CMS 356

User Manual

Manual version: ENU 1114 05 01

The product information, specifications, and technical data embodied in this manual represent the technical status at the time of writing. Subject to change without notice.

We have done our best to ensure that the information given in this manual is useful, accurate and entirely reliable. However, OMICRON does not assume responsibility for any inaccuracies which may be present. The user is responsible for every application that makes use of an OMICRON product.

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

Table of Contents

Preface

The purpose of this user manual is to familiarize users with *CMS 356* amplifier and to show how to use it properly in various application areas.

The manual contains important tips on how to use *CMS 356* 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 *CMS 356*.

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

The user manual should always be available at the site where *CMS 356* is used. It should be read by all personnel operating the test set.

Note: The *CMS 356* installation DVD also installs a PDF version of this manual. The PDF can be found by default at C:\Program Files (x86)\OMICRON\CMS 356\Doc.

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

Keep this manual during the entire service life of the product and always have it available for reference.

Note: In order to get familiar with the web interface for configuring and monitoring the status of *CMS 356*, please refer to the *CMS 356* Getting Started manual and/or the web interface Help.

Note:

From time to time the manual is updated to reflect the actual development status or changes of *CMS 356*. You find this manual's version number on page 2.

Safety Instructions

Before operating the *CMS 356* amplifier, carefully read the following safety instructions.

Only operate (or even turn on) *CMS 356* after you have read this user manual and fully understood the instructions herein.

CMS 356 may only be operated by trained personnel. Any maloperation can result in damage to property or persons.

For Your Safety Please Note

The *CMS 356* amplifier 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 chapters.

Rules for Use

- *CMS 356* 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.
- The instructions provided in this manual and in the *CMS 356* Getting Started are considered part of the rules governing proper usage.
- *CMS 356* is exclusively intended for the application areas specified in chapter 1, "Designated Use" on page 10. The manufacturer/ distributors are not liable for damage resulting from unintended usage. The user alone assumes all responsibility and risk.
- Do not open *CMS 356* or remove any of its housing components.

Orderly Practices and Procedures

- The user manual (or its "electronic PDF pendant", which is installed on your computer with the *CMS 356* installation DVD) should always be available on site where *CMS 356* is used.

  Note: The *CMS 356* installation DVD also installs a PDF version of this user manual. The PDF can be found by default at C:\Program Files (x86)\OMICRON\CMS 356\Doc.
- Personnel assigned to use *CMS 356* must have read this user manual and fully understood the instructions herein.

- Do not carry out any modifications, extensions or adaptations at *CMS 356*.

Operator Qualifications

- Testing with *CMS 356* should only be carried out by authorized and qualified personnel.
- Personnel receiving training, instruction, direction, or education on *CMS 356* should remain under the constant supervision of an experienced operator while working with the equipment.

Safe Operation Procedures

- Follow the instructions in chapters 3.2 and 3.3 that describe the safe use of the connecting cables and how to set *CMS 356* into operation.
- *CMS 356* must only be used from a power outlet that has a protective earth.
- The power supply cable must be rated for the nominal voltage and current as specified in 6.1 on page 30. We recommend using the cable that was supplied by OMICRON with the *CMS 356* amplifier.
- Do not block the access to safety-relevant *CMS 356* amplifier's 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 (the output amplitudes are zero). 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 exceeds 42 V, the associated signal light lights up.
- Do not insert objects (for example, screwdrivers, etc.) into the sockets or into the ventilation slots.
- Do not operate *CMS 356* under wet or moist conditions (condensation).
- Do not operate *CMS 356* when explosive gas or vapors are present.

- Connect only external devices to the *CMS 356* interfaces “USB”, “ETH”, “AMP. IN”, and “AMP. OUT” that meet the requirements for SELV equipment (SELV = Safety Extra Low Voltage) according to EN 60950 or IEC 60950.
- For applications with DC current: The load may not exceed 3 mH because of dangerous feedback current.
- When setting up *CMS 356*, 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 *CMS 356*. Therefore, opening *CMS 356* is only permitted by qualified experts either at the factory or at certified external repair centers.
- If *CMS 356* is opened by the customer, all guarantees are invalidated.
- If *CMS 356* seems to be functioning improperly, please contact the Technical Support (→ “Support,” page 61).

Changing the Power Fuse

- The fuse is located at the back of the test set.
- Fuse type: **T12.5 AH 250 V** (wire fuse 5 × 20 mm).
- Unplug the power cord between the test set and the power source.
- For safety reasons only use type of fuse recommended by the manufacturer. (→ chapter 6.1, "Main Power Supply" on page 30 for more information.)

Information for Disposal and Recycling

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

For customers in EU countries (incl. European Economic Area)

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

For Customers Outside the European Economic Area

Please contact the authorities in charge for the relevant environmental regulations in your country and dispose of the OMICRON test set only in accordance with your local legal requirements.

1 Designated Use

CMS 356 is a voltage and current amplifier used as one component in a setup for testing:

- protection relays
- transducers
- energy meters
- phasor measurement units (PMUs).

You can use *CMS 356* as an additional amplifier operating as a component in a test system setup with OMICRON software and a CMC test set. Just as well, you can use *CMS 356* in a setup where the signals to be amplified are generated from a digital real-time power system simulator.

Features of CMS 356:

- Output of test quantities:
  - 4 × voltage.
  - two galvanically separated three-phase current outputs.
- The following input signals can be amplified by the *CMS 356* internal current and voltage power amplifiers:
  - 6 analog low level signals.
  - 2 Sampled Values streams received on a network port.[1]
- Flexible web interface for settings configuration of *CMS 356*.

Any other use of *CMS 356* is considered improper and may result in damage to property or persons.

1. Note that only Sampled Values datasets according to IEC 61850-9-2 LE are supported.

2 Introduction

You can use *CMS 356* as an additional amplifier operating as a component for testing your system setup with *Test Universe* software and a CMC test set.

There are also other OMICRON software packages like *RelaySimTest* that control the CMC test set.

Just as well, you can use *CMS 356* in a setup where the signals to be amplified are generated from a digital real-time power system simulator.

CMS 356 may receive signals for amplification, which are generated by such software, at its low level inputs or as Sampled Values at a network port.

This user manual describes the *CMS 356* hardware. You can configure *CMS 356* through its web interface.

Note: For more detailed information → *CMS 356* Getting Started manual. The PDF can be found by default at C:\Program Files (x86)\OMICRON\CMS 356\Doc.

3 Operating CMS 356

Only operate (or even turn on) *CMS 356* after you have read this user manual and fully understood the instructions herein.

3.1 System Components

Before operating *CMS 356* for the first time, use the packing list to verify that all components of the test system are available.

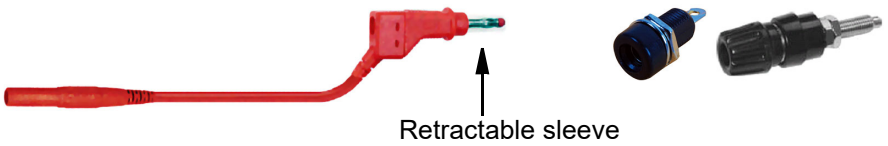
To set *CMS 356* into operation you need the following components:

- *CMS 356* test set with power supply cable.
- Connecting cable *CMS 356* ↔ computer.
- Connecting cable *CMS 356* ↔ test object.
- Connecting cable *CMS 356* ↔ signal source.
- A computer with the *CMS 356* installation: *Device Link* is necessary to find *CMS 356* device and open its web interface.

3.2 Safe Use of the Connecting Cables

3.2.1 Test Lead Adapter for Non-Safety Sockets

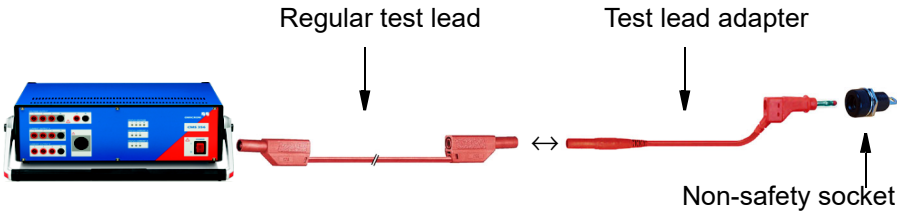
The *CMS 356* includes flexible test lead adapters of 5 cm/2 " length with a retractable sleeve (6 x black, 6 x red).



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 (→ picture above).

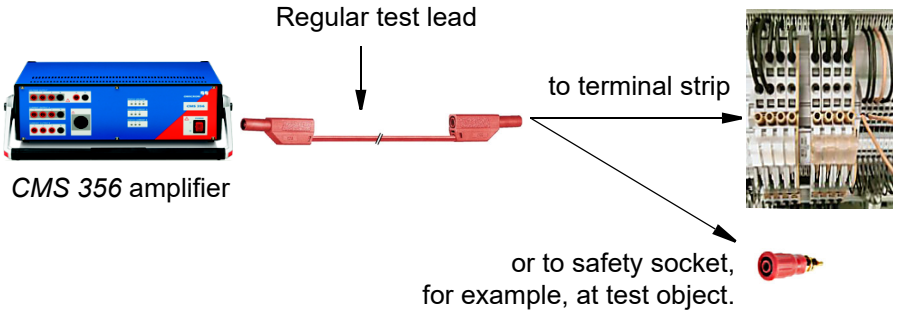
Never directly insert one of these retractable sleeves into a *CMS 356* output socket at the front of the test set. This does not comply with the designated purpose of these leads and is contrary to the safety regulations. Use the regular test leads, only (→ picture below).

Plug in the regular test leads of 2.0 m/6 ft. length into either the appropriate *CMS 356* output safety sockets or the test lead adapters.



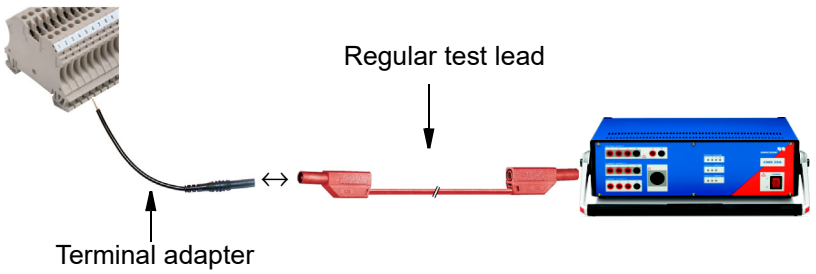
3.2.2 Regular Test Leads for Safety Sockets

Use the regular test leads of 2.0 m/6 ft. length to connect the *CMS 356* output to other safety sockets of, for example, amplifiers, test objects or to banana adapters in control cabinets.



3.2.3 Terminal adapters

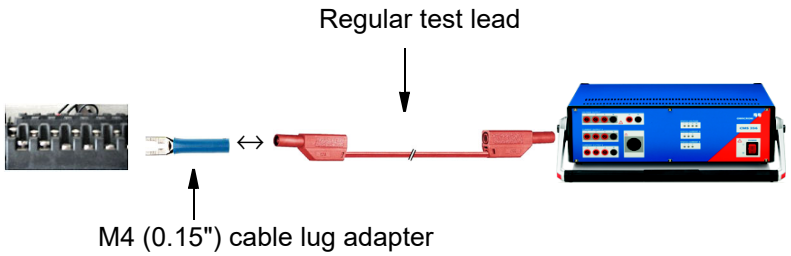
Use the flexible terminal adapters to connect the regular test leads to screw-clamp terminals.



The terminal adapters have blank ends. Therefore, before connecting these adapters, turn off both *CMS 356* and any possible power source applying voltage or current to the terminal strip. Only then connect the terminal adapter. Always insert the adapter with its blank end first into the terminal strip. Then fasten it before connecting it to a test lead.

3.2.4 M4 (0.15") Cable Lug Adapters

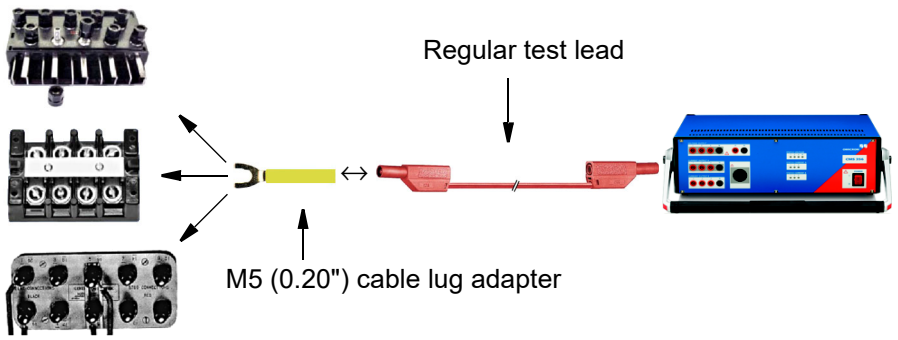
The optional “CMC Wiring Accessory Package” includes M4 (0.15") cable lug adapters to connect regular test leads to screw-clamp terminals of SEL/ABB/GE relays (and others).



The M4 cable lug adapters have blank ends. Turn off both *CMS 356* and any possible power source applying voltage or current to the screw-clamp terminals. Only then connect the cable lug adapter. Always insert the adapter with its blank end first into the screw-clamp terminal. Then fasten it before connecting it to a test lead.

3.2.5 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 M5 cable lug adapters have blank ends. Turn off both *CMS 356* and any possible power source applying voltage or current to the screw-clamp terminals. Only then connect the cable lug adapter. Always insert the adapter with its blank end first into the screw-clamp terminal. Then fasten it before connecting it to a test lead.

3.2.6 Generator Combination Cable

The generator combination cable provides a simple connection to the *CMS 356* combination socket (8-pole) and a flexible connection to the test object (safety plug, 4 mm, 0.16").

Characteristics:

- Wires: 8 x 2.5 mm^2.
- Length: 3 m/9.8 ft.
- Maximum current: 3 x 32 A continuous.

3.3 Starting the Test System

The following description assumes that the computer has been set up and that the *CMS 356* installation package has been installed.

At this point of time you may want to have a look at the *CMS 356* Getting Started manual. This manual guides you through the first steps and actions with *CMS 356* web interface.

- Learn how to find a *CMS 356* amplifier with your computer using the *Device Link* software.
- Learn about the *CMS 356* web interface.
- Learn how to configure *CMS 356* and monitor its status using the web interface.
- Learn how to use *CMS 356* together with a CMC test set and the *Test Universe* software.

The *CMS 356* Getting Started manual is provided as printed manual and as PDF. The PDF can be found by default at C:\Program Files (x86)\OMICRON\CMS 356\Doc.

Caution While Working with CMS 356

- When setting up *CMS 356*, do not obstruct the ventilation slots.
- The **last used configuration** of *CMS 356* is used **automatically** when *CMS 356* is powered on. Please keep this fact in mind when you inject input signals to *CMS 356* with a test object connected to the *CMS 356* outputs right after the *CMS 356* has been turned on.
- When you work on a simple setup with *CMS 356*, as long as the configuration stored in the *CMS 356* is suitable for the application, the use of a computer to configure the *CMS 356* is not mandatory.

Connecting the System Components[1]

Figure 3-1:
Connecting *CMS 356* to the computer

1. Connect *CMS 356* to the power supply.
2. If *CMS 356* requires a new configuration or the *CMS 356* status should be monitored by the web interface, then connect the *CMS 356* via Ethernet, WiFi or USB to your computer (USB and ETH ports are at the *CMS 356*'s rear side).
3. To learn how to incorporate *CMS 356* into an Ethernet network, please refer to the *CMS 356* Getting Started manual.
4. Turn on *CMS 356*.
5. During power-up, *CMS 356* will automatically self-check its hardware. You will hear relays switching inside *CMS 356*.
6. As mentioned in "Caution While Working with CMS 356" on page 15, carefully consider that *CMS 356* always amplifies analog input signals (at "**AMP. IN**") or incoming Sampled Values when *CMS 356* outputs are enabled. This fact is important in situations where:
   - Input signal amplitudes received by the *CMS 356* are not zero, *and*
   - a test object is connected to the *CMS 356* outputs at the front-panel, *and*
   - the *CMS 356* configuration is NOT valid for this setup.

1. To ensure the required EMC compatibility, we strongly recommend using the OMICRON-supplied cables, only.

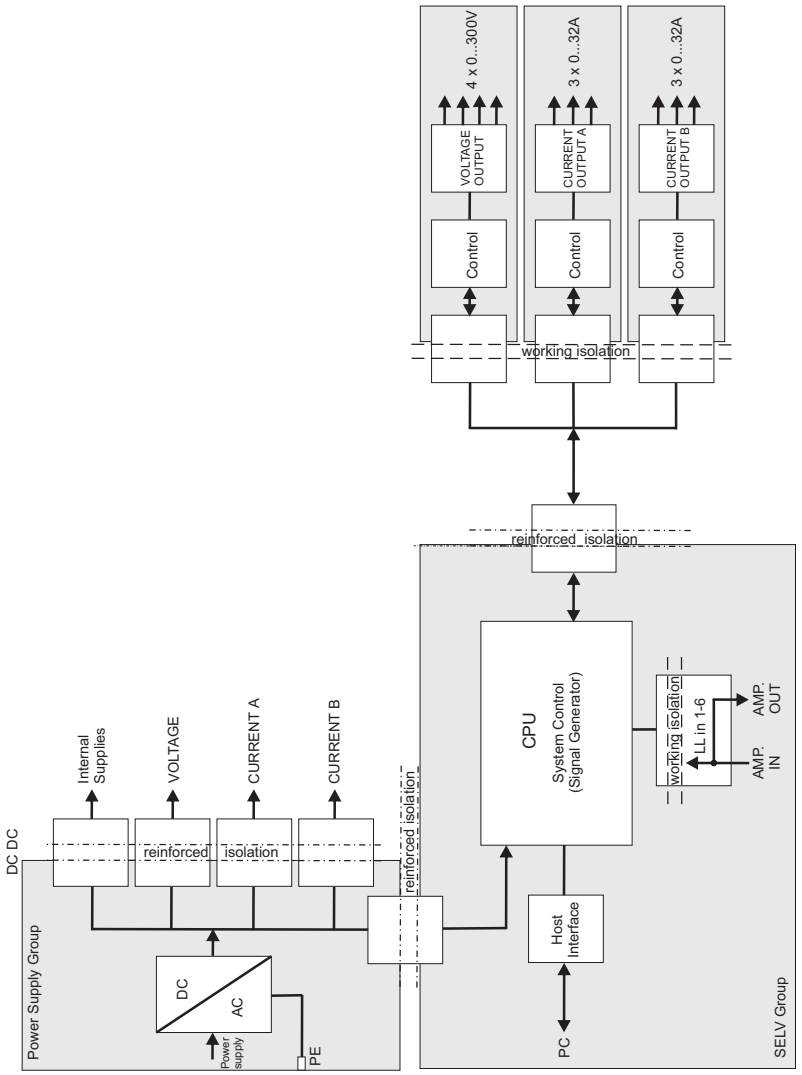
4 Setup and Function

The *CMS 356* amplifier offers the following functions:

- Output of test quantities:
  - 4 × voltage (300 V).
  - two galvanically separated three-phase current outputs (6 × 32 A).
- The following input signals can be amplified by the *CMS 356* internal current and voltage power amplifiers:
  - 6 analog low level signals.
  - 2 Sampled Values streams received on a network port.
- Configuration via web interface, for example, output configuration, setting the values for V_{max} and I_{max}, and flexible input to output routing.
- Monitoring of the *CMS 356* status via web interface.

4.1 Block Diagram

Figure 4-1:
Main block diagram of
CMS 356

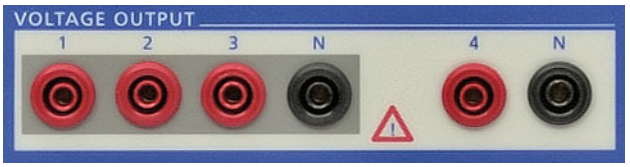


The block schematic diagram in figure 4-1 shows all externally accessible signals with gray shading. Every gray area represents a galvanic group that is isolated from all of the other galvanic groups.

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 *CMS 356*. The two black sockets labeled “N” are galvanically connected with one another.

The voltage amplifier is a linear amplifier 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.

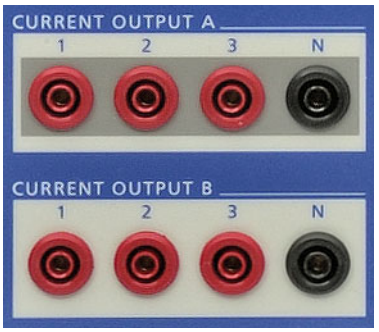
Overload Warning Flagged

When a voltage output is overloaded, a corresponding warning is displayed on the status LEDs of the *CMS 356* front panel or in the **Status** page of the *CMS 356* web interface (please refer to the web interface Help).

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

4.1.2 Current Outputs (Current Amplifier)

Figure 4-3:
CMS 356 current outputs
groups A & B



CURRENT OUTPUT A & B

Two galvanically separated three-phase current outputs, each with their own neutral (N).

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}; *CMS 356* turns off).

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

Overload Warning Flagged

When a current output is overloaded, a corresponding warning is displayed on the status LEDs of the *CMS 356* front panel or in the **Status** page of the *CMS 356* web interface (please refer to the web interface Help).

4.1.3 CPU

The *CMS 356* CPU (**C**entral **P**rocessing **U**nit) carries out the following tasks:

- Communication with the computer or a network via Ethernet (web interface).
- Configuration of *CMS 356* via web interface.
- Routing of analog low level input signals or Sampled Values to the *CMS 356* power amplifier outputs.
- Monitoring of the *CMS 356* hardware status (for example, via temperature).

4.1.4 Power Supplies (DC-DC)

An AC/DC converter generates the required DC voltage from 85 to 264 V_{AC} supply voltage (→ chapter 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

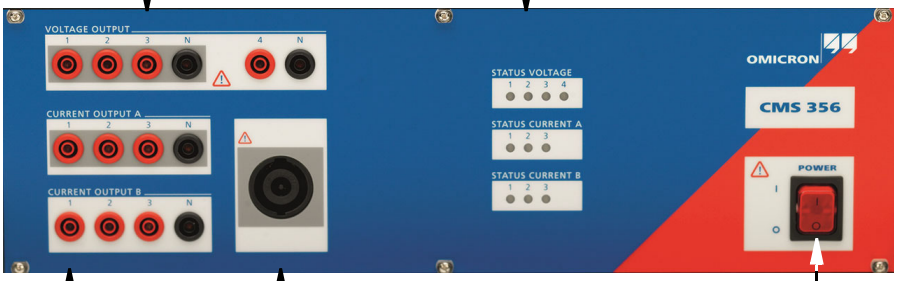
CMS 356 can receive input signals from an external signal source (for example from a CMC test set or a digital real-time power system simulator), either through its 6 analog low level inputs (“AMP. IN”) or as Sampled Values (up to 2 streams) on a network port.

The input signals are filtered, sampled, and used for further digital signal generation for the power amplifiers of *CMS 356*. The routing of the inputs to the *CMS 356* outputs is configured using the web interface.

5 Connections and Interfaces

5.1 Front Panel Connections

Figure 5-1:
Front view of *CMS 356*



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

STATUS LEDs
One status LED per each voltage and current output.

Power Switch

Generator combination socket
8-pole combination socket for VOLTAGE OUTPUT 1-3 and CURRENT OUTPUT A (32 A max.).

Warning indication: **Dangerous Voltage!**

At least one of the output voltages exceeds 42 V.

CURRENT OUTPUT

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

Group B: 3 x 32 A_{rms} output of the internal current amplifier.

Figure 5-2:
Simplified diagrams of current and voltage outputs

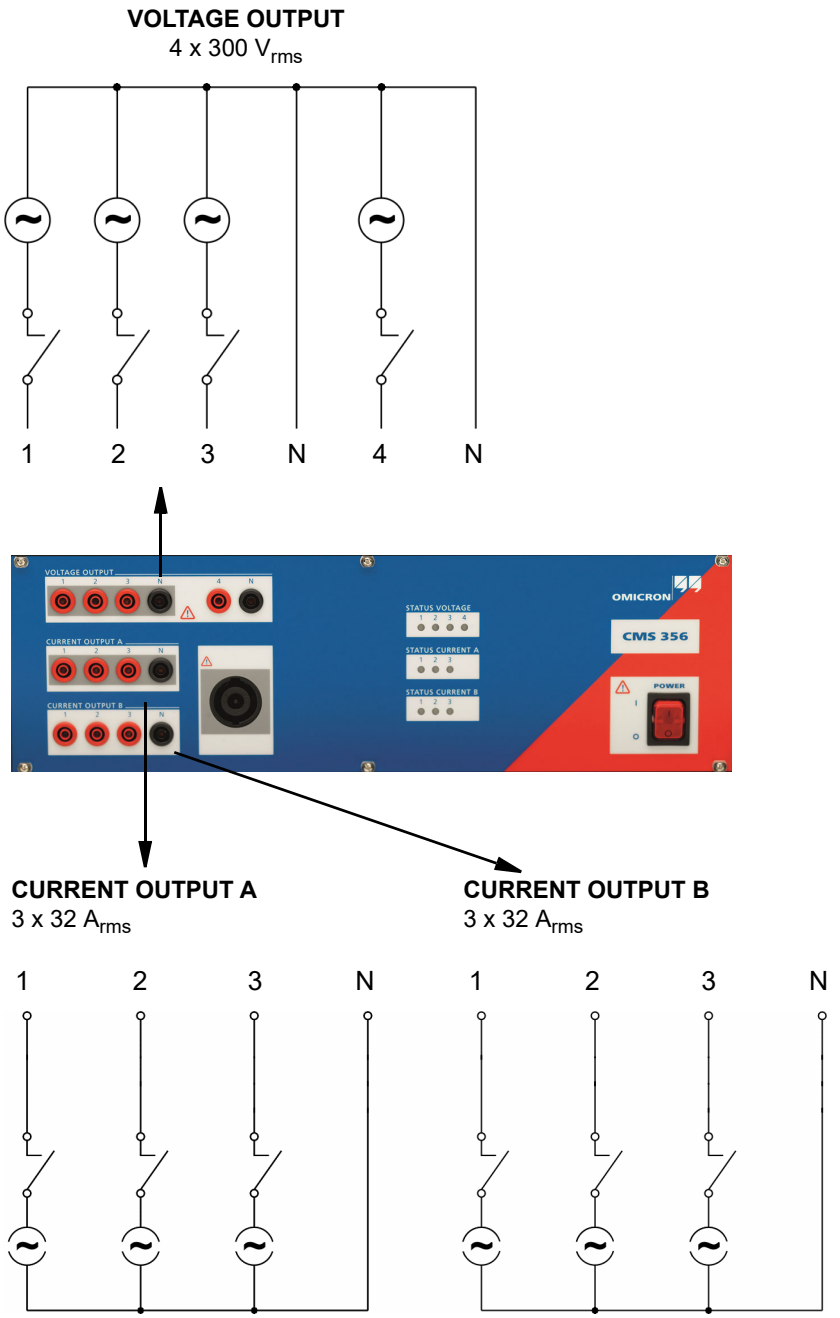


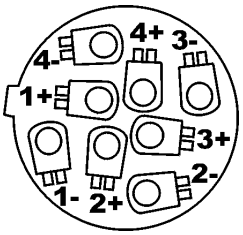
Figure 5-2 shows the non-operative state of *CMS 356* when turned off.

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 *CMS 356*. The three voltage outputs (VOLTAGE OUTPUT 1-3) as well as the CURRENT OUTPUT A are wired to the combination socket (→ table 5-1 on page 24).

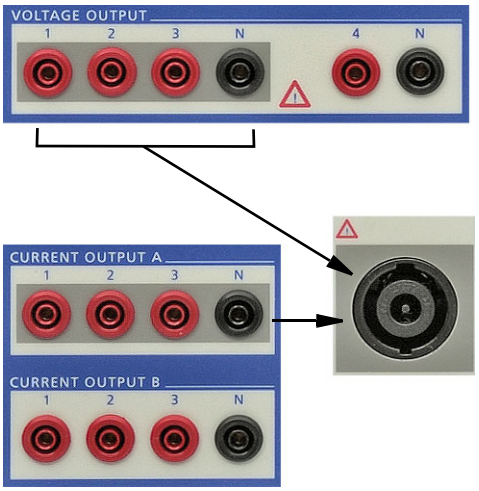
Figure 5-3:
Generator combination socket

Front view



View onto the connector from the rear cable wiring side

Figure 5-4:
The voltage and current outputs are wired to the combination socket



VOLTAGE OUTPUT 1-3 and CURRENT OUTPUT A are connected to the combination socket.

Warning: Keep in mind that the connections on the combination socket may carry a life-threatening potential when the *CMS 356* amplifier is turned on.

Follow the safety instructions of this manual (→ chapter , "Safety Instructions" on page 7) 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. The warning indicator also lights if a high burden mode (L-L) is set for the current outputs (e.g. see section 7.1).

For currents greater than 32 A, do not connect the test object (the load) to the generator combination socket. Use the 4 mm/0.16 " banana sockets instead.

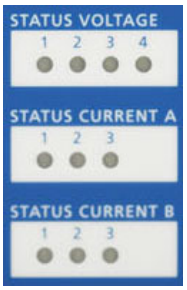
Table 5-1:
Pin assignment

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

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)

5.1.2 Status LEDs



On the front panel, *CMS 356* has 10 status LEDs. Each LED corresponds to one of the *CMS 356* amplifier outputs (VOLTAGE OUTPUT 1 ... 4 and CURRENT OUTPUT A & B 1 ... 3).

The colors of the LEDs show useful information about the hardware status of the *CMS 356* amplifier:

LED status	LED color	Description
Off	None	Output has not been configured via the web interface.
On	Green	Output has been configured and is active (delivers output signals).
On	Red	Output is overloaded (desired output signal cannot be generated).
On	Yellow	Output has been overloaded. After a certain amount of time, the LED turns green again. You can increase the indication time for the yellow LED via the web interface. The advantage of this is that you do not need to constantly monitor the status LEDs on the front panel.
Blinking	Green	Output has been switched off because there is a fault situation at another output.

LED status	LED color	Description
Blinking	Red	Output has an overtemperature error. All other *CMS 356* amplifier outputs have also been switched off (LED blinks green).
Blinking	Red/green	Error situation at the output, for example, because the current on CURRENT OUTPUT N is too high or the internal hardware check detected an error. All other *CMS 356* amplifier outputs have also been switched off (LED blinks green).

Note: During internal power up/initialization sequence of *CMS 356* all LEDs turn on for 2 seconds, following a sweeping pattern.

Outputs Switch Off due to an Error

When the outputs are switched off due to an error (LED blinks red or green), always the entire voltage or current triple is shown as the cause of the error.

Web Interface (Status Page)

When the test setup does not allow you to monitor the status LEDs directly on the *CMS 356* front panel, please refer to the same status information on the *CMS 356* web interface.

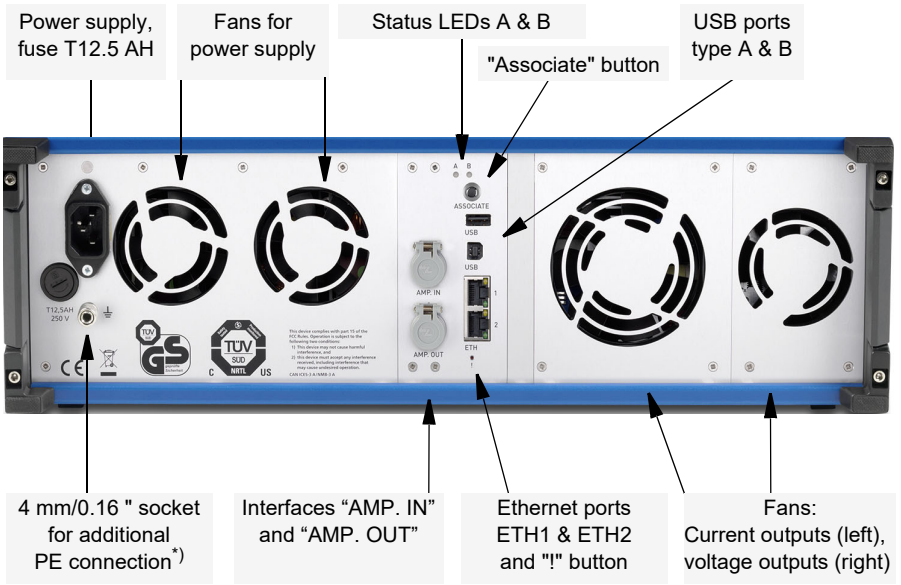
A short description of the reason for an error situation and switching off the outputs is also shown on the **Status** page of the web interface.

5.1.3 Automatic Restart Behavior

1. *CMS 356* waits for approx. 10 seconds after turning off due to an error.
2. An internal *CMS 356* hardware check is performed.
3. If the hardware check passes successfully, the last valid *CMS 356* amplifier configuration is set, and the configured outputs are enabled.
4. If the hardware check does not pass, because, for example, the cool-down time has not yet elapsed after an overtemperature error, proceed to step 1.

5.2 Connections on the Back Panel

Figure 5-5:
Rear view of *CMS 356*



*) To connect to low resistance grounding bars, for example.

5.2.1 Ethernet connection

CMS 356 amplifier has two 10/100/1000Base-TX (twisted pair) Ethernet ports (ETH1 and ETH2).

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

Since the *CMS 356* amplifier 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 *CMS 356* amplifier.

The yellow and green LEDs at each ETH port reflect the port’s operational status → chapter 6.7, "Technical Data of the Communication Ports" on page 44.

5.2.2 USB connection

The USB port type A (the upper USB port) of the *CMS 356* can be used to insert USB peripherals like a Wi-Fi stick.

The USB port type B (the lower USB port) of the *CMS 356* can be connected to your computer’s USB port.

To ensure the required EMC compatibility we recommend to only use cables and peripherals provided by OMICRON.

5.2.3 ! 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 *CMS 356*. In that case, the test set will not start as usual but wait for a new software image download.

5.2.4 Associate Button

Pressing the Associate button during the power-up sequence of the *CMS 356* resets all network settings of the *CMS 356* (IP configuration, restrictions, Wi-Fi configuration, etc.). Resetting the IP configuration of the Ethernet ports ETH1 and ETH2 to DHCP/AutoIP can also be done in the controlling software without restarting the *CMS 356*.

5.2.5 Status LED A, B

The status LED A and B above the “Associate” button are of interest in case of troubleshooting.

A: yellow status LED

- ON indicates that the test set is ready to be controlled by a computer. The hardware checks in the test set are finished, and the test set is properly connected to a computer or a network.
- OFF indicated the test set is waiting for an “emergency software image download”. This is the case when pressing the **!** button while powering-up the *CMS 356* amplifier.

B: green LED

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

- LED B blinks slowly: The *CMS 356* amplifier waits for the TFTP download (**T**rivial **F**ile **T**ransfer **P**rotocol) of a software image.
- LED B is ON: The TFTP download of the software image is in progress.
- LED B blinks quickly: The computer writes, for example, the software to the flash memory of the *CMS 356* amplifier. Do not turn off the *CMS 356* amplifier as long as the writing is in progress.

5.2.6 Ethernet / Network Settings

General

To configure *CMS 356* or to monitor its status, you need to open the *CMS 356* web interface. For this, you can either directly connect your *CMS 356* to the computer's network socket with a cable or you connect *CMS 356* and the controlling computer to a computer network.

The yellow and green LEDs at each ETH port reflect the port's operational status → chapter 6.7, "Technical Data of the Communication Ports" on page 44.

IP Configuration

An HTTP (TCP/IP) connection is used for the communication between controlling computer and *CMS 356*. The TCP/IP settings are configured via the *Device Link* included in the *CMS 356* installation package.

CMS 356 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).

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.

Security / Firewall Settings

To automatically detect and set the IP configuration of *CMS 356* amplifiers in the network, IP multicasts are used by the *Device Link*. Therefore, the firewall program has to be configured to allow communication with the *CMS 356* amplifier. For the Microsoft Windows[1] Firewall in Windows 7, Windows 8/8.1, or Windows 10, the firewall configuration is done automatically during the *Device Link* installation.

To learn how to incorporate *CMS 356* amplifiers into an Ethernet network, please refer to the *CMS 356* Getting Started manual.

Network Troubleshooting

For a complete list of ports and settings that are needed for the communication, please refer to the **Troubleshooting** chapter of the *CMS 356* Getting Started manual, subchapter **Firewall Configuration**.

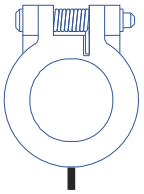
The *CMS 356* Getting Started manual is provided as printed manual and as PDF. The PDF can be found by default at C:\Program Files (x86)\OMICRON\CMS 356\Doc.

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

5.2.7 SELV Interfaces

SELV = Safety Extra Low Voltage.

5.2.7.1 Low Level Inputs (“AMP. IN”)



AMP. IN

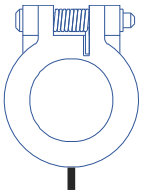
The SELV interface connector “AMP. IN” is used to connect low level signals with the following input ranges to the *CMS 356* amplifier:

- 0 ... ±7.071 V_{peak} (0 ... 5 V_{rms}) or
- 0 ... ±10 V_{peak} (0 ... 7.071 V_{rms})

These signals are amplified by *CMS 356* depending on the configuration set via the web interface.

For more detailed information, please refer to “Low Level Inputs “AMP. IN”” on page 40.

5.2.7.2 Low Level Outputs (“AMP. OUT”)



AMP. OUT

The low input signals supplied at “AMP. IN” are directly wired to the “AMP. OUT” connector. This process enables the connection of *CMS 356* to another *CMS 356*, for example, for paralleling the output currents of two or more *CMS 356*.

For more detailed information, please refer to “Wiring “AMP. IN” to “AMP. OUT”” on page 41.

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.

6.1 Main Power Supply

Table 6-1:
Power supply data

Main Power Supply	
Connection	Connector according to IEC 60320-1 C14
Voltage, single phase nominal voltage operational range	 100 ... 240 V_{AC} 85 ... 264 V_{AC}
Power fuse	T 12.5 AH 250 V (5 x 20 mm) "Schurter", order number 0001.2515
Nominal current[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. → Chapter 6.3.3, "Operational Limits in Conjunction with a Weak Power Supply Voltage" on page 39.

6.2 Insulation Coordination

Table 6-2:
Insulation coordination

Insulation Coordination	
Overvoltage category	II
Pollution degree	2
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: > 3.04 mm (0.12 ") - Test voltage: 1450 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

1. Functional groups on *CMS 356* front panel:
VOLTAGE OUTPUT, CURRENT OUTPUT (A, B)

6.3 Outputs

6.3.1 Current Outputs

Table 6-3:
Outputs of current groups A and B

Current Outputs[1] (Groups A and B)		
Output currents		
6-phase AC (L-N)	6 x 0 ... 32 A (Group A and B)	
3-phase AC (L-N)	3 x 0 ... 64 A (Group A + B parallel)	
2-phase AC (L-L)[2, 3]	2 x 0 ... 32 A (Group A and B)	
1-phase AC (L-L)[2, 3]	1 x 0 ... 64 A (Group A + B parallel)	
1-phase AC (L-L-L-L)[2, 3]	1 x 0 ... 32 A (Group A + B in series)	
2-phase AC (LL-LN)[2]	2 x 0 ... 64 A (Group A and B)	
1-phase AC (LL-LN)[2]	1 x 0 ... 128 A (Group A + B parallel)	
DC (LL-LN)[2]	1 x 0 ... ±180 A (Group A + B parallel)	
Power[7]	Typical	Guaranteed
6-phase AC (L-N)	6 x 430 VA at 25 A	6 x 250 W at 20 A
3-phase AC (L-N)	3 x 860 VA at 50 A	3 x 500 W at 40 A
2-phase AC (L-L)[2, 3]	2 x 870 VA at 25 A	2 x 550 W at 20 A
1-phase AC (L-L)[2, 3]	1 x 1740 VA at 50 A	1 x 1100 W at 40 A
1-phase AC (L-L-L-L)[2, 3]	1 x 1740 VA at 25 A	1 x 1100 W at 20 A
2-phase AC (LL-LN)[2]	2 x 500 VA at 40 A	2 x 350 W at 40 A
1-phase AC (LL-LN)[2]	1 x 1000 VA at 80 A	1 x 700 W at 80 A
DC (LL-LN)[2]	1 x 1400 W at ±80 A	1 x 1000 W at ±80 A
Accuracy	Typical	Guaranteed
$R_{load} \leq 0.5\ \Omega$	Error < 0.1 % rd.[4] + 0.04% of rg.	Error < 0.3 % of rd. + 0.1% of rg.
Harmonic distortion (THD+N)[5,6]	0.1 %	< 0.3 %
Phase error[5]	0.1 °	< 0.25 °
DC offset current	< 3 mA	< 10 mA
Resolution	1 mA, 2 mA (2 phases in parallel), ...	
Bandwidth (-3 dB)[8]	guaranteed: > 1 kHz typical: > 2.5 kHz[10]	
Propagation delay with input type “analog”	500 us (error < ± 2 us typ., ± 5 us guar.)	
Output delay with input type “Sampled Values”	Configurable, setting range[11]: 1000 – 6000 µs	
Short-circuit protection	Unlimited	

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 → chapter 7, "Increasing the Output Power, Operating Modes" on page 49.
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 and nominal value.
7. Guaranteed data at 230 V power supply for ohmic loads (PF=1); typical data for inductive loads. → Chapter 6.3.3, "Operational Limits in Conjunction with a Weak Power Supply Voltage" on page 39.
8. Current amplitude derating at frequencies above 380 Hz (→ figure 6-4).
9. For currents > 32 A, connect test object only to the 4 mm/0.16 " banana connections and not to the generator combination socket.
10. Except when using Sampled Values with a sampling rate ≤ 5760 Hz
11. Minimum delay depends on network delays and performance of Sampled Values source.

Current Outputs[1] (Groups A and B)	
Open-circuit protection	Open outputs (open-circuit) permitted
Connection	4 mm/0.16 " banana connectors, amplifier combination socket[9] (OUTPUT A only)
Insulation	Reinforced insulation of power supply and all SELV interfaces

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)

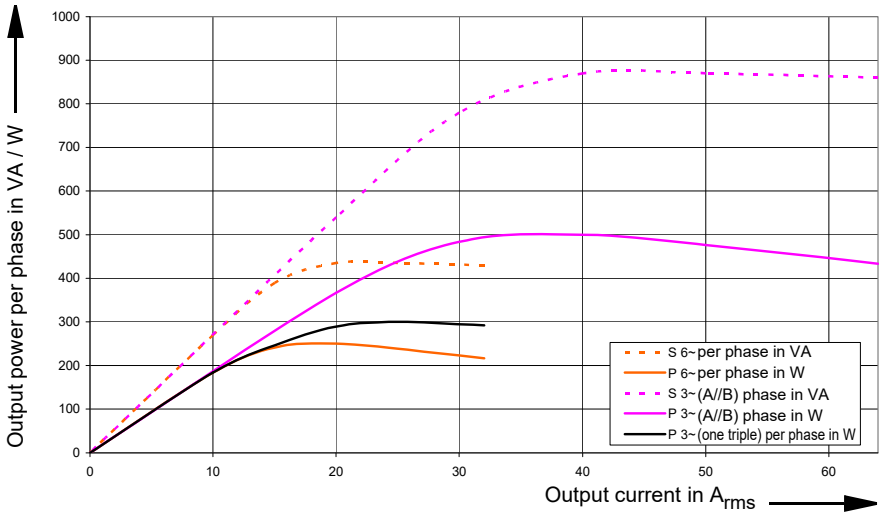
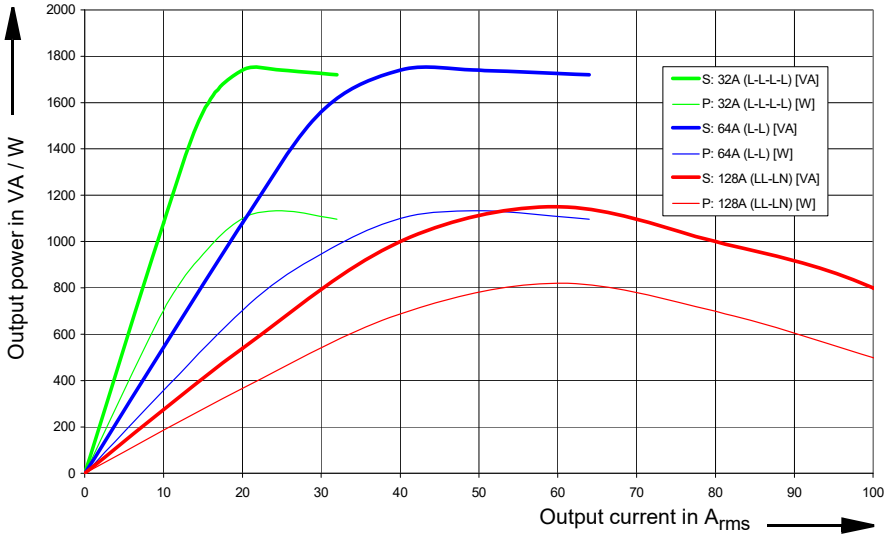
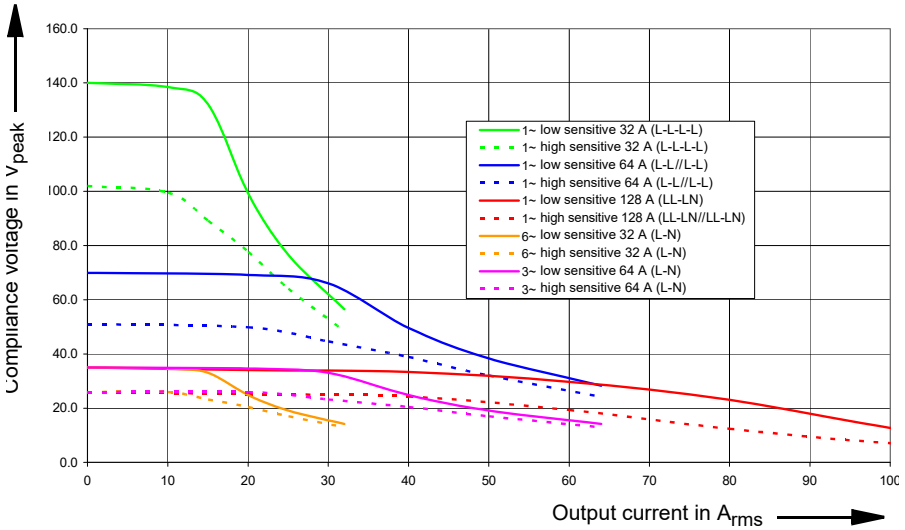


Figure 6-2:
Guaranteed single phase output power curves (active power values in W are guaranteed; apparent power values in VA are typical values)



For additional information → chapter 7.1, "Single-Phase Operation of CMS 356" on page 50.

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



The high and low sensitive curves in figure 6-3 correspond to the overload detection sensitivity settings in the *CMS 356* web interface. The low sensitive 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

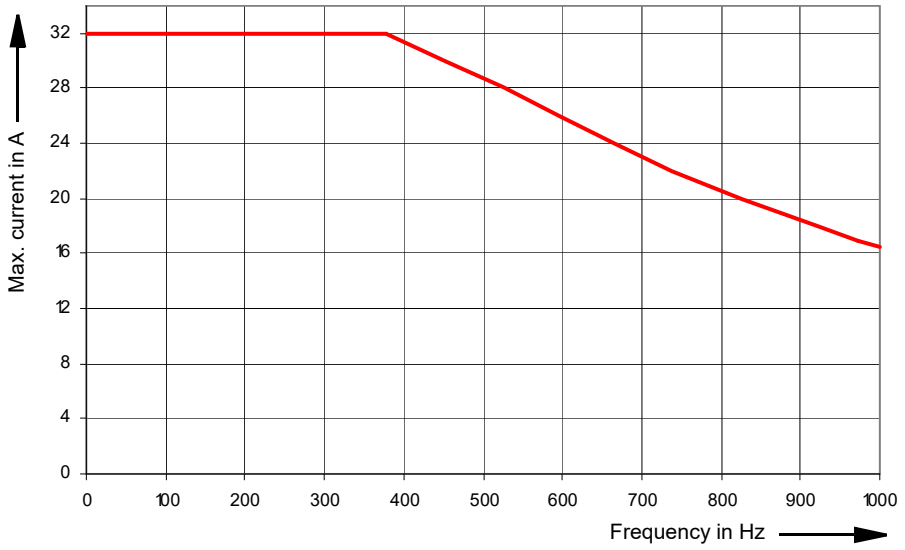


Figure 6-5:
Typical continuous output current and output power at 23 °C;
single-phase mode

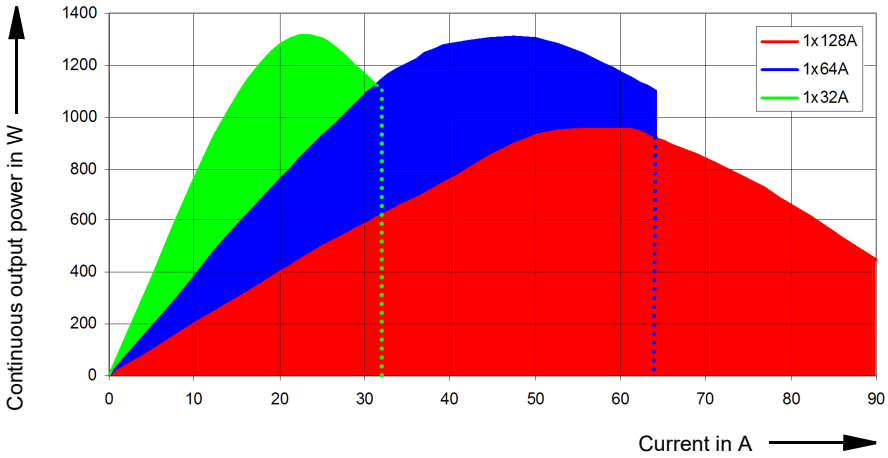
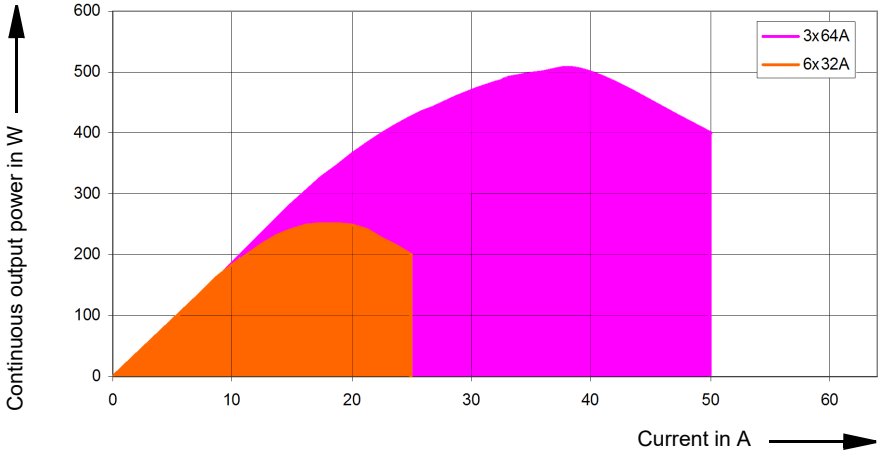


Figure 6-6:
Typical continuous output current and output power at 23 °C;
three- and six-phase mode



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

If you don’t require more than 64 A, we recommend to use the 1 x 64 A configuration rather than the 128 A one because the 1 x 64 A configuration provides more continuous output power.

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 6-4:
Typical duty cycles for operation at ambient temperature of 23 °C

6 x 32 A (L-N)					
I [A]	P [W]	duty cycle	t1 [min]	ton [s]	toff [s]
0 ... 25	0 ... 1200	100%	> 30	> 1800	-
26	1400	80%	7.5	80	20
29	1300	75%	6.0	60	20
32	1200	71%	3.5	50	20

3 x 64 A (L-N)					
I [A]	P [W]	duty cycle	t1 [min]	ton [s]	toff [s]
0 ... 50	0 ... 1200	100%	> 30	> 1800	-
52	1400	80%	7.5	80	20
58	1300	75%	6.0	60	20
64	1200	71%	3.5	50	20

1 x 128 A (LL-LN)					
I [A]	P [W]	duty cycle	t1 [min]	ton [s]	toff [s]
0 80	0 ... 700	100%	> 30.0	> 1800	0
100	450	60%	4.9	30	20
120	300	43%	2.6	15	20
128	200	38%	2.0	12	20

6.3.2 Voltage Outputs

Table 6-5:
CMS 356 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 < 0.06 % of rd.[5] + 0.02 % of rg.	Error < 0.16 % of rd. + 0.04 % of rg.
Harmonic distortion (THD+N)[6, 7]	0.03 %	< 0.1 %
Phase error[6]	Typical 0.05 °	Guaranteed < 0.15 °
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	
Bandwidth (-3 dB)	guaranteed: > 1 kHz typical: > 2.5 kHz[8]	
Propagation delay with input type “analog”	500 us (error < ± 2 us typ., ± 5 us guar.)	
Output delay with input type “Sampled Values”	Configurable, setting range[9]: 1000 – 6000 µs	
Short-circuit protect.	Unlimited for L - N	
Connection	4 mm/0.16 " banana connectors; amplifier combination socket V_{L1}-V_{L3}	
Insulation	Reinforced insulation of power supply and all SELV interfaces	

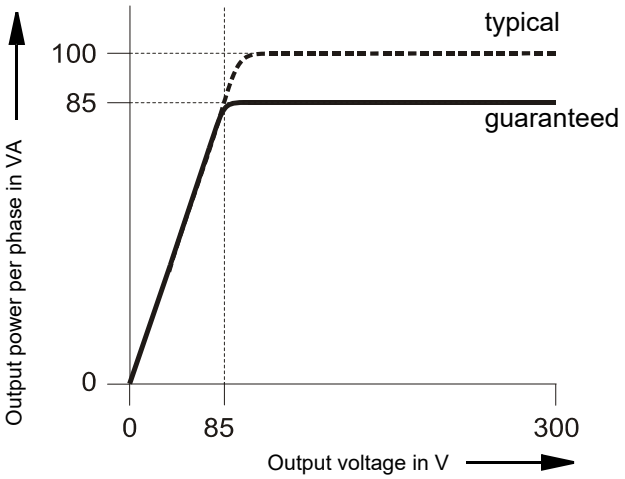
Footnotes:

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} as an amplified signal from “AMP. IN”.
2. Guaranteed data for ohmic loads, (PF=1). Refer to the accompanying figure of the output power curves. → Chapter 6.3.3, "Operational Limits in Conjunction with a Weak Power Supply Voltage" on page 39.
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.
8. Except when using Sampled Values with a sampling rate ≤ 5760 Hz
9. Minimum delay depends on network delays and performance of Sampled Values source.

6.3.2.1 Power Diagrams for Three- and Single-Phase Operation

To get the maximum output power as shown in the power diagrams, you must limit the voltage output to the max. voltage (or slightly above) that has to be put out to the test object. You can configure the voltage output limit in the *CMS 356* web interface.

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



Also refer to chapter 7.1.4, "Single-Phase Voltage" on page 53.

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

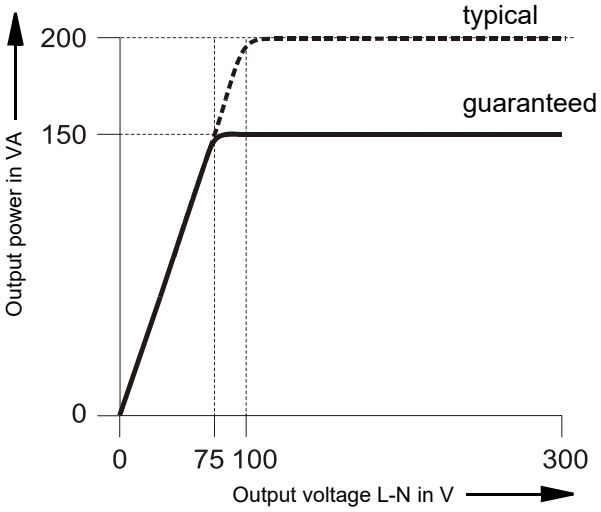
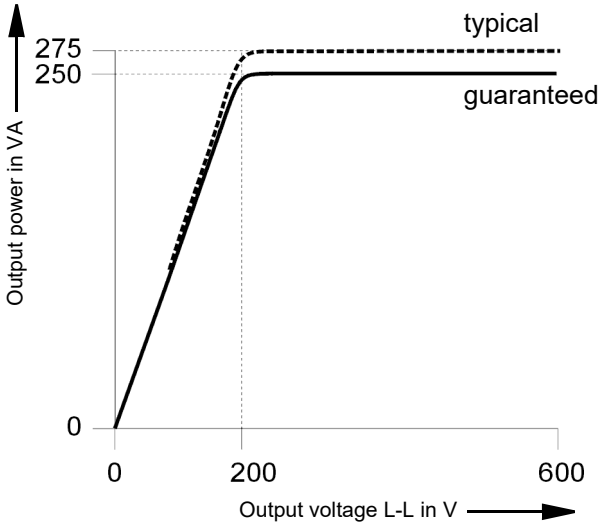


Figure 6-9:
Single-phase operation
L-L



6.3.3 Operational Limits in Conjunction with a Weak Power Supply Voltage

Principally, the maximum output power of *CMS 356* is limited by the power supply input voltage. If the supply input voltage is less than 115 V_{AC}, it is possible to supply *CMS 356* with two phases (L-L) instead of the normal phase-neutral (L-N) operation in order to increase the supply voltage (115 V * sqrt(3) = 200 V).

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

Apart from the reduction of the available total output power of low line voltages, no other significant degradations in the technical data of *CMS 356* occur.

Table 6-6:
Typical total output power at different power supply voltages.

Power supply	Current	Typical total output power		
		Currents only	Currents	Voltage
230 V	6 x 15 A	1600 W	1190 W	+ 300 W
	6 x 25 A	1470 W	1060 W	+ 300 W
	6 x 32 A	1320 W	910 W	+ 300 W
115 V[1]	6 x 15 A	1120 W	710 W	+ 300 W
	6 x 25 A	990 W	580 W	+ 300 W
	6 x 32 A	860 W	450 W	+ 300 W
100 V[1]	6 x 15 A	910 W	500 W	+ 300 W
	6 x 25 A	790 W	380 W	+ 300 W
	6 x 32 A	670 W	260 W	+ 300 W

1. After 15 min of continuous operation at full output power a duty cycle of 15 min on/15 min off is required at an ambient temperature of 25°C. This does not apply to the 6 x 32 A example because the output duration is limited by the current amplifier (→ chapter 6.3, "Outputs" on page 32 for more details).

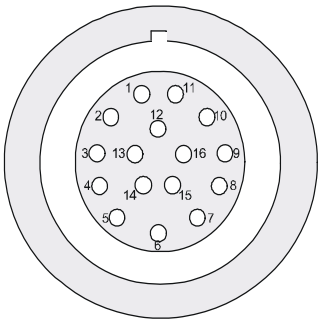
6.4 Low Level Inputs “AMP. IN”

The SELV interface “AMP. IN” allows the connection of low level input signals that are amplified by the *CMS 356* power amplifiers.

Table 6-7: Low level inputs “AMP. IN”

Low level inputs “AMP. IN”	
Number of analog inputs	6
Input voltage range	Possible settings: 7.071 V_{rms} (±10 V_{peak}) 5 V_{rms} (±7.071 V_{peak})
Input impedance	47 kΩ
Amplification at 5 V_{rms} input range	E.g. for standard configuration (300 V, 32 A) Voltage output: 60 V/V Current output: 6.4 A/V
Connection	Socket “AMP. IN” (at rear side of *CMS 356*)
Insulation	Reinforced insulation to mains, voltage, and current outputs of *CMS 356*

Table 6-8: Pin assignment of “AMP. IN” (upper 16-pole Lemo socket); view onto the connector from the cable wiring side.

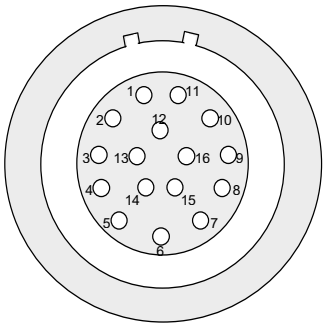


Pin	**Function “AMP. IN”**
1	LL in 1
2	LL in 2
3	LL in 3
4	Analog ground
5	LL in 4
6	LL in 5
7	LL in 6
8-16	For internal purposes
Housing	Screen connection

6.4.1 Wiring “AMP. IN” to “AMP. OUT”

To route the analog input signals **LL in 1-6** at “AMP. IN” to more than one *CMS 356*, the analog input signals are directly connected to “AMP. OUT”.

Table 6-9:
Pin assignment of “AMP. OUT” (lower 16-pole Lemo socket); view onto the connector from the cable wiring side.



Pin	Function “AMP. OUT”
1	LL out 1 (=LL in 1)
2	LL out 2 (=LL in 2)
3	LL out 3 (=LL in 3)
4	Analog ground
5	LL out 4 (=LL in 4)
6	LL out 5 (=LL in 5)
7	LL out 6 (=LL in 6)
8-16	For internal purposes
Housing	Screen connection

6.4.2 Socket Ordering Information

Table 6-10:
Ordering information

Socket ordering information	
Connector for one guide notch and pull relief (for “AMP. IN”)	FGG.2B.316.CLAD 72Z
Connector for two guide notches and pull relief (for “AMP. OUT”)	FGB.2B.316.CLAD 72Z
Black anti-bend cable cover	GMA.2B.070 DN

For a manufacturer description about the connection sockets “AMP. IN” and “AMP. OUT”, visit the website www.lemo.com.

6.5 IEC 61850 Sampled Values Subscription

Table 6-11: IEC 61850 Sampled Values

IEC 61850 Sampled Values	
Specification	Implementation guideline 9-2 LE for IEC 61850-9-2 and IEC 61869-9 (with fixed data sets)
Sampling frequency	4,000 Hz (80 SPC) - 1 sample per packet 4,800 Hz (80 SPC) - 1 sample per packet 5,760 Hz (96 SPC) - 1 sample per packet 12,800 Hz (256 SPC) - 8 samples per packet 15,360 Hz (256 SPC) - 8 samples per packet 4,800 Hz - 2 samples per packet 14,400 Hz - 6 samples per packet
Max. number of Sampled Values	2 streams

6.6 Time synchronization

Using the input type “Sampled Values” requires the Sampled Values source and the *CMS 356* to be synchronized via PTP.

The following specifications refer to the synchronization of the *CMS 356* internal time base:

Table 6-12: Synchronization specifications

Characteristic	Specification
IEEE 1588-2008 (v2)	
Offset	Error < ±1 µs
Pulling range	±100 ppm (±0.01 %)
Supported profiles	IEEE C37.238-2011 (Power Profile 1.0) IEEE C37.238-2017 (Power Profile 2.0) IEC/IEEE 61850-9-3:2016 (Power Utility Profile 1.0)
Supported sources	OMICRON CMGPS 588 or fulfilling one of the profiles listed above

With “PTP mode” set to “Master/Slave” the *CMS 356* acts as PTP master if no suitable PTP master is available in the defined network. Otherwise it will act as a PTP slave.
Be aware that in this mode, the announced time is based on the *CMS 356* internal time base and will not match the GPS time or similar time sources.

Specifications of the internal time base:

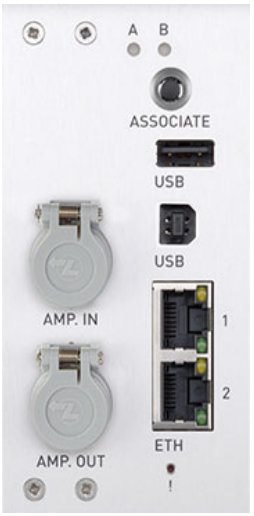
Table 6-13: Internal time base specifications

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

6.7 Technical Data of the Communication Ports

Note: The USB ports do not have any functionality yet. They are reserved for future use.

Table 6-14:



The NET-2 board's communication ports

2 x USB port and Ethernet ports ETH1/ETH2		
	USB type	USB 2.0 high speed up to 480 Mbit/s
	USB connector	USB type A
	Output current	500 mA max.
	USB type	USB 2.0 high speed up to 480 Mbit/s; USB 1.1-compatible
	USB connector	USB type B
	USB cable	USB 2.0 high speed
	ETH type	10/100/1000Base-TX[1] (twisted pair, auto-MDI/MDIX or auto-crossover)
	ETH connector	RJ45
	ETH cable type	LAN cable of category 5 (CAT5) or better[2]
	ETH port status LED 	Depending on the ETH type of your NET-2 interface board's counterpart, the status LED's behavior varies. Physical link established, port active: Mbit/s — Active LED ON 10 — yellow 100 — green 1000 — yellow + green If there is traffic via an ETH port, the active LEDs start blinking.

1. 10Base = 10 Mbit/s transfer rate
   100Base = 100 Mbit/s transfer rate
   1000Base = 1000 Mbit/s transfer rate
2. Shielded LAN cable

6.8 Environmental Conditions

6.8.1 Climate

Table 6-15:
Climate

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

6.8.2 Shock and Vibration

Table 6-16:
Shock and vibration

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

6.9 Mechanical Data

Table 6-17:
Data regarding size and weight

Size, Weight and Protection	
Weight	16.3 kg (35.9 lbs)
Dimensions W x H x D (without handle)	450 x 145 x 390 mm (17.7 x 5.7 x 15.4 ")
Housing	IP20 according to EN 60529

6.10 Acoustics – Noise Emission

Table 6-18:
Data regarding acoustics - noise emission

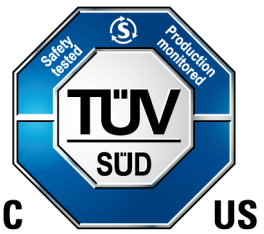
Acoustics – Noise Emission (At Operator's Position)	
Idle mode	47 dB(A)
Operating mode	50 dB(A)
Full load	55 dB(A)
Noise emission	Tested according to ISO 7779
Compliance	ETSI EN 300753 portable and non-stationary equipment working area < 4 m

6.11 Cleaning

To clean *CMS 356*, use a cloth dampened with isopropanol alcohol. Prior to cleaning, always turn off the power switch and unplug the power cord from the power supply.

6.12 Safety Standards, Electromagnetic Compatibility (EMC) and Certificates

Table 6-19:
EMC compatibility and certified safety standards

EMC	
Emission	
Europe	EN 61326-1; EN 61000-6-4; EN 61000-3-2/3
International	IEC 61326-1; IEC 61000-6-4; IEC 61000-3-2/3
USA	47 CFR 15 Subpart B (Class A) of FCC EN 55032/CISPR 32 (Class A)
Immunity	
Europe	EN 61326-1; EN 61000-6-2; EN 61000-6-5 EN 61000-4-2/3/4/5/6/8/11/16/18
International	IEC 61326-1; IEC 61000-6-2; IEC 61000-6-5; IEC 61000-4-2/3/4/5/6/8/11/16/18
Certified Safety Standards	
Europe International USA Canada	EN 61010-1 IEC 61010-1 UL 61010-1 CAN/CSA-C22.2 No 61010-1
Certificate	 Manufactured under an ISO9001 registered system

6.13 Compliance Statements

6.13.1 Declaration of Conformity (EU)

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, the low voltage Directive and the RoHS Directive.

6.13.2 FCC Compliance (USA)

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

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

6.13.3 Declaration of Compliance (Canada)

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

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

The use of shielded cables is required when connecting this equipment to any and all optional peripheral or host devices. Failure to do so may violate FCC and ICES rules as well as the EMC directive.

7 Increasing the Output Power, Operating Modes

CMS 356 has a very large application diversity. The current outputs offer enough output power to test all electromechanical relays.

In particular, *CMS 356* offers a variety of types of single-phase operation using its two galvanically separated three-phase current outputs 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 current amplifier groups of *CMS 356* in parallel.

Note: The following output configuration examples represent a selection, only. For a complete list of possible configurations start the **CMS 356 web interface** and go to the **Configuration** page. In section **Current Output** you can see the available **Output Configuration Details**.

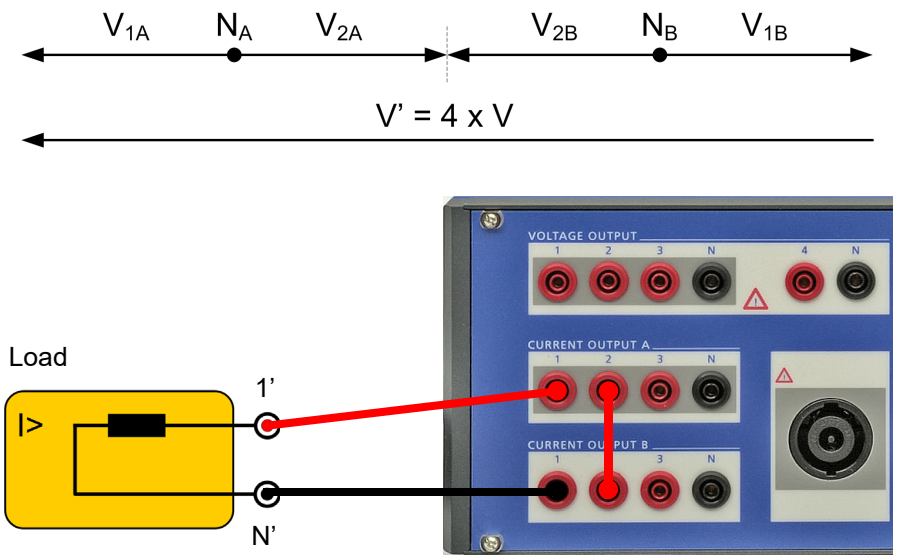
7.1 Single-Phase Operation of CMS 356

7.1.1 1 x 32 A High Burden Mode (L-L-L-L)

1 x 0 ... 32 A (±45 A_{DC}), max. 140 V_{peak}, 1 x 1740 VA at 25 A

Both amplifier groups CURRENT OUTPUT A and CURRENT OUTPUT B are connected in series. The currents 1 and 2 of a group are phase-opposite. This results in four times the compliance voltage of a single output.

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



See also the output curves shown in the figures 6-1 through 6-5 in chapter 6.3, "Outputs" on page 32.

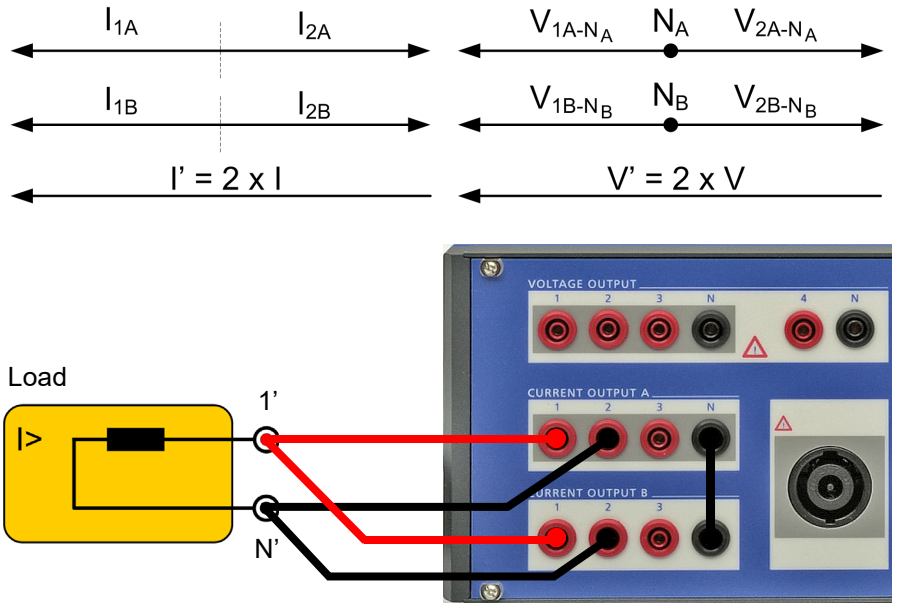
Warning: For currents greater than 32 A, do not connect the test object (the load) to the generator combination socket! Connect the test object to the 4 mm/0.16 " banana sockets, only!

7.1.2 1 x 64 A High Burden and High Current Mode (L-L)

1 x 0 ... 64 A (±90 A_{DC}), max. 70 V_{peak}, 1 x 1740 VA at 50 A

The currents 1 and 2 of each group are phase-opposite. In addition, the groups A and B are connected in parallel.

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



See also the output curves shown in the figures 6-1 through 6-5 in chapter 6.3, "Outputs" on page 32.

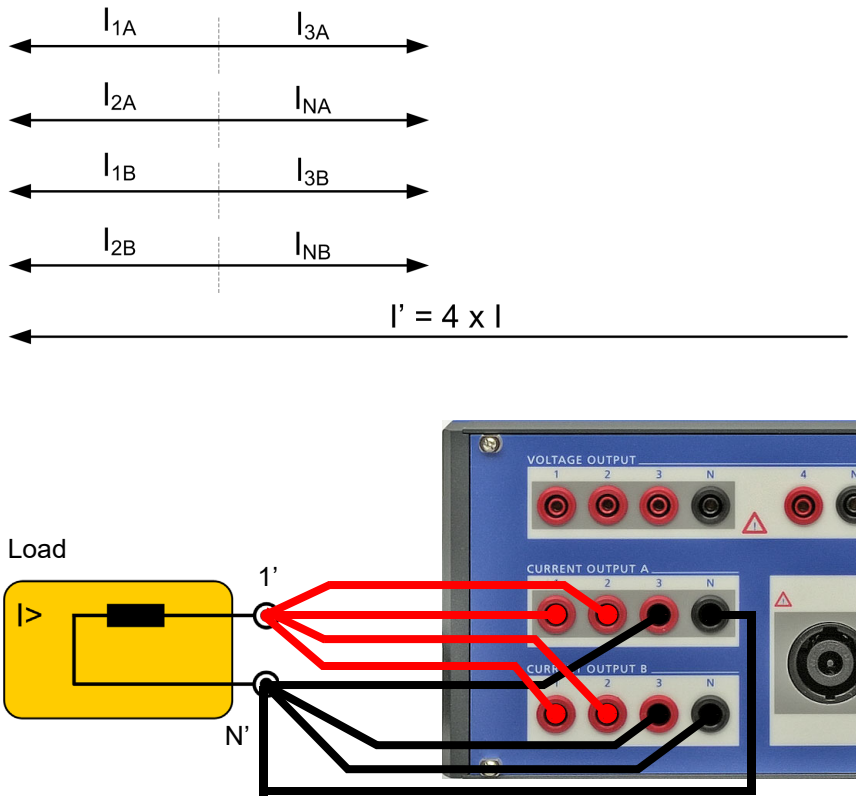
Warning: For currents greater than 32 A, do not connect the test object (the load) to the generator combination socket! Connect the test object to the 4 mm/0.16 " banana sockets, only!

7.1.3 1 x 128 A High Current Mode (LL-LN)

1 x 0 ... 128 A (±180 A_{DC}), max. 35 V_{peak}, 1 x 1000 VA at 80 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, 2 of groups A and B are connected in parallel.

Figure 7-3:
Single-phase operation, 1 x 128 A high current mode



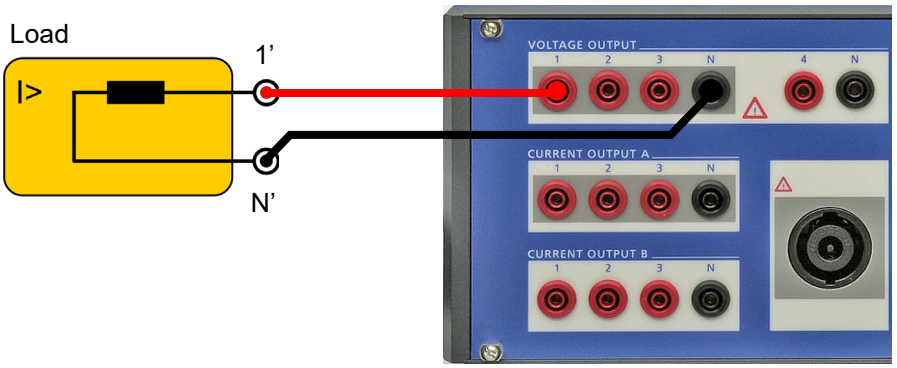
See also the output curves shown in the figures 6-1 through 6-5 in chapter 6.3, "Outputs" on page 32.

Warning: For currents greater than 32 A, do not connect the test object (the load) to the generator combination socket! Connect the test object to the 4 mm/0.16 " banana sockets, only!

7.1.4 Single-Phase Voltage

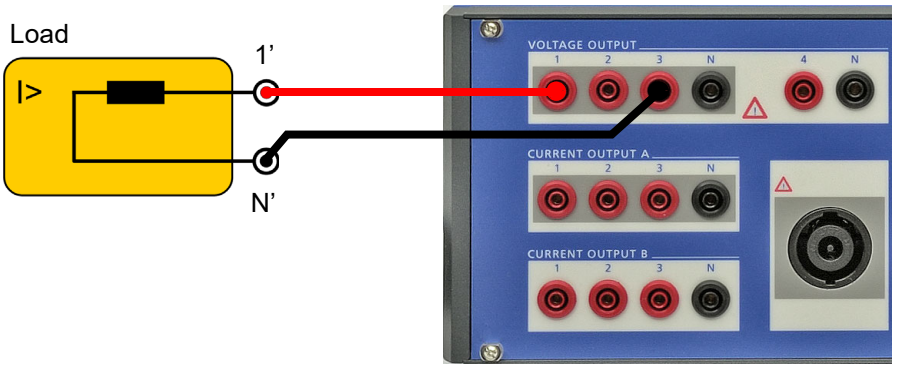
1 x 0 ... 300 V, 1 x 200 VA [100 ... 300 V] typical

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



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

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



See also the output curves shown in the figures 6-8 through 6-9 in chapter 6.3.2, "Voltage Outputs" on page 37.

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

7.2 Two-Phase Operation

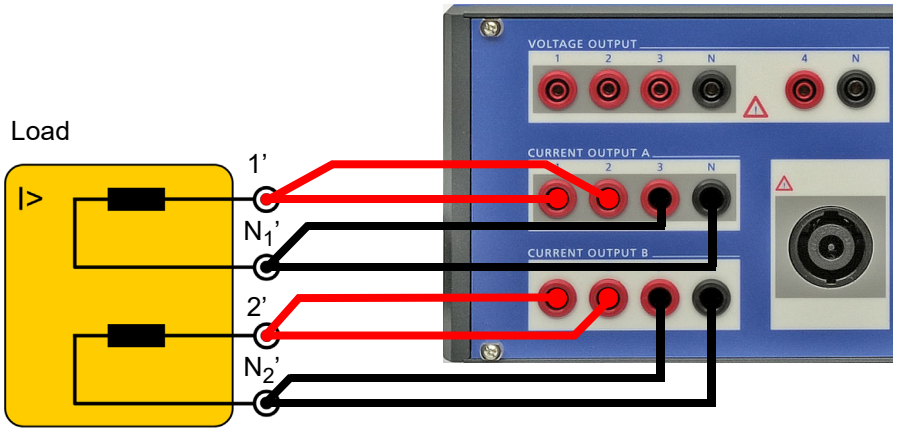
For some applications it is beneficial to have two independent currents, each higher than 32 A_{rms}, or a higher compliance voltage available.

7.2.1 2 x 64 A High Current Mode (LL-LN)

2 x 0 ... 64 A (±90 A_{DC}), max. 35 V_{peak}, 2 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.

Figure 7-6:
Two-phase operation,
2 x 64 A high current mode



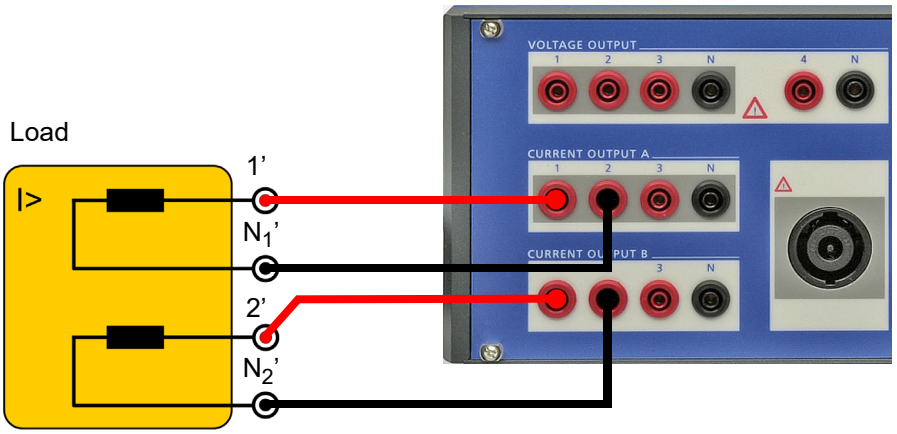
Warning: For currents greater than 32 A, do not connect the test object (the load) to the generator combination socket! Connect the test object to the 4 mm/0.16 " banana sockets, only!

7.2.2 2 x 32 A High Burden Mode (L-L)

2 x 0 ... 32 A (±45 A_{DC}), max. 70 V_{peak}, 2 x 870 VA at 25 A

The currents 1 and 2 of each group are phase-opposite.

Figure 7-7:
Two-phase operation
2 x 32 A high burden mode



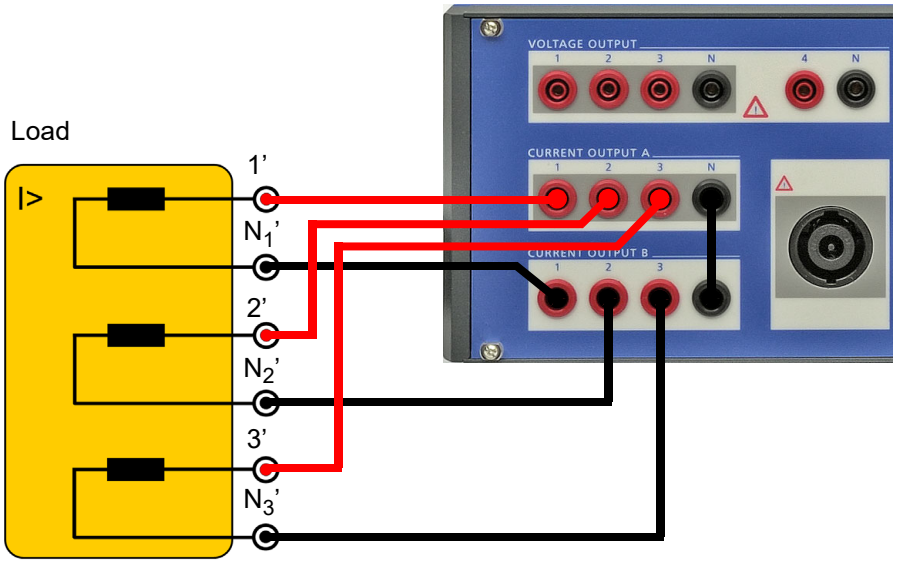
Warning: For currents greater than 32 A, do not connect the test object (the load) to the generator combination socket! Connect the test object to the 4 mm/0.16 " banana sockets, only!

7.3 Three-Phase Current Mode with High Burden

3 x 0 ... 32 A (±45 A_{DC}), max. 70 V_{peak}, 3 x 860 VA at 25 A

For loads with three separate phases it is possible to double the available compliance voltage. However, this configuration does not make sense, if a common N connector is required! **Do not** connect N1, N2 and N3 to each other!

Figure 7-8:
Three-phase operation



Warning: For currents greater than 32 A, do not connect the test object (the load) to the generator combination socket! Connect the test object to the 4 mm/0.16 " banana sockets, only!

7.4 Operation with Multiple CMS 356

You can use multiple *CMS 356* amplifiers to increase the number of independent voltage/current channels or to parallel their current output groups, for example, to get currents greater than 3 x 64 A:

- 3 x 128 A (with 2 *CMS 356*)
- 3 x 192 A (with 3 *CMS 356*)
- 6 x 64 A (with 2 *CMS 356*)

Caution While Paralleling Current Outputs of CMS 356

- You can parallel current outputs of several *CMS 356* as long as the current outputs of these *CMS 356* have the same configuration settings (web interface).
- Do not parallel current outputs of several *CMS 356* that are in high burden mode configurations (L-L) as described in chapters 7.1 to 7.3.
- Do not parallel *CMS 356* current outputs with other amplifier outputs than *CMS 356* (for example, do not parallel with *CMS 156* outputs).
- Make sure that there is sufficient wiring (cross section) of the high current path to the test object.

Example

This example shows the connection and configuration of two *CMS 356* to get 3 x 128 A.

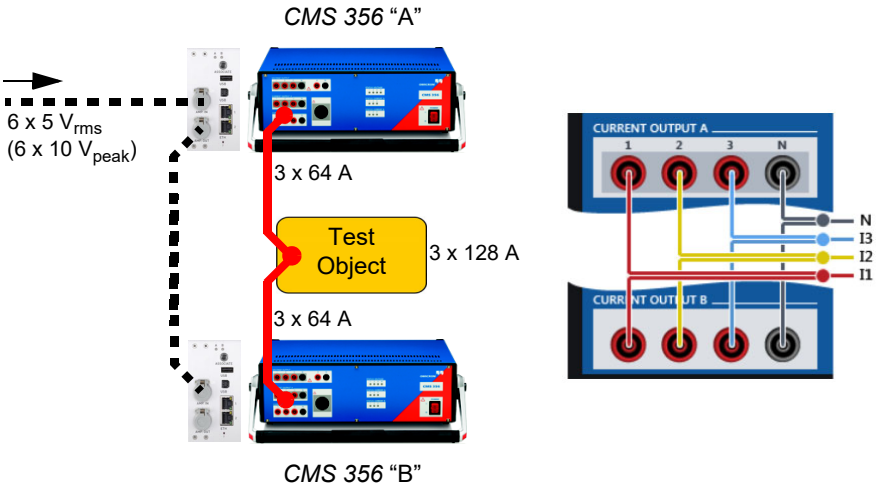


Figure 7-9: Current output configuration (web interf.) 3 x 64 A, 860 VA @ 50 A, 25 V_{rms}

Paralleling Current Groups of Two Combined CMS 356

While paralleling current groups of two combined *CMS 356*, you must comply with the following instructions:

1. Do not change the output wiring when the outputs are enabled. Remove or set analog input signals to zero or, in the web interface, go to **Configuration** > **Open configuration** > **Default configurations** and click **Device Off**.
2. Connect the analog low level source to “AMP. IN” of *CMS 356* “A”.
3. Connect “AMP. OUT” of *CMS 356* “A” to “AMP. IN” of *CMS 356* “B”.
4. Wire both *CMS 356* according to the output wiring of figure 7-9.
5. In high current modes, always use wires with sufficient cross section. Do the high-current wiring from each *CMS 356* to the test object separately as shown on figure 7-9 (left). (Not from *CMS 356* “A” to *CMS 356* “B” and finally to the test object.)
6. In the web interface, both *CMS 356* must be configured identically:
   - Selectable analog input range:
     ±7.071 V_{peak} (5 V_{rms}) or ±10 V_{peak} (7.071 V_{rms}).
   - Current output configuration.
   - Mapping of “AMP. IN” inputs to *CMS 356* outputs.

8 Troubleshooting

8.1 CMS 356 Switches Off its Outputs

CMS 356 may switch off its outputs due to various reasons, such as:

- Overtemperature error of the *CMS 356* internal power amplifiers.
- High current on socket N caused by unbalanced phase. The output sockets are internally protected against currents > 45 A_{peak} (32 A_{rms}).
- Hardware errors detected during the hardware check.

These reasons are indicated through the LEDs on the *CMS 356* front panel. You can see the LEDs status in the **Status** page of the *CMS 356* web interface. In the same page, the history section briefly describes errors occurred in the past.

To learn the LED color codes, please refer to “Status LEDs,” page 24.

8.2 CMS 356 Automatic Restart Behavior

In the event the *CMS 356* outputs switch off due to overtemperature, no interaction is necessary from your side, because the *CMS 356* automatic restart takes place:

1. *CMS 356* waits for approx. 10 seconds after turning off due to an error.
2. An internal *CMS 356* hardware check is performed.
3. If the hardware check passes successfully, the last valid *CMS 356* amplifier configuration is set, and the configured outputs are enabled. If the hardware check does not pass, because, for example, the cool-down time has not yet elapsed after an overtemperature error, proceed to step 1.

8.3 Miscellaneous Problems

If the problem still persists or you find other errors like communication problems with the device, please refer to the *CMS 356* Getting Started manual, chapter “Troubleshooting”.

Note: The *CMS 356* installation DVD also installs a PDF version of the *CMS 356* Getting Started manual. The PDF can be found by default at C:\Program Files (x86)\OMICRON\CMS 356\Doc.

If the problem still persists, please contact the OMICRON Technical Support (→ “Support,” page 61).

Open Source Software License Information

Parts of the *CMS 356* amplifier software are under OMICRON license, other parts are under open source software licenses. Both the open source license texts and the necessary source code are provided in the **OMICRON Open Source Download Area** at **www.omicronenergy.com/opensource/** .

Open this address in your Internet browser, click the **Download Software** button, and navigate to the **CMS 356/** directory.

Look for the file containing your corresponding version in the file name (for example, **Open Source CMS 356 2.52.zip for version 2.52**).

In addition to some open source code packages, the archive contains an overview of all license information of the *CMS 356* amplifier.

Support

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

24/7 Technical Support – Get Support

www.omicronenergy.com/support

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

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