

## Operating Instructions

### Ferrolux FL 10

Audio Frequency Receiver FLE 10



### Mess- und Ortungstechnik Measuring and Locating Technologies

Elektrizitätsnetze  
Power Networks



Kommunikationsnetze  
Communication Networks



Rohrleitungsnetze  
Water Networks



Leitungsortung  
Line Locating







## **FERROLUX® FLE 10**

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## Definition of Symbols:

Some special paragraphs are marked with a symbol. The following three symbols will be used:



Safety instruction

**TIP !**

Practical hint or example from practical experience

**i**

Information:





## EC Declaration of Conformity

We, the company

**Hagenuk  
Kabelmesstechnik GmbH  
Röderau 41  
D-01471 Radeburg**

declare under sole responsibility that our product

### **FERROLUX<sup>®</sup> FLE 10**

is in conformity with the provisions of the directive of the Council of the European Community for the harmonization of the legal regulations of member states on Electromagnetic Compatibility (EMC Directive 89/336/EWC).

The electromagnetic compatibility was tested according to the following standards:

EN 50081 Interference emission, EN 61000-6-2 Interference steadfastness, EN 55011 Product standard, EN 61000-4-2 Electrostatic discharge and EN 61000-4-4 Fast transient electrical disruptive factors

The fulfilment of the low voltage guidelines was tested according to the following standards: EN 61010-1 Safety regulations for electrical measuring and controlling instruments and laboratory as well as EN 60529 Ways of protection through casings

Radeburg, 2003-06-13

  
Dr. Lary  
Managing Director



## 1. GENERAL INFORMATION

### 1.1 Consultation by Megger

These Operating Instruction are intended to help you solve any questions and problems as fast and easily as possible. Please start with reading the manual whenever some problem should arise.

If, however, some question should remain unanswered, please contact one of the following addresses:

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## **1.2 Terms of Warranty**

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

Megger guarantees that at the time of delivery Megger products are free from faults in material and workmanship which would reduce their value and serviceability to a large degree. This warranty does not cover any error in the software supplied. During the warranty period Megger will repair faulty parts or replace them with new parts or parts as new (with the same usability and life as new parts) at their discretion.

Further warranty claims, in particular those from consequential damage, cannot be accepted. Each component and product replaced in accordance with this warranty becomes the property of Megger.

All warranty claims versus Megger expire after a period of 12 months from the date of delivery. Each component supplied by Megger in the context of warranty will also be covered by this warranty for the remaining period of time, but at least for 90 days.

Each measure to remedy a warranty claim must be carried out exclusively by Megger or one of their authorised service stations.

It is a precondition for accepting a warranty claim that the customer complains about the fault, in a case of an immediately detectable fault within 10 days from the date of delivery.

This warranty does not cover any fault or damage caused by exposing a product to conditions which are not in accordance with this specification, by storing, transporting or using it improperly, or having it serviced or installed by a workshop not authorised by Megger. No claim will be accepted in case of wear and tear, will of God, or connection to foreign components.

For any 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.

### 1.3 Safety Instructions

Every person dealing with the assembly, operation, maintenance and repair of this instrument is required to have read this manual with care.

At the time of supply, this device and its accessories are in line with the state of the art in safety engineering. Due to the course of operations, however, there may be places and parts on the device and its accessories which cannot be protected optimally without interfering with its function and operation by the user. For this reason it is a must that the operator has a comprehensive personal experience in safety matters in order to protect the staff and the devices.

#### **GENERAL INFORMATION**

Any operation on this device and its peripherals may only be carried out by trained and / or instructed staff. Keep any other persons away.

This manual shall be available to the supervising, operating and maintenance staff for reference. You are required to supervise all the time that all safety regulations are observed when running or servicing the the equipment.

Using the equipment improperly and for any other than its intended purpose may result in hazards to life and limb, to the instrumentation and the systems connected to it and may jeopardise the efficient operation of the device (UVV, German Prevention of Accidents Regulation). You are only allowed to use this device to the purpose stated by its manufacturer.

Operate the device and its peripherals only if they are in a good technical condition. Never use any foreign parts on the device and its peripherals, otherwise the required safety cannot be guaranteed. Abstain from any mode of operation which might jeopardise the safety of the device.

In any case of trouble that might impair the safety of the staff, the operator is required to shut the device down at once. The device may be switched on again only after the damage has been remedied.

#### **ELECTROTECHNICAL INSTRUCTIONS**

Connect the device and its accessories according to instructions. Observe all relevant **DIN** and **VDE** regulations.

Any repair and maintenance operations may be carried out only if the instrument has been switched off (is in a dead state) and only by an electrotechnical expert according to the Prevention of Accidents regulation (**UVV**). According to **UVV**, a person is regarded an electrotechnical expert if he or she, due to his or her vocational training, knowledge and experience as well as knowledge of relevant regulations, is able to assess the job he or she has been assigned to do and to recognise any possible hazard.

In order to avoid any damages to persons or property caused by the operation of the 'FERROLUX<sup>®</sup> FL 10' or in combination with other devices, always observe the following safety precautions:

Check whether in the immediate vicinity of the site where the 'FERROLUX<sup>®</sup> FL 10' will be used there are any unprotected devices / system components under voltage which you or your instrument may accidentally get into contact with. This applies in particular to components which are under **high voltage** (DIN VDE 100) or the voltage of which is not known.

Safeguard these components by means of insulating covers. If it is impossible to do so for technical reasons, de-energize them or have them de-energized for the time of your activity on this site. Before doing so, consult the responsible supervisor and ask him to give his permission. Make sure that all measures have been taken properly, e.g. by taking check measurements by means of a meter the proper functioning of which you have tested beforehand.

## 2. TECHNICAL DESCRIPTION 'FERROLUX<sup>®</sup> FL 10'

### 2.1 Application

Our Line and Fault Locating System 'FERROLUX<sup>®</sup> FL 10' is used for precisely locating metal lines such as cables and pipework laid out in the ground and for determining their depth below the surface. Furthermore it can be used for detecting the location of faults on cables or lines.

The main field of application of our 'FERROLUX<sup>®</sup> FL 10' is in the location finding of routes and faults in the following fields: Public power supply, telecommunication services, water supply systems and civil engineering for drawing up building plans and for the preparation of digging operations.

For route locating, receiver 'FERROLUX<sup>®</sup> FL 10' offers you a choice of 4 frequency ranges to implement different locating methods.

#### Frequency ranges:

- Range for passive locating methods
- Ranges for active locating methods using specific transmitter frequencies as emitted by transmitters 'FERROLUX<sup>®</sup> FLG 10', 'FERROLUX<sup>®</sup> FLG 50' or 'FERROLUX<sup>®</sup> FLG 200'

#### Locating methods:

- Location finding by the standard-minimum technique
- Location finding by the standard-maximum technique
- Precision location finding by the super-maximum technique
- Indication of signal flow direction by 'SignalSelect'
- Automatic depth and current measurement
- Location of lay fields
- Cable selection with mini aerial (optional extra)
- Locating finding of sheath faults with sensor (optional extra)
- Depth measurement (digital + 45° technique)
- Fault location finding by the inductive method (optional extra)

## 2.2 Technical Specification 'FERROLUX® FLE 10'

Receiving frequencies		
Passive:	50 Hz / 60 Hz / 100 Hz /120 HZ	
Active:	491 Hz, 982 Hz, 8440 Hz	
Dynamic range	(in relation to = 1 m)	
50Hz	10mA ... 10,000A	120dB
491Hz	400µA ... 400A	120dB
982Hz	180µA ... 180A	120dB
8440Hz	20µA ... 20A	120dB
Depth measurement	(491 / 982 / 8440 Hz only)	
Measurement range	0.13 m ... 7 m	
Tolerance	±5 % at the depth of 1.00 m	
Current measurement		
Current measuring range	1mA ... 400A / 180A / 20A	
Tolerance	± 10 %	
Measuring data memory	(only for the trace sensor FS 10)	
Number of records	99	
Number of measuring values	99 per record at maximum	
Total memory	413 measuring values at maximum	
Indication	Numerical indication Bar-graph indication	
Read-out of text, selectable	to be supplied on demand	
Power supply	Alcaline	4 x LR 6 >20h
Operating life	NiCd / NiMh	4 x R6 >13h
Weight	approx. 1.5 kg	
Dimensions	220mm x 100mm x 110mm	
Environmental conditions	according to DIN EN 60068-1	
Operating temperature range	-20°C to + 55°C	
Storage temperature range	-40°C to + 70°C	
Relative humidity	30°C / 93%	



---

Enclosure protection	according to EN 60529
Protection against dust and water	IP 54

### 2.3 Technical Data Mini-Antenna 'FLA 10'

Receiving frequencies active	491 Hz, 982 Hz, 8440 Hz	
Dynamic range	(based on = 0.2 m)	
491Hz	1.5mA ... 1500A	
982Hz	120dB	
8440Hz	500 $\mu$ A ... 500A	120dB
	50 $\mu$ A ... 50A	120dB
Weight	approx. 125g	
Dimensions without connecting cable	35mm x 53mm x 18mm	
Environmental conditions	according to DIN EN 60068-1	
Working temperature	-20°C to + 55°C	
Storage temperature	-40°C to + 70°C	
humidity, relative	30°C / 93%	
Protection class	according to EN 60529	
Dust and water protection	IP 54	

## 2.4 Technical data of the Step voltage probe DEB 3–10

Reception frequencies with generator only	491 Hz, 982 Hz, 8440 Hz
Sensitivity	Related to +3 dB
491 Hz	60 $\mu$ V
982 Hz	50 $\mu$ V
8440 Hz	80 $\mu$ V
Dynamic range	139 dB
Weight	2,5 kg
Dimensions without spikes / plates	57 cm x 69 cm x 5 cm
Environmental conditions	according to DIN EN 60068-1
working temperature range	–20 °C to +55 °C
storage temperature range	–40 °C to +70 °C
air humidity, relative	93 % at 30 °C
Protection class	according to EN 60529
dust and water protection	IP 54

## 2.5 Items Supplied and Accessory Items

### Basic equipment

FLE 10  
FS 10  
VK 13

### Accessory items

Headphone KS 10  
PC-Cable  
GPS-Tracer

### Sensors

Mini antenna FLA 10  
Microphone FLM 10  
Step voltage sensor

### Audio frequency generators

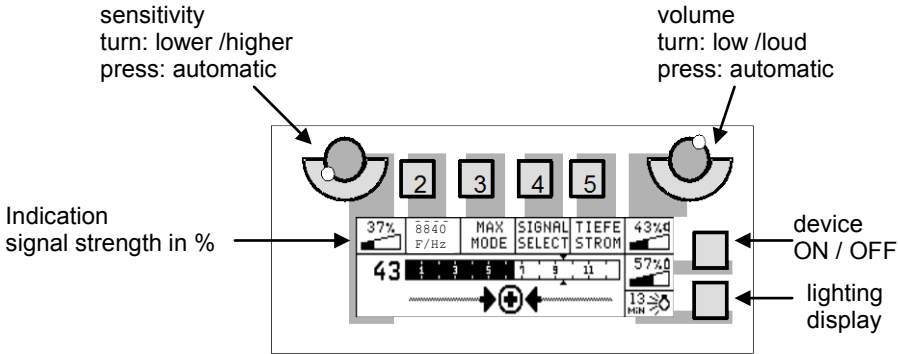
FERROLUX<sup>®</sup> FLG 10  
FERROLUX<sup>®</sup> FLG 50  
FERROLUX<sup>®</sup> FLG 50  
FM 9890-S (982 / 9820 Hz)



3. HOW TO OPERATE RECEIVER 'FERROLUX® FLE 10'

3.1 Receiver Controls

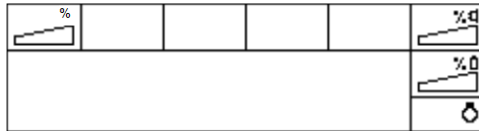
Key	Indication	Function				
2	<table border="1"> <tr> <td>50 F/Hz</td> <td>491 F/Hz</td> <td>982 F/Hz</td> <td>8440 F/Hz</td> </tr> </table>	50 F/Hz	491 F/Hz	982 F/Hz	8440 F/Hz	Selection of frequency
50 F/Hz	491 F/Hz	982 F/Hz	8440 F/Hz			
3	<table border="1"> <tr> <td>MIN MODE</td> <td>S-MAX MODE</td> <td>MAX MODE</td> <td></td> </tr> </table>	MIN MODE	S-MAX MODE	MAX MODE		Selection of technique
MIN MODE	S-MAX MODE	MAX MODE				
4	<table border="1"> <tr> <td></td> <td>SINUS SIGNAL</td> <td>SIGNAL SELECT</td> <td></td> </tr> </table>		SINUS SIGNAL	SIGNAL SELECT		Selection of filter
	SINUS SIGNAL	SIGNAL SELECT				
5	<table border="1"> <tr> <td>DEPHT : 0.57 m</td> </tr> <tr> <td>CURRENT : 0.43 A</td> </tr> </table>	DEPHT : 0.57 m	CURRENT : 0.43 A	Measurement of depth/ current		
DEPHT : 0.57 m						
CURRENT : 0.43 A						



'FERROLUX® FLE 10', Controls and Indicators

## 3.2 How to Switch the Receiver On and Off

Key I/O



For switching the receiver ON.

Pressing the key takes effect only after a short time delay. This will prevent that some short accidental touch may trigger the function.

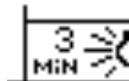
For switching the receiver OFF, press the key one more time

## 3.3 How to Switch the Display Lighting On and Off

Key LIGHT



display lighting ON:



Briefly depressing the key switches the display lighting on for a period of 3 minutes. Each time the key is depressed for a longer time, the lighting period will double up to a maximum of 96 min. The remaining time of lighting is indicated.

For immediately switching the display lighting OFF, briefly depress the key one more time.

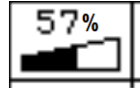
**TIP !** The operating life of the battery is noticeably reduced if you switch the display lighting on.

## 3.4 How to Adjust Sensitivity

Rotary control 1  
(to the left)

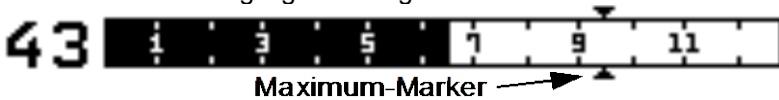


Indication of sensitivity setting:



Turn rotary control 1 to adjust the sensitivity of the receiver. By briefly depressing the control you may have sensitivity adjusted automatically. Below the rotary control, the percentage sensitivity setting is indicated.

Indication of receiving signal strength



Receiving signal strength is indicated both numerically, unit dB and as a bar graph.

The bar graph shows a maximum marker which indicates the maximum of indication encountered so far. Every turning of control 1 will reset the maximum marker.

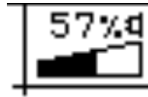
The scale of the bar graph is graduated in dB units.

## 3.5 How to Adjust the Volume

Rotary control 6  
(to the right)



Indication of volume setting:



Turn control 6 to adjust the volume (loudness) of the acoustic signal. Briefly depressing the control will switch the acoustic signal OFF, depressing the control one more time will switch it On.

The acoustic signal is reproduced by the built-in loudspeaker or ear-phones.



### 3.6 How to Set the Frequency Range

**Key 2**

8440 F/Hz
--------------

Keys 2 to 5: Selection of receiving frequency:

<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>
50 F/Hz	491 F/Hz	982 F/Hz	8440 F/Hz

Depress the key briefly to display all available receiving frequencies. Select your desired frequency by depressing the key above the indicated frequency.

For locating a line, 4 frequency ranges can be selected:

**50 Hz**

Narrow-band frequency range: 50 Hz

Furthermore you have the choice of: 60 Hz / 100 Hz / 120 Hz

Mode of operation for the passive location finding of power supply cables which carry current at mains frequency (50 / 60 Hz) or for the location finding of pipes which carry current due to Cathodic Corrosion Protection (100 Hz).

Benefit: Does not require any transmitter.

Drawback: Dependent on current, wide stray fields;  
automatic depth measurement not feasible.

## **491 Hz**

### Narrow-band frequency range: 491 Hz

Mode of operation for the active location finding of lines and cables into which a transmitter directly feeds a signal in the frequency range "491 Hz".

Benefit: Precise tracing of the route;  
any other lines have only a small influence;  
automatic measurement of depth and current

Drawback: As a rule, the transmitter must be directly connected.

## **982 Hz**

### Narrow-band frequency range: 982 Hz

Mode of operation for the active location finding of lines and cables into which a transmitter directly feeds a signal in the frequency range "982 Hz".

Benefit: Precise tracing of the route;  
any other lines have only a small influence;  
automatic measurement of depth and current

Drawback: As a rule, the transmitter must be directly connected.

## **8440 Hz**

### Narrow-band frequency range: 8440 Hz

Mode of operation for the active location finding of lines and cables into which a transmitter directly or inductively feeds a signal in the frequency range "8440 Hz".

Benefit: Precise tracing of the route;  
inductive coupling;  
automatic measurement of depth and current

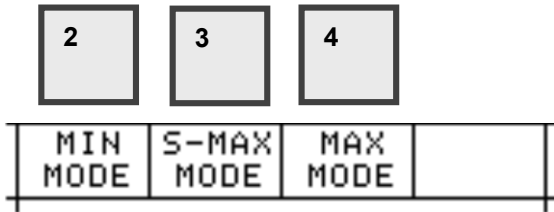
Drawback: Stronger pick-up of signal from other parallel lines.

### 3.7 How to Switch Over Between Minimum / Maximum / Super-Maximum

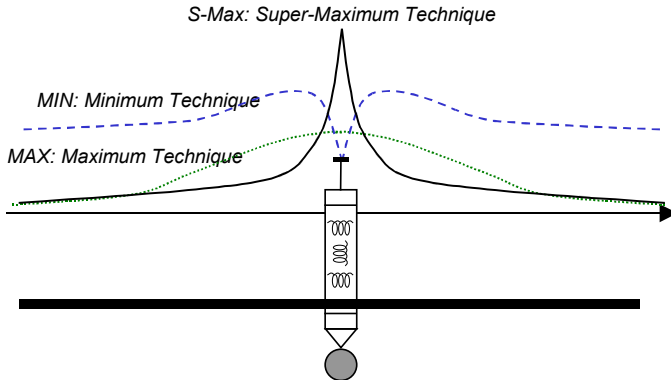
**Key 3**

Keys 2 to 4: Selection of locating technique

S-MAX  
MODE



Briefly depress the key to indicate the available methods of location finding. Select your desired method by depressing the key above the indicated method.



#### Minimum Technique:

When using the minimum method of location finding, the vertical component of the receiving signal is intercepted by means of a vertically arranged aerial and evaluated.

When you approach the line, signal indication and pitch will first increase. In its immediate vicinity, signal strength will drop sharply. There will be a signal minimum directly above the line.

**Maximum Technique:**

The tracing by means of the maximum method uses the horizontal component of the received signal. The signal is received via horizontally arranged aerials. When coming closer to the line the signal rises. Directly above the line the signal has its maximum.

**Super-Maximum Technique:**

When using the super-maximum method of location finding, the horizontal component of the receiving signal and the inverted signal of the vertical component are evaluated. When you approach the line, both the indicated signal strength and signal volume will suddenly increase. There will be a sharp signal maximum directly above the line.

Please note that there is no side maximum to the right and to the left of the super-maximum.

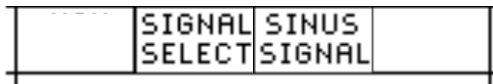
The signal maximum is sharply pronounced. In this way, adjacent lines are easier to locate and identify.

### 3.8 How to Set the Frequency Filter (SignalSelect / Sine Signal)

**Key 4**

SIGNAL  
SELECT

Keys 2 to 4: Selection of locating technique



Briefly depress the key to toggle between the two frequency filters.

Frequency filter ,SIGNAL SELECT' is the optimum setting for location finding by means of transmitter 'FLG 10', 'FLG 50' or 'FLG 200' which must be set to ,SignalSelect' by pressing its key S.

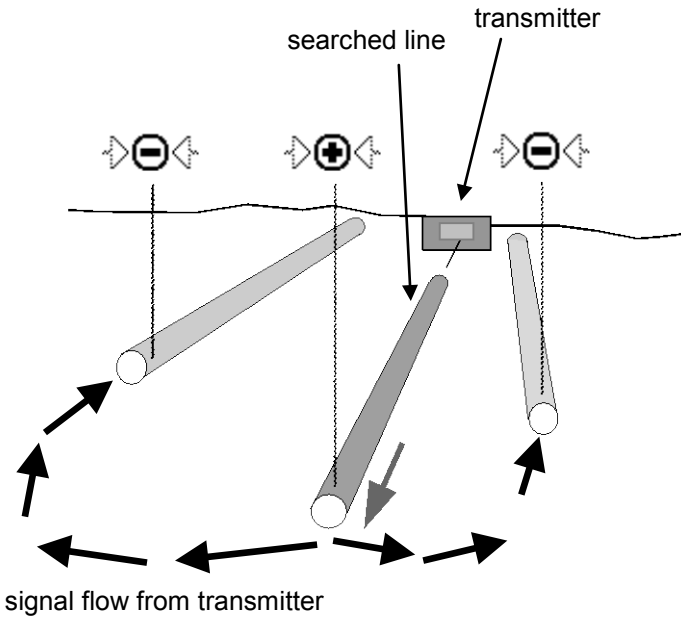
Frequency filter ,SINE SIGNAL' is highly selective (far more narrow than 'SIGNAL SELECT'), it is the optimum setting for receiving pure sine signals. Incoming signals from 'SignalSelect' are picked up, too. However, signal direction will not be indicated.

SIGNAL  
SELECT

If the text for 'SIGNAL SELECT' is cancelled out on the display, it is necessary to newly match the sensor to the receiver. This matching procedure is described in the section “**Matching for ,SignalSelect**”.

## SignalSelect

Using the encoded transmitter signal SignalSelect allows you to unambiguously identify a line.



Indication of signal flow direction under 'SignalSelect':

Signal direction from transmitter to earth:



Signal direction from earth to transmitter:



Signal direction cannot be measured:



Character '+', '-' indicates the direction of signal flow in relation to the coupling of the transmitter to the target line.

The indication is only enabled if the receiving signal is > 43 dB, the route sensor is within the 45° angle to the side of the target line and the receiving signal is not superimposed by strong interfering signals.



### INFORMATION

Make sure that the case of the route sensor with its label 'FERROLUX FS 10' and symbol '→⊕←' points in the walking direction of the operator, i.e. in forward direction.



### INFORMATION

The detection of signal flow direction will work reliably if the receiving signal above the target line, with the transmitter switched on, is by 20 dB stronger than the general background level measured with the transmitter switched off.



### ATTENTION

If the SignalSelect modulation is used, the problem may occur that the current flow direction displayed on the receiver is opposite to the actual flow direction in the target line. Thus the following test must be carried out prior to every measurement using SignalSelect:

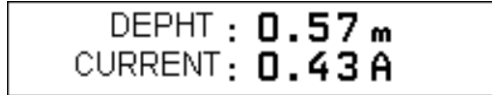
Choose a location where the target line can be clearly identified and check the displayed current flow direction. If the shown direction is wrong, turn the SignalSelect clamp or interchange the connection lines. As a result, the displayed and the actual current flow direction should match each other. Now the measurement can be started.

### 3.9 How to Select Measurement of Depth and Current

#### Key 5



Indication of depth and current



Key 'DEPTH / CURRENT' is only enabled if the conditions for taking a measurement are met. This means that the route sensor must be in a central position directly above the target line and the receiving signal must be  $> 43$  dB.

Press the key briefly to take a measurement of line depth below the surface (unit: metre) and to calculate the current intensity in the line (unit: Ampere).

In the event of heavy fluctuations of the receiving signal, the device will read out 'SIGNAL DISTURBED !'.

#### 45° - Technique

Route sensor



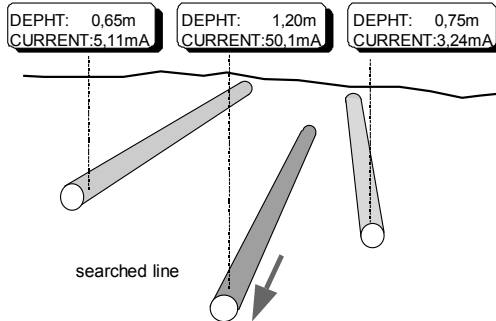
The transverse mark on the shaft will be indicated of the arrow as soon as the route sensor has reached the 45° angle to the side of the target line.

The distance between the line location and the marker indication of the 45° signal is equal the line depth.



## Current Evaluation

In our example, the line at the centre is connected to a transmitter. Due to coupling, both the neighbouring lines also carry transmitter current, but at a much lower level. This is why by measuring the current intensity the searched line can be identified unambiguously.



## 3.10 Recording and storage of records

The receiver FLE 10 has an embedded data memory for the storage of measuring values summarised in records.

99 records can be stored at maximum; each record may contain up to 99 individual measuring values. Each measuring value contains the information about the signal intensity, the depth, the current intensity as well as the information on the trace location, e. g. Right/Left and 'SignalSelect'. Records can be only recorded by the use of the trace sensor FS 10, if the measurement DEPTH is released.

If the measuring values should be stored, the locating of the cable route with the minimum method is recommended. In this case the trace sensor FS 10 has to be placed with the highest possible precision to the position of the signal minimum.

To represent the records as diagram directly on the display of the receiver FLE 10 a software version is optionally available.

The special PC software 'FLE-Draw' is available for representing and processing of records with a computer.

By means of this software the records with the measuring values can be transmitted to the PC and there represented as diagram. In addition to the data is available as ASCII file for the further processing with 'Microsoft-Excel' e. g.. The records in the receiver FLE 10 can be completely deleted from the PC. The PC cable for data transmission and the PC software are available as accessory.

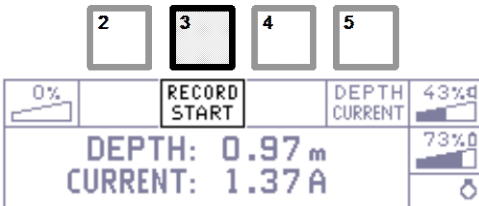
The following example shows a record with 17 test points and the representation of the measuring values for the current intensity. In the same way diagrams for the course of the laying depth or the signal intensity may be generated.



The measurement took place at a trace containing a low resistance shield defect. Starting with the test point MP 1 the trace has been accurately located and the measurement of DEPTH and CURRENT has been carried out each with the distance of about 3 m. The storage in a record took place simultaneously. The intense reduction of the current between the test points MP 6 and MP 7 caused by the shield defect can be well identified.

### 3.10.1 The start of a record

The start of a record is necessary for the storage of measuring values.



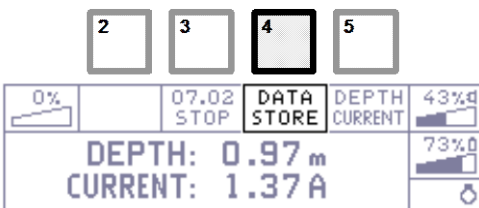
During the representation of the depth and the current intensity a new record will be started by pressing the key 3.

### 3.10.2 The storage of a measuring value

With the start of a new record this record receives a determined number automatically. It is impossible to change this number. After closing the record No. 99 the record No. 01 starts automatically again. Older records are overwritten.

After the start of a record each measuring value for the depth and the current can be included in the record. Each measuring value receives automatically a consecutive number starting with No. 01. If more than 99 measuring values are meant to be recorded, a new record with the next number and with the measuring value No. 01 will be automatically started.

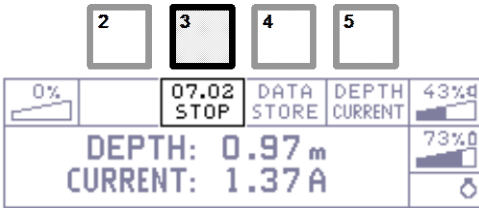
The representation of the current numbers of the record and the measuring value takes place on the display under the key 3. In the example the representation 07.02 signifies the record No. 07 with the measuring value No. 02.



During the representation of the depth and the current intensity a new measuring value will be saved in the current record by pressing the key 4.

### 3.10.3 The termination of a record

During the representation of depth and current the record can be terminated at any time. Also a record will be automatically terminated in the case of switch-off of the device or disconnection of the cable joint between the receiver FLE 10 and the trace sensor FS 10.



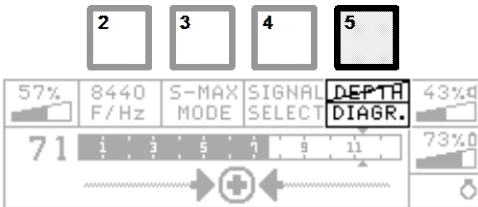
During the representation of the depth and the current intensity the current record will be terminated by pressing the key 3.

## 3.11 The representation of records as diagram

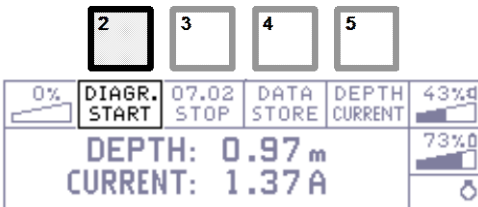
### 3.11.1 The start of the diagram representation

A trace sensor FS 10 has to be connected with the receiver FLE 10 to represent the records as diagram.

There are two possibilities to start the diagram representation.



If it is impossible to measure the depth, the diagram representation can be started by pressing the key 5.



The diagram representation can be started by pressing the key 2 during the representation of the depth.

This is even possible during the recording of any record.

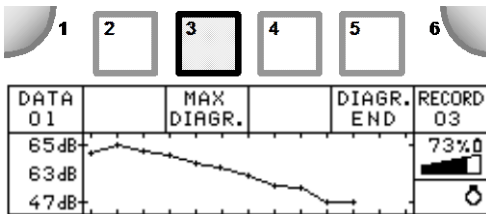
## 3.11.2 The representation of a diagram

In the diagram all measuring values of a record are represented as a line diagram. 13 measuring values are visible. If the record contains more than 13 measuring values, the other measuring values may be represented by the use of the rotary encoder 1. A further record is represented as diagram by the use of rotary encoder 6.

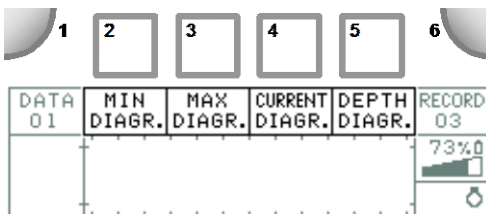
Each measuring value contains the individual measuring values for:

- the maximum method,
- the minimum method,
- the laying depth and
- the current intensity.

Each of these individual values can be represented as diagram.



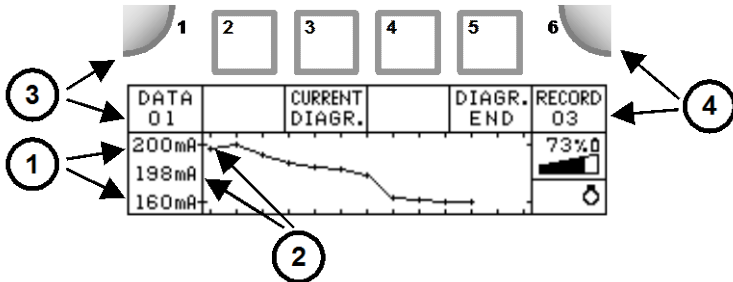
After starting of the diagram representation the diagram for the maximum method is consistently represented. The selection of any other diagram takes place by the use of the key 3.



After actuating of the corresponding key the diagram will be represented.

## 3.11.3 The interpretation of a diagram

The most important data of the represented record is shown on the display of the receiver FLE 10 in addition to the line diagram. As an example a diagram for the current intensity is demonstrated.



- ① Display for the maximum and minimum value of the total record.
- ② Display of the current measuring value.
- ③ Changing of the display of the current measuring value by the use of the rotary encoder 1.
- ④ Changing of the display of the record by the use of the rotary encoder 6.

### 3.11.4 The representation of the minimum-diffusion in the diagram

The minimum-diffusion is a well proven procedure of the fault location. This procedure uses the fact that the very homogeneous electromagnetic field of a current-carrying line generates a very narrow minimum signal directly above the line. That homogeneous field is highly distorted at fault positions in such a way that this minimum signal seems to be narrow to a lesser extent. In practice this behaviour is designated as minimum-diffusion.

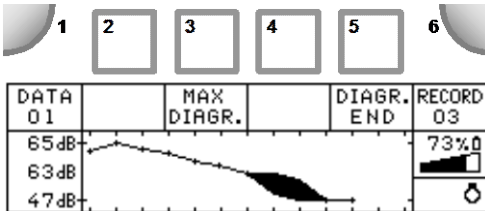
The minimum-diffusion may be located by following items e. g.:

- Cable joints
- Branch joints
- Core-core faults
- Core-shield faults
- Shield faults
- Contact by parasitic lines

The fault location by use of the minimum-diffusion procedure requires that a lot of practical experience and the precise knowledge of the trace of the cable route of the target line should be available.

The minimum-diffusion can be directly represented on the display of the receiver FLE 10 together with the representation of the diagram provided that a record has been recorded. All measuring values of a record are exactly analysed and the measuring values which are located in the region of a minimum-diffusion will be consequently identified. In the diagram the minimum-diffusion is characterised as a heavy extension of the diagram line.

The data of the records can be transmitted to a PC, represented as diagram and filed. For this purpose the special PC-software 'FLA-Draw' or 'FLE-Trace' is available.



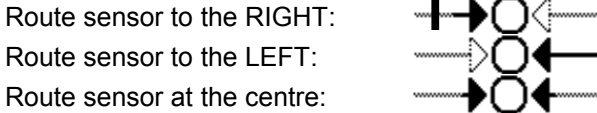
The minimum-diffusion can be clearly seen in the region of the test points 7 to 10.



### 3.12 Evaluation of Indicated Values and Acoustic Signals

#### Indication

Display of direction of route RIGHT / LEFT



The direction indicating arrows point out whether the route sensor FS 10 must be moved to the right or to the left in order to achieve that the target line is situated directly below the route sensor. The length of the arrow shaft will be shorter and shorter the smaller the lateral distance to the target line.

The transverse mark on the arrow shaft appears as soon as the route sensor has reached the 45° angle to the side of the target line.



#### ATTENTION

Make sure that the case of the route sensor with its label 'FERROLUX FS 10' and symbol '→⊕←' points in the walking direction of the operator, i.e. in forward direction.

#### Loudspeaker

There is a piezoelectric loudspeaker for reproducing the acoustic signals. The loudspeaker is situated on the left-hand side of the case, it cannot be seen from the outside.

For adjusting the volume, please turn the right rotary control.

## 3.13 Earphone Connection

Earphone Socket For connecting earphones when operating the receiver in a very noisy environment.



When plugging and unplugging the earphones, please make sure that the plug is always pulled at its case, never pull it at its pull relief or cable.

## 3.14 How to Set the Unit of Depth Measurement

### 3.14.1 How to Set the Unit

Receiver 'FERROLUX® FLE 10' allows you to select the unit for the measurement of depth.

#### This is how to proceed:

1. Connect the tracing probe FS 10
2. Depress key 5 before switching the receiver on and keep them depressed.
3. After the Megger logo appears, release the key 5.
4. Select unit of measurement.
5. Switch the device OFF.

### 3.14.2 Shift Line / Probe

The depth measurement on a line is different from the depth measurement with a probe (e.g. pig transmitter).

#### This is how to proceed:

1. Connect the tracing probe FS 10
2. Depress key 5 before switching the receiver on and keep them depressed.
3. After the Megger logo appears, release the key 5.
4. Select DEPTH/PROBE with key 4 or DEPTH/CURRENT with key 5.
5. Switch the device OFF.

## 3.15 How to Select Different Receiving Frequencies

Receiver 'FERROLUX<sup>®</sup> FLE 10' allows you to select the receiving frequencies of the frequency ranges.

### This is how to proceed:

1. Depress key 2 before switching the receiver on and keep it depressed.
2. Switch the receiver on and release key 2.
3. Press the keys above the frequency indication repeatedly until the desired frequency is indicated.
4. Switch the device OFF.



### ATTENTION

The functions ,DEPTH', ,CURRENT' und ,SignalSelect' are not available for these special frequencies.

## 3.16 Matching for ,SignalSelect'

### 3.16.1 Use

For the signal direction recognition with ,SignalSelect' to function reliably, it is necessary to match the sensor with the receiver FLE10. This concerns the sensors

- Trace Sensor FS 10
- Mini Antenna FLA 10

If the sensor is to be used with a different receiver FLE 10, also with ,SignalSelect', the matching must be repeated with that receiver.

### 3.16.2 Conditions

The matching cannot be done close to electric loads which cause stray currents. The environmental temperature should be in the range of +15°C to +25°C.

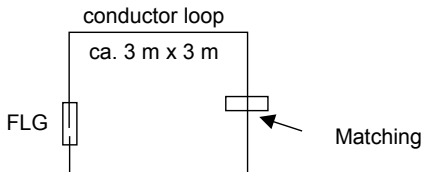
Pay also attention to the information and advices in section 3.8.

## 3.16.3 Equipment

The following devices and appliances are necessary:

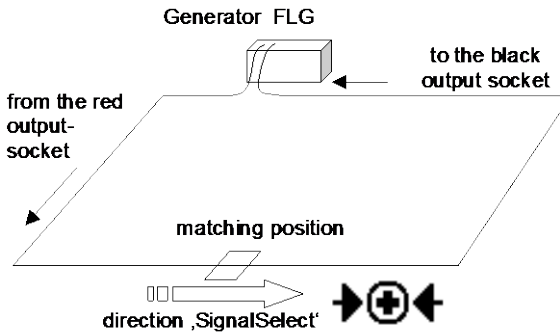
- Audio frequency generator FLG 10 or FLG 50
- Receiver FLE 10
- Sensor FS 10 or FLA 10
- 12 m wire, 4 mm banana plugs on both ends

## 3.16.4 Preparing the matching process



1. Arrange the wire in a square loop of approx. 3 m x 3 m on the ground and connect to the output sockets of the generator FLG 10 (FLG 50). Do NOT turn on the generator yet! (see figure above).
2. Connect the sensor FS 10 or FLA 10 to the receiver FLE 10, turn the receiver ON, hold the sensor above the matching position and measure the received signal in all frequencies. The display of the receiver FLE10 should NOT exceed 40 dB.
3. Turn ON the generator FLG 10 (FLG 50). Select the function 'SignalSelect' with **button S**. Slowly raise the transmitting power with **button P** until the received signal on the receiver is higher than **90 dB**.
4. Turn the receiver OFF.

### 3.16.5 Performing the matching



1. Press and hold **button 4** before turning on the receiver FLE 10. Turn the receiver ON, and release the **button 4** after approx. 3 seconds.
2. Hold the sensor to be matched approx. 10 cm above the matching position. Make sure that you hold it still. (see figure above).  
**!!! Caution !!!** Observe the correct orientation of the sensor case!!!
3. Choose the frequency for the matching on the receiver, according to the generator frequency.
4. The matching is done automatically and can take up to 30 seconds. During this period the sensor may not be moved and the device may not be switched off. It is not allowed to disconnect the sensor from the receiver (data loss would require calibration by the manufacturer).
5. After successful matching the sensor to the receiver the text SIGNAL SELECT will appear beneath **button 4**. The matching has to be confirmed by pressing the button.
6. Set the next frequency on the generator FLG 10 (FLG 50, FLG 200).
7. Do the compensation for the next frequency, as described as of section 2.
8. After matching all the frequencies, turn the receiver FLE 10 OFF.

## 3.16.6 Troubleshooting

If the automatic matching of the receiver FLE 10 could NOT be completed successfully, the text SIGNAL SELECT appears below **button 4**.



Following fault causes are possible:

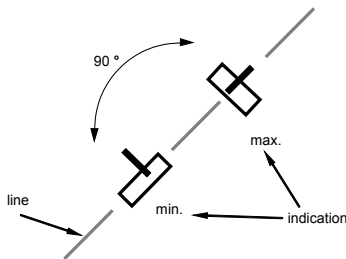
1. The receiving signal is too small: → raise power of the generator FLG, turn on 'SignalSelect'.
2. The interfering signals are too many: → switch off source of interference or go to another area.
3. Distance of the sensor to the generator too small: → Keep a distance of at least 3 m.
4. Generator, sensor or receiver defective: → Service.

## 3.17 How to Determine the Direction of a Line

Set receiver 'FERROLUX® FLE 10' to maximum or super maximum method, go to the place of maximum receiving signal intensity.

At this place: Turn the sensor around its vertical axis (see Fig 2.3).

As soon as the indication is minimum, the narrow sides of the device point in the direction of the line.



How to Determine the Direction of a Line

## 4. OPERATING THE MINI ANTENNA FLA 10

### 4.1 General

The mini antenna FLA 10 contains the receiving antenna, the amplifier electronics and the connection cable to connect to the receiver FLE 10. There are no operational elements whatsoever, operation is only via the receiver FLE 10 and is described in the section 'How to operate receiver FERROLUX FLE 10'.

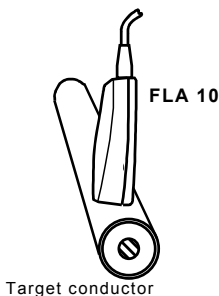
The following settings for the mini antenna are possible:

- adjustment of the frequency range
- alternation of the frequency filters (SignalSelect / Sinus Signal)
- adjustment of the sensitivity
- adjustment of the volume
- display light ON - OFF

It is not possible to measure the depth and the current intensity. The alternation between minimum and maximum methods is not caused by switching over on the receiver, but by different handling of the mini antenna.

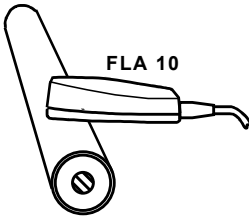
### 4.2 Locating with the Maximum or Minimum method

The mini antenna contains a directional coil. The position of the coil to the cable determines how the received signal is evaluated. Two methods are available: 'Maximum' (peak) and 'Minimum' (null).



#### **Maximum Method** (peak)

The maximum method is used when the thinner face plate (opposite to the connection lead) of the mini antenna is held vertically against the target conductor.

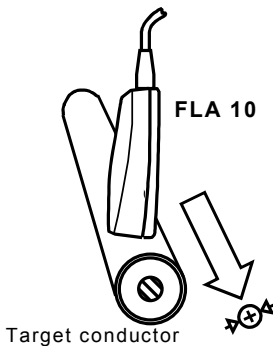


## Minimum Method (null)

To use the minimum method hold the larger side of the mini antenna against the target conductor.

### 4.3 Locating with ,SignalSelect‘

To measure the signal direction with ,SignalSelect‘ the maximum method must be used.



The direction for ,SignalSelect‘ is printed onto the casing.



If the text ‘SIGNAL SELECT‘ is cancelled out on the display, it is necessary to newly match the sensor to the receiver FLE 10. This matching process is described in the section “**Matching for ,SignalSelect‘**”.

## TIP !

The use of ,SignalSelect‘ with the mini antenna is only recommended if only a single phase cable is connected to the generator and it is sure that the signal returns via other cables or lines.



## **5. OPERATION OF THE STEP VOLTAGE PROBE DEB 3-10**

### **5.1 General description**

Isolation faults of buried cables e.g. isolated steel pipes or cables with plastic shielding can be located by means of the step voltage probe DEB 3-10. The cable must be connected with the output of an audio frequency generator, e.g. FLG 10, FLG 50 or FLG 200.

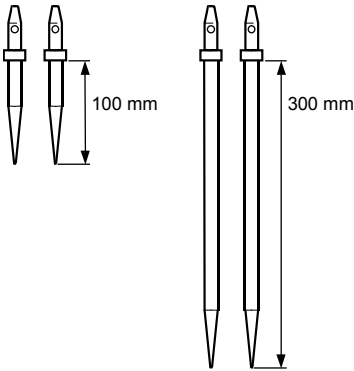
The Step voltage probe DEB 3-10 consists of a rugged frame with the enclosure for the electronic circuits. The connector plug for the receiver FLE 10 is situated on the top of the enclosure. Operating elements don't exist. The whole operation is done on the receiver FLE 10 and is described in the chapter "Operation of the receiver FERROLUX FLE 10".

The step voltage probe DEB 3-10 can be adjusted in the following way:

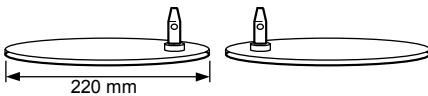
- Adjustment of the frequency range
- Adjustment of the sensitivity
- Adjustment of the sound volume
- Switching on and off the display

The step voltage probe DEB 3-10 has two possibilities for measurement:

- Direct galvanic measurement with spikes
- Capacitive measurement with the capacitive plates



A set of 100 mm long spikes is included in the standard delivery for the direct galvanic measurement. A set of 300 mm long spikes is available for measurements in dry environment.



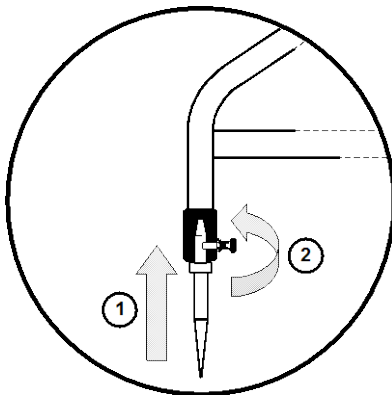
A set of capacitive plates is included in the standard delivery for the capacitive measurement. The application of the capacitive measurement is especially recommendable if the ground is sealed with concrete or asphalt.

The Step voltage probe DEB 3-10 and the accessory equipment are contained in a robust bag.

## 5.2 Insertion and removal of the capacitive plates or spikes

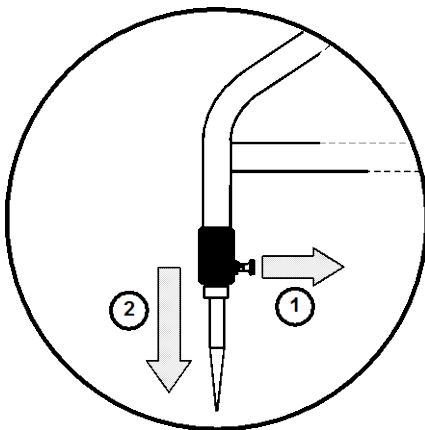
The capacitive plates or the spikes are mechanically locked in the isolators at the bottom side of the frame. A plug for the electrical connection of the capacitive plates or the spikes is located within the isolators.

Insertion of the capacitive plates or spikes:



- ① Push the capacitive plate or test prod bottom-up straight-forwardly into the isolator.
- ② Turn until the locking bolt of the isolator snaps into the hole of the capacitor plate or spike.

Removing of the capacitive plates or spikes:

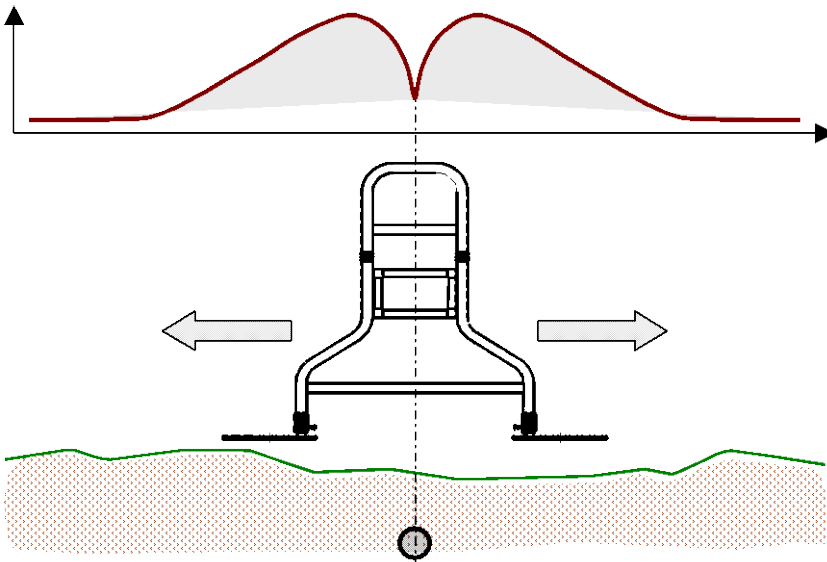


- ① Pull out the locking bolt of the isolator for about 5 mm and hold it.
- ② Pull the capacitive plate or spike downward.

### 5.3 Locating of the cable route

The trace of the cable route can be determined by means of the step voltage probe DEB 3-10. The location of the cable route can be carried out by the use of the capacitive plates or spikes. If the cable trace needs to be precisely located, the application of the Ferrolux tracing sensor FS 10 is recommended.

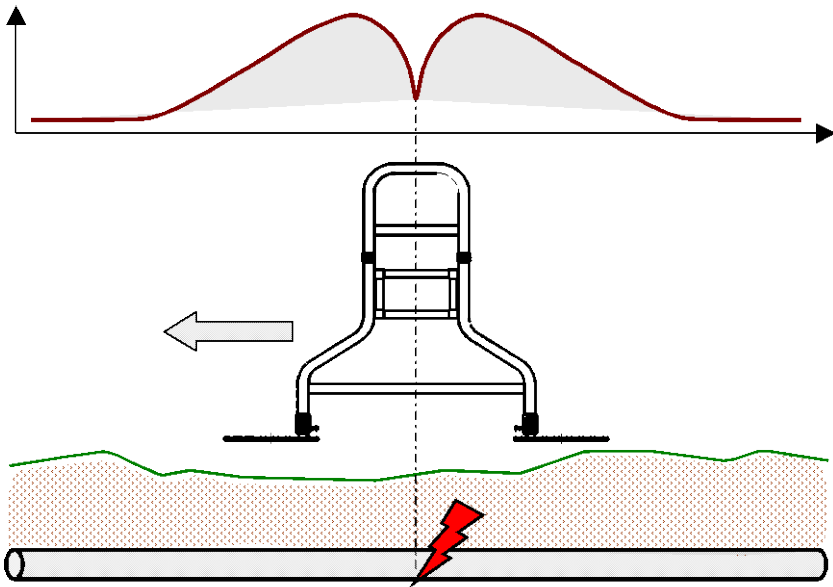
For locating of the trace the frame of the step recovery voltage probe DEB 3-10 has to be moved at an 90° angle with the cable route. The frame must be directly located above the cable, if the signal in the receiver FLE 10 has reached the minimum value.



## 5.4 Locating of faults

For locating of faults in the shield of cables or in the insulation of buried pipes the step voltage probe DEB 3-10 has to be moved in the direction of the trace above the cable or pipe. The locating of faults can be carried out by means of the spikes or the capacitive plates.

When approaching to the fault position, the signal in the receiver will increase rapidly and will decrease again after the fault position. If the signal in the receiver FLE 10 shows a minimum, the centre of the frame is directly above the fault.





## 6. CARE, MAINTENANCE AND REPAIR

### 6.1 General

Receiver FERROLUX<sup>®</sup> FLE 10 and FS 10, FLA 10 and DEB 3-10 work absolutely maintenance-free. All the operator has to do is exchange the batteries from time to time.



#### **ATTENTION**

The operator is only allowed to open the battery compartment. He or she is not allowed to open the receiver!

In order to keep the battery compartment from being soiled by leaking batteries, remove the batteries whenever you intend not to use the instrument for a longer period of time. Never use a mechanical tool such as a file, scraper or suchlike to clean or deform the contacts of the battery terminals. Use exclusively a mild detergent for plastic when cleaning the surface of the case and the front panel. Other detergents such as gasoline, acetone, spirit, acids or alkali would attack the surface and jeopardise the functionality of the devices or even cause their breakdown.

### 6.2 How to Replace the Batteries

Replace the batteries only in a dry environment. Make sure that the new batteries are of the same type and from the same manufacturer.



#### **ATTENTION**

Batteries are regarded as **hazardous waste**. Observe the relevant regulations when disposing of them!

Receiver 'FERROLUX<sup>®</sup> FLE 10' is equipped with a battery compartment which takes in customary alkaline-type round batteries or NiCd rechargeable batteries of size IEC R6.

## **This is how to proceed:**

1. Open the lid of the battery compartment in the back of the receiver with the two quick-release screws.
2. Remove the exhausted batteries.
3. Insert new batteries. In doing so, observe polarity as indicated on the bottom of the battery compartment.
4. Put the lid of battery compartment on and lock it by means of the two quick-release screws.

## **6.3 Repair**

Consult authorised expert staff exclusively whenever some trouble or malfunction should occur while running the instruments.

All the operator is allowed to do is to replace the primary or rechargeable batteries, if need be (see chapter 4).



### **ATTENTION**

You are not allowed to open the transmitter or the receiver or any accessory equipment. In any case of repair, always submit the item in question to authorised service staff.





Tento symbol indikuje, že výrobek nesoucí takové 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 působíště.



Dit symbol 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 of 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 изхвърля и в градски пунктове за отпадъци. Ако желаете да изхвърлите продукта, го занесете в пункт, специализиран на 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 brugsstationer. 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.



Selleli sümbooliga tähistatud toodet ei tohi käidelda tavallise olmejäätmena. Kuna tegemist on B2B-klassi kuuluva tootega, siis ei tohi seda viia kohaliku jäätmeäituspunkti. Kui soovite selle toote ära visata, siis viige see lähimasse vanade elektriseadmete äratamisestserunud 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 viellä kulluttajien 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'équipements électriques la plus proche de chez vous.



Cuireann an sibmóla seo in iúl nár cheart an tairgeadh a marcáilte sa tsá seo a dhíúscairt sa chóras fuiloll teaghlaigh. Os rud é gur tairgeadh ghnd nó gnó (B2B) é, ní féidir é a dhíúscairt ach oiread in ionaid dhíúscartha proibál. Más mian leat an tairgeadh seo a dhíúscairt, déan é a thógáil ag eagraíocht gar duit a sainfheidhmíonn i ndíúscairt sean-fhearrsáid leictreach.



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



Αυτό το σύμβολο υποδεικνύει ότι το προϊόν που φέρει τη σήμανση αυτή δεν πρέπει να απορρίπτεται μαζί με τα οικιακά απορρίματα. Καθώς πρόκειται για προϊόν B2B, δεν πρέπει να απορρίπτεται σε δημόσια 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 termékét tilos a háztartási hulladékokkal együtt kidobni. Mivel ez vállalati felhasználású termék, tilos a lakosság számára fenntartott hulladékgyűjtőbe dobni. Ha a terméket ki szeretné dobni, akkor vigye azt el a lakóhelyéhez közel működő, elhasznált elektronos 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.



Šis zīmē norāda, ka izstrādājums, uz kura tā atrodas, nedrīkst izmest kopā ar parastiem mājaiņmiecības atkritumiem. Tā kā tas ir izstrādājums, ko cits citam pārdo un lieto tikai uzņēmumi, tad to nedrīkst arī izmest atkritumos laodās izgāzules un atkritumu savākules, kas paredzētas vietējiem iedzīvotājiem. Ja būs vajadzīgs šo izstrādājumu izmest atkritumos, tad rīkojieties pēc noteikumiem un nodgādājiet to tuvākajā vietā, kur īpaši nodarbojas ar vecu elektriskā ierīču savākšanu.



Šis simbols rodo, kad joo paženklīto gaminio negalina īsmesti kaip paprastu būvīnu atlieku. Kadangi tai B2B (verslas verslu) produkta, jo negalina atiduoti ir būvīnu atlieku tvarkymo įmonėms. Jei norite īsmesti šį gaminį, atlikite tai tinkamai, atiduodami jį arti įsu esančiai specializuotai senos elektrines įrangos utilizavimo organizacijai.



Dan is-simbolu jindika li l-prodott li huwa mmakat b'dan il-mod m'ghandux jintrema bhāl skart normali tad-djad. Minhabba li huwa prodott B2B , ma jistax jintrema wkoll f'centri d'vici għar-rimi ta' l-iskart. Jekk tkun tixliq tamri dan il-prodott, jekk jogħġbok għamel dan kif suppost billi tiehdu għand organizzazzjoni fil-qrib li tispedjazzja fir-rimi ta' tagħmir qadim ta' l-elettriku.



Dette symbolot 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 opatrzonemu nie należy usuwać z typowymi odpadami z gospodarstwa domowego. Jest to produkt typu B2B, nie należy go więc przekazywać na komunalne składowiska odpadów. Aby we właściwy sposób usunąć ten produkt, należy przekazać go do najbliższej placówki specjalizującej się w usuwaniu starych urządzeń elektrycznych.



Este símbolo indica que o produto com esta marcação não deve ser deixado fora juntamente com o lixo doméstico normal. Como se trata de um produto B2B, também não pode ser deixado fora em centros 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, ducându-l la cea mai apropiată firmă specializată în colectarea echipamentelor electrice uzate.



Tento symbol znamená, že takto označený výrobek sa nesmie likvidovať ako bežný komunálny odpad. Keďže sa jedná o výrobok triedy B2B, nesmie sa likvidovať ani na mestských skládkach odpadu. Ak chcete tento výrobok likvidovať, odnesť 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 gospodinjnske odpadke. Ker je to izdelek, namenjen za druge proizvajalce, ki 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 está 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 återvinningssationer då den är förbrukad. Om ni vill avfallshandera den här produkten på rätt sätt, ska ni lämna den till myndighet eller företag, specialiserat på avfallshandling av förbrukad elektrisk utrustning i ert närområde.