Megger

Test and Diagnosis System

TDS40 / TDS60

(Stand-alone test operation)

Operating Manual

Issue: 01 (01/2014) - EN
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Consultation with Megger

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

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

Should any question remain unanswered or should you need the help of an authorized service station, please contact:

Megger Limited

Archcliffe Road
Kent CT17 9EN

T: +44 (0) 1304 502100

F: +44 (0)1 304 207342

E: uksales@megger.com

Seba Dynatronic

Mess- und Ortungstechnik GmbH

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

T: +49 / 9544 / 68 – 0

F: +49 / 9544 / 22 73

E: sales@sebakmt.com

Hagenuk KMT

Kabelmesstechnik GmbH

Röderaue 41
D - 01471 Radeburg / Dresden

T: +49 / 35208 / 84 – 0

F: +49 / 35208 / 84 249

E: sales@sebakmt.com

Megger USA

4271 Bronze Way
Dallas, Texas 75237-1019 USA

T: 1-800-723-2861

F: 1-214-331-7399

E: DEanfrage@megger.com

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

This warranty does not cover wear parts, lamps, fuses, batteries and accumulators.

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

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

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

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

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

Since some states do not allow the exclusion or limitation of an implied warranty or of consequential damage, the limitations of liability described above perhaps may not apply to you.

INHALTSVERZEICHNIS

Abbildungsverzeichnis

1. GENERAL INTRODUCTION

The test and diagnosis system TDS40/60 shall be used for the stated field of application in cable diagnosis and cable testing only. Any other application is strictly forbidden! Megger 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 chapter1 whenever you use the TDS40/60.

Each person involved in the assembly, operation, maintenance, and repair of the TDS40/60 is required to have read this handbook carefully.

Only trained and/or instructed staff are permitted to deal with the TDS40/60 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 TDS40/60 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 TDS40/60 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 test and diagnosis system TDS40/60 is an upright device and has to be only transported and operated in upright position.

1.1 General Instructions

Safety precautions

This manual contains basic instructions for the commissioning and operation of the device / system. For this reason, it is important to ensure that the manual is always available to the authorised and trained operator. He needs to read the manual thoroughly. The manufacturer is not liable for damage to material or humans due to non-observance of the instructions and safety advices provided by this manual.

Locally applying regulations have to be observed!

Labelling of safety instructions

The following symbols may be present on the packaging material, on the instrument and in the manual:

Symbol	Description
 **WARNING**	Indicates a potential danger of an electric shock that may result in fatal or serious injury.
 **CAUTION**	Caution (refer to accompanying manual for instructions)! Indicates a potential danger that may lead to slight or moderate injury.
	The notes contain important information and useful tips for using the system. Failure to observe them can render the measurement results useless.

Working with products from Megger

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

After working on the system, it must be voltage-free and secured against reconnection as well as having been discharged, earthed and short-circuited.

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

Operating Staff

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

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

Declaration of Conformity (CE)

The product meets the following security requirements of the European Council Directives:

- EMC Directive (2004/108/EG)
- Low Voltage Directive (2006/95/EG)

1.2 General Safety Instructions and Warnings

Intended application

The operating safety is only guaranteed if the delivered system is used as intended. Incorrect use may result in danger to the operator, to the system and the connected equipment.

The limits described under Technical Data may not be exceeded.

Behaviour at malfunction of normal operation

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

Five safety rules

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

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

Using cardiac pacemaker

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

Firefighting in electrical installations

- According to regulations, carbon dioxide (CO2) is required to be used as extinguishing agent for fighting fire in electrical installations.
- Carbon dioxide is electrically non conductive and does not leave residues. It is safe to be used in energized facilities as long as the minimum distances are maintained. A CO2 fire extinguisher must be always available within electrical installations.
- If, contrary to the regulations, any other extinguishing agent is used for fire fighting, this may lead to damage at the electrical installation. Megger disclaims any liability for consequential damage. Furthermore, when using a powder extinguisher near high-voltage installations, there is a danger that the operator of the fire extinguisher will get an electrical shock from a voltage arc-over (due to the powder dust created).
- It is essential to observe the safety instruction on the extinguishing agent.
- Applicable is DIN VDE 0132.

WARNING

Dangers when working with high voltage

Working on high voltage systems and equipment – especially in non-stationary operation – requires particular care and safety-conscious action on the part of test personnel. VDE regulations 0104 on setting up and operating electrical test systems, as well as EN 50191 and national standards and regulations must be strictly adhered to.

- The test system generates a dangerous test voltage of up to 40 resp. 60 kV_{PEAK}.
- The test system may not be operated without supervision.
- Never fail to use safety equipment or put it out of operation.
- Operation requires minimum two people whereas the second person must be able to activate the emergency switch in case of danger.
- To prevent dangerous charge accumulation, earth all metal parts in the vicinity of the high voltage equipment.

2. TECHNICAL DESCRIPTION

2.1 Description of the Functions

The test and diagnosis system TDS40/60 enables the standard-compliant testing of medium voltage cables and other equipment with a 0.1 Hz cosine rectangular test voltage of up to 40 kV_{PEAK} or 60 kV_{PEAK}.

With the help of such a cable test, operation-endangering faults as well as insulation faults (e.g. water tree damages in PE/XLPE cables or local damages in PILC cables) can be safely brought to failure. Due to the integrated breakdown detection, this test process takes place without damage to the fault-free cable insulation.

In combination with the partial discharge measurement system PDS60, the TDS40/60 forms a fully adequate diagnosis system (TDS NT) which is suitable for the partial discharge diagnosis on medium voltage cables according to the standards. In this stage of expansion the system is operated by remote control and can be operated in the VLF or DAC (damped AC) mode.

This manual solely describes the operation of the test and diagnosis system TDS40/60 in the stand-alone test operation. For information regarding the connection of the partial discharge measurement system PDS60 and the remote operation of the system please read the manual of the diagnosis system TDS NT.

2.2 Model Options

The model options of the test and diagnosis system differ in the following attributes:

TDS40Basis	40 kV test voltage; only negative voltage source
TDS40Plus	40 kV test voltage; negative and positive voltage source (higher test performance as a result)
TDS60Basis	60 kV test voltage; only negative voltage source
TDS60Plus	60 kV test voltage; negative and positive voltage source (higher test performance as a result)

2.3 Technical Specifications

Parameter	TDS40	TDS60
Output voltage DC	3 … 40 kV	3 … 60 kV
Output current source	7 mA	5 mA
Leakage current measurement (optional) Range of indication Resolution of indication	 0 - 7 mA 10 µA	 0 - 5 mA 10 µA
VLF-test Output voltage Frequency Voltage form	 3 … 40 kV_{PEAK} 0,1 Hz cosine rectangular	 3 … 60 kV_{PEAK} 0,1 Hz cosine rectangular
Sheath fault location Voltage Pulse rate	 3 … 10 kV 4 s (1:3), 4 s (1:5), 6 s (1:5), 6 s (1:9)	
DAC-operation Output voltage Frequency	 3 … 40 kV_{PEAK} 58 … 410 Hz	 3 … 60 kV_{PEAK} 58 … 475 Hz
Testable cable capacitance in the VLF-operation	(also see section 2.6)	
for full operating temperature range	2,2 µF (Basis) 4,4 µF (Plus)	0,8 µF (Basis) 1,6 µF (Plus)
At normal temperatures (≤20 °C) and with restrictions regarding the accuracy of the leakage current measurement values	2,4 µF (Basis) 4,7 µF (Plus)	1,0 µF (Basis) 2,0 µF (Plus)
Cable capacitance to be tested in the DAC-mode	(see section 2.7)	
Discharge device	integrated, 4,7 µF in 5 s	integrated, 2,0 µF in 2 s
Power supply	230 V ±10 %, 50 ... 60 Hz or optionally 120 V ±10 %, 60 Hz	
Power consumption	max. 500 VA	
Operating temperature range	-25 °C ... +55 °C	
Storage temperature range	-40 °C ... +70 °C	
Operating humidity	30 °C, 93% rel. humidity	30 °C, 93% rel. humidity up to 50 kV 30 °C, 70% rel. humidity from 50 to 60 kV

Parameter	TDS40	TDS60
Protection class (in accordance with IEC 61140 (DIN VDE 0140-1))	I	
Ingress protection rating (in accordance with IEC 60529 (DIN VDE 0470 1))	IP21	
Dimensions (W x H x D)	56 x 113 x 41,5 cm	62,5 x 118 x 62 cm
Weights (according to stage of expansion)	55 kg + 48,5 kg (Basis) 55 kg + 55,5 kg (Plus)	85 kg + 48,5 kg (Basis) 85 kg + 55,5 kg (Plus)

2.4 Scope of Delivery and Options

Equipment	Power cord 2,5 m Earth cable 5 m HV connection cable 5 m HV connection clamp (red) with MC plug Operational earth connection adapter Manual Equipment case
Optional features	Detection of breakdown Leakage current measurement Logging Protocol printout
Optional equipment	External safety device (128309600)

2.5 Description of the Test Procedure with VLF-Voltage

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.

Nowadays we can 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 must meet the following demands:

- The repetition rate has to be so low, that the power that is set free in any existing PD-channel (PD = 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 hand, it must be fast enough that any space charge at the tip of a PD-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 quick polarity reversal taking place within a frequency close to the power frequency.

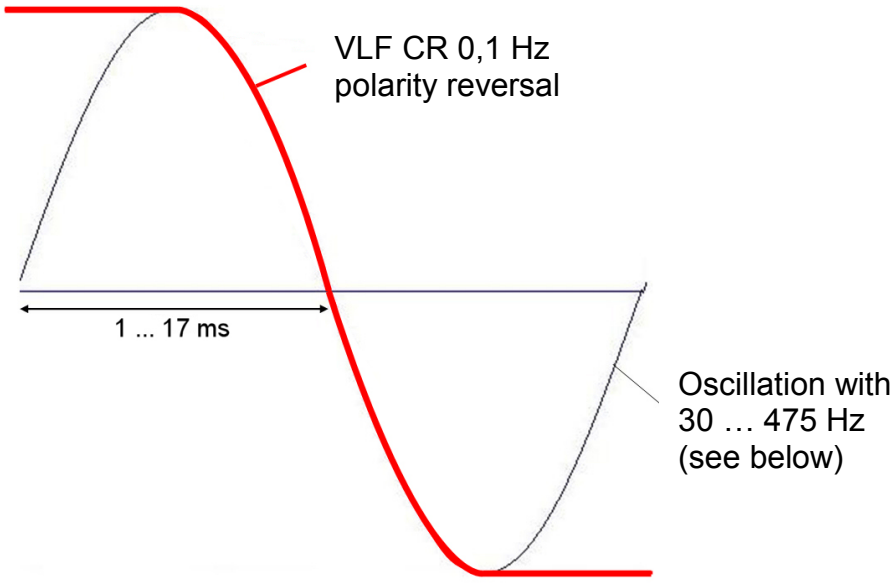


Fig. 1: Time frame of polarity reversal (type Plus)

Load-dependend frequency during polarity inversion:

TDS40Basis	40 ≤ f < 410 Hz
TDS40Plus	30 ≤ f < 410 Hz
TDS60Basis	55 ≤ f < 475 Hz
TDS60Plus	40 ≤ f < 475 Hz

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.

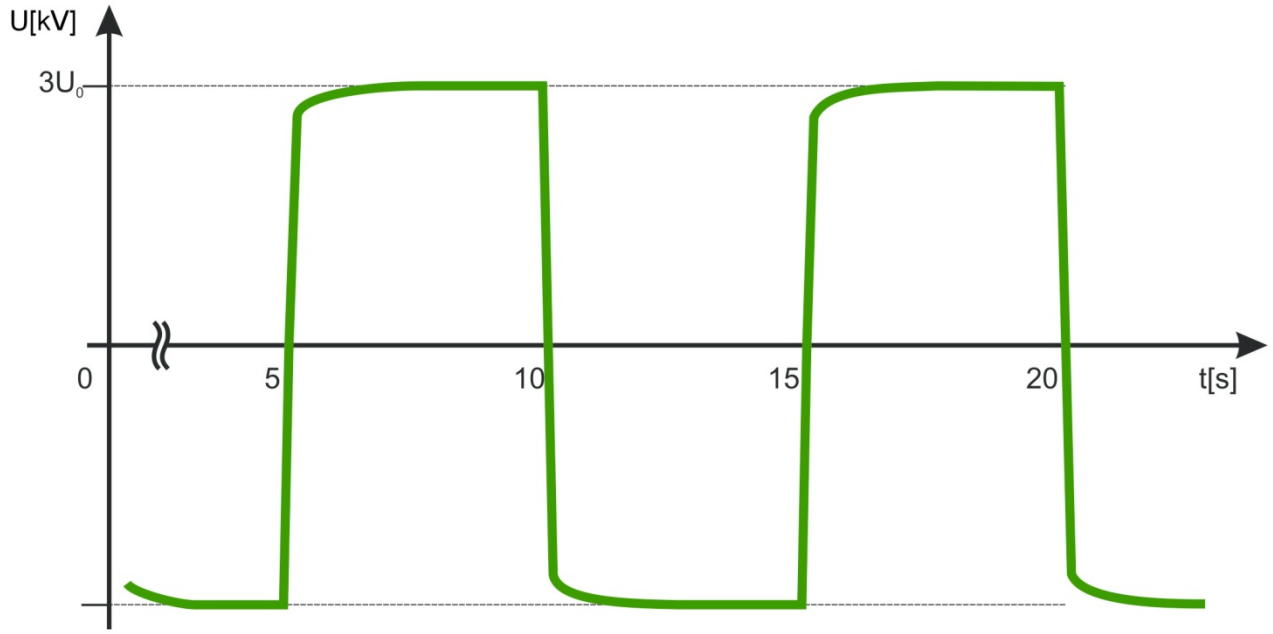


Fig. 2: Shape of 0.1 Hz cosine-rectangular VLF voltage (type Plus)

After a period of 5 seconds, the voltage source will be disconnected from the system resp. discharged via a resistance.

Subsequently, the polarity reversal is initiated. The test voltage changes its polarity from minus to plus.

Depending on the size of capacitance of the connected test object, time of the polarity reversal is between 1 and 17 msec.

Due to the losses which occur during the polarity inversion, the positive voltage is always decreased by these losses.

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

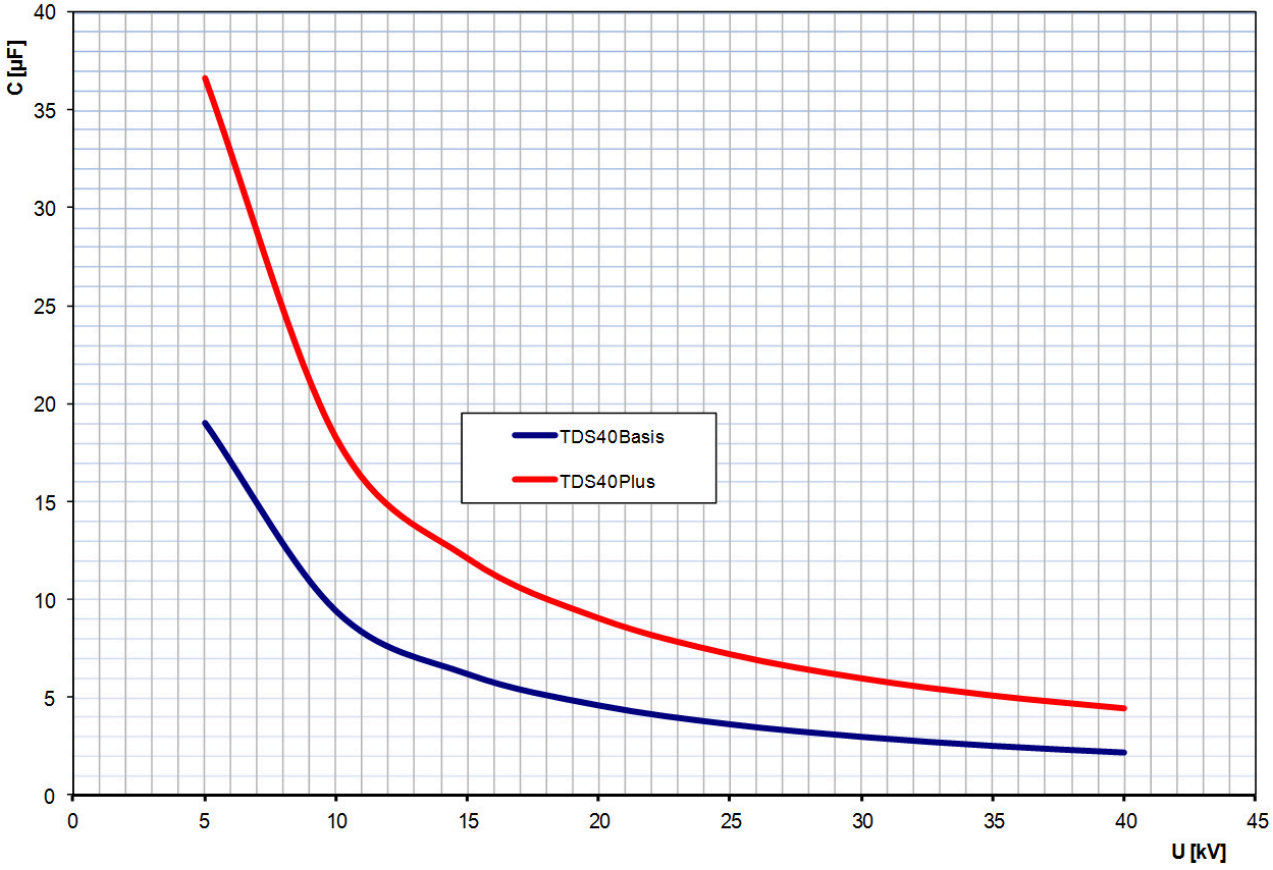
The negative voltage source is reconnected to the test object.

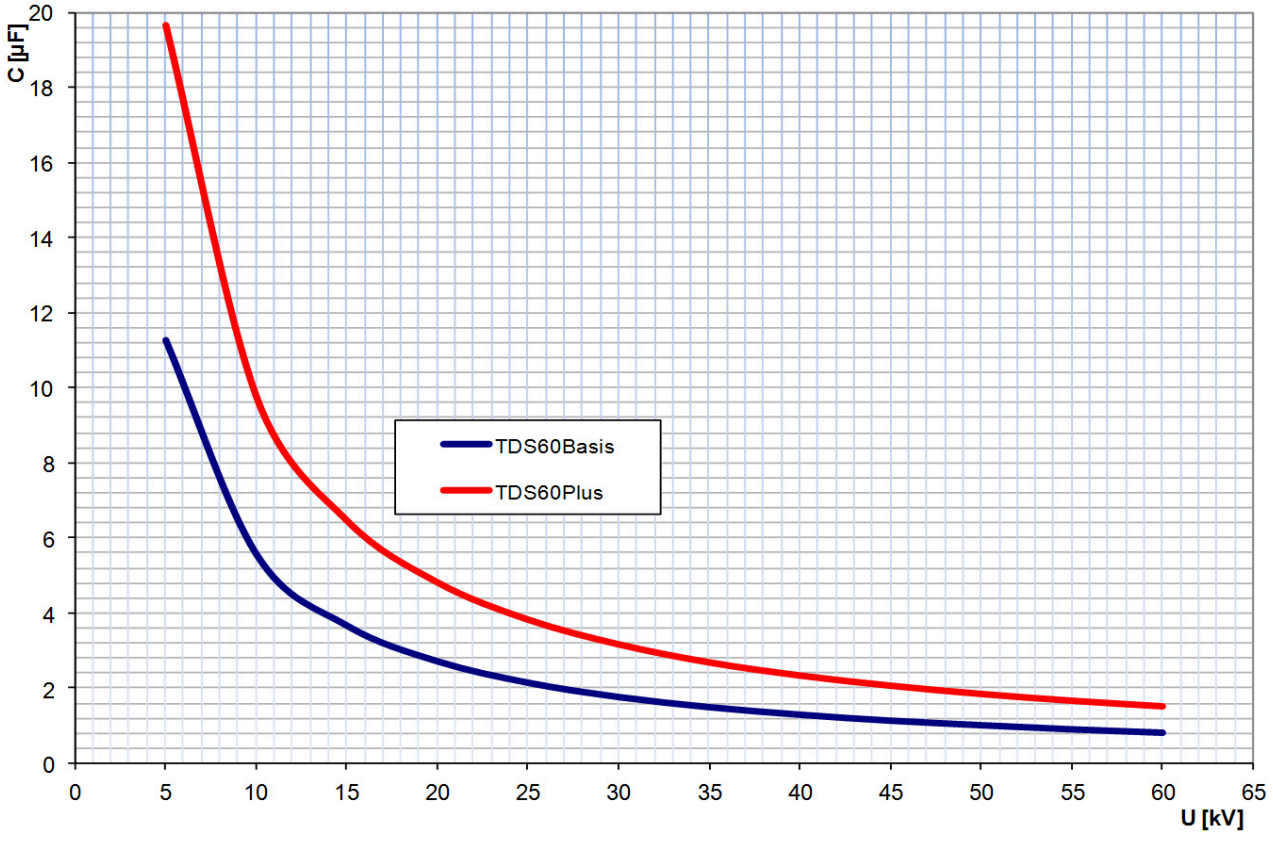
The loss of voltage caused by twice changing the polarity (device option Basis) will now be compensated for by recharging with the negative DC source. In contrast to this at the device option Plus the losses of a polarity reversal are immediately compensated.

The back-up capacitor has the following tasks:

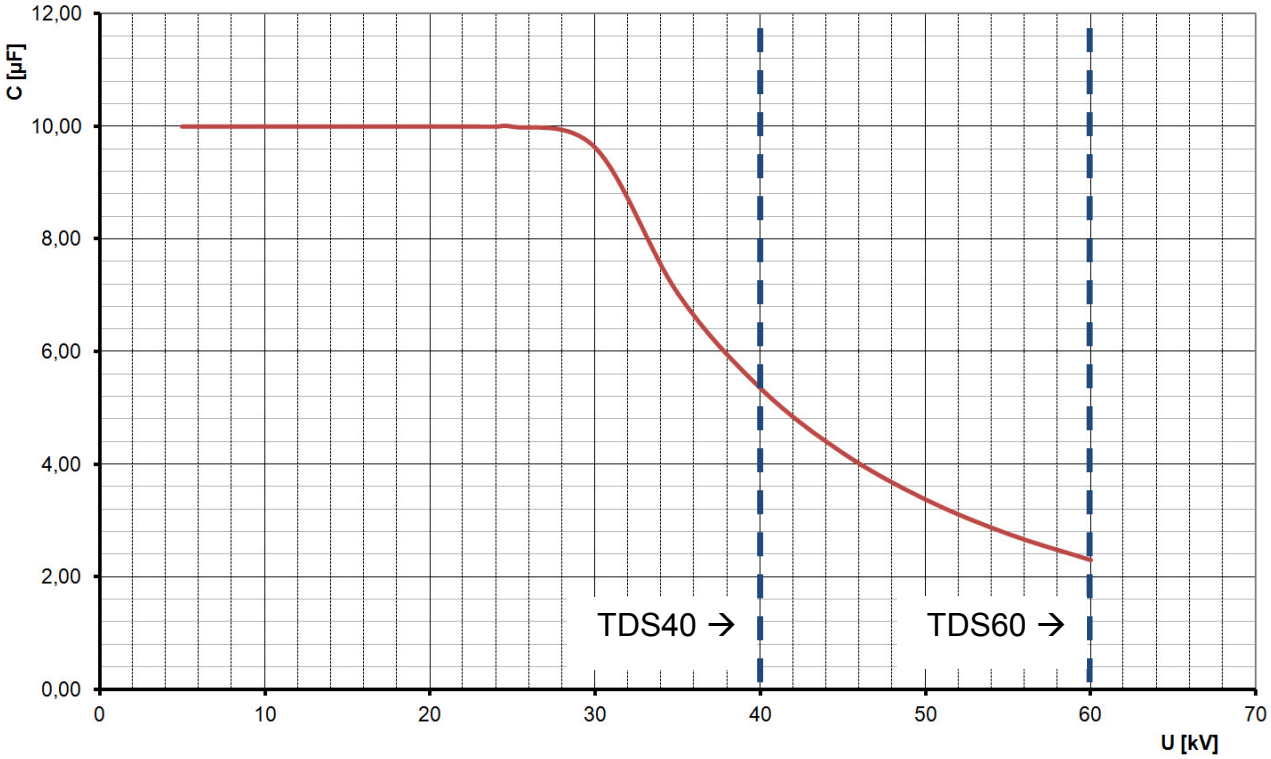
- It slows the ring-around event down to the msec range even for short cables,
- It compensates a part of the losses during the polarity reversal.

2.6 Testable Cable Capacitance in VLF Mode





2.7 Cable Capacitance that Can be Diagnosed in DAC Mode



2.8 Description of Components

2.8.1 Operating Module

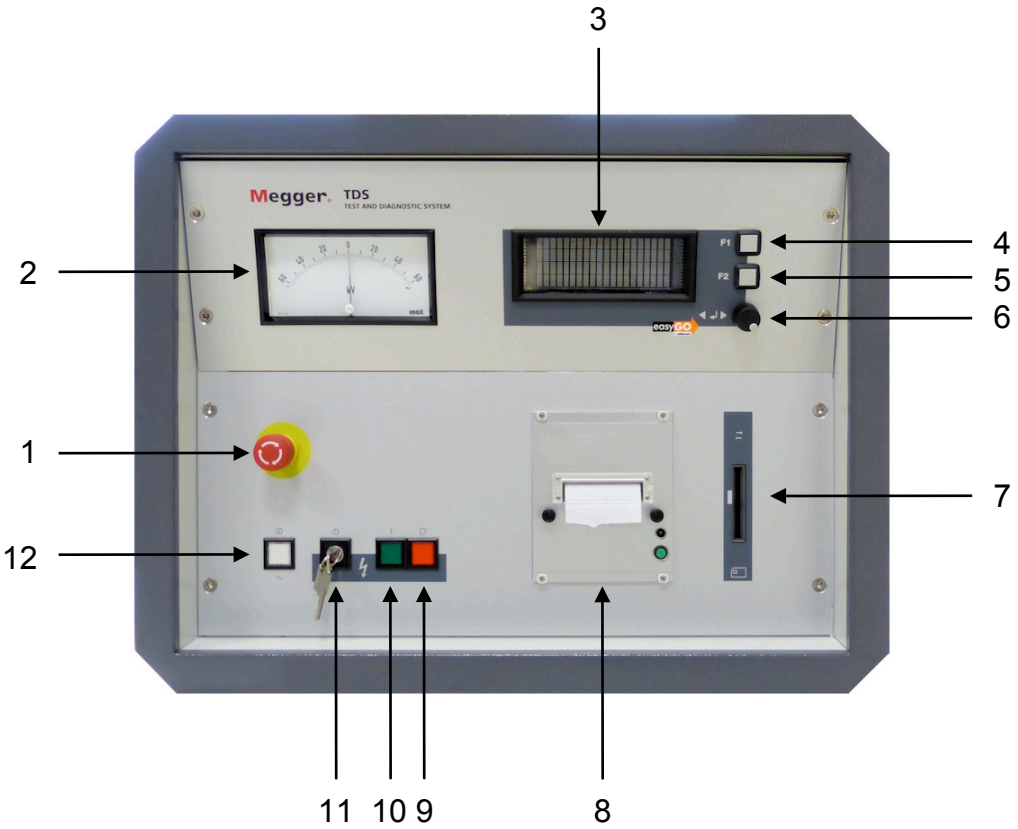


Fig. 3 Operating module - Front View

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 "HVOff" (red)
10	Key "HVOn" (green)
11	Key-operated switch "Interlock"
12	Key "Mains On" (white)

2.8.2 Display of the Operating Module

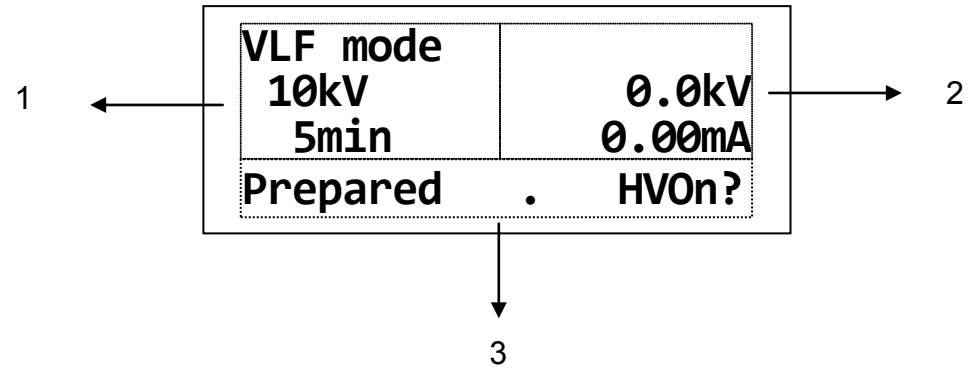


Fig. 4: Display of the Operating module (View of the standard operating mode)

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

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.

2.8.3 Connections

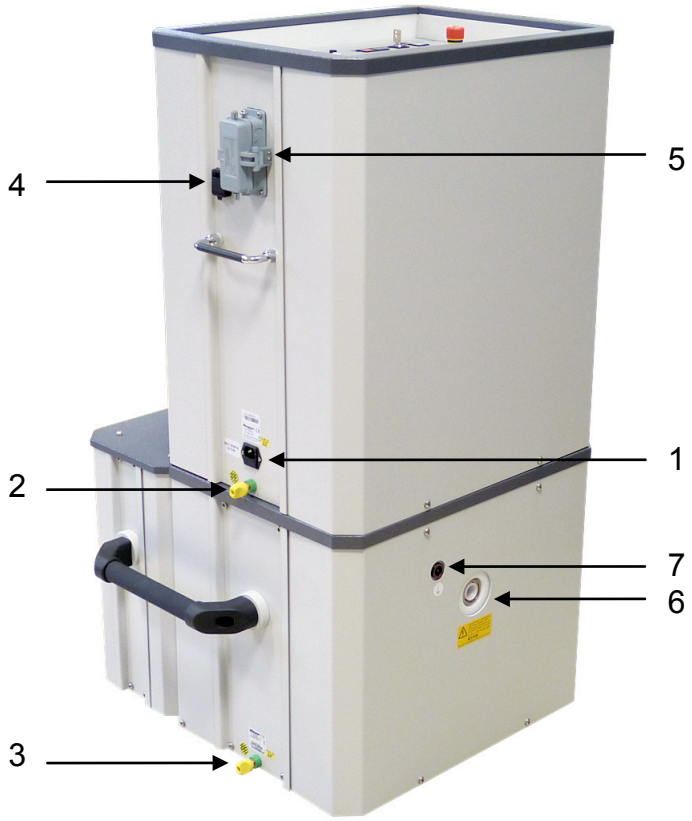


Fig. 5: Connections (in the example of the TDS60)

1	Power supply socket with F1, F2
2	Terminal clip for earth connection of the Operating module
3	Terminal clip for earth connection HV module
4	RJ45 network socket for the connection with the notebook (required for remote control)
5	Connector socket for connection line to PDS60
6	Test voltage output
7	Terminal clip for signal ground

2.8.4 Protection Covers of the Module

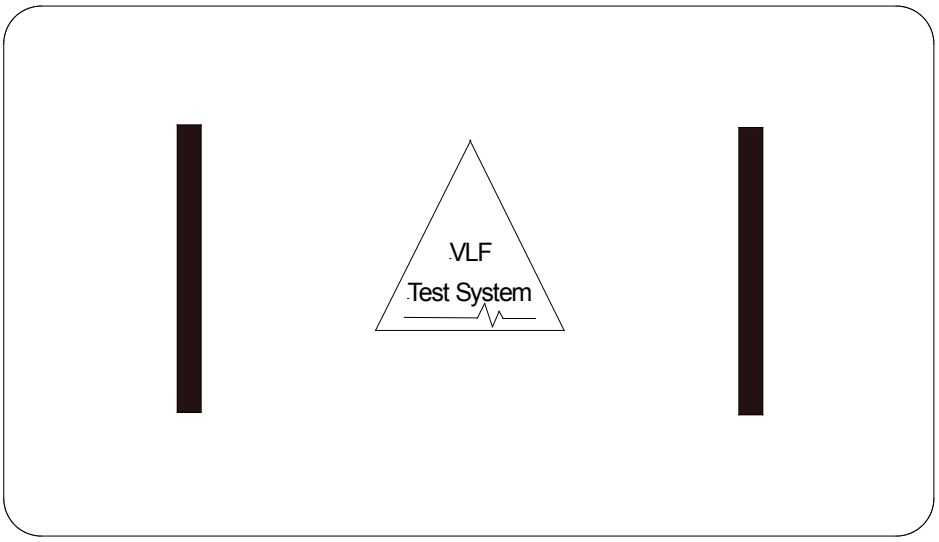


Fig. 6: Protection cover of the Operating module

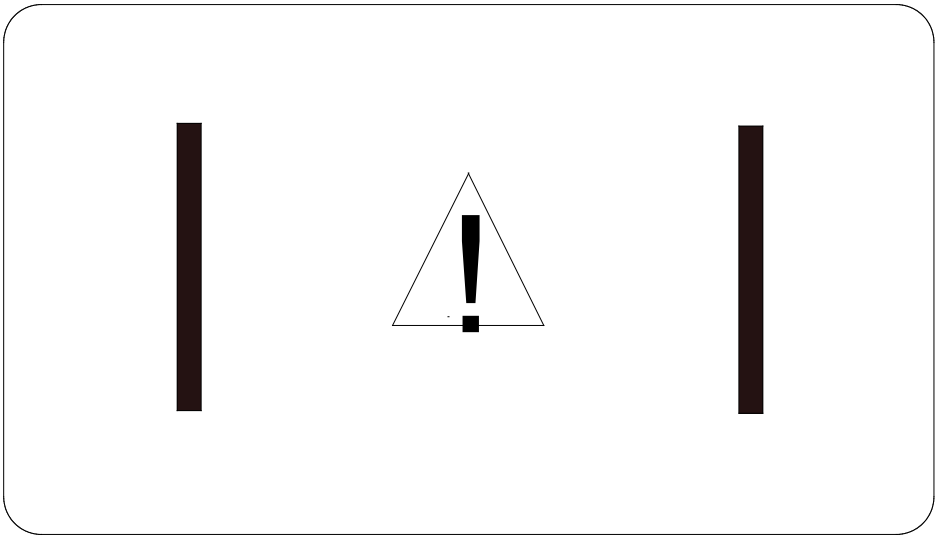


Fig. 7: Shorting device / Protection cover of the HV module

2.8.5 Transportation Protection Bottom from the Operating Module

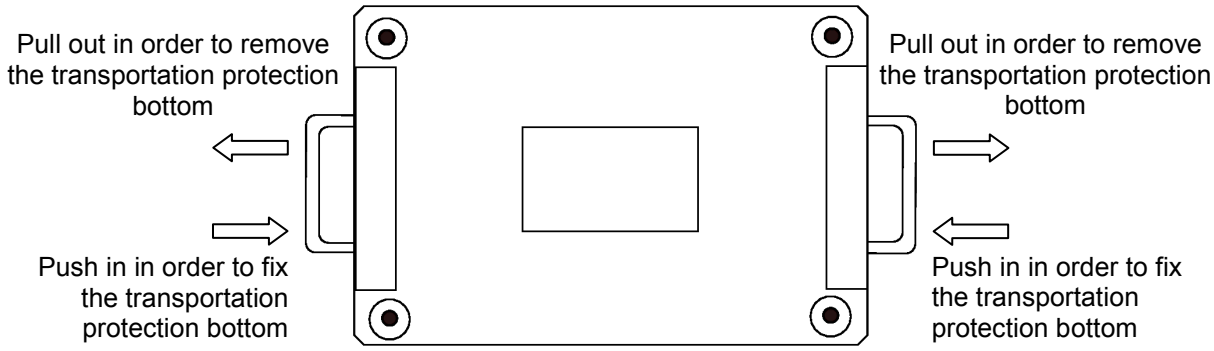


Fig. 8: Transportation protection bottom from the Operating module

3. SETTING UP OPERATION

3.1 Safety Precautions

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

- Disconnect the test object
- Protect it against reclosure
- Check for 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 test and diagnosis 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 and diagnosis system 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 weight. 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 test and diagnosis system. If due to the installation and operation of the test and diagnosis 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 test and diagnosis system TDS40 generates during the test process a dangerous test voltage up to 40 kV or the test and diagnosis system TDS60 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 test and diagnosis 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 test and diagnosis system unattended while operating.

In order to avoid dangerous charging, connect all metal parts in the vicinity of the test and diagnosis 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 if 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 with a suitable discharge rod.

Attention! The HV module of the test and diagnosis system 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. 7) 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:

* HV-connector (device side) and end termination (test object side) of the movable high-voltage connecting
* HV- output socket of the HV module
* HV connector between HV module and operating module

3.2 Electrical Connection for Stand-alone Test Operation

3.2.1 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!

3.2.2 Procedure

The descriptions in this section solely apply to the stand-alone operation. The features regarding the electrical connection in order to diagnose partial discharge are described in the manual of the diagnosis system TDS NT.

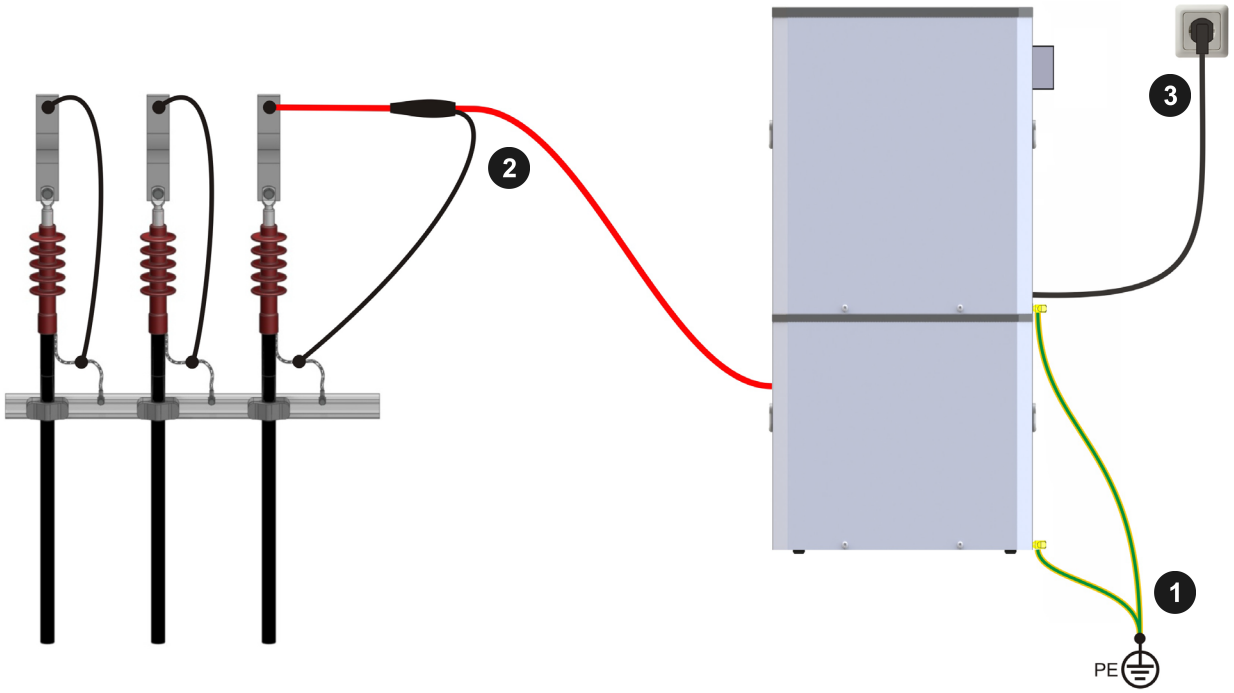


Fig. 9: Connection scheme

1 The earth cable has be connected to the protective earth system of the station at an appropriate point and then to be attached to the Terminal clips of the operating module (see Fig. 5, item 2) and of the HV-module (see Fig. 5, item 3).

2 The HV connection cable with its HV connector has to be plugged into the HV module (see Fig. 5, item 6) and to be fixed by turning the latch. The terminal clip for signal ground has to be plugged into the appropriate connection (see Fig. 5, item 7).

Afterwards the test cable is connected to the earthed test object.

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

3.2.3 Connection of the External Safety Device (Optional)

The optional external safety device can be connected in between the power outlet and the power inlet in order to ensure norm-compliant signalling and Emergency Stop according to DIN EN 50191 / VDE 0104.

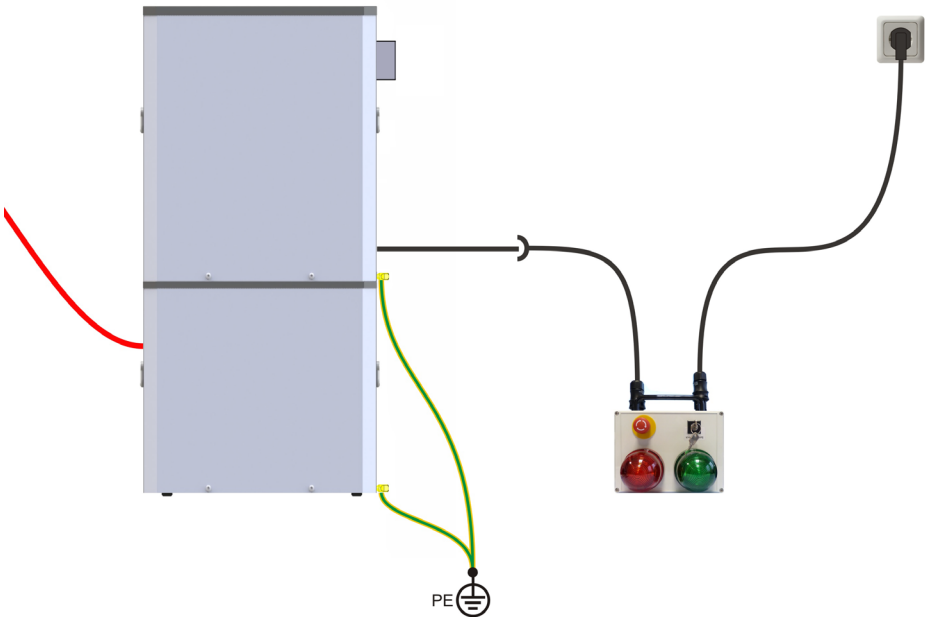


Fig. 10: Connection of the external safety device

As soon as the system has been connected to a mains outlet, the red signal light lights up and signals that high voltage could be generated.

By using the Emergency Stop button or key-operated switch, the power supply can be interrupted abruptly or be locked. A system that is currently operating is completed turned off and the discharge switch closed. High voltage cannot be generated, which is indicated by the green lamp.

4. Operating in Stand-alone Test Mode

This manual solely describes the operating of the test and diagnosis system TDS40/60 in the stand-alone mode. For information on operating the system by remote control in order to diagnose partial discharge please read the manual of the operating system TDS NT.

4.1 VLF- / DC-Test

For high voltage tests by using the test and diagnosis 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
 20kV          F1:Print
 15min         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
 20kV
 15min
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:

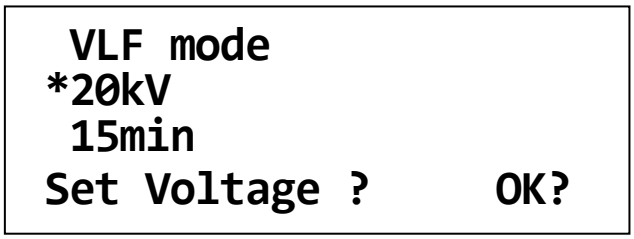


Fig. 13: Selection of the test voltage

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:

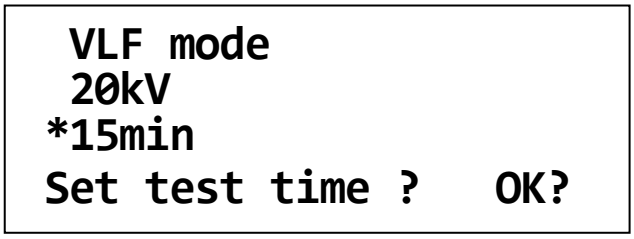


Fig. 14: Selection of the test time

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 Uo 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.

4.2 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 test and diagnosis 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).

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.

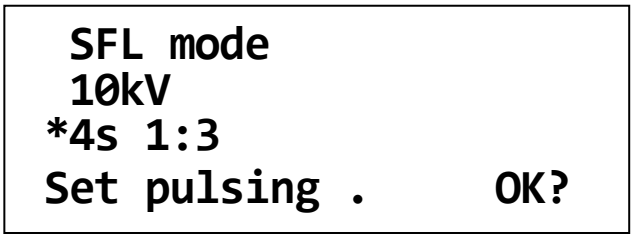


Fig. 15: Selection of the pulse rate

4.3 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.

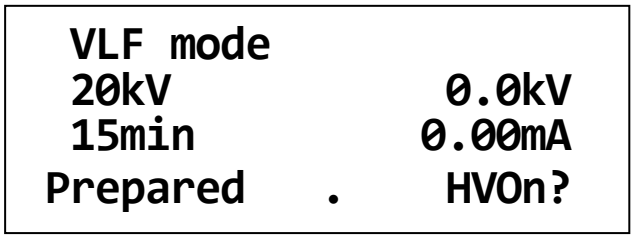


Fig. 16: Switching on high voltage

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 "HVOn" key (green) (Fig. 3, item 10) lights up for about 10 s and can be activated during this time. Afterwards, the "HVOff" 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).

By default, the measurement values for the voltage and the leakage current are updated every 5 seconds at a defined moment (in the VLF mode directly before the start of the polarity reversal. These logged measured values are displayed in square brackets (e.g. [10.1 kV]) and remain in the display until the next moment of the next measurement.

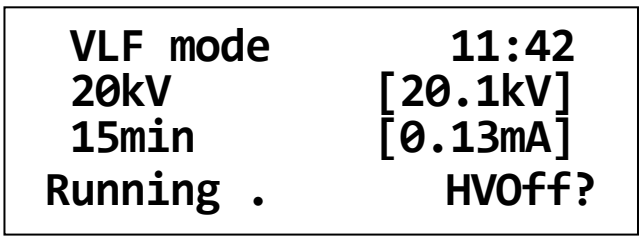


Fig. 17: Display of the logged measurement values

By using the menu button F2 (Fig. 3, item 5) the user can switch at any time to the display with the instantaneous data. The instantaneous data are displayed without square brackets and updated every 100 ms.

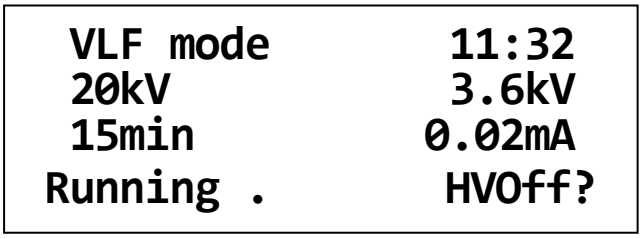


Fig. 18: Display of instantaneous data

If the button F2 is pushed again, the display changes back to the logged measured values.

Beyond this, by clicking the menu button F1, the user can switch between the display of the remaining time and the set voltage value (e.g. **!10.0 kV!**).

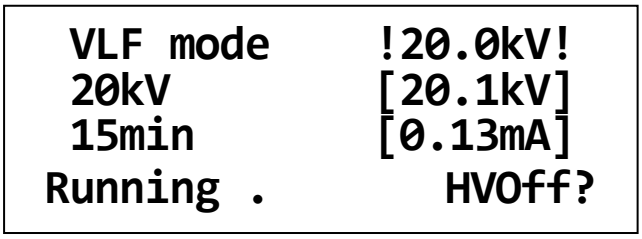


Fig. 19: Display of the set voltage value

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

- by pressing the "HVOff" 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.

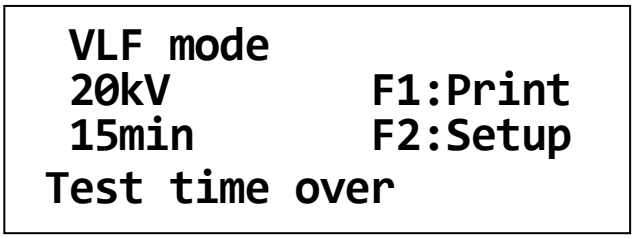


Fig. 20: Start menu after the test has been finished

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

- by activating the “Emergency Off” switch (Fig. 3; item 1),
- by turning the HV interlock key switch (Fig. 3; item 11)
- after drop out of the operating voltage
- by removing a system card which has been inserted prior to the test (see section 6.4)
- after detection of an internal failure (see section 7.5)

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 if 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.

5. Additional Functions

5.1 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 test and diagnosis system can be adjusted. Any new setting will be saved after pressing of the knob / push-button (Fig. 3, item 6).

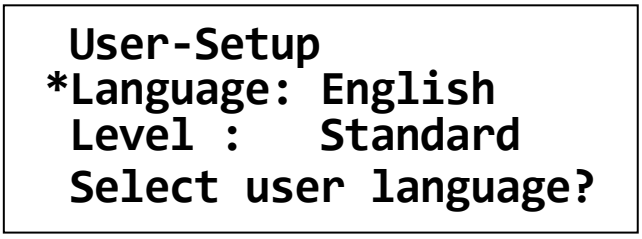


Fig. 21: User Setup: Language

5.2 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.

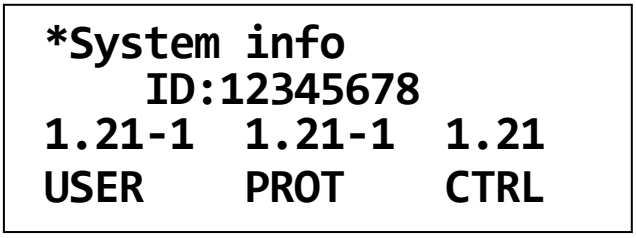


Fig. 22: Setup: System information

5.3 Viewing / Setting the System Parameters

Certain test parameters in the test and diagnosis system 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 5.4).

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 5.4), the following parameters can be adjusted:

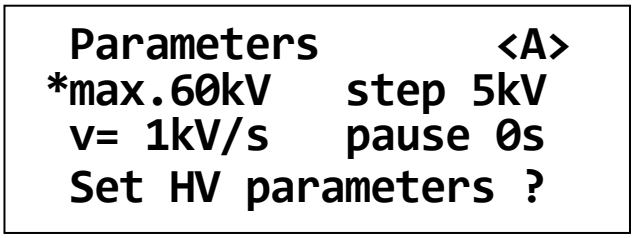


Fig. 23: Setup: Parameters

- 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.

5.4 Entering / Changing the Administrator Password

By pressing the F2 key “setup” (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 5.3). 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).

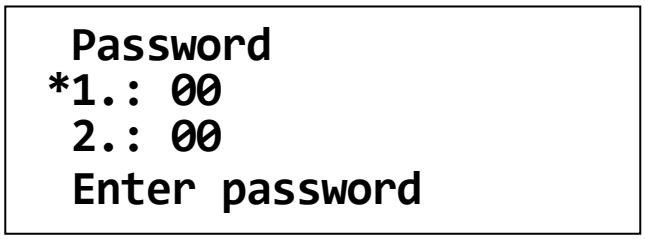


Fig. 24: Setup: Enter password

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.

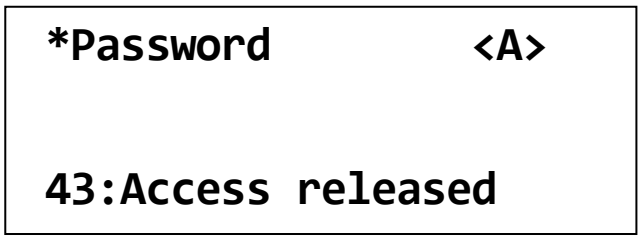


Fig. 25: Setup: Entered password ok

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).

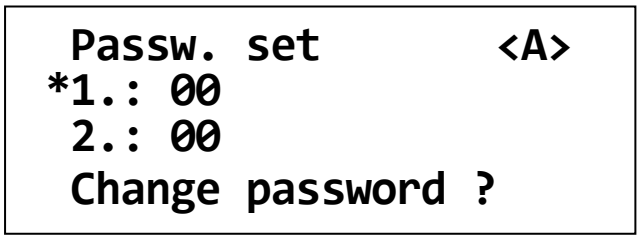


Fig. 26: Setup: Enter new password

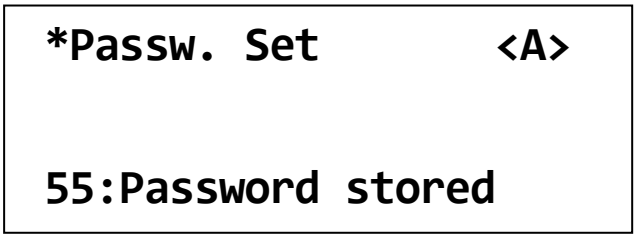


Fig. 27: Setup: New password stored

5.5 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.

Fig. 28: Setup: Return to start menu

6. Optional Features

6.1 Detection of Breakdown and Short Circuit

Systems with the optional breakdown and short circuit detection offers the following additional functions:

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.

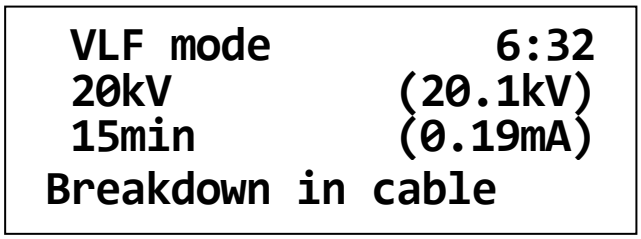


Fig. 29: Breakdown detection

6.2 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 test and diagnosis system has been additionally equipped with the logging option or protocol printout option, these measurement values can be additionally filed and printed out respectively.

6.3 Internal Protocol Printout

Systems, that are equipped with a protocol printer (Fig. 3, item 8), offer the opportunity to print those data that have been logged during the cable test.

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 settings 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.

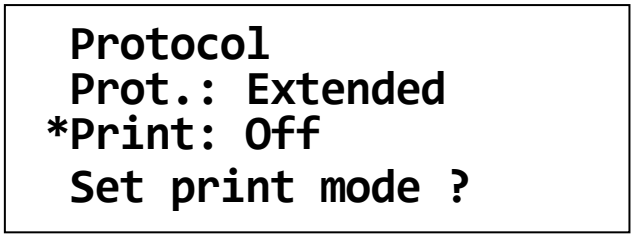


Fig. 30: Setup: Protocol printout off

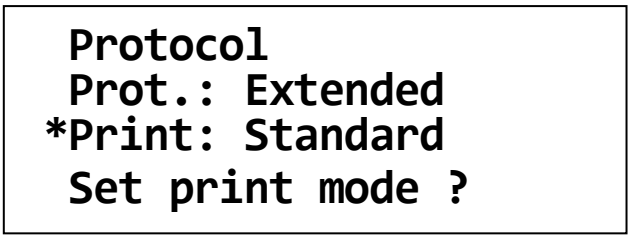


Fig. 31: Setup: Protocol Printout Standard

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 (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 6.4), 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.

These so called individual “**print templates**” can be imported into the system using a SystemCard (see section 6.4.2). 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)
    - If necessary, all calibration data from the system

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: a SystemCard is used with the system (see section 6.4), 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.

6.4 Cable Tests using a SystemCard

6.4.1 SystemCard and „WinkisVLF“

If the test and diagnosis system has been equipped with the logging option, the measured data can be saved 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 6.4.3) and to hand over predefined test parameters to the system (see section 6.4.2).

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 6.3) 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 6.3). 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 6.3).
- 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 6.3) which are also permanently stored on the system. **Attention:** This type of card cannot be used for storing measured data.

6.4.2 Parametrising the 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 6.3).

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 and diagnosis system right after the card has been plugged into the respective slot on the control unit (see section 6.4.4).

6.4.3 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 test and diagnosis system can be adjusted by rotating the knob / push-button and saved by pressing it.

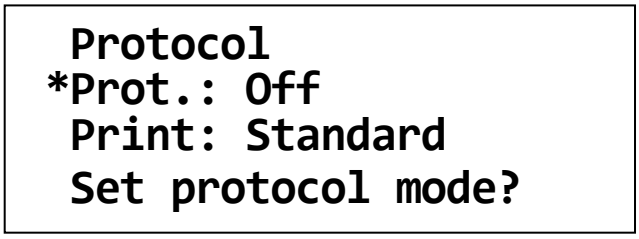


Fig. 32: Setup: Protocol off

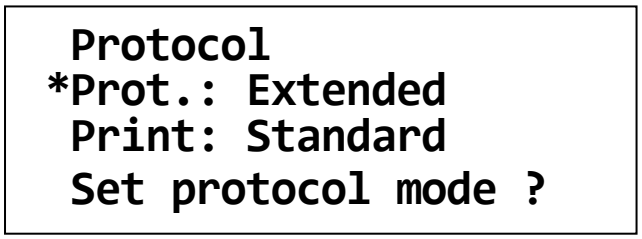


Fig. 33: Setup: Protocol extended

Depending on the logging mode, the following data are saved 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

- 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.

6.4.4 Operating the Test and Diagnosis System with a SystemCard

In order to use a SystemCard for parametrizing the test and diagnosis 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 “Proper 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 (Fig. 34):

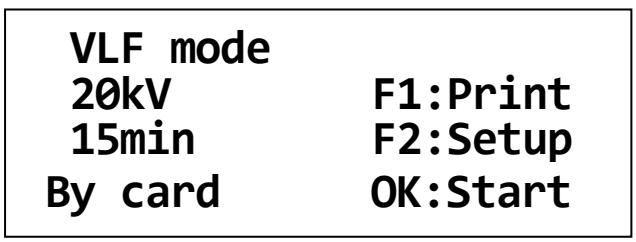


Fig. 34: Start menu with system card inserted

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 4.1.

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 6.4.1), 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.

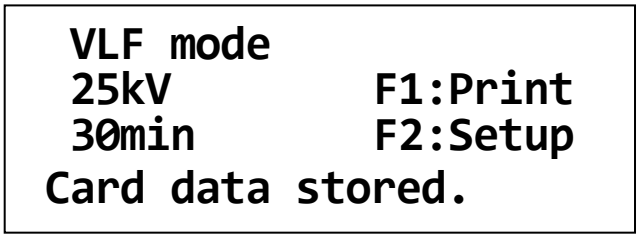


Fig. 35: Start menu after new system settings have been stored

6.5 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 5.4, the “User Setup” menu can be used to change the user level. That function is of importance when logging to SystemCard (see section 6.4.3) or parametrizing the system using a SystemCard (see section 6.4.2).

Fig. 36: 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.

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

The user interface of the test and diagnosis 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 5.4, 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.

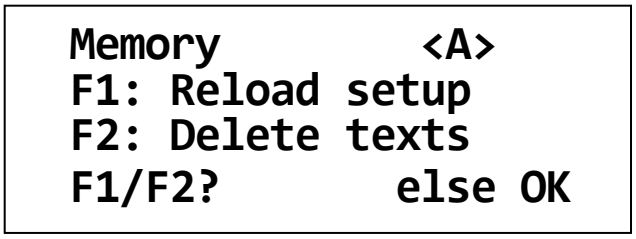


Fig. 37: Setup: Memory

„F1: Reload setup” resets all parameters and system settings to the default factory settings. The administrator password is not affected (see section 5.4).

“F2: Delete Texts” resets all print templates (individual header lines and footer lines) stored on the system (see section 6.3).

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

6.7 Adjustment of the System Time

If the test and diagnosis 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 7.3).

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 (test and diagnosis 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.

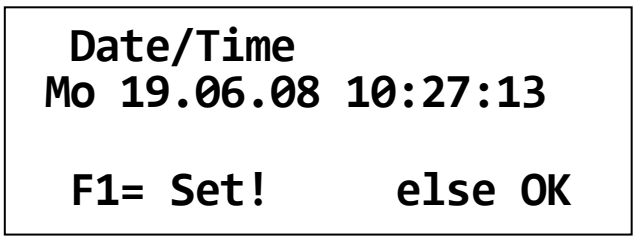


Fig. 38: Setup: Date / Time

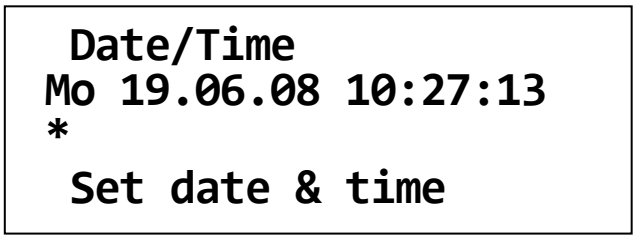


Fig. 39: Setup Date / Time: Adjusting the day of the week

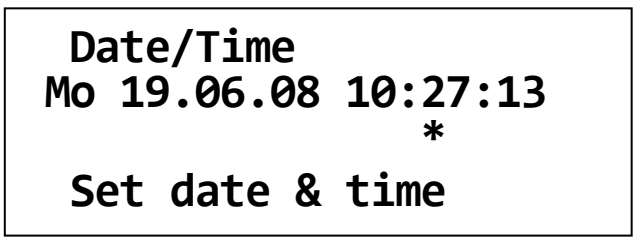


Fig. 40: Setup Date / Time: Adjusting the minutes

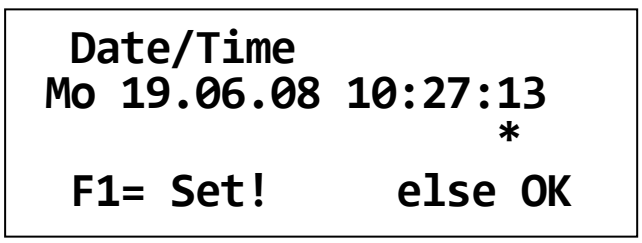


Fig. 41: Setup Date / Time: Saving by F1

7. Repair and Fault Diagnostics

Repair and maintenance work has to be carried out by Megger or authorised service partners using original spare parts only. Megger recommends having the system tested and maintained at a Megger service centre once a year.

This test allows, amongst others, checking the gas pressure of the discharge switch and the state of the HV switch.

Megger also offers its customers on-site service. Please contact your service centre as needed.

7.1 Replacing Fuses

If the device cannot be switched on, even though it is connected to the mains power supply, both fuses below the power supply socket must be checked. The fuse holder must be pulled out to do so.

If the fuses are defective, they must be replaced with suitable microfuses (5 x 20 mm) of the type T2.5A. Disconnet from the mains before changing a fuse.

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

7.2 Exchanging 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) Removing the front cover

Turn both knurled screws anti-clockwise (Fig. 42) until the front cover comes off the printer (Fig. 43).

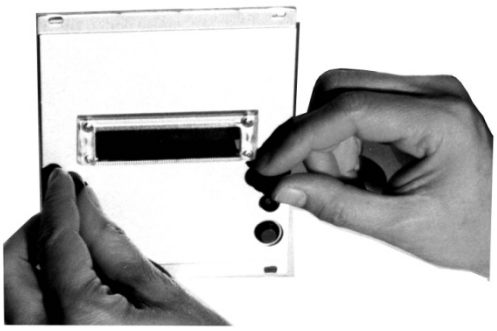


Fig. 42: Unscrewing the printer front cover

Fig. 43: Removing the front cover

b) Exchanging the ribbon

In order to exchange the ribbon, press down the left edge of the ink ribbon cartridge marked "Push" and "Eject" (Fig. 44). 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. 45). 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. 44: Removing the ribbon cartridge

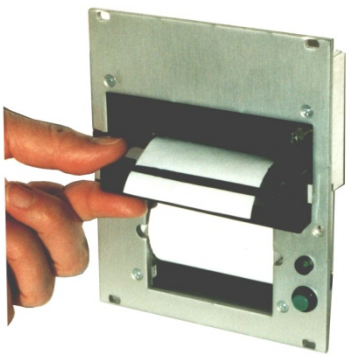


Fig. 45: Inserting the ribbon cartridge

c) Exchanging the paper roll

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

First follow step b 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. 46) until you sense some resistance. To lead the paper past the print head, press the paper feed button (Fig. 47) 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 b.

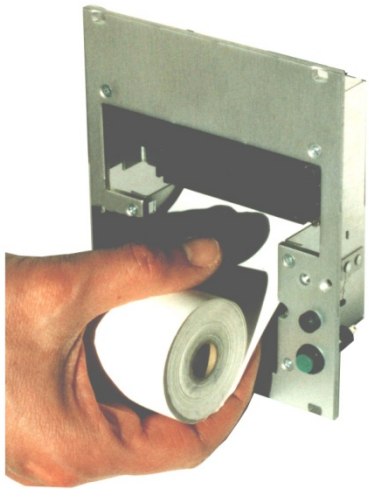


Fig. 46: Inserting the paper roll into the printer

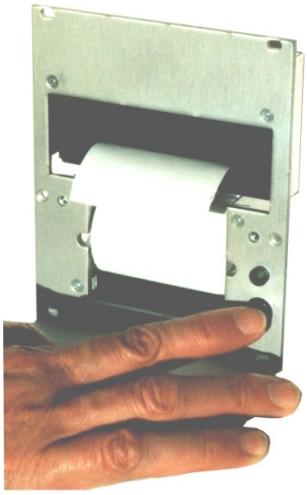


Fig. 47: Paper feed button

d) Attaching the front cover

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

7.3 Replacing the Battery of the System Clock

If the test and diagnosis 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.

7.4 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 regard 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.

7.5 Operational and Error Messages

7.5.1 Classification of Messages

Operational and error messages occurring during the operation of the test and diagnosis 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"**	HVOff	confirm - restart system
T	**Error of type "trans"**	HVOff	confirm - repetition possible
N	**Error of type "normal"**	HVOff	confirm - repetition possible
W	**Warning**	none	confirm - continue operation
R	**Messages in remote control mode**	different	No operational action possible at the system itself

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

7.5.2 Operational Messages about State of System

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

You don´t need to 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 plug-ged 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
-	U	**Set user language**	In Setup: Prompting to make entry	rotary knob + OK

Code	Cl.	Operational message	Description	Input
-	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

7.5.3 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 funct-ional, check signal on module
-	C	**Humidity sensor**	Degree of dew condens-ation 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

7.5.4 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 overflown.	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 acknow-ledgement 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 com-patible with the software version of the master.	Insert Slave PROM with suitable software version
05	**F**	**Master timeout**	Communication between master and slave is inter-rupted (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 I²C-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 availabe 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 I²C 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	**F**	**Illegal config.**	Configuration data of master and slave differ.	Software problem. Must not appear during regular operation.
58	**N**	**NOT GROUNDED**	Danger! The system cannot ensure proper dis-charging after "HVOff". (only 80 kV systems)	Manually discharge by external means, check return and control lines to discharge switches.
59	**N**	**Cal. by DC only**	The system cannot be calibrated in the active operation mode.	Only for service: Choose DC mode.
60	**W**	**St-data stored**	Statistic data have been reset.	Pure confirmation message.
61	**W**	**Mainten. Required**	Maintenance is required due to the high amount of operating hours.	Please make an appointment with your nearest SebaKMT serice station.
62	**R**	**Ignition error**	After the cable has been charged the Thyristor switch wasn´t operated.	Indicates a hardware fault. The cable is presumably still charged -> Press “HVOff”, discharge manually (!) and earth.
63	**R**	**DAC overload**	The cable couldn´t be charged within the set/restricted time frame.	Overload! Load capacitance presumably too big.

Code	Cl.	Operational message	Description	Input
64	**R**	**DAC timeout**	Automatic „HVOff“ after the expiry of a defined time frame without commands from the PD-measurement system	Restart measurement.
68	**R**	**Unknown version**	Software version of the TDS40/60 is not compatible with the software version of the PD measurement system.	Contact service and enquire about necessary steps.
69	**R**	**Task conflict**	Software problem - must not occur during operating.	
70	**R**	**Not connected**		
71	**R**	**Watchdog failed**		
72	**R**	**Card inserted**	In the remote control mode a SystemCard has been inserted.	Remove the SystemCard!
73	**R**	**Message lapse**	Software problem - must not occur during operating.	
74	**R**	**State mismatch**		
75	**R**	**Unknown request**		
76	**R**	**Parameter error**		
77	**R**	**Lost connection**	Communication between the TDS40/60 and the PD measurement system has been interrupted.	Potential interruption of the cable connection or crash of the PD software. Solve the problem and restart the system.