

Operating Manual

VLF Test System VLF CR-40 / 60 kV

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 or should you need the help of an authorized service station, please contact:

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1. GENERAL INTRODUCTION

The VLF Test System shall be used for the stated field of application in cable diagnosis only. Any other application is strictly forbidden! Hagenuk KMT cannot be made liable for any damage to persons or matter caused by using the system for some other application.

This is why we advise you to absolutely abide by the safety precautions given in chapter 1 whenever you use the VLF Test Systems.

Each person involved in the assembly, operation, maintenance, and repair of the VLF Test Systems is required to have read this handbook carefully.

Only trained and/or instructed staff are permitted to deal with the VLF Test System and its periphery. Other persons have to stay away.

This handbook must be available to the supervising, operating, and maintenance staff for reference.

Never use foreign components on the VLF Test System and its periphery, otherwise the safety of the system is jeopardised.

The user is obliged to immediately report any occurring change in the system to the supervisor in charge.

The operator is obliged to immediately shut down the system should any fault occur that might pose a threat to the staff. The system is permitted to be switched on again only after the fault has been eliminated.

The VLF Test System and all its supplementary equipment has to be connected and operated according to instructions. All relevant standards (DIN, VDE) shall be met. Any repair or maintenance operation may be carried out only after all circuits have been shut down (are in a dead state) and only by an electrical expert. A person is regarded an electrical expert if due to his or her practical training, knowledge, and experience as well as knowledge of the relevant standards he or she is able to assess the operation to be carried out and detect every possible risk.

Attention!

The VLF Test System 40 kV and VLF Test System 60 kV respectively, are upright devices and have to be only transported and operated in upright position.

1.1 Safety Precautions

Each person involved in the assembly, maintenance, and repair of this system is required to have read this manual carefully.

At the time of supply, this system and its supplementary equipment are in line with the state of the art in safety control. Due to the operating procedures there may be parts and places of the system and its peripherals, however, which cannot be protected properly without unreasonably interfering with their function and control. This is why comprehensive personal experience in safety matters is absolutely vital for the protection of both staff and equipment.

This is why we advise you to abide by the following safety precautions!

GENERAL INSTRUCTIONS

Only trained or instructed staff are permitted to deal with this system and its peripherals. Any other persons shall be kept away from it.

This manual shall be available to the supervising, operating, and maintenance staff for reference.

Improper use may constitute a high risk of damage to the life and health of the operator as well as the system and the equipment connected to it (UVV). Use the system exclusively for the purpose it has been designed for by its manufacturer.

Always use the appropriate tools for each operation on and for running the system and keep your tools in good condition.

Permanently supervise that during operation and maintenance all safety precautions are obeyed.

This system is allowed to be run by authorised persons with sufficient expertise only.

Operate the system and its pertaining peripherals only when they are in good working order.

Never use foreign components on the system and its peripherals, otherwise the safety of the system and its environment is not ensured. Refrain from any operation which might jeopardise the safety of the system.

The user is obliged to immediately report any arising change in the system to the supervisor in charge.

The operator is obliged to immediately shut down the system whenever a fault occurs which may be safety risk to the staff. The system is permitted to be switched on again only after the fault has been remedied.

Attention! Owing to the physical processes which take place within the high-voltage system, each person wearing a pacemaker is in potential danger when getting close to it.

ELECTROTECHNICAL INSTRUCTIONS

The system and all its peripherals shall be connected according to instructions. All relevant standards such **DIN** and **VDE** respectively, have to be met.

Any repair or maintenance operation may be carried out only after all circuit have been shut down (are in a dead state) and only by an electrical expert according to UVV. A person is regarded an electrical expert to UVV (Prevention of Accidents Regulation) if due to his or her practical training, knowledge, and experience he or she is able to clearly understand the operation to be carried out and detect any possible risk.

1.1.1 General Safety Precautions

Abide by the relevant Accident Prevention Regulations in the first place when you carry out maintenance and repair operations.

Mark all components before you start any repair operation.

Always use new sealing and locking elements when you re-assemble fittings and devices.

Leave all screw joints dry when assembling them (do not lubricate!).

Only trained staff are permitted to carry out maintenance and repair work.

Check the system for functionality whenever you have finished maintenance and repair operations; this has to be particularly accepted in the case of existent safety equipment.

De-energise the system and make the site safe.

Before starting any operation on electrical units: De-energise all components you are going to work on.

This applies even in the event that the repair seems to be marginal.

Make the place(s) of disconnection safe against any unintentional circuit reclosing.

After de-energising the system, before starting any work on the site: Check all components of the system for all-pole disconnection.

Do so using a circuit tester or meter the functionality of which has been tested on a live member of the system a short time before using it.

Fuses

It is absolutely inadmissible to patch or bridge a fuse or to use a patched fuse.

When replacing a fuse: Always use a fuse of identical or lower current rating and characteristic (slow, fast, superfast action).

Never unscrew or pull out a fuse while it is under load. It is inadmissible to use a fuse for switching a circuit.

Further important safety instructions:

- High-voltage installations has to be only operated in rooms with protection according to regulations or behind appropriate barriers. Never bypass nor render inactive any safety device.
- At least two persons must be present whenever a high-voltage installation is in operation. The second person shall be able to recognise any risk and, in case of emergency, immediately actuate the emergency-shutdown.

1.1.2 Supplementary Guidelines

The following guidelines which cannot be directly derived from the instructions should be added to the above mentioned regulations.

- Always connect all metal parts in the vicinity of a high-voltage installation to earth in order to avoid dangerous charging. Particularly great attention should be paid to non-stationary (mobile) operation.
- Open a circuit only when you are absolutely sure it does not carry any current or voltage (danger of arcs).
- High-voltage testing and burning devices are short-circuit-proof. This involves the danger of the voltage running up as soon as the short-circuit is removed. Connect a bleeder in parallel to the meter (e. g., a 90 V glow-type bleeder) when making a short-circuit test.
- Even after circuits have been properly disconnected and discharged, you are permitted to contact components which had been under voltage and disconnect any measuring or test equipment only after the installation has been visibly earthed and shorted by an appropriate device.

1.1.3 Danger Due To Returning Voltage From Space Charge

- Remove earth connection and short circuit only when the object under test is going to be put into operation again.
- As a basic principle capacitors and cables which are out of operation must be earthed and shorted!

Attention! The test object has to be connected to earth and shorted after terminating of the test.

You are not excused from this duty even the complete discharge by the internal discharging unit and the zero positioning of the residual voltage (Fig 3, item 2) have been performed.

In the case of an incomplete discharge of the test object the complete discharging must be carried out by a suitable discharge rod.

Attention! The HV module of the VLF Test System 40 / 60 kV contains electrical energy storage devices also. These devices are discharged in the same way like the test object by the internal discharging unit of the test device. To avoid the re-charging by space charges the HV module has to be immediately equipped by means of the provided shorting device (Fig 8) after disconnection of the both components HV module and Operating module. The shorting device has to be remained at the HV module even in the case of transportation and storage and may not be removed until the Operating module had been put on.

Instructions How to Handle Fixed and Flexible Cables and Leads

Do not use mains cables and their fixtures for attaching, fixing, or hanging up devices, clothes, etc.

Make sure that the cables are not bent while being disconnected. Prevent any moisture from infiltrating into the cable ends. Affix an appropriate moisture shelter, if need be.

Do not expose flexible leads to excessive tensile force while in operation or during transport. In particular, make sure that the instruments are not hung by their leads and that plugs are not pulled out of sockets by their leads.

How to Deal With Connectors and Cable Accessories

Connect every electrical removable appliances only by the connectors (plug, socket) intended for this purpose.

Do not use any adapter or plug which matches a socket for some other voltage.

Use appropriate lock washers and spring washer to make every cable connecting terminal safe against becoming detached.

When re-connecting a cable to a device or installation: Make sure that the cable shield is connected to earth (by an earthing cone) and the cable inlet is sealed (in accordance with the enclosure protection of the connected device).

As a rule, such installations contain a great number of connecting leads to the components of the system and between individual components. Never misuse a connecting lead, which is not insulated for operation under medium or high voltage, for making an HV connection. Do not use patch cords for making HV connections. There might be discharges between such a lead and other system components which would immediately destroy the insulating capacity of this lead and so do away with its safety.

Use only cables and connectors intended for application under high voltage
(HV cables or leads without insulation)!

1.1.4 General Rules for Dealing with High Voltage

Dealing with high voltage and related equipment requires utmost care. This applies in particular to cases of non-stationary (mobile) operation, i.e. such instances where there is no special room which is permanently furnished with the appropriate safety equipment to provide for safety from the start.

Absolutely abide by the VDE directive 0104 "Installation and operation of electrical test systems" or relevant IEC standards, respectively.

2. TECHNICAL DESCRIPTION

2.1 Technical Specification

2.1.1 VLF Test System 40 kV

Output voltage, DC	3 - 40 kV
Output current source	7 mA
Range of indication, Leakage current measurement	0 - 7 mA
Resolution of indication	10 μ A
Output voltage, VLF	0 - 40 kV
Frequency	0,1 Hz
Waveform	rectangular cosine
Sheath fault location voltage	3 ... 10 kV
Pulse rate for sheath fault location	4s 1:3 4s 1:5 6s 1:5 6s 1:9
Cable capacitance to be tested	
VLF Test System 40 kV Basis	2,2 μ F (for full operating temperature range) 2,4 μ F (at common temperatures ($\leq 20^{\circ}$ C) and with limited accuracy of the measured leakage current values)
VLF Test System 40 kV Plus	4,4 μ F (for full operating temperature range) 4,7 μ F (at common temperatures ($\leq 20^{\circ}$ C) and with limited accuracy of the measured leakage current values)
Discharging unit	integrated, 4,4 μ F per 5 s

Supply voltage	230 V \pm 10 %, 50 ... 60 Hz
Option	120 V \pm 10 %, 60 Hz
Power consumption	500 VA at maximum
Operating temperature range	-25 °C ... +55 °C
Operating humidity	30 °C, 93 % rel. humidity
Storage temperature range	-40 °C ... +70 °C
Protection class	I to DIN VDE 0140 T.1
Enclosure protection	IP 20 to EN 60529
Dimensions (W x H x D)	ca. 550 x 1000 x 420 mm
Weights (according to stage of expansion)	ca. 55 kg + 48 kg (Basis) / 55 kg (Plus)

2.1.2 VLF Test System 60 kV

Output voltage, DC	3 - 60 kV
Output current source	5 mA
Range of indication, Leakage current measurement	0 - 5 mA
Resolution of indication	10 μ A
Output voltage, VLF	3 - 60 kV
Frequency	0,1 Hz
Waveform	rectangular cosine
Sheath fault location voltage	3 ... 10 kV
Pulse rate for sheath fault location	4s 1:3 4s 1:5 6s 1:5 6s 1:9
Cable capacitance to be tested	
VLF Test System 60 kV Basis	0,8 μ F (for full operating temperature range) 1,0 μ F (at common temperatures (\leq 20° C) and with limited accuracy of the measured leakage current values)
VLF Test System 60 kV Plus	1,6 μ F (for full operating temperature range) 2,0 μ F (at common temperatures (\leq 20° C) and with limited accuracy of the measured leakage current values)

Discharging unit	integrated, 1,5 µF in 2 s
Supply voltage	230 V ±10 %, 50 ... 60 Hz
Option	120 V ±10 %, 60 Hz
Power consumption	300 VA at maximum
Operating temperature range	-25 °C ... +55 °C
Operating humidity	30 °C, 93 % rel. humidity (60 kV) 30 °C, 70 % rel. humidity (50 kV)
Storage temperature range	-40 °C ... +70 °C
Protection class	I to DIN VDE 0140 T.1
Enclosure protection	IP 20 to EN 60529
Dimensions (W x H x D)	ca. 550 x 1000 x 620/420 mm
Weights (according to stage of expansion)	ca. 85 kg + 48 kg (Basis) / 55 kg (Plus)

2.1.3 Accessory equipment

Accessory equipment	Mains connecting cable 2,5 m Earth connecting cable 5 m HV connecting cable 5 m Phase clip Terminal clip for earth connection Instruction manual Equipment case
Optional equipment	Detection of breakdown Leakage current measurement Logging Printout (Protocol printing)

2.2 Description of the VLF Test System

Based on comprehensive scientific research, relevant DIN and VDE standards which we recommend to your attention, and more than 10 years of practical experience on more than 300 VLF Test Systems, we can today take it for granted that the 0.1 Hz VLF method for testing cables with plastics insulation outclasses any other test method using DC voltage or power-frequency AC voltage as used so far.

A 0.1 Hz VLF Test System is required to meet the following demands:

- The repetition rate has to be so slow, that the power set free in any TE channel that may already exist (TE = Teilentladung, partial discharge) is small enough not to cause further erosion and so increase gas pressure.
- The inversion of polarity, on the one hand, must be slow enough to exclude any transients caused by travelling waves. On the other, it must be fast enough that any space charge at the tip of a TE channel from where it grows in the direction of the opposite electrode is preserved.

A system that meets these requirements has to supply a 0.1 Hz oscillation, with the inversion of polarity taking place within the time duration of a 50 Hz half-wave.

Another vital characteristic to be considered when designing this system was to ensure simple on-site testing by

- small dimensions,
- light weight, and
- low power consumption.

Every cycle starts with a charging phase in which the test object as well as the back-up capacitor switched in parallel are charged from a DC source until the desired test voltage is reached.

After a period of 5 seconds, the voltage source will be disconnected from the system by S1(S2) and via R1(R2) discharged.

Subsequently, V1 initiates the desired inversion process through inductor L1.

The test object changes its polarity from minus to plus.

Depending on the capacitance of the connected test object, the ring-around time during polarity inversion is between 2 and 10 msec.

Owing to the losses which occur in both the polarity inversion coil L1 and V1 during polarity inversion, the positive voltage is decreased by these losses.

After a 5 seconds dwelling period at positive polarity (Device option Basis) or equalisation of the polarity inversion losses due to recharging by the positive DC voltage source (Device option Plus), the return to negative polarity. takes place by means of V1.

The negative voltage source is no longer discharged and again connected to the test object.

The drop in voltage caused by twice ringing around (Device option Basis) will now be compensated for by recharging from the negative DC source.

In contrast to this at the device option Plus the polarity inversion losses of a single ring-around event are consistently compensated.

The back-up capacitor has three tasks:

- It slows the ring-around event down to the msec range even for short cables,
- it compensates for part of the losses during the ring-around event,
- it reduces the polarity reversal stress caused by travelling waves.

Fig 2 represents the generated characteristics of the test voltage in the case of the device option Basis.

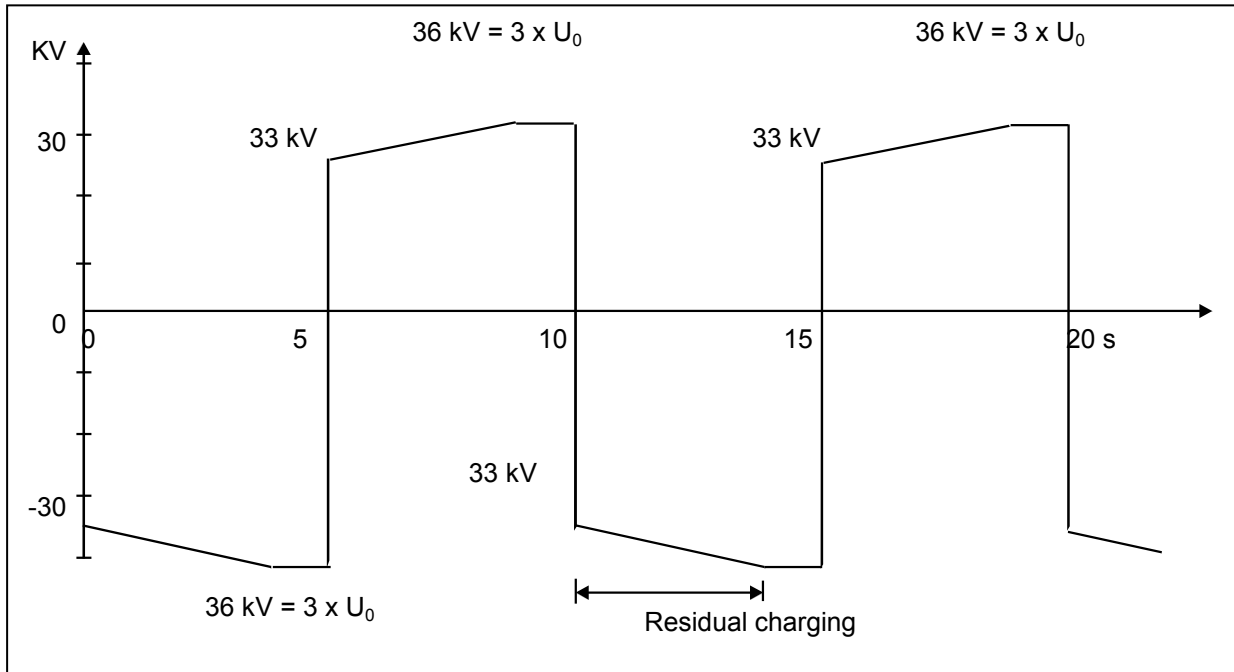


Fig 1: Representation of the test voltage characteristics (Device option Plus)

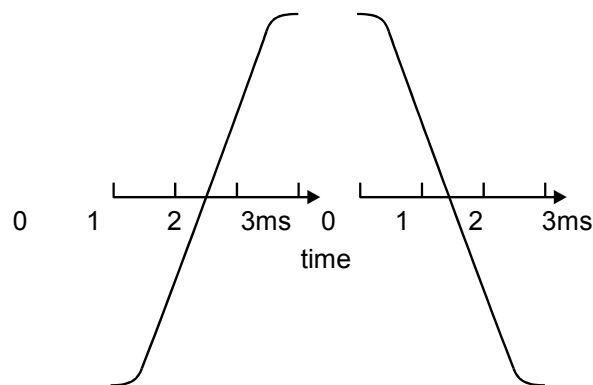


Fig 2: voltage waveform during polarity inversion

2.3 Description of components of the VLF Test System 40 / 60 kV

2.3.1 Operating module

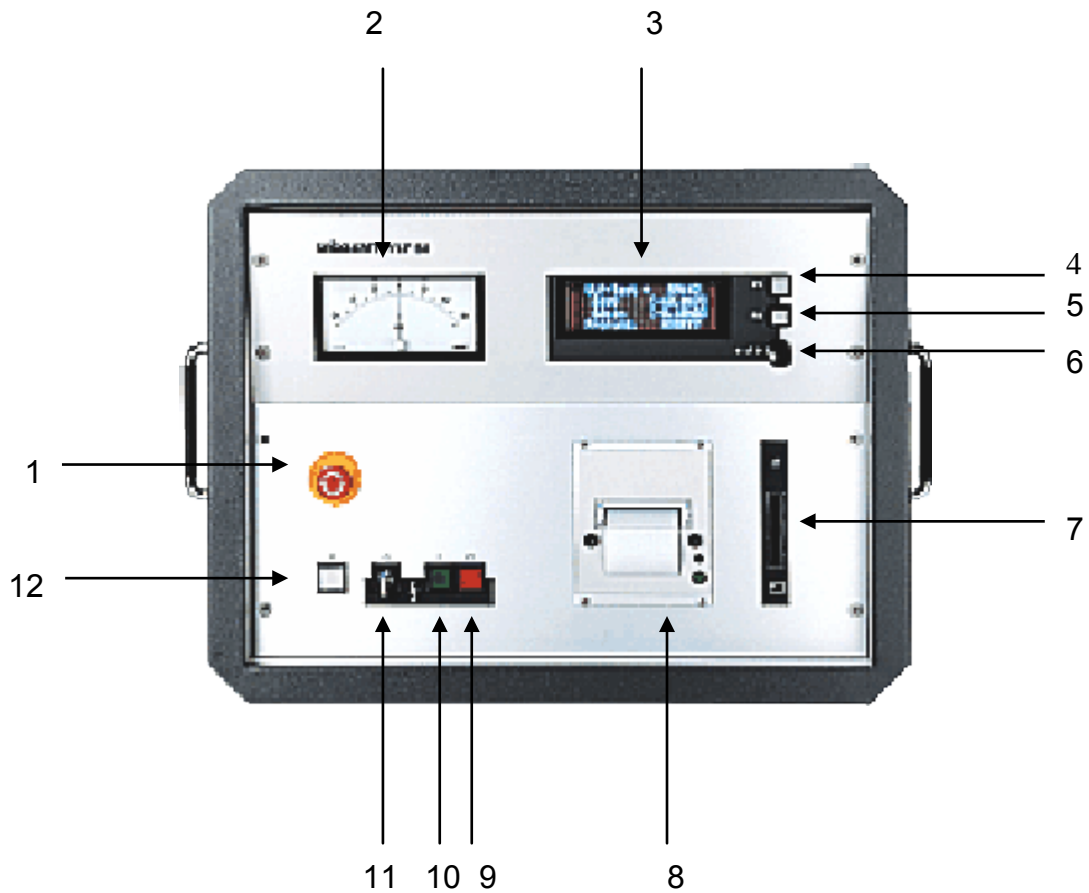


Fig 3: Operating module, Front View

- | | |
|----|--|
| 1 | Key "Emergency Off" |
| 2 | Analogue indication instrument test voltage (kV) |
| 3 | Display |
| 4 | Menu key F1 |
| 5 | Menu key F2 |
| 6 | Knob / push-button |
| 7 | Intake slot for the System Card |
| 8 | Protocol printer |
| 9 | Key "HV Off" (red) |
| 10 | Key "HV On" (green) |
| 11 | Key-operated switch "Interlock" |
| 12 | Key "Mains On" (white) |

2.3.2 Display of the Operating module

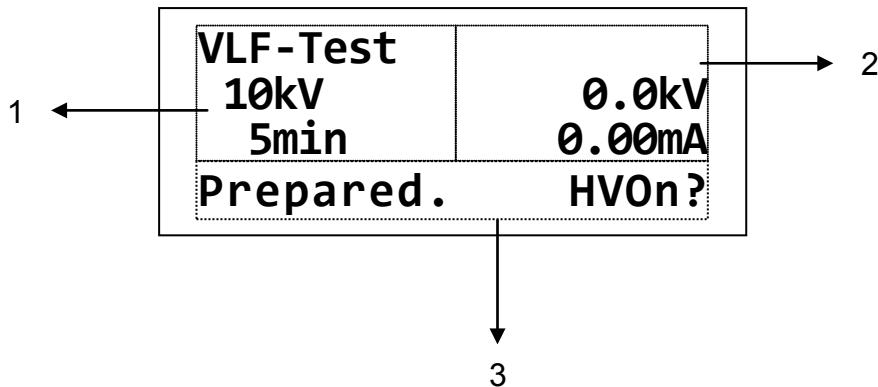


Fig 4: Display of the Operating module (View of the standard operating mode)

- | | |
|---|---|
| 1 | Representation of parameters with value and content resp. |
| 2 | Representation of residual time and/or measuring values |
| 3 | Representation of operator guidance / status display |

The representation of the residual time / measuring values (Fig 4; number 2) takes place according to following pattern:

- **Residual time** **31:45** or after calling by the F1 key (Fig 3; item 4) e. g.
- **HV-Set value** **!10.0 kV!** (Return after residual time by the F1 key) e. g.

- **Measuring voltage** **-10.4 kV** or independent to e. g.
- VLF final voltage** **[-11.0 kV]** (change back by the menu key F2) e. g. or
- Storage voltage** **(-11.8 kV)** (after breakdown in the cable) e. g.

- **Measuring current** **-0.14 mA** or independent to e. g.
- VLF final current** **[-0.16 mA]** (change back by the menu key F2) e. g. or
- Storage current** **(-0.21 mA)** (after breakdown in the cable) e. g.

Following signals are indicated in the line of operator guidance / status display (Fig 4, item 3):

- **Operator guidance** „Select mode OK?“ e. g.
- **Status display** „Running. HVOff?“ e. g.
- **Switching condition** „HV interlock“ e. g.
- **Cause for shutdown** „Breakdown in cable“ e. g.
- **Warning** „34: No printer data“ e. g.
- **Failure message** „19: Coil overload“ e. g.

2.3.3 VLF Test System as a whole

VLF Test System 40 kV

VLF Test System 60 kV

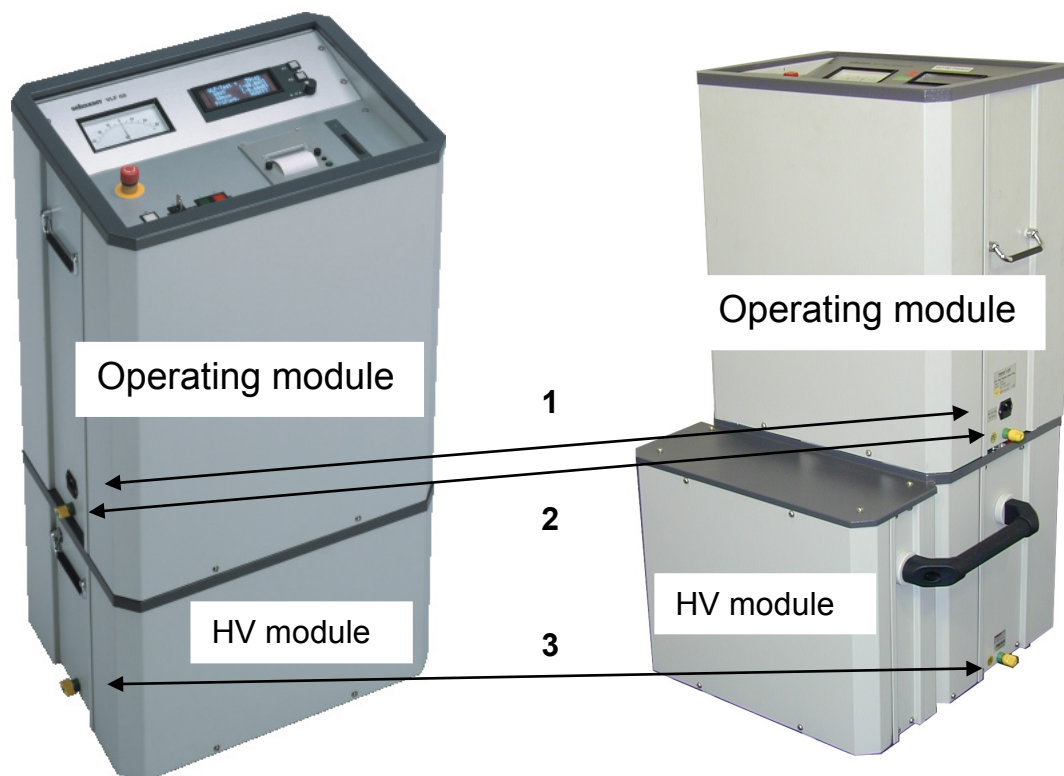


Fig 5: Connections at the right hand side of the VLF Test System

- 1 Mains input with F1, F2
- 2 Terminal clip for earth connection of the Operating module
- 3 Terminal clip for earth connection HV module

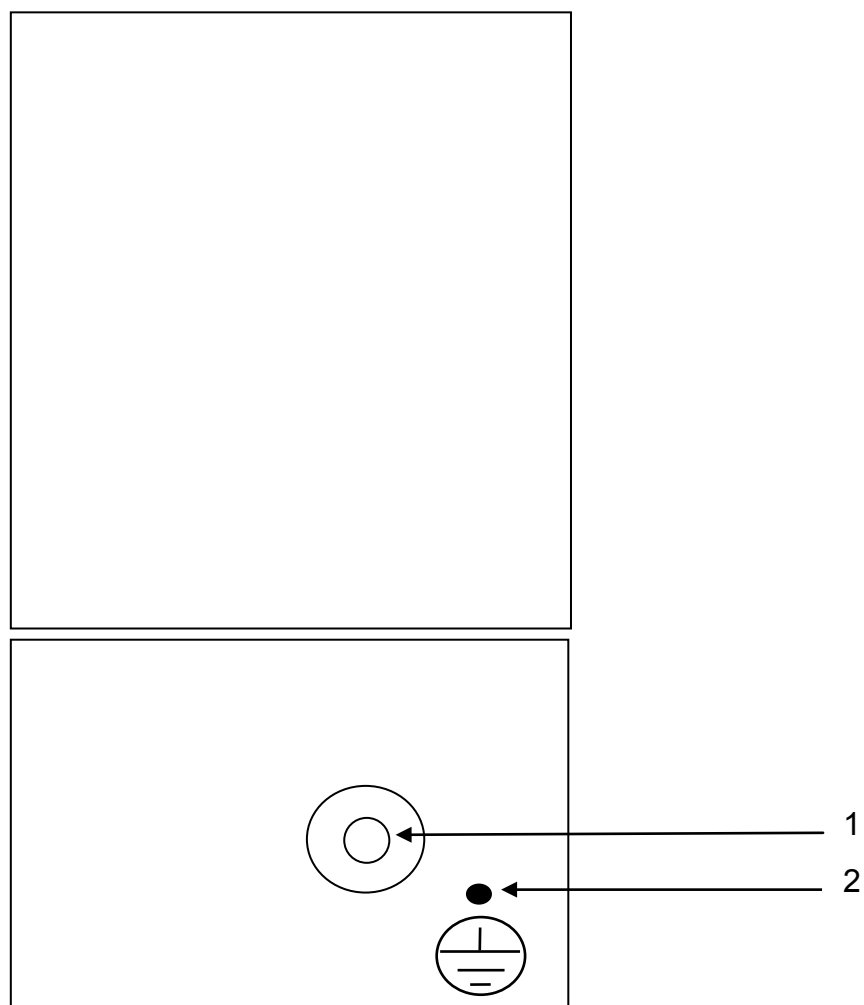


Fig 6: Connectors on the rear of the VLF Test System

- 1 Test voltage output
- 2 Terminal clip for signal ground

2.3.4 Protection covers of the modules

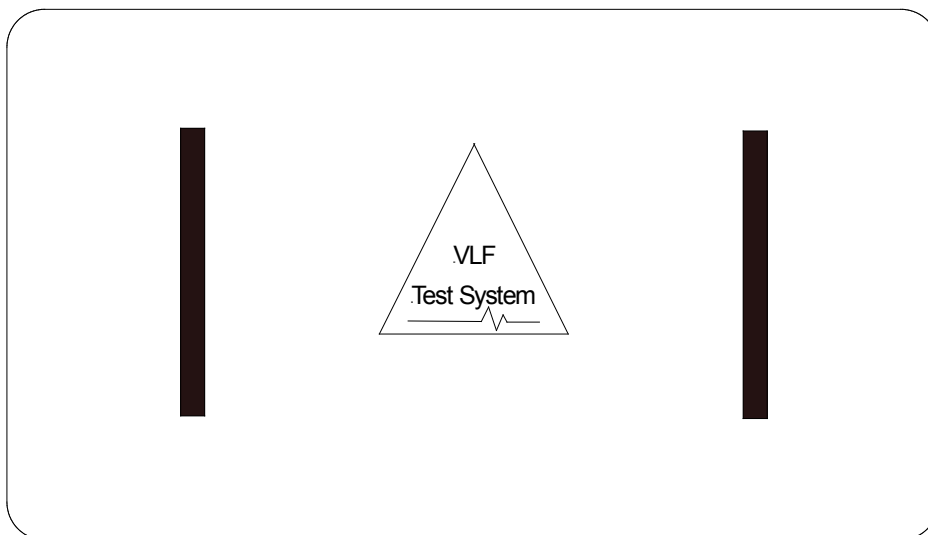


Fig 7: Protection cover of the Operating module

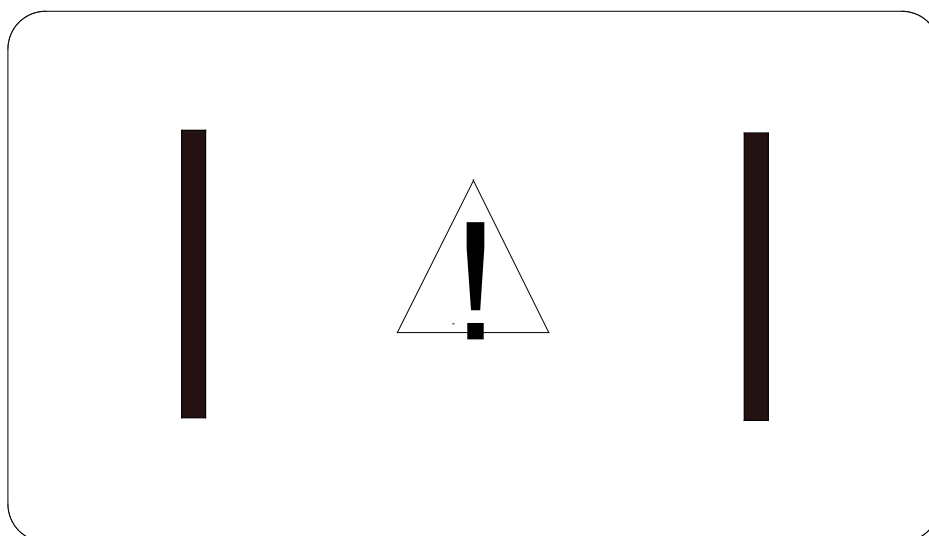


Fig 8: Shorting device / Protection cover of the HV module

2.3.5 Transportation protection bottom from the Operating module

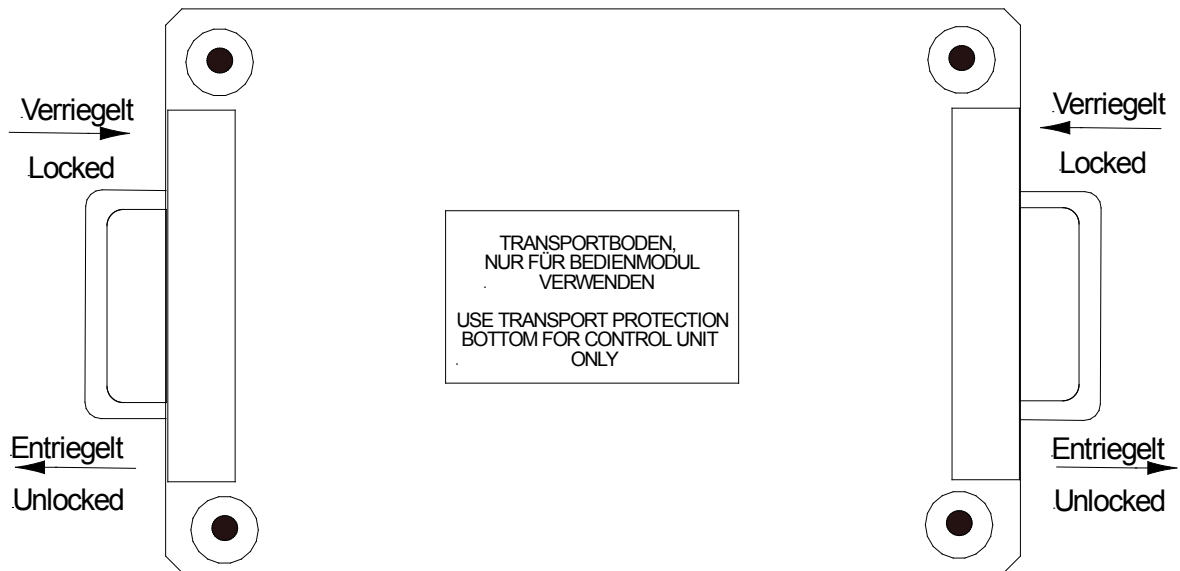


Fig 9: Transportation protection bottom from the Operating module

3. DESCRIPTION OF THE TEST METHOD

Because of the space charges formed in the dielectric of the cable, DC test methods prove to be dangerous when applied to PE and VPE cables and should therefore never be used on such types of cables.

VLF testing is an alternative test method. It is based on the classical method of AC testing but is carried out at a very low frequency (VLF).

Meaningful test results can be obtained by using a rectangular test voltage with a cosine-type alternation of polarity at a frequency of 0.1 Hz.

The VLF Test System 40 kV generates such a test voltage up to 40 kV at maximum or the VLF Test System 60 kV up to 60 kV at maximum resp.

Its mode of operation has been described in section 2.2.

4. SETTING-UP OPERATION

4.1 Safety Precautions

Before starting any operation, always observe the 5 rules of safety:

- Disconnect the test object
- Protect it against reclosure
- Check the absence of voltage
- Connect it to earth and short-circuit it
- Cover all neighbouring parts carrying voltage or seal them off by a barrier

In order to prevent any damage to persons and/or installations that might directly be caused by the operation of the VLF Test System alone or in combination with other systems or instruments, always observe the following safety precautions:

Make sure there are no unprotected systems or system components carrying voltage in the immediate vicinity of the test site with which you or your system may unintentionally get into contact. This applies in particular to all components under high voltage or components the voltage of which is not known.

Protect these components by putting up insulating covers. If, for technical reasons, this cannot be done, disconnect these components or have them disconnected for the duration of your test at this site after having consulted the relevant supervisor and asked for his/her permission. Make sure this measure is carried out properly.

Take a test measurement using an appropriate voltage meter. Beforehand, check the proper operation of this meter, e.g. by taking a test measurement of a known voltage.

Position your system in a place suitable with regard to its dimensions and its load-carrying capacity. Check whether the system stands in a stable position.

Make sure that the site where the HV module is situated is vented properly to avoid the accumulation of ozone during lengthy periods of operation.

Make sure that no other system/system component is restricted in its operation by the presence of your VLF Test System. If due to the installation and operation of the VLF Test System some changes have to be made on another system/system component, always make sure that the former condition is restored after all operations have been concluded. Observe the special requirements of these systems/system components without fail, and start any operation on them only after having consulted the supervisor in charge and asked for his/her permission.

This applies in particular to all changes made on an existing safety device.

The VLF Test System 40 kV generates during the test process a dangerous test voltage up to 40 kV or the VLF Test System 60 kV a test voltage up to 60 kV resp. The test voltage is fed via the HV connecting cable in the test object.

Protect the test object against unintentional contact of persons to active parts by means of protective devices (handrails, chains, bars, etc.) which guarantee that no one can get into the zone of danger.

Disconnect the test object to ensure that no dangerous voltage can get to unprotected places or unprotected technical equipment.

Whenever the VLF Test System is operated, a second person must be present within viewing and hearing distance who can recognise possible hazards and press the Emergency Off key.

Never leave the VLF Test System unattended while operating.

In order to avoid dangerous charging, connect all metal parts in the vicinity of the VLF Test System to earth.

As a matter of principle, all unused cables not needed for the test have to be shorted and connected to earth.

Attention! The test object has to be connected to earth and shorted after terminating of the test.

You are not excused from this duty even the complete discharge by the internal discharging unit and the zero positioning of the residual voltage (Fig 3, item 2) have been performed.

In the case of an incomplete discharge of the test object the complete discharging must be carried out by a suitable discharge rod.

Attention! The HV module of the VLF Test System 40 / 60 kV contains electrical energy storage devices also. These devices are discharged in the same way like the test object by the internal discharging unit of the test device. To avoid the re-charging by space charges the HV module has to be immediately equipped by means of the provided shorting device (Fig 8) after disconnection of the both components HV module and Operating module. The shorting device has to be remained at the HV module even in the case of transportation and storage and may not be removed until the Operating module had been put on.

Attention! Before each use it has to be checked whether the following components of the system are intact, dry and clean:

- connector and end termination of the high-voltage connecting
- HV output socket of the HV module
- connector between HV module and operating module

4.2 Electrical Connection of the VLF Test System

4.2.1 General Rules for Making Connections

Always keep in mind that you are required to comply with all relevant safety precautions for high voltage and power systems when you bring the system into service!

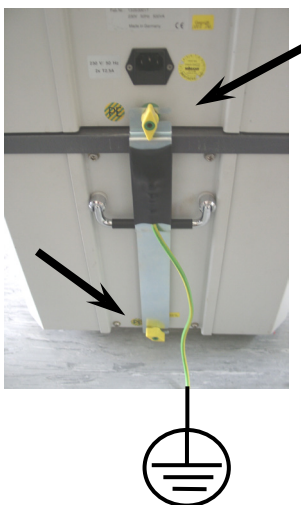
In particular, make sure that the test object is connected to earth and shorted and the cable testing apparatus is switched off when it is connected to the test object or disconnected from it.

It is only for the duration of intrinsic testing that this short-circuit and earth connection may be removed.

Please regard the discharge switch contained in the device only as a facility for discharging the capacitors without risk. Do not use it for earthing and shorting according to VDE 0104!

4.2.2 Connecting the Earth Cable

Connect the earth cable to a suitable point of the protective earth system of the VLF Test System and then attach it to the earth terminal clips of the Operating module (see Fig 5, item 2) and of the HV module (see Fig 5, item 3).



4.2.3 Connecting the Test Object

Plug the connector of the high-voltage connecting cable into the HV module (see Fig below) and fix it by turning the latch. Plug the connector of the signal ground into the corresponding terminal (see Fig 6, item 2).



After that, connect the test cable to the earthed test object.

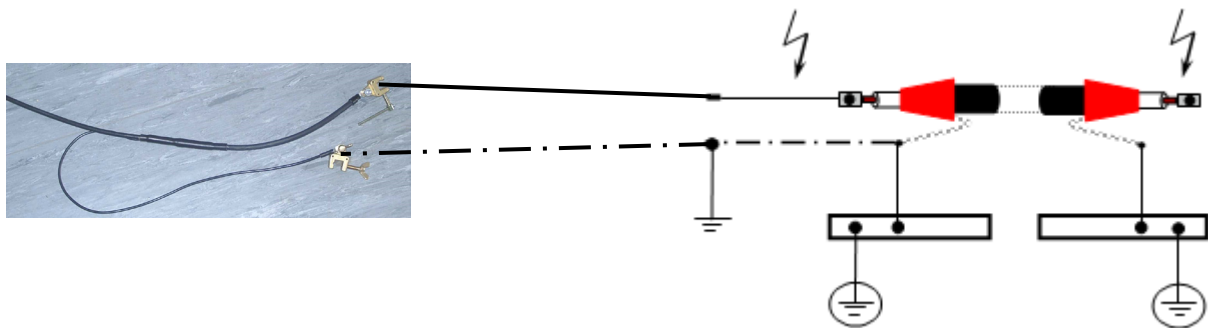


Fig 10: Connection of the test object

4.2.4 Connecting the Mains Cable

Plug the mains cable supplied with the system into the terminal (see Fig 5, item 1) and connect it to a mains outlet.

5. EXECUTION OF TESTS

5.1 VLF / DC Test

For high voltage tests by using the VLF Test System to be carried out, all electrical connections must have been established as described in sections before.

Now the test system can be put into operation. After activation of the "Mains On" pushbutton (Fig 3, item 12) the system can be operated using the knob / push-button (Fig 3, item 6) and the display (Fig 3, item 3).

The following start menu is represented on the display (Fig 3, item 3) after start-up:

VLF mode	
10kV	F1:Print
5min	F2:Setup
Ready	OK:Start

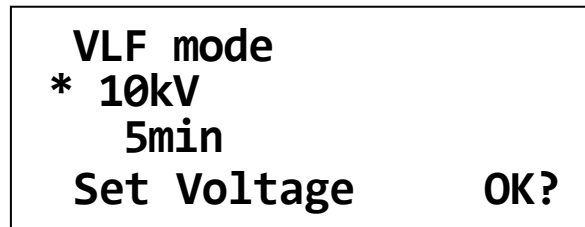
Fig 11: Start menu

A singular pressure on the knob / push-button (Fig 3, item 6) will enable the operation mode to be selected:

*VLF mode	
10kV	
5min	
Select Mode	OK?

Fig 12: Selection of the operation mode

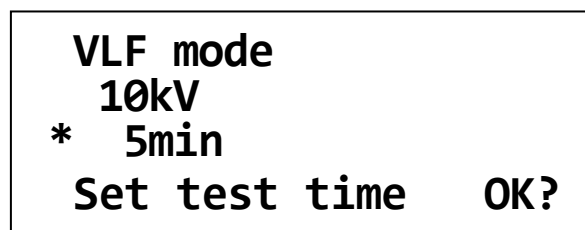
Now the user is able to choose the operation mode out of VLF, DC– and DC+ (only available on systems with two voltage sources) by turning the knob / push-button (Fig 3, item 6). The selection has to be confirmed by a singular pressure on the knob / push-button (Fig 3, item 6). Now it is possible to select the test voltage level:



VLF mode
*** 10kV**
5min
Set Voltage OK?

Fig 13: Selection of the test voltage

The test voltage level can be adjusted in steps of 1 kV up to the maximum test voltage of the system by turning the knob / push-button (Fig 3, item 6). The adjusted test voltage level has to be confirmed by pressure on the knob / push-button (Fig 3, item 6). Now it is possible to adjust the test time:



VLF mode
10kV
*** 5min**
Set test time OK?

Fig 14: Selection of the test time

The test time can be adjusted in steps of 1 min from 5 min up to 45 min and in steps of 5 min from 45 min up to 90 min test duration at maximum by turning the knob / push-button (Fig 3, item 6). The adjusted test time has to be confirmed by pressure on the knob / push-button (Fig 3, item 6).

Use the information given in DIN VDE 0276 - 620 and 0276 - 621 as a guideline to start from. These standards recommend a test level of 3 x U₀ and a test duration of 30 or 60 minutes, respectively

When you follow these guidelines, the test level is near the peak voltage of a 50-Hz test (2 x U₀ rms).

For sheath tests with DC voltage, the test voltage should not exceed 3 kV for PVC cables or 5 kV for PE cables respectively.

5.2 Sheath Fault Location

Following a failed sheath test with DC voltage fault location based on the step voltage method can be immediately performed at the cable under test with the VLF test system serving as voltage source.

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 is 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.

By turning the knob / push-button (Fig 3, item 6) the **SFL** operation mode has to be selected. Afterwards, the voltage level (max. 10 kV) and the pulse rate can be selected as described in the section before.

By changing the pulse rate you can vary the cycle period too (between 4 or 6 seconds). E.g. the setting **4s 1:3** enables 4 seconds cycles where 1 second of high voltage is followed by a 3 seconds dropout.

SFL mode	
10kV	
*4s 1:3	
Set pulsing	OK?

Fig 15: Selection of the pulse rate

5.3 Starting the Test / Location

After the system has carried out all necessary settings which takes a short period of time, the high voltage can be enabled.

VLF mode	
10kV	0.0kV
5min	0.00mA
Prepared	HVOn?

Fig 16: HV on

It depends on the following conditions whether or not HV can be switched on using the respective pushbutton (Fig 3, item 10):

- the key "Emergency Off" (Fig 3; item 1) is not activated,
- the key-operated switch "Interlock" (Fig 3; item 11) is activated,
- both the Operating and the HV module are assembled in proper form.

If these conditions have been fulfilled, the "HV On" key (green) (Fig 3, item 10) lights up for about 10 s and can be activated during this time. Afterwards, the "HV Off" key (red) (Fig 3, item 9) lights up. Under maintaining of the predetermined charging parameters the test voltage will be regulated to the adjusted test voltage level.

At the analogue indication instrument (Fig 3, item 2) and on the display (Fig 3, item 3) the level and the polarity of the test voltage are represented. In addition, the leakage current of the test object is indicated on the display (Fig 3, item 3).

VLF mode	11:42
20kV	20.1kV
15min	0.13mA
Running.	HVOff?

Fig 17: Cable test

During normal operation, the voltage source is / can be switched off

- by pressing the "HV Off" key (red) (Fig 3, item 9)
- automatically after the lapse of the test time
- automatically after a voltage breakdown in the cable under test or a short circuit has been detected

In these cases the predefined discharging of the (voltage source), back-up capacitor and test object follows.

<p>VLF mode 20kV 15min Test time over</p>	<p>F1:Print F2:Setup</p>
---	--

Fig 18: Start menu after the test has been finished

In addition, the voltage source is / can be switched off

- by activating the “Emergency Off” switch (Fig 3; item 1),
- by turning HV interlock key switch (Fig 3; item 11),
- by removing a system card which has been inserted prior to the test (see section 7.4)
- after drop out of the operating voltage
- after detection of an internal failure (see section 8.4)

In these cases the predefined discharging of the voltage source, back-up capacitor and test object follows too.

Attention! The test object has to be connected to earth and shorted after termination of the test.

You are not excused from this duty even the complete discharge by the internal discharging unit and the zero positioning of the residual voltage (Fig 3, item 2) have been performed.

In the case of an incomplete discharge of the test object the complete discharging must be carried out by a suitable discharge rod.

After the test session has been finished, the test system has to be switched off. Afterwards, it must be disconnected from the cable under test which has been grounded and shorted before. Finally, the earth cable has to be disconnected.

6. ADDITIONAL FUNCTIONS

6.1 Adjustment of Language

By pressing the F2 key (Fig 3, item 5) and turning the knob / push-button (Fig 3, item 6) the "User setup" menu can be accessed. Here the language on the display and in the protocol printing of the VLF Test System can be adjusted. Any new setting will be saved after pressing of the knob / push-button (Fig 3, item 6).

```
User setup
*Lang.: English
Level: Standard
Select user language
```

Fig 19: User Setup: Language

6.2 Viewing the System Information

By pressing the F2 key (Fig 3, item 5) and turning the knob / push-button (Fig 3, item 6) the "System info" menu can be accessed. When accessing this menu, the software versions of several system components and the system ID, you should have on-hand when calling a service centre, are shown on the display. In some cases the system ID is also required for the subsequent activation of optional system features. A short instruction how to enable optional system features is handed out with the certificate you get when buying one or more options.

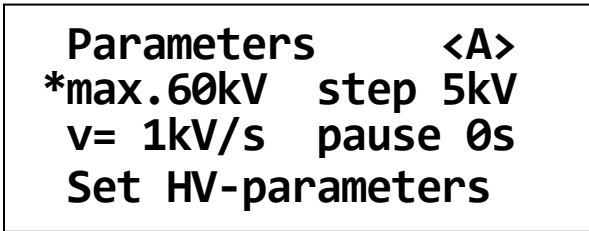
```
*System info
ID:12345678
1.21-1 1.21-1 1.21
USER PROT CTRL
```

Fig 20: Setup: System Informationen

6.3 Viewing / Setting the System Parameters

Certain test parameters are permanently stored as system parameters and secured against unauthorized changes. As a standard user you can only view these parameters. In order to adjust these parameters you have to gain administrator rights by entering the administrator password first (see section 6.4).

By pressing the F2 key (Fig 3, item 5) and turning the knob / push-button (Fig 3, item 6) the "Parameters" menu can be accessed. Provided you own administrator rights (see section 6.4), the following parameters can be adjusted:



```
Parameters      <A>
*max.60kV  step 5kV
v= 1kV/s  pause 0s
Set HV-parameters
```

Fig 21: Setup: Parameters

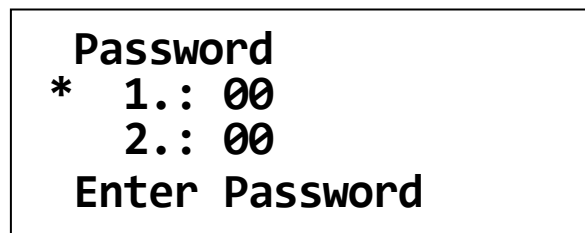
- Adjustment of the **maximum test voltage in kV**: By this adjustment the maximum output voltage of the system can be permanently restricted in the space of its standard data. Any re-setting can be only carried out by the administrator. The standard maximum voltage of the test system represents the default setting.
- Adjustment of the **rate of the test voltage increase v in kV/s**: By this means the rate of increase of the test voltage during the charging phase can be adjusted. Any re-setting can be only carried out by the administrator. The default setting is 1 kV/s.
- Adjustment **Step in kV**: By this means the increment at stepwise increasing of the test voltage during the charging phase can be adjusted. Any re-setting can be only carried out by the administrator. The default setting is 5 kV.
- Adjustment **Pause** (rest period) **in s**: Here the duration of the rest period at stepwise increasing of the test voltage during the charging phase can be adjusted. Any re-setting can be only carried out by the administrator. The default setting is 0 s.

6.4 Entering / Changing the Administrator Password

By pressing the F2 key (Fig 3, item 5) and turning the knob / push-button (Fig 3, item 6) the "Password" menu can be accessed. When entering this menu, you have to enter the administrator password in order to gain the administrator rights enabling you to adjust the test parameters accessible via the "Parameters" menu (see section 6.3).

The factory-provided default password for any VLF test system is **2345**.

The first two digits of the password (**23**) have to be entered under 1. and the last two digits (**45**) have to be entered under 2. Any entered number sequence has to be confirmed by pressing the knob / push-button (Fig 3, item 6).



```

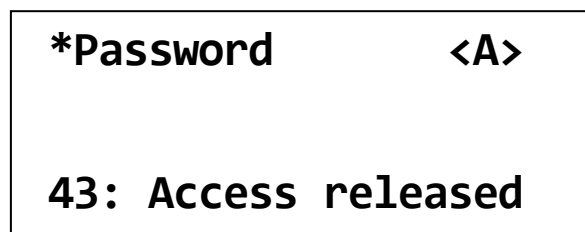
Password
* 1.: 00
   2.: 00
Enter Password

```

Fig 22: Setup: Enter password

The access will be gained, if the correct password has been entered. The respective system message has to be confirmed by pressing the knob / push-button (Fig 3, item 6).

You are now authorised as an administrator which is indicated by the characteristic **<A>** in the top right of the display.



```

*Password                <A>

43: Access released

```

Fig 23: Setup: Entered password ok

After the password has been entered and accepted, it can be changed.

In order to change the password, you have to access the “Passw. Set” menu right after you gained administrator rights. The new password has to be entered the same way as the current password has been entered (see previous page).

```
Passw. Set      <A>
*  1.: 00
   2.: 00
Change password
```

Fig 24: Setup: Enter new password

```
*Passw. Set    <A>

55: Password stored
```

Fig 25: Setup: New password stored

6.5 Returning to the start menu

In order to return to the start menu you have to access either the “Return” or the “Escape” menu item.

If you leave the setup via “Return” (fully to the left), you lose the administrator rights.

If you leave the setup via “Escape” (fully to the right), you keep the administrator rights.

```
*Return        <A>

Your selection ?
```

Fig 26: Setup: Return to start menu

7. Optional Features

7.1 Detection of Breakdown and Short Circuit

For systems equipped with the optional breakdown and short circuit detection, the test voltage will be immediately switched off in any case of a breakdown in the cable under test. The status message "Cable break down" is indicated on the display.

The level of the break down voltage is indicated on the display. That value is represented as storage voltage (i.e. in parentheses).

In case of a short circuit (test voltage < 5% of rated voltage), the test voltage will be switched off. The status message "Cable cannot be charged" is indicated on the display.

VLF mode	6:32
20kV	(20.1kV)
15min	(0.19mA)
Breakdown in cable	

Fig 27: Breakdown detection

7.2 Measurement of Leakage Current

If a system is equipped with the optional Leakage Current measurement, the leakage currents of the test object are indicated on the display during the test.

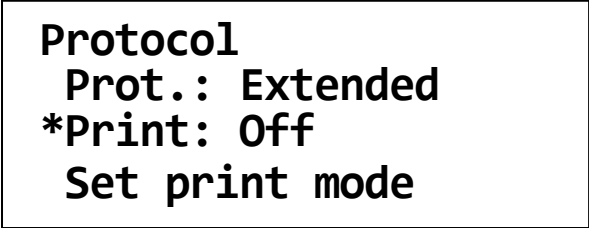
During charging period, the instantaneous measurement values are indicated on the display. Afterwards, the VLF final values are indicated on the display. The final values (test voltage and leakage current) are represented in brackets. Change-over to the representation of the instantaneous measurement values (values without parentheses or brackets) and back can be carried out by activating the F2 key.

If the VLF Test System has been additionally equipped with the logging option or protocol printout option, these measurement values can be additionally filed and printed out respectively.

7.3 Internal Protocol Printout

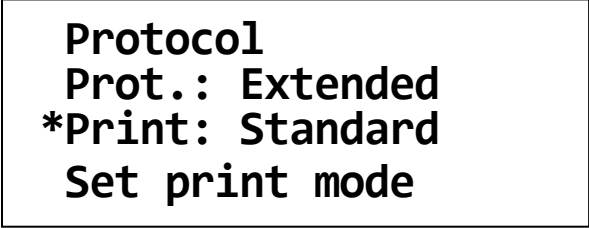
If the VLF Test System is equipped with an internal protocol printer (Fig 3, item 8), data logged during a cable test can be printed out on this printer.

By pressing the F2 key (Fig 3, item 5) and turning the knob / push-button (Fig 3, item 6) the "Protocol" menu can be accessed. Here you can change the behaviour of the printer by adjusting the "Print" parameter. The value of the parameter can be changed by rotating the knob / push-button (Fig 3, item 6) and can be accepted / saved by pressing it.



```
Protocol
Prot.: Extended
*Print: Off
Set print mode
```

Fig 28: Setup: Protocol Printout Off



```
Protocol
Prot.: Extended
*Print: Standard
Set print mode
```

Fig 29: Setup: Protocol Printout Standard

After a cable test has been finished, the protocol printout can be triggered from the start menu (Fig. 9) by pressing the F1 key once or repeatedly.

Depending on the print settings (see above), the following information are included in the printout:

- Printout "**Standard**":
 - Header (extended by the header from the SystemCard (if specified))
 - System type and version
 - Mode of operation, test voltage, test time
 - Date / Time of test start
 - Result of the test
 - Measured data (time, test voltage in kV, leakage current in mA) of the test phase (affected by the "print time points" set on the SystemCard (if specified))
 - Footer (extended by the footer from the SystemCard (if specified))
 - Date / Time of the printout

- Printout "**Extended**":
 - All information listed under "**Standard**"
 - Maximum test voltage, test voltage increase, step increment, rest period of the ramp (ramp pause)
 - Settings for logging and printing
 - User profile, service / administrator mode (if applicable)
 - Measured data (time, test voltage, current) of the charging period
- Printout „**Detailed**“:
 - All information listed under "**Extended**"
 - A bunch of measuring data logged right before the end of the test

For systems equipped with the logging option (see section 7.4), up to 4 header lines and 4 footer lines (e.g. the company name or a field for the signature of the operator) can be specified.

This so called individual "**print templates**" can be imported into the system using a SystemCard (see section 7.4.2). It depends on the settings of the SystemCard whether these print templates are permanently stored in the test system configuration or are only valid for the period of the cable test under way.

In order to test the layout of the individual header lines and footer lines you can initiate a test printout even if no cable test has been performed before. For this purpose, you have to change the print settings to "Text" or "System" first. Afterwards, you can initiate the test printout from the start menu by pressing F1.

Depending on the print settings, the following information are included in the printout:

- Printout "**Text**":
 - Header (extended by the header from the SystemCard (if specified))
 - System type and version
 - Footer (extended by the footer from the SystemCard (if specified))
 - Date / Time of the printout
- Printout „**System**“:
 - All information listed under "**Text**"
 - All information about the system configuration (options, software versions)

Attention: When initiating a test printout ("Text" or "System"), any set of measuring data that may have been logged during a previous cable test will be deleted.

Attention: Immediately change the print settings back to your normal protocol printout mode after you performed a test printout.

Note: If a SystemCard is used with the system (see section 7.4), make sure that when parametrizing the SystemCard under "WinkisVFL", the "**Settings: Protocol printout**" parameter has been set to **[set on device]**. Otherwise, the print settings are automatically adopted from the SystemCard and cannot be changed manually.

7.4 Using a SystemCard

7.4.1 Purpose of a SystemCard

If the VLF Test System has been equipped with the logging option, the measured data can be written to a so-called **SystemCard** which has the dimensions of a conventional credit card.

The SystemCard can be used to store and transfer logged data (see section 7.4.3) and to hand over predefined test parameters to the system (see section 7.4.2).

In order to format and, if required, parametrize a SystemCard and to analyze / archive the logged measuring data, the software *WinkisVLF* has to be used. For detailed information about the *WinkisVLF* software, please refer to its online help.

In general, a SystemCard can be used for the following purposes:

- A SystemCard can be prepared for storing measured data only (**Protocol card**). No test parameters are handed over to the system. The card may also contain header lines and footer lines for printouts (see section 7.3) which, however, are only valid for the cable test under way.
- A SystemCard can be prepared for parametrizing the system (**Parameter card**). In this case, the SystemCard changes the settings of the system as specified under *WinkisVLF* before. The card may also contain header lines and footer lines for printouts (see section 7.3). Both, the parameters handed over by the SystemCard are and the print templates are not permanently stored on the system and only valid for the cable test under way.
- A SystemCard can be prepared for both **parametrizing the system** and **storing the measured data**. The parameters handed over by such a SystemCard are not permanently stored on the system and only valid for the cable test under way. The card may also contain header lines and footer lines for printouts as well as “print time points” (see section 7.3).
- A SystemCard can be prepared for parametrizing the system in a way that the parameters handed over by the SystemCard **change the device settings permanently**. The card may also contain header lines and footer lines for printouts (see section 7.3) which are also permanently stored on the system.
Attention: This type of card cannot be used for storing measured data.

7.4.2 Preparing a SystemCard

Using a SystemCard appropriately parametrized under *WinkisVLF* will enable you to make volatile (only for the cable test under way) or permanent changes to your device settings. Depending on how the card has been parametrized, either all or only certain test parameters are affected.

That way, cable tests can be planned and prepared in the office using *WinkisVLF*. Later, on-site, you only have to plug the SystemCard into the system in order to change the system settings the way it has been planned.

Furthermore, this will allow you to prepare volatile print templates (individual header lines and footer lines for the ongoing cable test) or non-volatile print templates (as default protocol template for permanent use) (see section 7.3).

By defining “print time points” using *WinkisVLF* you can also schedule the logging timeline. These “print time points” are only valid for the cable test under way and cannot be stored permanently.

For detailed information about the *WinkisVLF* software, please refer to its online help.

The parameters stored on a SystemCard are automatically adopted by the test system right after the card has been plugged into the respective slot on the control unit (see section 7.4.4).

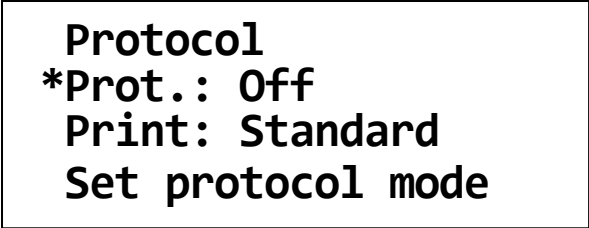
7.4.3 Logging to SystemCard

By activating the logging function, measuring data logged during a cable test can be written to a SystemCard. These data may consist of system information, system / test settings, information about the course of the cable test, the measured data (test voltage, leakage current) and the test result.

Back in the office, the logged data can be transmitted from the card to a PC where it can be analyzed and archived using the *WinkisVLF* software.

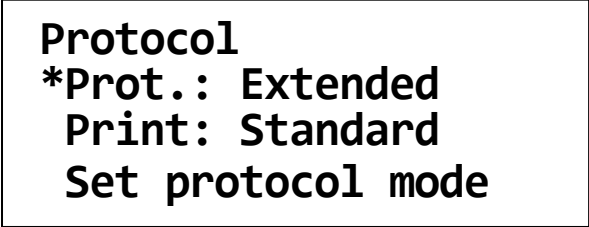
For detailed information about the *WinkisVLF* software, please refer to its online help.

By pressing the F2 key (Fig 3, item 5) and turning the knob / push-button (Fig 3, item 6) the menu "Protocol" can be accessed. Here the logging mode ("Prot.") of the VLF test system can be adjusted by rotating the knob / push-button and saved by pressing it.



```
Protocol
*Prot.: Off
Print: Standard
Set protocol mode
```

Fig 30: Setup: Protocol Off



```
Protocol
*Prot.: Extended
Print: Standard
Set protocol mode
```

Fig 31: Setup: Protocol Extended

Depending on the logging mode, the following data is written to the SystemCard:

- Protocol **“Off”**:
 - If the protocol mode is set to “Off”, **no** measured data is written to the SystemCard.
- Protocol **"Standard"**:
 - System type and version
 - Test settings relevant for analysis
 - Date / time of test start
 - Result of the test and remaining test time
 - Measured data (time, test voltage in kV, leakage current in mA) of the test phase
- Protocol **"Extended"**:
 - All information listed under **“Standard”**
 - Measured data (time, test voltage, current) of the charging period

Hint: Setting the protocol mode to "Standard" or "Extended" requires a SystemCard to be plugged in.

Hint: After a test run has been finished, the system card has to remain in the slot until the system is completely discharged (status message appears). Otherwise, data may be lost.

7.4.4 Operating the Test System with a SystemCard

In order to use a SystemCard for parametrizing the test system or storing the logged data, the card has to be plugged into the respective slot (Fig 3; item 7) of the control unit prior to the start of the cable test (while the start menu is visible).

If it is a valid card, the parameters and other relevant information are read out from the card. The operator has to identify the card as “Porper Card ?“ while the test parameters obtained from the card are shown on the display.

After the card has been acknowledged by pressing the knob / push-button, the system performs some more checks of the system card (e.g. available logging memory on the SystemCard) whereupon the start menu should look as follows:

VLF mode	
20kV	F1:Print
15min	F2:Setup
By card.	OK:Start

Fig 32: Start menu with SystemCard inserted

From now on, only the test parameters which have been specified as **[set on device]** under *WinkisVLF* can be manually changed. This does also apply for the parameters accessible via the setup menu (F2 key).

If the card is removed from the slot, the settings are undone and the standard start menu appears on the display.

A cable test can be started as described in section 5.1.

Attention! If the SystemCard is removed during an ongoing cable test, the test is interrupted!

For the **special case** of a SystemCard intended to change the settings of the test system permanently (see section 7.4.1), the settings (test parameter, print templates etc.) are handed over and stored in the system right after the card has been identified as a “Proper Card ?”. Afterwards, the start menu looks as follows and the card has to be removed from the slot.

VLF mode	
25kV	F1:Print
30min	F2:Setup
Card data stored	

Fig 33: Start menu after new system settings have been stored

7.5 Function User Setup / User Level

By pressing the F2 key (Fig 3, item 5) and turning the knob / push-button (Fig 3, item 6) the menu "User Setup" can be accessed.

After administrator rights have been gained as described in section 6.4, the "User Setup" menu can be used to change the user level. That function is of importance when logging to SystemCard (see section 7.4.3) or parametrizing the system using a SystemCard (see section 7.4.2).

```
User setup      <A>
Lang.: English
*Level: Standard
User level ?
```

Fig 34: Setup: User Profile

By setting the user level to "**Single**", the system can only be operated with a parametrized SystemCard. That way, the users operating the system on-site are not allowed to change test parameters not specified as **[set on device]**.

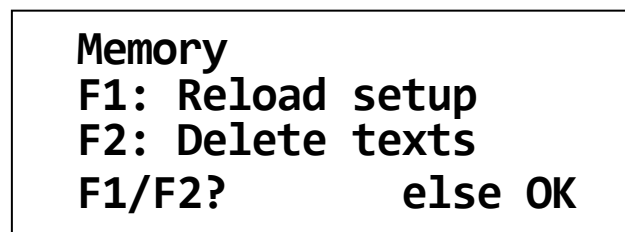
By setting the user level to "**Standard**", the system can be operated with or without SystemCard.

Attention! Only the user level "**Standard**" allows the system to be operated without SystemCard.

7.6 Re-Setting the System Settings / Deleting the Print Templates

The user interface of the VLF Test System allows you to reset the non-volatile system settings back to the default factory settings and to delete permanently stored print templates.

After administrator rights have been gained as described in section 6.4, the “Memory” menu can be accessed via the “Setup” menu. The functions of this menu can be activated by pressing the F1 key or F2 key respectively. By pressing the knob / push-button the menu can be left without triggering a function.



```
Memory
F1: Reload setup
F2: Delete texts
F1/F2?           else OK
```

Fig 35: Setup, Memory

“**F1: Reload setup**” resets all parameters and system settings to the default factory settings. The administrator password is not affected (see section 6.4).

“**F2: Delete Texts**” resets all print templates (individual header lines and footer lines) stored on the system (see section 7.3).

Hint: These functions are not accessible, if a System Card inserted.

7.7 Adjustment of the System Timer

If the test system is equipped with at least one of the system options “Logging” or “Protocol printout”, the system contains a battery-operated and crystal-controlled clock (see section 8.2).

After activating of the Menu key F2 (Fig 3, item 5) and by turning the knob / push-button (Fig 3, item 6) the menu "Date / Time" can be accessed. Here the date and the clock time of the system timer (VLF Test System) can be adjusted. By turning the knob / push-button, the value of the selected segment is changed. You can toggle through the segments by pressing the knob / push-button.

After all segments have been set, the date and time can be stored by pressing the F1 key. By pressing the knob / push-button again, the changes are discarded.

```
Date/Time  
Mo 19.06.08 10:27:13  
  
F1= set!      else OK
```

Fig 36: Setup Date / Time

```
Date/Time  
Mo 19.06.08 10:27:13  
*  
Set date & time
```

Fig 37: Setup Date / Time: adjusting the day of the week

```
Date/Time  
Mo 19.06.08 10:27:13  
          *  
Set date & time
```

Fig 38: Setup Date / Time: adjusting the minutes

```
Date/Time  
Mo 19.06.08 10:27:13  
          *  
F1= Set!      else OK
```

Fig 39: Setup Date / Time: Saving by F1

8. Maintenance and Troubleshooting

8.1 How to Exchange the Paper Roll or Ink Ribbon of the Printer

The optional built-in printer is housed in a robust metal case with removable front cover. To exchange the paper roll or the ink-ribbon cartridge, first remove the front cover from the printer.

a) How to remove the front cover

Turn either knurled screws anti-clockwise (Fig 40) until the front cover comes off the printer (Fig 41).

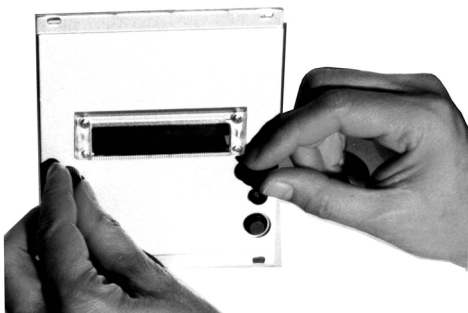


Fig 40: Unscrewing the printer front cover

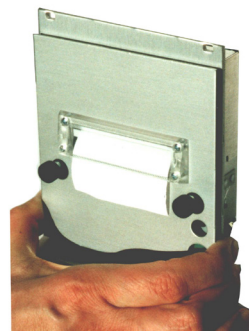


Fig 41: Removing the front cover

b) How to exchange the ribbon

To exchange the ribbon, press down the left edge of the ink ribbon cartridge marked "Push" and "Eject" (Fig 42). The cartridge will come off on the right-hand side and can now be removed. Tighten the ribbon of the new cartridge by turning the small wheel on the right-hand side, following the direction of the arrow. After that, guide the ribbon cartridge over the paper. See to it that the paper is between the textile ribbon and the plastic bridge (Fig 43). Let the ink cartridge engage distinctly. If you encounter blurred or unbalanced printing, improper engagement of the ink cartridge is very likely to be the cause.

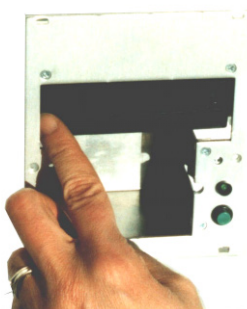


Fig 42: Removing the ribbon cartridge

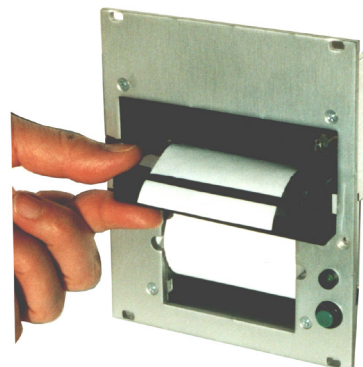


Fig 43: Inserting the ribbon cartridge

c) How to exchange the paper roll

The container can hold paper rolls with up to 50 mm diameter.

First follow step 2 and remove the ribbon cartridge. Remove the spindle from the core of the empty roll and insert it into the core of the new paper roll.

If necessary, cut the front edge of the paper strip in a straight line. Hold the paper roll in your hand and thread the front end of the paper from below into the slot of the printer unit intended to this purpose (see Fig 44) until you sense some resistance. To lead the paper past the print head, press the paper feed button (Fig 45) until approx 5 cm (2 inches) of paper stand out of the printer unit.

Insert the new paper roll with the spindle into the paper container und tension the paper. After that, again insert the ribbon cartridge into the printer unit, as described in step 2.

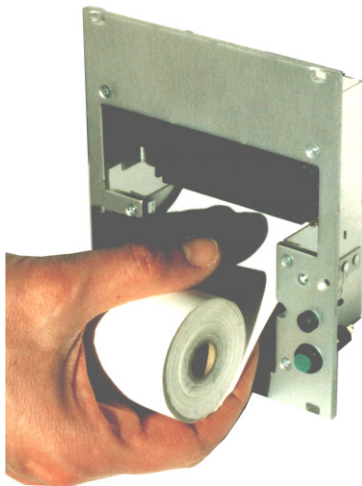


Fig 44: Inserting the paper roll into the printer

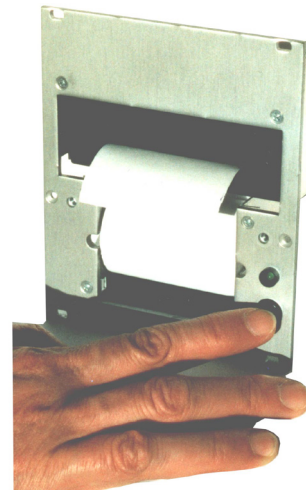


Fig 45: Paper feed button

d) How to attach the front cover

Lead the paper from the rear through the front cover and again screw the front cover onto the printer.

8.2 Replacing the Battery of the System Clock

If the test system is equipped with at least one of the system options “Logging” or “Protocol printout”, the system contains a crystal-controlled clock. The built in lithium cell is capable of powering the clock for several years.

If this battery needs to be changed, please contact the next service centre.

8.3 Connecting Cables, HV Couplings

Maintenance and troubleshooting include regularly checking the connecting cables such as earth cables, mains cables and test cables for being in good repair. In addition to that we recommend that the HV couplings at the Operating module and HV module should be checked with respect to mechanical integrity and cleanness.

Make absolutely sure that after use the HV plug of the test voltage cable is again covered with the included protective sleeve.

8.4 Operational and Error Messages

8.4.1 Classification of Messages

Operational and error messages occurring during operation of the "VLF Test System" are classified as follows:

Symbol	Class	Response	What to do
U	Operational message about state of system		refer to instruction manual
C	Operational message about switching condition		confirm - continue operation
F	Error of type "fatal"	HV Off	confirm - restart system
T	Error of type "trans"	HV Off	confirm - repetition possible
N	Error of type "normal"	HV Off	confirm - repetition possible
W	Warning	none	confirm - continue operation

For detailed information about the messages, please refer to the following paragraphs.

8.4.2 Operational Messages about State of System

The following operational messages inform the operator about the current state of the system.

You need not confirm any of them. The system, however, expects the operator to make one of the entries listed in the table.

Code	Cl.	Operational message	Description	Input
-	-	[Start-up screen]	System is starting up.	none
-	U	Connecting...	System is connecting Master and Slave processors.	none
-	U	Initiating system	System is initializing parameters etc.	none
-	U	Remove any card !	No card must be plugged in during start-up.	none pull out card !
-	U	Ready. OK:Start	System is ready for starting a test.	OK (or to Setup)
-	U	By card. OK:Start	System is ready for starting a test.	OK (or to Setup)
-	U	Stopped. OK:Start	System is ready for starting a test.	OK (or to Setup)
-	U	Select mode OK?	System is waiting for input of mode.	rotary knob + OK
-	U	Set voltage OK?	System is waiting for input of test voltage.	rotary knob + OK
-	U	Set test time OK?	System is waiting for input of test time.	rotary knob + OK
-	U	Set pulsing OK?	System is waiting for input of pulsing rate.	rotary knob + OK
-	U	Insert SystemCard	System is waiting for a system card to be inserted.	none insert card !
-	U	Without card only	Operation mode can only be performed without system card	none pull out card !
-	U	Card is invalid !	System card not readable or invalid.	none pull out card !
-	U	Card is full !	System card is full.	none pull out card !

Code	Cl.	Operational message	Description	Input
-	U	Card is faulty !	Content of system card is faulty.	none pull out card !
-	U	Really this card ?	System is waiting for confirmation of card.	OK
-	U	Reading card...	System is reading data from the system card.	none
-		Checking...	System is checking the read data	none
-	U	Card data stored	Non-volatile storage of data	none pull out card !
-	U	Preparing...	System is setting up parameters.	none
-	U	Prepared. HVOn?	System is waiting for "HVon".	HVon or OK (abortion)
-	U	Turning on...	System is starting up after "HVon".	none
-	U	Running. HVOff?	System is preparing high voltage.	HVoff or OK
-	U	Holding. HVOff?	System is preparing high voltage.	HVoff or OK
-	U	Discharging...	System is discharging and earthing after "HVoff".	none
-	U	F1=retry F2=reboot	System is waiting for a decision after error.	F1 or F2
-	U	Press F2 to reboot	System is waiting for reboot after fatal error.	F2
-	U	Rebooting...	System is going to reboot .	none
-	U	Printing...	Device-internal protocol printing under way.	none
-	U	Your selection ?	In Setup: Prompting to select from menu.	rotary knob + OK
-	U	Set HV-parameters	In Setup: Prompting to make entry	rotary knob + OK
-	U	Set protocol mode	In Setup: Prompting to make entry	rotary knob + OK
-	U	Set print mode	In Setup: Prompting to make entry	rotary knob + OK

Code	Cl.	Operational message	Description	Input
-	U	Set user language	In Setup: Prompting to make entry	rotary knob + OK
-	U	Set user level	In Setup: Prompting to make entry	rotary knob + OK
-	U	F1= set! else OK	In Setup: query for setting the clock	F1: set or OK (abortion)
-	U	Set date & time	In Setup: Prompting to make entry	rotary knob + OK
-	U	Enter code number	In Setup: Prompting to make entry	rotary knob + OK
-	U	Enter password	In Setup: Prompting to make entry	rotary knob + OK
-	U	Change password	In Setup: Prompting to make entry	rotary knob + OK
-	U	F1/F2 ? else OK	In Setup: query of "Memory"	F1 or F2 or OK (abortion)
-	U	F1/F2 ? else OK	In Setup: query of "Calibration"	F1 or F2 or OK (abortion)
-	U	Set service mode	In Setup: Prompting to make entry	rotary knob + OK
-	U	Set configuration	In Setup: Prompting to make entry	rotary knob + OK
-	U	System is locked.	In Setup: no access authorization	Config. code needed to obtain access.
-	U	Values are fixed.	In Setup: no access authorization.	Password needed to obtain access.
-	U	Unknown message	A user message has been called that is unknown to the system.	Software trouble - must not occur during operation

8.4.3 Operational Messages about Switching Conditions

The following operational messages inform the user about the switching conditions prior to "HVon" and about the cause of shut-down after "HVoff". These messages need to be confirmed by the operator with "OK" unless they disappear on their own accord after having set a switching condition.

Code	Cl.	Operational message	Description	Input
-	C	Checking...	After the parameters have been set, the switching conditions are being queried.	No action required, only information
-	C	HV interlock	Detachable key switch is switched off.	Switch detachable key switch on
-	C	Emergency switch	Internal emergency switch has tripped.	Switch emergency switch on
-	C	Ext. safety loop	External safety loop is open.	Close emergency loop
-	C	Door contact(s)	At least one door contact is open.	Close doors of vehicle
-	C	Module coupling	Connection between modules is interrupted..	Connect modules
-	C	SF6 pressure	SF6 gas pressure in HV switching system is below rated value.	Gas pressure monitor at present not functional, check signal on module
-	C	Humidity sensor	Degree of dew condensation on system is above permissible limit.	Dew monitor at present not functional, check signal on module, if need be
-	C	HV connector	The HV cable is not properly connected at the HV connector	Connect the HV cable
-	C	Ground monitor	Earth monitoring is reporting inadequate protective earth connection.	Check the electrical connections / grounding conditions
-	C	Cable shield	Earth monitoring is reporting inadequate operational earth connection.	Check the electrical connections / grounding conditions

Code	Cl.	Operational message	Description	Input
-	C	Breakdown in cable	High voltage has been switched off by system after breakdown in cable.	Possible result of a cable test
-	C	Cannot be charged	High voltage has been switched off by system due to breakdown of voltage.	Possible result of a cable test
-	C	Test time over	High voltage has been switched off by system after test time has elapsed.	No action required
-	C	HVoff by OWTS-M	HV is switched off via the connected OWTS system	No action required
-	C	HVoff by system	High voltage has been switched off by system after a fault has occurred.	No action required, refer to error list
-	C	Unknown message	A condition message has been called up that is unknown to the system.	Software trouble - must not occur during operation

8.4.4 Error Messages and Warnings

With the exception of operating errors, every error, once it has occurred, is reported by way of a two-digit error code. Each of these messages needs to be confirmed by the operator with "OK", further procedures are determined by the system.

Code	Cl.	Operational message	Description	Input
00	F	Unknown error	An error message has been called that is unknown to the system.	Software trouble - must not occur during operation
01	F	Event overflow	The software buffer of events in the master has overflowed.	Software trouble - may occur during operation only if there is an unusual accumulation of errors
02	F	Slave not found	The master has not received any acknowledgement of receipt from the slave via LON.	LON Bus / wiring / power supply
03	F	Slave not ready	The master has not received any confirmation from the slave on its request.	LON Bus / wiring / power supply
04	F	Unknown slave	The software version of the slave is not compatible with the software version of the master.	Insert Slave PROM with suitable software version
05	F	Master timeout	Communication between master and slave is interrupted (slave does not respond).	LON Bus / wiring / power supply
06	F	P-node missing	A protocol node registered in Setup does not answer to the network.	Check protocol node and its linkage as well as power supply
07	F	Config. restart	The system needs to be rebooted after the device configuration has been changed.	Initiate restart by confirmation of error message
08	F	State mismatch	The slave is unable to carry out the requested transition of condition.	Software trouble - must not occur during operation

Code	Cl.	Operational message	Description	Input
09	F	Unknown master	The software version of the master is not compatible with the software version of the slave.	Insert Master Flash with appropriate software version
10	F	Slave timeout	Communication between master and slave is interrupted (master does not respond any more).	LON Bus / wiring / power supply
11	F	Slave is locked	The slave does not perform a task requested by the master owing to preceding errors.	Software trouble - must not occur during operation
12	F	VOK malfunction	The so-called operation stand-by of module "Control node VLF..." has broken down.	Check hardware signal VOK on module, check cable between LON and module
13	F	SPI data error	In the slave the exchange of data between LON node and module "Control" is interrupted.	Hardware damage / EMC trouble in module, check cable between LON and module
14	T	Parameter error	The slave does not perform any parameter setting because the set of parameters is faulty.	Software trouble - must not occur during operation
15	T	Turn on failed	Error when opening the discharge unit and/or when switching the HV source(s) on.	Check return and control lines to discharge unit and HV sources
16	T	NOT DISCHARGED	Danger ! The system cannot ensure proper discharging after "HVoff".	Manually discharge by external means, check return and control lines to discharge switches
17	T	Turn off failed	Error when closing the earthing switch and/or when switching the HV source(s) off.	Check return message and control lines to discharge switches and HV sources
18	N	HVon line error	In the slave the so-called HV contactor (module: K2) is reported switched on in spite of being locked	Check control line of relay K2 as well as hardware signal KISON on module

Code	Cl.	Operational message	Description	Input
19	N	Jumper changed	Jumper coding of module "Control node VLF..." has been changed during operation.	Undo changes or make changes only when system is switched off
20	N	Module coupling	The connection between the modules of the system has been interrupted.	Restore connection, check hardware signal COUPL on module
21	N	SF6 pressure	The SF6 gas pressure in the HV switching system is below limit.	Gas pressure monitor at present not functional, check hardware signal PRESS on module
22	N	GND SWITCH OPEN	Danger! The system cannot ensure proper earth protection. (only 80 kV systems)	Manually discharge by external means, check return and control lines to discharge switches
23	N	Feed switch on	At least one of either charge switches has not opened.	Check control of either charge switches and hardware signal XXXn on module
24	N	Dischg. switch	The discharge switch has not opened.	Check control of discharge switch and hardware signal XXXn on module
25	N	HV source on	Return message from a switched-off HV source reports source switched on.	Check HV sources, their mains lines as well as hardware signals N/PISON on module
26	N	HV source(s) !	The return messages expected from either HV sources have broken down or are wrong.	Check HV sources, their mains fuses and hardware signals N/PISON on module
27	N	Coil overload	Current monitor in slave reports overcurrent through the VLF ring-around coil.	Reduce load at HV output of system or magnitude of high voltage
28	N	HV polarity +	Polarity monitor in slave reports wrong (positive) polarity at HV measuring divider.	Check operation of HV thyristors (ring-around may have not taken place)
29	N	HV polarity -	Polarity monitor in slave reports wrong (negative) polarity at HV measuring divider.	Check operation of HV thyristors (ring-around may have not taken place)

Code	Cl.	Operational message	Description	Input
30	N	VOLTAGE FOUND	Danger! Voltage monitor in reports residual voltage at HV measuring divider.	Eliminate possible residual voltage manually. Check discharge switches and voltage monitoring.
31	N	Overvoltage	Voltage monitor in slave reports overvoltage at HV measuring divider.	Check voltage control of HV sources, check measuring divider
32	N	Meas. Overflow	Voltage monitor in slave reports overflow of voltage divider.	Hardware damage / EMC trouble on module, check HV measuring divider
33	N	Card removed	The system card has been removed during a cable test.	Remove the system card only after the cable test has been finished!
34	N	Card is full	The system card is full prior to or during the cable test.	The required memory space on the card can only be guessed before testing.
35	N	Bad card format	There is a formatting error on the system card.	Card/Device/Command Header erroneous, print text line too long, Data Page not empty
36	N	No card access	Some error has occurred when reading from or writing on system card.	Access to card is via I ² C-Bus in protocol node. Contacts of card clean ?
37	N	Protocol error	There has been an error in the timing of measuring data and their recording in the protocol.	The protocol node checks the measuring data received from contro node with time stamp.
38	W	Config. changed	The jumper encoding of module "Control node VLF..." is found changed during start-up.	Any change to the encoding is reserved to the Customer Service and manufacturer!
39	W	Memory written	Non-volatile device settings have been reset to their default values at the time of delivery.	This is a receipt message after "Reload setup" or "Delete texts".
40	W	Bad card param.	Erroneous parameters found on the system card have been reset to default values.	Call parameters up to display (also in Setup) and check their usability.

Code	Cl.	Operational message	Description	Input
41	W	Setup is faulty	System of conditions on master inhibits start of HV operation if user level is inappropriate.	Software trouble - must not occur during operation
42	W	Access denied	Entered password is wrong and will be rejected.	To administrator, customer service und manufacturer: Enter correct password!
43	W	Access released	Entered password is right and will be accepted.	To administrator, customer service und manufacturer: Access to extended Setup is granted.
44	W	Not accepted	Entered password is illegal and will be rejected.	To administrator, customer service und manufacturer: Enter approved password!
45	W	Relaxed mode on	The slave is operating in Relaxed mode after the respective adjustment has been made in Setup.	Must not occur during operation - Relaxed mode is reserved for customer service!
46	W	DEMO MODE ON	The system has been set to demo mode via the setup menu.	Should not appear during regular operation. Demo mode is only for service purposes.
47	W	C-values stored	Calibration data have been changed by entry and stored on slave in non-volatile mode.	Any change of calibration data is reserved for customer service and manufacturer !
48	W	Not calibrated	System has not been calibrated / calibration data in slave have been lost (possibly only in parts).	Perform initial calibration / Call customer service, as initial calibration is reserved for customer service!
49	W	No print data	No data are available for built-in protocol printing.	Record protocol, data will be available till next "HVon".
50	W	Printer error	The built-in protocol printer is not ready for operation.	Check protocol printer and its linkage as well as power supply
51	W	IIC-Bus error	Some error has occurred when reading from or writing on the real-time clock.	Access to the real-time clock is via I ² C Bus in protocol node. System card involved?

Code	Cl.	Operational message	Description	Input
52	N	Check sum error	Some check-sum error has occurred when reading from the system card.	Data are stored on card in an EEPROM. Life time expired?
53	W	Unlocked system	Only in test lab: Automatic configuration interlock is blocked.	Only in test lab: Enable configuration interlock manually!
54	W	Code accepted	Entered configuration code has been accepted by the respective device.	Configuration authority has been granted, access to configuration setup is open.
55	W	Password stored	Entered administrator password has been stored and is accepted.	Help can be given quickly should you have forgotten your password (specify Device-ID).
56	N	Incompat. card	The system card contains a wrong Device-ID or Command-ID.	Check your version of "WinkisVLF" and perform an update if necessary.
57	N	OWTS version	the software version of the interface node is not compatible with the VLF system.	Update the interface node to a supported software version.
58	N	OWTS timeout	The communication between the OWTS interface node and the VLF test system is interrupted.	Check the connections to the OWTS system. Switch the OWTS on, if it is not already running.
59	N	OWTS sync error	The communication within the OWTS system (between interface node and PC) is interrupted.	Check the interface node and its connection to the RS232 interface of the PC. Check the version and functionality of the OWTS software.
60	N	OWTS comm error		
61	N	OWTS data error		
62	W	OWTS line test	Test reports successful communication between OWTS and VLF system.	Two-stage test, see OWTS manual for details.
63	W	OWTS ignored	The OWTS system is not configured in the VLF test system.	Enable the "OWTS-System" option in the system configuration of the VLF test system.
64	F	Illegal config.	Configuration data of master and slave differ.	Software problem. Must not appear during regular operation.

Code	Cl.	Operational message	Description	Input
65	N	NOT GROUNDED	Danger! The system cannot ensure proper discharging after "HVoff". (only 80 kV systems)	Manually discharge by external means, check return and control lines to discharge switches
66	N	Cal. by DC only	The system cannot be calibrated in the active operation mode.	Only for service: Choose DC mode
68	W	Mainten. Required	Maintenance is required due to the high amount of operating hours.	Please make an appointment with your nearest Megger service station.



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.



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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 изхвърля 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 jäätmeaialuspunkti. 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 kotilousjätteen 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 tsí seo a dhíúscairt sa chóras fuíoll teaghlaigh. Os rud é gur táirgeadh ghnó le gnó (B2B) é, ní féidir é a dhíúscairt ach oiread in ionaid dhíúscairthe phobail. Más mian leat an táirgeadh seo a dhíúscairt, déan é a thógáil ag eagraíocht gar duit a sainfheidhmiú in ndíúscairt sean-fhearas leictreach.



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 απορρίμματα. 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 termék tilos a háztartási hulladékokkal együtt kidobni. Mivel ez vállalati felhasználású termék, tilos a lakosság számára fenntartott hulladékgyűjtőbe 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.



Št zíme noráda, ka izstrādājumu, 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 rāda, kad jūo paženklīto 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'ghandux jintrema bhal skart normali tad-djar. Minhabba li huwa prodott B2B , ma jistax jintrema wkoll f'centri civici ghar-rimi ta' l-iskart. Jekk tkun tixtieq tarmi dan il-prodott, jekk joghgbok ghamel dan kif suppost billi tiehdu ghand organizzazzjoni fil-qrib li tispeccjalizza fir-rimi ta' taghmir qadim ta' l-eletriku.



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 spesialisert 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 deixado fora juntamente com o lixo doméstico normal. Como se trata de um produto B2B, também não pode ser deixado fora em centros civicos 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 și un gunoi menajer obișnuit. Deoarece acesta este un produs B2B, el nu trebuie aruncat nici la centrele de colectare urbane. Dacă vreți să aruncați acest produs, vă rugăm s-o faceți într-un mod adecvat, ducându-l la cea mai apropiată firmă specializată în colectarea echipamentelor electrice uzate.



Tento symbol znamená, že takto označený výrobek 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 gospodinske 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 señalado 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 avfallshandera den här produkten på rätt sätt, ska ni lämna den till myndighet eller företag, specialiserad på avfallshandering av förbrukad elektrisk utrustning i ert närområde.