



IFL-1210



USER'S MANUAL

1. Purpose

The cable route locator is intended to define the position and depth of hidden buried utilities (signal and power cables, pipelines) at a depth up to 6m, to locate the damage points of cable lines and to survey of areas before construction works commencing.

1.1 Kit Design and Principle of Operation

The cable route locator consists of the electromagnetic emission receiver and the generator providing the electromagnetic emission of the examined route.

The receiver sensors convert electromagnetic signal into the electric one. The amplified and filtered signal is converted and applied to the built-in speaker and to the LED indicator. The operator uses the signal from the built-in speaker and the readings of the LED indicator to define the route location.

The receiver also has the feature of signal reception from emission sources with industrial frequency (50/60 Hz) and cathode protection systems (100/120 Hz). These modes are used to detect laying places of cables and routes energized with appropriate frequency.

The generator in the sine generation mode represents the auto-oscillation system with a transformer output. The output transformer with adjustable transformation factor is used for matching with the load in a high range of resistance. The automatic matching allows to issue the specified current to the random load. The cable or pipeline can serve as the generator load. The generator can be connected to the load directly (with connecting wires) or through the framework antenna or “transmitting clamp”, providing for contact-free (inductive) connection to the monitored buried utility.

The framework antenna can be used as a load only at a frequency of 8928 Hz (selected automatically when the antenna is connected).





Fig.1.

1.2 Specifications of the Cable route locator Monitoring receiver IFL-1210R

Operation frequencies	
Passive, Hz	50, 60, 100, 120, 15 000
Active, Hz	512, 1024, 1450, 8928, 9820
Features	
Maximum measured depth, m	Up to 10
Maximum depth of pipe and cable discovery, m	Up to 25
Continuous operating time, hour	Up to 50
Power supply	
Power	2 D-type power elements
Design parameters	
Dimensions , mm	720x110x150
Weight of device without case, kg	1,7
Operating temperature range, °C	-30 ... +60

Multifrequency generator IFL-1210G

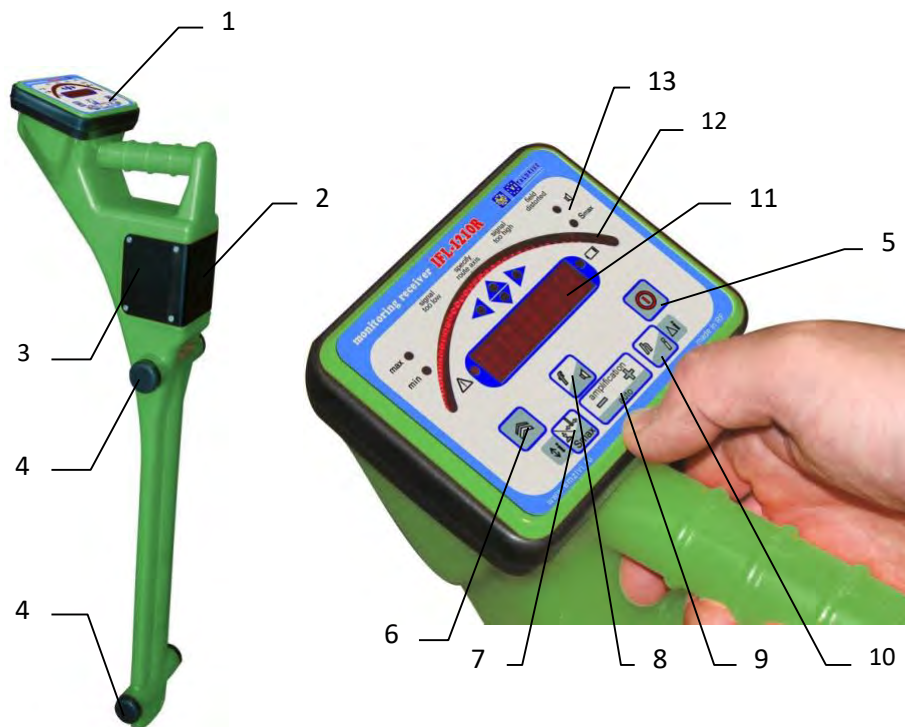
Frequency of generated signal	
Frequencies f1, f2, f3 (three frequencies fixed in memory), Hz	Range 200...9999 (selected in the range with a resolution of 1 Hz and accuracy of ±0,05% Hz and input in the power-independent memory)
Frequency f4 (one «temporary»), Hz	Range 200...9999 (selected instead of one of the «fixed», not input to the memory, exists while the power is on)
Generation modes	
Mode 1	Continuous « CO »
Mode 2 pulse duration, ms pulse rate, Hz	Short pulses transmission « PU » 350 0,7
Mode 3 Pulse duration, ms Pulse rate, Hz	Three frequencies (sent with alternation of frequencies f1, f2, f3) « 3F » 350 1,4
Output parameters	
Output current	
Maximum in manual mode: - continuous and three frequencies generation, A - pulse generation, A	10 15
Specified for auto matching	Four values (I1, I2, I3, I4) Selected in the range 0,1...9,9 A with a resolution of 0,1A and kept in power-independent memory
Maximum output voltage	
- when working in safe mode, V - under internal power supply, V - with added external accumulator 12V, V - when supplied from power adapter, V	24 220 330 140

Maximum output power when accumulators are fully charged	
- under internal power supply or from external accumulator 24V, W	120 continuous and «3F» at a load of 1,2...300 Ohm / 180 pulsed at a load of 0,8...200 Ohm
- with added external accumulator 12V, W	180 continuous and «3F» at a load of 1,8...450 Ohm / 270 pulsed at a load of 1,2...300 Ohm
- from power adapter, W	70 at a load of 0,7...200 Ohm
NOTE. <i>When incompletely charged or (and) frequencies above the “logarithmic middle point” of the range (1,4kHz) the reduction of the maximum power with an increase of frequency and load resistance is possible at no more than 3dB.</i>	
Allowed load resistance	
	Any (0...∞) Current limit at “low-ohm” loads, «Umax» at “high-ohm” loads
Resistance range for matched loads, broader than	
For minimum specified current (0,1A)	
- for internal power, Ohm	4...2200
-with external accumulator 12V added, Ohm	4...3300
For maximum continuous current (10A)	
- for internal power, Ohm	0...1,2
-with external accumulator 12V added, Ohm	0...1,8
For maximum pulsed current (15A)	
- for internal power, Ohm	0...0,8
-with external accumulator 12V added, Ohm	0...1,2
Matching with the load	
	- automatic, providing achieving of the specified current in the load - manual (buttons «  » or «  »)
Design parameters	
Output power amplifier	Pulsed, technology CLASS D(BD) , Efficiency factor > 80%
LED-based superbright digital indicators of high temperature range	- all supply voltages - modes and settings - power resource - «OUTPUT MULTIMETER»: «output voltage», «current in load», «load resistance», «power in load»
Control	Nine-button keyboard and external power switch with generation indicator providing work under rain with closed cover (due to parameter setup “memorizing”). Intuitive interface
Dimensions of electronic block (case), maximum, mm	305x270x194
Weight of electronic block, maximum, kg	12
Operating temperature range, °C	-30 ...+60

Power supplies	
Built-in battery set	Two acid-lead sealed accumulator batteries 12V/12Ah (AGM technology) with automatic switching: 12V/24Ah or 24V/12Ah
Power resource with an ambient temperature of 0°C depending on the initially achieved power, minimum, hours	
- continuous generation, hours	1,2 at 120W internal/180W with extra battery 12V 16 at 60W internal/15W with extra battery 12V
- pulses at single frequency, hours	3,5 at 180W internal/270W with extra battery 12V 64 at 90W internal/15W with extra battery 12V
- pulses at three frequencies, hours	2,5 at 120W internal/180W with extra battery 12V 32 at 60W internal/15W with extra battery 12V
Maximum recharge time of internal batteries, hours	8
Power adapter for work or battery charging	Output voltage 15V, output current 15A max
Allowed external batteries	11...14V/ 20...28V ≥ 24Ah
Functional features	
Automatic functions	<ul style="list-style-type: none"> - selection of optimum power supply mode (switching of internal and external power sources) - auto matching (achieving of specified current in the load) - automatic «smart» selection of output power - special program of transmitting antenna control - built-in automatic charger device - automatic power cutoff when long-time idling (1min)
Automatic generation (charging) switch off	<ul style="list-style-type: none"> - when the batteries are discharged below limit (prevention of deep irreversible discharge) - when the external voltage does not match charging mode - when maximum allowed consumed current is exceeded - when the power is switch off during generation - when there is a short-circuit during generation - when the generation mode does not match antenna presence/absence at the output
Type of connected loads	<ul style="list-style-type: none"> - direct connection to the subject with current returning through the wire or cable armor - direct connection to the subject with current returning through the ground via the grounding rod - inductive connection with the use of transmitting framework antenna at a frequency of 8928Hz (selected automatically when the antenna is connected) - inductive connection using transmitting clamps (selection of cable from the batch is possible)
Automatic repeated matching	When there is a deviation of the specified load current higher than ±2dB

Monitoring receiver IFL-1210R

2.1 Appearance. Controls



pos.1	Front panel
pos.2	Built-in speaker
pos.3	Battery compartment
pos.4	Receiving elements
pos.5	Power on/off button
pos.6	FUNCTION button. Its depressing and holding together with another functional button activates additional functions
pos.7	Switching between modes / activation of mode min max
pos.8	Button of selection of working frequency / sound parameters setting / backlit
pos.9	Button of manual selection of frequency / auto setting of frequency
pos.10	Button depth measurement / flowing current indication
pos.11	Digital indication field
pos.12	LED scale
pos.13	LEDs of instrument functional status

2.2 Functional description of the IFL-1210R receiver

The monitoring receiver IFL-1210R (Figure 2.1) is used to amplify and filter the signals incoming from the sensors and to output the information signals to the digital indicator.

The receiver has the following modes of operation:

- **Passive route detection** (without use of the generator).
 - "50/60 Hz" – for passive route detection of cables under voltage with industrial frequency of 50/60Hz
 - "100/120 Hz" – for passive route detection of cables and pipelines with cathode protection

These modes of operation allow detection of the loaded power cables, cables and pipelines under cathode protection. It is possible to trace the power cables under voltage but without load and pipelines where the signal with a frequency of 50/60 Hz can be induced if they are long enough;

- **Active route detection (operated together with the generator).**

"512 Hz", "1024 Hz", "1450 Hz", "8928 Hz", "9820 Hz"- for active tracing of the cables, pipelines (operated together with the generator).

- **Measurement of laying depths and value of current in buried utilities.**
- **Digital or linear indication.**

The operator uses the LED indicator and sound signal to monitor exact location of the route. This instrument allows direct measurement of the buried utilities laying depth and value of alternative current flowing through it.

2.3 Controls and displays

Each button can fulfill up to three functions:

- Simple short depression of the button (up to 2 sec) activates the main function indicated with a big symbol on the light background.
- Long depression of the button (longer than 2 sec) activates the auxiliary function indicated with a symbol on the dark background.
- Depression with the use of the FUNCTION button (pos.6 figure 2.2)

The function on the additional field is activated by pressing the button while the FUNCTION button is kept depressed.



Fig.2.2 6 5

2.4 Turning the instrument on

When the instrument turn on button (pos.5 figure 2.2) is depressed the power supply of the receiver is turned on. The receiver conducts a short test of the LED, plays the welcome music (if the sound is on) and outputs the battery voltage in volts (for instance, voltage of 3,0 V at figure 2.2).

The indication of battery voltage is kept on the screen for about 2 sec, then the current operating frequency is displayed (for instance frequency of 8928 Hz figure 2.3): If batteries voltage is lower than 2,6 V (2,2 V for accumulators), batteries require to replacing (ref. to p. 2.11).

After that the receiver comes to the search mode of maximum at the frequency at which the receiver has been used in the previous session with switched off mode "SuperMax" and auto set amplification.



8 Fig.2.3

2.5 Operation frequency selection

The first depression on the operation frequency selection button pos.8 figure 2.1 displays the current working frequency, following ones – scan through the operation frequencies. In doing this the first offered frequency is the one used before (for more comfortable switching between the passive mode and used generator frequency), then the next frequencies are offered from low to high. The basic version of the receiver supports eight operation frequencies:

Frequency, Hz	50/60	100/120	512	1024	1450	8928	9280	15k .. 30k
Reading of indicator	F-50/F-60	F-100 /F-120	F-512	F-1.02	F-1.45	F-8.92	F-9.28	F-15.0
Mode	Passive		Active				Passive	
Purpose	Detection of power cables and buried utilities, gathering the wandering currents and industrial noises	Detection of pipelines under cathode protection potential	Operation together with the generator of the AG series				Detection of signal cables and buried utilities gathering the industrial noises radio frequencies	
Depth measurement	no	yes	yes				no	
Current measurement	no	no	yes				no	
Indication of deviation direction from the trace axis	yes	yes	yes				no	

After operation frequency change the receiver is switched to the search mode of maximum with auto set amplification.

The receiver memorizes the current operation frequency and automatically switches to it when the power is turned on for the next time.

2.6. Sound volume adjustment and sound signal change

The button pos.8 figure 2.4 when depressed for a long time turns the sound on/off. The reading "3" and from 0 to 3 lines corresponding selected volume appear on the screen figure 2.4. Attention: when the volume is off the mode of sound signal of route axis is activated.

The sound status is maintained while the power is on and the sound will be on automatically at the next activation of the receiver if the sound was on before turning off the power. If the sound is on in the mode of maximum, the sound tone is increased with the increase of the signal level. The maximum tone corresponds to the full scale. If the scale is filled at less than one third, the sound is off.

In the mode of minimum, the sound is off above the route axis and is increased with the deviation from the axis. The continuous sound means there is a deviation to the left, the intermittent signal – to the right. The low tone sound signal accompanies the error messages.



8 Fig. 2.4

2.7. Switching between modes of minimum and maximum

In the mode of maximum the signal from the horizontal antenna is used, it reaching the maximum value above the route axis figure 2.5

At the top there is the scale working from the left to the right and reflecting the current level of signal. If the scale "floated" to the right or to the left, adjust the amplification with buttons pos.9.



Fig.2.5 9

If the scale is in zero (at the left) the amplification must be increased and vice versa. Otherwise, the amplification auto selection can be used. If the signal value is too high, the overload of receiver inputs can happen. The reading OL will be displayed on the indicator in this case figure 2.6.

Reduce the amplification. If the overload is met for relatively low signals, the strong side interference is possibly intruding. Locate and remove the source of interference or switch to another frequency.

At the display bottom the signal value in absolute units is indicated in the mode of maximum. These units are proportional to the signal level and do not depend on the amplification settings. If the signal is low (less than 10 units), the achieved results will not probably be correct. Shift the generator connection point closer to the search area or change the operation frequency.

In the central part of the screen in the mode of maximum the arrows indicate the position of the buried utilities with respect to the operator (at figure 2.7 – to the right). Two arrows are highlighted above the axis of buried utilities. At a large distance from the axis (comparable to the laying depth) the direction finding method stops working and the arrows are not highlighted. The direction finding does not work in the mode «SuperMax» as well.

To switch to the mode of minimum figure 2.8 depress the mode selection button pos.7.

In this case three segments are highlighted at the scale, their position indicates position of the buried utilities axis and distance to it (at the figure the buried utilities is to the left). The arrows are not used. The digital value corresponds to the signal from the vertical antenna and shall be of minimum value over the axis. Switching back to the mode of maximum is conducted by the same button pos.7.

When moving away from the route axis for a significant distance (about laying depth) as well as when the field is heavily distorted or the level of interference is high the

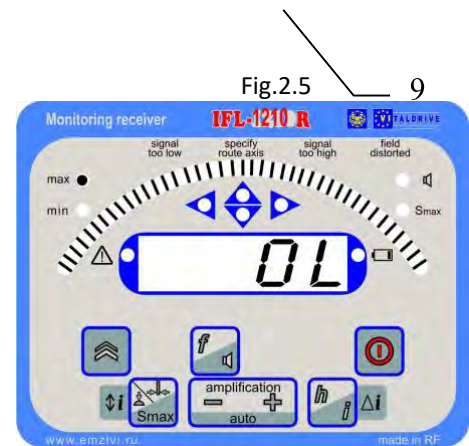


Fig.2.6



Fig.2.7



Fig.2.8



Fig.2.9

receiver is automatically switched to the mode of maximum figure 2.9, the error message (Err 4) is issued in this case.

2.8 Increase/reduction of sensitivity

The receiver sensitivity is modified by depression of the amplification selection button pos.9. It influences only the upper scale in the mode of maximum. The first depression reveals the current amplification (figure 2.10 – amplification level 12). The subsequent depressions increase /reduce amplification (from 0 to 19). If the signal is low, the scale works in the left part and signal change is resolved badly, the increase of amplification is reasonable. If the scale works mostly in its right part and periodically “hits the boundary”, the amplification needs to be reduced. The amplification must be reduced irrespectively from the scale readings if the receiver indicates overload figure 2.11.

The depression and keeping for some time of the amplification buttons pos.9 activates the amplification auto selection button. The receiver measures the input signals for several seconds and selects the optimum amplification itself. The procedure status is indicated on the scale in the bottom part of the screen figure 2.12. The selected amplification is also indicated on the screen. The automatic selection of amplification is started automatically when the receiver turning on, operation frequency changing and in some other cases.

2.1 Error messages

The measurement conditions do not always allow correct measurement conduction. Some of these cases are as follows:

1. The measured signal is too weak and distorted heavily by side interferences.
2. There are other buried utilities located near measurement points which provide the parasite signal.
3. The monitored buried utilities has turn, branch, valve, cartridge etc. near measurement point.
4. The monitored buried utilities go upwards or downwards at the measurement point at a significant angle.
5. The measurements are carried out close to the connection point of the generator or the cathode protection system.



Fig.2.10 9



Fig.2.11



Fig.2.12



Fig.2.13

6. There are massive metal objects near the receiver antenna.
7. There is a source of electromagnetic interference (for instance, the vehicle with running motor) near the measurement point.
8. The signal incoming to the receiver sensors is too strong and thereby distorted.

Some of such situations are recognized by the receiver. For example, figure 2.13: when there is a minimum signal instead of switching to the mode of minimum the error message «Err 4» appears on the screen. Here “4” is an error code.

<i>Code</i>	<i>Meaning</i>
Err 1	Signal is too weak
Err 2	Signal is too high
Err 3	Field is heavily distorted
Err 4	Not on the route axis

Unfortunately, the receiver cannot always detect the distorting factors. If there are doubts regarding the correctness of depth defining, the following techniques can be used to detect some of the distorting factors:

- Conduct 5-10 measurements of depth in a row without moving the receiver. The readings must not differ at more than 20%.
- The position of route axis obtained by the method of minimum and the method of maximum must not differ at more than 20 cm.
- Lift the receiver at 20 cm above the ground and repeat the measurement – the reading must have a 20 cm increase as well.

The depth can be also defined by one of the indirect techniques (the receiver shall be in the mode of maximum, «SuperMax» shall be off).

If the conditions allow depth measurement but do not allow defining the current, the latter is not output.

2.10 Work procedure for passive route detection

This mode of search is intended to locate and trace the underground engineering buried utilities and does not require use of the generator. The modes “50/60 Hz”, “100/120 Hz” are to be used.

Turn on the receiver by depressing the receiver power button pos.5. figure 2.14. The receiver conducts the short test of the indicator and displays the current supply voltage in volts and current operation frequency in kHz (F=8.92).



8 Fig.2.14 5

Select the required frequency from the row “50/60 Hz”, “100/120 Hz”. The first depression of the operation frequency selection button pos.8 reflects the current operation frequency, the subsequent ones scan through the operation frequencies.

After that the receiver is switched to the search mode of maximum (figure 2.15).

The method of maximum or the method of minimum may be used to trace the buried utilities. Depress the button pos.7 figure 2.18 to switch between the modes.

Turn on the receiver, keep its body strictly upright and slowly move on the surveyed area



Fig.2.15

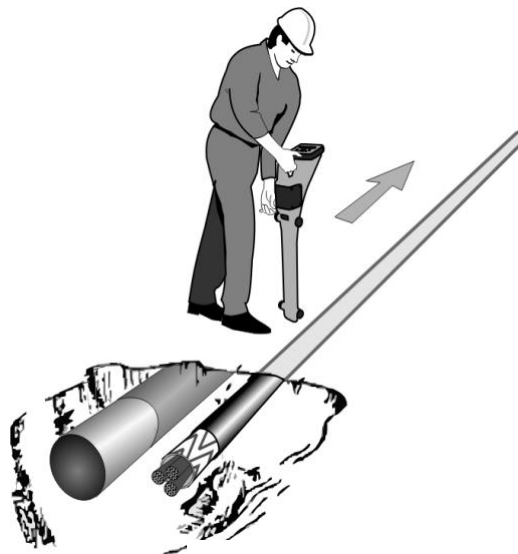


Fig.2.16

1). Method of maximum

In the mode of maximum (activated automatically when the receiver is turned on) the signal from the horizontal antenna is used. This signal is of the maximum value above the route axis. The screen in this mode looks as shown on figure 2.17 (the buried utilities is located on the right).

The maximum deviation on the scale will indicate that the buried utility is below.

This method is most effective for quick tracing of the buried utilities because it has large operation distance.



Fig.2.17

2). Method of minimum

Depress the button pos.7 figure 2.18 to switch to the search mode by method of minimum. Three segments shall appear on the screen, their position indicates at what distance and side there is a buried utilities axis (on figure 2.18 the buried utility is located to the left). The digital value corresponds to the signal from the vertical antenna and shall be of minimum value above the axis. The same button is used to return to the method of maximum. This method gives higher accuracy of buried utility detection, that being $\pm 0.15\text{m}$ at a depth of up to 1...1,5m and $\pm 0.25\text{ m}$ at a depth of up to 10m.



7 Fig.2.18

Remark – the distortion effect can be encountered when there are space-occupying metal objects, reinforced-concrete structures, cables or pipelines located near the monitored buried utility.

3). Measurement of depth and current

Place the receiver over the route axis as accurate as possible, keep it strictly upright (The receiver handle must be directed along the route axis).

To specify the direction it is possible to slightly rotate the receiver in the mode of maximum around its vertical axis reading the signal level on the digital indicator. The maximum of the readings correspond to the right position. Depress the button pos.10. The measured depth in meters is depicted on the screen figure 2.19. The receiver must not move during measurement.



Fig.2.19

When the button pos.10 is depressed for the second time the measured current in milliamps shall be displayed on the screen in the form of: (242 mA) figure 2. 20. The reading shall stay on the screen while the button is kept depressed.


If there is an attempt to measure the depth at a frequency at which this function is not supported («50/60»), the symbol  is illuminated, and the measurement is not conducted. The receiver cannot calculate the depth accurately enough if it exceeds 10 m, in this case the value 10,0m blinks on the screen.



Fig.2.20

The depth measurement is a complicated procedure requiring accurate calculations. The measurement conditions do not always permit depth defining with required accuracy. Some of such situations are as follows:

1. The measured signal is too low and distorted heavily by side interferences.
2. There are other buried utilities located near measurement points which provide the parasite signal.
3. The monitored buried utility has a turn, branch, valve, cartridge etc. near measurement point.
4. The monitored buried utility goes upwards or downwards at the measurement point at a significant angle.
5. The measurements are carried out close to the connection point of the generator or the cathode protection system.
6. There are massive metal objects near the receiver antenna.
7. There is a source of electromagnetic interference (for instance, the vehicle with running motor) near the measurement point.
8. The signal incoming to the receiver sensors is too strong and thereby distorted.

2.11 Battery installation and replacement

After each switching on, the receiver displays the current voltage of the batteries in volts. The voltage below 2,6V (2,2V for accumulators) indicates that the batteries will need to be replaced soon, so make sure the spare batteries are available. When the battery charge is expiring, the symbol in the corner of the indicator starts blinking. That means the operation time left is from 15 minutes to 1 hour depending on the battery type. When the battery is discharged totally, the receiver turns off all the symbols on the LED, blinks with the signal for some time and switches off after that.

The receiver is fed from two D-size elements (element 373). It is recommended to use the alkaline elements for power supply.

To replace the power elements (see figure 2.21) unscrew the screw of the battery compartment cover (a), remove the cover (b), pull the battery compartment outside using the cord (c). Replace the power elements. Observe the polarity!

To avoid the battery discharge due to accidental activation of the receiver, the latter features automatic switch-off capability.

Do not use together galvanic elements and accumulators, new and discharged batteries nor batteries of different types. This may result in leakage (in some cases – to ignition) and damage to the receiver. Remove the batteries if the instrument is to be stored for a long time.

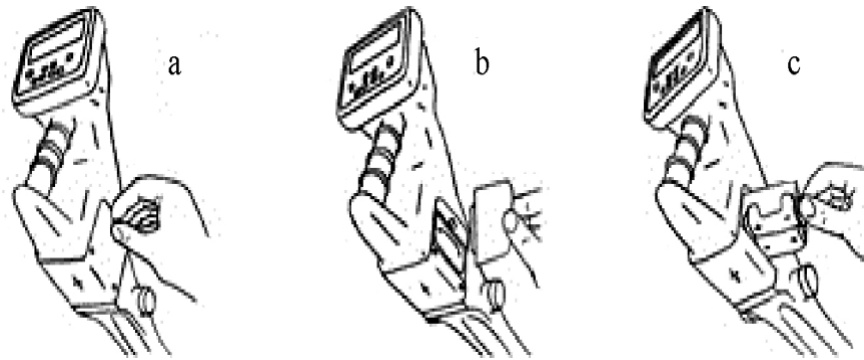


Fig.2.21

3. Tracing multifrequency generator IFL-1210G

3.1 Appearance. Controls

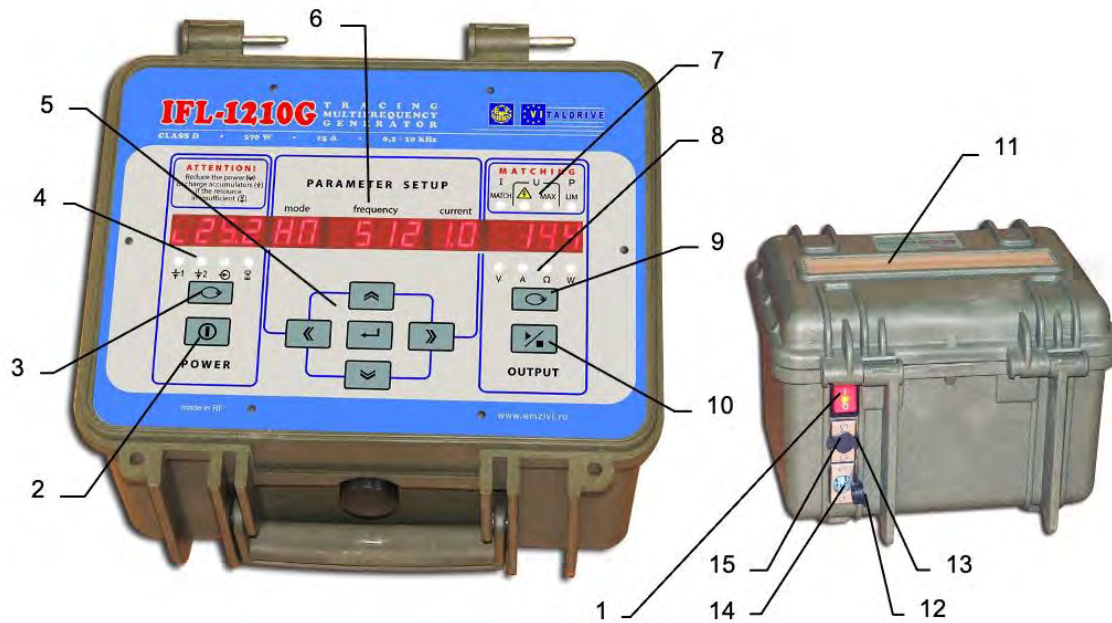








Fig. 3.1

1	External power switch (mechanical waterproof) with generation indicator
2	Button «I» control of internal electronic power switch
3	Button of power supply parameter indication
4	Indicated power supply parameter: voltage acc.1/acc.2/ext. power. (V), life time (hour) or charging time (hour, min)

5	Menu control buttons
	«  » - selection of parameter to be set in the left direction by the indicator
	«  » - increase of value or «up» in the list
	«  » - reduction of value or «down» in the list
	«  » - selection of parameter to be set in the right direction by the indicator
6	«  » - in the «stop» condition – entering to the parameter setting / exit from parameter setting with saving of settings
	- in the «generation» condition – input of current value of output current as setup value
7	Indicator of power supply parameters (V, hours), work mode , generation frequency (Hz), set current (A), output parameters (V/A/Ω/W)
8	« MATCHING » (results): set current is achieved «Imatch», mode of unlimited voltage «U Δ », maximum voltage «Umax», power limited at the optimal level «P lim»
9	Parameter indicated by «output multimeter»: U «V», I «A», R «Ω» , P«W»
10	Button of selection of parameter indicated by «output multimeter»
11	Button «  » « START/STOP » of generation, matching or charging
12	Transparent window for indication reading with closed cover
13	Plug sealing the external power supply connector (closed)
14	Plug sealing the output connector (opened)
15	Output connector to connect the buried utility, transmitting antenna or “clamp”
	Input connector to connect external accumulator or mains power supply adapter (operation/charging)

3.2. Procedure of work with the generator

SAFETY REQUIREMENTS

The dangerous voltage (from 24 to 400 V) may exist on the generator output (including the clamps). The route detection procedure is based on the grounding of one of the generator output clamps.

NEVER! Touch the output connecting cables clamps and elements of the monitored buried utility when the generator is in operation.

NEVER! Connect and disconnect the connecting cables when the generator is in operation. The persons properly instructed and having no medical restrictions are admitted for instrument operation.

Personnel safe procedure for work with the generator when connecting to the route:

- A. make sure on the monitored buried utility and near it no activities are conducted or planned which can result in deliberate or accidental touching of the current-conducting part under voltage;
- B. make sure the generator is switched off;
- C. ground the cable conductor opposite to the generator connection point and put the table «Grounded» («High voltage»);
- D. if the paragraphs a), c) can not be fulfilled use the contact-free mode of connection with inductive antenna or transmitting clamps;

- E. make sure the instrument can not be activated accidentally by another person during connection of the output cable;
- F. connect the output cable clamp to the monitored buried utility (cable wire, pipeline, link cable);
- G. connect the second clamp of the output cable to the grounding, cable armor or to the grounded rod;
- H. connect the output cable connector to the output socket of the deactivated generator;
- I. if there are other persons near current conductive parts alert them about voltage supply by saying «Applying voltage ».

ATTENTION!

When connecting the generator, the latter itself shall be **TURNED OFF!**

Personnel safe procedure for work with the generator when disconnecting from the route

- turn off the generator power;
- disconnect the output cable from the generator and close the connector with rubber plug;
- conduct the troubleshooting activities (cable digging out, placing the clamp, etc.) only AFTER the generator is turned off and disconnected from the buried utility

3.3 Generator connection

1). Contact mode of generator connection

This mode guarantees transmission of signal without interference and allows use of low frequencies.

The connection to buried utility is done by mating of the output connector of the generator to the buried utility and grounding rod figure 3.2.

The grounding is carried out in any convenient place, which should be cleaned from the dirt with file or sandpaper to the metal. This ensures more reliable contact of the clamp and buried utility.

Rules for grounding:

- To achieve the maximum tracing distance when the generator is connected to the buried utility the grounding shall be arranged at an angle close to 90 and as far as possible from the route in the assumed search direction

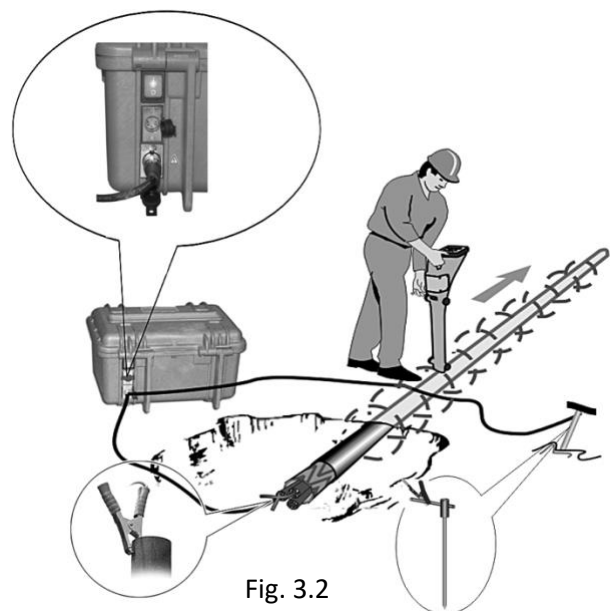


Fig. 3.2

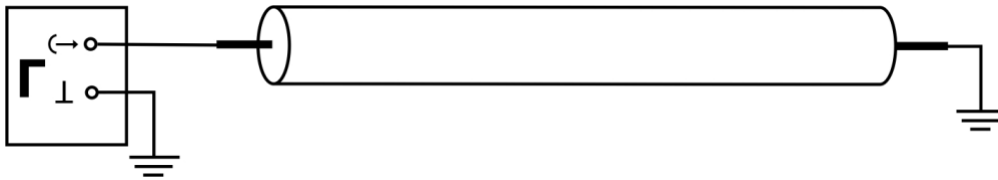
- The grounding rod shall be inserted for at least 2/3 of its height.
- To achieve better grounding effect the following methods shall be used in the place of grounding rod installation: cleaning of contact in the place of contact wire connection to the ground rod, pressing of the ground, moistening of the ground using salt solution

Methods of generator connection to the route

To achieve quality in route position detection the following rules should be observed: The direct connection of the generator to the load provides the longest tracing distance. Several ways can be used to define the underground cable (or pipeline) route when directly connected to the buried utility. They are as follows:

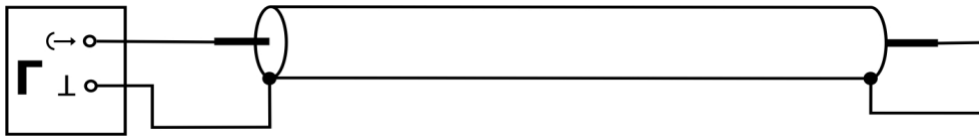
1). The ground is a return conductor

Connect the generator to one end of the cable, ground the other end of the cable



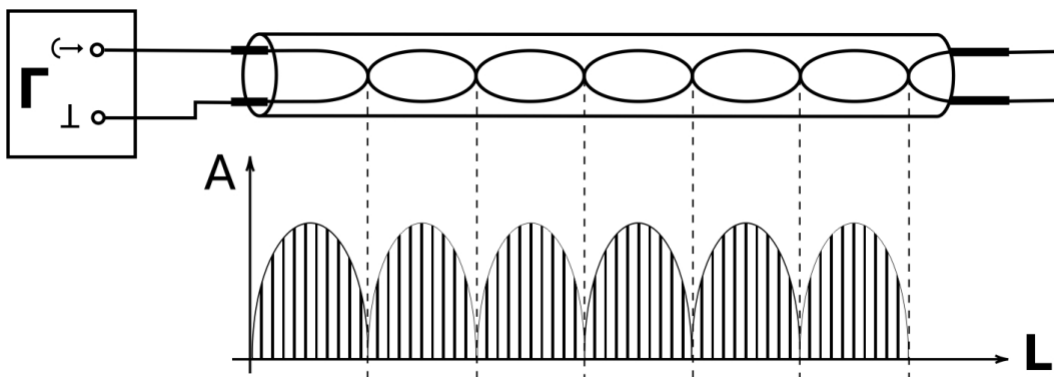
2). The cable armor is a return conductor

Connect the generator to ends of the cable; join the other ends of the cable.



3). The cable cord is a return conductor

Connect the generator to two cords from one end of the cable, join the cords from the opposite side.



2) Contact free mode using the inductive antenna – IEM -301.2 Connecting to the utility is carried out by induction method.

To do this: remove the antenna from its package and insert active part of the antenna (pos. 16 figure 3.3) in the foundation body pos.17. Connect the antenna to the generator output connector (pos. 14 figure 3.3) and install over assumed place of route. The antenna and route must lay in the same plane.

3) Contact-free mode using the **transmitting** clamp.

Allows tracing of the selected buried utilities, energized and de-energized cables. The clamp shall be put around the conductor to be traced figure 3.4

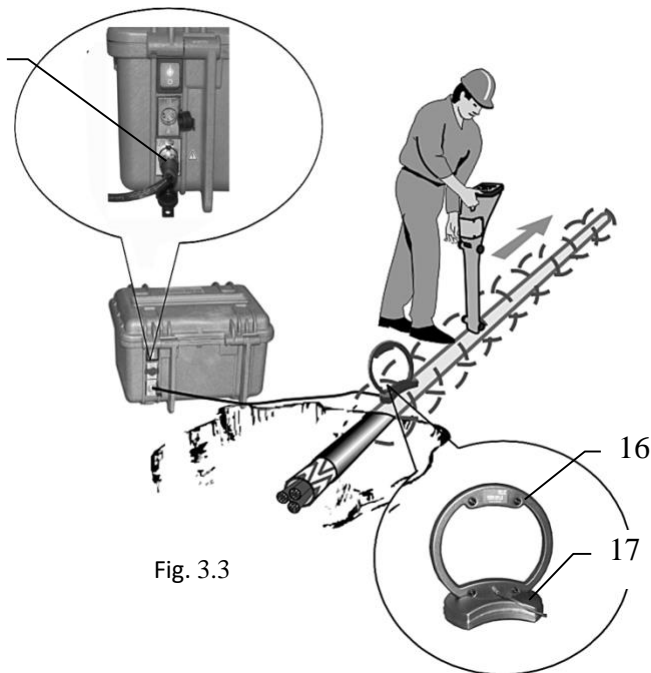


Fig. 3.3



Fig. 3.4

NEVER! Touch the clamps of connecting cables and parts of monitored buried utility while the generator is working.

NEVER! Mate and disconnect the connecting cables while the generator is working.

3.4 Turning on the generator power

Connect the load to the lowest connector on the generator rear panel in accordance with the tracing procedure (pos.14 figure 3.5). The examined route (pipeline, cable), inductive antenna or transmitting clamp can be used as a load.

To ensure safety it is strongly recommended to complete all connection works before the generation is started.

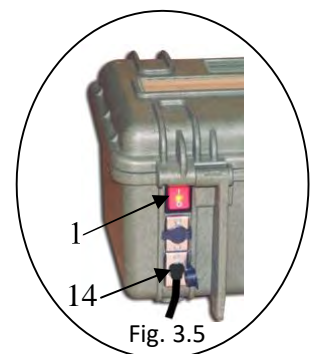
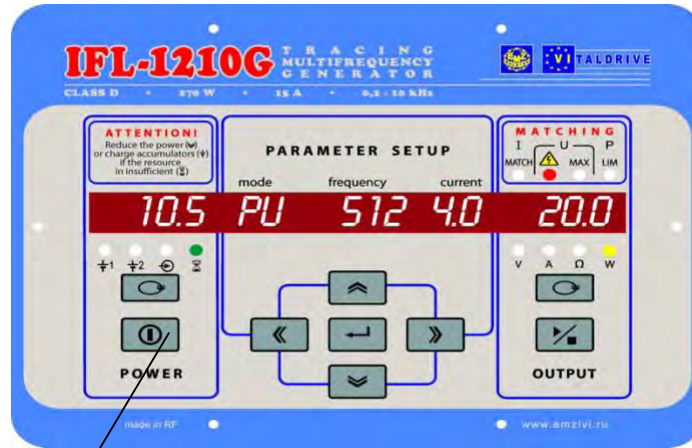


Fig. 3.5

Turn on the power with external mechanical switch «I/O» on the rear panel by setting it into the «I» position pos.1. Open the cover. Turn on the power with the button pos.2 figure 3.6. The indicators on fields «POWER» and «PARAMETER SETUP» will start indicating.



2 Fig. 3.6

3.5. Parameter setup

The field «PARAMETER SETUP» figure 3.7 is used for selection of one of three generation frequencies f_1 , f_2 , f_3 , one of three modes of sine generation (continuous «CO», one frequency transmission «PU», three frequencies transmission «3F» or charging mode «CH») and of four current loads. If necessary the “banks” of currents and frequencies can be modified quickly. The use of the transmitting antenna as a load is possible only if a generation frequency of 8928 Hz which is set automatically when the antenna is connected to the output.

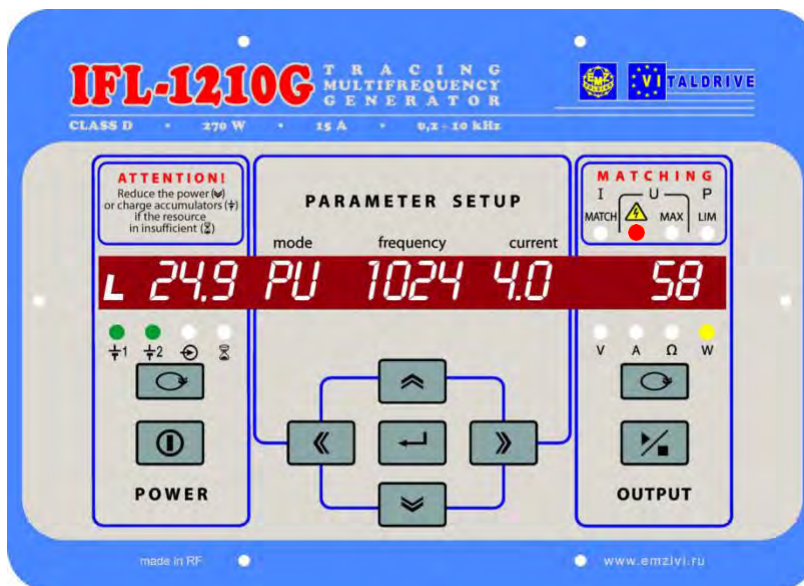


Fig. 3.7

- 1) To enter the setup mode depress the button of entering into parameters setup « ↵ » pos.5 while staying in the “stop” mode (no generation, yellow LEDs on the “OUTPUT” field figure 3.7. are not on). Will begin to blink field of the indicator «MODE».
- 2) Depending on the task, to set the mode the buttons « ⏶ » or « ⏷ » (cycle) pos.5 figure 3.7 are used to select on the field “MODE” the symbol depicting the required generation mode or mode of internal accumulators charging. The mode codes are shown on figure 3.8. If the transmitting antenna is connected to the output, the signal «AC» is indicated (mode «antenna, continuous»). The selection in this case is possible only between modes «AC» and «AP» (mode «antenna, pulsed») directly by the buttons « ⏷ » or « ⏶ ».
- 3) To set the operation frequency or current, use the button « ⏪ » until the indicator «FREQUENCY» or «CURRENT» appears on the indicator screen. In the modes «CO» and «PU» the blinking value (figure) can be modified.

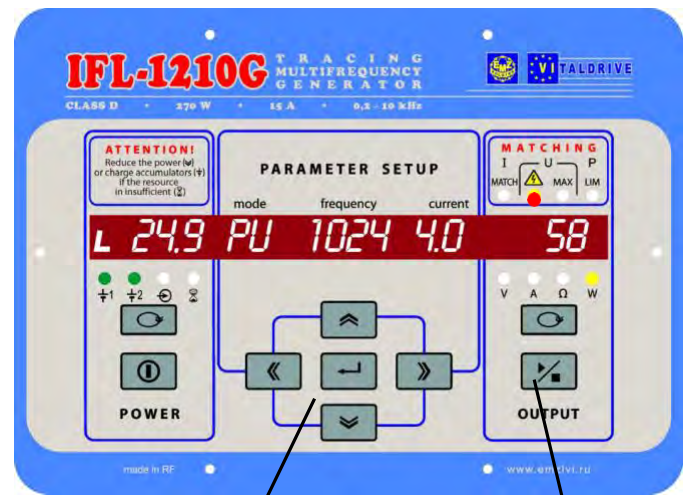
REMARK- In the stable three-frequency mode («3F») the lowest frequency used during automatic matching appears on the indicator «FREQUENCY».

To input another value of frequency instead of the blinking one press the button « ↵ » so that only first digit of the figure would be blinking (the highest digit). To select another digit, use the buttons « ⏪ » or « ⏩ ». The blinking figure can be modified with buttons « ⏶ » or « ⏷ » (0...9). To save the new value in the «bank» of frequencies (instead of the previous one), press the button « ↵ ».

MODE CODES	
CO	continuous generation
PU	pulsed generation
3F	three frequencies
CH	charge
AC	antenna, continuous generation
AP	antenna, pulsed generation

It is possible to work with the specified frequency temporarily before power is switched off, if the generation (automatic matching) is activated immediately with the button « ⏸ » pos.10 figure 3.9.

- 4) The setting of the specified current is conducted similarly to the work frequency specification. The range of specified current is 0,1...9,9 A with a step of 0,1 A. The «bank» of currents may contain up to four preset values. If necessary, the current of pulsed transmission (“PU”) in the stable mode of transmission can be increased up to 15A (if there is enough power). The values of current exceeding 9,9A may not be saved in the “bank” of currents. The high output current (up to 15 A) allows tracing of buried utility with extremely low resistance (for example, to pass the output current between grounded pipeline and grounding circuit bus). In this case the small, but still






5 Fig. 3.9 1












sufficient, part of the output current is branched into the remote areas of buried utility. The serviceability is maintained till full short-circuit of the output clamp.

When selecting the load current (or power) and frequency of the transmission the following guidelines are to be followed:

- the lower is the power – the higher is power supply life
- the lower is the current, the lower is the frequency – the lower «induction» on the neighboring elements
- the higher is the frequency – the higher is sensitivity of receiver, the less current (power) is enough, energy saving is possible, recommended for high-resistance buried utilities, on the other hand, the higher level of signal penetration into the neighboring objects and, as a result of higher attenuation, the signal is spread at the less distance.
- the higher is the current, the lower is the frequency – the range of transmission and route detection is higher, but the power required is higher.


3.6 Modification of the set parameters


To modify the set parameters, stop the generation with the button «  » pos.10 figure 3.9 at the field «OUTPUT» by one or two depressions and proceed to the parameter's setup. The first depression of the button «  » pos.10 results in stop of the automatic matching process at the achieved level (the indicator readings are “frozen”, no generation, yellow LEDs on the field «OUTPUT» are not on), second depression on the button «  » results in the stop of generation (the indicator is off).

To enter the parameters modification mode depress the parameters setup button «  » pos.5 while staying in the «stop» mode. The indicator field «MODE» will start blinking, to change the mode use the buttons «  » or «  » (by cycle) pos.5 to select the required generation mode symbol and go to modification of other parameter (frequency, current) with buttons «  » or «  ». The blinking value of parameters from the databank can be selected with buttons «  » or «  » (0..9). To modify the parameter value when the required value is not in the databank (the selected parameter blinks) depress the parameter setup button «  », after that the blinking figure can be modified with buttons «  » or «  » (0..9). To save the new value in the data “bank” (instead of the previous one) depress the button «  ».

3.7 Indication of parameters

1)Indication on the field «POWER» figure 3.10.

One of the digital indicator readings is selected by the corresponding button  pos.3 by the green LEDs.

1 - voltage on the “base” internal accumulator No1

2 - voltage on the «superstructure» internal accumulator No2

- ⏻ - voltage on the external power supply input
- ⌚ - in the generation mode – estimated power supply life meaning: «for this level of energy consumption it will work for N hours» (on base the family of discrete discharge curves for new accumulator for $t = 0^{\circ}\text{C}$). The reading «20» means «very high life time which is difficult to estimate». The reading «0,1» means: «the instrument may switch off at any moment».
- in the «charging» mode - time of charging by the stable current (counting up) and time of charging by the stable voltage (counting down), hours/min

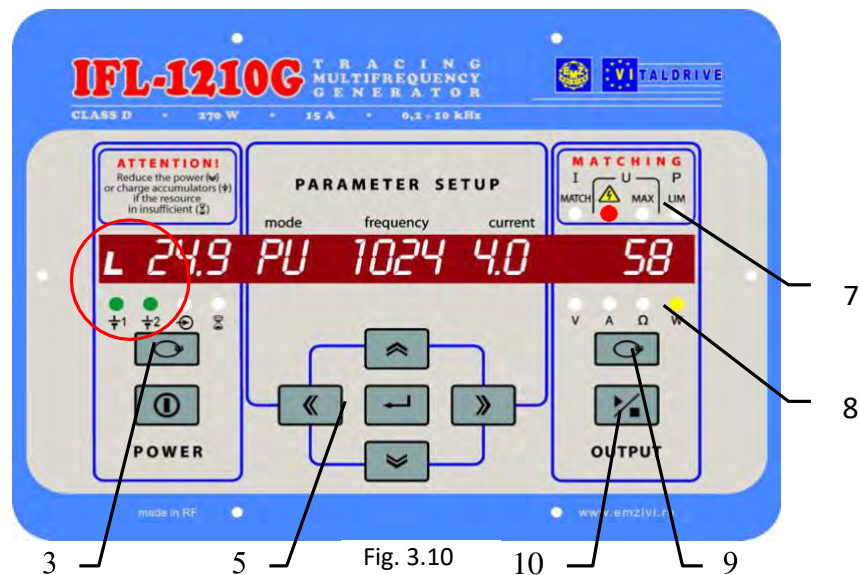


Fig. 3.10

If two or three first LEDs are illuminated at the same time, that means that the digital field «POWER» indicates the resulting voltage, supplying the terminal power amplifier. In this the first (left) seven-segment indicator on the field «POWER» symbolically depicts the configuration of mutual connection of the power supplies. The list of possible power supply configurations and codes is given on the generator cover (figure 3.11).

POWER SUPPLY CONFIGURATION CODES	
	internal in parallel (12V)
	internal serial (24V)
	internal in parallel, external serial (24V)
	internal and external in parallel (12V)
	internal and external serial (36V)
	only external (accumul 24V or network power 15V)



Fig. 3.11


2) Indication on the field «PARAMETER SETUP»





Indication on the field «PARAMETER SETUP» is described in the section's parameters setup and parameters modifications.

3) Indication on the field «OUTPUT»

When the **power is applied** to the generator two situations are possible:

- If the LEDs on the field «OUTPUT» are not illuminated– the generator is in the standby mode («stop»). The parameter setup can be conducted or the generation (automatic matching) may be initiated immediately by depressing of the button  pos.10. The mode «stop» will last for 1 minute. If no button is depressed the internal electronic power switch will switch the power off automatically.
- If one of the yellow LEDs is illuminated on the field «OUTPUT» (and the external switch pos.1 is highlighted), the power has been turned off during generation and the same mode with the previous settings is restored. The automatics tries to recover the situation through the automatic matching. If it is necessary to change the set parameters, stop the generation with the button «  » pos.10 on the field «OUTPUT» («turn off» the yellow LED and illumination of the external switch with one or two pressing) and proceed to the parameters setup.

During the generation the estimated values of output parameters are indicated on the digital field «OUTPUT»: load voltage «V», load current «A», load resistance «Ω», load power «W». The accuracy of measurement ($\pm 5\%$ for «V» and «A» and $\pm 10\%$ for «Ω» and «W») is sufficient for situation evaluation and decision making. The indicated parameter is selected by the button «  » pos.9 the LED corresponding to the selected parameter is illuminated pos.8 figure 3.10.


The power is selected automatically according to the principle: «sufficient (or maximum possible) for achieving of the specified output current (or closest possible value)». When the automatic matching is finished (or interrupted with button «START/STOP  ») manual control of voltage (current, power) with buttons «  » and «  » is possible. During this the indicator «  » always indicates the remaining life of the internal power supply (hours) depending on the accumulator discharge level and current energy consumption.

The high output voltage (above 330 V with the use of additional accumulator 12 V) and high reserve of power (up to 270 W with additional 12V accumulator) provide sufficient tracing current for long buried utilities with high resistance.

After complete attempt of automatic matching (not aborted) the field «MATCHING» pos.7 figure 3.10 reveals the result:



- «Imatch» - completed successfully, specified current achieved. After generation is turned off from this condition the set parameters of generation and selected parameters of indication becomes default values, that means loaded after power interruption.



- «Umax» - the voltage is not enough to achieve the specified current for this load (the load resistance is too high or the contact between output clamps with the load is broken)
- «P lim» - not enough power to achieve the specified current for this load.

The potentially «dangerous» unlimited mode of generation is depicted with a special «alert» indicator «». The «default» increase of the output voltage is limited by level safe for a human (24V). If necessary (for tracing the cables) it is possible to operatively remove the limitation (temporarily) if the appropriate precautions are taken.

Here the decision should be made about necessity to correct the parameters of output current. For this purpose the test tracing is recommended.

3.8 Start and stop of generation

If after power is turned on the button «» pos.10 is depressed **shortly** in the standby mode («stop»), the generation and automatic matching – step-by-step increase of voltage at the output until the specified current is reached shall be started. It is recommended to monitor the power life indicator («» on the field «POWER»). If the output voltage («V») exceeds «24.0» the automatic matching shall stop anyway. If the specified current is not reached, the indicator “Umax” shall be on in the field «MATCHING». This is a **safe mode** set by default when the power is on.

If higher output voltage is required to achieve the necessary current during tracing of the cables (AND APPROPRIATE SAFETY MEASURES ARE TAKEN!), the automatic matching can be started in the «unlimited» mode. For this purpose, press the button «» in the standby mode (“stop”) and keep it depressed until the “alerting” indicator «» is on. That means the potentially dangerous “unlimited” mode is activated, the output voltage may exceed 200 V with internal power supply and 300 V with added 12V external power supply. The «unlimited» mode shall exist until the power is off.

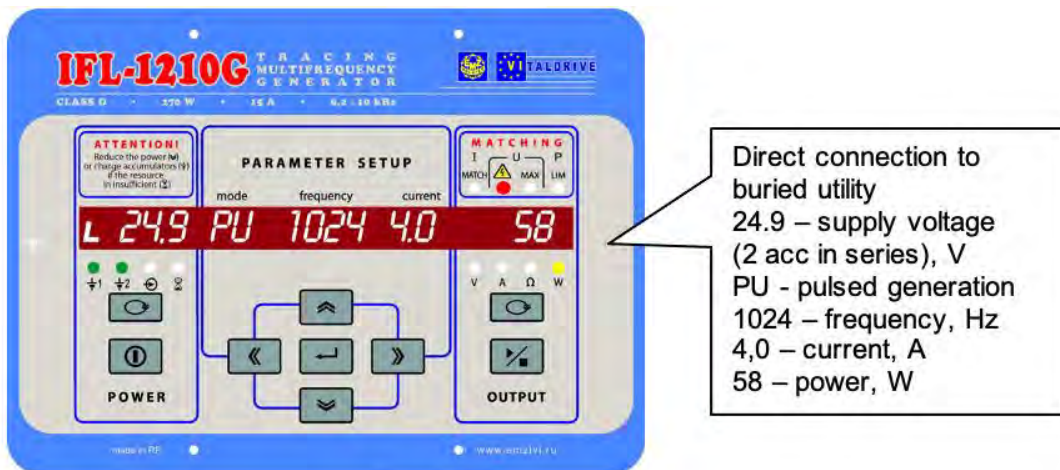




Fig. 3.12

The current in load is selected or input from the keyboard in the indicator field «CURRENT». In the course of automatic matching the voltage on the load is increased step by step till the current in the load exceeds the value stated in the setter («CURRENT»). In this case the voltage increase is stopped and the “Imatch” sign appears in the field «MATCHING». If the load resistance is changed in the stable mode of generation, the power selection program shall maintain the specified current within $\pm 2\text{dB}$ by repeated automatic matching with appropriate adjustment of power.


The incomplete automatic matching procedure can be stopped at any point by depressing of the button «». The first pressing in the course of automatic matching – «stop» of matching, second– «stop» of generation. Depression in the stable mode of generation results in «stop» of generation.





ATTENTION! ENERGY SAVING!

All manipulations with output current (power) lead to energy consumption (power supply lifetime) change. Observe the lifetime indicator «» on the filed «POWER» to make sure there is enough time to complete the tracing. To save the energy, work with the minimum sufficient power in the load. Use the mode of short-time transmission if possible. The breaks in operation help in partial replenishment of capacity. Charge the accumulators if the situation allows. Do not bring to automatic switch off through insufficient power.

Long-term storage of accumulators in discharged condition results in complete loss of their serviceability. Before long term storage charge the accumulators and recharge them at least every 6 months. The temperature during storage shall be $+20\dots 25^{\circ}\text{C}$.

3.9 Operation with inductive frame antenna

To achieve the maximum intensity of the «induction», the buried utility line and antenna frame must be located as close as possible to each other and in a single plane. Prior to connection of the frame to the output turn off the power in the “stop” mode with power button pos.2 «» figure 3.13 or with external mechanical switch.

If the antenna is connected to the output when the power is on, the instrument switches to “antenna” mode characterized by permanent parameters setup. The following is indicated: mode «AC», frequency «8928», current «0,2». After transmission is activated with the button «» pos.10 the automatic matching results in automatic setting with optimum specified parameters. After that if necessary the output voltage can be reduced or increased with the buttons «» and «». To continue transmission after power interruption restart with the button «» is required.

3.10 Operation with the transmitting «clamp»

If there are several closely located buried utilities it is recommended to use the transmitting clamp figure 3.14 to induce the current specifically in one of them contact-free. The power consumed by the clamp is reverse proportional to the signal frequency if the voltage is constant. It is not recommended to apply the power more than 60W in the continuous generation mode (CO).

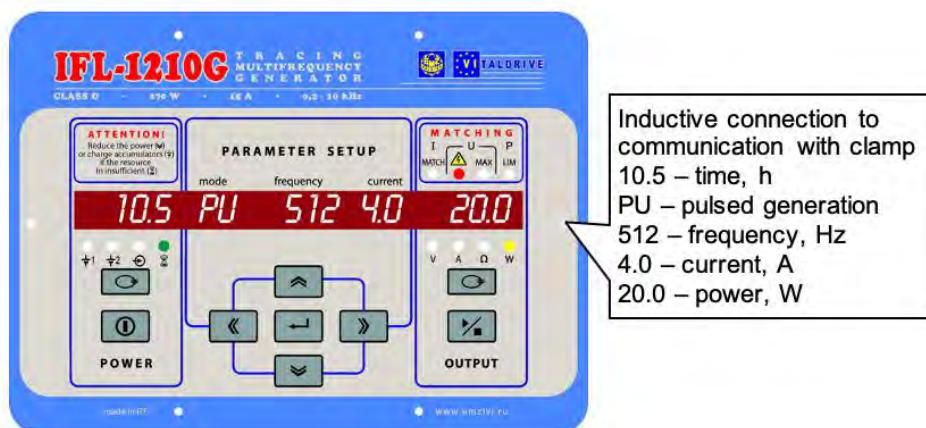


Fig. 3.14

3.11 Operations under precipitations

The waterproof instrument (IP54) allows operation under precipitations when the cover is closed providing the on-line adjustment of parameters is not required. The power is turned on/off with external waterproof power switch «I/O» pos. 1 figure 3.15. The readings are monitored through the transparent window in the cover pos. 11 figure 3.15. Make sure the required mode is selected and start the transmission before closing the cover. Every time the power is turned on with the closed cover the system shall restart this mode (except for «AC» and «AP») with automatic matching. The transmission is indicated by highlighting of the external switch. The free connectors on the rear panel are protected by rubber plugs.

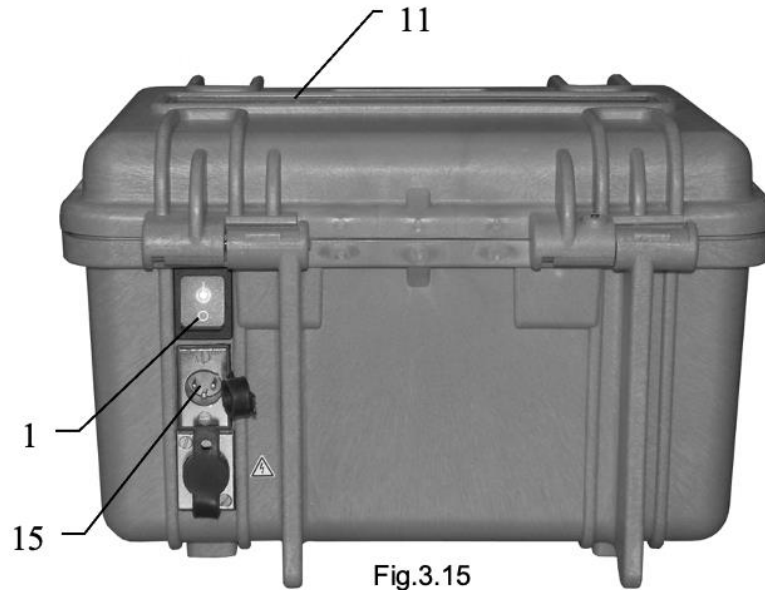


Fig.3.15

3.12 External power connection

The additional accumulator (12/24V) or power adapter output (15 V) can be connected to the upper connector of the rear panel pos.15 figure 3.15.

ATTENTION!

The external source output may have no galvanic link except for with the generator output. Prior to connection make sure there is no grounding, zeroing or link to the vehicle body for any of the external source outputs.

Depending on the task the instrument uses the external power for increase of the lifetime or increase of power or for charging.

3.13 Internal accumulators charging

It is strongly recommended to conduct the internal accumulators charging under ambient air temperature of 20...25°C. To charge the internal accumulators connect the power adapter to the mains and to the external power input (upper connector on the rear panel). Turn on the mains power and « I » of the generator. Select the mode «CH» on the «MODE» indicator. Press the button « ⏏ ». Observe the time counting on the indicator « ⌚ » and “animated picture” of the charging procedure on the digital field «OUTPUT». When the picture becomes static, the charging can be aborted with the button « ». The instrument is ready for operation (charging at least 90%). If the time allows, it is recommended to continue charging with the stable voltage **14,7-14,9V**. Time of full charging is 8 hours, after that the automatic switching off happens.

NOTE.

In the course of charging it is recommended to periodically monitor: « $\frac{1}{1}$ » or « $\frac{1}{2}$ » - voltage on the charged internal accumulator and « \odot » - voltage on the power adapter output. If « $\frac{1}{1}$ » or « $\frac{1}{2}$ » exceeds the maximum allowed «14,9», one should “specify” the output voltage POWER ADAPTER (optimal value «15.0...15.2») using its adjustment resistor output “under flat screwdriver”. The readings « $\frac{1}{1}$ » or « $\frac{1}{2}$ » above «14,9» correspond to the start of “overcharging” and increased internal gas output. The continuous stable readings below «14,7» indicate lowered output voltage of power adapter.

4. The joint operation of generator and receiver during active route detection

The inductive (active) search method is now most widespread for detection of underground buried utilities. The basis of the method is the fact that there is an electromagnetic field around the conductor with current.

The generator connected to one end of the monitored buried utility serves as a source of test current of special frequency. For flowing of the current it is necessary to have a special electric conductive circuit with monitored buried utility as one branch and grounding as another branch for return of current through the ground.

The maximum strength of the electromagnetic field measured above the ground surface corresponds to the axis of searched buried utility.

To properly operate the kit the following rules are to be observed:

- Generator grounding selection (refer to p.3.3);
- Definition of generator connection type (refer to p.3.3);
- Setting of generator parameters (refer to p.3.5);
- Adjustment of receiver (refer to p.2).

After performing the above items, you can start buried utility tracing.

5. Tracing procedure in active mode

- Set mode “3F” on the generator
- Select the frequency “1024” on the receiver. Set the amplification level of 50%. Set mode of maximum. Keep the receiver strictly upright, survey the area slowly and evenly.
- When the signal is detected, continue movement in the search direction until the signal is reduced, then return to the place where it was the highest.
- Without changing the amplification level change alternately the frequency on the receiver to 512 Hz, then to 8928 Hz. After each frequency change fulfill test tracing. As a result, determine the optimum frequency, depending on one or several tasks. Set generation mode to the selected frequency on the generator (see p.3.5).
- To define the buried utility axis direction by the mode of maximum (see p.2.10) turn the receiver until the strongest signal is achieved. The receiver handle will be PARALLEL to the searched buried utility. Slowly move the receiver to the left – to the right till the maximum of the signal is reached. In this point the receiver is directly above the route axis, one can

measure depth of trace laying and current using the button pos.10. If necessary, adjust the amplification level using the buttons pos.9 figure 5.1.

Basic mode of the generator operation for the active searching - unceasing generation, the method of maximum.

- To define the buried utility position the method of minimum can be also used (refer to p.2.10). Use the button pos.7 figure 5.1 to switch to the mode of minimum.

- For energy efficiency and the long-term generator operation ensuring, without charge, use the pulse mode. In this mode, when tracing on the method of maximum pulse generator sending are displayed as periodic pulsations on the LED scale (pos.12 figure 2.1) and digital indicator of the receiver.

Instability readings are possible in pulsed mode with a frequency of 8928 Hz in three cases:

- 1) when use the method of minimum.
- 2) when determine the buried utility depth.
- 3) when measure the current in buried utility

NOTE

When tracing buried utility, the defining factor is "LED bar graph", which displays only a qualitative picture of searching (approximation or removing for routes). The additional digital indicator displays absolute value of the received signal level in dimensionless units of measurement. If you receive a pulsed signal, digital display readings respectively pulse. Therefore, in this case estimate of the absolute signal level should be considered maximum values at pulsation.

After tracing work disconnect the generator from the buried utility as stated above (p.3.2).

6. Transportation and storage

The packed instruments can be transported by any kind of closed vehicles. When transported by air the devices shall be located in the heated sealed compartments.

The railway carriages, containers, automobiles cargo bodies used for transportation of the instruments shall be free from traces of cement, coal, chemicals etc. transportation.

The transportation conditions for the packed instruments:

- Temperature from -50°C to +60°C;
- Relative humidity up to 98% for a temperature of up to +35 ° C;
- Relative pressure from 84 to 106,7 kPa;
- Maximum acceleration of transportation vibration 30 m/sec² with shocks frequency from 80 to 120 per minute within 1 hour or 15000 shocks with the same acceleration.

The transportation conditions for instruments without package:

- Ambient air temperature from -30° to +60° C;
- Relative humidity up to 98% for a temperature +25°C;
- Atmospheric pressure from 84 to 106,7 kPa;

- Vibration with amplitude no more than 0,1 mm in the frequency range from 5 to 25 Hz;

The location and fixing of the packages with instruments in the vehicles shall fully prevent them from moving, shocks, pushes.

The boxes shall be in position when the arrows are directed upwards.

The packaged and unpacked instruments are to be kept on the shelves in a dry room. The storage room shall be free from the current conductive dust, vapors of acid and alkali, corrosive and isolation-destructive gases.

The instruments in the transportation package can be stored for six months, the transportation package shall be free from leakage and dirt.

Annex

Symbols displaying the power supply configuration of the generator IFL-1210G



accumulator No2 is connected **in parallel** with the base accumulator No1 (12V)



accumulator No2 is connected **in series** with the base accumulator No1 (24V)



the external accumulator (12V) is connected **in series** to the internal accumulators No1 and No2 connected in parallel (24V).



the external accumulator (12V) is connected **in parallel** to the internal accumulators No1 and No2 connected in parallel (24V) .







the external accumulator (12V) is connected **in series** to the internal accumulators No1 and No2 connected in series (36V)



the power amplifier is supplied only from external source with an elevated voltage (external accumulator 24B or power adapter 15V). The internal (accumulators No1 and No2) supply the rest of the circuit.

The horizontal segments designate the power supplies with «-» output connected to the common wire of the circuit. The base internal accumulator No1 is always connected to the common ground and is designated by the lowest horizontal segment (if participates in the power amplifier supply). The vertical segments designate the power supplies with «-» output connected to the «+» of the other sources («superstructure sources»).

Dependency of power supply lifetime of the generator IFL-1210G from the configuration of different kind of used power sources

External supply type	Power source connection configuration			
	 External only	 All in parallel	 External in series with mutually parallel internal ones	 All in series
Accumulator 12 V / ≥ 24 Ah	-	Increase depends from external accumulator capacity	Life time $\times 2$	Either life time or $P_{max} \times 1,5$
Accumulator 24 V / 15 A	The life time is fully defined by the external accumulator capacity	—		
Power adapter 15 V / 15 A	The life time is fully defined by 220 V AC mains availability.	—		

Symbolic depiction of the generator IFL-1210G operation modes



continuous generation



pulsed generation (short transmissions)



three frequencies (frequencies sent in turn)



charging of internal accumulators





transmitting antenna connected, continuous generation



transmitting antenna connected, pulsed generation

Indication of emergency situations during the generator IFL-1210G operation

Indication	Reason	Implication
Er 10	Signal reached minimum	Incorrect actions of the operators when the level of output signal is changed manually with the buttons «  » or «  ». The transmission is not stopped
Er 11	Signal reached maximum	
Er 12	Power reached maximum	
Er 14	Current in load reached maximum	
Er 20	Encountered external power voltage not allowed for charging	Indication of emergency situations resulting in automatic switching the transmission off
Er 21	External power voltage during generation has been too low	
Er 22	Voltage of one of internal accumulators has been too low	
Er 23	Voltage of external power has been too high	
Er 30	Current mode did not match to “presence/absence” of transmitting antenna due to incorrect connection	
Er 40	Highest allowed current in output cascade has been exceeded	
Er 41	Highest allowed consumption current has been exceeded	



CONTACT INFORMATION:



SALESVD@VITALDRIVE.NET



VITALDRIVE.NET



[@VITALDRIVECY](https://www.instagram.com/VITALDRIVECY)

