

User's Manual V 2.1

MRT-700

Cable tracer



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1. Safety instructions



Read the following instructions carefully before using the equipment. If the equipment is used in a different way from the one explained in this manual, it could be permanently damaged.



WARNING: Direct connection only for de-energized cables. Connecting the equipment to a live conductor between red and blue cables may result in permanent damage to the unit and the operator.

MRT-700 signal detector complies with security Standard IEC 61010-1: 2011 / UNE-EN 61010-1: 2011.

- Category II of protection against electric shock.

MRT-700 signal detector complies with EMC Standard IEC 61326-1:2012 / UNE EN 61326-1:2013.

The equipment has been designed in order to be used both indoors and outdoors, including wet environments because the transmitter has an IP 65 degree of protection (with the cover closed) and the receptor has an IP 54 degree of protection

- Read this manual before using the equipment or its accessories.
- Avoid working alone. When using the equipment inside a transformation center, there must be two operators at less.
- Do not use the equipment in gas or explosive vapour places.
- Before using the equipment, inspect cables and sensors and make sure no mechanical damages are present; if they would, replace them. Try to locate tears or missing plastic components. Be especially cautious with isolating material near connectors.
- Disconnect all accessories which are not being used.
- Connect battery recharging AC/DC (\sim / \equiv) power supplies first to mains and then to equipment's DC (\equiv) input.
- Use earth connection spike only for connecting the equipment to ground.
- Avoid using the equipment out of the temperature's range specified in this manual.










The charge of this equipment must be done from a home electrical plug (category II) avoiding IV category conductors.

Use only manufacturer approved power supplies for MRT-700 TX and MRT-700 RX units. Check Technical Specifications on this manual. Make sure mains voltage and frequency range complies with specifications. Make sure that the electrical plug, where the charge is being done, is easily accessible

If the equipment is used in any way not specified by manufacturer, its built-in protections could be affected.

Symbols

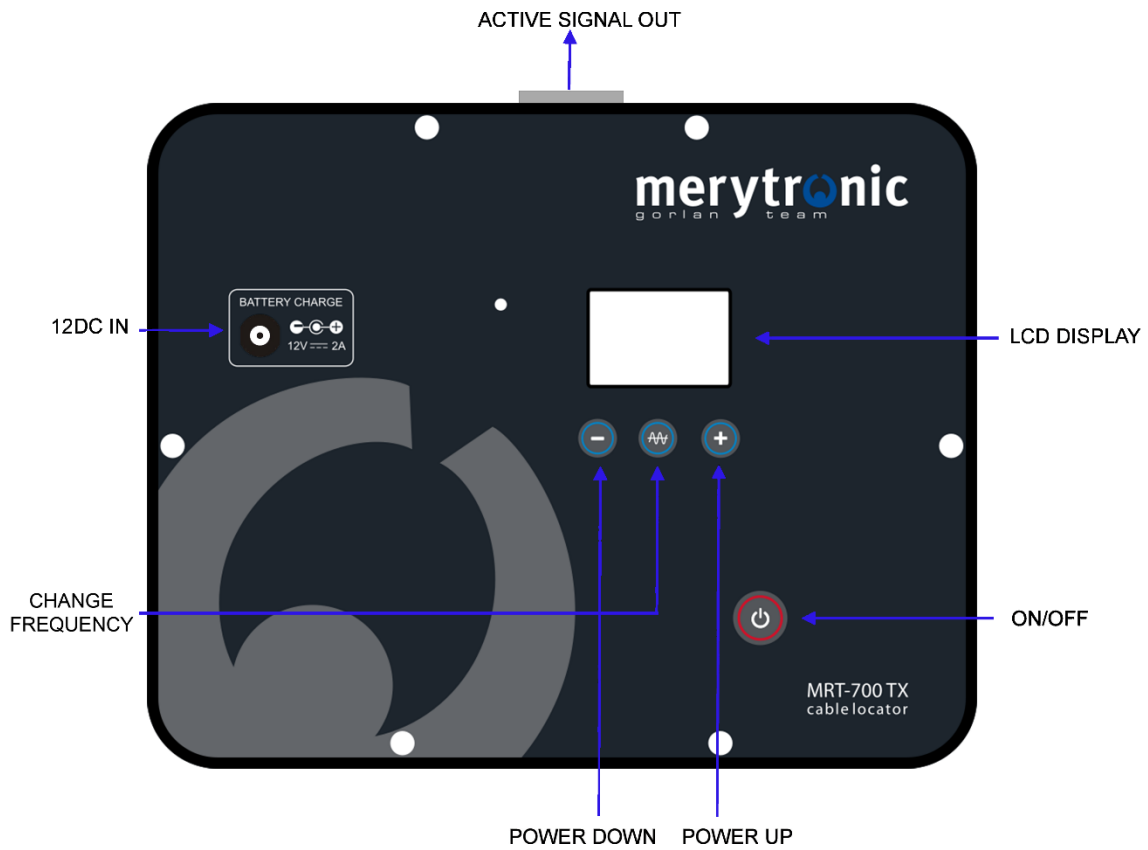
This table shows the symbols that are present both in the user's manual and in the equipment. The symbols that appear in the different screens of the equipment, independently of the mode using, are explained along the manual.

	The presence of this symbol in any part of the equipment means the need of reading this documentation in purpose of assuring a correct and safe use of the equipment.
	DC Voltage
	AC Voltage
	Earth terminal
	European conformity
	Equipment class II protection against electric shock. Reinforced insulation
<hr/>	
	Signal induction clamp
	Crocodile clamps
	Headphones connector

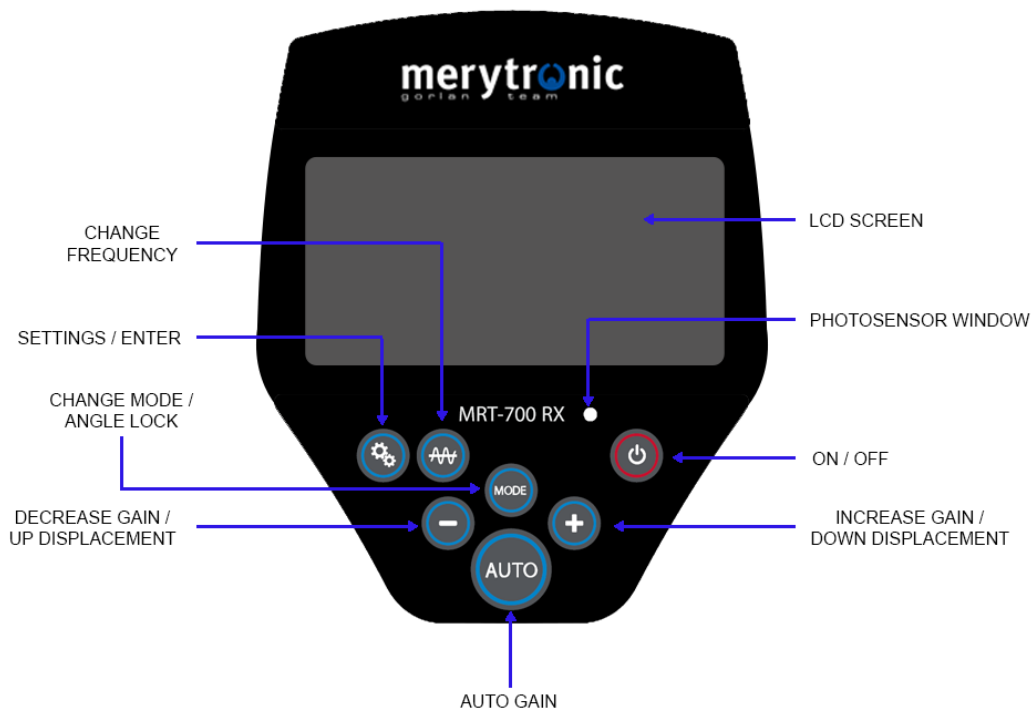
2. Equipment contents

- MRT-700 TX signal transmission unit.
- MRT-700 RX digital signal reception unit with sleeve.
- Cables with crocodile clamps for MRT-700 TX unit connection to target cables.
 - Specifications: PVC, $\text{Ø} = 1\text{mm}^2$, 295cm, 32A, fuseholder.
 - Crocodile specifications: 600V Cat IV, 36A.
 - Fuse: $\text{Ø}: 6,3 \times 32 \text{ mm} / 250\text{V} / 2\text{A} / \text{Response type: F}$
- Induction clamp for signal injection with the MRT-700 TX (optional, must be provided by the manufacturer).
 - Specifications: $\text{Ø} = 105\text{mm}$, 200cm.
- Earth pin.
- MRT-700 TX AC/DC power adapter for battery charging.
- MRT-700 RX AC/DC power adapter for battery charging.
- Car Lighter plug for MRT-700 TX and MRT-700 RX battery charging.
- User's manual.
- Quick start guide.
- Soft carrying bag.
- Rogowski sensor for cable identification (optional, must be provided by the manufacturer).
- U sensor for cable identification (optional, must be provided by the manufacturer).

Control panel of the MRT-700 TX transmitter



Control panel of the MRT-700 RX tracer



3. Conductor locator

In this operating mode, MRT-700 works as a conductor locator. It marks the route and indicates the depth of different distribution networks using three different active frequency signals (640Hz, 8 kHz and 32 kHz).

The MRT-700 TX transmitter can inject the signal in three different ways depending on the accessibility of the conductor. Once the signal is injected, it can be traced by the MRT-700 RX receiver.

Despite having 3 modes of signal injection, it is recommended to use the direct connection or the induction clamp. If we are transmitting with the internal antenna it can not be assured that the signal is being injected into the desired cable, and it may be inducing on adjacent cables as well.

All the operating modes are explained step by step in the next pages.

3.1 Injection of the signal

3.1.1. Conducted frequencies. DIRECT CONNECTION

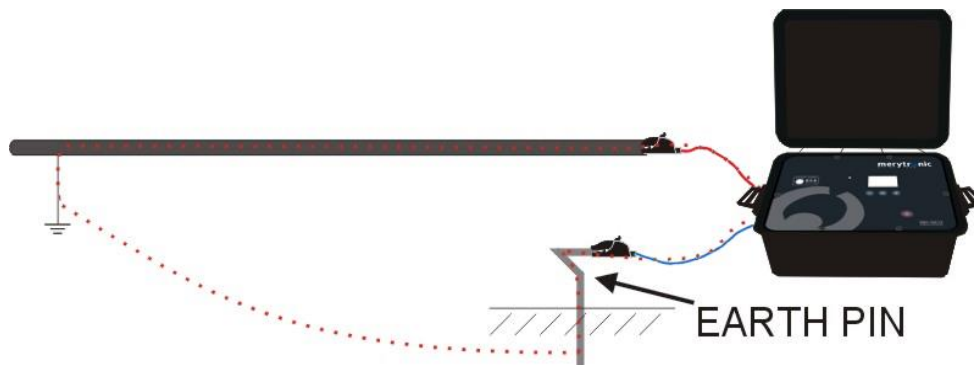


WARNING!

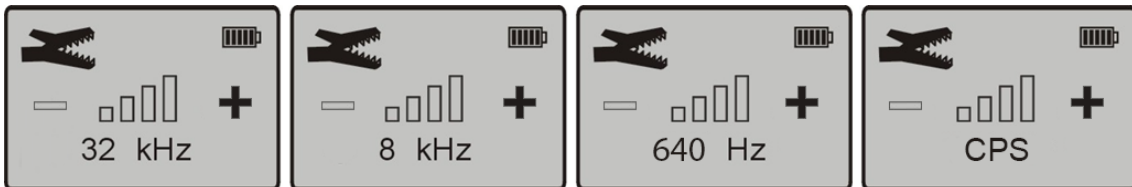
It's absolutely necessary that the cable to be traced is DE-ENERGIZED for direct connection.


Connecting the equipment to a live conductor between red and blue cable can result in permanent damage to the unit and the operator.

Connect the red cable to the conductor and the blue cable to the earth pin with the crocodile clamps (if there is no earth pin on one side of the cable to be traced, it is possible to use the one included on the equipment.) and connect both to the "Active signal out" connector:



Push the "On/off" button* and use the "Change frequency" button to select the frequency you want to inject (32 kHz, 8 kHz, 640 Hz or CPS/Polarity):



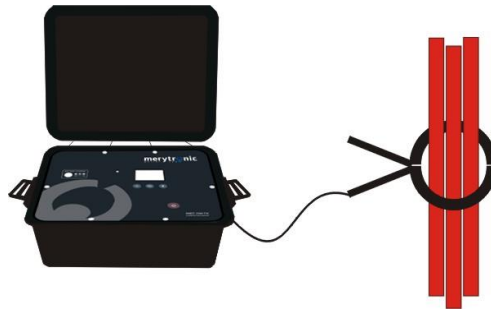
* When the direct connection cables are connected, the transmitter turns to "Direct connection mode"  automatically.

Once the desired frequency is selected (8 kHz for this example) push the "Power up" button 1, 2, 3 or 4 times (more times the button is pushed, bigger the signal becomes) and the device will start transmitting:

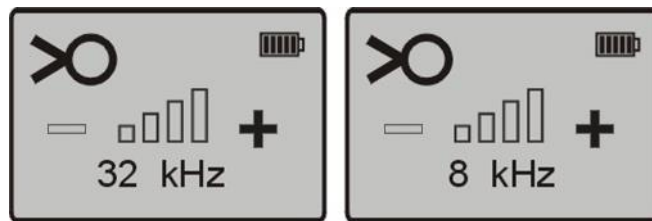



3.1.2. Injection of the frequency using the INDUCTION CLAMP

Hook the clamp around the conductor(s) you wish to locate, and then connect the clamp to the "Active signal out" connector:

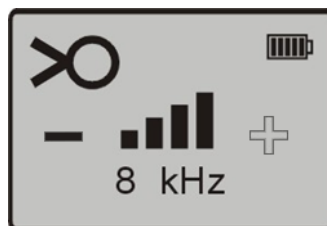


Push the "On/off" button and use the "Change frequency" button to select the frequency you want to inject (32 kHz or 8 kHz):



When the signal clamp is connected, the transmitter turns to "signal clamp mode"  automatically.

Once the desired frequency is selected (8 kHz for this example) push the "Power up" button 1, 2, 3 or 4 times (more times the button is pushed, bigger the signal becomes) and the device will start transmitting:

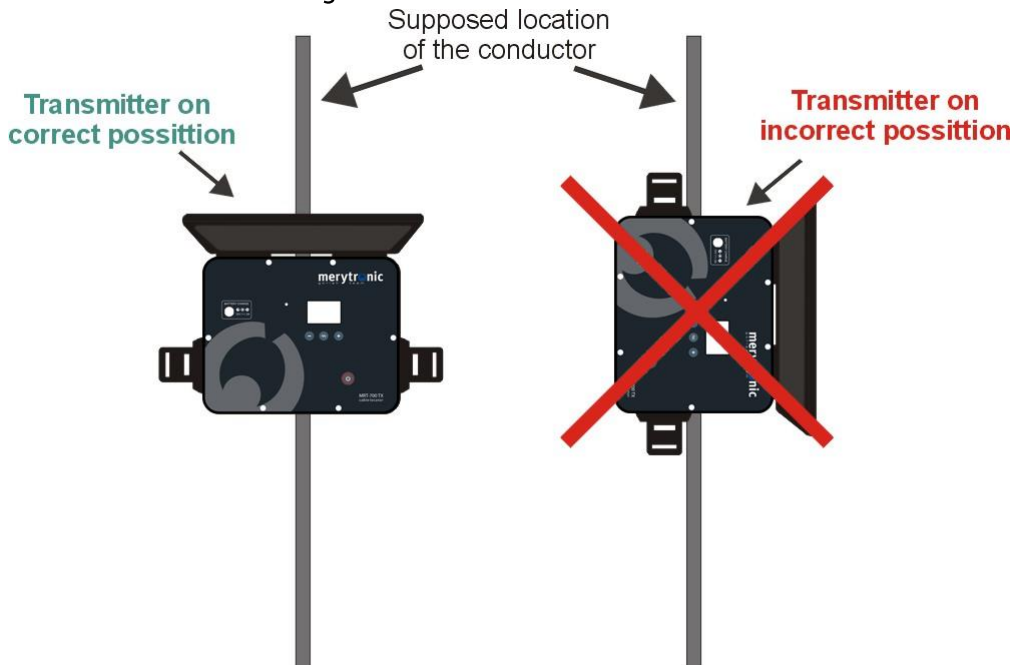


In order for the current to pass through the cable, the circuit must be closed on both of its sides. With electrical distribution networks, having one earth pin on each side is sufficient.

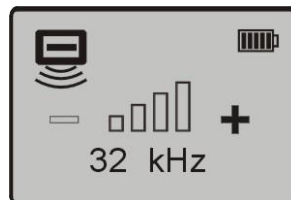


3.1.3. Injection of the frequency using the transmitter's INTERNAL ANTENNA

When there is no possible access to the conductor (underground cable for example), the MRT-700 TX transmitter can induce the signal using its internal transmitting antenna. To do that, put the transmitter above the place where the conductor is supposed to be in the same direction the conductor goes:



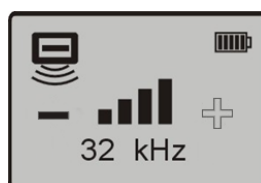
Once the transmitter is in the correct position, check nothing is connected in the "Active signal out" connector* and push the "On/off" button:



* When nothing is connected in the "Active signal out" connector, the transmitter turns automatically to the internal antenna mode .

Choose the frequency, in this operating mode you can only choose between 8 and 32 kHz.

Push the "Power up" button 1, 2, 3 or 4 times (more times the button is pushed, bigger the signal becomes) and the MRT-700 TX transmitter will start transmitting automatically:

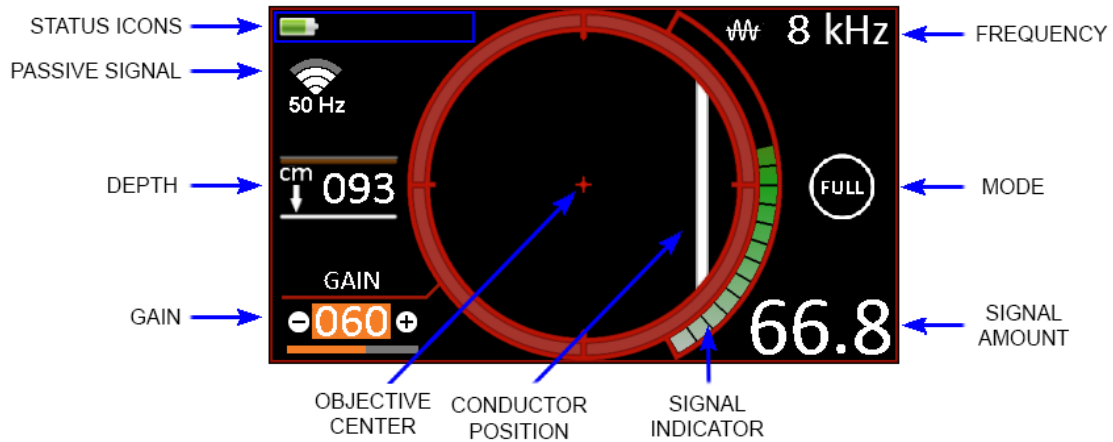


3.2. Locating a conductor

Once the transmitter is injecting an active frequency, we can locate the conductor. In that purpose, we will use the MRT-700 RX.



3.2.1. Information of the symbols on the MRT-700 RX's screen



- **Conductor position:** it shows the position of the conductor.
- **Objective center:** it shows the position of the MRT-700 RX-'s vertical axis.
- **Gain:** it shows the selected gain in dB.
- **Depth:** it shows the distance between the tracer and the conductor. This distance is measured from the base of the tracer.
- **Frequency:** it shows the selected detection frequency.
- **Mode:** it shows detection mode.
- **Signal amount:** it shows the detected signal quantity.
- **Signal indicator:** its function is the same than the previous one but it is shown graphically.
- **Passive signal:** it shows the quantity of 50/60 Hz signal that we are detecting, independently of the selected frequency detection. This is very useful to differentiate electricity supply cables of any other type of conductor (gas pipelines, water pipelines, telecommunications, etc.).
- **Status icons:** different symbols may appear in this area of the screen, reflecting the different options chosen in the tracer configuration. The following table shows all possible symbols that may appear in this area.

SETTINGS

- Battery indicator
- Mute
- Cable angle disabled
- Headphones connected

BLUETOOTH (proprietary protocol)

- Bluetooth module turned on
- Bluetooth connection established

BLUETOOTH (open protocol)

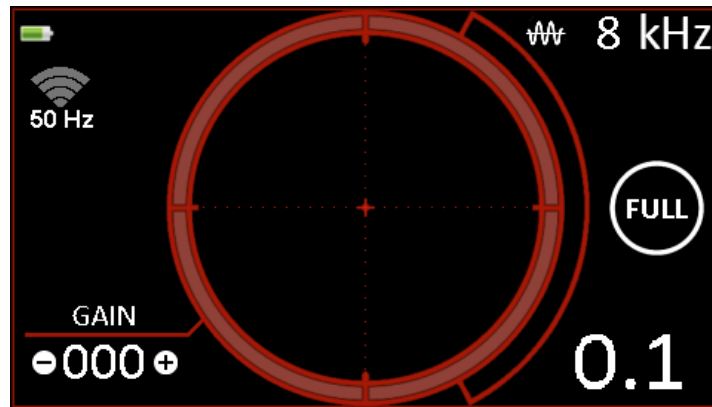
- Bluetooth module turned on (previously paired)
- Bluetooth connection established (with the previously paired device)

SELECTED NETWORK

- Electrical power network
- Gas network
- Telecommunication network
- CATV network
- Water network
- Sewer network

3.2.2. Settings

Push the "On/off" button to turn on the device, then push the "Change mode" button as many times as necessary to select the "FULL" mode in the main screen. Push the "Change frequency" button as many times as necessary to select the same frequency which has been selected in the transmitter (in this example 8 kHz).



This mode could be considered as the most automatic mode of all. Automatically, the tracer is responsible of eliminating false peaks caused by signal's bounces. It doesn't only show if the conductor is in one or another side of the equipment, it also shows its angle.

ANGLE LOCK

Although the "FULL" mode shows the angle in which the cable is in relation to the operator, there is the possibility of blocking this option.

To do this, keep pressing the "Mode" button while tracing until the symbol shown at the right of this paragraph appears in the left corner of the screen.



After doing that, everything is ready to locate and trace the conductor. First, we have to go to the detection zone. In case there is a conductor and it is outside the displayed zone of the tracer, it could not be represented in the equipment's screen. If this happens, we must take notice of the signal quantity that the equipment shows, moving in the growing direction of the signal gradient. It could also appear an arrow that will indicate the direction we have to move to. When the distance decreases, the conductor will appear in the display of the tracer. Then we must rotate until the conductor is vertical positioned in the screen. Finally, we must move until the cable is in the center of the screen.

Once the cable is vertically and centered in the viewer, the equipment will show the depth of the conductor and the current that it transports on the screen (these two values are not in shown all the frequencies)

Once these steps have been done, we can continue tracing the conductor, always following equipment's indications.

Operating instructions that are shown in next pages are valid for all the frequencies the MRT-700 operates with.

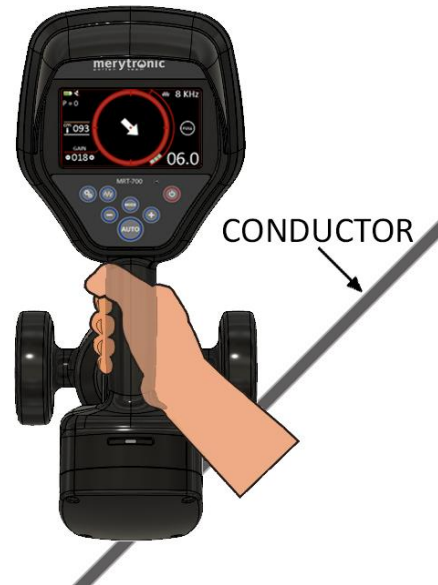
See how to do it step by step in the next pages.

3.2.3. Positioning the MRT-700 RX

1. First, there could not appear anything in the screen, but a signal is detected. If this happens, we will have to move in the growing direction of the quantity signal gradient. After that, we could adjust the gain (it is explained later in this manual).



2. Now we are receiving a small signal quantity and the conductor does not appear in the display. Because of this, we will have to move in the arrow's direction. *



3. The signal is increasing and the conductor has appeared in the display so we are doing right.



4. The conductor isn't in vertical position so we'll have to rotate the tracer until we get it.



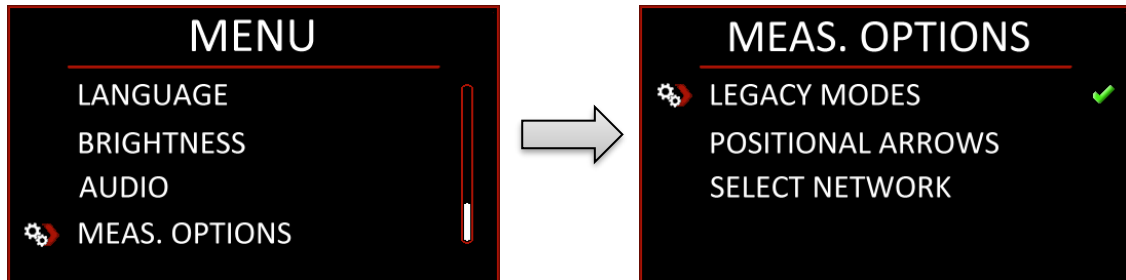
5. Finally, we will have to move to the right until the conductor is centered in the screen. The signal starts to grow up so we are going in the right way. When the conductor is completely centered, we will get the higher signal. In that moment, the tracer will show the depth of the conductor we are tracing.



*In function of the distance between the tracer and the conductor, the view field of the equipment changes and it could make the equipment going from the first step to the third one without appearing any arrow.

3.2.4. Another operating modes

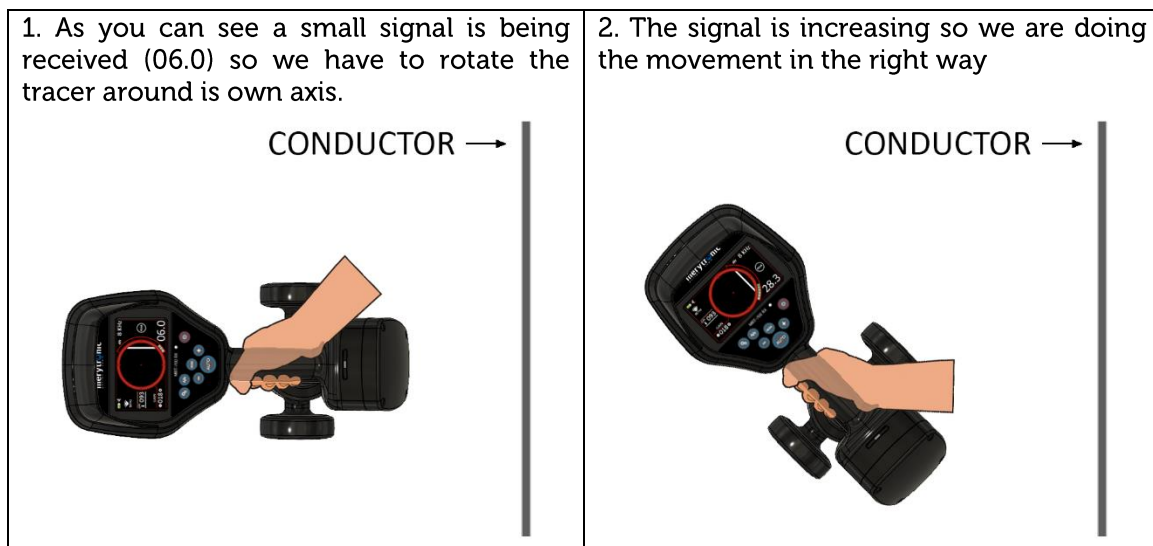
Besides the "FULL" mode, we can use another 3 operating modes when tracing/locating. "PEAK" and "NULL" modes don't appear in the unit by default. If we want to use these modes, they can be activated from the main menu of the receiver, in order to do this, we will have to enter the menu, select the "Options measure" options and the push the "Enter" button until a confirmation icon appears as you can see in the following images:



"PEAK" mode. This mode is like conventional tracers. To access it, "Change mode" button must be pushed once if we are at "FULL" mode (default mode), only if it has been previously activated. Unlike the "FULL" mode, the angle of the conductor is not shown.

The first step is similar to the "FULL" mode and no conductor may appear on the screen. If this happened, we should move in the increasing direction of the signal quantity gradient until the conductor was displayed or an arrow appears indicating the direction which it is located.

Once it was displayed on the screen, we would have to rotate the tracer around his own axis until it would be parallel to the conductor. If we want to know if this has happened, we must take notice of signal quantity indicators. Here's how to do it step by step.



3. If we preserve on the rotation the signal continues increasing its value (66.8). In this moment, the equipment is parallel to the conductor, but this can't be known at this moment so we will continue with the rotation.



4. The signal starts decreasing so the direction of the rotation must be changed in purpose of returning to the maximum signal point.



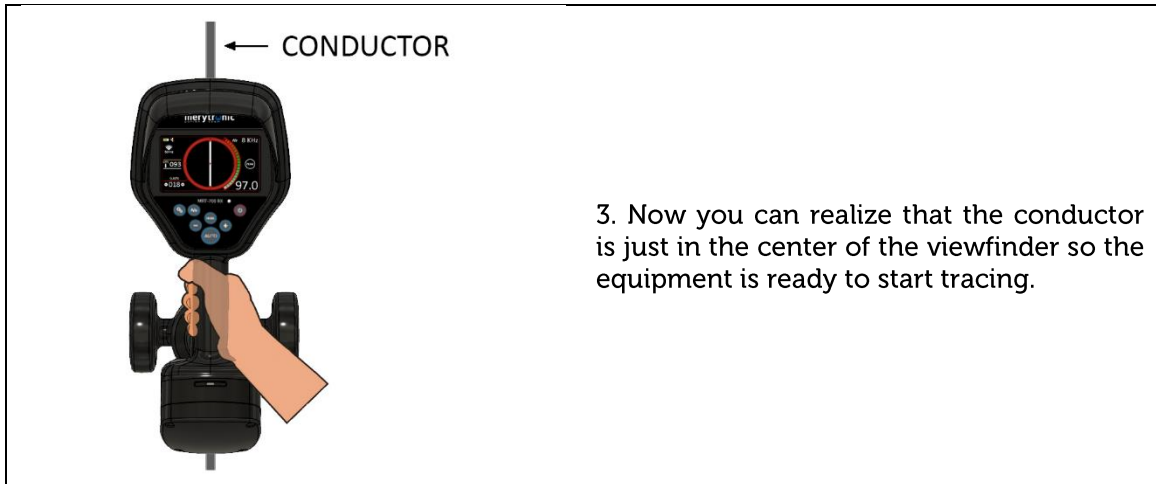
Once the MRT-700 is parallel to the conductor, we have to move to place just about it. For doing this, you must take notice of the positioning information that appears in the screen (viewfinder, signal quantity...) and then follow the next steps.

1. The conductor is in the right of the viewfinder's center so we will have to move in the same direction.



2. The signal starts to increase (83.0) and the conductor is closer the viewfinder's center



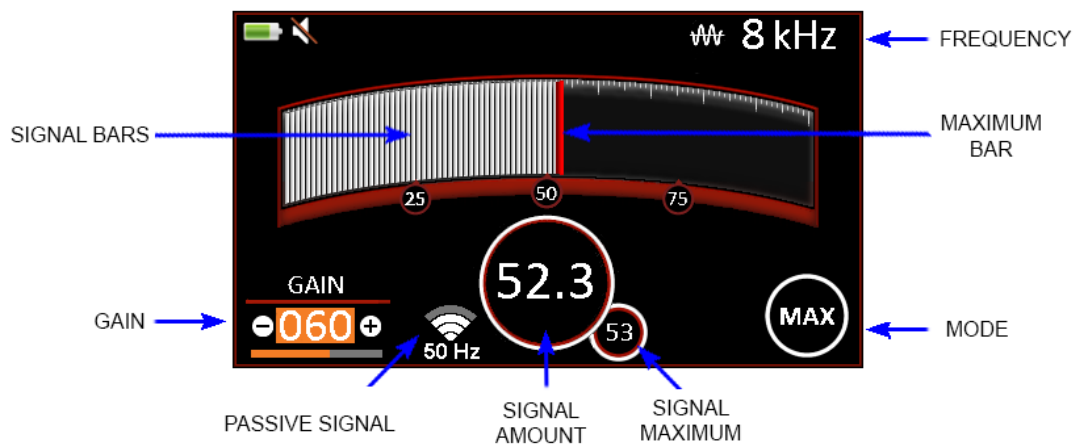


This mode has the disadvantage of the false peaks. These peaks are generated because of signal bounces and they can lead us to errors, because the tracer could draw a conductor where there isn't anyone. In purpose of avoiding this, we see the quantity of signal and move in the increasing direction of its gradient.

"NULL" mode. This mode is very similar to "PEAK" mode. In this mode, when we are getting close to the conductor the signal goes down. When we are above the conductor the signal showed is minimum. Otherwise, the positioning information is the same of the "PEAK" mode. For accessing this mode, "Change mode" must be pushed the needed times, only if it has been previously activated from the main menu

This mode has one advantage in regard to the "PEAK" mode. The advantage is that false peaks disappear, making the detection of the conductor easier.

“MAX” mode: In this mode, the positioning info disappears and the screen only shows the gain and the amount of signal. In the next image, it is shown the appearance and functionality of this mode.



- **Gain:** it shows the selected gain.
- **Frequency:** it shows the selected detection frequency.
- **Mode:** it shows detection mode.
- **Signal amount:** it shows the detected signal quantity.
- **Signal bars:** their function is the same than the previous one but it is shown graphically.
- **Signal maximum:** it shows the maximum detected signal in the last 5 seconds.
- **Maximum bar:** its function is the same than the previous one but it is shown graphically.
- **Passive signal:** it shows the quantity of 50/60 Hz signal that we are detecting, independently of the selected frequency detection. This is very useful to differentiate electricity supply cables of any other type of conductor (gas pipelines, water pipelines, telecommunications, etc.).

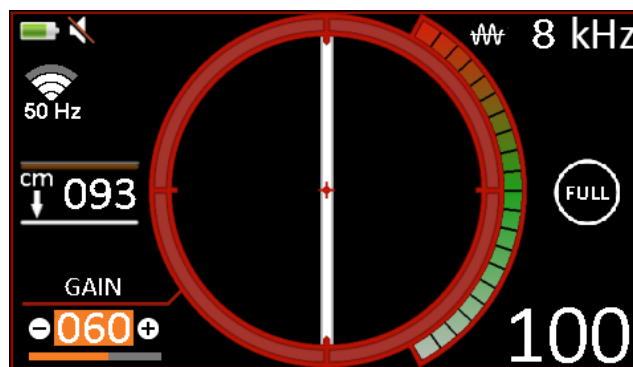
This mode is suitable to refine the position of the conductor when we have already located it. Sometimes the position shown in the “FULL”, “PEAK” and “NULL” modes can have an error of few centimeters due to the influence of other close conductors, curves in its trajectory etc. In “MAX” mode, we can correct this error in an easy way.

To do that, when we have located the conductor, in order to select this mode, just push “Change mode” button. Then move the MRT-700 some centimeters left and right looking for the maximum of signal. This maximum indicates that we are just above the conductor.

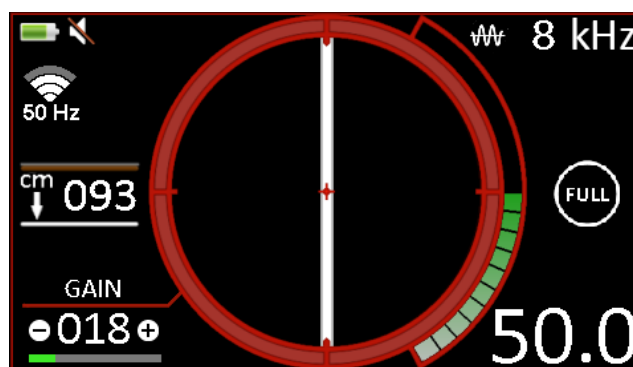
3.2.5. Gain adjustment

The amount of signal shown in the screen is vital in some stages of the location of a conductor. The amount of signal, shown as a number and represented with a bar indicator, is directly linked with the gain level. Sometimes happens that the signal shown is maximum but we aren't above the cable. In this situation, although we are getting closer to the conductor and the signal is growing it is not reflected in the display.

This is the moment to use the possibility of adjusting the gain. To decrease the gain, we will have to push the button with the minus symbol, "Decrease gain". Easier, the tracer offers the possibility of adjusting the gain automatically. For doing that, push the "Auto" button and the equipment will adjust the gain in order to the quantity of signal to become to the fifty percent.



When we are in the situation of the previous picture, we push the "Auto" button and automatically the device adjusts itself:



As you can see, the gain is also represented by a bar. If the gain is raised too high, the tracer will start reading lower and lower signals, which means that the unwanted noise will affect more, and the position of the conductor on the screen will be less consistent. For this reason, for high gain values, the number is highlighted with a color, to remind the user that the work may be affected by unwanted noise.

3.2.6. Locating cables using passive frequencies

It is possible to detect 50/60 Hz magnetic field created by current carried by electricity supply cables.

To do that, press the "Change frequency" button as many times as necessary until 50/60 Hz is shown in the top right corner.

Previously, it has been said that independently of the selected frequency, the tracer shows the quantity of passive signal and this allows us to differentiate conductors. However, now our intention is to trace an electricity supply cable through which a current flows.

The location process will be the same but in this case, it wouldn't be necessary any current induction.

3.2.7. Locating pipes and telecommunication cables

Telecommunication cables usually carry currents with frequencies between 15 kHz and 27 kHz. MRT-700 RX receiver can detect the magnetic field generated by those currents and trace the conductor.

In order to do that you have to choose "Radio" in the list of available frequencies of the receptor.

The location process will be the same but in this case, it wouldn't be necessary any current induction.

This mode is very used in pre-location of pipes, because it is very common for telecommunication frequencies to be induced in nearby pipes.

3.2.8. Locating cables / pipes with polarity

First, we must do in this case is to induce the signal, in this case the signal can only be induced in direct connection. In this purpose, we must choose the "CPS" option in the transmitter and choose the desired transmission's level.



When using this mode, it is important to let the transmitter stabilize before starting to trace. In order to do this, wait at least 1 minute since the start of the signal transmission.

Once the signal has been induced like in previously cases and it has been stabilized, in the receiver we must select "CPS" in the list of available frequencies and start to trace.

In the receiver, we will be able to see the polarity of the conductor we are tracing. We will obtain a polarity by the principal conductor in which we have induced the signal, and the opposite one in the conductors by which the signal returns.

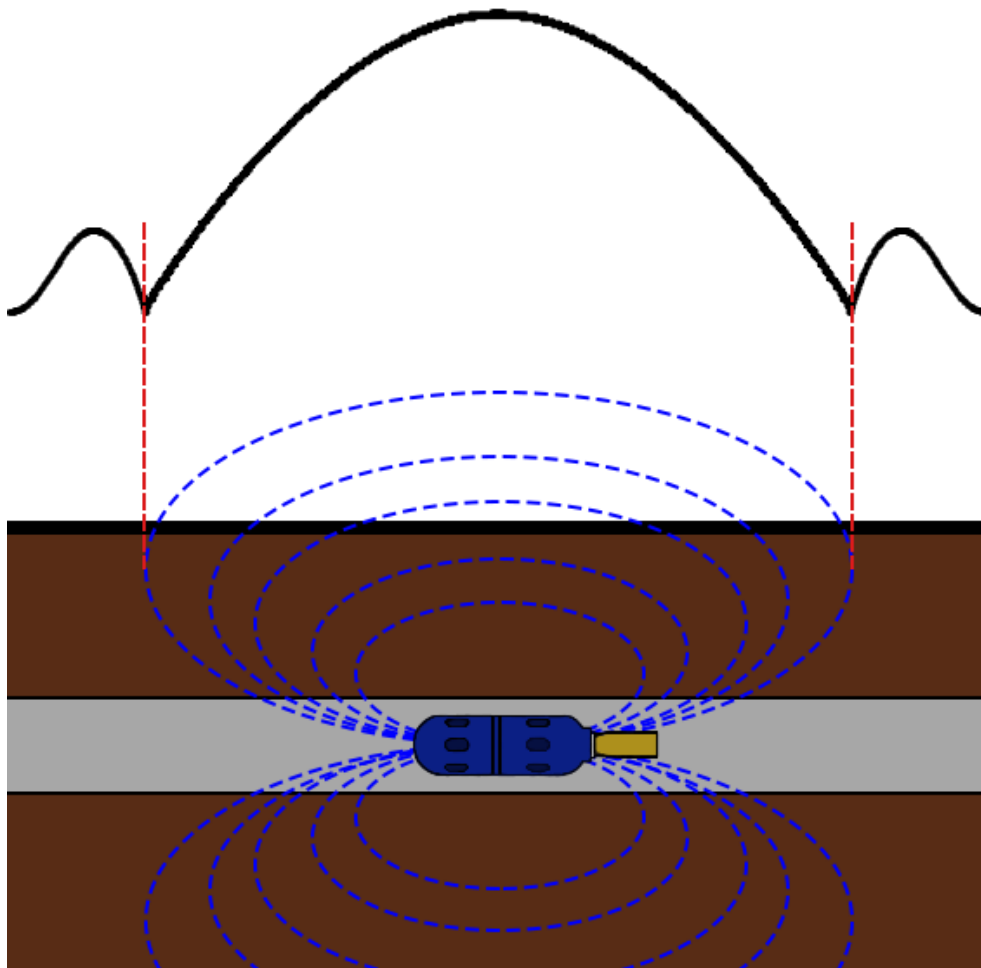
3.3. Locating Sondes

The MRT-700 RX tracer has also the ability to locate Sondes. The use of Sondes is very common, especially in the location of non-metallic pipes. Most market Sondes work with predefined frequencies. This tracer is capable of locating Sondes of two different very common frequencies that are 8,192 kHz and 32,768 kHz.

In this section, we will explain how to locate Sondes and know the approximate depth to which the Sonde is located. The process will be the same regardless of which Sonde is used.

3.3.1. Field created by a Sonde

In order to locate a Sonde, first, we have to know what the field created by one is like. The field is not completely clean, and creates false peaks as you can see in the following image.

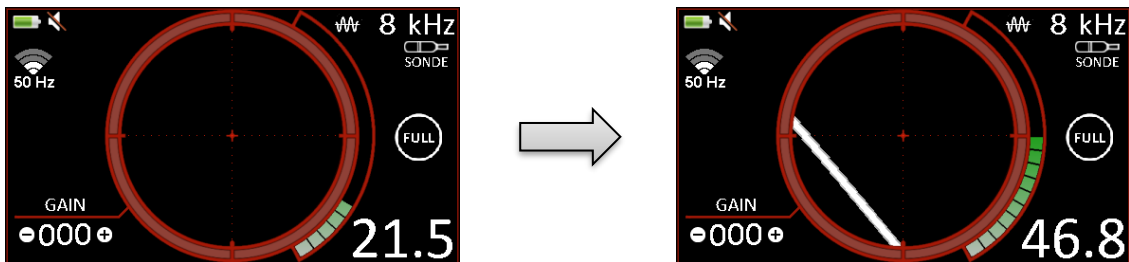


The fact that the Sonde creates these types of fields, can cause errors in locating the Sonde, but as will be seen later, this can also be used to ensure better its position.

3.3.2. Location and depth of the Sonde

In order to locate the Sonde with the MRT-700 RX, you have to use the "FULL" and "MAX" modes, because with the combination of these two modes it is easy to assure the position of the Sonde. We will start working in "FULL" mode.

First choose the frequency of the Sonde that you want to draw. Once the working frequency has been selected, follow the direction in which the amount of signal increases. Therefore, the amount of signal shown on the screen must be continuously set. In this way you will reach the Sonde.



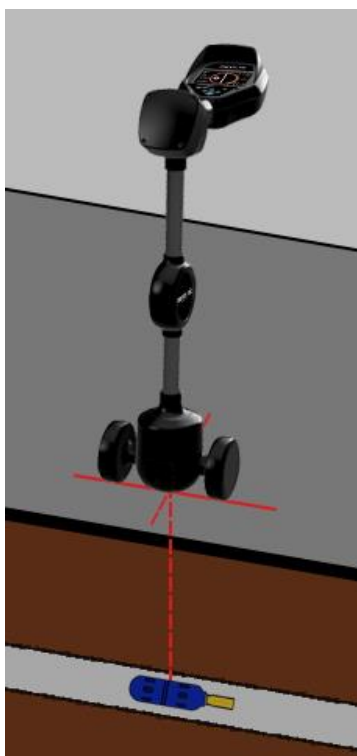
In this mode, the amount of signal will not be affected by the false peaks, and will grow as long as we get closer to the Sonde.

When we are at the point where the amount of signal is maximum, it will be necessary to rotate until the graphical interface shows the representation of the Sonde completely centered and vertical.



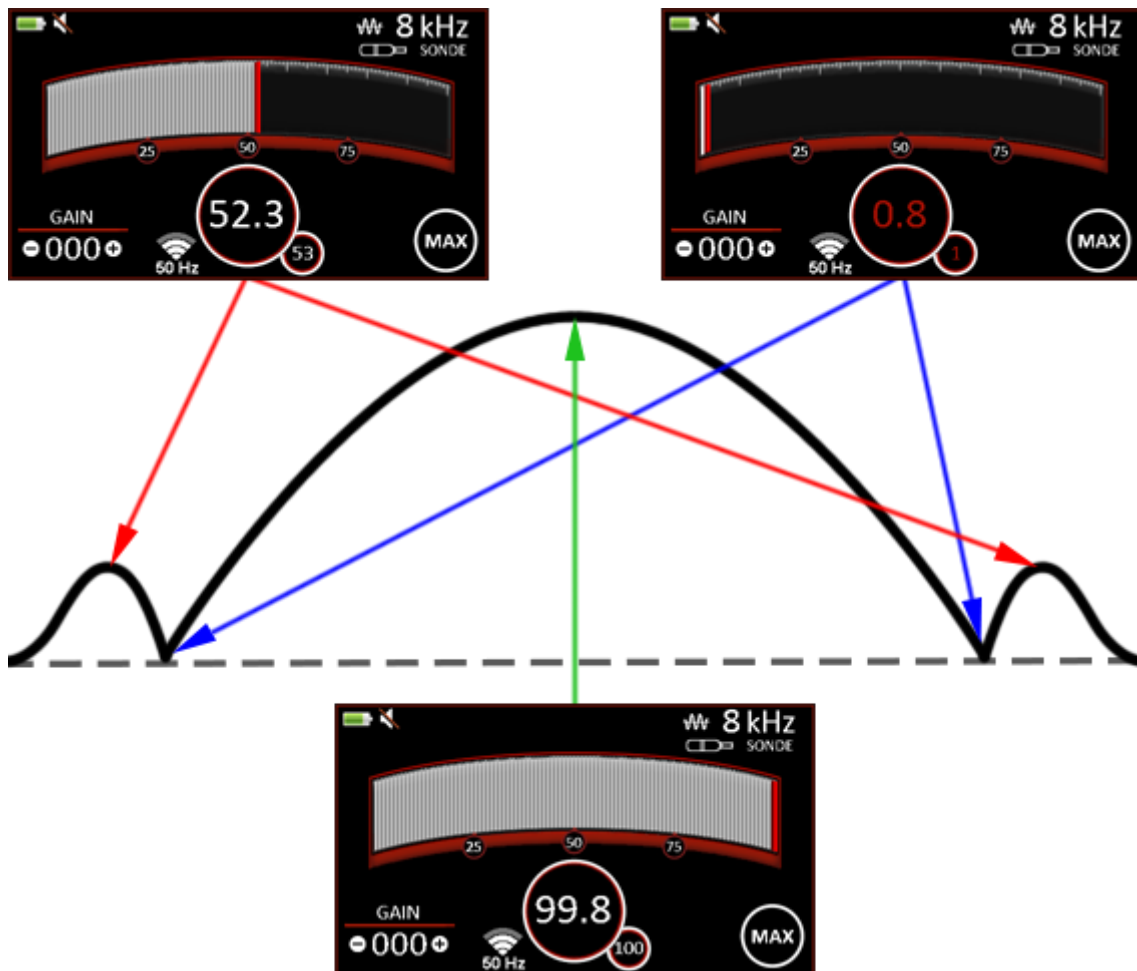
WARNING! The representation indicates the perpendicular direction to the real of the Sonde, due to the peculiarity of the field

At this time, it is in which the depth measurement of the MRT-700 RX will be reliable



Even so, in order to ensure that we are at the specific point, before making the height measurement, we can make sure that we are in the correct position using the "MAX" mode.

Once in the position in which the representation is vertical and centered, we will change to "MAX" mode. This mode is more accurate than the previous one, and does not eliminate false peaks, which will allow us to find the phantom signals, and the points where the field is null. If we move to the left and right, without rotating with respect to the previous position, we will start from a maximum and we must find a null and then a peak on each side, with less signal than the main one. When having located the 3 peaks, the central one (which is the one that more amount of signal will show) will indicate the correct position of the Sonde. The behavior of the tracer should be like in the following image:



4. De-energized cable identifier

In this operating mode, the MRT-700 helps users to easily identify de-energized electrical cables among multiple conductors, in trenches, manholes, panels, aerial/underground conversions, etc.

A positive cable selection is made by analyzing amplitude and sign of the received active signal.

The injected current amplitude depends on the transmit level (1 to 4) and on the cable loop resistance. This measurement will be displayed on the MRT-700 TX equipment, and the detection of a similar signal amplitude with the receiver MRT-700 RX, will indicate that it could have been found the cable to be identified (direct connection only).

The sign detection is used to know if the conductor corresponds with the one the transmitter has been connected to, or with a returning current through another cable.

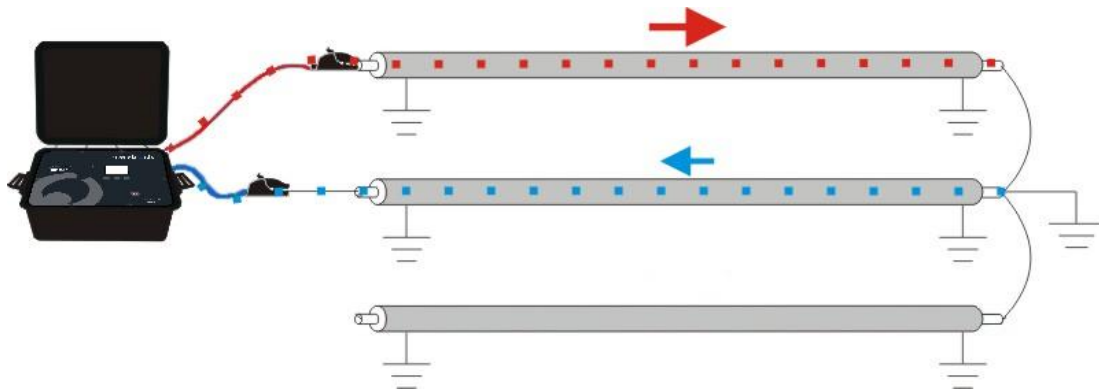
There are different ways to connect the transmitter MRT-700 TX on de-energized cables, depending on the network configuration and on the type of cable to be identified.

4.1. First Step, MRT-700 TX transmitter connection

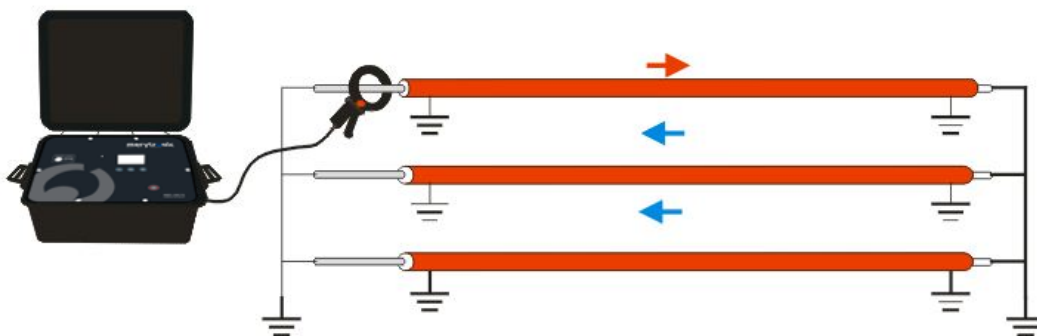


It is absolutely necessary that the cable to be identified is DE-ENERGIZED for direct connection. Connecting the equipment to a live conductor between red and blue cables may result in permanent damage to the unit and the operator.

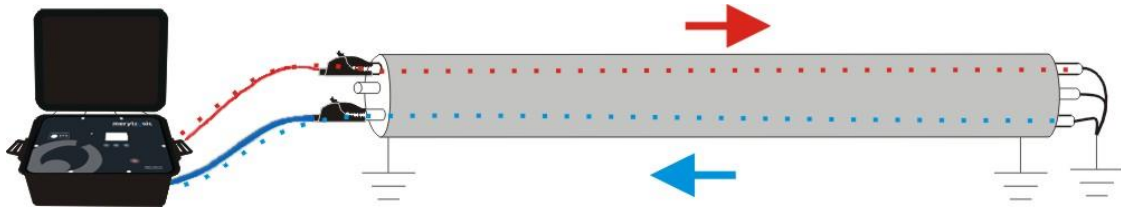
In the next pages, are showed the different ways to connect the MRT-700 TX transmitter.

Single Core Cables (shielded or unshielded). Direct Connection

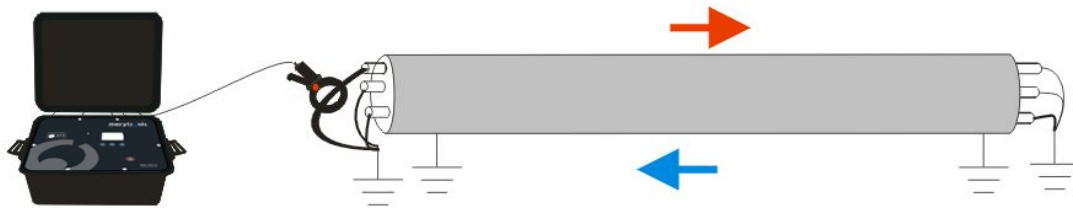
- Short-circuit and connect to ground all inner conductor and cable shields from the opposite side of the MRT-700 TX.
- Connect the red cable of the transmitter to the inner cable to be identified.
- Connect the blue cable to another of the conductors, which will be the responsible of returning the signal.

Single Core Cables (shielded or unshielded). Inductive coupling

- Short-circuit and connect to ground all inner conductor and cable shields from both sides of cables.
- The transmitter does not show the amount of intensity that sends (it is not known exactly).
- The transmitter does not show the cable loop resistance.

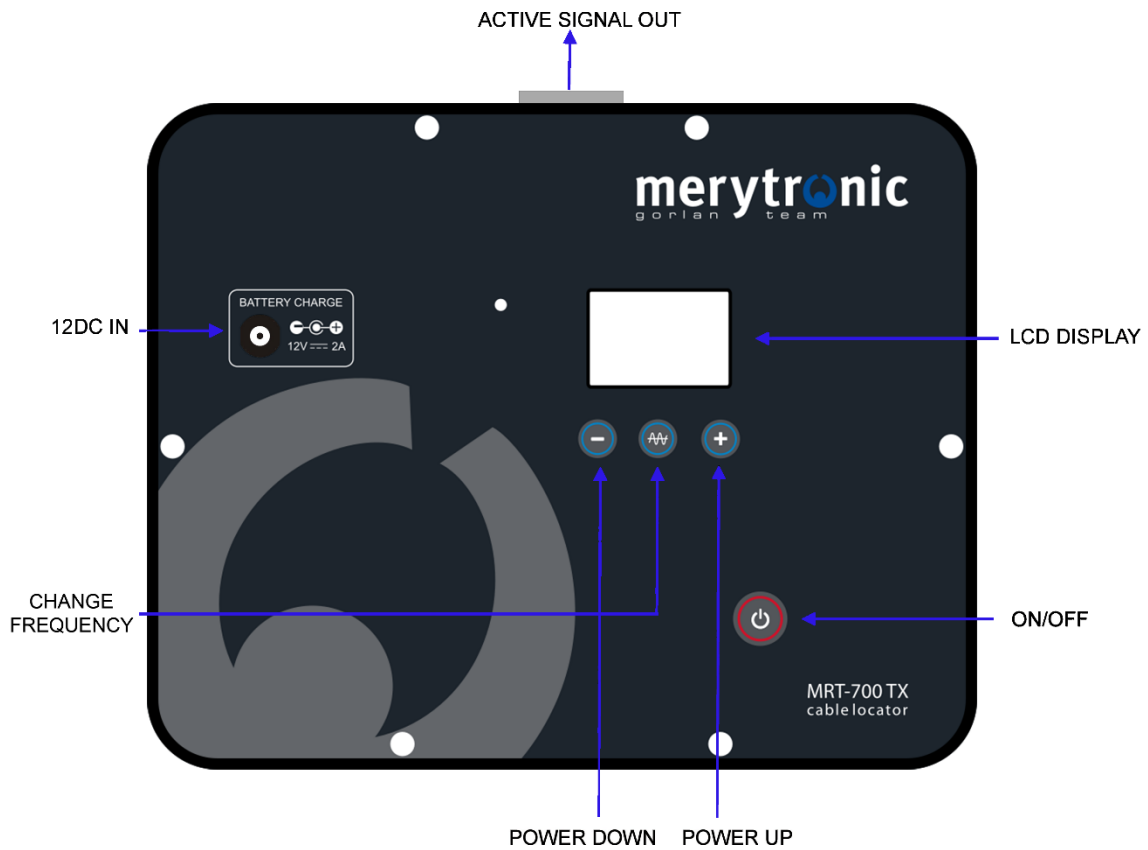
Multi Core Cables (shielded or unshielded). Direct Connection

- Short-circuit and connect to ground all inner conductor and cable shields from the opposite side of the TX.
- Connect the red cable of the transmitter to one of the inner conductors of the cable to be identified (one phase).
- Connect the blue cable of the transmitter to one of the inner conductors of the cable to be identified (another phase).

Multi Core Cables (shielded or unshielded). Inductive coupling

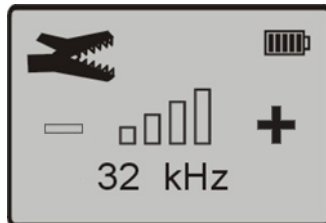
- Short-circuit and connect to ground all inner conductor and cable shields.
- Short-circuit and connect to ground all inner conductor and cable shields from the opposite side of cables.
- Connect the induction clamp of the transmitter to one of the inner conductors of the cable to be identified (one phase).
- The transmitter does not show the amount of intensity that sends (it is not known exactly).
- The transmitter does not show the resistance.

4.2. Control panel of the MRT-700 TX transmitter

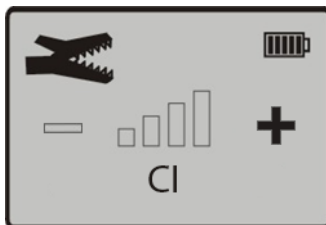


4.3. Steps to follow once the transmitter is connected

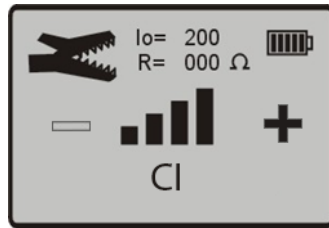
4.3.1. Push the "On/off" button, then the LCD display turns on looking in this way:



4.3.2. Push the "Change frequency" button to reach the CI mode:



4.3.3. Push the "Power up" button 1, 2, 3 or 4 times for the device starts transmitting (more pushes, stronger signal). In the next picture, the LCD display as it looks at the maximum power (pushing the button 4 times):

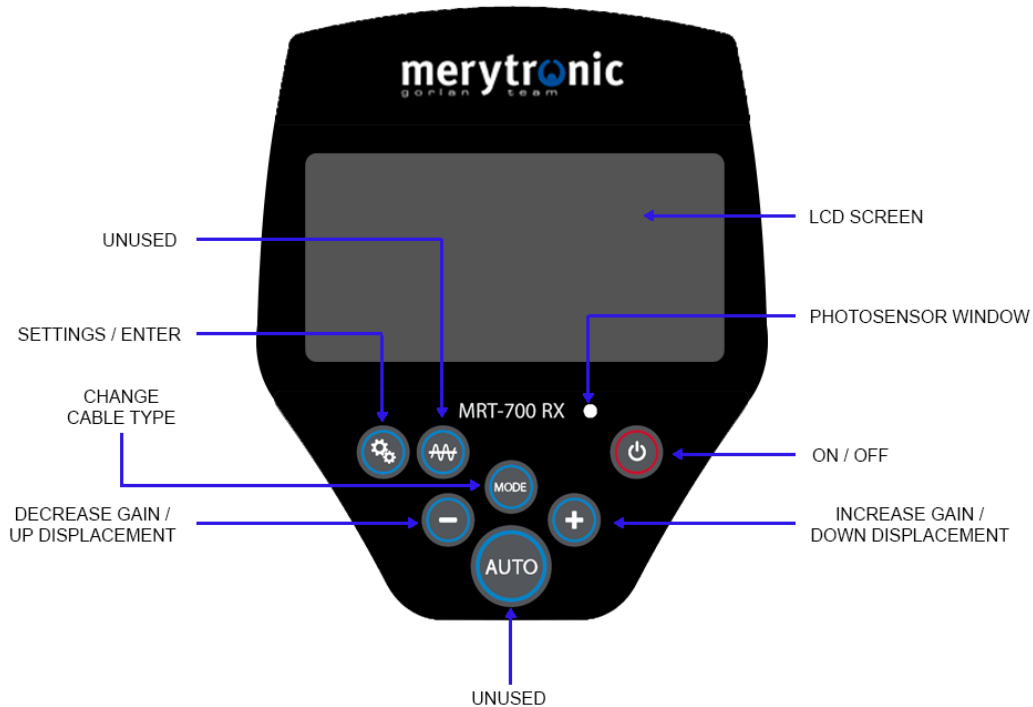


Notice that once the device starts transmitting, the LCD display shows two new features. The first one is the signal's level (200 mA in this case) and the second one is the cable loop resistance (in this case 0 Ohms). Now we can identify the cable with the MRT-700 RX receiver.

** In the inductive coupling mode, the LCD display does not show the signal level neither the cable loop resistance, and the icon shown in left upper corner will be an inductive clamp instead of a crocodile clamp.*

4.4. Control panel of the MRT-700 RX receiver

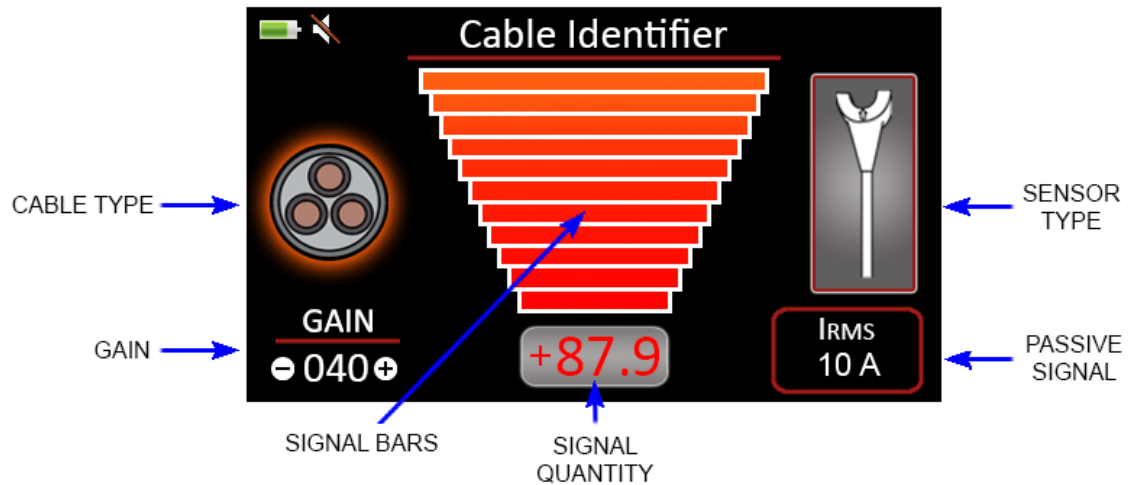
In this cable identifying mode, receptor's buttons don't have the same functions as in the rest of the modes.



- **On/Off:** doesn't change. Its' function is to switch on and switch off the unit.
- **Settings/Enter:** doesn't change. It can be used to access the menu and in it select the different options.
- **Gain buttons/Displacement buttons (+/-):** they are only useful to change the gain with the "U" sensor, because with the Rogowski it can't be changed. In the menu, they have the same displacement function.
- **Change cable type (Mode):** it is useful to change the type of cable we are identifying, only if we are using the "U" sensor. It is unuseful with the Rogowski because it can only be used unipolar cables.
- **Unused (Auto/Freq):** "Auto" and "Change frequency" are unused in this mode.

*The connector for the different sensors is in the backside of the panel showed in the previous image

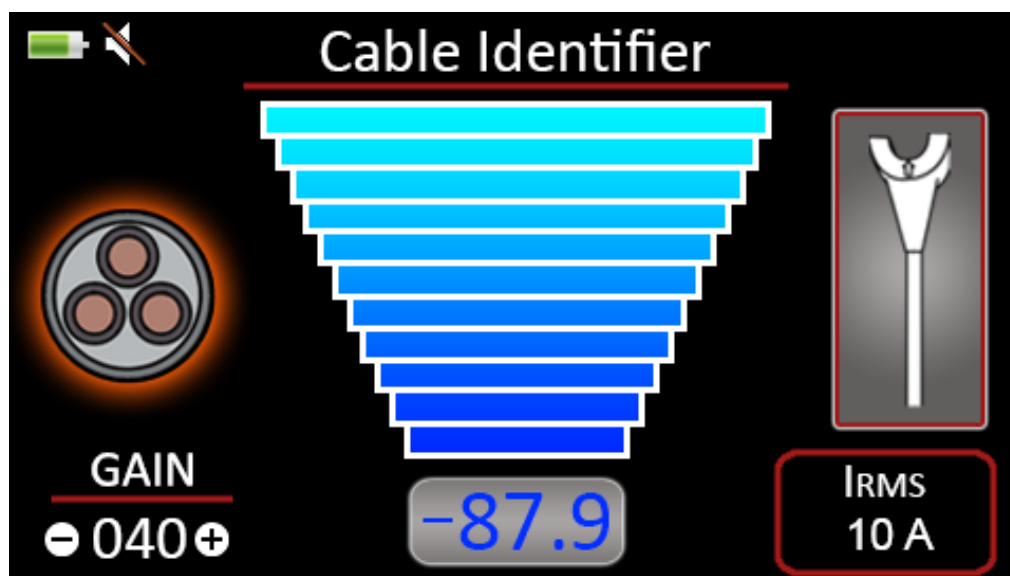
4.5. Information of the symbols on the screen



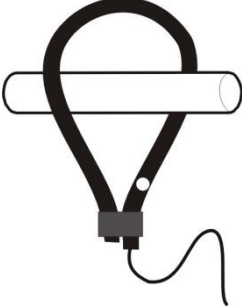
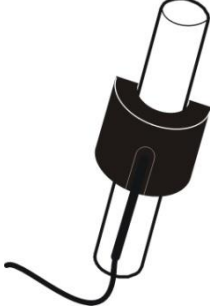
- **Cable type:** it shows if we are identifying an unipolar or multipolar cable. As mentioned, this is only changeable with the "U" sensor.
- **Gain:** it will only appear if we are using the "U" sensor, because with the Rogowski sensor gain can't be adjusted.
- **Signal bars:** indicate the signal quantity we are detecting. They can be red or blue. Red bars indicate a positive polarity and the blue ones a negative polarity, as long as we are placing the sensors in the correct position. This will be explained later.
- **Signal quantity:** indicates the same as the bars, but with numbers. It will have the same color as bars and it will also show the polarity with the "+" or "-" symbols.
- **Sensor type:** it will show the connected sensor.
- **Passive signal:** indicates the passive signal (50 Hz / 60 Hz) quantity present in the cable we are identifying.

4.6. Settings of the MRT-700 RX Receiver

4.6.1. Once the equipment has been switched on, we must connect the desired sensor and the equipment will automatically enter in the cable identifier mode, with the corresponding characteristics of the connected sensor.



4.6.2. It is very important to connect the correct sensor in the sensor's connector.

<p>A - Identification of single core cables when is possible to hook around the cable to be identified:</p> <p>Connect "ROG" sensor:</p> 	<p>B - Identification of multi core cables or single core cables when it's not possible to hook around the cable to be identified:</p> <p>Connect "U" sensor:</p> 
<p>Attention: When identifying single core conductors, use the "ROG" sensor ring for a maximum reliability of the identification. When identifying multi core cables, you must use "U" shaped sensor. When using the "U" shaped sensor, take into account that received amount of signal depends on the distance from the sensor to the conductor (which varies with the type of cable). Also picked up signal may be coming from an adjacent conductor.</p>	

The following image shows the confusion situation mentioned, which is very common with the U sensor, especially when unipolar conductors are identified.



In spite of the fact that for the conductor in which the sensor is being placed in U, no current is circulating, the receiver is detecting a signal which can lead to an erroneous identification.

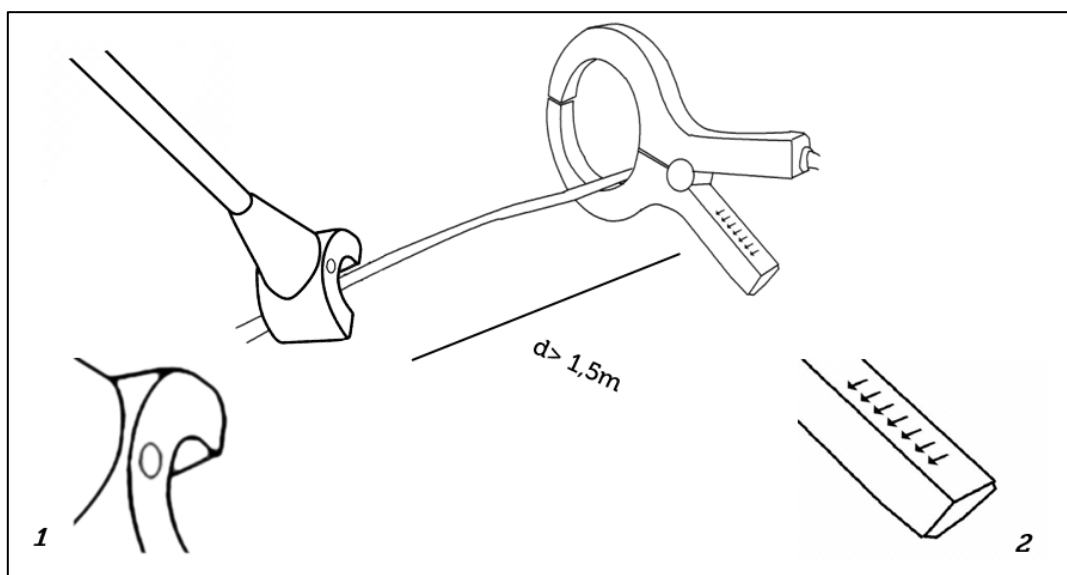
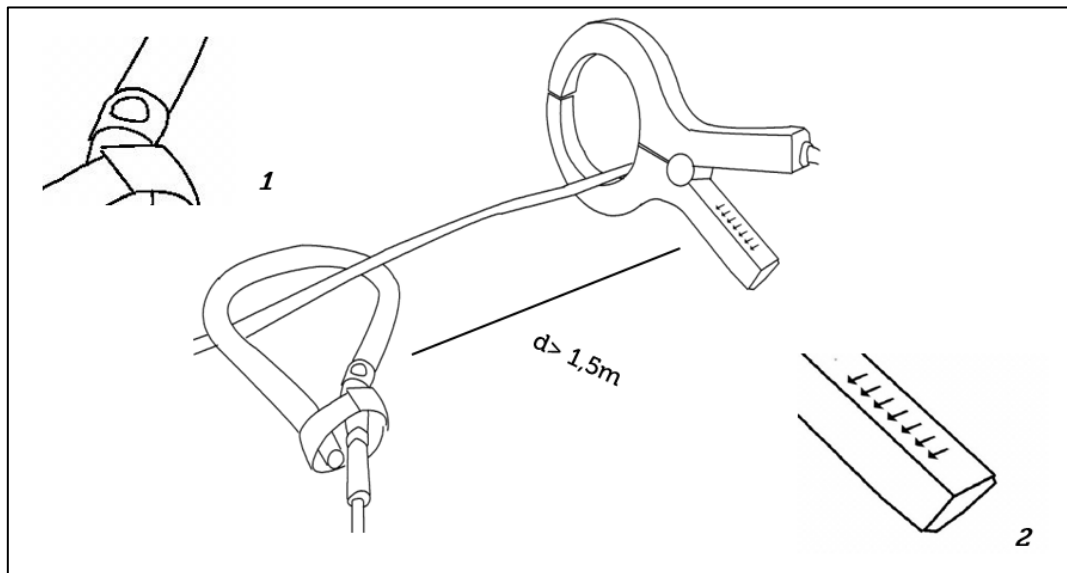
This signal will be proportional to the distance, current and direction of the current of all the conductors present in the detection range of the sensor. In the case of the image, the field generated by the currents of both conductors would be detected. The result of adding or subtracting those magnetic fields will be the result shown by the tracer on the screen. To make a correct identification, the sensor should be positioned so that only the desired cable is found in its detection range.

Because of this, whenever the conductor to be identified can be rounded and it is unipolar, it is recommended to use the Rogoski sensor.

4.6.3. Signal's polarity

In purpose of making easy to get a positive polarity, both sensors have a dot. This dot (1) must be facing signal injection's arrows (2). There must be at least 1,5 meters between the signal injection's clamp and the sensor.

In the next images, it is shown how to do a correct cables' identification in order to get a positive polarity using signal injection's clamp.



In case of direct connection signal's transmission, sensor's dot will have to be facing the transmitter's red cable.



WARNING

It is absolutely necessary that the cable to be identified is DE-ENERGIZED for direct connection. Connecting the equipment to a live conductor between red and blue cables may result in permanent damage to the unit and the operator.

Summarizing, if the sensor has been positioned in the previous explained position, the color of the bars will help to differentiate the correct cable.

Dot pointing to the TX	Dot not pointing to the TX
Red bars = good cable	Blue bars = good cable
Blue bars = cable that returns the signal	Red bars = cable that returns the signal

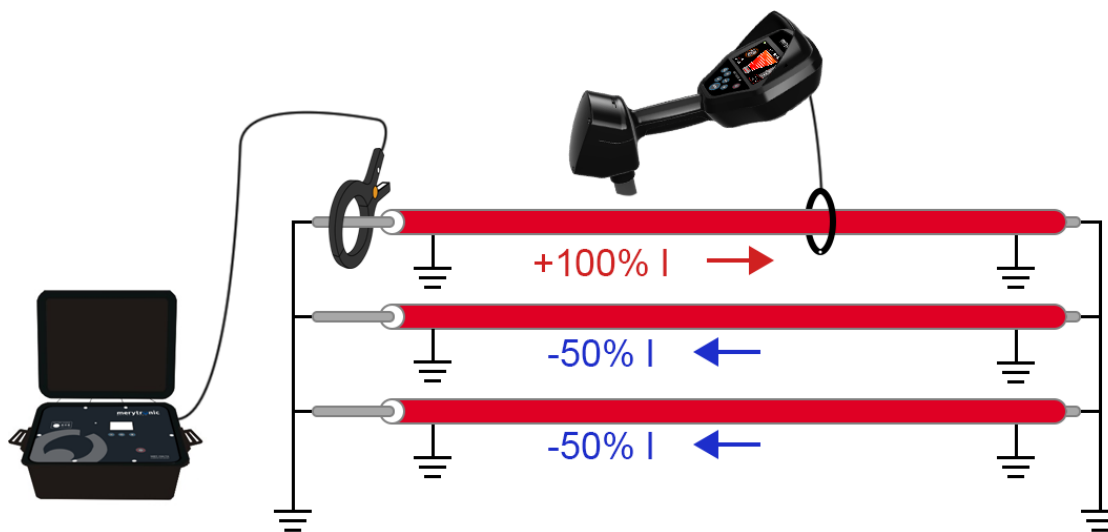
4.7. Detection

A positive cable selection is made by analyzing the amplitude and sign of the received active signal.

This signal's amplitude depends on the transmit level (1 to 4) and the sort of cable and connection we have. In the following pages, the distribution of flowing currents is shown on different cases. In each case, it's shown the expected amplitude and sign of the received signal.

4.7.1 Single core conductor identification

In single core conductor identification, both sensors can be used. Even so, if the unipolar cable can be rounded it is recommended to use the Rogowski sensor, due to its greater simplicity and precision.



Current flows in one sense (red) through the inner conductor of the cable to be identified, and returns through the inner conductors of the rest of cables (2 cables). If their impedance is similar, then each of them will carry around half of the signal.

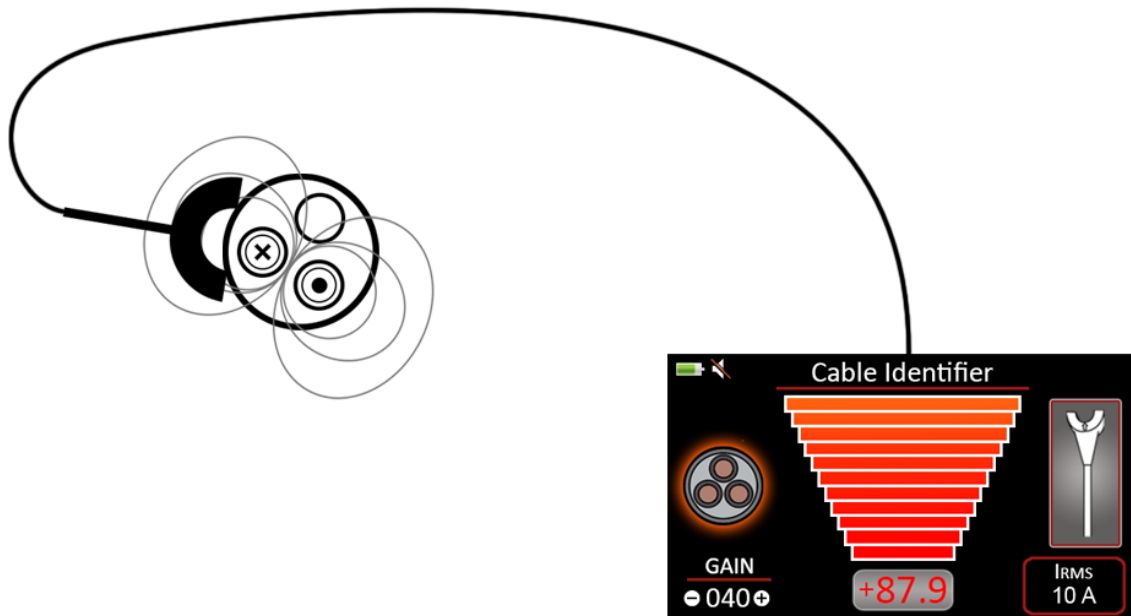
- All the signal injected by the transmitter will appear in the cable wanted to be identified (if it's injected with the signal clamp it's recommended to take a measurement near the transmitter in order to know how much signal has been injected)
- On the rest of cables, assuming a similar impedance the injected signal will be divided between all the conductors (in this case 2, 50%).
- If we have placed the sensors in the correct position, we will find a positive polarity in one cable, represented with red bars in the receptor and the negative in the rest, represented with blue bars.

4.7.2 Multi core conductor identification

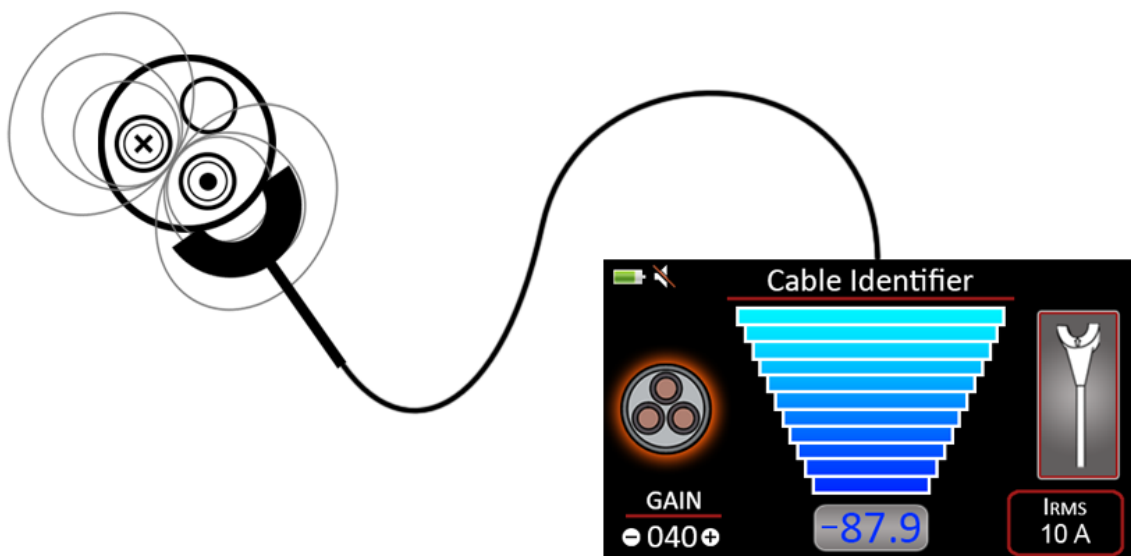
To identify a multi core cable the sensor to be used will be the "U" shaped Sensor (If the "ROG" Sensor Ring is used in this case we'll have a 0 reading because it measures the resultant of all currents flowing through embraced cable which, in this case, would cancel out each other).

Once the "U" shaped sensor is connected, move it around the conductor. For a positive identification, we should measure three different signals after one full turning:

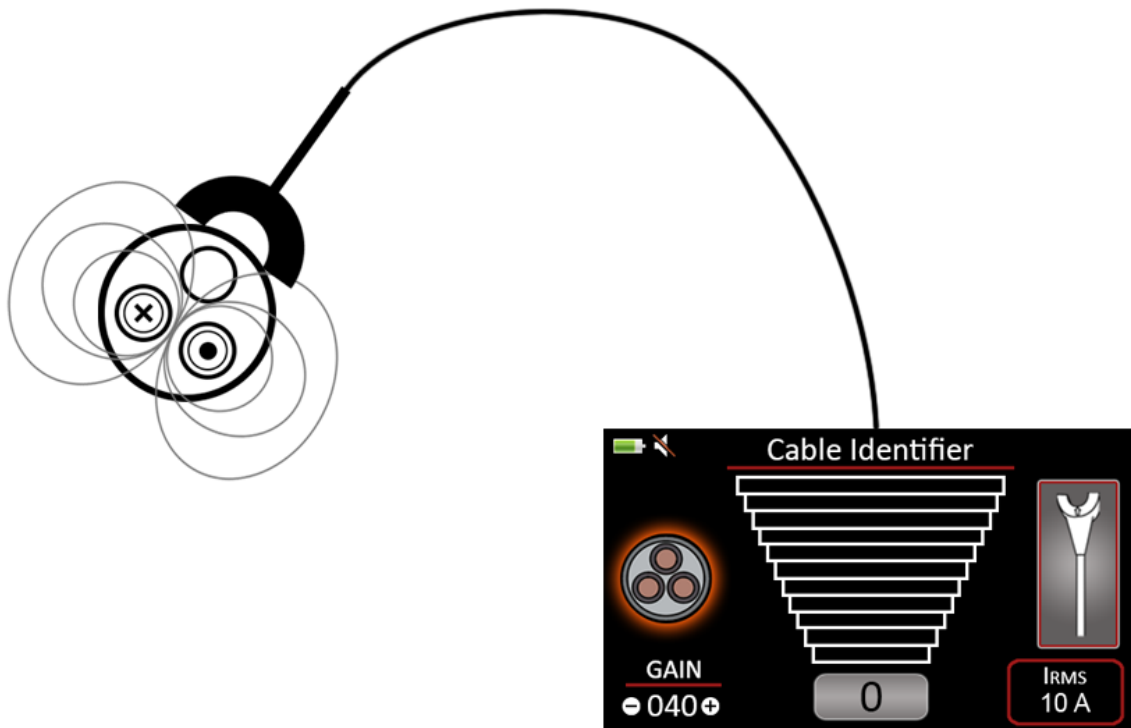
1. A maximum positive (red bars indicate a positive polarity):



2. A maximum negative (blue bars indicate negative polarity):



3. NULL (no signal, point of cancellation):



In the previous example, the maximum is 87.9. Take in account that it is only an example. This value depends on the injection level selected in the transmitter, the gain level selected in the receiver, the particular characteristics of the cable etc.

Anyway, although the signal level will be different in different situations, **the maximum positive and the maximum negative levels should be very similar.**

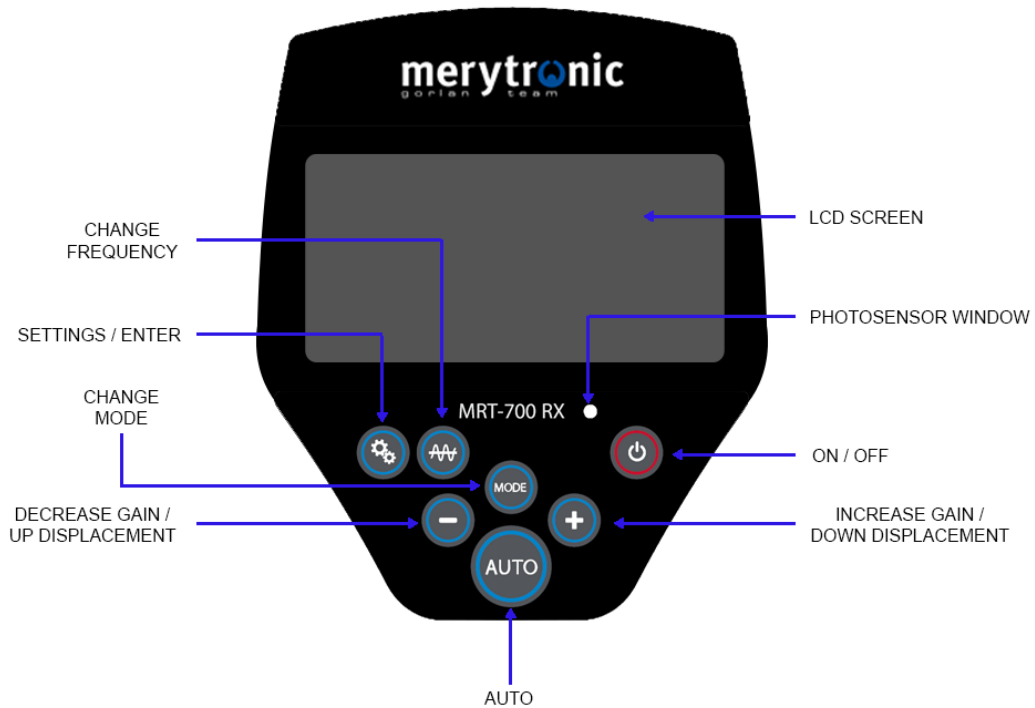
Notice that when using the "ROG" detector ring the gain can't be adjusted, but using the "U"-Shaped detector the gain can be changed with the gain adjust buttons.

Maximum cable loop resistance is 1000 ohm

The identification of de-energized cables, even if it most probably will prevent cutting the wrong conductor, does not by any mean elude the use of corresponding security tools.

5. MRT-700 tracer settings

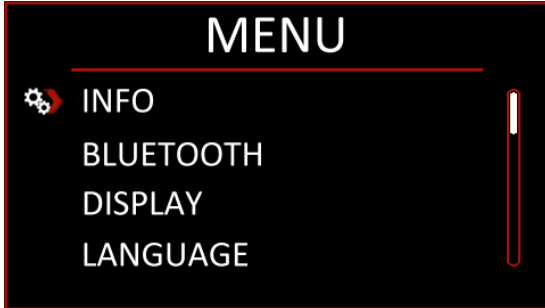
Control panel of the MRT-700 tracer



*As you can see there isn't any button to go to the previous page. This is because in case of not pushing any button, the tracer will return to the main screen after 5 seconds

5.1. Brightness settings

From the main screen, pushing the "Settings" button you can access to the main menu.



Push the "Down displacement" button until the prompt points to brightness options and the push the "Enter" button.



By default, automatic configuration will appear.



Pushing the "minus" button, you can decrease brightness to the minimum level.



The "plus" button allows you to increase brightness to the maximum level.

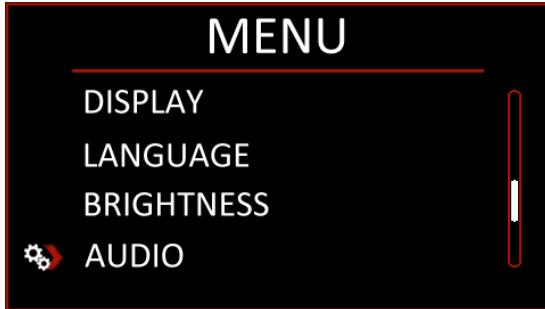


If you want to establish automatic level, you may only push "Auto".

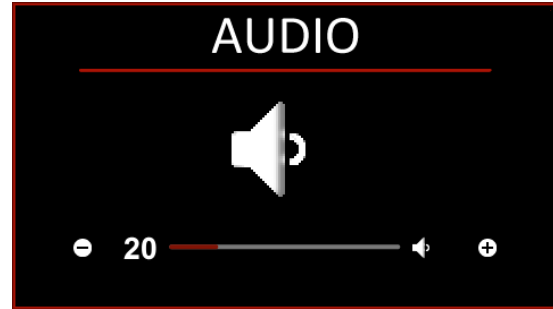


5.2. Audio settings

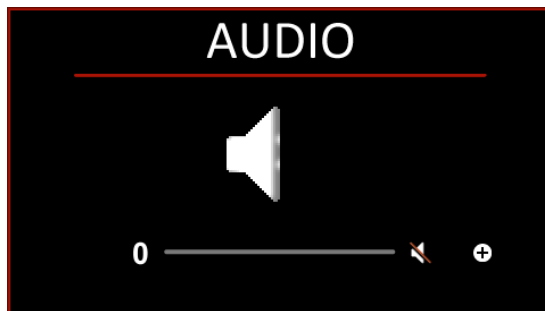
Such as configuring brightness, in the main menu push the "Down displacement" button until the prompt points to brightness option and the push "Enter" button



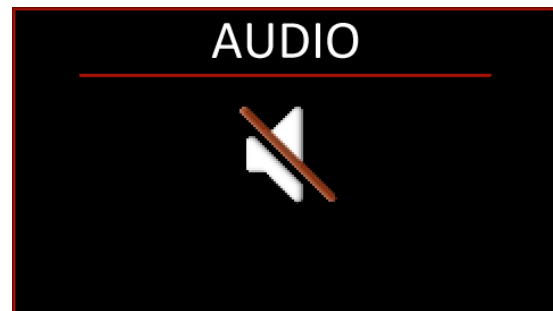
When you turn on the tracer, the audio level will be the last configured when it was switched off.



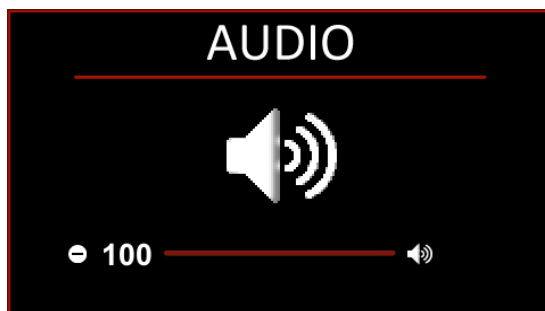
Pushing the "minus" button, you can decrease audio to the minimum level (0).



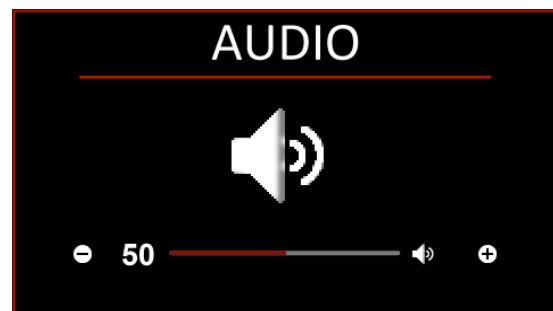
If you want to mute the tracer, you could have pushed the "Mode" button.



The "plus" button allows you to increase audio to the maximum level.



If you push the "Auto" button, audio will be established to level 50.



5.3. Bluetooth settings

The tracer has two different modes of Bluetooth communication called “proprietary” and “open”. The “proprietary” protocol is the one that must be used if we want to connect with Ariadna Instruments’ application, GridGIS. The “open” protocol lets the user to establish connection between the tracer and another equipment with the same technology.

Here's how to activate the proprietary protocol.

From the main screen, pushing the “Settings” button you can access to the main menu.



Push the “Down displacement” button until the prompt points to the Bluetooth option and then push the “Enter” button.



Then, the options of turning on the Bluetooth and select protocol will appear. Choose the second one and push the “Enter” button.



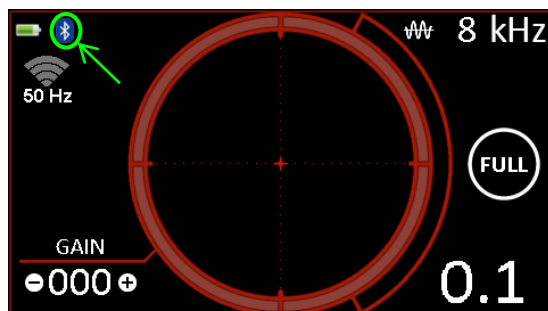
If the “proprietary” protocol is not selected, select it.



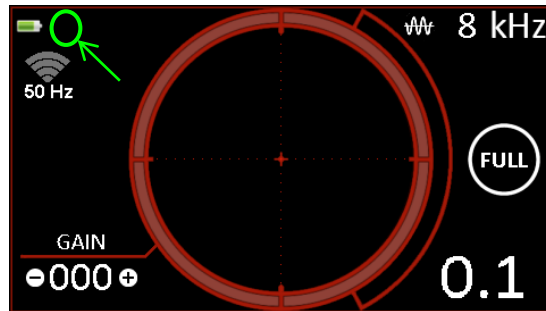
Once the protocol has been selected, from the same menu, turn on the Bluetooth.



Letting the tracer to return to the main screen, you can verify that the Bluetooth symbol has appeared in the left top corner.



The Bluetooth can be turned off from it's menu. Doing this, the symbol will disappear from the main screen.



*When the Bluetooth is connected, the Bluetooth icon will become green .

The Bluetooth can be used with the open protocol. It will let the user to connect the tracer with another equipment with the same technology. Here's how to use this protocol.

From the main screen, pushing the "Settings" button you can access to the main menu.



Push the "Down displacement" button until the prompt points to the Bluetooth option and then push the "Enter" button.



Then, the options of turning on the Bluetooth and select protocol will appear. Choose the second one and push the "Enter" button.



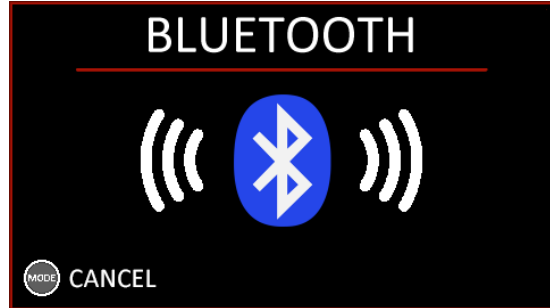
If the "open" protocol is not selected, select it.



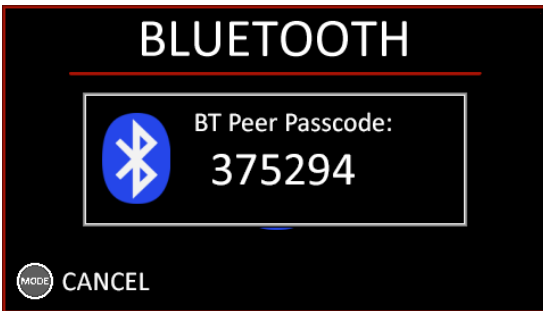
Once the protocol has been selected, in the menu, the option set BT pair will appear. We must select it to establish with the connection with the desired device.



When doing that, it will appear the next screen. This is the moment to search the tracer with the other device.



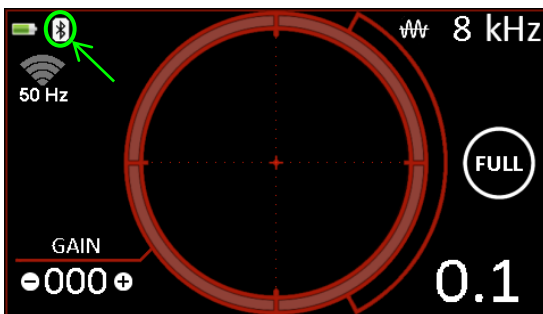
Once the other device try to pair with it, the tracer will show a code that must be introduced correctly to stablish the connection.



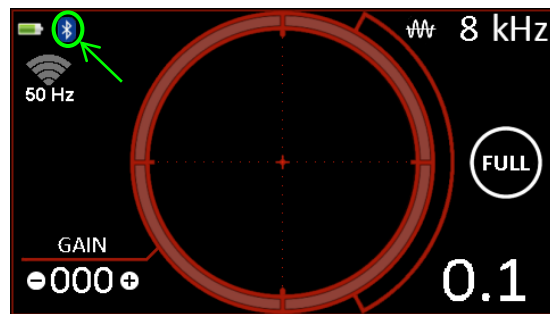
Once the devices have been paired, the Bluetooth must be turned on in the tracer.



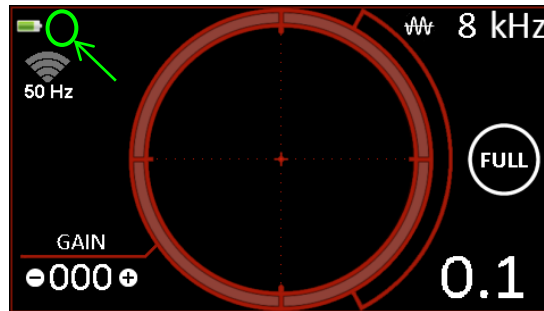
After turning on the Bluetooth, being it paired, the equipment will show the next symbol. It means that the equipment is paired, but not connected.



If the connection were established, the symbol will become blue.



The Bluetooth can be turned off from it's menu. Doing this, the symbol will disappear from the main screen.



The tracer can only be paired with one device, the, if we have paired it previously and want to pair it with another one device, it must be previously unpaired from the first device and the tracer. The MRT-700 RX is automatically unpaired when we try to establish another new link.

In order to process the data in this mode, it must be known how the RX sends the information. With this protocol, data frame is sent following the next example:

SIGNAL	GAIN	FREQ.	DEPTH	CURR.	MODE	TYPE	POL.
4 Bytes	4 Bytes	2 Bytes	2 Bytes	2 Bytes	1 Byte	1 Byte	1 Byte

- **SIGNAL.** Estimated signal quantity measured with the tracer, without measure unit. 4 bytes in hexadecimal (32-bit float) starting by the LSB.
- **GAIN.** Gain applicated in the receiver, measured in dB. 4 bytes in hexadecimal (32-bit float) starting by the LSB.
- **FREQ.** Selected frequency in Hz. 2 bytes in hexadecimal (16-bit unsigned short) starting by the LSB. In CPS frequency, take care of the polarity bit. In radio frequency, the maximum peak's frequency value is sended.
- **DEPTH.** Cable's estimated Depth in centimetres. 2 bytes in hexadecimal (16-bit unsigned short) starting by the LSB.
- **CURR.** Estimated current measured in miliamperes. 2 bytes in hexadecimal (16-bit unsigned short) starting by the LSB.
- **MODE.** Receiver's selected mode:
 - **0x00:** Full mode.
 - **0x01:** Peak mode.
 - **0x02:** Max mode.
 - **0x03:** Null mode.
- **TYPE.** Type of conductor we are tracing:
 - **0x00:** Not defined.
 - **0x01:** Electricity.
 - **0x02:** Gas.
 - **0x03:** Telephone.
 - **0x04:** CATV.
 - **0x05:** Water.
 - **0x06:** Sanitary.


- **POL.** Polarity of the signal, just in case of choosing CPS frequency in the receiver. 1 byte in hexadecimal:
 - **0x01:** polarity in the same direction of the user.
 - **0xFF:** polarity in the opposite direction of the user.
 - **0x00:** used in the rest of frequencies without polarity.

The next examples try to clarify the performance of the tracer. The data frame sended is CDACD4445EDACA3FBF1F2B000E00000000.

FIELD	HEXADECIMAL VALUE	VALUE
SIGNAL	0x44D4ACCD	1701.4
GAIN	0x3FCADA5E	1.58479 dB
FREQUENCY	0x1FBF	8127 Hz
DEPTH	0x002B	43 cm.
CURRENT	0x000E	14 mA.
MODE	0x00	Full mode
TYPE OF CONDUCTOR	0x00	Not defined
POLARITY	0x00	No polarity

5.3.1. Bluetooth specifications

The MRT-700 RX is equipped with a Bluetooth 4.2 Low Energy communications module that allows an external device to read the results of the equipment measurements.

	MRT-700 RX's Bluetooth module only supports Bluetooth Low Energy (BLE), this means that the device that connects with this equipment must be compatible with this type of Bluetooth, normally compatible with the Bluetooth 4.0 specification or higher.
---	--

BLE bluetooth communications are oriented to peripheral devices' communications (ex: headphones, cardiac monitor, etc.) with a central device (ex: mobile phone). To make sure that the communication between both devices is secure, a pairing or linkage is made between both, which prevents the connection of a third device to the peripheral device. In order to link the MRT-700 RX to another device that acts as a central unit, a new linking must be established from the Bluetooth menu. Once the devices have been paired, the MRT-700 RX will only be visible and connectable by the linked device. To delete the current link, you have only to perform a new link from the Bluetooth menu. If the protocol mode is changed between owner and open, the existing link is deleted.

The Bluetooth protocol defines a series of GATT (Generic Attributes) profiles that define his own connection capacity. If two devices are able to support at least one of the defined profiles, they are compatible to establish a communication. Each profile has a known identifier UUID (Universally Unique Identifier) that identifies the profile used in the communication. The BLE protocol predefines a series of public profiles, in addition to private connection profiles. Each profile also has several features that contain the different variables that intervene in the communication, and which on which the different devices will act (read, write, etc.) to exchange information between them. The MRT-700 RX has its own private profile. This profile has a variable, which will be in which the data frame explained above is written. That variable has been assigned with "READ" and "NOTIFY"

properties. The first requires the receiver to make a reading to access the data written by the tracer. However, if the option "NOTIFY" is activated the receiver will receive the data automatically when it is generated by the tracer. To generate that data frame, you just have to keep the "AUTO" button pressed, while tracing, until you hear a beep.

In order to establish a correct connection, it is necessary to know the UUID from the profile and from the variable

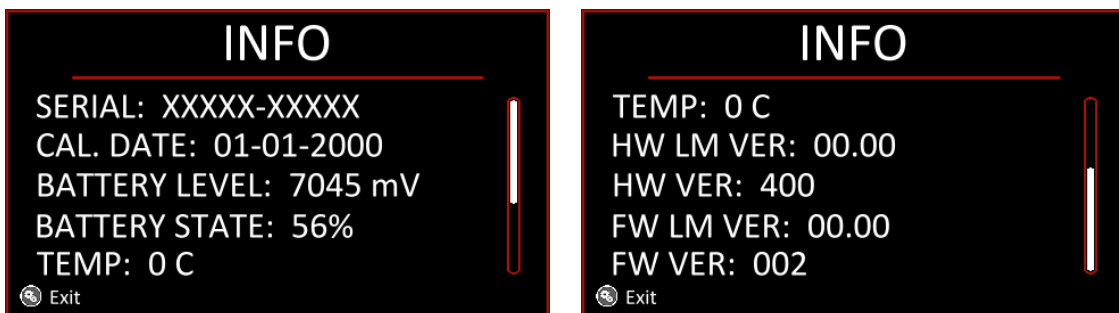
- **Profile's UUID:** b04ff9c7-e349-442e-90e3-bb6ac28bb946
- **Variable's UUID:** 4d35e1b0-8c55-451f-9c1e-a23347157648

5.4. Information screen

Such as it can be appreciated in the next picture, in the tracer menu you can find an item called "INFO".



Pushing the "Enter" button, you can find a screen like this:



In this screen, you can see some information, the most important is:

- SERIAL: it shows equipment's serial number.
- CAL. DATE: indicates the date in which the equipment was calibrated.
- BATTERY LEVEL: indicates the voltage of the battery.
- BATTERY STATE: indicates unit's remaining battery.
- TEMP: it shows unit's temperature.
- HW Ver: it shows the actual hardware version of the tracer, in this case 400.
- SW Ver: it shows the actual software version of the tracer, in this case 002.

5.5. Changing display's mode

The MRT-700 RX tracer offers the possibility of changing the display mode of the different screens. Along this manual it has always been shown the default display, but you can change it from the main menu. In order to do this, you have to follow the following steps.

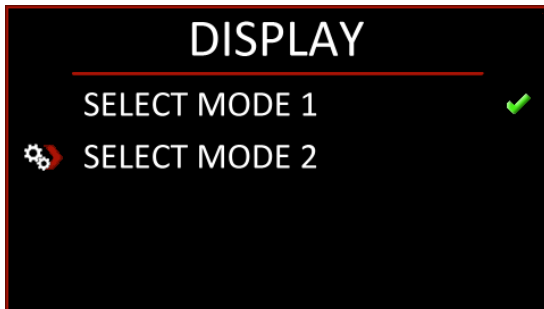
From the main screen, pushing the "Settings" button you can access to the main menu.



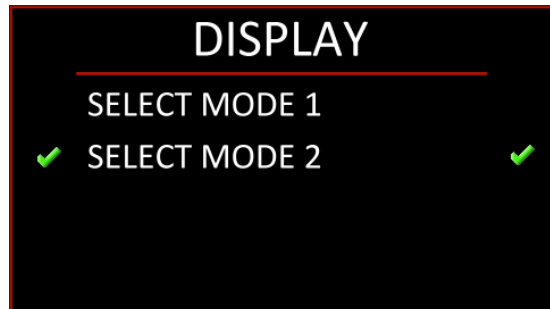
Push the "Down displacement" button until the prompt points to the Display option and then push the "Enter" button.



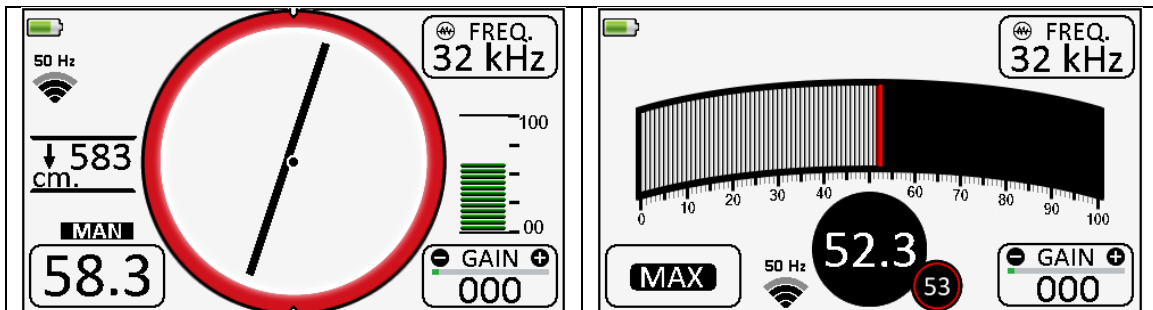
Here you can choose between two modes. Select the second one and push "Enter" button.



When selected, a verification icon will appear next to the active mode.



Once this has been done, when returning to the main screen, depending of the operation mode, you will be able to see screens with different appearance like these.

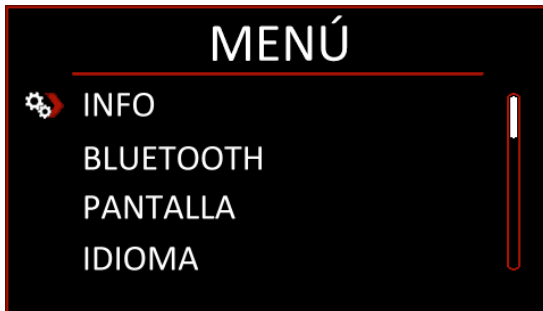


In order to change the screen again, you must follow the same steps and select the inactive option

5.6. Selecting language

In order to make easy to understand the different menus, the device allows to select between different languages. In order to do this, follow the next steps:

From the main screen, pushing the "Settings" button you can access to the main menu.



Push the "Down displacement" button until the prompt points to the Display option and then push the "Enter" button.



The different selectable languages will appear here, then select the desired one and then push the "Enter" button.

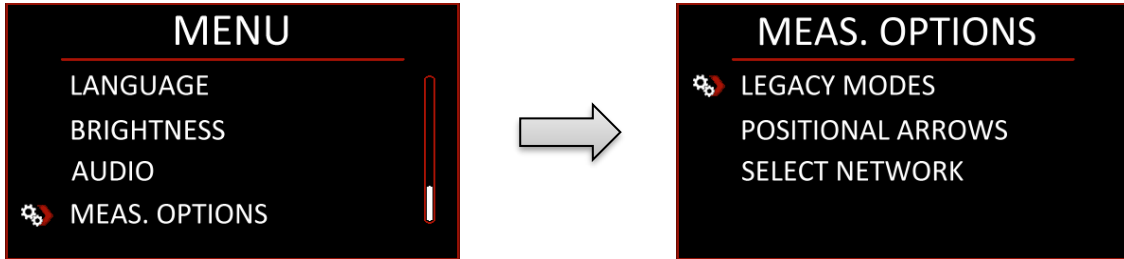


You can choose between the next languages:

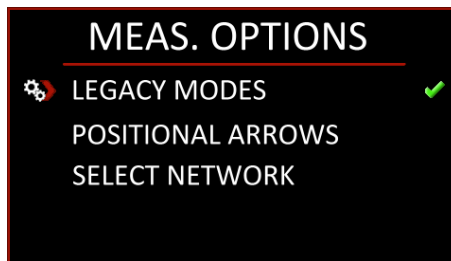
- English
- Spanish
- French
- German
- Basque
- Turkish

5.7. Measure options

The tracer also has a series of measure options to make the tracing easier and that can be enabled or disabled from the main menu. In order to do that, you must enter the main menu and you can see these options.

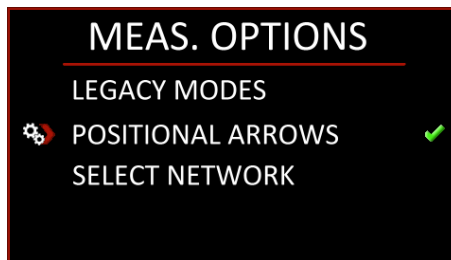


If you push the "Enter" button in the first option, a check icon will appear.

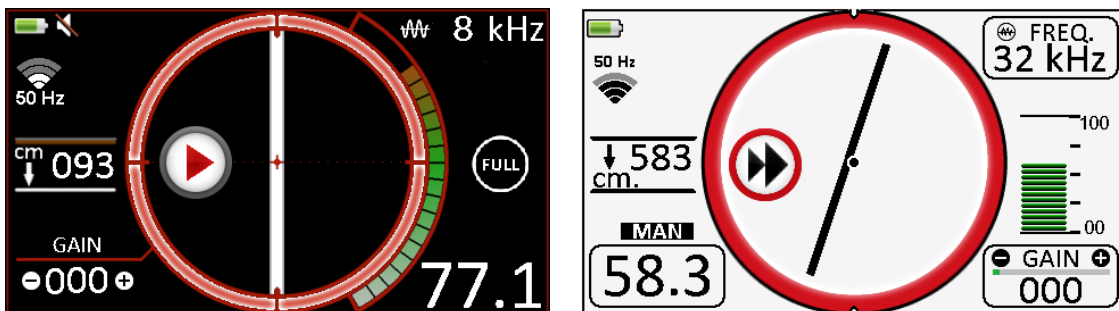


As previously explained, activating this option will allow you to use the "PEAK" and "NULL" modes to trace, if you perform the same steps you could disable this option again.

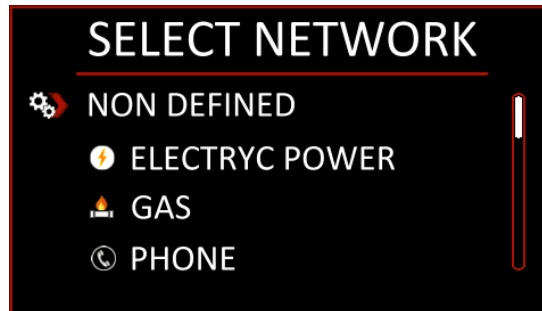
The second option can also be activated and, as in the first option, the check icon will appear.









Activating this option means that arrows will appear in the viewer, in order to help to center the cable while tracing, regardless of the screen mode and frequency, as shown in the following image.



Finally, the last option allows to choose what type of conductor is being traced, once the third option is selected, a screen like the following one will appear.




Here you will select between the next options:

-  Electrical power network
-  Gas network
-  Telecommunication network
-  CATV network
-  Water network
-  Sewer network

Here you can select the desired network, which will be reflected in the main screen of the device. When you want to change the network type, you will only have to follow the same steps.

6. Technical specifications

MRT-700 TX

Size	315x255x150 mm
Weight	2.5kg
Protection degree (with lid closed)	IP65
Rechargeable Internal Battery	7.4V 6.6Ah Li-ion
Battery power supply input	100-240VAC 50/60Hz 0.55A
Battery power supply output	12VDC 2A
Operating time (at level 2)	>24h
Active signal frequency	640 Hz, 8 kHz, 32 kHz.
Max. output power	10W
Max. output current	500mA
Operating temperature (discharging).....	-20°C to 60°C
Operating temperature (charging).....	0°C to 45°C
Max. Cable loop resistance	1000 Ω
 MRT-700 TX Max. Output Voltage	50Vac

Security standards: IEC 61010-1: 2011 / UNE-EN 61010-1: 2011

EMC standard: IEC 61326-1:2012 / UNE EN 61326-1:2013

MRT-700 RX

Size	790x370x230mm
Weight	2.2kg
Protection degree (with sleeve)	IP54
Rechargeable Internal Battery	7.4V 7.2Ah Li-ion
Battery power supply input	100-240VAC 50/60Hz 0.3A
Battery power supply output	12VDC 2A
Operating time	>12h
Active signal frequency	640 Hz, 8 kHz, 32 kHz
Passive signal frequency	50/60Hz
Operating temperature (discharging).....	-20°C to 60°C
Operating temperature (charging).....	0°C to 45°C

Security standards: IEC 61010-1: 2011 / UNE-EN 61010-1: 2011

EMC standard: IEC 61000-4-2, IEC 61000-4-3, IEC 61000-4-4, IEC 61000-4-5, IEC 61000-4-6, IEC 61000-4-8, IEC 61000-4-11

7. Quality and safety standards



Do not position the equipment in such a way that may difficult battery power supply disconnection.

MRT-700 RX battery replacement: remove screws from battery lid, disconnect the battery, connect the new one and screw back battery lid.

MRT-700 TX battery replacement: remove screws from equipment's front panel, disconnect the battery and loose Velcro tape, replace with new battery, tighten up Velcro tape and screw back front panel screws.



Use only manufacturer supplied batteries (these batteries include an internal protection).



Fuse replacement: If it is necessary to replace the fuse, it is necessary to use one with the same characteristics of the one provided by the manufacturer:

- Ø: 6,3 x 32 mm / 250V / 2A / Type of response: F

Equipment and accessories clean up: Clean equipment and its accessories with a damp cloth and a soft detergent. Do not use abrasives or solvents. These substances may damage equipment's sticker readings.

If the equipment is used in a manner not specified by the manufacturer, equipment's internal protection damage may result.

Users accessing a transformer substation should always observe and comply with the pertinent safety standards.

Operators accessing the transformer substation should use the following Individual Protection Equipment (IPE):

- Rubber boots
- Helmet with insulated facial protector
- Fire-resistant gloves and insulated gloves, and outer gloves to protect them from being damaged
- Insulating mat, floor grill or stool
- Work clothes that cover upper and lower limbs

MRT-700 is a conductor tracer complies with security Standard IEC 61010-1: 2011 / UNE-EN 61010-1: 2011.

- **Category II of protection against electric shock.**

MRT-700 is a conductor tracer complies with EMC Standard IEC 61326-1:2012 / UNE EN 61326-1:2013.

Said conformity is denoted by this symbol:



8. Warranty and technical service

From the date of purchase and throughout the warranty period, MERYTRONIC, S.L., will repair or replace free of charge any defective item under warranty. All inspections and repairs under warranty must be performed by authorized personnel from MERYTRONIC, S.L.

The equipment has an operational guarantee lasting two years starting on the date of purchase and three months following repairs. The warranty shall become void in case of destruction or deterioration of any of the seals by unauthorized personnel. Not included in said warranty: unit's external cabling, units not supplied by an authorized distributor of MERYTRONIC, S.L., or any damages or other problems caused by improper use of the equipment.

The continued development and improvement of our products could result in modifications to the material, design, technical specifications and standardizations without prior notice. MERYTRONIC, S.L., makes every effort to ensure the accuracy of the information provided about the identification equipment and its usage.

MERYTRONIC, S.L., offers its customers technical support via mail, phone, fax or email:

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