

TESTRANO 600

Getting Started



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. Consequently, only personnel qualified, authorized and skilled in electrical engineering and trained by OMICRON are allowed to operate *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 operator is responsible for the safety requirements during the whole test.

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 36).

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.

1.3 Operating the measurement setup

- ▶ 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 is fully extinguished (see 3.1.1 "TESTRANO 600 front panel" on page 8). As long as this warning light is lit, 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.
- ▶ Switch off the high voltage. Always obey the five safety rules and follow the detailed safety instructions.
- ▶ Before switching on the high voltage, leave the high-voltage test area.

Before performing tests using high voltage, observe the following instructions:

- ▶ Before operating *TESTRANO 600*, ground it as described in sections 1.2.2 "Safety rules" on page 3 and 4 "Application" on page 14.
- ▶ Make sure that the ground terminal of the test object is in good condition, clean, and free of oxidation.
- ▶ 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.
- ▶ 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 lit, *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 28.
- ▶ Check any additional equipment (for example, your computer) for environmental conditions before use.
- ▶ 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 *TESTRANO 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 36).
- ▶ Observe the high-voltage areas.
- ▶ Always obey the internal safety instructions for working in areas with high voltage to avoid injury.

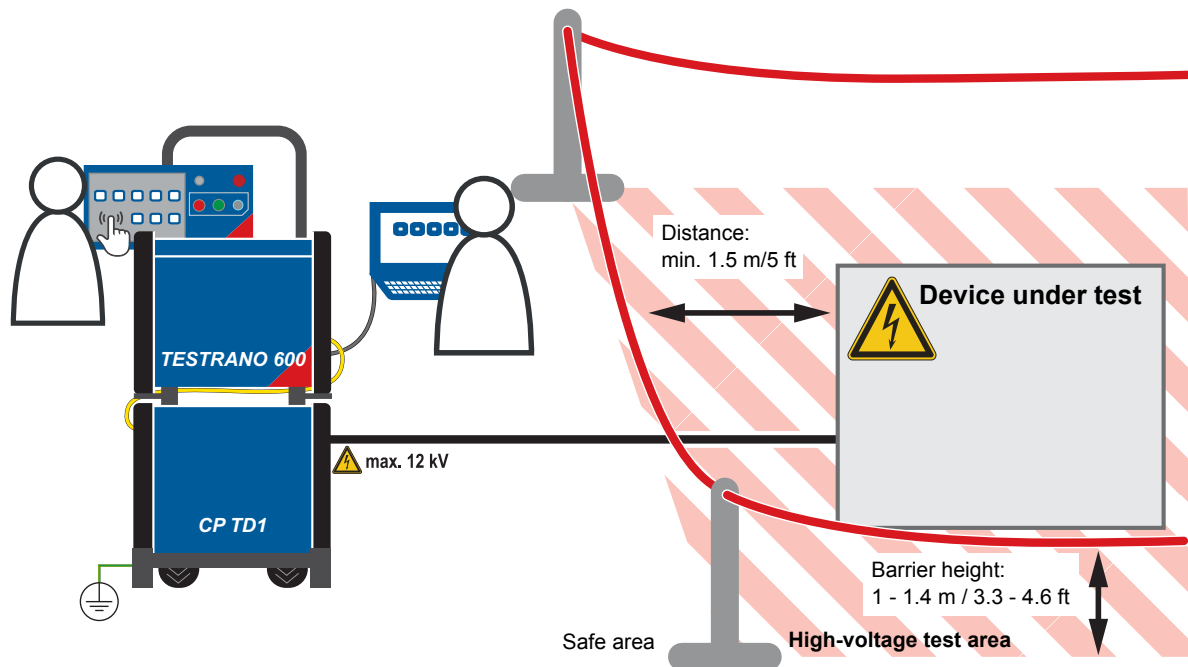


Figure 1-1: Illustration of safe area and high-voltage area established for working with *TESTRANO 600* and *CP TD1*

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 be used only as described in this Getting Started. Any other use is not in accordance with the regulations. The manufacturer and the distributor are not liable for damage resulting from improper use. The user alone assumes all responsibility and risk.

Following the instructions provided in this Getting Started is also considered part of being in accordance with the regulations.

Opening *TESTRANO 600* or its accessories invalidates all warranty claims.

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 specified by the manufacturer, the protection provided by the equipment may be impaired.

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, 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.

1.7 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 Introduction

2.1 Designated use

In combination with the *CP TD1* 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 built-in 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 28 for detailed hardware information.

3.1.1 TESTRANO 600 front panel

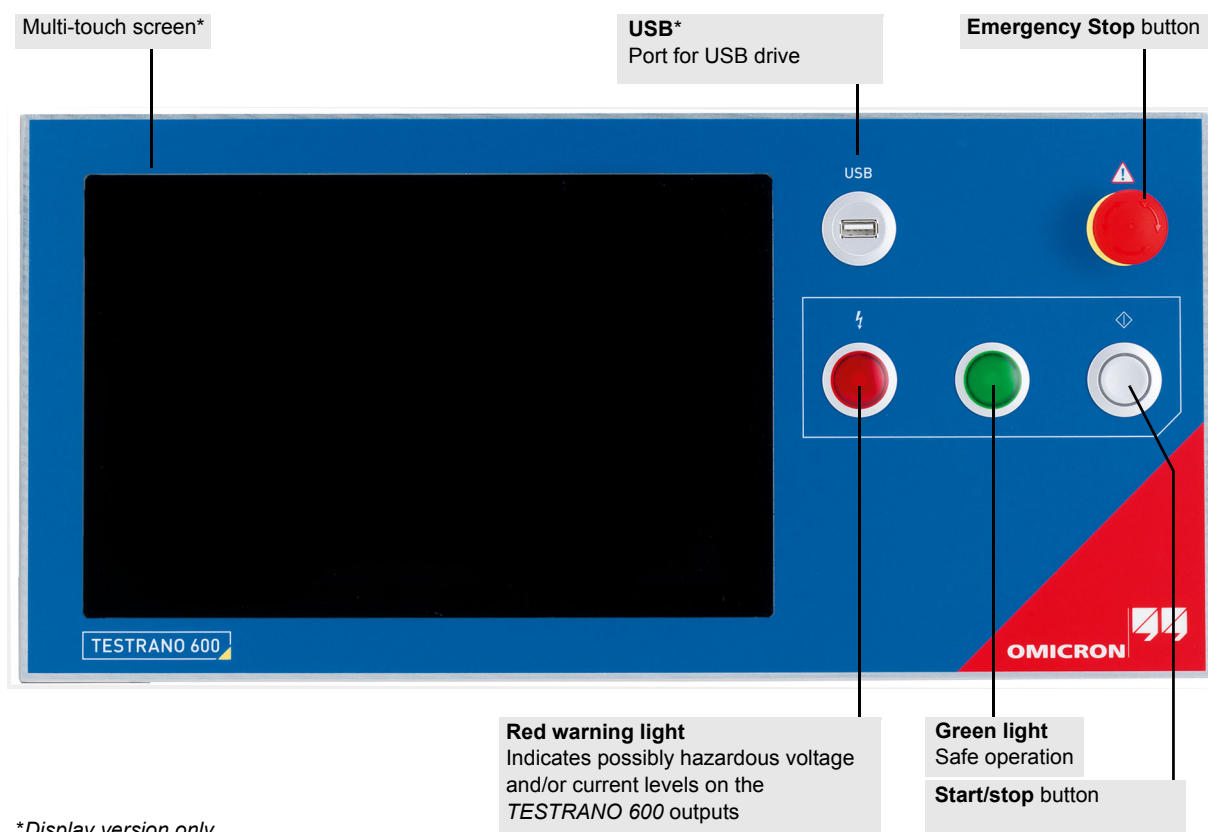
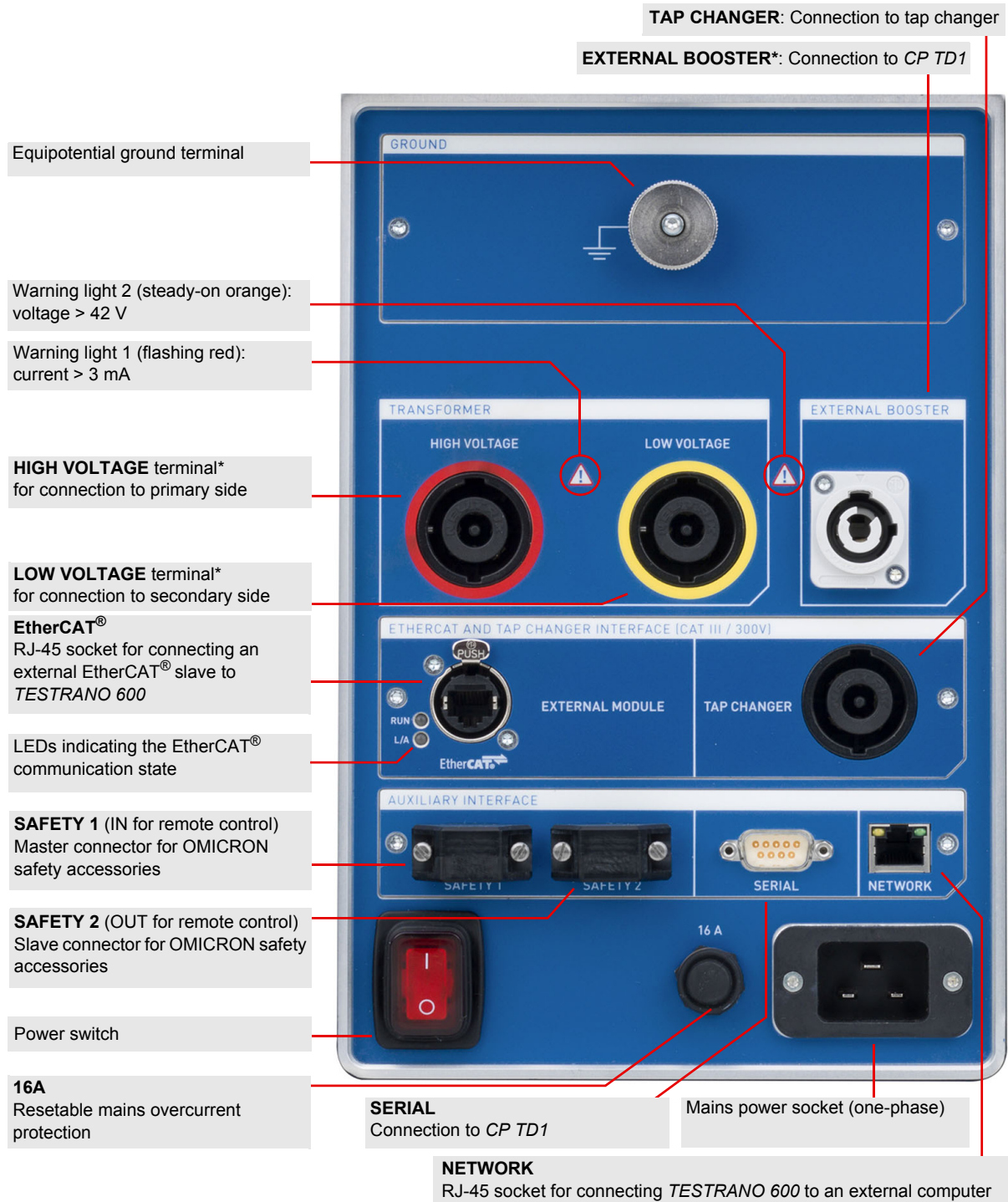


Figure 3-1: TESTRANO 600 front panel with display

3.1.2 TESTRANO 600 side panel



* Max. output voltage: 300 V_{RMS}

Figure 3-2: TESTRANO 600 side panel

3.1.3 Safety and warning indicators

TESTRANO 600 provides the following warning lights to indicate safe and dangerous operating conditions.

Table 3-1: Warning lights

Light	Description	Device sState	Operating condition	
Front panel				
	Green light on the front panel is on	<i>TESTRANO 600</i> is up and running in the stand-by mode.	Safe operating condition as long as no voltage is applied from outside – as long as the warning symbol on the side panel is off.	
	Blue ring on the Start/Stop button is lit	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.		Dangerous operating condition
	Red warning 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.		Dangerous operating 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 operating condition
	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.		Dangerous operating condition

- Always observe the warning lights while working with TESTRANO 600.
- Do not cover the warning lights (for example, with a computer) – they indicate possible hazards.

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

- If TESTRANO 600 appears to be defective, do not use it anymore. Contact OMICRON support (see "Support" on page 36).

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 guaranty the safe connection/disconnection of 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.



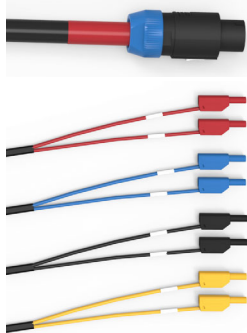
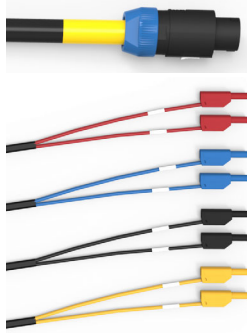
NOTICE

Equipment damage possible

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

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Table 3-2: *TESTRANO 600* measuring cables

Item	Picture	Description
High-voltage cable marked red		• Polarity protection: only suitable for HIGH VOLTAGE and LOW VOLTAGE sockets • 15 m length • 8 poles
Low-voltage cable marked yellow		• cross-section: 4 × 4 mm² for output 4 × 1 mm² for measurement • Neutrik® plug
Tap changer cable		• Polarity protection: only suitable for TAP CHANGER socket • 15 m length • 8 poles • 8 × 2.5 mm² cross-section • Neutrik® plug

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

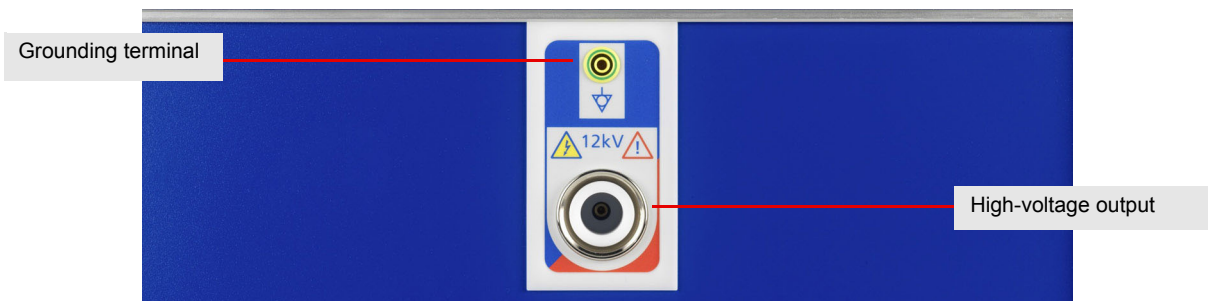


Figure 3-5: Back side view of the CP TD1

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.
- ▶ Separate your working area – see Figure 1-1: "Illustration of safe area and high-voltage area established for working with TESTRANO 600 and CP TD1" 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



DANGER

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:
 - equipotential ground: Ground *TESTRANO 600* with a cable of at least 6 mm² cross-section as close as possible to the operator.
 - the computer (optional if *TESTRANO 600* is used with *TouchControl*)
 - the mains power supply

Optional

Connect the *CP TD1* to *TESTRANO 600*

- a) Connect to ground.

Without trolley:

- ▶ Properly connect the *TESTRANO 600* and *CP TD1* grounding terminals to substation ground.

With trolley (optional):

- ▶ Properly connect the *TESTRANO 600* and *CP TD1* grounding terminals to the trolley's ground bar.
- ▶ Connect the trolley's ground bar to earth.

- b) Connect the *CP TD1* **BOOSTER IN** to the *TESTRANO 600* **EXTERNAL BOOSTER** using the booster cable.
- c) Connect the *CP TD1* **SERIAL** to *TESTRANO 600* **SERIAL** with the data cable.

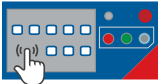
Note: The serial cable also provides the power supply for the *CP TD1*.

4. Turn on the power switch on the *TESTRANO 600* side panel.
5. 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.
6. 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 36).

4.3 Connecting to the transformer

Preparing the software

<i>TouchControl</i>	<i>Primary Test Manager</i>
	
▶ Select a test. ▶ After defining the asset's vector group, tap Wiring  to display the wiring diagram for the test. ▶ Lock <i>TESTRANO 600</i> using the Software lock.	▶ Create a job with tests or select a manual test. ▶ View the wiring diagram in the General tab of the test. ▶ Lock your computer.
▶ Connect the test leads to <i>TESTRANO 600</i> (or the <i>CP TD1</i> , if applicable).	

Connection to the transformer



DANGER

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 and in the order given below:

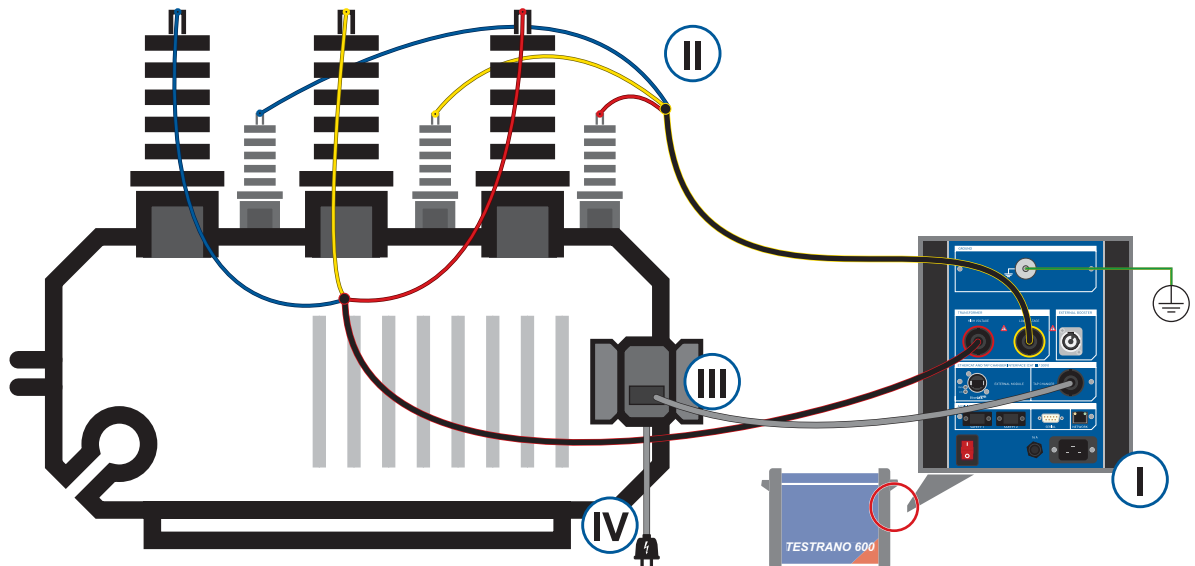


Figure 4-1: Connection sequence *TESTRANO 600* to transformer

- 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.

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 10).

Tap changer connection

- 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-**.
- 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 switching of the tap changer.

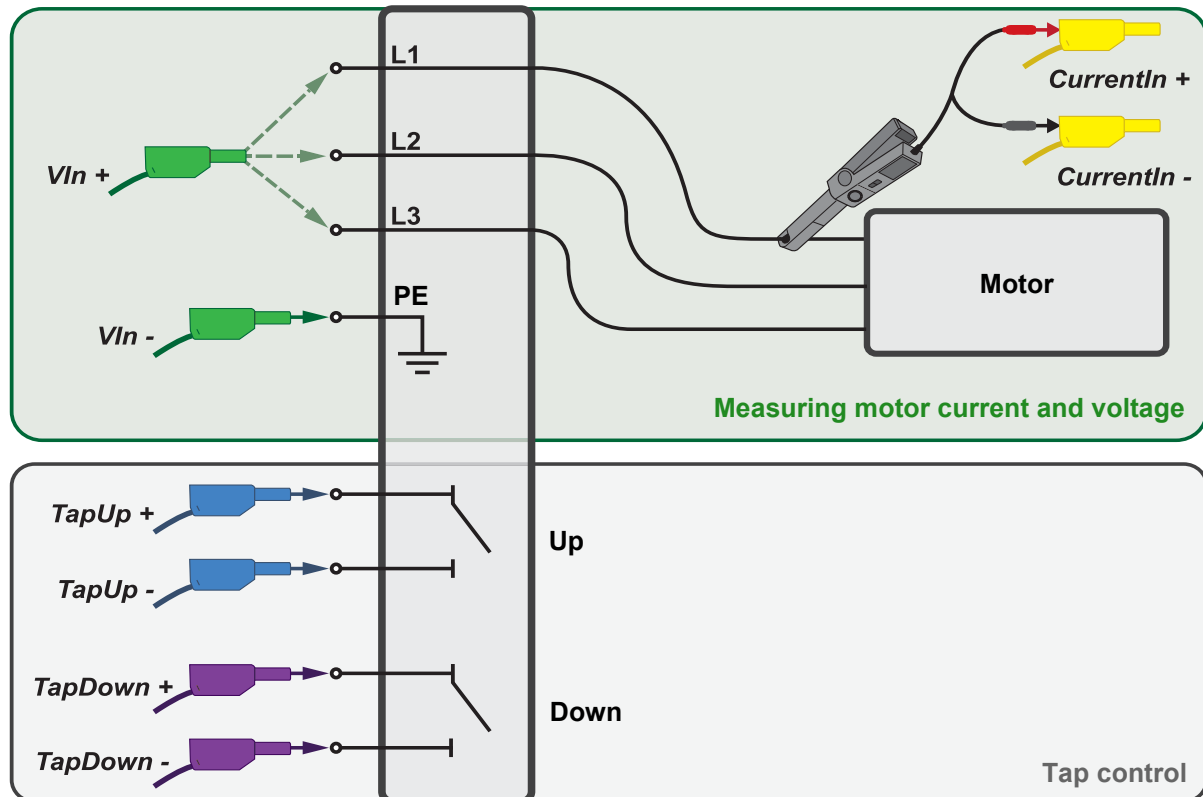


Figure 4-2: Connection scheme tap changer cable to tap changer

Optional

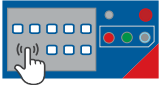
Connect the CP TD1 to the transformer

If you connected the CP TD1 to TESTRANO 600 (step 4 in section 4.2), connect the **IN_A**, **IN_B** and high-voltage output of the CP TD1 to the transformer.

- Refer to the CP TD1 User Manual for more information on safely connecting the CP TD1 to a device under test.

2. Erect a barrier separating the safe area from the high-voltage test area (see page 5).
3. Remove the grounding set from the test object.
4. Release the **Emergency Stop** button.

4.4 Measurement

<i>TouchControl</i>	<i>Primary Test Manager</i>
	
► Disable the Software lock .	► Establish the connection between PTM and TESTRANO.
► Enter/adjust the test settings in the Settings view.	► Enter/adjust the test settings in the Settings and conditions area.
► Tap 	► Select a standard in the Assessment area (if applicable).
► Press 	► Press 
 The blue ring on the Start/stop button lights up. ► Press the Start/stop button to start the test.	
 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 <i>TESTRANO 600</i> front panel. ► In an emergency, press the Emergency Stop button to stop the test.	
 After the measurement is completed or stopped, the green warning light switches on.	
<i>TouchControl</i> displays the results in the Measurement view of the test.	<i>Primary Test Manager</i> displays the results in the Measurements section of the test.

- To perform additional tests, repeat the steps in chapters 4.3 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 10).

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



DANGER

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 5.5 "Software lock" on page 32) and/or lock your computer.
4. Remove the barrier between the high-voltage area and the safe area.



DANGER

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 TD1*.
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 user manual chapters listed on the right.

Step		User manual chapter
	1. SAFETY	Safety instructions Hardware overview Safety and warning indicators Emergency Stop button Application
	2. Start <i>TESTRANO 600</i>	TESTRANO 600 side panel
	3. Enter asset info	Asset info
	4. Add tests	TouchControl tests
	5. Connect to transformer	Safety instructions TESTRANO 600 measuring cables Application Wiring diagrams
	6. Prepare test	Settings view
 	7. Measurement	Measurement

5.2 Test view

The *TESTRANO 600* tests are divided into the **Settings** and **Measurement** views.

- Swipe right or left or tap the arrow on the side of the screen to change between the views.

In the **Settings** view, you can enter asset data and the values necessary for your test. The **Measurement** view displays test results in a live, table or plot view, depending on the test.

5.2.1 Settings view

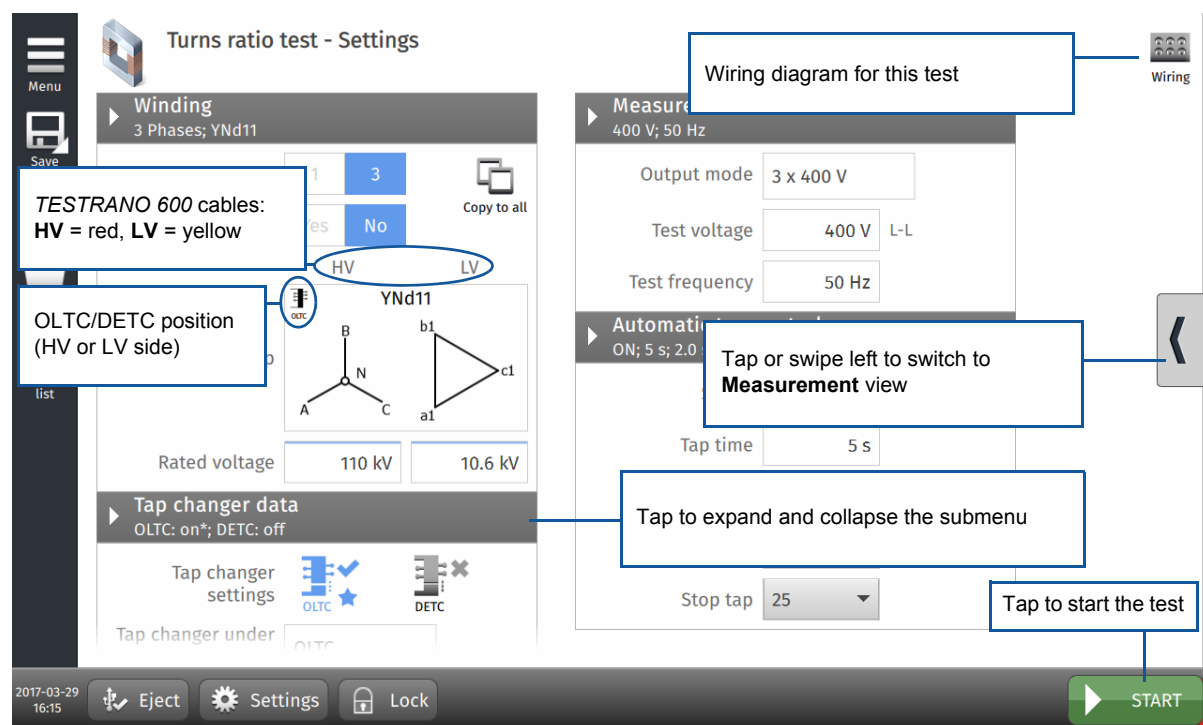


Figure 5-1: Turns ratio test - **Settings** view

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-
- Use the slider to increase or decrease the displayed value. Release the slider to stop at the desired value.

Note: The slider will stop at the minimum/maximum value.

Defining a tap changer

- ▶ To define a tap changer press the tap changer icon  in the test's **Settings** view.
- ▶ Tap **Copy to all**  to copy the settings to all tests that have not yet been executed.

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

Tap changer settings – 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 box.
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 .

5.2.2 Measurement view

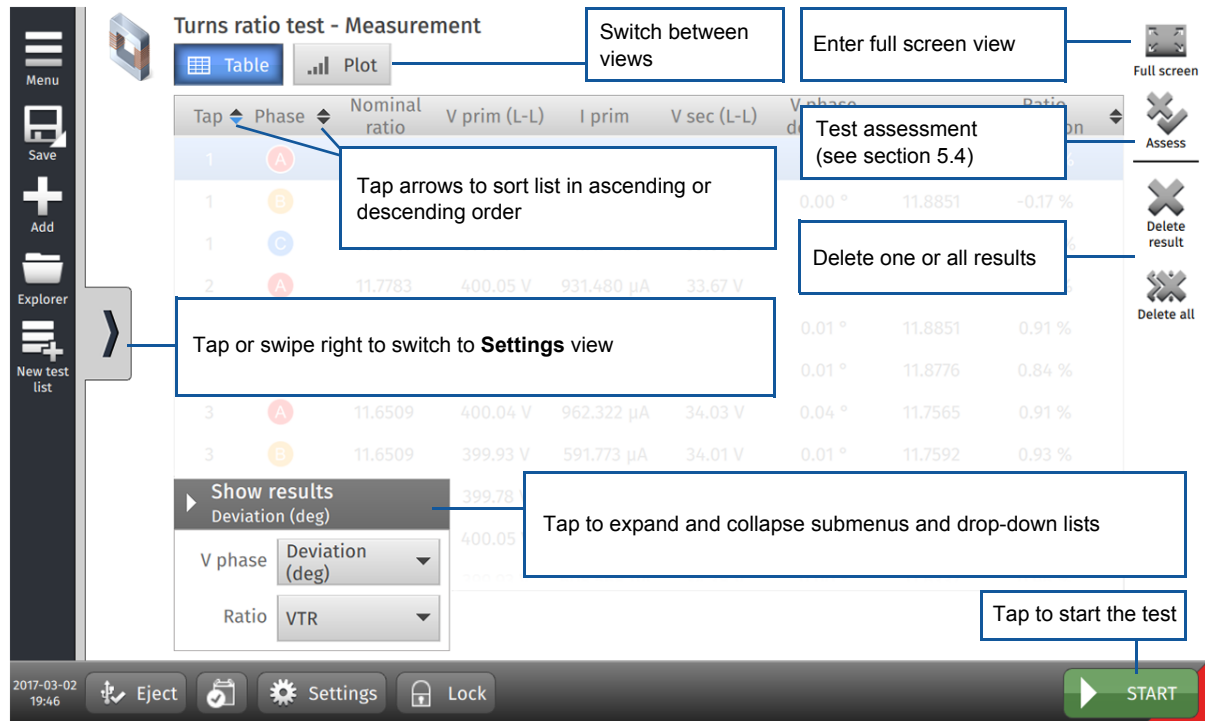


Figure 5-2: Turns ratio test – **Measurement** view

5.2.3 Wiring diagrams

► Tap **Wiring**  to display the wiring diagram for the test and vector group.

The colors in the wiring diagram represent the cable ends (see 3.1.5 "TESTRANO 600 measuring cables" on page 11).

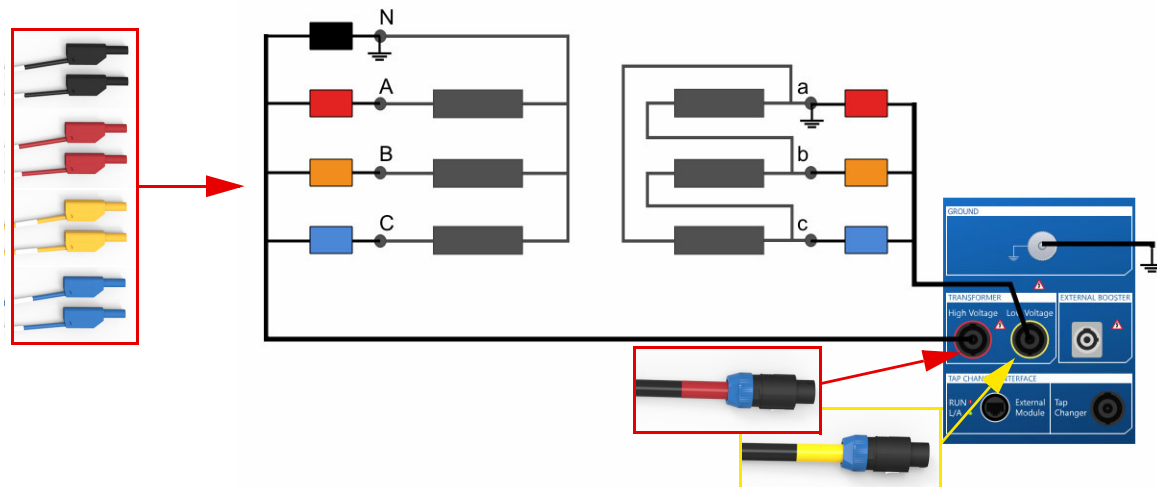


Figure 5-3: Wiring diagram for a TTR on a transformer with vector group YNd5

5.3 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 36).

DANGER



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.

WARNING



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.

- ▶ 1. Tap **Start**.
- ▶ 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 *TouchControl* displays the results in the **Measurement** view.

5.4 Assessment

- ▶ Tap **Assess** to expand the available assessment states:

- Pass**: results accepted; measurement OK
- Fail**: results rejected; measurement failed
- Investigate**: marked for further investigation

Note: Each measurement of an assessed test will individually be tagged with the selected assessment when displayed in *Primary Test Manager* or a report.

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
	1. SAFETY	Safety instructions Hardware overview Safety and warning indicators Emergency Stop button Application
	2. Connection to <i>TESTRANO 600</i>	Preparing the test setup
	3. Start device and software	TESTRANO 600 side panel Software start and device update
	4. Location and asset	Location view Asset view
	5. Jobs	Jobs
	6. Tests	Test view PTM Transformer tests PTM Bushing tests Device-independent <i>PTM</i> tests
	7. Connection to device under test	Safety instructions TESTRANO 600 measuring cables Application Connecting to the transformer
	8. Test settings	Performing tests
	9. Test assessment	Assessing measurement results
	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 36).

DANGER



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.

WARNING



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 $23\text{ }^{\circ}\text{C} \pm 5\text{ }^{\circ}\text{C}/73\text{ }^{\circ}\text{F} \pm 10\text{ }^{\circ}\text{F}$, 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 $23\text{ }^{\circ}\text{C} \pm 5\text{ }^{\circ}\text{C}/73\text{ }^{\circ}\text{F} \pm 10\text{ }^{\circ}\text{F}$, 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:

$\pm (\text{value read} \times \text{reading error [rd]} + \text{full scale of range} \times \text{range error [rg]})$.

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 sea level (see section 7.4 "Environmental conditions" on page 34).

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 TESTRANO 600 specifications

7.1.1 Output specifications

Table 7-1: General output specifications

Characteristic	Rating		
Frequency	DC or 15 Hz ... 599 Hz		
Power	V_{mains}	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 × 0 ... ±113 V _{DC} 1 × 0 ... ±340 V _{DC}	16 A _{DC}
DC low range	3 × 0 ... ±56 V _{DC} 1 × 0 ... ±170 V _{DC}	33 A _{DC}
AC high range low current	3 × 0 ... 230 V _{RMS} (LN)	100 mA _{RMS}
AC high range	3 × 0 ... 80 V _{RMS} (LN) 1 × 0 ... 240 V _{RMS}	16 A _{RMS}
AC low range	3 × 0 ... 40 V _{RMS} (LN) 1 × 0 ... 120 V _{RMS}	33 A _{RMS}

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

TESTRANO 600 Getting Started

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

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

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

7.1.2 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°

Table 7-9: Current inputs (internal)

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

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

7.2 Combined values

Table 7-11: Resistance measurement AC

Range name	Current	Range	Accuracy ¹
40 A _{RMS}	30 A _{RMS}	1 Ω ... 10 Ω	0.053 % rd + 0.033 % range
		0.1 Ω ... 1 Ω	0.053 % rd + 0.033 % range
		0.01 Ω ... 0.1 Ω	0.053 % rd + 0.033 % range
		0.001 Ω ... 0.01 Ω	0.053 % rd + 0.033 % range
		0.0001 Ω ... 0.001 Ω	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
		0.01 Ω ... 0.1 Ω	0.053 % rd + 0.037 % range
		0.001 Ω ... 0.01 Ω	0.067 % rd + 0.037 % range

1. Typical accuracy at 23 °C ±5 K

Table 7-12: Resistance measurement DC

Range name	Current	Range	Accuracy ¹
40 A _{RMS}	30 A _{DC}	1 Ω ... 10 Ω	0.037 % rd + 0.017 % range
		0.1 Ω ... 1 Ω	0.04 % rd + 0.027 % range
		0.01 Ω ... 0.1 Ω	0.033 % rd + 0.017 % range
		0.001 Ω ... 0.01 Ω	0.037 % rd + 0.027 % range
		0.0001 Ω ... 0.001 Ω	0.05 % rd + 0.043 % range
4 A _{RMS}	3 A _{DC}	10 Ω ... 100 Ω	0.1 % rd + 0.18 % range
		1 Ω ... 10 Ω	0.1 % rd + 0.267 % range
		0.1 Ω ... 1 Ω	0.1 % rd + 0.18 % range
		0.01 Ω ... 0.1 Ω	0.1 % rd + 0.267 % range
		0.001 Ω ... 0.01 Ω	0.113 % rd + 0.433 % range

1. Typical accuracy at 23 °C ±5 K

Table 7-13: Ratio measurement

Range name (LV voltage range)	Voltage at HV	Range ¹	Accuracy ²
300 V _{RMS}	230 V _{RMS} HV (LN)	$\frac{1}{1 \dots 10}$	0.03 % rd + 0.043 % range
30 V _{RMS}		$\frac{1}{10 \dots 100}$	0.027 % rd + 0.043 % range
3 V _{RMS}		$\frac{1}{100 \dots 1000}$	0.027 % rd + 0.043 % range
300 mV _{RMS}		$\frac{1}{1000 \dots 10000}$	0.027 % rd + 0.043 % range

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

2. Typical accuracy at 23 °C ±5 K

7.3 Power supply specifications

Table 7-14: 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

7.4 Environmental conditions

Table 7-15: 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

7.5 Mechanical data

Table 7-16: 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

7.6 Standards

Table 7-17: Standards conformity

EMC, safety		
EMC	IEC/EN 61326-1 (industrial electromagnetic environment) FCC subpart B of part 15, class A	   C US
Safety	IEC/EN/UL 61010-1, IEC/EN/UL 61010-2-30	
Other		
Shock	IEC/EN 60068-2-27 (15 g/11 ms, half-sinusoid, 3 shocks in each axis)	
Vibration	IEC/EN 60068-2-6 (frequency range 10 Hz...150 Hz, acceleration 2 g continuous (20 m/s ² /65 ft/s ²), 20 cycles per axis)	
Humidity	IEC/EN 60068-2-78 (5 % ... 95 % relative humidity, no condensation), tested at 40 °C/104 °F for 48 hours	

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