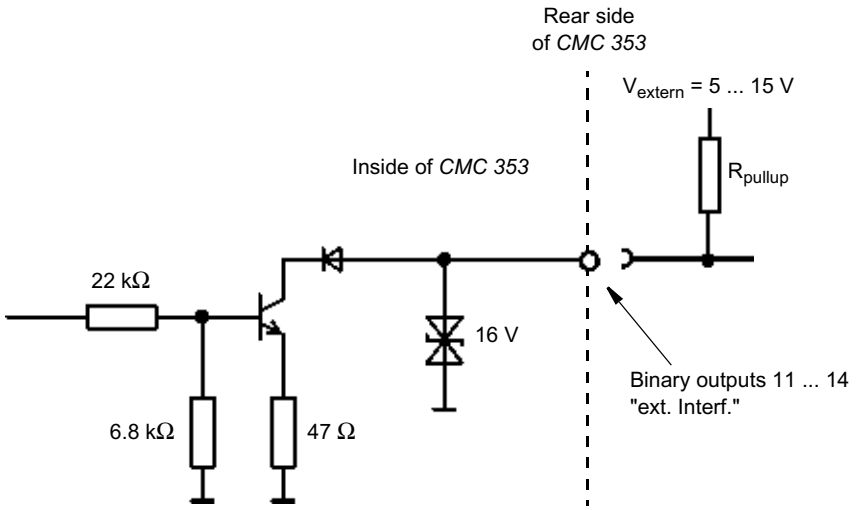


Table 6-13:
Ordering Information

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

For a manufacturer description about the connection sockets "LL out" and "ext. Interf.", visit the Web site www.lemo.com.

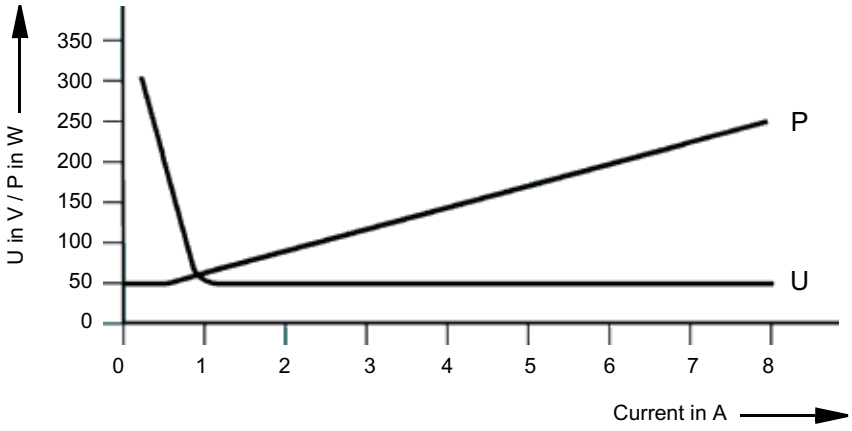
6.3.8 Binary Output Relays

Table 6-14:
Data of binary output relays

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

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

Figure 6-13:
Load limit curve for relays on the binary outputs with DC voltages



6.3.9 DC Supply (AUX DC)

Table 6-15: DC Voltage supply AUX DC

DC Supply (AUX DC)	
Voltage ranges	0 ... 66 V_{DC} (max. 0.8 A) 0 ... 132 V_{DC} (max 0.4 A) 0 ... 264 V_{DC} (max. 0.2 A)
Power	Max. 50 W
Accuracy[1]	Error: typical < 2 %, guaranteed < 5 %
Resolution	< 70 mV
Connection	4 mm/0.16 " banana sockets on front panel
Short-circuit protection	Yes
Overload indication	Yes
Insulation	Reinforced insulation from power supply and all SELV interfaces

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

6.4 Inputs

6.4.1 Binary Inputs

Table 6-16: General data of binary inputs

General Data of 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	Unlimited
Debounce time	0…25 ms (refer to page 60)
Deglitch time	0…25 ms (refer to page 60)
Counting function counter frequency pulse width	 3 kHz (per input) >150 µs (for high and low signals)
Configuration	Binary inputs can be configured. Refer to the OMICRON *Test Universe* Help.
Connection	4 mm/0.16 " 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 6-17: Data for potential-sensing operation

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

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

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

[2] Refer to figure 5-2, "Simplified circuit diagrams of binary inputs and outputs" on page 28.

Table 6-18:
Data for potential-free operation

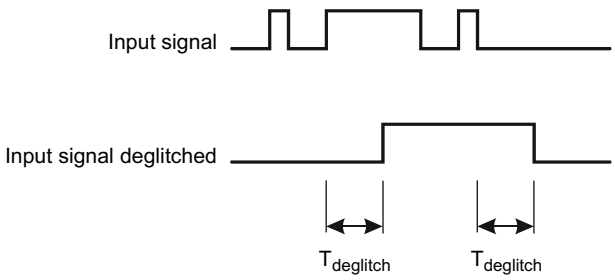
Data for Potential-Free Operation[1]	
Trigger criteria	Logical 0: R > 100 kΩ Logical 1: R < 10 kΩ
Input impedance	216 kΩ

[1] Refer to figure 5-2, "Simplified circuit diagrams of binary inputs and outputs" on page 28.

Deglitching input signals

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

Figure 6-14:
Signal curve, deglitching input signals



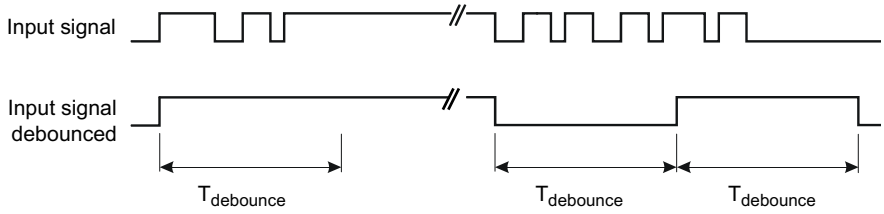
Debouncing input signals

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

The debounce function is placed after the deglitch function described above and both are realized by the firmware of the *CMC 353* and are calculated in real time.

The figure below illustrates the deglitch 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 6-15:
Signal curve, debounce input signals



6.4.2 Counter Inputs 100 kHz (Low Level)

The SELV interface connector "ext. Interf." holds two high frequency counter inputs for up to 100 kHz are available for the testing of energy meters.

In addition, four transistor binary outputs (Bin. out 11 - 14) are available. They are described in section 6.3.7, "Low-Level Binary Outputs ("ext. Interf.")" on page 54.

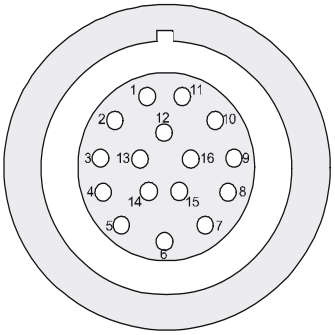


Figure 6-16:
Pin assignment of "ext. Interf." (upper 16-pole Lemo socket); view onto the connector from the cable wiring side

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

Table 6-19:
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 353*)
Insulation	Reinforced insulation to all other potential groups of the test equipment. GND is connected to protective earth (PE).

Figure 6-17:
Circuit diagram of "ext. Interf." counter inputs 1 and 2

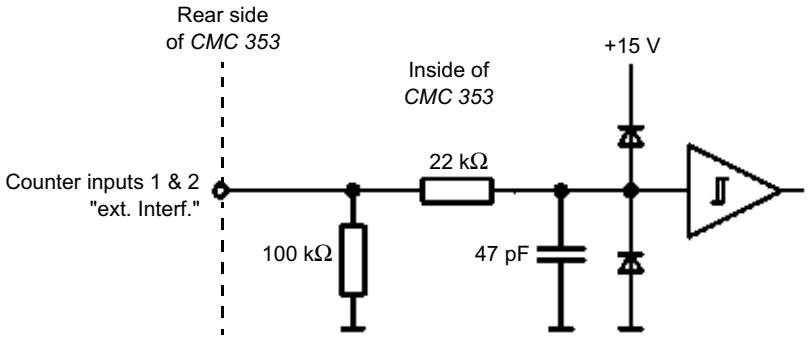


Table 6-20:
Ordering Information

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

For a manufacturer description about the connection sockets "LL out 1-6" and "ext. Interf.", visit the Web site www.lemo.com.

6.5 Technical Data of the Ethernet Ports

Table 6-21:
Technical data of the Ethernet ports

Ethernet ports ETH1 and ETH2	
Type	10/100Base-TX (10/100Mbit, twisted pair, auto-MDI/MDIX or auto-crossover)
Connector	RJ45
Cable type	LAN cable of category 5 (CAT5) or better
Status indication	Green LED: physical link present Yellow LED: traffic on interface
Power **o**ver **E**thernet (PoE)	IEEE 802.3af compliant. Port capability limited to one Class 1 (3.84 W) and one Class 2 (6.49 W) power device.

6.6 Environmental Conditions

6.6.1 Climate

Table 6-22: Climate

Climate	
Operating temperature	0 ... +50 °C; above +30 °C a 50 % duty cycle may apply.
Storage and transportation	-25 … +70 °C
Max. altitude	2000 m
Humidity	5 … 95% relative humidity; no condensation
Climate	Tested according to IEC 68-2-78

6.6.2 Shock and Vibration

Table 6-23: Shock and vibration

Dynamics	
Vibration	Tested according to IEC 60068-2-6 (operating mode); frequency range 10 ... 150 Hz; acceleration 2 g continuous (20 m/s²); 10 cycles per axis
Shock	Tested according to IEC 60068-2-27 (operating mode); 15 g / 11 ms, half-sinusoid, each axis

6.7 Mechanical Data

Table 6-24: Data regarding size and weight

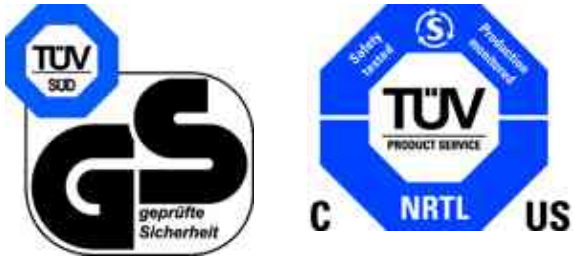
Size, Weight and Protection	
Weight	12.9 kg (28.5 lbs)
Dimensions W x H x D (without handle)	343 x 145 x 390 mm (13.5 x 5.7 x 15.4 ")
Housing	IP20 according to EN 60529

6.8 Cleaning

To clean the *CMC 353*, use a cloth dampened with isopropanol alcohol or water. Prior to cleaning, always switch off the power switch and unplug the power cord from the mains.

6.9 Safety Standards, Electromagnetic Compatibility (EMC) and Certificates

Table 6-25:
CE conformity, certified Safety Standards and EMC-compatibility

CE Conformity, Requirements	
The product adheres to the specifications of the guidelines of the council of the European Community for meeting the requirements of the member states regarding the electromagnetic compatibility (EMC) Directive 89/336/EEC and the low voltage Directive 73/23/EEC.	
EMC	
Emission Europe International USA	 EN 61326; EN 61000-6-4; EN 61000-3-2/3 IEC 61326; IEC 61000-6-4; IEC 61000-3-2/3 FCC Subpart B of Part 15 Class A
Immunity Europe International	 EN 61326; EN 61000-6-2; EN 61000-4-2/3/4/5/6/11 IEC 61326; IEC 61000-6-2; IEC 61000-4-2/3/4/5/6/11
Certified Safety Standards	
Europe	EN 61010-1 Insulation of PC and SELV interfaces complies with EN 60950-1
International USA Canada	IEC 61010-1 UL 61010-1 CAN/CSA-C22.2 No 61010-1-04
Certificate	 Manufactured under an ISO9001 registered system

7 Increasing the Output Power, Operating Modes

The *CMC 353* has a very large application diversity. The current outputs offer enough output power to test almost all electromechanical relays.

The *CMC 353* offers a variety of single-phase operation 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 353* in parallel or to connect external amplifiers (up to six independent additional channels) to the "LL out 1-6".

The operating modes illustrated in the following sections can be set in the Hardware Configuration of the OMICRON *Test Universe* software.

7.1 Safety Instructions for High Current Output

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

- For currents greater than 25 A, the test object (load) should be exclusively connected to the 4 mm/0.16 " banana sockets and not to the generator combination socket.
- Since a current of 32 A flowing through a test lead (2 m/6 ft. legth, 2.5 mm^2) causes a loss of 15 ... 18 W, we recommend to use the connection methods shown in this chapter.
- When connecting current outputs in parallel, it has to be ensured that the test leads are only connected together immediately at the test object and that the test leads have sufficient diameter.
- At maximum amplitude of the 64 A mode, the cable losses can amount to 66 W for AC and 140 W for DC operation.

- For applications drawing DC current: The test object (load) should be exclusively non-inductive! Note that a load of, for example, 1 Henry can store 50 J (Joule) at 10 A DC for a long period of time. Electrical shocks with more than 350 mJ can be life-hazardous for the user.

7.2 Single-Phase Operation of the CMC 353

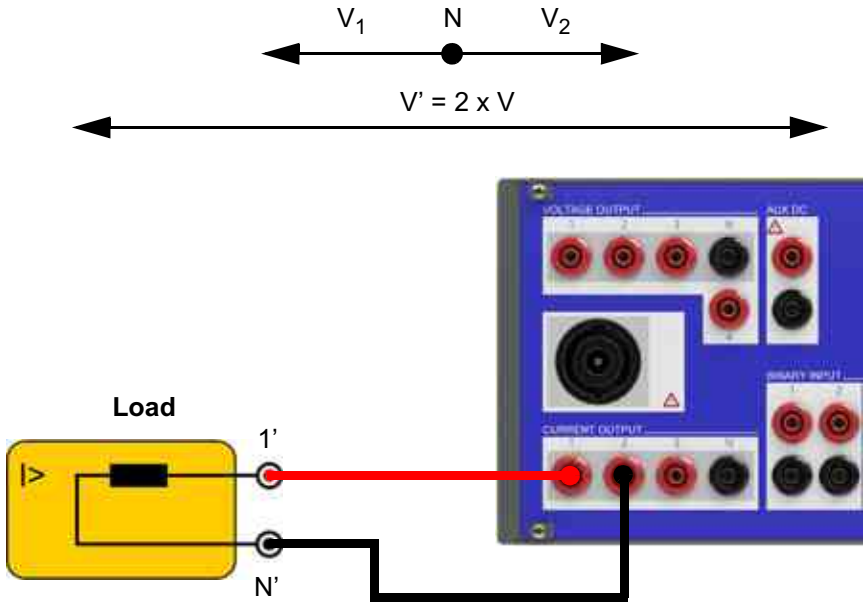
7.2.1 1 x 32 A High Burden Mode (L-L)

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

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

Observe the safety instructions given in Section 7.1 on page 65 when using this operating mode.

Figure 7-1:
Single-phase operation,
1 x 32 A high burden mode



Refer to the output curves shown in the figures 6-1 through 6-5 in section 6.3.2, "Current Outputs" on page 43.

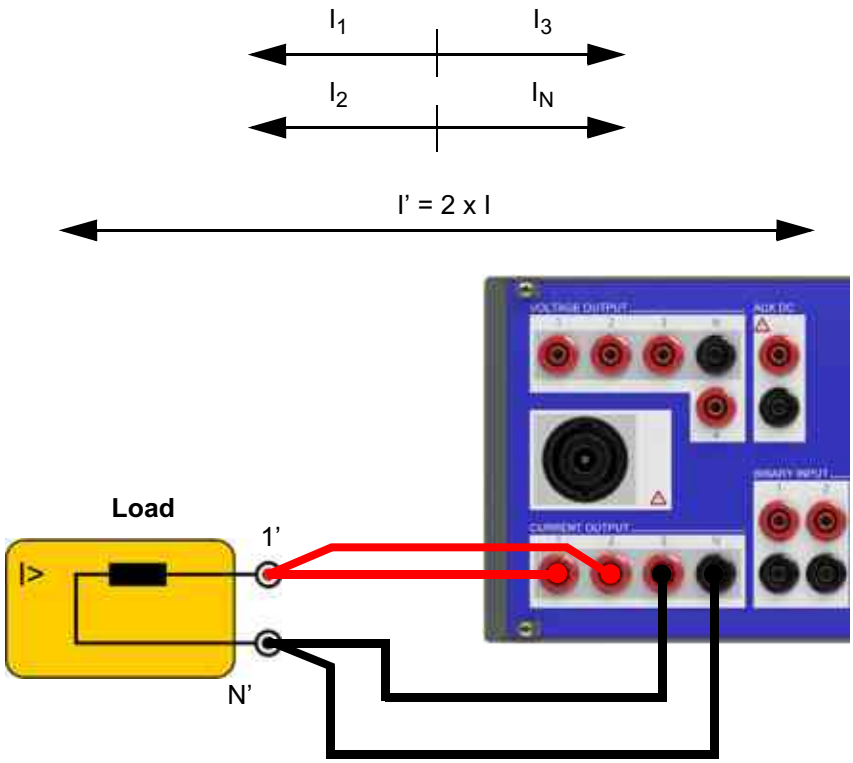
7.2.2 1 x 64 A High Current Mode (LL-LN)

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

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

Observe the safety instructions given in Section 7.1 on page 65 when using this operating mode.

Figure 7-2:
Single-phase operation,
1 x 64 A high current mode

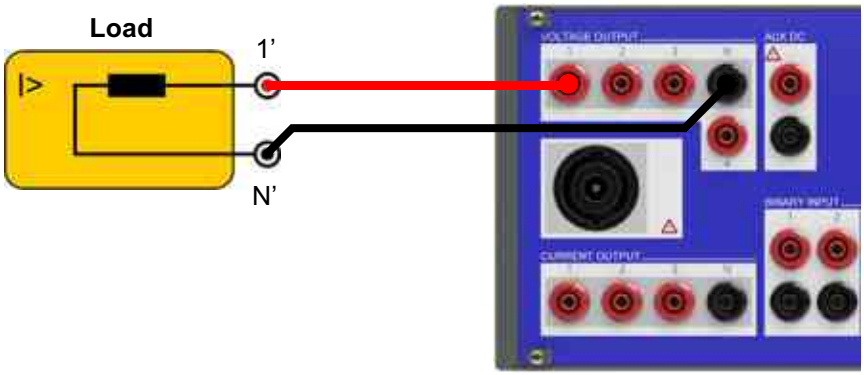


Refer to the output curves shown in the figures 6-1 through 6-5 in section 6.3.2, "Current Outputs" on page 43.

7.2.3 Single-Phase Voltage

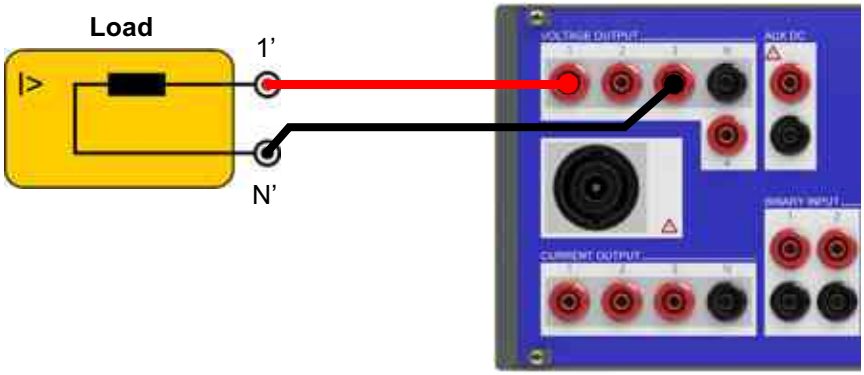
1 x 0 ... 300 V, 1 x 200 VA [100 ... 300 V] typical

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



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

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



Refer to the output curves shown in the figures 6-8 through 6-9 in section 6.3.3, "Voltage Outputs" on page 48.

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

7.3 Operation with External Amplifiers

The connections "LL out 1-6" offer a large variety of extension possibilities. They enable the connection of external amplifiers in order to increase the number of independent voltage or current channels and thus provide the possibility to realize additional applications the *CMC 353* alone cannot cover.

The LL output socket can connect up to four external amplifiers with six independent channels.

The following configurations are possible:

- 9 × 25 A_{rms} / 70 VA for differential relays in three galvanically separated current triples with *CMC 353* + *CMA 156.*
- 6 × 250 V / 75 VA for the synchronization in two galvanically separated voltage triples with *CMC 353* + *CMS 156.*

For a complete overview of the supported configurations of the *CMC 353* and CMA/S amplifiers see the OMICRON *Test Universe* Help, topic **Hardware Configuration**.

8 TROUBLESHOOTING

8.1 Troubleshooting Guide

In case of operational problems with the *CMC 353* proceed as follows:

1. Consult the reference manual or the *Test Universe* Help.
2. Check whether the malfunction is reproducible and document it.
3. Try to isolate the malfunction by using another computer, test set or connecting 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 computer: Manufacturer, type, memory, installed printers, operating system (and language) and the installed version and language of the OMICRON *Test Universe* software.
   - screenshots or the exact wording of possible error messages.
6. If you call the OMICRON hotline, please have your computer and test set available and be prepared to repeat the steps that caused the problem.

To speed up the support, please attach the following diagnostic log files:

- **Communication log file**

  This file records any communication between the *CMC 353* and the computer. To send the log file to the OMICRON technical support:

  1. Close all other applications.
  2. From the *Test Universe* Start Page, select **Calibration & Diagnosis…** and then **Logfile**.
  3. Select **Logging on (Detailed)** in the **Edit** menu and minimize the window.
  4. Start the test module and reproduce the malfunction.
  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, select **Calibration & Diagnosis…** and then **Hardware Check** from the *Test Universe* Start Page.

8.2 Potential Errors, Possible Causes, Remedies

Some potential disruptions that may occur while operating the *CMC 353* are listed below. Try to eliminate them by applying the remedies proposed here.

Table 8-1: Troubleshooting the *CMC 353*

Error	Possible causes	Remedies
Power switch does not light up after turning on the *CMC 353* 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 is blown	Unplug the power cord from the power source! Replace the fuse: T 12.5 AH 250 V (5 x 20 mm).
	Malfunction of internal test set components	Please contact the OMICRON technical support (refer to section "Contact Information / Technical Support" on page 95).
The following message appears in the status line: "WARNING: Broken ground connection! Immediately turn off the test set! Resuming the operation can result in hazard to life and is done at your own risk."	Ground-wire connection to the *CMC 353* is broken or the test set is powered by an earth-free power supply. **Note:** Never connect the *CMC 353* to an isolating transformer.	Check the ground connection. Ground the housing of the test set separately using the PE connection socket (on the back panel of the test set).

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, i.e., to optimize the output power limit of the current outputs set the compliance voltage of the internal current amplifiers.

To do so, go to the **Compliance Voltage** group box of the **Output Configuration Details** dialog box in the *Test Universe* **Hardware Configuration**.

By reducing the power supply voltage, the ON-time can be prolonged considerably for low-ohmic burdens, because this causes the internal amplifier to consume less power. Hence, the internal heat dissipation can be reduced, especially when testing with low burden test objects. This then considerably extends the time until the device switches OFF due to thermal overload.

For more detailed information refer to the *Test Universe* Help. Select the **Hardware Configuration** Help and navigate to the topic **Setting the Current Output Power Limit of CMC Test Sets**.

9 CMC 353-Related Products and Accessories

This chapter describes the optional equipment for the *CMC 353* test set. In the following the amplifiers *CMA 56*, *CMA 156*, *CMS 156*, *CMS 251* and *CMS 252* are jointly named CMA/S. Please visit the OMICRON Web site **www.omicron.at** for up-to-date information.

9.1 CMA Current Amplifiers & CMS Voltage Amplifiers

The CMA/CMS external amplifiers are controlled by the *CMC 353* test set 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 353*

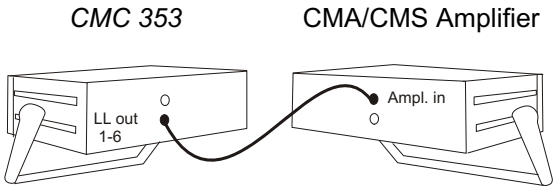


Table 9-1:
Technical data of CMA/S amplifiers

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 (34 lbs)
CMS 156	3-phase current/voltage amplifier 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 7.5 A 1 × 210 VA at 22.5 A	Amplitude accuracy: error < 0.1 %. Weight: 14.7 kg (32.4 lbs)

Detailed information about the CMA/S amplifiers can be found in the corresponding user manuals, the product catalog, or on the OMICRON Web site **www.omicron.at**.

For ordering information about the individual OMICRON amplifiers, please refer to table 9-4, "Ordering information" on page 87.

9.2 CMControl-3

Figure 9-2:
CMControl-3 attached to a *CMC 353* test set

Order numbers:
VEHO2902 (CMControl-3), upgrade for an existing CMC 353
VEHO2901 (CMControl-3), add-on for a new CMC 353.

The *CMControl* is a front panel control device for use with CMC test sets. Its instant availability and its easy operation concept make it the ideal solution for the quick verification of test objects.

The CMControl provides an intuitive touch screen user interface that makes setting up tests particularly easy and convenient. The control wheel allows quick and accurate adjustment of the output quantities. The included test tools and integrated fault models cover almost all arising test tasks and support the tester in getting reliable results quickly.

The *CMControl* can either be used attached to the CMC test set as front panel control unit or detached as a handheld control device. Its magnetic rear allows easy attachment to standard racks while its built-in stand works perfectly on every table.

The *CMControl* is available in two variations: CMControl-6 for *CMC 356*, *CMC 256plus* and *CMC 256-6*, and CMControl-3 for *CMC 353*.

The rugged Ethernet connector ensures reliable communication with the CMC test set. The *CMControl* is designed to optimally meet the requirements for commissioning and maintenance of protection devices and substations.

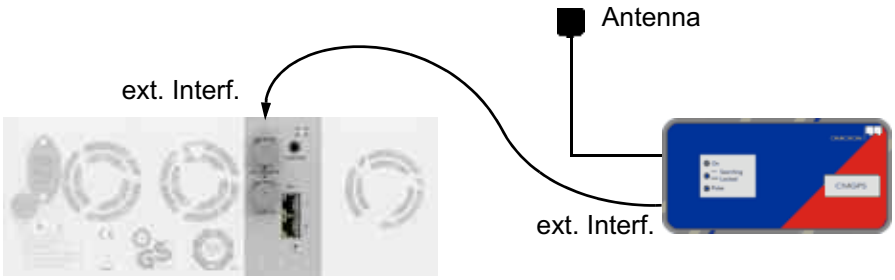
For ordering information about the *CMControl,* refer to table 9-4, "Ordering information" on page 87.

9.3 Time Synchronization Accessories

9.3.1 CMGPS

You can synchronize two or more CMC test sets by connecting a *CMGPS* synchronization unit to each of the test sets' "ext. Interf." inputs. Since the GPS (Global Positioning System) signal is available worldwide, the physical distance between these test sets is thereby of no relevance ("end to end" testing).

Figure 9-3:
CMGPS synchronization unit



For detailed information about the *CMGPS,* please refer to the *CMGPS* reference manual, the product catalog, or the OMICRON Web site **www.omicron.at**. For ordering information about the *CMGPS,* refer to table 9-4, "Ordering information" on page 87.

Table 9-2:
Basic technical data of the *CMGPS* synchronization unit

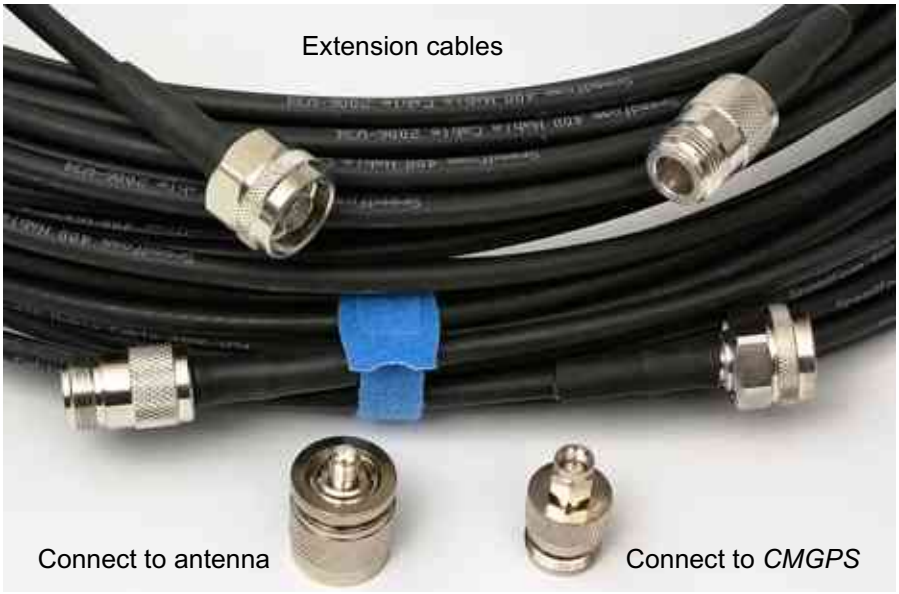
Pulse outputs	2
Accuracy	Error < ±1 µs or ±5 µs
Synchronization of test sets[1]	Error < 100 µs / < 5 µs (voltage amplifier) Error < 100 µs / < 20 µs (current amplifier)
Connection	Voltage supply from the *CMC 353* test set. Configured by the *Test Universe* software.
Weight	440 g (1 lbs)
Dimensions W x H x D	140 x 70 x 40 mm (5.5 x 2.8 x 1.6 ")

[1] Error corresponds to amplifier output signals (voltage/current) of *CMGPS*-synchronized test sets at configured GPS trigger event
5 µs / 20 µs: enhanced mode only in supported *Test Universe* test modules (refer to *Test Universe* Help, topic "Time Trigger Configuration").

Figure 9-4:
CMGPS connected to antenna via 2 × 20 m extension cables

For cases that may require an extension of the antenna cable, an optional set of 2 × 20 m cables is available from OMICRON. For ordering information, refer to table 9-4, "Ordering information" on page 87.

Figure 9-5:
Adapter to connect the extension cables to *CMGPS* and antenna

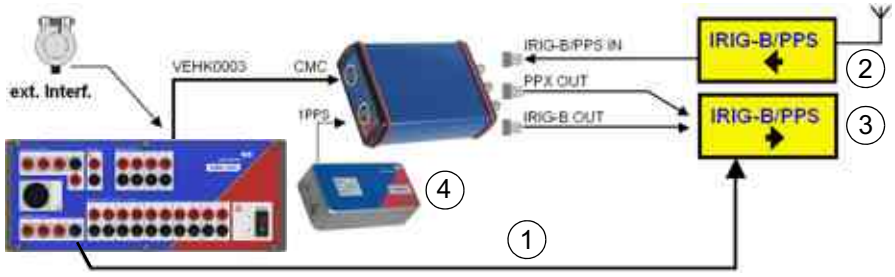


9.3.2 CMIRIG-B

Via the *CMIRIG-B* interface box you can connect devices to the *CMC 353* test set that either transmit or receive the IRIG-B time reference signal (DC level shift protocol B00x). That way, two or more CMC test sets are synchronized. Furthermore, an optional *CMGPS* synchronization unit can be integrated into the test setup to serve as source of the synchronization moment or 1PPS signal, respectively. *CMC 353* decodes (when receiving) or encodes (when transmitting) the IRIG-B protocol. The IRIG-B protocol extensions required by standard IEEE C37.118 are supported as well.

The most significant functional enhancement of those *Test Universe* test modules supporting the IRIG-B time reference is the starting and synchronizing of *CMC 353* states (signal output) with high accuracy synchronous to the IRIG-B[1] time reference or PPS/PPX[2] signal, respectively; for example for PMU synchrophasor tests.

Figure 9-6:
Typical test setup with *CMIRIG-B*
(not true to scale)



(1) Test signals (e.g., 3 x current, 3 x voltage).

(2) IRIG-B/PPS source, e.g. GPS receiver with IRIG-B output.

(3) IRIG-B/PPS receiver, e.g. protection relay, PMU.

(4) Optional *CMGPS* synchronization unit (depends on the application).

Requirements:

- *CMC 353* standard test set with Ethernet ports.
- IRIG-B source or receiver with 5 V/TTL level; demodulated; DC level shift protocol (B00x).

---

[1] IRIG stands for **I**nter **R**ange **I**nstrumentation **G**roup and represents a serial time code format.

[2] PPS: pulses per second
PPX: programmable PPS signal (pulse rate, e.g., 1 pulse per minute or one pulse per 10 seconds)

CMIRIG-B timing specifications

Figure 9-7:
CMIRIG-B timing in detail

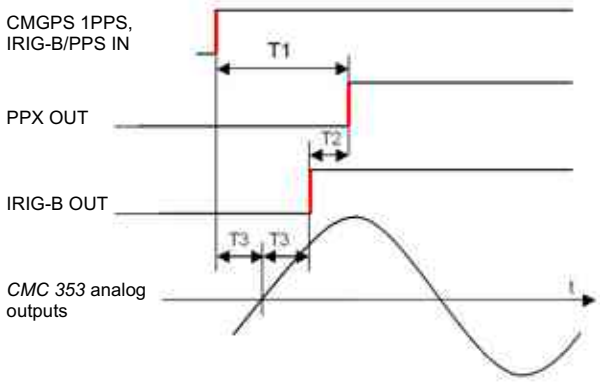


Table 9-3:
Timing specifications

Timing specifications		
T1	(delay time PPS source to PPX OUT)	< 1 µs typ., 1.5 µs max.
T2	(time skew PPX OUT to IRIG-B OUT)	< ± 0.1 µs typ., ± 0.5 µs max.
T3	(time error of time reference source to analog outputs)[1]	
	- Current outputs	± 5 µs typ., ± 20 µs guar.
	- Voltage outputs	± 1 µs typ., ± 5 µs guar.

[1] Valid for *CMC 353* output frequencies < 100 Hz and re-synchronized analog output signals.

For ordering information about the *CMIRIG-B,* refer to table 9-4, "Ordering information" on page 87.

For detailed information about the OMICRON *CMIRIG-B* interface box please refer to the CMIRIG-B Reference Manual.

Detailed information about the IRIG-B standard can be found, for example, in the IRIG SERIAL TIME CODE FORMATS publication at the url **https://wsmrc2vger.wsmr.army.mil/rcc/manuals/200-04/index.html**.

Detailed information about how to configure the *Test Universe* software component **Time Trigger Configuration** for the use of *CMIRIG-B* with or without *CMGPS* can be found in the *CMIRIG-B* Reference Manual and in the *Test Universe* Help, topics **Time Trigger Configuration** and **Hardware Configuration** (**IRIG-B & GPS** tab).

9.4 100TX to 100FX-SC Converter

Figure 9-8:
100TX to 100FX-SC Converter

Order number: @@@@@@

This converter connects the *CMC 353* to a network via fiber optics.

The *100TX to 100FX-SC Converter* transfers data from a 10/100Base-TX copper to a fiber interface. It is designed to receive both data and power from PoE networks, and to pass on the data to a fiber optics connection.

9.5 Wiring Accessories

9.5.1 Standard Delivery Scope

The following three cs belong to the standard delivery scope of a *CMC 353* test set. They can, however, also be ordered separately.

1. Flexible test lead

Order number: VEHK0112

2 m (6 ft.) test lead to connect the *CMC 353* output to other safety sockets of, for example, amplifiers, test objects or to banana adapters in control cabinets.

Specification: 1000 V/32 A

Amount supplied: 6 x red, 6 x black

2. Flexible jumper

Order number: VEHZ0009

Flexible jumper to connect current outputs in parallel (up to 32 A) or to short-out the neutrals of binary inputs.

Specification: 1000 V/32 A

Amount supplied: 4 x black

3. Flexible terminal adapter

Order number: VEHS0009

Flexible terminal adapter to connect to screw-clamp terminals.

Specification: 1000 V/32 A

Amount supplied: 12 pieces

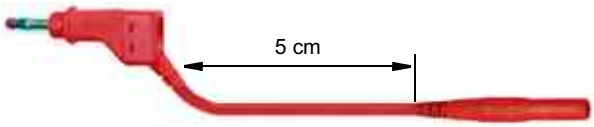
9.5.2 Optional CMC Wiring Accessory Package

Figure 9-9:
The CMC Wiring Accessory Package

Order number: VEHZ0060

The CMC Wiring Accessory Package contains the following articles:

1. Flexible test lead adapter



5 cm (2") test lead adapter with retractable sleeve to connect the *CMC 353* output to non-safety sockets in combination with a regular flexible 2 m (6 ft.) test lead as shown at section 9.5.1.

Specification: 600 V/32 A

Amount: 6 x red, 6 x black

2. Flexible jumper

Flexible jumper to connect current outputs in parallel (up to 32 A) or to short-out the neutrals of binary inputs. Identical to article of standard delivery scope listed under 9.5.1.

Specification: 1000 V/32 A

Amount: 4 x black

3. Crocodile clamp

Crocodile clamps for secondary side to connect to pins or screw bolts.

Specification: 1000 V/32 A

Amount: 4 x red, 4 x black

4. Flexible terminal adapter

Flexible terminal adapter to connect to screw-clamp terminals. Identical to article of standard delivery scope listed under 9.5.1.

Specification: 1000 V/32 A

Amount: 12 pieces

5. M4 (0.15") Cable Lug Adapters

Cable lug adapters for M4 (0.15") screws to connect regular test leads to screw-clamp terminals of SEL/ABB/GE relays (and others).

Specification: 1000 V/20 A

Amount: 20 pieces

6. M5 (0.2") Cable Lug Adapters

Cable lug adapters for M5 (0.2") screws to connect regular test leads to screw-clamp terminals of SEL/ABB/GE relays (and others).

Specification: 1000 V/20 A

Amount: 10 pieces

7. Cable Tie (Velcro fastener)

Cable Tie (Velcro fastener), length 150 mm (6"), black.

Amount: 10 pieces

9.6 Ordering Information

This section lists ordering information for optional equipment of the *CMC 353* test set.

Figure 9-10:
Connection cables I

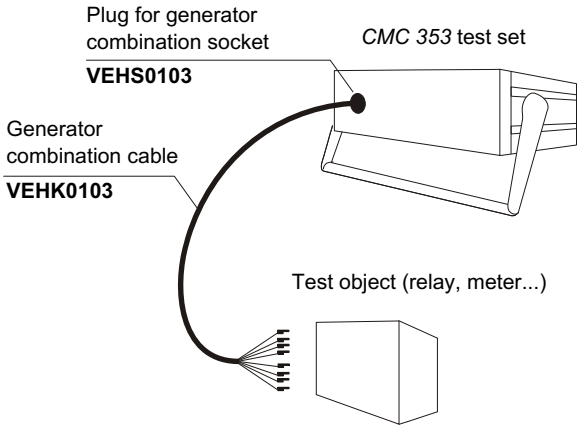


Figure 9-11:
Connection cables II

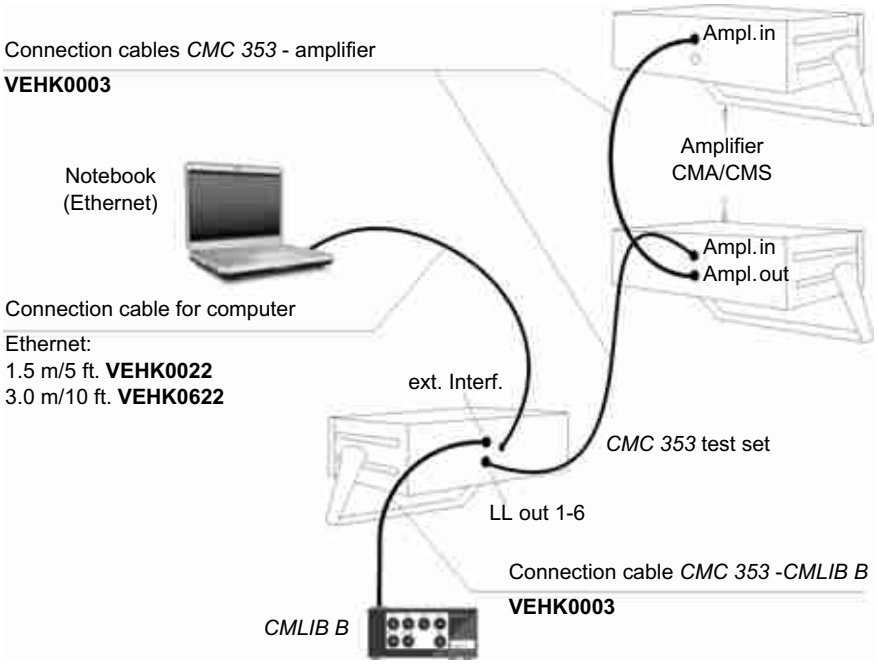


Table 9-4:
Ordering information

Article	Order no.
Amplifiers (⟶ section 9.1)	
CMA 156 Current amplifier (6×25 A)	VEHV1010
CMS 156 Voltage/current amplifier (3×250 V, 3×25 A)	VEHV1030
CMControl-3 (⟶ section 9.2)	
CMControl-3; upgrade for an existing *CMC 353* (includes soft bag VEHP0013)	VEHO2901
CMControl-3; add-on for a new *CMC 353*	VEHO2902
CMIRIG-B Interface box (⟶ section 9.3.2)	
CMIRIG-B Interface box incl. all accessories	VEHZ1150
CMIRIG-B Interface box	VEHZ1151
Connection cable *CMIRIG-B* ↔ *CMC 353*	VEHK0003
CMGPS Synchronization unit (⟶ section 9.3.1)	
CMGPS Synchronization unit, consisting of: - *CMGPS* synchronization unit - antenna - 15 m antenna cable - power supply unit - 16-pole LEMO cable CMC-CMGPS - carrying bag	VEHZ3000
2 × 20 m antenna extension cable and SMA adapter	VEHZ3003
100TX to 100FX-SC Converter (⟶ section 9.4)	
Converter for data transfer from a 10/100Base-TX copper to a fiber interface.	VEHZ0021
Connector	
Plug for generator combination socket	VEHS0103
Cables	
Ethernet cable 1.5 m /5 ft.	VEHK0022
Ethernet cable 3.0 m/10 ft.	VEHK0622
Connection cable *CMC 353*-to-amplifier, *CMLIB A/B* or *CMGPS*	VEHK0003
Generator combination cable	VEHK0103

Article	Order no.
Wiring accessories (⟶ section 9.5)	
Flexible test lead 1000 V/32 A, 6 x red, 6 x black	VEHK0112
CMC Wiring Accessory Package	VEHZ0060
containing the following items: 1. Flexible test lead with retractable sleeve, 600 V/32 A, 6 x red, 6 x black 2. Flexible jumper, 600 V/32 A, 4 x black 3. Crocodile clamps, 1000 V/32 A, 4 x red, 4 x black 4. Flexible terminal adapter, 1000 V/32 A, black, 12 pcs. 5. M4 (0.15") Cable Lug Adapters, 1000 V/20 A, 20 pcs. 6. M5 (0.2") Cable Lug Adapters, 1000 V/20 A, 10 pcs. 7. Cable Tie (Velcro fastener), length 150 mm (6"), 10 pcs. 8. OMICRON Accessory Bag, 1 piece	

Article	Order no.
Heavy-duty transport case with wheels and extendable handle for the *CMC 353* test set with or without CMControl-3. 	VEHP0022
Soft bag for *CMC 353* test set Soft bag for *CMC 353* test set with attached CMControl-3 	VEHP0023 VEHP0013

APPENDIX

The OMICRON Bootloader software

The OMICRON Bootloader software includes software parts developed by:

- Intel Corporation (IXP400 SW Release version 2.3)
- Intrinsyc Software (Intrinsyc Bootloader)
- Swedish Institute of Computer Science, Adam Dunkels (lwIP TCP/IP stack)
- Mark Adler (puff - decompress the deflate data format)
- Jean-loup Gailly and Mark Adler ("zlib" general purpose compression library)

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Intrinsyc Bootloader

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lwIP TCP/IP stack

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puff (Mark Adler)

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zlib (Jean-loup Gailly and Mark Adler)

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The data format used by the zlib library is described by RFCs (Request for Comments) 1950 to 1952 in the files ftp://ds.internic.net/rfc/rfc1950.txt (zlib format), rfc1951.txt (deflate format) and rfc1952.txt (gzip format).

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