

CT Analyzer & CT SB2

User Manual



CT Analyzer & CT SB2 User Manual

Manual Version: ENU 1132 05 03

This manual refers to version 5.00 of the *CT Analyzer* firmware and the *CT Analyzer Suite* software.

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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.

CT Analyzer

User Manual



CT Analyzer User Manual

Manual Version: ENU 1039 05 03

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About this manual

This User Manual provides information on how to use the *CT Analyzer* test set. The *CT Analyzer* User Manual contains important safety instructions for working with *CT Analyzer* and gets you familiar with operating the *CT Analyzer* test set. Read and observe the safety instructions described in chapter 1 "Safety instructions" on page 9 and all relevant installation and operation instructions. Following the instructions in this User Manual will help you to prevent danger, repair costs, and avoid possible down time due to incorrect operation.

The *CT Analyzer* User Manual always has to be available at the site where *CT Analyzer* is used. All users of *CT Analyzer* must read this manual before operating the device and observe the safety, installation, and operation instructions therein.

Reading the *CT Analyzer* User Manual alone does not release you from the duty to comply with all relevant national and international safety regulations.

Safety symbols

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



DANGER

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



WARNING

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



CAUTION

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

NOTICE

Equipment damage or loss of data possible.

Related documents

The following documents complete the information covered in the CT Analyzer User Manual:

Title	Description
CT SB2 User Manual	Contains information how to use and operate the optional <i>CT SB2</i> switch box for multi-ratio CT measurement with <i>CT Analyzer</i> as well as safety instructions for working with the <i>CT SB2</i> switch box.
<i>CT Analyzer Suite</i> help	Contains detailed information about the <i>CT Analyzer Suite</i> software.

1 Safety instructions

1.1 Operator qualifications

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

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

1.2 Safety standards and rules

1.2.1 Safety standards

Testing with *CT Analyzer* 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 the *CT Analyzer* test set, read the safety instructions in this User Manual carefully.

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

Maintenance and repair of the *CT Analyzer test set* is only permitted by qualified experts at OMICRON service centers (see "Support" on page 186).

1.2.2 Safety rules

Always observe the five safety rules:

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

1.3 Operating the measurement setup

The safety instructions given here always apply when operating *CT Analyzer*. They are supplemented by further notes and warnings applicable for specific actions only. Such specific notes and warnings are given where necessary in this user manual.

In addition to the safety instructions given in this manual, always observe the applicable company-internal safety instructions and safety documents.

In case of any problems or questions, or if you do not understand some safety instructions, contact the OMICRON Technical Support (refer to chapter "Support" on page 186).

Before performing tests, observe the following instructions:

- ▶ Always be aware of the danger of the high voltages and currents associated with this equipment. Pay attention to the information provided in this user manual.
- ▶ Always position the *CT Analyzer* test set on dry, solid ground.
- ▶ Position the *CT Analyzer* test set so that you can easily disconnect it from mains.
- ▶ Before putting *CT Analyzer* into operation, check the equipment for visible damages.
- ▶ Use the *CT Analyzer* test set and its accessories only in a technically sound condition. Make sure its use is in accordance with the regulations on site and the designated use described in this document.
- ▶ The mains cable for the *CT Analyzer* test set must be rated for the nominal voltage and current specified in chapter 12 on page 169. It is recommended to use the cable supplied with *CT Analyzer*.
- ▶ Only use original cables and accessories available from OMICRON.
- ▶ If *CT Analyzer* or any add-on device or accessory seems to be functioning improperly, please call the OMICRON hotline (refer to chapter "Support" on page 186).
- ▶ Do not operate *CT Analyzer* when explosive gas or vapors are present.
- ▶ Do not operate *CT Analyzer* under ambient conditions that exceed the temperature and humidity limits listed in chapter 12 "Technical data" on page 169.
- ▶ Do not open the *CT Analyzer* test set. Opening *CT Analyzer* invalidates all warranty claims. Do not repair, modify, extend, or adapt *CT Analyzer* or any accessories.
- ▶ Do not insert objects (e.g. screwdrivers, etc.) into the ventilation slots or any input/output sockets.
- ▶ Never remove any cables from *CT Analyzer* or the test object during a running test.
- ▶ When disconnecting cables, always start at the device feeding the power.
- ▶ Do not stand right next to or directly underneath a connection point because the clamps may fall off and touch you.
- ▶ Full compliance with the regulations also includes following the instructions provided in this User Manual.

Observe the following when running tests:

- ▶ Prevent the presence of other persons in the potentially dangerous area around the test object.
- ▶ If necessary, perform appropriate additional safety precautions according to the relevant standard, for example, by defining a high-voltage area around the test object and securing this area against unauthorized access by using a barrier chain and warning sign.
- ▶ Start the test only if all safety precautions were taken and if you are absolutely sure that no other person is present in the potentially dangerous area around the test object.

1.4 Power supply

Supply the *CT Analyzer* test set only from a power outlet that is equipped with protective ground (PE). Instead of supplying *CT Analyzer* from phase-neutral, it may also be supplied from phase-phase. However, the voltage must not exceed 240V AC.

1.5 Orderly measures

The *CT Analyzer* User Manual or alternatively the e-book has always to be available on the site where *CT Analyzer* is being used.

The users of *CT Analyzer* must read this manual before operating the device and observe the safety instructions and all relevant instructions for connection and operation.

The *CT Analyzer* test set and its accessories may only be used in accordance with the user documentation (including but not limited to user manuals, reference manuals, getting started manuals and manufacturer manuals). The manufacturer and the distributor are not liable for damage resulting from improper usage.

Opening the *CT Analyzer* device 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.

1.6 Disclaimer

If the equipment is used in a manner not described in the user documentation, the protection provided by the equipment may be impaired. The manufacturer and the distributor are not liable if the safety instructions given in this manual or any of the relevant international, national, company-internal or local safety standards and rules are not observed.

1.7 Compliance statements

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.

1.8 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

CT Analyzer is intended to perform automatic testing and calibration of low leakage flux current transformers (i.e., CTs with non-gapped cores) in laboratories as well as on-site in utilities. Testing of CTs with gapped cores is also possible with restricted accuracy. The following tests can be performed using *CT Analyzer*:

- Burden measurement
- Residual magnetism measurement of CTs
- CT winding resistance measurement
- CT excitation characteristic measurement according to IEC 61869-2, IEC 60044-1, IEC 60044-6 (TPS, TPX, TPY, TPZ) and IEEE C57.13.
- CT ratio measurement with consideration of a connected burden
- CT phase and polarity measurement
- Determination of accuracy limiting factor, instrument security factor, secondary time constant, symmetrical short-circuit current factor, transient dimensioning factor, remanence factor, knee point voltage/current, class, saturated inductance and non-saturated inductance.
- Guessing of unknown CT parameters and automatic assessment based on these values (see section 2.2 below).

Using the *Quick Test* feature it is also possible to use *CT Analyzer* as a versatile multimeter with included power source, e.g. for:

- Quick and easy resistance measurement, e.g. for wiring checks on the secondary side of CTs.
- Quick voltage ratio checks for VTs.
- Measurement of burden values, e.g., to determine the new burden value after changes of the relay equipment. This allows the re-calculation of the CT test results for the new burden value by *CT Analyzer* and thus makes it unnecessary to run an additional CT test in order to determine the behavior of the CT with the new burden.
- Quick wiring checks using the *CPOL2* polarity checker from OMICRON. Using the *CPOL2* in combination with the specific test signal provided by the *CT Analyzer's Quick Test* feature you can check a series of test points (e.g., the burden wiring) for correct polarity.

CT Analyzer is intended exclusively for the applications described above. Any other use is deemed not to be according to the regulations. The manufacturer and the distributor are not liable for damage resulting from improper usage. The user alone assumes all responsibility and risk.

Ratio error and phase displacement measurements with direct (primary current injection) and indirect test equipment (secondary voltage injection)

Alternative testing methods with indirect testing technology as applied by *CT Analyzer* provide similar results to direct testing with high currents for CT designs having low leakage flux. Comparability is given and both testing methods can be used without additional procedures. For CTs having a considerable leakage flux (e.g., with large air gaps, low ratio or non-uniformly wound secondary windings), the ratio error and/or phase displacement results may differ between the direct and the indirect testing method due to the different testing methodologies requiring further procedures.

If the CT design type is unknown, OMICRON recommends to reconfirm the CT characteristics beforehand and/or to perform an initial calibration between direct and indirect method for the certain CT type.

As an example, the so-called factor of construction mentioned in IEC 61869-2 indicates if the CT is of low or high leakage flux. Below the specified limit, both test methods (direct and indirect) provide similar results.

In all other cases, there might be differences between the direct and the indirect test method and an initial calibration, documentation of results, and later consideration of the differences is recommended. Following this procedure, the high reproducibility of *CT Analyzer* even allows to apply *CT Analyzer* for traceable CT calibration.

2.2 "Guessing" of parameters

The Advanced CT Test mode of *CT Analyzer* provides a so-called guesser function which is intended as an aid for the user to find out single unknown name plate data, for example if parts of the CT's name plate are unreadable. If sufficient other name plate data of the CT are available and specified by the user, this function is often able to reliably determine single missing CT data, for example I_{prim} , I_{sec} , class or ratio.

Parameters that are guessed by *CT Analyzer* are marked by a question mark in the user interface of the **CT-Object** card prior to the test. To have a parameter guessed by *CT Analyzer*, select the ? soft key instead of specifying a value for this parameter. During the test, *CT Analyzer* replaces the question mark by the value guessed.

When using this function, please be aware that assessments performed with one or more guessed parameters may possibly differ from an assessment based on exact name plate data. Absolutely reliable assessment is only guaranteed if all necessary CT data are specified prior to the test.

For detailed information about the guesser function, please refer to chapter 9 on page 138.

2.3 Functional components of *CT Analyzer*

2.3.1 Overview

Figure 2-1 provides an overview of the operating and display elements and the connectors of *CT Analyzer*.

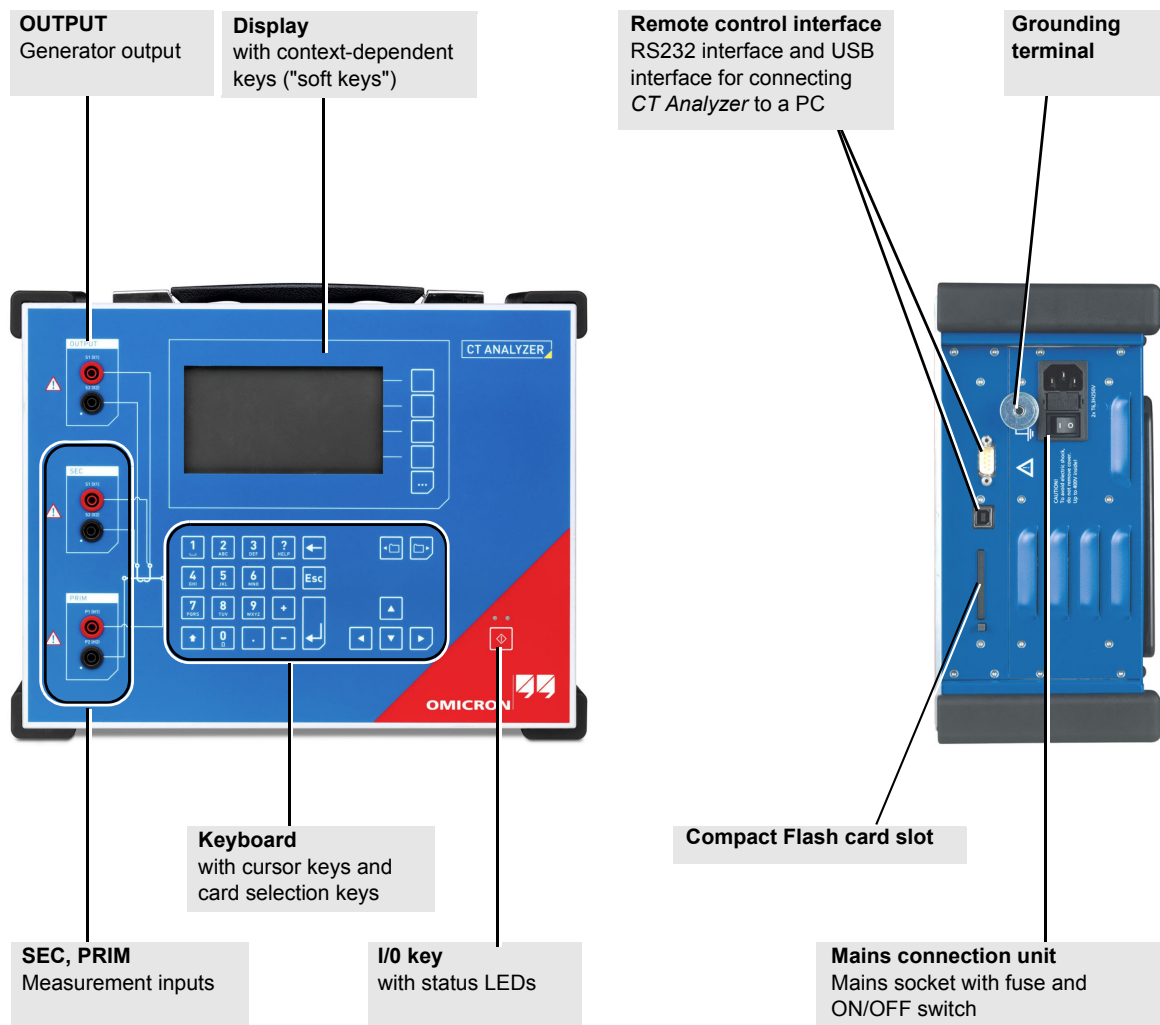


Figure 2-1: *CT Analyzer* overview

2.3.2 Mains connection unit and grounding

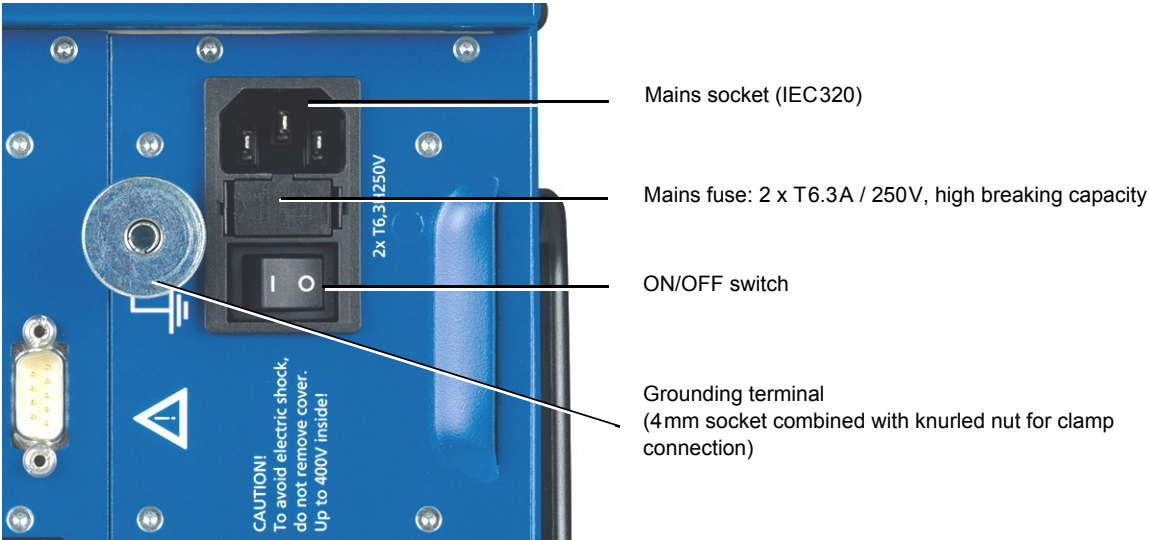


Figure 2-2: Mains connection unit and grounding terminal

2.3.3 Compact Flash card slot

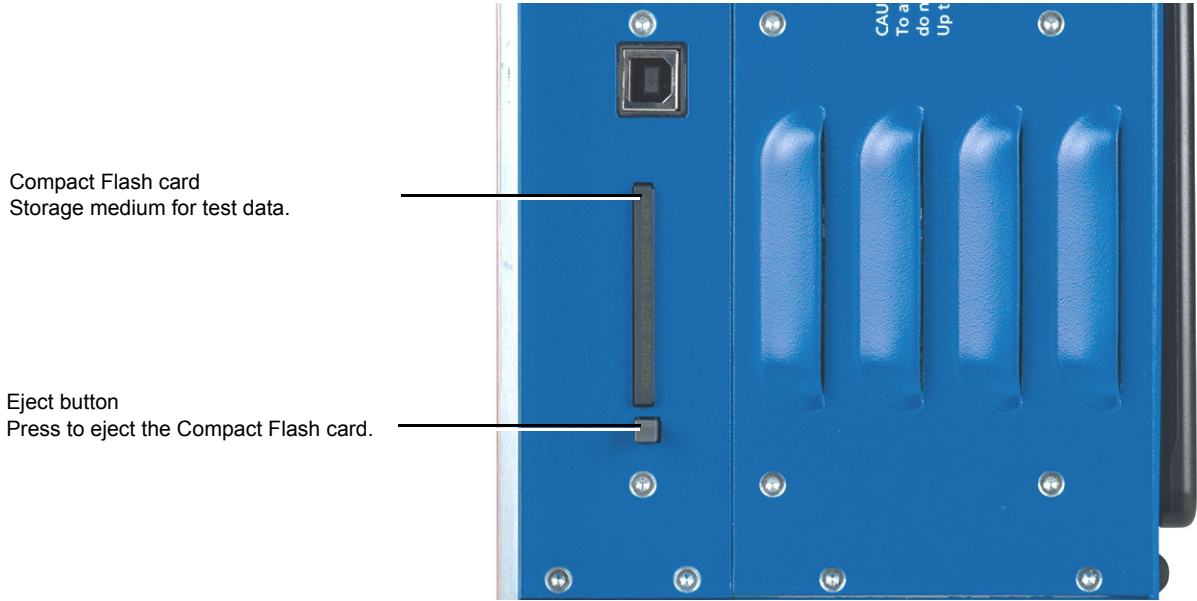


Figure 2-3: Compact Flash card slot

2.3.4 Remote control interface (PC connection)

CT Analyzer devices as of serial number JHxxxx or newer are equipped with a USB interface and a RS232 interface. You can use both interfaces alternatively to connect the *CT Analyzer* test set to a computer.

OMICRON recommends to use the USB interface since communication via USB is considerably faster than communication via RS232.

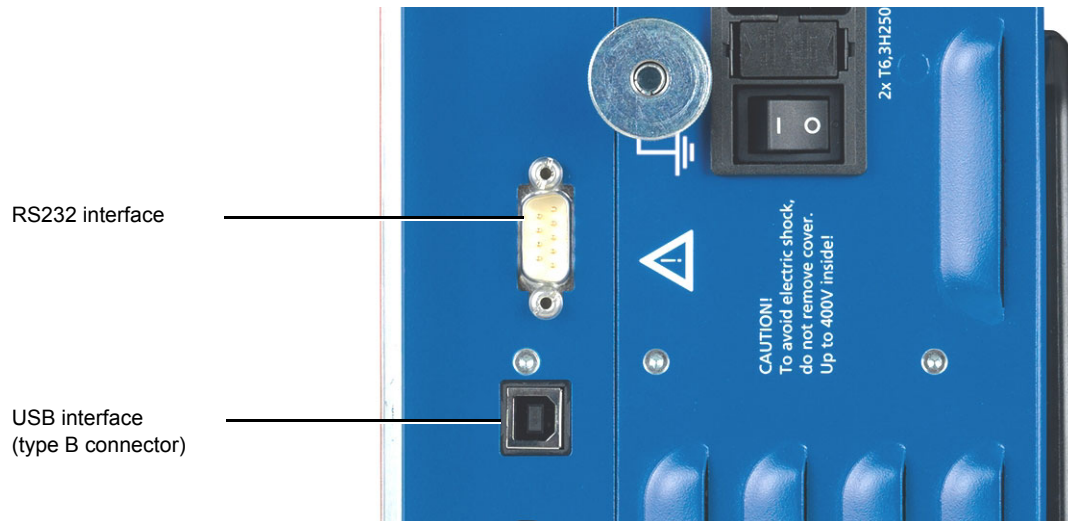


Figure 2-4: Remote control interface (RS232 and USB)

Since in this case *CT Analyzer* provides two alternative interfaces, the user has to select the interface to be used (or check the selection) in the *CT Analyzer* settings before connecting *CT Analyzer*. The factory default setting for those devices is **USB**.

1. Open the **Main Menu** of *CT Analyzer* and select **Settings**.
2. In the **Setting Menu** page, select **Remote Interface**.
3. In the **Select remote interface port** page, select the interface actually used to connect *CT Analyzer* to the computer: **USB** or **RS232**.

CT Analyzer will only communicate via the selected interface. It will not be recognized by the computer if the *CT Analyzer* settings do not match the interface used for connection.

Note: Please refer to the following sections for more information:


- ▶ Section 3.3 on page 26 for information on how to connect *CT Analyzer* to a PC.
- ▶ Chapter 6 on page 62 for general information on how to operate *CT Analyzer*.
- ▶ Section 6.8 on page 66 for more detailed information about the **Setting Menu** page.

2.3.5 Inputs and outputs

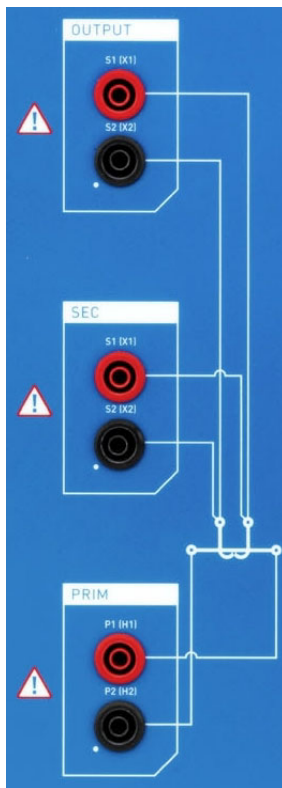
WARNING



Death or severe injury caused by high voltage possible

As long as the red LED of the  key is flashing, the output is active and lethal voltages can occur due to the high energy stored in external inductors.

- ▶ Do not touch the test object or the measurement leads while the red LED is flashing.
- ▶ Wait until the red LED is off and the green LED is on before touching the measurement setup.



OUTPUT

Generator output.

AC: $40V_{rms}$, $5A_{rms}$

DC: $120V$, $5A$ ($15A_{peak}$)

SEC

Measurement input for secondary side of CT, $300V_{AC}$ max.

PRIM

Measurement input for primary side of CT, $30V_{AC}$ max.

Figure 2-5: Inputs and outputs of *CT Analyzer*

2.3.6 I/O key with status LEDs



Red LED on the left, green LED on the right.

I/O key to start the test.

During the boot process after switching *CT Analyzer* on, both LEDs are on. The red LED goes off when the boot process is finished and *CT Analyzer* is ready for operation.

The **green LED lights continuously** to indicate that the equipment is operational and no voltage is applied to the test setup.

The **red LED flashes** to indicate that a test is in progress and voltage is applied to the test setup. Do not touch any part of the test setup while the red LED flashes.

Any other behavior of the status LEDs than described above indicates an error. In this case, switch off *CT Analyzer*. Do not touch any part of the test setup until the red LED is off and contact the OMICRON Technical Support (refer to chapter "Support" on page 29).

2.3.7 Display with soft keys

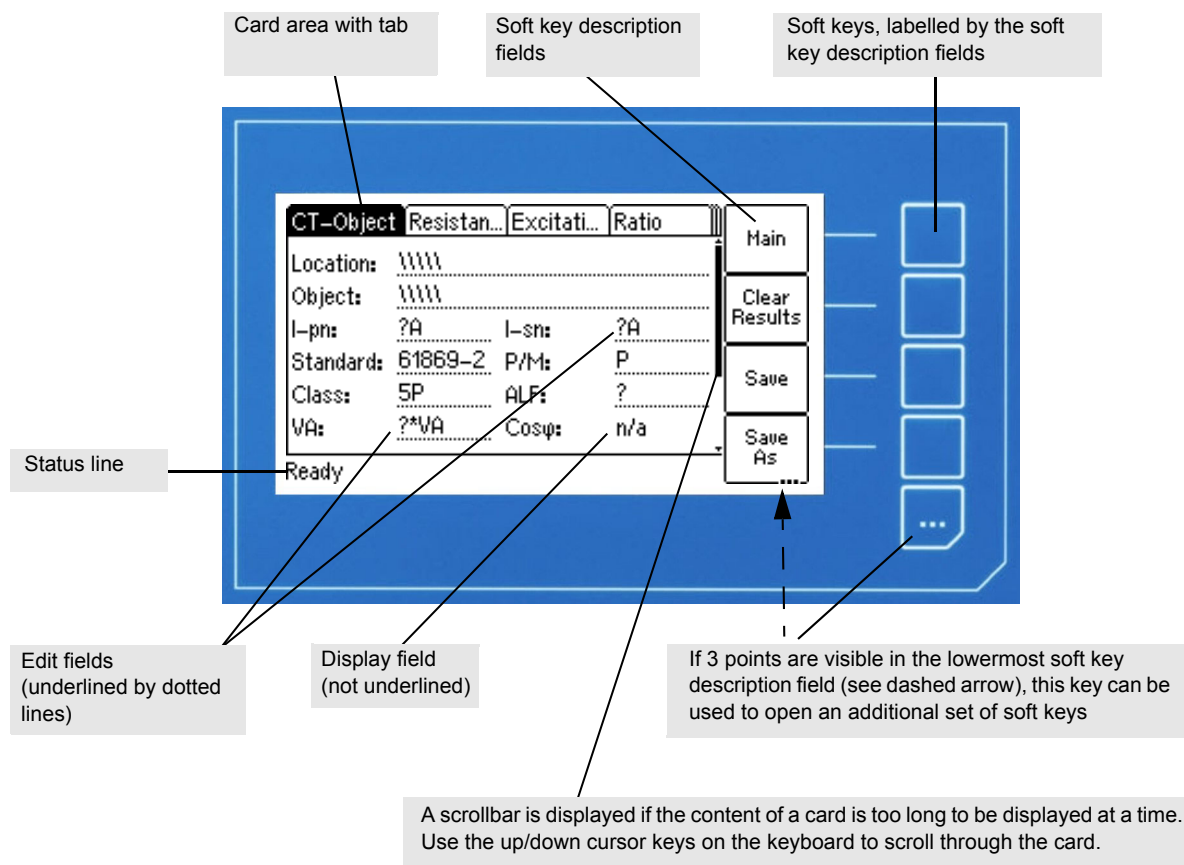







Figure 2-6: Display with context-dependent soft keys

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The following icons may be displayed in the status line:

Table 2-1: Icons displayed in the status line

Icon	Description
	Remote control. The <i>CT Analyzer Suite</i> software established connection to <i>CT Analyzer</i> .
	The keyboard on <i>CT Analyzer</i> is locked until the running test is finished.
	<p>Security key. The data measured with <i>CT Analyzer</i> can be stored in XML files. Stored files are protected by a security checksum to prevent the data within these files from being edited.</p> <p>If <i>CT Analyzer</i> displays the data of a previously stored test, and the data in this file are valid, a key is shown in the status line. If the data are invalid since someone tried to edit them later, a broken key is displayed.</p> <p>Note: When loading older files containing no security checksum, no security information is shown.</p>
	Overload indication. <i>CT Analyzer</i> could not output the required test current or take all necessary measurement points due to an overload.
	Multi-ratio CT measurement. Indicates that a multi-ratio CT test using the optional <i>CT SB2</i> switch box has been initialized on <i>CT Analyzer</i> (here: full tap combination X1-X4).

2.3.8 Keyboard

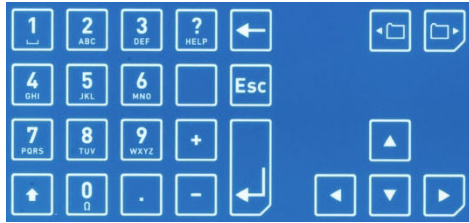


Figure 2-7: Keyboard

Table 2-2: Keyboard elements

Key	Description
	<p>Numeric / character keys for entering values and text.</p> <p>After pressing a key, the status line displays the character set available for the key. Press the key as often as required to scroll through the displayed character set. After 1 second or after pressing another key, the character selected in the status line is entered into the edit field in the display.</p> <p>Note: To quickly change between letters and numerics, hold the button pressed for a second.</p>
	Press this key to enter capital letters.
	Press this key to display the context-sensitive help system (see section 6.11 on page 79).
	Press this key to delete the character left of the cursor position.
	<p>Press this key to leave an edit field without applying a change or to leave the edit mode of a card or to go one level back in the user interface level.</p> <p>The CT-Object card is the top user interface level. Pressing this key several times will always bring you back to the CT-Object card.</p>
	<p>Press this key to apply a change for an edit field.</p> <p>When working in the <i>CT Analyzer</i> file system, use this key to open a selected folder or to confirm to move back to the next higher level in the file structure.</p>
	Use the card selector keys to display a specific card.
	<p>Use the cursor keys to select an edit field in the user interface or to move the cursor within an edit field.</p> <p>Use the cursor key to enter the edit mode of a displayed card.</p>

2.4 License-depending functional scope

The functional scope provided by *CT Analyzer* depends on the licenses actually available on the device.

This User Manual describes the full functional scope provided when the complete set of licenses is available on the *CT Analyzer* test set. A lack of licenses may primarily result in functional restrictions regarding the selectable standards, classes, core types and frequencies as well as the availability of individual measurement functions and/or test cards.

For up-to-date information about the licenses and packages available for *CT Analyzer* please refer to the OMICRON website.

2.5 Scope of delivery, accessories, available licenses

For up-to-date information about the scope of delivery and available accessories and licenses for *CT Analyzer* please refer to the OMICRON website or the OMICRON office nearest you.

3 Setup and connection

3.1 General safety rules for connecting and operating *CT Analyzer*

Observe the following general safety rules and the safety instructions given in chapter 1 "Safety instructions" on page 9 when connecting and operating *CT Analyzer*. The safety rules given here are supplemented by further notes and warnings applicable for specific actions only. Such specific notes and warnings are given where necessary in this user manual.

- ▶ Before putting *CT Analyzer* into operation, check the test set for visible damages.
- ▶ When taking *CT Analyzer* into operation, make sure that the air slots, the power switch and the power supply plug at the test set are not obstructed and that the test set can be easily disconnected from mains.
- ▶ Only use wires with 4mm safety "banana" connectors and plastic housing for connection to the front panel input/output sockets.
- ▶ During the test always connect one terminal of the transformer's primary side to protective earth.

WARNING



Death or severe injury caused by high voltage or current possible

- ▶ Make sure that the terminals of the test object to be connected to *CT Analyzer* do not carry any voltage potential.
- ▶ During a test, *CT Analyzer* is the only permitted power source for the test object.

WARNING



Death or severe injury caused by high voltage or current possible

As long as the red LED on the *CT Analyzer* test set is flashing, the output is active and lethal voltages can occur due to the high energy stored in external inductors.

- ▶ Do not touch the equipment under test or the measurement leads while the red LED on *CT Analyzer* is flashing.
- ▶ Never connect or disconnect measurement leads while the red LED on *CT Analyzer* is flashing.

WARNING



Death or severe injury caused by high voltage or current possible

Accidentally mixing up primary and secondary windings can cause life-threatening voltages and/or destroy the connected CT or the *CT Analyzer* test set.

- ▶ Always make sure that the *CT Analyzer* output is connected to the correct side of the current transformer according to the wiring instructions given in sections 3.4 to 3.5 below.



WARNING

Death or severe injury caused by high voltage or current possible

Feeding test voltage to a CT can cause life-threatening voltages on other taps and/or cores of the CT.

- ▶ Do not touch other taps or windings of the CT during the test.
- ▶ When testing multi-core CTs, make sure that no other windings of the CT are open. Leave the secondary windings of the other (non-measured) cores connected, or short-circuit them if the windings are open.
- ▶ If possible, use the optional *CT SB2* switch box for testing multi-ratio CTs. *CT Analyzer* then automatically reduces the test voltage in a way that the maximum possible voltage within the measurement setup (i.e., the voltage occurring at the tap combination with the highest ratio) is limited to 200V.



WARNING

Death or severe injury caused by high voltage or current possible

Observe the following when running tests:

- ▶ Prevent the presence of other persons in the potentially dangerous area around the test object.
- ▶ If necessary, perform appropriate additional safety precautions according to the relevant standard, for example, by defining a high-voltage area around the test object and securing this area against unauthorized access by using a barrier chain and warning sign.
- ▶ Start the test only if all safety precautions were taken and if you are absolutely sure that no other person is present in the potentially dangerous area around the test object.

3.2 Setting up *CT Analyzer*

Proceed as follows to set up *CT Analyzer*:

1. Make sure to position the *CT Analyzer* test set on dry, solid ground.
2. Connect the grounding terminal on the *CT Analyzer*'s side panel (see section 2.3 on page 15) to protective ground (PE). Use the original cable supplied by OMICRON or alternatively a solid connection of at least 6mm². Use a ground point as close as possible to the test object.
3. Connect *CT Analyzer* to mains using the supplied power cord. Supply *CT Analyzer* only from a power outlet that is equipped with protective ground (PE).

An error message (901) appears if the PE connection is defective or if the power supply has no galvanic connection to ground. This can be the case in very special grid applications or if *CT Analyzer* is supplied by a generator or an isolating transformer. The error message 901 is a safety relevant message!

WARNING



Death or severe injury caused by high voltage or current possible

- ▶ Always make sure that protective ground and equipotential ground are connected properly to ensure safe operation.

4. Connect the equipment under test according to the instructions given in this manual. Refer to sections 3.4 and 3.5 for detailed descriptions how to connect *CT Analyzer* for a specific measurement and/or application.

3.3 Connecting CT Analyzer to a PC (optional)

CT Analyzer devices as of serial number JHxxxx or newer are equipped with a USB interface and a RS232 interface. You can use both interfaces alternatively to connect CT Analyzer to a computer.

Proceed as follows to connect the CT Analyzer test set to a PC:

1. Select the interface to be used (or check the selection) in the CT Analyzer settings:
 - ▶ Open the **Main Menu** of CT Analyzer and select **Settings**.
 - ▶ In the **Setting Menu** page, select **Remote Interface**.
 - ▶ In the **Select remote interface port** page, select the interface actually used to connect CT Analyzer to the computer: **USB** or **RS232**.
2. Connect CT Analyzer to the PC using a RS232 cable or a USB cable as shown in the following figure.

CT Analyzer connected via USB



CT Analyzer connected via RS232 interface and a RS232/USB adapter on the PC side



CT Analyzer connected via RS232 interface



Figure 3-1: Connecting CT Analyzer to a PC

3.4 Connection for usual applications

3.4.1 Wiring for a CT test

Applicable for CT Test mode and Advanced CT Test mode.

This section shows the basic wiring of *CT Analyzer* for a CT test.

Observe the general safety rules in section 3.1 on page 23 and the safety instructions given in chapter 1 "Safety instructions" on page 9. Observe the hints and instructions for improving the quality of the measurement results given in section 3.7 on page 45.



WARNING

Death or severe injury caused by high voltage or current possible

Feeding test voltage to a CT can cause life-threatening voltages on other taps and/or cores of the CT.

- ▶ Do not touch other taps or windings of the CT during the test.
- ▶ Make sure that no other windings of the CT are open.

NOTICE

Falsification of measurement results possible

- ▶ Always connect the grounded terminal on the secondary side of the CT to the black sockets of input SEC and the OUTPUT of *CT Analyzer*. Connecting the red sockets of *CT Analyzer* to PE can result in incorrect measurement and/or cause an automatic abortion of the measurement with an error message.
- ▶ If it is necessary to use clamps for the connection of the measurement leads to the secondary side of the test object, always use the 4-wire connection technique as described in section 3.7.1 on page 45 in order to avoid measurement errors.

For a CT test, connect *CT Analyzer* as shown in Figure 3-2:

1. Make sure that the primary side of the CT is connected to PE on one side and open on the other side.

NOTICE

Falsification of measurement results possible

It is absolutely important to avoid coupling of interferences into the primary circuit during measurement.

- ▶ Connect the side of the primary circuit that is able to receive more interferences to PE (e.g. the side with the longer line length). The ungrounded side should be the side that receives less interferences (refer to Figure 3-2).
2. Disconnect all secondary windings of the CT core under test in order to remove any load from this core. Every kind of load remaining on the secondary side of a CT core during measurement will lead to incorrect measurement results or error messages.
If the CT under test is a multi-core CT, leave the secondary windings of the other (non-measured) cores connected, or short-circuit them if the windings are open.
 3. Connect the black socket of *CT Analyzer* input PRIM to the grounded side of the CT's primary circuit and the red socket of this input to the open (ungrounded) side.

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- 4. Connect the black OUTPUT socket and the black socket of input SEC of *CT Analyzer* to that terminal on the secondary side of the CT that is connected to PE.
- 5. Connect the red OUTPUT socket and the red socket of input SEC of *CT Analyzer* to the other (ungrounded) terminal on the secondary side of the CT.

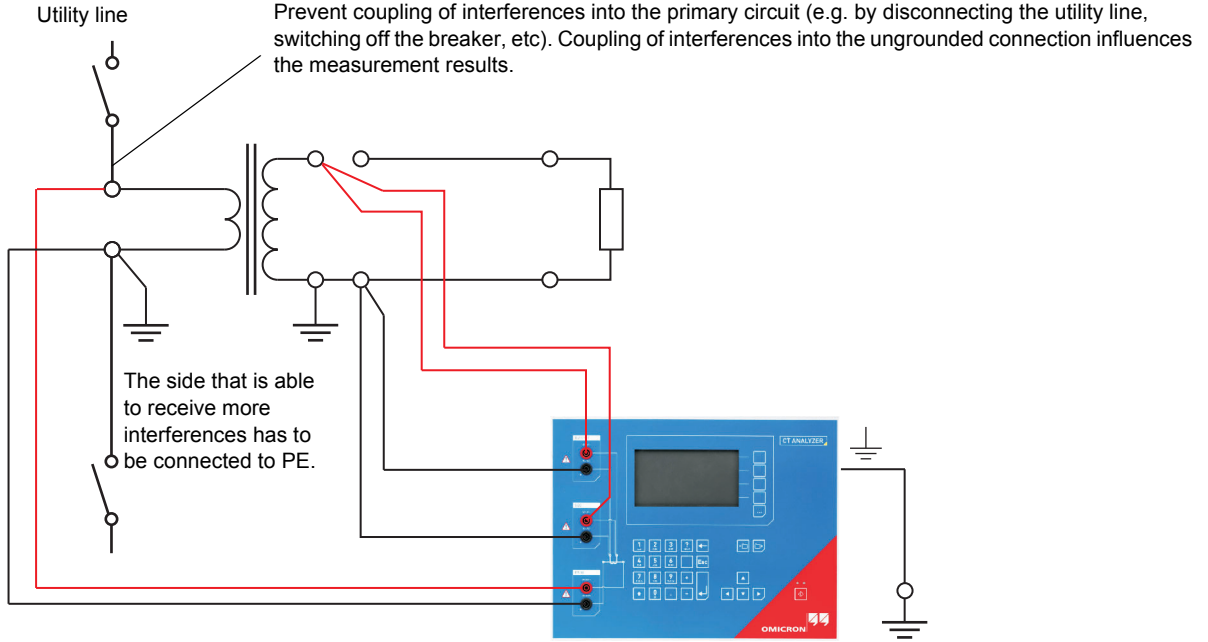


Figure 3-2: Basic wiring for a CT test

Note: The CT may make humming or buzzing noises of varying frequency during the CT test. This is normal behavior and does not indicate a defective CT.

3.4.2 Wiring for a burden test

Applicable for Advanced CT Test mode only.

For a burden test, connect *CT Analyzer* as shown in Figure 3-3. Observe the general safety rules in section 3.1 on page 23 and the safety instructions given in chapter 1 "Safety instructions" on page 9.

1. Open the connection line to the ungrounded side of the CT (refer to Figure 3-3).

NOTICE

Falsification of measurement results possible

It is important to disconnect the CT under test prior to the burden test.

- ▶ If you do not disconnect the CT for the burden test, *CT Analyzer* measures the parallel impedance of the burden and the CT winding instead of the burden itself. Although in many cases the impedance of the CT is many times higher than the burden impedance, this will cause a measuring error.
- ▶ *CT Analyzer* does not perform demagnetization after burden measurement. Therefore, CT saturation could occur if you do not disconnect the CT prior to the burden test.

2. Connect the black OUTPUT socket and the black socket of *CT Analyzer* input SEC to that side of the burden that is connected to PE.
3. Connect the red OUTPUT socket and the red socket of *CT Analyzer* input SEC of to the other (ungrounded) side of the burden.

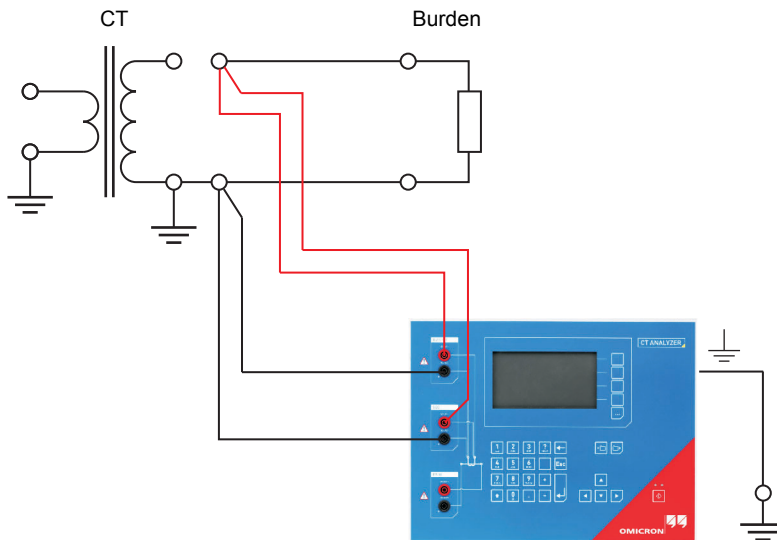


Figure 3-3: Basic wiring for a burden test

3.4.3 Wiring for primary resistance measurement

Applicable for Advanced CT Test mode only.

For the primary winding resistance measurement, connect *CT Analyzer* as shown in Figure 3-4. Observe the general safety rules in section 3.1 on page 23 and the safety instructions given in chapter 1 "Safety instructions" on page 9.

1. Make sure that the primary side of the CT is connected to PE on one side and open on the other side.
2. Disconnect the burden from the winding/core under test in order to remove any load from the CT. Every kind of load remaining on the secondary side of the core under test during measurement leads to incorrect measurement results or error messages.
3. Connect the black socket of *CT Analyzer* input PRIM to the grounded side of the CT's primary winding and the red socket of this input to the open (ungrounded) side.
4. Connect the black OUTPUT socket of *CT Analyzer* to the grounded side of the CT's primary winding and the red OUTPUT socket to the ungrounded side of the primary winding.

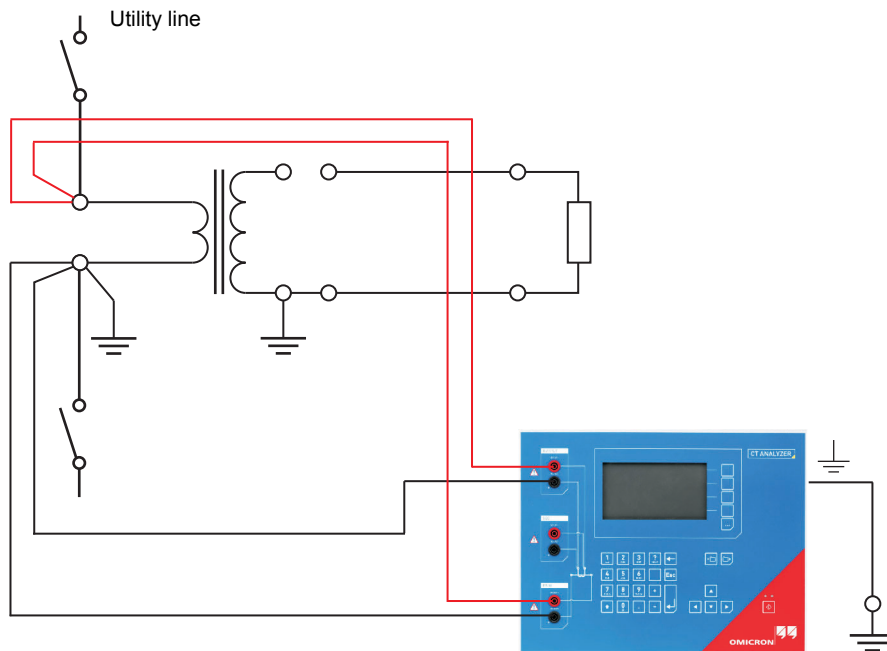



Figure 3-4: Basic wiring for primary winding resistance measurement

WARNING



Death or severe injury caused by high voltage or current possible

The primary winding resistance measurement is performed with DC current.

- ▶ Do not open the measurement circuit while current is flowing.
- ▶ Stop the measurement by pressing the  key on the *CT Analyzer* test set and wait until the red LED is off before opening the measurement circuit.

3.5 Connection for special applications

3.5.1 Measurement on a gapped core

Applicable for CT Test mode and Advanced CT Test mode.

For gapped cores, the position of the primary wire inside the core has a large influence on the ratio measurement results.

Therefore, in order to obtain correct measurement results, it is very important to arrange the primary wire during measurement to the same position inside the core as it is during real operation. Depending on the position of the primary wire inside the core, the measured ratio can differ by up to 20%.

The figure below shows how the ratio error can differ depending on the position of the primary wire inside the core.

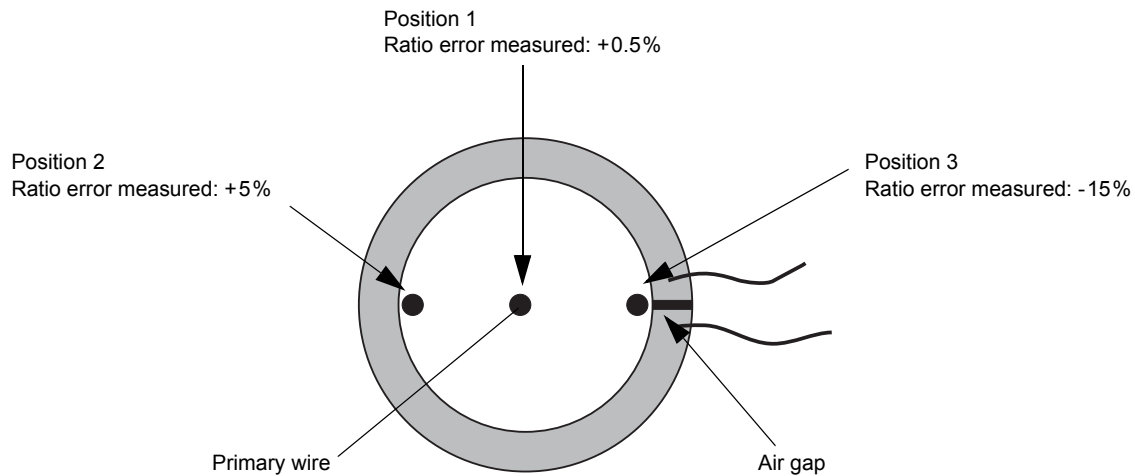


Figure 3-5: Ratio error depending on the position of the primary wire inside the gapped core

As shown in Figure 3-5, the measured ratio error may differ considerably depending on the position of the primary wire. Best measurement results are obtained if the primary wire is positioned exactly to the center of the core. As an alternative, a copper foil formed to a ring and placed to the inner side of the core can be used as shown in Figure 3-6.

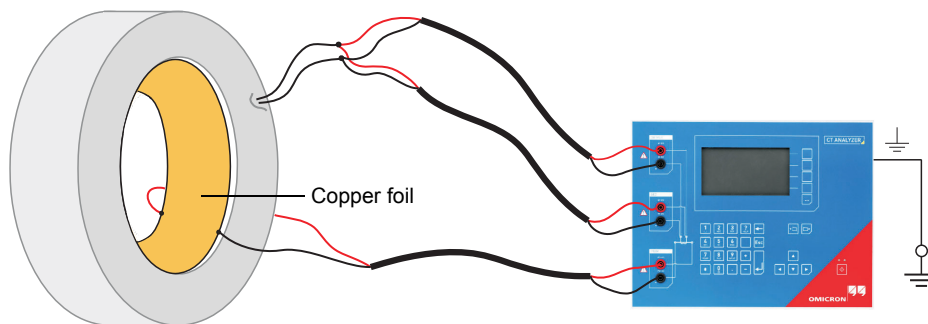


Figure 3-6: Using a copper foil formed to a ring as primary wire

Note: Exact measurement results are only possible if the primary wire is positioned exactly in the center of the core.

CT Analyzer does not consider leakage inductances. The leakage inductances are neglected instead. This way, *CT Analyzer* is able to reach a measurement error of approx. 0.1% for class PR and class TPY CTs and approx. 0.8% for class TPZ CTs.

3.5.2 Excitation curve measurement for an unwound iron core

Applicable for Advanced CT Test mode only.

Using *CT Analyzer* it is possible to measure the magnetic properties of an empty, unwound iron core. For this purpose, it is necessary to apply an "auxiliary winding" of at least 20 turns to the core.

For this purpose, OMICRON offers a special cable with 23 turns (VEHK0658) and a special Microsoft Excel template for the required calculations. Please note that this measurement cannot be performed from the *CT Analyzer Suite* software.

Proceed as follows to perform the measurement (refer to Figure 3-7 and Figure 3-8). Observe the general safety rules in section 3.1 on page 23 and the safety instructions given in chapter 1 "Safety instructions" on page 9.

1. Apply the "auxiliary winding" cable to the unwound core.
2. Connect the *CT Analyzer* OUTPUT sockets and input SEC to the cable as shown in Figure 3-7. For cores that require high currents to reach the knee point, several cables can be cascaded to increase the number of turns, see Figure 3-8.
3. Connect *CT Analyzer* to a computer as described in section 3.3 on page 26.
4. On the computer, browse for the Excel template "EXL-0007 Measurement of Iron Core ENU.xlt". This template is installed together with *CT Analyzer Suite* to the \RemoteEFL\Templates\ folder of the *CT Analyzer Suite* installation path. For the default installation path on a 64 bit operating system, the full path is C:\Program Files\OMICRON\CT Analyzer\RemoteEFL\Templates\, for example.
5. Open the template "EXL-0007 Measurement of Iron Core ENU.xlt" with Microsoft Excel, for example, by double-clicking the template.
6. Enter the iron parameters to the corresponding worksheet of the template.
7. Start the measurement by clicking the **Start Test** button in the worksheet

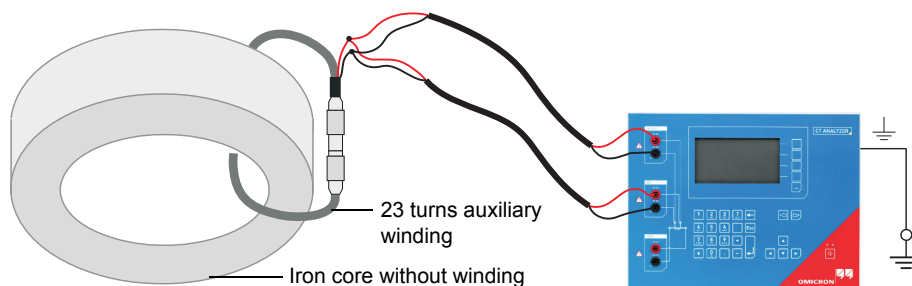


Figure 3-7: Excitation curve measurement using one "auxiliary winding" cable

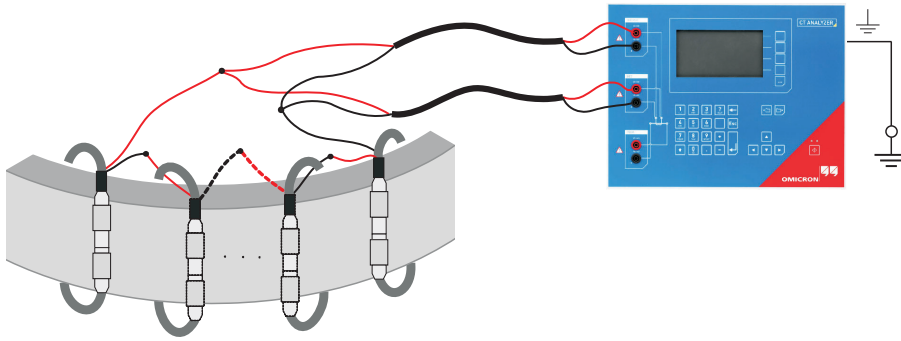


Figure 3-8: Excitation curve measurement using several cascaded "auxiliary winding" cables

3.5.3 Measurement on a GIS (SF6) switch gear

Applicable for CT Test mode and Advanced CT Test mode.

Proceed as follows to perform measurements on a GIS (SF6) switch gear (refer to Figure 3-9). Observe the general safety rules in section 3.1 on page 23 and the safety instructions given in chapter 1 "Safety instructions" on page 9.

1. Disconnect all utility lines.
2. Open all circuit breakers to the bus bars.
3. Close the earthing switch.
4. Connect one secondary side terminal of the CT to protective earth.
5. Connect the secondary side of the CT to the *CT Analyzer* OUTPUT sockets and input SEC:
 - ▶ Connect that side of the CT that is connected to PE to the black sockets of *CT Analyzer*.
 - ▶ Connect that side of the CT that is open to the red sockets of *CT Analyzer*.
6. Connect the primary side of the CT to *CT Analyzer* input PRIM. Make sure that the polarity is correct (same colors on same polarity).

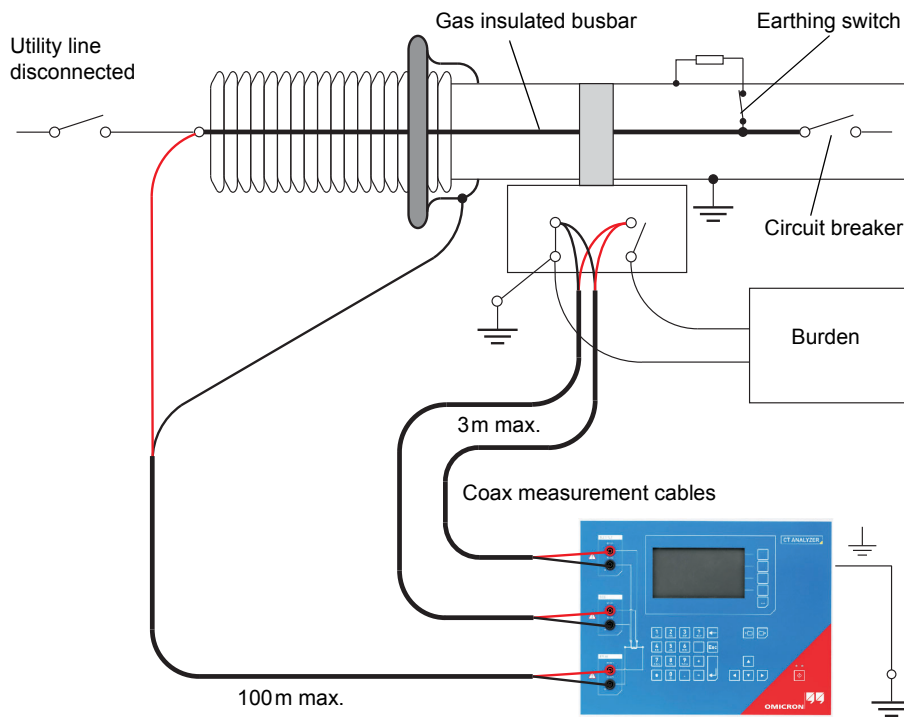


Figure 3-9: Measurement on a GIS (SF6) switch gear

3.5.4 Measurement on bushing-type CTs

Applicable for CT Test mode and Advanced CT Test mode.

Measurement on a bushing-type CT

Proceed as follows to perform measurements on a bushing-type CT (refer to Figure 3-10). Observe the general safety rules in section 3.1 on page 23 and the safety instructions given in chapter 1 "Safety instructions" on page 9.

1. Disconnect all utility lines from the transformer (i.e., isolate the transformer from the energized power system).
2. Connect all transformer terminals that are not used for measurement (in this example H2 and H3) to protective earth (PE) in order to minimize the external disturbances. External disturbances can influence the measurement results because the bushings are acting as an antenna.
3. Connect terminal H0 to protective earth.
4. Connect one secondary side terminal of the CT to protective earth.
5. Connect the secondary side of the CT to the OUTPUT sockets and the SEC sockets of *CT Analyzer*.
 - ▶ Connect that side of the CT that is connected to PE to the black sockets of *CT Analyzer*.
 - ▶ Connect that side of the CT that is open to the red sockets of *CT Analyzer*.
6. Connect the primary side of the CT to *CT Analyzer* input PRIM. Make sure that the polarity is correct (same colors on same polarity).
7. Short-circuit and ground the free winding on the measured transformer leg to reduce the impedance of the winding that is connected in series to the primary side of the CT. The input impedance of *CT Analyzer* may influence the measurement results, if no winding of that leg is short-circuited.
8. If the transformer has a tap changer installed, the position of the tap changer should be changed to a position where the regulation winding is completely bridged in order to ensure that the regulation winding cannot act as a voltage divider together with the main winding of the transformer.

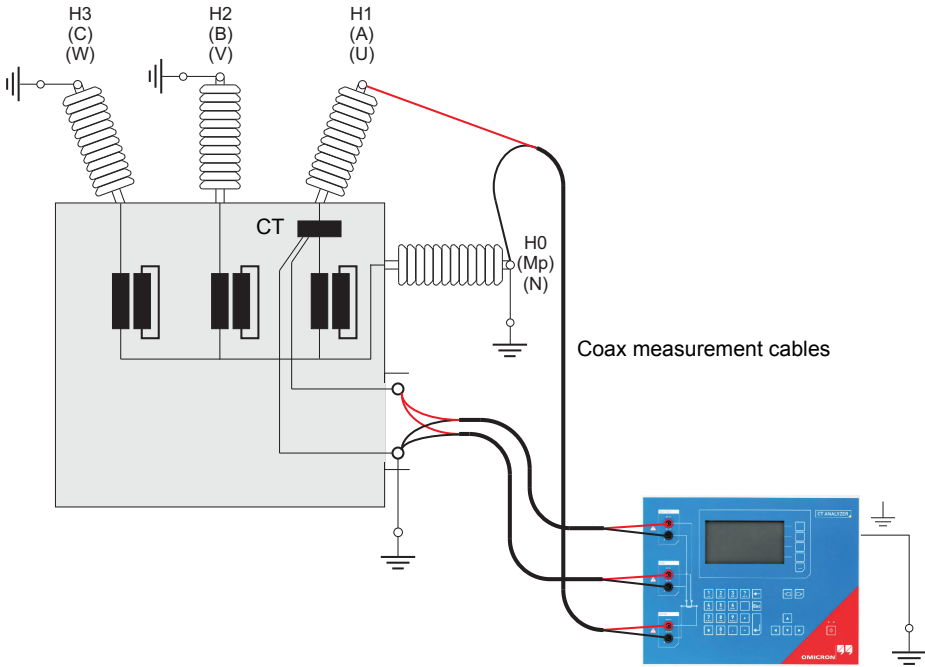


Figure 3-10: Measurement on a bushing-type CT

Note: Primary terminal H1 must be open. Otherwise the primary side is shorted and *CT Analyzer* cannot obtain proper results.

Measurement on a Y (wye) winding transformer

For measurements on current transformers in Y-connected transformer windings it has to be assured that the main impedance of the transformer does not influence the measurement results.

The input impedance of *CT Analyzer* may also influence the measurement results. In order to prevent any influence of the *CT Analyzer's* input impedance to the measurement results, the transformer winding at the same leg should be short-circuited. Short-circuiting the windings on all legs of the transformer is even better.

Furthermore, all bushing terminals that are not connected to *CT Analyzer* should be connected to protective earth in order to prevent influence of external disturbances (see Figure 3-11).

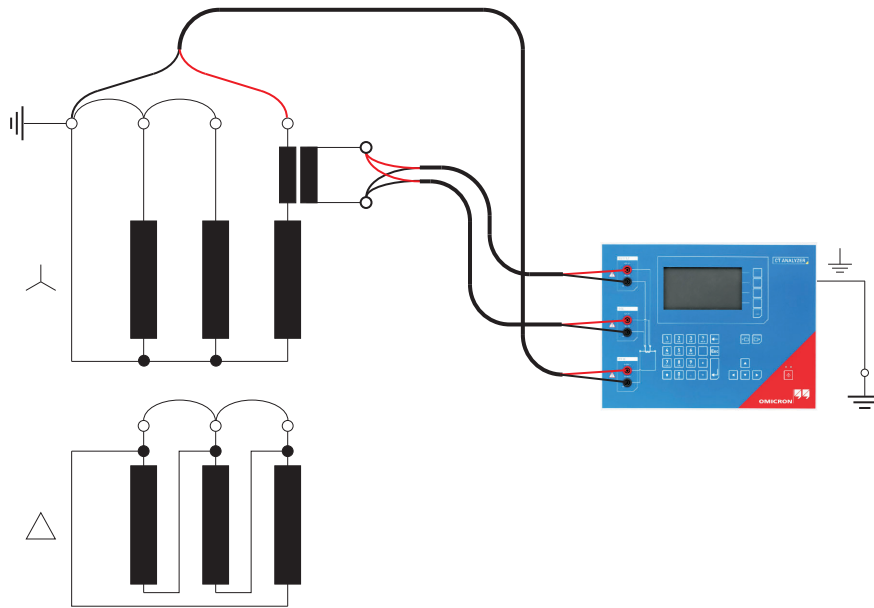


Figure 3-11: Measurement on a Y winding transformer

Measurement on a Δ (delta) winding transformer

CTs outside the delta winding

For CTs that are located in the bushing outside of the delta winding (Figure 3-12), no delta compensation is needed.

In this case, only two parallel transformer windings are connected in series to the CT. This connection method provides least possible influence to the measurement result for the winding resistance of the CT.

The Y winding and the remaining windings of the power transformer's delta winding are short-circuited to avoid influence of the induced flux of the power transformer's core to the measurement.

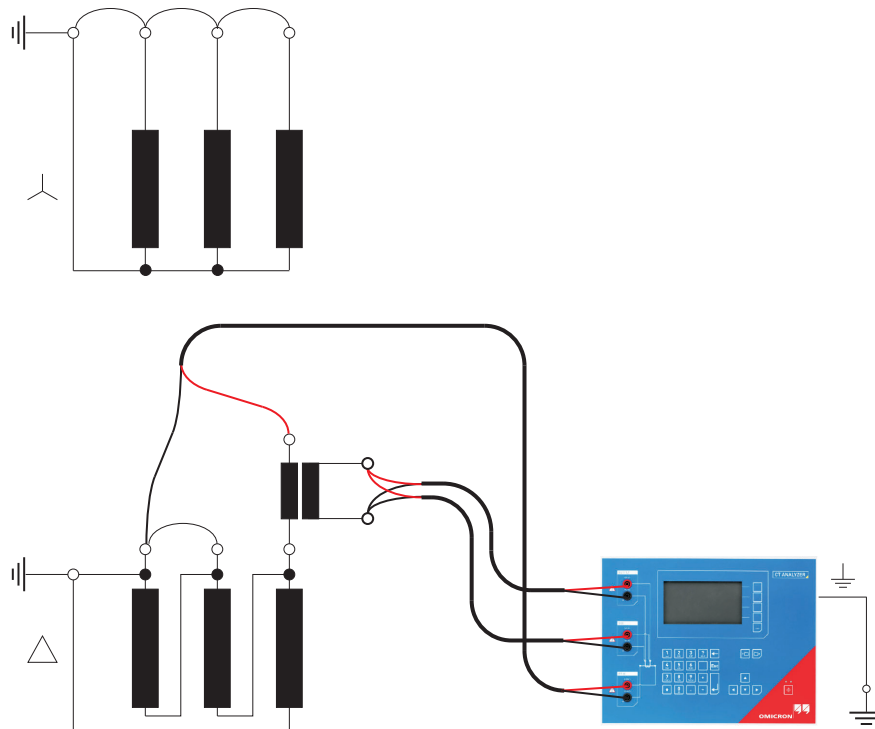


Figure 3-12: Bushing-type CT outside the delta winding power transformer

CTs inside the delta winding

For CTs that are integrated in the delta winding of the transformer, it is not possible to read the CT ratio directly since the delta winding acts as a voltage divider. In order to obtain the correct CT ratio, the ratio value determined by *CT Analyzer* has to be corrected.

For this purpose, *CT Analyzer* provides a "Delta Compensation" field on the **CT-Object** card where you can select the delta compensation factor depending on the bushing terminals that are used for primary signal measurement.

CT-Object	Resistan...	Excitati...	Ratio	Ratio
VA:	?VA	Cosφ:	n/a	Ratio 1
Burden:	?VA	Cosφ:	?	Ratio 2/3
f:	50Hz	Rprim:	?Ω	Ratio 1/3
Class mult. factor:	1.0			
Delta compensation:			Ratio 2/3	

Ready

Figure 3-13: Setting the delta compensation on the **CT-Object** card

If it is possible to short-circuit the transformer winding at the same leg as the primary measurement is done (see Figure 3-15), the measurement should be performed with the winding short-circuited. In this case, no delta compensation is required since the voltage induced on the transformer's secondary winding is zero and thus the voltage induced on the primary side of the transformer is also zero.

For the measurement setup shown in Figure 3-14, the delta compensation factor on the **CT-Object** card has to be set to "Ratio 2/3" (see Figure 3-13).

If input PRIM is connected between L1 and L2, the delta compensation has to be set to "Ratio 1/3".

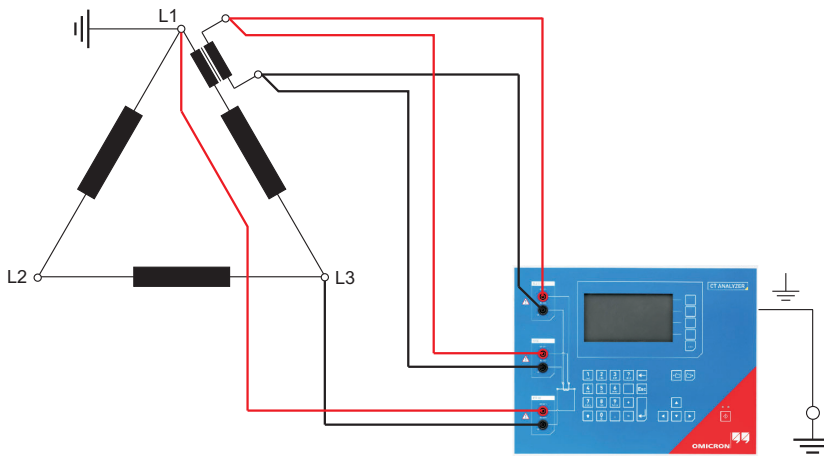


Figure 3-14: Measurement setup for delta compensation "Ratio 2/3"

In the configuration shown in Figure 3-15, no delta compensation is required since the main winding of the power transformer is short-circuited on the other side. This avoids the induction of flux in the main winding of the power transformer that could influence the measurement results.

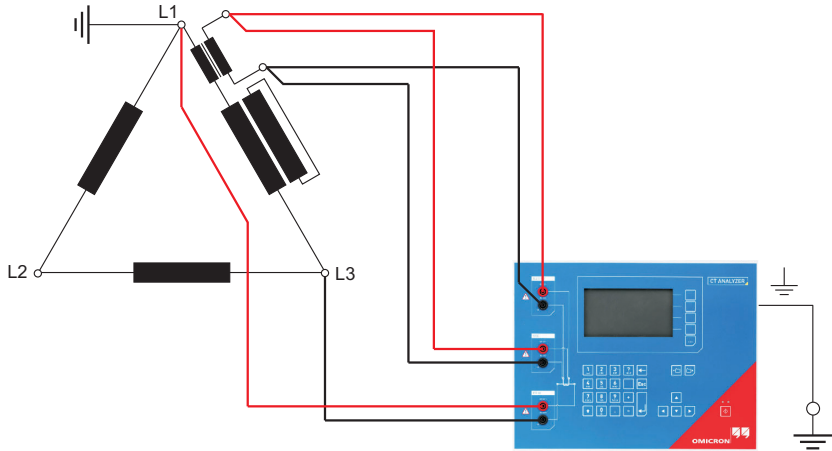


Figure 3-15: Measurement setup for delta compensation "Ratio 1"

3.5.5 VT ratio measurement using *Quick Test*

Applicable for *Quick Test* mode only.

To measure the ratio of VTs using *CT Analyzer*, you can either use the *Quick Test* function of *CT Analyzer* (see chapter 10 on page 142) or the *CT Analyzer Quick Test* function of the *CT Analyzer Suite* software.

Observe the general safety rules in section 3.1 on page 23 and the safety instructions given in chapter 1 "Safety instructions" on page 9.

For VT ratio measurements using *Quick Test*, connect *CT Analyzer* as shown in Figure 3-16. For a detailed description on how to perform such measurements, please refer to section 10.7 on page 157.

1. Connect the *CT Analyzer* OUTPUT sockets and input SEC to the primary side of the VT.
2. Connect *CT Analyzer* input PRIM to the secondary winding of the VT.

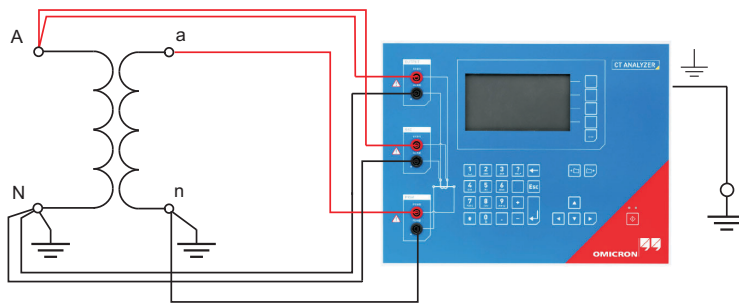


Figure 3-16: Connecting the VT for ratio measurement using *CT Analyzer*

WARNING



Death or severe injury caused by high voltage or current possible

For VT ratio measurement, the *CT Analyzer* output has to be connected to the primary side of the VT. Connecting the *CT Analyzer* output to the secondary side of the VT by mistake will cause hazardous voltages on the primary side.

- For VT ratio measurements using *Quick Test*, always make sure to connect the *CT Analyzer* output to the primary side of the VT.

3.5.6 Winding resistance measurement using *Quick Test*

Applicable for *Quick Test* mode only.

To measure the winding resistance of VTs or CTs using *CT Analyzer*, you can either use the *Quick Test* function of *CT Analyzer* (see chapter 10 on page 142) or the *CT Analyzer Quick Test* function of the *CT Analyzer Suite* software.

Observe the general safety rules in section 3.1 on page 23 and the safety instructions given in chapter 1 "Safety instructions" on page 9.

For winding resistance measurements using *Quick Test*, connect *CT Analyzer* as shown in Figure 3-17. For a detailed description on how to perform such measurements, please refer to section 10.8 on page 160.

Connect the *CT Analyzer* OUTPUT sockets and input SEC to the winding to be measured.

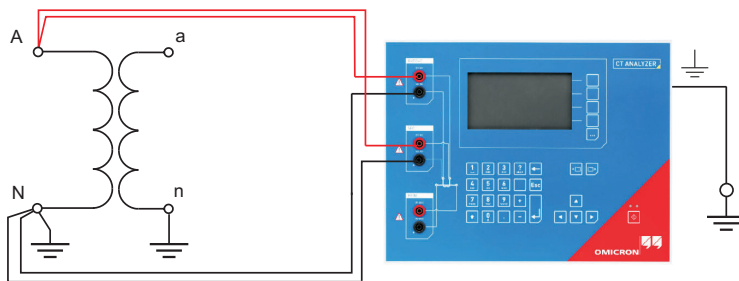


Figure 3-17: Connecting *CT Analyzer* for winding resistance measurement

WARNING



Death or severe injury caused by high voltage or current possible

Resistance measurement is performed with DC current. Feeding an inductance with DC current will charge the inductance. *CT Analyzer* does not perform automatic discharge of the inductance.

- ▶ Wait until the inductance has discharged completely before touching any connections or disconnecting the measurement leads of *CT Analyzer*.

NOTICE

Equipment damage possible

Too high currents could destroy the winding.

- ▶ Use only low currents of e.g. 100 mA when measuring the primary side of VTs.

3.5.7 Polarity check using *Quick Test* and the *CPOL2* polarity checker

Applicable for *Quick Test* mode only.

Observe the general safety rules in section 3.1 on page 23 and the safety instructions given in chapter 1 "Safety instructions" on page 9.

For the polarity check using *Quick Test*, connect *CT Analyzer* as shown in Figure 3-18. For a detailed description on how to perform the polarity check, please refer to section 10.5 on page 151.

1. Ensure that the ungrounded side of the CT winding is not connected to the wiring to be checked.
2. Connect the black OUTPUT socket and the black socket of input SEC of *CT Analyzer* to that side of the burden that is connected to PE.
3. Connect the red OUTPUT socket and the red socket of input SEC of *CT Analyzer* to the other (ungrounded) side of the burden.

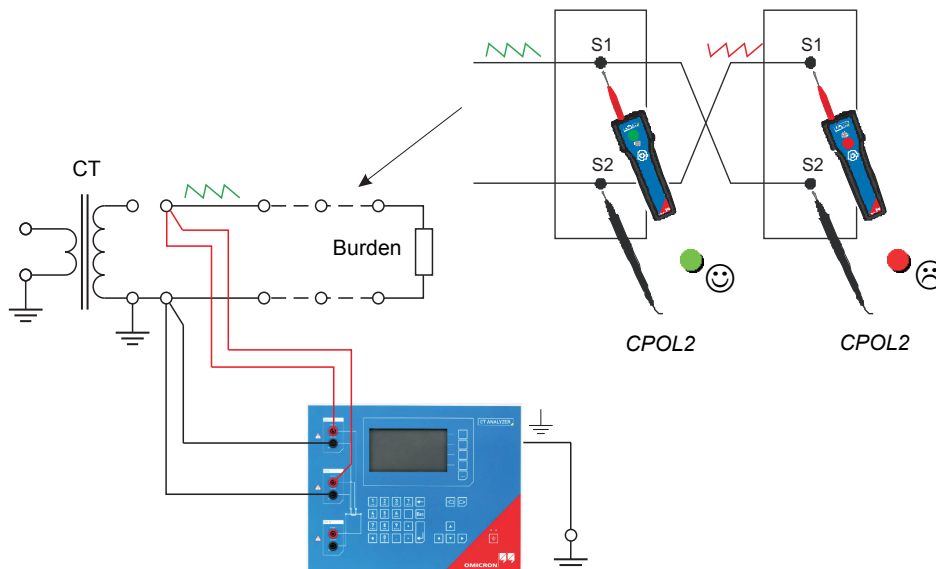


Figure 3-18: Wiring for a polarity check of the burden wiring using *Quick Test* and the *CPOL2* polarity checker

Note: *CT Analyzer* measures the voltage of the injected signal using input SEC. Therefore, you should always connect this input when using the Polarity Check measurement type. The higher the resistance of the wiring checked (i.e., the burden wiring) or the current amplitude set on *CT Analyzer*, the higher the terminal voltage generated by this current!

3.6 Disconnection



WARNING

Death or severe injury caused by high voltage or current possible

As long as the red LED on *CT Analyzer* is flashing, the output is active and lethal voltages can occur due to the high energy stored in external inductors.

- ▶ Do not disconnect measurement leads while the red LED on *CT Analyzer* is flashing.
- ▶ Always wait until the red LED is off before disconnecting measurement leads.

Proceed as follows to disconnect *CT Analyzer*:

1. Wait until the red LED on *CT Analyzer* is off.
2. Disconnect the measurement leads starting at *CT Analyzer*.

3.7 Improving the quality of measurement results

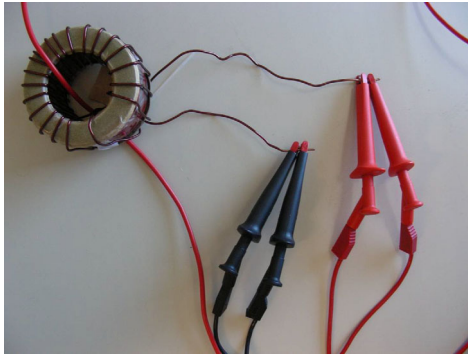
3.7.1 4-wire measurement vs. 2-wire measurement

If the secondary side of the test object does not provide screw terminals for connecting the delivered terminal adapters or banana sockets to insert the measurement leads directly, and it is therefore necessary to use clamps (e.g. crocodile clamps or Kelvin clamps) for the connection of the measurement leads, always use the 4-wire connection technique as described below.

Otherwise, the possibly existing contact resistance of the clamps could affect the measurement results, i.e., *CT Analyzer* possibly delivers incorrect measurement results.

Both connection techniques are shown in the following figure.

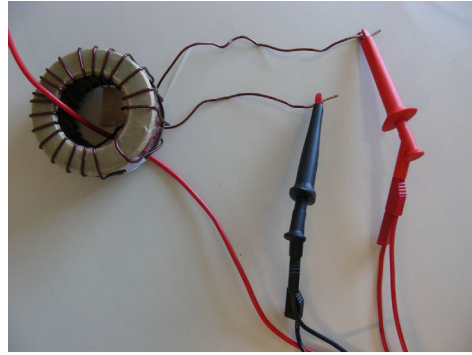
 **OK**
4-wire connection



The measurement leads from the OUTPUT sockets and input SEC of *CT Analyzer* are connected to the test object via separate clamps.

One clamp is used for each measurement lead! **Correct!**

 **Do not use!**
2-wire connection



Separate measurement leads are used for the OUTPUT sockets and input SEC of *CT Analyzer*, but the measurement leads are connected to the test object via one common clamp.

Two measurement leads use one single clamp! **Do not use!**

Figure 3-19: Demonstration of 2-wire and 4-wire connection technique

3.7.2 Noise reduction techniques

For proper test results it is important to consider the following:

- ▶ If possible, disconnect both primary terminals of the CT from the utility lines.
- ▶ If possible, always use the original coax measurement cables delivered by OMICRON. If it is necessary to use loose single-wire measurement cables, twist the wires to a twisted-pair line. Avoid open loops consisting of individual single-wire measurement cables in order to prevent interference voltages caused by magnetic fields.
- ▶ Connect one terminal of the CT's primary side to protective earth. If it is not possible to disconnect the utility lines from both primary terminals, connect that side of the primary circuit that is able to receive more interferences to PE (the primary side that is still connected to the utility lines or the side with the longer line length, respectively). The ungrounded side should be the side that receives less interferences.
- ▶ When testing a CT in a utility, take care that one side of the CT is connected to PE and at least the ungrounded terminal is disconnected from all utility lines.

Refer to Figure 3-20.

NOTICE

Falsification of measurement results possible

- ▶ Do not connect both primary terminals to PE. This would cause incorrect measurement results. Connecting both primary terminals to PE has the same effect as a short-circuit in the CT.

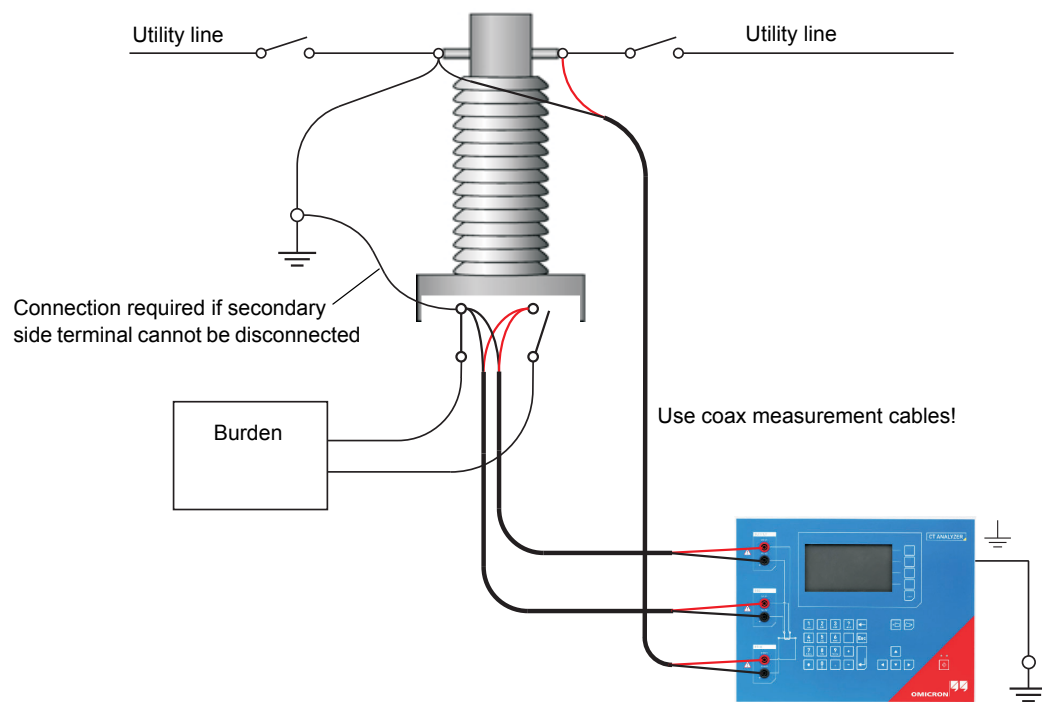


Figure 3-20: Noise reduction for CT measurement

4 CT testing in CT Test mode ("New CT Test")

When working with *CT Analyzer*, always observe the safety rules given in section 3.1 on page 23 and the safety instructions given in chapter 1 "Safety instructions" on page 9.

WARNING



Death or severe injury caused by high voltage or current possible

As long as the red LED on the *CT Analyzer* test set is flashing, the output is active and lethal voltages can occur due to the high energy stored in external inductors.

- ▶ Do not touch the equipment under test or the measurement leads while the red LED on *CT Analyzer* is flashing.
- ▶ Never connect or disconnect measurement leads while the red LED on *CT Analyzer* is flashing.

WARNING



Death or severe injury caused by high voltage or current possible

Accidentally mixing up primary and secondary windings can cause life-threatening voltages and/or destroy the connected CT or the *CT Analyzer* test set.

- ▶ Always make sure that the *CT Analyzer* output is connected to the correct side of the current transformer according to the wiring instructions given in sections 3.4 to 3.5.

WARNING



Death or severe injury caused by high voltage or current possible

Feeding test voltage to a CT can cause life-threatening voltages on other taps and/or cores of the CT.

- ▶ Do not touch other taps or windings of the CT during the test.
- ▶ Make sure that no other windings of the CT are open.
- ▶ If possible, use the optional *CT SB2* switch box for testing multi-ratio CTs. *CT Analyzer* then automatically reduces the test voltage in a way that the maximum possible voltage within the measurement setup (i.e., the voltage occurring at the tap combination with the highest ratio) is limited to 200V.

Note: The CT may make humming or buzzing noises of varying frequency during the CT test. This is normal behavior and does not indicate a defective CT.

4.1 Short guide (CT Test mode)

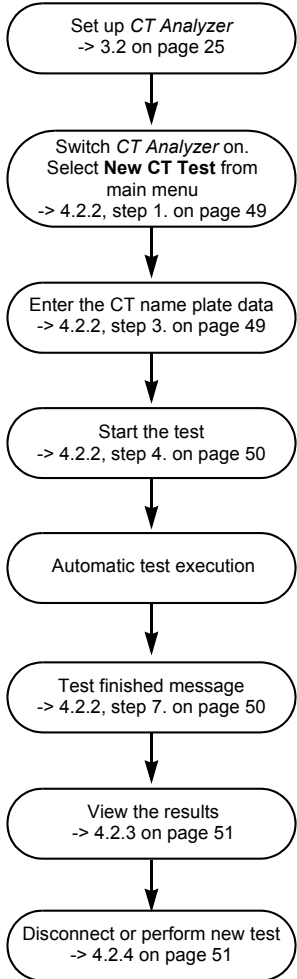


Figure 4-1: Short guide for testing in CT Test mode

4.2 Running a test (CT Test mode)

This section provides a detailed description how to run a CT test in the **CT Test** mode of *CT Analyzer*. Follow the sections 4.2.1 to 4.2.4 in the given order.

4.2.1 Setting up *CT Analyzer*

1. Set up the *CT Analyzer* test set as described in section 3.2 on page 25.

4.2.2 Preparing, configuring and running the test

1. Proceed as follows to display the **CT-Object** card for a new CT test.
 - ▶ If necessary, switch *CT Analyzer* on and wait until the boot process is finished.
 - ▶ Press the **Main** soft key to display the main menu.
 - ▶ In the main menu, select "New CT Test" and press the **OK** soft key to initialize a new CT test.
 - ▶ The display shows the **CT-Object** card, ready to start a test.
2. Connect the CT to *CT Analyzer* as described in chapter 3.
 - ▶ Make sure that the red LED on *CT Analyzer* is off.
 - ▶ Refer to section 3.4.1 on page 27 for detailed information on how to connect *CT Analyzer* for the CT test.
 - ▶ Be sure that the polarity of all wires is correct.
 - ▶ You can display the connection diagram by pressing the **?** key while the focus is set to the **CT-Object** card's tab.

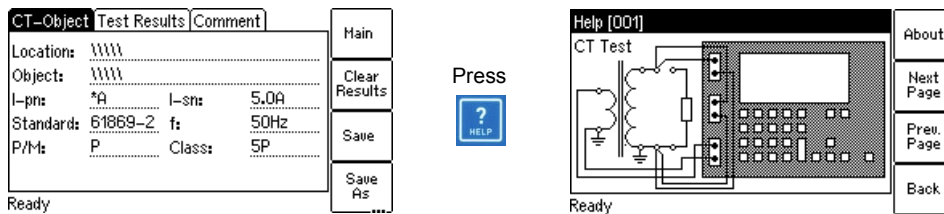


Figure 4-2: Displaying the wiring diagram (CT Test mode)

3. Enter the name plate data of the CT to the **CT-Object** card (see Figure 4-3). Refer to the table below.

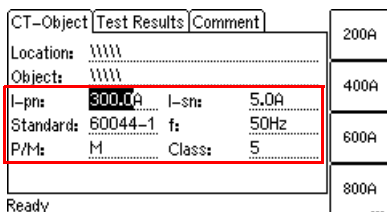



Figure 4-3: **CT-Object** card with name plate data entered

Table 4-1: Name plate data in the **CT-Object** card

Parameter	Description
I-pn	Rated primary current.
I-sn	Rated secondary current.
Standard	Standard according to which the test has to be performed.
f	Rated frequency of the CT.
P/M	CT type. Set "P" for a protection CT or "M" for a metering CT.
Class	Rated accuracy class of the CT.

Refer to table 7-4 on page 83 for detailed information on the parameters.

The parameters I-pn and I-sn are mandatory parameters. Test execution is not possible if no data are specified for such parameters. All other parameters are assigned with default values and have to be adapted accordingly.

4. Start the test by pressing the  key. The red LED flashes to indicate that the CT test is running.
5. *CT Analyzer* performs a wiring check. A corresponding message is displayed if the wiring is not correct. If necessary, correct your wiring and press the **Cont. Test** soft key to execute the CT test.

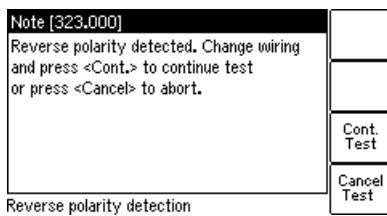


Figure 4-4: Reverse polarity message

6. *CT Analyzer* executes the CT test and measures the winding resistance, the excitation curve and the ratio.
7. "Test finished" message

When the test is over, the red LED stops flashing and the green LED is on. *CT Analyzer* displays a "Test finished" message showing the status of the test execution (see Figure 4-5). Press any key on the keyboard to close this message.

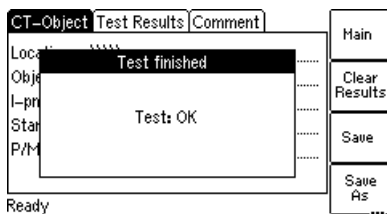


Figure 4-5: **Test finished** message when the test is over

4.2.3 After the test is finished

1. Display the **Test Results** card to view the test results (refer to Figure 4-6). Press **Wdg. Res. Test** to display the details of the winding resistance test and/or press **Excit. Graph** to display the excitation graph (see also 7.3.3 on page 85 and 7.3.4 on page 86).

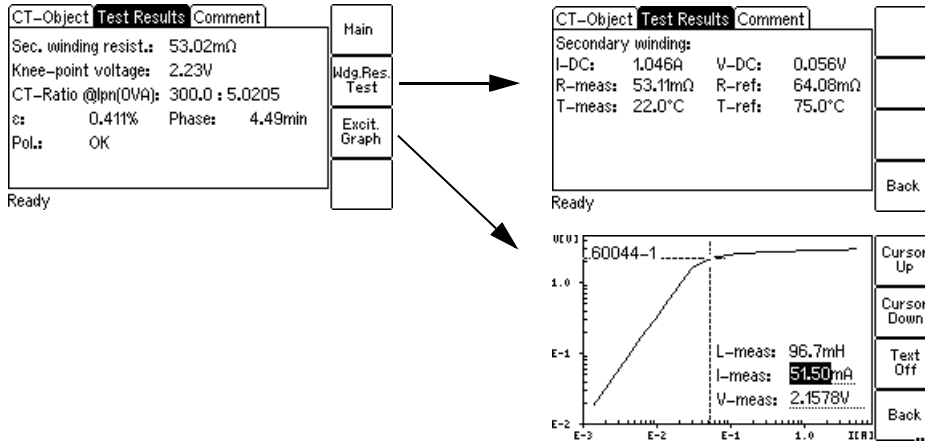


Figure 4-6: **Test Results** card after the test is finished

2. Display the **CT-Object** card and enter the "Location" and "Object" details. Then press **Save** to save your test.

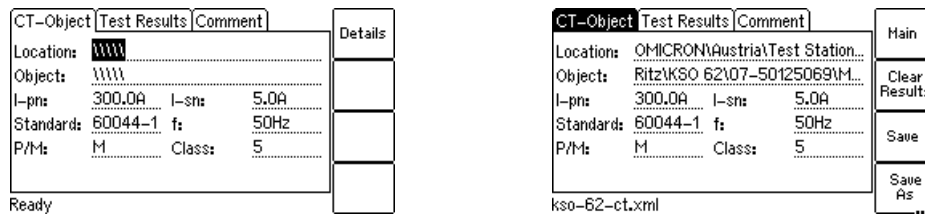


Figure 4-7: **CT-Object** card after the test, ready to enter location details (left) and after saving the test (right)

4.2.4 Disconnection

After the CT test is finished, disconnect the CT under test from *CT Analyzer*.

WARNING



Death or severe injury caused by high voltage or current possible

As long as the red LED on the *CT Analyzer* test set is flashing, the output is active and lethal voltages can occur due to the high energy stored in external inductors.

- ▶ Do not disconnect measurement leads while the red LED on *CT Analyzer* is flashing.
- ▶ Always wait until the red LED is off before disconnecting measurement leads.

1. Wait until the red LED on *CT Analyzer* is off.
2. Disconnect the measurement leads starting at *CT Analyzer*.

5 CT testing in Advanced CT Test mode ("New Advanced CT Test")

When working with *CT Analyzer*, always observe the safety rules given in section 3.1 on page 23 and the safety instructions given in chapter 1 "Safety instructions" on page 9.

WARNING



Death or severe injury caused by high voltage or current possible

As long as the red LED on the *CT Analyzer* test set is flashing, the output is active and lethal voltages can occur due to the high energy stored in external inductors.

- ▶ Do not touch the equipment under test or the measurement leads while the red LED on *CT Analyzer* is flashing.
- ▶ Never connect or disconnect measurement leads while the red LED on *CT Analyzer* is flashing.

WARNING



Death or severe injury caused by high voltage or current possible

Accidentally mixing up primary and secondary windings can cause life-threatening voltages and/or destroy the connected CT or the *CT Analyzer* test set.

- ▶ Always make sure that the *CT Analyzer* output is connected to the correct side of the current transformer according to the wiring instructions given in sections 3.4 to 3.5.

WARNING



Death or severe injury caused by high voltage or current possible

Feeding test voltage to a CT can cause life-threatening voltages on other taps and/or cores of the CT.

- ▶ Do not touch other taps or windings of the CT during the test.
- ▶ Make sure that no other windings of the CT are open.
- ▶ If possible, use the optional *CT SB2* switch box for testing multi-ratio CTs. *CT Analyzer* then automatically reduces the test voltage in a way that the maximum possible voltage within the measurement setup (i.e., the voltage occurring at the tap combination with the highest ratio) is limited to 200V.

Note: The CT may make humming or buzzing noises of varying frequency during the CT test. This is normal behavior and does not indicate a defective CT.

5.1 Short guide (Advanced CT Test mode)

This short guide does not consider residual magnetism measurement (see section 8.4 on page 109).

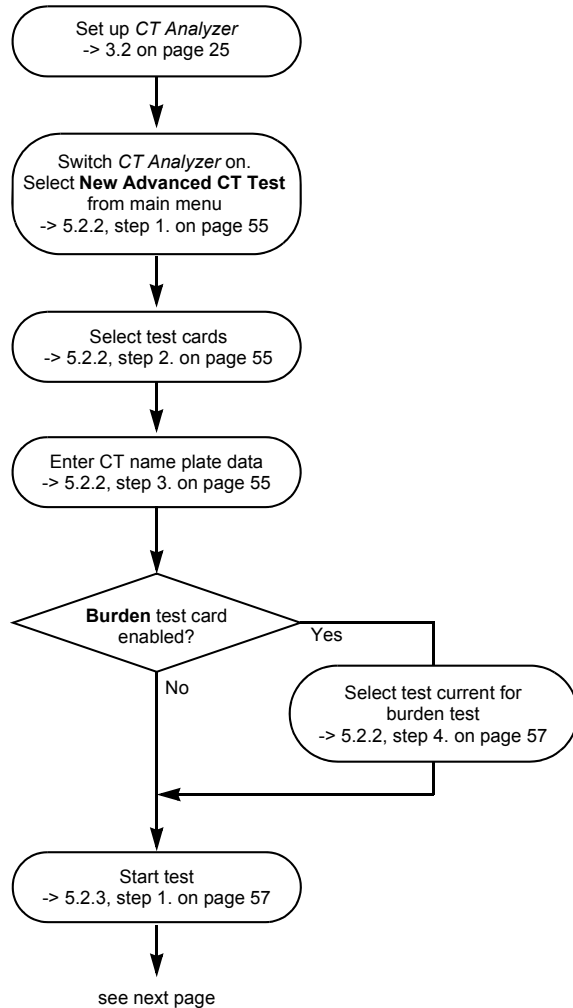


Figure 5-1: Short guide for testing in Advanced CT Test mode (1)

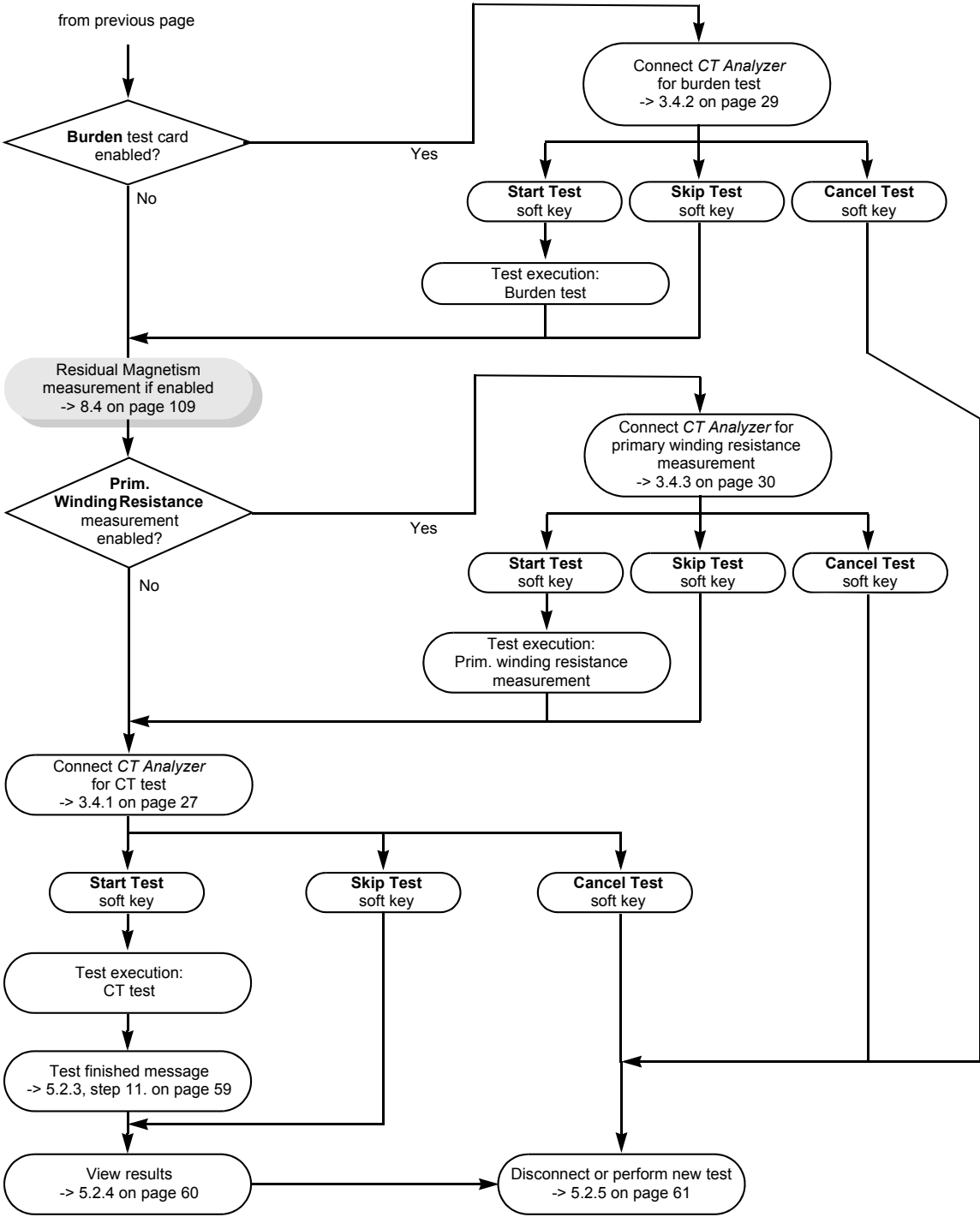


Figure 5-2: Short guide for testing in Advanced CT Test mode (2)

5.2 Running a test (Advanced CT Test mode)

This section provides a detailed description how to run a CT test in the **Advanced CT Test** mode of *CT Analyzer*. Follow the sections 5.2.1 to 5.2.5 in the given order.

The example CT test described below does not use the guesser function, which is an aid for the user to find out single unknown name plate data of a CT, for example if parts of the CT's name plate are unreadable. For detailed information about the guesser function, please refer to chapter 9 on page 138.

5.2.1 Setting up *CT Analyzer*

1. Set up the *CT Analyzer* test set as described in section 3.2 on page 25.

5.2.2 Preparing and configuring the test

1. Proceed as follows to display the **CT-Object** card for a new Advanced CT test.
 - ▶ If necessary, switch *CT Analyzer* on and wait until the boot process is finished.
 - ▶ Press the **Main** soft key to display the main menu.
 - ▶ In the main menu, select "New Advanced CT Test" and press the **OK** soft key to initialize a new Advanced CT test.
 - ▶ The display shows the **CT-Object** card, ready to start a test.
2. For reasons of simplicity, we do not want to perform a residual magnetism measurement in our example CT test described here. Press the **Select Cards** soft key in the **CT-Object** card to open the **Select Cards** page. Check, and if necessary make the following test card selection (see Figure 5-3):

We are using the following test cards in this example: **CT-Object**, **Burden**, **Primary Winding Resistance**, **Secondary Winding Resistance**, **Excitation**, **Ratio** and **Assessment**.

The **Residual Magnetism** test card is not used in this example. Deselect it if necessary.

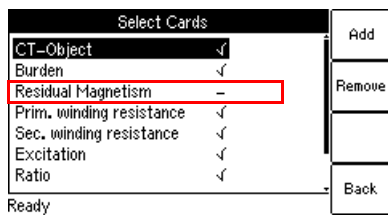


Figure 5-3: **Select Cards** page

When finished, press the **Back** soft key to return to the **CT-Object** card.

3. Enter the CT data listed in the tables below to the **CT-Object** card (see Figure 5-4).

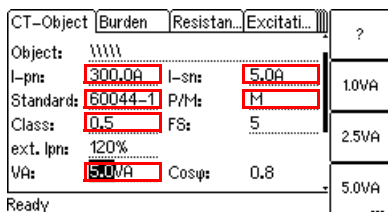


Figure 5-4: **CT-Object** card with name plate data entered

Table 5-1: Name plate data in the **CT-Object** card

Parameter	Description
I-pn	Rated primary current of the CT.
I-sn	Rated secondary current of the CT.
Standard	Standard to be used for the CT test and the test assessment.
P/M	CT type. Set "P" for a protection CT or "M" for a metering CT.
Class	Rated accuracy class of the CT. This field becomes available after selecting the CT type (protection CT or metering CT).
VA	Rated power of the CT. Note: For protection CTs of the IEEE C57.13 classes C, K and T, the VA parameter is not accessible. Enter the rated secondary terminal voltage V_b instead (see also "Specific parameters and settings displayed for IEEE C57.13 protection CTs" on page 105).

Refer to table 8-4 on page 92 for detailed information on the parameters.

Note: Depending on the selected standard and CT type, other or further CT data may be necessary for a correct assessment. If the "Check "*" settings before start" option is enabled in the default test settings (see section 6.8.3 on page 71), all parameters that are required for assessment are marked by a star "*" in the **CT-Object** card. In this case, no automatic assessment will be available if you do not enter data for one or more parameters marked by a star "*" (see section 8.2.3 on page 92).

Table 5-2: Further information to be specified data in the **CT-Object** card

Parameter	Description
Burden / $\cos \varphi$	Burden value and $\cos \varphi$ of the operating burden.
f	Rated frequency of the CT.
Rprim	Specified primary winding resistance (only available if primary winding resistance measurement is enabled for the test).
Class mult. factor	Class multiplying factor. (Can be used to increase the assessment level for the ratio test. Example: Class multiplier 0.5 -> maximum accepted tolerance for the ratio error is only half the standard tolerance).
Delta compensation	Correction factor for ratio measurement if a CT is installed inside a delta winding transformer (see also "Measurement on a Δ (delta) winding transformer" on page 38). "Ratio 1": No correction is required. "Ratio 2/3": If input PRIM is connected to the two terminals of that transformer winding, the CT is in series with. "Ratio 1/3": If input PRIM is connected to the terminals of a transformer winding, the CT is not in series with.

CT testing in Advanced CT Test mode ("New Advanced CT Test")

Table 5-2: Further information to be specified data in the **CT-Object** card

Parameter	Description
LV CT Test Mode	<p>Can be used to change the measuring mode for testing very small CTs with very low knee point voltages.</p> <p>"Toggle Mode": Normal measuring mode of <i>CT Analyzer</i>.</p> <p>"Sinus Mode": Applies sinusoidal test signals with rated frequency to the CT. This is only applicable for CTs with low knee-point voltages.</p>

Refer to table 8-4 on page 92 for detailed information on the parameters.

- If you enabled the **Burden** test card in step 2., display the **Burden** card and specify the test current for the burden measurement. Use the default test current derived from the I_{sn} previously entered in the **CT-Object** card or enter a test current of your choice to the "I-test" parameter.

CT-Object	Burden	Resistance	Excitation	
I-test:	5.0A	I-sn:	5.0A	1.0A
I-meas:	n/a			5.0A
V-meas:	n/a			
Burden:	n/a			
Z:	n/a			

Ready

Figure 5-5: Defining the test current in the **Burden** card

5.2.3 Running the automatic test and connecting *CT Analyzer*

- Start the test by pressing the ◀▶ key. The red LED flashes to indicate that the CT test is running.
- If you enabled the **Burden** test card in section 5.2.2, step 2. on page 55 a message is displayed, asking you to change the wiring for the burden test. Connect the burden as described in chapter 3.
 - ▶ Make sure that the red LED on *CT Analyzer* is off.
 - ▶ Refer to section 3.4.2 on page 29 for detailed information on how to connect *CT Analyzer* for the burden test.
 - ▶ You can display the connection diagram by pressing the ? key while the wiring check message is displayed.

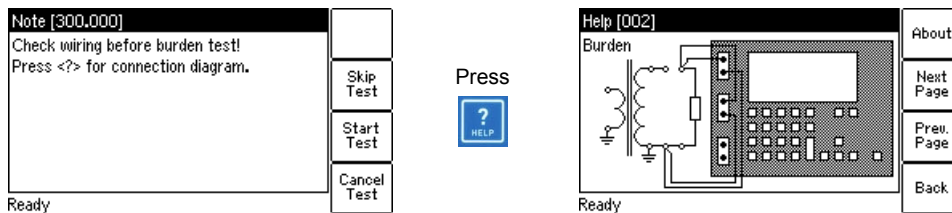


Figure 5-6: Burden test: Wiring check message (left) and wiring diagram (right)

- Press the **Start Test** soft key to execute the automatic burden test.

Note: If you do not want to perform the burden test, press **Skip Test** to skip the burden test and continue with the next test step or **Cancel Test** to abort the complete test.

Note: If the "Continuous burden measurement" option is enabled in the Settings (see section 6.8.3 on page 71), the burden test has to be stopped manually by pressing the ◀▶ key.

4. If you enabled the **Primary Winding Resistance** test card in section 5.2.2, step 2. on page 55, a message is displayed, asking you to change the wiring for the primary winding resistance measurement. Connect the primary winding of the CT as described in chapter 3.
 - ▶ Make sure that the red LED on *CT Analyzer* is off.
 - ▶ Refer to section 3.4.3 on page 30 for detailed information on how to connect *CT Analyzer* for the primary resistance measurement.
 - ▶ You can display the connection diagram by pressing the **?** key while the wiring check message is displayed.

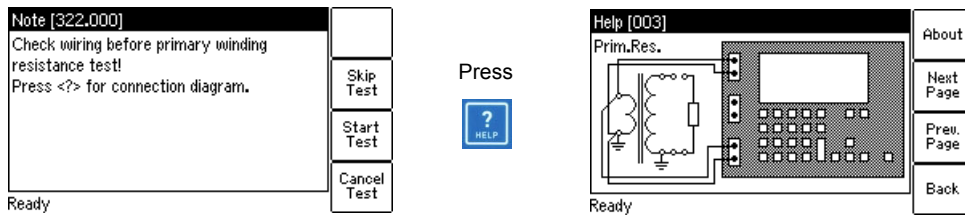


Figure 5-7: Primary winding resistance measurement: Wiring check message (left) and wiring diagram (right)

5. Press the **Start Test** soft key to execute the automatic primary winding resistance measurement.

Note: If you do not want to perform the primary winding resistance measurement, press **Skip Test** to skip the primary winding resistance measurement and continue with the CT test or **Cancel Test** to abort the complete test.

WARNING



Death or severe injury caused by high voltage or current possible

The primary winding resistance measurement is performed with DC current.

- ▶ Do not open the measurement circuit while current is flowing.
- ▶ Stop the measurement by pressing the **◀▶** key on *CT Analyzer* and wait until the red LED is off before opening the measurement circuit.

6. A message is displayed asking you to change the wiring for the Advanced CT test. Connect the CT to *CT Analyzer* as described in chapter 3.
 - ▶ Make sure that the red LED on *CT Analyzer* is off.
 - ▶ Refer to section 3.4.1 on page 27 for detailed information on how to connect *CT Analyzer* for the CT test.
 - ▶ Be sure that the polarity of all wires is correct.
 - ▶ You can display the connection diagram by pressing the **?** key while the wiring check message is displayed.

Note: If you do not want to execute the CT test, press the **Skip Test** soft key instead of changing the wiring. This will skip the CT test and immediately perform the demagnetization cycle to finish the test.

CT testing in Advanced CT Test mode ("New Advanced CT Test")

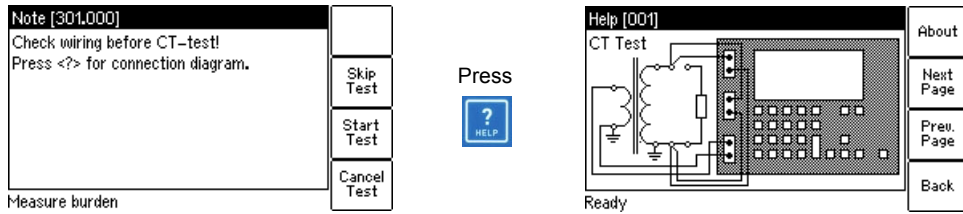


Figure 5-8: CT test: Wiring check message (left) and wiring diagram (right)

7. Press the **Start Test** soft key to execute the automatic CT test.

Note: If you do not want to perform the CT test, press **Skip Test** to skip the CT test or **Cancel Test** to abort the complete test.

8. Automatic test step 1: CT resistance measurement

CT Analyzer measures the secondary winding resistance of the CT.

9. Automatic test step 2: Determination of the excitation characteristic

CT Analyzer measures the excitation curve and determines the knee point and other important CT data.

10. Automatic test step 3: Ratio measurement

CT Analyzer then measures the current ratio error, the phase error, the composite error and the polarity. *CT Analyzer* calculates the ratio error for the operating burden and the nominal burden.

11. "Test finished" message

When the test is over, the red LED stops flashing and the green LED is on.

CT Analyzer displays a "Test finished" message showing the status of the test execution and the overall test assessment (see Figure 5-9).

Press any key on the keyboard to close this message.

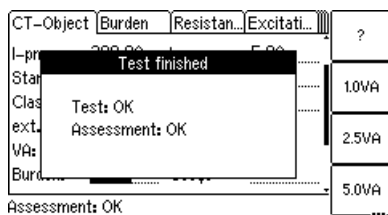


Figure 5-9: **Test finished** message when the test is over

Note: The test results and settings of each test started on *CT Analyzer* and finished with the "Test ok" status are automatically stored to the file **OMICRON\AutoSave\CTAnalyzer.xml** on the Compact Flash card. The existing **CTAnalyzer.xml** file is overwritten with each successful test. Tests that could not be finished successfully or that were aborted by the user are not stored and thus do not overwrite the existing **CTAnalyzer.xml** file. Tests executed from the *CT Analyzer Suite* software are not saved automatically on *CT Analyzer* and therefore do not overwrite the **CTAnalyzer.xml** file.

5.2.4 After the test is finished

After the test is finished, the **CT-Object** card displays the CT data determined during the test (refer to Figure 5-10).

CT-Object	Burden	Resistan...	Excitati...	?
Standard:	60044-1	P/M:	M	
Class:	0,5	FS:	5	1.0VA
ext. I _{pn} :	120%			
VA:	5.0VA	Cosφ:	0.8	2.5VA
Burden:	29.44VA	Cosφ:	1.0	5.0VA
		R _{prim} :	0,0104Ω	
Ready				

Figure 5-10: **CT-Object** card after the test is finished

Now, you can enter the "Location" and "Object" details and save the test (use the cursor keys to scroll within the card and select edit fields).

CT-Object	Burden	Resistan...	Excitati...	Details
Location:	WWW			
Object:	WWW			
I _{pn} :	300.0A	I _{sn} :	5.0A	
Standard:	60044-1	P/M:	M	
Class:	0,5	FS:	5	
ext. I _{pn} :	120%			
Ready				

CT-Object	Burden	Resistan...	Excitati...	Main
Location:	OMICRONAustriaTest\Testfe...			
Object:	Ritz\KSO 62107-50125069\...			Clear Results
I _{pn} :	300.0A	I _{sn} :	5.0A	
Standard:	60044-1	P/M:	M	Save
Class:	0,5	FS:	5	
ext. I _{pn} :	120%			Save As
Ritz_07-50125069.xml				

Figure 5-11: **CT-Object** card after the test, ready to enter location details (left) and after saving the test (right)

The assessment of the individual parameters can be viewed on the **Assessment** card (Figure 5-12).

Resista...	Excitati...	Ratio	Assessment	Main
Standard:	60044-1	Class:	0,5	
Parameter		Auto	Manual	Show failed & n/a only
Class		OK	?	
c		OK	?	
Δφ		OK	?	
FS		OK	?	
Ritz_07-50125069.xml				

Figure 5-12: **Assessment** card after the test is finished

If desired, you can view the individual measurement results acquired during the test by viewing the **Burden**, **Resistance**, **Excitation** and **Ratio** cards, as shown in the following figures 5-13 to 5-16.

CT-Object	Burden	Resistance	Excitation	Main
I _{test} :	5.0A	I _{sn} :	5.0A	
I _{meas} :	4.963A		0.00°	
V _{meas} :	5.844V		0.18°	
Burden:	29.44VA	Cosφ:	1.000	
Z:	1.178Ω			
Ritz_07-50125069.xml				

Figure 5-13: **Burden** card with measurement results after the test is finished

CT testing in Advanced CT Test mode ("New Advanced CT Test")

Burden	Resistance	Excitati...	Ratio	Main
Primary winding:				
I-DC:	10.003A	V-DC:	0.086V	
R-meas:	8.588mΩ	R-ref:	10.38mΩ	
Secondary winding:				
I-DC:	1.050A	V-DC:	0.054V	
R-meas:	51.68mΩ	R-ref:	62.36mΩ	
T-meas:	22.0°C	T-ref:	75.0°C	
Ritz_07-50125069.xml				

Figure 5-14: **Resistance** card with measurement results after the test is finished

Burden	Resistan...	Excitation	Ratio	Main
Standard:	60044-1	Class:	0.5	
VA:	5.00VA	Cosφ:	0.800	Results with Op. Burden
V-kn:	2.23V	I-kn:	49.57mA	Excit. Graph
FS:	2.39	FSi:	2.32	AL Error Graph
Ls:	50.7μH	Lm:	169.1mH	
Ts:	0.7606s	Kr:	88%	
ε _t :	>35.99% (@FS = 5)			
Ritz_07-50125069.xml				

Figure 5-15: **Excitation** card with measurement results after the test is finished

Burden	Resistance	Excitation	Ratio	Main
Standard:	60044-1	Class:	0.5	
VA:	5.00VA	Cosφ:	0.800	Results with Op. Burden
Ratio:	300.0 : 5.0052		0.105%	Ratio Table
Pol.:	OK	ε _c :	0.300%	Phase Table
Phase:	9.70min			
N:	59.70			
I-p:	300.0A			
Ritz_07-50125069.xml				

Figure 5-16: Ratio error and phase displacement at operating burden after the test is finished

5.2.5 Disconnection

After the Advanced CT test is finished, disconnect the CT under test from *CT Analyzer*.

WARNING



Death or severe injury caused by high voltage or current possible

As long as the red LED on the *CT Analyzer* test set is flashing, the output is active and lethal voltages can occur due to the high energy stored in external inductors.



- ▶ Do not disconnect measurement leads while the red LED on *CT Analyzer* is flashing.
- ▶ Always wait until the red LED is off before disconnecting measurement leads.

1. Wait until the red LED on *CT Analyzer* is off.
2. Disconnect the measurement leads starting at *CT Analyzer*.

6 Operating and configuring CT Analyzer

6.1 Working in the user interface

6.1.1 Displaying a specific card

To display a specific card, select the card by pressing the card selection keys  .

The card's tab showing the name of the selected card is then highlighted (see Figure 6-1).

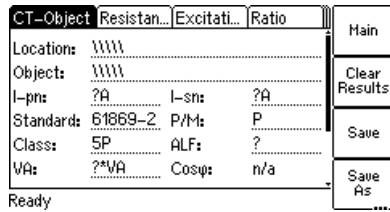



Figure 6-1: CT-Object card selected

6.1.2 Using the soft keys

Using the soft keys you can operate *CT Analyzer* and change the user interface level of the software.

The functionality of the soft keys is context-dependent, i.e., the software offers different functions or selectable sets of parameters depending on the focus (i.e., depending on which card or field is highlighted or selected in the user interface).

If the lowermost soft key description field contains 3 points (see **Save As** in Figure 6-1), additional soft key functions are available. Then you can switch the set of displayed soft keys using the  key located below the soft keys (see Figure 6-2).

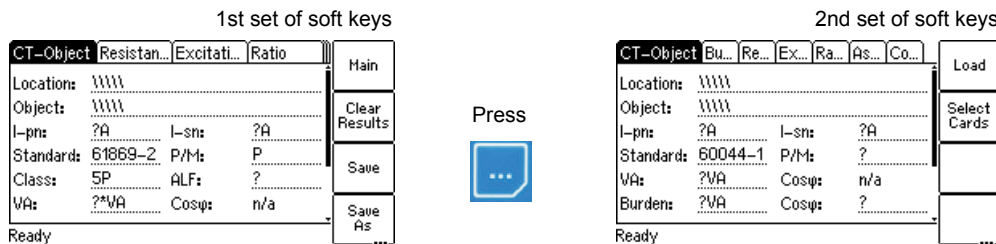



Figure 6-2: Switching the set of soft keys in the CT-Object card

6.1.3 Editing a card

To open the edit mode for a displayed card, press the  cursor key. The card's tab is then no longer highlighted (see Figure 6-3). Use the cursor keys to move the cursor and to select the desired edit field. Some edit fields have soft keys assigned. The soft keys available for an edit field are displayed if the field is selected.

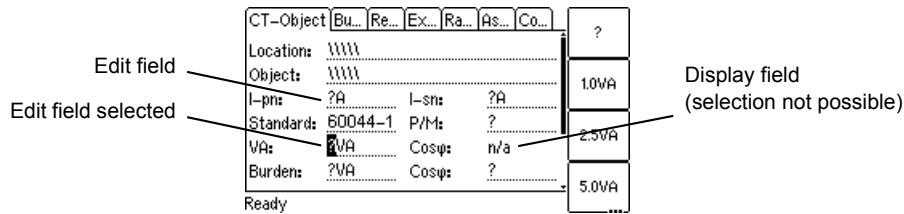








Figure 6-3: Edit field selected in the **CT-Object** card

Proceed as follows to edit a card:

1. Select the edit field using the cursor keys.
2. Enter or edit the value or text:
 - ▶ Select an entry offered by the soft keys (if available)
 - ▶ or enter the value or text using the keyboard and then press the  key to confirm your input or use the  key to leave an edit field without applying and saving the entry.
3. Leave the edit mode either by moving the cursor to the card's tab using the  cursor key or by pressing the  key. The focus is then set to the card's tab again (tab highlighted).

6.2 The main menu

The main menu can be opened from any test card by pressing the **Main** soft key. The items in the list can be selected using the   cursor keys. When an item is selected (highlighted), the soft keys are labeled with the functions available for this specific item.

How to get there:
Press the **Main** soft key in any test card
-> **Main Menu**

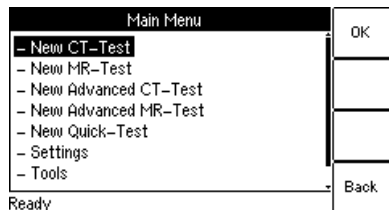
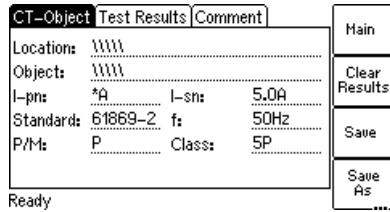


Figure 6-4: **Main Menu** page

6.3 New CT-Test

By selecting "New CT-Test" in the main menu and then pressing the **OK** soft key, a new CT test is displayed in the **CT-Object** card.



How to get there:
 Press the **Main** soft key in any test card
Main Menu:
 - New CT-Test
OK soft key
 -> **CT-Object** card

Figure 6-5: **CT-Object** card with default test settings after initializing a new CT test

For more detailed information about the parameters and fields in the **CT-Object** card of the CT Test mode, please refer to section 7.2 on page 81.

6.4 New MR-Test

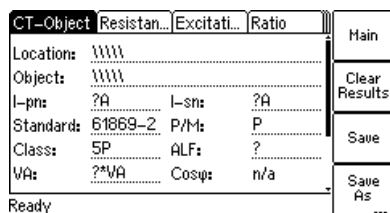
Using the "New MR-Test" option in the main menu you can initialize a new multi-ratio CT test using the optional *CT SB2* switch box.

This option is only available if you have purchased a corresponding license. For more detailed information about multi-ratio CT testing using the *CT SB2* switch box, please refer to the CT SB2 User Manual.

How to get there:
 Press the **Main** soft key in any test card
Main Menu:
 - New MR-Test
OK soft key
 -> **CT-Object** card

6.5 New Advanced CT-Test

By selecting "New Advanced CT-Test" in the main menu and then pressing the **OK** soft key, a new Advanced CT test with the default parameter settings is loaded and displayed in the **CT-Object** card. Some of the default values can be defined in the default test settings (see section 6.8 on page 66).



How to get there:
 Press the **Main** soft key in any test card
Main Menu:
 - New Advanced CT-Test
OK soft key
 -> **CT-Object** card

Figure 6-6: **CT-Object** card with default test settings after initializing a new Advanced CT test

This option is only available if you have purchased a corresponding license. For more detailed information about the parameters and fields in the **CT-Object** card of the Advanced CT Test mode, please refer to section 8.2 on page 90.

6.6 New Advanced MR-Test

Using the "New Advanced MR-Test" option in the main menu you can initialize a new advanced multi-ratio CT test using the optional *CT SB2* switch box.

This option is only available if you have purchased a corresponding license. For more detailed information about advanced multi-ratio CT tests using the *CT SB2* switch box, please refer to the CT SB2 User Manual.

How to get there:

Press the **Main** soft key in any test card

Main Menu:
- **New Advanced MR-Test**

OK soft key

-> **CT-Object** card

6.7 New Quick-Test

Using the "New Quick-Test" option in the main menu you can open the optional *Quick Test* feature. With this feature you can use *CT Analyzer* as a multimeter or perform polarity checks using the *CPOL2* polarity checker.

This option is only available if you have purchased a corresponding license. For more detailed information about *Quick Test*, please refer to chapter 10 on page 142.

How to get there:

Press the **Main** soft key in any test card

Main Menu:
- **New Quick-Test**

OK soft key

-> **CT-Quick** card

6.8 Settings

In the **Setting Menu** page you can access the device settings and the default settings for new CT tests. Select an entry using the ▲ ▼ cursor keys and then press the **Select** soft key to open the corresponding settings page.

How to get there:
 Press the **Main** soft key in any test card
Main Menu:
 - **Settings**
Select soft key
 -> **Setting Menu** page

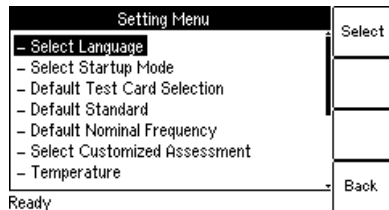


Figure 6-7: **Setting Menu** page

6.8.1 Available options in the Setting Menu page

Table 6-1: Setting Menu options

Option	Description
Select Language	Selection of the user interface language. One user language can be installed on <i>CT Analyzer</i> . The English user interface is part of the firmware and therefore always available. The second language can be installed by the user as required (refer to section 6.9 on page 73).
Select Startup Mode	Using this option you can select the default test mode <i>CT Analyzer</i> comes up each time when it is switched on. Test at Startup: Select the default test mode using the soft keys CT Test , Adv. CT Test or Quick . Mode at Startup: Select the default test mode using the soft keys Single Ratio or Multi-Ratio . More detailed information: → CT Test mode, see chapter 7 on page 80. → Advanced CT Test mode, see chapter 8 on page 89. → <i>Quick Test</i> measurement function, see chapter 10 on page 142 → Multi-ratio testing with <i>CT SB2</i> switch box, see <i>CT SB2 User Manual</i> .
Default Test Card Selection	Select the test cards a new Advanced CT test should contain by default. Please refer to section 6.8.2 on page 70.

Table 6-1: Setting Menu options (continued)

Option	Description
Default Standard	<p>Select the default I_{sn}, standard, class and CT type (P/M) setting to be used for a new CT test using the soft keys.</p> <p>"Isn": Select the default secondary current (1A or 5A, or ? if you want to use the guesser function by default).</p> <p>"Standard": Select IEC 61869-2, IEC 60044-1, IEC 60044-6 or IEEE C57.13, or CUSTOM to load a customized assessment rule file (see "Select Customized Assessment" on page 68; the guesser function is not available if you use a customized assessment configuration instead of a standard).</p> <p>"P/M": Select Prot. CT or Meter. CT (protection or metering CT), or ? if you want to use the guesser function by default.</p> <p>"Class": The classes available for selection depend on the selected standard and CT type (P/M). Select a class or ? if you want to use the guesser function by default.</p> <p>"Ktd" (IEC 60044-6 only): If IEC 60044-6 is selected for the standard, it is furthermore possible to select the calculation method for the K_{td} (transient dimensioning factor): acc. to IEC 60044-6: K_{td} is calculated exactly according to the standard. acc. to OMICRON: K_{td} calculation considers the CT remanence. acc. to GB 16847: K_{td} is calculated acc. to the Chinese standard GB16847.</p> <p>"TPX/Y/Z Spec. Mtd." (IEC 61869-2 protection CTs only): For IEC 61869-2 protection CTs of the classes TPX, TPY and TPY it is possible to select the default method for specifying the protection requirements used for the accuracy class assessment (refer to page 101 for more information). by Duty: Protection requirements specification by duty cycle and the necessary time constants (standard specification according to IEC 61869-2; <i>CT Analyzer</i> then calculates the K_{td} automatically from the entered values). by Ktd: Protection requirements specification by the rated transient dimensioning factor K_{td} stated on the CT's name plate (alternative specification according to IEC 61869-2).</p>
Default Nominal Frequency	<p>Nominal frequency to be used for a new Advanced CT test: 16.7Hz, 50Hz, 60Hz or 400Hz.</p>

Table 6-1: Setting Menu options (continued)

Option	Description
Select Customized Assessment	<p><i>CT Analyzer</i> offers the possibility to customize the automatic test assessment of the Advanced CT Test mode according to your needs by applying your own assessment rules (so-called customized assessment configurations) instead of the predefined assessment rules based on the class definitions stated in the IEC and IEEE standards.</p> <p>You can create such customized assessment rules in <i>CT Analyzer Suite</i> and then send them to your <i>CT Analyzer</i> test set (Save as -> Send to CT Analyzer). <i>CT Analyzer Suite</i> by default stores such customized assessment rules (*.car files) to the OMICRON/CAR folder on the Compact Flash card of <i>CT Analyzer</i>.</p> <p>Press the Select File soft key to select a customized assessment rule file stored on the Compact Flash card of your <i>CT Analyzer</i>. The customized assessment rule selected is offered for selection in the Standard field of the CT-Object card.</p> <p>Use the Disable soft key to clear your selection.</p> <p>Note: The guesser function is not available if you use a customized assessment configuration instead of a standard.</p>
Temperature	<p>Select the temperature unit (°C or °F) and the default values for the ambient temperature and the reference temperature (for winding resistance measurement and calculation).</p>
Date/Time	<p>Clock settings for the device-internal clock. Select a field using the cursor keys, enter the value, and press Set to apply your changes.</p>
Display Contrast	<p>Display contrast adjustment.</p>
Accur. Limiting Error Graph	<p>Enable or disable the accuracy limiting error graph.</p> <p>This graph is primarily required for Chinese standards. It shows the maximum possible primary current ($K * I_{pn}$) that can flow over a specific burden without exceeding the accuracy limit (5% or 10%).</p>
Start Delay	<p>Allows the definition of a delay time of up to 10s for the actual test start after pressing the start button.</p> <p>You can apply the defined delay for the burden test, the residual magnetism measurement, the primary winding resistance measurement and the secondary winding resistance measurement.</p>

Table 6-1: Setting Menu options (continued)

Option	Description
Rated Burden Constraints	<p>Two options are available:</p> <p><u>"Enable rated burdens < 1 VA":</u> Enable or disable the use of nominal burdens smaller than 1 VA. If enabled, it is possible to select a nominal burden smaller than 1 VA in the CT-Object card ("VA" parameter) of the Advanced CT Test mode. If disabled, the nominal burden is automatically set to 1 VA if you try to enter a smaller burden value.</p> <p><u>"Min. VA at M cores Isn 5A":</u> Applies to IEC 60044-1 metering CTs with $I_{sn} = 5A$ only!</p> <p>Here you can set the minimum VA value used for the CT assessment to 3.75VA. This means, selecting the 3.75VA soft key will cause <i>CT Analyzer</i> to assess the CT only up to a lower nominal burden limit of 3.75VA instead of 1 VA. When 3.75VA is active, it is not possible to enter VA values lower than 3.75VA in the CT-Object card of the Advanced CT Test mode.</p> <p>Selecting 0VA deactivates this option. Assessment is then performed up to a lower burden value of 1 VA. This is the factory default which is suitable for most cases. You should not change it without important reason.</p>
Remote interface ¹	<p>If your <i>CT Analyzer</i> is equipped with a USB interface and a RS232 interface, use this option to display the Select remote interface port page. On this page you can select the interface used to connect <i>CT Analyzer</i> to a PC: USB or RS232.</p> <p>If equipped with both interfaces, <i>CT Analyzer</i> will only communicate via the selected interface. It will not be recognized by the computer if <i>CT Analyzer</i> settings do not match the interface used for connection.</p>
Misc. Settings	<p>Use the Miscellaneous Settings page to</p> <ul style="list-style-type: none"> ▶ enable or disable automatic test assessment if a parameter marked with a star "*" in the CT-Object card was not entered by the user prior to the test. Parameters marked with a star are mandatory parameters that are required for assessment (and possibly for the calculation of further parameters). ▶ enable or disable continuous burden measurement. ▶ define the default value of the class multiplication factor. ▶ select the default measuring mode used by <i>CT Analyzer</i> (Toggle mode or Sinus mode; Sinus mode may be indicated for testing very small CTs with very low knee point voltages). ▶ define the thresholds for the decision algorithms of the guesser function (1 A/5 A, P/M decision). <p>These settings are only relevant for the Advanced CT Test mode. Please refer to section 6.8.3 on page 71 for more information.</p>

1. Only available for *CT Analyzer* devices that are equipped with a USB interface (serial number JHxxxx or newer).

6.8.2 Default test card selection

Enabling or disabling test cards for the **default Advanced CT test** is done using the **Default Test Card Selection** option from the **Setting Menu**. In this case, the test card selection made in this page becomes effective when starting a new Advanced CT test.

If you want to enable or disable **test cards for your currently active test** only, press the **Select Cards** soft key in the **CT-Object** card. In this case, the test card selection made in this page is immediately effective after pressing the **Back** soft key.

To enable or disable a test card, select its entry using the **▲ ▼** cursor keys and then press the **Add** or **Remove** soft key. Enabled cards are marked with a check mark, see Figure 6-8.

How to get there:
 Press the **Main** soft key in any test card
Main Menu:
 - Settings
Select soft key
Setting Menu:
 - Default Test Card Selection
Select soft key
 -> **Select Cards** page

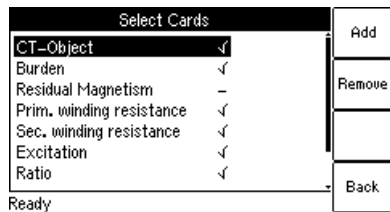


Figure 6-8: **Select Cards** page for selecting the default test cards

Some cards require the existence of other cards. This means that if you are adding such a card, the required other cards are automatically added, too. On the other hand, if you remove a card which is required by another card, the other card is removed, too. Figure 6-9 shows these dependencies.

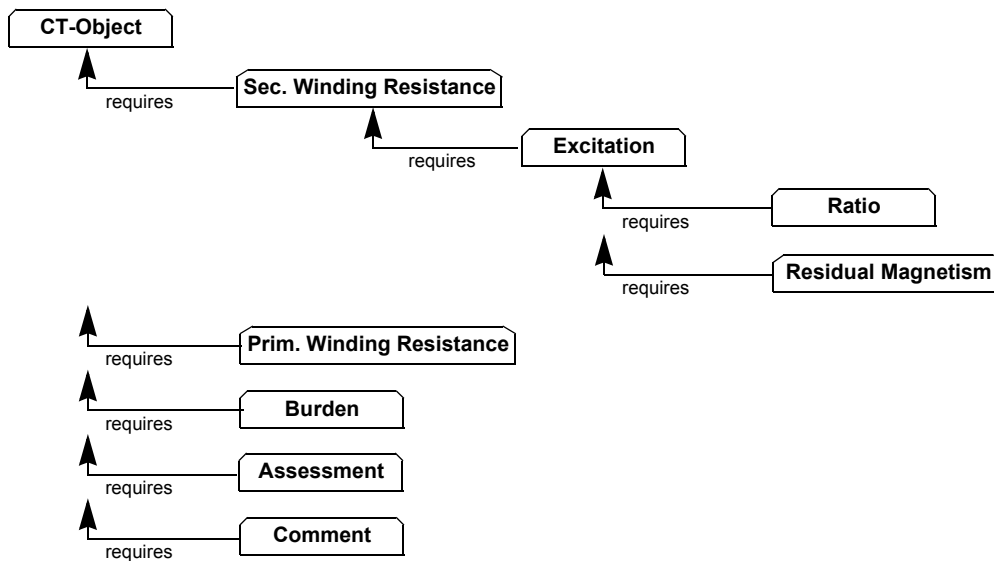
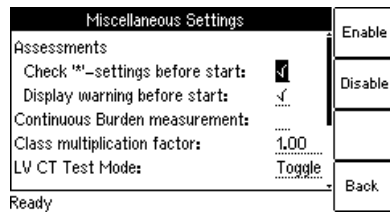


Figure 6-9: Dependencies of test cards

Press the **Back** soft key to save your selection and to return to the setting menu. Press the **ESC** key to return to the setting menu without saving the selection.

6.8.3 Miscellaneous settings



How to get there:
 Press the **Main** soft key in any test card
Main Menu:
 - **Settings**
Select soft key
Setting Menu:
 - **Misc. Settings**
Select soft key
 -> **Miscellaneous Settings** page

Figure 6-10: Miscellaneous Settings page

The following values can be defined in the **Miscellaneous Settings** page. These settings are only relevant for the Advanced CT Test mode.

Table 6-2: Miscellaneous Settings options


Option	Description
Assessments Check "*" settings before start Display warning before start	<p>Depending on the selected standard and CT type, some parameters and data (for example, the nominal burden) are required to obtain reliable assessment of the CT. If the user does not specify these data prior to the test, the automatic assessment function of <i>CT Analyzer</i> possibly performs the assessment based on the actual values determined for the CT during the test and not based on the CT's nominal data stated on the name plate.</p> <p><u>"Check "*" settings before start"</u></p> <p>If this option is enabled, <i>CT Analyzer</i> checks whether the user has entered all necessary values and data relevant for an automatic assessment prior to the test start. The respective parameters are then marked by a star ("*") in the CT-Object card. If the user did not enter data for one or more of these mandatory parameters, no automatic assessment is performed and <i>CT Analyzer</i> displays an "Assessment not available" message after the test is finished.</p> <p>This option can be used to avoid an automatic assessment if the user did not enter all required parameters and CT data prior to the test.</p> <p><u>"Display warning before start"</u></p> <p>This option is only relevant if the "Check "*" settings before start" option is enabled. It is enabled automatically when enabling the "Check "*" settings before start" option but can be disabled manually.</p> <p>Enabling the "Display warning before start" option displays a corresponding warning message prior to the test start if the user did not enter data for one or more of the mandatory parameters that are required for assessment.</p>
Continuous burden measurement	<p><i>CT Analyzer</i> normally stops the burden test automatically as soon as it obtains stable measurement values for the connected burden.</p> <p>If this option is enabled, the burden measurement is not stopped automatically but instead performed continuously until the user stops it manually by pressing the  key.</p>

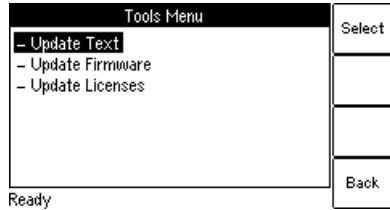
Table 6-2: Miscellaneous Settings options (continued)

Option	Description
Class multiplication factor	<p>The default value for the class multiplying factor can be set. This default is used when <i>CT Analyzer</i> is switched on or if a new CT test is selected in the main menu.</p> <p>The class multiplying factor increases the assessment level for the ratio test. For example, a class multiplier of 0.5 means that the maximum accepted tolerance for the ratio error is only half the standard tolerance.</p> <p>Possible values: 0.25 to 1.00. Default: 1.00</p>
LV CT Test Mode	<p>Use the soft keys to define the default measuring mode of <i>CT Analyzer</i>.</p> <p>Toggle Mode: Normal measuring mode of <i>CT Analyzer</i>. Applies test signals of different magnitudes and frequencies to the CT in order to measure the excitation characteristic.</p> <p>Sinus Mode: Applies sinusoidal test signals with rated frequency to the CT in order to measure the excitation characteristic. The Sinus measuring mode may be indicated for testing very small CTs with very low knee point voltages.</p>
Decision 1A/5A CT	<p>If the guesser function is active, the device uses the measured winding resistance to decide whether the CT is a 1A or 5A CT. This value specifies the decision threshold.</p> <p>Possible values: 0.5 to 2Ω. Default: 1Ω.</p> <p>If the measured winding resistance is higher than the defined value, the guesser function decides that the CT's nominal secondary current is 1A. Otherwise the secondary current is 5A.</p>
Decision P/M CT	<p>If the guesser function is active, the device uses the measured knee point voltage to decide whether the measured CT is a protection CT or a metering CT. This value specifies the decision threshold.</p> <p>If the knee point voltage is higher than the defined value, the guesser function decides that the measured CT is a protection CT. Otherwise it is a metering CT.</p> <ul style="list-style-type: none"> • "1A: Prot. CT, if V-kn >" Possible values: 50 to 300V. Default: 100V. • "5A: Prot. CT, if V-kn >" Possible values: 15 to 60V. Default: 20V.

The **Reset Values** soft key resets all values to their default values.

6.9 Tools (update functions)

From the **Tools Menu** page you can access the update functions of *CT Analyzer*.



How to get there:
 Press the **Main** soft key in any test card
Main Menu:
 - **Tools**
Select soft key
 -> **Tools Menu** page

Figure 6-11: **Tools Menu** page

6.9.1 Available options

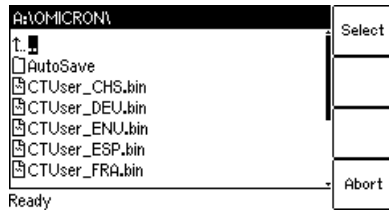
Table 6-3: Tools Menu options

Option	Description
Update Text	<p>Using this item you can install a new user interface language file.</p> <p>The file system page opened after selecting Update Text only displays files named CTUser_*.bin.</p> <p>Please refer to section 6.9.2 on page 74.</p>
Update Firmware	<p>Using this item you can update the firmware of your <i>CT Analyzer</i>.</p> <p>The file system page opened after selecting Update Firmware only displays files named CTAnalyzer.bin.</p> <p>Please refer to section 6.9.3 on page 75.</p>
Update Licenses	<p>This function allows to add additional licenses to your <i>CT Analyzer</i>.</p> <div> </div> <p>Using the Update License soft key you can read a license file from the Compact Flash card.</p> <p>Using the New License soft key you can add new licenses manually.</p> <p>For information on how to receive new licenses or a new license key for additional functions, please contact your local OMICRON distributor or the OMICRON support.</p>

6.9.2 Update text

Note: Instead of using the **Update Text** function of *CT Analyzer* you can also use the *Device Update* function of the *CT Analyzer Suite* software. For detailed information, please refer to the *CT Analyzer Suite* help.

Using this function you can install a new user interface language file. The new language installed is then available for selection in the **Language** page.



How to get there:
Press the **Main** soft key in any test card
Main Menu:
- Tools
Select soft key
Tools Menu:
- Update Text
-> File system card

Figure 6-12: File system card for selecting a new language file

To install a new language, select the corresponding file **CTUser_xxx.bin** in the **A:\OMICRON** directory on the Compact Flash card using the **▲ ▼** cursor keys and press the **Select** soft key.

English is contained in the firmware and does not require a user language file.

NOTICE

Equipment damage or loss of data possible

- ▶ Do not install a language file that does not belong to the same package as the installed firmware version. The user interface may become unreadable.
- ▶ Only install language files that are included in the package of the installed firmware version.

Refer to the OMICRON website for available languages or ask your distributor for a special language file.

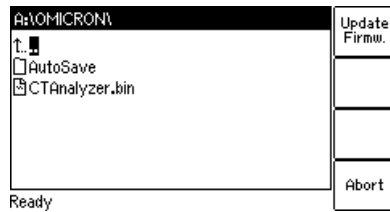
If the text update process is interrupted or fails, the device displays an error message and automatically resets the user interface to English when it is switched on the next time.

Press **Abort** to return to the **Tools Menu** page without installing a new language.

6.9.3 Update firmware

Note: Instead of using the **Update Firmware** function of the *CT Analyzer* you can also use the *Device Update* function of the *CT Analyzer Suite* software. For detailed information, please refer to the *CT Analyzer Suite* help.

Using this function you can install new device firmware.



How to get there:
 Press the **Main** soft key in any test card
Main Menu:
 - Tools
Select soft key
Tools Menu:
 - Update Firmware
 -> File system card

Figure 6-13: File system card for selecting a new firmware file

To perform a firmware update, a corresponding firmware file **CTAnalyzer.bin** has to be available in the **A:\OMICRON** directory on the Compact Flash card.



To update the firmware, select the desired firmware file **CTAnalyzer.bin** using the **▲ ▼** cursor keys and press the **Update Firmw.** soft key.

Note: The firmware update process may take some minutes. If the update process is interrupted or fails, switch the *CT Analyzer* test set off and on again. The device then tries to perform the firmware update again automatically.

Note:
 It is also possible to install older firmware. In this case, the user interface text is deleted and the device automatically changes to the English user interface. After you have downgraded the firmware, you also have to install the user interface language file of this (older) firmware package.
 After the installation of new firmware, the user interface language automatically changes to English if the installed user interface text is no longer compatible. If you are using a user interface language other than English, install the corresponding new user interface language file delivered with the new firmware.

Press **Abort** to return to the **Tools Menu** page without updating the firmware.

6.10 File handling

In the **File Menu** page you can access all available file operation functions by selecting the entry using the   cursor keys and then pressing the **Select** soft key.

How to get there:
 Press the **Main** soft key in any test card
Main Menu:
 - **File Handling**
Select soft key
 -> **File Menu** page

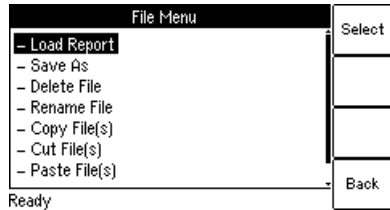





Figure 6-14: **File Menu** page

6.10.1 Available functions

Table 6-4: File handling functions

Function	Description
Load Report	Loading an existing report or settings file from the Compact Flash card. You can also load a file by pressing the Load soft key in the CT-Object card.
Save As	Saving the current file to the Compact Flash card. Saving a file is described in detail on page 78.
Delete File	Deleting a selected file or folder from the Compact Flash card. Only empty folders can be deleted. If you try to delete a folder still containing files or subfolders, an error message is displayed. To select several neighboring files at a time, keep the  key pressed while selecting the files or folders using the   cursor keys.
Rename File	Renaming a selected file on the Compact Flash card. Only files can be renamed. Renaming of folders is not possible on the <i>CT Analyzer</i> .
Copy / Cut / Paste File(s)	Copying or cutting a file on the Compact Flash card and pasting it at another location on the Compact Flash card. Copying/cutting and pasting a file is described in detail on page 78.
Format CF card	Formatting the Compact Flash card. All data on the Compact Flash card will be lost!

Note: In the *CT Analyzer* file system, the root directory can contain a maximum of 240 files and the file name length (incl. the path) is limited to 240 characters.

6.10.2 Working in the file system

After selecting one of the available file operation functions in the **File Menu**, the file system card is displayed showing the current path in its title bar and the file system elements in the card area (refer to Figure 6-15).

Navigating in the file system

- ▶ To open a folder, select its entry (see Figure 6-15, left) using the **▲ ▼** cursor keys and then press the **↵** key.
- ▶ To go one level higher in the directory structure, select the "one level higher" entry **↑..** and then press the **↵** key.

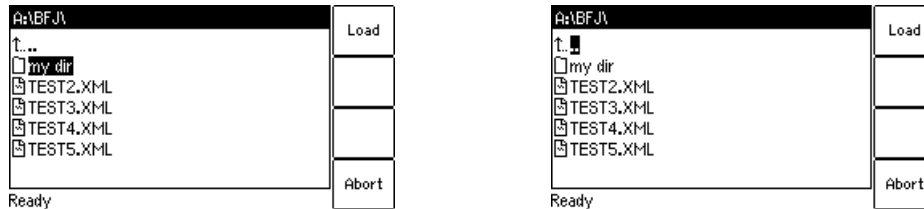


Figure 6-15: File system card for loading a report

Creating a new folder

Creating a new folder is only possible for the functions **Save As** and **Paste File(s)** of the **File Menu**.

To create a new folder in the file system, select **Save As** or **Paste Files(s)** in the file menu and then navigate to the desired location in the file system where you want to create the new folder. Then press the **New Dir** soft key. A new folder with an empty name is created. Enter a name for the folder and press the **↵** key.

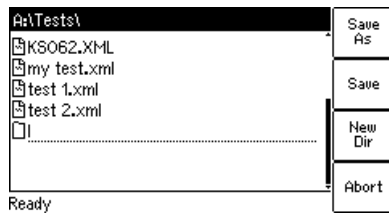


Figure 6-16: File system card after creating a new folder

Note: In the *CT Analyzer* file system, a directory can contain a maximum of 240 files and the maximum file name length is 240 characters. Renaming of folders is not supported by *CT Analyzer*.

How to get there:
Press the **Main** soft key in any test card

Main Menu:
- File Handling

Select soft key

File Menu:
- Load Report or
- Save As or
- Delete File or
- Rename File or
- Copy File(s) or
- Cut File(s) or
- Paste File(s)

How to get there:
Press the **Main** soft key in any test card

Main Menu:
- File Handling

Select soft key





File Menu:
- Save As or
- Paste File(s)

Saving a file

1. Open the file menu and select **Save As**.

Note: You can also save a file by pressing the **Save** or the **Save As** soft key in the **CT-Object** card.

2. Navigate to the desired folder in the file system where you want to save the file:

- ▶ If you like to save the file with the same name, press the **Save** soft key. A warning will pop up asking whether the existing file should be overwritten or not.
- ▶ If you want to use a similar file name as an existing one in the selected folder, select this file using the   cursor keys and press the **Save As** soft key or the  key. A new *.xml file entry with the selected file name is added. Edit this file name and then press again **Save**, **Save As** or the  key.

Note: The test results and settings of each test started on *CT Analyzer* and finished with the "Test ok" status are automatically stored to the file **OMICRON\AutoSave\CTAnalyzer.xml** on the Compact Flash card. The existing CTAnalyzer.xml file is overwritten with each successful test. Tests that could not be finished successfully or that were aborted by the user are not stored and thus do not overwrite the existing CTAnalyzer.xml file. Tests executed from the *CT Analyzer Suite* software are not saved automatically on *CT Analyzer* and therefore do not overwrite the CTAnalyzer.xml file.

How to get there:

Press the **Main** soft key in any test card

Main Menu:

- File Handling

Select soft key

File Menu:

- Save As

Copying / cutting and pasting a file on the Compact Flash card

Note: Copying / cutting and pasting folders is not possible on *CT Analyzer*.

1. Open the file menu and select **Copy File(s)** or **Cut File(s)**.
2. The file system card appears. Navigate to the desired file you want to copy or cut.
3. Highlight the file and then press the **Copy** (or **Cut**) soft key.
To go back to the main menu without copying or cutting a file, press **Abort**.

Note: To select several neighboring files at a time, keep the  key pressed while selecting the files using the   cursor keys.

4. The file system card is closed and the file menu is displayed. Select **Paste File(s)**.
5. The file system card appears again. Navigate to the desired location in the file system where you want to paste the file.
6. Press the **Paste** soft key to paste the file.

In case of a cut/paste action, the file is not deleted from its old location until it has been pasted at its new location.

How to get there:

Press the **Main** soft key in any test card

Main Menu:

- File Handling

Select soft key

File Menu:

- Copy File(s) or

- Cut File(s)

6.11 CT Analyzer help system

CT Analyzer provides a context-sensitive help system. Pressing the **?** key displays a help page, the content of which depends on where the focus was set before the **?** key was pressed.

For example:

- ▶ If the focus is set to the **CT-Object** card's tab, pressing the **?** key displays a help page showing the wiring for a CT test.
- ▶ If the focus is set to the **Burden** card's tab, pressing the **?** key displays a help page showing the wiring for a burden test.
- ▶ If a parameter field in the **CT-Object** card or the **Assessment** card is selected with the cursor, pressing the **?** key displays a help page with explanatory texts for this specific parameter.

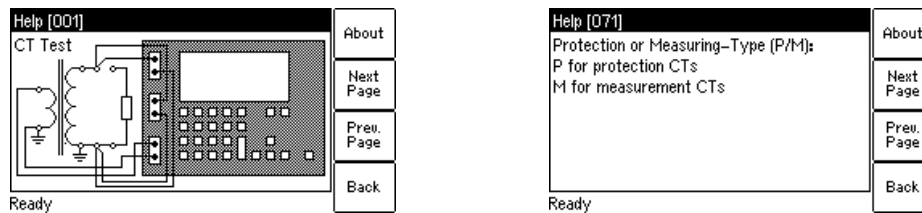


Figure 6-17: Help system showing the wiring diagram for a CT test (left) and explanatory text for a parameter (right)

When the help system is displayed, you can use the **Next Page** and **Prev. Page** soft keys to scroll through the available help pages. Pressing the **About** soft key opens a page with information about the CT Analyzer hardware, the installed firmware version, the serial number, etc.

6.12 Operating CT Analyzer from a computer

It is also possible to operate CT Analyzer remote controlled from a computer using the CT Analyzer Suite software.

For more detailed information, please refer to chapter 11 on page 167 and the CT Analyzer Suite help.

7 Test cards for CT Test mode

7.1 Overview of test cards available in CT Test mode

The following table provides an overview of the test cards available in the CT Test mode of *CT Analyzer*.

Table 7-1: Overview of the test cards available in CT Test mode

Test card	Description
CT-Object	This card contains the CT data. Refer to page 81.
Test Results	This card displays the results of the CT test. Refer to page 84.
Comment	In this card you can enter any text, e.g. additional notes regarding the test. Refer to page 88.

7.2 CT-Object card

The **CT-Object** card of the CT Test mode holds all necessary settings for the test.

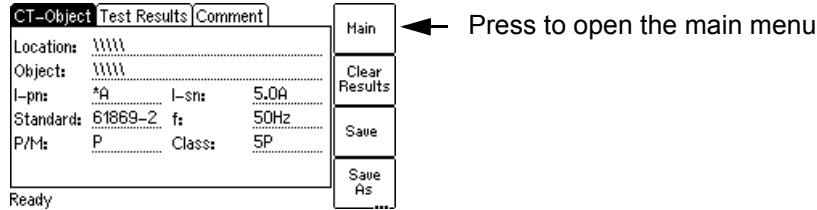


Figure 7-1: **CT-Object** card with default settings after initializing a new test

7.2.1 Available soft keys

Table 7-2: Soft keys available in the CT-Object card

Soft key	Description
	Clears the results of the previous test and enables to start a new test. Text entries for "Location" and "Object" remain unchanged.
	Saves the test results and test settings to the currently loaded <i>CT Analyzer</i> report file. If the test results have not been saved yet, the Save As dialog is opened. Saving a file is described on page 78.
	Saves the test results and test settings to a new .xml file. Saving a file is described on page 78.
	Allows to load a test previously performed in the CT Test mode and stored on the Compact Flash card in order to check its results or to use its settings for a new test. When loading a test stored in the Advanced CT Test mode, <i>CT Analyzer</i> will automatically switch to the Advanced CT Test mode.

7.2.2 Information fields to be filled by the user

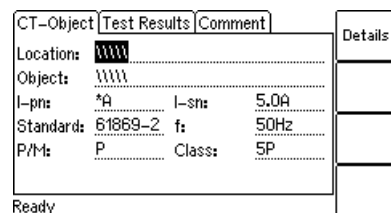


Figure 7-2: Editing the location settings in the **CT-Object** card

The "Location" and "Object" text fields are only used for reporting and documentation purposes. They can be filled by the user after the test is finished. These fields provide information about the location of the CT and the CT itself. The content of these fields is defined in the **Location settings** page and the **Object settings** page, respectively.


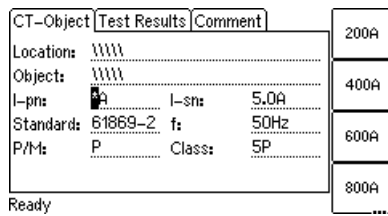
To open these settings pages, position the cursor on the "Location" or the "Object" field and then press the **Details** soft key or the  key.

Table 7-3: Location and Object settings page

Page	Description
Location settings page	<p>The Location settings page provides the following text fields. Each field can contain a maximum of 40 numbers or letters.</p> <p>Company, Country, Station, Feeder: Information where the CT is installed.</p> <p>Phase: Phase to which the CT is connected.</p> <p>IEC-ID: IEC-ID of the CT or freely definable information.</p>
Object settings page	<p>The Object settings page provides the following text fields. Each field can contain a maximum of 40 numbers or letters.</p> <p>Manufact.: Manufacturer of the CT under test.</p> <p>Type: Type number or description of the CT under test.</p> <p>Serial No.: Serial number of the CT under test.</p> <p>Core: Number of the tested core.</p> <p>Tap: Description of the tap (e.g. 1S1-1S3, X1-X4, ...).</p> <p>Optional 1: Optional field for free use.</p>

7.2.3 Parameters and settings used

The fields described in this section are used by the test process.



CT-Object	Test Results	Comment	
Location:		200A
Object:		400A
I-prn:	I-srn: 5.0A	600A
Standard:	61869-2	f: 50Hz	800A
P/T:	P	Class: 5P
Ready			

Figure 7-3: Editing the **CT-Object** card

Note: Parameters marked by a star "*" in the *CT Analyzer* user interface are mandatory parameters. Test execution is not possible if no data are specified for such parameters. All other parameters can be assigned with default values defined in the default test settings and have to be adapted accordingly.

Table 7-4: Parameters and settings in the **CT Object** card for the CT Test mode

Parameter	Description
I-pn	Rated primary current. Possible values: 1 to 99000A or soft keys 200A, 400A, 600A, 800A, or 1000A.
I-sn	Rated secondary current. Possible values: 0.05 to 25A or soft keys 1.0A, 2.0A, 5.0A, 1.0A/√3, 2.0A/√3, 5.0A/√3. Default: As defined in the default test settings.
Standard	Standard according to which the test has to be performed. Possible values: Soft keys IEC 60044-1, IEC 60044-6, IEEE C57.13 or IEC 61869-2 Default: Standard defined in the default test settings. Note: Using the IEEE C57.13 standard for transformers with gapped cores may possibly deliver incorrect results.
f	Rated frequency of the CT. Possible values: Integer value between 16 and 400 Hz or soft keys 16.7Hz, 50Hz, 60Hz or 400Hz. Default: Frequency defined in the default test settings.
P/M	Definition of CT type: Protection or metering CT. Possible values: Soft keys Prot. CT, Meter. CT or ? . Default: As defined in the default test settings.
Class	Accuracy class of the CT. Possible values: Depending on the selected standard. Default: As defined in the default test settings.

7.3 Test Results card

The **Test Results** card of the CT Test mode displays the results of the CT test loaded or performed previously.

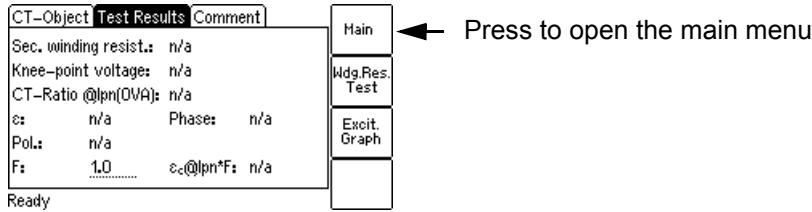




Figure 7-4: **Test Results** card of the CT Test mode

7.3.1 Available soft keys

Table 7-5: Soft keys available in the **Test Results** card

Soft key	Description
	Displays the results of the secondary winding resistance test. See section 7.3.3 below.
	Displays the excitation graph calculated from the measurement results. See section 7.3.4 below.

7.3.2 Test results displayed

The following test results are displayed directly in the **Test Results** card.

Table 7-6: Test results displayed in the **Test Results** card

Parameter	Description
Sec. winding resist.	Measured secondary winding resistance of the CT.
Knee-point voltage	Measured knee point voltage.
CT-Ratio@I _{pn} (0VA)	Current ratio of the CT at nominal primary current and 0 VA burden.
ε	Available for IEC standards only. Error in % at nominal primary current and 0 VA burden.
RCF	Available for IEEE C57.13 only. Ratio correction factor.
Phase	Phase displacement at nominal primary current and 0 VA burden.
Pol.	OK: Polarity OK, phase angle is in the range of 0° ± 45°. Failed: Wrong polarity of the CT or wrong polarity of the measurement leads.
F and ε _c @I _{pn} *F	Two additional parameters are available for IEC 60044-1 and IEC 61869-2 protection CTs to allow the display of the composite error for different multiples of the nominal secondary current I _{sn} . Use the "F" parameter to specify the factor (for example, 1 x, 5 x, or 10 x I _{sn}) and read the resulting composite error from the "ε _c @I _{pn} *F" field.

7.3.3 Secondary winding resistance measurement details

Press the **Wdg. Res. Test** soft key in the **Test Results** card to display the secondary winding resistance measurement details.

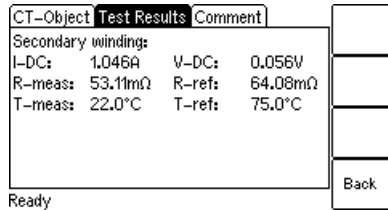


Figure 7-5: Winding resistance measurement details

Table 7-7: Test results for secondary winding resistance measurement

Parameter	Description
I-DC	Current used for measurement. Selected automatically, cannot be changed by the user. If I_{sn} is 0.2 A or higher, I_{DC} is automatically set to I_{sn} . If I_{sn} is lower than 0.2 A, I_{DC} is automatically set to 0.2 A. Maximum value: 5 A.
V-DC	Measured voltage.
R-meas	Measured resistance at ambient temperature.
R-ref	Reference resistance (temperature-compensated resistance, compensated to T_{ref}).
T-meas	Winding temperature of the CT at the time of measurement. Value used: Ambient Temperature defined in the Settings (main menu). If this temperature is not set correctly, the reference resistance value (R_{ref}) at reference temperature will not be calculated correctly.
T-ref	Reference temperature, i.e, temperature the CT is specified for. Value used: Reference temperature defined in the Settings (main menu). The winding resistance at reference temperature is calculated from the winding resistance measured at ambient temperature (T_{meas}) and the specified reference temperature.

7.3.4 Excitation graph

Press the **Excit. Graph** soft key in the **Test Results** card to display the excitation graph calculated from the test results. The graph shows the r.m.s. terminal/core voltage over the r.m.s./peak current depending on the selected standard.

On the bottom right of the diagram the voltage, current and inductance values for the selected point in the graph are displayed. The currently selected point in the graph is marked by a horizontal and a vertical dashed line.

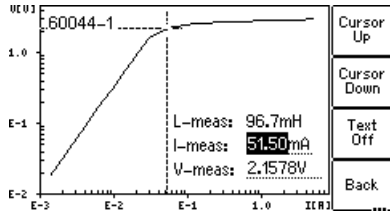


Figure 7-6: Excitation graph

Definition of axes in the excitation graph for different standards

Table 7-8: Definition of axes in the excitation graph

Standard	Vertical axis	Horizontal axis
IEC 60044-1	r.m.s. terminal voltage	r.m.s. excitation current
IEC 60044-6	r.m.s. e.m.f. voltage	peak excitation current
IEC 61869-2	average rectified ¹ terminal voltage	r.m.s. excitation current
IEEE C57.13	r.m.s. e.m.f. voltage	r.m.s. excitation current

1. Calibrated to r.m.s.

Available soft keys

Table 7-9: Soft keys available for the excitation graph





Soft key	Description
	Moves the cursor upwards on the excitation graph.
	Moves the cursor downwards on the excitation graph.
	Switches off the display of values on the bottom right of the diagram. If you have switched off the values, this soft key changes to Text On to switch the values display on again.
	Closes the excitation graph and brings you back to the Excitation card.

Table 7-9: Soft keys available for the excitation graph (continued)

Soft key	Description
IEC 60044-1	By pressing one of these soft keys you can display the measured excitation graph and knee point as defined in the respective standard. IEEE C57.13 displays the knee point for the 45° tangent. After pressing this soft key, its labeling changes to IEEE C57.13 (30°) to enable the display of the knee point for the 30° tangent. 30° is recommended for gapped cores in IEEE C37.110, chapter 4.3. Note: The test report only contains the graph for the standard selected in the CT-Object card.
IEC 60044-6	
IEEE C57.13	
IEC 61869-2	

Viewing the measured values for different points on the graph

By default, the knee point values are displayed after opening the excitation graph page. However, you can also view the corresponding voltage, current and inductance values for any point on the graph. To select a specific point on the graph,

- ▶ either use the soft keys (**Cursor Up**, **Cursor Down**)
- ▶ or enter a specific voltage or current value using the keyboard:
 - ▶ Select the desired edit field using the ▲ ▼ cursor keys.
 - ▶ Enter the desired voltage or current value using the keyboard.
 - ▶ Press the ← key to apply the entered value and read the corresponding values in the respective fields (e.g. "V-meas" and "L-meas" if you have entered a current "I-meas").

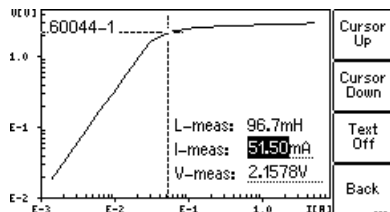


Figure 7-7: Entering a current value to display its corresponding voltage and inductance values on the excitation graph

7.4 Comment card

Use the **Comment** card of the CT Test mode to enter additional notes regarding your test.

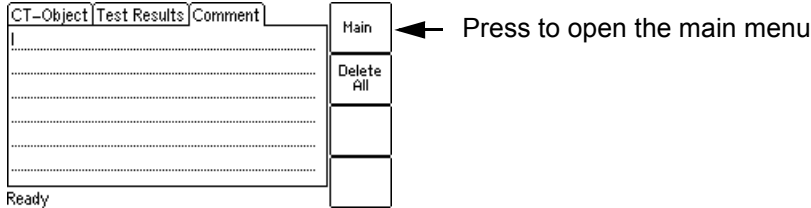


Figure 7-8: **Comment** card

8 Test cards for Advanced CT Test mode

8.1 Overview of test cards available in Advanced CT Test mode

The following table provides an overview of all test cards available in the Advanced CT Test mode of *CT Analyzer*. **The set of test cards actually available on your *CT Analyzer* depends on your purchased license(s).**

Note: For up-to-date information about available licenses for *CT Analyzer* please refer to the OMICRON website or contact your OMICRON sales contact.

Table 8-1: Overview of the test cards available in Advanced CT Test mode

Test card	Description
CT-Object	This card contains the basic CT data and is always required to perform a CT test. Refer to page 90.
Burden	This card is used to measure a current transformer's secondary burden with AC current. Refer to page 107.
Res. Magnetism	This card is used to measure the residual magnetism of CTs. Refer to page 109.
Resistance	This card is used to measure the secondary winding resistance and the primary winding resistance of the CT. Refer to page 112.
Excitation	This card is used to trace the excitation curve of the current transformer and to determine further CT-specific parameters. Refer to page 115.
Ratio	This card is used to measure the current ratio of the CT considering the external load or the nominal burden and to determine the current ratio error and the phase displacement. Refer to page 125.
Assessment	This card shows the automatic assessment of the tested parameters according to the selected standard. In this card you can also perform a manual assessment. Refer to page 130.
Comment	In this card you can enter any text, e.g. additional notes regarding the test. Refer to page 137.

8.2 CT-Object card

The **CT-Object** card of the Advanced CT Test mode is the most important card and always required for all types of tests. In this card all necessary settings for a test are done. Some of the settings contained in the **CT-Object** card are also shown in other cards for information.

Note: The **CT-Object** card is the top user interface level. Pressing the **ESC** key several times will always bring you back to the **CT-Object** card.

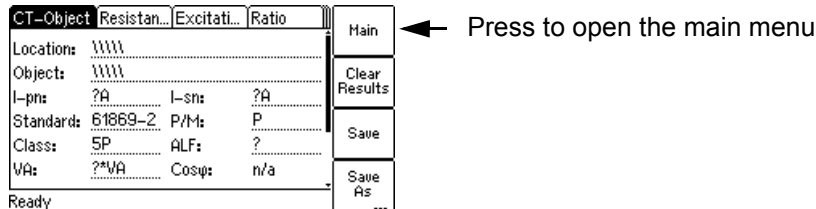


Figure 8-1: **CT-Object** card with default settings after initializing a new Advanced CT test

8.2.1 Available soft keys

Table 8-2: Soft keys available in the **CT-Object** card

Soft key	Description
	Clears the results of the previous test and enables to start a new test. All measurement results as well as all the parameters previously determined using the "guesser function" are cleared. Text entries for "Location" and "Object" remain unchanged.
	Saves the test results and test settings to the currently loaded <i>CT Analyzer</i> report file. If the test results have not been saved yet, the Save As dialog is opened. Saving a file is described on page 78.
	Saves the test results and test settings to a new .xml file. Saving a file is described on page 78.
	<p>Allows to load a test previously performed in the Advanced CT Test mode and stored on the Compact Flash card in order to check its results, to recalculate the results with different settings or to use its settings for a new test.</p> <p>When loading a test stored in the CT Test mode, <i>CT Analyzer</i> will automatically switch to the CT Test mode.</p> <p>Note: Recalculation of the existing CT test results in order to verify the behavior of the CT at different burdens or primary currents can be performed by changing the burden value on the CT-Object card or the primary current on the Ratio card. The recalculated results can then be stored again like for a regular test.</p>
	<p>Opens the Select Cards page where you can select the test cards for the current test. The Select Cards page is described on page 70.</p> <p>Note: When loading a new CT test from the main menu (using the "New Advanced CT Test" entry), the test card selection defined in the default test settings is used for this new test. The card selection performed in the CT-Object card will then be discarded.</p>

8.2.2 Information fields to be filled by the user

CT-Object	Resistan...	Excitati...	Ratio	Details
Location:	OmicronAustriaKlausWJestVL1...			
Object:	UnknownKSO62107/5012506...			
I-pri:	300.0A	I-sni:	5.0A	
Standard:	60044-1	P/M:	M	
Class:	0.5S	FS:	5	
ext. I-pri:	120%			
KSO62.xml				

Figure 8-2: Editing the location settings in the **CT-Object** card

The "Location" and "Object" text fields are only used for reporting and documentation purposes. They can be filled by the user after the test is finished. These fields provide information about the location of the CT and the CT itself. The content of these fields is defined in the **Location settings** page and the **Object settings** page, respectively.


To open these settings pages, position the cursor on the "Location" or the "Object" field and then press the **Details** soft key or the  key.

Table 8-3: Location and Object settings page

Page	Description
Location settings page	<p>The Location settings page provides the following text fields. Each field can contain a maximum of 40 numbers or letters.</p> <ul style="list-style-type: none"> • Company, Country, Station, Feeder: Information where the CT is installed. • Phase: Phase to which the CT is connected. • IEC-ID: IEC-ID of the CT or freely definable information.
Object settings page	<p>The Object settings page provides the following text fields. Each field can contain a maximum of 40 numbers or letters.</p> <ul style="list-style-type: none"> • Manufact.: Manufacturer of the CT under test. • Type: Type number or description of the CT under test. • Serial No.: Serial number of the CT under test. • Core: Number of the tested core. • Tap: Description of the tap (e.g. 1S1-1S3, X1-X4, ...). • Optional 1: Optional field for free use.

8.2.3 Parameters and settings used or determined by the test process

The fields described in this section are used and/or determined by the test process.

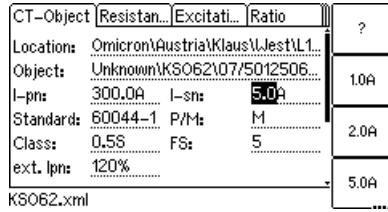


Figure 8-3: Editing the CT-Object card

Note: If the "Check "*" settings before start" option is enabled in the default test settings (see section 6.8.3 "Miscellaneous settings" on page 71), no automatic assessment will be available if you do not enter data for a parameter that is relevant for assessment. Such parameters are marked by a star "*" in the *CT Analyzer* user interface and in the following tables.

Common parameters and settings displayed for all standards, CT types and classes

The table below lists the parameters and settings that are displayed for all standards, CT types and classes.

In addition to these common parameters, specific additional parameters are displayed in the **CT-Object** card depending on the selected standard, CT type (protection or metering CT) and class. For these specific parameters, please refer to the tables on pages 96 to 106.

Table 8-4: Parameters and settings common for all standards, CT types and classes

Parameter	Description
I-pn	Rated primary current. Possible values: 1 to 99000A or ? ¹ soft key. Default: ?.
I-sn	Rated secondary current. Possible values: 0.05 to 25A or soft keys 1.0 , 2.0 , 5.0 , 1.0A/√3 , 2.0A/√3 , 5.0A/√3 or ? ¹ . Default: ?.
Standard	Standard according to which the test has to be performed. Possible values: Soft keys IEC 60044-1 , IEC 60044-6 , IEEE C57.13 or IEC 61869-2 If a customized assessment configuration is selected in the settings (Main Menu -> Settings -> Select Customized Assessment (see page 68)), an additional Custom soft key is available to allow selection of this customized assessment rule. Default: Standard defined in the default test settings. Note: Using the IEEE C57.13 standard for transformers with gapped cores may possibly deliver incorrect results.

Table 8-4: Parameters and settings common for all standards, CT types and classes (continued)

Parameter	Description
P/M *	<p>Definition of CT type: Protection or metering CT.</p> <p>Possible values: Soft keys Prot. CT, Meter. CT or ?¹.</p> <p>Default: As defined in the default test settings.</p> <p>* This parameter is relevant for assessment. No automatic assessment is available if the user did not enter data for this parameter prior to the test.</p>
Class *	<p>Accuracy class of the CT.</p> <p>Possible values: Depending on the selected standard or ?¹.</p> <p>Default: As defined in the default test settings.</p> <p>This parameter is only displayed, after the parameters "Standard" and "P/M" have been defined or determined by <i>CT Analyzer</i>. Depending on these parameters, the parameters for the CT class can be selected using the soft keys.</p> <p>The class can be selected by soft keys or is determined by <i>CT Analyzer</i> during the test. Automatic determination during the test only works for IEC 61869-2 or IEC 60044-1 metering CTs and IEEE C57.13 metering CTs. If the question mark has been entered for the "P/M" parameter, the "Class" cannot be defined by the user but is automatically determined by <i>CT Analyzer</i> instead.</p> <p>* This parameter is relevant for assessment. No automatic assessment is available if the user did not enter data for this parameter prior to the test.</p> <p><u>For IEEE C57.13 metering CTs only:</u></p> <p>An additional soft key Assess @ VA and an additional "Burden designation" field are available for metering CTs according to IEEE C57.13. Use the Assess @ VA option if the accuracy class of the CT only applies to one specific burden or burden range.</p> <p>CT assessment is normally performed for the maximum burden specified and all lower burdens defined in the standard. Example: If the burden specified is B-0.9, the assessment is performed for the burdens B-0.9, B-0.5, B-0.2 and B-0.1, and the electronic burdens E-0.2 and E-0.04.</p> <p>Selecting the Assess @ VA option in addition to the class setting will cause <i>CT Analyzer</i> to perform assessment only for the burden value or burden range specified in the "Burden designation" field. The ratio table and the phase table in the Ratio card then only show the error for this specific burden or burden range (see section 8.7.5 on page 129).</p> <p>When Assess @ VA is selected, the soft key changes to Assess all VA to enable deactivation of this option.</p> <p>Refer to section "Specific parameters and settings displayed for IEEE C57.13 metering CTs" on page 106 for information on the "Burden designation" field and detailed instructions how to use the Assess @ VA option.</p>

Table 8-4: Parameters and settings common for all standards, CT types and classes (continued)

Parameter	Description
VA * Cos φ	<p>Nominal burden of the CT, used to calculate the behavior of the CT with the nominal burden.</p> <p>Possible values: 0 to 400VA or soft keys 1.0VA to 30VA or ?¹.</p> <p>Depending on the burden and the selected test standard, the corresponding cos φ is used (cos φ not editable by the user).</p> <p>* This parameter is relevant for assessment. No automatic assessment is available if the user did not enter data for this parameter prior to the test.</p> <p>If the IEEE C57.13 standard is selected with the type "protection CT" (class C, K or T), the VA and Cos φ parameters are not accessible to the user. In this case, the user has to enter the terminal voltage V_b instead. See "Specific parameters and settings displayed for IEEE C57.13 protection CTs" on page 105.</p>
Burden Cos φ	<p>"Burden" and "Cos φ" are used to define the operating burden connected to the CT. These parameters are used to calculate the behavior of the CT at the operating burden (connected burden) and the corresponding cos φ.</p> <p>Possible values for "Burden": 0 to 400VA or soft keys 1.0VA to 30VA or ?¹.</p> <p>Possible values for "Cos φ": 0 to 1.</p> <p>These parameters can also be changed after the test or in a loaded test report in order to check the CT behavior at different burden values.</p> <p>If the IEEE C57.13 standard is selected with the type "metering CT", CT Analyzer offers soft keys with standard loads for the power (for example, E-0.1, B-0.1, B-0.2, etc.). If these soft keys are used, the power is calculated according to table 9 of IEEE C57.13. If the rated current is not 5A, the resistance and inductance of the table is multiplied by the factor</p> $\alpha = \left(\frac{5}{I_{\text{rated}}} \right)^2$
f	<p>Rated frequency of the CT.</p> <p>Possible values: Integer value between 16 and 400 Hz or soft keys 16.7Hz, 50Hz, 60Hz or 400Hz.</p> <p>Default: Frequency defined in the default test settings.</p>
Rprim	<p>Specified primary winding resistance (only available if primary winding resistance measurement is enabled for the test).</p> <p>Possible values: 0 to 3000 ohms or soft key ?¹.</p> <p>Default: ?.</p>
Class mult. factor	<p>Class multiplying factor.</p> <p>This factor increases the assessment level for the ratio test. E.g. a class multiplier of 0.5 means that the maximum accepted tolerance for the ratio error is only half the standard tolerance.</p> <p>Possible values: 0.25 to 1.00 or soft key 1.0.</p> <p>Default: As defined in the default test settings (Main menu -> Settings -> Misc. Settings).</p>

Table 8-4: Parameters and settings common for all standards, CT types and classes (continued)

Parameter	Description
Delta compensation	<p>Correction factor for the ratio measurement. This factor enables the ratio measurement for CTs that are installed inside a delta winding transformer.</p> <p>Possible values: Soft keys Ratio 1, Ratio 2/3 or Ratio 1/3.</p> <p>Default: Ratio 1.</p> <p>Choose "Ratio 1" if no correction is required.</p> <p>Choose "Ratio 2/3" if input PRIM is connected to the two terminals of that transformer winding, the CT is in series with.</p> <p>Choose "Ratio 1/3" if input PRIM is connected to the terminals of a transformer winding, the CT is not in series with.</p>
LV CT Test Mode	<p>Use this parameter to change the measuring mode for testing very small CTs with very low knee point voltages.</p> <p>"Toggle Mode": Normal measuring mode of <i>CT Analyzer</i>. Applies test signals of different magnitudes and frequencies to the current transformer in order to measure the excitation characteristic.</p> <p>"Sinus Mode": Applies sinusoidal test signals with rated frequency to the CT in order to measure the excitation characteristics. The Sinus measuring mode may be indicated for testing very small CTs with very low knee point voltages.</p> <p>Possible values: Soft key Toggle Mode or Sinus Mode.</p> <p>Default: As defined in the default test settings (Main menu -> Settings -> Misc. Settings).</p>

1. If the question mark is entered for this parameter and a new test is started, *CT Analyzer* automatically tries to determine the value using its integrated guesser function (see chapter 9 on page 138).

Specific parameters and settings displayed for IEC 60044-1 protection CTs

The following parameters are only displayed in the **CT-Object** card if the standard IEC 60044-1 is selected with the type "Protection CT".

Table 8-5: Parameters and settings for IEC 60044-1 protection CTs

Param.	Description	Available for IEC 60044-1 protection CTs, class		
		2P, 3P, 4P, 5P, 6P, 10P	2PR, 3PR, 4PR, 5PR, 6PR, 10PR	PX
ALF	Accuracy limiting factor acc. to IEC 60044-1. Possible values: Integer value from 1 to 300 or soft keys ? ¹ , 5, 10, 15, 20 or 30 . Default: ?.	x	x	
Rct	Specified secondary winding resistance. Possible values: 0 to 3000 ohms or soft key ? ¹ . Default: ?		x	x
Ts	Specified secondary time constant. Possible values: 0.000 to 100.0s or soft key ? ¹ . Default: 100s.		x	
Kx	Dimensioning factor acc. to IEC 60044-1, PX. Possible values: 1 to 300 or soft key ? ¹ . Default: ?.			x
Ek	Rated knee point e.m.f. Possible values: 0 to 40000V or soft key ? ¹ . Default: ?.			x
Ie	Accuracy limiting current acc. to IEC 60044-1, PX. Possible values: 0.03mA to 30000mA or soft key ? ¹ . Default: ?.			x
E1	User-defined e.m.f. to verify the excitation current at this specific e.m.f. Possible values: 0.1 to 40000V or soft key ? ² . Default: ?.			x
Ie1	Maximum allowed excitation current at E ₁ . Possible values: 0.03mA to 30000mA or soft key ? ³ . Default: ?.			x

1. If the question mark is entered for this parameter and a new test is started, *CT Analyzer* automatically tries to determine the value using its integrated guesser function (see chapter 9 on page 138).

2. If the question mark is entered, half the voltage entered or measured for E_k is used.

3. If the question mark is entered, *CT Analyzer* uses the excitation current measured at the voltage value defined at E₁. In this case, the assessment for this parameter is OK.

Specific parameters and settings displayed for IEC 60044-1 metering CTs

The following parameters are only displayed in the **CT-Object** card if the standard IEC 60044-1 is selected with the type "Metering CT".

Table 8-6: Parameters and settings for IEC 60044-1 metering CTs

Param.	Description	Available for IEC 60044-1 metering CTs, class	
		0.1, 0.2, 0.2s	0.5, 0.5s, 1, 3, 5
FS	<p>Instrument security factor acc. to IEC 60044-1.</p> <p>Possible values: Integer value from 1 to 30 or soft keys n/a, ?¹, FS1, FS1.5, FS2, FS5, FS10, FS20 or FS30.</p> <p>Default: n/a.</p> <p>According to the standard, it is optional to consider this parameter for assessment. Therefore, use the default setting "n/a" for "do not assess", or specify a factor to have the parameter assessed.</p>	x	x
ext. Ipn	<p>Extended current rating.</p> <p>Possible values: 100 to 400% or soft keys 120%, 150%, 200%, 300%, 400%.</p> <p>Default: 120%.</p>	x	x
ext. VA	<p>Extended burden range for ratio error and phase displacement assessment according to IEC 61869-2.</p> <p>The assessment of the ratio error and the phase displacement is usually performed down to a burden of 12.5% of the nominal burden. If the "ext. VA" parameter is set to "on", the assessment is performed for an extended range down to a burden of 1VA if the limit of 12.5% results in a burden higher than 1VA.</p> <p>Possible values: Soft keys On or Off.</p> <p>Default: On.</p>	x	

1. If the question mark is entered for this parameter and a new test is started, *CT Analyzer* automatically tries to determine the value using its integrated guesser function (see chapter 9 on page 138).

Specific parameters and settings displayed for IEC 60044-6

The following parameters are only displayed in the **CT-Object** card if the standard IEC 60044-6 is selected.

Table 8-7: Parameters and settings for IEC 60044-6

Param.	Description	Available for IEC 60044-6, class			
		TPS	TPX	TPY	TPZ
Rct	Specified secondary winding resistance. Possible values: 0 to 3000 ohms or soft key ? ¹ . Default: ?	x	x	x	x
Kssc	Rated symmetrical short-circuit current factor. Possible values: 1 to 300 or soft keys ? ¹ , 3, 5, 7.5, 10, 12.5, 15, 17.5, 20, 25, 30, 40 or 50 . Default: ?.	x	x	x	x
Tp	Primary time constant. Possible values: 0.000 to 5.000s or soft keys 20ms, 40ms, 60ms, 80ms, 100ms or 120ms . T_p depends on K as follows: $T_p = \frac{K - 1}{\omega}$	x	x	x	x
K	Dimensioning factor. Possible values: 1 to 1572. K depends on T_p as described above for T_p .	x			
V-al	Rated equivalent excitation limiting secondary voltage. Possible values: 0 to 9999V or soft key ? ¹ . Default: ?.	x			
I-al	Accuracy limiting secondary excitation current. Possible values: 0.03mA to 30000mA or soft key ? ¹ . Default: ?.	x			
Ktd	Rated transient dimensioning factor. Possible values: 1.0 to 2043 or soft key ? ¹ . Default: ?.		x	x	x
Ts	Specified secondary time constant. Possible values: 0.000 to 100.0s or soft key ? ¹ . Default: ?.			x	x
Duty	Specified duty cycle. Using the soft keys, two different energizing cycles can be selected: C-O or C-O-C-O Default: C-O.		x	x	

Table 8-7: Parameters and settings for IEC 60044-6 (continued)

Param.	Description	Available for IEC 60044-6, class			
		TPS	TPX	TPY	TPZ
t-al1	Permissible time to accuracy limit for first energizing period of the duty cycle. Possible values: 0.000 to 5.000s and max. t_1 or soft key 40ms . Default: 0.04s.		x	x	
t-al2	Permissible time to accuracy limit for second energizing period of the duty cycle. Only displayed if "Duty" is C-O-C-O. Possible values: 0.000 to 5.000s and max. t_2 or soft key 40ms . Default: 0.04s.		x	x	
tfr	Dead time between first opening and reclosure. Only displayed if "Duty" is C-O-C-O. Possible values: 0.00 to 5.00s or soft key 300ms . Default: 0.3s.		x	x	
Ktd calculation	Calculation method for transient dimensioning factor K_{td} . Select a calculation method using the soft keys: acc. to IEC 60044-6 (calculation exactly acc. to standard), acc. to OMICRON (calculation considers CT remanence) or acc. to GB 16847 (acc. to Chinese standard GB 16847). Default: As defined in the default test settings (see "Default Standard" parameter in section 6.8.1 on page 66).		x	x	

1. If the question mark is entered for this parameter and a new test is started, *CT Analyzer* automatically tries to determine the value using its integrated guesser function (see chapter 9 on page 138).

Specific parameters and settings displayed for IEC 61869-2 protection CTs

The following parameters are only displayed in the **CT-Object** card if the standard IEC 61869-2 is selected with the type "Protection CT".

Table 8-8: Parameters and settings for IEC 61869-2 protection CTs

Param.	Description	Available for IEC 61869-2 protection CTs, class						
		protection				transient protection		
		...P	...PR	PX	PXR	TPX	TPY	TPZ
ALF	Accuracy limiting factor acc. to IEC 61869-2. Possible values: Integer value from 1 to 300 or soft keys ? ¹ , 5, 10, 15, 20 or 30 . Default: ?.	x	x					
Rct	Specified secondary winding resistance. Possible values: 0 to 3000 ohms or soft key ? ¹ . Default: ?		x	x	x	x	x	x
Ts	Specified secondary time constant. Possible values: 0.000 to 100.0s or soft key ? ¹ . Default: 100s.		x				x	
Kx	Dimensioning factor acc. to IEC 61869-2. Possible values: 1 to 300 or soft key ? ¹ . Default: ?.			x	x			
Ek	Rated knee point e.m.f. Possible values: 0 to 40000V or soft key ? ¹ . Default: ?.			x	x			
E1	User-defined e.m.f. to verify the excitation current at this specific e.m.f. Possible values: 0.1 to 40000V or soft key ? ² . Default: ?.			x	x			
le	Accuracy limiting current acc. to IEC 61869-2. Possible values: 0.03mA to 30000mA or soft key ? ¹ . Default: ?.			x	x			
le1	Maximum allowed excitation current at E ₁ . Possible values: 0.03mA to 30000mA or soft key ? ³ . Default: ?.			x	x			

Table 8-8: Parameters and settings for IEC 61869-2 protection CTs (continued)

Param.	Description	Available for IEC 61869-2 protection CTs, class						
		protection				transient protection		
		...P	...PR	PX	PXR	TPX	TPY	TPZ
Kssc	<p>Rated symmetrical short-circuit current factor.</p> <p>Possible values: 1 to 300 or soft keys ?¹, 3, 5, 7.5, 10, 12.5, 15, 17.5, 20, 25, 30, 40 or 50.</p> <p>Default: ?.</p>					x	x	x
Spec.	<p>The accuracy class assessment has to be performed for the specific protection requirements the CT is built for. According to the standard, these requirements are normally stated by the duty cycle and the time constants.</p> <p>However, in some cases the choice of one specific duty cycle/time constant cannot describe all protection requirements. Therefore, <i>CT Analyzer</i> offers the possibility to specify "more general requirements" (which cover the requirements of different duty cycles and time constants) by entering the K_{td} instead.</p> <p>Use the soft keys to choose if you want to specify the protection requirements used for the accuracy class assessment</p> <ul style="list-style-type: none"> ▶ by specifying the duty cycle and the necessary time constants (by Duty, standard specification according to IEC 61869-2; <i>CT Analyzer</i> then calculates the K_{td} automatically from the entered values) ▶ or alternatively by specifying the rated transient dimensioning factor K_{td} stated on the CT's name plate (by Ktd, alternative specification according to IEC 61869-2). <p>The setting of this parameter displays or hides the parameters K_{td}, and T_p, Duty and t_{al1} (see parameter descriptions below).</p> <p>Possible values: Soft keys by Duty or by Ktd.</p> <p>Default: As defined in the default test settings.</p>					x	x	x

Table 8-8: Parameters and settings for IEC 61869-2 protection CTs (continued)

Param.	Description	Available for IEC 61869-2 protection CTs, class						
		protection				transient protection		
		...P	...PR	PX	PXR	TPX	TPY	TPZ
Ktd *	<p>Rated transient dimensioning factor according to the name plate.</p> <p>Only displayed if parameter "Spec." is "by Ktd".</p> <p>Possible values: 1.0 to 2043 or soft key ?¹.</p> <p>Default: ? or ?*.</p> <p>* If displayed, this parameter is relevant for assessment. No automatic assessment is available if the user did not enter data for this parameter prior to the test (see page 92).</p>					x	x	x
Tp *	<p>Primary time constant.</p> <p>Only displayed if parameter "Spec." is "by Duty".</p> <p>Possible values: 0.000 to 5.000s or soft keys 20ms, 40ms, 60ms, 80ms, 100ms or 120ms.</p> <p>T_p depends on K as follows: $T_p = \frac{K-1}{\omega}$</p> <p>Default: ? or ?*.</p> <p>* If displayed, this parameter is relevant for assessment. No automatic assessment is available if the user did not enter data for this parameter prior to the test.</p>					x	x	x
Duty	<p>Specified duty cycle.</p> <p>Only displayed if parameter "Spec." is "by Duty".</p> <p>Using the soft keys, two different energizing cycles can be selected: C-O or C-O-C-O</p> <p>Default: C-O.</p>					x	x	x
t-al1 *	<p>Permissible time to accuracy limit for first energizing period of the duty cycle.</p> <p>Only displayed if parameter "Spec." is "by Duty".</p> <p>Possible values: 0.000 to 5.000s and max. t_1 or soft key 40ms.</p> <p>Default: ? or ?*.</p> <p>* If displayed, this parameter is relevant for assessment. No automatic assessment is available if the user did not enter data for this parameter prior to the test.</p>					x	x	x

Table 8-8: Parameters and settings for IEC 61869-2 protection CTs (continued)

Param.	Description	Available for IEC 61869-2 protection CTs, class						
		protection				transient protection		
		...P	...PR	PX	PXR	TPX	TPY	TPZ
t1 *	<p>Duration of first current flow. The specified accuracy limit must not be reached within time t_{al1}.</p> <p>Only displayed if parameter "Spec." is "by Duty" and "Duty" is "C-O-C-O".</p> <p>Possible values: 0.000 to 5.000s or soft key 100ms.</p> <p>Default: ? or ?*.</p> <p>* If displayed, this parameter is relevant for assessment. No automatic assessment is available if the user did not enter data for this parameter prior to the test.</p>					X	X	X
tfr *	<p>Dead time between first opening and reclosure.</p> <p>Only displayed if parameter "Spec." is "by Duty" and "Duty" is "C-O-C-O".</p> <p>Possible values: 0.00 to 5.00s or soft key 300ms.</p> <p>Default: ? or ?*.</p> <p>* If displayed, this parameter is relevant for assessment. No automatic assessment is available if the user did not enter data for this parameter prior to the test.</p>					X	X	X
t-al2 *	<p>Permissible time to accuracy limit for second energizing period of the duty cycle.</p> <p>Only displayed if parameter "Spec." is "by Duty" and "Duty" is "C-O-C-O".</p> <p>Possible values: 0.000 to 5.000s or soft key 40ms.</p> <p>Default: ? or ?*.</p> <p>* If displayed, this parameter is relevant for assessment. No automatic assessment is available if the user did not enter data for this parameter prior to the test.</p>					X	X	X

1. If the question mark is entered for this parameter and a new test is started, *CT Analyzer* automatically tries to determine the value using its integrated guesser function (see chapter 9 on page 138).
2. If the question mark is entered, half the voltage entered or measured for E_k is used.
3. If the question mark is entered, *CT Analyzer* uses the excitation current measured at the voltage value defined at E_1 . In this case, the assessment for this parameter is OK.

Specific parameters and settings displayed for IEC 61869-2 metering CTs

The following parameters are only displayed in the **CT-Object** card if the standard IEC 61869-2 is selected with the type "Metering CT".

Table 8-9: Parameters and settings for IEC 61869-2 metering CTs

Param.	Description	Available for IEC 61869-2 metering CTs, class 0.1, 0.2, 0.2s, 0.5, 0.5s, 1, 3, 5
FS	Instrument security factor acc. to IEC 61869-2. Possible values: Integer value from 1 to 30 or soft keys ? ¹ , FS1 , FS1.5 , FS2 , FS5 , FS10 , FS20 or FS30 . Default: ?.	x
ext. Ipn	Extended current rating. Possible values: 100 to 400% or soft keys 120% , 150% , 200% , 300% , 400% . Default: 120%.	x
ext. VA	Extended burden range for ratio error and phase displacement assessment according to IEC 61869-2. The assessment of the ratio error and the phase displacement is usually performed down to a burden of 12.5% of the nominal burden. If the "ext. VA" parameter is set to "on", the assessment is performed for an extended range down to a burden of 1VA if the limit of 12.5% results in a burden higher than 1VA. Possible values: Soft keys On or Off . Default: On.	x

1. If the question mark is entered for this parameter and a new test is started, *CT Analyzer* automatically tries to determine the value using its integrated guesser function (see chapter 9 on page 138).

Specific parameters and settings displayed for IEEE C57.13 protection CTs

The following parameters are only displayed in the **CT-Object** card if the IEEE C57.13 standard is selected with the type "Prot. CT".

Table 8-10: Parameters and settings for IEEE C57.13 protection CTs

Param.	Description	Available for IEEE C57.13, class			
		C	T	X	K ¹
Vb *	<p>Rated secondary terminal voltage.</p> <p>If the IEEE C57.13 standard is selected with the type "protection CT" (class C, K or T), the VA and Cos φ parameters are not accessible to the user. In this case, the user has to enter the terminal voltage V_b instead.</p> <p>Possible values: Integer values from 10 to 2000V or soft keys ?², 10V, 20V, 50V, 100V, 200V, 400V, 800V or 1600V</p> <p>Default: ? or ?*.</p> <p>* This parameter is relevant for assessment. No automatic assessment is available if the user did not enter data for this parameter prior to the test.</p>	x	x		x
Burden designation	<p>After selecting the terminal voltage V_b (see above) using one of the available soft keys, this field displays the corresponding standard burden designation, for example, B-1.0. The burden designation is calculated automatically by <i>CT Analyzer</i>. If you enter a V_b value not offered by the soft keys, CUSTOM is displayed in this field to indicate that the burden selected is not defined in the standard.</p>	x	x	x	x
RE(20*Isn)	<p>Ratio error at 20 * I_{sn}.</p> <p>Possible values: Integer values from 1% to 20%.</p> <p>Default: 10%.</p>			x	
Vk Vk1	<p>User-defined measuring point.</p> <p>User-defined measuring point 1.</p> <p>Possible values: Integer values from 0.1V to 20.000V or soft key ?².</p> <p>Default: ?.</p>		x	x	
Ik Ik1	<p>User-defined measuring point.</p> <p>User-defined measuring point 1.</p> <p>Possible values: Integer values from 0.03mA to 30.000mA or soft key ?².</p> <p>Default: ?.</p>		x	x	
Rct	<p>Specified secondary winding resistance.</p> <p>Possible values: 0 to 3000 ohms or soft key ?².</p> <p>Default: ?</p>			x	

1. Acc. to IEEE C57.13 (2008)

2. If the question mark is entered for this parameter and a new test is started, *CT Analyzer* automatically tries to determine the value using its integrated guesser function (see chapter 9 on page 138).

Specific parameters and settings displayed for IEEE C57.13 metering CTs

The following parameters are only displayed in the **CT-Object** card if the IEEE C57.13 standard is selected with the type "Metering CT".

Table 8-11: Parameters and settings for IEEE C57.13 metering CTs

Param.	Description	Available for IEEE C57.13 metering CTs, class 0.15, 0.15S, 0.15N, 0.3, 0.3S, 0.6, 1.2, 2.4, 4.8
RF	<p>Continuous current rating factor.</p> <p>Possible values: Value from 1.0 to 4.0 or soft keys RF1.5, RF2, RF3 or RF4.</p> <p>Default: 2.</p>	x
Burden designation	<p>Use this field to specify the operating burden of IEEE C57.13 metering CTs by selecting a burden designation defined in the standard using the soft keys (instead of using the "VA" parameter).</p> <p>If you use the "VA" parameter to specify the operating burden, the "Burden designation" field displays the standard burden designation (for example, B-0.1) corresponding to this burden value (if the burden value specified is a standard burden) or CUSTOM, if the burden value specified in the "VA" field is not defined in the standard.</p> <p>Possible values: Soft keys ?, E-0.04, E-0.2, B-0.1, B-0.2, B-0.5, B-0.9 or B-1.8.</p> <p>Using the Assess @ VA option for the "Class" parameter, it is possible to perform assessment only for one specific burden or a burden range instead of the maximum burden specified and all lower burdens defined in the standard (see also the explanations regarding IEEE C57.13 metering CTs given for the "Class" parameter on page 93).</p> <p>Proceed as follows to perform assessment only for a specific burden value or burden range using the Assess @ VA option:</p> <ul style="list-style-type: none"> ▶ Select the "Class" field. ▶ Press the Assess @ VA soft key and then select the class using the soft keys (for example, Class 0.15). ▶ Select the "Burden designation" field and select a standard burden using the soft keys (for example, B-0.9) to specify the burden value or the lower limit of the burden range. ▶ To specify a burden range, press the Range - soft key and select the upper limit of the range using the available soft keys. ▶ The "Burden designation" field displays the standard burden or the burden range selected for assessment (for example, B-0.9 - B1.8). The ratio table and the phase table in the Ratio card will now only show the error for this specific burden or burden range. 	x

8.3 Burden card

The **Burden** card of the Advanced CT Test mode is only available if it is enabled on the **Select Cards** page (Default Test Card Selection or **Select Cards** soft key in the **CT-Object** card).

Using the **Burden** card, a current transformer’s secondary burden impedance can be measured with the selected secondary current (I_{sn}) at nominal frequency. If a current other than I_{sn} should be used to test the burden, the desired test current can be entered in the "I-test" parameter field.

No soft keys are available in the **Burden** card.

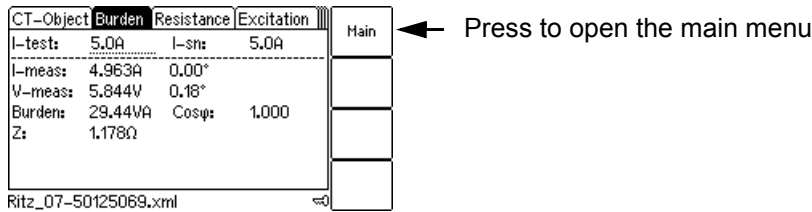


Figure 8-4: **Burden** card

If *CT Analyzer* cannot reach the desired test current I_{test} , an overload message is displayed in the right-hand corner of the status line.

8.3.1 Test settings

The following settings can be done in the **Burden** card.

Table 8-12: Test settings in the **Burden** card

Parameter	Description															
I-test	<p>Test current used to measure the external burden.</p> <p>After clearing the test results or when starting a new CT test, the test current is automatically chosen as follows:</p> <table border="1"> <thead> <tr> <th>Value for I-sn in CT-Object card</th> <th>Value for I-test in Burden card</th> <th>Test current used for burden test</th> </tr> </thead> <tbody> <tr> <td>"?"</td> <td>none</td> <td>1A</td> </tr> <tr> <td>e.g. "?"</td> <td>e.g. 5A</td> <td>5A (value of I-test)</td> </tr> <tr> <td>e.g. 5A</td> <td>none</td> <td>5A (value of I-sn)</td> </tr> <tr> <td>e.g. 5A</td> <td>e.g. 1A</td> <td>1A (value of I-test)</td> </tr> </tbody> </table> <p>It is possible to overwrite the default test current using the keyboard (0.1 to 5A). Always verify the test current settings prior to starting the test in order to avoid damaging of the CT or other equipment.</p>	Value for I-sn in CT-Object card	Value for I-test in Burden card	Test current used for burden test	"?"	none	1A	e.g. "?"	e.g. 5A	5A (value of I-test)	e.g. 5A	none	5A (value of I-sn)	e.g. 5A	e.g. 1A	1A (value of I-test)
Value for I-sn in CT-Object card	Value for I-test in Burden card	Test current used for burden test														
"?"	none	1A														
e.g. "?"	e.g. 5A	5A (value of I-test)														
e.g. 5A	none	5A (value of I-sn)														
e.g. 5A	e.g. 1A	1A (value of I-test)														

8.3.2 Test results

The lower part of the **Burden** card shows the results of the burden test after the test is finished.

Table 8-13: Test results in the Burden card

Parameter	Description
I-meas	Current measured during the test.
V-meas	Voltage measured at the load during the test.
Burden / Cos φ	Burden and cos φ calculated from the measured quantities. If the rated secondary current is not known, the result field will only show "n/a" as long as I_{SN} is not defined.
Z	Impedance of the burden calculated from the measured quantities.

8.3.3 Connecting the burden and running the burden test

1. Press the **Select Cards** key soft in the **CT-Object** card to open the **Select Cards** page. Enable the **Burden** test card in the **Select Cards** page. Press the **Back** soft key to apply your test card selection and to return to the **CT-Object** card.

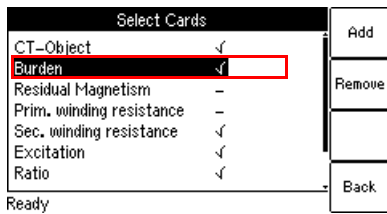


Figure 8-5: **Select Cards** page with **Burden** test card enabled

2. In the **Burden** card, use the default test current or enter the desired test current to parameter "I-test".
3. Execute the burden test as described in section 5.2.3 on page 57.

Possible test steps following the burden test:

- ▶ Residual magnetism measurement, see section 8.4.2 on page 110.
- ▶ Primary resistance measurement, see section 5.2.3, steps 4. & 5. on page 58.
- ▶ CT test, see section 5.2.3, steps 7. to 11. on page 59, and sections 5.2.4 on page 60 and 5.2.5 on page 61.

8.4 Residual Magnetism card

Note: *Residual magnetism* is an optional feature. The functionality described below is only available if you have purchased a corresponding license. For further information, please contact your OMICRON sales contact or the OMICRON office nearest you.

The **Residual Magnetism** card of the Advanced CT Test mode is only available if it is enabled on the **Select Cards** page (Default Test Card Selection or **Select Cards** soft key in the **CT-Object** card).

High transient currents or DC currents applied to the primary side of a CT can cause saturation effects inside the CT with a possible subsequent displacement of the operating point on the CT's excitation curve. The CT then has a residual magnetic flux in its core even if no current is applied on the primary side. The CT has residual magnetism.

Residual magnetism in CTs may cause erroneous tripping or prevent tripping of the connected protection relay since the behavior of the CT is no longer as specified and expected.

Using the **Residual Magnetism** card it is possible to measure the residual magnetism of CTs.

CT Analyzer performs demagnetization of the CT after the test is finished. Please note that the residual magnetism the CT had prior to testing gets lost through the test.

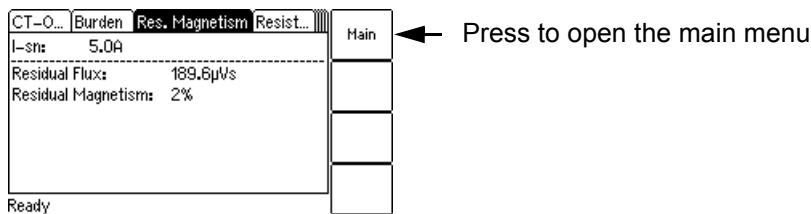


Figure 8-6: **Residual Magnetism** card

Note: The wiring for residual magnetism measurement is identical to the wiring for a normal CT test (see section 3.4.1 on page 27).

Note: Gapped cores normally have very low residual magnetism. *CT Analyzer* is possibly not able to determine the knee point of gapped cores.

8.4.1 Test settings and results

The following settings and test results are displayed in the **Residual Magnetism** card.

Table 8-14: Test settings and results in the **Residual Magnetism** card

Parameter	Description
I _{sn}	Nominal secondary current of the CT as entered in the CT-Object card. The I _{sn} of the CT has to be specified prior to the execution of the residual magnetism measurement. Otherwise, a corresponding message is displayed.
Residual Flux	Absolute value [in Vs] of the residual magnetic flux in the CT determined by <i>CT Analyzer</i> . The residual flux is always displayed after measurement, even if <i>CT Analyzer</i> could not determine the residual magnetism.
Residual Magnetism	Residual magnetism [in %] of the CT, calculated from the residual flux and the maximum flux of the CT. No value is displayed if <i>CT Analyzer</i> was not able to reach the knee point of the excitation curve.

8.4.2 Running a residual magnetism measurement

1. Press the **Select Cards** soft key in the **CT-Object** card to open the **Select Cards** page. Enable the **Residual Magnetism** test card in the **Select Cards** page. Press the **Back** soft key to apply your test card selection and return to the **CT-Object** card.

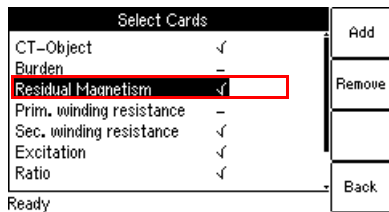


Figure 8-7: **Select Cards** page with **Residual Magnetism** test card enabled

2. If not already specified, enter the I_{sn} of the CT on the **CT-Object** card.

3. Connect the CT to *CT Analyzer* as described in chapter 3.
 - ▶ Make sure that the red LED on *CT Analyzer* is off.
 - ▶ Refer to section 3.4.1 on page 27 for detailed information on how to connect *CT Analyzer*. The wiring for the residual magnetism measurement is identical to the wiring for the CT test.
 - ▶ Be sure that the polarity of all wires is correct.
 - ▶ You can display the connection diagram by pressing the **?** key while the wiring check message is displayed.

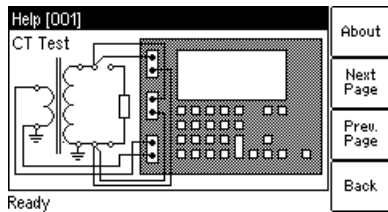


Figure 8-8: Wiring diagram for residual magnetism measurement and CT testing

4. Start the test by pressing the **◀▶** key.

WARNING



Death or severe injury caused by high voltage or current possible

As long as the red LED on the *CT Analyzer* test set is flashing, the output is active and lethal voltages can occur due to the high energy stored in external inductors.

- ▶ Do not touch the equipment under test or the measurement leads while the red LED on *CT Analyzer* is flashing.
- ▶ Never connect or disconnect measurement leads while the red LED on *CT Analyzer* is flashing.

5. **If the burden test is enabled**, the test halts and *CT Analyzer* displays a corresponding message, asking you to check the wiring for the burden test. Connect the burden and run the burden test as described in section 5.2.3, steps 2. & 3. on page 57.
6. After the burden measurement is finished, the test halts to allow rewiring for the residual magnetism measurement. Make sure that the red LED on *CT Analyzer* is off and reconnect the CT as described in step 3 above.
7. Continue testing by pressing the **Start Test** soft key.
8. *CT Analyzer* runs the residual magnetism measurement.
9. **If the primary resistance measurement is enabled**, the test halts and *CT Analyzer* displays a corresponding message, asking you to check the wiring for the test. Connect *CT Analyzer* and run the primary winding resistance measurement as described in section 5.2.3, steps 4. & 5. on page 58.
10. After the primary resistance measurement is finished, the test halts to allow rewiring for the CT test. Connect *CT Analyzer* and run the CT test as described in section 5.2.3, steps 6. to 11. on page 59.

8.5 Resistance card

The **Resistance** card of the Advanced CT Test mode is only available if winding resistance measurement is enabled in the **Select Cards** page (Default Test Card Selection or **Select Cards** soft key in the **CT-Object** card).

The **Select Cards** page offers two different types of winding resistance measurements for selection:

- ▶ **Primary winding resistance measurement** (only required in case of a perceptible primary winding resistance, i.e., if the primary winding actually consists of multiple turns). See section 8.5.1 on page 113 for more information.
- ▶ **Secondary winding resistance measurement** (always required for CT testing for particular calculations in the excitation and ratio test). See section 8.5.2 on page 113 for more information.

Depending on your selection on the **Select Cards** page, the **Resistance card** shows the parameters and results for the primary winding resistance measurement or the secondary winding resistance measurement only, or for both measurements.

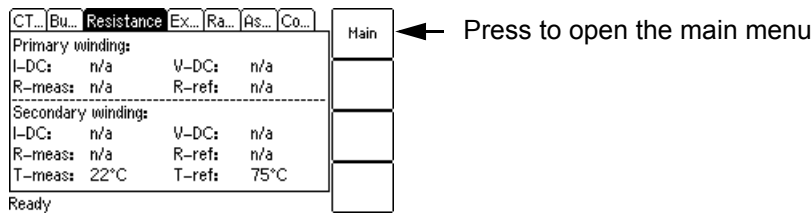


Figure 8-9: **Resistance card** showing parameters and results for primary *and* secondary winding resistance measurement

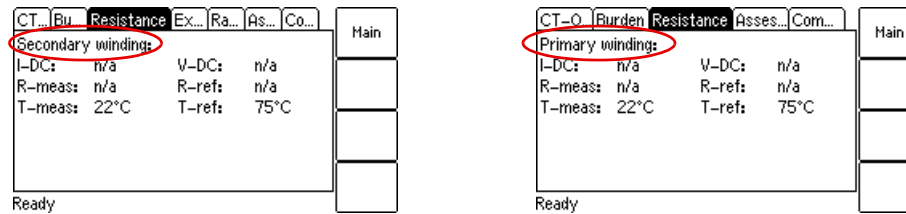


Figure 8-10: **Resistance card** for secondary winding resistance measurement only (left) and for primary winding resistance measurement only (right)

8.5.1 Primary winding resistance measurement

Measuring the primary winding resistance is only required in case of a perceptible primary winding resistance, i.e., if the primary winding actually consists of multiple turns.

Primary winding resistance measurement is performed prior to the CT test and requires special wiring.

Note: If no CT test is performed following the primary winding resistance test, a demagnetizing cycle is performed after the test to guarantee complete demagnetization of the CT.

Running the primary winding resistance measurement

1. Press the **Select Cards** soft key in the **CT-Object** card to open the **Select Cards** page. Enable the **Primary winding resistance** measurement in the **Select Cards** page. Press the **Back** soft key to apply your selection and return to the **CT-Object** card.

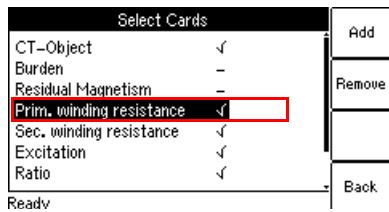


Figure 8-11: **Select Cards** page with **Primary winding resistance** measurement enabled


2. Execute the test as described in section 5.2.3 on page 57.

WARNING



Death or severe injury caused by high voltage or current possible

This measurement is performed with DC current.

- ▶ Do not open the measurement circuit while current is flowing.
- ▶ Stop the measurement by pressing the  key on *CT Analyzer* and wait until the red LED is off before opening the measurement circuit.

8.5.2 Secondary winding resistance measurement

During the CT test, secondary winding resistance measurement is necessary since the CT winding resistance is needed for particular calculations in the excitation and ratio test. This measurement is performed completely automatically.

Note: If only the secondary winding resistance test is selected, a demagnetizing cycle is performed after the test to guarantee complete demagnetization of the CT.

8.5.3 Test settings and results

The following settings are required to perform a winding resistance test.

Table 8-15: Test settings for secondary winding resistance measurement

Parameter	Description
T-meas	Winding temperature of the CT at the time of measurement. Value used: Ambient Temperature defined in the Settings (main menu). If this temperature is not set correctly, the reference resistance value (R_{ref}) at reference temperature will not be calculated correctly.
T-ref	Reference temperature, i.e., temperature the CT is specified for. Value used: Reference temperature defined in the Settings (main menu). The winding resistance at reference temperature is calculated from the winding resistance measured at ambient temperature (T_{meas}) and the specified reference temperature.

The following parameters show the results of the winding resistance test after the test is finished.

Table 8-16: Test results for secondary winding resistance measurement

Parameter	Description
I-DC	Current used for measurement. Selected automatically, cannot be changed by the user. Secondary winding resistance measurement only: If I_{sn} is 0.2 A or higher, I_{DC} is automatically set to I_{sn} . If I_{sn} is lower than 0.2 A, I_{DC} is automatically set to 0.2 A. Maximum value: 5 A. Primary winding resistance measurement only: Maximum value: 10 A.
V-DC	Measured voltage.
R-meas	Measured resistance at ambient temperature.
R-ref	Reference resistance (temperature-compensated resistance, compensated to T_{ref}).

8.6 Excitation card

The **Excitation** card of the Advanced CT Test mode is only available if it is enabled in the **Select Cards** page (Default Test Card Selection or **Select Cards** soft key in the **CT-Object** card).

The excitation test is used to trace the excitation curve of the current transformer and to determine many CT-specific parameters (see test results below). The test is done completely automatically up to a maximum current of $5A_{rms}$.

CTs with closed cores can be tested up to a knee point voltage of 30kV. For CTs with gapped cores the maximum test voltage and current are limited depending on the maximum output power of the device.

The settings for the excitation test are specified in the **CT-Object** card. For a better understanding of the test results, the most important settings from the **CT-Object** card are shown in the upper part of the **Excitation** card.

The test results displayed in the lower part of the **Excitation** card depend on the standard selected in the **CT-Object** card. Using the soft keys, the user can choose between different sets of results. If the **Results with Nom. Burden** soft key is pressed, the page shows the results related to the nominal burden ("VA" parameter in **CT-Object** card). If the **Results with Op. Burden** soft key is pressed, the page shows the results related to the operating burden ("Burden" parameter in **CT-Object** card).

Pressing the **Excit. Graph** soft key opens a page with the excitation graph (see page 121).

Pressing the **AL Error Graph** soft key opens a page with a graph showing the maximum possible primary current ($K * I_{pn}$) that can flow over a specific burden without exceeding the accuracy limit (5% or 10%).

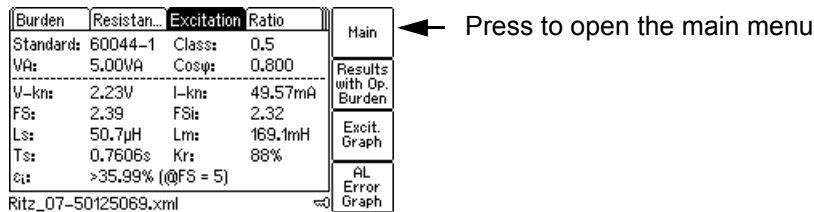






Figure 8-12: **Excitation** card with values related to nominal burden

If *CT Analyzer* displays an overload in the **Excitation** card, either the desired knee point could not be reached or not all necessary measurement points could be taken (e.g. in the knee point area, not enough points for a proper calculation of the knee point could be measured).

8.6.1 Available soft keys

Table 8-17: Soft keys available in the **Excitation** card

Soft key	Description
 or 	Displays the results related to the nominal burden of the CT. Displays the results related to the operating burden of the CT.
	Opens the excitation graph page (refer to section 8.6.4 on page 121).
	Opens the AL error graph page (refer to section 8.6.5 on page 124). This graph is part of Chinese standards and shows the maximum possible primary current ($K * I_{pn}$) that can flow over a specific burden without exceeding the accuracy limit.

8.6.2 Test settings

The upper part of the **Excitation** card shows the test settings adjusted in the **CT-Object** card.

8.6.3 Test results

The test results are displayed in the lower part of the **Excitation** card. The display of test results depends on the following:

- The standard defined in the **CT-Object** card, the class and the type of CT (metering or protection CT). The following tables provide an overview of which test results (parameters) are displayed for which standard.
- The burden selected with the soft key (**Results with Nom. Burden** or **Results with Op. Burden**).

Depending on the selected burden, the **Excitation** card shows the results either calculated with the nominal burden (**Results with Nom. Burden**) or calculated with the operating burden (**Results with Op. Burden**).

The displayed pages are identical to a large extend, except the labeling of the burden parameter field ("VA" in case of nominal burden and "Burden" in case of operating burden) and the result values.

Test results displayed in the Excitation card for IEC 60044-1

Table 8-18: Test results for IEC 60044-1

Param.	Description	Results displayed for IEC 60044-1			
		protection CTs			metering CTs
		...P	...PR	PX	
V-kn	Knee point voltage (acc. to standard) of the topmost knee point found.	x	x	x	x
I-kn	Knee point current (acc. to standard) of the topmost knee point found.	x	x	x	x
Ls	Saturated inductance.	x	x	x	x
Lm	Non-saturated inductance.	x	x	x	x
Ts	Secondary time constant.	x	x	x	x
Kr	Remanence factor.	x	x	x	x
ϵ_j	Indirect error (acc. to standard).	x	x		x
ALF	Accuracy limiting factor according to IEC 60044-1 direct measurement method, calculated for nominal and operating burden. ¹	x	x		
ALFi	Accuracy limiting factor according to IEC 60044-1 indirect measurement method, calculated for nominal and operating burden. ¹	x	x		
FS	Instrument security factor according to IEC 60044-1 direct measurement method, calculated for nominal and operating burden. ¹				x
FSi	Instrument security factor according to IEC 60044-1 indirect measurement method, calculated for nominal and operating burden. ¹				x
Kx	Dimensioning factor (acc. to IEC 60044-1 class PX) at accuracy limit with the selected load.			x	
Ek	Accuracy limiting voltage according to IEC 60044-1 for class PX (that point on the excitation graph where an increase of the e.m.f. r.m.s. voltage (core flux) by 10% causes an increase of the r.m.s. current by 50%).			x	
Ie	Accuracy limiting current according to IEC 60044-1 class PX (at E_k).			x	
E1	User-defined e.m.f. to verify the excitation current at this e.m.f.			x	
Ie1	Max. allowed excitation current at E_1 .			x	

1. If *CT Analyzer* is not able to measure up to the actual value, the prefix ">" is displayed to indicate that the measurement value is larger than the displayed value.

Test results displayed in the Excitation card for IEC 60044-6

Table 8-19: Test results for IEC 60044-6

Param.	Description	Results displayed for IEC 60044-6, class			
		TPS	TPX	TPY	TPZ
V-kn	Knee point voltage according to standard.	x	x	x	x
I-kn	Knee point current according to standard.	x	x	x	x
Ls	Saturated inductance.	x	x	x	x
Lm	Non-saturated inductance.	x	x	x	x
Ts	Secondary time constant.	x	x	x	x
Kr	Remanence factor.	x	x	x	x
Kssc	Rated symmetrical short-circuit current factor at accuracy limit with the selected load. ¹	x	x	x	x
Ktd	Theoretical transient dimensioning factor.		x	x	x
V-al	Accuracy limiting voltage according to IEC 60044-6 for class TPS (that point on the excitation graph where an increase of the e.m.f. r.m.s. voltage (core flux) by 10% causes an increase of the peak current by 100%).	x			
I-al	Accuracy limiting current according to IEC 60044-6 class TPS (at V _{al}).	x			
E1	User-defined e.m.f. to verify the excitation current at this e.m.f.	x			
Ie1	Max. allowed excitation current at E ₁ .	x			
E-max	Maximum e.m.f. voltage. This parameter allows the determination of the working point on the excitation curve that would be reached with the entered settings.		x	x	x
$\hat{\epsilon}$	Peak instantaneous error at voltage E _{max} .		x	x	
$\hat{\epsilon}_{ac}$	Peak instantaneous alternating current component error according to the standard.				x

1. If CT Analyzer is not able to measure up to the actual value, the prefix ">" is displayed to indicate that the measurement value is larger than the displayed value.

Test results displayed in the Excitation card for IEC 61869-2

Table 8-20: Test results for IEC 61869-2

Param.	Description	Results displayed for IEC 61869-2							
		protection CTs, class							metering CTs
		...P	...PR	PX	PXR	TPX	TPY	TPZ	
V-kn	Knee point voltage according to standard.	x	x	x	x	x	x	x	x
I-kn	Knee point current according to standard.	x	x	x	x	x	x	x	x
Ls	Saturated inductance.	x	x	x	x	x	x	x	x
Lm	Non-saturated inductance.	x	x	x	x	x	x	x	x
Ts	Secondary time constant.	x	x	x	x	x	x	x	x
Kr	Remanence factor.	x	x	x	x	x	x	x	x
ε_i	Indirect error (acc. to standard).	x	x						x
FS	Instrument security factor according to IEC 61869-2 direct measurement method, calculated for nominal and operating burden. ¹								x
FSi	Instrument security factor according to IEC 61869-2 indirect measurement method, calculated for nominal and operating burden. ¹								x
ALF	Accuracy limiting factor according to IEC 61869-2 direct measurement method, calculated for nominal and operating burden. ¹	x	x						
ALFi	Accuracy limiting factor according to IEC 61869-2 indirect measurement method, calculated for nominal and operating burden. ¹	x	x						
Kx	Dimensioning factor (acc. to IEC 61869-2) at accuracy limit with the selected load.			x	x				
Ek	Accuracy limiting voltage according to IEC 61869-2 (that point on the excitation graph where an increase of the e.m.f. r.m.s. voltage (core flux) by 10% causes an increase of the r.m.s. current by 50%).			x	x				
Ie	Accuracy limiting current according to IEC 61869-2 (at Ek).			x	x				
E1	User-defined e.m.f. to verify the excitation current at this e.m.f.			x	x				
Ie1	Max. allowed excitation current at E ₁ .			x	x				
Kssc	Rated symmetrical short-circuit current factor at accuracy limit with the selected load. ^{1, 2}					x	x	x	
Ktd	Theoretical transient dimensioning factor. ³					x	x	x	

Table 8-20: Test results for IEC 61869-2 (continued)

Param.	Description	Results displayed for IEC 61869-2						
		protection CTs, class						metering CTs
		...P	...PR	PX	PXR	TPX	TPY	
E-max	Maximum e.m.f. voltage. This parameter allows the determination of the working point on the excitation curve that would be reached with the entered settings.					x	x	
$\hat{\varepsilon}$	Peak instantaneous error at voltage E_{max} .					x	x	
$\hat{\varepsilon}_{ac}$	Peak alternating error component acc. to the standard.							x

1. If *CT Analyzer* is not able to measure up to the actual value, the prefix ">" is displayed to indicate that the measurement value is larger than the displayed value.
2. If parameter "Spec." is set to "by Duty" in the **CT-Object** card (see page 101), no calculation is performed for this parameter if the user did not specify values for T_p and t_{a11} in the **CT-Object** card prior to the test.
3. This parameter is only displayed if parameter "Spec." is set to "by Duty" in the **CT-Object** card (see page 101). No calculation is performed for this parameter if the user did not specify values for T_p and t_{a11} in the **CT-Object** card prior to the test.

Test results displayed in the Excitation card for IEEE C57.13

Table 8-21: Test results for IEEE C57.13

Param.	Description	Results displayed for IEEE C57.13	
		protection CTs	metering CTs
V-kn	Knee point voltage according to standard.	x	x
I-kn	Knee point current according to standard.	x	x
Ls	Saturated inductance.	x	x
Lm	Non-saturated inductance.	x	x
Ts	Secondary time constant.	x	x
Kr	Remanence factor.	x	x
Vs (10% RE) ¹	Terminal voltage at 10 % ratio error.	x ¹	
Vs (User def. % RE) ²	Terminal voltage at the user-defined percentage of the ratio error specified for the RE(20*Isn) parameter in the CT-Object card.	x ²	
FS	Instrument security factor (direct measurement method), calculated for nominal and operating burden. ³		x
FSi	Instrument security factor (indirect measurement method), calculated for nominal and operating burden. ¹		x

1. For IEEE C57.13 classes C, T and K.
2. For IEEE C57.13 class X only.
3. If *CT Analyzer* is not able to measure up to the actual value, the prefix ">" is displayed to indicate that the measurement value is larger than the displayed value.

8.6.4 Excitation graph

The excitation graph page shows the graph calculated from the test results. To display the excitation graph, press the **Excit. Graph** soft key in the **Excitation** card. The graph shows the r.m.s. terminal/core voltage over the r.m.s./peak current depending on the selected standard.

On the bottom right of the diagram the voltage, current and inductance values for the selected point in the graph are displayed. The currently selected point in the graph is marked by a horizontal and a vertical dashed line.

In this page it is possible to load the excitation graph of an already saved test from the Compact Flash card in order to compare this graph with the one of the current test.

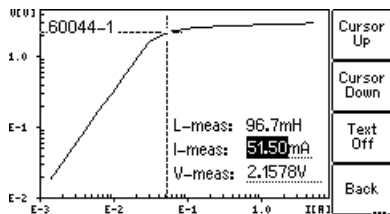


Figure 8-13: Excitation graph

Definition of axes in the excitation graph for different standards

Table 8-22: Definition of axes in the excitation graph

Standard	Vertical axis	Horizontal axis
IEC 60044-1	r.m.s. terminal voltage	r.m.s. excitation current
IEC 60044-6	r.m.s. e.m.f. voltage	peak excitation current
IEC 61869-2	average rectified ¹ terminal voltage	r.m.s. excitation current
IEEE C57.13	r.m.s. e.m.f. voltage	r.m.s. excitation current










1. Calibrated to r.m.s.

Available soft keys

Table 8-23: Soft keys available for the excitation graph

Soft key	Description
Cursor Up	Moves the cursor upwards on the excitation graph.
Cursor Down	Moves the cursor downwards on the excitation graph.
Text Off	Switches off the display of values on the bottom right of the diagram. If you have switched off the values, this soft key changes to Text On to switch the values display on again.

Table 8-23: Soft keys available for the excitation graph (continued)

Soft key	Description
	<p>Closes the excitation graph and brings you back to the Excitation card.</p>
	<p>Moves the cursor to the knee point on the graph according to the selected standard. If two or more knee points could be found on the graph, this soft key is alternately labeled Knee Point 1 or Knee Point 2, depending on which knee point the cursor is actually positioned to. By pressing the soft key you can switch between knee point 1 and knee point 2.</p> <p>After opening the excitation graph, the cursor shows the topmost knee point (knee point 1) and the soft key is labeled Knee Point 2.</p>
	<p>Moves the cursor to the knee point on the reference graph. This soft key is only available if a reference graph is loaded.</p> <p>If the reference graph loaded has two or more knee points, this soft key is alternately labeled Ref. Knee Point 1 or Ref. Knee Point 2, depending on which knee point the cursor is actually positioned to. By pressing the soft key you can switch between knee point 1 and knee point 2.</p> <p>After loading the reference graph, the cursor shows the topmost knee point (knee point 1) and the soft key is labeled Ref. Knee Point 2.</p>
	<p>Opens the file system card to select a previous test in order to load the excitation curve of this test as a reference curve and compare it with the current one.</p> <p>The reference curve is displayed as a dotted line in addition to the excitation curve of the actual test. If a reference curve is loaded, the values V_{ref}, I_{ref} and L_{ref} are displayed in addition to the measured values.</p>
	<p>Switches off the reference curve from the display. If you have switched off the reference curve, the soft key changes to Ref. On to switch the reference curve on again.</p> <p>This soft key is only available if a reference curve has been loaded.</p>
   	<p>By pressing one of these soft keys you can display the measured excitation graph and knee point as defined in the respective standard.</p> <p>IEEE C57.13 displays the knee point for the 45° tangent. After pressing this soft key, its labeling changes to IEEE C57.13 (30°) to enable the display of the knee point for the 30° tangent. 30° is recommended for gapped cores in IEEE C37.110, chapter 4.3.</p> <p>Note: The test report only contains the graph for the standard selected in the CT-Object card.</p>

Viewing the measured values for different points on the graph

By default, the knee point values are displayed after opening the excitation graph page. However, you can also view the corresponding voltage, current and inductance values for any point on the graph. To select a specific point on the graph,

- ▶ either use the soft keys (**Cursor Up**, **Cursor Down**, **Knee Point**)
- ▶ or enter a specific voltage or current value using the keyboard:
 - ▶ Select the desired edit field using the ▲ ▼ cursor keys.
 - ▶ Enter the desired voltage or current value using the keyboard.
 - ▶ Press the ← key to apply the entered value and read the corresponding values in the respective fields (e.g. "V-meas" and "L-meas" if you have entered a current "I-meas").

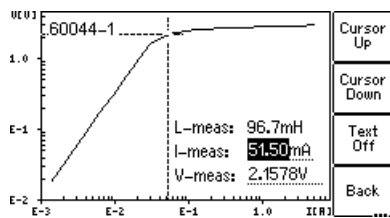


Figure 8-14: Entering a current value to display its corresponding voltage and inductance values on the excitation graph

8.6.5 Accuracy limiting error graph*

* According to the "China Electric Regulations for protection CTs".

To display the AL error graph, press the **AL Error Graph** soft key in the **Excitation** card.

Note: The "AL Error Graph" function can be switched on or off in the device settings (Main Menu -> Settings -> Accur. Limiting Error Graph). If switched off, the AL error graph is not included in the test report.

All standards are supported, except IEC 60044-6 class TPZ.

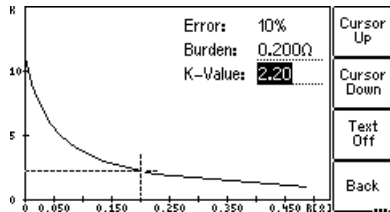








Figure 8-15: AL error graph

Available soft keys




Table 8-24: Soft keys available for the accuracy limiting error graph

Soft key	Description
	Moves the cursor upwards on the error graph.
	Moves the cursor downwards on the error graph.
	Switches off the display of values on the top right of the diagram. If you have switched off the values, this soft key changes to Text On to switch the values display on again.
	Closes the AL error graph and brings you back to the Excitation card.
	Moves the cursor to that point on the error graph that corresponds to the nominal burden value defined in the "VA" field of the CT-Object card (value entered by the user or determined by <i>CT Analyzer</i>).
	Moves the cursor to that point on the error graph that corresponds to the operating burden value defined in the "Burden" field of the CT-Object card (value entered by the user or determined by <i>CT Analyzer</i>).

Viewing the measured values for different points on the graph

By default, the cursor is positioned to the nominal burden values after opening this page.

To select a specific point on the graph:

- ▶ Select the desired edit field "K-Value" or "Burden" using the   cursor keys and enter the desired value using the keyboard.
- ▶ Press the  key to apply the entered value and read the corresponding value in the respective field.

8.7 Ratio card

The **Ratio** card of the Advanced CT Test mode is only available if it is enabled in the **Select Cards** page (Default Test Settings or **Select Cards** soft key in the **CT-Object** card).

The ratio test measures the current ratio of the CT considering the operating burden (parameter "Burden" in **CT-Object** card) or the nominal burden (parameter "VA" in **CT-Object** card).

The results of the ratio test can be found in 3 pages:

- The **Ratio** card (refer to Figure 8-16) shows the polarity, the ratio error and the phase displacement for the primary current and the burden defined in the **CT-Object** card.

If the **Results with Nom. Burden** soft key is pressed, the page shows the results related to the nominal burden ("VA" parameter in the **CT-Object** card). If the **Results with Op. Burden** soft key is pressed, the page shows the results related to the operating burden ("Burden" parameter in the **CT-Object** card).

- The **ratio table** shows the current ratio error for different currents (200% down to 1% of the rated current) at different burden values (depending on the selected standard, see section 8.7.4 on page 128 and 8.7.5 on page 129).
- The **phase table** shows the phase displacement for different currents at different burden values (depending on the selected standard, see section 8.7.4 on page 128 and 8.7.5 on page 129).

For a better understanding of the test results, the most important settings from the **CT-Object** card are shown once again in the upper part of the **Ratio** card.





Note: Although the test is not performed with the real current, the test results reflect the current ratio and not the voltage ratio.

CT-Object	Resistance	Excitation	Ratio	Main
Standard: 60044-1	Class: 0.5			← Press to open the main menu
VA: 5.00VA	Cosφ: 0.800			
-----				Results with Op. Burden
Ratio: 300.0 : 5.0009			0.017%	Ratio Table
Pol.: OK	ε _{ct} :		0.063%	Phase Table
Phase: 1.95min				
N: 59.70				
I-p: 300.0A				
Ready				

Figure 8-16: **Ratio** card

8.7.1 Available soft keys

Table 8-25: Soft keys available in the **Ratio** card

Soft key	Description
 or 	Displays the results related to the operating burden of the CT. Displays the results related to the nominal burden of the CT.
	Displays the ratio table (refer to section 8.7.4 on page 128 and 8.7.5 on page 129). In the ratio table it is also possible to display the values related to the nominal burden or the operating burden of the CT.
	Displays the phase table (refer to section 8.7.4 on page 128 and 8.7.5 on page 129). In the phase table it is also possible to display the values related to the nominal burden or the operating burden of the CT.

8.7.2 Test settings

The following settings can be done in the **Ratio** test card.

Table 8-26: Test settings in the **Ratio** card

Parameter	Description
I-p	Primary current for calculation of the ratio error and phase displacement with the burden (operating burden) defined in the CT-Object card. After the test is finished, it is possible to change the value for the primary current. The ratio error and/or the phase error are then recalculated and displayed again. When storing the test results, the currently displayed measurement results are stored. Changing this value only influences the results displayed in the Ratio card (operating burden related values). It does not affect the values displayed in the separate pages for the ratio and phase tables (values related to nominal burden). Default: Value of I_{pn}

8.7.3 Test results

The following test results are displayed in the lower part of the **Ratio** card. In addition to the results displayed in the **Ratio** card you can view the ratio and phase table pages described in section 8.7.4 on page 128 and 8.7.5 on page 129.

Table 8-27: Test results in the **Ratio** card

Parameter	Description
Ratio	Current ratio error (in %) at the specified primary current (I_p) and burden.
Pol.	OK: Polarity OK, phase angle is in the range of $0^\circ \pm 45^\circ$. Failed: Wrong polarity of the CT or wrong polarity of the measurement leads.
ϵ_C	Composite error in % at the specified primary current (I_p) and operating burden. This parameter is only displayed if the IEC 60044-1 standard is selected in the CT-Object card.
Phase	Phase displacement (in minutes) at the specified primary current (I_p) and burden.
N	Winding turns ratio.
et	Turns ratio error acc. to IEC 60044-6 class TPS or IEC 60044-1 class PX.
RCF	Ratio correction factor. This parameter is only displayed if the IEEE C57.13 standard is selected in the CT-Object card.
TCF	Transformer correction factor. This parameter is only displayed if the IEEE C57.13 standard is selected in the CT-Object card.
RE@(20*Isn)	Ratio error at $20 * I_{sn}$. This parameter is only displayed if the IEEE C57.13 standard with class C, T or X is selected in the CT-Object card.

8.7.4 Ratio table and phase table for IEC 60044-1, IEC 60044-6 and IEC 61869-2



To display the ratio table or the phase table, press the **Ratio Table** or **Phase Table** soft key in the **Ratio** card.

If the selected standard is **IEC 60044-1**, **IEC 60044-6** or **IEC 61869-2**, these tables show the ratio error and the phase displacement

- for different current values between 1% and 200% of the rated current, and
- at 100%, 50%, 25% and 12.5% of the **operating burden** defined in the **CT-Object** card ("Burden" parameter), and
- at 100%, 50%, 25% and 12.5% of the **nominal burden** defined in the **CT-Object** card ("VA" parameter) or at 1VA if one of these percentages results in a nominal burden smaller than 1VA.

Use the **Results with Op. Burden** or **Results with Nom. Burden** soft key to display the results related to the operating burden ("Burden" parameter in the **CT-Object** card) or related to the nominal burden ("VA" parameter in the **CT-Object** card).

The ratio table and the phase table contain all measurement points defined in the standards IEC 60044-1, IEC 60044-6 and IEC 61869-2.

Use the   cursor keys to scroll through the table columns (1% of rated current to 200% of rated current).

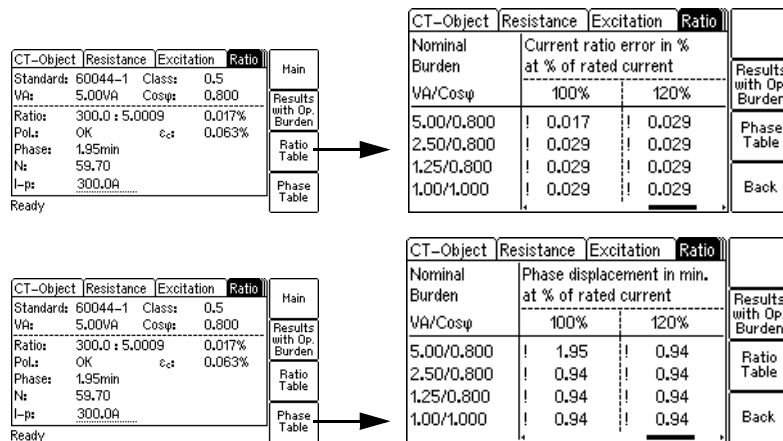


Figure 8-17: Displaying the ratio table and the phase table in the **Ratio** card (for IEC 60044-1, IEC 60044-6 and IEC 61869-2)

Note: Values that caused a failed assessment are highlighted by black background in the tables. Values without the prefix "!" have guaranteed accuracy. The accuracy of values marked with a "!" in the tables is reduced by factor 2.

Note: For IEC 60044-1 metering CTs with $I_{sn} = 5A$, it is possible to increase the minimum **nominal burden** used for the assessment to 3.75VA in the device settings (Main menu -> Settings -> Rated Burden Constraints -> "Min. VA at M cores Isn 5A" parameter). In this case, the lowest nominal burden value displayed in the ratio table and the phase table is 3.75VA instead of 1VA. Please note that this only applies if the results are displayed with the nominal burden. It has no effect if the results in the ratio table and the phase table are displayed with the operating burden.

8.7.5 Ratio table and phase table for IEEE C57.13

To display the ratio table or the phase table, press the **Ratio Table** or **Phase Table** soft key in the **Ratio** card.

If the selected standard is **IEEE C57.13**, these tables show the ratio error and the phase displacement





- for different current values between 1% and 200% of the rated current.
- at the burden specified in the **CT-Object** card and all burden values defined in the IEEE C57.13 standard that are smaller than the specified burden.

If the **Assess @ VA** option has been selected for the "Class" parameter of an IEEE C57.13 metering CT in the **CT-Object** card, the tables only show the ratio error and the phase displacement for the burden value or burden range specified in the **CT-Object** card.

Use the **Results with Op. Burden** or **Results with Nom. Burden** soft key to display the results related to the operating burden or related to the nominal burden.

Note: If a high accuracy license is available for IEEE C57.13, metering burdens also include the electronic burdens.

The ratio table and the phase table contain all measurement points defined in the IEEE C57.13 standard.

Use the   and   cursor keys to scroll through the table columns (1% of rated current to 200% of rated current) and table lines (burden values).

Note: Values that caused a failed assessment are highlighted by black background in the tables. Values without the prefix "!" have guaranteed accuracy. The accuracy of values marked with a "!" in the tables is reduced by factor 2.

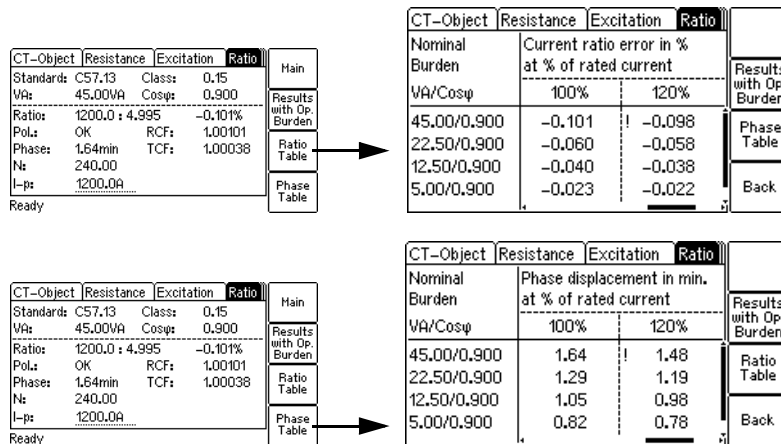


Figure 8-18: Displaying the ratio table and the phase table in the **Ratio** card (for IEEE C57.13)

8.8 Assessment card

The **Assessment** card of the Advanced CT Test mode is only available if it is enabled in the **Select Cards** page (Default Test Card Selection or **Select Cards** soft key in the **CT-Object** card).

Depending on the standard and the type of CT (protection or metering CT), the according parameters are listed.

The automatic assessment column ("Auto") is automatically filled after the test is finished. The following assessments are possible:

- **OK** assessment:
The result measured for the parameter complies with the requirements defined by the selected standard and the parameters in the **CT-Object** card.
The overall test assessment **OK** is assigned if all required parameters could be measured and are within the tolerances.
- **Failed** assessment:
The result measured for the parameter does not comply with the requirements.
The overall test assessment **Failed** is assigned if at least one parameter was assessed **Failed**.
- **n/a** assessment:
No assessment possible for the parameter due to one of the following reasons:
 - Comparison with input parameter is not possible.
 - Assessment does not make sense due to incorrect polarity or invalid measurement value.
 - The parameter could not be determined due to an output limitation of *CT Analyzer* (example: *CT Analyzer* was not able to deliver enough current).
 The overall test assessment **n/a** is assigned if at least one parameter was assessed **n/a** (even if all other parameters were assessed **OK**).

It is also possible to perform manual assessment for the individual parameters. To do this, select the parameter to be assessed using the **▲ ▼** cursor keys and apply your assessment using the **OK**, **Failed** or **?** soft key.

Use the **Show failed & n/a only** soft key to apply an according display filter. The **Assessment** card then only displays the parameters with this assessment. Press **Show all** to display all parameters again.

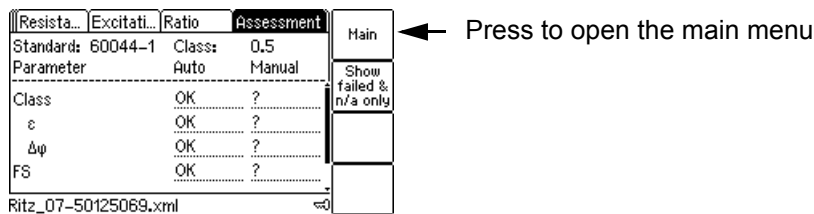


Figure 8-19: **Assessment** card (example)

Note: Correct and reliable assessment according to the standard is only guaranteed if you specify all necessary CT data (nameplate data) prior to the test. If you enter the **?** for one or more parameters to have them determined by the guesser function of *CT Analyzer*, the automatic assessment may possibly be incorrect if the values measured/determined for this parameters differ from the rated values the CT should have according to the nameplate. In other words: If a parameter is guessed by *CT Analyzer*, the automatic CT assessment is partly based on its actual values instead of its rated values and therefore possibly incorrect.

Note: Automatic assessment is only performed for the CT behavior at nominal burden. For the CT behavior at operating burden, no automatic assessment is performed.

Customizing the automatic assessment

The automatic assessment uses predefined assessment rules based on the class definitions stated in the IEC and IEEE standards by default. *CT Analyzer* offers the possibility to use customized assessment rules defined in *CT Analyzer Suite* instead of the predefined assessment rules. See the *CT Analyzer Suite* help for information on how to create customized assessment rule sets. See the Setting Menu option **Select Customized Assessment** on page 68 for information on how to select and apply customized assessment rules in *CT Analyzer*.

8.8.1 Assessment details

It is also possible to display details regarding the automatic assessment for a parameter in the **Assessment** card:

- ▶ Select the **Auto** assessment of a parameter using the cursor keys and then press the ? key to display general assessment information for this parameter.
- ▶ Or select the **Auto** assessment of a parameter using the cursor keys and press the **Details** soft key to display details regarding the assessment for this parameter. The details view of the **Assessment** card depends on the standard and the specific parameter selected. It displays for example the measured value determined by *CT Analyzer*, the rated value to be met for an "OK" assessment and, if applicable, the reason for a "Failed" or "n/a" assessment of the parameter.

8.8.2 Assessed parameters

Parameters assessed for IEC 60044-1

Table 8-28: Parameters assessed for IEC 60044-1 protection CTs

Param.	Description	Parameter assessed for IEC 60044-1 protection CTs						
		standard classes					OMICRON extension	
		5P	10P	5PR	10PR	PX	2P, 3P, 4P, 6P	2PR, 3PR, 4PR, 6PR
Class	Accuracy class according to standard.	x	x	x	x	x	x	x
$\Delta\phi$	Phase deviation.	x		x			x	x
ε	Current ratio error.	x	x	x	x		x	x
ε_c	Composite error.	x	x	x	x		x	x
ε_t	Turns ratio error (incl. in class).					x		
Kr	Remanence factor			x	x			x
Ts	Secondary time constant.			x	x			x
ALFi	Accuracy limiting factor (indirect measurement method).	x	x	x	x		x	x
Ek	Rated knee point e.m.f.					x		

Table 8-28: Parameters assessed for IEC 60044-1 protection CTs (continued)

Param.	Description	Parameter assessed for IEC 60044-1 protection CTs						
		standard classes					OMICRON extension	
		5P	10P	5PR	10PR	PX	2P, 3P, 4P, 6P	2PR, 3PR, 4PR, 6PR
Kx	Dimensioning factor (according to IEC 60044-1 class PX).					x		
le	Accuracy limiting secondary excitation current.					x		
le1	Max. allowed secondary excitation current at E ₁ .					x		
Rct	Secondary winding resistance.			x	x	x		x
Rprim	Primary winding resistance.	x	x	x	x	x	x	x

Table 8-29: Parameters assessed for IEC 60044-1 metering CTs

Param.	Description	Parameter assessed for IEC 60044-1 metering CTs	
		0.1, 0.2, 0.2s, 0.5, 0.5s, 1	3, 5
Class	Accuracy class according to standard.	x	x
$\Delta\phi$	Phase deviation.	x	
ε	Current ratio error.	x	x
FSi	Instrument security factor (indirect meas. method).	x	x
Rprim	Primary winding resistance.	x	x

Parameters assessed for IEC 60044-6

Table 8-30: Parameters assessed for IEC 60044-6

Param.	Description	Parameter assessed for IEC 60044-6			
		TPS	TPX	TPY	TPZ
Class	Accuracy class according to standard.	x	x	x	x
$\Delta\phi$	Phase deviation.		x	x	x
ε	Current ratio error.		x	x	x
εt	Turns ratio error (included in class).	x			
$\hat{\varepsilon}$	Peak instantaneous error at voltage E_{max} .		x	x	
$\hat{\varepsilon}_{ac}$	Peak instantaneous alternating current component error according to the standard.				x
T_s	Secondary time constant.			x	x
K_r	Remanence factor.			x	x
$K_{td} * K_{ssc}$	Transient dimensioning factor (K_{td}) multiplied by the rated symmetrical short-circuit current factor (K_{ssc}).		x	x	x
$K * K_{ssc}$	Dimensioning factor (K) multiplied by the rated symmetrical short-circuit current factor (K_{ssc}).	x			
V-al	Rated equivalent excitation limiting secondary voltage.	x			
I-al	Accuracy limiting secondary excitation current.	x			
R _{ct}	Secondary winding resistance.	x	x	x	x
R _{prim}	Primary winding resistance.	x	x	x	x

Parameters assessed for IEC 61869-2

Table 8-31: Parameters assessed for IEC 61869-2 protection CTs

Param.	Description	Parameter assessed for IEC 61869-2 protection CTs							
		standard classes						OMICRON extension	
		5P	10P	5PR	10PR	PX	PXR	2P, 3P, 4P, 6P	2PR, 3PR, 4PR, 6PR
Class	Accuracy class according to standard.	x	x	x	x	x	x	x	x
$\Delta\varphi$	Phase deviation.	x		x				x	x
ε	Current ratio error.	x	x	x	x			x	x
ε_c	Composite error.	x	x	x	x			x	x
ε_t	Turns ratio error (incl. in class).					x	x		
Kr	Remanence factor			x	x		x		x
Ts	Secondary time constant.			x	x				x
ALFi	Accuracy limiting factor (indirect measurement method).	x	x	x	x			x	x
Ek	Rated knee point e.m.f.					x	x		
Kx	Dimensioning factor (according to IEC 61869-2).					x	x		
le	Accuracy limiting secondary excitation current.					x	x		
le1	Max. allowed secondary excitation current at E_1 .					x	x		
Rct	Secondary winding resistance.			x	x	x	x		x
Rprim	Primary winding resistance.	x	x	x	x	x	x	x	x

Table 8-32: Parameters assessed for IEC 61869-2 transient protection CTs

Param.	Description	Parameter assessed for IEC 61869-2 transient protection CTs		
		TPX	TPY	TPZ
Class	Accuracy class according to standard.	x	x	x
$\Delta\varphi$	Phase deviation.	x	x	x
ε	Current ratio error.	x	x	x
Ktd * Kssc	Transient dimensioning factor (K_{td}) multiplied by the rated symmetrical short-circuit current factor (K_{SSC}).	x	x	x
$\overset{\wedge}{\varepsilon}$	Peak instantaneous error at voltage E_{max} .	x	x	
$\overset{\wedge}{\varepsilon}_{ac}$	Peak alternating error component according to the standard.			x
Ts	Secondary time constant.		x	
Kr	Remanence factor		x	x
Rct	Secondary winding resistance.	x	x	x
Rprim	Primary winding resistance.	x	x	x

Table 8-33: Parameters assessed for IEC 61869-2 metering CTs

Param.	Description	Parameter assessed for IEC 61869-2 metering CTs	
		0.1, 0.2, 0.2s, 0.5, 0.5s, 1	3, 5
Class	Accuracy class according to standard.	x	x
$\Delta\varphi$	Phase deviation.	x	
ε	Current ratio error.	x	x
FSi	Instrument security factor (indirect meas. method).	x	x
Rprim	Primary winding resistance.	x	x

Parameters assessed for IEEE C57.13

Table 8-34: Parameters assessed for IEEE C57.13

Parameter	Description	IEEE C57.13				meter. CTs 0.3, 0.3S, 0.6, 1.2, 2.4, 4.8	IEEE C57.13.6 high accuracy metering CTs 0.15, 0.15S 0.15N
		protection CTs					
		C	T	X	K ¹		
Class	Accuracy class according to standard.	x	x	x	x	x	x
$\Delta\varphi$	Phase deviation.					x	x
RCF	Ratio correction factor.					x	x
RE @ Isn	Current ratio error at secondary current I_{sn} .	x	x	x	x		
RE @ 20 * Isn	Current ratio error at 20 times the secondary current I_{sn} .	x	x	x	x		
Vknee	Knee point voltage.				x		
Vk / Ik	User-defined measuring point.		x	x			
Vk1 / Ik1	User-defined measuring point 1.		x	x			
Rct	Secondary winding resistance.			x			
Rprim	Primary winding resistance	x	x	x	x	x	x

1. Acc. to IEEE C57.13 (2008)

8.9 Comment card

The **Comment** card of the Advanced CT Test mode is only available if it is enabled in the **Select Cards** page (Default Test Card Selection or **Select Cards** soft key in the **CT-Object** card).

Use the **Comment** card to enter additional notes regarding your test.

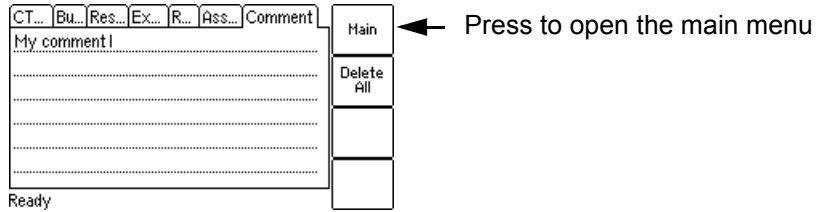


Figure 8-20: **Comment** card

9 Using the guesser function

Applicable for Advanced CT Test (and Advanced MR Test) mode only.

This chapter provides a detailed description how to run a CT test using the guesser function of *CT Analyzer*. Follow the sections 9.2 to 9.5 in the given order.

For reasons of simplicity, the following example only considers a straight forward Advanced CT test without performing a **burden test**, a **primary winding resistance measurement** or a **residual magnetism measurement**.

When working with *CT Analyzer*, always observe the safety rules given in section 3.1 on page 23 and the safety instructions given in chapter 1 "Safety instructions" on page 9.

WARNING



Death or severe injury caused by high voltage or current possible

As long as the red LED on the *CT Analyzer* test set is flashing, the output is active and lethal voltages can occur due to the high energy stored in external inductors.

- ▶ Do not touch the equipment under test or the measurement leads while the red LED on *CT Analyzer* is flashing.
- ▶ Never connect or disconnect measurement leads while the red LED on *CT Analyzer* is flashing.

WARNING



Death or severe injury caused by high voltage or current possible

Accidentally mixing up primary and secondary windings can cause life-threatening voltages and/or destroy the connected CT or *CT Analyzer*.

- ▶ Always make sure that the *CT Analyzer* output is connected to the correct side of the current transformer according to the wiring instructions given in sections 3.4 to 3.5.

WARNING



Death or severe injury caused by high voltage or current possible

Feeding test voltage to a CT can cause life-threatening voltages on other taps and/or cores of the CT.

- ▶ Do not touch other taps or windings of the CT during the test.
- ▶ Make sure that no other windings of the CT are open.
- ▶ If possible, use the optional *CT SB2* switch box for testing multi-ratio CTs. *CT Analyzer* then automatically reduces the test voltage in a way that the maximum possible voltage within the measurement setup (i.e., the voltage occurring at the tap combination with the highest ratio) is limited to 200V.

9.1 About the guesser function

The guesser function of *CT Analyzer* is intended as an aid for the user to find out single unknown name plate data of a CT, for example, if parts of the CT's name plate are unreadable. If sufficient other name plate data of the CT are available and specified by the user, this function is often able to reliably determine single missing CT data, for example I_{prim} , I_{sec} , class or ratio.

Parameters that are guessed by *CT Analyzer* are marked by a question mark in the user interface of the **CT-Object** card prior to the test. To have a parameter guessed by *CT Analyzer*, select the ? soft key instead of specifying a value for this parameter. During the test, *CT Analyzer* replaces the question mark by the value guessed.

When using this function, please be aware that assessments performed with one or more guessed parameters may possibly differ from an assessment based on exact name plate data. Absolutely reliable assessment is only guaranteed if all necessary CT data are specified prior to the test.

The guesser function cannot release the user from specifying the CT's name plate data prior to testing. Always specify as many CT data as possible to increase the reliability of the values guessed by *CT Analyzer*.

Note:

The data and values determined by *CT Analyzer* using the guesser function are not guaranteed and have to be verified by the user.

It is possible to configure the guesser function of *CT Analyzer* in a way that it checks whether the user has entered all necessary values and data relevant for an automatic assessment prior to the test start. The respective parameters are then marked by a star ("*") in the **CT-Object** card. If the user did not enter data for one or more of these parameters, no automatic assessment is performed and *CT Analyzer* displays an "Assessment not available" message after the test is finished.

This option can be used to avoid an automatic assessment if important parameters were guessed by *CT Analyzer* and not entered by the user. This behavior can be selected using the "Check "*" settings before start" option in the default test settings (see section 6.8.3 "Miscellaneous settings" on page 71). This settings page also provides an option to enable the display of a corresponding message prior to the test start.

Note: The guesser function is not available if you use a customized assessment configuration instead of a standard (see "Select Customized Assessment" on page 68).

9.2 Setting up and connecting *CT Analyzer*

1. Set up *CT Analyzer* as described in section 3.2 on page 25.
2. Connect the CT to *CT Analyzer* as described in chapter 3.
 - ▶ Refer to section 3.4.1 on page 27 for detailed information on how to connect *CT Analyzer* for the CT test.
 - ▶ Be sure that the polarity of all wires is correct.

9.3 Preparing and configuring the test

1. Proceed as follows to display the **CT-Object** card for a new Advanced CT test.
 - ▶ If necessary, switch *CT Analyzer* on and wait until the boot process is finished.
 - ▶ Press the **Main** soft key to display the main menu.
 - ▶ In the main menu, select "New Advanced CT Test" and press the **OK** soft key to initialize a new Advanced CT test.
 - ▶ The display shows the **CT-Object** card, ready to start a test.

9.4 Running a test

1. After switching *CT Analyzer* on or after initializing a new test from the main menu, the default **CT-Object** card is displayed.

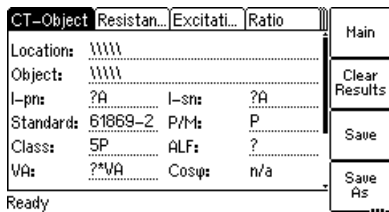


Figure 9-1: Empty **CT-Object** card after initializing a new test

2. Enter as many name plate data as available. The full set of CT data includes: I_{pn} , I_{sn} , standard, CT type (P/M), class and rated power of the CT (VA).

Note: If the "Check "*" settings before start" option is enabled in the default test settings (see section 6.8.3 "Miscellaneous settings" on page 71), no automatic assessment will be available if you do not enter data for a parameter that is relevant for assessment. Such parameters are marked by a star "*".
3. Execute the CT test as described in section 5.2.3 on page 57.

If the "Display warning before start" option is enabled in the default test settings (see section 6.8.3 "Miscellaneous settings" on page 71), a warning is displayed if you did not enter data for a parameter marked by a star "*".

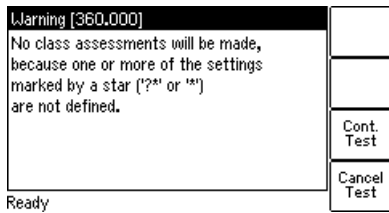


Figure 9-2: "No assessment" warning displayed if you did not enter data for a parameter relevant for assessment

Press **Cont. Test** to continue testing without an automatic assessment. Or press **Cancel Test** and enter data for all parameters marked with a star "*" in the **CT-Object** card and start the test again.

9.5 After the test is finished

After the test is finished, the **CT-Object** card displays the CT data determined during the test. Refer to section 5.2.4 on page 60 for more information.

9.6 Disconnection

After the CT test is finished, disconnect the CT under test from *CT Analyzer*.

WARNING



Death or severe injury caused by high voltage or current possible

As long as the red LED on the *CT Analyzer* test set is flashing, the output is active and lethal voltages can occur due to the high energy stored in external inductors.

- ▶ Do not disconnect measurement leads while the red LED on *CT Analyzer* is flashing.
- ▶ Always wait until the red LED is off before disconnecting measurement leads.

1. Wait until the red LED on *CT Analyzer* is off.
2. Disconnect the measurement leads starting at *CT Analyzer*.

10 Using the *Quick Test* feature

Quick Test is an optional feature. The functionality described in this chapter is only available if you have purchased a corresponding license. For further information, please contact your OMICRON sales contact or the OMICRON office nearest you.

The *Quick Test* feature cannot be used when a CT SB2 switch box is connected to the remote control interface of CT Analyzer.

Measurements using *Quick Test* are not automatically stopped by CT Analyzer. Such measurements have to be stopped manually.

CT Analyzer possibly switches off its output automatically after a long period (> 15 min) of continuous operation at its maximum output power to prevent thermal overload of the device.

10.1 Safety notes and notes for using *Quick Test*

WARNING



Death or severe injury caused by high voltage or current possible

For VT ratio measurement, the *CT Analyzer* output has to be connected to the primary side of the VT. Connecting the *CT Analyzer* output to the secondary side of the VT by mistake will cause hazardous voltages on the primary side.

- ▶ For VT ratio measurements using *Quick Test*, always make sure to connect the *CT Analyzer* output to the primary side of the VT.

WARNING



Death or severe injury caused by high voltage or current possible

Using the **DC current mode of the Advanced measurement type** may be very dangerous. In this mode, it is not possible to interrupt the circuit using a standard relay or a standard circuit breaker. Due to the arc, contact clearances of up to 10 mm are required to switch off the current.

- ▶ Do not use a standard relay or a standard circuit breaker to interrupt the current in this mode.
- ▶ Always use a switching device with a sufficient contact clearance of > 10 mm to interrupt the current or stop the current output on *CT Analyzer*.

WARNING



Death or severe injury caused by high voltage or current possible

Feeding an inductance with DC current will charge the inductance. *CT Analyzer* does not perform automatic discharge of the inductance after measurements with *Quick Test*.

- ▶ Wait until the inductance has discharged completely before touching any connections or disconnecting the measurement leads of *CT Analyzer*.

NOTICE

Equipment damage possible

When using *Quick Test*, the input SEC of *CT Analyzer* is able to measure voltages up to 150 V_{RMS}.

- ▶ Do not connect voltages above 150 V or even mains voltage to the *CT Analyzer* inputs! This will damage *CT Analyzer*.

NOTICE

CT saturation possible

When performing measurements on CTs using *Quick Test*, consider that *CT Analyzer* does not perform automatic demagnetization of the CT.

- ▶ If necessary, run a normal CT test with its automatic demagnetizing cycle following *Quick Test* measurements for a CT.

10.2 Introduction to Quick Test

Using *Quick Test* it is possible to use *CT Analyzer* as a versatile multimeter with included power source or to perform polarity checks using the *CPOL2* polarity checker from OMICRON.

Possible fields of application for *Quick Test* are:

- Quick and easy resistance measurement, e.g. for wiring checks on the secondary side of CTs.
- Quick voltage ratio checks for VTs.
- Measurement of burden values, e.g. to determine the new burden value after changes of the relay equipment. This allows the re-calculation of the CT test results for the new burden value by *CT Analyzer* and thus makes it unnecessary to run an additional CT test in order to determine the behavior of the CT with the new burden.
- Quick wiring checks using the *CPOL2* polarity checker from OMICRON. Using the *CPOL2* in combination with the specific test signal provided by the *Quick Test* feature of *CT Analyzer* you can check a series of test points (e.g., the connecting terminals of the burden wiring) for correct polarity.

The user interface of *Quick Test* consists of two test cards, the **CT-Quick** card containing the measurement parameters and the **Results** card showing the results of the measurement. Figure 10-1 shows the test cards for a resistance measurement as an example.

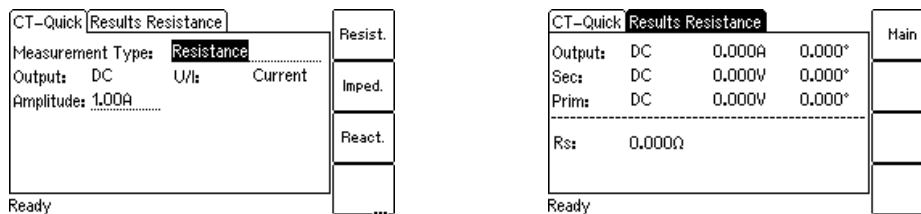


Figure 10-1: **CT-Quick** test card (left) and **Results** test card (right) for resistance measurement

Note: For a general description of the *CT Analyzer* user interface and basic procedures how to operate *CT Analyzer* and *Quick Test*, please refer to chapter 6 on page 62.


To select a measurement type, use the  cursor key to move the cursor to the **Measurement Type** field in the **CT-Quick** card and then press the corresponding soft key of the measurement type. The following measurement types are available in *Quick Test*.

Table 10-1: Measurements available in *Quick Test*








Meas. type	Usage
Advanced 	Provides complete multimeter measurement functionality and free adjustment of all measurement quantities, such as AC or DC signal output, voltage or current output, output frequency, measurement mode for the input (DC, RMS or frequency-selective), etc. For details, please refer to section 10.4 on page 146.
Polarity Check 	Predefined type, especially intended for polarity checks. The only adjustable measurement quantity is the output current. Requires the <i>CPOL2</i> polarity checker from OMICRON. For details, please refer to section 10.5 on page 151.

Table 10-1: Measurements available in *Quick Test* (continued)

Meas. type	Usage
 CT Ratio	Predefined type, especially intended for quick measurement of CT ratios. Adjustable measurement quantities are the voltage and the frequency of the output signal and the resistance and inductance of the CT to be measured. For details, please refer to section 10.6 on page 155.
 VT Ratio	Predefined type, especially intended for quick measurement of VT ratios. Adjustable measurement quantities are the voltage and the frequency of the output signal. For details, please refer to section 10.7 on page 157.
 Resistance	Predefined type, especially intended for quick measurement of resistances. The only adjustable measurement quantity is the value of the output current. For details, please refer to section 10.8 on page 160.
 Impedance	Predefined type, especially intended for quick measurement of impedances. Adjustable measurement quantities are the amplitude and the frequency of the current output signal. For details, please refer to section 10.9 on page 163.
 Reactance	Predefined type, especially intended for quick measurement of reactances. Adjustable measurement quantities are the voltage and the frequency of the output signal. For details, please refer to section 10.10 on page 165.

10.3 Performing measurements with *Quick Test*

Measurements using *Quick Test* are not automatically stopped by *CT Analyzer*. Such measurements have to be stopped manually by the user.

Proceed as follows to perform measurements using the *Quick Test* feature:

1. Select **New Quick-Test** from the main menu and press the **OK** soft key to open *Quick Test*. The display then shows the **CT-Quick** card.

How to get there:
 Press the **Main** soft key in any test card
Main Menu:
 - **New Quick-Test**
OK soft key
 -> **CT-Quick** card

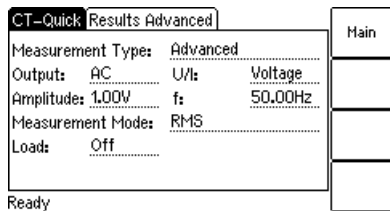



Figure 10-2: **CT-Quick** card

2. Select the measurement type and connect your test object to *CT Analyzer* correspondingly (see sections 10.4 to 10.10 below).
3. Define your measurement quantities.
4. Start and stop your measurement by pressing the  key.
5. After starting a measurement, the **Results** card is displayed automatically, showing the measurement results.

10.4 Advanced measurement

The Advanced measurement type offers complete multimeter measurement functionality and free adjustment of all measurement quantities, such as AC or DC signal output, voltage or current output, output frequency, measurement mode for the input (DC, RMS or frequency-selective), etc.

Using the Advanced measurement type it is also possible to use input SEC of *CT Analyzer* as a voltmeter for **measuring external voltages** up to $150V_{RMS}$ with frequencies up to 4kHz.

How to get there:
 Press the **Main** soft key in any test card
Main Menu:
 - **New Quick-Test**
OK soft key
CT-Quick card:
 Measurement Type:
 Advanced

NOTICE

Equipment damage possible

When using *Quick Test*, the input SEC of the *CT Analyzer* test set is able to measure voltages up to $150 V_{RMS}$.

- ▶ Do not connect voltages above 150 V or even mains voltage to the *CT Analyzer* inputs! This will damage *CT Analyzer*.

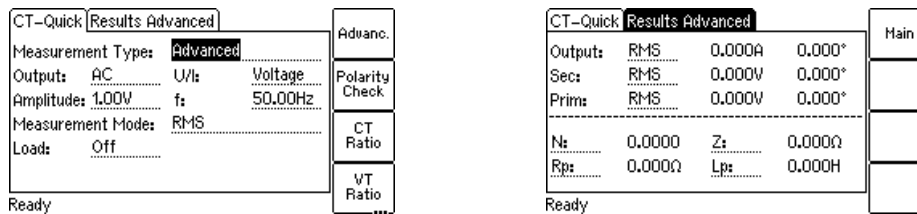


Figure 10-3: **CT-Quick** card and **Results** card for Advanced measurement type

For the Advanced measurement type, all measurement quantities available in the **CT-Quick** card can be adjusted by the user.


Observe the following when using the DC output mode:

WARNING



Death or severe injury caused by high voltage or current possible

When using the DC output mode:

- ▶ Do not open the measurement circuit while DC current is flowing.
- ▶ Stop the measurement by pressing the  key on *CT Analyzer* and wait until the red LED is off before opening the measurement circuit.

WARNING



Death or severe injury caused by high voltage or current possible

Feeding an inductance with DC current will charge the inductance. *CT Analyzer* does not perform automatic discharge of the inductance.

- ▶ Wait until the inductance has discharged completely before touching any connections or disconnecting the measurement leads of *CT Analyzer*.

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

Using the DC current mode may be very dangerous. In this mode, it is not possible to interrupt the circuit using a standard relay or a standard circuit breaker. Due to the arc, contact clearances of up to 10 mm are required to switch off the current.

- ▶ Do not use a standard relay or a standard circuit breaker to interrupt the current in this mode.
- ▶ Always use a switching device with a sufficient contact clearance of > 10 mm to switch off the current or stop the current output on *CT Analyzer*.

For this measurement type, the **CT-Quick** card holds the following measurement quantities:

Table 10-2: Parameters for Advanced measurement type

Parameter	Description
Output	Output signal type AC or DC or output signal switched off. Possible values: AC or DC or Off . Default: AC.
U/I	Operating mode of the internal signal generator: voltage or current source. Possible values: U (voltage) or I (current). Default: Voltage
Amplitude	RMS voltage or current value of the output signal. Possible values: Mode "AC" and "Voltage": 0 to 40V Mode "DC" and "Voltage": 0 to 120V Mode "AC" and "Current": 0 to 5A Mode "DC" and "Current": 0 to 10A Default: 1.00V or 1.00A.
f	Frequency of the output signal. Only available for AC voltage or current output. Possible values: Any value between 5.0 and 400.0Hz or soft keys 16.7Hz , 50Hz , 60Hz or 400Hz . Default: 50Hz
Measurement Mode	Measurement mode. Possible values: DC , RMS or f-sel. filter . Default: RMS <u>DC measurement:</u> Measures the DC part of the signal only. <u>RMS measurement:</u> Performs a standard true RMS measurement of the signal. <u>Frequency selective measurement:</u> Allows high precision measurement of the fundamental wave of an applied signal. All frequencies below and above the output frequency plus/minus the filter bandwidth are suppressed by at least 110 dB. This measurement mode is deactivated for output signal type DC. See also "B-width" below.

Table 10-2: Parameters for Advanced measurement type (continued)

Parameter	Description						
B-width	<p>Filter bandwidth for frequency selective measurement. Only available for measurement mode Freq. sel. filter.</p> <p>Possible values: 3Hz to 20Hz. Default: 6Hz</p> <p>Depending on the filter bandwidth selected, the measurement time can differ considerably. The typical time needed for a frequency selective measurement depends on the filter bandwidth as follows:</p> <table border="1"> <thead> <tr> <th><u>Filter bandwidth</u></th> <th><u>Measurement time</u></th> </tr> </thead> <tbody> <tr> <td>3Hz</td> <td>approx. 5 seconds</td> </tr> <tr> <td>6Hz</td> <td>approx. 4 seconds</td> </tr> </tbody> </table>	<u>Filter bandwidth</u>	<u>Measurement time</u>	3Hz	approx. 5 seconds	6Hz	approx. 4 seconds
<u>Filter bandwidth</u>	<u>Measurement time</u>						
3Hz	approx. 5 seconds						
6Hz	approx. 4 seconds						
Load	<p>Only available for AC signal output.</p> <p>Setting the Load parameter to "on" and specifying the winding resistance and the unsaturated inductance in the fields R and L will prevent saturation of the connected CT.</p> <p>The output generator of <i>CT Analyzer</i> then keeps the DC part of the output current at zero using a current regulator.</p> <p>Possible values: On or Off. Default: Off</p>						
R, L	<p>Only available if Load is set to "on".</p> <p>Winding resistance (R) and unsaturated inductance (L) of the CT, used by the internal output regulator to prevent saturation of the connected CT (see "Load" above).</p> <p>Possible values: 0 to 1000Ω or 0 to 1000H.</p> <p>Default: 1.00Ω for R and 50.00H for L</p> <p>If these values are not set correctly for the connected CT, the CT will saturate sooner or later, depending on the inaccuracy of the values used.</p>						

The **upper part** of the **Results Advanced** card (Figure 10-4) displays the measured values:

Table 10-3: Measured values for Advanced measurement type

Value	Description
OUTPUT	Internally measured current value and phase of the output signal. ¹
SEC	Voltage measured at input SEC. ¹ Max. input voltage: $150V_{RMS}$ Measurement is performed according to the measurement mode selected on the CT-Quick card. This input is considered as the phase reference, therefore the phase is always 0.
PRIM	Value and phase of the voltage measured at input PRIM. ¹ Max. input voltage: $30V_{RMS}$ Measurement is performed according to the measurement mode selected on the CT-Quick card.

1. Select the display mode for the current or voltage value using the soft keys: **RMS**, **DC**, **Peak+** (highest positive peak value) or **Peak-** (highest negative peak value).

The **lower part** of the **Results Advanced** card (Figure 10-4) displays the measurement results calculated from the measured values. In this area, you can freely define which result each single field should display.

Figure 10-4 shows the **Results Advanced** card with the default selection for the results fields.

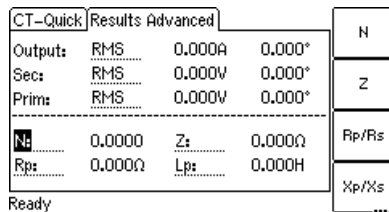


Figure 10-4: **Results Advanced** card with default selection for the displayed results

The following table lists the calculated results available for the Advanced measurement type. Use the cursor keys to move the cursor to a field and then select the result to be displayed in this field using the available soft keys.

Table 10-4: Results for Advanced measurement type

Result	Description
N	Ratio calculated from the values measured at inputs SEC and PRIM.
Z	Impedance, calculated from the amplitude and phase angle of the output signal and the voltage measured at input SEC.
Rp, Rs	Use the Rp/Rs soft key to switch between R_p and R_s . Parallel or serial resistance, calculated from the output signal and the voltage measured at input SEC.

Table 10-4: Results for Advanced measurement type (continued)

Result	Description
Xp, Xs	Use the Xp/Xs soft key to switch between X_p and X_s . Parallel or serial reactance, calculated from the output signal and the voltage measured at input SEC.
cos φ	Power factor of the measured impedance.
Lp, Ls or Cp, Cs	Use the Lp/Ls (or Cp/Cs) soft key to switch between L_p (C_p) and L_s (C_s). Parallel or serial inductance or capacitance of the test object, calculated from the output signal and the voltage measured at input SEC. <i>CT Analyzer</i> automatically detects whether the test object is an inductance or a capacitance based on the phase angle.
f	Frequency measured at input SEC.
Crest Out, Crest Sec, Crest Prim	Crest factor of the output signal or the signal measured at input SEC or input PRIM. The crest factor is the peak/rms ratio of a waveform. For a sinusoidal waveform the crest factor is 1.414 ($\sqrt{2}$). The crest factor may indicate possible signal distortion. More detailed information can be found at http://en.wikipedia.org/wiki/Crest_factor .

Note: The results for R_p , X_p and L_p (C_p) are calculated using the parallel equivalent circuit diagram, the results for R_s , X_s and L_s (C_s) are calculated using the serial equivalent circuit diagram.

Use the following wiring (examples):

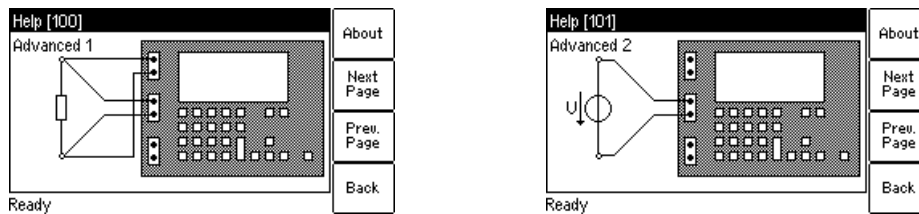


Figure 10-5: Wiring examples for Advanced measurement type


10.5 Polarity check

This measurement type is exclusively intended for polarity checks using the *CPOL2* polarity checker as described below. Do not use this mode for any other measurements!

Note: The Polarity Check measurement type requires the *CPOL2* polarity checker from OMICRON.

Polarity Check is a predefined measurement type, intended especially for checking a series of test points (e.g., the connecting terminals of the burden wiring) for correct polarity. For this purpose, *CT Analyzer* injects a signal with a special waveform similar to a saw-tooth signal with a different steepness for the rising and the falling slope. The *CPOL2* polarity checker from OMICRON checks the polarity of the injected signal and provides a clear indication whether the polarity is OK or not.

Checking the polarity using the Polarity Check measurement type is much faster than conventional methods and can easily be performed by a single person.

To select the Polarity Check measurement type, use the  cursor key to move the cursor to the **Measurement Type** field in the **CT-Quick** card and then press the **Polarity Check** soft key.

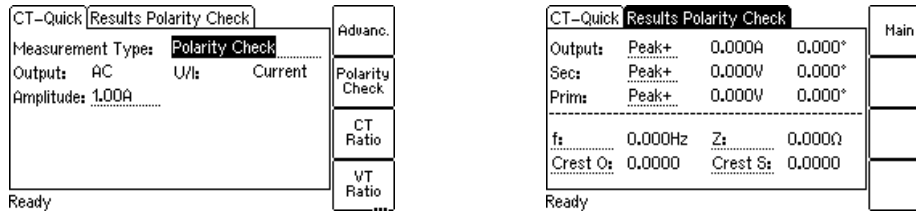


Figure 10-6: **CT-Quick** card and **Results** card for the Polarity Check measurement type

For the **Polarity Check** measurement type, the **CT-Quick** card holds the following measurement quantities:

Table 10-5: Parameters for Polarity Check measurement type

Parameter	Description
Output	The output signal type is fixed to "AC".
U/I	Operating mode of the internal signal generator: voltage or current source. Fixed to "Current".
Amplitude	Current value of the polarity check signal. Adjustable by the user. Possible values: 0 to 7A. Default: 1.00A.

How to get there:

Press the **Main** soft key in any test card

Main Menu:
- **New Quick-Test**

OK soft key

CT-Quick card:
Measurement Type:
Polarity Check

The **upper part** of the **Results Polarity Check** card (Figure 10-7) displays the following values:

Table 10-6: Values displayed for Polarity Check measurement type

Value	Description
OUTPUT	Internally measured current value and phase of the output signal. ¹
SEC	Voltage measured at input SEC. ¹ The higher the resistance of the wiring checked or the current amplitude set on <i>CT Analyzer</i> , the higher the terminal voltage generated by the injected current signal. This input is considered as the phase reference, therefore the phase is always 0.
PRIM	Value and phase of the voltage measured at input PRIM. ¹ Input PRIM is not used for the Polarity Check measurement type.

1. Select the display mode for the current or voltage value using the soft keys: **RMS**, **DC**, **Peak+** (highest positive peak value) or **Peak-** (highest negative peak value).

The **lower part** of the **Results Polarity Check** card (Figure 10-7) displays some quantities of the injected polarity check signal. In this area, you can freely define which quantity each single field should display.

Figure 10-7 shows the **Results Polarity Check** card with the default selection for the fields.

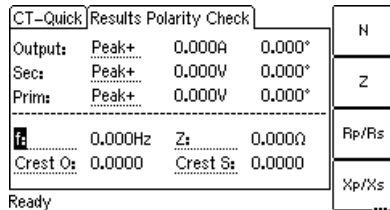


Figure 10-7: **Results Polarity Check** card with default selection for the displayed quantities

Use the cursor keys to move the cursor to a field and then select the quantity to be displayed in this field using the available soft keys. Please refer to page 149 (Advanced Measurement type) for a detailed description of the available quantities (soft keys).

Use the following wiring for the polarity check (example):

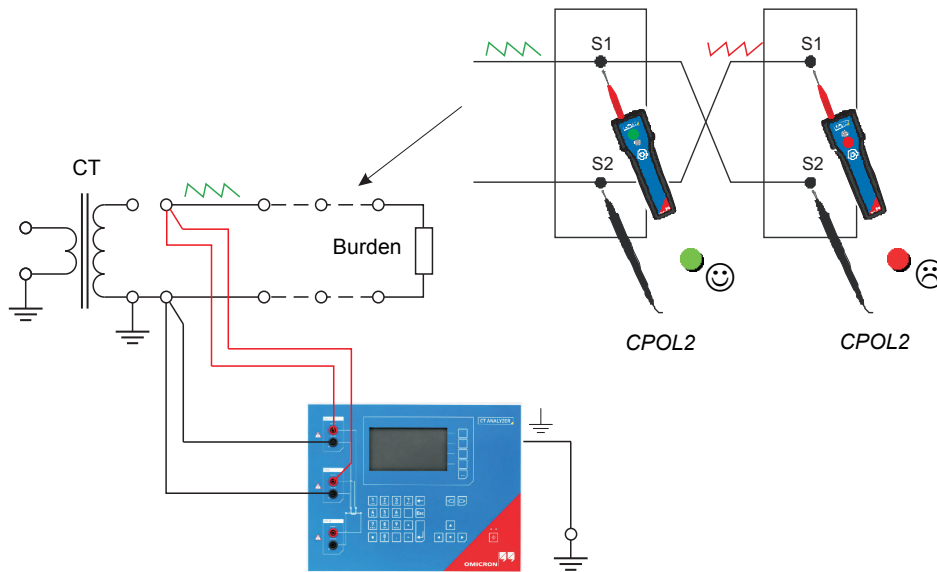



Figure 10-8: Wiring example for polarity check

Note: *CT Analyzer* measures the voltage of the injected signal using input SEC. Therefore, you should always connect this input when using the Polarity Check measurement type. The higher the resistance of the wiring checked (i.e., the burden wiring) or the current amplitude set on *CT Analyzer*, the higher the terminal voltage generated by this current!

Proceed as follows to perform a polarity check

1. Make sure that the wiring to be checked is disconnected from the ungrounded side of the CT (see Figure 10-8).
2. Connect the OUTPUT sockets and input SEC of *CT Analyzer* to the wiring to be checked (see Figure 10-8).
3. Open the *Quick Test* measurement function of *CT Analyzer*.
4. Select the **Polarity Check** measurement type and set the amplitude of the polarity check signal appropriately.
5. Start the polarity check by pressing the  key on *CT Analyzer*.
6. The **Results Polarity Check** card displays the measured values as long as the measurement is active.

7. Use the *CPOL2* polarity checker to check the polarity of the wiring (see Figure 10-8).
 - ▶ If *CPOL2* detects the same signal characteristic at a test point, it considers the polarity OK. The green LED lights up.
 - ▶ If the signal characteristic is inverted, *CPOL2* considers the polarity not OK. The red LED lights up.



WARNING

Death or severe injury caused by high voltage or current possible

If you detect wrong polarity in the signal path:

- ▶ Do not disconnect the terminals as long as *CT Analyzer* injects the polarity check signal.
 - ▶ Stop the measurement (see step 8) and turn off *CT Analyzer* first. Only then disconnect the terminals.
- ▶ If *CPOL2* does not detect any signal (for example, due to a too small signal magnitude), both LEDs light up at the same time.
 - ▶ If the wiring to be tested is open (disconnected or interrupted), *CT Analyzer* indicates by an intermittent beep sound that no output current is flowing.

If you are in doubt whether your measurement is correct, you can confirm it by reversing the probes of *CPOL2*. In that case, the other LED should light up.


8. Stop the measurement by pressing the  key on *CT Analyzer* again.

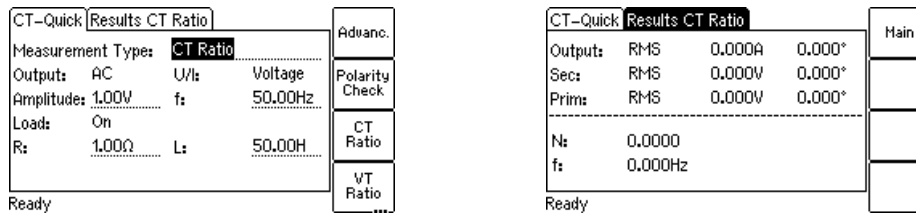
Note: Please refer to the *CPOL2* User Manual for detailed information about the *CPOL2* polarity checker.

10.6 CT ratio measurement

CT ratio measurement is a predefined measurement type, intended especially for the quick measurement of CT ratios.

Note: This is not a complete CT test. It only determines the current ratio of CTs.

To select the CT Ratio measurement type, use the  cursor key to move the cursor to the **Measurement Type** field in the **CT-Quick** card and then press the **CT Ratio** soft key.



How to get there:

Press the **Main** soft key in any test card

Main Menu:
- **New Quick-Test**

OK soft key

CT-Quick card:
Measurement Type:
CT Ratio

Figure 10-9: **CT-Quick** card and **Results** card for CT ratio measurement

For the **CT Ratio** measurement type, the **CT-Quick** card holds the following measurement quantities:

Table 10-7: Parameters for CT Ratio measurement type

Parameter	Description
Output	The output signal type is fixed to "AC".
U/I	Operating mode of the internal signal generator: voltage or current source. Fixed to "Voltage".
Amplitude	RMS voltage of the output signal. Adjustable by the user. Possible values: 0 to 40V. Default: 1.00V.
f	Frequency of the output signal. Adjustable by the user. Possible values: 5.0 to 400.0Hz or soft keys 16.7Hz , 50Hz , 60Hz or 400Hz . Default: 50Hz
Load	Fixed to "On". Setting the Load parameter to "on" and specifying the winding resistance and the unsaturated inductance in the fields R and L will prevent saturation of the connected CT. The output generator of <i>CT Analyzer</i> then keeps the DC part of the output current at zero using a current regulator.
R, L	Winding resistance (R) and unsaturated inductance (L) of the CT, used by the internal output regulator to prevent saturation of the connected CT (see Load above). Possible values: 0 to 1000Ω or 0 to 1000H. Default: 1.00Ω for R and 50.00H for L If these values are not set correctly for the connected CT, the CT will saturate sooner or later, depending on the inaccuracy of the values used.

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The following values are displayed in the **Results CT Ratio** card:

Table 10-8: Values displayed for CT Ratio measurement type

Value	Description
OUTPUT	Internally measured RMS current value and phase of the output signal.
SEC	RMS value of the voltage measured at input SEC. This input is considered as the phase reference, therefore the phase is always 0.
PRIM	RMS value and phase of the voltage measured at input PRIM.
N	Current ratio of the CT calculated from the voltages measured at inputs SEC and PRIM.
f	Frequency measured at input SEC.

Use the following wiring for CT ratio measurement (example):

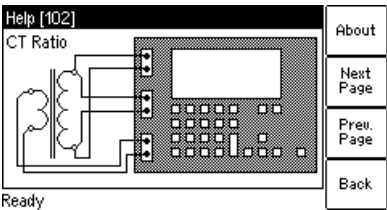



Figure 10-10: Wiring example for CT ratio measurement

10.7 VT ratio measurement

This is a predefined measurement type, intended especially for the quick measurement of VT ratios.

Note: This is not a complete VT test. This measurement only determines the voltage ratio of VTs.

To select the VT Ratio measurement type, use the  cursor key to move the cursor to the **Measurement Type** field in the **CT-Quick** card and then press the **VT Ratio** soft key.

How to get there:

Press the **Main** soft key in any test card

Main Menu:
- **New Quick-Test**

OK soft key

CT-Quick card:
Measurement Type:
VT Ratio

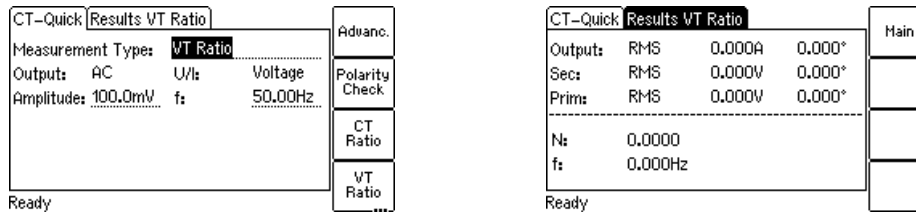


Figure 10-11: **CT-Quick** card and **Results** card for VT ratio measurement

For the **VT Ratio** measurement type, the **CT-Quick** card holds the following measurement quantities:

Table 10-9: Parameters for VT Ratio measurement type

Parameter	Description
Output	The output signal type is fixed to "AC".
U/I	Operating mode of the internal signal generator: voltage or current source. Fixed to "Voltage".
Amplitude	RMS voltage of the output signal. Adjustable by the user. Possible values: 0 to 40V. Default: 1.00V.
f	Frequency of the output signal. Adjustable by the user. Possible values: 5.0 to 400.0Hz or soft keys 16.7Hz , 50Hz , 60Hz or 400Hz . Default: 50Hz

The following values are displayed in the **Results VT Ratio** card:

Table 10-10: Values displayed for VT Ratio measurement type

Value	Description
OUTPUT	Internally measured RMS current value and phase of the output signal.
SEC	RMS value of the voltage measured at input SEC. This input is considered as the phase reference, therefore the phase is always 0.
PRIM	RMS value and phase of the voltage measured at input PRIM.
N	Voltage ratio of the VT calculated from the voltages measured at inputs SEC and PRIM.
f	Frequency measured at input SEC.

Proceed as follows to perform a VT ratio measurement:

1. Connect the OUTPUT sockets and input SEC of *CT Analyzer* to the primary side of the VT, and *CT Analyzer* input PRIM to the secondary winding of the VT (see Figure 10-12).

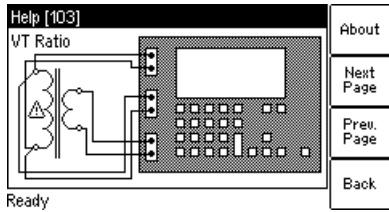


Figure 10-12: Wiring example for VT ratio measurement

WARNING



Death or severe injury caused by high voltage or current possible

Connecting the *CT Analyzer* output to the secondary side of the VT by mistake will cause hazardous voltages on the primary side.

- ▶ Make sure to connect the *CT Analyzer* output to the primary side of the VT.

2. Open the *Quick Test* measurement function of *CT Analyzer* or start the *CT Analyzer Quick Test* tool of the *CT Analyzer Suite* software.
3. Select the **VT Ratio** measurement type. Set the amplitude to the maximum output voltage of 40V and the frequency to the mains frequency. Refer to Figure 10-13.

Note: If it is necessary to suppress mains frequency interferences, use the **Advanced** measurement type with a frequency of e.g. 3Hz above the mains frequency (e.g. 53Hz) and choose the frequency-selective measurement mode with a filter bandwidth of 6Hz. Mains frequency interferences are then suppressed by 120 dB.

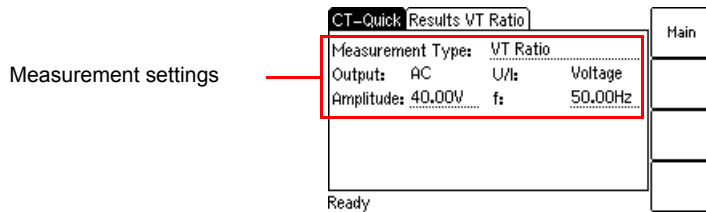




Figure 10-13: **CT-Quick** test card with settings for VT ratio measurement

4. Start the measurement by pressing the  key on *CT Analyzer* or clicking the **ON** button on the **VT Ratio** tab of the *CT Analyzer Quick Test* software tool. The measured values are displayed and permanently updated as long as the measurement is active. Refer to Figure 10-14.

- Stop the measurement by pressing the  key on *CT Analyzer* again or clicking the **OFF** button on the **VT Ratio** tab of the *CT Analyzer Quick Test* software tool.

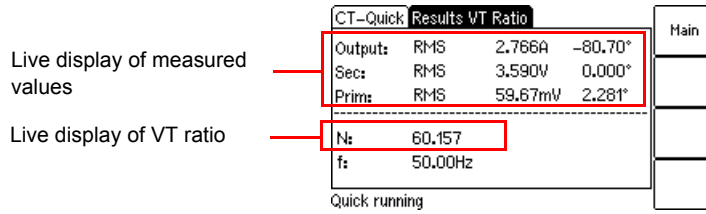


Figure 10-14: **Results** test card for VT ratio measurement

10.8 Resistance measurement

This is a predefined measurement type, intended especially for the quick measurement of resistances.


To select the Resistance measurement type, use the  cursor key to move the cursor to the **Measurement Type** field in the **CT-Quick** card and then press the **Resist.** soft key.



Figure 10-15: **CT-Quick** card and **Results** card for resistance measurement

How to get there:
 Press the **Main** soft key in any test card
Main Menu:
 - **New Quick-Test**
OK soft key
CT-Quick card:
 Measurement Type:
 Resistance

For the **Resistance** measurement type, the **CT-Quick** card holds the following measurement quantities:

Table 10-11: Parameters for Resistance measurement type


Parameter	Description
Output	The output signal type is fixed to "DC".
U/I	Operating mode of the internal signal generator: voltage or current source. Fixed to "Current".
Amplitude	Amplitude of the output current. Adjustable by the user. Possible values: 0 to 10A. Default: 1.00A.

WARNING



Death or severe injury caused by high voltage or current possible

This measurement is performed with DC current.

- ▶ Do not open the measurement circuit while current is flowing.
- ▶ Stop the measurement by pressing the  key on *CT Analyzer* and wait until the red LED is off before opening the measurement circuit.

WARNING



Death or severe injury caused by high voltage or current possible

This measurement is performed with DC current. Feeding an inductance with DC current will charge the inductance. *CT Analyzer* does not perform automatic discharge of the inductance.

- ▶ Wait until the inductance has discharged completely before touching any connections or disconnecting the measurement leads of *CT Analyzer*.

The following values are displayed in the **Results Resistance** card:

Table 10-12: Values displayed for Resistance measurement type

Value	Description
OUTPUT	Internally measured output current.
SEC	Voltage measured at input SEC.
PRIM	Not used for resistance measurement.
Rs	Serial resistance, calculated from the output current and the voltage measured at input SEC.

Note: The resistance measurement uses the serial equivalent circuit diagram for results calculation.

Use the following wiring for resistance measurement (example):

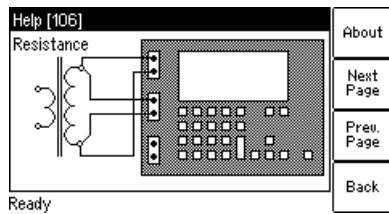


Figure 10-16: Wiring example for resistance measurement

Proceed as follows to perform a winding resistance measurement:

1. Connect the OUTPUT sockets and input SEC of *CT Analyzer* to the winding to be measured (see Figure 10-16).
2. Open the *Quick Test* measurement function of *CT Analyzer* or start the *CT Analyzer Quick Test* tool of the *CT Analyzer Suite* software.
3. Select the **Resistance** measurement type and set the amplitude of the DC output current appropriately. Refer to Figure 10-17.

NOTICE

Equipment damage possible

Too high currents could destroy the winding.

- Use only low currents of e.g. 100 mA when measuring the primary side of VTs.

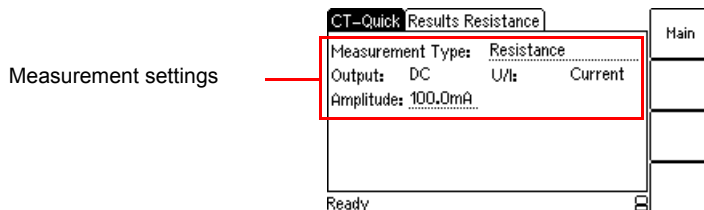




Figure 10-17: **CT-Quick** test card with settings for resistance measurement

- 4. Start the measurement by pressing the  key on *CT Analyzer* or clicking the **ON** button on the **Resistance** tab of the *CT Analyzer Quick Test* software tool. The measured values are displayed and permanently updated as long as the measurement is active. Refer to Figure 10-18.
- 5. Stop the measurement by pressing the  key on *CT Analyzer* again or clicking the **OFF** button on the **Resistance** tab of the *CT Analyzer Quick Test* software tool.

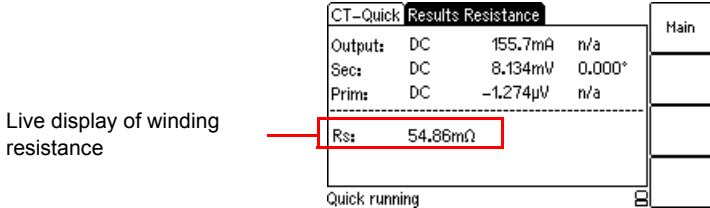



Figure 10-18: **Results** test card for resistance measurement

10.9 Impedance measurement

This is a predefined measurement type, intended especially for the quick measurement of impedances.

To select the Impedance measurement type, use the  cursor key to move the cursor to the **Measurement Type** field in the **CT-Quick** card and then press the **Imped.** soft key.



How to get there:

Press the **Main** soft key in any test card

Main Menu:
- **New Quick-Test**

OK soft key

CT-Quick card:
Measurement Type:
Impedance

Figure 10-19: **CT-Quick** card and **Results** card for impedance measurement

For the **Impedance** measurement type, the **CT-Quick** card holds the following measurement quantities:

Table 10-13: Parameters for Impedance measurement type

Parameter	Description
Output	The output signal type is fixed to "AC".
V/I	Operating mode of the internal signal generator: voltage or current source. Fixed to "Current".
Amplitude	RMS value of the output current. Adjustable by the user. Possible values: 0 to 5A. Default: 1.00A.
f	Frequency of the output signal. Adjustable by the user. Possible values: 5.0 to 400.0Hz or soft keys 16.7Hz , 50Hz , 60Hz or 400Hz . Default: 50Hz

The following values are displayed in the **Results Impedance** card:

Table 10-14: Values displayed for Impedance measurement type

Value	Description
OUTPUT	Internally measured RMS value and phase of the output current.
SEC	RMS value of the voltage measured at input SEC. This input is considered as the phase reference, therefore the phase is always 0.
PRIM	Not used for impedance measurement.
Z	Measured impedance, calculated from the magnitude and phase angle of the output signal and the voltage measured at input SEC.
cos φ	Power factor of the measured impedance.

Use the following wiring for impedance measurement (example):

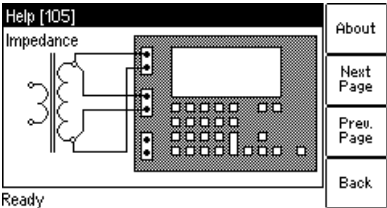



Figure 10-20: Wiring example for impedance measurement

10.10 Reactance measurement

This is a predefined measurement type, intended especially for the quick measurement of reactances.

To select the Reactance measurement type, use the  cursor key to move the cursor to the **Measurement Type** field in the **CT-Quick** card and then press the **React.** soft key.



How to get there:

Press the **Main** soft key in any test card

Main Menu:
- **New Quick-Test**

OK soft key

CT-Quick card:
Measurement Type:
Reactance

Figure 10-21: **CT-Quick** card and **Results** card for reactance measurement

For the **Reactance** measurement type, the **CT-Quick** card holds the following measurement quantities:

Table 10-15: Parameters for Reactance measurement type

Parameter	Description
Output	The output signal type is fixed to "AC".
U/I	Operating mode of the internal signal generator: voltage or current source. Fixed to "Voltage".
Amplitude	RMS voltage of the output signal. Adjustable by the user. Possible values: 0 to 40V. Default: 1.00V.
f	Frequency of the output signal. Adjustable by the user. Possible values: 5.0 to 400.0Hz or soft keys 16.7Hz , 50Hz , 60Hz or 400Hz . Default: 400Hz

The following values are displayed in the **Results Reactance** card:

Table 10-16: Values displayed for Reactance measurement type

Value	Description
OUTPUT	Internally measured RMS current value and phase of the output signal.
SEC	RMS value of the voltage measured at input SEC. This input is considered as the phase reference, therefore the phase is always 0.
PRIM	Not used for reactance measurement.
Rs	Serial resistance, calculated from the output signal and the voltage measured at input SEC.
Xs	Serial reactance, calculated from the magnitude and phase angle of the output signal and the voltage measured at input SEC.

Table 10-16: Values displayed for Reactance measurement type (continued)

Value	Description
f	Frequency measured at input SEC.
Ls or Cs	Serial inductance or capacitance of the test object, calculated from the measured values. <i>CT Analyzer</i> automatically detects whether the test object is an inductance or a capacitance based on the phase angle.

Note: The reactance measurement uses the serial equivalent circuit diagram for results calculation. Use the following wiring for reactance measurement (example):

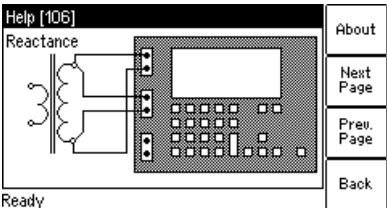


Figure 10-22: Wiring example for reactance measurement

11 CT Analyzer Suite

The *CT Analyzer Suite* software enables complete remote control of *CT Analyzer* test sets from a computer. For detailed information about the *CT Analyzer Suite* software, please refer to the *CT Analyzer Suite* help.

11.1 System requirements

CT Analyzer Suite is exclusively intended for operation with *CT Analyzer* test sets equipped with firmware version 5.00 or later.

CT Analyzer Suite requires one of the following operating systems installed on your computer: Windows 7 32 bit or 64 bit, Windows 8 64 bit, Windows 8.1 64 bit, Windows 10 32 bit or 64 bit.

11.2 Installing CT Analyzer Suite

The *CT Analyzer Suite* software and its installation program *Setup Wizard* are included on the *CT Analyzer Suite* CD ROM accompanying *CT Analyzer*. Proceed as follows to install *CT Analyzer Suite*:


1. Exit all other major programs running on your computer.
2. Insert the *CT Analyzer Suite* CD ROM into your computer's CD ROM drive. The Setup Wizard starts automatically.

Note: Should the Setup Wizard not start automatically a few seconds after the CD has been inserted into the CD ROM drive, change to the Windows Explorer and double-click **setup.exe** on the *CT Analyzer Suite* CD ROM.

3. Follow the instructions displayed on the screen to install the software.

11.3 The CT Analyzer Suite home view

Launching *CT Analyzer Suite* opens the *CT Analyzer Suite* home view. The home view provides an overview of all available features and functions. Clicking a button in the home view displays the corresponding view or executes the specific function.

Press the **F1** key on your keyboard or click the help button  and select **Help** to display the help system providing detailed information about *CT Analyzer Suite*.

The figure below shows the *CT Analyzer Suite* home view.

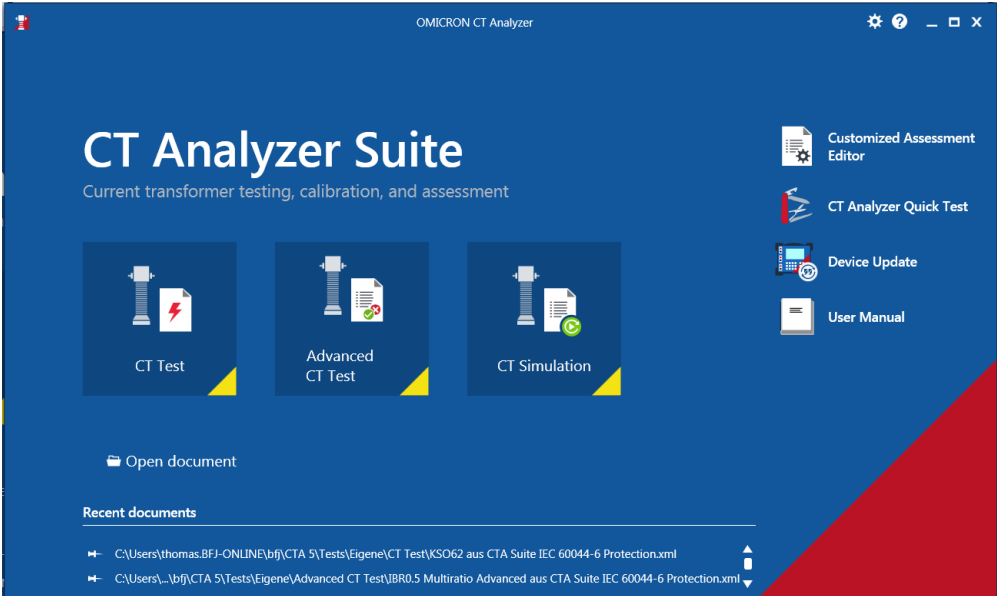


Figure 11-1: CT Analyzer Suite home view

12 Technical data

Guaranteed data are specified for an ambient temperature of $23^{\circ}\text{C} \pm 5^{\circ}$ ($73^{\circ}\text{F} \pm 9^{\circ}$), a power supply of $115/230\text{V}_{\text{AC}}$, and after a warm-up time longer than 15 minutes.

Guaranteed data are valid for the period of one year after factory adjustment.

12.1 Mains power supply

Table 12-1: Mains power supply

Characteristic	Rating
Connection	Connector according to IEC 60320
Mains voltage	100 - 240V_{AC} / 50/60Hz / 6A Instead of supplying <i>CT Analyzer</i> from phase-neutral (L1-N, A-N), it may also be supplied from phase-phase (e.g. L1-L2, A-B). However, the nominal voltage must not exceed 240V_{AC} .
Mains fuses	2 x T6AH 250V (high-breaking capacity wire fuse 5 x 20mm)

12.2 Generator output

Table 12-2: Generator output data

Characteristic	Rating
Output voltage / current	AC: 40V_{rms} / 5A_{rms} max. DC: 120V / 5A (15A_{peak})
Output power	$400\text{VA}_{\text{rms}}$ max.

12.3 Measurement inputs

Table 12-3: Measurement input SEC

Characteristic	Rating
Voltage ranges	0 - 0.3 / 3 / 30 / 300V_{AC} (auto ranging)
Accuracy	0.1% (guaranteed)
Insulation	Reinforced insulation (R) to all other circuits

Table 12-4: Measurement input PRIM

Characteristic	Rating
Voltage ranges	0 - 0.03 / 0.3 / 3 / 30V _{AC} (auto ranging)
Accuracy	0.1% (guaranteed)
Insulation	Reinforced insulation (R) to all other circuits

12.4 Winding resistance measurement accuracy

Table 12-5: Winding resistance measurement accuracy

Characteristic	Rating
Resolution	1 mΩ
Accuracy	0.05% (typical) 0.1% + 1 mΩ (guaranteed)

12.5 Ratio and phase measurement accuracy

The values given in the following table are only valid under the following conditions:

- All utility lines to the primary side of the CT are disconnected.
- One terminal of the primary side of the CT is connected to PE.
- The original measurement cables delivered by OMICRON for *CT Analyzer* are used.
- The CT under test is a CT with a non-gapped core.
- The knee point voltage according to IEEE C57.13 is > 3V.

Under interfering conditions the device has reduced accuracy.

Values without the prefix "!" in the ratio table of the **Ratio** card have guaranteed accuracy. The accuracy of values marked with a "!" in the table is reduced by factor 2 since these values are not directly measured but calculated from the measured values instead.

Table 12-6: Ratio measurement accuracy for 1 A CTs at rated current

CT ratio	I _{sn}	Rated power ¹	Typical accuracy	Guaranteed accuracy
0.2 - 1	1	1.0 - 30VA	0.05%	0.1%
> 1 - 2000	1	0 - 30VA	0.02%	0.05%
> 2000 - 5000	1	0 - 30VA	0.03%	0.1%
> 5000 - 10000	1	0 - 30VA	0.05%	0.2%

1. Nominal burden of the CT.

Table 12-7: Ratio measurement accuracy for 5 A CTs at rated current

CT ratio	I _{sn}	Rated power ¹	Typical accuracy	Guaranteed accuracy
0.2 - 1	5	1.0 - 75VA	0.05%	0.1%
> 1 - 2000	5	0 - 75VA	0.02%	0.05%
> 2000 - 5000	5	0 - 75VA	0.03%	0.1%
> 5000 - 10000	5	0 - 75VA	0.05%	0.2%

1. Nominal burden of the CT.

Table 12-8: Phase measurement accuracy at rated current

Characteristic	Rating
Resolution	0.01 min
Accuracy (cos φ 0.8 - 1)	1min (typical) 3min (guaranteed)

Table 12-9: Turns ratio measurement accuracy

Characteristic	Rating
Resolution	0.01 turns
Accuracy	0.05% (typical) 0.1% (guaranteed)

12.6 Compact Flash card interface

Table 12-10: Compact Flash card interface

Characteristic	Rating
Card type	CF type 1
Allowed memory size	16MB - 2GB

12.7 Remote control interface

The remote control interface of *CT Analyzer* is exclusively intended to connect *CT Analyzer* to a computer (e.g. running the *CT Analyzer Suite* software) or to the optional *CT SB2* switch box (for multi-ratio CT measurement).

As of serial number JHxxxx or newer, *CT Analyzer* is equipped with a USB interface and a RS232 interface.

Note: The user has to select the interface to be used in the *CT Analyzer* settings before connecting *CT Analyzer* to a computer (refer to section 3.3 on page 26). *CT Analyzer* will only communicate via the selected interface. It will not be recognized by the computer if *CT Analyzer* settings do not match the interface used for connection.

12.7.1 RS232 interface

The RS232 interface can be used to connect *CT Analyzer* to a computer or to the optional *CT SB2* switch box.

9-pole SUB-D connector, male

Figure shows outside view onto the pins at *CT Analyzer*!

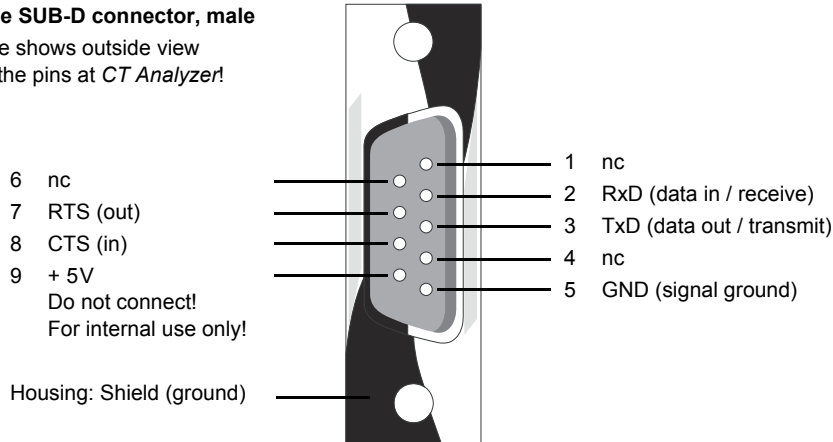


Figure 12-1: Pin assignment for RS232 remote control interface

9-pole (DB9) null modem or crossover cable, 2 x female

Connections required:

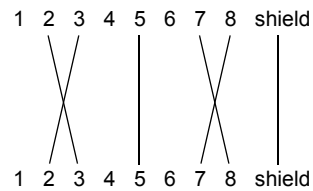


Figure 12-2: Connection cable for RS232 remote control interface

12.7.2 USB interface

The USB interface can be used to connect *CT Analyzer* to a computer. Communication via USB is considerably faster than communication via RS232.

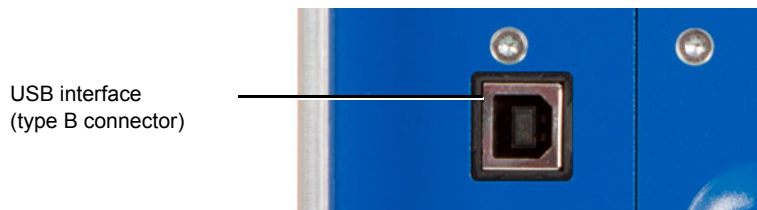


Figure 12-3: USB remote control interface (standard type B connector)

12.8 Environmental conditions

Table 12-11: Environmental conditions

Characteristic	Rating
Operating temperature	-10 ... +50 °C (14 ... 122 °F)
Storage and transportation	-25 ... +70 °C (-13 ... 158 °F)
Max. altitude for operation	2000m




12.9 Mechanical data

Table 12-12: Mechanical data

Characteristic	Rating
Weight	< 8kg (17.6lbs) without accessories
Dimensions W x H x D	360 x 285 x 145mm (14.2 x 11.2 x 5.7")

12.10 Standards

Table 12-13: Standards

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	
Other		
Shock	IEC/EN 60068-2-27 (15 g/11 ms, half-sinusoid, 3 shocks in each axis)	
Vibration	IEC/EN 60068-2-6 (frequency range 10 Hz...150 Hz, acceleration 2 g continuous (20 m/s ² /65 ft/s ²), 20 cycles per axis)	
Humidity	IEC/EN 60068-2-78 (5%...95% relative humidity, no condensation), tested at 40 °C/104 °F for 48 hours	
Protection class	IP20 according to EN 60529	

13 User maintenance

13.1 Care and cleaning

CT Analyzer does not require any special maintenance or care. Clean the device from time to time or as necessary using a cloth dampened with water or isopropanol alcohol. Always disconnect *CT Analyzer* prior to cleaning!

13.2 Replacing fuses

1. Turn off *CT Analyzer* and unplug the power cord.
2. Ground the test object, and disconnect it from *CT Analyzer*. By disconnecting it you prevent a possibly faulty test object from feeding power back into *CT Analyzer*.
3. Locate the blown fuse on the side panel of *CT Analyzer* and replace it by an identical fuse type: T6.3H 250 V (6.3 Amps slow-acting high breaking capacity wire fuse 5 x 20mm). *CT Analyzer* has two fuses of the same type. Proceed as follows:
 - ▶ Use a small screwdriver to unlock the two locking tongues one after the other as shown in Figure 13-1.
 - ▶ Pull out the fuse holder and locate the blown fuse.
 - ▶ Replace the blown fuse by an identical fuse type.
 - ▶ Insert the fuse holder and press it into the base until the two locking tongues engage audibly.

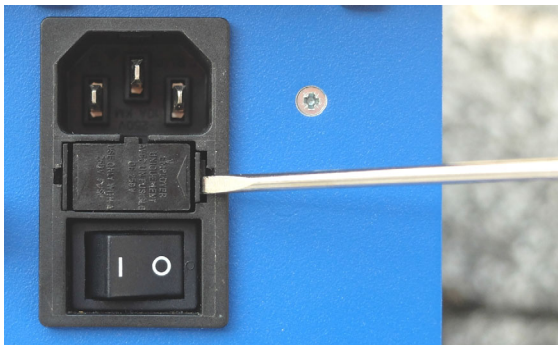


Figure 13-1: Unlocking the locking tongues of the fuse holder

13.3 Calibrating *CT Analyzer*

OMICRON offers a reference CT (calibration CT VEHZ0649) to verify the calibration of *CT Analyzer*. This reference CT is delivered together with a calibration certificate of a national test laboratory.

The calibration CT has a ratio of 2000:1 and 2000:5. Its class is 0.02.

To verify the calibration of *CT Analyzer*, it is necessary to measure both ratios (2000:1 and 2000:5). *CT Analyzer* is within the specifications, if all measurement results are within class 0.02.

If the measurement results are not within class 0.02, we recommend to send *CT Analyzer* back to OMICRON for calibration in order to guarantee proper operation in accordance with the regulations.

14 Error and warning messages

- 001.xxx Error [001] No valid CT software!**
Reason: No valid software in the device Flash memory or incorrect checksum.
Solution: Insert a Compact Flash card with valid software (**CTAnalyzer.bin**) in the **Omicron** directory and switch the *CT Analyzer* off and on again.
- 002.xxx Error [002] Can't open file!**
Reason: The firmware cannot read the file **CTAnalyzer.bin** from the Compact Flash card since the CF card or the file is missing.
Solution: Insert a Compact Flash card with valid software (**CTAnalyzer.bin**) in the **Omicron** directory and switch the *CT Analyzer* off and on again.
- 003.xxx Error [003] Download error!**
Reason: The downloaded software is corrupt.
Solution: Insert a Compact Flash card with valid software (**CTAnalyzer.bin**) in the **Omicron** directory and switch the *CT Analyzer* off and on again.
- 100.xxx Warning [100.xxx] CT resistance > 3000 Ohms.**
Reason: The resistance measured during primary or secondary winding resistance measurement is > 3000Ω.
Solution: The test cannot be continued. Check the connections to the CT. If the connections are ok, the CT resistance is > 3000Ω. Such CTs cannot be tested using the *CT Analyzer*.
- 101.xxx Warning [101.xxx] Timeout during measurement. No constant winding resistance can be determined within 10 sec.**
Reason: The *CT Analyzer* cannot determine a constant winding resistance within 10sec. during primary or secondary winding resistance measurement.
Solution: The test cannot be continued. Check the connections to the CT.
- 110.xxx Warning [110.xxx] The impedance of the CT is too high.**
Reason: The impedance of the CT or the load is too high to reach the minimum toggle frequency of 0.2Hz / 0.8Hz.
Solution: The test cannot be continued. Check the connections to the CT. If the connections are ok, it is not possible to test this CT due to its too high inductance.
- 111.xxx Warning [111.xxx] Inductance of load too low.**
Reason: Measurement frequency is too high and cannot be decreased because of too low CT inductance.
Solution: The test cannot be continued. Check the connections to the CT. If the connections are ok, it is not possible to test this CT due to its too low inductance.
- 112.xxx Warning [112.xxx] Measurement error, reduce noise level.**
Reason: It is not possible to obtain stable measurement results due to incorrect wiring, wiring short-circuit, connected load or external interferences.
Solution: Check the wiring. The primary side of the CT must not be short-circuited. Disconnect the primary side of the CT from the transmission lines, connect one primary side terminal to PE and open the other one. Use the delivered original coax cables for measurement (see section 3.7.2 "Noise reduction techniques" on page 46). Make sure that no burden is connected to the secondary side of the CT. This error may also indicate a winding short circuit of the CT.
- 113.xxx Warning [113.xxx] Test not successful. Kneepoint not found.**
Reason: Knee point for specified standard not found.
Solution: The current required to reach the knee point for the specified standard cannot be delivered. The CT cannot be tested up to the knee point voltage.
- 114.xxx Warning [114.xxx] Low inductance detected during excitation measurement.**
Reason: Low inductance was measured during the excitation test.
Solution: Verify that the primary side of the CT is not short-circuited.
This warning can also occur for CTs with very low excitation loss and high parasitic capacitance.

- 115.xxx Warning [115.xxx] Invalid eddy loss measurement.**
Reason: Reliable determination of the eddy losses is not possible.
Solution: Verify the wiring and repeat the test. If the error message is displayed repeatedly, it is currently not possible to test this CT using the *CT Analyzer*.
- 116.xxx Warning [116.xxx] Knee point too low! CTs with a knee point below 1 volt are not supported.**
Reason: The knee point voltage is smaller than 1 V.
Solution: Currently it is not possible to test CTs with such a low knee point using the *CT Analyzer*.
- 121.xxx Warning [121.xxx] Test not successful! Reverse polarity. Check wiring and repeat the measurement.**
Reason: Measured polarity is wrong.
Solution: Reverse the polarity of the measurement cables on the primary or secondary side of the CT.
- 130.xxx Warning [130.xxx] Burden impedance > 1kOhm.**
Reason: Burden impedance > 1 k Ω .
Solution: The test cannot be continued. Check the connections to the Burden.
- 131.xxx Warning [131.xxx] Overload during Burden measurement.**
Reason: The required test current cannot be reached, even at the maximum output voltage.
Solution: The *CT Analyzer* cannot deliver enough current. Reduce the test current or the impedance of the burden. Check the wiring for proper contacts; one connection possibly has a bad connection.
- 140.xxx Warning [140.xxx] Timeout during remanence test. Measured magnetic flux is unstable. Reduce noise level.**
Reason: The magnetic flux during remanence measurement is not stable.
Solution: The test cannot be continued. Check the connections to the CT. Try to reduce the noise level for the measurement.
- 200.xxx Warning [200.xxx] Check connection. Make sure burden is properly wired.**
Reason: The measured input voltage differs by more than 5V from the input voltage expected during burden test.
Solution: Check whether the output generator ("Output") and measurement input "Sec" are connected correctly.
- 200.xxx Warning [200.xxx] Check CT SB2 switch box wiring: CTA OUTPUT and/or BURDEN terminal may be disconnected.**
Reason: The measured input voltage differs by more than 5V from the input voltage expected during the burden test using the *CT SB2* switch box.
Solution: Check whether the BURDEN OUT and the BURDEN IN sockets on the *CT SB2* are connected correctly.
- 201.xxx Warning [201.xxx] Check connection. Measured ratio > 50000:1.**
Reason: Measurement input "Prim" is possibly not connected properly.
Solution: Check whether the primary side measurement input "Prim" is connected properly.
- 202.xxx Warning [202.xxx] Check connection. Polarity of input SEC and power output are not the same.**
Reason: Polarity of input "Sec" and "Output" are not the same.
Solution: Check whether the output generator ("Output") and measurement input "Sec" are connected properly and with correct polarity.
- 203.xxx Warning [203.xxx] Check connection. Input SEC may be disconnected.**
Reason: Input signal at input "Sec" differs from the expected one.
Solution: Check whether the output generator ("Output") and measurement input "Sec" are connected properly.
- 204.xxx Warning [204.xxx] Check connection. Polarity of input PRIM and power output are not the same.**
Reason: Input signal at input "Prim" differs from the expected one: Reverse polarity at input "Prim".
Solution: Check whether the output generator ("Output") and measurement input "Prim" are connected properly and with correct polarity.

- 204.xxx Warning [204.xxx] Check CT SB2 switch box wiring: Wrong polarity at PRIM terminal.**
Reason: Input signal at input "PRIM" differs from the expected one: Reverse polarity at CT SB2 input "PRIM".
Solution: Check whether the PRIM IN sockets on the CT SB2 are connected properly and with correct polarity. If necessary, connect with changed polarity.
- 205.xxx Warning [205.xxx] Check connection. Input PRIM may be disconnected.**
Reason: Input signal at input "Prim" differs from the expected one.
Solution: Check whether the output generator ("Output") and measurement input "Prim" are connected properly.
- 205.xxx Warning [205.xxx] Check CT SB2 switch box wiring: PRIM IN terminal may be disconnected.**
Reason: Input signal at input "Prim" differs from the expected one.
Solution: Check whether the PRIM IN sockets on the CT SB2 are connected properly.
- 206.xxx Warning [206.xxx] Check connection. Ensure that the output is connected to the primary side of the CT.**
Reason: Input signal at input "Prim" differs from the expected one.
Solution: Check that the output generator ("Output") is connected to the CT and that the primary side of the CT is connected to input "Prim".
- 206.xxx Warning [206.xxx] Check CT SB2 switch box wiring: CTA OUTPUT and/or PRIM OUT terminal may be disconnected.**
Reason: Input signal at input "Prim" differs from the expected one.
Solution: Check whether the PRIM OUT and the PRIM IN sockets on the CT SB2 are connected correctly to the primary side of the CT.
- 207.xxx Warning [207.xxx] Check connection! OUTPUT may be disconnected.**
Reason: The current signal differs from the expected one.
Solution: Check whether the output generator ("Output") and measurement input "SEC" are connected properly to the secondary side of the CT.
- 210.xxx Warning [210.xxx] Permanent data overflow.**
Reason: Internal data buffer overflow. The data could not be fetched fast enough from the internal data buffer.
Solution: Try to repeat the measurement. If this error occurs more frequently, you should contact your next OMICRON service center.
- 211.xxx Warning [211.xxx] Sinus mode measurement timeout.**
Reason: Measurement timeout due to frequent range switching or invalid data from the measurement inputs.
Solution: Check the wiring and repeat the measurement. Try to reduce noise for the measurement.
- 220.xxx Warning [220.xxx] Test aborted!**
Reason: The test sequence has been interrupted by the user.
Solution: Repeat the test without interrupting it.
- 308.xxx Note [308.xxx] I_{sn} value has to be specified in CT-Object Card prior to Residual Magnetism test!**
Reason: For the remanence test the I_{sn} value should be defined.
Solution: Enter valid I_{sn} value before starting the remanence test.
- 310.xxx Note [310.xxx] License: <Guesser functionality> is missing! Values for: I_{pn}, I_{sn}, P/M, Class, FS/ALF should be provided.**
Reason: The license required for class guessing is not available.
Solution: Specify the values for I_{pn}, I_{sn}, Class, P/M and FS/ALF before starting the test.
- 311.xxx Warning [311.xxx] License: <Simulation after test> is missing!**
Reason: The license required for simulation is not available.
Solution: Simulation of the results for changed test settings (e.g. different burden values) after the test is not possible. Purchase a corresponding license.
- 312.xxx Warning [312.xxx] License: <...> is missing!**
Reason: The license specified in the message is not available.
Solution: The functionality included in the license is not available. Purchase a corresponding license.

- 313.xxx Warning [313.xxx] License: <All languages> is missing! Test can be performed only if the Chinese user interface is set.**
Reason: The license required to use all languages is not available.
Solution: Perform the test with the Chinese user interface or purchase a corresponding license.
- 318.xxx Warning [318.xxx] License: <Burden guesser> is missing! Values for VA, Burden, Cosφ should be provided.**
Reason: The license required for the burden guesser functionality is not available.
Solution: Specify the values for nominal and operating burden (VA, Burden and cosφ) or purchase a corresponding license.
- 319.xxx Warning [319.xxx] License: <Quick test> is missing!**
Reason: The license required for the Quick Test functionality is not available.
Solution: Purchase a corresponding license if you want to perform measurements using Quick Test.
- 331.xxx Note [331.xxx] I_{pn} is invalid! The value must be between the I_{pn} values of the neighboring taps.**
Reason: An invalid I_{pn} value has been entered to the **MR-Config** card.
Solution: Enter a valid I_{pn} value.
- 332.xxx Note [332.xxx] I_{sn} has to be specified. V_b and VA are calculated dependent on I_{sn}.**
Reason: You tried to enter values for V_b or VA without specifying the I_{sn} value first.
Solution: Enter a valid I_{sn} value before specifying values for V_b and VA.
- 333.xxx Note [333.xxx] First define I-pn for this tap.**
Reason: You tried to enter a nominal burden (VA) value for a tap without specifying the I_{pn} for this tap first.
Solution: Enter a valid I_{pn} value for the tap before specifying the nominal burden (VA).
- 334.xxx Note [334.xxx] Test cannot be started. Nominal burden (VA) should be >= 3.75VA.**
Reason: The nominal burden (VA) entered is lower than the limit specified in the device settings (parameter "Min. VA at M cores I_{sn} 5A").
Solution: Enter a nominal burden (VA) higher than or equal to 3.75VA.
- 356.xxx Warning [356.xxx] License: <All frequencies support> is missing! Only 60 Hz nominal frequency is supported.**
Reason: The license required to use all frequencies is not available.
Solution: Measurements are only possible for 60 Hz. Purchase a corresponding license if you want to perform testing with other frequencies.
- 357.xxx Note [357.xxx] License: <P cores support> is missing! Only metering CTs can be measured.**
Reason: The license required to perform testing of protection cores is not available.
Solution: Testing is only possible for metering cores. Purchase a corresponding license if you want to perform testing of protection cores.
- 358.xxx Warning [358.xxx] License: <M cores support> is missing! Only protection CTs can be measured.**
Reason: The license required to perform testing of metering cores is not available.
Solution: Testing is only possible for protection cores. Purchase a corresponding license if you want to perform testing of metering cores.
- 360.xxx Note [360.xxx] No class assessments will be made, because one or more of the settings marked by a star ('?' or '*') "are not defined.**
Reason: Some of the assessment-relevant settings are not defined.
Solution: Make sure that all settings that are relevant for assessment (marked by '?' or '*') are defined.
- 400.xxx Warning [400.xxx] You cannot make a multi-ratio measurement without a CT SB2 switch box!**
Reason: No CT SB2 is connected when starting a multi-ratio measurement.
Solution: Connect the CT SB2 to the CT Analyzer before starting a multi-ratio test.
- 401.xxx Warning [401.xxx] CT SB2 switch box is disconnected!**
Reason: The CT SB2 is not properly connected to the CT Analyzer.
Solution: Restore proper connection between the CT SB2 and the CT Analyzer and restart your test.
- 402.xxx Warning [402.xxx] CT SB2 switch box communication error.**
Reason: Communication between the CT SB2 and the CT Analyzer failed.
Solution: Restore proper connection between the CT SB2 and the CT Analyzer and restart your test.

- 403.xxx Warning [403.xxx] Check CT SB2 switch box wiring: CTA OUTPUT, TAPS XN and/or X1 may be disconnected.**
Reason: The CTA OUTPUT sockets of the *CT SB2* are not properly connected to the *CT Analyzer* output.
Solution: Make sure that the CTA OUTPUT sockets on the *CT SB2* are properly connected to the *CT Analyzer* and restart your test.
- 404.xxx Warning [404.xxx] Check CT SB2 switch box wiring: CTA PRIM and/or PRIM IN terminal may be disconnected.**
Reason: The CTA PRIM sockets of the *CT SB2* are not properly connected to *CT Analyzer* input PRIM.
Solution: Make sure that the CTA PRIM sockets on the *CT SB2* are properly connected to *CT Analyzer* input PRIM and restart your test.
- 405.xxx Warning [405.xxx] Check CT SB2 switch box wiring: CTA SEC terminal, TAPS XN IN and/or X1 IN may be disconnected.**
Reason: The CTA SEC sockets of the *CT SB2* are not properly connected to *CT Analyzer* input SEC.
Solution: Make sure that the CTA SEC sockets on the *CT SB2* are properly connected to *CT Analyzer* input SEC and restart your test.
- 406.xxx Warning [406.xxx] Check CT SB2 switch box wiring: <text depending on connection actually detected>**
Reason: The CTA SEC sockets of the *CT SB2* are not properly connected to *CT Analyzer* input SEC.
Solution: Make sure that the CTA SEC sockets on the *CT SB2* are properly connected to *CT Analyzer* input SEC and restart your test.
- 407.xxx Warning [407.xxx] Check CT SB2 switch box wiring: Wrong polarity at CTA SEC or CTA OUTPUT terminal**
Reason: Reverse polarity at the CTA SEC sockets or the CTA OUTPUT sockets of the *CT SB2*.
Solution: Make sure that the CTA SEC sockets and the CTA OUTPUT sockets on the *CT SB2* are properly connected to *CT Analyzer* and restart your test.
- 408.xxx Warning [408.xxx] Check CT SB2 switch box wiring: <text depending on missing connection actually detected>**
Reason: At least one of the CT taps enabled for multi-ratio testing is not connected to the *CT SB2* correctly.
Solution: Make sure that all CT taps are connected correctly to the TAPS terminals on the *CT SB2* and restart your test.
- 409.xxx Warning [409.xxx] Check CT SB2 switch box wiring: <text depending on incorrect connection actually detected>**
Reason: Wiring of at least two CT taps is mixed, e.g. CT tap X2 is connected to TAPS X3 on the *CT SB2* and vice versa.
Solution: Make sure that all CT taps are connected to the correct TAPS terminals on the *CT SB2* and restart your test.
- 411.xxx Warning [411.xxx] Firmware download to switch box failed! Error: SBErrNo**
Reason: *CT SB2* firmware download failed.
Solution: Ensure that the *CT SB2* is connected to the *CT Analyzer* and repeat the firmware download to the *CT SB2*.
- 415.xxx Warning [415.xxx] Quick measurement cannot be started. Please disconnect the CT SB2 switch box.**
Reason: You are trying to initiate a *Quick* measurement with the *CT SB2* switch box still connected to the *CT Analyzer*.
Solution: Measurements using *Quick Test* are not possible when the *CT SB2* is connected to the *CT Analyzer*. Remove all connections to the *CT SB2* and restart your *Quick* measurement on the *CT Analyzer*.

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- 501.xxx** No message displayed on the *CT Analyzer*. Message only displayed on remote PC connected to the *CT Analyzer*.
Reason: The remote interface handler couldn't decipher the command.
Solution: Remote interface error. Check the connection between *CT Analyzer* and PC.
- 504.xxx** No message displayed on the *CT Analyzer*. Message only displayed on remote PC connected to the *CT Analyzer*.
Reason: Data transmission error.
Solution: Check the connection between *CT Analyzer* and PC.
- 505.xxx** No message displayed on the *CT Analyzer*. Message only displayed on remote PC connected to the *CT Analyzer*.
Reason: Data transmission error.
Solution: Check the connection between *CT Analyzer* and PC.
- 510.xxx** No message displayed on the *CT Analyzer*. Message only displayed on remote PC connected to the *CT Analyzer*.
Reason: Remote interface error: Failed to get the required measurement data because the measurement is still running.
Solution: Check the connection between *CT Analyzer* and PC.
- 511.xxx** No message displayed on the *CT Analyzer*. Message only displayed on remote PC connected to the *CT Analyzer*.
Reason: Remote interface error: Failed to unzip the transmitted data block.
Solution: Check the connection between *CT Analyzer* and PC.
- 513.xxx** No message displayed on the *CT Analyzer*. Message only displayed on remote PC connected to the *CT Analyzer*.
Reason: The current remote interface command is not allowed.
Solution: Make sure that the current *CT Analyzer* state allows the execution of the command.
- 514.xxx** No message displayed on the *CT Analyzer*. Message only displayed on remote PC connected to the *CT Analyzer*.
Reason: Remote interface error: Remote command was submitted with an invalid parameter.
Solution: Verify the parameter (index) submitted with the remote interface command.
- 800.xxx** **Warning [800.xxx] Flash card access error. Internal file system error.**
Reason: The file system sent an error message.
Solution: Compact Flash card is possibly corrupt. Use a new Compact Flash card.
- 801.xxx** **Warning [801.xxx] Flash card access error. Invalid file name or path.**
Reason: The file system sent an error message.
Solution: The Compact Flash card is possibly corrupt. Try to save the data to a PC and format the CF card.
- 802.xxx** **Warning [802.xxx] Flash card access error. Access denied.**
Reason: The file system sent an error message. You tried to open a "read only" file or a special directory.
Solution: Access the Compact Flash card on a PC and remove the "read-only" file attribute. File attributes cannot be modified with the *CT Analyzer*.
- 803.xxx** **Warning [803.xxx] Flash card access error. File or folder already exists.**
Reason: The file system sent an error message.
Solution: Enter a different file or folder name.
- 804.xxx** **Warning [804.xxx] Flash card access error. Disk full.**
Reason: The file system sent an error message.
Solution: Delete some files on the Compact Flash card or insert a new CF card.
- 805.xxx** **Warning [805.xxx] Flash card access error. No or corrupt flash card.**
Reason: No or no valid CF card can be found.
Solution: Insert a valid Compact Flash card.

- 806.xxx Warning [806.xxx] Flash card access error. Corrupt directory structure.**
Reason: The file system sent an error message.
Solution: Try to backup the data on the Compact Flash card to a PC and perform formatting of the Compact Flash card.
- 807.xxx Warning [807.xxx] Nothing to paste.**
Reason: No file(s) selected to paste.
Solution: Select one or more files using the **Copy** or **Cut** function and try again.
- 808.xxx Warning [808.xxx] Renaming of folders not supported.**
Reason: This action is not supported.
Solution: Renaming of folders is not supported by the *CT Analyzer*.
- 809.xxx Warning [809.xxx] Are you sure you want to format the CF card? All data will be lost!**
Reason: This warning always appears before formatting of a Compact Flash card is executed, since all data stored on the Compact Flash card will be erased during formatting.
Solution: Press **Format** to start formatting or **Abort** to cancel the operation without formatting the Compact Flash card.
- 810.xxx Warning [810.xxx] File exists. Do you want to overwrite it?**
Reason: The file name used to save the data already exists. This warning always appears before overwriting files on the Compact Flash card.
Solution: Enter another file name, if desired.
- 811.xxx Warning [811.xxx] Are you sure you want to delete <File Name>?**
Reason: This warning always appears prior to the deletion of a file on the Compact Flash card.
Solution: Press **Yes** to delete the file or **No** to return to the file system card without deleting the file.
- 812.xxx Warning [812.xxx] Are you sure you want to delete all selected files?**
Reason: This warning always appears prior to the deletion of files on the Compact Flash card.
Solution: Press **Yes** to delete the files or **No** to return to the file system card without deleting the files.
- 813.xxx Warning [813.xxx] One or more parameters could not be found. Some calculations may not work.**
Reason: The .xml report file read from the Compact Flash card is of a newer format than the device can generate.
Solution: The loaded file is incompatible or the software version on your *CT Analyzer* is older than the software version that has generated the report. To enable your *CT Analyzer* to read this report, it is necessary to update the *CT Analyzer* software.
- 814.xxx Warning [814.xxx] You tried to load an old report. One or more parameters could not be found. Some calculations may not work.**
Reason: One or more entries could not be found in the .xml report file.
Solution: The software version on the *CT Analyzer* is newer than the software version used to generate the report. The report probably does not contain all parameters supported by the new *CT Analyzer* software.
- 815.xxx Error [815.xxx] Folder must be empty. Can't remove folder <Folder Name>.**
Reason: The folder selected for deletion is not empty. Only empty folders can be deleted.
Solution: Navigate to the folder you want to delete. Open the folder and delete all contained files and subfolders. Then you can delete the empty folder.
- 816.xxx Error [816.xxx] You tried to load a report built with a <Device>.**
Reason: The .xml file seems to be not a *CT Analyzer* report.
Solution: The report cannot be loaded by the *CT Analyzer*.
- 817.xxx Error [817.xxx] The xml file has no valid OMICRON report style.**
Reason: The .xml file has no valid OMICRON report style.
Solution: The report cannot be loaded by the *CT Analyzer*.
- 818.xxx Warning [818.xxx] Moving of folders not supported.**
Reason: Moving of folders is not supported by the *CT Analyzer*.
Solution: Select only files to move, not folders. Using the shift key and the up/down cursor keys it is possible to select any number of files within a folder.

- 819.xxx Warning [819.xxx] File name contains an invalid character.**
Reason: An invalid character was used to specify the file name.
Invalid characters: \ / : * ? \ < > |
Solution: Only use valid characters for the file name.
- 820.xxx Error [820.xxx] Memory management error. Contact the next OMICRON service center.**
Reason: Memory management error.
Solution: Switch the *CT Analyzer* off, wait a second then switch it on again. If this error occurs more frequently, you should contact your next OMICRON service center.
- 821.xxx Error [821.xxx] Could not update firmware.**
Reason: An error has occurred in the boot loader software.
Solution: Insert a Compact Flash card with valid software (**CTAnalyzer.bin**) in the directory **A:\Omicron** and switch the *CT Analyzer* off and on again.
- 823.xxx Error [823.xxx] Could not update user text!**
Reason: An error has occurred in the user text loader software.
Solution: Insert a Compact Flash card with valid software (**CTUser_xxx.bin**) in the directory **A:\Omicron** and try again.
- 824.xxx Error [824.xxx] An internal software error has occurred at address xxxxxxxH. To log this error, make sure that a CF card is inserted and then press OK. Please send the file \OMICRON\ ErrorLog.xml on the CF card to the next OMICRON service center.**
Reason: Invalid result in a floating point operation (NaN).
Solution: Contact your next OMICRON service center.
- 825.xxx Warning [825.xxx] Size of file [FileName] >= 1Mbyte.**
Reason: The size of the file copied to the *CT Analyzer* Compact Flash card or virtual disc is > 1 MB.
Solution: Avoid transfer of large files > 1 MB to the *CT Analyzer*.
- 826.xxx Error [826.xxx] The CT standard of the loaded report is not supported by the current firmware version. Please check for a CT Analyzer firmware update.**
Reason: You are trying to load a report that makes use of a CT standard your current firmware version of *CT Analyzer* does not support.
Solution: Perform a firmware update to the latest version for your *CT Analyzer*.
- 830.xxx License < ... > is invalid.**
Reason: An invalid license entry was found in the license file **Omicron.lic** on the CF Card.
Solution: Specify a valid license key.
- 831.xxx Setting value for < ... > is invalid. The default value of < ... > is used.**
Reason: Invalid item in file **Settings.inf**.
Solution: The file **Settings.inf** in the **Omicron** directory on the CF card of the *CT Analyzer* has a formatting error in one of the parameters. Delete this file and check the settings in the menu **Main Menu -> Settings -> Misc. Settings**. If necessary, change the settings and store the file again.
- 832.xxx Lifetime of relays near end. Contact the next OMICRON service center soon to arrange a hardware service.**
Reason: The relays inside the *CT Analyzer* near the end of their lifetime (more than 1,000,000 measurements performed).
Solution: Arrange a hardware service in order to replace the relays.
- 833.xxx You are about to load a report with an invalid hash code. Some measurement values may not be authentic.**
Reason: The file checksum is not valid.
Solution: Check the authenticity of the report file loaded.
- 834.xxx No valid license was found in this file!**
Reason: No valid license found.
Solution: Check the license file. The license possibly does not correspond to the serial number of the *CT Analyzer*.

835.xxx Downgrade a firmware below version 3.53 is not supported.

Reason: Attempt for a downgrade to a version number < 3.53.

Solution: Make sure that die FW version number for the upgrade/downgrade is not below 3.53.

900.xxx Error [900.xxx] Power supply error. Switch off the device and wait 1 minute to restart.

Reason: The output power was larger than 350VA or the power supply is defective.

Solution: Switch the *CT Analyzer* off, wait 1 minute and then switch it on again. If this error occurs more frequently, you should contact your next OMICRON service center.

901.xxx Warning [901.xxx] Protective earth (PE) connection in power supply cord missing. Connect PE to equipotential terminal. Lethal voltage may occur on housing and all terminals.

Reason: Earth wire break, no earth wire connected or device is supplied via an isolation transformer.

Solution: The mains supply does not have reference to protective earth or protective earth is not connected. The mains supply must have galvanic connection to PE. If you are using an isolation transformer, connect one supply line of the *CT Analyzer* to PE.

WARNING



Death or severe injury caused by high voltage possible

- ▶ Make sure that the grounding terminal of the device is connected to protective earth potential. Lethal voltages may occur at the housing otherwise.

NOTICE

Equipment damage possible

The device may become damaged if mains supply is galvanically isolated from earth potential.

Comment: If a galvanically isolated mains supply is used, voltage stress may occur for the insulation system, the device is not constructed for. **Safety is no longer guaranteed!** Therefore, always use a mains power cord with a protective earthing conductor connected to PE of the mains supply. Connect the grounding terminal of the device to protective earth in order to prevent electric shock caused by lethal voltages possibly present at the housing. If this error is ignored, the device will probably work but safety is no longer guaranteed.

903.xxx Warning [903.xxx] Excessive reverse power, don't disconnect any wires, don't switch off mains, wait until power is dissipated. ATTENTION: Lethal voltages on output terminals!

Reason: The device receives excessive reverse power so that the power output had to be shortened to prevent overload of the internal output stage.

Solution: This error is displayed if an excess amount of energy is fed back into the *CT Analyzer*. The *CT Analyzer* discharges the connected inductor with approximately 20Ws, but depending on the connected inductance the discharge process may take some time.

Safety action: All measurements are stopped until reverse power is dissipated.

WARNING



Death or severe injury caused by high voltage possible

Lethal voltages up to many kV may occur.

- ▶ Do not disconnect any wires and do not switch off the *CT Analyzer*.
- ▶ Wait until the power is dissipated.

904.xxx Error [904.xxx] Power supply error. Contact next Omicron service center.

Reason: Temperature limit of secondary power supply exceeded.

Solution: It is not possible to acknowledge this error until the temperature is back in safe limits. If this error occurs, please contact your next OMICRON service center.

Safety action: All measurements are stopped.

- 905.xxx Error [905.xxx] Over-temperature of power supply, wait until device has cooled down.**
Reason: Secondary side power supply has reached the warning temperature limit and entered save mode to cool down.
Solution: When this error is acknowledged as long it is active, the popup window is closed and only the message in the status line remains active until the overtemperature disappears. If the error is not acknowledged, the popup window remains active.
Comment: The status line displays the flashing message "905.xxx Overtemp."
Safety action: All measurements are stopped and the error message is displayed in the status line and a popup window. After acknowledgement, the software waits at least 1 minute before the test can be started again.
- 906.xxx Error [906.xxx] Excess temperature of power supply, wait until device has cooled down.**
Reason: The primary side power supply has reached its warning temperature limit and entered save mode to cool down.
Solution: When this error is acknowledged as long it is active, the popup window is closed and only the message in the status line remains active until the overtemperature disappears. If the error is not acknowledged, the popup window remains active.
Comment: The status line displays the flashing message "906.xxx Overtemp."
Safety action: All measurements are stopped and the error message is displayed in the status line and a popup window. After acknowledgement, the software waits at least 1 minute before the test can be started again.
- 908.xxx Error [908.xxx] Device shut down.**
Reason: Internal power failure on the measurement interface module.
Solution: The message is active as long as the internal power for the measurement interface fails. Contact the next OMICRON service center if the error does not disappear.
- 911.xxx Error [911.xxx] Power supply error, contact next Omicron service center. Desired voltage xxxx, measured voltage yyyy.**
Reason: One supply voltage on the measurement interface boards is out of tolerance.
Solution: Contact your next OMICRON service center.
Comment: It is no longer possible to work with the device.
- 912.xxx Error [912.xxx] Excess internal temperature, wait until device has cooled down.**
Reason: Device-internal temperature at measurement interface > 75°C.
Solution: Excessive heating of the device. Prevent the device from direct sunlight and wait until it has cooled down. If the error occurs without previous exposure to direct sunlight, the error is probably caused by a hardware error. Please contact your next OMICRON service center.
Comment: The status line displays the flashing message "912.xxx Overtemp."
Safety action: All measurements are stopped and the error is displayed in the status line and in a popup window. The error is active until the temperature falls below 60°C.
- 929.xxx Error [929.xxx] Hardware failure, contact next Omicron service center.**
Reason: The circuit for reverse power dissipation does not work properly.
Solution: Contact your next OMICRON service center.
Safety action: All measurements are stopped and the power supply is switched off.
- 930.xxx Error [930.xxx] Measurement input Vsec defective, contact next Omicron service center.**
Reason: Power supply for analog input "Sec" is defective.
Solution: Contact your next OMICRON service center.
- 931.xxx Error [931.xxx] Measurement input Vprim defective, contact next Omicron service center.**
Reason: Power supply for analog input "Prim" is defective.
Solution: Contact your next OMICRON service center.
- 932.xxx Error [932.xxx] Data error.**
Reason: The sequence of reading of the analog input channels is not correct.
Solution: If this error occurs more frequently, contact your next OMICRON service center.
- 933.xxx Error [933.xxx] Hardware failure, contact next Omicron service center.**
Reason: Temperature detection circuit on secondary side is defective.
Solution: Send the device to your next OMICRON service center.
Safety action: Power supply is switched off and all measurements are disabled.

- 934.xxx Warning [934.xxx] Reverse power, don't disconnect any wires, don't switch off mains, wait until power is dissipated. I = xxxxA.**
Reason: The device receives reverse power of > 20mA.
Solution: Wait until the power is dissipated within the device and the error message disappears.
Safety action: All measurements are stopped until reverse power is dissipated.
- 935.xxx Error [935.xxx] No valid CT Analyzer software. Insert a CF-Card with valid Software and press "Update Firmw."**
Reason: Cannot find valid *CT Analyzer* software.
Solution: Insert a Compact Flash card with valid software (**CTAnalyzer.bin**) in the directory **A:\Omicron**.
- 936.xxx Warning [936.xxx] Corrupt Calibration Data for voltage inputs. Change to tools menu and try to reset factory calibration. Until update of calibration data the device will be not calibrated.**
Reason: The calibration data checksum for the analog inputs is not correct.
Solution: Try to update the factory calibration using the tools menu. If this does not solve the problem, contact your next OMICRON service center.
- 937.xxx Warning [937.xxx] Corrupt Calibration Data for power output. Change to tools menu and try to update factory calibration. Until update of calibration data the device will be not calibrated.**
Reason: The calibration data checksum for the power output is not correct.
Solution: Try to update the factory calibration using the tools menu. If this does not solve the problem, contact your next OMICRON service center.
- 938.xxx Warning [938.xxx] MIF data block 1 corrupt.**
Reason: The checksum of the factory settings data is faulty.
Solution: Licensing or device settings data are possibly corrupt. Contact your next OMICRON service center.
- 939.xxx Warning [939.xxx] MIF data block 2 corrupt.**
Reason: The checksum of the factory settings data is faulty.
Solution: Licensing or device settings data are possibly corrupt. Contact your next OMICRON service center.
- 940.xxx Warning [940.xxx] CMOS data block corrupt. Check all device settings. Press Clear Values to work with default values. Press OK to work with corrupt device settings.**
Reason: Device settings data block corrupt.
Solution: Check all device settings.
- 941.xxx Error [941.xxx] Corrupt factory calibration data for voltage inputs. Contact next Omicron service center.**
Reason: Factory calibration data block for voltage inputs corrupt.
Solution: Contact your next OMICRON service center.
- 942.xxx Error [942.xxx] Corrupt factory calibration data for power unit. Contact next Omicron service center.**
Reason: Factory calibration data corrupt.
Solution: Contact your next OMICRON service center.
- 943.xxx Error [943.xxx] Error overwriting calibration data.**
Reason: Factory calibration data cannot be restored.
Solution: Contact your next OMICRON service center.
- 944.xxx Warning [944.xxx] Corrupt user text! Change to tools menu and try to update text. Until update of user text, the device will use default text.**
Reason: Checksum for user language support data invalid.
Solution: Copy a user text file (**CTUser_xxx.bin**) to the directory **A:\Omicron** on the Compact Flash card and try to update the user language support data using the "Update Text" function in the tools menu.
- 945.xxx Error [945.xxx] Corrupt or missing phase calibration data for power unit. Contact the next OMICRON service center.**
Reason: The phase calibration data are corrupt or missing.
Solution: Contact the next OMICRON service center

Support

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



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At our technical support hotline, you can reach well-educated technicians for all of your questions. Around the clock – competent and free of charge.

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Asia-Pacific: +852 3767 5500

Europe / Middle East / Africa: +43 59495 4444

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Learn more about your product in one of the training courses offered by the OMICRON Academy.

CT SB2

User Manual



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About this manual

This CT SB2 User Manual provides information on how to use the *CT SB2* switch box. The CT SB2 User Manual contains important safety instructions for working with *CT SB2*, gets you familiar with operating it, and provides typical application examples. Read and observe the safety instructions described in chapter 1 "Safety instructions" on page 7 and all relevant operation and installation instructions. Following the instructions in this User Manual will help you to prevent danger, repair costs, and avoid possible down time due to incorrect operation.

The CT SB2 User Manual and the CT Analyzer User Manual always have to be available at the site where the *CT SB2* switch box is used.

Reading the CT SB2 User Manual alone does not release you from the duty to comply with all relevant national and international safety regulations.

Safety symbols

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



DANGER

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



WARNING

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



CAUTION

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

NOTICE

Equipment damage or loss of data possible

Related documents

The following documents complete the information covered in the CT SB2 User Manual:

Title	Description
CT Analyzer User Manual	Contains information on how to use and operate <i>CT Analyzer</i> as well as safety instructions for working with <i>CT Analyzer</i> .
<i>CT Analyzer Suite</i> help	Contains detailed information about the <i>CT Analyzer Suite</i> software.

1 Safety instructions

1.1 Operator qualifications

Working on high-voltage power equipment can be extremely dangerous. Consequently, only personnel qualified, skilled and authorized in electrical engineering and trained by OMICRON are allowed to operate the *CT SB2* switch box. Before starting to work, clearly establish the responsibilities.

Personnel receiving training, instructions, directions, or education on testing with the *CT SB2* switch box must be under constant supervision of an experienced operator while working with the equipment. The supervising operator must be familiar with the equipment and the regulations on site. The operator is responsible for the safety requirements during the whole test.

1.2 Safety standards and rules

1.2.1 Safety standards

Testing with the *CT SB2* switch box 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.

The *CT SB2* switch box is designated for use with the *CT Analyzer* test set. Before operating *CT Analyzer* and *CT SB2*, read the safety, installation, and operation instructions in this User Manual and the *CT Analyzer* User Manual carefully.

Do not turn on the *CT SB2* switch box and do not operate the device without understanding the safety information in this manual. If you do not understand some safety instructions, contact OMICRON before proceeding.

Maintenance and repair of *CT SB2* is only permitted by qualified experts at OMICRON service centers (see "Support" on page 63).

1.2.2 Safety rules

Always observe the five safety rules:

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

1.3 Operating the measurement setup

The safety instructions given here always apply when operating *CT SB2*. They are supplemented by further notes and warnings applicable for specific actions only. Such specific notes and warnings are given where necessary in this user manual.

In addition to the safety instructions given in this manual, always observe the applicable company-internal safety instructions and safety documents.

In case of any problems or questions, or if you do not understand some safety instructions, contact the OMICRON Technical Support (refer to chapter "Support" on page 63).

Before performing tests, observe the following instructions:

- ▶ Always be aware of the danger of the high voltages and currents associated with this equipment. Pay attention to the information provided in this user manual.
- ▶ Always position the test equipment on dry, solid ground.
- ▶ Position the *CT SB2* switch box so that you can easily disconnect it from mains.
- ▶ Before putting *CT SB2* into operation, check the equipment for visible damages.
- ▶ If working in other than laboratory environment only use *CT SB2* with a solid connection to ground of at least 6mm². Use a ground point as close as possible to the test object.
- ▶ Use *CT SB2* and its accessories only in a technically sound condition. Make sure its use is in accordance with the regulations on site and the designated use described in this document.
- ▶ The mains cable for *CT SB2* must be rated for the nominal voltage and current specified in chapter 10 "Technical data" on page 58. It is recommended to use the cable supplied with *CT SB2*.
- ▶ Only use original cables and accessories available from OMICRON.
- ▶ If *CT SB2* or any accessory seems to be functioning improperly, please call the OMICRON hotline (refer to chapter "Support" on page 63).
- ▶ Do not operate *CT SB2* when explosive gas or vapors are present.
- ▶ Do not operate *CT SB2* under ambient conditions that exceed the temperature and humidity limits listed in chapter 10 "Technical data" on page 58.
- ▶ Do not open *CT SB2*. Opening *CT SB2* invalidates all warranty claims. Do not repair, modify, extend, or adapt *CT SB2* or any accessories.
- ▶ Never connect or disconnect a test object while the outputs of the connected *CT Analyzer* are active.
- ▶ When disconnecting cables, always start at the device feeding the power.
- ▶ For protection against parasitic currents or voltages, always connect the equipotential connector of *CT SB2* to protective ground (PE). Only use the original cable set supplied by OMICRON.
- ▶ Make sure that the terminals of the test object to be connected to *CT SB2* do not carry any voltage potential. During a test, *CT Analyzer* (with *CT SB2* connected) is the only permitted power source for the test object.
- ▶ Only use wires with 4 mm safety "banana" connectors and plastic housing for connection to the front panel input/output sockets.
- ▶ Full compliance with the regulations also includes following the instructions provided in this User Manual.

Observe the following when running tests:

- ▶ Prevent the presence of other persons in the potentially dangerous area around the test object.
- ▶ If necessary, perform appropriate additional safety precautions according to the relevant standard, for example, by defining a high-voltage area around the test object and securing this area against unauthorized access by using a barrier chain and warning sign.
- ▶ Start the test only if all safety precautions were taken and if you are absolutely sure that no other person is present in the potentially dangerous area around the test object.

1.4 Power supply

Supply *CT SB2* only from a power outlet that is equipped with protective ground (PE). Instead of supplying *CT SB2* from phase-neutral, it may also be supplied from phase-phase. However, the voltage must not exceed 240V AC.

1.5 Orderly measures

The *CT SB2* User Manual or alternatively the e-book has always to be available on the site where *CT SB2* is being used.

The *CT SB2* users must read this manual before operating the device and observe the safety instructions and all relevant instructions for connection and operation.

CT SB2 may only be used in accordance with the user documentation (including but not limited to user manuals, reference manuals, getting started manuals and manufacturer manuals). The manufacturer and the distributor are not liable for damage resulting from improper usage.

Opening *CT SB2* 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.

1.6 Disclaimer

If the equipment is used in a manner not described in the user documentation, the protection provided by the equipment may be impaired. The manufacturer and the distributor are not liable if the safety instructions given in this manual or any of the relevant international, national, company-internal or local safety standards and rules are not observed.

1.7 Compliance statements

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.

1.8 Recycling



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

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

OMICRON devices 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 and designated use

The *CT SB2* switch box is an accessory for the *CT Analyzer* test set and therefore exclusively designated for use with *CT Analyzer*.

CT SB2 is intended for the following applications:

- Multi-ratio CT testing

The *CT SB2* switch box enables automatic testing of multi-ratio CTs with up to 6 tap connections. With this accessory, *CT Analyzer* is able to measure every tap combination of multi-ratio CTs without any need for wiring changes during the test.

- Burden and primary winding resistance measurement

Using *CT SB2* it is also possible to include burden and primary winding resistance measurement to the automatic CT test procedure without rewiring.

- Single-ratio CT testing

Due to the possibility to include burden and primary winding resistance measurement, *CT SB2* is not only useful for testing multi-ratio CTs but also for testing single-ratio CTs.

CT SB2 is intended exclusively for the applications described above. Any other use is deemed not to be according to the regulations. The manufacturer and the distributor are not liable for damage resulting from improper usage. The user alone assumes all responsibility and risk.

Note:

The *Quick Test* function included in *CT Analyzer* and *CT Analyzer Suite* cannot be used with the *CT SB2* switch box.

3 Hardware

3.1 Functional components of CT SB2

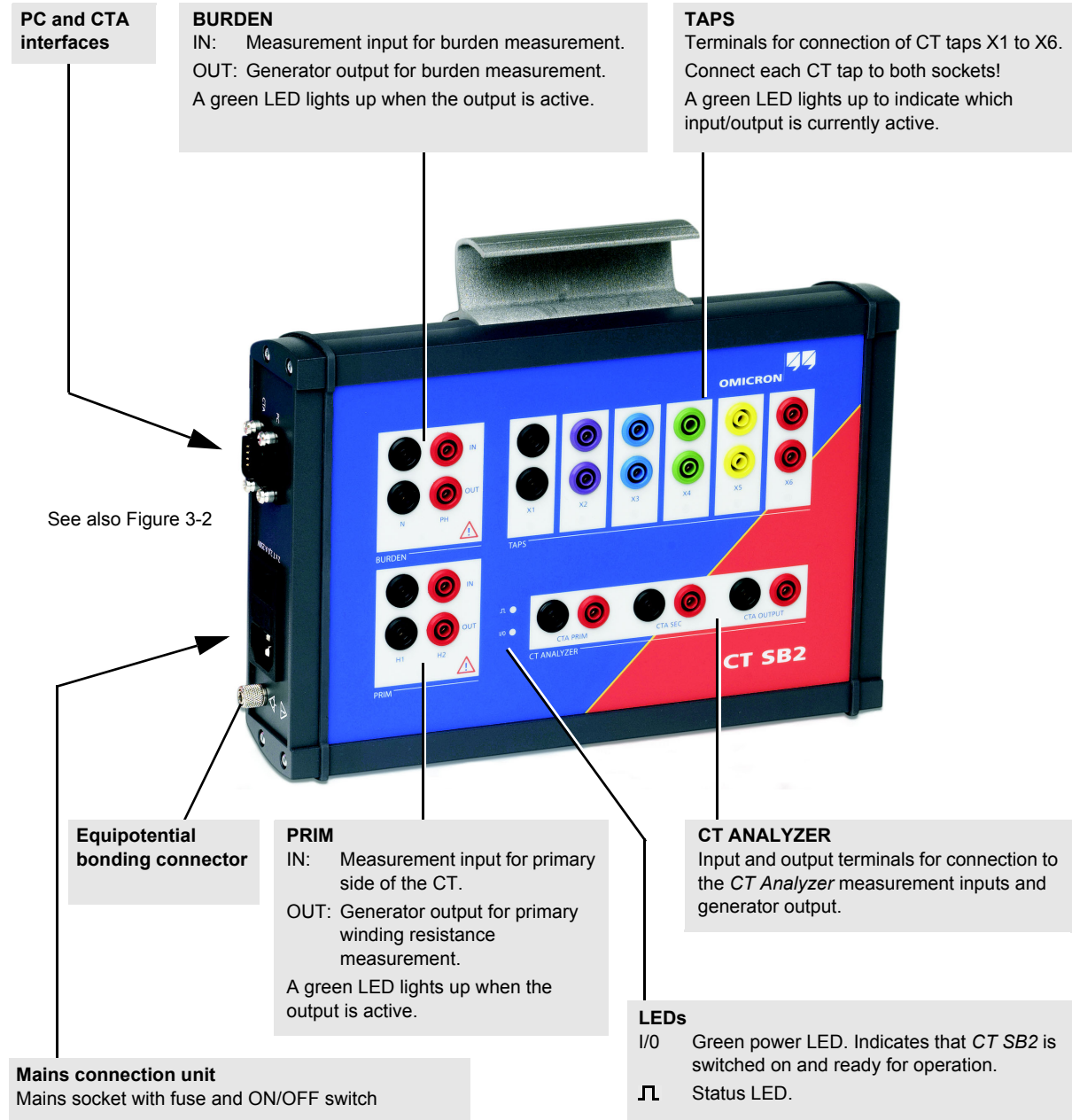


Figure 3-1: CT SB2 overview

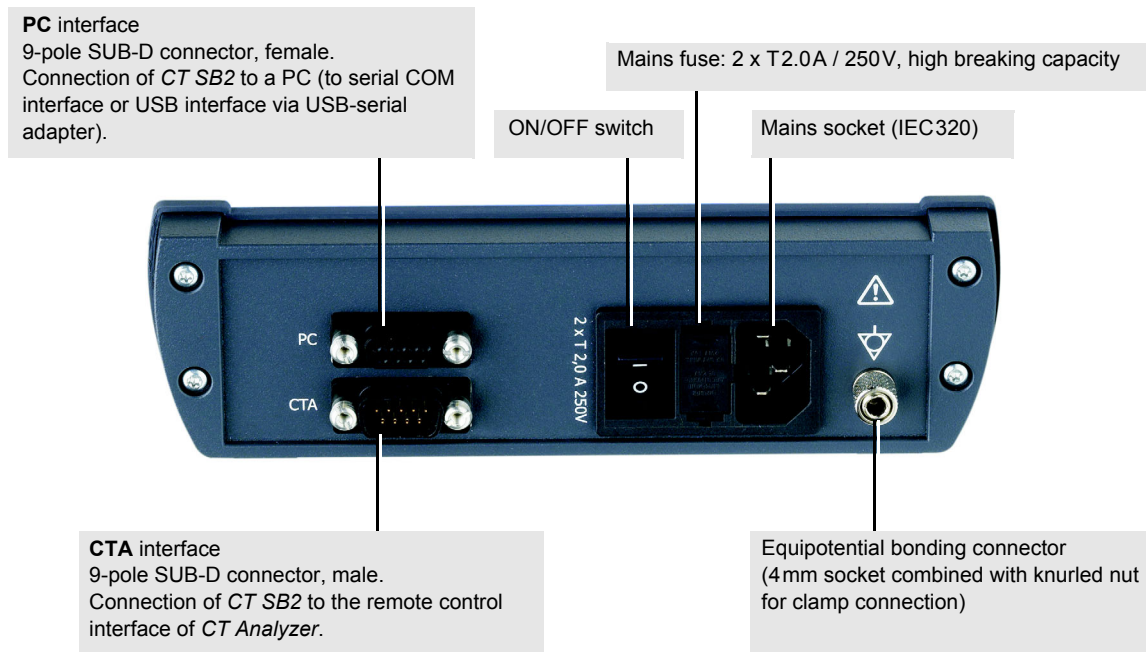


Figure 3-2: Side view of CT SB2 with mains connection unit, PC and CTA interfaces, and equipotential bonding connector

3.2 Block diagram (simplified)

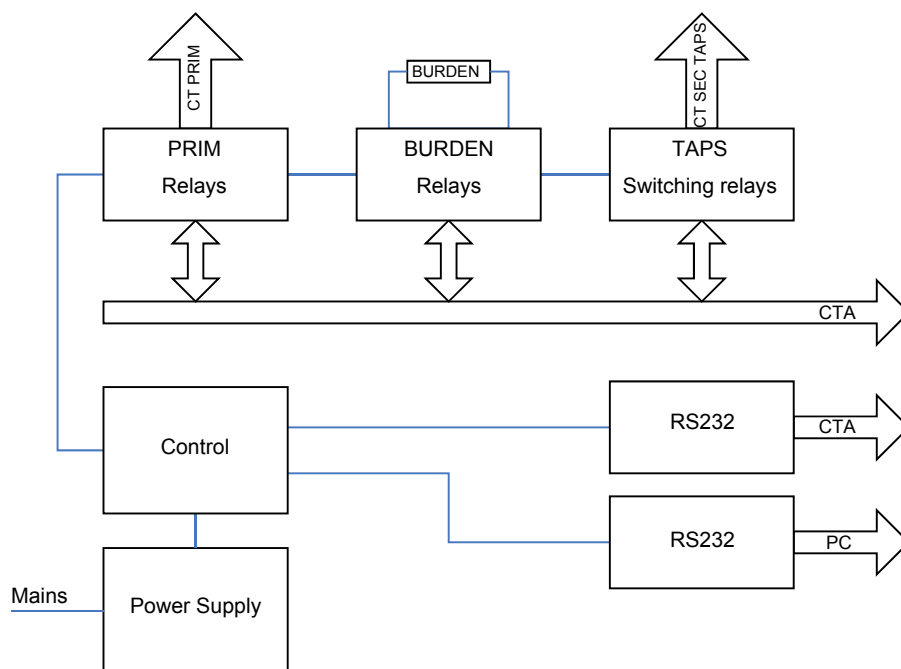









Figure 3-3: Simplified block diagram of CT SB2

3.3 CT SB2 accessories (scope of delivery)

The following accessories are delivered with the CT SB2 switch box:

Table 3-1: CT SB2 accessories

Accessory		Description
1 x 6-pole cable		Cable for connecting <i>CT SB2</i> to <i>CT Analyzer</i>
1 x 12-pole cable, 7m (22ft)		Test cable for connecting the secondary side of the CT to <i>CT SB2</i>
1 x 4-pole cable, 7m (22ft)		Test cable for connecting the burden to <i>CT SB2</i>
1 x 9-pole SUB-D cable, 0.3m (1ft)		Data connection cable from the CTA interface on <i>CT SB2</i> to the remote control interface on <i>CT Analyzer</i>
12 x clamp		Clamps in 6 different colors according to the 12-pole test cable for connecting the test cable plugs to the tap connections on the secondary side of the CT
1 x Power cord adapter		Using this adapter, only one power supply cord is required to supply <i>CT Analyzer</i> and <i>CT SB2</i>
1 x Cable bag		Bag for cables and accessories

4 Measurement setup

4.1 General

When connecting the CT to the *CT SB2* switch box, please also observe the wiring hints given in the *CT Analyzer* User Manual.

Always connect only one CT to *CT SB2*. Disconnect and remove unused cabling from *CT SB2* and the CT after testing.

Using the *CT SB2* switch box, CT testing, burden measurement and primary winding resistance measurement can be performed separately (i.e., using separate test procedures) or together in one test sequence. Figure 4-2 and Figure 4-3 show the basic wiring required for CT testing. To measure the burden and the primary winding resistance together with the CT test, the additional wiring shown in Figure 4-4 and Figure 4-5 is necessary (Advanced MR Test mode only).

The advantage of using *CT SB2* for single-ratio CT testing is the option to include burden and/or primary winding resistance measurement to the test without any need for wiring changes during the test procedure. If you do not want to perform burden or primary winding resistance measurement, you should preferably use the normal single-ratio test modes of *CT Analyzer* without using *CT SB2*.

If you do not use the *CT SB2* switch box for CT testing with *CT Analyzer*, disconnect all cabling to *CT SB2* from *CT Analyzer* (incl. the data connection cable connected to the remote control interface of *CT Analyzer*).

WARNING



Death or severe injury caused by high voltage or current possible

Accidentally mixing up primary and secondary windings can cause life-threatening voltages and/or destroy the connected CT, the *CT SB2* switch box, or the *CT Analyzer* test set.

- ▶ When measuring the ratio of current transformers, make sure that the test voltage is connected to the corresponding secondary winding, and the primary winding is connected to the according measurement input.

WARNING



Death or severe injury caused by high voltage or current possible

Feeding test voltage to a CT can cause life-threatening voltages on other taps and/or cores of the CT.

- ▶ Do not touch other taps or windings of the CT during the test.
- ▶ When testing multi-core CTs, make sure that no other windings of the CT are open. Leave the secondary windings of the other (non-measured) cores connected, or short-circuit them if the windings are open.
- ▶ Always connect all secondary taps/windings to the *CT SB2* switch box in order to guarantee safety during testing.



WARNING

Death or severe injury caused by high voltage or current possible

Observe the following when running tests:

- ▶ Prevent the presence of other persons in the potentially dangerous area around the test object.
- ▶ If necessary, perform appropriate additional safety precautions according to the relevant standard, for example, by defining a high-voltage area around the test object and securing this area against unauthorized access by using a barrier chain and warning sign.
- ▶ Start the test only if all safety precautions were taken and if you are absolutely sure that no other person is present in the potentially dangerous area around the test object.

4.2 Connecting the communication link between *CT SB2* and *CT Analyzer*

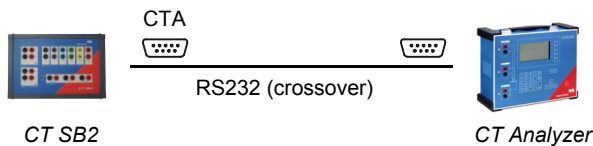
CT Analyzer devices as of serial number JHxxxx or newer are equipped with a USB interface and a RS232 interface. You can use both interfaces alternatively.

The setup for connecting the *CT SB2* switch box depends on two factors:

- Should *CT Analyzer* be connected to a PC?
- Which *CT Analyzer* interface should be used for PC connection?

Connect *CT Analyzer* and *CT SB2* accordingly as shown in the following figure.

CT Analyzer/CT SB2 not connected to a PC:



CT Analyzer/CT SB2 connected to PC via USB:



CT Analyzer/CT SB2 connected to PC via RS232 interface:

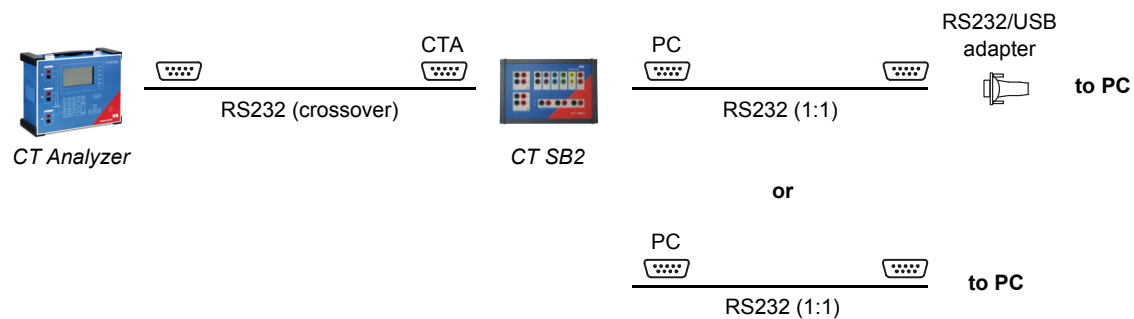
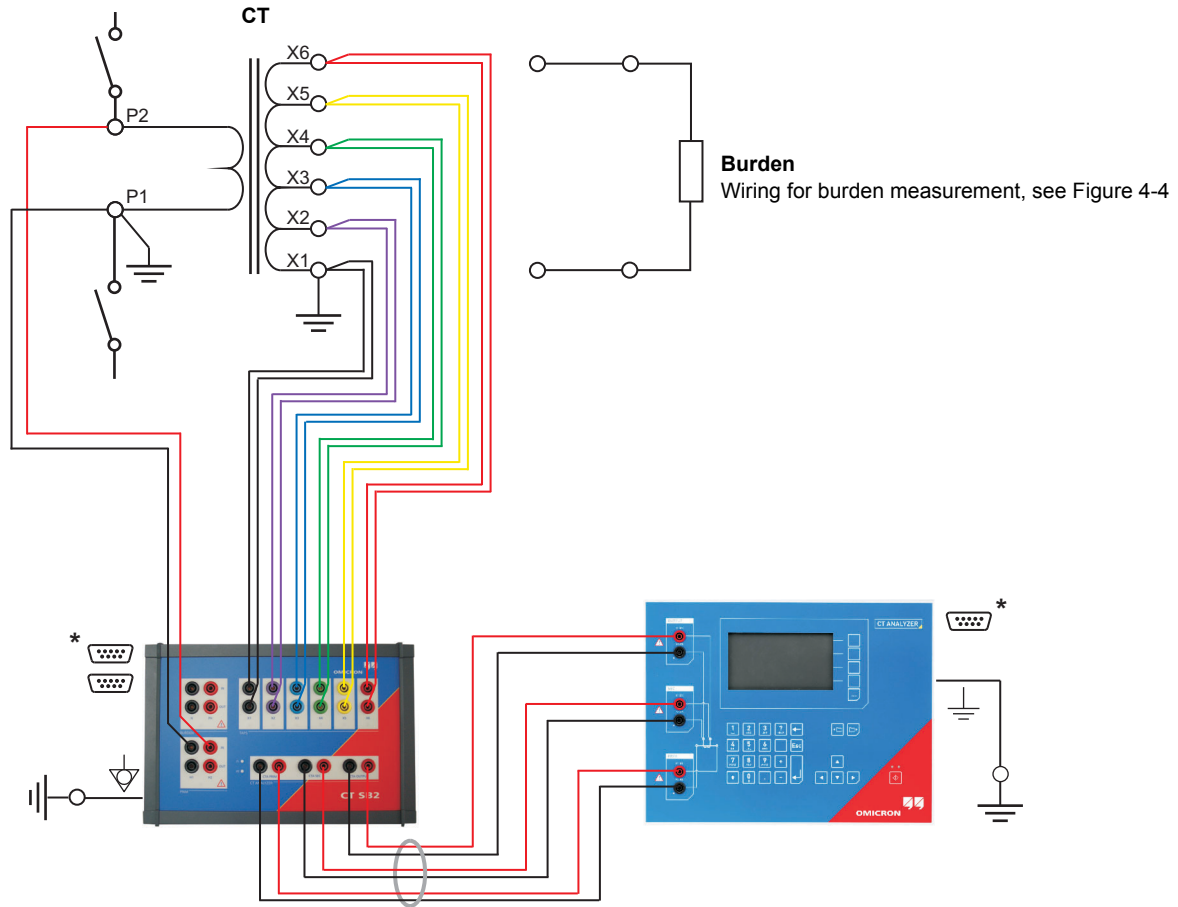


Figure 4-1: Connection diagrams for communication link *CT SB2* - *CT Analyzer* - PC

4.3 Basic measurement setup for multi-ratio CT testing



* For information on how to connect the communication link between CT SB2 and CT Analyzer, please refer to section 4.2 on page 17.

Figure 4-2: Basic measurement setup for multi-ratio CT testing (6-tap CT, no burden measurement, no primary winding resistance measurement)

WARNING



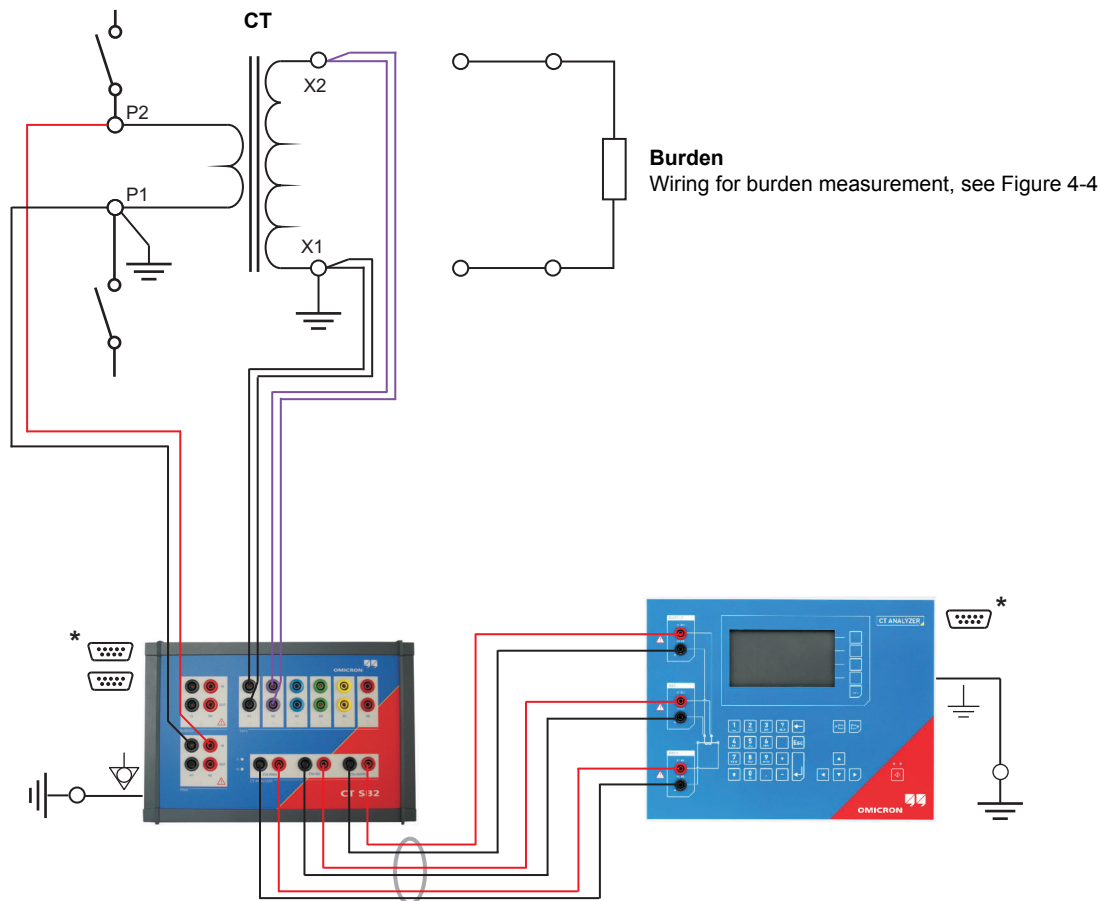
Death or severe injury caused by high voltage or current possible

Feeding test voltage to a CT can cause life-threatening voltages on other taps and/or cores of the CT.

- ▶ Do not touch other taps or windings of the CT during the test.
- ▶ When testing multi-core CTs, make sure that no other windings of the CT are open. Leave the secondary windings of the other (non-measured) cores connected, or short-circuit them if the windings are open.
- ▶ Always connect all secondary taps/windings to the CT SB2 switch box in order to guarantee safety during testing.

4.4 Basic measurement setup for single-ratio CT testing

Note: If you do not want to perform burden or primary winding resistance measurement, you should preferably use the normal single-ratio test modes of *CT Analyzer* without using *CT SB2*. Remove the data connection cable from the remote control interface of *CT Analyzer* if you do not use *CT SB2* for CT testing with *CT Analyzer*.



* For information on how to connect the communication link between *CT SB2* and *CT Analyzer*, please refer to section 4.2 on page 17.

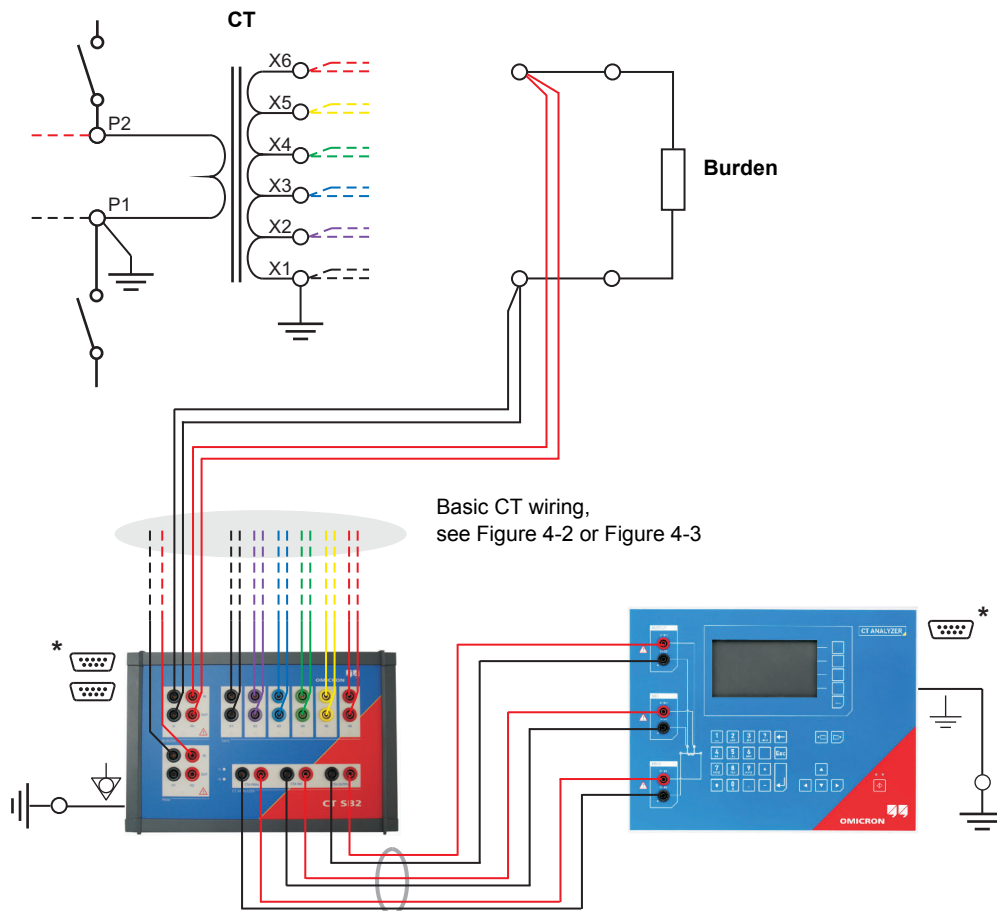
Figure 4-3: Basic measurement setup for single-ratio CT testing (no burden measurement, no primary winding resistance measurement)

4.5 Additional wiring for burden measurement

Applicable for Advanced MR Test mode only.

Burden measurement may be performed separately or in conjunction with CT testing and/or primary winding resistance measurement.

The following wiring is required for burden measurement (in addition to the basic measurement setup shown in Figure 4-2 and Figure 4-3 and/or the additional wiring for primary winding resistance measurement shown in Figure 4-5, as required).



* For information on how to connect the communication link between CT SB2 and CT Analyzer, please refer to section 4.2 on page 17.

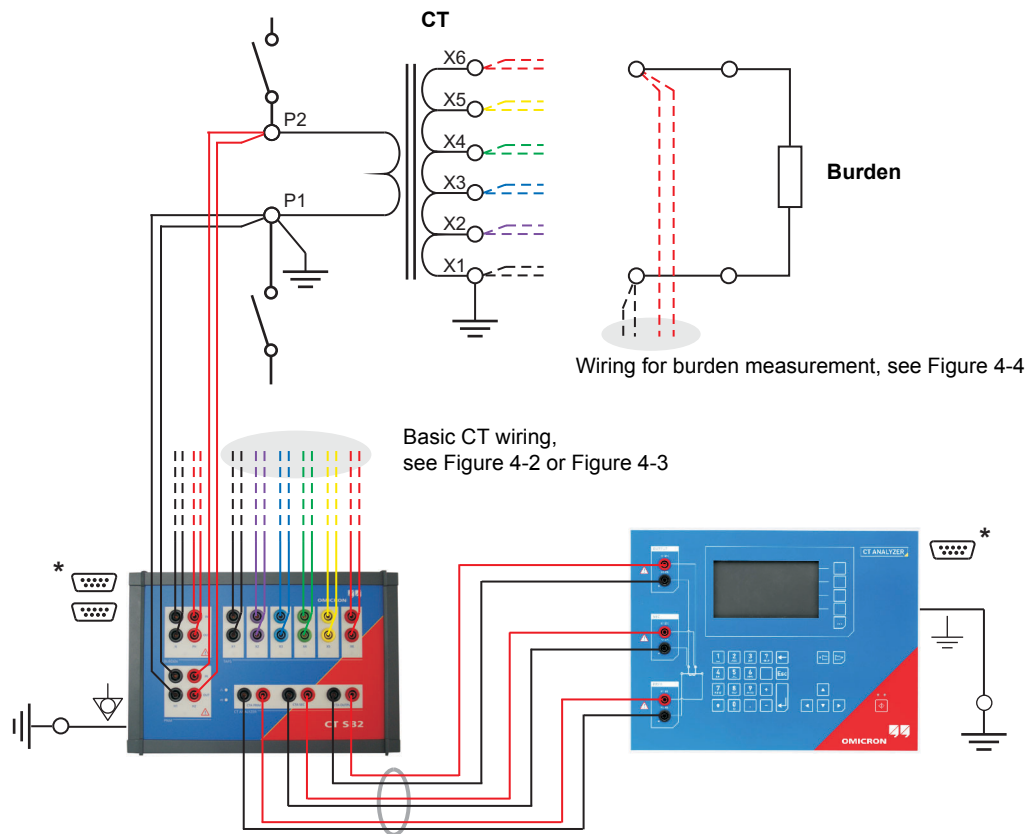
Figure 4-4: Additional wiring required for burden measurement

4.6 Additional wiring for primary winding resistance measurement

Applicable for Advanced MR Test mode only.

Primary winding resistance measurement may be performed separately or in conjunction with CT testing and/or burden measurement.

The following wiring is required for primary winding resistance measurement (in addition to the basic measurement setup shown in Figure 4-2 and Figure 4-3 and/or the additional wiring for burden measurement shown in Figure 4-4, as required).



* For information on how to connect the communication link between CT SB2 and CT Analyzer, please refer to section 4.2 on page 17.

Figure 4-5: Additional wiring required for primary winding resistance measurement

5 CT testing in MR Test mode ("New MR Test")

Note: For detailed instructions regarding the operation of *CT Analyzer*, please refer to the *CT Analyzer User Manual*.

5.1 Preparing and configuring the test

1. Connect *CT SB2*, *CT Analyzer* and the CT under test as described in section 4.3 on page 18.
2. Switch on *CT SB2* and *CT Analyzer*.
3. Select "New MR-Test" from the *CT Analyzer* **main menu** and press the **OK** soft key to initialize a new test in the MR Test mode.
4. Enter the name plate data of the CT to the **CT-Object** card.

CT-Object	MR-Con...	MR-Res...	Test Res...
Location:	WW		
Object:	WW		
I-pn:	1200.0A	I-sn:	5.0A
Standard:	61869-2	f:	50Hz
P/M:	P	Class:	5P
Ready X1-X5			

Figure 5-1: **CT-Object** card for MR Test mode

Table 5-1: Name plate data in the **CT-Object** card

Parameter	Description
I-pn	Rated primary current.
I-sn	Rated secondary current.
Standard	Standard according to which the test has to be performed.
f	Rated frequency of the CT.
P/M	CT type. Set "P" for a protection CT or "M" for a metering CT.
Class	Rated accuracy class of the CT.

Refer to table 8-3 on page 38 for detailed information on the parameters.

Test execution is not possible if no data is specified for the I-pn parameter. All other parameters can be assigned with default values and have to be adapted accordingly.

5. Display the **MR-Config** card (see Figure 5-2) and configure the multi-ratio test according to your CT under test.

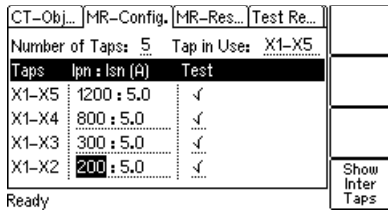



Figure 5-2: **MR-Config** card for MR Test mode

Note: Table 5-2 provides brief descriptions of the parameters and fields available in the **MR-Config** card. For complete information, please refer to section 8.2 on page 37.

Table 5-2: Data to be specified in the **MR-Config** card

Parameter	Description
Number of Taps	Select the overall number of tap connections available on the multi-ratio CT using the soft keys.
Tap in Use	Select the tap combination actually used during operation of the CT (e.g. X1-X5) using the soft keys. By default, the "Tap in Use" field is set to the full tap combination. After completion of the test, the Test Results card will display the results for the tap combination selected in this field.
Taps	This column lists all possible tap combinations of the CT (e.g. X1-X5, X1-X4, X1-X3, ...). The number of available tap combinations depends on the number of taps specified in the "Number of Taps" field. When the MR-Config card's tab is highlighted you can select whether X1 or the highest available tap is used as the common tap. The default common tap can be selected in the device settings of <i>CT Analyzer</i> , see chapter 7 on page 32. Using the Show Inter Taps soft key you can display the intertap combinations instead of the tap combinations. If the intertap combinations are displayed, the soft key changes to Show Taps .
I _{pn} : I _{sn} (A)	Enter the nominal ratio for each single tap combination. I _{pn} has to be specified for each tap combination listed in this column. I _{sn} is taken from the CT-Object card. The data for the full tap combination can only be set in the CT-Object card.
Test	Use this column to select the tap combinations you actually want to measure during the test. You can enable or disable each single tap combination individually (disabling the full tap combination is not possible). Disabling unused tap combinations reduces the test duration.

5.2 Running the test

1. Start the test by pressing the  key on *CT Analyzer*. The red LED on *CT Analyzer* flashes to indicate that the CT test is running.
2. After starting the test, *CT Analyzer* first checks communication with the *CT SB2* switch box via the serial interface. *CT Analyzer* then checks the input/output wiring between *CT Analyzer* and *CT SB2* and the corresponding wiring from *CT SB2* to the test object. If *CT Analyzer* detects any missing or faulty connections, a corresponding error message is displayed.
3. *CT Analyzer* measures the secondary winding resistance, the excitation curve, and the ratio of the CT for each tap combination. The currently active input/output of the *CT SB2* switch box is indicated by a green LED on the *CT SB2* front panel.
4. When the test is over, the red LED stops flashing and the green LED is on. *CT Analyzer* displays a "Test finished" message showing the status of the test execution. The MR Test mode does not provide automatic test assessment. Press any key on the keyboard to close this message.

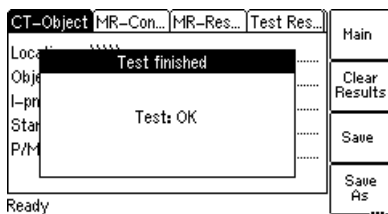


Figure 5-3: Test finished message when the test is over

5.3 After the test is finished

1. Display the **Test Results** card to view the test results for the tap combination selected as tap in use in the **MR-Config.** card prior to the test (refer to Figure 5-4).

Press **Wdg. Res. Test** to display the details of the winding resistance test and/or press **Excit. Graph** to display the excitation graph (see also 8.4.3 on page 43 and 8.4.4 on page 44).

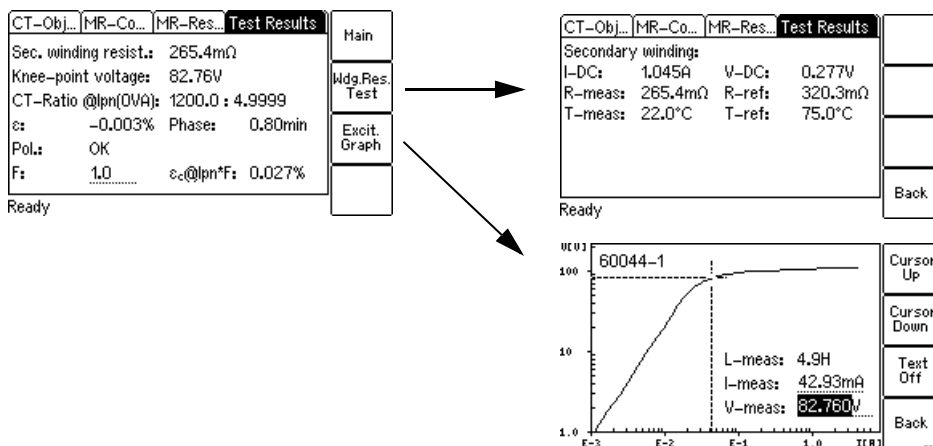


Figure 5-4: Test Results card after the test is finished

CT testing in MR Test mode ("New MR Test")

2. Display the **MR-Results** card to view detailed data for the individual tap combinations of the multi-ratio CT. You can switch this card to display the ratio results (e.g. winding ratio, ratio and phase error, etc.) or the excitation results (e.g. V_{kn} , I_{kn} , etc.).

CT-Obj...	MR-Con...	MR-Results	Test Re...	Show Excit.
VA:	0.000VA	Cosφ:	1.000	
Taps	I _{pn} : I _{sec} (A)	N	Rat.(%)	Pol.(°)
X1-X5	1200:5.0	240.0	-0.003	0.80
X1-X4	800:4.9995	160.0	-0.011	1.32
X1-X3	300:4.995	60.00	-0.099	5.18
X1-X2	200:4.991	40.00	-0.181	8.85
Ready				Pol. in Degrees Show Inter Taps

CT-Obj...	MR-Con...	MR-Results	Test Re...	Show Ratio
VA:	0.000VA	Cosφ:	1.000	
Taps	Rct (mΩ)	V _{kn} (V)	I _{kn} (mA)	ALF
X1-X5	265.9	82.76	42.9	>69.21
X1-X4	202.5	55.17	64.4	>60.57
X1-X3	132.2	20.70	172.1	>34.83
X1-X2	106.5	13.82	258.2	28.53
Ready				Show Inter Taps

Figure 5-5: **MR-Results** card showing ratio results (left) and excitation results (right)

For a detailed description of this card, please refer to section 8.3 on page 40.

3. Display the **CT-Object** card and enter the "Location" and "Object" details. Then press the **ESC** key to set the focus to the **CT-Object** card's tab and save your test.

CT-Object	MR-Con...	MR-Res...	Test Res...	Details
Location:	WVV			
Object:	WVV			
I-pn:	1200.0A	I-sec:	5.0A	
Standard:	61869-2	f:	50Hz	
P/M:	P	Class:	5P	
Ready				

Figure 5-6: **CT-Object** card after the test, ready to enter location details

6 CT testing in Advanced MR Test mode ("New Advanced MR Test")

Note: For detailed instructions regarding the operation of *CT Analyzer*, please refer to the *CT Analyzer User Manual*.

The test procedure described below shows an example for a multi-ratio CT test executed in the Advanced MR Test mode without using the guesser function of *CT Analyzer*. For a more detailed description of the guesser function, please refer to the *CT Analyzer User Manual*.

For reasons of simplicity, the test described below does not use the burden measurement and the primary winding resistance measurement.

6.1 Preparing the test

1. Connect *CT SB2*, *CT Analyzer* and the CT under test as described in section 4.3 on page 18.
2. Switch on *CT SB2* and *CT Analyzer*.
3. Select "New Advanced MR-Test" from the *CT Analyzer* **main menu** and press the **OK** soft key to initialize a new test in the Advanced MR Test mode.

6.2 Configuring and starting the test

After initializing a new test, the default **CT-Object** card is displayed on *CT Analyzer*.

1. Press the **Select Cards** soft key in the **CT-Object** card to open the **Select Cards** page. Check, and if necessary make the following test card selection. When finished, press the **Back** soft key to return to the **CT-Object** card.

How to get there:
 Press the ... key in the **CT-Object** card
 Press the **Select Cards** soft key
 In the **Select Cards** page, use the **Add** or **Remove** soft key to select or deselect a test card

Table 6-1: Test cards required for this example

Test cards used in this example (add if necessary)	Test cards not used in this example (remove if necessary)
CT-Object Secondary Winding Resistance Excitation Ratio Assessment	Burden Residual Magnetism Primary Winding Resistance

CT testing in Advanced MR Test mode ("New Advanced MR Test")

- In the **CT-Object** card, specify the CT data according to the CT's name plate. Specify the data in the order of the following table.

CT-Object	MR-Co...	MR-Res...	Burden	Main
Location: WWW				Clear Results
Object: WWW				Save
I-pn: ?A	I-sn: ?A			Save As
Standard: 60044-1	P/M: ?*			
VA: ?*VA	cosφ: n/a			
Burden: ?VA	cosφ: ?			
Ready	X1-X5			

Figure 6-1: **CT-Object** card for Advanced MR Test mode

Note: Table 6-2 provides brief descriptions of the most important parameters and fields available in the **CT-Object** card. Depending on the selected standard and CT type, other or further CT data may be necessary for a correct assessment. If the "Check "*" settings before start" option is enabled in the default test settings of *CT Analyzer*, all parameters that are required for assessment are marked by a star "*" in the **CT-Object** card. For complete information, please refer to section 9.1 on page 47 or the *CT Analyzer* User Manual.

Table 6-2: Data to be specified in the **CT-Object** card

Parameter	Description
I-pn	Rated primary current for the full tap combination of the CT and rated secondary current of the CT.
I-sn	The CT data for the full tap combination can only be set in the CT-Object card. If the selected standard is IEEE C57.13 and the "Number of Taps" is set to 5 or 3 in the MR-Config card, <i>CT Analyzer</i> offers soft keys with predefined ratios when the "I-pn" field is selected with the cursor. If you select one of these predefined multi-ratio schemes, <i>CT Analyzer</i> automatically specifies the ratios for all tap combinations in the MR-Config card. If the selected standard is not IEEE C57.13, enter the values for I_{pn} and I_{sn} manually.
Standard	Standard to be used for the CT test and the test assessment.
P/M	CT type. Set "P" for a protection CT or "M" for a metering CT.
Class	Rated accuracy class of the CT. This field becomes available after selecting the CT type (protection or metering CT).
VA (or Vb)	Nominal burden for the full tap combination of the CT.
cos φ	For protection CTs of the IEEE C57.13 classes C, K and T, enter the rated secondary terminal voltage V_b instead of VA. <i>CT Analyzer</i> then automatically calculates the value for VA. The cos φ for the nominal burden is automatically selected according to the standard.

Table 6-2: Data to be specified in the **CT-Object** card (continued)

Parameter	Description
Burden	Operating burden and $\cos \phi$ of the tap in use .
$\cos \phi$	If the value of the connected operating burden is available, enter the values to these fields. If you measure the burden during the CT test using the burden measurement function of <i>CT Analyzer</i> , these fields are filled automatically. If you do not set any value in these fields, <i>CT Analyzer</i> automatically uses the same values as for the nominal burden.

3. Display the **MR-Config.** card (see Figure 6-2) and configure the test according to your CT under test.

CT-Obj... MR-Config. MR-Res... Resista...					Main
Number of Taps: 5 Tap in Use: X1-X5					
Taps	I _{pn} : I _{sn} (A)	VA	cosφ	Test	Op. Burden Common Tap to X5 Show Inter Taps
X1-X5	1200 : 5,0	25,00	0,5	✓	
X1-X4	800 : 5,0	12,50	0,9	✓	
X1-X3	300 : 5,0	5,00	0,9	✓	
X1-X2	200 : 5,0	5,00	0,9	✓	
Ready					

MR-Config. card for a new test after selecting a predefined multi-ratio scheme for I_{pn} in the **CT-Object** card (Advanced MR Test mode).

CT-Obj... MR-Config. MR-Res... Resista...					Main
Number of Taps: 5 Tap in Use: X1-X5					
Taps	I _{pn} : I _{sn} (A)	VA	cosφ	Test	Op. Burden Common Tap to X5 Show Inter Taps
X1-X5	1200 : 5,0	25,00	0,5	✓	
X1-X4	? : 5,0	?	n/a	✓	
X1-X3	? : 5,0	?	n/a	✓	
X1-X2	? : 5,0	?	n/a	✓	
Ready					

MR-Config. card for a new test after specifying the values for I_{pn} and I_{sn} manually in the **CT-Object** card (Advanced MR Test mode).

Figure 6-2: **MR-Config.** card for Advanced MR Test mode

Note: Table 6-3 provides brief descriptions of the parameters and fields available in the **MR-Config.** card. For complete information, please refer to section 9.2 on page 50.

Table 6-3: Data to be specified in the **MR-Config** card

Parameter	Description
Number of Taps	Select the overall number of tap connections available on the multi-ratio CT using the soft keys. If the number of taps selected is 5 or 3, <i>CT Analyzer</i> offers soft keys with predefined CT ratios when the "I _{pn} " field is selected in the CT-Object card.
Tap in Use	Select the tap combination actually used during operation of the CT (e.g. X1-X5) using the soft keys. By default, the "Tap in Use" field is set to the full tap combination. For the tap combination selected here, <i>CT Analyzer</i> displays the detailed test results in the Resistance , Excitation and Ratio cards. The automatic test assessment in the Assessment card is always done for the full tap combination given by the Number of Taps (e.g. for X1-X5 if number of taps = 5).


CT testing in Advanced MR Test mode ("New Advanced MR Test")

Table 6-3: Data to be specified in the **MR-Config** card (continued)

Parameter	Description
Taps	<p>This column lists all possible tap combinations of the CT (e.g. X1-X5, X1-X4, X1-X3, ...). The number of available tap combinations depends on the number of taps specified in the "Number of Taps" field.</p> <p>When the MR-Config card's tab is highlighted you can select whether X1 or the highest available tap is used as the common tap. The default common tap can be selected in the device settings of <i>CT Analyzer</i>, see chapter 7 on page 32.</p> <p>Using the Show Inter Taps soft key you can display the intertap combinations instead of the tap combinations. If the intertap combinations are displayed, the soft key changes to Show Taps.</p>
I _{pn} : I _{sn} (A)	<p>Enter the nominal ratio for each single tap combination.</p> <p>If you selected a predefined multi-ratio scheme for IEEE C57.13 in the CT-Object card, this column is automatically filled with predefined ratios for all tap combinations.</p> <p>If you entered I_{pn} and I_{sn} manually in the CT-Object card, you have to specify the I_{pn} for each tap combination in this column. I_{sn} is always taken from the CT-Object card.</p> <p><i>CT Analyzer</i> automatically performs a plausibility check for the ratios entered by the user. For example, an error message is displayed if the I_{pn} entered for X1-X3 is higher than the I_{pn} specified for X1-X4.</p> <p>The data for the full tap combination can only be set in the CT-Object card.</p>
VA cos φ	<p>Nominal burden for each tap combination.</p> <p>To obtain correct measurement results, the nominal burdens for the inner tap combinations (e.g. X1-X2 etc.) should be smaller than the nominal burden for the full tap combination according to the winding ratios of the tap combinations (e.g. 25 VA for X1-X5, 12.5 VA for X1-X4 etc.). <i>CT Analyzer</i> supports this with an automatic function.</p>
or	<p>As soon as the primary current I_{pn} is specified for a tap combination, <i>CT Analyzer</i> automatically calculates and sets the corresponding nominal burden and cos φ for this tap combination. The nominal burden (VA) automatically assigned by <i>CT Analyzer</i> can be changed manually by the user for all tap and intertap combinations except the full tap combination.</p> <p>The "VA" column is displayed by default when opening the MR-Config card the first time after initializing a new test in the Advanced MR Test mode. Using the Op. Burden soft key you can display the "Burden" column instead.</p>
Burden cos φ	<p>Operating burden and cos φ for each tap combination.</p> <p>This column displays for each tap combination the operating burden and cos φ specified in the CT-Object card. The values cannot be changed by the user.</p> <p>The "Burden" column is displayed if you selected to display the operating burden using the Op. Burden soft key.</p>

Table 6-3: Data to be specified in the **MR-Config** card (continued)

Parameter	Description
Test	Use this column to select the tap combinations you actually want to measure during the CT test. You can enable or disable each single tap combination individually (disabling the full tap combination is not possible). Disabling unused tap combinations reduces the test duration.

4. Start the test by pressing the  key on *CT Analyzer*. The red LED on *CT Analyzer* flashes to indicate that the CT test is running.

6.3 Automatic test execution

After starting the test, *CT Analyzer* first checks the communication with the *CT SB2* switch box via the serial interface. *CT Analyzer* then checks the input/output wiring between *CT Analyzer* and *CT SB2* and, prior to each measurement, the corresponding wiring from *CT SB2* to the test object required for this particular measurement. If *CT Analyzer* detects any missing or faulty connections, a corresponding error message is displayed.

The currently active input/output of the *CT SB2* switch box is indicated by a green LED on the *CT SB2* front panel.

1. *CT Analyzer* measures the secondary winding resistance of the CT for each tap combination.
2. *CT Analyzer* measures the excitation curve and determines the knee point and other important CT data for each tap combination.
3. *CT Analyzer* measures the actual current ratio, the winding ratio, the ratio error and the phase error for each tap combination.
4. When the test is over, the red LED stops flashing and the green LED is on.

CT Analyzer displays a "Test finished" message showing the status of the test execution and the overall test assessment. Press any key on the keyboard to close this message.

6.4 After the test is finished

After the test is finished, the **CT-Object** card is displayed, showing the CT data (see Figure 6-3).

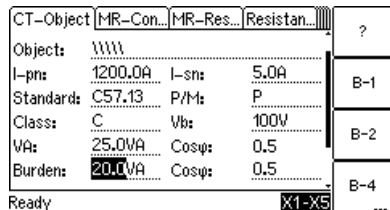


Figure 6-3: **CT-Object** card after the test is finished

CT testing in Advanced MR Test mode ("New Advanced MR Test")

The **MR-Config.** card displays the test configuration defined prior to the test.

CT-Obj...	MR-Config...	MR-Res...	Resista...	
Number of Taps: 5 Tap in Use: X1-X5				Main
Taps I _{pn} : I _{sc} (A) VA Cosφ Test				Op. Burden
X1-X5	1200 : 5,0	25,00	0,5	✓
X1-X4	800 : 5,0	12,50	0,9	✓
X1-X3	300 : 5,0	5,00	0,9	✓
X1-X2	200 : 5,0	5,00	0,9	✓
Ready				Common Tap to X5
				Show Inter Taps

Figure 6-4: **MR-Config.** card

The **MR-Results** card displays detailed data for the individual tap combinations of the multi-ratio CT. You can switch this card to display the ratio results (e.g. winding ratio, ratio and phase error, etc.) or the excitation results (e.g. V_{kn} , I_{kn} , etc.).

For a detailed description of this card, please refer to section 9.3 on page 54.

CT Analyzer calculates the results for the operating burden (parameter "Burden" in the **CT-Object** card) and for the nominal burden (parameter "VA" in the **CT-Object** card). Depending on the burden selected, the **MR-Results** card shows the results calculated with the nominal burden or calculated with the operating burden.

CT-Obj...	MR-Co...	MR-Results	Resista...	
VA: 25,00VA Cosφ: 0,500				Show Excit.
Taps I _{pn} : I _{sec} (A) N Rat.(%) Pol.(°)				Results with Op. Burden
X1-X5	1200:4,997	240,0	-0,065	0,09
X1-X4	800:4,9961	160,0	-0,078	1,86
X1-X3	300:4,9877	60,00	-0,245	5,62
X1-X2	200:4,9745	40,01	-0,511	10,4
Ready				Pol. in Degrees
				Show Inter Taps

→

CT-Obj...	MR-Co...	MR-Results	Resista...	
VA: 25,00VA Cosφ: 0,500				Show Ratio
Taps Ret (mΩ) V _{kn} (V) I _{kn} (mA) V _b (W)				Results with Op. Burden
X1-X5	221,7	64,06	22,9	>115,17
X1-X4	162,8	42,70	34,4	>65,11
X1-X3	88,0	16,00	91,8	>22,25
X1-X2	81,5	10,67	137,6	>15,23
Ready				Show Inter Taps

Figure 6-5: **MR-Results** card showing ratio results (left) and excitation results (right)

Hint: It is possible to simulate the performance of the CT for other burden values than the nominal burden by changing the "Burden" value in the **CT-Object** card. *CT Analyzer* then automatically performs a recalculation of the results displayed in the **MR-Results** card for the new operating burden.

In the **CT-Object** card, enter the "Location" and "Object" details and save the test (use the cursor keys to scroll within the card and select the edit fields).

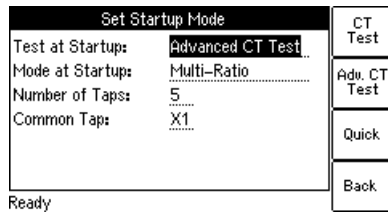
The assessment of the measurement results **for the full tap combination** can be viewed on the **Assessment** card.

If desired, you can view the measurement results **for the tap in use** selected in the **MR-Config.** card by viewing the **Resistance** card, the **Excitation** card and the **Ratio** card.

7 Default settings on CT Analyzer for multi-ratio CT testing using CT SB2

CT Analyzer allows customization of the default settings for multi-ratio CT testing using CT SB2. These settings are defined using the **Select Startup Mode** option in the **Setting Menu** of CT Analyzer.

Open the **Set Startup Mode** page and press the **Multi-Ratio** soft key. The **Set Startup Mode** page then looks as shown in Figure 7-1.



How to get there:
 Press the **Main** soft key in any test card on the CT Analyzer
Main Menu:
 - Settings
Select soft key
Setting Menu:
 - Select Startup Mode
Select soft key
 -> **Set Startup Mode** page

Figure 7-1: Set Startup Mode page

Modify the default settings according to your needs and press the **Back** soft key to apply your default settings.

Table 7-1: Options in the Set Startup Mode page

Option	Description
Test at Startup and Mode at Startup	<p>Use the Test at Startup option together with the Mode at Startup option to select the default test mode CT Analyzer comes up each time when it is switched on.</p> <p>Test at Startup: Select CT Test, Advanced CT Test or Quick. Mode at Startup: Select Single Ratio or Multi-Ratio.</p> <ul style="list-style-type: none"> ▶ The Single Ratio CT Test mode and the Advanced Single Ratio CT Test mode correspond to the CT Analyzer main menu options "New CT-Test" and "New Advanced CT-Test". → See CT Analyzer User Manual. ▶ The Multi-Ratio CT Test mode and the Advanced Multi-Ratio CT Test mode correspond to the CT Analyzer main menu options "New MR-Test" and "New Advanced MR-Test". Selecting a multi-ratio test mode displays the additional parameters "Number of Taps" and "Common Tap" described below. → See chapter 5 on page 22 for the Multi-Ratio CT Test mode. → See chapter 6 on page 26 for the Advanced Multi-Ratio CT Test mode. ▶ Quick: Selecting the Quick Test mode will hide the options Mode at Startup, Number of Taps, and Common Tap because the <i>Quick Test</i> function cannot be used with the CT SB2 switch box.

Default settings on CT Analyzer for multi-ratio CT testing using CT SB2

Table 7-1: Options in the **Set Startup Mode** page

Option	Description
Number of Taps	<p>Only available if Mode at Startup = Multi-Ratio.</p> <p>The number of taps is the overall number of tap connections available on the multi-ratio CT.</p> <p>Select the default number of taps using the soft keys No. of Taps 2 to No. of Taps 6.</p> <p>The number of taps defined here is applied as default for new multi-ratio tests initialized in the MR Test mode or the Advanced MR Test mode.</p>
Common Tap	<p>Only available if Mode at Startup = Multi-Ratio.</p> <p>The common tap is the tap that is used as reference for all tap combinations (e.g. X1-X2, X1-X3, X1-X4, etc. if common tap is X1).</p> <p>Select the default common tap using the soft keys X1 and X#, where # is the highest tap number available depending on the selected number of taps.</p> <p>The common tap defined here is applied as default for new multi-ratio tests initialized in the MR Test mode or the Advanced MR Test mode.</p>

8 CT Analyzer test cards for MR Test mode

The test cards described in this chapter are only available for the MR Test mode. Initialize a new test by selecting "New MR-Test" from the CT Analyzer main menu to enter the MR Test mode.

CT-Object	MR-Con...	MR-Res...	Test Res...	Main
Location:	W\W\			Clear Results
Object:	W\W\			
I-pn:	*A	I-sn:	5.0A	
Standard:	61869-2	f:	50Hz	
P/M:	P	Class:	5P	
Ready	X1-X5			Save As

See section 8.1 on page 35.

CT-Obj...	MR-Config	MR-Res...	Test Re...	Main
Number of Taps:	5	Tap in Use:	X1-X5	Common Tap to X1
Taps	Ipn : Isn (A)	Test		
X1-X5	1200 : 5.0	✓		
X2-X5	? : 5.0	✓		
X3-X5	? : 5.0	✓		
Ready	X1-X5			Show Inter Taps

See section 8.2 on page 37.

CT-Obj...	MR-Con...	MR-Results	Test Re...	Show Excit.
VA:	0.000VA	Cosφ:	1.000	Pol. in Degrees
Taps	Ipn : Isec (A)	N	Rat.(%)	
X1-X5	n/a	n/a	n/a	
X2-X5	n/a	n/a	n/a	
X3-X5	n/a	n/a	n/a	
Ready	X1-X5			Show Inter Taps

See section 8.3 on page 40.

CT-Obj...	MR-Co...	MR-Res...	Test Results	Main
Sec. winding resist.:	265.4mΩ			Wdg. Res. Test
Knee-point voltage:	82.76V			
CT-Ratio @Ipn(0VA):	1200.0 : 4.9999			Excit. Graph
ε:	-0.003%	Phase:	0.80min	
Pol.:	OK			
F:	1.0	εc@Ipn*F:	0.027%	
Ready	X1-X5			

See section 8.4 on page 42.

8.1 CT-Object card for MR Test mode

Use the **CT-Object** card to specify the CT data according to the CT's name plate.

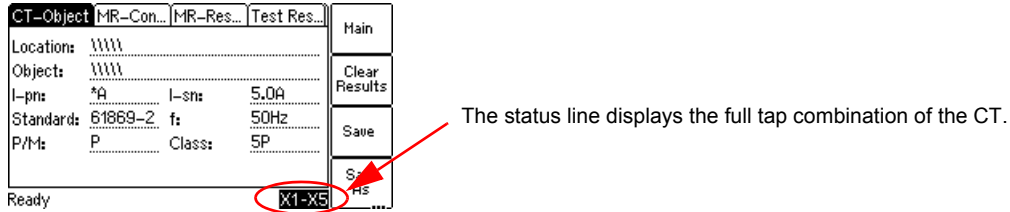


Figure 8-1: **CT-Object** card with name plate data entered

Table 8-1: Parameters and settings in the **CT-Object** card for the MR Test mode

Parameter	Description
I-pn I-sn	<p>Rated primary current for the full tap combination of the CT and rated secondary current of the CT. These values specify the full tap ratio displayed in the MR-Config card. The full tap ratio of the CT can only be specified and/or changed here.</p> <p>Possible values for I-pn: 1 to 99000A.</p> <p>Possible values for I-sn: 0.05 to 25A or soft keys 1.0A, 2.0A, 5.0A, 1.0A/√3, 2.0A/√3, 5.0A/√3. Default: As defined in the default test settings.</p> <p><u>For IEEE C57.13 only:</u></p> <p>If the selected standard is IEEE C57.13 and the "Number of Taps" is set to 3 or 5 in the MR-Config card, <i>CT Analyzer</i> offers soft keys with predefined ratios for 3-tap or 5-tap CTs when the "I-pn" field is selected with the cursor.</p> <p>If you select one of these predefined multi-ratio schemes, <i>CT Analyzer</i> automatically specifies the ratios for all tap combinations in the MR-Config card. For example, selecting the 1200 : 5 A soft key will result in nominal ratios of 1200 : 5, 1000 : 5, 900 : 5 and 400 : 5.</p> <p>Selecting a predefined multi-ratio scheme overwrites possibly existing settings for I_{pn} and I_{sn} in the CT-Object card and the ratios in the MR-Config card.</p>
Standard	<p>Standard according to which the test has to be performed.</p> <p>Possible values: Soft keys IEC 60044-1, IEC 60044-6, IEEE C57.13 or IEC 61869-2</p> <p>Default: Standard defined in the default test settings.</p>
f	<p>Rated frequency of the CT.</p> <p>Possible values: Value between 16 and 400 Hz or soft keys 16.7Hz, 50Hz, 60Hz or 400Hz.</p> <p>Default: Frequency defined in the default test settings.</p>
P/M	<p>Definition of CT type: Protection or metering CT.</p> <p>Possible values: Soft keys Prot. CT, Meter. CT.</p> <p>Default: As defined in the default test settings.</p>

Table 8-1: Parameters and settings in the **CT-Object** card for the MR Test mode (continued)

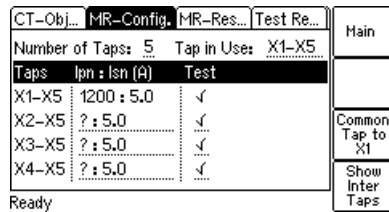
Parameter	Description
Class	Accuracy class of the CT. Possible values: Depending on the selected standard. Default: As defined in the default test settings.

8.2 MR-Config. card for MR Test mode

Use the **MR-Config.** card to configure the multi-ratio test. In this card, set

- ▶ the number of taps available on the CT,
- ▶ the "tap in use", i.e., the tap combination (ratio) actually used and connected to the operating burden during operation of the CT,
- ▶ the nominal CT ratios for the tap combinations,
- ▶ and select the tap combinations you want to test during the multi-ratio CT test.

If necessary, use the   cursor keys to scroll the table.







Fields underlined by dotted lines can be edited.

Figure 8-2: **MR-Config.** card for MR Test mode

8.2.1 Available soft keys

The following soft keys are available if the **MR-Config.** card is selected but not in edit mode (the card's tab is highlighted as shown in Figure 8-2):

Table 8-2: Soft keys available in the **MR-Config.** card

Soft key	Description
 	<p>Using the Common Tap to X# soft key you can select the common tap (e.g. tap X5 instead of default tap X1). The common tap is the tap that is used as reference for all tap combinations (e.g. X1-X2, X1-X3, X1-X4 etc. if the common tap is X1).</p> <p>If the highest tap (e.g. X5) is selected as common tap, the soft key changes to Common Tap to X1.</p> <p>The default common tap can be selected using the Select Startup Mode option in the Setting Menu, see chapter 7 on page 32.</p>
 	<p>Use the Show Inter Taps soft key to display the intertap combinations instead of the tap combinations. If the intertap combinations are displayed, the soft key is labeled Show Taps.</p> <p>Examples of tap combinations: X1-X2, X1-X3, X1-X4, etc.</p> <p>Examples of intertap combinations: X2-X3, X2-X4, X3-X4, etc.</p>

8.2.2 Parameters and settings

Table 8-3: Parameters and settings

Parameter	Description
Number of Taps	<p>Overall number of tap connections available on the multi-ratio CT.</p> <p>Possible values: Soft keys No. Taps 2, No. Taps 3, No. Taps 4, No. Taps 5 or No. Taps 6.</p> <p>The default number of taps can be selected using the Select Startup Mode option in the Setting Menu, see chapter 7 on page 32.</p> <p>When testing a single-ratio CT using the <i>CT SB2</i> switch box, select No. Taps 2. However, single-ratio CT testing should preferably be performed using the normal single-ratio CT test mode of <i>CT Analyzer</i> without using <i>CT SB2</i>.</p>
Tap in Use	<p>The tap combination actually used during operation of the CT (e.g. X1-X4).</p> <p>Select the tap combination using the soft keys (for example X1-X5, X1-X4). To select an intertap combination for the tap in use, press the Show Inter Taps soft key. The MR-Config. card then offers soft keys for the intertap combinations (for example X2-X4, X3-X4).</p> <p>After completion of the test, the Test Results card will display the results for the tap combination selected in this field.</p> <p>By default, the "Tap in Use" is set to the full tap combination given by the "Number of Taps".</p>
Taps	<p>This column lists all possible tap combinations of the CT (e.g. X1-X5, X1-X4, X1-X3, ...). The number of available tap combinations depends on the number of taps specified in the "Number of Taps" field.</p> <p>When the MR-Config. card is displayed but not in edit mode (i.e., the card's tab is highlighted as shown in Figure 8-2 on page 37) you can switch the common tap.</p> <p><u>Example:</u> X1 is assumed as the default common tap, X5 as the highest available tap: Press the Common Tap to X5 soft key to use X5 as common tap instead of X1. The soft key then changes to Common Tap to X1.</p> <p>Using the Show Inter Taps soft key you can display the intertap combinations instead of the tap combinations. If the intertap combinations are displayed, the soft key changes to Show Taps.</p> <p>Examples of intertap combinations: X2-X3, X2-X4, X3-X4.</p>

Table 8-3: Parameters and settings (continued)

Parameter	Description
I _{pn} : I _{sn} (A)	<p>Use this column to set the nominal current ratio I_{pn} / I_{sn} for each tap combination.</p> <p>The nominal ratio for the full tap combination (e.g. X1-X5 for a 5-tap CT) is automatically taken from the CT-Object card and cannot be changed in the MR-Config. card.</p> <p>For all other tap combinations, I_{pn} can be changed or entered by the user. I_{sn} is always taken from the CT-Object card.</p> <p><i>CT Analyzer</i> automatically performs a plausibility check for the ratios entered by the user. For example, an error message is displayed if the I_{pn} entered for X1-X3 is higher than the I_{pn} specified for X1-X4.</p> <p>The ratios of the intertap combinations (e.g. X2-X4) are calculated from the tap combinations and cannot be changed by the user.</p>
Test	<p>In this column, select the tap combinations you actually want to measure during the test.</p> <p>Select or deselect each single tap combination individually using the Enable and Disable soft keys. It is not possible to disable the full tap combination.</p> <p>Disabling unused tap combinations reduces the test duration. Disabled taps are not measured. Therefore, no test results are available for disabled tap combinations.</p> <p>Disabling a tap combination also disables the corresponding intertap combinations. It is not possible to disable a specific intertap combination.</p>

8.3 MR-Results card for MR Test mode

After the multi-ratio test is finished, the **MR-Results** card shows the measurement results for each tap combination and/or intertap combination enabled for testing in the **MR-Config.** card.

If necessary, use the   cursor keys to scroll the display.

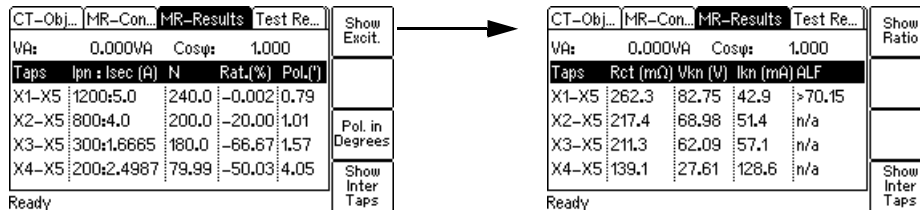








Figure 8-3: **MR-Results** card with measurement results: Page for **ratio** results (left) and page for **excitation** results (right)

8.3.1 Available soft keys

The following soft keys are available in the **MR-Results** card.

Table 8-4: Soft keys available in the **MR-Results** card

Soft key	Description
	Use this soft key to switch between the ratio results and the excitation results. If the ratio results are displayed, the soft key is labeled Show Excit. to display the excitation results.
	
	Using this soft key you can switch the unit for the phase error ("Pol. (°)" column) between minutes and degrees. If the phase error is displayed in minutes, the soft key is labeled Pol. in Degrees. If the phase error is displayed in degrees, the soft key is labeled Pol. in Min..
	
	Using this soft key you can display the intertap combinations instead of the tap combinations. If the tap combinations are displayed, the soft key is labeled Show Inter Taps. If the intertap combinations are displayed, the soft key is labeled Show Taps.
	

8.3.2 Ratio results and excitation results

The measurement results are displayed on two different pages (see Figure 8-3 on page 40). You can toggle these pages using the **Show Excit.** or **Show Ratio** soft key.

The following table lists the **ratio results** displayed in the **MR-Results** card.

Table 8-5: Ratio results displayed in the **MR-Results** card

Column	Description
I _{pn} : I _{sec} (A)	This column shows for each tap combination the measured current ratio I_{pn} / I_{sec} .
N	This column shows for each tap combination the measured winding ratio.
Rat. (%)	This column shows for each tap combination the measured ratio error in %.
Pol. (')	This column shows for each tap combination the measured phase error (polarity) in minutes or degrees. Switch the unit using the Pol. in Degrees or Pol. in Min. soft key.
Pol. (°)	

The following table lists the **excitation results** displayed in the **MR-Results** card.

Table 8-6: Excitation results displayed in the **MR-Results** card

Column	Description
Rct (mΩ)	Secondary winding resistance.
V _{kn} (V)	Knee point voltage.
I _{kn} (mA)	Knee point current.
V _b (V) TCF ALF FS K _{ssc}	<p>The result displayed in this column depends on the standard selected in the CT-Object card and the type of CT.</p> <p>V_b (IEEE C57.13, protection CTs only): Rated secondary terminal voltage for protection CTs.</p> <p>TCF (IEEE C57.13, metering CTs only): Transformer correction factor for metering CTs.</p> <p>ALF (IEC 60044-1, protection CTs only): Accuracy limiting factor for protection CTs.</p> <p>FS (IEC 60044-1, metering CTs only): Instrument security factor for metering CTs.</p> <p>K_{ssc} (IEC 60044-6 only): Rated symmetrical short-circuit current factor.</p>

8.4 Test Results card for MR Test mode

The **Test Results** card of the MR Test mode displays the test results for the tap combination selected as tap in use in the **MR-Config.** card prior to the test.

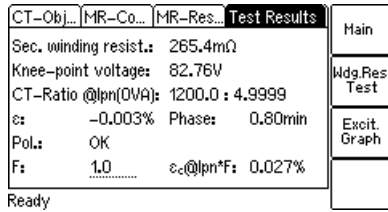




Figure 8-4: **Test Results** card for MR Test mode

8.4.1 Available soft keys

Table 8-7: Soft keys available in the **Test Results** card

Soft key	Description
	Displays detailed results of the secondary winding resistance test. See section 8.4.3 below.
	Displays the excitation graph calculated from the measurement results. See section 8.4.4 below.

8.4.2 Test results displayed

The following test results are displayed directly in the **Test Results** card.

Table 8-8: Test results displayed in the **Test Results** card

Parameter	Description
Sec. winding resist.	Measured secondary winding resistance of the tap combination.
Knee-point voltage	Measured knee point voltage.
CT-Ratio@I _{pn} (0VA)	Current ratio at nominal primary current and 0 VA burden.
ε	Available for IEC standards only. Error in % at nominal primary current and 0 VA burden.
RCF	Available for IEEE C57.13 only. Ratio correction factor.
Phase	Phase displacement at nominal primary current and 0 VA burden.
Pol.	OK: Polarity OK, phase angle is in the range of 0° ± 45°. Failed: Wrong polarity of the CT or wrong polarity of the measurement leads.
F and ε _c @I _{pn} *F	Two additional parameters are available for IEC 60044-1 and IEC 61869-2 protection CTs to allow the display of the composite error for different multiples of the nominal secondary current I _{sn} . Use the "F" parameter to specify the factor (for example, 1 x, 5 x, or 10 x I _{sn}) and read the resulting composite error from the "ε _c @I _{pn} *F" field.

8.4.3 Secondary winding resistance measurement details

Press the **Wdg. Res. Test** soft key in the **Test Results** card to display the secondary winding resistance measurement details for the tap combination selected as tap in use in the **MR-Config.** card prior to the test.

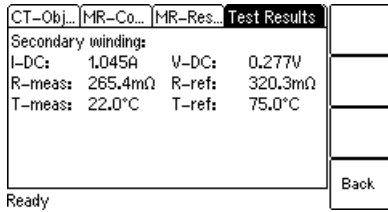


Figure 8-5: Winding resistance measurement details

Table 8-9: Test results for secondary winding resistance measurement

Parameter	Description
I-DC	Current used for measurement. Selected automatically, cannot be changed by the user. If I_{sn} is 0.2 A or higher, I_{DC} is automatically set to I_{sn} . If I_{sn} is lower than 0.2 A, I_{DC} is automatically set to 0.2 A. Maximum value: 5 A.
V-DC	Measured voltage.
R-meas	Measured resistance at ambient temperature.
R-ref	Reference resistance (temperature-compensated resistance, compensated to T_{ref}).
T-meas	Winding temperature of the CT at the time of measurement. Value used: Ambient Temperature defined in the Settings (main menu). If this temperature is not set correctly, the reference resistance value (R_{ref}) at reference temperature will not be calculated correctly.
T-ref	Reference temperature, i.e, temperature the CT is specified for. Value used: Reference temperature defined in the Settings (main menu). The winding resistance at reference temperature is calculated from the winding resistance measured at ambient temperature (T_{meas}) and the specified reference temperature.

8.4.4 Excitation graph

Press the **Excit. Graph** soft key in the **Test Results** card to display the excitation graph calculated from the test results. The graph shows the r.m.s. terminal/core voltage over the r.m.s./peak current depending on the selected standard.

On the bottom right of the diagram the voltage, current and inductance values for the selected point in the graph are displayed. The currently selected point in the graph is marked by a horizontal and a vertical dashed line.

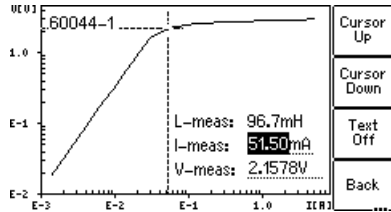


Figure 8-6: Excitation graph

Definition of axes in the excitation graph for different standards

Table 8-10: Definition of axes in the excitation graph

Standard	Vertical axis	Horizontal axis
IEC 60044-1	r.m.s. terminal voltage	r.m.s. excitation current
IEC 60044-6	r.m.s. e.m.f. voltage	peak excitation current
IEC 61869-2	average rectified ¹ terminal voltage	r.m.s. excitation current
IEEE C57.13	r.m.s. e.m.f. voltage	r.m.s. excitation current





1. Calibrated to r.m.s.

Available soft keys

Table 8-11: Soft keys available for the excitation graph




Soft key	Description
	Moves the cursor upwards on the excitation graph.
	Moves the cursor downwards on the excitation graph.
	Switches off the display of values on the bottom right of the diagram. If you have switched off the values, this soft key changes to Text On to switch the values display on again.
	Closes the excitation graph and brings you back to the Excitation card.

Table 8-11: Soft keys available for the excitation graph (continued)

Soft key	Description
   	<p>By pressing one of these soft keys you can display the measured excitation graph and knee point as defined in the respective standard.</p> <p>IEEE C57.13 displays the knee point for the 45° tangent. After pressing this soft key, its labeling changes to IEEE C57.13 (30°) to enable the display of the knee point for the 30° tangent. 30° is recommended for gapped cores in IEEE C37.110, chapter 4.3.</p> <p>Note: The test report only contains the graph for the standard selected in the CT-Object card.</p>

Viewing the measured values for different points on the graph

By default, the knee point values are displayed after opening the excitation graph page. However, you can also view the corresponding voltage, current and inductance values for any point on the graph. To select a specific point on the graph,

- ▶ either use the soft keys (**Cursor Up**, **Cursor Down**)
- ▶ or enter a specific voltage or current value using the keyboard:
 - ▶ Select the desired edit field using the   cursor keys.
 - ▶ Enter the desired voltage or current value using the keyboard.
 - ▶ Press the  key to apply the entered value and read the corresponding values in the respective fields (e.g. "V-meas" and "L-meas" if you have entered a current "I-meas").

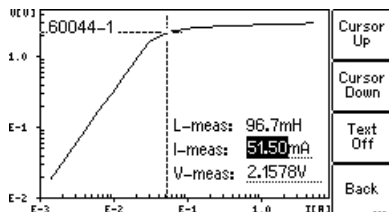


Figure 8-7: Entering a current value to display its corresponding voltage and inductance values on the excitation graph

9 CT Analyzer test cards for Advanced MR Test mode

The test cards described in this chapter are only available for the Advanced MR Test mode. Initialize a new test by selecting "New Advanced MR-Test" from the *CT Analyzer* main menu to enter the Advanced MR Test mode.

Depending on the selected standard, the behavior of the **CT-Object** card may differ slightly from the normal single-ratio CT test mode without using *CT SB2*.

CT-Object	MR-Co...	MR-Res...	Burden	
Location:	WVV			Main
Object:	WVV			Clear Results
I-pn:	?A	I-sn:	?A	Save
Standard:	60044-1	P/M:	?*	
VA:	?*VA	Cosp:	n/a	Save As
Burden:	?VA	Cosp:	?	
Ready		X1-X5		

See section 9.1 on page 47.

CT-Obj...	MR-Config...	MR-Res...	Resista...		
Number of Taps:	5	Tap in Use:	X1-X5	Main	
Taps	Ipn : Isn (A)	VA	Cosp Test	Op. Burden	
X1-X5	1200 : 5,0	25,00	0,5		✓
X1-X4	? : 5,0	?	n/a	✓	Common Tap to X5
X1-X3	? : 5,0	?	n/a	✓	
X1-X2	? : 5,0	?	n/a	✓	Show Inter Taps
Ready					

See section 9.2 on page 50.

CT-Obj...	MR-Co...	MR-Results	Resista...		
VA:	25.00VA	Cosp:	0,500	Show Exit.	
Taps	Ipn : Isec (A)	N	Rat.(%)	Pol.(°)	Results with Op. Burden
X1-X5	1200:4,997	240,0	-0,065	0,09	
X1-X4	800:4,9961	160,0	-0,078	1,86	Pol. in Degrees
X1-X3	300:4,9877	60,00	-0,245	5,62	
X1-X2	200:4,9745	40,01	-0,511	10,4	Show Inter Taps
Ready					

See section 9.3 on page 54.

9.1 CT-Object card for Advanced MR Test mode

Use the **CT-Object** card to specify the CT data according to the CT's name plate. Specify the data in the order of the following table.

CT-Object	MR-Co...	MR-Res...	Burden	
I-pn:	1200.0A	I-sn:	5.0A	?
Standard:	C57.13	P/M:	P	1.0
Class:	C	Vb:	100V	0.9
Burden designation:	B-1.0			0.5
VA:	25.0VA	Cosφ:	0.5	
Burden:	25.0VA	Cosφ:	0.5	
Ready			X1-X5	

Fields underlined by dotted lines can be edited.

In multi-ratio test mode, the status line displays the full tap combination of the CT.

Figure 9-1: **CT-Object** card with name plate data entered

Table 9-1: CT data in the **CT-Object** card

Parameter	Description
I-pn I-sn	<p>Rated primary current for the full tap combination of the CT and rated secondary current of the CT. These values specify the full tap ratio displayed in the MR-Config. card. The full tap ratio of the CT can only be specified and/or changed here.</p> <p>Possible values for I-pn: 1 to 99000A.</p> <p>Possible values for I-sn: 0.05 to 25A or soft keys 1.0A, 2.0A, 5.0A, 1.0A/√3, 2.0A/√3, 5.0A/√3. Default: As defined in the default test settings.</p> <p><u>For IEEE C57.13 only:</u></p> <p>If the selected standard is IEEE C57.13 and the "Number of Taps" is set to 3 or 5 in the MR-Config. card, <i>CT Analyzer</i> offers soft keys with predefined ratios for 3-tap or 5-tap CTs when the "I-pn" field is selected with the cursor.</p> <p>If you select one of these predefined multi-ratio schemes, <i>CT Analyzer</i> automatically specifies the ratios for all tap combinations in the MR-Config. card. For example, selecting the 1200 : 5 A soft key will result in nominal ratios of 1200 : 5, 1000 : 5, 900 : 5 and 400 : 5.</p> <p>Selecting a predefined multi-ratio scheme overwrites possibly existing settings for I_{pn} and I_{sn} in the CT-Object card and the ratios in the MR-Config. card.</p>
Standard	Standard to be used for the CT test and the test assessment.
P/M *	<p>CT type. Set "P" for a protection CT or "M" for a metering CT.</p> <p>* This parameter is relevant for assessment. No automatic assessment is available if the user did not enter data for this parameter prior to the test</p>

Table 9-1: CT data in the **CT-Object** card (continued)

Parameter	Description
Class *	<p>Rated accuracy class of the CT. This field becomes available after selecting the CT type (protection CT or metering CT).</p> <p>The class can be selected by soft keys or is determined by <i>CT Analyzer</i> during the test. Automatic determination during the test only works for IEC 61869-2 or IEC 60044-1 metering CTs and IEEE C57.13 metering CTs. If the question mark has been entered for the "P/M" parameter, the "Class" cannot be defined by the user but is automatically determined by <i>CT Analyzer</i> instead.</p> <p>* This parameter is relevant for assessment. No automatic assessment is available if the user did not enter data for this parameter prior to the test.</p>
and Burden designation (if available)	<p><u>For IEEE C57.13 metering CTs only:</u></p> <p>An additional soft key Assess @ VA and an additional "Burden designation" field are available for metering CTs according to IEEE C57.13.</p> <ul style="list-style-type: none"> ▶ Use the Assess @ VA option if the accuracy class of the CT only applies to one specific burden or burden range. <p>CT assessment is normally performed for the maximum burden specified and all lower burdens defined in the standard. Selecting the Assess @ VA option in addition to the class setting will cause <i>CT Analyzer</i> to perform assessment only for the burden value or burden range specified in the "Burden designation" field. The ratio table and the phase table in the Ratio card then only show the error for this specific burden or burden range.</p> <ul style="list-style-type: none"> ▶ Use the "Burden designation" field to specify the operating burden of IEEE C57.13 metering CTs by selecting a burden designation defined in the standard using the soft keys (instead of using the "VA" parameter). <p>Refer to the CT Analyzer User Manual for more detailed information:</p> <ul style="list-style-type: none"> ▶ See section 8.2.3, Table 8-4 on page 92: Description for "Class" parameter ▶ See section 8.2.3, Table 8-11 on page 106: Description for "Burden designation" parameter

Table 9-1: CT data in the **CT-Object** card (continued)

Parameter	Description
VA (or V _b) *	Nominal burden for the full tap combination of the CT.
cos φ	<p>The cos φ for the nominal burden is automatically selected according to the standard.</p> <p><i>CT Analyzer</i> automatically scales down the nominal burden specified here for the individual tap combinations available in the MR-Config. card according to their ratios (see "VA" on page 53).</p> <p>* This parameter is relevant for assessment. No automatic assessment is available if the user did not enter data for this parameter prior to the test.</p> <p><u>For IEEE C57.13 protection CTs only:</u></p> <p>If the IEEE C57.13 standard is selected with the type "protection CT" (class C, K or T), the VA and cos φ parameters are not accessible to the user. In this case, the user has to enter the terminal voltage V_b instead.</p> <p>After selecting the terminal voltage V_b using one of the available soft keys, the "Burden designation" field displays the corresponding standard burden designation, for example, B-1.0. The burden designation is calculated automatically by <i>CT Analyzer</i>. If you enter a V_b value not offered by the soft keys, CUSTOM is displayed in this field to indicate that the burden selected is not defined in the standard.</p>
Burden	Operating burden and cos φ of the tap in use .
cos φ	<p>Enter the burden manually or measure the burden using the Burden card.</p> <p>The operating burden specified here is used for all tap combinations specified in the MR-Config. card. In contrast to the nominal burden (VA), the operating burden is not scaled down according to the ratios (see "Burden" on page 53).</p> <p>You could use these fields for example to simulate the CT behavior at different load conditions after the test. Enter the value of your choice and view the measurement results of the multi-ratio CT test for the new operating burden in the MR-Results card (see section 9.3.2 on page 55).</p>

Note: Depending on the selected standard and CT type, other or further CT data may be necessary for a correct assessment. If the "Check "" settings before start" option is enabled in the default test settings for *CT Analyzer*, all parameters that are required for assessment are marked by a star "*" in the **CT-Object** card. For more detailed information, please refer to the CT Analyzer User Manual.

9.2 MR-Config. card for Advanced MR Test mode

Use the **MR-Config.** card to configure the multi-ratio test. In this card, set

- ▶ the number of taps available on the CT,
- ▶ the "tap in use", i.e., the tap combination (ratio) actually used and connected to the operating burden during operation of the CT,
- ▶ the nominal CT ratios for the tap combinations,
- ▶ the nominal burden for each tap combination,
- ▶ and select the tap combinations you want to test during the multi-ratio CT test.

If necessary, use the ▲ ▼ cursor keys to scroll the table.

The current ratio I_{pn}/I_{sn} and the nominal burden for the full tap combination as well as the operating burden have to be specified in the **CT-Object** card, see section 9.1 on page 47.

CT-Obj...				MR-Config.				MR-Res...				Resista...				Main			
Number of Taps: 5				Tap in Use: X1-X5															
Taps	$I_{pn} : I_{sn} (A)$	VA	Cosφ	Test															
X1-X5	1200 : 5.0	25.00	0.5	✓															
X1-X4	800 : 5.0	12.50	0.9	✓															
X1-X3	300 : 5.0	5.00	0.9	✓															
X1-X2	200 : 5.0	5.00	0.9	✓															

Ready

MR-Config. card for a new test after selecting a predefined multi-ratio scheme for I_{pn} in the **CT-Object** card (Advanced MR Test mode).

CT-Obj...				MR-Config.				MR-Res...				Resista...				Main			
Number of Taps: 5				Tap in Use: X1-X5															
Taps	$I_{pn} : I_{sn} (A)$	VA	Cosφ	Test															
X1-X5	1200 : 5.0	25.00	0.5	✓															
X1-X4	? : 5.0	?	n/a	✓															
X1-X3	? : 5.0	?	n/a	✓															
X1-X2	? : 5.0	?	n/a	✓															

Ready

MR-Config. card for a new test after specifying the values for I_{pn} , I_{sn} and VA manually in the **CT-Object** card (Advanced MR Test mode).

Fields underlined by dotted lines can be edited.

Figure 9-2: **MR-Config.** card

The **MR-Config.** card can be switched to display







- the tap combinations or intertap combinations of the CT with
- the nominal burden values or the operating burden.

Refer to sections 9.2.1 and 9.2.2 on the following pages for more information.

9.2.1 Available soft keys

The following soft keys are available if the **MR-Config** card is selected but not in edit mode (the card's tab is highlighted as shown in Figure 9-2):

Table 9-2: Soft keys available in the **MR-Config** card

Soft key	Description
 	<p>By default, the table in the MR-Config card displays the nominal burden values. Use the Op. Burden soft key to display this table with the operating burden instead.</p> <p>The soft key then changes to Nom. Burden to switch the table back to the nominal burden values.</p> <p>For the nominal burden values the column header is "VA", for the operating burden values the column header is "Burden".</p> <p>See "VA" and "Burden" on page 53 for more detailed information.</p>
 	<p>Using the Common Tap to X# soft key you can select the common tap (e.g. tap X5 instead of default tap X1). The common tap is the tap that is used as reference for all tap combinations (e.g. X1-X2, X1-X3, X1-X4 etc. if the common tap is X1).</p> <p>If the highest tap (e.g. X5) is selected as common tap, the soft key changes to Common Tap to X1.</p> <p>The default common tap can be selected using the Select Startup Mode option in the Setting Menu, see chapter 7 on page 32.</p>
 	<p>Use the Show Inter Taps soft key to display the intertap combinations instead of the tap combinations. If the intertap combinations are displayed, the soft key is labeled Show Taps.</p> <p>Examples of tap combinations: X1-X2, X1-X3, X1-X4, etc.</p> <p>Examples of intertap combinations: X2-X3, X2-X4, X3-X4, etc.</p>

9.2.2 Parameters and settings used or determined during the test

Table 9-3: Parameters and settings used or determined during the test

Parameter	Description
Number of Taps	<p>Overall number of tap connections available on the multi-ratio CT.</p> <p>Possible values: Soft keys No. Taps 2, No. Taps 3, No. Taps 4, No. Taps 5 or No. Taps 6.</p> <p>If the number of taps selected is 5 or 3, <i>CT Analyzer</i> offers soft keys with predefined CT ratios when the "I-pn" field is selected in the CT-Object card (IEEE C57.13 only; see "I-pn" on page 47).</p> <p>The default number of taps can be selected using the Select Startup Mode option in the Setting Menu, see chapter 7 on page 32.</p> <p>When testing a single-ratio CT using the <i>CT SB2</i> switch box, select No. Taps 2. However, single-ratio CT testing should preferably be performed using the normal single-ratio CT test mode of <i>CT Analyzer</i> without using the <i>CT SB2</i>.</p>

Table 9-3: Parameters and settings used or determined during the test (continued)

Parameter	Description
Tap in Use	<p>The tap combination actually used during operation of the CT (e.g. X1-X4).</p> <p>Select the tap combination using the soft keys (for example X1-X5, X1-X4). To select an intertap combination for the tap in use, press the Show Inter Taps soft key. The MR-Config. card then offers soft keys for the intertap combinations (for example X2-X4, X3-X4).</p> <p>For the tap combination selected here, <i>CT Analyzer</i> displays the detailed test results in the Resistance, Excitation and Ratio cards. The automatic test assessment in the Assessment card is however always done for the full tap combination given by the Number of Taps (e.g. for X1-X5 if number of taps = 5). See sections 9.4 and 9.5 on page 57.</p> <p>By default, the "Tap in Use" is set to the full tap combination given by the "Number of Taps".</p>
Taps	<p>This column lists all possible tap combinations of the CT (e.g. X1-X5, X1-X4, X1-X3, ...). The number of available tap combinations depends on the number of taps specified in the "Number of Taps" field.</p> <p>When the MR-Config. card is displayed but not in edit mode (i.e., the card's tab is highlighted as shown in Figure 9-2 on page 50) you can switch the common tap.</p> <p><u>Example:</u> X1 is assumed as the default common tap, X5 as the highest available tap: Press the Common Tap to X5 soft key to use X5 as common tap instead of X1. The soft key then changes to Common Tap to X1.</p> <p>Using the Show Inter Taps soft key you can display the intertap combinations instead of the tap combinations. If the intertap combinations are displayed, the soft key changes to Show Taps.</p> <p>Examples of intertap combinations: X2-X3, X2-X4, X3-X4.</p>
I _{pn} : I _{sn} (A)	<p>Use this column to set the nominal current ratio I_{pn} / I_{sn} for each tap combination.</p> <p>The nominal ratio for the full tap combination (e.g. X1-X5 for a 5-tap CT) is automatically taken from the CT-Object card and cannot be changed in the MR-Config. card.</p> <p>For all other tap combinations, I_{pn} can be changed or entered by the user. I_{sn} is always taken from the CT-Object card.</p> <p><i>CT Analyzer</i> automatically performs a plausibility check for the ratios entered by the user. For example, an error message is displayed if the I_{pn} entered for X1-X3 is higher than the I_{pn} specified for X1-X4.</p> <p>If you selected a predefined multi-ratio scheme in the CT-Object card using the soft keys (IEEE C57.13 only; see "I-pn" on page 47), <i>CT Analyzer</i> automatically enters the nominal CT ratios for all tap combinations according to this scheme.</p> <p>The ratios of the intertap combinations (e.g. X2-X4) are calculated from the tap combinations and cannot be changed by the user.</p>

Table 9-3: Parameters and settings used or determined during the test (continued)

Parameter	Description
VA cos φ	<p>Use this column to set the nominal burden for each tap combination.</p> <p>To obtain correct measurement results, the nominal burdens for the inner tap combinations (e.g. X1-X2 etc.) should be smaller than the nominal burden for the full tap combination according to the winding ratios of the tap combinations (e.g. 25VA for X1-X5, 12.5VA for X1-X4 etc.). <i>CT Analyzer</i> supports this with an automatic function.</p> <p>As soon as the primary current I_{pn} is specified for a tap combination, <i>CT Analyzer</i> automatically calculates and sets the corresponding nominal burden and cos φ for this tap combination. For this, <i>CT Analyzer</i> automatically scales down the nominal burden for the full tap combination according to the ratio of the specific tap combination and rounds it to the next value stated in the standard (see Figure 9-2 on page 50).</p> <p>The nominal burden (VA) automatically assigned by <i>CT Analyzer</i> can be changed manually by the user for all tap and intertap combinations except the full tap combination. The cos φ cannot be changed by the user.</p> <p>The "VA" column is displayed by default when opening the MR-Config. card the first time after initializing a new test in the Advanced MR Test mode. If the "Burden" column is displayed instead, use the Nom. Burden soft key to display the "VA" column with the nominal burdens again.</p>
Burden cos φ	<p>The "Burden" column is displayed if you selected to display the operating burden in the MR-Config. card using the Op. Burden soft key.</p> <p>This column displays the operating burden for the tap combination. The operating burden is taken from the CT-Object card and cannot be changed in the MR-Config. card. The same value is used for all tap combinations to test the behavior of the CT with the connected burden.</p>
Test	<p>In this column, select the tap combinations you actually want to measure during the test.</p> <p>Select or deselect each single tap combination individually using the Enable and Disable soft keys. It is not possible to disable the full tap combination.</p> <p>Disabling unused tap combinations reduces the test duration. Disabled taps are not measured. Therefore, no test results are available for disabled tap combinations.</p> <p>Disabling a tap combination also disables the corresponding intertap combinations. It is not possible to disable a specific intertap combination.</p>

9.3 MR-Results card for Advanced MR Test mode

After the test is finished, the **MR-Results** card shows the measurement results for each tap combination and/or intertap combination enabled for testing in the **MR-Config.** card.

If necessary, use the   cursor keys to scroll the display.

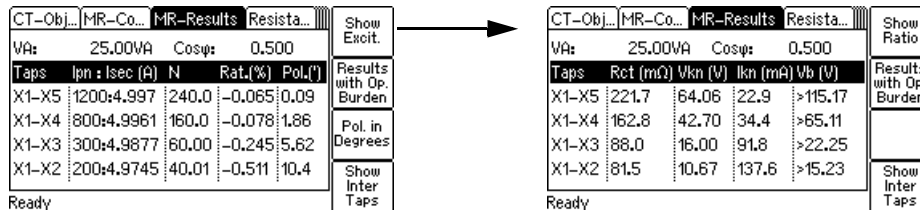


Figure 9-3: **MR-Results** card with measurement results: Page for **ratio** results (left) and page for **excitation** results (right)

The **MR-Results** card can be switched to display

- the ratio results or the excitation results (see "Ratio results and excitation results" on page 55),
- the results for the tap combinations or the intertap combinations of the CT (see **Show Inter Taps** and **Show Taps** on page 55), and
- the results with the nominal burdens or the operating burden (see section 9.3.2 on page 55).

9.3.1 Available soft keys

The following soft keys are available in the **MR-Results** card.

Table 9-4: Soft keys available in the **MR-Results** card









Soft key	Description
 	Use this soft key to switch between the ratio results and the excitation results. If the ratio results are displayed, the soft key is labeled Show Excit. to display the excitation results. If the excitation results are displayed, the soft key is labeled Show Ratio to display the ratio results.
 	By default, the results are displayed for the nominal burden values. Use the Results with Op. Burden soft key to display the results for the operating burden instead. The operating burden is the same for all tap combinations. If the results are displayed for the operating burden, the soft key changes to Results with Nom. Burden to toggle back to the results with nominal burden. See section 9.3.2 below.
 	Using this soft key you can switch the unit for the phase error ("Pol. (°)" column) between minutes and degrees. If the phase error is displayed in minutes, the soft key is labeled Pol. in Degrees . If the phase error is displayed in degrees, the soft key is labeled Pol. in Min..

Table 9-4: Soft keys available in the **MR-Results** card (continued)

Soft key	Description
	Using this soft key you can display the intertap combinations instead of the tap combinations.
	If the tap combinations are displayed, the soft key is labeled Show Inter Taps . If the intertap combinations are displayed, the soft key is labeled Show Taps .

9.3.2 Test results

Results with nominal burden or with operating burden

The measured or calculated results in the **MR-Results** card can be displayed for the nominal burden or for the operating burden. Select the burden to be used using the corresponding soft key

Results with Op. Burden or **Results with Nom. Burden**.

- When the results are displayed for the nominal burden, the "VA" and "cos ϕ " fields on the top of the page show for each tap or intertap combination selected with the cursor in the "Taps" column the assigned nominal burden and cos ϕ used for the measurement (e.g. 25VA for X1-X5, 12.5VA for X1-X4 etc., as assigned in the **MR-Config**. card).

Using the **Show Inter Taps** soft key you can display the intertap combinations instead of the tap combinations.

- When the results are displayed for the operating burden, the "Burden" and "cos ϕ " fields on the top of the page display the operating burden specified on the **CT-Object** card. The operating burden is the same for all tap or intertap combinations.

Note: Notice that the nominal burdens assigned to the tap combinations are scaled down from the nominal burden for the full tap combination according to the ratios! The **MR-Results** card will therefore show different results for the tap combinations when switching between the **results display with nominal burdens** and the **results display with operating burden**, even if identical values are specified for **VA** and **Burden** in the **CT-Object** card.

Hint: Once the test is finished, it is possible to simulate the performance of the CT for other burden values than the nominal burden by changing the "Burden" value in the **CT-Object** card. *CT Analyzer* then automatically performs a recalculation of the results for the new operating burden. Such simulations can be done at any time after the test is finished if the corresponding test file containing the measurement results of the CT is loaded in *CT Analyzer*.

Ratio results and excitation results

The measurement results are displayed on two different pages (see Figure 9-3 on page 54). You can toggle these pages using the **Show Excit.** or **Show Ratio** soft key.

The following table lists the **ratio results** displayed in the **MR-Results** card.

Table 9-5: Ratio results displayed in the **MR-Results** card

Column	Description
I _{pn} : I _{sec} (A)	This column shows for each tap combination the measured current ratio I_{pn} / I_{sec} .
N	This column shows for each tap combination the measured winding ratio.
Rat. (%)	This column shows for each tap combination the measured ratio error in %.
Pol. (')	This column shows for each tap combination the measured phase error (polarity) in minutes or degrees. Switch the unit using the Pol. in Degrees or Pol. in Min. soft key.
Pol. (°)	

The following table lists the **excitation results** displayed in the **MR-Results** card.

Table 9-6: Excitation results displayed in the **MR-Results** card

Column	Description
Rct (mΩ)	Secondary winding resistance.
Vkn (V)	Knee point voltage.
Ikn (mA)	Knee point current.
Vb (V)	The result displayed in this column depends on the standard selected in the CT-Object card and the type of CT. V_b (IEEE C57.13, protection CTs only): Rated secondary terminal voltage for protection CTs. TCF (IEEE C57.13, metering CTs only): Transformer correction factor for metering CTs. ALF (IEC 60044-1, protection CTs only): Accuracy limiting factor for protection CTs. FS (IEC 60044-1, metering CTs only): Instrument security factor for metering CTs. K_{SSC} (IEC 60044-6 only): Rated symmetrical short-circuit current factor.
TCF	
ALF	
FS	
Kssc	

9.4 Resistance, Excitation and Ratio card for Advanced MR Test mode

The **Resistance** card, the **Excitation** card and the **Ratio** card display the detailed test results for the tap combination specified as "Tap in Use" in the **MR-Config.** card.

Please refer to the CT Analyzer User Manual for detailed information about these cards.

9.5 Test assessment for Advanced MR Test mode

The automatic test assessment in the **Assessment** card is always performed for the full tap combination given by the **Number of Taps** (e.g. for X1-X5 if number of taps = 5).

Please refer to the CT Analyzer User Manual for detailed information about the **Assessment** card.

10 Technical data

10.1 Specifications

Table 10-1: CT SB2 specifications

Characteristic	Rating
Mains connection	Connector according to IEC 60320
Mains voltage	100 - 240V _{AC} / 50/60Hz / 0.2A
Mains fuses	2 x T2.0AH 250V (high-breaking capacity wire fuse 5 x 20mm)
Output voltage	0 - 120V

10.2 PC and CTA interfaces

The **PC** interface of the *CT SB2* switch box is exclusively intended to connect the *CT SB2* switch box to a computer (e.g., running the *CT Analyzer Suite* software).

The **CTA** interface of the *CT SB2* switch box is exclusively intended to connect *CT SB2* to a *CT Analyzer* test set.

PC interface

9-pole SUB-D connector, female

Outside view onto the sockets on *CT SB2*!

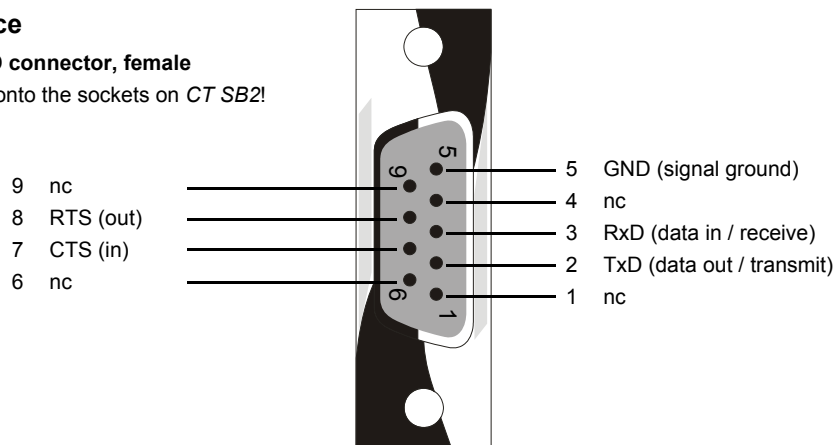


Figure 10-1: PC interface on *CT SB2*

CTA interface

9-pole SUB-D connector, male
 Outside view onto the pins on *CT SB2!*

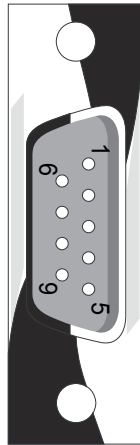


Figure 10-2: CTA interface on *CT SB2*

9-pole (DB9) null modem or crossover cable, 2 x female

Connections required:

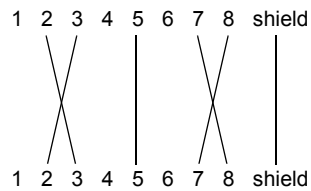


Figure 10-3: Connection cable *CT SB2* to *CT Analyzer*

10.3 Environmental conditions

Table 10-2: Environmental conditions

Characteristic	Rating
Operating temperature	-10 ... +50 °C (14 ... 122 °F)
Storage and transportation	-20 ... +70 °C (-4 ... 158 °F)
Max. altitude for operation	2000m


10.4 Mechanical data

Table 10-3: Mechanical data

Characteristic	Rating
Weight	2.6 kg (5.7 lbs) without accessories
Dimensions W x H x D	285 x 68 x 225 mm (11.2 x 2.7 x 8.9")

10.5 Standards

Table 10-4: Standards

EMC, safety		
EMC	IEC/EN 61326-1 (industrial electromagnetic environment) FCC subpart B of part 15, class A	
Safety	IEC/EN/UL 61010-1	
Other		
Shock	IEC/EN 60068-2-27 (15 g/11 ms, half-sinusoid, 3 shocks in each axis)	
Vibration	IEC/EN 60068-2-6 (frequency range 10 Hz...150 Hz, acceleration 2 g continuous (20 m/s ² /65 ft/s ²), 20 cycles per axis)	
Humidity	IEC/EN 60068-2-78 (5%...95% relative humidity, no condensation), tested at 40 °C/104 °F for 48 hours	
Protection class	IP20 according to EN 60529	

11 User maintenance

11.1 Care and cleaning

CT SB2 does not require any special maintenance or care. Clean the device from time to time or as necessary using a cloth dampened with water or isopropanol alcohol. Always disconnect *CT SB2* prior to cleaning!

11.2 Replacing fuses

1. Turn off *CT SB2* and unplug the power cord.
2. Ground the test object, and disconnect it from *CT SB2*. By disconnecting it you prevent a possibly faulty test object from feeding power back into *CT SB2*.
3. Disconnect *CT SB2* from *CT Analyzer* and, if applicable, from the computer.
4. Locate the blown fuse on the side panel of *CT SB2* and replace it by an identical fuse type: T2.0A H 250V (2.0 Amps slow-acting high breaking capacity wire fuse 5 x 20mm). *CT SB2* has two fuses of the same type. Proceed as follows:
 - ▶ Use a small screwdriver to unlock the two locking tongues one after the other as shown in Figure 11-1.
 - ▶ Pull out the fuse holder and locate the blown fuse.
 - ▶ Replace the blown fuse by an identical fuse type.
 - ▶ Insert the fuse holder and press it into the base until the two locking tongues engage audibly.



Figure 11-1: Unlocking the locking tongues of the fuse holder

12 Error and warning messages for *CT SB2*

The *CT SB2*-specific error and warning messages of *CT Analyzer* are listed in chapter "Error and Warning Messages" of the CT Analyzer User Manual.

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