ENSURING THE FLOW.

High voltage test and diagnostics device

viola TD

Dissipation factor measurement and MWT with tan δ

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1 GENERAL

1.1 Using this manual

This additional manual for viola TD contains all necessary information for performing dissipation factor measurements with viola TD.

- This additional manual is part of the operating manual for viola and applies only together with it.
- Follow the safety instructions given in the main user manual for viola.
- Read this additional manual and the safety instructions in the operating manual for viola fully before carrying out dissipation factor measurements with viola TD for the first time.

1.2 Application of the instructions

These operating instructions apply to devices with a firmware version from 2.0.

The details of the firmware version currently installed are given at *Main menu* > *Device settings* > *Info*.

2 FOR YOUR SAFETY

All BAUR devices and systems are reliable and are manufactured as per state-of-the-art technology. The individual parts and the finished devices are subject to continuous testing by our qualified personnel as part of our quality assurance system. Each device is fully tested before delivery.

However, the operational safety and reliability in practice can be achieved only when all necessary measures have been taken. The owner[1] and user[2] of the device or system are responsible for planning these measures and monitoring their implementation.

Before operating the device or system you should read and understand this user manual and the user manuals of all integrated devices.

2.1 Avoid dangers, take safety measures

When installing the test system and operating viola TD observe the following rules and guidelines:

- Accident prevention and environment protection rules applicable for your country
- Safety instructions and regulations of the country where viola TD is being used (according to the latest version)
- EU/EFTA countries: EN 50191 “Installation and operation of electric testing systems"
  Other countries: The standard for installation and operation of electric testing systems applicable for your country
- EU/EFTA countries: EN 50110 “Operation of electric systems”
  Other countries: The standard for operating electric systems applicable for your country
- If necessary, other national and international standards and guidelines in accordance with the latest applicable version
- Local safety and accident prevention regulations

Operational insurance association regulations (if any)

[1] Operator is the person or group that is responsible for the safe operation of the device and its maintenance (EN 61010, 3.5.12).
[2] User is the person who uses the device for its intended purpose (according to the definition of user in compliance with EN 61010, 3.5.11).

Technical secure state of the system

Safety, function and availability depend on the proper condition of the system. Upgrades, modifications or alterations to the product are essentially prohibited.

- Operate the system only in a technical perfect condition.
- In case of damage and malfunction, immediately stop the system, mark it accordingly and have the faults rectified by appropriately qualified and authorised personnel.
- Comply with the inspection and maintenance conditions.
- Use only accessories and original spare parts recommended by BAUR. The use of spare parts, accessories and special facilities that are not tested and approved by BAUR could adversely affect the safety, function and features of the product.

Check and maintain the safety devices

The safety devices must be inspected regularly for proper condition and function. viola TD must not be operated in case of defects or non-functional safety devices.

The safety devices must not be changed, bridged or switched off.

No operation on condensation

Condensation can form in devices and systems due to temperature fluctuations and high air humidity, which in some components can lead to leakage currents and flashovers.

Maximum danger arises when relatively high air humidity and temperature fluctuations occur consecutively, e.g. which is the case when storing the device in an unheated room or when placed outdoors. Then when the device is exposed to a high ambient temperature, the devices cold surfaces cool the air in the immediate vicinity, which leads to the formation of condensation, even inside the device.

Thereby, two factors are crucial:

- The higher the relative air humidity, the faster the dew point is reached and water is condensed.
- The higher the temperature difference between the surfaces and the ambient air, the more intensive the tendency for condensation.

Always prevent condensation in devices. Temper the device and system before and during measurements, so that no condensation occurs.

No operation in areas with risk of explosion and fire

Measurements in direct contact with water, in environments with explosive gases and in areas with fire risks are not permitted. Possible danger zones are e.g. chemical factories, refineries, lacquer factories, paint shops, cleaning plants, mills and storage for milled products, tank and loading plants for combustible gases, liquids and solid matter.

Splash-proof

The equipment is splash-proof only in the assembled state.

- Use the device for tests and measurements only in assembled state.

Lifting and carrying the device

The high voltage part of viola TD weighs 57 kg. 2 persons are required to lift and carry the high voltage part.

2.1.1 Dangers when working with high voltage

During tests and measurements with the viola TD, dangerous at times very high voltage is generated and is fed to the test object via a high voltage connection cable.

The personnel need to pay special attention and must be very careful while working with high voltage.

Commissioning and operation of the viola TD is permitted only in compliance with EN 50110 and EN 50191 (EU/EFTA countries) or with standards applicable in your country.

Observe 5 safety rules

Comply with the following safety rules before beginning tasks in and on electrical plant:

- Disconnect the test object.
- Secure against re-energisation.
- Ascertain the voltage status of the disconnected object.
- Short-circuit the test object to earth.
- Protect or isolate the test object from adjoining live HV plant.

⚠ DANGER

High voltage

Danger to life or risk of injury due to electric shock

- Before commencing work, the operator must assess the danger of the working conditions. Protective measures are based on the risk assessment and must be followed within the workplace.
- Connect the system as described in this user manual.
- In particular, properly earthing the test object and system.
- Observe the warning and safety signs on the system. Always check whether the warning signs are available and are legible.
- Never put the safety devices out of operation. It is forbidden to bypass the safety devices.
- Cordon off all metal parts in the area of the test object terminals (connection point and far end). Insulate and earth metal parts to avoid dangerous charges.

After a measurement or test - after switching off the device or system - the test object can still be "live" and have dangerous voltages present.

- Before lifting the safety measures, all live parts must compulsorily be discharged, earthed and short-circuited.

DANGER

Arcing fault when establishing a connection

Danger of burn injuries due to arcing fault

- Use suitable personal protective equipment to protect against arcing fault.
- Cover the adjacent live parts with an insulating material.
- Use only undamaged connection cable.
- Secure both the connection point and far end of the test object.
- Use special locking devices to lock connection points.

Guaranteeing immediate measures in case of danger

viola TD may be operated only if a second person with visual and audio contact to the tester is present and is in the position to detect possible dangers and to act immediately and properly.

Securing against unauthorised commissioning

- Press the Emergency-Stop button on leaving the device or system and pull out the key.
- Keep the key away safely.

3 PRODUCT INFORMATION

▸ Information on the layout and control elements of the device is given in the main user manual for viola TD. Here it pertains to an additional manual for dissipation factor measurements.

3.1 Connection set

The connection for a dissipation factor measurement is always possible without any additional equipment.

In order to achieve measurement results that are as precise as possible we recommend the use of:

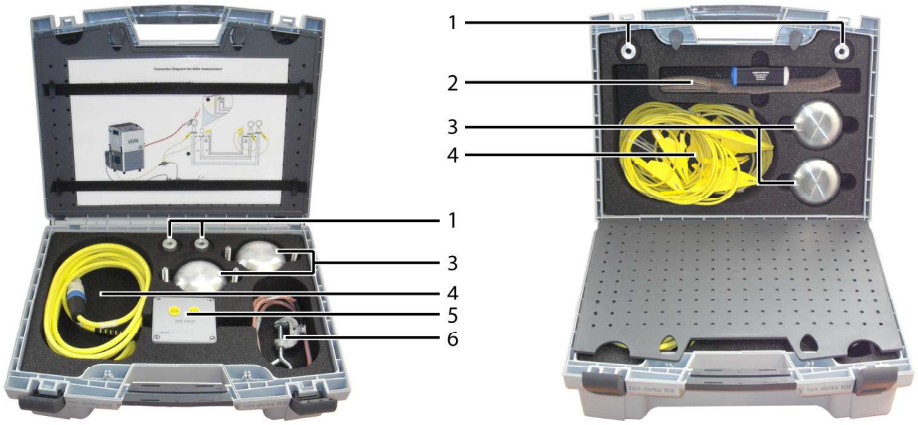
- Anti-corona protection

  Corona discharges on sharp edges in a test setup may cause a high noise level. Due to the anti-corona hoods included within the scope of delivery, sharp-edged parts are protected in order to prevent corona discharges affecting the measurement result.

- VSE box (option)

  With the VSE box, leakage currents are recorded and considered in the measurement result.

Connection set



No.	Element	Function
1	Distance pieces for anti-corona protection	Is used to install anti-corona protection
2	Screen ring (option)	Is used for the measurement setup with VSE box for the detection of leakage currents
3	Anti-corona protection	Anti-corona protection hoods are used to protect against corona discharges.
4	Connection cable (option)	Is used - ▪ to connect VSE box - viola TD ▪ to connect VSE box - screen ring at near end ▪ to connect VSE box - screen ring at far end (via return circuit) ▪ to connect screen ring at far end - adjoining voltage-free phase as return circuit
5	VSE box (option)	Is used for detecting leakage currents
6	Earth cable (VSE box)	Is used to connect the protective earthing

4 OPERATION OF THE DEVICE

4.1 Menus

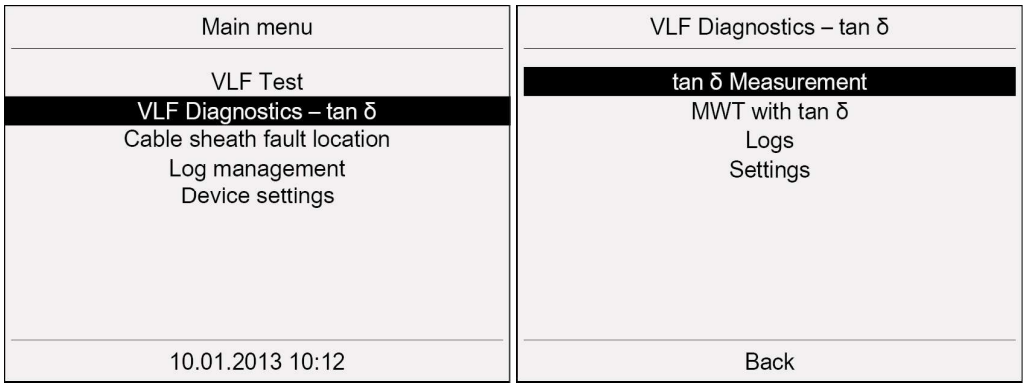
4.1.1 Note on the screenshots used

The screenshots used are intended to illustrate the procedure and may therefore differ slightly from the actual state.

4.1.2 Symbols and abbreviations on the display

C	Electric capacity	TD	current dissipation factor
I	Output current	MTD	Mean value of dissipation factor
Ivse	Leakage currents acquired through the VSE box	SDTD	Stability of the dissipation factor: Standard deviation
R	Resistance	ΔTD	Change of the dissipation factor between successive voltage steps.
Umax	Max. voltage	ΔTDt	Change of the dissipation factor over time
L	Phase on which the measurement or test is carried out	M	Current measurement
t	Test time	S	Current voltage step
Eval.	Evaluation	Ramp up	Ramp-up stage of a MWT measurement (increasing the voltage in steps)
MWT	MWT stage of an MWT measurement (VLF voltage test)		The measurement has not been started or no evaluations are still carried out.
	Measured value or measured values are within the permissible range.		Alarm level "Risk": The defined threshold value has been reached or exceeded.
	Alarm level "High risk": The defined threshold value has been reached or exceeded.		The measurement was cancelled: The defined threshold value has been reached or exceeded.

4.1.3 Main menu > VLF Diagnostics – tan delta



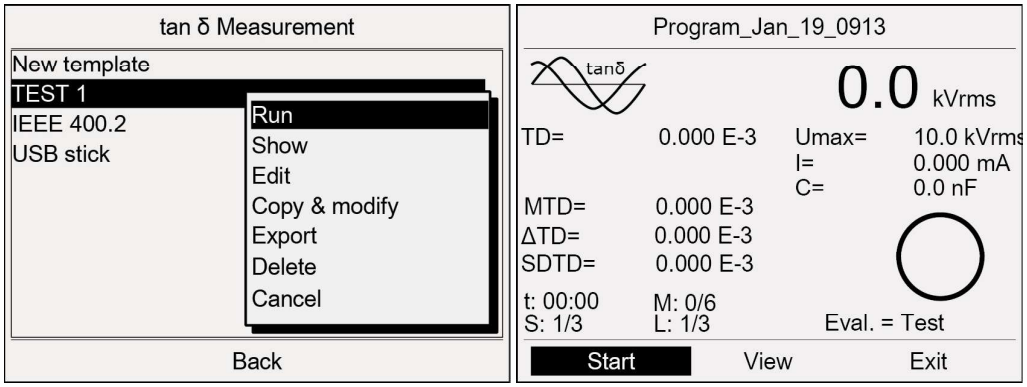
The following functions are available to you in the menu *VLF Diagnostics – tan δ* :

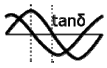
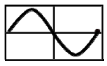
Menu item	Function
tan-δ measurement	Opens a menu with the following menu items: ▪ *New template*: For creating a new template for dissipation factor measurements ▪ *IEEE 400.2*: For setting parameters for a dissipation factor measurement according to IEEE 400.2 ▪ *USB stick*: For importing templates from a USB stick ▪ Available templates, if present
MWT with tanδ	Opens a menu with the following menu items: ▪ *New template*: For creating a new MWT template (combined cable test and dissipation factor measurement) ▪ *IEEE 400.2*: For setting parameters for a MWT measurement according to IEEE 400.2 ▪ *USB stick*: For importing templates from a USB stick ▪ Available templates, if present
Logs	Opens a menu with the following menu items: ▪ *tan-δ measurement*: For viewing and managing the logs of the tan-δ measurements ▪ *MWT with tanδ*: For viewing and managing logs of the MWT measurements
Settings	Opens a menu with the following menu items: ▪ *Using the VSE box*: for activating the VSE box ▪ *Start delay*: for setting the delay when starting the measurement ▪ *Split MWT measurement:* for the separation and separate control of the ramp-up stage and MWT stage of an MWT measurement

4.1.4 Measurement mode window “tan δ Measurement"

The measurement mode window *tan-δ Measurement* is used for starting, controlling and stopping a dissipation factor measurement.

1. In order to be able to access the measurement mode window, select the following menu item in the main menu *VLF Diagnostics – tan δ* > *tan-δ Measurement*.
2. In the menu *tan-δ Measurement* select a template and, in the context menu, select the menu item *Run*.



Element	Function
	This indicates that a dissipation factor measurement can be started or is being carried out
	This indicates that the measurement is running
Start / Stop	Starts the measurement / ends the measurement After starting the measurement, the menu item *Start* in the bottom menu bar changes to *Stop*.
View	Switches the display of the measurement results between ▪ Main view (measurement mode window) ▪ Diagram tan δ versus voltage ▪ Detail view (all measured values per phase)
Exit	Switches into the menu *VLF Diagnostics – tan δ*

An explanation of the symbols and abbreviations for different measured values is given in the chapter *Symbols and abbreviations on the display* (on page 14).

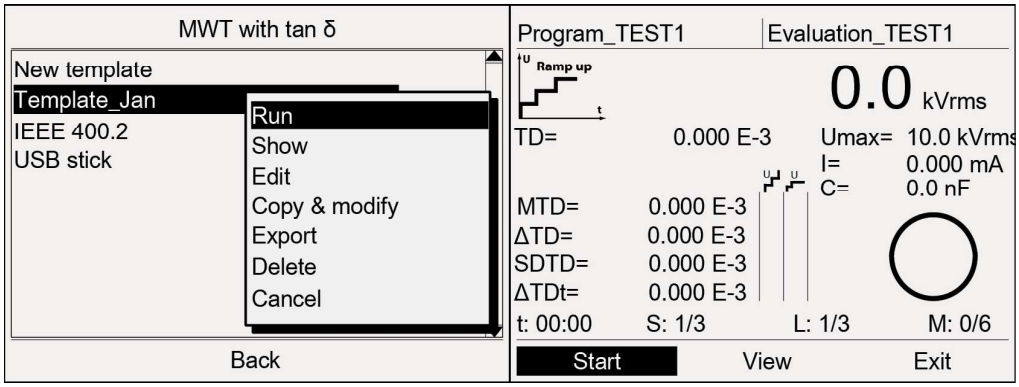
4.1.5 Measurement mode window “MWT with tan delta”

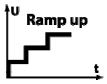
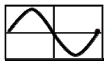
The measurement mode window *MWT with tan δ* is used for starting, controlling and stopping a MWT with tan δ. (see "Monitored Withstand Test with dissipation factor measurement (MWT with tan delta)" on page 19)

1. In order to be able to access the measurement mode window, select the following menu item in the main menu *VLF Diagnostics – tan δ* > *MWT with tan δ*.
2. In the menu *MWT with tan δ* select a template and, in the context menu, select the menu item *Run*.

Ramp-up stage

The first stage of the MWT is the ramp-up stage.

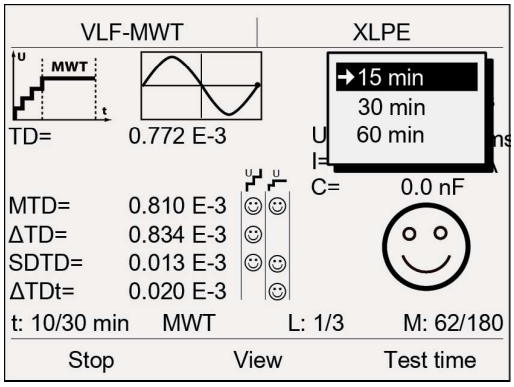


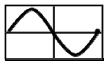
Element on the display	Function
	Shows that the ramp-up stage can be started or is being carried out
	This indicates that the measurement is running
Start / Stop	Starts the measurement / ends the measurement After starting the measurement, the menu item *Start* in the bottom menu bar changes to *Stop*.
View	Switches the display of the measurement results between ▪ Main view (measurement mode window); ▪ Diagram tan δ versus voltage ▪ Diagram tan δ versus time ▪ Detail view (all measured values per phase)
Exit	Switches into the menu *VLF Diagnostics – tan δ*
Column with the symbol	Evaluation of the measured values in the ramp-up stage
Column with the symbol	Evaluation of the measured values in the MWT stage

An explanation of the symbols and abbreviations for different measured values is given in the chapter *Symbols and abbreviations on the display* (on page 14).

MWT stage

Following the ramp-up stage the MWT stage is carried out. AT a constant voltage the VLF voltage test is carried out, with the dissipation factor being measured at the same time.



Element on the display	Function
	Indicates that the MWT stage is carried out.
	This indicates that the measurement is running
Test time	The menu item is indicated following a preset time after the start of the MWT stage. Using the measurement results acquired at this point in time, you can adapt the remaining test time to the cable condition: ▪ If the cable is in a good condition: Reduction of the test time to a preset time (e. g. 15 minutes) ▪ If the cable requires further examination: Test time in accordance with the recommendation by the standard (e. g. 30 minutes) ▪ If the cable is in a poor condition: Extension of the test time (e. g. to 60 minutes) The test evaluates automatically acquired measured values and proposes a suitable test time in the pop-up window.

4.2 Cable diagnostics: Overview of the available diagnostics types

4.2.1 Dissipation factor measurement

The dissipation factor measurement is an established integral diagnostics method for assessing the condition of medium-voltage cables, where the ratio of active power and reactive power is determined.

For diagnostics, the test voltage is increased in steps up to a predefined level. Here, the dissipation loss factor is measured for various different voltage steps (e.g. for 0.5 x Uo, Uo and 1.5 x Uo). At each voltage step, several measurements are carried out and the following values are acquired:

- Dissipation factor (as current value of tan delta)
- Mean value of the dissipation factor per voltage step
- Standard deviation of the dissipation factor per voltage step (stability of the dissipation factor)
- Change of the dissipation factor between successive voltage steps.

These values serve as diagnostics criteria and indicate the ageing and water-tree damage of the cable insulation.

4.2.2 Monitored Withstand Test with dissipation factor measurement (MWT with tan delta)

In the Monitored Withstand Test, a VLF cable test and a dissipation factor measurement are carried out in parallel. Whilst the cable test shows whether the cable system withstands a load (e.g. 2 x Uo) over a specific test time, the dissipation factor measurement provides for a condition evaluation of the cable and allows conclusions as to the ageing of the same or any latent damage.

In the draft of the new IEEE 400-2012 the VLF-Sinus-MWT with dissipation factor measurement is recommended in particular for operationally aged cable systems.

The Monitored Withstand Test comprises 2 parts:

Ramp-up stage

In the ramp-up stage, as for a standard dissipation factor measurement, the voltage up to the next test voltage is built up in steps. In this “start stage" the dissipation factor is measured for various pre-defined voltage steps (e.g. for 0.5 x Uo, Uo and 1.5 x Uo). At each voltage step, several measurements are carried out and the following values are acquired:

- Dissipation factor (as current value of tan delta)
- Mean value of the dissipation factor per voltage step
- Standard deviation of the dissipation factor per voltage step (stability of the dissipation factor)
- Change of the dissipation factor between the voltage steps.

As a result of the analysis of these values the first evaluation of the cable system condition is already effected during the ramp-up stage. If the measurement results in the ramp-up stage already indicate a poor condition of the cable, if necessary, a cable test may be done without in order to avoid damage to the system as a result of permanent stress.

MWT stage

In the MWT stage the proper cable test is carried out with a continuous dissipation factor measurement at a defined test voltage (e.g. 2 x Uo). In addition to the values specified above, the change of the dissipation factor is also measured under the influence of the test voltage over time. This provides further information on the condition of the cable.

Depending on the dissipation factor values you can do the following during the Monitored Withstand Test:

- cancel the cable test if the diagnostics points to a critical condition and a continuation of the cable test may cause damage to the cable system;
- reduce the cable test time and thus save time if the diagnostics indicate a healthy cable;
- extend the cable test time, in order to observe the cable over a longer period of time and so to identify insulation weaknesses clearly.

4.2.3 IEEE 400.2

Two templates according to IEEE-400.2 are available to you:

- Dissipation factor measurement
- MWT with dissipation factor measurement

The parameters of this template correspond to the valid draft of the new IEEE 400.2. Below you will find full details on the test voltages implemented and the evaluation criteria.

Test voltages according to IEEE 400.2 (new)

The implemented test voltages correspond to the valid draft of the new IEEE 400.2:

Nominal voltage U	Installation	Acceptance	Maintenance
(Phase - Phase) [kV]	(Phase - Earth) [kVrms]	(Phase - Earth) [kVrms]	(Phase - Earth) [kVrms]
5	9	10	7
8	11	13	10
15*	19 According to IEEE 400.2-2004 = 18 kVrms	21 According to IEEE 400.2-2004 = 20 kVrms	16
20 (new)**	24	26	20
25*	29 According to IEEE 400.2-2004 = 27 kVrms	32 According to IEEE 400.2-2004 = 31 kVrms	24 According to IEEE 400.2-2004 = 23 kVrms
28 (new)**	32	36	27
30 (new)**	34	38	29
35	39	44	33

* In the currently valid version of IEEE 400.2-2004 lower test voltages are recommended for 15-kV cables and 25-kV cables than in the draft version of the new standard.

** These nominal voltages have been newly included in the new IEEE 400.2.

In the draft of the new IEEE 400.2 new test voltages (for 20kV, 28kV and 30kV cables) were included, in comparison to IEEE 400.2-2004 some test voltages were increased. If you wish to apply the test voltages of the IEEE 400.2-2004, prepare a user-specific template.

Evaluation criteria according to IEEE 400.2 (new)

The threshold values of the evaluation have been implemented in accordance with the valid draft version of the new IEEE 400.2 standard.

Valid for North America

XLPE cable

Characteristic values	Alarm level	Ramp up	MWT*
SDTD	Cancel**	0.0	0.0
	High risk	> 0.5	> 6
	Risk	> 0.1	> 0.25
MTD	Cancel**	0.0	0.0
	High risk	> 50	> 45
	Risk	> 4	> 5
ΔTDt	Cancel**	–	0.0
	Extended test time	–	> 17
	Reduced test time	–	< 0.25
ΔTD	Cancel**	0.0	–
	High risk	> 80	–
	Risk	> 5	–

* For the MWT stage, the draft standard does not specify any threshold values. The implemented threshold values correspond to the recommendation by NEETRAC, The National Electric Energy Testing Research and Applications Center (see Fletcher, Hampton, Hernandez, Hesse, Pearman, Perkel, Wall, Zenger: First practical utility implementations of monitored withstand diagnostics in the USA, Jicable 11, A.10.2)

** The draft standard does not define any cancellation criteria, therefore the threshold values for cancelling the measurement is set to 0.0 (no cancellation).

PILC cable

Characteristic values	Alarm level	Ramp up	MWT*
SDTD	Cancel**	0.0	0.0
	High risk	> 0.4	> 3.5
	Risk	> 0.1	> 0.7
MTD	Cancel**	0.0	0.0
	High risk	> 200	> 135
	Risk	> 85	> 75
ΔTDt	Cancel**	–	0.0
	Extended test time	–	> 4
	Reduced test time	–	< 1.3

Characteristic values	Alarm level	Ramp up (+)	Ramp up (-)
ΔTD	Cancel**	0.0	0.0
	High risk	100	-50
	Risk	10	-35

* For the MWT stage, the draft standard does not specify any threshold values. The implemented threshold values correspond to the recommendation by NEETRAC, The National Electric Energy Testing Research and Applications Center (see Fletcher, Hampton, Hernandez, Hesse, Pearman, Perkel, Wall, Zenger: First practical utility implementations of monitored withstand diagnostics in the USA, Jicable 11, A.10.2)

** The draft standard does not define any cancellation criteria, therefore the threshold values for cancelling the measurement is set to 0.0 (no cancellation).

EPR cable

Characteristic values	Alarm level	Ramp up	MWT*
SDTD	Cancel**	0.0	0.0
	High risk	> 1.3	> 1.3
	Risk	> 0.1	> 0.1
MTD	Cancel**	0.0	0.0
	High risk	> 120	> 120
	Risk	> 35	> 35
ΔTDt	Cancel**	–	0.0
	Extended test time	–	0.0
	Reduced test time	–	0.0
ΔTD	Cancel**	0.0	–
	High risk	> 100	–
	Risk	> 5	–

* For the MWT stage, the draft standard does not specify any threshold values. The implemented threshold values correspond to the standard recommendation for the ramp-up stage.

** The draft standard does not define any cancellation criteria, therefore the threshold values for cancelling the measurement is set to 0.0 (no cancellation).

All countries outside North America (World)

XLPE cable

Characteristic values	Alarm level	Ramp up	MWT*
SDTD	Cancel**	0.0	0.0
	High risk	> 0.5	> 0.5
	Risk	> 0.1	> 0.1
MTD	Cancel**	0.0	0.0
	High risk	> 2.0	> 2.0
	Risk	> 1.2	> 1.2
ΔTDt	Cancel**	–	0.0
	Extended test time	–	0.0
	Reduced test time	–	0.0
ΔTD	Cancel**	0.0	–
	High risk	> 1.0	–
	Risk	> 0.6	–

* For the MWT stage, the draft standard does not specify any threshold values. The implemented threshold values correspond to the standard recommendation for the ramp-up stage.

** The draft standard does not define any cancellation criteria, therefore the threshold values for cancelling the measurement is set to 0.0 (no cancellation).

PILC cable

Characteristic values	Alarm level	Ramp up	MWT*
SDTD	Cancel**	0.0	0.0
	High risk	> 1.0	> 1.0
	Risk	> 0.5	> 0.5
MTD	Cancel**	0.0	0.0
	High risk	> 100	> 100
	Risk	> 50	> 50
ΔTDt	Cancel**	–	0.0
	Extended test time	–	0.0
	Reduced test time	–	0.0

Characteristic values	Alarm level	Ramp up (+)	Ramp up (-)
ΔTD	Cancel**	0.0	0.0
	High risk	50	-50
	Risk	20	-20

* For the MWT stage, the draft standard does not specify any threshold values. The implemented threshold values correspond to the standard recommendation for the ramp-up stage.

** The draft standard does not define any cancellation criteria, therefore the threshold values for cancelling the measurement is set to 0.0 (no cancellation).

EPR cable

Characteristic values	Alarm level	Ramp up	MWT
SDTD	Cancel**	0.0	0.0
	High risk	> 1.0	> 1.0
	Risk	> 0.5	> 0.5
MTD	Cancel**	0.0	0.0
	High risk	> 80	> 80
	Risk	> 10	> 10
ΔTDt	Cancel**	–	0.0
	Extended test time	–	0.0
	Reduced test time	–	0.0
ΔTD	Cancel**	0.0	–
	High risk	> 10	–
	Risk	> 4	–

* For the MWT stage, the draft standard does not specify any threshold values. The implemented threshold values correspond to the standard recommendation for the ramp-up stage.

** The draft standard does not define any cancellation criteria, therefore the threshold values for cancelling the measurement is set to 0.0 (no cancellation).

4.3 Template: Definition and component parts

The VLF cable diagnostics is carried out on the basis of templates. A template offers a basic configuration for executing a dissipation factor measurement or an MWT with dissipation factor measurement and contains the following information:

- Program: Parameters on the diagnostics process
- Evaluation criteria.

You have the option to configure templates for different diagnostics tasks and to save the same for further use.

When creating templates you can combine existing programs and evaluations in any way or create new programs and evaluations.

Two templates according to IEEE-400.2 are available to you:

- Dissipation factor measurement (*VLF Diagnostics – tan δ > tan-δ Measurement*)
- MWT with dissipation factor measurement (*VLF Diagnostics – tan δ > MWT with tan δ*)

Program

In a program, the parameters of the diagnostics sequence are defined such as e.g. test voltage, voltage steps, number of measurements per voltage step and number of phases to be measured. For the MWT, the MWT stage is also determined in the program.

Evaluation

Criteria for analysis of the measurement results in view of the test object condition are determined in an evaluation.

The criteria are entered in the form of threshold values. The alarm levels *Risk*, *High Risk* or *Cancel* will be assigned to these threshold values. If the threshold values are reached, depending on the alarm level an appropriate warning symbol is displayed in the measurement mode window or the measurement is cancelled.

Alarm level	Cable state	Measure on reaching the preset threshold value	Symbol
Cancel	Cable is seriously damaged. Operational safety and reliability is no longer assured.	The measurement is cancelled immediately.	
High risk	The cable is damaged and represents a high risk for operational safety and reliability.	Warning symbol in the measurement mode window	
Risk	Cable is partially damaged and may represent a risk for operational safety and reliability.	Warning symbol in the measurement mode window	
No alarm	Cable is not damaged and continues to be ready for operation.	Symbol in measurement mode window	

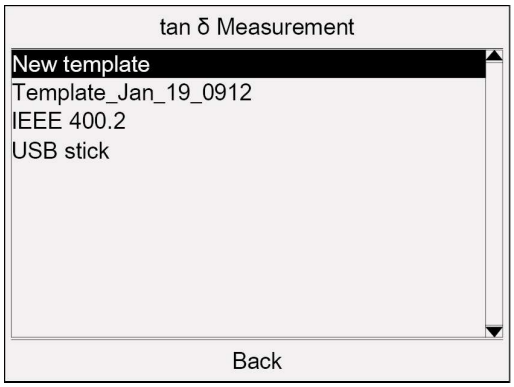
Cable data

Templates for dissipation factor measurements can also be created by means of the BAUR software and imported to the device by means of a USB stick. These templates additionally contain cable data.

4.3.1 Menu for the creation and editing of templates

- In order to create and edit templates, select the following menu item depending on the type of diagnostics:
  - Dissipation factor measurement: *Main menu* > *VLF Diagnostics – tan δ* > *tan-δ Measurement*
  - MWT with tanδ:*Main menu* > *VLF Diagnostics – tan δ* > *MWT with tan δ*

  For both diagnostics types the structure of the menu is the same.



In the menu *tan-δ Measurement* resp. *MWT with tan δ* the following functions are available:

- **Start diagnostics in accordance with a template:** Select a template and, in the context menu, select the menu item *Run* (see "*Starting a dissipation factor measurement*" on page 78, "*Starting a MWT measurement*" on page 84).
- **Create a new template**: Select the menu item *New template* (see "*Creating a new MWT template*" on page 51, "*Creating a new template for dissipation factor measurement*" on page 44).
- **Manage templates:**
  a. Select a template and press the rotary knob to confirm.
  b. Select one of the following functions in the context menu:

     Run – Start diagnostics in accordance with the template selected

     Show – Display the template parameters

     Edit – Edit template

     Copy & modify – Create a new template on the basis of the template selected

     Export – Export a template to a USB stick

     Delete – Delete template
- **Load templates from a USB stick:** Insert a USB stick, which the required template is saved on, and select the menu item *USB stick* (see "*Importing a template from a USB stick*" on page 60).

5 COMMISSIONING

- Observe the following:
  - The safety instructions in the chapter *For your safety* (on page 8)
  - Local safety and accident prevention regulations
  - Safety instructions and regulations according to the latest version
  - National and international standards and guidelines in the latest applicable version:
    EN 50110 for operation of electric systems (EU/EFTA countries);
    EN 50191 for installation and operation of electric systems (EU/EFTA countries)
    or applicable standards in your country.

In compliance with the local work safety and accident prevention regulations, use the personal safety equipment for protection against electric shock and burns due to arcing faults.

5.1 Lifting and carrying the device

- The high voltage part of viola TD weighs 57 kg. 2 persons are required to lift and carry the high voltage part.

5.2 Checks to perform before commissioning

1. Check the device and mechanical connections for damage.
2. Check electrical connections and cables for damage.
   Use only undamaged connection cable.
3. Once a month check that the emergency stop button (see "Monthly check of emergency stop button" on page 30) is working properly.
4. Check if the device has been assembled correctly and if the rubber fasteners are closed.

5.2.1 Monthly check of emergency stop button

- Check the function of the emergency stop button on a monthly basis. Proceed as follows:

1. Switch on the device. The device conducts a self-test after it is switched on.
   The switch-on menu appears in the display.
2. Press the emergency stop button.
3. Select the menu item *Main menu* > *VLF Test* > *Manual test*.
   The message that the emergency stop circuit is activated must be displayed. In this case, the emergency stop circuit works properly.
4. If no message on the activation of the emergency stop circuit is displayed, immediately put the device out of operation and clearly mark it as defective. Contact your BAUR representative (http://www.baur.at/worldwide/).

DANGER

Dangerous voltage on device and test object

Danger to life, risk of injury from high electric voltage.

- Do not use the defective device under any circumstances.

5.3 Ensure there is no voltage at the work place

Before connecting the test object follow the 5 safety rules:

1. Disconnect the test object.
2. Secure the test object against re-energisation.
3. Ensure that there is no voltage present.
4. Secure adjacent live parts against accidental contact and flashovers with suitable covers.
5. Connect all conductors of the test object to the station earth.

Note:

- If the **cable sheath is not earthed**, establish a short earth connection to the station earth. The station earth is the neutral point of the earth connections.
- The earthing conductor should be as short as possible and show low impedance. Use a copper **earthing conductor with a cross-section of min. 16 mm²**.

5.4 Preparing the test object terminals

The test object terminals are **the connection point and the far end** of the test object.

1. Disconnect all operating resources that are connected to the test object and are not designed for the stipulated test voltage.
2. Cordon off all metal parts, e.g. lighting masts at the test object terminals or insulate them with insulating safety plates.
3. Earth all metal parts at the terminals to avoid dangerous charging.
4. All cables that are used in danger zones can also carry high voltage potential outwards. Therefore, remove this cable from the danger zone or ensure low ohmic earthing and short-circuit.
5. Follow the cable line and ensure that no work is being carried out underground on gas lines and that there are no other danger points.

5.5 Installing the device

- Select the place of installation for the device in such a way that
  - a stable base is guaranteed.
  - the device and the test object are easy to access for the connections and operation.
  - sufficient safety distances are kept. Comply in this regard with EN 50110 for operation of electric systems (EU/EFTA countries) or the relevant standards applicable in your country.

5.6 Connecting the device

⚠ WARNING

Danger due to electric voltage, flashovers at the connection point, arcing fault on connection

Electric shock on touching live and/or active parts and due to residual charges and/or induction voltages;

Burns, hearing damage.

- Use suitable personal safety equipment against electric shock and arcing fault.
- Observe the phase breaks.
- Ensure that adjacent live parts are secured against accidental contact and flashovers with suitable covers (insulation mats, insulating safety plates).

⚠ WARNING

High electric voltage through potential increase.

A fault can cause flashovers in the respective device. In this case, a potential increase of the housing is possible due to high short-circuit currents.

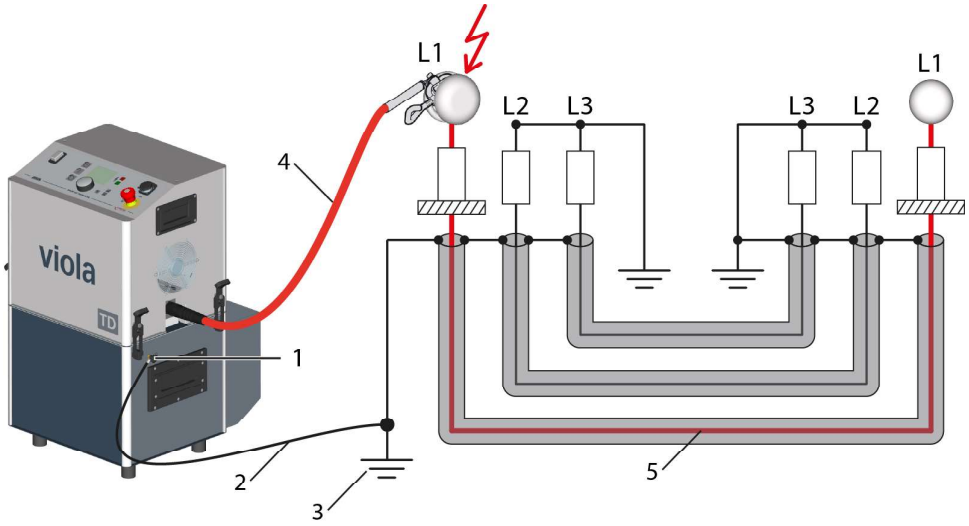
Danger due to the potential increase is reduced when a protective earthing is connected properly.

- Connect the protective earthing carefully. The protective earthing conductor should be as short as possible and of low impedance.

You have the following options for performing VLF diagnostics:

- Standard measurement: without recording of leakage currents
- Measurement with recording of leakage currents by using virtual protective earth VSE (option)

5.6.1 Connecting without VSE box



1	Earth connection screw
2	Earthing conductor
3	Station earth
4	High voltage connection cable
5	Phase to be tested

1. The scope of delivery of viola TD comprises an earthing conductor. Connect the earthing conductor to the station earth.
2. The earth connection terminal is located on the side of the device. Unscrew the earth connection terminal.
3. Connect the cable lug of the earthing conductor to the earth connection terminal.
4. Re-screw the earth connection terminal screw into the earth connection terminal.

   The device is now connected to the station earth.
5. If necessary, connect the earthing conductor of the discharge and earth rod to the station earth.

   At near end:
6. *NOTICE!* Dirt and moisture at terminations can adversely affect the measurement results. Carefully clean the dirty terminations.
7. Remove the earthing and short-circuit connection from the conductor to be tested.
8. To exclude the influence of corona discharges on the tan delta measurement result, attach the anti-corona hoods of the anti-corona protection (tan delta kit) to the termination of the phase to be tested.
9. Connect the high voltage connection cable to the test object.

   Observe the minimum distance at high voltage.
10. Make sure that the phases not being tested are earthed and short-circuited.

At far end:

11. *NOTICE!* Dirt and moisture at terminations can adversely affect the measurement results. Carefully clean the dirty terminations.
12. Remove the earthing and short-circuit connection from the conductor to be tested.
13. To exclude the influence of corona discharges on the tan delta measurement result, attach the anti-corona hoods of the anti-corona protection (tan delta kit) to the termination of the phase to be tested.
14. Make sure that the phases not being tested are earthed and short-circuited.

    At the near end (on the device)

15. If you are not connecting an external emergency stop unit (option), ensure that the jumper plug is inserted in the connection for external emergency stop unit.

    If you are using an external emergency stop unit, connect it:

    a. Mount the external emergency stop unit so that it is easy to reach.
    b. Remove the jumper plug from the connection for external emergency stop unit.
    c. Connect the external emergency stop unit to the connection for external emergency stop unit.

Procedure for diagnostics on 2 or 3 phases (without VSE box)

Carry out a measurement on the phases to be tested successively in accordance with the phase number. During the measurement you must reconnect the phases.

At near end

1. When the measurement of a phase has been completed, discharge, earth and short-circuit this phase.
2. Remove the anti-corona protection from the phase where you have completed the measurement.
3. Attach the anti-corona protection to the termination of the next phase to be tested.
4. Connect the next phase to be tested.

At far end

5. Remove the anti-corona protection from the phase where you have completed the measurement.
6. Attach the anti-corona protection to the termination of the next phase to be tested.

5.6.2 Connecting with VSE box (option)

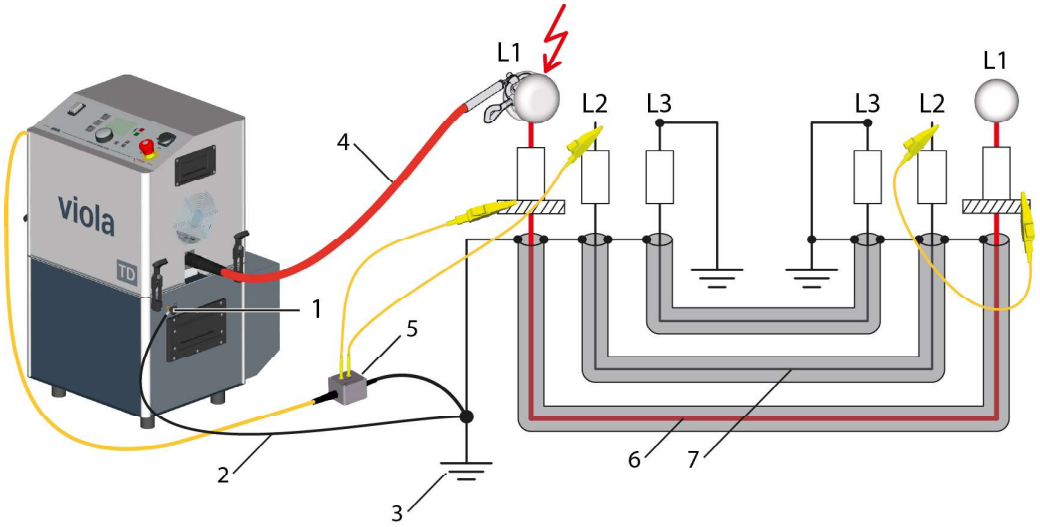
Note: VSE box is available as an option (see “Scope of delivery" in the main user manual).

With the VSE box, leakage currents are recorded and considered in the measurement result. With this option, you receive more precise measurement results.

- If you want to use a VSE box for the current measurement, activate this option under *Main menu* > *VLF Diagnostics – tan δ* > *VLF Diagnostics – settings*.

Depending on how many phases you wish to carry out the diagnostics, please note the following information:

- on a phase (see the following description)
- on 2 phases (see "How to proceed in the case of diagnostics on 2 phases" on page 37)
- on 3 phases (see "How to proceed in the case of diagnostics on 3 phases" on page 38)



1	Earth connection screw
2	Earthing conductor
3	Station earth
4	High voltage connection cable
5	VSE box
6	Phase to be tested
7	Return circuit from far end (voltage-free phase)

1. The scope of delivery of viola TD comprises an earthing conductor. Connect the earthing conductor to the station earth.
2. The earth connection terminal is located on the side of the device. Unscrew the earth connection terminal.
3. Connect the cable lug of the earthing conductor to the earth connection terminal.
4. Re-screw the earth connection terminal screw into the earth connection terminal.

   The device is now connected to the station earth.
5. If necessary, connect the earthing conductor of the discharge and earth rod to the station earth.

   At near end:
6. *NOTICE!* Dirt and moisture at terminations can adversely affect the measurement results. Carefully clean the dirty terminations.
7. Remove the earthing and short-circuit connection from the conductor to be tested.
8. To exclude the influence of corona discharges on the tan delta measurement result, attach the anti-corona hoods of the anti-corona protection (tan delta kit) to the termination of the phase to be tested.
9. Attach a shield ring made of copper braid with Velcro tape (tan delta kit) - directly over the screen - to the termination of the phase to be tested.

   Important note: Ensure that the screen ring does not touch the screen.
10. Connect the VSE box to the station earth.
11. Connect the VSE box to viola TD.

12. Connect the shield ring to the phase to be tested by means of a yellow connection cable from the tan delta kit directly to the VSE box.
13. A voltage-free phase where no measurement is taken will be used for returning the leakage currents from the far end.

    Connect a voltage-free phase by means of a yellow connection cable from the tan delta kit with the VSE box.

    For example, in the connection diagram L2 is used to return leakage currents.
14. Remove the earthing and the short-circuit connection at this voltage-free phase.
15. Connect the high voltage connection cable to the test object.

    Observe the minimum distance at high voltage.

    At far end:
16. *NOTICE!* Dirt and moisture at terminations can adversely affect the measurement results. Carefully clean the dirty terminations.
17. Remove the earthing and short-circuit connection from the conductor to be tested.
18. To exclude the influence of corona discharges on the tan delta measurement result, attach the anti-corona hoods of the anti-corona protection (tan delta kit) to the termination of the phase to be tested.
19. Attach a shield ring made of copper braid with Velcro tape (tan delta kit) - directly over the screen - to the termination of the phase to be tested.

    Important note: Ensure that the screen ring does not touch the screen.
20. Use a yellow connection cable from the tan delta kit to connect the screen ring with the voltage-free phase that is connected to the VSE box at the near end.

    The screen ring is now connected with the VSE box via the voltage-free conductor.
21. Remove the earthing and the short-circuit connection at the voltage-free phase.

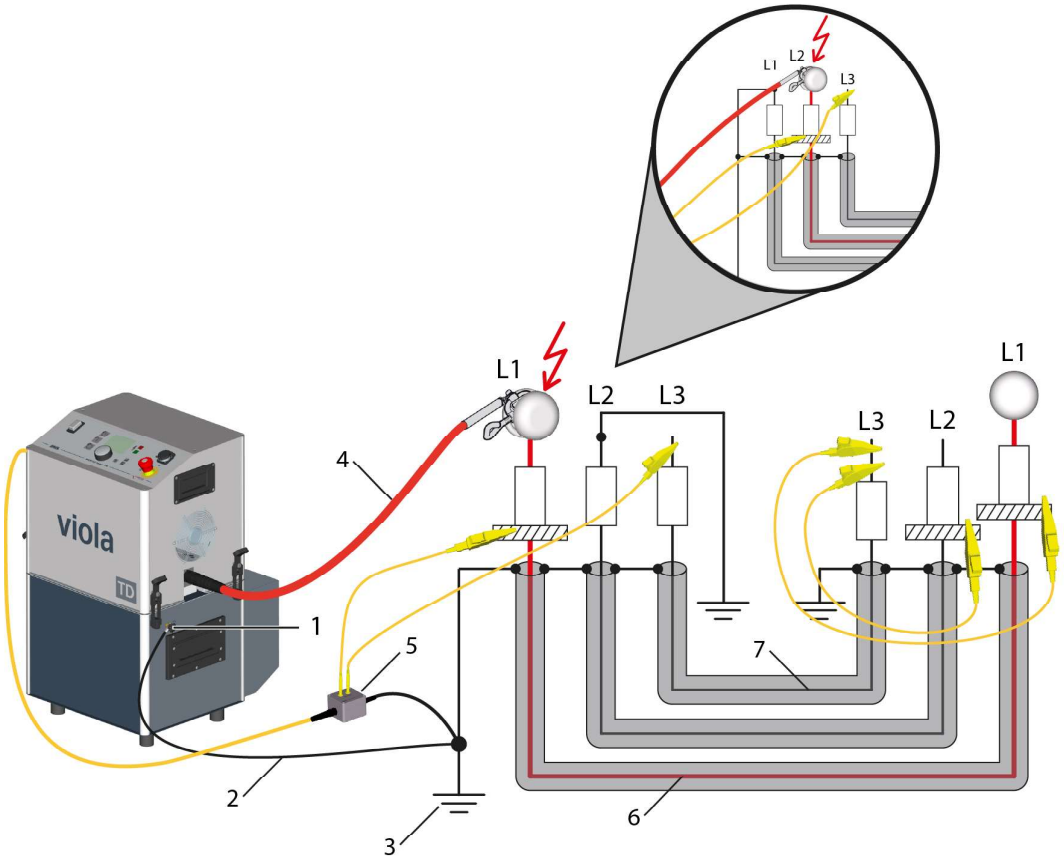
    At the near end (on the device)
22. If you are not connecting an external emergency stop unit (option), ensure that the jumper plug is inserted in the connection for the external emergency stop unit.

    If you are using an external emergency stop unit, connect it:

    a. Mount the external emergency-stop unit so that it is easy to reach.
    b. Remove the jumper plug from the connection for the external emergency-stop unit.
    c. Connect the external emergency-stop unit to the connection for the external emergency-stop unit.

How to proceed in the case of diagnostics on 2 phases

Example of a measurement setup: Phase L3 serves as return line for the dissipation factor measurement at the phases L1 and L2.



1	Earth connection screw
2	Earthing conductor
3	Station earth
4	High voltage connection cable
5	VSE box
6	Phase to be tested
7	Return circuit from far end (voltage-free phase)

Carry out a measurement on 2 phases successively in accordance with the phase number. At the near end, phase 1 is connected first. On completion of the measurement on phase L1, phase L2 is connected. The voltage-free phase L3 serves as return line for the measurement at the phases L1 and L2. The measurement structure at the far end remains the same for measurements at both phases.

At near end

1. First, connect phase L1. Proceed exactly as for the dissipation factor measurement at a phase (see "Connecting with VSE box (option)" on page 34).

   The phase L3 is used as a return circuit for leakage currents from the far end.

   The phase L2 must remain short-circuited.

   At far end

2. *NOTICE!* Dirt and moisture at terminations can adversely affect the measurement results. Carefully clean the dirty terminations.
3. Remove the earthing and short-circuit connection from both phases to be tested.

4. To exclude the influence of corona discharges on the tan delta measurement result, attach the anti-corona hoods of the anti-corona protection (tan delta kit) to the two terminations.
5. Attach a respective screen ring made of copper braid with Velcro tape directly over the screen to both terminations of the phases to be tested (tan delta kit).

   Important note: Ensure that the screen ring does not touch the screen.
6. Use yellow connection cables from the tan delta kit to connect the two screen rings to the voltage-free phase, which is connected to the near end of the VSE box.

   The two screen rings are now connected to the VSE box via the voltage-free phase.
7. Remove the earthing and the short-circuit connection at this voltage-free phase.

   At the near end (on the device)
8. If you are not connecting an external emergency stop unit (option), ensure that the jumper plug is inserted in the connection for external emergency stop unit.

   If you are using an external emergency stop unit, connect it. (see "Connecting with VSE box (option)" on page 34)

On completion of the measurement on phase L1

1. Discharge, earth and short-circuit the test object.

   At near end:
2. Connect the phase L2 to be tested.
3. Remove the anti-corona hoods of the anti-corona protection from phase L1 and attach the anti-corona hood of the anti-corona protection to the termination of the phase L2 to be measured.

   At far end:

   No change required.

How to proceed in the case of diagnostics on 3 phases

- Carry out a measurement on the first 2 phases as described in chapter *How to proceed in the case of diagnostics on 2 phases* (on page 37).

  For the dissipation factor measurement on phase L3 the adjacent voltage-free phase, e.g. L2, is used as a return line. On completion of the measurement on phase L2 you must reconnect the phases at the far end.

On completion of the measurement on phase L2:

1. Discharge, earth and short-circuit the test object.

   At near end:
2. Connect the phase L3 to be tested.
3. Connect the voltage-free phase L2 with the VSE box.

   The phase L2 is used as a return circuit for leakage currents from the far end.

   The phase L1 must be short-circuited.
4. Remove the anti-corona protection from phase L2 and attach the anti-corona protection to the termination of the phase L3 to be measured.

   At far end:
5. Remove the connection cables between the screen rings of the phases L1 and L2 and the phase L3, which was used as a return circuit for the measurement on the phases L1 and L2.
6. Remove the screen ring from phase L2.

7. Attach the screen ring to the termination of the phase L3 to be measured - directly over the screen - using Velcro tape.

   Important note: Ensure that the screen ring does not touch the screen.
8. Remove the anti-corona protection from phase L2 and attach the same to the termination of the phase L3 to be tested.
9. Connect the screen ring of the phase L3 to the voltage-free phase L2.

   The screen ring is now connected with the VSE box via the voltage-free phase L2. Phase L2 serves as return line for the dissipation factor measurement on phase L3.

5.7 Connecting to the supply voltage

NOTICE

Too high or too low mains voltage

A low mains voltage adversely affects the function of the system, a high mains voltage can cause damage.

- Ensure that the supply voltage matches the specifications on the rating plate.

1. Measure the mains voltage with a voltmeter.
2. Compare the mains voltage with the specifications on the rating plate.

CAUTION

High electric voltage through potential increase

Risk of personal injury due to electric shock. Damage to property due to potential differences from mains input to the housing.

- Make sure that the mains supply earth is not isolated from the station earth.

3. Connect the system to the mains voltage. If necessary, use a country-specific adapter.

5.7.1 Voltage supply via an external power generator

- Follow the user manual for viola and the user manual for the external power generator.

- Make sure that the selected power generators meet the necessary technical requirements for the voltage quality (see user manual for viola).

5.8 Securing the test area

1. Mark out the path for pedestrians.
2. Protect the test lead (connection cable), e.g. with cable bridges or rubber mats. The cables must be protected against damage and there must be no danger of people tripping.
3. If the connection creates a hazard for the testing personnel and pedestrians, mark them.
4. The area around the test structure (test area) must be demarcated from workplaces and traffic in such a way that
   - “except for the tester, no other person can remain in the test area,
   - except for the tester, no other person can access the test area,
   - persons standing outside the boundary cannot reach the operating elements of the test system located inside the boundary.” (EN 50191)

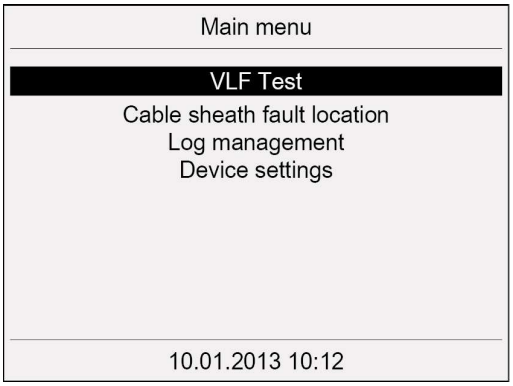
   The minimum height of individual boundaries must be 1 m.
5. If the system is cordoned off from general areas only with ropes, chains or bars, the entire test structure must be monitored during the test in compliance with EN 50191. If the test structure includes several local test areas, security guards must be appointed for each test area. But it is important that the testing personnel and the security guards understand each other well.
6. Mark the test area and terminals clearly. It must be very obvious that a cable test is in progress.
7. Make sure that unauthorised persons cannot access the local mains stations.

5.9 Switching on the device

1. The main switch is located on the control panel. Use it to switch on the device.

   The device conducts a self-test after it is switched on.

   The display shows the Switch-on menu.

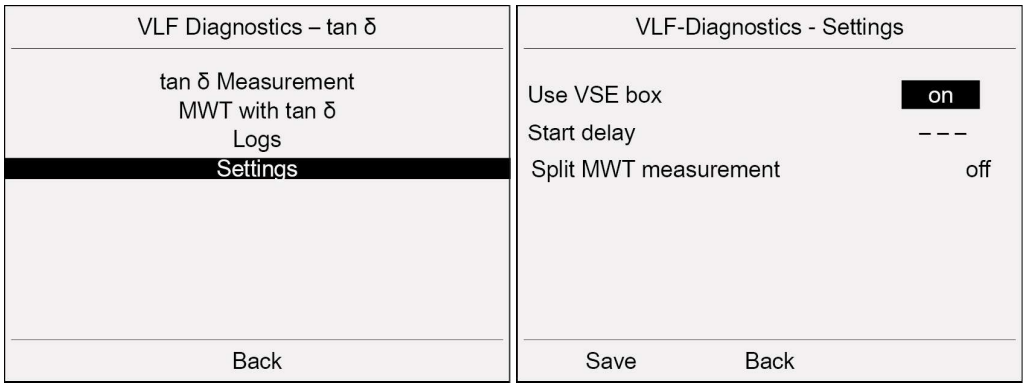


   The device changes to the *Ready for operation* status. The green lamp lights up and shows that all test voltage supplies are switched off.

5.10 Device settings

In the menu *Settings* you can enter the basic settings for VLF diagnostics.

Main menu > *VLF Diagnostics – tan δ* > *Settings*



5.10.1 Using the VSE box (Option)

Preset here whether you wish to use the VSE box for the measurement.

1. In the main menu, select the menu item *VLF Diagnostics – tan δ* and press the rotary knob to confirm.
2. In the menu *VLF Diagnostics – tan δ* select the menu item *Settings* and press the rotary knob to confirm.
3. Select the input field *Use VSE box* and press the rotary knob to confirm.
4. Press the rotary knob to select one of the following settings:
   - *On*: The VSE box is used.
   - *Off*: The measurement is performed without VSE box.
5. In order to save the settings, select the menu item *Save*.

5.10.2 Setting a start delay

Define the time lag for starting the measurement. You can define a delay up to 30 minutes. The measurement begins only after the set time.

1. In the main menu, select the menu item *VLF Diagnostics – tan δ* and press the rotary knob to confirm.
2. In the menu *VLF Diagnostics – tan δ* select the menu item *Settings* and press the rotary knob to confirm.
3. Select the input field *Start delay* and press the rotary knob to confirm.
4. Enter a delay time and press the rotary knob to confirm.
5. In order to save the settings, select the menu item *Save*.

5.10.3 Activating the function “Split MWT measurement"

This function allows the phases of the MWT measurement – ramp-up stage and MWT stage – to be separated and controlled individually.

In this case the ramp-up stage and the MWT stage are not automatically executed sequentially one after another. On completion of a stage, e.g. ramp-up stage on phase L1, you can select which stage is to be carried out next on which phase. For example, after the ramp-up stage and using the dissipation factor values, you can decide whether the voltage test (MWT stage) is to be carried out. The measurement stages not shown may also be carried out at a later time.

1. In the main menu, select the menu item *VLF Diagnostics – tan δ* and press the rotary knob to confirm.
2. In the menu *VLF Diagnostics – tan δ* select the menu item *Settings* and press the rotary knob to confirm.
3. Select the input field *Split MWT measurement* and press the rotary knob to confirm.
4. Press the rotary knob to select one of the following settings:
   - *On*: The MWT measurement is split.
   - *Off*: The MWT measurement is not split.
5. In order to save the settings, select the menu item *Save*.

6 DISSIPATION FACTOR MEASUREMENT: TEMPLATES

6.1 Overview of the program and evaluation

Program

For diagnostics, the test voltage is increased in steps up to a predefined level. Here, the dissipation loss factor is measured for various different voltage steps (e.g. for 0.5 x Uo, Uo and 1.5 x Uo). At each voltage step, several measurements are carried out and the following values are acquired:

- Dissipation factor (as current value of tan delta)
- Mean value of the dissipation factor per voltage step
- Standard deviation of the dissipation factor per voltage step (stability of the dissipation factor)
- Change of the dissipation factor between successive voltage steps.

In a program, the following parameters can be set:

Parameter	Setting range
Nominal voltage Uo (Phase - Earth)	1...42.5 kVrms
Number of voltage steps	1...20 steps
Test voltage per step	What is set is the factor by which the voltage Uo is increased or reduced, up to max. 42.5 kVrms.
Number of measurements per voltage step,	1...20
Number of phases	1...3 phases

Evaluation

The evaluation for the dissipation factor measurement comprises the following threshold values:

- Threshold values for the dissipation factor (TD)
- Threshold values for the change of the dissipation factor between the successive steps (ΔTD)

The alarm levels *Risk*, *High Risk* or *Cancel* will be assigned to these threshold values. If the threshold values are reached, depending on the alarm level an appropriate warning symbol is displayed in the measurement mode window or the measurement is cancelled. More information on the alarm levels is given in the chapter *Evaluation* (on page 28).

Cable data

Templates created in the BAUR software additionally comprise the cable data.

6.2 Creating a new template for dissipation factor measurement

Where you can create a template

You have 2 options for creating templates for dissipation factor measurements:

- on the device (see the description below)
- using the BAUR software on the PC (see operating instructions for BAUR software dissipation factor measurement). You can import templates to the device via a USB stick.

How you can create a new template

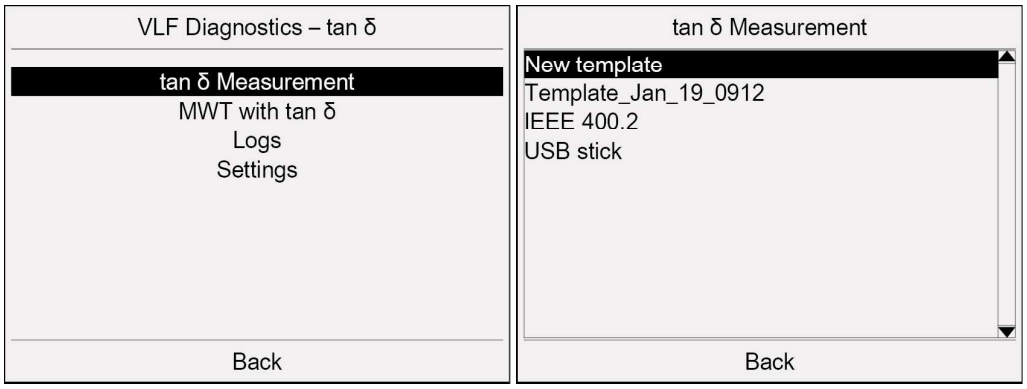
You can create a new template in different ways:

- completely new from scratch (see "Creating a template newly from scratch" on page 44)
- on the basis of a template that you have created at an earlier point in time (see "Creating a new template on the basis of an existing template" on page 57)

  For the new template a new program and a new evaluation can be created or already existing programs and evaluations can be selected and, if necessary, adapted.

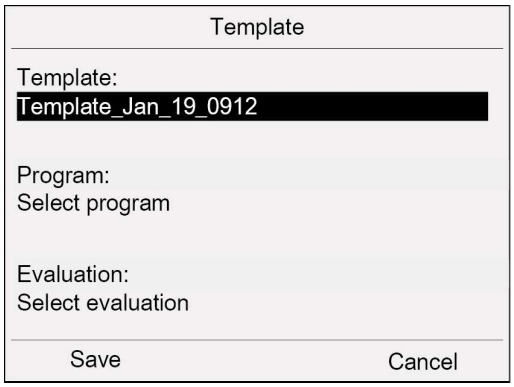
6.2.1 Creating a template newly from scratch

1. In the main menu, select the menu item *VLF Diagnostics – tan δ* and press the rotary knob to confirm.
2. In the menu *VLF Diagnostics – tan δ* select the menu item *tan-δ Measurement* and press the rotary knob to confirm.



3. In the menu *tan-δ Measurement* select the menu item *New template* and press the rotary knob to confirm.

   The window *Template* for setting the parameters of the new template opens.



Entering a name

The device proposes a name consisting of the word *Template*, the date (month and day) and the time.

1. If you wish to assign a different name, select the input field *Name* and press the rotary knob to confirm.

   The name input window opens.
2. Enter a name:
   a. In order to navigate between letters, turn the rotary knob.
   b. In order to confirm selection, press the rotary knob.
   c. After entering the name, select the button *OK*, in order to confirm the entry.

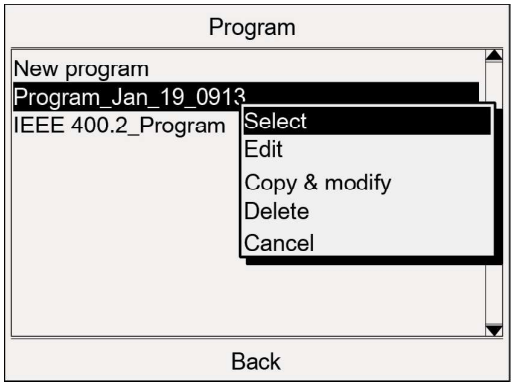
Selecting a program

You have 3 options for selecting a program:

- select existing program (see the description below)
- change and select existing program (see "Editing a program" on page 67)
- create new program (see "Creating a new program on the basis of an existing program" on page 66, "Creating a new program for dissipation factor measurement" on page 62)

Selecting an existing program

1. In the window *Template* , select the input field for the program and press the rotary knob to confirm.
2. In the menu *Program* select a program and press the rotary knob to confirm.



If you wish to use a program according to IEEE 400.2 (new), select the same, and in the context menu select the menu item *Copy & modify* and adapt the program if required (see "IEEE 400.2" on page 21).

3. In the context menu, select the menu item *Select*.

The program is included in the current template.

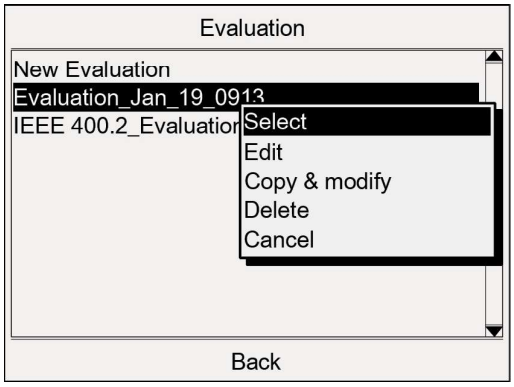
Selecting an evaluation

You have 3 options for selecting an evaluation:

- select existing evaluation (see the following description)
- change and select existing evaluation (see "Editing an evaluation" on page 75)
- create new evaluation (see "Creating a new evaluation on the basis of an existing one" on page 73, "Creating a new evaluation for dissipation factor measurement" on page 70, "Creating a new evaluation on the basis of a standard evaluation IEEE-400.2" on page 74)

Selecting an existing evaluation

1. In the menu *Template* select the input field for the evaluation and press the rotary knob to confirm.



2. In the menu *Evaluation* select an evaluation and press the rotary knob to confirm.
   If you wish to use an evaluation according to IEEE 400.2 (new), select the same and, in the context menu, select the menu item *Copy & modify* and adapt the evaluation, if required (see "IEEE 400.2" on page 21).
3. In the context menu, select the menu item *Select*.
   The evaluation is included in the current template.
4. Select the menu item *Save*, in order to save the template.

6.3 Template according to IEEE 400.2: Setting the parameters

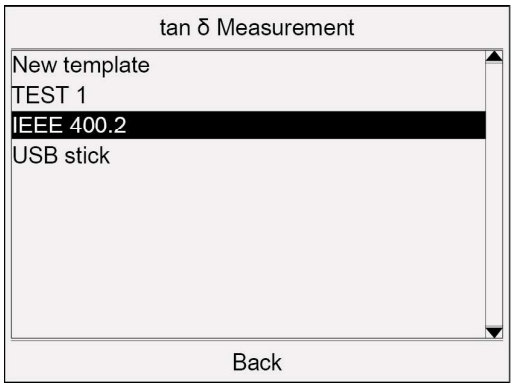
The parameters of this template correspond to the valid draft of the new IEEE 400.2. The exact details about the implemented test voltages and evaluation criteria are given in chapter *IEEE 400.2* (on page 21)

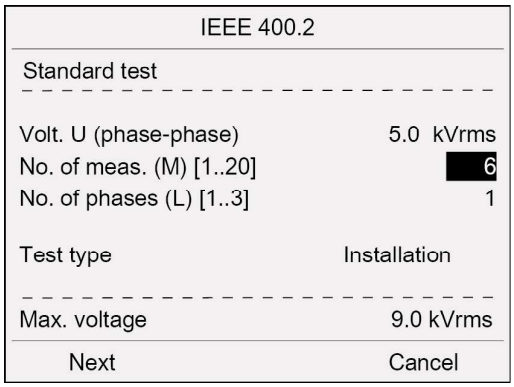
Test types according to IEEE 400.2:

- **Installation -** Test after installation of a cable system before installation of terminations/joints, connection and transition sleeves. This test is conducted to detect damage during transport, storage and installation.
- **Acceptance -** Test after installation of a cable system, including terminations/joints, connection and transition sleeves before the cable system is put into normal operation. This test is conducted to detect damage during installation.
- **Maintenance -** Test during life cycle of a cable system. This test is conducted to detect the age of a cable system and to check the operational viability. Maintenance tasks can be planned depending on the test results.

1. In the main menu, select the menu item *VLF Diagnostics – tan δ* and press the rotary knob to confirm.
2. In the menu *VLF Diagnostics – tan δ* select the menu item *tan-δ Measurement* and press the rotary knob to confirm.
3. In the menu *tan-δ Measurement* select the menu item *IEEE 400.2* and press the rotary knob to confirm.

   The window *IEEE 400.2* opens.





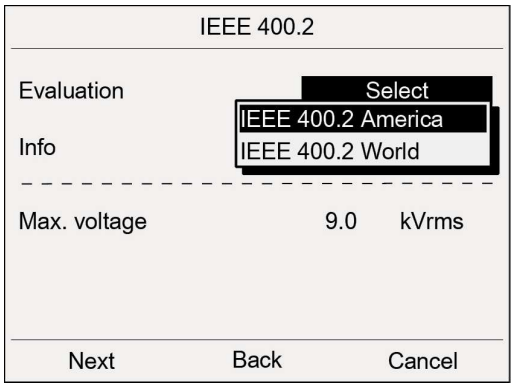
4. Set the following parameters:
   - Voltage U (phase – phase)

     Setting range: In accordance with the specifications of the draft IEEE 400.2 (to 42.5 kVrms)
   - Number of measurements per voltage step (1...20)
   - Number of phases (1...3)
   - Test type

     The following test types are available: Installation, acceptance inspection (commissioning) and maintenance.

   The max. voltage is determined and displayed automatically after entering the voltage U (phase – phase). The information about the implemented test voltages is given in the chapter *Test voltages according to IEEE 400.2* (see "*Test voltages according to IEEE 400.2 (new)*" on page 21).
5. Select the menu item *Next* and press the rotary knob to confirm.

   The dialog for selecting the evaluation opens. The cursor is in the input field for the evaluation.



6. Press the rotary knob in order to select an evaluation.

7. In the context menu, select whether you wish to use evaluation criteria for America or for other countries (World) according to IEEE 400.2, and press the rotary knob to confirm.
8. In the next context menu, select which insulation the test object has and press the rotary knob to confirm. You have the following options:
   - Evaluation for XLPE cables
   - Evaluation for EPR cables
   - Evaluation for PILC cables

   The information about the preset threshold values is given in the chapter *Evaluation criteria according to IEEE 400.2* (see "*Evaluation criteria according to IEEE 400.2 (new)*" on page 21).
9. Select the menu item *Next* and press the rotary knob to confirm.

   The measurement mode window for starting the measurement opens (see "Starting a MWT measurement" on page 84).

7 MWT WITH TAN-DELTA: TEMPLATES

7.1 Overview of the program and evaluation

Program

The MWT with tan δ consists of 2 stages:

1. Ramp-up stage

In the ramp-up stage, as for a standard dissipation factor measurement, the voltage up to the next test voltage is built up in steps. In this “start stage" the dissipation factor is measured for various pre-defined voltage steps (e.g. for 0.5 x Uo, Uo and 1.5 x Uo). At each voltage step, several measurements are carried out and the following values are acquired:

- Dissipation factor (as current value of tan delta)
- Mean value of the dissipation factor per voltage step
- Standard deviation of the dissipation factor per voltage step (stability of the dissipation factor)
- Change of the dissipation factor between the voltage steps.

The following parameters can be preset for the ramp-up stage of a MWT program.

Parameter	Setting range
Nominal voltage Uo (Phase - Earth)	1...42.5 kVrms
Number of voltage steps	1...20 steps
Test voltage per step	What is set is the factor by which the voltage Uo is increased or reduced, up to max. 42.5 kVrms.
Dissipation factor values that are to be evaluated per step	MTD, ΔTD, SDTD
Number of measurements per voltage step,	1...20
Number of phases	1...3 phases

2. MWT stage

In the MWT stage the proper cable test is carried out with a continuous dissipation factor measurement at a defined test voltage (e.g. 2 x Uo). In addition to the values specified above, the change of the dissipation factor is also measured under the influence of the test voltage over time.

The MWT stage is determined by the level of the test voltage and the specifications for the test time. With 3 settings for the test time you have the option to shorten or extend the test time during diagnostics depending on the actual condition of the cable. A proposal for a suitable test time is shown following a defined period after the start of the MWT phase.

Parameters of the MWT stage	Setting range
Test voltage	What is set is the factor by which the voltage Uo is increased or reduced, up to max. 1...42.5 kVrms
Extended test time	30 ... 60 min
Standard test time	15 ... 60 min
Reduced test time	10 ... 60 min
The time after which, following the start of the MWT stage, the device issues a recommendation for the test time	1 ... 60 min

Evaluation

A MWT evaluation comprises the following threshold values:

Ramp-up stage

- Threshold values for the stability of the dissipation factor (SDTD) (see "Stability of the dissipation factor" on page 110)
- Threshold values for the mean value of the dissipation factor (MTD) (see "Mean value of dissipation factor" on page 109)
- Positive and negative threshold values for the change of the dissipation factor between the successive steps (ΔTD)

MWT stage

- Threshold values for the stability of the dissipation factor (SDTD)
- Threshold values for the mean value of the dissipation factor (MTD)
- Threshold values for the change of the dissipation factor over time (ΔTDt) for the MWT stage (see "Change of the dissipation factor over time" on page 109)

7.2 Creating a new MWT template

You can create a new template in different ways:

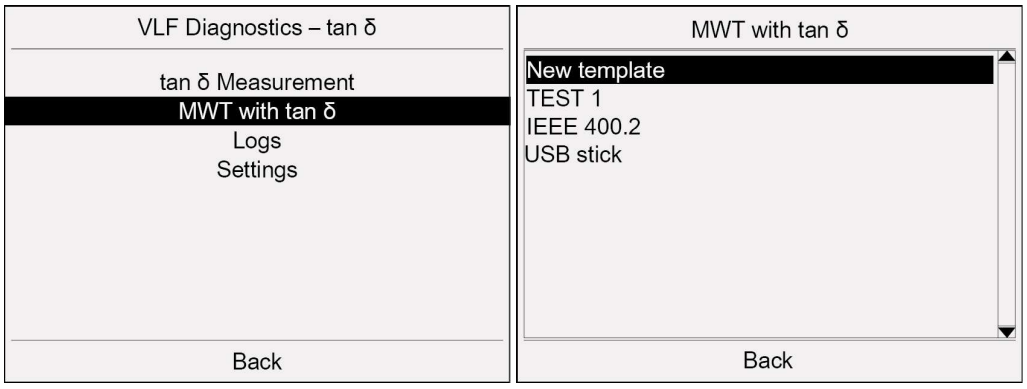
- completely new from scratch
- on the basis of a MWT template that you have created at an earlier point in time (see "Creating a new template on the basis of an existing template" on page 57)

For the new template a new program and a new evaluation can be created or already existing programs and evaluations can be selected and, if necessary, adapted.

Note: You can only create MWT templates directly at the device.

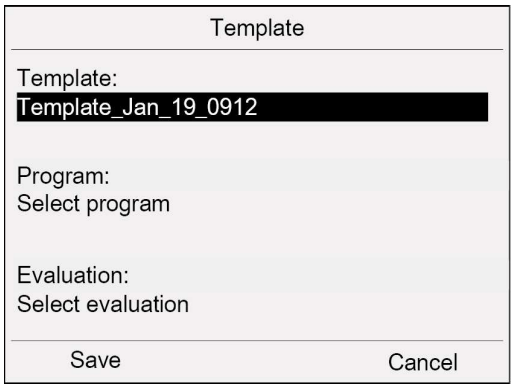
7.2.1 Creating a MWT template newly from scratch

1. In the main menu, select the menu item *VLF Diagnostics – tan δ* and press the rotary knob to confirm.
2. In the menu *VLF Diagnostics – tan δ* select the menu item *MWT with tan δ* and press the rotary knob to confirm.



3. In the menu *MWT with tan δ* select the menu item *New template* and press the rotary knob to confirm.

   The window *Template* for setting the template parameters opens.



7.2.2 Entering a name

The device proposes a name consisting of the word *Template*, the date (month and day) and the time.

1. If you wish to assign a different name, select the input field *Name* and press the rotary knob to confirm.

   The name input window opens.
2. Enter a name:
   a. In order to navigate between letters, turn the rotary knob.
   b. In order to confirm selection, press the rotary knob.
   c. After entering the name, select the button *OK*, in order to confirm the entry.

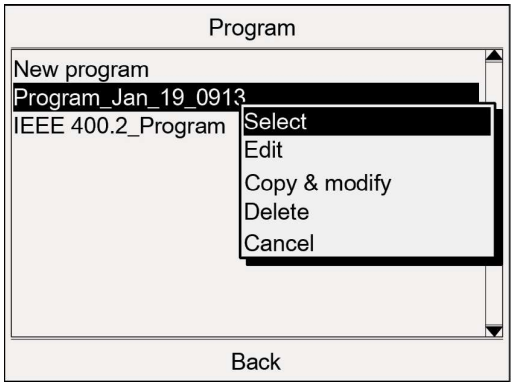
7.2.3 Selecting a program

You have 3 options for selecting a program:

- select existing program (see the description below)
- change and select existing program
- create new program (see "Creating a new MWT program" on page 63)

Selecting an existing program

1. In the window *Template* , select the input field for the program and press the rotary knob to confirm.
2. In the menu *Program* select a program and press the rotary knob to confirm.



If you wish to use a program according to IEEE 400.2 (new), select the same, and in the context menu select the menu item *Copy & modify* and adapt the program if required (see "IEEE 400.2" on page 21).

3. In the context menu, select the menu item *Select*.

   The program is included in the current template.

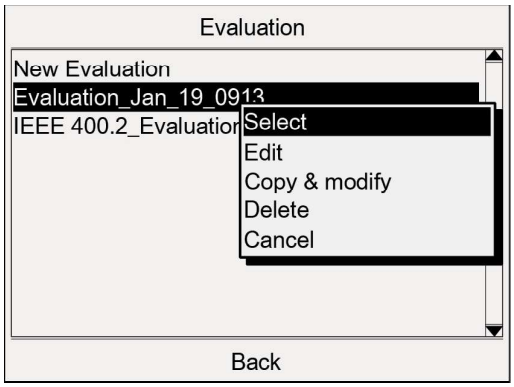
7.2.4 Selecting an evaluation

You have 3 options for selecting an evaluation:

- select existing evaluation (see the following description)
- edit and select existing evaluation (see "Editing an evaluation" on page 75)
- create new evaluation (see "Creating a new MWT evaluation" on page 71, "Creating a new evaluation on the basis of an existing one" on page 73, "Creating a new evaluation on the basis of a standard evaluation IEEE-400.2" on page 74)

Selecting an existing evaluation

1. In the menu *Template* select the input field for the evaluation and press the rotary knob to confirm.



2. In the menu *Evaluation* select an evaluation and press the rotary knob to confirm.
   If you wish to use an evaluation according to IEEE 400.2 (new), select the same and, in the context menu, select the menu item *Copy & modify* and adapt the evaluation, if required (see "IEEE 400.2" on page 21).
3. In the context menu, select the menu item *Select*.
   The evaluation is included in the current template.
4. Select the menu item *Save*, in order to save the template.

7.3 MWT template according to IEEE 400.2: Setting the parameters

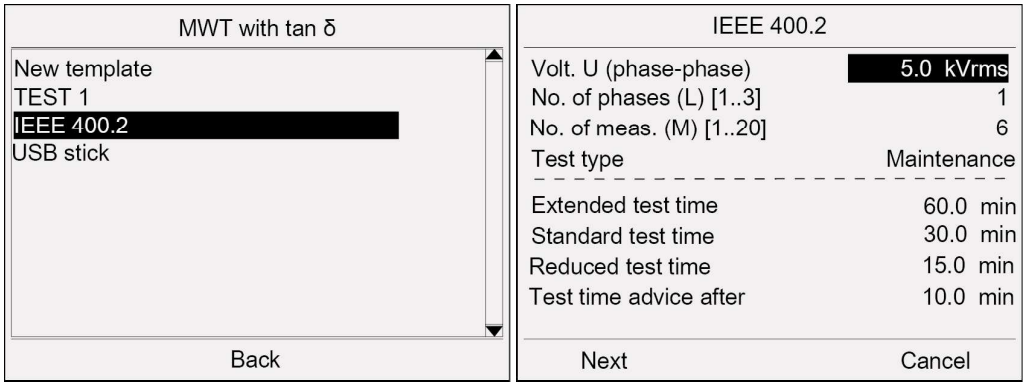
The parameters of this template correspond to the valid draft of the new IEEE 400.2. The exact details about the implemented test voltages and evaluation criteria are given in chapter *IEEE 400.2* (on page 21)

Test types according to IEEE 400.2:

- **Installation -** Test after installation of a cable system before installation of terminations/joints, connection and transition sleeves. This test is conducted to detect damage during transport, storage and installation.
- **Acceptance -** Test after installation of a cable system, including terminations/joints, connection and transition sleeves before the cable system is put into normal operation. This test is conducted to detect damage during installation.
- **Maintenance -** Test during life cycle of a cable system. This test is conducted to detect the age of a cable system and to check the operational viability. Maintenance tasks can be planned depending on the test results.

1. In the main menu, select the menu item *VLF Diagnostics – tan δ* and press the rotary knob to confirm.
2. In the menu *VLF Diagnostics – tan δ* select the menu item *MWT with tan δ* and press the rotary knob to confirm.
3. In the menu *MWT with tan δ* select the menu item *IEEE 400.2* and press the rotary knob to confirm.

   The window *IEEE 400.2* opens.



4. Set the following parameters:
   - Voltage U (phase – phase)

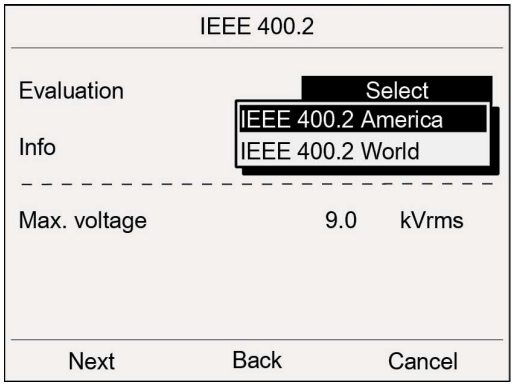
     Setting range: In accordance with the specifications of the draft IEEE 400.2 (to 42.5 kVrms)
   - Number of phases (1...3)
   - Number of measurements per voltage step (1...20)
   - Test type: Installation, acceptance inspection (commissioning) or maintenance.

   The max. voltage is determined automatically after entering the voltage U (phase – phase), and displayed in the next window. The information about the implemented test voltages is given in the chapter *Test voltages according to IEEE 400.2* (see "*Test voltages according to IEEE 400.2 (new)*" on page 21).

   The following parameters are determined by the standard and cannot be changed:
   - Extended test time
   - Standard test time
   - Reduced test time
   - Time after which a test time recommendation is to be issued by the device

5. Select the menu item *Next* and press the rotary knob to confirm.

   The dialog for selecting the evaluation opens. The cursor is in the input field for the evaluation.



6. Press the rotary knob in order to select an evaluation.
7. In the context menu, select whether you wish to use evaluation criteria for America or for other countries according to IEEE 400.2, and press the rotary knob to confirm.
8. In the next context menu, select which insulation the test object has and press the rotary knob to confirm. You have the following options:
   - Evaluation for XLPE cable
   - Evaluation for EPR cables
   - Evaluation for PILC cables
9. Select the menu item *Next* and press the rotary knob to confirm.

   The measurement mode window for starting the measurement opens (see "Starting a MWT measurement" on page 84).

8 MANAGEMENT OF TEMPLATES

The VLF cable diagnostics is carried out on the basis of templates. A template summarises the most important parameters for the diagnostics process and for the evaluation of measurement results.

In this chapter you will learn

- how to select a template for diagnostics (see "Selecting a template for diagnostics" on page 57)
- how to create a template (see "Creating a new MWT template" on page 51, "Creating a new template for dissipation factor measurement" on page 44)
- how to process templates (see "Editing a template" on page 58)
- how to import and export templates (see "Importing a template from a USB stick" on page 60, "Exporting a template to a USB stick" on page 59)

8.1 Creating a new template on the basis of an existing template

If you wish to create a new template, which will differ from an already existing template in some minor details only, you can use the existing template as a basis.

1. Depending on the test type, select the following menu item and press the rotary knob to confirm:
   - Dissipation factor measurement: *Main menu* > *VLF Diagnostics – tan δ* > *tan-δ Measurement*
   - MWT with tanδ: *Main menu* > *VLF Diagnostics – tan δ* > *MWT with tan δ*
2. Select a template and press the rotary knob to confirm.
3. In the context menu, select the menu item *Copy & modify* and press the rotary knob to confirm.

   The window *Template* displaying the parameters of the template selected opens.
4. Change the parameters for the new template. Proceed as for creating a new template:
   - Dissipation factor measurement (see "Creating a new template for dissipation factor measurement" on page 44)
   - MWT with tanδ

8.2 Selecting a template for diagnostics

1. Depending on the test type, select the following menu item and press the rotary knob to confirm:
   - Dissipation factor measurement: *Main menu* > *VLF Diagnostics – tan δ* > *tan-δ Measurement*
   - MWT with dissipation factor measurement: *Main menu* > *VLF Diagnostics – tan δ* > *MWT with tan δ*
2. Select a template and press the rotary knob to confirm.
3. In the context menu, select the menu item *Run* and press the rotary knob to confirm.

   The measurement mode window for starting the diagnostics opens. Further information on how to carry out the test is found in the following chapters:
   - Performing dissipation factor measurement (see "Performing a dissipation factor measurement" on page 77)
   - Performing MWT measurement (see "Performing a MWT measurement" on page 83)

8.3 Displaying a template

1. Depending on the diagnostics type, select the following menu item and press the rotary knob to confirm.
   - Dissipation factor measurement: *Main menu* > *VLF Diagnostics – tan δ* > *tan-δ Measurement*
   - MWT with dissipation factor measurement: *Main menu* > *VLF Diagnostics – tan δ* > *MWT with tan δ*
2. Select a template and press the rotary knob to confirm.
3. In the context menu, select the menu item *Show* and press the rotary knob to confirm.

   The template selected is displayed on the display.
4. In order to display further parameters of the template, select the menu item *Next*.
5. If you wish to start diagnostics in accordance with this template, select the following menu item in the bottom menu bar *Start*.

   The measurement mode window for starting the diagnostics opens. Further information on how to carry out the test is found in the following chapters:
   - Performing dissipation factor measurement (see "Performing a dissipation factor measurement" on page 77)
   - Performing MWT measurement (see "Performing a MWT measurement" on page 83)
6. In order to be able to return to the respective menu, select the menu item *Back*.

8.4 Editing a template

1. Depending on the diagnostics type, select the following menu item and press the rotary knob to confirm:
   - Dissipation factor measurement: *Main menu* > *VLF Diagnostics – tan δ* > *tan-δ Measurement*
   - MWT with dissipation factor measurement: *Main menu* > *VLF Diagnostics – tan δ* > *MWT with tan δ*
2. Select a template and press the rotary knob to confirm.
3. In the context menu, select the menu item *Edit* and press the rotary knob to confirm.
   The window displaying the parameters of the selected template opens.
4. Change the parameters for the new template. Proceed as for creating a new template:
   - Dissipation factor measurement (see "Creating a new template for dissipation factor measurement" on page 44)
   - MWT with tanδ

8.5 Deleting a template

1. Depending on the diagnostics type, select the following menu item and press the rotary knob to confirm:
   - Dissipation factor measurement: *Main menu* > *VLF Diagnostics – tan δ* > *tan-δ Measurement*
   - MWT with dissipation factor measurement: *Main menu* > *VLF Diagnostics – tan δ* > *MWT with tan δ*
2. Select a template and press the rotary knob to confirm.
3. In the context menu, select the menu item *Delete* and press the rotary knob to confirm.
   A prompt appears asking if you really want to delete the selected template.
4. Confirm the prompt with *Yes*.
   The template is deleted.

8.6 Exporting a template to a USB stick

Note: The device supports only USB sticks with the FAT32 and FAT16 file system. We recommend using USB sticks with the FAT32 file system.

1. Insert a USB stick into the USB port of viola TD.
2. Depending on the diagnostics type, select the following menu item and press the rotary knob to confirm:
   - Dissipation factor measurement: *Main menu* > *VLF Diagnostics – tan δ* > *tan-δ Measurement*
   - MWT with dissipation factor measurement: *Main menu* > *VLF Diagnostics – tan δ* > *MWT with tan δ*
3. Select a template and press the rotary knob to confirm.
4. In the context menu, select the menu item *Export* and press the rotary knob to confirm.
   The window *USB* with the display of the main directory of the USB stick opens.

5. If you wish to save the template to a folder, select a folder or create a new one.
   If you wish to create a new folder,
   a. select the menu item *Create new folder* and press the rotary knob to confirm.
   b. Enter a name and confirm this entry with *OK*.
   You have the option to create subfolders. In order to return to the superordinate folder, select the menu item *Back*.
6. In the lower menu bar, select the menu item *Save*.
   The template is saved to the USB stick.
7. Acknowledge this save confirmation with *OK*.

8.7 Importing a template from a USB stick

Note: The device supports only USB sticks with the FAT32 and FAT16 file system. We recommend using USB sticks with the FAT32 file system.

You can load diagnostics templates from a different device or from the BAUR software via the USB interface or start a measurement according to a template directly from the USB stick.

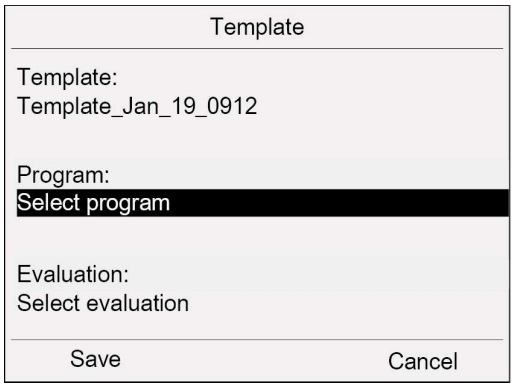
1. Insert a USB stick into the USB port of viola TD.
2. Depending on the diagnostics type, select the following menu item and press the rotary knob to confirm:
   - Dissipation factor measurement: *Main menu* > *VLF Diagnostics – tan δ* > *tan-δ Measurement*
   - MWT with dissipation factor measurement: *Main menu* > *VLF Diagnostics – tan δ* > *MWT with tan δ*
3. Select the menu item *USB stick* and press the rotary knob to confirm.
   The window *USB* with the display of the main directory of the USB stick opens.
4. Select a template and press the rotary knob to confirm.
5. In the context menu, select the menu item *Import* and press the rotary knob to confirm.
   The template is saved in the device memory.
   If the device already has a template, a program or an evaluation with the same name, you will be asked to enter a new name.
6. Acknowledge this save confirmation with *OK*.

9 MANAGEMENT OF PROGRAMS

The program is a component part of a template. If you process a template or create a new one, you can select an existing program and, if required, edit the same or create a new one.

An overview of already existing programs and the menu item *New program* are located - depending on the diagnostics type - in the menu:

- Dissipation factor measurement: *Main menu* > *VLF Diagnostics – tan δ* > *tan-δ Measurement* > selected or new template > *Program*
- MWT with tanδ: *Main menu* > *VLF Diagnostics – tan δ* > *MWT with tan δ* > selected or new template > *Program*.



The following functions are available to you:

- create new program

  Dissipation factor measurement: Further information is given in the chapter *Create new program for dissipation factor measurement* (see "*Creating a new program for dissipation factor measurement*" on page 62)

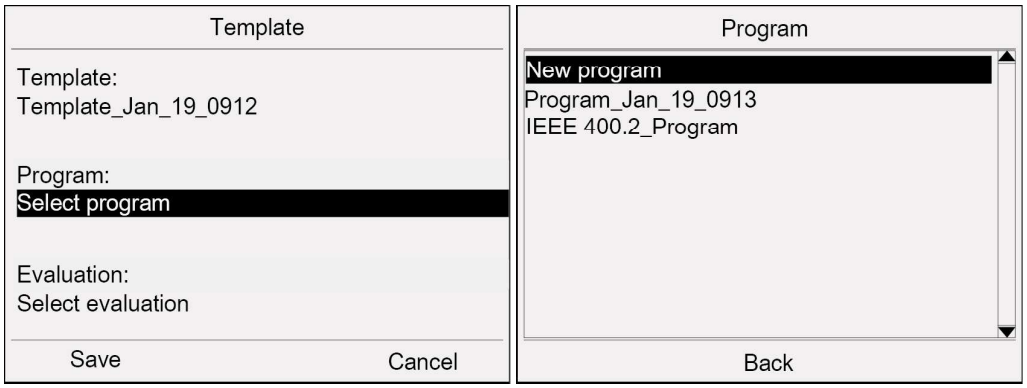
  MWT with tanδ: Further information is given in the chapter *Create new MWT program* (see "*Creating a new MWT program*" on page 63)
- *Create new program on the basis of an existing program* (see "*Creating a new program on the basis of an existing program*" on page 66)
- *Edit program* (see "*Editing a program*" on page 67)
- *Delete program* (see "*Deleting a program*" on page 68)

9.1 Creating a new program for dissipation factor measurement

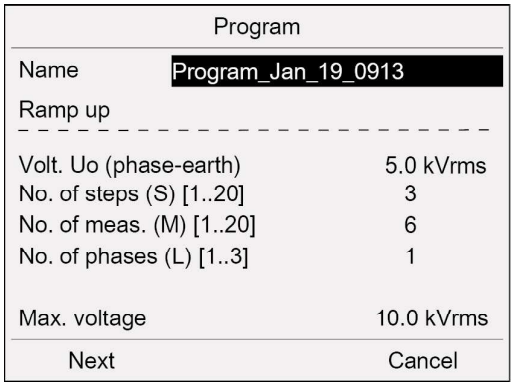
You can create a new program in different ways:

- new from scratch (see the following description)
- on the basis of a program that you have created at an earlier point in time, or on the basis of the IEEE-400.2 program (see "Creating a new program on the basis of an existing program" on page 66)

1. If you are not in the menu *Template* ,
   a. select in the main menu the menu item *VLF Diagnostics – tan δ* > *tan-δ Measurement* and press the rotary knob to confirm.
   b. Select a template or select the menu item *New template*.
2. In the menu *Template* select the input field for the program and press the rotary knob to confirm.

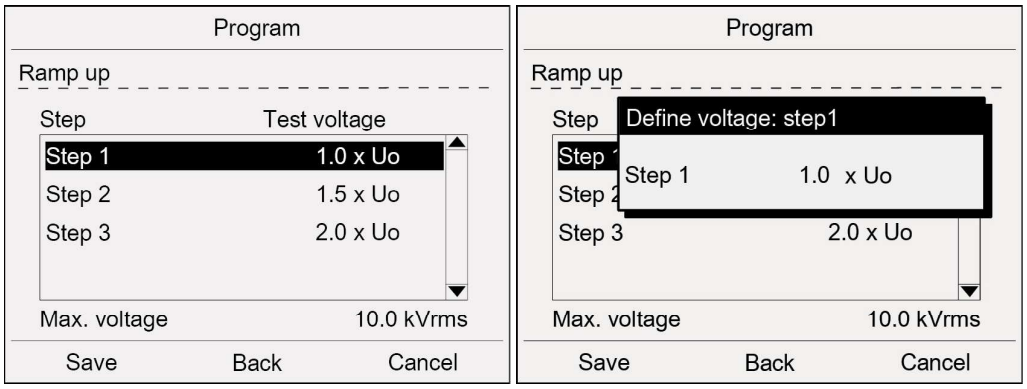


3. In the menu *Program* select the menu item *New program* and press the rotary knob to confirm.
   The window for creating a new program opens.



   The device suggests a name consisting of the word *Program*, the date (month and day) and the time.
4. If you wish to assign a different name, select the input field *Name* and press the rotary knob to confirm.
   The window for entering a name opens.
5. Enter a name.
   a. In order to navigate between letters, turn the rotary knob.
   b. In order to confirm selection, press the rotary knob.
   c. After entering the name, select the button *OK*, in order to confirm the entry.

6. Enter the following program parameters:
   - Nominal voltage Uo (Phase - Earth)
     Setting range: 1...42.5 kVrms
   - Number of voltage steps (1...20)
   - Number of measurements per voltage step (1...20)
   - Number of phases (1...3)
7. Select the menu item *Next*.
   The window for entering the voltage per step opens.



8. Enter the voltage for each step. Proceed as follows:
   a. Select a step and press the rotary knob to confirm.
      The window for entering the voltage for the selected step opens.
   b. Enter a factor by means of which the nominal voltage Uo is to be multiplied at the respective step, and press the rotary knob to confirm.
9. Select the menu item *Save* and press the rotary knob to confirm.
   The program is saved and included in the current template.

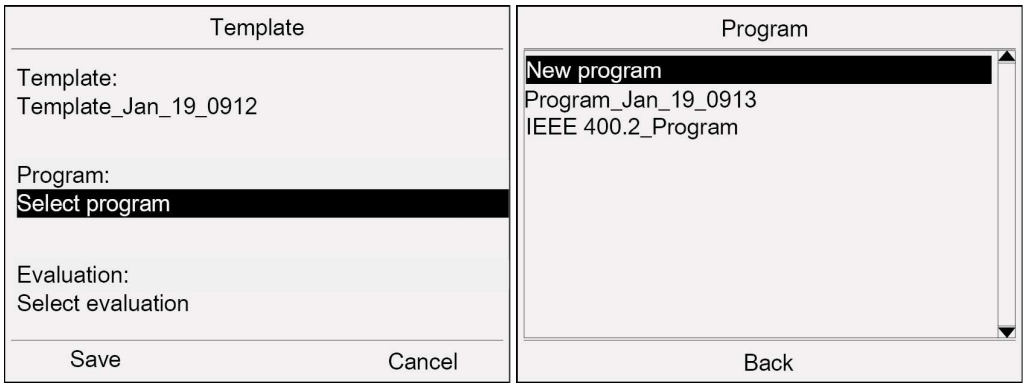
9.2 Creating a new MWT program

You can create a new program in different ways:

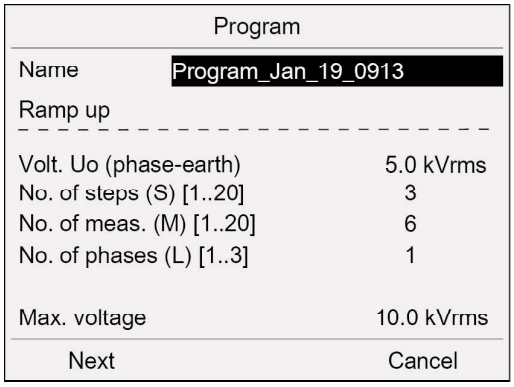
- new from scratch (see the following description)
- on the basis of a program that you have created at an earlier point in time, or on the basis of the IEEE-400.2 program (see "Creating a new program on the basis of an existing program" on page 66)

9.2.1 Ramp-up stage

1. If you are not in the menu *Template* ,
   a. select in the main menu the menu item *VLF Diagnostics – tan δ* > *MWT with tan δ* and press the rotary knob to confirm.
   b. Select a template or select the menu item *New template*.
2. In the menu *Template* select the input field for the program and press the rotary knob to confirm.

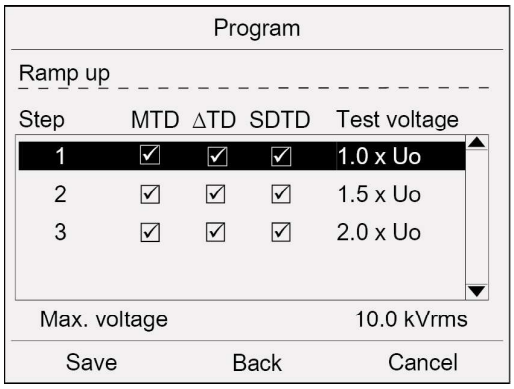


3. In the menu *Program* select the menu item *New program* and press the rotary knob to confirm.
   The window for creating a new program opens.

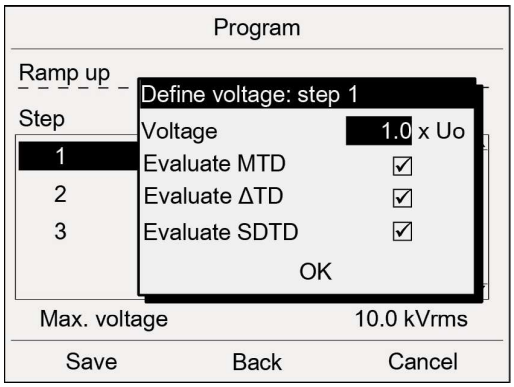


   The device suggests a name consisting of the word *Program*, the date (month and day) and the time.
4. If you wish to assign a different name, select the input field *Name* and press the rotary knob to confirm.
   The window for entering a name opens.
5. Enter a name.
   a. In order to navigate between letters, turn the rotary knob.
   b. In order to confirm selection, press the rotary knob.
   c. After entering the name, select the button *OK*, in order to confirm the entry.

6. Enter the following program parameters:
   - Nominal voltage Uo (Phase - Earth)
     Setting range: 1...42.5 kVrms
   - Number of voltage steps (1...20)
   - Number of measurements per voltage step (1...20)
   - Number of phases (1...3)
7. Select the menu item *Next*.
   The window for entering the voltage and evaluation criteria per voltage step opens.



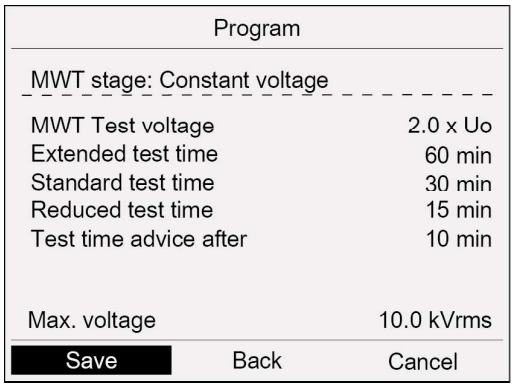
8. Enter the voltage for each voltage step and determine which dissipation factor values are to be evaluated in this step. Proceed as follows:
   a. Select a step and press the rotary knob to confirm.
      The window for entering the voltage for the selected step opens.



   b. Enter a factor by means of which the nominal voltage Uo is to be multiplied at the respective step, and press the rotary knob to confirm.
   c. Select the input field *Evaluate MTD* (MTD = mean value of the dissipation factor).
   d. Activate or deactivate the evaluation of MTD in the respective voltage step by pressing the rotary knob.
   e. Activate or deactivate the evaluation of further dissipation factor values. Proceed in exactly the same way.

   Note: For the evaluation of dissipation factor changes between steps (ΔTD), select at least 2 voltage steps so that the comparison takes place.
9. Select the menu item *Next* and press the rotary knob to confirm.
   The window for entering the MWT stage parameters opens.

9.2.2 MWT stage



1. Set the test voltage: Enter a factor by which the nominal voltage Uo is multiplied.
2. Enter the extended test time and press the rotary knob to confirm.

   The extended test time is recommended if the measurement results in the ramp-up stage and the first measurement results in the MWT stage indicate a poor condition of the cable and if, therefore, the cable should be observed for an extended period of time.
3. Enter the extended test time according to the standard and press the rotary knob to confirm.
4. Enter the reduced test time and press the rotary knob to confirm.

   The reduced test time is recommended if the measurement results in the ramp-up stage and the first measurement results in the MWT stage indicate a good condition of the cable.
5. In the input field *Test time advice after*enter the time after which, following the start of the MWT stage, the device issues a recommendation for the test time.

   It is assumed that the trend showing during the first 10 minutes of the MWT stage is sufficiently meaningful to be able to come to a decision with regard to the appropriate test time.
6. Select the menu item *Save* and press the rotary knob to confirm.

   The program is saved and will be included in the current template.

9.3 Creating a new program on the basis of an existing program

If you wish to create a new program which will differ from an existing one in some minor details only, you can use the existing program as a basis.

1. If you are not in the menu *Template* ,
   a. depending on the diagnostics type, select the following menu item and press the rotary knob to confirm:

      Dissipation factor measurement: *Main menu* > *VLF Diagnostics – tan δ* > *tan-δ Measurement*

      MWT with dissipation factor measurement: *Main menu* > *VLF Diagnostics – tan δ* > *MWT with tan δ*

   b. Select a template or select the menu item *New template*.
2. In the menu *Template* select the input field for the program and press the rotary knob to confirm.
3. In the menu *Program* select a program and press the rotary knob to confirm.

   If a new program is to correspond to the program according to IEEE 400.2 or differ from the same in some minor details only, select the program *IEEE 400.2_Program*.
4. In the context menu, select the menu item *Copy & modify*.

   The menu *Program* with the display of the parameters of the program selected opens.
5. Change the parameters as required. To do this, proceed as you would when creating a new program.
   - Dissipation factor measurement (see "Creating a new program for dissipation factor measurement" on page 62)
   - MWT measurement (see "Creating a new MWT program" on page 63)

   The new program is accepted for the current template.

9.4 Editing a program

1. If you are not in the menu *Template* ,
   a. depending on the diagnostics type, select the following menu item and press the rotary knob to confirm:

      Dissipation factor measurement: *Main menu* > *VLF Diagnostics – tan δ* > *tan-δ Measurement*

      MWT with dissipation factor measurement: *Main menu* > *VLF Diagnostics – tan δ* > *MWT with tan δ*

   b. Select a template or select the menu item *New template*.
2. In the menu *Template* select the input field for the program and press the rotary knob to confirm.
3. In the menu *Program* select a program which you wish to edit and press the rotary knob to confirm.
4. In the context menu, select the menu item *Edit*.

   The window *Program* with the display of the parameters of the program selected opens.
5. Change the parameters as required. To do this, proceed as you would when creating a new program.
   - Dissipation factor measurement (see "Creating a new program for dissipation factor measurement" on page 62)
   - MWT measurement (see "Creating a new MWT program" on page 63)

   The program is included in the current template.

9.5 Deleting a program

Dissipation factor measurement: *Main menu* > *VLF Diagnostics – tan δ* > *tan-δ Measurement*

MWT with tan δ: *Main menu* > *VLF Diagnostics – tan δ* > *MWT with tan δ*

1. If you are not in the menu *Template* ,
   a. depending on the diagnostics type, select the following menu item and press the rotary knob to confirm:

      Dissipation factor measurement: *Main menu* > *VLF Diagnostics – tan δ* > *tan-δ Measurement*

      MWT with dissipation factor measurement: *Main menu* > *VLF Diagnostics – tan δ* > *MWT with tan δ*

   b. Select a template or select the menu item *New template*.
2. Select a template or select the menu item *New template*.
3. In the menu *Template* , select the input field for the program and press the rotary knob to confirm.
4. In the menu *Program* a program and press the rotary knob to confirm.
5. In the context menu, select the menu item *Delete*.

   A prompt appears asking whether you really want to delete the program.
6. Confirm the prompt with *Yes*.

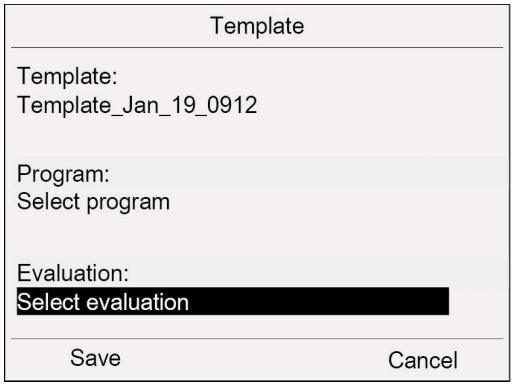
   The program is deleted.

10 MANAGEMENT OF EVALUATIONS

The evaluation is a component part of a template. If you edit a template or create a new one, you can select an existing evaluation and, if required, edit the same or create a new one.

An overview of already existing evaluations and the menu item *New Evaluation* is given - depending on the diagnostics type - in the menu:

- Dissipation factor measurement: *Main menu* > *VLF Diagnostics – tan δ* > *tan-δ Measurement* > selected or new template > *Evaluation*
- MWT with tanδ: *Main menu* > *VLF Diagnostics – tan δ* > *MWT with tan δ* > selected or new template > *Evaluation*.



The following functions are available to you:

- create new evaluation

  Dissipation factor measurement: Further information is given in the chapter *Create new evaluation for dissipation factor measurement* (see "*Creating a new evaluation for dissipation factor measurement*" on page 70)

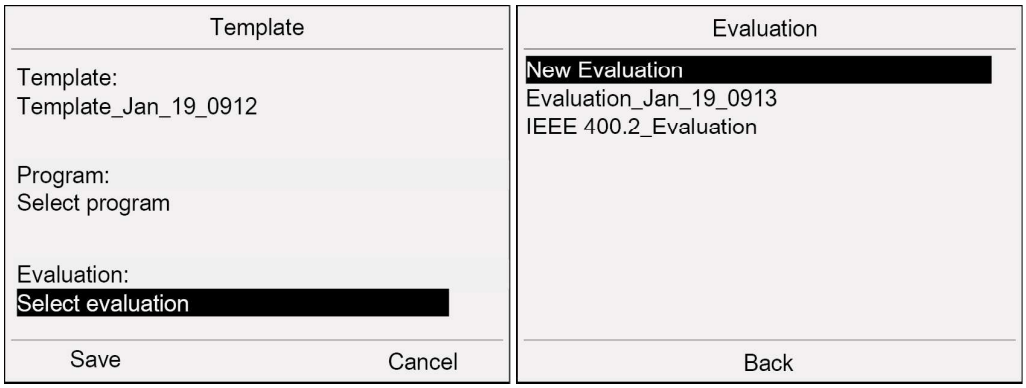
  MWT with tanδ: Further information is given in the chapter *Create new MWT evaluation* (see "*Creating a new MWT evaluation*" on page 71),
- *Create a new evaluation on the basis of an existing one* (see "*Creating a new evaluation on the basis of an existing one*" on page 73)
- *Edit evaluation* (see "*Editing an evaluation*" on page 75)
- *Delete evaluation* (see "*Deleting an evaluation*" on page 76)

10.1 Creating a new evaluation for dissipation factor measurement

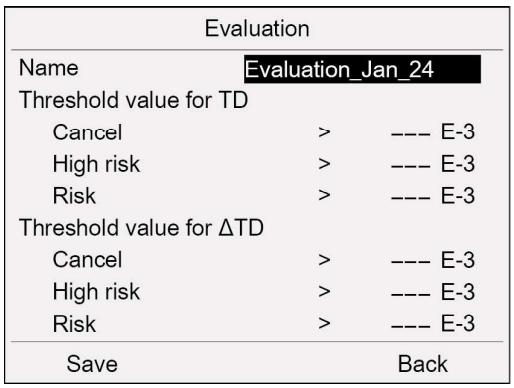
You can create a new evaluation in different ways:

- new from scratch (see the following description)
- on the basis of an evaluation which you have created at an earlier point in time, or on the basis of the IEEE-400.2 evaluation (see "Creating a new evaluation on the basis of an existing one" on page 73)

1. If you are not in the menu *Template* ,
   a. select in the main menu the menu item *VLF Diagnostics – tan δ* > *tan-δ Measurement* and press the rotary knob to confirm.
   b. Select a template or select the menu item *New template*.
2. In the menu *Template* select the input field for the evaluation and press the rotary knob to confirm.



3. In the menu *Evaluation* select the menu item *New Evaluation* and press the rotary knob to confirm.
   The window for creating a new evaluation opens. The device suggests a name consisting of the word *Evaluation*, the date (month and day) and the time.



4. If you wish to assign a different name, select the input field *Name* and press the rotary knob to confirm.
   The window for entering a name opens.
5. Enter a name.
   a. In order to navigate between letters, turn the rotary knob.
   b. In order to confirm selection, press the rotary knob.
   c. After entering the name, select the button *OK*, in order to confirm the entry.

6. An evaluation is determined by threshold values. The alarm levels *Risk*, *High Risk* or *Cancel* will be assigned to these threshold values. If the threshold values are reached or exceeded, depending on the alarm level an appropriate warning symbol is displayed in the measurement mode window or the measurement is cancelled. More information on the alarm levels is given in the chapter *Evaluation* (on page 28).

   Enter the threshold values for each alarm step:

   - for the dissipation factor (TD)
   - for the change of the dissipation factor between the successive steps (ΔTD).

   Proceed as follows:

   a. Select the respective input field and press the rotary knob to confirm.
   b. Enter a dissipation factor value with a decade E-3 and press the rotary knob to confirm.

NOTICE
▸ Never set the threshold values for the “Cancel” alarm level at “0.0”.
If measured tan δ values point to a very poor condition of the test object and the threshold values for the “Cancel” alarm level is equal to “0.0”, the measurement is nevertheless continued and the voltage load of the test object continues. This can lead to irreversible damage to the test object.

7. Select the menu item *Save* and press the rotary knob to confirm.

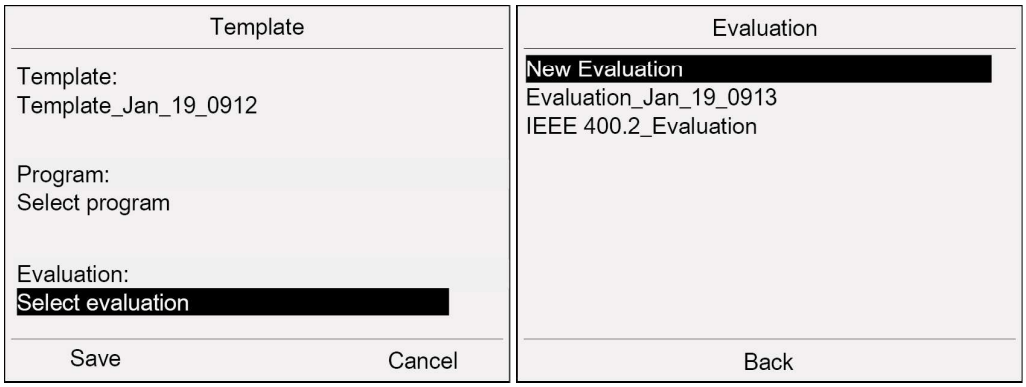
   The evaluation is saved and included in the current template.

10.2 Creating a new MWT evaluation

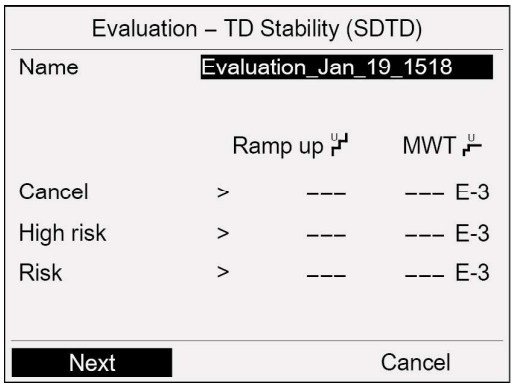
You can create a new evaluation in different ways:

- new from scratch (see the following description)
- on the basis of an evaluation which you have created at an earlier point in time, or on the basis of the IEEE-400.2 evaluation

1. If you are not in the menu *Template* ,
   a. select in the main menu the menu item *VLF Diagnostics – tan δ* > *MWT with tan δ* and press the rotary knob to confirm.
   b. Select a template or select the menu item *New template*.
2. In the menu *Template* select the input field for the evaluation and press the rotary knob to confirm.



3. In the menu *Evaluation* select the menu item *New Evaluation* and press the rotary knob to confirm.
   The window for creating a new evaluation opens. The device suggests a name consisting of the word *Evaluation*, the date (month and day) and the time.



4. If you wish to assign a different name, select the input field *Name* and press the rotary knob to confirm.
   The window for entering a name opens.
5. Enter a name:
   a. In order to navigate between letters, turn the rotary knob.
   b. In order to confirm selection, press the rotary knob.
   c. After entering the name, select the button *OK*, in order to confirm the entry.

Enter threshold values

An evaluation is determined by threshold values. The alarm levels *Risk*, *High Risk* or *Cancel* will be assigned to these threshold values. If the threshold values are reached or exceeded, depending on the alarm level an appropriate warning symbol is displayed in the measurement mode window or the measurement is cancelled. More information on the alarm levels is given in the chapter *Evaluation* (on page 28).

The MWT evaluation comprises 4 dissipation factor values, for which you can define the threshold values:

- Threshold values for the stability of the dissipation factor (SDTD) for the ramp-up stage and MWT stage
- Threshold values for the mean value of the dissipation factor (MTD) for the ramp-up stage and MWT stage
- Positive and negative threshold values for the change of the dissipation factor between the successive steps (ΔTD) for the ramp-up stage
- Threshold values for the change of the dissipation factor over time (ΔTDt) for the MWT stage

6. Enter the threshold values for the stability of the dissipation factor (SDTD) for the ramp-up stage and MWT stage.

   Proceed as follows:

   a. Select the respective input field and press the rotary knob to confirm.
   b. Enter a dissipation factor value with a decade E-3 and press the rotary knob to confirm.

7. Select the menu item *Next*, in order to go to the input screen for the next dissipation factor value.
8. Enter the threshold values for the next dissipation factor value. Proceed just as for entering the threshold values for SDTD.

   After entering the threshold values for TD change over time (ΔTDt), the bottom right menu item changes to *Save*.

9. In order to be able to return to the menu *Template* select the menu item *Save*.

NOTICE

▸ Never set the threshold values for the “Cancel” alarm level at “0.0”.

If measured tan δ values point to a very poor condition of the test object and the threshold values for the “Cancel” alarm level is equal to “0.0”, the measurement is nevertheless continued and the voltage load of the test object continues. This can lead to irreversible damage to the test object.

10.3 Creating a new evaluation on the basis of an existing one

If you wish to create a new evaluation, which will differ from an already existing template in some minor details only, you can use the existing evaluation as a basis.

1. If you are not in the menu *Template* ,
   a. depending on the diagnostics type, select the following menu item and press the rotary knob to confirm:

      Dissipation factor measurement: *Main menu* > *VLF Diagnostics – tan δ* > *tan-δ Measurement*

      MWT with dissipation factor measurement: *Main menu* > *VLF Diagnostics – tan δ* > *MWT with tan δ*

   b. Select a template or select the menu item *New template*.
2. In the menu *Template* select the input field for the evaluation and press the rotary knob to confirm.
3. In the menu *Evaluation* an evaluation and press the rotary knob to confirm.
4. In the context menu, select the menu item *Copy & modify*.

   The window *Evaluation* displaying the parameters of the selected evaluation opens.
5. Change the parameters for the new evaluation as required. Proceed as for creating a new evaluation (see "Creating a new MWT evaluation" on page 71, "Creating a new evaluation for dissipation factor measurement" on page 70).

   The new evaluation is included in the current template.

10.4 Creating a new evaluation on the basis of a standard evaluation IEEE-400.2

If you wish to create a new evaluation, which will differ from an already existing evaluation in some minor details only, you can use the existing standard evaluation as a basis.

1. If you are not in the menu *Template* ,
   a. depending on the diagnostics type, select the following menu item and press the rotary knob to confirm:

      Dissipation factor measurement: *Main menu* > *VLF Diagnostics – tan δ* > *tan-δ Measurement*

      MWT with dissipation factor measurement: *Main menu* > *VLF Diagnostics – tan δ* > *MWT with tan δ*

   b. Select a template or select the menu item *New template*.
2. In the menu *Template* select the input field for the evaluation and press the rotary knob to confirm.
3. In the menu *Evaluation* the evaluation *IEEE 400.2_Evaluation*.
4. In the context menu, select the menu item *Copy & modify*.
5. In the next context menu, select whether you wish to use evaluation criteria for America or for other countries according to IEEE 400.2, and press the rotary knob to confirm.
6. In the next context menu, select which insulation the test object has and press the rotary knob to confirm. You have the following options:
   - Evaluation for XLPE cable
   - Evaluation for EPR cables
   - Evaluation for PILC cables

   The window displaying the evaluation criteria opens.
7. If required adapt the threshold values (see "Creating a new MWT evaluation" on page 71, "Creating a new evaluation for dissipation factor measurement" on page 70).
8. Select the menu item *Save*, in order to save the evaluation.

10.5 Editing an evaluation

1. If you are not in the menu *Template* ,
   a. depending on the diagnostics type, select the following menu item and press the rotary knob to confirm:

      Dissipation factor measurement: *Main menu* > *VLF Diagnostics – tan δ* > *tan-δ Measurement*

      MWT with dissipation factor measurement: *Main menu* > *VLF Diagnostics – tan δ* > *MWT with tan δ*

   b. Select a template or select the menu item *New template*.
2. In the menu *Template* select the input field for the evaluation and press the rotary knob to confirm.
3. In the menu *Evaluation* an evaluation you wish to change and press the rotary knob to confirm.
4. In the context menu, select the menu item *Edit*.

   The window *Evaluation* displaying the parameters of the selected evaluation opens.
5. Change the parameters as required. Proceed as for defining a new evaluation (see "Creating a new MWT evaluation" on page 71, "Creating a new evaluation for dissipation factor measurement" on page 70).

   The evaluation is included in the current template.

10.6 Deleting an evaluation

1. If you are not in the menu *Template* ,
   a. depending on the diagnostics type, select the following menu item and press the rotary knob to confirm:

      Dissipation factor measurement: *Main menu* > *VLF Diagnostics – tan δ* > *tan-δ Measurement*

      MWT with dissipation factor measurement: *Main menu* > *VLF Diagnostics – tan δ* > *MWT with tan δ*

   b. Select a template or select the menu item *New template*.
2. In the menu *Template* select the input field for the evaluation and press the rotary knob to confirm.
3. In the menu *Evaluation* select an evaluation and press the rotary knob to confirm.
4. In the context menu, select the menu item *Delete*.

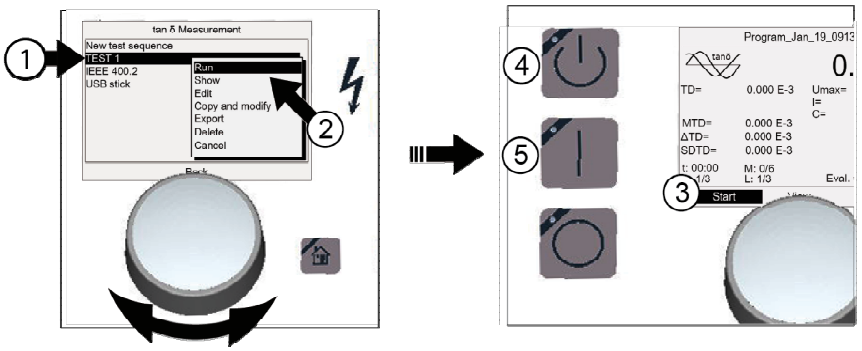
   A prompt appears asking whether really want to delete the evaluation.
5. Confirm the prompt with *Yes*.

   The evaluation is deleted.

11 PERFORMING A DISSIPATION FACTOR MEASUREMENT

11.1 Dissipation factor measurement process - Overview

In the following, the sequence of a dissipation factor measurement is described in principle. Detailed instructions for carrying out dissipation factor measurements are given in the chapter *Start dissipation factor measurement* (see "*Starting a dissipation factor measurement*" on page 78).



Dissipation factor measurement process:

① *Main menu* > *VLF Diagnostics – tan δ* > *tan-δ Measurement*

- Selecting a template: Turn rotary knob until the cursor is located on the required template and then press rotary knob to confirm.

② - In the context menu, select *Run* .

③ - Start measurement: *Start* .

- In the context menu, select a phase.

④ - Press the *Ready to switch on* button.

⑤ - Press the *High voltage on* button. The measurement is started.

⑥ On expiry of the preset time or if a threshold value with the alarm level *Cancel measurement* has been reached, the measurement is terminated automatically.

- **Dangerous voltage at test object:** Before touching, discharge, earth and short-circuit.

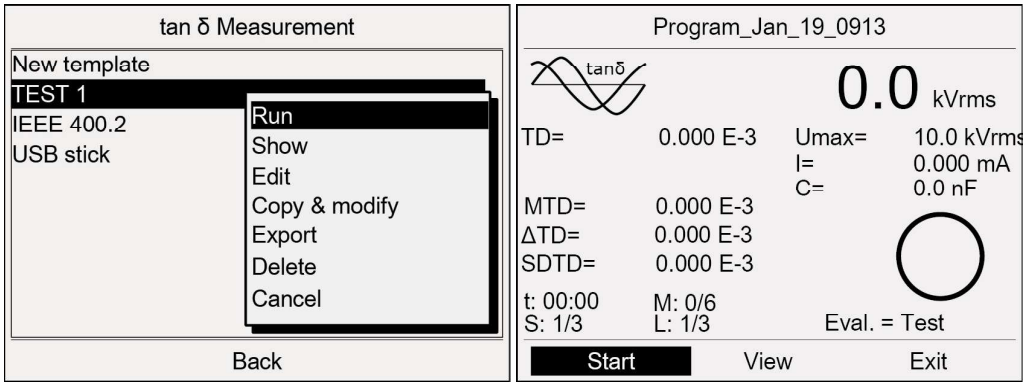
11.2 Starting a dissipation factor measurement

	**⚠ CAUTION**
	Risk of ear-shattering noise during flashover. High electric charging is produced in the test object during high voltage tests on longer cables. When this leads to a flashover in the test object, it can damage the ears. ▸ Use ear protection.

Prerequisites:

- The device is connected (see "Commissioning" on page 30) properly.
- The test zone issecured (see "Securing the test area" on page 39).

1. In the main menu, select the menu item *VLF Diagnostics – tan δ* > *tan-δ Measurement*.
   A list of available templates is shown.
2. You now have the following options:
   - **Select existing template**
     This will take you to the next step.
   - **Create a new template**
     Further information is given in the chapter *Create new evaluation for dissipation factor measurement* (see "*Creating a new template for dissipation factor measurement*" on page 44).
     When you have created the new template, proceed to the next step.
   - **Edit existing template**
     Further information is given in the chapter *Edit template* (see "*Editing a template*" on page 58).
     After you have edited the template, proceed to the next step.
3. In the menu *tan-δ Measurement* select a template from the list and press rotary knob to confirm.
4. In the context menu, select the menu item *Run* and press the rotary knob to confirm.
   The measurement mode window for starting a measurement opens.
   Note: The following screenshots are examples.

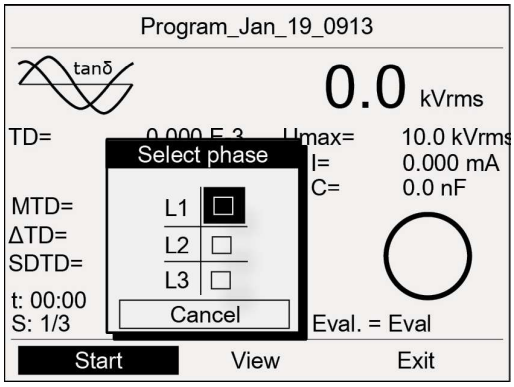


5. In the lower menu bar, select *Start* and press the rotary knob to confirm.

   If only one phase is specified in the program, a prompt for high voltage activation appears: *Press button <Ready for switch-on>*. This will take you to the next step.

   Measurement on several phases

   If more than one phase has been specified in the program, a context menu for phase selection opens. The phases on which the measurement has already been carried out are indicated by means of a tick. If the measurement on a phase was cancelled, this is indicated by a cross.



   a. Turn the rotary knob to select a phase, and then press the rotary knob to confirm. You have the option to repeat the measurement on a phase.

      The prompt for connecting the phase selected appears on the display.

   b. If the phase selected has not yet been connected, connect the same. Further information on how to connect the test object is given in the chapter *Connect device (see "Connecting the device" on page 32).*

   c. Select the menu item *Next.*

      The prompt for high voltage activation appears on the display: *Press button <Ready for switch-on>*.

6. Press the *Ready to switch on* button for minimum 1 second.

   The device changes to *Ready to switch on* operating state. The red indicator light blinks for approx. 6 seconds. The prompt for switching on the high voltage appears on the display: *Press button <High voltage on>*.

   If you wish to cancel high voltage activation and return to the measurement mode window, press the rotary knob.

7. When the red indicator light blinks, press the *High voltage on* button.

   The device changes to *In operation* operating state. The red indicator light is steady.

   The device determines the applied load. The load determination takes approx. 10 - 20 seconds depending on the load. This is displayed by the *Load determination in progress...* message.

   Note: Information on the option of frequency and voltage adaptation in dependence of the load capacity of the test object is given in the main operating instructions in the chapter *Activate / deactivate automatic voltage reduction*.

   The measurement is started after the load determination. The menu item *Start* changes to *Stop*.

11.3 Displaying the measurement results during the measurement

During the measurement the current measured values are displayed continuously and evaluated in accordance with the selected evaluation criteria.

- Information on abbreviations and symbols on the display is given in the chapter *Symbols and abbreviations on the display* (on page 14)

The following views are available to you: Main view, detail view and diagram tan δ versus voltage

- In the lower menu bar, in order to toggle between views, select the menu item *View* and press the rotary knob to confirm.

Main view

The main view is the measurement mode window in which all measured values are continuously displayed.

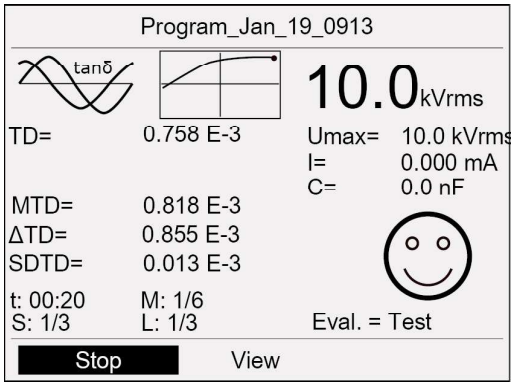


Diagram tan δ versus voltage

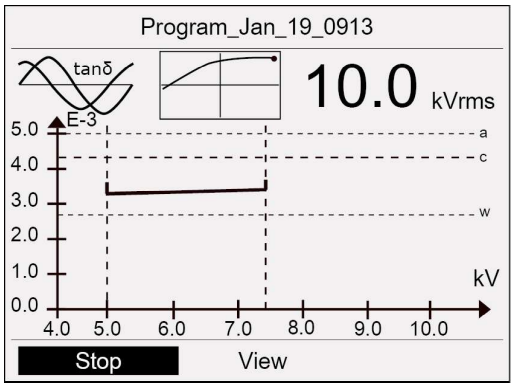
In the diagram the determined average tan-delta values (MTD) per phase are shown in dependence of the voltage.

The threshold values for tan d are displayed by dotted lines as follows:

a - Alarm level *Cancel*

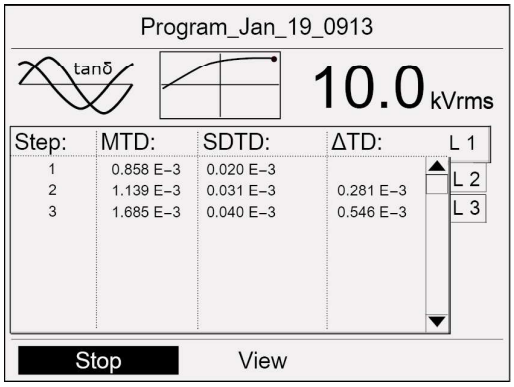
c - Alarm level *High risk*

w - Alarm level *Risk*



Detail view

The detail view shows a tabular summary of the following values per phase and per voltage step: The mean value of the dissipation factor, stability of the dissipation factor (standard deviation) and change of the dissipation factor between successive steps.



- In order to display all measured values for a step or time interval, select a step in the detail view and press the rotary knob to confirm.
- For navigating between the measurement results for different phases, turn the rotary knob.

11.4 Measuring other phases

The measurement ends after the preset time or after reaching one of the preset threshold values. After the measurement, the high voltage is reduced and the device is discharged internally. This is shown by the message *Discharge process* .

When the discharge process is completed, the device changes to *Ready for operation* operating state. The red indicator light goes out, the green indicator light comes on. The device no longer delivers dangerous voltage. A safety message appears which prompts you to discharge, earth and short-circuit the test object.

For the measurement on a different phase, you must connect the next phase. Proceed as follows:

1. Discharge, earth and short-circuit the test object.

DANGER

Dangerous voltage at test object and other live plant parts.

Danger to life, risk of injury from high electric voltage.

- Before touching test object, discharge, earth and short-circuit the same: at the connection point and at the far end.
- You may touch the parts that were under voltage only if they are visibly earthed and short-circuited.

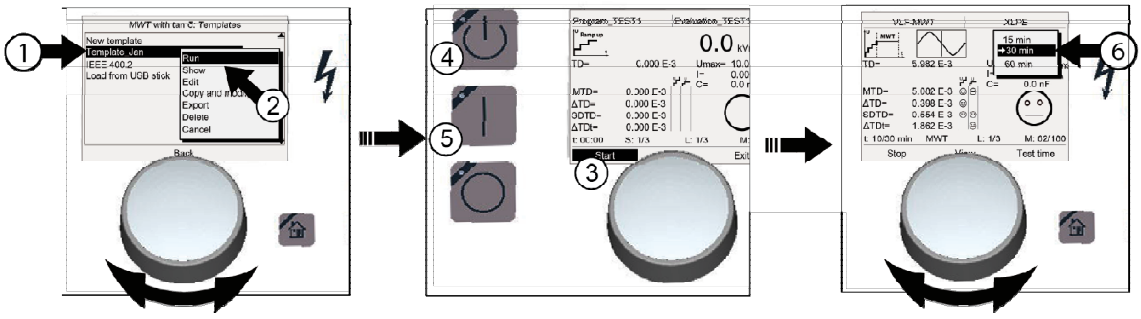
---

2. Disconnect the connected phase.
3. Connect the required phase (see "Connecting the device" on page 32).
4. In the lower menu bar, select the menu item *Start*.
5. The description of how to proceed further is given in the chapter *Start dissipation factor measurement* (see "*Starting a dissipation factor measurement*" on page 78).

12 PERFORMING A MWT MEASUREMENT

12.1 Sequence of an MWT with tan delta - overview

In the following, the sequence of an MWT with dissipation factor measurement is described in principle. Detailed instructions for carrying out an MWT are given in the chapter *Start MWT measurement* (see "*Starting a MWT measurement*" on page 84).



Sequence of an MWT test and dissipation factor diagnostics	
①	*Main menu* > *VLF Diagnostics – tan δ* > *MWT with tan δ* ▸ Select diagnostics template: Turn rotary knob until the cursor comes to rest on the required template, and press the rotary knob in order to confirm the selection.
②	▸ In the context menu, select *Run* .
③	▸ Start measurement: *Start* .
	▸ In the context menu, select a phase.
④	▸ Press the *Ready to switch on* button.
⑤	▸ Press the *High voltage on* button. The measurement (ramp-up stage) is started. After the ramp-up stage voltage test starts automatically (MWT stage).
⑥	▸ After the preset time, the test time recommendation is displayed. Select the remaining test time in accordance with the tan-δ values already determined.
⑦	On expiry of the preset time or if a threshold value with the alarm level *Cancel measurement* has been reached, the measurement is terminated automatically. ▸ **Dangerous voltage at test object:** Before touching, discharge, earth and short-circuit.

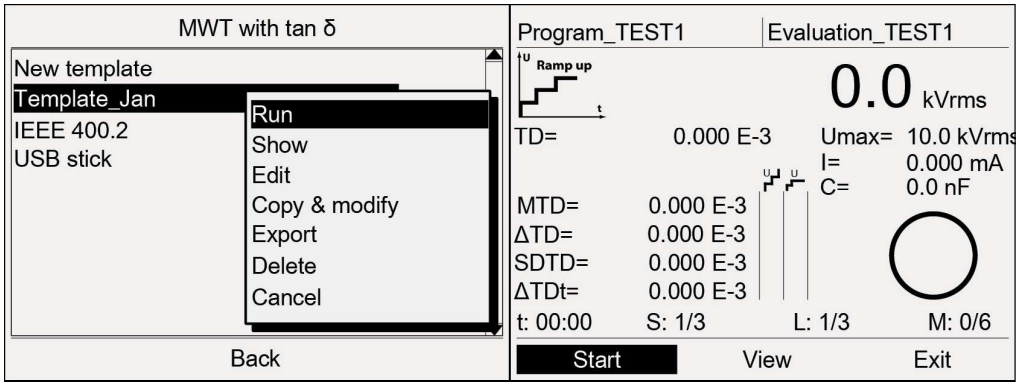
12.2 Starting a MWT measurement

	**⚠ CAUTION**
	Risk of ear-shattering noise during flashover. High electric charging is produced in the test object during high voltage tests on longer cables. When this leads to a flashover in the test object, it can damage the ears. ▸ Use ear protection.

Prerequisites:

- The device is connected (see "Commissioning" on page 30) properly.
- The test zone issecured (see "Securing the test area" on page 39).

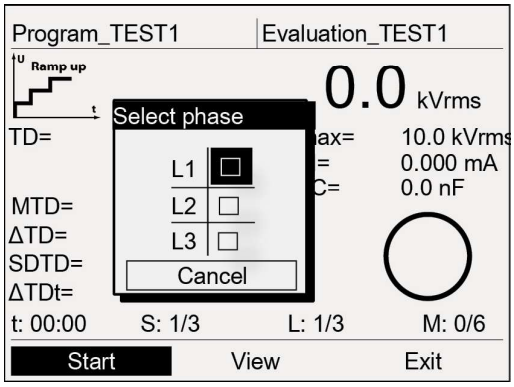
1. In the main menu, select the menu item *VLF Diagnostics – tan δ* > *MWT with tan δ*
   A list of available templates is shown.
2. You now have the following options:
   - **Select existing template**
     This will take you to the next step.
   - **Create a new template**
     Further information is given in the chapter *Create new MWT template* (see "*Creating a new MWT template*" on page 51).
     When you have created the new template, proceed to the next step.
   - **Edit existing template**
     Further information is given in the chapter *Edit template* (see "*Editing a template*" on page 58).
     After you have edited the template, proceed to the next step.
3. In the menu *MWT with tan δ* select a template from the list and press rotary knob to confirm.
4. In the context menu, select the menu item *Run* and press the rotary knob to confirm.
   The measurement mode window for starting a measurement opens.
   Note: The following screenshots are examples.



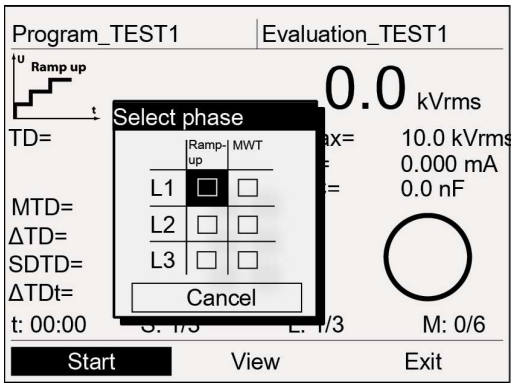
5. Make your selection in the lower menu bar *Start* and press the rotary knob to confirm.
   If only one phase is specified in the program, a prompt for high voltage activation appears: *Press button <Ready for switch-on>*. This will take you to the next step.

Measurement on several phases

If more than one phase has been specified in the program, a context menu for phase selection opens. The phases on which the measurement has already been carried out are indicated by means of a tick. If the measurement on a phase was cancelled, this is indicated by a cross.



If the function *Split MWT measurement* is activated, the context menu is used additionally for selecting the measurement stage (Ramp-up or MWT) on the respective phase. The phases on which the respective measurement stage has already been carried out are indicated by means of a tick. If a measurement stage on a phase was cancelled, this is indicated by a cross.



a. Turn the rotary knob to select a phase and, if necessary, that measurement stage which is to be measured. You have the option to repeat the measurement on a phase.

   The prompt for connecting the phase selected appears on the display.

b. If the phase selected has not yet been connected, connect the same. Further information on how to connect the test object is given in the chapter *Connect device (see "Connecting the device" on page 32).*

c. Select the menu item *Next*.

   The prompt for high voltage activation appears on the display: *Press button <Ready for switch-on>*.

6. Press the button *Ready to switch on* for minimum 1 second.

   The device changes to *Ready to switch on* operating state. The red indicator light blinks for approx. 6 seconds. The prompt for switching on the high voltage appears on the display:

   Press button <High voltage on>.

   If you wish to cancel high voltage activation and return to the measurement mode window, press the rotary knob.

7. When the red indicator light blinks, press the button *High voltage on*.

   The device changes to *In operation* operating state. The red indicator light is steady.

   The device determines the applied load. The load determination takes approx. 10 - 20 seconds depending on the load. This is displayed by the *Load determination in progress...* message.

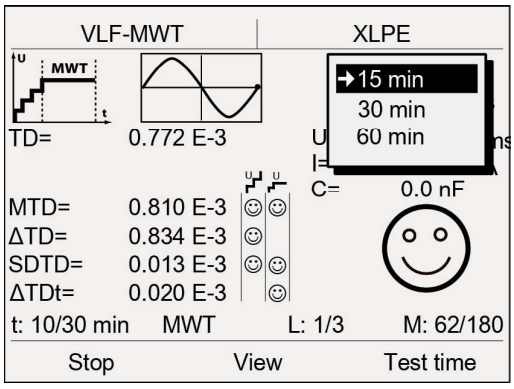
   Note: Information on the option of frequency and voltage adaptation in dependence of the load capacity of the test object is given in the main operating instructions in the chapter *Activate / deactivate automatic voltage reduction*.

   The measurement is started after the load determination. The menu item *Start* changes to *Stop*.

12.3 Selecting a test time

First the ramp-up stage is carried out. The results are displayed immediately. The ramp-up stage is followed by voltage test (MWT stage). After the preset time, the test time recommendation is displayed. This recommendation is based on the measurement results in the ramp-up stage and the first measurement results of the MWT stage that have already been entered. In the bottom menu bar, there appears a new menu item *Test time*.

Note: If no dissipation factor values have been selected for evaluation in the program, the test time of 30 minutes will be proposed in accordance with the recommendation by NEETRAC, The National Electric Energy Testing Research and Applications Center (see Fletcher, Hampton, Hernandez, Hesse, Pearman, Perkel, Wall, Zenger: First practical utility implementations of monitored withstand diagnostics in the USA, Jicable 11, A.10.2)



- Select the remaining test time.

  The MWT ends after the set test time.

12.4 Displaying the measurement results during the measurement

During the measurement the current measured values are displayed continuously and evaluated in accordance with the selected evaluation criteria.

- Information on abbreviations and symbols on the display is given in the chapter *Symbols and abbreviations on the display* (on page 14)

The following views are available to you: Main view, detail view and diagrams tan δ versus voltage as well as tan δ versus time.

- In the lower menu bar, in order to toggle between views, select the menu item *View* and press the rotary knob to confirm.

Main view

The main view is the measurement mode window in which all measured values are continuously displayed.

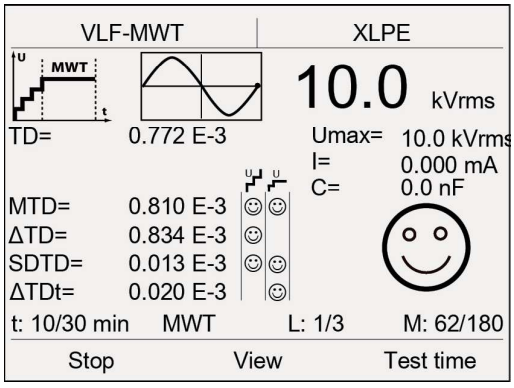


Diagram tan δ versus voltage (for the ramp-up stage)

In the diagram the determined average tan-delta values per phase are shown in dependence of the voltage.

The threshold values for tan d are displayed by dotted lines as follows:

a - Alarm level *Cancel*

c - Alarm level *High risk*

w - Alarm level *Risk*

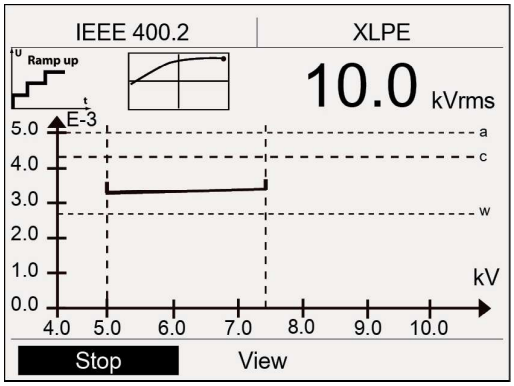
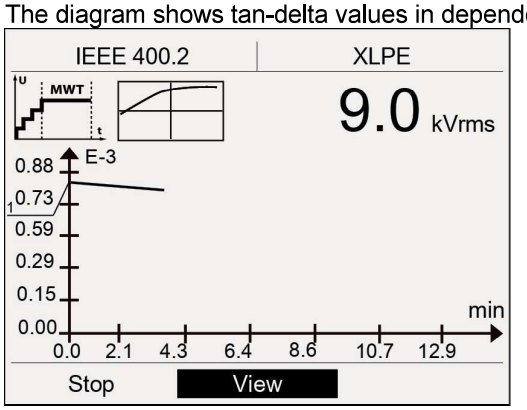


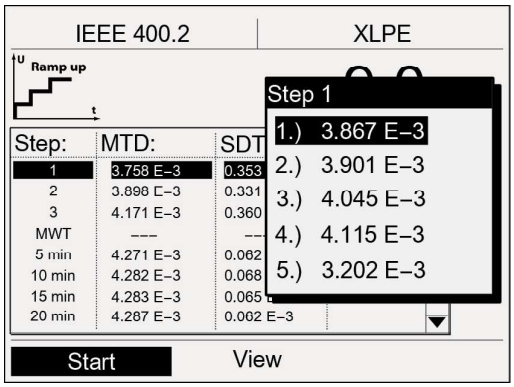
Diagram tan δ versus time (for the MWT stage)

The diagram shows tan-delta values in dependence of the test time.



Detail view

The detail view shows a tabular summary of the dissipation factor values per phase and per voltage step. In the case of an MWT measurement the column *MTD* also shows the dissipation factor values that were measured in 5 minute intervals during the MWT stage.



- On completion of a measurement you can display in detail view all measured values for a step or a time interval: For this purpose, in detail view, select a step and press the rotary knob to confirm.
- For navigating between the measurement results for different phases, turn the rotary knob.

12.5 Taking a measurement on the next phase or starting the next measurement stage

12.5.1 The function “Split MWT measurement" is not activated

The measurement ends after the two measurement stages (ramp-up and MWT) have been carried out on the respective phase. After the measurement, the high voltage is reduced and the device is discharged internally. This is shown by the message *Discharge process* .

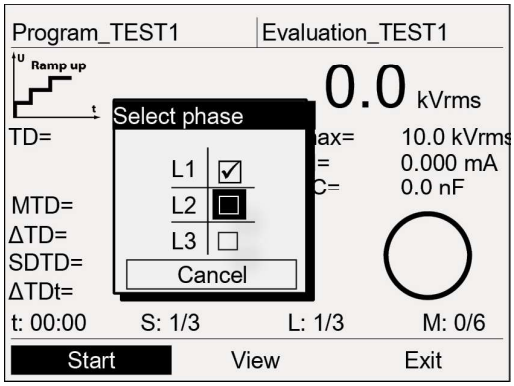
When the discharge process is completed, the device changes to *Ready for operation* operating state. The red indicator light goes out, the green indicator light comes on. The device no longer delivers dangerous voltage. A safety message appears which prompts you to discharge, earth and short-circuit the test object.

On completion of the measurement you have the following options:

Repeat the measurement on the same phase

Proceed as follows:

1. In the lower menu bar, select the menu item *Start*.



2. Select the same phase in the context menu.
3. The description of how to proceed further is given in the chapter *Start MWT measurement* (see "*Starting a MWT measurement*" on page 84).

Start measurement on another phase

For the measurement on a different phase, you must connect the next phase. Proceed as follows:

1. Discharge, earth and short-circuit the test object.

DANGER

Dangerous voltage at test object and other live plant parts.

Danger to life, risk of injury from high electric voltage.

- Before touching test object, discharge, earth and short-circuit the same: at the connection point and at the far end.
- You may touch the parts that were under voltage only if they are visibly earthed and short-circuited.

---

2. Disconnect the connected phase.
3. Connect the required phase (see "Connecting the device" on page 32).
4. In the lower menu bar, select the menu item *Start*.

   The description of how to proceed further is given in the chapter *Start MWT measurement* (see "*Starting a MWT measurement*" on page 84).

12.5.2 The function “Split MWT measurement” is activated

If the function *Split MWT measurement* is activated, the measurement ends on completion of the measurement stage selected. After the measurement, the high voltage is reduced and the device is discharged internally. This is shown by the message *Discharge process* .

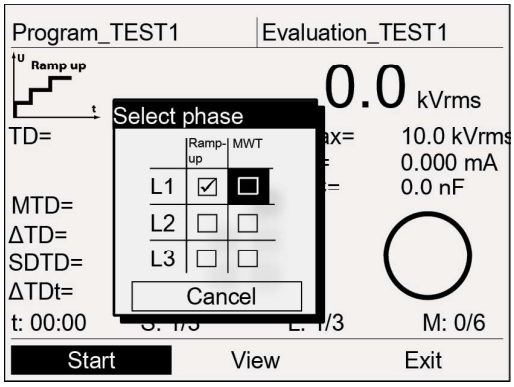
When the discharge process is completed, the device changes to *Ready for operation* operating state. The red indicator light goes out, the green indicator light comes on. The device no longer delivers dangerous voltage. A safety message appears which prompts you to discharge, earth and short-circuit the test object.

On completion of a measurement stage you have the following options:

Carry out the next measurement stage (ramp-up or MWT) on the same phase

Proceed as follows:

1. In the lower menu bar, select the menu item *Start*.



2. In the context menu, select the next measurement stage on the same phase.
3. The description of how to proceed further is given in the chapter *Start MWT measurement* (see "*Starting a MWT measurement*" on page 84).

Start measurement on another phase

For the measurement on a different phase, you must connect the next phase. Proceed as follows:

1. Discharge, earth and short-circuit the test object.

DANGER

Dangerous voltage at test object and other live plant parts.

Danger to life, risk of injury from high electric voltage.

- Before touching test object, discharge, earth and short-circuit the same: at the connection point and at the far end.
- You may touch the parts that were under voltage only if they are visibly earthed and short-circuited.

---

2. Disconnect the connected phase.
3. Connect the required phase (see "Connecting the device" on page 32).
4. In the lower menu bar, select the menu item *Start*.

   The description of how to proceed further is given in the chapter *Start MWT measurement* (see "*Starting a MWT measurement*" on page 84).

Note: You have the option to complete the measurement also at a later point in time (see "Completing a measurement at a later point in time" on page 101).

13 FINISHING A MEASUREMENT

13.1 Finishing a measurement

After the measurement, the high voltage is reduced and the device is discharged internally. This is shown by the message *Discharge process* .

When the discharge process is completed, the device changes to *Ready for operation* operating state. The red indicator light goes out, the green indicator light comes on. The device no longer delivers dangerous voltage. A safety message appears which prompts you to discharge, earth and short-circuit the test object.

DANGER

Dangerous voltage at test object and other live plant parts.

Danger to life, risk of injury from high electric voltage.

- Before touching test object, discharge, earth and short-circuit the same: at the connection point and at the far end.
- You may touch the plant parts that were under voltage only if they are visibly earthed and short-circuited.

1. The safety message is hidden after approx. 5 seconds. In order to hide this message sooner, press the rotary knob. The device switches to the test mode start window.
2. In order to end the measurement, select the menu item *Exit* and press the rotary knob to confirm.

   A prompt appears, asking if you really want to save the log.
3. If you wish to save the log, confirm the prompt with *Yes*. Further information on saving the log is given in the chapter *Save log*.

   If you do not wish to save any log, select the button *No*.

   In order to remain in the measurment mode window, select the button *Cancel*.
4. Information on turning off the device and taking the testing system out of operation is given in the chapter *Putting the testing system out of operation* (on page 99).

13.2 Saving a log

1. If you have completed the test, select in the bottom menu bar the menu item *Exit* and press the rotary knob to confirm.

   A prompt appears asking if you really want to save the log.
2. Confirm the prompt with *Yes*.
3. If you have enabled the setting *Add ambient temperature to log* , then there appears an ambient temperature prompt.

   Enter the ambient temperature, at which the test has been carried out. This information is inserted into the log.
4. The window for entering a name for the log opens. The device suggests a name composed of date (month, day) and time.
5. If you want to save the log under another name, enter a name.
   a. In order to navigate between letters, turn the rotary knob.
   b. In order to confirm selection, press the rotary knob.
6. In order to save the log you have the following options:

   Save log in the device memory:

   a. Select the button *OK* and press the rotary knob to confirm.

   Save log on a USB stick.

   b. Insert a USB stick in the USB port of viola TD.
   c. Select the button *USB* and press the rotary knob to confirm.

      The device switches to the USB stick directory.
   d. Select a folder in which the log is to be saved.

      In order to create a new folder, select the menu item *Create new folder* and enter a name for the new folder.
   e. Select the menu item *Save*.

      Note: If the test has been carried out on several phases, test results for all phases are saved in a single log.

      The log is saved to the USB stick.
   f. Acknowledge this save confirmation with *OK*.

13.3 Cancelling a measurement manually

You can cancel the diagnostics manually at any time by viola TD. Proceed as follows:

1. For this purpose, select *Stop* in the bottom menu bar, and press the rotary knob to confirm.

   After cancelling the diagnostics, the high voltage is reduced and the device is discharged internally. When the discharge process is completed, the device changes to “Ready for operation” operating state. The green indicator light comes on. The device no longer delivers dangerous voltage. The test voltage supply is switched off.

DANGER

Dangerous voltage at test object and other live plant parts.

Danger to life, risk of injury from high electric voltage.

- Before touching test object, discharge, earth and short-circuit the same: at the connection point and at the far end.
- You may touch the plant parts that were under voltage only if they are visibly earthed and short-circuited.

---

1. You now have the following options:

   - Repeat measurement, start a different measurement phase (MWT measurement), or measure a different phase:

   a. Select *Start*.

   b. The description of how to proceed further is given in the chapter *Start measuring loss factors* (see "*Starting a dissipation factor measurement*" on page 78) or *Start MWT measurement* (see "*Starting a MWT measurement*" on page 84).

   - Exit measurement and return to menu *VLF Diagnostics – tan δ*:

   a. Select *Exit*.

      A prompt appears, asking if you really want to save the log. If you save the log, you can complete this measurement at a later point in time (see "Completing a measurement at a later point in time" on page 101).

   b. In order to save the log, confirm the prompt with *Yes*.

   c. The description of the procedure when saving the log is given in the chapter *Save log*.

13.4 Automatic shutdown of the device on overload

On overload at the device input, the overcurrent protection switch of the main switch is released and switches off the device. Proceed as follows:

- Allow the device to cool.
- After it has cooled, the device can be operated again.

13.5 Discharging and earthing the test object

On completion of cable sheath testing or measurement the test object still carries a dangerous voltage.

DANGER

Dangerous voltage on test object.

Danger of electric shock or risk of injury

- **Before touching, discharge, earth and short-circuit:** the test object at the connection point and at the far end.
- You may touch the plant parts that were under voltage only if they are visibly earthed and short-circuited.
- Connect the discharge and earth rod correctly to the station earth.
- Use the discharge and earth rod in dry weather conditions only.
- Hold the discharge and earth rod only at the handles!
- Observe the minimum discharge period in accordance with the capacity of the test object.

13.5.1 Discharging

1. If not yet connected, connect the earthing conductor of the discharge and earthing rod to the station earth.

DANGER

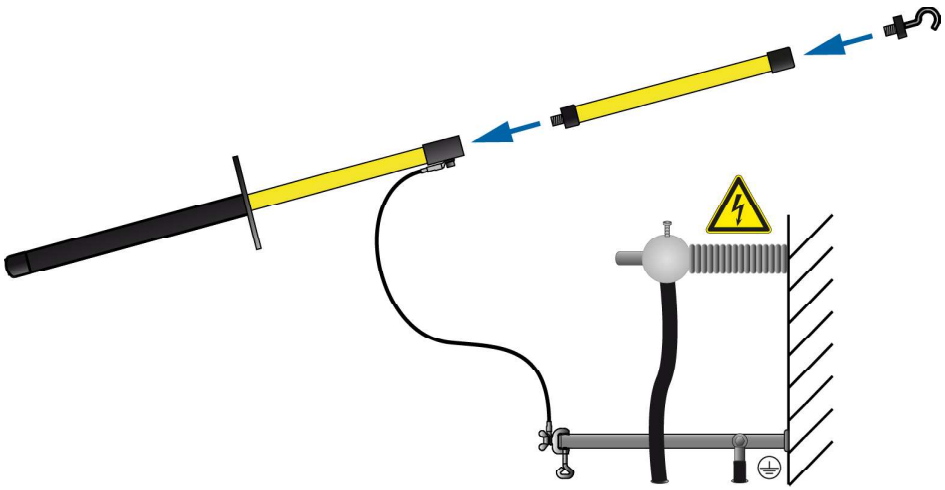
Dangerous voltage on test object.

Danger to life, risk of injury from high electric voltage.

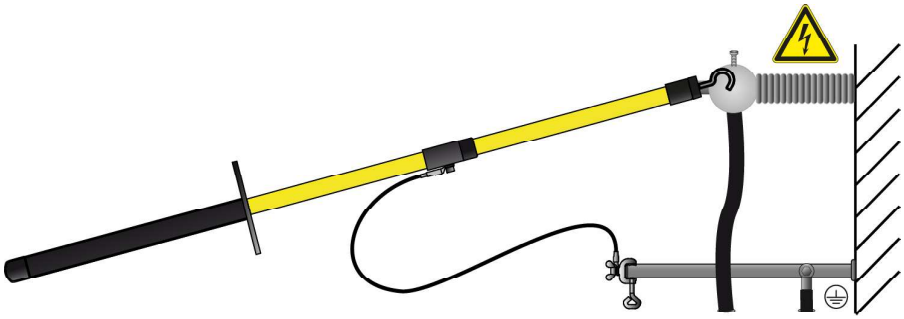
- Keep a distance from the earthing conductor of the discharge and earth rod of at least 50 cm.

---

2. Assemble the discharge rod:
   a. Screw the hook onto the discharge part.
   b. Screw the discharge part onto the handle.



3. Use the black handle to hold the discharge and earthing rod and contact the test object with the tip of the discharge and earthing rod.



4. Observe the minimum discharge period in accordance with the capacity of the test object.

13.5.2 Earthing

1. If not yet connected, connect the earthing conductor of the discharge and earthing rod to the station earth.

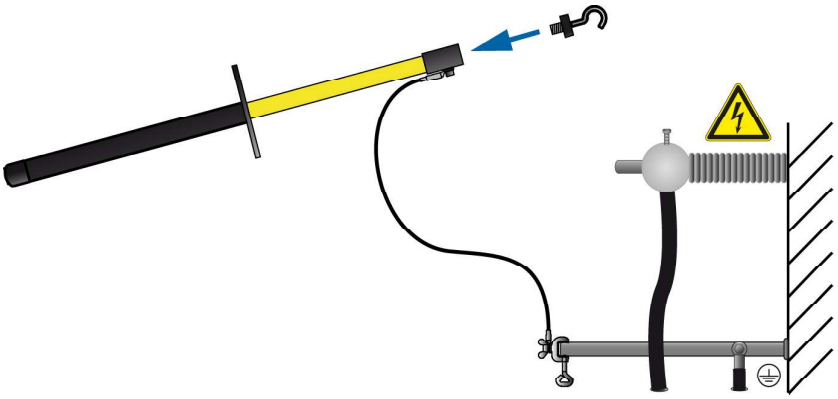
DANGER

Dangerous voltage on test object.

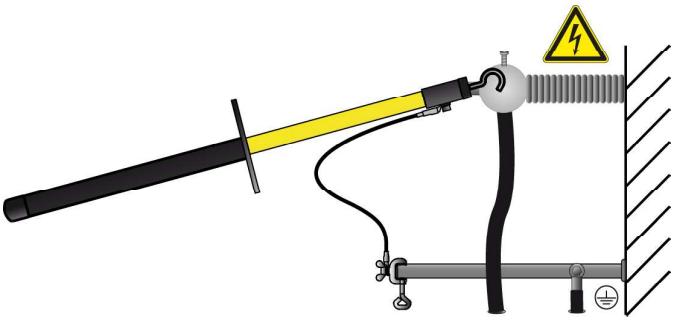
Danger to life, risk of injury from high electric voltage.

- Keep a distance from the earthing conductor of the discharge and earth rod of at least 50 cm.

2. Assemble the earthing rod: For this purpose, screw the hook into the handle.



3. Contact the test object with the tip of the earthing rod.



13.6 Putting the testing system out of operation

13.6.1 Test setup without VSE box

⚠ WARNING

High electrical voltage

Electric shock on touching live and active parts and due to residual charges if earthing is removed too early

- Disconnect the earth connections as the last connection of the test setup.
- Never disconnect the earth connections as long as power and other periphery connections are still connected.

NOTICE

Damage to devices due to improper use.

- Do not switch off the device under load.
- Before switching off the device, bring it to *Ready for operation* operating state.

Note: The following description refers to a test setup with anti-corona-protection and without VSE box.

1. Discharge and earth the phase on which you have carried out the measurement.
2. Connect the potential equalisation cable, between a short-circuited phase and the phase on which the measurement was carried out and where the anti-corona hoods are mounted.
3. The main switch is located on the control panel. Switch off the device.
4. To disconnect the device completely from the mains voltage, pull out the mains plug.
   If you are using an external power generator, follow the user manual of the respective power generator.
5. Disconnect the high voltage connection cable.
6. Remove the anti-corona hoods from the tested phase.
7. Short-circuit the tested phase.
8. Remove the potential equalisation cable.
9. Finally, as the last connection, disconnect the earth conductor.
10. If necessary, remove the insulating panels.
11. Remove the earthing short-circuit to the test object only if no subsequent work is required and if the test object will be reinstated.
12. Remove the barriers and marking of the test area.

13.6.2 Test setup with VSE box

⚠ WARNING

High electrical voltage

Electric shock on touching live and active parts and due to residual charges if earthing is removed too early

- Disconnect the earth connections as the last connection of the test setup.
- Never disconnect the earth connections as long as power and other periphery connections are still connected.

NOTICE

Damage to devices due to improper use.

- Do not switch off the device under load.
- Before switching off the device, bring it to *Ready for operation* operating state.

Note: The following description refers to a test setup with anti-corona-protection and with VSE box.

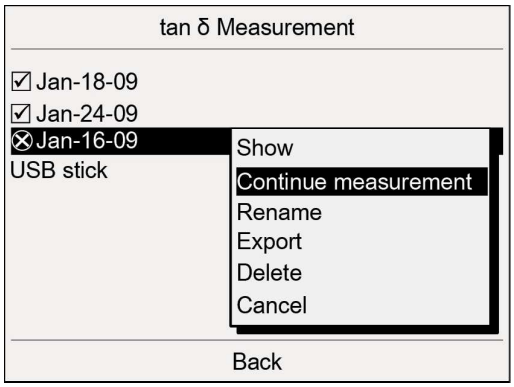
1. Discharge and earth all phases that were connected in the measurement setup:
   - Phase on which you have carried out the measurement.
   - Phase which was used as a return line for leakage currents from the far earth.
2. Short-circuit the phase which was used as a return line.
3. Connect the potential equalisation cable, between a short-circuited phase and the phase on which the measurement was carried out and where the anti-corona hoods are mounted.
4. The main switch is located on the control panel. Switch off the device.
5. To disconnect the device completely from the mains voltage, pull out the mains plug.
   If you are using an external power generator, follow the user manual of the respective power generator.
6. Disconnect the high voltage connection cable.
7. Remove the anti-corona hoods from the tested phase.
8. Short-circuit the tested phase.
9. Remove the potential equalisation cable.
10. Remove the connection cables (yellow cables).
11. Disconnect the earthing conductors from the VSE box.
12. Disconnect the earthing conductor from the device.
13. If necessary, remove the insulating panels.
14. Remove the earthing and the short-circuit on the test object only if no subsequent work is required and if the test object will be reinstated.
15. Remove the barriers and marking of the test area.

14 COMPLETING A MEASUREMENT AT A LATER POINT IN TIME

If you have saved the log following cancellation of the measurement, you can complete this measurement at a later point in time.

1. Depending on the diagnostics type, select the following menu item and press the rotary knob to confirm:
   - Dissipation factor measurement: *Main menu* > *VLF Diagnostics – tan δ* > *Logs* > *tan-δ Measurement*
   - MWT with dissipation factor measurement: *Main menu* > *VLF Diagnostics – tan δ* > *Logs* > *MWT with tan δ*

   If the measurement is not complete, this is indicated by a cross.
2. Select the relevant log and press the rotary knob to confirm.

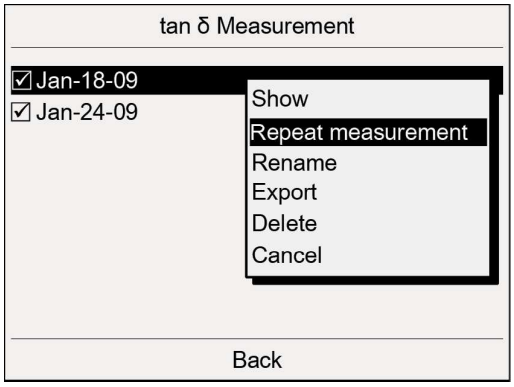


3. In the context menu, select the menu item *Continue measurement* and press the rotary knob to confirm.

   The measurement mode window opens. The description of how to proceed further is given in the chapter *Start dissipation factor measurement* (see "*Starting a dissipation factor measurement*" on page 78) or *Start MWT measurement* (see "*Starting a MWT measurement*" on page 84).

15 REPEATING A MEASUREMENT AT A LATER POINT IN TIME

1. Depending on the diagnostics type, select the following menu item and press the rotary knob to confirm:
   - Dissipation factor measurement: *Main menu* > *VLF Diagnostics – tan δ* > *Logs* > *tan-δ Measurement*
   - MWT with dissipation factor measurement: *Main menu* > *VLF Diagnostics – tan δ* > *Logs* > *MWT with tan δ*
2. Select the relevant log and press the rotary knob to confirm.



3. In the context menu, select the menu item *Repeat measurement* and press the rotary knob to confirm.

   The measurement mode window opens. The description of how to proceed further is given in the chapter *Start dissipation factor measurement* (see "*Starting a dissipation factor measurement*" on page 78) or *Start MWT measurement* (see "*Starting a MWT measurement*" on page 84).

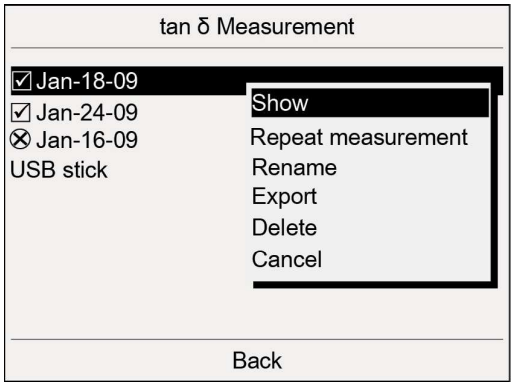
16 LOG MANAGEMENT

- Information on how to edit logs using Diagnostics Reporter is provided in the main operating instructions for the device. These instructions here are only an additional manual for dissipation factor measurements and MWT.

16.1 Displaying a log

1. Depending on the diagnostics type, select the following menu item and press the rotary knob to confirm:
   - Dissipation factor measurement: *Main menu* > *VLF Diagnostics – tan δ* > *Logs* > *tan-δ Measurement*
   - MWT with dissipation factor measurement: *Main menu* > *VLF Diagnostics – tan δ* > *Logs* > *MWT with tan δ*

   In the menu *Logs* all logs available for the diagnostics type selected are shown, e.g.:



   If a measurement is not complete, – that is, not all phases are measured or the measurement was cancelled –, the respective log is indicated by a cross. You can start the cancelled measurements directly from the menu *Logs* and complete the same. For this purpose, select the respective log and, in the context menu, select the menu item *Continue measurement*. This menu item is shown, if you have selected a previously cancelled measurement.
2. Select a log and press the rotary knob to confirm.
3. In the context menu, select the menu item *Show* and press the rotary knob to confirm.

4. In the next context menu, select which parameters of the log you wish to view. You have the following options:
   - Measurement
     What is displayed is the detail view, the diagram tan δ versus voltage and the diagram tan δ versus time (MWT with tan δ).
   - In the lower menu bar, in order to toggle between views, select the menu item *View* and press the rotary knob to confirm. Further information on the various views is given in the chapter *Displaying the measurement results during measurement* (see "*Displaying the measurement results during the measurement*" on page 80, "*Displaying the measurement results during the measurement*" on page 88)
   - Program
     Here, the program parameters are displayed.
   - Evaluation
     Here, the evaluation criteria are displayed.

16.2 Renaming a log

1. Depending on the diagnostics type, select the following menu item and press the rotary knob to confirm:
   - Dissipation factor measurement: *Main menu* > *VLF Diagnostics – tan δ* > *Logs* > *tan-δ Measurement*
   - MWT with dissipation factor measurement: *Main menu* > *VLF Diagnostics – tan δ* > *Logs* > *MWT with tan δ*

   In the menu *Logs* all logs available for the diagnostics type selected are shown.
2. Select a log and press the rotary knob to confirm.
3. In the context menu, select the menu item *Rename* and press the rotary knob to confirm.
   A window for entering a name opens.
4. Enter a new name for the log.
5. To confirm the entry, select the button *OK* and press the rotary knob to confirm.
   The new name of the log is saved.

16.3 Deleting a log

1. Depending on the diagnostics type, select the following menu item and press the rotary knob to confirm:
   - Dissipation factor measurement: *Main menu* > *VLF Diagnostics – tan δ* > *Logs* > *tan-δ Measurement*
   - MWT with dissipation factor measurement: *Main menu* > *VLF Diagnostics – tan δ* > *Logs* > *MWT with tan δ*

   In the menu *Logs* all logs available for the diagnostics type selected are shown.
2. Select a log and press the rotary knob to confirm.
3. In the context menu, select the menu item *Delete* and press the rotary knob to confirm.
   A prompt appears asking if you really want to delete the log.
4. Confirm the prompt with *Yes*.
   The log is deleted.

16.4 Exporting a log to a USB stick

Note: The device supports only USB sticks with the FAT32 and FAT16 file system. We recommend using USB sticks with the FAT32 file system.

1. Insert a USB stick into the USB port of viola TD.
2. Depending on the diagnostics type, select the following menu item and press the rotary knob to confirm:
   - Dissipation factor measurement: *Main menu* > *VLF Diagnostics – tan δ* > *tan-δ Measurement* >*Logs*
   - MWT with dissipation factor measurement: *Main menu* > *VLF Diagnostics – tan δ* > *MWT with tan δ* > *Logs*
3. Select a log and press the rotary knob to confirm.
4. In the context menu, select the menu item *Export* and press the rotary knob to confirm.

   The window *USB* with the display of the main directory of the USB stick opens.
5. If you wish to save the log to a folder, select a folder or create a new one.

   If you wish to create a new folder,

   a. select the menu item *Create new folder* and press the rotary knob to confirm.

   b. Enter a name and confirm this entry with *OK*.
6. In the lower menu bar, select the menu item *Save*.

   The log is saved to the USB stick.

   Note: A MWT measurement is saved in a single file. For a dissipation factor measurement a single file is saved for each phase so as to enable the data to be exchanged with the BAUR software.
7. Acknowledge this save confirmation with *OK*.

   The device switches to the respective menu *Logs*.

16.5 Importing a log from a USB stick

16.5.1 Importing a log of a dissipation factor measurement

Note: The device supports only USB sticks with the FAT32 and FAT16 file system. We recommend using USB sticks with the FAT32 file system.

1. Insert a USB stick into the USB port of viola TD.
2. Select the menu item *Main menu* > *VLF Diagnostics – tan δ* >*Logs* > *tan-δ Measurement* and press the rotary knob to confirm.
3. Select the menu item *USB stick* and press the rotary knob to confirm.

   The window *USB* with the folder tree existing on the USB stick opens.
4. Select a log or a folder and press the rotary knob to confirm.

   When selecting a folder

   If you have selected a folder, all logs saved in this folder will be automatically selected. In order to cancel the selection of individual logs, if necessary,

   a. select the relevant log and press the rotary knob to confirm.

   b. In the context menu, select the menu item *Cancel selection* and press the rotary knob to confirm.

   When selecting a log

   c. In the context menu, select the menu item *Select* and press the rotary knob to confirm.

      The log selected is shown with a hook.

   d. If you wish to import further logs, select the same.
5. If the cursor is located on one the logs selected, then press the rotary knob.
6. In the context menu, select the menu item *Import* and press the rotary knob to confirm.

   When the selected logs have been imported, an import confirmation is displayed.
7. Press *OK* to acknowledge the import confirmation.

   The device switches to the respective menu *Logs*. If you import a dissipation factor measurement log consisting of the individual files per phase, the individual files are collated into a single file.

16.5.2 Importing a log of an MWT measurement

Note: The device supports only USB sticks with the FAT32 and FAT16 file system. We recommend using USB sticks with the FAT32 file system.

1. Insert a USB stick into the USB port of viola TD.
2. Select the menu item *Main menu* > *VLF Diagnostics – tan δ* >*Logs* > *MWT with tan δ* and press the rotary knob to confirm.
3. Select the menu item *USB stick* and press the rotary knob to confirm.

   The window *USB* with the folder tree existing on the USB stick opens.
4. Select a log and press the rotary knob to confirm.
5. In the context menu, select the menu item *Select* and press the rotary knob to confirm.

   The log selected is shown with a hook.
6. If you wish to import further logs, select the same.
7. If the cursor is located on one the logs selected, then press the rotary knob.
8. In the context menu, select the menu item *Import* and press the rotary knob to confirm.

   Following the import of the log, an import confirmation is displayed.
9. Press *OK* to confirm the import.

   The device switches to the respective menu *Logs*.

17 DATA EXPORT AND IMPORT

With the BAUR Software you can create templates for dissipation factor measurements on the PC comfortably and import it to the internal memory of viola TD via a USB stick or start a measurement according to a template directly from the USB stick. You can also create templates directly in viola TD and save these either on the device or import them via a USB stick to the BAUR software.

After completing a measurement, you can import the measured data via the USB stick to the BAUR Software and edit it on PC.

Important note! The data exchange between viola TD and the BAUR software is only possible for standard dissipation factor measurements. Templates for MWT with tan δ can only be created directly on the device.

- Follow the user manual for the BAUR software for dissipation factor measurement.

18 VLF DIAGNOSTICS BY REMOTE CONTROL

- Information on the remote control of the device is given in the main operating instructions for the device. These instructions here are only an additional manual for dissipation factor measurements and MWT.

19 GLOSSARY

A

Anti-corona protection

Anti-corona protection hoods are used to protect against corona discharges at the terminations

C

Change of the dissipation factor between successive steps

Change of the dissipation factor between pre-defined successive voltage steps (Designation on the display: ΔTD)

Change of the dissipation factor over time

Change of the dissipation factor within the first 10 minutes of the MWT stage (designation on the display: tΔTD)

D

Dissipation factor, dielectric dissipation factor

Abbreviation: tan δ

Tangent of the dissipation angle - amount of the ratio between the ideal capacitive current and the real total current. The difference between these two values is determined by the ohmic dissipation current and various different polarisation mechanisms.

The greater the dissipation angle is, the higher the dielectric dissipation is.

M

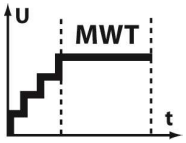
Mean value of dissipation factor

Average value of the dissipation factor for a constant test voltage (designation on the display: MTD)

MWT stage

The MWT stage is a component part of the MWT with tan δ.

Designation on the display:



In the MWT stage the proper cable test is carried out with a continuous dissipation factor measurement at a defined test voltage (e. g. 2 x Uo).

N

Nominal voltage

voltage at which the structure and testing of cables are applied with regard to electrical properties. According to IEC 60183, the nominal voltage is specified by entering 2 AC voltage values **Uo** (conductor - earth) and **U** (conductor - conductor).

P

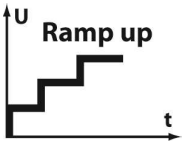
Program

In a program, the parameters of the diagnostics sequence are defined such as e.g. test voltage, voltage steps, number of measurements per voltage step and number of phases to be measured. For the MWT, the MWT stage is also determined in the program.

R

Ramp-up stage

The ramp-up stage is a component part of the MWT with tan δ and is used for a first evaluation of the cable condition during the voltage build-up – before the proper VLF cable test (Monitored Withstand Test MWT).



In the ramp-up stage, the test voltage is built up. During this time, a dissipation factor measurement is carried out on the test object for pre-defined voltages (e. g. 0.5 x Uo, 1 x Uo and 1.5 Uo). For each voltage step, 6 to 10 measured values are recorded. The measurement results provide information on the actual condition of the cable and allow the subsequent cable test to be adapted to that cable condition.

S

Stability of the dissipation factor

Change of the dissipation factor over time for a constant test voltage (Designation on the display: SDTD).

The stability of the dissipation factor is determined on the basis of the standard deviation of the dissipation factor during a voltage step.

T

Template

Basic configuration for executing VLF cable diagnostics.

A template consists of

- program (parameters of the diagnostics process)
- evaluation (evaluation criteria)
- cable data (only in the case of dissipation factor measurement templates created in the BAUR software)

U

U - voltage

rms value of the nominal voltage between 2 conductors (phases). Uo / U = 1 / √ 3

Uo - voltage

rms value of the nominal voltage between an conductor (Phase) and earth.

V

VSE box

Setup for recording leakage currents by using virtual safety earth.

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