

TESTRANO 600

Getting Started



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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.

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 the *TESTRANO 600* and its accessories. Before starting to work, clearly establish the responsibilities.

Personnel receiving training, instructions, directions, or education on *TESTRANO 600* 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.

1.2 Safety standards and rules

1.2.1 Safety standards

Testing with *TESTRANO 600* 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 *TESTRANO 600* and its accessories, read the safety instructions in this Getting Started carefully.

Do not turn on or operate *TESTRANO 600* if you do not understand the safety information in this manual. If you have questions or do not understand some safety instructions, contact OMICRON before proceeding.

Maintenance and repair of *TESTRANO 600* and its accessories is only permitted by qualified experts at OMICRON service centers (see "Support" on page 55).

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 (see "Support" on page 55).

1.3 Operating the measurement setup

Note: The *CP TD1*, *CP TD12* or *CP TD15* works as an add-on device to the *TESTRANO 600*. These three add-on devices are collectively named *CP TD* if no specific device is referred to.

- ► Before connecting or disconnecting test objects and/or cables, make sure that *TESTRANO 600* is turned off. Either use the power switch or press the **Emergency Stop** button.
- ► Do not connect or disconnect a test object while the outputs are active.
- ► After switching off *TESTRANO 600*, wait until the red warning light on the front panel has switched off (see 3.1.1 "*TESTRANO 600* front panel" on page 11). As long as this warning light is on, there is still voltage and/or current potential on one or more of the outputs.
- Make sure that the test object's terminals to be connected to TESTRANO 600 do not carry any voltage potential.
- ▶ Make sure that during a test, *TESTRANO 600* is the only power source for a test object.
- ► Leave the high-voltage test area before performing a test with TESTRANO 600.
- ▶ Before operating *TESTRANO 600*, ground it as described in section 1.6 "Grounding" on page 7.
- ▶ Do not connect any cable to the test object without a visible grounding of the test object.
- ▶ Do not remove any cables from TESTRANO 600 or the test object during a test.
- ► Do not use inadequately rated supply cords.
- Before connecting cables to TESTRANO 600's high-voltage or current outputs, or other conducting parts that are not protected against accidental contact, press the Emergency Stop button. Do not release it unless an output signal is absolutely necessary for the test.
- ▶ Before switching on the high voltage, leave the high-voltage test area.
- Do not stand right next to or directly underneath a connection point. The clamps may fall off and hit you.

The red warning light on the *TESTRANO 600* front panel indicates hazardous voltage and/or current levels on the outputs. The green light indicates that the *TESTRANO 600* outputs are not active.

Note: If none or both lights on the front panel are on, *TESTRANO 600* is either not supplied by mains or it is defective. In this case do not use it anymore.

- ► Always lock connectors properly.
- The counterpart of the sockets are locking connectors. To lock these connectors safely, insert them carefully and turn clockwise until you feel them click into place. Check if they are locked by trying to turn counterclockwise without pulling the silver latch.
- ► To remove the locking connectors, unlock them by pulling the silver latch.
- ► Do not insert any objects into any input/output socket.
- ► Do not operate *TESTRANO 600* under ambient conditions that exceed the temperature and humidity limits listed in chapter 7 "Technical data" on page 36.

- Before use check that the environmental conditions are suitable for any additional equipment such as your laptop.
- Use dry and clean cables. In dusty regions, use protective caps. To avoid leakage current, make sure that the cables have ground contact.
- ► Only use cables supplied by OMICRON.
- Position the measurement setup in a way that you can easily disconnect TESTRANO 600 from mains. If permanently connected, make sure that the measurement setup is positioned in a way that the switch or circuit breaker can be easily reached.
- ▶ Do not operate *TESTRANO 600* and its accessories in the presence of explosives, gas or vapors.
- If TTESTRANO 600 or its accessories do not seem to function properly (for example, in case of cable damages, abnormal warming or overheating of components), stop using them and contact OMICRON support (see "Support" on page 55).
- ► Observe the high-voltage areas.
- ► Always obey the internal safety instructions for working in areas with high voltage to avoid injury.



Figure 1-1: Illustration of work area and high-voltage area established for working with *TESTRANO 600* and *CP TD*

1.4 Orderly measures

The TESTRANO 600 Getting Started or alternatively the e-book always has to be available on the site where *TESTRANO 600* is operated.

The users of *TESTRANO 600* must read this manual before operating *TESTRANO 600* and observe the safety, installation, and operation instructions therein.

TESTRANO 600 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).

Opening *TESTRANO 600* 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.

1.5 Disclaimer

Using *TESTRANO 600* in any way differing from the one mentioned above is considered improper use, and will invalidate all customer warranty claims and exempt the manufacturer from any liability to recourse.

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

Automatic assessment

The applied auto-assessment rules (for example, indicated colors, indications) and limits within the Program are defined according to industry standards and/or are based on the experience of industry experts. The purpose of the auto-assessment is to indicate to the person that uses the Program – "User" any deviation of the measured parameters from the expected values based on the recommended limits provided by OMICRON or defined by the User. Any decision to return the apparatus to service or remove the apparatus from service cannot be based on the results of the auto-assessment alone. This decision is the sole responsibility of the owner or end user of the apparatus.

1.6 Grounding

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

- ▶ Only operate the TESTRANO 600 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 the TESTRANO 600 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 *TESTRANO 600* grounding terminal to the grounding system on site.

1.7 Power supply

Operating the TESTRANO 600 without PE and ground connection is life-threatening and not permitted.

▶ Only operate the TESTRANO 600 with a mains power supply connected to protective earth (PE).

Power supply from grounded grids (TN/TT)

Before a measurement is started, the *TESTRANO 600* 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 the *TESTRANO 600* is powered by a generator. Since every operation mandates a PE connection, you need to manually verify this.

If the *TESTRANO 600* 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 the *TESTRANO 600* 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 240 V 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.

External Booster

- ► Handle the Ext. Booster connector with extreme caution.
- Only use booster cables supplied by OMICRON.
- ▶ Do not use booster cables that are frayed or damaged in any way.

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 Introduction

2.1 Designated use

In combination with the *CP TD* or as a stand-alone unit, *TESTRANO 600* is a multi-purpose power transformer test system for routine and diagnostic testing of power transformers during manufacturing, commissioning and maintenance.

The various partly automated tests are defined and parameterized via the front panel control of a builtin embedded PC or via an externally connected laptop.

2.2 Device variants

TESTRANO 600 is available with two interface variants.

With multi-touch screen and USB port

Controlled via the embedded PC using *TouchControl* or via a connected laptop using the *Primary Test Manager* software

Without touch screen and embedded PC

Controlled only via laptop using the Primary Test Manager software

3 Hardware overview

3.1 **TESTRANO 600**

▶ Refer to user manual chapter 7 "Technical data" on page 36 for detailed hardware information.

3.1.1 **TESTRANO 600** front panel



*Display version only

Figure 3-1: TESTRANO 600 front panel with display

3.1.2 TESTRANO 600 side panel



Figure 3-2: TESTRANO 600 side panel

3.1.3 Safety and warning indicators

TESTRANO 600 provides the following indicators for safe and dangerous operating conditions.

Table 3-1: Warning indicators

Indicator	Description	Device State	Operat	ing condition
Front pane	l			
	Green status light on the front panel is on	<i>TESTRANO 600</i> is up and running in the stand-by mode.	Current/voltage source is inactive/off	
	Blue ring on the Start/Stop button is on	A test is ready to start.		
	Blue ring on the Start/Stop button is flashing	The Start/Stop button has just been pressed. There may be hazardous voltage and/or current levels on the <i>TESTRANO 600</i> outputs.	A	Dangerous operating
	Red status light on the front panel is flashing	A test is running. There probably are hazardous voltage and/or current levels on the <i>TESTRANO 600</i> outputs.		condition
Side panel				
	Warning light 1 on the side panel is flashing (red)	There are hazardous current levels (>3 mA) on the <i>TESTRANO 600</i> inputs/outputs independent of the measurement state.		Dangerous
	Warning light 2 on the side panel is on (orange)	There are hazardous voltage levels (>42 V) on the <i>TESTRANO 600</i> inputs/outputs independent of the measurement state.	<u> </u>	condition
Acoustic signals				
	1 x beep	<i>Primary Test Manager</i> has established the connection to <i>TESTRANO 600</i> .	Safe op long as	perating condition as no test has been
())	2 x beep	<i>TESTRANO 600</i> has booted or a test is ready for execution.	warning lights are off.	
•	Continuous beening	TESTRANO 600 outputs are active or device is discharging		Dangerous
	Continuous beeping	 Observe the warning lights on the front and side panel. 	<u> </u>	condition

Warning lights

- ► Always observe the warning and status lights while working with TESTRANO 600.
- ▶ Do not cover the warning and status lights during operation.

If no or both status lights on the front panel are on, the unit is defective or not supplied by mains.

Beeper

The beeper is an additional indicator for the main device status but does not compensate for the lights on the *TESTRANO 600* front and side panel.

If the beeper has been disabled, no acoustical signal will be emitted while the *TESTRANO 600* outputs are active.

▶ Refer to section "Beeper" on page 40 of this manual on how to disable and activate the beeper.

If the beeper is activated but does not emit a signal for the scenarios listed above in Table 3-1, *TESTRANO 600* might be defective.

► If TESTRANO 600 appears to be defective, do not use it anymore. Contact OMICRON support (see "Support" on page 55).

3.1.4 Emergency Stop button



Pressing the **Emergency Stop** button *immediately* shuts off all *TESTRANO 600* outputs and stops the running measurement. When the **Emergency Stop** button is pressed, you cannot start any measurements.

- Only use the Emergency Stop button in an emergency or to ensure that you can safely connect/disconnect cables.
- During regular operation, stop tests via the Start/Stop button or the software.

3.1.5 **TESTRANO 600** measuring cables

► To connect a measuring cable to *TESTRANO 600*, insert the connector and turn it to the right until it locks with a "click".

For disconnection:

- Hold the connector and pull back the silver latch.
- Turn the connector to the left and gently pull it out.



NOTICE

Equipment damage possible

- ► Do not pull the cable when disconnecting.
- ► Hold, turn and gently pull the connector for disconnection.

Item	Picture	Description
High-voltage cable Red marked sleeve after the connector		 Polarity protection: only suitable for HIGH VOLTAGE and LOW VOLTAGE sockets 15 m length 8 poles
Low-voltage cable Yellow marked sleeve after the connector		 cross-section: 4 × 4 mm² for output 4 × 1 mm² for measurement Neutrik[®] plug
Tap changer cable No marked sleeve after the connector		 Polarity protection: only suitable for TAP CHANGER socket 15 m length 8 poles 8 × 2.5 mm² cross-section Neutrik[®] plug

Table 3-2: TESTRANO 600 measuring cables

3.2 CP TD1

▶ Refer to the CP TD1 User Manual for detailed information and safety instructions.

3.2.1 Grounding terminal and booster input



Figure 3-3: Left side view of the CP TD1

3.2.2 Serial interface connector and measuring inputs



Figure 3-4: Right side view of the CP TD1

3.2.3 High-voltage connector



Figure 3-5: Back side view of the CP TD1

3.3 CP TD12/15

▶ Refer to the CP TD12/15 User Manual for detailed information and safety instructions.

3.3.1 CP TD12/15 grounding terminal and Booster input



* For more details on the interlock function refer to 3.3.4 "Safety and interlock functions" on page 19.

Figure 3-6: Grounding terminal and booster input of the CP TD12/15 (left side of the device)

3.3.2 CP TD12/15 serial interface connector and measuring inputs



Figure 3-7: Serial interface and measuring inputs of the CP TD12/15 (right side of the device)



3.3.3 *CP TD12/15* high-voltage connector

* For more details on the interlock function refer to 3.3.4 "Safety and interlock functions" on page 19.

Figure 3-8: High-voltage connector of the CP TD12/15 (rear of the device)

3.3.4 Safety and interlock functions

The *CP TD12/15* has several internal and external safety functions to prevent dangerous situations. The *CP TD12/15* will not work if a safety function detects a problem, such as:

- · defect of the protective earth connection to the Control device
- missing measurement ground connection (cable not connected to device)
- bad measurement ground connection (measurement ground has no contact to protective ground)
- HV-cable is not connected to the CP TD12/15

Additionally, the interlock function is active when an external *CP CR600* is connected. The *CP TD12/15* will not work if the interlock function detects one of the following problems:

- missing safety connection to the CP CR600
- HV-cable is not connected to the CP CR600
- overtemperature of the CP CR600

Note: If the interlock function prevents the *CP TD12/15* from working, check all connections and options mentioned above.

3.4 Cleaning

Death or severe injury caused by high voltage or current possible

- ▶ Do not clean TESTRANO 600 the CP TD or any other device when connected to the test object.
- Disconnect the test object, accessories and connection cables before cleaning.
- ▶ Use a cloth dampened with isopropanol alcohol to clean *TESTRANO 600* and its accessories.

4 Application

4.1 Safety precautions in the substation

Before setting *TESTRANO 600* into operation and carrying out a test, it is essential that you have read and understood chapter 1 "Safety instructions" on page 3.

- ▶ Be aware that all output sockets of *TESTRANO 600* can carry life-hazardous voltage and current.
- Only use TESTRANO 600 with a solid connection to ground. Refer to 1.6 "Grounding" on page 7 for more information on grounding TESTRANO 600.
- ► Separate your working area see Figure 1-1: "Illustration of work area and high-voltage area established for working with *TESTRANO 600* and *CP TD*" on page 5.
- ► Tests with high voltages and currents must only be carried out by authorized and qualified personnel.
- Personnel receiving training, instructions, directions, or education on high- voltage/current tests should remain under the constant supervision of an experienced operator while working with the equipment.
- ▶ The instructions have to be renewed at least once per year.
- The instructions must be available in written form and signed by each person assigned to do high-voltage/current tests.

Prior to connecting a test object to *TESTRANO 600*, the following steps need to be carried out by an authorized employee of the utility:

- Protect yourself and your working environment against an accidental re-connection of high voltage by other persons and circumstances.
- ► Verify that the test object is safely isolated.
- Earth-connect and shorten out the test object's terminals using a grounding set.
- Protect yourself and your working environment with a suitable protection against other (possibly live) circuits.
- Protect others from accessing the high-voltage area and accidentally touching live parts by setting up a suitable barrier and, if applicable, warning lights.
- ► If there is a longer distance between the location of *TESTRANO 600* and the area of danger, a second person with an additional **Emergency Stop** button is required.

4.2 Preparing the test setup

Death or severe injury caused by high voltage or current

The output sockets of *TESTRANO 600* can carry life-hazardous voltage potential and life-hazardous currents.

- ▶ Do not use *TESTRANO 600* without a solid connection to ground.
- ▶ Before switching on TESTRANO 600, make sure it is completely dry.
- Before connecting any cables, check them for damage. Make sure that the connectors are clean and dry and that the insulation is intact.
- 1. Make sure that the power switch on the TESTRANO 600 side panel is turned off.
- 2. Press the Emergency Stop button.
- 3. Connect TESTRANO 600 to:
 - a) equipotential ground: Ground *TESTRANO 600* with a cable of at least 6 mm² cross-section as close as possible to the operator.
 - b) the computer with the PTM installed on it (optional if TESTRANO 600 is used with TouchControl)
 - c) the mains power supply
- 4. Optional: Connect the CP TD to TESTRANO 600.
 - a) Properly connect the TESTRANO 600 grounding terminal to substation ground.
 - b) Properly connect the *CP TD* grounding terminal/measurement ground to ground of the asset to be measured.
 - c) Connect the *CP TD* **BOOSTER IN** to the *TESTRANO 600* **EXTERNAL BOOSTER** using the booster cable.
 - d) Connect the CP TD SERIAL to TESTRANO 600 SERIAL with the data cable.
- 5. Turn on the power switch on the *TESTRANO 600* side panel.
- 6. The green light and the blue ring of the **Start/Stop** button are switched on, showing that *TESTRANO 600* does not output dangerous voltage or current.
- 7. If the PE connection is defective or if the power supply has no galvanic connection to ground, a warning message appears.

Note: If *TESTRANO 600* is supplied by mains and switched on, and no or both warning lights are on, the unit might be defective. Contact OMICRON support (see "Support" on page 55).

4.3 Connecting to the transformer

4.3.1 Preparing the software

TouchControl

- 1. Select a test.
- 2. After defining the asset's vector group, tap **Wiring** improve to display the wiring diagram for the test.
- 3. Lock *TESTRANO 600* using the **Software lock** (see the **Software lock** in the *TouchControl* software, chapter 6.5 "Software lock" on page 41).
- 4. Connect the test leads to *TESTRANO 600* (and, if applicable, the *CP TD*) as described in the following section 4.3.2 "Connecting to the transformer".

Primary Test Manager

- 1. Create a job with tests or select a manual test.
- 2. View the wiring diagram in the **General** tab of the test.
- 3. Lock your computer.
- 4. Connect the test leads to *TESTRANO 600* (and, if applicable, the *CP TD*) as described in the following section 4.3.2 "Connecting to the transformer".

4.3.2 Connecting to the transformer

Death or severe injury caused by high voltage or current possible

- Before connecting any test leads to the transformer, turn off and disconnect any voltage to and from the transformer (e. g. high voltage on the main terminals, control voltage of the tap changer).
- Ground and short-circuit its terminals using a grounding set.
- 1. Connect the test leads to *TESTRANO 600* as shown in the wiring diagram on the *TouchControl* or in *Primary Test Manager*. Additionally, observe the connection sequence given below in Figure 4-1: "Connection sequence *TESTRANO 600* to transformer":

Minor or moderate injury caused by wrong connection possible

► Always observe the wiring diagram shown on the *TouchControl* or in *Primary Test Manager*.



Figure 4-1: Connection sequence TESTRANO 600 to transformer

- I. Connect the high-voltage (red), low-voltage (yellow) and tap changer cables to *TESTRANO 600*.
- **II.** Connect the high-voltage (red) and low-voltage (yellow) cables to the transformer's main terminals.
- **III.** Connect the tap changer cable to the appropriate terminals in the control cabinet of the transformer (see Figure 4-2 below).
- IV. Re-connect and turn on the voltage of the tap changer.

switching of the tap changer.

Note: If the tap changer control voltage exceeds 42 V, the orange warning light 2 on the side panel will indicate a hazardous voltage on the *TESTRANO 600* inputs (see 3.1.3 "Safety and warning indicators" on page 13).

- 2. Depending on the measurement purpose, tap changers might be required. Therefore, none, one or both of the following two instructions are necessary:
 - For tap changer control connect TapUp+ and TapUp- (blue) to the connectors controlling the upward switching of the tap changer.
 Connect TapDown+ and TapDown- (purple) to the connectors controlling the downward
 - For the measurement of motor current and voltage, connect VIn+ and VIn- (green) as illustrated below. On a three-phase motor VIn+ can be connected to either L1, L2 or L3. Connect the current clamp to CurrentIn+ and CurrentIn-.



Figure 4-2: Connection scheme tap changer cable to tap changer

- 3. Optional: If you connected the *CP TD* to the *TESTRANO 600* (step 4 in section 4.2), connect the **IN_A**, **IN_B** and high-voltage output of the *CP TD* to the transformer.
 - Refer to the CP TD1 User Manual for more information on safely connecting the CP TD1 to a device under test.
 - Refer to the CP TD12/15 User Manual for more information on safely connecting the CP TD12/15 to a device under test.
- 4. Erect a barrier separating the work area from the high-voltage test area (see page 5).
- 5. Remove the grounding set from the test object.
- 6. Release the Emergency Stop button.

4.4 Measurement

TouchControl

- 1. Disable the **Software lock** by entering the 4-digit code into the **Enter code** entry field and by then pressing the **Unlock** button **Unlock** or the **Enter** button **Unlock**.
- 2. Enter/adjust the test settings in the Settings view.
- 3. Open the **Measurement** view and prepare to start the test by tapping **Start** button **start**.
- 4. The blue ring on the **Start/Stop** button O located on the front panel lights up.
- 5. Press the Start/Stop button to confirm and actually start the test.
- The blue ring and the red warning light on the front panel are now flashing for approx.
 3 seconds.
 - ► To suspend the test at any time, press the **Start/Stop** button on the *TESTRANO 600* front panel.
 - ▶ In an emergency, press the **Emergency Stop** button to stop the test.
- 7. After the measurement is completed or stopped, the green warning light () switches on.
- 8. TouchControl displays the results in the Measurement view of the test.
- ► To perform additional tests, repeat the steps in chapters 4.3.2 to 4.4.

Primary Test Manager

- 1. Establish the connection between Primary Test Manager and TESTRANO 600.
- 2. Enter/adjust the test settings in the Settings and conditions area.
- 3. Select a standard in the **Assessment** area (if applicable).
- 4. Press the Start button Start .
- 5. The blue ring on the **Start/Stop** button 🔘 lights up.
- 6. Press the Start/Stop button to start the test.
- 7. The blue ring on and the red warning light of are now flashing for approx. 3 seconds.
 - ► To suspend the test, press the **Start/Stop** button on the *TESTRANO 600* front panel.
 - ▶ In an emergency, press the **Emergency Stop** button to stop the test.
- 8. After the measurement is completed or stopped, the green warning light 🔘 switches on.
- 9. Primary Test Manager displays the results in the Measurements section of the test.
- ▶ To perform additional tests, repeat the steps in chapters 4.3.2 to 4.4.

4.5 Disconnection

1. Wait until the green light on the *TESTRANO 600* front panel is on and the warning lights on the front and side panel are off.

Note: If the tap changer control voltage exceeds 42 V, the orange warning light 2 on the side panel will indicate a hazardous voltage on the *TESTRANO 600* inputs (see 3.1.3 "Safety and warning indicators" on page 13).

- ▶ Disconnect the tap changer cable to extinguish warning light 2.
- 2. Press the Emergency Stop button on the TESTRANO 600 front panel.

Death or severe injury caused by high voltage or current

- Never unplug any cables while the measurement is running.
- Only disconnect cables when **all** of the following apply:
 - The red warning light on the front panel is off.
 - The warning lights on the side panel are off.
 - The green light on the front panel is **on**.
- If all lights on TESTRANO 600 are off, the device is defective or not supplied by mains.
- 3. To prevent anyone from starting a test, use the **Software lock** in the *TouchControl* software (see chapter 6.5 "Software lock" on page 41) and/or lock your computer.
- 4. Remove the barrier between the high-voltage area and the work area.

Death or severe injury caused by high voltage or current possible

- Before touching any part of the transformer, ground and short-circuit its terminals using a grounding set.
- 5. Disconnect all cables from the transformer.
- 6. Disconnect all cables from TESTRANO 600 and, if applicable, from the CP TD.
- 7. Switch TESTRANO 600 off by pressing the mains power switch on the side panel.
- 8. Disconnect the mains power cord.
- 9. Remove the equipotential ground as the last connection that is removed first from *TESTRANO 600* and then on the substation side.

5 Testing with *TouchControl*

5.1 Getting started

The following table lists the basic steps necessary to complete a measurement using TouchControl.

▶ For more information on each step refer to the chapters listed on the right.

Step		User manual chapter
4	1. SAFETY	Safety instructions Hardware overview Safety and warning indicators Emergency Stop button Application
	2. Start TESTRANO 600	TESTRANO 600 side panel
	3. Enter asset info	Edit asset
	4. Add tests	TouchControl tests
	5. Connect to transformer	Safety instructions TESTRANO 600 measuring cables Application Wiring diagram
	6. Prepare test	Test views
► START	7. Measurement	Actual measurement

5.2 Test views

All *TESTRANO 600* test views (except the **Quick** view) of tests listed on the **Home** view contain when opened the **Settings** tab, the view of which displayed as default and through which the settings for the test are defined.

Depending on the selected test the top menu bar may contain other tabs such as **Measurement**, **Single phase**, **Three phase**, **Per phase** and **Plot** for starting and monitoring the actual measurement, or the **Capacitor** tab or **Define Winding** view for selecting further settings.

After all settings have been determined, the measurement can be started by tapping the START button

START located at the bottom left corner of the **Measurement** view. The user must confirm the start of the test by pressing the physical **Start/Stop** button on the front panel of the *TESTRANO 600*.

The progress of the measurement can be followed via **Measurement** view in which measured values are updated into a table during the measurement.

In the example below the **Turns ratio** test has been selected from the Test view. The **Settings** tab is opened as default.

To define the tap changer select either **OLTC** (On-Load Tap Changer) or **DETC** (De-Energized Tap Changer) icon after which the **Define Tap Changer** view opens.

If mandatory data are missing, the corresponding submenu and the **Start** button are marked with **(9)**.

It is possible to copy the settings entered through the **Settings** view to all tests that have not yet been executed by tapping **Copy to all**



Figure 5-1: Example of a Settings view - Turns ratio test

Some features in the above Settings view example are highlighted in the list below:

1

Each test opens up by default to the **Settings** view, which has at the top menu bar tabs to select other possible views.

The other possible views depending on the test are one or more of the following views:

- Measurement
- Three phase
- Single phase
- Per phase
- Capacitor
- Plot

The selected options and entered values from this **Settings** view can be copied to all other tests which have not been executed yet by pressing

The vector group is defined by pressing the rectangle shaped area on the screen and by selecting the appropriate vector options.

TESTRANO 600 cables: HV = RED / LV = YELLOW

Settings for Automatic tap changer.

OLTC / **DETC** position selection is done by tapping the appropriate icon (HV or LV side). Active choice is shown in blue color.

Some values are selected from a drop-down list of predetermined values.

Other values are entered using a pop-up numpad, which offers in addition a slider control option.

Manual tap control UP 1 and DOWN 4 control buttons.

The wiring example for the defined test can be displayed by tapping this icon.

To minimize all select and to expand again select

Entering values

- ▶ Tap a box, then use the numpad to enter or correct a value.
- ▶ If needed, tap the metric prefixes below after entering a value:
 - k for kilo-
 - M for mega-
 - **m** for milli-
- If you want to use a slider control after entering an initial value by using the numpad, tap the Slider button and use the slider to increase or decrease the displayed value. Release the slider to stop at the desired value.

The slider will stop at the minimum/maximum value.

When all required settings have been entered and to continue with the actual measurement, select the **Measurement** tab from the top bar.

Defining a tap changer

To define a tap changer first select the appropriate tap changer type in the test's Settings view by pressing the appropriate tap changer icon: OLTC (on-load tap changer) s or DETC (de-energized tap changer)

Tap changer setting	gs – Define Tap Changer
Available	Mark the type of tap changer on the left and tap Yes to confirm and display the settings.
Position	Choose the tap changer's transformer side: HV or LV.
Tap scheme	Select the notation scheme for tap identification from the drop-down list.
No. of taps	Enter the number of taps.
Voltage table	The Voltage table displays the voltage for each tap. You can either enter each values manually or have them calculated.
	Enter at least the first two values and press Calculate .
	 Compare the calculated values with the nominal values on the nameplate before proceeding.
	Add more taps at the end of the voltage table.
	Delete a tap from the voltage table.
	Delete all taps from the voltage table.
	Insert a tap below the marked tap.
Middle	Enter the voltage for the middle tap (rated voltage) and the deviation value for the calculation, then press Calculate.
First/middle/last	► Enter the voltages for the first, middle and last tap, then press Calculate .

Table 5-1: Steps in the Define Tap Changer view

When all required settings have been entered and to continue with the actual measurement, select the **Measurement** tab (or **Three phase**, **Per phase** or **Plot**) from the top bar.

5.3 Measurement view

In the **Measurement** view (or **Three phase**, **Per phase** or **Plot**) you can start the actual measurement by tapping the **Start** button **Start** located at the bottom left corner. You will be required to confirm the starting of the test by pushing the **Start/Stop** button on the *TESTRANO 600* front panel.

An ongoing measurement is indicated by a vertical red striped bar at the far left side of the **Measurement** view with a lightning symbol flashing at the top. The shown table is updated with the measured values.

Depending on the test the **Measurement** view may provide several options for displaying the measured values in different ways. You can save the measured values at any time by tapping the **Keep results** button which makes an intermediate save of the results so far. If you want to stop the measurement completely tap the **Stop** button **Stop** button **Stop**.

If mandatory data is missing, the **Start** button is marked with the symbol **(0)**. In this case the missing data must be entered via the **Settings** view. If all missing information has been entered/selected the **Start** button should now be green **START**.

The right side of the **Measurement** view has the buttons listed in the following table.

lcon	Description
K N N	Full screen
~~	Assess
\checkmark	Pass
×	Fail
2	Investigate
\approx	Not assessed
×	Delete result
×	Delete all

Table 5-2: Measurement view right side buttons

5.3.1 Plot view

With some measurement the top menu bar will show a button called **Plot** and graphs or bar graphs, when applicable, can be viewed by tapping the **Plot** button.

5.3.2 Wiring diagram

When in the Settings tab, you can display the wiring diagram for the selected test and vector group by tapping the Wiring icon.

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The colors in the wiring diagram represent the cable ends (see 3.1.5 "*TESTRANO 600* measuring cables" on page 15).



Figure 5-2: Wiring diagram for a TTR (Turns Ratio Test) on a transformer with the vector group YNd5

5.4 Actual measurement

- ▶ Refer to chapter 1 "Safety instructions" on page 3 for detailed information about safe testing.
- ▶ If in doubt, contact OMICRON support (see "Support" on page 55).

Death or severe injury caused by high voltage or current

- Do not unplug any cables while the measurement is running.
- Only remove cables when all of the following apply to TESTRANO 600:
 - The red warning light on the front panel is off.
 - The warning lights on the side panel are off.
 - The green light on the front panel is **on**.

If all lights on TESTRANO 600 are off, the device is defective or not supplied by mains.

Death or severe injury caused by high voltage or current possible

- Do not enter the high-voltage area during the test.
- ► Do not touch any part of the transformer before grounding and short-circuiting its terminals.
- **5 START** 1. To start the test measurement tap **Start**.
 - 2. To stop the test measurement tap Stop.
 - 3. The blue ring on the **Start/Stop** button on *TESTRANO* 600 lights up.
 - 4. Press the Start/Stop button on TESTRANO 600 front panel to start the test.
 - 5. The blue ring and the red warning light are now flashing for approx. 3 seconds.
 - ► To suspend the test, press the **Start/Stop** button on the *TESTRANO 600* front panel.
 - ▶ In an emergency, press the **Emergency Stop** button to stop the test.
 - 6. After the measurement is completed or stopped, the green warning light switches on and *TouchControl* displays the results in the **Measurement** view.

6 Testing with Primary Test Manager

6.1 Getting started

The following table lists the basic steps necessary to complete a measurement using *TESTRANO 600* and the *Primary Test Manager* guided workflow.

► For more information refer to the user manual chapters listed on the right.

Step		User manual chapter
<u></u>	1. SAFETY	Safety instructions Hardware overview Safety and warning indicators Emergency Stop button Application
	2. Connection to TESTRANO 600	Preparing the test setup
	3. Start device and software	TESTRANO 600 side panel Software start and device update
<mark></mark>	4. Location and asset	Location view Asset view
	5. Jobs	Jobs
7	6. Tests	Test view PTM Transformer tests PTM Bushing tests Device-independent PTM tests
	7. Connection to device under test	Safety instructions TESTRANO 600 measuring cables Application Connecting to the transformer
7	8. Test settings	Performing tests
	9. Test assessment	Assessing measurement results
Start	10. Measurement	Measurement

6.2 Measurement

- ▶ Refer to chapter 1 "Safety instructions" on page 3 for detailed information about safe testing.
- ► If in doubt, contact OMICRON support (see "Support" on page 55).

Death or severe injury caused by high voltage or current

- ► Do not unplug any cables while the measurement is running.
- Only remove cables when all of the following apply to TESTRANO 600:
 - The red warning light on the front panel is **off**.
 - The warning lights on the side panel are **off**.
 - The green light on the front panel is **on**.

If all lights on TESTRANO 600 are off, the device is defective or not supplied by mains.

Death or severe injury caused by high voltage or current possible

- Do not enter the high-voltage area during the test.
- ► Do not touch any part of the transformer before grounding and short-circuiting its terminals.
- start 1. Press **Start** in *Primary Test Manager*.
 - 2. The blue ring on the **Start/Stop** button lights up.
 - 3. Press the Start/Stop button to start the test.
 - 4. The blue ring and the red warning light are now flashing for approx. 3 seconds.
 - ► To suspend the test, press the **Start/Stop** button on the *TESTRANO 600* front panel.
 - ▶ In an emergency, press the **Emergency Stop** button to stop the test.
- 5. After the measurement is completed or stopped, the green warning light switches on and *Primary Test Manager* displays the results in the **Measurements** view.

7 Technical data

At the time of factory adjustment all units are within the typical accuracy values specified in this document.

Typical accuracy means that 98 % of all units meet the specified values at 23 $^{\circ}C \pm 5 ^{\circ}C/73 ^{\circ}F \pm 10 ^{\circ}F$, after a warm-up time of more than 25 min., and in a frequency range of 45 Hz to 65 Hz or DC.

The typical accuracy values multiplied by 3 are guaranteed at an ambient temperature of 23 °C \pm 5 °C/73 °F \pm 10 °F, after a warm-up time more than 25 min., and in a frequency range of 45 Hz to 65 Hz or DC.

Accuracy values indicate that the error is smaller than:

± (value read × reading error [rd] + full scale of range × range error [rg]).

For mains voltages below 190 V AC the system is subject to power restrictions.

OMICRON suggests that you send in your unit for calibration at least once a year.

Technical data are subject to change without notice.

CAT level

The CAT level required depends on the *TESTRANO 600* application. All CAT ratings are defined for sea levels below 2000 m. There are some limitations between 2000 m and 5000 m from sea level (see section 7.8 "Environmental conditions" on page 53).

CAT I is required when the measured voltage is generated by the test set itself. No voltages from other sources are measured.

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.

7.1 **Output specifications**

Table 7-1: General output specification

Characteristic	Rating		
Frequency	DC or 15 Hz 599 Hz		
Power	Vmains	P _{30 s}	P _{continuous}
	>100 V _{RMS}	1500 W	1000 W
	>190 V _{RMS}	4000 W	2400 W

Table 7-2: Voltage source (HV and LV connectors)

Source	Range	I _{max, continuous}
DC high range	$3 \times 0 \dots \pm 113 V_{DC}^{1}$ 1 × 0 … ±340 V _{DC} ²	16 A _{DC}
DC low range	$3 \times 0 \dots \pm 56 V_{DC}^{1}$ 1 × 0 … ±170 V _{DC} ²	33 A _{DC}
AC high range low current	3 × 0 … 230 V _{RMS} (LN) ³	100 mA _{RMS}
AC high range	3 × 0 … 80 V _{RMS} (LN) ⁴ 1 × 0 … 240 V _{RMS} ⁵	16 A _{RMS}
AC low range	3 × 0 … 40 V _{RMS} (LN) ⁵ 1 × 0 … 120 V _{RMS}	33 A _{RMS}

See Figure 7-3: "Permitted operating range 3 x DC 113 V 16 A" on page 40
 See Figure 7-1: "Permitted operating range 1 x DC 340 V 16 A" on page 39

See Figure 7-5: "Derating of output power and output voltage 3 x 230 V_{RMS}" on page 41
 See Figure 7-4: "Permitted operating range 3 x AC 80 V 16 A" on page 40
 See Figure 7-2: "Permitted operating range 1 x AC 240 V 16 A" on page 39

Table 7-3: Voltage source accuracy

Characteristic	Accuracy ¹
Voltage accuracy DC	0.033 % rd ± 0.017 % range
Voltage accuracy AC (50 Hz) at burden open load	0.33 % rd ± 0.17 % range
Phase accuracy AC (50 Hz) burden open load, V>20 V _{RMS}	± 0.36°

1. Typical accuracy at 23 °C ±5 K

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Source	Range	V _{max, continuous}
DC source high range	3 × 0 ±33 A _{DC} ¹ or	56 V _{DC}
	1 × 0 ±100 A _{DC} (3 × 33.33 A _{DC})	
	1 × 0 ±33 A _{DC} ²	170 V _{DC}
DC source low range	3 × 0 ±16 A _{DC} ¹	113 V _{DC}
	1 × 0 ±50 A _{DC} (3 × 16.66 A _{DC}) ¹	
	1 × 0 ±16 A _{DC} ²	340 V _{DC}
AC source high range	3 × 0 33 A _{RMS} (LN) ³	40 V _{RMS}
	1 × 0 33 A _{RMS} ⁴	120 V _{RMS}
AC source low range	3 × 0 16 A _{RMS} (LN) ³ or	80 V _{RMS}
	1 × 0 50 A _{RMS} (3 × 16.66 A _{RMS})	
	1 × 0 16 A _{RMS} ⁴	240 V _{RMS}

Table 7-4: Current source (HV and LV)

1. See Figure 7-3: "Permitted operating range 3 x DC 113 V 16 A" on page 40

2. See Figure 7-1: "Permitted operating range 1 x DC 340 V 16 A" on page 39

See Figure 7-4: "Permitted operating range 3 x AC 80 V 16 A" on page 40
 See Figure 7-2: "Permitted operating range 1 x AC 240 V 16 A" on page 39

Table 7-5: Current source accuracy

Characteristic	Accuracy ¹
Current accuracy DC	0.033 % rd ± 0.017 % range
Current accuracy AC 50/60 Hz at burden 0.1 Ω	0.33 % rd ± 0.17 % range

1. Typical accuracy at 23 °C ±5 K

Table 7-6: Voltage source (Booster)

Source	Range	I _{max, cont.} 1	I _{max, 30 s} ¹
Power	-	3 kVA	4.4 kVA
AC high voltage 1 × 0 240 V _{RMS}		16 A _{RMS}	20 A _{RMS}
Characteristic		Rating	
Channels		1	
Voltage accuracy ² AC (50/60 Hz) at burden open load		0.33 % rd ± 0.16 % range	

1. Within the above specified power limit

2. Typical accuracy at 23 °C ±5 K



The following figures display the output characteristics of TESTRANO 600.

Figure 7-1: Permitted operating range 1 x DC 340 V 16 A



Figure 7-2: Permitted operating range 1 x AC 240 V 16 A



Figure 7-3: Permitted operating range 3 x DC 113 V 16 A



Figure 7-4: Permitted operating range 3 x AC 80 V 16 A



Figure 7-5: Derating of output power and output voltage 3 x 230 $\mathrm{V}_{\mathrm{RMS}}$



Figure 7-6: Derating of continuous output current

7.2 Input specifications

Table 7-7: Voltage inputs (HV and LV) 3 phase

Range name	Range value	Accuracy ¹
AC		
300 mV _{RMS}	0 300 mV _{RMS}	0.01 % rd + 0.003 % range
3 V _{RMS}	0 3 V _{RMS}	0.01 % rd + 0.003 % range
30 V _{RMS}	0 30 V _{RMS}	0.01 % rd + 0.003 % range
300 V _{RMS}	0 300 V _{RMS}	0.012 % rd + 0.003 % range
DC		
42.4 mV _{DC}	0 42.4 mV _{DC}	0.022 % rd + 0.032 % range
424 mV _{DC}	0 424 mV _{DC}	0.01 % rd + 0.017 % range
4.24 V _{DC}	0 4.24 V _{DC}	0.007 % rd + 0.012 % range
42.4 V _{DC}	0 42.4 V _{DC}	0.01 % rd + 0.017 % range
424 V _{DC}	0 424 V _{DC}	0.007 % rd + 0.012 % range

1. Typical accuracy at 23 °C ±5 K

Typical phase accuracy at 50/60 Hz, V>30 % of used range: 0.017°

Table 7-8: Voltage input (Booster)

Range name	Range value	Accuracy ¹
280 V _{RMS}	0 280 V _{RMS}	0.012 % rd + 0.003 % range

1. Typical accuracy at 23 °C ±5 K

Typical phase accuracy at 50/60 Hz, V>30 % of used range: 0.017°

Range name	Range value	Accuracy ¹
AC		
4 A _{RMS}	0 4 A _{RMS}	0.036 % rd + 0.0033 % range
40 A _{RMS}	0 40 A _{RMS}	0.023 % rd + 0.013 % range
DC		
0.56 A _{DC}	0 0.56 A _{DC}	0.01 % rd + 0.023 % range
5.6 A _{DC}	0 5.6 A _{DC}	0.037 % rd + 0.026 % range
56 A _{DC}	0 56 A _{DC}	0.008 % rd + 0.01 % range

Table 7-9: Current inputs (internal)

1. Typical accuracy at 23 °C ±5 K

Typical phase accuracy at 50/60 Hz, I>30 % of used range: 0.017°

Table 7-10: On-load tap changer measurement (tap changer connector)

Characteristic	Rating
Voltage	300 V _{RMS}
Accuracy ¹ AC (50/60 Hz)/DC	0.07 % rd + 0.07 % range
Current clamp input	3 V _{RMS}
Tap up/down switch current	300 mA continuous, 9 A for 0.7 s (AC permitted only)
Tap up/down switch voltage	300 V _{RMS} (AC permitted only)

1. Typical accuracy at 23 °C ±5 K



Figure 7-7: Filter characteristic of frequency-selective measurements (example at 50 Hz)

7.3 Interfaces

The types and number of connectors on TESTRANO 600 are listed below.

Table 7-11: Connector overview

Interface	Rating		
Digital	1 x EtherCAT® ¹		
	1 x Ethernet		
	1 x Serial		
	2 x Safety		
	6 x Configurable outputs:		
	 (HV) 3 x analog output 		
	 (LV) 3 x analog output 		
	6 x Configurable inputs:		
	 (HV) 3 x analog input 		
Analog	 (LV) 3 x analog input 		
	On-load tap changer interface:		
	 2 x internal switch 		
	 1 x voltage measurement 		
	 1 x current clamp measurement 		
	1 x Booster interface		

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

7.4 SAFETY connectors

TESTRANO 600 has two SAFETY connectors: SAFETY 1 (primary) and SAFETY 2 (secondary) for connecting optional OMICRON safety accessories (for more information see OMICRON document named "Safety Accessories Supplementary Sheet"). 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 *TESTRANO 600* preventing the operation of the device.

Using Safety Accessories

OMICRON offers several Safety Accessories designed to enhance the safety awareness and/or safety when using the *TESTRANO 600*. 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 *TESTRANO 600* SAFETY 1 or SAFETY 2 connector must be attached to it to close the emergency stop loop circuit.

SAFETY 1 and SAFETY 2 connector pin-outs

SAFETY 1 and SAFETY 2 connector pin-outs differ slightly (see Table 7-12: on page 46, Figure 7-8: "SAFETY 1 (primary) connector schematics" on page 47 and Figure 7-9: "SAFETY 2 (secondary) connector schematics" on page 47).

External START button connection

SAFETY 1 (primary) connector can be used to connect an external START button to allow remote control of *TESTRANO 600*. If an external START button is used, the switch must fulfill these requirements:

- R_{off} (open resistance) > 1 MΩ
- R_{on} (close resistance) < 10 Ω
- I_{switch} (switching current) < 1.5 mA
- V_{switch} (switching voltage) < 15 V

Connector	Pin no.	SAFETY 1 (primary)	SAFETY 2 (secondary)
	1*	Warning light green	Warning light green
(2) (4)	2*	Warning light red	Warning light red
1 3 5	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

Table 7-12:

* Typical output for pin 1 and 2 for both SAFETY 1 and SAFETY 2 connectors: 10 ... 14 V max. 400 mA.



Figure 7-8: SAFETY 1 (primary) connector schematics



Figure 7-9: SAFETY 2 (secondary) connector schematics

7.4.1 Safety Connector Dongle

More information concerning Safety Accessories and the use of the SAFETY connectors and the Safety Connector Dongle can be found in an OMICRON document named "Safety Accessory Supplementary Sheet".



Figure 7-10: Safety Connector Dongle

7.5 Display

Table 7-13: Display

Characteristic	Rating
Size	26.9 cm / 10.6 in
Resolution	1280 x 768 WXGA
Туре	Color touch TFT LCD
Contrast ratio	1000:1
Luminance	800 cd/m ²
Viewing angle (CR ≥ 10)	85° (H), 85° (V)

7.6 Combined values

Table 7-14: Resistance measurement AC

Range name	Current	Range	Accuracy ¹
	30 A _{RMS}	1 Ω 10 Ω	0.053 % rd + 0.033 % range
		0.1 Ω 1 Ω	0.053 % rd + 0.033 % range
40 A _{RMS}		10 mΩ 100 mΩ	0.053 % rd + 0.033 % range
		1 mΩ 10 mΩ	0.053 % rd + 0.033 % range
		100 μΩ 1000 μΩ	0.063 % rd + 0.033 % range
4 A _{RMS}	3 A _{RMS}	10 Ω 100 Ω	0.053 % rd + 0.037 % range
		1 Ω 10 Ω	0.053 % rd + 0.037 % range
		0.1 Ω 1 Ω	0.053 % rd + 0.037 % range
		10 mΩ 100 mΩ	0.053 % rd + 0.037 % range
		1 mΩ 10 mΩ	0.067 % rd + 0.037 % range

1. Typical accuracy at 23 $^\circ\text{C}$ ±5 K

Table 7-15:	Resistance	measurement	DC
-------------	------------	-------------	----

Range name	Current	Range	Accuracy ¹
		10 Ω 100 Ω	0.1 % rd + 0.18 % range
		1 Ω 10 Ω	0.1 % rd + 0.267 % range
4 A _{RMS}	3 A _{DC}	0.1 Ω 1 Ω	0.1 % rd + 0.18 % range
		10 mΩ 100 mΩ	0.1 % rd + 0.267 % range
		1 mΩ 10 mΩ	0.113 % rd + 0.433 % range
	30 A _{DC}	1 Ω 10 Ω	0.037 % rd + 0.017 % range
		0.1 Ω 1 Ω	0.04 % rd + 0.027 % range
40 A _{RMS}		10 mΩ 100 mΩ	0.033 % rd + 0.017 % range
		1 mΩ 10 mΩ	0.037 % rd + 0.027 % range
		100 μΩ 1000 μΩ	0.05 % rd + 0.043 % range
120 A _{RMS}	100 A _{DC}	30 mΩ 300 mΩ	0.04 % rd + 0.027 % range
		3 mΩ 30 mΩ	0.033 % rd + 0.017 % range
		300 μΩ 3000 μΩ	0.037 % rd + 0.027 % range
		30 μΩ 300 μΩ	0.05 % rd + 0.043 % range
		3 μΩ 30 μΩ	0.07 % rd + 0.44 % range

1. Typical accuracy at 23 °C ±5 K

Table 7-16: Ratio measurement

Range name (LV voltage range)	Voltage at HV	Range ¹	Accuracy ²
300 V _{RMS}	230 V _{RMS} HV (LN)	<u>1</u> 110	0.03 % rd + 0.043 % range
30 V _{RMS}		<u>1</u> 10100	0.027 % rd + 0.043 % range
3 V _{RMS}		1 100 1000	0.027 % rd + 0.043 % range
300 mV _{RMS}		<u>1</u> 1000 10000	0.027 % rd + 0.043 % range
300 mV _{RMS}		<u>1</u> 10000 50000	0.027 % rd + 0.22 % range

1. Range = $\frac{LV}{HV}$

2. Typical accuracy at 23 °C ±5 K

7.7 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	<3.6 kW
	Peak	<5.0 kW
Current consumption, continuous		<16 A _{AC}
Connector type		IEC320/C20, 1 phase

Table 7-17: Power supply specifications

7.8 Environmental conditions

Table 7-18: 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. Output **TAP CHANGER (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

7.9 Mechanical data

Table 7-19: Mechanical data

Characteristic		Rating
Dimensions (w × h× d)	With cover, without handles	464 × 386 × 229 mm 18.3 × 15.2 × 9 in
	With cover, with handles	580 × 386 × 229 mm 22.8 × 15.2 × 9 in
Weight	Device with display	20.6 kg/45.5 lb
	Device without display	19.5 kg/43 lb

7.10 Standards

Table 7-20: Standards conformity

EMC, safety		
EMC	IEC/EN 61326-1 (industrial electromagnetic environment) FCC subpart B of part 15, class A	CE
Safety	IEC/EN/UL 61010-1, IEC/EN/UL 61010-2-30	
		SUD SUD US
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 Hz150 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	

Support

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



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