Megger

Teleflex SX-1

Portable reflectometer and control unit of the fault location system Surgeflex 40

USER GUIDE

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Consultation with Megger

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

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

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

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Terms of Warranty

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

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

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.

Contents

1 Safety Instructions

1.1 General Notes

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 signal words and symbols are used in this manual and on the product itself:

Signal word / symbol	Description
DANGER	Indicates a potential hazard which **will result** in death or serious injury if not avoided.
WARNING	Indicates a potential hazard which **may result** in death or serious injury if not avoided.
CAUTION	Indicates a potential hazard which may result in moderate or minor injury if not avoided.
NOTICE	Indicates a potential hazard which may result in material damage if not avoided.
	Serves to highlight warnings and safety instructions. As a warning label on the product it is used to draw attention to potential hazards which have to be avoided by reading the manual.
	Serves to highlight warnings and safety instructions that explicitly indicate the risk of an electric shock.
	Serves to highlight important information and useful tips on the operation of the device/system. Failure to observe may lead to unusable measurement results.

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

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.

Anyone else must be kept away!

Declaration of Conformity (CE)

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

- EMV Directive
- Low Voltage Directive
- RoHS Directive

The full text of the EU declaration of conformity is available by request.

1.2 General Safety Instructions and Warnings

Intended application

The operating safety is only guaranteed if the delivered system is used as intended (see page 10). Incorrect use may result in danger to the operator, to the system and the connected equipment.

The thresholds listed in the technical data may not be exceeded under any circumstances.

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

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

Fire fighting in electrical installations

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

2 Technical description

2.1 System description

Description

The Teleflex SX-1 is a two-phase time domain reflectometer (TDR), which excels on account of its lightweight and compact design.

It is an ideal addition for a "satellite"-based fault location concept in supply areas with low density and failure rate, where reaction speed, weight, size and economy are the driving factors.

The operating principle of the Teleflex SX-1 is identical to the radar's familiar pulse-echo process. Adequately shaped measuring pulses are fed into the cable, which are then propagated at cable-specific speed towards the end of the cable. Any change in the electrical properties of the cable results in a certain portion of the pulse being reflected back. These reflections are registered by the Teleflex SX-1 and then shown on the screen. The changes in the electric cable properties can also be caused by cable faults and joints. The end of the cable also generates a very specifically-shaped reflection. The type and distance of a noticeable problem can be derived from the reflection's shape and propagation time.

Product variants

The Teleflex SX-1 can be used both as an individual device as well as in combination with various HV fault location systems (e.g. surge-wave generators, burn-down instruments). Thanks to the CAN interface the device is also ideally suited to directly control the SPG 40 and combines both devices into the fully-fledged fault location system Surgeflex 40 (SFX 40), which is often also expanded to become an entry-level test van system (Compact City). Teleflex SX-1 is provided specifically for these vehicle installations in a 19-inch version without internal battery.

Features

The Teleflex SX-1 combines the following features and functions in a single system:

- Sturdy and weatherproof for outdoor use
- Rechargeable battery or mains operation possible
- Dual operating concept (touch screen and rotary knob)
- USB interface for data transfer
- Supports all existing prelocation methods.
- Automatic detection of cable end and fault position
- ARMslide technology with 15 measurements per ARM surge
- Partial Discharge (PD) pinpointing in combination with PD-TX pulse transmitter
- Direct control of SPG 40 fault location system

Scope of delivery

The scope of delivery of the system includes the following:

- Basic device
- Plug-in power adapter
- Earthing lead with right-angle plug, 1.5 m
- 2 x measurement cables incl. alligator clips, 2.5 m
- 3 x BNC connection cables, 1.5 m
- Operating manual

If permanently installed in a test van or on a trolley, the scope of delivery may be different.

Check contents

Check the contents of the package for completeness and visible damage right after receipt. In the case of visible damage, the device must under no circumstances be taken into operation. If something is missing or damaged, please contact your local sales representative.

Optional accessories

If the following optional accessories do not form part of the scope of delivery, these can be ordered from sales:

Accessory	Description	Item number
CAN bus cable	For connection of Teleflex SX-1 to the SPG 40 fault location system	2005251 (0,75 m) 2005252 (3 m) 2005253 (5 m)
HV connection set	Suitable for connection to outdoor HV cable terminations.	2004385 (5 m) 2005067 (12 m)
Separating filter TF VX	For connection to live low-voltage lines. Suitable for stand-alone devices and test van systems with LV cable (adapter cable VK 131 is included).	1010520
Separating filter TF VX-M	For connection to live low-voltage lines. This version is intended for test van systems without LV cable.	1010838

2.2 Technical data

The Teleflex SX-1 is defined by the following technical parameters:

Parameter	Value
Distance range	20 m … 160 km at V/2 = 80 m/µs
Pulse width	20 ns … 10 µs
Pulse amplitude	50 V
Resolution	0.1 m at V/2 = 80 m/µs,
Accuracy	0.1%
Data rate	>533 MHz
Propagation velocity • Input • Range (V/2)	 As V/2 or NVP value 10 … 149.9 m/µs or 33 … 492 ft/µs
Dynamic response range	>96 dB
Output impedance	50 Ω
Distance dependent de-attenuation (ProRange)	>22 dB, adjustable
Refresh rate	7 images per second
Number of measurements per ARM surge	15
Withstand voltage for IN1 and IN2 measuring inputs	Up to max. 400 V AC, 50/60 Hz (only when connected via separating filter)
Power supply • Battery[1] • Plug-in power adapter • Socket for external power supply	 Lithium-ion rechargeable battery (97 Wh) 100 V … 240 V, 50 / 60 Hz, 50 VA 10 V … 17 V DC, 3.8 A
Operating time in operating mode[1]	Up to 6 hours permanent recording (with new rechargeable battery)
Display	10.1" colour TFT WXGA 1280x800, capacitive touch screen, 1000 cd/m², LED-backlight
Memory	4 GB mSATA for program and data
Interfaces	USB, BNC, CAN

[1] The 19-inch version does not contain an internal battery

Parameter	Value
Operating temperature	–10 °C ... +55 °C
Storage temperature • Short-term storage (max. 3 days) • Long-term storage (preserves rechargeable battery)	 –20 °C ... +60 °C 15 °C ... 35 °C
Dimensions (W x H x D)	362 x 195 x 195 mm
Weight[2]	7.8 kg
Protection class (in accordance with IEC 61140 (DIN VDE 0140-1))	II
Ingress protection rating[2] (in accordance with IEC 60529 (DIN VDE 0470-1))	IP54 (open case but closed USB-cover) IP65 (closed case)

[2] Data apply only to the portable stand-alone version in the Pelicase

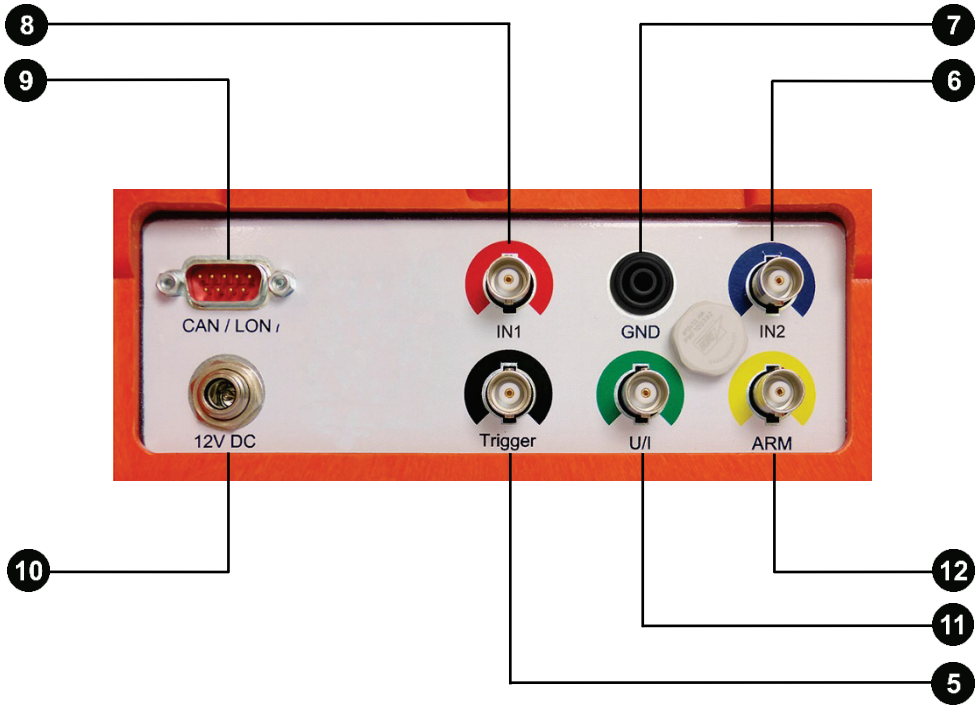
2.3 Display and controls

The following control and display elements are located on the front panel of the Teleflex SX-1:

Element	Description
1	Display
2	Rotary encoder with function keys on the side
3	USB port for connecting a USB flash drive or a USB printer
4	ON/OFF button with charge state indication (see page 68)

2.4 Connection elements

The following connection elements are located on the rear of the Teleflex SX-1:



Element	Description
5	BNC socket for connection to the trigger output of the ARM coupling unit
6	BNC socket for direct connection to any phase of the test object
7	Auxiliary/functional earth connection
8	BNC socket for direct connection to any phase of the test object
9	CAN interface (LON optional) for connection of specific HV devices (e.g. SPG 40)
10	Charging socket
11	BNC socket for connection to current or voltage decoupler of a fault location system
12	BNC socket for connection to signal (KLV) socket of the ARM coupling unit

3 Start-up

Initial start-up

The rechargeable battery of the Teleflex SX-1 is pre-charged by the manufacturer to roughly 50% of its capacity. We recommend that the rechargeable battery be fully charged (see page 69) before initial start-up for a period of roughly 8 hours. This measure is not necessary for the 19-inch version without internal battery.

Applicable guidelines

The guidelines for implementation of occupational safety when operating a test system / test van often differ between one network operator and another and it is not uncommon for national regulations (like, i.e. the German BGI 5191) to be used as well.

Inform yourself of the guidelines applicable in the area of operation beforehand, and comply with the specified rules for work organization and for implementing the test system / test van.

3.1 Electrical connection

3.1.1 Connection to test object or HV devices

WARNING

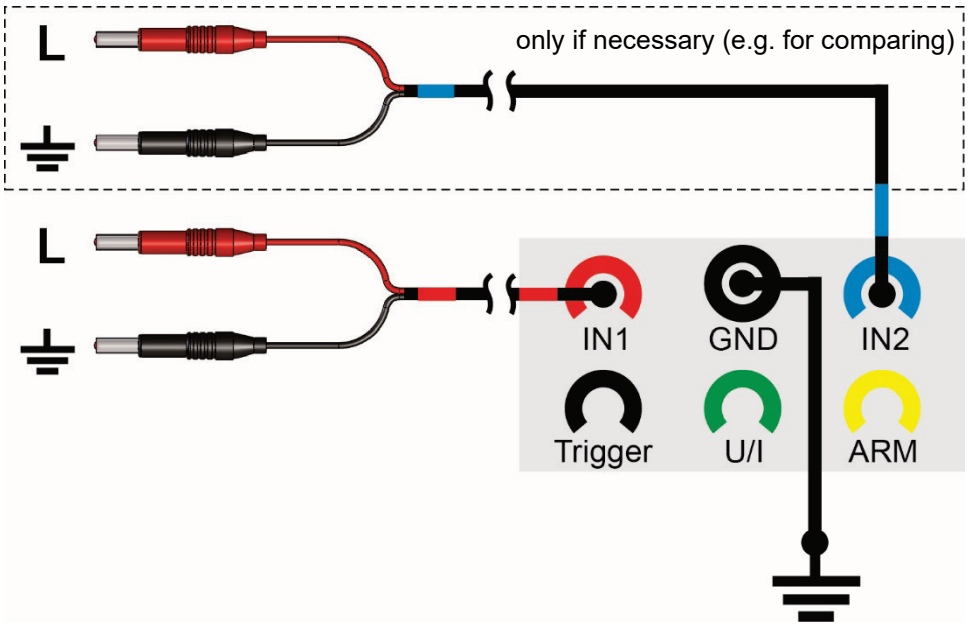
Safety instructions for the electrical connection

- The device may only be connected to **de-energized** equipment. The general safety instructions and, in particular, the five safety rules (see page 8) must always be followed prior to connection to the test object.
- When connected to an HV device, the instructions and safety information for electrical connection as contained in the operating manual for the respective device must be complied with.
- All the cables at the measuring point that are out of operation and are not to be tested must be shorted and earthed.
- Because the amount of voltage applied to the test object poses a danger in the event of contact, the test station itself and the ends of the cables must be shielded as per VDE 0104 to ensure that such contact is not possible. Make sure that all cable branches are taken into account.

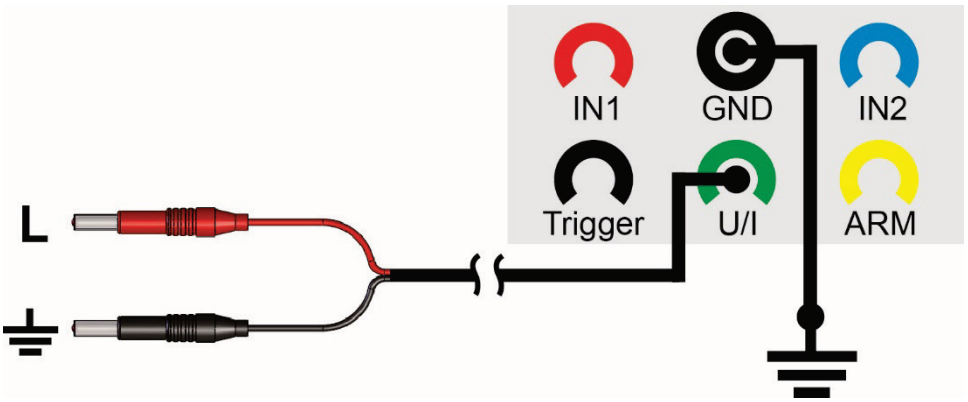
The electrical connection to HV devices is described in this section on as generally-applicable a basis as possible. Some detailed connection configurations with the device-specific designations for the relevant connecting point are available in the Appendix (see page 72).

Direct connection to the test object

To enable the Teleflex SX-1 to be used to conduct a **pulse reflection measurement**, the device must be connected to one or two phases of the test object as shown in the figure directly:



To enable the Teleflex SX-1 to be used for **PD pinpointing**, the device must be directly connected to the PD-affected phase of the test object as shown in the figure:



Connection to live low-voltage lines

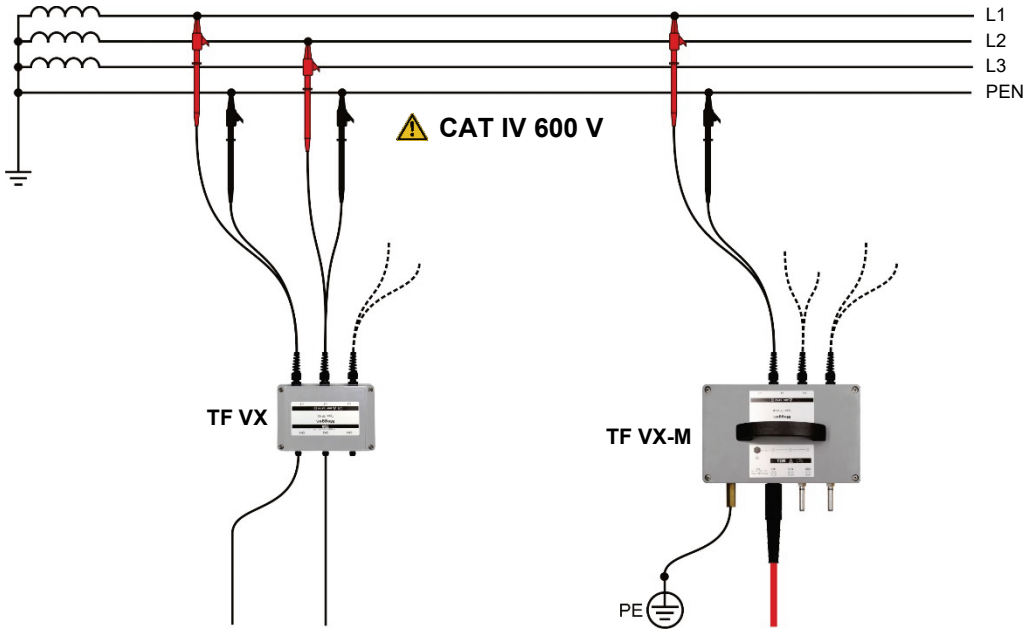
By using the optional separation filter TF VX (or TF VX-M), the Teleflex SX-1 can be connected to low-voltage lines with a voltage of up to 400 V.

WARNING

Danger from electrical shock!

When connecting to live parts, the applicable safety regulations for live-line working must be observed!

The connection can be made between two phases or, as shown in the following example, between phase and earth.



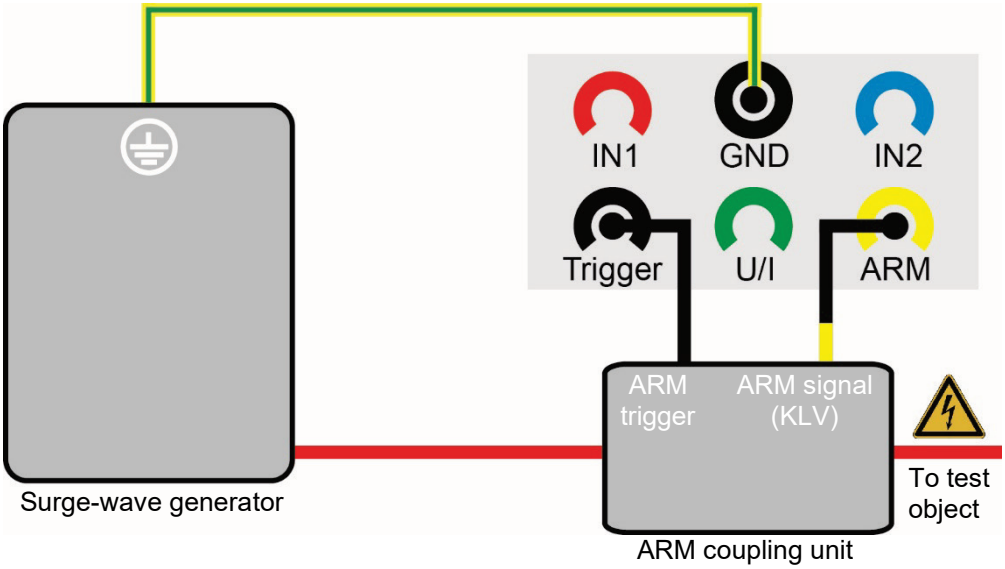
Direct connection and connection via LV cable of a test van

Connection via HV cable of a test van

When connecting via the separation filter, an additional virtual cable length of approx. 4 m (at v/2 = 80 m/µs) must be taken into account when evaluating the located distance!

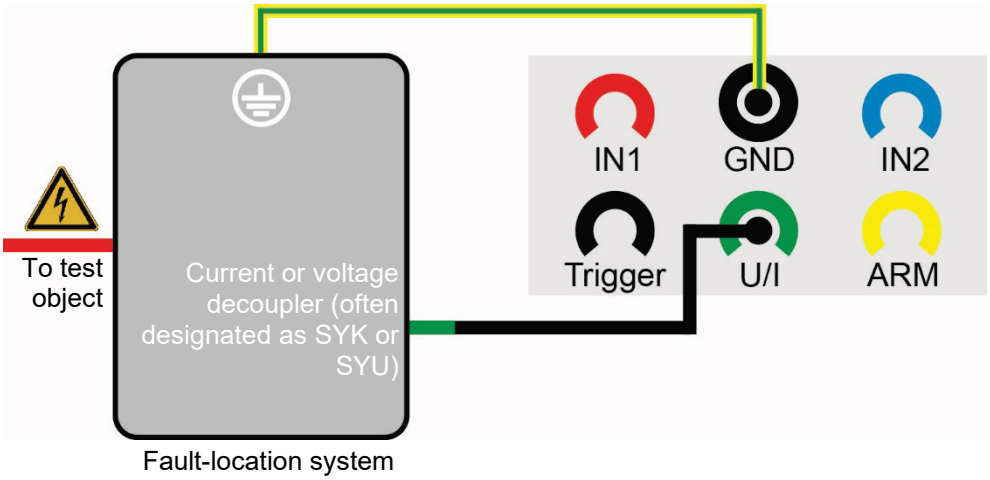
Connection to an ARM coupling unit

To enable the Teleflex SX-1 to be used to conduct an **arc reflection measurement (ARM)**, the device must be connected to a suitable ARM coupling unit (e.g. arc surge adapter, power-separation filter) as shown in the figure. The coupling unit ensures reliable coupling and decoupling of the test pulses and also safeguards the reflectometer against the high voltage present in the cable. Some fault location systems comprise both surge wave generator and ARM coupling unit in the same housing.



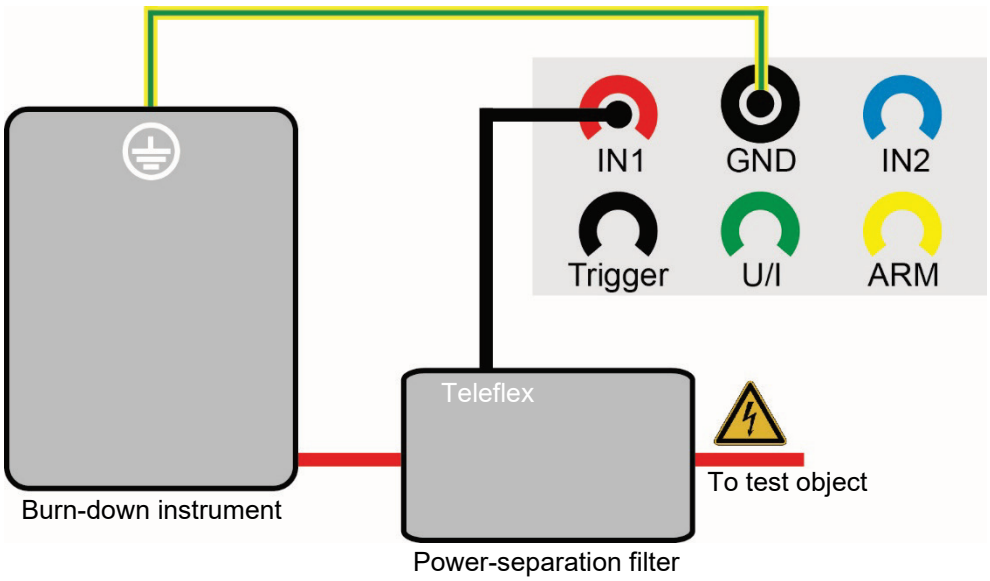
Connection to current or voltage decoupler

To enable the Teleflex SX-1 to be used to conduct a **transient prelocation procedure (ICE or decay)**, the device must be connected to the current or voltage decoupler of a fault location system as shown in the figure.



Connection to a burn-down instrument

To enable the Teleflex SX-1 to be used to conduct an prelocation in the **ARM burning** operating mode, the device must be connected as shown in the figure to a suitable power-separation filter (e.g. M 219). This ensures reliable coupling and decoupling of the test pulses and it also safeguards the reflectometer against the high voltage pending in the cable.

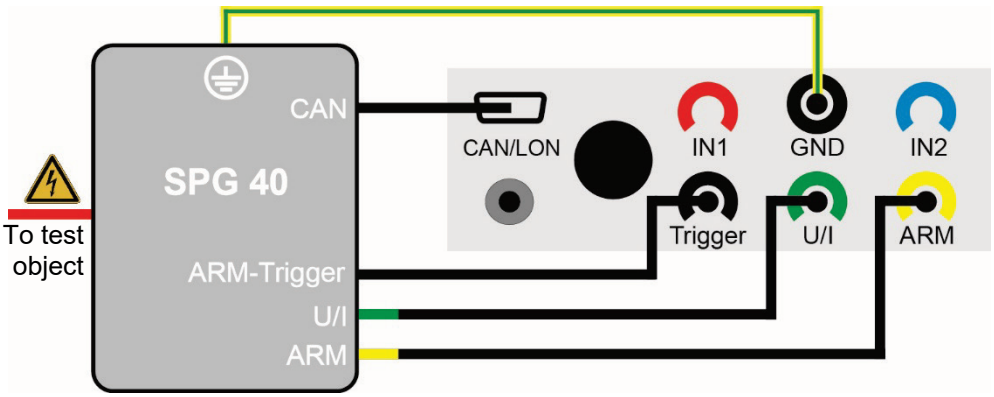


Connection to SPG 40

Normally, the combination of Teleflex SX-1 and **SPG 40** is used as a permanent installation in a test van. In this case, the two systems are permanently wired to each other.

If however, two individual systems are to be connected to each other for a measuring procedure, then the wiring must be manually connected as shown in the figure below.

The CAN bus connection here is only necessary if the Teleflex SX-1 is to be used for remote control (see page 27) of the SPG 40. The cable required for this is available as a special accessory (see page 11).



3.1.2 Ensuring power supply

The Teleflex SX-1 has a powerful Li-ion battery, with which it can be operated for up to 6 hours after being fully charged.

If the battery indicates a low remaining capacity (see page 68), the plug-in power supply can be used to establish a connection between the charging socket 10 and a mains socket (110 V… 240 V, 50/60 Hz) in order to ensure continuous measurement operation.

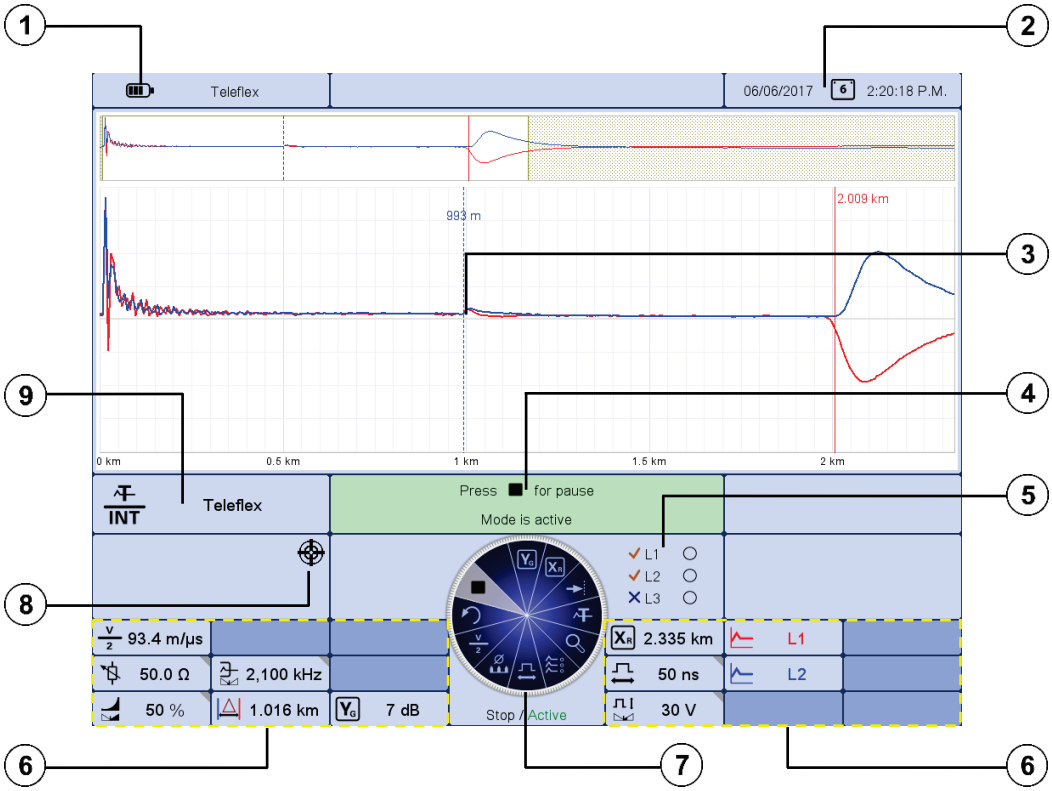
3.2 Switching on

The device is switched on by pressing the ON/OFF button 4. The software starts within a few seconds whereupon it then resides in the main menu.

4 Operation

4.1 Screen layout

The following figure shows the typical screen layout:



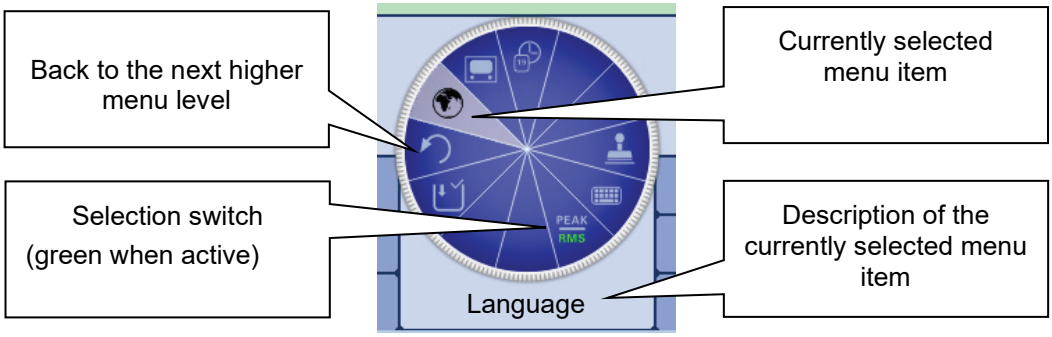
Segment	Description
1	Battery-status display (see page 68) This icon is not available for the 19-inch version without internal battery.
2	Date and time
3	Traces for current measurement or loaded measurements. The display is split up into a general overview (top) and in an enlarged section (bottom).
4	Current status messages and information on the next step required in the test sequence.
5	Information on current phase selection (see page 30). When the SPG 40 remote-control mode (see page 27) is active, the symbol to the left of the currently selected phase indicates the SPG 40's operating state. The following states can occur here: ⏚ High voltage generation is switched off and the HV output on the SPG 40 is discharged and connected to earth through a resistor. ● The resistor discharge is not effective. High voltage is active!

Segment	Description
6	The display elements arranged in the lower area of the screen may contain the following information: • Set measurement parameters • Current measurement values, which are continuously updated as the measurement progresses • Legend of traces currently shown in display (see page 35). Information (such as, e.g. measurement values) which apply for a particular trace only, is shown in the respective colour.
7	Selection menu (see page 24)
8	Current device state — The device is currently in standby. ∿ Pulse reflection measurement currently under way.  The measurement was stopped and the traces frozen.  The device is in measurement operational readiness and waiting to be triggered. **SPG** The device is in the SPG 40 remote-control mode (see page 27).  The FOHM safeguard of the SPG 40 has been deactivated in the system settings (see page 36).  The FU safeguard of the SPG 40 has been deactivated in the system settings (see page 36).  The user operating the system has successfully logged into the administration menu (see page 41) and identified himself / herself as administrator.
9	Current operating mode

4.2 Basics of control system

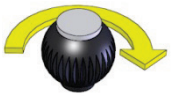
Selection menu

Navigation within the menus is effected almost entirely from the circular selection menu:



Operation with rotary encoder

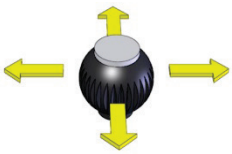
The system can be operated using the rotary encoder **2** as follows:



- Select the required menu item
- Increase or decrease the value of a variable parameter
- Select an option from a selection list

- Call up the selected menu item
- Confirm the setting or the selection made

The four additional functions are called either by tilting the rotary encoder (portable device) or by pressing the corresponding function button (19-inch version):




Quick selection of operating modes


On-line help


Phase selection (see page 30)

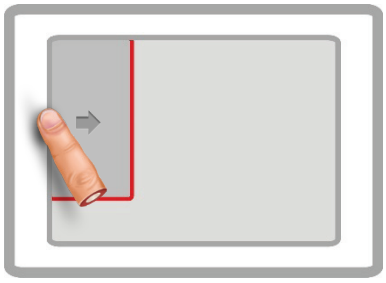

History database (see page 31)

Operation using the touchscreen

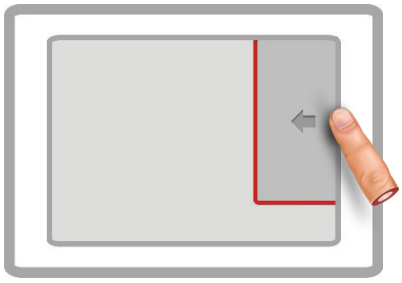
If the device/system is equipped with a touch-sensitive display, then the software can also be operated just by using your fingers.

Briefly tapping on the buttons in the various menus, and tapping and holding the buttons in isolated cases, allows the respective functions to be activated in the same way as the rotary encoder control.

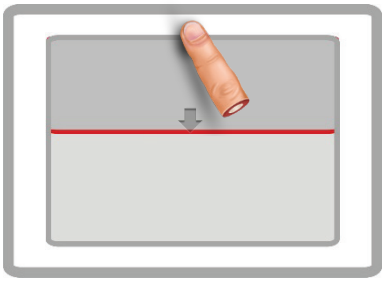
The four menus at the side can be opened by a swiping motion.



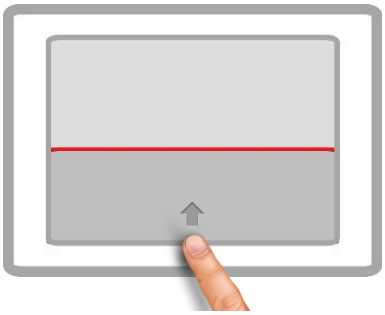
Quick selection of operating modes



Phase selection (see page 30)



Online help

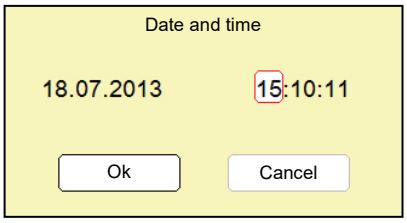


History database (see page 31)

Whenever character strings need to be entered or changed, an on-screen keyboard appears at the lower edge of the display:

If wanted, the touch functionality and the on-screen keyboard can be disabled in the basic settings (see page 39). The latter is particularly useful, if a hardware keyboard is connected.

Dialog boxes A few settings, which require values to be entered, are not made directly using the Selection menu, but rather in a separate dialog box.



By tilting the rotary encoder 2 to the side (or by using buttons and) the user can switch back and forth between the individual buttons in a dialog box. Each active button is then highlighted in white or it is surrounded by a red frame. Whenever the selected button requires letters or digits to be entered the screen keyboard automatically appears, and it can then be used to make the entries.

To close a dialog box, the corresponding button must be selected and then the rotary encoder pressed.

4.3 SPG 40 remote-control mode (Surgeflex 40 Fault Location System)

Introduction

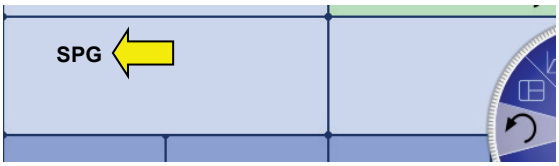
Combining the Teleflex SX-1 with the SPG 40 effectively combines the strengths of both devices in the test and fault location system Surgeflex 40 (SFX 40). The abilities of the SPG 40 allow numerous additional operating modes that are seamlessly integrated in the user interface of the Teleflex SX-1 and benefit from its wide range of functions (e.g. high resolution measuring graphs and extensive options for managing measurement data).

Systems of this type are mostly delivered from the plant either permanently wired on a trolley or as a vehicle installation (Compact City). It is however also possible to combine two individual devices quickly and easily on site with the help of the necessary connecting cables.

Activating and deactivating remote-control mode

If the Teleflex SX-1 is used for remote control of an SPG 40, then the remote control mode must be started before the measurement. To do so, the SPG 40 must be properly connected (see page 20)and switched on. In this case, the Teleflex SX-1 recognises at start-up the existing connection and automatically activates the remote-control mode. Otherwise the mode can also be manually activated using the menu item **SPG** in the main menu.

If the connection to the SPG 40 could be established, then the operating modes selection is automatically adapted and a symbol is shown at the left-hand edge of the screen.



The mode can be deactivated again at any given time using the menu item **SPG**.

If the remote-control mode cannot be activated or is suddenly interrupted, you should check the connecting lines between Teleflex SX-1 and SPG 40 and the power supply of the SPG 40.

If this does not resolve the problems, they might be caused by an unsuitable firmware or kernel version. In the Teleflex SX-1 it is possible to determine the currently installed versions from the system menu (see page 36). In the SPG 40, the version is displayed during the starting process.

The following versions are required for the remote-control mode to function:

Teleflex SX-1 kernel	4.13 or higher
Teleflex SX-1 application	5.2.4 or higher
SPG 40 firmware[3]	T30SPG07 or higher

The kernel of the Teleflex SX-1 and the firmware of the SPG 40 can only be updated by an authorized service workshop.

[3] Versions without the addition "T30" are generally unsuitable for remote-control mode

Messages The display of the SPG 40 is not active in remote-control mode. For this reason, all status and error messages affecting the SPG 40 are output directly on the Teleflex SX-1. The following table provides an overview of all messages that require intervention by the user:

Message	Description / fault clearance information
Door is open	Close the rear door of the vehicle.
HV Unit disabled by internal Emergency Off	The EMERGENCY OFF switch in the system has been activated. Once the reason for the emergency off has been removed, the switch must be returned to its original position.
HV Unit disabled by Interlock Key	Generating high voltage is prevented by means of the key switch. The key switch must be unlocked again.
Cable shield not grounded	FOHM safeguard of the SPG 40 reports: Resistance between the operational earth and protective earth too high. Check whether the earth cable as well as the cable shield of the HV connection cable are correctly connected and that the respective connection points are able to make good metallic contact. You can deactivate (see page 36) the FOHM safeguard in the system settings, **but you do so at your own risk**.
Voltage raise of protective earth	FU safeguard of the SPG 40 reports: Resistance between the device / vehicle and the surrounding ground is too high. It is likely that the ground conditions around the earth spike are causing too great an earth resistance. The earth spike should be reinserted as close to the device / vehicle as possible. You can deactivate (see page 36) the FU safeguard in the system settings, **but you do so at your own risk**.
Internal error occurred	Collective message for various internal errors in the SPG 40. You should restart the system. If you cannot delete the error, or if it occurs repeatedly, inform an authorized service workshop.
Overtemperature in SPG 40	Excess temperature in the HV components of the SPG 40. Let the system cool down and then continue operation.
Internal discharging of the capacitor to 500 V	The surge capacitor in the SPG 40 could not be discharged via the discharge resistance due to abrupt termination of high-voltage operation (e.g. EMERGENCY OFF): High voltage operation can only continue once the capacitor has been discharged via internal resistances. This can take several minutes.
HV connector not properly connected	The plug of the HV connection cable is not fixed firmly enough in the high voltage output of the SPG 40. You must feel the plug engage when you plug it in.

HV control

In portable systems, high voltage is enabled and deactivated either directly using the "HV ON" and "'HV OFF" buttons on the SPG 40, or via the buttons on an external safety device connected to the SPG 40 that have equal access.

Vehicle installations such as the Compact City system usually have an operating space that is spatially separated from the high voltage components and feature a separate operating unit that includes the hardware buttons for on/off switching, high voltage control and emergency off. The buttons function exactly as described in the SPG 40 manual. The following illustration shows the typical composition of such a 19-inch operating unit:

High voltage can also be deactivated at any time during high voltage operation using the software button HV OFF that has equal access as the HV OFF button.

4.4 Quick selection of operating modes –

Tilting the rotary encoder 2 towards the symbol (or pressing the button) enables the quick selection menu to be called up at any given time (and to close it again). The menu provides direct access to all the available operating modes.

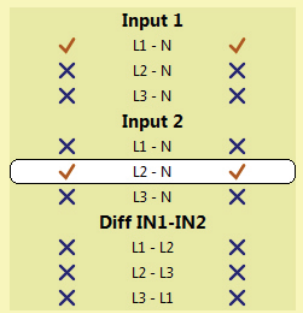
4.5 On-line help –

Tilting the rotary encoder 2 towards the symbol (or pressing the button) enables the compact on-line help menu with its basic operating information to be called up at any given time.

4.6 Phase selection -

Immediately after activating an operating mode or after tilting the rotary encoder 2 towards the symbol (or pressing the button) the phase selection menu is opened. This is used to select the phases which are to be tested. The options available differ according to the operating mode in question:

Pulse reflection measurements

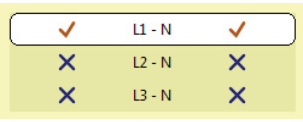


Under **Input 1** the phase connected to the IN1 input is to be selected.

For the purposes of comparison the phase connected to the IN2 input can be activated simultaneously under **Input 2** (not possible in the FL INT operating mode).

Alternatively, a differential measurement can be conducted between the two inputs. To do so, the appropriate option is to be selected under **Diff IN1 – IN2**. In this mode the reflections of both inputs are combined to form a single trace. However, the reflections received at the second input have their polarity reversed through a differential transformer. Consequently, the differential trace generated here then shows genuine differences only. Faults of identical magnitude or breaks on all wires will not be visible because a difference does not exist.

All other operating modes



The phase actually connected with the Teleflex SX-1 / fault location system has to be selected.

The desired option can be marked for selection by turning the rotary encoder and then selected or deselected by pressing it.

✓ Option active

✗ Option inactive

Only once a valid selection has been made can the phase selection menu be closed again by tilting the rotary encoder towards the symbol (or by pressing the button) whereupon the phase selection is then confirmed. Up to the time at which the operating mode starts, the phase selection menu can be called up again and a change can then be made to the selection.

Make sure that the phase selection matches the actual connection situation! Otherwise, the measuring data will be stored with incorrect phase details whereupon the data will not be able to be correctly assigned afterwards.

4.7 History database -

Purpose

Each conducted measurement is temporarily stored in the History database and it can be retrieved from there again. This enables the user to access old traces and to compare them with the current traces. The parameters under which the measurement was conducted are also shown.

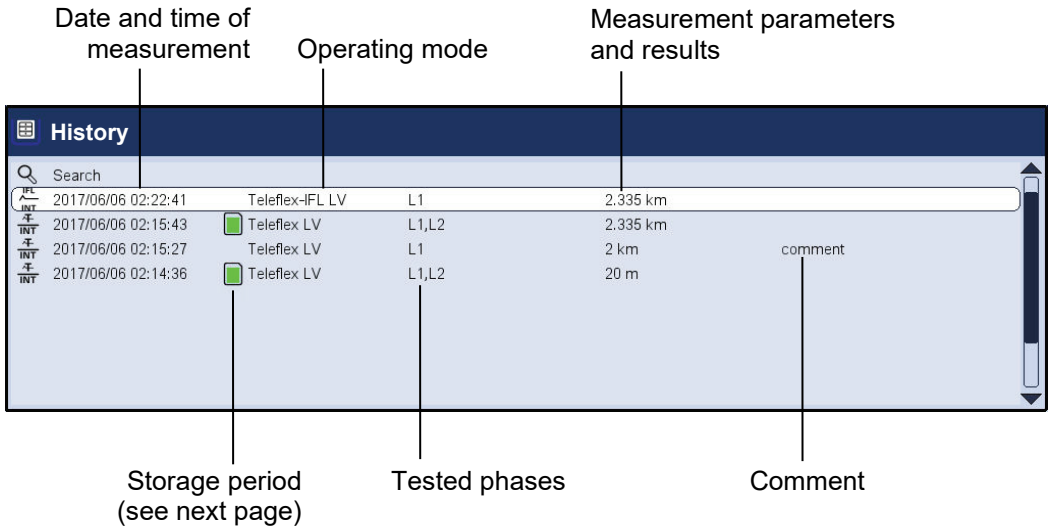
In addition to the individual measurements, the measurement logs created using the log function are also archived in the History database.

Searching in the History database

Tilting the rotary encoder 2 towards the symbol (or pressing the button) enables the database to be opened at any given time.

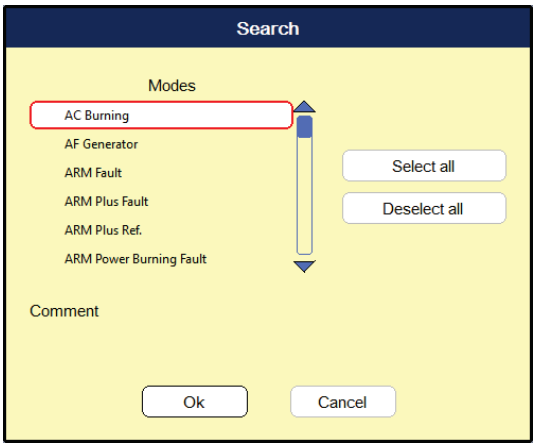
The measurement data records are organised by date in sub-directories.

After the desired month and then the desired day have been selected, the measurement data records registered on this days can be searched through and retrieved.



Via the list entry you can always return to the next directory level up.

Via the 🔍 list entry you can reach the search mask using which you can search for particular operating modes and comment entries through the data records of the current directory and all sub-directories.



If you are searching for both an operating mode and comment entry at the same time, only those results which fulfil both criteria will be displayed.

Holding down the 🔍 button will cause the search criteria to be discarded and all the data records to be displayed again.

Storage period

The default setting stores the measurement data for 7 days in the History database. The following symbol indicates how long a measurement has already been stored:

Symbol	Description
No symbol	The data record has been conducted within the last four days. An automatic deletion is not imminent.
	The data record is either imported or permanently stored (see page 50).
	The data record is at least 4 days old and may be deleted on any of the next startups.

Managing data records

In order to delete / export a data record or a complete folder it needs to be selected with the rotary encoder (2) first. Afterwards, the rotary encoder needs to be tilted to the right or the left until the appropriate marking is shown.

Symbol	Description
	The data record or the folder (incl. all data records in it) is marked for deletion.
	The data record or the folder (incl. all data records in it) is marked for export.
	Several data records within the folder have been marked for deletion.
	Several data records within the folder have been marked for export.
	The folder contains both data records marked for deletion and data records marked for export.

After selection of the measurements the data deletion or export process must be initiated in the data menu (see page 38). Otherwise the markings will expire the next time the device is started up.

Accessing measurement data from the History database

To access traces and data from old measurements, first select the History database and then use the rotary encoder to select the respective measurement from the directory structure. **Briefly pressing** the rotary encoder calls up all the traces and measurement data for this measurement.

By contrast a **long press** of the rotary encoder opens a pop-up menu from which various special functions can be accessed depending on the operating mode involved:

- Add / edit a comment for the measurement
- Access special measurement data or only individual traces of this measurement (possible in certain modes only)

Once you have opened one or more traces from the history database, they are shown on the display according to the following conditions:

- If the operating mode currently selected is the same operating mode in which the loaded measurement was recorded in, the accessed traces are shown together with the currently recorded traces. This enables the results of different measuring operations to be easily compared.
- The traces from the History database are always scaled to the display parameters used for the current measurement.
- If there are not enough free slots to display the loaded traces, the currently recorded traces are overwritten. In this case it is advisable to select traces from the History database one by one so that you can assign them individually to slots that are free or no longer needed.
- If the current and the loaded measurement are not of the same operating mode, the current measurement is automatically ended and only the loaded measurement is displayed.

Legend of the displayed traces

The legend on the bottom right of the screen shows all the information for the traces currently displayed. The numerical and coloured assignment is as follows:

The symbols in front of the trace names indicate the status of the traces:

Symbol	Description
	Traces which were recorded during the measurement in progress.
	Traces which were recorded during the measurement in progress but not with the currently set measuring parameters (such as compensation and gain).
	Traces selected from the History database whose measurement parameters are the same as those of the measurement in progress.
	Traces selected from the History database whose measurement parameters are different to those of the measurement in progress.

4.8 System settings -

The System menu can be access directly through the menu item when in the main menu, and it contains the following menu items:

Menu item	Description
	Submenu for managing the measurement data (see page 38).
	Basic settings (see page 39)
	Default values can be adapted for nearly all the system settings. If user management (see page 43) is active then each user can define and store his / her own default values. These defaults are then loaded each time the system starts or a user logs in. The submenu contains the following items: This menu item enables the current settings to be stored as default values. Naturally, only the changes made during this session are taken into consideration. The following parameters may be affected: • all parameters that can be configured within the operating modes such as, e.g. voltage values, pulse width etc. (with exception of phase selection and propagation velocity) • the names for the **Tester** and **Owner** entered in the log function When saving the default values, note that all values that have been changed since the last system start are saved, which means that you might inadvertently save some changes that you do not want. To be on the safe side, you can first reload the current defaults (see below), make the required settings and then save them. This menu item can be used by the current user to reload his / her stored default values. This menu item restores the factory settings. EXP DEFS This menu item enables the default values for the current user to be exported as XML files to the *DefaultValues* directory for the inserted USB flash drive. IMP DEFS This menu item can be used to import defaults values that are stored on an inserted USB flash drive into the system. The imported values then become immediately applicable. When user management (see page 43) is active, the imported default values are only applicable for the user currently logged on.
	Service menu which can only be accessed by a service technician.
	The administration menu (see page 41) enables a user with the appropriate permissions to access extended system functions.

Menu item	Description
	This submenu enables various settings to be made for scale graduation on the X-axis and for entering the propagation velocity. It provides the following menu items: µs,ms Depending on the setting of this switch, the X-axis is either scaled in seconds (runtime) or in length units (distance). m,km kft ***Only available when the X-axis is scaled in length units (see above)*** This menu item can be used to switch the unit of the X-axis between meters and feet. NVP SPEED ***Only available when the X-axis is scaled in length units (see above)*** To achieve reliable distance details, knowledge about the exact signal propagation velocity for the test object is absolutely essential. This can be specified in two different ways: • **NVP** (Nominal Velocity of Propagation) - The signal propagation velocity is stated relative to the speed of light, e.g. NVP 0.53 = 0.53 x c. • **SPEED** - The signal propagation velocity is stated with half the actual propagation speed (the cable's so-called V/2). Depending on the above settings, a default propagation velocity value can be defined using the menu items $\frac{V}{2}$ and **NVP** respectively. This value is then preset whenever a measurement is started.
	Submenu for displaying and exporting important system information. SW Information on software version HW Information on system hardware and the current IP address LOG This menu item enables messages stored in the System log to be displayed, and exported to an inserted USB flash drive (*SystemLog* directory). This menu item enables all the system information to be exported to an inserted USB flash drive (*SystemLog*-directory). Option for checking key assignment for a connected USB keyboard.
FΩ / FU	Only available in SPG 40 remote control mode Manual shut-off for the SPG 40 safeguards. If a safeguard has been switched off, this fact is indicated permanently by the corresponding symbol in the display (see page 23). When the Teleflex SX-1 has been restarted, both safeguards are active again. **WARNING** **If you switch off these safeguards that are relevant to safety, you do so at your own risk!**

4.8.1 Data menu -

The Data menu enables stored measurement data to be imported, exported or deleted. It contains the following menu items:

Menu item	Description
DEL	Menu item to enable measurement data records / logs to be deleted from the History database. The measurements to be deleted must be marked beforehand (see page 33).
EXP DATA	Menu item that enables measurement data records / logs from the History database to be exported to the inserted USB flash drive (*Winkis* directory). The data records to be exported must be marked beforehand (see page 33).
IMP DATA	Menu item to enable measurement data records / logs to be imported from a USB flash drive. To do so, a window is opened in which the user can navigate through the directories on the drive.
	List of common cable types that can be extended by own cable and insulation types. This eliminates the need to manually enter the propagation speed during cable fault pre-location. Instead, the appropriate cable type can simply be selected from the list and its stored propagation speed automatically applied. Two filters (cable type and cable insulation) can be used to limit the number of cables displayed. Saved cable types can only be edited or deleted with administration rights (see page 41).
EXP	Menu item to enable the cable list (see above) to be exported to a USB flash drive (*Cables* directory).

4.8.2 Basic settings -

The following menu items can be used to adapt the device's basic settings:

Menu item	Description
	Sets the language. Select the desired language by turning the rotary encoder and activate by pressing it. The language selection is immediately active.
	This submenu enables the following screen settings to be made: This menu item enables the user to select one of the available screen layouts. This menu item can be used to change the line thickness for the traces to meet one's own requirements. Sets the screen brightness. This menu item enables the following power settings to be made, which can then exert a positive influence on the operating time when in the rechargeable battery mode: • Automatic reduction of screen brightness to a configurable value after a period of inactivity that can also be configured • Automatic switching off of the screen after a period of inactivity that can be configured For systems with a touch sensitive display, this menu item can be used to enable / disable touch functionality. Menu item to show/hide the mouse cursor which is required to operate the software via a connected mouse. Menu item to enable / disable the on-screen keyboard. If the screen brightness has been reduced or the screen has been switched off the first time the screen is touched or the rotary encoder (2) is used re-activates the screen only, and is not deemed to be an input. This helps to prevent any incorrect entries being made such as, e.g. the unintentional stopping of a currently active measurement.
	Date and time.
	This menu item enables the following functions that influence the measurement sequence to be activated or deactivated: Activates / deactivates automatic scaling adjustment of the X axis as soon as a trace is recorded. Activates / deactivates automatic gain adjustment of the Y axis as soon as a trace is recorded. Activates / deactivates the automatic positioning of the marker on the suspected fault location as soon as a trace is recorded.

Menu item	Description
	Screen keyboard layout
	This menu item enables the currently logged-on system user to be changed. Once a new user has been selected, the new user's default settings are then loaded. The menu item is only available if at least one user exists in the database. The administrator can manage user accounts in the administration menu (see page 41).

4.8.3 Administration menu - (Administration password required)

Purpose The administration menu is password-protected and provides access to advanced system settings such as the user administration, as well as update and backup functions.

The software's menu structure has concealed menu items added to it when administration rights are issued. These enabled functions, which are only rarely used during day-to-day operation of the device, are described in greater detail throughout the course of the manual.

Access To open the administration menu, you must first enter the password. Proceed as follows:

Step	Action
1	Select menu item , to access the Control Panel and then select menu item .
2	Select menu item , to enter the password.
	Result: The password entry dialogue appears in the display.
3	Enter the password and confirm your entry with **OK**.
	Result: If you entered the password correctly, the menu items of the administration menu appear (see below). If your entry is incorrect, you must repeat the procedure from **Step 2**.

Menu items The administration menu contains the following menu items:

Menu item	Description
UP DATE	Software update (see next page).
BACK UP	This menu item allows various system data (such as the log file and the configuration file) to be exported to a inserted USB flash drive. The directory name consists of the serial number of the system and a consecutive number. These data can provide important information about the cause of the problem in case of malfunction and should be made available to service personnel upon request.
	This menu item can be used to completely empty the database, i.e. all measurement results, users, cable types and system logs are deleted. However, calibration and configuration data is retained. After you select this function, the system needs to be switched off and on again. After the restart, you must once again confirm that you want to reset the database.
	Menu item used to manage the users accounts (see page 43) of the system.
	This menu item can be used to enable operating modes and functions in the software that have not yet been activated. An appropriate unlock key is required for the enabling process. Please contact your local Megger sales partner for more information on activating a function or an operating mode.

Menu item	Description
	Menu item to activate/deactivate the connection lead calibration mode (see page 44).
	Menu item used to disable administrator rights and to protect the administration menu with a password again.

4.8.3.1 Updating the software - UP DATE

Proceed as follows to update the software:

Step	Action
1	Download the latest software from the Megger website.
2	Unpack the update package into the root directory of a USB flash drive.
3	Insert the USB flash drive into the USB port.
5	Call up the UP DATE menu item in the Administration menu.
	Result: A selection dialogue appears.
6	Select the option **System Software (RPM/DEBIAN package)**. The option **Single file (file selection)** enables the import of individual files, but should only be used in the event of an error and after consultation with a service employee.
7	Start the update via **OK** and confirm the following message.
	Result: The system / unit switches off.
8	Switch the system / unit on again.
	Result: During the boot process, the update package on the inserted USB stick is recognised and automatically installed. Do not switch off the system / device during the update!

4.8.3.2 User administration -

User administration allows you to set up various user accounts on the system, so that each user can adjust the default values and the way the system behaves according to his own preferences.

Menu item	Description
NEW	A new user can only be created if a user name is entered. You can also limit the maximum voltage that the user can adjust and protect the account with a password. If you do not specify a password, the user does not need to enter a password when logging in, which makes the procedure quicker. The default values for the new user are the same as the factory settings. If necessary, you can import (see page 36) the default values from another user account (or even another system).
EDIT	This menu item can be used to edit the name, voltage range and password of a user.
DEL	This menu item can be used to delete individual users from the user database. If the last user has been deleted, the user management is deactivated and there is no longer a login procedure when the system is started. You can only delete the last user by interrupting the login. When deleting a user, his default values are lost. Therefore – particularly for the last user – you should export the default values beforehand (see page 36) beforehand.
EXP. USER	All user profiles are exported along with the respective default values as an XML file into the *User* directory on the inserted USB flash drive.
IMP. USER	This menu item can be used to import user profiles that are stored on an inserted USB flash drive into the system. This does not affect existing users. If two user names are the same, the system asks whether you want to overwrite or keep the existing user in the system.

4.8.3.3 Connection Cable Calibration -

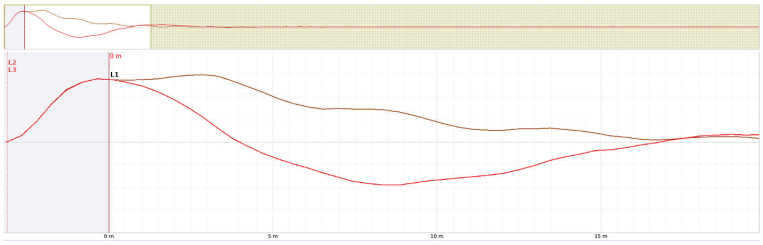
Purpose A properly calibrated connection cable ensures the accuracy of all operating modes which function according to the TDR principle (e.g. Teleflex, IFL, ARM and ARM burning). The length of the connection cable is not only automatically hidden from the visible diagram area, but also automatically subtracted from the calculated distance specifications.

As a principle, a calibration was already performed using the connection cables supplied during the final test. A repeat calibration should only be performed when one of the connection cables was replaced with a cable with a different length.

An individual calibration must be performed for all operating modes with a signal path which is affected by the cable replacement. Even if all three phases use the same signal path, all phases must be calibrated individually!

Procedure To calibrate a pre-measuring cable, proceed as follows:

Step	Action
1	Activate calibration mode using the menu item in the administration menu.
2	Start the operating mode for which you wish to perform the calibration.
3	Select the phase for which you wish to perform the calibration.
4	Connect the new connection cable to the output of the unit that corresponds to the selected operating mode / phase (see page 16).
5	Perform a measurement with the end of the connection cable open.
6	Exit the operating mode using the menu item and then open it again immediately. Select the same phase as in **Step 3**.
7	Open the trace recorded in the history database beforehand (see page 31).
8	Short circuit the connection cable at its end, and perform another measurement.

Step	Action
9	Select the menu item and move the red cursor exactly to the point at which both traces diverge. Then press and hold the rotary encoder (for about 4 seconds) until the new zero position is applied.
	Result: The area to the left of the newly calibrated zero point is shown in grey. It will no longer be included in the distance calculation in future measurements and will only be displayed in the upper diagram area. 
10	Repeat the procedure, if necessary, for other phases and operating modes.
11	Deactivate calibration mode using the menu item in the administration menu or restart the device.

5 Performing measurements

5.1 Good to know ...

5.1.1 Propagation velocity

Introduction

To enable the exact distance between the start of the cable and the fault position to be calculated, the TDR must be aware of the propagation velocity in the cable. This velocity depends on several physical variables in the cable: insulation material and thickness, cable diameter, etc.

If the setting for the propagation velocity value is out by 2%, then the measurement result will also be out by 2%.

Determining unknown propagation velocity

If the correct physical length of the cable under test is known, the propagation velocity can be measured. To do so, perform a pulse reflection measurement, and make sure that the end cursor is positioned exactly on the identified end of the cable. The propagation velocity is then continuously altered until the actual cable length is displayed. The propagation velocity should then be noted down for future measurements.

If the length of the cable under test is unknown because of elbows, reserves, etc., then a piece of the same cable can be measured in the workshop and the determined propagation velocity used for the cable out in the field. A reference cable such as this however, should be at least 50 metres in length.

5.1.2 Pulse width

Due the attenuation and dispersion characteristics of a cable, signals get changed in amplitude and shape as runtime progresses. Naturally, this also applies to the measuring pulse and its reflections.

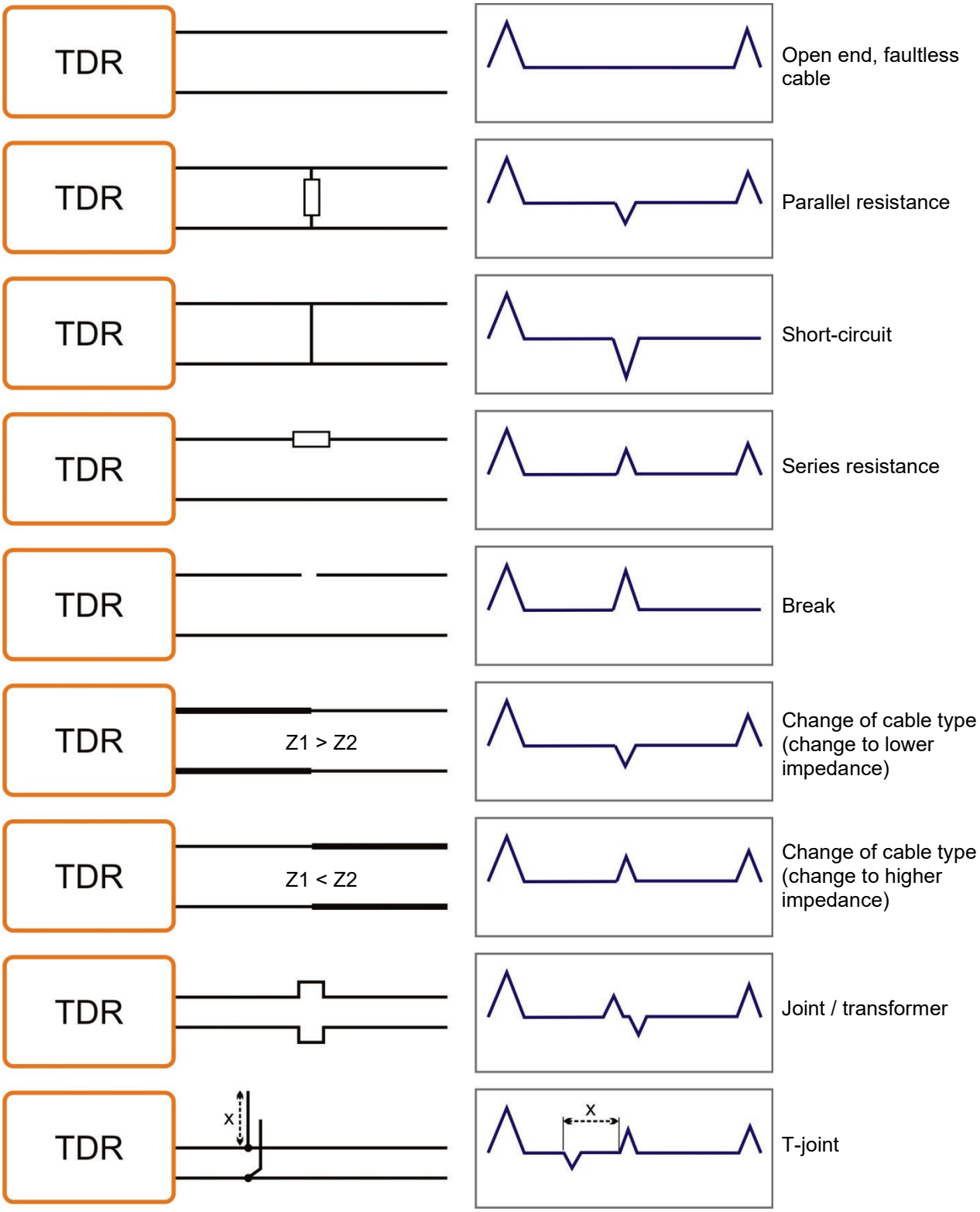
Narrow pulses, which contain a large portion of high frequencies, are subject to greater deformation than wide pulses. Consequently, narrow pulses are more suited for shorter ranges in which they can provide an image with higher resolution than wide pulses, whereas over larger distances they suffer from greater attenuation and dispersion. Here, wide pulses (up to 10 µs) must be used, as they are subject to significantly lower attenuation and therefore they supply a much clearer echo over longer distances.

The following table provides an overview of the pulse widths recommended for each required distance range:

Required distance range	Recommended pulse width
<100 m	20 ns
100 m … 200 m	100 ns
200 m … 1 km	200 ns
1 km … 2.5 km	500 ns
2.5 km … 10 km	1 µs
10 km … 30 km	2 µs
30 km … 80 km	5 µs
>80 km	10 µs

5.1.3 Typical TDR reflectograms

The following illustration shows several idealised examples for TDR reflectograms:



5.2 Standard functions

5.2.1 Teleflex menu -

The Teleflex menu can be activated in all LV and HV prelocation operating modes through the menu item. This submenu combines all the relevant measurement parameters for each operating mode and several additional functions.

Depending on the particular operating mode involved the Teleflex menu includes a selection of the following menu items:

Menu item	Description
TRI	In all the operating modes in which the measurement has to be triggered, the respective trigger threshold can be manually adapted. Normally the trigger threshold is automatically pre-configured to a suitable value. If the measurement should however be interrupted by low voltage reflections which are clearly not induced by the transmitted pulses, then the trigger threshold should be manually increased. If, instead of this, no reflections are displayed at all, then it may be helpful to reduce the threshold.
Y_G	This menu item can be used to set the gain. For pulse reflection and ARM measurements, the gain can be set for the received signal. If the setting is good, the reflection for the open cable end can be clearly identified as a positive reflection. In the ICE and Decay operating modes, any change of the gain setting requires a new fault flash-over to be triggered for the effect to become visible.
X_R	This menu item can be used to set the measurement range (X-axis). For pulse reflection and ARM measurements, the end of the cable should be visible as a positive reflection at the right-hand edge of the screen. In the ICE and Decay operating modes, the measurement range should be set to five times - ten times the cable length. Whenever the measurement range is changed, the settings for filter, pulse width and de-attenuation are automatically adapted.

Menu item	Description
	This menu item can be used to move the red cursor along the X-axis. By pressing and holding the rotary encoder a blue mark can be set on the current position of the cursor whereupon the red cursor can then be moved further. In this way, e.g. the real distance between two noticeable positions along the trace can be measured. Depending on the operating mode, the distance (calculated from the runtime) between the two marks is shown in one of the following fields at the lower edge of the screen:  The **full** distance between the blue mark and the red cursor  **Half** the distance between the blue mark and the red cursor (in Decay operating mode only).
	This menu item can be used to increase or reduce the visual range on the X-axis. The system aligns itself with the cursor position here.
M	This menu item can be used to access a list of all data records stored in the History database which match the currently active operating mode. Only the permanently stored data records are taken into account here. Using the rotary encoder 2 enables a data record in the list to be selected and then accessed. This way, e.g. a reference trace previously recorded on the same cable can be quickly located and compared with the current trace. Furthermore, the menu item can be used to store the current measurement permanently in the History database.
	This menu item can be used to set the bandpass filter, which limits the frequency range to be measured. Interference signals outside this frequency range are suppressed. The filter value is reset to its default value as soon as one of the following operations has been performed: • change to the operating mode • change to the pulse width • change to the measurement range
 | **NVP**	Setting signal propagation velocity (see page 46). The type of entry depends on the system settings (see page 37). The signal propagation velocity can also be adopted directly from one of the cables filed in the Cable database (see page 38). To do so, the menu item must first be called up and then the rotary encoder 2 pressed for at least two seconds.
	This menu item can be used to delete individually no longer required traces from the current display, to make it easier to read the important traces.
	The de-attenuation function enables the attenuation of the electrical pulses in the cable to be counteracted. This is done through amplification of the input signal which increases as the runtime increases, i.e. as distance increases the reflections are further amplified. The amplification increases exponentially up to a fixed maximum amplification. The ideal de-attenuation setting depends on the length of the cable, so the de-attenuation setting is effectively adapted whenever the measuring range is changed.
	This menu item can be used for all types of pulse reflection measurement to set the pulse width (see page 47) for the measurement pulse.

5.2.2 Trace functions -

This submenu, which can be activated during a measurement using the menu item provides diverse options to adapt the arrangement of traces on the screen to meet individual requirements:

Menu item	Description
1	This menu item can be used to move trace 1 along the Y-axis.
2	This menu item can be used to move trace 2 along the Y-axis.
3	This menu item can be used to move trace 3 along the Y-axis.
	This menu item can be used to move all visible traces along the Y-axis.
|	This menu item can be used to move the traces mapped on the display further apart from each other along the Y-axis and back in position. All traces are separated from each other by 50 pixels along the Y-axis. The traces are moved back into their original position and they are at the same level again.
	This menu item can be used to move all visible traces along the X-axis.
1-2	The difference between trace 1 and 2 is used to calculate and display a new trace. All other traces are hidden here.
2-3	The difference between trace 2 and 3 is used to calculate and display a new trace. All other traces are hidden here.
3-1	The difference between trace 3 and 1 is used to calculate and display a new trace. All other traces are hidden here.
2	This menu item can be used to move one of two traces along the X-axis.

Functions which can only be applied to traces 1 to 3 are only available when the respective slots are actually assigned (see page 35).

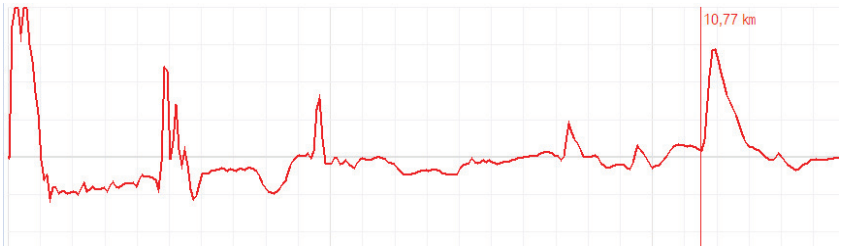
Loading a trace from the History database into one of these slots has to be done by calling up the individual trace (see page 34) instead of the complete measurement data record.

5.3 Pulse reflection measurement - $\frac{\Lambda}{INT}$ / $\frac{IFL}{INT}$

Introduction

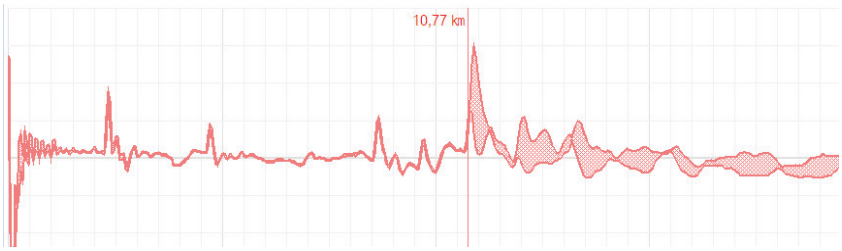
Low-resistance cable faults can be localised using the tried-and-tested and widely-used pulse reflection measurements. This method is based on the radar principle and makes use of the fact that any sudden deviations in the characteristic impedance of a cable reflect part of the energy transmitted into the cable. The degree of reflection is dependent on the magnitude of the deviation in the characteristic impedance, the number of reflections, the cable length and the distance to the fault position.

The recorded trace shows any deviation in the cable's characteristic impedance. Naturally, this means that not only fault positions, but also other changes in resistance such as, e.g. in joints are recorded. These recordings can indeed also represent an additional orientation aid for accurate pinpointing of the fault position.



The special operating mode $\frac{IFL}{INT}$ can be used to localise sporadically (time-variant) occurring low-resistance cable faults (caused, e.g. through traffic vibrations).

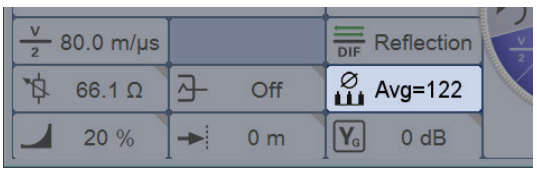
To this end, the individual traces in this operating mode are not continuously updated, but rather they form an enveloping trace from all the recorded measurements. In this way, any changes that occur (e.g. temporary fault triggering) during continuous measurements are rendered visible for the user.



Averaging

In the operating mode $\frac{\Lambda}{INT}$ the averaging function can be activated or deactivated using the menu item Ø. When averaging is active, the trace shown on the display presents the average of all previously recorded measurements. A maximum of 256 measurements are taken into consideration here. After reaching this figure, the recording stops automatically.

The number of measurements the currently displayed average trace is composed of is shown at the bottom area of the display and is continuously updated.



Procedure Proceed as follows to perform a pulse reflection measurement:

Step	Action
1	Activate the required operating mode T INT or IFL INT either directly from the main menu (Stand-alone mode) or from the submenu TDR (SPG 40 remote-control mode).
2	Make your phase selection (see page 30) and then close the phase selection menu by tilting the rotary encoder 2 to the side.
3	Use the Teleflex menu (see page 49) to make suitable settings for propagation velocity, pulse width and filter and, if necessary, activate the averaging function (see preceding page).
4	Start the measurement using the menu item ⏻.
	Result: Continuous measuring pulses are coupled into the phases involved in the measurement. Depending on the operating mode the recorded traces are either continuously updated or combined to form an enveloping curve.
5	Examine the recorded trace for deviations (see page 48) and, if necessary, use the available functions (see page 49) to improve the accuracy and display of the trace. In IFL INT operating mode you may also try to manually provoke fault triggering.
6	Stop the measurement using the menu item □.
	Result: The measurement is stopped and the trace is frozen. The measurement can be continued using menu item ▷.

5.4 High-voltage prelocation method

In order to perform accurate pinpointing of the cable fault in as small a segment of the cable route as possible, a thorough prelocation procedure should be conducted beforehand. This achieves both a significantly shorter total location time, while also protecting the cables.

In combination with a suitable HV fault location system (e.g. SPG 40, diverse surge-wave generators) the Teleflex SX-1 is capable of performing a variety of established HV-prelocation methods. The electrical connection (see page 16) differs according to the type of fault location system and operating mode involved.

5.4.1 Arc reflection measurement (ARM) - ARM

Introduction

The ARM method is suited for the prelocation of high-resistance cable faults on power cables with a total length of up to 10 km. When locating the fault position a reflection image is taken first under normal conditions (reference trace). Afterwards, a fault flash-over is provoked by a sudden discharge of the charged surge capacitor and a total of 15 reflection measurements are taken one after another while the arc is standing at the fault location. The user can then analyse the 15 resulting traces and choose the most suitable one (fault trace).

Both traces (reference trace and fault trace) diverge at the position of the ignited arc, which corresponds to the fault position.

Delay between TDR measuring pulses

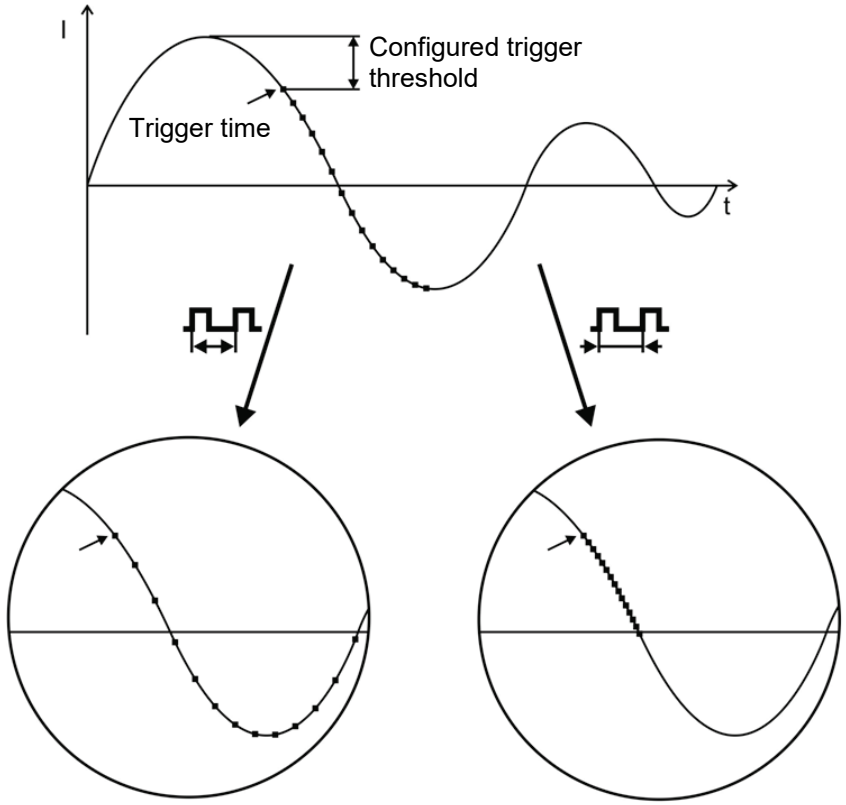
Before recording a fault trace, the user can manually configure the delay between two successive pulses using the menu item . This type of delay however, should not be mixed up with the trigger delay time (see page 56), which only delays the first pulse.

In principle, it is advisable to record the first series of fault traces with a default delay of 256 µs.

If required, the delay can be varied to suit between 0 µs and 3.84 ms and a new fault flash-over be provoked.

For a setting of 0 µs, the pulses are triggered as quickly as possible one after the other.

The affect of a delay adjustment is best illustrated in the current curve following a voltage flash-over:



■ Triggering a measuring pulse

As can be clearly seen in this diagram, by increasing the delay a “broader time span” can be projected, in which the arc may occasionally already be extinguished and ignited again.

Adjusting trigger delay time

A user issued with administration rights (see page 41) can use the menu item to adjust the delay time between the received trigger signal (configured trigger threshold exceeded) and the actual start of the TDR measurement.

This is intended to give the ignition process at the fault position sufficient time to form a stable arc.

Basically, the delay time is set to an ideal setting at the factory for the system configuration and it should only be adjusted in exceptional cases (in very special measurement layouts) and this should be conducted by experienced users only.

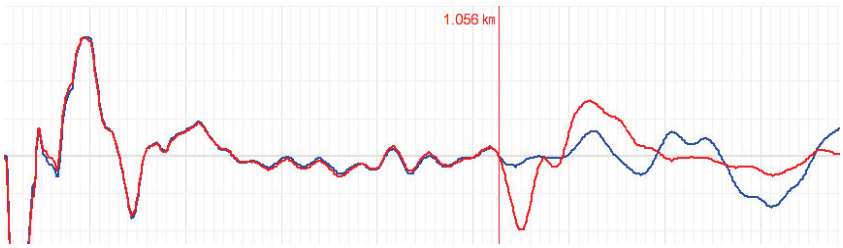
Any improper adjustment to the delay time poses the following risks:

- **Delay time too short**: The arc is not yet stable and the fault trace is not reliable or distorted.
- **Delay time too long**: As the delay time increases the risk of conducting a measurement in the decay curve's zero crossing increases. The re-ignition processes that occur at this time can distort the reflectogram. If the delay time is excessively high there is also a risk that the arc may already be completely extinguished.

Procedure

Proceed as follows to pre-locate a cable fault using the ARM method:

Step	Action	
	SPG 40 remote-control mode	**HV control directly at the fault location system**
1	When in the submenu PRE activate the menu item ARM.	Activate the operating mode using the menu item ARM.
2	In the phase selection menu (see page 30) select the test object's phase connected through the HV connection cable to the fault location system, and then close the menu by tilting the rotary encoder 2 to the side.	
3	Set the required voltage range.	Start the fault location system and enable HV to be switched on (earthing of HV output deactivated).
	To achieve the highest possible surge energy, the voltage range / surge level (see data sheet of the surge wave generator used) should be set as low as possible (under consideration of the required fault ignition voltage).	
4	Use the Teleflex menu (see page 49) to make suitable settings for propagation velocity, pulse width and filter.	
5	Start recording the reference trace using the menu item .	
6	Press the "HV ON" button on the SPG 40 or on the separate operating unit.	
	Result: Following a brief calibration procedure the reference trace is shown on the display.	

Step	Action	
	SPG 40 remote-control mode	**HV control directly at the fault location system**
7	Check whether the recorded trace and, in particular, the marked end of the cable (blue marking) match the expected result. If necessary, use the available functions (see page 49) to improve the accuracy and the display of the reference trace and repeat the recording using the menu item ▷.	
8	Prepare the Teleflex SX-1 for fault trace recording using the menu item REF/FAU.	
9	Taking the required fault ignition voltage into consideration, set the surge voltage and then trigger the surge discharge using the menu item _/_.	Trigger a surge discharge with the required fault ignition voltage directly on the fault location system.
	Result: If a voltage flash-over occurs at the fault position, a red (fault) trace is shown on the display. If no trigger is received, and therefore no fault trace is shown, it may be necessary to adjust the trigger threshold or the surge voltage before triggering a further surge.	
10	Turn the rotary encoder 2 to select one of the 15 recorded traces and confirm your selection by pressing it briefly. The selected trace can be changed using the menu item up until high voltage is deactivated.	
	Result: The red marking is automatically positioned at the location identified as the fault position (where both traces diverge from each other). 	
11	If necessary, use the available functions (see page 49) to optimise the trace display (filter, gain) and re-adjust the marked fault position. Then read off the fault distance.	
12	Switch off the high voltage using the menu item HV OFF.	Stop the measurement using the menu item and only then switch off the high voltage on the fault location system.

5.4.2 Voltage decoupling (Decay) - DEC

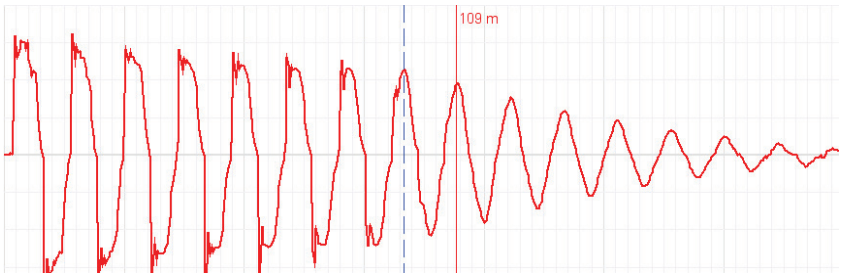
Introduction

The Decay method is used to pre-locate high-resistance cable faults with a high ignition voltage in chargeable cables.

To this end, the cable is charged with a DC voltage until it exceeds the fault's breakdown voltage. The energy stored in the cable capacitance discharges through the fault and generates a travelling wave, which is recorded and displayed by the Teleflex SX-1 as an attenuated oscillation. The period of this oscillation can be used to determine the actual fault distance.

Procedure

Proceed as follows to pre-locate a cable fault using the Decay method:

Step	Action	
	SPG 40 remote-control mode	**HV control directly at the fault location system**
1	When in the submenu PRE activate the menu item DEC.	Activate the operating mode using the menu item DEC.
2	In the phase selection menu (see page 30) select the test object's phase connected through the HV connection cable to the fault location system, and then close the menu by tilting the rotary encoder 2 to the side.	
3	Use menu item V/2 or **NVP** to set the propagation velocity (see page 46) and then use menu item X_R to set the measuring range to roughly five to ten times the complete length of the cable.	
4	Set the Teleflex SX-1 into recording readiness using the menu item ⏻.	
5	Press the "HV ON" button on the SPG 40 or on the separate operating unit.	Start the fault location system and enable HV to be switched on (earthing of HV output deactivated).
6	Set the voltage, taking the required fault ignition voltage into consideration.	At the fault location system, increase the voltage slowly and steady until a voltage breakdown takes place.
	Result: If the faulty cable was able to be charged up to the breakdown voltage, the display shows an attenuated and oscillating voltage curve.  The software automatically attempts to identify a period of the oscillation and to set corresponding markings.	

Step	Action	
	SPG 40 remote-control mode	**HV control directly at the fault location system**
7	Switch off the high voltage using the menu item HV OFF.	Stop the measurement using the menu item and only then switch off the high voltage on the fault location system.
8	If the recorded decay curve is superimposed to an excessive degree by interference signals, use the available filter settings (see page 50) to smooth the curve. Amplitudes that are too high can be counteracted by reducing the gain (see page 49). Each time an adjustment is made, the procedure has to be repeated from **Step 4**.	
9	If the automatically set markings do not enclose a period exactly, you can use the function → to correct their positions (see page 50). Read off the distance between the two markings directly next to the red marking. **Because the length displayed already corresponds to half the distance of a period, only the length of the connection lead needs to be subtracted** to determine the fault distance (see formula on preceding page).	

5.4.3 Current decoupling (ICE) -

Introduction

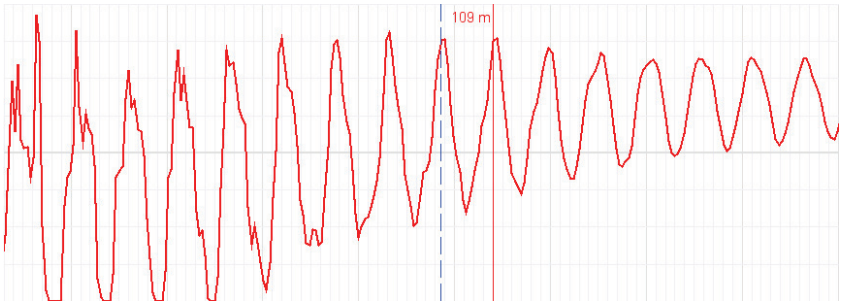
Prelocation using the current decoupling method (ICE) has established itself, particularly with regard to faults in the lower kOhm range and for extremely large fault distances, in which the ARM method often fails to achieve any results.

As with the ARM method, a capacitive discharge of the surge wave generator ignites the fault and causes it to a flash over. Consequently, an attenuated transient wave moves back and forth between the fault and the surge generator. Decoupling the current induces the Teleflex SX-1 into displaying an oscillation, which has a period equivalent to a single fault distance.

Procedure

Proceed as follows to pre-locate a cable fault using the ICE method:

Step	Action	
	SPG 40 remote-control mode	**HV control directly at the fault location system**
1	When in the submenu PRE activate the menu item .	Activate the operating mode using the menu item .
2	In the phase selection menu (see page 30) select the test object's phase connected through the HV connection cable to the fault location system, and then close the menu by tilting the rotary encoder (2) to the side.	
3	Set the required voltage range.	Start the fault location system and enable HV to be switched on (earthing of HV output deactivated).
	To achieve the highest possible surge energy, the voltage range / surge level (see data sheet of the surge wave generator used) should be set as low as possible (under consideration of the required fault ignition voltage).	
4	Use menu item V/2 or **NVP** to set the propagation velocity (see page 46) and then use menu item X_R to set the measuring range to roughly five to ten times the complete length of the cable.	
5	Set the Teleflex SX-1 into recording readiness using the menu item .	
6	Press the "HV ON" button on the SPG 40 or on the separate operating unit.	

Step	Action	
	SPG 40 remote-control mode	**HV control directly at the fault location system**
7	Taking the required fault ignition voltage into consideration, set the surge voltage and then trigger the surge discharge using the menu item _/_.	Trigger a surge discharge with the required fault ignition voltage directly on the fault location system.
	Result: If a voltage flash-over occurs at the fault position, the display shows an attenuated and oscillating current curve.  The software automatically attempts to identify a period of the oscillation and to set corresponding markings. If no trigger is received, and therefore no fault trace is shown, it may be necessary to adjust the trigger threshold or the surge voltage before triggering a further surge.	
8	Switch off the high voltage using the menu item HV OFF.	Stop the measurement using the menu item and only then switch off the high voltage on the fault location system.
9	If the recorded decay curve is superimposed to an excessive degree by interference signals, it uses the available filter settings (see page 50) to smooth of the curve. Amplitudes that are too high can be counteracted by reducing the gain (see page 49). Each time an adjustment is made, you must repeat the procedure from **Step 5**.	
10	If the automatically set markings do not enclose a period exactly, you can use the function to correct their positions (see page 50). Read off the distance between the two markings directly next to the red marking and **subtract the length of the connection lead** to determine the fault distance.	

5.4.4 ARM burning - ARM (not available in SPG 40 remote-control mode)

Introduction

In ARM burning a continuous arc reflection measurement takes place during the burning process. This enables any conversion of the fault caused by the burning process to be monitored on the screen. If required, the Teleflex SX-1 automatically stops measurement as soon as a stable low resistance condition of the fault is achieved.

As with the ARM method, the reference trace and the fault trace are compared with each other and the fault distance can be read off directly.

The advantage of this method compared with conventional burning is the controlled procedure which restricts the actual burning to the shortest necessary time and by doing so preserves the cable's service life.

Procedure

Proceed as follows to pre-locate a cable fault using the ARM burning method:

Step	Action
1	Activate the operating mode using the menu item ARM.
2	In the phase selection menu (see page 30) select the test object's phase connected through the HV connection cable to the burn-down instrument, and then close the menu by tilting the rotary encoder 2 to the side.
3	Start the burn-down instrument and enable HV to be switched on (earthing of HV output deactivated).
4	Use the Teleflex menu (see page 49) to make suitable settings for propagation velocity, pulse width and filter.
5	Start recording the reference trace using the menu item ⏻.
	Result: Following a brief calibration procedure the reference trace is shown on the display.
6	Check whether the recorded trace and, in particular, the marked end of the cable (blue marking) match the expected result. If necessary, use the available functions (see page 49) to improve the accuracy and the display of the reference trace and repeat the recording using the menu item ▷.
7	The menu item TRI can be used to activate or deactivate an automatic switch-off. If automatic switch-off is activated, the measurement is automatically stopped as soon as the fault position becomes clearly apparent during the burning process when comparing reference and fault traces. Otherwise the measurement has to be manually stopped.
8	Prepare the Teleflex SX-1 for fault trace recording using the menu item REF/FAU.
	Result: Measuring pulses are continuously coupled into the cable. With each of these pulses, the red (fault) trace is updated.

Step	Action
9	Start the burning process on the burn-down instrument.
10	As the burning process continues, monitor the accompanying fault conversion on the screen and stop the measurement using the menu item as soon as the fault position becomes clearly apparent through the comparison of reference and fault traces. If automatic switch-off is activated, the measurement is automatically stopped at that moment.
11	Switch off the high voltage on the burn-down instrument.
12	Use the function to mark the position identified as the fault position on the trace (see page 50) and read off the fault distance.

5.5 Partial discharge pinpointing - PD (not available in SPG 40 remote-control mode)

Introduction

This operating mode requires not only the Teleflex SX-1 but also the PD-TX pulse transmitter. This is connected at an easily accessible point, as close as possible to the suspected PD fault position through an inductive hinged coil to the partially-discharged cable. The Teleflex SX-1 must then be connected to the same cable end on which the PD- measurement was made, and then connected (see page 17)through the U/I input to any phase on the cable.

The Teleflex SX-1 receives the pulses sent by the pulse transmitter to the cable (and the reflections from the other end). The difference in time between the incoming reflections is used to determine the distance up to the feed-in position for the pulse, and then compared with the results from the previously-conducted partial discharge measurement. The suspected location of the PD fault position can then be localised more accurately, which in an ideal case helps to save any unnecessary and cost intensive excavation measures.

Procedure

Proceed as follows to pre-locate a PD fault position using the PD-TX pulse transmitter:

Step	Action
1	Activate the operating mode using the menu item PD.
2	In the phase selection menu (see page 30) select the test object's phase connected to the U/I input, and then close the menu by tilting the rotary encoder 2 to the side.
3	Start PD-TX pulse transmitter. For more details about starting up the PD-TX pulse transmitter, please read the accompanying operating manual.
4	Using the menu item V/2 or **NVP** to make the setting for the propagation velocity (see page 46). To ensure that both reflectograms can be compared, the propagation velocity must be set to the exact same value as was configured and used for the previous PD measurement!

Step	Action
5	Start recording the incoming pulses using the menu item ⏻.
	Result: The pulses that come directly from the PD-TX pulse transmitter and their reflections from the end of the cable are recorded and shown as a reflectogram on the display. If no incoming pulses / reflections are shown, an adjustment to the trigger threshold or the gain may help to rectify this (see page 49). If this measure fails to achieve any improvement, the settings and the connection for the PD-TX pulse transmitter should be checked.
6	Use the function →⋮ to determine the distance between the first and second reflection (see page 50), which corresponds to the distance to the pulse transmitter. 📖 More detailed information on evaluating the measurement result is available in the operating manual for the PD LOC PD- pinpointing system.

5.6 Additional operating modes in the SPG 40 remote-control mode

In the SPG 40 remote-control mode (see page 27) the Teleflex SX-1 enables access to all the SPG 40 operating modes. Next to the prelocation methods already described, the individual operating modes are as follows:

Submenu	Menu item	Description
	Ω	Insulation resistance measurement
TEST	DC	DC test up to 40 kV
TEST		Breakdown detection
		Acoustic pinpointing (Surging)
		Sheath fault pinpointing based on the step voltage method
		Burning

In these operating modes the Teleflex SX-1 does not act as a time domain reflectometer (TDR), but rather purely as a control unit. Operation is similar to direct control of the SPG 40. Accordingly, the operating steps and setting options are identical for direct control and remote control.

More detailed information is available for each of the operating modes in the operating manual for the SPG 40.

6 Exporting and processing measurement data

After the actual measurement job, the recorded measurement data can be conveniently analysed, archived and summarised in a report on a Windows PC.

To do this, the desired data must first be marked for export in the History database (see page 31) and then exported to an inserted USB flash drive via the data menu (see page 38). On the Windows PC, the data can then be imported into the protocol software and processed further. Depending on the version of the protocol software, the following functions are available:

	Megger Book Lite (free download on the Megger website)	**Megger Book** (full version) (article number: 2015875)
Analysis of the measurement data with practical tools	●	●
Creation of a report based on extensively customisable report templates	●	●
Creation and maintenance of a cable database		●
Archiving of measurement activities in the data stock of the respective cable		●

7 Information on rechargeable battery

Introduction

The Teleflex SX-1 (with the exception of the 19-inch version) is equipped with a high-resistance lithium-ion rechargeable battery and therefore it can be operated without the plug-in power supply. When fully charged, the rechargeable battery can permanently record traces for up to 6 hours.

The rechargeable battery is equipped with state-of-the-art protective and automatic control technology, which safeguards it against overloading, total discharge, excess current and short circuits. However, it is advisable to study the information provided in this section when handling the device to ensure that any unnecessary ageing or even a defect to the rechargeable battery is avoided.

Battery status icon

The battery status icon on the left-hand upper edge of the screen provides continuous information about the rechargeable battery's charging state at any given time when the device is switched on:

The rechargeable battery is fully charged.

The rechargeable battery is only half charged.

The rechargeable battery is almost fully spent and must be charged as soon as possible. To protect the rechargeable battery against total discharge, the device automatically switches off as soon as the remaining battery charge is no longer sufficient for reliable operation.

The device is powered by the plug-in power supply and the rechargeable battery is charged with a small charging current (see next page).

Temperature - monitoring

To protect the rechargeable battery against loads which would impair its service life or even lead to damage, the internal temperature is continuously monitored during operation. As soon as a value of 59 °C is exceeded, a warning message is shown on the display. In battery mode an immediate switch to an external power supply (see page 21) can under certain circumstances contribute to cooling down.

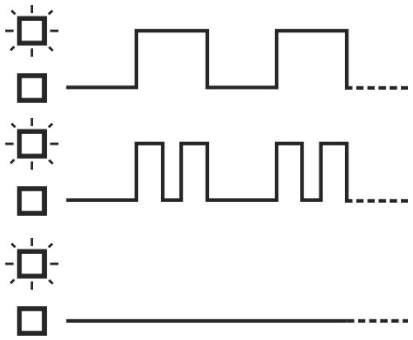
 **CAUTION**	If the warning message appears repeatedly and the displayed temperature continues to rise, we urgently recommend that you switch off the device to let it to cool down. Otherwise the rechargeable battery and therefore the device itself will automatically switch itself off at a temperature in excess of 60 °C.

Charging rechargeable battery

To charge the rechargeable battery, the plug-in power adapter delivered with the device is to be used to set up a connection between the charging socket 10 and a mains socket (110 V … 240 V, 50 / 60 Hz).

CAUTION	Only the plug-in power adapter delivered with the device may be used for charging!

During operation the charging progress is indicated by the battery status icon (see preceding page). When the device is switched off the status can be read off by the flashing characteristic of the ON/OFF button 4:



The rechargeable battery is being charged.

The rechargeable battery is fully charged.

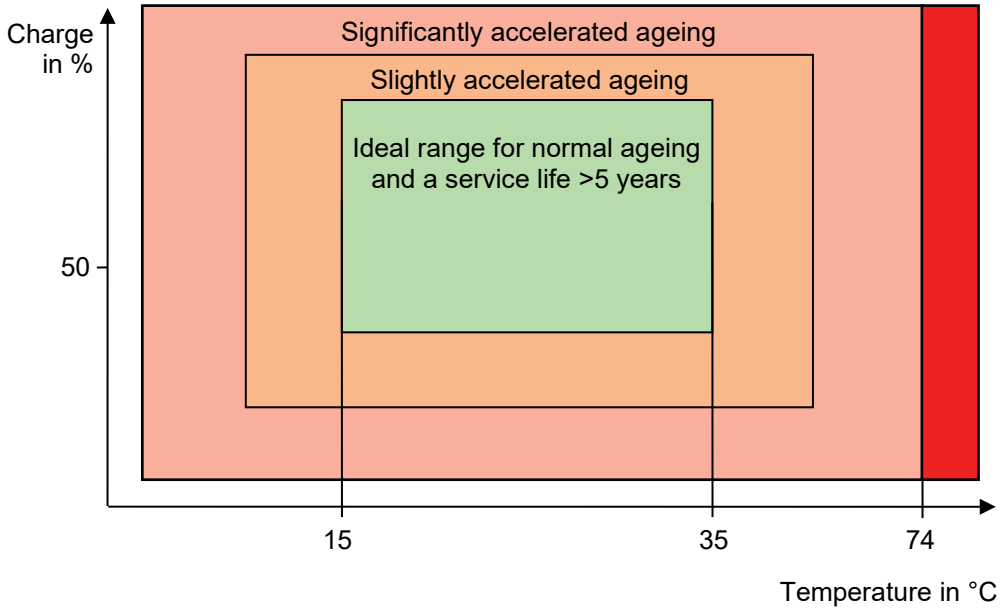
The device is not connected to an external power supply. The rechargeable battery is not being charged.

The rechargeable battery should be charged, where possible, **when the device is switched off** and in a temperature range that lies between 10 °C and 45 °C! Only under these conditions will the charging process run with a full charging current of 3 A and a charging period of roughly 8 hours.

If the device is switched on or in the event of deviating ambient temperatures, the charging current is limited to 0.5 A, which in turn means that the charging period is significantly lengthened The rechargeable battery is also not charged to its full capacity when the device is switched on.

Rechargeable battery care and storage

Cell oxidisation causes ageing to a lithium-ion rechargeable battery, the intensity of which is considerably influenced by temperature and the rechargeable battery's charge state. The following diagram illustrates in a somewhat simplified manner how these two factors impact on the rechargeable battery's service life:



The dependencies illustrated here, coupled with the fact that because of self-discharge a certain amount of capacity is lost even when the device is switched off, enable the following decisive rules to be drawn up with regard to achieving a long service life:

- Where possible, the rechargeable battery should not be discharged to less than 10%.
- To avoid any total discharge to the rechargeable battery, it should be charged again immediately after any intensive periods of use and particularly after an automatic switch-off.
- A device, which is not used for an extended period, should be charged one a month to 80% of its capacity.
- The rechargeable battery should not be subjected to extreme temperatures, neither under operation nor when in storage (such as, e.g. in a heated luggage compartment of a vehicle). A rechargeable battery temperature in excess of 74 °C (including during storage) may cause a defect in the rechargeable battery!
- A device that is not used for more than three days should be stored at an ambient temperature of between 15 °C and 35 °C.

CAUTION	As soon as the operating period for the rechargeable battery drops to less than 50% of the initial value, please contact a service centre, to have the rechargeable battery replaced. Do not replace the rechargeable battery yourself! If installed improperly it may explode.

Transportation

The transportation of lithium batteries, as well as devices, in which such batteries or rechargeable batteries are installed, is governed by regulations, which are based on the UN Model Regulations “Transport of Dangerous Goods” (UN document ST/SG/AC.10-1).

You should read the transport regulations and observe them when transporting the device.

8 Maintenance, care and troubleshooting

Repair and maintenance

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.

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

To ensure that a high measuring accuracy can be maintained for a long period of time, the device should be regularly calibrated at the manufacturer's plant (a two-year cycle is recommended).

Caring for the display

Do not clean the display with aggressive products such as solvents or spirits.

Instead, lukewarm water containing some washing-up liquid and a microfibre cloth should be used to clean the display.

Problem solving

If problems occur, these can - under certain circumstances - be diagnosed and solved using the following table:

Problem	Possible cause	Remedy
The system time has to be set again after every restart.	Spent BIOS battery	The battery is to be replaced by an authorised service centre.
Even after a 2 to 3 hour charging period the device can no longer be switched on in the rechargeable battery mode.	Total discharge of rechargeable battery	The rechargeable battery must be regenerated using an extremely small charging current, and charged for up to 16 hours at a time. The device can be operated during this period without any restrictions. If, afterwards, the device still cannot be switched on without using mains power, contact your local authorised service centre.
While beeing connected through the separating filter TF VX or TF VX-M, no signal can be measured on one or more phases.	Blown fuse	The fuses in the aligator clips (F 1.25A 500V; 6.3 x 32mm) and in the separating filter housing (F 1.6A 250V TR5) need to be checked and, if they are defective, replaced with fuses of the same type.

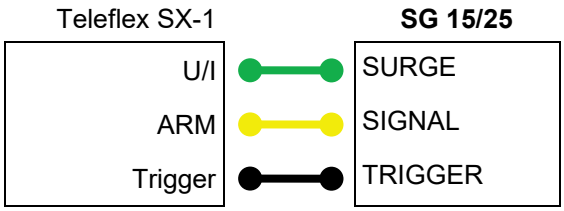
Appendix 1: Connection configurations

The following overview describes some possible connection configurations, in which the Teleflex SX-1 can be operated as a reflectometer connected to an HV fault location system.

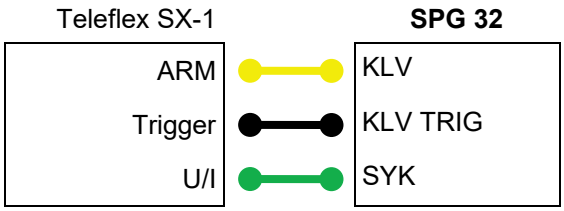
If you own a device which is not included in this overview list, you can discuss the options available for connecting to the Teleflex SX-1 with your local Megger sales representative.

ICE

ARM, ICE



ARM, ICE



Decay

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

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

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

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

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

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

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

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

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

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

Αυτό το σύμβολο υποδεικνύει ότι το προϊόν που φέρει τη σήμανση αυτή δεν πρέπει να απορρίπτεται μαζί με τα οικιακά 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 terméket tilos a háztartási hulladékokkal együtt kidobni. Mivel ez vállalati felhasználású termék, tilos a lakosság számára fenntartott hulladékgyűjtőkbe dobni. Ha a terméket ki szeretné dobni, akkor vigye azt el a lakóhelyéhez közel működő, elhasznált elektromos berendezések begyűjtésével foglalkozó hulladékkezelő központhoz.

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

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

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

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

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

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

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

Acest simbol indică faptul că produsul marcat în acest fel nu trebuie aruncat ca 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, ducând-ul la cea mai apropiată firmă specializată în colectarea echipamentelor electrice uzate.

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

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

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

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