

DIRANA

Getting Started



DIRANA Getting Started

Manual Version: ENU 1135 03 02

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The product information, specifications, and technical data embodied in this manual represent the technical status at the time of writing and are subject to change without prior notice.

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

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

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

1 Safety instructions

1.1 Operator qualifications

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

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

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

1.2 Safety standards and rules

1.2.1 Safety standards

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

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

Maintenance and repair of *DIRANA* and its accessories is only permitted by qualified experts at OMICRON service centers (see "Support" on page 16).

1.2.2 Safety rules

Always observe the five safety rules:

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

1.3 Safe operation

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

1.3.1 Test equipment integrity

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

1.3.2 *DIRANA*

- ▶ Use only adequately rated power cords.
- ▶ Supply *DIRANA* only from a power outlet with protective earth (PE).
- ▶ Position the measurement setup so that you can easily disconnect *DIRANA* from mains.
- ▶ Do not use extension cables on a cable reel to prevent overheating of the cord. Instead, run out the extension cord.
- ▶ Before handling *DIRANA* in any way, connect its equipotential ground terminal with a solid connection of at least 6 mm² cross-section to the ground terminal of the high-voltage asset under test.
- ▶ Do not operate *DIRANA* and its accessories in the presence of explosives, dangerous gases or vapors.
- ▶ If *DIRANA* or its accessories do not seem to function properly, stop using them and contact your regional OMICRON service center.

1.3.3 Measurement setup

- ▶ Ensure that the ground terminal of the test object is in good condition, clean, and free of oxidation.
- ▶ Do not touch any terminals and do not connect any cables to the test object without a visible connection to ground.
- ▶ Only use test leads and tools which provide full protection against direct contact.
- ▶ Always insert connectors completely and use the interlock mechanism.
- ▶ Always turn off *DIRANA* with the power switch before connecting or disconnecting any cable.
- ▶ Never remove any cables from *DIRANA* or the test object during a test.
- ▶ Do not insert objects (for example, screwdrivers) into any input/output socket.

1.4 Orderly measures

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

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

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

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

Opening *DIRANA* or its accessories invalidates all warranty claims.

1.5 Disclaimer

If the equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

1.6 Compliance statement

Declaration of conformity (EU)

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

FCC compliance (USA)

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

Declaration of compliance (Canada)

This Class A digital apparatus complies with Canadian ICES-003.

Cet appareil numérique de la classe A est conforme à la norme NMB-003 du Canada.

1.7 Recycling



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

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

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

For customers outside the European Economic Area

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

2 System requirements

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

Characteristic	Requirement (*recommended)
Operating system	Windows 10 64-bit* Windows 8.1 64-bit* , Windows 8 64-bit* , Windows 7 SP1 64-bit* and 32-bit
CPU	Multicore system with 2 GHz or faster* , single-core system with 2 GHz or faster
RAM	min. 2 GB (4 GB*)
Hard disk	min. 4 GB of available space
Storage device	DVD-ROM drive
Graphics adapter	Super VGA (1280×768) or higher-resolution video adapter and monitor ¹
Interface	Ethernet NIC ² , USB 2.0 ³
Installed software required for the optional Microsoft Office interface functions	Microsoft Office 2016* , Office 2013, Office 2010, Office 2007

1. We recommend graphics adapter supporting Microsoft DirectX 9.0 or later.

2. For testing with *TESTRANO 600*, *CPC 100* and *CIBANO 500*. NIC = Network Interface Card. *TESTRANO 600*, *CPC 100* and *CIBANO 500* can be connected with RJ-45 connectors either directly to the computer or to the local network, for example, by using an Ethernet hub.

3. For testing with *FRANEO 800*

3 Introduction

Water in oil-paper insulated assets such as power transformers or instrument transformers is accelerating the aging of the paper insulation and thus reducing the life expectancy of the asset. Knowing the water content therefore allows to assess the aging status of assets. By measuring the dielectric response of the equipment in a wide frequency range, *DIRANA* determines the moisture content. To save time, *DIRANA* combines frequency domain spectroscopy (FDS) and advanced time domain spectroscopy (PDC+).

DIRANA can also be used as an universal dielectric analyzer für all kind of asset insulations, for example, for bushings and rotating machines.

3.1 Frequency domain spectroscopy

By using the frequency domain spectroscopy (FDS), the dissipation factor of the insulation system under test is measured by frequency sweep. The FDS allows fast measurements at high frequencies but requires long measurement times at lower frequencies.

3.2 Advanced time domain spectroscopy (PDC+)

The advanced time domain spectroscopy (PDC+) uses the principles of the PDC measurement which applies a DC voltage to the insulation and measures the response current. The result (current over time) is mathematically transferred to the frequency domain so that the result can be presented, for example, as power factor/dissipation factor over frequency. PDC+ is applicable for frequencies lower than 0.1 Hz and is significantly faster than frequency domain measurements.

3.3 Designated use

DIRANA is a dielectric response analyzer for the insulation diagnosis. The underlying concept – combined FDS and PDC+ methods – makes *DIRANA* an intelligent, fast, and powerful solution for the insulation diagnosis of high-voltage assets in the power industry such as power transformers, rotating machines, and cables.

DIRANA combines the FDS and PDC+ measurements to get the advantages of both methods. At high frequencies, the dielectric response is measured with the FDS while at low frequencies, the results obtained by measuring the polarization current are transformed into the frequency domain and the dielectric response is calculated. This unique concept facilitates the dielectric response measurements within a wide frequency range. By comparing the dielectric response with model curves, *DIRANA* provides an indication of the insulation condition such as:

- Moisture content in the oil/paper insulation
- Condition of OIP, RBP, and RIP high-voltage bushings
- Condition of the generator, motor, and cable insulation

DIRANA is controlled by *Primary Test Manager* running on a computer connected to *DIRANA* by USB interface. *Primary Test Manager* combines seamlessly the FDS and PDC+ methods and merges the results, allowing you to work only in the frequency domain. *DIRANA* provides two measurement channels for faster measurements. *Primary Test Manager* provides an automatic procedure for the moisture content analysis of the power transformer insulation based on fitting the measurement results with a collection of model curves which are adapted to fit the measured asset.

3.4 Connections and operating controls

This section describes the connections and operating controls of *DIRANA*.

3.4.1 Front panel

WARNING



Death or severe injury caused by high voltage or current possible

- ▶ Do not touch the **OUTPUT** connector or any parts of the test setup when the red LED lights continuously or flashes.
- ▶ Always ensure that the device is safely switched off and the sample is discharged before touching any parts of the test setup.
- ▶ Before connecting *DIRANA* to the test object, observe the five safety rules (see 1.2.2 "Safety rules" on page 3) and all additional relevant laws and internal safety standards.

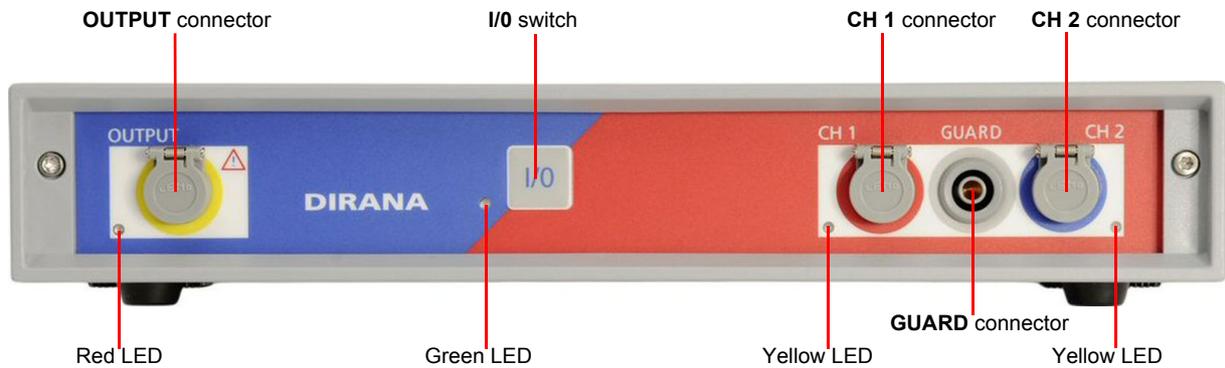


Figure 3-1: Front view of *DIRANA*

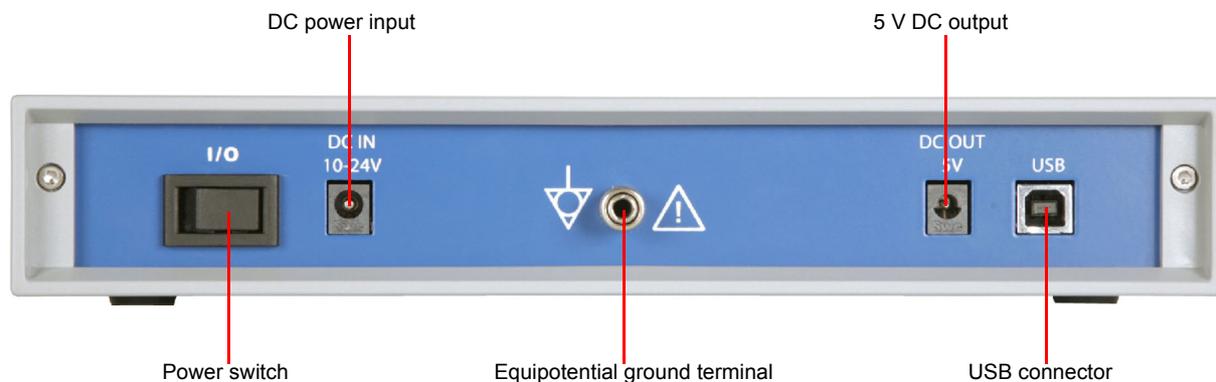
Table 3-1: Front-panel operating controls

Operating control	State	Description
OUTPUT connector	n/a	Signal source output
I/O switch	n/a	Starts and to stops measurements in the disconnected mode.
CH 1 connector	n/a	Channel 1 input
CH 2 connector	n/a	Channel 2 input
GUARD connector	n/a	Connector for connecting an additional guard cable
Red LED	LED is flashing	Signals that a measurement is running.
	On for approx. 10 s	Signals that you the test object is depolarized after a measurement has been stopped.

Table 3-1: Front-panel operating controls (continued)

Operating control	State	Description
Green LED	On	Indicates that the power switch is on.
Yellow LEDs	The LED next to the active channel is flashing	Signals that measurement results are available in <i>DIRANA</i> for one-channel measurements.
	LEDs are flashing concurrently	Signal that measurement results are available in <i>DIRANA</i> for two-channel measurements.
	LEDs are flashing alternately	Signal an error during a measurement. In the disconnected mode, after a computer has been connected to <i>DIRANA</i> , the error information is sent to the computer and the LEDs switch over to continuous lighting.

3.4.2 Rear panel

Figure 3-2: Rear view of *DIRANA*

3.5 Delivery

The DIRANA delivery includes:



DIRANA



Power supply



Power cable



Grounding cable (GR/YE) 6 m/20 ft, 6 mm² with clamp



Braid wire



USB 2.0 A/B cable 2 m/6.6 ft



50 Ω triaxial cable 18 m/60 ft (red)



50 Ω triaxial cable 18 m/60 ft (blue)



50 Ω triaxial cable 18 m/60 ft (yellow)



3 × triaxial cable adapter with banana plugs



3 × laboratory cable 6 m/20 ft, 2.5 mm² with banana plugs



Crank handle



Screw clamp



3 × measuring clamp with triaxial and guard connections



3 × connection clamp with banana plugs



Crocodile clamps with banana socket



Terminal adapters with banana socket



Soft bag



Transport case



DIRANA Getting Started



TMDRA 100



Primary Test Manager DVD

3.6 Primary Test Manager

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

With *Primary Test Manager*, you can create new jobs, execute prepared jobs, manage objects, create new manual tests, open existing manual tests, and perform tests. After you have performed a test, you can generate test reports. *Primary Test Manager* runs on a computer and communicates with *DIRANA* through USB interface.

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

3.7 Cleaning

WARNING



Death or severe injury caused by high voltage or current possible

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

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

4 Installation

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

4.1 Connect *DIRANA* to the computer

DIRANA communicates with the computer through USB interface. To connect *DIRANA* to the computer:

1. Connect the USB 2.0 A/B cable to the USB connector on the *DIRANA* rear panel (see Figure 3-2: "Rear view of *DIRANA*" on page 11).

NOTICE

Equipment damage possible

- ▶ Do not crush the cables when closing the transport case.
- ▶ Always place the cables deliberately before closing the transport case.

2. Connect the USB cable on the front of the transport case to the USB connector of your computer by using the USB 2.0 A/B cable.

4.2 Power up *DIRANA*



WARNING

Death or severe injury caused by high voltage or current possible

- ▶ Do not power up *DIRANA* without grounding connection.
- ▶ Before powering *DIRANA* up, connect its equipotential ground terminal with a solid connection of at least 6 mm² cross-section to the ground terminal of the asset under test.

To power *DIRANA* by using the delivered AC power supply:

1. Plug the DC output connector of the AC power supply into the DC power input on the *DIRANA* rear panel (see Figure 3-2: "Rear view of *DIRANA*" on page 11).
2. Connect the power cable to the AC power supply.



DANGER

Death or severe injury caused by high voltage or current

- ▶ Do not use power outlets without protective ground (PE).
- ▶ Only use the delivered AC power supply to power *DIRANA*.
- ▶ Connect the *DIRANA* power supply only to a power outlet that is equipped with protective ground (PE).
- ▶ For safe operation always make sure that protective ground and equipotential ground are connected properly.

3. Plug the mains plug of the power cable into the power outlet.
4. Toggle the power switch on the *DIRANA* rear panel.

4.3 Install *Primary Test Manager*

For the minimum requirements your computer needs to run *Primary Test Manager*, see 2 "System requirements" on page 7.

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

4.4 Start *Primary Test Manager* and connect to *DIRANA*

- ▶ To start *Primary Test Manager*, click **Start** on the task bar, and then click **OMICRON Primary Test Manager**, or double-click the **OMICRON Primary Test Manager** icon  on the desktop.
- ▶ To connect to *DIRANA*, select the device from the list, and then click **Connect**.



Figure 4-1: Connecting to *DIRANA*

If you could not connect to your *DIRANA* device, do one of the following:

- ▶ Ensure that *DIRANA* is switched on and connected to the computer.
- ▶ Click **More** beneath the **Connect** button, and then click **Refresh**.
- ▶ Press F5.

Note: The **Update device software**, **Open device web interface** and **Add device manually** options are not available for *DIRANA*.

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

During the connection process, *Primary Test Manager* checks the *DIRANA* firmware version and updates it, if necessary.

NOTICE

Equipment damage or loss of data possible

- ▶ Do not disconnect *DIRANA* from the computer during the firmware update process.
- ▶ Always wait until the firmware update has finished before disconnecting *DIRANA*.

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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DIRANA PTM

User Manual



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About this manual

This User Manual provides information on how to use the *DIRANA* test system safely, properly and efficiently. The DIRANA PTM User Manual contains important safety instructions for working with *DIRANA* and gets you familiar with operating *DIRANA*. 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 DIRANA PTM User Manual always has to be available on the site where *DIRANA* is used. The users of *DIRANA* must read this manual before operating *DIRANA* and observe the safety, installation, and operation instructions therein.

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

Safety symbols used

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



DANGER

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



WARNING

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



CAUTION

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

NOTICE

Equipment damage or loss of data possible

1 Safety instructions

1.1 Operator qualifications

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

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- ▶ Use only adequately rated power cords.
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- ▶ Do not operate *DIRANA* and its accessories in the presence of explosives, dangerous gases or vapors.
- ▶ If *DIRANA* or its accessories do not seem to function properly, stop using them and contact your regional OMICRON service center.

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- ▶ Ensure that the ground terminal of the test object is in good condition, clean, and free of oxidation.
- ▶ Do not touch any terminals and do not connect any cables to the test object without a visible connection to ground.
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- ▶ Always insert connectors completely and use the interlock mechanism.
- ▶ Always turn off *DIRANA* with the power switch before connecting or disconnecting any cable.
- ▶ Never remove any cables from *DIRANA* or the test object during a test.
- ▶ Do not insert objects (for example, screwdrivers) into any input/output socket.

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

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

DIRANA and its accessories may be used only as described in this User Manual. Any other use is not in accordance with the regulations. The manufacturer and the distributor are not liable for damage resulting from improper usage. The user alone assumes all responsibility and risk.

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

Opening *DIRANA* or its accessories invalidates all warranty claims.

1.5 Disclaimer

If the equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

1.6 Compliance statement

Declaration of conformity (EU)

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

FCC compliance (USA)

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

Declaration of compliance (Canada)

This Class A digital apparatus complies with Canadian ICES-003.

Cet appareil numérique de la classe A est conforme à la norme NMB-003 du Canada.

1.7 Recycling



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

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

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

For customers outside the European Economic Area

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

2 System requirements

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

Characteristic	Requirement (*recommended)
Operating system	Windows 10 64-bit* Windows 8.1 64-bit* , Windows 8 64-bit* , Windows 7 SP1 64-bit* and 32-bit
CPU	Multicore system with 2 GHz or faster* , single-core system with 2 GHz or faster
RAM	min. 2 GB (4 GB*)
Hard disk	min. 4 GB of available space
Storage device	DVD-ROM drive
Graphics adapter	Super VGA (1280×768) or higher-resolution video adapter and monitor ¹
Interface	Ethernet NIC ² , USB 2.0 ³
Installed software required for the optional Microsoft Office interface functions	Microsoft Office 2016* , Office 2013, Office 2010, Office 2007

1. We recommend graphics adapter supporting Microsoft DirectX 9.0 or later.

2. For testing with *TESTRANO 600*, *CPC 100* and *CIBANO 500*. NIC = Network Interface Card. *TESTRANO 600*, *CPC 100* and *CIBANO 500* can be connected with RJ-45 connectors either directly to the computer or to the local network, for example, by using an Ethernet hub.

3. For testing with *FRANEO 800*

3 Introduction

Water in oil-paper insulated assets such as power transformers or instrument transformers is accelerating the aging of the paper insulation and thus reducing the life expectancy of the asset. Knowing the water content therefore allows to assess the aging status of assets. By measuring the dielectric response of the equipment in a wide frequency range, *DIRANA* determines the moisture content. To save time, *DIRANA* combines frequency domain spectroscopy (FDS) and advanced time domain spectroscopy (PDC+).

DIRANA can also be used as an universal dielectric analyzer für all kind of asset insulations, for example, for bushings and rotating machines.

3.1 Frequency domain spectroscopy

By using the frequency domain spectroscopy (FDS), the dissipation factor of the insulation system under test is measured by frequency sweep. The FDS allows fast measurements at high frequencies but requires long measurement times at lower frequencies.

3.2 Advanced time domain spectroscopy (PDC+)

The advanced time domain spectroscopy (PDC+) uses the principles of the PDC measurement which applies a DC voltage to the insulation and measures the response current. The result (current over time) is mathematically transferred to the frequency domain so that the result can be presented, for example, as power factor/dissipation factor over frequency. PDC+ is applicable for frequencies lower than 0.1 Hz and is significantly faster than frequency domain measurements.

3.3 Designated use

DIRANA is a dielectric response analyzer for the insulation diagnosis. The underlying concept – combined FDS and PDC+ methods – makes *DIRANA* an intelligent, fast, and powerful solution for the insulation diagnosis of high-voltage assets in the power industry such as power transformers, rotating machines, and cables.

DIRANA combines the FDS and PDC+ measurements to get the advantages of both methods. At high frequencies, the dielectric response is measured with the FDS while at low frequencies, the results obtained by measuring the polarization current are transformed into the frequency domain and the dielectric response is calculated. This unique concept facilitates the dielectric response measurements within a wide frequency range. By comparing the dielectric response with model curves, *DIRANA* provides an indication of the insulation condition such as:

- Moisture content in the oil/paper insulation
- Condition of OIP, RBP, and RIP high-voltage bushings
- Condition of the generator, motor, and cable insulation

DIRANA is controlled by *Primary Test Manager* running on a computer connected to *DIRANA* by USB interface. *Primary Test Manager* combines seamlessly the FDS and PDC+ methods and merges the results, allowing you to work only in the frequency domain. *DIRANA* provides two measurement channels for faster measurements. *Primary Test Manager* provides an automatic procedure for the moisture content analysis of the power transformer insulation based on fitting the measurement results with a collection of model curves which are adapted to fit the measured asset.

3.4 Connections and operating controls

This section describes the connections and operating controls of *DIRANA*.

3.4.1 Front panel

WARNING



Death or severe injury caused by high voltage or current possible

- ▶ Do not touch the **OUTPUT** connector or any parts of the test setup when the red LED lights continuously or flashes.
- ▶ Always ensure that the device is safely switched off and the sample is discharged before touching any parts of the test setup.
- ▶ Before connecting *DIRANA* to the test object, observe the five safety rules (see 1.2.2 "Safety rules" on page 7) and all additional relevant laws and internal safety standards.

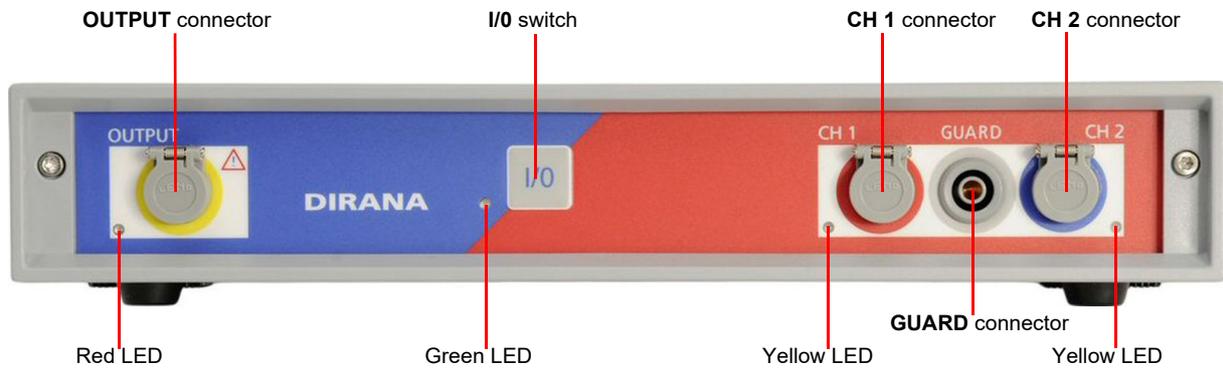


Figure 3-1: Front view of *DIRANA*

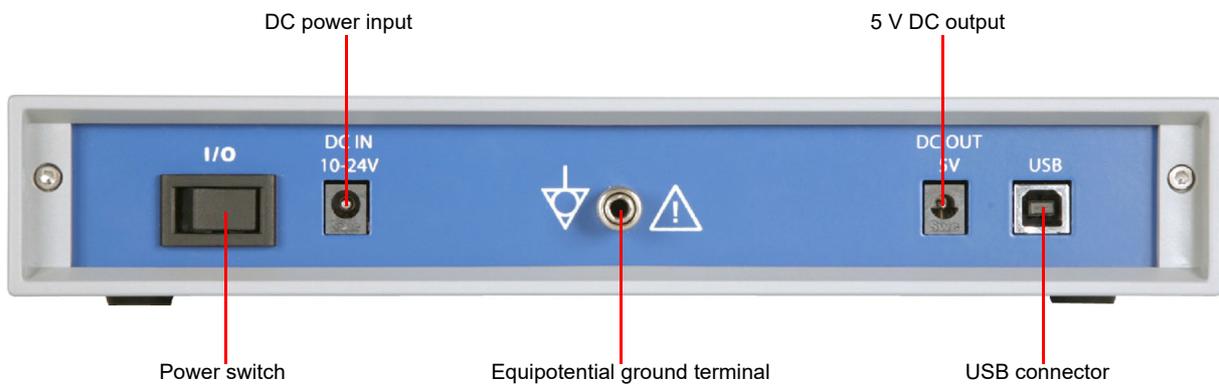
Table 3-1: Front-panel operating controls

Operating control	State	Description
OUTPUT connector	n/a	Signal source output
I/O switch	n/a	Starts and to stops measurements in the disconnected mode.
CH 1 connector	n/a	Channel 1 input
CH 2 connector	n/a	Channel 2 input
GUARD connector	n/a	Connector for connecting an additional guard cable
Red LED	LED is flashing	Signals that a measurement is running.
	On for approx. 10 s	Signals that you the test object is depolarized after a measurement has been stopped.

Table 3-1: Front-panel operating controls (continued)

Operating control	State	Description
Green LED	On	Indicates that the power switch is on.
Yellow LEDs	The LED next to the active channel is flashing	Signals that measurement results are available in <i>DIRANA</i> for one-channel measurements.
	LEDs are flashing concurrently	Signal that measurement results are available in <i>DIRANA</i> for two-channel measurements.
	LEDs are flashing alternately	Signal an error during a measurement. In the disconnected mode, after a computer has been connected to <i>DIRANA</i> , the error information is sent to the computer and the LEDs switch over to continuous lighting.

3.4.2 Rear panel

Figure 3-2: Rear view of *DIRANA*

3.5 Delivery

The DIRANA delivery includes:



DIRANA



Power supply



Power cable



Grounding cable (GR/YE) 6 m/20 ft, 6 mm² with clamp



Braid wire



USB 2.0 A/B cable 2 m/6.6 ft



50 Ω triaxial cable 18 m/60 ft (red)



50 Ω triaxial cable 18 m/60 ft (blue)



50 Ω triaxial cable 18 m/60 ft (yellow)



3 × triaxial cable adapter with banana plugs



3 × laboratory cable 6 m/20 ft, 2.5 mm² with banana plugs



Terminal adapters with banana socket



Screw clamp



3 × measuring clamp with triaxial and guard connections



3 × connection clamp with banana plugs



Crocodile clamps with banana socket



TMDRA 100



Soft bag



Transport case



DIRANA Getting Started



Primary Test Manager
DVD

3.6 Primary Test Manager

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

With *Primary Test Manager*, you can create new jobs, execute prepared jobs, manage objects, create new manual tests, open existing manual tests, and perform tests. After you have performed a test, you can generate test reports. *Primary Test Manager* runs on a computer and communicates with *DIRANA* through USB interface.

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

3.7 Cleaning

WARNING



Death or severe injury caused by high voltage or current possible

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

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

4 Installation

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

4.1 Connect *DIRANA* to the computer

DIRANA communicates with the computer through USB interface. To connect *DIRANA* to the computer:

1. Connect the USB 2.0 A/B cable to the USB connector on the *DIRANA* rear panel (see Figure 3-2: "Rear view of *DIRANA*" on page 15).

NOTICE

Equipment damage possible

- ▶ Do not crush the cables when closing the transport case.
- ▶ Always place the cables deliberately before closing the transport case.

2. Connect the USB cable on the front of the transport case to the USB connector of your computer by using the USB 2.0 A/B cable.

4.2 Power up *DIRANA*



WARNING

Death or severe injury caused by high voltage or current possible

- ▶ Do not power up *DIRANA* without grounding connection.
- ▶ Before powering *DIRANA* up, connect its equipotential ground terminal with a solid connection of at least 6 mm² cross-section to the ground terminal of the asset under test.

To power *DIRANA* by using the delivered AC power supply:

1. Plug the DC output connector of the AC power supply into the DC power input on the *DIRANA* rear panel (see Figure 3-2: "Rear view of *DIRANA*" on page 15).
2. Connect the power cable to the AC power supply.



DANGER

Death or severe injury caused by high voltage or current

- ▶ Do not use power outlets without protective ground (PE).
- ▶ Only use the delivered AC power supply to power *DIRANA*.
- ▶ Connect the *DIRANA* power supply only to a power outlet that is equipped with protective ground (PE).
- ▶ For safe operation always make sure that protective ground and equipotential ground are connected properly.

3. Plug the mains plug of the power cable into the power outlet.
4. Toggle the power switch on the *DIRANA* rear panel.

4.3 Install *Primary Test Manager*

For the minimum requirements your computer needs to run *Primary Test Manager*, see 2 "System requirements" on page 13.

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

4.4 Start *Primary Test Manager* and connect to *DIRANA*

- ▶ To start *Primary Test Manager*, click **Start** on the task bar, and then click **OMICRON Primary Test Manager**, or double-click the **OMICRON Primary Test Manager** icon  on the desktop.
- ▶ To connect to *DIRANA*, select the device from the list, and then click **Connect**.



Figure 4-1: Connecting to *DIRANA*

If you could not connect to your *DIRANA* device, do one of the following:

- ▶ Ensure that *DIRANA* is switched on and connected to the computer.
- ▶ Click **More** beneath the **Connect** button, and then click **Refresh**.
- ▶ Press F5.

Note: The **Update device software**, **Open device web interface** and **Add device manually** options are not available for *DIRANA*.

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

During the connection process, *Primary Test Manager* checks the *DIRANA* firmware version and updates it, if necessary.

NOTICE

Equipment damage or loss of data possible

- ▶ Do not disconnect *DIRANA* from the computer during the firmware update process.
- ▶ Always wait until the firmware update has finished before disconnecting *DIRANA*.

5 Home view

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

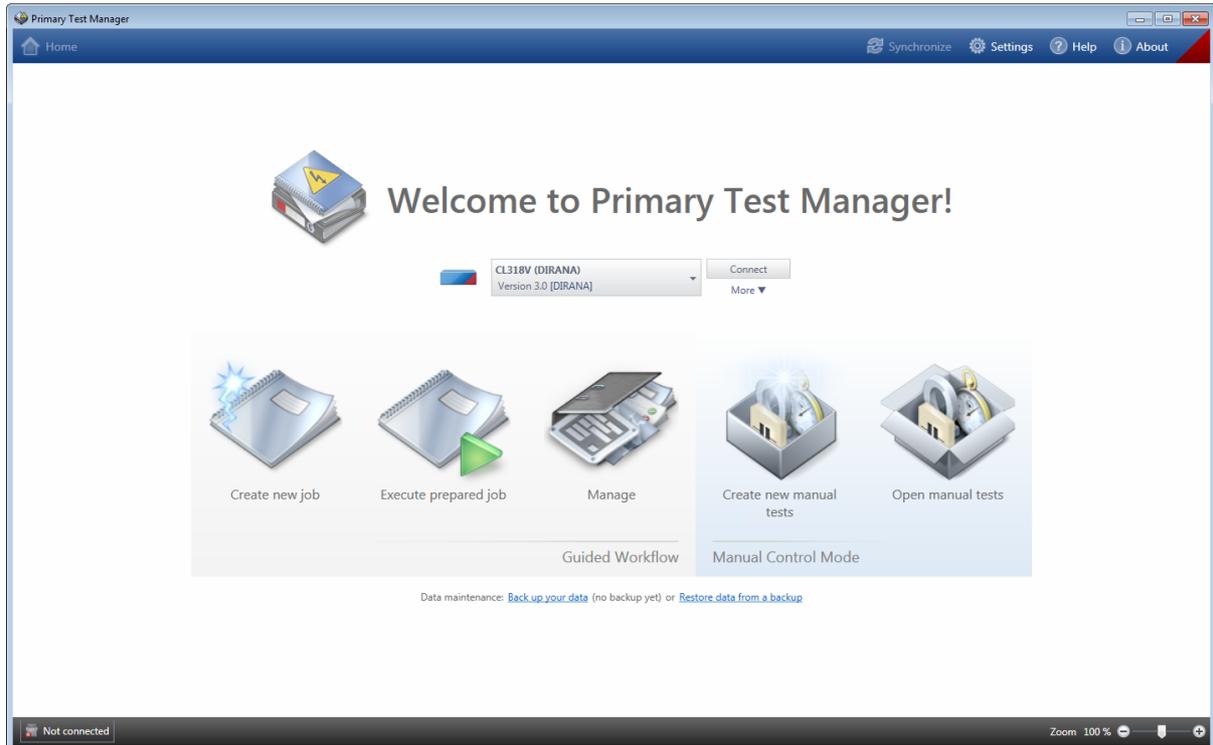


Figure 5-1: *Primary Test Manager* home view

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

Table 5-1: Data importance categories

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

Primary Test Manager supports the following user tasks.

Table 5-2: Selecting the user tasks

Button	Description	Action
	Create new job	Click the Create new job button to start the guided test workflow (see 6 "Create new job" on page 37).
	Execute prepared job	Click the Execute prepared job button to execute a prepared job (see 7 "Execute prepared job" on page 60).
	Manage	Click the Manage button to manage locations, assets, jobs, and reports (see 8 "Manage objects" on page 61).
	Create new manual tests	Click the Create new manual tests button to create a new manual test (not available for <i>DIRANA</i>).
	Open manual tests	Click the Open manual tests button to open a manual test (see 9 "Open manual tests" on page 68)

5.1 Title bar

Note: The title bar is displayed in any *Primary Test Manager* view.

The following table describes the title bar commands.

Table 5-3: Title bar commands

Command	Action
Home	Click Home to move from any view to the home view.
Synchronize ¹	Click Synchronize to synchronize your local database with the <i>Primary Test Manager</i> server database (see 5.4 "Data synchronization" on page 34).
Settings	Click Settings to open the Settings dialog box (see 5.1.1 "Settings" later in this chapter).
Help	Click Help to open the <i>DIRANA</i> technical documentation and send data to OMICRON Technical Support (see 5.1.2 "Help" on page 30).
About	Click About to open the About Primary Test Manager dialog box (see 5.1.3 "About" on page 31).

1. Only enabled with the appropriate license.

5.1.1 Settings

In the **Settings** dialog box, you can make a number of *Primary Test Manager* settings to match your regional conventions, manage the job templates, and set the *Primary Test Manager* server settings for data synchronization (see 5.4 "Data synchronization" on page 34). To open the **Settings** dialog box, click **Settings** in the title bar.

NOTICE

Equipment damage or loss of data possible

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

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

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

Profiles

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

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

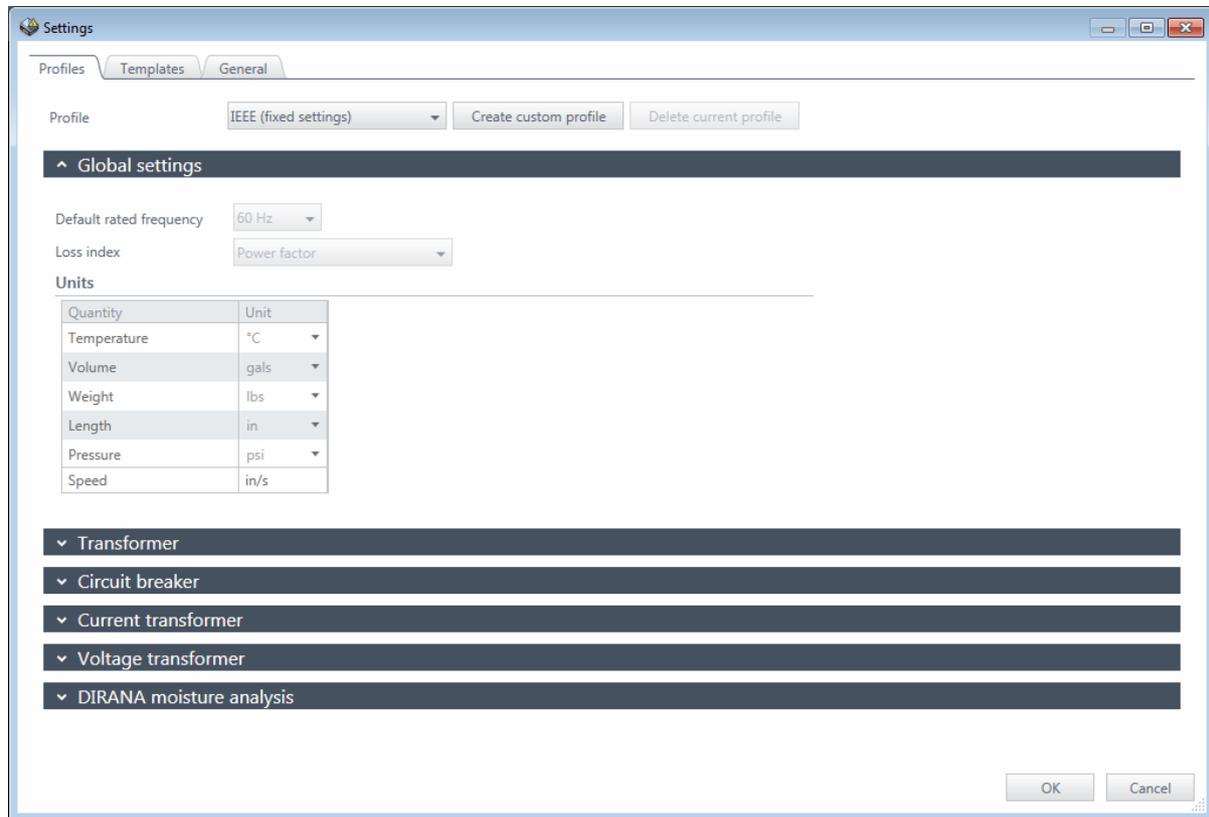


Figure 5-2: Profiles tab: Global settings

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

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

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

To create your own profile:

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

4. Under **Transformer**, **Current transformer**, or **Voltage transformer**, make your preferred settings for the asset under test.

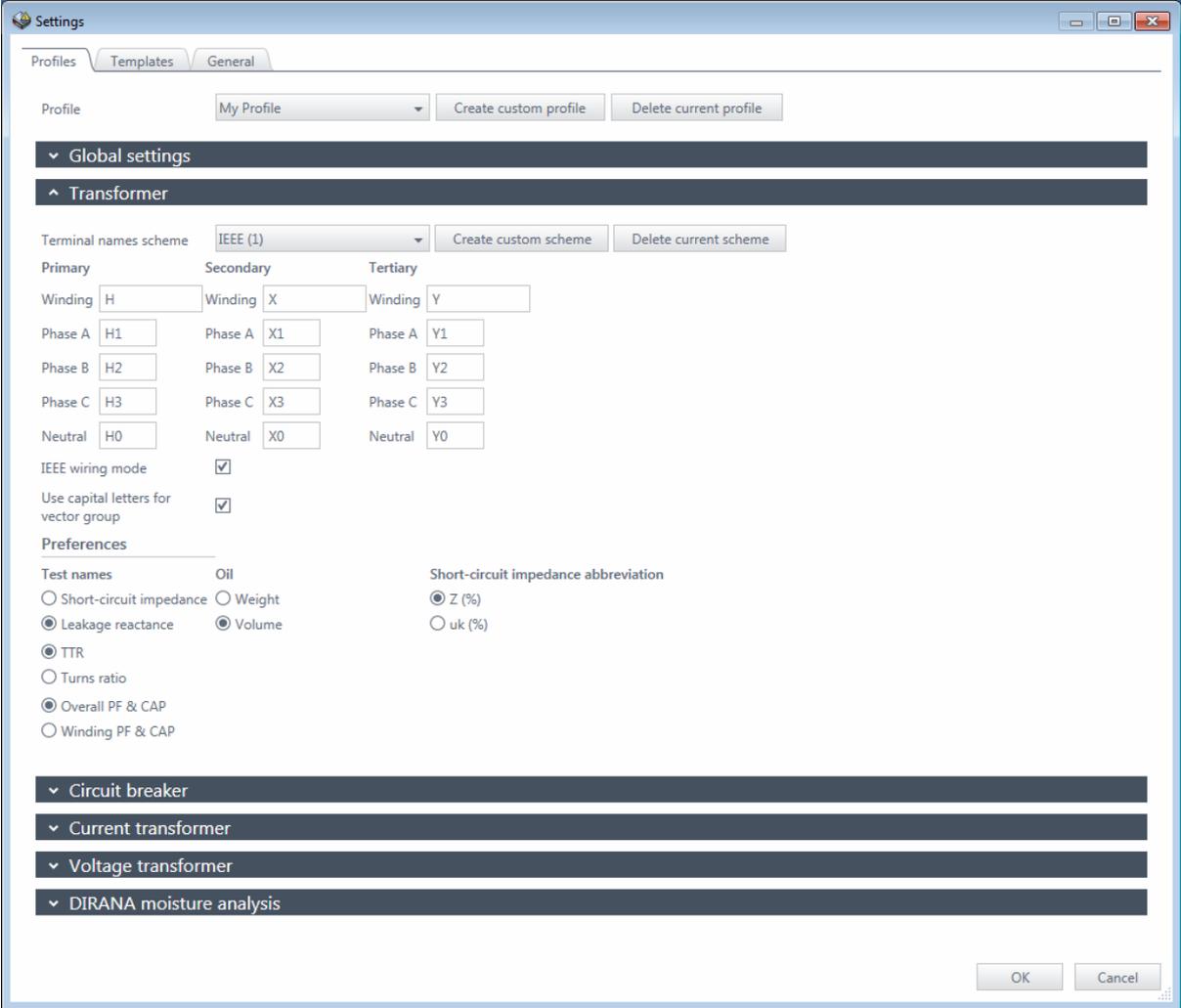


Figure 5-3: Profiles tab: Transformer

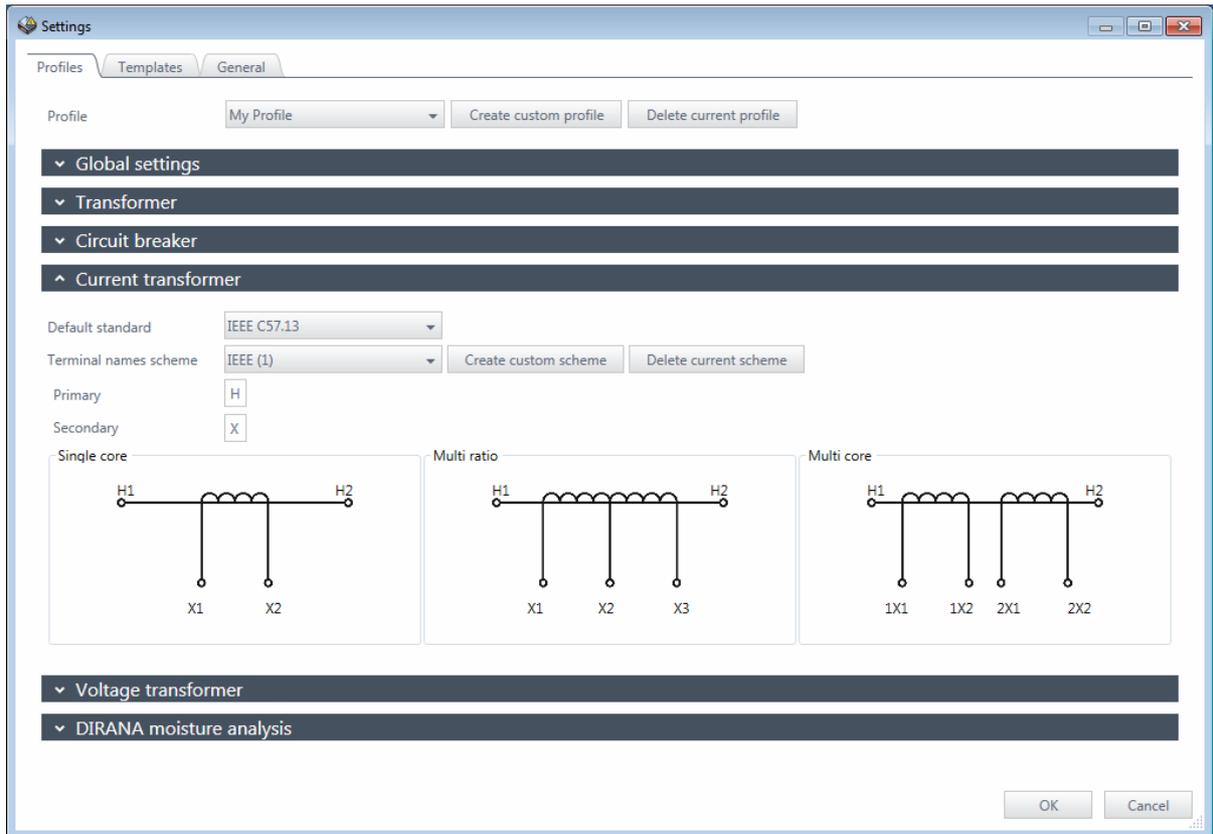


Figure 5-4: Profiles tab: Current transformer

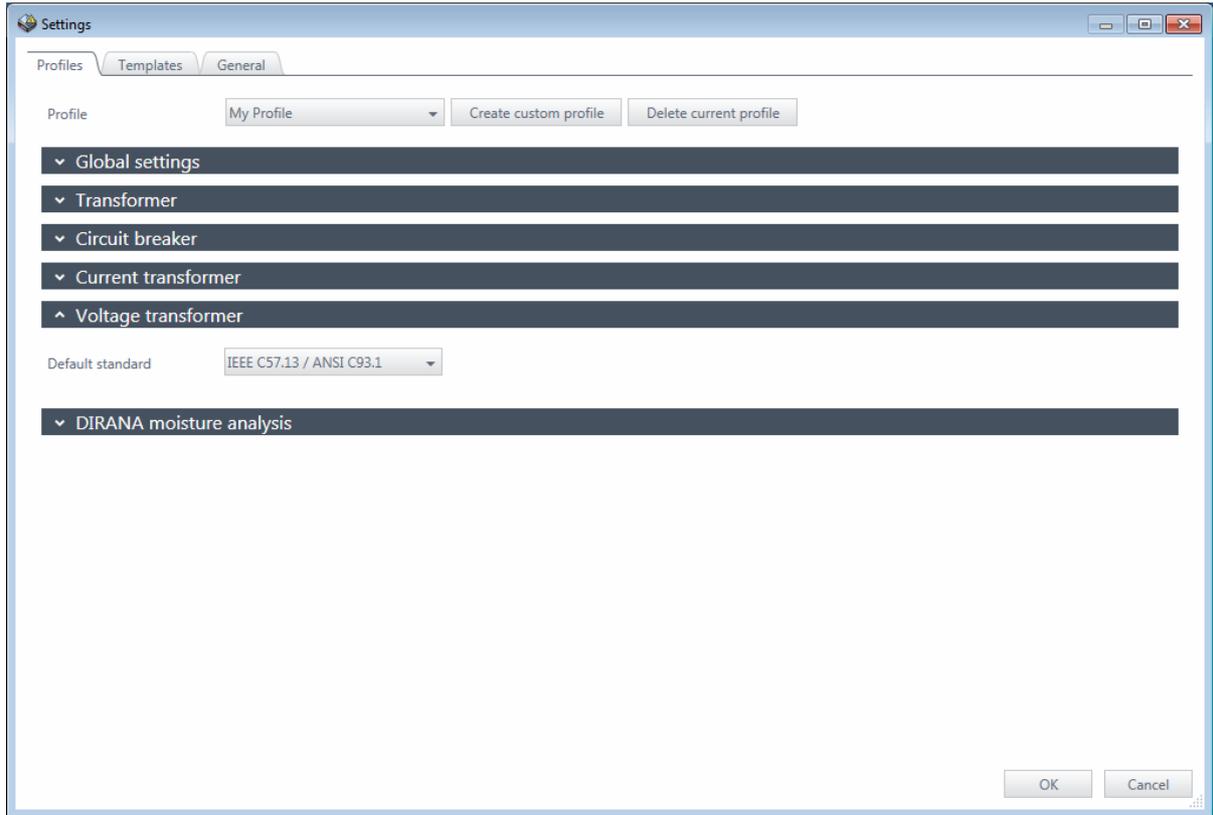


Figure 5-5: Profiles tab: Voltage transformer

5. If applicable, select the terminal names scheme you want to use from the **Terminal names scheme** list or create your own terminal names scheme (see "Create your own terminal names scheme" on page 26.)
6. Click **OK** to close the **Settings** dialog box.
 - ▶ To delete your own profile, select the profile from the **Profiles** list, and then click **Delete current profile**.

Create your own terminal names scheme

With *Primary Test Manager*, you can use predefined terminal names schemes according to the established standards and create your own terminal names schemes.

To create your own terminal names scheme:

1. Click **Create custom scheme**.
2. In the **Enter scheme name** dialog box, type the scheme name.
3. Set the terminal names, scheme options, and preferences depending on the asset.
 - ▶ To delete your own terminal name scheme, select the scheme from the **Terminal names scheme** list, and then click **Delete current scheme**.

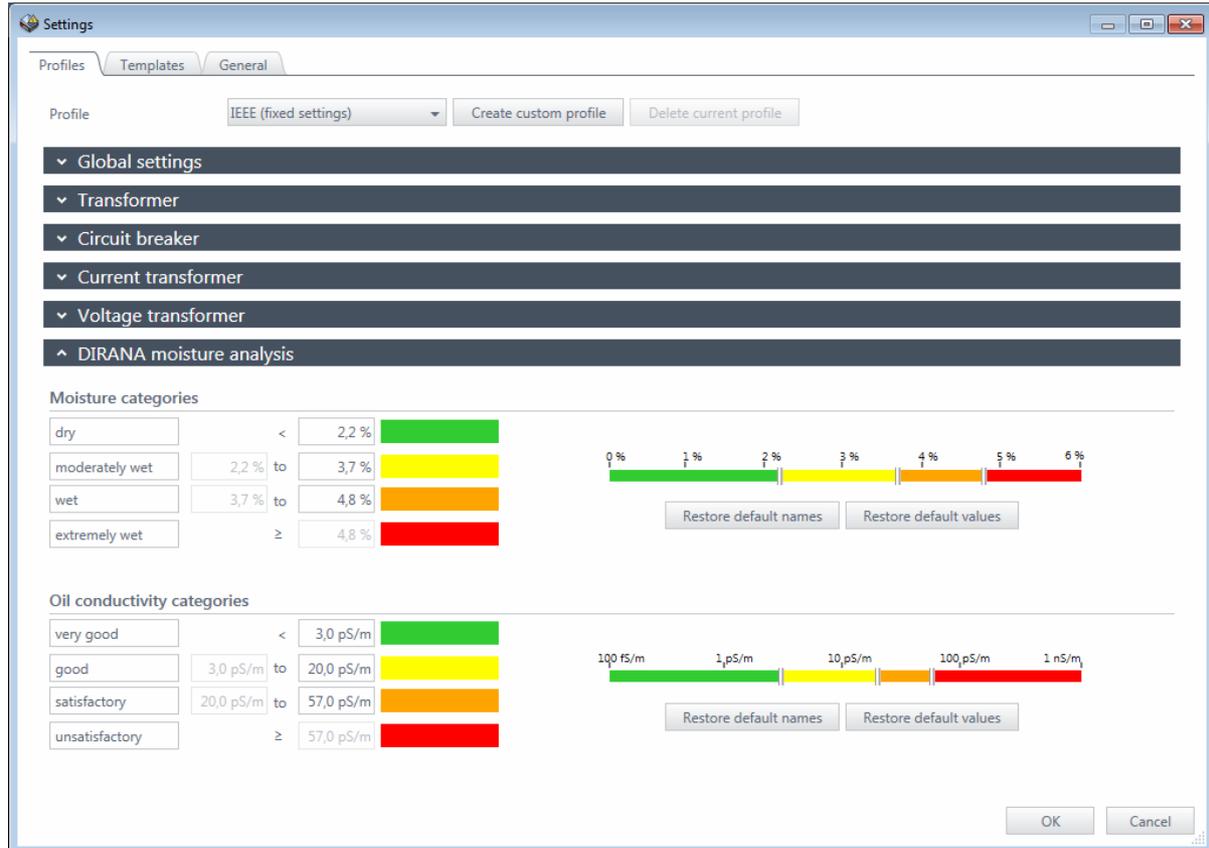


Figure 5-6: Profiles tab: DIRANA moisture analysis

Under **DIRANA moisture analysis**, you can set the moisture and oil conductivity categories. You can rename the default category names and the thresholds according to your needs. To restore the default names and thresholds, click **Restore default names** and **Restore default values** respectively.

Templates

On the **Templates** tab, you can edit, import and export job templates. For information on how to process the templates, see 6.5.4 "Processing templates" on page 58.

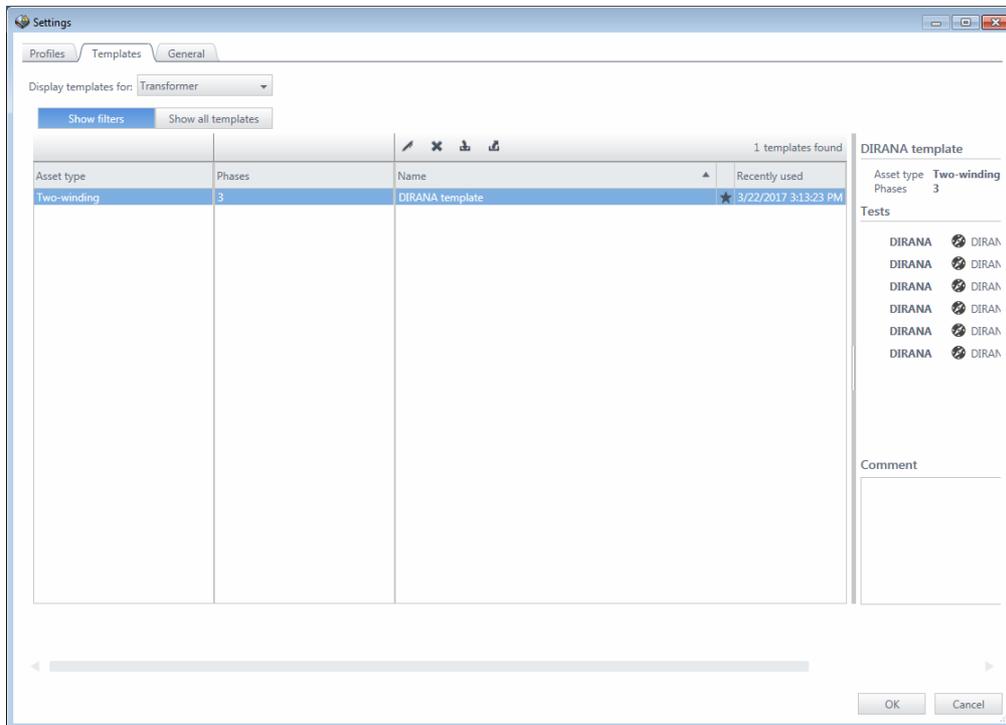


Figure 5-7: **Templates** tab

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

- ▶ To import a template, click the **Import** button , and then browse to the template you want to import.
- ▶ To edit the template properties, select the template, and then click the **Edit** button .
- ▶ To delete a template, select the template, and then click the **Delete** button .
- ▶ To export a template, select the template, and then click the **Export** button .

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

General

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

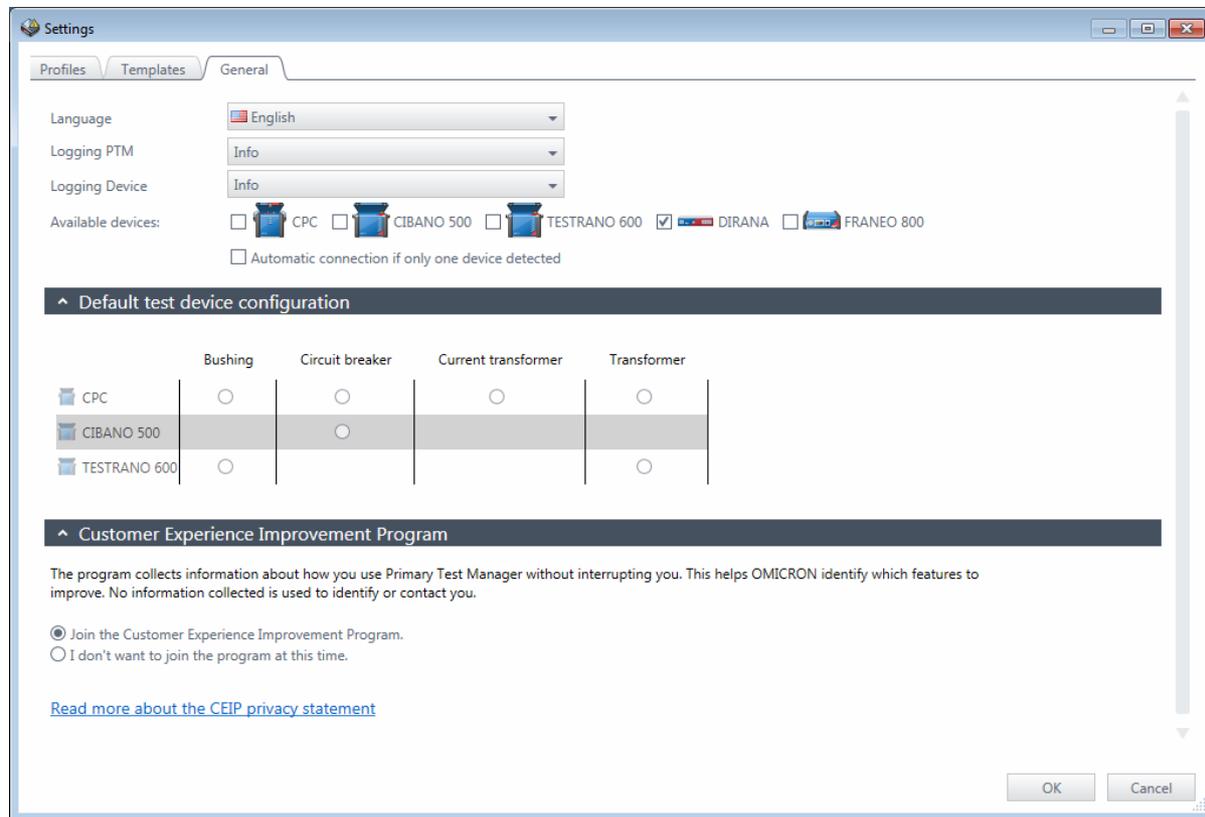


Figure 5-8: **General** tab

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

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

Table 5-4: Logging levels

Logging level	Description
Disabled	Logging is disabled.
Errors only	Only errors are logged. Recommended setting
Info	Errors and some additional information are logged.
Full	All software-related activities are logged.
	Note: Full logging will slow down software performance.

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

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

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

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

Under **Server settings**, you can set server settings for *DataSync*. For more information, see 5.4.1 "Server settings" on page 34.

5.1.2 Help

In the **Help** dialog box, you can get the relevant information about *DIRANA* and data synchronization, and send data to OMICRON Technical Support. To open the **Help** dialog box, click **Help** in the title bar.

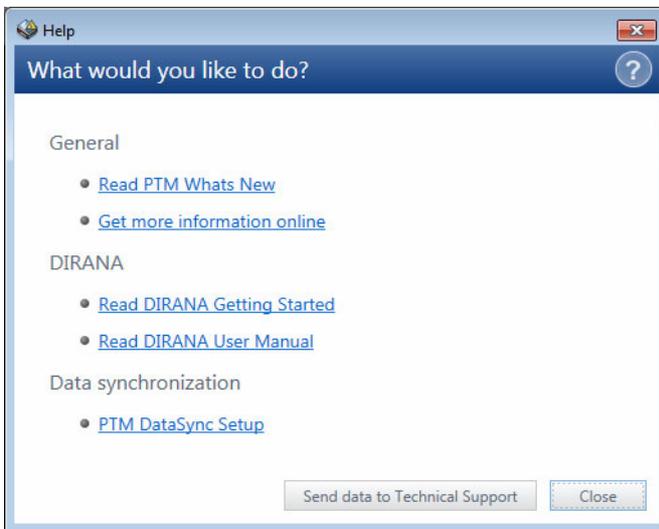


Figure 5-9: **Help** dialog box

5.1.3 About

In the **About Primary Test Manager** dialog box, you can enter a license key to upgrade your *Primary Test Manager* and enhance its functionality by installing additional features. To open the **About Primary Test Manager** dialog box, click **About** in the title bar.

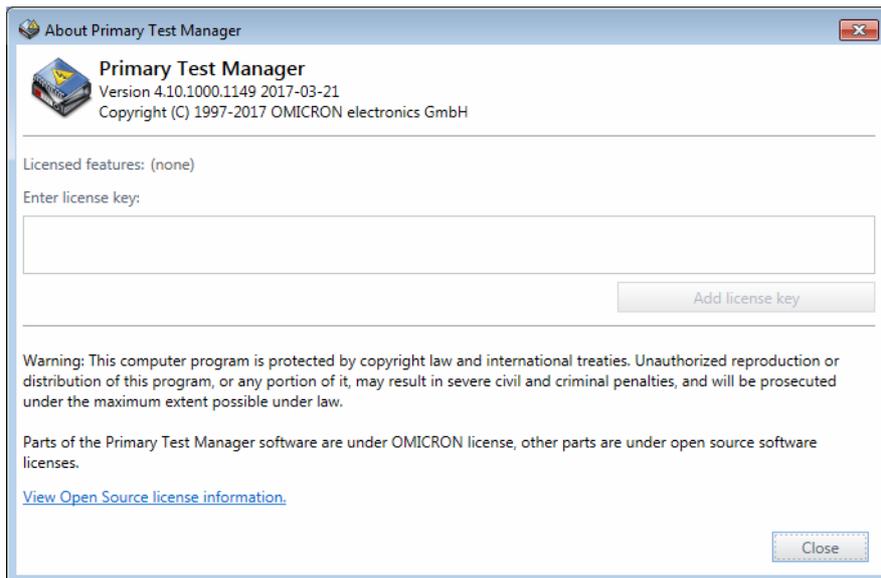


Figure 5-10: **About Primary Test Manager** dialog box

To activate a license, enter the license key in the **About Primary Test Manager** dialog box, and then click **Add license key**. For detailed information about the *Primary Test Manager* licensing, contact your OMICRON local sales representative or distributor.

5.2 Status bar

Note: The status bar is displayed in any *Primary Test Manager* view.

The status bar displays information about the status of the test system and provides access to the zoom function. The following table describes the statuses of the test system.

Table 5-5: Test system statuses

Symbol	Status
	<i>DIRANA</i> is connected and idle.
	<i>DIRANA</i> is connected and a measurement is running.
	<i>DIRANA</i> is not connected.

In the status bar, you can connect to and disconnect from a test system, and show and refresh the test set information.

To connect to a test system:

1. Right-click the *DIRANA* symbol in the status bar, and then click **Connect**.



Figure 5-11: **Connect to device** dialog box

2. In the **Connect to device** dialog box, select the test system from the list, and then click **Connect**.

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

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

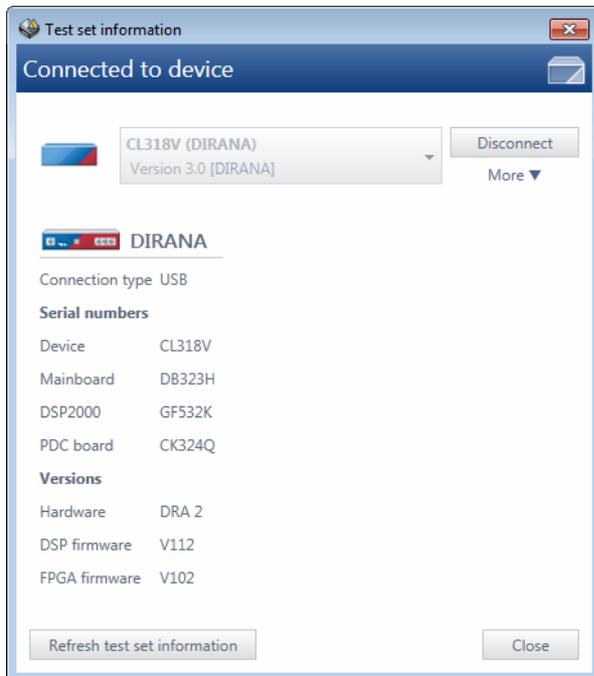


Figure 5-12: **Connected to device** dialog box

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

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

Note: You can open the **Connect to device** and the **Connected to device** dialog boxes also by double-clicking the *DIRANA* symbol.

5.3 Data backup and restoring

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

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

1. In the home view, click **Back up your data**.

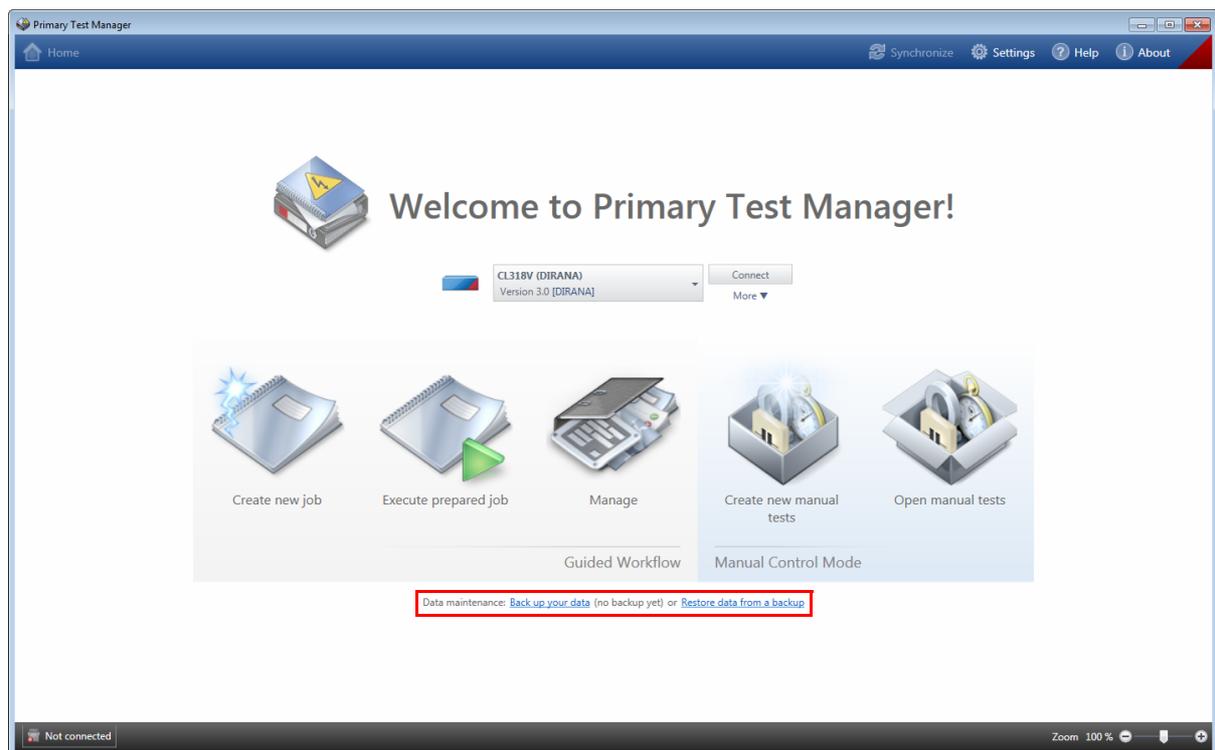


Figure 5-13: *Primary Test Manager* home view

2. Save the data in your preferred location.

To restore the data:

1. In the home view, click **Restore data from a backup**.
2. Browse to the file you want to restore.

5.4 Data synchronization

Primary Test Manager comes with the client/server architecture. With this feature, you can synchronize your local database with the *Primary Test Manager* server database.

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

The data synchronization is a partial data replication based on subscriptions. All local data is uploaded to the server database and only selected data on the server is downloaded to the local database.

5.4.1 Server settings

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

1. In the title bar, click **Settings**, and then select the **General** tab in the **Settings** dialog box.
The next step depends on the data synchronization method (*DataSync* via web server or *DataSync* on premises) you use.

DataSync via web server

- ▶ For the *DataSync* service address and the authentication certificate, contact your regional OMICRON Service Center.

DataSync on premises

- ▶ For the *DataSync* service address and the authentication certificate, contact your system administrator.

2. Under **Server settings**, type the service address and the authentication certificate.

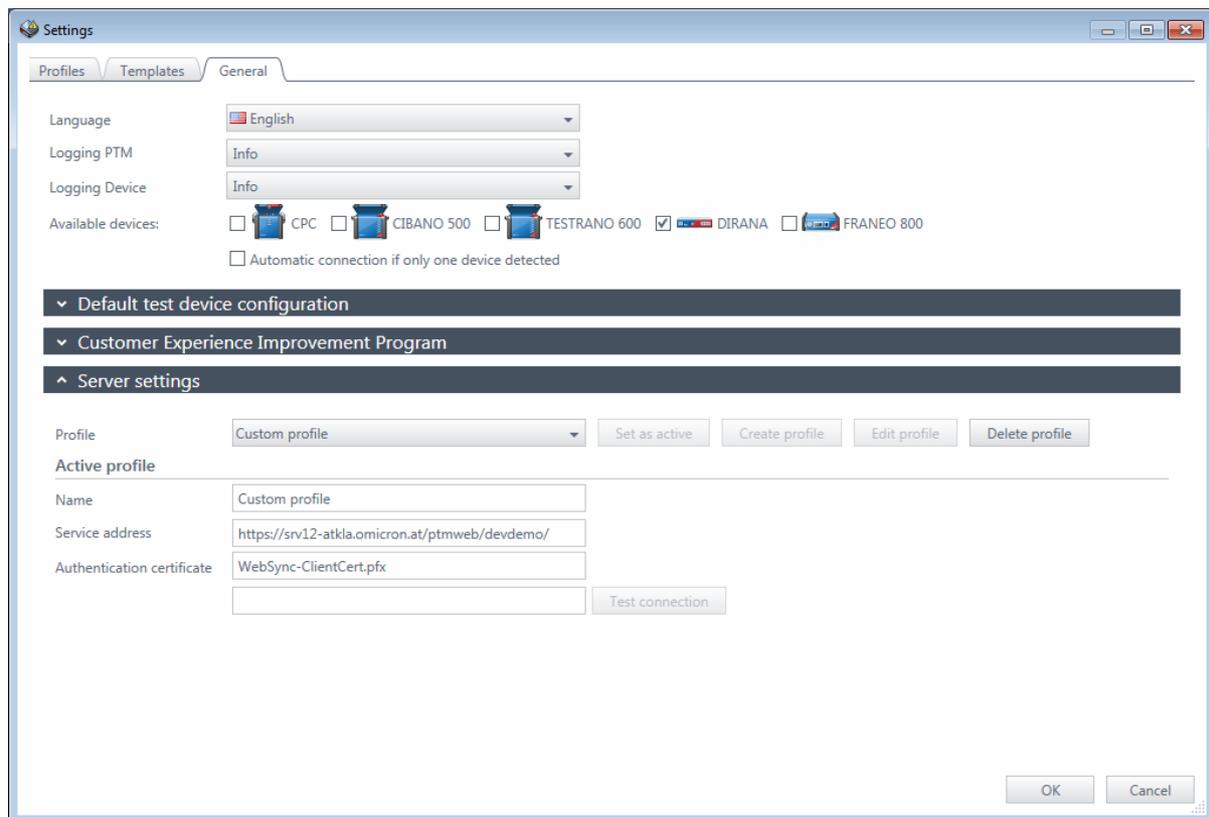


Figure 5-14: Server settings for *DataSync*

3. To test the connection to the server, click **Test connection**.

Server settings profiles

You can create server settings profiles in order to use different data bases for testing and switch between them.

- ▶ Use the corresponding buttons next to the **Profile** drop-down box to create, edit or delete a profile.
- ▶ To switch to a different profile, select one from the drop-down list and click **Set as active**.

5.4.2 Managing subscriptions

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

1. In the home view (see Figure 5-1: "Primary Test Manager home view" on page 20), click the **Manage** button .

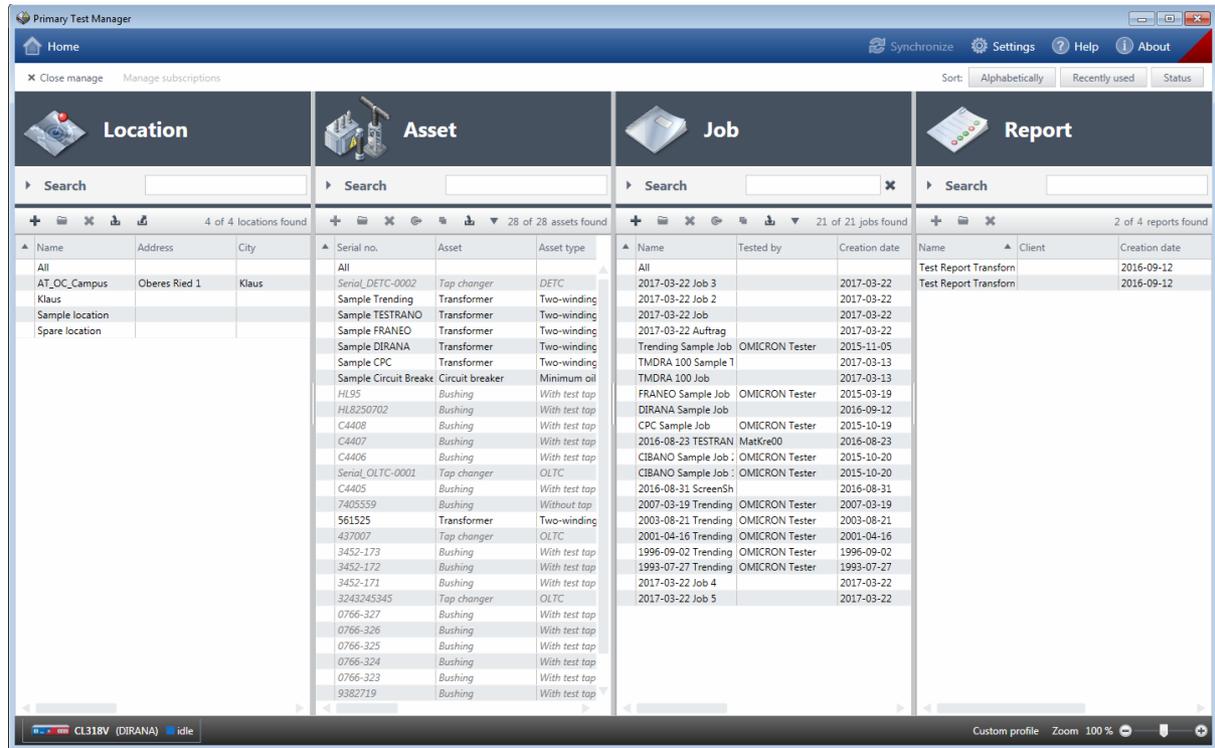


Figure 5-15: Manage view

2. In the manage view, click **Manage subscriptions** on the top of the workspace.
3. In the **Manage Subscriptions** dialog box, select the data on the server database you want to synchronize with your local database, and then click **OK**.

5.4.3 Database synchronization

- To synchronize the local *Primary Test Manager* database with the server database, click **Synchronize** in the title bar of the **Manage** view. *Primary Test Manager* then displays the synchronization progress.

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

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

6 Create new job

When creating a new job, *Primary Test Manager* leads you through the guided test workflow. To open the create new job view, click the **Create new job** button  in the home view.

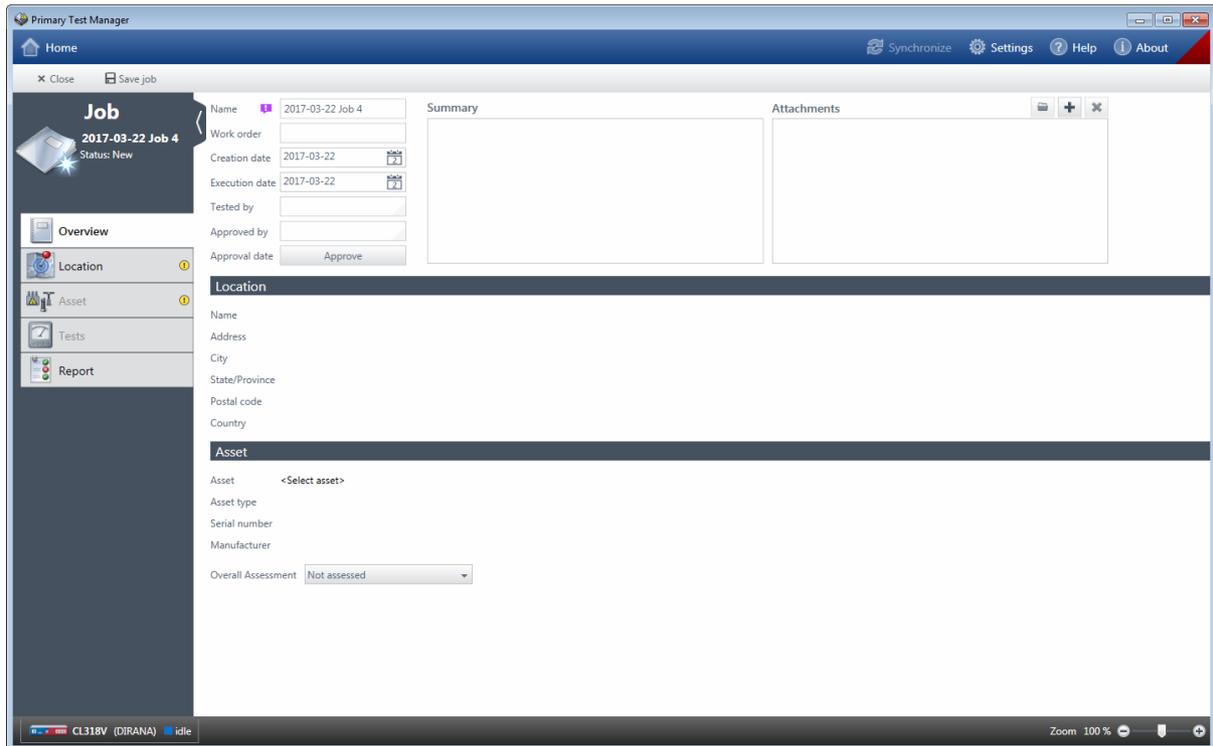


Figure 6-1: Create new job view

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

Table 6-1: Job statuses

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

6.1 Guided test workflow

The guided test workflow leads you through the following steps:

1. Enter the job data (see 6.2 "Job overview" on page 39).
2. Specify the location (see 6.3 "Location view" on page 41).
3. Specify the asset (see 6.4 "Asset view" on page 45).
4. Specify and perform the tests (see 6.5 "Test view" on page 56).
5. Generate the test reports (see 10 "Generate test reports" on page 69).

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

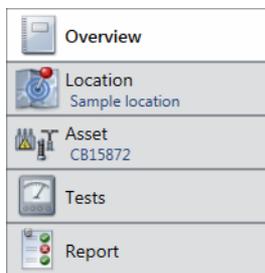


Figure 6-2: Navigation buttons

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

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

Table 6-2: Operations on the jobs

Command	Action
Close	Closes a job displayed in the create new job view and leads you back to home or manage view respectively.
Save job	Saves the job displayed in the create new job view.
Copy test¹	Adds another test of the same kind and with the same settings to the test list. Results are not copied.
Take screenshot¹	Takes screenshot of the selected area of the <i>Primary Test Manager</i> workspace. The screenshot appears as attachment in the General area and can be attached to the test report (see 10 "Generate test reports" on page 69).

¹ Only available if a test is open

For more information about operations on the jobs, see 8 "Manage objects" on page 61.

6.2 Job overview

In the job overview of the create new job view, you can enter the job data (see Table 6-3: "Job data" on page 39). In the course of the guided test workflow, *Primary Test Manager* sets also some basic location, asset, and test data. To open the job overview, click the **Create new job** button  in the home view.

Figure 6-3: Job overview

6.2.1 Job data

The following table describes the job data.

Table 6-3: Job data

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

Table 6-3: Job data (continued)

Data	Description
Approved by	Person who approved the test
Approval date	Date the job was approved (see 6.2.2 "Approving jobs" later in this section)
Summary	Text field to summarize the job data in own words
Attachments	Attachments to the job (see 6.2.3 "Managing attachments" on page 40)

1 Mandatory data

6.2.2 Approving jobs

If the job displayed in the job overview has been approved, you can set the approval date of the job. To set the job approval date, click **Approve**.

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

6.2.3 Managing attachments

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

To add an attachment to a job:

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

To open an attachment, do one of the following:

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

To delete an attachment from a job:

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

6.3 Location view

In the location view of the create new job view, you can specify locations. To open the location view, click the **Location** navigation button .

Figure 6-4: Location view

To specify a location, do one of the following:

- Enter the location data (see Table 6-4: "Location data" later in this section).

Note: If you enter location data different from the master location, a notification bar at the top of the *Primary Test Manager* workspace prompts you to import the master location or update the master location. For more information, see 8.3 "Understanding the master locations and assets" on page 64.

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

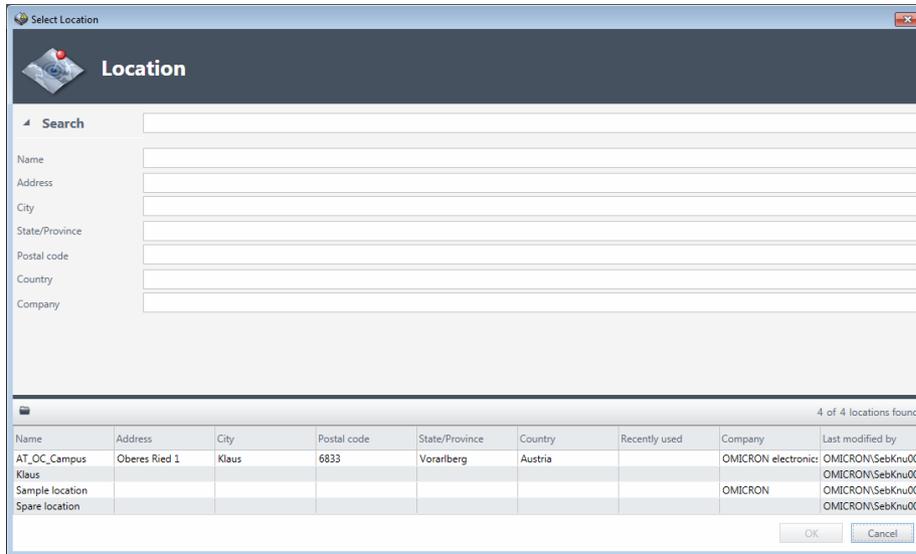


Figure 6-5: **Select location** dialog box

In the **Select location** dialog box, you can search for locations (see 8.1 "Search for objects" on page 62).

6.3.1 Location data

The following table describes the location data.

Table 6-4: Location data

Data	Description
Name ¹	Name of the location where the asset is located
Region	Region where the asset is located
Division	Division where the asset is located
Area	Area where the asset is located
Plant	Plant where the asset is located
Address	Address of the location where the asset is located
City	City where the asset is located
State/Province	State or province where the asset is located
Postal code	Postal code of the location where the asset is located
Country	Country where the asset is located
Geo coordinates	Geo coordinates of the location where the asset is located (see 6.3.2 "Setting the geo coordinates" later in this section)
Location system code	Location code used by maintenance planning systems

Table 6-4: Location data (continued)

Data	Description
Contact person	
Name	Name of the contact person
Phone no. 1	Phone number of the contact person
Phone no. 2	Alternative phone number of the contact person
Fax no.	Fax number of the contact person
E-mail	E-mail address of the contact person
Comment	Comment on the location
Attachments	Attachments to the location (see 6.3.3 "Managing attachments" on page 44)
Company	
Company	Company the asset belongs to
Department	Department of the company
Address	Address of the company
City	City where the company is located
State/Province	State or province where the company is located
Postal code	Postal code of the company
Country	Country where the company is located
Phone no.	Phone number of the contact person
Fax no.	Fax number of the contact person
E-mail	E-mail address of the contact person

1 Mandatory data

In the location view, you can enter additional addresses of, for example, a client, owner or utility. To enter additional addresses, click **Add address** under **Additional addresses**. For the additional address data, see Table 6-4: "Location data" on page 42.

6.3.2 Setting the geo coordinates

To set the geo coordinates of a location:

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

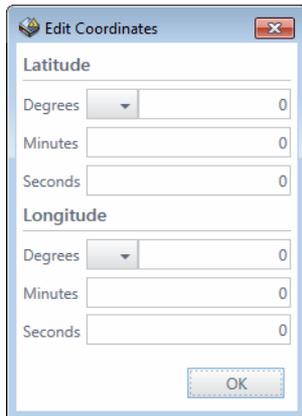


Figure 6-6: **Edit Coordinates** dialog box

2. In the **Edit Coordinates** dialog box, enter the latitude and longitude of the location.

6.3.3 Managing attachments

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

To add an attachment to a location:

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

To open an attachment, do one of the following:

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

To delete an attachment from a location:

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

6.4 Asset view

In the asset view of the create new job view, you can specify assets. To open the asset view, click the **Asset** navigation button .

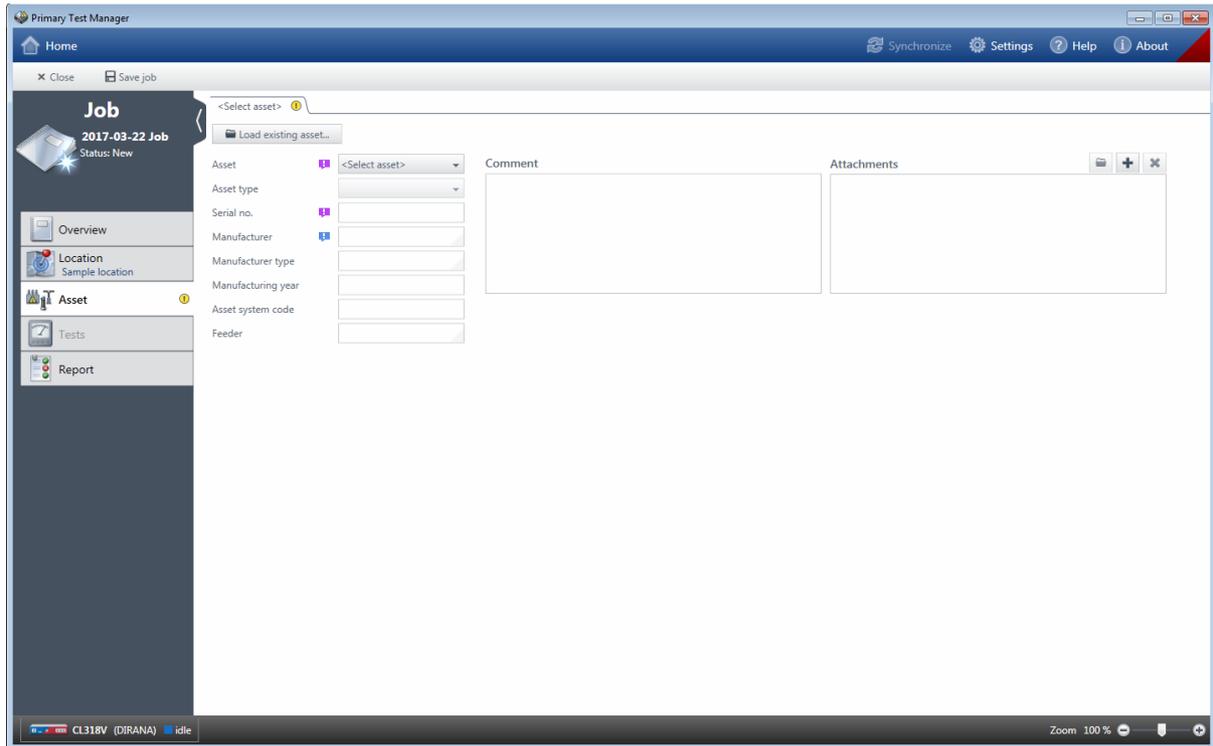


Figure 6-7: Asset view

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

- ▶ Enter the asset data. The asset data includes the general asset data common to all assets (see Table 6-5: "General asset data" on page 46) and the asset-specific data described in 11 "Asset data" on page 71.

Note: If you enter asset data different from the master asset, a notification bar at the top of the *Primary Test Manager* workspace prompts you to import the master asset or update the master asset. For more information, see 8.3 "Understanding the master locations and assets" on page 64.

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

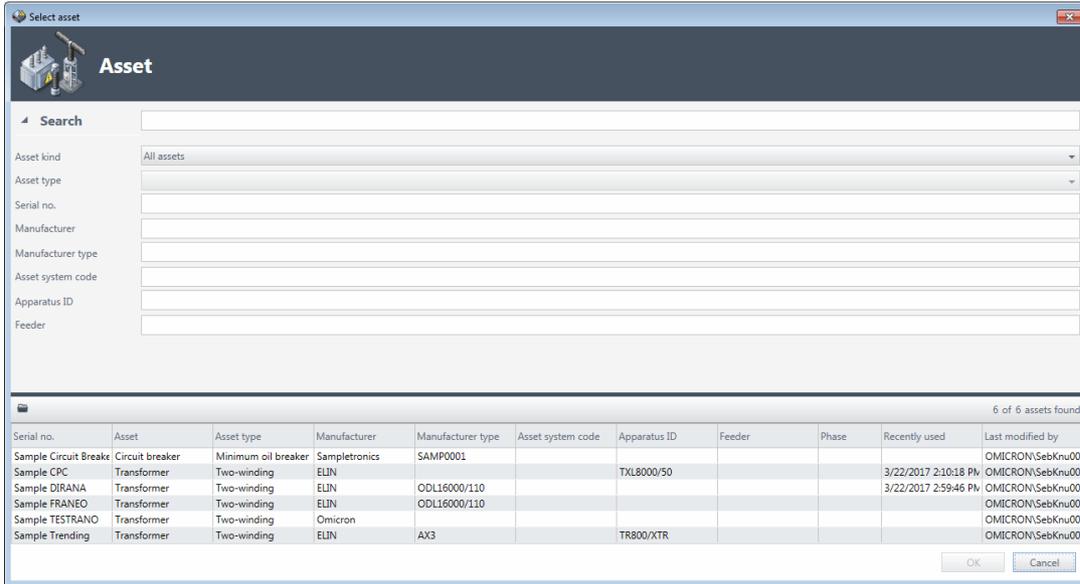


Figure 6-8: Select asset dialog box

In the **Select asset** dialog box, you can search for assets (see 8.1 "Search for objects" on page 62) and sort them alphabetically or in the chronological order.

6.4.1 General asset data

The following table describes the general asset data.

Table 6-5: General asset data

Data	Description
Asset ¹	Asset under test
Asset type	Type of the asset
Serial no. ¹	Serial number of the asset
Manufacturer	Manufacturer of the asset
Manufacturer type	Type of the asset according to the manufacturer
Manufacturing year	Year of the asset's manufacturing
Asset system code	Code of the asset used by the maintenance planning systems
Apparatus ID ²	Identifier of the asset
Feeder	Feeder the asset is connected to
Comment	Comment on the asset
Attachments	Attachments to the asset (see 6.4.2 "Managing attachments" on page 47)

1 Mandatory data

2 Visible after you have selected an asset

6.4.2 Managing attachments

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

To add an attachment to an asset:

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

To open an attachment, do one of the following:

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

To delete an attachment from an asset:

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

6.4.3 Transformer view

In the transformer view, you can specify transformers and assets associated with the transformers such as bushings, tap changers, and surge arresters.

To specify a transformer:

1. From the **Asset** list, select **Transformer**.
2. From the **Asset type** list, select the type of the transformer.

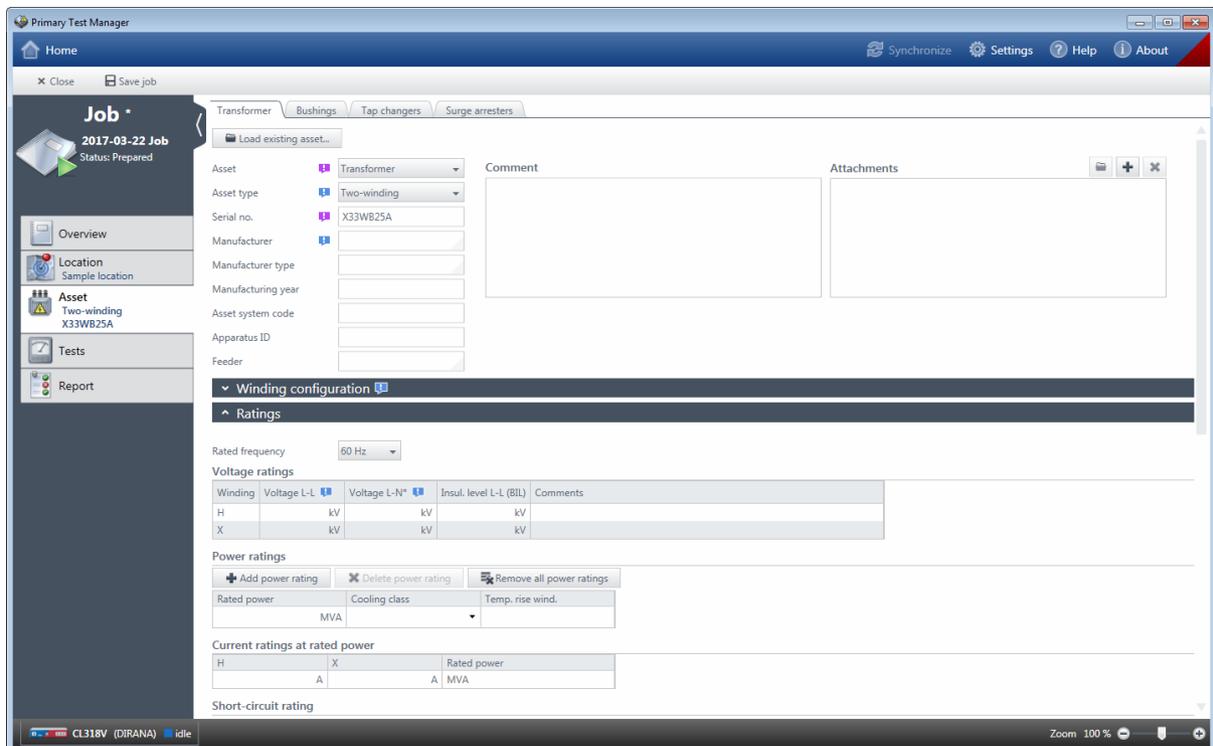


Figure 6-9: Transformer view

3. In the transformer view, enter the general asset data (see Table 6-5: "General asset data" on page 46).
4. In the **Winding configuration** area, set the transformer's vector group (see "Setting the vector group" later in this section).
5. In the **Ratings** area, the **Impedances** area and the **Others** area, enter the transformer data (see 11.1 "Transformer data" on page 71).
6. Optionally, specify the bushings mounted on the transformer (see "Bushings tab" on page 49).
7. Optionally, specify the tap changers of the transformer (see "Tap changers tab" on page 50).
8. Optionally, specify the surge arresters mounted on the transformer (see "Surge arresters tab" on page 52).

Setting the vector group

To set the vector group of a transformer:

1. In the **Winding configuration** area, select the number of transformer's phases.
2. Click **Select winding configuration** and in the **Edit Vector Group** dialog box, set the transformer's vector group.

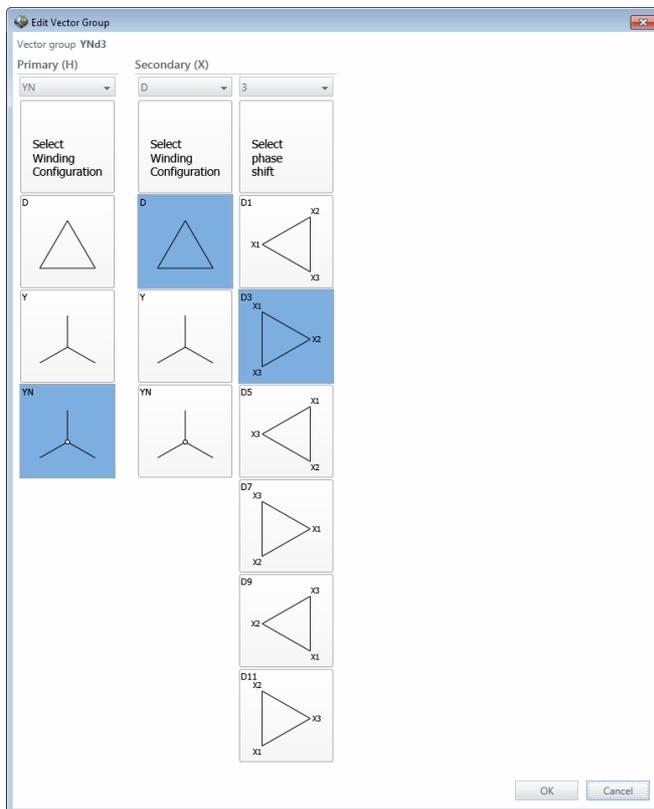


Figure 6-10: **Edit Vector Group** dialog box

Note: *Primary Test Manager* sets the vector group of an autotransformer without tertiary winding automatically.

Bushings tab

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

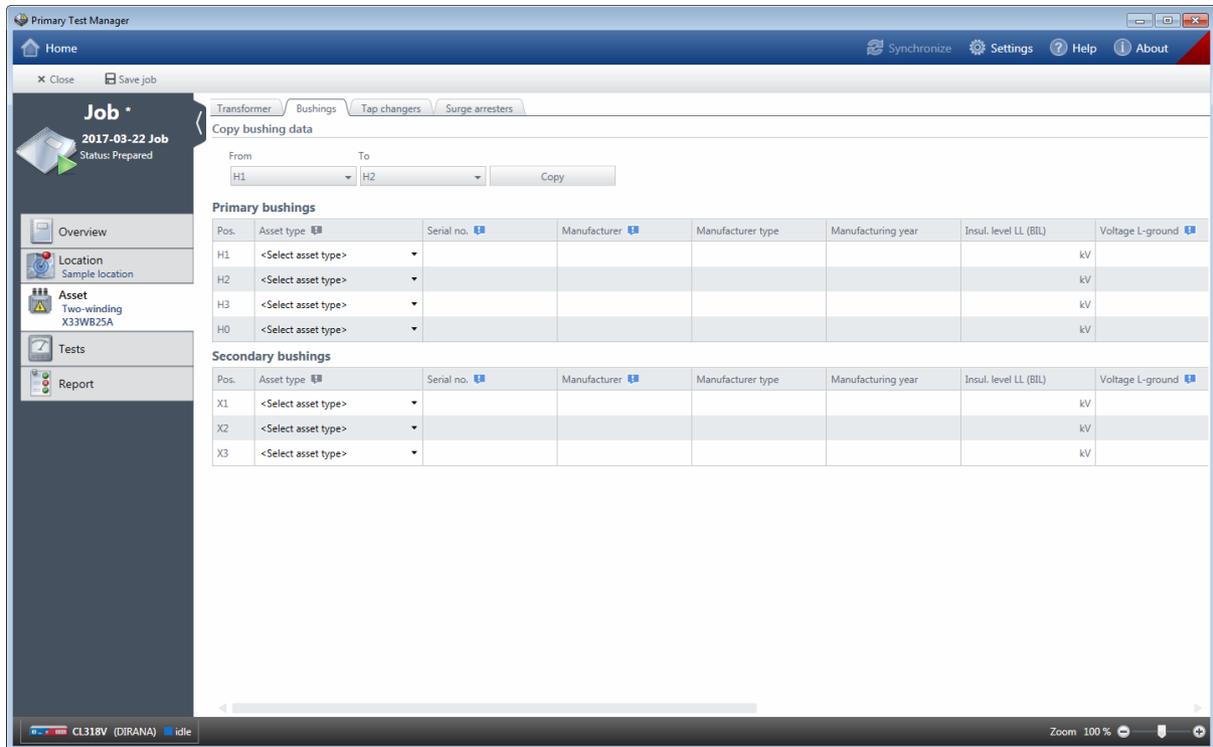


Figure 6-11: Transformer view: **Bushings** tab

To specify a bushing:

1. From the **Asset type** list, select the type of the bushing for all transformer's terminals.
2. Enter the bushing data (see 11.2 "Spare bushing data" on page 74).

Under **Copy bushing data**, you can copy data of a bushing to other bushings. To copy the bushing data, select the respective bushings from the **From** and **To** lists, and then click **Copy**.

Tap changers tab

On the **Tap changers** tab, you can specify the transformer's tap changers.

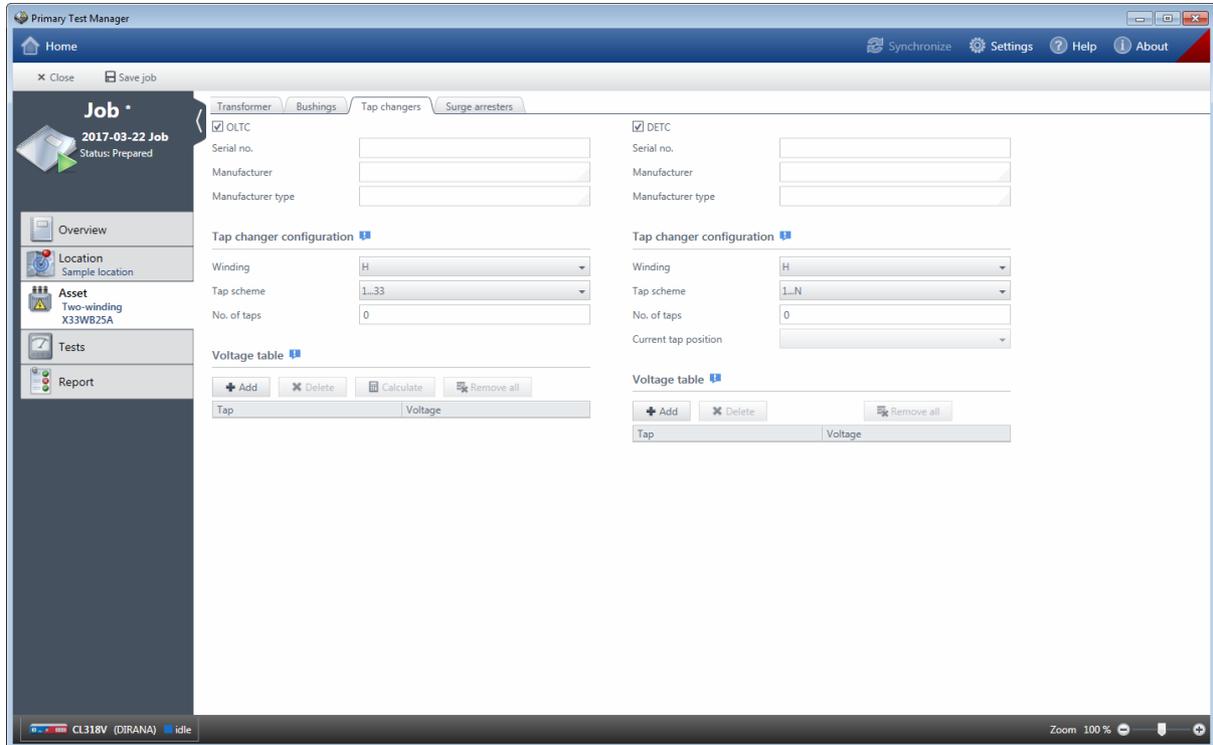


Figure 6-12: Transformer view: **Tap changers** tab

To specify an on-load tap changer (OLTC):

1. Select the **OLTC** check box.
2. Enter the OLTC data (see 11.1.2 "Tap changer data" on page 73).
3. Under **Tap changer configuration**, set the tap changer's winding, the tap scheme, and the number of taps.

4. Under **Voltage table**, do one of the following:
 - ▶ Type the voltage of all taps.
 - ▶ Click **Calculate** to calculate the tap voltage automatically.

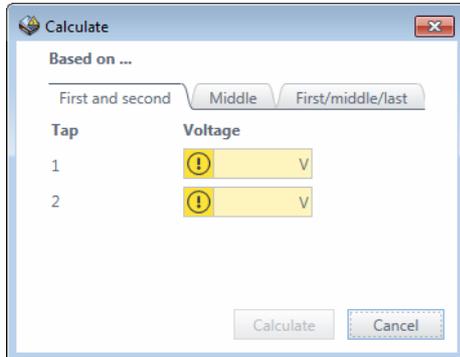


Figure 6-13: **Calculate** dialog box

To calculate the tap voltage automatically:

1. Do one of the following:
 - ▶ In the **Calculate** dialog box, select **Based on first two entries**, and then type the voltage of the first two taps.
 - ▶ Select **Based on middle position**, and then type the voltage of the middle-position tap and the deviation.
2. Click **Calculate**.

To specify a de-energized tap changer (DETC):

1. Select the **DETC** check box.
2. Enter the DETC data (see 11.1.2 "Tap changer data" on page 73).
3. Under **Tap changer configuration**, set the tap changer's winding, the tap scheme, the number of taps, and the current tap position.
4. Type the voltage of all taps.

To add a tap, select the tap below which you want to add a tap, and then click **Add**.

Note: The added taps match no tap scheme.

To delete a tap, select the tap you want to delete, and then click **Delete**.

To delete all taps, click **Remove all**.

Surge arresters tab

On the **Surge arresters** tab, you can specify surge arresters mounted on the transformer.

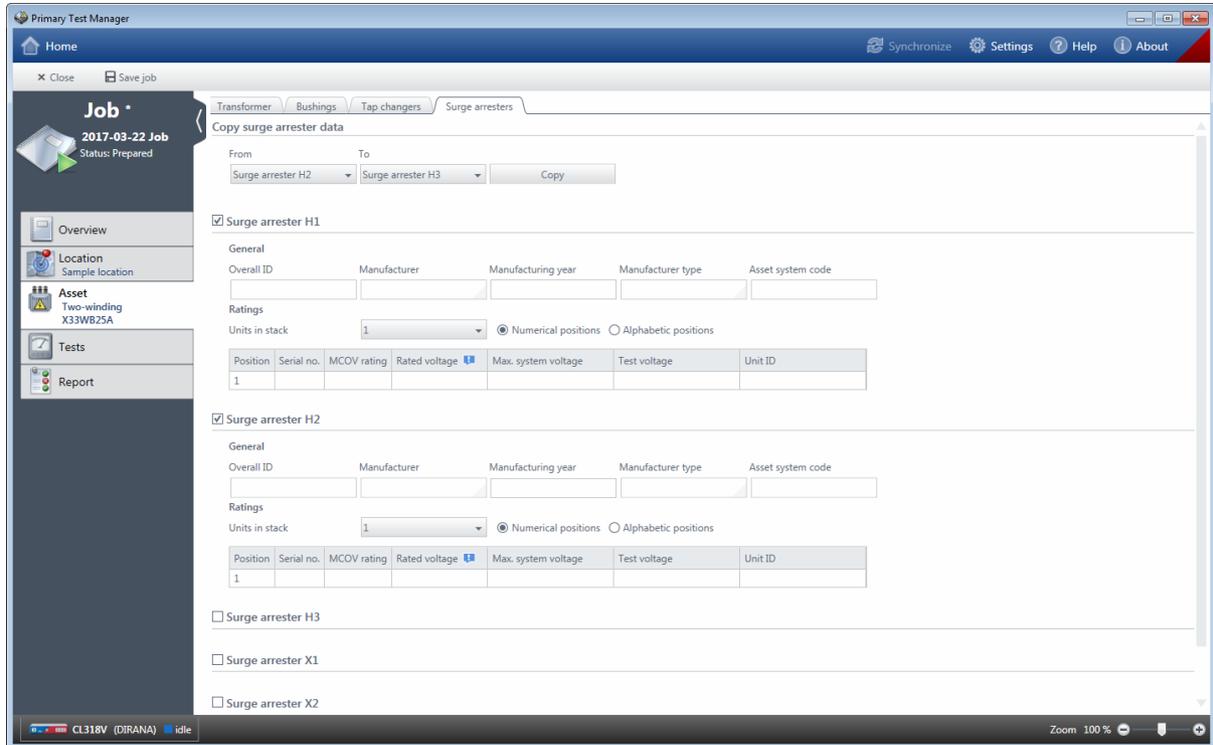


Figure 6-14: Transformer view: **Surge arresters** tab

To specify a surge arrester:

1. Select the respective **Surge arrester** check box.
2. Enter the surge arrester data (see 11.1.3 "Surge arrester data" on page 73).

Under **Copy surge arrester data**, you can copy data of a surge arrester to other surge arresters. To copy the surge arrester data, select the respective surge arresters from the **From** and **To** lists, and then click **Copy**.

DGA Trending

DGA Trending is a licensed feature that visualizes a transformer's historic Oil analysis data in various charts and offers a comparison of data recorded at different points in time.

Refer to 12.2 "Oil analysis" on page 99 for more detailed information on the Oil analysis.

6.4.4 Current transformer view

In the current transformer view, you can specify current transformers.

To specify a current transformer:

1. From the **Asset** list, select **Current transformer**.

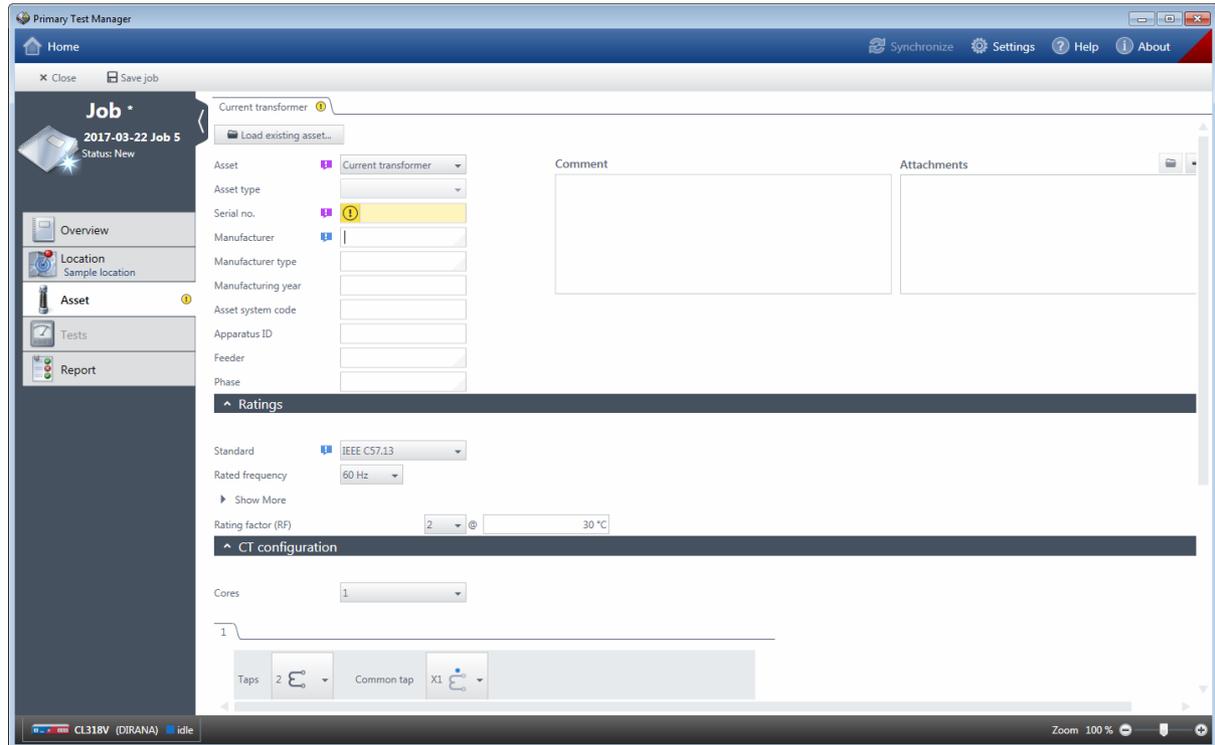


Figure 6-15: Current transformer view

2. In the current transformer view, enter the general asset data (see Table 6-5: "General asset data" on page 46).
3. In the **Ratings** area and the **CT configuration** area, enter the current transformer data (see 11.3 "Current transformer data" on page 76).

6.4.5 Voltage transformer view

In the voltage transformer view, you can specify voltage transformers.

To specify a voltage transformer:

1. From the **Asset** list, select **Voltage transformer**.
2. From the **Asset type** list, select the type of the voltage transformer.

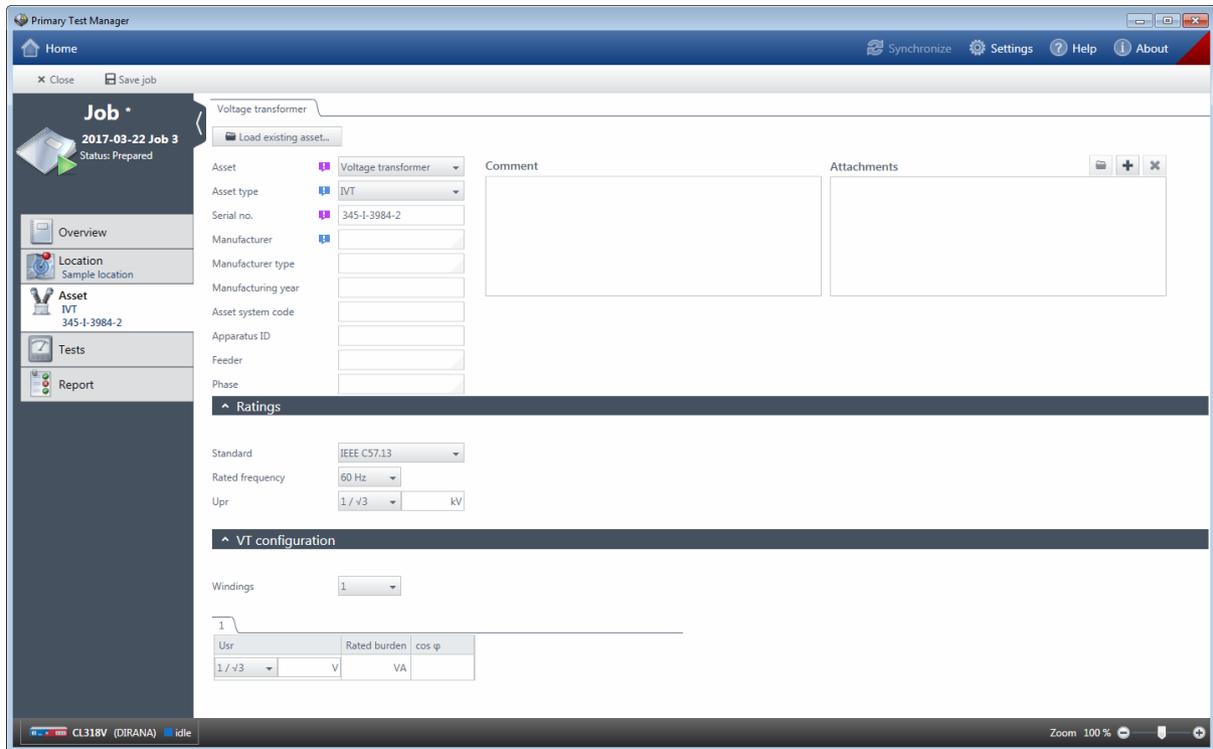


Figure 6-16: Voltage transformer view

3. In the voltage transformer view, enter the general asset data (see Table 6-5: "General asset data" on page 46).
4. In the **Ratings** area and the **VT configuration** area, enter the voltage transformer data (see 11.4 "Voltage transformer data" on page 82).

6.4.6 Rotating machine view

In the rotating machine view, you can specify rotating machines.

To specify a rotating machine:

1. From the **Asset** list, select **Rotating machine**.
2. From the **Asset type** list, select the type of the rotating machine.

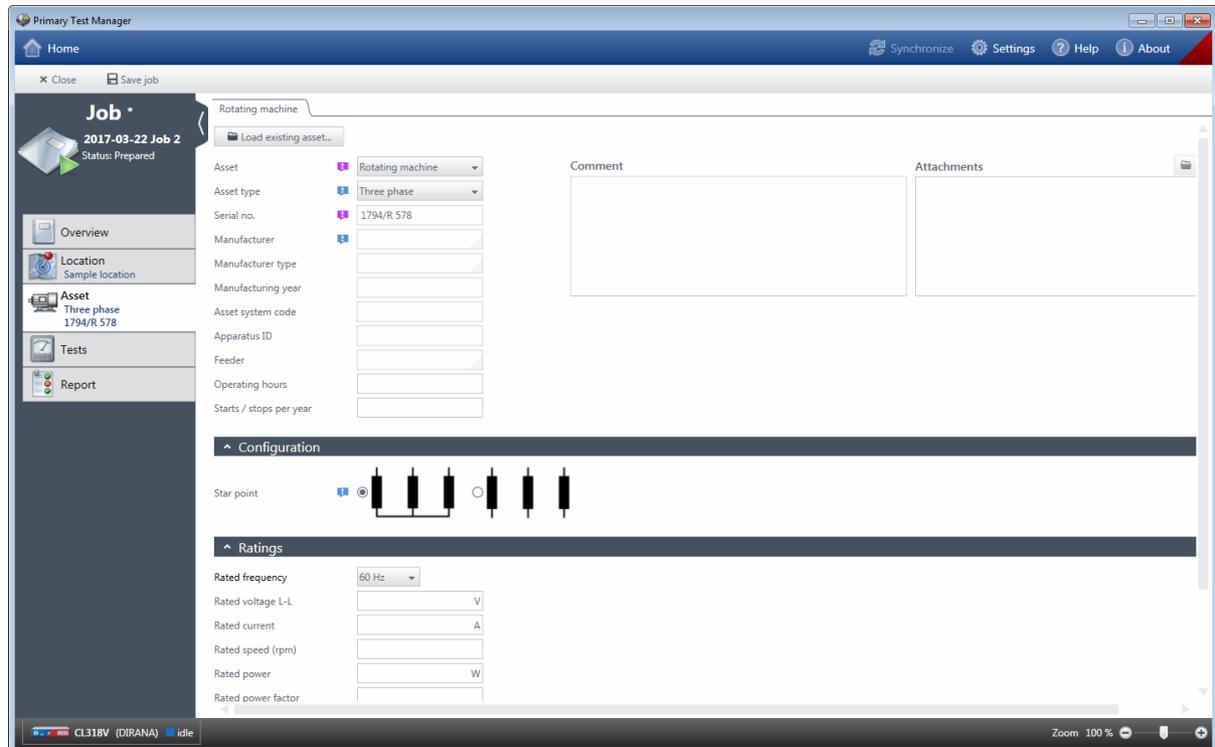


Figure 6-17: Rotating machine view

3. In the rotating machine view, enter the general asset data (see Table 6-5: "General asset data" on page 46).
4. In the **Configuration** area and the **Ratings** area, enter the rotating machine data (see 11.5 "Rotating machine data" on page 83).

6.5 Test view

In the test view, you can select, import and perform tests. To open the test view, click the **Tests** navigation button .

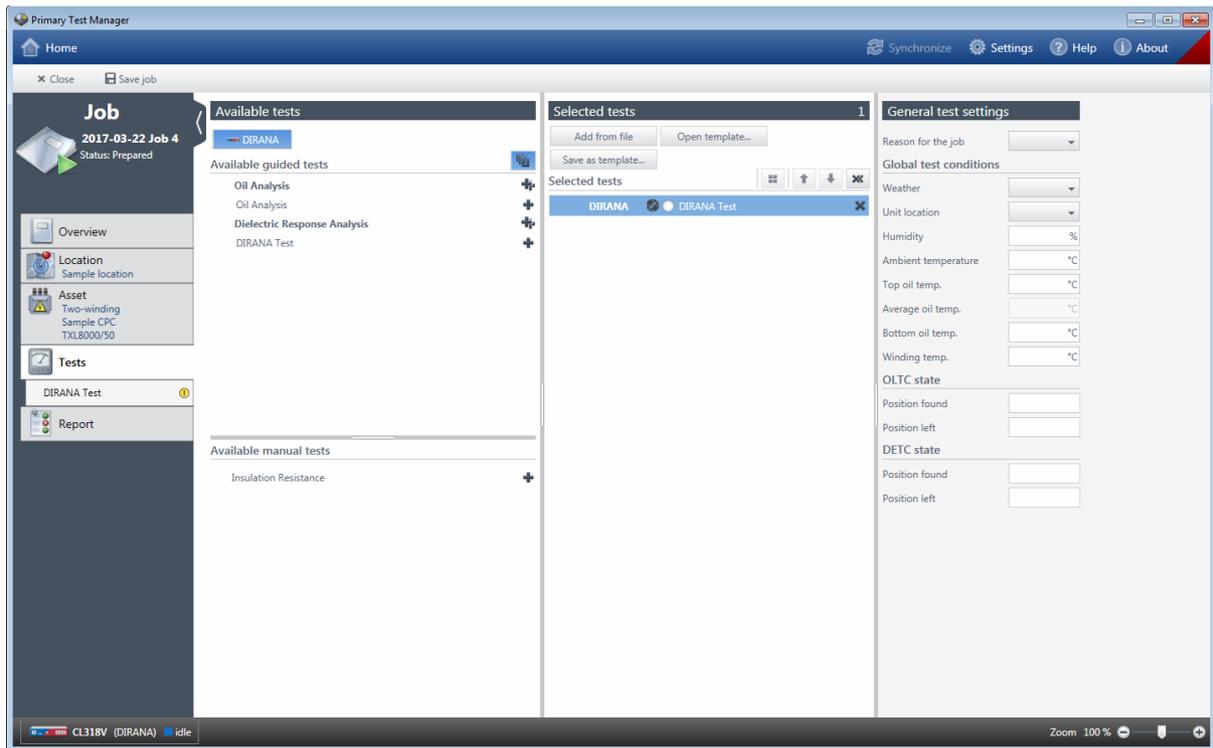


Figure 6-18: Test view

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

On the top of the **Available tests** area, click the button labeled with the test system with which you want to perform the test. Then *Primary Test Manager* displays the available guided tests and optional manual tests supported for the selected test system and the asset under test. To display the guided tests grouped in categories, click the **Show test categories** button .

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

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

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

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

6.5.1 Selecting tests

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

▶ To add all tests of a category into the **Selected tests** area, click the **+** symbol.

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

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

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

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

▶ To open a test, click the test name in the left pane of the test view.

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

- **General**
Displays the wiring diagram and test instructions. Optionally, you can type a comment on the test and add an attachment.
- **Settings and conditions**
Displays the test settings. For the test settings description, see 12 "Application" on page 84.
- **Measurements**
Displays the measurement results.

The **General test settings** area displays the reason for the job, the global test conditions, and some asset-specific data.

6.5.2 Importing tests

In the test view, you can import test data (measurement results without any information about the job, the asset or the location) in the following formats.

Table 6-6: Supported file import formats

Format name	File name extension	Description
DIRANA test file	.drax	DIRANA 1.x native exchange format
DIRANA CSV file	.csv	Comma-separated values format
IDAX test file	.idax	Format for import of test data from the IDAX-300 insulation diagnostic analyzer

To import test data:

1. In the **Selected tests** area, click **Add from file**.
2. In the **Open** dialog box, browse to the file you want the import.

Note: The tests contained in the imported .drax file are appended to the test list.

For information about importing and exporting jobs, see 8.6 "Import and export jobs" on page 67.

6.5.3 Performing tests

To perform the tests, you must know and understand the test settings and the measurement data. For detailed information, see 12 "Application" on page 84.

6.5.4 Processing templates

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

To save a job as template:

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

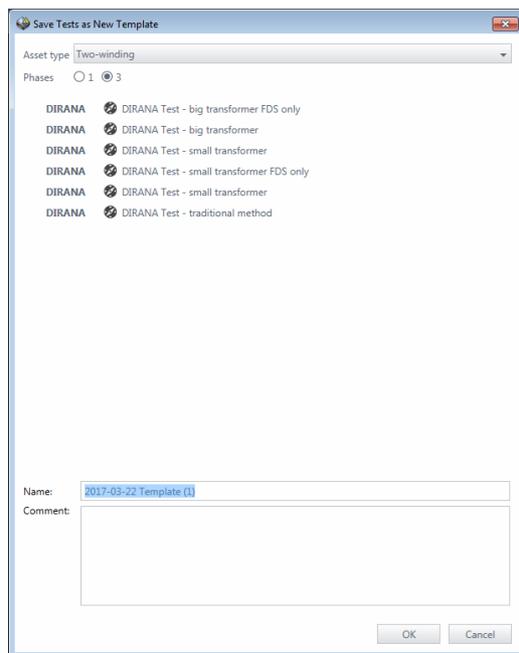


Figure 6-19: **Save Tests as New Template** dialog box

3. In the **Save Tests as New Template** dialog box:
 - ▶ Select the asset type from the **Asset type** list.
 - ▶ Select the number of transformer's phases.
 - ▶ In the **Name** box, enter the template name.
 - ▶ Optionally, type a comment on the template.

To open a template:

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

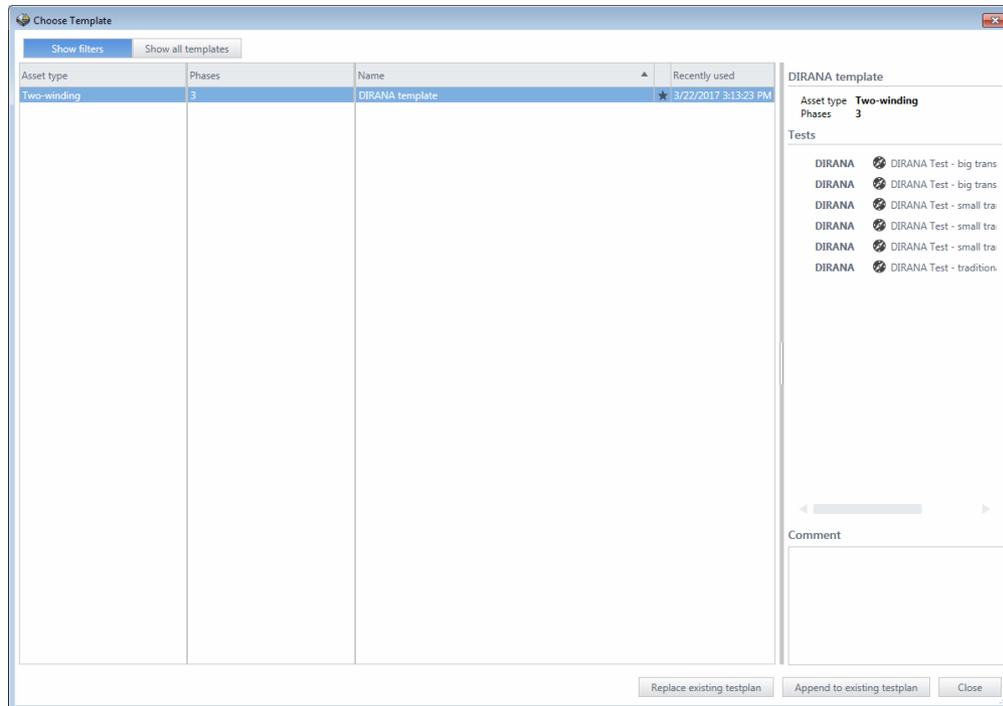


Figure 6-20: **Choose Template** dialog box

2. In the **Choose Template** dialog box, select the template you want to open.
 - ▶ To replace the tests in the currently opened job with the selected template, click **Replace existing testplan**.
 - ▶ To add the selected template to the currently opened job, click **Append to existing testplan**.

7 Execute prepared job

In a typical application scenario, *Primary Test Manager* tests primary assets in the field. To facilitate the field tests, you or your colleague can configure a job in the office, save it in *Primary Test Manager*, and execute it later in the field.

To execute a prepared job saved in a file:

1. In the home view, click the **Execute prepared job** button .

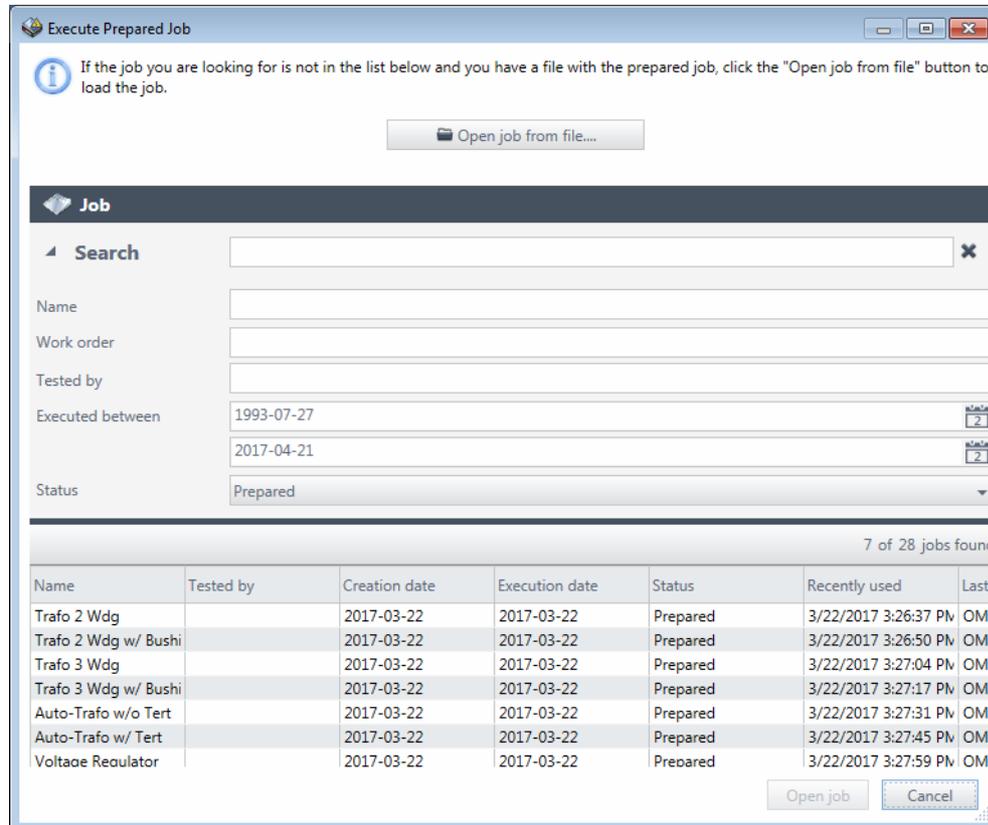


Figure 7-1: Execute prepared job view

2. In the execute prepared job view, click **Open job from file**.
3. In the **Open** dialog box, browse to the .ptm file you want to import.
4. Import the job, and then go through the guided test workflow (see 6 "Create new job" on page 37).

To execute a prepared job available in *Primary Test Manager*:

1. In the home view, click the **Execute prepared job** button .
2. In the execute prepared job view, search for the job you want to execute (see 8.1 "Search for objects" on page 62).
3. Open the job, and then go through the guided test workflow (see 6 "Create new job" on page 37).

8 Manage objects

In the manage view, you can manage locations, assets, jobs, and test reports. To open the manage view, click the **Manage** button  in the home view.

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

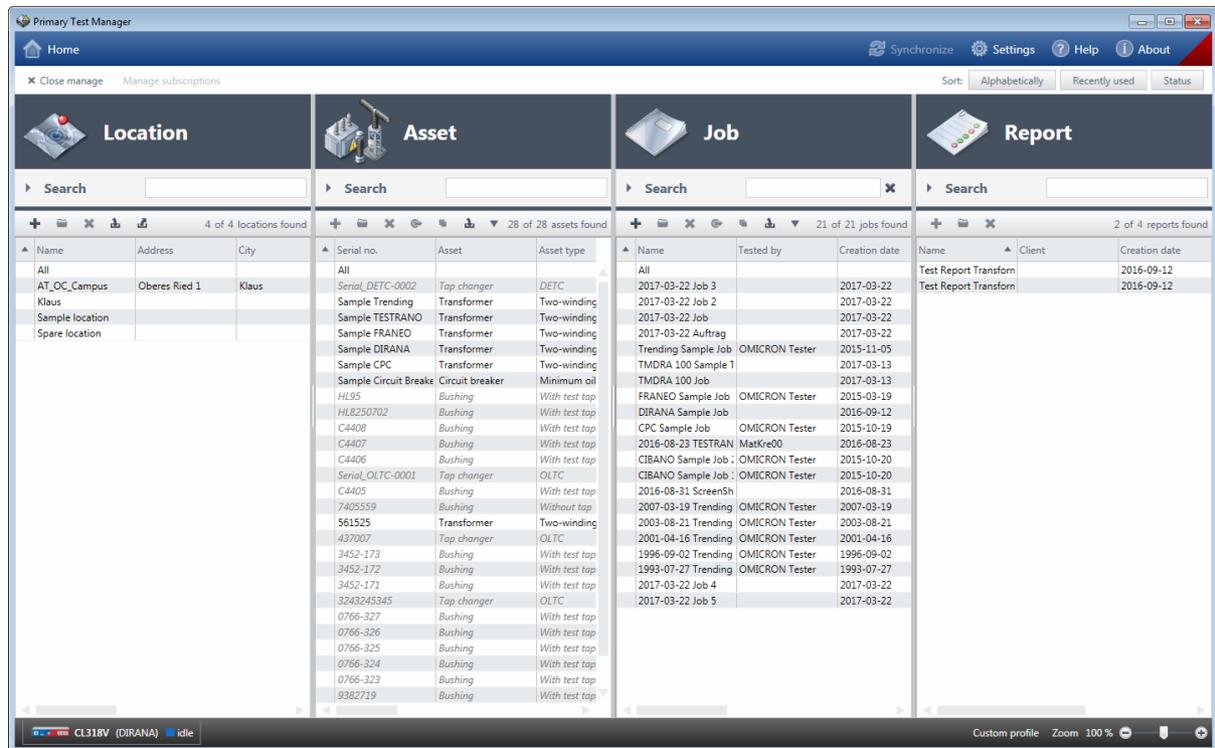


Figure 8-1: Manage view

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

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

- If you select a location, the manage view displays the assets, jobs, and reports associated with the selected location.
- If you select an asset, the manage view displays the jobs and reports associated with the selected asset.
- If you select a job, the manage view displays the reports associated with the selected job.

You can sort the objects alphabetically or in the chronological order.

- Drag and drop the column headers to rearrange the columns.

In the manage view, you can:

- Search for objects (see 8.1 "Search for objects" on page 62)
- Perform operations on objects (see 8.2 "Perform operations on objects" on page 63)
- Relocate assets (see 8.5 "Relocate assets" on page 66)
- Import and export jobs (see 8.6 "Import and export jobs" on page 67)

8.1 Search for objects

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

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

To search for keywords in particular object data:

1. Expand the **Search** area by clicking the arrow next to **Search**.
2. Type the keyword(s) you search for in the respective object data box(es).

The following table describes the location search data.

Table 8-1: Location search data

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

The following table describes the asset search data.

Table 8-2: Asset search data

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

The following table describes the job search data.

Table 8-3: Job search data

Data	Description
Name/WO	Name of the job or work order
Tested by	Person who performed the test
Executed between	Time period between the job was executed
Status	Status of the job

The following table describes the report search data.

Table 8-4: Report search data

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

8.2 Perform operations on objects

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

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

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

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

8.3 Understanding the master locations and assets

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

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

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

8.4 Duplicate assets

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

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

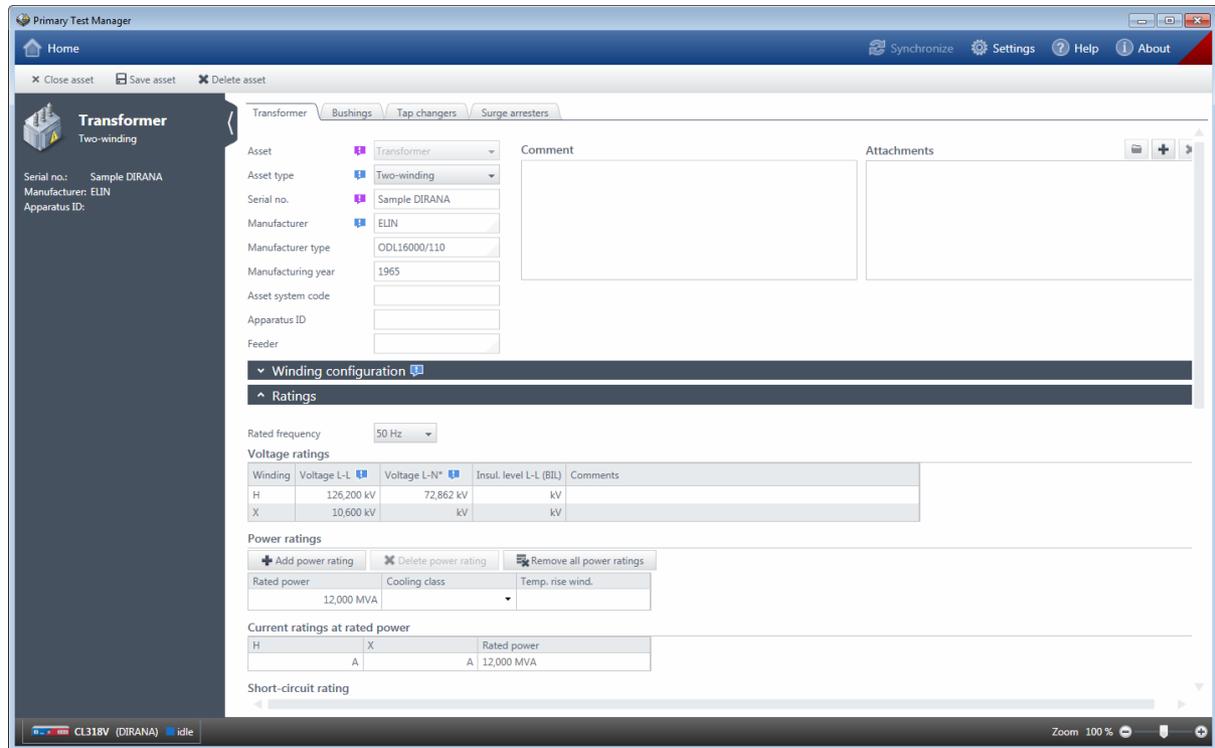


Figure 8-2: Asset view

4. In the asset view, click **Save asset**.

Note: By default, the duplicated asset are linked to location of the original asset. For relocating the asset to a different location, see 8.5 "Relocate assets" later in this chapter.

8.5 Relocate assets

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

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

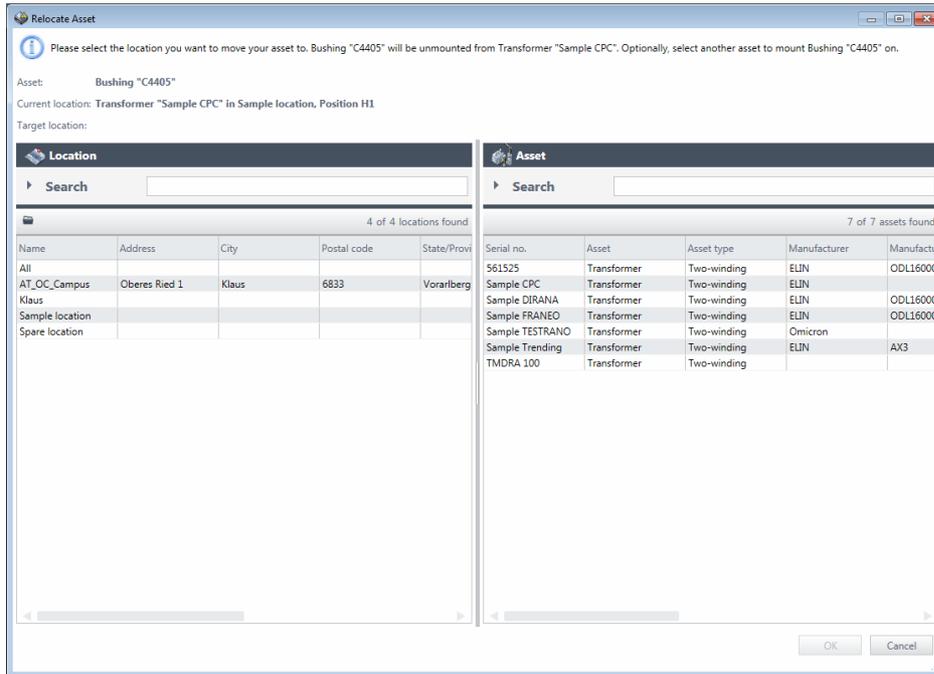


Figure 8-3: **Relocate Asset** dialog box

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

Note: You can filter the locations and assets by searching for keywords (see 8.1 "Search for objects" on page 62).

8.6 Import and export jobs

Primary Test Manager supports data exchange between different test systems.

You can export *Primary Test Manager* jobs in the following formats.

Table 8-5: Supported job export formats

Format name	File name extension	Description
PTM files	.ptm	<i>Primary Test Manager</i> native exchange format
DIRANA CSV file	.csv	Comma-separated values format
DIRANA 1.7 CSV file	.csv	Comma-separated values format compatible with the <i>DIRANA</i> software version 1.7

To export a job:

1. From the job list, select the job you want to export.
2. Click the **Export** button , and then click **Export to file**.
3. In the **Save as** dialog box, browse to the folder where you want to save the file.

You can import *Primary Test Manager* jobs in the following formats.

Table 8-6: Supported job import formats

Format name	File name extension	Description
PTM files	.ptm	<i>Primary Test Manager</i> native exchange format
DIRANA test file	.drax	<i>DIRANA</i> 1.x native exchange format
DIRANA CSV file	.csv	Comma-separated values format
IDAX test file	.idax	Format for import of test data from the <i>IDAX-300</i> insulation diagnostic analyzer

To import a job:

1. In the **Job** area, click the **Import** button , and then click **Import from file**.
2. In the **Open** dialog box, select the data format of the file you want to import.
3. Browse to the file you want to import.

9 Open manual tests

With *Primary Test Manager*, you can open existing manual tests. To open a manual test:

1. Click the **Open manual tests** button  in the home view (see Figure 5-1: "Primary Test Manager home view" on page 20).
2. In the **Open** dialog box, browse to the file you want to open.

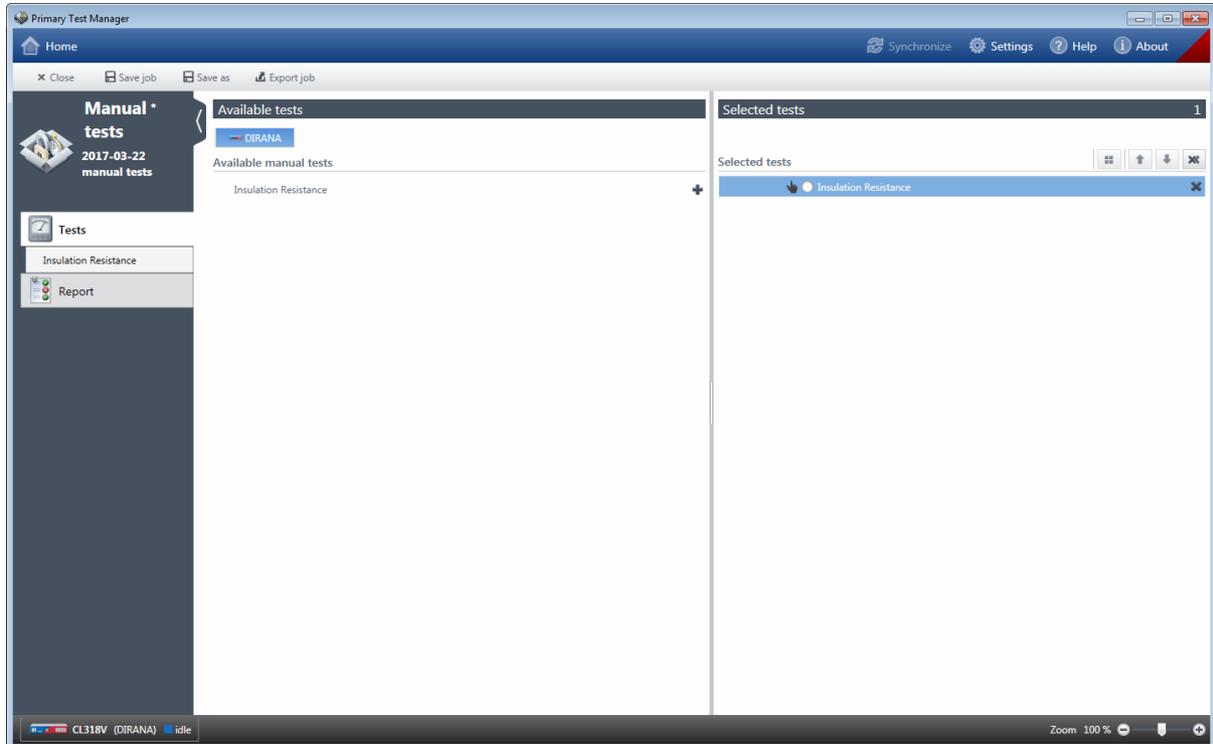


Figure 9-1: Open manual tests view

The open manual tests view displays the tests in the left pane. To view the test results, click the corresponding test button.

10 Generate test reports

In the report view, you can configure and generate test reports. To open the report view, click the **Report** button  in the left pane.

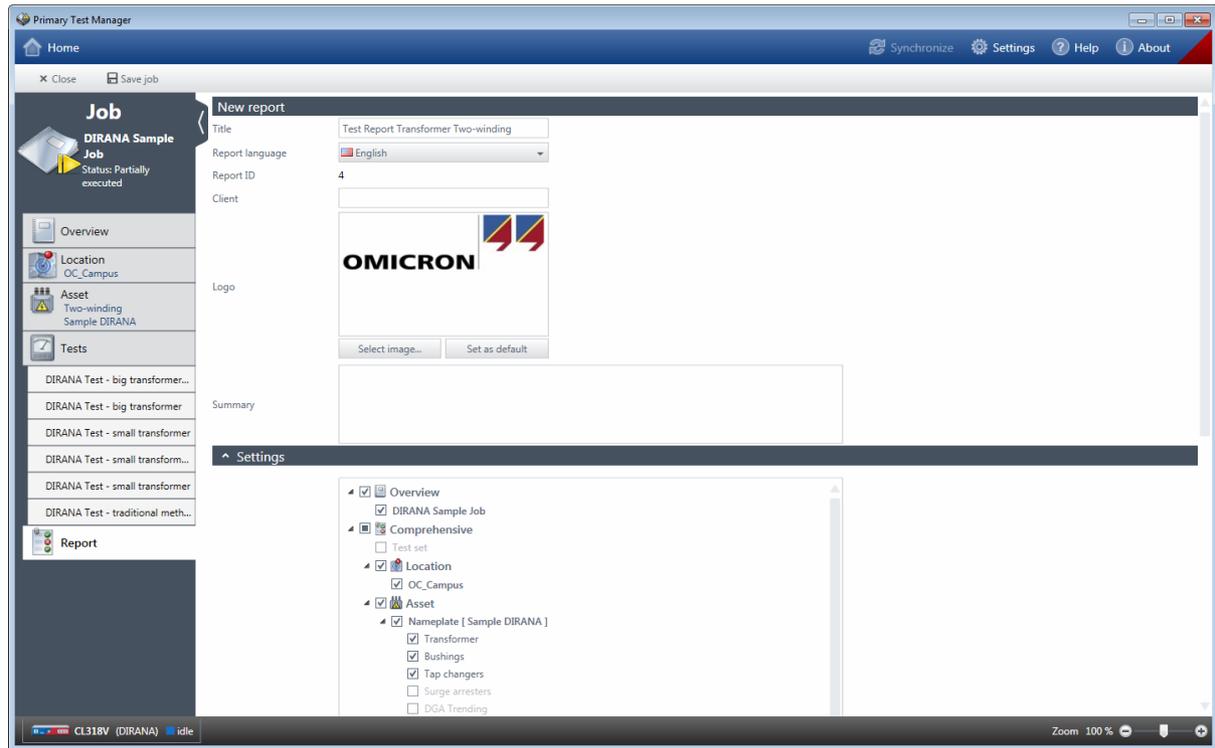


Figure 10-1: Report view

The report view is divided into the **New report** area, the **Settings** area and the **Existing reports** area. In the **New report** area, you can set the report data. The following table describes the report data.

Table 10-1: Report data

Data	Description
Title	Title of the report. Appears as the report header.
Report language	Language the report is created in
Report ID ¹	Identifier of the report
Client	Customer for which the report is designated
Logo	Logo to appear in the report (see "Setting the logo" later in this chapter)
Summary	Text field to summarize the content of the test report in own words

1. By default generated by *Primary Test Manager*.

Setting the logo

To insert your own logo:

1. In the **New report** area, click **Select image**.
2. In the **Open Image File** dialog box, browse to the file you want to insert.

To set your own logo as default, click **Set as default**.

In the **Settings** area, you can configure the test report by selecting the respective check boxes. You can generate test reports as Microsoft Word and Microsoft Excel documents or in PDF format. To generate a test report in your preferred format, click **Report to Word**, **Export to Excel** or **Report as PDF**. You can also add custom reports to jobs. To add a report to a job:

1. In the **Settings** area, click **Add report from file**.
2. In the **Add** dialog box, browse to the report you want to add.

The **Existing reports** area displays the reports available for the job.

11 Asset data

This section describes the asset specific data.

11.1 Transformer data

The following tables describe the transformer data.

Table 11-1: Winding configuration

Data	Description
Phases	Number of the transformer's phases
Vector group	Vector group of the transformer (see "Setting the vector group" on page 48)
Unsupported vector group (for documentation)	Vector group not supported by <i>Primary Test Manager</i> as text for documentation

Table 11-2: Ratings

Data	Description
Rated frequency	Rated frequency of the transformer
Voltage ratings	
Winding	Transformer's winding
Voltage L-L	L-L voltage of the transformer's winding
Voltage L-N	L-N voltage of the transformer's winding
Insul. level L-L (BIL)	L-L basic impulse level rating of the transformer's winding
Power ratings	
Rated power	Power rating of the transformer
Cooling class	Cooling class of the transformer
Temp. rise wind.	Temperature rise of the transformer's winding
Current ratings at rated power	
H/X/Y ¹	Maximum power frequency current of the transformer at rated power
Short-circuit rating	
Max. short-circuit current	Maximum short-circuit current of the transformer in kA during a given time in seconds

1. Set by the regional conventions (see 5.1.1 "Settings" on page 22).

Table 11-3: Impedances

Data	Description
Ref. temp.	Reference temperature
Short-circuit impedances H - X¹, H - Y¹, X - Y¹	
Short-circuit impedance Z (%) ¹	Short-circuit impedance of the transformer
Base power	Base power used for calculating the percent values of impedances
Base voltage	Base voltage used for calculating the percent values of impedances
Load losses Pk	Load loss at the transformer's rated load
OLTC position	Tap position of the OLTC
DETC position	Tap position of the DETC
Zero sequence impedance	
Base power	Base power used for calculating the percent values of impedances
Base voltage	Base voltage used for calculating the percent values of impedances
Winding	Transformer's winding
Zero sequence impedance Z0 (%)	Zero sequence impedance of the transformer

1. Set by the regional conventions (see 5.1.1 "Settings" on page 22).

Table 11-4: Others

Data	Description	
Category	Application category of the transformer	
Status	Usage status of the transformer	
Tank type	Type of the transformer's tank	
Insulation medium	Insulation medium of the transformer	
Insulation	Weight	Weight of the transformer's insulation
	Volume	Volume of the transformer's insulation
Total weight	Total weight of the transformer	
Winding	Transformer's winding	
Conductor material	Conductor material of the transformer's winding	

11.1.1 Bushing data

For the data of the transformer's bushings, see 11.2 "Spare bushing data" on page 74.

11.1.2 Tap changer data

The following table describes the on-load tap changer (OLTC) and the de-energized tap changer (DETC) data.

Table 11-5: Tap changer data

Data	Description
OLTC/DETC	Select the OLTC check box to set the OLTC data. Select the DETC check box to set the DETC data.
Tap changer configuration	
Winding	Transformer's winding to which the tap changer is connected
Tap scheme	Notation scheme for tap identification
No. of taps	Number of the tap changer's taps
Current tap position ¹	Current position of the tap
Voltage table	
Tap	Number of the tap
Voltage	Voltage on the tap

1. Only available for the DETC

11.1.3 Surge arrester data

The following table describes the surge arrester data.

Table 11-6: Surge arrester data

Data	Description
General	
Overall ID	Identifier of the surge arrester stack
Ratings	
Units in stack	Number of the surge arrester's units
Numerical positions	Select the Numerical positions check box to set numerical positions of the surge arrester.
Literal positions	Select the Literal positions check box to set alphabetical positions of the surge arrester.
Position	Position of the surge arrester
Serial no.	Serial number of the surge arrester
MCOV rating	Maximum continuous operating voltage between the terminals of the surge arrester
Rated voltage	Rated voltage of the surge arrester
Max. system voltage	Maximum voltage between phases during normal service
Test voltage	Test voltage of the surge arrester
Unit ID	Identifier of the surge arrester's unit

11.2 Spare bushing data

The following table describes the spare bushing data.

Table 11-7: Spare bushing data

Data	Description
Pos. ¹	Terminal of the transformer's winding to which the spare bushing is connected
Ratings	
Rated frequency	Rated frequency of the spare bushing
Insul. level LL (BIL)	L-L basic impulse level rating of the spare bushing
Voltage L-ground	Rated line-to-ground voltage
Max. system voltage	Maximum voltage between phases during normal service
Rated current	Rating current of the spare bushing
Manufacturer info	
Catalog no.	Catalog number of the spare bushing
Drawing no.	Drawing number of the spare bushing
Style no.	Style number of the spare bushing
Nominal values	
PF (C1)/ DF (C1)/ Tan δ (C1) ²	Power factor, dissipation factor, or tangent delta of the capacitance C1 between the top of the spare bushing and the voltage/test tap
Cap. (C1)	Capacitance C1 between the top of the spare bushing and the voltage/test tap
PF (C2)/ DF (C2)/ Tan δ (C2) ²	Power factor, dissipation factor, or tangent delta of the capacitance C2 between the voltage/test tap of the spare bushing and ground
Cap. (C2)	Capacitance C2 between the voltage/test tap of the spare bushing and ground

Table 11-7: Spare bushing data (continued)

Data	Description
Other	
Insulation type	Insulation type of the spare bushing
Outer insulation type	Outer insulation type of the spare bushing

1. Only available for spare bushings mounted on another assets
2. Set by the regional conventions (see 5.1.1 "Settings" on page 22).

11.3 Current transformer data

11.3.1 Common parameters and settings

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

In addition to these common parameters, specific additional parameters are displayed, depending on the selected standard, CT type (protection or metering CT) and class. For these specific parameters, please refer to the tables on pages 76 to 81.

Table 11-8: Ratings

Data	Description
Standard	Standard used for testing the current transformer
Rated frequency	Rated frequency of the current transformer
Rated $I_{pn} : I_{sn}^1$ Rated $I_{pr} : I_{sr}^2$	Rated primary- to-secondary current ratio of the current transformer
Primary windings	Number of primary windings on the current transformer (for primary reconnection)
IEEE C57.13	
System voltage	System voltage of the current transformer
Rated insulation level (BIL)	Basic impulse level rating of the current transformer
Rating factor (RF)	Continuous thermal current rating factor of the current transformer
IEC 60044/IEC 61869	
U_m (r.m.s.)	Highest voltage for equipment
U withstand (r.m.s.)	Rated power-frequency withstand voltage
U lightning (peak)	Rated lightning impulse withstand voltage
I_{cth}	Rated continuous thermal current
I_{dyn} (peak)	Rated dynamic current
I_{th} (r.m.s.)	Rated short time thermal current
Duration	Duration of rated short time thermal current

1. According to IEC 60444

2. According to IEC 61869 and IEEE C57.13

Table 11-9: CT configuration

Data	Description
Cores	Number of the current transformer's cores
Name	Inter-tap identification
I_{pn}^1/I_{pr}^2	Inter-tap rated primary current
I_{sn}^1/I_{sr}^2	Inter-tap rated secondary current
In use	Tap on which the CT is operated
Ratings	
Application	Application category of the current transformer
Class	Rated accuracy class of the current transformer
Rated burden	Rated burden of the current transformer
Burden	Secondary burden of the current transformer
Operating burden	Burden (VA value) connected to the current transformer
$\cos \varphi$	Phase angle of the secondary burden

1. According to IEC 60444
2. According to IEC 61869 and IEEE C57.13

11.3.2 IEC 60044 protection CTs

The following parameters are only displayed if the standard IEC 60044 is selected with the type "Protection CT".

Table 11-10: Specific parameters and settings displayed for IEC 60044 protection CTs

Parameter	Description	Available for IEC 60044 protection CTs, class			Available for IEC 60044, class			
		xP	xPR	PX	TPS	TPX	TPY	TPZ
ALF	Accuracy limiting factor.	x	x					
Win-ding resistance	Specified secondary winding resistance.		x	x	x	x	x	x
Ts	Specified secondary time constant.		x				x	x
Kx	Dimensioning factor.			x				
Ek	Rated knee point e.m.f.			x				
le	Accuracy limiting current			x				
E1	User-defined e.m.f. to verify the excitation current at this specific e.m.f.			x				
le1	Maximum allowed excitation current at E ₁ .			x				
Kssc	Rated symmetrical short-circuit current factor.				x	x	x	x
Tp	Primary time constant.				x	x	x	x
K	Dimensioning factor.				x			

Table 11-10: Specific parameters and settings displayed for IEC 60044 protection CTs (continued)

Parameter	Description	Available for IEC 60044 protection CTs, class			Available for IEC 60044, class			
		xP	xPR	PX	TPS	TPX	TPY	TPZ
V-al	Rated equivalent excitation limiting secondary voltage.				x			
I-al	Accuracy limiting secondary excitation current.				x			
Ktd	Rated transient dimensioning factor.					x	x	x
Duty	Specified duty cycle.					x	x	
t1	Duration of first current flow. The specified accuracy limit must not be reached within time t_{al1} .					x	x	
t-al1	Permissible time to accuracy limit for first energizing period of the duty cycle.					x	x	
t2	Duration of second current flow. The specified accuracy limit must not be reached within time t_{al2} .					x	x	
t-al2	Permissible time to accuracy limit for second energizing period of the duty cycle.					x	x	
tfr	Dead time between first opening and reclosure.					x	x	

The following parameters are only displayed if the standard IEC 60044 is selected with the type "Metering CT".

Table 11-11: Specific parameters and settings displayed for IEC 60044 metering CTs

Parameter	Description	Available for IEC 60044 metering CTs, class
		0.1, 0.2, 0.2s, 0.5, 0.5s, 1, 3, 5
FS	Instrument security factor.	x
ext. I _{pn}	Extended current rating.	x

11.3.3 IEC 61869 protection CTs

The following parameters are only displayed if the standard IEC 61869 is selected with the type "Protection CT".

Table 11-12: Specific parameters and settings displayed for IEC 61869 protection CTs

Parameter	Description	Available for IEC 61869 protection CTs, class						
		protection				transient protection		
		xP	xPR	PX	PXR	TPX	TPY	TPZ
ALF	Accuracy limiting factor.	x	x					
Winding resistance	Specified secondary winding resistance.		x	x	x	x	x	x
Ts	Specified secondary time constant.		x			x	x	x
Kx	Dimensioning factor.			x	x			
Ek	Rated knee point e.m.f.			x	x			
E1	User-defined e.m.f. to verify the excitation current at this specific e.m.f.			x	x			
le	Accuracy limiting current.			x	x			
le1	Maximum allowed excitation current at E ₁ .			x	x			
Kssc	Rated symmetrical short-circuit current factor.					x	x	x
Duty cycle 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>Primary Test Manager</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>					x	x	x
Ktd	<p>Rated transient dimensioning factor according to the name plate.</p> <p>Note: Only displayed if parameter "Duty cycle spec." is "by Ktd".</p>					x	x	x
Tp	<p>Primary time constant.</p> <p>Note: Only displayed if parameter "Duty cycle spec." is "by Duty".</p>					x	x	x
Duty	<p>Specified duty cycle.</p> <p>Note: Only displayed if parameter "Duty cycle spec." is "by Duty".</p>					x	x	x

Table 11-12: Specific parameters and settings displayed for IEC 61869 protection CTs (continued)

Parameter	Description	Available for IEC 61869 protection CTs, class						
		protection				transient protection		
		xP	xPR	PX	PXR	TPX	TPY	TPZ
t-al1	Permissible time to accuracy limit for first energizing period of the duty cycle. Note: Only displayed if parameter "Duty cycle spec." is "by Duty".					x	x	x
t1	Duration of first current flow. The specified accuracy limit must not be reached within time t_{a1} . Note: Only displayed if parameter "Duty cycle spec." is "by Duty" and "Duty" is "CO-CO".					x	x	x
tfr	Dead time between first opening and reclosure. Note: Only displayed if parameter "Duty cycle spec." is "by Duty" and "Duty" is "CO-CO".					x	x	x
t-al2	Permissible time to accuracy limit for second energizing period of the duty cycle. Note: Only displayed if parameter "Duty cycle spec." is "by Duty" and "Duty" is "CO-CO".					x	x	x

11.3.4 IEC 61869 metering CTs

The following parameters are only displayed if the standard IEC 61869 is selected with the type "Metering CT".

Table 11-13: Specific parameters and settings displayed for IEC 61869 metering CTs

Parameter	Description	Available for IEC 61869 metering CTs, class
		0.1, 0.2, 0.2s, 0.5, 0.5s, 1, 3, 5
FS	Instrument security factor.	x
ext. Ipn	Extended current rating.	x
ext. VA	Extended burden range.	x

11.3.5 IEEE C57.13 protection CTs

The following parameter is only displayed if the IEEE C57.13 standard is selected with the type "Prot. CT".

Table 11-14: Specific parameters and settings displayed for IEEE C57.13 protection CTs

Parameter	Description	Available for IEEE C57.13, class			
		C	T	X	K
Vb	Rated secondary terminal voltage. 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.	x	x		x
Vk Vk1	User-defined measuring point. User-defined measuring point 1.		x	x	
Ik Ik1	User-defined measuring point. User-defined measuring point 1.		x	x	
RE(20*Isn)	Ratio error at $20 * I_{sn}$.			x	
Winding resistance	Specified secondary winding resistance.			x	

11.3.6 IEEE C57.13 metering CTs

The following parameter is only displayed if the IEEE C57.13 standard is selected with the type "Metering CT".

Table 11-15: Specific parameters and settings displayed for IEEE C57.13 metering CTs

Parameter	Description	Available for IEEE C57.13 metering CTs, class
		0.15, 0.15s, 0.3, 0.6, 1.2
RF	Continuous current rating factor.	x

11.4 Voltage transformer data

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

Table 11-16: Ratings

Data	Description
Standard	Standard used for testing the voltage transformer
Rated frequency	Rated frequency of the voltage transformer
Upr	Rated primary voltage

Table 11-17: VT configuration

Data	Description
Windings	Number of windings on the voltage transformer
Usr	Rated secondary voltage
Rated burden	Rated burden of the voltage transformer
cos φ	Phase angle of the secondary burden

11.5 Rotating machine data

The following tables describe the rotating machine data.

Table 11-18: Configuration

Data	Description
Star point ¹	Star point connection of the rotating machine during test
Overall capacitance	Overall capacitance of the rotating machine
Capacitance per phase ¹	Capacitance per phase of the rotating machine

1. Only available for three-phase rotating machines

Table 11-19: Ratings

Data	Description
Rated frequency	Rated frequency of the rotating machine
Rated voltage L-L	L-L voltage of the rotating machine
Rated current	Rated current of the rotating machine
Rated speed (rpm)	Rated speed of the rotating machine in revolutions per minute
Rated power	Rated power of the rotating machine
Rated thermal class	Rated thermal class of the rotating machine
Rated excitation current (rotor)	Rated excitation current of the rotor
Rated excitation voltage (rotor)	Rated excitation voltage of the rotor
cos(φ)	Rated power factor of the rotating machine

12 Application

This section describes testing of high-voltage assets with *DIRANA*. *Primary Test Manager* in combination with *DIRANA* supports the following guided tests:

- DIRANA test
- Oil analysis

and the Insulation Resistance manual test.

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

12.1 DIRANA test

The DIRANA test is used for the insulation diagnosis of high-voltage assets. With the DIRANA test, you can measure the dielectric response of the insulation system, analyze the moisture content of the power transformer insulation, and compare the measurement results.

12.1.1 Test set and software startup

To put *DIRANA* into operation and start *Primary Test Manager*:

1. Connect the *DIRANA* equipotential grounding terminal to the substation ground properly.
2. Start *Primary Test Manager*.

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

- Create new jobs (see 6 "Create new job" on page 37)
- Execute prepared jobs (see 7 "Execute prepared job" on page 60)
- Manage locations, assets, jobs and test reports (see 8 "Manage objects" on page 61)
- Open existing manual tests (see 9 "Open manual tests" on page 68)
- Generate test reports (see 10 "Generate test reports" on page 69)

12.1.2 Connection

To connect *DIRANA* to the test object:

1. In *Primary Test Manager*, open the DIRANA test.



WARNING

Death or severe injury caused by high voltage or current possible

- ▶ Before connecting *DIRANA* to the test object, observe the five safety rules (see 1.2.2 "Safety rules" on page 7) and all additional relevant laws and internal safety standards.
- ▶ Do not touch the **OUTPUT** connector or any parts of the test setup when the red LED on the *DIRANA* front panel lights continuously or blinks.
- ▶ Always ensure that the device is safely switched off and the sample is discharged before touching any parts of the test setup.

2. Connect *DIRANA* to the test object's terminals by using the delivered cables and clamps according to the wiring diagram displayed in the **General** area of the *Primary Test Manager* workspace.

Note: We recommend using the default settings for the measurement profile and selecting the **Configure all parameters automatically** check box for optimum results of moisture analysis.

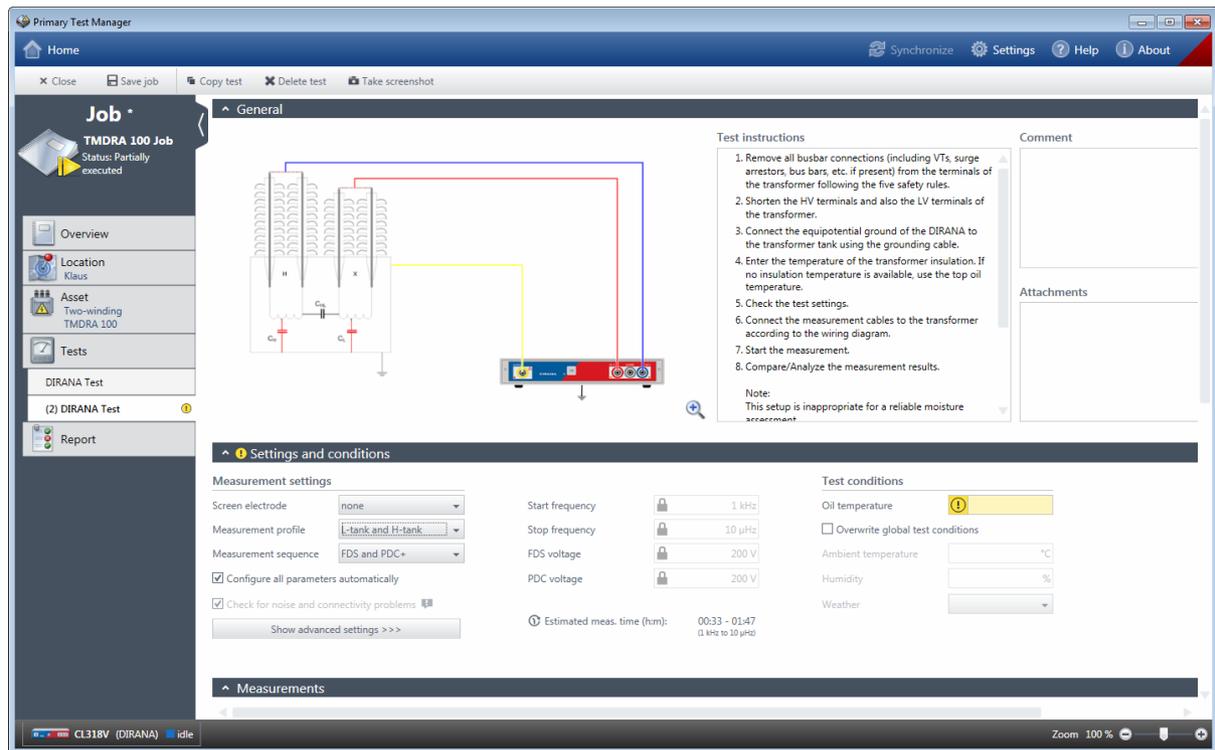


Figure 12-1: Example of the wiring diagram for a two-winding transformer

3. Connect *DIRANA* to the computer with the delivered USB cable and switch the computer on.
4. Connect *DIRANA* to the mains power supply by using the delivered power cord.
5. Switch *DIRANA* on by toggling the power switch on the rear panel.
6. Connect *Primary Test Manager* to *DIRANA* as described in 4.4 "Start Primary Test Manager and connect to DIRANA" on page 19.

12.1.3 Settings and conditions

The following table describes the DIRANA test settings and conditions.

Table 12-1: DIRANA test settings and conditions

Setting	Description
Measurement settings	
Asset with screen electrode	Select the Asset with screen electrode check box if you test an asset with the screen electrode.
Measurement profile	Measured insulation of the asset under test We highly recommend using the default setting for moisture analysis. Other settings can lead to inaccurate results.
Measurement sequence	Measurement method (see "Measurement sequence" later in this section)
Configure all parameters automatically	Select the Configure all parameters automatically check box to set the recommended values of the test parameters. We highly recommend using this setting for moisture analysis. A manual change of settings can lead to inaccurate results.
Check for noise and connectivity problems	Select the Check for noise and connectivity problems check box to check automatically the measurement environment before starting the measurement. We recommend checking for noise and connectivity problems as the time is justifiable compared with the total measurement time.
Start frequency	Highest test frequency
Stop frequency	Lowest test frequency
FDS voltage	FDS output peak voltage
PDC voltage	PDC output voltage
Test conditions	
Oil temperature	Temperature of the transformer's oil
Overwrite global test conditions	Select the Overwrite global test conditions check box to set test conditions different from the global test conditions.
Ambient temperature	Ambient temperature
Humidity	Relative ambient humidity
Weather	Weather during the test
Estimated meas. time (h:m)	The estimated measurement time applies for a full sweep of the frequency range. As it is very likely that only a part of the full frequency range has to be measured, the real measurement time is most probably shorter than this time. During the measurement, the required time is updated once all relevant information for the calculation has been measured.

Measurement sequence

The following table describes the measurement methods available for the DIRANA test.

Table 12-2: Measurement methods

Measurement sequence	Description
FDS and PDC+	Combined FDS and PDC methods with optimization of the measurement time
FDS only	FDS method
PDC only	PDC method ¹
PDC with depolarization measurement	PDC method with the measurement of the depolarization current ¹
FDS and PDC with depolarization measurement	Combined FDS and PDC methods with the measurement of the depolarization current

1. Only applicable for frequencies < 100 mHz

The following table describes the advanced settings of the DIRANA test.

Note: We strongly recommend using the default advanced settings. Change the advanced settings in well-founded cases only if you are an experienced user.

Table 12-3: Advanced DIRANA test settings

Setting	Description
FDS sampling points	Measurement frequencies of the FDS method (see "FDS sampling points" later in this section)
Polarization time	Time interval during which the test object is polarized (charged) by the applied PDC voltage.
Depolarization time	Time interval during which the test object is depolarized (discharged).
Noise suppression (PDC)	<p>Noise suppression level of the PDC method:</p> <ul style="list-style-type: none"> • Default (hardware only): no software-based noise suppression • Moderate (software enhanced) • Strong (software enhanced) • Extreme (software enhanced) <p>The software enhanced options (moderate, strong, extreme) smooth the measurement curve before transformation into the frequency domain. The software enhanced options enable using the combined FDS and PDC methods in the presence of severe noise but can result in reduced measurement accuracy.</p>

Table 12-3: Advanced DIRANA test settings (continued)

Setting	Description
Noise suppression (FDS)	Level of noise suppression of the FDS method: Default or Improved The Improved option suppresses the noise better than the Default option but results in longer measurement times.
Pre-measurement delay¹	
Minimum time	Minimum pre-measurement delay
Depol. current below	Threshold level of the depolarization current

1. Only available if the **Check for noise and connectivity problems** check box is cleared.

FDS sampling points

Under **FDS sampling points**, you can manage the measurement frequencies of the FDS method. When you set the start and stop sweep frequencies, *Primary Test Manager* generates a default list of the FDS measurement frequencies. You can edit the list as follows.

To add a measurement frequency to the list:

1. In the **FDS sampling points** list, select the frequency above which you want to add the new measurement frequency.
2. Click **+**.
 - ▶ To change a measurement frequency in the list, click the frequency, and then edit the frequency value.
 - ▶ To remove a measurement frequency from the list, select the frequency, and then click **X**.
 - ▶ To remove all measurement frequencies from the list, click **Clear all**.
 - ▶ To restore the default list, click **Restore**.

12.1.4 Measurement

To perform a measurement:

1. In the **Settings and conditions** area, enter the settings and conditions of the DIRANA test (see 12.1.3 "Settings and conditions" on page 86).

Note: We recommend configuring all parameters automatically by selecting the **Configure all parameters automatically** check box if you do not have a particular reason to set some special parameter values.

2. Enter the oil temperature of the asset. If more than one temperature sensor is available, use the top oil temperature.

WARNING



Death or severe injury caused by high voltage or current possible

- ▶ Do not touch the **OUTPUT** connector or any parts of the test setup when the red LED on the *DIRANA* front panel lights continuously or blinks.
- ▶ Always ensure that the device is safely switched off and the sample is discharged before touching any parts of the test setup.

3. On the **Measurements** tab in the **Measurements** area, click **Start** to start the measurement.

Note: You can start a measurement only if *Primary Test Manager* is connected to *DIRANA*.

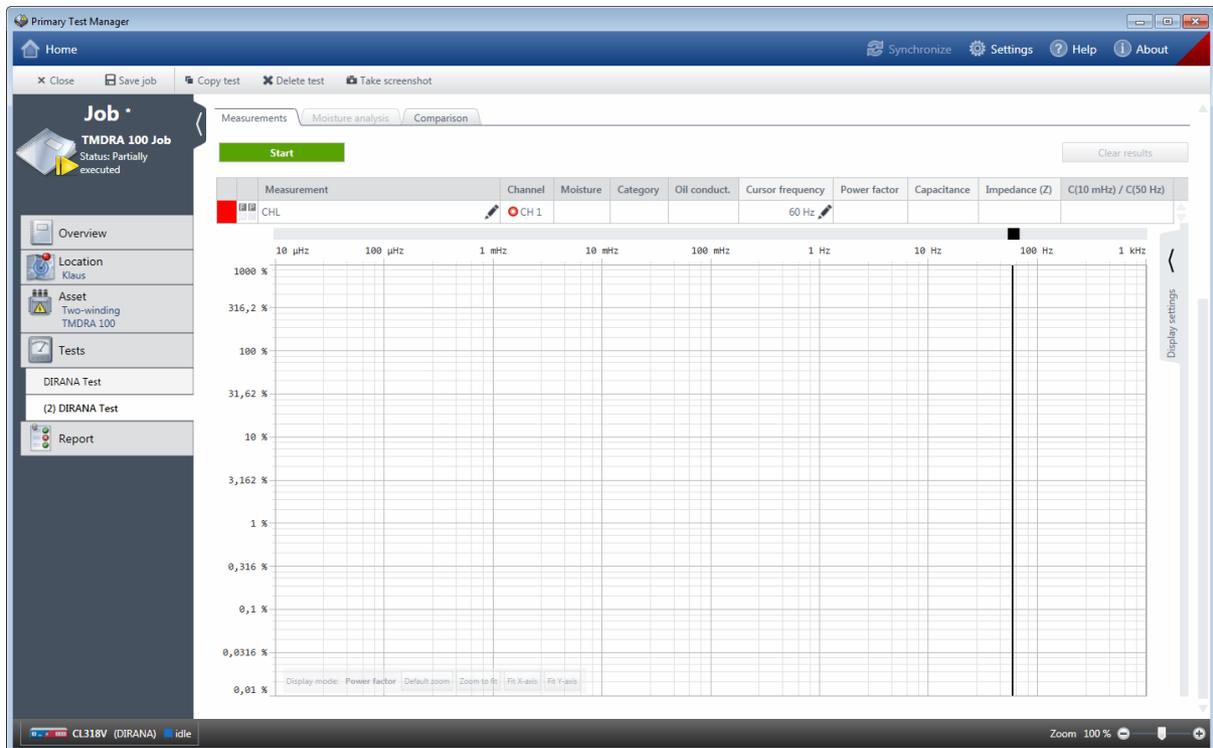


Figure 12-2: Starting a measurement

After the measurement has finished, *Primary Test Manager* displays the measurement results.

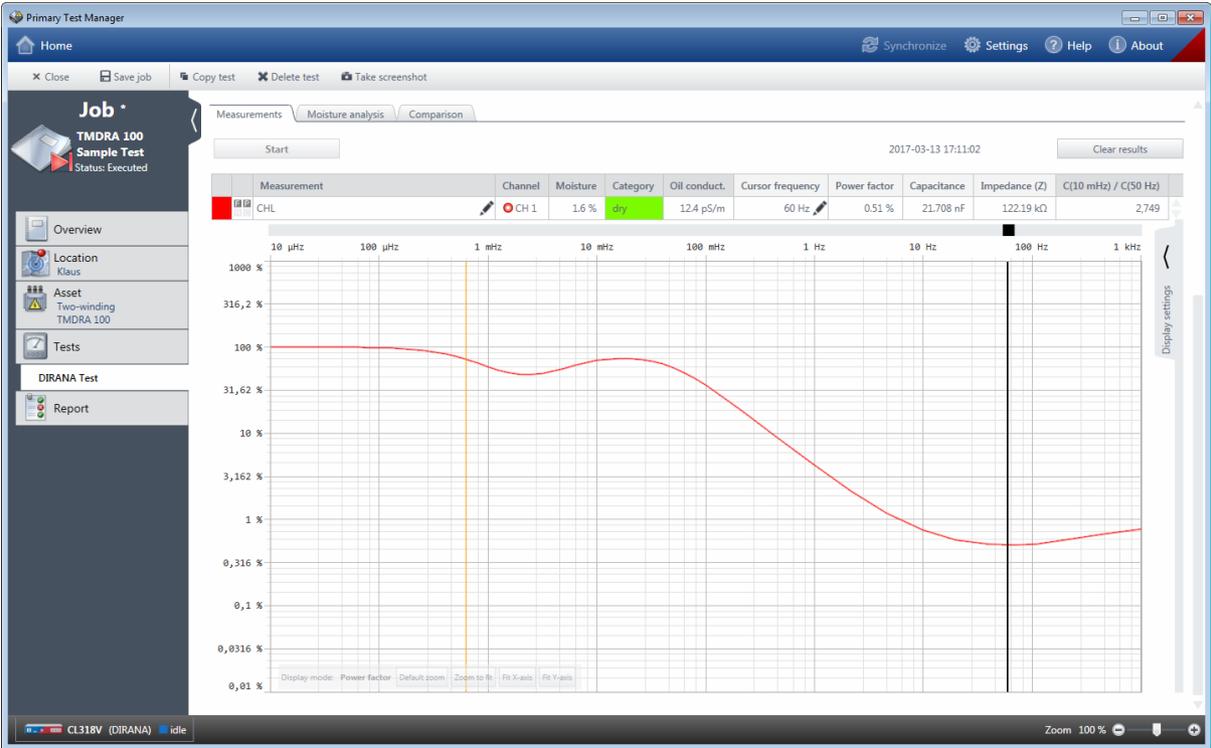


Figure 12-3: Typical dielectric response of power transformer insulation

The measurement data depends on the display mode selected on the **Display settings** tab (see "Display settings" later in this section) in the **Measurements** area. The following tables describe the DIRANA test measurement data for different display modes.

Table 12-4: DIRANA test measurement data for the Power factor/Dissipation factor/ $\tan\delta^1$, Capacitance and Impedance display mode

Data	Description
Measurement	Editable measurement name
Channel	<i>DIRANA</i> measurement channel
Moisture	Moisture content of the insulation in weight percent
Category	Moisture content category
Oil conduct.	Oil conductivity
Cursor frequency	Measurement frequency set by the cursor
Power factor/ Dissipation factor	Power factor or dissipation factor of the insulation
Capacitance	Capacitance of the insulation
Impedance (Z)	Impedance of the insulation
Resistance (R)	Parallel resistance of the equivalent circuit
C(10 mHz) / C(50 Hz)	Ratio of the capacitance at 10 mHz to the capacitance at 50 Hz

1. Set on the **Profiles** tab of the **Settings** dialog box

Table 12-5: DIRANA test measurement data for the Current display mode

Data	Description
Measurement	Editable measurement name
Channel	<i>DIRANA</i> measurement channel
Moisture	Moisture content of the insulation in weight percent
Category	Moisture content category
Cursor time	Measurement time set by the cursor
Polarization current	Polarization current of the PDC+ method
Resistance (R)	Resistance of the insulation determined by the test voltage divided by the measured current at this time
Depol. current	Depolarization current of the PDC+ method
Polarization index	Ratio of the current after 60 s to the current after 600 s
DAR	Dielectric absorption ratio Ratio of the current after 60 s to the current after 30 s

Display settings

To access the display settings of the DIRANA test, click the **Display settings** tab on the right of the **Measurements** area.

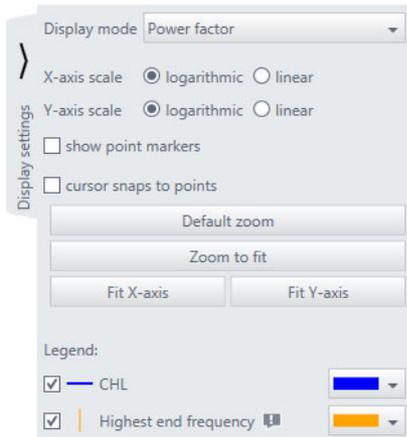


Figure 12-4: Display settings of the DIRANA test

The following table describes the display settings of the DIRANA test.

Table 12-6: Display settings

Setting	Description
Display mode	Measured quantity displayed in the chart: Power factor/Dissipation factor/Tanδ¹, Current, Capacitance or Impedance
X-axis scale	Scale of the X-axis
Y-axis scale	Scale of the Y-axis
Show point markers	Select the Show point markers check box to display the measurement points with markers.
Default zoom	Default zoom setting
Zoom to fit	Zoom setting for the best fit of the measurement results
Fit X-axis	Zoom setting for the best fit of the measurement data on the X-axis
Fit Y-axis	Zoom setting for the best fit of the measurement data on the Y-axis
Legend	Under Legend , you can select information to be displayed in the chart and set the chart colors.

1. Set on the **Profiles** tab of the **Settings** dialog box

Note: Alternatively, you can access the display settings quickly on the left bottom of the chart.

12.1.5 Moisture analysis

Primary Test Manager provides an automated procedure for the moisture content analysis of the cellulose (pressboard and paper) of the power transformer insulation. A manual adjustment of single parameters is usually not required and should only be performed by experienced users. The moisture analysis is based on fitting the measured dielectric response by model curves of the transformer insulation system available in *Primary Test Manager*. For the insulation diagnosis of other high-voltage assets, see 12.1.6 "Comparison" on page 95. The moisture analysis requires only the insulation temperature to be known. *Primary Test Manager* calculates all values for the best fit. Consequently, the automated fitting procedure finds out any of the insulation parameters, even if none is known.

To enter the moisture analysis:

1. In the **Measurements** area, click the **Moisture analysis** tab.
2. From the **Selected measurement** list, select the measurement for which you want to perform the moisture analysis.

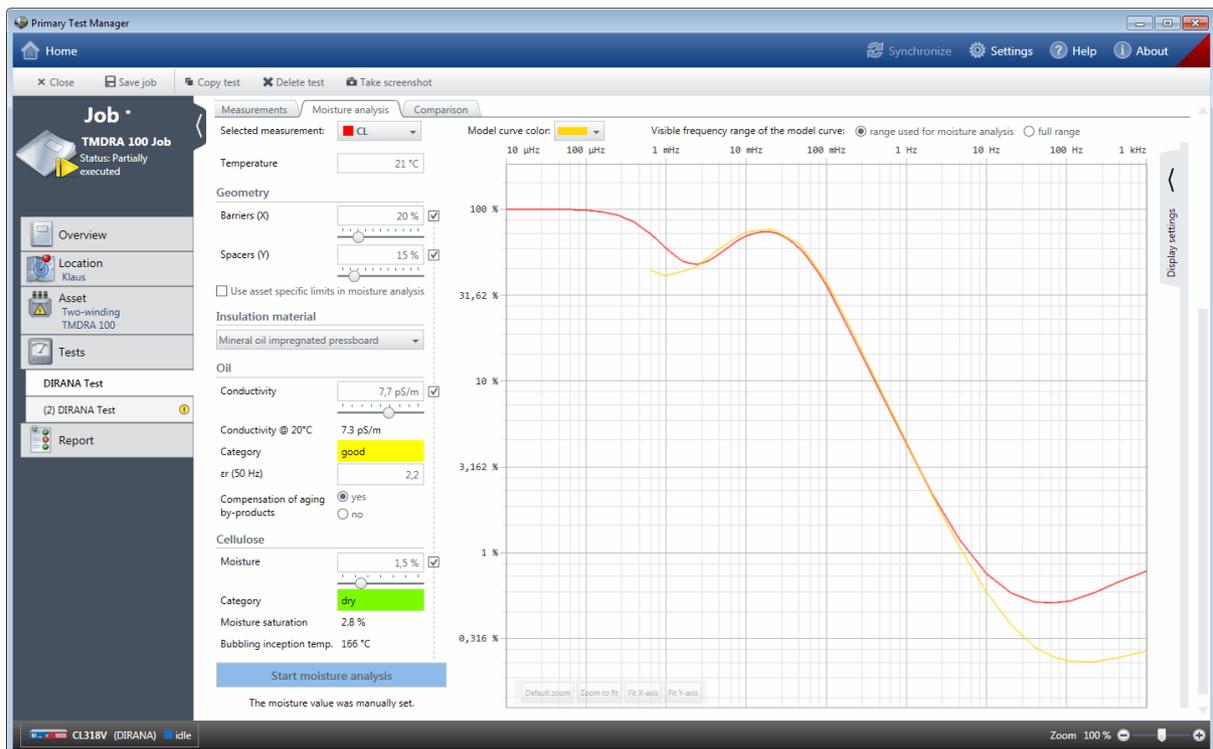


Figure 12-5: Setting the moisture analysis parameters

Table 12-7: Moisture analysis parameters

Parameter	Description
Geometry	
Barriers (X)	Insulation barriers (axial) in percent of the volume between the windings (stray channel) The values are determined automatically and do not have to be set manually.
Spacers (Y)	Insulation spacers (radial) in percent of the volume between the windings (stray channel) The values are determined automatically and do not have to be set manually.
Use asset specific limits in moisture analysis	Select the Use asset specific limits in moisture analysis check box to constrain the values of barriers and spacers within a typical range for the asset under test.
Insulation material	Select the insulation material of the asset under test from the Insulation material list.

3. On the top of the workspace, set the chart options.

Table 12-8: Chart options

Option	Description
Model curve color	Color of the model curve
Visible frequency range of the model curve	Frequency range of the model curve displayed in the chart

4. On the **Display settings** tab on the right of the **Measurements** area, set your preferred display settings (see "Display settings" on page 92).

5. Click **Start moisture analysis** to perform an automated moisture analysis. All parameters for which you selected the check boxes are determined automatically.

After the moisture analysis has finished, *Primary Test Manager* displays the numerical analysis results and the model curve fitting the measured dielectric response (see Figure 12-5: "Setting the moisture analysis parameters" on page 93).

Table 12-9: Moisture analysis results

Data	Description
Oil	
Conductivity	Oil conductivity
Conductivity @ 20 °C	Oil conductivity at 20 °C
Category	Moisture content category
ϵ_r	Relative permittivity of the oil
Compensation of aging byproducts	If this option is selected, <i>Primary Test Manager</i> automatically compensates the result for aging byproducts which otherwise could lead to an overestimation of the water content.

Table 12-9: Moisture analysis results (continued)

Data	Description
Cellulose	
Moisture	Moisture content of the cellulose in weight percent
Category	Moisture content category
Moisture saturation	Estimated relative moisture saturation of the cellulose insulation
Bubbling inception temp.	Estimated temperature where the bubbling effect is possible

12.1.6 Comparison

With *Primary Test Manager*, you can compare any number of measurements. By comparing different measurements, for example, the measurements on the same asset at different times, you can diagnose the insulation condition of the asset under test where the moisture assessment is not applicable.

To compare measurements:

1. In the **Measurements** area, click the **Comparison** tab.
2. Optionally, click the **Assign unique colors** check box to change the colors of added measurements to unique colors in the comparison.
3. In the *Test selector*, select the measurement you want to add to the comparison, and then click **Add** next to the measurement.

Note: You can select measurements from all tests currently available in *Primary Test Manager*.

4. Repeat step 3 for all measurements you want to compare.

- Optimize the chart for the visual assessment by using the display settings (see "Display settings" on page 92).

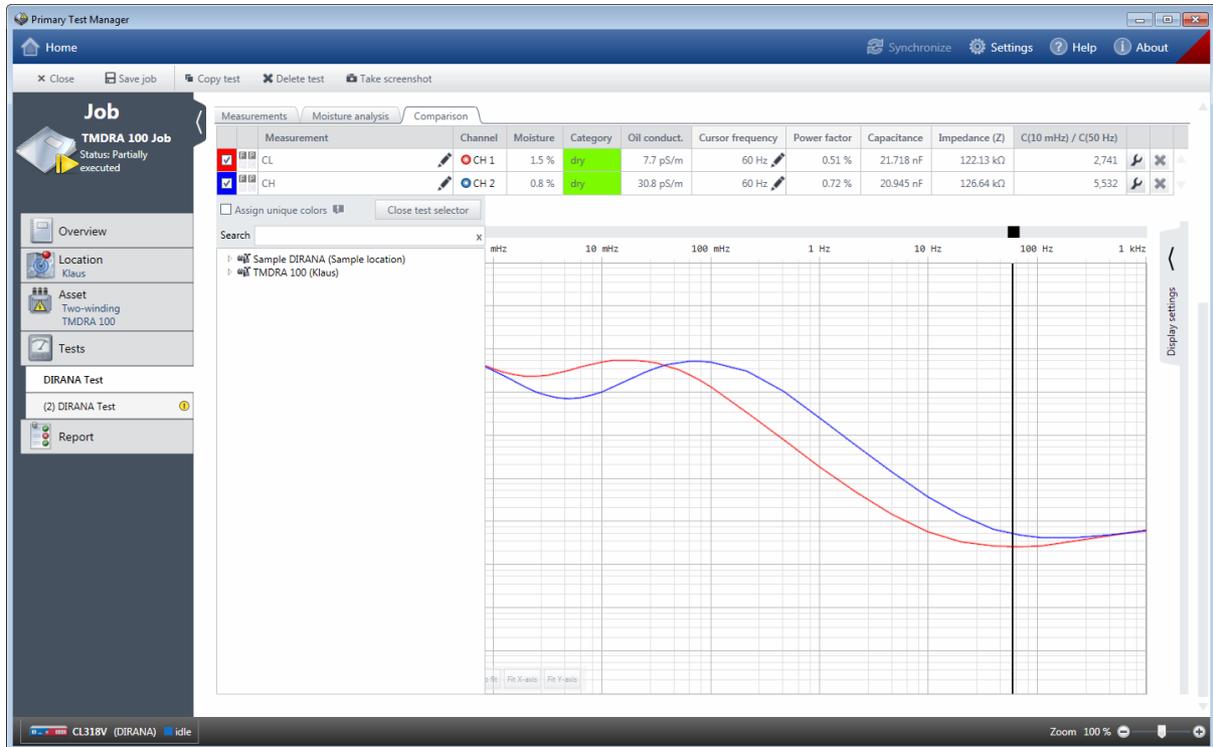


Figure 12-6: Example of a measurement comparison

- Compare the measurements visually.

Advanced data processing

With *Primary Test Manager*, you can further process the measurement data in the comparison view. You can:

- Simulate a measurement at another temperature than the measurement was done for comparison
 - Note:** The moisture assessment and the assessment of the oil should only be performed on the original measurement.
- Filter the measured polarization current
- Re-calculate the part of the FDS curve calculated from the PDC measurement to smooth the curve for comparison
- Update moisture analysis after the advanced data processing

Note: The advanced data processing addresses expert users. Use this feature only in well-founded cases.

To access the advanced data processing options, click  next to the measurement you want to process.



Figure 12-7: Advanced data processing window

Table 12-10: Advanced data processing options

Option	Description
Temperature correction (FDS)	
Actual temperature	Temperature at which the measurement was done
Simulated temperature	Temperature at which you want to simulate the measurement
Temperature change	Difference between the simulated temperature and the actual temperature
Pressboard activation energy	Activation energy of the asset's insulation
Noise filter	
Polarization meas. (current)	Noise filtering of the measured polarization current
Miscellaneous options	
Re-calculate calculated part of the curve	Select this option to re-calculate the part of the FDS curve calculated from the PDC measurement, for example, to smooth the curve for comparison. This option is only available for combined FDS and PDC measurements made with <i>Primary Test Manager</i> or the <i>DIRANA</i> software version 1.5 or later.
Update moisture analysis	Select this option if you want to update the moisture analysis after the advanced data processing.

- ▶ To create a modified copy of the selected measurement after the advanced data processing, click **Create a modified copy**.
- ▶ To update the selected measurement after the advanced data processing, click **Update existing measurement**.

12.1.7 Disconnection

To disconnect *DIRANA* from the test object:



WARNING

Death or severe injury caused by high voltage or current possible

- ▶ Before disconnecting *DIRANA* from the test object, observe the five safety rules (see 1.2.2 "Safety rules" on page 7) and all additional relevant laws and internal safety standards.
- ▶ Do not touch the **OUTPUT** connector or any parts of the test setup when the red LED on the *DIRANA* front panel lights continuously or blinks.
- ▶ Always ensure that the device is safely switched off and the sample is discharged before touching any parts of the test setup.

1. Switch off *DIRANA*.
2. Disconnect all clamps and cables from the test object's terminals.
3. Disconnect all cables from *DIRANA*.

12.2 Oil analysis

The Oil analysis is used to add the results of oil analyses performed by an oil laboratory or using a mobile DGA test instrument. The values can be entered directly or imported from an Excel file.

For the dissolved gas in oil values the standard assessments and visualization according to IEEE C57.104-2008 and IEC 60599-2007-05 Edition 2.1. are performed.

The following table describes the Oil analysis settings.

Table 12-11: Oil analysis settings

Setting	Description
Asset	
Asset	Asset under test – set in the asset data (see 11 "Asset data" on page 71)
Tank type	Type of transformer tank
Insulation medium	Insulation medium of the transformer – set in the asset data (see 11 "Asset data" on page 71) Note: The DGA is only valid for the insulation medium Mineral oil .
Oil type	Type of transformer oil
Test conditions	
Sample date	Date of sample collection
Oil sample temperature	Oil temperature at the time of sampling
Measurement	
Analyzed by	Information on how the sample was analyzed <ul style="list-style-type: none"> • Oil lab: The sample was analyzed by a laboratory. After selecting Oil lab, you can enter the Name and Address of the laboratory. • Mobile DGA: The sample was analyzed using a mobile DGA device. After selecting Mobile DGA, you can enter the device Manufacturer/Type and its Serial number. • Online DGA: The sample was analyzed using a permanently installed monitoring device. After selecting Online DGA, you can enter the device Manufacturer/Type and its Serial number.
Use C3 hydrocarbons	Activate the Use C3 hydrocarbons check box to add C ₃ H ₆ and C ₃ H ₈ to the list of Gas in oil values , and to activate ratio assessment according to the MSS scheme.
Sampling point	Sampling point on the transformer tank: <ul style="list-style-type: none"> • Top • Middle • Bottom

The following table describes the gas-in-oil values.

Table 12-12: Gas-in-oil values

Data	Description
TDCG	Total dissolved combustible gas
TDG	Total dissolved gas
TCGe	Estimation of the percentage of total combustible gas in the gas space. It will only correspond to the actually measured value if there is a balance between the gas blanket and the oil.
Lab. result	Assessment result of the laboratory according to the IEEE or IEC standard.
Assessment	Manual Gas-in-oil analysis assessment: <ul style="list-style-type: none">• Manual pass• Manual fail• Manual investigate• Not assessed

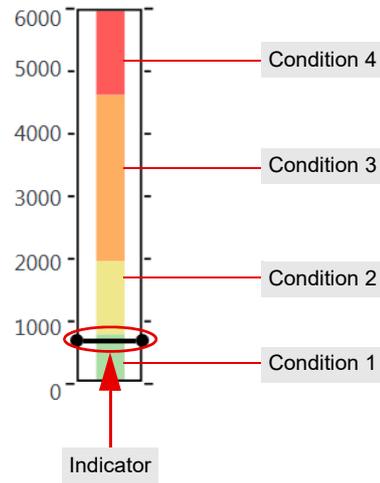
Assessment summary

The results are assessed using the following interpretation methods:

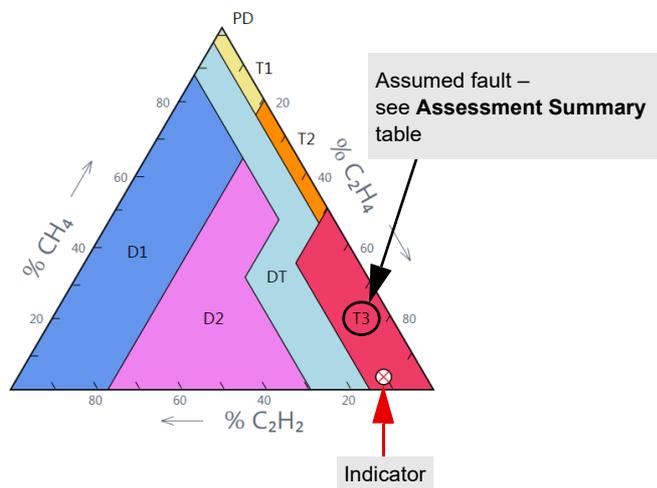
- Duval's triangles (see Table 12-13)
- IEC basic gas ratios
- Roger's ratios
- Doernenburg's ratios
- Key gases according to IEEE C57.104 and IEC60599 (see Table 12-13)
- MSS scheme

Table 12-13: Examples of result visualization in the **Assessment Summary** section

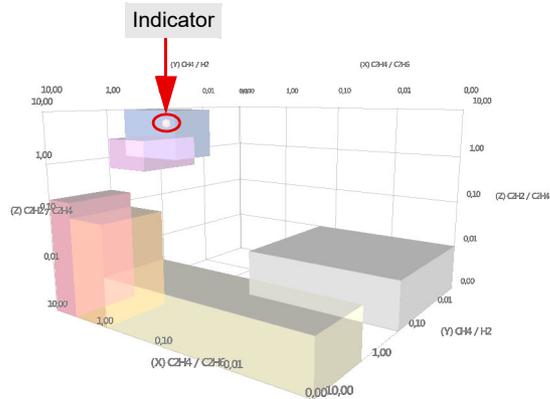
Key gas ranges and conditions according to IEEE C57.104



Duval's triangle 1



Key gas ranges and conditions according to IEC 60599, visualized in 3D



Assessment details

- The **Table** contains condition ranges and states for individual gases.
- The **Ratio Table** lists all used gas ratios, depending on the selected standard, and provides an **Interpretation** of the recorded values.

Table 12-14: Assessment Details

Data	Description
Table	
Standard	Standard used for the condition assessment
Overall assessment	Condition fulfilled by the measured value of an individual gas
TDCG ppm/day	Increase in TDCG per day since the last measurement
Recommendation	Recommended interval for future measurements
Ratio Table	
Sample Date	Date of the sampling

Duval triangle

Duval's triangles visualize faults in a triangular coordinate system (see Table 12-13).

- Triangle 1: gases formed by faults of low to high energy
- Triangle 4: gases formed more specifically by faults of low energy or temperature
- Triangle 5: gases formed more specifically by faults of high temperature

Pattern

The key gas results are visually compared to four reference patterns. If a reference graph matches the measured value, it is highlighted.

Physico-chemical oil analysis

The following table describes the physico-chemical oil analysis data.

Table 12-15: Physico-chemical oil analysis data

Data	Description
Water content	
H ₂ O meas.	Measured water content in oil
H ₂ O @ 20 °C	Calculated water content in oil
Relative saturation	Relative water saturation
Assessment	Water content assessment
DC conductivity	
Meas. value	Measured DC conductivity
Test temperature	Temperature of the oil during DC conductivity test
Field strength	Field strength

Table 12-15: Physico-chemical oil analysis data (continued)

Data	Description
Assessment	DC conductivity assessment
Power factor	
Standard	Standard underlying the power factor analysis
Meas. value @ 25 °C	Power factor measured at 25 °C
Meas. value @ 100 °C	Power factor measured at 100 °C
Assessment	Power factor assessment
Dielectric breakdown voltage	
Standard	Standard underlying the dielectric breakdown voltage analysis
Meas. value	Measured dielectric breakdown voltage
Test temperature	Oil temperature during dielectric breakdown voltage test
Assessment	Dielectric breakdown voltage assessment
Chemical	
Interfacial tension	Interfacial tension of the oil
Neutralization value	Neutralization value of the oil
Particle count	Particle count of the oil
Color	Color of the oil
Assessment	Chemical assessment

The following table describes the test status.

Table 12-16: Test status

Status	Description
Prepared	See Table 6-1: "Job statuses" on page 37.
Partially executed	
Executed	

Note: The test status set in the Oil analysis is displayed in the job overview (see 6.2 "Job overview" on page 39) under **Tests**.

12.3 Insulation Resistance test

The Insulation Resistance test is used to import or enter data from an insulation testing device.

Table 12-17: Insulation Resistance test settings

Setting	Description
Test conditions	
Test object temperature	Temperature of the test object
Custom test conditions	Activate the Custom test conditions check box to set test conditions differing from the global test conditions.
Ambient temperature	Ambient temperature on site
Humidity	Relative ambient humidity
Calculations	
PI calculation	Calculation of polarization index
Time 1	In the standard PI calculation, the testing device is applied and insulation resistance measurements are taken after 60 seconds (Time 1) and 600 seconds (Time 2). The polarization index (PI) is calculated as follows: $PI = \frac{R_{600}}{R_{60}}$
Time 2	
DAR calculation	Calculation of dielectric absorption ratio
Time 1	In the standard DAR calculation, the testing device is applied and insulation resistance measurements are taken after 30 seconds (Time 1) and 60 seconds (Time 2). The dielectric absorption ratio (DAR) is calculated as follows: $DAR = \frac{R_{60}}{R_{30}}$
Time 2	
Correction factors	
Temperature correction	Select the Temperature correction check box to activate temperature correction.
Correction temp.	Temperature correction factor

Table 12-18: Insulation Resistance measurement data

Setting	Description
Test data	<p>To import a file containing test data:</p> <ul style="list-style-type: none"> ▶ Press Add  to browse your computer and add data from a file. <p>To directly import data from a measurement file:</p> <ul style="list-style-type: none"> ▶ Open the file on your computer. ▶ In the file press CTRL+A to mark all content, and then press CTRL+C to copy. ▶ In <i>Primary Test Manager</i> press Paste from clipboard. The results may take a few seconds to load.
Measurement	Name or number of the measurement
PI	Polarization index
DAR	Dielectric absorption ratio
Time	Time at which the given values were recorded
Voltage	Voltage and current values recorded at the Time specified in the first column
V DC	
I DC	

13 Technical data

Table 13-1: DIRANA specifications

Characteristic	Rating
Test modes	
UST, GST, GSTg	
Voltage source	
Measurement voltage	$\pm 200 V_{\text{peak}}$
Max. continuous output current	$50 \text{ mA}_{\text{peak}}$
PDC	
Current measurement	
Range	$\pm 10 \text{ mA}$
Resolution	0.1 pA
Input resistance	2 k Ω
Accuracy	0.5 % \pm 1 pA
FDS	
Measurement voltage	$200 V_{\text{peak}}$
Measurement current	$\pm 50 \text{ mA}_{\text{peak}}$
Dissipation factor	
Range	0...10
Accuracy¹	
1 mHz < f < 100 Hz	1 % + 3×10^{-4}
f < 1 mHz and f > 100 Hz	2 % + 5×10^{-4}
Capacitance	
Range	10 pF...100 μ F
Accuracy	0.5 % + 1 pF
Ranges for combined FDS and PDC measurements	
Frequency	10 μ Hz...5 kHz

1. For capacitances > 100 pF and using default settings

Table 13-2: Power requirements

Characteristic	Rating
Input voltage/power	10 V...24 V DC/24 W

Table 13-3: Power supply specifications

Characteristic	Rating
Input	
Voltage	85 V...264 V
Frequency	50 Hz/60 Hz
Power	40 W max.
Output	
Voltage	12 V _{DC}
Current	3.34 A max.

Table 13-4: Climate

Characteristic	Rating	
Temperature	Operating	-10 °C...+55 °C/+14 °F...+131 °F
	Storage	-35 °C...+65 °C/-31 °F...+149 °F
Max. altitude (air pressure)	Operating	70 kPa...106 kPa
	Storage	70 kPa...106 kPa

Table 13-5: Mechanical data

Characteristic	Rating
Dimensions (w × h × d)	260 mm × 50 mm × 265 mm/10.25 inch × 2 inch × 10.5 inch
Weight of instrument	<2.3 kg/5 lb (without measuring cables)

Table 13-6: Standards conformity

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

14 TMDRA 100

14.1 Designated use

The *TMDRA 100* is an accessory to the *DIRANA* test system for performing two-channel measurements in the laboratory, delivering typical dielectric response characteristics of transformers as shown later in this chapter. The moisture analysis can be done as for real measurements. The *TMDRA 100* is a demo box used for demo and training purposes. It can also be used to verify the integrity of the device and measurement cables.

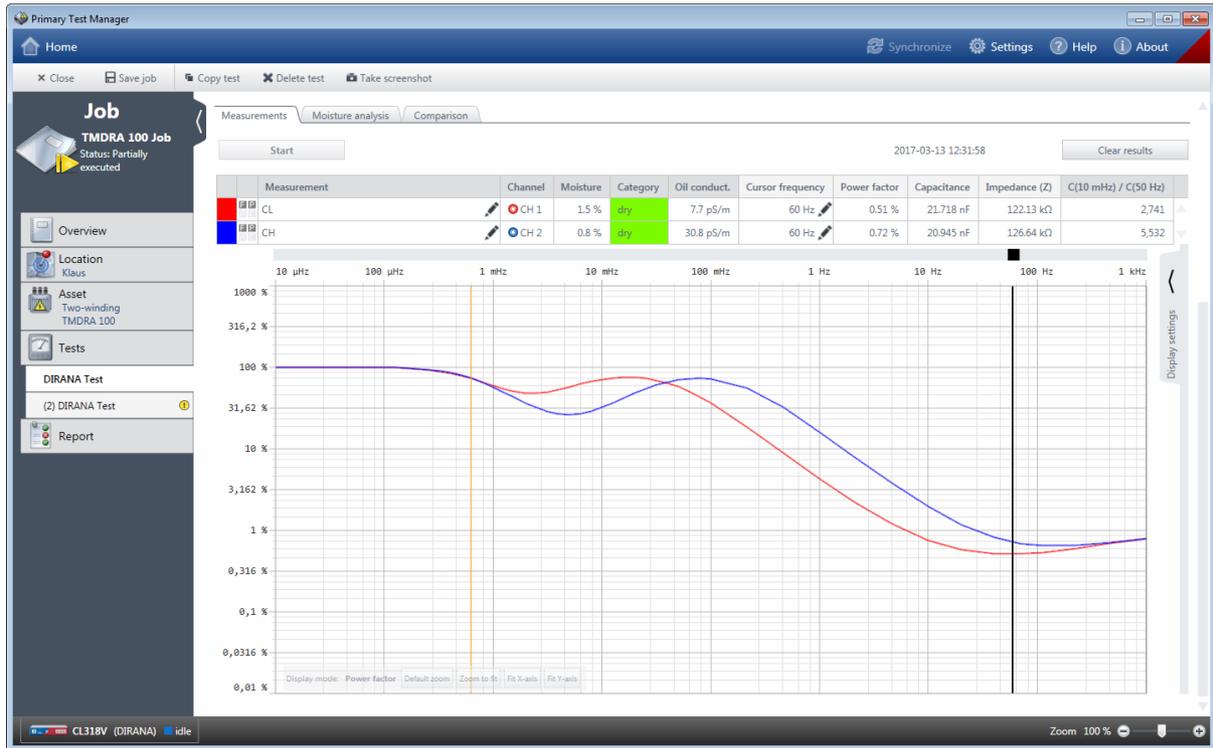


Figure 14-1: Typical dielectric response characteristics measured with the *TMDRA 100*

14.2 Interfaces

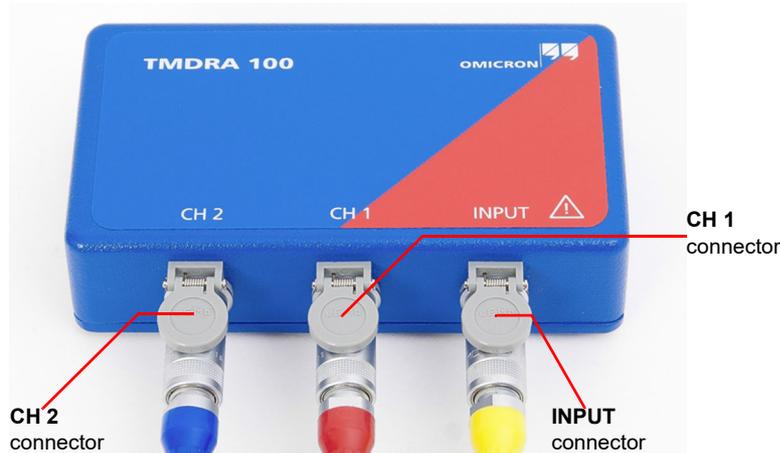


Figure 14-2: TMDRA 100

Table 14-1: TMDRA 100 interfaces

Interface	Description
CH 1 connector	Channel 1 output (connect to the channel 1 of DIRANA)
CH 2 connector	Channel 2 output (connect to the channel 2 of DIRANA)
INPUT connector	Signal source input (connect to the output of DIRANA)

14.3 Application

This section describes the application of the TMDRA 100 demo box.

14.3.1 Connection

To connect the TMDRA 100 to the DIRANA test system:

1. Connect the **CH 2** connector of the TMDRA 100 to the **CH 2** connector of DIRANA by using the blue triaxial cable.
2. Connect the **CH 1** connector of the TMDRA 100 to the **CH 1** connector of DIRANA by using the red triaxial cable.
3. Connect the **INPUT** connector of the TMDRA 100 to the **OUTPUT** connector of DIRANA by using the yellow triaxial cable.
4. Connect DIRANA to your computer (see 4.1 "Connect DIRANA to the computer" on page 18).
5. Power up DIRANA (see 4.2 "Power up DIRANA" on page 18).

14.3.2 Measurement

The TMDRA 100 can be used as a one-winding or a two-winding transformer for both single-phase and three-phase configuration.

- ▶ Perform dielectric response analysis measurements as described in 12.1 "DIRANA test" on page 84.

14.3.3 Disconnection

1. Switch off *DIRANA* by pressing the power switch on the *DIRANA* rear panel.

WARNING



Death or severe injury caused by high voltage or current

- ▶ Do not touch the *DIRANA* connectors and the connected cables while the red LED on the *DIRANA* front panel is on or flashing.
- ▶ Wait until the red LED is off before disconnecting the cables.

2. Disconnect the color-coded triaxial cables from the **CH 1**, **CH 2** and **INPUT** connectors of the *TMDRA 100*.

14.4 Technical data

Table 14-2: TMDRA 100 specifications

Characteristic		Rating
Input voltage		$\pm 200 V_{\text{peak}}$
CH 1¹		
Tan(δ)	@ 0.1 Hz	0.409
	@ 50 Hz	0.004
Capacitance	@ 0.1 Hz	21.0 nF
	@ 50 Hz	20.3 nF
CH 2¹		
Tan(δ)	@ 0.1 Hz	1.026
	@ 50 Hz	0.007
Capacitance	@ 0.1 Hz	30.1 nF
	@ 50 Hz	20.4 nF

1. Typical ratings at +25 °C/+77 °F

Table 14-3: Climate

Characteristic		Rating
Temperature	Operating	-10 °C...+55 °C/+14 °F...+131 °F
	Storage	-20 °C...+70 °C/-4 °F...+158 °F
Max. altitude		2000 m

Table 14-4: Mechanical data

Characteristic	Rating
Dimensions (w × h × d)	115 mm × 70 mm × 30 mm/4.5 inch × 2.8 inch × 1.2 inch
Weight	177 g/0.4 lb

Table 14-5: Standards conformity

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

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