

CMS 356

Getting Started



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About this manual

This Getting Started with *CMS 356* manual provides information on how to get started with the *CMS 356*. The Getting Started contains brief safety instructions, designated use, system requirements, list of accessories delivered with the device, and first steps to set up the working environment and start using the device.

The *CMS 356* configuration is based on an example, which explains all steps in detail. The operations with the web interface are mentioned in the web interface Help.

The Getting Started with *CMS 356* ends with troubleshooting, frequently asked questions, and software license information.

Safety symbols used

In this manual, the following symbol indicates safety instructions for avoiding hazards.



WARNING

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

1 Safety instructions

WARNING



The CMS 356 can output life-hazardous voltages and currents.

VOLTAGE OUTPUTS and CURRENT OUTPUTS of *CMS 356* can conduct life-hazardous voltages and currents.

Before operating the *CMS 356*, carefully read the following safety instructions. Only operate (or even turn on) *CMS 356* after you have read this Getting Started including the “Technical data” chapter in the Reference Manual and fully understood the instructions herein.

Safety instructions of accompanying accessories are described in their respective documentation.

1.1 For your safety

The OMICRON documentation is to be supplemented by existing national safety standards for accident prevention and environmental protection. Keep the documentation available at the site where the OMICRON device is used. It should be read by all personnel operating the device.

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

The *CMS 356* must be operated by trained personnel only. Any maloperation can result in injury to persons and/or damage to property.

FOR YOUR OWN SAFETY

Always follow the five basic safety rules:

1. Insulate
2. Secure to prevent reconnecting
3. Check isolation
4. Earth and short-circuit
5. Cover or shield neighboring live parts

1.2 Rules for use

- *CMS 356* must be used only when in a technically sound condition. Its use must be in accordance with the safety regulations for the specific job site and application. Always be aware of the dangers of high voltages. Pay attention to the information provided in the *CMS 356* Getting Started and Reference Manual.
- The instructions provided in the *CMS 356* Getting Started and Reference Manual are considered part of the rules governing proper usage.

1.2.1 Orderly practices and procedures

- Keep the *CMS 356* Getting Started and Reference Manual, which contains printed safety instructions, available on site where *CMS 356* is used.
- Personnel assigned to using *CMS 356* must have read the *CMS 356* Getting Started and fully understood the instructions therein.
- Do not carry out any modifications, extensions, or adaptations at *CMS 356*.

1.2.2 Operator qualifications

- Installation and configuration of *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 device.

1.2.3 Safe operation procedures

- Before wiring the terminals, verify that the conducting parts are de-energized. The terminal connectors have hazardous live parts.
- Do not operate *CMS 356* under wet or moist conditions (condensation).
- Do not operate *CMS 356* when explosive gas or vapors are present.
- When setting up *CMS 356*, make sure that the ventilation holes on the rear of the device remain unobstructed.
- Do not open *CMS 356*. There are no user serviceable parts inside. If *CMS 356* is opened by unauthorized personnel, all guarantees are invalidated.
- If *CMS 356* seems to be functioning improperly, please contact the OMICRON Technical Support (→ "Support" on page 35).

2 Introduction

The *CMS 356* is a voltage and current amplifier for analog low level signals provided by a CMC test set or by any other signal source, such as a digital real-time power system simulator. When used in combination with a CMC test set, the amplifier extends the capabilities of the CMC test set to provide additional output channels and higher amplitudes.

The high-amplitude and high-power current outputs make it equally suitable for testing modern numerical relays as well as high-burden electromechanical relays. The outputs of the voltage amplifier and the current amplifier are galvanically separated from each other and also from the power supply. Configuring and monitoring the device status of the *CMS 356* amplifier is done via the easy-to-use web interface.

2.1 Key features

- Six analog low level inputs with selectable range ($\pm 7.071 V_{\text{peak}}$ or $\pm 10 V_{\text{peak}}$)
- Numerous output configurations, for example 3 x 300 V + 3 x 64 A or 6 x 32 A
- Calculation and output of residual voltage and current
- Parallel connection of several *CMS 356* units for even higher current amplitudes
- All current and voltage outputs are fully overload and short circuit proof
- Protection against voltage transients and over-temperature

2.2 System requirements

- Physical computer with x86 or x64 architecture
- DVD drive
- Ethernet port 10/100/1000Base-TX (RJ45) to connect the amplifier
- Administrative privileges (installation)
- Operating system: Microsoft Windows 7, 8/8.1, or 10
- Web browser: Microsoft Internet Explorer 9 or higher, Mozilla Firefox, or Google Chrome

3 First steps to get started

In this chapter, you follow the steps to get started with the application and learn its workflow and features. You start by installing the *Device Browser*, then connecting *CMS 356* to your computer, opening the web interface from the *Device Browser*, and follow two configuration examples.

3.1 Installation

1. Exit all major programs running on your computer.
2. Insert the DVD into your computer's DVD drive and click **Install CMS 356 Software** on the start page. Should the start page not appear automatically a few seconds after the DVD has been inserted into the DVD drive, change to **Windows Explorer** and, on the DVD, double-click **autorun.exe**.
3. Follow the on-screen instructions to complete the installation. Afterwards, to open the *Device Browser*, double-click the **OMICRON Devices** desktop icon.



Note: After installation, the PDF documentation can be found by default at:
C:\Program Files (x86)\OMICRON\CMS 356\Doc.

3.2 Connecting the CMS 356 to your computer

CMS 356 communicates with your computer through the Ethernet network interface (ETH1 or ETH2). The Ethernet connector is located at the rear of *CMS 356*.

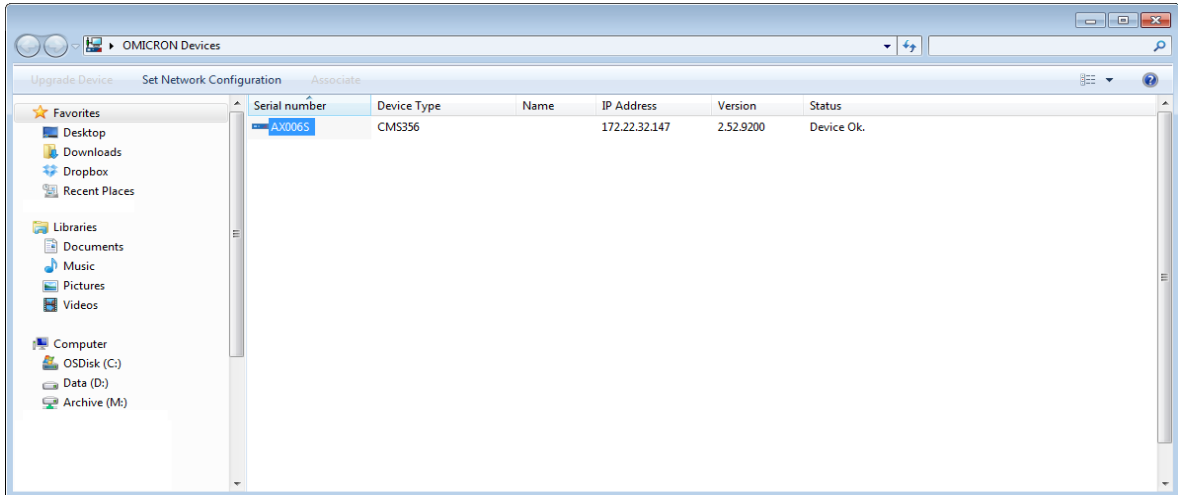
To connect *CMS 356* to the controlling computer using the Ethernet interface, you may consider one of two possibilities:

- Connect *CMS 356* directly to the controlling computer Ethernet port.
- Connect both *CMS 356* and controlling computer Ethernet port to the Ethernet network.

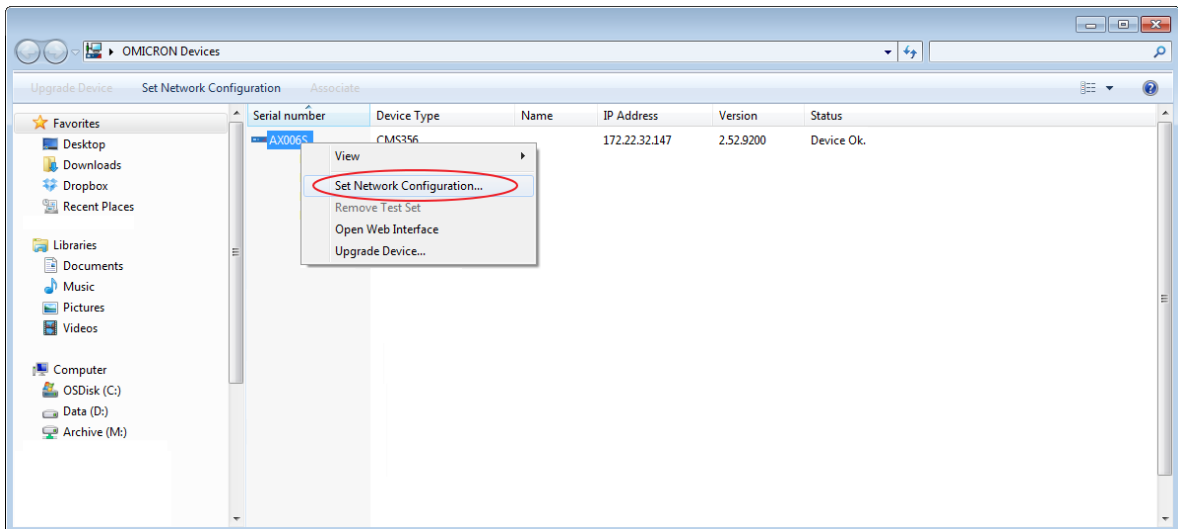
3.3 Opening the CMS 356 web interface

To open the *CMS 356* web interface:

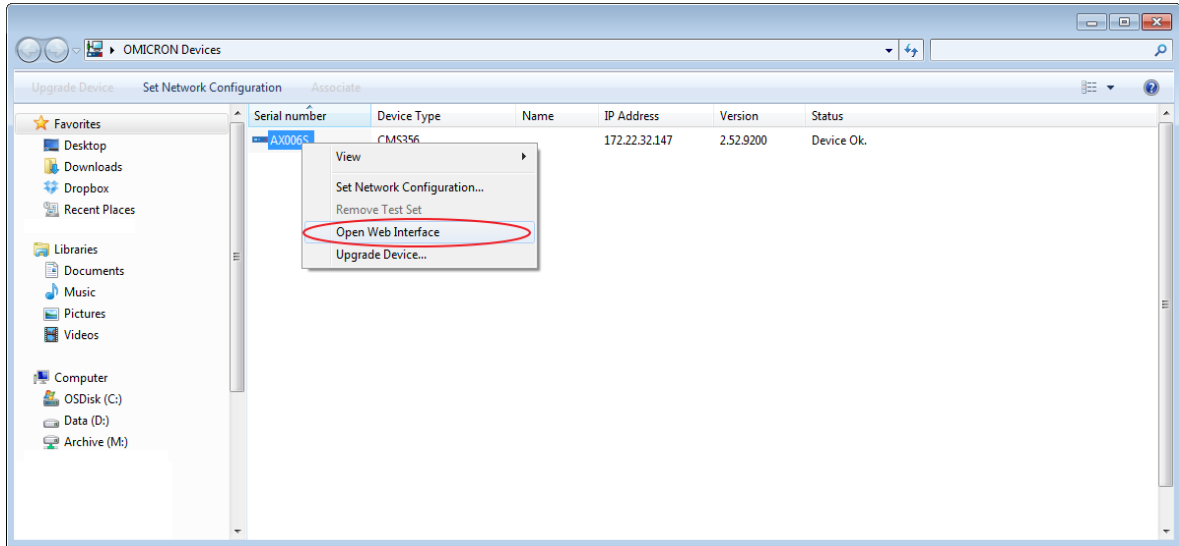
1. Launch the *Device Browser*. It finds and displays *CMS 356* automatically.



If the IP address configurations of *CMS 356* and PC are not compatible, the respective status appears in the **Status** column. In this case, right-click the *CMS 356* serial number and select **Set Network Configuration** to assign a suitable IP address to *CMS 356*.



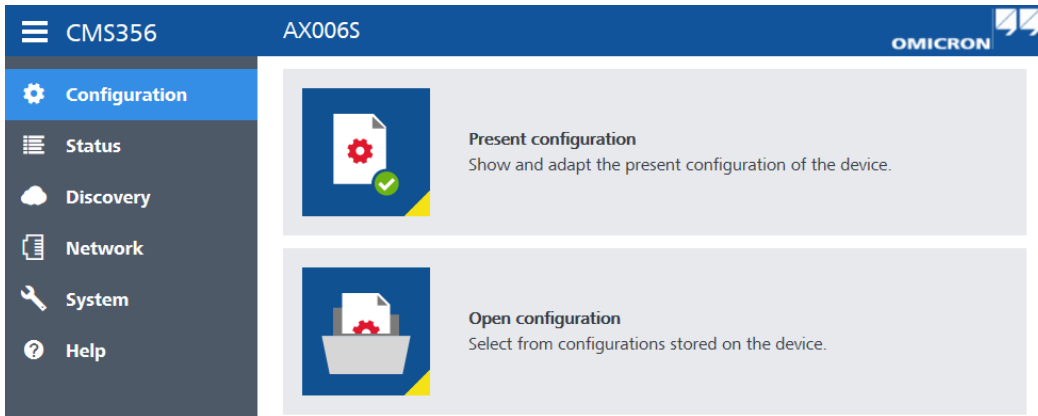
2. Right-click the *CMS 356* serial number. Click **Open Web Interface** from the shortcut menu.



3.4 Understanding the web interface

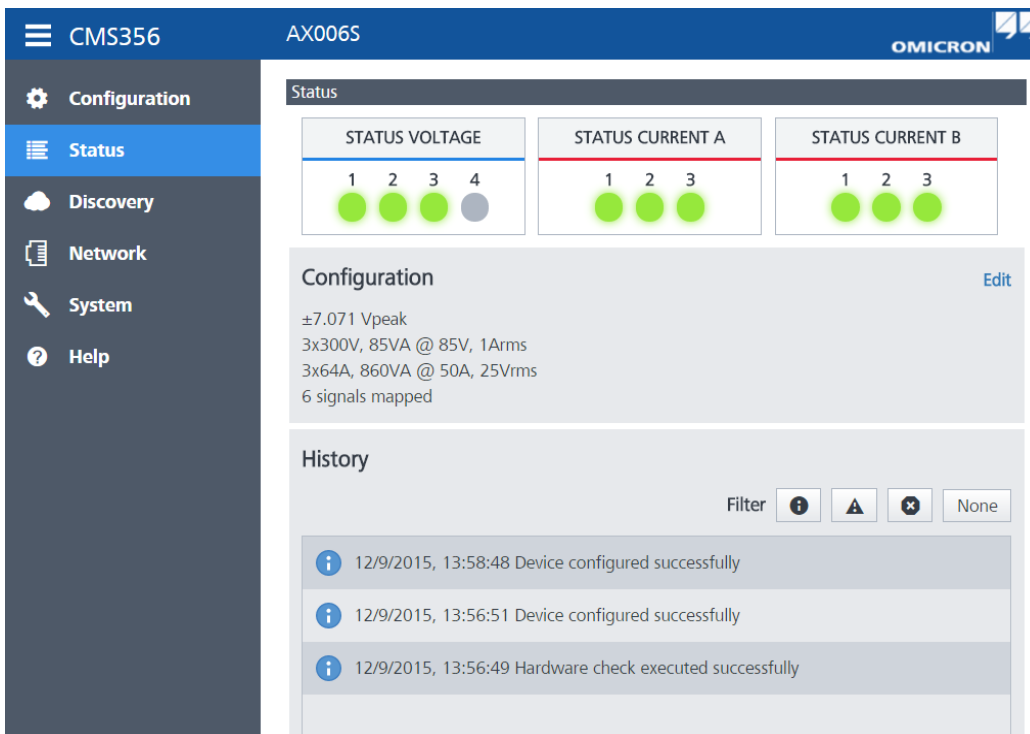
The web interface comprises **Configuration**, **Status**, **Discovery**, **Network**, **System**, and **Help** pages.

3.4.1 Configuration



Provides the interface to configure analog input range, overload sensitivity, voltage and current outputs, and mapping of outputs per low level input.

3.4.2 Status



Shows status of voltage and current outputs, just like in the front panel of the device. Shows amplifier configuration settings and amplifier history.

3.4.3 Discovery

The screenshot shows the 'Discovery' page of the CMS356 web interface. The left sidebar contains a menu with the following items: Configuration, Status, Discovery (highlighted), Network, System, and Help. The main content area is titled 'Discovered devices' and includes a 'Filter devices:' input field. Below this, there are two tables of discovered devices. The first table has columns for Serial no., Device type, Name, IP address, and Version, with a link to 'Open web interface'. The second table has the same columns and a link to 'Open web interface'.

Serial no.	Device type	Name	IP address	Version	
AX006S	CMS356	--	172.22.25.231	2.52.0013	Open web interface
AC014C	CMS356	--	172.22.25.188	1.03.0033	Open web interface

Provides a list of OMICRON test sets and/or accessories that are connected to the same Ethernet networks as CMS 356. From your CMS 356 web interface, you can also change the IP configuration of connected devices and open the web interface of a connected device.

3.4.4 Network

The screenshot shows the 'Network' page of the CMS356 web interface. The left sidebar contains a menu with the following items: Configuration, Status, Discovery, Network (highlighted), System, and Help. The main content area is titled 'Local network settings - CMS356 (AX006S)'. It includes a 'Network interface:' section with buttons for 'Port ETH1' and 'Port ETH2'. Below this is an 'IP assignment:' section with buttons for 'Dynamic' and 'Static'. The 'IP address:', 'Network mask:', and 'Gateway:' fields are text input boxes. An 'Apply' button is located at the bottom right.

Local network settings - CMS356 (AX006S)		
Network interface:	Port ETH1	Port ETH2
IP assignment:	Dynamic	Static
IP address:	172.22.25.231	
Network mask:	255.255.254.0	
Gateway:	172.22.24.1	
Apply		

Provides local network settings of Ethernet ports. You can select the IP assignment (dynamic or static).

3.4.5 System

☰
CMS356
AX006S

⚙️ Configuration

📋 Status

☁️ Discovery

🖨️ Network

🔧 System

❓ Help

Device information

Serial number:	AX006S
Image version:	2.52.0012
Friendly name:	✓

System information

Uptime:	4 hours 38 minutes 20 seconds
Kernel version:	3.18.21
System snapshot:	Download
Debug logging enabled:	☒
Language:	English ▼

Port ETH1

MAC address:	20-B7-C0-00-5B-65
IP address:	172.22.25.231
Network mask:	255.255.254.0
OMFind protocol:	☒

Port ETH2

MAC address:	20-B7-C0-00-5B-66
IP address:	192.168.105.4
Network mask:	255.255.255.0
OMFind protocol:	☒

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Provides device and system information, including MAC and IP addresses of all network ports. You can enter a friendly name, so that the device can be easily identified in the *Device Browser*, and select another language. You can also download the system snapshot, which can be useful in case of problems with the device, and comprises system log, CMS 356 engine startup log, and list of hardware checks.

3.4.6 Help

Opens the web interface Help. It provides instructions and descriptions about using *CMS 356*.

3.5 Configuration example

This configuration example is divided in two parts:

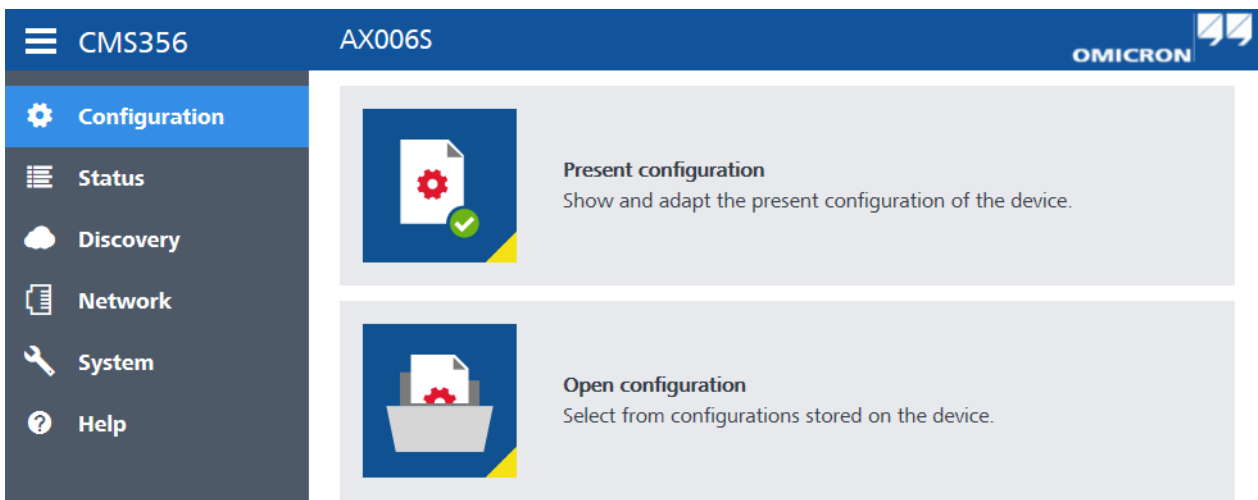
- **Part 1:** Configuring *CMS 356* through its web interface.
- **Part 2:** Configuring the *Test Universe* Hardware Configuration—a necessary task **only** when *CMS 356* is used to extend a CMC test set.

You will configure *CMS 356* to provide:

- Three voltage outputs of 300 V (maximum amplitude).
- Three current outputs of 64 A (maximum amplitude).
- An automatically calculated residual voltage put out on VOLTAGE OUTPUT 4.

3.5.1 Part 1: Web interface

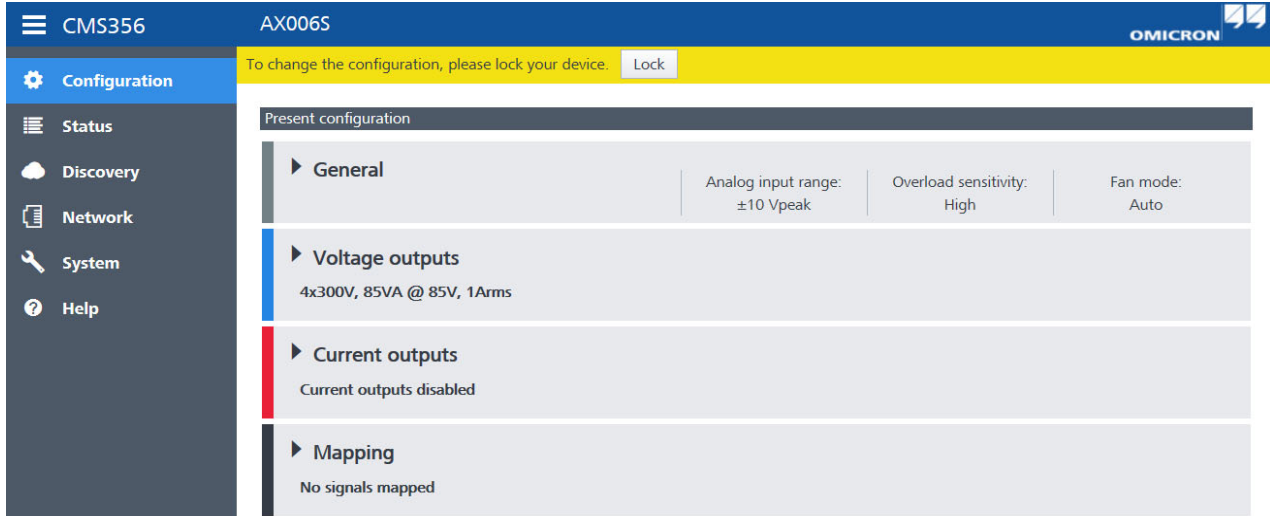
To configure *CMS 356*, from the **Navigation** pane, click **Configuration**.



You can start the *CMS 356* configuration in two possible ways:

- Showing the present configuration and adapting the appropriate parts.
- Opening a configuration stored on the device and adapting the appropriate parts. Default configurations are available for the most common tasks. Adapted configurations can also be saved for later use.

The following example, based on “Present configuration”, introduces you the CMS 356 configuration.



The four configuration panes, when collapsed, show summary settings. The yellow bar that appears on the top is the **Notification** bar.

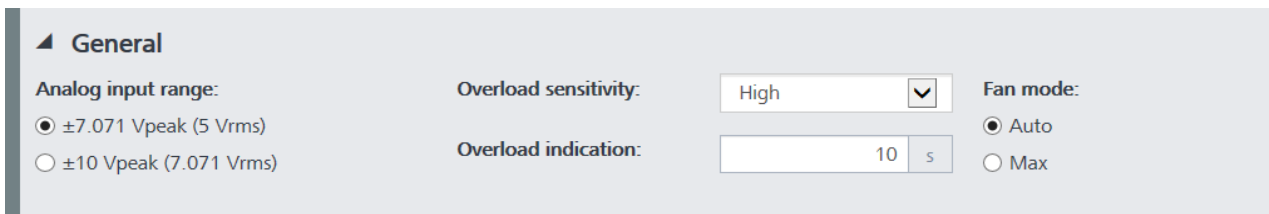
To expand a pane, click the  on its header.

To change the CMS 356 configuration:

1. On the **Notification** bar, click **Lock**. The device is locked for you and inaccessible to other users.
2. Expand the appropriate pane.
3. Configure the necessary settings.
4. Click **Apply** to make the changed settings effective.
5. (Optional) Click **Unlock** to unlock the device.

General settings

Expand the General pane and select the desired input range, for example **±7.071 Vpeak (5 Vrms)**.



Voltage outputs

To configure the voltage outputs:

1. Expand the **Voltage outputs** pane.
2. Turn on **Enable voltage outputs**.
3. From the list, select the appropriate voltage configuration. In this example, **3x300V, 50VA @ 75V, 660mArms, VE automatically calculated**. The figure shows the output connections for the selected configuration.
4. (Optional) Select **Limit voltage output**.

NOTE



You gain two benefits by limiting the voltage output:

- ▶ Preventing damage to the equipment under test.
- ▶ Increasing available power at the voltage outputs at lower amplitudes.

Therefore, you are recommended to always limit the voltage output to the lowest possible voltage for the test. If enabled, output signals above the limit are clipped and the amplifier indicates “Overload” at the respective output.

5. In **Residual voltage factor** enter an appropriate value. (The default value of $1/\sqrt{3} = 0.5773$ V is used in this example.)

Voltage outputs

☐ Enable voltage outputs

4x300V, 85VA @ 85V, 1Arms
 3x300V, 85VA @ 85V, 1Arms
 1x300V, 150VA @ 75V, 2Arms
3x300V, 50VA @ 75V, 660mArms, VE automatically calculated
 1x600V, 250VA @ 200V, 1.25Arms
 2x600V, 125VA @ 150V, 1Arms

Details

Setting a voltage limit optimizes output power

☒ Limit voltage output:

Vrms

Vpeak

Residual voltage factor:

Current outputs

To configure the current outputs:

1. Expand the **Current outputs** pane.
2. Turn on **Enable current outputs**.
3. (Optional) Filter the configurations list using the Filter. In this example, **64 A**.
4. From the list, select the appropriate current configuration. In this example, **3x64A, 860VA @ 50V, 25Vrms**. The figure shows the output connections of the selected configuration.

NOTE



Limiting the current output

You are recommended to limit the current output to the lowest possible current for the test as it can prevent damage to the equipment under test. If enabled, output signals above the limit are clipped and the amplifier indicates “Overload” at the respective output.

5. (Optional) Select **Limit current output**.

Current outputs

☐ Enable current outputs

Filter

32 A
 64 A
 128 A
 None

3x64A, 860VA @ 50A, 25Vrms

1x64A, 1740VA @ 50A, 50Vrms

2x64A, 500VA @ 40A, 25Vrms

1x64A, 500VA @ 40A, 25Vrms

1x64A, 500VA @ 40A, 25Vrms

Details

☒ Limit current output:

50 Arms

70.7 Apeak

Residual current factor:

1

Mapping

The Mapping table shows a list of available logical output signals according to selected configurations. Each output signal can be mapped to a low level input. You only need to map the output signals required for the test. Output signals that are not mapped to an input remain inactive.

NOTE



Since residual voltage (VE) and residual current (IE) are automatically calculated from V1, V2, V3 and I1, I2, I3, they do not appear in the mapping table.

Mapping

		Inputs (AMP. IN)					
		1	2	3	4	5	6
Output signals	V1	✓					
	V2		✓				
	V3			✓			
	I1				✓		
	I2					✓	
	I3						✓

Clear mapping

Applying changes

Configuration has been changed. To make it effective, please apply it to the device.

Unlock

Apply

To send the changed configuration to the CMS 356, on the **Notification** bar, click **Apply**. After a short self-test, the new configuration becomes effective.

3.5.2 Part 2: Test Universe Hardware Configuration

The *Test Universe* Hardware Configuration is a necessary task **only** when *CMS 356* is used to extend a CMC test set.

NOTE



Amplifier configuration files on the CMS 356 installation DVD

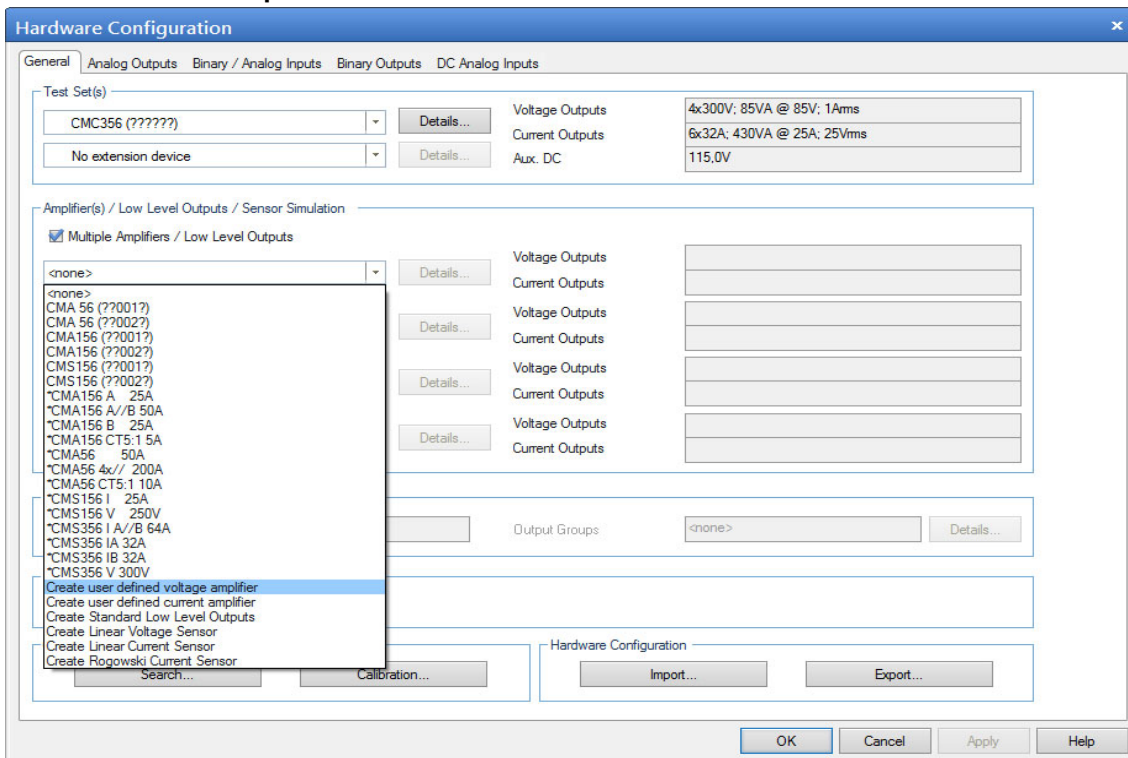
The *CMS 356* installation DVD includes a file containing amplifier configurations for the *Test Universe* Hardware Configuration. These configurations match the default *CMS 356* configurations. To make them available, copy the file from **TestUniverse\CMS356.AMP** to **C:\Program Data\OMICRON\Test Universe\Hardware Configurations_OHC**.

Amplifiers are always defined as a set of three outputs, so you must define two amplifiers (voltage and current). To configure voltage and current amplifiers:

1. Launch the Hardware Configuration from the test module or from your OMICRON Control Center (OCC) document.



2. In the **General** tab, on **Amplifier(s) / Low Level Outputs / Sensor Simulation**, select **Multiple Amplifiers / Low Level Outputs**.



3. From the drop-down list, choose **Create user defined voltage amplifier**. The **Amplifier Details** dialog opens.

4. Configure the voltage amplifier settings according to the following figure.

i When you choose the “*CMS356 V 300V” predefined configuration, you only need to configure **Output System**. All other parameters are already set to the correct values.

Output System	“LL out 1-3” because the voltage outputs are mapped to the inputs 1-3.
Amplification	The amplifier’s analog input range is 5 Vrms, thus the amplification factor is $300 \text{ V} / 5 \text{ V} = 60 \text{ V/V}$.
Propagation delay phase 1-3	The propagation delay of a CMS 356 amplifier is 500 µs. The propagation delay is factory-calibrated and identical for all units. Hint: You can type 500u to set 500 µs.

5. Click **OK**.
6. From the drop-down list, choose **Create user defined current amplifier**. The **Amplifier Details** dialog opens.
7. Configure the current amplifier settings according to the following figure.

i When you choose the “*CMS356 I A/B 64A”, predefined configuration, you only need to configure **Output System**. All other parameters are already set to the correct values.

Output System	“LL out 4-6” because the current outputs are mapped to the inputs 4-6.
Amplification	The amplification factor for this configuration is $64 \text{ A} / 5 \text{ V} = 12.8 \text{ A/V}$.
Propagation delay phase 1-3	The propagation delay of a CMS 356 amplifier is 500 µs. The propagation delay is factory-calibrated and identical for all units. Hint: You can type 500u to set 500 µs.

8. Click **OK**. All amplifier outputs are available on the **Analog Outputs** tab and can be assigned for testing.

4 Troubleshooting

This chapter provides suggestions for troubleshooting. Follow the list of steps on chapter 4.1 "How to proceed in case of operational problems".

4.1 How to proceed in case of operational problems

There are several options to handle operational problems with *CMS 356*:

1. Check whether your problem is documented on chapter 4.2 "Device Browser does not list your CMS 356 as connected" on page 26.
2. Check the web interface Help.
3. Check whether the malfunction is reproducible. If yes, document it by taking note of the exact wording of any error message or unexpected conditions.
4. Contact the Technical Support. Please provide:
 - Your full contact details.
 - Serial number of your *CMS 356*.
 - Screenshots or the exact wording of possible error messages.
 - System snapshot. Please refer to chapter 5 "Frequently asked questions" on page 31.

Note: Make sure that your computer and test setup are available and be prepared to repeat the steps that caused the problem.

The OMICRON Technical Support contact details are available in chapter → "Support" on page 35.

4.2 Device Browser does not list your CMS 356 as connected

There are several causes for communication failures between your *CMS 356* and your computer. The following steps help to narrow down the problem to its root cause:

1. To simplify troubleshooting, reduce the complexity of your test setup as much as possible. Use a direct point-to-point Ethernet connection between your *CMS 356* and your computer. This is to prevent impacts of the network topology and/or configuration.
2. *Device Browser* does not refresh automatically. To refresh the device list, press F5.
3. To rule out incompatibilities, close other programs that are currently running on your computer.
4. If possible, replace your *CMS 356* by another one. This is to find out whether the problem is related or not to the actual *CMS 356*.
5. If possible, replace the computer by another one with an installed *Device Browser* of the same version. This is to find out whether the problem is related to the computer and/or its installation.

4.2.1 Power supply problems? Check the ON/OFF power switch of CMS 356

1. Does the ON/OFF switch light up? If so, continue with → “Check the status LEDs at the rear side of CMS 356”. Else, → item 2 below.
2. If the ON/OFF switch does not light up, verify the *CMS 356* power supply. Unplug the power cord and check the fuse of *CMS 356* (→ *CMS 356* Reference Manual). If needed, exchange the fuse and try again.

If all of this does not work and the ON/OFF switch remains dark, please contact your regional Service Center or the Technical Support (→ “Support” on page 35).



4.2.2 Check the status LEDs at the rear side of CMS 356

The LEDs at the rear side of *CMS 356* inform you about the operational status of the device.

LED A indicates that *CMS 356* is ready to be controlled by a computer. The hardware checks of *CMS 356* are finished, and *CMS 356* is properly connected to a computer or a network.



LED B lights while powering-up *CMS 356* and during a hardware self-test.

Does the LED A light up once *CMS 356* is powered-up?

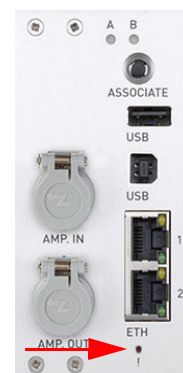
1. If so, continue with → “Check the physical connection between *CMS 356* and your computer”. Else, → item 2 below.
2. *CMS 356* is not ready for operation. This could, for example, be due to an unsuccessful firmware up-/downgrade. In rare cases the *CMS 356* firmware can get corrupted during this process.

To recover from such situation, reset the firmware using the “!” button. The “!” button enables you to recover from unsuccessful software image downloads or other emergency situations:

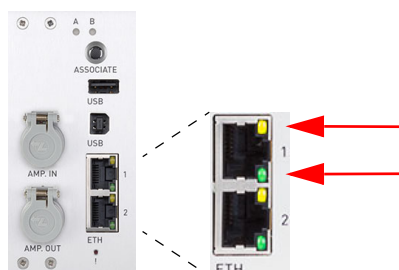
- a) Turn off *CMS 356*.
- b) Press the “!” button with a pointed tool or a paper clip while powering-up *CMS 356*.
- c) Wait for approximately 10 seconds before releasing the “!” button.
- d) LED A remains off and LED B blinks slowly to indicate that *CMS 356* waits for a new software image download.

Launch *Device Browser*. Your *CMS 356* should be visible now.

If this does not work and your *CMS 356* is still not listed, please contact your regional Service Center or the Technical Support (→ “Support” on page 35).



4.2.3 Check the physical connection between CMS 356 and your computer



Depending on the transfer rate, the status LEDs behavior varies (→ table below).

A physical link of the communication port to the computer or a network is established; port is active:

Transfer rate	Active LED ON
10 Mbit/s	yellow
100 Mbit/s	green
1000 Mbit/s	yellow + green

If there is traffic via an ETH port, the active LED starts blinking.

Is the active LED of the Ethernet port ON?

1. If yes, continue with → “Disable unused network connections”.
Else, → item 2 below.
2. If no LED is ON, your *CMS 356* does not seem to be physically connected to the Ethernet:
 - a) Try the other Ethernet port on *CMS 356*.
 - b) Replace the Ethernet cable with another one known to be working.
 - c) Some laptops turn off the network interface when running on battery. Please connect the AC adapter to the laptop.

If the above procedure does not work and the active LED remains off, please contact your regional Service Center or the Technical Support (→ “Support” on page 35).

4.2.4 Disable unused network connections

Most computers hold more than just one network interface. This may be useful to, for example, connect to a CMS 356 via Ethernet and at the same time to the Internet via Wireless LAN. However, there are cases where the configuration of the individual network interfaces interfere and consequently block the communication with CMS 356.

Disable any network connection other than the Ethernet connection that is used to control CMS 356.

If *Device Browser* still does not list your CMS 356 → “Firewall configuration”.

4.2.5 Firewall configuration

A proper firewall configuration is essential to successfully establish a communication between your CMS 356 and your computer.

Windows Firewall

The configuration of the Windows Firewall is carried out automatically during the installation of *Device Browser*. However, in certain cases this may have no immediate effect.

To exclude the Windows Firewall from being the cause of blocked communication, you should (temporarily) disable it in the Windows Control Panel.

NOTE



Is your CMS 356 listed at Device Browser after disabling the Windows Firewall?

- ▶ If so, the Windows Firewall blocked the communication between your CMS 356 and your computer. You need to reconfigure the Windows Firewall in order to enable a permanent use of the CMS 356 without the need of having to disable the Windows Firewall. To implement the necessary exceptions into the Windows Firewall configuration, run the **C:\Program Files\Common Files\OMICRON\OMFwCfg\ConfigureFirewall.bat** or **C:\Program Files (x86)\Common Files\OMICRON\OMFwCfg\ConfigureFirewall.bat** batch file, respectively, in a 64-bit or 32-bit operating system.
- ▶ Running the batch file requires Administrator rights on your computer.

If your CMS 356 is **still not** listed in *Device Browser* after disabling the Windows Firewall, → “Third-party firewall” below.

Third-party firewall

If you are using a firewall other than the Windows Firewall, temporarily disable it to see if this firewall may be the cause for the blocked communication.

How to configure such a third-party firewall to allow a permanent communication between CMS 356 and your computer, → “Manual firewall configuration for ETH connection” on page 29.

NOTE



Disabling antivirus software

- ▶ Please note that numerous computer security programs or antivirus packages often contain an integrated firewall function! Double-check and, if applicable, disable all such programs that may be installed on your computer.

Manual firewall configuration for ETH connection

If you would like to manually configure your firewall settings, please note that the following ports/services have to be open in order to get a functional communication.

Program/service name	Rule name	Protocol & ports				Scope		
		Traffic direction	Protocol type	Protocol numbers	Local port	Remote port	Local IP	Remote IP
OMFind.exe ¹	OMICRON OMFind (UDP 4988)	inbound	UDP	17	4987	all	any	any
	OMICRON OMFind (UDP-in 4988)	inbound	UDP	17	4988	all	234.5.6.7	any
	OMICRON OMFind (UDP-out 4988)	outbound	UDP	17	all	4988	any	234.5.6.7
	OMICRON OMFind (ICMPv4-Out)	outbound	ICMPv4	1	all	all	any	any
CMS 356 communication	OMICRON CMEP (Out)	outbound	TCP	6	all	2200	any	any
	OMICRON LAP (Out)	outbound	TCP	6	all	2201	any	any
Web Interface	OMICRON Web Interface (HTTP)	outbound	TCP	6	all	80	any	any
OMICRON Device Browser	OMICRON Device Browser TFTP (UDP-Out)	outbound	UDP	17	any	69	any	any
	OMICRON Device Browser FTP CMD (TCP-Out)	outbound	TCP	6	any	21	any	any
	OMICRON Device Browser FTP DATA (TCP-Out)	outbound	TCP	6	any	3000-3020	any	any
	OMICRON Device Browser File Monitor FTP CMD (TCP-Out)	outbound	TCP	6	any	21	any	any
	OMICRON Device Browser File Monitor FTP DATA (TCP-Out)	outbound	TCP	6	any	3000-3020	any	any

¹ Installation path: C:\Program Files\Common Files\OMICRON
(On a 64 bit operating system the default installation path is C:\Program Files (x86))

5 Frequently asked questions

5.1 Where can I find the newest updates for my CMS 356?

You can download the latest software updates for your *CMS 356* in the “Software Downloads” section of the OMICRON Customer Portal. To upgrade your *CMS 356* image, please use *Device Browser*.

5.2 What is the meaning of the status LEDs on CMS 356?

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.
Blinking	Red	Output has an overtemperature error. All other <i>CMS 356</i> 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 <i>CMS 356</i> amplifier outputs have also been switched off (LED blinks green).

5.3 How can I obtain a system snapshot for the Technical Support?

To aid the OMICRON Technical Support, please attach a system snapshot of your *CMS 356*:

1. Open the *CMS 356* web interface.
2. Go to **System**.
3. Navigate to section **System information**, and click **Download**. The download of the system snapshot starts (.zip file). This file contains internal log files and results of hardware self-checks performed during start-up and whenever the *CMS 356* configuration changed.

5.4 How does the CMS 356 calculate residual voltage?

Using the configuration “3 x 300 V, 50 VA @ 75 V, 660 mArms, VE automatically calculated” the voltage VE is generated between terminals 4 and N of the voltage outputs.

VE represents the vectorial sum of the three phase voltages V1-N, V2-N, V3-N and is scaled by the residual voltage factor.

The default value for the residual voltage factor is $1/\sqrt{3} = 0.57735$.

For a voltage transformer with a secondary nominal voltage of $110\text{ V}/\sqrt{3}$, the windings that form the residual voltage in an open-delta connection are typically rated $110\text{ V}/3$. Then, the residual voltage factor must be set to $\sqrt{3}/3 = 1/\sqrt{3}$.

Residual voltage $VE = 3 \times V_0$ (= zero sequence voltage) x residual voltage factor.

5.5 How does the CMS 356 calculate residual current?

Using the configuration “3 x 32 A, 430 VA @ 25 A, 25 Vrms, IE automatically calculated”, the IE current is generated between terminals 1 and 2 of current output B. IE represents the vectorial sum of the three phase currents I1, I2, I3 and is scaled by the residual current factor. Using phase CTs with a ratio of 200:1 and a residual CT with a ratio of 60:1, the residual current factor is $200/60 = 3.3333$.

Residual current $IE = -3 \times I_0$ (= zero sequence current) x residual current factor.

5.6 What is the purpose of the USB ports on the CMS 356?

The USB ports are for future use. Currently, the CMS 356 does not use them.

Appendix A: Open Source Software License Information

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

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!



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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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Reference Manual



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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.

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

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Preface

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

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 reference 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 9. 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 reference 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 reference 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 reference 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 29. 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 57).

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 29 for more information.)

Information for Disposal and Recycling



This test set (including all accessories) is not intended for household use. After use, the test set cannot be disposed of as household waste!

For Customers in EU Countries (incl. EEA)

OMICRON test sets are subject to the EU Waste Electrical and Electronic Equipment Directive 2012/19/EU (WEEE directive). As part of our legal obligations under this legislation, OMICRON offers to take back the OMICRON test set and ensure that it is disposed of by authorized recycling agents.

For Customers Outside the EEA

Please contact the competent authorities 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 power 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 *Test Universe* 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.
- 6 inputs for analog low level signals that can be amplified by *CMS 356* internal current and voltage power amplifiers.
- 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.

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. *CMS 356* may receive signals for amplification, which are generated by such software, at its low level inputs.

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.

This reference 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 reference 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.

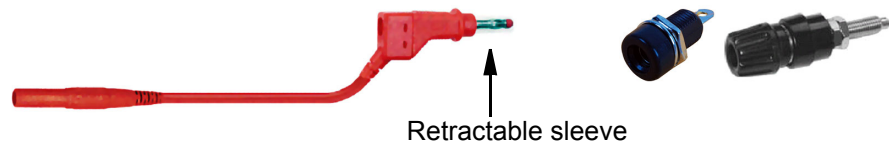
To set *CMS 356* into operation you need the following components:

- *CMS 356* test set with power supply cable.
- Connecting cable *CMS 356* ↔ computer.
- Connecting cable *CMS 356* ↔ test object.
- Connecting cable *CMS 356* ↔ low level signal source (for example, with CMC test set, use cable VEHK0003).
- A computer with the *CMS 356* installation: *Device Browser* 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).

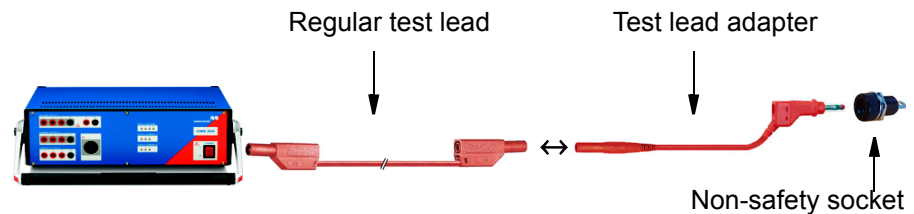


These test leads are to be used as **adapters**, only. They are intended to make the 4 mm/0.16 " banana plugs of the standard test leads fit into non-safety sockets (→ picture above).

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).

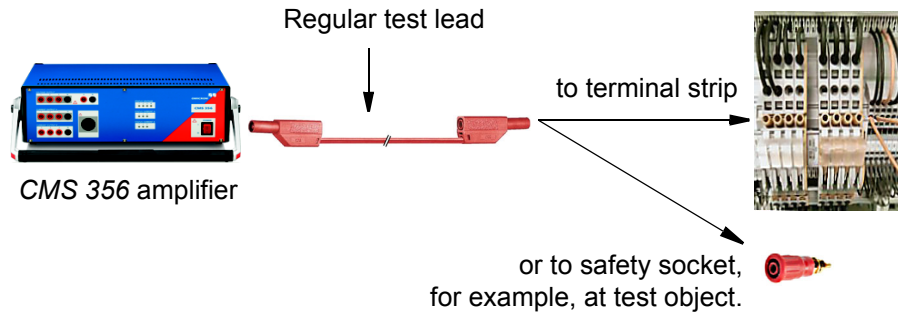


Plug in the regular test leads of 2.0 m/6 ft. length into either the appropriate CMS 356 output safety sockets or the test lead adapters.



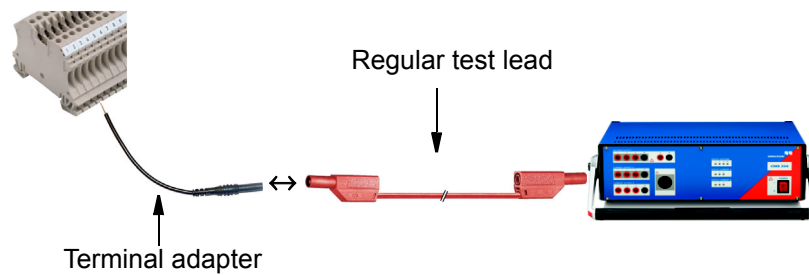
3.2.2 Regular Test Leads for Safety Sockets

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

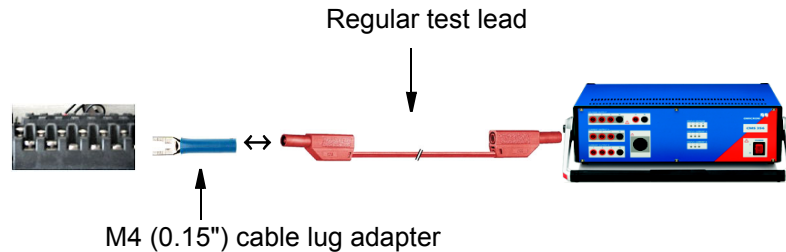
Use the flexible terminal adapters to connect the regular test leads to screw-clamp terminals.



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

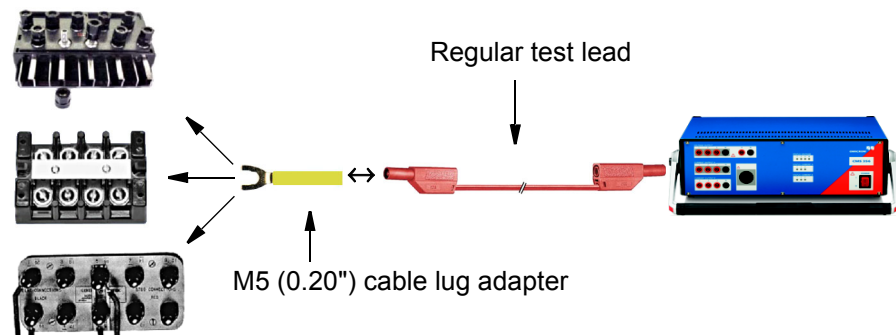
The optional "CMC Wiring Accessory Package" includes M4 (0.15") cable lug adapters to connect regular test leads to screw-clamp terminals of SEL/ABB/GE relays (and others).



The M4 cable lugs 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 lugs 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 (VEHK0154) 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 mm².
- 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 Browser* 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, and CMS 356 is 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 completely mandatory.

Connecting the System Components¹

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 use one of the Ethernet ports ETH1 or ETH2 at the CMS 356's rear side to connect to your computer's Ethernet port (or connect to an Ethernet network).
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 14, please carefully consider that CMS 356 always amplifies analog input signals present at "**AMP. IN**" when CMS 356 outputs are enabled. This fact is important in situations where:
 - Input signals amplitudes are not zero and are injected to CMS 356, *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.

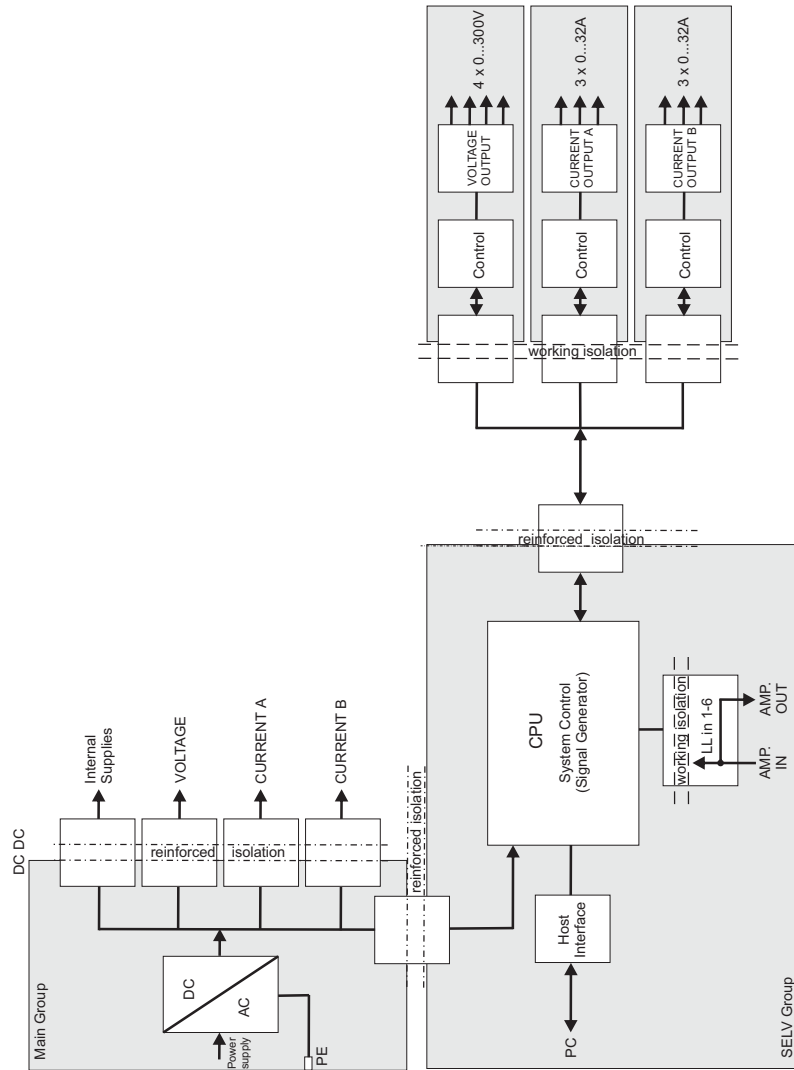
4 Setup and Function

The *CMS 356* amplifier offers the following functions:

- 6 inputs for analog low level signals that can be amplified:
 $6 \times 5 V_{\text{rms}}$ or $7.071 V_{\text{rms}}$ ($6 \times \pm 7.071 V_{\text{peak}}$ or $\pm 10 V_{\text{peak}}$).
- Output capabilities of 4 x 300 V and 6 x 32 A (two groups for all three phases).
- 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

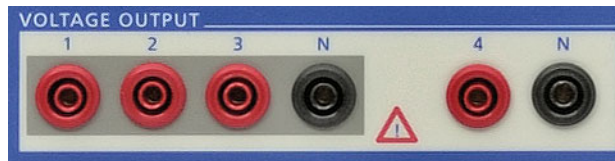


The block schematic diagram in figure 4-1 shows all externally accessible signals with gray shading. Every gray area represents a galvanic group that is isolated from all of the other galvanic groups.

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

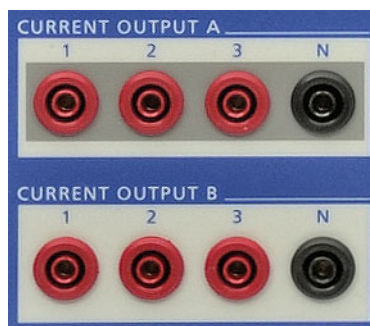
When a voltage output is overloaded, a corresponding warning is displayed on the status LEDs of the CMS 356 front panel or in the **Status** page of the CMS 356 web interface (please refer to the web interface Help).

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 $> 45\text{ A}_{\text{peak}}$ (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 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 has 6 analog low level inputs that have to be supplied by an external signal source (for example, a CMC test set or a digital real-time power system simulator). The external signal source is connected to connector “AMP. IN” at the rear side of CMS 356. To forward the analog signals to other CMS 356 amplifiers, the analog low level inputs are wired directly to connector “AMP. OUT” that is also located at the rear side of CMS 356 (see section 5.2.7).

The analog input signals are filtered, sampled, and used for further digital signal generation for the power amplifiers of CMS 356. The routing of the analog inputs to the CMS 356 outputs is very flexible and enables some special functions, such as limiting the output amplitudes or calculating residual current and voltage.

5 Connections and Interfaces

5.1 Front Panel Connections

Figure 5-1:
Front view of CMS 356

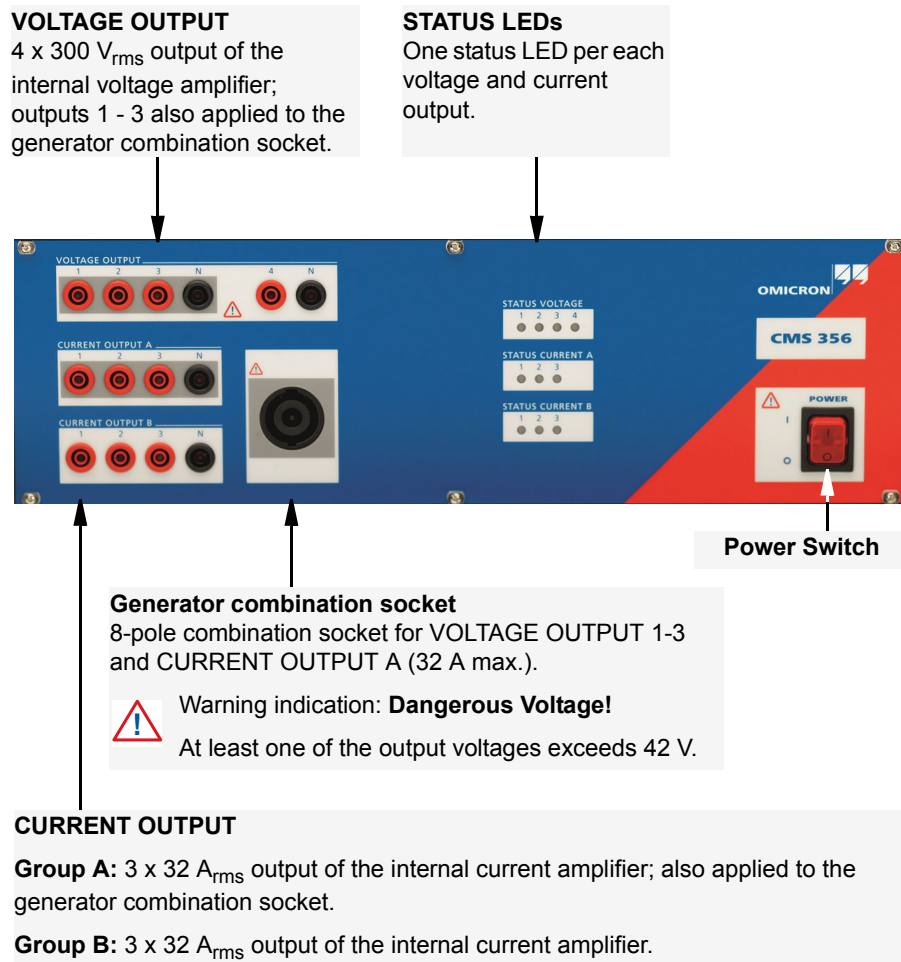


Figure 5-2:
Simplified diagrams of
current and voltage
outputs

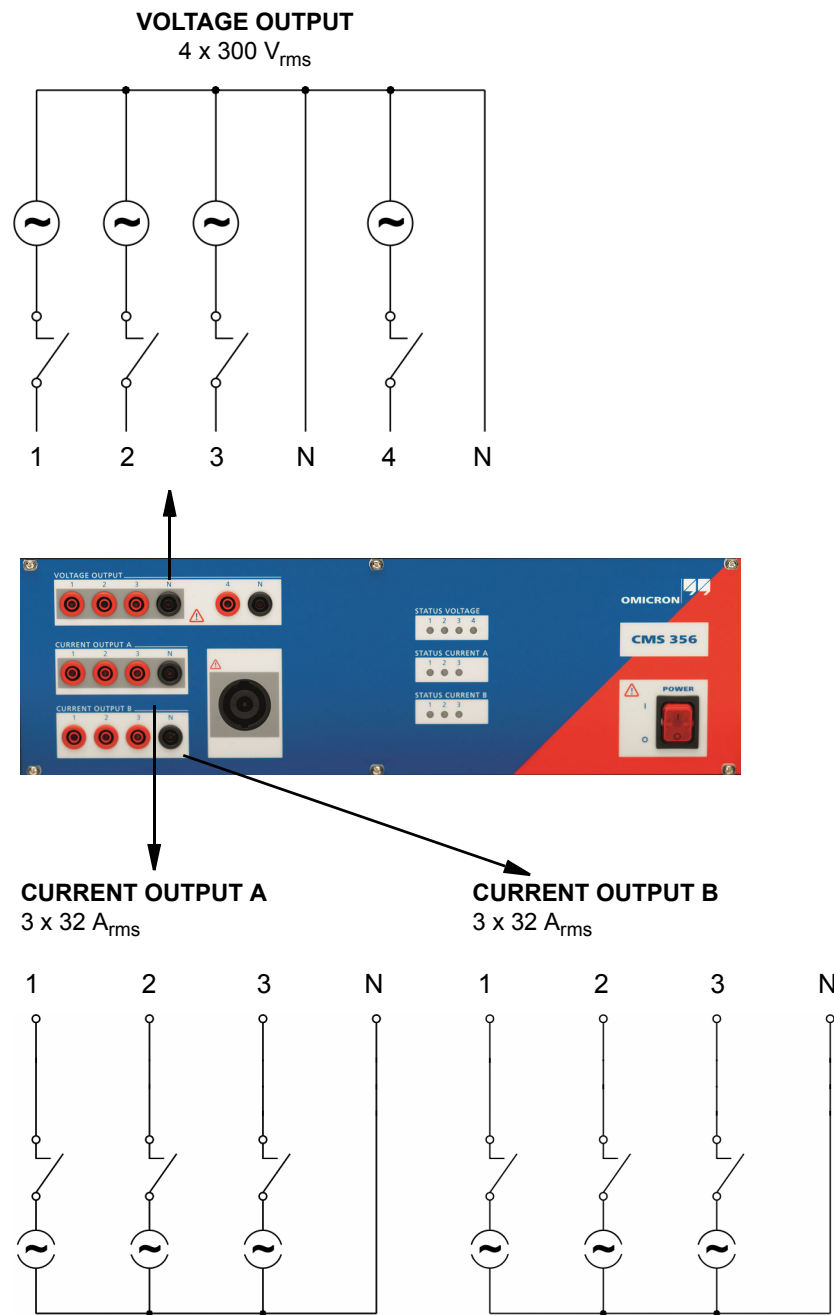


Figure 5-2 shows the non-operative state of *CMS 356* when turned off.

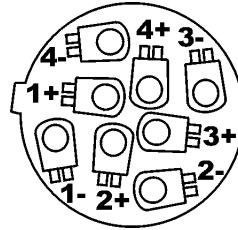
5.1.1 Generator Combination Socket for VOLTAGE OUTPUT and CURRENT OUTPUT

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 23).

Figure 5-3:
Generator combination
socket

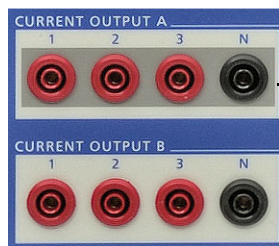
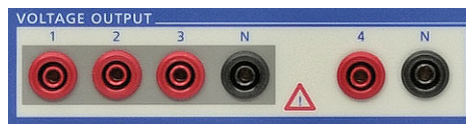


Front view



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 6) 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.

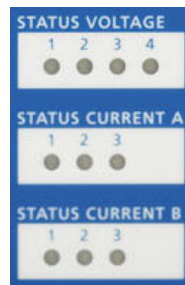
Table 5-1:
Pin assignment

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 <i>CMS 356</i> 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 <i>CMS 356</i> 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 switched off and 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.

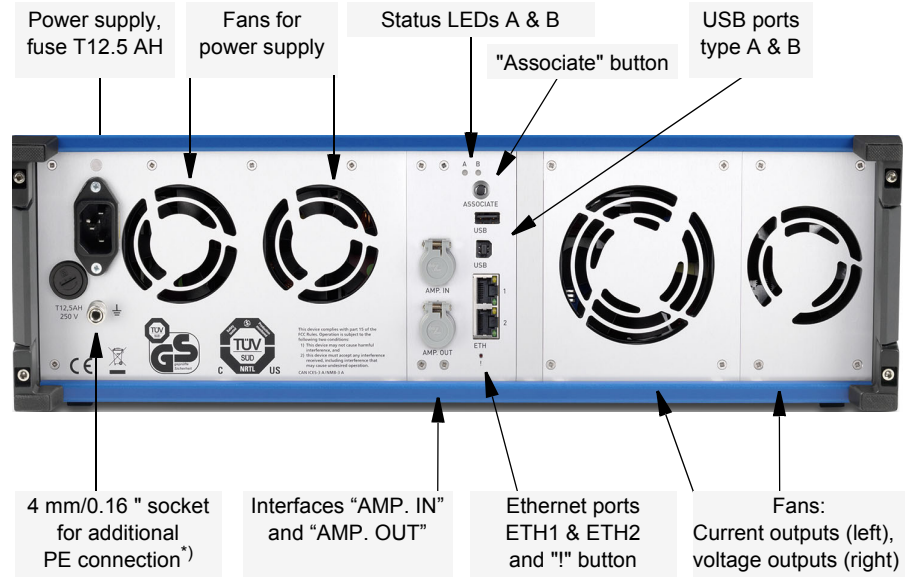
A short description of the reason for an error situation and switching off the outputs is also shown on the **Status** page of the web interface.

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 Ports ETH1 and ETH2



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 6.5, "Technical Data of the Communication Ports" on page 41.

5.2.2 USB Ports



The USB ports of CMS 356 are reserved for future use.

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



With the **Associate** button you can **reset the IP configuration**. If the **Associate** button is pressed while turning on the *CMS 356* amplifier, 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.

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 6.5, "Technical Data of the Communication Ports" on page 41.

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 Browser* 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 IP **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 Browser*. Therefore, the firewall program has to be configured to allow communication with the *CMS 356* amplifier. For the Microsoft Windows¹ Firewall in Windows 7, Windows 8/8.1, or Windows 10, the firewall configuration is done automatically during the *Device Browser* 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**.



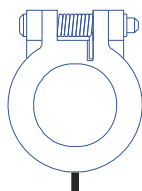
The *CMS 356* Getting Started manual is provided as printed manual and as PDF. The PDF can be found by default at C:\Program Files (x86)\OMICRON\CMS 356\Doc.

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

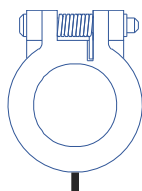
The SELV interface connector “AMP. IN” is used to connect low level signals with the following input ranges to the CMS 356 amplifier:

- $0 \dots \pm 7.071 V_{\text{peak}}$ ($0 \dots 5 V_{\text{rms}}$) or
- $0 \dots \pm 10 V_{\text{peak}}$ ($0 \dots 7.071 V_{\text{rms}}$)

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 39.

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 40.

6 Technical Data

Guaranteed Values:

- General:
The values are valid for the period of one year after factory calibration, within $23\text{ °C} \pm 5\text{ °C}$ at nominal value and after a warm-up time greater than 25 min.
- Guaranteed values from the generator outputs:
The values are valid in the frequency range from 10 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 38.

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

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 45.

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 38.

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.

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	> 1 kHz	
Input to output propagation delay time	500 us (error < ± 2 us typ., ± 5 us guar.)	
Short-circuit protection	Unlimited	
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)

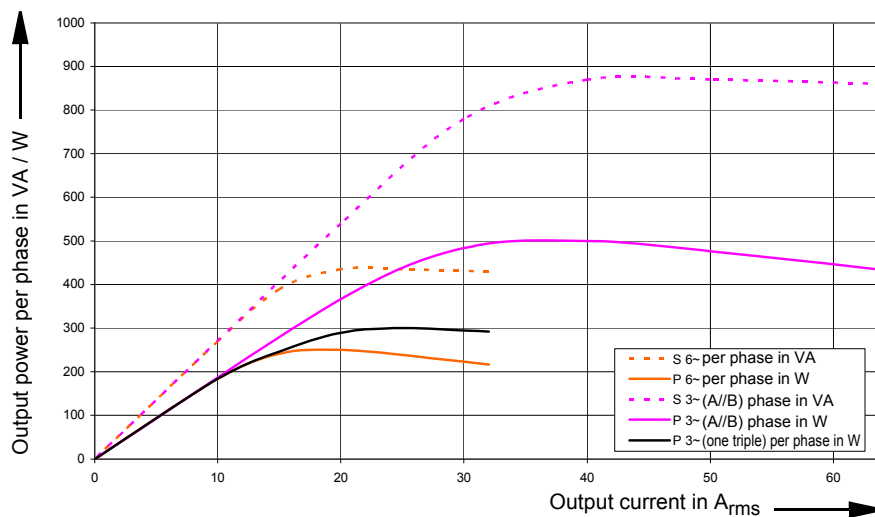
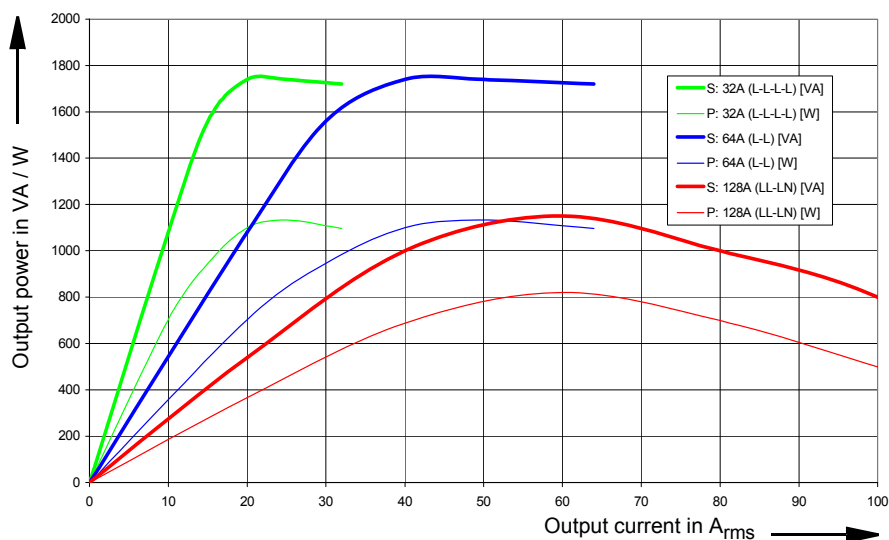
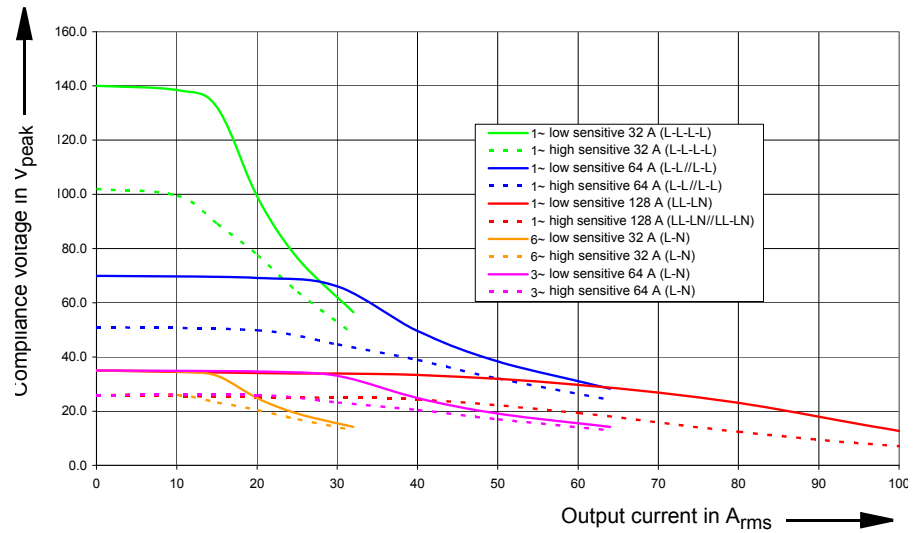


Figure 6-2:
Guaranteed single phase output power curves (active power values in W are guaranteed; apparent power values in VA are typical values)



For additional information → chapter 7.1, "Single-Phase Operation of CMS 356" on page 46.

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

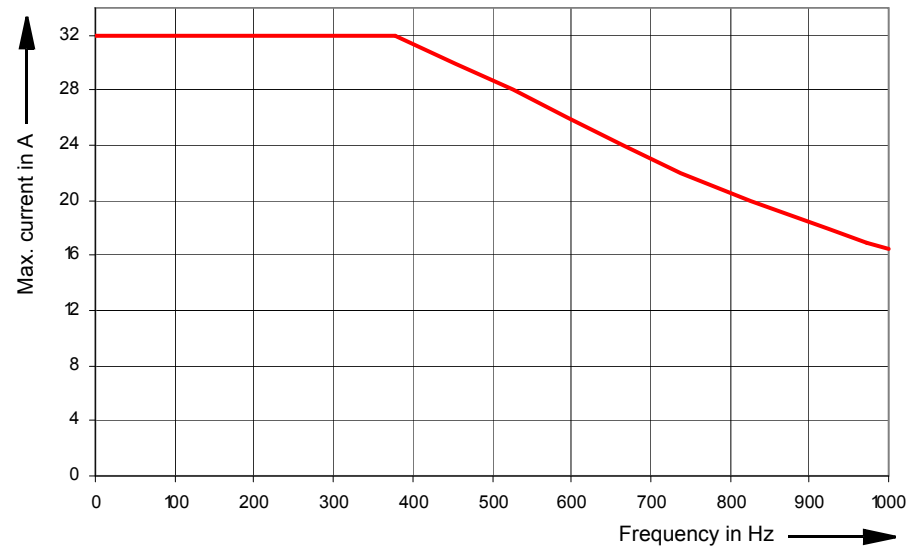


Figure 6-5:
Typical continuous output
current and output power
at 23 °C;
single-phase mode

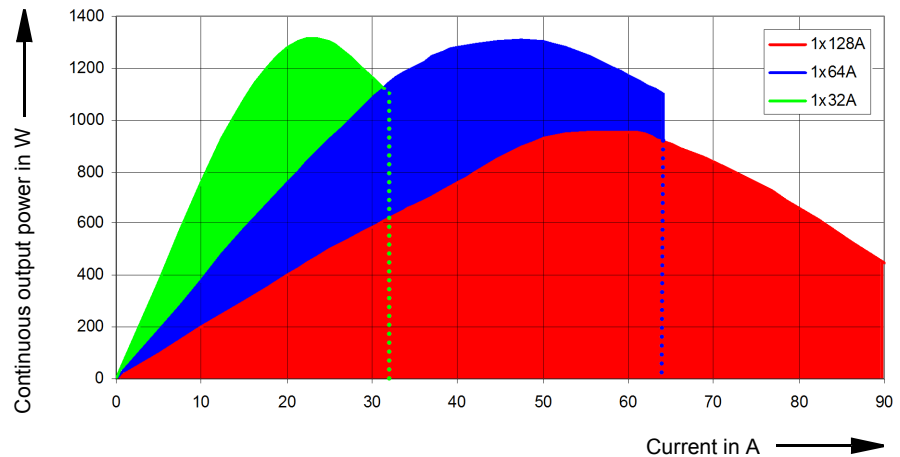
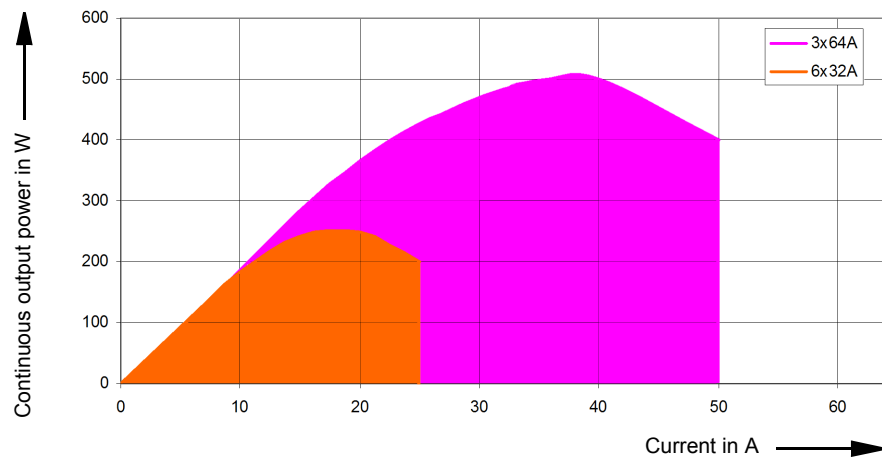


Figure 6-6:
Typical continuous output
current and output power
at 23 °C;
three- and six-phase mode



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 (t_1 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

Footnotes:

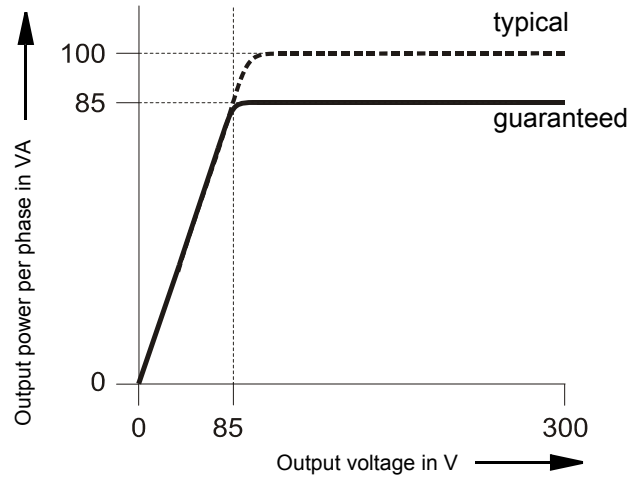
- 1.a) V_{L4} (t) automatically calculated:
 $V_{L4} = (V_{L1} + V_{L2} + V_{L3}) \cdot C$
 C: configurable constant from -4 to +4.
- b) V_{L4} as an amplified signal from "AMP. IN".
2. Guaranteed data for ohmic loads, (PF=1). Refer to the accompanying figure of the output power curves. → Chapter 6.3.3, "Operational Limits in Conjunction with a Weak Power Supply Voltage" on page 38.
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.

4 Voltage Outputs		
Output voltages		
3-phase AC (L-N)	3 x 0 ... 300 V	
4-phase AC (L-N) ¹	4 x 0 ... 300 V	
1-phase AC (L-N)	1 x 0 ... 300 V	
1-phase AC (L-L)	1 x 0 ... 600 V	
DC (L-N)	4 x 0 ... ± 300 V	
Output power ²	Typical	Guaranteed
3-phase AC ³	3 x 100 VA at 100 ... 300 V	3 x 85 VA at 85 ... 300 V
4-phase AC ⁴	4 x 75 VA at 100 ... 300 V	4 x 50 VA at 85 ... 300 V
1-phase AC (L-N)	1 x 200 VA at 100 ... 300 V	1 x 150 VA at 75 ... 300 V
1-phase AC (L-L)	1 x 275 VA at 200 ... 600 V	1 x 250 VA at 200 ... 600 V
DC (L-N)	1 x 420 W at 300 VDC	1 x 360 W at 300 VDC
Accuracy	Error < 0.06 % 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)	> 1 kHz	
Input to output propagation delay time	500 us (error < ± 2 us typ., ± 5 us guar.)	
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	

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 49.

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

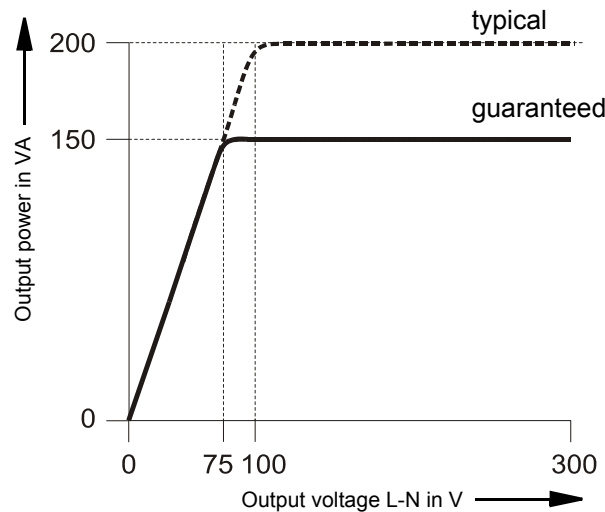
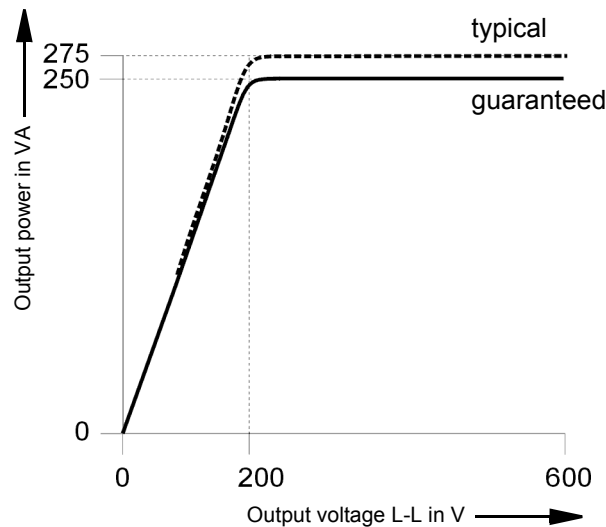


Figure 6-9:
Single-phase operation
L-L



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 ($115 \text{ V} \cdot \sqrt{3} = 200 \text{ V}$).

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 31 for more details).

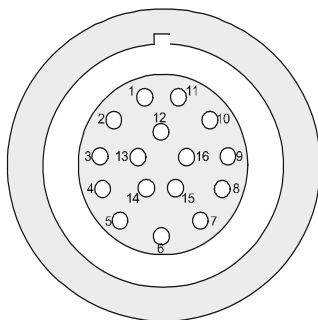
6.4 Low Level Inputs “AMP. IN”

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 <i>CMS 356</i>)
Insulation	Reinforced insulation to mains, voltage, and current outputs of <i>CMS 356</i>

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

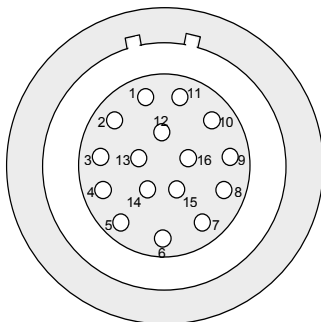


Pin	Function “AMP. IN”
1	LL in 1
2	LL in 2
3	LL in 3
4	Analog ground
5	LL in 4
6	LL in 5
7	LL in 6
8-16	For internal purposes
Housing	Screen connection

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

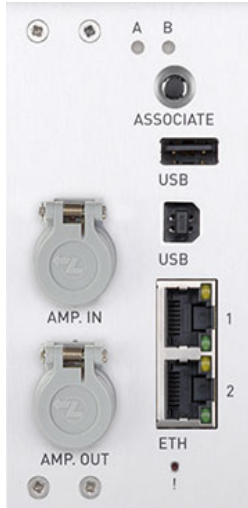
Socket ordering information	
Connector for one guide notch and pull relief (for “AMP. IN”)	FGG.2B.316.CLAD 72Z
Connector for two guide notches and pull relief (for “AMP. OUT”)	FGB.2B.316.CLAD 72Z
Black anti-bend cable cover	GMA.2B.070 DN

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

6.5 Technical Data of the Communication Ports

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

Table 6-11:



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 (for future use of USB peripherals)
	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 type A-B, 2 m/6 ft.
	ETH type	10/100/1000Base-TX ¹ (twisted pair, auto-MDI/MDIX or auto-crossover)
	ETH connector	RJ45
	ETH cable type	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.

- 10Base = 10 Mbit/s transfer rate
100Base = 100 Mbit/s transfer rate
1000Base = 1000 Mbit/s transfer rate
- Shielded LAN cable

6.6 Environmental Conditions

6.6.1 Climate

Table 6-12:
Climate

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

6.6.2 Shock and Vibration

Table 6-13:
Shock and vibration

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

6.7 Mechanical Data

Table 6-14:
Data regarding size and
weight

Size, Weight and Protection	
Weight	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

6.8 Acoustics – Noise Emission

Table 6-15:
Data regarding acoustics -
noise emission

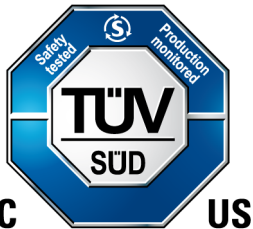
Acoustics – Noise Emission (At Operator's Position)	
Idle mode	47 dB(A)
Operating mode	50 dB(A)
Full load	55 dB(A)
Noise emission	Tested according to ISO 7779
Compliance	ETSI EN 300753 portable and non-stationary equipment working area < 4 m

6.9 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.

6.10 Safety Standards, Electromagnetic Compatibility (EMC) and Certificates

Table 6-16:
EMC compatibility and
certified safety standards

EMC	
Emission Europe International USA	EN 61326-1; EN 61000-6-4; EN 61000-3-2/3 IEC 61326-1; IEC 61000-6-4; IEC 61000-3-2/3 FCC Subpart B of Part 15 Class A
Immunity Europe International	EN 61326-1; EN 61000-6-2; EN 61000-4-2/3/4/5/6/8/11/16/18 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	

6.11 Compliance Statements

6.11.1 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 2014/30/EU, the low voltage Directive 2014/35/EU and the RoHS Directive 2011/65/EU.

6.11.2 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.

The use of shielded I/O cables is required when connecting this equipment to any optional peripheral or host devices. Failure to do so may violate FCC and ICES rules.

6.11.3 Declaration of Compliance (Canada)

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

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

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**.

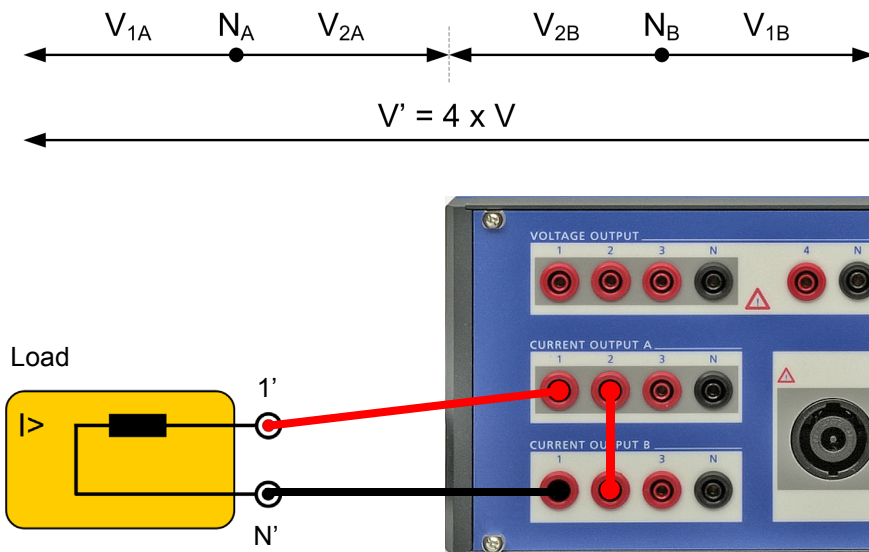
7.1 Single-Phase Operation of CMS 356

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

1 x 0 ... 32 A ($\pm 45 A_{DC}$), 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 31.



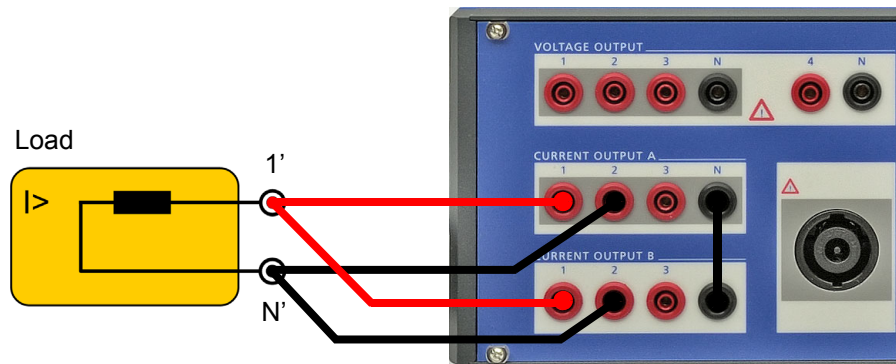
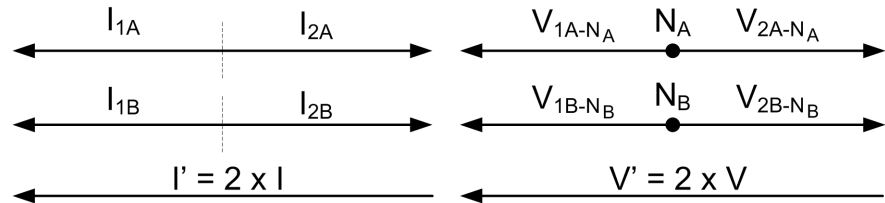
Warning: For currents greater than 32 A, do not connect the test object (the load) to the generator combination socket! Connect the test object to the 4 mm/0.16 " banana sockets, only!

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

1 x 0 ... 64 A ($\pm 90 A_{DC}$), 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 31.



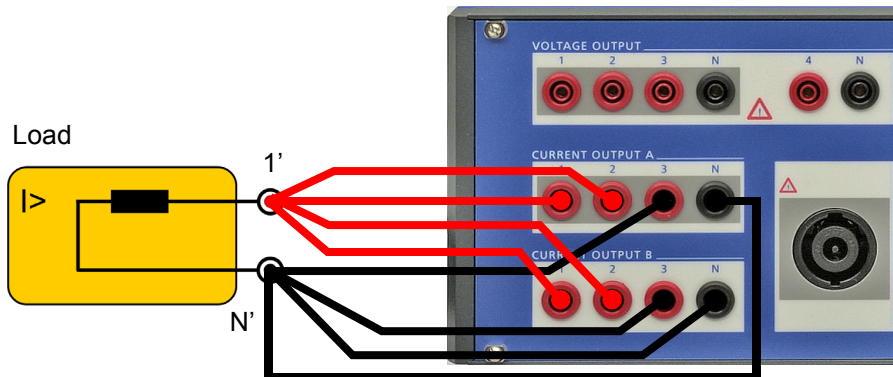
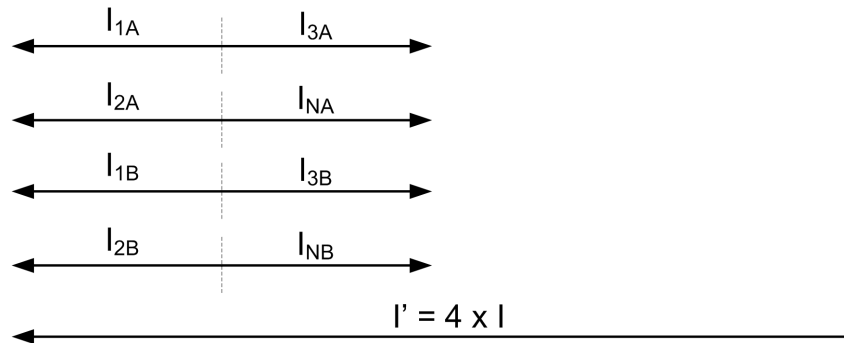
Warning: For currents greater than 32 A, do not connect the test object (the load) to the generator combination socket! Connect the test object to the 4 mm/0.16 " banana sockets, only!

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 31.

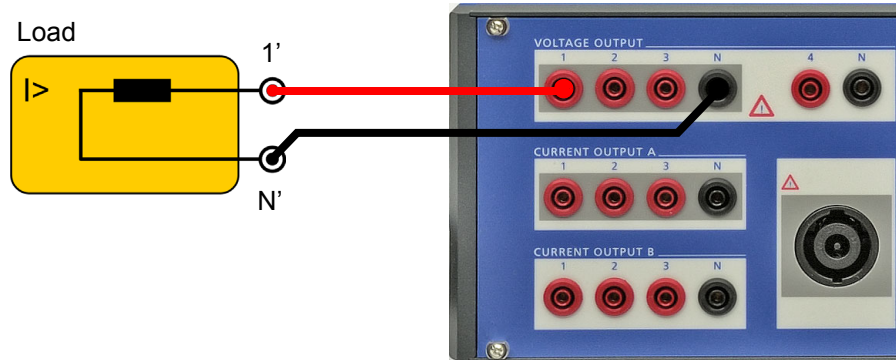


Warning: For currents greater than 32 A, do not connect the test object (the load) to the generator combination socket! Connect the test object to the 4 mm/0.16 " banana sockets, only!

7.1.4 Single-Phase Voltage

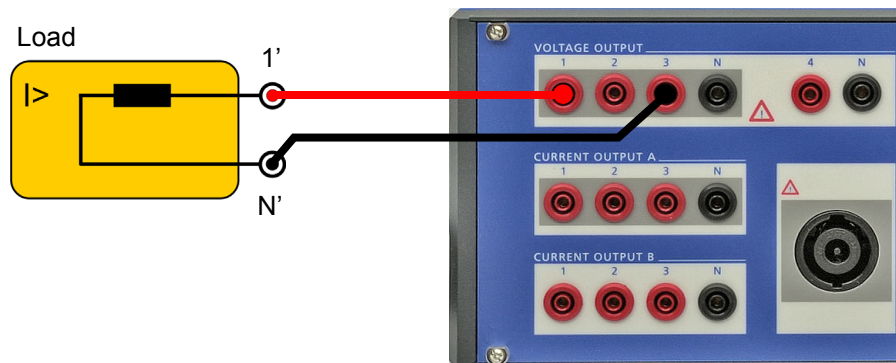
1 x 0 ... 300 V, 1 x 200 VA [100 ... 300 V] typical

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 36.



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

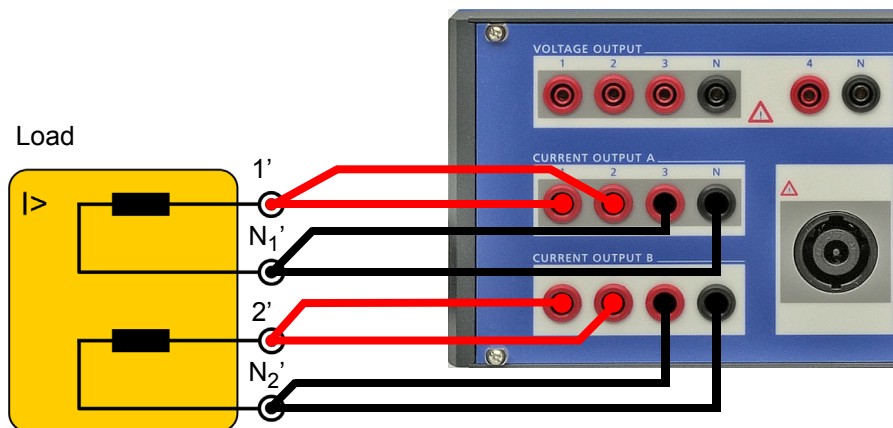
For some applications it is beneficial to have two independent currents, each higher than 32 A_{rms}, or a higher compliance voltage available.

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



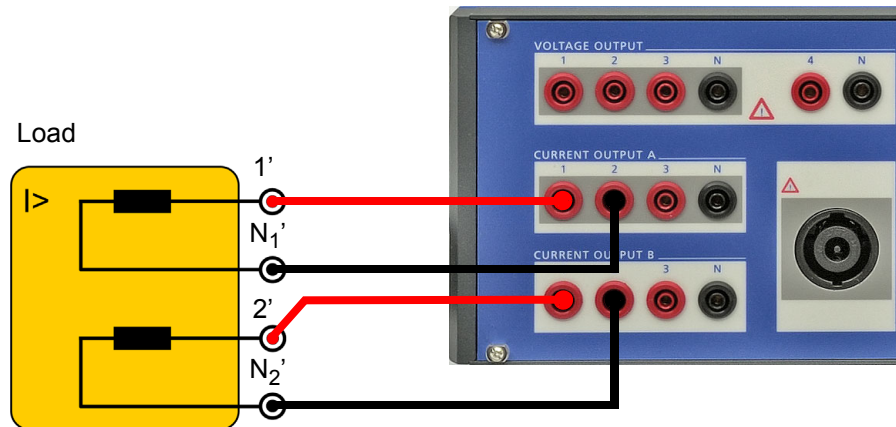
Warning: For currents greater than 32 A, do not connect the test object (the load) to the generator combination socket! Connect the test object to the 4 mm/0.16 " banana sockets, only!

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

$2 \times 0 \dots 32 \text{ A}$ ($\pm 45 \text{ A}_{\text{DC}}$), max. $70 \text{ V}_{\text{peak}}$, $2 \times 870 \text{ VA}$ 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



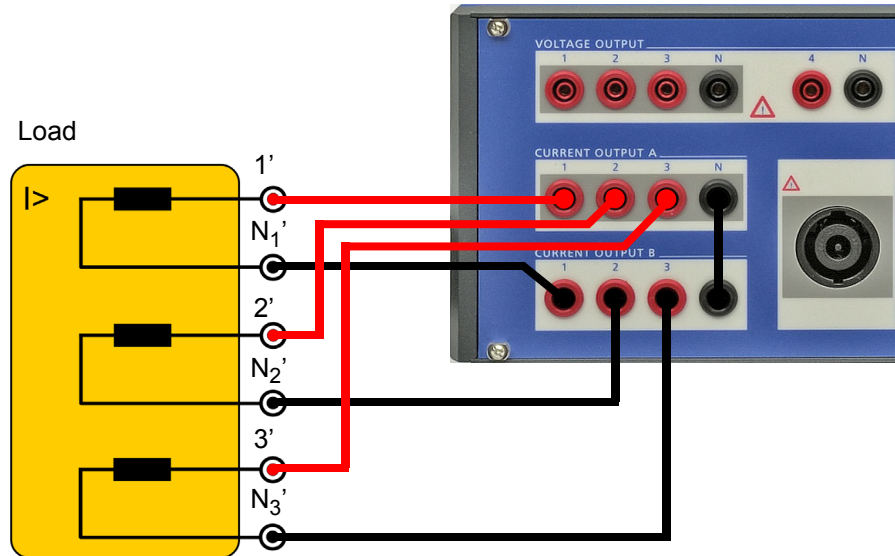
Warning: For currents greater than 32 A , do not connect the test object (the load) to the generator combination socket! Connect the test object to the $4 \text{ mm}/0.16 \text{ ''}$ banana sockets, only!

7.3 Three-Phase Current Mode with High Burden

$3 \times 0 \dots 32 \text{ A}$ ($\pm 45 \text{ A}_{\text{DC}}$), max. $70 \text{ V}_{\text{peak}}$, $3 \times 860 \text{ VA}$ 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 $4 \text{ mm}/0.16 \text{ "}$ 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*)



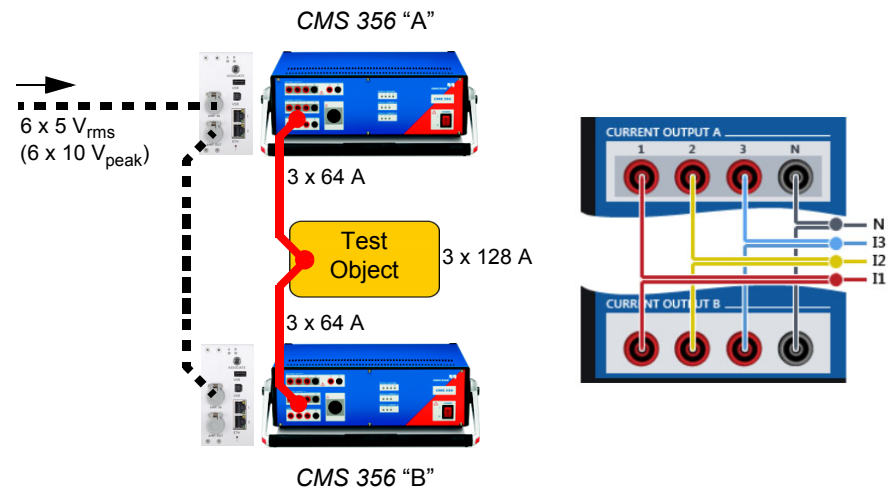
Caution While Paralleling Current Outputs of CMS 356

- 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:
 $\pm 7.071 V_{\text{peak}}$ ($5 V_{\text{rms}}$) or $\pm 10 V_{\text{peak}}$ ($7.071 V_{\text{rms}}$).
 - 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 $> 45 A_{\text{peak}}$ ($32 A_{\text{rms}}$).
- 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 23.

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 57).

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

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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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