

CIBANO 500 PTM

User 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 and are subject to change without prior notice.

We have done our best to ensure that the information given in this manual is useful, accurate and entirely reliable. However, OMICRON does not assume responsibility for any inaccuracies which may be present.

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

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

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About this manual

This User Manual provides information on how to use the *CIBANO 500* test system safely, properly and efficiently. The CIBANO 500 PTM User Manual contains important safety instructions for working with *CIBANO 500* and gets you familiar with operating *CIBANO 500*. Following the instructions in this User Manual will help you to prevent danger, repair costs, and avoid possible down time due to incorrect operation.

The CIBANO 500 PTM User Manual always has to be available on the site where *CIBANO 500* is used. The users of *CIBANO 500* must read this manual before operating *CIBANO 500* and observe the safety, installation, and operation instructions therein.

Reading the CIBANO 500 PTM User Manual alone does not release you from the duty to comply with all national and international safety regulations relevant to working on high-voltage equipment.

Safety symbols used

In this manual, the following symbols indicate safety instructions for avoiding hazards.



DANGER

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



WARNING

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



CAUTION

Minor or moderate injury may occur if the appropriate safety instructions are not observed.

NOTICE

Equipment damage or loss of data possible

1 Safety instructions

1.1 Operator qualifications

Working on high-voltage assets can be extremely dangerous. Only authorized personnel who are qualified, skilled and regularly trained in electrical engineering are allowed to operate *CIBANO 500* and its accessories. Before starting to work, clearly establish the responsibilities.

Personnel receiving training, instructions, directions, or education on *CIBANO 500* must be under constant supervision of an experienced operator while working with the equipment. The supervising operator must be familiar with the equipment and the regulations on site. The operator is responsible for the safety requirements during the whole test.

Maintenance and repair of *CIBANO 500* and its accessories is only permitted by qualified experts at OMICRON service centers except for hardware update options delivered with the relevant Supplementary Sheet.

1.2 Safety standards and rules

1.2.1 Safety standards

Testing with *CIBANO 500* must comply with the internal safety instructions and additional safety-relevant documents.

In addition, observe the following safety standards, if applicable:

- EN 50191 (VDE 0104) "Erection and Operation of Electrical Test Equipment"
- EN 50110-1 (VDE 0105 Part 100) "Operation of Electrical Installations"
- IEEE 510 "IEEE Recommended Practices for Safety in High-Voltage and High-Power Testing"

Moreover, observe all applicable regulations for accident prevention in the country and at the site of operation.

Before operating *CIBANO 500* and its accessories, read the safety instructions in this User Manual carefully.

Do not turn on *CIBANO 500* and do not operate *CIBANO 500* without understanding the safety information in this manual. If you do not understand some safety instructions, contact OMICRON before proceeding.

Maintenance and repair of *CIBANO 500* and its accessories is only permitted by qualified experts at OMICRON service centers (see "Support" on page 353).

1.2.2 Safety rules

Always observe the five safety rules:

- ▶ Disconnect completely.
- ▶ Secure against re-connection.
- ▶ Verify that the installation is dead.
- ▶ Carry out grounding and short-circuiting.
- ▶ Provide protection against adjacent live parts.

1.2.3 Safety accessories

OMICRON offers a range of accessories for added safety during the operation of our test systems. For further information and specifications, refer to the corresponding Supplementary Sheet or contact OMICRON Support.

1.3 Grounding

Operating the device without PE and ground connection is life-threatening and not permitted.

- ▶ Only operate *CIBANO 500* with a mains power supply connected to protective earth (PE).
- ▶ Make sure that both the PE connection of the power supply and the ground connector of *CIBANO 500* have a solid and low-impedance connection to the grounding system on site. This also applies to all other test devices and accessories in the test setup.
- ▶ Make sure that the grounding clamp has a good electrical contact to the grounding system on site and avoid connecting it to corroded or painted surfaces.
- ▶ Make sure that the grounding terminal connections of all grounded devices in use remain intact during the whole measurement procedure, and are not accidentally disconnected.
- ▶ Only use ground and supply cables provided by OMICRON.



Connect the *CIBANO 500* grounding terminal to the grounding system on site.

1.4 Power supply

Operating *CIBANO 500* without PE and ground connection is life-threatening and not permitted.

- ▶ Only operate *CIBANO 500* with a mains power supply connected to protective earth (PE).

Power supply from grounded grids (TN/TT)

Before a measurement is started, *CIBANO 500* automatically verifies the PE connection in grounded grids (TN/TT).

- ▶ If this check fails, check the power cord and power supply.

If the error message persists, there is no intact connection to protective earth (PE).

This is life-threatening. In this case measurements are not permitted and cannot be performed.

Power supply from isolated grids (IT)

An IT grid is a grid structure where none of the active conductors are galvanically connected to ground. In an IT grid, only the PE is connected to ground.

In IT grids the check fails – even if there is a PE connection. This can be the case when *CIBANO 500* is powered by a generator. Since every operation mandates a PE connection, you need to manually verify this.

If *CIBANO 500* is supplied by a generator, the equipotential ground or PE of the generator has to be grounded properly.

- ▶ If this is not possible, measurements are not permitted and cannot be performed.

Additional information

Instead of supplying *CIBANO 500* from phase-neutral (L1-N, A-N), it may also be supplied from phase-phase (for example, L1-L2; A-B).

- ▶ Make sure that the voltage does not exceed 240V AC.
- ▶ Make sure that the power supply is fuse-protected (16 A automatic circuit breaker).
- ▶ Do not use an extension cable on a cable reel to prevent an overheating of the cord; run out the extension cord.
- ▶ Keep extension cables as short as possible to prevent power loss.

1.5 Operation

When operating the *CIBANO 500* test system and its accessories, observe the following safety instructions.

1.5.1 Test equipment integrity

- ▶ Do not modify, extend, or adapt *CIBANO 500* and its accessories.
- ▶ Use only the *CIBANO 500* original accessories and cables and only use the OMICRON accessories together with OMICRON devices as described in this manual.
- ▶ Operate *CIBANO 500* and its accessories only under ambient conditions specified in "Technical data" in the *CIBANO 500* User Manual.

1.5.2 *CIBANO 500*

- ▶ Use only adequately rated power cords.
- ▶ Supply *CIBANO 500* only from a power outlet with protective earth (PE).
- ▶ To run *CIBANO 500* at the maximum power level, we recommend mains overcurrent protection with a 16 A automatic circuit breaker.
- ▶ Position the measurement setup so that you can easily disconnect *CIBANO 500* from mains.
- ▶ Do not use extension cables on a cable reel to prevent overheating of the cord. Instead, run out the extension cord.
- ▶ Do not operate *CIBANO 500* without a solid connection to ground of at least 6 mm² cross-section. Ground *CIBANO 500* as close as possible to the operator.

- ▶ The voltage/current indicator on the side panel of *CIBANO 500* (see 3.2.2 "Side panel" on page 18) indicates dangerous voltage on one of the *CIBANO 500* sockets, either from an internal source or from an external one, for example, from the station battery.
- ▶ After booting *CIBANO 500* either the red or the green status light on the front panel should be on. If after booting both status lights are on or off, *CIBANO 500* might be defective. In this case, do not use *CIBANO 500* and contact your regional OMICRON service center.
- ▶ Do not operate *CIBANO 500* and its accessories in the presence of explosives, dangerous gases or vapors.
- ▶ Use *CIBANO 500* and its accessories only in a technically sound condition.
- ▶ Make sure the use of *CIBANO 500* is in accordance with the regulations on site and the designated use described in this document.
- ▶ Comply with the workflows described in this document. Avoid interruptions or distractions that could affect safety.
- ▶ If *CIBANO 500* or its accessories do not seem to function properly, stop using them and contact your regional OMICRON service center.

1.5.3 Obey the work area

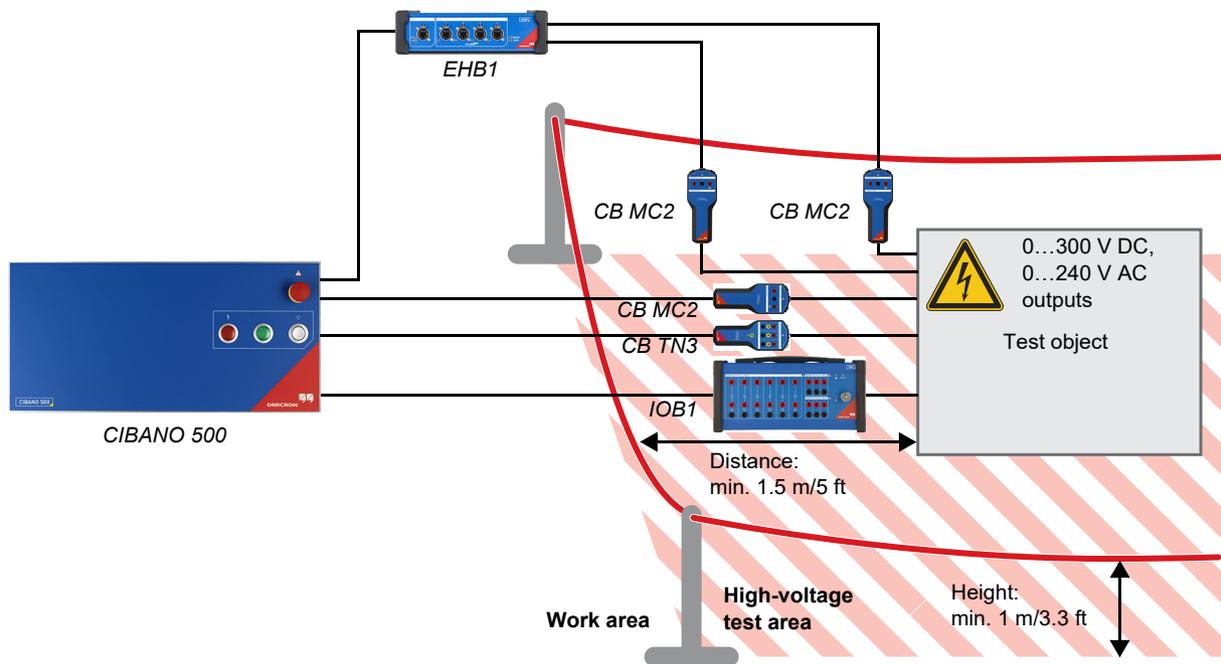


Figure 1-1: Example of the separation of the work and high-voltage test areas

- ▶ Always stay in the work area during test.
- ▶ Prior operation make sure that the test equipment is not mounted within the motion path of the circuit breaker. If needed, perform an operation prior mounting of test equipment (for example, motion sensors).
- ▶ For defining the appropriate high-voltage test area, consider any potential falling equipment (for example, the *CB MC2* modules or clamps) as well as wrong connected motion equipment.
- ▶ Position the test equipment on dry and solid surface.

1.5.4 De-energize the switchgear

- ▶ Identify your test object and make sure that you are using the corresponding wiring diagram.
- ▶ Disable any charging mechanism (for example, the motor).
- ▶ Ensure that the control circuit of the circuit breaker is de-energized (for example, the spring is discharged).
- ▶ Make sure that the circuit breaker cannot be tripped or closed remotely and locally (for example, use manual controls or distance orders).
- ▶ If you have to make connections to the auxiliary circuit (for example, to the trip or close coils):
 - ▶ Switch off or disconnect the test object from the station supply.
 - ▶ Apply the five safety rules.
 - ▶ Use terminal adapters to connect the test leads.
 - ▶ Only if required for testing, turn the supply back on.

1.5.5 Measurement setup

- ▶ Only use test leads and tools which provide full protection against direct contact.
- ▶ Make sure that grounding is applied as described in 1.3 "Grounding" on page 10.
- ▶ Connect the test leads of communication cables first to the grounded device before unreeling.
- ▶ Keep the unreeled cables close to the ground.
- ▶ Always insert connectors completely and use the interlock mechanism.
- ▶ Press the **Emergency Stop** button on the *CIBANO 500* front panel while connecting the test leads to the test object.
- ▶ Always insert connectors completely and use the interlock mechanism.
- ▶ Do not insert objects (for example, screwdrivers) into any input/output socket.

1.5.6 Perform tests

- ▶ Stay in the work area during test.
- ▶ Make sure that nobody is within the high-voltage test area.
- ▶ Warn people prior any operation to make them aware of any possible disturbances.

1.6 Orderly measures

The *CIBANO 500* PTM User Manual or alternatively the e-book has always to be available on the site where *CIBANO 500* is operated.

The users of *CIBANO 500* must read this manual before operating *CIBANO 500* and observe the safety, installation, and operation instructions therein.

CIBANO 500 and its accessories may only be used in accordance with the user documentation (including but not limited to User Manuals, Reference Manuals, Getting Started manuals and manufacturer manuals). The manufacturer and the distributor are not liable for damage resulting from improper usage.

Opening *CIBANO 500* or its accessories without authorization invalidates all warranty claims. Any kind of maintenance, calibration or repair on the device itself may only be carried out by persons authorized by OMICRON.

1.7 Disclaimer

If the equipment is used in a manner not described in the user documentation, the protection provided by the equipment may be impaired.

1.8 Compliance statement

Declaration of conformity (EU)

The equipment adheres to the guidelines of the council of the European Community for meeting the requirements of the member states regarding the electromagnetic compatibility (EMC) directive, the low voltage directive (LVD) and the RoHS directive.

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.

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.

1.9 Recycling



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

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

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

For customers outside the European Economic Area

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

2 System requirements

Table 2-1: *Primary Test Manager* system requirements

Characteristic	Requirement (*recommended)
Operating system	Windows 10 64-bit
CPU	Multicore system with 2 GHz or faster* , single-core system with 2 GHz or faster
RAM	min. 4 GB (8 GB*)
Hard disk	min. 5 GB of available space
Storage device	DVD-ROM drive
Graphics adapter	Super VGA (1280×768) or higher-resolution video adapter and monitor ¹
Interface	Ethernet NIC ² , USB 2.0 ³
Installed software ⁴	Microsoft 365* , Office 2019, Office 2016, Office 2013

1. We recommend graphics adapter supporting Microsoft DirectX 9.0 or later.
2. For testing with *TESTRANO 600*, *CPC 100* and *CIBANO 500*. NIC = Network Interface Card. *TESTRANO 600*, *CPC 100* and *CIBANO 500* can be connected with RJ-45 connectors either directly to the computer or to the local network, for example, by using an Ethernet hub.
3. For testing with *FRANEO 800*
4. Installed software required for the optional Microsoft Office interface functions

3 Introduction

3.1 Designated use

CIBANO 500, in conjunction with its accessories or as stand-alone unit, is a test system for commissioning and maintenance of circuit breakers. The following tests can be performed using *CIBANO 500* according to IEC and ANSI standards:

- Main contact resistance measurement ($\mu\Omega$ meter)
- Minimum pick-up voltage measurement of trip and close coils
- Motor current and voltage
- Main and resistive contact timing measurement
- Sending trip and close commands to perform different operations:
 - Open (O)
 - Close (C)
 - Reclose (OC)
 - Trip-free (CO)
 - Autoreclose (O-CO)
 - CO-CO
 - O-CO-CO
- Main contact dynamic resistance measurement enabling users to perform the operations listed earlier in this section
- Along with timing and dynamic resistance measurements, the following measurements can be included:
 - Trip and close coil current and voltage
 - Test of under voltage trip function
 - Main contact travel

CIBANO 500 operates only when connected to an external computer through an Ethernet connection. By using the *Primary Test Manager* software, you can define, parametrize, and execute various, partly automated tests.

3.2 Connections and operating controls

CIBANO 500 is available with two interface modules:

- EtherCAT^{®1} module providing 4×EtherCAT[®] interfaces
- Auxiliary module providing 1×EtherCAT[®], 3×AUX interfaces

The following figures describe the connections and operating controls of *CIBANO 500*.

1. EtherCAT[®] is registered trademark and patented technology, licensed by Beckhoff Automation GmbH, Germany.

3.2.1 Front panel

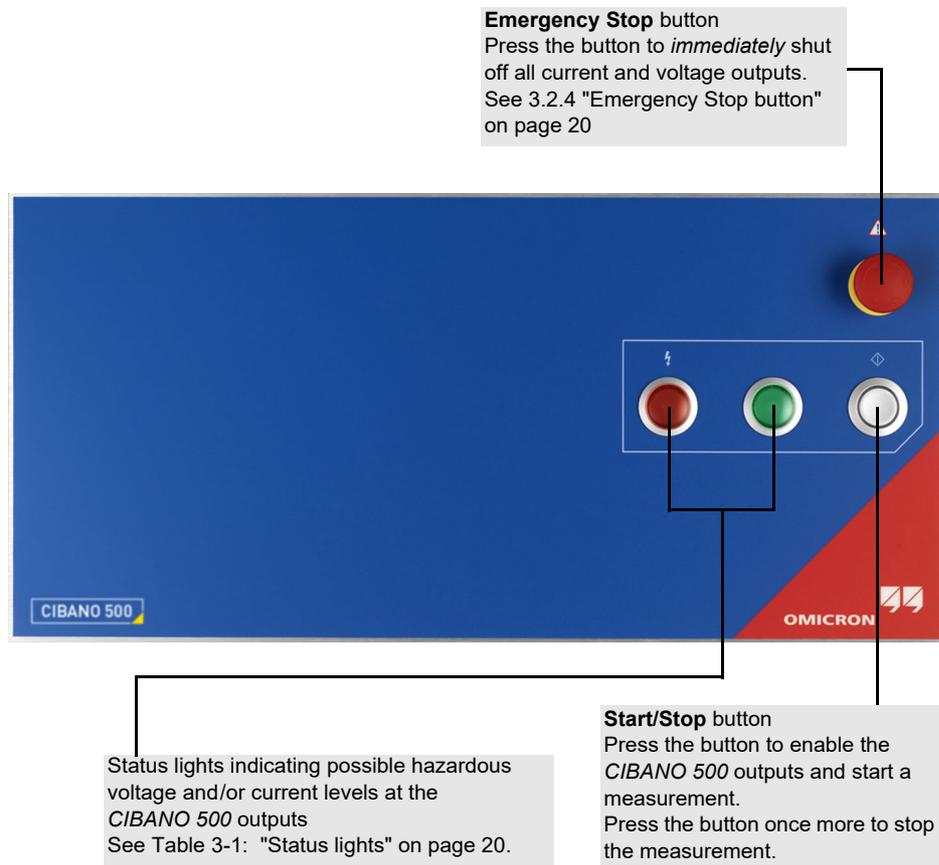


Figure 3-1: Front view of CIBANO 500

⚠ WARNING

Death or severe injury caused by high voltage or current possible

- ▶ Do not cover the status lights (for example, with a computer) since the status lights indicate possible hazards.
- ▶ Always observe the status lights while working with CIBANO 500.

3.2.2 Side panel

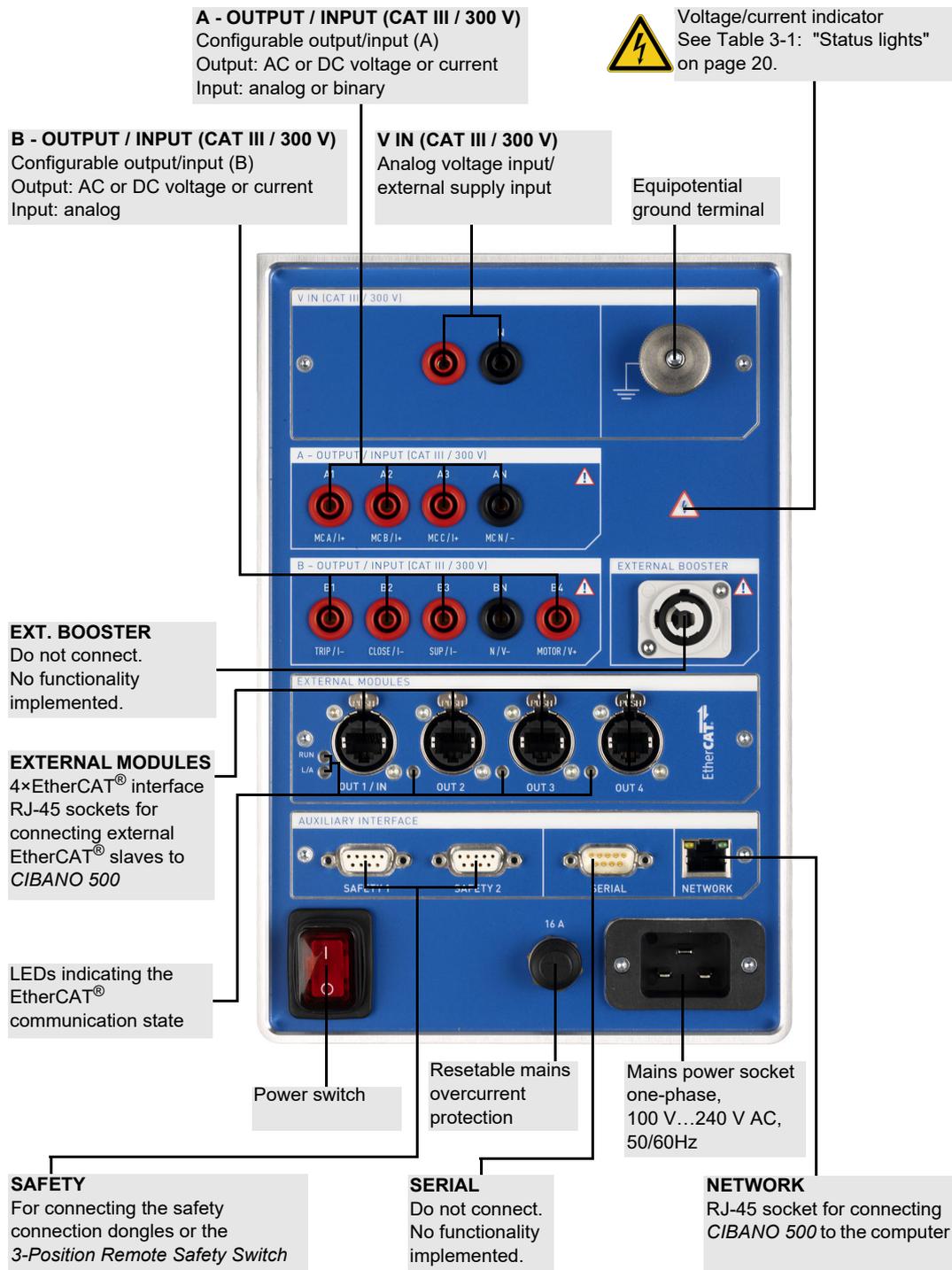


Figure 3-2: Side view of CIBANO 500 with the EtherCAT® module

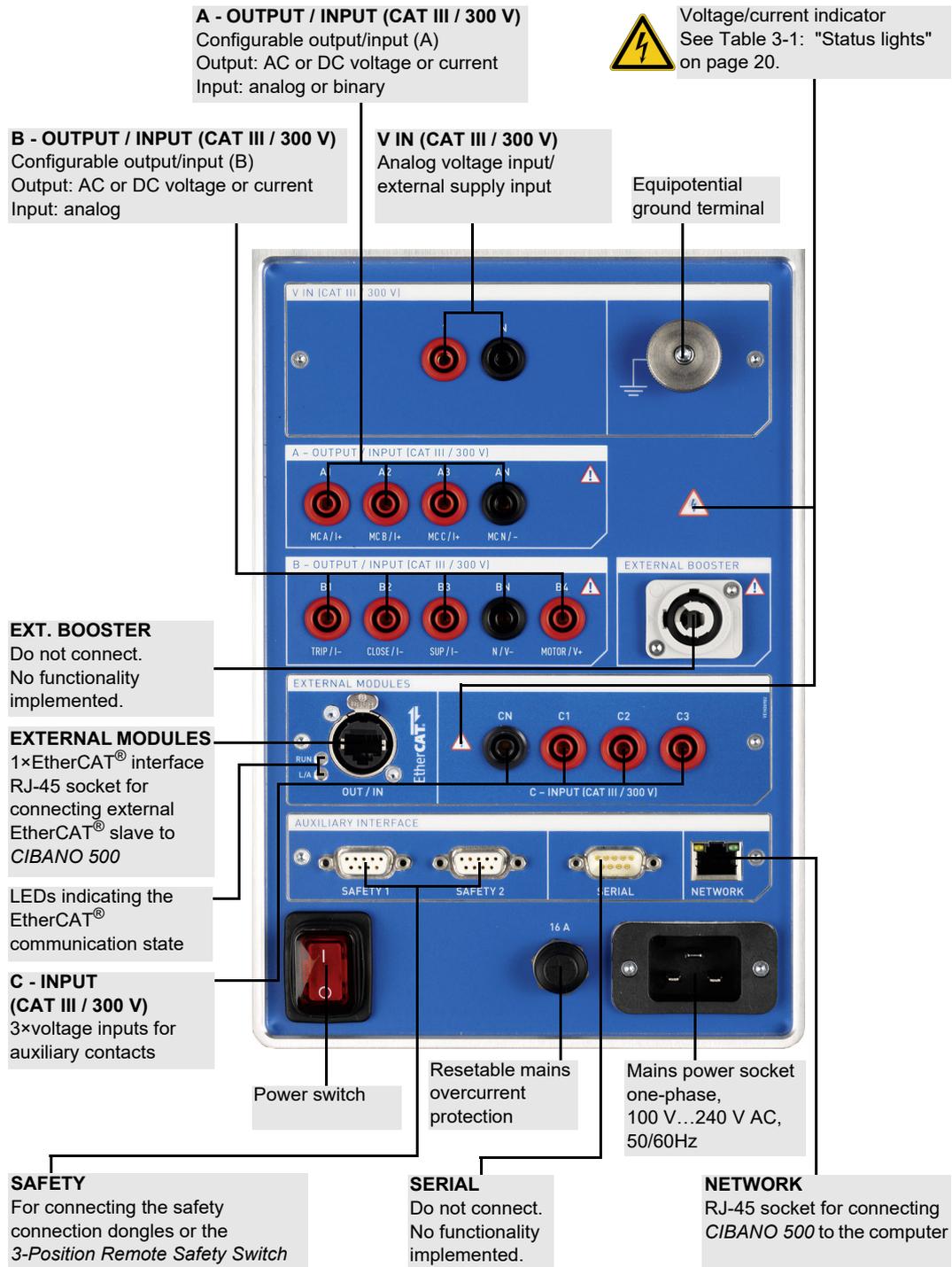


Figure 3-3: Side view of CIBANO 500 with the Auxiliary module

3.2.3 Status lights

CIBANO 500 provides the following status lights to indicate operating condition.

Table 3-1: Status lights

Status light	Description	CIBANO 500 state	Operating condition
	Green light on the front panel is on.	CIBANO 500 is up and running in the stand-by mode.	No voltage/current output from CIBANO 500. Obey the voltage/current indicator on the side panel for external hazardous voltage levels.
	Blue ring on the Start/Stop button is on.	A test is prepared and ready to start.	
	Blue ring on the Start/Stop button is flashing.	A test is starting. Possibly there are hazardous voltage and/or current levels at the CIBANO 500 outputs.	 Dangerous operating condition
	Red light on the front panel is flashing.	A test is running. Possibly there are hazardous voltage and/or current levels at the CIBANO 500 outputs.	 Dangerous operating condition
	Voltage/current indicator on the side panel is flashing.	There are hazardous voltage levels (> 42 V) at the CIBANO 500 inputs/outputs independent of the measurement state.	 Dangerous operating condition

3.2.4 Emergency Stop button

Pressing the **Emergency Stop** button *immediately* shuts off all CIBANO 500 outputs and stops the running measurement. After pressing the **Emergency Stop** button, *Primary Test Manager* does not allow starting a measurement.

To restart the measurement after the reason for the emergency stop has been resolved, release the **Emergency Stop** button by carefully turning it, click the **Start** button in *Primary Test Manager*, and then press the **Start/Stop** button.

For information about the CIBANO 500 accessories, see "Accessories" in the CIBANO 500 PTM User Manual.

3.3 Primary Test Manager

Primary Test Manager is a control software for testing high-voltage assets with OMICRON test systems. *Primary Test Manager* provides a computer interface to the test set and assists you with the hardware configuration and test assessment.

With *Primary Test Manager*, you can manage locations, assets, jobs and reports, create new jobs, open jobs, and perform tests. For a specified test, you can make measurements by just pressing the **Start/Stop** button on the front panel of the *CIBANO 500* test system. After you have performed a test, you can generate exhaustive test reports. *Primary Test Manager* runs on a computer and communicates with *CIBANO 500* through Ethernet interface.

For detailed information about *Primary Test Manager*, see the relevant chapters in the *CIBANO 500* PTM User Manual.

3.4 Cleaning



WARNING

Death or severe injury caused by high voltage or current possible

- ▶ Do not clean the *CIBANO 500* test set when connected to the test object.
- ▶ Before cleaning *CIBANO 500* and its accessories, always disconnect the test object, accessories and connection cables.

To clean *CIBANO 500* and its accessories, use a cloth dampened with isopropanol alcohol.

4 Functional scheme

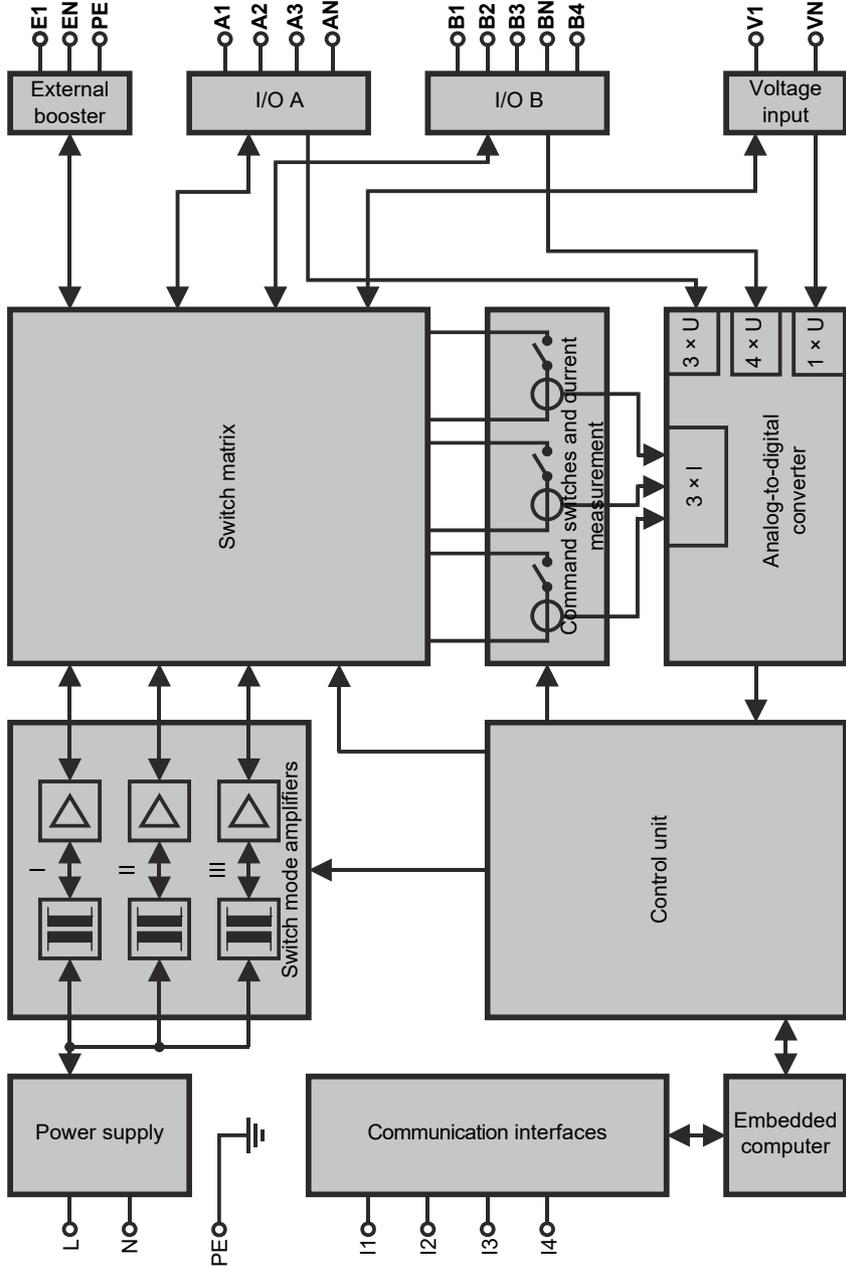


Figure 4-1: CIBANO 500 with the EtherCAT® module

The following table describes the terminals of the functional scheme of *CIBANO 500* with the EtherCAT® module.

Table 4-1: Terminals of *CIBANO 500* with the EtherCAT® module

Terminal	Description
Mains interface	
L	Mains phase
N	Mains neutral
PE	Equipotential ground
Communication interfaces	
I1	4 × external EtherCAT® modules
I2	1 × Ethernet
I3	1 × serial
I4	2 × safety
External booster	
E1	External booster phase
EN	External booster neutral
PE	Equipotential ground
I/O A	
A1	Input/output A1
A2	Input/output A2
A3	Input/output A3
AN	Input/output AN
I/O B	
B1	Input/output B1
B2	Input/output B2
B3	Input/output B3
BN	Input/output BN
B4	Input/output B4
Voltage input	
V1	Voltage input 1
VN	Voltage input N

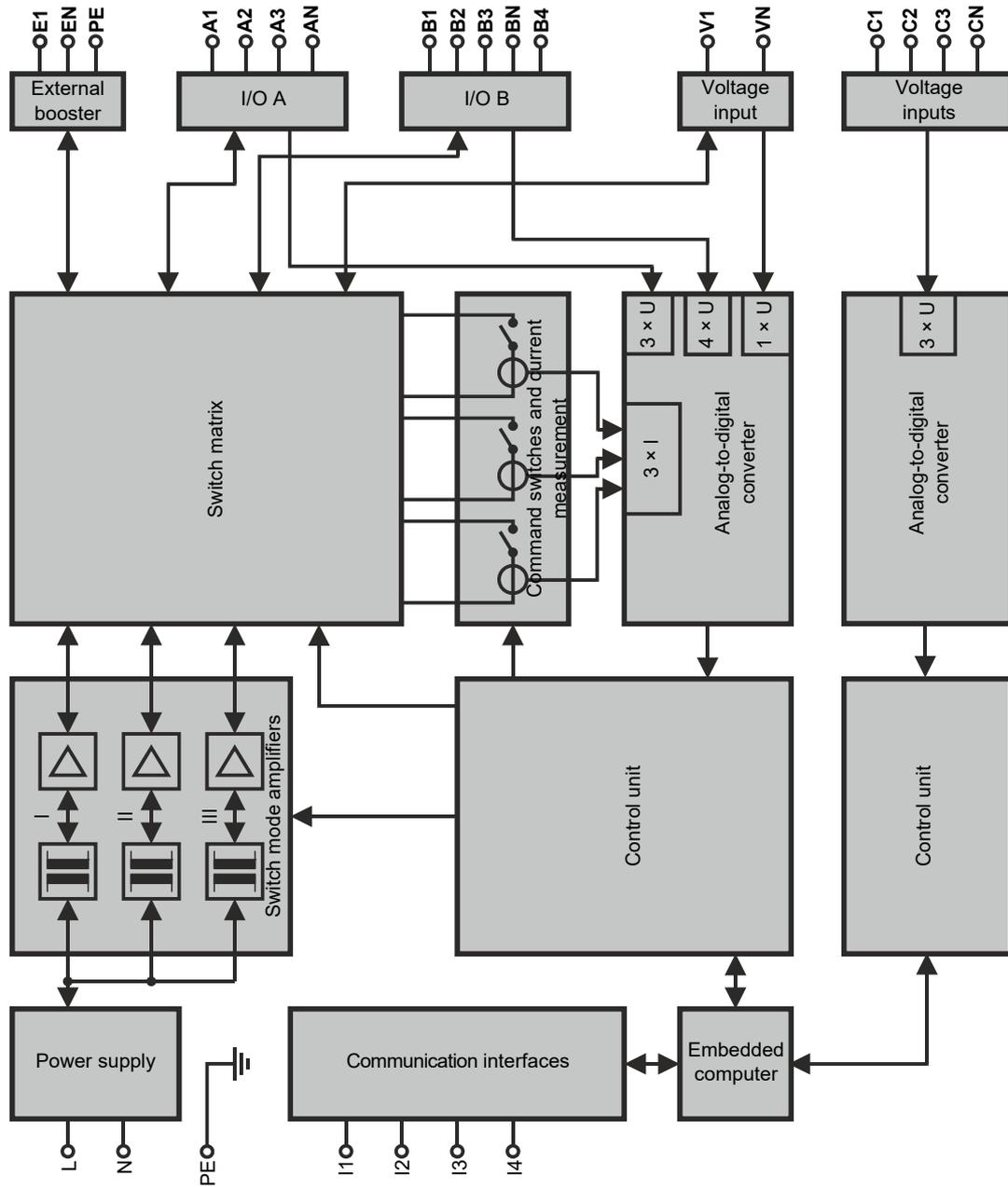


Figure 4-2: CIBANO 500 with the Auxiliary module

The following table describes the terminals of the functional scheme of *CIBANO 500* with the Auxiliary module.

Table 4-2: Terminals of *CIBANO 500* with the Auxiliary module

Terminal	Description
Mains interface	
L	Mains phase
N	Mains neutral
PE	Equipotential ground
Communication interfaces	
I1	1 × external EtherCAT® module
I2	1 × Ethernet
I3	1 × serial
I4	2 × safety
External booster	
E1	External booster phase
EN	External booster neutral
PE	Equipotential ground
I/O A	
A1	Input/output A1
A2	Input/output A2
A3	Input/output A3
AN	Input/output AN
I/O B	
B1	Input/output B1
B2	Input/output B2
B3	Input/output B3
BN	Input/output BN
B4	Input/output B4
Voltage inputs	
C1	Voltage input C1
C2	Voltage input C2
C3	Voltage input C3
CN	Voltage input CN
Voltage input	
V1	Voltage input 1
VN	Voltage input N

4.1 Voltage operating mode

The following figure explains the *CIBANO 500* voltage operating mode.

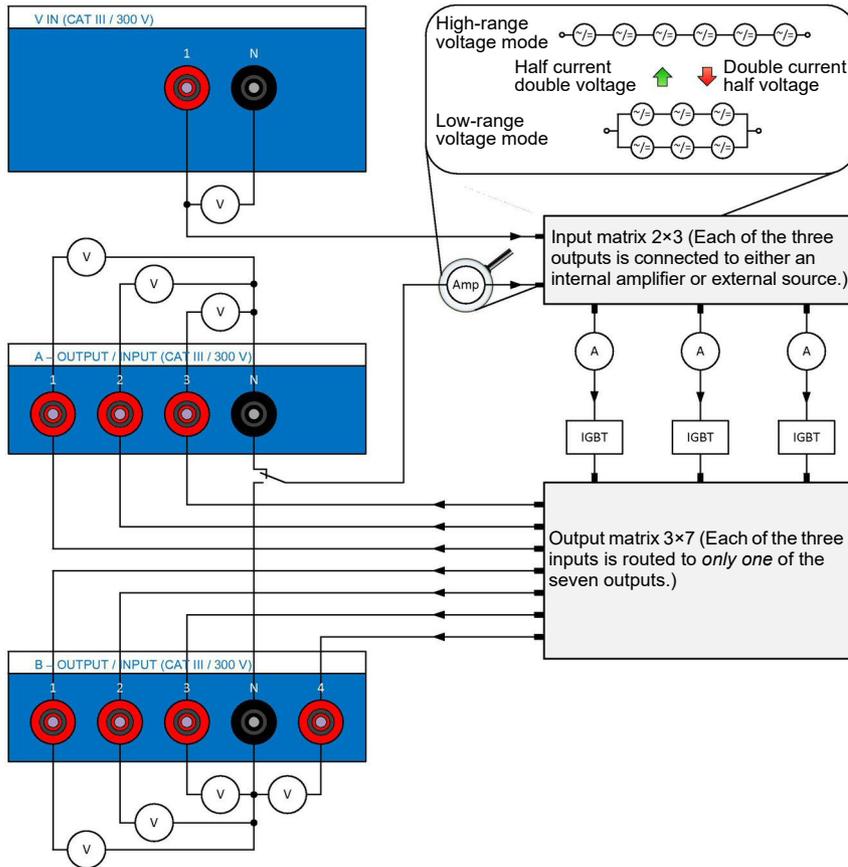


Figure 4-3: The *CIBANO 500* voltage operating mode

Figure 4-3: "The CIBANO 500 voltage operating mode" shows the switching of the internal amplifiers in the voltage operating mode. In this case seven channels are available: **A1...A3** and **B1...B4**. Three channels of these seven channels can be used synchronously but all either of the section **A** or the section **B**. You cannot use the outputs of both sections at the same time but only sequentially, one after each other.

The driving source of the channel can be either the internal amplifiers or an external source connected to the **V IN** input of *CIBANO 500*. Depending on the settings of the firmware the amplifier matrix in Figure 4-3 connects inputs of the IGBTs (integrated gate bipolar transistors) to either the internal amplifier or the external source. The socket matrix then routes the output of each of the three IGBTs to the seven channels on the *CIBANO 500* side panel. To apply a voltage to a socket the corresponding IGBT is closed.

Note: There is a certain voltage drop across the IGBTs which is not controlled by the source due to the design related issues of the device.

In comparison to the current operating mode (see 4.2 "Current operating mode" later in this chapter) in which you can select three individual amplifiers the voltage operating mode provides only one single amplifier composed of six amplifiers. Consequently, you cannot apply two different voltages at the same time but only sequentially. In the voltage operating mode, two modes are available: the high-range voltage mode and the low-range voltage mode. For the output data of the voltage operating mode, see 21.2 "CIBANO 500 specifications" on page 321.

The current measurement is performed in series to each IGBT. The voltage is measured for each output individually.

4.2 Current operating mode

The following figure explains the *CIBANO 500* current operating mode.

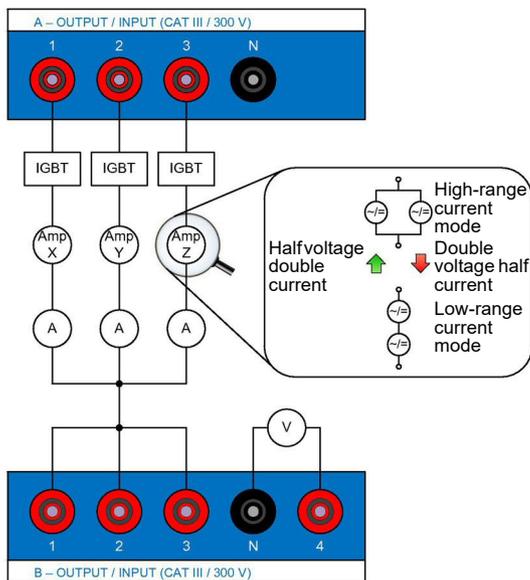


Figure 4-4: The *CIBANO 500* current operating mode

Figure 4-4: "The *CIBANO 500* current operating mode" shows the switching of the internal amplifiers in the current operating mode. In this case three independent current channels are available: **A1**, **A2** and **A3**. These channels are driven by the amplifiers Amp X, Amp Y and Amp Z. The sockets **B1**, **B2** and **B3** are connected to the same potential, in this case to the neutral potential of the channels **A1**, **A2** and **A3**.

In the current operating mode, two modes are available: the high-range current mode and the low-range current mode. Each channel is equipped with two amplifiers giving a total of six amplifiers which can either be switched in parallel (high-current mode) or in series (low-current mode). For the output data of the current operating mode, see 21.2 "CIBANO 500 specifications" on page 321.

5 Installation

This section describes how to put the *CIBANO 500* test system into operation. The *CIBANO 500* operation is controlled by the *Primary Test Manager* software. Consequently, before operating *CIBANO 500*, you must install *Primary Test Manager* and connect *CIBANO 500* to a computer.

5.1 Connect *CIBANO 500* to the computer

CIBANO 500 communicates with the computer through Ethernet interface. To connect *CIBANO 500* to the computer:

1. Connect the delivered Ethernet cable to the **NETWORK** socket on the *CIBANO 500* side panel.
2. Connect the other end of the Ethernet cable to the Ethernet connector of your computer.
3. Check whether the safety dongles shipped with *CIBANO 500* are plugged in and locked in the **SAFETY** connectors on the side panel (see 3.2.2 "Side panel" on page 18).

5.2 Power up *CIBANO 500*

To power up *CIBANO 500*:

1. Connect the equipotential ground terminal of *CIBANO 500* (see 3.2.2 "Side panel" on page 18) to ground as close as possible to the operator.
2. Plug the power cable into the power socket on the *CIBANO 500* side panel.
3. Plug the mains plug of the power cable into the power outlet.
4. Press the power switch on the *CIBANO 500* side panel.

5.3 Install *Primary Test Manager*

For the minimum requirements your computer needs to run *Primary Test Manager*, see 2 "System requirements" on page 15.

- ▶ To install *Primary Test Manager*, put the delivered *Primary Test Manager* DVD in the DVD drive of your computer and follow the instructions on the screen.

5.4 Start *Primary Test Manager* and connect to *CIBANO 500*

- ▶ To start *Primary Test Manager*, click the **Start** button on the taskbar, and then click **OMICRON Primary Test Manager**, or double-click the **Primary Test Manager** icon  on the desktop.

- To connect to *CIBANO 500*, select the device from the list, and then click **Connect**.

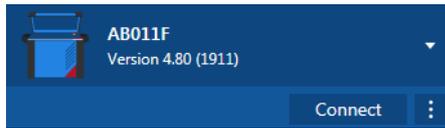


Figure 5-1: Connecting to *CIBANO 500*

If you could not connect to your *CIBANO 500* device and the green light is permanently on, wait a few seconds, and then proceed as follows:

1. Click **More** next to the **Connect** button, and then click **Refresh**.
2. Select the test system from the list, and then click **Connect**.

If the *CIBANO 500* device to which you want to connect is not displayed in the list of available devices, proceed as described in "Troubleshooting" in the *CIBANO 500 PTM User Manual*.

Alternatively, you can manage the connection to *CIBANO 500* in the *Primary Test Manager* status bar (see "Status bar" in the *CIBANO 500 PTM User Manual*).

There is embedded software and firmware in *CIBANO 500* and firmware in each of the *CB MC2*, *CB TN3* and *IOB1* modules. The embedded software upgrade requires a special procedure, all other upgrades can be done during normal operation.

5.4.1 Upgrade the *CIBANO 500* embedded software

The *CIBANO 500* embedded software must be compatible with *Primary Test Manager*. You can upgrade the *CIBANO 500* embedded software in the *Primary Test Manager* home view (see "Home view" in the *CIBANO 500 PTM User Manual*).

- To upgrade the *CIBANO 500* embedded software, select the device you want to upgrade from the list, and then click **Connect**. *Primary Test Manager* will prompt you to upgrade the *CIBANO 500* embedded software, if necessary.

Alternatively, you can proceed as follows:

1. In the home view, select the device you want to upgrade from the list.
2. Click **More** next to the **Connect** button, and then click **Update device software**.
3. In the **Select CIBANO upgrade image** dialog box, double-click the embeddedImage.tar file.

If you encounter problems when upgrading the *CIBANO 500* embedded software, proceed as described in "Troubleshooting" in the *CIBANO 500 PTM User Manual*.

5.4.2 Upgrade the *CIBANO 500* firmware

After upgrading the *CIBANO 500* embedded software, you might need to upgrade also the firmware of *CIBANO 500* or the firmware of the *CB MC2*, *CB TN3* and *IOB1* modules. If a firmware upgrade is necessary, the following notification bar appears after you selected a test.



Figure 5-2: Upgrading the firmware of *CIBANO 500* and connected external modules

- To upgrade the *CIBANO 500* firmware, click **Start firmware update**.

5.4.3 Open the device web interface

On the device website, you can upgrade the device embedded software, get log files, roll back software images, reboot the device and manage license files.

To open the device web interface:

1. In the home view, select the device from the list.
2. Click **More** next to the **Connect** button, and then click **Open device web interface**.
A website with the IP address of the device opens in the default web browser.

5.5 Connect CIBANO 500 to the test object

⚠ WARNING

Death or severe injury caused by high voltage or current possible

- ▶ Do not connect *CIBANO 500* to a test object before isolating the test object according to the five safety rules.
- ▶ Always obey the five safety rules (see 1.2.2 "Safety rules" on page 9) and all additional relevant laws and internal safety standards when connecting *CIBANO 500* to a test object.

You can connect *CIBANO 500* to the test object without disconnecting other parts of the station or with complete disconnection from the station as shown in the following figure.

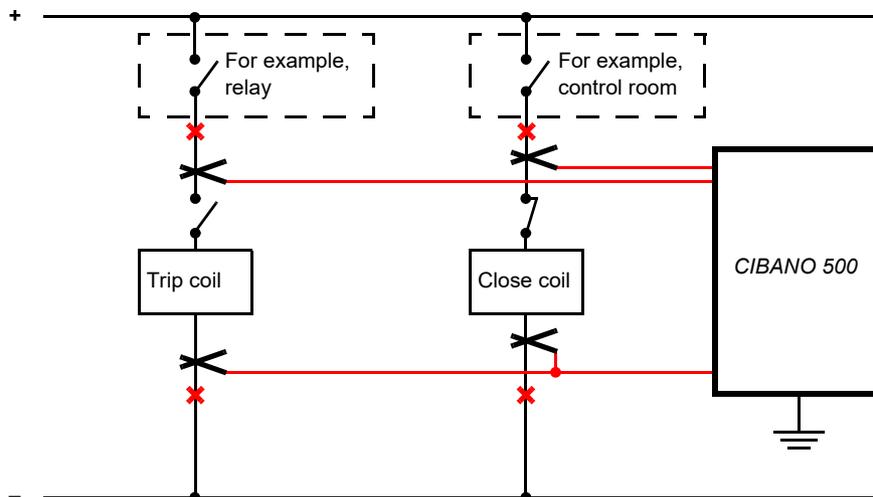


Figure 5-3: Principal connection of *CIBANO 500* to the test object

To connect *CIBANO 500* to the test object:

1. Connect the equipotential ground terminal of *CIBANO 500* (see 3.2.2 "Side panel" on page 18) to ground as close as possible to the operator.

2. Do one of the following:

- ▶ Assure that the points of connection carry no voltage. Voltage on the connection points can impact the safety of the operator but poses no danger to the test set. Clamp *CIBANO 500* to the circuit breaker's trip and close coils without disconnecting other parts of the station. The advantage of this method is that you do not need to modify the wiring of the circuit breaker to the station. The disadvantage is that it is difficult to ensure that there is no voltage on the points of connection. Connecting *CIBANO 500* while voltage is present on the connection point requires special safety precautions depending on the company and national standards and is explicitly not recommended by OMICRON.
- ▶ Disconnect the circuit breaker at the points marked by the red crosses completely from the substations. Then clamp *CIBANO 500* to the circuit breaker's trip and close coils. You can often do it easily on medium-voltage breakers by removing a single plug and therefore recommended for maximum safety.

The following figures show typical *CIBANO 500* measurement setups for testing medium-voltage and high-voltage circuit breakers. Depending on the *Primary Test Manager* settings, many other configurations are possible.

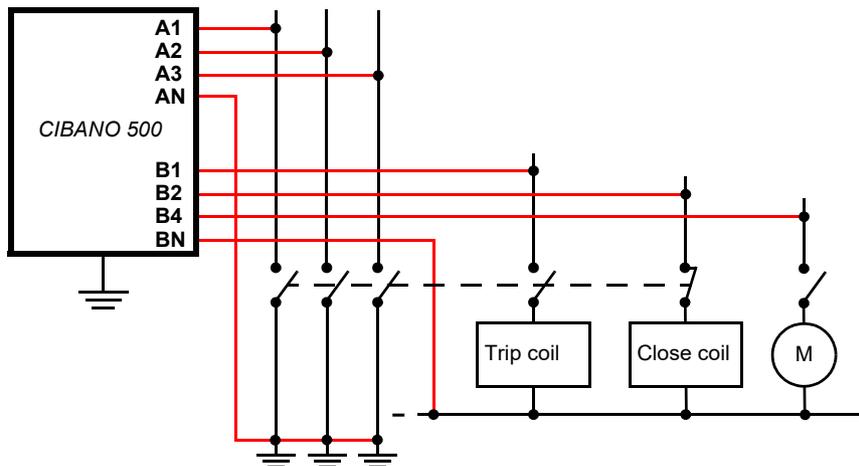


Figure 5-4: Typical measurement setup for the Timing test on medium-voltage circuit breakers with complete disconnection from the station

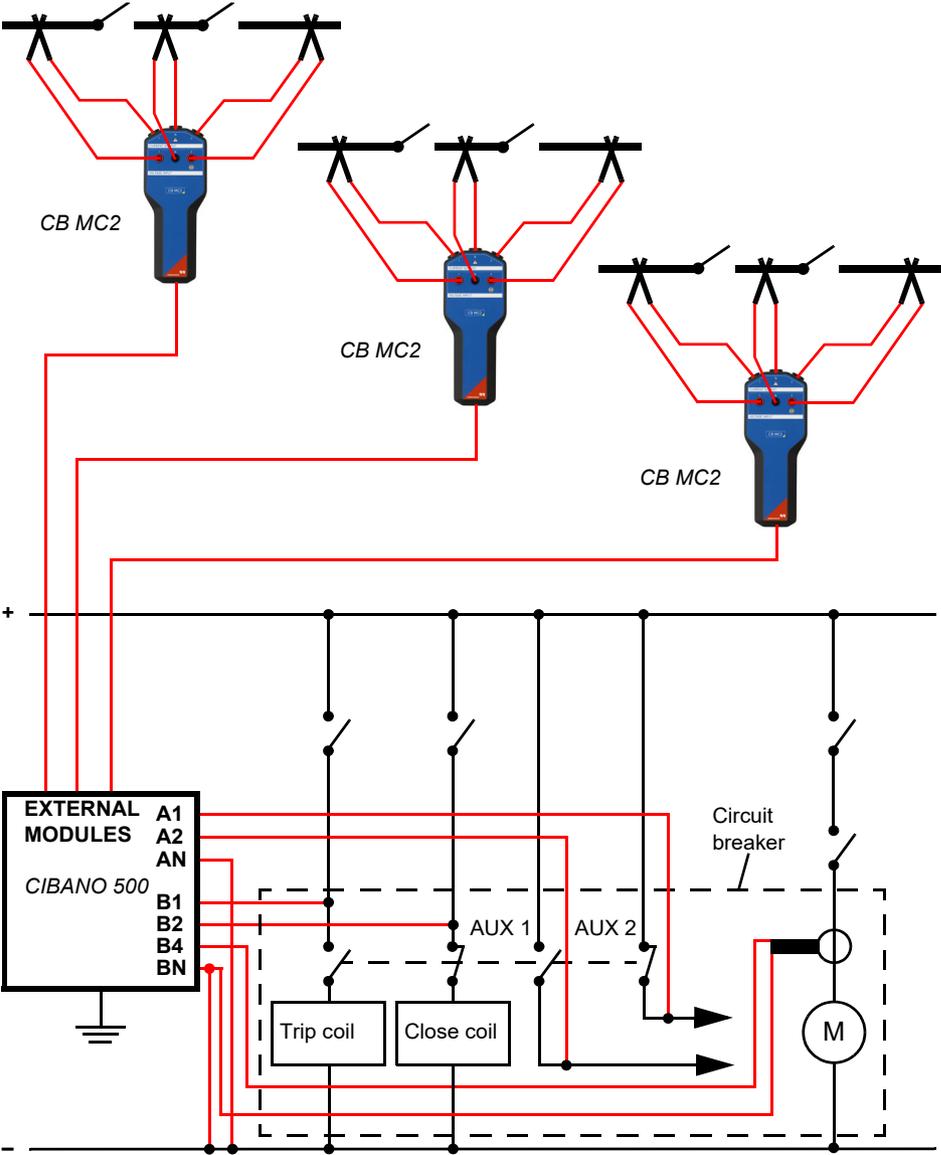


Figure 5-5: Typical measurement setup for testing high-voltage circuit breakers

6 Home view

After starting *Primary Test Manager*, the home view opens. In the home view, you can select different user tasks designed to support you during diagnostic testing and management of test objects and test data.

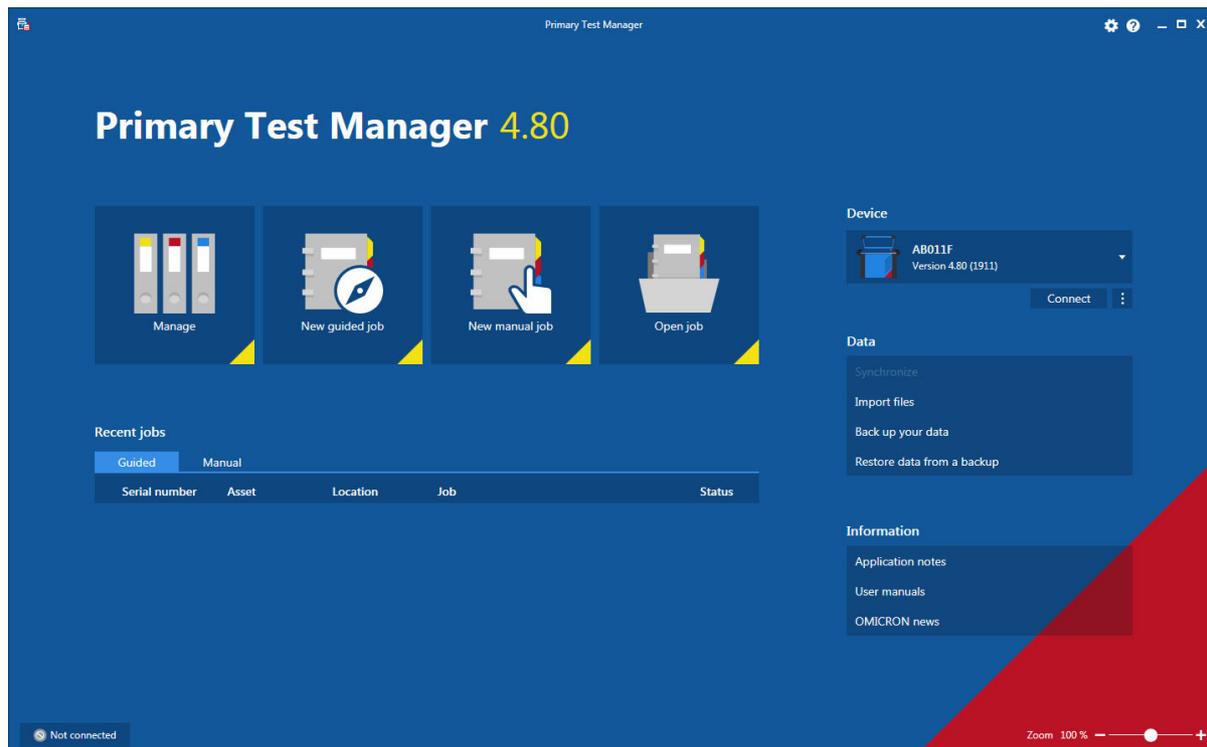


Figure 6-1: *Primary Test Manager* home view

Primary Test Manager processes data of different workflow importance. This is indicated by balloons of different categories as described in the following table.

Table 6-1: Data importance categories

Balloon	Category	Description
	Mandatory	Indicates data required for performing tests.
	Recommended	Indicates data supporting the <i>Primary Test Manager</i> workflow.
	Information	Contains descriptive information.

Primary Test Manager supports the following user tasks.

Table 6-2: Selecting the user tasks

Button	Description	Action
	Manage	Click to manage locations, assets, jobs, and reports (see 10 "Manage objects" on page 77).
	New guided job	Click to start the guided test workflow (see 7 "Create new guided jobs" on page 50).
	New manual job	Click to create a new manual job (see 8 "Create new manual jobs" on page 72).
	Open job	Click to open a job (see 9 "Open jobs" on page 76).

Table 6-3: User interface actions

User interface element	Action
Title bar	
Settings	Click to open the Settings dialog box (see 6.1 "Settings" later in this chapter).
Help	Click to get access to the relevant technical documentation and send data to OMICRON technical support (see 6.2 "Help" on page 41).
Send data to technical support	Click to send system information and your data to OMICRON technical support (see 6.3 "Send data to Technical Support" on page 42).
About	Click to open the About Primary Test Manager dialog box (see 6.4 "About" on page 43).
Device	
Connect/Disconnect	Click to manage connection to the test system (see 6.5 "Manage connection to the test system" on page 43).
Data	
Synchronize¹	Click to synchronize your local database with the <i>Primary Test Manager</i> server database (see 6.6 "Synchronize data" on page 44).
Import files	Click to import <i>Primary Test Manager</i> data (see 6.7 "Import data" on page 47).
Back up your data	Click to back up the <i>Primary Test Manager</i> database (see 6.8 "Back up and restore data" on page 47).
Restore data from a backup	Click to restore your data in the database (see 6.8 "Back up and restore data" on page 47).
Information	
Click a list item to get information about your test system and its application.	
Recent guided jobs/Recent manual jobs	
Click a list item to open a recently created guided or manual job.	
Status bar	
In the status bar, you can connect to and disconnect from a test system and view the test set information (see 6.9 "Status bar" on page 48).	

1. Only enabled with the appropriate license.

6.1 Settings

In the **Settings** dialog box, you can make a number of *Primary Test Manager* settings to match your regional conventions, manage the job templates, and set the *Primary Test Manager* server settings for data synchronization (see 6.6 "Synchronize data" on page 44).

- ▶ To open the **Settings** dialog box, click **Settings** in the title bar.

NOTICE
Equipment damage or loss of data possible

Changing the settings in the **Settings** dialog box affects all data in *Primary Test Manager*.

- ▶ Only change settings if you are qualified to do so.
- ▶ Review your changes before clicking **OK**.

Note: After changing a setting, you must restart *Primary Test Manager* for the setting to take effect.

General

On the **General** tab, you can make the general settings of *Primary Test Manager*.

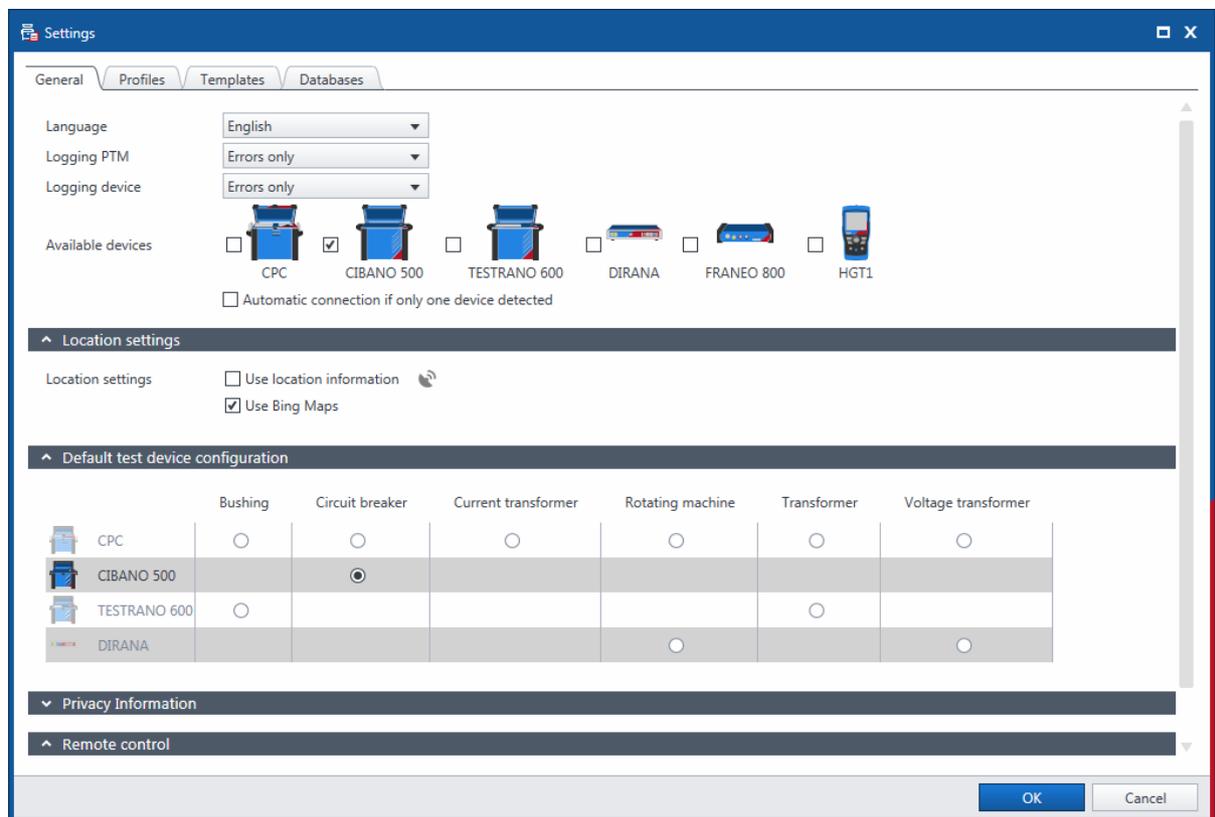


Figure 6-2: **General** tab

- ▶ To set the *Primary Test Manager* language, select your preferred language from the **Language** list.

- ▶ To set the logging level, select your preferred level from the **Logging PTM** and **Logging device** lists. The logging function provides information to help find the cause for an error in cooperation with an OMICRON support engineer. **Logging PTM** collects information on PTM while **Logging device** focuses on your device.

Note: Log files do not contain any information about users or devices.

Table 6-4: Logging levels

Logging level	Description
Disabled	Logging is disabled.
Errors only	Only errors are logged. Recommended setting
Info	Errors and some additional information are logged.
Full	All software-related activities are logged.

Note: Full logging will slow down software performance.

- ▶ To set the types of available devices, select the respective check boxes.

The **Locations settings** options do not apply to testing with *CIBANO 500*.

Under **Default test device configuration**, *Primary Test Manager* displays the default devices for testing different assets. If more than one device is available for an asset, you can set your preferred test system as default device for that asset.

Note: If no device is connected, *Primary Test Manager* will automatically compile the test list (see section 7.5 "Test view" on page 66) for the selected default test set.

The **Customer Experience Improvement Program** collects information about how you use *Primary Test Manager* without interrupting you. This helps OMICRON identify which features to improve. No information collected is used to identify or contact you. We encourage you to join the program to help improve *Primary Test Manager*.

Remote control

Certain features of *Primary Test Manager* can be controlled via the *PTMate* app. Complete the steps below to establish the connection between your smartphone and your computer.

1. Select the **Allow remote control via HTTP** check box in the **Remote control** section of the **Settings** dialog box. *Primary Test Manager* will establish a Wi-Fi access point.
 - ▶ If both your smartphone and your computer are already connected to the same Wi-Fi network, proceed with step 2.
 - ▶ If you are *not* connected to a Wi-Fi network, press the **Start Wi-Fi access point** button. *Primary Test Manager* will attempt to create a Wi-Fi access point and refresh the displayed QR code.

Note: If your computer does not support ad hoc Wi-Fi access point creation, you can use an external Wi-Fi device supporting this functionality or create a hotspot on your smartphone. Be aware that using a smartphone hotspot can lead to additional costs.

2. Open the *PTMate* app on your smartphone, go to **Settings** and scan the QR code displayed in the **Remote control** section in *Primary Test Manager*.

Primary Test Manager displays status icons in the bottom bar:

-  Number of active remote connections
-  Active Wi-Fi access point
-  Active remote control

Profiles

On the **Profiles** tab, you can set your profile, the default rated frequency, the loss index, the units of your own profiles, and make the test system settings.

Note: The dissipation factor and the tangent delta are identical characteristics of the primary asset under test. For your convenience, with *Primary Test Manager* you can use your preferred naming.

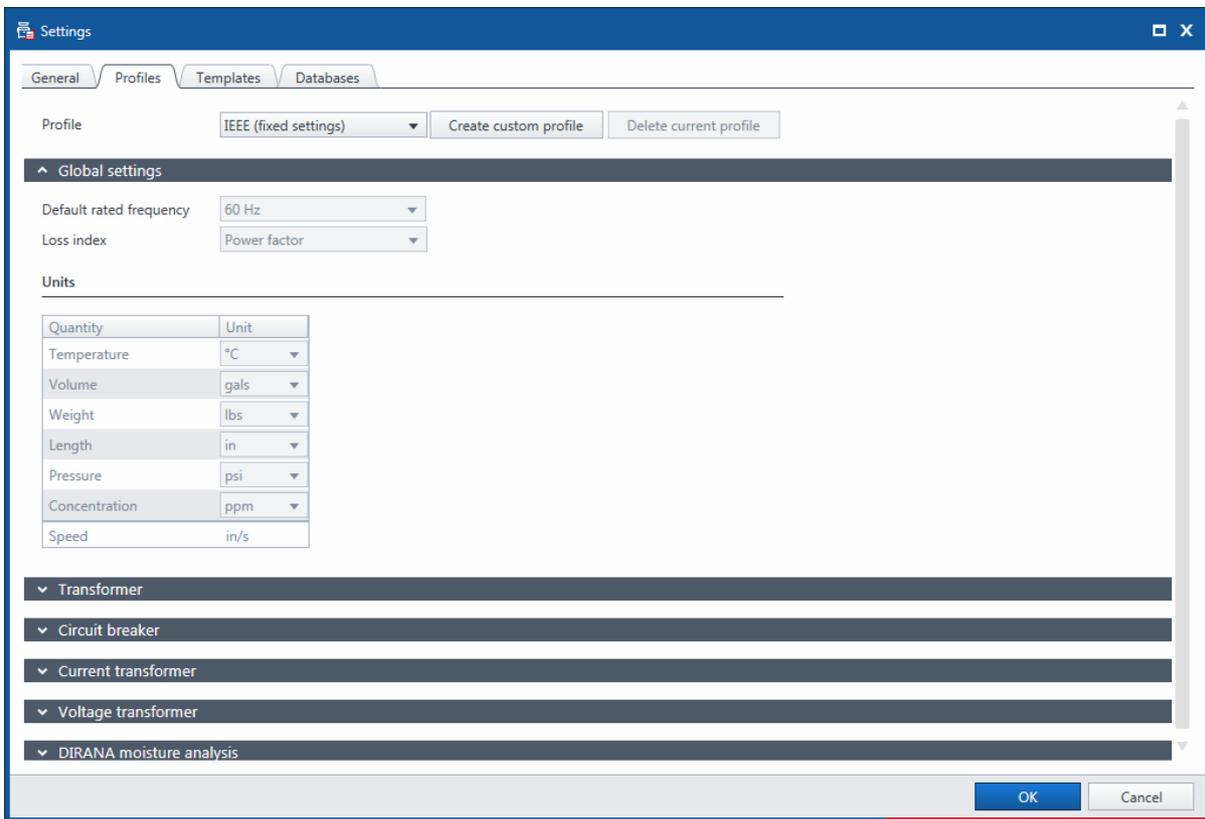


Figure 6-3: **Profiles** tab: **Global settings**

With *Primary Test Manager*, you can use predefined profiles and create your own profiles for naming conventions.

Note: *Primary Test Manager* sets the default profile according to the regional settings of your computer.

- ▶ To set a profile, select the profile you want to use from the **Profiles** list.

To create your own profile:

1. Click **Create custom profile**.
2. In the **Create custom profile** dialog box, type the profile name, and then click **Create**.
3. Under **Global settings**, set the default rated frequency, the loss index, and your preferred units.
4. Under **Circuit breaker**, set the circuit breaker terminal name schemes.

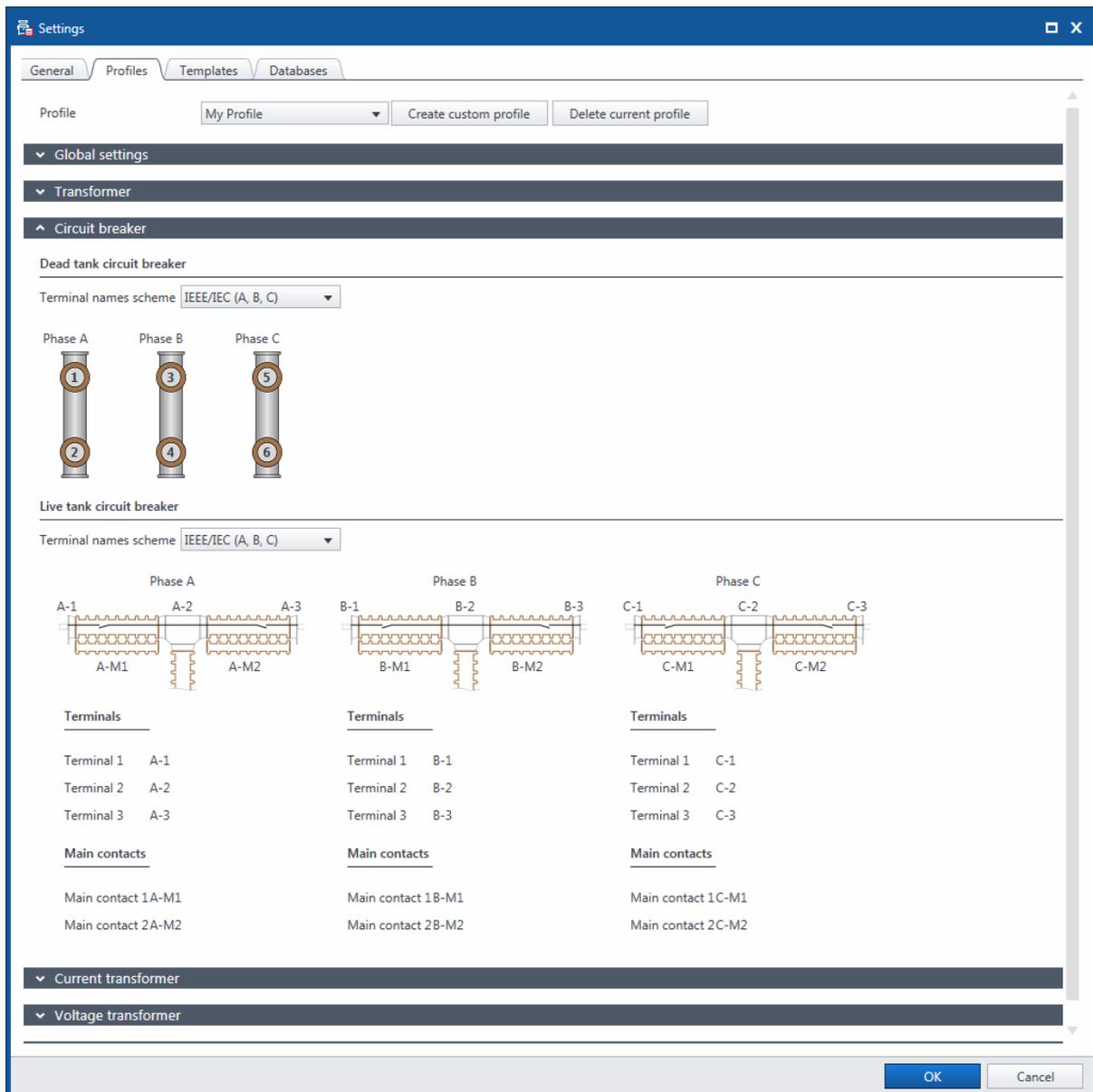


Figure 6-4: Profiles tab: Circuit breaker

5. Click **OK** to close the **Settings** dialog box.
 - To delete your own profile, select the profile from the **Profiles** list, and then click **Delete current profile**.

Templates and libraries

On the **Templates and libraries** tab, you can process job templates and libraries. For more information, see 7.5.6 "Process templates" on page 69 and 14 "Circuit Breaker Testing Library" on page 97.

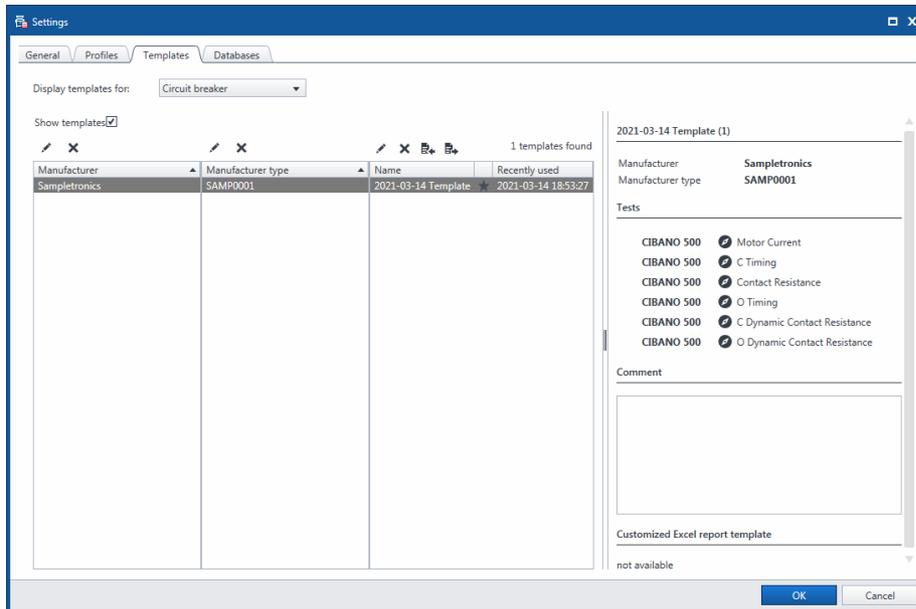


Figure 6-5: **Templates and libraries** tab

To manage the job templates, select **Circuit breaker** from the **Display templates for** list, and then do one of the following:

- ▶ To edit the manufacturer, the manufacturer type or the template properties (manufacturer, manufacturer type, name, comment), click the respective **Edit** button .
- ▶ To delete a manufacturer and all associated templates, select the manufacturer, and then click the corresponding **Delete** button .
- ▶ To delete a manufacturer type and all associated templates, select the manufacturer type, and then click the corresponding **Delete** button .
- ▶ To delete a template, select the template, and then click the corresponding **Delete** button .
- ▶ To export a template, select the template, and then click the **Export the selected template** button .
- ▶ To import a template, click the **Import template** button , and then browse to the template you want to import.
- ▶ To set a template as favorite, click the star icon .

Note: The first template you associate with a manufacturer type is set as favorite by default.

The right pane of the template workspace displays the template preview.

Databases

On the **Databases** tab you can create, manage and optimize (comprise) the *Primary Test Manager* database, and switch between different databases. Under **Properties**, you can adjust the server settings for *DataSync*. For more information, see 6.6.1 "Server settings" on page 45.

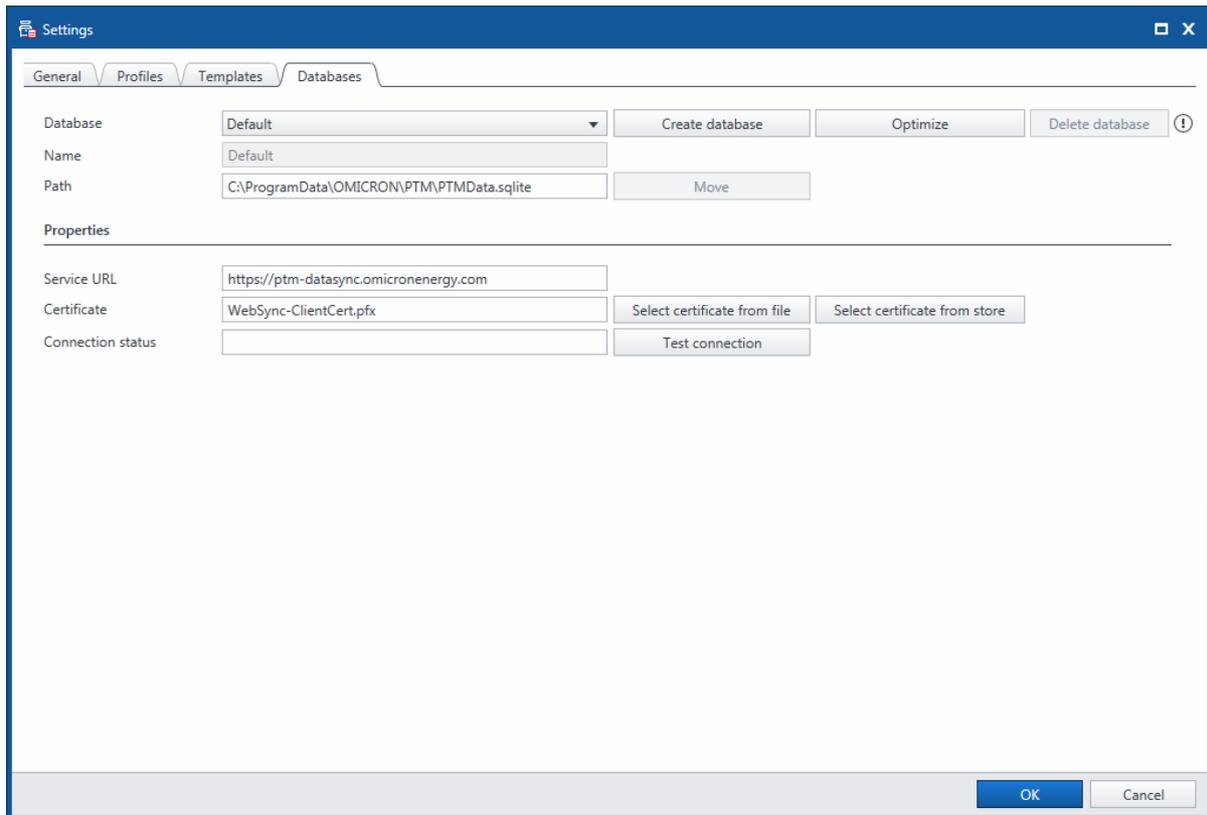


Figure 6-6: **Databases** tab

6.2 Help

Alternatively to this User Manual, *Primary Test Manager* provides online Help. To open the PTM Help, click **Help** in the title bar or press F1.

6.3 Send data to Technical Support

In the **Contact Technical Support** dialog box, you can send system information and your data to OMICRON technical support.

- ▶ To open the **Contact Technical Support** dialog box, click **Send data to Technical Support** in the title bar.

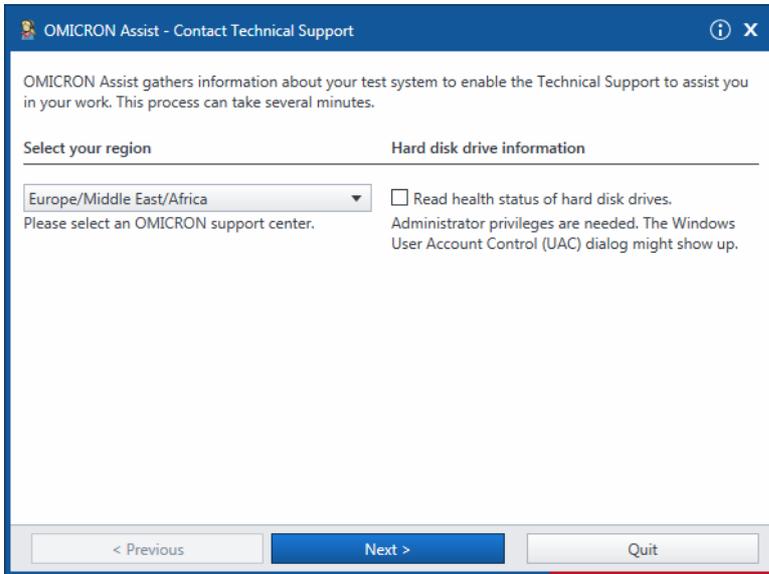


Figure 6-7: **Contact Technical Support** dialog box

1. In the **Contact Technical Support** dialog box, select your region, and then click **Next**.
2. Click **Add files**.
3. Browse to the data you want to send, and then click **Next**.
4. Click **Send**.

6.4 About

In the **About Primary Test Manager** dialog box, you can enter license keys to upgrade your *Primary Test Manager* and enhance its functionality by installing additional features.

► To open the **About Primary Test Manager** dialog box, click **About** in the title bar.

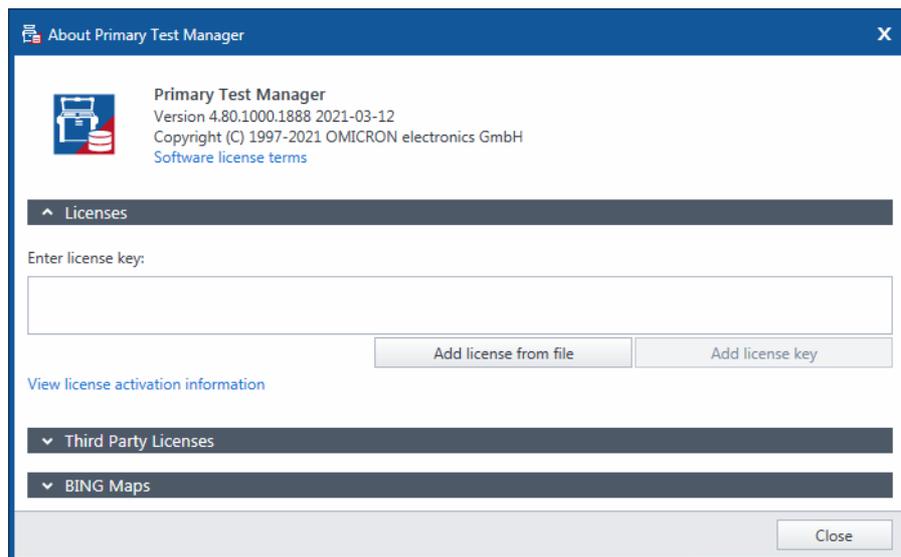


Figure 6-8: **About Primary Test Manager** dialog box

To activate a license:

1. Enter the license key in the **About Primary Test Manager** dialog box, and then click **Add license key**.

The **About Primary Test Manager** dialog box displays the available licenses and a new **Enter license key** box.

2. Repeat step 1 for all license keys you want to enter.

Alternatively, you can enter license keys from files. To enter a license key from a file, click **Add license from file**, and then browse to the file containing the license you want to add.

For detailed information about the *Primary Test Manager* licensing, contact your OMICRON local sales representative or distributor.

6.5 Manage connection to the test system

Under **Device**, you can connect to and disconnect from the test system.

► To connect to a *CIBANO 500* device, select the device from the list, and then click **Connect**.

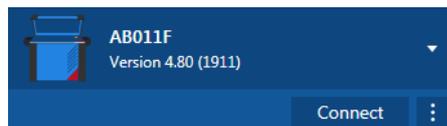


Figure 6-9: Connecting to *CIBANO 500*

If you could not connect to your *CIBANO 500* device and the green light is permanently on, wait a few seconds, and then proceed as follows:

1. Click **More** next to the **Connect** button, and then click **Refresh**.
2. Select the test system from the list, and then click **Connect**.

If the *CIBANO 500* device to which you want to connect is not displayed in the list of available devices, proceed as described in "Troubleshooting" in the CIBANO 500 PTM User Manual.

Alternatively, you can manage the connection to *CIBANO 500* in the *Primary Test Manager* status bar (see 6.9 "Status bar" on page 48).

6.6 Synchronize data

Primary Test Manager comes with the client/server architecture. With this feature, you can synchronize your local database with the *Primary Test Manager* server database. The data synchronization is a partial data replication based on subscriptions, that is, all local data is synchronized with the server database and selected data on the server is synchronized with the local database.

Note: To synchronize your data, you need a license. To get the license, contact your regional OMICRON Service Center or sales partner. You can find our Service Center or sales partner closest to you at www.omicronenergy.com.

6.6.1 Server settings

Before synchronizing the *Primary Test Manager* databases for the first time, you need to set the server settings.

1. In the title bar, click **Settings**, and then select the **Databases** tab.
The next step depends on the data synchronization method you use: *DataSync* via web server or *DataSync* on premises.
 - ▶ For the service URL and certificate for *DataSync* via web server, contact your regional OMICRON Service Center.
 - ▶ For the service URL and certificate for *DataSync* on premises, contact your system administrator.

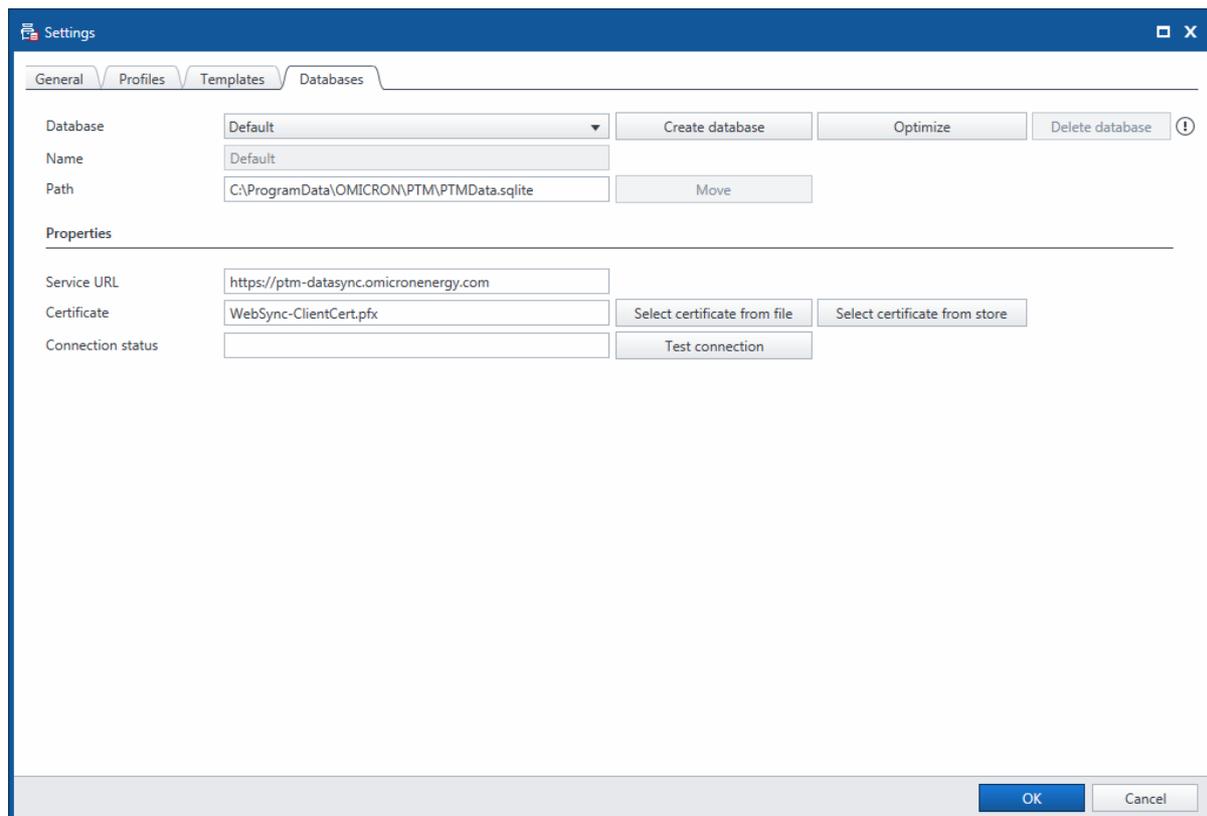


Figure 6-10: Server settings for *DataSync*

2. Enter the **Service URL** and upload the **Certificate**.
3. To test the connection to the server, click **Test** next to **Connection status**.

You can create different databases for testing and switch between them.

- ▶ Use the corresponding buttons next to **Database** to create, optimize or delete a database.
- ▶ To switch to a different database, select it from the **Database** list.

6.6.2 Managing subscriptions

You can select data on the server which you want to synchronize with your local data by managing subscriptions. To manage subscriptions:

1. In the home view, click the **Manage** button .

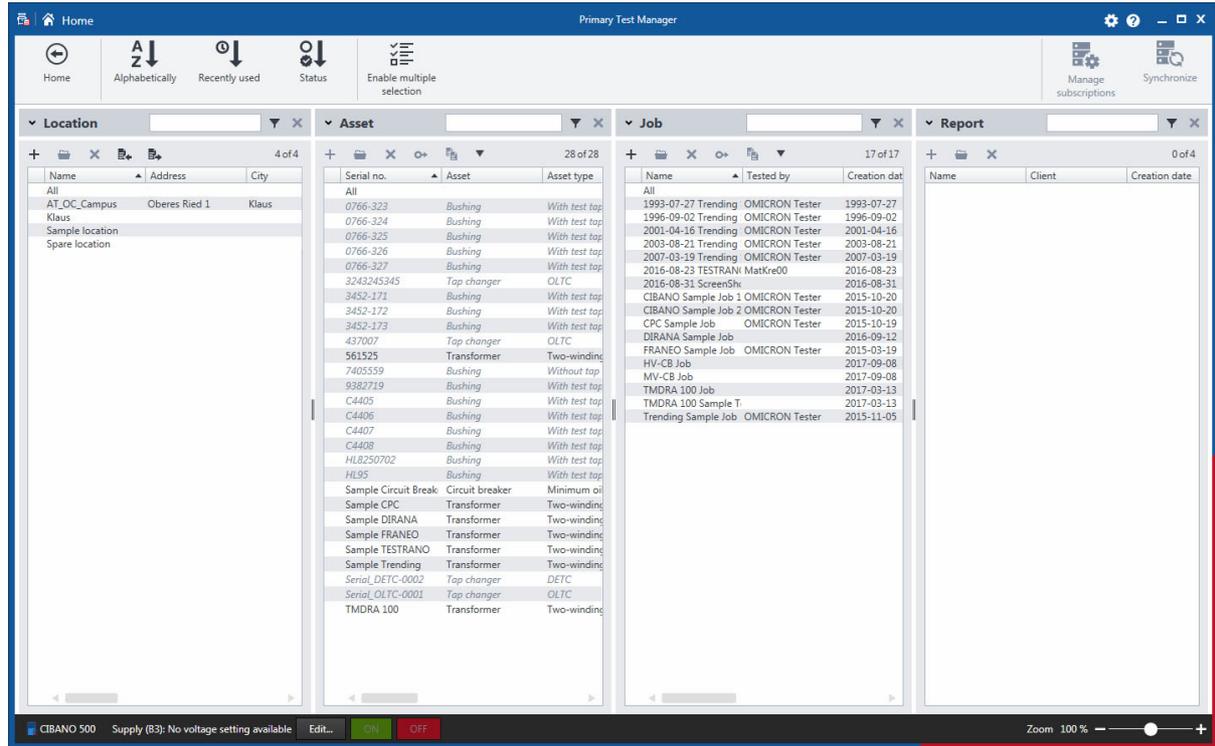


Figure 6-11: Manage view

2. In the manage view, click **Manage subscriptions** on the ribbon.
3. In the **Subscriptions** dialog box, select the data on the server you want to synchronize with your local data.

6.6.3 Database synchronization

- To synchronize the local *Primary Test Manager* database with the server database: In the home view, click **Synchronize**.

Note: You can synchronize databases at any time, as long as a connection to the server database is available.

When the database synchronization is complete, the locations, assets, and jobs (objects) newly added to the local database are marked with blue dots in the manage view. You can sort the objects by this column. As soon as you open an object, its blue dot is removed. All blue dots are removed when you perform another database synchronization.

6.7 Import data

In the home view, you can import *Primary Test Manager* jobs.

To import a job:

1. Under **Data**, click **Import files**.
2. Browse to the file you want to import.

Primary Test Manager supports the following file import formats.

Table 6-5: Supported file import formats

File name extension	Description
.ptm	<i>Primary Test Manager</i> native exchange format
.ptma	Format for import of manual test data. ¹

1. To import manual test data, you must select the corresponding asset in the manage view.

6.8 Back up and restore data

We strongly recommend backing up your data in the *Primary Test Manager* database on a regular basis. *Primary Test Manager* reminds you to back up the data periodically by prompting you to save the data in your preferred location. The data is backed up in DBPTM format. You can back up and restore the data in the *Primary Test Manager* home view.

To back up the data without the *Primary Test Manager* prompt:

1. Under **Data**, click **Back up your data**.
2. Save the data in your preferred location.

To restore the data:

1. Under **Data**, click **Restore data from a backup**.
2. Browse to the file you want to restore.

6.9 Status bar

The status bar displays the status of the test system, the controls of the continuous power supply (see 17.1.15 "Continuous power supply" on page 168 and 17.2.11 "Continuous power supply" on page 220) and provides access to the zoom function. In the status bar, you can connect to and disconnect from a test system, and show and refresh the test set information.

To connect to a test system:

1. In the status bar, right-click **Not connected**, and then click **Connect**.

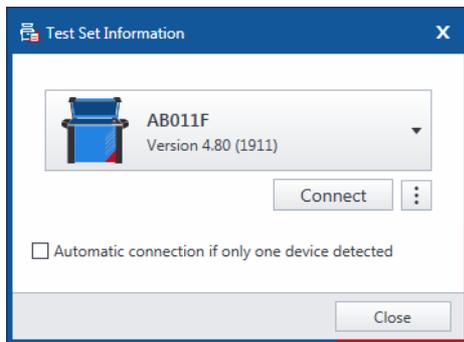


Figure 6-12: **Test set information** dialog box before connecting to *CIBANO 500*

2. In the **Test set information** dialog box, select the test system from the list, and then click **Connect**.

Note: Select the **Automatic connection if only one device detected** check box if only one device is available. Then *Primary Test Manager* connects to the available device automatically.

If you could not connect to your *CIBANO 500* device and the green light is permanently on, wait a few seconds, and then proceed as follows:

1. Click **More** next to the **Connect** button, and then click **Refresh**.
2. Select the test system from the list, and then click **Connect**.

After you have connected to the test system, the following dialog box appears.

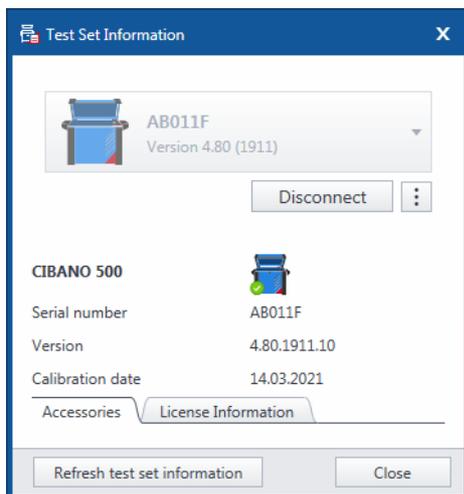


Figure 6-13: **Test set information** dialog box after connecting to *CIBANO 500*

Note: For connecting to a test system not included in the list, see 20.1 "Connecting to CIBANO 500" on page 315.

After you have connected to a test system, right-click the *CIBANO 500* symbol in the status bar, and then do one of the following:

- ▶ To disconnect from a test system, click **Disconnect**.
- ▶ To display information about the connected test system, click **Show test set information**.
- ▶ To update the test set information, click **Refresh test set information**.

Note: You can open the **Test set information** dialog box also by double-clicking the *CIBANO 500* symbol.

7 Create new guided jobs

When creating a new guided job, *Primary Test Manager* leads you through the guided test workflow.

► To open the new guided job view, click the **New guided job** button  in the home view.

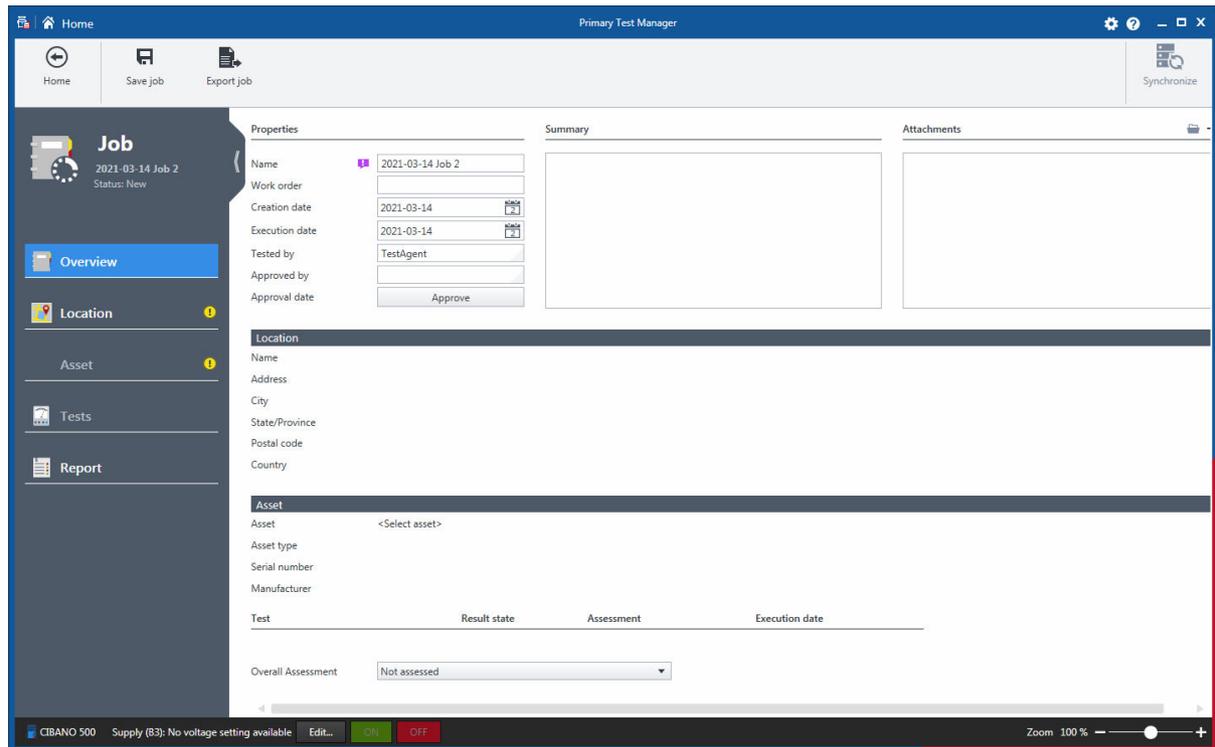


Figure 7-1: New guided job view

In the new guided job view, you can configure and execute jobs. A job contains all relevant information about the location, the asset under test, and the tests. With *Primary Test Manager*, you can process jobs as separate entities. During the guided test workflow, the job status displayed in the left pane of the new guided job view changes. The following table describes the job statuses.

Table 7-1: Job statuses

Status	Description
New	Location has been defined.
Prepared	Asset has been defined.
Partially executed	At least one measurement has been executed.
Executed	All tests of the job have been executed.
Approved	Job has been approved.

7.1 Guided test workflow

The guided test workflow leads you through the following steps:

1. Enter the job data (see 7.2 "Job overview" on page 53).
2. Specify the location (see 7.3 "Location view" on page 56).
3. Specify the asset (see 7.4 "Asset view" on page 60).
4. Specify and perform the tests (see 7.5 "Test view" on page 66).
5. Generate the test reports (see 13 "Generate test reports" on page 93).

To navigate through the test workflow, click the navigation buttons in the left pane of the new guided job view.

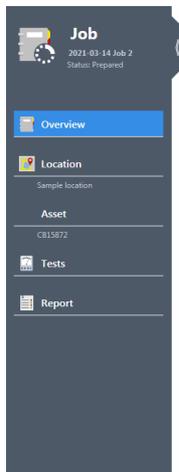


Figure 7-2: Navigation buttons

Note: You can interrupt the test workflow and return to any view at any time by clicking the corresponding navigation button.

By using the commands on the ribbon, you can process jobs. The following table describes the available operations.

Table 7-2: Operations on the guided jobs

Command	Action
Close	Closes a job displayed in the new guided job view and leads you back to the home or manage view respectively.
Save job	Saves the job displayed in the new guided job view.
Export job	Exports the job displayed in the new guided job view into a Microsoft Excel spreadsheet.
Copy test¹	Adds another test of the same kind and with the same settings to the test list. Results are not copied.
Delete test¹	Adds another test of the same kind and with the same settings to the test list. Results are not copied.
Take screenshot¹	Takes screenshot of the selected area of the <i>Primary Test Manager</i> workspace. The screenshot appears as attachment in the General area and can be attached to the test report (see 13 "Generate test reports" on page 93).

¹ Only available if a test is open

For more information about operations on the jobs, see 10 "Manage objects" on page 77.

7.2 Job overview

In the job overview, you can enter the job data (see Table 7-3: "Job data" on page 53). In the course of the guided test workflow, *Primary Test Manager* sets also some basic location, asset, and test data.

► To open the job overview, click the **New guided job** button  in the home view.

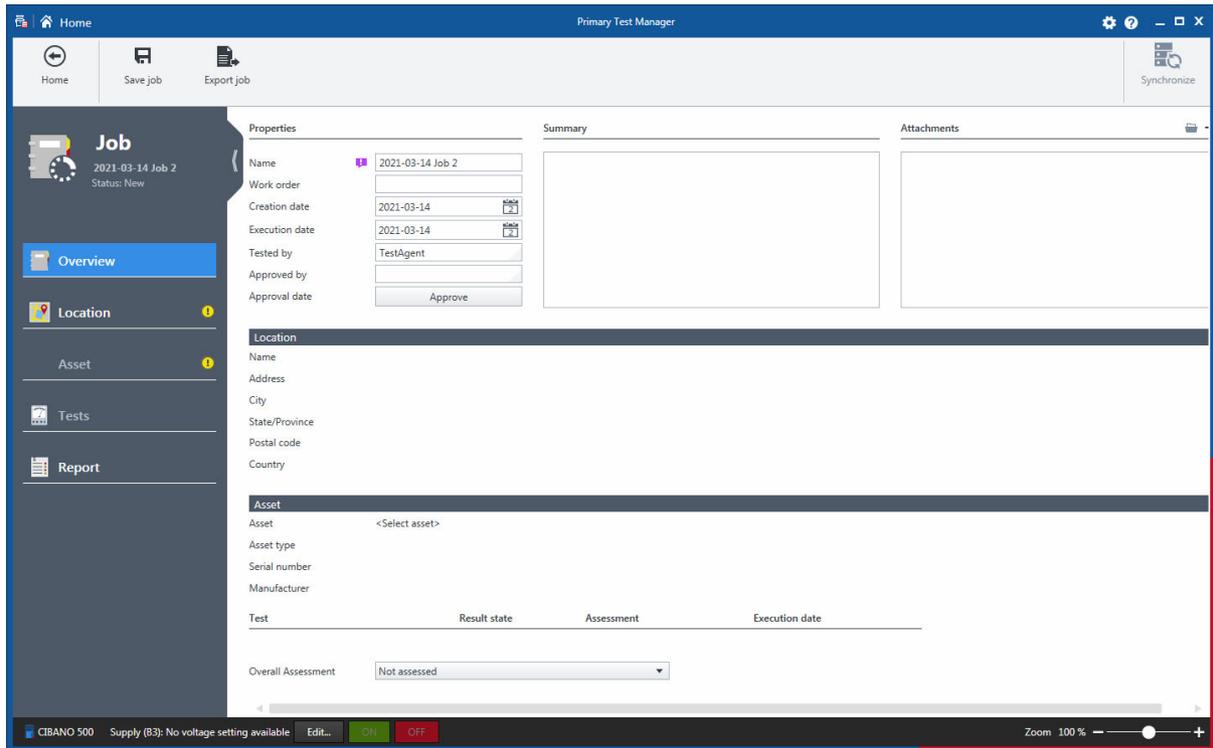


Figure 7-3: Job overview

7.2.1 Job data

The following table describes the job data.

Table 7-3: Job data

Data	Description
Name/Work order ¹	Name of the job or work order (by default generated by <i>Primary Test Manager</i>)
Creation date	Date the job was created
Execution date	Date the job was executed
Tested by	Person who performed the test

Table 7-3: Job data (continued)

Data	Description
Approved by	Person who approved the test
Approval date	Date the job was approved (see 7.2.2 "Approving jobs" later in this section)
Summary	Text field to summarize the job data in own words.
Attachments	Attachments to the job (see 7.2.4 "Managing attachments" on page 55)

1 Mandatory data

7.2.2 Approving jobs

If the job data displayed in the job overview has been approved, you can set the approval date of the job.

► To set the job approval date, click **Approve**.

Note: After approving a job, some settings cannot be edited anymore. The job approval cannot be undone.

7.2.3 Assessment summary

In the **Tests** area of the job overview, the **Result state** and **Assessment** status of test results are displayed.

► Use the **Overall Assessment** box to manually characterize the asset's condition for reporting purposes.

Table 7-4: Result state

Result state	Description
Not executed	No measurement of the test has been executed.
Partially executed	At least one measurement of the test has been executed.
Executed	All measurements of the test have been executed.

Table 7-5: Assessment

Status	Description
Fail	The status was automatically set to <i>Fail</i> by <i>Primary Test Manager</i> .
Manual fail	The status was manually set to <i>Fail</i> .
Investigate	The status was automatically set to <i>Investigate</i> by <i>Primary Test Manager</i> .
Manual investigate	The status was manually set to <i>Investigate</i> .
Pass	The status was automatically set to <i>Pass</i> by <i>Primary Test Manager</i> .
Partial pass	Some measurements have not been assessed.

Table 7-5: Assessment (continued)

Status	Description
Manual pass	The status was manually set to <i>Pass</i> .
Manual partial pass	Some measurements have not been assessed and at least one assessment status was changed manually.
Not assessed	The measurement has not been assessed.
Not rated	The status was automatically set to <i>Not Rated</i> by <i>Primary Test Manager</i> .

7.2.4 Managing attachments

Under **Attachments**, you can manage attachments to jobs.

- ▶ To add an attachment to a job, click the **Add** button , and then browse to the file you want to attach to the job.
- ▶ To open an attachment, select the attachment, and then click the **Open** button , or double click the attachment.
- ▶ To remove an attachment from a job, select the attachment you want to delete, and then click the **Remove** button  .

7.3 Location view

In the location view, you can specify locations.

- ▶ To open the location view, click the **Location** navigation button .

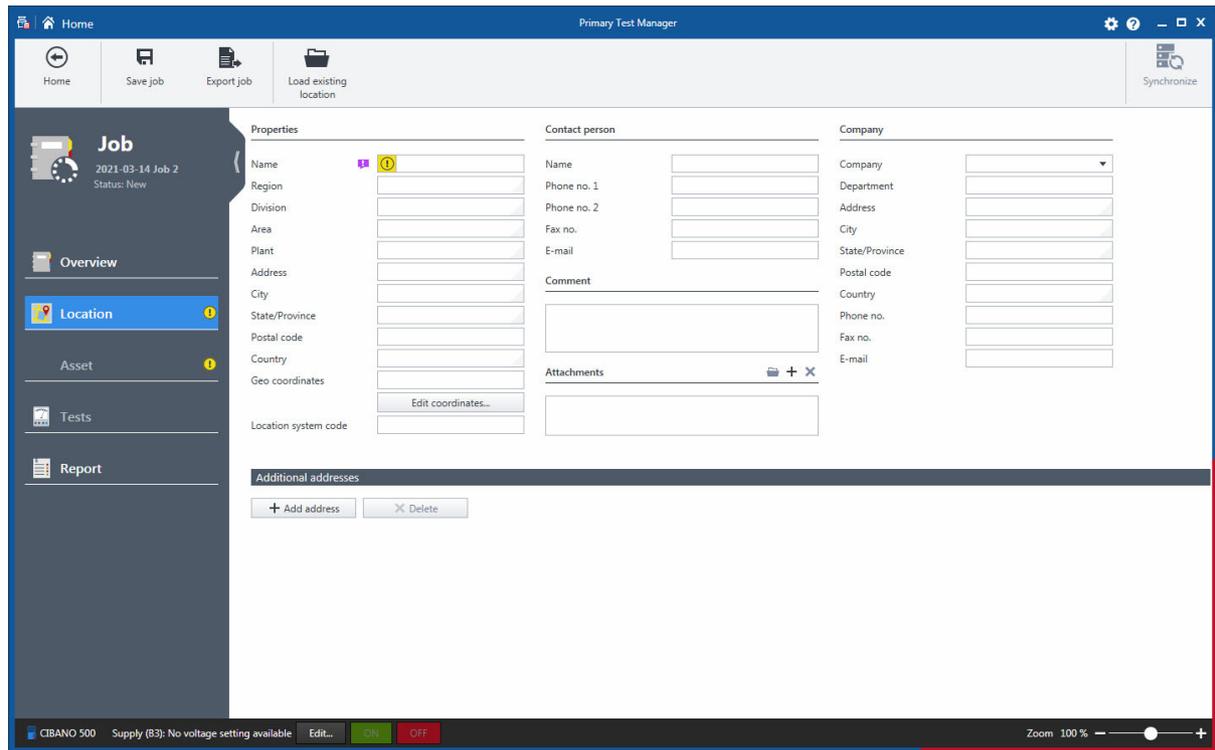


Figure 7-4: Location view

To specify a location, do one of the following:

- ▶ Enter the location data (see Table 7-6: "Location data" later in this section).

Note: If you enter location data different from the master location, a notification bar at the top of the *Primary Test Manager* workspace prompts you to import the master location or update the master location. For more information, see 10.3 "Understanding the master locations and assets" on page 80.

- To load the location data available in *Primary Test Manager*, click **Load existing location** on the ribbon, and then select the location you want to load in the **Select Location** dialog box.

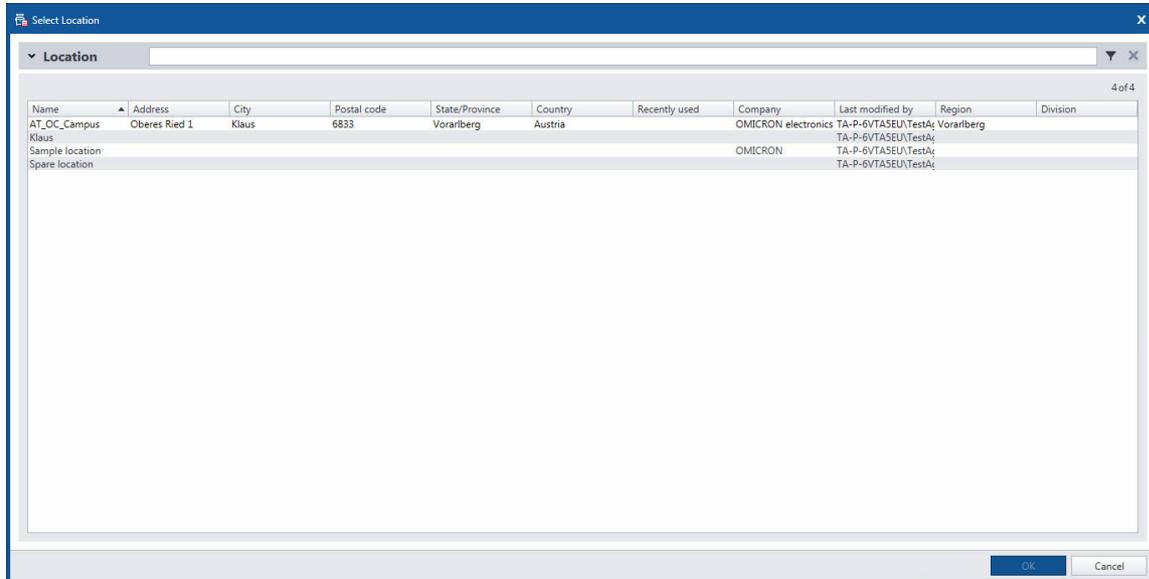


Figure 7-5: **Select Location** dialog box

In the **Select Location** dialog box, you can search for locations (see 10.1 "Search for objects" on page 78).

7.3.1 Location data

The following table describes the location data.

Table 7-6: Location data

Data	Description
Name ¹	Name of the location where the asset is located
Region	Region where the asset is located
Division	Division where the asset is located
Area	Area where the asset is located
Plant	Plant where the asset is located
Address	Address of the location where the asset is located
City	City where the asset is located
State/Province	State or province where the asset is located
Postal code	Postal code of the location where the asset is located
Country	Country where the asset is located
Geo coordinates	Geo coordinates of the location where the asset is located (see 7.3.2 "Setting the geo coordinates" later in this section)

Table 7-6: Location data (continued)

Data	Description
Location system code	Location code used by maintenance planning systems
Contact person	
Name	Name of the contact person
Phone no. 1	Phone number of the contact person
Phone no. 2	Alternative phone number of the contact person
Fax no.	Fax number of the contact person
E-mail	E-mail address of the contact person
Comment	Comment on the location
Attachments	Attachments to the location (see 7.3.3 "Managing attachments" on page 59)
Company	
Company	Company the asset belongs to
Department	Department of the company
Address	Address of the company
City	City where the company is located
State/Province	State or province where the company is located
Postal code	Postal code of the company
Country	Country where the company is located
Phone no.	Phone number of the contact person
Fax no.	Fax number of the contact person
E-mail	E-mail address of the contact person

1 Mandatory data

In the location view, you can enter additional addresses of, for example, a client, owner or utility.

► To enter additional addresses, click **Add address** under **Additional addresses**.

7.3.2 Setting the geo coordinates

To set the geo coordinates of a location:

1. In the location view, click **Edit coordinates**.

Figure 7-6: **Edit Coordinates** dialog box

2. In the **Edit Coordinates** dialog box, enter the latitude and longitude of the location by using the WGS-84 World Geodetic System in the DMS (degrees, minutes, seconds) format.

7.3.3 Managing attachments

Under **Attachments**, you can manage attachments to locations.

- ▶ To add an attachment to a location, click the **Add** button **+**, and then browse to the file you want to attach to the location.
- ▶ To open an attachment, select the attachment, and then click the **Open** button **📁**, or double click the attachment.
- ▶ To remove an attachment from a location, select the attachment you want to delete, and then click the **Remove** button **-**.

7.4 Asset view

In the asset view, you can specify assets.

- ▶ To open the asset view, click the **Asset** navigation button .

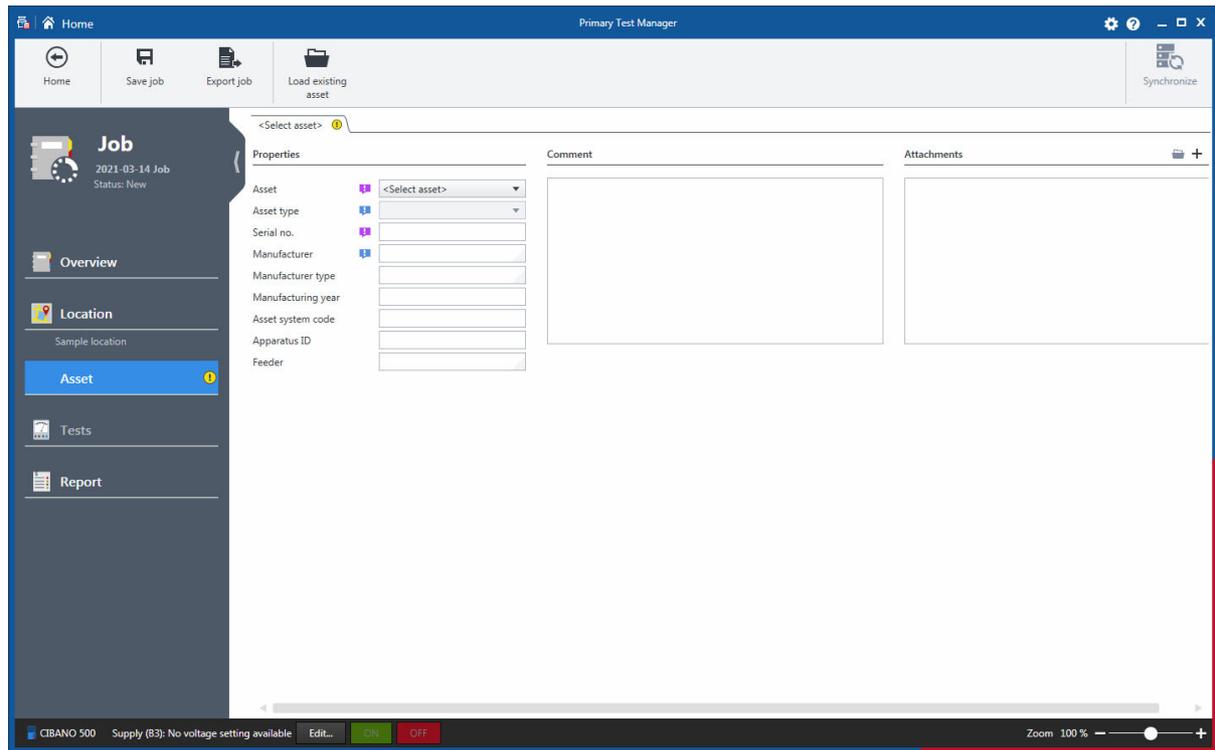


Figure 7-7: Asset view

The asset view depends on the asset you want to specify with *Primary Test Manager*. To specify an asset, do one of the following:

- ▶ Enter the asset data. The asset data includes the general asset data common to all assets (see Table 7-7: "General asset data" on page 61) and the asset-specific data described in 15 "Circuit breaker data" on page 100 and 16 "Spare bushing data" on page 114.

Note: If you enter asset data different from the master asset, a notification bar at the top of the *Primary Test Manager* workspace prompts you to import the master asset or update the master asset. For more information, see 10.3 "Understanding the master locations and assets" on page 80.

- ▶ To load the asset data available in *Primary Test Manager*, click **Load existing asset** on the ribbon, and then select the asset you want to load in the **Select asset** dialog box.

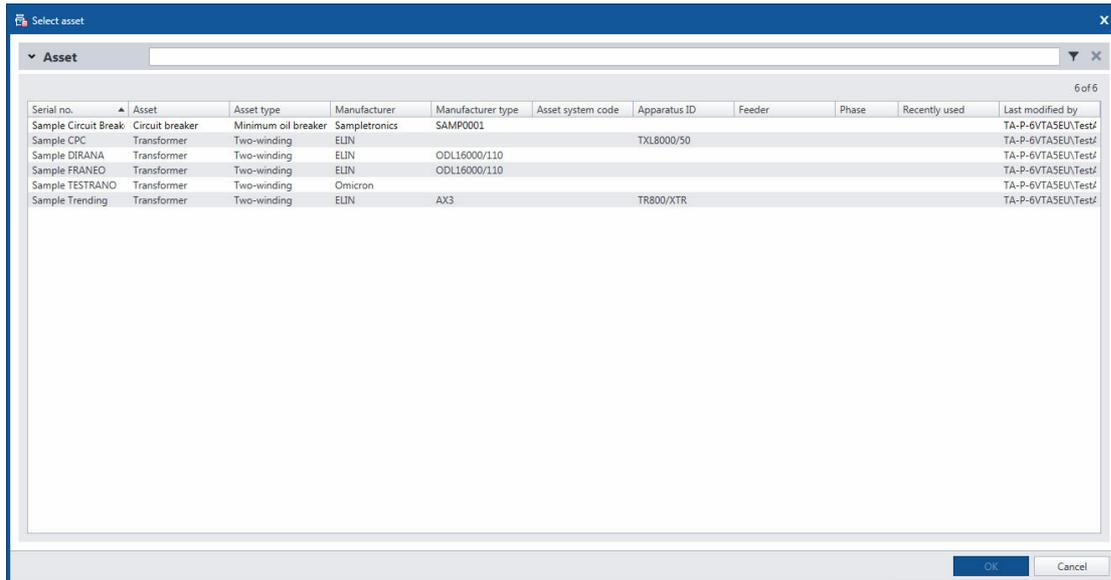


Figure 7-8: **Select asset** dialog box

In the **Select asset** dialog box, you can search for assets (see 10.1 "Search for objects" on page 78) and sort them alphabetically or in the chronological order.

- For loading the asset data from the circuit breaker testing library, see 14 "Circuit Breaker Testing Library" on page 97.

7.4.1 General asset data

The following table describes the general asset data.

Table 7-7: General asset data

Data	Description
Asset ¹	Asset under test
Asset type	Type of the asset
Serial no. ¹	Serial number of the asset
Manufacturer	Manufacturer of the asset
Manufacturer type	Type of the asset according to the manufacturer
Manufacturing year	Year of the asset's manufacturing
Asset system code	Code of the asset used by the maintenance planning systems
Apparatus ID ²	Identifier of the asset
Feeder	Feeder the asset is connected to
Comment	Comment on the asset
Attachments	Attachments to the asset (see 7.4.2 "Managing attachments" on page 62)

1 Mandatory data

2 Visible if an asset is selected

7.4.2 Managing attachments

Under **Attachments**, you can manage attachments to assets.

- ▶ To add an attachment to an asset, click the **Add** button , and then browse to the file you want to attach to the asset.
- ▶ To open an attachment, select the attachment, and then click the **Open** button , or double click the attachment.
- ▶ To remove an attachment from an asset, select the attachment you want to delete, and then click the **Remove** button .

7.4.3 Circuit breaker view

In the circuit breaker view, you can specify circuit breakers and assets associated with the circuit breakers such as bushings.

To specify a circuit breaker:

1. From the **Asset** list, select **Circuit breaker**.
2. From the **Asset type** list, select the type of the circuit breaker.

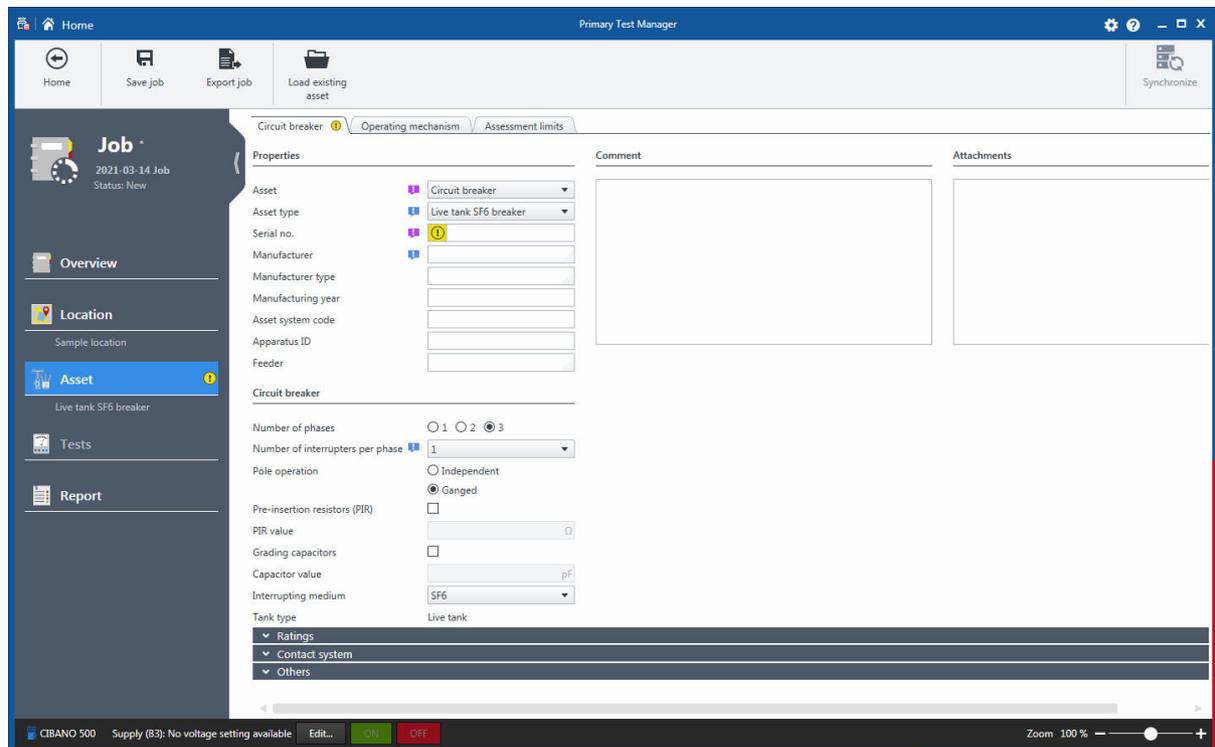


Figure 7-9: Circuit breaker view

3. In the circuit breaker view, enter the general asset data (see Table 7-7: "General asset data" on page 61).
4. Under **Circuit breaker**, enter the circuit breaker data (see 15 "Circuit breaker data" on page 100).
5. Specify the operating mechanism of the circuit breaker (see "Operating mechanism tab" on page 63).

6. Optionally, specify the bushings mounted on the circuit breaker (see "Bushings tab" on page 64).
7. Set the assessment limits of the circuit breaker (see "Assessment limits tab" on page 65).

Operating mechanism tab

On the **Operating mechanism** tab, you can specify the circuit breaker's operating mechanism.

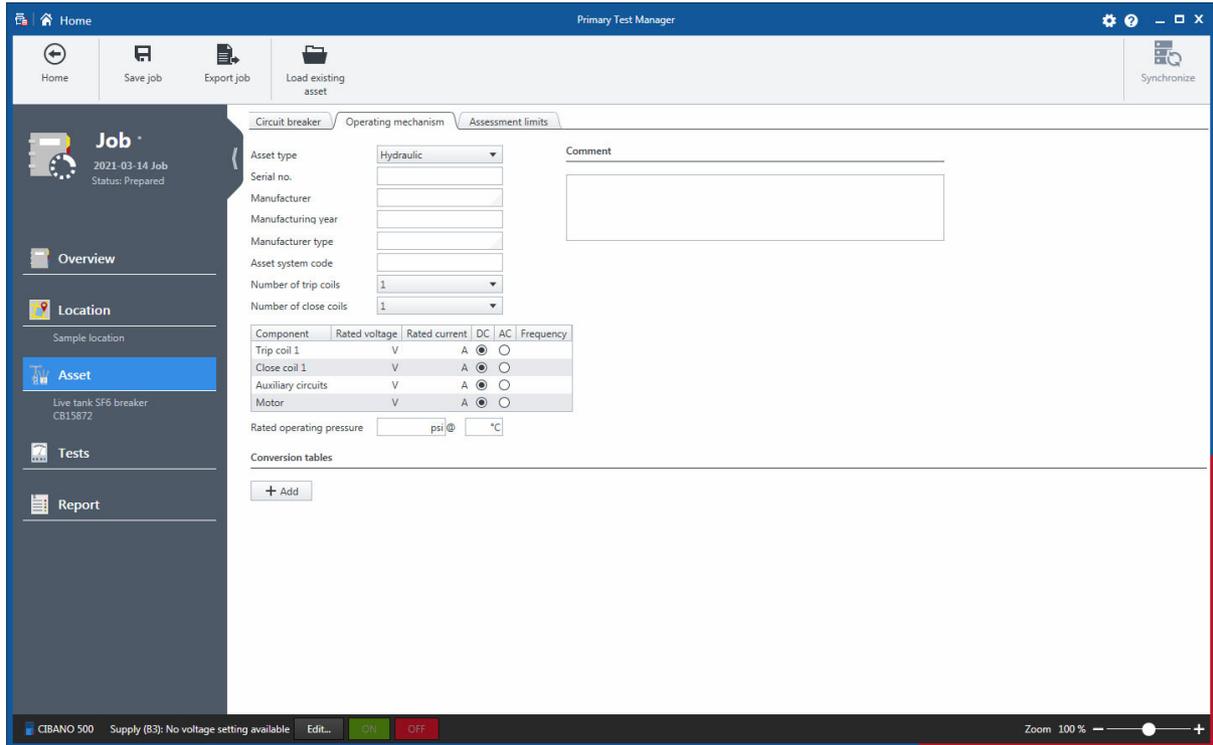


Figure 7-10: Circuit breaker view: **Operating mechanism** tab

- ▶ To specify an operating mechanism, enter the operating mechanism data (see 15.1 "Operating mechanism data" on page 102).

Bushings tab

On the **Bushings** tab, you can specify bushings mounted on the circuit breaker.

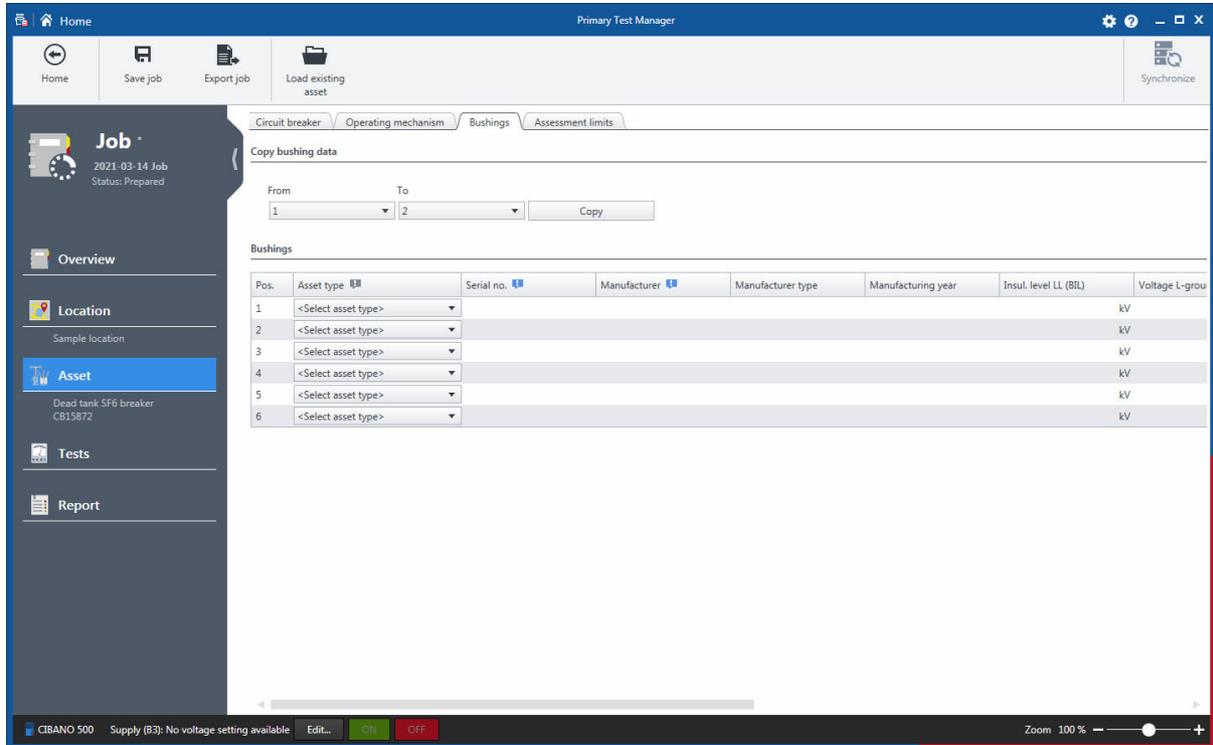


Figure 7-11: Circuit breaker view: **Bushings** tab

To specify a bushing:

1. From the **Asset type** list, select the type of the bushing for all circuit breaker's terminals.
2. Enter the bushing data (see 16 "Spare bushing data" on page 114).

Under **Copy bushing data**, you can copy data of a bushing to other bushings.

- To copy the bushing data, select the respective bushings from the **From** and **To** lists, and then click **Copy**.

Assessment limits tab

On the **Assessment limits** tab, you can set the circuit breaker's absolute and relative assessment limits.

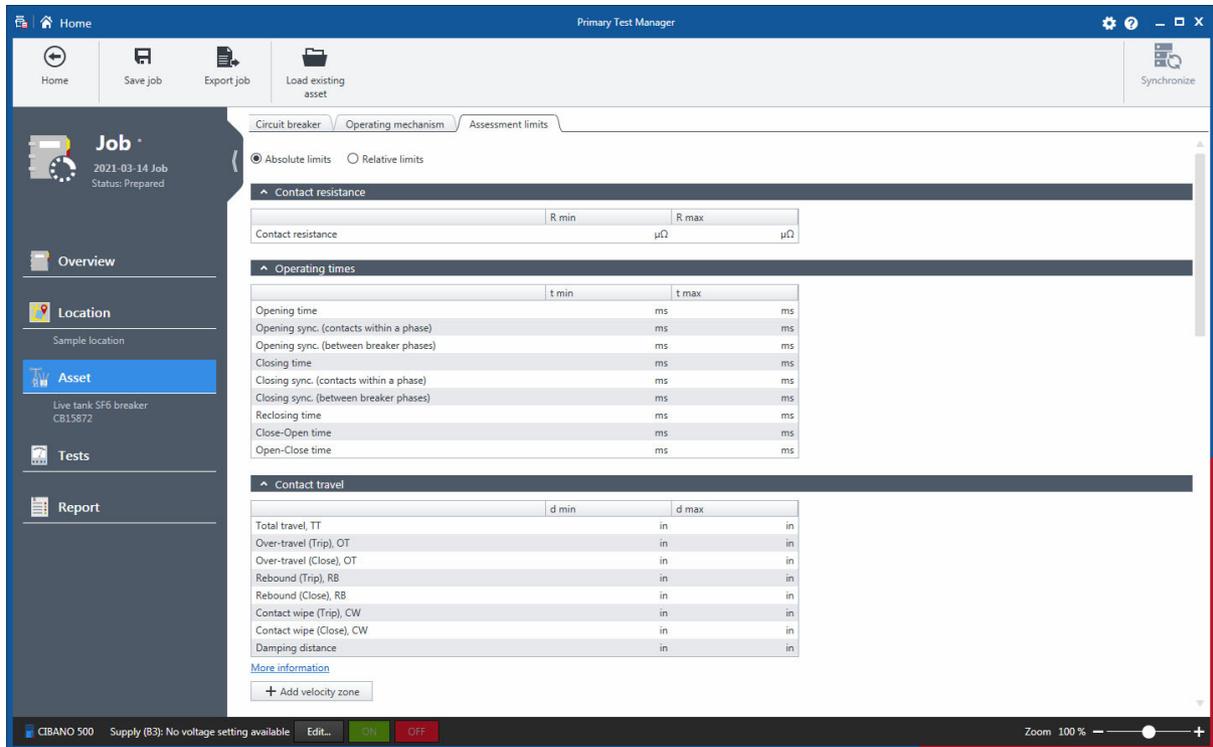


Figure 7-12: Circuit breaker view: **Assessment limits** tab

- To set the circuit breaker's assessment limits, enter the absolute or relative assessment limits (see 15.3 "Assessment limits" on page 106).

7.5 Test view

In the test view, you can select, import and perform tests.

- ▶ To open the test view, click the **Tests** navigation button .

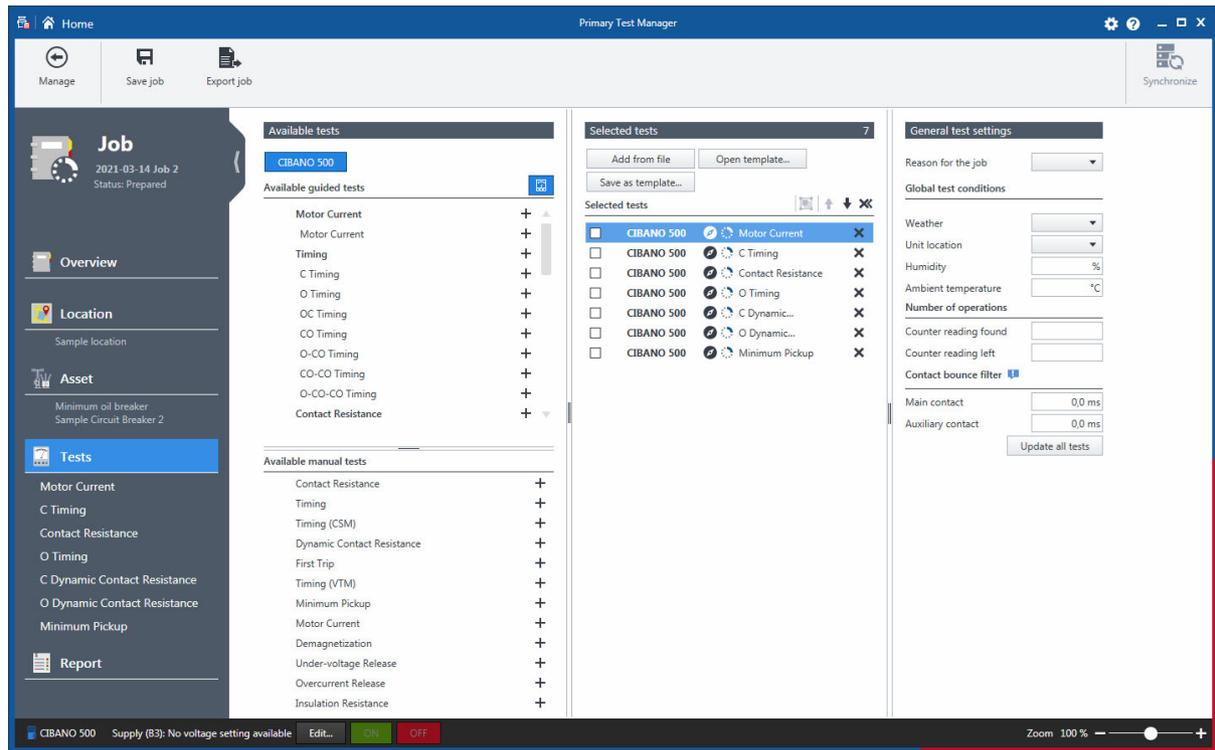


Figure 7-13: Test view

The test view is divided into the **Available tests** area, the **Selected tests** area, and the **General test settings** area.

Click the button labeled with the test system with which you want to perform the test on the top of the **Available tests** area. Then *Primary Test Manager* displays the available guided tests and optional manual tests supported for the selected test system and the asset under test.

- ▶ To display the guided tests grouped in categories, click the **Show test categories** button .

You can select tests for different test systems supported by *Primary Test Manager* within the same job.

Then the  symbol indicates the tests not available for the connected test system to signal to you that you need to connect another test system before proceeding to execute the job.

The optional manual tests are asset-independent. You can perform manual tests for any asset described in this User Manual, but *Primary Test Manager* does not guide you through the tests and provides no test settings data. The manual tests offer a large amount of flexibility to define the test procedures and specify test settings according to your specific needs.

- ▶ For more information about the manual tests, see 8 "Create new manual jobs" on page 72.

The **Selected tests** area displays the tests and test groups you want to perform. By default, *Primary Test Manager* displays the tests recommended by OMICRON.

7.5.1 Select tests

- ▶ To add a test or all tests of a category into the **Selected tests** area, click the **+** symbol next to the test or the category name in the **Available tests** area.

The tests added to the **Selected tests** area are displayed under **Tests** in the left pane of the test view.

- ▶ To rename a test, click the test name, and then type the name you want to use.

The **Selected tests** area displays the test in the recommended execution order. You can change the order of the tests by dragging them or by using the **↑** and **↓** buttons.

- ▶ To remove a test from the **Selected tests** area and from the left pane, click the **X** symbol next to the test name.
- ▶ To open a test, click the test name in the left pane of the test view.

After you have opened a test, the workspace is split into the following areas:

- **General**
Here you can type a comment on the test and add an attachment.
- **Hardware configuration**
Displays the test-specific controls of the test set. For information on the hardware configuration options, see 17 "Off-service diagnostic methods" on page 116.
- **Settings and conditions**
Displays the basic test settings you typically need to configure the tests. For the test settings and conditions, see 17 "Off-service diagnostic methods" on page 116.
- **Advanced settings**
Displays the advanced settings for experienced users. For the advanced test settings, see 17 "Off-service diagnostic methods" on page 116.
- **Assessment**
Provides access to setting the assessment limits. For the assessment limit description, see 15.3 "Assessment limits" on page 106.
- **Measurements**
Displays the measurement results. For more information, see 12 "Display measurement results" on page 87.

7.5.2 Group tests

With *Primary Test Manager*, you can group tests. You define the hardware configuration and certain settings and conditions for a test group. These settings are then applied to all tests in the test group.

To group tests:

1. In the **Selected tests** area, select the check boxes next to the tests you want to group.
2. Click the  symbol.

The test groups are displayed under **Tests** in the left pane of the test view.

- ▶ To rename a test group, click the test group name, and then type the name you want to use.
- ▶ To remove a test from the test group, click the  symbol next to the test name.
- ▶ To remove a test group from the **Selected tests** area and from the left pane, click the **X** symbol next to the test group name.
- ▶ To open a test group, click the test group name in the left pane of the test view.

After you have opened a test group, the workspace is split into the following areas:

- **Hardware configuration**
Displays the test-specific controls of the test set. For information on the hardware configuration options, see 17 "Off-service diagnostic methods" on page 116.
- **Settings and conditions**
Displays the test settings common to all tests of the test group. For information on the test settings, see 17 "Off-service diagnostic methods" on page 116.
- **Test control**
Displays the test control buttons and the list of the tests with the execution and assessment status. For information on executing test groups, see 17.1.3 "Test group execution" on page 119.

7.5.3 General test settings

The **General test settings** area displays the following data.

Table 7-8: General test settings

Data	Description
Reason for the job	Reason why the job has been created
Global test conditions	
Weather	Weather conditions on site
Unit location	Location of the unit under test
Humidity	Relative ambient humidity on site
Ambient temperature	Ambient temperature on site
Number of operations	
Counter reading found	Counter reading before starting the tests
Counter reading left	Counter reading after the tests has finished
Contact bounce filter	
Main contact	Threshold value of the time interval between two consequent bounces of the main contact. For time intervals equal or below the threshold, the contact is considered as closed. Setting the value to 0.0 ms deactivates the contact bounce filter.
Auxiliary contact	Threshold value of the time interval between two consequent bounces of the auxiliary contact. For time intervals equal or below the threshold, the contact is considered as closed. Setting the value to 0.0 ms deactivates the contact bounce filter.
Update all tests	Click Update all tests to set the contact bounce filter for all tests.

7.5.4 Import tests

In the test view, you can import test data (measurement results without any information about the job, the asset and the location) in PTMA format.

To import test data:

1. In the **Selected tests** area, click **Add from file**.
2. Browse to the file you want the import.
3. In the left pane of the test view, click the imported test.

The tests contained in the imported PTMA file are appended to the test list.

► For information about importing and exporting jobs, see 10.6 "Export and import jobs" on page 83.

7.5.5 Perform tests

To perform and assess the tests, you must know and understand the test settings and the measurement data. For detailed information, see 17 "Off-service diagnostic methods" on page 116 and 18 "In-service diagnostic methods" on page 286.

7.5.6 Process templates

In the guided test workflow, you can save jobs as templates and open the saved templates. By using the templates, you can configure jobs according to your needs (for example, for repeated routines), and then repeatedly perform the (once defined) tests. When you create a new job, the favorite template for the corresponding manufacturer and manufacturer type is loaded automatically, if available.

To save a job as template:

1. In the guided test workflow, configure a job.
2. In the **Selected tests** area of the test view, click **Save as template**.

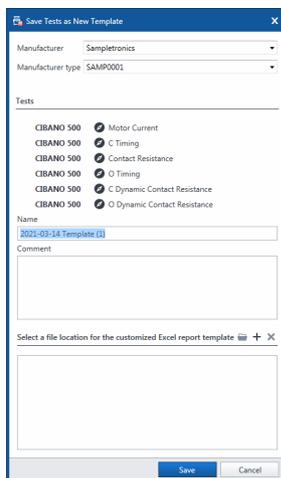


Figure 7-14: **Save Tests as New Template** dialog box

3. In the **Save Tests as New Template** dialog box, enter the manufacturer, the manufacturer type and the template name, and then click **Save**.

Note: Select **[Generic]** from the **Manufacturer** list if you want to use the template for all circuit breakers of the same manufacturer or for all circuit breakers.

4. Optionally, you can add a customized Microsoft Excel report template (see 13 "Generate test reports" on page 93) to the job template.
 - ▶ To add a Microsoft Excel report template, click **Select template**, and then browse to the report template you want to add.

To open a template:

1. In the **Selected tests** area of the test view, click **Open template**.

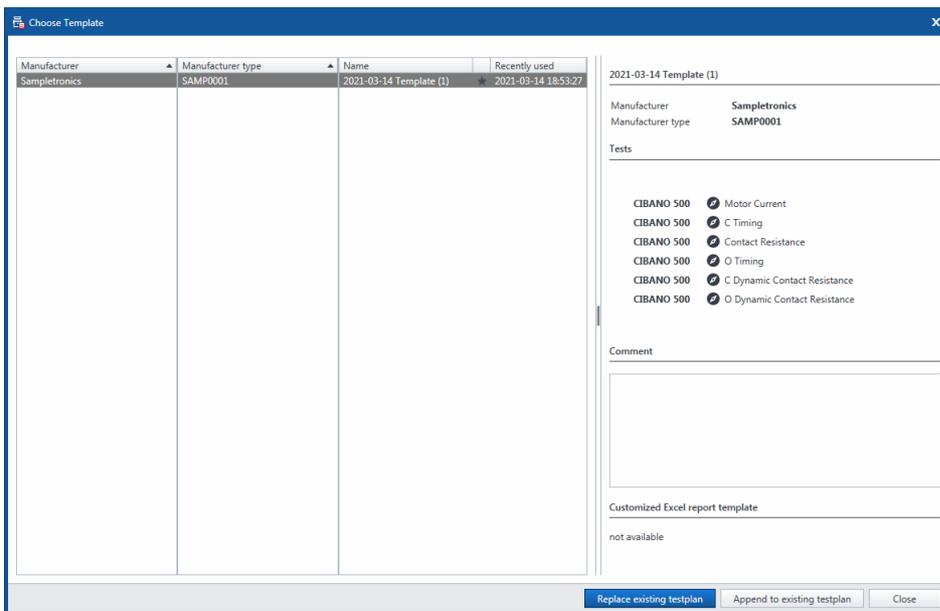


Figure 7-15: **Choose Template** dialog box

2. In the **Choose Template** dialog box, select the manufacturer, the manufacturer type and the template you want to open.

Note: If you added a Microsoft Excel report template to the job template, its location is displayed under **Customized Excel report template**.

- ▶ To replace the tests in the current job with the selected template, click **Replace existing testplan**.
- ▶ To add the selected template to the current job, click **Append to existing testplan**.

Note: If you click **Append to existing testplan**, the Microsoft Excel report template will not be added to the currently open job.

7.5.7 Offline hardware configuration

With *Primary Test Manager*, you can configure tests without connection to *CIBANO 500*. This enables you to prepare a test in the office and execute it later in the field. To set the hardware configuration offline:

1. Create a job without connection to *CIBANO 500*.
2. Click a test name in the left pane of the test view to open a test.
3. In the notification bar at the top of the *Primary Test Manager* workspace, click **Simulator settings**.

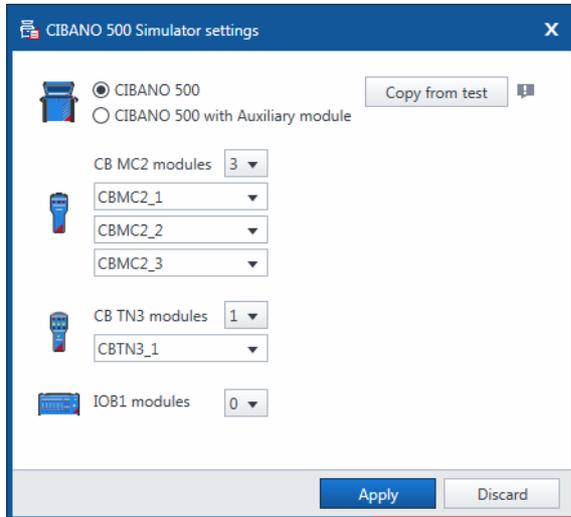


Figure 7-16: **CIBANO 500 Simulator settings** dialog box.

4. In the **CIBANO 500 Simulator settings** dialog box, configure *CIBANO 500* and its accessories, and then click **Apply**.
5. In the notification bar, click **Activate simulator**.

Primary Test Manager supports you in preparing tests with different hardware configurations. As soon as you saved a test, the test configuration is completely stored. To load the saved configuration into the *Simulator*, proceed as follows:

1. In the manage view, open the job you want to work on.
2. Open the test you want to prepare.
3. In the notification bar at the top of the *Primary Test Manager* workspace, click **Simulator settings**.
4. In the **CIBANO 500 Simulator settings** dialog box, click **Copy from test**, and then click **Apply**. Then, *Primary Test Manager* will load the hardware configuration saved in the job.

8 Create new manual jobs

Primary Test Manager assists you to create new manual jobs.

► To open the new manual job view, click the **New manual job** button  in the home view.

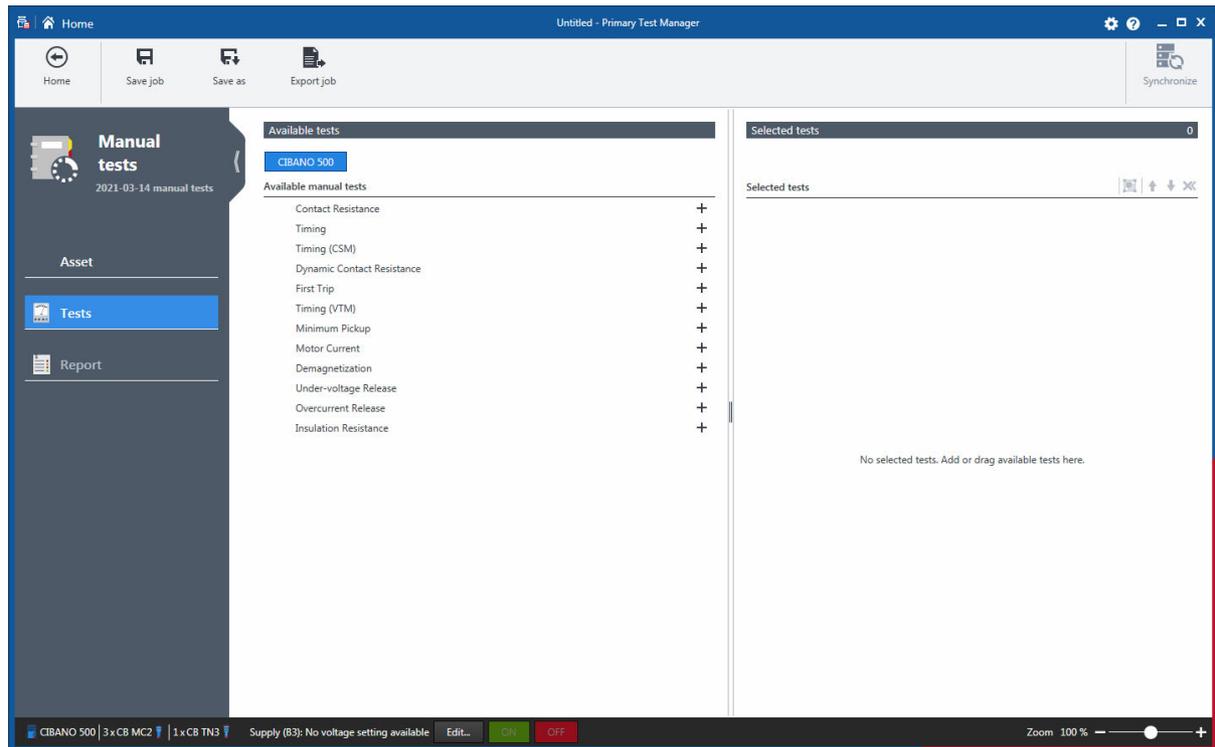


Figure 8-1: New manual job view

The workspace of the new manual job view depends on the selected button in the left pane (see Figure 8-2: "Left-pane buttons" on page 73):

- Initially, the workspace is divided into the **Available tests** area and the **Selected tests** area.
- If you click the **Asset** button, *Primary Test Manager* displays the general asset data (see 7.4.1 "General asset data" on page 61).
- If you click the **Tests** button, *Primary Test Manager* displays the **Available tests** area and the **Selected tests** area. In this workspace, you can add tests to a job (see 8.1 "Add tests to a job" on page 73).
- If you have added a test to a job and click the **Report** button, *Primary Test Manager* displays the report view (see 13 "Generate test reports" on page 93). In the report view, you can configure and generate test reports.

8.1 Add tests to a job

- ▶ On the top of the **Available tests** area, click the button labeled with the test system with which you want to perform the test.
Primary Test Manager then displays all available manual tests supported for the selected test system.
- ▶ To add a test to a job, click the **+** symbol next to the test name or double-click the test in the **Available tests** area.

The tests added to a job are displayed in the **Selected tests** area and in the left pane.

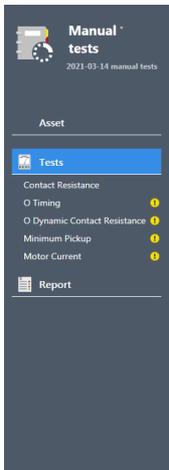


Figure 8-2: Left-pane buttons

Note: You can change the default test names. To rename a test, click the corresponding button in the left pane, and then click the test name.

- ▶ To remove a test from the **Selected tests** area, click the **X** symbol next to the test name in the left pane.
- ▶ To open a test, click the left-pane button with the test name.
- ▶ To add the currently open test to the job, click **Copy test** on the ribbon.

After you have opened a test, the workspace is split into the following areas:

- **Hardware configuration**
Displays the test-specific controls of the test set. For information on the hardware configuration options, see 17 "Off-service diagnostic methods" on page 116.
- **Settings and conditions**
Displays the basic test settings you typically need to configure the tests. For the test settings and conditions, see 17 "Off-service diagnostic methods" on page 116.
- **Advanced settings**
Displays the advanced settings for experienced users. For the advanced test settings, see 17 "Off-service diagnostic methods" on page 116.
- **Assessment**
Provides access to setting the assessment limits. For the assessment limit description, see 15.3 "Assessment limits" on page 106.

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- **Measurements**

Displays the measurement results. For more information, see 12 "Display measurement results" on page 87.

The following figure shows an example of the new manual job view if a test is open.

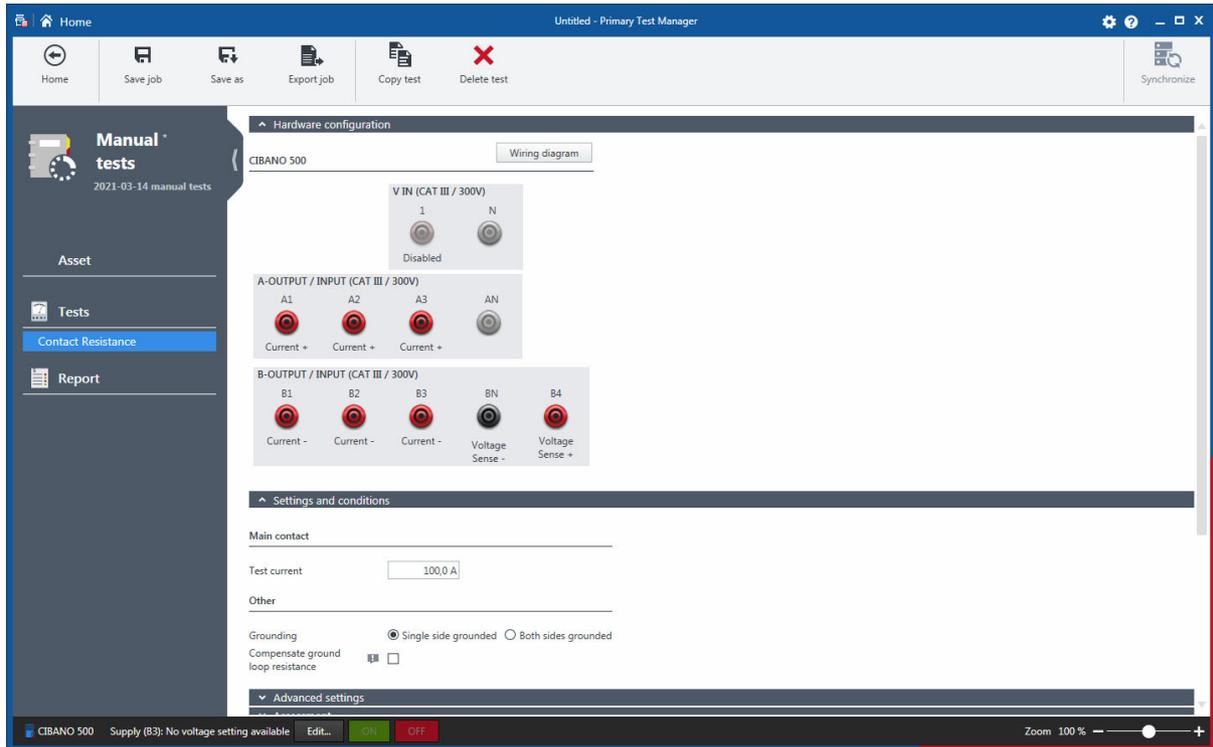


Figure 8-3: A test in the new manual job view

If you click the **Tests** button in the left pane, the workspace displays the **Available tests** area and the **Selected tests** area again.

8.2 Process tests

By using the commands on the ribbon, you can process tests. The following table describes the available operations.

Table 8-1: Operations on the manual jobs

Command	Action
Home	Closes the job displayed in the new manual job view and leads you to the <i>Primary Test Manager</i> home view. Before closing the job, you can save the changes for all tests.
Save job	Saves the job displayed in the new manual job view. When saving a job for the first time, you must specify the file name and directory of the job.
Save as	Saves the job displayed in the new manual job view in a newly specified directory.
Export job	Exports the job displayed in the new manual job view into a Microsoft Excel spreadsheet.
Copy test¹	Adds another test of the same kind and with the same settings to the test list. Results are not copied.
Delete test¹	Deletes the open test.

1. Only available if a test is open

9 Open jobs

With *Primary Test Manager*, you can open existing guided and manual jobs. To open a job:

1. Click the **Open job** button  in the home view.
2. Browse to the job you want to open.

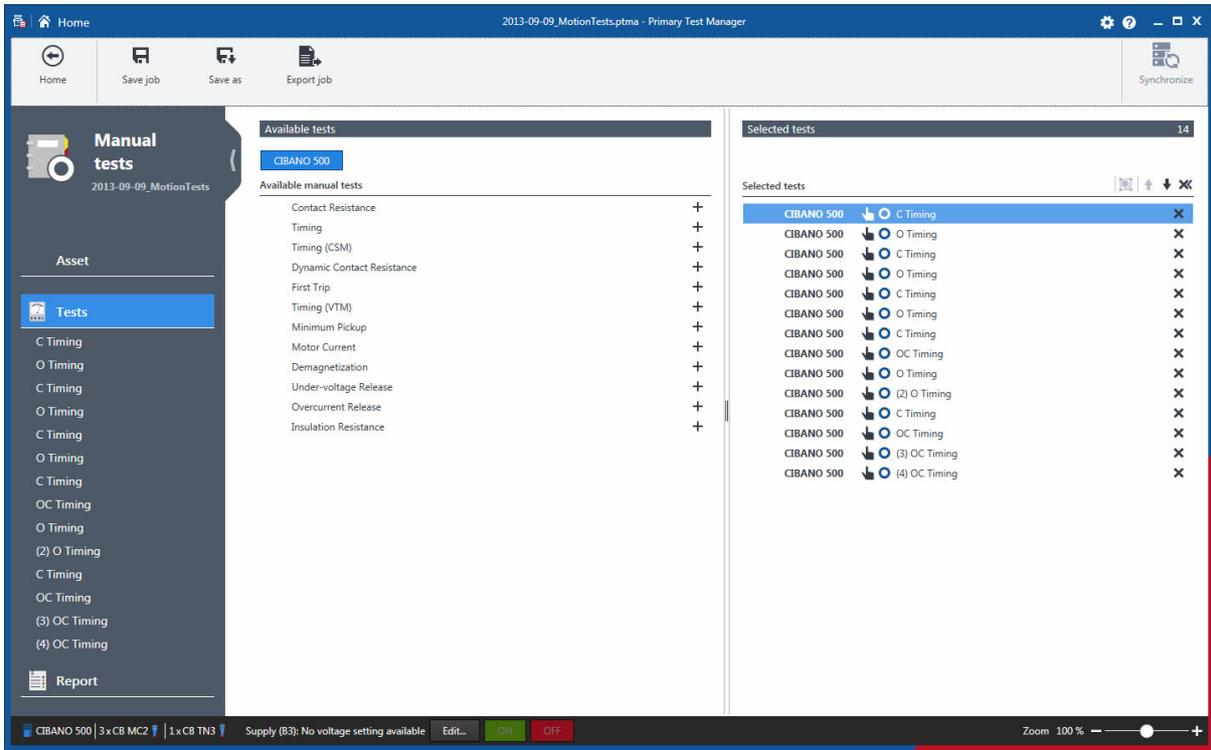


Figure 9-1: Open job view

The open job view displays the tests in the left pane. To view the test results, click the corresponding test button. You can add new tests to the job and process tests as described in 7 "Create new guided jobs" on page 50.

Note: The operating times for the Timing test and the Dynamic Contact Resistance test are calculated according to IEC 62271-100 standard. If you open a manual test performed with *Primary Test Manager* version 3.11 and earlier, the operating times are recalculated according to IEC 62271-100. The original data is still available on the **Legacy data** tab in the **Measurements** area. You can delete the original data irreversibly by clicking **Delete legacy data**.

10 Manage objects

In the manage view, you can manage locations, assets, jobs, and test reports available in *Primary Test Manager*.

► To open the manage view, click the **Manage** button  in the home view.

Note: In this chapter, the locations, assets, jobs, and test reports are collectively called objects.

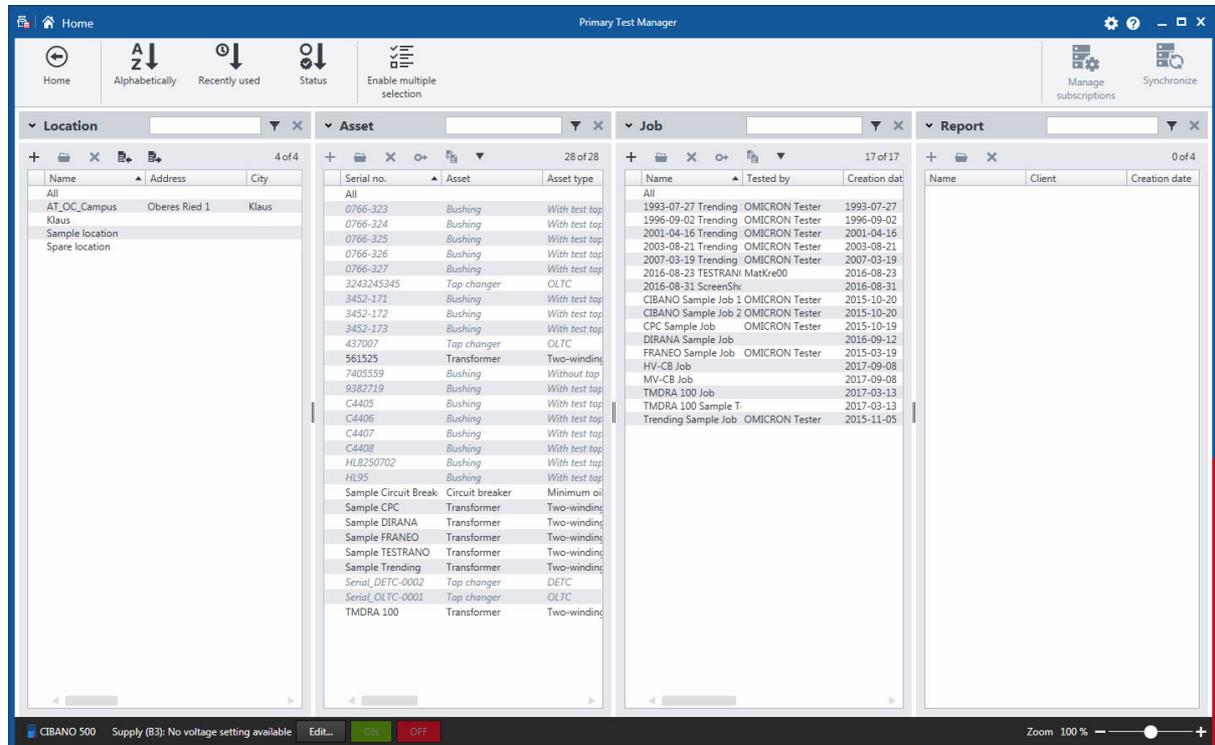


Figure 10-1: Manage view

Note: The mounted assets are displayed in italics. To hide them, expand the **Asset** area, and then select the **Hide mounted assets** check box.

The manage view displays the objects in a hierarchical structure as follows:

- If you select a location, the manage view displays the assets, jobs, and reports associated with the selected location.
 - If you select an asset, the manage view displays the jobs and reports associated with the selected asset.
 - If you select a job, the manage view displays the reports associated with the selected job.
- To sort the objects alphabetically, click **Alphabetically** on the ribbon.
 - To sort the objects in the chronological order, click **Recently used** on the ribbon.
 - To sort the objects according to the job status, click **Status** on the ribbon.
 - To rearrange the columns, drag and drop the column headers.

In the manage view, you can:

- Search for objects
- Perform operations on objects
- Relocate assets
- Import and export jobs

10.1 Search for objects

In the manage view, you can search for the objects available in *Primary Test Manager*:

- By searching for keywords in all object data
- By searching for keywords in particular object data
- ▶ To search for keywords in all object data, type the keyword you search for in the respective search box.

To search for keywords in particular object data:

1. Expand the **Location**, **Asset**, **Job** and **Report** areas.
2. Type the keyword(s) you search for in the respective object data box(es).

The following table describes the location search data.

Table 10-1: Location search data

Data	Description
Name	Name of the location
Address	Address of the location
City	City where the asset is located
State/Province	State or province where the asset is located
Postal code	Postal code of the location
Country	Country where the asset is located
Company	Company the asset belongs to

The following table describes the asset search data.

Table 10-2: Asset search data

Data	Description
Asset kind	Asset under test
Asset type	Type of the asset
Serial no.	Serial number of the asset
Manufacturer	Manufacturer of the asset
Manufacturer type	Type of the asset according to the manufacturer
Asset system code	Code of the asset used by the maintenance planning systems
Apparatus ID	Identifier of the asset
Feeder	Feeder the asset is connected to

The following table describes the job search data.

Table 10-3: Job search data

Data	Description
Name	Name of the job
Work order	Work order of the job
Tested by	Person who performed the test
Executed between	Time period within which the job was executed
Status	Status of the job

The following table describes the report search data.

Table 10-4: Report search data

Data	Description
Name	Name of the report
Client	Customer for which the report is designated
Created between	Time period within which the report was created

10.2 Perform operations on objects

To perform operations on objects, select an object from the respective list, and then do one of the following:

- ▶ Click the **Create new *object*** button  to add a new object of the same category.
- ▶ Click the **Open selected *object*** button  to display the data of the selected object.
- ▶ Click the **Delete selected *object*** button  to delete the selected object.

Additionally, you can copy jobs with the associated location, asset and test data. The test results and reports are not copied. To copy a job:

1. Select the job you want to copy.
2. Click the **Copy selected job** button .

To perform operations on multiple objects, click **Enable multiple selection** on the ribbon, and then do one of the following:

- ▶ To delete multiple locations, assets, jobs, and test reports, select the check boxes next to the objects you want to delete, and then click the **Delete selected object(s)** button .
- ▶ To export multiple jobs, select the check boxes next to the jobs you want to export, and then click the **Export** button .

10.3 Understanding the master locations and assets

Primary Test Manager supports master locations and assets to help you keep your data consistent. When you create a job, the location and asset associated with the job – called master location and master asset, respectively – are copied to the job.

Consequently, whenever you try to change the location or the asset of an existing job, a notification bar at the top of the *Primary Test Manager* workspace prompts you to do one of the following:

- ▶ Click **Import from master location** or **Import from master asset** to import the location or asset originally associated with the job (master location/asset) to the current job.
- ▶ Click **Update master location** or **Update master asset** to update the location or asset originally associated with the job (master location/asset) with the data of the current job.

10.4 Duplicate assets

In the manage view, you can duplicate assets available in *Primary Test Manager*. To duplicate an asset:

1. From the **Asset** list, select the asset you want to duplicate.
2. Click the **Duplicate selected asset** button .
3. In the asset view, type the serial number of the new asset.

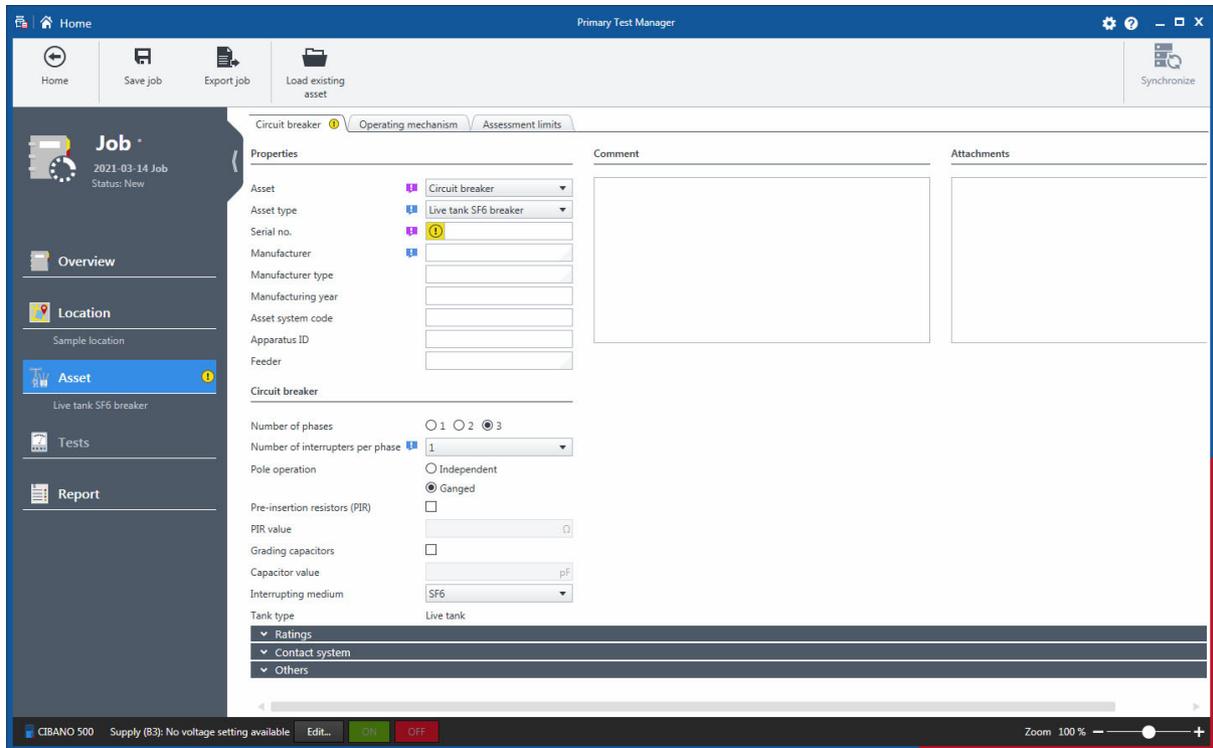


Figure 10-2: Asset view

4. Click **Save asset** on the ribbon.

Note: By default, the duplicated assets are linked to the location of the original asset. For relocating the asset to a different location, see 10.5 "Relocate assets" later in this chapter.

10.5 Relocate assets

In the manage view, you can relocate assets available in *Primary Test Manager*. To relocate an asset:

1. From the **Asset** list, select the asset you want to relocate.
2. Click the **Relocate selected asset** button .

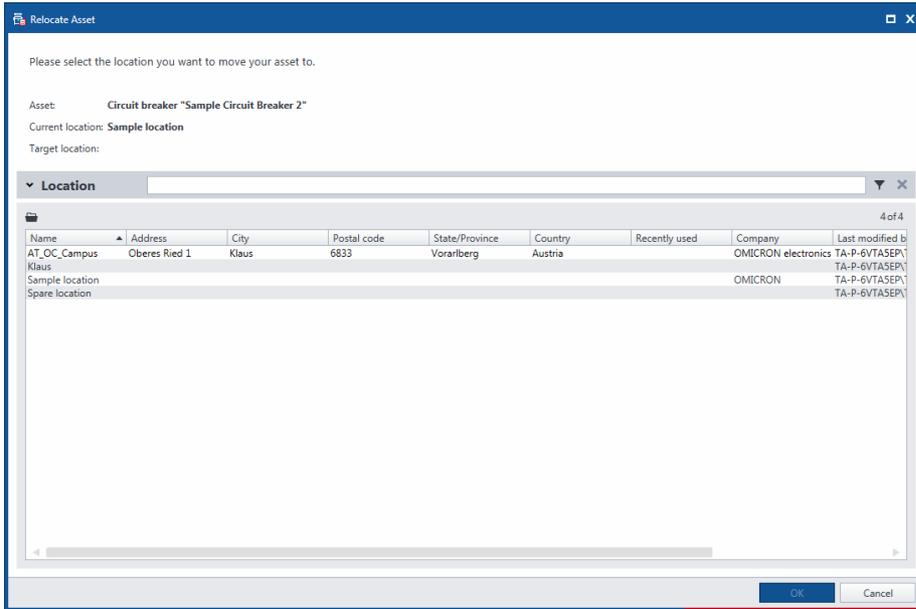


Figure 10-3: **Relocate Asset** dialog box

3. In the **Relocate Asset** dialog box, select the location you want to move the asset to.
4. If the asset you want to relocate is mountable, select an asset where the moved asset is to be mounted.

Note: You can filter the locations and assets by searching for keywords (see 10.1 "Search for objects" on page 78).

10.6 Export and import jobs

Primary Test Manager supports data exchange between different test systems.

You can export jobs in the *Primary Test Manager* native PTM format and as Microsoft Excel documents.

To export a job:

1. From the **Job** list, select the job you want to export.
2. Click the **Export** button , and then click **Export to file**.
3. Browse to the folder where you want to save the job.

You can import *Primary Test Manager* jobs from file and from data stored with the Megger *CABAWin* software.

Note: When importing the jobs with the Megger *CABAWin* software, also the assessment limits are imported as read-only.

To import a job from file:

1. In the **Job** area, click the **Import** button , and then click **Import from file**.
2. Browse to the file you want to import.

Primary Test Manager supports the following formats for import from file.

Table 10-5: Supported formats for import from file

File name extension	Description
.ptm	<i>Primary Test Manager</i> native exchange format
.ptma	Format for import of manual test data. ¹

1. To import manual test data, you must select the corresponding asset in the manage view.

To import a job from data stored with the Megger *CABAWin* software:

1. In the **Job** area, click the **Import** button , and then click **Import from Megger CABAWin**.

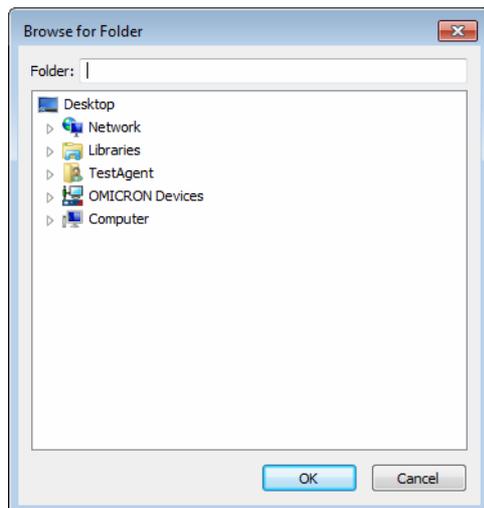


Figure 10-4: **Browse For Folder** dialog box

2. In the **Browse For Folder** dialog box, browse to the directory where your Megger *CABAWin* data is stored, for example, C:\Program Files (x86)\Programma\CABAWIN\Spec.
3. Select the folder one level above the plan and test folders, and then click **OK**.

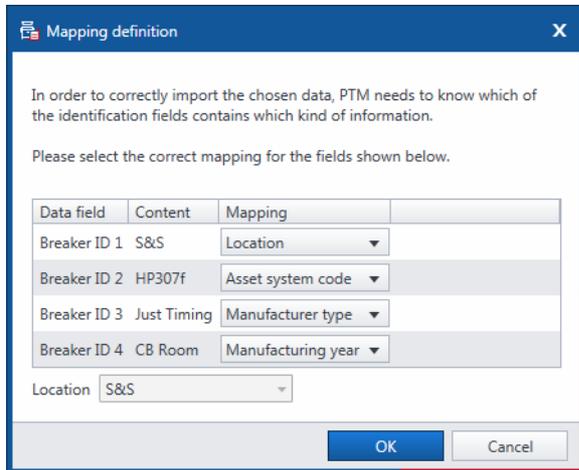


Figure 10-5: **Mapping definition** dialog box

4. In the **Mapping definition** dialog box, map the data fields to the location name and general asset data, if applicable.
5. If you have not mapped any data field to the location name, you can enter a location name in the **Location** box.
6. Click **OK** to confirm the mapping. If you entered a location name in the **Location** box, *Primary Test Manager* will create a new location with the entered name.

11 Control tests

In the **Measurements** area of *Primary Test Manager*, you can control the test execution and check the circuit breaker state.



Figure 11-1: Part of the **Measurements** area with the test control commands and circuit breaker state indicators

11.1 Test control commands

The following table describes the commands for controlling tests.

Note: Not all test control commands are available for all tests.

Table 11-1: Test control commands

Command	Action
Start/Start all	Starts the selected measurement/all measurements of the currently open test.
Stop/Stop all	Stops the running measurement/measurements.
Clear all	Deletes all measurement results of the currently open test.
Open breaker	Opens the circuit breaker's main contacts.
Close breaker	Closes the circuit breaker's main contacts.
Supply motor	Starts charging the circuit breaker's motor. The measurement stops automatically when the motor is fully charged.
Clear result	Deletes the results of the selected measurement.
Delete measurement	Deletes the selected measurement row.
Add measurement	Adds a new measurement row to the currently open test.
Refresh	Updates the circuit breaker state.

11.2 Checking the circuit breaker state

With *Primary Test Manager*, you can check the circuit breaker state for the following tests:

- 17.1.5 "Timing test with CIBANO 500 and the EtherCAT® module" on page 127
- 17.1.6 "Timing test with CIBANO 500 and the Auxiliary module" on page 136
- 17.5.1 "Timing test" on page 259

Table 11-2: Circuit breaker state indicators

Indicator	Description
	Indicates the open state of the circuit breaker.
	Indicates the closed state of the circuit breaker.
	Indicates that the state of the circuit breaker's phase could not be detected.

Primary Test Manager updates the circuit breaker state automatically after:

- You opened a test with the circuit breaker state indication.
- A measurement has finished.
- You reset or restored the hardware configuration.
- You reconfigured a *CIBANO 500* channel from Main contact *x* to Closed *x*, Motor *x* or Disabled.

You can update the circuit breaker state manually by clicking **Refresh**.

Note: The detection of the circuit breaker state produces clicking sound in *CIBANO 500*.

12 Display measurement results

For some tests, *Primary Test Manager* provides graphical display of measurement results. The graphical display of the measurement results consists of the following parts: cursors, binary traces and analog traces. *Primary Test Manager* displays the analog traces in the oscilloscope view.

- To display the measurement results graphically, click the **Plot** tab in the **Measurements** area, if available.

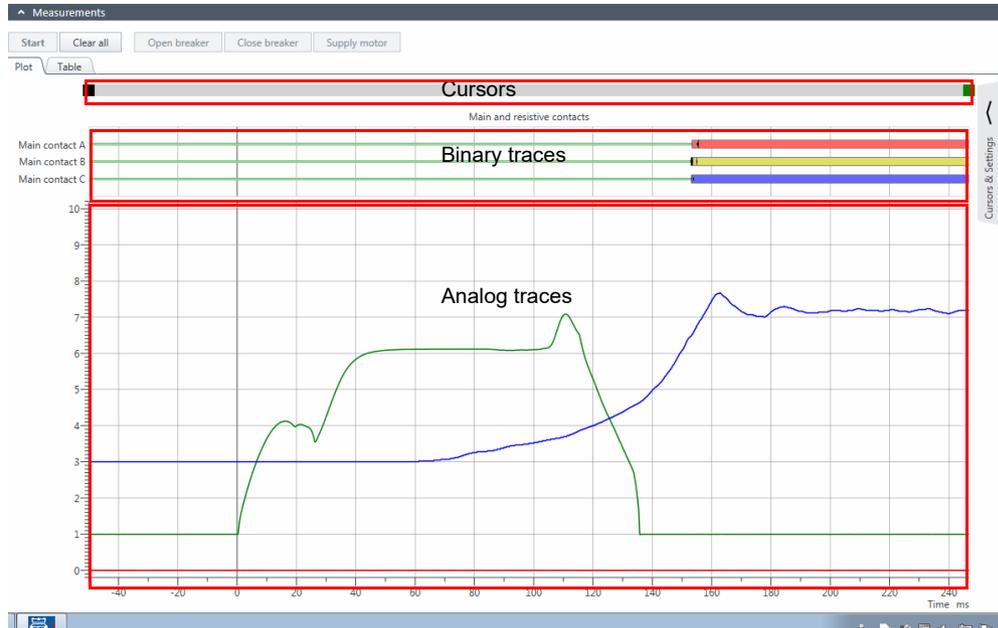


Figure 12-1: Example of the graphical display of measurement data

- To open a workspace for setting the cursors and graphical display options, click the arrow next to **Cursors & Settings** in the upper-right corner of the window.

12.1 Cursor and graphical display options

Cursors tab

The graphical display provides two cursors for measuring the analog traces data. To read the data, move the cursors in the cursor part of the graphical display. On the **Cursors** tab, you can view the measurement results marked by the cursor 1 (C1), the measurement results marked by the cursor 2 (C2), and the difference between the two values (C2–C1). The **Cursors** tab displays the measured analog traces selected on the **Settings** tab (for more information, see "Settings tab" later in this section).

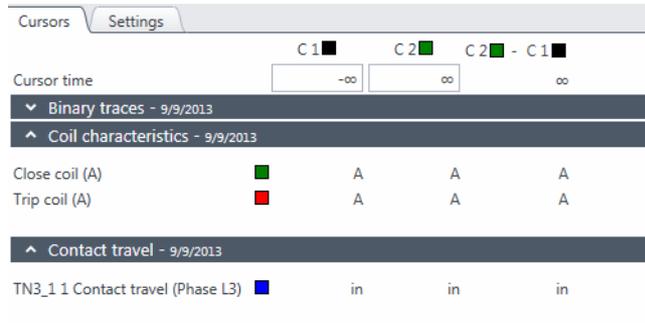


Figure 12-2: Cursors & settings workspace: **Cursors** tab

Settings tab

► To set your preferred graphical display options, click the **Settings** tab.

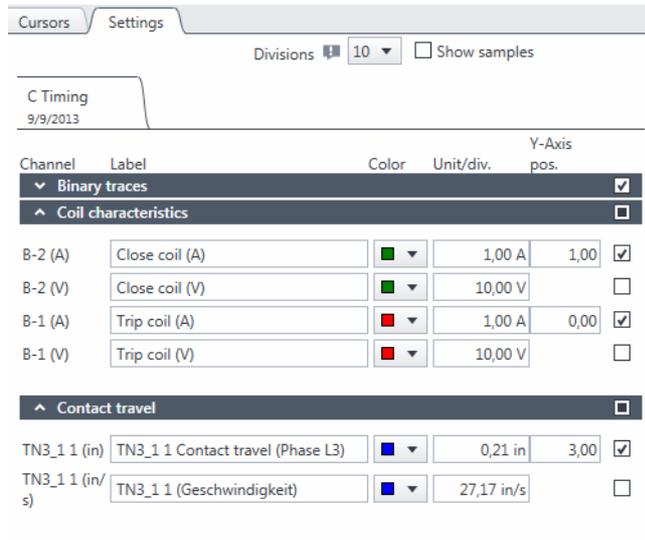


Figure 12-3: Cursors & settings workspace: **Settings** tab

On the **Settings** tab, you can do the following settings.

Table 12-1: Graphical display settings

Setting	Description
Divisions	Number of the graphical display divisions according to the ruler on the Y-axis
Show samples	Select the Show samples check box to display only the measured values.
Channel	Channels of <i>CIBANO 500</i> and the connected external modules
Label	Editable label of the analog trace
Color	Color of the analog trace
Unit/div.	Number of units per division
Y-axis position	Number of units (offset) the analog trace is displaced from 0

Because the graphical display may contain curves with different units, for example, Volts, Amperes or Ohms, the scale on the Y-axis has no units but a unitless numbers called division (div). On the **Settings** tab, you can set how many, for example, Amperes shows the graphical display per division. As an example, the B-2 (A) channel in Figure 12-1: "Example of the graphical display of measurement data" on page 87 has its highest peak at the seventh division. As the offset on the Y-axis is 1 division and the magnitude is 1 A/div (see Figure 12-3: "Cursors & settings workspace: Settings tab" on page 88), the peak close coil current is approx. $(7-1) \times 1 = 6$ A.

► To display a binary or analog trace, select the check box next to the trace.

Note: You can save all changes made to the graphical display options on the **Settings** tab. To save the changes you have done, click **Save job** on the ribbon. The changed settings are reflected also in the test reports.

► To display the numerical measurement results, click the **Table** tab in the **Measurements** area. For the measurement data description, see "Measurement data" of the relevant test in 17 "Off-service diagnostic methods" on page 116 and 18 "In-service diagnostic methods" on page 286.

12.2 Graphical comparison

Note: Graphical comparison is available only in the guided workflow.

With *Primary Test Manager*, you can visually compare up to ten measurement results. A typical use case is to compare the latest measurement results with a previous measurement at the same circuit breaker. To compare the measurement results:

1. In *Primary Test Manager*, open the test you want to compare with other tests.
2. In the **Measurements** area, click the **Plot** tab.
3. Expand the Cursors & settings workspace on the right side of the **Plot** tab, and then click the **Settings** tab.

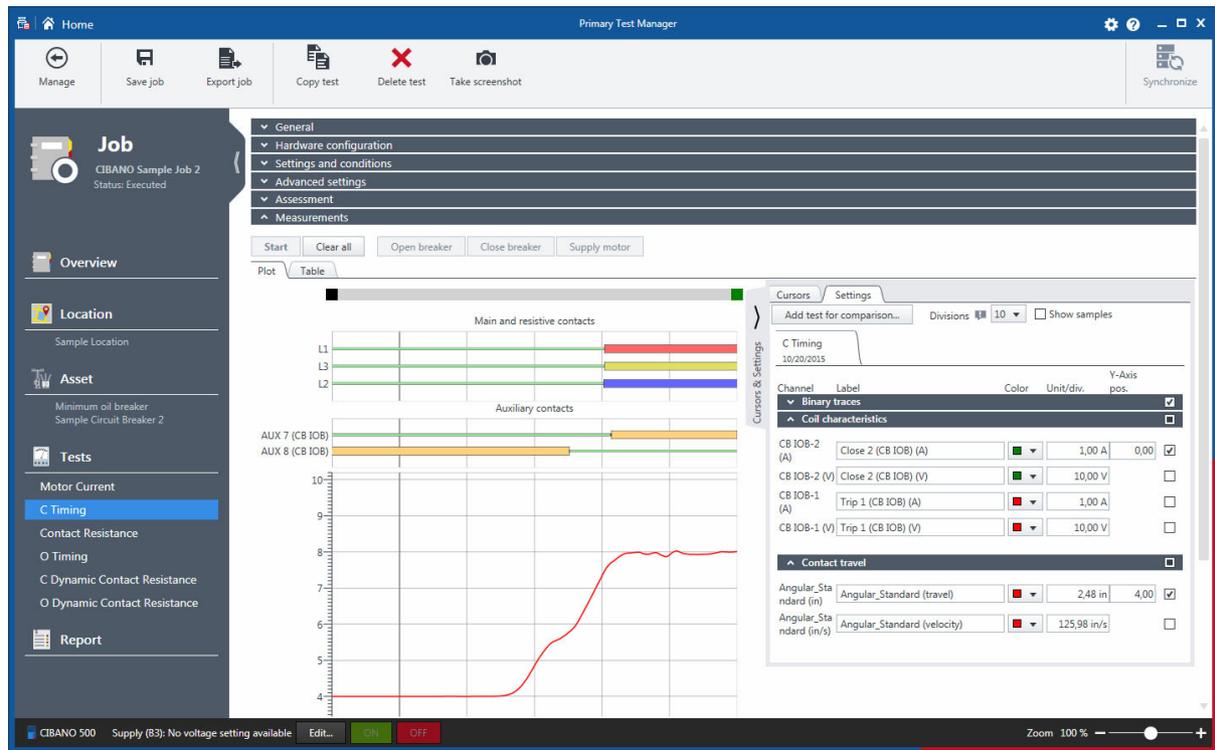


Figure 12-4: Processing the graphical comparison

4. On the **Settings** tab, click **Add test for comparison**.

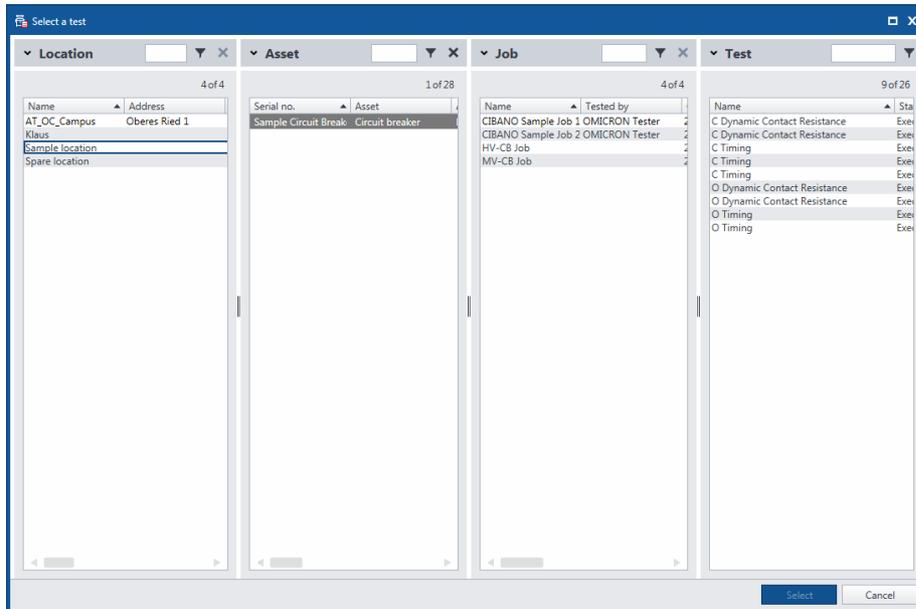


Figure 12-5: Selecting a test for comparison

5. In the **Select a test** dialog box, select the test you want to compare with the currently open test. You can search for the locations, assets, jobs and tests as described in 10.1 "Search for objects" on page 78.
6. *Primary Test Manager* appends the test you added for comparison on a new tab in the Cursors & Settings workspace, and the corresponding binary and analog traces appear in the graphical display.
7. Set the graphical display options for the traces you want to compare.
8. Repeat steps 5 to 7 for all tests you want to compare.

NOTICE

Loss of information possible

The graphical comparison information is not saved in the job. After you close the currently open job, the graphical comparison information will be lost.

- ▶ To save the graphical comparison information, take a screenshot (see 7.1 "Guided test workflow" on page 51) of the **Measurements** area. You can then attach the screenshot to the test report (see 13 "Generate test reports" on page 93).

The following figure shows an example of the graphical comparison.

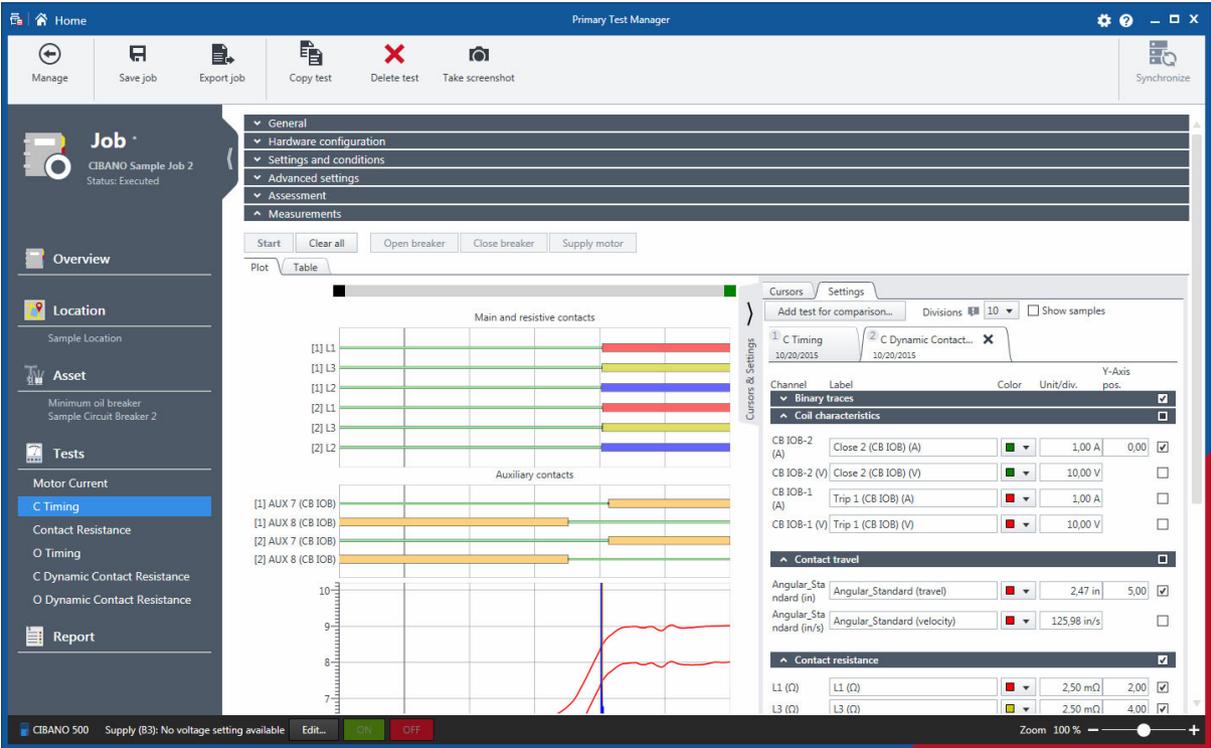


Figure 12-6: Example of the graphical comparison of two measurements on the same asset

13 Generate test reports

In the report view, you can configure and generate test reports.

- To open the report view, click the **Report** button  in the left pane.

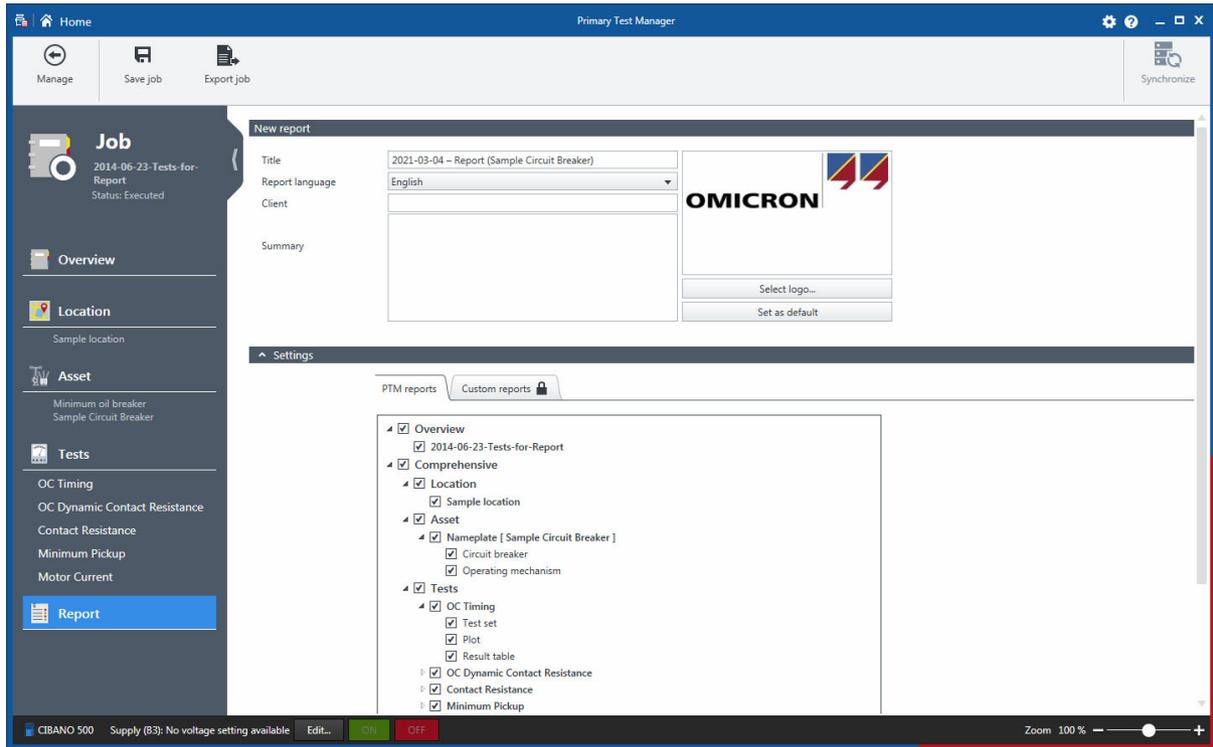


Figure 13-1: Report view

The report view is divided into the **New report** area, the **Settings** area and the **Existing reports** area.

13.1 Setting the report data

In the **New report** area, you can set the report data. The following table describes the report data.

Table 13-1: Report data

Data	Description
Title	Title of the report. Appears as the report header.
Report language	Language the report is created in
Client	Customer for which the report is designated
Summary	Text field to summarize the content of the test report in own words

Setting the logo

To insert your own logo:

1. In the **New report** area, click **Select logo**.
2. Browse to the file you want to insert.
 - ▶ To set your own logo as default, click **Set as default**.

13.2 Generating test reports

In the **Settings** area, you can generate standard test reports or design your own Excel reports.

13.2.1 Standard test reports

- ▶ To generate a standard test report, click the **PTM reports** tab in the **Settings** area, and then configure the test report by selecting the respective check boxes.

You can generate test reports as Microsoft Word documents or in PDF format.

- ▶ To generate a test report in your preferred format, click **Report to Word** or **Report as PDF**.

13.2.2 Customized Excel reports

With *Primary Test Manager*, you can generate Microsoft Excel reports to tailor test reports to your needs.

Note: To design the customized Excel reports, you must have the *PTM Report Designer* add-in installed on your computer. You can download the *PTM Report Designer* add-in from the OMICRON Customer Portal.

To generate a customized test report:

1. In the **Settings** area, click the **Custom reports** tab.
2. Click **Report Designer**.
3. Click **Create Report Template** to create a new report template or click **Choose an Existing Template** to use an available template.
4. Click **Design** to design a report template as described in detail in 13.2.3 "Designing the Excel report templates" later in this section. To download the *PTM Report Designer* add-in from the OMICRON Customer Portal, click [PTM Report Designer Add-in](#), and then download and execute the CRDAddInSetup_1.00_x86 (1).exe file.
5. Click **Preview** to display the test report by using the report template.
6. Click **Add** to add the customized report template to the list of available Excel report templates.
7. To generate the test report in your preferred format, click **Report to Excel** or **Report as PDF**.

In the list of available Excel report templates, you can manage the templates by using the **Open** , **Add**  and **Remove**  buttons.

13.2.3 Designing the Excel report templates

This section describes how to design report templates in Microsoft Excel. With the *PTM Report Designer* add-in installed on your computer, the Excel workbook displays the **PTM Report Designer** menu and the default **Report Model** view on the right.

- ▶ To load your own report model, click **Load Model** on the ribbon, and then browse to the report model you want to use.

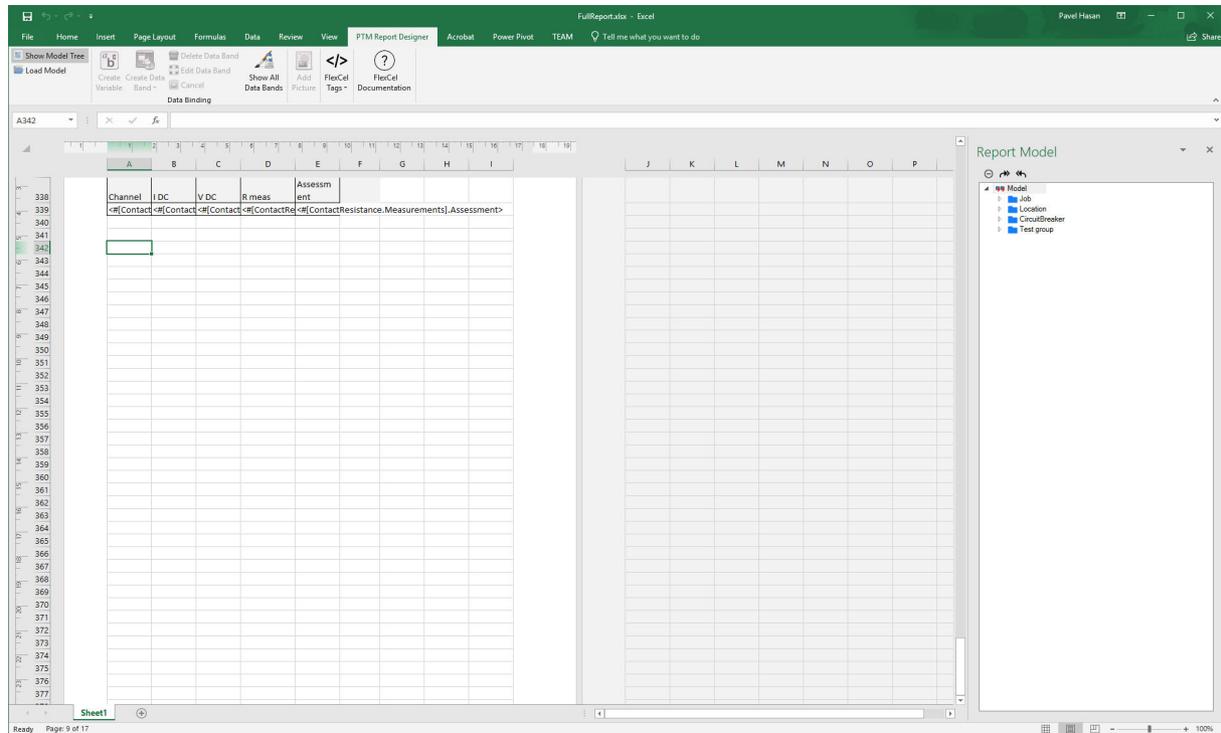


Figure 13-2: Blank Excel workbook with *PTM Report Designer* add-in

Create simple properties

To create simple properties in the Excel report template:

1. Select the simple property you want to create from the **Report Model** view.
2. In the Excel worksheet, select the cell where you want to place the property.
3. Click **Create Variable** on the ribbon or double-click the property in the **Report Model** view.

Use FlexCel tags

The **FlexCel tags** **</>** button on the ribbon provides three tags which help you manage the FlexCel syntax. To edit the syntax of a cell:

1. In the Excel worksheet, select the cell the syntax of which you want to edit.
2. Click the **FlexCel tags** **</>** button on the ribbon, and then select the tag you want to apply to the cell.

Add graphics

To add a graphic to the report template:

1. In the **Report Model** view, select the graphic you want to add to the report template.
2. In the Excel worksheet, select the cell where you want to place the graphic.
3. Click **Add Picture** on the ribbon.

Create data bands

Some data in the report model can be organized in a list format. You can represent this data in the report template by data bands. To create a data band:

1. Select a list item from the **Report Model** view.
2. In the Excel worksheet, select the cells where you want to place the data band.
3. Click the **Create Data Band** button on the ribbon, and then select the data band type.

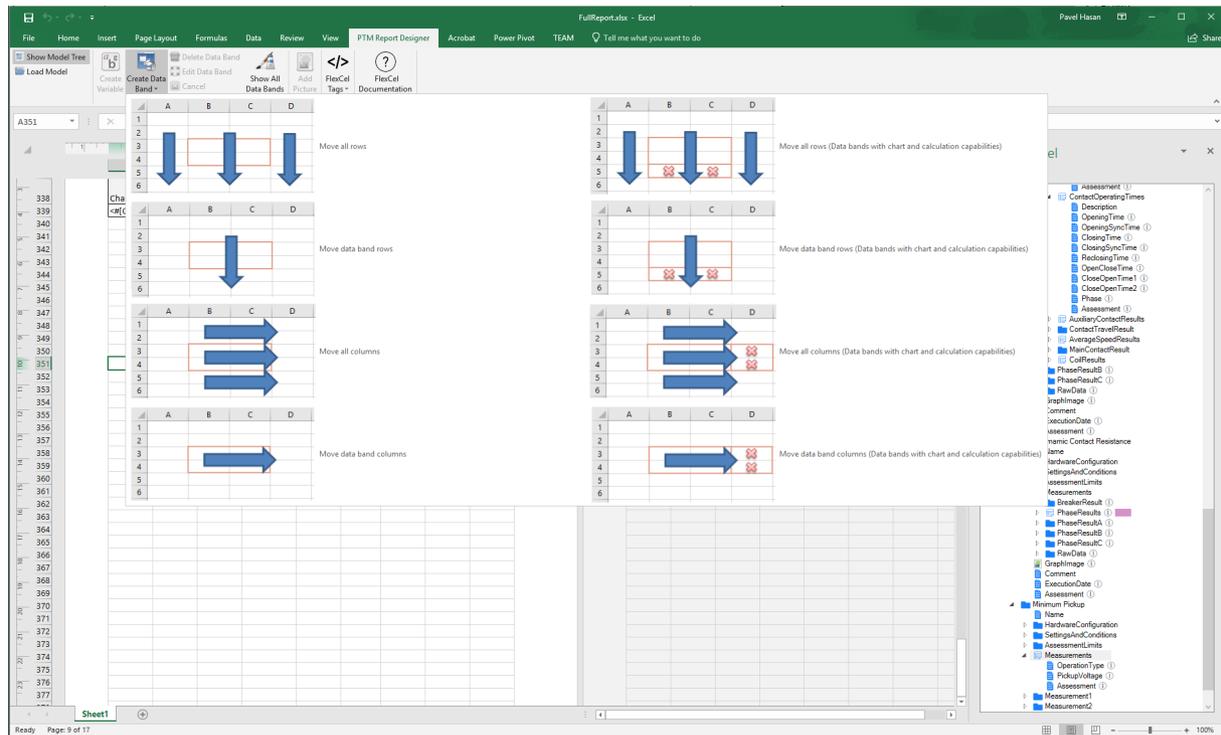


Figure 13-3: Data band types

4. After the data band has been created, the list item in the **Report Model** view is marked by a colored rectangle.

13.3 Adding reports from file

The **Existing reports** area displays the test reports available for the job. In addition to the test reports generated by *Primary Test Manager*, you can add other reports to jobs. To add a report to a job:

1. In the **Existing reports** area, click **Add report from file**.
2. Browse to the report you want to add to the job.

14 Circuit Breaker Testing Library

The *Circuit Breaker Testing Library (CBTL)* is a database of circuit breakers provided by OMICRON. You can use it to specify your assets by loading the available data from the library into *Primary Test Manager*. You can find a list of circuit breakers available in the *CBTL* on the OMICRON Customer Portal.

To go to this site:

1. Visit our website at www.omicronenergy.com, and then log in to the Customer Portal.
2. On the menu, click **Software**, and then click **CIBANO 500**.
3. On the navigation bar on the left, click **Circuit Breaker Testing Library (CBTL)**, and then click [CBTL \(Page\)](#).

14.1 Licensing

To use the *Circuit Breaker Testing Library*, you need a license. To get the license, contact your regional OMICRON Service Center or sales partner. You can find our Service Center or sales partner closest to you at www.omicronenergy.com. For information on how to enter the license key, see 6.4 "About" on page 43.

14.2 Installation

You can install the *Circuit Breaker Testing Library* by running the installation file *CBTLSetup X.YZ SR1.exe*, where *X.YZ* is the *Primary Test Manager* version. You can find the installation file:

- On the delivered *Circuit Breaker Testing Library* DVD at *.\CBTLSetup X.YZ SR1.exe*
- On the OMICRON Customer Portal
To get the installation file, go to the **Circuit Breaker Testing Library (CBTL)** page as described earlier in this section.

► To install the *Circuit Breaker Testing Library*, double-click the installation file.

14.3 Updating the *CBTL*

The installed *Circuit Breaker Testing Library* is periodically checked for updates. If an update is available, the *CBTL* updater will prompt you to update the library. To update the *CBTL* without the prompt:

1. On the taskbar, click the **Start** button.
2. Expand the **OMICRON** folder, and then click **Check for Circuit Breaker Testing Library updates**.

14.4 Customizing the *CBTL*

You can customize the OMICRON *Circuit Breaker Testing Library* by adding your own asset data.

To add asset data to the *Circuit Breaker Testing Library*:

1. In the asset view, specify the asset.
2. Click **Save to asset library** on the ribbon.

You can export and import your own asset data from and into the *Circuit Breaker Testing Library* in PTMLIB format.

To export asset data from the *Circuit Breaker Testing Library*:

1. On the **Templates and libraries** tab of the **Settings** dialog box, select the asset you want to export.

Note: You can filter the displayed data. To display the job templates, OMICRON CBTL data and your own asset data, select the respective check boxes.

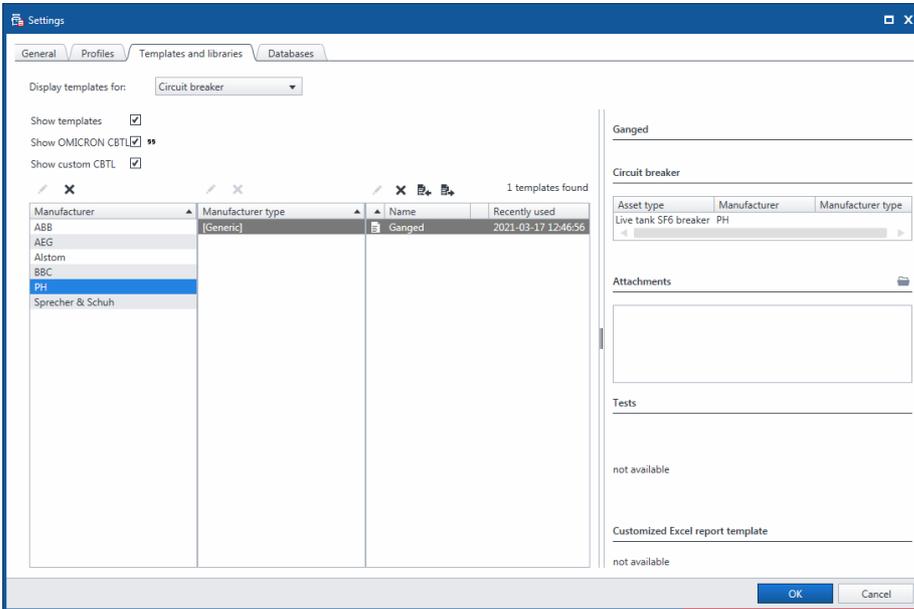


Figure 14-1: Exporting asset data into the *Circuit Breaker Testing Library*

2. Click the **Export the selected template** button .
3. Browse to the folder where you want to save the file.

To import asset data into the *Circuit Breaker Testing Library*:

1. On the **Templates and libraries** tab of the **Settings** dialog box, click the **Import template** button .
2. Browse to the file you want to import.

14.5 Working with the *CBTL*

To load data from the *Circuit Breaker Testing Library*:

1. In the asset view, select **Circuit breaker** from the **Asset** list.

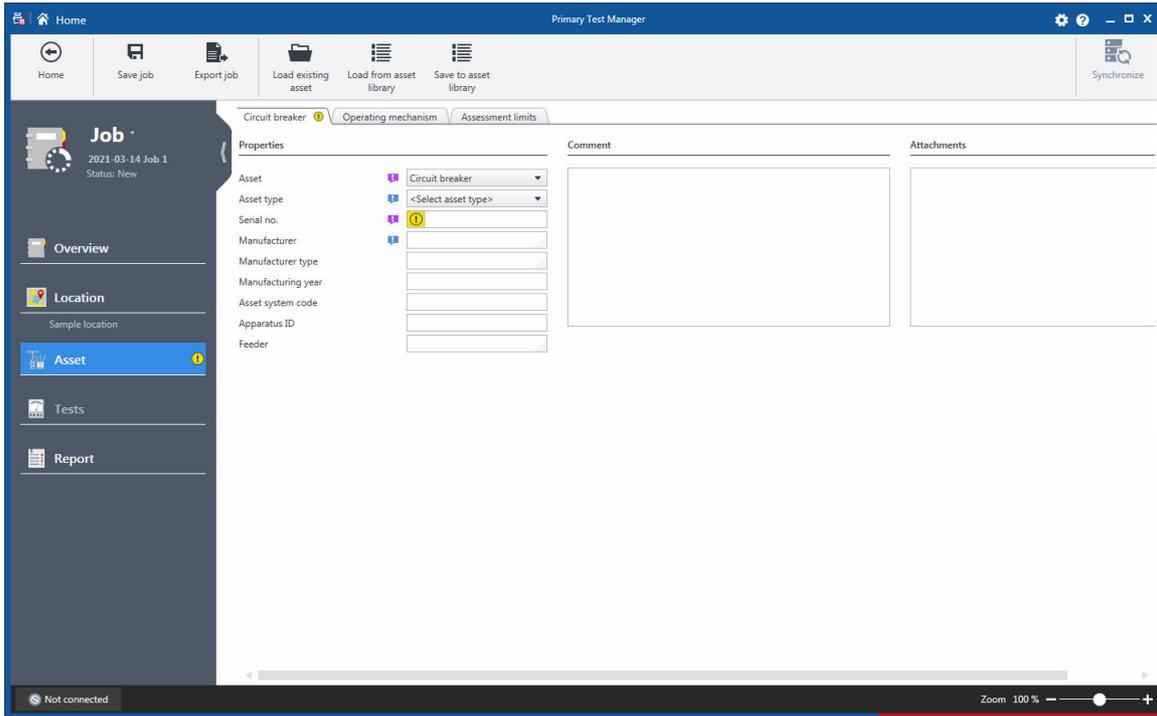


Figure 14-2: Loading data from the *Circuit Breaker Testing Library*

2. Click **Load from asset library** on the ribbon.

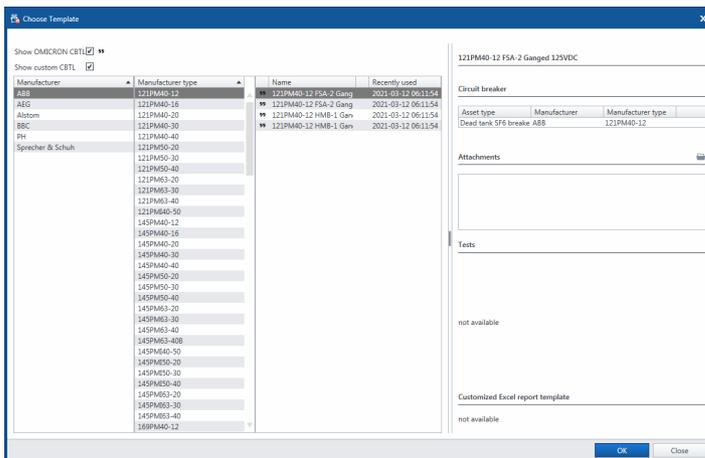


Figure 14-3: **Choose Template** dialog box

3. In the **Choose Template** dialog box, select the manufacturer, the manufacturer type and the name of the circuit breaker you want to specify, and then click **OK**.

15 Circuit breaker data

The following table describes the circuit breaker data.

Table 15-1: Circuit breaker data

Data	Description
Circuit breaker	
Number of phases	Number of the circuit breaker's phases
Number of interrupters per phase	Number of the circuit breaker's interrupters per phase
Pole operation	Pole operation of the circuit breaker
Pre-insertion resistors (PIR)	Select the Pre-insertion resistors (PIR) check box if the circuit breaker contains pre-insertion resistors.
PIR value	Pre-insertion resistor value
Grading capacitors	Select the Grading capacitors check box if the circuit breaker contains grading capacitors.
Capacitor value	Grading capacitor value
Interrupting medium	Interrupting medium of the circuit breaker
Tank type	Type of the circuit breaker's tank
Ratings	
Rated frequency	Rated frequency of the circuit breaker
Rated voltage L-L	Rated voltage of the circuit breaker
Rated current	Rated current of the circuit breaker
Rated short-circuit breaking current	Rated short-circuit breaking current of the circuit breaker
Short-circuit nominal duration	Nominal duration of the short-circuiting
Rated insulation level (BIL)	Basic impulse level rating of the circuit breaker
Rated interrupting time	Rated interrupting time of the circuit breaker
Interrupting duty cycle	Interrupting duty cycle of the circuit breaker
Rated power at closing	Rated power of the circuit breaker at closing
Rated power at opening	Rated power of the circuit breaker at opening
Rated power at motor charge	Rated power of the circuit breaker at motor charge
Contact system	
Nominal total travel	Total distance traveled by the contact during operation (excluding possible over-travel) For more information, see Figure 17-56: "Contact travel characteristics" on page 268.

Table 15-1: Circuit breaker data (continued)

Data	Description
Damping time	Time in which the damping units are engaged to decelerate the circuit breaker's moving contacts
Nozzle length	Length of the circuit breaker's nozzle
Others¹	
Total weight with oil/gas	Total weight of the circuit breaker with oil or gas
Weight of oil/gas	Weight of the circuit breaker's oil or gas
Volume of oil/gas	Volume of the circuit breaker's oil or gas
Rated gas pressure	Rated gas pressure of the circuit breaker at given temperature
Comment	Comment on the circuit breaker
Attachments	Attachments to the circuit breaker (see "Managing attachments" later in this chapter)

1. Depending on the circuit breaker type

Managing attachments

Under **Attachments**, you can manage attachments to circuit breakers.

To add an attachment to a circuit breaker:

1. Click the **Add** button .
2. In the **Select Files** dialog box, browse to the file you want to attach to the circuit breaker.

To open an attachment, do one of the following:

- ▶ Select the attachment, and then click the **Open** button .
- ▶ Double click the attachment.

To delete an attachment from a circuit breaker:

1. Select the attachment you want to delete.
2. Click the **Remove** button .

15.1 Operating mechanism data

The following table describes the data of the circuit breaker's operating mechanism.

Table 15-2: Operating mechanism data

Data	Description
Number of trip coils	Number of trip coils to operate the circuit breaker
Number of close coils	Number of close coils to operate the circuit breaker
Component	Operating mechanism's component
Rated voltage	Rated voltage of the operating mechanism's component
Rated current	Rated current of the operating mechanism's component
DC	Select the DC check box to set the component's DC operation
AC	Select the AC check box to set the component's AC operation
Frequency	AC operation frequency
Rated operating pressure ¹	Rated operating pressure of the operating mechanism at given temperature
Conversion tables	
Name	Name of the conversion table
Comment	Comment on the conversion table

1. Only available for the hydraulic and pneumatic operating mechanisms

Conversion tables

To perform motion measurements on a circuit breaker a travel transducer needs to be applied to the mechanical linkage. One goal of the motion measurement method is the assessment of the main contacts within the interrupter unit. However, the interrupter units are not accessible by the motion sensor directly. Therefore the sensors are applied to the connecting rod or the drive lever on the outside of the interrupter unit. In order to still be able to get the motion path of the main contacts, you can calculate it based on the measurements taken by the motion sensor.

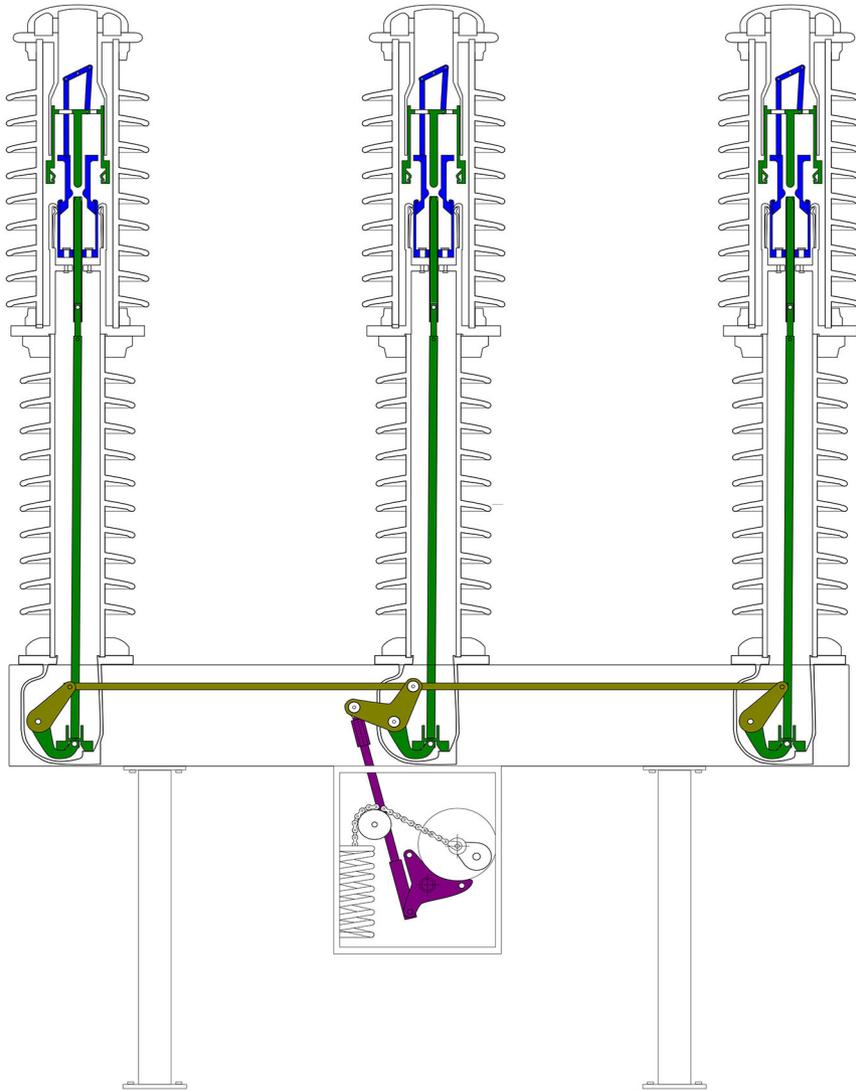


Figure 15-1: Mechanical linkage of a live-tank high-voltage circuit breaker

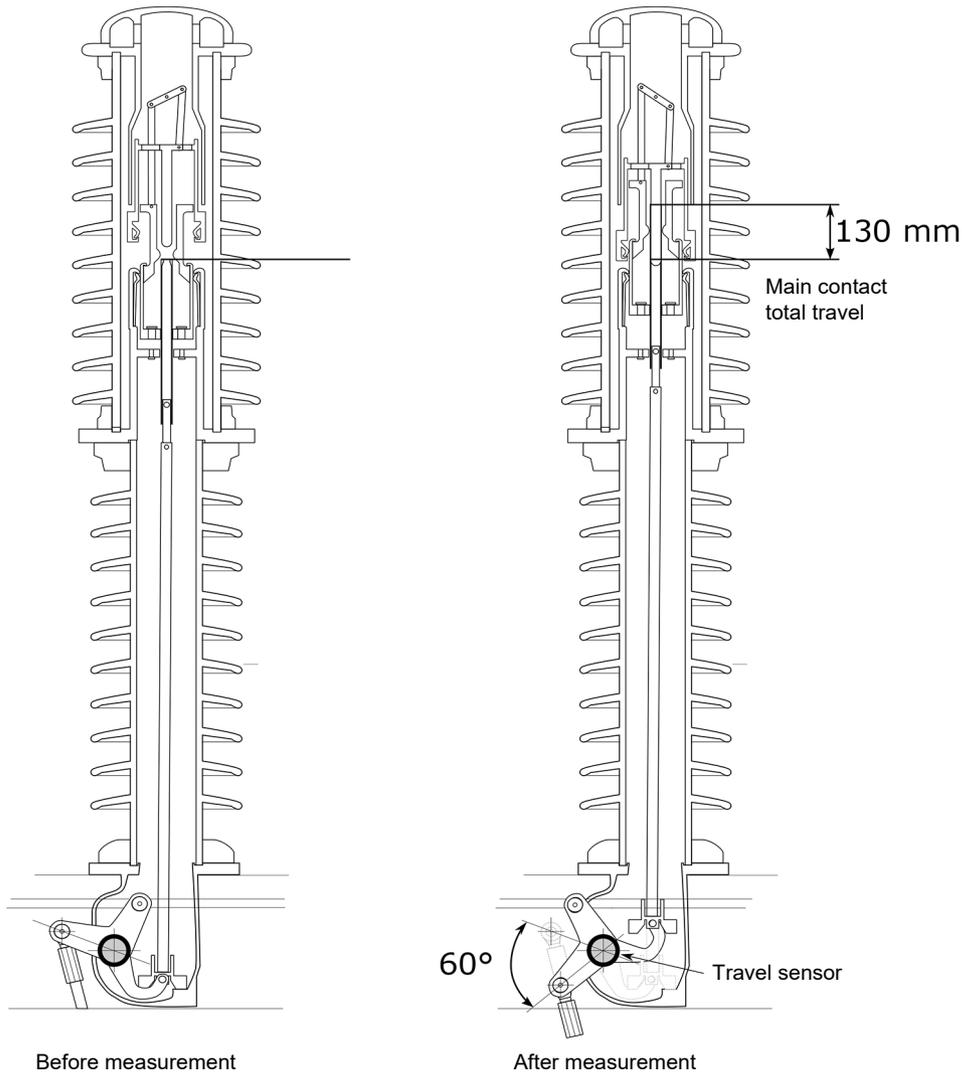


Figure 15-2: 60 degree travel at the travel sensor corresponds to 130 mm travel at the main contacts

For a basic circuit breaker design a contact factor is accurate enough for calculating the path of the main contacts. Use conversion tables if there are more than one lever within the mechanical linkage between the sensors.

Under **Conversion tables**, you can manage conversion tables for the contact travel calculation when using angular transducers. You can load conversion tables in the native Megger format (.tbl) and as comma-separated value files (.csv).

The imported CSV files must comply with a special format in which the first line is reserved for a comment and the second line specifies the units “degree” and “mm” separated by a semicolon (“;”). All following lines consist of one value pair per line that specifies the transducer movement in degrees and the converted movement in millimeters separated by a semicolon. The following example shows the general CSV format structure.

```
comment; THIS IS AN EXAMPLE COMMENT
degree;mm
-10.00;-9.00
-9.90;-8.91
...
119.80;241.14
119.90;241.04
```

To add a conversion table:

1. Click the **Add** button **+**.
2. In the **Open** dialog box, browse to the conversion table you want to add.

Note: To rename a conversion table, click the conversion table, and then edit the conversion table name.

► To delete a conversion table, click the **Remove** button **—** next to the conversion table.

15.2 Bushing data

For the data of the circuit breaker’s bushings, see 16 "Spare bushing data" on page 114.

15.3 Assessment limits

15.3.1 Absolute assessment limits

The following tables describe the circuit breaker's absolute assessment limits.

Table 15-3: Contact resistance

	R min	R max
Contact resistance	Minimum contact resistance	Maximum contact resistance

Table 15-4: Operating times

	t min	t max
Opening time	Minimum operating time of main contacts	Maximum operating time of main contacts
Opening sync. (contacts within a phase)		
Opening sync. (between breaker phases)		
Closing time		
Closing sync. (contacts within a phase)		
Closing sync. (between breaker phases)		
Reclosing time		
Close-Open time		
Open-Close time		

Table 15-5: Contact travel¹

	d min	d max
Total travel, TT	Minimum distance of the contact travel	Maximum distance of the contact travel
Over-travel (Trip), OT		
Over-travel (Close), OT		
Rebound (Trip), RB		
Rebound (Close), RB		
Contact wipe (Trip), CW		
Contact wipe (Close), CW		
Damping distance		
Add velocity zone	Click Add velocity zone to define a velocity zone for assessment of the contact travel velocity (see 15.4 "Velocity zones" on page 112).	

1. Only available if testing with the CB TN3 modules

Note: Click [More information](#) to open a diagram explaining the characteristics described in the table.

Table 15-6: Auxiliary contacts: Trip operation

	t min	t max
Switching time (a-type), $t_{switch,a}$	Minimum operating time of auxiliary contacts	Maximum operating time of auxiliary contacts
Diff. to main (a-type), Δt_a		
Switching time (b-type), $t_{switch,b}$		
Diff. to main (b-type), Δt_b		
Switching time (wiper), $t_{switch,w}$		
Duration (wiper), Δt_w		

Note: Click [More information](#) to open a diagram explaining the characteristics described in the table.

Table 15-7: Auxiliary contacts: Close operation

	t min	t max
Switching time (a-type), $t_{switch,a}$	Minimum operating time of auxiliary contacts	Maximum operating time of auxiliary contacts
Diff. to main (a-type), Δt_a		
Switching time (b-type), $t_{switch,b}$		
Diff. to main (b-type), Δt_b		
Switching time (wiper), $t_{switch,w}$		
Duration (wiper), Δt_w		

Note: Click [More information](#) to open a diagram explaining the characteristics described in the table.

Table 15-8: Miscellaneous

	Minimum	Maximum
Bounce time	Minimum duration of the main contact bounce	Maximum duration of the main contact bounce
Bounce count	Minimum number of main contact bounces within the bounce time	Maximum number of main contact bounces within the bounce time
PIR closing time	Minimum closing time for pre-insertion resistors	Maximum closing time for pre-insertion resistors
Reaction time	Minimum contact response time	Maximum contact response time

Table 15-9: Coil characteristics

	Minimum	Maximum
Peak close coil current	Minimum coil current	Maximum coil current
Peak trip coil current		
Average close coil current		
Average trip coil current		
Average close coil voltage	Minimum coil voltage	Maximum coil voltage
Average trip coil voltage		
Close coil resistance	Minimum coil resistance	Maximum coil resistance
Trip coil resistance		

Table 15-10: Pickup voltage

	V min	V max
Minimum pickup voltage (close)	Minimum pickup voltage	Maximum pickup voltage
Minimum pickup voltage (trip)		

Table 15-11: Motor characteristics

	Minimum	Maximum
Inrush current	Minimum motor characteristic	Maximum motor characteristic
Charging time		
Charging current		
Minimum voltage		

Table 15-12: Under-voltage release

	Minimum	Maximum
UV coil trip voltage	Minimum UV coil trip voltage	Maximum UV coil trip voltage

Table 15-13: Overcurrent release

	Minimum	Maximum
OC relay trip current	Minimum OC relay trip current	Maximum OC relay trip current

15.3.2 Relative assessment limits

The following tables describe the circuit breaker's relative assessment limits.

Table 15-14: Contact resistance

	R ref	R dev
Contact resistance	Reference contact resistance	Allowed deviation from the reference contact resistance

Table 15-15: Operating times

	t ref	-t dev	+t dev
Opening time	Reference operating time of main contacts	Allowed negative deviation from the reference operating time of main contacts	Allowed positive deviation from the reference operating time of main contacts
Opening sync. (contacts within a phase)			
Opening sync. (between breaker phases)			
Closing time			
Closing sync. (contacts within a phase)			
Closing sync. (between breaker phases)			
Reclosing time			
Close-Open time			
Open-Close time			

Table 15-16: Contact travel¹

	d ref	d dev
Total travel, TT	Reference distance of the contact travel	Allowed deviation from the reference distance of the contact travel
Over-travel (Trip), OT		
Over-travel (Close), OT		
Rebound (Trip), RB		
Rebound (Close), RB		
Contact wipe (Trip), CW		
Contact wipe (Close), CW		
Damping distance		
Add velocity zone	Click Add velocity zone to define a velocity zone for assessment of the contact travel velocity (see 15.4 "Velocity zones" on page 112).	

1. Only available if testing with the CB TN3 modules

Note: Click [More information](#) to open a diagram explaining the characteristics described in the table.

Table 15-17: Auxiliary contacts: Trip operation

	t ref	t dev
Switching time (a-type), $t_{switch,a}$	Reference operating time of auxiliary contacts	Allowed deviation from the reference operating time of auxiliary contacts
Diff. to main (a-type), Δt_a		
Switching time (b-type), $t_{switch,b}$		
Diff. to main (b-type), Δt_b		
Switching time (wiper), $t_{switch,w}$		
Duration (wiper), Δt_w		

Note: Click [More information](#) to open a diagram explaining the characteristics described in the table.

Table 15-18: Auxiliary contacts: Close operation

	t ref	t dev
Switching time (a-type), $t_{switch,a}$	Reference operating time of auxiliary contacts	Allowed deviation from the reference operating time of auxiliary contacts
Diff. to main (a-type), Δt_a		
Switching time (b-type), $t_{switch,b}$		
Diff. to main (b-type), Δt_b		
Switching time (wiper), $t_{switch,w}$		
Duration (wiper), Δt_w		

Note: Click [More information](#) to open a diagram explaining the characteristics described in the table.

Table 15-19: Miscellaneous

	Reference	Deviation
Bounce time	Reference duration of the main contact bounce	Allowed deviation from the reference bounce time
Bounce count	Reference number of main contact bounces within the bounce time	Allowed deviation from the reference bounce count
PIR closing time	Reference closing time for pre-insertion resistors	Allowed deviation from the reference closing time for pre-insertion resistors
Reaction time	Reference contact response time	Allowed deviation from the reference contact response time

Table 15-20: Coil characteristics

	Reference	-Deviation	+Deviation
Peak close coil current	Reference coil current	Allowed negative deviation from the reference coil current	Allowed positive deviation from the reference coil current
Peak trip coil current			
Average close coil current			
Average trip coil current			
Average close coil voltage	Reference coil voltage	Allowed negative deviation from the reference coil voltage	Allowed positive deviation from the reference coil voltage
Average trip coil voltage			
Close coil resistance	Reference coil resistance	Allowed negative deviation from the reference coil resistance	Allowed positive deviation from the reference coil resistance
Trip coil resistance			

Table 15-21: Pickup voltage

	V ref	V dev
Minimum pickup voltage (close)	Reference pickup voltage	Allowed deviation from the reference pickup voltage
Minimum pickup voltage (trip)		

Table 15-22: Motor characteristics

	Reference	Deviation
Inrush current	Reference motor characteristic	Allowed deviation from the reference motor characteristic
Charging time		
Charging current		
Minimum voltage		

Table 15-23: Under-voltage release

	Reference	Deviation
UV coil trip voltage	Reference UV coil trip voltage	Allowed deviation from the reference UV coil trip voltage

Table 15-24: Overcurrent release

	Reference	Deviation
OC relay trip current	Reference OC relay trip current	Allowed deviation from the reference OC relay trip current

15.4 Velocity zones

To add a new zone for assessment of the contact travel velocity:

1. Under **Contact travel**, click **Add velocity zone**.
2. In the **Define New Velocity Zone** dialog box, set the configuration settings.

The following table describes the configuration settings of the velocity zones.

Table 15-25: Velocity zone settings

Setting	Description		
Operation	Trip		
		Parameters	
Zone start	Contact break	no offset	
		Distance (absolute)	
		Distance (% of total travel)	
		Time	
	Initial contact position	Distance (absolute)	
		Distance (% of total travel)	
	Final contact position	Distance (absolute)	
		Distance (% of total travel)	
	Sequence start (t=0)	no offset	
		Time	
			Parameters
	Zone end	Contact break	no offset
Distance (absolute)			
Distance (% of total travel)			
Time			
Initial contact position		Distance (absolute)	
		Distance (% of total travel)	
Final contact position		Distance (absolute)	
		Distance (% of total travel)	
Sequence start (t=0)		no offset	
		Time	
Zone start		Distance (absolute)	
		Distance (% of total travel)	
	Time		
Operation	Close		
		Parameters	

Table 15-25: Velocity zone settings (continued)

Setting	Description		
Zone start	Contact make	no offset	
		Distance (absolute)	
		Distance (% of total travel)	
		Time	
	Initial contact position	Distance (absolute)	
		Distance (% of total travel)	
	Final contact position	Distance (absolute)	
		Distance (% of total travel)	
	Sequence start (t=0)	no offset	
		Time	
			Parameters
	Zone end	Contact make	no offset
Distance (absolute)			
Distance (% of total travel)			
Time			
Initial contact position		Distance (absolute)	
		Distance (% of total travel)	
Final contact position		Distance (absolute)	
		Distance (% of total travel)	
Sequence start (t=0)		no offset	
		Time	
Zone start		Distance (absolute)	
		Distance (% of total travel)	
		Time	

Note: For the definitions of the velocity zone settings, see the graphic preview in the **Define New Velocity Zone** dialog box.

16 Spare bushing data

The following table describes the spare bushing data.

Table 16-1: Spare bushing data

Data	Description
Pos. ¹	Terminal of the asset to which the spare bushing is connected
Ratings	
Rated frequency	Rated frequency of the spare bushing
Insul. level LL (BIL)	L-L basic impulse level rating of the spare bushing
Voltage L-ground	Rated line-to-ground voltage
Max. system voltage	Maximum voltage between phases during normal service
Rated current	Rating current of the spare bushing
Manufacturer info	
Catalog no.	Catalog number of the spare bushing
Drawing no.	Drawing number of the spare bushing
Style no.	Style number of the spare bushing
Nominal values	
PF (C1)/ DF (C1)/ Tan δ (C1) ²	Power factor, dissipation factor, or tangent delta of the capacitance C1 between the top of the spare bushing and the voltage/test tap
Cap. (C1)	Capacitance C1 between the top of the spare bushing and the voltage/test tap
PF (C2)/ DF (C2)/ Tan δ (C2) ²	Power factor, dissipation factor, or tangent delta of the capacitance C2 between the voltage/test tap of the spare bushing and ground
Cap. (C2)	Capacitance C2 between the voltage/test tap of the spare bushing and ground
Other	
Insulation type	Insulation type of the spare bushing
Outer insulation type	Outer insulation type of the spare bushing
Comment	Comment on the spare bushing
Attachments	Attachments to the spare bushing (see "Managing attachments" later in this chapter)

1. Only available for spare bushings mounted on another assets
2. Set by the selected profile

Managing attachments

Under **Attachments**, you can manage attachments to spare bushings.

To add an attachment to a spare bushing:

1. Click the **Add** button .
2. In the **Select Files** dialog box, browse to the file you want to attach to the spare bushing.

To open an attachment, do one of the following:

- ▶ Select the attachment, and then click the **Open** button .
- ▶ Double click the attachment.

To delete an attachment from a spare bushing:

1. Select the attachment you want to delete.
2. Click the **Remove** button .

17 Off-service diagnostic methods

This section describes off-service testing of circuit breakers with *CIBANO 500* and its accessories. *Primary Test Manager* in combination with *CIBANO 500* supports the following off-service tests:

- Contact Resistance
- Timing
- Dynamic Contact Resistance
- Minimum Pickup
- Motor Current
- Under-voltage Release
- Overcurrent Release
- Insulation Resistance
- Timing (CSM)
- Demagnetization
- Inspection

The tests are grouped according to their application areas in:

- 17.1 "Testing medium-voltage circuit breakers" on page 117
- 17.2 "Testing high-voltage circuit breakers" on page 170
- 17.3 "Testing gas insulated switchgears with both sides grounded" on page 221
- 17.4 "Demagnetization" on page 253
- 17.5 "Testing circuit breakers with CIBANO 500 and the CB TN3 modules" on page 259

Note: You can configure the tests in different ways as described earlier in this User Manual. For conciseness, the wording *open the test* in the application procedures means clicking the test in the *Primary Test Manager* workspace independently of how the test has been configured.

17.1 Testing medium-voltage circuit breakers

The medium-voltage (MV) circuit breakers are typically tested with *CIBANO 500* only (without the *CB MC2* modules). If you want to test the MV circuit breakers with the *CB MC2* modules, see 17.2 "Testing high-voltage circuit breakers" on page 170.

17.1.1 Safety precautions in the substation

Always observe the following safety rules:

- ▶ Disconnect completely.
- ▶ Secure against re-connection.
- ▶ Verify that the installation is dead.
- ▶ Carry out grounding and short-circuiting.
- ▶ Provide protection against adjacent live parts.
- ▶ Ground the test object at one or more terminals during connecting, testing and disconnecting.

Separate your working area as shown in Figure 1-1: "Example of the separation of the work and high-voltage test areas" on page 12 into a work area and a high-voltage test area when a test is running.



WARNING

Death or severe injury caused by high voltage or current possible

- ▶ Never use the *CIBANO 500* test set without a solid connection to ground.
- ▶ Ground *CIBANO 500* with a cable of at least 6 mm² cross-section as close as possible to the operator.

Typical MV circuit breakers are opened and then removed from the rack according to the specifications of the circuit breaker manufacturer and the substation regulations. We recommend disconnecting the circuit breaker completely from the station, including the secondary connections, and to ground the circuit breaker on one side. Because you can use *CIBANO 500* to supply the circuit breaker during the test, in this way the maximum safety is guaranteed.

17.1.2 Test set and software startup

To put *CIBANO 500* into operation and start *Primary Test Manager*:

1. Connect the *CIBANO 500* grounding terminals properly to the substation ground.
2. Connect *CIBANO 500* to a computer with the delivered Ethernet cable and switch on the computer.
3. Connect *CIBANO 500* to the mains power supply by using the delivered power cord.
4. Switch on *CIBANO 500* by pressing the mains power on/off switch on the side panel. The green status light on the *CIBANO 500* front panel (see Figure 3-1: "Front view of *CIBANO 500*" on page 17) flashes for a short time and then extinguishes for approximately one minute. After it lights up, the *CIBANO 500* outputs carry no dangerous voltage or current.
5. Start *Primary Test Manager* and connect to *CIBANO 500* as described in 5.4 "Start Primary Test Manager and connect to *CIBANO 500*" on page 28.



If you could not connect to your *CIBANO 500* device and the green light is permanently on, wait a few seconds, and then proceed as follows:

1. Click **More** next to the **Connect** button, and then click **Refresh**.
2. Select the test system from the list, and then click **Connect**.

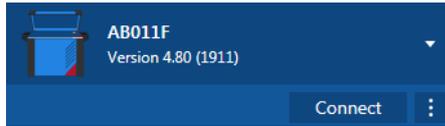


Figure 17-1: Connecting to *CIBANO 500*

If the *CIBANO 500* device to which you want to connect is not displayed in the list of available devices, proceed as described in 20.1 "Connecting to CIBANO 500" on page 315.

After you have started *Primary Test Manager* and connected to *CIBANO 500*, proceed as described earlier in this User Manual. You can:

- Create new guided jobs (see 7 "Create new guided jobs" on page 50)
- Manage locations, assets, jobs and test reports (see 10 "Manage objects" on page 77)
- Create new manual jobs (see 8 "Create new manual jobs" on page 72)
- Open existing jobs (see 9 "Open jobs" on page 76)
- Generate test reports (see 13 "Generate test reports" on page 93)

The next sections describe the MV circuit breaker tests.

17.1.3 Test group execution

Primary Test Manager provides you with a powerful capability for executing test groups. For information on grouping tests in test groups, see 7.5.2 "Group tests" on page 67. After you set the hardware configuration of the test set and the test group settings, you can execute all tests of the test group automatically by clicking the **Start all** button.

To execute a test group:

1. Group tests in a test group (see 7.5.2 "Group tests" on page 67).
2. Connect the test object to *CIBANO 500*.
3. In *Primary Test Manager*, open the test group you want to execute.
4. In the **Hardware configuration** area, set the hardware configuration. For the hardware configuration options of *CIBANO 500*, see Table 17-6: "Hardware configuration options of CIBANO 500" on page 127.

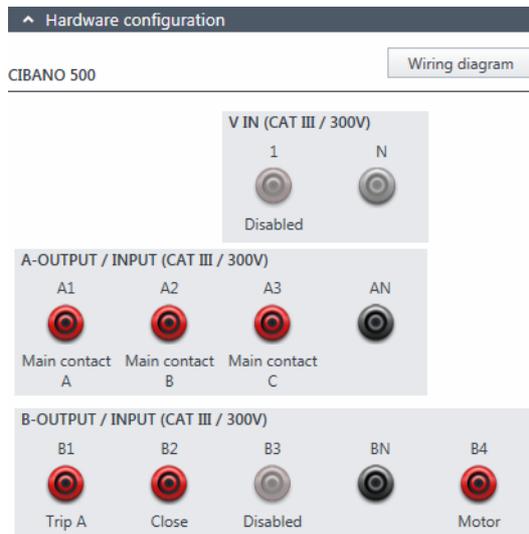


Figure 17-2: Hardware configuration of the test set for a test group

5. In the **Settings and conditions** area, enter the test group settings.

Table 17-1: Test group settings

Setting	Description
Coil supply	
Supply source	Click CIBANO 500 to supply the coils with <i>CIBANO 500</i> . Click External source to supply the coils with the source connected to V IN .
Supply settings ^{1,2}	Select a preconfigured coil supply setting from the asset data or select Custom to enter custom settings.
Coil supply voltage	Rated voltage of the coil supply Click AC or DC for AC or DC coil supply voltage respectively.
Test frequency	Coil supply frequency (AC only)
Main contact	
Test current	Current of the test
Motor supply	
Supply source	Click CIBANO 500 to supply the motor with <i>CIBANO 500</i> . Click External source if the motor is supplied from the station supply or battery without any connection to <i>CIBANO 500</i> or if the station battery is connected to the V IN section and supplied, for example, via the B4 socket. Note: We do not recommend supplying the motor with undervoltage. Doing so does not provide any additional useful information and can cause degradation of the motor operation over time.
Supply settings ^{1,2}	Select the preconfigured motor supply setting from the asset data or select Custom to enter custom settings.
Motor supply voltage	Rated voltage of the motor supply Click AC or DC for AC or DC motor supply voltage respectively.
Test frequency	Motor supply frequency (AC only)
Max. supply duration	Maximum duration of supplying the motor if not stopped automatically
Other	
Grounding	Select the grounding condition of the circuit breaker under test.

1. Only available in the guided test workflow and if *CIBANO 500* is selected as source

2. Data taken from the nameplate

6. By using the **Open breaker**, **Close breaker** and **Supply motor** buttons in the **Test control** area of *Primary Test Manager* (see 11.1 "Test control commands" on page 85) you can check whether your *CIBANO 500* is properly wired with the test object.

7. In the **Test control** area, click **Start all**.
The blue ring on the **Start/Stop** button is on.





8. Start the measurement by pressing the **Start/Stop** button.
The blue ring on the **Start/Stop** button flashes for approx. 3 seconds, and the lightning symbol in *Primary Test Manager* and the red status light on the front panel are flashing.

Note: You can abort the measurement anytime manually by pressing the **Emergency Stop** button or the **Start/Stop** button on the *CIBANO 500* front panel or click **Stop all** in *Primary Test Manager*.

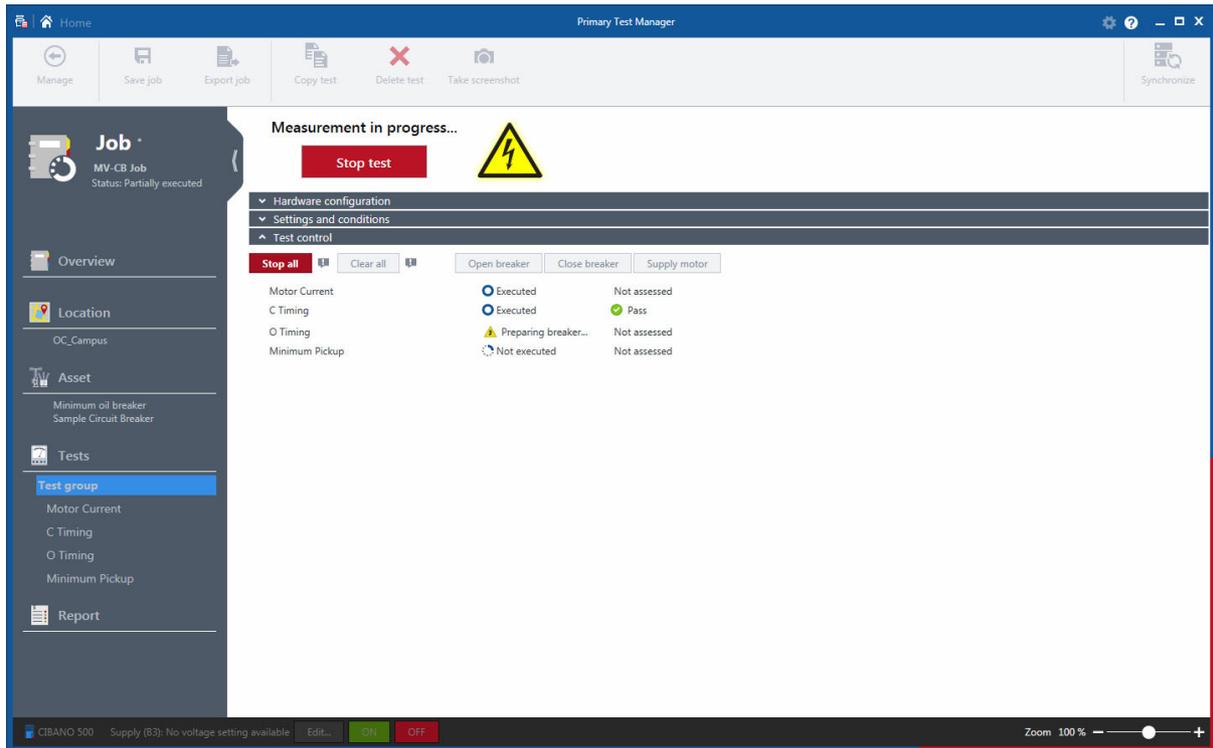


Figure 17-3: Test group execution

9. *Primary Test Manager* executes the tests of the test group sequentially. Before a test is executed, the circuit breaker is brought into the required state and the motor is supplied. After a test has been executed, *Primary Test Manager* displays the execution and assessment status if the **Automatic assessment** check box is selected in the tests.

Note: If a test in the test group is invalid, it will be skipped during the test group execution. You can remove invalid tests before or after executing the test group.



10. After the test execution has finished, the lightning symbol in *Primary Test Manager* stops flashing and the green status light is on.

17.1.4 Contact Resistance test

The Contact Resistance test measures the static resistance of the circuit breaker’s main contacts.

The Contact Resistance test can be performed only when the circuit breaker is closed. A typical MV circuit breaker has manual operation buttons at its front plate to control the circuit breaker’s spring. If the spring is not charged, first charge the spring as described in 17.1.9 "Motor Current test" on page 150, and then close the circuit breaker.

Note: To increase the accuracy of the measurement results for the both-side grounded circuit breakers, you can compensate for the resistance of the ground loop by making two measurements with the circuit breaker closed and open. To compensate for the resistance of the ground loop, select the **Compensate ground loop resistance** check box (see Table 17-3: "Settings of the Contact Resistance test" on page 124).

Connection

WARNING

Death or severe injury caused by high voltage or current possible

- ▶ Do not use external power sources for the circuit breaker’s main contacts.
- ▶ During the test, supply the circuit breaker’s main contacts only with *CIBANO 500*.

To connect the test object to *CIBANO 500*:

1. In *Primary Test Manager*, open the Contact Resistance test.

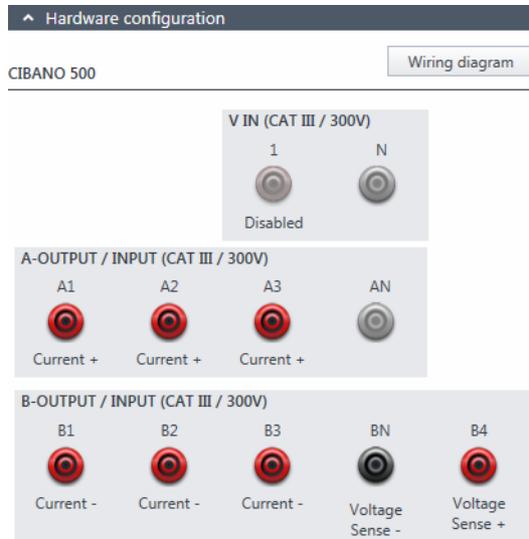


Figure 17-4: Hardware configuration of the Contact Resistance test

Table 17-2: Hardware configuration options of *CIBANO 500*

CIBANO 500	Option
A-OUTPUT / INPUT (CAT III / 300 V)	
A1	Current +
A2	Current +
A3	Current +
AN	Not connected in this test
B-OUTPUT / INPUT (CAT III / 300 V)	
B1	Current –
B2	Current –
B3	Current –
BN	Voltage Sense –
B4	Voltage Sense +

2. Make sure that all cable connectors are clean and dry before being tightly connected.
3. Connect *CIBANO 500* to the main contact of the circuit breaker for one phase according to the wiring diagram displayed in *Primary Test Manager*.

Tips & Tricks: For easy connection use the delivered multi-core cables and connect the end with the short wires to the *CIBANO 500* sockets according to the short-wire labels. Connect the cable end with the long wires according to the wiring diagram to the corresponding Kelvin clamp. The black **AN** cable is not needed for this test and remains unconnected.

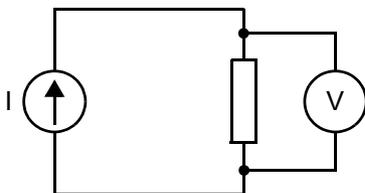


Figure 17-5: Principal scheme of the contact resistance test

Tips & Tricks: The delivered Kelvin clamp is the perfect solution for connecting to a massive conductor like a copper busbar or similar. We recommend using only the red connectors of the Kelvin clamps (which is the current path) when connecting to the contact fingers of a MV circuit breaker. Use a separate clamp for the voltage sense cables (**BN** and **B4**) which can be mounted closer to the MV circuit breaker contact. If the connection is set up properly the resistance decreases when the voltage sense clamps are connected closer to the circuit breaker contact. The polarity of connection does not matter for this test.

Measurement

To perform a measurement:

1. In the **Settings and conditions** area, enter the settings of the Contact Resistance test.

Table 17-3: Settings of the Contact Resistance test

Setting	Description
Main contact	
Test current ¹	Current of the test (typically 100 A)
Other	
Grounding	Grounding of the circuit breaker under test
Compensate ground loop resistance	Select the Compensate ground loop resistance check box to compensate for the resistance of the ground loop.

1. For normal circuit breakers always use 100 A.

2. Optionally, enter the advanced settings in the **Advanced settings** area.

Table 17-4: Advanced settings of the Contact Resistance test

Setting	Description
Test conditions	
Ambient temperature ¹	Ambient temperature on site
Main contact	
V DC range ²	DC voltage measurement range
CT mode ^{3,4}	Select the Enabled check box to enable CT mode for measuring circuit breakers with current transformers (CT).
Test duration ⁴	Duration of the test

1. Only for reference in the report, the result is not temperature compensated.

2. For normal circuit breakers the lowest range is recommended. Only if the result is "infinite" select a higher range.

3. Data taken from the nameplate (for circuit breakers with dead tank and GIS)

4. Only available for circuit breakers with integrated current transformer, such as dead-tank and GIS

3. In the **Assessment** area, configure the assessment.

- ▶ Click **Edit configuration** or click in the table to open the **Assessment configuration** dialog box, and then edit the assessment limits.

- ▶ Select the **Automatic assessment** check box to enable the automatic assessment.

Note: For the assessment limit definitions, see 15.3 "Assessment limits" on page 106.



4. In the **Measurements** area, select the measurement you want to perform, and then click **Start**. The blue ring on the **Start/Stop** button is on.

**WARNING****Death or severe injury caused by high voltage or current possible**

- ▶ Do not enter the high-voltage test area while testing with *CIBANO 500* since any part of the circuit breaker can carry dangerous voltages.
- ▶ Stay in the work area during the test.



5. Start the measurement by pressing the **Start/Stop** button. The blue ring on the **Start/Stop** button flashes for approx. 3 seconds, and the lightning symbol in *Primary Test Manager* and the red status light on the front panel are flashing.

Note: You can abort the measurement anytime manually by pressing the **Emergency Stop** button or the **Start/Stop** button on the *CIBANO 500* front panel.



6. After the measurement has finished, the lightning symbol in *Primary Test Manager* stops flashing, the green status light is on, and *Primary Test Manager* displays the measurement results.
7. Connect *CIBANO 500* to the main contact of the circuit breaker for the next phase according to the wiring diagram provided by *Primary Test Manager*. To display the wiring diagram, click the **Wiring diagram** button. Click in the diagram to close it.
8. Repeat steps 1 to 7 for all phases.
9. For the measurement results, see Table 17-5: "Contact Resistance measurement data" on page 126.

If you selected the **Compensate ground loop resistance** check box, proceed as follows:

1. Open the circuit breaker.
2. In the **Measurements** area of *Primary Test Manager*, select the breaker state **Open**.



3. Select the measurement you want to perform, and then click **Start**. The blue ring on the **Start/Stop** button is on.

**WARNING****Death or severe injury caused by high voltage or current possible**

- ▶ Do not enter the high-voltage test area while testing with *CIBANO 500* since any part of the circuit breaker can carry dangerous voltages.
- ▶ Stay in the work area during the test.



4. Start the measurement by pressing the **Start/Stop** button. The blue ring on the **Start/Stop** button flashes for approx. 3 seconds, and the lightning symbol in *Primary Test Manager* and the red status light on the front panel are flashing.

Note: You can abort the measurement anytime manually by pressing the **Emergency Stop** button or the **Start/Stop** button on the *CIBANO 500* front panel.



5. After the measurement has finished, the lightning symbol in *Primary Test Manager* stops flashing, the green status light is on, and *Primary Test Manager* displays the measurement results.
6. Connect *CIBANO 500* to the main contact of the circuit breaker for the next phase according to the wiring diagram provided by *Primary Test Manager*. To display the wiring diagram, click the **Wiring diagram** button. Click in the diagram to close it.

7. Repeat steps 1 to 6 for all phases.

Table 17-5: Contact Resistance measurement data

Data	Description
Channel	Current +/-
Phase	Measured phase
I DC ¹	DC test current with the circuit breaker open
V DC ¹	Measured voltage with the circuit breaker open
R open ¹	Measured resistance with the circuit breaker open
I DC	DC test current with the circuit breaker closed
V DC	Measured voltage with the circuit breaker closed
R closed ¹	Measured resistance with the circuit breaker closed
R meas	Measured contact resistance
Assessment	Measurement assessment

1. Only available if the **Compensate ground loop resistance** check box is selected.

Disconnection

For disconnecting the circuit breaker, see "Disconnection" on page 163.

17.1.5 Timing test with *CIBANO 500* and the EtherCAT® module

The Timing test measures the contact timing of the circuit breaker. Depending on the selected sequence all relevant timing values are automatically calculated.

Connection

To connect the test object to *CIBANO 500*:

1. In *Primary Test Manager*, open the Timing test.
2. In the **Hardware configuration** area, set the hardware configuration.

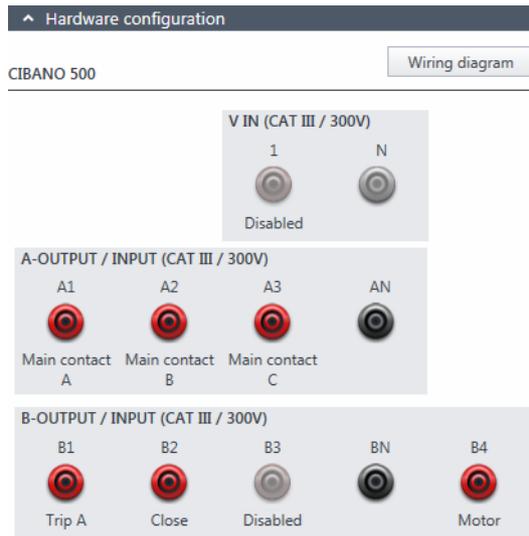


Figure 17-6: Hardware configuration of the Timing test

Table 17-6: Hardware configuration options of *CIBANO 500*

CIBANO 500	Option
V IN (CAT III / 300 V)	
1	External source, Trigger IN ¹ or Disabled
N	Neutral connection of V IN
A-OUTPUT / INPUT (CAT III / 300 V)	
A1	Main contact A, Close A, Motor A, Trigger IN ¹ or Disabled
A2	Main contact B, Close B, Motor B, Trigger IN ¹ or Disabled
A3	Main contact C, Close C, Motor C, Trigger IN ¹ or Disabled
AN	Common neutral connection for outputs/inputs in group A
B-OUTPUT / INPUT (CAT III / 300 V)	
B1	Trip A, Trigger IN ¹ , I clamp 1 or Disabled

Table 17-6: Hardware configuration options of CIBANO 500 (continued)

CIBANO 500	Option
B2	Trip B, Close, Trigger IN ¹ , I clamp 2 or Disabled
B3	Trip C, Supply, Trigger IN ¹ , I clamp 3 or Disabled
BN	Neutral connection of outputs in group B
B4	Trigger IN ¹ , I clamp 4, Motor or Disabled

1. Trigger signal starting the measurement
3. Make sure that all cable connectors are clean and dry before being tightly connected.
4. Connect CIBANO 500 to the trip and close coils of the circuit breaker for all phases according to the wiring diagram displayed in *Primary Test Manager* and the following figure.

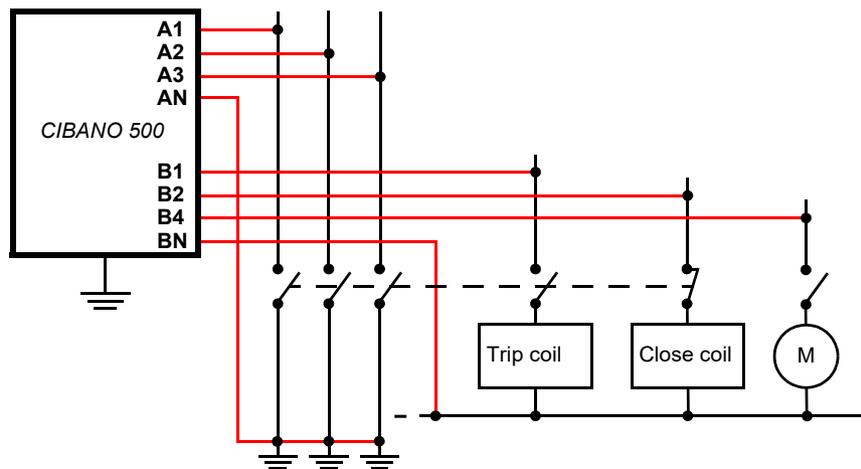


Figure 17-7: Connecting CIBANO 500 to the circuit breaker for the Timing test

NOTICE
Equipment damage or loss of data possible

- ▶ Never connect CIBANO 500 between the respective AUX contacts of the trip and close coils and the coils themselves since these contacts assure that the voltage is not applied too long to the coils.
- ▶ Connect CIBANO 500 to the circuit breaker as shown in Figure 17-7: "Connecting CIBANO 500 to the circuit breaker for the Timing test".

NOTICE
Equipment damage or loss of data possible

- ▶ Do not connect the DC coils with false polarity to prevent damaging the free running diodes.
- ▶ Always observe the right polarity of the DC coils.

5. Depending on the test requirements, connect *CIBANO 500* to the motor of the circuit breaker.
6. In a typical test of a MV circuit breaker the motor is supplied from *CIBANO 500*. To do so, click the **B4** socket in the hardware configuration, and then click **Motor**. After that connect the **B4** socket on the side panel of *CIBANO 500* to "+" or phase contact of the motor and the **BN** socket to "-" or neutral contact of the motor.

Measurement

To perform a measurement:

1. In the **Settings and conditions** area, enter the settings of the Timing test.

Table 17-7: Settings of the Timing test

Setting	Description
Coil supply	
Supply source	Select one of the following supply-source options: <ul style="list-style-type: none"> • CIBANO 500 to supply the coils with <i>CIBANO 500</i>. • External source to supply the coils with the source connected to V IN. • Control board to supply the coils with a control-board switch.¹
Supply settings ^{2,3}	Select a preconfigured coil supply setting from the asset data or select Custom to enter custom settings.
Coil supply voltage	Rated voltage of the coil supply Click AC or DC for AC or DC coil supply voltage respectively.
Test frequency	Coil supply frequency (AC only)
Trip signal ⁴	Select whether the rising or falling edge of the trip signal opens the circuit breaker.
Close signal ⁴	Select whether the rising or falling edge of the close signal closes the circuit breaker.
Motor supply	
Supply source	Click CIBANO 500 to supply the motor with <i>CIBANO 500</i> . Click External source if the motor is supplied from the station supply or battery without any connection to <i>CIBANO 500</i> or if the station battery is connected to the V IN section and supplied, for example, via the B4 socket.
Supply settings ^{2,3}	Select the preconfigured motor supply setting from the asset data or select Custom to enter custom settings.
Motor supply voltage	Rated voltage of the motor supply Click AC or DC for AC or DC motor supply voltage respectively.
Test frequency	Motor supply frequency (AC only)
Max. supply duration	Maximum duration of supplying the motor if not stopped automatically
Main contact	
Contact system	Contact system of the circuit breaker under test Select PIR to measure timing of contacts with pre-insertion resistors.

Table 17-7: Settings of the Timing test (continued)

Setting	Description
Other	
Grounding	Select the grounding condition of the circuit breaker under test.
Sequence	
Test sequence	Test sequence to be performed
Trigger setting⁵	
Threshold	Threshold value of the trigger signal The measurement starts if the trigger signal rises above (rising edge) or falls below (falling edge) the threshold.
Edge type	Rising or falling edge

1. Only available if the trip and/or close signals are configured on the *IOB1* module.
2. Only available in the guided test workflow and if *CIBANO 500* is selected as source
3. Data taken from the nameplate
4. Only available if **Control board** is selected as supply source.
5. Only available if **V IN**, or one output in group **A** or group **B** is set to Trigger IN.

2. Optionally, enter the advanced settings in the **Advanced settings** area.

Table 17-8: Advanced settings of the Timing test

Setting	Description
Main contact	
Sine wave filter	Select the Sine wave filter check box to suppress sinusoidal interference.
Start evaluation at	Start time of the sine wave evaluation. Select the time at which the sinusoidal interference is clearly present in the measurement signal.
Sine frequency	Frequency of the sinusoidal interference
Other	
Close breaker before test ¹	Select the Close breaker before test check box to automatically close the circuit breaker 1 second before starting a measurement.
Sample rate	Measurement sample rate

Table 17-8: Advanced settings of the Timing test (continued)

Setting	Description
Contact bounce filter	
Main contact	Threshold value of the time interval between two consecutive bounces of the main contact. For time intervals equal or below the threshold, the contact is considered as closed. Setting the value to 0.0 ms deactivates the contact bounce filter.
Auxiliary contact	Threshold value of the time interval between two consecutive bounces of the auxiliary contact. For time intervals equal or below the threshold, the contact is considered as closed. Setting the value to 0.0 ms deactivates the contact bounce filter.
Average coil current/voltage	
Begin	Start of the average coil current/voltage evaluation in percent of the time period during which the current flows through the coil
End	End of the average coil current/voltage evaluation in percent of the time period during which the current flows through the coil
Sequence	

See Table 17-9: "Timing test sequences" on page 132.

1. The **Close breaker before test** check box is only active if the test sequence begins with the open command and no output is set to Trigger IN.

The following table explains the sequences of the Timing test.

Table 17-9: Timing test sequences

Sequence	Action
O	With this sequence, the opening time of the circuit breaker is measured. Only for O and C sequences we recommend performing the test twice, once with nominal voltage and once with 20% undervoltage to assure the functionality of the circuit breaker for a weak station battery.
C	This is the sequence to measure the closing time of the circuit breaker.
OC	With this sequence, a closing operation after the circuit breaker has tripped to clear a fault is simulated. Initially, the circuit breaker must be in the closed position. An open command initiates the sequence, followed by a dead time to clear the fault; and finally a close command must close the circuit breaker. This sequence is also known as reclosing sequence. To find out the shortest reclosing time the circuit breaker can provide, the close command is already applied while the circuit breaker is still opening. The circuit breaker then will close after opening as fast as possible.
CO	With this sequence, a tripping operation after the circuit breaker has been closed under a fault condition (trip-free) or the verification of the correct operation of the anti-pumping system is simulated. To test the trip-free time the circuit breaker must be in the open position before the test is started. The circuit breaker is closed and then during the close operation is still in progress an open command is sent. The circuit breaker then opens as fast as possible. To test the anti-pumping function of the circuit breaker, the circuit breaker must be in closed position before the test is started. For this test the open time is set shorter (typically 200 ms) than the closing time (typically 400 ms). Ensure that the end time is increased so that the test sequence covers the whole close command duration (typically at least 190 ms). When the close command is sent the circuit breaker is already closed which initiates the anti-pumping function. Then an open command is sent and the circuit breaker trips. The closing command is still on when the open command ends, but the circuit breaker should not "pump", so that it should not close again.
O-CO	With this sequence, a reclose sequence (OC) under a fault condition is simulated. If the fault is not released, the circuit breaker must open (O) immediately and remain in this position. Initially, the circuit breaker must be in the closed position. The sequence begins with an open command, after a dead time the close and open commands (CO) must be applied at the same time (delay time typically 300 ms).

3. In the **Assessment** area, configure the assessment.
 - ▶ Click **Edit configuration** or click in one of the tables to open the **Assessment configuration** dialog box, and then edit the assessment limits.
 - ▶ Select the **Automatic assessment** check box to enable the automatic assessment.

Note: For the assessment limit definitions, see 15.3 "Assessment limits" on page 106.
4. By using the **Open breaker**, **Close breaker** and **Supply motor** buttons in the **Measurements** area of *Primary Test Manager* (see 11.1 "Test control commands" on page 85) you can check whether all cables are correctly connected and bring the circuit breaker to the proper state. For example, to test an O sequence, the circuit breaker must be closed and the spring charged.



5. In the **Measurements** area, click **Start**.
The blue ring on the **Start/Stop** button is on.



WARNING

Death or severe injury caused by high voltage or current possible

- ▶ Do not enter the high-voltage test area while testing with *CIBANO 500* since any part of the circuit breaker can carry dangerous voltages.
- ▶ Stay in the work area during the test.



6. Start the measurement by pressing the **Start/Stop** button.
The blue ring on the **Start/Stop** button flashes for approx. 3 seconds, and the lightning symbol in *Primary Test Manager* and the red status light on the front panel are flashing.

Note: You can abort the measurement anytime manually by pressing the **Emergency Stop** button or the **Start/Stop** button on the *CIBANO 500* front panel.



7. After the measurement has finished, the lightning symbol in *Primary Test Manager* stops flashing, the green status light is on, and *Primary Test Manager* displays the measurement results. The operating times depend on the sequence of the trip and close commands. The following table describes the operating times for all measurement sequences.

Table 17-10: Operating times¹

Data	Description
Opening time	Contact opening time of O, OC, O-CO and O-CO-CO operation
Opening sync.	Opening synchronization time of O, OC, O-CO and O-CO-CO operation
Closing time	Contact closing time of C, CO and O-CO operation
Closing sync.	Closing synchronization time of C, CO and O-CO operation
Reclosing time	Contact reclosing time of OC operation
Open-close time	Contact open-close time of O-CO, CO-CO, and O-CO-CO operation
Close-open time 1	Contact close-open time of CO and O-CO operation
Close-open time 2	Second contact close-open time of CO-CO and O-CO-CO operation
Assessment	Assessment of operating times

1. The operating times are calculated per contact, phase or circuit breaker.

Table 17-11: Auxiliary contact characteristics¹

Data	Description
Contact	Name of the auxiliary contact of the circuit breaker under test
Phase	Phase to which the auxiliary contact belongs
Type	Type of the auxiliary contact (a, b, wiper)
Switching time	Closing or opening time of the auxiliary contact depending on its type
Duration	Duration the wiper contact remains closed
Diff. to main	Time difference between the opening or closing of the auxiliary contact and the corresponding main contact
Assessment	Assessment of auxiliary contact characteristics

1. Only calculated for O and C sequences

Table 17-12: Main contact characteristics

Data	Description
Main contact	Main contact this measurement row refers to
Bounce time ¹	Duration of the main contact bounce
Bounce count ¹	Number of main contact bounces within the bounce time
PIR closing time	Closing time for pre-insertion resistors
Assessment	Measurement assessment

1. Only available for O and C sequences

Table 17-13: Coil characteristics

Data	Description
Peak current	Peak current value through a trip or close coil
Average current	Average current through the coil (see Average coil current/voltage settings in Table 17-8: "Advanced settings of the Timing test" on page 130)
Average voltage	Average voltage applied to the coil (see Average coil current/voltage settings in Table 17-8: "Advanced settings of the Timing test" on page 130)
Resistance	Calculated resistance of the coil
Assessment	Assessment of coil characteristics

Disconnection

For disconnecting the circuit breaker, see "Disconnection" on page 163.

17.1.6 Timing test with *CIBANO 500* and the Auxiliary module

The Timing test measures the contact timing of the circuit breaker. Depending on the selected sequence all relevant timing values are automatically calculated.

Connection

To connect the test object to *CIBANO 500*:

1. In *Primary Test Manager*, open the Timing test.
2. In the **Hardware configuration** area, set the hardware configuration.

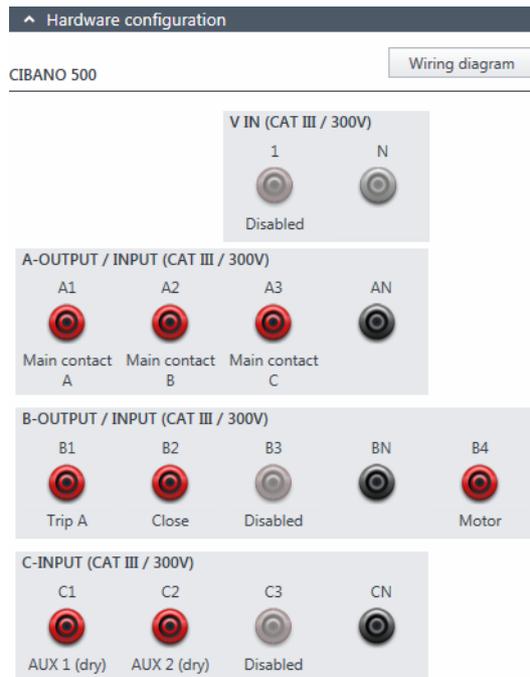


Figure 17-8: Hardware configuration of the Timing test

Table 17-14: Hardware configuration options of *CIBANO 500*

CIBANO 500	Option		
V IN (CAT III / 300 V)			
1	External source, Trigger IN ¹ or Disabled		
N	Neutral connection of V IN		
A-OUTPUT / INPUT (CAT III / 300 V)			
A1	Main contact A, Close A, Motor A, Trigger IN ¹ or Disabled		
A2	Main contact B, Close B, Motor B, Trigger IN ¹ or Disabled		
A3	Main contact C, Close C, Motor C, Trigger IN ¹ or Disabled		
AN	Common neutral connection for outputs/inputs in group A		
B-OUTPUT / INPUT (CAT III / 300 V)			
B1	Trip A, Trigger IN ¹ , I clamp 1 or Disabled		
B2	Trip B, Close, Trigger IN ¹ , I clamp 2 or Disabled		
B3	Trip C, Supply, Trigger IN ¹ , I clamp 3, or Disabled		
BN	Neutral connection of outputs in group B		
B4	Trigger IN ¹ , I clamp 4, Motor or Disabled		
C-INPUT (CAT III / 300 V)			
C1	AUX 1	Dry contact (potential-free)	Trigger IN ¹ or Disabled
		Wet contact (with potential)	
C2	AUX 2	Dry contact (potential-free)	Trigger IN ¹ or Disabled
		Wet contact (with potential)	
C3	AUX 3	Dry contact (potential-free)	Trigger IN ¹ or Disabled
		Wet contact (with potential)	
CN	Neutral connection of inputs in group C		

1. Trigger signal starting the measurement

3. Make sure that all cable connectors are clean and dry before being tightly connected.

4. Connect *CIBANO 500* to the trip and close coils of the circuit breaker for all phases according to the wiring diagram displayed in *Primary Test Manager* and the following figure.

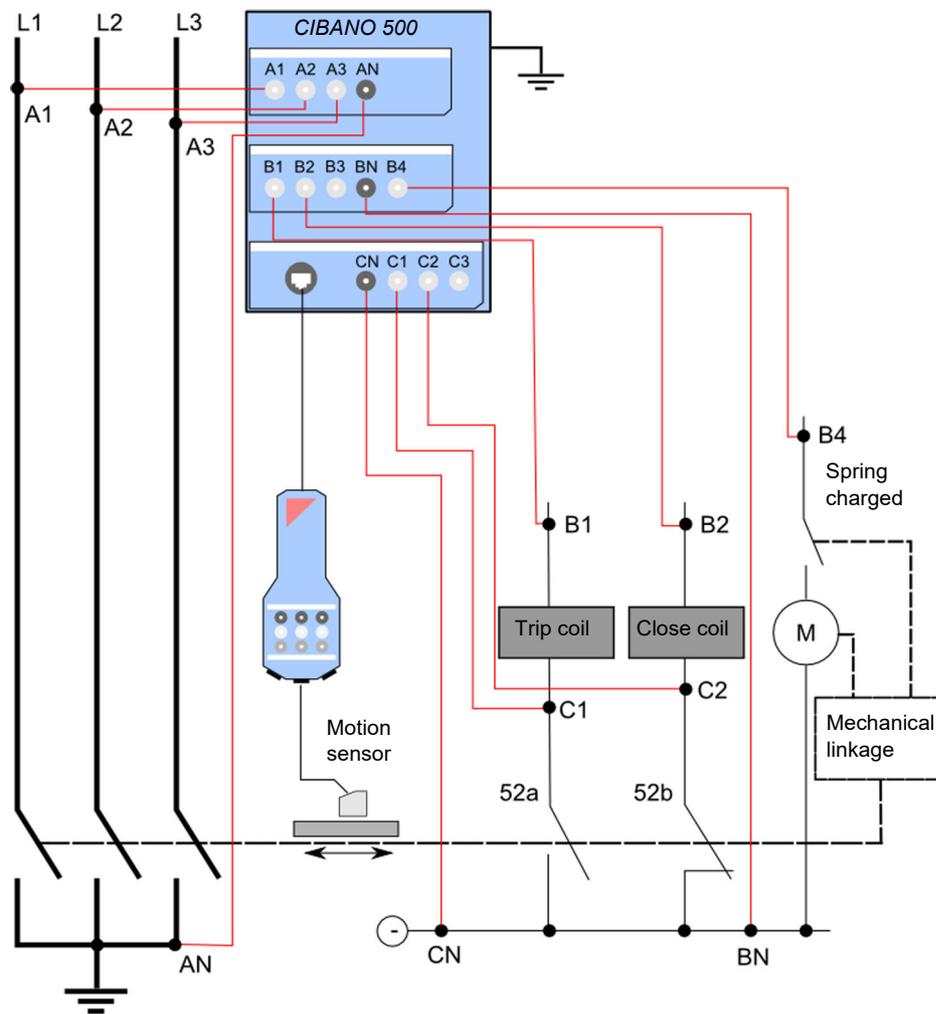


Figure 17-9: Connecting *CIBANO 500* to the circuit breaker for the Timing test

NOTICE
Equipment damage or loss of data possible

- ▶ Never connect *CIBANO 500* between the respective AUX contacts of the trip and close coils and the coils themselves since these contacts assure that the voltage is not applied too long to the coils.
- ▶ Connect *CIBANO 500* to the circuit breaker as shown in Figure 17-9: "Connecting CIBANO 500 to the circuit breaker for the Timing test".

NOTICE**Equipment damage or loss of data possible**

- ▶ Do not connect the DC coils with false polarity to prevent damaging the free running diodes.
- ▶ Always observe the right polarity of the DC coils.

5. Depending on the test requirements, connect *CIBANO 500* to the motor of the circuit breaker.
6. In a typical test of a MV circuit breaker the motor is supplied from *CIBANO 500*. To do so, click the **B4** socket in the hardware configuration, and then click **Motor**. After that connect the **B4** socket on the side panel of *CIBANO 500* to "+" or phase contact of the motor and the **BN** socket to "-" or neutral contact of the motor.

Measurement

To perform a measurement:

1. In the **Settings and conditions** area, enter the settings of the Timing test.

Table 17-15: Settings of the Timing test

Setting	Description
Coil supply	
Supply source	Select one of the following supply-source options: <ul style="list-style-type: none"> • CIBANO 500 to supply the coils with <i>CIBANO 500</i>. • External source to supply the coils with the source connected to V IN. • Control board to supply the coils with a control-board switch.¹
Supply settings ^{2,3}	Select a preconfigured coil supply setting from the asset data or select Custom to enter custom settings.
Coil supply voltage	Rated voltage of the coil supply Click AC or DC for AC or DC coil supply voltage respectively.
Test frequency	Coil supply frequency (AC only)
Trip signal ⁴	Select whether the rising or falling edge of the trip signal opens the circuit breaker.
Close signal ⁴	Select whether the rising or falling edge of the close signal closes the circuit breaker.
Motor supply	
Supply source	Click CIBANO 500 to supply the motor with <i>CIBANO 500</i> . Click External source if the motor is supplied from the station supply or battery without any connection to <i>CIBANO 500</i> or if the station battery is connected to the V IN section and supplied, for example, via the B4 socket.
Supply settings ^{2,3}	Select the preconfigured motor supply setting from the asset data or select Custom to enter custom settings.
Motor supply voltage	Rated voltage of the motor supply Click AC or DC for AC or DC motor supply voltage respectively.

Table 17-15: Settings of the Timing test (continued)

Setting	Description
Test frequency	Motor supply frequency (AC only)
Max. supply duration	Maximum duration of supplying the motor if not stopped automatically
Main contact	
Contact system	Contact system of the circuit breaker under test Select PIR to measure timing of contacts with pre-insertion resistors.
Other	
Grounding	Select the grounding condition of the circuit breaker under test.
Sequence	
Test sequence	Test sequence to be performed
Trigger setting⁵	
Threshold	Threshold value of the trigger signal The measurement starts if the trigger signal rises above (rising edge) or falls below (falling edge) the threshold.
Edge type	Rising or falling edge

1. Only available if the trip and/or close signals are configured on the *IOB1* module.
 2. Only available in the guided test workflow and if *CIBANO 500* is selected as source
 3. Data taken from the nameplate
 4. Only available if **Control board** is selected as supply source.
 5. Only available if **V IN**, or one output in group **A**, group **B** or group **C** is set to Trigger IN.
2. Optionally, enter the advanced settings in the **Advanced settings** area.

Table 17-16: Advanced settings of the Timing test

Setting	Description
Main contact	
Sine wave filter	Select the Sine wave filter check box to suppress sinusoidal interference.
Start evaluation at	Start time of the sine wave evaluation. Select the time at which the sinusoidal interference is clearly present in the measurement signal.
Sine frequency	Frequency of the sinusoidal interference
Other	
Close breaker before test ¹	Select the Close breaker before test check box to automatically close the circuit breaker 1 second before starting a measurement.
Sample rate	Measurement sample rate

Table 17-16: Advanced settings of the Timing test (continued)

Setting	Description
Contact bounce filter	
Main contact	Threshold value of the time interval between two consecutive bounces of the main contact. For time intervals equal or below the threshold, the contact is considered as closed. Setting the value to 0.0 ms deactivates the contact bounce filter.
Auxiliary contact	Threshold value of the time interval between two consecutive bounces of the auxiliary contact. For time intervals equal or below the threshold, the contact is considered as closed. Setting the value to 0.0 ms deactivates the contact bounce filter.
Average coil current/voltage	
Begin	Start of the average coil current/voltage evaluation in percent of the time period during which the current flows through the coil
End	End of the average coil current/voltage evaluation in percent of the time period during which the current flows through the coil
Sequence	

See Table 17-17: "Timing test sequences" later in this section.

1. The **Close breaker before test** check box is only active if the test sequence begins with the open command and no output is set to Trigger IN.

The following table explains the sequences of the Timing test.

Table 17-17: Timing test sequences

Sequence	Action
O	With this sequence, the opening time of the circuit breaker is measured. Only for O and C sequences we recommend performing the test twice, once with nominal voltage and once with 20% undervoltage to assure the functionality of the circuit breaker for a weak station battery.
C	This is the sequence to measure the closing time of the circuit breaker.
OC	With this sequence, a closing operation after the circuit breaker has tripped to clear a fault is simulated. Initially, the circuit breaker must be in the closed position. An open command initiates the sequence, followed by a dead time to clear the fault; and finally a close command must close the circuit breaker. This sequence is also known as reclosing sequence. To find out the shortest reclosing time the circuit breaker can provide, the close command is already applied while the circuit breaker is still opening. The circuit breaker then will close after opening as fast as possible.
CO	With this sequence, a tripping operation after the circuit breaker has been closed under a fault condition (trip-free) or the verification of the correct operation of the anti-pumping system is simulated. To test the trip-free time the circuit breaker must be in the open position before the test is started. The circuit breaker is closed and then during the close operation is still in progress an open command is sent. The circuit breaker then opens as fast as possible. To test the anti-pumping function of the circuit breaker, the circuit breaker must be in closed position before the test is started. For this test the open time is set shorter (typically 200 ms) than the closing time (typically 400 ms). Ensure that the end time is increased so that the test sequence covers the whole close command duration (typically at least 190 ms). When the close command is sent the circuit breaker is already closed which initiates the anti-pumping function. Then an open command is sent and the circuit breaker trips. The closing command is still on when the open command ends, but the circuit breaker should not "pump", so that it should not close again.
O-CO	With this sequence, a reclose sequence (OC) under a fault condition is simulated. If the fault is not released, the circuit breaker must open (O) immediately and remain in this position. Initially, the circuit breaker must be in the closed position. The sequence begins with an open command, after a dead time the close and open commands (CO) must be applied at the same time (delay time typically 300 ms).

3. In the **Assessment** area, configure the assessment.
 - ▶ Click **Edit configuration** or click in one of the tables to open the **Assessment configuration** dialog box, and then edit the assessment limits.
 - ▶ Select the **Automatic assessment** check box to enable the automatic assessment.

Note: For the assessment limit definitions, see 15.3 "Assessment limits" on page 106.
4. By using the **Open breaker**, **Close breaker** and **Supply motor** buttons in the **Measurements** area of *Primary Test Manager* (see 11.1 "Test control commands" on page 85) you can check whether all cables are correctly connected and bring the circuit breaker to the proper state. For example, to test an O sequence, the circuit breaker must be closed and the spring charged.



5. In the **Measurements** area, click **Start**.
The blue ring on the **Start/Stop** button is on.



WARNING

Death or severe injury caused by high voltage or current possible

- ▶ Do not enter the high-voltage test area while testing with *CIBANO 500* since any part of the circuit breaker can carry dangerous voltages.
- ▶ Stay in the work area during the test.



6. Start the measurement by pressing the **Start/Stop** button.
The blue ring on the **Start/Stop** button flashes for approx. 3 seconds, and the lightning symbol in *Primary Test Manager* and the red status light on the front panel are flashing.

Note: You can abort the measurement anytime manually by pressing the **Emergency Stop** button or the **Start/Stop** button on the *CIBANO 500* front panel.



7. After the measurement has finished, the lightning symbol in *Primary Test Manager* stops flashing, the green status light is on, and *Primary Test Manager* displays the measurement results.
The operating times depend on the sequence of the trip and close commands. The following table describes the operating times for all measurement sequences.

Table 17-18: Operating times¹

Data	Description
Opening time	Contact opening time of O, OC, O-CO and O-CO-CO operation
Opening sync.	Opening synchronization time of O, OC, O-CO and O-CO-CO operation
Closing time	Contact closing time of C, CO and O-CO operation
Closing sync.	Closing synchronization time of C, CO and O-CO operation
Reclosing time	Contact reclosing time of OC operation
Open-close time	Contact open-close time of O-CO, CO-CO, and O-CO-CO operation
Close-open time 1	Contact close-open time of CO and O-CO operation
Close-open time 2	Second contact close-open time of CO-CO and O-CO-CO operation
Assessment	Assessment of operating times

1. The operating times are calculated per contact, phase or circuit breaker.

Table 17-19: Auxiliary contact characteristics¹

Data	Description
Contact	Name of the auxiliary contact of the circuit breaker under test
Phase	Phase to which the auxiliary contact belongs
Type	Type of the auxiliary contact (a, b, wiper)
Switching time	Closing or opening time of the auxiliary contact depending on its type
Duration	Duration the wiper contact remains closed
Diff. to main	Time difference between the opening or closing of the auxiliary contact and the corresponding main contact
Assessment	Assessment of auxiliary contact characteristics

1. Only calculated for O and C sequences

Table 17-20: Main contact characteristics

Data	Description
Main contact	Main contact this measurement row refers to
Bounce time ¹	Duration of the main contact bounce
Bounce count ¹	Number of main contact bounces within the bounce time
PIR closing time	Closing time for pre-insertion resistors
Assessment	Measurement assessment

1. Only available for O and C sequences

Table 17-21: Coil characteristics

Data	Description
Peak current	Peak current value through a trip or close coil
Average current	Average current through the coil (see Average coil current/voltage settings in Table 17-16: "Advanced settings of the Timing test" on page 140)
Average voltage	Average voltage applied to the coil (see Average coil current/voltage settings in Table 17-16: "Advanced settings of the Timing test" on page 140)
Resistance	Calculated resistance of the coil
Assessment	Assessment of coil characteristics

Disconnection

For disconnecting the circuit breaker, see "Disconnection" on page 163.

17.1.7 Dynamic Contact Resistance test

The Dynamic Contact Resistance test is typically not done on MV circuit breakers and can be performed only with the *CB MC2* modules in connection with *CIBANO 500*. For more information, see 17.2.7 "Dynamic Contact Resistance test" on page 196.

17.1.8 Minimum Pickup test

The Minimum Pickup test determines the minimum voltage required to trip or close the circuit breaker. By using the internal power source of *CIBANO 500*, the coil supply voltage is increased step by step through an automated test sequence until the circuit breaker operates.

Note: To perform the Minimum Pickup test, you need a license. Without the license, it is not possible to start the measurement and *Primary Test Manager* displays a missing license message. To get the license, contact your regional OMICRON service center.

Connection

To connect the test object to *CIBANO 500*:

1. In *Primary Test Manager*, open the Minimum Pickup test.
2. In the **Hardware configuration** area, set the hardware configuration.
Often you can leave the cables as already connected in the previous test. Unused sockets can remain connected.

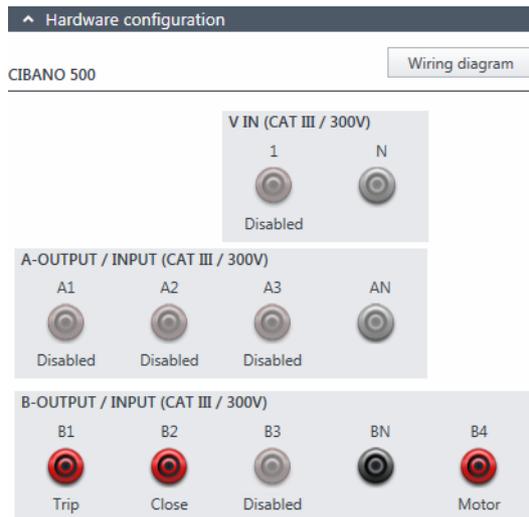


Figure 17-10: Hardware configuration of the Minimum Pickup test

Table 17-22: Hardware configuration options of *CIBANO 500*

CIBANO 500	Option
V IN (CAT III / 300 V)¹	
1	External source or Disabled
N	Neutral connection of V IN
A-OUTPUT / INPUT (CAT III / 300 V)	
A1	Motor A or Disabled
A2	Motor B or Disabled
A3	Motor C or Disabled

Table 17-22: Hardware configuration options of *CIBANO 500* (continued)

CIBANO 500	Option
AN	Common neutral connection for outputs in group A
B-OUTPUT / INPUT (CAT III / 300 V)	
B1	Trip or Disabled
B2	Close or Disabled
B3	Supply or Disabled
BN	Common neutral connection for outputs in group B
B4	Motor or Disabled

1. Cannot be used to supply the trip or close coil because a variable voltage is needed, however it can be used to supply the motor.
3. Make sure that all cable connectors are clean and dry before being tightly connected.
4. Connect *CIBANO 500* to the trip and close coils of the circuit breaker according to the wiring diagram displayed in *Primary Test Manager*.

Measurement

To perform a measurement:

1. In the **Settings and conditions** area, enter the settings of the Minimum Pickup test.

Table 17-23: Settings of the Minimum Pickup test

Setting	Description
Coil supply	
Supply settings ^{1,2}	Select a preconfigured coil supply setting from the asset data or select Custom to enter custom settings.
Coil supply voltage	Rated voltage of the coil supply Click AC or DC for AC or DC coil supply voltage respectively.
Test frequency	Coil supply frequency (AC only)
Test sequence	
Coil supply voltage start	Start voltage of the automated test sequence to determine the minimum pickup voltage
Coil supply voltage end	End voltage of the automated test sequence to determine the minimum pickup voltage
Coil supply voltage step	Stepwise voltage increase of the automated test sequence
Motor supply	
Supply source	Click CIBANO 500 to supply the motor with <i>CIBANO 500</i> . Click External source to supply the motor externally.

Table 17-23: Settings of the Minimum Pickup test (continued)

Setting	Description
Supply settings ^{1,2,3}	Select the preconfigured motor supply setting from the asset data or select Custom to enter custom settings.
Motor supply voltage	Rated voltage of the motor supply Click AC or DC for AC or DC motor supply voltage respectively.
Test frequency	Motor supply frequency (AC only)
Max. supply duration	Maximum duration of supplying the motor if not stopped automatically

1. Only available in the guided test workflow
2. Data taken from the nameplate
3. Only available if *CIBANO 500* is selected as source

2. Optionally, enter the advanced settings in the **Advanced settings** area.

Table 17-24: Advanced settings of the Minimum Pickup test

Setting	Description
Supply during coil supply	
Enable	Select the Enable check box to supply voltage on the B3 socket during test execution. ¹
Supply voltage	Voltage supplied on the B3 socket (same as the coil supply voltage)
Supply before test	Time interval within which the voltage is supplied before the test starts
Test sequence	
Command impulse duration	Duration of the command pulse of the automated test sequence
Pause between impulses	Time interval between impulses of the automated test sequence

1. The **B3** socket must be configured as **Supply** and the coil supply voltage must be specified.
3. In the **Assessment** area, configure the assessment.
 - ▶ Click **Edit configuration** or click in the table to open the **Assessment configuration** dialog box, and then edit the assessment limits.
 - ▶ Select the **Automatic assessment** check box to enable the automatic assessment.

Note: For the assessment limit definitions, see 15.3 "Assessment limits" on page 106.
4. By using the **Open breaker**, **Close breaker** and **Supply motor** buttons in the **Measurements** area of *Primary Test Manager* (see 11.1 "Test control commands" on page 85) you can check whether all cables are correctly connected and bring the circuit breaker to the proper state. For testing the minimum pickup by the open sequence the circuit breaker must be closed and vice versa.



- In the **Measurements** area, select the measurement you want to perform, and then click **Start**. The blue ring on the **Start/Stop** button is on.



WARNING

Death or severe injury caused by high voltage or current possible

- ▶ Do not enter the high-voltage test area while testing with *CIBANO 500* since any part of the circuit breaker can carry dangerous voltages.
- ▶ Stay in the work area during the test.



- Start the measurement by pressing the **Start/Stop** button. The blue ring on the **Start/Stop** button flashes for approx. 3 seconds, and the lightning symbol in *Primary Test Manager* and the red status light on the front panel are flashing.

Note: You can abort the measurement anytime manually by pressing the **Emergency Stop** button or the **Start/Stop** button on the *CIBANO 500* front panel.

Note: If you connect, for example, three coils of three phases in parallel not all might operate at the same voltage. In this case the test will run until the last phase has operated and the highest voltage (worst case) will be shown.



- After the measurement has finished, the lightning symbol in *Primary Test Manager* stops flashing, the green status light is on, and *Primary Test Manager* displays the measurement results.

Table 17-25: Minimum Pickup measurement data

Data	Description
No.	Number of the measurement
Operation	Trip or close
V pickup	Pickup voltage of the coil under test
Assessment	Measurement assessment

Disconnection

For disconnecting the circuit breaker, see "Disconnection" on page 163.

17.1.9 Motor Current test

The Motor Current test records the supply voltages and currents of the circuit breaker's charging motor(s).

Note: To perform the Motor Current test, you need a license. Without the license, it is not possible to start the measurement and *Primary Test Manager* displays a missing license message. To get the license, contact your regional OMICRON service center.

Connection

To connect the test object to *CIBANO 500*:

1. In *Primary Test Manager*, open the Motor Current test.
2. In the **Hardware configuration** area, set the hardware configuration.
3. After setting the hardware configuration, connect the **B4** socket on the side panel of *CIBANO 500* to "+" or phase contact of the motor and the **BN** socket to "-" or neutral contact of the motor.

Note: Do not connect Trigger IN and current clamps to the same neutral connection socket of the group **A** or group **B**.

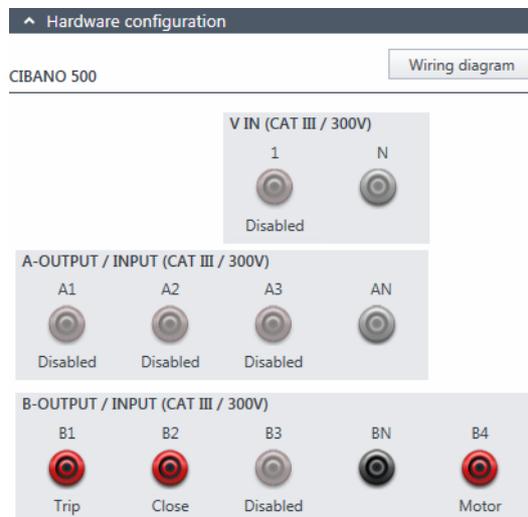


Figure 17-11: Hardware configuration of the Motor Current test

Note: You can control three circuit breaker's motors simultaneously. In this case connect the phase contact of the motor 1 to the **A1** socket, the phase contact of the motor 2 to the **A2** socket, the phase contact of the motor 3 to the **A3** socket, and the neutral motor contacts to the **AN** socket.

Table 17-26: Hardware configuration options of *CIBANO 500*

CIBANO 500	Option			
V IN (CAT III / 300 V)				
1	External source, Trigger IN ¹ or Disabled			
N	Neutral connection of V IN			
A-OUTPUT / INPUT (CAT III / 300 V)				
A1	Motor A, Trigger IN ¹ or Disabled			
A2	Motor B, Trigger IN ¹ or Disabled			
A3	Motor C, Trigger IN ¹ or Disabled			
AN	Common neutral connection for outputs/inputs in group A			
B-OUTPUT / INPUT (CAT III / 300 V)				
B1	Trip			or Disabled
	Trigger IN ¹			
	I clamp 1	Motor	all	
			Phase A	
			Phase B	
Phase C				
B2	Close			or Disabled
	Trigger IN ¹			
	I clamp 2	Motor	all	
			Phase A	
			Phase B	
Phase C				
B3	Supply			or Disabled
	Trigger IN ¹			
	I clamp 3	Motor	all	
			Phase A	
			Phase B	
Phase C				
BN	Neutral connection of outputs in group B			

Table 17-26: Hardware configuration options of CIBANO 500 (continued)

CIBANO 500	Option			
B4	Motor			or Disabled
	Trigger IN ¹			
	I clamp 4	Motor	all	
			Phase A	
			Phase B	
Phase C				

1. Trigger signal starting the measurement
4. Make sure that all cable connectors are clean and dry before being tightly connected.
5. Connect CIBANO 500 to the motor of the circuit breaker according to the wiring diagram displayed in Primary Test Manager and the following figure.

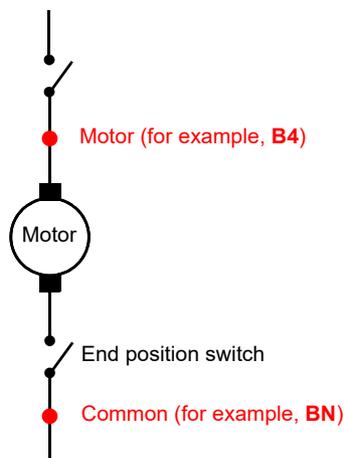


Figure 17-12: Connecting CIBANO 500 to the circuit breaker for the Motor Current test (The end position switch opens when the spring is charged.)

Measurement

To perform a measurement:

1. In the **Settings and conditions** area, enter the settings of the Motor Current test.

Table 17-27: Settings of the Motor Current test

Setting	Description
Motor supply	
Supply source	Click CIBANO 500 to supply the motor with CIBANO 500. Click External source to supply the motor externally.
Supply settings ^{1,2}	Select the preconfigured motor supply setting from the asset data or select Custom to enter custom settings.

Table 17-27: Settings of the Motor Current test (continued)

Setting	Description
Motor supply voltage	Rated voltage of the motor supply Click AC or DC for AC or DC motor supply voltage respectively.
Test frequency	Motor supply frequency (AC only)
Max. supply duration	Maximum duration of supplying the motor if not stopped automatically
Coil supply	
Supply source	Select one of the following supply-source options: <ul style="list-style-type: none"> • CIBANO 500 to supply the coils with <i>CIBANO 500</i>. • External source to supply the coils with the source connected to V IN. • Control board to supply the coils with a control-board switch.³
Supply settings ^{1,2}	Select a preconfigured coil supply setting from the asset data or select Custom to enter custom settings.
Coil supply voltage	Rated voltage of the coil supply Click AC or DC for AC or DC coil supply voltage respectively.
Test frequency	Coil supply frequency (AC only)
Trip signal ⁴	Select whether the rising or falling edge of the trip signal opens the circuit breaker.
Close signal ⁴	Select whether the rising or falling edge of the close signal closes the circuit breaker.
Current clamp settings⁵	
Channel	Group B I/O socket
Ratio	Current clamp ratio
I max	Maximum current of the selected probe range
Trigger setting⁶	
Threshold	Threshold value of the trigger signal The measurement starts if the trigger signal rises above (rising edge) or falls below (falling edge) the threshold.
Edge type	Rising or falling edge

1. Only available in the guided test workflow and if *CIBANO 500* is selected as source

2. Data taken from the nameplate

3. Only available if the trip and/or close signals are configured on the *IOB1* module.

4. Only available if **Control board** is selected as supply source.

5. Only available if at least one output in group **B** is set to I clamp x.

6. Only available if **V IN**, or one output in group **A** or group **B** is set to Trigger IN.

2. Optionally, enter the advanced settings in the **Advanced settings** area.

Table 17-28: Advanced settings of the Motor Current test

Setting	Description
Other	
Sample rate	Measurement sample rate
Charging current	
Begin	Start of the charging current evaluation in percent of the total charging duration of the motor
End	End of the charging current evaluation in percent of the total charging duration of the motor

3. In the **Assessment** area, configure the assessment.

- ▶ Click **Edit configuration** or click in one of the tables to open the **Assessment configuration** dialog box, and then edit the assessment limits.
- ▶ Select the **Automatic assessment** check box to enable the automatic assessment.

Note: For the assessment limit definitions, see 15.3 "Assessment limits" on page 106.



4. In the **Measurements** area, click **Start**.
The blue ring on the **Start/Stop** button is on.



WARNING

Death or severe injury caused by high voltage or current possible

- ▶ Do not enter the high-voltage test area while testing with *CIBANO 500* since any part of the circuit breaker can carry dangerous voltages.
- ▶ Stay in the work area during the test.



5. Start the measurement by pressing the **Start/Stop** button.
The blue ring on the **Start/Stop** button flashes for approx. 3 seconds, and the lightning symbol in *Primary Test Manager* and the red status light on the front panel are flashing.

Note: In emergency cases, you can abort the measurement anytime manually by pressing the **Emergency Stop** button on the *CIBANO 500* front panel.

6. After the charging process has finished, *CIBANO 500* stops the measurement automatically.
The lightning symbol in *Primary Test Manager* stops flashing, the green status light is on, and *Primary Test Manager* displays the measurement results.



The following figure shows an example of the Motor Current test graphical results.

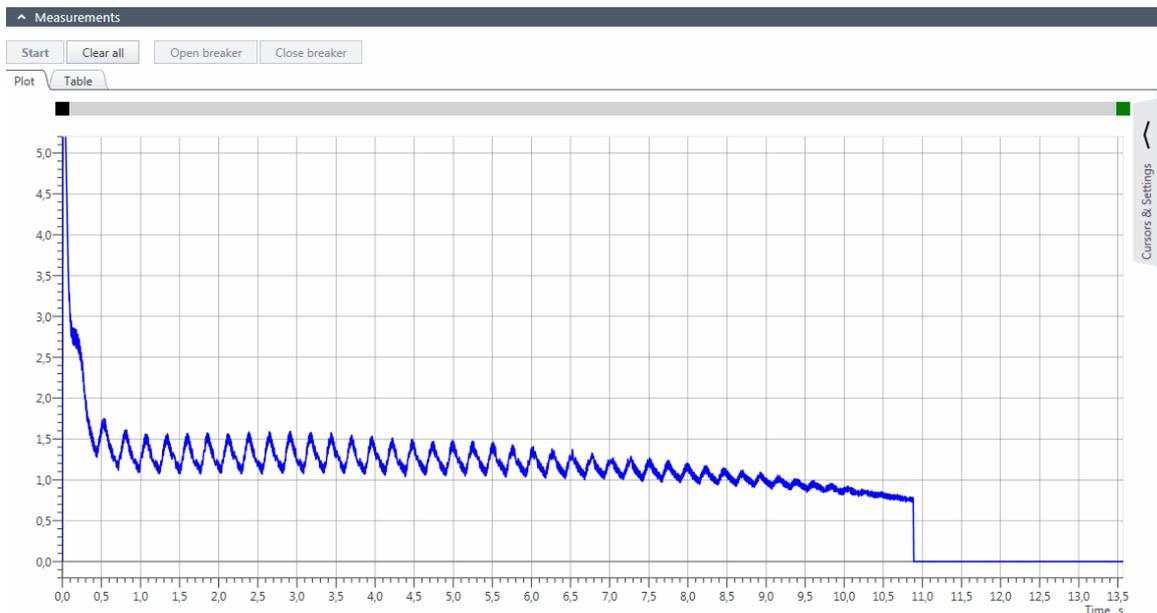


Figure 17-13: Example of the Motor Current test graphical results

To display the numerical measurement results, click the **Table** tab in the **Measurements** area.

Table 17-29: Motor characteristics

Data	Description
Inrush current	Maximum current drawn by the motor On a DC motor, the inrush current is usually reached during the startup phase.
Charging time	Time the motor needs to charge the spring The spring is used to store the energy for a trip or close operation.
Charging current	Average charging current of the motor (see Charging current settings in Table 17-28: "Advanced settings of the Motor Current test" on page 154)
Minimum voltage	Minimum motor supply voltage during the charging operation of the motor
Assessment	Measurement assessment

Disconnection

For disconnecting the circuit breaker, see "Disconnection" on page 163.

17.1.10 Under-voltage Release test

The Under-voltage Release test checks the condition of the under-voltage release mechanism of medium-voltage circuit breakers. During the test, a sequence of decreasing DC voltage pulses is applied to the under-voltage (UV) coil and the voltage trip level is evaluated.

Connection

To connect the test object to *CIBANO 500*:

1. In *Primary Test Manager*, open the Under-voltage Release test.
2. In the **Hardware configuration** area, set the hardware configuration.

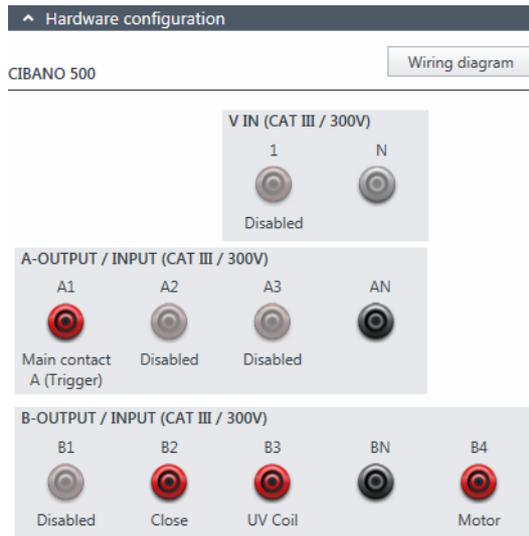


Figure 17-14: Hardware configuration of the Under-voltage Release test

Table 17-30: Hardware configuration options of *CIBANO 500*

CIBANO 500	Option
V IN (CAT III / 300 V)¹	
1	External source or Disabled
N	Neutral connection of V IN
A-OUTPUT / INPUT (CAT III / 300 V)	
A1	Main contact A, Main contact A (Trigger) or Disabled
A2	Main contact B, Main contact B (Trigger) or Disabled
A3	Main contact C, Main contact C (Trigger) or Disabled
AN	Common neutral connection for outputs in group A

Table 17-30: Hardware configuration options of *CIBANO 500* (continued)

CIBANO 500	Option
B-OUTPUT / INPUT (CAT III / 300 V)	
B1	Disabled
B2	Close
B3	UV coil
BN	Common neutral connection for outputs in group B
B4	Motor or Disabled

1. Cannot be used to supply the trip or close coil because a variable voltage is needed, however it can be used to supply the motor.
3. Make sure that all cable connectors are clean and dry before being tightly connected.
4. Connect *CIBANO 500* to the circuit breaker according to the wiring diagram displayed in *Primary Test Manager*.

Measurement

To perform a measurement:

1. In the **Settings and conditions** area, enter the settings of the Under-voltage Release test.

Table 17-31: Settings of the Under-voltage Release test

Setting	Description
Coil supply	
Supply settings ^{1,2}	Select a preconfigured coil supply setting from the asset data or select Custom to enter custom settings.
Coil supply voltage	Rated voltage of the coil supply Click AC or DC for AC or DC coil supply voltage respectively.
Test frequency	Coil supply frequency (AC only)
Test sequence	
Start voltage	Start level of the DC voltage pulse sequence applied to the UV coil
End voltage	End level of the DC voltage pulse sequence applied to the UV coil
Step voltage	Step level of the DC voltage pulse sequence applied to the UV coil
Motor supply	
Supply source	Click CIBANO 500 to supply the motor with <i>CIBANO 500</i> . Click External source to supply the motor externally.

Table 17-31: Settings of the Under-voltage Release test (continued)

Setting	Description
Supply settings ^{1,2,3}	Select the preconfigured motor supply setting from the asset data or select Custom to enter custom settings.
Motor supply voltage	Rated voltage of the motor supply Click AC or DC for AC or DC motor supply voltage respectively.
Test frequency	Motor supply frequency (AC only)
Max. supply duration	Maximum duration of supplying the motor if not stopped automatically

1. Only available in the guided test workflow
2. Data taken from the nameplate
3. Only available if *CIBANO 500* is selected as source

2. Optionally, enter the advanced settings in the **Advanced settings** area.

Table 17-32: Advanced settings of the Under-voltage Release test

Setting	Description
Test sequence	
Step duration	Pulse width of the DC voltage pulse sequence applied to the UV coil

3. In the **Assessment** area, configure the assessment.
 - ▶ Click **Edit configuration** or click in the table to open the **Assessment configuration** dialog box, and then edit the assessment limits.
 - ▶ Select the **Automatic assessment** check box to enable the automatic assessment.

Note: For the assessment limit definitions, see 15.3 "Assessment limits" on page 106.



4. In the **Measurements** area, click **Start**.
The blue ring on the **Start/Stop** button is on.

WARNING

Death or severe injury caused by high voltage or current possible

- ▶ Do not enter the high-voltage test area while testing with *CIBANO 500* since any part of the circuit breaker can carry dangerous voltages.
- ▶ Stay in the work area during the test.



5. Start the measurement by pressing the **Start/Stop** button.
The blue ring on the **Start/Stop** button flashes for approx. 3 seconds, and the lightning symbol in *Primary Test Manager* and the red status light on the front panel are flashing.

Note: You can abort the measurement anytime manually by pressing the **Emergency Stop** button or the **Start/Stop** button on the *CIBANO 500* front panel.



6. After the measurement has finished, the lightning symbol in *Primary Test Manager* stops flashing, the green status light is on, and *Primary Test Manager* displays the measurement results.

Table 17-33: Under-voltage Release measurement data

Data	Description
UV coil characteristics	
Trip voltage	Voltage level at which the circuit breaker trips
Assessment	Measurement assessment

Disconnection

For disconnecting the circuit breaker, see "Disconnection" on page 163.

17.1.11 Overcurrent Release test

The Overcurrent Release test checks the condition of the overcurrent release mechanism of medium-voltage circuit breakers. During the test, a sequence of increasing AC current pulses is applied to the overcurrent (OC) relay and the current trip level is evaluated.

Connection

To connect the test object to *CIBANO 500*:

1. In *Primary Test Manager*, open the Overcurrent Release test.
2. In the **Hardware configuration** area, set the hardware configuration.

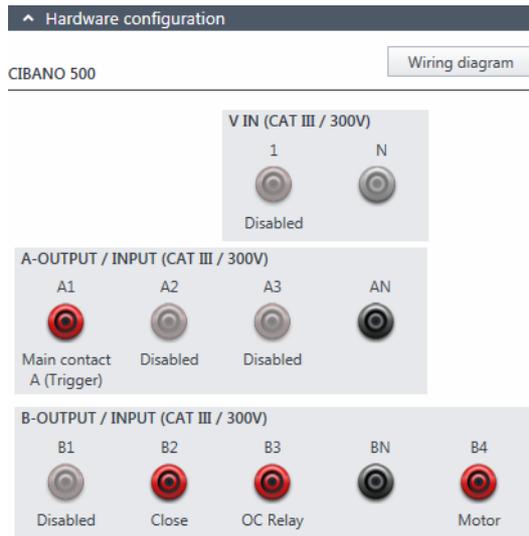


Figure 17-15: Hardware configuration of the Overcurrent Release test

Table 17-34: Hardware configuration options of *CIBANO 500*

CIBANO 500	Option
V IN (CAT III / 300 V)¹	
1	External source or Disabled
N	Neutral connection of V IN
A-OUTPUT / INPUT (CAT III / 300 V)	
A1	Main contact A, Main contact A (Trigger) or Disabled
A2	Main contact B, Main contact B (Trigger) or Disabled
A3	Main contact C, Main contact C (Trigger) or Disabled
AN	Common neutral connection for outputs in group A

Table 17-34: Hardware configuration options of *CIBANO 500* (continued)

CIBANO 500	Option
B-OUTPUT / INPUT (CAT III / 300 V)	
B1	Trip or Disabled
B2	Close or Disabled
B3	OC relay
BN	Common neutral connection for outputs in group B
B4	Motor or Disabled

1. Cannot be used to supply the trip or close coil because a variable voltage is needed, however it can be used to supply the motor.

3. Make sure that all cable connectors are clean and dry before being tightly connected.

4. Connect *CIBANO 500* to the circuit breaker according to the wiring diagram displayed in *Primary Test Manager*.

Measurement

To perform a measurement:

1. In the **Settings and conditions** area, enter the settings of the Overcurrent Release test.

Table 17-35: Settings of the Overcurrent Release test

Setting	Description
Coil supply	
Supply settings ^{1,2}	Select a preconfigured coil supply setting from the asset data or select Custom to enter custom settings.
Coil supply voltage	Rated voltage of the coil supply Click AC or DC for AC or DC coil supply voltage respectively.
Test frequency	Coil supply frequency (AC only)
Test sequence	
Start current	Start level of the AC current pulse sequence applied to the OC relay
End current	End level of the AC current pulse sequence applied to the OC relay
Step current	Step level of the AC current pulse sequence applied to the OC relay
Test frequency	Frequency of the AC current pulses sequence applied to the OC relay
Motor supply	
Supply source	Click CIBANO 500 to supply the motor with <i>CIBANO 500</i> . Click External source to supply the motor externally.

Table 17-35: Settings of the Overcurrent Release test (continued)

Setting	Description
Supply settings ^{1,2,3}	Select the preconfigured motor supply setting from the asset data or select Custom to enter custom settings.
Motor supply voltage	Rated voltage of the motor supply Click AC or DC for AC or DC motor supply voltage respectively.
Test frequency	Motor supply frequency (AC only)
Max. supply duration	Maximum duration of supplying the motor if not stopped automatically

1. Only available in the guided test workflow
2. Data taken from the nameplate
3. Only available if *CIBANO 500* is selected as source

2. Optionally, enter the advanced settings in the **Advanced settings** area.

Table 17-36: Advanced settings of the Overcurrent Release test

Setting	Description
Test sequence	
Step duration	Pulse width of the AC current pulse sequence applied to the OC relay
Pause duration	Duration of the pause between the current pulses. The current level during the pause is 0 A.

3. In the **Assessment** area, configure the assessment.
 - ▶ Click **Edit configuration** or click in the table to open the **Assessment configuration** dialog box, and then edit the assessment limits.
 - ▶ Select the **Automatic assessment** check box to enable the automatic assessment.

Note: For the assessment limit definitions, see 15.3 "Assessment limits" on page 106.
4. In the **Measurements** area, click **Start**.
The blue ring on the **Start/Stop** button is on.



WARNING

Death or severe injury caused by high voltage or current possible

- ▶ Do not enter the high-voltage test area while testing with *CIBANO 500* since any part of the circuit breaker can carry dangerous voltages.
- ▶ Stay in the work area during the test.



5. Start the measurement by pressing the **Start/Stop** button.
The blue ring on the **Start/Stop** button flashes for approx. 3 seconds, and the lightning symbol in *Primary Test Manager* and the red status light on the front panel are flashing.

Note: You can abort the measurement anytime manually by pressing the **Emergency Stop** button or the **Start/Stop** button on the *CIBANO 500* front panel.



6. After the measurement has finished, the lightning symbol in *Primary Test Manager* stops flashing, the green status light is on, and *Primary Test Manager* displays the measurement results.

Table 17-37: Overcurrent Release measurement data

Data	Description
OC Relay characteristics	
Trip current	Current level at which the circuit breaker trips
Assessment	Measurement assessment

Disconnection

Note: Do not disconnect the test object from *CIBANO 500* if you intend to make further measurements.

To disconnect the test object from *CIBANO 500*:



1. Press the **Emergency Stop** button on the *CIBANO 500* front panel.
2. Wait until the green status light on the *CIBANO 500* front panel is on and the voltage/current indicator on the *CIBANO 500* side panel is off.
3. Remove the barrier between the dangerous and the work area.

WARNING

Death or severe injury caused by high voltage or current possible

- ▶ Do not touch any part of the circuit breaker before grounding and short-circuiting its terminals.
- ▶ Always ground and short-circuit the circuit breaker's terminals by using a grounding set.

4. Disconnect all cables from the circuit breaker.
5. Disconnect all cables from *CIBANO 500*.
6. Switch off *CIBANO 500* by pressing the mains power on/off switch on the *CIBANO 500* side panel.
7. Disconnect the mains power cord.
8. Remove the equipotential ground as the last connection that is removed first on the substation side and then from *CIBANO 500*.

WARNING

Death or severe injury caused by high voltage or current possible

- ▶ Do not leave the circuit breaker's spring(s) charged after disconnecting *CIBANO 500* from the circuit breaker.
- ▶ Always operate the circuit breaker manually by using the circuit breaker's operation buttons until the spring(s) are discharged.

17.1.12 Insulation Resistance test

The Insulation Resistance test is used to import or enter data from an insulation testing device.

Note: To perform the Insulation Resistance test, you need a license. Without the license, it is not possible to start the measurement and *Primary Test Manager* displays a missing license message. To get the license, contact your regional OMICRON service center.

Table 17-38: Insulation Resistance test settings

Setting	Description
Test conditions	
Test object temperature	Temperature of the test object
Reference temperature	Reference temperature for calculating the correction factor
Custom test conditions	Select the Custom test conditions check box to set test conditions different from the global test conditions.
Ambient temperature	Ambient temperature on site
Humidity	Relative ambient humidity
Calculations	
PI calculation	Select the PI calculation check box to calculate the polarization index.
Time 1	In the standard PI calculation, the testing device is applied and the insulation resistance measurements are taken after 60 seconds (Time 1) and 600 seconds (Time 2). The polarization index (PI) is calculated as follows: $PI = \frac{R_{600}}{R_{60}}$
Time 2	
DAR calculation	Select the DAR calculation check box to calculate the dielectric absorption ratio.
Time 1	In the standard DAR calculation, the testing device is applied and the insulation resistance measurements are taken after 30 seconds (Time 1) and 60 seconds (Time 2). The dielectric absorption ratio (DAR) is calculated as follows: $DAR = \frac{R_{60}}{R_{30}}$
Time 2	

Table 17-39: Insulation Resistance measurement data

Setting	Description
Test data	<p>To import a file containing test data:</p> <ul style="list-style-type: none"> ▶ Click Add  to browse your computer and add data from a file. <p>To directly import data from a measurement file:</p> <ul style="list-style-type: none"> ▶ Open the file on your computer. ▶ In the file, press CTRL+A to mark all content, and then press CTRL+C to copy. ▶ In <i>Primary Test Manager</i>, press Paste from clipboard. The results may take a few seconds to load.
Measurement	Name or number of the measurement
PI	Polarization index
DAR	Dielectric absorption ratio
Time	Time at which the given values were recorded
R meas	Measured insulation resistance
R corr	Measured insulation resistance corrected by the correction factor
V DC	Voltage recorded at the Time specified in the first column
I DC	Current recorded at the Time specified in the first column

17.1.13 Inspection

Inspection is used to add the results of (visual) inspections of assets performed before measurements. The input fields in the Test results section of the test can be user-defined and saved as asset-specific templates.

The following table describes the Inspection settings.

Table 17-40: Inspection – Settings and conditions

Setting	Description
Test template	<p>► Select a saved Inspection template.</p> <p>Note: Only templates fitting the selected Asset kind and Asset type (where applicable) are shown here.</p>
	Opens the Inspection template dialog box
Assessment	<p>Manual Inspection assessment:</p> <ul style="list-style-type: none"> • Manual pass • Manual fail • Manual investigate • Not assessed

The following table describes the Inspection template dialog box.

Table 17-41: Dialog box – Inspection templates

Setting	Description
+ Add Template	► Create a new Inspection template.
 Edit Template	► Edit the currently selected Inspection template.
 Remove Template	► Remove the currently selected Inspection template from the template list
 Import Template	► Import a Inspection template from a file
 Export Template	► Export a Inspection template as a file
Templates	Shows a list of the stored Inspection templates
Preview	Shows a preview of the currently selected Inspection template

The following table describes the Inspection template creation/editing dialog box.

Table 17-42: Dialog box – Inspection template creation and editing

Setting	Description
 Save	▶ Save the template
 Add Insp. point	▶ Add a new inspection point to a group of inspection points.
 Add Group	▶ Add a new group of inspection points.
 Duplicate	▶ Duplicate the currently selected group or inspection point
 Remove	▶ Remove the element currently selected in the checklist (see below)
Template name	Name of the Inspection test template
Author	Author of the Inspection test template
Asset	Asset
Asset type	Asset type (where applicable)

17.1.14 Testing with external power supply

If you use an external power supply (for example, the station battery) for supplying the motor or the coils of the circuit breaker during the test, connect the external power supply to the **V IN** input of *CIBANO 500* and wire the **N** and **BN** sockets as shown in the following figure.

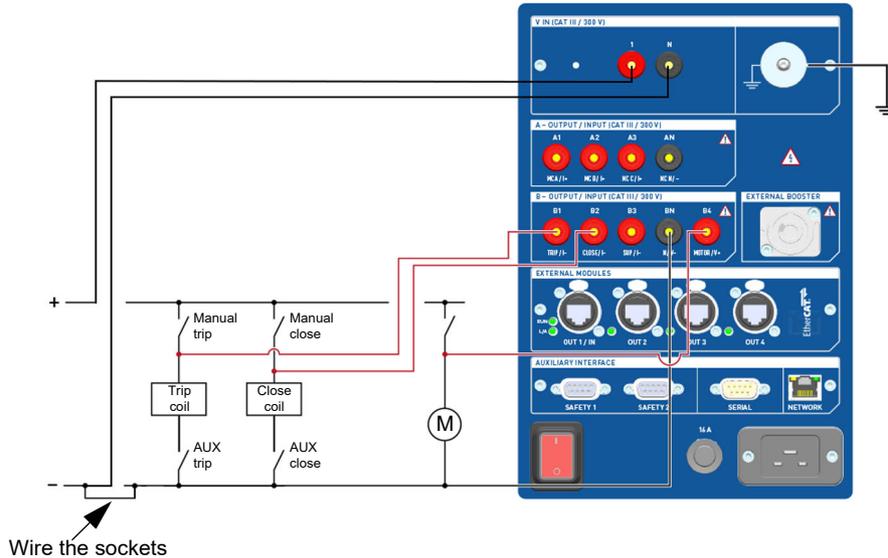


Figure 17-16: Wiring the *CIBANO 500* sockets for testing with external power supply

17.1.15 Continuous power supply

CIBANO 500 provides a continuous power supply on the **B3** socket to supply, for example, circuit breakers with electronic control boards prior to the test and whenever it is needed. After you have connected to *CIBANO 500*, you can configure the continuous power supply in the *Primary Test Manager* status bar.

Note: The continuous power supply is not available for the Contact Resistance test with *CIBANO 500* only (see 17.1.4 "Contact Resistance test" on page 122) and the Minimum Pickup test (see 17.1.8 "Minimum Pickup test" on page 146). If you have activated the continuous power supply and you open one of these tests, *Primary Test Manager* will prompt you to deactivate the continuous power supply before executing the test.

To configure the continuous power supply:

1. In the status bar, click **Edit**.

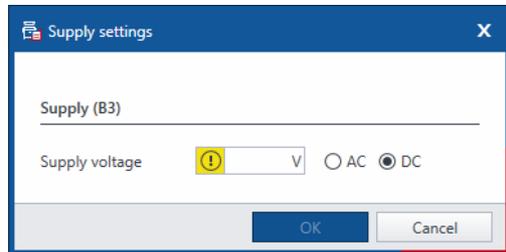


Figure 17-17: **Supply settings** dialog box

2. In the **Supply settings** dialog box, enter the supply voltage you want to use for testing your circuit breaker.

 **WARNING**

Death or severe injury caused by high voltage or current possible

- ▶ Do not touch the **B3** socket and any connected cables after you have activated the continuous power supply.
 - ▶ Always use a strobe light to warn the operating personnel of the possibly dangerous operating condition.
- ▶ To activate the continuous power supply, click **ON** in the status bar. After you click **Activate** in the **Activate power supply** dialog box, the configured supply voltage is applied to the **B3** socket, and the red light on the front panel will be flashing indicating possibly dangerous operating condition.

Note: If you have activated the continuous power supply, the coil supply settings are not available because the supply voltage is set by the continuous power supply.

 **CAUTION**

Personal injury due to unexpected operation of the circuit breaker possible

- ▶ Before deactivating the continuous power supply, open the circuit breaker.
- ▶ To deactivate the continuous power supply, click **OFF** in the status bar.

17.2 Testing high-voltage circuit breakers

The high-voltage (HV) circuit breakers are typically tested with the *CB MC2* and *CB TN3* modules in connection with *CIBANO 500*. If you want to test the HV circuit breakers without the *CB MC2* modules, see 17.1 "Testing medium-voltage circuit breakers" on page 117. In this case read both sections carefully and use *Primary Test Manager* as described in 17.1 "Testing medium-voltage circuit breakers" on page 117 but observe also the safety rules and tips and tricks relevant for testing the HV circuit breakers.

17.2.1 Safety precautions in the substation

DANGER

Death or severe injury caused by a lightning discharge

- ▶ Do not connect the test set to the test object if there is a possibility of a thunderstorm over any part of the system.
- ▶ Always observe the weather conditions while testing with *CIBANO 500*.

Always observe the following safety rules:

- Disconnect completely.
- Secure against re-connection.
- Verify that the installation is dead.
- Carry out grounding and short-circuiting.
- Provide protection against adjacent live parts.
- Ground the test object at one or more terminals during connecting, testing and disconnecting.

WARNING

Death or severe injury caused by high voltage or current possible

- ▶ Do not test with *CIBANO 500* without grounding the circuit breaker.
- ▶ Always ground the circuit breaker on both ends on all phases and close the circuit breaker to have proper grounding between the interrupters.

Separate your working area as shown in Figure 1-1: "Example of the separation of the work and high-voltage test areas" on page 12 into a work area and a high-voltage test area when a test is running. Set up a suitable barrier and, if applicable, status lights to protect others from accessing the high-voltage test area and accidentally touching live parts.

If there is a longer distance between the location of *CIBANO 500* and the high-voltage test area (that is, the test object), a second person with an additional **Emergency Stop** button is required.

WARNING

Death or severe injury caused by high voltage or current possible

- ▶ Never use the *CIBANO 500* test set without a solid connection to ground.
- ▶ Ground *CIBANO 500* with a cable of at least 6 mm² cross-section as close as possible to the operator.

17.2.2 Test set and software startup

To put *CIBANO 500* into operation and start *Primary Test Manager*:

1. Connect the *CIBANO 500* grounding terminals properly to the substation ground.
2. Connect *CIBANO 500* to a computer with the delivered Ethernet cable and switch on the computer.
3. Connect *CIBANO 500* to the mains power supply by using the delivered power cord.
4. Switch on *CIBANO 500* by pressing the mains power on/off switch on the side panel. The green status light on the *CIBANO 500* front panel (see Figure 3-1: "Front view of CIBANO 500" on page 17) flashes for a short time and then extinguishes for approx. one minute. After it lights up, the *CIBANO 500* outputs carry no dangerous voltage or current.
5. Start *Primary Test Manager* and connect to *CIBANO 500* as described in 5.4 "Start Primary Test Manager and connect to CIBANO 500" on page 28.

If you could not connect to your *CIBANO 500* device and the green light is permanently on, wait a few seconds, and then proceed as follows:

1. Click **More** next to the **Connect** button, and then click **Refresh**.
2. Select the test system from the list, and then click **Connect**.

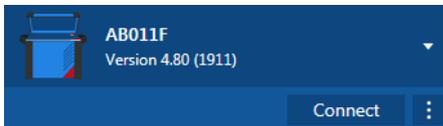


Figure 17-18: Connecting to *CIBANO 500*

If the *CIBANO 500* device to which you want to connect is not displayed in the list of available devices, proceed as described in 20.1 "Connecting to CIBANO 500" on page 315.

After you have started *Primary Test Manager* and connected to *CIBANO 500*, proceed as described earlier in this User Manual. You can:

- Create new guided jobs (see 7 "Create new guided jobs" on page 50)
- Manage locations, assets, jobs and test reports (see 10 "Manage objects" on page 77)
- Create new manual jobs (see 8 "Create new manual jobs" on page 72)
- Open existing jobs (see 9 "Open jobs" on page 76)
- Generate test reports (see 13 "Generate test reports" on page 93)

The next sections describe the HV circuit breaker tests.

17.2.3 Testing circuit breakers with *CIBANO 500* and the *CB MC2* modules

One or two interrupters per phase

When testing circuit breakers with one or two interrupters per phase you can hook up the *CB MC2* modules to all interrupters at the same time, without reconnecting them during any of the following tests.

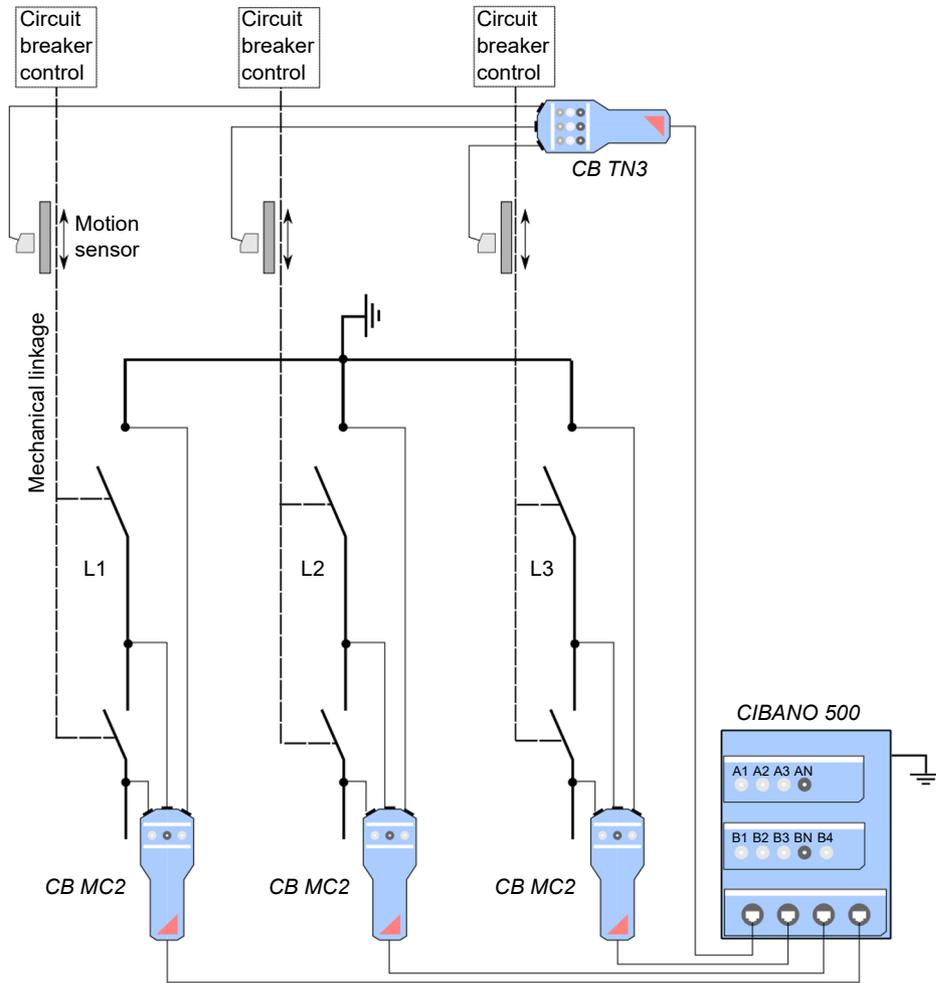


Figure 17-19: High-voltage section of a circuit breaker with two interrupters per phase with directly connected *CB MC2* modules

The *CB MC2* modules can be directly connected to the EtherCAT® module of the main devices or via the EtherCAT® hub as shown in the following figure.

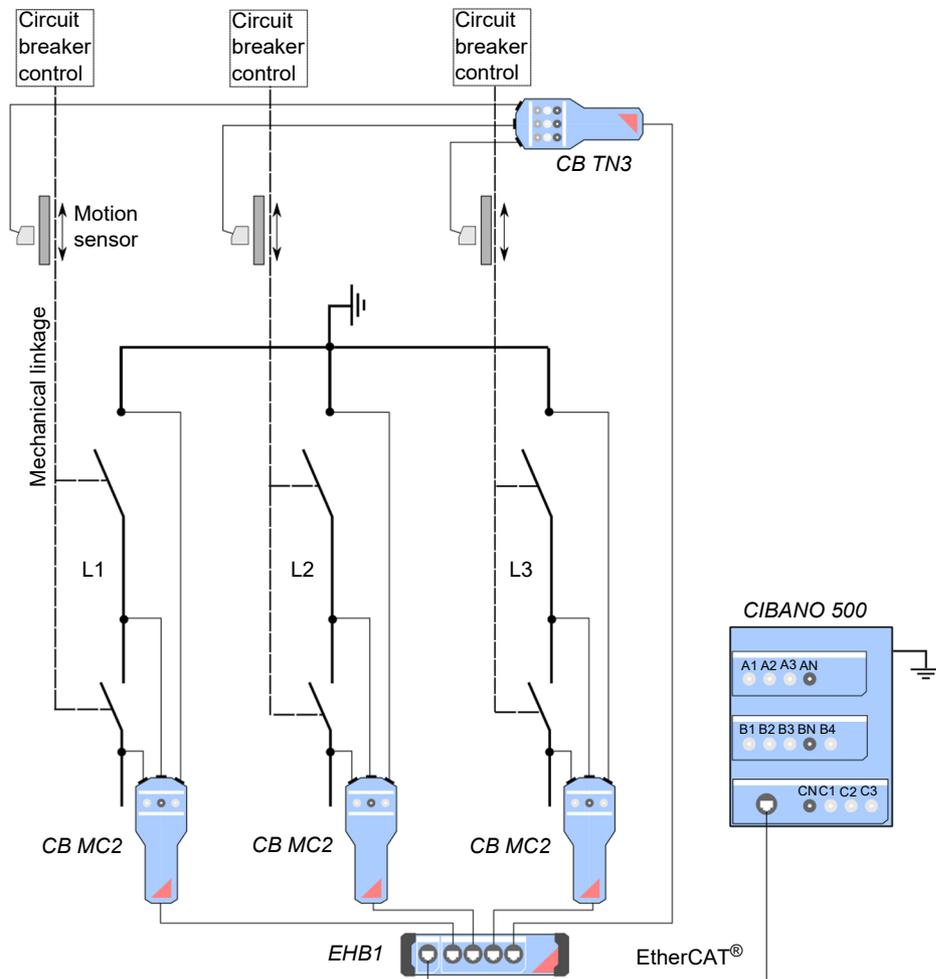


Figure 17-20: High-voltage section of a circuit breaker with two interrupters per phase with the *CB MC2* modules connected via the EtherCAT® hub

Three to six interrupters per phase

If you want to test circuit breakers with more than two interrupters per phase simultaneously phase by phase, connect the EtherCAT® hub to the main device as shown in the following figure.

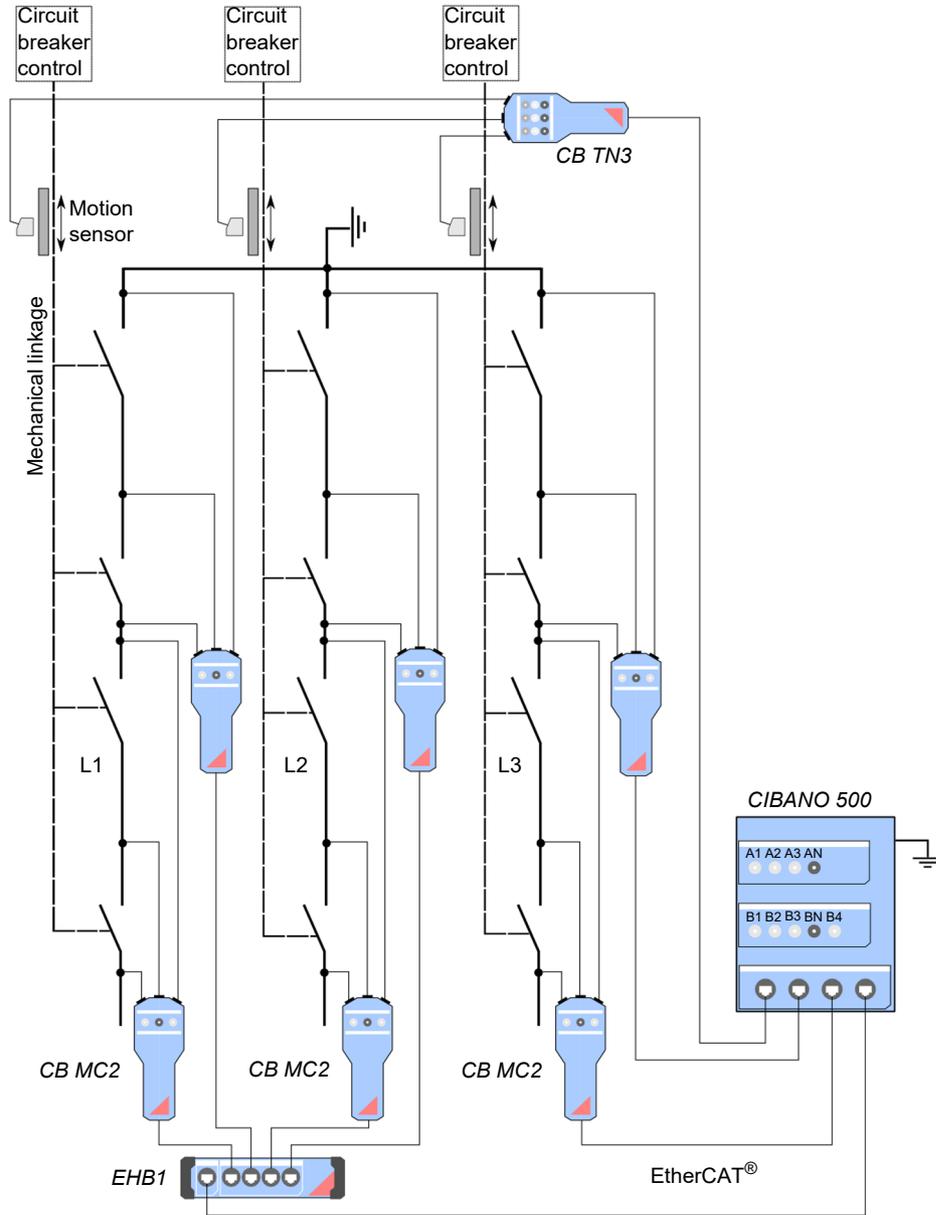


Figure 17-21: Example of simultaneous measurement of the circuit breakers with up to four interrupters per phase

17.2.4 Test group execution

Primary Test Manager provides you with a powerful capability for executing test groups. For information on grouping tests in test groups, see 7.5.2 "Group tests" on page 67. After you set the hardware configuration of the test set and the test group settings, you can execute all tests of the test group automatically by clicking the **Start all** button.

To execute a test group:

1. Group tests in a test group (see 7.5.2 "Group tests" on page 67).
2. Connect the test object to *CIBANO 500*.
3. In *Primary Test Manager*, open the test group you want to execute.
4. In the **Hardware configuration** area, set the hardware configuration and check whether *Primary Test Manager* recognized all connected *CB MC2* modules. For the hardware configuration options of *CIBANO 500* and the *CB MC2* module, see Table 17-49: "Hardware configuration options of *CIBANO 500*" on page 186 and Table 17-50: "Hardware configuration options of the *CB MC2* module" on page 187.

The screenshot displays the hardware configuration interface. On the left, there are three sections of physical connection points for the CIBANO 500:

- V IN (CAT III / 300V):** Two terminals labeled 1 and N, both marked as "Disabled".
- A-OUTPUT / INPUT (CAT III / 300V):** Four terminals labeled A1, A2, A3, and AN, all marked as "Disabled".
- B-OUTPUT / INPUT (CAT III / 300V):** Five terminals labeled B1, B2, B3, BN, and B4. B1 is "Trip A", B2 is "Close", B3 is "Disabled", BN is a black terminal, and B4 is "Motor".

On the right, the **CB MC2** configuration table is shown. It lists three modules (CBMC2-0, CBMC2-1, and CBMC2-2) across three phases (A, B, and C). Each module has two channels (1 and 2). The "Active" column shows checkboxes and status icons (red circles with a lightning bolt) for each channel. The "Combine" column has checkboxes. The "Ch.name" column lists specific channel names like CBMC2-0-1, CBMC2-0-2, etc. The "Charge" column shows battery icons, and the "LED" column shows status icons.

Module name	Phase	Channel	Active	Combine	Ch.name	Charge	LED
CBMC2-0	A	1	<input checked="" type="checkbox"/>	<input type="checkbox"/>	CBMC2-0-1		
		2			CBMC2-0-2		
CBMC2-1	B	1	<input checked="" type="checkbox"/>	<input type="checkbox"/>	CBMC2-1-1		
		2			CBMC2-1-2		
CBMC2-2	C	1	<input checked="" type="checkbox"/>	<input type="checkbox"/>	CBMC2-2-1		
		2			CBMC2-2-2		

Figure 17-22: Hardware configuration of the test set for a test group

5. In the **Settings and conditions** area, enter the test group settings.

Table 17-43: Test group settings

Setting	Description
Coil supply	
Supply source	Click CIBANO 500 to supply the coils with <i>CIBANO 500</i> . Click External source to supply the coils with the source connected to V IN .
Supply settings ^{1,2}	Select a preconfigured supply setting from the asset data or select Custom to enter custom settings.
Coil supply voltage	Rated voltage of the coil supply Click AC or DC for AC or DC coil supply voltage respectively.
Test frequency	Coil supply frequency (AC only)
Main contact	
Test current per channel	Output current of each <i>CB MC2</i> current channel ³
Motor supply	
Supply source	Click CIBANO 500 to supply the motor with <i>CIBANO 500</i> . Click External source if the motor is supplied from the station supply or battery without any connection to <i>CIBANO 500</i> or if the station battery is connected to the V IN section and supplied, for example, via the B4 socket. Note: We do not recommend supplying the motor with undervoltage. Doing so does not provide any additional useful information and can cause degradation of the motor operation over time.
Supply settings ^{1,2}	Select the preconfigured motor supply setting from the asset data or select Custom to enter custom settings.
Motor supply voltage	Rated voltage of the motor supply Click AC or DC for AC or DC motor supply voltage respectively.
Test frequency	Motor supply frequency (AC only)
Max. supply duration	Maximum duration of supplying the motor if not stopped automatically
Other	
Grounding	Select the grounding condition of the circuit breaker under test.

1. Only available in the guided test workflow and if *CIBANO 500* is selected as source
2. Data taken from the nameplate
3. In general, we recommend the maximum current of 100 A for maximum accuracy. If during a test the time the circuit breaker is closed should be longer than 1.5 s you might necessarily reduce the test current to drive the current for the whole test duration. Normally, times of 1.5 seconds are however unproblematic.
6. By using the **Open breaker**, **Close breaker** and **Supply motor** buttons in the **Test control** area of *Primary Test Manager* (see 11.1 "Test control commands" on page 85) you can check whether your *CIBANO 500* is properly wired with the test object.
7. In the **Test control** area, click **Start all**.
The blue ring on the **Start/Stop** button is on.





8. Start the measurement by pressing the **Start/Stop** button. The blue ring on the **Start/Stop** button flashes for approx. 3 seconds, and the lightning symbol in *Primary Test Manager* and the red status light on the front panel are flashing.

Note: You can abort the measurement anytime manually by pressing the **Emergency Stop** button or the **Start/Stop** button on the *CIBANO 500* front panel or click **Stop all** in *Primary Test Manager*.

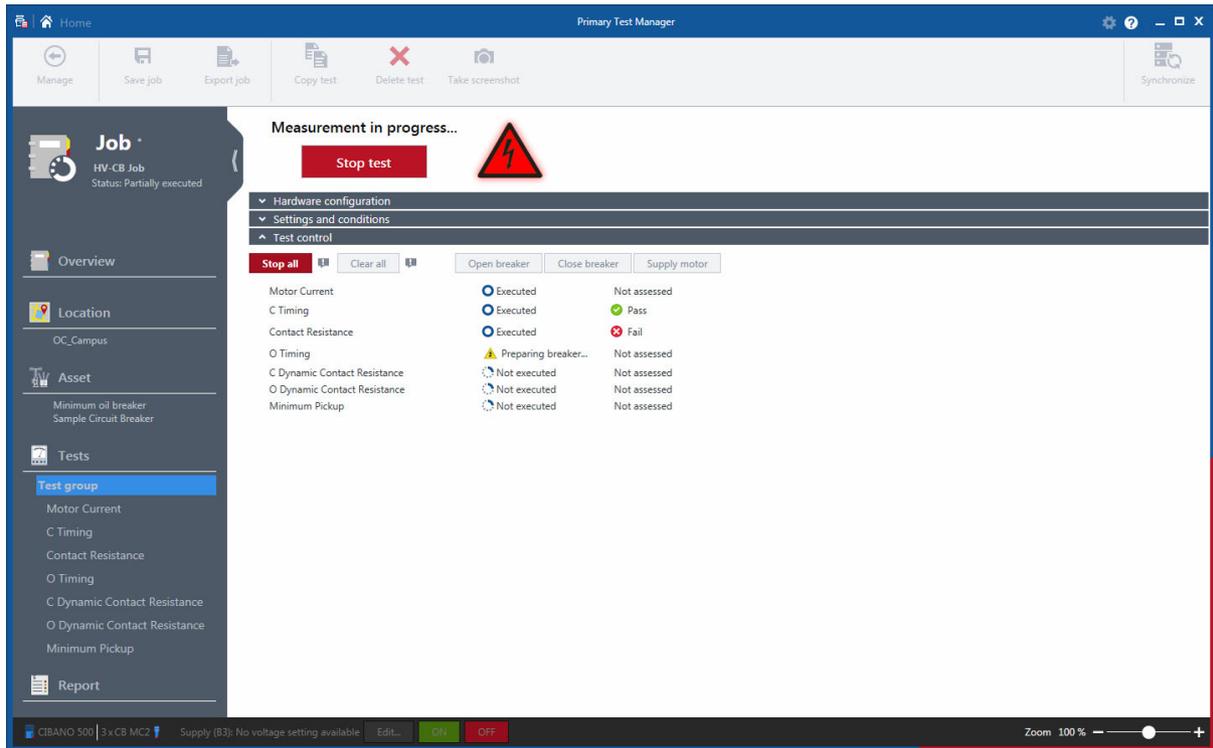


Figure 17-23: Test group execution

9. *Primary Test Manager* executes the tests of the test group sequentially. Before a test is executed, the circuit breaker is brought into the required state, the motor is supplied and the *CB MC2* modules are charged. After a test has been executed, *Primary Test Manager* displays the execution and assessment status if the **Automatic assessment** check box is selected in the tests.

Note: If a test in the test group is invalid, it will be skipped during the test group execution. You can remove invalid tests before or after executing the test group.



10. After the test execution has finished, the lightning symbol in *Primary Test Manager* stops flashing and the green status light is on.

17.2.5 Contact Resistance test

The Contact Resistance test measures the static resistance of the circuit breaker's main contacts.

Note: To increase the accuracy of the measurement results for the both-side grounded circuit breakers, you can compensate for the resistance of the ground loop by making two measurements with the circuit breaker closed and open. To compensate for the resistance of the ground loop, select the **Compensate ground loop resistance** check box (see Table 17-46: "Settings of the Contact Resistance test" on page 181).

Connection



WARNING

Death or severe injury caused by high voltage or current possible

- ▶ Do not use external power sources for the circuit breaker's main contacts.
- ▶ During the test, supply the circuit breaker's main contacts only with *CIBANO 500*.



WARNING

Death or severe injury caused by high voltage or current possible

- ▶ Do not connect anything to the circuit breaker under test without grounding the circuit breaker.
- ▶ Always ground the circuit breaker on both ends on all phases and close the circuit breaker to have proper grounding between the interrupters.

To connect the test object to *CIBANO 500*:



WARNING

Death or severe injury caused by high voltage or current possible

- ▶ Do not connect the EtherCAT[®] cables to the *CB MC2* module before they are connected to *CIBANO 500*.
- ▶ Connect the EtherCAT[®] cables first to *CIBANO 500* and then to the *CB MC2* module.

1. Make sure that all cable connectors are clean and dry before being tightly connected.
2. Connect the *CB MC2* to *CIBANO 500* with the EtherCAT[®] cable.
3. Hook up the *CB MC2* to the first or the first two interrupter(s) of the circuit breaker.
4. Connect the *CB MC2* to the main contact of the circuit breaker with the delivered cables and clamps.

Tips & Tricks: The delivered Kelvin clamp is the perfect solution for connecting to a massive conductor like a copper busbar or similar. If you cannot connect in this way, use the Kelvin clamp as a normal current clamp only for current injection (6 mm connector) and use a separate crocodile clamp for voltage sensing. Then connect the voltage sense closer to the circuit breaker contact than the current clamp.

Because sometimes it is difficult to connect to the center point between two interrupters by using the Kelvin clamp, one pair of Y-clamps is shipped with each *CB MC2* module. With the Y-clamps you can connect alternatively, even cutting through paint with the clamp. In this case connect the voltage sense clamp on the other side of the central housing opposite to the current injection clamp.

5. Repeat steps 2 to 4 for all interrupters you want to test.
6. In *Primary Test Manager*, open the Contact Resistance test.

7. In the **Hardware configuration** area, set the hardware configuration and check whether *Primary Test Manager* recognized all connected *CB MC2* modules.

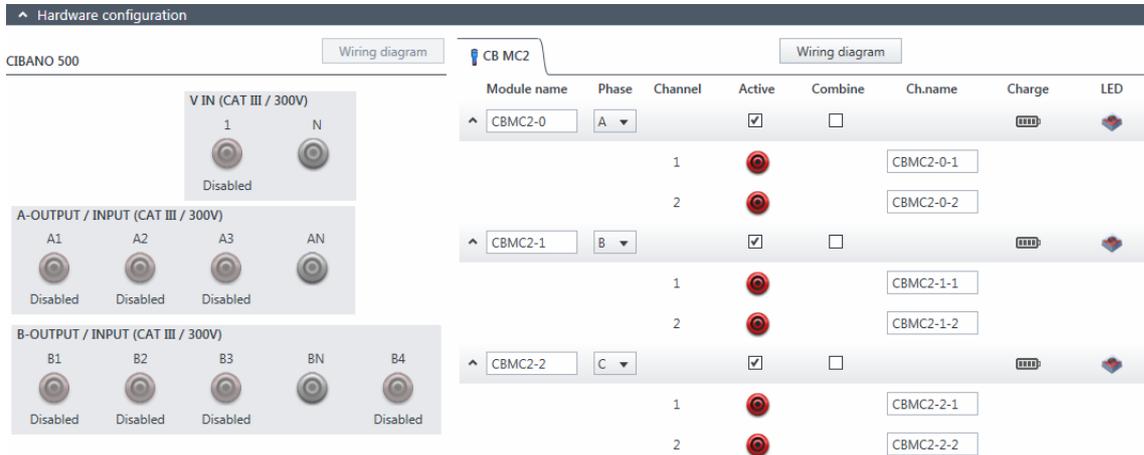


Figure 17-24: Hardware configuration of the Contact Resistance test

Table 17-44: Hardware configuration options of *CIBANO 500*

CIBANO 500	Option
V IN (CAT III / 300 V)	
1	External source or Disabled
N	Neutral connection of V IN
A-OUTPUT / INPUT (CAT III / 300 V)	
A1	Disabled
A2	Disabled
A3	Disabled
AN	Common neutral connection for outputs/inputs in group A
B-OUTPUT / INPUT (CAT III / 300 V)	
B1	Trip or Disabled
B2	Close or Disabled
B3	Supply or Disabled
BN	Neutral connection of outputs in group B
B4	Motor or Disabled

Table 17-45: Hardware configuration options of the *CB MC2* module

CB MC2	Option
Module name ¹	Editable name of the <i>CB MC2</i> module
Phase	Editable phase assignment of the <i>CB MC2</i> module (stored on the device)
Channel	Channel of the <i>CB MC2</i> module
Active	Click the socket symbol to activate or deactivate the channel.
Combine	Click the Combine check box to combine the channels of the <i>CB MC2</i> module. The combined <i>CB MC2</i> channels can both be either active or inactive. The measurement results are labeled with the name of channel 1, and the voltage is only measured on channel 1.
Ch.name ¹	Editable name of the <i>CB MC2</i> channel
Charge	Indicates the charge status of the <i>CB MC2</i> module.
LED	Click the LED symbol to identify the connected <i>CB MC2</i> module by flashing LED.

1. Permanently stored in the *CB MC2* memory. You can, for example, mark your *CB MC2* modules with the colored stickers and name them according to the colors. You can also rename the *CB MC2* modules depending on the connection point.

For the basic connection diagram, see Figure 17-5: "Principal scheme of the contact resistance test" on page 123 and 17.2.3 "Testing circuit breakers with CIBANO 500 and the *CB MC2* modules" on page 172.

Measurement

To perform a measurement:

1. In the **Settings and conditions** area, enter the settings of the Contact Resistance test.

Table 17-46: Settings of the Contact Resistance test

Setting	Description
Coil supply	
Supply source	Select one of the following supply-source options: <ul style="list-style-type: none"> • CIBANO 500 to supply the coils with <i>CIBANO 500</i>. • External source to supply the coils with the source connected to V IN. • Control board to supply the coils with a control-board switch.¹
Supply settings ^{2,3}	Select a preconfigured coil supply setting from the asset data or select Custom to enter custom settings.
Coil supply voltage	Rated voltage of the coil supply Click AC or DC for AC or DC coil supply voltage respectively. Note: To perform the undervoltage trip and undervoltage close tests set the coil supply voltage lower than the nominal voltage.
Test frequency	Coil supply frequency (AC only)
Trip signal ⁴	Select whether the rising or falling edge of the trip signal opens the circuit breaker.
Close signal ⁴	Select whether the rising or falling edge of the close signal closes the circuit breaker.
Main contact	
Test current per channel	Output current of each <i>CB MC2</i> current channel ⁵
Other	
Grounding	Grounding of the circuit breaker under test
Compensate ground loop resistance	Select the Compensate ground loop resistance check box to compensate for the resistance of the ground loop.

Table 17-46: Settings of the Contact Resistance test (continued)

Setting	Description
Motor supply	
Supply source	Click CIBANO 500 to supply the motor with <i>CIBANO 500</i> . Click External source if the motor is supplied from the station supply or battery without any connection to <i>CIBANO 500</i> or if the station battery is connected to the V IN section and supplied, for example, via the B4 socket. Note: We do not recommend supplying the motor with undervoltage. Doing so does not provide any additional useful information and can cause degradation of the motor operation over time.
Supply settings ^{2,3}	Select the preconfigured motor supply setting from the asset data or select Custom to enter custom settings.
Motor supply voltage	Rated voltage of the motor supply Click AC or DC for AC or DC motor supply voltage respectively.
Test frequency	Motor supply frequency (AC only)
Max. supply duration	Maximum duration of supplying the motor if not stopped automatically

1. Only available if the trip and/or close signals are configured on the *IOB1* module.
2. Only available in the guided test workflow and if *CIBANO 500* is selected as source
3. Data taken from the nameplate
4. Only available if **Control board** is selected as supply source.
5. In general, we recommend the maximum current of 100 A for maximum accuracy. If during a test the time the circuit breaker is closed should be longer than 1.5 s you might necessarily reduce the test current to drive the current for the whole test duration. Normally, times of 1.5 seconds are however unproblematic.

2. Optionally, enter the advanced settings in the **Advanced settings** area.

Table 17-47: Advanced settings of the Contact Resistance test

Setting	Description
Other	
Close breaker before test	Select the Close breaker before test check box to automatically close the circuit breaker 1 second before starting a measurement.
Test conditions	
Ambient temperature ¹	Ambient temperature on site

1. Only for reference in the report, the results are not temperature compensated.
3. In the **Assessment** area, configure the assessment.
 - ▶ Click **Edit configuration** or click in the table to open the **Assessment configuration** dialog box, and then edit the assessment limits.
 - ▶ Select the **Automatic assessment** check box to enable the automatic assessment.

Note: For the assessment limit definitions, see 15.3 "Assessment limits" on page 106.
4. In the **Measurements** area, click **Start all**.
The blue ring on the **Start/Stop** button is on.





5. Start the measurement by pressing the **Start/Stop** button.
The blue ring on the **Start/Stop** button flashes for approx. 3 seconds, and the lightning symbol in *Primary Test Manager* and the red status light on the front panel are flashing.

Note: You can abort the measurement anytime manually by pressing the **Emergency Stop** button or the **Start/Stop** button on the *CIBANO 500* front panel.



6. After the measurements have finished, the lightning symbol in *Primary Test Manager* stops flashing, the green status light is on, and *Primary Test Manager* displays the measurement results.
7. For the measurement results, see Table 17-48: "Contact Resistance measurement data" later in this section.

If you selected the **Compensate ground loop resistance** check box, proceed as follows:

1. Open the circuit breaker.
2. In the **Measurements** area of *Primary Test Manager*, select the breaker state **Open**.



3. In the **Measurements** area, click **Start all**.
The blue ring on the **Start/Stop** button is on.



4. Start the measurement by pressing the **Start/Stop** button.
The blue ring on the **Start/Stop** button flashes for approx. 3 seconds, and the lightning symbol in *Primary Test Manager* and the red status light on the front panel are flashing.

Note: You can abort the measurement anytime manually by pressing the **Emergency Stop** button or the **Start/Stop** button on the *CIBANO 500* front panel.



5. After the measurements have finished, the lightning symbol in *Primary Test Manager* stops flashing, the green status light is on, and *Primary Test Manager* displays the measurement results.

Note: If the circuit breaker has an even number of interrupters per phase, the test is typically performed with the circuit breaker grounded on both ends. In this case no compensation is needed because the voltages of the two channels of each *CB MC2* module cancel out each other which results in no current through the ground loop.

Tips & Tricks: The connection to the center point between two circuit breaker's interrupters can be tricky. If you are not sure whether the connection you have made is good, you can verify the connection as follows. Perform a measurement with only channel 1, then a measurement with channel 2, and finally a measurement with both channels. If the results match you have a perfect center point connection. If the results do not match you either have a bad center connection or the effect of the ground loop, that affects the result only when measuring asymmetrically, is too big.

Table 17-48: Contact Resistance measurement data

Data	Description
Channel	Channel of the <i>CB MC2</i> module
Phase	Measured phase
I DC ¹	DC test current with the circuit breaker open
V DC ¹	Measured voltage with the circuit breaker open
R open ¹	Measured resistance with the circuit breaker open

Table 17-48: Contact Resistance measurement data (continued)

Data	Description
I DC	DC test current with the circuit breaker closed
V DC	Measured voltage with the circuit breaker closed
R closed ¹	Measured resistance with the circuit breaker closed
R meas	Measured contact resistance
Assessment	Measurement assessment

1. Only available if the **Compensate ground loop resistance** check box is selected.

Disconnection

Do not disconnect the circuit breaker but leave it connected for performing the next test. For disconnecting the circuit breaker, see "Disconnection" on page 218.

17.2.6 Timing test

The Timing test measures the contact timing of the circuit breaker. Depending on the selected sequence the opening time, closing time, close-open time, and so on are automatically calculated. With the *CB TN3* modules, you can also measure the displacement of the circuit breaker's main contacts during operation (see 17.5 "Testing circuit breakers with CIBANO 500 and the CB TN3 modules" on page 259).

Note: If you have the software license to perform the Dynamic Contact Resistance test proceed with that test as described in 17.2.7 "Dynamic Contact Resistance test" on page 196. The Timing test requires the same amount of work but gives less information.

Connection

WARNING

Death or severe injury caused by high voltage or current possible

- ▶ Do not connect anything to the circuit breaker under test without grounding the circuit breaker.
- ▶ Always ground the circuit breaker on both ends on all phases and close the circuit breaker to have proper grounding between the interrupters.

To connect the test object to *CIBANO 500*:

WARNING

Death or severe injury caused by high voltage or current possible

- ▶ Do not connect the EtherCAT[®] cables to the *CB MC2* module before they are connected to *CIBANO 500*.
- ▶ Connect the EtherCAT[®] cables first to *CIBANO 500* and then to the *CB MC2* module.

1. Make sure that all cable connectors are clean and dry before being tightly connected.
2. Connect the *CB MC2* to *CIBANO 500* with the EtherCAT[®] cable.
3. If the *CB MC2* modules are not connected from the last test, hook up the *CB MC2* to the first or the first two interrupter(s) of the circuit breaker.
4. Connect the *CB MC2* to the main contact of the circuit breaker with the delivered cables and clamps.
5. Repeat steps 2 to 4 for all interrupters you want to test.
6. In *Primary Test Manager*, open the Timing test.

7. In the **Hardware configuration** area, set the hardware configuration and check whether *Primary Test Manager* recognized all connected *CB MC2* modules.

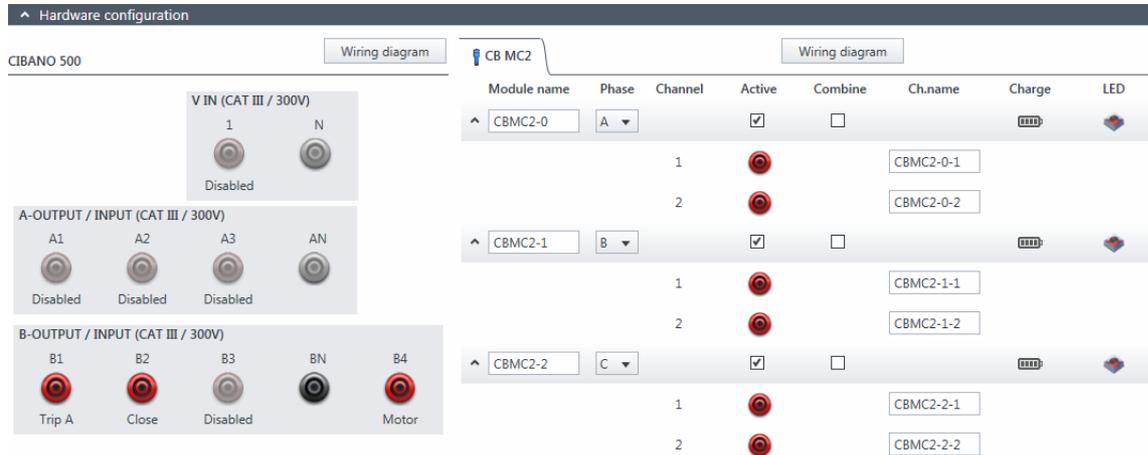


Figure 17-25: Hardware configuration of the Timing test

Table 17-49: Hardware configuration options of *CIBANO 500*

CIBANO 500	Option		
V IN (CAT III / 300 V)			
1	External source, Trigger IN ¹ or Disabled		
N	Neutral connection of V IN		
A-OUTPUT / INPUT (CAT III / 300 V)			
A1	AUX 1	Dry contact (potential-free)	Close A, Motor A, Trigger IN ¹ or Disabled
		Wet contact (with potential)	
A2	AUX 2	Dry contact (potential-free)	Close B, Motor B, Trigger IN ¹ or Disabled
		Wet contact (with potential)	
A3	AUX 3	Dry contact (potential-free)	Close C, Motor C, Trigger IN ¹ or Disabled
		Wet contact (with potential)	
AN	Common neutral connection for outputs/inputs in group A		

Table 17-49: Hardware configuration options of *CIBANO 500* (continued)

CIBANO 500	Option
B-OUTPUT / INPUT (CAT III / 300 V)	
B1	Trip A, Trigger IN ¹ , I clamp 1 or Disabled
B2	Trip B, Close, Trigger IN ¹ , I clamp 2 or Disabled
B3	Trip C, Supply, Trigger IN ¹ , I clamp 3, or Disabled
BN	Neutral connection of outputs in group B
B4	Trigger IN ¹ , I clamp 4, Motor or Disabled

1. Trigger signal starting the measurement

V IN (CAT III / 300 V)

The **V IN (CAT III / 300 V)** inputs can be configured to connect an external source such as a station battery or an external power supply. In general, the input is not used but if you need to test the behavior (voltage) of the station battery under real load conditions this option is available.

Note: The coils or the motor can be configured to be supplied from **V IN** (external source). When activated, the respective output of *CIBANO 500* is supplied from the socket **1** of the **V IN** section via the internal command switch. This command switch can also disrupt the current in case of a short circuit. Input **N** of the **V IN** section is for voltage reference measurement only.

A-OUTPUT / INPUT (CAT III / 300 V)

For most tests, the group **A** is used for measuring timing of auxiliary contacts. The contacts can be “wet” or “dry”. While dry contacts are free of potential, wet contacts may have a voltage applied to them. The group **A** can also be used to record the supply voltage and current of three close coils or three motors simultaneously by configuring them.

Note: *CIBANO 500* has only three command switches. Consequently, three trip or three close coils can be operated simultaneously but not all six coils at the same time. To record currents for three trip coils and three close coils separately, connect three close coils to **A1** to **A3**, three trip coils to **B1** to **B3**, and then perform the Timing test.

B-OUTPUT / INPUT (CAT III / 300 V)

The group **B** is generally used as follows. **B1** is used for the open command, **B2** is used for the close command, and **B3** is used for the continuous power supply (see 17.2.11 "Continuous power supply" on page 220). **B4** is used to supply the motor or to measure the motor current by using a current clamp.

Table 17-50: Hardware configuration options of the *CB MC2* module

CB MC2	Option
Module name ¹	Editable name of the <i>CB MC2</i> module
Phase	Editable phase assignment of the <i>CB MC2</i> module (stored on the device)
Channel	Channel of the <i>CB MC2</i> module
Active	Click the socket symbol to activate or deactivate the channel.

Table 17-50: Hardware configuration options of the *CB MC2* module (continued)

CB MC2	Option
Combine	Click the Combine check box to combine the channels of the <i>CB MC2</i> module. The combined <i>CB MC2</i> channels can both be either active or inactive. The measurement results are labeled with the name of channel 1, and the voltage is only measured on channel 1.
Ch.name ¹	Editable name of the <i>CB MC2</i> channel
Charge	Indicates the charge status of the <i>CB MC2</i> module.
LED	Click the LED symbol to identify the connected <i>CB MC2</i> module by flashing LED.

1. Permanently stored in the *CB MC2* memory. You can, for example, mark your *CB MC2* modules with the colored stickers and name them according to the colors. You can also rename the *CB MC2* modules depending on the connection point.
8. Connect *CIBANO 500* to the trip and close coils of the circuit breaker for all phases according to the wiring diagram displayed in *Primary Test Manager* and the following figure.

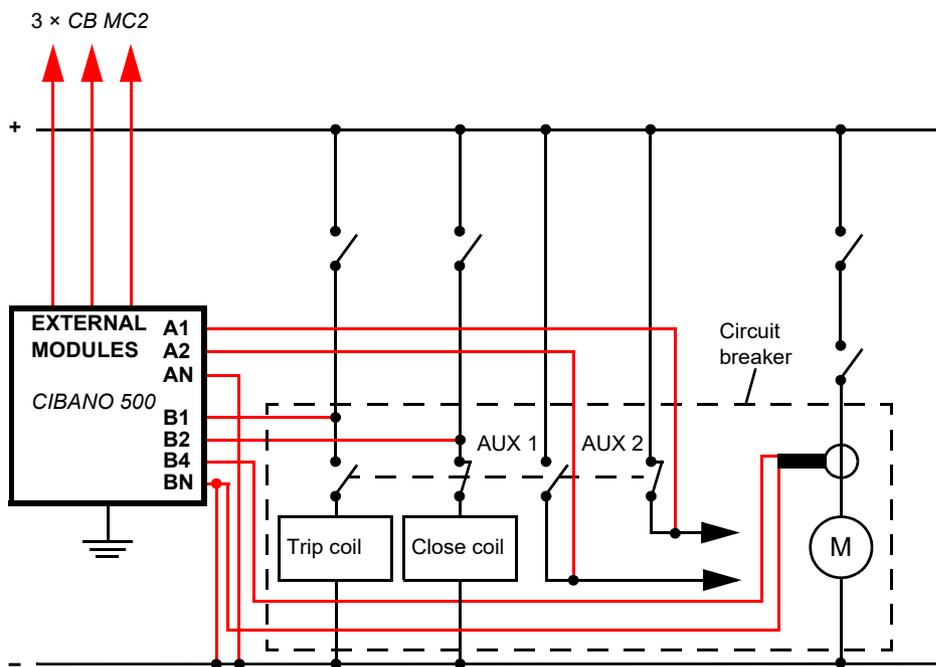


Figure 17-26: Typical measurement setup for the Timing test

For the circuit breakers with one drive for all three phases connect the trip coil to **B1**, the close coil to **B2**, and the common connection of the trip and close coils (typically the battery minus) to **BN**. In general, the motor of the HV circuit breakers remains connected to the station battery throughout the test and a current clamp connected to **BN** and **B4** is used to record the motor current.

Note: Connect the current clamp neutral directly to *CIBANO 500* and not to the other end of the neutral cable to avoid measurement errors due to the voltage drop on the cable. Alternatively you can supply the motor from *CIBANO 500* if you want or no station battery is available.

⚠ WARNING

Death or severe injury caused by high voltage or current possible

- ▶ If you use the station battery to supply the motor or the coils via *CIBANO 500*, do not connect the cables to the station battery before they are connected to *CIBANO 500*.
- ▶ Always connect the cables first to grounded *CIBANO 500* and then to the station battery.

Measurement

To perform a measurement:

1. In the **Settings and conditions** area, enter the settings of the Timing test.

Table 17-51: Settings of the Timing test

Setting	Description
Coil supply	
Supply source	Select one of the following supply-source options: <ul style="list-style-type: none"> • CIBANO 500 to supply the coils with <i>CIBANO 500</i>. • External source to supply the coils with the source connected to V IN. • Control board to supply the coils with a control-board switch.¹
Supply settings ^{2,3}	Select a preconfigured coil supply setting from the asset data or select Custom to enter custom settings.
Coil supply voltage	Rated voltage of the coil supply Click AC or DC for AC or DC coil supply voltage respectively. Note: To perform the undervoltage trip and undervoltage close tests set the coil supply voltage lower than the nominal voltage.
Test frequency	Coil supply frequency (AC only)
Trip signal ⁴	Select whether the rising or falling edge of the trip signal opens the circuit breaker.
Close signal ⁴	Select whether the rising or falling edge of the close signal closes the circuit breaker.
Motor supply	
Supply source	Click CIBANO 500 to supply the motor with <i>CIBANO 500</i> . Click External source if the motor is supplied from the station supply or battery without any connection to <i>CIBANO 500</i> or if the station battery is connected to the V IN section and supplied, for example, via the B4 socket. Note: We do not recommend supplying the motor with undervoltage. Doing so does not provide any additional useful information and can cause degradation of the motor operation over time.

Table 17-51: Settings of the Timing test (continued)

Setting	Description
Supply settings ^{2,3}	Select the preconfigured motor supply setting from the asset data or select Custom to enter custom settings.
Motor supply voltage	Voltage of the motor supply Click AC or DC for AC or DC motor supply voltage respectively.
Test frequency	Motor supply frequency (AC only)
Max. supply duration	Maximum duration of supplying the motor if not stopped automatically
Main contact	
Contact system	Contact system of the circuit breaker under test Select PIR to measure timing of contacts with pre-insertion resistors.
Test current per channel ⁵	Output current of each <i>CB MC2</i> current channel
Other	
Grounding	Select the grounding condition of the circuit breaker under test.
Current clamp settings⁶	
Channel	Group B I/O socket
Ratio	Current clamp ratio
I max	Maximum current of the selected probe range
Sequence	
Test sequence	Test sequence to be performed
Trigger setting⁷	
Threshold	Threshold value of the trigger signal The measurement starts if the trigger signal rises above (rising edge) or falls below (falling edge) the threshold.
Edge type	Rising or falling edge

1. Only available if the trip and/or close signals are configured on the *IOB1* module.
2. Only available in the guided test workflow and if *CIBANO 500* is selected as source
3. Data taken from the nameplate
4. Only available if **Control board** is selected as supply source.
5. Only available for **Standard** contact system. We recommend using a test current of 100 A per *CB MC2* channel for the most accurate results.
6. Only available if a current clamp is configured. The channel value displayed refers to the group **B** of the I/O sockets on the *CIBANO 500* side panel. The **B1...B4** sockets can be configured as **I clamp 1...I clamp 4** respectively.
7. Only available if **V IN**, or one output in group **A** or group **B** is set to Trigger IN.

2. Optionally, enter the advanced settings in the **Advanced settings** area.

Table 17-52: Advanced settings of the Timing test

Setting	Description
Main contact	
PIR thresholds ¹	<p>Select Automatic if you want to let <i>Primary Test Manager</i> set the PIR thresholds or select Custom to set the PIR thresholds according to your needs.</p> <p>If you select Automatic, <i>Primary Test Manager</i> fits the PIR thresholds as follows:</p> <ul style="list-style-type: none"> • If the PIR value is not defined in the circuit breaker data, <i>Primary Test Manager</i> sets the default values. • If the PIR value is defined in the circuit breaker data, <i>Primary Test Manager</i> sets the Close / PIR threshold to 75% of the PIR value and the PIR / Open threshold to 125% of the PIR value.
C-O threshold ²	Resistance threshold to detect whether the main contact is open or closed. <i>Primary Test Manager</i> interprets the contact as open if the contact resistance is above the C-O threshold and vice versa.
Close / PIR threshold PIR / Open threshold ¹	Resistance thresholds for the PIR measurement <i>Primary Test Manager</i> interprets the contact in the PIR state if the contact resistance is above the Close / PIR threshold and below the PIR / Open threshold.
Sine wave filter	Select the Sine wave filter check box to suppress sinusoidal interference.
Start evaluation at	Start time of the sine wave evaluation. Select the time at which the sinusoidal interference is clearly present in the measurement signal.
Sine frequency	Frequency of the sinusoidal interference
Other	
Close breaker before test ³	Select the Close breaker before test check box to automatically close the circuit breaker 1 second before starting a measurement.
Sample rate	Measurement sample rate ⁴
Contact bounce filter	
Main contact	Threshold value of the time interval between two consecutive bounces of the main contact. For time intervals equal or below the threshold, the contact is considered as closed. Setting the value to 0.0 ms deactivates the contact bounce filter.

Table 17-52: Advanced settings of the Timing test (continued)

Setting	Description
Auxiliary contact	Threshold value of the time interval between two consecutive bounces of the auxiliary contact. For time intervals equal or below the threshold, the contact is considered as closed. Setting the value to 0.0 ms deactivates the contact bounce filter.
Average coil current/voltage	
Begin	Start of the average coil current/voltage evaluation in percent of the time period during which the current flows through the coil
End	End of the average coil current/voltage evaluation in percent of the time period during which the current flows through the coil
Sequence	
See Table 17-53: "Timing test sequences" later in this section.	

1. Only available for **PIR** contact system
2. Only available for **Standard** contact system
3. The **Close breaker before test** check box is only active if the test sequence begins with the open command and no output is set to Trigger IN.
4. We recommend 10 kHz to constrain the amount of created data. Higher sample rates are needed for special tests only.

The following table explains the sequences of the Timing test.

Table 17-53: Timing test sequences

Sequence	Action
O	With this sequence, the opening time of the circuit breaker is measured. Only for O and C sequences we recommend performing the test twice, once with nominal voltage and once with 20% undervoltage to assure the functionality of the circuit breaker for a weak station battery.
C	This is the sequence to measure the closing time of the circuit breaker.
OC	With this sequence, a closing operation after the circuit breaker has tripped to clear a fault is simulated. Initially, the circuit breaker must be in the closed position. An open command initiates the sequence, followed by a dead time to clear the fault; and finally a close command must close the circuit breaker. This sequence is also known as reclosing sequence. To find out the shortest reclosing time the circuit breaker can provide, the close command is already applied while the circuit breaker is still opening. The circuit breaker then will close after opening as fast as possible.

Table 17-53: Timing test sequences (continued)

Sequence	Action
CO	<p>With this sequence, a tripping operation after the circuit breaker has been closed under a fault condition (trip-free) or the verification of the correct operation of the anti-pumping system is simulated.</p> <p>To test the trip-free time the circuit breaker must be in the open position before the test is started. The circuit breaker is closed and then during the close operation is still in progress an open command is sent. The circuit breaker then opens as fast as possible.</p> <p>To test the anti-pumping function of the circuit breaker, the circuit breaker must be in closed position before the test is started. For this test the open time is set shorter (typically 200 ms) than the closing time (typically 400 ms). Ensure that the end time is increased so that the test sequence covers the whole close command duration (typically at least 190 ms). When the close command is sent the circuit breaker is already closed which initiates the anti-pumping function. Then an open command is sent and the circuit breaker trips. The closing command is still on when the open command ends, but the circuit breaker should not "pump", so that it should not close again.</p>
O-CO	<p>With this sequence, a reclose sequence (OC) under a fault condition is simulated. If the fault is not released, the circuit breaker must open (O) immediately and remain in this position.</p> <p>Initially, the circuit breaker must be in the closed position. The sequence begins with an open command, after a dead time the close and open commands (CO) must be applied at the same time (delay time typically 300 ms).</p>
CO-CO	<p>Some circuit breakers have a different specification for the pause time between CO and CO for CO-CO and O-CO-CO sequences. Therefore both sequences are available for testing. The time between the two CO subsequences shall be set according to the technical data of the circuit breaker (typically 15000 ms).</p>
O-CO-CO	<p>Some circuit breakers have a different specification for the pause time between CO and CO for CO-CO and O-CO-CO sequences. Therefore both sequences are available for testing. The time between the two CO subsequences shall be set according to the technical data of the circuit breaker (typically 15000 ms).</p>

3. In the **Assessment** area, configure the assessment.
 - ▶ Click **Edit configuration** or click in one of the tables to open the **Assessment configuration** dialog box, and then edit the assessment limits.
 - ▶ Select the **Automatic assessment** check box to enable the automatic assessment.

Note: For the assessment limit definitions, see 15.3 "Assessment limits" on page 106.
4. By using the **Open breaker**, **Close breaker** and **Supply motor** buttons in the **Measurements** area of *Primary Test Manager* (see 11.1 "Test control commands" on page 85) you can check whether all cables are correctly connected and bring the circuit breaker to the proper state. For example, to test a C sequence, the circuit breaker must be open and the spring charged.



- In the **Measurements** area, click **Start**.
The blue ring on the **Start/Stop** button is on.



WARNING

Death or severe injury caused by high voltage or current possible

- ▶ Do not enter the high-voltage test area while testing with *CIBANO 500* since any part of the circuit breaker can carry dangerous voltages.
- ▶ Stay in the work area during the test.



- Start the measurement by pressing the **Start/Stop** button.
The blue ring on the **Start/Stop** button flashes for approx. 3 seconds, and the lightning symbol in *Primary Test Manager* and the red status light on the front panel are flashing.



- After the measurement has finished, the lightning symbol in *Primary Test Manager* stops flashing, the green status light is on, and *Primary Test Manager* displays the measurement results.
The operating times depend on the sequence of the trip and close commands. The following table describes the operating times for all measurement sequences.

Table 17-54: Operating times¹

Data	Description
Opening time	Contact opening time of O, OC, O-CO and O-CO-CO operation
Opening sync.	Opening synchronization time of O, OC, O-CO and O-CO-CO operation
Closing time	Contact closing time of C, CO and O-CO operation
Closing sync.	Closing synchronization time of C, CO and O-CO operation
Reclosing time	Contact reclosing time of OC operation
Open-close time	Contact open-close time of O-CO, CO-CO, and O-CO-CO operation
Close-open time 1	Contact close-open time of CO and O-CO operation
Close-open time 2	Second contact close-open time of CO-CO and O-CO-CO operation
Assessment	Assessment of operating times

1. The operating times are calculated per contact, phase or circuit breaker.

Table 17-55: Auxiliary contact characteristics¹

Data	Description
Contact	Name of the auxiliary contact of the circuit breaker under test
Phase	Phase to which the auxiliary contact belongs
Type	Type of the auxiliary contact (a, b, wiper)

Table 17-55: Auxiliary contact characteristics¹ (continued)

Data	Description
Switching time	Closing or opening time of the auxiliary contact depending on its type
Duration	Duration the wiper contact remains closed
Diff. to main	Time difference between the opening or closing of the auxiliary contact and the corresponding main contact
Assessment	Assessment of auxiliary contact characteristics

1. Only calculated for O and C sequences

Table 17-56: Main contact characteristics¹

Data	Description
Main contact	Main contact this measurement row refers to
Bounce time ²	Duration of the main contact bounce
Bounce count ²	Number of main contact bounces within the bounce time
PIR closing time	Closing time for pre-insertion resistors
Assessment	Measurement assessment

1. Only available for O and C sequences

2. Not available for **PIR** contact system

Table 17-57: Coil characteristics

Data	Description
Peak current	Peak current value through a trip or close coil
Average current	Average current through the coil (see Average coil current/voltage settings in Table 17-52: "Advanced settings of the Timing test" on page 191)
Average voltage	Average voltage applied to the coil (see Average coil current/voltage settings in Table 17-52: "Advanced settings of the Timing test" on page 191)
Resistance	Calculated resistance of the coil
Assessment	Assessment of coil characteristics

Disconnection

Do not disconnect the circuit breaker but leave it connected for performing the next test. For disconnecting the circuit breaker, see "Disconnection" on page 218.

17.2.7 Dynamic Contact Resistance test

The Dynamic Contact Resistance test measures the resistance of the circuit breaker's main contacts during opening or closing. With the *CB TN3* modules, you can also measure the displacement of the circuit breaker's main contacts during operation (see 17.5 "Testing circuit breakers with CIBANO 500 and the CB TN3 modules" on page 259).

Note: To perform the Dynamic Contact Resistance test, you need a license. Without the license, it is not possible to start the measurement and *Primary Test Manager* displays a missing license message. To get the license, contact your regional OMICRON service center.

Connection

 **WARNING**

Death or severe injury caused by high voltage or current possible

- ▶ Do not connect anything to the circuit breaker under test without grounding the circuit breaker.
- ▶ Always ground the circuit breaker on both ends on all phases and close the circuit breaker to have proper grounding between the interrupters.

To connect the test object to *CIBANO 500*:

 **WARNING**

Death or severe injury caused by high voltage or current possible

- ▶ Do not connect the EtherCAT[®] cables to the *CB MC2* module before they are connected to *CIBANO 500*.
- ▶ Connect the EtherCAT[®] cables first to *CIBANO 500* and then to the *CB MC2* module.

1. Connect the *CB MC2* to *CIBANO 500* with the EtherCAT[®] cable.
2. If the *CB MC2* modules are not connected from the last test, hook up the *CB MC2* to the first or the first two interrupter(s) of the circuit breaker.
3. Connect the *CB MC2* to the main contact of the circuit breaker with the delivered cables and clamps.
4. Repeat steps 1 to 3 for all interrupters you want to test.
5. Make sure that all cable connectors are clean and dry before being tightly connected.
6. In *Primary Test Manager*, open the Dynamic Contact Resistance test.

7. In the **Hardware configuration** area, set the hardware configuration and check whether *Primary Test Manager* recognized all connected *CB MC2* modules.

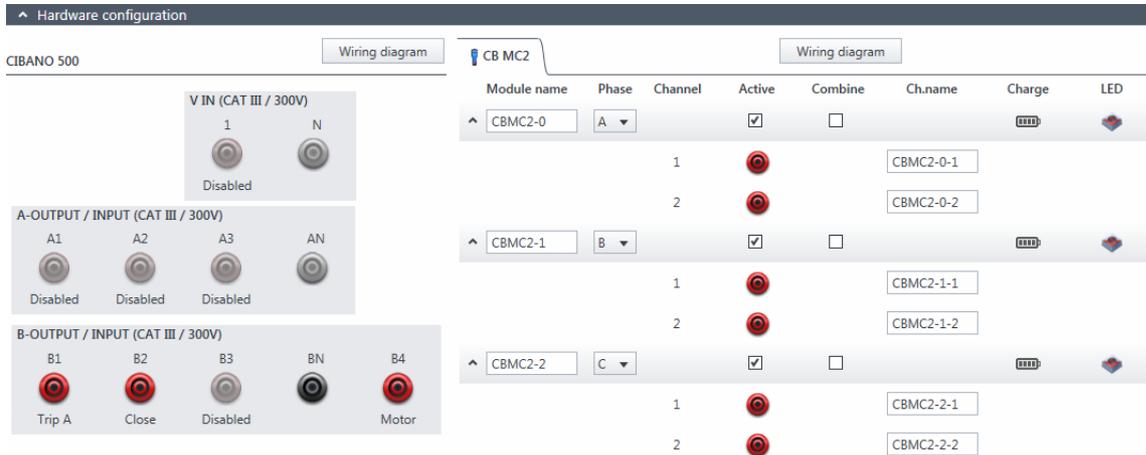


Figure 17-27: Hardware configuration of the Dynamic Contact Resistance test

Table 17-58: Hardware configuration options of *CIBANO 500*

CIBANO 500		Option	
V IN (CAT III / 300 V)			
1	External source, Trigger IN ¹ or Disabled		
N	Neutral connection of V IN		
A-OUTPUT / INPUT (CAT III / 300 V)			
A1	AUX 1	Dry contact (potential-free)	Close A, Motor A, Trigger IN ¹ or Disabled
		Wet contact (with potential)	
A2	AUX 2	Dry contact (potential-free)	Close B, Motor B, Trigger IN ¹ or Disabled
		Wet contact (with potential)	
A3	AUX 3	Dry contact (potential-free)	Close C, Motor C, Trigger IN ¹ or Disabled
		Wet contact (with potential)	
AN	Common neutral connection for outputs/inputs in group A		

Table 17-58: Hardware configuration options of *CIBANO 500* (continued)

CIBANO 500	Option
B-OUTPUT / INPUT (CAT III / 300 V)	
B1	Trip A, Trigger IN ¹ , I clamp 1 or Disabled
B2	Trip B, Close, Trigger IN ¹ , I clamp 2 or Disabled
B3	Trip C, Supply, Trigger IN ¹ , I clamp 3 or Disabled
BN	Neutral connection of outputs in group B
B4	Trigger IN ¹ , I clamp 4, Motor or Disabled

1. Trigger signal starting the measurement

V IN (CAT III / 300 V)

The **V IN (CAT III / 300 V)** inputs can be configured to connect an external source such as a station battery or an external power supply. In general, the input is not used but if you need to test the behavior (voltage) of the station battery under real load conditions this option is available.

Note: The coils or the motor can be configured to be supplied from **V IN** (external source). When activated, the respective output of *CIBANO 500* is supplied from the socket **1** of the **V IN** section via the internal command switch. This command switch can also disrupt the current in case of a short circuit. Input **N** of the **V IN** section is for voltage reference measurement only.

A-OUTPUT / INPUT (CAT III / 300 V)

For most tests, the group **A** is used for measuring timing of auxiliary contacts. The contacts can be “wet” or “dry”. While dry contacts are free of potential, wet contacts may have a voltage applied to them. The group **A** can also be used to record the supply voltage and current of three close coils or three motors simultaneously by configuring them.

Note: *CIBANO 500* has only three command switches. Consequently, three trip or three close coils can be operated simultaneously but not all six coils at the same time. To record currents for three trip coils and three close coils separately, connect three close coils to **A1** to **A3**, three trip coils to **B1** to **B3**, and then perform the Dynamic Contact Resistance test. The other tests like CO or OC with the trip and close signal applied simultaneously are then performed with different wiring.

B-OUTPUT / INPUT (CAT III / 300 V)

The group **B** is generally used as follows. **B1** is used for the open command, **B2** is used for the close command, and **B3** is used for the continuous power supply (see 17.2.11 "Continuous power supply" on page 220). **B4** is used to supply the motor or to measure the motor current by using a current clamp.

Table 17-59: Hardware configuration options of the *CB MC2* module

CB MC2	Option
Module name ¹	Editable name of the <i>CB MC2</i> module
Phase	Editable phase assignment of the <i>CB MC2</i> module (stored on the device)
Channel	Channel of the <i>CB MC2</i> module
Active	Click the socket symbol to activate or deactivate the channel.
Combine	Click the Combine check box to combine the channels of the <i>CB MC2</i> module. The combined <i>CB MC2</i> channels can both be either active or inactive. The measurement results are labeled with the name of channel 1, and the voltage is only measured on channel 1.
Ch.name ¹	Editable name of the <i>CB MC2</i> channel
Charge	Indicates the charge status of the <i>CB MC2</i> module.
LED	Click the LED symbol to identify the connected <i>CB MC2</i> module by flashing LED.

1. Permanently stored in the *CB MC2* memory. You can, for example, mark your *CB MC2* modules with the colored stickers and name them according to the colors. You can also rename the *CB MC2* modules depending on the connection point.

8. Connect *CIBANO 500* to the trip and close coils of the circuit breaker for all phases according to the wiring diagram displayed in *Primary Test Manager* and the following figure.

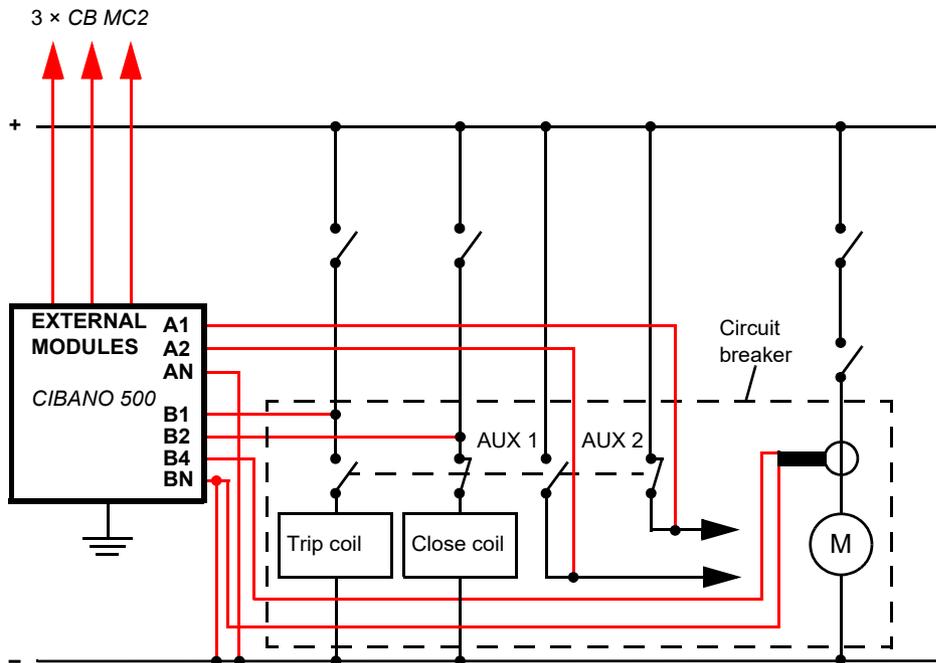


Figure 17-28: Typical measurement setup for the Dynamic Contact Resistance test

For circuit breakers with one drive for all three phases connect the trip coil to **B1**, the close coil to **B2**, and the common connection of the trip and close coils (typically the battery minus) to **BN**. The HV circuit breaker's motor remains generally connected to the station battery throughout the test and a current clamp connected to **BN** and **B4** is used to record the motor current.

Note: Connect the current clamp neutral directly to *CIBANO 500* and not to the other end of the neutral cable to avoid measurement errors due to the voltage drop on the cable. Alternatively you can supply the motor from *CIBANO 500* if you want or no station battery is available.

Circuit breakers with three drives are either tested phase by phase (see 17.2.3 "Testing circuit breakers with *CIBANO 500* and the CB MC2 modules" on page 172) or you can connect the three trip and close signals together. If you want to record the supply current for three coils simultaneously you can configure the sockets by clicking them.

⚠ WARNING

Death or severe injury caused by high voltage or current possible

- ▶ If you use the station battery to supply the motor or the coils via *CIBANO 500*, do not connect the cables to the station battery before they are connected to *CIBANO 500*.
- ▶ Always connect the cables first to grounded *CIBANO 500* and then to the station battery.

Measurement

To perform a measurement:

1. In the **Settings and conditions** area, enter the settings of the Dynamic Contact Resistance test.

Table 17-60: Settings of the Dynamic Contact Resistance test

Setting	Description
Coil supply	
Supply source	Select one of the following supply-source options: <ul style="list-style-type: none"> • CIBANO 500 to supply the coils with <i>CIBANO 500</i>. • External source to supply the coils with the source connected to V IN. • Control board to supply the coils with a control-board switch.¹
Supply settings ^{2,3}	Select a preconfigured coil supply setting from the asset data or select Custom to enter custom settings.
Coil supply voltage	Rated voltage of the coil supply Click AC or DC for AC or DC coil supply voltage respectively. Note: To perform the undervoltage trip and undervoltage close tests set the coil supply voltage lower than the nominal voltage.
Test frequency	Coil supply frequency (AC only)
Trip signal ⁴	Select whether the rising or falling edge of the trip signal opens the circuit breaker.
Close signal ⁴	Select whether the rising or falling edge of the close signal closes the circuit breaker.
Motor supply	
Supply source	Click CIBANO 500 to supply the motor with <i>CIBANO 500</i> . Click External source if the motor is supplied from the station supply or battery without any connection to <i>CIBANO 500</i> or if the station battery is connected to the V IN section and supplied, for example, via the B4 socket. Note: We do not recommend supplying the motor with undervoltage. Doing so does not provide any additional useful information and can cause degradation of the motor operation over time.
Supply settings ^{2,3}	Select the preconfigured motor supply setting from the asset data or select Custom to enter custom settings.
Motor supply voltage	Rated voltage of the motor supply Click AC or DC for AC or DC motor supply voltage respectively.
Test frequency	Motor supply frequency (AC only)
Max. supply duration	Maximum duration of supplying the motor if not stopped automatically
Main contact	

Table 17-60: Settings of the Dynamic Contact Resistance test (continued)

Setting	Description
Contact system	Contact system of the circuit breaker under test Select PIR to measure timing of contacts with pre-insertion resistors. Select Graphite nozzle to measure timing of contacts with graphite nozzle.
Nozzle length	Length of the circuit breaker's graphite nozzle
Trip velocity/ Close velocity ⁵	Contact travel velocity during the O sequence/C sequence
Travel data ⁶	<i>CB TN3</i> channel associated with the measured phase The Travel data boxes display a list of <i>CB TN3</i> travel measurement channels set to the corresponding phase in the hardware configuration of the <i>CB TN3</i> module.
Test current per channel ⁷	Output current of each <i>CB MC2</i> current channel
Other	
Grounding	Select the grounding condition of the circuit breaker under test.
Current clamp settings⁸	
Channel	Group B I/O socket
Ratio	Current clamp ratio
I max	Maximum current of the selected probe range
Sequence	
Test sequence	Test sequence to be performed
Trigger setting⁹	
Threshold	Threshold value of the trigger signal The measurement starts if the trigger signal rises above (rising edge) or falls below (falling edge) the threshold.
Edge type	Rising or falling edge

1. Only available if the trip and/or close signals are configured on the *IOB1* module.
2. Only available in the guided test workflow and if *CIBANO 500* is selected as source
3. Data taken from the nameplate
4. Only available if **Control board** is selected as supply source.
5. These values are used for calculating the timing characteristics of contacts with graphite nozzle.
6. Only available if at least one *CB TN3* module is connected to *CIBANO 500*. The corresponding travel data is used to calculate the timing characteristics of contacts with graphite nozzle.
7. Not available for **PIR** contact system. We recommend using a test current of 100 A per *CB MC2* channel for the most accurate results.
8. Only available if a current clamp is configured. The channel value displayed refers to the group **B** of the I/O sockets on the *CIBANO 500* side panel. The **B1...B4** sockets can be configured as **I clamp 1...I clamp 4** respectively.
9. Only available if **V IN**, or one output in group **A** or group **B** is set to Trigger IN.

2. Optionally, enter the advanced settings in the **Advanced settings** area.

Table 17-61: Advanced settings of the Dynamic Contact Resistance test

Setting	Description
Main contact	
PIR thresholds ¹	<p>Select Automatic if you want to let <i>Primary Test Manager</i> set the PIR thresholds or select Custom to set the PIR thresholds according to your needs.</p> <p>If you select Automatic, <i>Primary Test Manager</i> fits the PIR thresholds as follows:</p> <ul style="list-style-type: none"> • If the PIR value is not defined in the circuit breaker data, <i>Primary Test Manager</i> sets the default values. • If the PIR value is defined in the circuit breaker data, <i>Primary Test Manager</i> sets the Close / PIR threshold to 75% of the PIR value and the PIR / Open threshold to 125% of the PIR value.
C-O threshold ²	Resistance threshold to detect whether the main contact is open or closed. <i>Primary Test Manager</i> interprets the contact as open if the contact resistance is above the C-O threshold and vice versa.
Close / PIR threshold PIR / Open threshold ¹	Resistance thresholds for the PIR measurement <i>Primary Test Manager</i> interprets the contact in the PIR state if the contact resistance is above the Close / PIR threshold and below the PIR / Open threshold.
Resistance threshold ³	Threshold value of the contact resistance for calculating the timing characteristics of contacts with graphite nozzle
Spike compensation ³	Time interval for calculating the timing characteristics of contacts with graphite nozzle The contact is considered closed (C sequence) or opened (O sequence) if the contact resistance stays in the threshold state within the spike compensation interval.
Sine wave filter	Select the Sine wave filter check box to suppress sinusoidal interference.
Start evaluation at	Start time of the sine wave evaluation. Select the time at which the sinusoidal interference is clearly present in the measurement signal.
Sine frequency	Frequency of the sinusoidal interference
Other	
Close breaker before test ⁴	Select the Close breaker before test check box to automatically close the circuit breaker 1 second before starting a measurement.
Sample rate	Measurement sample rate ⁵

Table 17-61: Advanced settings of the Dynamic Contact Resistance test (continued)

Setting	Description
Contact bounce filter	
Main contact	Threshold value of the time interval between two consecutive bounces of the main contact. For time intervals equal or below the threshold, the contact is considered as closed. Setting the value to 0.0 ms deactivates the contact bounce filter.
Auxiliary contact	Threshold value of the time interval between two consecutive bounces of the auxiliary contact. For time intervals equal or below the threshold, the contact is considered as closed. Setting the value to 0.0 ms deactivates the contact bounce filter.
Average coil current/voltage	
Begin	Start of the average coil current/voltage evaluation in percent of the time period during which the current flows through the coil
End	End of the average coil current/voltage evaluation in percent of the time period during which the current flows through the coil

Sequence

See Table 17-62: "Dynamic Contact Resistance test sequences" later in this section.

1. Only available for **PIR** contact system
2. Only available for **Standard** contact system
3. Only available for **Graphite nozzle** contact system
4. The **Close breaker before test** check box is only active if the test sequence begins with the open command and no output is set to Trigger IN.
5. We recommend 10 kHz to constrain the amount of created data. Higher sample rates are needed for special tests only.

The following table explains the sequences of the Dynamic Contact Resistance test.

Table 17-62: Dynamic Contact Resistance test sequences

Sequence	Action
O	With this sequence, the opening time of the circuit breaker is measured. Only for O and C sequences we recommend performing the test twice, once with nominal voltage and once with 20% undervoltage to assure the functionality of the circuit breaker for a weak station battery.
C	This is the sequence to measure the closing time of the circuit breaker.
OC	With this sequence, a closing operation after the circuit breaker has tripped to clear a fault is simulated. Initially, the circuit breaker must be in the closed position. An open command initiates the sequence, followed by a dead time to clear the fault; and finally a close command must close the circuit breaker. This sequence is also known as reclosing sequence. To find out the shortest reclosing time the circuit breaker can provide, the close command is already applied while the circuit breaker is still opening. The circuit breaker then will close after opening as fast as possible.

Table 17-62: Dynamic Contact Resistance test sequences (continued)

Sequence	Action
CO	<p>With this sequence, a tripping operation after the circuit breaker has been closed under a fault condition (trip-free) or the verification of the correct operation of the anti-pumping system is simulated.</p> <p>To test the trip-free time the circuit breaker must be in the open position before the test is started. The circuit breaker is closed and then during the close operation is still in progress an open command is sent. The circuit breaker then opens as fast as possible.</p> <p>To test the anti-pumping function of the circuit breaker, the circuit breaker must be in closed position before the test is started. For this test the open time is set shorter (typically 200 ms) than the closing time (typically 400 ms). Ensure that the end time is increased so that the test sequence covers the whole close command duration (typically at least 190 ms). When the close command is sent the circuit breaker is already closed which initiates the anti-pumping function. Then an open command is sent and the circuit breaker trips. The closing command is still on when the open command ends, but the circuit breaker should not "pump", so that it should not close again.</p>
O-CO	<p>With this sequence, a reclose sequence (OC) under a fault condition is simulated. If the fault is not released, the circuit breaker must open (O) immediately and remain in this position.</p> <p>Initially, the circuit breaker must be in the closed position. The sequence begins with an open command, after a dead time the close and open commands (CO) must be applied at the same time (delay time typically 300 ms).</p>
CO-CO	<p>Some circuit breakers have a different specification for the pause time between CO and CO for CO-CO and O-CO-CO sequences. Therefore both sequences are available for testing. The time between the two CO subsequences shall be set according to the technical data of the circuit breaker (typically 15000 ms).</p>
O-CO-CO	<p>Some circuit breakers have a different specification for the pause time between CO and CO for CO-CO and O-CO-CO sequences. Therefore both sequences are available for testing. The time between the two CO subsequences shall be set according to the technical data of the circuit breaker (typically 15000 ms).</p>

3. In the **Assessment** area, configure the assessment.

- ▶ Click **Edit configuration** or click in one of the tables to open the **Assessment configuration** dialog box, and then edit the assessment limits.
- ▶ Select the **Automatic assessment** check box to enable the automatic assessment.

Note: For the assessment limit definitions, see 15.3 "Assessment limits" on page 106.

4. By using the **Open breaker**, **Close breaker** and **Supply motor** buttons in the **Measurements** area of *Primary Test Manager* (see 11.1 "Test control commands" on page 85) you can check whether all cables are correctly connected and bring the circuit breaker to the proper state. For example, to test a C sequence, the circuit breaker must be open and the spring charged.



- In the **Measurements** area, click **Start**.
The blue ring on the **Start/Stop** button is on.



WARNING

Death or severe injury caused by high voltage or current possible

- ▶ Do not enter the high-voltage test area while testing with *CIBANO 500* since any part of the circuit breaker can carry dangerous voltages.
- ▶ Stay in the work area during the test.



- Start the measurement by pressing the **Start/Stop** button.
The blue ring on the **Start/Stop** button flashes for approx. 3 seconds, and the lightning symbol in *Primary Test Manager* and the red status light on the front panel are flashing.



- After the measurement has finished, the lightning symbol in *Primary Test Manager* stops flashing, the green status light is on, and *Primary Test Manager* displays the measurement results.
The operating times depend on the sequence of the trip and close commands. The following table describes the operating times for all measurement sequences.

Table 17-63: Operating times¹

Data	Description
Opening time	Contact opening time of O, OC, O-CO and O-CO-CO operation
Opening sync.	Opening synchronization time of O, OC, O-CO and O-CO-CO operation
Closing time	Contact closing time of C, CO and O-CO operation
Closing sync.	Closing synchronization time of C, CO and O-CO operation
Reclosing time	Contact reclosing time of OC operation
Open-close time	Contact open-close time of O-CO, CO-CO, and O-CO-CO operation
Close-open time 1	Contact close-open time of CO and O-CO operation
Close-open time 2	Second contact close-open time of CO-CO and O-CO-CO operation
Assessment	Assessment of operating times

1. The operating times are calculated per contact, phase or circuit breaker.

Table 17-64: Auxiliary contact characteristics¹

Data	Description
Contact	Name of the auxiliary contact of the circuit breaker under test
Phase	Phase to which the auxiliary contact belongs
Type	Type of the auxiliary contact (a, b, wiper)

Table 17-64: Auxiliary contact characteristics¹ (continued)

Data	Description
Switching time	Closing or opening time of the auxiliary contact depending on its type
Duration	Duration the wiper contact remains closed
Diff. to main	Time difference between the opening or closing of the auxiliary contact and the corresponding main contact
Assessment	Assessment of auxiliary contact characteristics

1. Only calculated for O and C sequences

Table 17-65: Main contact characteristics¹

Data	Description
Main contact	Main contact this measurement row refers to
Bounce time ²	Duration of the main contact bounce
Bounce count ²	Number of main contact bounces within the bounce time
PIR closing time	Closing time for pre-insertion resistors
Assessment	Measurement assessment

1. Only available for O and C sequences

2. Not available for **PIR** contact system

Table 17-66: Coil characteristics

Data	Description
Peak current	Peak current value through a trip or close coil
Average current	Average current through the coil (see Average coil current/voltage settings in Table 17-61: "Advanced settings of the Dynamic Contact Resistance test" on page 203)
Average voltage	Average voltage applied to the coil (see Average coil current/voltage settings in Table 17-61: "Advanced settings of the Dynamic Contact Resistance test" on page 203)
Resistance	Calculated resistance of the coil
Assessment	Assessment of coil characteristics

Disconnection

Do not disconnect the circuit breaker but leave it connected for performing the next test. For disconnecting the circuit breaker, see "Disconnection" on page 218.

17.2.8 Minimum Pickup test

The Minimum Pickup test determines the minimum voltage required to trip or close the circuit breaker. By using the internal power source of *CIBANO 500*, the coil supply voltage is increased step by step through an automated test sequence until the circuit breaker operates.

Note: To perform the Minimum Pickup test, you need a license. Without the license, it is not possible to start the measurement and *Primary Test Manager* displays a missing license message. To get the license, contact your regional OMICRON service center.

Connection

WARNING

Death or severe injury caused by high voltage or current possible

- ▶ Do not connect anything to the circuit breaker under test without grounding the circuit breaker.
- ▶ Always ground the circuit breaker on both ends on all phases and close the circuit breaker to have proper grounding between the interrupters.

To connect the test object to *CIBANO 500*:

1. In *Primary Test Manager*, open the Minimum Pickup test.
2. In the **Hardware configuration** area, set the hardware configuration.
Often you can leave the cables as already connected in the previous test. Unused sockets can remain connected.

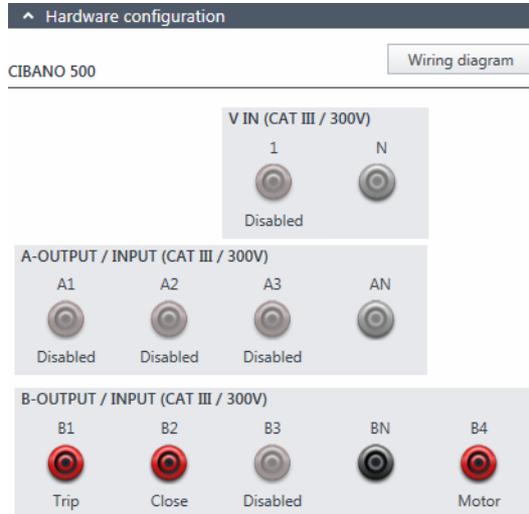


Figure 17-29: Hardware configuration of the Minimum Pickup test

Table 17-67: Hardware configuration options of *CIBANO 500*

CIBANO 500	Option
V IN (CAT III / 300 V)¹	
1	External source or Disabled
N	Neutral connection of V IN
A-OUTPUT / INPUT (CAT III / 300 V)	
A1	Motor A or Disabled
A2	Motor B or Disabled
A3	Motor C or Disabled
AN	Common neutral connection for outputs in group A
B-OUTPUT / INPUT (CAT III / 300 V)	
B1	Trip or Disabled
B2	Close or Disabled
B3	Supply or Disabled
BN	Common neutral connection for outputs in group B
B4	Motor or Disabled

1. Cannot be used to supply the trip or close coil because a variable voltage is needed, however it can be used to supply the motor.
3. Make sure that all cable connectors are clean and dry before being tightly connected.
4. Connect *CIBANO 500* to the trip and close coils of the circuit breaker according to the wiring diagram displayed in *Primary Test Manager*.

Measurement

To perform a measurement:

1. In the **Settings and conditions** area, enter the settings of the Minimum Pickup test.

Table 17-68: Settings of the Minimum Pickup test

Setting	Description
Coil supply	
Supply settings ^{1,2}	Select a preconfigured coil supply setting from the asset data or select Custom to enter custom settings.
Coil supply voltage	Rated voltage of the coil supply Click AC or DC for AC or DC coil supply voltage respectively.
Test frequency	Coil supply frequency (AC only)
Test sequence	

Table 17-68: Settings of the Minimum Pickup test (continued)

Setting	Description
Coil supply voltage start	Start voltage of the automated test sequence to determine the minimum pickup voltage
Coil supply voltage end	End voltage of the automated test sequence to determine the minimum pickup voltage
Coil supply voltage step	Stepwise voltage increase of the automated test sequence
Motor supply	
Supply source	Click CIBANO 500 to supply the motor with <i>CIBANO 500</i> . Click External source to supply the motor externally.
Supply settings ^{1,2,3}	Select the preconfigured motor supply setting from the asset data or select Custom to enter custom settings.
Motor supply voltage	Rated voltage of the motor supply Click AC or DC for AC or DC motor supply voltage respectively.
Test frequency	Motor supply frequency (AC only)
Max. supply duration	Maximum duration of supplying the motor if not stopped automatically

- 1. Only available in the guided test workflow
- 2. Data taken from the nameplate
- 3. Only available if *CIBANO 500* is selected as source

2. Optionally, enter the advanced settings in the **Advanced settings** area.

Table 17-69: Advanced settings of the Minimum Pickup test

Setting	Description
Supply during coil supply	
Enable	Select the Enable check box to supply voltage on the B3 socket during test execution. ¹
Supply voltage	Voltage supplied on the B3 socket (same as the coil supply voltage)
Supply before test	Time interval within which the voltage is supplied before the test starts
Test sequence	
Command impulse duration	Duration of the command pulse of the automated test sequence
Pause between impulses	Time interval between impulses of the automated test sequence

- 1. The **B3** socket must be configured as **Supply** and the coil supply voltage must be specified.

3. In the **Assessment** area, configure the assessment.
 - ▶ Click **Edit configuration** or click in the table to open the **Assessment configuration** dialog box, and then edit the assessment limits.
 - ▶ Select the **Automatic assessment** check box to enable the automatic assessment.

Note: For the assessment limit definitions, see 15.3 "Assessment limits" on page 106.
4. By using the **Open breaker**, **Close breaker** and **Supply motor** buttons in the **Measurements** area of *Primary Test Manager* (see 11.1 "Test control commands" on page 85) you can check whether all cables are correctly connected and bring the circuit breaker to the proper state. For testing the minimum pickup by the open sequence the circuit breaker must be closed and vice versa.
5. In the **Measurements** area, select the measurement you want to perform, and then click **Start**. The blue ring on the **Start/Stop** button is on.



WARNING

Death or severe injury caused by high voltage or current possible

- ▶ Do not enter the high-voltage test area while testing with *CIBANO 500* since any part of the circuit breaker can carry dangerous voltages.
- ▶ Stay in the work area during the test.



6. Start the measurement by pressing the **Start/Stop** button. The blue ring on the **Start/Stop** button flashes for approx. 3 seconds, and the lightning symbol in *Primary Test Manager* and the red status light on the front panel are flashing.

Note: You can abort the measurement anytime manually by pressing the **Emergency Stop** button or the **Start/Stop** button on the *CIBANO 500* front panel.

Note: If you connect, for example, three coils of three phases in parallel not all might operate at the same voltage. In this case the test will run until the last phase has operated and the highest voltage (worst case) will be shown.



7. After the measurement has finished, the lightning symbol in *Primary Test Manager* stops flashing, the green status light is on, and *Primary Test Manager* displays the measurement results.

Table 17-70: Minimum Pickup measurement data

Data	Description
No.	Number of the measurement
Operation	Trip or close
V pickup	Pickup voltage of the coil under test
Assessment	Measurement assessment

In case of three different trip coils, the trip coils can trip at different voltages. After the last pole has tripped the test will stop and show the worst case result.

Note: If there is an active discordance protection in place you must deactivate it for this test to avoid tripping of the other phases due to the discordance protection instead of the minimum pickup test.

Disconnection

Do not disconnect the circuit breaker but leave it connected for performing the next test. For disconnecting the circuit breaker, see "Disconnection" on page 218.

17.2.9 Motor Current test

The Motor Current test records the supply voltages and currents of the circuit breaker's charging motor(s).

Note: To perform the Motor Current test, you need a license. Without the license, it is not possible to start the measurement and *Primary Test Manager* displays a missing license message. To get the license, contact your regional OMICRON service center.

Connection



WARNING

Death or severe injury caused by high voltage or current possible

- ▶ Do not connect anything to the circuit breaker under test without grounding the circuit breaker.
- ▶ Always ground the circuit breaker on both ends on all phases and close the circuit breaker to have proper grounding between the interrupters.

To connect the test object to *CIBANO 500*:

1. In *Primary Test Manager*, open the Motor Current test.
2. In the **Hardware configuration** area, set the hardware configuration.
3. After setting the hardware configuration, connect the **B4** socket on the side panel of *CIBANO 500* to "+" or phase contact of the motor and the **BN** socket to "-" or neutral contact of the motor.

Note: Do not connect Trigger IN and current clamps to the same neutral connection socket of the group **A** or group **B**.

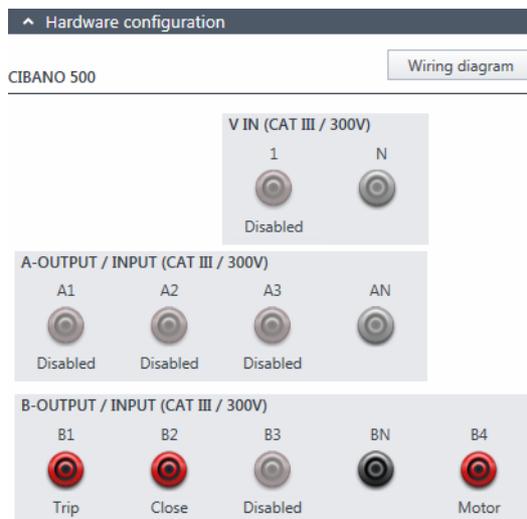


Figure 17-30: Hardware configuration of the Motor Current test

Note: You can control three circuit breaker's motors simultaneously. In this case connect the phase contact of the motor 1 to the **A1** socket, the phase contact of the motor 2 to the **A2** socket, the phase contact of the motor 3 to the **A3** socket, and the neutral motor contacts to the **AN** socket.

Table 17-71: Hardware configuration options of *CIBANO 500*

CIBANO 500		Option		
V IN (CAT III / 300 V)				
1	External source, Trigger IN ¹ or Disabled			
N	Neutral connection of V IN			
A-OUTPUT / INPUT (CAT III / 300 V)				
A1	Motor A, Trigger IN ¹ or Disabled			
A2	Motor B, Trigger IN ¹ or Disabled			
A3	Motor C, Trigger IN ¹ or Disabled			
AN	Common neutral connection for outputs/inputs in group A			
B-OUTPUT / INPUT (CAT III / 300 V)				
B1	Trip			or Disabled
	Trigger IN ¹			
	I clamp 1	Motor	all	
			Phase A	
			Phase B	
Phase C				
B2	Close			or Disabled
	Trigger IN ¹			
	I clamp 2	Motor	all	
			Phase A	
			Phase B	
Phase C				

Table 17-71: Hardware configuration options of CIBANO 500 (continued)

CIBANO 500	Option			
B3	Supply			or Disabled
	Trigger IN ¹			
	I clamp 3	Motor	all	
			Phase A	
			Phase B	
Phase C				
BN	Neutral connection of outputs in group B			
B4	Motor			or Disabled
	Trigger IN ¹			
	I clamp 4	Motor	all	
			Phase A	
			Phase B	
Phase C				

1. Trigger signal starting the measurement
4. Make sure that all cable connectors are clean and dry before being tightly connected.
5. Connect CIBANO 500 to the motor of the circuit breaker according to the wiring diagram displayed in *Primary Test Manager* and the following figure.

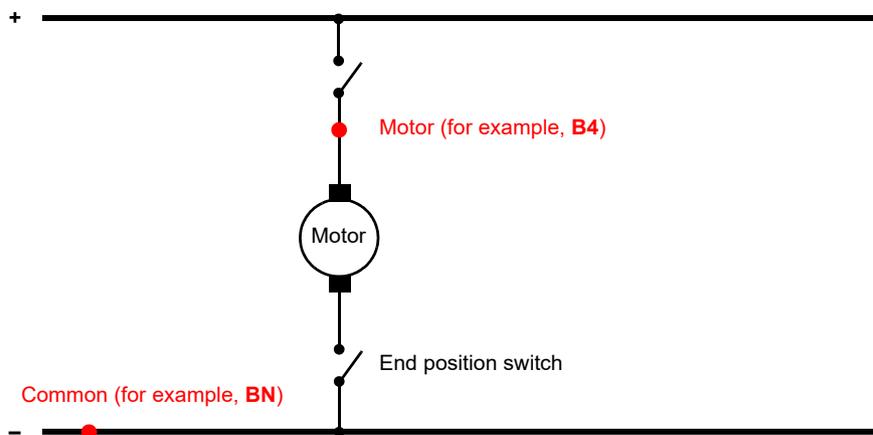


Figure 17-31: Connecting CIBANO 500 to the circuit breaker for the Motor Current test (The end position switch opens when the spring is charged.)

Measurement

To perform a measurement:

1. In the **Settings and conditions** area, enter the settings of the Motor Current test.

Table 17-72: Settings of the Motor Current test

Setting	Description
Motor supply	
Supply source	Click CIBANO 500 to supply the motor with <i>CIBANO 500</i> . Click External source to supply the motor externally.
Supply settings ^{1,2}	Select the preconfigured motor supply setting from the asset data or select Custom to enter custom settings.
Motor supply voltage	Rated voltage of the motor supply Click AC or DC for AC or DC motor supply voltage respectively.
Test frequency	Motor supply frequency (AC only)
Max. supply duration	Maximum duration of supplying the motor if not stopped automatically
Coil supply	
Supply source	Select one of the following supply-source options: <ul style="list-style-type: none"> • CIBANO 500 to supply the coils with <i>CIBANO 500</i>. • External source to supply the coils with the source connected to V IN. • Control board to supply the coils with a control-board switch.³
Supply settings ^{1,2}	Select a preconfigured coil supply setting from the asset data or select Custom to enter custom settings.
Coil supply voltage	Rated voltage of the coil supply Click AC or DC for AC or DC coil supply voltage respectively.
Test frequency	Coil supply frequency (AC only)
Trip signal ⁴	Select whether the rising or falling edge of the trip signal opens the circuit breaker.
Close signal ⁴	Select whether the rising or falling edge of the close signal closes the circuit breaker.
Current clamp settings⁵	
Channel	Group B I/O socket
Ratio	Current clamp ratio
I max	Maximum current of the selected probe range
Trigger setting⁶	
Threshold	Threshold value of the trigger signal The measurement starts if the trigger signal rises above (rising edge) or falls below (falling edge) the threshold.
Edge type	Rising or falling edge

1. Only available in the guided test workflow and if *CIBANO 500* is selected as source

2. Data taken from the nameplate

3. Only available if the trip and/or close signals are configured on the *IOB1* module.

4. Only available if **Control board** is selected as supply source.

5. Only available if at least one output in group **B** is set to I clamp x.

6. Only available if **V IN**, or one output in group **A** or group **B** is set to Trigger IN.

- Optionally, enter the advanced settings in the **Advanced settings** area.

Table 17-73: Advanced settings of the Motor Current test

Setting	Description
Other	
Sample rate	Measurement sample rate
Charging current	
Begin	Start of the charging current evaluation in percent of the total charging duration of the motor
End	End of the charging current evaluation in percent of the total charging duration of the motor

- In the **Assessment** area, configure the assessment.
 - Click **Edit configuration** or click in one of the tables to open the **Assessment configuration** dialog box, and then edit the assessment limits.
 - Select the **Automatic assessment** check box to enable the automatic assessment.

Note: For the assessment limit definitions, see 15.3 "Assessment limits" on page 106.



- In the **Measurements** area, click **Start**.
The blue ring on the **Start/Stop** button is on.



WARNING

Death or severe injury caused by high voltage or current possible

- Do not enter the high-voltage test area while testing with *CIBANO 500* since any part of the circuit breaker can carry dangerous voltages.
- Stay in the work area during the test.



- Start the measurement by pressing the **Start/Stop** button.
The blue ring on the **Start/Stop** button flashes for approx. 3 seconds, and the lightning symbol in *Primary Test Manager* and the red status light on the front panel are flashing.

Note: In emergency cases, you can abort the measurement anytime manually by pressing the **Emergency Stop** button on the *CIBANO 500* front panel.

- After the charging process has finished, *CIBANO 500* stops the measurement automatically.
The lightning symbol in *Primary Test Manager* stops flashing, the green status light is on, and *Primary Test Manager* displays the measurement results.



The following figure shows an example of the Motor Current test graphical results.

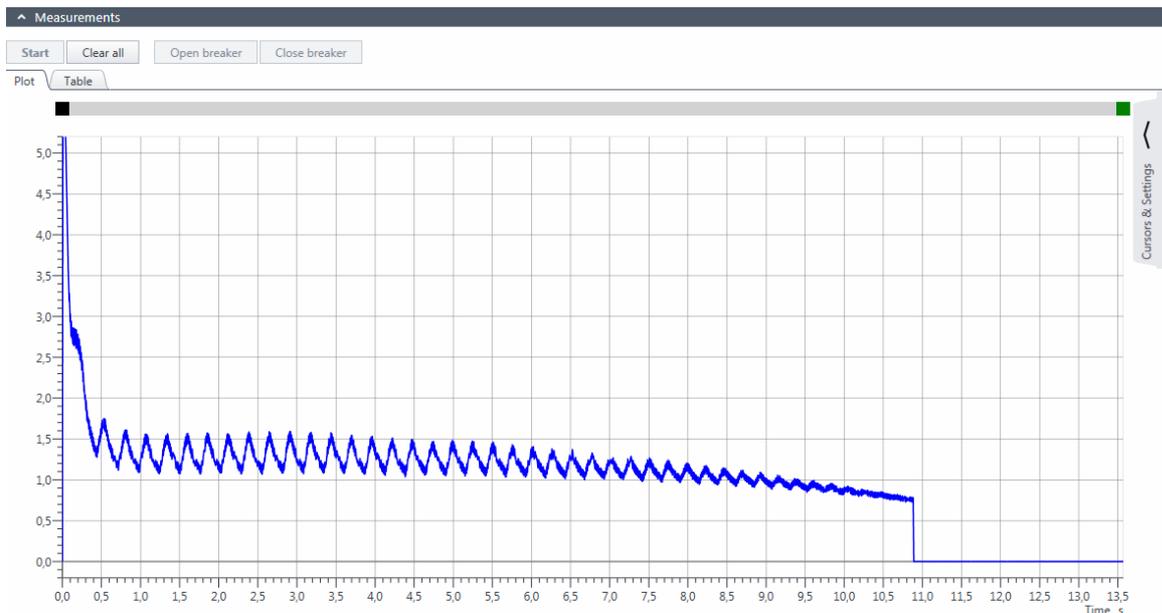


Figure 17-32: Example of the Motor Current test graphical results

To display the numerical measurement results, click the **Table** tab in the **Measurements** area.

Table 17-74: Motor characteristics

Data	Description
Inrush current	Maximum current drawn by the motor On a DC motor, the inrush current is usually reached during the startup phase.
Charging time	Time the motor needs to charge the spring The spring is used to store the energy for a trip or close operation.
Charging current	Average charging current of the motor (see Charging current settings in Table 17-73: "Advanced settings of the Motor Current test" on page 216)
Minimum voltage	Minimum motor supply voltage during the charging operation of the motor
Assessment	Measurement assessment

Disconnection

Note: Do not disconnect the test object from *CIBANO 500* if you intend to make further measurements.

To disconnect the test object from *CIBANO 500*:



1. Press the **Emergency Stop** button on the *CIBANO 500* front panel.
2. Wait until the green status light on the *CIBANO 500* front panel is on and the voltage/current indicator on the *CIBANO 500* side panel is off.
3. Remove the barrier between the dangerous and the work area.

WARNING

Death or severe injury caused by high voltage or current possible

- ▶ Do not touch any part of the circuit breaker before grounding and short-circuiting its terminals.
- ▶ Always ground and short-circuit the circuit breaker's terminals by using a grounding set.

4. Disconnect the cables from the station battery, if connected.
5. Disconnect the cables from the circuit breaker's motor, if connected.
6. Disconnect the cables from the circuit breaker's trip and close coils.
7. Disconnect one *CB MC2* module from *CIBANO 500*.

WARNING

Death or severe injury caused by high voltage or current possible

- ▶ Do not proceed without grounding the test object's terminals.
- ▶ Ground the test object's terminals by using a grounding set.

8. Disconnect the *CB MC2* from the main contact of the circuit breaker.
9. Unhook the *CB MC2* from one phase of the circuit breaker.
10. Repeat steps 7 to 9 for all phases tested.
11. Switch off *CIBANO 500* by pressing the mains power on/off switch on the *CIBANO 500* side panel.
12. Disconnect the mains power cord.
13. Remove the equipotential ground as the last connection that is removed first on the substation side and then from *CIBANO 500*.

WARNING

Death or severe injury caused by high voltage or current possible

- ▶ Do not leave the circuit breaker's spring(s) charged after disconnecting *CIBANO 500* from the circuit breaker.
- ▶ Always operate the circuit breaker manually by using the circuit breaker's operation buttons until the spring(s) are discharged.

17.2.10 Testing with external power supply

If you use an external power supply (for example, the station battery) for supplying the motor or the coils of the circuit breaker during the test, connect the external power supply to the **V IN** input of *CIBANO 500* and wire the **N** and **BN** sockets as shown in the following figure.

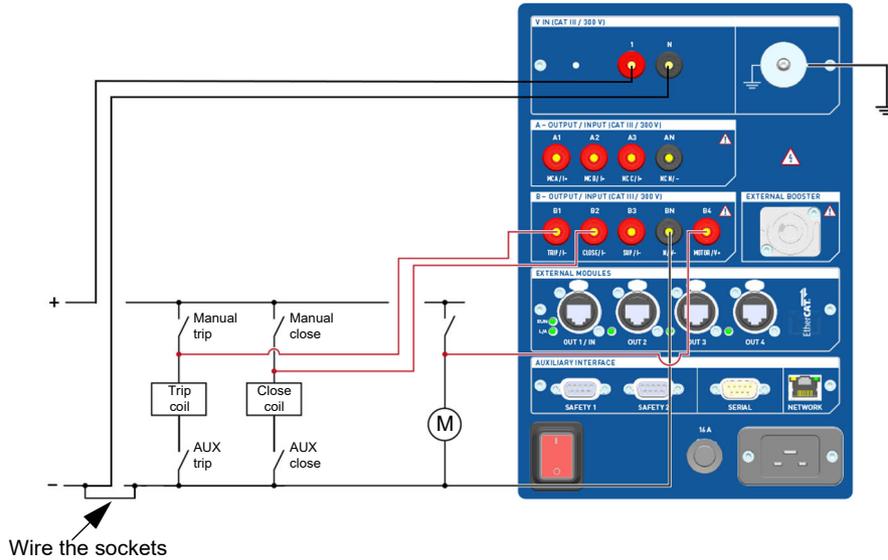


Figure 17-33: Wiring the *CIBANO 500* sockets for testing with external power supply

17.2.11 Continuous power supply

CIBANO 500 provides a continuous power supply on the **B3** socket to supply, for example, hybrid circuit breakers prior the test and whenever it is needed. After you have connected to *CIBANO 500*, you can configure the continuous power supply in the *Primary Test Manager* status bar.

Note: The continuous power supply is not available for the Minimum Pickup test (see 17.2.8 "Minimum Pickup test" on page 208). If you have activated the continuous power supply and you open the Minimum Pickup test, *Primary Test Manager* will prompt you to deactivate the continuous power supply before executing the test.

To configure the continuous power supply:

1. In the status bar, click **Edit**.

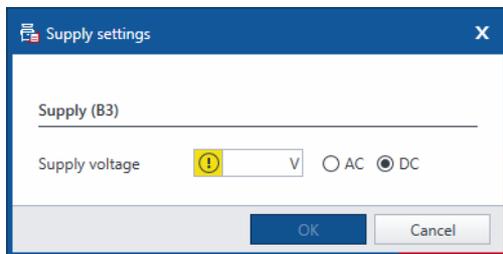


Figure 17-34: **Supply settings** dialog box

2. In the **Supply settings** dialog box, enter the supply voltage you want to use for testing your circuit breaker.

WARNING

Death or severe injury caused by high voltage or current possible

- ▶ Do not touch the **B3** socket and any connected cables after you have activated the continuous power supply.
 - ▶ Always use a strobe light to warn the operating personnel of the possibly dangerous operating condition.
- ▶ To activate the continuous power supply, click **ON** in the status bar. After you click **Activate** in the **Activate power supply** dialog box, the configured supply voltage is applied the **B3** socket, and the red light on the front panel will be flashing indicating possibly dangerous operating condition.

Note: If you have activated the continuous power supply, the coil supply settings are not available because the supply voltage is set by the continuous power supply.

CAUTION

Personal injury due to unexpected operation of the circuit breaker possible

- ▶ Before deactivating the continuous power supply, open the circuit breaker.
- ▶ To deactivate the continuous power supply, click **OFF** in the status bar.

17.3 Testing gas insulated switchgears with both sides grounded

CIBANO 500 in connection with *Primary Test Manager* supports testing of gas insulated switchgears (GIS) with both sides grounded. This section describes the following GIS tests:

- Contact Resistance (see 17.3.4 "Contact Resistance test" on page 228)
- Timing (CSM) (see 17.3.5 "Timing (CSM) test" on page 233)
- Minimum Pickup (see 17.3.6 "Minimum Pickup test" on page 243)
- Motor Current (see 17.3.7 "Motor Current test" on page 247)

For testing of single-side grounded gas insulated switchgears, proceed as described in 17.1 "Testing medium-voltage circuit breakers" on page 117 or 17.2 "Testing high-voltage circuit breakers" on page 170.

17.3.1 Safety precautions in the substation

DANGER

Death or severe injury caused by a lightning discharge

- ▶ Do not connect the test set to the test object if there is a possibility of a thunderstorm over any part of the system.
- ▶ Always observe the weather conditions while testing with *CIBANO 500*.

Always observe the following safety rules:

- Disconnect completely.
- Secure against re-connection.
- Verify that the installation is dead.
- Carry out grounding and short-circuiting.
- Provide protection against adjacent live parts.
- Ground the test object at one or more terminals during connecting, testing and disconnecting.

WARNING

Death or severe injury caused by high voltage or current possible

- ▶ Do not test with *CIBANO 500* without grounding the circuit breaker.
- ▶ Always ground the circuit breaker on both ends on all phases and close the circuit breaker to have proper grounding between the interrupters.

Separate your working area as shown in Figure 1-1: "Example of the separation of the work and high-voltage test areas" on page 12 into a work area and a dangerous area when a test is running. Set up a suitable barrier and, if applicable, status lights to protect others from accessing the dangerous area and accidentally touching live parts.

If there is a longer distance between the location of *CIBANO 500* and the dangerous area (that is, the test object), a second person with an additional **Emergency Stop** button is required.

⚠ WARNING

Death or severe injury caused by high voltage or current possible

- ▶ Never use the *CIBANO 500* test set without a solid connection to ground.
- ▶ Ground *CIBANO 500* with a cable of at least 6 mm² cross-section as close as possible to the operator.

17.3.2 Gas insulated switchgears

In order to do safe maintenance work, grounding switches are commonly incorporated into gas insulated switchgears (GIS). They connect the conductor to ground and prevent any parts to be charged with high voltages as result of capacitive coupling.

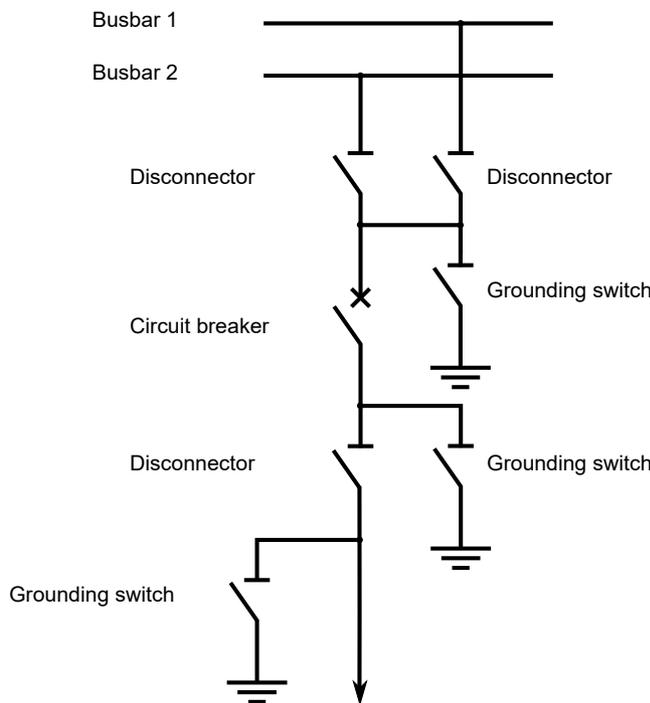


Figure 17-35: Single-line diagram of a GIS with enough grounding switches – safe and comfortable solution for circuit breaker maintenance

The more grounding switches and disconnectors are incorporated, the safer is the maintenance work on the circuit breaker.

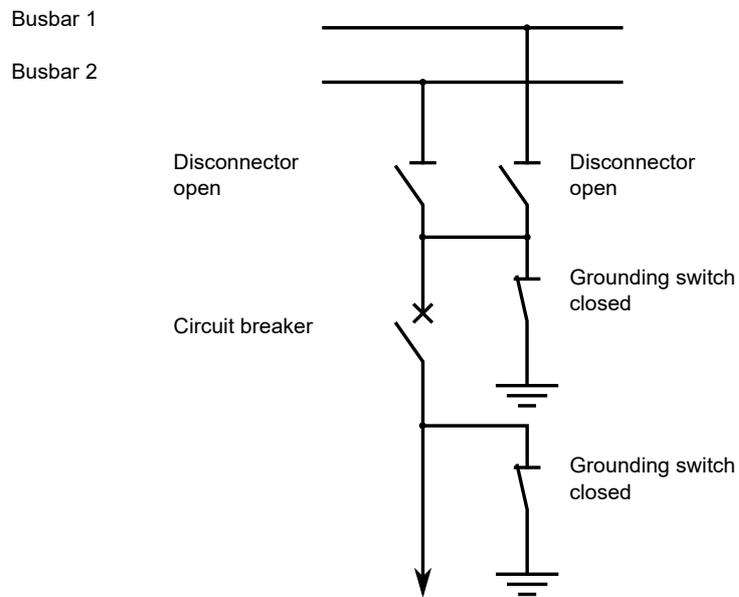


Figure 17-36: Single-line diagram of a GIS with a minimum set of grounding switches and disconnectors – unsafe to open grounding switches during circuit breaker maintenance

Because the grounding switch connects the line conductor to the ground connection, the line conductor can usually be accessed from outside of the GIS.

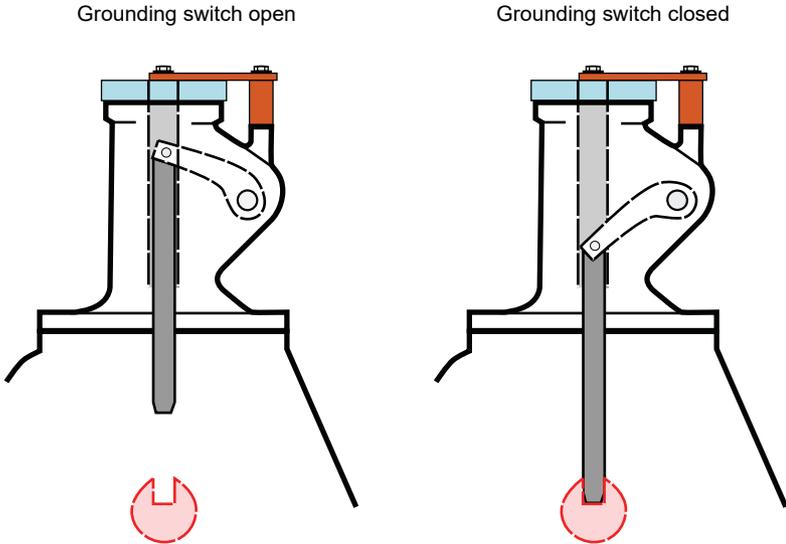


Figure 17-37: How a grounding switch works

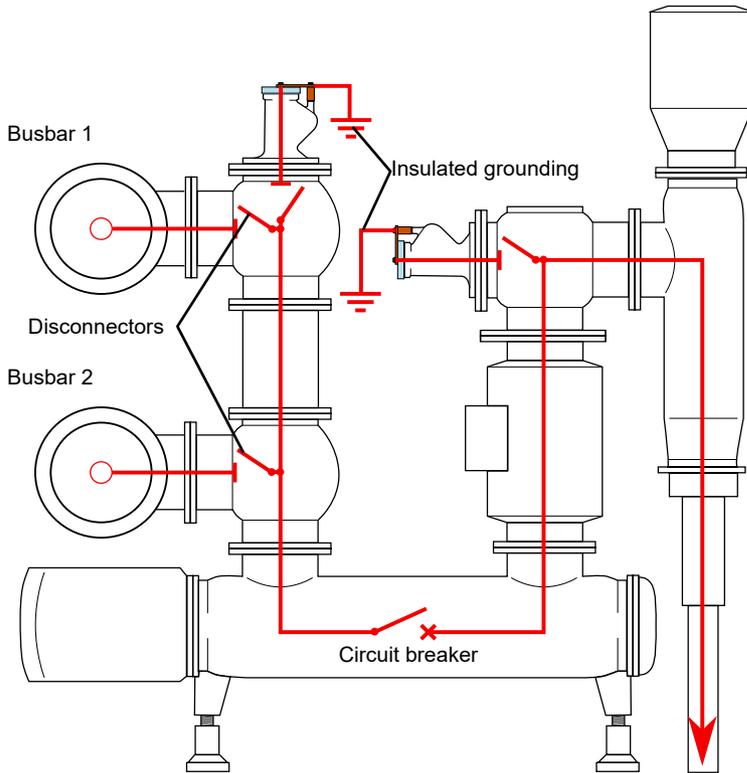


Figure 17-38: GIS with two insulated grounding switches

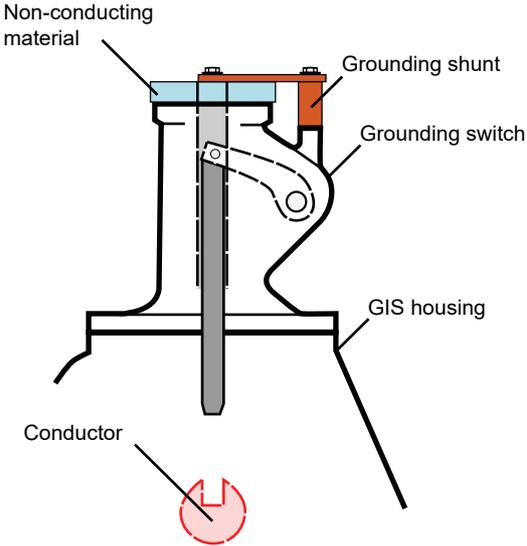


Figure 17-39: Grounding switch components

If the grounding switch is closed, the line conductor within the GIS is connected via a grounding shunt on top of the grounding switch with the GIS housing which has ground potential.

Grounding switches can be insulated or non-insulated. On insulated grounding switches the connection between the line conductor and the ground connection (housing of the GIS) can be removed.

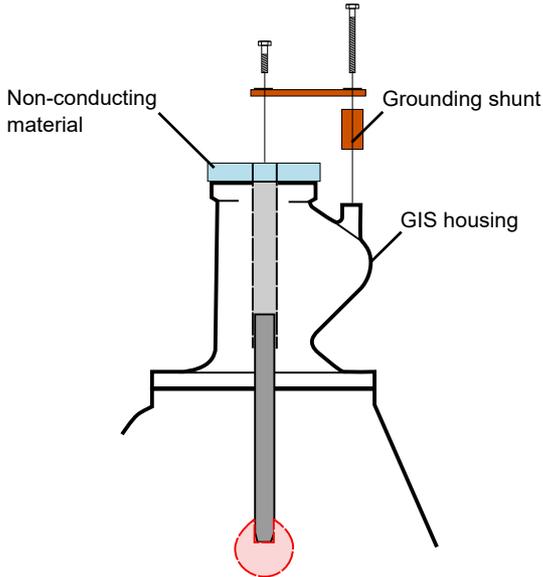


Figure 17-40: Insulated grounding switch

17.3.3 Test set and software startup

To put *CIBANO 500* into operation and start *Primary Test Manager*:

1. Connect the *CIBANO 500* grounding terminals properly to the substation ground.
2. Connect *CIBANO 500* to a computer with the delivered Ethernet cable and switch on the computer.
3. Connect *CIBANO 500* to the mains power supply by using the delivered power cord.
4. Switch on *CIBANO 500* by pressing the mains power on/off switch on the side panel. The green status light on the *CIBANO 500* front panel (see Figure 3-1: "Front view of CIBANO 500" on page 17) flashes for a short time and then extinguishes for approx. one minute. After it lights up, the *CIBANO 500* outputs carry no dangerous voltage or current.
5. Start *Primary Test Manager* and connect to *CIBANO 500* as described in 5.4 "Start Primary Test Manager and connect to CIBANO 500" on page 28.

If you could not connect to your *CIBANO 500* device and the green light is permanently on, wait a few seconds, and then proceed as follows:

1. Click **More** next to the **Connect** button, and then click **Refresh**.
2. Select the test system from the list, and then click **Connect**.

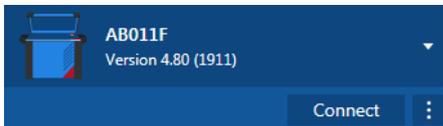


Figure 17-41: Connecting to *CIBANO 500*

If the *CIBANO 500* device to which you want to connect is not displayed in the list of available devices, proceed as described in 20.1 "Connecting to CIBANO 500" on page 315.

After you have started *Primary Test Manager* and connected to *CIBANO 500*, proceed as described earlier in this User Manual. You can:

- Create new guided jobs (see 7 "Create new guided jobs" on page 50)
- Manage locations, assets, jobs and test reports (see 10 "Manage objects" on page 77)
- Create new manual jobs (see 8 "Create new manual jobs" on page 72)
- Open existing jobs (see 9 "Open jobs" on page 76)
- Generate test reports (see 13 "Generate test reports" on page 93)

The next sections describe the tests of gas insulated switchgears with both sides grounded.

17.3.4 Contact Resistance test

The Contact Resistance test measures the static resistance of the circuit breaker’s main contacts.

The Contact Resistance test can be performed only when the circuit breaker is closed. A typical MV circuit breaker has manual operation buttons at its front plate to control the circuit breaker’s spring. If the spring is not charged, first charge the spring as described in 17.1.9 "Motor Current test" on page 150, and then close the circuit breaker.

Note: To increase the accuracy of the measurement results for the both-side grounded circuit breakers, you can compensate for the resistance of the ground loop by making two measurements with the circuit breaker closed and open. To compensate for the resistance of the ground loop, select the **Compensate ground loop resistance** check box (see Table 17-76: "Settings of the Contact Resistance test" on page 230).

Connection

WARNING

Death or severe injury caused by high voltage or current possible

- ▶ Do not use external power sources for the circuit breaker’s main contacts.
- ▶ During the test, supply the circuit breaker’s main contacts only with *CIBANO 500*.

To connect the test object to *CIBANO 500*:

1. In *Primary Test Manager*, open the Contact Resistance test.

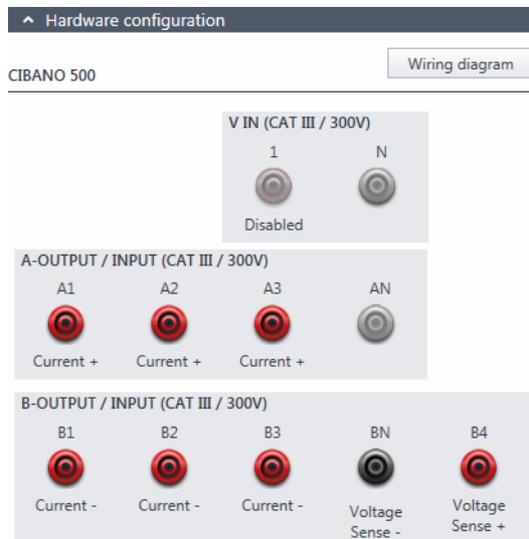


Figure 17-42: Hardware configuration of the Contact Resistance test

Table 17-75: Hardware configuration options of *CIBANO 500*

CIBANO 500	Option
A-OUTPUT / INPUT (CAT III / 300 V)	
A1	Current +
A2	Current +
A3	Current +
AN	Not connected in this test
B-OUTPUT / INPUT (CAT III / 300 V)	
B1	Current –
B2	Current –
B3	Current –
BN	Voltage Sense –
B4	Voltage Sense +

2. Make sure that all cable connectors are clean and dry before being tightly connected.
3. Connect *CIBANO 500* to the main contact of the circuit breaker for one phase according to the wiring diagram displayed in *Primary Test Manager*.

Tips & Tricks: For easy connection use the delivered multi-core cables and connect the end with the short wires to the *CIBANO 500* sockets according to the short-wire labels. Connect the cable end with the long wires according to the wiring diagram to the corresponding Kelvin clamp. The black **AN** cable is not needed for this test and remains unconnected.

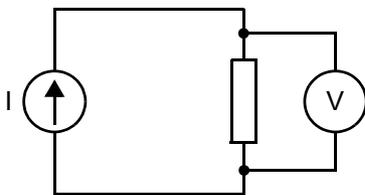


Figure 17-43: Principal scheme of the contact resistance test

Tips & Tricks: The delivered Kelvin clamp is the perfect solution for connecting to a massive conductor like a copper busbar or similar. We recommend using only the red connectors of the Kelvin clamps (which is the current path) when connecting to the contact fingers of a MV circuit breaker. Use a separate clamp for the voltage sense cables (**BN** and **B4**) which can be mounted closer to the MV circuit breaker contact. If the connection is set up properly the resistance decreases when the voltage sense clamps are connected closer to the circuit breaker contact. The polarity of connection does not matter for this test.

Measurement

To perform a measurement:

1. In the **Settings and conditions** area, enter the settings of the Contact Resistance test.

Table 17-76: Settings of the Contact Resistance test

Setting	Description
Main contact	
Test current ¹	Current of the test (typically 100 A)
Other	
Grounding	Grounding of the circuit breaker under test
Compensate ground loop resistance	Select the Compensate ground loop resistance check box to compensate for the resistance of the ground loop.

1. For normal circuit breakers always use 100 A.

2. Optionally, enter the advanced settings in the **Advanced settings** area.

Table 17-77: Advanced settings of the Contact Resistance test

Setting	Description
Test conditions	
Ambient temperature ¹	Ambient temperature on site
Main contact	
V DC range ²	DC voltage measurement range
CT mode ^{3,4}	Select the Enabled check box to enable CT mode for measuring circuit breakers with current transformers (CT).
Test duration ⁴	Duration of the test

1. Only for reference in the report, the result is not temperature compensated.

2. For normal circuit breakers the lowest range is recommended. Only if the result is "infinite" select a higher range.

3. Data taken from the nameplate (for circuit breakers with dead tank and GIS)

4. Only available for circuit breakers with integrated current transformer, such as dead-tank and GIS

3. In the **Assessment** area, configure the assessment.

- ▶ Click **Edit configuration** or click in the table to open the **Assessment configuration** dialog box, and then edit the assessment limits.

- ▶ Select the **Automatic assessment** check box to enable the automatic assessment.

Note: For the assessment limit definitions, see 15.3 "Assessment limits" on page 106.



- In the **Measurements** area, select the measurement you want to perform, and then click **Start**. The blue ring on the **Start/Stop** button is on.

**WARNING****Death or severe injury caused by high voltage or current possible**

- ▶ Do not enter the high-voltage test area while testing with *CIBANO 500* since any part of the circuit breaker can carry dangerous voltages.
- ▶ Stay in the work area during the test.



- Start the measurement by pressing the **Start/Stop** button. The blue ring on the **Start/Stop** button flashes for approx. 3 seconds, and the lightning symbol in *Primary Test Manager* and the red status light on the front panel are flashing.

Note: You can abort the measurement anytime manually by pressing the **Emergency Stop** button or the **Start/Stop** button on the *CIBANO 500* front panel.



- After the measurement has finished, the lightning symbol in *Primary Test Manager* stops flashing, the green status light is on, and *Primary Test Manager* displays the measurement results.
- Connect *CIBANO 500* to the main contact of the circuit breaker for the next phase according to the wiring diagram provided by *Primary Test Manager*. To display the wiring diagram, click the **Wiring diagram** button. Click in the diagram to close it.
- Repeat steps 1 to 7 for all phases.
- For the measurement results, see Table 17-78: "Contact Resistance measurement data" on page 232.

If you selected the **Compensate ground loop resistance** check box, proceed as follows:

- Open the circuit breaker.
- In the **Measurements** area of *Primary Test Manager*, select the breaker state **Open**.



- Select the measurement you want to perform, and then click **Start**. The blue ring on the **Start/Stop** button is on.

**WARNING****Death or severe injury caused by high voltage or current possible**

- ▶ Do not enter the high-voltage test area while testing with *CIBANO 500* since any part of the circuit breaker can carry dangerous voltages.
- ▶ Stay in the work area during the test.



- Start the measurement by pressing the **Start/Stop** button. The blue ring on the **Start/Stop** button flashes for approx. 3 seconds, and the lightning symbol in *Primary Test Manager* and the red status light on the front panel are flashing.

Note: You can abort the measurement anytime manually by pressing the **Emergency Stop** button or the **Start/Stop** button on the *CIBANO 500* front panel.



- After the measurement has finished, the lightning symbol in *Primary Test Manager* stops flashing, the green status light is on, and *Primary Test Manager* displays the measurement results.
- Connect *CIBANO 500* to the main contact of the circuit breaker for the next phase according to the wiring diagram provided by *Primary Test Manager*. To display the wiring diagram, click the **Wiring diagram** button. Click in the diagram to close it.

7. Repeat steps 1 to 6 for all phases.

Table 17-78: Contact Resistance measurement data

Data	Description
Channel	Current +/-
Phase	Measured phase
I DC ¹	DC test current with the circuit breaker open
V DC ¹	Measured voltage with the circuit breaker open
R open ¹	Measured resistance with the circuit breaker open
I DC	DC test current with the circuit breaker closed
V DC	Measured voltage with the circuit breaker closed
R closed ¹	Measured resistance with the circuit breaker closed
R meas	Measured contact resistance
Assessment	Measurement assessment

1. Only available if the **Compensate ground loop resistance** check box is selected.

Disconnection

Do not disconnect the circuit breaker but leave it connected for performing the next test. For disconnecting the circuit breaker, see "Disconnection" on page 252.

17.3.5 Timing (CSM) test

The Timing (CSM) test (CSM stands for Current Sensor Measurement) measures the contact timing of the circuit breaker. Depending on the selected sequence the opening time, closing time, close-open time, and so on are automatically calculated. With the *CB TN3* modules, you can also measure the displacement of the circuit breaker's main contacts during operation (see 17.5 "Testing circuit breakers with CIBANO 500 and the CB TN3 modules" on page 259).

Connection

⚠ WARNING

Death or severe injury caused by high voltage or current possible

- ▶ Do not connect anything to the circuit breaker under test without grounding the circuit breaker.
- ▶ Always ground the circuit breaker on both ends on all phases and close the circuit breaker to have proper grounding between the interrupters.

To connect the test object to *CIBANO 500*:

⚠ WARNING

Death or severe injury caused by high voltage or current possible

- ▶ Do not connect the EtherCAT® cables to the *CB MC2* module before they are connected to *CIBANO 500*.
- ▶ Connect the EtherCAT® cables first to *CIBANO 500* and then to the *CB MC2* module.

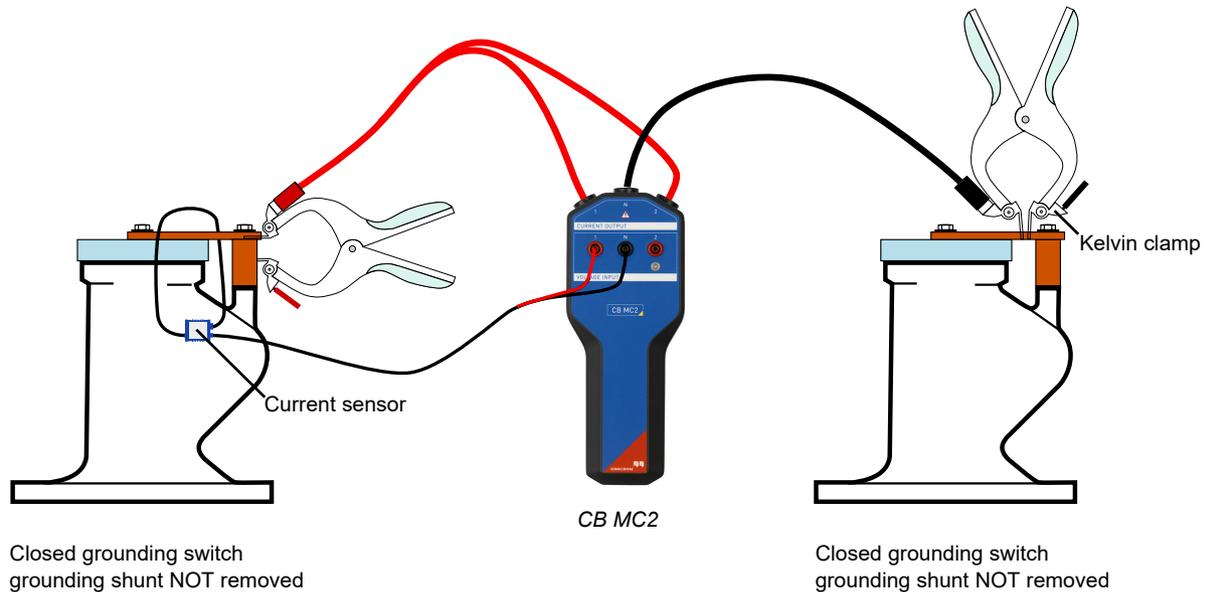


Figure 17-44: Connecting the *CB MC2* module to a both-side grounded GIS

1. Make sure that all cable connectors are clean and dry before being tightly connected.
2. Connect the *CB MC2* to *CIBANO 500* with the EtherCAT® cable.

3. If the *CB MC2* modules are not connected from the last test, hook up the *CB MC2* to the interrupter of the circuit breaker.
4. Connect the *CB MC2* current channels to the main contact of the circuit breaker with the delivered cables and clamps.
5. Connect the current sensor to channel 1 of the *CB MC2* voltage channel and put it around the insulated ground connection point.
6. Repeat steps 2 to 4 for all phases you want to test.
7. In *Primary Test Manager*, open the Timing (CSM) test.
8. In the **Hardware configuration** area, set the hardware configuration and check whether *Primary Test Manager* recognized all connected *CB MC2* modules.

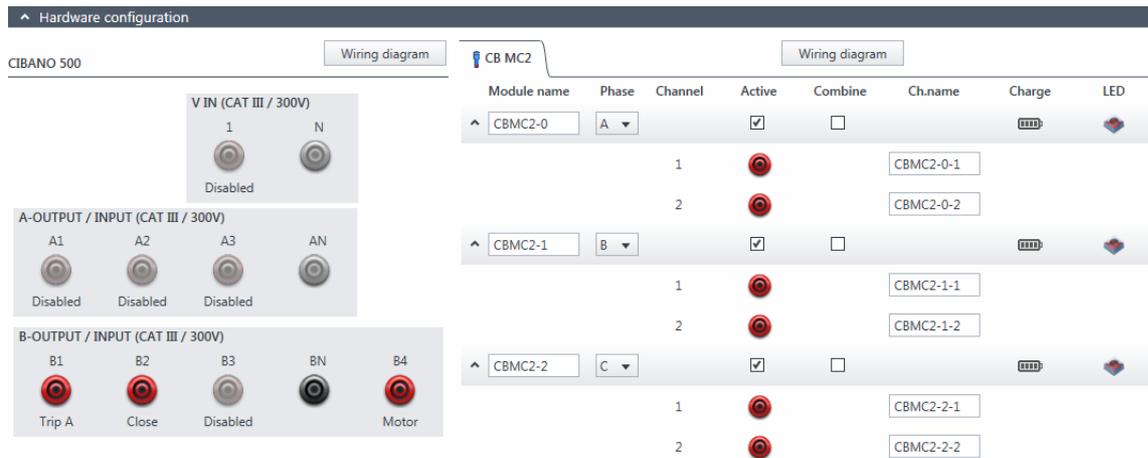


Figure 17-45: Hardware configuration of the Timing (CSM) test

Table 17-79: Hardware configuration options of *CIBANO 500*

CIBANO 500	Option		
V IN (CAT III / 300 V)			
1	External source, Trigger IN ¹ or Disabled		
N	Neutral connection of V IN		
A-OUTPUT / INPUT (CAT III / 300 V)			
A1	AUX 1	Dry contact (potential-free)	Close A, Motor A, Trigger IN ¹ or Disabled
		Wet contact (with potential)	
A2	AUX 2	Dry contact (potential-free)	Close B, Motor B, Trigger IN ¹ or Disabled
		Wet contact (with potential)	

Table 17-79: Hardware configuration options of *CIBANO 500* (continued)

CIBANO 500		Option	
A3	AUX 3	Dry contact (potential-free)	Close C, Motor C, Trigger IN ¹ or Disabled
		Wet contact (with potential)	
AN	Common neutral connection for outputs/inputs in group A		
B-OUTPUT / INPUT (CAT III / 300 V)			
B1	Trip A, Trigger IN ¹ , I clamp 1 or Disabled		
B2	Trip B, Close, Trigger IN ¹ , I clamp 2 or Disabled		
B3	Trip C, Supply, Trigger IN ¹ , I clamp 3 or Disabled		
BN	Neutral connection of outputs in group B		
B4	Trigger IN ¹ , I clamp 4, Motor or Disabled		

1. Trigger signal starting the measurement

V IN (CAT III / 300 V)

The **V IN (CAT III / 300 V)** inputs can be configured to connect an external source such as a station battery or an external power supply. In general, the input is not used but if you need to test the behavior (voltage) of the station battery under real load conditions this option is available.

Note: The coils or the motor can be configured to be supplied from **V IN** (external source). When activated, the respective output of *CIBANO 500* is supplied from the socket 1 of the **V IN** section via the internal command switch. This command switch can also disrupt the current in case of a short circuit. Input **N** of the **V IN** section is for voltage reference measurement only.

A-OUTPUT / INPUT (CAT III / 300 V)

For most tests, the group **A** is used for measuring timing of auxiliary contacts. The contacts can be “wet” or “dry”. While dry contacts are free of potential, wet contacts may have a voltage applied to them. The group **A** can also be used to record the supply voltage and current of three close coils or three motors simultaneously by configuring them.

Note: *CIBANO 500* has only three command switches. Consequently, three trip or three close coils can be operated simultaneously but not all six coils at the same time. To record currents for three trip coils and three close coils separately, connect three close coils to **A1** to **A3**, three trip coils to **B1** to **B3**, and then perform the Timing (CSM) test.

B-OUTPUT / INPUT (CAT III / 300 V)

The group **B** is generally used as follows. **B1** is used for the open command, **B2** is used for the close command, and **B3** is used for the continuous power supply (see 17.2.11 "Continuous power supply" on page 220). **B4** is used to supply the motor or to measure the motor current by using a current clamp.

Table 17-80: Hardware configuration options of the *CB MC2* module

CB MC2	Option
Module name ¹	Editable name of the <i>CB MC2</i> module
Phase ¹	Editable phase assignment of the <i>CB MC2</i> module
Channel	Channel of the <i>CB MC2</i> module
Active	Click a socket symbol to activate or deactivate both channels. ²
Combine	The Combine check box is selected by default and this option cannot be changed by the user. The measurement results are labeled with the name of channel 1, and the voltage is only measured on channel 1.
Ch.name ¹	Editable name of the <i>CB MC2</i> channel
Charge	Indicates the charge status of the <i>CB MC2</i> module.
LED	Click the LED symbol to identify the connected <i>CB MC2</i> module by flashing LED.

1. Permanently stored in the *CB MC2* memory. You can, for example, mark your *CB MC2* modules with the colored stickers and name them according to the colors. You can also rename the *CB MC2* modules depending on the connection point.
2. Only channel 1 is used for the timing measurements. Channel 2 is used for current output.

9. Connect *CIBANO 500* to the trip and close coils of the circuit breaker for all phases according to the wiring diagram displayed in *Primary Test Manager* and the following figure.

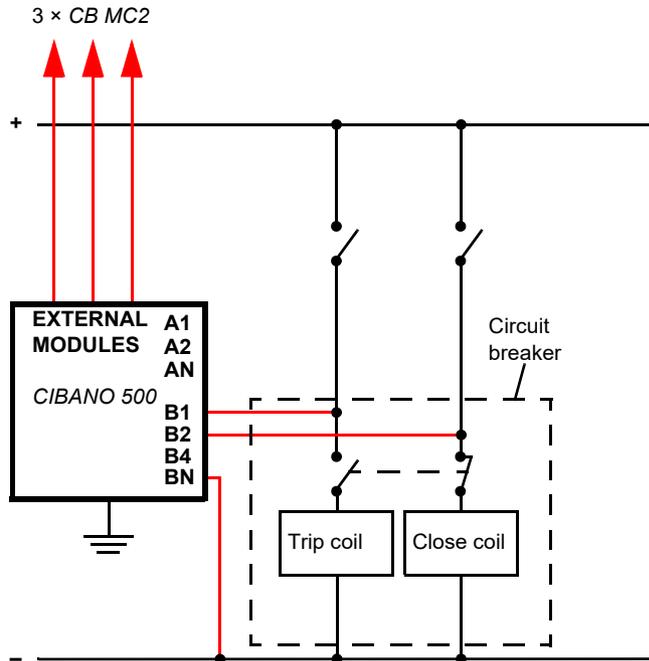


Figure 17-46: Typical measurement setup for the Timing (CSM) test

For the circuit breakers with one drive for all three phases connect the trip coil to **B1**, the close coil to **B2**, and the common connection of the trip and close coils (typically the battery minus) to **BN**.

⚠ WARNING

Death or severe injury caused by high voltage or current possible

- ▶ If you use the station battery to supply the motor or the coils via *CIBANO 500*, do not connect the cables to the station battery before they are connected to *CIBANO 500*.
- ▶ Always connect the cables first to grounded *CIBANO 500* and then to the station battery.

Measurement

To perform a measurement:

1. In the **Settings and conditions** area, enter the settings of the Timing (CSM) test.

Table 17-81: Settings of the Timing (CSM) test

Setting	Description
Coil supply	
Supply source	Click CIBANO 500 to supply the coils with <i>CIBANO 500</i> . Click External source to supply the coils with the source connected to V IN .
Supply settings ^{1,2}	Select a preconfigured coil supply setting from the asset data or select Custom to enter custom settings.
Coil supply voltage	Rated voltage of the coil supply Click AC or DC for AC or DC coil supply voltage respectively. Note: To perform the undervoltage trip and undervoltage close tests set the coil supply voltage lower than the nominal voltage.
Test frequency	Coil supply frequency (AC only)
Motor supply	
Supply source	Click CIBANO 500 to supply the motor with <i>CIBANO 500</i> . Click External source if the motor is supplied from the station supply or battery without any connection to <i>CIBANO 500</i> or if the station battery is connected to the V IN section and supplied, for example, via the B4 socket. Note: We do not recommend supplying the motor with undervoltage. Doing so does not provide any additional useful information and can cause degradation of the motor operation over time.
Supply settings ^{1,2}	Select the preconfigured motor supply setting from the asset data or select Custom to enter custom settings.
Motor supply voltage	Rated voltage of the motor supply Click AC or DC for AC or DC motor supply voltage respectively.
Test frequency	Motor supply frequency (AC only)
Max. supply duration	Maximum duration of supplying the motor if not stopped automatically
Main contact	

Table 17-81: Settings of the Timing (CSM) test (continued)

Setting	Description
Test current per channel	Output current of each <i>CB MC2</i> current channel ³
Sequence	
Test sequence	Test sequence to be performed
Trigger setting⁴	
Threshold	Threshold value of the trigger signal The measurement starts if the trigger signal rises above (rising edge) or falls below (falling edge) the threshold.
Edge type	Rising or falling edge

1. Only available in the guided test workflow and if *CIBANO 500* is selected as source
2. Data taken from the nameplate
3. We recommend using a test current of 100 A per *CB MC2* channel for the most accurate results.
4. Only available if **V IN**, or one output in group **A** or group **B** is set to Trigger IN.

2. Optionally, enter the advanced settings in the **Advanced settings** area.

Table 17-82: Advanced settings of the Timing (CSM) test

Setting	Description
Other	
Close breaker before test ¹	Select the Close breaker before test check box to automatically close the circuit breaker 1 second before starting a measurement.
Sample rate	Measurement sample rate ²
Contact bounce filter	
Auxiliary contact	Threshold value of the time interval between two consecutive bounces of the auxiliary contact. For time intervals equal or below the threshold, the contact is considered as closed. Setting the value to 0.0 ms deactivates the contact bounce filter.
Average coil current/voltage	
Begin	Start of the average coil current/voltage evaluation in percent of the time period during which the current flows through the coil
End	End of the average coil current/voltage evaluation in percent of the time period during which the current flows through the coil
Sequence	

See Table 17-83: "Timing (CSM) test sequences" on page 240.

1. The **Close breaker before test** check box is only active if the test sequence begins with the open command and no output is set to Trigger IN.
2. We recommend 40 kHz to get the most accurate test results.

The following table explains the sequences of the Timing (CSM) test.

Table 17-83: Timing (CSM) test sequences

Sequence	Action
O	With this sequence, the opening time of the circuit breaker is measured. Only for O and C sequences we recommend performing the test twice, once with nominal voltage and once with 20% undervoltage to assure the functionality of the circuit breaker for a weak station battery.
C	This is the sequence to measure the closing time of the circuit breaker.
OC	With this sequence, a closing operation after the circuit breaker has tripped to clear a fault is simulated. Initially, the circuit breaker must be in the closed position. An open command initiates the sequence, followed by a dead time to clear the fault; and finally a close command must close the circuit breaker. This sequence is also known as reclosing sequence. To find out the shortest reclosing time the circuit breaker can provide, the close command is already applied while the circuit breaker is still opening. The circuit breaker then will close after opening as fast as possible.
CO	With this sequence, a tripping operation after the circuit breaker has been closed under a fault condition (trip-free) or the verification of the correct operation of the anti-pumping system is simulated. To test the trip-free time the circuit breaker must be in the open position before the test is started. The circuit breaker is closed and then during the close operation is still in progress an open command is sent. The circuit breaker then opens as fast as possible. To test the anti-pumping function of the circuit breaker, the circuit breaker must be in closed position before the test is started. For this test the open time is set shorter (typically 200 ms) than the closing time (typically 400 ms). Ensure that the end time is increased so that the test sequence covers the whole close command duration (typically at least 190 ms). When the close command is sent the circuit breaker is already closed which initiates the anti-pumping function. Then an open command is sent and the circuit breaker trips. The closing command is still on when the open command ends, but the circuit breaker should not "pump", so that it should not close again.
O-CO	With this sequence, a reclose sequence (OC) under a fault condition is simulated. If the fault is not released, the circuit breaker must open (O) immediately and remain in this position. Initially, the circuit breaker must be in the closed position. The sequence begins with an open command, after a dead time the close and open commands (CO) must be applied at the same time (delay time typically 300 ms).

3. In the **Assessment** area, configure the assessment.
 - ▶ Click **Edit configuration** or click in one of the tables to open the **Assessment configuration** dialog box, and then edit the assessment limits.
 - ▶ Select the **Automatic assessment** check box to enable the automatic assessment.

Note: For the assessment limit definitions, see 15.3 "Assessment limits" on page 106.
4. By using the **Open breaker**, **Close breaker** and **Supply motor** buttons in the **Measurements** area of *Primary Test Manager* (see 11.1 "Test control commands" on page 85) you can check whether all cables are correctly connected and bring the circuit breaker to the proper state. For example, to test a C sequence, the circuit breaker must be open and the spring charged.



5. In the **Measurements** area, click **Start**.
The blue ring on the **Start/Stop** button is on.



WARNING
Death or severe injury caused by high voltage or current possible

- ▶ Do not enter the dangerous area while testing with *CIBANO 500* since any part of the circuit breaker can carry dangerous voltages.
- ▶ Stay in the work area during the test.



6. Start the measurement by pressing the **Start/Stop** button.
The blue ring on the **Start/Stop** button flashes for approx. 3 seconds, and the lightning symbol in *Primary Test Manager* and the red status light on the front panel are flashing.



7. After the measurement has finished, the lightning symbol in *Primary Test Manager* stops flashing, the green status light is on, and *Primary Test Manager* displays the measurement results.
The operating times depend on the sequence of the trip and close commands. The following table describes the operating times for all measurement sequences.

Table 17-84: Operating times¹

Data	Description
Opening time	Contact opening time of O, OC, O-CO and O-CO-CO operation
Opening sync.	Opening synchronization time of O, OC, O-CO and O-CO-CO operation
Closing time	Contact closing time of C, CO and O-CO operation
Closing sync.	Closing synchronization time of C, CO and O-CO operation
Reclosing time	Contact reclosing time of OC operation
Open-close time	Contact open-close time of O-CO, CO-CO, and O-CO-CO operation
Close-open time 1	Contact close-open time of CO and O-CO operation
Close-open time 2	Second contact close-open time of CO-CO and O-CO-CO operation
Assessment	Assessment of operating times

1. The operating times are calculated per contact, phase or circuit breaker.

Table 17-85: Auxiliary contact characteristics¹

Data	Description
Contact	Name of the auxiliary contact of the circuit breaker under test
Phase	Phase to which the auxiliary contact belongs
Type	Type of the auxiliary contact (a, b, wiper)
Switching time	Closing or opening time of the auxiliary contact depending on its type
Duration	Duration the wiper contact remains closed
Diff. to main	Time difference between the opening or closing of the auxiliary contact and the corresponding main contact
Assessment	Assessment of auxiliary contact characteristics

1. Only calculated for O and C sequences

Table 17-86: Coil characteristics

Data	Description
Peak current	Peak current value through a trip or close coil
Average current	Average current through the coil (see Average coil current/voltage settings in Table 17-82: "Advanced settings of the Timing (CSM) test" on page 239)
Average voltage	Average voltage applied to the coil (see Average coil current/voltage settings in Table 17-82: "Advanced settings of the Timing (CSM) test" on page 239)
Resistance	Calculated resistance of the coil
Assessment	Assessment of coil characteristics

Disconnection

Do not disconnect the circuit breaker but leave it connected for performing the next test. For disconnecting the circuit breaker, see "Disconnection" on page 252.

17.3.6 Minimum Pickup test

The Minimum Pickup test determines the minimum voltage required to trip or close the circuit breaker. By using the internal power source of *CIBANO 500*, the coil supply voltage is increased step by step through an automated test sequence until the circuit breaker operates.

Note: To perform the Minimum Pickup test, you need a license. Without the license, it is not possible to start the measurement and *Primary Test Manager* displays a missing license message. To get the license, contact your regional OMICRON service center.

Connection

WARNING

Death or severe injury caused by high voltage or current possible

- ▶ Do not connect anything to the circuit breaker under test without grounding the circuit breaker.
- ▶ Always ground the circuit breaker on both ends on all phases and close the circuit breaker to have proper grounding between the interrupters.

To connect the test object to *CIBANO 500*:

1. In *Primary Test Manager*, open the Minimum Pickup test.
2. In the **Hardware configuration** area, set the hardware configuration.
Often you can leave the cables as already connected in the previous test. Unused sockets can remain connected.

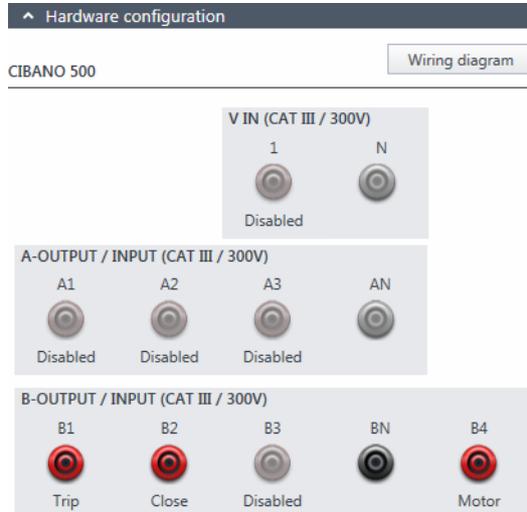


Figure 17-47: Hardware configuration of the Minimum Pickup test

Table 17-87: Hardware configuration options of *CIBANO 500*

CIBANO 500	Option
V IN (CAT III / 300 V)¹	
1	External source or Disabled
N	Neutral connection of V IN
A-OUTPUT / INPUT (CAT III / 300 V)	
A1	Motor A or Disabled
A2	Motor B or Disabled
A3	Motor C or Disabled
AN	Common neutral connection for outputs/inputs in group A
B-OUTPUT / INPUT (CAT III / 300 V)	
B1	Trip or Disabled
B2	Close or Disabled
B3	Supply or Disabled
BN	Common neutral connection for outputs/inputs in group B
B4	Motor or Disabled

1. Cannot be used to supply the trip or close coil because a variable voltage is needed, however it can be used to supply the motor.
3. Make sure that all cable connectors are clean and dry before being tightly connected.
4. Connect *CIBANO 500* to the trip and close coils of the circuit breaker according to the wiring diagram displayed in *Primary Test Manager*.

Measurement

To perform a measurement:

1. In the **Settings and conditions** area, enter the settings of the Minimum Pickup test.

Table 17-88: Settings of the Minimum Pickup test

Setting	Description
Coil supply	
Supply settings ^{1,2}	Select a preconfigured coil supply setting from the asset data or select Custom to enter custom settings.
Coil supply voltage	Rated voltage of the coil supply Click AC or DC for AC or DC coil supply voltage respectively.
Test frequency	Coil supply frequency (AC only)
Test sequence	

Table 17-88: Settings of the Minimum Pickup test (continued)

Setting	Description
Coil supply voltage start	Start voltage of the automated test sequence to determine the minimum pickup voltage
Coil supply voltage end	End voltage of the automated test sequence to determine the minimum pickup voltage
Coil supply voltage step	Stepwise voltage increase of the automated test sequence
Motor supply	
Supply source	Click CIBANO 500 to supply the motor with <i>CIBANO 500</i> . Click External source to supply the motor externally.
Supply settings ^{1,2,3}	Select the preconfigured motor supply setting from the asset data or select Custom to enter custom settings.
Motor supply voltage	Rated voltage of the motor supply Click AC or DC for AC or DC motor supply voltage respectively.
Test frequency	Motor supply frequency (AC only)
Max. supply duration	Maximum duration of supplying the motor if not stopped automatically

1. Only available in the guided test workflow
2. Data taken from the nameplate
3. Only available if *CIBANO 500* is selected as source

2. Optionally, enter the advanced settings in the **Advanced settings** area.

Table 17-89: Advanced settings of the Minimum Pickup test

Setting	Description
Supply during coil supply	
Enable	Select the Enable check box to supply voltage on the B3 socket during test execution. ¹
Supply voltage	Voltage supplied on the B3 socket (same as the coil supply voltage)
Supply before test	Time interval within which the voltage is supplied before the test starts
Test sequence	
Command impulse duration	Duration of the command pulse of the automated test sequence
Pause between impulses	Time interval between impulses of the automated test sequence

1. The **B3** socket must be configured as **Supply** and the coil supply voltage must be specified.

3. In the **Assessment** area, configure the assessment.
 - ▶ Click **Edit configuration** or click in the table to open the **Assessment configuration** dialog box, and then edit the assessment limits.
 - ▶ Select the **Automatic assessment** check box to enable the automatic assessment.

Note: For the assessment limit definitions, see 15.3 "Assessment limits" on page 106.
4. By using the **Open breaker**, **Close breaker** and **Supply motor** buttons in the **Measurements** area of *Primary Test Manager* (see 11.1 "Test control commands" on page 85) you can check whether all cables are correctly connected and bring the circuit breaker to the proper state. For testing the minimum pickup by the open sequence the circuit breaker must be closed and vice versa.
5. In the **Measurements** area, select the measurement you want to perform, and then click **Start**. The blue ring on the **Start/Stop** button is on.



WARNING

Death or severe injury caused by high voltage or current possible

- ▶ Do not enter the dangerous area while testing with *CIBANO 500* since any part of the circuit breaker can carry dangerous voltages.
- ▶ Stay in the work area during the test.



6. Start the measurement by pressing the **Start/Stop** button. The blue ring on the **Start/Stop** button flashes for approx. 3 seconds, and the lightning symbol in *Primary Test Manager* and the red status light on the front panel are flashing.

Note: You can abort the measurement anytime manually by pressing the **Emergency Stop** button or the **Start/Stop** button on the *CIBANO 500* front panel.

Note: If you connect, for example, three coils of three phases in parallel not all might operate at the same voltage. In this case the test will run until the last phase has operated and the highest voltage (worst case) will be shown.



7. After the measurement has finished, the lightning symbol in *Primary Test Manager* stops flashing, the green status light is on, and *Primary Test Manager* displays the measurement results.

Table 17-90: Minimum Pickup measurement data

Data	Description
No.	Number of the measurement
Operation	Trip or close
V pickup	Pickup voltage of the coil under test
Assessment	Measurement assessment

In case of three different trip coils, the trip coils can trip at different voltages. After the last pole has tripped the test will stop and show the worst case result.

Note: If there is an active discordance protection in place you must deactivate it for this test to avoid tripping of the other phases due to the discordance protection instead of the minimum pickup test.

Disconnection

Do not disconnect the circuit breaker but leave it connected for performing the next test. For disconnecting the circuit breaker, see "Disconnection" on page 252.

17.3.7 Motor Current test

The Motor Current test records the supply voltages and currents of the circuit breaker's charging motor(s).

Note: To perform the Motor Current test, you need a license. Without the license, it is not possible to start the measurement and *Primary Test Manager* displays a missing license message. To get the license, contact your regional OMICRON service center.

Connection

WARNING

Death or severe injury caused by high voltage or current possible

- ▶ Do not connect anything to the circuit breaker under test without grounding the circuit breaker.
- ▶ Always ground the circuit breaker on both ends on all phases and close the circuit breaker to have proper grounding between the interrupters.

To connect the test object to *CIBANO 500*:

1. In *Primary Test Manager*, open the Motor Current test.
2. In the **Hardware configuration** area, set the hardware configuration.
3. After setting the hardware configuration, connect the **B4** socket on the side panel of *CIBANO 500* to "+" or phase contact of the motor and the **BN** socket to "-" or neutral contact of the motor.

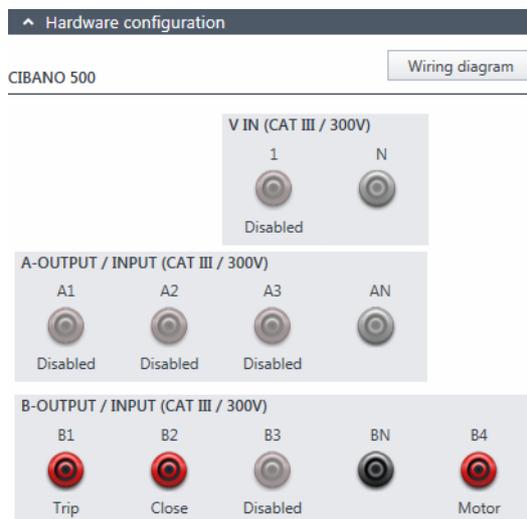


Figure 17-48: Hardware configuration of the Motor Current test

Note: You can control three circuit breaker's motors simultaneously. In this case connect the phase contact of the motor 1 to the **A1** socket, the phase contact of the motor 2 to the **A2** socket, the phase contact of the motor 3 to the **A3** socket, and the neutral motor contacts to the **AN** socket.

Table 17-91: Hardware configuration options of CIBANO 500

CIBANO 500	Option
V IN (CAT III / 300 V)	
1	External source or Disabled
N	Neutral connection of V IN
A-OUTPUT / INPUT (CAT III / 300 V)	
A1	Motor A or Disabled
A2	Motor B or Disabled
A3	Motor C or Disabled
AN	Common neutral connection for outputs/inputs in group A
B-OUTPUT / INPUT (CAT III / 300 V)	
B1	Trip or Disabled
B2	Close or Disabled
B3	Supply or Disabled
BN	Neutral connection of outputs in group B
B4	Motor or Disabled

4. Make sure that all cable connectors are clean and dry before being tightly connected.
5. Connect CIBANO 500 to the motor of the circuit breaker according to the wiring diagram displayed in *Primary Test Manager* and the following figure.

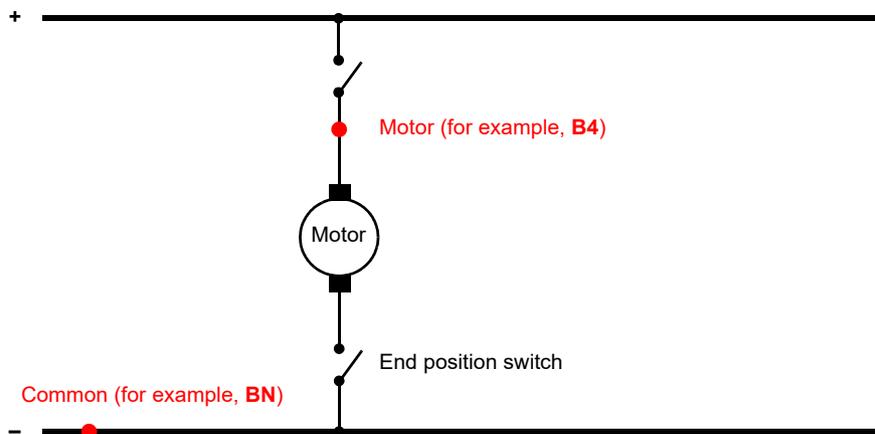


Figure 17-49: Connecting CIBANO 500 to the circuit breaker for the Motor Current test (The end position switch opens when the spring is charged.)

Measurement

To perform a measurement:

1. In the **Settings and conditions** area, enter the settings of the Motor Current test.

Table 17-92: Settings of the Motor Current test

Setting	Description
Motor supply	
Supply source	Click CIBANO 500 to supply the motor with <i>CIBANO 500</i> . Click External source to supply the motor externally.
Supply settings ^{1,2}	Select the preconfigured motor supply setting from the asset data or select Custom to enter custom settings.
Motor supply voltage	Rated voltage of the motor supply Click AC or DC for AC or DC motor supply voltage respectively.
Test frequency	Motor supply frequency (AC only)
Max. supply duration	Maximum duration of supplying the motor if not stopped automatically
Coil supply	
Supply source	Click CIBANO 500 to supply the coils with <i>CIBANO 500</i> . Click External source to supply the coils externally.
Supply settings ^{1,2}	Select a preconfigured coil supply setting from the asset data or select Custom to enter custom settings.
Coil supply voltage	Rated voltage of the coil supply Click AC or DC for AC or DC coil supply voltage respectively.
Test frequency	Coil supply frequency (AC only)

1. Only available in the guided test workflow and if *CIBANO 500* is selected as source
2. Data taken from the nameplate

2. Optionally, enter the advanced settings in the **Advanced settings** area.

Table 17-93: Advanced settings of the Motor Current test

Setting	Description
Other	
Sample rate	Measurement sample rate
Charging current	
Begin	Start of the charging current evaluation in percent of the total charging duration of the motor
End	End of the charging current evaluation in percent of the total charging duration of the motor

3. In the **Assessment** area, configure the assessment.
 - ▶ Click **Edit configuration** or click in one of the tables to open the **Assessment configuration** dialog box, and then edit the assessment limits.
 - ▶ Select the **Automatic assessment** check box to enable the automatic assessment.

Note: For the assessment limit definitions, see 15.3 "Assessment limits" on page 106.



4. In the **Measurements** area, click **Start**.
The blue ring on the **Start/Stop** button is on.

WARNING

Death or severe injury caused by high voltage or current possible

- ▶ Do not enter the dangerous area while testing with *CIBANO 500* since any part of the circuit breaker can carry dangerous voltages.
- ▶ Stay in the work area during the test.



5. Start the measurement by pressing the **Start/Stop** button.
The blue ring on the **Start/Stop** button flashes for approx. 3 seconds, and the lightning symbol in *Primary Test Manager* and the red status light on the front panel are flashing.

Note: In emergency cases, you can abort the measurement anytime manually by pressing the **Emergency Stop** button on the *CIBANO 500* front panel.



6. After the charging process has finished, *CIBANO 500* stops the measurement automatically.
The lightning symbol in *Primary Test Manager* stops flashing, the green status light is on, and *Primary Test Manager* displays the measurement results.

The following figure shows an example of the Motor Current test graphical results.

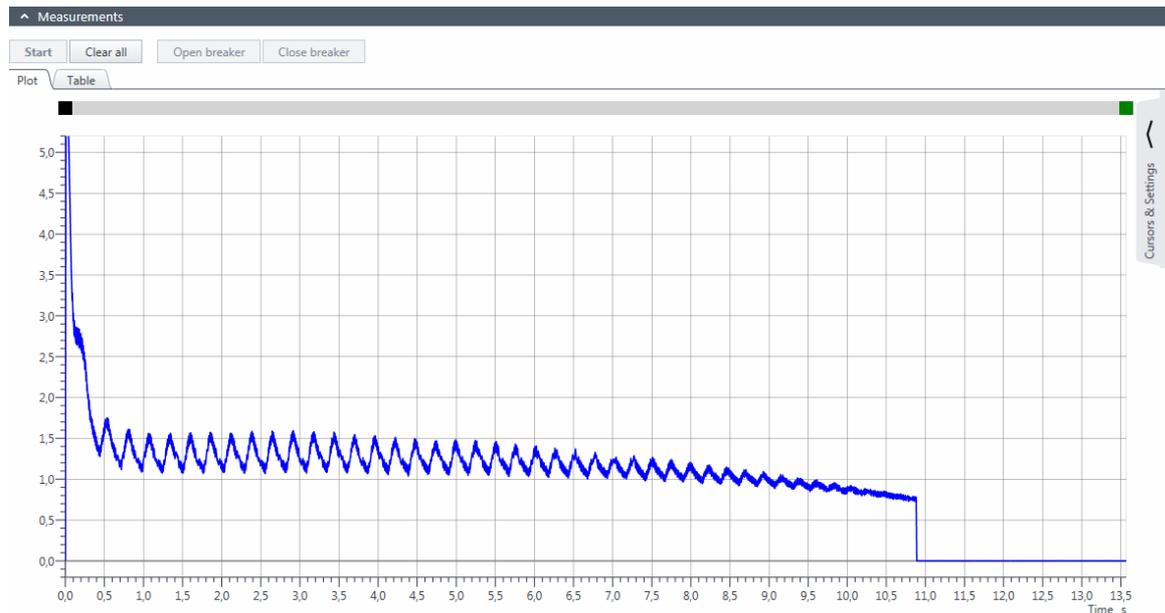


Figure 17-50: Example of the Motor Current test graphical results

To display the numerical measurement results, click the **Table** tab in the **Measurements** area.

Table 17-94: Motor characteristics

Data	Description
Inrush current	Maximum current drawn by the motor On a DC motor, the inrush current is usually reached during the startup phase.
Charging time	Time the motor needs to charge the spring The spring is used to store the energy for a trip or close operation.
Charging current	Average charging current of the motor (see Charging current settings in Table 17-93: "Advanced settings of the Motor Current test" on page 249)
Minimum voltage	Minimum motor supply voltage during the charging operation of the motor
Assessment	Measurement assessment

Disconnection

Note: Do not disconnect the test object from *CIBANO 500* if you intend to make further measurements.

To disconnect the test object from *CIBANO 500*:



1. Press the **Emergency Stop** button on the *CIBANO 500* front panel.
2. Wait until the green status light on the *CIBANO 500* front panel is on and the voltage/current indicator on the *CIBANO 500* side panel is off.
3. Remove the barrier between the dangerous and the work area.

WARNING

Death or severe injury caused by high voltage or current possible

- ▶ Do not touch any part of the circuit breaker before grounding and short-circuiting its terminals.
- ▶ Always ground and short-circuit the circuit breaker's terminals by using a grounding set.

4. Disconnect the cables from the station battery, if connected.
5. Disconnect the cables from the circuit breaker's motor, if connected.
6. Disconnect the cables from the circuit breaker's trip and close coils.
7. Disconnect one *CB MC2* module from *CIBANO 500*.

WARNING

Death or severe injury caused by high voltage or current possible

- ▶ Do not proceed without grounding the test object's terminals.
- ▶ Ground the test object's terminals by using a grounding set.

8. Disconnect the *CB MC2* from the main contact of the circuit breaker.
9. Unhook the *CB MC2* from one phase of the circuit breaker.
10. Repeat steps 7 to 9 for all phases tested.
11. Switch off *CIBANO 500* by pressing the mains power on/off switch on the *CIBANO 500* side panel.
12. Disconnect the mains power cord.
13. Remove the equipotential ground as the last connection that is removed first on the substation side and then from *CIBANO 500*.

WARNING

Death or severe injury caused by high voltage or current possible

- ▶ Do not leave the circuit breaker's spring(s) charged after disconnecting *CIBANO 500* from the circuit breaker.
- ▶ Always operate the circuit breaker manually by using the circuit breaker's operation buttons until the spring(s) are discharged.

17.4 Demagnetization

On circuit breakers like gas insulated switchgears (GIS), dead tank circuit breakers and hybrid circuit breakers, current transformers are typically integrated in the main contact path. After each performed test on the circuit breaker or due to DC components during a short circuit the current transformers might be magnetized. This magnetism can be caused by DC currents flowing through the primary side of the current transformer. The Demagnetization feature is designed to demagnetize the current transformers from the primary side. Consequently, you do not need to disconnect the current transformers from the secondary side.

The Demagnetization function as featured by *CIBANO 500*, needs to apply at least 30 A through the primary side of the current transformer. If this cannot be assured, use the *OMICRON CTAnalyzer* instead and demagnetize the current transformers from their secondary side.

Note: To check the maximum continuous output current of your *CIBANO 500* test system, contact OMICRON technical support (see "Support" on page 353).

Connection



WARNING

Death or severe injury caused by high voltage or current possible

- ▶ Do not use external power sources for the circuit breaker's main contacts.
- ▶ During the test, supply the circuit breaker's main contacts only with *CIBANO 500*.

To connect the test object to *CIBANO 500*:

1. In *Primary Test Manager*, open the Demagnetization.

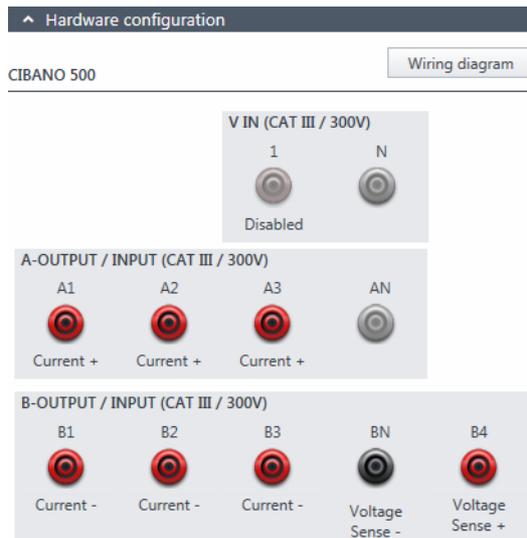


Figure 17-51: Hardware configuration of the Demagnetization

Table 17-95: Hardware configuration options of *CIBANO 500*

CIBANO 500	Option
A-OUTPUT / INPUT (CAT III / 300 V)	
A1	Current +
A2	Current +
A3	Current +
AN	Not connected in this test
B-OUTPUT / INPUT (CAT III / 300 V)	
B1	Current –
B2	Current –
B3	Current –
BN	Voltage Sense –
B4	Voltage Sense +

2. Make sure that all cable connectors are clean and dry before being tightly connected.

3. Connect *CIBANO 500* to the main contact of the circuit breaker according to the wiring diagram displayed in *Primary Test Manager*.

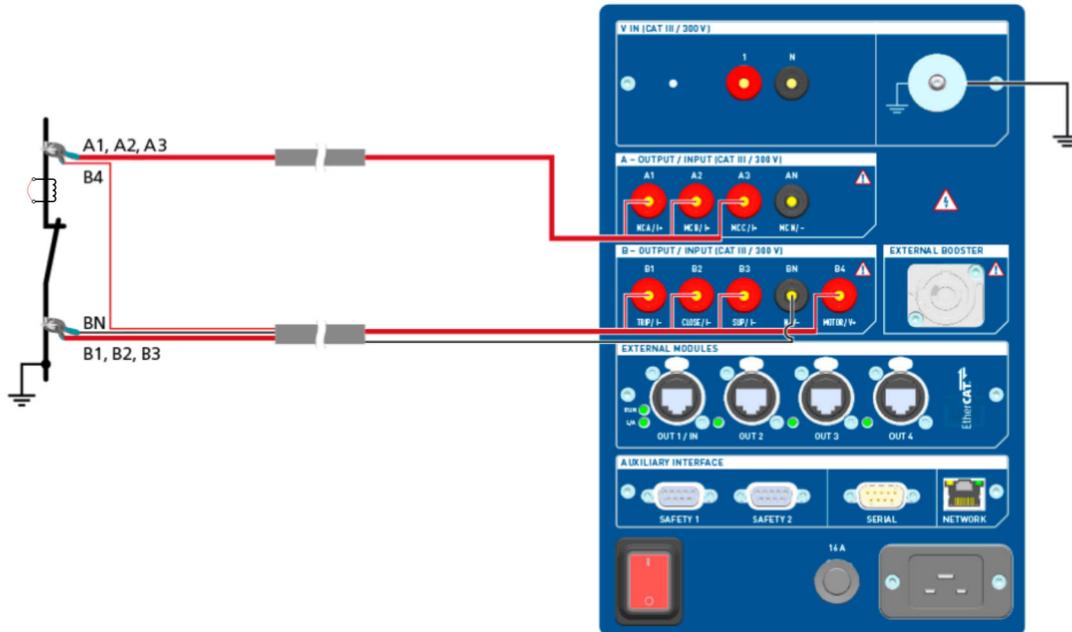


Figure 17-52: Default wiring diagram of the Demagnetization

Tips & Tricks: For easy connection use the delivered multi-core cables and connect the end with the short wires to the *CIBANO 500* sockets according to the short-wire labels. Connect the cable end with the long wires according to the wiring diagram to the corresponding Kelvin clamp. The black **AN** cable is not needed for this test and remains unconnected.

Tips & Tricks: The delivered Kelvin clamp is the perfect solution for connecting to a massive conductor like a copper busbar or similar. We recommend using only the red connectors of the Kelvin clamps (which is the current path) when connecting to the contact fingers of a circuit breaker. Use a separate clamp for the voltage sense cables (**BN** and **B4**) which can be mounted closer to the circuit breaker contact. If the connection is set up properly the resistance decreases when the voltage sense clamps are connected closer to the circuit breaker contact. The polarity of connection does not matter for this test.

Procedure

To demagnetize the circuit breaker’s current transformers:

1. In the **Settings and conditions** area, enter the settings of the Demagnetization.

Table 17-96: Demagnetization settings

Setting	Description
CT settings	
Number of CT cores (per phase)	Number of cores of the circuit breaker’s current transformers If the number of current transformers cores is not known, select the Unknown check box.
Other	
Single side grounded Both side grounded	Select the Single side grounded or Both side grounded option.



2. In the **Measurements** area, click **Start**.
The blue ring on the **Start/Stop** button is on.



WARNING

Death or severe injury caused by high voltage or current possible

- ▶ Do not enter the high-voltage test area while testing with *CIBANO 500* since any part of the circuit breaker can carry dangerous voltages.
- ▶ Stay in the work area during the test.



3. Start the demagnetization by pressing the **Start/Stop** button.
The blue ring on the **Start/Stop** button flashes for approx. 3 seconds, and the lightning symbol in *Primary Test Manager* and the red status light on the front panel are flashing.



4. After the initialization and analysis have finished, press the **Start/Stop** button again.
The blue ring on the **Start/Stop** button flashes for approx. 3 seconds, and the lightning symbol in *Primary Test Manager* and the red status light on the front panel are flashing.

5. *Primary Test Manager* displays the demagnetization progress.

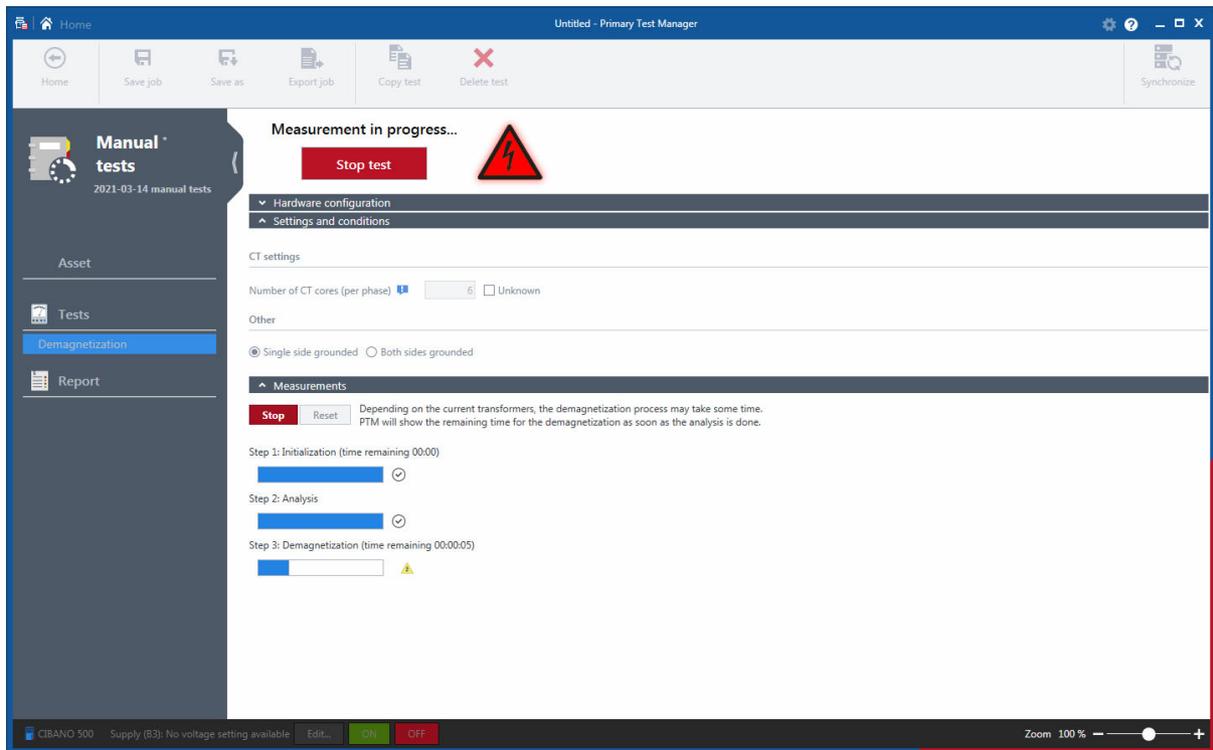


Figure 17-53: Demagnetization progress



6. After the demagnetization has finished, the lightning symbol in *Primary Test Manager* stops flashing and the green status light is on.

Disconnection

Note: Do not disconnect the test object from *CIBANO 500* if you intend to make further measurements.

To disconnect the test object from *CIBANO 500*:



1. Press the **Emergency Stop** button on the *CIBANO 500* front panel.
2. Wait until the green status light on the *CIBANO 500* front panel is on and the voltage/current indicator on the *CIBANO 500* side panel is off.
3. Remove the barrier between the dangerous and the work area.

WARNING

Death or severe injury caused by high voltage or current possible

- ▶ Do not touch any part of the circuit breaker before grounding and short-circuiting its terminals.
- ▶ Always ground and short-circuit the circuit breaker's terminals by using a grounding set.

4. Disconnect the cables from the station battery, if connected.
5. Disconnect the cables from the circuit breaker's motor, if connected.
6. Disconnect the cables from the circuit breaker's trip and close coils.
7. Disconnect one *CB MC2* module from *CIBANO 500*.

WARNING

Death or severe injury caused by high voltage or current possible

- ▶ Do not proceed without grounding the test object's terminals.
- ▶ Ground the test object's terminals by using a grounding set.

8. Disconnect the *CB MC2* from the main contact of the circuit breaker.
9. Unhook the *CB MC2* from one phase of the circuit breaker.
10. Repeat steps 7 to 9 for all phases tested.
11. Switch off *CIBANO 500* by pressing the mains power on/off switch on the *CIBANO 500* side panel.
12. Disconnect the mains power cord.
13. Remove the equipotential ground as the last connection that is removed first on the substation side and then from *CIBANO 500*.

WARNING

Death or severe injury caused by high voltage or current possible

- ▶ Do not leave the circuit breaker's spring(s) charged after disconnecting *CIBANO 500* from the circuit breaker.
- ▶ Always operate the circuit breaker manually by using the circuit breaker's operation buttons until the spring(s) are discharged.

17.5 Testing circuit breakers with *CIBANO 500* and the *CB TN3* modules

Within the scope of the Timing and Dynamic Contact Resistance tests, you can also measure the displacement of the circuit breaker's main contacts during operation by using the *CB TN3* modules. The following procedures apply to *CIBANO 500* with both the EtherCAT® and the Auxiliary module.

With *Primary Test Manager*, you can select how the opening time and the closing time of the circuit breaker are calculated. By default, the contact timing is calculated according to IEC 62271-100 standard. For tests in the executed state, *Primary Test Manager* provides an optional time calculation with the zero point set to the beginning of the contact movement. You can use the calculation based on the contact movement start, for example, if the trip or close coil is not available. If you select this option, a notification bar at the top of the *Primary Test Manager* workspace will inform you that the calculation is not compliant with the IEC 62271-100 standard. You can recalculate the contact timing anytime after the test has been executed. The selected calculation method is specified in the Time calculation section of the test report.

17.5.1 Timing test

Connection

WARNING

Death or severe injury caused by high voltage or current possible

- ▶ Do not connect anything to the circuit breaker under test without grounding the circuit breaker.
- ▶ Always ground the circuit breaker on both ends on all phases and close the circuit breaker to have proper grounding between the interrupters.

To connect the test object to *CIBANO 500*:

WARNING

Death or severe injury caused by high voltage or current possible

- ▶ Do not connect the EtherCAT® cables to the *CB MC2* module before they are connected to *CIBANO 500*.
- ▶ Connect the EtherCAT® cables first to *CIBANO 500* and then to the *CB MC2* module.

1. Make sure that all cable connectors are clean and dry before being tightly connected.
2. Connect the *CB TN3* to *CIBANO 500* with the EtherCAT® cable.
3. Hang up the *CB TN3* close to the circuit breaker's mechanical moving part.
4. Connect the transducer to the *CB TN3* with the delivered cable.
5. Attach the transducer to the circuit breaker. For detailed information, see 19 "Transducers" on page 302.
6. Repeat steps 2 to 5 for all *CB TN3* modules you want to connect.
7. In *Primary Test Manager*, open the Timing test.

8. In the **Hardware configuration** area, set the hardware configuration and check whether *Primary Test Manager* recognized all connected *CB TN3* modules.
 The following figure shows the hardware configuration of *CIBANO 500* with the Auxiliary module and one *CB TN3* module connected.

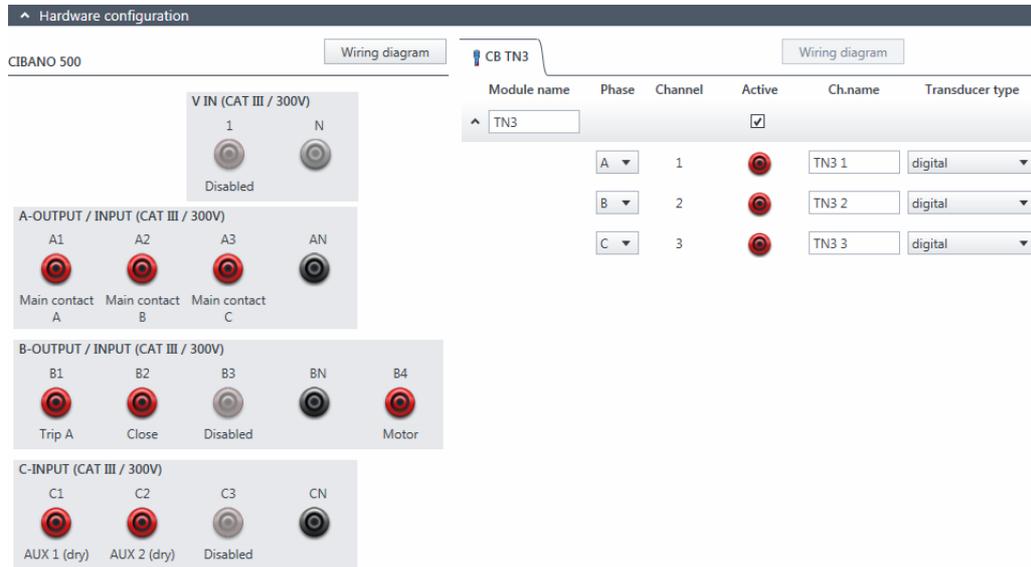


Figure 17-54: Example of the hardware configuration of the Timing test for measuring the main contact travel during operation

Table 17-97: Hardware configuration options of *CIBANO 500*

CIBANO 500	Option
V IN (CAT III / 300 V)	
1	External source, Trigger IN ¹ or Disabled
N	Neutral connection of V IN
A-OUTPUT / INPUT (CAT III / 300 V)	
A1	Main contact A, Close A, Motor A, Trigger IN ¹ or Disabled
A2	Main contact B, Close B, Motor B, Trigger IN ¹ or Disabled
A3	Main contact C, Close C, Motor C, Trigger IN ¹ or Disabled
AN	Common neutral connection for outputs/inputs in group A
B-OUTPUT / INPUT (CAT III / 300 V)	
B1	Trip A, Trigger IN ¹ , I clamp 1 or Disabled
B2	Trip B, Close, Trigger IN ¹ , I clamp 2 or Disabled
B3	Trip C, Supply, Trigger IN ¹ , I clamp 3, or Disabled

Table 17-97: Hardware configuration options of *CIBANO 500* (continued)

CIBANO 500		Option	
BN	Neutral connection of outputs in group B		
B4	Trigger IN ¹ , I clamp 4, Motor or Disabled		
C-INPUT (CAT III / 300 V)			
C1	AUX 1	Dry contact (potential-free)	Trigger IN ¹ or Disabled
		Wet contact (with potential)	
C2	AUX 2	Dry contact (potential-free)	Trigger IN ¹ or Disabled
		Wet contact (with potential)	
C3	AUX 3	Dry contact (potential-free)	Trigger IN ¹ or Disabled
		Wet contact (with potential)	
CN	Neutral connection of inputs in group C		

1. Trigger signal starting the measurement

Table 17-98: Hardware configuration options of the *CB TN3* module

CB TN3	Option
Module name ¹	Editable name of the <i>CB TN3</i> module
Phase	Phase to which the <i>CB TN3</i> module is connected
Channel ¹	Editable name of the <i>CB TN3</i> channel. Click the socket symbol to activate or deactivate the channel depending on the connections made.
Active	Click the socket symbol to activate or deactivate the channel.
Ch.name ¹	Editable name of the <i>CB TN3</i> channel
Transducer type	Type of the connected transducer: digital or analog

1. Permanently stored in the *CB TN3* memory. You can, for example, rename the *CB TN3* modules depending on the connection point.

Measurement

To perform a measurement:

1. In the **Settings and conditions** area, enter the settings of the Timing test.

Table 17-99: Settings of the Timing test

Setting	Description
Coil supply	
Supply source	Select one of the following supply-source options: <ul style="list-style-type: none"> • CIBANO 500 to supply the coils with <i>CIBANO 500</i>. • External source to supply the coils with the source connected to V IN. • Control board to supply the coils with a control-board switch.¹
Supply settings ^{2,3}	Select a preconfigured coil supply setting from the asset data or select Custom to enter custom settings.
Coil supply voltage	Rated voltage of the coil supply Click AC or DC for AC or DC coil supply voltage respectively.
Test frequency	Coil supply frequency (AC only)
Trip signal ⁴	Select whether the rising or falling edge of the trip signal opens the circuit breaker.
Close signal ⁴	Select whether the rising or falling edge of the close signal closes the circuit breaker.
Motor supply	
Supply source	Click CIBANO 500 to supply the motor with <i>CIBANO 500</i> . Click External source if the motor is supplied from the station supply or battery without any connection to <i>CIBANO 500</i> or if the station battery is connected to the V IN section and supplied, for example, via the B4 socket.
Supply settings ^{2,3}	Select the preconfigured motor supply setting from the asset data or select Custom to enter custom settings.
Motor supply voltage	Rated voltage of the motor supply Click AC or DC for AC or DC motor supply voltage respectively.
Test frequency	Motor supply frequency (AC only)
Max. supply duration	Maximum duration of supplying the motor if not stopped automatically
Main contact	
Contact system	Contact system of the circuit breaker under test Select PIR to measure timing of contacts with pre-insertion resistors.
Other	
Grounding	Select the grounding condition of the circuit breaker under test.
Sequence	

Table 17-99: Settings of the Timing test (continued)

Setting	Description
Test sequence	Test sequence to be performed
Trigger setting⁵	
Threshold	Threshold value of the trigger signal The measurement starts if the trigger signal rises above (rising edge) or falls below (falling edge) the threshold.
Edge type	Rising or falling edge

1. Only available if the trip and/or close signals are configured on the *IOB1* module.
2. Only available in the guided test workflow and if *CIBANO 500* is selected as source
3. Data taken from the nameplate
4. Only available if **Control board** is selected as supply source.
5. Only available if **V IN**, or one output in group **A**, group **B** or group **C** is set to Trigger IN.

2. In the **Advanced settings** area, enter the transducer settings, and optionally the advanced settings.

Table 17-100: Transducer settings

Setting	Description
Digital transducer settings	
Module	Name of the <i>CB TN3</i> module set in the hardware configuration
Channel	Channel name set in the <i>CB TN3</i> hardware configuration
Type	Transducer type: linear or angular
Supply	Transducer supply voltage
Resolution	Transducer travel per one pulse
Conversion data	Data for converting the transducer movement to main contact movement depending on the transducer type Linear transducer: Type the contact factor. Angular transducer: Type the contact factor or select a conversion table from the list, if available (see "Conversion tables" on page 102). ^{1,2}

Table 17-100: Transducer settings (continued)

Setting	Description
Analog transducer settings	
Module	Name of the <i>CB TN3</i> module set in the hardware configuration
Channel	Channel name set in the <i>CB TN3</i> hardware configuration
Type ³	Transducer type: linear or angular
Supply	Transducer supply voltage
Resolution ³	Transducer travel per 1 V
Conversion data	Data for converting the transducer movement to main contact movement depending on the transducer type Linear transducer: Type the contact factor. Angular transducer: Type the contact factor or select a conversion table from the list, if available (see "Conversion tables" on page 102). ^{1,2}
Calibrate	Click Calibrate to calculate the transducer resolution (see "Calibration" on page 269).

1. The selected conversion table remains associated with the test even after it has been deleted from the asset.
2. When performing a manual test, you can load a conversion table by clicking the **Browse** button ... in the Conversion data column.
3. For information about the pressure measurement, see "Measuring pressure signals" on page 270.

Table 17-101: Advanced settings of the Timing test

Setting	Description
Main contact	
Sine wave filter	Select the Sine wave filter check box to suppress sinusoidal interference.
Start evaluation at	Start time of the sine wave evaluation. Select the time at which the sinusoidal interference is clearly present in the measurement signal.
Sine frequency	Frequency of the sinusoidal interference
Other	
Close breaker before test ¹	Select the Close breaker before test check box to automatically close the circuit breaker 1 second before starting a measurement.
Sample rate	Measurement sample rate
Contact bounce filter	
Main contact	Threshold value of the time interval between two consecutive bounces of the main contact. For time intervals equal or below the threshold, the contact is considered as closed. Setting the value to 0.0 ms deactivates the contact bounce filter.

Table 17-101: Advanced settings of the Timing test (continued)

Setting	Description
Auxiliary contact	Threshold value of the time interval between two consecutive bounces of the auxiliary contact. For time intervals equal or below the threshold, the contact is considered as closed. Setting the value to 0.0 ms deactivates the contact bounce filter.
Average coil current/voltage	
Begin	Start of the average coil current/voltage evaluation in percent of the time period during which the current flows through the coil
End	End of the average coil current/voltage evaluation in percent of the time period during which the current flows through the coil
Begin of contact movement²	
Trip operation/ Close operation	Deviation of the contact travel from the rest position in percent of the total travel. With the Trip operation and Close operation settings, you can define the start of the contact movement.
Time calculation based on contact movement start	Select None to calculate the contact timing according to IEC 62271-100 standard. Select the channel name of the <i>CB TN3</i> module to be used for calculating the contact timing based on the contact movement start. ³
Begin of contact damping⁴	
Contact travel deviation	Deviation of the actual contact travel from the distance the contact would travel with its maximum velocity in percent of the total travel
Start evaluation at	Start contact travel for the evaluation of the contact travel deviation
End evaluation at	End contact travel for the evaluation of the contact travel deviation
Sequence	

See Table 17-102: "Timing test sequences" later in this section.

1. The **Close breaker before test** check box is only active if the test sequence begins with the open command and no output is set to Trigger IN.
2. Only available for O and C sequences
3. Only available for tests in the executed state
4. Only available for O sequence

The following table explains the sequences of the Timing test.

Table 17-102: Timing test sequences

Sequence	Action
O	With this sequence, the opening time of the circuit breaker is measured. Only for O and C sequences we recommend performing the test twice, once with nominal voltage and once with 20% undervoltage to assure the functionality of the circuit breaker for a weak station battery.
C	This is the sequence to measure the closing time of the circuit breaker.
OC	With this sequence, a closing operation after the circuit breaker has tripped to clear a fault is simulated. Initially, the circuit breaker must be in the closed position. An open command initiates the sequence, followed by a dead time to clear the fault; and finally a close command must close the circuit breaker. This sequence is also known as reclosing sequence. To find out the shortest reclosing time the circuit breaker can provide, the close command is already applied while the circuit breaker is still opening. The circuit breaker then will close after opening as fast as possible.
CO	With this sequence, a tripping operation after the circuit breaker has been closed under a fault condition (trip-free) or the verification of the correct operation of the anti-pumping system is simulated. To test the trip-free time the circuit breaker must be in the open position before the test is started. The circuit breaker is closed and then during the close operation is still in progress an open command is sent. The circuit breaker then opens as fast as possible. To test the anti-pumping function of the circuit breaker, the circuit breaker must be in closed position before the test is started. For this test the open time is set shorter (typically 200 ms) than the closing time (typically 400 ms). Ensure that the end time is increased so that the test sequence covers the whole close command duration (typically at least 190 ms). When the close command is sent the circuit breaker is already closed which initiates the anti-pumping function. Then an open command is sent and the circuit breaker trips. The closing command is still on when the open command ends, but the circuit breaker should not "pump", so that it should not close again.
O-CO	With this sequence, a reclose sequence (OC) under a fault condition is simulated. If the fault is not released, the circuit breaker must open (O) immediately and remain in this position. Initially, the circuit breaker must be in the closed position. The sequence begins with an open command, after a dead time the close and open commands (CO) must be applied at the same time (delay time typically 300 ms).

3. In the **Assessment** area, configure the assessment.
 - ▶ Click **Edit configuration** or click in one of the tables to open the **Assessment configuration** dialog box, and then edit the assessment limits.
 - ▶ Select the **Automatic assessment** check box to enable the automatic assessment.

Note: For the assessment limit definitions, see 15.3 "Assessment limits" on page 106.



4. In the **Measurements** area, click **Start**.
The blue ring on the **Start/Stop** button is on.

WARNING

Death or severe injury caused by high voltage or current possible

- ▶ Do not enter the high-voltage test area while testing with *CIBANO 500* since any part of the circuit breaker can carry dangerous voltages.
- ▶ Stay in the work area during the test.



5. Start the measurement by pressing the **Start/Stop** button.
The blue ring on the **Start/Stop** button flashes for approx. 3 seconds, and the lightning symbol in *Primary Test Manager* and the red status light on the front panel are flashing.
6. After the measurement has finished, the lightning symbol in *Primary Test Manager* stops flashing, the green status light is on, and *Primary Test Manager* displays the measurement results.

When testing with the *CB TN3* modules, *Primary Test Manager* calculates and displays also the velocity of the contact travel. You can set the display options for the velocity data on the **Settings** tab in the **Cursors & settings** workspace.

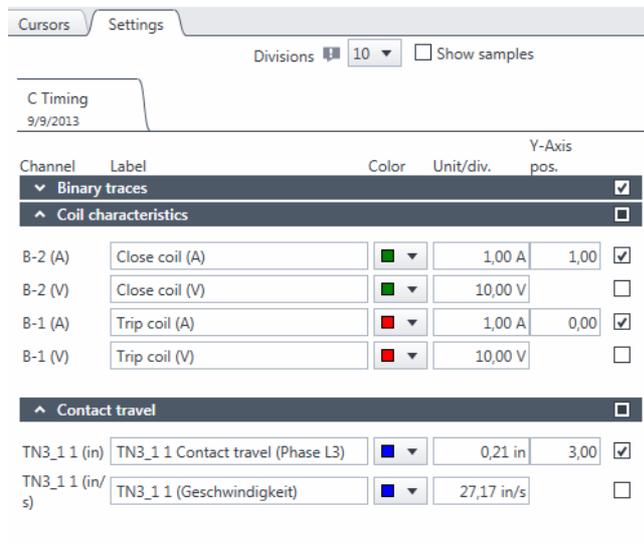


Figure 17-55: Setting the velocity display options

To view the numeric measurement data, click the **Table** tab. For the operating times, auxiliary contact characteristics and coil characteristics, see Table 17-54: "Operating times" on page 194, Table 17-55: "Auxiliary contact characteristics" on page 194 and Table 17-57: "Coil characteristics" on page 195.

The following figure explains the contact travel characteristics defined in Table 17-103: "Contact travel characteristics" later in this section.

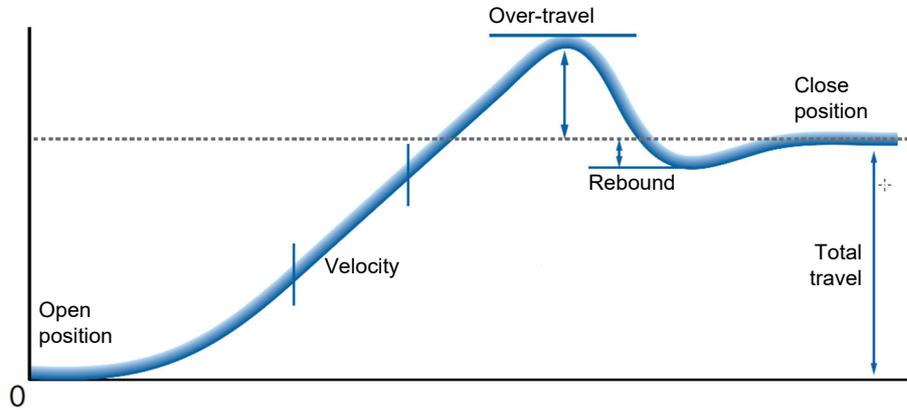


Figure 17-56: Contact travel characteristics

Table 17-103: Contact travel characteristics¹

Data	Description
Module	Name of the <i>CB TN3</i> module set in the hardware configuration
Channel	Channel of the <i>CB TN3</i> module
Total travel	Total distance traveled by the contact during operation (excluding possible over-travel). The row labeled with the <i>CB TN3</i> channel displays the maximum of all measurement results for this channel.
Over-travel	Contact travel distance between the maximum contact travel and the final contact resting position
Rebound	Contact travel distance between the minimum contact travel after returning from an over-travel and the final contact resting position
Assessment	Measurement assessment
Velocity zone definition	Time period within which the contact travel velocity is evaluated (see 15.4 "Velocity zones" on page 112)
v meas	Measured velocity of the contact travel within the velocity zone
Information	Information about the measurement
Damping distance ²	Distance the contact travels while damping is effective (see Begin of contact damping settings in Table 17-16: "Advanced settings of the Timing test" on page 140)
Assessment	Measurement assessment

1. Only available for O and C sequences
 2. Only available for O sequence

Table 17-104: Main contact characteristics¹

Data	Description
Main contact	Main contact this measurement row refers to
Travel data	CB TN3 channel this measurement row refers to
Contact wipe	C sequence: Distance the contact travels between the first contact touch and the contact steady state O sequence: Distance the contact travels between the contact steady state and the final contact separation
Reaction time	Time interval after which the contact responds to the open or close signal (see Begin of contact movement settings in Table 17-16: "Advanced settings of the Timing test" on page 140)
Bounce time ²	Duration of the main contact bounce
Bounce count ²	Number of main contact bounces within the bounce time
PIR closing time	Closing time for pre-insertion resistors
Assessment	Measurement assessment

1. Only available for O and C sequences
2. Not available for **PIR** contact system

Calibration

With *Primary Test Manager*, you can calibrate analog transducers when using them. To calibrate an analog transducer:

1. In the **Hardware configuration** area, select the analog transducer type.
2. In the **Settings and conditions** area, click **Calibrate**.
3. In the **Transducer Calibration** dialog box, enter the maximum stroke of the transducer, and then click **Start**.
4. Press the **Start/Stop** button on the *CIBANO 500* front panel.
5. During the calibration time (10 seconds), move the transducer manually from the minimum to maximum position.
6. After the calibration process has finished, the calculated transducer resolution appears in the **Settings and conditions** area.

Measuring pressure signals

With the *CB TN3* modules and analog transducers, you can measure and display pressure signals. To measure pressure signals:

1. Connect at least one *CB TN3* module to *CIBANO 500*.
2. Connect the analog pressure sensors to the analog interface of the *CB TN3* module (see 22.2.1 "Designated use" on page 337).
3. In the **Hardware configuration** area, set the hardware configuration of *CIBANO 500* and the *CB TN3* module.
4. Configure the Timing test as described earlier in this section.
5. In the **Advanced settings** area, enter the analog transducer settings.

Table 17-105: Analog transducer settings for pressure measurement

Setting	Description
Module	Name of the <i>CB TN3</i> module set in the hardware configuration
Channel	Channel name set in the <i>CB TN3</i> hardware configuration
Type	Select Pressure .
Supply	Pressure sensor supply voltage
Resolution	Pressure in kPa, bar or psi per 1 V according to the profile set in the Settings dialog box (see 6.1 "Settings" on page 36).
Conversion data	Not available for pressure measurement
Calibrate	Not available for pressure measurement

6. Start the measurement as described in "Measurement" on page 262.

After the measurement has finished, *Primary Test Manager* displays the pressure curve graphically. You can set the display options for the pressure data on the **Settings** tab in the Cursors & settings workspace.

Disconnection

Do not disconnect the circuit breaker but leave it connected for performing the next test. For disconnecting the circuit breaker, see "Disconnection" on page 285.

17.5.2 Dynamic Contact Resistance test

Connection

 **WARNING**

Death or severe injury caused by high voltage or current possible

- ▶ Do not connect anything to the circuit breaker under test without grounding the circuit breaker.
- ▶ Always ground the circuit breaker on both ends on all phases and close the circuit breaker to have proper grounding between the interrupters.

To connect the test object to *CIBANO 500*:

 **WARNING**

Death or severe injury caused by high voltage or current possible

- ▶ Do not connect the EtherCAT[®] cables to the *CB MC2* module before they are connected to *CIBANO 500*.
- ▶ Connect the EtherCAT[®] cables first to *CIBANO 500* and then to the *CB MC2* module.

1. Make sure that all cable connectors are clean and dry before being tightly connected.
2. Connect the *CB TN3* to *CIBANO 500* with the EtherCAT[®] cable.
3. If the *CB TN3* modules are not connected from the last test, hang up the *CB TN3* close to the circuit breaker's mechanical moving part.
4. Connect the transducer to the *CB TN3* with the delivered cable.
5. Attach the transducer to the circuit breaker. For detailed information, see 19 "Transducers" on page 302.
6. Repeat steps 2 to 5 for all *CB TN3* modules you want to connect.
7. In *Primary Test Manager*, open the Dynamic Contact Resistance test.

8. In the **Hardware configuration** area, set the hardware configuration and check whether *Primary Test Manager* recognized all connected *CB TN3* modules.
 The following figure shows the hardware configuration of *CIBANO 500* with the EtherCAT® module and one *CB MC2* and one *CB TN3* module connected.

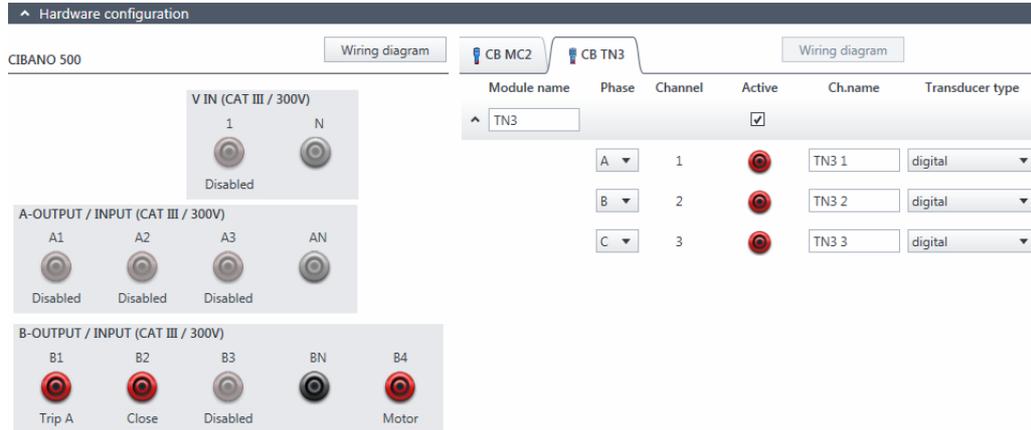


Figure 17-57: Example of the hardware configuration of the Dynamic Contact Resistance test for measuring the main contact travel during operation

Table 17-106: Hardware configuration options of *CIBANO 500*

CIBANO 500		Option
V IN (CAT III / 300 V)		
1		External source, Trigger IN ¹ or Disabled
N		Neutral connection of V IN
A-OUTPUT / INPUT (CAT III / 300 V)		
A1	AUX 1	Dry contact (potential-free)
		Wet contact (with potential)
		Close A, Motor A, Trigger IN ¹ or Disabled
A2	AUX 2	Dry contact (potential-free)
		Wet contact (with potential)
		Close B, Motor B, Trigger IN ¹ or Disabled
A3	AUX 3	Dry contact (potential-free)
		Wet contact (with potential)
		Close C, Motor C, Trigger IN ¹ or Disabled
AN		Common neutral connection for outputs/inputs in group A

Table 17-106: Hardware configuration options of *CIBANO 500* (continued)

CIBANO 500	Option
B-OUTPUT / INPUT (CAT III / 300 V)	
B1	Trip A, Trigger IN ¹ , I clamp 1 or Disabled
B2	Trip B, Close, Trigger IN ¹ , I clamp 2 or Disabled
B3	Trip C, Supply, Trigger IN ¹ , I clamp 3 or Disabled
BN	Neutral connection of outputs in group B
B4	Trigger IN ¹ , I clamp 4, Motor or Disabled

1. Trigger signal starting the measurement

Table 17-107: Hardware configuration options of the *CB MC2* module

CB MC2	Option
Module name ¹	Editable name of the <i>CB MC2</i> module
Phase	Editable phase assignment of the <i>CB MC2</i> module (stored on the device)
Channel	Channel of the <i>CB MC2</i> module
Active	Click the socket symbol to activate or deactivate the channel.
Combine	Click the Combine check box to combine the channels of the <i>CB MC2</i> module. The combined <i>CB MC2</i> channels can both be either active or inactive. The measurement results are labeled with the name of channel 1, and the voltage is only measured on channel 1.
Ch.name ¹	Editable name of the <i>CB MC2</i> channel
Charge	Indicates the charge status of the <i>CB MC2</i> module.
LED	Click the LED symbol to identify the connected <i>CB MC2</i> module by flashing LED.

1. Permanently stored in the *CB MC2* memory. You can, for example, mark your *CB MC2* modules with the colored stickers and name them according to the colors. You can also rename the *CB MC2* modules depending on the connection point.

Table 17-108: Hardware configuration options of the *CB TN3* module

CB TN3	Option
Module name ¹	Editable name of the <i>CB TN3</i> module
Phase	Phase to which the <i>CB TN3</i> module is connected
Channel ¹	Editable name of the <i>CB TN3</i> channel. Click the socket symbol to activate or deactivate the channel depending on the connections made.
Active	Click the socket symbol to activate or deactivate the channel.
Ch.name ¹	Editable name of the <i>CB TN3</i> channel
Transducer type	Type of the connected transducer: digital or analog

1. Permanently stored in the *CB TN3* memory. You can, for example, mark your *CB TN3* modules with the colored stickers and name them according to the colors. You can also rename the *CB TN3* modules depending on the connection point.

Measurement

To perform a measurement:

1. In the **Settings and conditions** area, enter the settings of the Dynamic Contact Resistance test.

Table 17-109: Settings of the Dynamic Contact Resistance test

Setting	Description
Coil supply	
Supply source	Select one of the following supply-source options: <ul style="list-style-type: none"> • CIBANO 500 to supply the coils with <i>CIBANO 500</i>. • External source to supply the coils with the source connected to V IN. • Control board to supply the coils with a control-board switch.¹
Supply settings ^{2,3}	Select a preconfigured coil supply setting from the asset data or select Custom to enter custom settings.
Coil supply voltage	Rated voltage of the coil supply Click AC or DC for AC or DC coil supply voltage respectively. Note: To perform the undervoltage trip and undervoltage close tests set the coil supply voltage lower than the nominal voltage.
Test frequency	Coil supply frequency (AC only)
Trip signal ⁴	Select whether the rising or falling edge of the trip signal opens the circuit breaker.
Close signal ⁴	Select whether the rising or falling edge of the close signal closes the circuit breaker.
Motor supply	
Supply source	Click CIBANO 500 to supply the motor with <i>CIBANO 500</i> . Click External source if the motor is supplied from the station supply or battery without any connection to <i>CIBANO 500</i> or if the station battery is connected to the V IN section and supplied, for example, via the B4 socket. Note: We do not recommend supplying the motor with undervoltage. Doing so does not provide any additional useful information and can cause degradation of the motor operation over time.
Supply settings ^{2,3}	Select the preconfigured motor supply setting from the asset data or select Custom to enter custom settings.
Motor supply voltage	Rated voltage of the motor supply Click AC or DC for AC or DC motor supply voltage respectively.
Test frequency	Motor supply frequency (AC only)
Max. supply duration	Maximum duration of supplying the motor if not stopped automatically
Main contact	

Table 17-109: Settings of the Dynamic Contact Resistance test (continued)

Setting	Description
Contact system	Contact system of the circuit breaker under test Select PIR to measure timing of contacts with pre-insertion resistors. Select Graphite nozzle to measure timing of contacts with graphite nozzle.
Nozzle length	Length of the circuit breaker's graphite nozzle
Trip velocity/ Close velocity ⁵	Contact travel velocity during the O sequence/C sequence
Travel data ⁶	<i>CB TN3</i> channel associated with the measured phase The Travel data boxes display a list of <i>CB TN3</i> travel measurement channels set to the corresponding phase in the hardware configuration of the <i>CB TN3</i> module.
Test current per channel ⁷	Output current of each <i>CB MC2</i> current channel
Other	
Grounding	Select the grounding condition of the circuit breaker under test.
Current clamp settings⁸	
Channel	Group B I/O socket
Ratio	Current clamp ratio
I max	Maximum current of the selected probe range
Sequence	
Test sequence	Test sequence to be performed
Trigger setting⁹	
Threshold	Threshold value of the trigger signal The measurement starts if the trigger signal rises above (rising edge) or falls below (falling edge) the threshold.
Edge type	Rising or falling edge

1. Only available if the trip and/or close signals are configured on the *IOB1* module.
2. Only available in the guided test workflow and if *CIBANO 500* is selected as source
3. Data taken from the nameplate
4. Only available if **Control board** is selected as supply source.
5. These values are used for calculating the timing characteristics of contacts with graphite nozzle.
6. Only available if at least one *CB TN3* module is connected to *CIBANO 500*. The corresponding travel data is used to calculate the timing characteristics of contacts with graphite nozzle.
7. Not available for **PIR** contact system. We recommend using a test current of 100 A per *CB MC2* channel for the most accurate results.
8. Only available if a current clamp is configured. The channel value displayed refers to the group **B** of the I/O sockets on the *CIBANO 500* side panel. The **B1...B4** sockets can be configured as **I clamp 1...I clamp 4** respectively.
9. Only available if **V IN**, or one output in group **A** or group **B** is set to Trigger IN.

2. In the **Advanced settings** area, enter the transducer settings, and optionally the advanced settings.

Table 17-110: Transducer settings

Setting	Description
Digital transducer settings	
Module	Name of the <i>CB TN3</i> module set in the hardware configuration
Channel	Channel name set in the <i>CB TN3</i> hardware configuration
Type	Transducer type: linear or angular
Supply	Transducer supply voltage
Resolution	Transducer travel per one pulse
Conversion data	Data for converting the transducer movement to main contact movement depending on the transducer type Linear transducer: Type the contact factor. Angular transducer: Type the contact factor or select a conversion table from the list, if available (see "Conversion tables" on page 102). ^{1,2}
Analog transducer settings	
Module	Name of the <i>CB TN3</i> module set in the hardware configuration
Channel	Channel name set in the <i>CB TN3</i> hardware configuration
Type ³	Transducer type: linear or angular
Supply	Transducer supply voltage
Resolution ³	Transducer travel per 1 V
Conversion data	Data for converting the transducer movement to main contact movement depending on the transducer type Linear transducer: Type the contact factor. Angular transducer: Type the contact factor or select a conversion table from the list, if available (see "Conversion tables" on page 102). ^{1,2}
Calibrate	Click Calibrate to calculate the transducer resolution (see "Calibration" on page 284).

1. The selected conversion table remains associated with the test even after it has been deleted from the asset.
2. When performing a manual test, you can load a conversion table by clicking the **Browse** button ... in the Conversion data column.
3. For information about the pressure measurement, see "Measuring pressure signals" on page 284.

Table 17-111: Advanced settings of the Dynamic Contact Resistance test

Setting	Description
Main contact	
PIR thresholds ¹	Select Automatic if you want to let <i>Primary Test Manager</i> set the PIR thresholds or select Custom to set the PIR thresholds according to your needs. If you select Automatic , <i>Primary Test Manager</i> fits the PIR thresholds as follows: <ul style="list-style-type: none"> • If the PIR value is not defined in the circuit breaker data, <i>Primary Test Manager</i> sets the default values. • If the PIR value is defined in the circuit breaker data, <i>Primary Test Manager</i> sets the Close / PIR threshold to 75% of the PIR value and the PIR / Open threshold to 125% of the PIR value.
C-O threshold ²	Resistance threshold to detect whether the main contact is open or closed. <i>Primary Test Manager</i> interprets the contact as open if the contact resistance is above the C-O threshold and vice versa.
Close / PIR threshold PIR / Open threshold ¹	Resistance thresholds for the PIR measurement <i>Primary Test Manager</i> interprets the contact in the PIR state if the contact resistance is above the Close / PIR threshold and below the PIR / Open threshold.
Resistance threshold ³	Threshold value of the contact resistance for calculating the timing characteristics of contacts with graphite nozzle
Spike compensation ³	Time interval for calculating the timing characteristics of contacts with graphite nozzle The contact is considered closed (C sequence) or opened (O sequence) if the contact resistance stays in the threshold state within the spike compensation interval.
Sine wave filter	Select the Sine wave filter check box to suppress sinusoidal interference.
Start evaluation at	Start time of the sine wave evaluation. Select the time at which the sinusoidal interference is clearly present in the measurement signal.
Sine frequency	Frequency of the sinusoidal interference
Other	
Close breaker before test ⁴	Select the Close breaker before test check box to automatically close the circuit breaker 1 second before starting a measurement.
Sample rate	Measurement sample rate ⁵
Contact bounce filter	
Main contact	Threshold value of the time interval between two consecutive bounces of the main contact. For time intervals equal or below the threshold, the contact is considered as closed. Setting the value to 0.0 ms deactivates the contact bounce filter.

Table 17-111: Advanced settings of the Dynamic Contact Resistance test (continued)

Setting	Description
Auxiliary contact	Threshold value of the time interval between two consecutive bounces of the auxiliary contact. For time intervals equal or below the threshold, the contact is considered as closed. Setting the value to 0.0 ms deactivates the contact bounce filter.
Average coil current/voltage	
Begin	Start of the average coil current/voltage evaluation in percent of the time period during which the current flows through the coil
End	End of the average coil current/voltage evaluation in percent of the time period during which the current flows through the coil
Begin of contact movement⁶	
Trip operation/ Close operation	Deviation of the contact travel from the rest position in percent of the total travel. With the Trip operation and Close operation settings, you can define the start of the contact movement.
Time calculation based on contact movement start	Select None to calculate the contact timing according to IEC 62271-100 standard. Select the channel name of the <i>CB TN3</i> module to be used for calculating the contact timing based on the contact movement start. ⁷
Begin of contact damping⁸	
Contact travel deviation	Deviation of the actual contact travel from the distance the contact would travel with its maximum velocity in percent of the total travel
Start evaluation at	Start contact travel for the evaluation of the contact travel deviation
End evaluation at	End contact travel for the evaluation of the contact travel deviation
Sequence	
See Table 17-112: "Dynamic Contact Resistance test sequences" later in this section.	

1. Only available for **PIR** contact system
2. Only available for **Standard** contact system
3. Only available for **Graphite nozzle** contact system
4. The **Close breaker before test** check box is only active if the test sequence begins with the open command and no output is set to Trigger IN.
5. We recommend 10 kHz to constrain the amount of created data. Higher sample rates are needed for special tests only.
6. Only available for O and C sequences
7. Only available for tests in the executed state
8. Only available for O sequence

The following table explains the sequences of the Dynamic Contact Resistance test.

Table 17-112: Dynamic Contact Resistance test sequences

Sequence	Action
O	With this sequence, the opening time of the circuit breaker is measured. Only for O and C sequences we recommend performing the test twice, once with nominal voltage and once with 20% undervoltage to assure the functionality of the circuit breaker for a weak station battery.
C	This is the sequence to measure the closing time of the circuit breaker.
OC	With this sequence, a closing operation after the circuit breaker has tripped to clear a fault is simulated. Initially, the circuit breaker must be in the closed position. An open command initiates the sequence, followed by a dead time to clear the fault; and finally a close command must close the circuit breaker. This sequence is also known as reclosing sequence. To find out the shortest reclosing time the circuit breaker can provide, the close command is already applied while the circuit breaker is still opening. The circuit breaker then will close after opening as fast as possible.
CO	With this sequence, a tripping operation after the circuit breaker has been closed under a fault condition (trip-free) or the verification of the correct operation of the anti-pumping system is simulated. To test the trip-free time the circuit breaker must be in the open position before the test is started. The circuit breaker is closed and then during the close operation is still in progress an open command is sent. The circuit breaker then opens as fast as possible. To test the anti-pumping function of the circuit breaker, the circuit breaker must be in closed position before the test is started. For this test the open time is set shorter (typically 200 ms) than the closing time (typically 400 ms). Ensure that the end time is increased so that the test sequence covers the whole close command duration (typically at least 190 ms). When the close command is sent the circuit breaker is already closed which initiates the anti-pumping function. Then an open command is sent and the circuit breaker trips. The closing command is still on when the open command ends, but the circuit breaker should not "pump", so that it should not close again.
O-CO	With this sequence, a reclose sequence (OC) under a fault condition is simulated. If the fault is not released, the circuit breaker must open (O) immediately and remain in this position. Initially, the circuit breaker must be in the closed position. The sequence begins with an open command, after a dead time the close and open commands (CO) must be applied at the same time (delay time typically 300 ms).

Table 17-112: Dynamic Contact Resistance test sequences (continued)

Sequence	Action
CO-CO	Some circuit breakers have a different specification for the pause time between CO and CO for CO-CO and O-CO-CO sequences. Therefore both sequences are available for testing. The time between the two CO subsequences shall be set according to the technical data of the circuit breaker (typically 15000 ms).
O-CO-CO	Some circuit breakers have a different specification for the pause time between CO and CO for CO-CO and O-CO-CO sequences. Therefore both sequences are available for testing. The time between the two CO subsequences shall be set according to the technical data of the circuit breaker (typically 15000 ms).

3. In the **Assessment** area, configure the assessment.

- ▶ Click **Edit configuration** or click in one of the tables to open the **Assessment configuration** dialog box, and then edit the assessment limits.
- ▶ Select the **Automatic assessment** check box to enable the automatic assessment.

Note: For the assessment limit definitions, see 15.3 "Assessment limits" on page 106.



4. In the **Measurements** area, click **Start**.
The blue ring on the **Start/Stop** button is on.



WARNING

Death or severe injury caused by high voltage or current possible

- ▶ Do not enter the high-voltage test area while testing with *CIBANO 500* since any part of the circuit breaker can carry dangerous voltages.
- ▶ Stay in the work area during the test.



5. Start the measurement by pressing the **Start/Stop** button.

The blue ring on the **Start/Stop** button flashes for approx. 3 seconds, and the lightning symbol in *Primary Test Manager* and the red status light on the front panel are flashing.

6. After the measurement has finished, the lightning symbol in *Primary Test Manager* stops flashing, the green status light is on, and *Primary Test Manager* displays the measurement results.

When testing with the *CB TN3* modules, *Primary Test Manager* calculates and displays also the velocity of the contact travel. You can set the display options for the velocity data on the **Settings** tab in the **Cursors & settings** workspace.

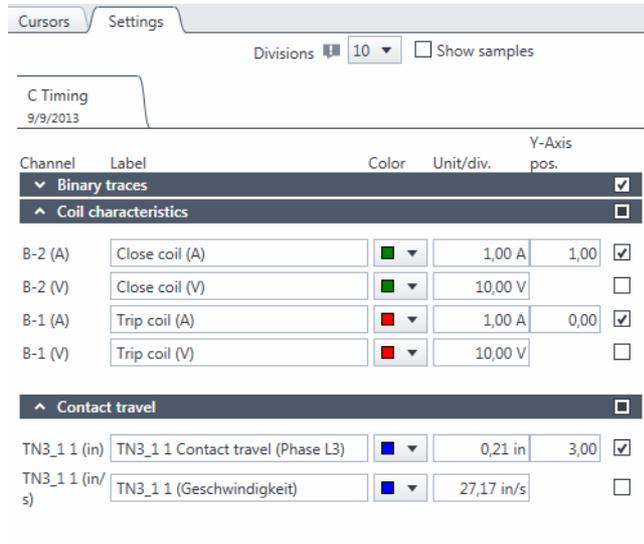


Figure 17-58: Setting the velocity display options

To view the numeric measurement data, click the **Table** tab. For the operating times, auxiliary contact characteristics and coil characteristics, see Table 17-63: "Operating times" on page 206, Table 17-64: "Auxiliary contact characteristics" on page 206 and Table 17-66: "Coil characteristics" on page 207.

For explanation of the contact travel characteristics, see Figure 17-56: "Contact travel characteristics" on page 268.

Table 17-113: Contact travel characteristics¹

Data	Description
Module	Name of the <i>CB TN3</i> module set in the hardware configuration
Channel	Channel of the <i>CB TN3</i> module
Total travel	Total distance traveled by the contact during operation (excluding possible over-travel). The row labeled with the <i>CB TN3</i> channel displays the maximum of all measurement results for this channel.
Over-travel	Contact travel distance between the maximum contact travel and the final contact resting position
Rebound	Contact travel distance between the minimum contact travel after returning from an over-travel and the final contact resting position
Assessment	Measurement assessment
Velocity zone definition	Time period within which the contact travel velocity is evaluated (see 15.4 "Velocity zones" on page 112)

Table 17-113: Contact travel characteristics¹ (continued)

Data	Description
v meas	Measured velocity of the contact travel within the velocity zone
Information	Information about the measurement
Damping distance ²	Distance the contact travels while damping is effective (see Begin of contact damping settings in Table 17-16: "Advanced settings of the Timing test" on page 140)
Assessment	Measurement assessment

1. Only calculated for O and C sequences

2. Only available for O sequence

Table 17-114: Main contact characteristics¹

Data	Description
Main contact	Main contact this measurement row refers to
Travel data	CB TN3 channel this measurement row refers to
Contact wipe	C sequence: Distance the contact travels between the first contact touch and the contact steady state O sequence: Distance the contact travels between the contact steady state and the final contact separation
Reaction time	Time interval after which the contact responds to the open or close signal (see Begin of contact movement settings in Table 17-16: "Advanced settings of the Timing test" on page 140)
Bounce time ²	Duration of the main contact bounce
Bounce count ²	Number of main contact bounces within the bounce time
PIR closing time	Closing time for pre-insertion resistors
Assessment	Measurement assessment

1. Only available for O and C sequences

2. Not available for **PIR** contact system

Calibration

With *Primary Test Manager*, you can calibrate analog transducers when using them. To calibrate an analog transducer:

1. In the **Hardware configuration** area, select the analog transducer type.
2. In the **Settings and conditions** area, click **Calibrate**.
3. In the **Transducer Calibration** dialog box, enter the maximum stroke of the transducer, and then click **Start**.
4. Press the **Start/Stop** button on the *CIBANO 500* front panel.
5. During the calibration time (10 seconds), move the transducer manually from the minimum to maximum position.
6. After the calibration process has finished, the calculated transducer resolution appears in the **Settings and conditions** area.

Measuring pressure signals

With the *CB TN3* modules and analog transducers, you can measure and display pressure signals. To measure pressure signals:

1. Connect at least one *CB TN3* module to *CIBANO 500*.
2. Connect the analog pressure sensors to the analog interface of the *CB TN3* module (see 22.2.1 "Designated use" on page 337).
3. In the **Hardware configuration** area, set the hardware configuration of *CIBANO 500* and the *CB TN3* module.
4. Configure the Dynamic Contact Resistance test as described earlier in this section.
5. In the **Advanced settings** area, enter the analog transducer settings.

Table 17-115: Analog transducer settings for pressure measurement

Setting	Description
Module	Name of the <i>CB TN3</i> module set in the hardware configuration
Channel	Channel name set in the <i>CB TN3</i> hardware configuration
Type	Select Pressure .
Supply	Pressure sensor supply voltage
Resolution	Pressure in kPa, bar or psi per 1 V according to the profile set in the Settings dialog box (see 6.1 "Settings" on page 36).
Conversion data	Not available for pressure measurement
Calibrate	Not available for pressure measurement

6. Start the measurement as described in "Measurement" on page 275.

After the measurement has finished, *Primary Test Manager* displays the pressure curve graphically. You can set the display options for the pressure data on the **Settings** tab in the Cursors & settings workspace.

Disconnection

Note: Do not disconnect the test object from *CIBANO 500* if you intend to make further measurements.

To disconnect the test object from *CIBANO 500*:



1. Press the **Emergency Stop** button on the *CIBANO 500* front panel.
2. Wait until the green status light on the *CIBANO 500* front panel is on and the voltage/current indicator on the *CIBANO 500* side panel is off.
3. Remove the barrier between the dangerous and the work area.



WARNING

Death or severe injury caused by high voltage or current possible

- ▶ Do not touch any part of the circuit breaker before grounding and short-circuiting its terminals.
- ▶ Always ground and short-circuit the circuit breaker's terminals by using a grounding set.

4. Disconnect the cables from the station battery, if connected.
5. Disconnect the cables from the circuit breaker's motor, if connected.
6. Disconnect the cables from the circuit breaker's trip and close coils.
7. Disconnect all *CB TN3* modules first from *CIBANO 500* and then from the transducers, if connected.
8. Disconnect one *CB MC2* module from *CIBANO 500*.



WARNING

Death or severe injury caused by high voltage or current possible

- ▶ Do not proceed without grounding the test object's terminals.
- ▶ Ground the test object's terminals by using a grounding set.

9. Disconnect the *CB MC2* from the main contact of the circuit breaker.
10. Unhook the *CB MC2* from one phase of the circuit breaker.
11. Repeat steps 7 to 9 for all phases tested.
12. Switch off *CIBANO 500* by pressing the mains power on/off switch on the *CIBANO 500* side panel.



WARNING

Death or severe injury caused by high voltage or current possible

- ▶ Do not leave the circuit breaker's spring(s) charged after disconnecting *CIBANO 500* from the circuit breaker.
- ▶ Always operate the circuit breaker manually by using the circuit breaker's operation buttons until the spring(s) are discharged.

18 In-service diagnostic methods

This section describes in-service testing of circuit breakers with *CIBANO 500* and its accessories. *Primary Test Manager* in combination with *CIBANO 500* supports the following in-service tests:

- Timing (VTM)
- First Trip

18.1 Timing (VTM) test

Note: To perform the Timing (VTM) test (VTM stands for Voltage-based Timing Measurement), you need a license. Without the license, it is not possible to start the measurement and *Primary Test Manager* displays a missing license message. To get the license, contact your regional OMICRON service center.

Connection

To connect the test object to *CIBANO 500*:

1. In *Primary Test Manager*, open the Timing (VTM) test.
2. In the **Hardware configuration** area, set the hardware configuration.

Note: Do not connect the trigger channel (Trigger IN) and the current clamps to the same neutral connection socket of the group **A** or group **B**.

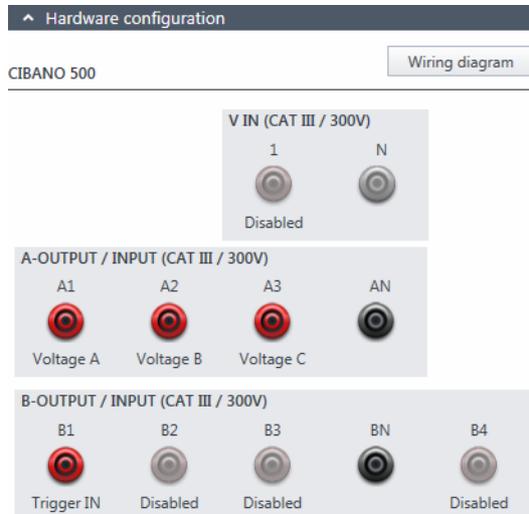


Figure 18-1: Hardware configuration of the Timing (VTM) test

Table 18-1: Hardware configuration options of *CIBANO 500*

CIBANO 500		Option			
V IN (CAT III / 300 V)					
1	Voltage or Disabled				
N	Neutral connection of V IN				
A-OUTPUT / INPUT (CAT III / 300 V)					
A1	Voltage	Phase A	or Disabled		
		Phase B			
		Phase C			
A2	Voltage	Phase A	or Disabled		
		Phase B			
		Phase C			
A3	Voltage	Phase A	or Disabled		
		Phase B			
		Phase C			
AN	Neutral connection of inputs in group A				
B-OUTPUT / INPUT (CAT III / 300 V)					
B1	I clamp 1	Trigger IN ¹		or Disabled	
		Generic	Trip		all
					Phase A
					Phase B
					Phase C
			Close		all
					Phase A
					Phase B
					Phase C
					Motor
		Motor	all		
			Phase A		
			Phase B		
Phase C					

Table 18-1: Hardware configuration options of CIBANO 500 (continued)

CIBANO 500		Option			
B2	I clamp 2	Trigger IN ¹		or Disabled	
		Trip	Generic		
			all		
			Phase A		
			Phase B		
		Close	all		
			Phase A		
			Phase B		
			Phase C		
		Motor	all		
			Phase A		
			Phase B		
			Phase C		
B3	I clamp 3	Trigger IN ¹		or Disabled	
		Trip	Generic		
			all		
			Phase A		
			Phase B		
		Close	all		
			Phase A		
			Phase B		
			Phase C		
		Motor	all		
			Phase A		
			Phase B		
			Phase C		
BN	Neutral connection of inputs in group B				

Table 18-1: Hardware configuration options of *CIBANO 500* (continued)

CIBANO 500	Option							
B4	Trigger IN ¹			or Disabled				
	I clamp 4	Generic						
		Trip	all					
			Phase A					
			Phase B					
			Phase C					
		Close	all					
			Phase A					
			Phase B					
			Phase C					
		Motor	all					
			Phase A					
			Phase B					
			Phase C					

1. Trigger signal starting the measurement

3. Make sure that all cable connectors are clean and dry before being tightly connected.

4. Connect *CIBANO 500* to the circuit breaker for all phases according to the wiring diagram displayed in *Primary Test Manager* and as shown by the following figure.

NOTICE
Equipment damage or loss of data possible

► Never connect *CIBANO 500* between the respective AUX contacts of the trip and close coils and the coils themselves since these contacts assure that the voltage is not applied too long to the coils.

Measurement

To perform a measurement:

1. In the **Settings and conditions** area, enter the settings of the Timing (VTM) test.

Table 18-2: Settings of the Timing (VTM) test

Setting	Description
Trigger setting	
Threshold	Threshold value of the trigger signal The measurement starts if the trigger signal rises above (rising edge) or falls below (falling edge) the threshold.
Edge type	Rising or falling edge
Sequence	
Test sequence	Test sequence to be performed

2. Optionally, enter the advanced settings in the **Advanced settings** area.

Table 18-3: Advanced settings of the Timing (VTM) test

Setting	Description
Other	
Sample rate	Measurement sample rate
Contact bounce filter	
Auxiliary contact	Threshold value of the time interval between two consecutive bounces of the auxiliary contact. For time intervals equal or below the threshold, the contact is considered as closed. Setting the value to 0.0 ms deactivates the contact bounce filter.
Average coil current/voltage	
Begin	Start of the average coil current/voltage evaluation in percent of the time period during which the current flows through the coil
End	End of the average coil current/voltage evaluation in percent of the time period during which the current flows through the coil
Sequence	
O	Sequence for measuring the opening time of the circuit breaker
C	Sequence for measuring the closing time of the circuit breaker

3. In the **Assessment** area, configure the assessment.
 - ▶ Click **Edit configuration** or click in one of the tables to open the **Assessment configuration** dialog box, and then edit the assessment limits.
 - ▶ Select the **Automatic assessment** check box to enable the automatic assessment.

Note: For the assessment limit definitions, see 15.3 "Assessment limits" on page 106.



- In the **Measurements** area, click **Start**.
The blue ring on the **Start/Stop** button is on.



WARNING

Death or severe injury caused by high voltage or current possible

- ▶ Do not enter the high-voltage test area while testing with *CIBANO 500* since any part of the circuit breaker can carry dangerous voltages.
- ▶ Stay in the work area during the test.



- Start the measurement by pressing the **Start/Stop** button.
The blue ring on the **Start/Stop** button flashes for approx. 3 seconds, and the lightning symbol in *Primary Test Manager* and the red status light on the front panel are flashing.

Note: If the test does not react to the trigger signal after the circuit breaker has operated, you can press the **Start/Stop** button to stop the measurement manually. Then, *Primary Test Manager* will display the data recorded until you stopped the measurement.

Note: In emergency cases, you can abort the measurement anytime manually by pressing the **Emergency Stop** button on the *CIBANO 500* front panel.



- After the measurement has finished, the lightning symbol in *Primary Test Manager* stops flashing, the green status light is on, and *Primary Test Manager* displays the measurement results.

Table 18-4: Auxiliary contact characteristics

Data	Description
Contact	Name of the auxiliary contact of the circuit breaker under test
Phase	Phase to which the auxiliary contact belongs
Type	Type of the auxiliary contact (a, b, wiper)
Switching time	Closing or opening time of the auxiliary contact depending on its type
Duration	Duration the wiper contact remains closed
Diff. to main	Time difference between the opening or closing of the auxiliary contact and the corresponding main contact
Assessment	Assessment of auxiliary contact characteristics

Table 18-5: Coil characteristics

Data	Description
Peak current	Peak current value through a trip or close coil

Table 18-5: Coil characteristics (continued)

Data	Description
Average current	Average current through the coil (see Average coil current/voltage settings in Table 18-3: "Advanced settings of the Timing (VTM) test" on page 290)
Average voltage	Average voltage applied to the coil (see Average coil current/voltage settings in Table 18-3: "Advanced settings of the Timing (VTM) test" on page 290)
Resistance	Calculated resistance of the coil
Assessment	Assessment of coil characteristics

With the Timing (VTM) test, you can also measure the contact travel characteristics. For detailed information, see 17.5 "Testing circuit breakers with CIBANO 500 and the CB TN3 modules" on page 259.

Disconnection

For disconnecting the circuit breaker, see "Disconnection" on page 301.

18.2 First Trip test

The First Trip test measures the opening time of the circuit breaker during the first operation after a long static period. The trip coil current characteristic is automatically recorded and, if spare auxiliary contacts are available, they also could be included in the First Trip measurement.

Note: To perform the First Trip test, you need a license. Without the license, it is not possible to start the measurement and *Primary Test Manager* displays a missing license message. To get the license, contact your regional OMICRON service center.

Connection

To connect the test object to *CIBANO 500*:

1. In *Primary Test Manager*, open the First Trip test.
2. In the **Hardware configuration** area, set the hardware configuration.

Note: Do not connect the trigger channel (Trigger IN) and the current clamps to the same neutral connection socket of the group **A** or group **B**.

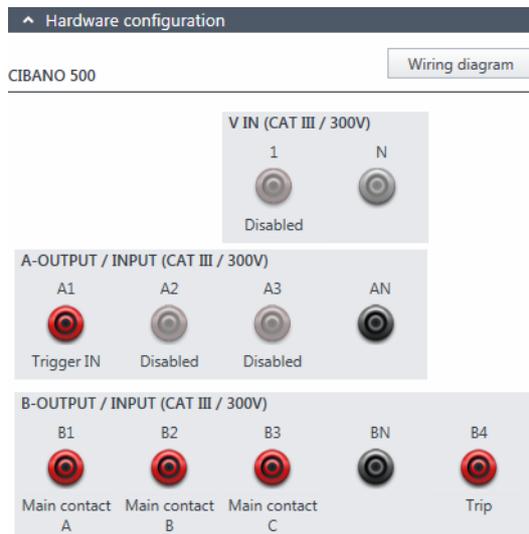


Figure 18-2: Hardware configuration of the First Trip test

Table 18-6: Hardware configuration options of CIBANO 500

CIBANO 500	Option			
V IN (CAT III / 300 V)				
1	Trigger IN ¹ , Voltage or Disabled			
N	Neutral connection of V IN			
A-OUTPUT / INPUT (CAT III / 300 V)				
A1	Trigger IN ¹		or Disabled	
	AUX 1	Dry contact (potential-free)		
		Wet contact (with potential)		
A2	Trigger IN ¹		or Disabled	
	AUX 2	Dry contact (potential-free)		
		Wet contact (with potential)		
A3	Trigger IN ¹		or Disabled	
	AUX 3	Dry contact (potential-free)		
		Wet contact (with potential)		
AN	Neutral connection of inputs in group A			
B-OUTPUT / INPUT (CAT III / 300 V)				
B1	Trigger IN ¹		or Disabled	
	I clamp 1	Generic		
		Trip		all
				Phase A
				Phase B
		Main contact		Phase C
				Phase A
				Phase B
		Trip (Trigger)		Phase C

Table 18-6: Hardware configuration options of CIBANO 500 (continued)

CIBANO 500	Option			
B2	Trigger IN ¹			or Disabled
	I clamp 2	Generic		
		Trip	all	
			Phase A	
			Phase B	
			Phase C	
		Main contact	Phase A	
			Phase B	
			Phase C	
		Trip (Trigger)		
B3		Trigger IN ¹		
	I clamp 3	Generic		
		Trip	all	
			Phase A	
			Phase B	
			Phase C	
		Main contact	Phase A	
			Phase B	
			Phase C	
		Trip (Trigger)		
BN		Neutral connection of inputs in group B		
B4	Trigger IN ¹			or Disabled
	I clamp 4	Generic		
		Trip	all	
			Phase A	
			Phase B	
			Phase C	
		Main contact	Phase A	
			Phase B	
			Phase C	
		Trip (Trigger)		

1. Trigger signal starting the measurement

3. Make sure that all cable connectors are clean and dry before being tightly connected.
4. Configure the current clamps (see "Current clamp settings" on page 298).
5. Connect *CIBANO 500* to the circuit breaker for all phases according to the wiring diagram displayed in *Primary Test Manager* and as shown by the following figure.

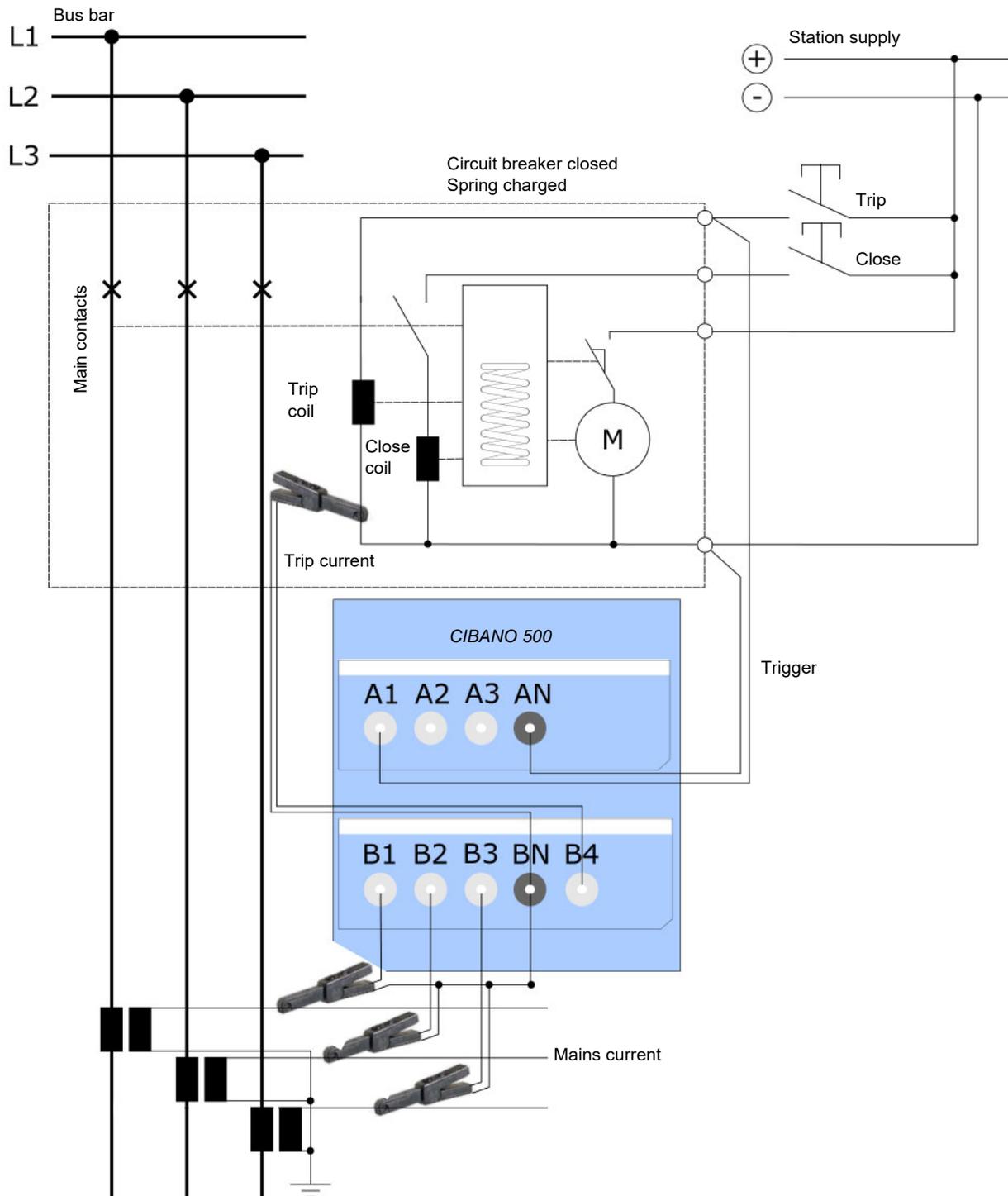


Figure 18-3: Connecting CIBANO 500 to the circuit breaker for the First Trip test

NOTICE

Equipment damage or loss of data possible

► Never connect *CIBANO 500* between the respective AUX contacts of the trip and close coils and the coils themselves since these contacts assure that the voltage is not applied too long to the coils.

Current clamp settings

You must configure the current clamps before connecting them to the circuit breaker under test. The following figure shows the setting controls of OMICRON current clamps.

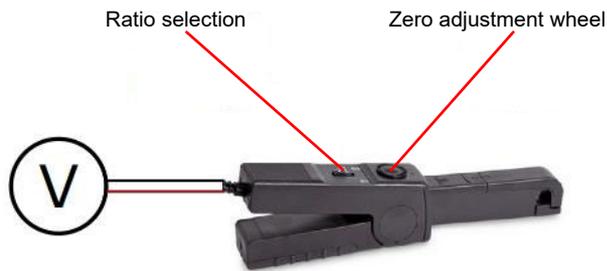


Figure 18-4: Setting controls of OMICRON current clamps

To configure the current clamps:

1. Set the current clamp ratio (ratio of the voltage output to the measured current). Typically, the current clamp ratio is 100 mV/A for measuring current on the secondary side of a metering current transformer.
2. Adjust the null point of the current clamp by turning the zero adjustment wheel until a voltage meter connected to the current clamp output shows 0 V.

Measurement

To perform a measurement:

1. In the **Settings and conditions** area, enter the settings of the First Trip test.

Table 18-7: Settings of the First Trip test

Setting	Description
Current clamp settings	
Channel	Group B I/O socket
Ratio	Current clamp ratio
I max	Maximum current of the selected probe range
Trigger setting	
Threshold	Threshold value of the trigger signal The measurement starts if the trigger signal rises above (rising edge) or falls below (falling edge) the threshold. For the trigger signal Trigger IN, the threshold value is in V, for the trigger signal Trip (Trigger), the threshold value is in A.

Table 18-7: Settings of the First Trip test (continued)

Setting	Description
Edge type	Rising or falling edge
Determine threshold ¹	Click Determine threshold to set the threshold automatically by using the Record preview function of <i>Primary Test Manager</i> (see Record preview in step 4).
Sequence	
Test sequence	Test sequence to be performed

1. Only available for the trigger signal Trip (Trigger)
2. Optionally, enter the advanced settings in the **Advanced settings** area.

Table 18-8: Advanced settings of the First Trip test

Setting	Description
Other	
Sample rate	Measurement sample rate
Contact bounce filter	
Auxiliary contact	Threshold value of the time interval between two consecutive bounces of the auxiliary contact. For time intervals equal or below the threshold, the contact is considered as closed. Setting the value to 0.0 ms deactivates the contact bounce filter.
Average coil current/voltage	
Begin	Start of the average coil current/voltage evaluation in percent of the time period during which the current flows through the coil
End	End of the average coil current/voltage evaluation in percent of the time period during which the current flows through the coil
Sequence	
O	Sequence for measuring the opening time of the circuit breaker

3. In the **Assessment** area, configure the assessment.
 - ▶ Click **Edit configuration** or click in one of the tables to open the **Assessment configuration** dialog box, and then edit the assessment limits.
 - ▶ Select the **Automatic assessment** check box to enable the automatic assessment.

Note: For the assessment limit definitions, see 15.3 "Assessment limits" on page 106.
4. In the **Measurements** area, click **Record preview** to perform a preview measurement for 2 seconds. With the preview measurement, you can check the input signals before starting the First Trip test. The results of the preview measurement are only displayed graphically and are available until you leave the job or start the First Trip test.



- In the **Measurements** area, click **Start**.
The blue ring on the **Start/Stop** button is on.



WARNING

Death or severe injury caused by high voltage or current possible

- ▶ Do not enter the high-voltage test area while testing with *CIBANO 500* since any part of the circuit breaker can carry dangerous voltages.
- ▶ Stay in the work area during the test.



- Start the measurement by pressing the **Start/Stop** button. From now on, the trigger input is switched on.
The blue ring on the **Start/Stop** button flashes for approx. 3 seconds, and the lightning symbol in *Primary Test Manager* and the red status light on the front panel are flashing.

Note: If the test does not react to the trigger signal after the circuit breaker has operated, you can press the **Start/Stop** button to stop the measurement manually. Then, *Primary Test Manager* will display the data recorded until you stopped the measurement.

Note: In emergency cases, you can abort the measurement anytime manually by pressing the **Emergency Stop** button on the *CIBANO 500* front panel.



- After the measurement has finished, the lightning symbol in *Primary Test Manager* stops flashing, the green status light is on, and *Primary Test Manager* displays the measurement results.

Table 18-9: Operating times¹

Data	Description
Opening time	Contact opening time of O operation
Opening sync.	Opening synchronization time of O operation
Assessment	Assessment of operating times

1. The operating times are calculated per phase or circuit breaker.

Table 18-10: Auxiliary contact characteristics

Data	Description
Contact	Name of the auxiliary contact of the circuit breaker under test
Phase	Phase to which the auxiliary contact belongs
Type	Type of the auxiliary contact (a, b, wiper)
Switching time	Closing or opening time of the auxiliary contact depending on its type
Duration	Duration the wiper contact remains closed
Diff. to main	Time difference between the opening or closing of the auxiliary contact and the corresponding main contact
Assessment	Assessment of auxiliary contact characteristics

Table 18-11: Coil characteristics

Data	Description
Peak current	Peak current value through a trip or close coil
Average current	Average current through the coil (see Average coil current/voltage settings in Table 18-8: "Advanced settings of the First Trip test" on page 299)
Average voltage	Average voltage applied to the coil (see Average coil current/voltage settings in Table 18-8: "Advanced settings of the First Trip test" on page 299)
Resistance	Calculated resistance of the coil
Assessment	Assessment of coil characteristics

Disconnection

Note: Do not disconnect the test object from *CIBANO 500* if you intend to make further measurements.

To disconnect the test object from *CIBANO 500*:



1. Press the **Emergency Stop** button on the *CIBANO 500* front panel.
2. Wait until the green status light on the *CIBANO 500* front panel is on and the voltage/current indicator on the *CIBANO 500* side panel is off.
3. Remove the barrier between the dangerous and the work area.

WARNING

Death or severe injury caused by high voltage or current possible

- ▶ Do not touch any part of the circuit breaker before grounding and short-circuiting its terminals. Always ground and short-circuit the circuit breaker's terminals by using a grounding set.

4. Disconnect all cables from the circuit breaker.
5. Disconnect all cables from *CIBANO 500*.
6. Switch off *CIBANO 500* by pressing the mains power on/off switch on the *CIBANO 500* side panel.
7. Disconnect the mains power cord.
8. Remove the equipotential ground as the last connection that is removed first on the substation side and then from *CIBANO 500*.

WARNING

Death or severe injury caused by high voltage or current possible

- ▶ Do not leave the circuit breaker's spring(s) charged after disconnecting *CIBANO 500* from the circuit breaker.
- ▶ Always operate the circuit breaker manually by using the circuit breaker's operation buttons until the spring(s) are discharged.

19 Transducers

Note: Based on their robust design, digital motion sensors delivered by OMICRON need neither a periodic accuracy validation nor calibration.

This section describes how to use the transducers for measuring the circuit breaker's contact travel with *CIBANO 500* and the related issues. The emphasis is on the attachment of the transducers to the circuit breaker.

Motion measurements are a well proven and widely used method to assess the mechanical linkage of a circuit breaker. To benefit from this method, you have to connect a travel sensor.

There are following options, priority-wise ordered:

1. Use the same connection point as used by the manufacturer during factory routine tests.
2. Use the same connection point as during the commissioning of the circuit breaker on site.
3. Connect the travel sensor as close to the main contacts as possible. However, do not touch the integrity of the circuit breaker.
4. On a ganged operated circuit breaker – Pick the pole which is closest to the spring operating mechanism.

19.1 Angular transducers

The angular transducers are used to derive motion curves from a rotating part of the circuit breaker. There is a mechanical coupling between the transducer and the circuit breaker.

19.1.1 Components

The following components are typically required to perform measurements by using the angular transducer.

Transducer and adapter

The angular transducer comes with an adapter which facilitates attaching the transducer to the articulating arm described later in this section. The adapter has five threaded holes (M8) for mounting flexibility. To enhance the number of options for fixing the transducer, three additional holes with a diameter of 8.2 mm are available.



Figure 19-1: Angular transducer

Articulating arm and screw clamp

The articulating arm consists of two levers coupled by a ball joint. On the ends of the levers, the ball joints hold a threaded stub for interfacing with other mechanical components. All three joints can be fixed with a single set screw. The articulating arm is connected on one side to the screw clamp and on the other side, it holds the transducer.



Figure 19-2: Articulating arm

The screw clamp is attached directly to the circuit breaker. It has a ball joint for connecting the articulating arm or the mechanical extensions described later in this section. The ball joint can be fixed by bringing the lever in the corresponding position.



Figure 19-3: Screw clamp

Extensions

Two types of extensions of length 100 mm and 50 mm are available to increase the range of the articulating arm. The extensions can be inserted at either end of the articulating arm.



Figure 19-4: Articulating arm extensions

Couplings

Two types of couplings are available for the angular transducers: a flexible coupling and a coupling using a drill chuck. The couplings are used to connect the shaft of the angular transducer to a rotating part of the circuit breaker. The diameter of the hole of the flexible coupling is 10 mm, the drill chuck accepts shafts with diameters between 0.8 mm and 10 mm.



Figure 19-5: Flexible coupling



Figure 19-6: Coupling with a drill chuck

Mounting kit

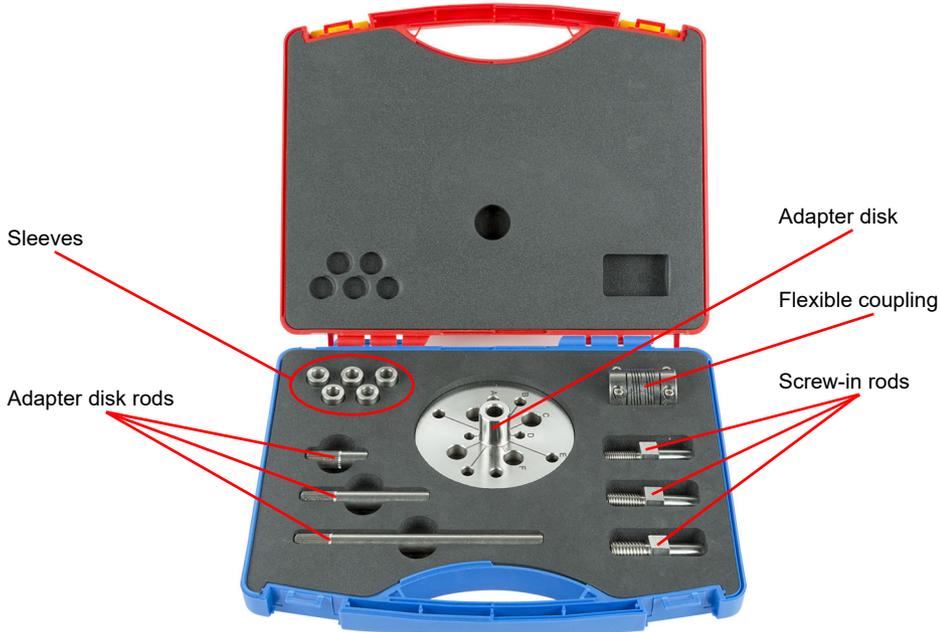


Figure 19-7: Mounting kit

The following table shows examples of circuit breakers fitting the drill holes in the adapter disk. You can use the mounting kit for any other circuit breakers which fit the drill holes.

Table 19-1: Examples of circuit breakers fitting the adapter disk

Character on the disk	Circuit breaker
A	Siemens SPS/3AP <72.5 kV
B	Siemens SPS/3AP 72.5 kV – 145 kV
C	ABB HPL/LTB >145 kV
D	Alstom GL >72.5 kV
E	Siemens 3AP >145 kV
F	ABB HPL/LTB >145 kV

19.1.2 Installation and measurement setup

The angular transducer has to be installed directly in front of the rotating shaft (axial alignment) of the circuit breaker. Before installing the transducer, check that there is enough space for mounting the screw clamp and the articulating arm.

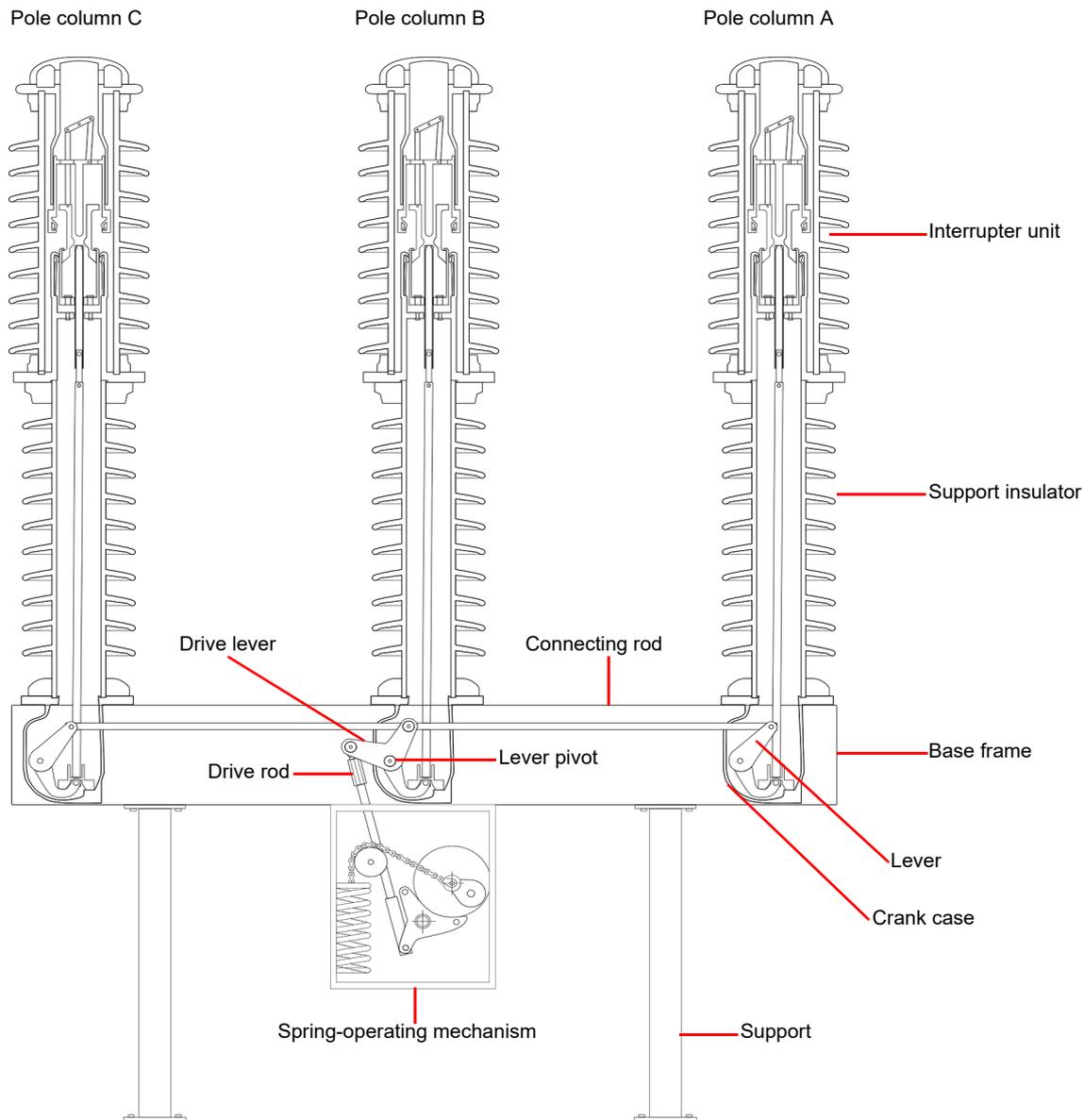


Figure 19-8: Spring-operated live-tank high-voltage circuit breaker

To install an angular transducer:

1. Attach the flexible coupling and the drill chuck, if necessary, to the rotating shaft of the circuit breaker.
2. Mount the screw clamp and the articulating arm holding the transducer in the optimal position in front of the rotating shaft on the circuit breaker.

3. Fit the shaft of the transducer into the hole of the flexible coupling and tighten the screws.
4. Fix the articulating arm by using the set screw and the joint of the screw clamp by switching the lever to the corresponding position.
5. Connect the cable of the transducer to one digital interface of the *CB TN3* module.
6. Configure the *CB TN3* digital interface in *Primary Test Manager*.

If it is possible to exchange the screw on the lever pivot, mount the travel sensor as described in Figure 19-9 and Figure 19-10.

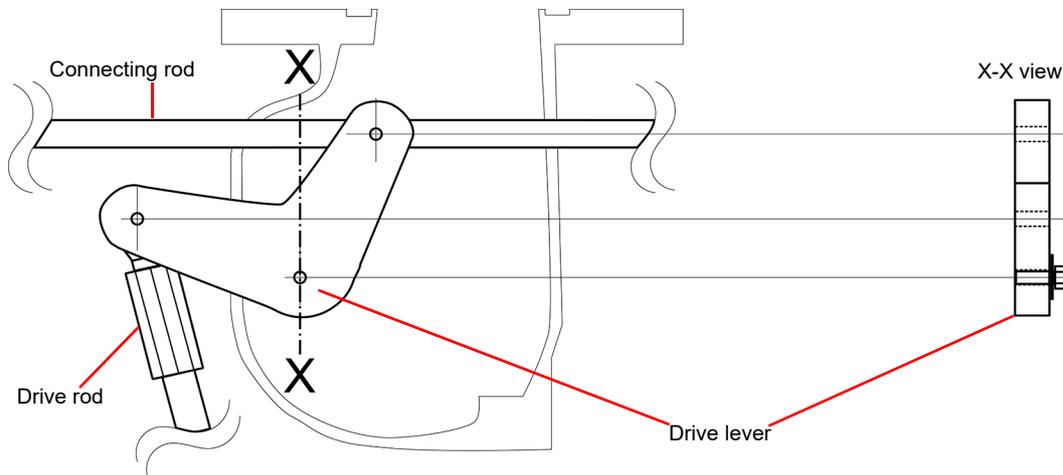


Figure 19-9: Lever (X-X view) where the screw at the pivot point of the lever can be exchanged

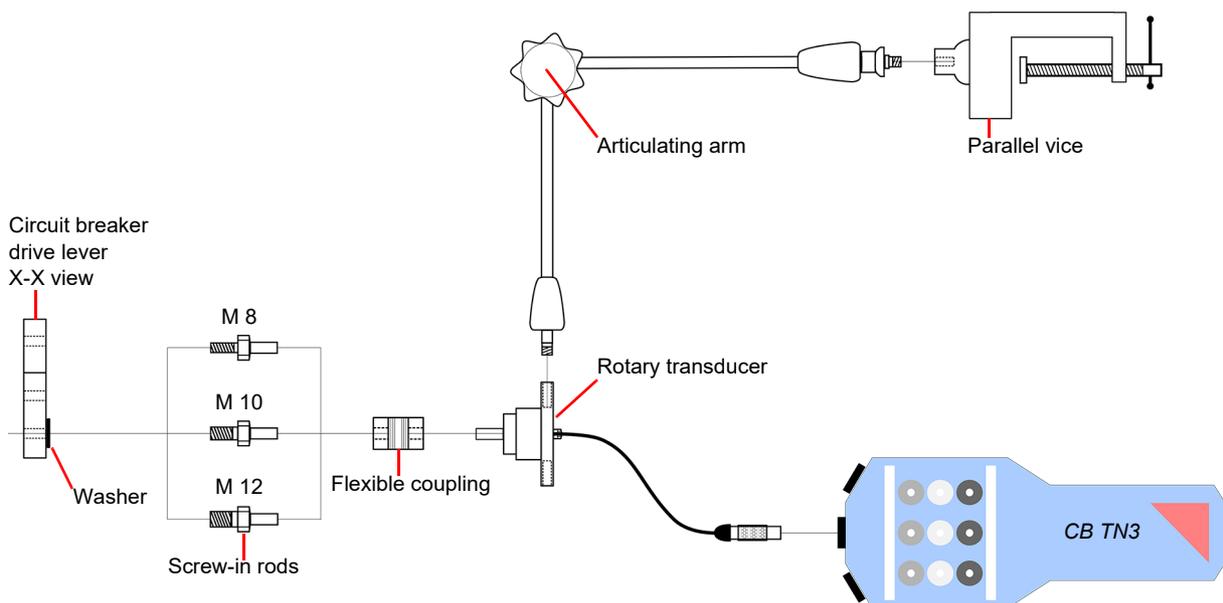


Figure 19-10: Use screw-in rods to apply OMICRON motion transducer to the drive lever of the circuit breaker

If it is not possible to exchange the screw on the lever pivot, mount the travel sensor as described in Figure 19-11 and Figure 19-12.

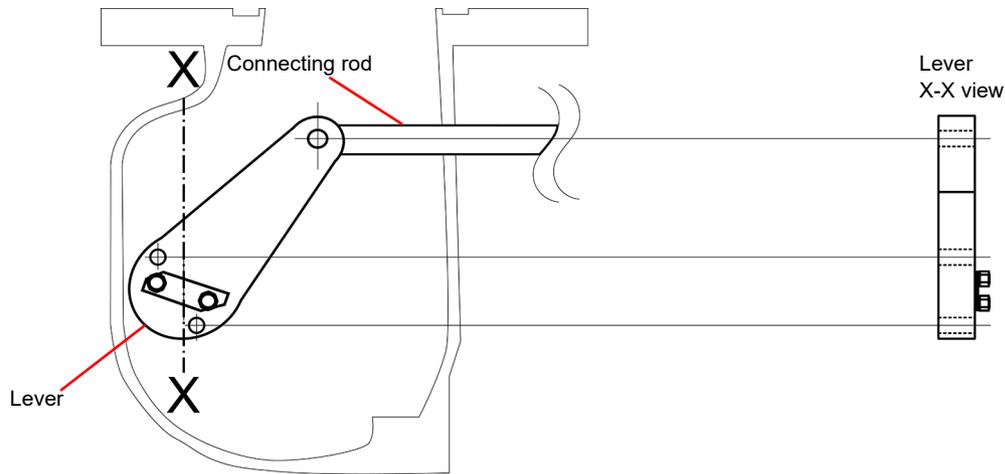


Figure 19-11: Lever (X-X view) where the screw at the pivot point of the lever cannot be exchanged

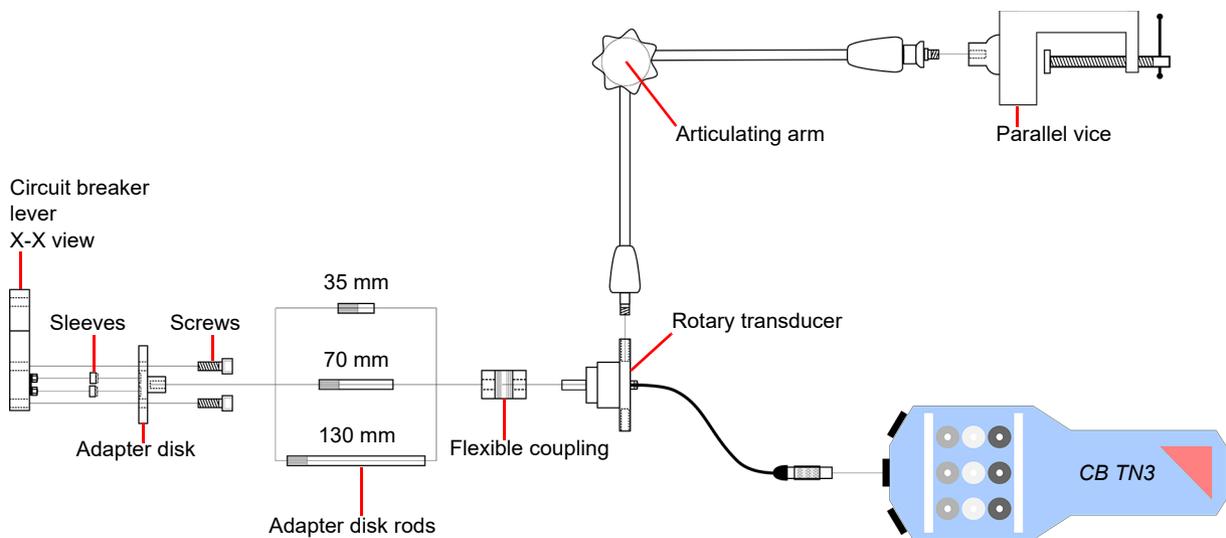


Figure 19-12: Use the adapter disk to apply OMICRON motion transducer to the drive lever of the circuit breaker

19.1.3 Technical data

The following specifications apply to angular transducers supplied by OMICRON.

Table 19-2: Angular transducer specifications

Characteristic	Rating
Resolution	0.0125°
Maximum velocity	2500 rpm
Supply voltage	5 V DC

19.2 Linear transducers

The linear transducers are used to derive motion curves from a linearly moving part of the circuit breaker. Alternatively, the linear transducers can translate the rotation of a shaft into a motion curve if the diameter of the shaft is large enough. There is no mechanical connection between the circuit breaker and the transducer.

19.2.1 Components

The following components are typically required to perform measurements by using the linear transducer.

Transducer and adapter

The linear transducer comes with an adapter which facilitates the transducer to the articulating arm described earlier in this chapter.



Figure 19-13: Linear transducer

Magnetic tape

The magnetic tape is the “scale” for the linear transducer. It is either fixed onto the flat surface of a moving part of the circuit breaker or wrapped around a rotating shaft. Usually, a double-sided adhesive tape is used for the mechanical bond between the tape and the circuit breaker.

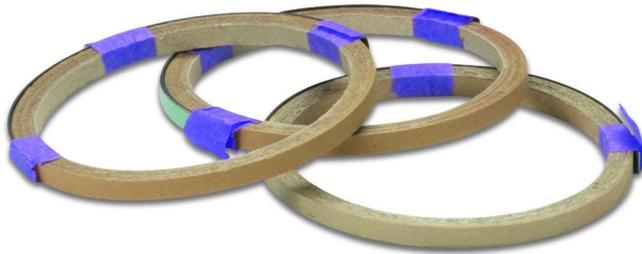


Figure 19-14: Magnetic tapes

Adhesive tapes

Adhesive tapes are used to fix the magnetic tapes to the circuit breaker. The double-sided adhesive tape can be used for flat mounting surfaces. Both double-sided and standard adhesive tapes support mounting of the magnetic tape on the perimeter of a shaft (“wrapping the magnetic tape around a shaft”).



Figure 19-15: Double-sided adhesive tape

Articulating arm and screw clamp

For information about the articulating arm and the screw clamp, see "Articulating arm and screw clamp" on page 304.

Extensions

For information about the extensions, see "Extensions" on page 305.

19.2.2 Installation and measurement setup

Before installing the linear transducer, evaluate the options of attaching the magnetic tape on a part of the circuit breaker that undergoes a linear or a nearly linear motion during switching operation. Alternatively, evaluate the options of attaching the magnetic tape to a rotating shaft of the circuit breaker. The minimum diameter of the shaft is 20 mm. Below this diameter the accuracy specifications are no longer guaranteed.

To install a linear transducer:

1. Place the transducer such that the gap between the magnetic tape and the read head is between 0.1 mm and 2 mm. Evaluate the options of connecting the screw clamp in conjunction with the articulating arm such that the transducer can be held in the desired position.
2. Mount the screw clamp and the articulating arm holding the transducer in the optimal position.
3. Fix the articulating arm by using the set screw and the joint of the screw clamp by switching the lever to the corresponding position.
4. Connect the cable of the transducer to one digital interface of the *CB TN3* module.
5. Configure the *CB TN3* digital interface in *Primary Test Manager*.

19.2.3 Technical data

The following specifications apply to linear transducers supplied by OMICRON.

Table 19-3: Linear transducer specifications

Characteristic	Rating
Resolution	10 µm
Maximum velocity	25 m/s
Supply voltage	5 V DC

19.3 Transducer for the ABB HMB driving mechanism

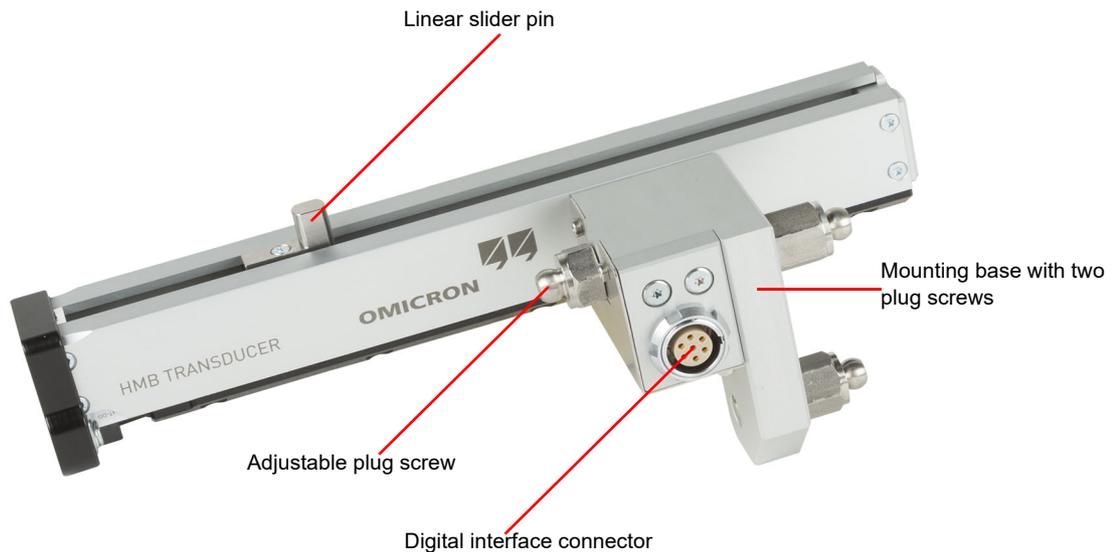


Figure 19-16: Transducer for the ABB HMB circuit breaker driving mechanism

19.3.1 Installation and measurement setup

- ▶ Before starting to mount or to link a digital linear transducer, bring the circuit breaker into the open position, discharge the disc spring column completely and de-energize the pump module which primes the disc spring.

To mount the digital linear transducer:

1. Protect the circuit breaker drive rod with a clean cloth.
2. Screw in the adjustable plug screw completely.
3. In the driving mechanism, locate the hole where the linear slider pin should be placed.
4. Insert and guide the transducer above the drive rod carefully and gently.
5. Insert the linear slider pin into the hole of the driving mechanism's moving plate.
6. Insert the two plug screws of the mounting base into the head of the respective Allen screws of the circuit breaker.
7. Unscrew the adjustable plug screw, place its cap head into the upper Allen screw head, and then tighten it gently with an open-ended spanner.
8. Plug the cable into the digital interface connector.
9. Remove the cloth from the circuit breaker's rod.

19.3.2 Technical data

The following specifications apply to transducers made for the ABB HMB driving mechanism supplied by OMICRON.

Table 19-4: Specifications of the transducers for the ABB HMB driving mechanism

Characteristic	Rating
Resolution	9.7609 μm
Supply voltage	5 V DC

20 Troubleshooting

20.1 Connecting to CIBANO 500

If you encounter any problems when connecting to *CIBANO 500* we recommend turning off any wireless adapter and VPN software on your computer.

If the *CIBANO 500* device to which you want to connect is not displayed in the list of available devices, proceed as follows:

1. Click the **Start OMICRON Device Link** button .
2. In the **OMICRON Device Link** window, look for the device you want to connect to and read its IP address.
3. In the home view, click **More** next to the **Connect** button, and then click **Add device manually**.

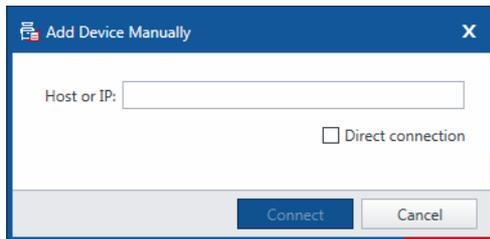


Figure 20-1: **Add device manually** dialog box

4. In the **Add device manually** dialog box, type the IP address of the device you want to connect to.
5. Click **Connect**.

If you assigned a static IP address to the device, you can try to connect as follows:

1. In the **Add device manually** dialog box, select the **Direct connection** check box.
2. In the **IP (with prefix)** box, type `cb://a.b.c.d`, where *a.b.c.d* is the static IP address of the device.

20.2 Firewall configuration

A correct firewall configuration is essential for successful establishing a communication between *CIBANO 500* and your computer.

Note: Any change to the firewall settings mentioned in this section requires administrator rights on your computer.

20.2.1 Windows firewall

The configuration of the Windows firewall is carried out automatically during the installation of *Primary Test Manager*. However, in certain cases this may have no immediate effect.

- ▶ To prevent the Windows firewall from blocking communication, (temporarily) disable it via the Windows Control panel.

If you are now able to successfully establish communication, the Windows firewall was the reason for the blocked communication between your test set and your computer.

- ▶ Reconfigure the Windows firewall in order to enable a permanent use of the test set without having to disable the Windows firewall.
For more information, see 20.2.3 "Manual firewall configuration" later in this section.

20.2.2 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.

For more information on configuring a third-party firewall to allow a permanent communication between *CIBANO 500* and your computer, see 20.2.3 "Manual firewall configuration" later in this section.

Note: Numerous computer security programs or anti-virus packages also contain an integrated firewall function. Double-check and, if applicable, remove all such programs that may be installed on your computer.

20.2.3 Manual firewall configuration

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

Table 20-1: Inbound rules

Program/service name	Rule name	Protocol type	Local port	Remote port	Local IP	Remote IP
OMFind.exe ¹	OMICRON OMFind 4987 (UDP-In)	UDP	4987	Any	Any	Any
	OMICRON OMFind 4988 (UDP-In)	UDP	4988	Any	234.5.6.7	Any
	OMICRON OMFind 4987 (UDP-In)	UDP	4987	Any	Any	Any
	OMICRON OMFind 4988 (UPD-In)	UDP	4988	Any	234.5.6.7	Any
OMComm.exe ²	OMICRON Device Detection (In)	UDP (17)	4987,4988	Any	Any	Any
Any	OMICRON Interprocess Communication	TCP (6), UDP (17)	Any	Any	127.0.0.0/8	127.0.0.0/8

- Default installation path:
64-bit: C:\Program Files (x86)\Common Files\OMICRON
32-bit: C:\Program Files\Common Files\OMICRON
- Default installation path:
C:\Program Files\Common Files\OMICRON\OMCOMM\omcomm.exe

Table 20-2: Outbound rules

Program/service name	Rule name	Protocol type	Local port	Remote port	Local IP	Remote IP
Any	OMICRON CIBANO (ICMPv4-Out)	ICMPv4	Any	Any	Any	Any
	OMICRON OMFind (ICMPv4-Out)	ICMPv4	Any	Any	Any	Any
	OMICRON Primary Test Manager (ICMPv4-Out)	ICMPv4	Any	Any	Any	Any
ODBFileMonitor.exe ¹	OMICRON Device Browser File Monitor FTP CMD (TCP-Out)	TCP	Any	21	Any	Any
	OMICRON Device Browser File Monitor FTP DATA (TCP-Out)	TCP	Any	3000 - 3020	Any	Any
OMFind.exe ¹	OMICRON OMFind 4988 (UDP-Out)	UDP	Any	4988	Any	234.5.6.7
PTM.exe ²	OMICRON CIBANO 6643 (TCP-Out)	TCP	Any	6643	Any	Any
Any	OMICRON Device Detection (ICMP)	ICMP (1)	Any	Any	Any	Any

Table 20-2: Outbound rules (continued)

Program/service name	Rule name	Protocol type	Local port	Remote port	Local IP	Remote IP
OMComm.exe ³	OMICRON Device Detection (Out)	UDP (17)	Any	4988	Any	Any
Any	OMICRON Interprocess Communication	TCP (6), UDP (17)	Any	Any	127.0.0.0/8	127.0.0.0/8
Any	OMICRON Test Set Communication	TCP (6)	Any	2200-2204	Any	Any
DeviceLink.exe ⁴	OMICRON DeviceLink	UDP	Any	69	Any	Any

1. Default installation path:
64-bit: C:\Program Files (x86)\Common Files\OMICRON
32-bit: C:\Program Files\Common Files\OMICRON
2. Default installation path: C:\Program Files\OMICRON\PTM
3. Default installation path: C:\Program Files\Common Files\OMICRON\OMCOMM\omcomm.exe
4. Default installation path: C:\Program Files\Common Files\OMICRON\DeviceLink\DeviceLink.exe

20.3 CIBANO 500 does not start

If the mains voltage exceeds the maximum rated level (see Table 21-18: "Power supply specifications" on page 329), an overvoltage protection will disconnect *CIBANO 500* from mains. In this case, the red lamp on the power switch is on and both status lights on the *CIBANO 500* front panel are off.

First, switch *CIBANO 500* off and wait at least five minutes before powering *CIBANO 500* up again. If *CIBANO 500* still has not started, check the mains voltage and ensure that it does not exceed the maximum permitted rating.

20.4 Hardware self-test

Before performing the first test after *CIBANO 500* has been powered on, a hardware self-test runs for approximately 6 seconds. The self-test checks functionality of the *CIBANO 500* hardware components such as relays, IGBT and amplifiers. If the self-test passed, no action is required. If the self-test failed, *Primary Test Manager* displays detailed information and instructions.

Note: During the self-test, the **Emergency Stop** button must be released.

20.5 Changing the hardware configuration

When you open a prepared test or you connect a test set while having a previously prepared test open, *Primary Test Manager* automatically checks the hardware configuration of your test setup. The following dialog box informs you about the difference between the stored and the currently connected hardware configuration.

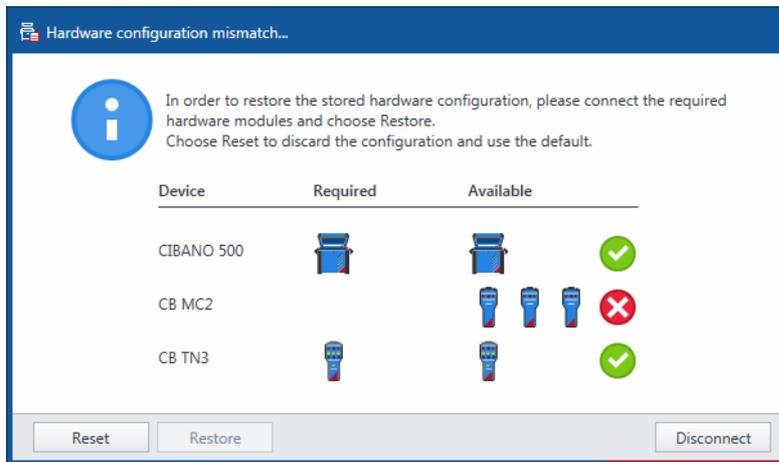


Figure 20-2: Example of the hardware configuration mismatch

Then, do one of the following:

- ▶ To restore the stored hardware configuration, change the connected configuration to match the hardware configuration of the original test, and then click **Restore**.
- ▶ Click **Reset** to discard the stored hardware configuration and use the current hardware configuration of the test set with default settings.

Note: After you click **Reset**, the test will be irreversibly reconfigured with the currently connected hardware configuration.

- ▶ Click **Close** to disconnect *Primary Test Manager* from *CIBANO 500*.

20.6 Upgrading the *CIBANO 500* embedded software

If you encounter any problems when upgrading the *CIBANO 500* embedded software in the *Primary Test Manager* home view, we recommend doing it by using the device browser.

To upgrade the *CIBANO 500* embedded software by using the device browser:

1. We recommend exiting *Primary Test Manager* if it is running.
2. Double-click the **OMICRON Devices** icon on the desktop.
3. In the **OMICRON Devices** window, right-click the *CIBANO 500* device you want to upgrade, and then click **Upgrade device** to open the *CIBANO 500* device website in your default web browser. In the default web browser, a website with the IP address of the *CIBANO 500* device opens.
4. On the navigation bar, click the flag representing the language you want to use.

5. On the navigation bar, click **Upgrade**, and then click **Select file**.

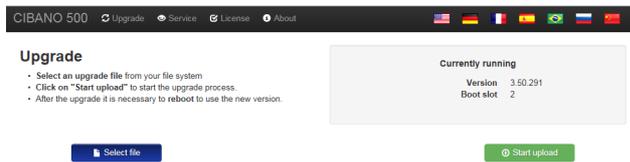


Figure 20-3: Upgrading the *CIBANO 500* embedded software

6. In the **Choose File to Upload** window, browse to the upload file. You can find the upload file:

- On the *Primary Test Manager* DVD at
._EmbeddedSoftware\Cibano500\embeddedImage.tar
- On the hard disk of your computer at
C:\Program Files (x86)\Common Files\OMICRON\UpgradeImages\CHIMERA\
embeddedImage.tar

7. On the device website, click **Start upload**.

8. After the upload has finished, *CIBANO 500* reboots automatically.

Note: Depending on the browser you are using you may wait up to 30 seconds for a response after you pressed **Start upload**. Sometimes a message may appear that the server does not respond. Ignore this message, after a while the upload will start automatically.

9. If you exited *Primary Test Manager* before upgrading the *CIBANO 500* embedded software, start *Primary Test Manager* again after the upgrade procedure has finished.

10. Connect to the *CIBANO 500* device.

21 Technical data

21.1 Calibration interval of *CIBANO 500*

All input/output values are guaranteed for one year within an ambient temperature of $23\text{ °C} \pm 5\text{ °C}/73\text{ °F} \pm 10\text{ °F}$, a warm-up time longer than 25 min. and in a frequency range of 45 Hz to 65 Hz. Accuracy values indicate that the error is smaller than $\pm(\text{value read} \times \text{reading error [rd]} + \text{full scale of the range} \times \text{full scale error [fs]})$. For mains voltages below 190 V AC the system is subject to power restrictions. Technical data is subject to change without notice.

21.2 *CIBANO 500* specifications

Table 21-1: General output specifications

Characteristic	Rating		
Frequency	DC/15 Hz...400 Hz		
Power	Vmains	P_{30 s}	P_{2 h}
	>100 V	1500 W	1000 W
	>190 V	3200 W	2400 W

Table 21-2: Voltage source (A & B)

Source	Range	I _{max, 30 s} ¹	I _{max, 2 h} ¹
DC high range	0...±300 V	27.5 A	12 A
DC low range	0...±150 V	55 A	24 A
AC high range	0...240 V	20 A	12 A
AC low range	0...120 V	40 A	24 A

1. Within the power limits specified in Table 21-1: "General output specifications"

Table 21-3: Current source (A & B)

Source	Range	V _{max, 5 min} ¹	V _{max, 15 min} ¹
DC source	3 × 0...±50 A	50 V	n/a
DC source	3 × 0...±24 A	n/a	50 V

1. Within the power limit specified earlier in this section

The following figures display the output characteristics of *CIBANO 500*.

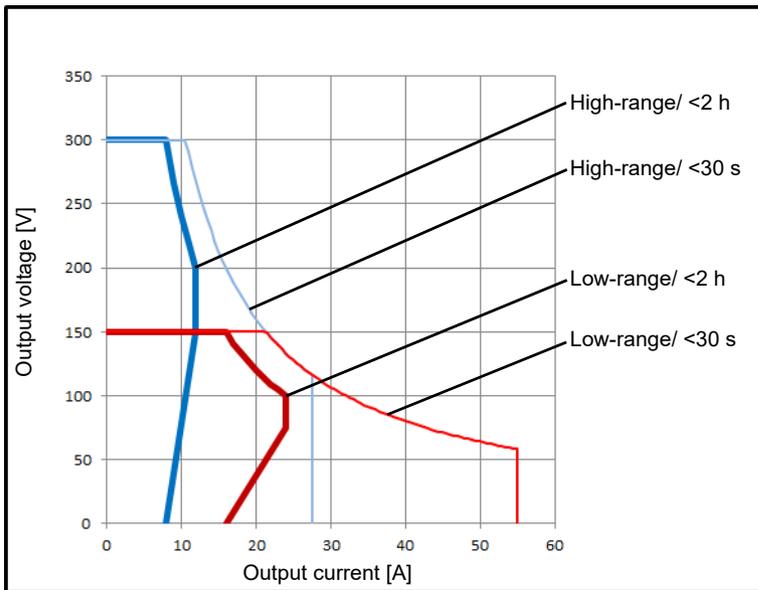


Figure 21-1: DC output characteristics

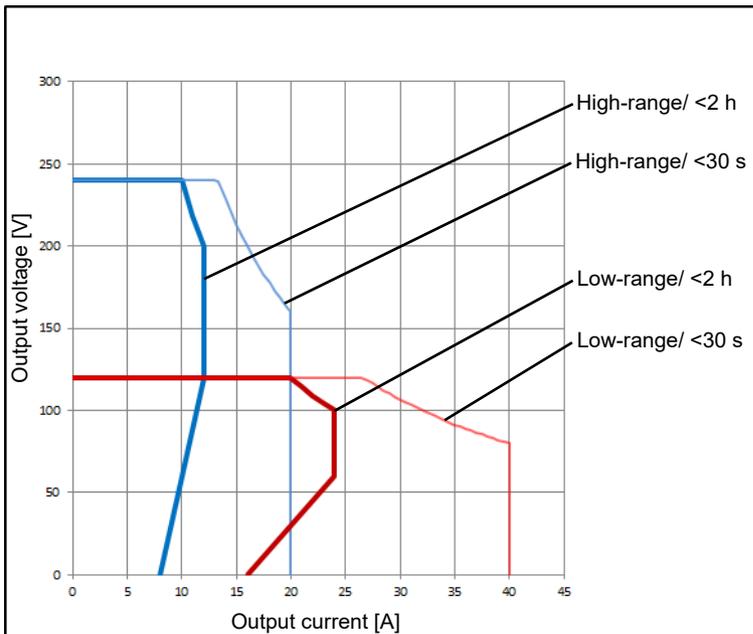


Figure 21-2: AC output characteristics

The CAT level required depends on the *CIBANO 500* application. All CAT ratings are defined for sea levels below 2000 m. There are some limitations between 2000 m and 5000 m sea level.

CAT I is required when the measured voltage is generated by the test set itself. No voltages from other sources are measured. When measuring on circuit breakers that are fully disconnected from the substation installation CAT I would be sufficient.

CAT II is required when measuring within electrical devices or between mains supply and devices.

CAT III is required when measuring in electrical installations such as control cubicles that are still connected to the station battery or mains. The electrical installations are protected by a fuse.

Table 21-4: Internal measurement of outputs **A (CAT III / 300 V)**¹

Range name	Range value	Accuracy ²
300 V	0...300 V	DC: 0.1% rd + 0.05% fs AC: 0.03% rd + 0.01% fs

1. For limited specifications, see Table 21-19: "Climate" on page 330.
2. Means "typical accuracy"; 98% of all units have an accuracy which is better than specified.

Table 21-5: Internal measurement of outputs **B (CAT III / 300 V)**¹

Range name	Range value	Accuracy ²
300 V	0...300 V	DC: 0.1% rd + 0.05% fs AC: 0.03% rd + 0.01% fs
3 V	0...3 V	DC: 0.1% rd + 0.05% fs
300 mV	0...300 mV	DC: 0.1% rd + 0.1% fs
30 mV	0...30 mV	DC: 0.1% rd + 0.1% fs

1. For limited specifications, see Table 21-19: "Climate" on page 330.
2. Means "typical accuracy"; 98% of all units have an accuracy which is better than specified.

Table 21-6: Internal measurement of outputs

Range name	Range value	Accuracy ¹
55 A	0...55 A	DC: 0.1% rd + 0.2% fs
40 A	0...40 A	AC: 0.1% rd + 0.1% fs

1. Means "typical accuracy"; 98% of all units have an accuracy which is better than specified.

Table 21-7: Resistance measurement

Range name	Range value	Meas. current	Accuracy ¹
30 mV	0.1 μΩ...300 μΩ	100 A	0.2% rd + 0.1 μΩ
300 mV	0.5 μΩ...3000 μΩ	100 A	0.2% rd + 0.5 μΩ
3 V	5 μΩ...30 mΩ	100 A	0.2% rd + 5 μΩ
3 V	50 μΩ...300 mΩ	10 A	0.2% rd + 50 μΩ

1. Means "typical accuracy"; 98% of all units have an accuracy which is better than specified.

Table 21-8: Timing accuracy

Characteristic	Rating
Timing accuracy	±1 sample interval ±0.01% rd

Table 21-9: Voltage input **V IN (CAT III / 300 V)**¹

Input	Range	Accuracy ²
DC input	0...420 V	0.5% rd + 0.5% fs
AC input	0...300 V	0.5% rd + 0.5% fs

1. For limited specifications, see Table 21-19: "Climate" on page 330.
2. Means "typical accuracy"; 98% of all units have an accuracy which is better than specified.

Table 21-10: Binary input **A (CAT III / 300 V)**¹

Characteristic	Rating
Binary input type	Toggling with potential-free (dry) contacts or voltages (wet) up to 300 V DC
Maximum sample rate	40 kHz
Minimum resolution	25 μs

1. For limited specifications, see Table 21-19: "Climate" on page 330.

21.3 Interfaces

CIBANO 500 provides the following interfaces.

Table 21-11: Interfaces

Interface	Rating
Digital	2 × safety connection dongle, 1 × serial, 1 × Ethernet EtherCAT [®] module: 4 × EtherCAT [®] Auxiliary module: 1 × EtherCAT [®] , 3 × binary input (C)
Analog	1 × analog input (V IN) 3 × analog input/analog output/binary input (A) 4 × analog input/analog output (B) Auxiliary module: 3 × binary input (C)

21.3.1 Commands

The commands for trip, close and motor can be routed to up to three output sockets in section **A** or **B**.

Table 21-12: Specifications when internal supply is used

Typical voltage drop = 3 V

Command	Max. current ¹	Duty cycle
Trip/Close/Supply	6 A _{RMS} AC or DC	Continuous
	15 A _{RMS} AC or DC	20 s on, 80 s off
	30 A _{RMS} AC or DC	10 s on, 190 s off
	40 A _{RMS} AC or 55 A DC	200 ms
Motor	24 A _{RMS} AC or DC	Continuous
	40 A _{RMS} AC or DC	20 s on, 80 s off
	55 A DC	10 s on, 190 s off

1. Valid while using one channel. Thermal derating when 2 or 3 channels are used in parallel.

Table 21-13: Specifications when external supply is used

Command	Max. current ¹	Duty cycle
Trip/Close/Supply/Motor	24 A _{RMS} AC or DC	Continuous
	40 A _{RMS} AC or DC	20 s on, 80 s off
	55 A DC	10 s on, 190 s off

1. Valid while using one channel. Thermal derating when 2 or 3 channels are used in parallel.

21.3.2 EtherCAT[®] interface

For the maximum use case of the EtherCAT[®]-based accessories, you can connect up to twelve *CB MC2* modules, one *CB TN3* module and up to three *IOB1* modules. In this case, the default sample rate of 10 kHz and the recommended system setup for *Primary Test Manager* (see 2 "System requirements" on page 15) have to be used.

21.3.3 Auxiliary module

Table 21-14: Voltage input **C (CAT III / 300 V)**¹

Input	Range	Accuracy ²
DC input	0...420 V	0.5% rd + 0.1% fs
AC input	0...300 V	0.5% rd + 0.1% fs

1. For limited specifications, see Table 21-19: "Climate" on page 330.
2. Means "typical accuracy"; 98% of all units have an accuracy which is better than specified.

Table 21-15: Binary input **C (CAT III / 300 V)**¹

Characteristic	Rating
Binary input type	Toggling with potential-free (dry) contacts or voltages (wet) up to 300 V DC
Maximum sample rate	40 kHz
Minimum resolution	25 µs

1. For limited specifications, see Table 21-19: "Climate" on page 330.

Table 21-16: Interfaces

Interface	Rating
Digital	1 × EtherCAT [®]
Analog	3 × binary input

21.4 SAFETY connectors

CIBANO 500 has two SAFETY connectors: SAFETY 1 (primary) and SAFETY 2 (secondary) for connecting optional OMICRON safety accessories (for more information, see the Safety Accessory Supplementary Sheet provided by OMICRON). Both connectors have as default a removable safety connector dongle connected to it. Removing either one or both safety connector dongles will open the emergency stop circuit loop inside *CIBANO 500* preventing the operation of the device.

21.4.1 Using the safety accessories

OMICRON offers several safety accessories designed to enhance the safety awareness and/or safety when using *CIBANO 500*. The use of a safety accessory typically requires the removal of one of the safety connector dongles to allow the safety accessory to be plugged in. Some safety accessories themselves contain a SAFETY OUT connector to allow daisy-chaining safety accessories with each other. If the connected (or the last daisy-chained) safety accessory itself also contains a SAFETY OUT connector, the safety connector dongle initially removed from *CIBANO 500* SAFETY 1 or SAFETY 2 connector must be attached to it to close the emergency stop loop.

21.4.2 SAFETY 1 and SAFETY 2 connector pinouts

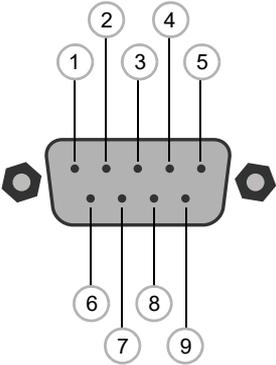
SAFETY 1 and SAFETY 2 connector pinouts differ slightly (see Table 21-17: "SAFETY 1 and SAFETY 2 pin assignment", Figure 21-3: "SAFETY 1 (primary) connector schematics" and Figure 21-4: "SAFETY 2 (secondary) connector schematics" later in this section).

21.4.3 External START button connection

SAFETY 1 (primary) connector can be used to connect an external START button to allow remote control of *CIBANO 500*. If an external START button is used, the switch must fulfill the following requirements:

- R_{off} (open resistance) > 1 M Ω
- R_{on} (close resistance) < 10 Ω
- I_{switch} (switching current) < 1.5 mA
- V_{switch} (switching voltage) < 15 V

Table 21-17: SAFETY 1 and SAFETY 2 pin assignment

	Pin no.	SAFETY 1 (primary)	SAFETY 2 (secondary)
	1 ¹	Warning light green	Warning light green
	2 ¹	Warning light red	Warning light red
	3	Start button IN (n/o)	Start button OUT (n/o)
	4	Common start n/o + emergency stop	Common start n/o + emergency stop
	5	Emergency stop	Emergency stop
	6	Ground	Ground
	7	Ground	Ground
	8	Start button IN (n/c)	Start button OUT (n/c)
	9	Ground	Ground

1. Typical output pin 1 and pin 2 for SAFETY 1 and SAFETY 2 each: 10 V...14 V/max. 400 mA

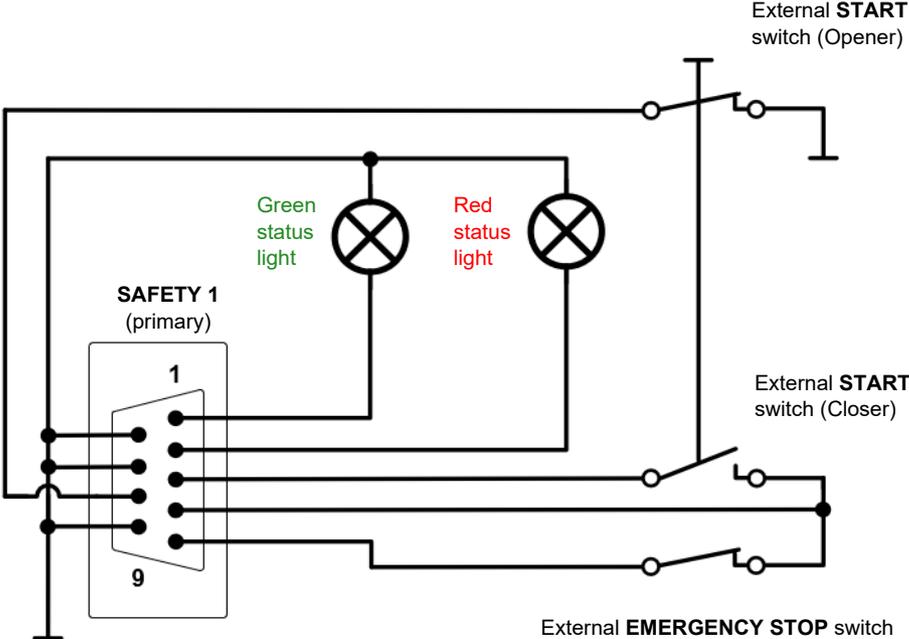


Figure 21-3: SAFETY 1 (primary) connector schematics

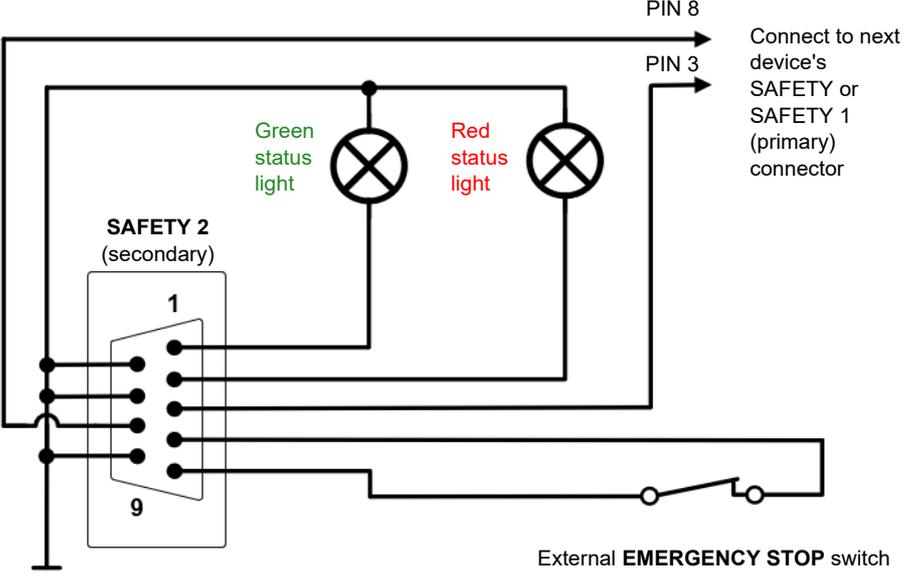


Figure 21-4: SAFETY 2 (secondary) connector schematics

21.4.4 Safety connector dongle

For more information about the safety accessories and the use of the SAFETY connectors and the safety connector dongle, see the Safety Accessory Supplementary Sheet.



Figure 21-5: Safety connector dongle

21.5 Power supply specifications

Table 21-18: Power supply specifications

Characteristic		Rating
Voltage	Nominal	100 V...240 V AC
	Permitted	85 V...264 V AC
Current	Nominal	16 A
Frequency	Nominal	50 Hz/60 Hz
	Permitted	45 Hz...65 Hz
Power fuse		Automatic circuit breaker with magnetic overcurrent tripping at $I > 16$ A
Power consumption	Continuous	<3.5 kW
	Peak	<5.0 kW
Connector type		IEC320/C20, 1 phase

21.6 Environmental conditions

Table 21-19: Climate

Characteristic		Rating
Temperature	Operating	−10 °C...+55 °C/+14 °F...+131 °F
	Storage	−30 °C...+70 °C/−22 °F...+158 °F
Max. altitude	Operating	2000 m/6550 ft, up to 5000 m/16400 ft with limited specifications ^{1,2}
	Storage	12 000 m/40 000 ft

1. Voltage inputs **V IN (CAT III / 300 V)** and **C (CAT III / 300 V)**: from 2000 m/6550 ft to 5000 m/16400 ft altitude CAT III compliance only with half voltage
2. Outputs **A (CAT III / 300 V)** and **B (CAT III / 300 V)** and binary inputs **A (CAT III / 300 V)** and **C (CAT III / 300 V)**: from 2000 m/6550 ft to 5000 m/16400 ft altitude only CAT II compliance or CAT III compliance with half voltage

21.7 Mechanical data

Table 21-20: Mechanical data

Characteristic	Rating
Dimensions (w × h × d)	580 mm × 386 mm × 229 mm/22.9 inch × 15.2 inch × 9.0 inch (w = 464 mm/18.3 inch without handles)
Weight	20 kg/44.1 lb

21.8 Standards

Table 21-21: Standards conformity

EMC, safety		
EMC	IEC/EN 61326-1 (industrial electromagnetic environment) FCC subpart B of part 15, class A	
Safety	IEC/EN/UL 61010-1, IEC/EN/UL 61010-2-30	 
Other		
Shock	IEC/EN 60068-2-27 (15 g/11 ms, half-sinusoid, 3 shocks in each axis)	
Vibration	IEC/EN 60068-2-6 (frequency range 10 Hz...150 Hz, acceleration 2 g continuous (20 m/s ² /65 ft/s ²), 20 cycles per axis)	
Humidity	IEC/EN 60068-2-78 (5%...95% relative humidity, no condensation), tested at 40 °C/104 °F for 48 hours	

22 Accessories

22.1 CB MC2 module

22.1.1 Designated use

The *CB MC2* module is a probe for timing, static and dynamic resistance measurements on the circuit breaker's main contacts. It facilitates measurements where current is injected over the circuit breaker interrupter while the circuit breaker is operated (tripped or closed).



Figure 22-1: Front view of the *CB MC2* module



Figure 22-2: Bottom view of the *CB MC2* module

22.1.2 Technical data

Table 22-1: CB MC2 specifications

Characteristic	Rating
Current output	
Number of channels	2
Current source	0...100 A DC
Maximum output voltage	2.6 V DC
Static contact resistance measurement	
Range	0.1 $\mu\Omega$...1000 $\mu\Omega$
Accuracy ¹	0.2% rd + 0.1 $\mu\Omega$
Measuring current	100 A
Dynamic contact resistance measurement²	
Range	10 $\mu\Omega$...200 m Ω
Accuracy ¹	0.2% rd + 10 $\mu\Omega$
Settling time	40 μ s
Maximum sample rate	40 kHz
Minimum resolution	25 μ s
Pre-insertion resistance (PIR) measurement	
Range	0...10 k Ω
Accuracy (<500 Ω) ¹	0.5% rd + 10 m Ω
Accuracy (500 Ω ...10 k Ω) ¹	3% rd
Timing measurement	
Maximum sample rate	40 kHz
Minimum resolution	25 μ s
Accuracy	± 1 sample interval $\pm 0.01\%$ rd
Interface	
Communication protocol	EtherCAT [®]
Connector type	RJ-45

1. Means "typical accuracy"; 98% of all units have an accuracy which is better than specified.

2. Valid for test currents ≥ 10 A

Table 22-2: Maximum output current duration with a fully charged capacitor¹

Output current	Load		
	100 $\mu\Omega$	500 $\mu\Omega$	3 m Ω
1 × 100 A	6200 ms	5960 ms	4460 ms
2 × 100 A	1900 ms	1780 ms	1030 ms

1. Only valid if the standard 3 m red and 0.75 m black high-current cables are used.

All input/output values are guaranteed for one year within the environmental conditions specified in the following table.

Table 22-3: Climate

Characteristic	Rating	
Temperature	Operating	-30 °C...+70 °C/-22 °F...+158 °F
	Storage	-30 °C...+70 °C/-22 °F...+158 °F
Max. altitude	Operating	5 000 m/16 400 ft
	Storage	12 000 m/40 000 ft

Table 22-4: Mechanical data

Characteristic	Rating
Dimensions (w × h × d)	109 mm × 272 mm × 63 mm/ 4.3 inch × 10.7 inch × 2.5 inch
Weight	1.2 kg/2.6 lb

Table 22-5: Standards conformity

EMC, safety		
EMC	IEC/EN 61326-1 (industrial electromagnetic environment) FCC subpart B of part 15, class A	
Safety	IEC/EN/UL 61010-1	
Other		
Shock	IEC/EN 60068-2-27 (15 g/11 ms, half-sinusoid, 3 shocks in each axis)	
Vibration	IEC/EN 60068-2-6 (frequency range 10 Hz... 150 Hz, acceleration 2 g continuous (20 m/s ² /65 ft/s ²), 20 cycles per axis)	
Humidity	IEC/EN 60068-2-78 (5%...95% relative humidity, no condensation), tested at 40 °C/104 °F for 48 hours	
Protection class	IP 42 (only in the pendent position), according to IEC/EN 60529	

22.2 CB TN3 module

22.2.1 Designated use

The *CB TN3* module is used to evaluate pressure signals and the displacement of the circuit breaker's main contacts during operation. The pressure and contact travel are measured by transducers connected to the *CB TN3* module. The *CB TN3* module supports digital and analog transducers.

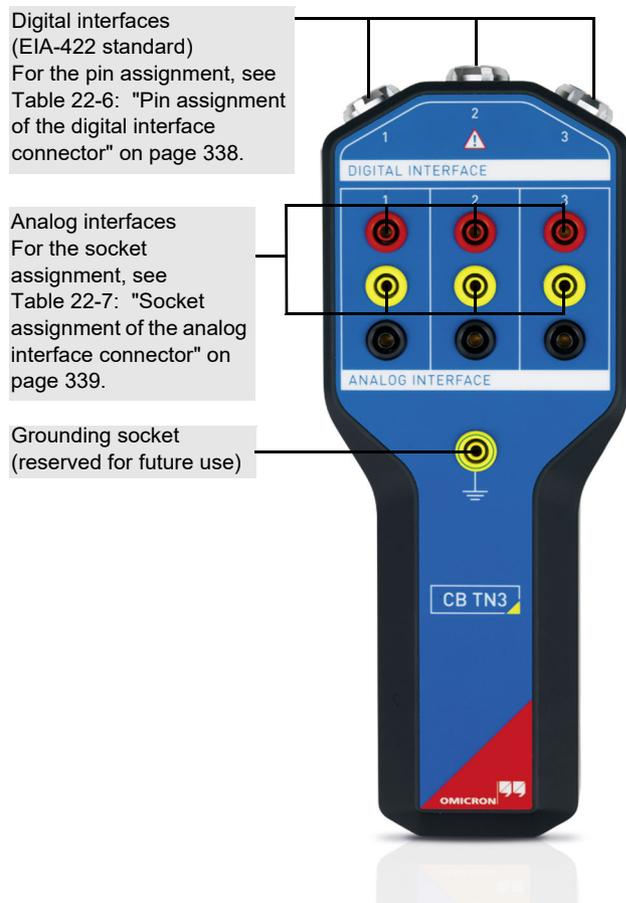


Figure 22-3: Front view of the *CB TN3* module

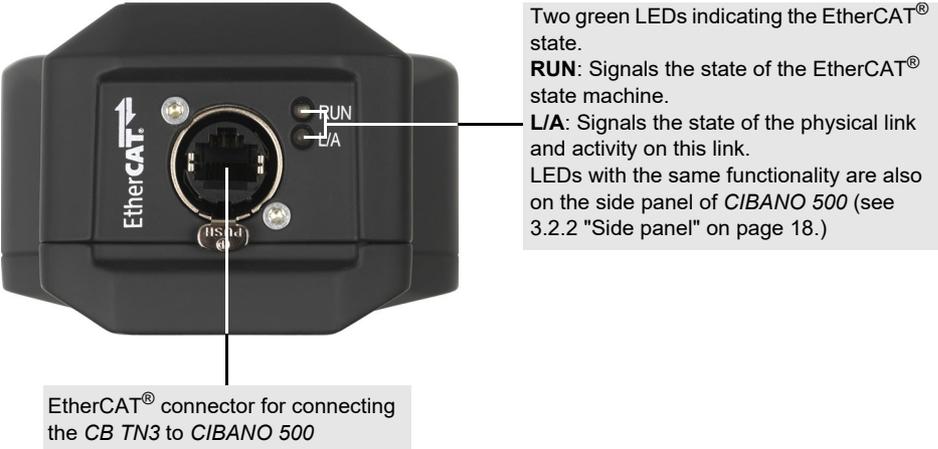


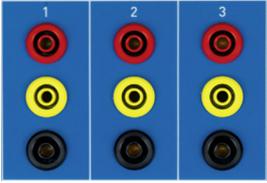
Figure 22-4: Bottom view of the CB TN3 module

Table 22-6: Pin assignment of the digital interface connector

Layout	Pin	Description
	Differential signals	
	1	A
	2	!A ¹
	3	B
	4	!B ¹
	Supply voltage	
	5 (reserved for future use)	+5 V
6	+5 V...+30 V (set by the user in <i>Primary Test Manager</i>)	
Grounding		
7	GND	

1. Inverted signal

Table 22-7: Socket assignment of the analog interface connector

Layout	Socket	Channel	Description
	Red	1	Voltage/current output
	Yellow		Voltage measurement
	Black		Current measurement/GND
	Red	2	Voltage/current output
	Yellow		Voltage measurement
	Black		Current measurement/GND
	Red	3	Voltage/current output
	Yellow		Voltage measurement
	Black		Current measurement/GND

22.2.2 Technical data

Table 22-8: CB TN3 specifications

Characteristic	Rating
Max. number of digital/analog transducers used simultaneously	3
Interface to CIBANO 500	
Communication protocol	EtherCAT®
Connector type	RJ-45

Table 22-9: Analog transducer interface

Characteristic	Rating
Output	
Number of channels	3
Voltage	5 V...30 V DC
Current	10 mA...50 mA
Voltage input	
Number of channels	3
Range	30 V
Accuracy ¹	0.1% rd + 20 mV
Maximum sample rate	40 kHz
Minimum resolution	25 µs
Current input	
Number of channels	3
Range	50 mA
Accuracy ¹	0.1% rd + 20 µA

1. Means "typical accuracy"; 98% of all units have an accuracy which is better than specified.

Table 22-10: Digital transducer interface

Characteristic	Rating
Output	
Number of channels	3
Voltage	5 V...30 V DC
Current	10 mA...200 mA
Max. power per channel	5 W
Input	
Input signal	2 square-wave signals according to EIA-422/485 standard
Max. input frequency	10 MHz
Maximum sample rate	40 kHz
Minimum resolution	25 μ s
Accuracy	± 1 pulse $\pm 0.01\%$ rd

All input/output values are guaranteed for one year within the environmental conditions specified in the following table.

Table 22-11: Climate

Characteristic	Rating	
Temperature	Operating	-30 °C...+70 °C/-22 °F...+158 °F
	Storage	-30 °C...+70 °C/-22 °F...+158 °F
Max. altitude	Operating	5 000 m/16 400 ft
	Storage	12 000 m/40 000 ft

Table 22-12: Mechanical data

Characteristic	Rating
Dimensions (w × h × d)	109 mm × 272 mm × 63 mm/4.3 inch × 10.7 inch × 2.5 inch
Weight	0.76 kg/1.7 lb

Table 22-13: Standards conformity

EMC, safety		
EMC	IEC/EN 61326-1 (industrial electromagnetic environment) FCC subpart B of part 15, class A	
Safety	IEC/EN/UL 61010-1	
Other		
Shock	IEC/EN 60068-2-27 (15 g/11 ms, half-sinusoid, 3 shocks in each axis)	
Vibration	IEC/EN 60068-2-6 (frequency range 10 Hz... 150 Hz, acceleration 2 g continuous (20 m/s ² /65 ft/s ²), 20 cycles per axis)	
Humidity	IEC/EN 60068-2-78 (5%...95% relative humidity, no condensation), tested at 40 °C/104 °F for 48 hours	
Protection class	IP 42 (only in the pendent position), according to IEC/EN 60529	

22.3 IOB1 module

22.3.1 Designated use

The *IOB1* module extends the amount of inputs and outputs of *CIBANO 500*. It provides 12 completely independent galvanically isolated channels (CAT III / 300 V). The additional inputs and outputs can be used for reading auxiliary contacts and controlling trip and close coils and motors.

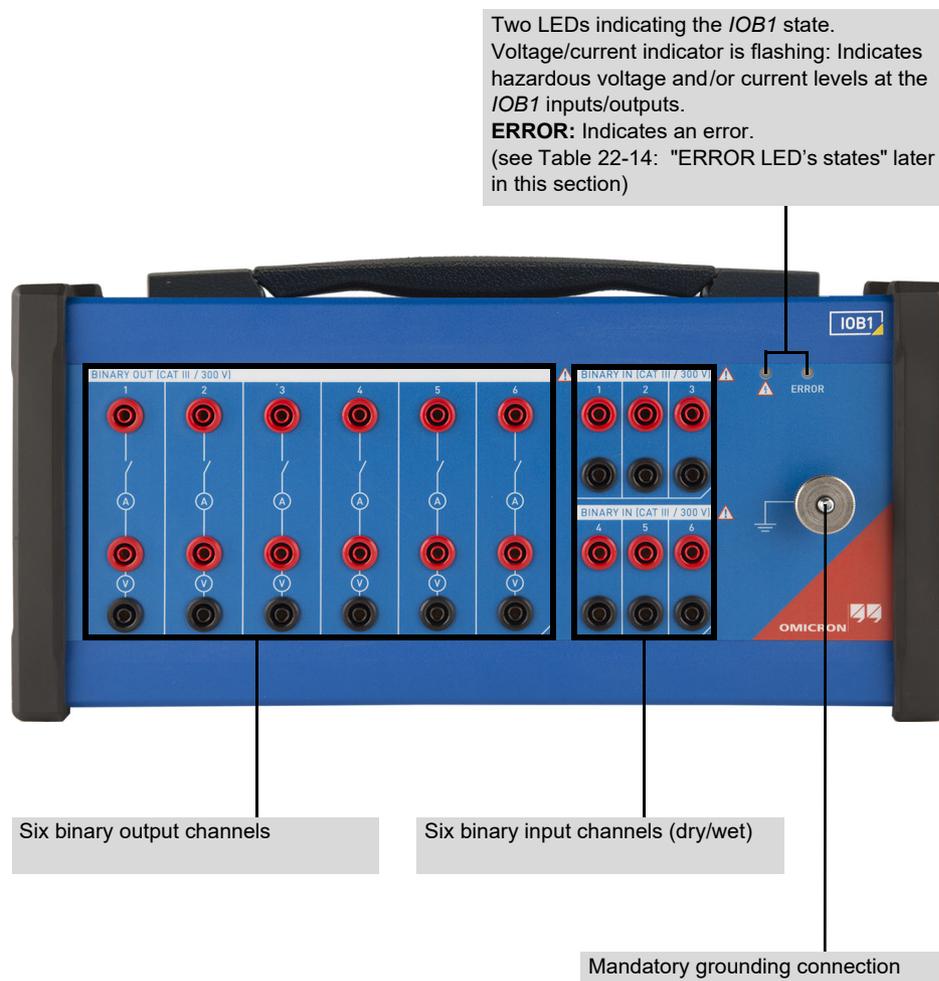


Figure 22-5: Front view of the *IOB1* module

Table 22-14: **ERROR** LED's states

State	Description
Off	No error
Flashes periodically two times	Supply failure of the channel relay
Flashes periodically three times	Overtemperature

The following figures show the output and input channel configurations.

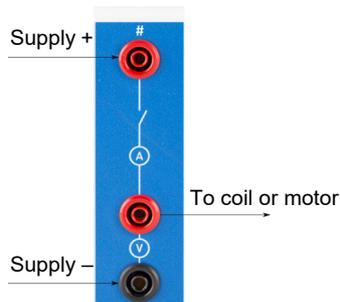


Figure 22-6: Output channel configuration

The contacts of the output channels are controlled by *CIBANO 500* according to the specified test sequence. Each output channel has an integrated voltage and current measurement. Because of the integrated voltage measurement, the output channels can also be used to detect the state of an auxiliary contact. The output channels are externally supplied, for example, via the **B3/BN** output of *CIBANO 500*.

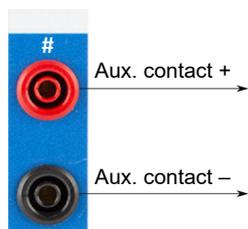


Figure 22-7: Input channel configuration

The input channels are used to detect the state of an auxiliary contact. These contacts can have a voltage supplied to them (wet) or can be potential free (dry).

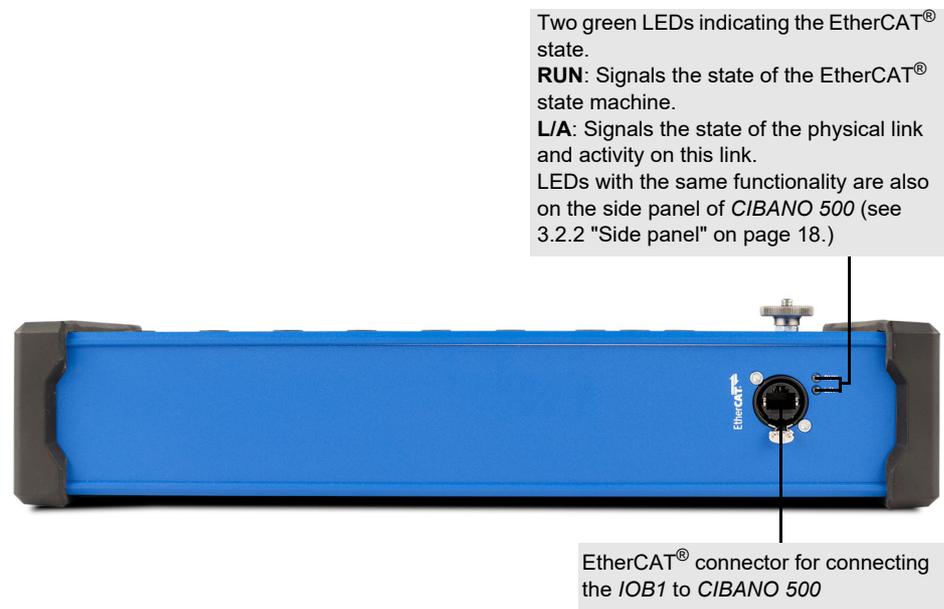


Figure 22-8: Bottom view of the *IOB1* module

22.3.2 Technical data

Table 22-15: Voltage measurement on **BINARY OUT/BINARY IN (CAT III / 300 V)**¹

Signal type	Measurement range	Accuracy ²
DC, continuous	300 V	0.05% rd + 0.05% fs
AC, continuous		0.05% rd + 0.02% fs

1. For limited specifications, see Table 22-21: "Climate" on page 346.
2. Means "typical accuracy"; 98% of all units have an accuracy which is better than specified.

Table 22-16: Current measurement on **BINARY OUT (CAT III / 300 V)**¹

Signal type	Measurement range	Accuracy ²
DC, continuous	40 A	0.1% rd + 0.2% fs
AC, continuous		0.1% rd + 0.05% fs

1. For limited specifications, see Table 22-21: "Climate" on page 346.
2. Means "typical accuracy"; 98% of all units have an accuracy which is better than specified.

Table 22-17: Voltage rating on **BINARY OUT/BINARY IN (CAT III / 300 V)**¹

Voltage per channel	Duty cycle
±300 V DC or AC	continuous
±500 V	transient peak

1. For limited specifications, see Table 22-21: "Climate" on page 346.

Table 22-18: Current rating on **BINARY OUT (CAT III / 300 V)**¹

Current per channel	Duty cycle
24 A _{RMS} DC or AC	continuous
40 A _{RMS} AC or 55 A _{peak}	200 ms on, 5 s off
±85 A	transient peak

1. For limited specifications, see Table 22-21: "Climate" on page 346.

Table 22-19: Timing accuracy

Characteristic	Rating
Timing accuracy	±1 sample interval ±0.01% rd

Table 22-20: **BINARY IN (CAT III / 300 V)**¹

Characteristic	Rating
Binary input type	Toggling with potential-free (dry) contacts or voltages (wet) up to 300 V DC
Maximum sample rate	40 kHz
Minimum resolution	25 µs

1. For limited specifications, see Table 22-21: "Climate" on page 346.

All input/output values are guaranteed for one year within the environmental conditions specified in the following table.

Table 22-21: Climate

Characteristic		Rating
Temperature	Operating	-10 °C...+55 °C/+14 °F...+131 °F
	Storage	-30 °C...+70 °C/-22 °F...+158 °F
Max. altitude	Operating	2000 m/6550 ft, up to 5000 m/16400 ft with limited specifications ¹
	Storage	12 000 m/40 000 ft

1. **BINARY OUT (CAT III / 300 V)** outputs and **BINARY IN (CAT III / 300 V)** inputs: from 2000 m/6550 ft to 5000 m/16400 ft altitude only CAT II compliance or CAT III compliance with half voltage

Table 22-22: Mechanical data

Characteristic	Rating
Dimensions (w × h × d)	381 mm × 190 mm × 90 mm/15 inch × 7.5 inch × 3.5 inch
Weight	3.0 kg/6.6 lb

Table 22-23: Standards conformity

EMC, safety		
EMC	IEC/EN 61326-1 (industrial electromagnetic environment) FCC subpart B of part 15, class A	
Safety	IEC/EN/UL 61010-1, IEC/EN/UL 61010-2-30	
Other		
Shock	IEC/EN 60068-2-27 (15 g/11 ms, half-sinusoid, 3 shocks in each axis)	
Vibration	IEC/EN 60068-2-6 (frequency range 10 Hz... 150 Hz, acceleration 2 g continuous (20 m/s ² /65 ft/s ²), 20 cycles per axis)	
Humidity	IEC/EN 60068-2-78 (5%...95% relative humidity, no condensation), tested at 40 °C/104 °F for 48 hours	

22.4 EHB1 EtherCAT® hub

22.4.1 Designated use

The *EHB1* EtherCAT® hub is a module for connecting OMICRON accessories like the *CB MC2*, *CB TN3* and *IOB1* modules to *CIBANO 500* EtherCAT® interface.

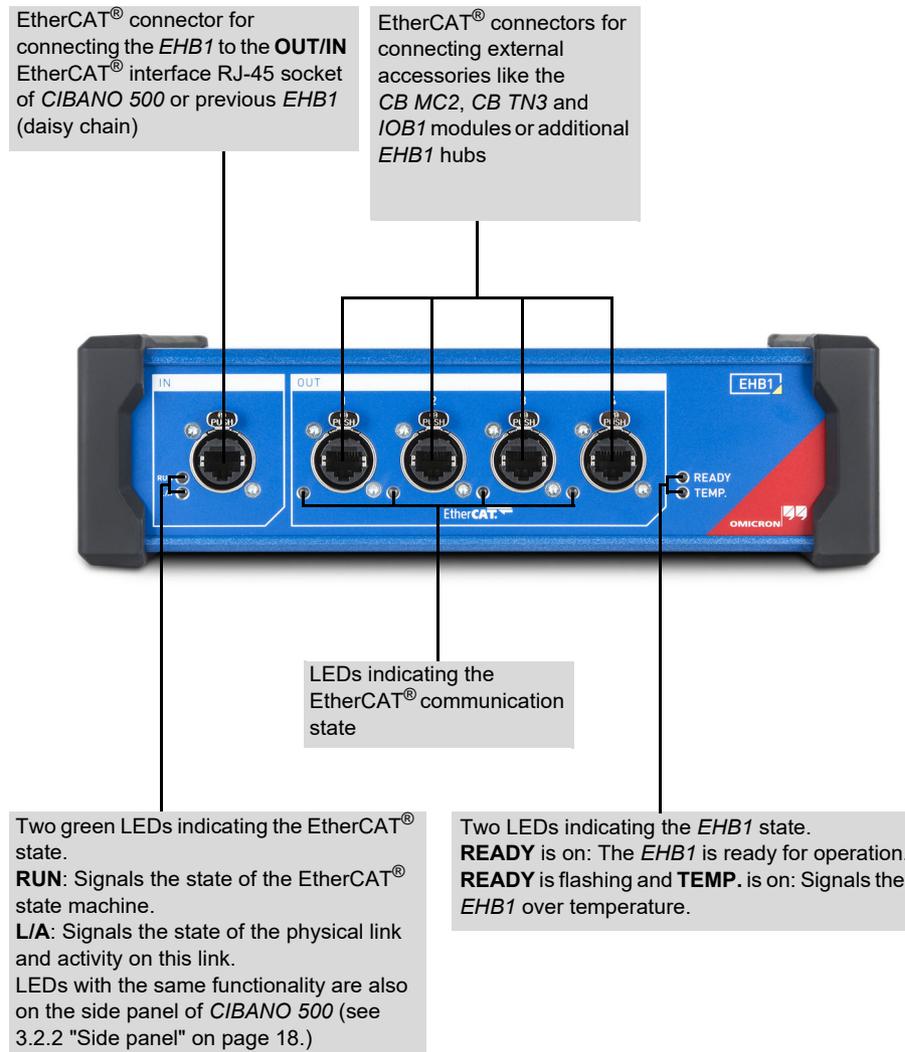


Figure 22-9: Front view of the *EHB1* EtherCAT® hub

22.4.2 Technical data

Table 22-24: *EHB1* communication specifications

Characteristic	Rating
Output	
Number of channels	4
Devices per channel	1× <i>CB MC2</i> , 1× <i>CB TN3</i> or 1× <i>IOB1</i>
Max. cable length	50 m/164 ft
Input	
Number of channels	1
Interface	
Communication protocol	EtherCAT®
Connector type	RJ-45

Table 22-25: Power supply specifications

Characteristic	Rating	
Voltage	Nominal	100 V...240 V AC
	Permitted	85 V...264 V AC
Current	Maximal	2.5 A
Frequency	Nominal	50 Hz/60 Hz
	Permitted	45 Hz...65 Hz
Connector type	IEC320/C14, 1 phase	

Table 22-26: Climate

Characteristic	Rating	
Temperature	Operating	−10 °C...+55 °C/+14 °F...+131 °F
	Storage	−30 °C...+70 °C/−22 °F...+158 °F
Max. altitude	Operating	5 000 m/16 400 ft
	Storage	12 000 m/40 000 ft

Table 22-27: Mechanical data

Characteristic	Rating
Dimensions (w × h × d)	265 mm × 80 mm × 180 mm/10.4 inch × 3.1 inch × 7.1 inch
Weight	1.8 kg/4.0 lb

Table 22-28: Standards conformity

EMC, safety		
EMC	IEC/EN 61326-1 (industrial electromagnetic environment) FCC subpart B of part 15, class A	
Safety	IEC/EN/UL 61010-1	
Other		
Shock	IEC/EN 60068-2-27 (15 g/11 ms, half-sinusoid, 3 shocks in each axis)	
Vibration	IEC/EN 60068-2-6 (frequency range 10 Hz...150 Hz, acceleration 2 g continuous (20 m/s ² /65 ft/s ²), 20 cycles per axis)	
Humidity	IEC/EN 60068-2-78 (5%...95% relative humidity, no condensation), tested at 40 °C/104 °F for 48 hours	

22.5 Current sensor

22.5.1 Designated use

The current sensor is used to measure the operating times on both-side grounded gas insulated switchgears (GIS) with grounding switches. During the dedicated Timing (CSM) test (see 17.3.5 "Timing (CSM) test" on page 233) the sensor detects the change of current flow through the measured ground connection of the grounding switch. The current sensor is only intended to be used with the *CIBANO 500* test system.

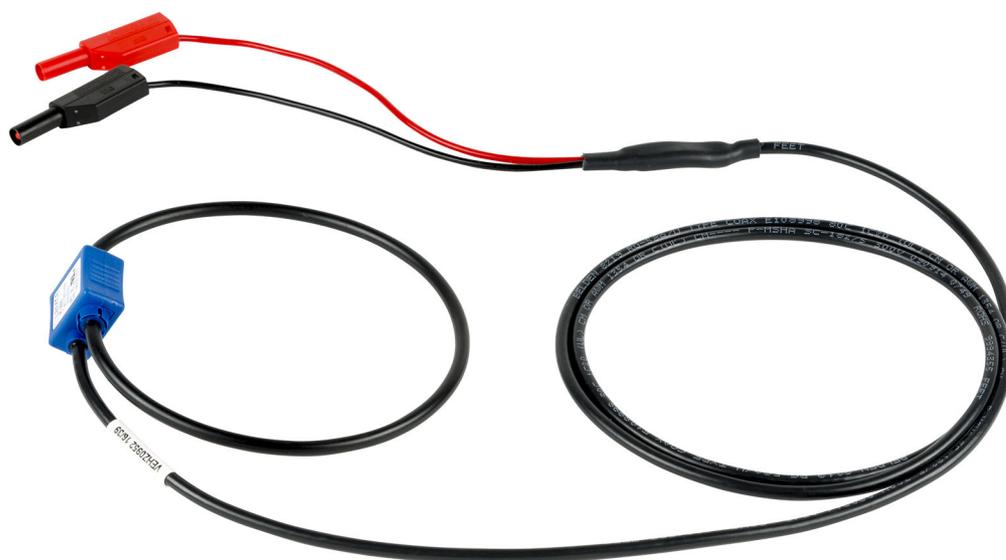


Figure 22-10: Current sensor

22.5.2 Technical data

Table 22-29: Current sensor specifications

Characteristic	Rating
Primary nominal RMS current	2.000 A
IP class	IP 2X

23 Software license information

Parts of the *CIBANO 500* software are under OMICRON license, other parts are under open source software licenses.

The following OMICRON licenses are available for activating the corresponding tests and software features:

- First Trip
- Timing (VTM)
- Timing
- Dynamic Contact Resistance
- Current Sensor Measurement
- Contact Resistance
- Minimum Pickup
- Motor Current
- Current clamp
- Motion
- Demagnetization

23.1 Manage OMICRON licenses

To manage the OMICRON licenses for a *CIBANO 500* device:

1. Double-click the **OMICRON Devices** icon  on the desktop.
2. In the **OMICRON Devices** window, right-click the *CIBANO 500* device in the list, and then click **Upgrade device** to open the *CIBANO 500* device website.
3. On the navigation bar, click the flag representing the language you want to use.
4. On the navigation bar, click **License** to display the list of available licenses.

23.2 Upload a license file

To upload a license file:

1. On the *CIBANO 500* device website, click **Select file**.
2. In the **Choose File to Upload** window, browse to the license file you want to upload.
3. On the device website, click **Start upload**.

23.3 Read the open source licensing information

For the complete open source licensing information:

1. Open the *CIBANO 500* device website.
2. On the navigation bar, click **About**, and then click **Manifest**.

The open source code is available at www.omicronenergy.com/opensource.

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