Megger

VLF Sinus 34 kV

VLF Test System

USER GUIDE

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Consultation with Megger

The present system manual has been designed as an operating guide and for reference. It is meant to answer your questions and solve your problems in as fast and easy a way as possible. Please start with referring to this manual should any trouble occur.

In doing so, make use of the table of contents and read the relevant paragraph with great attention. Furthermore, check all terminals and connections of the instruments involved.

Should any question remain unanswered, please contact:

Megger Limited

Archcliffe Road
Kent CT17 9EN

T: +44 1304 502100

F: +44 1304 207342

E: uksales@megger.com

Megger Germany GmbH (Baunach)

Dr.-Herbert-Iann-Str. 6
D - 96148 Baunach

T: +49 9544 68 – 0

F: +49 9544 22 73

E: team.dach@megger.com

Megger Germany GmbH (Radeburg)

Röderaue 41
D - 01471 Radeburg / Dresden

T: +49 35208 84 – 0

F: +49 35208 84 249

E: team.dach@megger.com

Megger USA

Valley Forge Corporate Centre
2621 Van Buren Avenue
Norristown, PA 19403 USA

T: +1 610 676 8500

F: +1 610 676 8610

Terms of Warranty

Megger accept responsibility for a claim under warranty brought forward by a customer for a product sold by Megger under the terms stated below.

Megger warrant that at the time of delivery Megger products are free from manufacturing or material defects which might considerably reduce their value or usability. This warranty does not apply to faults in the software supplied. During the period of warranty, Megger agree to repair faulty parts or replace them with new parts or parts as new (with the same usability and life as new parts) according to their choice.

Megger reject all further claims under warranty, in particular those from consequential damage. Each component and product replaced in accordance with this warranty becomes the property of Megger.

All warranty claims versus Megger are hereby limited to a period of 12 months from the date of delivery. Each component supplied by Megger within the context of warranty will also be covered by this warranty for the remaining period of time but for 90 days at least.

Each measure to remedy a claim under warranty shall exclusively be carried out by Megger or an authorized service station.

To register a claim under the provisions of this warranty, the customer has to complain about the defect, in case of an immediately detectable fault within 10 days from the date of delivery.

This warranty does not apply to any fault or damage caused by exposing a product to conditions not in accordance with this specification, by storing, transporting, or using it improperly, or having it serviced or installed by a workshop not authorized by Megger. All responsibility is disclaimed for damage due to wear, will of God, or connection to foreign components.

For damage resulting from a violation of their duty to repair or re-supply items, Megger can be made liable only in case of severe negligence or intention. Any liability for slight negligence is disclaimed.

Contents

1 Safety Advices

1.1 General Notes

Safety precautions

This manual contains basic instructions on commissioning and operating the VLF Sinus 34 kV. For this reason, it is important to ensure that the manual is available at all times to authorised and trained personnel. Any personnel who will be using the devices should read the manual thoroughly. The manufacturer will not be held liable for any injury or damage to personnel or property through failure to observe the safety precautions contained in this handbook.

Locally applying regulations have to be observed.

Labelling of safety instructions

Important instructions concerning personal, operational and technical safety are marked in the text as follows:

Symbol	Description
 WARNING	Indicates a potential danger that may lead to fatal or serious injury.
 CAUTION	Indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury or material damage.
	The notes contain important information and useful tips for using the system. Failure to observe them can render the measuring results useless.

Working with products from Megger

It is important to observe the general electrical regulations of the country in which the device will be installed and operated, as well as the current national accident prevention regulations and internal company rules (work, operating and safety regulations).

Use genuine accessories to ensure system safety and reliable operation. The use of other parts is not permitted and invalidates the warranty.

Operating staff

This system and its peripheral equipment may only be operated by trained or instructed personnel. Anyone else must be kept away.

The system may only be installed by an authorised electrician. DIN VDE 0104 (EN 50191), DIN VDE 0105 (EN 50110) and the German accident prevention regulations (UVV) define an electrician as someone whose knowledge, experience and familiarity with the applicable regulations enables him to recognise potential hazards.

1.2 General Cautions and Warnings

Intended application

Safe operation is only realised when using the equipment for its intended purpose (see chapter 2.1). Using the equipment for other purposes may lead to human danger and damage of equipment of involved installations.

The limits described under technical data may not be exceeded. Operating products of Megger in condensing environment may lead to flash-over, danger and damage. The instruments should only be operated under tempered conditions. It is not allowed to operate Megger products at direct contact with humidity, water or near aggressive chemicals nor explosive gases and fumes.

Five safety rules

The five safety rules must always be followed when working with HV (High Voltage):

1. De-energise
2. Protect against re-energising
3. Confirm absence of voltage
4. Ground and short-circuit
5. Cover up or bar-off neighbouring energised parts

Using cardiac pacemaker

Physical processes during operation of high voltage may endanger persons wearing a cardiac pacemaker when near these high voltage facilities.

Fire fighting in electrical installations

- According to regulations, carbon dioxide (CO_2) is **required to be used** as extinguishing agent for fighting fire in electrical installations.
- Carbon dioxide is electrically non conductive and does not leave residues. It is safe to be used in energized facilities as long as the minimum distances are maintained. A CO_2 fire extinguisher must be always available within electrical installations.
- If, contrary to the regulations, any other extinguishing agent is used for fire fighting, this may lead to damage at the electrical installation. Megger disclaims any liability for consequential damage. Furthermore, when using a powder extinguisher near high-voltage installations, there is a danger that the operator of the fire extinguisher will get an electrical shock from a voltage arc-over (due to the powder dust created).
- It is essential to observe the safety instruction on the extinguishing agent.
- Applicable is DIN VDE 0132.

WARNING

Dangers when operating with HV

Special attention and safety-conscious behaviour is needed when operating HV facilities and especially non-stationary equipment. The regulations VDE 0104 about setting up and operation of electric test equipment, i.e. the corresponding EN 50191 as well as country-specific regulations and standards must be observed.

- The VLF Sinus 34 kV generates a dangerous voltage of up to ±24 kV_{RMS} during testing. This is supplied via a HV cable to the test object.
- The test system may not be operated without supervision.
- Operation requires minimum two people whereas the second person must be able to activate the emergency switch in case of danger.
- Safety installations may not be by-passed nor deactivated.
- To avoid hazardous electric charges of metallic parts in the vicinity, all metallic parts must be grounded.
- Check whether there are any unsecured live systems or components in the immediate vicinity of the test system which might you or the system might accidentally come into contact with. This particularly applies to components which carry high voltage or where the voltage is unknown.
  Secure these components using insulating covers. If technical reasons make it impossible to do this, switch them off or have this action carried out at the site for the duration of your work after consulting whoever is responsible. Make sure this is done properly.

2 Technical Description

2.1 General Description

Functional description

The VLF Sinus test system enables testing of medium-voltage cables in accordance with the CENELEC Harmonization Documents HD 620 S1:1996 und HD 621 S1:1996 with a 0.1 Hz sine wave voltage of up to 24 kV_{RMS}.

With the aid of such cable testing, faults in the insulation - particularly water tree damage - will be reliably made to flash over in PE/XLPE cables but also in paper insulated cables. The test procedure does not damage fault-free insulation.

The cables can also be tested for dielectric breakdown strength with positive and negative DC voltage, as well as with trapezoidal AC voltage (rectangular wave voltage).

The slew rate of the rectangular wave voltage depends on the cable capacitance and is automatically adapted.

The additional leakage current measurement in DC mode enables evaluation of the relative quality of the cable insulation.

The sine-wave shape of the system test voltage can also be used in combination with the tan Delta test attachment from Megger to determine the loss factor and thus the cable's degree of deterioration. A detailed description of this use can be found in the operating manual of the tan Delta test attachment.

Features

The VLF Sinus test system unites the following features and functions in a single device:

- Full AC voltage testing up to 24 kV_{RMS} (sine wave voltage)
- Additional output voltage shapes of DC and rectangular wave
- Sheath testing and pinpointing up to 10 kV
- Leakage current measurement
- Manual and automatic frequency adjustment
- Voltage breakdown detection with automatic disconnection of the high voltage
- Logging to USB
- Firmware updates via USB

Scope of delivery

The scope of delivery of the test system comprises the following components:

- Trolley bag with extendable handle
- Mains power cable, 2.5 m
- Earthing cable, 4 m
- HV connection cable, 5 m
- USB stick
- Operating manual
- Accessory bag

2.2 Technical Data

The VLF Sinus 34 kV test system is defined by the following technical parameters:

Parameter	Value
Output voltage (sine wave)	
Testing	max. 24 kV_{RMS} (33.9 kV_{PEAK})
Loss factor measurement with the tan Delta test attachment	max. 21,2 kV_{RMS} (30 kV_{PEAK})
Source output current	8.8 mA_{RMS} (12.45 mA_{PEAK})
Leakage current measurement	0 … 14 mA
Frequency	0.01 Hz … 0.1 Hz (automatic or settable in 0.01 Hz increments)
Testable cable capacitance	see also section 2.3
24 kV_{RMS} at 0.01 Hz	3.5 µF
24 kV_{RMS} at 0.1 Hz	0.58 µF
Output voltage (DC)	±33.9 kV
Output voltage (sheath testing and sheath pinpointing)	−10 kV DC
Power supply	110 V … 230 V ±15%, 50 / 60 Hz
Power consumption	max. 400 VA
Operating temperature	-20 °C ... +55 °C
Storage temperature	-25 °C ... +70 °C
Dimensions (W x H x D)	520 mm x 450 mm x 300 mm
Weight	25 kg
Display	3.5" colour display, 320 x 240 pixels
Interfaces	USB, Ethernet
Protection class (in accordance with DIN VDE 0140 Part 1)	I
Protection rating (in accordance with EN 60529)	IP 54 (for enclosed housing) IP 20 (open)

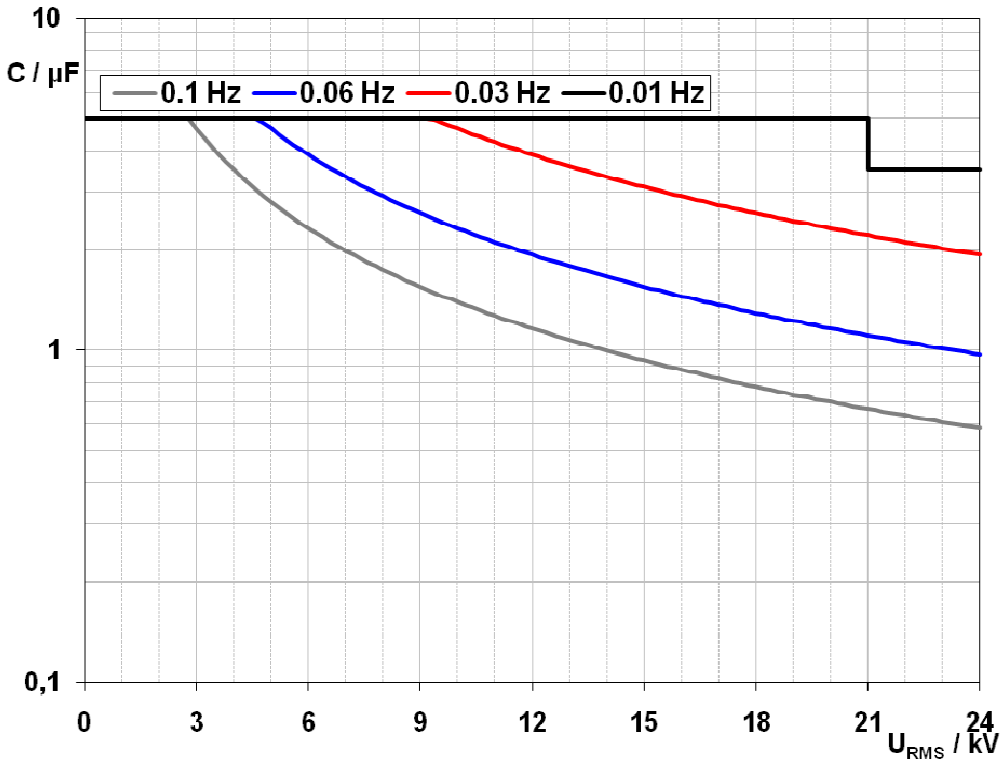
2.3 Testable Cable Capacities

Introduction

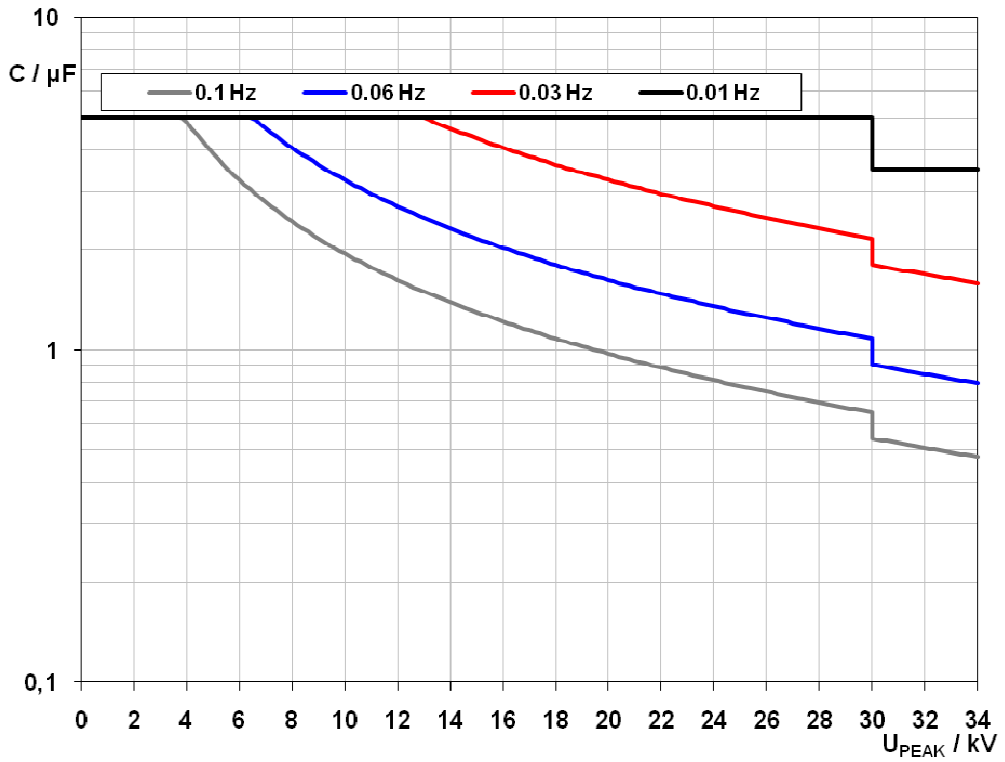
The following diagrams show the relation of the test frequency to the connected load capacitance and the set test voltage.

If the set test frequency cannot be used due to the restrictions visible here, the system prompts for a switch to the lowest possible frequency or, if automatic frequency adaption is enabled, immediately switches to this frequency.

Sine-wave shaped output voltage

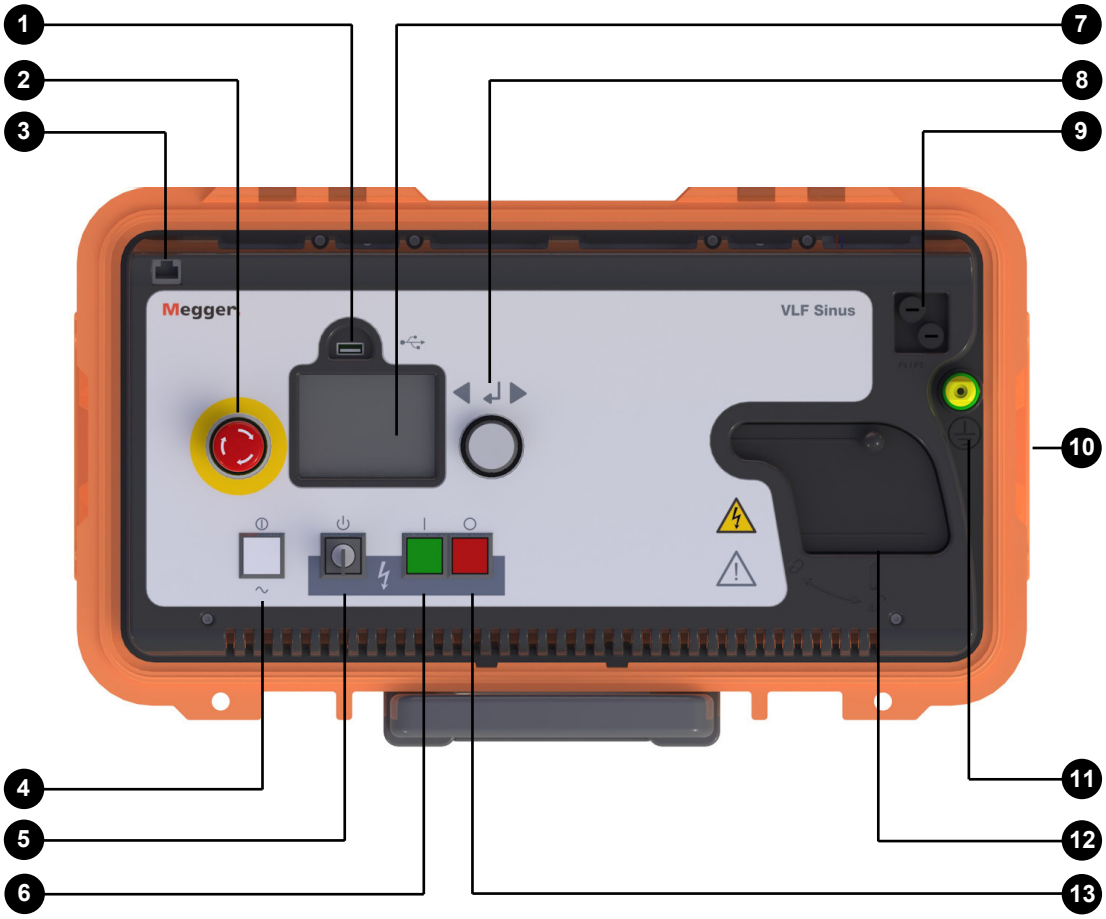


Rectangular output voltage



2.4 Connectors and Controls

The system has the following connectors and controls:



Element	Description
1	**USB slot**
2	**Emergency off button**
3	**Ethernet interface** for servicing and remote control
4	**On/off button**
5	**HV “interlock” key switch**
6	**“HV ON” button**
7	**Display**
8	**Rotary encoder**
9	**Fuses F1 / F2** (2 x T4A)
10	**Power supply socket**
11	**Protective earthing connection**
12	**HV output**
13	**“HV OFF” button**

3 Setting Up the System

Safety instructions for setting up

- Select a location which is sufficient for the weight and size of the system and ensures that it stands securely.
- When setting up the testing system, ensure that it does not impair the function of any other systems or components. If other systems and components have to be modified in order to set up and operate the test system, be sure to reverse these actions when the work is finished. Always take the special requirements of these systems and components into account and only carry out work on them after consulting and obtaining approval from whoever is in charge of them.
- Install protective equipment (such as railings, chains or bars) near the test object to block access to the danger zone and prevent the risk of touching live parts.
- The ventilation slits on the front and back sides of the front panel must not be covered.
- In the event of larger differences in temperature between the storage and installation locations (cold to warm) condensation may form on components carrying high voltage (condensation effect). To avoid any risk of damage to people and components caused by voltage arc-overs, the device needs to be acclimated for about half an hour while being switched on (fans are running) before high voltage operation can be started.

3.1 Electrical Connection

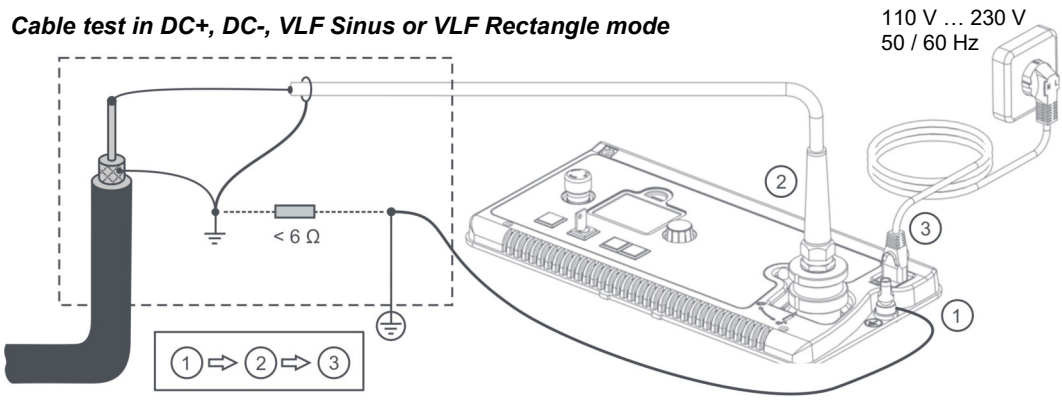
Safety instructions for the electrical connection

- Always follow the safety instructions in chapter 1 - in particular the five safety rules - before connecting the test object.
- The test system may only be connected to or disconnected from a test object when it is switched off, and only when the test object is earthed and shorted.
- Since the voltage applied to the test object can assume values that pose a risk of incidental contact, the cable ends must be shielded in accordance with VDE 0104 to avoid this. When doing so, be sure to take all cable branches into account as well.
- After granting clearance to the test object, make sure that dangerous voltage cannot reach unprotected places or technical equipment.
- The discharge switch installed in the device is merely an apparatus for safely discharging capacitance, and not an earthing and shorting device as described by VDE 0104.
- Before operating the system, any existing voltage transformers must be disconnected from the test object.
- All cables which are out of operation and not connected to the test system must be shorted and earthed.

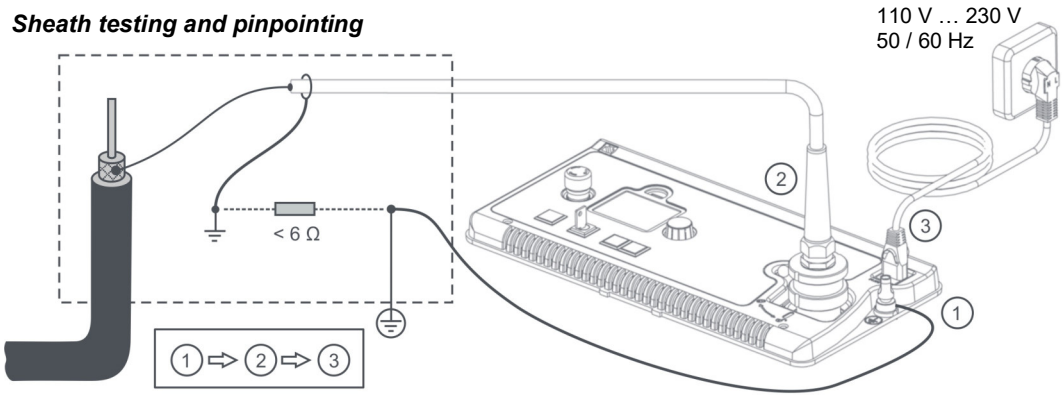
Connection diagram

The following figure shows the simplified connection diagram:

Cable test in DC+, DC-, VLF Sinus or VLF Rectangle mode

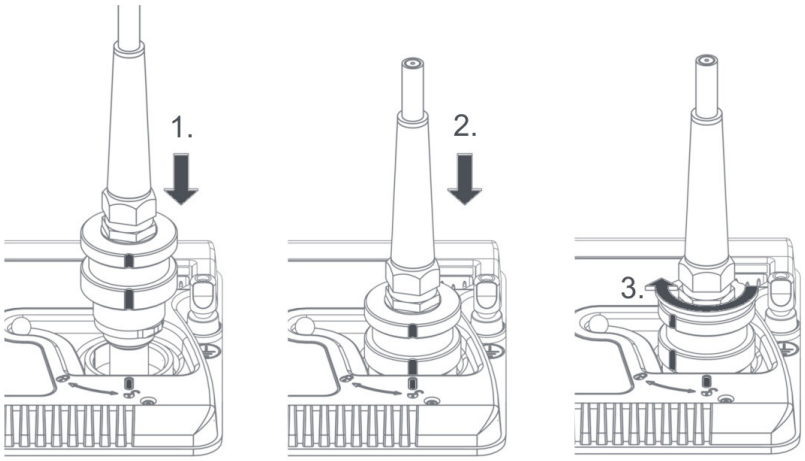


Sheath testing and pinpointing



Connection sequence

Connect the system in the following order:

Step	Action
1	The earthing cable is to be fastened on the earthing connection ⓫ of the system and then connected to a suitable point on the protective earthing system of the station.
2	Attach the high voltage connection cable to the HV output ⓬ of the system as shown in the figures below: 

Step	Action
3	The inner conductor of the HV connection cable must be connected by means of suitable connection accessories to either the phase or the screen of the cable under test. When working in sheath test or sheath pinpointing mode, the cable screen must not be connected to earth on both ends of the cable. Make also sure that there is no indirect contact to earth, e.g. through joints.
4	The screen of the HV connection cable has to be connected to an earth bar close to the cable termination (system earth).
5	Plug the supplied power cable into the power connection ⑩ of the system and connect it to a mains socket.

3.2 Switching On the System

Switching on

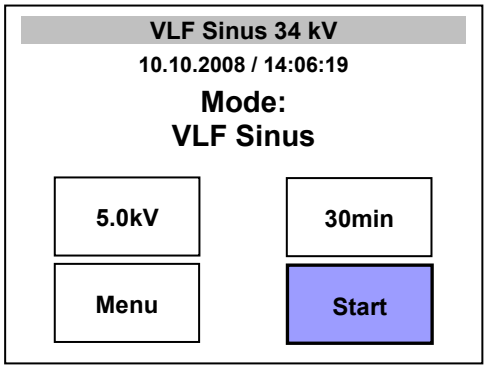
Before it is switched on with the on/off button ④, the device is in the 'Out of service' state.

Once the button is pressed, the system is in the 'Ready for operation' state. The operational readiness is indicated by the lit button. The controls are activated and after a short booting phase the start menu appears.

The high voltage source is switched off and the high voltage output is earthed via a discharge resistor.

After the booting process, the start menu appears, from which a test with the settings of the previous test can be immediately started via the **Start** button (see section 4.4).

If instead you need to change the system or test settings in preparation for the upcoming test, the **Menu** button takes you to the settings menu (see section 4.3).



4 Stand-Alone Operation

4.1 Basics of Operation

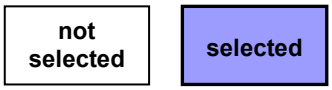
Operation with rotary encoder

Navigation within the menus is done using the rotary encoder ❽ as follows:

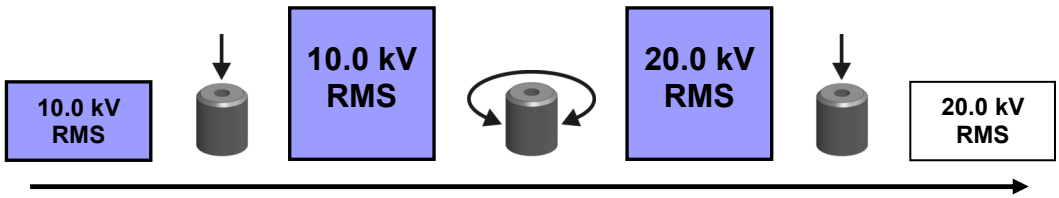
Turning = selecting

Pressing = confirming (“Enter” function)

The currently selected menu item can be identified by its background colour.



With the aid of the rotary encoder, the individual menus can be accessed and values can be entered. Once a menu item with an adaptable parameter is selected, it is then shown enlarged. The value for the parameter can then be adapted by turning the rotary encoder and pressing it again to confirm.



Switching high voltage on / off

Before the start of the test, the user is prompted to enable high voltage. To do so, the green illuminated “HV ON” button ❻ must be pressed.

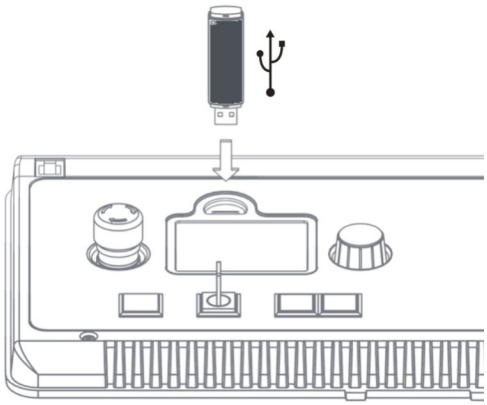
This lifts the resistor discharge and enables the generation of high voltage. The red illuminated “HV OFF” button ⓭ signals high voltage at the HV output. The green button goes dark.

The switching on of high voltage requires the conditions of the safety circuit to be fulfilled, which are described in section 4.2.

The high voltage can be switched off at any time during the course of the test via the “HV OFF” button ⓭. The test is then immediately aborted and the system is placed in the 'Ready for operation' state. High voltage is switched off and the HV output is discharged.

Use of a USB stick

To import firmware updates into the system or to record the log data of tests, a USB stick must be inserted into the provided slot:



While the system detects the USB stick, the icon in the top left of the display is flashing for appr. 5 seconds. After the icon stops flashing, the stick is ready for use.

4.2 Safety Measures

Introduction

Once high voltage is enabled, the system's safety circuit continuously checks all safety-relevant parameters and switching operations of the system. Should the safety circuit detect a deviation from the monitored requirements while in high voltage mode, the system automatically switches back to the 'Ready for operation' state. High voltage is switched off and the HV output is discharged. The fault that occurred is shown in the display and must be eliminated before test mode can be activated again.

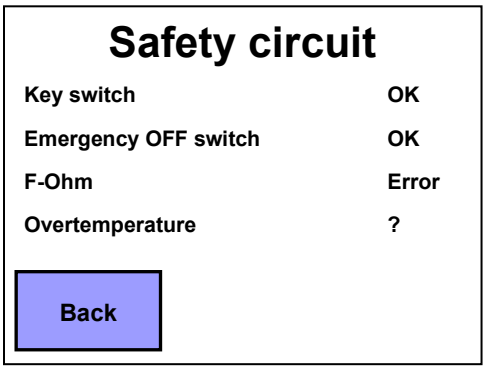
Conditions of the safety circuit

The following conditions must be fulfilled in order to perform tests under high voltage:

- The HV key switch ❺ must be in the ⏻ position.
- The emergency off button ❷ must not be pressed.
- F-Ohm: The transfer resistance between protective earth and high voltage return may not exceed 6 Ω (possible fault sources: poor earthing conditions or HV plugs that are not securely bolted).
- The temperature within the system must be under a value which would jeopardise operation.

Fault messages

The safety circuit checks the conditions in a hierarchical manner according to the prescribed sequence and stops as soon as it detects a deviation. The following example shows the system message after triggering of the F-Ohm monitor:



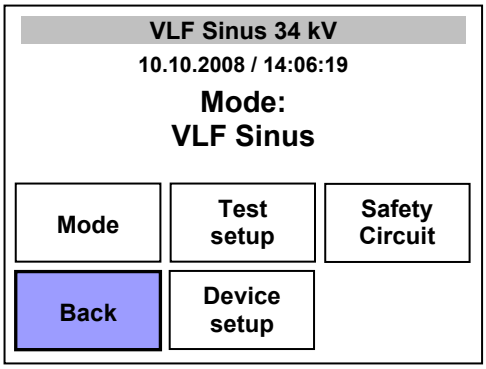
If a fault is directly resolved, its status changes to **OK** and the subsequent conditions are checked.

The safety circuit can also be queried before the start of a test while the system is in the 'Ready for operation' state by means of a menu item provided for this purpose (see page 18).

4.3 Settings

After the booting process, the start menu appears, from which a test with the settings of the previous test can be immediately started.

If you instead wish to change the operation mode, the test parameters or the system settings, selecting **Menu** will take you to the settings menu:



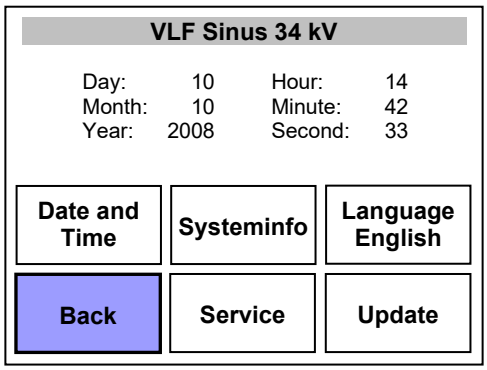
In the upper portion of the menu, similarly to nearly all other menus, general information such as date / time and the currently selected test voltage shape is displayed.

From the settings menu the following functions can be accessed:

- Querying the status of the safety circuit (see section 4.2)
- Changing device settings (see section 4.3.1)
- Changing the operating mode and the test parameters (see section 4.3.2)
- Returning to start menu (see section 3.2)

4.3.1 Device Settings

The **Device setup** menu can be accessed from the settings menu (see page 18).

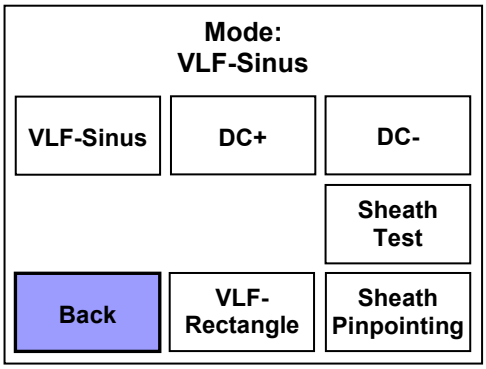


Menu item	Description
Date and Time	This menu item is used to change the date and time shown in the upper portion of the display. Press the rotary encoder to jump from value to value and turn it to adapt the individual values.
Systeminfo	This menu item is used to obtain detailed system information such as serial numbers and version numbers.
Language	This menu item is used to change the language of the system.
Update	This menu item is used to import firmware updates for various modules of the system (e.g. application, boot loader, kernel). The required files must be contained in the *updates* folder on the USB stick plugged in the system. After the system has automatically recognised all relevant files, the updates are started. If the version of the firmware on the stick is older than or identical to the currently installed version, the update must be confirmed by the user. Only update with firmware provided by Megger. Do not switch off the system during the update. If you do, the system will have to be repaired by Megger Service.
Service	A password-protected service menu which can only be accessed by a service technician.
Back	This menu item is used to return to the settings menu (see page 18).

4.3.2 Changing the Test Settings

Changing the operation mode

To select the operation mode, select **Mode** from the settings menu (see page 18).



Menu item	Description
VLF-Sinus	In this mode, the test object is tested with a true VLF sine wave voltage of up to 24 kV_{RMS} (33.9 kV_{peak}) and a frequency of between 0.01 Hz and 0.1 Hz (settable).
DC+	In this mode, the test object is tested with positive DC voltage of up to 33.9 kV. This mode is especially useful for testing the dielectric strength of a newly laid or disconnected cable (particularly for paper insulated cables).
DC-	In this mode, the test object is tested with negative DC voltage of up to 33.9 kV. This mode is especially useful for testing the dielectric strength of a newly laid or disconnected cable (particularly for paper insulated cables).
VLF-Rectangle	In this mode, the test object is tested with a rectangular AC voltage with an amplitude of up to 33.9 kV and a frequency of between 0.01 Hz and 0.1 Hz (settable). The slew rate is automatically adapted. This mode is especially suitable for start-up testing of the dielectric strength of a newly laid or disconnected cable.
Sheath Test	In this mode, the sheath of the test object (e.g. a newly laid cable system) is tested with negative DC voltage of up to 10 kV.
Sheath Pinpointing	In the case that the results of a sheath test do indicate the presence of a sheath fault, the sheath pinpointing mode can be used to immediately pinpoint the fault position by means of the step voltage method. Thereby, the fault position is pinpointed with a pulsed DC voltage of up to 10 kV and a duty cycle of either 1:3 or 1:4.
Back	This menu item is used to return to the settings menu (see page 18).

Recommendations for selection of test voltage and duration

Before one starts the actual test, the currently set test parameters should be checked and adapted if needed.

The requirements for a meaningful cable test are found in Harmonization Documents HD 620 S1:1996 and HD 621 S1:1996 and often in company-internal testing guidelines as well.

The following table provides some generally accepted test parameters for different applications:

Application	Test voltage	Test duration in minutes
VLF test on cables with extruded insulation	3Uo	30 … 60
DC test on PILC (Paper Insulated Lead Covered) cables	8Uo	15
Sheath test on…		
… PVC cables	3 kV	5
… medium voltage PE cables	5 kV	5
… high voltage PE cables	10 kV	1

Adapting the test parameters

To adjust the test settings, select **Test setup** from the settings menu (see section 4.1). The amount of adjustable test parameters differs between the different operation modes.

Menu item	Description
Test voltage	The test voltage can be set in increments of 0.1 kV. For sheath test and pinpointing, the selected value represents the initial voltage level which can still be cautiously increased up to the voltage threshold specified under **Range** (see next page) during operation.
Test frequency	For the modes “VLF Sinus” and “VLF Rectangle”, the test frequency can be set in increments of 0.01 Hz between 0.01 Hz and 0.1 Hz. Alternatively, automatic frequency calculation (**auto**) can also be activated. At the start of a voltage test, automatic load recognition is conducted. Since the maximum permitted test frequency depends on the determined cable capacitance and the set test voltage (see section 2.3), it can happen that the test cannot be performed with the set but with a decreased frequency. If test frequency is set to **auto**, the switch to the lower frequency is automatically performed. But if the parameter is set to a fixed value, the system prepares for a switch to the highest possible frequency which requires the confirmation of the user (20 second timeout).

Menu item	Description
Test duration	The test duration can be set in increments of one minute from between 1 and 90 minutes independent of the set operating mode. The system can also be set to continuous operation (particularly useful in sheath pinpointing mode). For this, the running test must be manually interrupted in due time by the user. Correspondingly, a continuous test is always logged as failed test.
RMS | PEAK	This menu item can be used in “VLF Sinus” mode to specify whether the voltage values on the display are to be shown as effective (**RMS**) or **PEAK** values. When switching to “VLF Sinus” mode, the parameter is automatically set to **RMS** by default.
Range	Maximum voltage range for sheath test and pinpointing.
Duty Cycle	Voltage pulse rate during sheath pinpointing. For example, the option **1:3** means that 1 second of high voltage is followed by a 3 seconds dropout.
Back	This menu item is used to return to the settings menu (see page 18).

4.4 Testing / Pinpointing

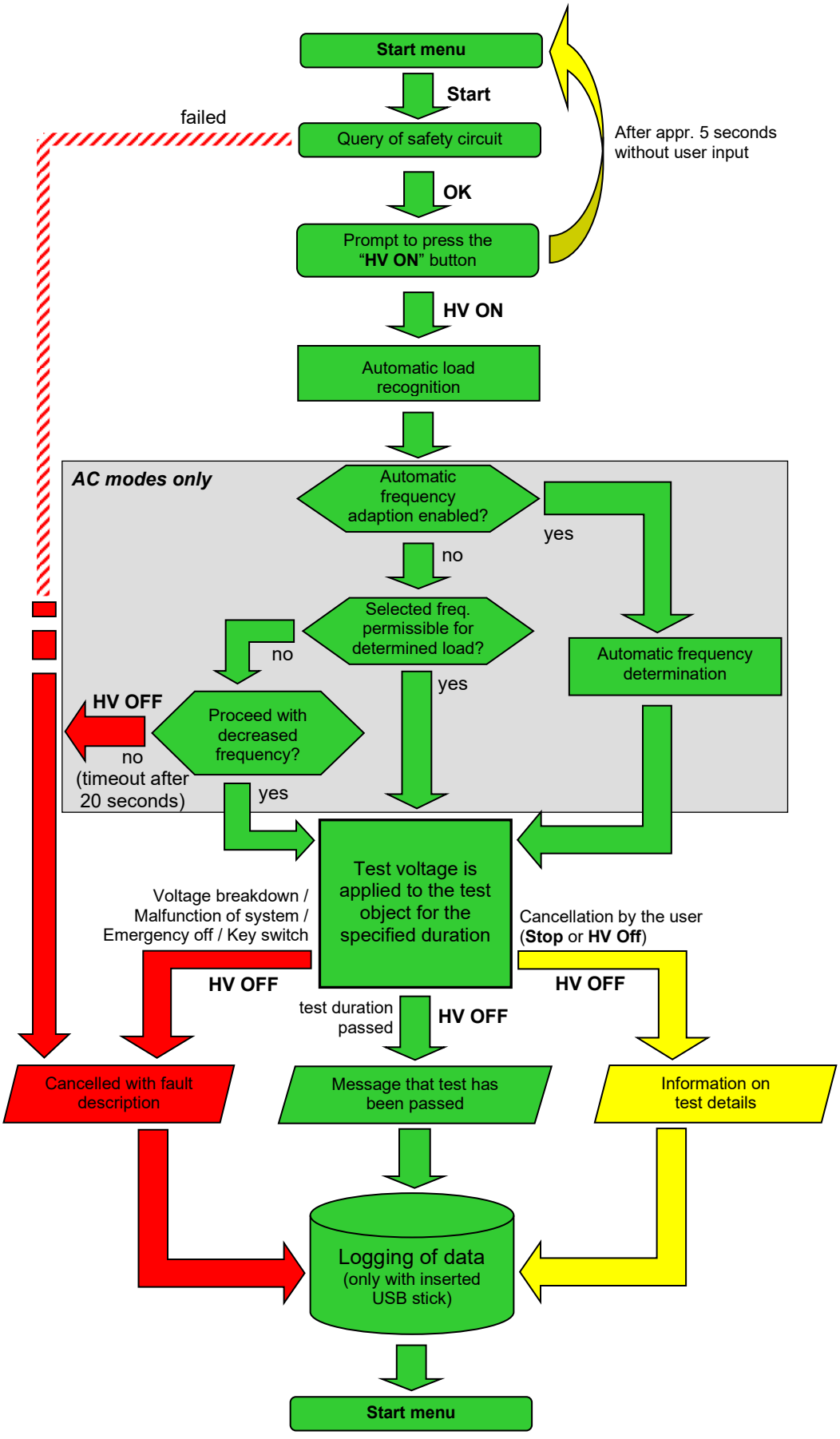
After the operating mode and the test parameters have been set (see section 4.3.2), select **Back** from the settings menu to open the start menu.

This menu provides a final opportunity to review the test voltage and duration and adapt it if necessary.

The actual test can then be started through the menu item **Start**. Afterwards, you are asked to press the “HV ON” button ❻. Press the button within 5 seconds. Otherwise, the system returns to the start menu.

With the start of a new test, the current settings and the operation mode are adopted as new default values and remain valid even after the system has been restarted. However, this does not apply for the sheath pinpointing mode.

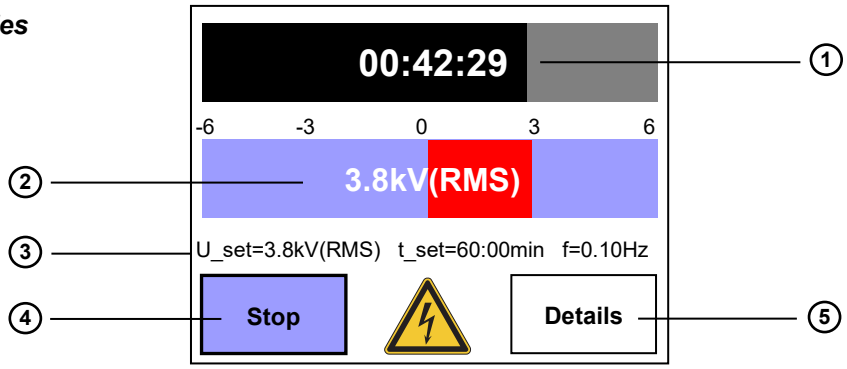
Test sequence The following flow chart describes the test sequence in principle:



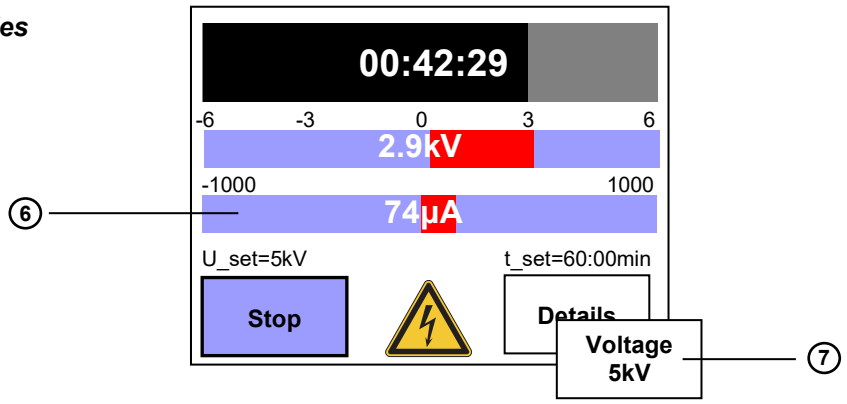
Status information during the test procedure

While the test is running, the user is kept continually updated regarding current parameters and results. The screen content does differ in dependence of the respective operation mode as shown in the figures below:

AC modes



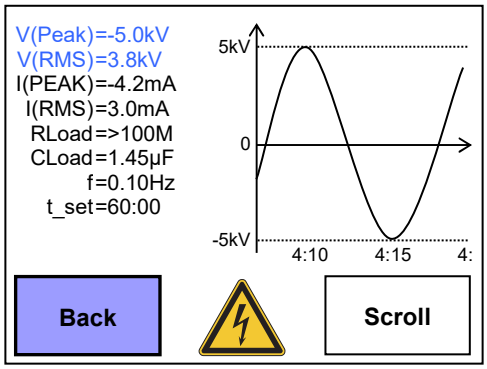
DC modes



Segment	Description
①	Remaining test duration in minutes. The black bar represents the remaining amount of time. In continuous operation, the cumulative test duration is displayed instead of the remaining test duration.
②	Actual present test voltage value as RMS or peak value. The red bar represents the instantaneous value.
③	Specified test settings (test voltage, total test duration, frequency). If a frequency adaption took place during the start of the test, the frequency value is written in green.
④	**Stop** button to interrupt the test. A test interrupted using the **Stop** button cannot be resumed!
⑤	**Details** button to access the detail view (see next page). In sheath test and sheath pinpointing mode, this button is replaced with ⑦.
⑥	Leakage current indication (DC modes only).
⑦	This button is available in sheath test and sheath pinpointing mode only and can be used to adjust the test voltage level within the specified range (see section 4.3.2).

Detail view

The **Details** button can be used to display details on the measurement in progress at any time:



On the right side of the detail view, the test voltage characteristics (AC voltage test) or the characteristics of the leakage current (DC voltage test) are drawn in real time in a diagram. By using the **Scroll** button and turning the rotary encoder, the user can at any time scroll back to earlier time points.

On the left side of the display, the following test parameters are shown according to operating mode:

Math symbol	Description
V(Peak)	Peak value of the AC test voltage
V(RMS)	Effective value of the sine wave test voltage (updated after every period)
V	Present value of the DC or rectangular wave test voltage
I(PEAK)	Peak value of the AC test current
I(RMS)	Effective value of the sine wave test current (updated after every period)
I	Present value of the DC or rectangular wave test current
RLoad	Load resistance (result of load recognition)
CLoad	Load capacity (result of load recognition)
f	Test frequency If a frequency adaption took place during the start of the test, the frequency value is written in green.
t_set	Total test duration

Completion / Cancellation of a test

A running test can be completed / interrupted in various ways.
The user can interrupt the test by means of the following:

- Activation of the **Stop** button with the aid of the rotary encoder
- Pressing the “HV OFF” button 13

In addition, the test is automatically interrupted in the following cases:

- A condition of the safety circuit is no longer fulfilled (see section 4.2).
- A severe deviation of the test voltage has occurred.
- The test object has experienced a voltage breakdown.

If none of these criteria occur over the entire duration of the test, the test is successfully completed.

In all these scenarios, the voltage source is deactivated and the HV output discharged at the same time as the cancellation / completion of the test.

A result screen informs the user of the progress of the test and, if applicable, the reason and time point of cancellation.

Saving log data

If a USB stick is plugged in the slot (see section 4.1) at the conclusion of a test, log data (see chapter 7) are automatically saved to this stick and saving is confirmed in the test's result screen. If not, the user is prompted through a notice on the result screen to insert the USB stick.

If the prompt is ignored and the screen is instead acknowledged, the data are not saved.

When the stick is inserted into the USB slot, it can take up to 10 seconds until the notice on the screen disappears and the successful saving of the log data is confirmed.

Sheath pinpointing

If a voltage breakdown took place during a sheath test or if the measured leakage currents do indicate the presence of a sheath fault, the fault position can be immediately pinpointed with the test system serving as voltage source.

For this purpose, a button to switch to pinpointing mode becomes visible right after the sheath test has been finished.

After the mode has been switched and HV clearance has been granted, the test system applies a pulsed DC voltage to the screen of the cable under test. The test current coming from the pulsed DC source is flowing into the ground at the point of fault and results in a maximum step voltage at the fault. This peak can be located with an earth fault locator (e.g. ESG 80-2). When approaching the fault position, the step voltage increases and decreases after the fault with a change in polarity.

For detailed information on how to pinpoint a sheath fault, please refer to the operating instructions of the earth fault locator in use.

5 Remote Control

Introduction

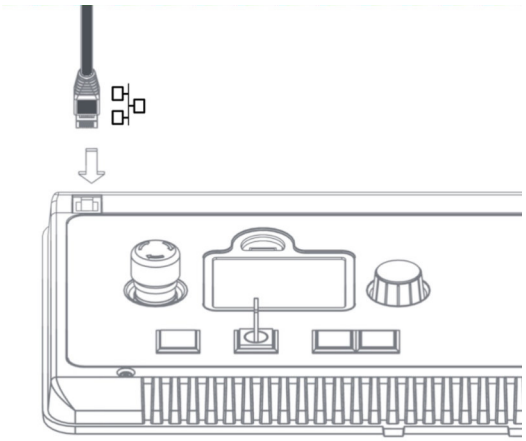
The VLF Sinus test system can be remotely-controlled using a notebook with the respective software. This is particularly required if you want to operate the test system as voltage source for the Tan Delta Test Attachment to measure the loss factor tanδ.

Specific electrical connections

In general, the electrical connection of a remote-controlled device is done in the same manner as described in section 3.1.

Connecting the Tan Delta measuring equipment does, however, require some additional work steps which are described in the manual of the Tan Delta Test Attachment.

The connection between the test system and the notebook is established using an Ethernet patch cable. The notebook supplied by Megger is already properly configured (drivers and network data) and will establish the connection as soon as the cable has been plugged in and the test system has been switched on.



Operation

After the connection has been established and the software has been started on the notebook, the test system switches to slave mode displaying an appropriate message on the display. As from now, the control by rotary encoder ❽ is deactivated. Hence, the test system can only be controlled by the software. For a detailed description, please refer to the manual “Software for Remote Control of a VLF Sinus Test System”.

With a USB stick plugged into the test system, log files are exported after completion of a test as known from stand-alone operation. But in contrast to stand-alone operation, the export is not indicated on the display.

6 Completing the Test

After the test has been completed, the test object is to be earthed and shorted.

Afterwards, the test system can be disconnected from the test object in accordance with the safety instructions below.

 **WARNING**	• Follow the five safety rules described in section 1.2. • Even if proper disconnection and discharging has taken place, system components which have been under voltage should only be touched if they have been visibly earthed and shorted. • Do not undo the earthing and shorting measures before the test object is put into operation again.

7 Further Processing of the Log Data

Introduction

When exporting log data after completion of a measurement (see section 4.4), the following file types are written to the USB stick:

- Text-based log files
- Unformatted overview of the most important test results / system parameters

The log files can be easily opened and further processed with standard programs such as Word and Excel (or comparable applications).

In addition, Megger offers a lightweight tool called **MeggerBook Lite** for visual processing of these log files. Please download the latest version of this tool from the download section of our website (*www.Megger.com*).

Log file names

The file names of these log files are constructed as follows:

<Prefix><Date><Sequential number>

Prefix	H: Header file (**.txt*) D: Data file (**.csv*)
Date:	in YMMDD format
Sequential number:	Two-digit number which increases by one with each completed test. The number is reset each day.

Header file

The header file prepares and clearly summarises the essential information on the test settings and results in a document that is then ready for signature.

Data file

This file contains the logged measurement data over the entire course of the test in CSV (comma-separated values) format. The data is arranged in rows (one for each second of the test) containing the time stamp and the absolute values for voltage and current.

8 Repair and Maintenance

Maintenance

Repairs and service must only be done by Megger or authorised service departments of Megger. Megger recommends having the equipment serviced and checked once per year at a Megger service location.

Megger also offers direct on-site support. Please contact our service office for more information.

The connecting cables, like the earthing cable, the power cord and the HV test lead need to be checked for damages and cleaned at regular intervals.

Behaviour at malfunction of normal operation

The equipment may only be used when working properly. When irregularities or malfunctions appear that cannot be solved consulting this manual, the equipment must immediately be put out of operation and marked as not functional. In this case inform the person in charge who should inform the Megger service to resolve the problem. The instrument may only be operated when the malfunction is resolved.

In the case of a persistent system malfunction you might be asked to send the system error log for further fault diagnosis to the Megger service.

In order to export the error log, the USB stick has to be plugged into the system before it is switched on. During power up, the log file is written to the *logfiles* folder on the USB stick.

Replacing fuses

If the device cannot be switched on, even though it is connected to the mains power supply, the two fuses ❾ must be checked. Before doing so, disconnect the system / device from power supply!

Then the fuse holders can be loosened (using a screwdriver) and pulled out. If the fuses are defective, they must be replaced with suitable microfuses (5 x 20 mm) of the type T4A.

If the fuses continue to trip, please get in touch with an authorised service department in order to have the problem resolved.

Tento symbol indikuje, že výrobek nesoucí takovéto označení nelze likvidovat společně s běžným domovním odpadem. Jelikož se jedná o produkt obchodovaný mezi podnikatelskými subjekty (B2B), nelze jej likvidovat ani ve veřejných sběrných dvorech. Pokud se potřebujete tohoto výrobku zbavit, obraťte se na organizaci specializující se na likvidaci starých elektrických spotřebičů v blízkosti svého působiště.

Dit symbool duidt aan dat het product met dit symbool niet verwijderd mag worden als gewoon huishoudelijk afval. Dit is een product voor industrieel gebruik, wat betekent dat het ook niet afgeleverd mag worden aan afvalcentra voor huishoudelijk afval. Als u dit product wilt verwijderen, gelieve dit op de juiste manier te doen en het naar een nabij gelegen organisatie te brengen gespecialiseerd in de verwijdering van oud elektrisch materiaal.

This symbol indicates that the product which is marked in this way should not be disposed of as normal household waste. As it is a B2B product, it may also not be disposed of at civic disposal centres. If you wish to dispose of this product, please do so properly by taking it to an organisation specialising in the disposal of old electrical equipment near you.

Този знак означава, че продуктът, обозначен по този начин, не трябва да се изхвърля като битов отпадък. Тъй като е B2B продукт, не бива да се изхърля и в градски пунктове за отпадъци. Ако желаете да извърлите продукта, го занесете в пункт, специализиран в изхвърлянето на старо електрическо оборудване.

Dette symbol viser, at det produkt, der er markeret på denne måde, ikke må kasseres som almindeligt husholdningsaffald. Eftersom det er et B2B produkt, må det heller ikke bortskaffes på offentlige genbrugsstationer. Skal dette produkt kasseres, skal det gøres ordentligt ved at bringe det til en nærliggende organisation, der er specialiseret i at bortskaffe gammelt el-udstyr.

Sellise sümboliga tähistatud toodet ei tohi käidelda tavalise olmejäätmena. Kuna tegemist on B2B-klassi kuuluva tootega, siis ei tohi seda viia kohalikku jäätmekäitluspunkti. Kui soovite selle toote ära visata, siis viige see lähimasse vanade elektriseadmete käitlemisele spetsialiseerunud ettevõttesse.

Tällä merkinnällä ilmoitetaan, että kyseisellä merkinnällä varustettua tuotetta ei saa hävittää tavallisen kotitalousjätteen seassa. Koska kyseessä on yritysten välisen kaupan tuote, sitä ei saa myöskään viedä kuluttajien käyttöön tarkoitettuihin keräyspisteisiin. Jos haluatte hävittää tämän tuotteen, ottakaa yhteys lähimpään vanhojen sähkölaitteiden hävittämiseen erikoistuneeseen organisaatioon.

Ce symbole indique que le produit sur lequel il figure ne peut pas être éliminé comme un déchet ménager ordinaire. Comme il s'agit d'un produit B2B, il ne peut pas non plus être déposé dans une déchetterie municipale. Pour éliminer ce produit, amenez-le à l'organisation spécialisée dans l'élimination d'anciens équipements électriques la plus proche de chez vous.

Cuireann an siombail seo in iúl nár cheart an táirgeadh atá marcáilte sa tslí seo a dhiúscairt sa chóras fuíoll teaghlaigh. Os rud é gur táirgeadh ghnó le gnó (B2B) é, ní féidir é a dhiúscairt ach oiread in ionaid dhiúscartha phobail. Más mian leat an táirgeadh seo a dhiúscairt, déan é a thógáil ag eagraíocht gar duit a sainfheidhmíonn i ndiúscairt sean-fhearas leictrigh.

Dieses Symbol zeigt an, dass das damit gekennzeichnete Produkt nicht als normaler Haushaltsabfall entsorgt werden soll. Da es sich um ein B2B-Gerät handelt, darf es auch nicht bei kommunalen Wertstoffhöfen abgegeben werden. Wenn Sie dieses Gerät entsorgen möchten, bringen Sie es bitte sachgemäß zu einem Entsorger für Elektroaltgeräte in Ihrer Nähe.

Αυτό το σύμβολο υποδεικνύει ότι το προϊόν που φέρει τη σήμανση αυτή δεν πρέπει να απορρίπτεται μαζί με τα οικιακά απορρίματα. Καθώς πρόκειται για προϊόν B2B, δεν πρέπει να απορρίπτεται σε δημοτικά σημεία απόρριψης. Εάν θέλετε να απορρίψετε το προϊόν αυτό, παρακαλούμε όπως να το παραδώσετε σε μία υπηρεσία συλλογής ηλεκτρικού εξοπλισμού της περιοχής σας.

Ez a jelzés azt jelenti, hogy az ilyen jelzéssel ellátott terméket tilos a háztartási hulladékokkal együtt kidobni. Mivel ez vállalati felhasználású termék, tilos a lakosság számára fenntartott hulladékgyűjtőkbe dobni.Ha a terméket ki szeretné dobni, akkor vigye azt el a lakóhelyéhez közel működő, elhasznált elektromos berendezések begyűjtésével foglalkozó hulladékkezelő központhoz.

Questo simbolo indica che il prodotto non deve essere smaltito come un normale rifiuto domestico. In quanto prodotto B2B, può anche non essere smaltito in centri di smaltimento cittadino. Se si desidera smaltire il prodotto, consegnarlo a un organismo specializzato in smaltimento di apparecchiature elettriche vecchie.

Šī zīme norāda, ka iztrādājumu, uz kura tā atrodas, nedrīkst izmest kopā ar parastiem mājsaimniecības atkritumiem. Tā kā tas ir izstrādājums, ko cits citam pārdod un lieto tikai uzņēmumi, tad to nedrīkst arī izmest atkritumos tādās izgāztuvēs un atkritumu savāktuvēs, kas paredzētas vietējiem iedzīvotājiem. Ja būs vajadzīgs šo izstrādājumu izmest atkritumos, tad rīkojieties pēc noteikumiem un nogādājiet to tuvākajā vietā, kur īpaši nodarbojas ar vecu elektrisku ierīču savākšanu.

Šis simbolis rodo, kad juo paženklinto gaminio negalima išmesti kaip paprastų buitinių atliekų. Kadangi tai B2B (verslas verslui) produktas, jo negalima atiduoti ir buitinių atliekų tvarkymo įmonėms. Jei norite išmesti šį gaminį, atlikite tai tinkamai, atiduodami jį arti jūsų esančiai specializuotai senos elektrinės įrangos utilizavimo organizacijai.

Dan is-simbolu jindika li l-prodott li huwa mmarkat b'dan il-mod m'għandux jintrema bħal skart normali tad-djar. Minħabba li huwa prodott B2B , ma jistax jintrema wkoll f'ċentri ċiviċi għar-rimi ta' l-iskart. Jekk tkun tixtieq tarmi dan il-prodott, jekk jogħġbok għamel dan kif suppost billi tieħdu għand organizzazzjoni fil-qrib li tispeċjalizza fir-rimi ta' tagħmir qadim ta' l-elettriku.

Dette symbolet indikerer at produktet som er merket på denne måten ikke skal kastes som vanlig husholdningsavfall. Siden dette er et bedriftsprodukt, kan det heller ikke kastes ved en vanlig miljøstasjon. Hvis du ønsker å kaste dette produktet, er den riktige måten å gi det til en organisasjon i nærheten som spesialiserer seg på kassering av gammelt elektrisk utstyr.

Ten symbol oznacza, że produktu nim opatrzonego nie należy usuwać z typowymi odpadami z gospodarstwa domowego. Jest to produkt typu B2B, nie należy go więc przekazywać na komunalne składowiska odpadów. Aby we właściwy sposób usunąć ten produkt, należy przekazać go do najbliższej placówki specjalizującej się w usuwaniu starych urządzeń elektrycznych.

Este símbolo indica que o produto com esta marcação não deve ser deitado fora juntamente com o lixo doméstico normal. Como se trata de um produto B2B, também não pode ser deitado fora em centros cívicos de recolha de lixo. Se quiser desfazer-se deste produto, faça-o correctamente entregando-o a uma organização especializada na eliminação de equipamento eléctrico antigo, próxima de si.

Acest simbol indică faptul că produsul marcat în acest fel nu trebuie aruncat ca şi un gunoi menajer obişnuit. Deoarece acesta este un produs B2B, el nu trebuie aruncat nici la centrele de colectare urbane. Dacă vreţi să aruncaţi acest produs, vă rugăm s-o faceţi într-un mod adecvat, ducând-ul la cea mai apropiată firmă specializată în colectarea echipamentelor electrice uzate.

Tento symbol znamená, že takto označený výrobok sa nesmie likvidovať ako bežný komunálny odpad.Keďže sa jedná o výrobok triedy B2B, nesmie sa likvidovať ani na mestských skládkach odpadu. Ak chcete tento výrobok likvidovať, odneste ho do najbližšej organizácie, ktorá sa špecializuje na likvidáciu starých elektrických zariadení.

Ta simbol pomeni, da izdelka, ki je z njim označen, ne smete zavreči kot običajne gospodinjske odpadke. Ker je to izdelek, namenjen za druge proizvajalce, ga ni dovoljeno odlagati v centrih za civilno odlaganje odpadkov. Če želite izdelek zavreči, prosimo, da to storite v skladu s predpisi, tako da ga odpeljete v bližnjo organizacijo, ki je specializirana za odlaganje stare električne opreme.

Este símbolo indica que el producto así señalizado no debe desecharse como los residuos domésticos normales. Dado que es un producto de consumo profesional, tampoco debe llevarse a centros de recogida selectiva municipales. Si desea desechar este producto, hágalo debidamente acudiendo a una organización de su zona que esté especializada en el tratamiento de residuos de aparatos eléctricos usados.

Den här symbolen indikerar att produkten inte får blandas med normalt hushållsavfall då den är förbrukad. Eftersom produkten är en så kallad B2B-produkt är den inte avsedd för privata konsumenter, den får således inte avfallshanteras på allmänna miljö- eller återvinningsstationer då den är förbrukad. Om ni vill avfallshantera den här produkten på rätt sätt, ska ni lämna den till myndighet eller företag, specialiserad på avfallshantering av förbrukad elektrisk utrustning i ert närområde.