

FRANEO 800 PTM

User Manual



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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.

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About this manual

This User Manual provides information on how to use the *FRANEO 800* test system safely, properly and efficiently. The *FRANEO 800* PTM User Manual contains important safety instructions for working with *FRANEO 800* and gets you familiar with operating *FRANEO 800*. 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 *FRANEO 800* PTM User Manual always has to be available on the site where *FRANEO 800* is used. The users of *FRANEO 800* must read this manual before operating *FRANEO 800* and observe the safety, installation, and operation instructions therein.

Reading the *FRANEO 800* 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 *FRANEO 800* and its accessories. Before starting to work, clearly establish the responsibilities.

Personnel receiving training, instructions, directions, or education on *FRANEO 800* must be under constant supervision of an experienced operator while working with the equipment. The operator is responsible for the safety requirements during the whole test.

1.2 Safety standards and rules

1.2.1 Safety standards

Testing with *FRANEO 800* 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 *FRANEO 800* and its accessories, read the safety instructions in this User Manual carefully.

Do not turn on *FRANEO 800* and do not operate *FRANEO 800* without understanding the safety information in this manual. If you do not understand some safety instructions, contact OMICRON before proceeding.

Maintenance and repair of *FRANEO 800* and its accessories is only permitted by qualified experts at OMICRON Service Centers (see "Support" on page 100).

1.2.2 Safety rules

Always observe the five safety rules:

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

1.2.3 Safety accessories

OMICRON offers a range of accessories for added safety during the operation of our test systems. For further information and specifications, refer to the corresponding Supplementary Sheet or contact OMICRON Support.

1.3 Operating the measurement setup

- ▶ Before handling *FRANEO 800* 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 power transformer under test.
- ▶ Make sure that the ground terminal of the power transformer is in good condition, clean and free of oxidation.
- ▶ Before disconnecting the power transformer under test from *FRANEO 800*, ground all transformer's connections.
- ▶ Do not open the *FRANEO 800* housing.
- ▶ Do not repair, modify, extend, or adapt *FRANEO 800* or its accessories.
- ▶ Use only the *FRANEO 800* original accessories available from OMICRON.
- ▶ Use *FRANEO 800* and its accessories only in a technically sound condition and when its use is in accordance with the regulations. In particular, avoid disruptions that could in turn affect safety.

1.4 Orderly measures

The *FRANEO 800* PTM User Manual or alternatively the e-book has always to be available on the site where *FRANEO 800* is operated.

The users of *FRANEO 800* must read this manual before operating *FRANEO 800* and observe the safety, installation, and operation instructions therein.

FRANEO 800 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 *FRANEO 800* 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

3.1 Frequency response analysis (FRA)

Power transformers are essential components of any power transmission and distribution system. The strong electrodynamic forces resulting from short-circuit faults in the power system and the high acceleration potentially emerging during transportation can give rise to severe deformations of the transformer windings and mechanical construction. Transformers can also be exposed to stress during installation and due to inrush current or seismic occurrences.

Consequently, the mechanical construction and the windings of power transformers are subject to high mechanical stress. Depending on the grade of the overstressing, this may cause mechanical deformation or defects of the transformer windings and magnetic core.

The equivalent circuit of the transformer winding includes the coil's resistance and inductance as well as parasitic capacitances between consecutive turns and between the winding and the tank wall and the core. Figure 3-1: "Equivalent circuit of the transformer winding" on page 10 shows the circuitry of discrete RLC elements. The frequency response of the particular transformer winding is a unique characteristic depending on the transformer's mechanical construction. Deformations of the transformer's mechanical construction cause altering the values of the RLC elements and, consequently, the frequency response of the transformer windings changes. By measuring the frequency response of the transformer windings in a wide frequency range, defects in the windings and magnetic core of power transformers can be diagnosed.

The following figure shows the equivalent circuit of the transformer winding.

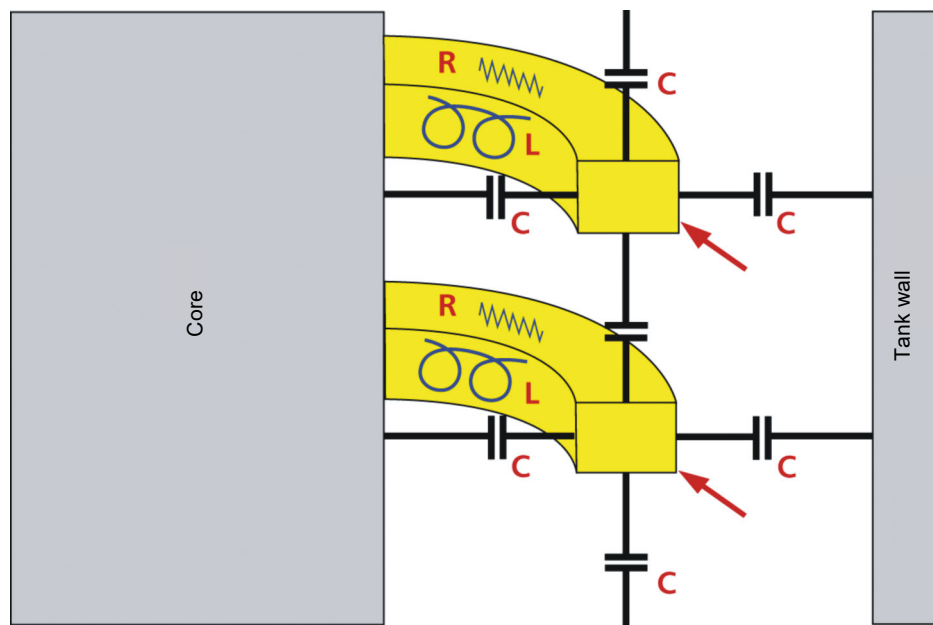


Figure 3-1: Equivalent circuit of the transformer winding

The following figure compares the frequency responses of the phase U, V and W windings of a power transformer with those in a healthy condition. The deviations of the FRA measurement results indicate that the U and W phase windings might have a defect.

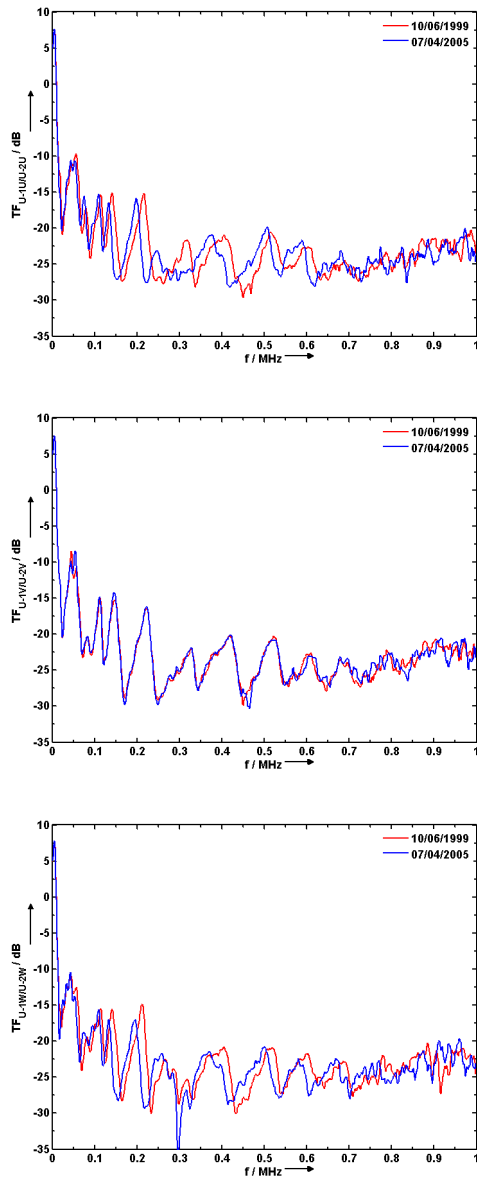


Figure 3-2: FRA measurement results

The following figure shows the windings of the phase U and the radial displacements of the windings.



Figure 3-3: Radial coil deformation

3.2 Designated use

FRANEO 800 is a sweep frequency response analyzer for power transformer core and winding diagnosis. Its concept – universal hardware controlled by *Primary Test Manager* running on a computer – makes *FRANEO 800* an efficient and flexible solution for the diagnosis of power transformer windings and magnetic cores.

FRANEO 800 evaluates the frequency response of the transformer windings by using the sweep frequency response analysis (SFRA) in the frequency domain. Figure 3-4: "Sweep frequency response analysis" shows the measurement procedure. A sinusoidal voltage with constant amplitude and variable discrete frequencies is applied to the winding under test and the frequency of the input signal is successively increased. The amplitude and phase of the output signal is measured against the frequency and the output-to-input amplitude ratio and the phase shift between the output and input signals are evaluated.

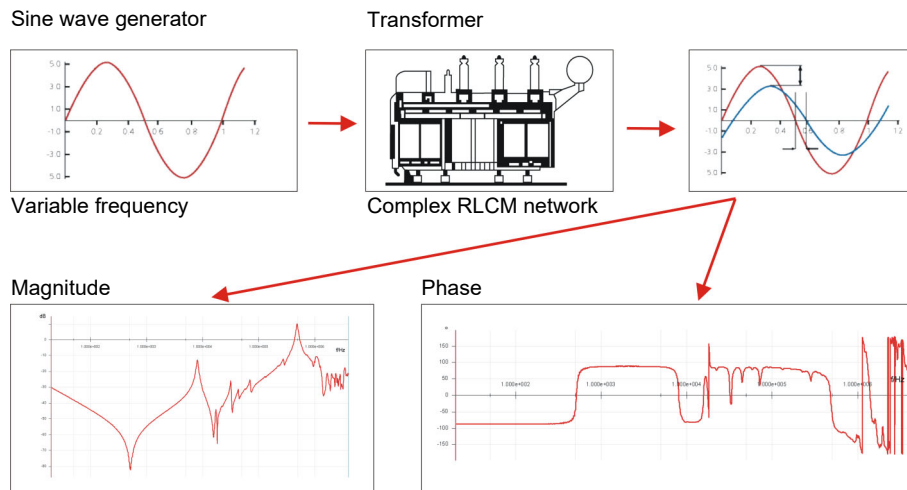


Figure 3-4: Sweep frequency response analysis

FRANEO 800 measures the frequency response of the transformer windings in a wide frequency range and compares it with that in a healthy condition. From the frequency response deviations, you can diagnose many different types of defects in the transformer winding and magnetic core. These include:

- Coil deformation – axial and radial
- Faulty core grounds
- Partial winding collapse
- Hoop buckling
- Broken or loose clamps
- Shorted turns and open windings
- Core deformation

With *FRANEO 800*, you can measure the magnitude and phase, the impedance and the admittance frequency responses of the transformer windings. The measurement results are available on your computer for further processing and documentation.

FRANEO 800 operates only when connected to an external computer with USB interface. With *Primary Test Manager* running on the computer, you can define, parametrize, and execute automated FRA tests.

3.3 Connections and operating controls

The following figures describe the connections and operating controls of *FRANEO 800*.

3.3.1 Front panel

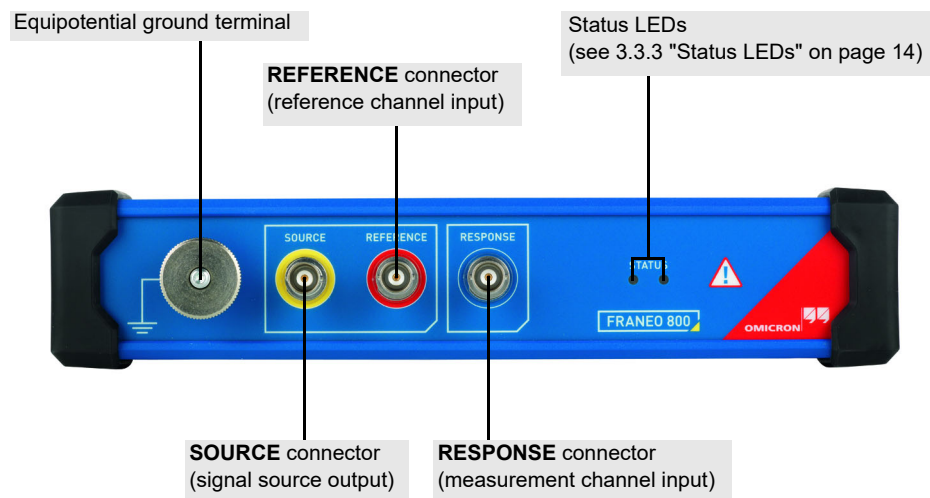


Figure 3-5: Front view of *FRANEO 800*

3.3.2 Rear panel

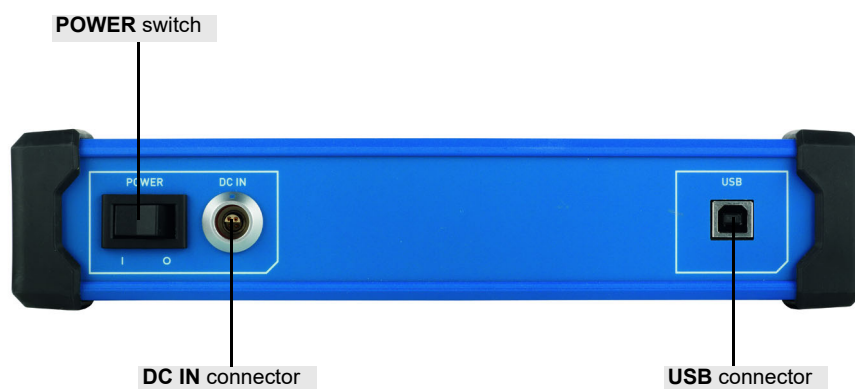


Figure 3-6: Rear view of *FRANEO 800*

3.3.3 Status LEDs

The following table describes the status LEDs.

Table 3-1: Status LEDs

LED	Description
Green	The LED lights when power is on and no measurement is being performed.
Red	The LED lights when power is on and a measurement is being performed.

3.4 *Primary Test Manager*

Primary Test Manager is a control software for testing power transformers with the *FRANEO 800* test system. *Primary Test Manager* provides a computer interface to *FRANEO 800* and assists you with the hardware configuration and test analysis.

With *Primary Test Manager*, you can create guided workflows, execute prepared jobs, and manage jobs. After you have performed a test, you can generate exhaustive test reports. *Primary Test Manager* runs on a computer and communicates with *FRANEO 800* through USB interface.

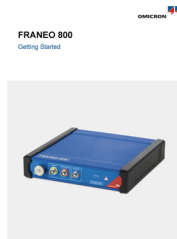
For detailed information about *Primary Test Manager*, see the relevant chapters in the *FRANEO 800 PTM User Manual*.

3.5 Delivery

The *FRANEO 800* delivery includes:



Transport case



FRANEO 800 Getting Started



Primary Test Manager DVD



AC power supply and battery charger (including international mains plug adapters)



FRANEO 800



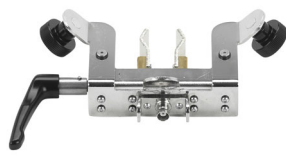
RBP1 rechargeable battery pack



Battery connection cable



USB 2.0 A/B cable
2.0 m/6.6 ft



2 × Bushing clamp



4 × Aluminum braid
25 mm² roll



Grounding cable
(GR/YE) 6 m/20 ft, 6 mm



3 × Carabiner for cable
relief



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



50 Ω coaxial cable
18 m/60 ft (red)



50 Ω coaxial cable
18 m/60 ft (blue)



4 × Screw clamp



Insulation sleeve



Crank handle



File



BNC T adapter

3.6 Cleaning

WARNING



Death or severe injury caused by high voltage or current possible

- ▶ Do not clean the *FRANEO 800* test set when connected to the test object.
- ▶ Before cleaning *FRANEO 800* and its accessories, always disconnect the test object, accessories and connection cables.

To clean *FRANEO 800* and its accessories, use a cloth dampened with isopropanol alcohol.

4 Functional scheme

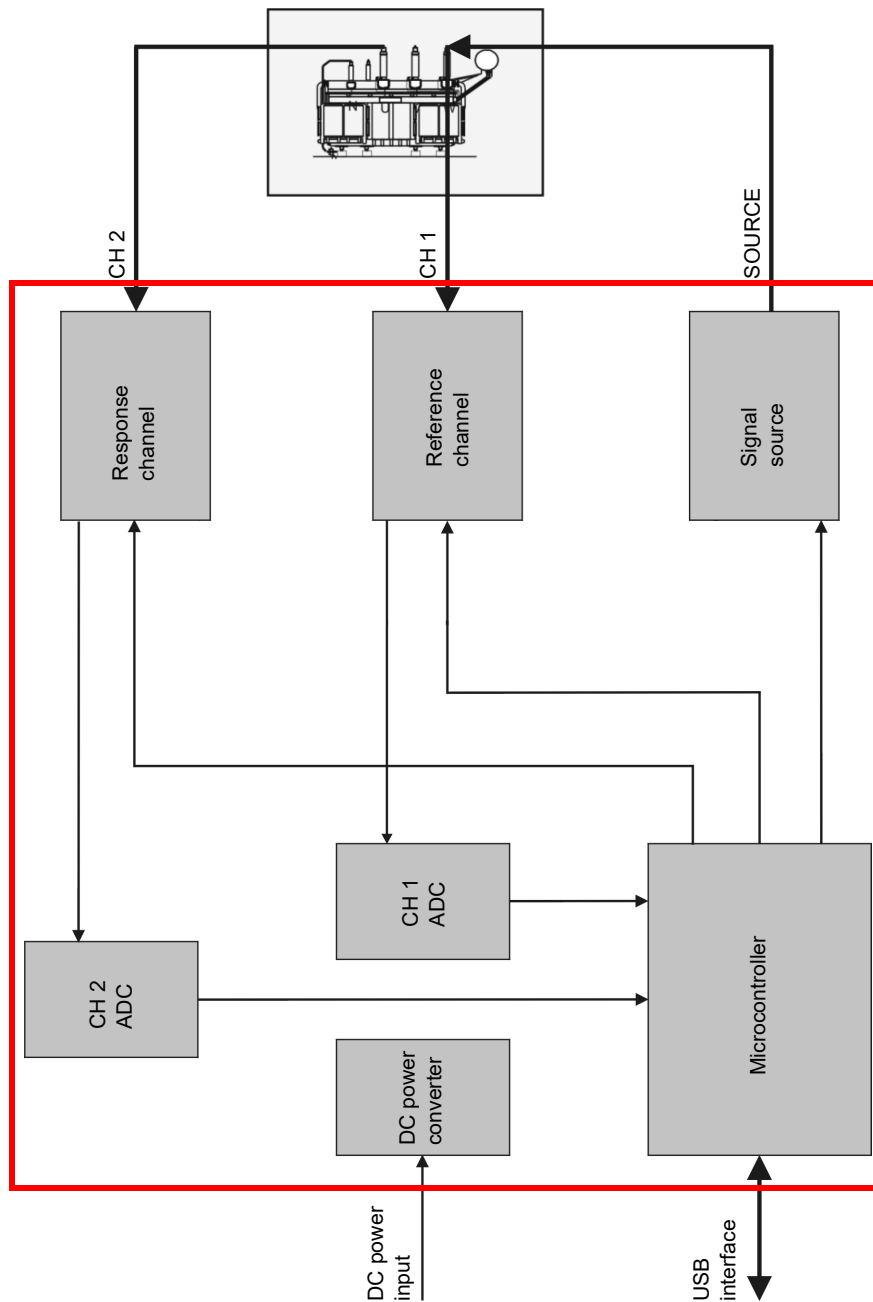


Figure 4-1: *FRANEO 800* functional scheme

5 Installation

Before installing *FRANEO 800*, check the environmental and power requirements (see "Technical data" in the *FRANEO 800 PTM User Manual*).

5.1 Install *Primary Test Manager*

Note: Install *Primary Test Manager* before connecting *FRANEO 800* to the computer.

For the minimum requirements your computer needs to run *Primary Test Manager*, see 2 "System requirements" on page 9.

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. For detailed instructions about how to migrate your data from the *FRAnalyzer* software database into *Primary Test Manager*, see 5.2 "Migrate the *FRAnalyzer* data" later in this chapter.

5.2 Migrate the *FRAnalyzer* data

You can migrate your data available in the *FRAnalyzer* software into *Primary Test Manager*.

NOTICE

You can migrate data in *FRAnalyzer* 2.2 format.

- If your data is available in an earlier version of the *FRAnalyzer* software, update the software to version 2.2 before migrating the data. You can download the *FRAnalyzer* software 2.2 from the OMICRON customer area.

The migration procedure differs according to whether the *FRAnalyzer* software is installed on the same computer or on another computer as *Primary Test Manager*. The following sections describe in detail the different scenarios.

NOTICE

PTM FRAnalyzer Migration Assistant migrates all data available in the *FRAnalyzer* software database into *Primary Test Manager*. If you do not want to migrate all data:

- Back up the *FRAnalyzer* software database, delete the data you do not want to migrate, and then start *PTM FRAnalyzer Migration Assistant*.

NOTICE

Duplication of data possible

Importing .dbefra files created with *PTM FRAnalyzer Migration Assistant* that come from the same database already migrated to *Primary Test Manager* could lead to duplication of data.

Importing .fra or .tfra files that come from the same database already migrated to *Primary Test Manager* could lead to duplication of data.

Scenario I

The *FRAnalyzer* software and *Primary Test Manager* are installed on the same computer

To migrate the *FRAnalyzer* data if the *FRAnalyzer* software and *Primary Test Manager* are installed on the same computer:

1. If you selected during the installation procedure *FRANEO 800* as your test system and the *FRAnalyzer* software 2.0 or later is installed on your computer, *Primary Test Manager* Setup installs *PTM FRAnalyzer Migration Assistant* on your computer.
2. When *Primary Test Manager* Setup prompts you for migration of the *FRAnalyzer* data, do one of the following:
 - ▶ Select **Start PTM FRAnalyzer Migration Assistant after setup completion** to migrate data from the *FRAnalyzer* software database into *Primary Test Manager* automatically after *Primary Test Manager* Setup is completed.
 - ▶ Select **Create PTM FRAnalyzer Migration Assistant shortcut on the desktop** to create a shortcut on desktop for migration of data from the *FRAnalyzer* software database into *Primary Test Manager* when you want.
3. If you selected **Create PTM FRAnalyzer Migration Assistant shortcut on the desktop** and want to migrate the data now, proceed as follows.
4. Start *PTM FRAnalyzer Migration Assistant*.
5. To export the data, follow the instructions provided by the *PTM FRAnalyzer Migration Assistant*.
6. Start *Primary Test Manager*.
7. In the home view, click the **Manage** button .
8. Under **Jobs**, click the **Import** button .
9. In the **Open** dialog box, select *FRAnalyzer* 2.2 database export (*.dbefra) data format.
10. Browse to the file you want to import.

Scenario II

The *FRAnalyzer* software and *Primary Test Manager* are installed on different computers

To migrate the *FRAnalyzer* data if the *FRAnalyzer* software and *Primary Test Manager* are installed on different computers:

1. Do one of the following:
 - ▶ Put the delivered *Primary Test Manager* DVD in the DVD drive of the computer the *FRAnalyzer* software is installed on, and then go to the directory *PTM_FRAnalyzer_Migration_Assistant*.
 - ▶ Download the *PTM FRAnalyzer Migration Assistant* Setup from the OMICRON customer area.
2. Start *PTM FRAnalyzer Migration Assistant* Setup to create a shortcut on the desktop.
3. Start *PTM FRAnalyzer Migration Assistant*.
4. To export the data, follow the instructions provided by the *PTM FRAnalyzer Migration Assistant*.
5. Copy the exported data to a removable storage device such the USB flash drive.
6. Install the removable storage device on the computer *Primary Test Manager* is installed on.
7. Start *Primary Test Manager*.
8. In the home view, click the **Manage** button .
9. Under **Jobs**, click the **Import** button .

10. In the **Open** dialog box, select FRAnalyzer 2.2 database export (*.dbefra) data format.

11. Browse to the file you want to import.

5.3 Power up *FRANEO 800*

You can power *FRANEO 800* with the delivered AC power supply¹ or from the *RBP1* lithium-ion battery pack.

5.3.1 Powering with the AC power supply

To power *FRANEO 800* by using the delivered AC power supply:

1. Plug the DC output connector of the AC power supply into the **DC IN** connector on the *FRANEO 800* rear panel (see Figure 3-6: "Rear view of FRANEO 800" on page 14).
2. Fit the mains plug of the AC power supply to the power outlet, if necessary.
3. Connect the mains plug of the AC power supply to the power outlet.
4. Press the **POWER** switch on the *FRANEO 800* rear panel.
When power is on, the green LED on the *FRANEO 800* front panel lights up.

1. The delivered AC power supply is a battery charger for the *RBP1* lithium-ion battery pack. It is suitable for powering *FRANEO 800* directly, too.

5.3.2 Powering from the *RBP1* battery pack

To power *FRANEO 800* from the *RBP1* battery pack:

1. Plug the red marked end of the battery connection cable shipped with the *RBP1* into the **OUTPUT** connector of the battery pack.
2. Plug the blue marked end of the battery connection cable into the *FRANEO 800* **DC IN** connector.

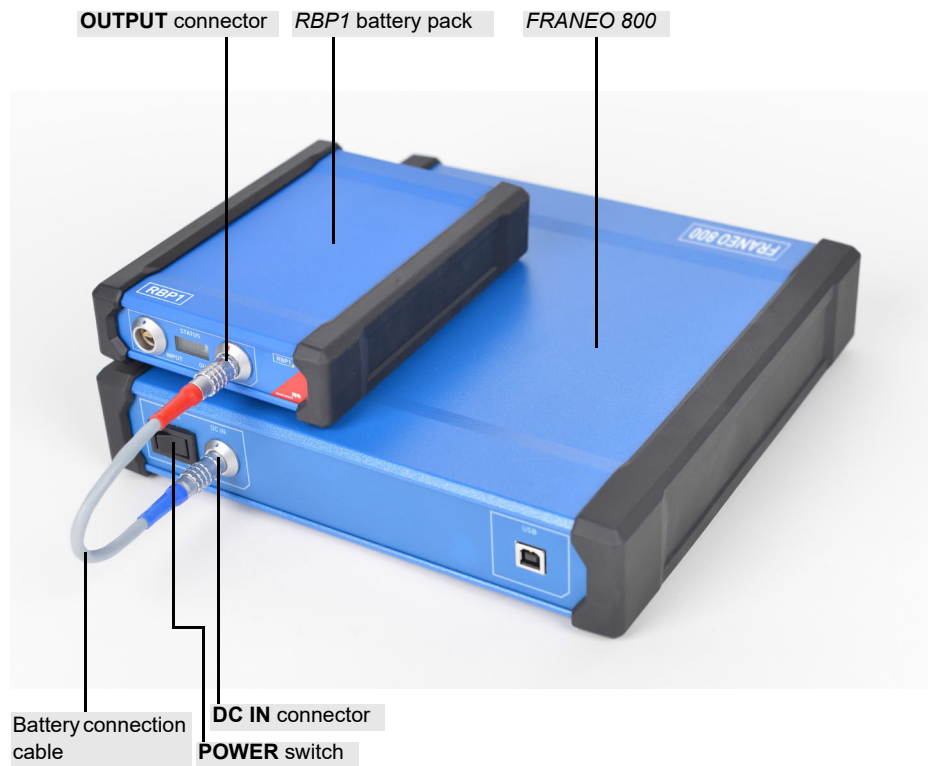


Figure 5-1: Powering *FRANEO 800* from the *RBP1* battery pack

3. Press the **POWER** switch on the *FRANEO 800* rear panel.
When power is on, the green LED on the *FRANEO 800* front panel lights up.

5.3.3 Charging the *RBP1* battery pack

Use only the delivered AC power supply to charge the *RBP1* battery pack. You can charge the *RBP1* even while powering *FRANEO 800* during a test. For more information, see "RBP1 Rechargeable battery pack" in the *FRANEO 800* PTM User Manual.

5.4 Connect *FRANEO 800* to the computer

FRANEO 800 communicates with the computer through USB interface. To connect *FRANEO 800* to the computer:

1. Connect the delivered USB 2.0 A/B cable to the *FRANEO 800* **USB** connector.
2. Connect the USB 2.0 A/B cable to the USB connector of your computer.

NOTICE

Equipment damage possible

- ▶ Do not to crush the cables when closing the transport case.
- ▶ Always place the cables carefully within the transport case when closing it.



Figure 5-2: Connecting *FRANEO 800* to the computer by using the delivered USB 2.0 A/B cable

5.5 Start *Primary Test Manager* and connect to *FRANEO 800*

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 *FRANEO 800*, select the device in the list, and then click **Connect**.

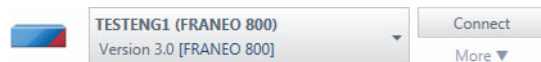


Figure 5-3: Connecting to *FRANEO 800*

Alternatively, you can manage the connection to *FRANEO 800* in the *Primary Test Manager* status bar (see "Status bar" in the *FRANEO 800* PTM User Manual).

5.6 Connect *FRANEO 800* to the power transformer

For testing a power transformer, the test traces are defined by the test. For each test trace, *Primary Test Manager* assigns the **SOURCE**, **REFERENCE** and **RESPONSE** connectors of *FRANEO 800* to the transformer's terminal bushings. To connect *FRANEO 800* to the power transformer under test:

1. Fasten a bushing clamp to the transformer's terminal bushing to be connected to the **REFERENCE** connector according to the wiring diagram displayed in the General area of the *Primary Test Manager* test view.
2. Connect the yellow and red coaxial cables to the BNC connector on the bushing clamp by using a delivered BNC adapter.

NOTICE

Equipment damage possible

- ▶ Do not connect the coaxial cables to the bushing clamp without relieving the pressure on the BNC shield.
- ▶ Always attach the coaxial cables by provided cord loops and the delivered carabiner to the ring of the bushing clamp's strap as shown in Figure 5-4: "Connecting the yellow and red coaxial cables to the bushing clamp by using the mechanism for relieving the pressure on the BNC shield" on page 24.

3. Connect the aluminum braid to the bushing clamp by using the screw on the bushing clamp and tighten the screw. If necessary, use the delivered insulation sleeve to prevent electrical contact between the aluminum braid and the bushing.

Note: In the past, we have recommended using two aluminum braids for grounding the bushing clamps. Based on the recommendations given by the IEC 60076-18 standard, only one aluminum braid should be used. If you made previous measurements with two aluminum braids we recommend repeating the measurements with the same connection technique.

NOTICE

Equipment damage possible

- ▶ Do not apply force when handling the aluminum braids to prevent breaking the small strands.
- ▶ Always bend and pull the aluminum braids carefully.



Figure 5-4: Connecting the yellow and red coaxial cables to the bushing clamp by using the mechanism for relieving the pressure on the BNC shield

4. Connect the aluminum braid to the transformer's tank by using the screw clamp.

Note: We recommend activating the ground-loop check in *Primary Test Manager* before performing the measurement for checking the quality of the contact. This ensures a proper measurement setup and increases the reproducibility of the measurements.



Figure 5-5: Fastening the screw clamp



Figure 5-6: Alternative way of fastening the screw clamp

5. Fasten a bushing clamp to the transformer's terminal bushing to be connected to the **RESPONSE** connector according to the wiring diagram displayed in the General area of the *Primary Test Manager* test view.

6. Connect the blue coaxial cable to the BNC connector on the bushing clamp.

NOTICE

Equipment damage possible

- ▶ Do not connect the coaxial cable to the bushing clamp without relieving the pressure on the BNC shield.
- ▶ Always attach the coaxial cable by provided cord loop and the delivered carabiner to the ring of the bushing clamp's strap as shown in the following figure.



Figure 5-7: Connecting the blue coaxial cable to the bushing clamp by using the mechanism for relieving the pressure on the BNC shield

7. To ground the bushing clamp, repeat steps 3 and 4.
8. Connect the other ends of the three BNC cables to the corresponding color-coded **SOURCE**, **REFERENCE** and **RESPONSE** connectors on the front panel of *FRANEO 800*.

6 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.

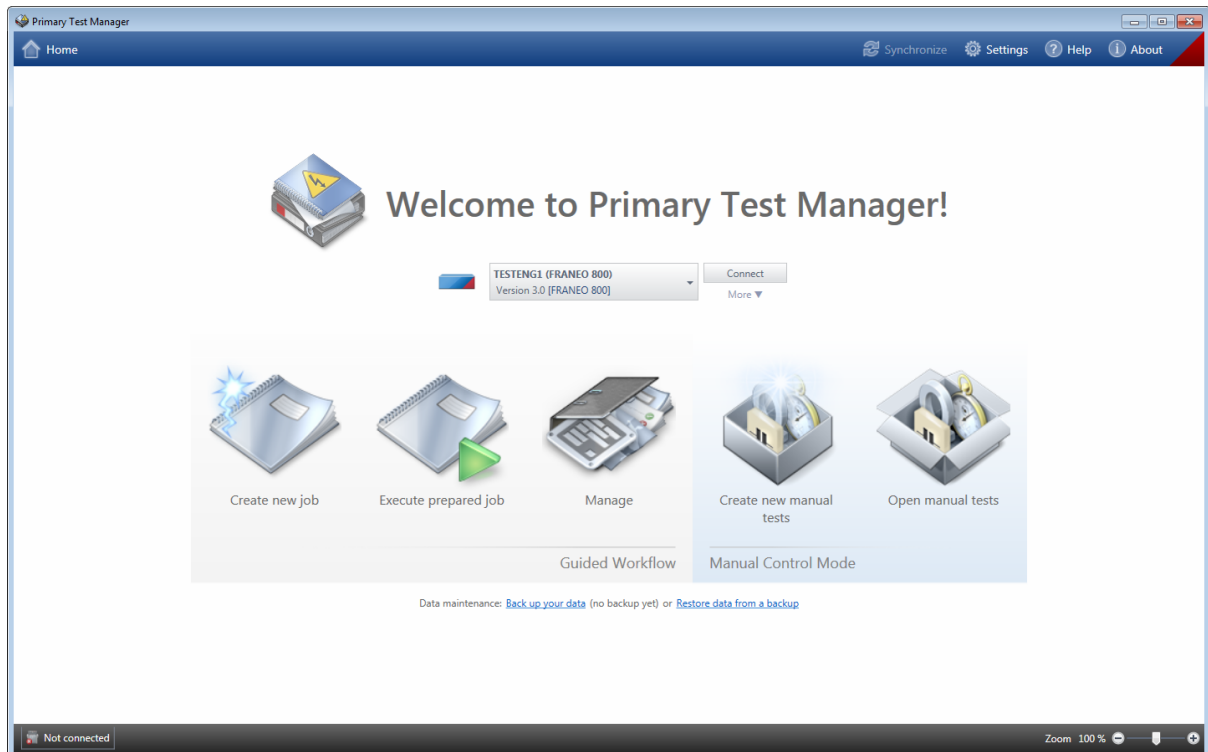


Figure 6-1: *Primary Test Manager* home view

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

Table 6-1: 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 6-2: Selecting the user tasks

Button	Description	Action
	Create new job	Click the Create new job button to start the guided test workflow (see 7 "Create new job" on page 40).
	Execute prepared job	Click the Execute prepared job button to execute a prepared job (see 8 "Execute prepared job" on page 60).
	Manage	Click the Manage button to manage locations, assets, jobs, and reports (see 9 "Manage objects" on page 62).

6.1 Title bar

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

The following table describes the title bar commands.

Table 6-3: Title bar commands

Command	Action
Home	Click Home to move from any view to the home view.
Synchronize¹	Click Synchronize to synchronize your local database with the <i>Primary Test Manager</i> server database (see 6.4 "Data synchronization" on page 36).
Settings	Click Settings to open the Settings dialog box (see 6.1.1 "Settings" later in this chapter).
Help	Click Help to open the <i>FRANEO 800</i> technical documentation and send data to OMICRON Technical Support (see 6.1.2 "Help" on page 33).
About	Click About to open the About Primary Test Manager dialog box (see 6.1.3 "About" on page 33).

1. Only available with the appropriate license.

6.1.1 Settings

In the **Settings** dialog box, you can make a number of *Primary Test Manager* settings to match your regional conventions and set the *Primary Test Manager* server settings for data synchronization (see 6.4 "Data synchronization" on page 36). 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.

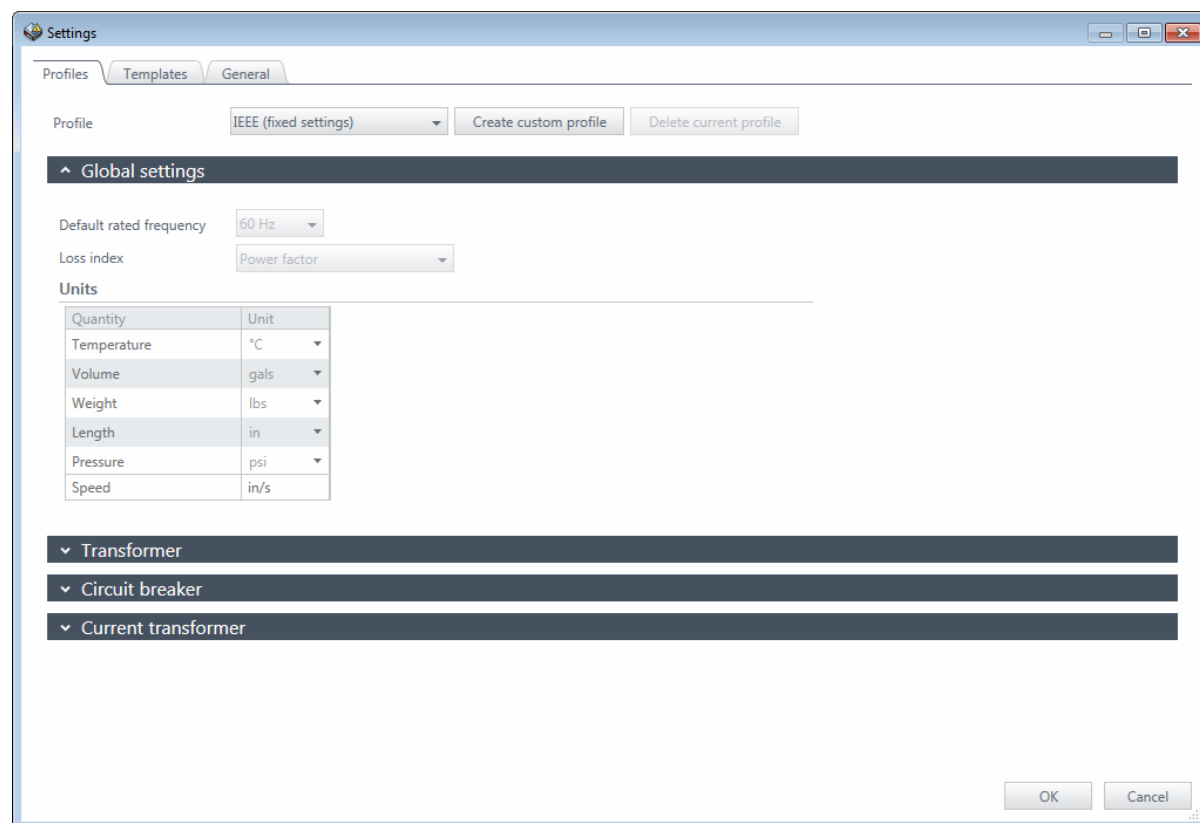


Figure 6-2: Profiles tab: Global settings

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**, set the transformer terminal name schemes and preferences such as the names of some tests, the oil measure, and the short-circuit impedance abbreviation.

The screenshot shows the 'Settings' dialog box with the 'Profiles' tab selected. The 'Transformer' section is expanded, showing terminal name schemes and preferences.

Profiles | **Templates** | **General**

Profile: My Profile [v] [Create custom profile] [Delete current profile]

▼ Global settings

▲ Transformer

Terminal names scheme: IEEE (1) [v] [Create custom scheme] [Delete current scheme]

Primary	Secondary	Tertiary
Winding: H	Winding: X	Winding: Y
Phase A: H1	Phase A: X1	Phase A: Y1
Phase B: H2	Phase B: X2	Phase B: Y2
Phase C: H3	Phase C: X3	Phase C: Y3
Neutral: H0	Neutral: X0	Neutral: Y0

IEEE wiring mode: ☒

Use capital letters for vector group: ☒

Preferences

Test names ☐ Short-circuit impedance ☒ Leakage reactance ☒ TTR ☐ Turns ratio ☒ Overall PF & CAP ☐ Winding PF & CAP	Oil ☐ Weight ☒ Volume	Short-circuit impedance abbreviation ☒ Z (%) ☐ uk (%)
--	---	---

▼ Circuit breaker

▼ Current transformer

[OK] [Cancel]

Figure 6-3: **Profiles** tab: **Transformer**

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

- To set a terminal names scheme, select the scheme you want to use from the **Terminal names scheme** list.

To create your own terminal names scheme:

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

General

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

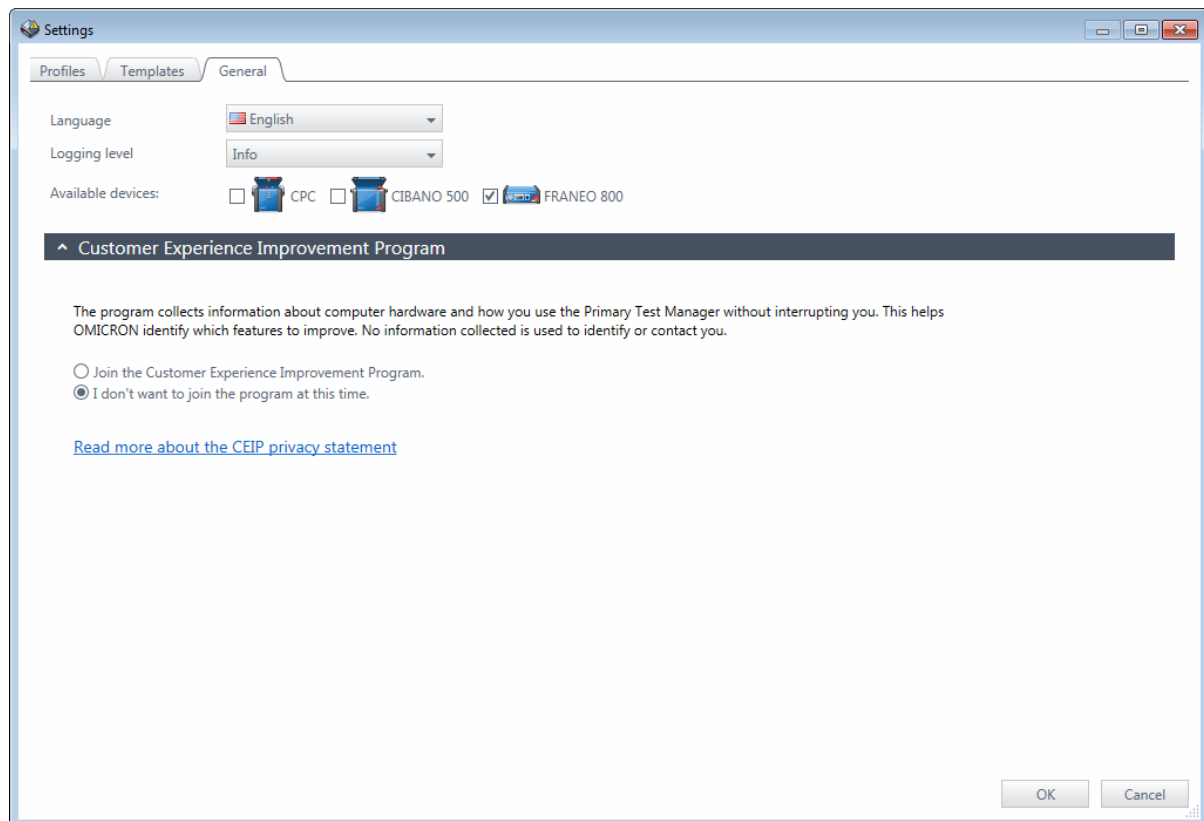


Figure 6-4: **General** tab

- 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 level** list.
The logging function provides information to help find the cause for an error in cooperation with an OMICRON support engineer.

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

Table 6-4: 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.	

- Under **Available devices**, select the test systems available for your test. *Primary Test Manager* generates lists of supported tests for the selected test systems.

General: CEIP

The Customer Experience Improvement Program (CEIP) collects information about computer hardware and how you use *Primary Test Manager* without interrupting you. This helps OMICRON identify which feature 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*.

General: Server settings

Under **Server settings**, you can set the SQL server for data synchronization. For more information, see "DataSync via SQL server" on page 38.

6.1.2 Help

In the **Help** dialog box, you can get the relevant information about *FRANEO 800* and data synchronization, and send data to OMICRON Technical Support. To open the **Help** dialog box, click **Help** in the title bar.

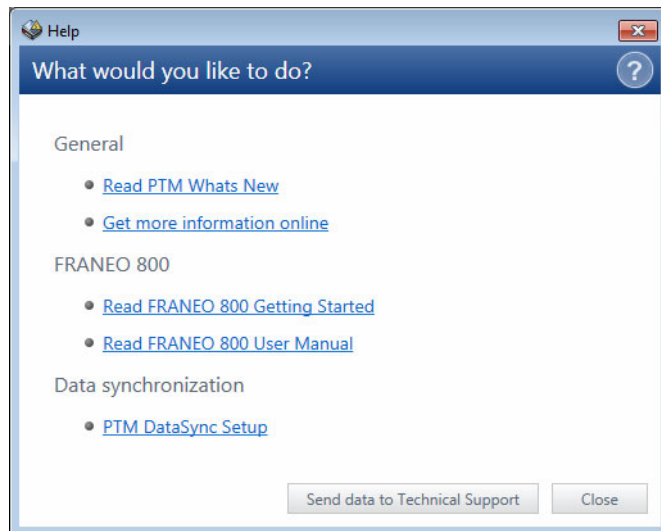


Figure 6-5: **Help** dialog box

6.1.3 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.

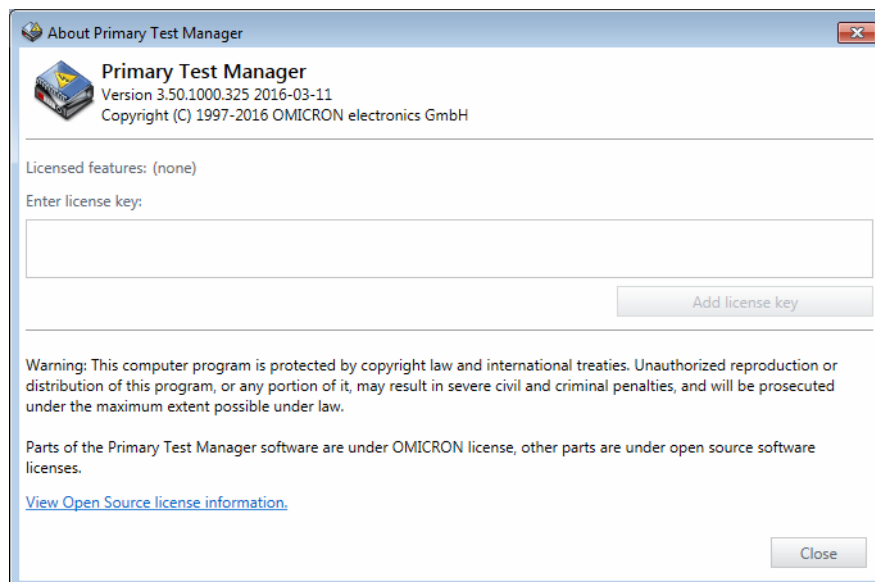


Figure 6-6: **About Primary Test Manager** dialog box

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.

6.2 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 6-5: Test system statuses

Symbol	Status
	FRANEO 800 is connected.
	FRANEO 800 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 *FRANEO 800* symbol in the status bar, and then click **Connect**.

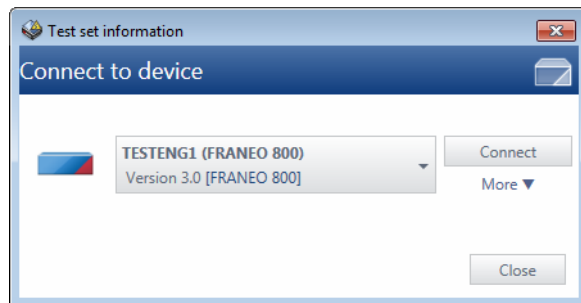


Figure 6-7: **Connect to device** dialog box

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

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

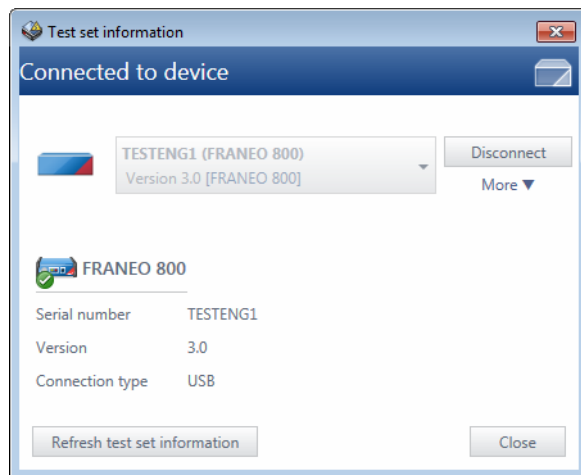


Figure 6-8: **Connected to device** dialog box

After you have connected to a test system, right-click the *FRANEO 800* 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 *FRANEO 800* symbol.

6.3 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**.

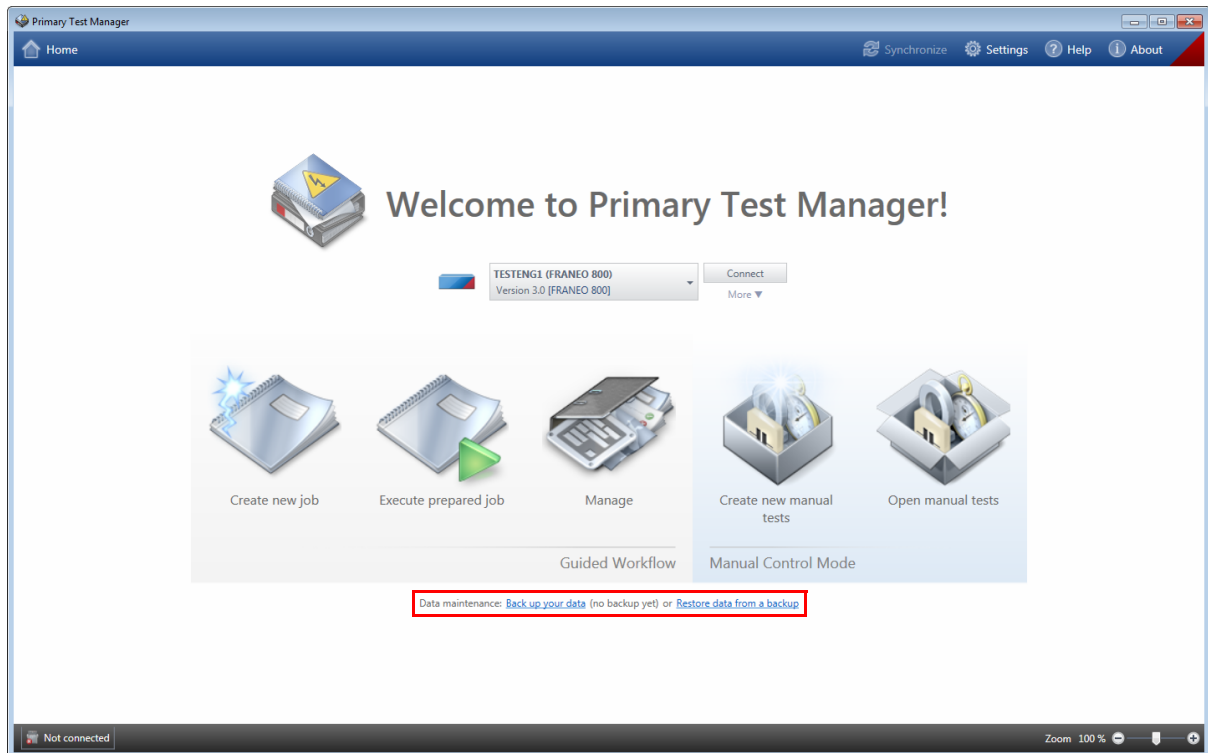


Figure 6-9: *Primary Test Manager* home view

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.

6.4 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 partial data replication based on subscriptions, that is, all local data is synchronized with the server database and selected data on the server is synchronized with the local database.

6.4.1 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** to open the **Settings** dialog box.
The next step depends on the data synchronization method (*DataSync* via web server or *DataSync* via SQL server) you use.

DataSync via web server

- For the *DataSync* service address and the authentication certificate, contact your regional OMICRON Service Center.
- In the Server settings area, type the server name and the database name.

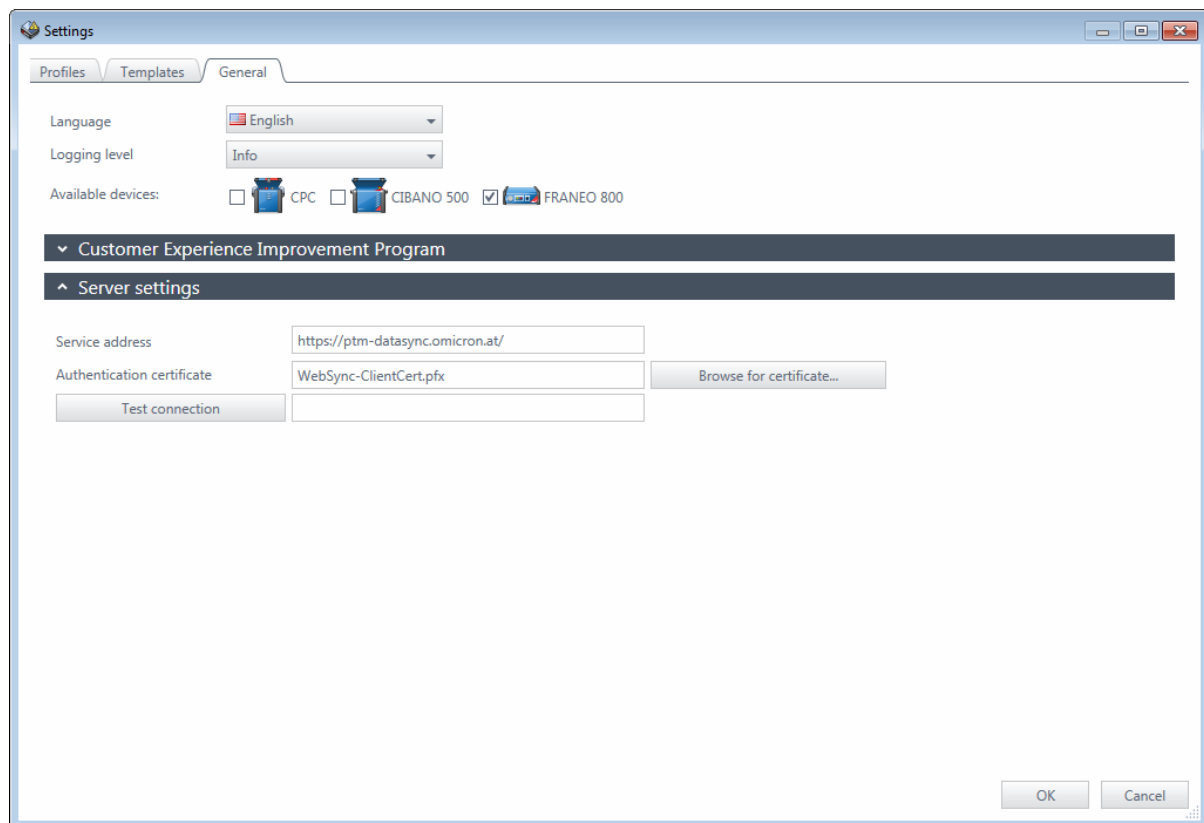


Figure 6-10: Server settings for *DataSync* via web server

DataSync via SQL server

- In the Server settings area, type the server name and the database name.

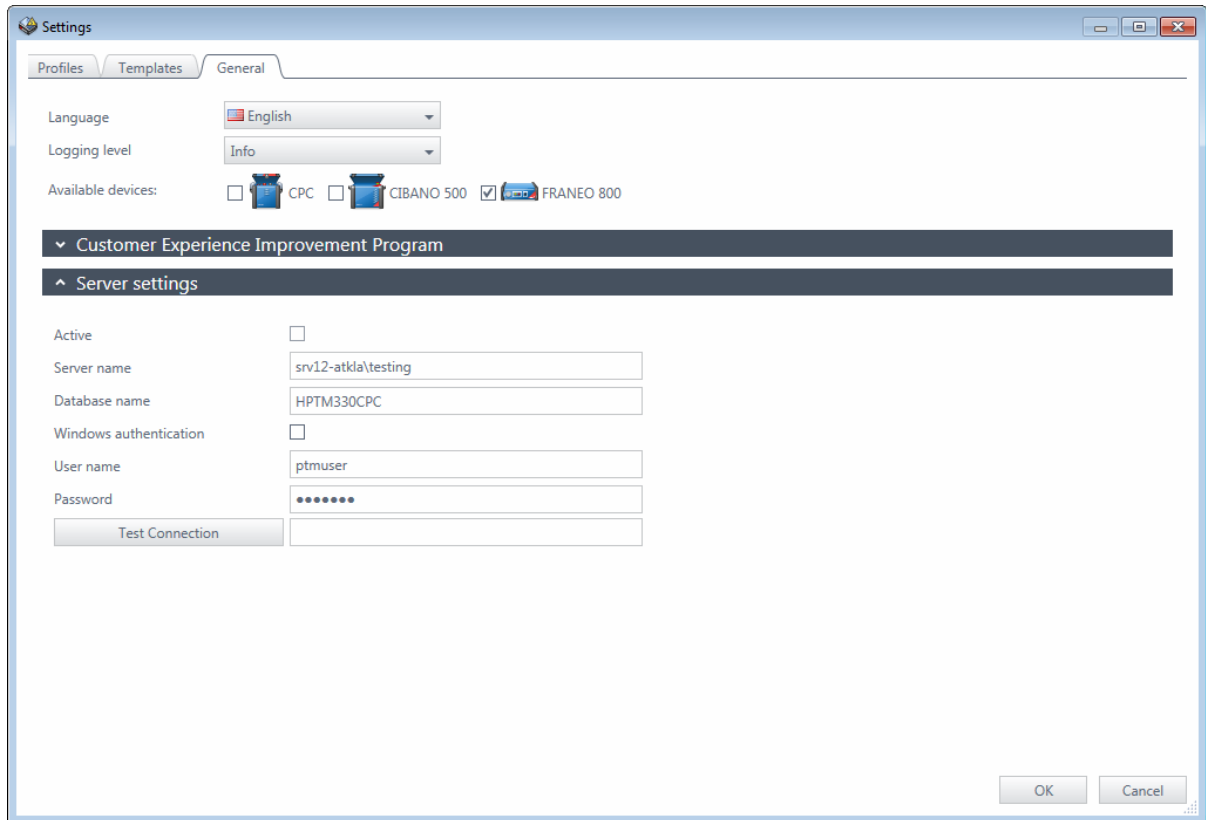


Figure 6-11: Server settings for *DataSync* via SQL server

2. Select the **Windows authentication** check box if the *Primary Test Manager* server allows the Windows authentication.
3. Otherwise, type the user name and the password.
4. To test the connection to the server, click **Test connection**.

The server settings are stored in the system. Consequently, you do not need to type them afterward.

Note: For the *Primary Test Manager* server settings, contact your server database administrator.

6.4.2 Managing subscriptions

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

1. In the home view (see Figure 6-1: "Primary Test Manager home view" on page 27), click the **Manage** button .

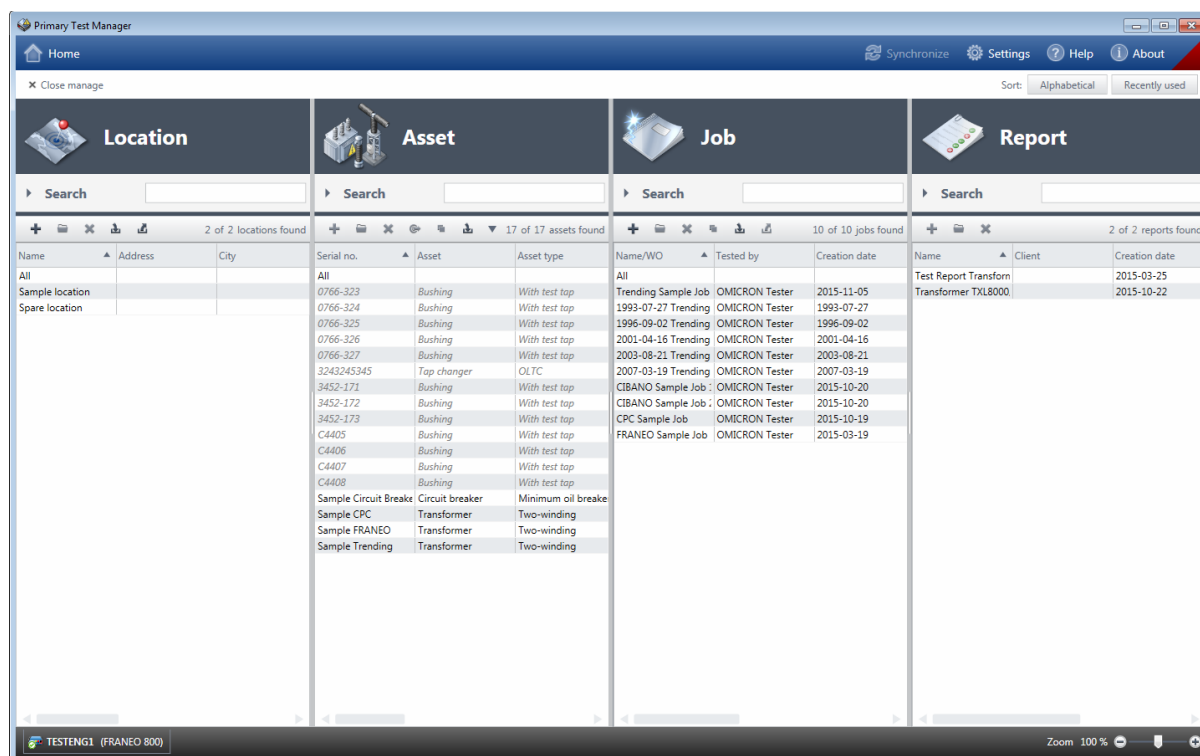


Figure 6-12: Manage view

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

You can synchronize the data anytime.

- To synchronize the data, click **Synchronize** in the title bar.
After that, *Primary Test Manager* shows the synchronization progress.

7 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 7-1: 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 7-1: 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.

7.1 Guided test workflow

The guided test workflow leads you through the following steps:

1. Enter the job data (see 7.2 "Job overview" on page 42).
2. Specify the location (see 7.3 "Location view" on page 44).
3. Specify the asset (see 7.4 "Asset view" on page 47).
4. Specify and perform the tests (see 7.5 "Test view" on page 55).
5. Generate the test reports (see 7.6 "Report view" on page 58).

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

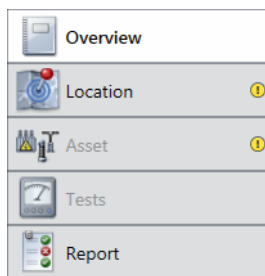


Figure 7-2: Navigation buttons

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 7-2: 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 test	Adds another test of the same kind and with the same settings to the test list. Results are not copied.
Take screenshot	Takes screenshot of the selected area of the <i>Primary Test Manager</i> workspace. The screenshot appears as attachment in the General area (see 7.5.1 "Selecting tests" on page 55) and can be attached to the test report (see 7.6 "Report view" on page 58).

For more information about operations on the jobs, see 9 "Manage objects" on page 62.

7.2 Job overview

In the job overview of the create new job view, you can enter the job data (see Table 7-3: "Job data" on page 42). 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.

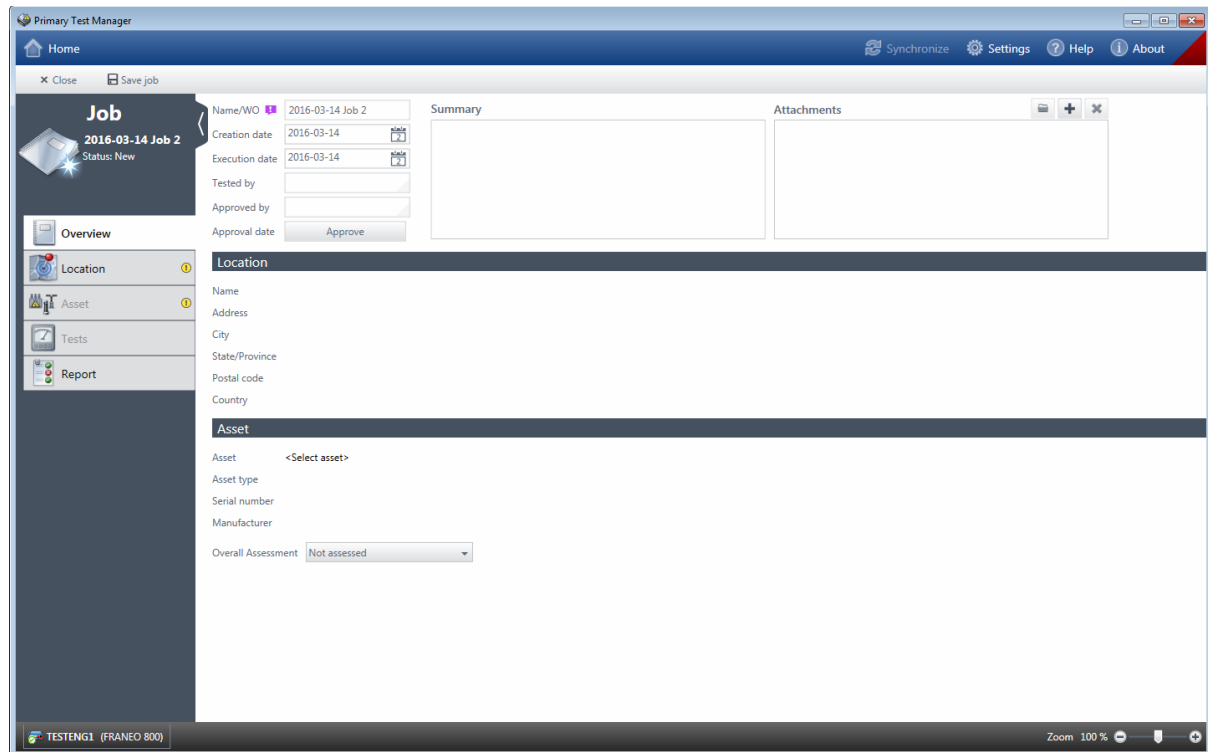


Figure 7-3: Job overview

7.2.1 Job data

The following table describes the job data.

Table 7-3: 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
Approved by	Person who approved the test
Approval date	Date the job was approved (see 7.2.2 "Approving jobs" later in this section)

1. Mandatory data

7.2.2 Approving jobs

If the job data 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.

7.2.3 Managing attachments

Under **Attachments**, you can manage attachments to the job overview.

To add an attachment to the job overview:

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

To open an attachment, do one of the following:

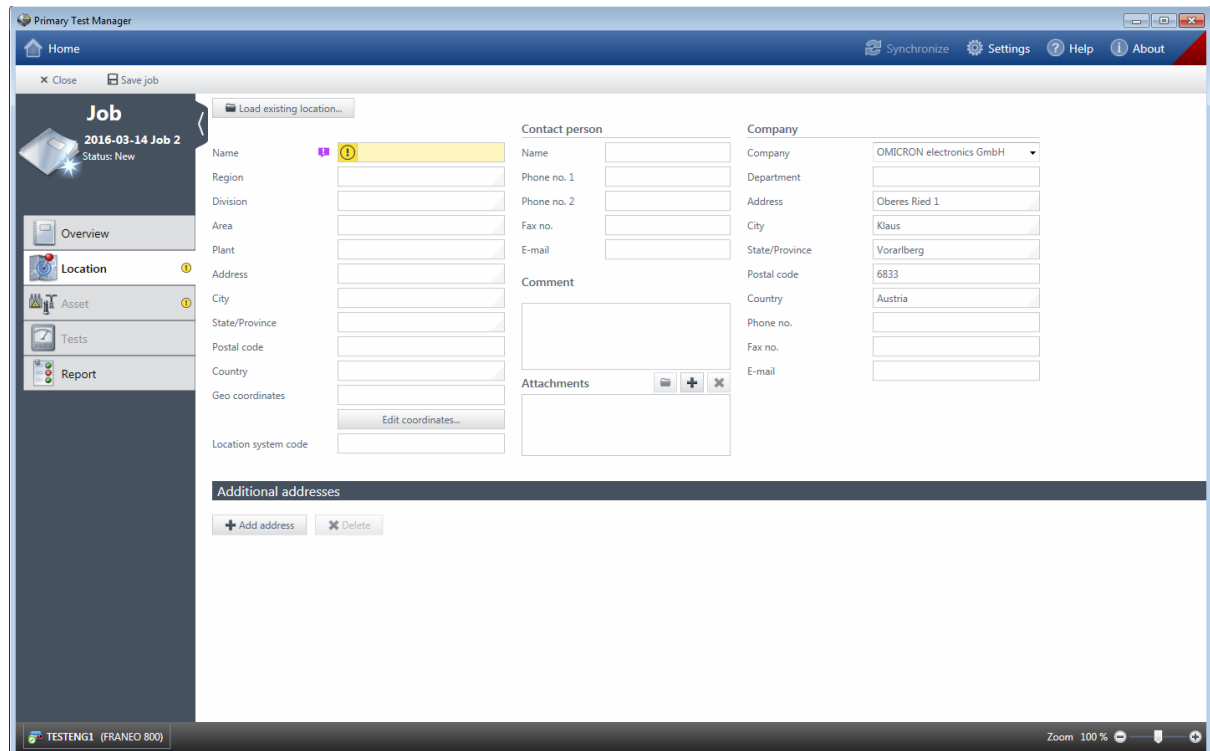
- ▶ Select the attachment, and then click the **Open** button .
- ▶ Double click the attachment.

To delete an attachment from the job overview:

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

7.3 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 .



Primary Test Manager

Home Synchronize Settings Help About

Close Save job

Job
2016-03-14 Job 2
Status: New

Overview

Location

Asset

Tests

Report

Load existing location...

Name

Region

Division

Area

Plant

Address

City

State/Province

Postal code

Country

Geo coordinates

Edit coordinates...

Location system code

Contact person

Name

Phone no. 1

Phone no. 2

Fax no.

E-mail

Comment

Attachments

Company

Company

Department

Address

City

State/Province

Postal code

Country

Phone no.

Fax no.

E-mail

Additional addresses

+ Add address

✕ Delete

TESTENG1 (FRANEO 800)

Zoom 100%

Figure 7-4: Location view

To specify a location, do one of the following:

- Enter the location data (see Table 7-4: "Location data" on page 45).

- 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 7-5: **Select location** dialog box

In the **Select location** dialog box, you can search for locations (see 9.1 "Search for objects" on page 63).

7.3.1 Location data

The following table describes the location data.

Table 7-4: Location data

Data	Description
Name ¹	Name of the location
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
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
Geo coordinates	Geo coordinates of the location (see 7.3.2 "Setting the geo coordinates" later in this section)
Location system code	Location code used by maintenance planning systems
Contact Person	

Table 7-4: Location data (continued)

Data	Description
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
E-mail	E-mail address of the contact person
Company	
Company	Company where the asset is located
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 7-4: "Location data" on page 45.

7.3.2 Setting the geo coordinates

To set the geo coordinates of a location:

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

Figure 7-6: **Edit Coordinates** dialog box

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

7.3.3 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 .

7.4 Asset view

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

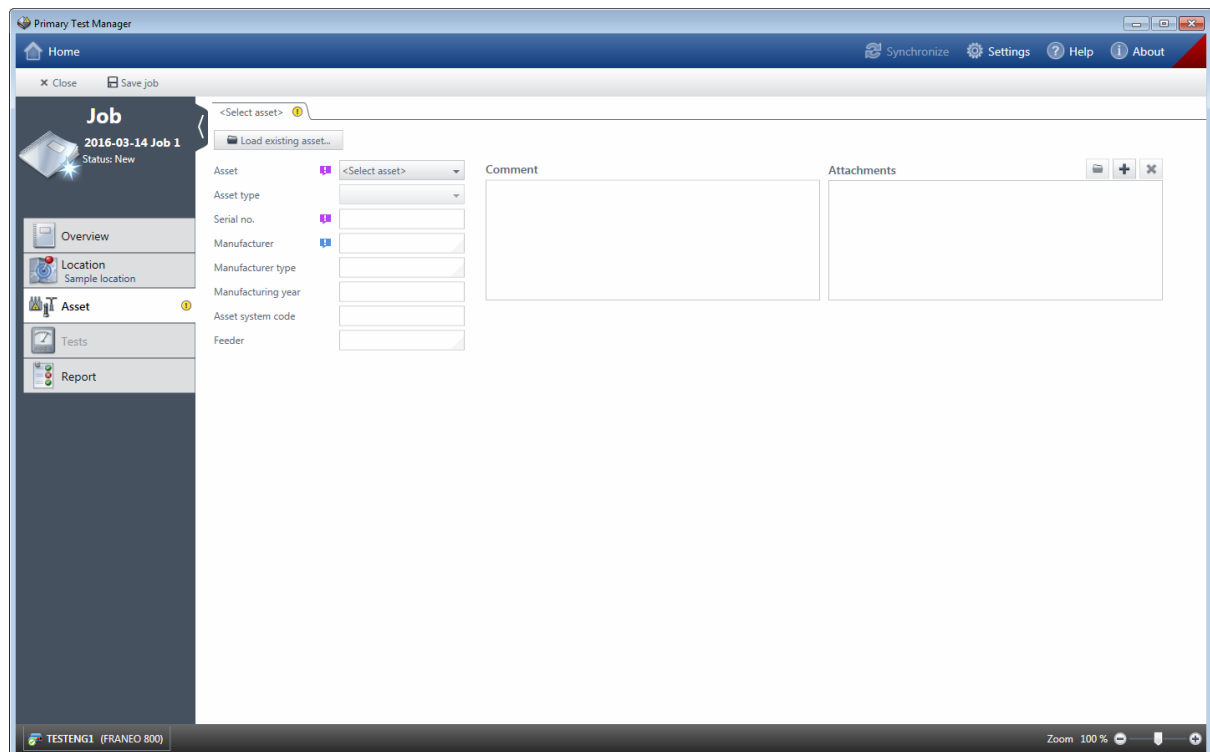


Figure 7-7: Asset view

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 7-5: "General asset data" on page 48) and the asset specific data described in 10 "Transformer data" on page 69 and 11 "Spare bushing data" on page 73.
- 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.

Serial no.	Asset	Asset type	Manufacturer	Manufacturer type	Asset system code	Apparatus ID	Feeder	Phase	Recently used	Last modified by
Sample Circuit Breaker	Circuit breaker	Minimum oil breaker	Sampletronics	SAMP0001					3/14/2016 4:07:20 AM	OMICRON\marbal00
Sample CPC	Transformer	Two-winding	ELIN			TXL8000/50			3/14/2016 4:52:38 AM	OMICRON\marbal00
Sample FRANEO	Transformer	Two-winding	ELIN	ODL16000/110					12/17/2015 4:47:36 P	OMICRON\marbal00
Sample Trending	Transformer	Two-winding	ELIN	AX3		TR800/XTR			12/17/2015 4:50:57 P	OMICRON\marbal00

Figure 7-8: **Select asset** dialog box

In the **Select asset** dialog box, you can search for assets (see 9.1 "Search for objects" on page 63) and sort them alphabetically or in the chronological order.

7.4.1 General asset data

The following table describes the general asset data.

Table 7-5: 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	Identifier of the asset
Feeder	Feeder the asset is connected to

1. Mandatory data

7.4.2 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:

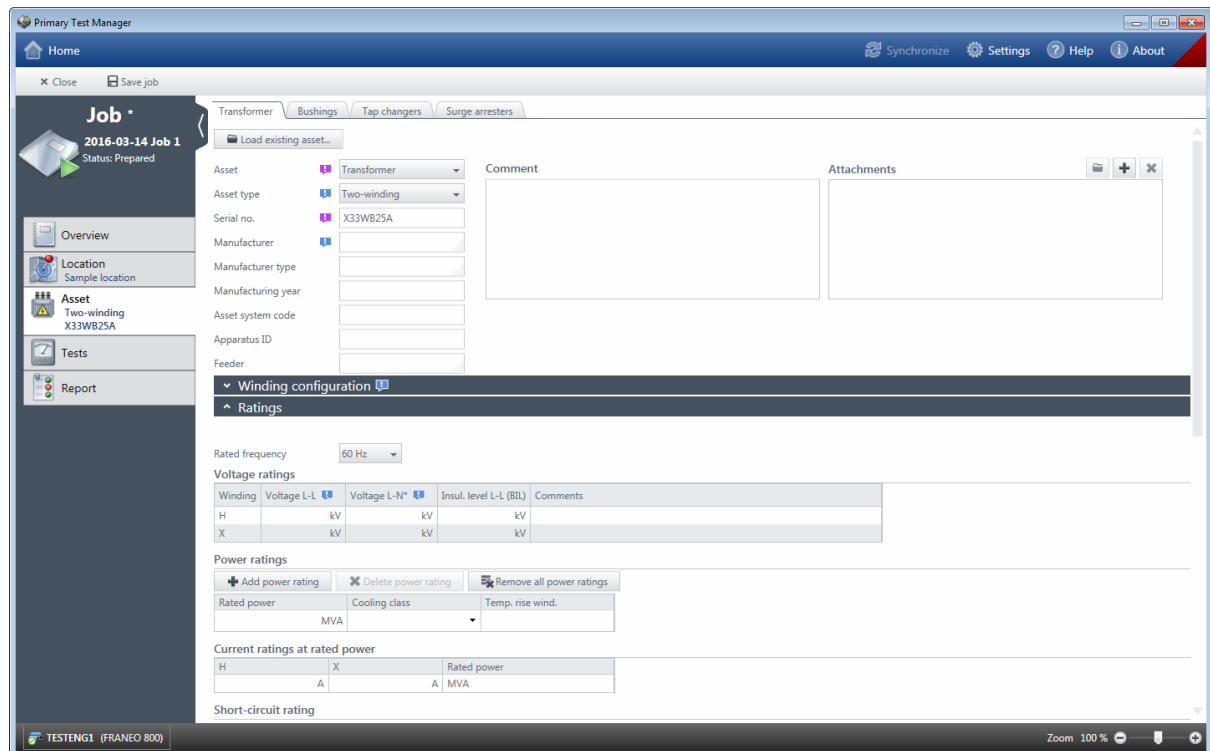
1. Select the attachment you want to delete.
2. Click the **Remove** button .

7.4.3 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.



The screenshot shows the 'Primary Test Manager' application window. On the left is a sidebar with a 'Job' section showing '2016-03-14 Job 1' with a 'Status: Prepared'. Below this are icons for Overview, Location, Asset, Tests, and Report. The main window has a top menu bar with 'Home', 'Synchronize', 'Settings', 'Help', and 'About'. Below the menu bar are tabs for 'Transformer', 'Bushings', 'Tap changers', and 'Surge arresters'. The 'Transformer' tab is active, showing a 'Load existing asset...' button and a form for asset details. The form includes fields for Asset, Asset type (Two-winding), Serial no. (X33WB25A), Manufacturer, Manufacturer type, Manufacturing year, Asset system code, Apparatus ID, and Feeder. Below these fields are expandable sections for 'Winding configuration' and 'Ratings'. The 'Ratings' section is expanded, showing 'Rated frequency' (60 Hz), 'Voltage ratings' table, 'Power ratings' section with buttons for adding, deleting, or removing power ratings, and 'Current ratings at rated power' table. The bottom status bar shows 'TESTENG1 (FRANEO 800)' and 'Zoom 100 %'.

Winding	Voltage L-L	Voltage L-N	Insul. level L-L (BIL)	Comments
H	kV	kV	kV	
X	kV	kV	kV	

H	X	Rated power
A	A	MVA

Figure 7-9: Transformer view

3. In the transformer view, enter further general asset data (see Table 7-5: "General asset data" on page 48).
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 10 "Transformer data" on page 69).
6. Optionally, specify the bushings mounted on the transformer (see "Bushings tab" on page 51).
7. Optionally, specify the tap changers of the transformer (see "Tap changers tab" on page 52).
8. Optionally, specify the surge arresters mounted on the transformer (see "Surge arresters tab" on page 54).

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.

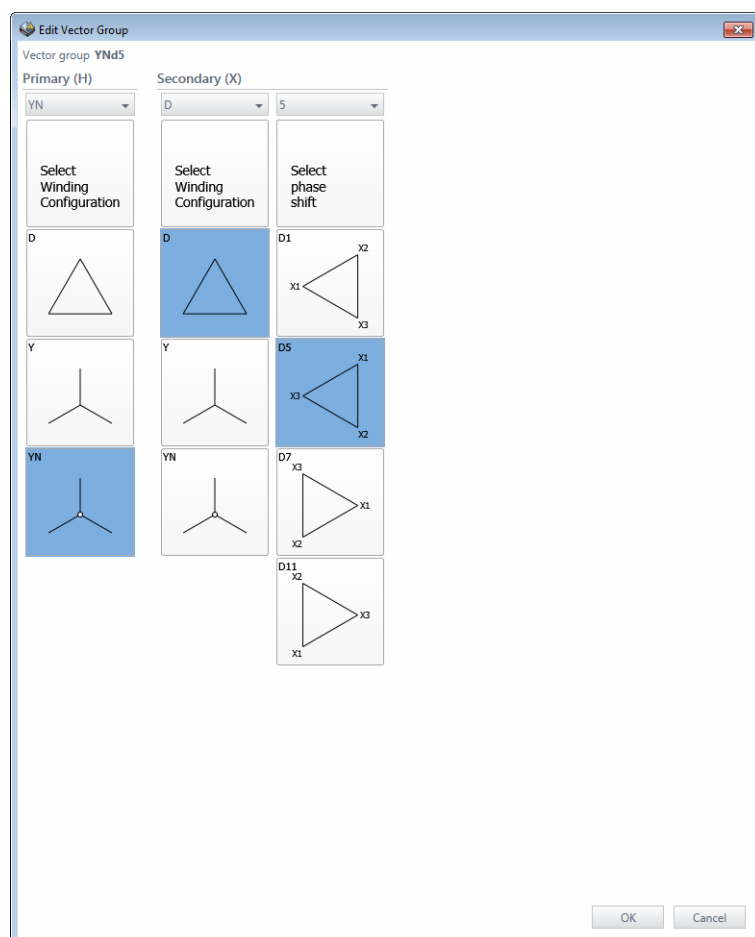


Figure 7-10: **Edit Vector Group** dialog box

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.

Primary Test Manager

Home Synchronize Settings Help About

Close Save job

Job 2016-03-14 Job 1 Status: Prepared

Overview Location Sample location Asset Two-winding X33WB2SA Tests Report

Transformer Bushings Tap changers Surge arresters

Copy bushing data

From H1 To H2 Copy

Primary bushings

Pos.	Asset type	Serial no.	Manufacturer	Manufacturer type	Manufacturing year	Insul. level LL (BIL)	Voltage L-ground
H1	<Select asset type>						kV
H2	<Select asset type>						kV
H3	<Select asset type>						kV
H0	<Select asset type>						kV

Secondary bushings

Pos.	Asset type	Serial no.	Manufacturer	Manufacturer type	Manufacturing year	Insul. level LL (BIL)	Voltage L-ground
X1	<Select asset type>						kV
X2	<Select asset type>						kV
X3	<Select asset type>						kV

TESTENG1 (FRANEO 800) Zoom 100 %

Figure 7-11: 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 "Spare bushing data" on page 73).

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.

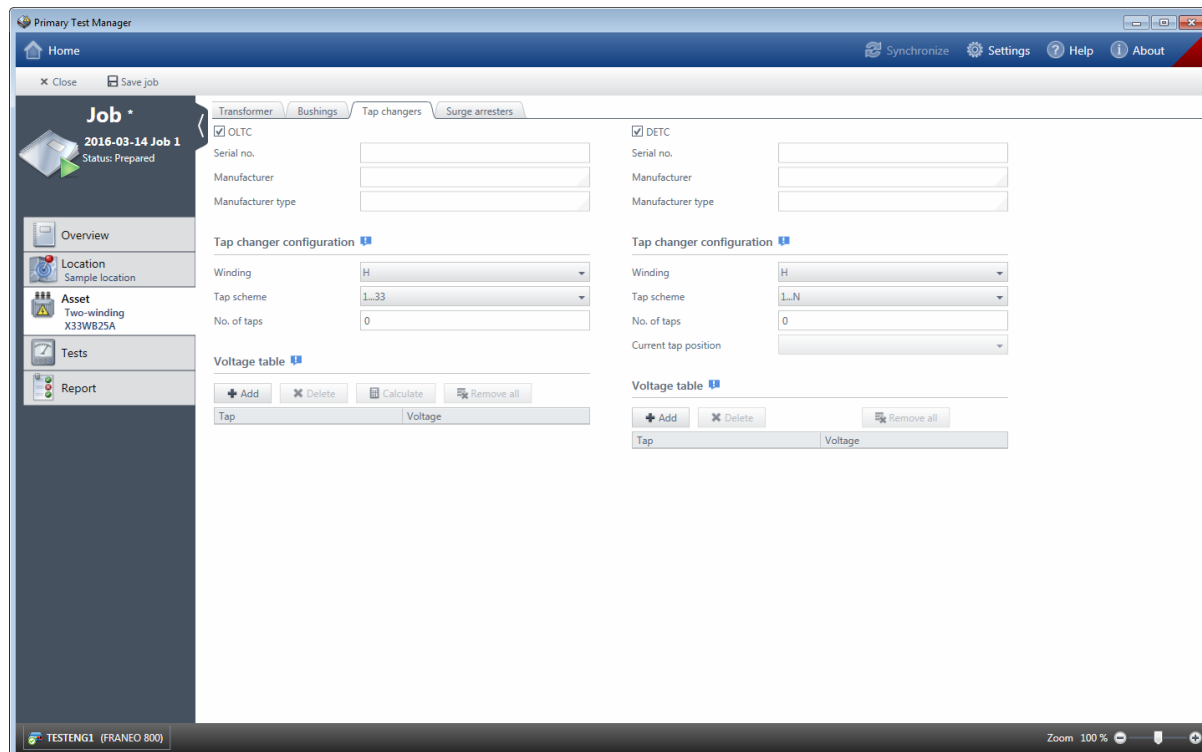


Figure 7-12: Transformer view: **Tap changers** tab

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

1. Select the **OLTC** check box.
2. Enter the OLTC data (see 10.2 "Tap changer data" on page 71).
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.

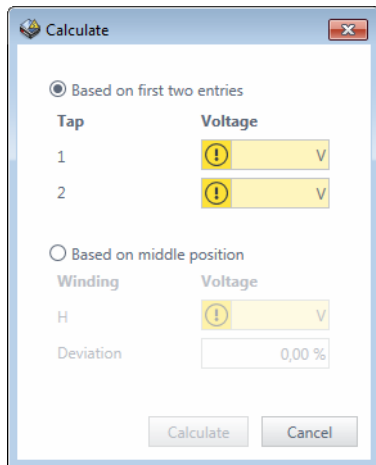


Figure 7-13: **Calculate** dialog box

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 10.2 "Tap changer data" on page 71).
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.

Primary Test Manager

Home Synchronize Settings Help About

Close Save job

Job 2016-03-14 Job 1 Status: Prepared

Overview Location Sample location Asset Two-winding X33WB25A Tests Report

Transformer Bushings Tap changers **Surge arresters**

Copy surge arrester data

From Surge arrester H2 To Surge arrester H3 Copy

☒ Surge arrester H1

General

Overall ID Manufacturer Manufacturing year Manufacturer type Asset system code

Ratings

Units in stack 1 ☒ Numerical positions ☐ Alphabetic positions

Position	Serial no.	MCOV rating	Rated voltage	Max. system voltage	Test voltage	Unit ID
1						

☒ Surge arrester H2

General

Overall ID Manufacturer Manufacturing year Manufacturer type Asset system code

Ratings

Units in stack 1 ☒ Numerical positions ☐ Alphabetic positions

Position	Serial no.	MCOV rating	Rated voltage	Max. system voltage	Test voltage	Unit ID
1						

☐ Surge arrester H3

☐ Surge arrester X1

☐ Surge arrester X2

TESTENG1 (FRANEO 800) Zoom 100%

Figure 7-14: 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 10.3 "Surge arrester data" on page 71).

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**.

7.5 Test view

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

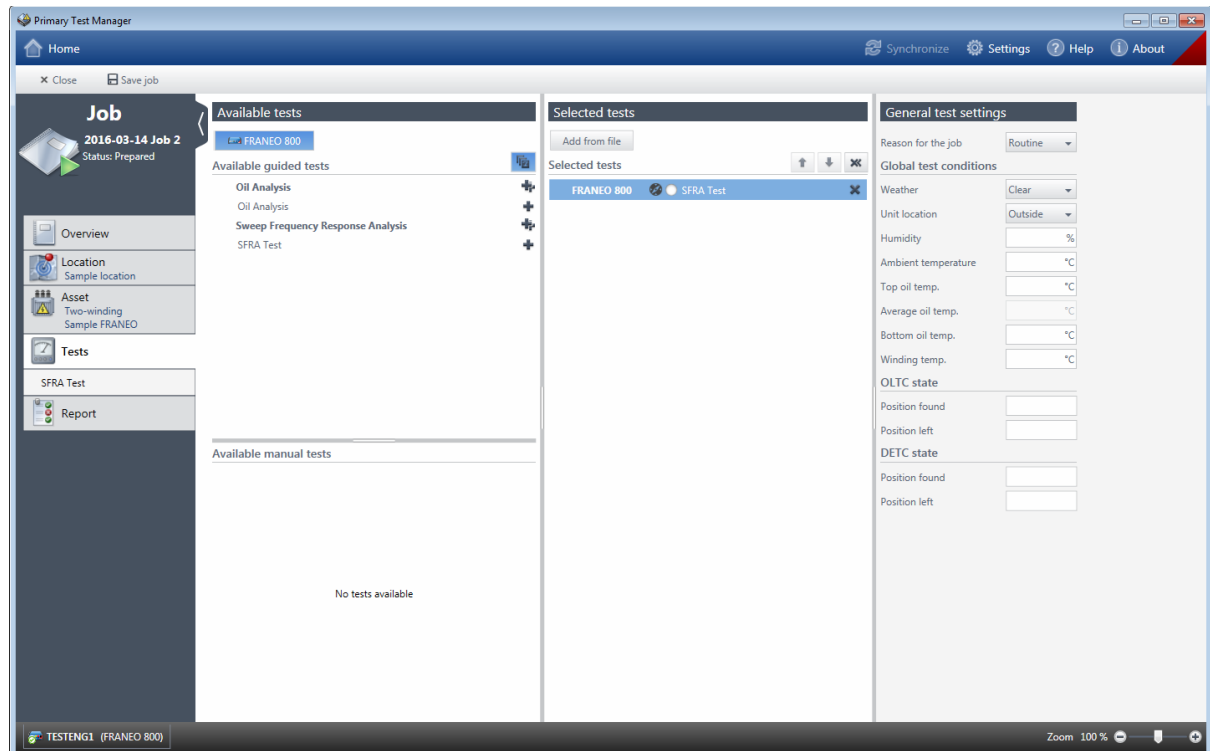


Figure 7-15: Test view

7.5.1 Selecting tests

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

Click the button labeled with the test system with which you want to perform the test on the top of the Available tests area. 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 the 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. These tests offer a large amount of flexibility to define test procedures and specify test settings according to your specific needs.

The Selected tests area displays the tests you want to perform. To add a test into the Selected tests area, click the  symbol next to the test name in the Available tests area. To add all tests of a category into the Selected tests area, click the  symbol. The Selected tests area displays the test to be performed in the recommended 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, click the  symbol next to the test name.

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

7.5.2 Importing test data

With *Primary Test Manager*, you can import FRA test data in different formats. In the test view, you can import test data (measurement results without any information about the test, the asset or the location). *Primary Test Manager* supports import of test data in the following formats.

Table 7-6: Supported test data formats

File name extension	Description	File content
.csv, .txt, .pax	CSV files containing FRA test data ¹	Measurement results without information about the test, asset or location
.fra ²	<i>FRA</i> analyzer 2.2 test file	One FRA test, including information about the asset and location
.csv ²	<i>FRA</i> analyzer 2.2 CSV file ³	One FRA test, including information about the asset and location
.xml ⁴ , .xml.zip ⁵	SFRA file according to IEC 60076-18 standard	One FRA trace (.xml) or multiple FRA traces (.xml.zip), including information about assets and locations
.xfra ⁴ , .xfra.zip ⁵	SFRA file according to CIGRE WG A2.26 standard	One FRA trace (.xfra) or multiple FRA traces (.xfra.zip), including information about assets and locations
.sfra ⁴	Doble SFRA file	One FRA test, including information about the asset and location
.frax ²	Megger FRAX file	One FRA test, including information about multiple traces, the asset and location

1. For each CSV file, one test is added to the current job.

2. The file contains all traces of a test. The test with all its traces is added to the current job.

3. Files in the *FRA* analyzer 1.x CSV format can only be imported by using the generic CSV import.

4. Multiple files that reside in the same folder as the selected one are combined into one test. The folder's name is used as test name. The test is added to the current job.

5. The zip file may contain multiple subfolders. All files in each subfolder are combined into one test. The subfolder's name is used as test name. All tests are added to the current job.

NOTICE**Mismatch of data possible**

Primary Test Manager does not compare the imported asset and location data with the data of the job into which the test data is imported.

- Double-check that the data you import into the current job really belongs to the job's asset.

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.
3. From the list next to the **File name** box, select **CSV file containing FRA data**.
4. In the left pane of the test view, click the imported test.

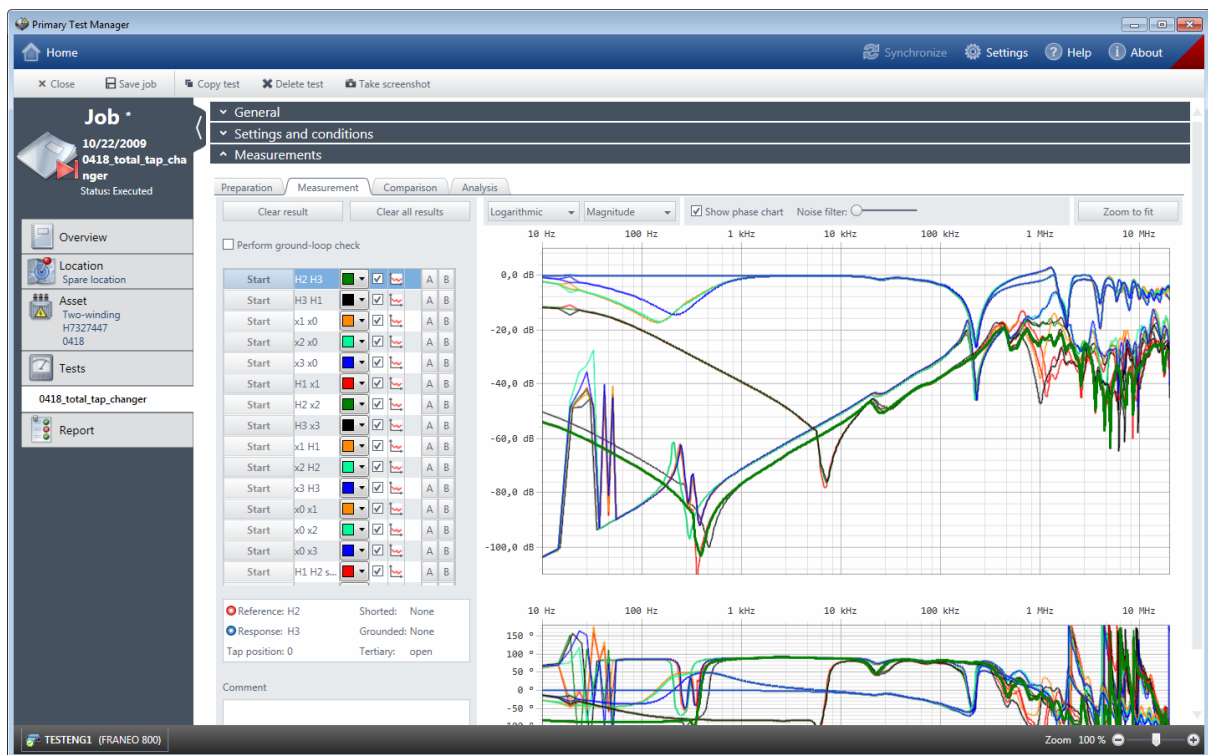


Figure 7-16: Test view after a test has been imported

5. In the workspace of the test view, you can change the test title and the test type.
6. To open the test, click the **Open** button  under **Test data**.
7. You can attach files as described earlier in this chapter and add comments to the test.

For information about importing and exporting jobs, see 9.5 "Import and export jobs" on page 67.

7.5.3 Performing tests

To perform and analyze the tests, you must know and understand the test settings and the measurement data. For detailed information about performing tests, see 12 "Application" on page 75.

7.6 Report view

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

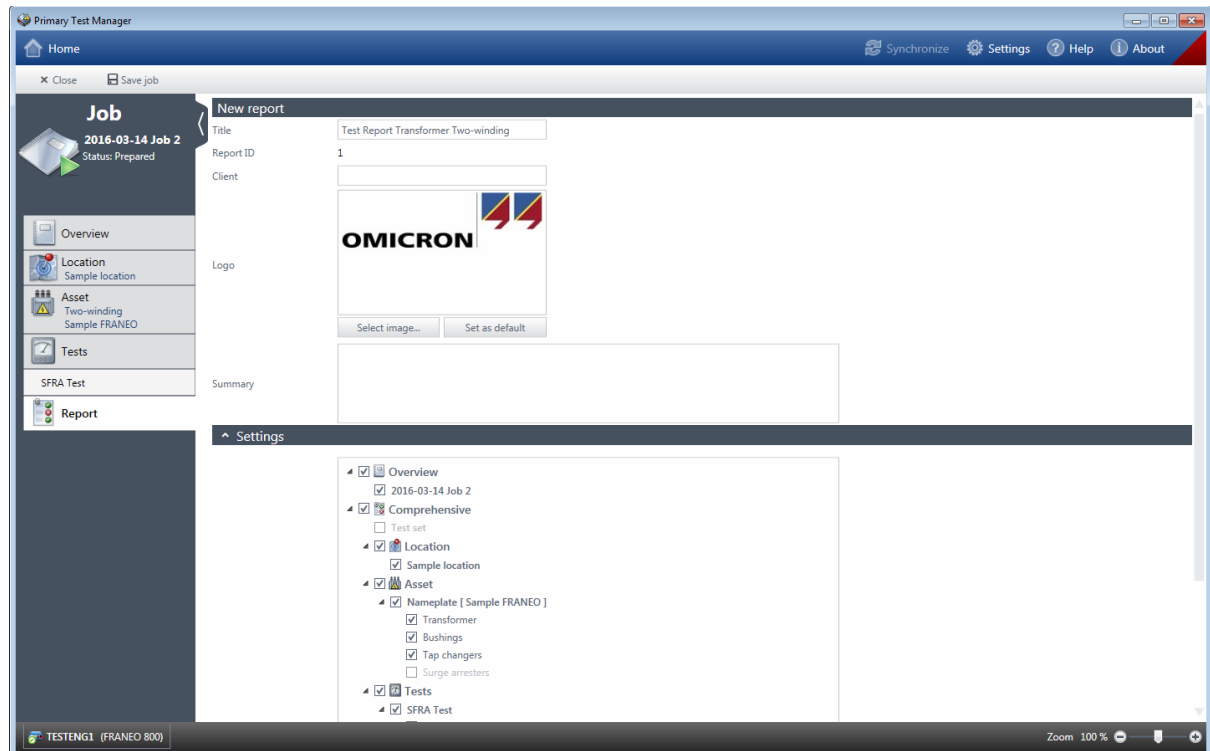


Figure 7-17: Report view

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 7-7: Report data

Data	Description
Title	Title of the report. Appears as the report header.
Report ID ¹	Identifier of the report
Client	Customer for which the report is designated
Logo	Logo to appear on the report (see "Setting the logo" on page 59)
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.

Note: To report the high-voltage and/or low-voltage comparisons, group the high-voltage and/or low-voltage test traces for comparison (see 12.1.6 "Compare the test results" on page 86), and then select these comparison groups in the test report.

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.

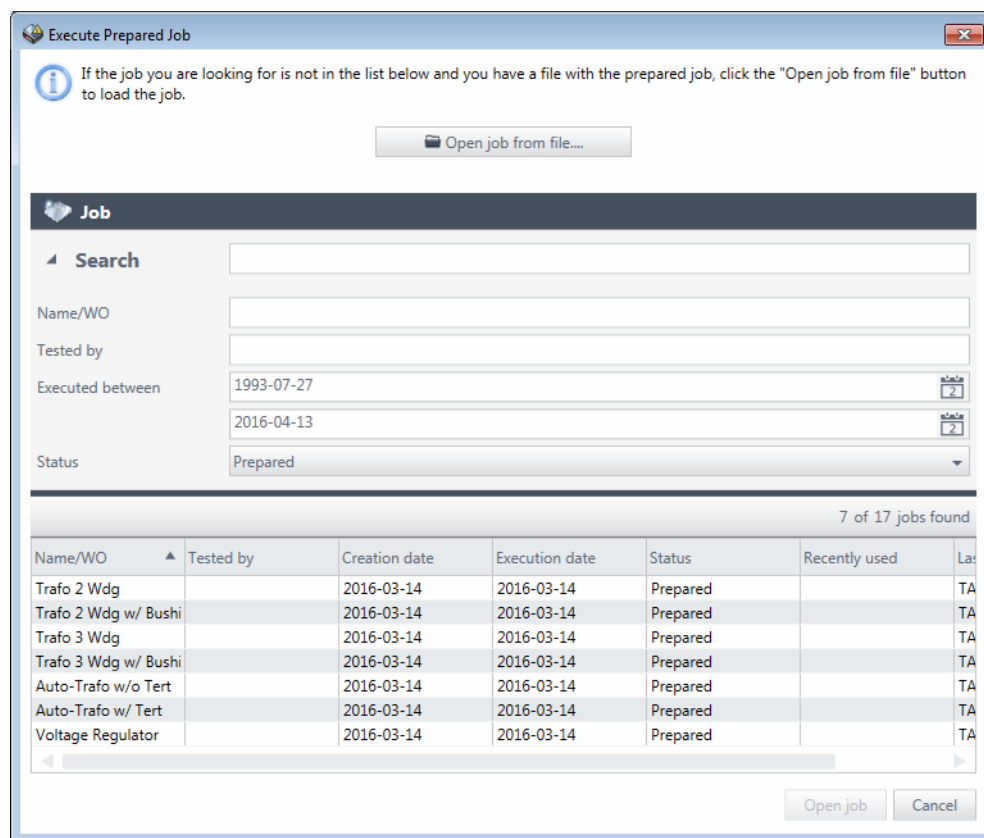
8 Execute prepared job

In the execute prepared job view, you can execute prepared jobs. To open the execute prepared job view, click the **Execute prepared job** button  in the home view.

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. With the **Execute prepared job** user task, you can execute prepared jobs saved in a file and jobs available in *Primary Test Manager*.

To execute a prepared job saved in a file:

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



Execute Prepared Job

If the job you are looking for is not in the list below and you have a file with the prepared job, click the "Open job from file" button to load the job.

Job

Search

Name/WO:

Tested by:

Executed between: 1993-07-27 2016-04-13

Status: Prepared

7 of 17 jobs found

Name/WO	Tested by	Creation date	Execution date	Status	Recently used	Last used
Trafo 2 Wdg		2016-03-14	2016-03-14	Prepared		TA
Trafo 2 Wdg w/ Bushi		2016-03-14	2016-03-14	Prepared		TA
Trafo 3 Wdg		2016-03-14	2016-03-14	Prepared		TA
Trafo 3 Wdg w/ Bushi		2016-03-14	2016-03-14	Prepared		TA
Auto-Trafo w/o Tert		2016-03-14	2016-03-14	Prepared		TA
Auto-Trafo w/ Tert		2016-03-14	2016-03-14	Prepared		TA
Voltage Regulator		2016-03-14	2016-03-14	Prepared		TA

Figure 8-1: 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 7 "Create new job" on page 40).

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 9.1 "Search for objects" on page 63).
3. Open the job, and then go through the guided test workflow (see 7 "Create new job" on page 40).

9 Manage objects

In the manage view, you can manage locations, assets, jobs, and reports available in *Primary Test Manager*. After you have opened a job, *Primary Test Manager* leads you through the guided test workflow (see 7 "Create new job" on page 40). To open the manage view, click the **Manage** button  in the home view.

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

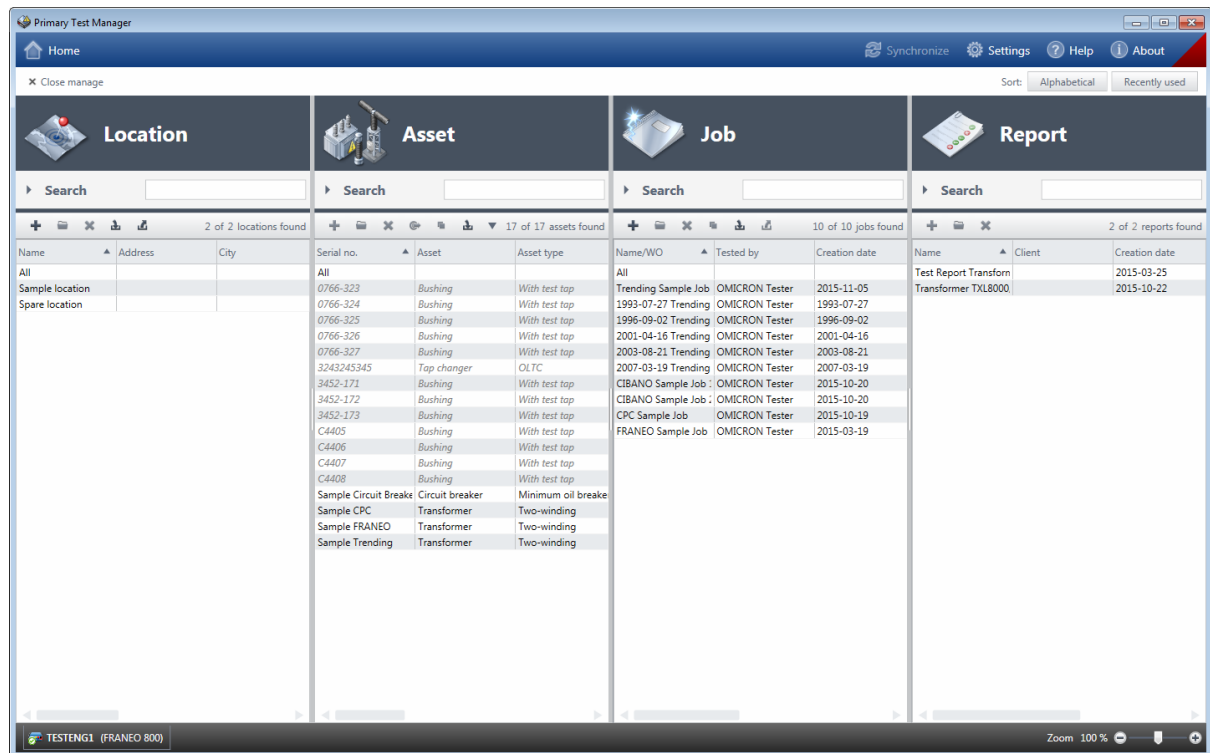


Figure 9-1: Manage view

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 9.1 "Search for objects" later in this chapter)
- Perform operations on objects (9.2 "Perform operations on objects" on page 64)
- Relocate assets (see 9.4 "Relocate assets" on page 66)
- Import and export jobs (9.5 "Import and export jobs" on page 67)

9.1 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 9-1: 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

The following table describes the asset search data.

Table 9-2: Asset search data

Data	Description
Asset	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

The following table describes the job search data.

Table 9-3: 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 9-4: 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

9.2 Perform operations on objects

To perform operations on the objects available in *Primary Test Manager*, 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 open a window with the selected object data.
- ▶ 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 .

9.3 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.

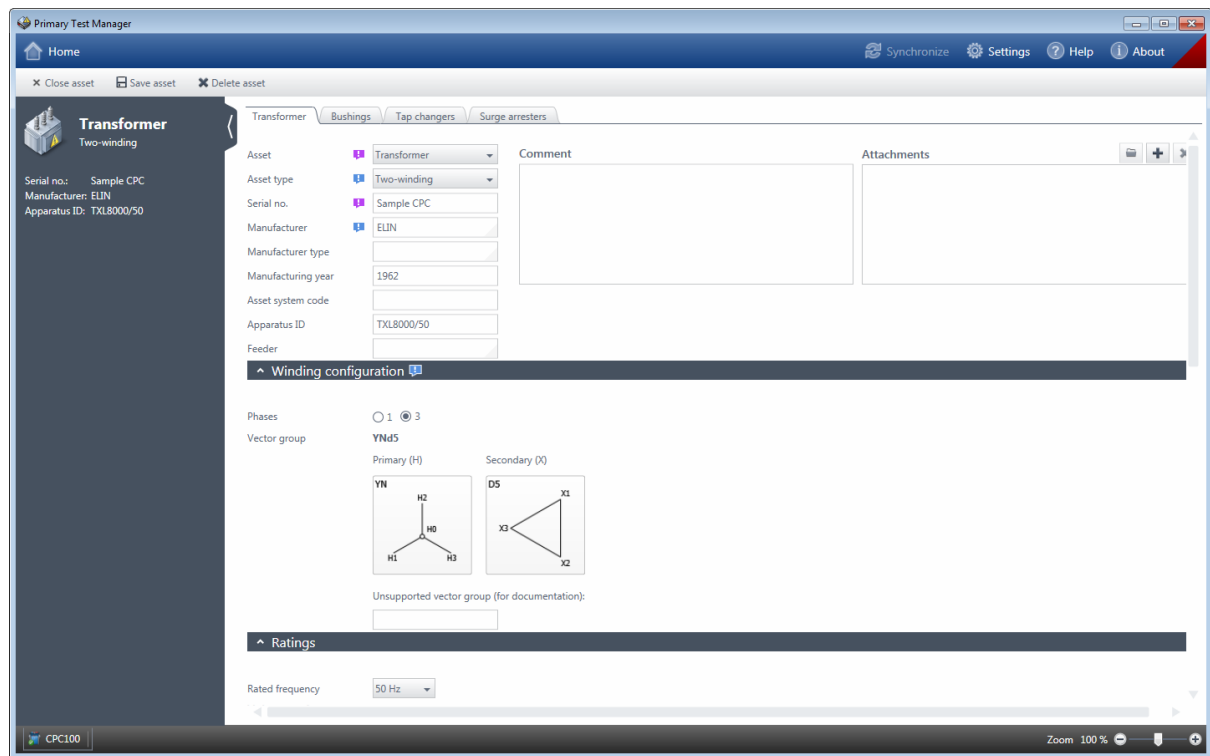


Figure 9-2: Asset view

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

Note: By default the duplicated asset will be linked to location of the original asset. For relocating the asset to a different location, see the next section.

9.4 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 .

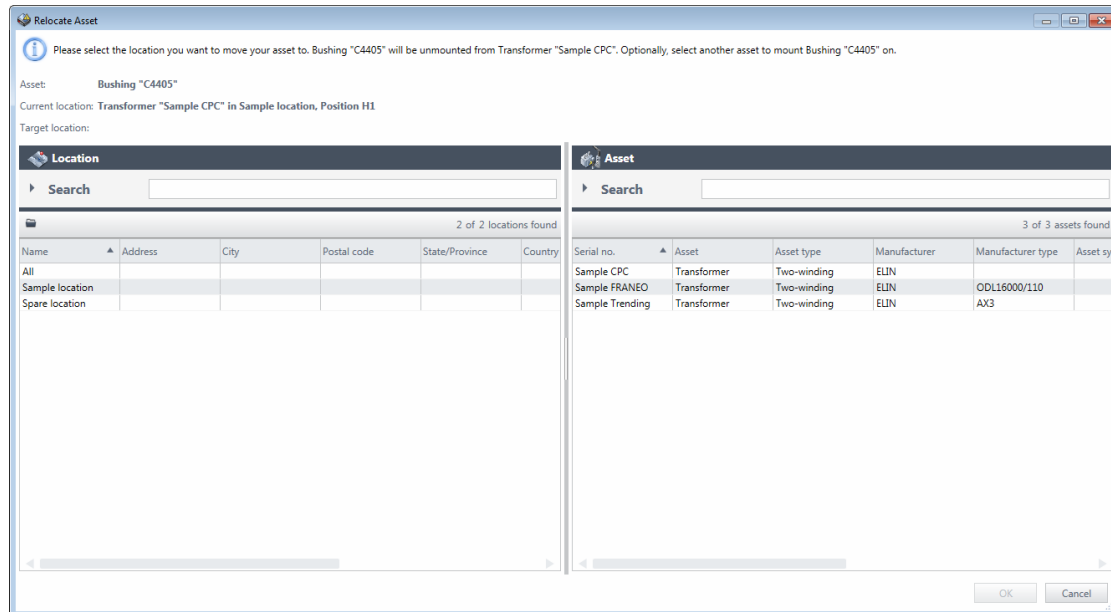


Figure 9-3: **Relocate Asset** dialog box

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 9.1 "Search for objects" on page 63).

9.5 Import and export jobs

In the manage view of *Primary Test Manager*, you can import and export *FRANEO 800* tests with the associated asset and location data as jobs. *Primary Test Manager* also facilitates data exchange between FRA test systems of other manufacturers such as Doble.

9.5.1 Import jobs

Primary Test Manager supports job import in the following formats.

Table 9-5: Supported job import formats

File name extension	Description	File content
.ptm	<i>Primary Test Manager</i> file	One job including information about the asset and location which may contain one ore more FRA tests
.fra, .tfra	<i>FRAnalyzer</i> 2.2 test file	One (.fra) or multiple (.tfra) FRA tests ¹ belonging to the same asset, including information about the asset and location
.csv	<i>FRAnalyzer</i> 2.2 CSV file ²	One FRA test, including information about the asset and location
.dbefra ³	<i>FRAnalyzer</i> 2.2 database export file	Multiple FRA tests, including information about the assets and locations
.xml ⁴ , .xml.zip ⁵	SFRA file according to IEC 60076-18 standard	One FRA trace (.xml) or multiple FRA traces (.xml.zip), including information about assets and locations
.xfra ⁴ , .xfra.zip ⁵	SFRA file according to CIGRE WG A2.26 standard	One FRA trace (.xfra) or multiple FRA traces (.xfra.zip), including information about assets and locations
.sfra ⁴	Doble SFRA file	One FRA test, including information about the asset and location
.frax	Megger FRAX file	One FRA test, including information about multiple traces, the asset and location

1. Each test imported from the *FRAnalyzer* software is represented as a job in *Primary Test Manager*. This jobs contains exactly one SFRA test.
2. Files in the *FRAnalyzer* 1.x CSV format can only be imported by using the generic CSV import.
3. Do not import the data repeatedly to prevent data duplication.
4. Multiple files that reside in the same folder as the selected one are combined into one test. The folder's name is used as test name.
5. The zip file may contain subfolders. All files in a subfolder are combined into one test. The subfolder's name is used as test name. All subfolders are imported into the selected job.

NOTICE

- If the asset and/or location data is not complete or false, import the test data by using the **Add from file** command (see 7.5.2 "Importing test data" on page 56).

To import a job:

1. Under **Jobs**, click the **Import** button .
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.

Note: We recommend using the supported foreign data formats for import even in cases where the foreign software supports common data formats such as the IEC or CIGRE format. For example, to import *FRAnalyzer* data, use .fra or .tfra import. Accordingly, use .sfra to import Doble data and .frax to import Megger data.

9.5.2 Export jobs

Primary Test Manager supports job export in the following formats.

Table 9-6: Supported job export formats

File name extension	Description	File content
.ptm	<i>Primary Test Manager</i> file	One job including information about the asset and location which may contain one ore more FRA tests
.csv	<i>FRAnalyzer</i> 2.2 CSV file ¹	One FRA test, including information about the asset and location
.xml.zip	Zipped XML data according to IEC 60076-18 standard	One file in XML format is written for each executed test trace of every SFRA test in the selected job. All generated XML files are saved in a zip file.
.xfra.zip	Zipped XFRA data according to CIGRE WG A2.26 standard	One file in XFRA format is written for each executed test trace of every SFRA test in the selected job. All generated XFRA files are saved in a zip file.

1. Files in the *FRAnalyzer* 1.x CSV format can only be imported by using the generic CSV import.

To export a job:

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

10 Transformer data

The following tables describe the transformer data.

Table 10-1: Winding configuration

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

Table 10-2: 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
Rated power	Power rating of the transformer
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 6.1.1 "Settings" on page 29).

Table 10-3: Impedances

Data	Description
Ref. temp.	Reference temperature
Leakage reactance H - X¹, H - Y¹, X - Y¹	
Leakage reactance Z (%) ¹	Leakage reactance 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 P _k	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 Z ₀ (%)	Zero sequence impedance of the transformer

1. Set by the regional conventions (see 6.1.1 "Settings" on page 29).

Table 10-4: 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
	Volume
Total weight	Total weight of the transformer
Winding	Transformer's winding
Conductor material	Conductor material of the transformer's winding

10.1 Bushing data

For the data of the transformer's bushings, see 11 "Spare bushing data" on page 73.

10.2 Tap changer data

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

Table 10-5: 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

10.3 Surge arrester data

The following table describes the surge arrester data.

Table 10-6: 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.
Alphabetic 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

Table 10-6: Surge arrester data (continued)

Data	Description
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 Spare bushing data

The following table describes the spare bushing data.

Table 11-1: Spare bushing data

Data	Description
Pos. ¹	Terminal of the asset 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)/ Tanδ (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)/ Tanδ (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
Other	
Insulation type	Insulation type of the spare bushing
Outer insulation type	Outer insulation type of the spare bushing
Comment	Comment on the spare bushing
Attachments	Attachments to the spare bushing (see "Managing attachments" later in this chapter)

1. Only available for spare bushings mounted on another assets

2. Set by the selected profile

Managing attachments

Under **Attachments**, you can manage attachments to spare bushings.

To add an attachment to a spare bushing:

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

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 spare bushing:

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

12 Application

This section describes testing of the power transformers with *FRANEO 800*. *Primary Test Manager* supports the following transformer tests:

- Sweep frequency response analysis
- Oil analysis

12.1 Sweep frequency response analysis (SFRA)

With *FRANEO 800*, you can perform the SFRA test of the transformer windings, compare the test results and analyze the transformer windings by calculating the difference between the test results of two comparable test traces.

12.1.1 Test traces

For testing with *FRANEO 800*, the test traces are of fundamental importance. The frequency response of a test trace strongly depends on the vector group of the transformer under test and the measurement type (for example, end-to-end or interwinding). When creating a new test, *Primary Test Manager* generates the default test traces automatically based on the selected template or according to IEC 60076-18 FRA testing recommendations. You can intentionally change the predefined test traces for your specific applications.

Typically, you do not need to change the default test traces. In well-founded cases, you can delete the default test traces and add new test traces. In particular, in typical *FRANEO 800* applications proceed as follows:

- ▶ If you want to test a transformer for the first time, create a test with a standard measurement profile based on the FRA testing recommendations. Then the default test traces are likely the traces you want to test.
- ▶ If you want to compare the current test results with reference test results, create a test with the same measurement template as used by the reference test. Then the default test traces are exactly the traces you want to test.

Note: We recommend organizing the reference tests and inspection tests into different jobs with descriptive names. For example, the reference tests executed at a manufacturer site should be organized in a job named **Reference tests**. The tests executed before transportation should be organized in a job named **Before transportation**, and the tests executed after transportation should be organized in a job named **After transportation**.

12.1.2 Primary Test Manager test view

After clicking the SFRA test in the left pane of the *Primary Test Manager* test view (see 7.5 "Test view" on page 55), the test view is split into the General area, the Settings and conditions area, and the Measurements area. You can expand and collapse the areas by clicking the arrows on the split bars.

The General area displays the wiring diagram for the selected test trace. In the Settings and conditions area, you can enter the SFRA test settings (see 12.1.3 "Test settings" later in this chapter). In the Measurements area, you can prepare (see 12.1.4 "Prepare the SFRA test" on page 80) and perform (see 12.1.5 "Perform the SFRA test" on page 84) the SFRA test, compare the test results (see 12.1.6 "Compare the test results" on page 86), and analyze the transformer windings (see 12.1.7 "Analyze the transformer windings" on page 88).

12.1.3 Test settings

The following table describes the SFRA test settings.

Table 12-1: SFRA test settings

Setting	Description
Measurement settings	
Measurement template	Template underlying the test (see "Measurement template" on page 77)
Injection	Transformer's terminal in which the signal is injected
Output level	
Test voltage (V_{pp}) ¹	Output voltage of the source channel
Sweep settings	
Sweep profile	Settings of the sweep (see "Sweep profile" on page 78)
Start frequency	Start sweep frequency
Stop frequency	Stop sweep frequency
Sweep mode	Distribution of the measurement points (see "Custom frequency ranges" on page 79)
Measurement points	Total number of measurement points
Custom frequency ranges	Click Custom frequency ranges to customize the measurement points (see "Custom frequency ranges" on page 79).
Receiver bandwidth	Bandwidth of the <i>FRANEO 800</i> receiver (see "Receiver bandwidth" on page 80)
Attenuator	Measurement channel attenuation (see "Attenuator" on page 80)
Measurement time	Estimated measurement time based on the test settings
Test conditions	
Oil filled	Transformer's insulation
Oil temperature	Temperature of the transformer's oil

Table 12-1: SFRA test settings (continued)

Setting	Description
Overwrite global test conditions	Select the Overwrite global test conditions check box to set the test conditions different from the global test conditions.
Ambient temperature	Ambient temperature
Humidity	Relative ambient humidity
Weather	Weather during the test
DETC tap	Position of the DETC tap

1. For compatibility with the test results obtained with the previous versions of *FRANEO 800*, the maximum test voltage is $2.83 V_{pp}$.

Measurement template

The measurement template specifies the default test traces. *Primary Test Manager* provides standard measurement templates based on the FRA testing recommendations. Select the measurement template you want to use from the **Measurement template** list. The following table describes the available measurement templates.

Table 12-2: Measurement templates

Template	Description
IEC 60076-18	Generates default test traces according to IEC 60076-18 standard.
OMICRON default	OMICRON template based on IEC 60076-18 standard
OMICRON extended	Advanced OMICRON template based on IEC 60076-18 standard
IEEE C57.149-2012 default	Generates the minimum recommended test traces according to IEEE C57.149-2012 standard.
IEEE C57.149-2012 extended	Generates all recommended test traces according to IEEE C57.149-2012 standard.
No traces	Generates no test traces, leaving you the freedom to define them.

The measurement templates specify also the positions of the OLTC tap including the minimum (min) or maximum (max) number of effective turns of the transformer's winding. You can select the tap positions corresponding to the min and max values from the list next to **min** or **max**.

You can add all test traces related to the tap changer with a specific tap position to the available test traces with a single click. To add test traces with a specific tap position:

1. Select the position of the tap from the **Tap position** list.
2. Click **Add traces for selected tap**.

To remove the test traces with a specific tap position, select the position of the tap from the **Tap position** list, and then click **Remove traces for selected tap**.

You can adapt the selected measurement template by adding and removing test traces to match your requirements.

Note: Customizing the test traces is an expert feature which enables an expert to specify whatever he wants. The provided standard templates are rule-based templates that recognize the nameplate values and adapt to nameplate changes automatically. For example, if the asset type is changed from

two-winding to three-winding the SFRA test automatically generates additional test traces for the three-winding asset type. Changes to the vector group or tap changer update the SFRA test in a similar way. However, as soon you customized the test traces, the measurement lines are "decoupled" from the nameplate, that is, changes to the nameplate do not adapt the measurement lines. You can also add measurement lines having no sense with respect to the nameplate, for example, you can add measurement lines for the tertiary winding even though the transformer's vector group does not specify it. Moreover, you can use any possible tap name, therefore no drop-down list box with the currently set tap names is available for the customized templates.

To adapt a measurement template:

1. Select the measurement template from the **Measurement template** list.
2. In the Measurements area, click the **Preparation** tab.
3. Click **Customize traces**.
4. Click **Add trace** to add a trace, or select the trace you want to remove, and then click **Remove trace**.
5. Repeat step 4 for all traces you want to add and remove.
6. Configure the added test traces to meet your needs (see Table 12-4: "SFRA measurement data" on page 83).
7. To save the measurement template, click **Save** beneath the **Measurement template** list.
8. In the **Measurement template** list box, type the template name, and then click **OK**.

Note: For the No traces measurement template, steps 1 to 3 are done by default.

To delete a user-defined measurement template:

1. Select the measurement template from the **Measurement template** list.
2. Click **Delete** beneath the **Measurement template** list.

Sweep profile

The sweep profile specifies the default sweep settings. Select the sweep profile you want to use from the **Sweep profile** list. The following table describes the available sweep profiles.

Table 12-3: Sweep profiles

Profile	Description
FRANEO default	Default sweep profile for testing with <i>FRANEO 800</i>
FRAnalyzer 2.1	Compatible with the <i>FRAnalyzer 2.1</i> software To view the distribution of the measurement points, click Custom frequency ranges .
FRAnalyzer 2.0	Compatible with the <i>FRAnalyzer 2.0</i> software To view the distribution of the measurement points, click Custom frequency ranges .
FRAnalyzer 1.1	Compatible with the <i>FRAnalyzer 1.1</i> software To view the distribution of the measurement points, click Custom frequency ranges .
QuickLin	Fast sweep with linearly distributed measurement points
QuickLog	Fast sweep with logarithmically distributed measurement points

You can adapt the selected sweep profile by changing any sweep settings.

To adapt a sweep profile:

1. Select the sweep profile from the **Sweep profile** list.
2. Change any sweep settings.
3. To save the sweep profile, click **Save** beneath the **Sweep profile** list.
4. In the **Sweep profile** list box, type the profile name, and then click **OK**.

To delete a user-defined sweep profile:

1. Select the sweep profile from the **Sweep profile** list.
2. Click **Delete** beneath the **Sweep profile** list.

Custom frequency ranges

The default measurement points are defined by the selected sweep profile. You can customize the measurement points to increase the measurement quality with respect to the resolution and measurement time. Typically, a higher resolution is necessary due to the enhanced information content at higher frequencies.

To customize the default measurement points:

1. Click **Custom frequency ranges**.

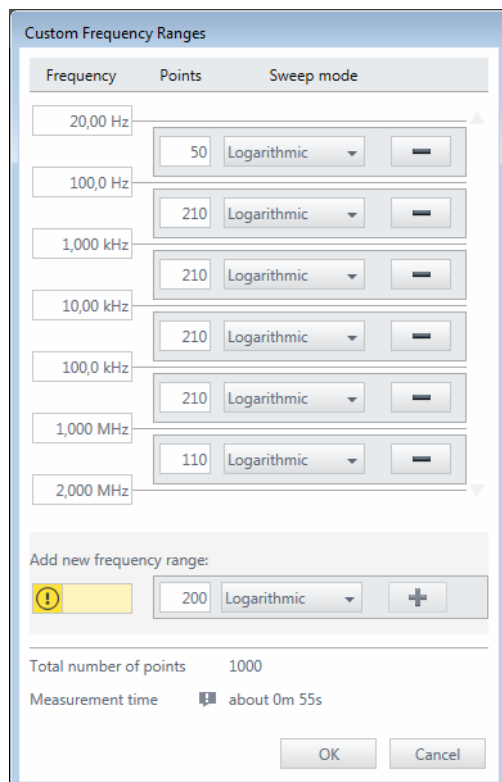


Figure 12-1: **Custom Frequency Ranges** dialog box

2. To change a default frequency range, click in the corresponding **Frequency** box, and then type the frequency.

3. To change the number of measurement points of a frequency range, select the number of measurements points you want to change, and then type the new number of measurement points.

Note: The maximum number of measurement points for a frequency range is 3201.

4. To change the distribution of measurement points within a frequency range, select the distribution from the corresponding **Sweep mode** list.
5. To delete a frequency range, click the corresponding **Remove section** button .

To add a frequency range:

1. Click **Custom frequency ranges**.
2. Under **Add new frequency range**, type the start frequency of the new frequency range. The stop frequency of the new frequency range is the stop frequency of the frequency range into which the new frequency range fits.
3. Type the number of measurement points.
4. Select the distribution of measurement points.
5. Click the **Add sweep section** button .
6. Click **OK** to close the **Custom Frequency Ranges** dialog box.

Receiver bandwidth

The bandwidth of the *FRANEO 800* receiver affects the noise suppression and the sweep speed. A narrow receiver bandwidth suppresses the most noise interference but slows down the sweep. A broad receiver bandwidth results in fast measurements with a reduced noise immunity of *FRANEO 800*. We recommend using the option **<adapt automatically>** to adapt the receiver bandwidth during the measurement for the best signal-to-noise ratio.

Attenuator

With the measurement channel attenuation you can balance the overload risk. The following attenuator settings are available: **0 dB**, **10 dB**, **20 dB**, **30 dB**, and **<adapt automatically>**. We recommend using the setting **<adapt automatically>** to adapt the attenuation during the test for the best signal-to-noise ratio without risk of overload.

12.1.4 Prepare the SFRA test

To prepare the SFRA test:

1. Install *FRANEO 800* and *Primary Test Manager* (see 5 "Installation" on page 18).
2. Start *Primary Test Manager* and connect to *FRANEO 800* (see 5.5 "Start Primary Test Manager and connect to FRANEO 800" on page 22).
3. In *Primary Test Manager*, do one of the following:
 - In the home view, click the **Create new job** button , and then create a job (see 7 "Create new job" on page 40).
 - In the home view, click the **Execute prepared job** button , and then open a prepared job (see 8 "Execute prepared job" on page 60).

4. In the test view, select the SFRA test (see 7.5.1 "Selecting tests" on page 55).
5. In the left pane of the test view, click the SFRA test.

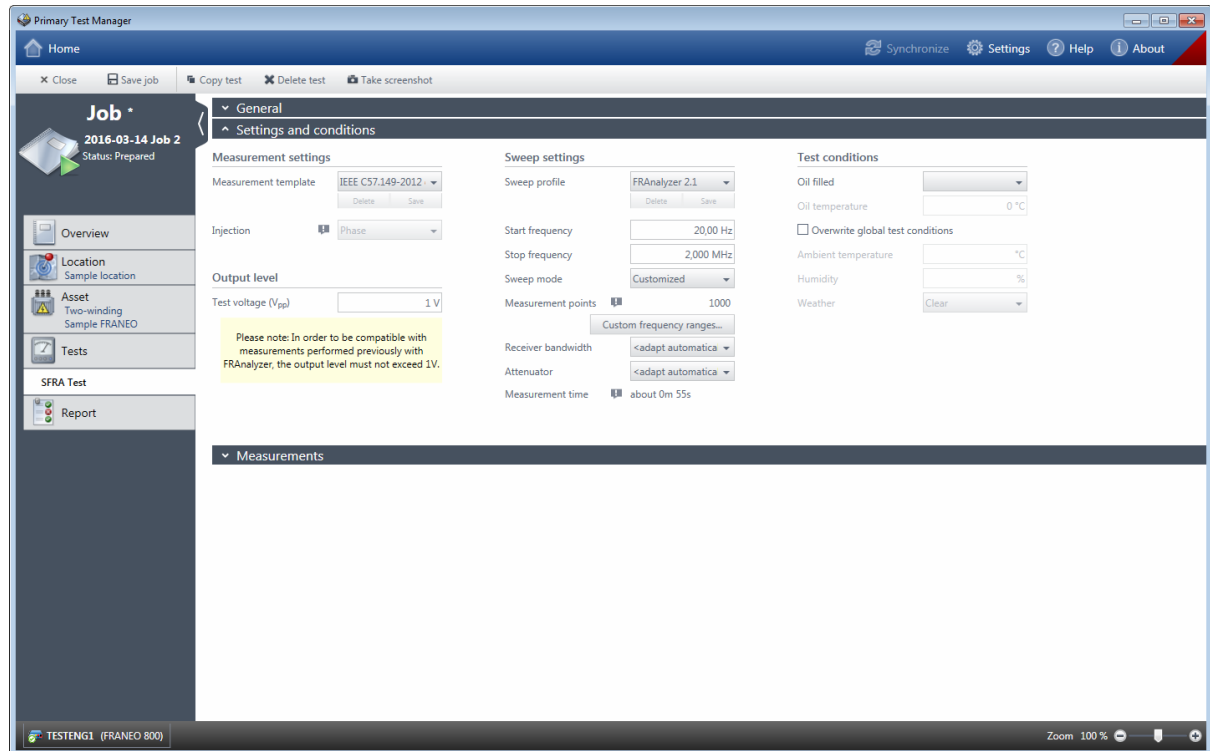
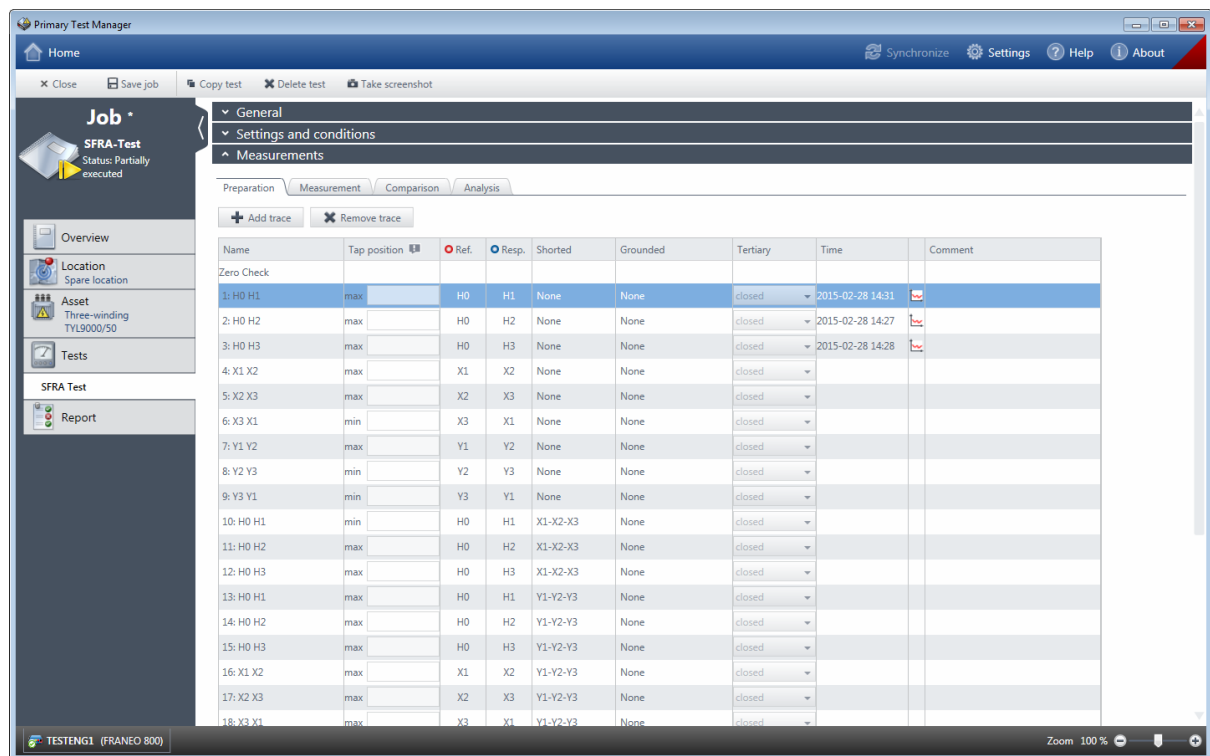


Figure 12-2: Settings and conditions area

Note: For better handling of more tests, we recommend replacing the generic name of the SFRA test with a specific name. To rename the test, click the test name in the left pane of the test view, and then type a new name.

6. In the Settings and conditions area:

- ▶ Select a measurement template from the **Measurement template** list and, optionally, adapt the template to meet your needs (see "Measurement template" on page 77).
- ▶ Select a sweep profile from the **Sweep profile** list and, optionally, adapt the profile to meet your needs (see "Sweep profile" on page 78).
- ▶ Enter other test settings (see Table 12-1: "SFRA test settings" on page 76).



Name	Tap position	Ref.	Resp.	Shorted	Grounded	Tertiary	Time	Comment
Zero Check								
1: H0 H1	max	H0	H1	None	None	closed	2015-02-28 14:31	
2: H0 H2	max	H0	H2	None	None	closed	2015-02-28 14:27	
3: H0 H3	max	H0	H3	None	None	closed	2015-02-28 14:28	
4: X1 X2	max	X1	X2	None	None	closed		
5: X2 X3	max	X2	X3	None	None	closed		
6: X3 X1	min	X3	X1	None	None	closed		
7: Y1 Y2	max	Y1	Y2	None	None	closed		
8: Y2 Y3	min	Y2	Y3	None	None	closed		
9: Y3 Y1	min	Y3	Y1	None	None	closed		
10: H0 H1	min	H0	H1	X1-X2-X3	None	closed		
11: H0 H2	max	H0	H2	X1-X2-X3	None	closed		
12: H0 H3	max	H0	H3	X1-X2-X3	None	closed		
13: H0 H1	max	H0	H1	Y1-Y2-Y3	None	closed		
14: H0 H2	max	H0	H2	Y1-Y2-Y3	None	closed		
15: H0 H3	max	H0	H3	Y1-Y2-Y3	None	closed		
16: X1 X2	max	X1	X2	Y1-Y2-Y3	None	closed		
17: X2 X3	max	X2	X3	Y1-Y2-Y3	None	closed		
18: X3 X1	max	X3	X1	Y1-Y2-Y3	None	closed		

Figure 12-3: Measurements area: **Preparation** tab

The following table describes the SFRA measurement data.

Table 12-4: SFRA measurement data

Data	Description
Name ¹	Name of the test trace
Tap position ¹	Position of the transformer's tap defined by the measurement template: - min: tap positions including the minimum number of effective turns of the transformer's winding - max: tap positions including the maximum number of effective turns of the transformer's winding Optionally, you can select the tap position from the list next to min and max to document the tap changer's position corresponding to the minimum and the maximum number of effective turns included into the measurement circuit for the selected trace.
Ref.	Transformer's terminal to be connected to the <i>FRANEO 800</i> REFERENCE connector
Resp.	Transformer's terminal to be connected to the <i>FRANEO 800</i> RESPONSE connector
Shorted	Transformer's terminals connected together
Grounded	Transformer's terminals connected to ground
Tertiary winding	State of the transformer's tertiary winding
Time	Time the test was performed
Comment ¹	Comment on the measurement

1. Editable by the user

12.1.5 Perform the SFRA test

You can perform the SFRA test in the **Measurement** tab workspace of *Primary Test Manager*.

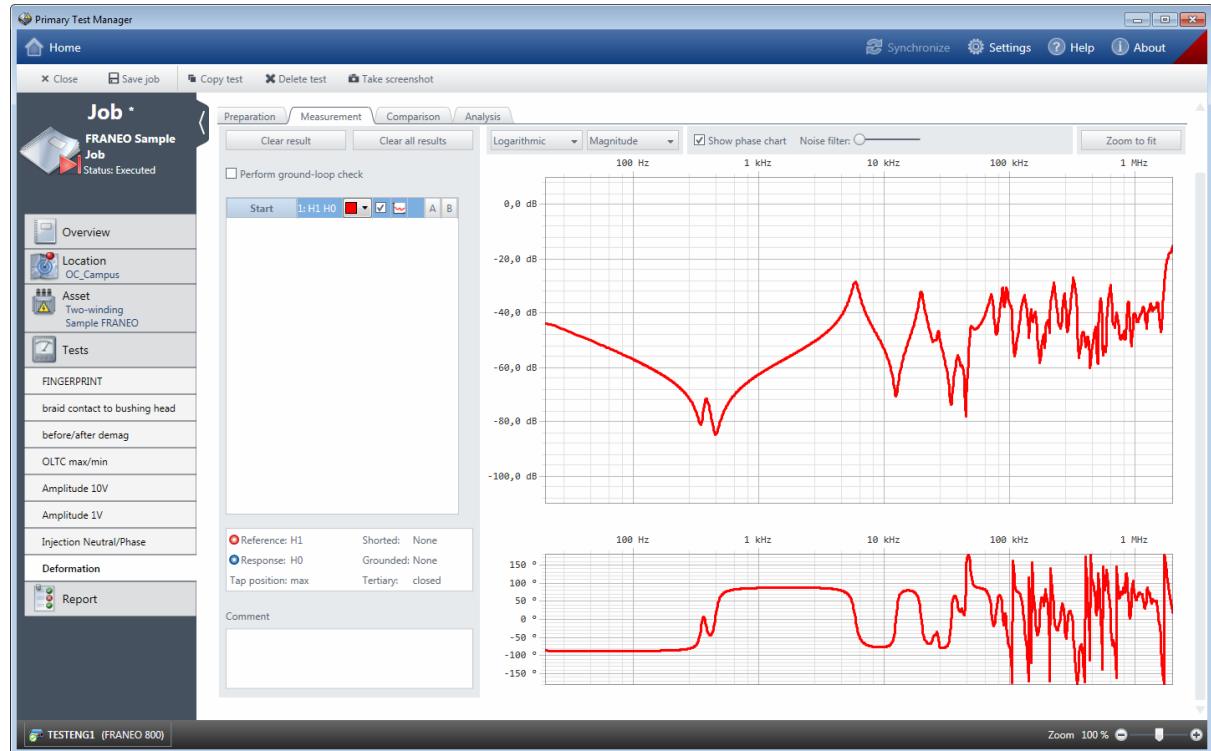


Figure 12-4: Measurements area: **Measurement** tab

The left area of the workspace displays a list of test traces generated during the test preparation with the following elements:

- ▶ To change the test trace color, click the arrow next to the color box, and in the color palette, click your preferred color.
- ▶ To display the measurement results for a test trace, select the check box corresponding to the test trace.
- ▶ The symbol  indicates available measurement results.
- ▶ The symbol  indicates a comment on the test trace.
- ▶ The symbol  indicates measurement error.
- ▶ To clear the measurement results for a test trace, click the test trace, and then click **Clear result**.
- ▶ To clear all measurement results, click **Clear all results**.

Ground-loop check

The ground-loop check measures the resistance of the conductor connection consisting of the grounding cable, connection between the transformer tank and the bushing clamp, and the shield of the coaxial cable. The ground-loop check measures the resistance for both bushing terminals. In this way, the ground-loop check proves whether the ground loop is not broken due to poor contacts between the transformer tank and the bushing clamp. Before checking the ground loop, connect the grounding cable

to the equipotential ground terminal of *FRANEO 800* and to the transformer tank. The ground-loop check does not require any reconnection of the test setup. To perform the ground-loop check during the SFRA test, select the **Perform ground-loop check** check box.

The right area of the workspace displays the measurement results for the selected test traces with the following display control options:

- ▶ To display the frequency response on the linear or logarithmic frequency axis, select **Linear** or **Logarithmic** from the list.
- ▶ To display the magnitude, impedance or admittance of the frequency response, select **Magnitude**, **Impedance**, or **Admittance** from the list.
- ▶ To display the phase frequency response, select the **Show phase chart** check box.
- ▶ To filter the measurement noise, move the **Noise filter** slider to the right.
- ▶ To zoom into the diagram, click **Zoom to fit**.

To perform the SFRA test:

1. In the Measurements area, click the **Measurement** tab.
2. On the **Measurement** tab, click the test trace you want to test.

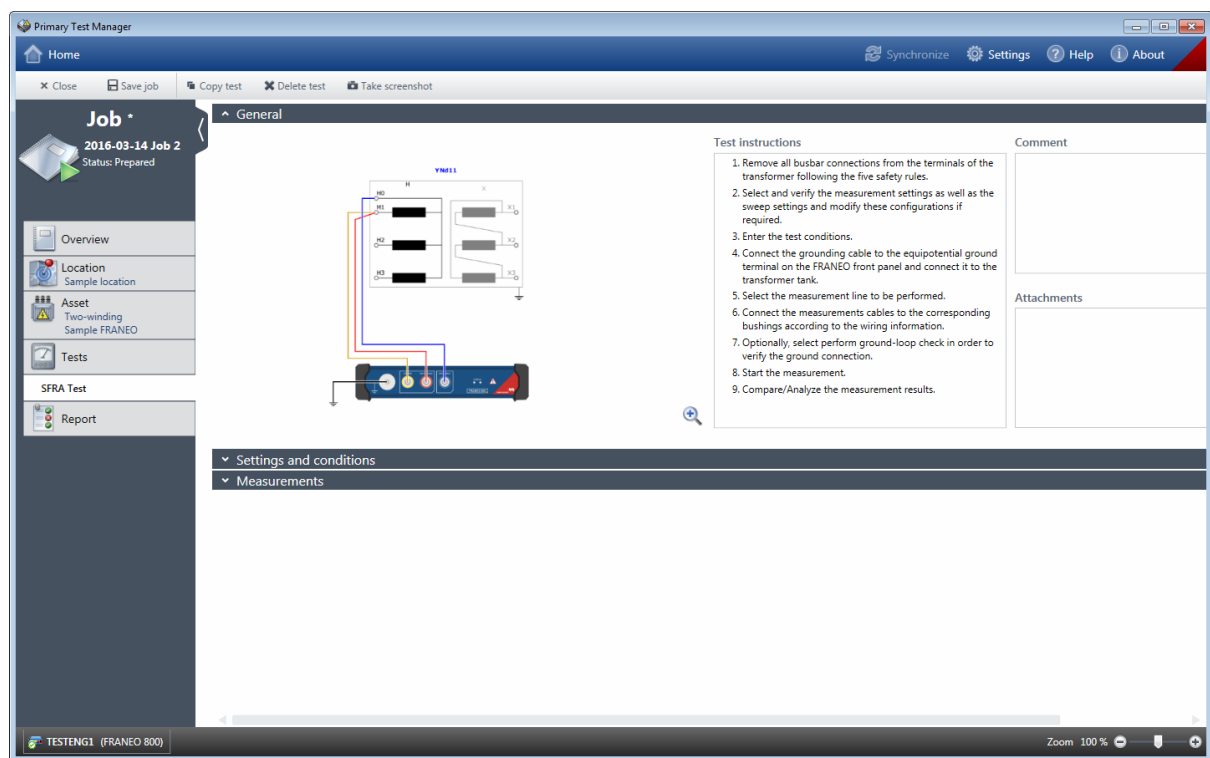


Figure 12-5: General area

3. Connect *FRANEO 800* to the transformer under test according to the wiring diagram displayed in the General area (see 5.6 "Connect FRANEO 800 to the power transformer" on page 23).
4. Click **Start** next to the selected test trace.
5. Repeat steps 2 to 4 for all test traces.

12.1.6 Compare the test results

With *FRANEO 800*, you can diagnose defects in the transformer windings and magnetic core by comparing the SFRA test results. You can compare the test results in the **Comparison** tab workspace of *Primary Test Manager*.

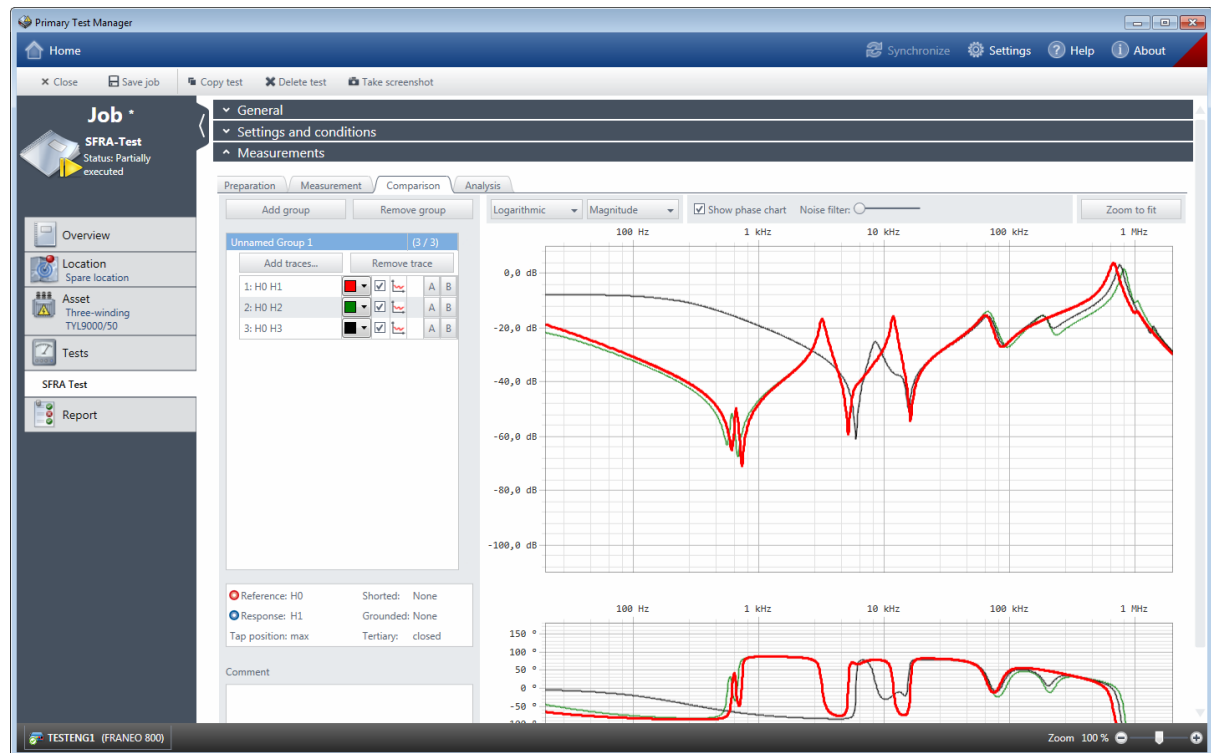


Figure 12-6: Measurements area: **Comparison** tab

In the left area of the workspace, you can configure groups of test traces for comparison. Click **Add group** to add a new group of test traces. To remove a group of test traces, select the group, and then click **Remove group**.

You can group any test traces with available measurement results and you can add as many groups as you want. You can add a test trace to multiple groups. To rename a group, click **Unamed Group x**.

Note: Groups are especially useful to individually compare the test traces on the high-voltage and low-voltage side.

The left area of the workspace displays a list of test traces of the selected group as described in 12.1.5 "Perform the SFRA test" on page 84. Additionally, two cursors are available. To set the cursors, click the buttons **A** and **B** in any trace of the group. After then, a table showing numerical results for the cursor positions displays in the right area of the workspace.

	Frequency	Magnitude	Phase	Impedance	Admittance	Close cursors table
Cursor A	60 Hz	-28,28 dB	-69 °	1,28 kΩ	781,59 μS	
Cursor B	250 Hz	-40,89 dB	-82,4 °	5,53 kΩ	180,76 μS	
Delta (B - A)	190 Hz	-12,61 dB	-13,5 °	4,25 kΩ	-600,82 μS	

Figure 12-7: Cursor table

Note: You can click the frequency column of a cursor to set or move the cursor to a specific frequency.

The right area of the workspace displays the measurement results for the selected group of test traces.

For control display options, see 12.1.5 "Perform the SFRA test" on page 84. Here, the symbol  indicates a test trace of the current test, while the symbol  indicates a test trace of a comparison test.

To compare the test results:

1. In the Measurements area, click the **Comparison** tab.
2. In the left area of the workspace, click **Add group**.
3. Under **Available traces**, all test traces with measurement results available in *Primary Test Manager* are displayed in a tree view.
4. Expand the tree view.
5. Click **Add all** to add all test traces to the group, or click **Add** next to the trace you want to add to the group.
6. Repeat steps 4 and 5 for all test traces you want to compare.
7. In the right area of the workspace, compare the measurement results for the group of test traces visually.

To rename a test trace group, click the group name, and then type a new name.

To remove a test trace from the group, select the test trace, and then click **Remove trace**.

To close the tree view, click **Close**, and to open the tree view again, click **Add traces**.

12.1.7 Analyze the transformer windings

With *FRANEO 800*, you can analyze the transformer windings by calculating the winding analysis factors of the frequency responses of two comparable test traces. You can calculate the winding analysis factors by using different algorithms (see 12.2 "Analysis algorithms" on page 89). You can perform the analysis in the **Analysis** tab workspace of *Primary Test Manager*.

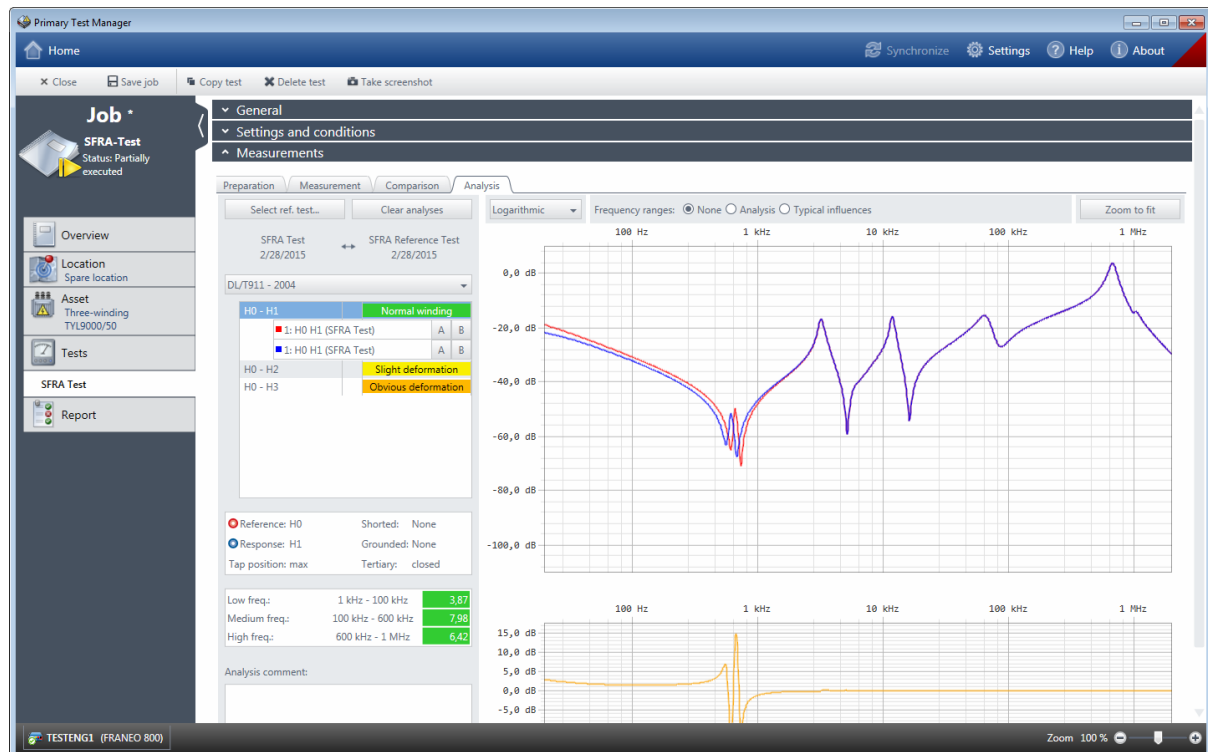


Figure 12-8: Measurements area: **Analysis** tab

In the left area of the workspace, you can configure the analysis of comparable test traces. The comparable test traces have:

- Measurement results on the same transformer
- Same measurement data Tap position (min or max), Ref., Resp., Shorted, Grounded, Tertiary winding (see Table 12-4: "SFRA measurement data" on page 83).

The right area of the workspace displays on the top the magnitude of the frequency responses of two comparable test traces, and on the bottom their difference. In addition to the control display options described earlier in this chapter, the right area of the workspace contains options for displaying the frequency ranges.

Table 12-5: Frequency range options

Frequency ranges	Description
None	Displays no frequency ranges.
Analysis	Displays frequency ranges according to the selected analysis algorithm.
Typical influences	Displays typical frequency ranges according to the influence of the different transformer parts.

To perform an analysis of the transformer windings:

1. In the Measurements area, click the **Analysis** tab.
2. In the left area of the workspace, click **Select ref. test**.
3. Under **Available tests**, all tests with measurement results available in *Primary Test Manager* are displayed.
4. Click **Use as ref.** next to the test you want to use for the analysis.
5. If the test contains test traces comparable with the test traces of the current test, the comparable test traces are displayed.
6. Select the analysis algorithm from the list.
7. On the top, the left area of the workspace displays the analysis next to the comparable test traces, and on the bottom the winding analysis factors.
8. Optionally, you can set the cursors as described earlier in this chapter.
9. In the right area of the workspace, you can set the options for displaying the frequency ranges and examine the test traces visually.

12.2 Analysis algorithms

The analysis of the transformer windings with *FRANEO 800* is based on two different algorithms described in this sections.

12.2.1 DL/T911-2004 standard

DL/T911-2004 is a standard for the frequency response analysis widely used in the People's Republic of China. For detailed information, see the China Electric Power Publishing Co. website www.cepp.com.cn. The algorithm evaluates the similarity of the frequency responses of two transformer's test traces by calculating the factors R_{LF} , R_{MF} and R_{HF} (see Table 12-6: "Winding analysis factors according to DL/T911-2004 standard" later in this section).

The basic underlying formulas of the DL/T911-2004 algorithm include:

$$D_x = \frac{1}{N} \sum_{k=0}^{N-1} \left[X(k) - \frac{1}{N} \sum_{k=0}^{N-1} X(k) \right]^2 \quad (\text{Eq. 12-1})$$

$$D_y = \frac{1}{N} \sum_{k=0}^{N-1} \left[Y(k) - \frac{1}{N} \sum_{k=0}^{N-1} Y(k) \right]^2 \quad (\text{Eq. 12-2})$$

$$C_{xy} = D_x \times D_y \quad (\text{Eq. 12-3})$$

$$LR_{xy} = C_{xy} / (\sqrt{D_x D_y}) \quad (\text{Eq. 12-4})$$

$$R_{xy} = \begin{cases} 10 & \text{if } 1 - LR_{xy} < 10^{-10} \\ -\lg(1 - LR_{xy}) & \text{otherwise} \end{cases} \quad (\text{Eq. 12-5})$$

where $X(k)$, $Y(k)$ are comparable frequency response sequences of length N .

The algorithm evaluates the factor R_{xy} at fixed frequencies within the frequency range 1 kHz...1 MHz. Consequently, the algorithm works only for frequency responses including measurement results within 1 kHz...1 MHz. Measurement results out of this range are not considered. The factor R_{xy} evaluated in different frequency ranges yields the winding analysis factors as given in the following table.

Table 12-6: Winding analysis factors according to DL/T911-2004 standard

Winding analysis factor	Frequency range
R_{LF}	1 kHz...100 kHz
R_{MF}	100 kHz...600 kHz
R_{HF}	600 kHz...1 MHz

By using the winding analysis factors described in the preceding table, the transformer winding deformation conditions are defined as follows.

Note: The data in the following table applies to the power transformers with $S > 1$ MVA.

Table 12-7: Winding analysis according to DL/T911-2004 standard

Winding deformation degree	Winding analysis factors
Normal winding	$R_{LF} \geq 2.0$ AND $R_{MF} \geq 1.0$ AND $R_{HF} \geq 0.6$
Slight deformation	$2.0 > R_{LF} \geq 1.0$ OR $0.6 \leq R_{MF} < 1.0$
Obvious deformation	$1.0 > R_{LF} \geq 0.6$ OR $R_{MF} < 0.6$
Severe deformation	$R_{LF} < 0.6$

Note: The algorithm according to the DL/T911-2004 standard analyzes only comparable test traces if the measurement results cover the frequency ranges required for the calculation of the winding analysis factors (see Table 12-6: "Winding analysis factors according to DL/T911-2004 standard" on page 90). In all other cases, the calculated winding analysis factors have no meaning or cannot be calculated and *Primary Test Manager* displays **Analysis Not Possible**.

As an example, Figure 12-9: "Winding analysis of an intact transformer" shows the winding analysis of an intact transformer.

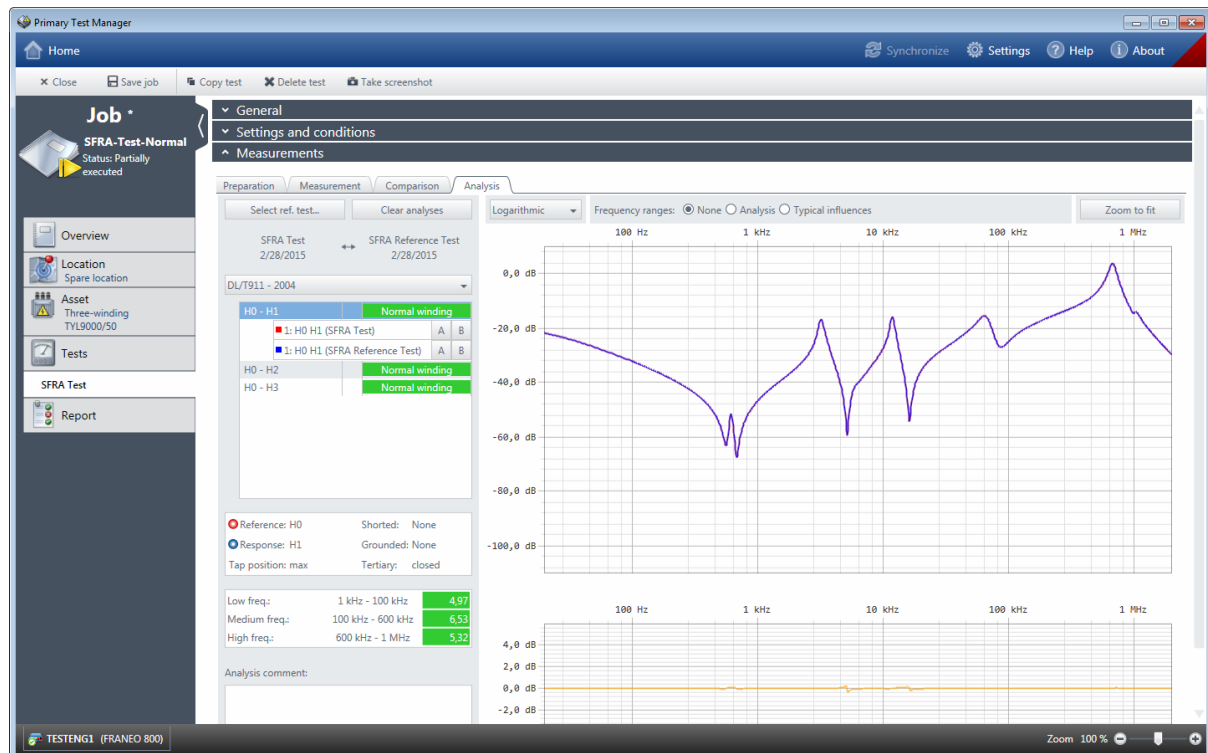


Figure 12-9: Winding analysis of an intact transformer

As an example, Figure 12-10: "Winding analysis of a defective transformer" shows the winding analysis of an defective transformer.

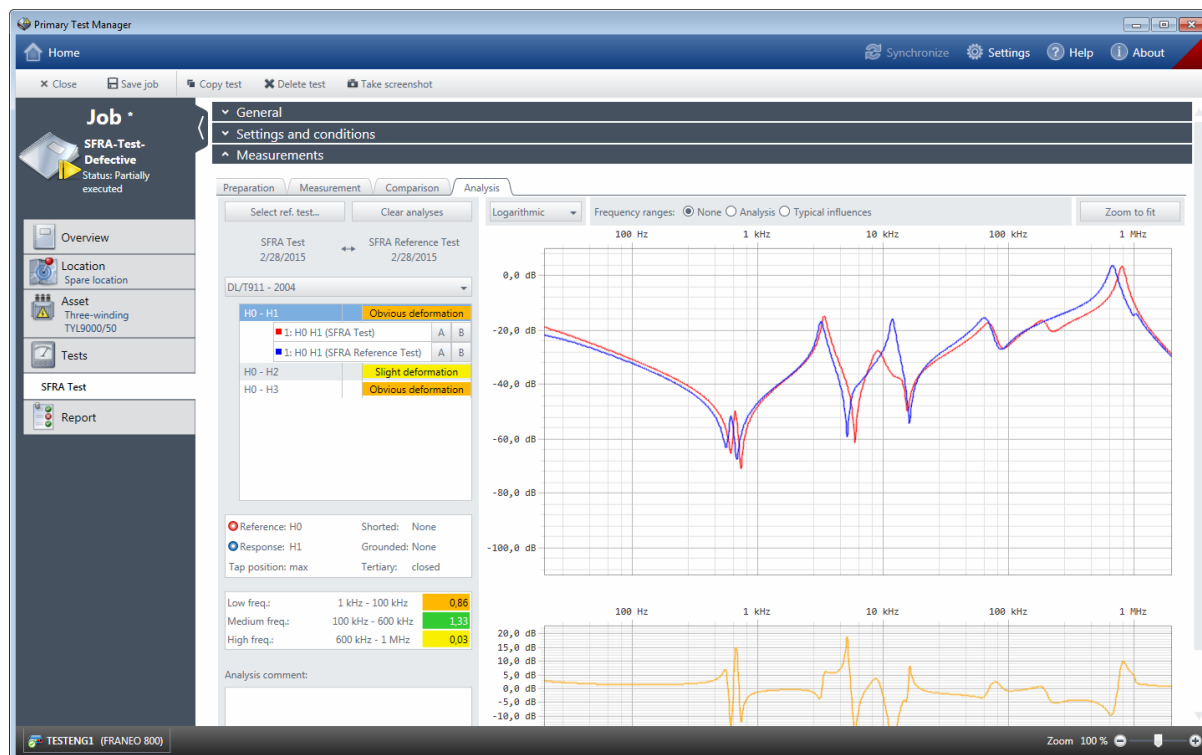


Figure 12-10: Winding analysis of a defective transformer

12.2.2 NCEPRI standard

NCEPRI is an alternative established method for the analysis of the transformer winding deformation. For detailed information, see the NCEPRI website www.ncepri.com. The algorithm evaluates the similarity of the frequency responses of two transformer's test traces by calculating their root mean-square deviation

$$E_{12} = \sqrt{\frac{\sum_{i=1}^N (F_{1i} - F_{2i})^2}{N}} \quad (\text{Eq. 12-6})$$

where F_{1i} , F_{2i} are comparable frequency response sequences of length N in dB.

The winding analysis factor E_{12} is evaluated in different frequency ranges for the high-voltage, low-voltage and tertiary windings as shown in the following table.

Table 12-8: Frequency ranges according to NCEPRI standard

Winding	Frequency range
High-voltage	10 kHz...515 kHz
Low-voltage	10 kHz...600 kHz
Tertiary-voltage	10 kHz...700 kHz

By using the winding analysis factor E_{12} , the transformer winding deformation conditions are defined as follows.

Table 12-9: Winding analysis according to NCEPRI standard

Winding distortion level	Winding analysis factor in dB
Normal condition	$E_{12} < 3.5$
Slight distortion	$3.5 < E_{12} < 7.0$
Severe distortion	$E_{12} > 7.0$

Note: The algorithm according to the NCEPRI standard analyzes only comparable test traces if the measurement results cover the frequency ranges required for the calculation of the winding analysis factor (see Table 12-8: "Frequency ranges according to NCEPRI standard" earlier in this section). In all other cases, the calculated winding analysis factor has no meaning or cannot be calculated and *Primary Test Manager* displays **Analysis Not Possible**.

Note: The overall winding analysis relies on the analysis algorithm with the levels for the winding analysis factors recommended by the respective standards and consequently cannot be guaranteed by OMICRON.

12.3 Oil analysis

The following table describes the oil analysis settings.

Table 12-10: Oil analysis settings

Setting	Description
Asset	
Asset	Asset under test
Insulation medium	Insulation medium of the asset set in the asset data
Oil level	Oil level of the asset
Oil sample temperature	Temperature of the oil at the time of sampling
Test conditions	
Sample date	Date the sample was taken
Custom test conditions	Select the Custom test conditions check box to set the test conditions different from the global test conditions.
Ambient temperature	Ambient temperature at the time of sampling
Humidity	Relative ambient humidity at the time of sampling
Weather	Weather at the time of sampling
Degree of contamination	
Oil sample facility	Degree of contamination of the oil sample facility
Expansion tank	Degree of contamination of the expansion tank

The following table describes the gas-in-oil analysis data.

Table 12-11: Gas-in-oil analysis data

Data	Description
H ₂	Hydrogen in oil
CH ₄	Methane in oil
C ₂ H ₆	Ethane in oil
C ₂ H ₄	Ethylene in oil
C ₂ H ₂	Acetylene in oil
CO	Carbon monoxide in oil
CO ₂	Carbon dioxide in oil
O ₂	Oxygen in oil
N ₂	Nitrogen in oil
TDCG	Total dissolved combustible gas

Table 12-11: Gas-in-oil analysis data (continued)

Data	Description
TDG	Total dissolved gas
TCG	Equivalent total combustible gas in %
Lab. result	Standard underlying the gas-in-oil analysis
Assessment	Gas-in-oil analysis assessment

The following table describes the gas ratios data.

Table 12-12: Gas ratio data

Data	Description
Standard	Standard underlying the gas ratio analysis
Gas ratios	
Description	Description of the gas ratio
Ratio	Ratio value
Assessment	Gas ratio assessment

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

Table 12-13: 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
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

Table 12-13: Physico-chemical oil analysis data (continued)

Data	Description
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 12-14: Test status

Status	Description
Prepared	See Table 7-1: "Job statuses" on page 40.
Partially executed	See Table 7-1: "Job statuses" on page 40.
Executed	See Table 7-1: "Job statuses" on page 40.

Note: The test status set in the oil analysis is displayed in the job overview (see 7.2 "Job overview" on page 42) under **Tests**.

13 Technical data

13.1 Calibration interval of *FRANEO 800*

All input/output values are guaranteed for one year within an ambient temperature of $23\text{ °C} \pm 5\text{ °C}/73\text{ °F} \pm 10\text{ °F}$, a warm-up time longer than 25 min. and in a frequency range of 45 Hz to 65 Hz. Accuracy values indicate that the error is smaller than $\pm(\text{value read} \times \text{reading error [rd]} + \text{full scale of the range} \times \text{full scale error [fs]})$. For mains voltages below 190 V AC the system is subject to power restrictions. Technical data is subject to change without notice.

13.2 *FRANEO 800* specifications

Table 13-1: General specifications

Characteristic	Rating
Frequency range	1 Hz...30 MHz
Source output	
Output impedance ¹	50 $\Omega \pm 2\%$
Connector	BNC
Wave form	Sinusoidal signal
Amplitude	10 V _{pp} at 50 Ω load
Reference and measurement inputs	
Input impedance ¹	50 $\Omega \pm 2\%$
Connectors	BNC
Input sensitivity	10 V _{pp}
Dynamic range ¹	>150 dB (+10 dB...< -140 dB noise floor _{RMS})

1. In the frequency range 20 Hz...2 MHz

Table 13-2: Accuracy¹

Attenuation	Typical	Guaranteed
0 dB...-50 dB	$\pm 0.1\text{ dB}$	$\pm 0.3\text{ dB}$
-50 dB...-100 dB	$\pm 0.3\text{ dB}$	$\pm 0.5\text{ dB}$

1. In the frequency range 20 Hz...2 MHz

Table 13-3: Phase accuracy¹

Characteristic	Rating
Phase accuracy	$\pm 1^\circ$

1. In the frequency range 20 Hz...2 MHz

13.3 Power supply specifications

Table 13-4: AC power supply specifications

Characteristic	Rating
Input	100 V...240 V AC/50...60 Hz/700...350 mA
Output	18 V DC/1.33 A

13.4 Environmental conditions

Table 13-5: Climate

Characteristic	Rating
Temperature	Operating –10 °C...+55 °C/+14 °F...+131 °F
	Storage ¹ –35 °C...+55 °C/–31 °F...+131 °F
Max. altitude	Operating 5 000 m/16 400 ft
	Storage 12 000 m/40 000 ft

1. For the reduction of the battery's lifetime with the storage temperature, see Table 13-6: "Aging speed" later in this section.

Storing the battery at higher temperatures reduces the battery's lifetime as shown in the following table.

Table 13-6: Aging speed

Storage temperature	Aging speed
+25 °C/+77 °F	Normal
+45 °C/+113 °F	4 times faster
+55 °C/+131 °F	12 times faster

13.5 Mechanical data

Table 13-7: Mechanical data

Characteristic	Rating
Dimensions (w × h × d)	25.2 cm × 5.5 cm × 26.9 cm/ 9.9 inch × 2.2 inch × 10.6 inch
Weight	1.82 kg/4.0 lb (without measuring cables)

13.6 Standards

Table 13-8: 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	
Other		
Shock	IEC/EN 60068-2-27 (15 g/11 ms, half-sinusoid, 3 shocks in each axis)	
Vibration	IEC/EN 60068-2-6 (frequency range 10 Hz...150 Hz, acceleration 2 g continuous (20 m/s ² /65 ft/s ²), 20 cycles per axis)	
Humidity	IEC/EN 60068-2-78 (5%...95% relative humidity, no condensation), tested at 40 °C/104 °F for 48 hours	

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