MONTESTO 200

User Manual

Manual Version: ENU 1221 05 01

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 Energy Solutions GmbH 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 Energy Solutions GmbH 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.

Contents

About this manual

This User Manual provides information on how to use the *MONTESTO 200* on-line partial discharge measurement and temporary monitoring system safely, properly and efficiently. The *MONTESTO 200* User Manual contains important safety rules for working with *MONTESTO 200* and gets you familiar with operating *MONTESTO 200*. 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 *MONTESTO 200* User Manual always has to be available on the site where *MONTESTO 200* is used. The users of *MONTESTO 200* must read this manual before operating *MONTESTO 200* and observe the safety, installation, and operation instructions therein.

Reading the *MONTESTO 200* 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 Safety standards and rules

Operation of *MONTESTO 200* 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 *MONTESTO 200* or system components, read the safety instructions in this User Manual carefully.

Do not operate *MONTESTO 200* without understanding the safety information in this manual. If you do not understand some safety instructions, contact OMICRON before proceeding.

Maintenance and repair of *MONTESTO 200* is only permitted by qualified experts at OMICRON service centers (see "Support" on page 54).

Make sure to follow all safety requirements of the substation or work environment.

MONTESTO 200 can be installed with the asset to be tested/monitored in operation, only when the OMICRON sensors are preinstalled. Please read the sensor’s user manual beforehand.

Before making any connections to a monitored high-voltage asset, 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 Operation

1.2.1 Operator qualifications

Working on high-voltage assets can be extremely dangerous. Consequently, only personnel qualified, skilled and authorized in electrical engineering and trained by OMICRON are allowed to operate *MONTESTO 200*. Before starting to work, clearly establish the responsibilities.

Installation of *MONTESTO 200* must be done by electrotechnically skilled workers according to the local rules and laws.

Personnel receiving training, instructions, directions, or education on *MONTESTO 200* must be under constant supervision of an experienced operator while working on system components or accessories connected to the high-voltage asset. 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 work duration.

1.2.2 Operating instructions

Observe the following instructions when operating *MONTESTO 200*:

- ► If the asset to be tested/monitored is in operation, always operate *MONTESTO 200* via remote (WiFi) or LAN (fiber-optic isolated) connection.
- ► During the *MONTESTO 200* operation, personnel must not be close to any system component except of the laptop / computer, when the asset is live.
- ► Operate *MONTESTO 200* only under ambient conditions specified in the "Technical Data" chapters of the respective system components.
- ► Do not operate *MONTESTO 200* in the presence of explosives, gas, or vapors.
- ► If *MONTESTO 200* or any of the system components does not seem to function properly, turn the device off, if feasible, and contact your regional OMICRON service center (see "Support" on page 54).

1.3 Orderly measures

The *MONTESTO 200* User Manual or alternatively the e-book has always to be available on the site where *MONTESTO 200* is operated.

The users of *MONTESTO 200* must read this manual before operating *MONTESTO 200* and observe the safety, installation, and operating instructions therein.

When operating *MONTESTO 200* in conjunction with OMICRON sensors, please make sure that you have read and understood the sensors' user manuals.

MONTESTO 200 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 *MONTESTO 200* 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.

1.4 Cleaning

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

1.5 Disclaimer

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

The installation of third-party SW components or other updates may lead to the loss of data stored in the database.

OMICRON does not take the responsibility if personnel injuries and/or equipment damage occurs while using *MONTESTO 200* together with third party sensors or devices.

1.6 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.

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.

1.7 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 *MONTESTO 200*

2.1 Designated use

MONTESTO 200 is a portable device for on-line PD measurement and monitoring of rotating machines, power transformers, cables and other high-voltage assets where PD measurement can be observed. *MONTESTO 200* designed for continuous indoor and outdoor operation.

2.2 Hardware overview

Figure 2-1: *MONTESTO 200*

2.2.1 *MONTESTO 200* front panel

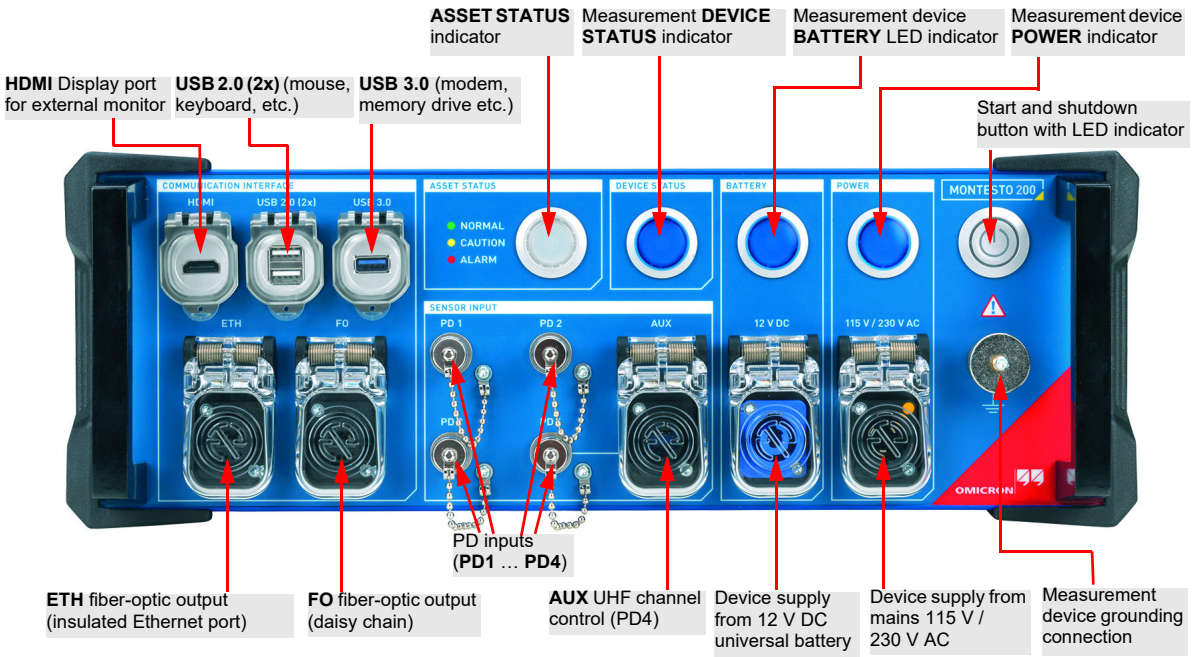


Figure 2-2: *MONTESTO 200* front panel

Table 2-1: *MONTESTO 200* front panel

Front panel	Description
COMMUNICATION INTERFACE	
HDMI	**HDMI** is a display port for connection of an external monitor to access the internal PC (IPC), see also 3.2.4 "Direct connection" on page 28.
USB 2.0 (2x)	The two **USB 2.0** ports are for keyboard and mouse connection to access the internal PC, see also 3.2.4 "Direct connection" on page 28. Any other USB device can be connected to these ports.
USB 3.0	With the **USB 3.0** port, you can create a WiFi connection via an WiFi modem, see also 3.2.2 "WiFi connection" on page 15. Any other USB device can be connected to these ports. You can also connect a storage drive to this port for data transfer.
ETH	The **ETH** port enables the *MONTESTO 200* integration into a LAN, or software setup via galvanic isolation, see also 3.2.3 "LAN cable connection" on page 16.
FO	The fiber-optic (**FO**) output port is used for daisy-chaining of multiple acquisition units.

Table 2-1: *MONTESTO 200* front panel (continued)

Front panel	Description
ASSET STATUS	
ASSET STATUS	The **ASSET STATUS** indicator changes its color from green to yellow and then red, according to the measured values (for example, PD) and the preset thresholds of warning and alarm. **NORMAL** (green): The warning and alarm level were not exceeded. **CAUTION** (yellow): The first preset threshold was exceeded. **ALARM** (red): The second preset threshold was exceeded.
DEVICE STATUS	
DEVICE STATUS	**DEVICE STATUS** indicator lights up continuously when the device is ready for setup and measurement. The indicator starts blinking when the measurement stops due to an internal device error. The indicator does not light up at all when an unknown error occurs.
BATTERY	
BATTERY	The **BATTERY** LED indicator lights up when the device is connected to a charged battery via the battery cable. It starts blinking when the voltage level of the battery is low.
12 V DC	Port to supply *MONTESTO 200* with the **12 V DC** universal battery.
POWER	
POWER	The **POWER** indicator lights up when the device is connected to the mains.
115 V / 230 V AC	Port to supply *MONTESTO 200* with a mains voltage of **115 V / 230 V AC**[1)].
SENSOR INPUT	
PD1	**PD1** input
PD2	**PD2** input
PD3	**PD3** input
PD4	**PD4** input
AUX	The **AUX** port is used for power supply and control of the UHF converter (when used). This port is only related to **PD4** input.
Other	
Start and shutdown button	Start the internal PC by pressing the start and shutdown button. Its built-in LED will blink while Windows is loading and *Monitoring Software* is starting. Then it lights up continuously. Press the button again in order to perform a safe shutdown of the internal PC. The built-in indicator blinks during the shutdown process and turns off afterwards.
Grounding connection	Grounding connection of the device. Always connect *MONTESTO 200* to a local ground before connecting anything else to the device.

1) *MONTESTO 200* can also be supplied with 100 V DC … 150 V DC voltage via the mains port.

2.2.2 Transport case

Figure 2-3: Transport case with *MONTESTO 200*

2.2.3 Scope of delivery

The following items are delivered with *MONTESTO 200*:

Table 2-2: Scope of delivery

Standard items for *MONTESTO 200*:
1 x *MONTESTO 200*
4 x color-coded coaxial cable (4 m / 13.12 ft)
1 x grounding cable with clamp (6 m / 19.69 ft)
1 x fiber-optic cable for Ethernet connection with IP 65 connector at *MONTESTO 200* side (10 m / 32.8 ft)
1 x battery cable (2.5 m / 8.2 ft)
2 x small crocodile clamps for battery cable
2 x large crocodile clamps for battery cable
1 x mounting kit (includes 2 plates and 4 magnetic holders)
1 x media converter (EMCON 200)

Table 2-2: Scope of delivery (continued)

Standard items for *MONTESTO 200*:
MONTESTO 200 User Manual
1 x transport case
Example of optional accessories[1] for *MONTESTO 200*:
Rogowski coil
WiFi modem (LINKSYS AE3000)
MCT 120

1) There are other accessories that can be used with *MONTESTO 200*.

2.3 Battery handling

MONTESTO 200 can be powered from a universal 12 V DC universal battery. Ideally, the battery should be recharged using the charger provided by the manufacturer. If, however, the battery has to be recharged through *MONTESTO 200*, only follow the steps below:

► Connect the battery which has to be recharged to *MONTESTO 200*.

► Connect *MONTESTO 200* to the mains.

The charging status of the battery is indicated via the **Battery** LED indicator on the *MONTESTO 200* front panel:

Table 2-3: Charging status of the battery

Battery LED indicator status	Description
LED → on	Battery almost fully charged
LED → blinking	Battery almost empty
LED → off (with the battery connected)	Battery empty, *MONTESTO 200* is about to shut down

During the charging process of the battery, the status of the LED will change from "off" to "blinking" and then to "on". The charging process has to be continued for a while to make sure that the battery is fully charged, even when the **Battery** LED is continuously "on". Depending on its capacity, the battery can take up to 2 hours (or more) to be fully charged, even if the "Battery LED" status has changed to "on".

NOTICE

Equipment damage possible

► Device damage can occur if batteries with a higher output voltage than specified are used.

► Do not connect the battery while *MONTESTO 200* is powered from the mains.

► Pay attention to the polarity while connecting the battery cable.

3 Application

3.1 Specific safety instructions for on-site measurements

WARNING

Death or severe injury caused by high voltage or current possible

- ► Make sure to observe dangerous areas.
- ► Always obey the internal safety instructions for working in areas with high voltage to avoid injury.
- ► Always ground *MONTESTO 200* before setting it up. Make sure that the grounding cable is in good condition (no interruptions).
- ► Make sure to ground *MONTESTO 200* at the "measurement device grounding connection" before connecting the sensors, see Figure 2-2: on page 10.
- ► All sensors (for example, MCT, UVS, UCS, MCC, BTA) have to be installed with the asset disconnected and grounded. For further details, please see the corresponding product manual.
- ► Check the voltage presence at the terminal box before installing *MONTESTO 200*.
- ► During the measurement, make sure to follow internal safety instructions. Always keep a safe distance from live or moving parts.
- ► Disconnect the external monitor, keyboard and mouse from *MONTESTO 200* before taking the asset on-line.

- ► Protect yourself and your working environment against an accidental reconnection of high voltage by other persons and circumstances, when preparing the setup for off-line measurements.
- ► Protect yourself and your working environment with a suitable protection against other (possible) live circuits.
- ► Protect others from accessing the dangerous area and accidentally touching live parts by setting up a suitable barrier.

3.2 Connection to the internal PC

A connection to the internal PC of *MONTESTO 200* is required for its setup. The internal PC can be accessed in different ways:

- WiFi
- LAN cable with static IP
- Direct connection (keyboard / video / mouse)

3.2.1 User role

The following user is assigned to access *MONTESTO 200*:

Table 3-1: User role

User name	Password	Admin rights
Admin	AdMontesto200	Yes

Note: Please change the initial password after the first login.

3.2.2 WiFi connection

Any WiFi modem with the capability of creating an access point under Windows 10 can be used to establish the WiFi connection to *MONTESTO 200*. OMICRON offers LINKSYS AE3000 WiFi modem as an optional item.

NOTICE

Equipment damage possible

- ► The device is no longer IP 65-rated while the WiFi modem is connected to any USB port.
- ► After disconnecting cables, or any other devices at the **HDMI**, **USB 3.0** or **USB 2.0** port, make sure to close the lids by pressing them. If one of the lids remain open, the device is no longer IP 65-rated.

In order to establish a WiFi connection with the LINKSYS AE3000 WiFi modem, perform the following steps:

- ► Power up the device and start the internal PC by pressing the start and shutdown button.
- ► When the start and shutdown button LED is lighted up continuously, connect the WiFi modem to one of the *MONTESTO 200* USB ports on the front panel (for example, use the **USB 3.0** port), see Figure 3-1: on page 16.
- ► After about 1 minute, the hot spot is created.
- ► Use a laptop and connect to local WiFi network created by *MONTESTO 200* as follows:
  - Select the WiFi SSID: WiFiMontesto
  - Enter the WiFi password: Montesto00

► Access *MONTESTO 200* via remote desktop connection with the PC/laptop within the WiFi network by entering:

- the **Computer** name "*Montesto200*" or IP address which will be automatically assigned by DHCP server
- the **User name**, see Table 3-1: on page 15
- the **Password**, see Table 3-1: on page 15

Figure 3-1: WiFi modem connection to the **USB 3.0** port

3.2.3 LAN cable connection

If a WiFi modem is not available, the internal PC can be accessed using its **ETH** Ethernet port. For safety reasons, the **ETH** port is isolated via a built-in Ethernet-to-fiber-optic media converter, providing a fully galvanic isolation of the device (usually installed in the high-voltage area). A special fiber-optic (FO) cable (IP 65-rated) and an external media converter (*EMCON 200*) are delivered with *MONTESTO 200*, see Figure 3-14: on page 23.

Note: The **ETH** port is set for static IP by default. Furthermore, a DHCP server is installed on *MONTESTO 200* by default. Keep in mind to disable this DHCP server if you plan to integrate *MONTESTO 200* in an existing network which already has DHCP servers.

In order to access *MONTESTO 200* via LAN connection, perform the following steps, after having powered up the device:

1. **To access your network settings on the device (for example, laptop) with which you plan to connect to *MONTESTO 200*, follow the instructions below:**

► Right-click the network connection symbol (Windows 10) in the taskbar and select **Open Network and Internet settings**.

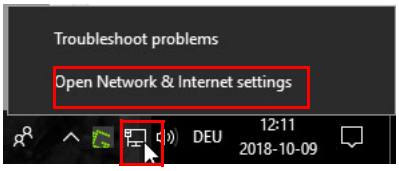


Figure 3-2: Selecting **Open Network and Internet settings**

► In the **Settings** dialog, select the **Ethernet** menu item on the left-hand side and then click **Change adapter options** on the right-hand side.

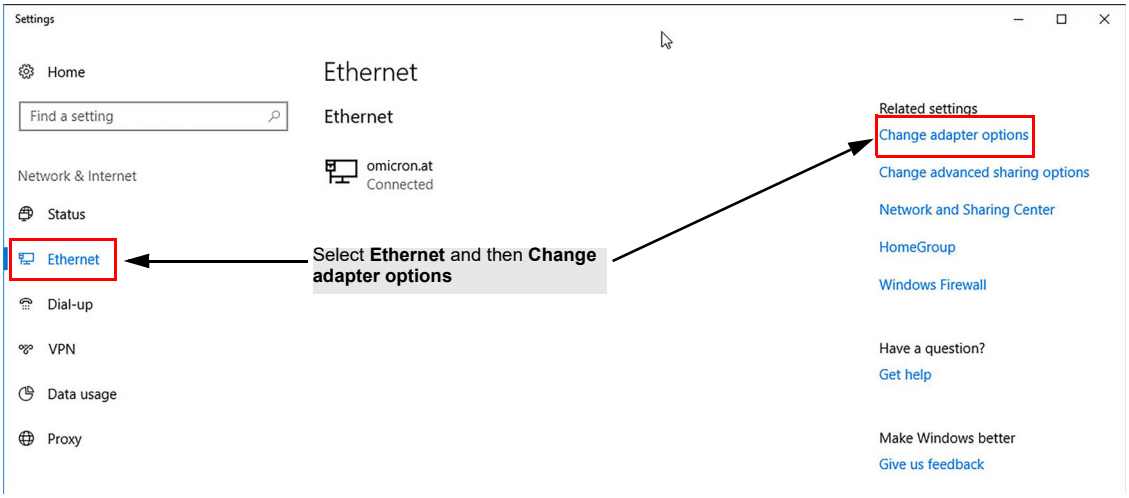


Figure 3-3: **Settings** dialog

► In the following **Network Connections** window, right-click the **Ethernet** connection and select **Properties**.

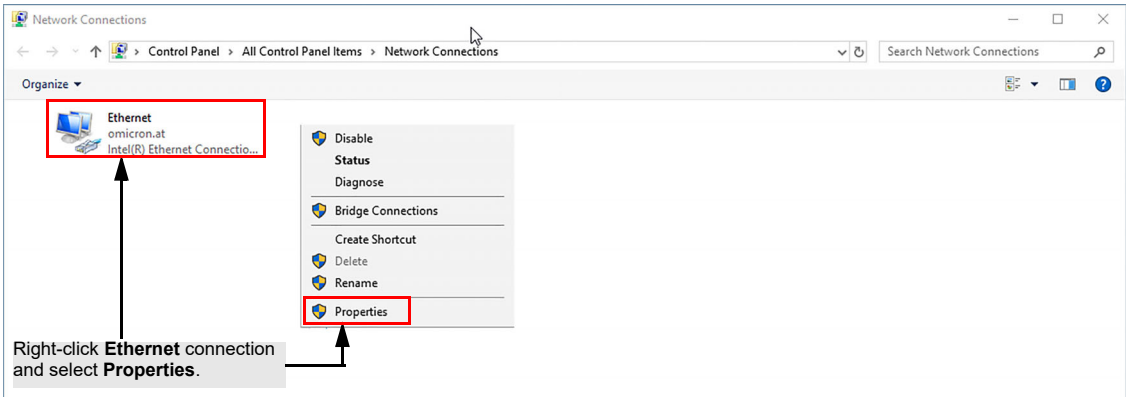


Figure 3-4: **Network connections** window

► In the **Ethernet Properties** window, select **Internet Protocol Version 4 (TCP/IPv4)** and click the **Properties** button.

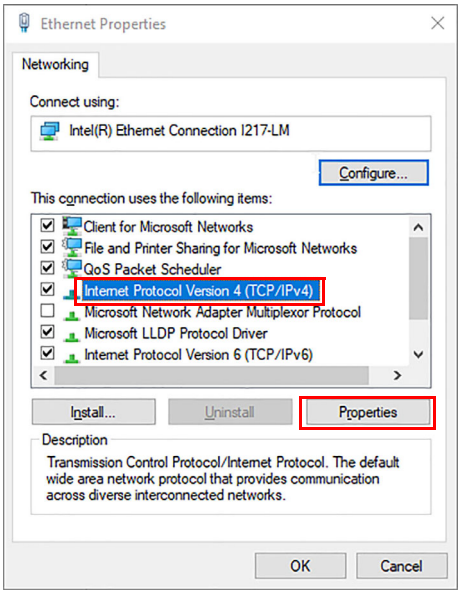


Figure 3-5: **Ethernet Properties** window

The following **Internet Protocol Version 4 (TCP/IPv4) Properties** window appears:

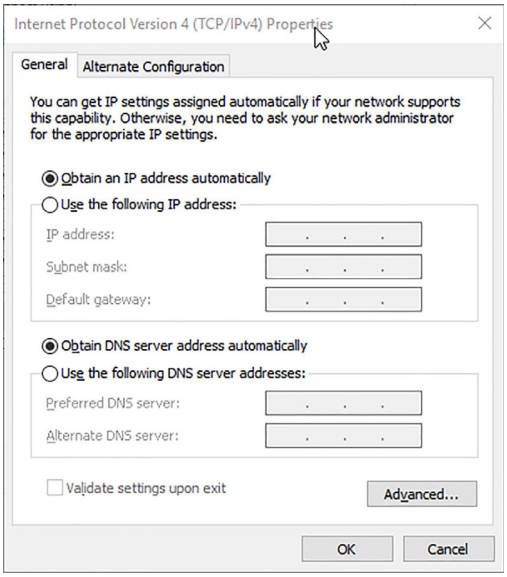


Figure 3-6: **Internet Protocol Version 4 (TCP/IPv4) Properties** window

To change the network settings on *MONTESTO 200* in order to be able to integrate *MONTESTO 200* into an existing network, you can use the following batch file which is located on the desktop:

Note: Disable the DHCP server on *MONTESTO 200* by right clicking the tray icon and select disable DHCP server. See "Disabling the DHCP server" on page 21.

► Double-click the **Dynamic Static Ip Switch** batch file on the desktop.

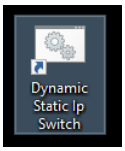


Figure 3-7: **Dynamic Static Ip Switch** batch file

Following window appears:

Figure 3-8: First window after running the **Dynamic Static Ip Switch** batch file

If you enter "A", the following window appears:

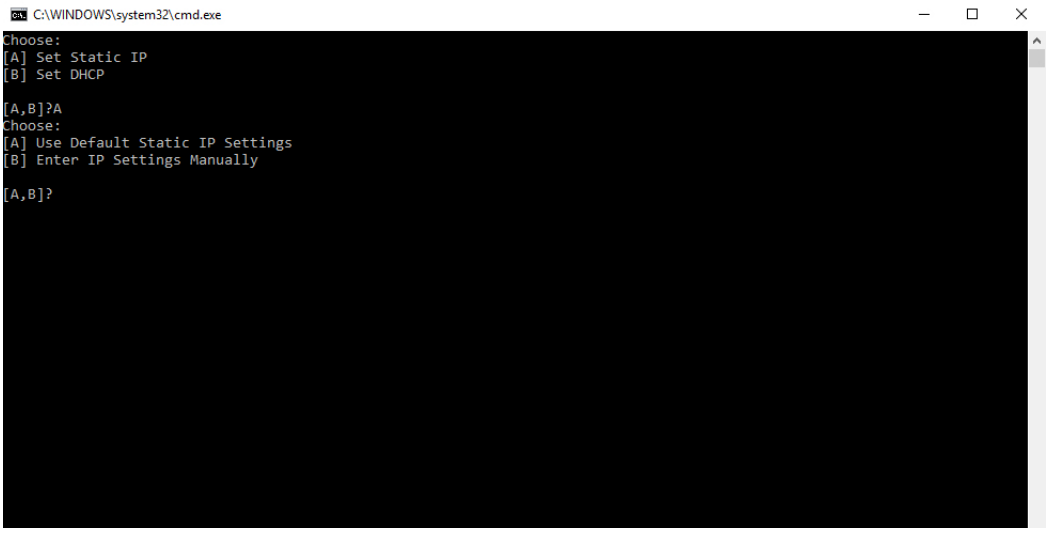


Figure 3-9: Window after entering "A"

Entering "A" again, following parameters for the network connection are set:

- IP Address: 192.168.0.200
- Subnet Mask: 255.255.255.0
- Default Gateway: (No default gateway is needed)

Entering "B" in the Figure 3-9, you must enter all three parameters manually.

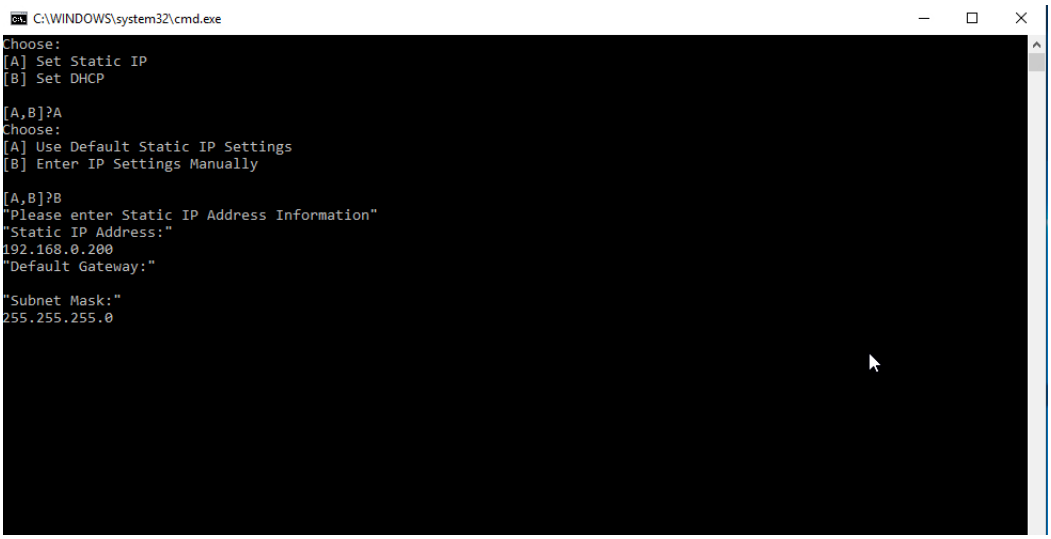


Figure 3-10: Window after entering "B" in the Figure 3-9

If you enter "B" in the Figure 3-8, the network connection is automatically set to DHCP.

Disabling the DHCP server

Option 1:

► Right click the tray icon in the taskbar and select **Exit DHCP Server**.

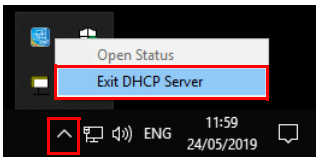


Figure 3-11: Selecting **Exit DHCP Server** in the taskbar

Option 2:

► Open Windows **Services** by pressing the Windows key and entering **Services**.

► Search for the entry **DHCP Server** and **Stop the service**.

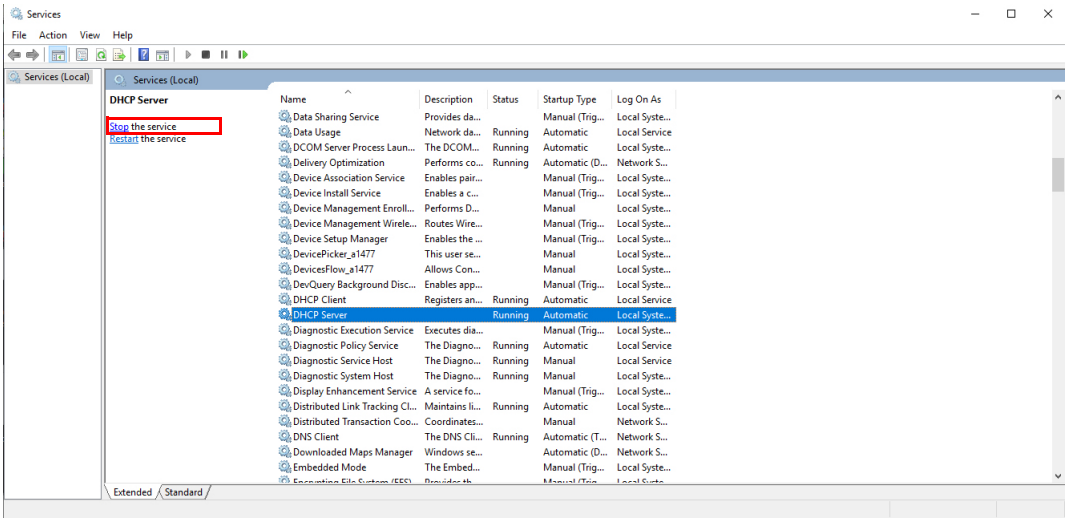


Figure 3-12: Windows **Services** selected via Windows key

2. If ETH port was set up for dynamic IP (DHCP):

► Connect the FO cable delivered with *MONTESTO 200* to the **ETH** port.

Note: Connect or disconnect the FO cable as follows:

– To connect the FO cable, insert the plug into the socket and push it until the mechanism is locked in place with a click.

– To disconnect the FO cable, press lightly the rear end of the plug forward with one hand while pulling the front ring of the plug back with other hand, and remove the whole plug.

Figure 3-13: Disconnecting the FO cable

► Connect the media converter to the free end of the FO cable.

► Connect the media converter to the existing Ethernet network (DHCP server) with a LAN cable (see Figure 3-14: on page 23).

► Access *MONTESTO 200* via remote desktop connection with the PC/laptop within the same network by entering:

- the **Computer** name "*Montesto200*" or its IP address
- the **User name**, see Table 3-1: on page 15
- the **Password**, see Table 3-1: on page 15

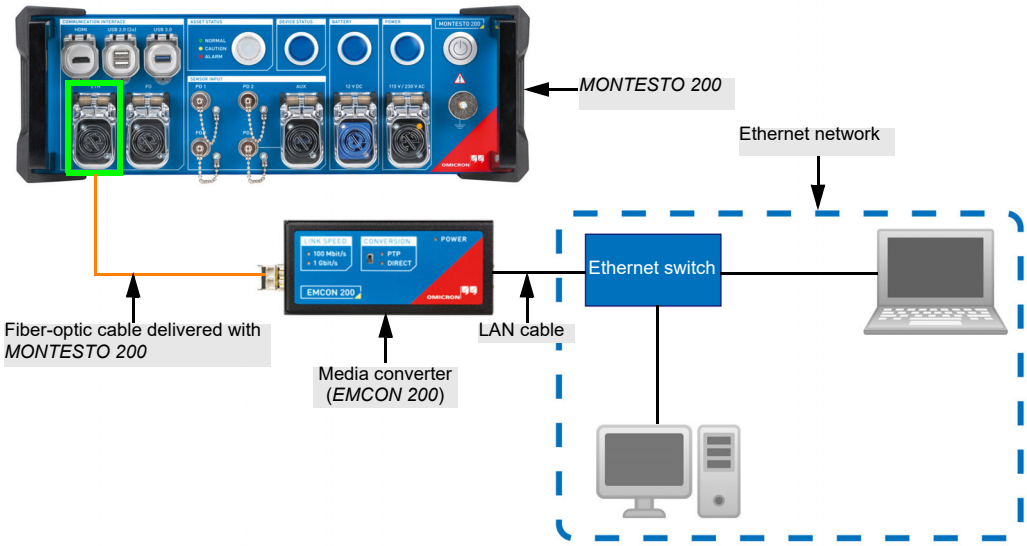


Figure 3-14: Ethernet network connection to the **ETH** port via external media converter

► Start the measurement.

3. **If ETH port was set up for static IP (for example, 192.168.10.10):**

► Connect the FO cable delivered with *MONTESTO 200* to the **ETH** port without the DHCP server running.

Note: Connect or disconnect the FO cable as follows:

– To connect the FO cable, insert the plug into the socket and push it until the mechanism is locked in place with a click.

– To disconnect the FO cable, press lightly the rear end of the plug forward with one hand while pulling the front ring of the plug back with other hand, and remove the whole plug.

Figure 3-15: Disconnecting the FO cable

► Connect the media converter to the free end of the FO cable.

► Connect the media converter to a laptop with a LAN cable.

► Set up the network connection on your laptop for static IP (for example, 192.168.10.11) subnet mask (255.255.255.0). For network settings, see section 1. on page 16.

► Access *MONTESTO 200* via remote desktop connection by entering:

- the **Computer** name "*Montesto200*" or static IP address
- the **User name**, see Table 3-1: on page 15
- the **Password**, see Table 3-1: on page 15

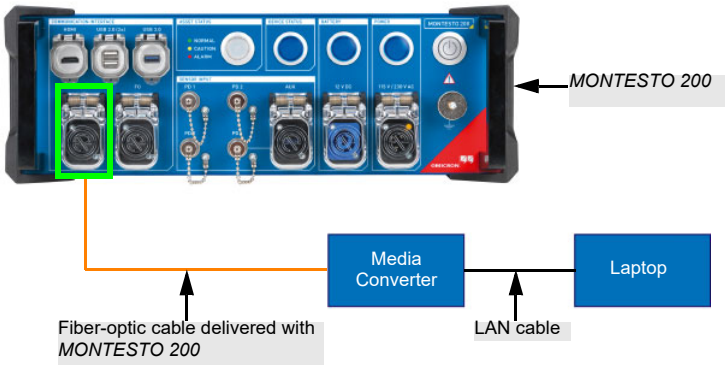


Figure 3-16: Laptop connection to the **ETH** port via external media converter

► Start the measurement.

4. To Change *MONTESTO 200* ETH port from dynamic to static IP:

► Access *MONTESTO 200* via WiFi or direct connection.

► Access the network connection settings as described in section 1. on page 16.

► In the **Internet Protocol Version 4 (TCP/IPv4) Properties** window, select **Use the following IP address:**.

► Enter the **IP address:** for example, 192.168.10.10 and press the tabulator key to automatically fill in the **Subnet mask**.

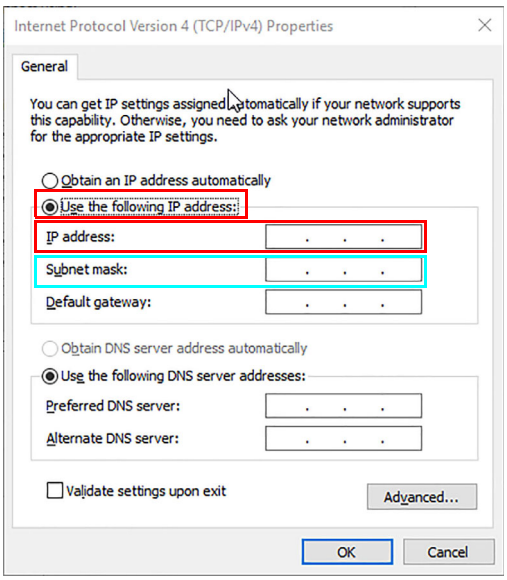


Figure 3-17: **Internet Protocol Version 4 (TCP/IPv4) Properties** window

► Press **OK**. The dynamic IP has now been changed to static IP.

5. To Change *MONTESTO 200* ETH port from static to dynamic IP:

► Access the network connection settings as described in section 1. on page 16.

► In the **Internet Protocol Version 4 (TCP/IPv4) Properties** window, select **Obtain an IP address automatically**.

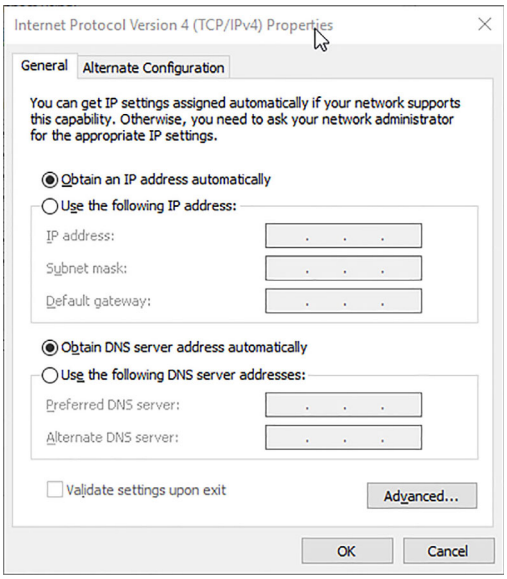


Figure 3-18: **Internet Protocol Version 4 (TCP/IPv4) Properties** window

► Press **OK**. The static IP has now been changed to dynamic IP.

3.2.4 Direct connection

WARNING

Death or severe injury caused by high voltage or current possible

The direct connection can only be used for data visualization or *MONTESTO 200* setup with the asset out of operation.

► Disconnect the external monitor, keyboard and mouse from *MONTESTO 200* before taking the asset on-line.

WiFi or LAN connections are preferred to set up the *MONTESTO 200*.

NOTICE

Equipment damage possible

► The device is no longer IP 65-rated, while an external monitor, a keyboard and a mouse is connected to the **HDMI** port or any USB port.

► After disconnecting cables, or any other devices at the **HDMI**, **USB 3.0** or **USB 2.0** port, make sure to close the lids by pressing them. If one of the lids remain open, the device is no longer IP 65-rated.

If neither the WiFi modem nor the laptop is available, *MONTESTO 200* can be set up by directly accessing its internal PC. To do so, perform the following steps:

► Connect an external monitor to *MONTESTO 200* via the **HDMI** port.

► Connect a keyboard and a mouse to the **USB 2.0** ports.

► Power up the device and start the internal PC by pressing the start and shutdown button. *MONTESTO 200* is now ready for the setup.

Figure 3-19: Direct connection to the internal PC via an external monitor, a keyboard and a mouse

3.3 Rotating machines

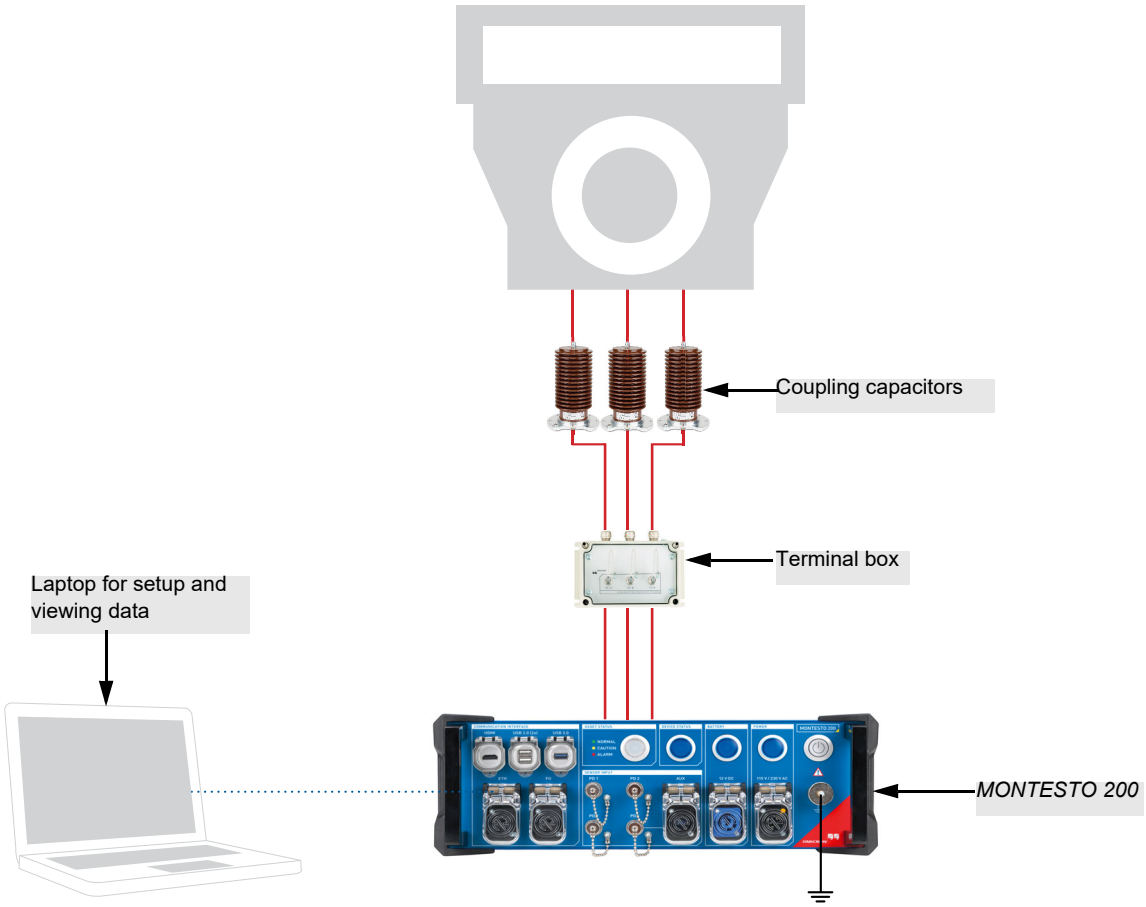


Figure 3-20: Typical measurement setup with preinstalled coupling capacitors and a terminal box

3.3.1 Connection

Wiring diagram

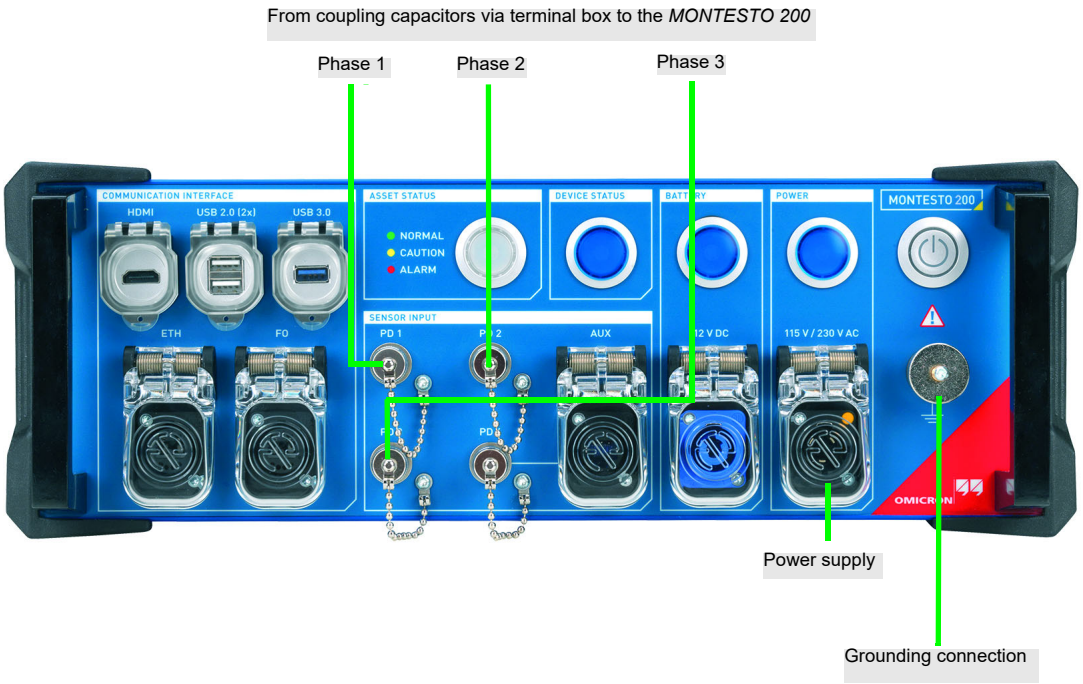


Figure 3-21: Wiring diagram of *MONTESTO 200* to coupling capacitors via a terminal box

Wiring instructions

CAUTION

Minor or moderate injury caused by leakage current possible

- ► Make sure that the cables have ground contact to avoid leakage current.
- ► Use only original cables provided by OMICRON.

WARNING

Death or severe injury caused by high voltage or current possible

- ► Always obey the internal safety instructions for working in high-voltage areas to avoid injury.

On-line PD measurements via preinstalled coupling capacitors and a terminal box

1. Read the User Manual of the preinstalled terminal box and coupling capacitors.
2. Unpack and ground *MONTESTO 200*.
3. Power up the device and start the internal PC by pressing the start and shutdown button.
4. When the start and shutdown button LED is lighted up continuously, the device is ready for setup and measurement.
5. Connect the coaxial cables to the preinstalled coupling capacitors via the terminal box following the steps presented in Figure 3-22: on page 31:
   - Identify the correct terminal box.
   - Open the terminal box and install the measurement device at one side of the TNC T connectors.
   - Open the short-circuit caps at the other side of the TNC T connectors.
6. Connect to the internal PC as explained in 3.2 "Connection to the internal PC" on page 14.
7. Start the *Monitoring Software* and set up all parameters relevant for the measurement.
   For more information, refer to *Monitoring Software* and *OMS System Software* User Manual.
8. When the measurement is finished:
   - Connect the short-circuit caps.
   - Unplug the signal cables and close the terminal box.

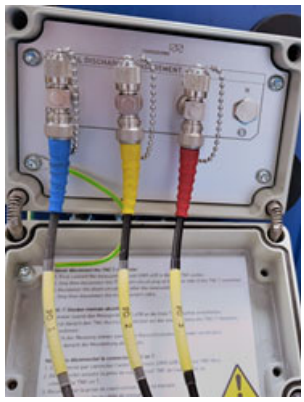
WARNING

Death or severe injury caused by high voltage or current possible

► Follow all internal safety instructions, while disconnecting the equipment.

9. Shut down the internal PC by pressing the start and shutdown button. When the start and shutdown button LED is turned off, the internal PC has shut down.
10. Make sure that no damages have occurred at the terminal box during the measurement.

Identify the correct terminal box



Install the measurement device

Disconnect the short-circuit caps

Figure 3-22: PD measurements with *MONTESTO 200* via permanent installed sensors and terminal box

Installation for temporary PD monitoring

MONTESTO 200 can be installed at the test object enclosure via magnetic holders, or directly at an adjacent wall.

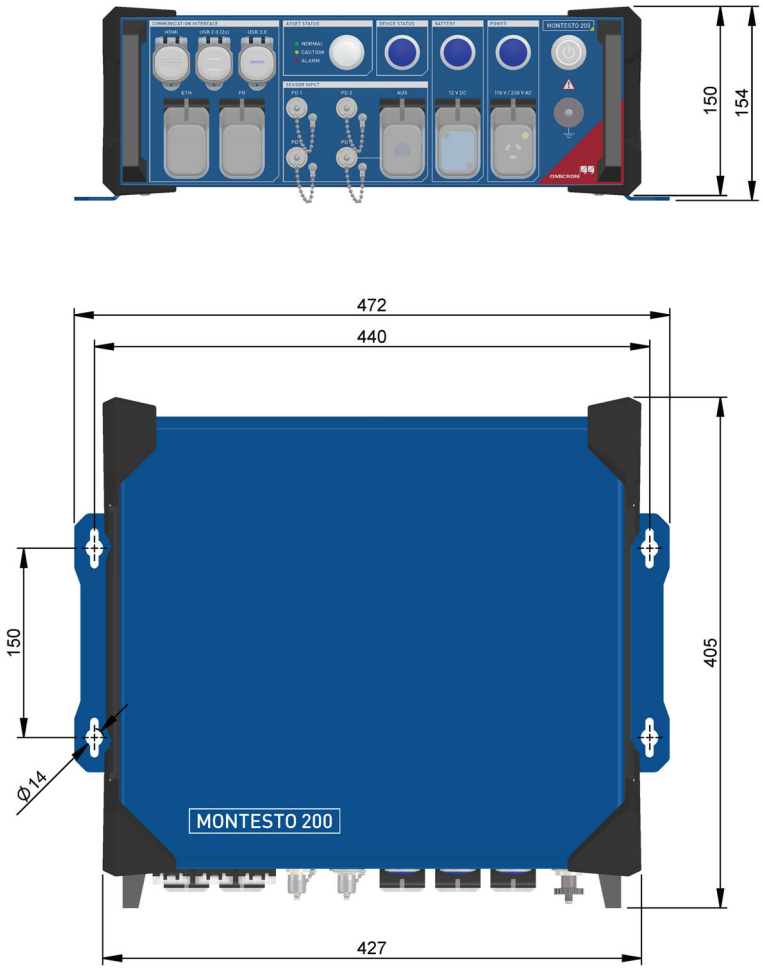


Figure 3-23: *MONTESTO 200* dimensions

For monitoring sessions, *MONTESTO 200* should be connected to the mains via an uninterruptible power supply (UPS) source.

► Set monitoring sessions following the instructions presented in the *Monitoring Software* User Manual.

NOTICE

Loss of data possible

► In case of power supply loss, *MONTESTO 200* turns off and after pressing the start and shutdown button, the measurement session starts automatically.

3.3.2 Normalization

Normalization can only be performed if an outage can be organized. This step is generally performed after the installation of coupling capacitors. Due to pulse propagation, resonance and mutual cross-coupling in machine windings, calibration according to IEC 60270 is not applicable to generators. Normalization of the test circuit facilitates the comparison between measurements on machines with a similar design, taken with the same PD system. Normalization is recommended by IEC 60034-27 before starting any monitoring session.

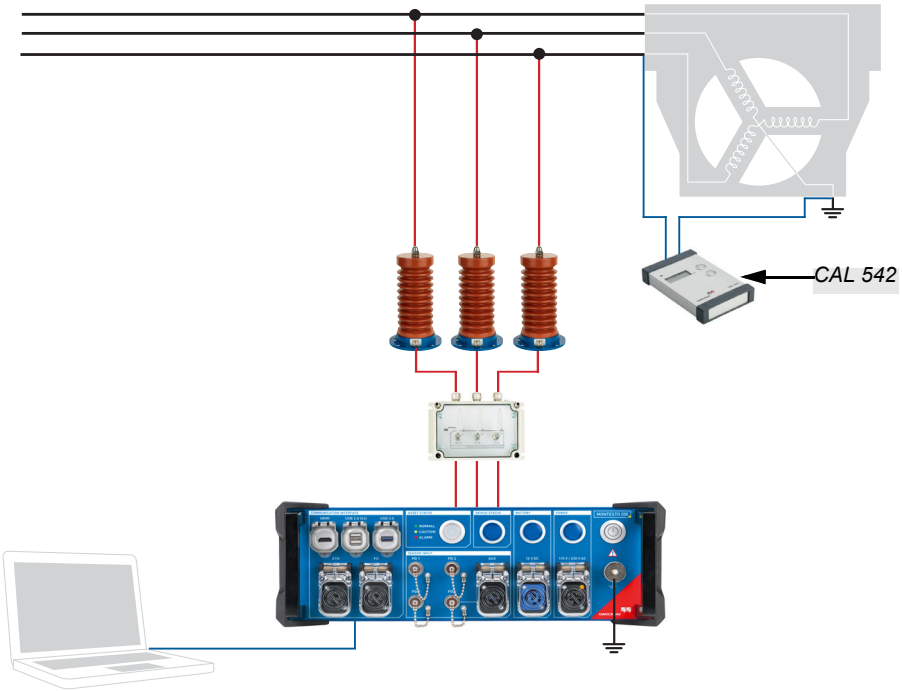


Figure 3-24: Normalization

Normalization of the test circuit is performed by injecting short-duration current pulses of a specified magnitude at the machine terminals or as close as possible to them. This is done by means of a reference pulse generator (calibrator) conforming to the specifications given in IEC 60270. The injected charge simulates PD pulses as they appear at the machine terminals during the measurement. The normalization procedure can only be performed off-line. The ratio between the magnitude of the injected pulse and the magnitude of the pulse read by the sensor gives the **Divider Factor**.

With the machine off-line and the *MONTESTO 200* connected (see "Wiring instructions" on page 30), the normalization procedure is performed as follows:

WARNING

Death or severe injury caused by high voltage or current possible

- ► Always follow all internal safety instructions when working with high-voltage equipment while connecting, disconnecting or handling the calibrator.
- ► Before connecting the calibrator (for example, *CAL 542*) to the rotating machine, make sure that the rotating machine is off-line and temporarily grounded.

1. Connect a calibrator (for example, *CAL 542*) to one of the three phases (see Figure 3-24: "Normalization" on page 33) by connecting one lead to the relevant phase and the second lead to the main grounding of the machine.
2. Apply the calibrator pulse of the chosen value. This value should give you a stable measurement reading with a good signal-to-noise ratio.

   Note: The normalization is only valid for a fixed set of center frequency and bandwidth.
3. If permitted, remove the temporary grounding.
4. From now on, you have two options to calibrate the system:
   – You can calibrate the system via *Monitoring Software* with a very fast calibration method. for this method, click the **Filter Settings** button in the **Measurement Templates** panel (see *Monitoring Software* User Manual, Chapter 5).

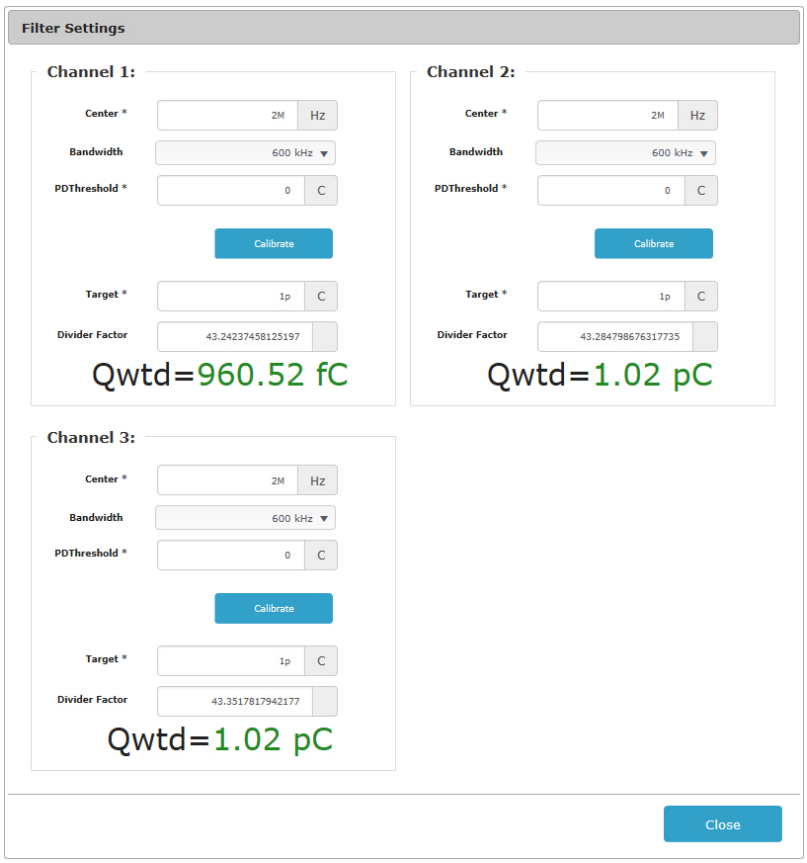


Figure 3-25: System normalization via **Filter Settings**

– You can start the diagnostic software (*OMS System Software*) inside the *Monitoring Software* by clicking **Diagnosis** button in the **Measurement Templates** panel (see, *Monitoring Software* User Manual, Chapter 5), to have access to more diagnosis features (for example, PD scope, PD FFT). The settings will be stored by leaving *OMS System Software*. You have only access to *OMS System Software* via the remote desktop connection.

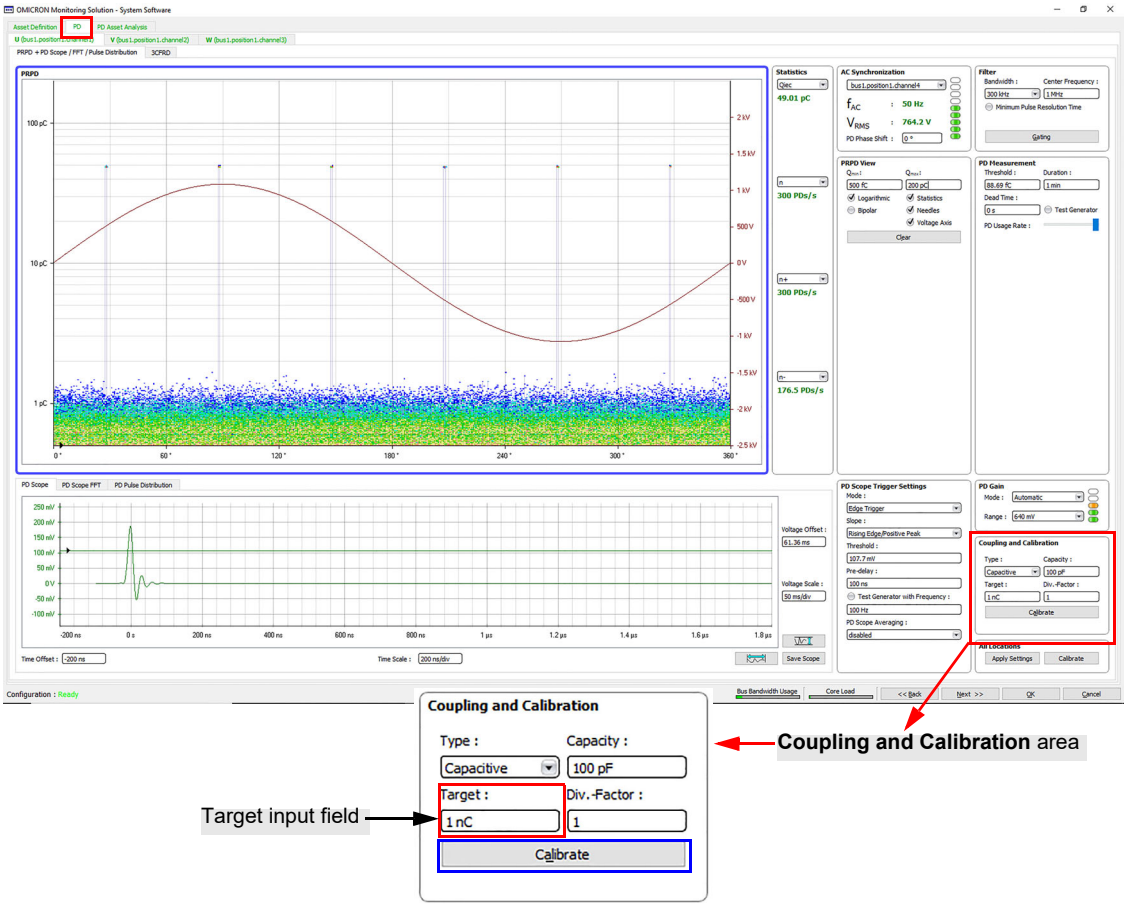


Figure 3-26: System normalization via **PD** phase configuration page

When you see the calibrator impulses clearly as the highest impulses on the respective channel, enter the chosen calibrator value in the **Target** input field and click **Calibrate** in the **Coupling and Calibration** area of the **PD** tab.

5. Reapply the temporary grounding.
6. Repeat the same procedure for the other two phases.

NOTICE

Equipment damage possible

► After normalization, disconnect the calibrator from the rotating machine.

3.3.3 Measurement

While choosing a suitable measuring frequency, please keep the following in mind:

► Select a frequency and bandwidth that results in an optimum signal-to-noise ratio.

► Check the working frequencies and transfer behavior of the sensors in use.

For further information on the sensors in use, see the corresponding manual for each sensor. Manuals can be found on the OMICRON website, in the Customer Area.

For further information on PD measurements on rotating machines, see also the following standards and guides:

- IEEE Std 1434-2014 – IEEE Guide for the Measurement of Partial Discharges in AC Electric Machinery
- IEC TS 60034-27 – Rotating electrical machines – Part 27: Off-line partial discharge measurements on the stator winding insulation of rotating electrical machines
- IEC TS 60034-27-2 – Rotating electrical machines – Part 27-2: On-line partial discharge measurements on the stator winding insulation of rotating electrical machines

3.4 Power transformer

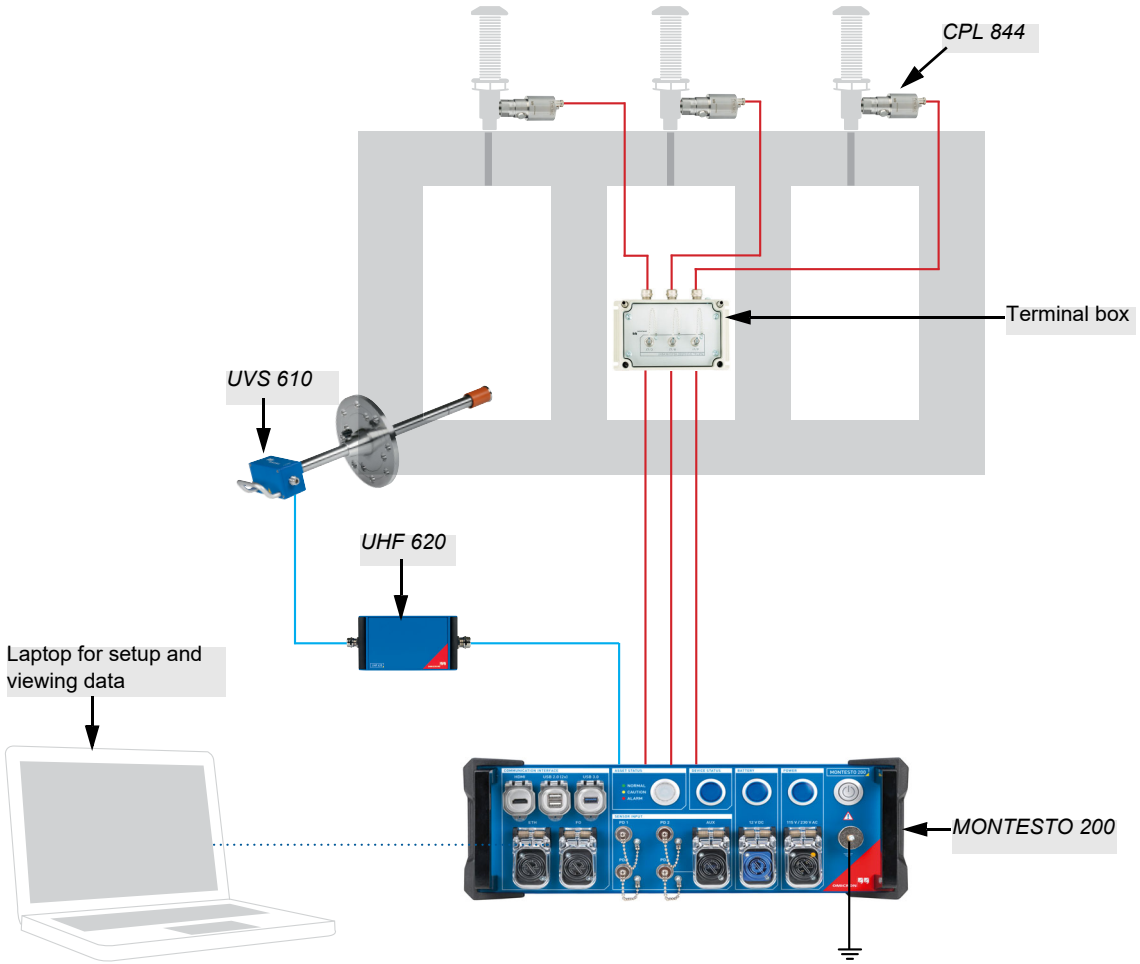


Figure 3-27: Typical measurement setup with preinstalled bushing sensors and a terminal box

3.4.1 Connection

Wiring diagram

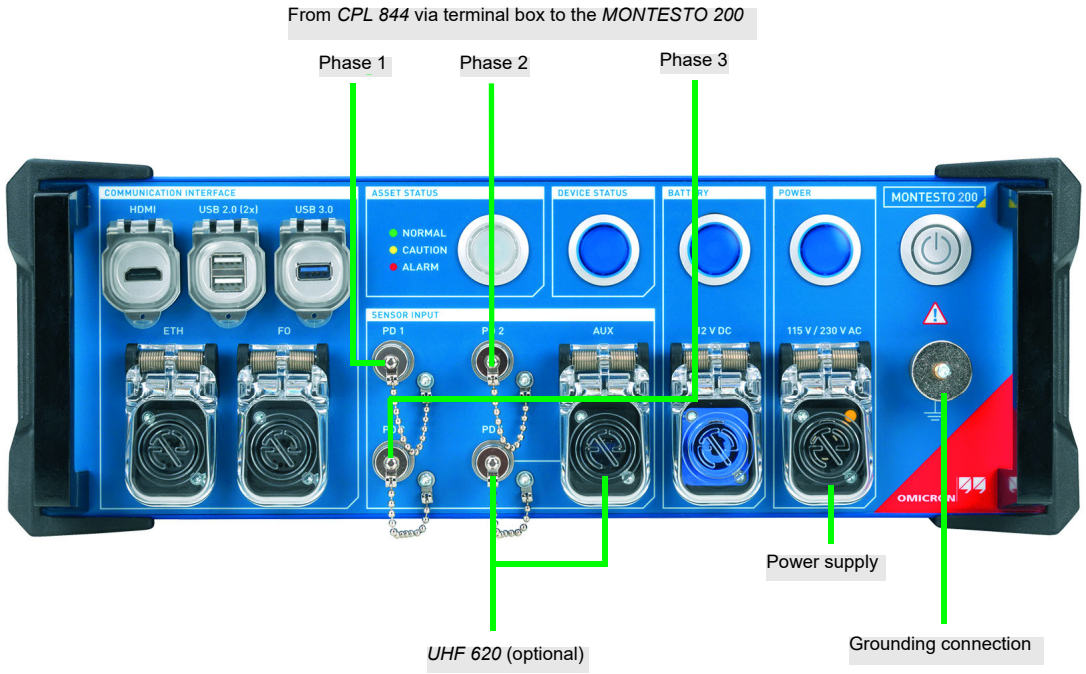


Figure 3-28: Wiring diagram of *MONTESTO 200* to bushing sensors via a terminal box and to UHF sensor (optional - channel 4 only)

Wiring instructions

CAUTION

Minor or moderate injury caused by leakage current possible

- ► Make sure that the cables have ground contact to avoid leakage current.
- ► Use only original cables provided by OMICRON.

WARNING

Death or severe injury caused by high voltage or current possible

- ► Always obey the internal safety instructions for working in high-voltage areas to avoid injury.

On-line PD measurements via preinstalled bushing sensors and a terminal box

The following steps/instructions only apply to the measurement on an already installed *CPL 844*/terminal box setup.

WARNING

Death or severe injury caused by high voltage or current possible

Before performing a measurement, observe the following instructions:

► Make sure to follow all safety requirements of the substation or work environment.

► Make sure that the terminal box is grounded before opening its cover.

► Open the terminal box only in a dry environment.

NOTICE

Equipment damage possible

► Make sure that your measurement device (if other than *MONTESTO 200*) can handle the power frequency reactive current (capacitive current) sourced by the transformer bushing.

To perform the PD measurement with *MONTESTO 200*, proceed as follows:

1. Since the transformer is energized, request a briefing from the site operator in which area you may stay and move safely. Also, request a confirmation which terminal box to use and if it is located in the work area. Read the User Manual of the preinstalled terminal box and sensors.
2. Before opening the terminal box, connect all measurement devices safely to the local grounding point of the terminal box. Observe the safety advise of your measurement devices.
3. Power up the device and start the internal PC by pressing the start and shutdown button.
4. When the start and shutdown button LED is lighted up continuously, the device is ready for setup and measurement.
5. Connect the coaxial cables to the preinstalled sensors via the terminal box following the steps presented in Figure 3-22: on page 31:
   - Identify the correct terminal box.
   - Open the terminal box and install the measurement device at one side of the TNC T connectors.
   - Open the short-circuit caps at the other side of the TNC T connectors.
6. Connect to the internal PC as explained in 3.2 "Connection to the internal PC" on page 14.
7. Start the *Monitoring Software* and set up all parameters relevant for the measurement.
   For more information, see the *Monitoring Software* and *OMS System Software* User Manual.
8. When the measurement is finished:
   - Connect the short-circuit caps.
   - Unplug the signal cables and close the terminal box.

WARNING

Death or severe injury caused by high voltage or current possible

► Follow all internal safety instructions, while disconnecting the equipment.

9. Shut down the internal PC by pressing the start and shutdown button. When the start and shutdown button LED is turned off, the internal PC has shut down.
10. Make sure that no damages have occurred at the terminal box during the measurement.

Installation for temporary PD monitoring

MONTESTO 200 can be installed at the test object enclosure via magnetic holders, or directly at an adjacent wall. For *MONTESTO 200* dimensions, see Figure 3-23: on page 32.

For monitoring sessions, *MONTESTO 200* should be connected to the mains via an uninterruptible power supply (UPS) source.

► Set monitoring sessions following the instructions presented in the *Monitoring Software* User Manual.

NOTICE

Loss of data possible

► In case of power supply loss, *MONTESTO 200* turns off and after pressing the start and shutdown button, the measurement session starts automatically.

3.4.2 Calibration

Calibration can only be performed if an outage can be organized. This step is generally performed after the installation of bushing sensors. Calibration of the test circuit facilitates comparisons between measurements on different transformers and reference values. It is recommended to perform calibration according to IEC 60270 before starting any monitoring session. This is only possible for the measurement at the bushing taps. For the measurement with UVS, a check of performance is recommended. Make sure to check the wiring and measurement sensitivity.

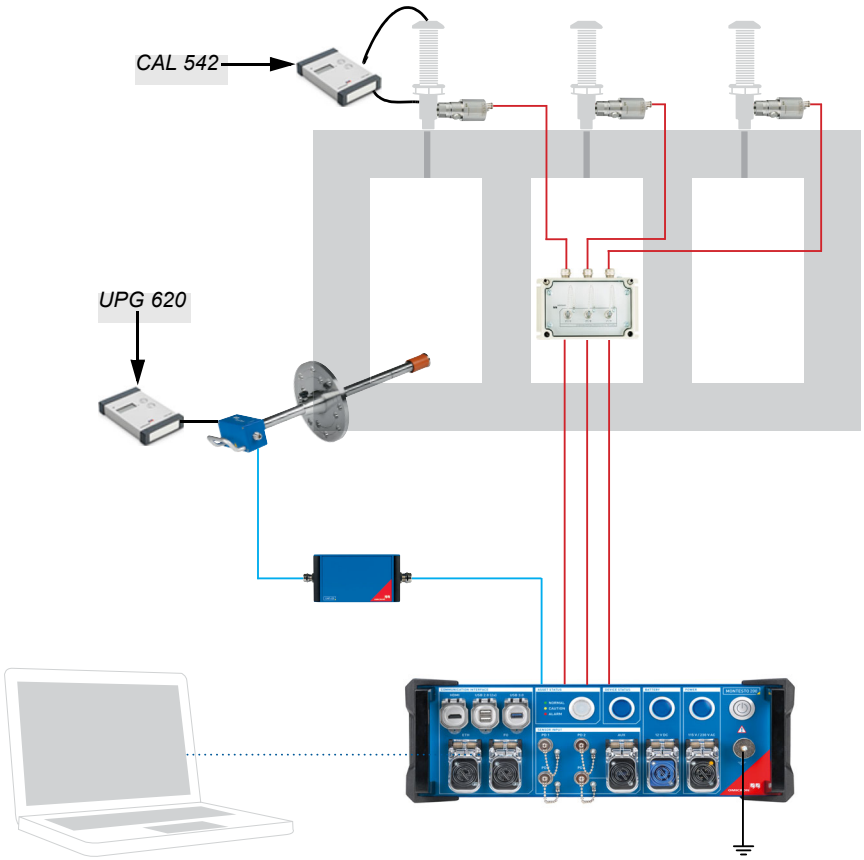


Figure 3-29: Calibration and check of performance

Calibration of the test circuit is performed by injecting short-duration current pulses of a specified magnitude at the transformer bushings. This is done by means of a reference pulse generator (calibrator) conforming to the specifications given in IEC 60270. The injected charge simulates PD pulses as they appear at the transformer bushings during the measurement. The calibration procedure can only be performed off-line (generally done after the installation of bushing sensors). The ratio between the magnitude of the injected pulse and the magnitude of the pulse read by the sensor gives the **Divider Factor**.

With the transformer off-line and the *MONTESTO 200* connected (see "Wiring instructions" on page 38), the calibration is performed as follows:

WARNING

Death or severe injury caused by high voltage or current possible

- ► Always follow all internal safety instructions when working with high-voltage equipment while connecting, disconnecting or handling the calibrator.
- ► Before connecting the calibrator (for example, *CAL 542*) to the transformer, make sure that the transformer is off-line and temporarily grounded.

1. Connect a calibrator (for example, *CAL 542*) to one of the three phases (see Figure 3-29: "Calibration and check of performance" on page 41) by connecting one lead to the high-voltage connection on the top of the bushing and the second lead to the ground at the bushing tap. Turn the calibrator on and select a calibration value. Calibrate via software. Turn the calibrator off and remove the calibrator and the connection cables.
2. Apply the calibrator pulse of the chosen value. This value should give you a stable measurement reading with a good signal-to-noise ratio.

   Note: The calibration is only valid for a fixed set of center frequency and bandwidth.
3. If permitted, remove the temporary grounding.
4. From now on, you have two options to calibrate the system:
   – You can calibrate the system via the *Monitoring Software* with a very fast calibration method. for this method, click the **Filter Settings** button in the **Measurement Templates** panel (see *Monitoring Software* User Manual, Chapter 5).

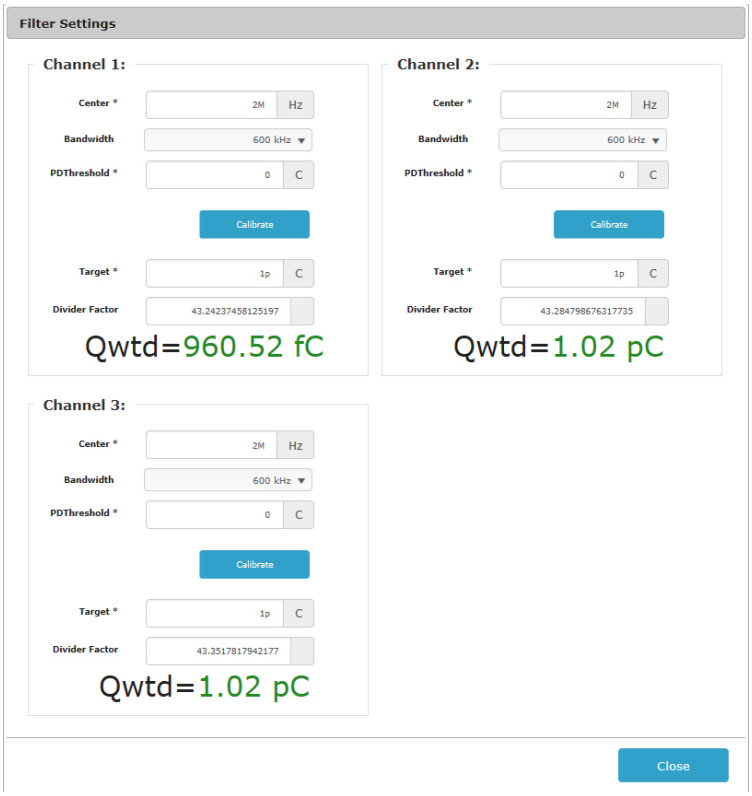


Figure 3-30: System calibration via **Filter Settings**

– You can start the diagnostic software (*OMS System Software*) inside the *Monitoring Software* by clicking **Diagnosis** button in the **Measurement Templates** panel (see, *Monitoring Software* User Manual, Chapter 5), to have access to more diagnosis features (for example, PD scope, PD FFT). The settings will be stored by leaving the *OMS System Software*. You have only access to the *OMS System Software* via the remote desktop connection.

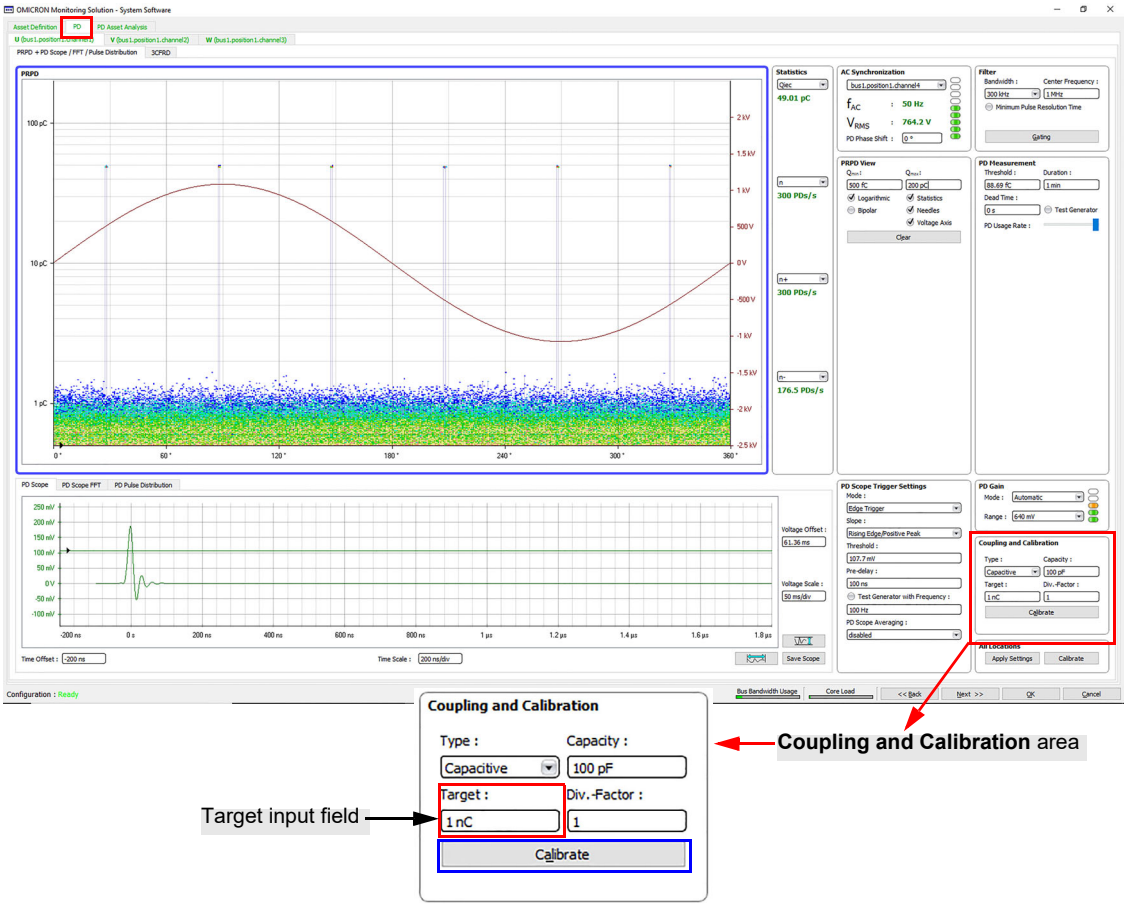


Figure 3-31: System calibration via **PD** phase configuration page

When you see the calibrator impulses clearly as the highest impulses on the respective channel, enter the chosen calibrator value in the **Target** input field and click **Calibrate** in the **Coupling and Calibration** area of the **PD** tab.

5. Reapply the temporary grounding
6. Repeat the same procedure for the other two phases.

NOTICE

Equipment damage possible

► After calibration, disconnect the calibrator from the bushing.

► Perform the UHF performance check as follows:

1. Perform a frequency sweep in a wide range (100 MHz … 2000 MHz) and save the signal spectra, see also the *OMS System Software* User Manual.

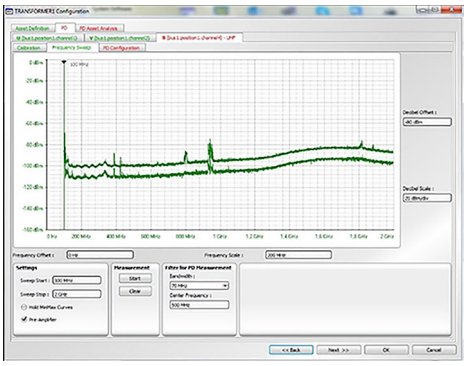


Figure 3-32: Frequency sweep with signal spectra

2. Connect the *UPG 620* pulse generator to the **TEST** input of the UHF sensor and apply calibration pulses. Perform a new frequency sweep. The new spectra should be different than those recorded without *UPG 620* connected. This is the first indication that the sensor was correctly wired.

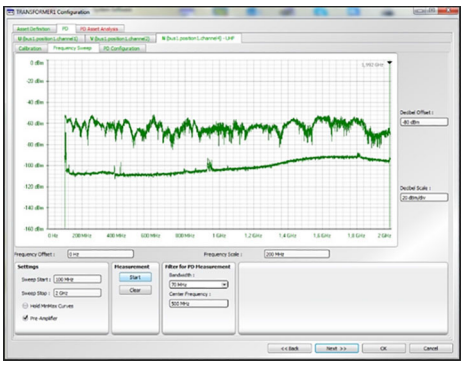


Figure 3-33: Frequency sweep with *UPG 620* connected

3. Compare both spectra (with and without *UPG 620* connected). Differences indicate the presence of the injected pulses. Check the PRPD patterns in this frequency range (use 70 MHz bandwidth) to identify the pulses injected by *UPG 620*.

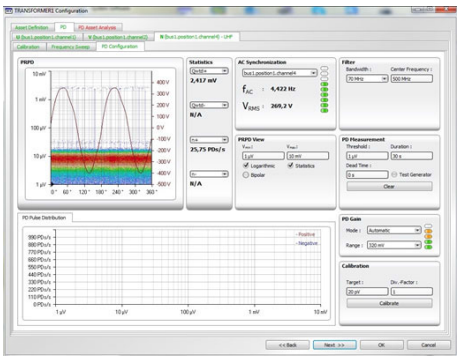


Figure 3-34: Check of PRPD patterns in **PD Configuration** tab

3.4.3 Measurement

While choosing a suitable measuring frequency, please keep the following in mind:

► Select a frequency and bandwidth that results in a high signal-to-noise ratio.

► Check the working frequencies and transfer behavior of the sensors in use.

For further information on the sensors in use, see the corresponding manual for each sensor. Manuals can be found on the OMICRON website, in the Customer Area.

For further information on PD measurements on transformers, see also the following standards and guides:

- IEEE Guide for Diagnostic Field Testing of Electric Power Apparatus – Part 1: Oil Filled Power Transformers, Regulators and Reactors, IEEE Std 62-1995, 1995
- IEEE Guide for Diagnostic Field Testing of Fluid-Filled Power Transformers, Regulators and reactors, IEEE Std C57.152-2013, 2013
- IEEE Recommended Practice for Partial Discharge Measurement in Liquid-Filled Power Transformers and Shunt Reactors, IEEE Std C57.113, 2010
- CIGRE Technical brochure 676 "Partial discharge in transformers"

3.5 Cable systems

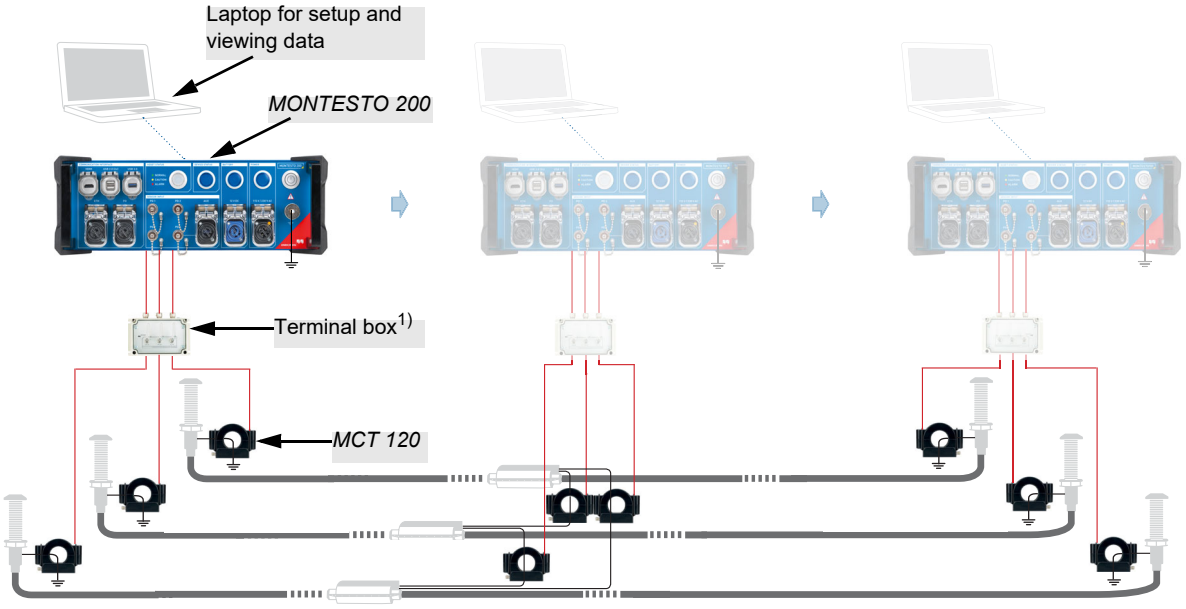


Figure 3-35: Typical measurement setup with high-frequency current transformer (HFCT) sensors and a terminal box

1) The terminal box is optional for on-line PD measurements and monitoring at cable terminations, as the HFCT sensors can be attached to the cable screen during operation.

3.5.1 Connection

Wiring diagram

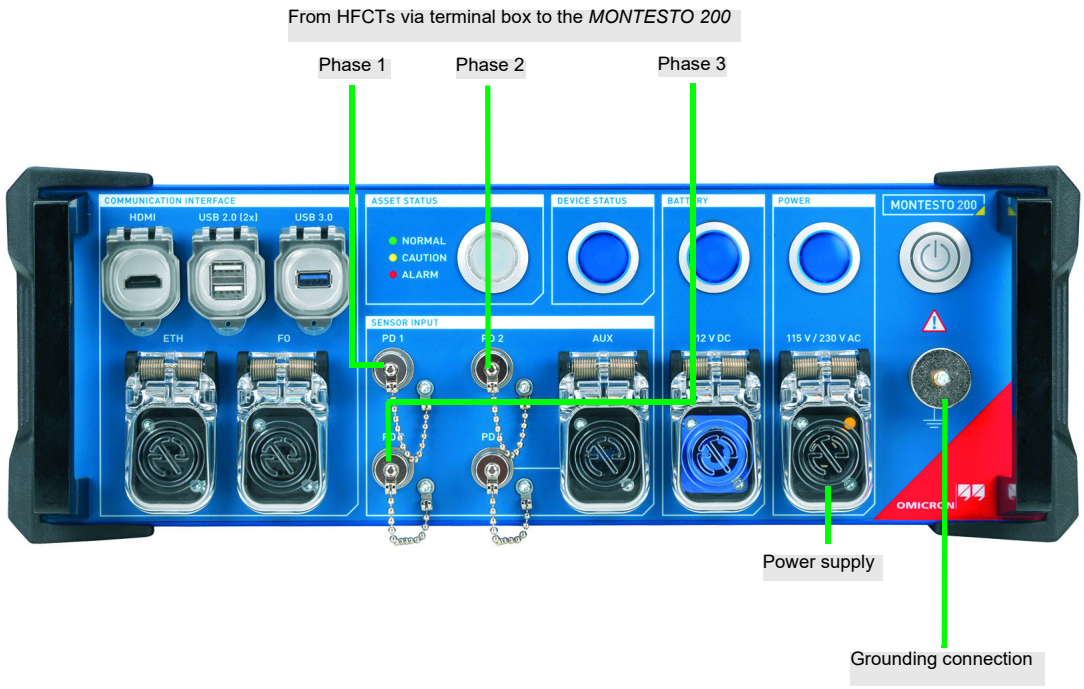


Figure 3-36: Wiring diagram of *MONTESTO 200* to HFCTs via a terminal box

Wiring instructions

CAUTION

Minor or moderate injury caused by leakage current possible

- ► Make sure that the cables have ground contact to avoid leakage current.
- ► Use only original cables provided by OMICRON.

WARNING

Death or severe injury caused by high voltage or current possible

- ► Always obey the internal safety instructions for working in high-voltage areas to avoid injury.

On-line PD measurements via HFCT sensors and a terminal box

WARNING

Death or severe injury caused by high voltage or current possible

- ► Never open a joint link box with the cable in operation.
- ► Never disconnect the grounding straps of the cable termination with the cable in operation.
- ► Never open the covers of the metal-clad switchgear during operation.

To perform the PD measurement with *MONTESTO 200*, proceed as follows:

1. Since the cable system is energized, request a briefing from the site operator in which area you may stay and move safely. If the HFCT sensors and terminal box are permanently installed, request a confirmation which terminal box to use and if it is located in the work area. Read the User Manual of the preinstalled terminal box and HFCT sensors.
2. Before starting the measurement, connect all measurement devices safely to the local grounding. Observe the safety instructions of your measurement devices.
3. If the sensors are not preinstalled, use split-core HFCTs and clamp them around the cable screen / grounding connection of the cable termination.

Figure 3-37: Example of a split-core HFCT installation at in-service cable termination

4. Use an inductive clamp to measure the current on the cable screen (only for future reference).

Figure 3-38: Example of current measurement on the cable screen

5. Power up the device and start the internal PC by pressing the start and shutdown button.
6. When the start and shutdown button LED is lighted up continuously, the device is ready for setup and measurement.
7. If a terminal box is available, connect the coaxial cables to the preinstalled HFCT sensors via the terminal box following the steps presented in Figure 3-22: on page 31:
   - Identify the correct terminal box.
   - Open the terminal box and install the measurement device at one side of the TNC T connectors.
   - Open the short-circuit caps at the other side of the TNC T connectors.
8. Connect to the internal PC as explained in 3.2 "Connection to the internal PC" on page 14.
9. Start the *Monitoring Software* and set up all parameters relevant for the measurement.
   For more information, refer to *Monitoring Software* and *OMS System Software* User Manual.
10. When the measurement is finished:
    - Connect the short-circuit caps.
    - Unplug the signal cables and close the terminal box.

WARNING

Death or severe injury caused by high voltage or current possible

► Follow all internal safety instructions, while disconnecting the equipment.

11. Shut down the internal PC by pressing the start and shutdown button. When the start and shut down button LED is turned off, the internal PC has shut down.
12. Make sure that no damages occurred at the terminal box during the measurement.

Installation for temporary PD monitoring

MONTESTO 200 can be installed at the test object enclosure via magnetic holders, or directly at an adjacent wall. For *MONTESTO 200* dimensions, see Figure 3-23: on page 32.

For monitoring sessions, *MONTESTO 200* should be connected to the mains via an uninterruptible power supply (UPS) source.

► Set monitoring sessions following the instructions presented in the *Monitoring Software* User Manual.

NOTICE

Loss of data possible

► In case of power supply loss, *MONTESTO 200* turns off and after pressing the start and shutdown button, the measurement session starts automatically.

3.5.2 Normalization

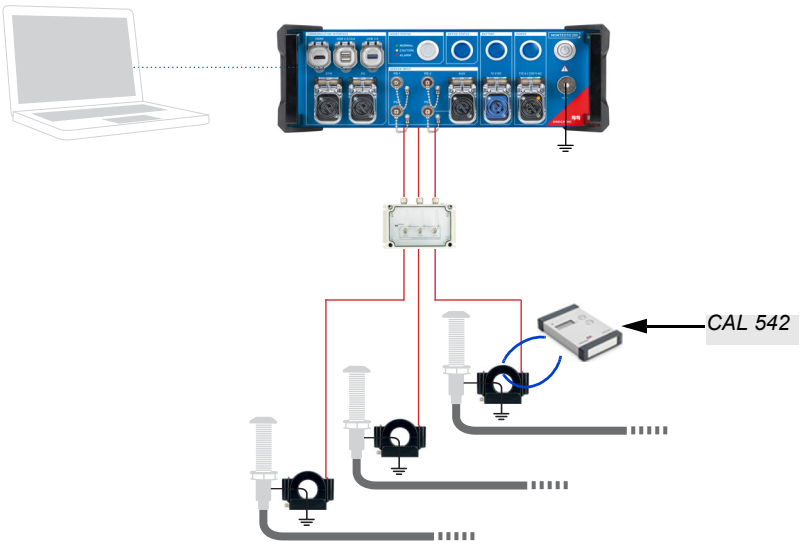


Figure 3-39: Normalization using HFCT sensors

WARNING

Death or severe injury caused by high voltage or current possible

► Always follow all internal safety instructions when working with high-voltage equipment while connecting, disconnecting or handling the calibrator.

A calibration of the setup according to IEC 60270 is not possible for on-line measurements. Therefore, only a normalization can be carried out.

With *MONTESTO 200* connected, the normalization procedure is performed as follows:

1. Connect a calibrator (for example, *CAL 542*) to one of the HFCTs (see Figure 3-39: "Normalization using HFCT sensors") by feeding a loop through the HFCT core.
2. Apply the calibrator pulse of the chosen value. This value should give you a stable measurement reading with a good signal-to-noise ratio.
3. Make sure that the calibrator impulses are clearly visible in the software as the highest impulses on the respective channel.
4. Repeat the same procedure for the other two phases.
5. After normalization, disconnect the calibrator from the HFCT sensor.

3.5.3 Measurement

While choosing a suitable measuring frequency please keep the following in mind:

► Select a frequency and bandwidth that results in a high signal-to-noise ratio.

► Consider the transfer behavior of the sensors in use.

► Check with the customer for specific requirements regarding the measuring frequencies.

► Make sure to check the whole frequency range to avoid measuring frequencies with cancellation of the signal due to superposition.

For further information on the sensors in use, see the corresponding manual for each sensor. Manuals can be found on the OMICRON website, in the Customer Area.

For further information on PD measurements on cable terminations, see also the following guide:

- IEEE Guide for Partial Discharge Testing of Shielded Power Cable Systems in a Field Environment, IEEE Std 400.3-2006, 2007
- CIGRE Technical Brochure 502 "High-Voltage On-Site Testing with Partial Discharge Measurement"

4 Technical data

4.1 *MONTESTO 200*

4.1.1 Partial discharge measurement

The partial discharge measurements comply with IEC 60270.

Table 4-1: Partial discharge measurement

Characteristic	Rating
Number of input channels	4 (device internal frequency separation AC/PD)
Connector type	TNC
Frequency range	AC: DC … 16 kHz PD: 16 kHz … 30 MHz
Sampling rate	AC: 31.25 kS/s PD: 125 MS/s
Peak input levels	AC: 200 mA PD: 80 V
Measurement accuracy[1)]	AC: ±0.25 % (40 Hz < f < 70 Hz) PD: ±5 % (f = 300 kHz, Δf = 150 kHz)
Maximum double pulse resolution	< 200 ns
PD event time resolution	< 2 ns
PD filter bandwidth	9 kHz … 5 MHz (10 bandwidth settings)
System noise[1)]	< 1 pC (f = 400 kHz, Δf = 300 kHz, input range ≤ 320 mV)
Power consumption	60 W max. (140 W max. while charging battery)

1) at 23 °C ±5 K

4.1.2 Auxiliary input/output

Table 4-2: Auxiliary input/output

Characteristic	Rating
Supported standards	In/Out: RS 485 (half-duplex) In/Out: TTL 3 V
Auxiliary supply	Out: 12 V DC

4.1.3 Power supply

Table 4-3: Power supply

Voltage	Supply voltage
AC	115 V AC … 240 V AC 50 / 60 Hz
DC	110 V DC … 150 V DC -20 % … +25 %

4.1.4 Mechanical data

Table 4-4: Mechanical data

Characteristic	Rating
***MONTESTO 200* device**	
Dimensions (W × H × D) (connectors unmated)	427 mm × 150 mm × 405 mm (16.8 inch × 5.9 inch× 15.9 inch)
Weight	< 12 kg (< 26.5 lb)

4.1.5 Environmental requirements

Table 4-5: Environmental requirements

Characteristic	Rating
Operating temperature	-20 °C … +55 °C (-4 °F … +131 °F)
Storage temperature	-40 °C … +80 °C (-40 °F … +176 °F)
Humidity	Up to 95 % r.H. (non-condensing)

4.1.6 Standards

Table 4-6: EMC and safety

EMC		
EMC	IEC/EN 61326-1 (industrial electromagnetic environment) FCC subpart B of part 15, class A	CE
Electromagnetic compatibility		
Emission	EN 55011/22, 30 MHz … 3 GHz FCC Subpart B, 30 MHz … 1 GHz	
Immunity	EN 61000-6-5: MV/HV substations	
Vibration, shock, and protection class		
Vibration	EN 60068-2-6 (Frequency range 10 Hz … 150 Hz Acceleration 2 g continuous (20 m/s^2), 10 cycles per axis)	
Shock	EN 60068-2-27 (15 g/11 ms, half-sinusoid, each axis)	
Protection class	EN 60529 IP 65 (*MONTESTO 200* cabinet)	

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