CPC 100 PTM

User Manual

Manual version: ENU 1036 06 14

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, up-to-date, and 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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1 Introduction

1.1 About this document

This document provides information on how to use this product safely, properly and efficiently.

It contains important safety rules for working with this product and gets you familiar with operating this product. Following the instructions in this document will help you to prevent danger, repair costs, and avoid possible down time due to incorrect operation.

This document is to be supplemented by existing national safety standards for accident prevention and environmental protection.

1.2 Symbols and conventions

The following symbols indicate safety instructions for avoiding hazards:

⚠ DANGER

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

⚠ WARNING

Death or severe injury may 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

Cybersecurity warning

The following symbols and formatting styles are used:

Symbol/format	Description
✓	Conditions to be met before starting a task
▶	Instructions that can be carried out in any order
1. 2.	Instructions that have to be carried out in the given order 1. Step 2. Step 2.1 Substep 2.2 Substep
➔ / ➔	Expected outcome of a step/task
Text in bold	Text shown on a device, its display or in a software
Text in italics	OMICRON product name
/ **Note:**	Additional information, explanations or tips

1.3 Related documents

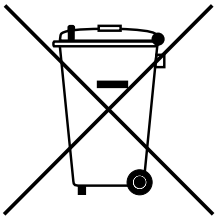
▶ Refer to the documents listed below for detailed information about the test systems used with the *CPC 100*.

Table 1-1: Related documents

Title	Description
CPC 100 Reference Manual	Contains detailed hardware and software information on the *CPC 100* accessories including relevant safety instructions.
CPC 100 User Manual	Contains safety and operation instructions for the *CPC 100* test system.
CPC 80 User Manual	Contains safety and operation instructions for the *CPC 80* test system.
CP TD1 User Manual	Contains detailed hardware and software information on the *CP TD1* including relevant safety instructions.
CP TD12/15 User Manual	Contains detailed hardware and software information on the *CP TD12/15* including relevant safety instructions.
CP CR500 User Manual	Contains detailed hardware and software information on the *CP CR500* including relevant safety instructions.
CP CR600 User Manual	Contains detailed hardware and software information on the *CP CR600* including relevant safety instructions.
CP SB1 User Manual	Contains safety and operation instructions for the *CP SB1* transformer switch box.
HGT1 User Manual	Contains safety and operation instructions for *HGT1*.

Title	Description
CP CU1 User Manual	Contains safety and operation instructions for the *CP CU1* test system.
CPOL 2 User Manual	Contains safety and operation instructions for the *CPOL 2* test system.

1.4 Recycling



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

EU countries (incl. European Economic Area)

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

Outside the European Economic Area

For information on the environmental regulations relevant to your country, contact the responsible authorities. Dispose of the OMICRON device only in accordance with your local legal requirements.

2 Safety

2.1 Basic safety information

- ▶ Before operating the device, make sure that you have read this document and fully understood all instructions.
- ▶ Only install and operate the device and any accessories according to the instructions in the corresponding user documentation.
- ▶ Make sure that this document is available on the site where the device is operated, either digitally or in print.
- ▶ Contact OMICRON Support (→ Support (page 245)) if you do not understand any of the instructions in this document.

Using the device must comply with all applicable local and national safety standards, regulations and safety-relevant documents.

Improper use may result in damage to persons or property and could invalidate warranty claims.

2.2 Designated use

This manual provides information on how to use the *Primary Test Manager* safely, properly and efficiently. The *CPC 100 PTM* User Manual familiarizes you with operating the *Primary Test Manager* and guides you through the test procedures with the OMICRON test systems.

This manual and the technical documentation shipped with the test systems must always be available on the site where the *Primary Test Manager* is used. Read all manuals carefully before using the *Primary Test Manager* and observe the safety, installation, and operation instructions therein. Reading this manual alone does not release you from the duty to comply with all national and international safety regulations relevant to working on the high-voltage equipment.

This user manual describes the *Primary Test Manager* with all available features. Please note that the features are only available if you have bought the corresponding license keys. For more information, see Primary Test Manager licensing (page 20).

2.3 Operator qualifications

Only authorized and qualified personnel who are regularly trained in electrical engineering and their specific tasks are permitted to operate the device and any accessories.

Operators must be familiar with the equipment and observe all applicable standards, local regulations, and safety-relevant documents, for example, the following standards or their equivalents:

- 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"

Personnel receiving training, instructions, directions, or education on the device must be under constant supervision of an experienced operator while working with the equipment.

- ▶ Before starting to work, clearly establish the responsibilities:
  - Designated person in control of the electrical installation
  - Designated person in control of the work activities
- ▶ Make sure that the designated person in control of the work activities coordinates the communication with all persons involved in work activities.

2.4 Safety rules

Always observe the five safety rules:

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

2.5 Safety instructions

- ▶ Stay focused on your tasks to ensure safety.
- ▶ Visually check the device for damage. If the device or any accessory is damaged, not in technically sound condition, or does not seem to function properly, do not use it. If in doubt, contact OMICRON Support (→ Support (page 245)).
- ▶ Only use original cables provided by OMICRON.
- ▶ Only use original accessories provided by OMICRON.
- ▶ Make sure that the test object is isolated from other sources during testing.

The use of different cables and accessories is at the operator's own risk, considering the necessary high safety standards, the technical requirements, as well as relevant norms and certification standards. If in doubt, contact OMICRON Support (→ Support (page 245)).

OMICRON offers a range of accessories for added safety during the operation of our test systems. For further information and specifications, contact OMICRON Support (→ Support (page 245)).

2.5.1 Work environment

- ▶ Only use the device on dry, solid ground.
- ▶ Do not operate the device in a condensing environment.
- ▶ Do not operate the device in the presence of explosive gas or vapors.
- ▶ Do not operate the device under environmental conditions that exceed the temperature and humidity limits listed in the "Technical data" section.

- Before using any additional equipment, make sure that the environmental conditions are suitable for that equipment.
- Make sure that the device and all accessories are dry and clean. In dusty regions, use protective cable caps.

2.5.2 Personal safety

- Protect others from accessing the danger zone and accidentally touching live parts by setting up a suitable safety barrier and, if applicable, signal lamps.
- Warn other people prior to any operation to make them aware of any possible disturbances.
- If you have a cardiac pacemaker, do not use the device. If you have another type of electronic medical implant consult a medical professional before operating the device. Make sure there is no person with an electronic medical implant such as a cardiac pacemaker in the immediate vicinity.
- Leave the danger zone before performing a test with the device. Stay in the work area during the test.

2.5.3 Mechanical safety

- Do not insert objects into any of the device's openings.
- Do not cover the device and make sure any ventilation openings remain unobstructed.
- Ensure that all safety-relevant components such as signal lights and emergency switching off buttons are always visible and accessible.
- Test leads wired to tall test objects must be sufficiently mechanically secured. Be aware of the hazard of falling adapters or cables.
- Do not open the device without authorization.
- Contact OMICRON Support (→ Support (page 245)) for maintenance and repair.

3 Cybersecurity

OMICRON applies the Secure Software Development Life Cycle (SSDLC) process. This ensures that our products are built with security in mind right from the beginning. It involves anything from planning and designing to deployment and maintenance while consistently addressing security concerns. By integrating security measures throughout the development process, SSDLC aims to create safe and trustworthy products.

- You can report any security issues that affect OMICRON products directly via www.omicronenergy.com/en/support/product-security.
- To protect your computer and data, make sure to keep your computer's protection software up to date. This includes but is not limited to a secure system configuration and firewall, virus and malware protection software, and responsible patch management.
- Only load files from trustworthy sources to prevent the introduction of malicious software that could compromise your system's security.
- To protect your local installation, make sure that writing in the program files directory is only possible with administrator rights.
- Contact us for further information regarding cybersecurity at OMICRON (→ OMICRON Support (page 245)).

4 Software and licensing information

4.1 System requirements

Table 4-1: *Primary Test Manager* system requirements

Characteristic	Requirement (*recommended)
Operating system	Windows 10 20H2 64-bit or Windows 11 64-bit
CPU	Single-core system with 2 GHz or faster (Multicore system with 2 GHz or faster*)
RAM	min. 4 GB (8 GB*)
Hard drive	min. 5 GB of available space
Storage device	DVD-ROM drive
Graphics adapter	Super VGA (1280×768) or higher-resolution video adapter and monitor (Graphics adapter supporting Microsoft DirectX 9.0 or later*)
Browser	Mozilla Firefox; Google Chrome; Microsoft Edge
Interface	Ethernet Network Interface Card (for testing with *TESTRANO 600*, *CPC 100* and *CIBANO 500*) The *TESTRANO 600, CPC 100* and *CIBANO 500* can be connected either directly to the computer using RJ-45 connectors or to the local network by using an Ethernet hub. USB 2.0 (for testing with *FRANEO 800)*
Installed software required for the optional Microsoft Office interface functions	Microsoft 365*, Office 2019, Office 2016, Office 2013

4.2 Open-source license information

Parts of the software are under OMICRON license, other parts are under open-source software licenses.

The *Primary Test Manager* contains the following open-source components:

Open-source component	License type
AutoMapper	MIT
Caliburn.Micro	MIT
Caliburn.Micro.Core	MIT
CommonServiceLocator	Ms-PL
Extended.Wpf.Toolkit	Ms-PL
Fare	MIT
FluentAssertions	Apache-2.0
IdentityModel	Apache-2.0
IdentityModel.OidcClient	Apache-2.0

Open-source component	License type
Microsoft.ApplicationInsights	MIT
Microsoft.ApplicationInsights.WindowsServer.TelemetryChannel	MIT
Microsoft.AspNet.SignalR.Client	Apache-2.0
Microsoft.Bcl.AsyncInterfaces	MIT
Microsoft.Build.Tasks.Git	Apache-2.0
Microsoft.CSharp	MIT
Microsoft.Extensions.Configuration.Abstractions	MIT
Microsoft.Extensions.DependencyInjection	MIT
Microsoft.Extensions.DependencyInjection.Abstractions	MIT
Microsoft.Extensions.FileProviders.Abstractions	MIT
Microsoft.Extensions.Hosting.Abstractions	MIT
Microsoft.Extensions.Logging	MIT
Microsoft.Extensions.Logging.Abstractions	MIT
Microsoft.Extensions.Options	MIT
Microsoft.Extensions.Primitives	MIT
Microsoft.Maps.MapControl.WPF	MICROSOFT SOFTWARE LICENSE TERMS
Microsoft.SourceLink.AzureDevOpsServer.Git	Apache-2.0
Microsoft.SourceLink.Common	Apache-2.0
Microsoft.VisualStudio.Composition	MIT
Microsoft.VisualStudio.Composition.NetFxAttributes	MIT
Microsoft.VisualStudio.Validation	MIT
Microsoft.Web.WebView2	Ms-PL
Nancy	MIT
Newtonsoft.Json	MIT
NLog	BSD-3-Clause
NLog.Extensions.Logging	BSD-2-Clause
SharpCompress	MIT
System.Buffers	MIT
System.ComponentModel.Annotations	MIT
System.ComponentModel.Composition	MIT
System.Diagnostics.DiagnosticSource	MIT
System.Memory	MIT
System.Numerics.Vectors	MIT
System.Reactive	MIT
System.Runtime.CompilerServices.Unsafe	MIT
System.Security.Principal.Windows	MIT
System.ServiceModel.Primitives	MIT
System.Text.Encoding.CodePages	MIT

Open-source component	License type
System.Text.Encodings.Web	MIT
System.Text.Json	MIT
System.Threading.Tasks.Extensions	MIT
System.ValueTuple	MIT
MathNet.Numerics	MIT
ZXing.Net	Apache-2.0
NETStandard.Library	MIT
Enterprise library	Ms-PL
NHibernate	LGPL 2.1
ANTLR	BSD
IESI Collections	Public domain
Remotion	LGPL 2.1
iTextSharp	LGPL 3
SQLite	Public domain
Costura.Fody	MIT
Fody	MIT
AutoFixture	MIT
AutoFixture.AutoRhinoMocks	MIT
AutoFixture.Idioms	MIT
Doxygen	GPL-2.0
RhinoMocks	BSD-2-Clause
Albedo	MIT
MSTest.TestAdapter	MIT
MSTest.TestFramework	MIT

- To access the open-source license information including the necessary source code, go to omicronenergy.com/opensource, select **DOWNLOAD SOFTWARE**, and navigate to the corresponding directory.
- In the *Primary Test Manager*, go to **File** > **About** to open the dialog in which the **Third-party licenses** are listed.

5 Primary Test Manager setup

5.1 The test set

The *Primary Test Manager* controls the test set consisting of the *CPC 100* multifunctional test system, the *CP TD* capacitance and power/dissipation factor measuring instrument, and the *CP SB1* transformer switch box.

For detailed information about the test set, see the technical documentation shipped with the test systems.

Figure 5-1: *CPC 100* front view

1	I/O button		

Figure 5-2: *CPC 100* right-side view

1	Network connector		

5.2 Installing PTM

For the minimum requirements your computer needs to run the *Primary Test Manager* software, see System requirements (page 14).

To install the *Primary Test Manager*:

▶ Put the *Primary Test Manager* DVD in the DVD drive of your computer and follow the instructions on the screen.

or:

▶ Download the *Primary Test Manager* from the OMICRON customer area.

5.3 Starting PTM and connecting to the device

5.3.1 Starting via the PTM icon

To start the *Primary Test Manager* via the Windows Start menu, click **Start** on the task bar, then click **OMICRON Primary Test Manager**, or double-click the **OMICRON Primary Test Manager** icon on the desktop.

5.3.2 Starting via the CPC Start Page

To start the *Primary Test Manager* via the *CPC Start Page*, complete the following steps:

1. Double-click the **CPC Start Page** icon on the desktop.

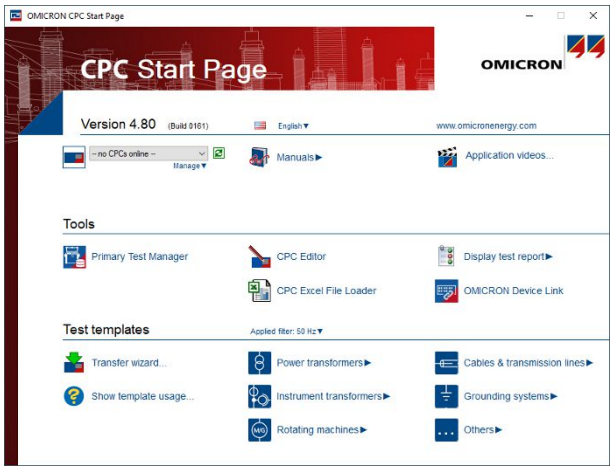


Figure 5-3: CPC Start Page

2. On the CPC Start Page, select the *CPC 100* device to which you want to connect.
3. Under **Tools**, click **Primary Test Manager**.

5.3.3 Connecting to the CPC 100

1. To connect to the *CPC 100*, select the device from the list on the *CPC Start Page* or in the PTM Home view.
2. In *Primary Test Manager* click **Connect** after selecting the device.

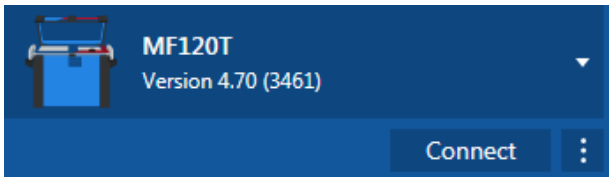


Figure 5-4: Connecting the device

If you were not able to connect to your *CPC 100* device and the green signal light is permanently on, wait a few seconds, and then do one of the following:

- ▶ Click **More** (under the Connect button), then click **Refresh**.
- ▶ Press F5.

If the *CPC 100* device is not displayed in the list of available devices, proceed as described in Manual connection to a test system (page 45).

Alternatively, you can manage the connection to the *CPC 100* in the *Primary Test Manager* status bar as described in Data synchronization (page 39)).

5.3.4 Updating the CPC 100 embedded software

The *CPC 100* embedded software must be compatible with the *Primary Test Manager* software. You can update the *CPC 100* embedded software by using one of the following procedures.

Updating via PTM Home view

To update the *CPC 100* embedded software in the *Primary Test Manager* home view:

1. In the home view, select the device you want to update from the list.
2. Click **More** beneath the **Connect** button.
3. Click **Update device software**.
4. In the **Select CPC Upgrade Image** dialog box, double-click the *UpgradeV1.upg* file.

- ▶ Alternatively, select the device you want to update from the list, and then click **Connect**. The *Primary Test Manager* will prompt you to update the *CPC 100* embedded software, if necessary.

Updating software via OMICRON *Device Link*

To update the *CPC 100* embedded software by using OMICRON *Device Link*:

1. Exit the *Primary Test Manager* if it is running.
2. Double-click the OMICRON *Device Link* icon on the desktop.
3. In the **Device Link** window, left-click the *CPC 100* device you want to update.
4. Click **Update firmware** to progress to the file selection screen.
5. Left click the **Choose image** button to open the file selection dialogue.
6. You can find the update file:
   6.1 On the *Primary Test Manager* DVD at ._EmbeddedSoftware\CPC100\V1 device\UpgradeV1.upg

6.2 On the hard drive of your computer at C:\Program Files (x86)\Common Files\OMICRON\UpgradeImages\CPC100\UpgradeV1.upg

6.3 For embedded Chinese language support, choose UpgradeV1_CHS or UpgradeV1_CHT for Chinese simplified or Chinese traditional respectively.

➔ After the update has finished, the *CPC 100* reboots automatically.

7. Restart the *Primary Test Manager* after the update procedure has finished.

5.4 Primary Test Manager licensing

The following table describes the *Primary Test Manager* licensing.

Table 5-1: Primary Test Manager licenses

License	Description
PTM Standard	Manual control mode with tests according to your device license. Additional 30 testing days with guided workflow according to your license.
PTM Advanced	Timely unlimited testing with guided workflow and manual tests according to your device license.

The PTM Advanced license key is on the device. You can update your device on the CPC start page or via OMICRON *Device Link*.

Updating licenses via OMICRON *Device Link*

To update a license using OMICRON *Device Link*:

1. Exit the *Primary Test Manager* if it is running.
2. Double-click the OMICRON *Device Link* icon on the desktop.
3. In the **Device Link** window, left click the device you want to update.
4. Click **Manage licenses** to progress to the file selection screen.
5. Select the license update package (.upg) and click **Open**.
6. Click **Yes** to proceed with the license update when prompted.
7. After the update has finished, reboot the device.

For detailed information, contact your local OMICRON sales representative or distributor.

Activating licenses via Primary Test Manager

To activate a license:

1. Enter the license key in the **About Primary Test Manager** dialog box, and then click **Add license key**.

   ➔ The **About Primary Test Manager** dialog box displays the available licenses and a new **Enter license key** box.

2. Repeat step 1 for all license keys you want to enter.

Alternatively, you can enter license keys from files. To add a license key from a file, click **Add license from file**, and then browse to the file containing the license you want to add.

Offline license activation

If the device running *Primary Test Manager* is not able to connect to the internet, an offline licensing activation method is available.
A second device connected to the internet with access to a web browser is required.

To activate a license for use on an offline device:

1. Enter the license key in the **About Primary Test Manager** dialog box, and then click **Add license key**.
   ➔ If the connection to the licensing servers fails, a dialogue box will open asking if you would like to activate offline or cancel.
2. Click **Activate offline**.
   ➔ The *Primary Test Manager* will provide you with an offline activation file and a link to the *OMICRON License Manager*.
3. Click the **Save the offline activation data to a file** button and select a location to save the .json file.
4. Transfer the file to a second device with internet access and a web browser.

On the second device:

5. Go to the link provided in the *Primary Test Manager* (www.activation.omicron.at/PTM/LicenseManager).
6. Browse for and upload the .json file that you saved in step 4.
7. Click **Activate your license**
   ➔ The *OMICRON License Manager* will provide you with a text file containing an activated license key.
8. Transfer the license key back to the offline device running the *Primary Test Manager*.
9. Copy this license key into the **Enter license key** field in the *Primary Test Manager*, and click **Add license key**.

➔ Your product will now be activated.

The license key obtained in step 6 is locked to the *PTM* device that generated the .json file and can only be activated on this device.

For detailed information about the *Primary Test Manager* licensing, contact your OMICRON local sales representative or distributor.

5.5 Firewall configuration

If you cannot connect to the device, check your firewall configuration as a correct firewall configuration is essential for successful establishing a communication between the device and your computer.

Any changes to the firewall settings mentioned in this section require administrator rights on your computer.

Windows firewall

The Windows firewall configuration is carried out automatically during the installation of the *Primary Test Manager*. However, in certain cases this may have no immediate effect.

- To prevent the Windows firewall from blocking communication, temporarily disable it via the Windows Control panel.

If you are now able to successfully establish communication, the Windows firewall was responsible for blocking communication between your test set and your computer.

- Reconfigure the Windows firewall in order to enable a permanent use of the test set without having to disable the Windows firewall.

Third-party firewall

- If you are using a firewall other than the Windows firewall, temporarily disable it to see if this firewall may be the cause for the blocked communication.

Numerous computer security programs or anti-virus packages also contain an integrated firewall function. Double-check and, if applicable, remove all such programs that may be installed on your computer.

Manual firewall configuration

If you would like to manually configure your firewall settings, the following ports/services have to be open in order to get a functional communication.

Table 5-2: Inbound rules

Program/ service name	Rule name	Protocol type	Local Port	Remote Port	Local IP	Remote IP
omfind.exe[1]	OMICRON OMFind 4987 (UDP-In)	UDP	4987	Any	Any	Any
	OMICRON OMFind 4988 (UDP-In)	UDP	4988	Any	234.5.6.7	Any
omcomm.exe[2]	OMICRON Device Detection (In)	UDP	4987, 4988	Any	Any	Any
Any	OMICRON Interprocess Communication (TCP-In)	TCP	Any	Any	127.0.0.0/8	127.0.0.0/8
Any	OMICRON Interprocess Communication (UDP-In)	UDP	Any	Any	127.0.0.0/8	127.0.0.0/8

1 default installation path:
64-bit: C:\Program Files (x86)\Common Files\OMICRON
32-bit: C:\Program Files\Common Files\OMICRON

2 default installation path:
C:\Program Files\Common Files\OMICRON\OMCOMM

Table 5-3: Outbound rules

Program/service name	Rule name	Protocol type	Local Port	Remote Port	Local IP	Remote IP
Excel.exe	OMICRON Excel File Loader FTP CMD (TCP-Out)	TCP	Any	21	Any	Any
	OMICRON Excel File Loader FTP DATA (TCP-Out)	TCP	Any	3000 - 3020	Any	Any
	OMICRON Excel File Loader TFTP (UDP-Out)	UDP	Any	69	Any	Any
Any	OMICRON OMFind (ICMPv4-Out)	ICMPv4	Any	Any	Any	Any
	OMICRON Primary Test Manager (ICMPv4-Out)	ICMPv4	Any	Any	Any	Any

Program/service name	Rule name	Protocol type	Local Port	Remote Port	Local IP	Remote IP
Any	OMICRON Device Detection (ICMP)	ICMP (1)	Any	Any	Any	Any
Any	OMICRON Interprocess Communication	TCP (6), UDP (17)	Any	Any	127.0.0.0/8	127.0.0.0/8
Any	OMICRON Test Set Communication	TCP (6)	Any	2200 - 2204	Any	Any
omcomm.exe[1]	OMICRON Device Detection (Out)	UDP (17)	Any	4987 - 4988	Any	Any
omfind.exe[2]	OMICRON OMFind 4988 (UDP-Out)	UDP	Any	4988	Any	234.5.6.7
devicelink.exe[3]	OMICRON DeviceLink	UDP	Any	69	Any	Any
cpceditor.exe[4]	OMICRON CPCEditor FTP CMD (TCP-Out)	TCP	Any	21	Any	Any
	OMICRON CPCEditor FTP DATA (TCP-Out)	TCP	Any	3000 - 3020	Any	Any
	OMICRON CPCEditor TFTP (UDP-Out)	UDP	Any	69	Any	Any
cpcstartpage.exe[2]	CPCStartPage FTP CMD (TCP-Out)	TCP	Any	21	Any	Any
	CPCStartPage FTP DATA (TCP-Out)	TCP	Any	3000 - 3020	Any	Any
	CPCStartPage TFTP (UDP-Out)	UDP	Any	69	Any	Any
cpcupgrade.exe[2]	CPCUpgrade FTP CMD (TCP-Out)	TCP	Any	21	Any	Any
	CPCUpgrade FTP DATA (TCP-Out)	TCP	Any	3000 - 3020	Any	Any
	CPCUpgrade TFTP (UDP-Out)	UDP	Any	69	Any	Any

Program/service name	Rule name	Protocol type	Local Port	Remote Port	Local IP	Remote IP
ptm.exe[2]	OMICRON Primary Test Manager 6642 (TCP-Out)	TCP	Any	6642	Any	Any

1 default installation path:
C:\Program Files\Common Files\OMICRON\OMCOMM

2 default installation path:
64-bit: C:\Program Files (x86)\Common Files\OMICRON
32-bit: C:\Program Files\Common Files\OMICRON

3 default installation path:
C:\Program Files\Common Files\OMICRON\DeviceLink

4 default installation path:
C:\Program Files\OMICRON\PTM

6 Home view

After starting the *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.

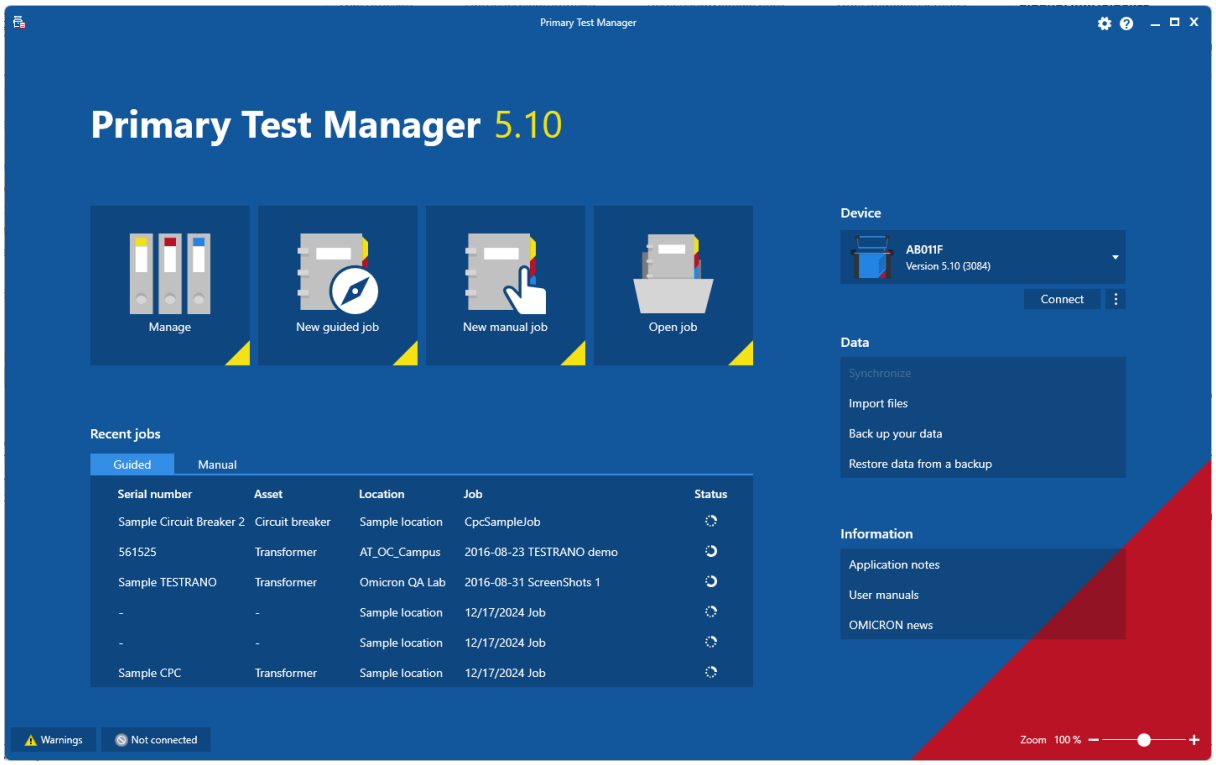


Figure 6-1: *Primary Test Manager* home view

The *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 *Primary Test Manager* workflows.
	Information	Contains descriptive information.

The *Primary Test Manager* supports the following user tasks:

Table 6-2: Selecting the user tasks

Button	Description	Action
	Manage	Click to open the **Manage** view for locations, assets, jobs, and reports (→ Manage view (page 86))

Button	Description	Action
	New guided job	Click to start the guided test workflow (→ New guided jobs (page 47))
	New manual job	Click to create a new manual test (→ New manual jobs (page 92))
	Open job	Click to open a manual test (→ Open jobs (page 95))

The following table describes the available user interface commands in the home view.

Table 6-3: Home view user interface commands

User interface element	Action
Title bar	
Settings	Click to open the **Settings** dialog box
Help	Click to open the *PTM* help Alternatively, press **F1** on your keyboard
Send data to technical support	Click to send system information and your data to OMICRON Support (→ OMICRON Assist (page 38))
About	Click to open the **About Primary Test Manager** dialog box
Device	
Connect/Disconnect	Click to manage connection to the test system
Data	
Synchronize[1]	Click to synchronize your offline database with the *Primary Test Manager* server database
Import files	Click to import *Primary Test Manager* data
Back up your data	Click to back up the *Primary Test Manager* database
Restore data from a backup	Click to restore your data in the database
Information	
Click a list item to get information about your test system and its application.	
Recent guided jobs/Recent manual jobs	
Click a list item to open a recently created guided or manual job.	
Status bar	
In the status bar, you can connect to and disconnect from a test system and view the test set information.	

[1] Only enabled with the appropriate license.

6.1 Title bar

The title bar is always displayed at the top of the *Primary Test Manager*.

6.1.1 Settings

In the **Settings** dialog box, you can change a number of *Primary Test Manager* settings to match your regional conventions, manage the job templates, and set the *Primary Test Manager* server settings for data synchronization (→ Status bar (page 43)).

▶ 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** dialogue box affects all data in *Primary Test Manager*.

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

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

General

The **General** tab lists the general settings of the *Primary Test Manager*.

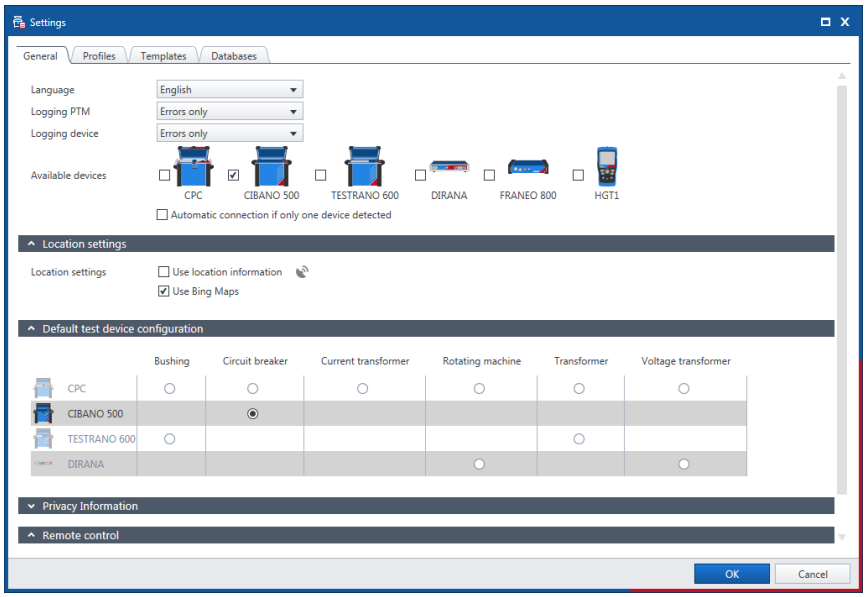


Figure 6-2: General tab

- ▶ To set the *Primary Test Manager* language, select your preferred language from the **Language** list.
- ▶ To set the logging level, select your preferred level from the **Logging PTM and Logging Device** lists.

Note: The logging function provides information to help find the cause for an error in cooperation with an OMICRON Support engineer. **Logging PTM** collects information on *PTM* while **Logging Device** focuses on your device.

Log files do not contain any personal information.

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

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

Location settings

In this section you can select the **Use location information** check box to allow GPS coordinates to be shared by a smartphone running the *PTMate* app connected via Bluetooth or Wi-Fi access point.

The *Primary Test Manager* displays status icons in the bottom bar:

	Waiting for GPS data from devices connected via Bluetooth
	GPS data is available from a device connected via Bluetooth

Default test set configuration

In this section, the *Primary Test Manager* displays the default devices for testing different assets. If more than one device is available for an asset, you can set your preferred test system as default device for that asset.

If no device is connected, the *Primary Test Manager* will automatically compile the test list (→ Test view (page 72)) for the selected default test set.

Customer Experience Improvement Program

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

Remote control

Certain features of the *Primary Test Manager* can be controlled via the *PTMate* app. Complete the steps below to establish the connection between your smartphone and your computer.

1. Activate the **Allow remote control via PTMate** check box in the **Remote control** section of the *PTM* **settings**.
   ➔ The *Primary Test Manager* will establish a Wi-Fi access point.

▶ If both your smartphone and your computer are already connected to the same Wi-Fi network, proceed to step 2 below.

▶ If you are not connected to a Wi-Fi network, press the Start Wi-Fi access point button.
   ➔ The *Primary Test Manager* will attempt to create a Wi-Fi access point and refresh the displayed QR code.

   If your computer does not support ad hoc Wi-Fi access point creation, you can use an external Wi-Fi device supporting this functionality or create a hotspot on your smartphone. Be aware that using a smartphone hotspot can lead to additional costs.

2. Open the *PTMate* app on your smartphone.

3. Navigate to **Settings**, and scan the QR code displayed in the **Remote control** section in the *Primary Test Manager*.

The *Primary Test Manager* displays status icons in the bottom bar:

	Number of active remote connections
	Active Wi-Fi access point
	Active remote control

Profiles

In 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.

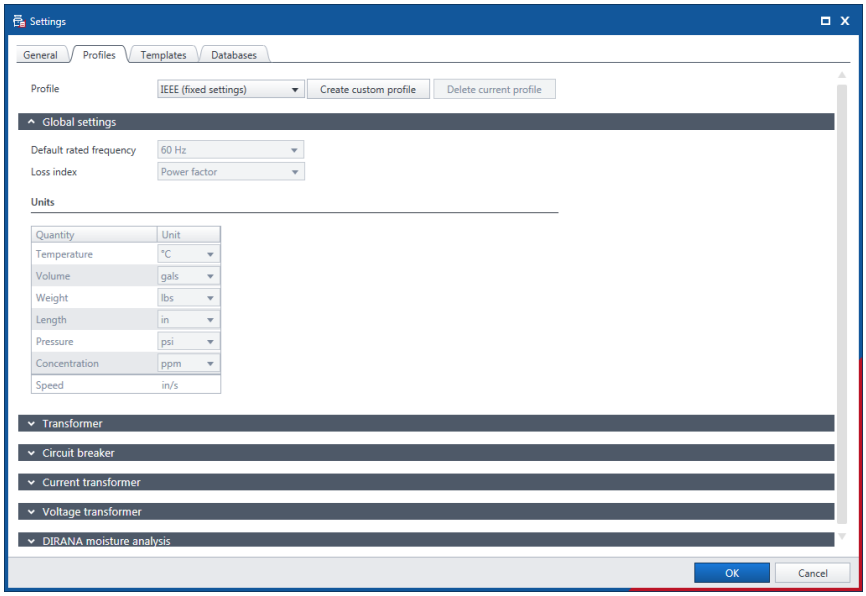


Figure 6-3: Profiles tab

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

The *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.

Profiles: Transformer

▶ 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.

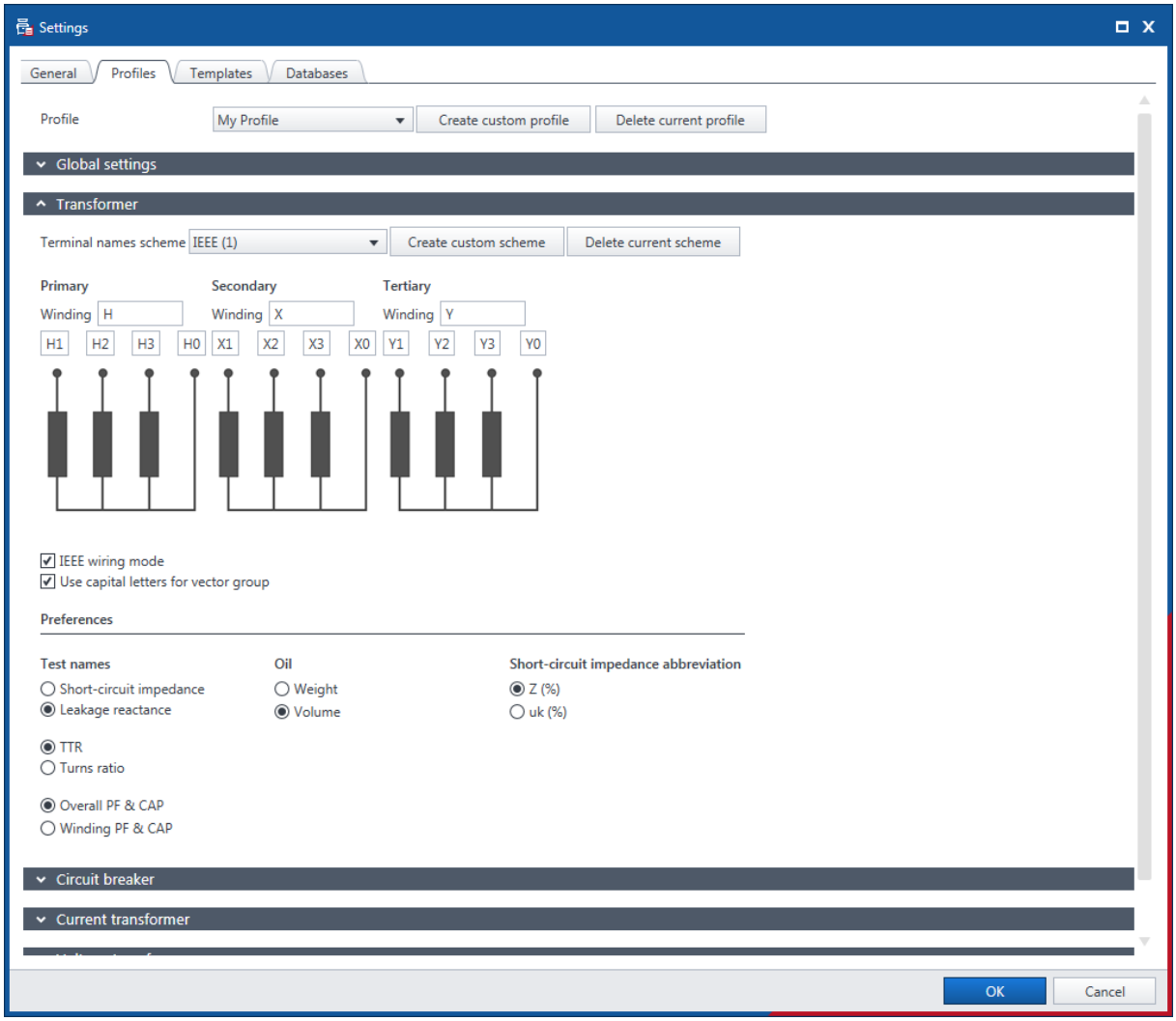


Figure 6-4: Profiles tab: Transformer

With the *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:

1. Click **Create custom scheme**.
2. In the **Enter scheme name** dialog box, type the scheme name.
3. 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**.

Profiles: Circuit breaker

▶ Under **Circuit breaker**, set the circuit breaker terminal name schemes.

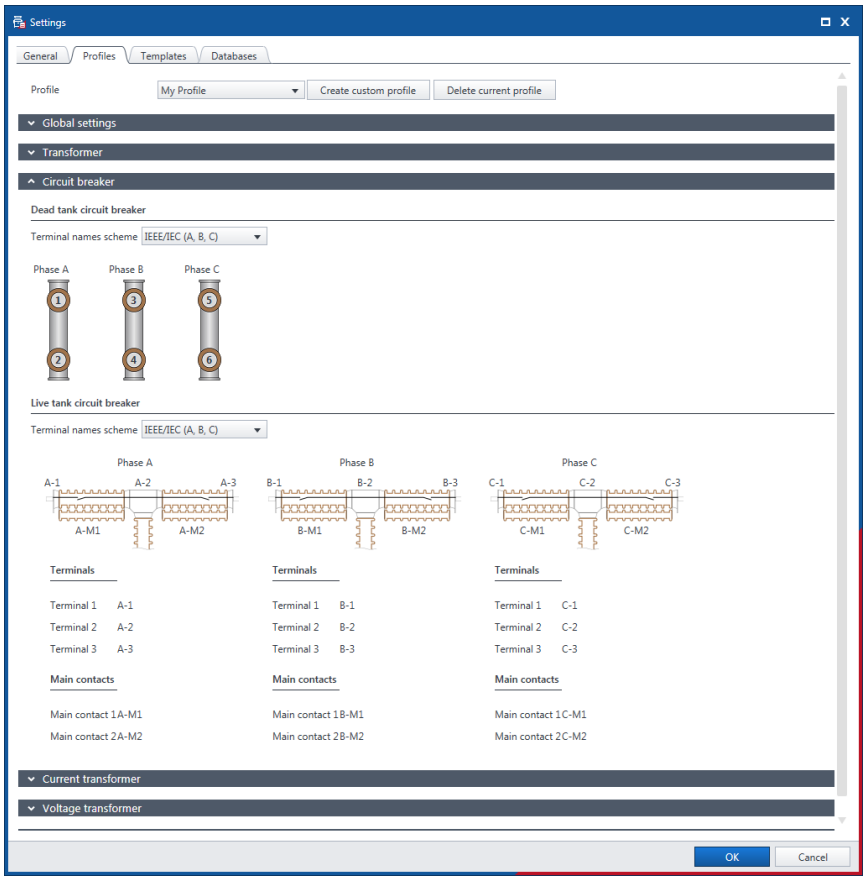


Figure 6-5: Profiles tab: Circuit breaker

Profiles: Current transformer

1. Under **Current transformer**, set the current transformer naming conventions.

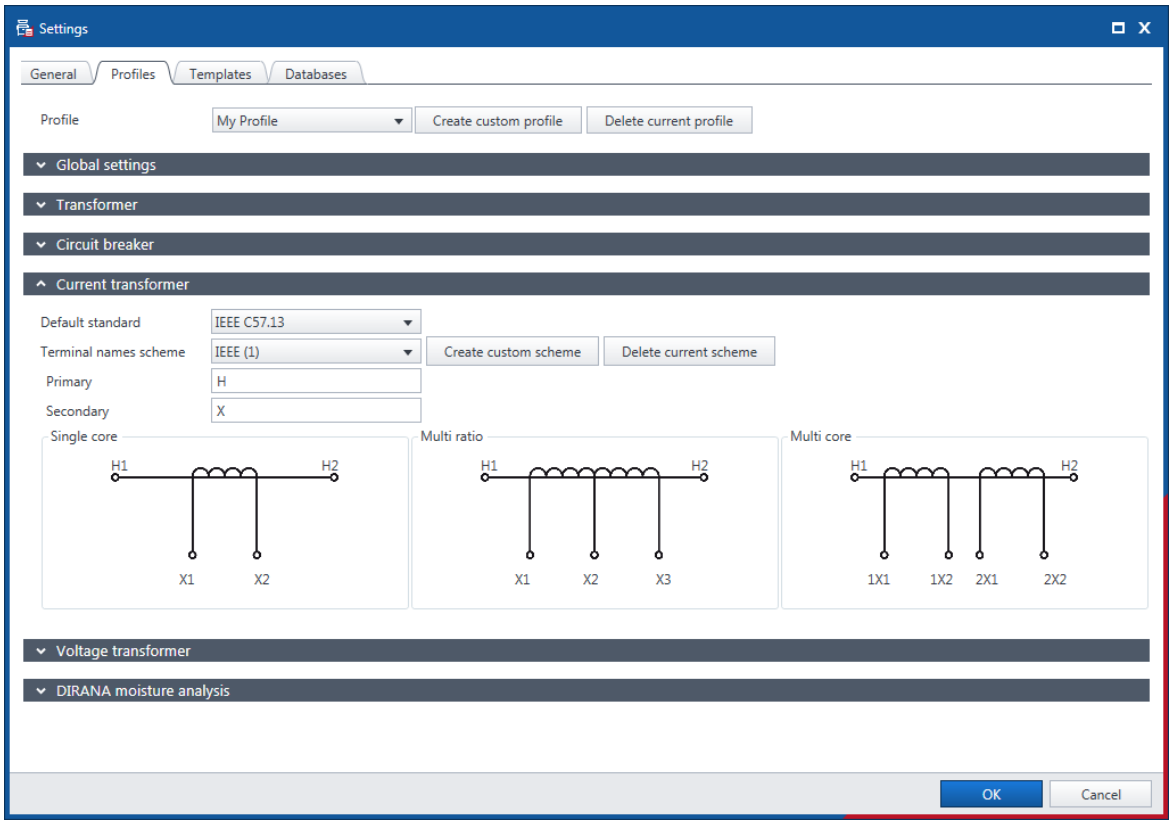


Figure 6-6: Profiles tab: Current transformer

2. 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**.

Templates

In the **Templates** tab, you can edit, export, and import job templates for transformers.

▶ For information on how to process the templates, see Processing templates (page 80).

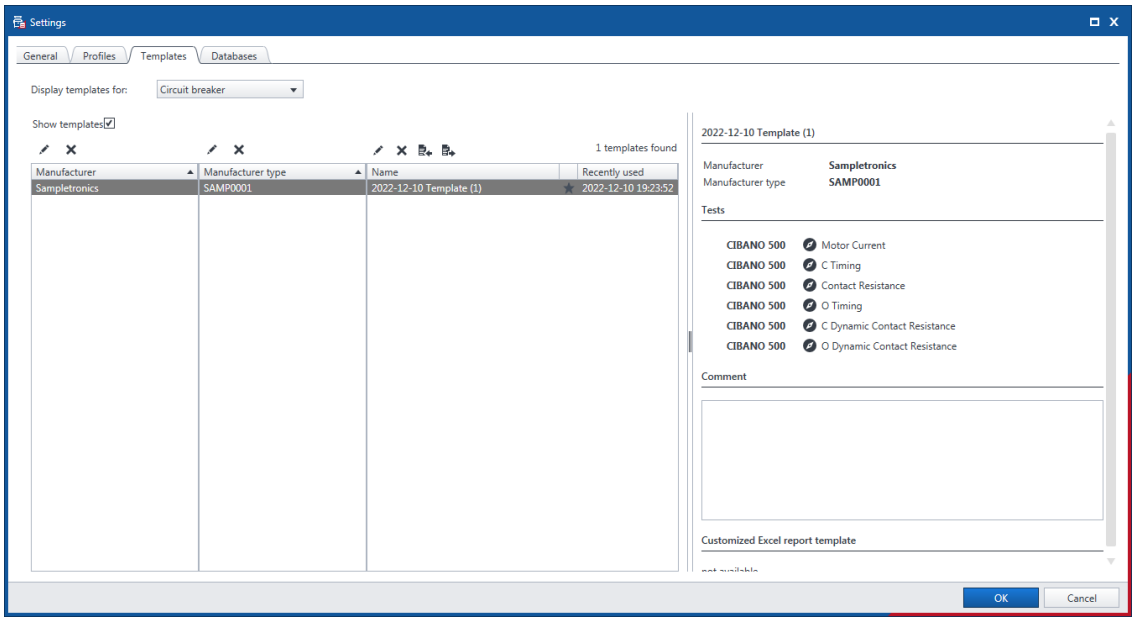


Figure 6-7: Templates tab

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

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

1. To assign a template to a different asset type or a phase group, or to edit template properties (name, comment), click the respective **Edit** button.
2. Press the **Delete** button to delete templates from the **Asset type** or **Phases** list.
3. To export a template, select the template, and click the **Export** button.
4. To import a template, click the **Import** button, then browse to the template you want to import.
5. To set a template as favorite, click the star icon.

All future test lists with the same asset and number of phases will by default be loaded with the tests defined in this favorite template.

If you own a *CBTL* (*Circuit Breaker Testing Library*) license, additional options are available in the Circuit breaker section:

- ▶ **Show template**
- ▶ **Show OMICRON CBTL**
- ▶ **Show custom CBTL**

Databases

In the **Databases** tab you can create, manage and switch between different databases for the *Primary Test Manager*.

Under **Properties**, you can adjust the server settings for *DataSync*. For more information, see Server settings (page 40). You can also select the method with which you would like to authenticate your *Primary Test Manager* login via *DataSync* two-factor authentication. See PTM DataSync Getting Started for more information on setting up multi-factor authentication.

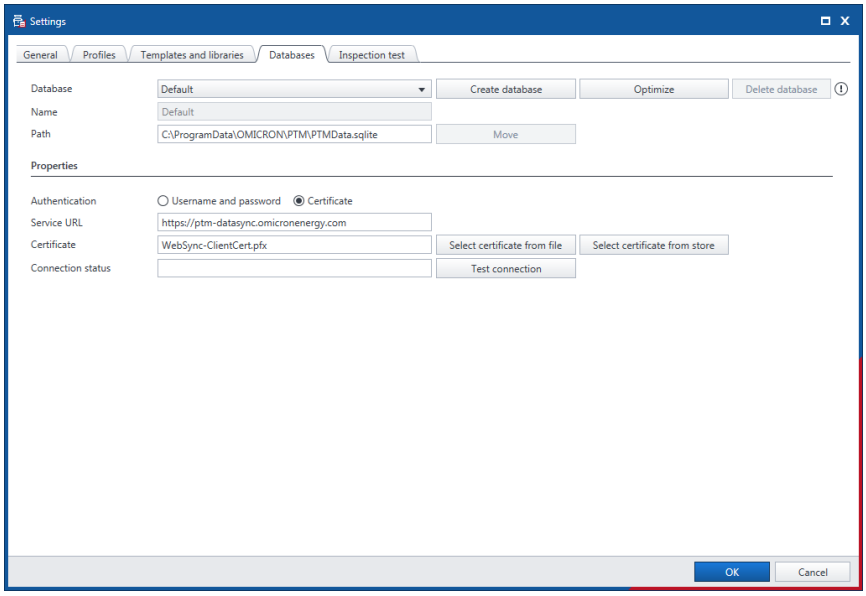


Figure 6-8: Databases tab

6.1.2 OMICRON Assist

In the **Omicron Assist** dialog box, you can send system information and your data to OMIRON Support.

1. To open the **Omicron Assist** dialog box, click **Send data to Technical Support** in the title bar.

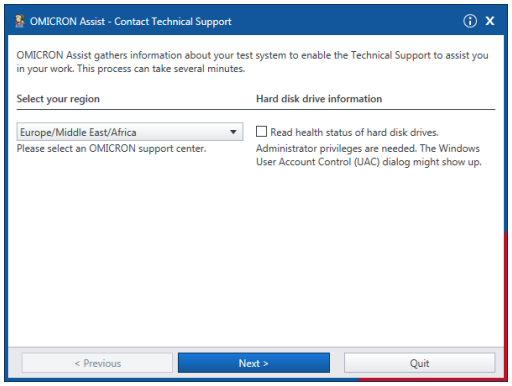


Figure 6-9: Contact technical support dialog box

2. In the **Omicron Assist** dialog box, select your region, and then click **Next**.
3. **Omicron Assist** will automatically collect your system information. Once this step is complete, click **Next**.
4. Click **Add files**.
5. Browse to the data you want to send, and then click **Next**.
6. Click **Prepare email**.

6.1.3 About

In the **About Primary Test Manager** dialog box, you can enter a license key to update 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.

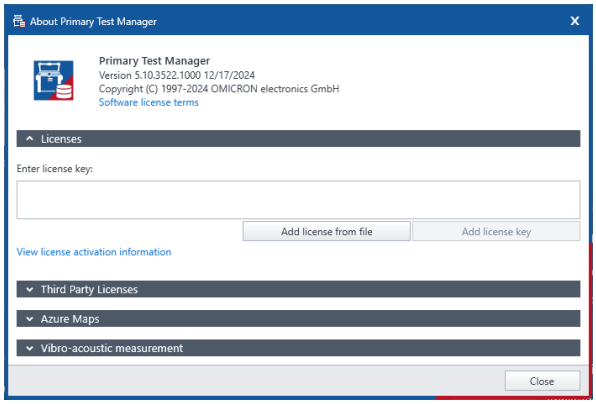


Figure 6-10: **About Primary Test Manager** dialog box

6.2 Connection to the test system

Under **Device**, you can connect to and disconnect from the test system.

▶ To connect to a device, select the device from the list, and then click **Connect**.

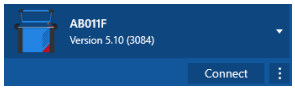


Figure 6-11: Connecting to a device

If you could not connect to your device and the green signal light is permanently on, wait a few seconds, and then proceed as follows:

1. Click **More** next to the **Connect** button.
2. Click **Refresh**.
3. Select the test system from the list, and then click **Connect**.

If the device to which you want to connect is not displayed in the list of available devices, proceed as described in Manual connection to a test system (page 45).

Alternatively, you can manage the connection to devices in the *Primary Test Manager* status bar (→ Status bar (page 43)).

6.3 Data synchronization

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

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 offline data is synchronized with the server database and selected data on the server is synchronized with the offline database.

6.3.1 Server settings

Before synchronizing the *Primary Test Manager* databases for the first time, you must set the server settings.

▶ In the title bar, click **Settings** and select the **Databases** tab.
The next step depends on the data synchronization method you use: *DataSync* via web server or *DataSync* on premises.

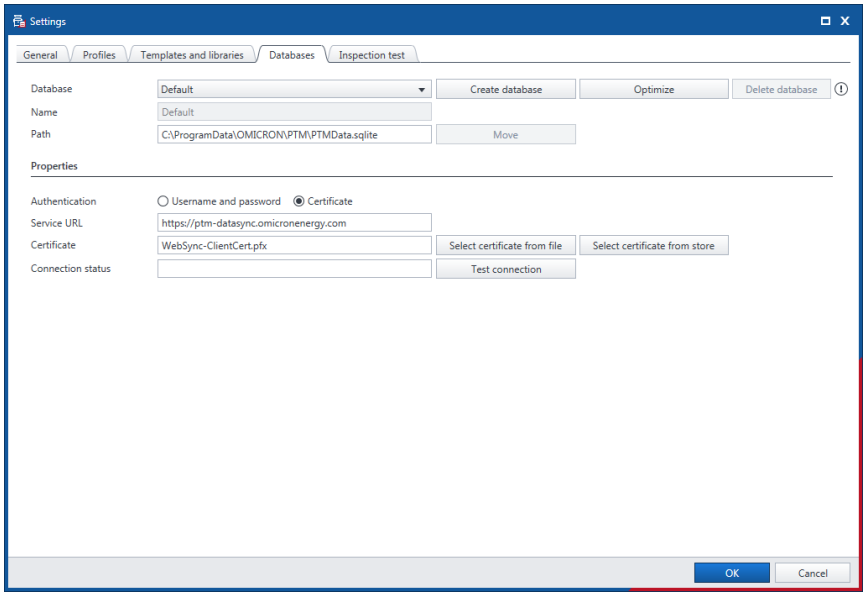


Figure 6-12: Server settings for DataSync

DataSync via web server

▶ For the service URL and certificate for DataSync via web server, contact your regional OMICRON Service Center.

DataSync on premises

▶ For the service URL and certificate for DataSync on premises, contact your system administrator.

1. In the **Databases** tab, enter the **Service URL** and upload the **Certificate**.
2. To test the connection to the server, click **Test** next to the **Connection status**.

6.3.2 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, click the **Manage** button.

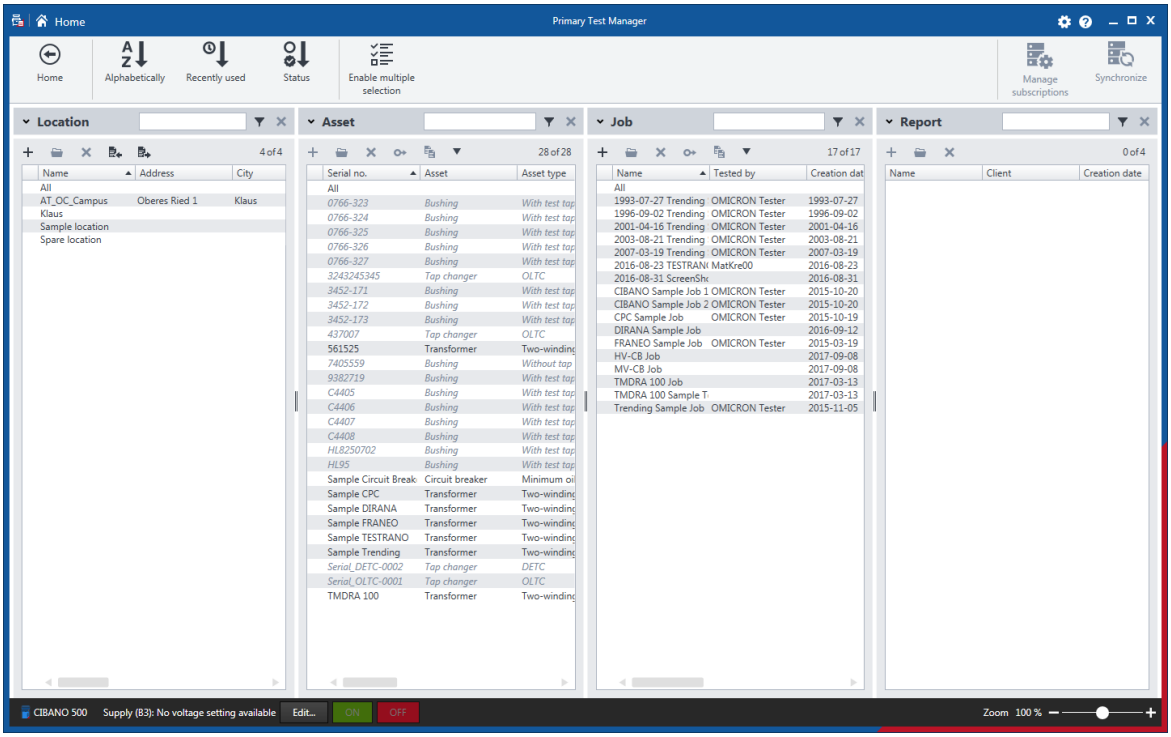


Figure 6-13: Manage View

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.

➔ The *Primary Test Manager* then displays the synchronization progress.

6.3.3 Database synchronization

▶ To synchronize the offline *Primary Test Manager* database with the server database, click **Synchronize** in the title bar of the **Manage** view.

➔ The *Primary Test Manager* then displays the synchronization progress.

You can synchronize databases at any time if a connection to the server database is available.

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

6.4 Import data

In the Home view you can import jobs.

To import a job:

1. Under **Data**, click **Import files**.
2. Browse to the file you want to import.

The *Primary Test Manager* supports the following file import formats:

Table 6-5: Supported file import formats

File name extension	Description
.ptm	*Primary Test Manager* native exchange format
.ptma	Format for import of manual test data. ▶ Select the corresponding asset in the Manage view to import manual test data.
.csv[1]	• DIRANA CSV files • FRAnalyzer 2.2 CSV files[2] • TDT 4/5/6 files
.drax	DIRANA test files
.dbefra	FRAnalyzer 2.2 database export
.fra[3]; .tfra	FRAnalyzer 2.2 files
.xml	• Doble DTA files • IEC SFRA files (IEC 60076-18)
.xfra.zip[4]; .xfra[5]	CIGRE SFRA files (CIGRE WG A2.26)
.dtax	Doble DTA files
.sfra	Doble SFRA files[6]
.frax; .pax	Megger SFRA files
.xlsx	Oil Analysis files
.dat	TDT 4/5/6 files

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

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

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

4 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.

5 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.

6 If you encounter any issues importing Doble SFRA files, convert the files into IEC SFRA file format and try again.

6.5 Data backup and restoring

We strongly recommend backing up your data in the *Primary Test Manager* database on a regular basis. The *Primary Test Manager* will remind 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**.

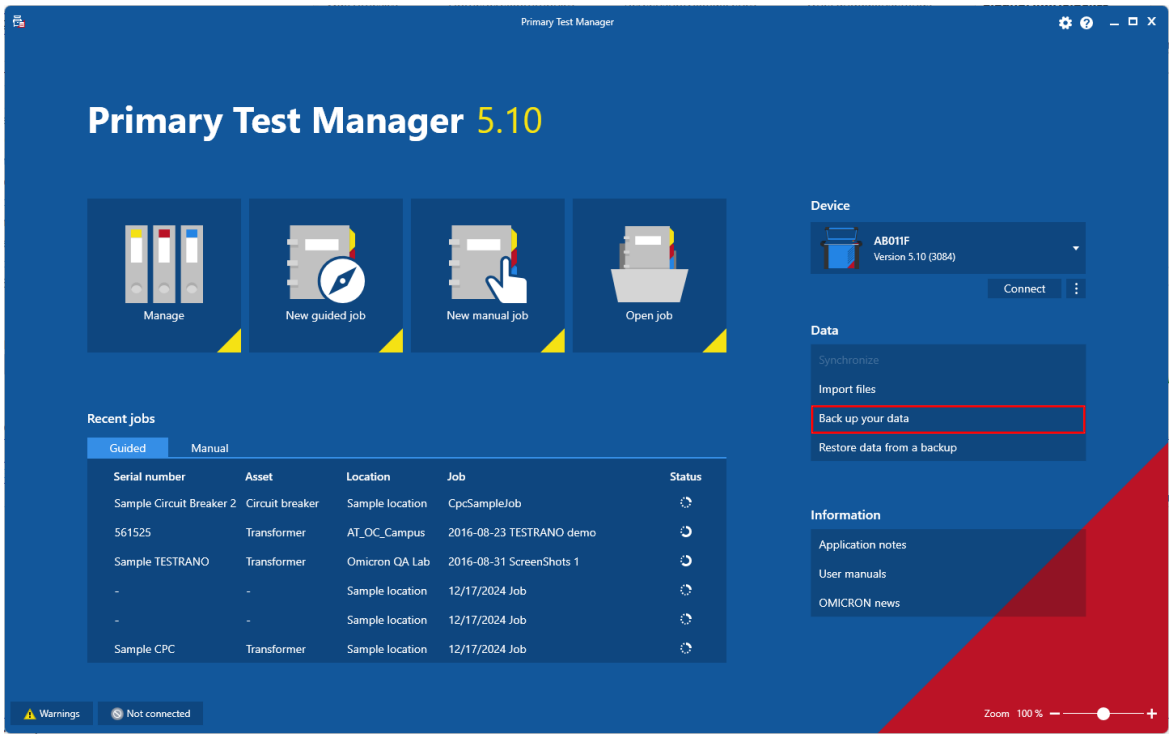


Figure 6-14: Backup data from home view

2. Save the data in your preferred location.

To restore the data:

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

6.6 Status bar

The status bar is displayed in any *Primary Test Manager* view. It displays information about the status of the test system and provides access to the zoom function.

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

6.6.1 Connecting to a test system

To connect to a test system:

1. Right-click the device icon in the status bar.
2. Click **Connect**.

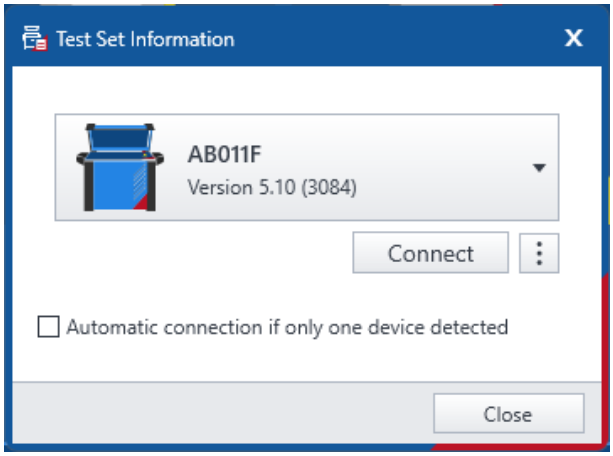


Figure 6-15: Connect to device dialog box

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

Select the **Automatic connection if only one device detected** check box if only one device is available. The *Primary Test Manager* will connect to the available device automatically.

If you could not connect to your device and the green signal light is permanently on, wait a few seconds, and then proceed as follows:

4. Click **More** next to the **Connect** button.
5. Click **Refresh**.
6. 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.

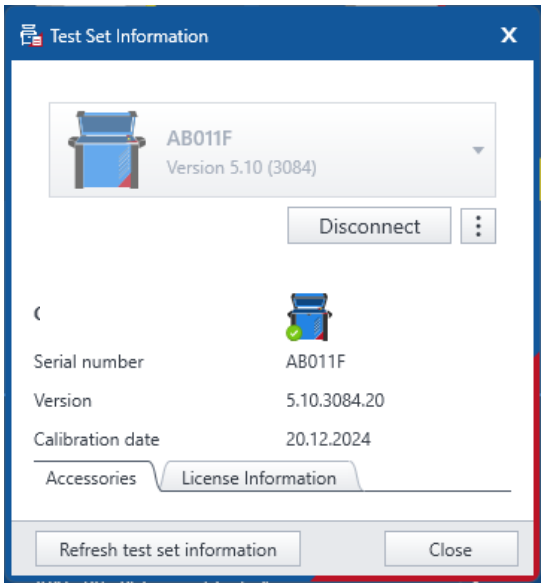


Figure 6-16: Connected to device dialog box

After you have connected to a test system, right-click the device icon 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**.

Alternatively, double-click the device icon to open the **Connect to device** and the **Connected to device** dialog boxes.

6.6.2 Manual connection to a test system

If you encounter any problems when connecting to an OMICRON device, we recommend turning off any wireless adapter and VPN software on your computer.

If the device to which you want to connect is not displayed in the list of available devices, proceed as follows:

1. Click **More** next to the **Connect** button.
2. Click **Start OMICRON Device Browser** in the opening context menu.
3. In the **OMICRON Device Browser** window, look for the device you want to connect to and read its IP address.
4. In the home view, click **More** beneath the **Connect** button.
5. Click **Add device manually**.
6. In the **Add Device Manually** dialog box, enter the IP address of the device you want to connect to.
7. Click **Connect**.

If you assigned a static IP address to the device, try to connect as follows:

8. In the **Add Device Manually** dialog box, select the **Direct connection** check box.
9. In the **Host or IP** box, enter cpc://a.b.c.d, where a.b.c.d is the static IP address of the device.

7 New guided jobs

When creating a new guided job, the *Primary Test Manager* leads you through the guided test workflow.

▶ To open the new guided job view, click the **New guided job** button in the home view.

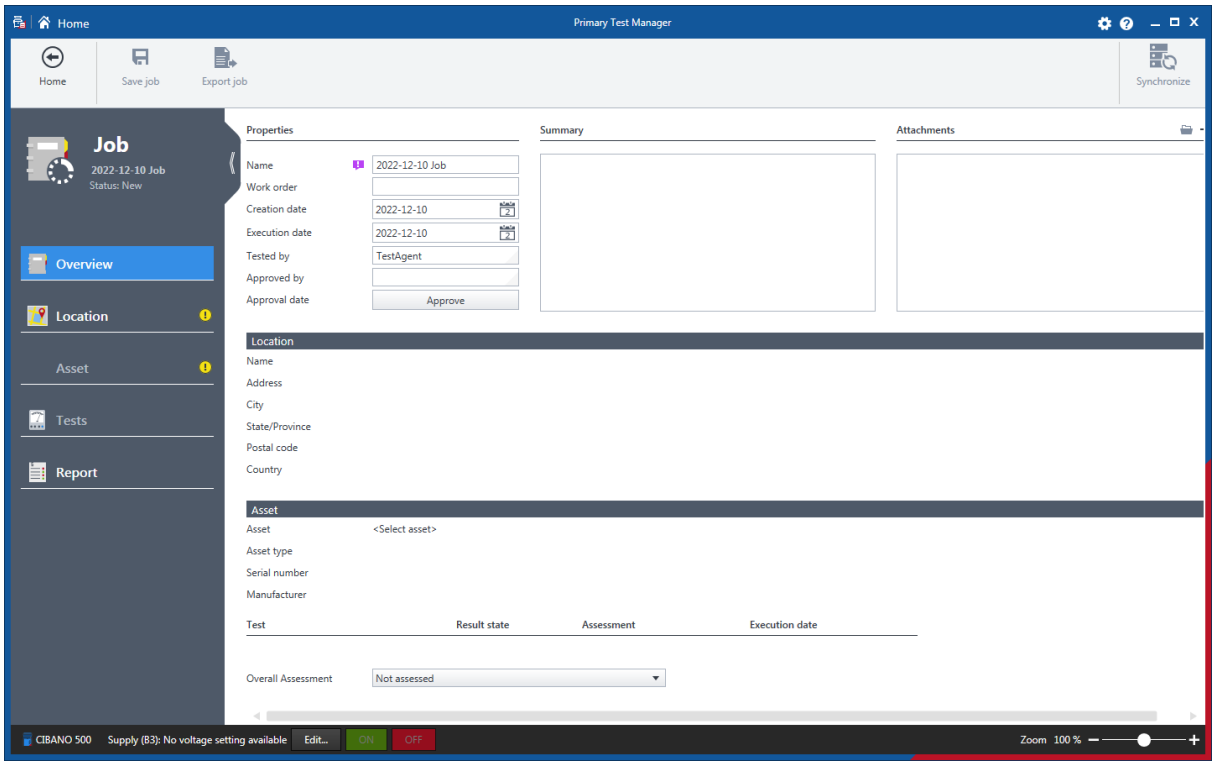


Figure 7-1: New guided job view

In the new guided 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 the *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 new guided 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 (→ Job overview (page 50)).
2. Specify the location (→ Location view (page 53)).
3. Specify the asset (→ Asset view (page 56)).
4. Specify and perform the tests (→ Test view (page 72)).
5. Generate the test reports (→ Generate test reports (page 98)).

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

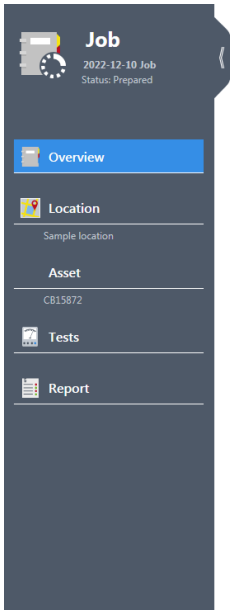


Figure 7-2: Navigation buttons

You can interrupt the test workflow at any time 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
Home/Manage	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.
Export job	Exports the job displayed in the new guided job view into a Microsoft Excel spreadsheet.
Load existing location[1]	Load an existing location available in the *Primary Test Manager*.
Load existing asset[2]	Load an existing asset available in the *Primary Test Manager*.
Copy test[3]	Adds another test of the same kind and with the same settings to the test list. Results are not copied.
Delete test	Deletes a test
Take screenshot	Takes screenshot of the selected area of the *Primary Test Manager* workspace. The screenshot appears as attachment in the **General** area and can be attached to the test report.

1 Only available if the **Location** view is open and the job has not been saved yet.

2 Only available if the **Asset** view is open and the job has not been saved yet.

3 Only available if a test is open.

For more information about operations on the jobs, see Manage view (page 86).

7.2 Job overview

In the job overview of the create new job view, you can enter the job data. During the guided test workflow, the *Primary Test Manager* sets some basic location, asset, and test data.

▶ To open the job overview, click the **New guided job** button in the home view.

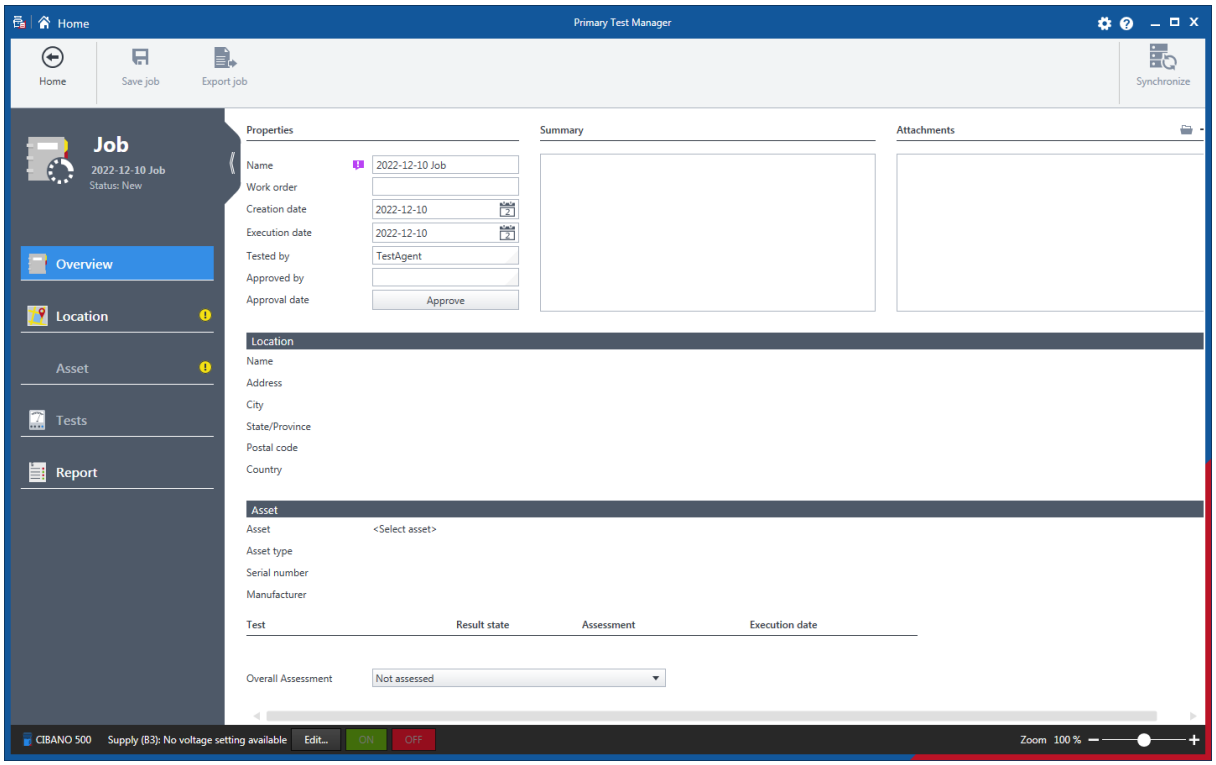


Figure 7-3: Job overview

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 (generated automatically by the *Primary Test Manager*)
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 (→ Job approval (page 51))
Summary	Text field to summarize the job data
Attachments	Attachments to the job (→ Attachments (page 52))

[1] Information required.

7.2.2 Job approval

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**.

After approving a job, some settings can no longer be edited.

7.2.3 Assessment summary

In the Tests area of the job overview, the **Result state** and **Assessment** status of test results are displayed.

▶ Use the **Overall Assessment** box to manually characterize the asset's condition for reporting purposes.

Table 7-4: Result state

Result state	Description
Not executed	No measurement of the test has been executed.
Partially executed	At least one measurement of the test has been executed.
Executed	All measurements of the test have been executed.

Table 7-5: Assessment

Status	Description
Fail	The status was automatically set to **Fail** by the *Primary Test Manager*.
Manual fail	The status was manually set to **Fail**.
Investigate	The status was automatically set to **Investigate** by the *Primary Test Manager*.
Manual investigate	The status was manually set to **Investigate**.
Pass	The status was automatically set to **Pass** by the *Primary Test Manager*.
Partial pass	Some measurements have not been assessed.
Manual pass	The status was manually set to **Pass**.
Manual partial pass	Some measurements have not been assessed and at least one assessment status was changed manually.
Not assessed	The measurement has not been assessed.
Not rated	The status was automatically set to **Not Rated** by the *Primary Test Manager*.

7.2.4 Attachments

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

To add an attachment:

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:

3. Select the attachment you want to delete.
4. 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 .

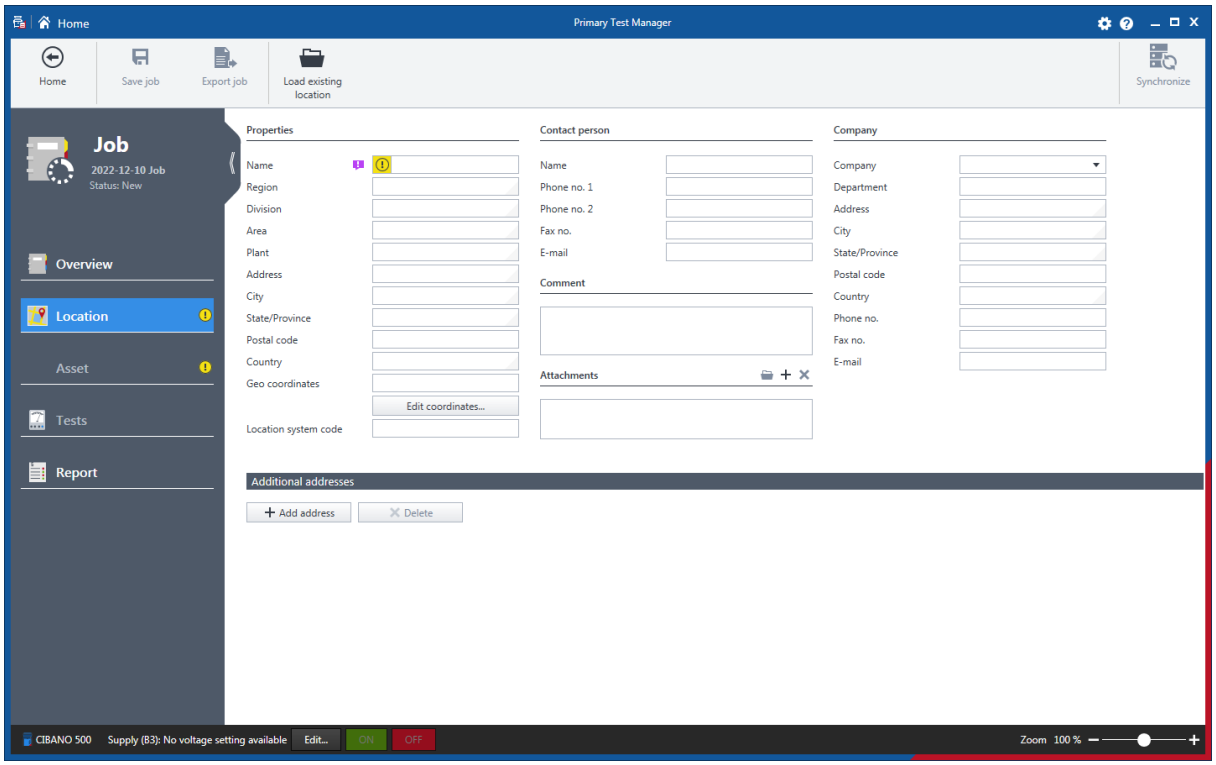


Figure 7-4: Location view

To specify a location, do one of the following:

▶ Enter the location data.

Note: If you enter location or asset data for a prepared job that differ from those of the master location or master asset, a notification bar will be displayed. In this case, choose between the following options:

▶ To import the previously defined location or asset data to this job, click **Import from master location** or **Import from master asset** in the notification bar.

▶ To update the previously defined location or asset data with the data you have entered for this job, click **Update master location** or **Update master asset** in the notification bar.

▶ For more information on operations on the jobs, see Manage view (page 86).

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

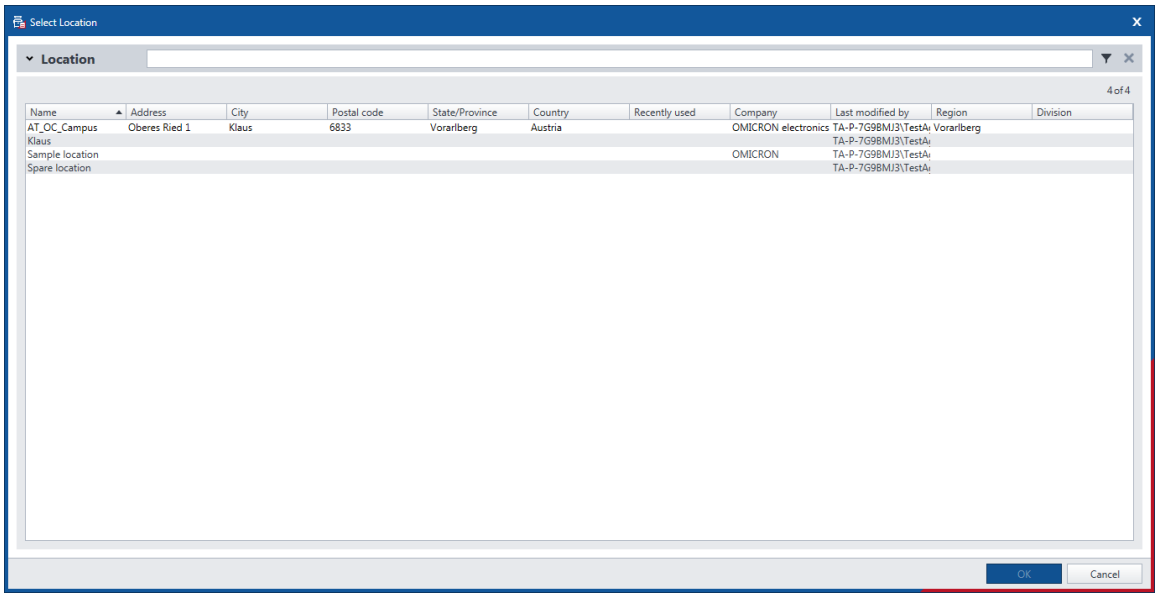


Figure 7-5: Select location dialog box

In the **Select Location** dialog box, you can search for locations (→ Search for objects (page 87)).

7.3.1 Location data

The following table describes the location data.

Table 7-6: 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 (→ Setting the geo coordinates (page 55))
Location system code	Location code used by maintenance planning systems
Contact Person	
Name	Name of the contact person
Phone no. 1	Phone number of the contact person
Phone no. 2	Alternative phone number of the contact person
Email	Email address of the contact person

Data Company	Description
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
Email	Email address of the contact person

[1] Information required.

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**.

7.3.2 Setting the geo coordinates

To set a location's geo coordinates:

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

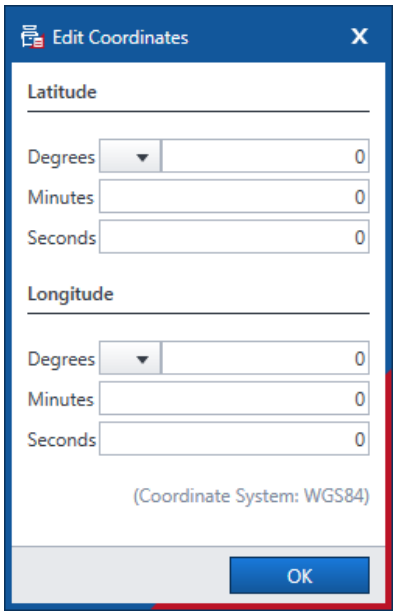


Figure 7-6: Edit coordinates dialog box

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

If you have a smartphone running the *PTMate* app connected via Bluetooth to the *Primary Test Manager*, you have the option to add coordinates through live location sharing by clicking the **Geo coordinates** button .

7.3.3 Attachments

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

To add an attachment:

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:

3. Select the attachment you want to delete.
4. Click the **Remove** button −.

7.4 Asset view

In the asset view of the create new job view, you can specify assets.

- ▶ To open the asset view, click the **Asset** navigation button.

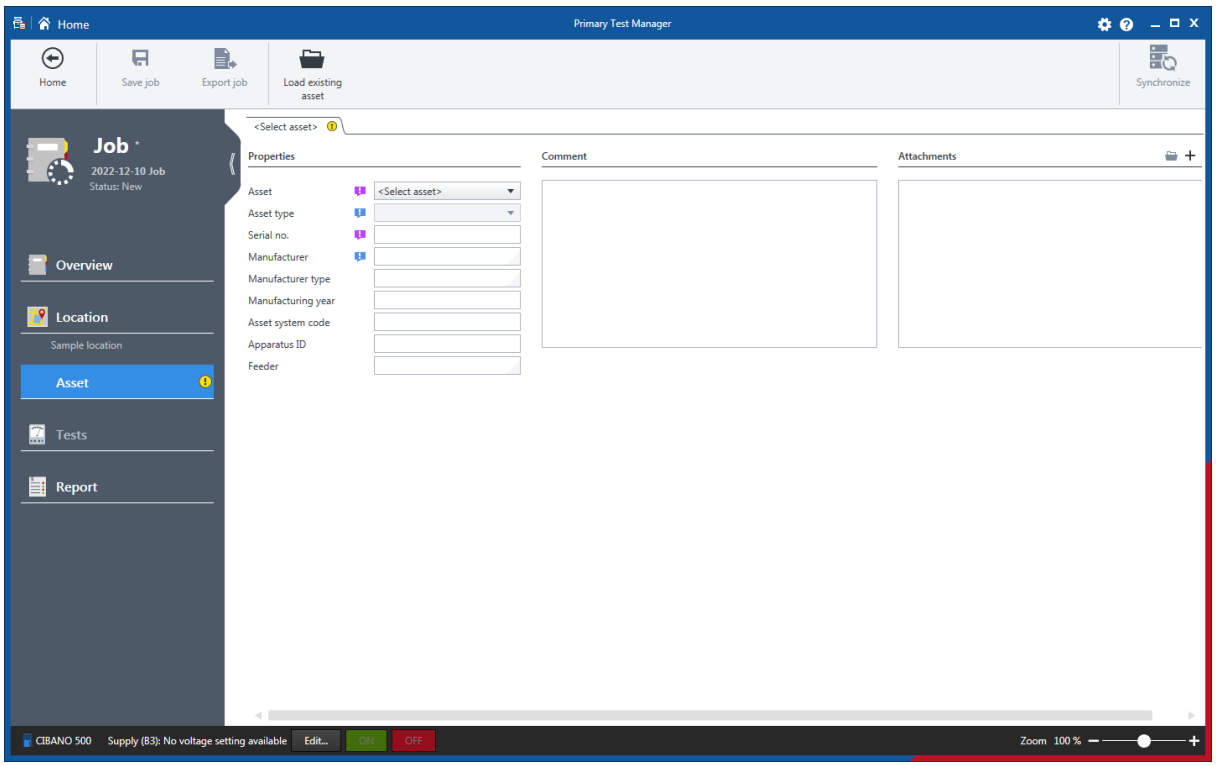


Figure 7-7: Asset View

The asset view depends on the asset you want to specify with the *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 (→ General asset data (page 57) and the asset-specific data described in Asset data (page 100)).

Note: If you enter location or asset data for a prepared job that differ from those of the master location or master asset, a notification bar will be displayed. In this case, choose between the following options:

1 To import the previously defined location or asset data to this job, click **Import from master location** or **Import from master asset** in the notification bar.

2 To update the previously defined location or asset data with the data you have entered for this job, click **Update master location** or **Update master asset** in the notification bar.

3 For more information on operations on the jobs, see Manage view (page 86).

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

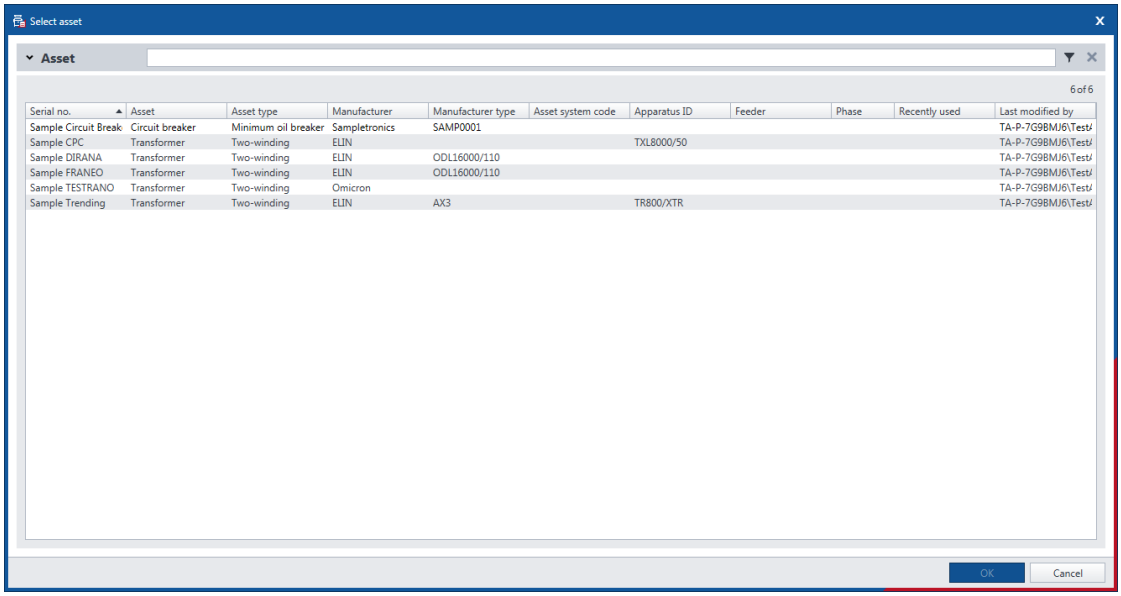


Figure 7-8: Select asset dialog box

In the **Select Asset** dialog box, you can search for assets (→ Search for objects (page 87)) and sort them alphabetically or in the chronological order.

7.4.1 General asset data

The following table describes the general asset data.

Table 7-7: 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

Data	Description
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 to which the asset is connected
Phase[2]	Phase to which the asset is connected

[1] Information required.

[2] Only available for current transformers, voltage transformers and miscellaneous assets.

7.4.2 Attachments

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

To add an attachment:

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:

3. Select the attachment you want to delete.
4. Click the **Remove** button −.

7.4.3 Transformer view

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

To specify a transformer:

1. From the **Asset** list, select **Transformer**.

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

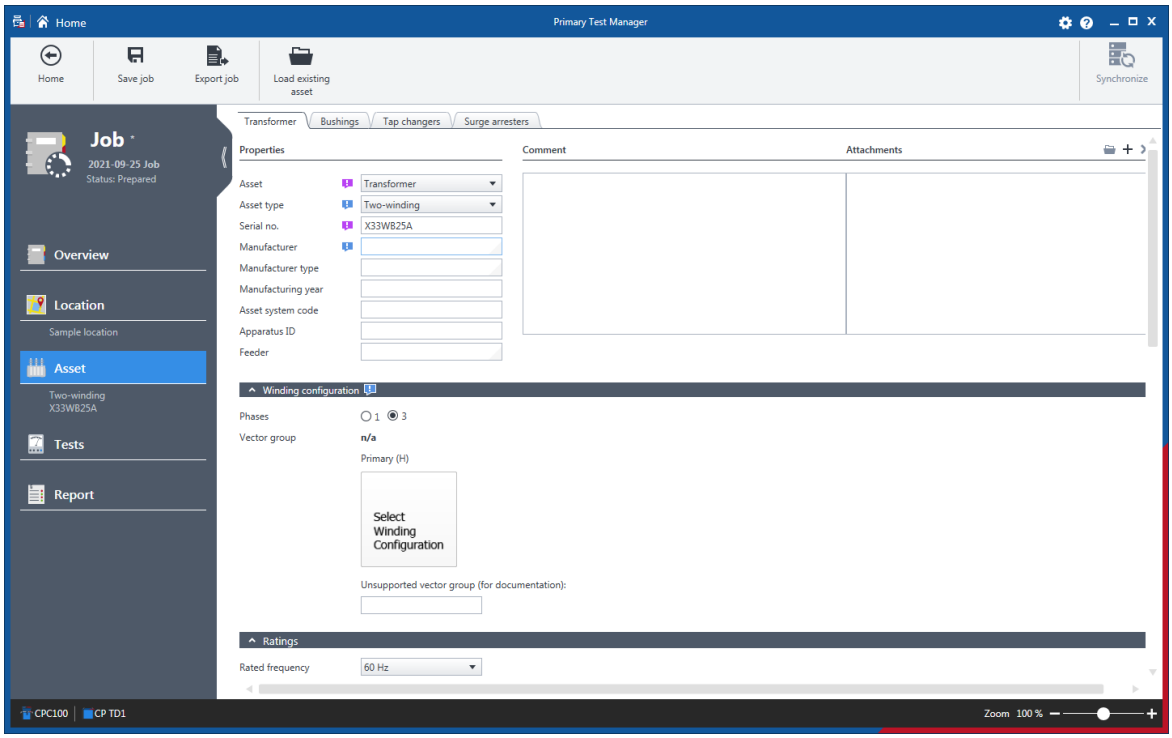


Figure 7-9: Transformer view

3. In the **Transformer** view, enter the general asset data.
4. Under **Winding configuration**, set the transformer's vector group.
5. Under **Ratings, Impedances and Others**, enter the transformer data (→ Transformer (page 100)).
6. Optionally, specify the bushing mounted on the transformer.
7. Optionally, specify the tap changers of the transformer.
8. Optionally, specify the surge arresters mounted on the transformer.

Setting the vector group

1. To set the vector group of a transformer:
2. Select the number of transformer's phases.

Do one of the following:

- ▶ Select the configuration of the transformer's windings from the respective lists.
- ▶ Click **Select Winding Configuration** and in the **Edit vector group** dialog box, set the transformer's vector group.

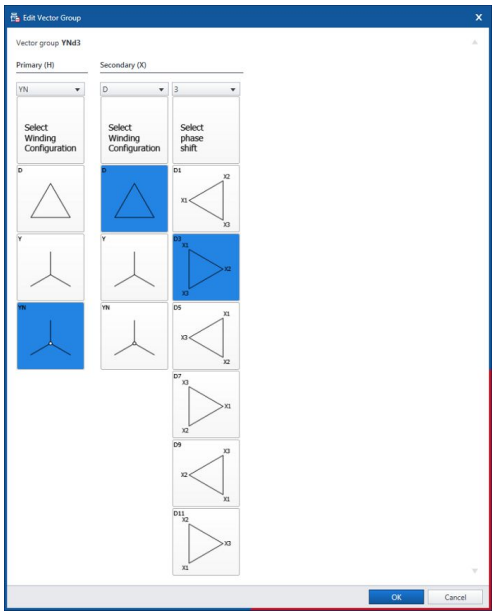


Figure 7-10: Edit vector group dialog box

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

Bushings tab (Transformer)

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

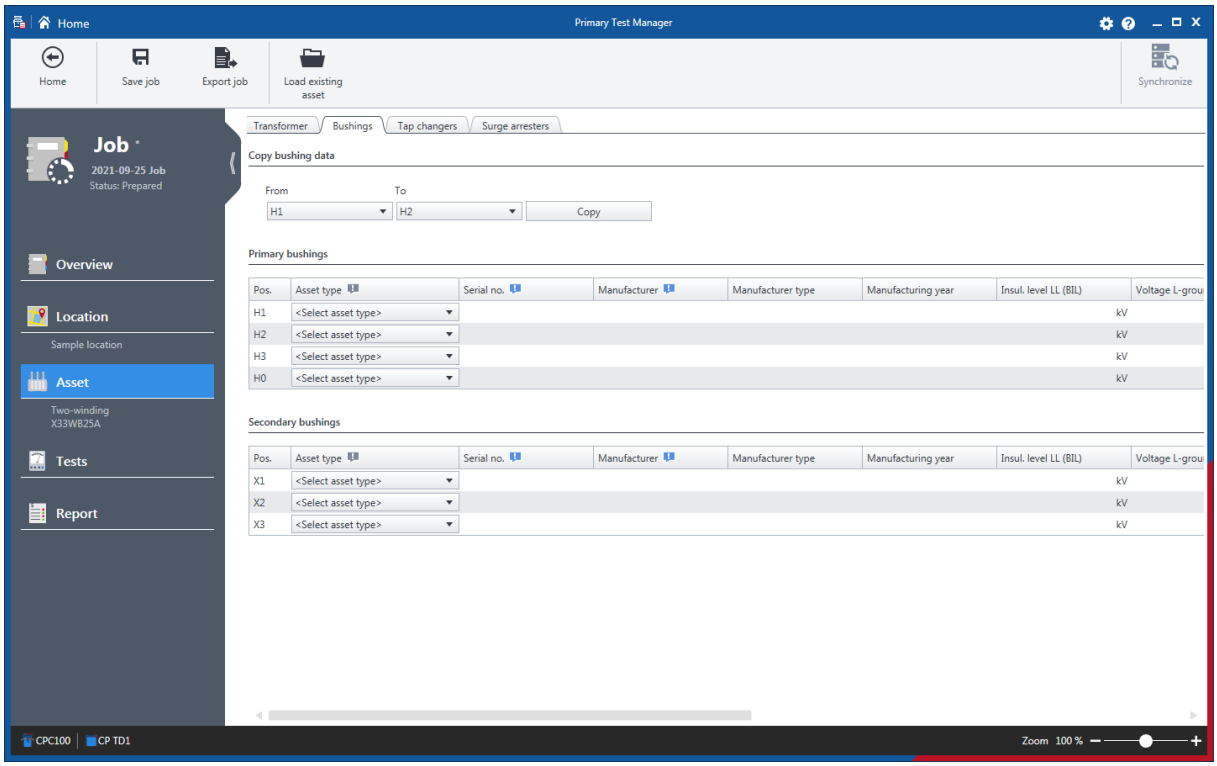


Figure 7-11: Transformer view: Bushings tab

Specifying a bushing

1. From the **Asset type** list, select the type of the bushing.
2. Enter the bushing data (→ Spare bushing (page 103)).

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 tap changers of the transformer.

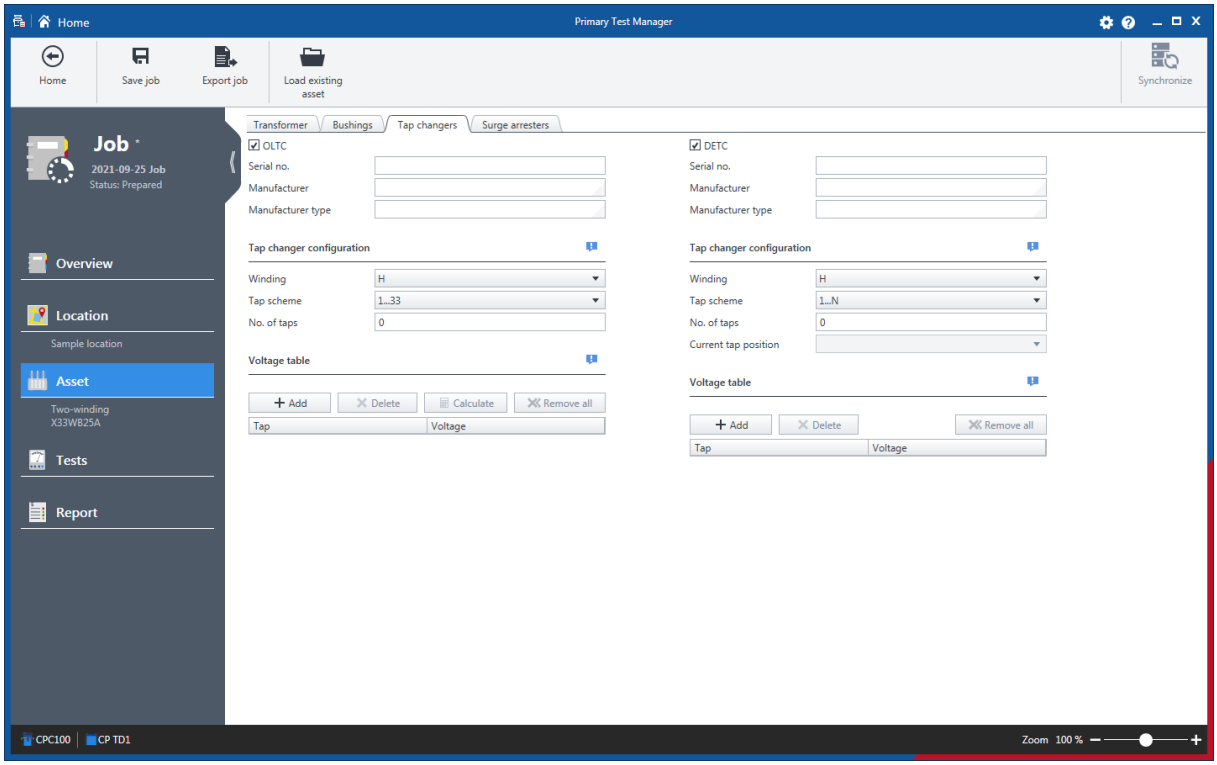


Figure 7-12: Transformer view: Tap changers tab

Specifying an on-load tap changer (OLTC)

1. Select the **OLTC** check box.
2. Enter the OLTC data (→ Tap changer (page 102)).
3. Under **Tap changer configuration**, set the tap changer's winding, the tap scheme, and the number of taps.
4. In the **Voltage table** you can either enter each value manually or have them calculated automatically. Click **Calculate** for the voltage table calculation and use one of the 3 methods:

- **First and second**: Calculation based on the voltages of the first and second tap
- **Middle**: Calculation based on the middle tap (rated voltage) and the entered deviation value. In the guided workflow, this value is automatically transferred from the **Voltage ratings** table under **Asset** data – **Transformer**.
- **First/middle/last**: Calculation based on the voltages of the first, middle and last tap

Middle and **First/middle/last** are only available for odd tap numbers.

▶ After calculation, compare the calculated values with the nominal values on the nameplate.

Specifying a de-energized tap changer (DETC)

5. Select the **DETC** check box.
6. Enter the DETC data (→ Tap changer (page 102)).
7. Under **Tap changer configuration**, set the tap changer's winding, the tap scheme, the number of taps, and the current tap position.
8. Type the voltage of all taps.
9. To add a tap, select the tap below which you want to add a tap, and then click **Add**.

The added taps match no tap scheme.

10. To delete a tap, select the tap you want to delete, and then click **Delete**.
11. To delete all taps, click **Remove all**.

Surge arresters tab

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

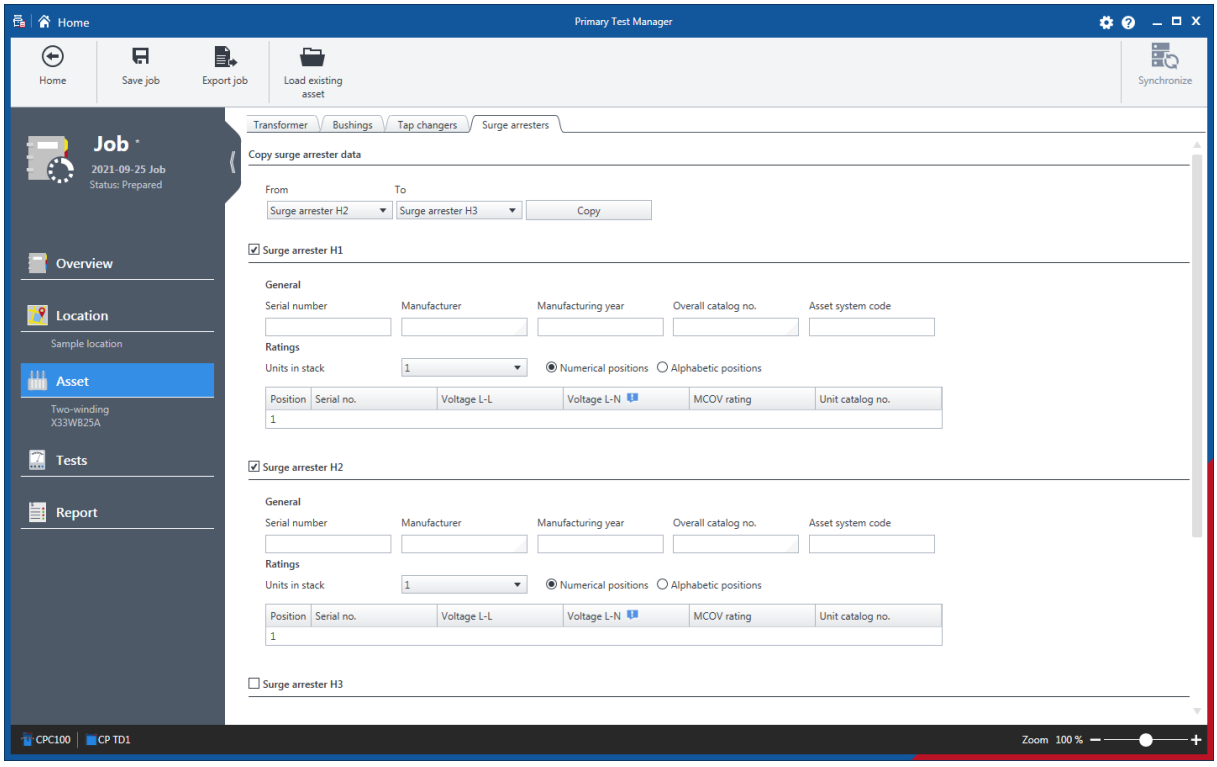


Figure 7-13: Transformer view: Surge arresters tab

Specifying a surge arrester

1. Select the respective **Surge arrester** check box.

2. Enter the surge arrester data (→ Surge arrester (page 102)).

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

DGA Trending

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

▶ Refer to Oil analysis for more detailed information on the Oil analysis test.

7.4.4 Spare bushing view

In the spare bushing view, you can specify bushings.

To specify a spare bushing:

1. From the **Asset** list, select **Bushing**.
2. From the **Asset type** list, select the type of the spare bushing.

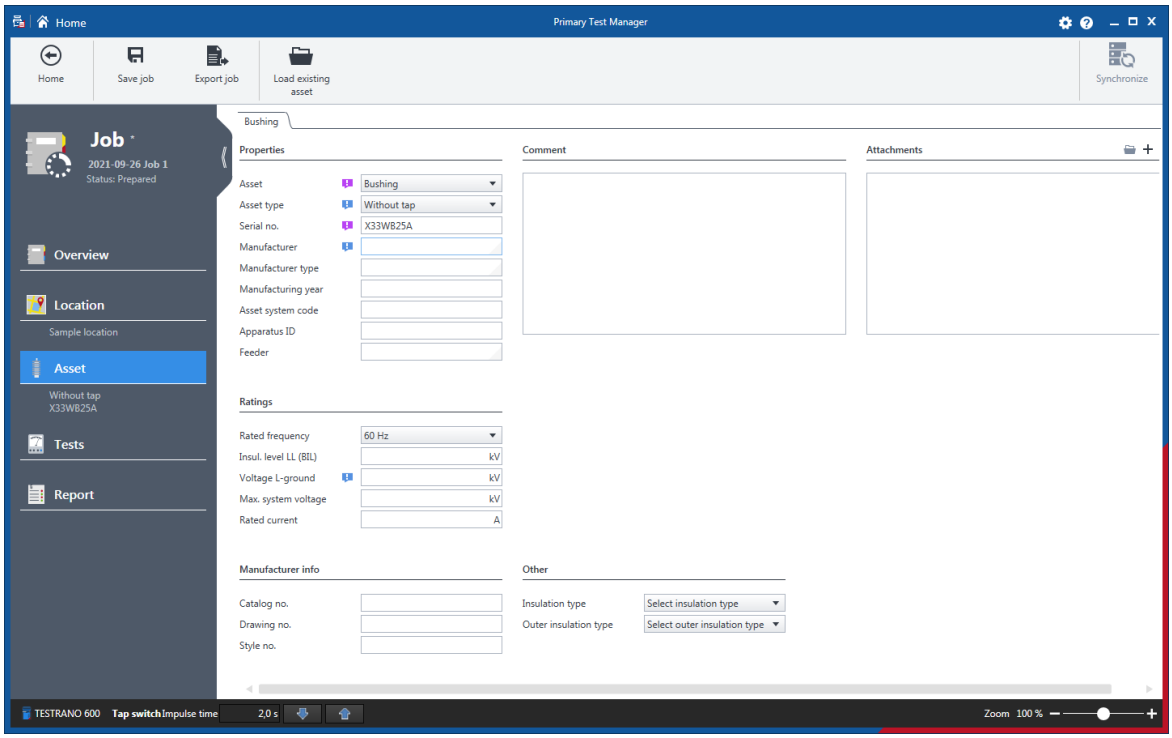


Figure 7-14: Spare bushing view

3. In the spare bushing view, enter the general asset data
4. Enter the spare bushing data (→ Spare bushing (page 103)).

7.4.5 Circuit breaker view

In the circuit breaker view, you can specify circuit breakers.

To specify a circuit breaker:

1. From the **Asset** list, select **Circuit breaker**.
2. From the **Asset type** list, select the type of the circuit breaker.

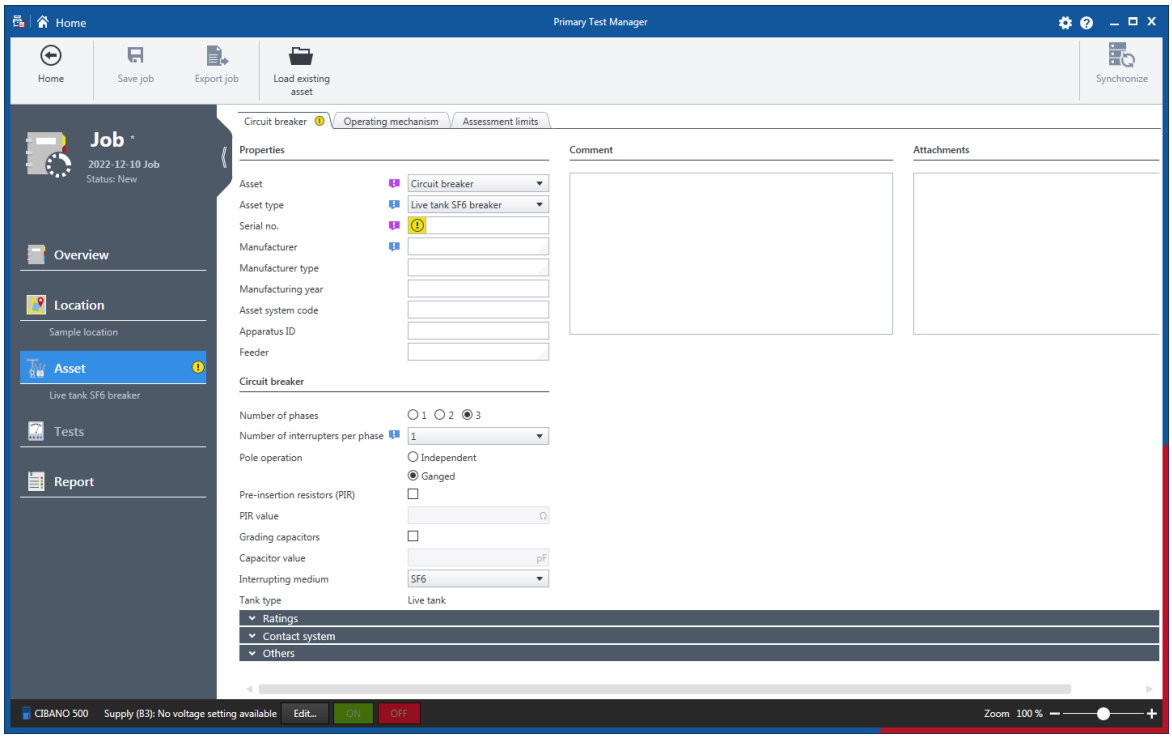


Figure 7-15: Circuit breaker view

3. In the circuit breaker view, enter further general asset data.
4. In the **Circuit breaker** area, enter the circuit breaker data (→ Circuit breaker (page 104)).
5. Specify the operating mechanism of the circuit breaker.
6. Optionally, specify the bushings mounted on the circuit breaker.
7. Set the assessment limits of the circuit breaker.

Operating mechanism tab

In the **Operating mechanism** tab, you can specify the circuit breaker's operating mechanism.

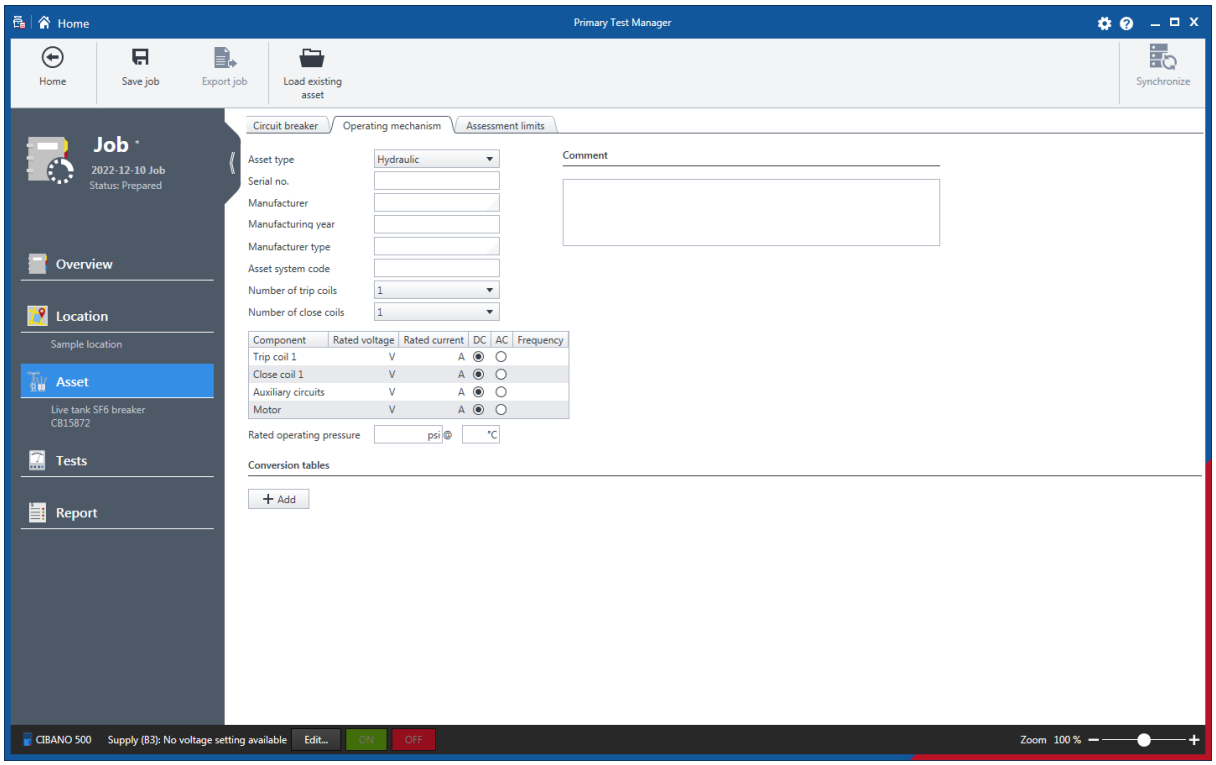


Figure 7-16: Circuit breaker view: Operating mechanism tab

To specify an operating mechanism, enter the operating mechanism data (→ Operating mechanism (page 105)).

Bushings tab (Circuit breaker)

In the **Bushings** tab, you can specify bushings mounted on the circuit breaker.

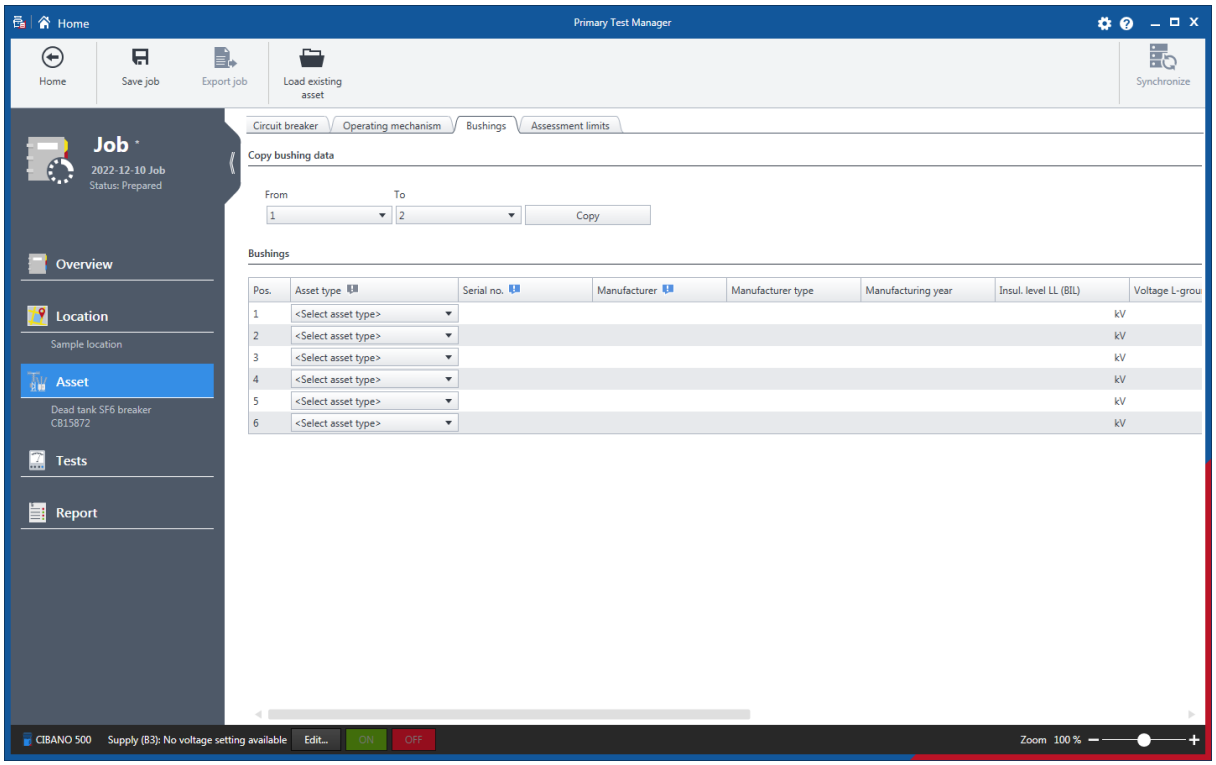


Figure 7-17: Circuit breaker view: Bushings tab

To specify a bushing:

1. From the **Asset type** list, select the type of the bushing for all circuit breaker's terminals.
2. Enter the bushing data (→ Spare bushing (page 103)).

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**.

Assessment limits tab

In the **Assessment** limits tab, you can set the circuit breaker's absolute and relative assessment limits.

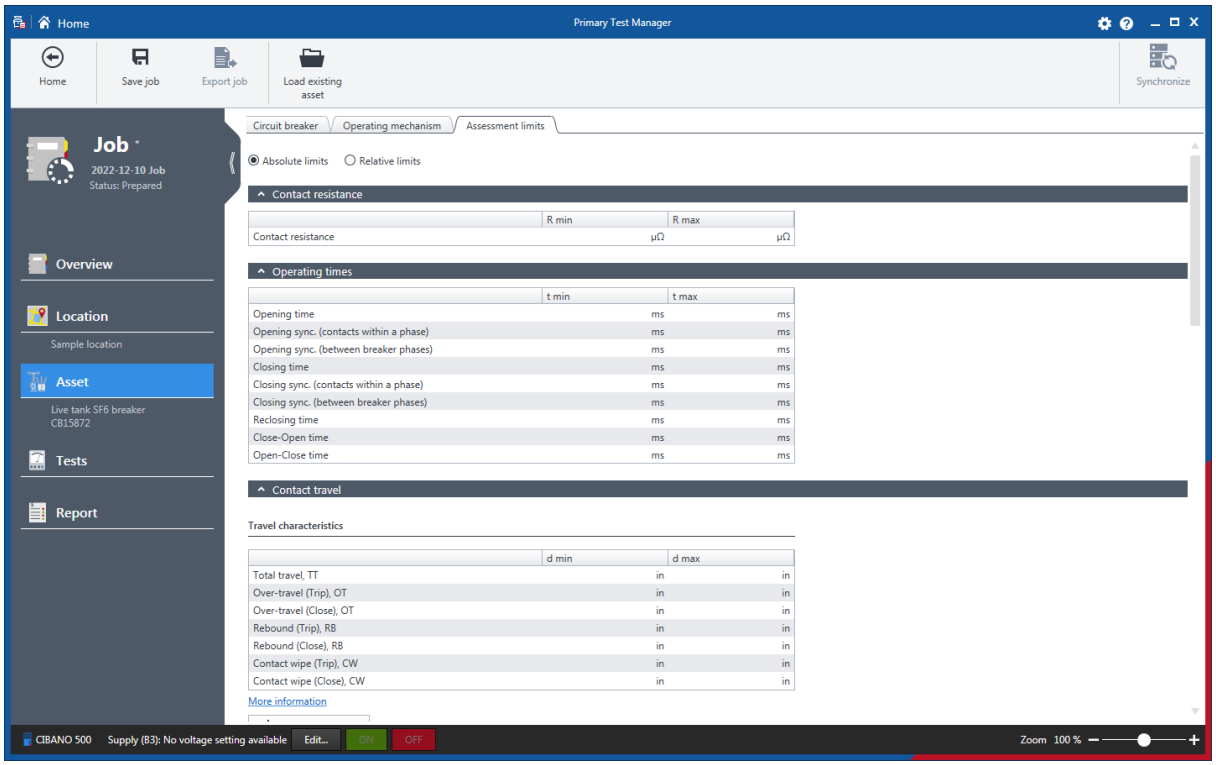


Figure 7-18: Circuit breaker view: Assessment limits tab

To set the circuit breaker's assessment limits:

1. In the **Assessment limits** tab, click **Absolute limits** or **Relative limits**.
2. Enter the assessment limits (→ Assessment limits (page 108)).

7.4.6 Current transformer view

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

To specify a current transformer:

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

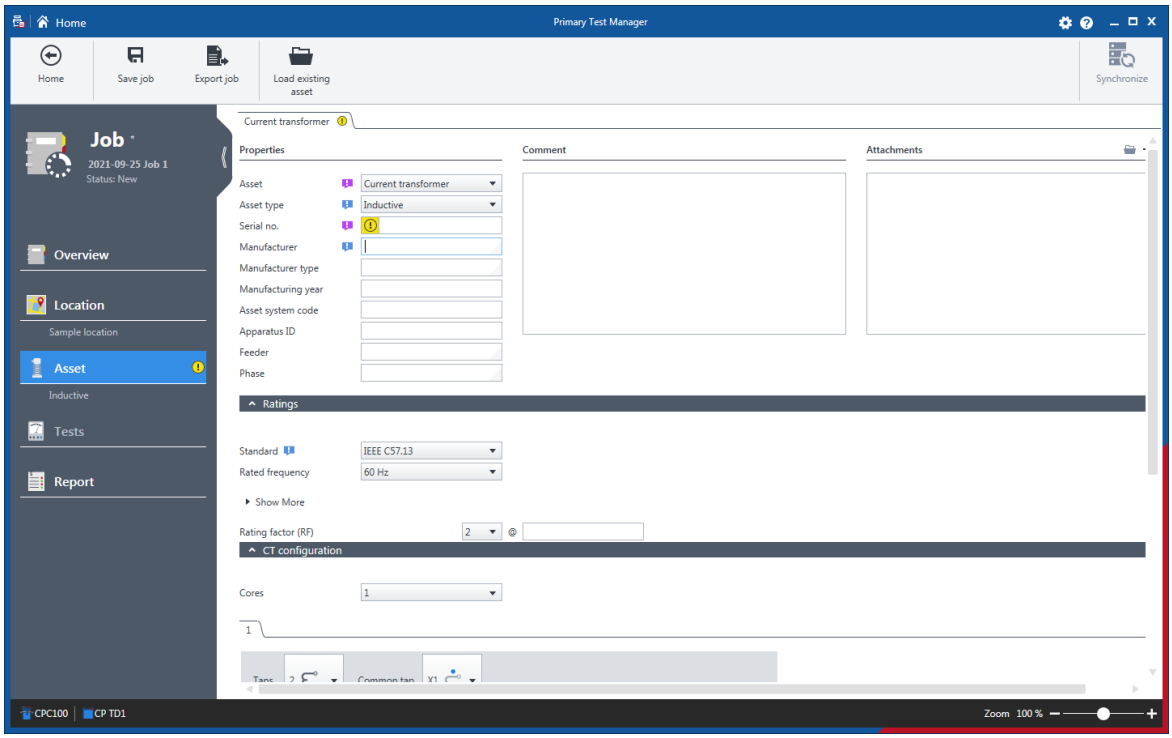


Figure 7-19: Current transformer view

2. In the current transformer view, enter the general asset data.
3. Enter the current transformer data (→ Current transformer (page 110)).

7.4.7 Voltage transformer view

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

To specify a voltage transformer:

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

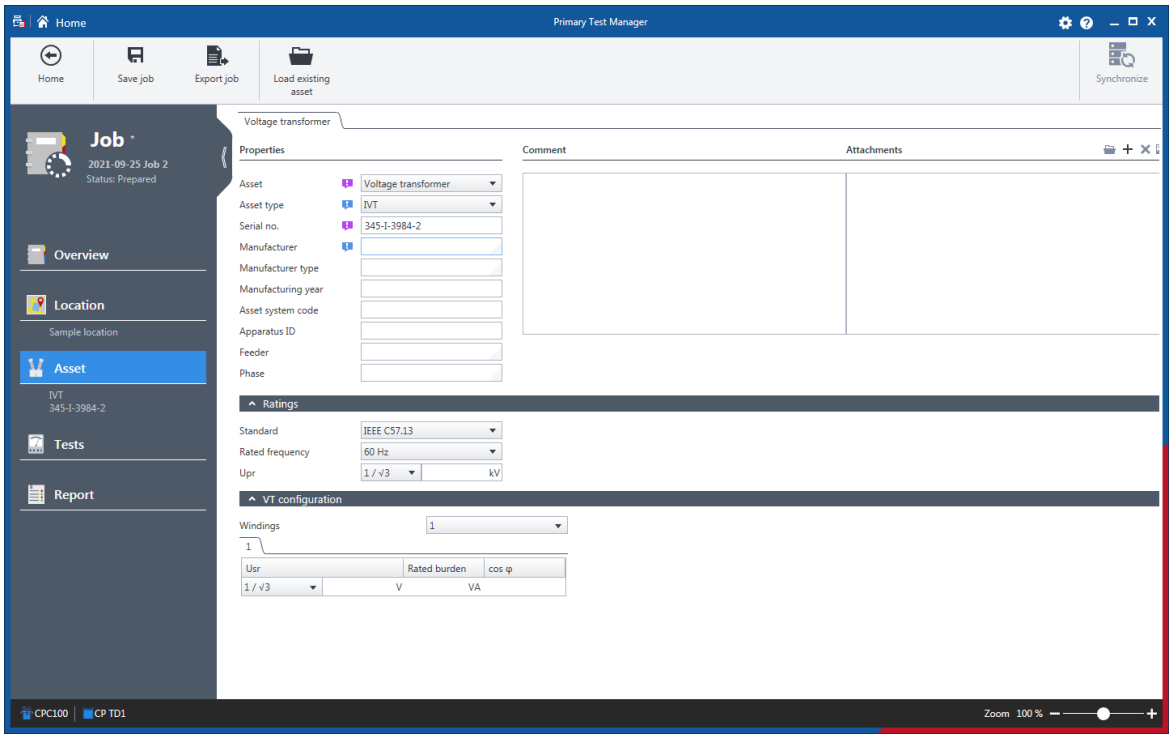


Figure 7-20: Voltage transformer view

3. In the voltage transformer view, enter the general asset data.
4. Enter the voltage transformer data (→ Voltage transformer (page 115)).

7.4.8 Rotating machine view

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

To specify a rotating machine:

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

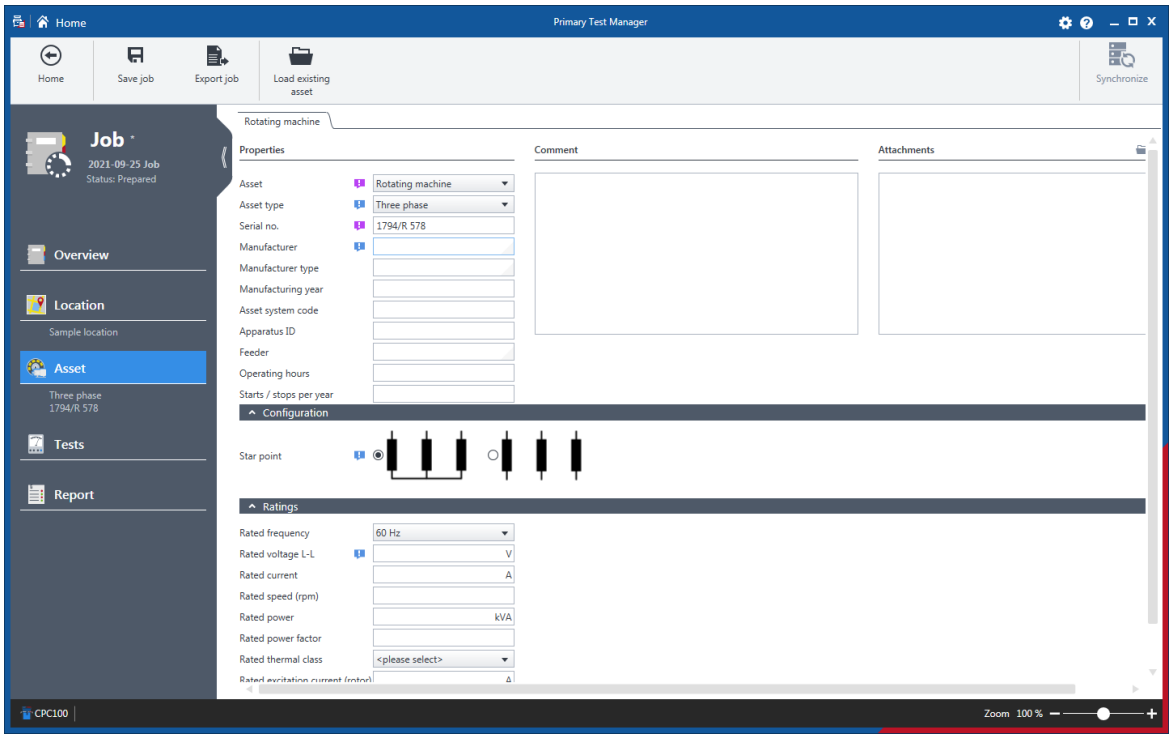


Figure 7-21: Rotating machine view

3. In the rotating machine view, enter the general asset data.
4. In the **Configuration** area and the **Ratings** area, enter the rotating machine data (→ Rotating machine (page 116)).

7.4.9 Miscellaneous view

In the miscellaneous view, you can specify miscellaneous assets.

To specify a miscellaneous asset:

1. From the **Asset** list, select **Miscellaneous**.

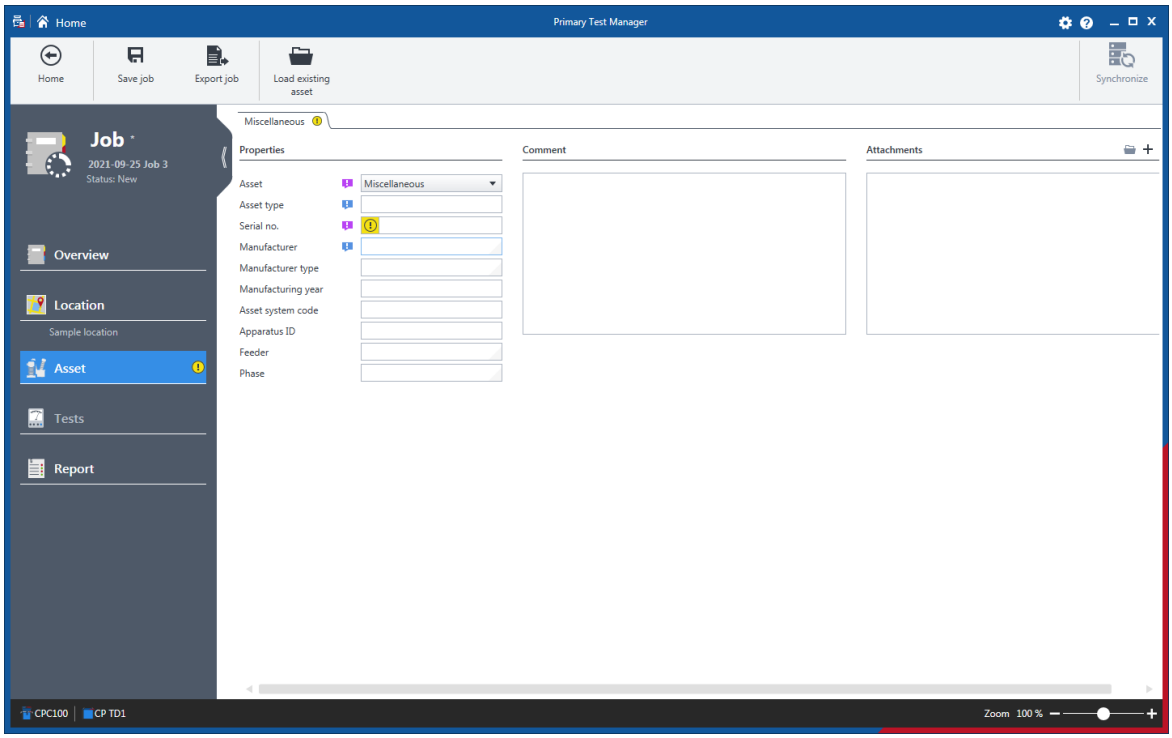


Figure 7-22: Miscellaneous view

2. In the miscellaneous view, enter the general asset data.

7.5 Test view

In the test view, you can select, import and perform tests.

▶ To open the test view, click the **Tests** navigation button .

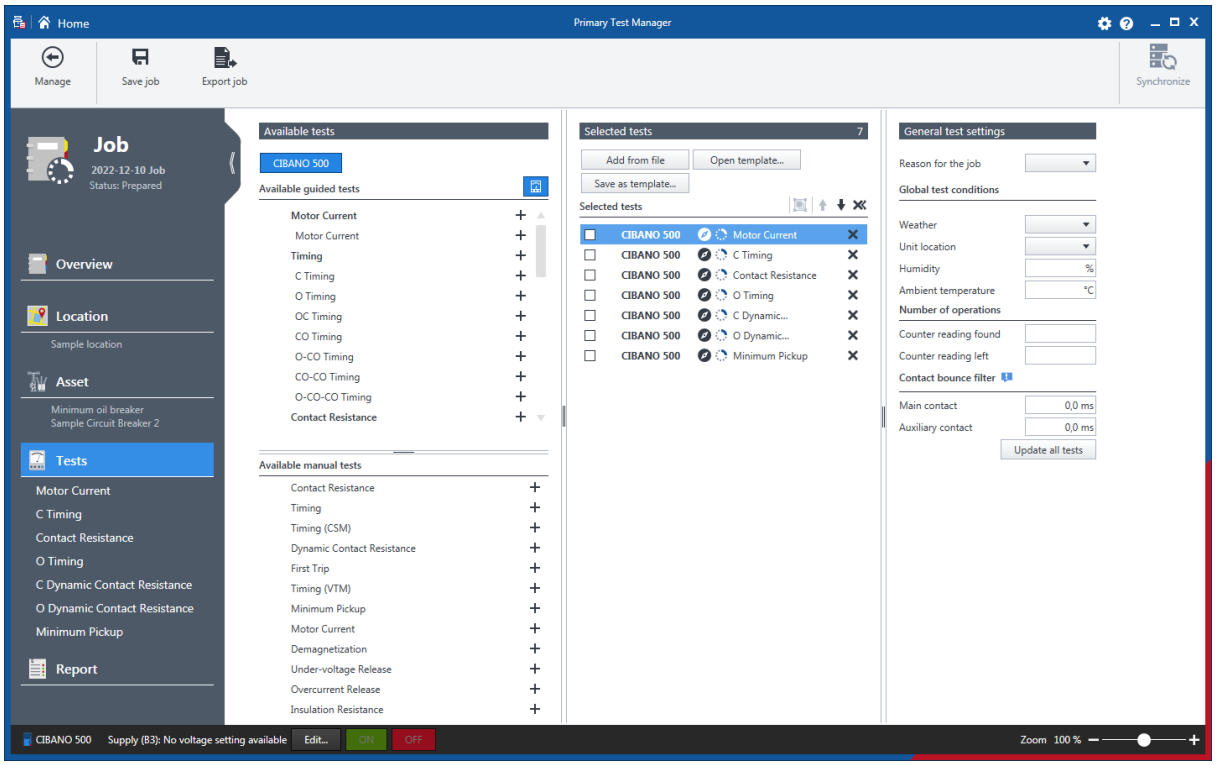


Figure 7-23: Test view

7.5.1 Test selection

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. The *Primary Test Manager* will then display 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 the *Primary Test Manager* within the same job. The symbol indicates that a test is not available for the connected test system. You must connect a different test system before proceeding to execute the job.

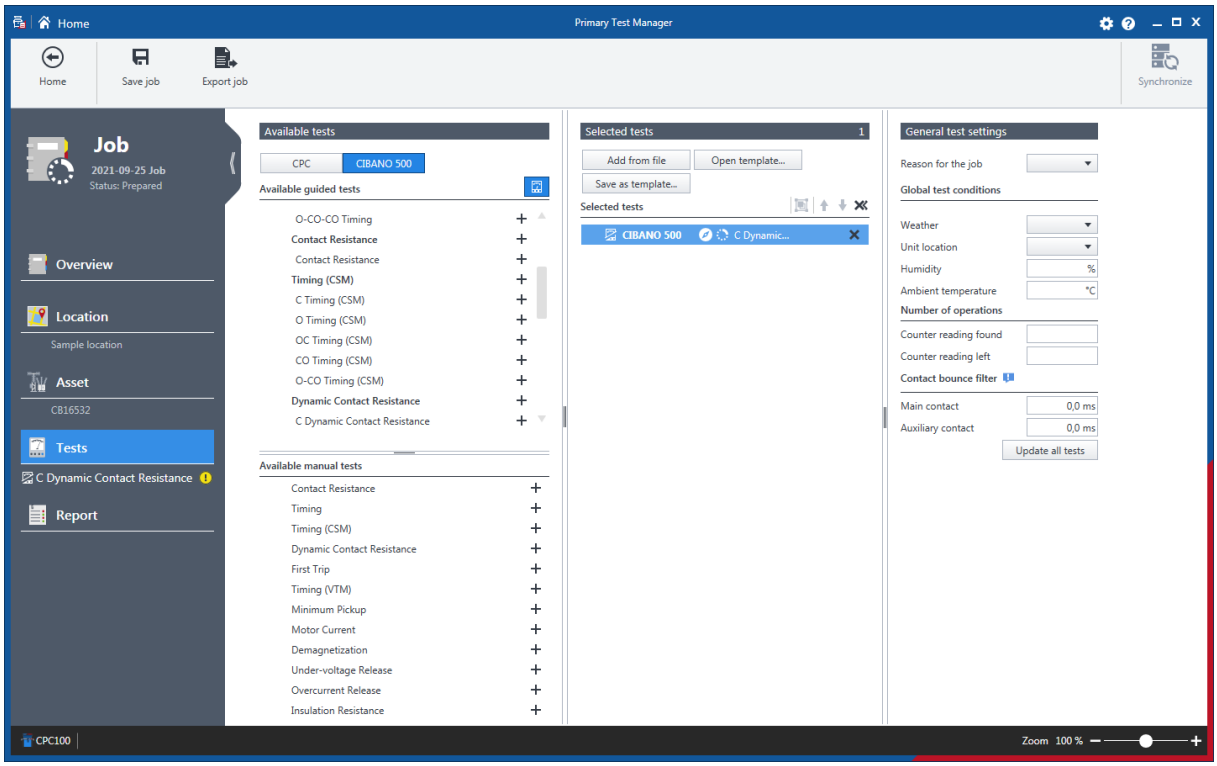


Figure 7-24: Job configured with test for the *CPC 100* and the *CIBANO 500* test systems

If you try to perform a *CIBANO 500* test with the *CPC 100* connected, a warning message appears.

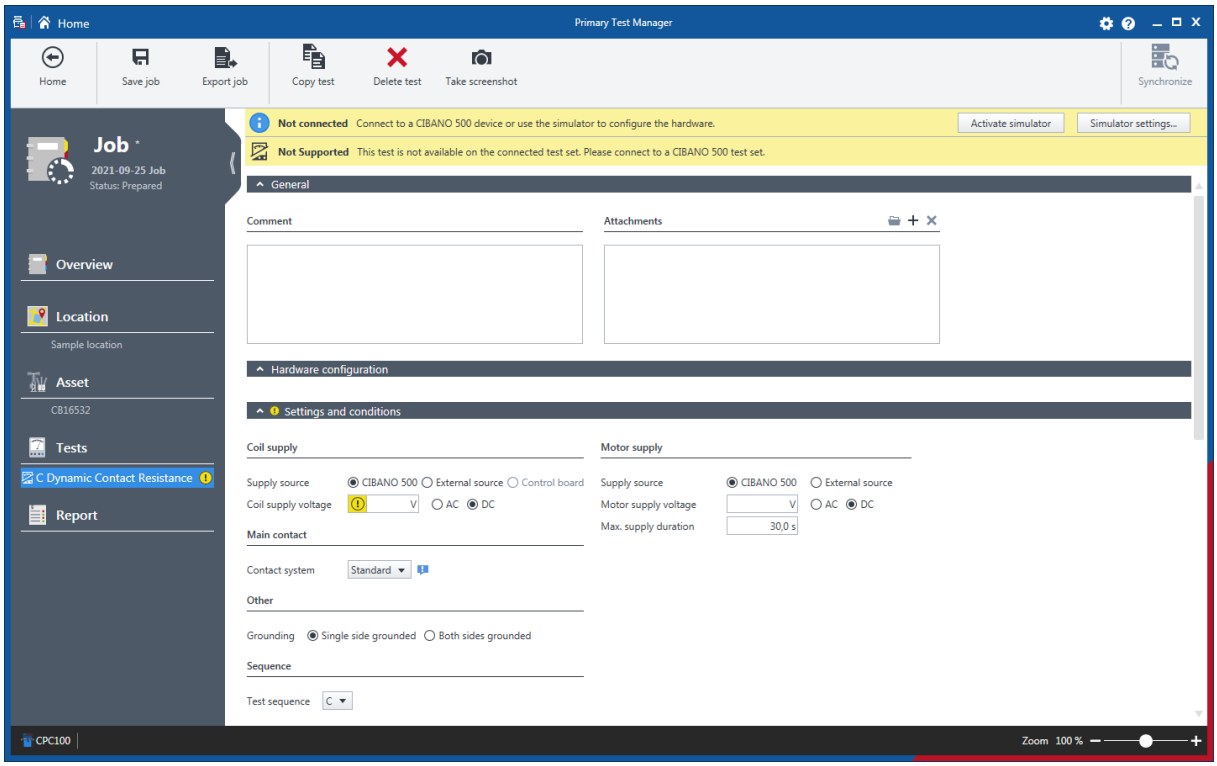


Figure 7-25: Warning message when trying to perform a test for the *CIBANO 500*

The optional manual tests are asset independent. You can perform the tests for any asset described in this user manual, but the *Primary Test Manager* will not guide you through the tests or provide any test settings data. These tests offer a large amount of flexibility to define test procedures and specify test settings according to your specific needs. For more information about the manual tests, see New manual jobs (page 92).

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

- ▶ 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.
- ▶ To change the order of the tests, drag them or use the and buttons.
- ▶ 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 of the job, the global test conditions, and some asset specific data.

7.5.2 Test groups

You can group tests with the *Primary Test Manager*. You are able to define the hardware configuration and certain settings and conditions for a test group. These settings are then applied to all tests in the test group.

To group tests:

1. In the **Selected tests** area, select the check boxes next to the tests you want to group.
2. Click the symbol.
   → The test groups are displayed under **Tests** in the left pane of the test view.

- ▶ To rename a test group, click the test group name, and then enter the name you want to use.
- ▶ To remove a test from the test group, click the symbol next to the test name.
- ▶ To remove a test group from the **Selected tests** area and from the left pane, click the symbol next to the test group name.
- ▶ To open a test group, click the test group name in the left pane of the test view.

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

- **Hardware configuration**
  Display the test-specific controls of the test set.
- **Settings and conditions**
  Display the test settings common to all tests of the test group.
- **Test control**
  Display the test control buttons and the list of the tests with the execution and assessment status.

7.5.3 General test settings

The **General test settings** area displays the following data.

Table 7-8: General test settings

Data	Description
Reason for the job	Reason why the job has been created
Global test conditions	
Weather	Weather conditions on site
Unit location	Location of the unit under test
Humidity	Relative ambient humidity on site
Ambient temperature	Ambient temperature on site
Number of operations	
Counter reading found	Counter reading before starting the tests
Counter reading left	Counter reading after the tests has finished
Contact bounce filter	
Main contact	Threshold value of the time interval between 2 consequent bounces of the main contact. For time intervals equal or below the threshold, the contact is considered as closed. Setting the value to 0.0 ms deactivates the contact bounce filter.
Auxiliary contact	Threshold value of the time interval between 2 consequent bounces of the auxiliary contact. For time intervals equal or below the threshold, the contact is considered as closed. Setting the value to 0.0 ms deactivates the contact bounce filter.
Update all tests	Click **Update all tests** to set the contact bounce filter for all tests.

7.5.4 Importing tests

In the test view, you can import tests performed with the *CPC 100,* as well as the test systems not currently supported by the *Primary Test Manager*. The *Primary Test Manager* supports import of tests of the following formats.

Table 7-9: Supported test formats

File Name Extension	Description
.xml	*CPC* files (jobs)
.xmt	*CPC* template files (job templates)
.ptma	*Primary Test Manager* manual test
.drax	*DIRANA* native format

You can also import tests in .jpg, .pdf or any Microsoft Office file format.

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. In the left pane of the test view, click the imported test.

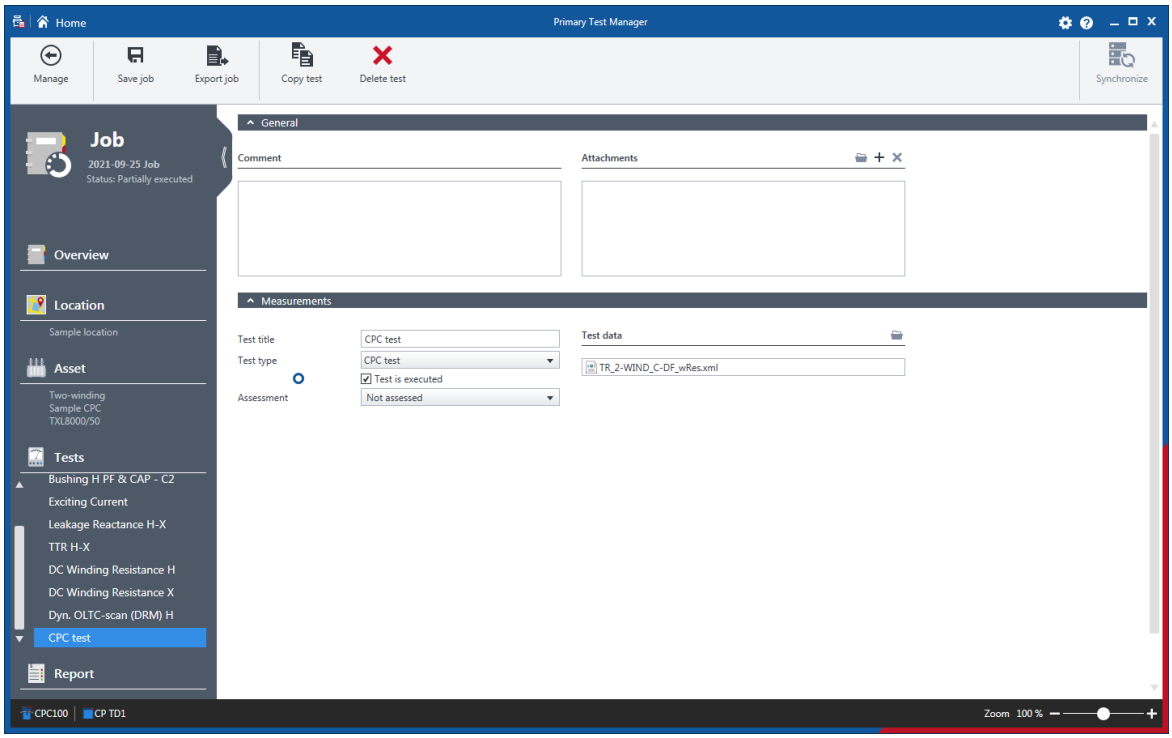


Figure 7-26: Test view after a test has been imported

4. In the workspace of the test view, you can change the test title and the test type.
5. To open the test, click the **Open** button under **Test data**.

To open a test, you must have installed the associated application software on your computer.

You can attach files and add comments to the test.

For information about importing and exporting jobs, see Export and import jobs (page 90).

7.5.5 Performing tests

To perform and assess the tests, you must know and understand the test settings and the measurement data. For detailed information, see the respective chapters on the asset tests later in this manual.

To perform a test:

1. Add the tests you want to perform into the selected tests area (→ Test selection (page 72)).
2. In the left pane of the test view, select the test you want to perform.
   ➜ The test view is then split into the **General** pane, the **Settings and conditions** pane, the **Measurements** pane and, if automatic assessment is available for the test, the **Assessment** pane. You can expand and collapse the panes by clicking the arrows on the split bars.

3. In the **Settings and conditions** pane, enter the test settings.

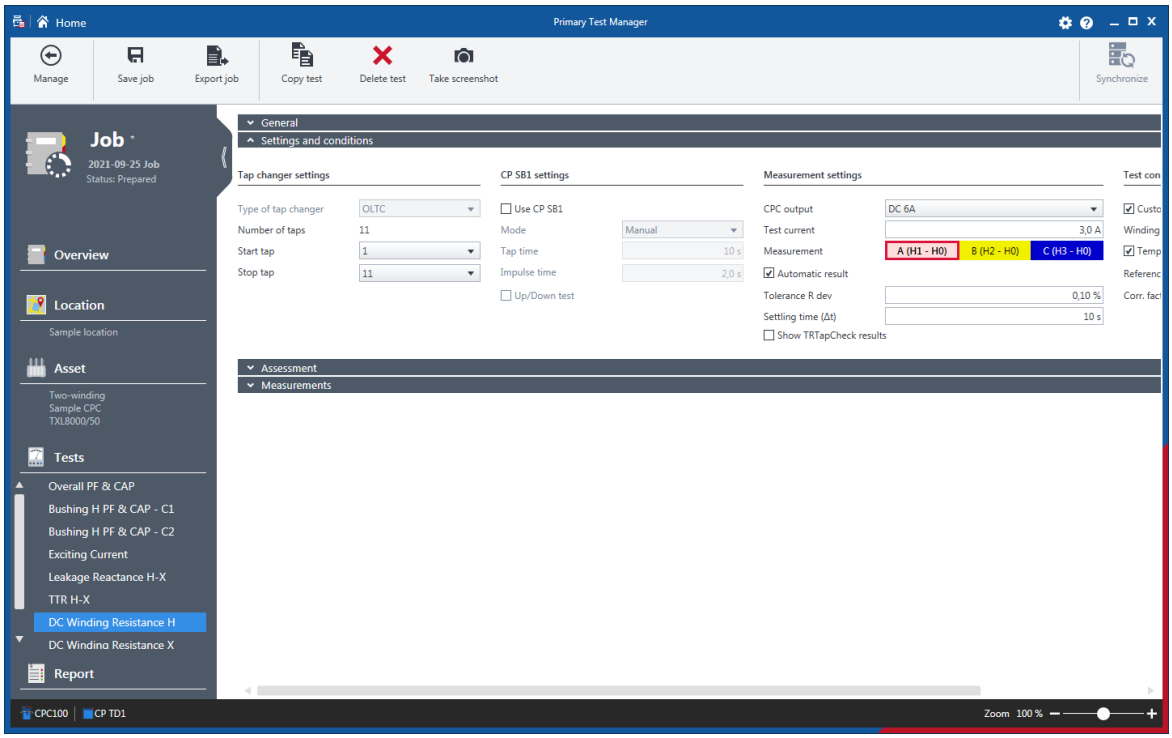


Figure 7-27: Test view: Settings and conditions pane

4. In the **Assessment** pane, enter the automatic assessment parameters and limits, if applicable.

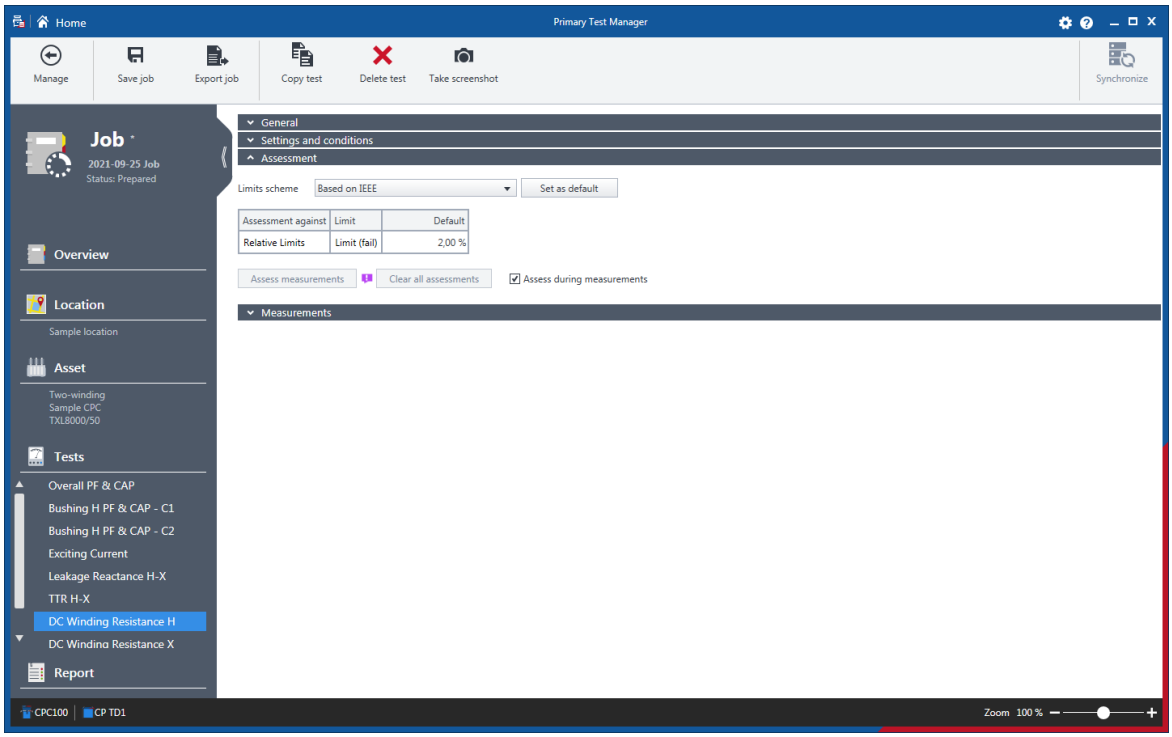


Figure 7-28: Test view: Assessment pane

5. Connect the test setup to the asset under test according to the wiring diagram displayed in the General pane. For information about connecting the test setup to the asset under test, see the technical documentation shipped with the *CPC 100*, *CP TD*, and *CP SB1* test systems.

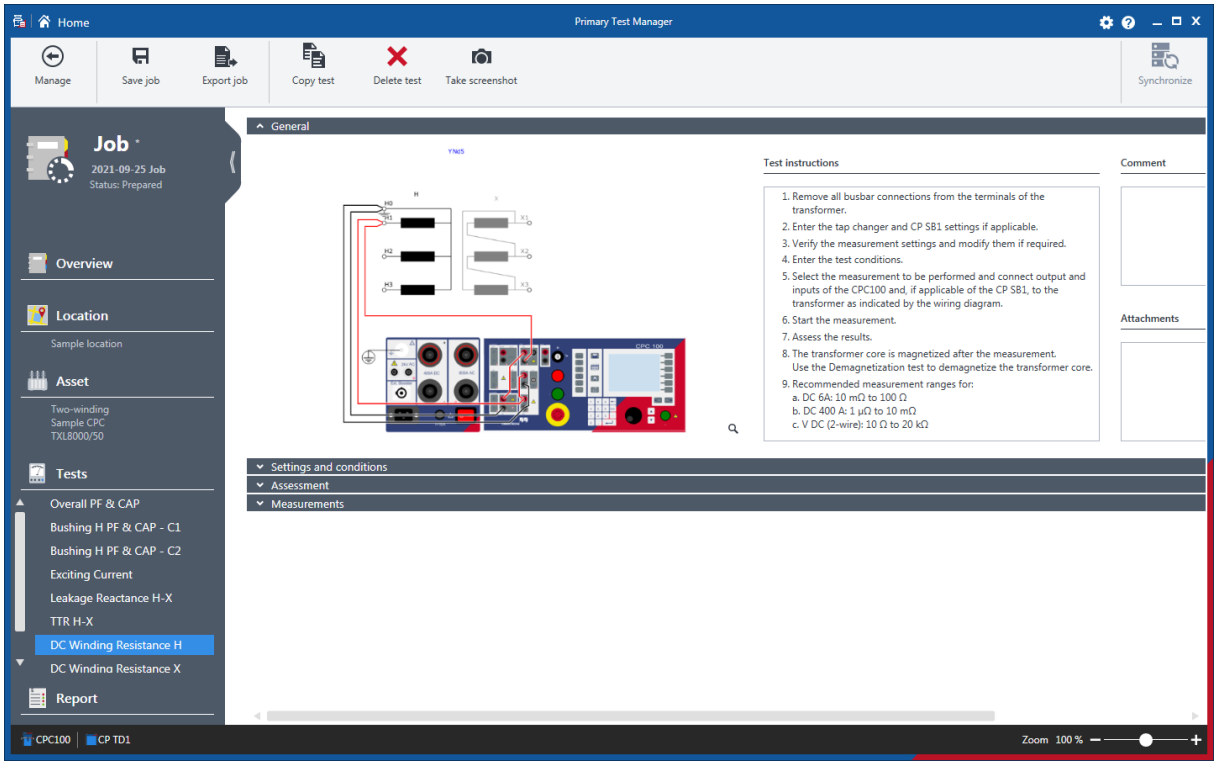


Figure 7-29: Test view: General pane

⚠ DANGER

Death or severe injury caused by high voltage or current

- ▶ Before connecting the test set to the test object, observe the five safety rules listed in Safety rules (page 11).
- ▶ Observe the relevant laws and internal safety standards.

▶ In the Measurements pane, click **Start** to start the selected measurement.

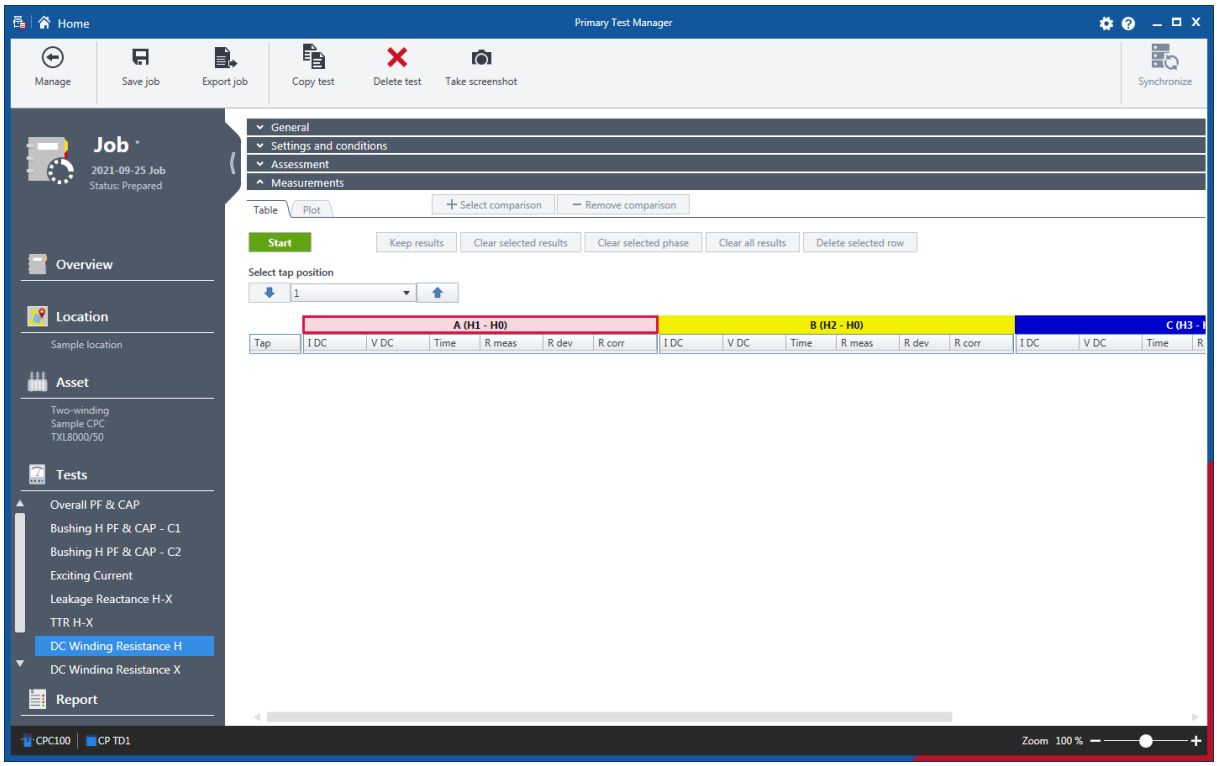


Figure 7-30: Test view: Measurements pane

⚠ DANGER

Death or severe injury caused by high voltage or current

The flashing lightning symbol in the *Primary Test Manager* test view indicates that one of the outputs on the test set is active

- ▶ Do not touch any of the outputs or cables on the test set while the lightning symbol is displayed.
- ▶ If in doubt, press the emergency switching off button.

▶ Press the **I/0** button or the **Start/Stop** button on the front panel of the test set.

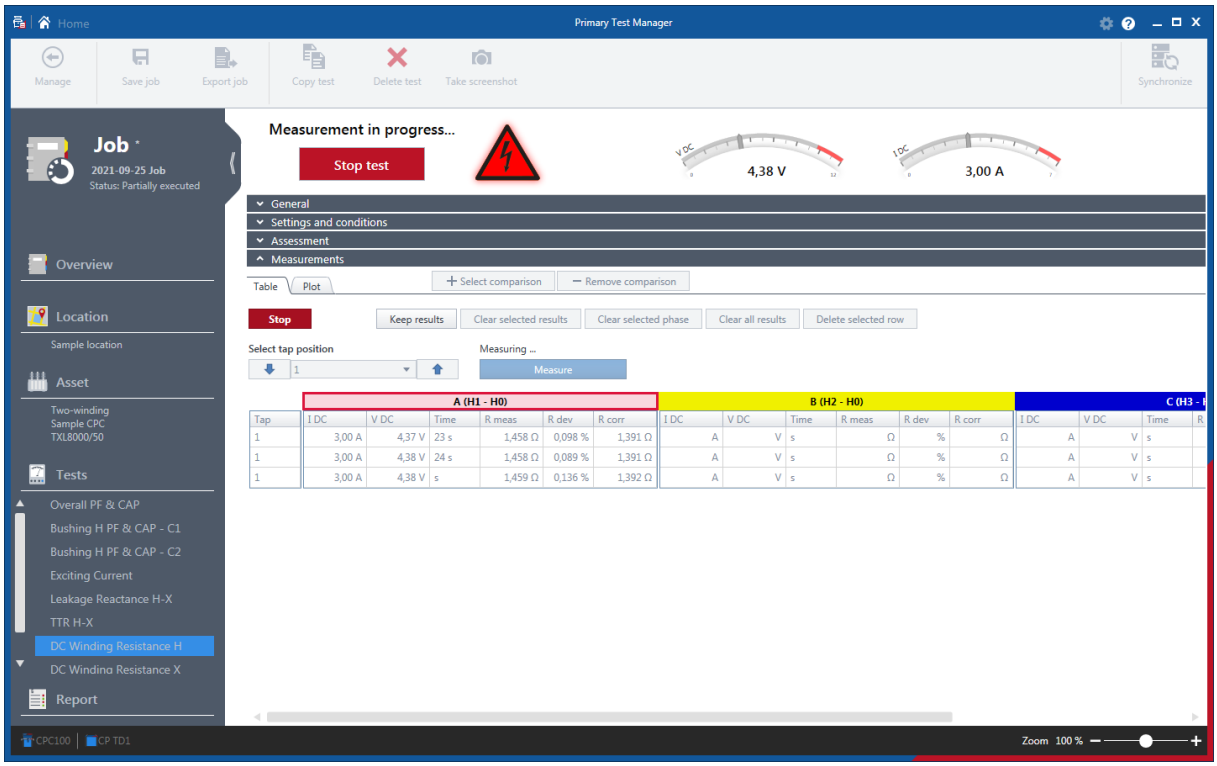


Figure 7-31: Test view during a measurement

After the measurement has finished, the *Primary Test Manager* will display the numeric measurement data and the automatic assessment, if available, in the Measurements pane. To view graphical diagrams of the measurement results, click the **Plot** tab.

▶ Repeat steps 6 and 7 for all test measurements.

Some tests support starting all measurements at once by clicking the **Start all** button.

After the test has been performed, some asset data relevant for the test configuration cannot be edited anymore.

7.5.6 Processing templates

In the guided test workflow, you can save jobs as templates and open the saved templates. With the help of templates, you can configure jobs according to your needs (for example, for repeated routines), and then repeatedly perform tests you only have to define once.

When you create a new job, the favorite template for the corresponding asset type and number of phases is loaded automatically, if available.

To save a job as template:

1. In the guided test workflow select configure a job.

2. In the **Selected tests** area of the test view, click **Save as template**.

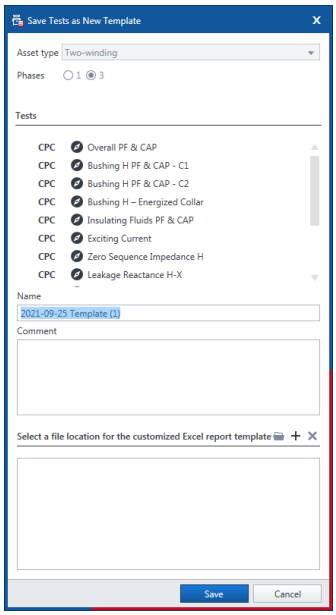


Figure 7-32: Save tests as new template dialog box

3. In the **Save Tests as New Template** dialog box:
   3.1 Select the **Asset type** and number of **Phases**.
   3.2 Enter a **Name** for the template.
4. Optionally, you can add a customized Microsoft Excel report template (→ Generate test reports (page 98)) for the job template. To add a Microsoft Excel report template:
   4.1 Click **Select template**.
   4.2 In the **Select** dialog box, browse to the report template you want to add.

To open a template:

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

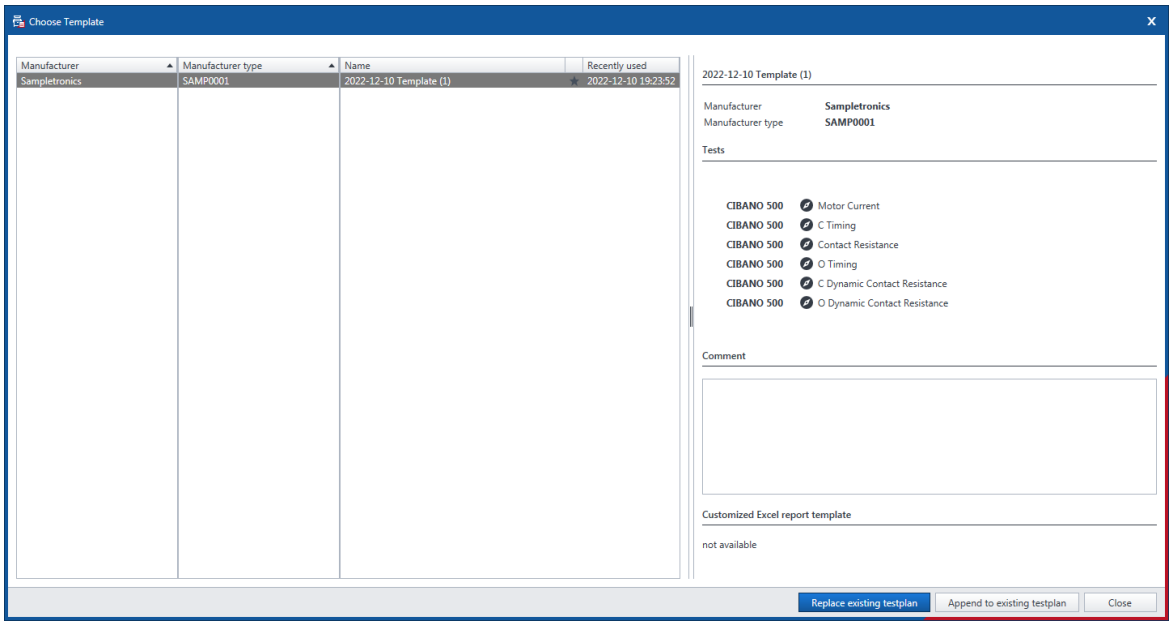


Figure 7-33: Choose Template dialog box

6. In the **Choose Template** dialog box, select the asset type, the number of phases and the template you want to open.

If you added a Microsoft Excel report template to the job template, its location is displayed under Customized Excel report template.

7. Press **Replace existing testplan** to replace the tests already listed in the test list. Press **Append to existing testplan** to add the tests listed in the template to the end of the existing testplan.

If you click Append to existing testplan, the Microsoft Excel report template will not be added the selected job template to the currently opened job.

7.6 Handling results

7.6.1 Trending tab

The **Trending** tab displays measurement data from PF tests performed at rated frequency at different points in time.

For the collection of data, the serial number and manufacturer are taken into account. Therefore, all measurements of the bushing in question are displayed, regardless of its location (for example spare bushing, bushing mounted on different transformers, etc.).

Trending is available for the following tests:

- Overall PF & CAP (page 128)
- Bushing PF & CAP – C1 (page 133)
- Bushing PF & CAP – C2 (page 138)
- Spare Bushing PF & CAP – C1 (page 172)
- Spare Bushing PF & CAP – C2 (page 174)

In the chart, measurements performed with 10 kV at rated frequency are displayed as circles. All other data are displayed as triangles.

If several tests are performed on one day, the most recent test of that day is connected to the curve in the Trending chart. The others are displayed in the same chart but are not connected.

7.6.2 Assessing measurement results

▶ Use the **Assessment** column in the **Measurements** area of a test to assess the measurement results or to change the automatic assessment provided by the *Primary Test Manager*.

Table 7-10: Assessment

Status	Description
Fail	The status was automatically set to **Fail** by the *Primary Test Manager*.
Manual fail	The status was manually set to **Fail**.
Investigate	The status was automatically set to **Investigate** by the *Primary Test Manager*.
Manual investigate	The status was manually set to **Investigate**.
Pass	The status was automatically set to **Pass** by the *Primary Test Manager*.
Partial pass	Some measurements have not been assessed.
Manual pass	The status was manually set to **Pass**.
Manual partial pass	Some measurements have not been assessed and at least one assessment status was changed manually.
Not assessed	The measurement has not been assessed.
Not rated	The status was automatically set to **Not Rated** by the *Primary Test Manager*.

7.6.3 Comparing results

Some tests support comparison of the graphical diagrams of measurement results. The comparison data is an integral part of the tests. You can compare tests for different assets, but we recommend to perform only comparisons of tests for the same assets or assets of the same design type. The *Primary Test Manager* offers you only tests of the same type for which the comparison is possible.

To compare a test with a test available in the database during measurement:

1. In the Home view (→ Home view (page 26)), click the **New guided job** button  .
2. In the **Create new job** view, configure a job as previously described in this chapter.
3. In the Test view (→ Test view (page 72)), select the test you want to perform.
4. In the Measurements pane, click the **+ Select comparison** button, if available.

5. In the **Select a test** window, select the test you want to compare with the current test.

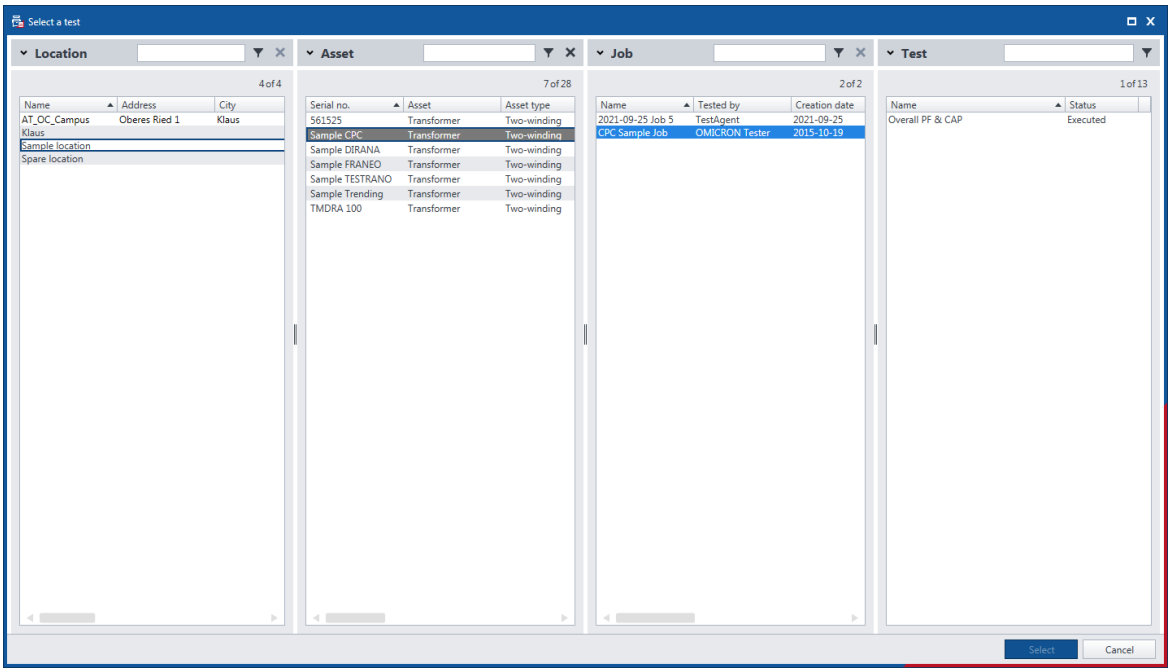


Figure 7-34: Select a test window

6. The **Measurements** pane displays the measurement results of the selected test.

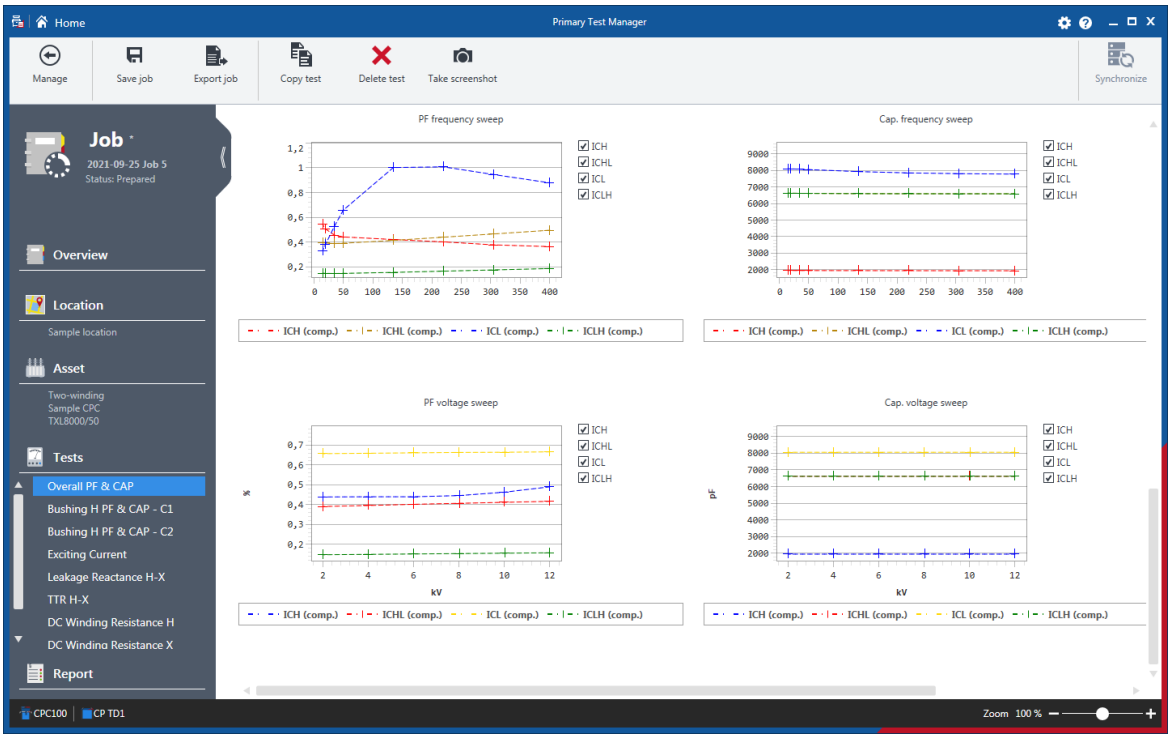


Figure 7-35: Test comparison: Measurement results of the first test

7. Start the test (→ Performing tests (page 76)).

8. Click the **Plot** tab.
9. The *Primary Test Manager* displays the measurement results of both tests in real time.

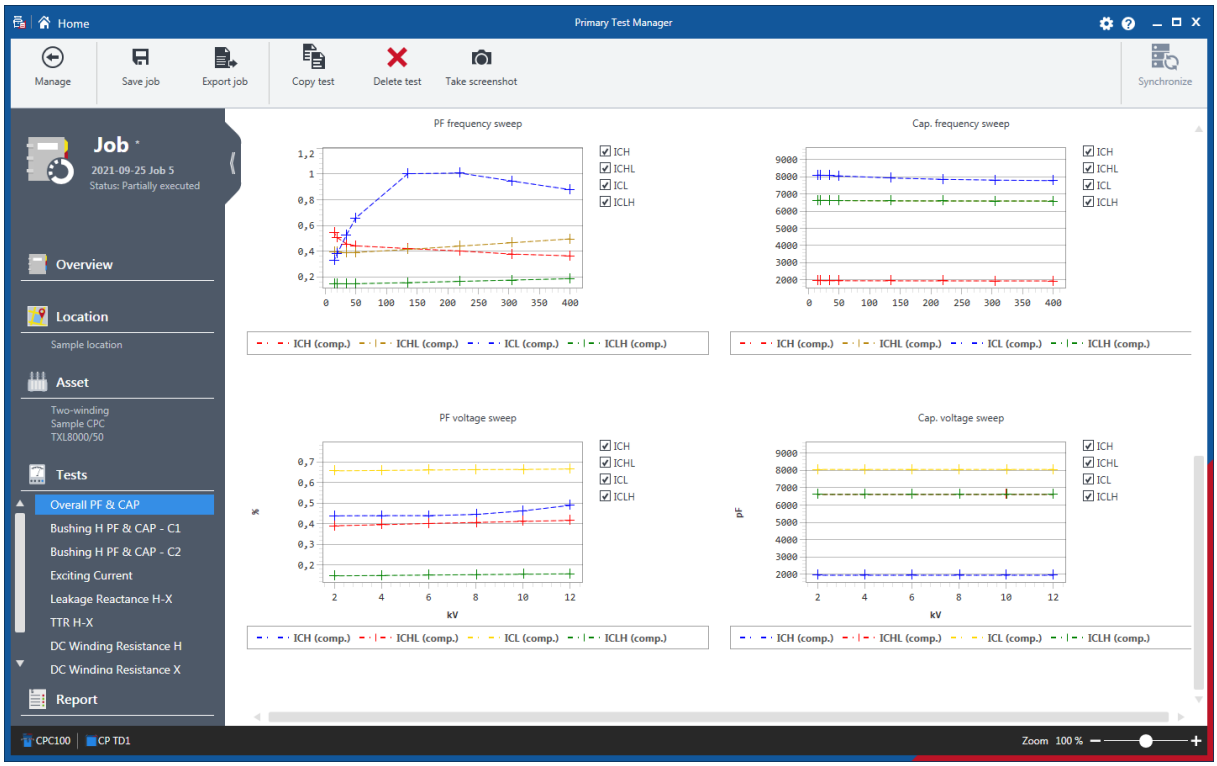


Figure 7-36: Test comparison: Measurement results of both tests

To remove the comparison diagram, click **Remove comparison**.

Alternatively, you can compare 2 tests available in the database:

10. In the **Manage** view (→ Manage view (page 86)), select the job including the first test for comparison.
11. In the left pane of the job overview, click the first test for comparison.
12. In the **Measurements** pane, click the **Select comparison** button, if available.
13. In the **Select a test** window, select the second test for comparison.
14. The *Primary Test Manager* displays the measurement results of both tests.

8 Manage view

In the manage view, you can manage locations, assets, jobs, and reports available in the *Primary Test Manager*. After you have opened a job, the *Primary Test Manager* leads you through the guided test workflow (→ New guided jobs (page 47)).

▶ To open the manage view, click the **Manage** button in the home view.

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

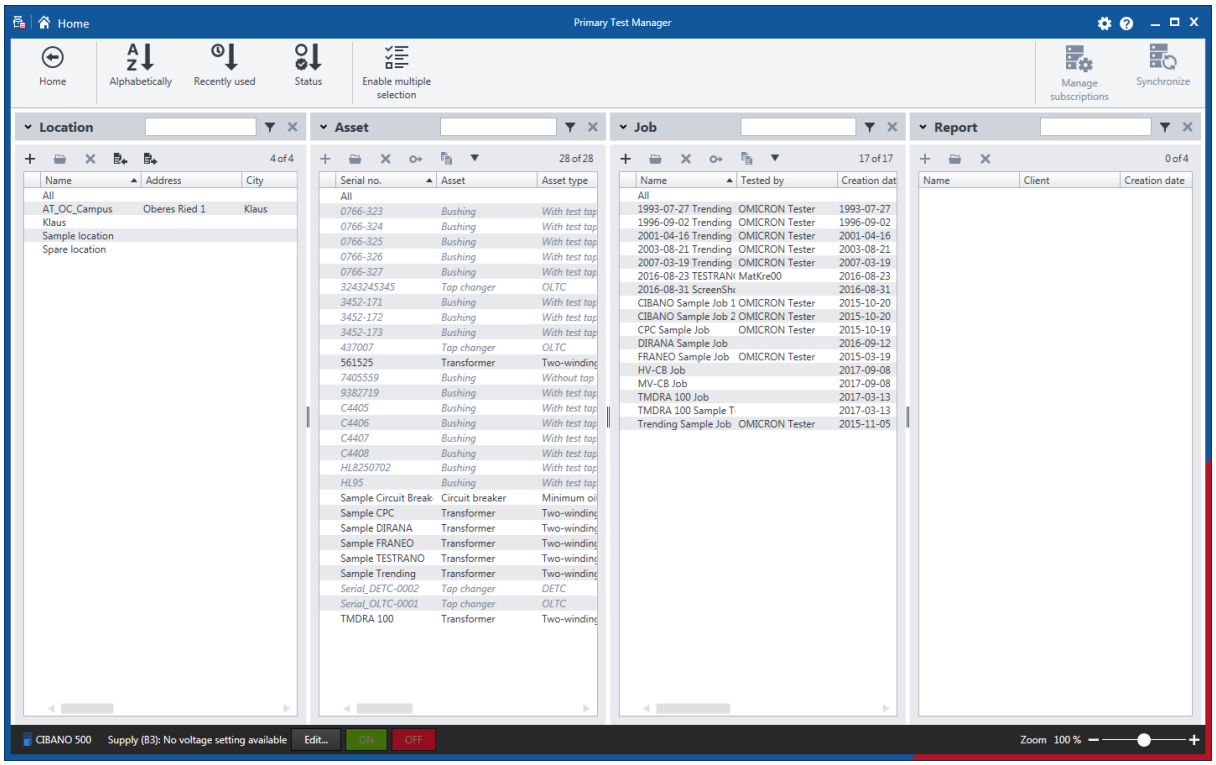


Figure 8-1: Manage view

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:

▶ To sort the objects alphabetically, click **Alphabetically** on the ribbon.

▶ To sort the objects in the chronological order, click **Recently used** on the ribbon.

▶ To sort the objects according to the job status, click **Status** on the ribbon.

▶ To rearrange the columns, drag the column headers.

In the manage view, you can:

8.1 Search for objects

In the manage view, you can search for the objects available in the *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, enter the keywords 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. Enter the keywords in the respective object data boxes.

The following table describes the location search data.

Table 8-1: Location search data

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

The following table describes the asset search data.

Table 8-2: 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 8-3: Job search data

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

The following table describes the report search data.

Table 8-4: Report search data

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

8.2 Perform operations on objects

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

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

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

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

To perform operations on multiple objects, click Enable multiple selection in the menu bar, and then do one of the following:

- To delete multiple locations, assets, jobs, and test reports, select the check boxes next to the objects you want to delete, and then click the **Delete selected object(s)** button ✕.
- To export multiple jobs, select the check boxes next to the jobs you want to export, and then click the **Export** button .

8.3 Master locations and assets

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

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

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

8.4 Duplicate assets

In the manage view, you can duplicate assets available in the *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, enter the serial number(s) of the new asset.

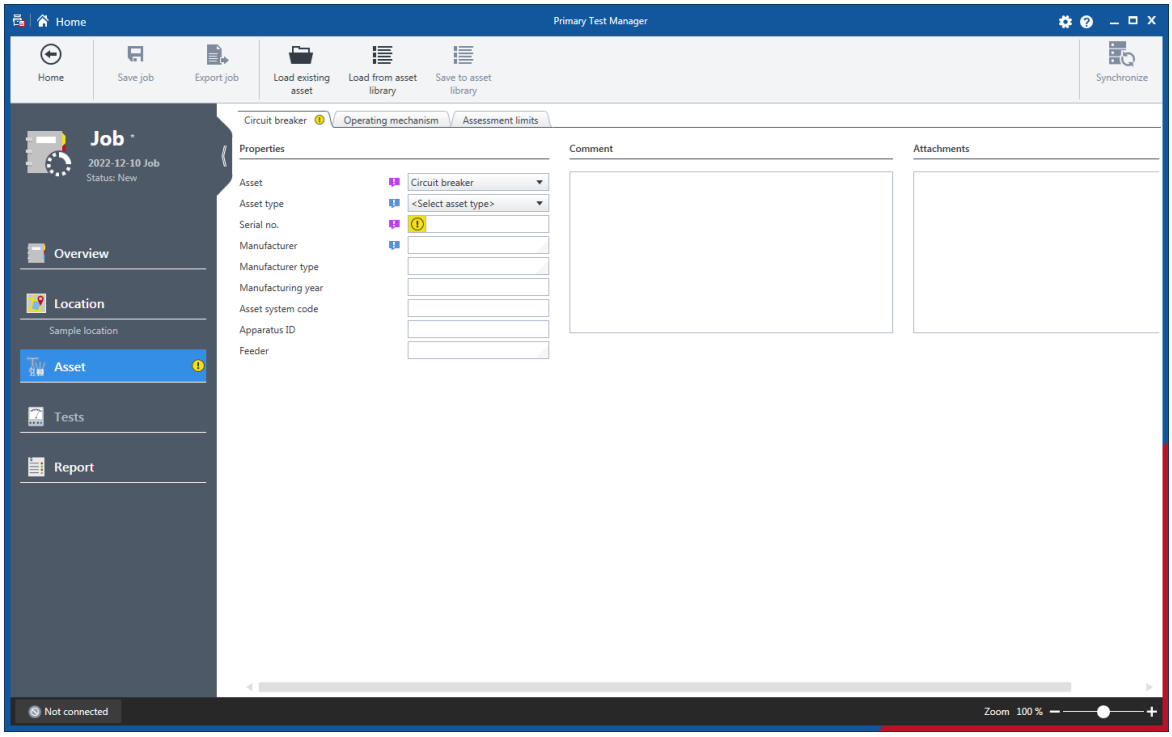


Figure 8-2: Asset view

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

By default, the duplicated assets are linked to location of the original asset. For relocating the asset to a different location, see Relocate assets (page 90).

8.5 Relocate assets

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

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

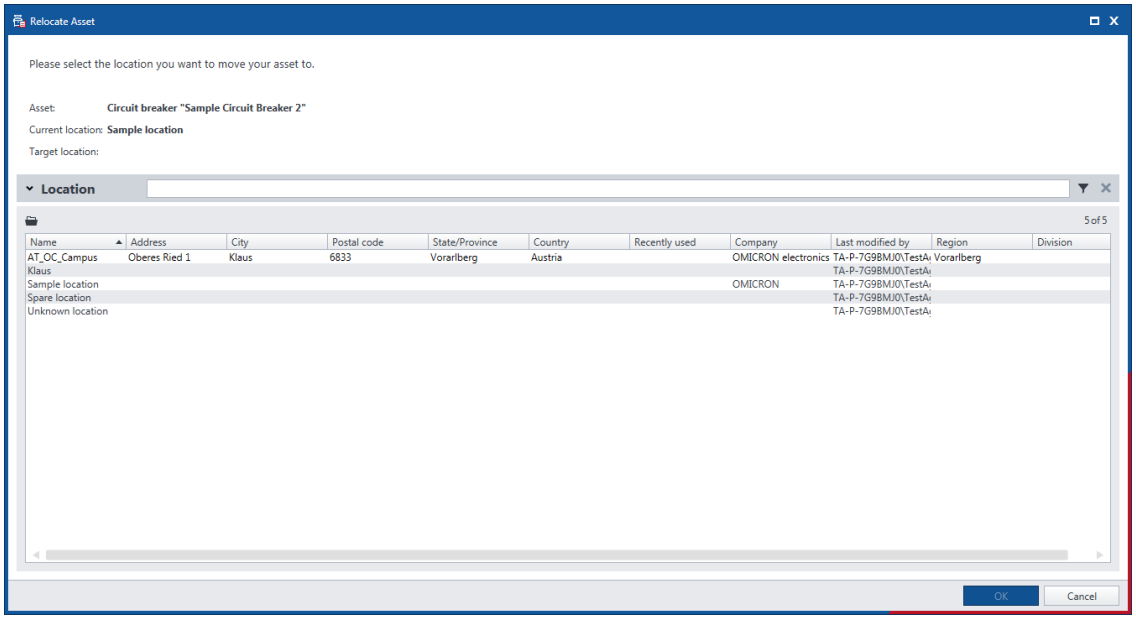


Figure 8-3: Relocate asset dialog box

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

You can filter the locations and assets by searching for keywords (→ Search for objects (page 87)).

8.6 Export and import jobs

The *Primary Test Manager* supports data exchange between different test systems.

You can export jobs in the *Primary Test Manager* native PTM format. 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.

You can import *Primary Test Manager* jobs in PTM format, test data in CSV format, and XML and SFRA Doble files.

During the import, the Doble XML data is mapped to the *Primary Test Manager* jobs.

To import a job:

4. Under **Jobs**, click the **Import** button .
5. In the **Open** dialog box, select the data format of the file you want to import.
6. Browse to the file you want to import.

9 New manual jobs

The *Primary Test Manager* assists you in creating new manual jobs.

▶ To open the new manual job view, click the **New manual job** button .

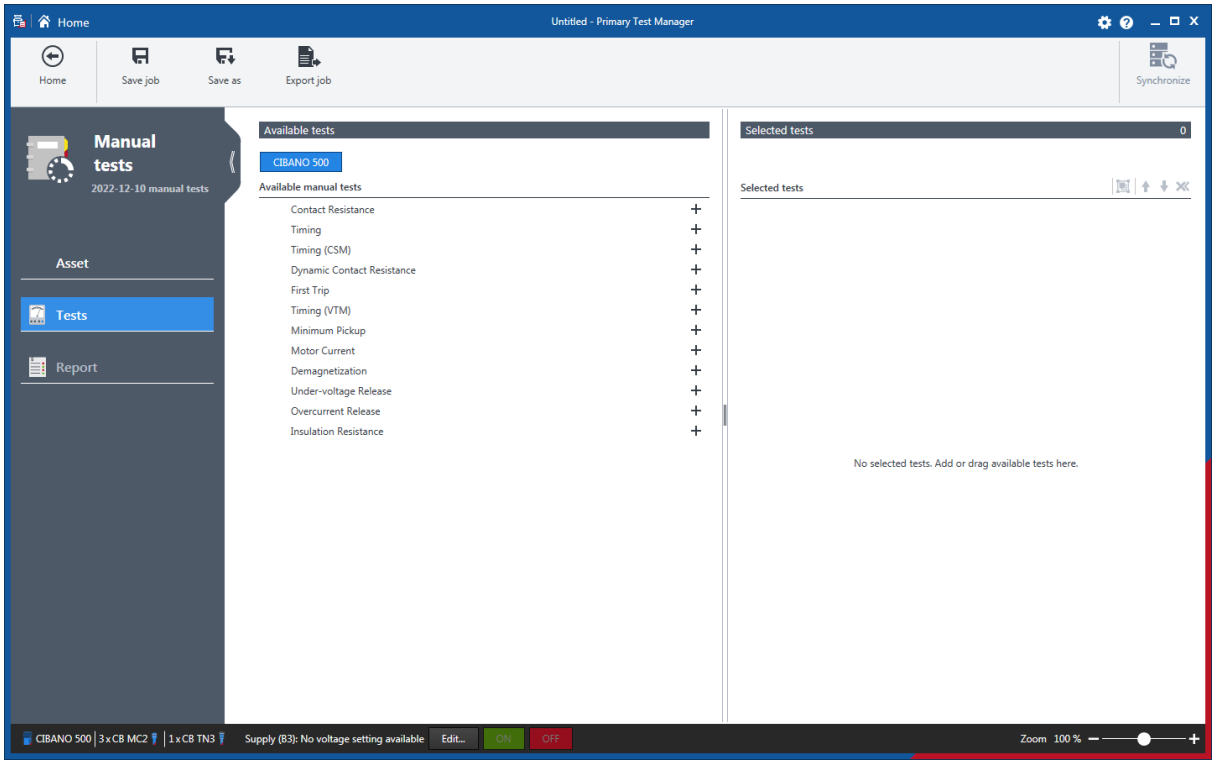


Figure 9-1: Create new manual tests view

The workspace of the new manual job view depends on the selected button in the left pane:

- Initially, the workspace is divided into the **Available tests** area and the **Selected tests** area.
- If you click the **Asset** button, the *Primary Test Manager* displays the general asset data (→ General asset data (page 57)).
- If you click the **Tests** button, the *Primary Test Manager* displays the **Available tests** area and the **Selected tests** area. In this workspace, you can add tests to a job (→ Add tests to a job (page 93)).

If you have added a test to a job and click the **Report** button, the *Primary Test Manager* displays the report view. In the report view, you can configure and generate test reports.

If you click the **Tests** button, the workspace displays the **General** area and the **Tests** area again.

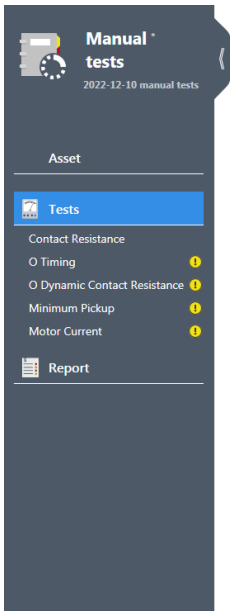


Figure 9-2: Left-pane buttons

You can change the default test names. To rename a test, click the corresponding button in the left pane, and then click the test name.

9.1 Add tests to a job

To add a test to a job, click the test in the **Tests** area. The selected test opens in the workspace and a button with the test name appears in the left pane.

You can open a selected test at any time by clicking the corresponding button in the left pane.

You can change the default test names.

▶ To rename a test, click the corresponding button in the left pane, and then click the test name.

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

- **Hardware configuration**
  Displays the test-specific controls of the test set.
- **Settings and conditions**
  Displays the basic test settings you typically need to configure the tests.
- **Advanced settings**
  Displays the advanced settings for experienced users.
- **Assessment**
  Provides access to setting the assessment limits.
- **Measurements**
  Displays the measurement results.

9.2 Processing tests

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

Table 9-1: Menu bar commands

Command	Action
Home	Closes the current job and leads you to the *Primary Test Manager* home view. Before closing the job, you can save the changes for all tests.
Save job	Saves the current job. When saving for the first time, you must specify the filename and local folder of the job.
Save as	Saves the current job in a newly specified local folder.
Export job	Exports the job displayed in the new manual job view into a Microsoft Excel spreadsheet.
Copy test[1]	Adds another test of the same kind and with the same settings to the test list. Results are not copied.
Delete test[1]	Deletes the currently open test.

[1] Only available if a test is open.

Clicking **Home** in the title bar and **Close** in the menu bar have the same functionality.

10 Open jobs

With the *Primary Test Manager*, you can open existing guided and manual jobs. To open a job:

1. Click the **Open job** button in the home view.
2. In the **Open** dialog box, browse to the file you want to open.

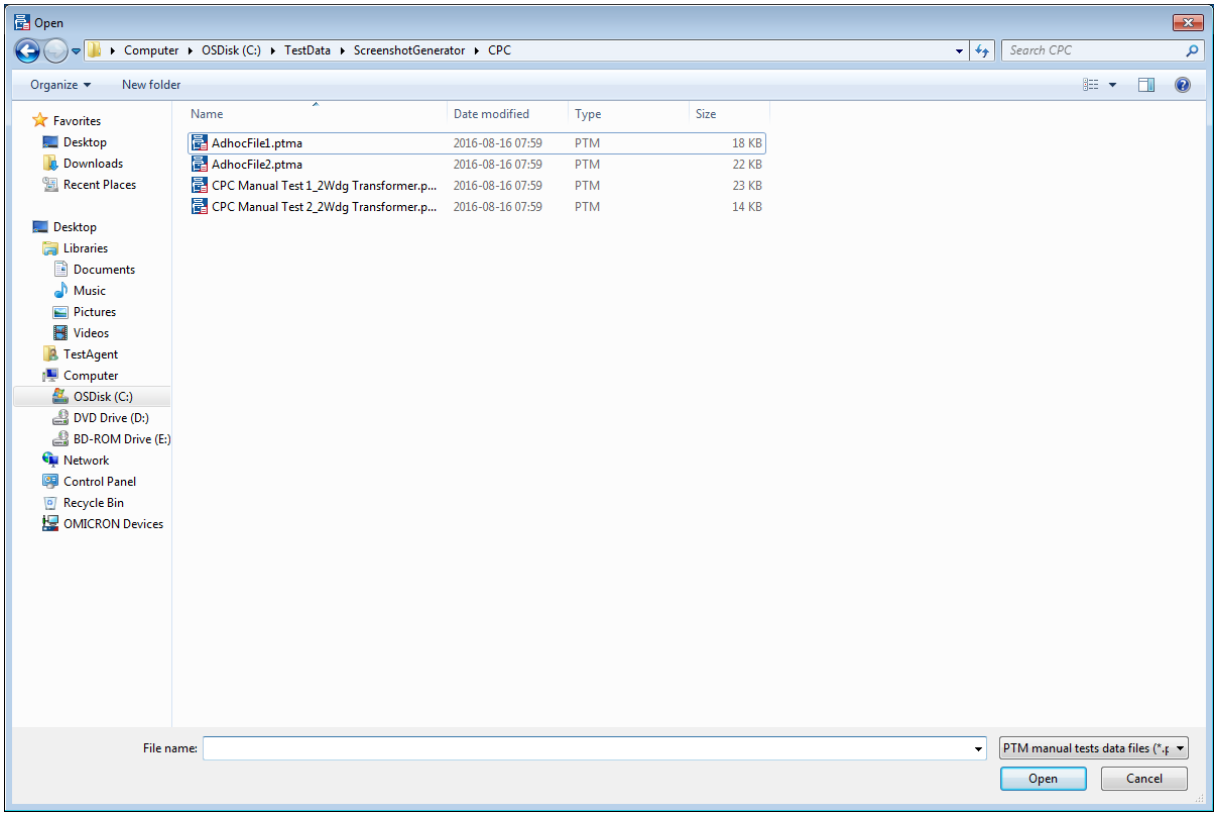


Figure 10-1: Open dialog box

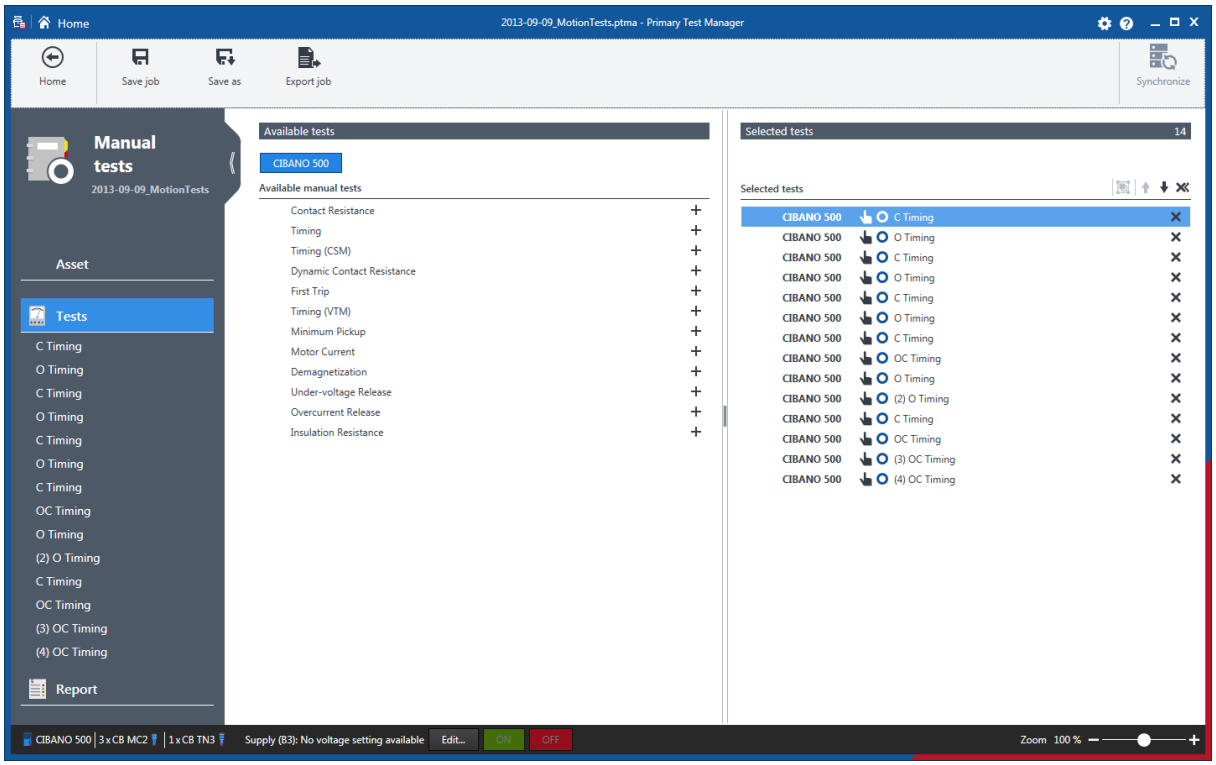


Figure 10-2: Open manual tests view

The open job view displays the tests in the left pane. To view the test results, click the corresponding test button. You can add new tests to the job and process tests as described in New guided jobs (page 47) and New manual jobs (page 92).

11 Control tests

In the **Measurements** area of the *Primary Test Manager*, you can control the test execution. The following table describes the available commands.

Table 11-1: Test control commands

Command	Action
Start	Starts the selected measurement of the currently open test.
Start all	Starts all measurements of the currently open test.
Stop	Stops the running measurement.
Stop all	Stops all running measurements.
Clear all	Deletes all measurement results of the currently open test.
Clear result	Deletes the results of the selected measurement.
Delete measurement	Deletes the selected measurement row.
Add measurement	Adds a new measurement row to the currently open test.

12 Generate test reports

In the report view, you can configure and generate test reports.

▶ To open the report view, click the **Report** button .

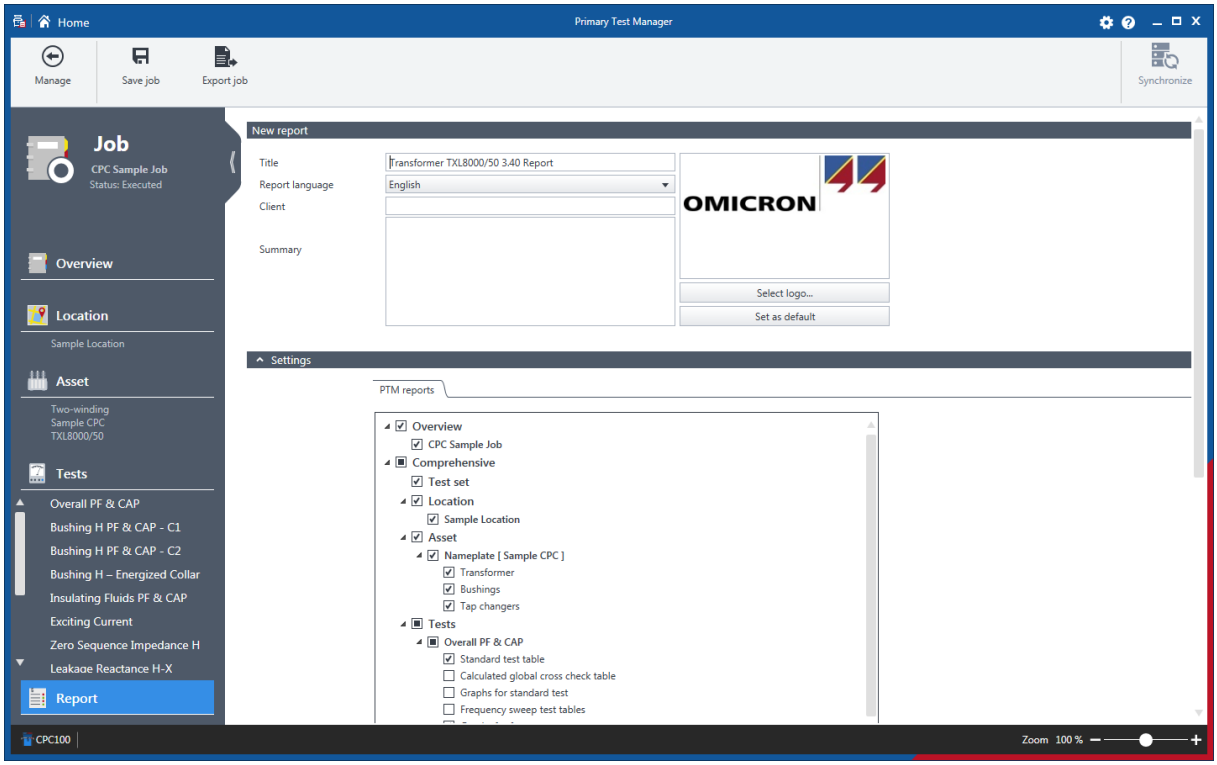


Figure 12-1: Report view

The report view is divided into the **New report** area, the **Settings** area and the **Existing reports** area.

In the **New report** area, you can set the report data. The following table describes the report data.

Table 12-1: Report data

Data	Description
Title	Title of the report. Appears as the report header.
Report language	Language the report is created in
Report ID[1]	Identifier of the report
Client	Customer for which the report is designated
Logo	Logo to appear in the report
Summary	Text field to summarize the content of the test report in own words.

1 Automatically generated by the *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**.

Configuring test reports

In the **Settings** area, you can configure test reports by selecting the respective check boxes. You can generate test reports as Microsoft Word or in PDF format.

▶ To generate a test report in your preferred format, click **Report to Word** or **Report as PDF**.

You can use customized Microsoft Excel templates provided by OMICRON to tailor test reports to your needs. For information about the test report templates, contact your OMICRON local sales representative or distributor.

To open a test report template:

1. In the **Settings** area, click the **Custom reports** tab.
2. Click **Select template**.
3. In the **Select** dialog box, browse to the template you want to use.
4. To set the customized test report template as default, click **Set as default**.

The **Existing reports** area displays the test reports available for the job. In addition to the test reports generated by the *Primary Test Manager*, you can add other reports to jobs. To add a report to a job:

5. In the **Existing reports** area, click **Add report from file**.
6. In the **Add** dialog box, browse to the report you want to add to the job.

13 Asset data

This section describes the asset-specific data.

13.1 Transformer

The following tables describe the transformer data.

Table 13-1: 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 the *Primary Test Manager* as text for documentation

Table 13-2: Ratings

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

[1] Set by the regional conventions (→ Settings (page 28)).

Table 13-3: Impedances

Data	Description
Ref. temp.	Reference temperature
Short-circuit impedances H - X, H - Y, X - Y	
Short-circuit impedance Z (%)[1]	Short-circuit impedance of the transformer
Base power	Base power used for calculating the percent values of impedances
Base voltage	Base voltage used for calculating the percent values of impedances

Data	Description
Load losses Pk	Load loss at the transformer's rated load
OLTC position	Tap position of the OLTC
DETC position	Tap position of the DETC
Zero-sequence impedance	
Base power	Base power used for calculating the percent values of impedances
Base voltage	Base voltage used for calculating the percent values of impedances
Winding	Transformer's winding
Zero-sequence impedance Z0 (%)	Zero-sequence impedance of the transformer

[1] Set by the regional conventions (→ Settings (page 28)).

Table 13-4: Others

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

13.1.1 Bushing

For the data of the transformer's bushings, see Spare bushing (page 103).

13.1.2 Tap changer

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

Table 13-5: 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 de-energized tap changer.

13.1.3 Surge arrester

The following table describes the surge arrester data.

Table 13-6: Surge arrester data

Data	Description
Ratings	
Units in stack	Number of the surge arrester's units
Numerical positions	Select the **Numerical positions** check box to set numerical positions of the surge arrester.
Literal positions	Select the **Literal positions** check box to set alphabetical positions of the surge arrester.
Position	Position of the surge arrester
Serial no.	Serial number of the surge arrester
Voltage L-L Voltage L-N	Values needed to calculate the maximum test voltages
MCOV rating	Maximum continuous operating voltage between the terminals of the surge arrester
Unit catalog no.	Identifier of the surge arrester unit

13.2 Spare bushing

The following table describes the spare bushing data.

Table 13-7: Spare bushing data

Data	Description
Pos.[1]	Terminal of the transformer's winding to which the spare bushing is connected
Ratings	
Rated frequency	Rated frequency of the spare bushing
Insul. level LL (BIL)	L-L basic impulse level rating of the spare bushing
Voltage L-ground	Rated line-to-ground voltage
Max. system voltage	Maximum voltage between phases during normal service
Rated current	Rating current of the spare bushing
Manufacturer info	
Catalog no.	Catalog number of the spare bushing
Drawing no.	Drawing number of the spare bushing
Style no.	Style number of the spare bushing
Nominal values	
PF (C1)/ DF (C1)/ 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

1 Only available for spare bushings mounted on another asset.

2 Set by the regional conventions (→ Settings (page 28)).

13.3 Circuit breaker

The following table describes the circuit breaker data.

Table 13-8: Circuit breaker data

Data	Description
Circuit breaker	
Number of phases	Number of the circuit breaker's phases
Number of interrupters per phase	Number of the circuit breaker's interrupters per phase
Pole operation	Pole operation of the circuit breaker
Pre-insertion resistors (PIR)	Select the **Pre-insertion resistors (PIR)** check box if the circuit breaker contains pre-insertion resistors.
PIR value	Pre-insertion resistor value
Grading capacitors	Select the **Grading capacitors** check box if the circuit breaker contains grading capacitors.
Capacitor value	Grading capacitor value
Interrupting medium	Interrupting medium of the circuit breaker
Tank type	Type of the circuit breaker's tank
Ratings	
Rated frequency	Rated frequency of the circuit breaker
Rated voltage L-L	Rated voltage of the circuit breaker
Rated current	Rated current of the circuit breaker
Rated short-circuit breaking current	Rated short-circuit breaking current of the circuit breaker
Short-circuit nominal duration	Nominal duration of the short-circuiting
Rated insulation level (BIL)	Basic impulse level rating of the circuit breaker
Rated interrupting time	Rated interrupting time of the circuit breaker
Interrupting duty cycle	Interrupting duty cycle of the circuit breaker
Rated power at closing	Rated power of the circuit breaker at closing
Rated power at opening	Rated power of the circuit breaker at opening
Rated power at motor charge	Rated power of the circuit breaker at motor charge
Contact system	
Total travel	Total distance traveled by the contact during operation (excluding possible overshoot)
Damping time	Time in which the damping units are engaged to decelerate the circuit breaker's moving contacts
Nozzle length	Length of the circuit breaker's nozzle
Others	
Total weight with oil/gas	Total weight of the circuit breaker with oil or gas
Weight of oil/gas	Weight of the circuit breaker's oil or gas

Data	Description
Volume of oil/gas	Volume of the circuit breaker’s oil or gas
Rated gas pressure	Rated gas pressure of the circuit breaker at given temperature
Comment	Comment on the circuit breaker
Attachments	Attachments to the circuit breaker

13.3.1 Operating mechanism

The following table describes the data of the circuit breaker’s operating mechanism.

Table 13-9: Operating mechanism data

Data	Description
Number of trip coils	Number of trip coils to operate the circuit breaker
Number of close coils	Number of close coils to operate the circuit breaker
Component	Operating mechanism’s component
Rated voltage	Rated voltage of the operating mechanism’s component
Rated current	Rated current of the operating mechanism’s component
DC	Select the **DC** check box to set the component’s DC operation
AC	Select the **AC** check box to set the component’s AC operation
Frequency	AC operation frequency
Rated operating pressure	Rated operating pressure of the operating mechanism at given temperature
Conversion tables	
Name	Name of the conversion table
Comment	Comment on the conversion table

Conversion tables

To perform motion measurements on a circuit breaker a travel transducer needs to be applied to the mechanical linkage. One goal of the motion measurement method is the assessment of the main contacts within the interrupter unit. However, the interrupter units are not accessible by the motion sensor directly. Therefore, the sensors are applied to the connecting rod or the drive lever on the outside of the interrupter unit. In order to still be able to get the motion path of the main contacts, you can calculate it based on the measurements taken by the motion sensor.

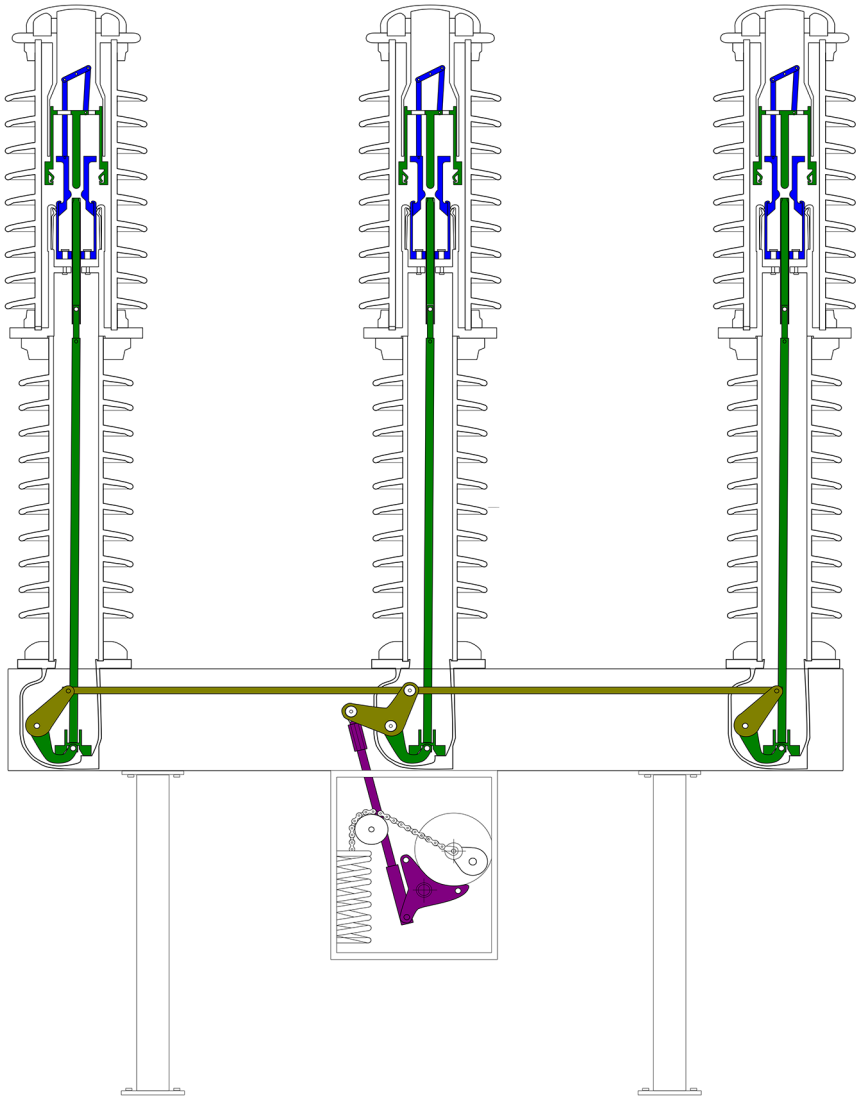


Figure 13-1: Mechanical linkage of a live-tank high-voltage circuit breaker

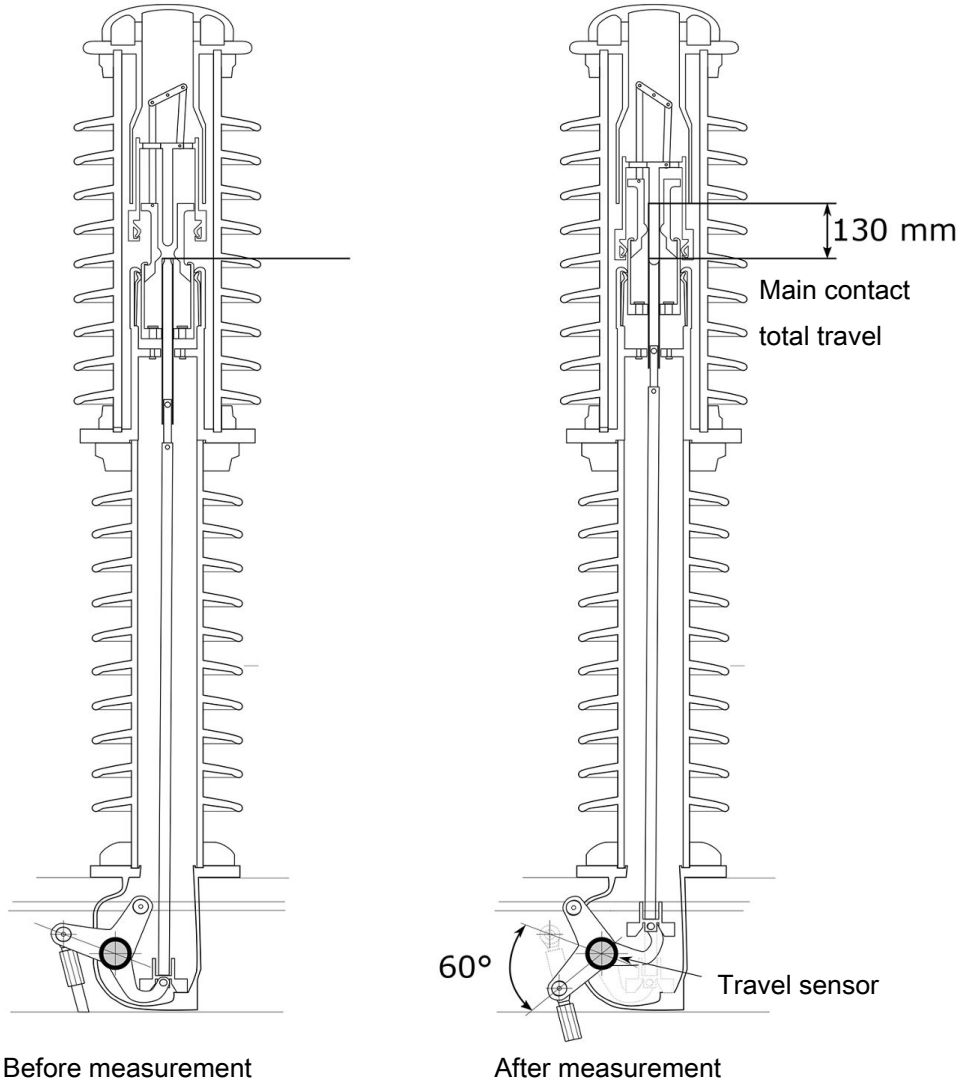


Figure 13-2: 60 degree travel at the travel sensor corresponds to 130 mm travel at the main contacts

For a basic circuit breaker design, a contact factor is accurate enough for calculating the path of the main contacts. Use conversion tables if there are more than one lever within the mechanical linkage between the sensors.

Under **Conversion tables**, you can manage conversion tables for the contact travel calculation when using angular transducers. You can load conversion tables in the native Megger format (.tbl) and as comma-separated value files (.csv).

The imported CSV files must comply with a special format in which the first line is reserved for a comment and the second line specifies the units “degree” and “mm” separated by a semicolon (“;”). All following lines consist of one value pair per line that specifies the transducer movement in degrees and the converted movement in millimeters separated by a semicolon. The following example shows the general CSV format structure.

```
comment; THIS IS AN EXAMPLE COMMENT
degree;mm
-10.00;-9.00
-9.90;-8.91
...
119.80;241.14
119.90;241.04
```

To add a conversion table:

1. Click the **Add** button +.
2. In the Open dialog box, browse to the conversion table you want to add.
3. To delete a conversion table, click the **Remove** button − next to the conversion table.

To rename a conversion table, click the conversion table, and then edit the conversion table name.

13.3.2 Bushing

For the data of the circuit breaker's bushings, see Spare bushing (page 103).

13.3.3 Assessment limits

The following table describes the circuit breaker's absolute assessment limits.

Table 13-10: Absolute assessment limits

Setting	Description
Contact resistance	
R min	Minimum limit of the contact resistance
R max	Maximum limit of the contact resistance
Operating times	
t min	Minimum limit of the operating time
t max	Maximum limit of the operating time
Contact travel[1]	
d min	Minimum assessment limit
d max	Maximum assessment limit
Add velocity zone	Click **Add velocity zone** to define a velocity zone for assessment of the contact travel velocity.
Coil currents	
I min	Minimum limit of the coil current
I max	Maximum limit of the coil current
Pickup voltage	
V min	Minimum limit of the pickup voltage

Setting	Description
V max	Maximum limit of the pickup voltage

[1] Only available if testing with the *CB TN3* modules.

The following table describes the circuit breaker's relative assessment limits.

Table 13-11: Relative assessment limits

Setting	Description
Contact resistance	
R ref	Reference contact resistance
R dev	Allowed deviation from the reference contact resistance
Operating times	
t ref	Reference operating time
–t dev	Allowed negative deviation from the reference operating time
+t dev	Allowed positive deviation from the reference operating time
Contact travel[1]	
d ref	Reference velocity
d dev	Allowed deviation from the reference velocity
Add velocity zone	Click **Add velocity zone** to define a velocity zone for assessment of the contact travel velocity.
Coil currents	
I ref	Reference coil current
–I dev	Allowed negative deviation from the reference coil current
+I dev	Allowed positive deviation from the reference coil current
Pickup voltage	
V ref	Reference pickup voltage
V dev	Allowed deviation from the reference pickup voltage

[1] Only available if testing with the *CB TN3* modules.

13.4 Current transformer

13.4.1 Common Parameters and settings

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

In addition to these common parameters, specific additional parameters are displayed, depending on the selected standard, CT type (protection or metering CT) and class.

Table 13-12: Ratings

Data	Description
Standard	Standard used for testing the current transformer
Rated frequency	Rated frequency of the current transformer
Rated Ipn: Isn[1] Rated Ipr: Isr[2]	Rated primary- to-secondary current ratio of the current transformer
Primary windings	Number of primary windings on the current transformer (for primary reconnection)
IEEE C57.13	
System voltage	System voltage of the current transformer
Rated insulation level (BIL)	Basic impulse level rating of the current transformer
Rating factor (RF)	Continuous thermal current rating factor of the current transformer
IEC 60044/IEC 61869	
Um (r.m.s.)	Highest voltage for equipment
U withstand (r.m.s.)	Rated power-frequency withstand voltage
U lightning (peak)	Rated lightning impulse withstand voltage
Icth	Rated continuous thermal current
Idyn (peak)	Rated dynamic current
Ith (r.m.s.)	Rated short time thermal current
Duration	Duration of rated short time thermal current

1 According to IEC 60444.

2 According to IEC 61869 and IEEE C57.13.

Table 13-13: CT configuration

Data	Description
Cores	Number of the current transformer’s cores
Name	Inter-tap identification
Ipn[1]/Ipr[2]	Inter-tap rated primary current
Isn[1]/Isr[2]	Inter-tap rated secondary current
In use	Tap on which the CT is operated
Ratings	
Application	Application category of the current transformer
Class	Rated accuracy class of the current transformer

Data	Description
Rated burden	Rated burden of the current transformer
Burden	Secondary burden of the current transformer
Operating burden	Burden (VA value) connected to the current transformer
cos φ	Phase angle of the secondary burden

1 According to IEC 60444.

2 According to IEC 61869 and IEEE C57.13.

13.4.2 IEC 60044 protection CTs

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

Table 13-14: Specific parameters and settings displayed for IEC 60044 protection CTs

Param.	Description	Available for IEC 60044 protection CTs, class			Available for IEC 60044, class			
		xP	xPR	PX	TPS	TPX	TPY	TPZ
ALF	Accuracy limiting factor.	x	x					
Winding resistance	Specified secondary winding resistance.		x	x	x	x	x	x
Ts	Specified secondary time constant.		x				x	x
Kx	Dimensioning factor.			x				
Ek	Rated knee point e.m.f.			x				
Ie	Accuracy limiting current			x				
E1	User-defined e.m.f. to verify the excitation current at this specific e.m.f.			x				
Ie1	Maximum allowed excitation current at E_1.			x				
Kssc	Rated symmetrical short-circuit current factor.				x	x	x	x
Tp	Primary time constant.				x	x	x	x
K	Dimensioning factor.				x			
V-al	Rated equivalent excitation limiting secondary voltage.				x			
I-al	Accuracy limiting secondary excitation current.				x			
Ktd	Rated transient dimensioning factor.					x	x	x
Duty	Specified duty cycle.					x	x	

Param.	Description	Available for IEC 60044 protection CTs, class			Available for IEC 60044, class			
		xP	xPR	PX	TPS	TPX	TPY	TPZ
t1	Duration of first current flow. The specified accuracy limit must not be reached within time t_{al1}.					x	x	
t-al1	Permissible time to accuracy limit for first energizing period of the duty cycle.					x	x	
t2	Duration of second current flow. The specified accuracy limit must not be reached within time t_{al2}.					x	x	
t-al2	Permissible time to accuracy limit for second energizing period of the duty cycle.					x	x	
tfr	Dead time between first opening and reclosure.					x	x	

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

Table 13-15: Specific parameters and settings displayed for IEC 60044 metering CTs

Param.	Description	Available for IEC 60044, metering CTs, class 0.1, 0.2, 0.2s, 0.5, 0.5s, 1, 3, 5
FS	Instrument security factor.	x
ext. Ipn	Extended current rating.	x

13.4.3 IEC 61869 protection CTs

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

Table 13-16: Specific parameters and settings displayed for IEC 61869 protection CTs

Param.	Description	Available for IEC 61869protection CTs, class						
		protection				transient protection		
		xP	xPR	PX	PXR	TPX	TPY	TPZ
ALF	Accuracy limiting factor.	x	x					
Winding resistance	Specified secondary winding resistance.		x	x	x	x	x	x
Ts	Specified secondary time constant.		x				x	

Param.	Description	Available for IEC 61869protection CTs, class						
		protection				transient protection		
		xP	xPR	PX	PXR	TPX	TPY	TPZ
Kx	Dimensioning factor.			x	x			
Ek	Rated knee point e.m.f.			x	x			
E1	User-defined e.m.f. to verify the excitation current at this specific e.m.f.			x	x			
Ie	Accuracy limiting current.			x	x			
Ie1	Maximum allowed excitation current at E_1.			x	x			
Kssc	Rated symmetrical short-circuit current factor.					x	x	x
Duty cycle spec.	The accuracy class assessment must be performed for the specific protection requirements the CT is built for. According to the standard, these requirements are normally stated by the duty cycle and the time constants. However, in some cases the choice of one specific duty cycle/time constant cannot describe all protection requirements. Therefore, the *Primary Test Manager* offers the possibility to specify "more general requirements" (which cover the requirements of different duty cycles and time constants) by entering the K_{td} instead.					x	x	x
Ktd	Rated transient dimensioning factor according to the nameplate.[1]					x	x	x
Tp	Primary time constant.[2]					x	x	x
Duty	Specified duty cycle.[2]					x	x	x
t-al1	Permissible time to accuracy limit for first energizing period of the duty cycle.[2]					x	x	x
t1	Duration of first current flow. The specified accuracy limit must not be reached within time t_{al1}.[3]					x	x	x
tfr	Dead time between first opening and reclosure.[3]					x	x	x

Param.	Description	Available for IEC 61869protection CTs, class						
		protection				transient protection		
		xP	xPR	PX	PXR	TPX	TPY	TPZ
t-al2	Permissible time to accuracy limit for second energizing period of the duty cycle.[3]					x	x	x

1 Only displayed if parameter **Duty cycle spec.** is **by Ktd**.

2 Only displayed if parameter **Duty cycle spec.** is **by Duty**.

3 Only displayed if parameter **Duty cycle spec.** is **by Duty** and **Duty** is **CO-CO**.

13.4.4 IEC 61869 metering CTs

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

Table 13-17: Specific parameters and settings displayed for IEC 61869 metering CTs

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

13.4.5 IEEE C57.13 protection CTs

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

Table 13-18: Specific parameters and settings displayed for IEEE C57.13 protection CTs

Param.	Description	Available for IEEE C57.13, class			
		C	T	X	K
Vb	Rated secondary terminal voltage. If the IEEE C57.13 standard is selected with the type **protection CT** (class C, K or T), the VA and Cos φ parameters are not accessible to the user. In this case, the user must enter the terminal voltage V_b instead.	x	x		x
Vk Vk1	User-defined measuring point. User-defined measuring point 1.		x	x	
Ik Ik1	User-defined measuring point. User-defined measuring point 1.		x	x	
RE (20*Isn)	Ratio error at 20 * I_{sn}			x	
Winding resistance	Specified secondary winding resistance.			x	

13.4.6 IEEE C57.13 metering CTs

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

Table 13-19: Specific parameters and settings displayed for IEEE C57.13 metering CTs

Param.	Description	Available for IEEE C57.13 metering CTs, class 0.1, 0.2, 0.2s, 0.5, 0.5s, 1, 3, 5
RF	Continuous current rating factor	x

13.5 Voltage transformer

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

Table 13-20: Ratings

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

Table 13-21: VT configuration

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

13.6 Rotating machine

The following tables describe the rotating machine data.

Table 13-22: Configuration

Data	Description
Star point[1]	Star point connection of the rotating machine during test

1 Only available for three-phase rotating machines.

Table 13-23: Ratings

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

13.7 Grounding system

The following tables describe the grounding system data. For reporting purposes, the location name is automatically inserted into the Serial no. field.

Table 13-24: Grounding system

Data	Description
Maximum grid current	Maximum current to be diverted to ground via the grounding system
Maximum fault duration	Maximum amount of time until the fault is considered as cleared
Unlimited fault duration	Select the check box for an unlimited fault duration. Maximum fault duration will be deactivated.

To document your measurement locations, you can add a Grounding system environment (for ground impedance measurements) and Ground mat plan (for step and touch voltage measurements).

- To add an existing map as an image, click **Select image** .
- To create a snapshot from Bing Maps, click **Show map** .
  Zoom in to the desired area and click **Create snapshot**

14 Rapid Fault Sense (RFS)

Rapid Fault Sense is an output supervisor that can detect output changes and initiate an immediate switch-off of the *CPC 100*.

⚠ WARNING

Death or severe injury caused by high voltage or current possible.

RFS is an addition, not a replacement for current safety measures. Its operability cannot be guaranteed in all situations.

▶ Do not take an increased risk or rely on the unconditional functioning of RFS.

RFS is activated in the following applications for the *Primary Test Manager* (*PTM*) operation:

- Quick
- Any *CP TD* application
- VT Ratio

RFS output supervision is not immediately active. Typical activation times are in the range of a few seconds.

A critical change in the signal form detected by RFS will initiate an immediate switch-off of the utilized *CPC 100* output. If active, RFS can detect a fault in less than 1 ms.

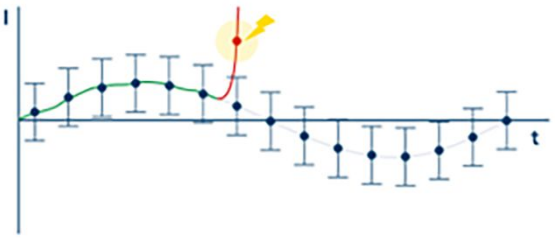


Figure 14-1: Visualization of RFS detecting a fault when the current exceeds the expected threshold

In the event of a switch-off triggered by the Rapid Fault Sense (RFS), the RFS log files will automatically be uploaded to the attachment section of the active test. For further assistance, contact OMICRON Support.

This triggers the following message on the display of the *CPC 100*, allowing the operator to select the following options:

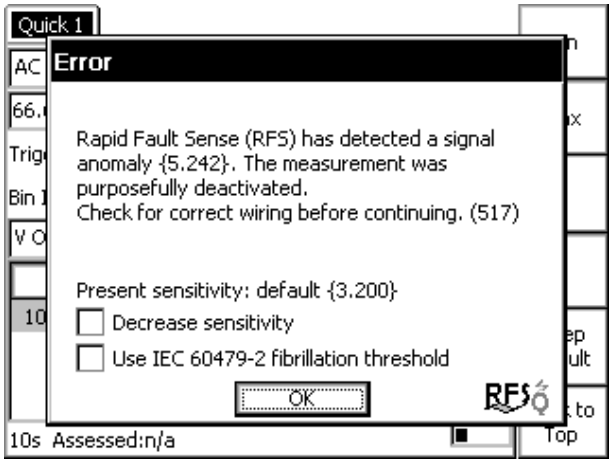


Figure 14-2: RFS activation message generated by the *CPC 100* embedded software

▶ Click **OK.**

➔ The *CPC 100* will continue to operate with the current RFS settings.

▶ Select **Decrease sensitivity**, and then click **OK**.

➔ The threshold of the RFS activation is increased based on the highest measured deviation from the last RFS activation. This leads to a less sensitive behavior of RFS.

The increased RFS threshold is only active as long as necessary. The *CPC 100* automatically sets the threshold back to the default values when the output signal form deviations are in a constantly low range.

▶ Select **Use IEC 60479-2 fibrillation threshold**, and then click **OK**.

➔ The IEC 60489-2 standard gives a general idea of how fast a device must be switched off to lower the risk for human heart fibrillation effectively. The *CPC 100* will only switch off if the threshold for the RFS activation is exceeded or the cumulative charge measured by the *CPC 100* exceeds the charge cumulation threshold.

The option **Use IEC 60479-2 fibrillation threshold** is active until it is deactivated in the RFS message box or on the **Supervision** tab.

When the amplitude or frequency of the test signal has changed, the RFS algorithm requires an initial data acquisition time for calibrating to the new expected deviation range. When the required confidence level is reached, the *CPC 100* will automatically activate the RFS supervision.

14.1 RFS Q – Use IEC 60479-2 fibrillation threshold

RFS Q is an extension of the general Rapid Fault Sense algorithm. When **Use IEC 60479-2 fibrillation threshold** is selected, a lower limit for switch-off decisions is set. Consequently, the *CPC 100* will prevent the RFS switch-off if the determined charge value measured by the *CPC 100* is below 500 µC, being approximately half of the “no fibrillation” threshold stated in the IEC 60489-2 standard.

It is important to note that the actual charge threshold measured by the *CPC 100* will deviate from the charge threshold stated by the IEC 60489-2 standard. According to the IEC 60489-2, the charge threshold is based on the current exposure through the human body. On the contrary, the *CPC 100* always measures the overall current of the measurement setup including the asset under test and the fault current.

Activating the option **Use IEC 60479-2 fibrillation threshold** may induce higher insensitivity to the fault states. Especially, when low testing voltages are used, the measured charge value may not surpass the charge threshold, thus preventing the RFS switch-off.

Activating the option **Use IEC 60479-2 fibrillation threshold** can be helpful when the *CPC 100* is operated with low output signals in very noisy environments.

14.2 Rapid Fault Sense indication

The *CPC* test cards that support Rapid Fault Sense (RFS) display different symbols in the status bar to indicate the current RFS status. The symbols are displayed at the bottom, next to the measurement time indicator. The following table describes the RFS status indicators.

Table 14-1: RFS status indicators

Symbol	Description	Status
^	Circumflex	RFS is active. When Rapid Fault Sense is active, it will switch off the *CPC* instantaneously if statistically significant deviations occur in the stable measurement signal.
ˇ	Caron	RFS is inactive. When Rapid Fault Sense is currently inactive, it will not switch off the *CPC*. The measurement signal might not be stable yet or the output value is too low.
~	Small tilde	Low-signal warning Indicates that the signal is not sufficiently distinguishable. This may occur if the test object is not correctly wired. RFS is still active and will detect attempts to fix the wiring while the output is active.

Symbol	Description	Status
∆	Delta	RFS Q mode is enabled. In the charge-enabled mode (Q stands for charge), RFS will switch off the *CPC* when statistically significant deviations occur in the signal and the ventricular fibrillation charge threshold is about to be exceeded. The delta symbol warns that the contact with a high-voltage lead may still be hurtful. **Note:** This status can only appear in the RFS Q mode, that is, when the ventricular fibrillation charge threshold according to IEC 60479-2 is enabled. Circumflex, caron or small tilde will appear to the right of the delta symbol.
‡	Double dagger	RFS Q warning A statistically significant deviation in the signal was detected in the RFS Q mode, but the fault charge is below the ventricular fibrillation threshold. The *CPC* is not switched off and the test continues to run. **Note:** This status can only appear in the RFS Q mode, that is, when the ventricular fibrillation charge threshold according to IEC 60479-2 is enabled. Circumflex, caron or small tilde will appear to the right of the double dagger symbol.

15 Transformer tests

In this chapter, the settings and measurement data of the transformer tests are described. For more information about testing with the *CPC 100*, see the CPC 100 User Manual shipped with your test system.

In the *Primary Test Manager*, tests for the following transformer types are supported:

- Two-winding transformers (page 122)
- Three-winding transformers (page 165)
- Autotransformers without tertiary winding (page 165)
- Autotransformers with tertiary winding (page 166)
- Voltage regulators (page 167)

Some test names depend on the **Profile** selected in the **Settings** (→ Settings (page 28)). For your convenience, you can use your preferred naming to, for example, match regional conventions:

- ▶ IEEE standard: **Power factor (PF)** for the loss indicator; H/X/Y for the windings
- ▶ IEC standard: **Dissipation factor (DF)** for the loss indicators; Prim/Sec/Tert for the windings,
- ▶ Custom profiles: **Power factor (PF)**, **Dissipation factor (DF)** or **Tangent delta (Tanδ)** for the loss indicator; various naming options for the windings

  ➔ The dissipation factor and the tangent delta are identical characteristics of the primary asset under test.

15.1 Two-winding transformers

The *Primary Test Manager* supports the following tests of two-winding transformers:

Test names may depend on the **Profile** selected in the **Settings**.

- Oil analysis (page 123)
- Overall PF & CAP (page 128)
- Bushing PF & CAP – C1 (page 133)
- Bushing PF & CAP – C2 (page 138)
- Bushing – Energized collar (page 142)
- Exciting Current (page 144)
- Insulating Fluids PF & CAP (page 145)
- Surge Arrester Watt Losses (page 148)
- Leakage Reactance (page 150)
- Zero Sequence Impedance (page 154)
- TTR (page 156)

- DC Winding Resistance (page 158)
- Dynamic OLTC-scan (DRM) (page 161)
- Demagnetization (page 163)

The *Primary Test Manager* also supports the **TanDelta – PF/DF/Tanδ & CAP** manual test. For more information, see Manual Tan Delta (page 237).

15.1.1 Oil analysis

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

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

The following table describes the Oil analysis settings.

Table 15-1: Oil analysis settings

Setting	Description
Asset	
Asset	Asset under test – set in the asset data (→ Transformer (page 100))
Tank type	Type of transformer tank
Insulation medium	Insulation medium of the transformer – set in the asset data (→ Transformer (page 100)) **Note:** The DGA is only valid for the insulation medium **Mineral oil**.
Oil type	Type of transformer oil
Test conditions	
Sample date	Date of sample collection
Oil sample temperature	Oil temperature at the time of sampling
Measurement	
Analyzed by	Information on how the sample was analyzed • **Oil lab**: The sample was analyzed by a laboratory. After selecting **Oil lab**, you can enter the **Name** and **Address** of the laboratory. • **Mobile DGA**: The sample was analyzed using a mobile DGA device. After selecting **Mobile DGA**, you can enter the device **Manufacturer/Type** and its **Serial** number. • **Online DGA**: The sample was analyzed using a permanently installed monitoring device. After selecting **Online DGA**, you can enter the device **Manufacturer/Type** and its **Serial** number.
Use C3 hydrocarbons	Select the **Use C3 hydrocarbons** check box to add C_3H_6 and C_3H_8 to the list of **Gas in oil values**, and to activate ratio assessment according to the MSS scheme.

Setting	Description
Sampling point	Sampling point on the transformer tank: • Top • Middle • Bottom

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

Table 15-2: Gas-in-oil values

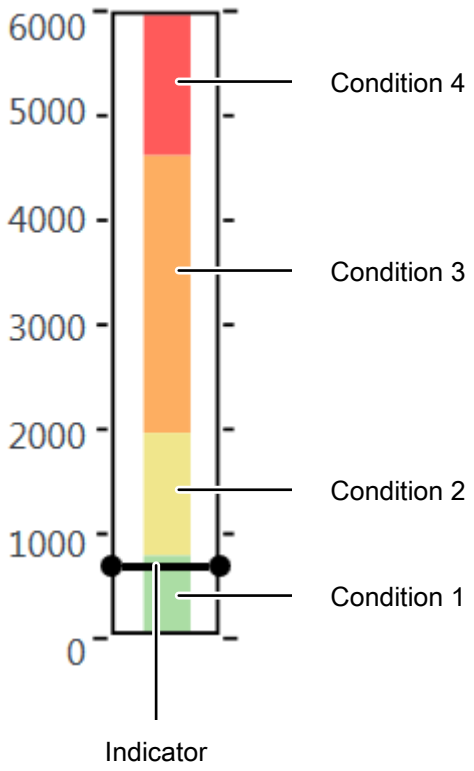
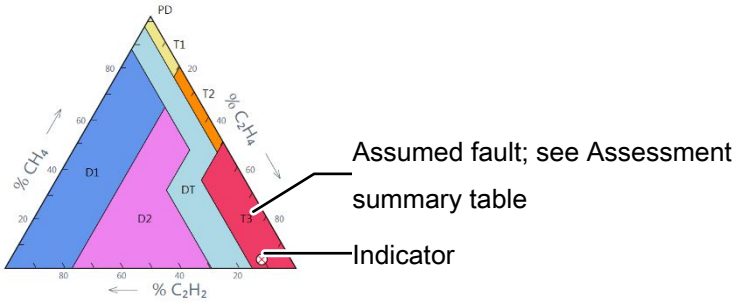
Data	Description
TDCG	Total dissolved combustible gas
TDG	Total dissolved gas
TCGe	Estimation of the percentage of total combustible gas in the gas space. It will only correspond to the actually measured value if there is a balance between the gas blanket and the oil.
Lab. result	Assessment result of the laboratory according to the IEEE or IEC standard.
Assessment	Manual Gas-in-oil analysis assessment: • Manual pass • Manual fail • Manual investigate • Not assessed

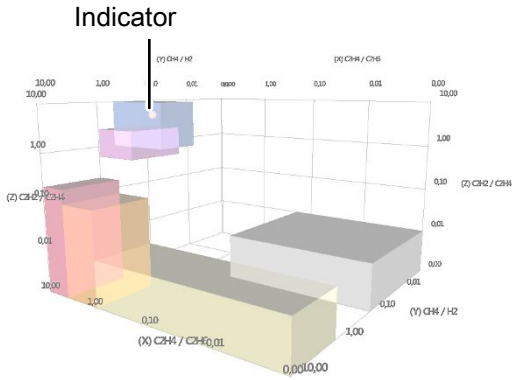
Assessment summary

The results are assessed using the following interpretation methods:

- Duval's triangles (→ Oil analysis (page 125))
- IEC basic gas ratios
- Roger's ratios
- Doernenburg's ratios
- Key gases according to IEEE C57.104 and IEC 60599:2022 (→ Oil analysis (page 125))
- MSS scheme

Table 15-3: Examples of result visualization in the Assessment Summary section

Key gas ranges and conditions according to IEEE C57.104	
Duval's triangle 1	

Key gas ranges and conditions according to IEC 60599:2022, visualized in 3D	

Assessment details

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

Table 15-4: Assessment details

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

Duval triangle

Duval's triangles visualize faults in a triangular coordinate system (→ Oil analysis (page 125)).

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

Pattern

The key gas results are visually compared to 4 reference patterns. If a reference graph matches the measured value, it is highlighted.

Physico-chemical oil analysis

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

Table 15-5: Physico-chemical oil analysis data

Data	Description
Water content	
H_2O meas.	Measured water content in oil
H_2O @ 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[1]	
Standard	Standard underlying the power factor analysis
Meas. value @ 25 °C	Power factor/dissipation factor/Tanδ measured at 25 °C
Meas. value @ 100 °C	Power factor/dissipation factor/Tanδ measured at 100 °C
Assessment	**Power factor assessment**
Dielectric breakdown voltage	
Standard	Standard underlying the dielectric breakdown voltage analysis
Meas. value	Measured dielectric breakdown voltage
Test temperature	Oil temperature during dielectric breakdown voltage test
Assessment	**Dielectric breakdown voltage assessment**
Chemical	
Interfacial tension	Interfacial tension of the oil
Neutralization value	Neutralization value of the oil
Particle count	Particle count of the oil
Color	Color of the oil
Assessment	**Chemical assessment**

[1] Term depends on the **Profile** selected in the **Settings**.

The following table describes the test status that can be set in the **Oil Analysis**:

Table 15-6: Test status

Status	Description
Partially executed	At least one measurement of the test has been executed.
Executed	All measurements of the test have been executed.

The test status set in the **Oil Analysis** test is displayed in the Job overview (page 50) under **Tests**. If you do not set the test status to **Partially executed** or **Executed** in the **Oil Analysis** test, the test status **Not executed** is displayed in the job overview.

15.1.2 Overall PF & CAP

⚠ DANGER

Death or severe injury caused by high voltage or current

- ▶ Never use the *CP TD* without a solid connection to ground with at least 6 mm².
- ▶ Use a ground point as close as possible to the test object.
- ▶ Make sure to position the test object in the danger zone.

⚠ DANGER

Death or severe injury caused by high voltage or current

The high-voltage cable is double shielded and therefore safe. However, the last 50 cm (20 in) of this cable have no shield.

- ▶ Avoid any direct contact of this part of the cable to ground potential and any objects.
- ▶ During a test, consider this part of the cable a live wire and life threatening.

Note: This test name depends on the **Profile** selected in the **Settings**.

- IEEE standard: **Overall PF & CAP**
- IEC standard: **Winding DF & CAP**
- Custom Profile: for example **Overall Tanδ & CAP** or **Winding Tanδ & CAP**

In this section, the terms **Power factor (PF)** and **Overall PF & CAP** will be used.

The following table describes the Overall PF & CAP test settings.

Table 15-7: Overall PF & CAP test settings

Setting	Description
Measurement settings	
Test frequency	▶ Set the output frequency for the test.
Sweep settings	
Frequency sweep	Sweep profile: • **None**: no frequency sweep • **OMICRON expertise**: sweep frequencies dynamically distributed within the device frequency range for optimum results (recommended*) • **CPC template**: sweep frequencies specified by the *CPC 100* test templates
Voltage sweep (tip-up)	Sweep profile: • **None**: no voltage sweep • **OMICRON expertise**: sweep voltages dynamically distributed within the asset-dependent voltage range for optimum results

Setting	Description
Sweep profiles	▶ Click the pen button to create a frequency or voltage sweep profile ▶ Add up to 30 measurement points with individual output voltages or frequencies. Double-click a value to change it. ▶ Mark a favorite ★ to use it as the default sweep profile for future tests **Note:** The predefined profiles **None, OMICRON expertise** and **CPC template** cannot be edited or deleted. The default sweep profiles for this test are: Frequency sweep: OMICRON expertise Voltage sweep: None
Noise suppression settings	
Averaging (no. points)	Number of averaged measurements
Bandwidth	*CP TD* filter bandwidth
Avoid test frequency	If this setting is active, the measurement will not be performed at the **Test frequency** set in the **Measurement** section. *Primary Test Manager* will instead measure two values at frequencies below and above the entered **Test frequency** and calculate the median of those two values. The **Avoid test frequency** setting is predefined for the selected test. ▶ Only change the default setting for special applications.
Device settings	
Tan delta device	▶ Select your *CP TD* device: • **CP TD1** • **CP TD12** • **CP TD15**
Enable shield check	▶ Select the check box if you want the device to check if the high-voltage cable shield is connected.
Use beeper	▶ Select the check box if you want to use the *CP TD* beeper during the measurement.
Open loop check (*TESTRANO 600*)	▶ Select the check box to activate the **Open loop check** option. ▶ Clear the check box to disable the **Open loop check** option. **Note:** When testing samples with a very low capacitance (< 100 pF), the system may detect an open loop. After the setup has been confirmed to be correct, you can disable the open loop check in order to measure small capacitance values.
Test conditions	
Custom test conditions	▶ Select the check box to set test conditions differing from the global test conditions.
Top oil temperature	Oil temperature at the top of the transformer's tank
Bottom oil temperature	Oil temperature at the bottom of the transformer's tank
Average oil temperature	Calculated average oil temperature of the transformer's tank

Setting	Description
Winding temperature	Temperature of the transformer's winding
Ambient temperature	Ambient temperature on site
Humidity	Relative ambient humidity
Weather	Weather during the test
Correction factors	
Temperature correction	▶ Select the check box to activate temperature correction.
Correction temp.	▶ In the **Custom** list, click the correction temperature, or type the correction temperature beneath.
Correction factor	▶ Click the **Calculate** button to calculate the correction factor automatically or enter the correction factor beneath.
Use reference voltage	▶ Select the check box to extrapolate the I out and Watt losses results for the specified reference voltage.
Reference voltage	Reference voltage for extrapolation of measurement results **Note:** The Reference voltage can be set up to 15 kV regardless of which *CP TD* device is used.
Bushing compensation	▶ Select the check box to activate bushings compensation. **Note:** Bushing compensation compensates the effect of the capacitance C1 of the transformer's bushings on the measurement results of the test.

NOTICE

Equipment damage or loss of data possible

Before making a decision based on the *Primary Test Manager*'s automatic assessment, read the disclaimer.

The *Primary Test Manager* supports automatic assessment for the following insulation media if you activate the temperature correction by selecting the **Temperature correction** check box:

- Natural ester
- Mineral oil
- Silicone

The following table describes the automatic assessment parameters of the Overall PF & CAP test.

Table 15-8: Overall PF & CAP automatic assessment parameters

Parameter	Description
Limit schema	Limit schema underlying the assessment
Global assessment criteria	
Min. Iout @10 kV	Threshold value of the automatic assessment. If Iout < Min. Iout @10 kV, the automatic assessment status is **Investigate**.

To save the selected limit schema as the default setting for all future jobs, click **Set as default**.

Under **Visible limits**:

▶ Click **only limits that are used for this measurement** to only display limits for the selected transformer's insulation type.

▶ Click **all limits** to display limits for all supported transformer's insulation types.

The following tables describe the automatic assessment limits of the Overall PF & CAP test.

Table 15-9: Overall PF & CAP automatic assessment limits based on Power factor

Assessment against	Limit	Power factor[1]
Absolute limits for measurements	Low limit (fail)[2] Low limit (warn.)[2] High limit (warn.) @<230 kV[2,3] High limit (warn.) @>=230 kV[2,3] High limit (fail)[2]	Limits for the measured power factor

1 Term depends on the **Profile** selected in the **Settings**.

2 Set to the absolute limits.

3 According to the IEEE guidelines for oil isolated transformers, the warning limit depends on the rated voltage (LL) of the primary winding. If the rated voltage (LL) of the primary winding is less than 230 kV, the first limit value is used for the high limit (warn.) otherwise the second one is used. For an automatic assessment based on the IEEE guidelines for another insulation or based on the IEC standards, the same values for high limit (warn.) @<230 kV and high limit (warn.) @>=230 kV are set.

If you selected the **Use reference voltage** check box, the *Primary Test Manager* performs an additional cross check using the following limits:

Table 15-10: Overall PF & CAP cross check limits based on Power Factor

Assessment against	Limit	Power factor[1]
Absolute limits for cross check	Multiplier (high warn. Limit)[2, 3] Multiplier (high fail limit) [2, 3] Divider (low fail limit) [2, 3]	Limits for the measured power factor

1 Term depends on the **Profile** selected in the **Settings**.

2 The high warn., high fail and low fail limits are calculated from the cross check corrected values by using the respective multiplier and divider and then compared to the corrected measured values. The low fail limit is set to 0.

3 The cross-check assessment of the power factor if the reference correction voltage is set to 10 kV. Otherwise, the cross assessment is based only on the capacitance.

Table 15-11: Overall PF & CAP cross check limits based on capacitance

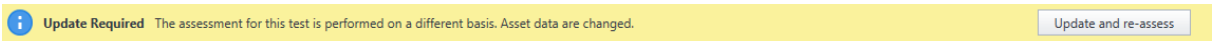
Assessment against	Limit	Capacitance
Relative limits for cross check	Low limit (warn)/ High limit (warn) Low limit (fail)/ High limit (fail)	Limits for the measured capacitance

You can assess the test:

- During measurement
  To assess the test while the measurements are running, select the **Assess during measurements** check box.
- Manually after all measurements have been finished
  To assess the test manually, click **Assess measurements**.

After a measurement has been assessed, the test settings and the assessment parameters are locked.

If you change nameplate data relevant for the assessment after a measurement has been assessed and you reopen the test the following message appears:



To update the assessment, click **Update and re-assess**.

To change the test data, the test settings or the assessment parameters, click **Clear all assessments**.

You can overwrite the *Primary Test Manager*'s automatic assessment manually. To do so, click the arrow next to the automatic assessment, and then select a manual assessment from the list.

The automatic assessment is stored in the Assessment box for documentation purposes.

The following table describes the Overall PF & CAP measurement data.

Table 15-12: Overall PF & CAP measurement data

Data	Description
No.	Number of the measurement
Measurement	Arrangement of the measurement
Test mode	Test mode according to the IEEE Std 62-1995
Sweep	Swept variable: frequency, voltage, or none
V test	Test voltage
Freq.	Test frequency
V out	Measured output voltage
I out	Measured output current
Watt losses	Measured losses
PF meas.[1]	Measured power factor
PF corr.[1]	Corrected measured power factor
Cap. meas.	Measured capacitance
Assessment	Measurement assessment

[1] Term depends on the **Profile** selected in the **Settings**.

15.1.3 Bushing PF & CAP – C1

⚠ DANGER

Death or severe injury caused by high voltage or current

- ▶ Never use the *CP TD* without a solid connection to ground with at least 6 mm².
- ▶ Use a ground point as close as possible to the test object.
- ▶ Make sure to position the test object in the danger zone.

⚠ DANGER

Death or severe injury caused by high voltage or current

The high-voltage cable is double shielded and therefore safe. However, the last 50 cm (20 in) of this cable have no shield.

- ▶ Avoid any direct contact of this part of the cable to ground potential and any objects.
- ▶ During a test, consider this part of the cable a live wire and life threatening.

Note: This test name depends on the **Profile** selected in the **Settings**.

The following table describes the Bushing PF & CAP – C1 test settings.

Table 15-13: Bushing PF & CAP – C1 test settings

Setting	Description
Measurement settings	
Test frequency	▶ Set the output frequency for the test.
Sweep settings	
Frequency sweep	Sweep profile: • **None**: no frequency sweep • **OMICRON expertise**: sweep frequencies dynamically distributed within the device frequency range for optimum results (recommended*) • **CPC template**: sweep frequencies specified by the *CPC 100* test templates
Voltage sweep (tip-up)	Sweep profile: • **None**: no voltage sweep • **OMICRON expertise**: sweep voltages dynamically distributed within the asset-dependent voltage range for optimum results

Setting	Description
Sweep profiles	▶ Click the pen button to create a frequency or voltage sweep profile ▶ Add up to 30 measurement points with individual output voltages or frequencies. Double-click a value to change it. ▶ Mark a favorite to use it as the default sweep profile for future tests **Note:** The predefined profiles **None, OMICRON expertise** and **CPC template** cannot be edited or deleted. The default sweep profiles for this test are: Frequency sweep: OMICRON expertise Voltage sweep: None
Noise suppression settings	
Averaging (no. points)	Number of averaged measurements
Bandwidth	*CP TD* filter bandwidth
Avoid test frequency	If this setting is active, the measurement will not be performed at the **Test frequency** set in the **Measurement** section. The *Primary Test Manager* will instead measure 2 values at frequencies below and above the entered **Test frequency** and calculate the median of those two values. The **Avoid test frequency** setting is predefined for the selected test. ▶ Only change the default setting for special applications.
Device settings	
Tan delta device	▶ Select your *CP TD* device: • **CP TD1** • **CP TD12** • **CP TD15**
Enable shield check	▶ Select the check box if you want the device to check if the high-voltage cable shield is connected.
Use beeper	▶ Select the check box if you want to use the *CP TD* beeper during the measurement.
Open loop check (*TESTRANO 600*)	▶ Select the check box to activate the **Open loop check** option. ▶ Clear the check box to disable the **Open loop check** option. **Note:** When testing samples with a very low capacitance (< 100 pF), the system may detect an open loop. After the setup has been confirmed to be correct, you can disable the open loop check in order to measure small capacitance values.
Test conditions	
Custom test conditions	▶ Select the check box to set test conditions differing from the global test conditions.
Top oil temperature	Oil temperature at the top of the transformer's tank
Ambient temperature	Ambient temperature on site

Setting	Description
Humidity	Relative ambient humidity
Weather	Weather during the test
Correction factors	
Temperature correction	▶ Select the check box to activate temperature correction.
Correction temp.	▶ In the **Custom** list, click the correction temperature, or enter the correction temperature beneath.
Use reference voltage	▶ Select the check box to extrapolate the I out and Watt losses results for the specified reference voltage.
Reference voltage	Reference voltage for extrapolation of measurement results **Note:** The Reference voltage can be set up to 15 kV regardless of which *CP TD* device is used.

NOTICE

Equipment damage or loss of data possible

Before making a decision based on the *Primary Test Manager*'s automatic assessment, read the disclaimer.

The *Primary Test Manager* supports automatic assessment for the following bushing's insulation types:

- Oil-impregnated paper
- Resin-bonded paper
- Resin-impregnated paper

The assessment can be done only if all bushings have the same insulation type.

The following table describes the automatic assessment parameters of the Bushing PF & CAP test.

Table 15-14: Bushing PF & CAP automatic assessment parameters

Parameter	Description
Limit schema	Limit schema underlying the assessment
Global assessment criteria	
Min. Iout @10 kV	Threshold value of the automatic assessment. If Iout < Min. Iout @10 kV, the automatic assessment status is **Investigate**.

To save the selected limit schema as the default setting for all future jobs, click **Set as default**.

Under **Visible limits**:

▶ Click **only limits that are used for this measurement** to display only limits for the selected bushing's insulation type and the PF (C1) nameplate values (if entered) or the absolute limits.

▶ Click **all limits** to display limits for all supported bushing insulation types and the PF (C1) nameplate values (if entered) or the absolute limits.

The following tables describe the automatic assessment limits of the Bushing PF & CAP – C1 test.

Table 15-15: Bushing PF & CAP – C1 automatic assessment limits based on Power Factor

Assessment against	Limit	Power factor[1]
Nameplate values	Multiplier (high fail limit)[2] / Divider (low warn. limit)[2] Multiplier (high warn. limit)[2]	Limits based on the PF (C1) nominal values
Absolute limits	Low limit (fail)[3] Low limit (warn.)[3] High limit (warn.)[3] High limit (fail)[3]	Limits based on the PF (C1) absolute limits

1 Term depends on the **Profile** selected in the **Settings**.

2 The high warn., high fail and low fail limits are calculated from the cross check corrected values by using the respective multiplier and divider and then compared to the corrected measured values. The low fail limit is set to 0.

3 Set to the absolute limits.

Table 15-16: Bushing PF & CAP – C1 automatic assessment limits based on capacitance

Assessment against	Limit	Capacitance
Nameplate values	Low limit (fail)[1]/ High limit (fail)[1] Low limit (warn)[1]/ High limit (warn)[1]	Limits based on the Cap. (C1) nominal value

1 Set to the absolute limits.

The following table shows the *Primary Test Manager* assessment logic.

Table 15-17: Assessment logic

PF (C1)[1] nominal value	Cap. (C1) nominal value	Assessment
Available	Available	Overall assessment
Available	Not available	Assessment based only on PF (C1) nominal values
Not available	Available	Overall assessment
Not available	Not available	Assessment based only on PF (C1) absolute limits

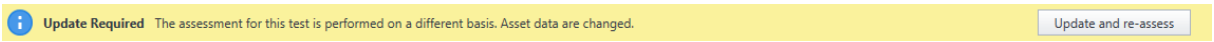
1 Term depends on the **Profile** selected in the **Settings**.

You can assess the test:

- During measurement
  To assess the test while the measurements are running, select the **Assess during measurements** check box.
- Manually after all measurements have been finished
  To assess the test manually, click **Assess measurements**.

After a measurement has been assessed, the test settings and the assessment parameters are locked.

If you change nameplate data relevant for the assessment after a measurement has been assessed and you reopen the test the following message appears:



To update the assessment, click **Update and re-assess**.

To change the test data, the test settings or the assessment parameters, click **Clear all assessments**.

You can overwrite the *Primary Test Manager* automatic assessment manually. To do so, click the arrow next to the automatic assessment, and then select a manual assessment from the list.

The automatic assessment is stored in the Assessment box for documentation purposes.

The following table describes the Bushing PF & CAP – C1 measurement data.

Table 15-18: Bushing PF & CAP – C1 measurement data

Data	Description
No.	Number of the measurement
Measurement	Terminal name of the bushing under test
Test mode	Test mode according to the IEEE Std 62-1995
Sweep	Swept variable: frequency, voltage, or none
V test	Test voltage
Freq.	Test frequency
V out	Measured output voltage
I out	Measured output current
Watt losses	Measured losses
PF meas.	Measured power factor
PF corr.	Corrected measured power factor
PF ref.	Reference power factor
Cap. meas.	Measured capacitance
Cap. ref.	Reference capacitance
Assessment	Measurement assessment

15.1.4 Bushing PF & CAP – C2

⚠ DANGER

Death or severe injury caused by high voltage or current

- ▶ Never use the *CP TD* without a solid connection to ground with at least 6 mm².
- ▶ Use a ground point as close as possible to the test object.
- ▶ Make sure to position the test object in the danger zone.

⚠ DANGER

Death or severe injury caused by high voltage or current

The high-voltage cable is double shielded and therefore safe. However, the last 50 cm (20 in) of this cable have no shield.

- ▶ Avoid any direct contact of this part of the cable to ground potential and any objects.
- ▶ During a test, consider this part of the cable a live wire and life threatening.

Note: This test name depends on the **Profile** selected in the **Settings**.

The following table describes the Bushing PF & CAP – C2 test settings.

Table 15-19: Bushing PF & CAP – C2 test settings

Setting	Description
Measurement settings	
Test frequency	▶ Set the output frequency for the test.
Noise suppression settings	
Averaging (no. points)	Number of averaged measurements
Bandwidth	*CP TD* filter bandwidth
Avoid test frequency	If this setting is active, the measurement will not be performed at the **Test frequency** set in the **Measurement** section. The *Primary Test Manager* will instead measure two values at frequencies below and above the entered **Test frequency** and calculate the median of those two values. The **Avoid test frequency** setting is predefined for the selected test. ▶ Only change the default setting for special applications.
Device settings	
Tan delta device	▶ Select your *CP TD* device: • **CP TD1** • **CP TD12** • **CP TD15**
Enable shield check	▶ Select the check box if you want the device to check if the high-voltage cable shield is connected.

Setting	Description
Use beeper	▶ Select the check box if you want to use the *CP TD* beeper during the measurement.
Open loop check (*TESTRANO 600*)	▶ Select the check box to activate the **Open loop check** option. ▶ Clear the check box to disable the **Open loop check** option. **Note:** When testing samples with a very low capacitance (< 100 pF), the system may detect an open loop. After the setup has been confirmed to be correct, the user may choose to disable the open loop check to measure small capacitance values.
Test conditions	
Custom test conditions	▶ Select the check box to set test conditions differing from the global test conditions.
Top oil temperature	Oil temperature at the top of the transformer's tank
Ambient temperature	Ambient temperature on site
Humidity	Relative ambient humidity
Weather	Weather during the test
Correction factors	
Temperature correction	▶ Select the check box to activate temperature correction.
Correction factor	Temperature correction factor
Use reference voltage	▶ Select the check box to extrapolate the I out and Watt losses results for the specified reference voltage.
Reference voltage	Reference voltage for extrapolation of measurement results **Note:** The Reference voltage can be set up to 15 kV regardless of which *CP TD* device is used.

NOTICE

Equipment damage or loss of data possible

Before making a decision based on the *Primary Test Manager*'s automatic assessment, read the disclaimer.

The *Primary Test Manager* supports automatic assessment for the following bushing's insulation types:

- Oil-impregnated paper
- Resin-bonded paper
- Resin-impregnated paper

The assessment can be done only if all bushings have the same insulation type.

The following table describes the automatic assessment parameters of the Bushing PF & CAP test.

Table 15-20: Bushing PF & CAP automatic assessment parameters

Parameter	Description
Limit schema	Limit schema underlying the assessment
Global assessment criteria	
Min. Iout @10 kV	Threshold value of the automatic assessment. If Iout < Min. Iout @10 kV, the automatic assessment status is **Investigate**.

To save the selected limit schema as the default setting for all future jobs, click **Set as default**.

Under **Visible limits**:

- Click **only limits that are used for this measurement** to display only limits for the selected bushing's insulation type and the PF (C2) nameplate values (if entered) or the absolute limits.
- Click **all limits** to display limits for all supported bushing insulation types and the PF (C2) nameplate values (if entered) or the absolute limits.

The following tables describe the automatic assessment limits of the Bushing PF & CAP – C2 test.

Table 15-21: Bushing PF & CAP – C2 automatic assessment limits based on Power Factor

Assessment against	Limit	Power factor[1]
Nameplate values	Multiplier (high fail limit)[2]/ Divider (low warn. limit)[2] Multiplier (high warn. limit)[2]	Limits based on the PF (C2) nominal values
Absolute limits	Low limit (fail)[3] Low limit (warn.)[3] High limit (warn.)[3] High limit (fail)[3]	Limits based on the PF (C2) absolute limits

1 Term depends on the **Profile** selected in the **Settings**.

2 The high warn., high fail and low fail limits are calculated from the cross check corrected values by using the respective multiplier and divider and then compared to the corrected measured values. The low fail limit is set to 0.

3 Set to the absolute limits.

Table 15-22: Bushing PF & CAP – C2 automatic assessment limits based on capacitance

Assessment against	Limit	Capacitance
Nameplate values	Low limit (fail)[1]/ High limit (fail)[1] Low limit (warn)[1]/ High limit (warn)[1]	Limits based on the Cap. (C2) nominal value

1 Set to the absolute limits.

The following table shows the *Primary Test Manager*'s assessment logic.

Table 15-23: Assessment logic

PF (C2)[1] nominal value	Cap. (C2) nominal value	Assessment
Available	Available	Overall assessment
Available	Not available	Assessment based only on PF (C2) nominal values
Not available	Available	Overall assessment
Not available	Not available	Assessment based only on PF (C2) absolute limits

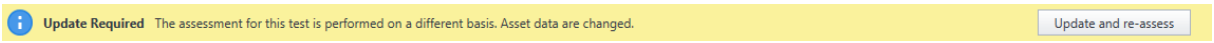
[1] Term depends on the **Profile** selected in the **Settings**.

You can assess the test:

- During measurement
  To assess the test while the measurements are running, select the **Assess during measurements** check box.
- Manually after all measurements have been finished
  To assess the test manually, click **Assess measurements**.

After a measurement has been assessed, the test settings and the assessment parameters are locked.

If you change nameplate data relevant for the assessment after a measurement has been assessed and you reopen the test the following message appears:



To update the assessment, click **Update and re-assess**.

To change the test data, the test settings or the assessment parameters, click **Clear all assessments**.

You can overwrite the *Primary Test Manager* automatic assessment manually. To do so, click the arrow next to the automatic assessment, and then select a manual assessment from the list.

The automatic assessment is stored in the **Assessment** box for documentation purposes.

The following table describes the Bushing PF & CAP – C2 measurement data.

Table 15-24: Bushing PF & CAP – C2 measurement data

Data	Description
No.	Number of the measurement
Measurement	Terminal name of the bushing under test
Test mode	Test mode according to the IEEE Std 62-1995
V test	Test voltage
Freq.	Test frequency
V out	Measured output voltage
I out	Measured output current
Watt losses	Measured losses
PF meas.	Measured power factor
PF corr.	Temperature corrected power factor
PF ref.	Reference power factor

Data	Description
Cap. meas.	Measured capacitance
Cap. ref.	Reference capacitance
Assessment	Measurement assessment

15.1.5 Bushing – Energized collar

⚠ DANGER

Death or severe injury caused by high voltage or current

- ▶ Never use the *CP TD* without a solid connection to ground with at least 6 mm².
- ▶ Use a ground point as close as possible to the test object.
- ▶ Make sure to position the test object in the danger zone.

⚠ DANGER

Death or severe injury caused by high voltage or current

The high-voltage cable is double shielded and therefore safe. However, the last 50 cm (20 in) of this cable have no shield.

- ▶ Avoid any direct contact of this part of the cable to ground potential and any objects.
- ▶ During a test, consider this part of the cable a live wire and life threatening.

Note: This test name depends on the **Profile** selected in the **Settings**.

- IEEE standard: **Bushing H/X – Energized Collar**
- IEC standard: **Bushing Prim/Sec – Energized Collar**

In this section, the term **Bushing – Energized Collar** will be used.

The following table describes the Bushing – Energized Collar test settings.

Table 15-25: Bushing – Energized Collar test settings

Setting	Description
Measurement settings	
Test frequency	▶ Set the output frequency for the test.
Noise suppression settings	
Averaging (no. points)	Number of averaged measurements
Bandwidth	*CP TD* filter bandwidth
Avoid test frequency	If this setting is active, the measurement will not be performed at the **Test frequency** set in the **Measurement** section. The *Primary Test Manager* will instead measure two values at frequencies below and above the entered **Test frequency** and calculate the median of those two values. The **Avoid test frequency** setting is predefined for the selected test. ▶ Only change the default setting for special applications.

Setting	Description
Device settings	
Tan delta device	▶ Select your *CP TD* device: • **CP TD1** • **CP TD12** • **CP TD15**
Enable shield check	▶ Select the check box if you want the device to check if the high-voltage cable shield is connected.
Use beeper	▶ Select the check box if you want to use the *CP TD* beeper during the measurement.
Open loop check (*TESTRANO 600*)	▶ Select the check box to activate the **Open loop check** option. ▶ Clear the check box to disable the **Open loop check** option. **Note:** When testing samples with a very low capacitance (< 100 pF), the system may detect an open loop. After the setup has been confirmed to be correct, the user may choose to disable the open loop check in order to measure small capacitance values.
Test conditions	
Custom test conditions	▶ Select the **Custom test conditions** check box to set test conditions differing from the global test conditions.
Top oil temperature	Oil temperature at the top of the transformer's tank
Ambient temperature	Ambient temperature on site
Humidity	Relative ambient humidity
Weather	Weather during the test
Correction factors	
Use reference voltage	▶ Select the check box to extrapolate the I out and Watt losses results for the specified reference voltage.
Reference voltage	Reference voltage for extrapolation of measurement results **Note:** The **Reference voltage** can be set up to 15 kV regardless of which CP TD device is used.

The following table describes the Bushing – Energized Collar measurement data.

Table 15-26: Bushing – Energized Collar measurement data

Data	Description
No.	Number of the measurement
Measurement	Terminal name of the bushing under test
Test mode	Test mode according to the IEEE Std 62-1995
V test	Test voltage
Freq.	Test frequency
V out	Measured output voltage
I out	Measured output current
Watt losses	Measured losses
Assessment	Measurement assessment

15.1.6 Exciting Current

⚠ DANGER

Death or severe injury caused by high voltage or current

- ▶ Never use the *CP TD* without a solid connection to ground with at least 6 mm².
- ▶ Use a ground point as close as possible to the test object.
- ▶ Make sure to position the test object in the danger zone.

⚠ DANGER

Death or severe injury caused by high voltage or current

The high-voltage cable is double shielded and therefore safe. However, the last 50 cm (20 in) of this cable have no shield.

- ▶ Avoid any direct contact of this part of the cable to ground potential and any objects.
- ▶ During a test, consider this part of the cable a live wire and life threatening.

Exciting current measurements are performed to assess the turn-to-turn insulation of the windings, the magnetic circuit of a transformer as well as the tap changer. The most valued benefit of the test is to detect turn-to-turn short-circuits in a winding. Physical movement of the core laminations or severe damage to the core can influence the reluctance and, thus, will result in a change in exciting current. Deviations may also indicate contact wear or improper wiring of the tap changer.

The following table describes the Exciting Current test settings.

Table 15-27: Exciting Current test settings

Setting	Description
Tap changer settings	
Type of tap changer	Tap changer (OLTC/DETC) whose taps are changed during the test
Number of taps	Number of taps of the tap changer
Start tap	Start tap position of the test
Stop tap	Stop tap position of the test
DETC position/OLTC position[1]	Tap position of the DETC or OLTC
Measurement settings	
Test voltage	Test voltage
Test mode	Test mode according to the IEEE Std 62-1995
Measurement	Phase of the winding under test
Noise suppression settings	
Averaging (no. points)	Number of averaged measurements

Setting	Description
Device settings	
Tan delta device	▶ Select your *CP TD* device: • **CP TD1** • **CP TD12** • **CP TD15**
Enable shield check	▶ Select the **Enable shield check** check box if you want the *CPC 100* to check if the high-voltage cable shield is connected.
Use beeper	▶ Select the **Use beeper** check box if you want to use the *CP TD* beeper during the measurement.
Correction factors	
Use reference voltage	▶ Select the **Use reference voltage** check box to extrapolate the I out and Watt losses results for the specified reference voltage.
Reference voltage	Reference voltage for extrapolation of measurement results **Note:** The Reference voltage can be set up to 15 kV regardless of which *CP TD* device is used.

[1] Only available if the transformer has both the OLTC and DETC tap changers and depends on the selected type of the tap changer.

The following table describes the Exciting Current measurement data.

Table 15-28: Exciting Current measurement data

Data	Description
Tap	Tap changer position
V out	Measured output voltage
I out	Measured output current
I phase	Measured primary current per phase
Watt losses	Measured losses
Reactance	Measured reactance
Assessment	Measurement assessment per tap position

15.1.7 Insulating Fluids PF & CAP

⚠ DANGER

Death or severe injury caused by high voltage or current

- ▶ Never use the *CP TD* without a solid connection to ground with at least 6 mm².
- ▶ Use a ground point as close as possible to the test object.
- ▶ Make sure to position the test object in the danger zone.

⚠ DANGER

Death or severe injury caused by high voltage or current

The high-voltage cable is double shielded and therefore safe. However, the last 50 cm (20 in) of this cable have no shield.

▶ Avoid any direct contact of this part of the cable to ground potential and any objects.

▶ During a test, consider this part of the cable a live wire and life threatening.

Note: This test name depends on the **Profile** selected in the **Settings**.

- IEEE standard: **Insulating Fluids PF & CAP**
- IEC standard: **Insulating Fluids DF & CAP**
- Custom Profile: for example **Insulating Fluids Tanδ & CAP**

In this section, the terms **Power factor (PF) and Insulating Fluids PF & CAP** will be used.

The following table describes the Insulating Fluids PF & CAP test settings.

Table 15-29: Insulating Fluids PF & CAP test settings

Setting	Description
Measurement settings	
Test frequency	▶ Set the output frequency for the test.
Noise suppression settings	
Averaging (no. points)	Number of averaged measurements
Bandwidth	*CP TD* filter bandwidth
Avoid test frequency	If this setting is active, the measurement will not be performed at the **Test frequency** set in the **Measurement** section. *Primary Test Manager* will instead measure two values at frequencies below and above the entered **Test frequency** and calculate the median of those two values. The **Avoid test frequency** setting is predefined for the selected test. ▶ Only change the default setting for special applications.
Device settings	
Tan delta device	▶ Select your CP TD device: • **CP TD1** • **CP TD12** • **CP TD15**
Enable shield check	▶ Select the check box if you want the device to check if the high-voltage cable shield is connected.
Use beeper	▶ Select the check box if you want to use the *CP TD's* beeper during the measurement.

Setting	Description
Open loop check (*TESTRANO 600*)	▶ Select the check box to activate the **Open loop check** option. ▶ Clear the check box to disable the **Open loop check** option when: 1 The capacitance is low (GST < 20pF; UST < 5pF), 2 The **Open loop check** fails and 3 The test setup corresponds to that of the wiring diagram
Test conditions	
Oil temperature	Temperature of the oil
Custom test conditions	▶ Select the check box to set test conditions differing from the global test conditions.
Ambient temperature	Ambient temperature on site
Correction factors	
Temperature correction	▶ Select the check box to activate temperature correction.
Correction factor	Temperature correction factor
Use reference voltage	▶ Select the check box to extrapolate the I out and Watt losses results for the specified reference voltage.
Reference voltage	Reference voltage for extrapolation of measurement results **Note:** The Reference voltage can be set up to 15 kV regardless of which CP TD device is used.

The following table describes the Insulating Fluids PF & CAP measurement data.

Table 15-30: Insulating Fluids PF & CAP measurement data

Data	Description
No.	Number of the measurement
Specimen	Oil sample under test
Test mode	Test mode according to the IEEE Std 62-1995
V test	Test voltage
Freq.	Test frequency
V out	Measured output voltage
I out	Measured output current
Watt losses	Measured losses
PF meas	Measured power factor
PF corr	Corrected measured power factor
Cap. meas	Measured capacitance
Assessment	Measurement assessment

15.1.8 Surge Arrester Watt Losses

⚠ DANGER

Death or severe injury caused by high voltage or current

- ▶ Never use the *CP TD* without a solid connection to ground with at least 6 mm².
- ▶ Use a ground point as close as possible to the test object.
- ▶ Make sure to position the test object in the danger zone.

⚠ DANGER

Death or severe injury caused by high voltage or current

The high-voltage cable is double shielded and therefore safe. However, the last 50 cm (20 in) of this cable have no shield.

- ▶ Avoid any direct contact of this part of the cable to ground potential and any objects.
- ▶ During a test, consider this part of the cable a live wire and life threatening.

Note: This test name depends on the **Profile** selected in the **Settings**.

- IEEE standard: **Surge Arrester Watt Losses H/X**
- IEC standard: **Surge Arrester Watt Losses Prim/Sec**

In this section, the term **Surge Arrester Watt Losses** will be used.

The following table describes the Surge Arrester Watt Losses test settings.

Table 15-31: Surge Arrester Watt Losses test settings

Setting	Description
Measurement settings	
Test frequency	▶ Set the output frequency for the test.
Noise suppression settings	
Averaging (no. points)	Number of averaged measurements
Bandwidth	*CP TD* filter bandwidth
Avoid test frequency	If this setting is active, the measurement will not be performed at the **Test frequency** set in the **Measurement** section. The *Primary Test Manager* will instead measure two values at frequencies below and above the entered **Test frequency** and calculate the median of those two values. The **Avoid test frequency** setting is predefined for the selected test. ▶ Only change the default setting for special applications.

Setting	Description
Device settings	
Tan delta device	▶ Select your *CP TD* device: • **CP TD1** • **CP TD12** • **CP TD15**
Enable shield check	▶ Select the check box if you want the device to check if the shield of the high-voltage cable is connected.
Use beeper	▶ Select the check box if you want to use the *CP TD* beeper during the measurement.
Open loop check (*TESTRANO 600*)	▶ Select the check box to activate the **Open loop check** option. ▶ Clear the check box to disable the **Open loop check** option when: 4 The capacitance is low (GST < 20 pF; UST < 5 pF), 5 The **Open loop check** fails and 6 The test setup corresponds to that of the wiring diagram
Test Conditions	
Custom test conditions	▶ Select the Custom test conditions check box to set test conditions differing from the global test conditions.
Top oil temperature	Oil temperature at the top of the transformer's tank
Ambient temperature	Ambient temperature on site
Humidity	Relative ambient humidity
Weather	Weather during the test
Correction factors	
Use reference voltage	▶ Select the **Use reference voltage** check box to extrapolate the I out and Watt losses results for the specified reference voltage.
Reference voltage	Reference voltage for extrapolation of measurement results **Note:** The Reference voltage can be set up to 15 kV regardless of which CP TD device is used.

The following table describes the Surge Arrester Watt Losses measurement data.

Table 15-32: Surge Arrester Watt Losses measurement data

Data	Description
Measurement	Terminal name of the surge arrester under test
Position	Surge arrester unit under test
Test mode	Test mode according to the IEEE Std 62-1995
V test	Test voltage
Freq.	Test frequency
V out	Measured output voltage
I out	Measured output current
Watt losses	Measured losses
Assessment	Measurement assessment

15.1.9 Leakage Reactance

Note: This test name depends on the **Profile** selected in the **Settings**.

- IEEE standard: **Leakage Reactance H–X**
- IEC standard: **Short-circuit Impedance Prim–Sec**

In this section, the terms **Leakage Reactance** and **Z (%)** as the abbreviation for the leakage reactance will be used.

The following table describes the Leakage Reactance test settings.

Table 15-33: Leakage Reactance test settings

Setting	Description
Measurement settings	
Test current	Test current
OLTC position	Tap position of the OLTC
DETC position	Tap position of the DETC
3Ph equiv. test	
Perform test	▶ Select the **Perform test** check box if you want to perform the 3Ph equiv. test.
Show FRSL results	▶ Select the **Show FRSL results** check box to show the FRSL results of the 3Ph equiv. test.
Per-phase test	
Perform test	▶ Select the **Perform test** check box if you want to perform the Per-phase test.
Show FRSL results	▶ Select the **Show FRSL results** check box to show the FRSL results of the Per-phase test.
Test conditions	
Custom test conditions	▶ Select the **Custom test conditions** check box to set test conditions differing from the global test conditions.
Winding temperature	Temperature of the transformer's winding
Temperature correction	▶ Select the **Temperature correction** check box to activate temperature correction.
Reference temp.	Reference temperature to be used for temperature correction
Corr. factor	Temperature correction factor

The *Primary Test Manager* supports automatic assessment of the Leakage Reactance test. The relevant data are grouped in the **Assessment** pane.

The automatic assessment is only possible if you have completed the steps below:

1. Enter the following transformer nameplate data:
   1.1 Leakage Reactance Z (%)
   1.2 Base power
   1.3 Base voltage
2. Activate the temperature correction by selecting the **Temperature correction** check box.

The *Primary Test Manager* determines the base power used for assessment using the following information in the specified order:

- The base power entered in the table of the Leakage Reactance field of the transformer nameplate
- The base power entered in the Zero sequence impedance field of the transformer nameplate

The *Primary Test Manager* determines the base voltage used for assessment using the following information in the specified order:

- The base voltage entered in the Leakage Reactance table in the transformer nameplate
- The voltage of the tap (if a tap changer is available)
- The base power entered in the Zero sequence impedance field of the transformer nameplate

NOTICE

Equipment damage or loss of data possible

Before making a decision based on the *Primary Test Manager*'s automatic assessment, read the disclaimer.

The automatic assessment is based on the selected limit schema. You can use predefined limit schemes according to the established standards or set customer specific limits. In the **Limit schema** box, select the limit schema you want to use for the assessment. To assign the selected limit schema to the asset under test, click **Set as default**. The automatic assessment limits differ depending on the number of the transformer's phases.

Single-phase transformers

The following table describes the automatic assessment limits for the single-phase transformer.

Table 15-34: Leakage Reactance automatic assessment limits for single-phase transformer

Assessment against	Limit	Default
Zk dev (%) relative to nameplate	Low limit (fail)	Default limit

During the test, the *Primary Test Manager* calculates the Zk meas (%) value. For the automatic assessment, the *Primary Test Manager* compares Zk meas (%) with the nameplate value Zk leakage reactance (%). If the deviation is less than the default limit, the assessment is set to Pass, otherwise to Fail.

Three-phase transformers

The following table describes the automatic assessment limits for the three-phase transformer.

Table 15-35: Leakage Reactance automatic assessment limits for three-phase transformer

Assessment against	Limit	Default
3Ph equiv. Zk (%) relative to nameplate	Low limit (fail)	Default limit
Per-phase equiv. Zk (%) relative to average of all phases	Low limit (fail)	Default limit

During the 3Ph equiv. measurement, the *Primary Test Manager* calculates one Zk meas (%) value for all phases. For the automatic assessment, the *Primary Test Manager* compares Zk meas (%) with the nameplate value Zk ref (%). If the deviation is less than the default limit, the assessment status is set to Pass, otherwise to Fail.

During the Per-phase measurement, the *Primary Test Manager* calculates the Zk meas (%) values for each phase. For the automatic assessment, the *Primary Test Manager* compares Zk meas (%) with the average of Zk meas (%) across all phases. If the deviation is less than the default limit, the assessment status is set to Pass, otherwise to Fail.

You can assess the test at 2 points in the process:

- Assessment during the measurement
  To assess the test while the measurements are running, select the **Assess during measurements** check box. After this, the test is locked, and you can only change assessment-relevant data.
- Manual assessment after all measurements have been finished
  To assess the test manually, click **Assess measurements**. After that, the test is locked, and you can only change assessment-relevant data.

To set new data in the test or to change the test settings, click **Clear all assessments**.

You can overwrite the *Primary Test Manager* automatic assessment manually. To do so, click the arrow next to the automatic assessment, and then select a manual assessment from the list.

The automatic assessment is stored in the Assessment box for documentation purposes.

Measurements: 3Ph equiv.

The following table describes the leakage reactance results (Zk).

Table 15-36: Leakage reactance results (Zk)

Data	Description
Phase	Phase under test
I AC	Measured current
V1 AC	Measured voltage
V1 AC phase	Phase angle of the voltage V1 AC
Watt losses	Measured losses
Zk	Measured leakage reactance
Rk	Real part of the measured Zk
Xk	Imaginary part of the measured Zk (leakage reactance)
Lk	Measured leakage inductance

The following table describes the assessment Zk.

Table 15-37: Assessment Zk

Data	Description
Phase	Phase under test
Zk meas (%)	Measured leakage reactance in percent
Zk avg (%)	Average of Zk meas (%) across all phases
Zk dev (%)	Deviation of the Zk meas (%) from the Zk ref (%) in percent
Xk meas (%)	Measured reactance in percent
Xk avg (%)	Average of Xk meas (%) across all phases
Xk dev (%)	Deviation of the Xk meas (%) from the Xk ref (%) in percent
Assessment	Measurement assessment

The following table describes the assessment Rk at 400 Hz.

Table 15-38: Assessment Rk at 400 Hz

Data	Description
Rk avg	Average value of the per phase Rk
Rk dev (%) phase A	Deviation of the measured Rk of the phase A from the average value
Rk dev (%) phase B	Deviation of the measured Rk of the phase B from the average value
Rk dev (%) phase C	Deviation of the measured Rk of the phase C from the average value
Assessment	Measurement assessment

Measurements: per-phase

The following table describes the leakage reactance results (Zk).

Table 15-39: Leakage Reactance results (Zk)

Data	Description
Phase	Phase under test
I AC	Measured current
V1 AC	Measured voltage
V1 AC phase	Phase angle of the voltage V1 AC
Watt losses	Measured losses
Zk	Measured leakage reactance
Rk	Real part of the measured Zk
Xk	Imaginary part of the measured Zk (leakage reactance)
Lk	Measured leakage inductance

The following table describes the assessment Zk.

Table 15-40: Assessment Zk

Data	Description
Phase	Phase under test
Zk meas (%)	Measured impedance in percent
Zk ref (%)	Reference impedance in percent[1]

Data	Description
Zk dev (%)	Deviation of the measured impedance from the reference impedance in percent
Xk meas (%)	Measured reactance in percent
Xk ref (%)	Reference reactance in percent
Xk dev (%)	Deviation of the Xk meas (%) from the Xk ref (%) in percent
Dominance order	Order of the Zk dev (%) values: 1 for the highest value 2 for the middle value 3 for the lowest value
Assessment	Measurement assessment

[1] Corresponds to the nameplate value Z %.

The following table describes the assessment Rk at 400 Hz.

Table 15-41: Assessment Rk at 400 Hz

Data	Description
Rk avg	Average value of the per phase Rk
Rk dev (%) phase A	Deviation of the measured Rk of the phase A from the average value
Rk dev (%) phase B	Deviation of the measured Rk of the phase B from the average value
Rk dev (%) phase C	Deviation of the measured Rk of the phase C from the average value
Assessment	Measurement assessment

15.1.10 Zero Sequence Impedance

Note: This test name depends on the **Profile** selected in the **Settings**.

- IEEE standard: **Zero Sequence Impedance H/X**
- IEC standard: **Zero Sequence Impedance Prim/Sec**

In this section, the term **Zero Sequence Impedance** will be used.

This test is only available for winding configurations with accessible neutral.

The following table describes the Zero Sequence Impedance test settings.

Table 15-42: Zero sequence impedance Test Settings

Setting	Description
Measurement settings	
Test current	Current of the test
Test conditions	
Custom test conditions	▶ Select the **Custom test conditions** check box to set test conditions differing from the global test conditions.
Winding temp.	Temperature of the transformer's winding
Reference temp.	Reference temperature to be used for temperature correction
Temperature correction	▶ Select the **Temperature correction** check box to activate temperature correction.

Setting	Description
Corr. factor	Temperature correction factor
Type of tap changer	Tap changer (OLTC/DETC) whose taps are changed during the test
Number of taps	Number of taps of the tap changer
DETC position/OLTC position	Tap position of the DETC or OLTC
Assessment settings	
Manual	▶ Click **Manual** to select the manual assessment settings.
Automatic	▶ Click **Automatic** to select the automatic assessment settings.

NOTICE

Equipment damage or loss of data possible

Before making a decision based on the *Primary Test Manager*'s automatic assessment, read the disclaimer.

Editing automatic assessment settings

To edit the automatic assessment settings:

1. In the Settings and conditions pane, click Edit test limits.

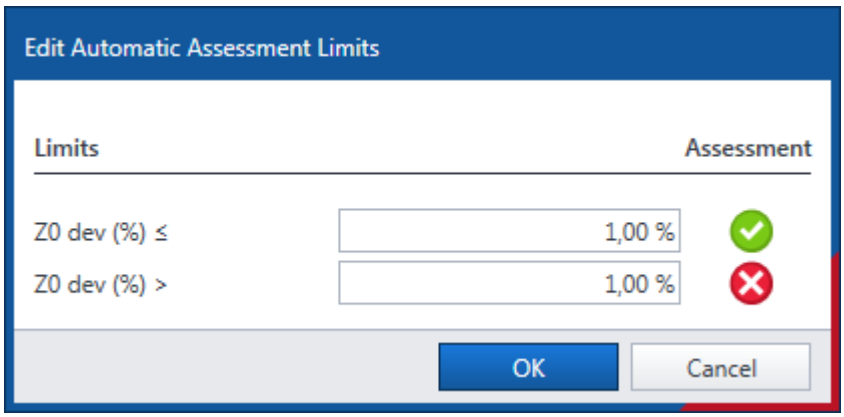


Figure 15-1: Edit automatic assessment limits dialog box

2. In the Edit automatic assessment limits dialog box, enter the deviation of the Z0 (%) from the Z0 ref (%) in percent.

The following table describes the Zero Sequence Impedance measurement data.

Table 15-43: Zero Sequence Impedance Measurement Data

Data	Description
Tap	Tap changer position
V1 AC	Measured voltage
V1 AC phase	Phase angle of the voltage V1 AC
I AC	Measured current
Z meas	Measured impedance

Data	Description
Z corr	Temperature corrected impedance
Z0	Measured zero sequence impedance
Z0 (%)	Measured zero sequence impedance in percent
Z0 ref (%)	Reference zero sequence impedance in percent
Z0 dev (%)	Deviation of the Z0 (%) from the Z0 ref (%) in percent
Assessment	Measurement assessment

15.1.11 TTR

⚠ DANGER

Death or severe injury caused by high voltage or current

▶ Do not connect the output of the test set to the low-voltage side of the transformer. This will cause dangerous voltages on the high-voltage side.

Note: This test name depends on the **Profile** selected in the **Settings**.

- IEEE standard: **TTR H–X**
- IEC standard: **Turns Ratio Prim–Sec**

In this section, the term **TTR** will be used.

You can perform the TTR test also for the vector groups not supported by the *Primary Test Manager* according to the IEC 61378-1 standard. To perform the test according to the IEC 61378-1 standard, select the IEC 61378-1 check box in the **Settings** and conditions pane.

The following table describes the TTR test settings.

Table 15-44: TTR test settings

Setting	Description
Tap changer settings	
Type of tap changer	Tap changer (OLTC/DETC) whose taps are changed during the test
Number of taps	Number of taps of the tap changer
Start tap	Start tap position of the test
Stop tap	Stop tap position of the test
DETC position/OLTC position	Tap position of the DETC or OLTC
CP SB1 settings	
Use CP SB1	▶ Select the **CP SB1** check box to perform the test by using the *CP SB1* switch box.
Auto switching of phases	Phases are switched automatically; Switching through taps is done manually.
Auto switching of taps and phases	Switching through taps and phases is both done automatically.
Auto switching of taps	Taps are switched automatically; Switching through phases is done manually.

Setting	Description
Tap time	Time for the automatic tap change between two positions
Impulse time	Duration of the impulse for the automatic tap change
IEC 61378-1	▶ Select the **IEC 61378-1** check box to perform the test according to the IEC 61378-1 standard.
Measurement settings	
Test voltage	Test voltage
Measurement	Phase of the winding under test
Ratio	Choose between TTR (transformer turns ratio) and VTR (voltage ratio) to be displayed in the **Measurements** table.
Assessment settings	
Manual	▶ Click **Manual** to select the manual assessment settings.
Automatic	▶ Click **Automatic** to select the automatic assessment settings.

NOTICE

Equipment damage or loss of data possible

Before making a decision based on the *Primary Test Manager*'s automatic assessment, read the disclaimer.

Editing automatic assessment settings

To edit the automatic assessment settings:

1. In the Settings and conditions pane, click **Edit test limits**.

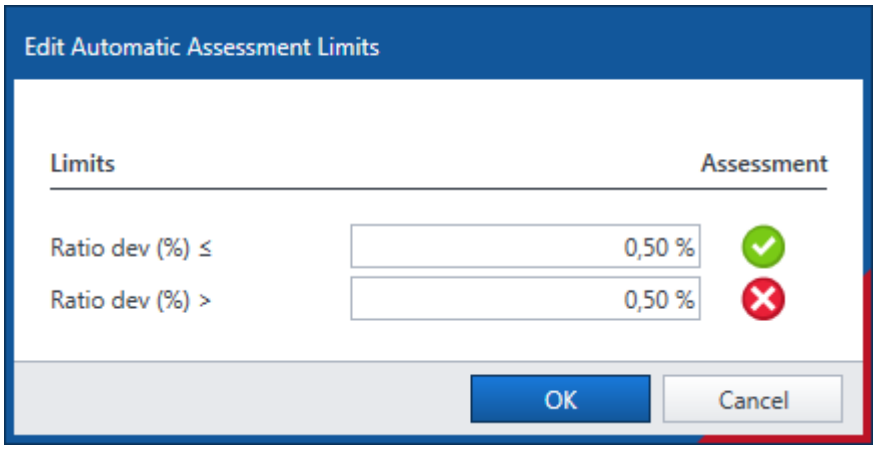


Figure 15-2: Edit automatic assessment limits dialog box

2. In the **Edit automatic assessment limits** dialog box, enter the deviation of the measured transformer ratio from the nominal transformer ratio in percent.

The following table describes the TTR measurement data.

Table 15-45: TTR measurement data

Data	Description
Tap	Tap changer position
Nominal ratio	Nominal transformer ratio
V prim	Measured primary voltage
I prim	Measured primary current
I phase	Phase angle of the measured primary current
V sec	Measured secondary voltage
V phase	Phase shift between primary and secondary voltage
TTR	Measured transformer turns ratio
VTR	Measured voltage ratio
Ratio dev	Deviation of the measured transformer ratio from the nominal transformer ratio
Assessment	Measurement assessment per tap position

15.1.12 DC Winding Resistance

⚠ DANGER

Death or severe injury caused by high voltage or current

Injecting direct current into test objects with inductive characteristics will charge the winding of the test object

- ▶ Follow instructions below
- ▶ Refer to the safety instructions in the CPC 100 User and Reference manuals.

⚠ DANGER

Death or severe injury caused by high voltage or current

- ▶ Never open the measuring circuit while current is flowing.
- ▶ Ground all terminals of the test object before touching the test setup.
- ▶ Short circuit the terminals before disconnecting the test leads.
- ▶ Disconnect cables not used for testing from the test object and test set.
- ▶ After obtaining a measurement, wait until the test device has discharged completely.

Note: This test name depends on the **Profile** selected in the **Settings**.

- IEEE standard: **DC Winding Resistance H/X**
- IEC standard: **DC Winding Resistance Prim/Sec**

In this section, the term **DC Winding Resistance** will be used.

The following table describes the DC Winding Resistance test settings.

Table 15-46: DC Winding Resistance test settings

Setting	Description
Tap changer settings	
Type of tap changer	Tap changer (OLTC/DETC) whose taps are changed during the test
Number of taps	Number of taps of the tap changer
Start tap	Start tap position of the test
Stop tap	Stop tap position of the test
DETC Position/OLTC Position[1]	Tap position of the DETC or OLTC
CP SB1 settings	
Use CP SB1	▶ Select the **CP SB1** check box to perform the test by using the *CP SB1* switch box.
Mode	Switching mode for taps and phases
Manual	Switching through taps and phases is both done manually.
Auto switching of phases	Phases are switched automatically; Switching through taps is done manually.
Auto switching of taps	Taps are switched automatically; Switching through phases is done manually.
Auto switching of taps and phases	Switching through taps and phases is both done automatically.
Tap time	Time for the automatic tap change between two positions.
Impulse time	Duration of the impulse for the automatic tap change.
Up/Down test	▶ Select the **Up/Down** test check box to run the test in two directions (up and down). Up means from the lowest tap to the highest tap while down means from the highest tap to the lowest tap.
Measurement settings	
CPC output	DC current output of the *CPC 100*
Test current	Current of the test
Measurement	Phase of the winding under test
Automatic result	▶ Select the **Automatic result** check box to stop the measurement automatically depending on the tolerance R dev and the settling time.
Tolerance R dev	Tolerance of the deviation of consecutive measurement results within the settling time
Settling time (Δt)	Time within which the deviation of consecutive measurement results is evaluated. If the deviation is less than the tolerance R dev, the measurement stops.
Show TRTapCheck results	▶ Select the **Show TRTapCheck results** check box to display information about the condition (ripple and slope) of the tap changer mechanisms
Test conditions	
Custom test conditions	▶ Select the **Custom test conditions** check box to set test conditions differing from the global test conditions.
Winding temperature	Temperature of the transformer's winding

Setting	Description
Temperature correction	▶ Select the **Temperature correction** check box to activate temperature correction.
Reference temp.	Reference temperature to be used for temperature correction
Corr. factor	Temperature correction factor

[1] Only available if the transformer has both the OLTC and DETC tap changers and depends on the selected type of the tap changer.

NOTICE

Equipment damage or loss of data possible

Before making a decision based on the *Primary Test Manager*'s automatic assessment, read the disclaimer.

The *Primary Test Manager* supports automatic assessment of the DC Winding Resistance test.

The following table describes the automatic assessment parameters of the DC Winding Resistance test.

Table 15-47: DC Winding Resistance automatic assessment parameters

Parameter	Description
Limit schema	Limit schema underlying the assessment

To save the selected limit schema as the default setting for all future jobs, click **Set as default**.

The following table describes the automatic assessment limits of the DC Winding Resistance test.

Table 15-48: DC Winding Resistance automatic assessment limits

Assessment against	Limit	Default
Relative limits	Limit (fail)	Default limit

During the automatic assessment, the *Primary Test Manager* compares the R corr values of all phases to each another. If a deviation is greater than the default limit the assessment status is set to **Fail**.

You can assess the test:

- During measurement
  To assess the test while the measurements are running, select the **Assess during measurements** check box.
- Manually after all measurements have been finished
  To assess the test manually, click **Assess measurements**.

After a measurement has been assessed, the test settings and the assessment parameters are locked.

To change the test data, the test settings, or the assessment parameters, click **Clear all assessments**.

You can overwrite the *Primary Test Manager* automatic assessment manually. To do so, click the arrow next to the automatic assessment, and then select a manual assessment from the list.

The automatic assessment is stored in the Assessment box for documentation purposes.

The following table describes the DC Winding Resistance measurement data.

Table 15-49: DC Winding Resistance measurement data

Data	Description
Tap	Tap changer position
I DC	Measured current
V DC	Measured voltage
Time	Time between the start and stop of a measurement
R meas	Measured resistance
R dev	Deviation of two successive measurement results at the time the test was stopped
R corr	Corrected measured resistance
Ripple[1]	Highest current ripple during the tap changer operation
Slope[1]	Highest measured falling edge slope of the test current during the tap changer operation
Assessment	Measurement assessment per tap position

[1] Only available if an OLTC is specified and the **Show TRTapCheck results** check box is selected.

If you did not select the **Automatic result** check box to stop the measurement automatically, you can stop the measurement by clicking the **Keep results** button.

15.1.13 Dynamic OLTC-scan (DRM)

Note: This test name depends on the **Profile** selected in the **Settings**.

- IEEE standard: **Dynamic OLTC-Scan (DRM) H/X**
- IEC standard: **Dynamic OLTC-Scan (DRM) Prim/Sec**

In this section, the term **Dynamic OLTC-Scan (DRM)** will be used.

Use the Dynamic OLTC-Scan (DRM) test card to visualize the on-load tap changer's transient switching behavior and assess its condition.

A Dynamic OLTC-Scan (DRM) can only be performed on resistive OLTCs and with the following settings adjusted:

1. Define the transformer's winding configuration in the **Transformer** tab of the **Asset** view (see Transformer view (page 58)).
2. Enter the **No. of taps** in the **Tap changers** tab of the **Asset** view. The **No. of taps** must be greater than 1 (see Tap changer (page 102)).

⚠ DANGER

Death or severe injury caused by high voltage or current

Injecting direct current into test objects with inductive characteristics will charge the winding of the test object

- ▶ Follow instructions below
- ▶ Refer to the safety instructions in the CPC 100 User and Reference manuals.

⚠ DANGER

Death or severe injury caused by high voltage or current

- ▶ Never open the measuring circuit while current is flowing.
- ▶ Ground all terminals of the test object before touching the test setup.
- ▶ Short circuit the terminals before disconnecting the test leads.
- ▶ Disconnect cables not used for testing from the test object and test set.
- ▶ After obtaining a measurement, wait until the test device has discharged completely.

Settings and conditions pane

The following table describes the Dynamic OLTC-Scan (DRM) test settings and conditions:

Table 15-50: Dynamic OLTC-Scan (DRM) test settings

Setting	Description
Tap changer settings	
Number of taps	Number of taps of the tap changer
Start tap	Start tap position of the test
Stop tap	Stop tap position of the test
CP SB1 settings	
Mode	Switching mode for taps
Manual switching of taps	Taps are switched manually.
Auto switching of taps	Taps are switched automatically.
Tap time	Time for the automatic tap change between two positions
Impulse time	Duration of the impulse for the automatic tap change
Measurement settings	
CPC output	DC current output of the *CPC 100*
Test current	Current of the test
Recording time	The time of the switching cycle that shall be recorded
Tolerance R dev	Tolerance of the deviation of consecutive measurement results within the settling time
Settling time (Δt)	Time within which the deviation of consecutive measurement results is evaluated. If the deviation is less than the tolerance R dev, the measurement stops.
Noise suppression	▶ Select the **Noise suppression** check box to activate an interference filter.
Dynamic shorting	Dynamic short-circuit of low-voltage windings on single- and three-phase transformers. Only selectable for two- and three-winding transformers with an OLTC on the high-voltage winding.

Measurements pane

The **Measurements** pane in the workspace displays the measurement results in table and graph format.

- ▶ Highlight a line to indicate the corresponding graph and vice versa.
- ▶ Use the **Assessment** drop-down box to manually assess the test results.
- ▶ To view graphical diagrams of the measurement results, click the Plot tab.

Filters

The following table describes the filters available for the Dynamic OLTC-Scan (DRM):

Table 15-51: Available filters for the Dynamic OLTC-Scan (DRM)

Filter	Description
Phase	Only results from the currently selected phase are displayed.
Parity	Only results from taps with even/odd numbers are displayed.
Direction	Only results from one direction of the OLTC's movement are displayed.

The Dynamic OLTC-Scan (DRM) is restricted to 50 taps at once. For OLTCs with more than 50 taps, enter the appropriate **Start tap** and **Stop tap** to define which set of 50 taps you would like to examine.

Errors during the test

In case of an error during measurement, the phrase **Some measurement results could not be recorded** is displayed. Faulty measurement results are not displayed and instead marked with exclamation points:

Table 15-52: Error messages during the Dynamic OLTC-Scan (DRM)

Notification	Description
!	**Data corruption**: A disturbance has been detected. This result is invalid. Repeat the measurement.
!!	**Time out**: No switching operation has been detected during the **Tap time**.

15.1.14 Demagnetization

With the Demagnetization test, you can demagnetize the transformer's core. We recommend performing the Demagnetization test after every DC Winding Resistance test.

You must connect the *CP SB1* transformer switch box to the *CPC 100* for the demagnetization test.

⚠ DANGER

Death or severe injury caused by high voltage or current

Injecting direct current into test objects with inductive characteristics will charge the winding of the test object

- ▶ Follow instructions below
- ▶ Refer to the safety instructions in the CPC 100 User and Reference manuals.

⚠ DANGER

Death or severe injury caused by high voltage or current

- ▶ Never open the measuring circuit while current is flowing.
- ▶ Ground all terminals of the test object before touching the test setup.
- ▶ Short circuit the terminals before disconnecting the test leads.
- ▶ Disconnect cables not used for testing from the test object and test set.
- ▶ After obtaining a measurement, wait until the test device has discharged completely.

The following table describes the Demagnetization test settings.

Table 15-53: Demagnetization test settings

Setting	Description
Measurement settings	
CPC output	DC current output of the *CPC 100*
Test current	Current of the test
Saturation criteria	
Saturation level	Saturation level of the transformer

The following table describes the Demagnetization measurement data.

Table 15-54: Demagnetization measurement data

Data	Description
No.	Number of the measurement
Measurement	Name of the measurement
Stage	Test status: • Wiring check • Saturating • Discharging • Canceled • Demagnetizing • Test stopped • Core is demagnetized (if measured remanence <1%)
I DC	Measured current
Min. neg. remanence	Maximum remanence in negative direction of the hysteresis curve
Max. pos. remanence	Maximum remanence in positive direction of the hysteresis curve
Remanence	Measured remanence
Initial remanence	Measured remanence at start of the test
Assessment	Measurement assessment

15.2 Three-winding transformers

Some test names depend on the **Profile** selected in the **Settings**. For your convenience, you can use your preferred naming.

- IEEE standard: **Power factor (PF)** for the loss indicator; **H/X/Y** for windings
- IEC standard: **Dissipation factor (DF)** for the loss indicators; **Prim/Sec/Tert** for windings
- Custom profiles: **Power factor (PF)**, **Dissipation factor (DF)** or **Tangent delta (Tanδ)** for the loss indicator; various naming options for windings

The dissipation factor and the tangent delta are identical characteristics of the primary asset under test.

The *Primary Test Manager* supports the following tests of three-winding transformers:

- Oil analysis (page 123)
- Overall PF & CAP (page 128)
- Bushing PF & CAP – C1 (page 133)
- Bushing PF & CAP – C2 (page 138)
- Bushing – Energized collar (page 142)
- Exciting Current (page 144)
- Insulating Fluids PF & CAP (page 145)
- Surge Arrester Watt Losses (page 148)
- Leakage Reactance (page 150)
- Zero Sequence Impedance (page 154)
- TTR (page 156)
- DC Winding Resistance (page 158)
- Dynamic OLTC-scan (DRM) (page 161)
- Demagnetization (page 163)

The *Primary Test Manager* also supports the **TanDelta – PF/DF/Tanδ & CAP** manual test. For more information, see Manual Tan Delta (page 237).

The tests of the three-winding transformers are identical or analogous to the respective tests of the two-winding transformers. For more information, see Two-winding transformers (page 122).

15.3 Autotransformers without tertiary winding

Some test names depend on the **Profile** selected in the **Settings**. For your convenience, you can use your preferred naming.

- IEEE standard: **Power factor (PF)** for the loss indicator; **H/X** for the windings
- IEC standard: **Dissipation factor (DF)** for the loss indicators; **Prim/Sec** for the windings,
- Custom profiles: **Power factor (PF)**, **Dissipation factor (DF)** or **Tangent delta (Tanδ)** for the loss indicator; various naming options for the windings

The dissipation factor and the tangent delta are identical characteristics of the primary asset under test.

The *Primary Test Manager* supports the following tests of autotransformers without tertiary winding:

- Oil analysis (page 123)
- Overall PF & CAP (page 128)
- Bushing PF & CAP – C1 (page 133)
- Bushing PF & CAP – C2 (page 138)
- Bushing – Energized collar (page 142)
- Exciting Current (page 144)
- Insulating Fluids PF & CAP (page 145)
- Surge Arrester Watt Losses (page 148)
- Leakage Reactance (page 150)
- Zero Sequence Impedance (page 154)
- TTR (page 156)
- DC Winding Resistance (page 158)
- Dynamic OLTC-scan (DRM) (page 161)
- Demagnetization (page 163)

The *Primary Test Manager* also supports the **TanDelta – PF/DF/Tanδ & CAP** manual test. For more information, see Manual Tan Delta (page 237).

The tests of the autotransformers without tertiary winding are identical to the respective tests of the two-winding transformers. For more information, see Two-winding transformers (page 122).

15.4 Autotransformers with tertiary winding

Some test names depend on the **Profile** selected in the **Settings**. For your convenience, you can use your preferred naming.

- IEEE standard: **Power factor (PF)** for the loss indicator; **H/X/Y** for the windings
- IEC standard: **Dissipation factor (DF)** for the loss indicators; **Prim/Sec/Tert** for the windings,
- Custom profiles: **Power factor (PF)**, **Dissipation factor (DF)** or **Tangent delta (Tanδ)** for the loss indicator; various naming options for the windings

The dissipation factor and the tangent delta are identical characteristics of the primary asset under test.

The *Primary Test Manager* supports the following tests of autotransformers with tertiary winding:

- Oil analysis (page 123)
- Overall PF & CAP (page 128)
- Bushing PF & CAP – C1 (page 133)
- Bushing PF & CAP – C2 (page 138)
- Bushing – Energized collar (page 142)
- Exciting Current (page 144)

- Insulating Fluids PF & CAP (page 145)
- Surge Arrester Watt Losses (page 148)
- Leakage Reactance (page 150)
- Zero Sequence Impedance (page 154)
- TTR (page 156)
- DC Winding Resistance (page 158)
- Dynamic OLTC-scan (DRM) (page 161)
- Demagnetization (page 163)

The *Primary Test Manager* also supports the **TanDelta – PF/DF/Tanδ & CAP** manual test. For more information, see Manual Tan Delta (page 237).

The tests of the autotransformers with tertiary winding are identical to the respective tests of the two-winding transformers. For more information, see Two-winding transformers (page 122)**.** The available tests depend on the accessibility of the tertiary winding.

15.5 Voltage regulators

Some test names depend on the **Profile** selected in the **Settings**. For your convenience, you can use your preferred naming.

- IEEE standard: **Power factor (PF)** for the loss indicator; **H/X** for the windings
- IEC standard: **Dissipation factor (DF)** for the loss indicators; **Prim/Sec** for the windings,
- Custom profiles: **Power factor (PF)**, **Dissipation factor (DF)** or **Tangent delta (Tanδ)** for the loss indicator; various naming options for the windings

The dissipation factor and the tangent delta are identical characteristics of the primary asset under test.

The *Primary Test Manager* supports the following tests of voltage regulators:

- Oil Analysis
- Overall PF & CAP (page 128)
- Bushing – Energized collar (page 142)
- Exciting Current (page 144)
- Insulating Fluids PF & CAP (page 145)
- Leakage Reactance (page 150)
- Zero Sequence Impedance (page 154)
- TTR (page 156)
- DC Winding Resistance (page 158)
- Dynamic OLTC-scan (DRM) (page 161)
- Demagnetization (page 163)

The tests of the voltage regulators are identical to the respective tests of the two-winding transformers. For more information, see Two-winding transformers (page 122)**.**

The *Primary Test Manager* also supports the **TanDelta – PF/DF/Tanδ & CAP** manual test. For more information, see Manual Tan Delta (page 237).

15.6 Shunt reactor

Some test names depend on the **Profile** selected in the **Settings**. For your convenience, you can use your preferred naming.

The *Primary Test Manager* supports the following tests of shunt reactors:

- Assessment summary (page 123)
- Bushing – Energized collar (page 142)
- Surge Arrester Watt Losses (page 148)
- Insulating Fluids PF & CAP (page 145)
- SFRA test
- DIRANA test
- Inspection (page 243)

16 Spare bushing tests

In this chapter, the settings and measurement data of the spare bushing tests are described. For more information about testing with *CPC 100*, see the CPC 100 User Manual shipped with your test system.

Some test names depend on the **Profile** selected in the **Settings** (→ Settings (page 28)). For your convenience, you can use your preferred naming to, for example, match regional conventions:

- ▶ IEEE standard: **Power factor (PF)** for the loss indicator; H/X/Y for the windings
- ▶ IEC standard: **Dissipation factor (DF)** for the loss indicators; Prim/Sec/Tert for the windings,
- ▶ Custom profiles: **Power factor (PF)**, **Dissipation factor (DF)** or **Tangent delta (Tanδ)** for the loss indicator; various naming options for the windings
  - ➔ The dissipation factor and the tangent delta are identical characteristics of the primary asset under test.

Primary Test Manager supports the following spare bushing tests:

- Spare Bushing PF & CAP – Overall (page 169)
- Spare Bushing PF & CAP – C1 (page 172)
- Spare Bushing PF & CAP – C2 (page 174)
- Spare Bushing PF & CAP – C1+C2 (page 176)
- Spare Bushing – Energized Collar (page 178)

Primary Test Manager also supports the **TanDelta – PF & CAP** manual test.

▶ For more information, see Manual Tan Delta (page 237).

16.1 Spare Bushing PF & CAP – Overall

⚠ DANGER

Death or severe injury caused by high voltage or current

- ▶ Never use the *CP TD* without a solid connection to ground with at least 6 mm².
- ▶ Use a ground point as close as possible to the test object.
- ▶ Make sure to position the test object in the danger zone.

⚠ DANGER

Death or severe injury caused by high voltage or current

The high-voltage cable is double shielded and therefore safe. However, the last 50 cm (20 in) of this cable have no shield.

- ▶ Avoid any direct contact of this part of the cable to ground potential and any objects.
- ▶ During a test, consider this part of the cable a live wire and life threatening.

Note: This test name depends on the **Profile** selected in the **Settings**.

- IEEE standard: **Spare Bushing PF & CAP – Overall**
- IEC standard: **Spare Bushing DF & CAP – Overall**
- Custom profile: **Spare Bushing Tanδ & CAP – Overall**

In this section, the **terms Spare Bushing PF & CAP – Overall** and **Power Factor (PF)** will be used.

The following table describes the Spare Bushing PF & CAP – Overall test settings.

Table 16-1: Spare Bushing PF & CAP – Overall test settings

Setting	Description
Measurement settings	
Test frequency	Test frequency
Sweep settings	
Frequency sweep	Sweep profile: **None**: no frequency sweep **OMICRON expertise**: sweep frequencies dynamically distributed within the device frequency range for optimum results (recommended*) **CPC template**: sweep frequencies specified by the *CPC 100* test templates
Voltage sweep (tip-up)	Sweep profile: **None**: no voltage sweep **OMICRON expertise**: sweep voltages dynamically distributed within the asset-dependent voltage range for optimum results
Sweep profiles	▶ Click the pen button to create a frequency or voltage sweep profile ▶ Add up to 30 measurement points with individual output voltages or frequencies. Double-click a value to change it. ▶ Mark a favorite to use it as the default sweep profile for future tests **Note:** The predefined profiles None, OMICRON expertise and CPC template cannot be edited or deleted. The default sweep profiles for this test are: • Frequency sweep: OMICRON expertise • Voltage sweep: none
Noise suppression settings	
Averaging (no. points)	Number of averaged measurements
Bandwidth	Filter bandwidth

Setting	Description
Device settings	
Tan delta device	▶ Select your *CP TD* device: • **CP TD1** • **CP TD12** • **CP TD15**
Enable shield check	▶ Select the **Enable shield check** check box if you want the device to check if the high-voltage cable shield is connected.
Use beeper	▶ Select the **Use beeper** check box if you want to use the *CP TD* beeper during the measurement.
Test conditions	
Custom test conditions	▶ Select the **Custom test conditions** check box to set test conditions differing from the global test conditions.
Ambient temperature	Ambient temperature on site
Humidity	Relative ambient humidity
Weather	Weather during the test
Correction factors	
Temperature correction	▶ Select the **Temperature correction** check box to activate temperature correction.
Correction factor	Temperature correction factor
Use reference voltage	▶ Select the **Use reference voltage** check box to extrapolate the I out and Watt losses results for the specified reference voltage.
Reference voltage	Reference voltage for extrapolation of measurement results **Note:** The Reference voltage can be set up to 15 kV regardless of which *CP TD* device is used.

The following table describes the Spare Bushing PF & CAP – Overall measurement data.

Table 16-2: Spare Bushing PF & CAP – Overall measurement data

Data	Description
No.	Number of the measurement
Measurement	Arrangement of the measurement
Test mode	Test mode according to the IEEE Std 62-1995
Sweep	Swept variable: frequency, voltage, or none
V test	Test voltage
Freq.	Test frequency
V out	Measured output voltage
I out	Measured output current
Watt losses	Measured losses
PF meas.	Measured power factor
PF corr.	Corrected measured power factor
Cap. meas.	Measured capacitance
Assessment	Measurement assessment

16.2 Spare Bushing PF & CAP – C1

⚠ DANGER

Death or severe injury caused by high voltage or current

- ▶ Never use the *CP TD* without a solid connection to ground with at least 6 mm².
- ▶ Use a ground point as close as possible to the test object.
- ▶ Make sure to position the test object in the danger zone.

⚠ DANGER

Death or severe injury caused by high voltage or current

The high-voltage cable is double shielded and therefore safe. However, the last 50 cm (20 in) of this cable have no shield.

- ▶ Avoid any direct contact of this part of the cable to ground potential and any objects.
- ▶ During a test, consider this part of the cable a live wire and life threatening.

Note: This test name depends on the **Profile** selected in the **Settings**.

- IEEE standard: **Spare Bushing PF & CAP – C1**
- IEC standard: **Spare Bushing DF & CAP – C1**
- Custom profile: **Spare Bushing Tanδ & CAP – C1**

In this section, the terms **Power Factor (PF)** and **Spare Bushing PF & CAP – C1** will be used.

The following table describes the Spare Bushing PF & CAP – C1 test settings.

Table 16-3: Spare Bushing PF & CAP – C1 test settings

Setting	Description
Measurement settings	
Test frequency	Test frequency
Perform inverted C1 test	▶ Select the **Perform inverted C1** test check box to include the inverted C1 measurement in the test.
Sweep settings	
Frequency sweep	Sweep frequency profile: **None**: no frequency sweep **OMICRON expertise**: sweep frequencies dynamically distributed within the device frequency range for optimum results (recommended*) **CPC template**: sweep frequencies specified by the *CPC 100* test templates

Setting	Description
Voltage sweep (tip-up)	Sweep profile: **None**: no voltage sweep **OMICRON expertise**: sweep voltages dynamically distributed within the asset-dependent voltage range for optimum results
Sweep profiles	▶ Click the pen button to create a frequency or voltage sweep profile. ▶ Add up to 30 measurement points with individual output voltages or frequencies. Double-click a value to change it. ▶ Mark a favorite to use it as the default sweep profile for future tests. **Note:** The predefined profiles None, OMICRON expertise and CPC template cannot be edited or deleted. The default sweep profiles for this test are: Frequency sweep: OMICRON expertise Voltage sweep: none
Noise suppression settings	
Averaging (no. points)	Number of averaged measurements
Bandwidth	Filter bandwidth
Device settings	
Tan delta device	▶ Select your *CP TD* device: • **CP TD1** • **CP TD12** • **CP TD15**
Enable shield check	▶ Select the **Enable shield check** check box if you want the device to check if the high-voltage cable shield is connected.
Use beeper	▶ Select the **Use beeper** check box if you want to use the *CP TD*'s beeper during the measurement.
Test conditions	
Custom test conditions	▶ Select the **Custom test conditions** check box to set test conditions differing from the global test conditions.
Ambient temperature	Ambient temperature on site
Humidity	Relative ambient humidity
Weather	Weather during the test
Correction factors	
Temperature correction	▶ Select the **Temperature correction** check box to activate temperature correction.
Correction factor	Temperature correction factor
Use reference voltage	▶ Select the **Use reference voltage** check box to extrapolate the I out and Watt losses results for the specified reference voltage.

Setting	Description
Reference voltage	Reference voltage for extrapolation of measurement results **Note:** The Reference voltage can be set up to 15 kV regardless of which *CP TD* device is used.

The following table describes the Spare Bushing PF & CAP – C1 measurement data.

Table 16-4: Spare Bushing PF & CAP – C1 measurement data

Data	Description
No.	Number of the measurement
Measurement	Arrangement of the measurement
Test mode	Test mode according to the IEEE Std 62-1995
Sweep	Swept variable: frequency, voltage, or none
V test	Test voltage
Freq.	Test frequency
V out	Measured output voltage
I out	Measured output current
Watt losses	Measured losses
PF meas.	Measured power factor
PF corr.	Corrected measured power factor
PF ref.	Reference power factor
Cap. meas.	Measured capacitance
Assessment	Measurement assessment

16.3 Spare Bushing PF & CAP – C2

⚠ DANGER

Death or severe injury caused by high voltage or current

- ▶ Never use the *CP TD* without a solid connection to ground with at least 6 mm².
- ▶ Use a ground point as close as possible to the test object.
- ▶ Make sure to position the test object in the danger zone.

⚠ DANGER

Death or severe injury caused by high voltage or current

The high-voltage cable is double shielded and therefore safe. However, the last 50 cm (20 in) of this cable have no shield.

- ▶ Avoid any direct contact of this part of the cable to ground potential and any objects.
- ▶ During a test, consider this part of the cable a live wire and life threatening.

Note: This test name depends on the **Profile** selected in the **Settings**.

- IEEE standard: **Spare Bushing PF & CAP – C2**
- IEC standard: **Spare Bushing DF & CAP – C2**
- Custom profile: **Spare Bushing Tanδ & CAP – C2**

In this section, the terms **Power Factor (PF)** and **Spare Bushing PF & CAP – C2** will be used.

The following table describes the Spare Bushing PF & CAP – C2 test settings.

Table 16-5: Spare Bushing PF & CAP – C2 test settings

Setting	Description
Measurement settings	
Test frequency	Test frequency
Noise suppression settings	
Averaging (no. points)	Number of averaged measurements
Bandwidth	Filter bandwidth
Device settings	
Tan delta device	▶ Select your CP TD device: • **CP TD1** • **CP TD12** • **CP TD15**
Enable shield check	▶ Select the **Enable shield check** check box if you want the device to check if the high-voltage cable shield is connected.
Use beeper	▶ Select the **Use beeper** check box if you want to use the *CP TD* beeper during the measurement.
Test conditions	
Custom test conditions	▶ Select the **Custom test conditions** check box to set test conditions differing from the global test conditions.
Ambient temperature	Ambient temperature on site
Humidity	Relative ambient humidity
Weather	Weather during the test
Correction factors	
Temperature correction	▶ Select the **Temperature correction** check box to activate temperature correction.
Correction factor	Temperature correction factor
Use reference voltage	▶ Select the **Use reference voltage** check box to extrapolate the I out and Watt losses results for the specified reference voltage.
Reference voltage	Reference voltage for extrapolation of measurement results **Note:** The Reference voltage can be set up to 15 kV regardless of which *CP TD* device is used.

The following table describes the Spare Bushing PF & CAP – C2 measurement data.

Table 16-6: Spare Bushing PF & CAP – C2 measurement data

Data	Description
No.	Number of the measurement
Measurement	Arrangement of the measurement
Test mode	Test mode according to the IEEE Std 62-1995
V test	Test voltage
Freq.	Test frequency
V out	Measured output voltage
I out	Measured output current
Watt losses	Measured losses
PF meas.	Measured power factor
PF corr.	Corrected measured power factor
PF ref.	Reference power factor
Cap. meas.	Measured capacitance
Assessment	Measurement assessment

16.4 Spare Bushing PF & CAP – C1+C2

⚠ DANGER

Death or severe injury caused by high voltage or current

- ▶ Never use the *CP TD* without a solid connection to ground with at least 6 mm².
- ▶ Use a ground point as close as possible to the test object.
- ▶ Make sure to position the test object in the danger zone.

⚠ DANGER

Death or severe injury caused by high voltage or current

The high-voltage cable is double shielded and therefore safe. However, the last 50 cm (20 in) of this cable have no shield.

- ▶ Avoid any direct contact of this part of the cable to ground potential and any objects.
- ▶ During a test, consider this part of the cable a live wire and life threatening.

Note: This test name depends on the **Profile** selected in the **Settings**.

- IEEE standard: **Spare Bushing PF & CAP – C1+C2**
- IEC standard: **Spare Bushing DF & CAP – C1+C2**
- Custom profile: **Spare Bushing Tanδ & CAP – C1+C2**

In this section, the terms **Power Factor (PF)** and **Spare Bushing PF & CAP – C1+C2** will be used.

The following table describes the Spare Bushing PF & CAP – C1+C2 test settings.

Table 16-7: Spare Bushing PF & CAP – C1+C2 test settings

Setting	Description
Measurement settings	
Test frequency	Test frequency
Noise suppression settings	
Averaging (no. points)	Number of averaged measurements
Bandwidth	Filter bandwidth
Device settings	
Tan delta device	▶ Select your *CP TD* device: • **CP TD1** • **CP TD12** • **CP TD15**
Enable shield check	▶ Select the **Enable shield check** check box if you want the device to check whether the high-voltage cable shield is connected.
Use beeper	▶ Select the **Use beeper** check box if you want to use the *CP TD*'s beeper during the measurement.
Test conditions	
Custom test conditions	▶ Select the **Custom test conditions** check box to set test conditions differing from the global test conditions.
Ambient temperature	Ambient temperature on site
Humidity	Relative ambient humidity
Weather	Weather during the test
Correction factors	
Temperature correction	▶ Select the **Temperature correction** check box to activate temperature correction.
Correction factor	Temperature correction factor
Use reference voltage	▶ Select the **Use reference voltage** check box to extrapolate the I out and Watt losses results for the specified reference voltage.
Reference voltage	Reference voltage for extrapolation of measurement results **Note:** The Reference voltage can be set up to 15 kV regardless of which *CP TD* device is used.

The following table describes the Spare Bushing PF & CAP – C1+C2 measurement data.

Table 16-8: Spare Bushing PF & CAP – C1+C2 measurement data

Data	Description
No.	Number of the measurement
Measurement	Arrangement of the measurement
Test mode	Test mode according to the IEEE Std 62-1995
V test	Test voltage
Freq.	Test frequency
V out	Measured output voltage
I out	Measured output current

Data	Description
Watt losses	Measured losses
PF meas.	Measured power factor
PF corr.	Corrected measured power factor
Cap. meas.	Measured capacitance
Assessment	Measurement assessment

16.5 Spare Bushing – Energized Collar

⚠ DANGER

Death or severe injury caused by high voltage or current

- ▶ Never use the *CP TD* without a solid connection to ground with at least 6 mm².
- ▶ Use a ground point as close as possible to the test object.
- ▶ Make sure to position the test object in the danger zone.

⚠ DANGER

Death or severe injury caused by high voltage or current

The high-voltage cable is double shielded and therefore safe. However, the last 50 cm (20 in) of this cable have no shield.

- ▶ Avoid any direct contact of this part of the cable to ground potential and any objects.
- ▶ During a test, consider this part of the cable a live wire and life threatening.

The following table describes the Spare Bushing – Energized Collar test settings.

Table 16-9: Spare Bushing – Energized Collar test settings

Setting	Description
Measurement settings	
Test frequency	Test frequency
Noise suppression settings	
Averaging (no. points)	Number of averaged measurements
Bandwidth	Filter bandwidth
Device settings	
Tan delta device	▶ Select your *CP TD* device: • **CP TD1** • **CP TD12** • **CP TD15**
Enable shield check	▶ Select the **Enable shield check** check box if you want the device to check if the high-voltage cable shield is connected.

Setting	Description
Use beeper	▶ Select the **Use beeper** check box if you want to use the *CP TD*'s beeper during the measurement.
Test conditions	
Custom test conditions	▶ Select the **Custom test conditions** check box to set test conditions differing from the global test conditions.
Ambient temperature	Ambient temperature on site
Humidity	Relative ambient humidity
Weather	Weather during the test
Correction factors	
Use reference voltage	▶ Select the **Use reference voltage** check box to extrapolate the I out and Watt losses results for the specified reference voltage.
Reference voltage	Reference voltage for extrapolation of measurement results **Note:** The Reference voltage can be set up to 15 kV regardless of which *CP TD* device is used.

The following table describes the Spare Bushing – Energized Collar measurement data.

Table 16-10: Spare Bushing – Energized Collar measurement data

Data	Description
No.	Number of the measurement
Measurement	Arrangement of the measurement
Test mode	Test mode according to the IEEE Std 62-1995
V test	Test voltage
Freq.	Test frequency
V out	Measured output voltage
I out	Measured output current
Watt losses	Measured losses
Assessment	Measurement assessment

17 Circuit breaker tests

In this chapter, the settings and measurement data of the circuit breaker tests are described. For more information about testing with the *CPC 100*, see the CPC 100 User Manual included with your test system.

Some test names depend on the **Profile** selected in the **Settings** (→ Settings (page 28)). For your convenience, you can use your preferred naming:

- ▶ IEEE standard: **Power factor (PF)** for the loss indicator.
- ▶ IEC standard: **Dissipation factor (DF)** for the loss indicators.
- ▶ Custom profiles: **Power factor (PF)**, **Dissipation factor (DF)** or **Tangent delta (Tanδ)** for the loss indicator.
  - ➔ The dissipation factor and the tangent delta are identical characteristics of the primary asset under test.

The *Primary Test Manager* supports the following circuit breaker tests:

- Circuit Breaker PF & CAP (page 180)
- Bushing PF & CAP – C1 (page 183)
- Bushing PF & CAP – C2 (page 186)
- Bushing – Energized Collar (page 188)
- Insulating Fluids PF & CAP (page 189)
- Contact Resistance (page 191)

The *Primary Test Manager* also supports the **TanDelta – PF/DF/Tanδ & CAP** manual test.

▶ For more information, see Manual Tan Delta (page 237).

17.1 Circuit Breaker PF & CAP

⚠ DANGER

Death or severe injury caused by high voltage or current

- ▶ Never use the *CP TD* without a solid connection to ground with at least 6 mm².
- ▶ Use a ground point as close as possible to the test object.
- ▶ Make sure to position the test object in the danger zone.

⚠ DANGER

Death or severe injury caused by high voltage or current

The high-voltage cable is double shielded and therefore safe. However, the last 50 cm (20 in) of this cable have no shield.

- ▶ Avoid any direct contact of this part of the cable to ground potential and any objects.
- ▶ During a test, consider this part of the cable a live wire and life threatening.

Note: This test name depends on the **Profile** selected in the **Settings**.

- IEEE standard: **Circuit Breaker PF & CAP**
- IEC standard: **Circuit Breaker DF & CAP**
- Custom profile: **Circuit Breaker Tanδ & CAP**

In this section, the terms **Power Factor (PF)** and **Circuit Breaker PF & CAP** will be used.

The following table describes the Circuit Breaker PF & CAP test settings.

Table 17-1: Circuit Breaker PF & CAP test settings

Setting	Description
Measurement settings	
Test frequency	Frequency of the test
Sweep settings	
Frequency sweep	Sweep profile: **None**: no frequency sweep **OMICRON expertise**: sweep frequencies dynamically distributed within the CPC 100 frequency range for optimum results (recommended*) **CPC template**: sweep frequencies specified by the CPC 100 test templates
Voltage sweep (tip-up)	Sweep profile: **None**: no voltage sweep **OMICRON expertise**: sweep voltages dynamically distributed within the asset-dependent voltage range for optimum results
Sweep profiles	▶ Click the pen button to create a frequency or voltage sweep profile. ▶ Add up to 30 measurement points with individual output voltages or frequencies. Double-click a value to change it. ▶ Mark a favorite to use it as the default sweep profile for future tests. **Note:** The predefined profiles None, OMICRON expertise and CPC template cannot be edited or deleted. The default sweep profiles for this test are: Frequency sweep: None Voltage sweep: None
Noise suppression settings	
Averaging (no. points)	Number of averaged measurements
Bandwidth	CPC 100 filter bandwidth

Setting	Description
Device settings	
Tan delta device	▶ Select your CP TD device: • **CP TD1** • **CP TD12** • **CP TD15**
Enable shield check	▶ Select the **Enable shield check** check box if you want *CPC 100* to check if the high-voltage cable shield is connected.
Use beeper	▶ Select the **Use beeper** check box if you want to use the *CP TD* beeper during the measurement.
Test conditions	
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 on site
Humidity	Relative ambient humidity
Weather	Weather during the test
Correction factors	
Temperature correction	▶ Select the **Temperature correction** check box to activate temperature correction.
Correction factor	Temperature correction factor
Use reference voltage	▶ Select the **Use reference voltage** check box to extrapolate the I out and Watt losses results for the specified reference voltage.
Reference voltage	Reference voltage for extrapolation of measurement results **Note:** The Reference voltage can be set up to 15 kV regardless of which CP TD device is used.

The following table describes the Circuit Breaker PF & CAP measurement data.

Table 17-2: Circuit Breaker PF & CAP measurement data

Data	Description
No.	Number of the measurement
Measurement	Tested insulation
Position	Contact position of the breaker
Test mode	Test mode according to the IEEE Std 62-1995
Sweep	Swept variable: frequency, voltage, or none
V test	Test voltage
Freq.	Test frequency
V out	Measured output voltage
I out	Measured output current
Watt losses	Measured losses
Cap. meas.	Measured capacitance
PF meas.	Measured power factor
PF corr.	Corrected measured power factor
Assessment	Measurement assessment

17.2 Bushing PF & CAP – C1

⚠ DANGER

Death or severe injury caused by high voltage or current

- ▶ Never use the *CP TD* without a solid connection to ground with at least 6 mm².
- ▶ Use a ground point as close as possible to the test object.
- ▶ Make sure to position the test object in the danger zone.

⚠ DANGER

Death or severe injury caused by high voltage or current

The high-voltage cable is double shielded and therefore safe. However, the last 50 cm (20 in) of this cable have no shield.

- ▶ Avoid any direct contact of this part of the cable to ground potential and any objects.
- ▶ During a test, consider this part of the cable a live wire and life threatening.

Note: This test name depends on the **Profile** selected in the **Settings**.

- IEEE standard: **Bushing PF & CAP – C1**
- IEC standard: **Bushing DF & CAP – C1**
- Custom profile: **Circuit Breaker Tanδ & CAP – C1**

In this section, the terms **Power Factor (PF)** and **Bushing PF & CAP – C1** will be used.

The following table describes the Bushing PF & CAP – C1 test settings.

Table 17-3: Bushing PF & CAP – C1 test settings

Setting	Description
Measurement settings	
Test frequency	Test frequency
Sweep settings	
Frequency sweep	Sweep profile: **None**: no frequency sweep **OMICRON expertise**: sweep frequencies dynamically distributed within the *CPC 100* frequency range for optimum results (recommended*) **CPC template**: sweep frequencies specified by the *CPC 100* test templates
Voltage sweep (tip-up)	Sweep profile: **None**: no voltage sweep **OMICRON expertise**: sweep voltages dynamically distributed within the asset-dependent voltage range for optimum results
Sweep profiles	▶ Click the pen button to create a frequency or voltage sweep profile. ▶ Add up to 30 measurement points with individual output voltages or frequencies. Double-click a value to change it. ▶ Mark a favorite to use it as the default sweep profile for future tests. **Note:** The predefined profiles None, OMICRON expertise and CPC template cannot be edited or deleted. The default sweep profiles for this test are: Frequency sweep: None Voltage sweep: None
Noise suppression settings	
Averaging (no. points)	Number of averaged measurements
Bandwidth	*CPC 100* filter bandwidth
Device settings	
Tan delta device	▶ Select your *CP TD* device: • **CP TD1** • **CP TD12** • **CP TD15**
Enable shield check	▶ Select the **Enable shield check** check box if you want the *CPC 100* to check if the high-voltage cable shield is connected.
Use beeper	▶ Select the **Use beeper** check box if you want to use the *CP TD* beeper during the measurement.

Setting	Description
Test conditions	
Custom test conditions	▶ Select the **Custom test conditions** check box if you want to set test conditions different from the job conditions.
Ambient temperature	Ambient temperature on site
Humidity	Relative ambient humidity
Weather	Weather during the test
Correction factors	
Temperature correction	▶ Select the **Temperature correction** check box to activate temperature correction.
Correction factor	Temperature correction factor
Use reference voltage	▶ Select the **Use reference voltage** check box to extrapolate the I out and Watt losses results for the specified reference voltage.
Reference voltage	Reference voltage for extrapolation of measurement results **Note:** The Reference voltage can be set up to 15 kV regardless of which CP TD device is used.

The following table describes the Bushing PF & CAP – C1 measurement data.

Table 17-4: Bushing PF & CAP – C1 measurement data

Data	Description
No.	Number of the measurement
Measurement	Terminal name of the bushing under test
Test mode	Test mode according to the IEEE Std 62-1995
Sweep	Swept variable: frequency, voltage, or none
V test	Test voltage
Freq.	Test frequency
V out	Measured output voltage
I out	Measured output current
Watt losses	Measured losses
Cap. meas.	Measured capacitance
PF meas.	Measured power factor
PF corr.	Corrected measured power factor
Assessment	Measurement assessment

17.3 Bushing PF & CAP – C2

⚠ DANGER

Death or severe injury caused by high voltage or current

- ▶ Never use the *CP TD* without a solid connection to ground with at least 6 mm².
- ▶ Use a ground point as close as possible to the test object.
- ▶ Make sure to position the test object in the danger zone.

⚠ DANGER

Death or severe injury caused by high voltage or current

The high-voltage cable is double shielded and therefore safe. However, the last 50 cm (20 in) of this cable have no shield.

- ▶ Avoid any direct contact of this part of the cable to ground potential and any objects.
- ▶ During a test, consider this part of the cable a live wire and life threatening.

Note: This test name depends on the **Profile** selected in the **Settings**.

- IEEE standard: **Bushing PF & CAP – C2**
- IEC standard: **Bushing DF & CAP – C2**
- Custom profile: **Bushing Tanδ & CAP – C2**

In this section, the terms **Power Factor (PF)** and **Bushing PF & CAP – C2** will be used.

The following table describes the Bushing PF & CAP – C2 test settings.

Table 17-5: Bushing PF & CAP – C2 test settings

Setting	Description
Measurement settings	
Test frequency	Test frequency
Test voltage	Test voltage
Noise suppression settings	
Averaging (no. points)	Number of averaged measurements
Bandwidth	*CPC 100* filter bandwidth
Device settings	
Tan delta device	▶ Select your *CP TD* device: • **CP TD1** • **CP TD12** • **CP TD15**
Enable shield check	▶ Select the **Enable shield check** check box if you want the *CPC 100* to check if the high-voltage cable shield is connected.
Use beeper	▶ Select the **Use beeper** check box if you want to use the *CP TD* beeper during the measurement.

Setting	Description
Test conditions	
Custom test conditions	▶ Select the **Custom test conditions** check box if you want to set test conditions different from the job conditions.
Ambient temperature	Ambient temperature on site
Humidity	Relative ambient humidity
Weather	Weather during the test
Correction factors	
Temperature correction	▶ Select the **Temperature correction** check box to activate temperature correction.
Correction factor	Temperature correction factor
Use reference voltage	▶ Select the **Use reference voltage** check box to extrapolate the I out and Watt losses results for the specified reference voltage.
Reference voltage	Reference voltage for extrapolation of measurement results **Note:** The Reference voltage can be set up to 15 kV regardless of which CP TD device is used.

The following table describes the Bushing PF & CAP – C2 measurement data.

Table 17-6: Bushing PF & CAP – C2 measurement data

Data	Description
No.	Number of the measurement
Measurement	Terminal name of the bushing under test
Test mode	Test mode according to the IEEE Std 62-1995
V test	Test voltage
Freq.	Test frequency
V out	Measured output voltage
I out	Measured output current
Watt losses	Measured losses
Cap. meas.	Measured capacitance
PF meas.	Measured power factor
PF corr.	Corrected measured power factor
Assessment	Measurement assessment

17.4 Bushing – Energized Collar

⚠ DANGER

Death or severe injury caused by high voltage or current

- ▶ Never use the *CP TD* without a solid connection to ground with at least 6 mm².
- ▶ Use a ground point as close as possible to the test object.
- ▶ Make sure to position the test object in the danger zone.

⚠ DANGER

Death or severe injury caused by high voltage or current

The high-voltage cable is double shielded and therefore safe. However, the last 50 cm (20 in) of this cable have no shield.

- ▶ Avoid any direct contact of this part of the cable to ground potential and any objects.
- ▶ During a test, consider this part of the cable a live wire and life threatening.

The following table describes the Bushing – Energized Collar test settings.

Table 17-7: Bushing – Energized Collar test settings

Setting	Description
Measurement settings	
Test frequency	Test frequency
Test voltage	Test voltage
Noise suppression settings	
Averaging (no. points)	Number of averaged measurements
Bandwidth	*CPC 100* filter bandwidth
Device settings	
Tan delta device	▶ Select your *CP TD* device: • **CP TD1** • **CP TD12** • **CP TD15**
Enable shield check	▶ Select the **Enable shield check** check box if you want *CPC 100* to check if the high-voltage cable shield is connected.
Use beeper	▶ Select the **Use beeper** check box if you want to use the *CP TD* beeper during the measurement.
Test conditions	
Custom test conditions	▶ Select the **Custom test conditions** check box if you want to set test conditions different from the job conditions.
Ambient temperature	Ambient temperature on site
Humidity	Relative ambient humidity
Weather	Weather during the test

Setting Correction factors	Description
Use reference voltage	▶ Select the **Use reference voltage** check box to extrapolate the I out and Watt losses results for the specified reference voltage.
Reference voltage	Reference voltage for extrapolation of measurement results **Note:** The Reference voltage can be set up to 15 kV regardless of which CP TD device is used.

The following table describes the Bushing – Energized Collar measurement data.

Table 17-8: Bushing – Energized Collar measurement data

Data	Description
No.	Number of the measurement
Measurement	Terminal name of the bushing under test
Test mode	Test mode according to the IEEE Std 62-1995
V test	Test voltage
Freq.	Test frequency
V out	Measured output voltage
I out	Measured output current
Watt losses	Measured losses
Assessment	Measurement assessment

17.5 Insulating Fluids PF & CAP

⚠ DANGER

Death or severe injury caused by high voltage or current

- ▶ Never use the *CP TD* without a solid connection to ground with at least 6 mm².
- ▶ Use a ground point as close as possible to the test object.
- ▶ Make sure to position the test object in the danger zone.

⚠ DANGER

Death or severe injury caused by high voltage or current

The high-voltage cable is double shielded and therefore safe. However, the last 50 cm (20 in) of this cable have no shield.

- ▶ Avoid any direct contact of this part of the cable to ground potential and any objects.
- ▶ During a test, consider this part of the cable a live wire and life threatening.

Note: This test name depends on the **Profile** selected in the **Settings**.

- IEEE standard: **Insulating Fluids PF & CAP**
- IEC standard: **Insulating Fluids DF & CAP**
- Custom profile: **Insulating Fluids Tanδ & CAP**

In this section, the terms **Power Factor (PF)** and **Insulating Fluids PF & CAP** will be used.

The following table describes the Insulating Fluids PF & CAP test settings.

Table 17-9: Insulating Fluids PF & CAP test settings

Setting	Description
Measurement settings	
Test frequency	Test frequency
Test voltage	Test voltage
Noise suppression settings	
Averaging (no. points)	Number of averaged measurements
Bandwidth	*CPC 100* filter bandwidth
Device settings	
Tan delta device	▶ Select your *CP TD* device: • **CP TD1** • **CP TD12** • **CP TD15**
Enable shield check	▶ Select the **Enable shield check** check box if you want *CPC 100* to check if the high-voltage cable shield is connected.
Use beeper	▶ Select the **Use beeper** check box if you want to use the *CP TD* beeper during the measurement.
Test conditions	
Oil temperature	Temperature of the oil
Custom test conditions	▶ Select the **Custom test conditions** check box to set test conditions differing from the global test conditions.
Ambient temperature	Ambient temperature on site
Correction factors	
Temperature correction	▶ Select the **Temperature correction** check box to activate temperature correction.
Correction factor	Temperature correction factor
Use reference voltage	▶ Select the **Use reference voltage** check box to extrapolate the I out and Watt losses results for the specified reference voltage.
Reference voltage	Reference voltage for extrapolation of measurement results **Note:** The Reference voltage can be set up to 15 kV regardless of which CP TD device is used.

The following table describes the Insulating Fluids PF & CAP measurement data.

Table 17-10: Insulating Fluids PF & CAP measurement data

Data	Description
No.	Number of the measurement

Data	Description
Specimen	Oil sample under test
Test mode	Test mode according to the IEEE Std 62-1995
V Test	Test voltage
Freq.	Test frequency
V out	Measured output voltage
I out	Measured output current
Watt losses	Measured losses
Cap. meas.	Measured capacitance
PF meas.	Measured power factor
PF corr.	Corrected measured power factor
Assessment	Measurement assessment

17.6 Contact Resistance

⚠ DANGER

Death or severe injury caused by high voltage or current

- ▶ Do not use the Resistance test card to measure the resistance of inductive test objects. Turning off the DC source results in dangerous voltage levels. There is no discharge functionality when using the Resistance test card.

⚠ WARNING

Death or severe injury caused by high voltage or current possible

- ▶ Do not use external power sources for the circuit breaker's main contacts.
- ▶ During the test, supply the circuit breaker's main contacts only with *CPC 100*.

The following table describes the Contact Resistance test settings.

Table 17-11: Contact Resistance test settings

Setting	Description
Measurement settings	
Test current	Test current
Manual input of V DC	▶ Select the **Manual input of V DC** check box to enter the V DC manually instead of measuring it.
Automatic result	▶ Select the **Automatic result** check box to stop the measurement automatically depending on the tolerance R dev and the settling time.
Tolerance R dev	Tolerance of the deviation of consecutive measurement results within the settling time

Setting	Description
Settling time (Δt)	Time within which the deviation of consecutive measurement results is evaluated. If the deviation is less than the tolerance R dev, the measurement stops.
Test conditions	
Custom test conditions	▶ Select the **Custom test conditions** check box to set test conditions differing from the global test conditions.
Ambient temperature	Ambient temperature on site
Assessment settings	
Manual	▶ Click **Manual** to select the manual assessment settings.
Automatic	▶ Click **Automatic** to select the automatic assessment settings.

NOTICE

Equipment damage or loss of data possible

Before making a decision based on the *Primary Test Manager*'s automatic assessment, read the disclaimer.

Editing automatic assessment settings

To edit the automatic assessment settings:

1. In the **Settings and conditions** pane, click **Edit test limits**.
2. In the **Edit automatic assessment limits** dialog box, enter the absolute or relative limits.

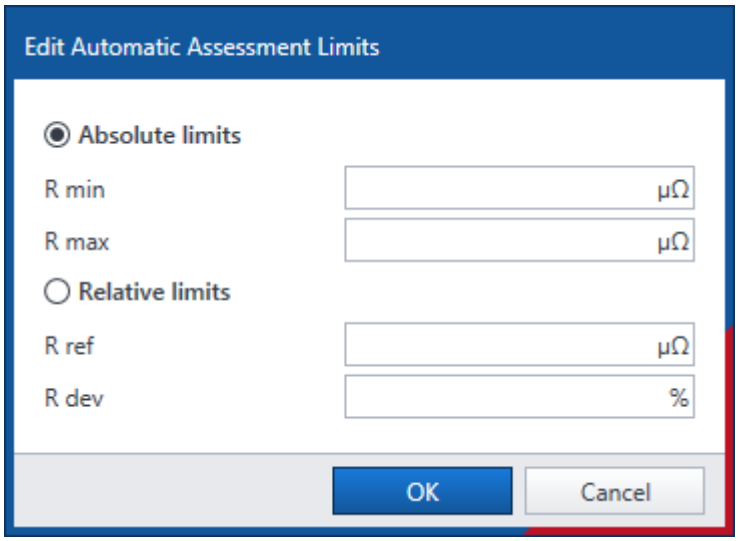


Figure 17-1: Edit automatic assessment limits dialog box

The following table describes the Contact Resistance measurement data.

Table 17-12: Contact Resistance measurement data

Data	Description
Main contact	Main contact of the circuit breaker under test

Data	Description
I DC	Measured current
V DC	Measured voltage
R meas	Measured resistance
R min	Minimum assessment limit
R max	Maximum assessment limit
Assessment	Measurement assessment

If you did not select the **Automatic result** check box to stop the measurement automatically, you can stop the measurement by clicking the Keep results button.

18 Current transformer tests

In this chapter, the settings and measurement data of the current transformer tests are described. For more information about testing with the *CPC 100*, see the CPC 100 User Manual shipped with your test system.

Some test names depend on the **Profile** selected in the **Settings** (→ Settings (page 28)). For your convenience, you can use your preferred naming:

- ▶ IEEE standard: **Power factor (PF)** for the loss indicator.
- ▶ IEC standard: **Dissipation factor (DF)** for the loss indicators.
- ▶ Custom profiles: **Power factor (PF)**, **Dissipation factor (DF)** or **Tangent delta (Tanδ)** for the loss indicator.
  - ➜ The dissipation factor and the tangent delta are identical characteristics of the primary asset under test.

Primary Test Manager supports the following current transformer tests:

- CT PF & CAP (page 195)
- CT Ratio (page 198)
- CT Winding Resistance Sec (page 200)
- CT Excitation (page 202) (Only available for IEC 60044 and IEEE C57.13)
- CT Ratio V (page 203)
- CT Burden (page 204)
- CT Composite Error (page 205)

Primary Test Manager also supports the **TanDelta – PF & CAP** manual test.

▶ For more information, see Manual Tan Delta (page 237).

18.1 CT PF & CAP

⚠ DANGER

Death or severe injury caused by high voltage or current

- ▶ Never use the *CP TD* without a solid connection to ground with at least 6 mm².
- ▶ Use a ground point as close as possible to the test object.
- ▶ Make sure to position the test object in the danger zone.

⚠ DANGER

Death or severe injury caused by high voltage or current

The high-voltage cable is double shielded and therefore safe. However, the last 50 cm (20 in) of this cable have no shield.

- ▶ Avoid any direct contact of this part of the cable to ground potential and any objects.
- ▶ During a test, consider this part of the cable a live wire and life threatening.

Note: This test name depends on the **Profile** selected in the **Settings**.

- IEEE standard: **CT PF & CAP**
- IEC standard: **CT DF & CAP**
- Custom profile: **CT Tanδ & CAP**

In this section, the terms **Power factor (PF)** and **CT PF & CAP** will be used.

The following table describes the CT PF & CAP test settings.

Table 18-1: CT PF & CAP test settings

Setting	Description
Measurement settings	
Test frequency	Frequency of the output signal
HV-shield connectable	▶ Select the **HV-shield connectable** check box if the HV screen or shield of the current transformer is accessible.
Sweep settings	
Frequency sweep	Sweep profile: **None**: no frequency sweep **OMICRON expertise**: sweep frequencies dynamically distributed within the *CPC 100* frequency range for optimum results (recommended*) **CPC template**: sweep frequencies specified by the *CPC 100* test templates

Setting	Description
Voltage sweep (tip-up)	Sweep profile: **None**: no voltage sweep **OMICRON expertise**: sweep voltages dynamically distributed within the asset-dependent voltage range for optimum results
Sweep profiles	▶ Click the pen button to create a frequency or voltage sweep profile. ▶ Add up to 30 measurement points with individual output voltages or frequencies. Double-click a value to change it. ▶ Mark a favorite to use it as the default sweep profile for future tests. **Note:** The predefined profiles None, OMICRON expertise and CPC template cannot be edited or deleted. The default sweep profiles for this test are: • Frequency sweep: OMICRON • Voltage sweep: None
Noise suppression settings	
Averaging (no. points)	Number of averaged measurements
Bandwidth	*CPC 100* filter bandwidth
Avoid test frequency	If this setting is active, the measurement will not be performed at the **Test frequency** set in the **Measurement** section. The *Primary Test Manager* will instead measure two values at frequencies below and above the entered **Test frequency** and calculate the median of those two values. The **Avoid test frequency** setting is predefined for the selected test. ▶ Only change the default setting for special applications.
Device settings	
Tan delta device	▶ Select your *CP TD* device: • **CP TD1** • **CP TD12** • **CP TD15**
Enable shield check	▶ Select the **Enable shield check** check box if you want the *CPC 100* to check if the high-voltage cable shield is connected.
Use beeper	▶ Select the **Use beeper** check box if you want to use the *CP TD* beeper during the measurement.
Test conditions	
Custom test conditions	▶ Select the **Custom test conditions** check box to set test conditions differing from the global test conditions.
CT oil temperature	Oil temperature of the current transformer
Ambient temperature	Ambient temperature on site
Humidity	Relative ambient humidity

Setting	Description
Weather	Weather during the test
Correction factors	
Temperature correction	▶ Select the **Temperature correction** check box to activate temperature correction.
Correction factor	Temperature correction factor
Use reference voltage	▶ Select the **Use reference voltage** check box to extrapolate the I out and Watt losses results for the specified reference voltage.
Reference voltage	Reference voltage for extrapolation of measurement results **Note:** The Reference voltage can be set up to 15 kV regardless of which CP TD device is used.

The following table describes the CT PF & CAP measurement data.

Table 18-2: CT PF & CAP measurement data

Data	Description
Measurement	Arrangement of the measurement
Test mode	Test mode according to the IEEE Std 62-1995
Sweep	Swept variable: frequency, voltage, or none
V test	Test voltage
Freq.	Test frequency
V out	Measured output voltage
I out	Measured output current
Watt losses	Measured losses
Cap. meas	Measured capacitance
PF meas	Measured power factor
PF corr	Corrected measured power factor
Assessment	Measurement assessment

18.2 CT Ratio

The following table describes the CT Ratio test settings.

⚠ DANGER

Death or severe injury caused by high voltage or current

- ▶ Ensure that no secondary CT windings are open.

⚠ DANGER

Death or severe injury caused by high voltage or current

Feeding test voltage to a tap of a CT can cause life-threatening voltages on other taps and windings.

- ▶ Do not touch tapped windings.
- ▶ Make sure that no secondary CT windings are open.

⚠ DANGER

Death or severe injury caused by high voltage or current

- ▶ Do not touch other taps or windings of the CT during the test. They carry life-threatening voltage.
- ▶ Do not exceed the current specification of the CT.
- ▶ When testing multi-core CTs, make sure that no other windings of the CT are open. Leave the secondary windings of the other (non-measured) cores connected, or short-circuit them if the windings are open.

Table 18-3: CT Ratio test settings

Setting	Description
Measurement settings	
CPC output	Selected output range for the current transformer test
Manual measurement I sec	▶ Select the **Manual measurement I sec** check box to enter the I sec manually, for example, if I sec was measured with an external current clamp not connected to the *CPC 100*.
Use current clamp	▶ Select the **Use current clamp** check box if you want to use current clamp.
I clamp	Current of the clamp
Clamp factor	Ratio of the clamp
Assessment settings	
Manual	▶ Click **Manual** to select the manual assessment settings.
Automatic	▶ Click **Automatic** to select the automatic assessment settings.

NOTICE

Equipment damage or loss of data possible

Before making a decision based on the *Primary Test Manager*'s automatic assessment, read the disclaimer.

Editing automatic assessment settings

To edit the automatic assessment settings:

1. In the Settings and conditions pane, click **Edit test limits**.

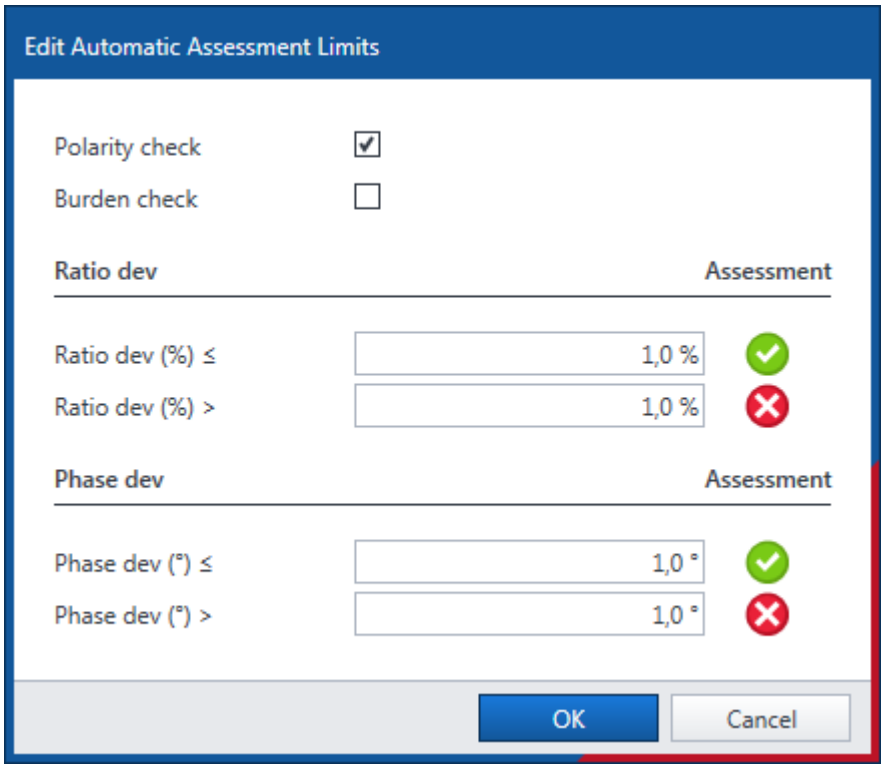


Figure 18-1: Edit automatic assessment limits dialog box

2. In the **Edit automatic assessment limits** dialog box, enter the assessment limits.

The following table describes the CT Ratio measurement data.

Table 18-4: CT Ratio measurement data

Data	Description
Tap	Identification of the tap under test
Ipn[1]/Ipr[2]	Rated primary current of the current transformer
Isn[1]/Isr[2]	Rated secondary current of the current transformer
Auto	Select the **Auto** check box to stop the measurement automatically. Otherwise, the result is saved when you press **Keep results**.
I test	Test current at the primary side of the current transformer
Frequency	Frequency of the output signal
I prim	Measured current at the primary side of the current transformer
I sec	Measured secondary current of the current transformer
Ratio	Measured ratio of the current transformer
Ratio dev	Deviation of the measured ratio from the rated ratio
Phase	Measured phase displacement between the primary and secondary current
Polarity	Polarity status
Measure burden	Select the **Measure burden** check box to measure the connected secondary burden in VA.
Manual input V sec	Select the **Manual input V sec** check box to enter the measured secondary voltage at the burden manually, for example, if it is measured with an external device.
V sec	Measured secondary voltage on the burden
Burden	Measured burden in VA related to the rated secondary current
Burden nom.	Rated power of the current transformer
Phase burden	Phase angle of the complex secondary burden
Cos φ	Phase angle of the complex rated secondary burden
In use	Tap on which the CT is operated
Assessment	Measurement assessment

1 According to IEC 60444.

2 According to IEC 61869 and IEEE C57.13.

18.3 CT Winding Resistance Sec

⚠ DANGER

Death or severe injury caused by high voltage or current

- ▶ Never use the *CP TD* without a solid connection to ground with at least 6 mm².
- ▶ Use a ground point as close as possible to the test object.
- ▶ Make sure to position the test object in the danger zone.

⚠ DANGER

Death or severe injury caused by high voltage or current

The high-voltage cable is double shielded and therefore safe. However, the last 50 cm (20 in) of this cable have no shield.

- ▶ Avoid any direct contact of this part of the cable to ground potential and any objects.
- ▶ During a test, consider this part of the cable a live wire and life threatening.

⚠ DANGER

Death or severe injury caused by high voltage or current

Injecting direct current into test objects with inductive characteristics will charge the winding of the test object.

- ▶ Do not exceed the current specification of the CT.
- ▶ Never open the measuring circuit while current flows.
- ▶ Make sure that no secondary windings are open.
- ▶ Before disconnecting from the test set, connect the device under test on both ends to protective ground.
- ▶ Ground all terminals of the test object before touching the test setup.
- ▶ Short-circuit the terminals before disconnecting the test leads.
- ▶ Disconnect cables not used for testing both from the device under test and the test set.

The following table describes the CT Winding Resistance Sec test settings.

Table 18-5: CT Winding Resistance Sec test settings

Setting	Description
Temperature compensation for Cu	
Winding temperature	Temperature of the transformer's winding
Reference temperature	Reference temperature to be used for temperature correction

The transformer's core is magnetized after the measurement. Demagnetization can be done using the CTExcitation test (→ CT Excitation (page 202)**).**

Table 18-6: CT Winding Resistance Sec measurement data

Setting	Description
Tap	Identification of the tap under test
Ipn[1]/Ipr[2]	Rated primary current of the current transformer
Isn[1]/Isr[2]	Rated secondary current of the current transformer
CPC output	Selected output range for the current transformer test
I test	Test current
I DC	Measured current
V DC	Measured voltage

Setting	Description
R meas	Measured resistance
R corr	Corrected measured resistance
In use	Tap on which the CT is operated
Assessment	Measurement assessment

[1] According to IEC 60444.

[2] According to IEC 61869 and IEEE C57.13.

18.4 CT Excitation

⚠ DANGER

Death or severe injury caused by high voltage or current

Feeding test voltage to a tap of a CT can cause dangerous voltages on other taps and windings.

- ▶ Do not touch tapped windings
- ▶ Make sure that no other secondary windings are open.

The following table describes the CT Excitation test settings.

Table 18-7: CT Excitation test settings

Setting	Description
Measurement settings	
Test frequency	Frequency of the output signal
Noise suppression	▶ Select the **Noise suppression** check box to activate an interference filter.

1. Click the **Plot** tab to view the excitation curve diagram.
2. Use the **Tab** check boxes to hide/unhide individual curves.

Table 18-8: CT Excitation measurement data

Setting	Description
Tap	Identification of the tap under test
Ipn	Rated primary current of the current transformer
Isn	Rated secondary current of the current transformer
I max	Maximum test current
V max	Maximum test voltage
I knee	Knee point current
V knee	Knee point voltage
Knee point calculation	Method used for the knee point calculation
In use	Tap on which the CT is operated
Assessment	Measurement assessment

18.5 CT Ratio V

⚠ DANGER

Death or severe injury caused by high voltage or current

Feeding test voltage to a tap of a CT can cause dangerous voltages on other taps and windings.

- ▶ Do not touch tapped windings
- ▶ Make sure that no other secondary windings are open.

The following table describes the CT Ratio V test settings.

Table 18-9: CT Ratio V test settings

Setting	Description
Measurement settings	
Test frequency	Frequency of the output signal

Table 18-10: CT Ratio V measurement data

Setting	Description
Tap	Identification of the tap under test
Ipn[1]/Ipr[2]	Rated primary current of the current transformer
Isn[1]/Isr[2]	Rated secondary current of the current transformer
V test	Test voltage
V sec	Measured secondary voltage
V prim	Measured primary voltage
Ratio	Measured ratio of the current transformer
Ratio dev	Deviation of the measured ratio from the rated ratio
Phase	Measured phase displacement between the primary and secondary current
Polarity	Polarity status
In use	Tap on which the CT is operated
Assessment	Measurement assessment

1 According to IEC 60444.

2 According to IEC 61869 and IEEE C57.13.

If the transformer's knee point voltage is approximated or exceeded due to the transformer's saturation, the measurement results are not correct anymore. If the knee point is significantly exceeded, the transformer can even be damaged. Therefore, the knee point voltage should be known or measured beforehand. Generally, it is advisable to set the test voltage to 75% of the knee point voltage. The frequency should be set between 15 and 20 Hz off the mains frequency to avoid interferences by life systems in the neighborhood.

18.6 CT Burden

⚠ WARNING

Do not exceed the current specification of the burden.

NOTICE

Equipment damage or loss of data possible

Disconnect burden from the CT to avoid measurement errors.

The following table describes the CT Burden test settings.

Table 18-11: CT Burden – Settings and conditions

Setting	Description
Measurement settings	
Test frequency	Frequency of the output signal

The following table describes the CT Burden measurement data.

Table 18-12: CT Burden measurement data

Setting	Description
Tap	Identification of the tap under test
Ipn[1]/Ipr[2]	Rated primary current of the current transformer
Isn[1]/Isr[2]	Rated secondary current of the current transformer
I test	Test current
I meas	Measured burden current
V meas	Measured burden voltage
Phase	Measured phase displacement
Burden (@ Itest)	Burden based on **Itest**
Burden (@ Isn[1]/Isr[2])	Burden based on **Isn/Isr**
cosφ	Cos φ of phase angle

1 According to IEC 60444.

2 According to IEC 61869 and IEEE C57.13.

18.7 CT Composite Error

⚠ DANGER

Death or severe injury caused by high voltage or current

Injecting direct current into test objects with inductive characteristics will charge the winding of the test object

- ▶ Follow instructions below
- ▶ Refer to the safety instructions in the CPC 100 User and Reference manuals.

⚠ DANGER

Death or severe injury caused by high voltage or current

- ▶ Never open the measuring circuit while current is flowing.
- ▶ Ground all terminals of the test object before touching the test setup.
- ▶ Short circuit the terminals before disconnecting the test leads.
- ▶ Disconnect cables not used for testing from the test object and test set.
- ▶ After obtaining a measurement, wait until the test device has discharged completely.

⚠ DANGER

Death or severe injury caused by high voltage or current

Feeding test voltage to a tap of a CT can cause dangerous voltages on other taps and windings.

- ▶ Do not touch tapped windings
- ▶ Make sure that no other secondary windings are open.

The CT Composite Error test is only available for protection CTs:

- classes C, K or T according to IEEE C57.13
- classes P or PR according to IEC 60044/IEC 61869

The transformer's core is magnetized after the Winding Resistance measurement. Since the core is demagnetized in the course of the CT Excitation test, we recommend performing the Winding Resistance measurement first (→ CT Excitation (page 202)).

Table 18-13: CT Composite Error – Settings and conditions

Setting	Description
CT Excitation Measurement Settings	
Test frequency	Frequency of the output signal
Noise suppression	▶ Select the check box to activate an interference filter.

Setting	Description
CT Winding Resistance Sec Measurement Settings	
Perform winding resistance measurement	▶ Activate the check box to perform a supplementary winding resistance measurement (optional for IEEE C57.13).
Temperature compensation for Cu[1]	
Winding temperature	Temperature of the transformer's winding
Reference temperature	Reference temperature to be used for temperature correction
Burden settings[2]	
Use rated burden Use operating burden	▶ Choose whether the rated burden or the operating burden be used for the composite error calculation. These values are entered in the asset.
Assessment settings	
Manual	▶ Select for manual assessment of the measurement results
Automatic	According to IEEE C57.13 the measurement will be assessed as failed if: **Composite error @ Isr** > 3 % or **Composite error @ 20 x Isr** > 10 %. According to IEC 60044 / IEC 61869, the measurement will be assessed as failed if the composite error at rated accuracy limit current is greater than [depending on the class]: • 2P, 2PR: composite error > 2 % • 3P, 3PR: composite error > 3 % • 4P, 4PR: composite error > 4 % • 5P, 5PR: composite error > 5 % • 6P, 6PR: composite error > 6 % • 10P, 10PR: composite error > 10 %

1 Only available if **Perform winding resistance measurement** check box is activated.

2 Only available for CTs according to IEC 60044 / IEC 61869.

The winding resistance measurement is only available for IEEE C57.13 and if **Perform winding resistance measurement** check box is activated.

Table 18-14: CT Composite Error – Winding resistance measurement

Setting	Description
Tap	Identification of the tap under test
Ipn[1]/Ipr[2]	Rated primary current of the current transformer
Isn[3]/Isr[1]	Rated secondary current of the current transformer
CPC output	DC current output of the *CPC 100*
I test	Test current at the primary side of the current transformer
I DC	Measured current
V DC	Measured voltage

Setting	Description
R meas	Measured resistance
R corr	Corrected measured resistance
In use	Indicates if the tap under test is designated as **In use** in the asset
Assessment	Measurement assessment

1 According to IEC 60444.

2 According to IEC 61869 and IEEE C57.13.

3 Only available if **Perform winding resistance measurement** check box is activated.

Table 18-15: CT Composite Error – Excitation curve measurement

Setting	Description
Tap	Identification of the tap under test
Ipn[1]/Ipr[2]	Rated primary current of the current transformer
Isn[1]/Isr[2]	Rated secondary current of the current transformer
I max	Maximum test current
V max	Maximum test voltage
I knee	Knee point current
V knee	Knee point voltage
Knee point calculation	Method used for the knee point calculation
In use	Tap on which the CT is operated
Assessment	Measurement assessment

1 According to IEC 60444.

2 According to IEC 61869 and IEEE C57.13.

Table 18-16: CT Composite Error – Composite error

Setting	Description
Tap	Identification of the tap under test
Ipn[1]/Ipr[2]	Rated primary current of the current transformer
Isn[1]/Isr[2]	Rated secondary current of the current transformer
Composite error @ Isr[3]	Composite error at rated secondary current Calculated on the basis of the excitation curve measurement and the asset's **Isr** and **Vb** values.
Composite error @ 20 × Isr[3]	Composite error at 20× rated secondary current
Composite error @ ALF × Isr[4]	Composite error at rated accuracy limit current
Assessment	Measurement assessment

1 According to IEC 60444.

2 According to IEC 61869 and IEEE C57.13.

3 According to IEEE C57.13.

4 According to IEC 60444 / IEC 61869.

18.8 Polarity Check

⚠ DANGER

Death or severe injury caused by high voltage or current

- ▶ Ensure that no secondary CT windings are open

⚠ WARNING

Death or severe injury caused by high voltage or current possible

- ▶ Do not touch the test probe or the top part of the *CPOL* during measurements.
- ▶ Only touch and hold the device below the finger guard.

Note: During a measurement, OMICRON devices are the only permitted power source for the instrument transformer.

⚠ WARNING

Death or severe injury caused by high voltage or current possible

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

- ▶ Do not touch other taps or windings of the current transformer during the measurement.
- ▶ When testing multi-core current transformers, make sure that no other windings of the current transformer are open.
- ▶ Leave the secondary windings of the other (non-measured) cores connected, or short-circuit them if the windings are open.

⚠ WARNING

Death or severe injury caused by high voltage or current possible

Accidentally mixing up primary and secondary windings can cause life-threatening voltages and/or destroy the connected instrument transformer or the OMICRON equipment.

- ▶ Make sure that the injecting device output is connected to the correct side of the instrument transformer according to the wiring instructions in the dedicated user manual.

NOTICE

Equipment damage or loss of data possible

Disconnect burden from the CT to avoid measurement errors.

The following table describes the Polarity Check test settings.

Table 18-17: Polarity Check – Settings and conditions

Setting	Description
Output settings	
Output	Select the output signal
Current	Enter the current
Sequence settings	
Continuous	If unchecked, enter the t on and t off times

The following table describes the Polarity Check measurement data.

Table 18-18: Polarity Check measurement data

Setting	Description
Start	Start the test
Add	Add new row directly under selected row If no row is selected, add a new row to the bottom of the table
Delete	Delete currently selected line
Delete all	Delete all results
Core	Identification of the core under test
Tap	Identification of the tap under test
Location	Location of the core
Polarity	Polarity result

19 Voltage transformer tests

In this chapter, the settings and measurement data of the voltage transformer tests are described. For more information about testing with the *CPC 100*, see the CPC 100 User Manual shipped with your test system.

Some test names depend on the **Profile** selected in the **Settings** (→ Settings (page 28)). For your convenience, you can use your preferred naming:

- ▶ IEEE standard: **Power factor (PF)** for the loss indicator.
- ▶ IEC standard: **Dissipation factor (DF)** for the loss indicators.
- ▶ Custom profiles: **Power factor (PF)**, **Dissipation factor (DF)** or **Tangent delta (Tanδ)** for the loss indicator.
  - ➔ The dissipation factor and the tangent delta are identical characteristics of the primary asset under test.

Primary Test Manager supports the following voltage transformer tests:

- VT PF & CAP (page 210)
- VT Ratio (page 211)
- VT Burden (page 212)

Primary Test Manager also supports the **TanDelta – PF & CAP** manual test.

▶ For more information, see Manual Tan Delta (page 237).

19.1 VT PF & CAP

⚠ DANGER

Death or severe injury caused by high voltage or current

- ▶ Never use the *CP TD* without a solid connection to ground with at least 6 mm².
- ▶ Use a ground point as close as possible to the test object.
- ▶ Make sure to position the test object in the danger zone.

⚠ DANGER

Death or severe injury caused by high voltage or current

The high-voltage cable is double shielded and therefore safe. However, the last 50 cm (20 in) of this cable have no shield.

- ▶ Avoid any direct contact of this part of the cable to ground potential and any objects.
- ▶ During a test, consider this part of the cable a live wire and life threatening.

Note: This test name depends on the **Profile** selected in the **Settings**.

- IEEE standard: **VT PF & CAP**
- IEC standard: **VT DF & CAP**
- Custom profile: **VT Tanδ & CAP**

This test is identical to the PF & CAP test for current transformers. Refer to CT PF & CAP (page 195).

19.2 VT Ratio

DANGER

Death or severe injury caused by high voltage or current

- Do not connect the *CPC 100* output to the secondary side of the VT. This will lead to dangerous voltages on the primary side.
- Ensure that any delta windings are disconnected from the voltage transformer under test. Failure to do so may result in the primary voltage injection inadvertently channeling power into other phases via connected delta windings, thereby creating a risk of circuits becoming energized.

The following table describes the VT Ratio measurement data.

Table 19-1: VT Ratio measurement data

Data	Description
Upr	Rated primary voltage of the voltage transformer
Usr	Rated secondary voltage of the voltage transformer
V test	Test voltage at the primary side of the voltage transformer
Test frequency	Test frequency of the output signal
V prim	Measured voltage at the primary side of the voltage transformer
V sec	Measured secondary voltage of the voltage transformer
Ratio	Measured ratio of the voltage transformer
Ratio dev	Deviation of the measured ratio from the rated ratio
Phase	Measured phase displacement between the primary and secondary voltage
Polarity	Polarity status
Assessment	Measurement assessment

19.3 VT Burden

⚠ DANGER

Death or severe injury caused by high voltage or current

- ▶ Ensure that all primary VT terminals are connected to ground.
- ▶ Disconnect all burdens from the VT.

⚠ WARNING

Do not exceed the current specification of the burden.

The following table describes the VT Burden test settings.

Table 19-2: VT Burden test settings

Setting	Description
Measurement settings	
Test frequency	Test frequency

Table 19-3: VT Burden measurement data

Setting	Description
Upr	Rated primary voltage of the voltage transformer
Usr	Rated secondary current of the voltage transformer
V test	Test voltage
V meas	Measured burden voltage
I meas	Measured burden current
Phase	Measured phase displacement
Burden (@ Vtest)	Burden based on **Vtest**
Burden (@ Usn)	Burden based on **Usn**
cosφ	Cos φ of phase angle
Assessment	Measurement assessment

19.4 Polarity Check

⚠ DANGER

Death or severe injury caused by high voltage or current

- ▶ Ensure that no secondary VT windings are open

⚠ WARNING

Death or severe injury caused by high voltage or current possible

- ▶ Do not touch the test probe or the top part of the *CPOL* during measurements.
- ▶ Only touch and hold the device below the finger guard.

Note: During a measurement, OMICRON devices are the only permitted power source for the instrument transformer.

⚠ WARNING

Death or severe injury caused by high voltage or current possible

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

- ▶ Do not touch other taps or windings of the current transformer during the measurement.
- ▶ When testing multi-core current transformers, make sure that no other windings of the current transformer are open.
- ▶ Leave the secondary windings of the other (non-measured) cores connected, or short-circuit them if the windings are open.

⚠ WARNING

Death or severe injury caused by high voltage or current possible

Accidentally mixing up primary and secondary windings can cause life-threatening voltages and/or destroy the connected instrument transformer or the OMICRON equipment.

- ▶ Make sure that the injecting device output is connected to the correct side of the instrument transformer according to the wiring instructions in the dedicated user manual.

NOTICE

Equipment damage or loss of data possible

Disconnect burden from the VT to avoid measurement errors.

The following table describes the Polarity Check test settings.

Table 19-4: Polarity Check – Settings and conditions

Setting	Description
Output settings	
Output	Select the output signal
Voltage	Enter the voltage
Sequence settings	
Continuous	If unchecked, enter the t on and t off times

The following table describes the Polarity Check measurement data.

Table 19-5: Polarity Check measurement data

Setting	Description
Start	Start the test
Add	Add new row directly under selected row If no row is selected, add a new row to the bottom of the table
Delete	Delete currently selected line
Delete all	Delete all results
Winding	Identification of the winding under test
Location	Location of the core
Polarity	Polarity result

20 Rotating machine tests

Some test names depend on the **Profile** selected in the **Settings** (→ Settings (page 28)). For your convenience, you can use your preferred naming:

- ▶ IEEE standard: **Power factor (PF)** for the loss indicator.
- ▶ IEC standard: **Dissipation factor (DF)** for the loss indicators.
- ▶ Custom profiles: **Power factor (PF)**, **Dissipation factor (DF)** or **Tangent delta (Tanδ)** for the loss indicator.
  - ➔ The dissipation factor and the tangent delta are identical characteristics of the primary asset under test.

Primary Test Manager supports the following tests for rotating machines:

- DC Winding Resistance Stator/Rotor (page 215)
- Stator Winding PF & CAP (page 218)
- Partial Discharge HV Source (page 221)
- Electromagnetic Core Imperfection Detection (page 225)

20.1 DC Winding Resistance Stator/Rotor

Primary Test Manager supports a DC Winding Resistance test for stator and rotor.

⚠ DANGER

Death or severe injury caused by high voltage or current

Injecting direct current into test objects with inductive characteristics will charge the winding of the test object

- ▶ Follow instructions below
- ▶ Refer to the safety instructions in the CPC 100 User and Reference manuals.

⚠ DANGER

Death or severe injury caused by high voltage or current

- ▶ Never open the measuring circuit while current is flowing.
- ▶ Ground all terminals of the test object before touching the test setup.
- ▶ Short circuit the terminals before disconnecting the test leads.
- ▶ Disconnect cables not used for testing from the test object and test set.
- ▶ After obtaining a measurement, wait until the test device has discharged completely.

Table 20-1: DC Winding Resistance – Settings and conditions

Setting	Description
Measurement settings	
CPC output	DC current output of the *CPC 100*
Test current	Current of the test
Result settings	
Automatic result	▶ Select the **Automatic result** check box to stop the measurement automatically depending on the tolerance R dev and the settling time.
Tolerance R dev	Tolerance of the deviation of consecutive measurement results within the settling time
Settling time (Δt)	Time within which the deviation of consecutive measurement results is evaluated. If the deviation is less than the tolerance R dev, the measurement stops.
Test conditions	
Temperature correction	▶ Select the **Temperature correction** check box to activate temperature correction.
Winding temperature	Temperature of the machine's winding
Reference temp.	Reference temperature to be used for temperature correction
Corr. factor	Temperature correction factor
Assessment settings	• Manual • Automatic **Note:** The Assessment settings are only available for a three-phase asset in the DC Winding Resistance Stator test.

Assessment

This section is only visible if **Automatic** is selected under **Assessment settings**.

The *Primary Test Manager* supports automatic assessment of the DC Winding Resistance Stator test.

Table 20-2: DC Winding Resistance Stator – automatic assessment parameters

Parameter	Description
Limit schema	Customer-specific limits for automatic assessment

▶ To save the selected limit schema as the default setting for all future jobs, click **Set as default**.

Table 20-3: DC Winding Resistance Stator – automatic assessment limits

Assessment against	Limit	Default
Relative limits	Limit (fail)	Default limit

During the automatic assessment, the *Primary Test Manager* compares the **R corr** values of all phases to each another. If a deviation is greater than the default limit, the assessment status is set to **Fail**.

You can assess the test:

- During measurement
  To assess the test while the measurements are running, select the **Assess during measurements** check box.
- Manually after all measurements have been finished
  To assess the test manually, click **Assess measurements**.

After a measurement has been assessed, the test settings and the assessment parameters are locked.

To change the test data, the test settings or the assessment parameters, click **Clear all assessments**.

You can overwrite the *Primary Test Manager* automatic assessment manually. To do so, click the arrow next to the automatic assessment, and then select a manual assessment from the list.

The automatic assessment is stored in the **Assessment** box for documentation purposes.

Table 20-4: DC Winding Resistance – Measurements

Data	Description
Phase	Measured phase
R meas	Measured resistance
R dev	Deviation of two successive measurement results at the time the test was stopped
R corr	Corrected measured resistance
Time	Time between the start and stop of a measurement
I DC	Measured current
V DC	Measured voltage
Assessment	Measurement assessment per tap position

If you did not select the **Automatic result** check box to stop the measurement automatically, you can stop the measurement by clicking the **Keep results** button.

20.2 Stator Winding PF & CAP

⚠ DANGER

Death or severe injury caused by high voltage or current

- ▶ Never use the *CP TD* without a solid connection to ground with at least 6 mm².
- ▶ Use a ground point as close as possible to the test object.
- ▶ Make sure to position the test object in the danger zone.

⚠ DANGER

Death or severe injury caused by high voltage or current

The high-voltage cable is double shielded and therefore safe. However, the last 50 cm (20 in) of this cable have no shield.

- ▶ Avoid any direct contact of this part of the cable to ground potential and any objects.
- ▶ During a test, consider this part of the cable a live wire and life threatening.

Note: This test name depends on the **Profile** selected in the **Settings**.

- IEEE standard: **Stator Winding PF & CAP**
- IEC standard: **Stator Winding DF & CAP**
- Custom profile: **Stator Winding Tanδ & CAP**

In this section, the term **Stator Winding PF & CAP** will be used.

Capacitance and power factor (PF) measurements are conducted to identify defects that affect the condition of the machine insulation.

For a suitable test object compensation using the CP CR, the capacitance value is required and can be measured or entered in the **Hardware configuration** section of the test.

Table 20-5: Stator Winding PF & CAP – Hardware configuration

Setting	Description
Detect capacitance	▶ Click **Yes** if you do not know the test objects capacitance and want to measure it before testing. This will add the **Capacitance** tab to the **Measurements** section. In this tab you can perform a measurement to detect the capacitance before performing the Stator Winding test.
Capacitance of test object	▶ Enter the test object's capacitance. If you measure the capacitance before the test (see **Detect capacitance** above), this field will be filled in automatically after the measurement is completed.

Setting	Description
Number of CP CR coils available	
▶ Enter the number of available coils, depending on the number and types of CP CR available. For more information on the options refer to the following user manuals: • *CP TD1* User Manual and *CP CR500* User Manual • *CP TD12/15* User Manual and *CP CR600* User Manual	

Table 20-6: Stator Winding PF & CAP – Settings and conditions

Setting	Description
Measurement settings	
Test frequency	▶ Enter the test frequency. This value is also used for the calculation of the necessary number of CP CR coils.
Sweep settings	
Voltage sweep (tip-up)	Sweep profiles: • **None**: no voltage sweep • **Umax = L - Gnd** (previously **OMICRON expertise** profile) • **Umax = L - L** • **Umax = 1.2*(L - L)** • **Umax = 1.2*(L - Gnd)**
Sweep profiles	▶ Click the pen button to create a voltage sweep profile. ▶ Add up to 30 measurement points with individual output voltages. Double-click a value to change it. ▶ Mark a favorite to use it as the default sweep profile for future tests. **Note:** The predefined profiles cannot be edited or deleted. The default voltage sweep profile is **Umax = L - Gnd**.
Noise suppression settings	
Averaging (no. points)	Number of averaged measurements
Device settings	
Tan delta device	▶ Select your *CP TD* device: • **CP TD1** • **CP TD12** • **CP TD15**
Enable shield check	▶ Select the **Enable shield check** check box if you want *CPC 100* to check if the high-voltage cable shield is connected.
Use beeper	▶ Select the **Use beeper** check box if you want to use the *CP TD* beeper during the measurement.
Test conditions	
Custom test conditions	▶ Select the check box to set test conditions differing from the global test conditions.

Setting	Description
Winding temperature	Temperature of the machine's winding
Ambient temperature	Ambient temperature on site
Humidity	Relative ambient humidity

Table 20-7: Stator Winding PF & CAP – Measurements

Setting	Description
Capacitance[1]	
Measurement	Measurement procedure
Test mode	Test mode according to IEEE Std 62-1995
Sweep	Disabled for the capacitance measurement
V test	Test voltage
Freq.	Test frequency
V out	Measured output voltage
I tot	Measured current in the parallel resonance circuit
Watt losses	Measured losses
PF meas[2]	Measured power factor
Cap. meas[2]	Measured capacitance
Measurements	
Measurement	Measurement procedure
Test mode	Test mode according to IEEE Std 62-1995
Sweep	Setting selected under **Sweep settings**
V test	Test voltage
I out	Measured output current
Watt losses	Measured losses
PF meas[2]	Measured power factor
Cap. meas[2]	Measured capacitance
Assessment	Measurement assessment

1 Only available if **Detect capacitance** is set to **Yes**.

2 According to IEC 60034-27-33 and IEEE 286.

20.3 Partial Discharge HV Source

⚠ DANGER

Death or severe injury caused by high voltage or current

- ▶ Never use the *CP TD* without a solid connection to ground with at least 6 mm².
- ▶ Use a ground point as close as possible to the test object.
- ▶ Make sure to position the test object in the danger zone.

⚠ DANGER

Death or severe injury caused by high voltage or current

The high-voltage cable is double shielded and therefore safe. However, the last 50 cm (20 in) of this cable have no shield.

- ▶ Avoid any direct contact of this part of the cable to ground potential and any objects.
- ▶ During a test, consider this part of the cable a live wire and life threatening.

The *CPC 100* is used as a high-voltage sweep source for parallel Partial Discharge (PD) measurements on a rotating machine with the *MPD*.

Table 20-8: Partial Discharge HV Source – Wiring diagram

Setting	Description
Wiring diagram	▶ Select a wiring diagram via the respective radio button: • **HV source wiring** • **Measurement wiring** **Note:** The measurement wiring changes according to the quadripole setting under Coupling in the measurement settings. There is no wiring diagram shown for calibration.

For a suitable test object compensation using the *CP CR*, the capacitance value is required and can be measured or entered in the **Hardware configuration** section of the test.

Table 20-9: Partial Discharge HV Source – Hardware configuration

Setting	Description
Detect capacitance	▶ Click **Yes** if you do not know the test objects capacitance and want to measure it before testing. This will add the **Capacitance** tab to the **Measurements** section. In this tab you can perform a measurement to detect the capacitance before performing the Partial Discharge HV Source test.
Capacitance of test object	▶ Enter the test object's capacitance. If you measure the capacitance before the test (see **Detect capacitance** above), this field will be filled in automatically after the measurement is completed.

Setting	Description
Number of CP CR coils available	
▶ Enter the number of available coils, depending on the number and types of *CP CR* available. For more information on the options refer to the following user manuals: • *CP TD1* User Manual and *CP CR500* User Manual • *CP TD12/15* User Manual and *CP CR600* User Manual	

Table 20-10: Partial Discharge HV Source – Settings and conditions

Setting	Description
Measurement settings	
Test frequency	▶ Enter the test frequency. This value is also used for the calculation of the necessary number of *CP CR* coils.
Get PD results	▶ Select the source of the PD results: • **no PD results** • **from MPD Suite** • **from MPD and MI** **Note:** The selected source must be installed on the same computer as the *Primary Test Manager*. Installed software will be shown in bold.
Coupling	▶ Select the quadripole used for the PD measurement: **from MPD and MI:** • internal quadripole • external quadripole **from MPD Suite:** • none • internal CPL • *CPL 1* or *CPL 2* • *CPL 542* (500 mA) • *CPL 542* (1.2 A) • *CPL 542* (2 A)
Sweep settings	
Voltage sweep (tip-up)	Sweep profiles: **None**: no voltage sweep **Umax = L - Gnd** (previously **OMICRON expertise** profile) **Umax = L - L** **Umax = 1.2*(L - L)** **Umax = 1.2*(L - Gnd)**

Setting	Description
Sweep profiles	1. Click the pen button to create a voltage sweep profile. 2. Add up to 30 measurement points with individual output voltages. Double-click a value to change it. 3. Mark a favorite to use it as the default sweep profile for future tests. **Note:** The predefined profiles cannot be edited or deleted. The default voltage sweep profile is **Umax = L - Gnd**.
Voltage slope	Voltage slope of the voltage sweep
Step duration	Step duration of the voltage sweep
Device settings	
Tan delta device	▶ Select your *CP TD* device: • **CP TD1** • **CP TD12** • **CP TD15**
Enable shield check	▶ Select the **Enable shield check** check box if you want the *CPC 100* to check if the high-voltage cable shield is connected.
Use beeper	▶ Select the **Use beeper** check box if you want to use the *CP TD* beeper during the measurement.
Test conditions	
Custom test conditions	▶ Select the check box to set test conditions differing from the global test conditions.
Winding temperature	Temperature of the machine's winding
Ambient temperature	Ambient temperature on site
Humidity	Relative ambient humidity

Table 20-11: Partial Discharge HV Source – Measurements

Setting	Description
V-Cal for MPD	
Calibration voltage	Voltage used for *MPD* voltage calibration
Start	▶ Click the **Start** button to start the voltage output used for *MPD* calibration.
Capacitance[1]	
Measurement	Measurement procedure
Test mode	Test mode according to IEEE Std 62-1995
Sweep	Disabled for the capacitance measurement
V test	Test voltage
Freq.	Test frequency
Step duration	Step duration of the voltage sweep
V out	Measured output voltage
Cap. meas[2]	Measured capacitance

Setting	Description
Measurements	
Measurement	Measurement procedure
Test mode	Test mode according to IEEE Std 62-1995
Sweep	Setting selected under **Sweep** settings
V test	Test voltage
Freq.	Test frequency
Step duration	Step duration of the voltage sweep
V out	Measured output voltage
Cap. meas[2]	Measured capacitance
Clear results	▶ Click the **Clear results** button to clear all results in the measurement tab.
Partial discharge results[3]	
Voltage and Q values over time (diagram)	Diagram giving an overview of one measurement. The following options can be toggled on or off via respective check boxes: Measurements • **Q (1.1)** - PD charges of measurement channel 1.1 • **Q (1.2)** - PD charges of measurement channel 1.2 • **Q (1.3)** - PD charges of measurement channel 1.3 • **Voltage** - AC voltage curve Additional information • **Cursor** • **Snapshots** • **Phases**
Channel	Measurement channel
V(t), Q(t)	Voltage and Q values over time diagram for each measurement channel
Q(V)	Q_{IEC} value over the voltage
Conforming to IEC60270?	Assessment whether the measurement is conforming to IEC 60270
Filter bandwidth	Displays the filter bandwidth calculated during the test
Report	▶ Select the **Report** check box to include a measurement in the measurement report
Advanced statistics	
Test voltage	Injected test voltage
Channel	Measurement channel
Q_{WTD}	Apparent charge of all PDs over a given time (also known as Q_{IEC})
Q_{Peak}	Largest absolute charge of any PD event seen during the evaluation interval
Q_{Avg}	Average Q_{IEC} (or Q_{WTD}) value for the evaluation interval
n	Pulse repetition rate, averaged over the evaluation interval
I_{Dis}	Average discharge current over the evaluation interval

Setting	Description
P_{Dis}	Average discharge power (discharge current times instantaneous AC voltage) over the evaluation interval
D	Quadratic rate over the evaluation interval
PRPD diagram	PRPD diagram for each measurement channel **Note:** The PRPD diagram is not available if 3-channel view is selected in the MPD software
Report	▶ Select the **Report** check box to include a measurement in the measurement report

1 Only available if **Detect capacitance** is set to **Yes**.

2 According to IEC 60034-27-33 and IEEE 286.

3 Only available if **Get PD results** is selected.

20.4 Electromagnetic Core Imperfection Detection

The *Primary Test Manager* supports an Electromagnetic Core Imperfection Detection test for stators.

⚠ DANGER

Death or severe injury caused by high voltage or current

- ▶ Refer to the safety instructions in the *CPC 100* User and Reference Manuals.
- ▶ For more information about this test, refer to the *SCMUO* User Manual.

Table 20-12: Electromagnetic Core Imperfection Detection – Asset

Setting	Description
Stator	
Rated voltage L-L	Rated voltage of the stator
Rated frequency	Rated frequency of the stator
Core length	Stator core length
Number of slots	Number of slots in the stator
Number of phases	Number of phases of the stator
Core factor	Core factor of the stator
Calculation based on	Whether calculations are based on the winding scheme or dimensions of the stator
Winding Scheme	
Bars per slot	The number of bars per slot in the machine
Turns per coil	The number of turns per coil according to the winding scheme
Parallel circuits per phase	The number of parallel circuits per phase according to the winding scheme
Dimensions	
No. of ventilation ducts	The number of ventilation ducts in the machine
Width of ventilation duct	The width of the ventilation ducts in the machine

Setting	Description
Core depth	The depth of the cores in the machine
Slot depth	The depth of the slots in the machine
Dovetail depth	The depth of the dovetails in the machine
Nominal excitation	The nominal excitation value

Table 20-13: Electromagnetic Core Imperfection Detection – Settings and conditions

Setting	Description
Measurement settings	
Stator excitation	The desired stator excitation in percent of the rated flux
Test frequency	The frequency used for stator excitation
Cable accessory	Select whether an 8-wire or 2-wire cable is being used
Number of turns	The number of physical turns of the cable accessory around the stator
Output voltage	Output voltage is calculated automatically based on the entered values

Table 20-14: Electromagnetic Core Imperfection Detection – Measurements

Setting	Description
Magnitude calibration	
Start calibration measurement	Prepares the *CPC 100* current output to inject a known current to the calibration slot
Set ratio manually	If the calibration factor is already known, input the value manually
Measurement settings	
Measurement	Select whether the test is being performed automatically (with rail) or manually (with handle)
Recording mode	Select whether to: ▶ Record new slot; or if an existing slot is selected: ▶ Record to selected slot ▶ Insert new slot below selected
Slot settings	
Start with slot	Enter slot number for first measurement
Counting direction	Select whether slots will be measured in ascending or descending order
Recording settings[1]	
Rail position	Offset distance between the beginning of the stator core and the zero point of the ruler on the rail unit
Start recording at	Position on the ruler where the recording of measurement values should start
Stop recording at	Position on the ruler where the recording of measurement values should stop

Setting	Description
Position	Position in the stator to which the currently measured result in manual mode refers to. Only available in manual measurement mode.
Increment	Increment (in mm) at which the position is increased after each recorded measurement Only available in manual measurement mode.
Start	Start the test
Record slot	Record the measurement data based on the selected recording mode
Keep result	Keep manually measured slot data
New slot	Start manual measurement of a new slot
Delete selected slot	Deletes the currently selected slot
Show all	Show all slot data on the graph
Hide all	Hide all slot data from the graph
Combine charts	Combine Quad and InPhase graphs
Stack charts	Separate Quad and InPhase graphs
Default zoom	Begin graph scale at 0mm and end at 1 760 mm
Zoom to fit	Zoom graph view to display only data range
Fit X-axis	Zoom graph view to display only data range along the x-axis
Fit Y-axis	Zoom graph view to display only data range along the y-axis
Heatmap	
Current threshold	The upper current limit as indicated on the heatmap
Tolerance	Define which percentage of the set threshold the heatmap displays the middle color of the gradient
Color scheme	Select preferred color scheme

[1] Only available in automatic measurement mode.

21 Grounding system tests

In this chapter, the settings and measurement data of the grounding system tests are described. For more information about safe testing with the *CP CU1*, *HGT1*, and *CPC 100*, refer to the respective user manuals.

1. For information on the grounding system and the corresponding maps, refer to Grounding system (page 116).
2. For information about the Location settings used for grounding system tests, refer to Settings (page 28).

21.1 Ground impedance measurement

⚠ DANGER

Death or severe injury caused by high voltage or current

In case of a high-current ground fault within the substation or at the transmission tower during the test, high voltages may occur in any wire connected to the grounding grid or leading away from it.

- ▶ Do not touch the current probe, the potential probe, or any wire without insulating gloves.
- ▶ First insert the current probe, then connect it to the provided clamp.
- ▶ Before removing the current probe, disconnect the clamp.

⚠ WARNING

Death or severe injury caused by high voltage or current possible

The auxiliary current probe carries-life threatening voltages during the test. In case of an error, unexpected high voltages can occur at any time. The step voltage around the auxiliary current probe can also be quite high.

- ▶ Always press the emergency switching off button before working with the auxiliary current probe or the associated wiring cables.
- ▶ Mark an area of 10 m (30 ft) around the electrode as dangerous zone and position a guard outside this area to keep people from entering the dangerous zone.

NOTICE

Equipment damage or loss of data possible

If the desired current cannot be reached or an overload occurs, the contact resistance of the auxiliary current probe to the soil may be too high. Place several electrodes at a distance of a few meters and connect them all together to keep the resistance to the soil low. This also reduces the hazard due to high voltages around the electrode.

Table 21-1: Ground impedance measurement – Settings and conditions

Setting	Description
Measurement settings	
Rated frequency	▶ Select the rated frequency of the substation. • **60 Hz** • **50 Hz** • **16.7 Hz**
Input source	▶ Select the source which is used for the injection of the test current. • **CPC 100 and 6A** • **CPC 100 and CP CU1**
Assessment settings	
Reduction factor	Ratio between current contributing to the ground potential rise and total injected current. The reduction factor can be determined with a measurement.
Injected currents	
Frequency	Frequency of the test current from the input signal
Current	Test current from the input source

Table 21-2: Ground impedance measurement – Overview

Setting	Description
Add	▶ Click **Add** to create a measurement point
Remove	▶ Click **Remove** to delete measurement point
Clear all	▶ Click **Clear all** to clear all measurement results in the overview
Distance	Distance to the reference point
Z	Impedance at nominal frequency
VStep	Step voltage
V	Voltage calculated in relation to the distance to the reference point
Show on map (symbol)	Select the **Show on map** check box to show the measurement on the map.
Measurement completed at incorrect position (symbol)	The measurement was completed at a location different than the defined position.
Assessment	▶ Select a manual assessment for the whole measurement. • **Not assessed** • **Manual pass** • **Manual fail** • **Manual investigate**

Table 21-3: Ground impedance measurement – Measurement

Setting	Description
Previous / Next	▶ Click **Previous** or **Next** to switch to the previous or next measurement respectively. **Note:** You can also select measurements directly by clicking on the respective measurement under Overview.
Settings	
Distance	Distance to the reference point ▶ Select the **Enter distance manually** check box to enter the distance manually. ▶ Select the **Show on map** check box to show the measurement on the map.
Results	
Frequency	Measured frequency
Voltage	Measured voltage
Impedance	Impedance at nominal frequency
Voltage	Voltage calculated in relation to the maximum current to ground
Map	
Map	Map showing the measurement traces ▶ Drag the map by holding left mouse button and moving the mouse. ▶ Zoom in or out with the mouse wheel.
Draw injection line	▶ Click **Draw injection line** to draw a new injection line on the map. ▶ Click **Save injection line** to save the injection line. or ▶ Click **Delete injection line** to delete the injection line.
Plot	
FFT	The FFT of the selected measurement
Impedance	Impedance over distance in relation to the distance to the reference point
Step voltage	Step voltage for all valid measurements
Voltage	Voltage over distance in relation to the distance to the reference point

21.2 Step & Touch voltage measurement

⚠ DANGER

Death or severe injury caused by high voltage or current

Employ the proper test set.

- ▶ Never use the *COMPANO 100* to directly inject currents into power cables or overhead lines. If direct injection should become inevitable, use the *CPC 100* test set together with the *CP CU1* and *CP GB1*. In case of a high-current ground fault within the substation or at the transmission tower during the test, high voltages may occur in any wire connected to the grounding grid or leading away from it.
- ▶ Do not touch the current probe, the potential probe, or any wire without insulating gloves.
- ▶ First insert the current probe, then connect it to the provided clamp. Before removing the current probe, disconnect the clamp.

⚠ WARNING

Death or severe injury caused by high voltage or current possible

The auxiliary current probe carries-life threatening voltages during the test. In case of an error, unexpected high voltages can occur at any time. The step voltage around the auxiliary current probe can also be quite high.

- ▶ Always press the emergency switching off button before working with the auxiliary current probe or the associated wiring cables.
- ▶ Mark an area of 10 m (30 ft) around the electrode as dangerous zone and position a guard outside this area to keep people from entering the dangerous zone.

NOTICE

Equipment damage or loss of data possible

If the desired current cannot be reached or an overload occurs, the contact resistance of the auxiliary current probe to the soil may be too high. Place several electrodes at a distance of a few meters and connect them all together to keep the resistance to the soil low. This also reduces the hazard due to high voltages around the electrode.

Table 21-4: Step & Touch voltage measurement – Settings and condtions

Setting	Description
Measurement settings	
Rated frequency	▶ Select the rated frequency of the substation • **60 Hz** • **50 Hz** • **16.7 Hz**

Setting	Description
Input source	▶ Select the source which is used for the injection of the test current. • **CPC 100 and 6A AC** • **CPC 100 and CP CU1** • **COMPANO 100 and V OUT** • **COMPANO 100 and I OUT**
Standard	▶ Select the standard applicable for the measurement • **EN 50522** • **IEEE 80/81**
Injected currents	
Frequency	Frequency of the test current from the input signal
Current	Test current from the input source
Assessment settings	
Reduction factor	Ratio between current contributing to the ground potential rise and total injected current The reduction factor can be determined with a measurement.
Add. considered resistance	Additional resistance considered for the fault scenario, depending on the applicable standard
Req. input impedance	Required input impedance depending on the **Standard** setting
Body current limit acc.	▶ Select the body current limit according to: • EN 50522 – **EN 50522** – **Custom** • IEEE 80/81 – **Dalziel 50 kg** – **Dalziel 70 kg** – **Biegelmeier** – **Custom**
Perm. body current	Required/permitted values depending on the **Standard** setting
Perm. touch voltage	
Perm. step voltage[1]	
Perm. hand-to-hand voltage[1]	

[1] Only available when selecting **Standard** IEEE 80/81 under **Assessment settings**.

Table 21-5: Step & Touch voltage measurement – Overview

Setting	Description
Add	▶ Click **Add** to create a measurement point
Remove	▶ Click **Remove** to create a measurement point
Clear all	▶ Click **Clear all** to clear all measurement results in the overview
Location Id	Location ID for reporting

Setting	Description
Location	Description field for the measurement location
Scenario	Type of measurement per measurement point
Impedance selection	Input impedance on the *HGT1*
Calculated touch voltage	The calculated touch voltage
Add. resistance	Additional resistance considered for the fault scenario, depending on the applicable standard
Measurement completed at incorrect position (symbol)	The measurement was completed at a location different than the defined position.
Assessment	Automatic assessment
Assessment (manual)	You can optionally select a manual assessment for the whole measurement • **Pass** • **Manual fail** • **Manual investigate**

Table 21-6: Ground impedance measurement – Measurement

Setting	Description
Previous / Next	▶ Click **Previous** or **Next** to switch to the previous or next measurement respectively **Note:** You can also select measurements directly by clicking on the respective measurement under **Overview**.
Settings	
Location ID	Location ID for reporting
Location	Description field for the measurement location
Input impedance	Input impedance on the *HGT1*
Scenario[1]	• **Touch Voltage** • **Step Voltage** • **Hand-to-hand Voltage**
Results	
Frequency	Measured frequency
Voltage	Measured voltage
Voltage	Voltage at nominal frequency
Assessment settings	
Standard	▶ Select the standard applicable for the measurement • **EN 50522** • **IEEE 80/81**
Add. considered resistance	Additional resistance considered for the fault scenario, depending on the applicable standard

Setting	Description
Body current limit acc.	▶ Select the body current limit according to: • EN 50522 – **EN 50522** – **Custom** • IEEE 80/81 – **Dalziel 50 kg** – **Dalziel 70 kg** – **Biegelmeier** – **Custom**
Perm. body current	Required/permitted values depending on the **Standard** setting
Perm. touch voltage[2]	
Assessment	Automatic assessment
Map	
Map	Map showing the measurement locations Drag the map by holding left mouse button and moving the mouse. Zoom in or out with the mouse wheel.
Plot	
FFT	The FFT of the selected measurement
Trend	Trending diagram for all measurements

[1] Only available when selecting **Standard** IEEE 80/81 under **Assessment settings**.

[2] Only available when selecting **Standard** EN 50522 under **Assessment settings**.

22 Manual tests

In this chapter, the settings and measurement data of the optional manual tests supported by the *Primary Test Manager* are described. For more information about testing with the *CPC 100*, see the *CPC 100* User Manual shipped with your test system.

The optional manual tests are asset-independent. You can perform the tests for any asset described in this user manual, but the *Primary Test Manager* does not guide you through the tests and provides no test settings data.

⚠ DANGER

Death or severe injury caused by high voltage or current

Wrong test settings and/or a faulty test procedure may damage the test set and the asset under test and can result in personal injury or death of the operating staff.

▶ Thoroughly review planned steps and test settings before performing a manual test.

22.1 Insulation Resistance test

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

Table 22-1: Insulation Resistance – Settings and conditions

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

Setting	Description
Time 1	In the standard DAR calculation, the testing device is applied, and insulation resistance measurements are taken after 30 seconds (**Time 1**) and 60 seconds (**Time 2**). The dielectric absorption ratio (DAR) is calculated as follows: $DAR = \frac{R_{60}}{R_{30}}$
Time 2	
Correction factors	
Temperature correction	▶ Select the **Temperature correction** check box to activate temperature correction.
Correction temp.	Temperature correction factor

Table 22-2: Insulation Resistance – Measurements

Setting	Description
Test data	To import a file containing test data: ▶ Click the **Add** button  to browse your PC and add data from a file. To directly import data from a measurement file: 1. Open the file on your computer. 2. In the file press Ctrl+A to select all content, then press Ctrl+C to copy. 3. In the *Primary Test Manager* click **Paste from clipboard**. The results may take a few seconds to load.
Measurement	Name or number of the measurement
PI	Polarization index
DAR	Dielectric absorption ratio
Time	Time at which the given values were recorded
Voltage	Voltage and current values recorded at the **Time** specified in the first column
V DC	
I DC	

22.2 Manual Tan Delta

⚠ DANGER

Death or severe injury caused by high voltage or current

- ▶ Never use the *CP TD* without a solid connection to ground with at least 6 mm².
- ▶ Use a ground point as close as possible to the test object.
- ▶ Make sure to position the test object in the danger zone.

⚠ DANGER

Death or severe injury caused by high voltage or current

The high-voltage cable is double shielded and therefore safe. However, the last 50 cm (20 in) of this cable have no shield.

- ▶ Avoid any direct contact of this part of the cable to ground potential and any objects.
- ▶ During a test, consider this part of the cable a live wire and life threatening.

The following table describes the test settings of the Manual Tan Delta test.

Table 22-3: Manual Tan Delta test – test settings

Setting	Description
Measurement settings	
Default frequency	Default test frequency
Show results	▶ Select the results you want to display from the list. All measurement results are stored and can be displayed by selecting them from the list.
Noise suppression settings	
Averaging (no. points)	Number of averaged measurements
Bandwidth	*CPC 100* filter bandwidth
Avoid test frequency	If this setting is active, the measurement will not be performed at the **Test frequency** set in the **Measurement** section. The *Primary Test Manager* will instead measure two values at frequencies below and above the entered **Test frequency** and calculate the median of those two values. The **Avoid test frequency** setting is predefined for the selected test. ▶ Only change the default setting for special applications.
Device settings	
Tan delta device	▶ Select your *CP TD* device: • **CP TD1** • **CP TD12** • **CP TD15**

Setting	Description
Enable shield check	▶ Select the **Enable shield check** check box if you want the *CPC 100* to check if the high-voltage cable shield is connected.
Use beeper	▶ Select the **Use beeper** check box if you want to use the *CP TD* beeper during the measurement.
Test conditions	
Ambient temperature	Ambient temperature on site
Test object temperature	Temperature of the test object
Humidity	Relative ambient humidity
Weather	Weather during the test
Correction factors	
Temperature correction	▶ Select the **Temperature correction** check box to activate temperature correction.
Correction factor	Temperature correction factor
Use reference voltage	▶ Select the **Use reference voltage** check box to extrapolate the I out and Watt losses results for the specified reference voltage.
Reference voltage	Reference voltage for extrapolation of measurement results **Note:** The Reference voltage can be set up to 15 kV regardless of which *CP TD* device is used.

The following tables describe the measurement data of the Manual Tan Delta test.

Table 22-4: Manual Tan Delta test – Common measurement data

Data	Description
No.	Number of the measurement A value is assigned after a measurement has been added
Measurement	Arrangement of the measurement The data is empty by default. You can enter your own measurement name.
Test mode	Test mode according to the IEEE Std 62-1995
V test	Test voltage
Freq.	Test frequency
V out	Measured output voltage
I out	Measured output current
Assessment	Measurement assessment

To add a measurement point to a measurement, click **Add meas. point**. To add a measurement to the Manual Tan Delta test, click **Add measurement**.

Table 22-5: Manual Tan Delta test – Common measurement data (PF, Cap., watt losses)

Data	Description
Watt losses	Measured losses
PF meas[1]	Measured power factor,

Data	Description
PF corr[1]	Corrected measured power factor
Cap. meas	Measured capacitance

1 Term depends on the **Profile** selected in the **Settings**.

Table 22-6: Manual Tan Delta test – Measurement data (Imp. Z)

Data	Description
Z phase	Phase of the measured impedance
Z abs	Magnitude of the measured impedance

Table 22-7: Manual Tan Delta test – Measurement data (Q power, S power)

Data	Description
Reactive power	Measured reactive power Q
Apparent power	Measured apparent power S

Table 22-8: Manual Tan Delta test – Measurement data (Cp, Rp)

Data	Description
Cp	Measured parallel capacitance
Rp	Measured parallel resistance

Table 22-9: Manual Tan Delta test – measurement data (Cp, quality factor)

Data	Description
Cp	Measured parallel capacitance
Quality factor	Measured quality factor

Table 22-10: Manual Tan Delta test – measurement data (Ls, Rs)

Data	Description
Ls	Measured series inductance
Rs	Measured series resistance

Table 22-11: Manual Tan Delta test – measurement data (Ls, quality factor)

Data	Description
Ls	Measured series inductance
Quality factor	Measured quality factor

22.3 Quick

Quick is the standard test with which all outputs and inputs of the *CPC 100* can be freely configured. This makes it possible to perform a manual test configuration.

Quick only supports the *CPC 100* test set.

⚠ DANGER

Death or severe injury caused by high voltage or current

Together with the test object's capacitance, the leakage inductance of the *CPC 100's* internal output transformer forms a series resonant circuit. Especially at frequencies > 50/60 Hz this may result in voltage superelevation.

- When testing capacitive test objects using voltages ≥ 500 V, make sure that the test object's capacitance does not exceed 25 nF.

⚠ DANGER

Death or severe injury caused by high voltage or current

- Never use Quick in combination with a DC output on test objects with highly capacitive characteristics.
- Mind the danger of a test object's charged capacitance. Before connecting or disconnecting any leads, use a grounding/discharging rod:
- to discharge all terminals of the test object
- to connect all terminals of the test object to ground and short-circuit all capacitances.

⚠ DANGER

Death or severe injury caused by high voltage or current

- Never use Quick to measure the resistance of windings with highly inductive characteristics. Turning off the DC source results in dangerous voltage levels.
- Only use the special winding resistance tests for this type of measurement.

The following table describes the Quick test settings.

Table 22-12: Quick test – Hardware configuration

Setting	Description
Outputs	
Output mode	Select the *CPC 100* output.
Voltage/Current	Start value of the *CPC 100* output **Note:** Output value is directly applied after pressing the I/0 button on the *CPC 100*.
Max. Voltage/Current	Maximum output voltage or current value selectable during the test
Frequency	Output frequency during the test

Setting	Description
Measurements	
Signal mode	▶ Select AC or DC as input signal mode (for 10 A I AC/DC only).
Input accessory	▶ Select a connected input accessory, if applicable: • **OFF** • **I Clamp** • **CT** • **VT**
I Clamp ratio	The current clamp ratio **Note:** Supported by V1 AC and V2 AC measurements
CT ratio	The current transformer transformation ratio **Note:** Supported by 10A IAC measurement
VT ratio	The voltage transformer transformation ratio **Note:** Supported by V1 AC measurement

Table 22-13: Quick test – Settings and conditions

Setting	Description
Trigger	▶ Select the **Trigger** check box to activate follow-up actions in defined event occurrences.
Trigger on	Define the trigger type • **Overload**: trigger event occurs in overload condition of the selected output • **Threshold**: trigger event occurs when the defined threshold value is exceeded – **Threshold**: define the threshold value • **Binary**: Trigger event occurs when the binary status changes
Channel	▶ Select the *CPC 100* input channel for trigger events. **Note:** The channel can only be selected when triggering on Threshold.
Action	Define the action in the occurrence of a trigger event • **Continue**: additional measurement point is created after the occurrence of a trigger event • **Stop**: trigger event stops the measurement
Noise suppression	
Frequency selective measurement	Applies a digital filter to the measurement input channels that attenuates signal components above and below test frequency
Avoid test frequency	Performs two measurements with frequencies above and below the configured test frequency. The result at the test frequency is then calculated by interpolation. **Note:** Cannot be combined with triggers.

Table 22-14: Quick test – Measurements

Setting	Description
Reading 1	Define reading channel 1 for measured quantities
Reading 2	Define reading channel 2 for measured quantities
Calculation	Define calculation based on reading channel 1 and 2
Index	Index of measurement point
Reading 1 value	Measured value (current or voltage)
Reading 1 phase	Measured phase angle **Note:** Only available for AC input reading.
Reading 2 value	Measured value (current or voltage)
Reading 2 phase	Measured phase angle **Note:** Only available for AC input reading.
Calculation value 1	Calculated value based on reading 1 & 2 values
Calculation value 2	Calculated value based on reading 1 & 2 values
Trigger	Time count between previous and current trigger activation **Note:** The first trigger time activation measures the time between starting the measurement and the first trigger activation.
Assessment	▶ Manually enter the assessment status.

23 Device-independent tests

This section describes the device-independent tests.

23.1 Inspection

Inspection is used to add the results of (visual) inspections of assets performed before measurements. The input fields in the Test results section of the test can be user-defined and saved as asset-specific templates.

The following table describes the Inspection settings.

Table 23-1: Inspection – Settings and conditions

Setting	Description
Test template	Select a saved Inspection template. **Note:** Only templates fitting the selected Asset kind and Asset type (where applicable) are shown here.
	Opens the Inspection template dialog box
Assessment	Manual Inspection assessment: • **Manual pass** • **Manual fail** • **Manual investigate** • **Not assessed**

The following table describes the Inspection template dialog box.

Table 23-2: Dialog box – Inspection templates

Setting	Description
+ Add Template	Create a new Inspection template.
Edit Template	Edit the currently selected Inspection template.
Remove Template	Remove the currently selected Inspection template from the template list
Import Template	Import an Inspection template from a file
Export Template	Export an Inspection template as a file
Templates	Shows a list of the stored Inspection templates
Preview	Shows a preview of the currently selected Inspection template

The following table describes the Inspection template creation/editing dialog box.

Table 23-3: Dialog box – Inspection template creation and editing

Setting	Description
Save	Save the template
Add Insp. point	Add a new inspection point to a group of inspection points.
Add Group	Add a new group of inspection points.
Duplicate	Duplicate the currently selected group or inspection point
Remove	Remove the element currently selected in the checklist (see below)
Template name	Name of the Inspection test template
Author	Author of the Inspection test template
Asset	Asset
Asset type	Asset type (where applicable)

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