Megger

FLG 50

Audio Frequency Generator

USER GUIDE

Issue: A (07/2022) - EN
Article number: 128311712

4 251821 412305

Operating manual

FLG 50

Operating manual
FLG 50

Consultation with Megger

The present system manual has been designed as an operating guide and for reference. It is meant to answer your questions and solve your problems in as fast and easy a way as possible. Please start with referring to this manual should any trouble occur.
In doing so, make use of the table of contents and read the relevant paragraph with great attention. Furthermore, check all terminals and connections of the instruments involved.

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

Megger Limited

Archcliffe Road
Kent CT17 9EN

T: +44 1304 502100

F: +44 1304 207342

E: uksales@megger.com

Megger Germany GmbH (Baunach)

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

T: +49 9544 68 – 0

F: +49 9544 22 73

E: team.dach@megger.com

Megger Germany GmbH (Radeburg)

Röderaue 41
D - 01471 Radeburg / Dresden

T: +49 35208 84 – 0

F: +49 35208 84 249

E: team.dach@megger.com

Megger USA

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

T: +1 610 676 8500

F: +1 610 676 8610

© Megger

All rights reserved. No part of this handbook may be copied by photographic or other means unless Megger have before-hand declared their consent in writing. The content of this handbook is subject to change without notice. Megger cannot be made liable for technical or printing errors or shortcomings of this handbook. Megger also disclaims all responsibility for damage resulting directly or indirectly from the delivery, supply, or use of this matter.

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.

Table of content

Table of Figures:

CE

The instrument meets the following standards:
EMC-standard : 89/336/EWG (EEC)
Electromagnetic compatibility
Changing modification rule : 92/31/EWG
As well as:
Low voltage regulation : 73/23/EWG (EEC)

1 Introduction

FERROLUX® is the trademark of a complete measuring system registered by Megger which has proved its worth for decades. It is for use in the following fields: operation of power cables, telecommunication cable systems, municipal water and gas supply systems, geodesy and construction industry.

FERROLUX® audio frequency systems are universally applicable, portable instruments for managing all kinds of localization problems. Its straight-forward principle of operation, i.e. evaluation of electromagnetic fields generated in the audio frequency range, allows all kinds of localization problems to be managed such as locating metal pipes, cable search, cable selection, depth measurement of pipes and cables, localizing die positions of sleeves and loading coil pots, sounding of land, pinpointing low-resistive cable faults and detecting reversed wires on telecommunication cables, phase determination and locating faults on pipeline and cable systems with cathodic corrosion protection.
The complete audio frequency set is made up of a generator, the output power of which is matched to the respective application and a universal receiver with inductive, capacitive and direct-coupled sensors connected to it.
A comprehensive range of special accessory units allows the operator to take measurements of audio-frequency step voltage using capacitive or direct-coupled methods, as desired. In this manner line-to ground faults on plastic-sheathed cables or sheath faults can precisely be pinpointed.

2 Technical Description

2.1 General Description / Fields of Application

The maximum output power of the FERROLUX® Audio Frequency (AF) Generator FLG 50 is 50 Watt, it can be adjusted in 2.5 W increments. The output signal is quartz stabilized in frequency and absolutely sinusoidal in waveform, it can be transmitted in continuous or pulsed mode. The standard configuration includes 491 Hz, 982 Hz and 8440 Hz as available output frequencies. In special cases of application further frequencies may be provided, if so desired by the customer.
The generator is equipped with an automatic facility by which it matches to any connected load impedance, which may occur in practice. The matched value which is equal to the connected impedance [Z] is indicated on the LC screen. Output power may be adjusted by means of the keys on the operator control panel.

Power is supplied by built-in Lead-gel-type rechargeable batteries, which can be recharged through the integrated charge controller from mains or any source of 12 V DC voltage. Charging time is dependent on the residual capacity of the battery but will not exceed 6 hours.
Furthermore the unit can be powered directly from an external source of DC voltage. In this event the internal battery is shut off.

The generator can be direct-coupled to the line to be tested or it can be coupled by induction.
For inductive coupling in the 8440 Hz range the internal antenna can be employed. To do so switch on the generator and press the antenna-button.
As an alternative method you may implement coupling by induction by means of transmitter clamps put around the cable or pipeline to be located. In this manner the generator signal is transmitted selectively to the test object. You may use any available transmitter frequency.
As optional extra the transmitter clamp UZ 100 (100 mm inside diameter) is available.

This method of coupling can also be employed on a cable, which is still energised. This method is suitable for coupling telecommunication and signal cables, provided that they are equipped with an ground-connected shield, metal sheath or protective-ground conductor, without causing any unwanted side effect.
Special voltage-proof filters allow coupling to power lines carrying up to 400 V (DC and AC). In this manner a line can be located selectively while it is active. There is no need to shut the line down.

Fields of Application of Ferrolux Systems

1. Locating of cables or pipelines with direct or inductive coupling
2. Terrain survey and locating of unknown cables and pipelines
3. Locating of joints on power and telecommunication cables
4. Locating of loading coils on telecommunication cables
5. Cable selection by the twisted-field method
6. Locating of splits in symmetric telecommunication cables
7. Pinpointing of low-resistive wire-to-wire faults with the twisted-field method
8. Fault direction determination on power and telecommunication cables
9. Pinpointing of sheath faults by the method of audio-frequency step voltage
10. Locating of faults on pipeline and cable systems with cathodic corrosion protection

2.2 Technical Specification

Output frequencies:	491 Hz / 982 Hz / 8440 Hz (other user-specific frequencies on request)
Frequency selection:	manual, automatic, single and multi-frequency operation
Power:	0 ... 50 W, manual adjustment in steps of 2.5 W
Supply mode:	Continuous or pulsed operation
Output sockets:	4 mm safety sockets, safe from contact
Display:	LCD graphics screen, illuminated
Impedance matching:	0.5 ... 1024 Ω, automatically
Modes of measurement:	Loop impedance, voltage, current, phase angle
Power supply:	Lead-gel rechargeable battery 12 V / 12 Ah (internal) 12 V from external source mains
Operating time: (of battery)	1.0 h at 50 W, up to 10 h depending on power setting
Battery monitor:	residual capacity is indicated continuously
Charging time:	ca. 6 h with electronic charge control
Protection against deep depletion:	for internal battery and external 12 V
Dimensions:	410 x 175 x 335 mm
Weight:	ca. 14 kg
Operating temp.:	-20°C to 55°C (-20°C possible with slower display)
Protection class:	IP 54

2.3 Connector Elements and Controls

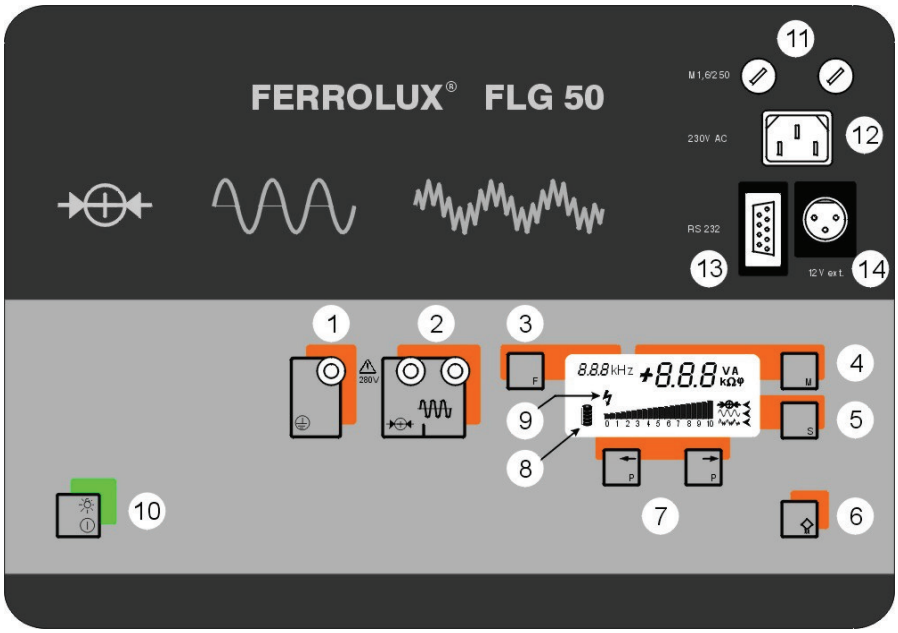

Figure 1: Operating Panel of Audio Frequency Generator FLG 50

1.	Socket:	Connection to external protective conductor
2.	Sockets:	Audio frequency output
3.	Key:	Frequency selection, selected frequency is indicated on screen
4.	Key:	Measurement mode of output signal: Ω / V / A / φ
5.	Key:	Selection of type of signal: “SignalSelect”, Single frequency or multi-frequency/pulsed
6.	Key:	Antenna (8440 Hz)
7.	Keys:	Adjustment of output power
8.	Icon:	Display of current battery capacity
9.	Icon:	Indication of dangerous contact voltage at output sockets
10.	Key:	ON / OFF; re-matching of output impedance
11.	Fuses:	For mains M 1,6 A / 250V
12.	Connector:	For mains input
13.	Connector:	Serial RS 232
14.	Connector:	External 12 V, min. 11 A

2.4 Items Supplied and Additional Extras

Items supplied with FLG 50:

Velcro-bag	KST 50
Cable set	VL FLG-50

Additional Extras to FLG 50:

Ground rod 35 cm	EB 35
Cable drum 25 m / 100m	HK 25 / HK 100-B
Universal clamp	UZ 100 (inside diameter 100 mm)
Connecting leads (2x) for connection to clamp	MK 31-B
Separating filter with NKG 1	TF 2050
12 V connecting cable (car)	LK 13

3 Safety

When using the Audio Frequency Generator FLG 50, always observe the relevant safety precautions applicable to the device and additionally the ones applicable to the mode of connection. Due to the measuring principle applied, the measuring circuit is absolutely separated from the power supply unit and from the technical structure of the device.

There is no connection to protective ground when running the instrument from batteries or an external source of 12 V. In this event please use the yellow grounding lead, which is part of the cable set, to connect socket [1] on the operating panel, designed for making connection to external ground, to some appropriate ground point. In this manner you ensure that each control, which is open to touch is connected to ground.

The two output sockets may carry a voltage of up to 280 V_{rms} at the uppermost stage of impedance matching! A high-voltage arrow [9] will be displayed on the screen whenever the output voltage of the generator exceeds 40 V.

The measuring circuit of Audio Frequency Generator FLG 50 is floating, it is not connected to the instrument case. We advise not to use the case as the point of grounding for the measuring circuit, even with the case being connected to ground by means of the ground lead. Voltage-carrying cables and lines as well as pipelines with cathodic protection may introduce voltage into the instrument which would also be carried by the metal parts of the case and so represent voltage which is dangerous to touch. This is why you are absolutely required to connect the case of the device to ground.

Attention !

When using grounding rods, make sure that the device is switched on only after the grounding rods have been connected and inserted. Never pull an grounding rod out as long as the generator is switched on ! [dangerous voltage]

Note !

Before making a direct connection from AF-Generator FLG 50 to a cable, always use a voltmeter to make sure that the cable is actually dead (does not carry voltage).
It is true that the internal protective circuit of the FLG 50 will signal any applied extraneous voltage and disable the switching-on of the generator. Nevertheless you cannot exclude that there may be a danger to life and instrumentation.

Note !

The mode of power supply (mains AC, 12 V DC or rechargeable battery) may only be changed when the FLG 50 is turned off or in charging mode.
This means, changing power supply connections mains or 12 V DC should never be done while the FLG 50 is transmitting.

4 Operating Instructions

Figure 2 : FLG 50, View of the Instrument

4.1 Description of Connector Elements, Controls and Indicators

The following description refers to the connector elements and controls as indicated on Figure 1.

4.1.1 External Protective Ground (1)

The ground socket is connected internally to base plate, to the heatsink, screws at the bottom, the front panel and device ground (battery -).

4.1.2 Connecting Sockets (2)

Sockets (2) are for making connection to the test object (transmitter clamps, cables, pipeline etc.).

Attention !
Voltage may be as high as 280 V_{rms} (dangerous to contact!).
The output sockets are separated from the protective ground socket (1), the socket for external power supply (12 V DC) and mains connection by means of a separating transformer.

4.1.3 ON/Off / Matching / Illumination (10)

This key has four functions:

- It is for switching the generator ON or Off. For switching on, keep key (10) depressed for a short time. The device is switched on as soon as you release the key.
- If you press the key briefly while a signal is transmitted, the generator will be re-matched to its load impedance and the measuring values will be updated. For as long as re-matching is under way, the screen will not indicate any measurement value but display a bar running from top to bottom. Frequency and signal waveform / timing mode will not be changed. An acoustic signal will sound as soon as re-matching has been finished.
- Keep key (10) pressed if you want to switch the FLG 50 off until the “Bargraph” disappears totally.
- After each keystroke the background lighting of the screen will remain on for approx. 30 seconds.

If the instrument has been connecting to an external source of power, battery charging will begin subsequently.

4.1.4 Frequency Selection (3)

This key is for switching between possible output frequencies. There is an internal EPROM in which the frequencies to be selected are stored.
Since any switching of frequency may result in a change of load impedance (inductive or capacitive component), re-matching is carried out after each change. The output power re-calibrates to the set value.
The available frequencies are toggled if you press the key several times.
The selected frequency is enabled after a short delay.
The FLG 50 also includes mode **automatic frequency selection** - a special mode of frequency selection when making direct connection to the test object.
Automatic frequency selection is enabled by pressing key Frequency selection (3) and the right arrow key (7) one after the other.
As a result of measuring impedance, the FLG 50 will automatically select the optimum frequency for the lowest load impedance.

4.1.5 Measuring Mode (Ω/V/A/φ) (4)

This key is for switching the mode of indication between load resistance, voltage, current and phase displacement.
When depressing the key for a while, the measured quantities will be indicated one after another (in rolling mode).
Load resistance and phase displacement (between output voltage- and current) indicate the properties of the connected test object. For instance, high load resistance in combination with direct transmitter coupling may be caused by poor grounding conditions.
The indication of current will give you a clue of the electromagnetic field strength to be expected along the line. The indication of voltage serves mainly as a warning of voltage possibly dangerous to touch.

4.1.6 Signal Waveform / Timing / “Signal Select” (5)

Three different modes of operation can be selected.
The upper icon indicates the operational Mode “Signal Select”. The Generator produces a specially coded audio frequency signal, which can be couple either direct galvanically or by transmitter clamp.
This procedure becomes very hand in case of very close installed parallel lines.
With the receiver system FLE 10 / FS 10 / Mini antenna this signal is detected above the target line, the direction is evaluated and displayed.

If the middle icon, Sine is indicated, a purely sinusoidal signal is transmitted.
The lower icon indicates mode Multi-frequency operation. A multiple-frequency signal is supplied to the output sockets, which is made up of two or three audio frequencies as stored in the software. In mode Multi-frequency operation the individual frequencies involved are indicated alternately top left on the screen whereas in mode “Signal Select” and Sine the currently selected frequency is indicated as a fixed value.

If you select the pulsed mode, the icon of the selected waveform either Single or Multi-Frequency will blink with the pulse frequency.
Pressing the key several times causes the individual waveforms or modes of pulsing to be displayed one after the other. After 3 seconds the selected setting is taken over and impedance re-matching is carried out.
In the “Signal Select” Mode, pulsing and the operation with transmitter antenna is not possible.

4.1.7 Transmitter antenna (6)

This key switches on the internal transmitter antenna. The used frequency is set to 8440 Hz, which is also shown on the display. If the transmitter antenna is in use, the multiple frequency and “SignalSelect” is disabled and cannot be chosen.
Please make sure that the cover is open to get the best results for coupling the signal into the line or hose to locate.
Using the transmitter antenna the output sockets (2) are internally disconnected.

4.1.8 Power (7)

The two keys are for adjusting output power. Here, too an acoustic signal will sound to confirm the change of power. Output power will be increased or decreased step by step, respectively, if you keep the respective key pressed. The selected power level is set after the key has been released. In Multi-frequency mode, the maximum output power is 30 Watts.
If a high-resistive load (>1kΩ) or no load at all is connected to the output sockets, the generator works primarily as a source of AC voltage. In this event output voltage can be adjusted by pressing either of keys (7). For this mode of operation the mode of indication is set at voltage measurement (V). Output voltage and signal waveform can furthermore be selected at will.

Battery gauge (8)

This symbol shows the available battery capacity.
When the battery gets low (below 10 %) the generator "beeps" to inform the user. Reducing the output power saves battery power and will increase operating time.
As the FLG 50 is in charge mode the actual battery capacity is shown on the LC-display. When charging is finished the value will be set to 100 % and maintenance charging will start.

Warning of voltage >40V at output sockets (9)

If the high-voltage icon (HV arrow) is displayed on the screen, the output sockets carry a voltage, which is higher than 40 V.
This operating condition can be regarded quite normal in mode transmission if the connected load is high-resistive and an output voltage of more than 40 V has been selected

When the generator is switched on (mode transmission), the output sockets are checked for absence of voltage. If extraneous voltage (>20 V) is detected, an optical warning (flashing high-voltage arrow) is displayed and an acoustic warning rings out. In this case the generator cannot be switched on to avoid any damage to the instrument. You will need to remove the extraneous voltage or use a separating filter before you can switch the instrument on.

4.1.9 Fuses for mains connection (11)

Attention !
Risk of electric shock !! Before changing the fuses for mains make sure that a main cable is disconnected.
Always use the correct value.

4.2 Power Supply

4.2.1 Internal power supply

The operation of the Generator is powered by an integrated maintenance free Lead-gel Accumulator. Under normal conditions the operation time is 1,0 Hours at maximum power of 50 Watts.

4.2.2 External Power Supply

The FLG 50 can be powered from mains or an external source of voltage (12V DC) (charging and transmission modes). Use the mains connection for 230 V use or 12 V connecting lead (car battery) LK 13 for making connection to 12 V.
If a source of external power is connected while the generator is off, the internal rechargeable battery will be charged automatically.
Please ensure that the 12 V source can deliver enough power (up to 11 amps in generator mode, up to 5 A in charge mode).
Pressing the ON/OFF key (10) will cause the instrument to toggle between the charging and transmission modes.

4.2.3 Charging the Internal Battery

The FLG 50 is equipped with an Lead-gel-type rechargeable battery. Total charging time is approx. 6 hours. Make sure that the FLG 50 is not placed next to a source of heat while charging is under way. This might possibly result in a longer charging time.
In mode charging the screen displays the available percentage capacity instead of frequency. An acoustic signal will sound as soon as the instrument changes over from quick charging to trickle charging. At the same time the indication of capacity is set at 100 per cent.
At maximum power output of 50 W, the operating life will be approx. 1.0 h.

5 Care and Maintenance

If during operation of the FLG 50 in bad weather any humidity gets on the surface of the membrane keypad in spite of the protective lid, this does not give cause for concern. However, do not forget to wipe the humidity off before stowing the instrument away in its transportation bag in order to avoid the diffusion of vapour into the instrument.

Use a soft cloth and some household detergent, if need be, to remove any soiling.

RESET

The FERROLUX generator FLG 50 is controlled by a microprocessor. If the instrument does not react to any kind of user input, you may execute a hardware reset operation.

- Remove any possibly connected external source of voltage.
- Press keys F (3) and M (4) simultaneously. This way the electronic circuit of the generator is completely separated from the internal source of power and the instrument is reset.

6 Description of Applications

6.1 Direct Coupling

The basic principle of direct coupling is to directly connect the cable or pipeline to be located to the generator by means of connecting leads to create an audio-frequency current flow through the line to be searched. In doing so please make sure that there is actually a closed loop from one output socket to the other. If there is any interruption no matter where, you will not be able to do any locating. Please use the supplied connecting leads to make connection as follows:

6.1.1 Locating a Pipeline using a Ground Rod

Insert the grounding rod into the ground at a distance of approx. 20 m and an angle of 45° in relation to the assumed route of the pipeline. Make sure that there is perfect contact between ground and grounding rod. The ground should be moistened at the place of contact, if need be. Make use of Cable drum HK 25 or HK 100 (100 m), available as optional extra, for making connection between generator and grounding rod. Use one of the short connecting leads to connect the generator to the drum. You will find the appropriate socket at the side of the drum. Fix the connecting clamp to one end of the other short connecting lead and attach the clamp to the accessible section of the pipeline. Here, too you have to make sure that contact is not hampered by paint or corrosion. Insert the other plug into the second output socket of the generator. By now both output sockets should be occupied.

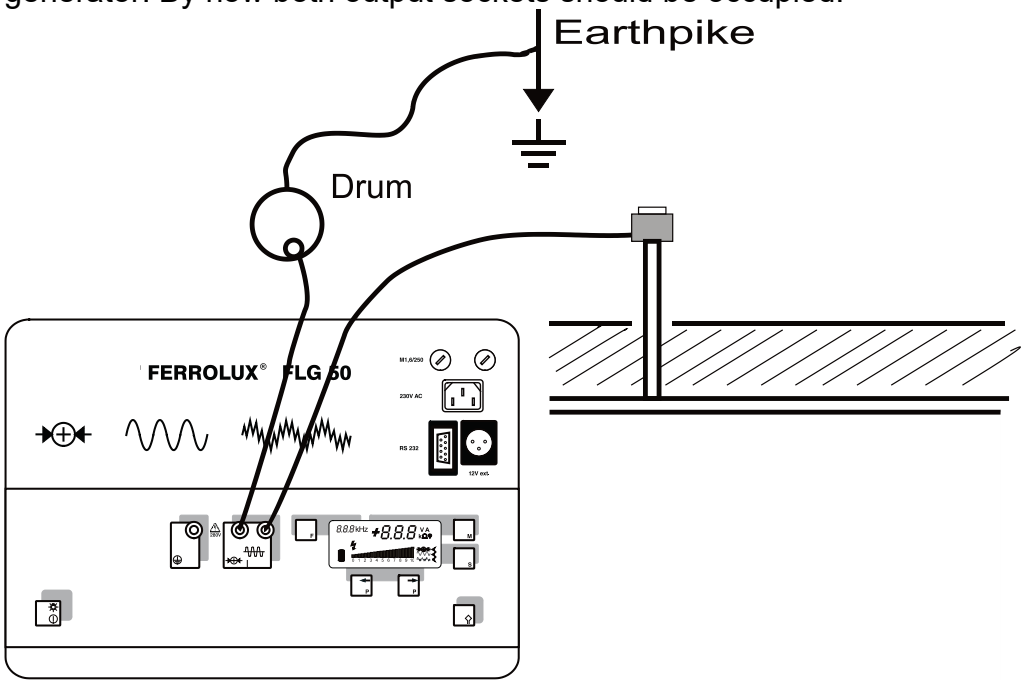

Figure 3 : Direct Connection to a Pipeline

Note:
If you are forced to use a long connecting lead to the ground rod, e.g. due to using a cable drum, do make sure that this lead is laid out as far away as possible from the line to be searched. In no event shall it be placed above the line to be located, otherwise you will inescapably get erroneous results.

6.1.2 Locating a Pipeline by Loop Measurement

Follow Figure 4 when connecting both ends of the tested pipeline to both output sockets of the generator by means of connecting leads of appropriate length (drum 25 m or 100 m). In this manner the audio frequency current is forced to flow along the line to be located. The connecting leads may have any length. You should make sure, however, that they are always unreeled full length to avoid the choking coil effect of reeled conductors. In no event shall the connecting leads be laid out above or near the pipeline to be searched.
It is a benefit of this method of coupling that the return current flows along the auxiliary lead. As a consequence there is no return current along any other cable or pipeline which avoids any electrical interference.
Of course this method is also suited for locating cables in complex situations.

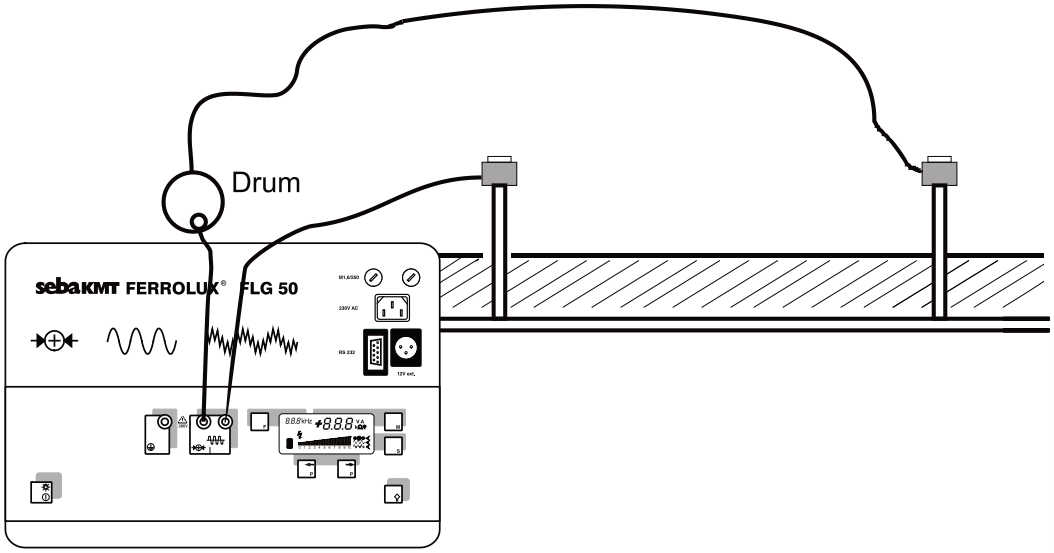

Figure 4 : Pipeline Locating Using the Loop Method

6.1.3 Cable Locating

1. Connect one of the generator output sockets to one of the de-energized conductors of the tested cable by means of a short connecting lead. Connect the other socket to ground or the cable shield. Make sure that at the far end the conductor connected to the generator is connected to ground or the cable shield (see Figure 5).

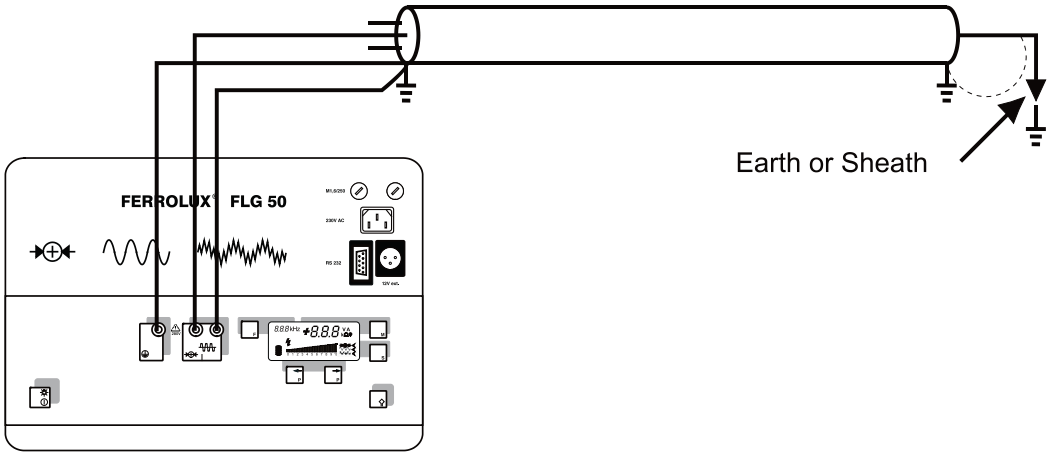

Figure 5 : Cable Localization with Direct Coupling

2. When testing at close range, i.e. if only a short near-by section of the cable route shall be tracked down, it is sufficient to use the easy-to-handle method of capacitive coupling as shown in Figure 6. In this event you need not make any connection to ground or cable shield at the far end. The distance range covered by this method is approx. 70 % of the entire cable length. We advise to use frequency 8440 Hz when working with this method.

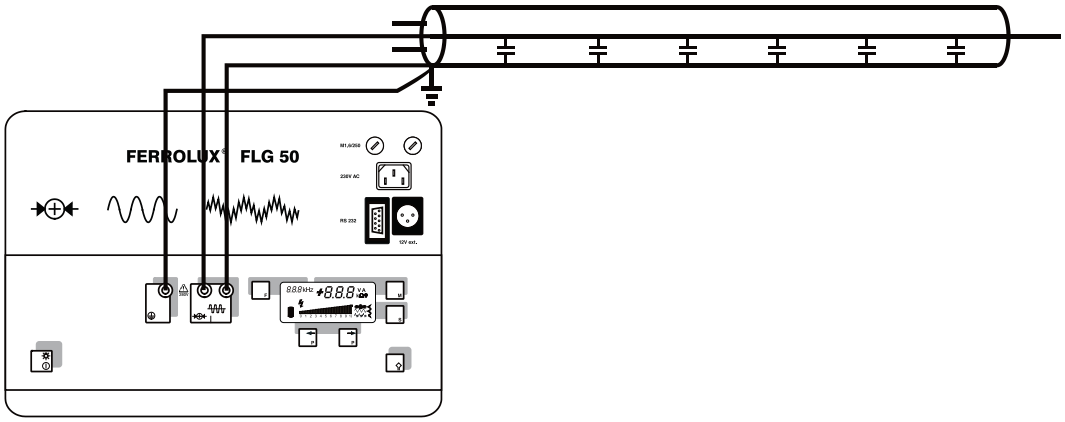

Figure 6 : Capacitive Coupling without Connection at the Far End

6.2 Inductive Coupling by Means of Transmitter antenna

Press the button for the transmitter antenna (6).

When using the transmitter antenna the output sockets are internally disconnected.

This mode of coupling is functional only at a frequency of 8440 Hz. The instrument is automatically re-matched to the impedance of the transmitter antenna which is approx. 100 Ohm.

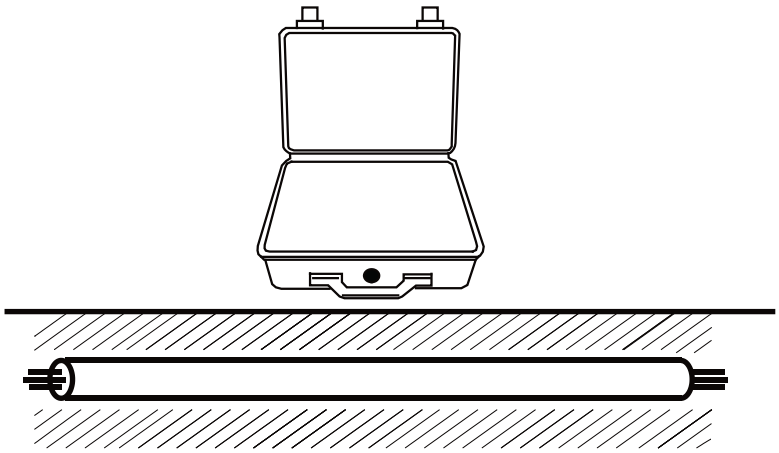

Figure 7 : Inductive Coupling with inbuilt transmitter antenna

When using the Transmitter Antenna, no change in frequency is possible.

Note !

When setting up the generator, please make sure that the cover is open and positioned directly above the line to be tested. Orient the transmitter antenna in parallel to the line. Avoid any places in the direct vicinity of large metal parts such as slide valve caps, sewerage caps, cable duct covers etc. since they will hamper radiation emission by the transmitter aerial.
With this mode of coupling, radiation is transmitted to all metal pipes and cables in the vicinity of the generator.

6.3 Inductive Coupling by Means of Transmitter Clamp

Coupling is implemented by connecting the transmitter clamp UZ 100 (100 mm inside diameter, max. 10 W) to the output sockets of the AF generator by means of the supplied connecting leads. Subsequently place the transmitter clamp around the tested cable as indicated on Figure 8. Make sure that the contact surface of the clamp is clean.

Note !
Please don't use the clamp UZF 150 with the FLG 50. The output power of the FLG 50 is to high for this clamp!

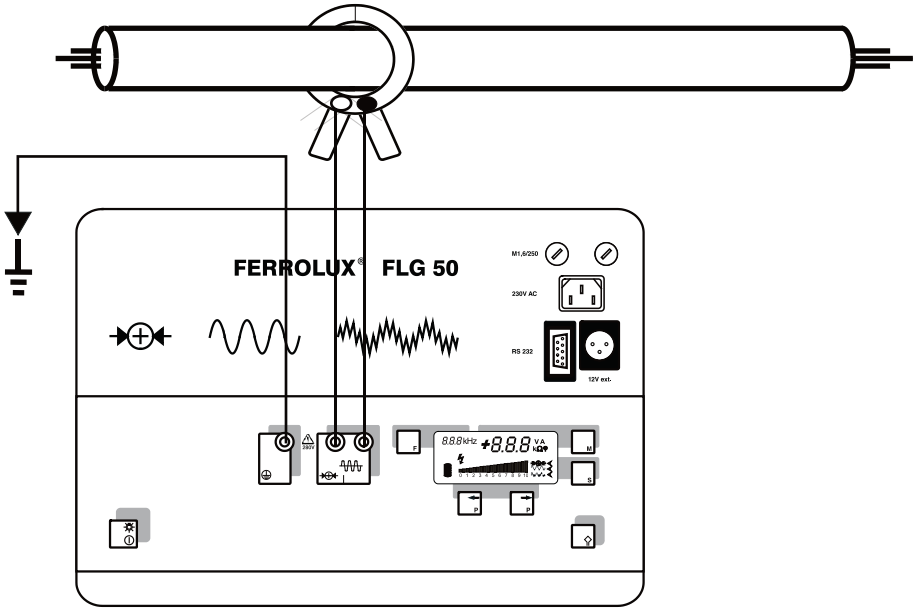

Figure 8 : Inductive Coupling by Means of Transmitter Clamp

You may use any frequency when working with the transmitter clamp. The instrument is re-matched automatically each time you switch the instrument on or change frequency.

6.4 Operational mode “Signal Select”

In the operational mode “Signal Select” the generator can be coupled to the cable galvanically (Figure 9) or inductive (with signal clamp, Figure 10) The clamp must be connected in such a way the imprinted arrow indicates to the cable end.

Due to the fact that this procedure provides a display of the signal direction, it is important to observe during the connection also the correct polarity of the Audio frequency output sockets.

The two output sockets have different coloured rings, red and black
The cable, resp. the line is connected to the output sockets.
At the receiver a (+) Symbol appears if the operator moves on the cable, which is connected to the red output socket in direction to the far end. The tracing Sensor FS 10 has to be held in such a way that the (+) Symbol on the sensor point away from the transmitter toward the far end,
If the receiver sees the return signal of induced signal the display will indicate the (-) Symbol.

This permits the decision if the operator moves on the correct line (+) away from the generator, or towards the generator (-). Tracing along a line will provide a constant indication of the same polarity.

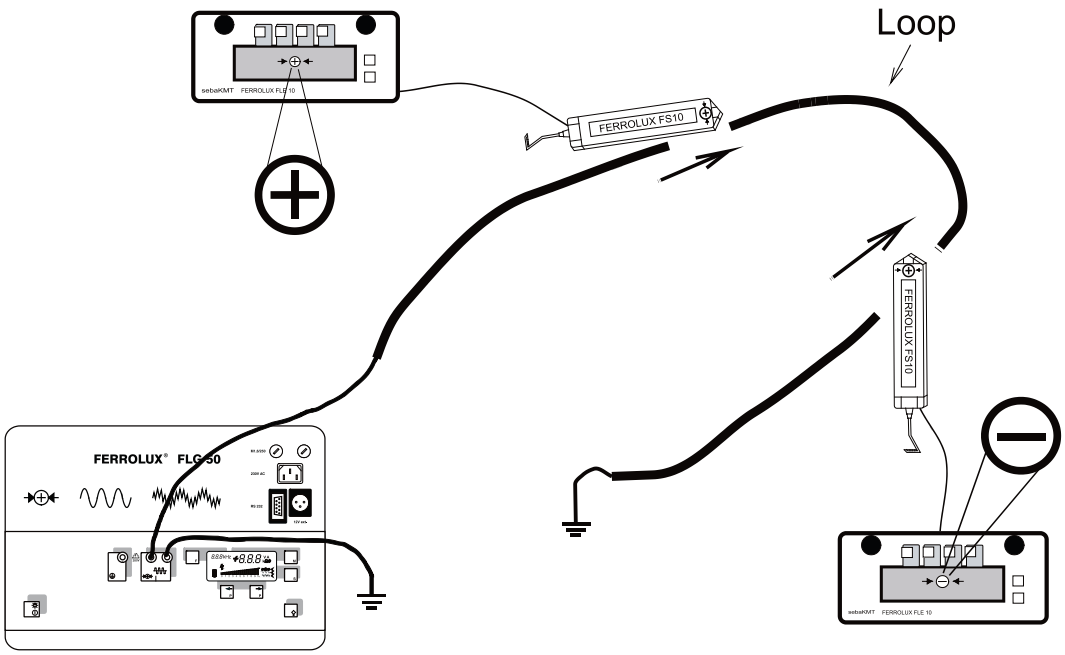

Figure 9 : Galvanic Coupling “Signal Select”

The coupling via a current clamp in the mode “Signal Select” is also possible. The direction is indicated by the imprinted arrows. The arrows must point toward the far end – away from the generator to provide a correct information.

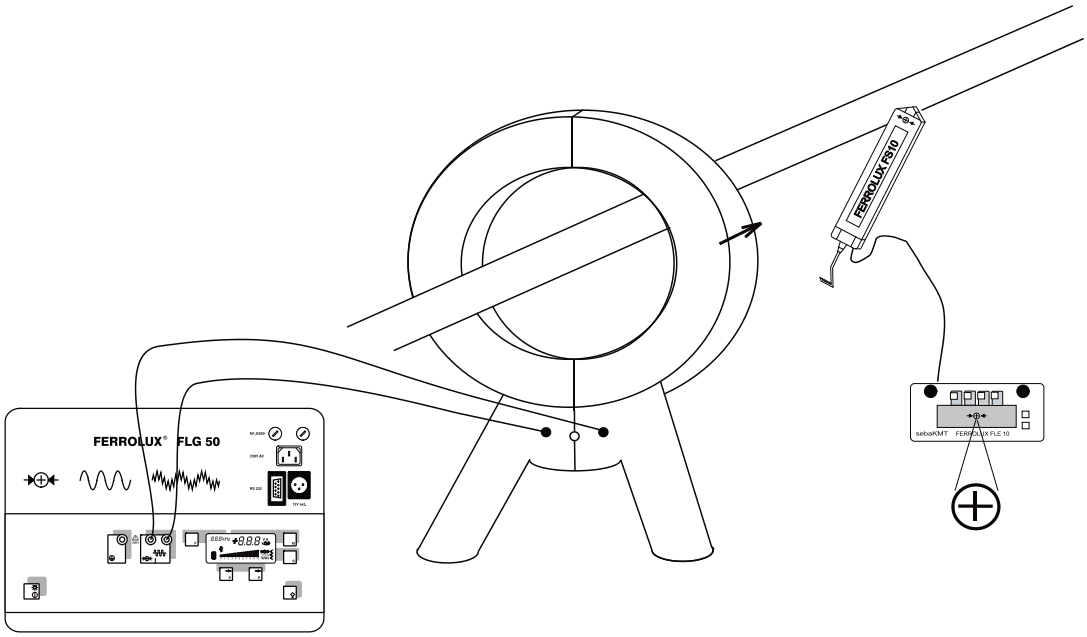

Figure 10 : Inductive Coupling for “Signal Select”