User Manual

Cable locator

CL 20

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Introduction

Congratulations on the purchase of your new BAUR CL 20 cable locator. The CL 20 is specially designed to detect conductors such as buried pipes & cables. This device may detect buried power cables, CATV cables, gas and water pipes, sewer lines, telecommunication lines, fibre optic cables with sheath, sondes, inspection camera transmitters.

CL 20 basic principle

The basic principle of the locator's operation is as follows:

The transmitter emits a signal to a conductive cable or pipe. The receiver detects the electromagnetic field that is generated by the transmitted signal. You can locate the relative position of the buried utility by following the tracing signal.

For safely & to help ensure the best locating results, please read & understand the manual in its entirety before using the product.

Note on the screenshots and graphics used

The screenshots and graphics used are intended to illustrate the procedure and may differ slightly from the actual state.

For your safety

Instructions to the user

The product may only be operated by authorised and trained electrical engineers. An electrical engineer is a person who, owing to his professional education (electrical engineering), knowledge, experience and acquaintance with the applicable standards and regulations, can assess the tasks assigned to him and detect possible dangers.

In addition, the user must have:

- Knowledge of the technical equipment and operation of CL 20
- Knowledge of plant engineering (cable types, switchboard plant, etc.).

Intended use

The CL 20 cable locator is used:

- For precise location of cable routes and metal pipes
- For depth measurement of electric cables, metal gas or water pipes, telephone cables and fibre optic cables with continuity wire or metal shielding
- To search for cables in use
- To locate cable sheath faults in conjunction with the STAFF A-Frame (optional)

If the device is used without observing this condition, safe operation cannot be guaranteed. The operator or user is liable for any damage to persons and property resulting from incorrect operation.

Proper use also includes

- Compliance with all instructions in this user manual,
- Compliance with the technical data and connection requirements given on the rating plate and in the user manual,
- Compliance with the inspection and maintenance tasks.

Avoiding dangers, taking safety measures

» When installing the test system and operating CL 20 observe the following rules and guidelines:

  – Accident prevention and environment protection rules applicable for your country
  – Safety instructions and regulations of the country where CL 20 is being used (according to the latest version)
  – EU/CENELEC countries: EN 50110 Operation of electric systems
    Other countries: The standard for operating electric systems applicable for your country
  – If necessary, other national and international standards and guidelines in accordance with the latest applicable version
  – Local safety and accident prevention regulations
  – Operational insurance association regulations (if any)

For your safety

Technical secure state of the device

Safety, function and availability depend on the proper condition of the device. Upgrades, modifications or alterations to the product are essentially prohibited.

- Operate the device only in a technical perfect condition.
- In case of damage and malfunction, immediately stop the device, mark it accordingly and have the faults rectified by appropriately qualified and authorised personnel.
- Comply with the inspection and maintenance conditions.
- Use only accessories and original spare parts recommended by BAUR. The use of spare parts, accessories and special facilities that are not tested and approved by BAUR could adversely affect the safety, function and characteristics of the product.
- Never take apart the device. Inside the device there are no components that could be serviced or repaired by the user.

No operation with condensation

Condensation can form in devices and systems due to temperature fluctuations and high air humidity, which in some components can lead from leakage currents and flashovers up to short-circuit.

Maximum danger arises when relatively high air humidity and temperature fluctuations occur in a device consecutively, e.g. which is the case when storing the device in an unheated room or when placed outdoors. When the device is then exposed to a high ambient temperature, the cold device surfaces cool the air in the immediate vicinity, which leads to formation of condensation even inside the device.

In this process, two factors are crucial:

- The higher the relative air humidity, the faster the dew point is reached and water is condensed.
- The higher the temperature difference between the surfaces and the ambient air, the stronger the tendency for condensation.

» Always prevent condensation in devices. Temper the device and system before and during the measurements so that no condensation occurs.

No operation in the rain and in areas with risk of explosion and fire

Measurements in direct contact with water and moisture, in environments with explosive gases and in areas with fire risks are not permitted. Possible danger zones are e.g. chemical factories, refineries, lacquer factories, paint shops, cleaning plants, mills and storage for milled products, tank and loading plants for combustible gases, liquids and solid matter.

For your safety

Dangers when working with electric voltage

During tests and measurements with CL 20, dangerous voltage is generated that is fed to the route (cable route or pipe) to be located. Lethal voltages may be present at the transmitter's output. Operating personnel need to pay special attention and must be very careful while working with electric voltage. Before commencing work, the operator must assess the danger for the specific working conditions. Protective measures are based on the risk assessment and must be followed at the workplace.

Commissioning and operation of the CL 20 are permitted only in compliance with the EN 50110 (EU/ CENELEC countries) or with standards applicable in your country.

Observe 5 safety rules

» Do not connect to live voltage or active utility lines. De-energize any circuits in or around the work area.

Before beginning tasks in and on the electrical installations:

1. Disconnect the test object.
2. Secure against re-connection.
3. Verify absence of operating voltage.
4. Earth and short all phases.
5. Provide protection against adjacent live parts.

⚠ DANGER

Dangerous electric voltage

Danger to life or risk of injury due to electric shock

» Before you start working with the transmitter, disconnect all electric circuits in and around the work area.

» Do not connect the transmitter to live cables and other operating resources.

» Earth the test object and transmitter properly and make the connection to the target conductor before turning on transmitter.

» Cordon off all metal parts around the end of the route to be located (connection point and far end). Insulate and earth metal parts to avoid dangerous charges.

» Do not expose the transmitter and receiver to rain or moisture.

After a measurement or test - after switching off the transmitter - the route can still be live with dangerous voltage.

» Before lifting the safety measures, all live parts must compulsorily be discharged, earthed and bypassed.

» Dangerous voltages can exist at the signal output of the transmitter. Turn off the transmitter before touching the connection cable or any un-insulated conductor.

Prepare for Use

Unpack your new CL 20. Make sure there is no shipping damage and all the parts are included.

Locate the battery compartment on the back of the of the receiver and on the bottom of the transmitter. Open the compartments using a Phillips screwdriver. Remove the terminal isolation paper to allow the battery spring to contact the battery terminal.

Charge for at least 5 hours before use.

Warranty and After Sales

Warranty

For warranty claims, please contact BAUR GmbH or your local BAUR representative (https://www.baur.eu/baur-worldwide). Warranty is cancelled in case of misuse. Wear parts are excluded from the warranty.

After Sales

For questions contact BAUR GmbH or your BAUR representative (https://www.baur.eu/baur-worldwide).

ensuring the flow

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Changing Pre-set Functions, Modes & Frequencies

The CL 20 operating modes, frequencies and other functions are user programmable and can be changed at any time through a quick selection process in the programming menu.

Receiver

To select the programming options for **software versions up to 3.42**:

» With the unit on, press and hold depressed the *PROGRAM MENU* ( ) button for 5 seconds. Once released "Pro"' will be displayed at the top of the LCD.

» To scroll through the programming menu headings, use the *ARROW DOWN* or *UP* ( ) buttons.

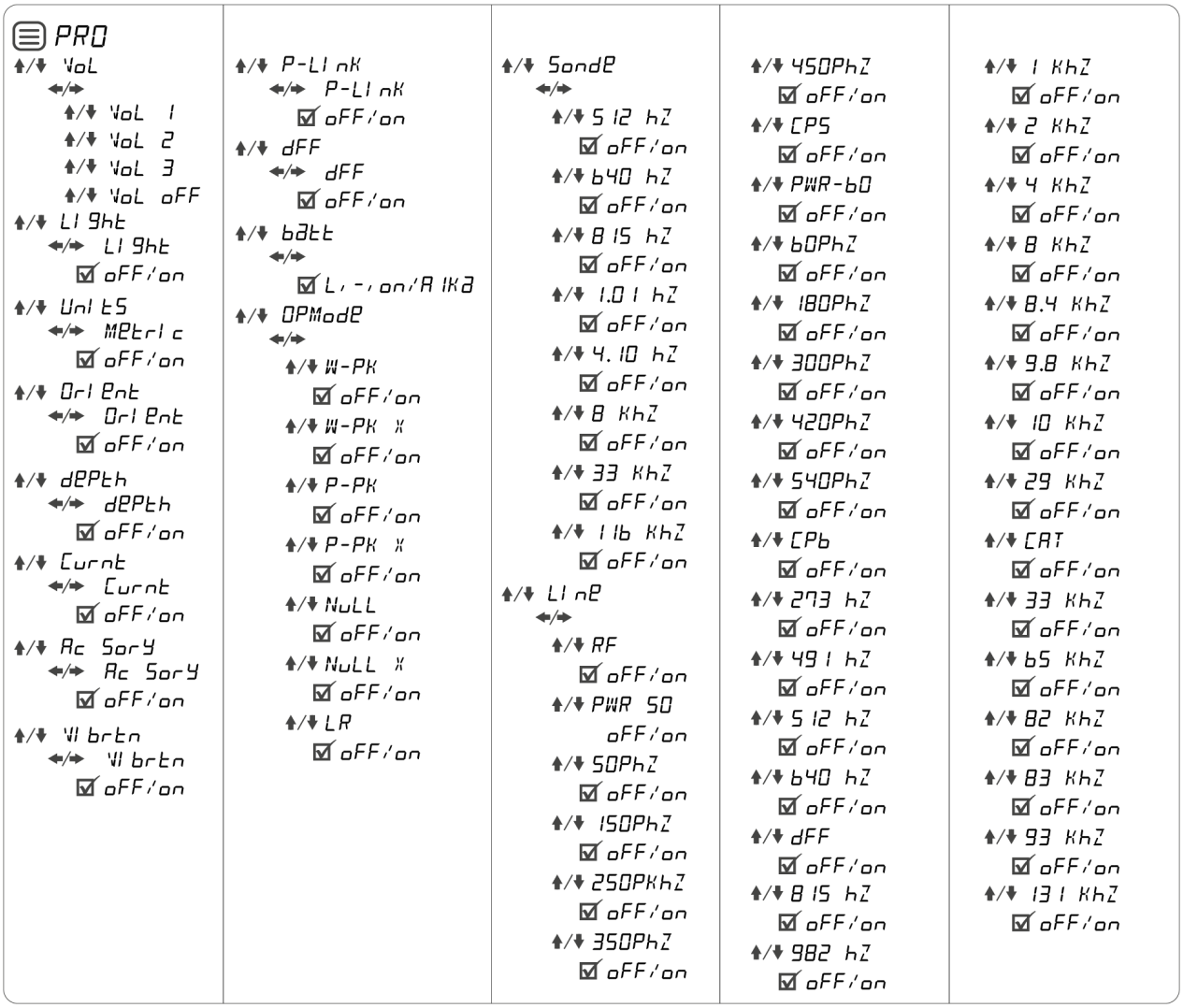
» To enter a selection's sub-menu use the *ARROW RIGHT* ( ) button.

» To exit a selection's sub-menu use the *ARROW LEFT* ( ) button.

» To scroll through sub-menu options use the *ARROW DOWN* or *UP* ( ) buttons.

» To select an item or to toggle between item options, press the *SELECT* ( ) button.

» Pressing the *PROGRAM MENU* ( ) button at any time will save the selected options for availability during normal operation and exit the programming menu.



Changing Pre-set Functions, Modes & Frequencies

Transmitter

To select the desired frequency set for **software versions 3.43 and greater**:

» Press and hold depressed the *POWER ON* (⏻) button.

» Pressing the *INFORMATION* (ⓘ) button will toggle through available configurations. Repeat pressing until 'u5' is displayed in the frequency indicator section of the LCD.

» Release the *POWER ON* button. 'Pro' will be displayed on the LCD.

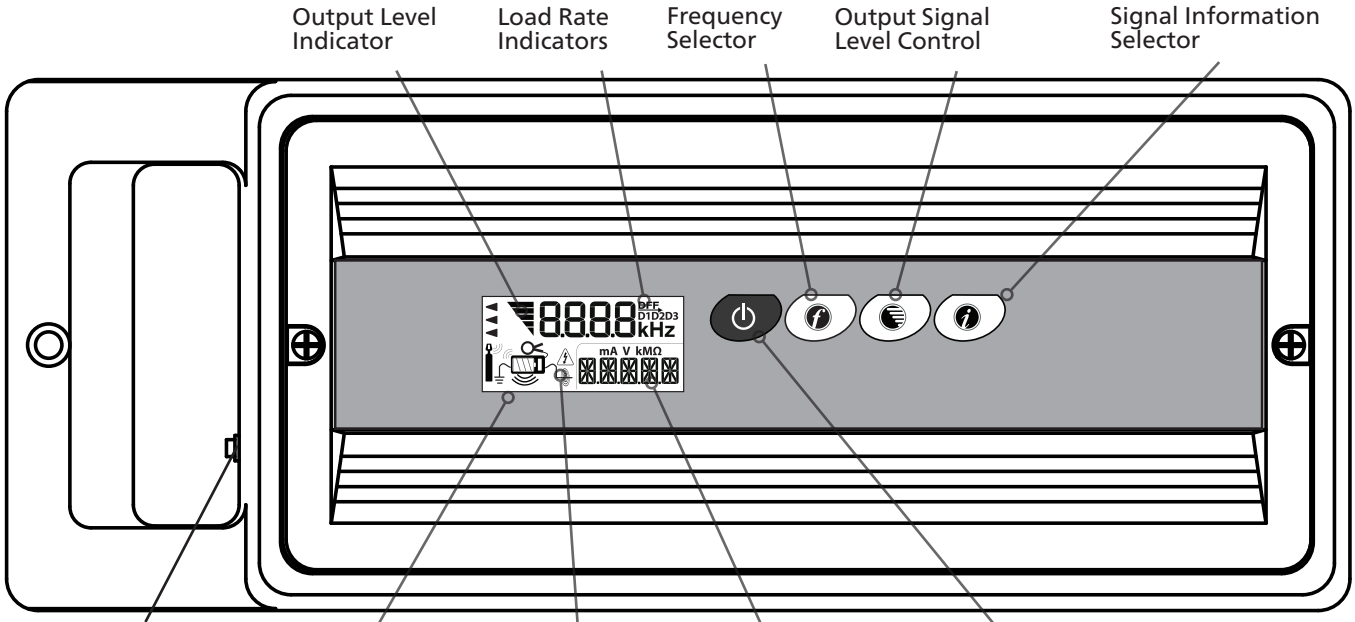
» Press the *FREQUENCY* (ⓘ) button to toggle through the available frequencies.

» To select and store the desired frequency press the ⓘ button. The count of the selected frequency will be displayed on the LCD.

» Continue to toggle through and select the desired frequencies.

» Press the *POWER ON* (⏻) button to shut the unit off. This will save the selected frequencies for availability during normal operation.

Transmitter Controls & Indicators



DANGER
Lethal voltages may be present

TX OUTPUT JACK

The red/black cord, coupler and Flexicoupler connects here to create a circuit on the buried utility.

FREQUENCY SELECTOR

This button toggles through the available frequencies. The selected frequency is displayed on the LCD. When dual frequency transmission options are selected, indicated by the D1 & D2 icons to the right large numeric segments, the frequencies will flash from one to another.

LOAD INDICATOR (visual & audible)

The load indicator symbol flashes to indicate signal output.

The quick triple beep audible tone indicates the circuit is open and no signal is being transmitted. A steady continuous beep indicates a closed circuit and signal is transmitted. When the indicator blinks 4 times per second, it is indicating a nearly short circuit. When the indicator blinks 1 time every 10 s, it is indicating a nearly open circuit.

OUTPUT SIGNAL LEVEL CONTROL

This button adjusts the power output from the transmitter. There are 5 selections on the standard power setting and 5 selections on the High Power Output (HPO) setting. The standard power output maximum is 30 V. In the HPO setting the maximum voltage is 200 V. Holding down the output signal level control button for 3 s will activate the HPO mode.

DANGER

Dangerous electric voltage

Lethal voltages at the transmitter's output.

» Turn off transmitter before touching test lead or any un-insulated conductor.

» Make connection to the earth and target conductor before turning on transmitter.

SIGNAL INFORMATION SELECTOR

The unit can display the relative resistance, current and voltage of the transmitted signal. The resistance is based on the feedback from the selected frequency and is not an actual impedance meter. The selections can be toggled by pressing the signal information button.

Direct Connection

⚠ DANGER

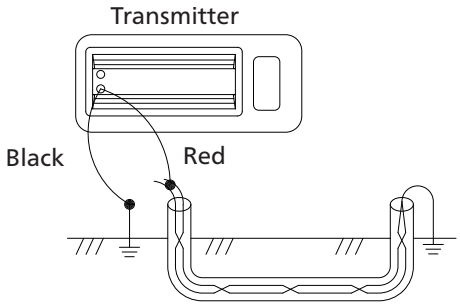
Dangerous electric voltage

Danger to life or risk of injury due to electric shock

» Do not connect to live or energized power cables.

Direct connection is the most reliable method of signal application. This method is relatively free of interference. The greatest amount of signal strength can be achieved by this method. Low, mid, and high frequency may be used. The far end of the utility must be earthed.

1. Connect the red test cord to an existing earthing point or an exposed metallic section of the utility.
2. Place the earth spike approximately 3 m from this point, at an angle of 90º to the buried cable or pipe.
3. Push the earth spike into the ground 20 to 25 cm.
4. Connect the black test cord to the earth spike.
5. Plug the red and black test cords into the *TX OUTPUT JACK*.
6. Select the desired frequency.
   The signal output indicator will flash once signal is established.



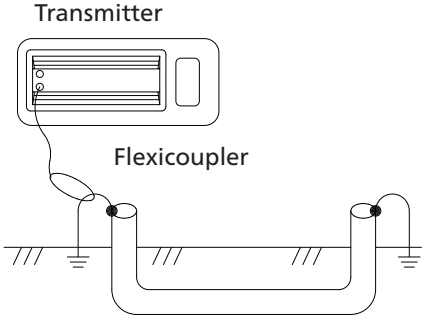
Coupler & Flexicoupler Connection

The optional flexicoupler and hard coupler are very easy to use, and services do not have to be interrupted. The operation range is shorter than for direct connection methods. The tracing signal can be affected by neighbouring cables and pipes. The red/black test cord or the earth spike are not needed for this method.

Successful coupler operation requires an insulated conductor that is earthed on both near and far ends.

1. Loop the flexicoupler around the cable and connect the two ends, or clamp the hard coupler around the cable. It is important to connect the coupler around the cable needing to be traced.
2. Connect the coupler around the wire closer to the outgoing cable not near the system earth. The result will be a stronger signal. By connecting near the earthing, the range will also be shorter, and difficulty may arise determining one cable from another.
3. Plug the coupler into the *TX OUTPUT JACK*.

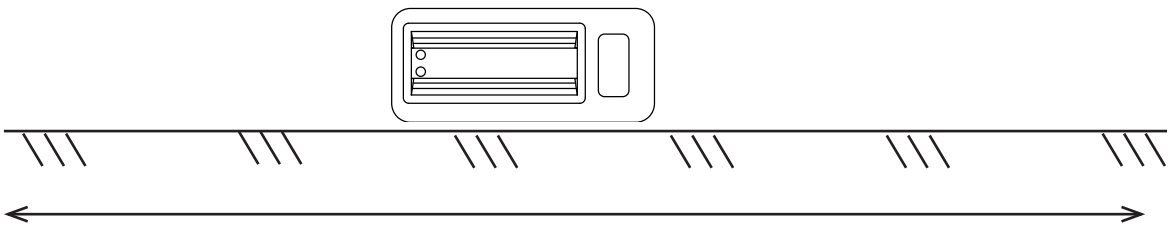
Some couplers are frequency specific others can operate on any frequency from 4 kHz to 82 kHz.



Inductive Connection

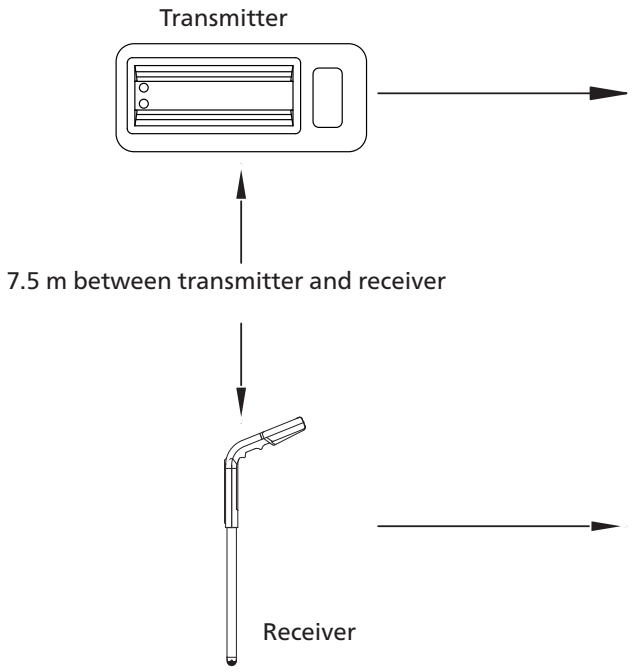
This method is convenient to use, and services are not interrupted. No test cords or connections are needed. The cable or pipe must have good insulation or non-conductive coating, or the operating range will be short.

1. Turn the transmitter on. Select 33 kHz through 82 kHz.
2. Place the transmitter on its side as close as possible to the path of the cable or pipe.
3. Align the arrows on the side of the transmitter in line with the cable or pipe.
4. First, locate the broad transmitter Null, then move toward the expected cable path while looking for the signal carried by the cable.
5. Start tracing the path with the receiver 7.5 m from the transmitter.
6. Search in the 90º zone as shown above.
7. Locate the cable or pipe, and follow the path.
8. If the signal becomes weak, move the transmitter to a point 7.5 m behind the last strong signal, and continue searching.



Blind Search

The blind search locating techniques is used if the operator is not aware if a buried utility exists. Two people are needed for this technique. The transmitter and the receiver are held 7.5 m away from each other. Each operator walks at the same speed keeping a distance of approx. 7.5 m from each other. When the receiver gives an audio response, then a buried utility is present between the receiver and the transmitter.



Selecting the Tracing Signal

The choice of frequency is dependent on the conditions of the locate. It is generally accepted that lower frequencies provide a more accurate locate. Therefore it is generally advised to use the lowest frequency that effectively conducts on the target line. Lower frequencies are less likely to bleed onto adjacent non-target lines, but low frequencies are less effective at locating higher-resistant conductors.

FREQUENCY RANGES

Frequencies are classified into three major categories, Low, Medium and High and they are classified as follows:

- Low Frequencies: < 1 kHz
- Medium Frequencies: 1 kHz to 44 kHz
- High Frequencies: 44 kHz to 82 kHz

FREQUENCY CHARACTERISTICS

The low, medium and high frequencies each have their advantages. It is recommended to begin by using a low frequency, and continue as long as you are confident in the results. If the signal is very weak try to adjust the connection or grounding. If there is no improvement in signal then try mid-range frequencies. Again, if there is weak or absent signal, repeat adjustments of the grounding and connection point before switching to a high frequency.

The method of signal application may dictate the frequencies used. While direct connection can be performed on any frequencies, coupler induction will only work with medium and high frequencies and transmitter induction will only work on the highest of the medium frequencies (33 kHz) and high frequencies.

Low frequencies are usually preferred to the mid-range frequencies and high frequencies because they are less susceptible to locating errors caused by coupling of signal to adjacent conductors, cables or pipes. The low frequency locating range is also much longer than the medium and high frequencies. Low frequencies will not travel well on highly resistive lines or conductors that have interruptions in their continuity (e.g. disconnected shield bonds or insulated pipe bushing). Low frequencies may only be applied via direct connection.

Medium frequencies take the best of both high and low frequencies. Medium frequencies are not as susceptible to bleed off or coupling as the high frequencies, and medium frequencies can jump minor breaks in continuity and conduct on higher resistant lines better than low frequencies. It is still best to use low frequencies whenever effective, but **8 kHz and 33 kHz are of the most common frequencies used in locating**. Medium frequencies may be applied via direct connection and via coupler induction. **Note:** 33 kHz may be applied via transmitter induction.

High frequencies are sometimes better than the low frequencies for locating highly resistant lines as well as conductors that have breaks in their continuity (e.g. disconnected shield bonds or insulated pipe bushing). The locating range is quite short for the high frequencies so the transmitter must be repositioned more often during the tracing operation. High frequencies may be applied via direct connection, coupler induction and transmitter induction.

Receiver Controls & Indicators

ON/OFF Button

The unit will load settings from previous usage. Automatic shut off after 10 min of no use.

FREQUENCY Button

Toggles through available selected active and passive frequencies.

Note: Some frequencies are only available in certain modes and some modes will only be available with certain frequencies. The available selectable frequencies can be edited within the programming menu.

MODE Button

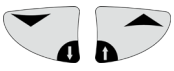
Toggles through the available modes: *Peak*, *Pinpoint Peak*, *Null*, *Left/Right*, and *Sonde*.

Note: The available selectable modes can be edited within the programming menu.

SHIFT/LOG/DEPTH Button

This button's function changes depending on the features turned on within the programming menu.

Under normal operation this button will force take a digital depth reading.



GAIN Buttons (Down and Up)

Adjusts the gain down or up. If the graph shows signal strength off scale, pressing the *GAIN* button will automatically adjust to 50% on the scale display.

Locating Modes

There is a variety of locating modes available in the CL 20 unit: *Peak*, *Pinpoint Peak*, *Null*, *Left/Right*, and *Sonde* as well as DFF and ACC. To toggle through *Peak*, *Pinpoint Peak* and *Null* simply press the button. To toggle to *Sonde* mode, hold the button for 5 seconds and release. DFF and ACC modes are only selectable when an appropriate accessory is plugged into the accessory port in the handle of the receiver.

Peak Mode Locating

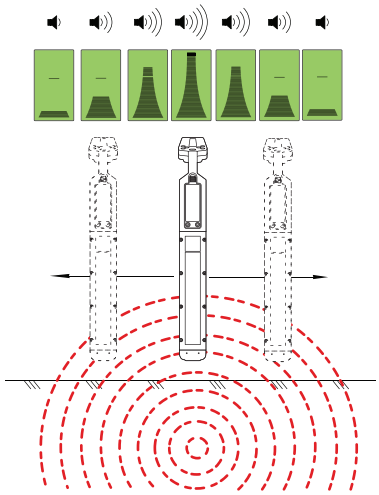
Peak and *Pinpoint Peak* modes have less error rates than the *Null* locating mode in most circumstances. The *Peak* mode location indication should be verified by the *Null* mode to ensure locating accuracy.

With the receiver in a vertical position.

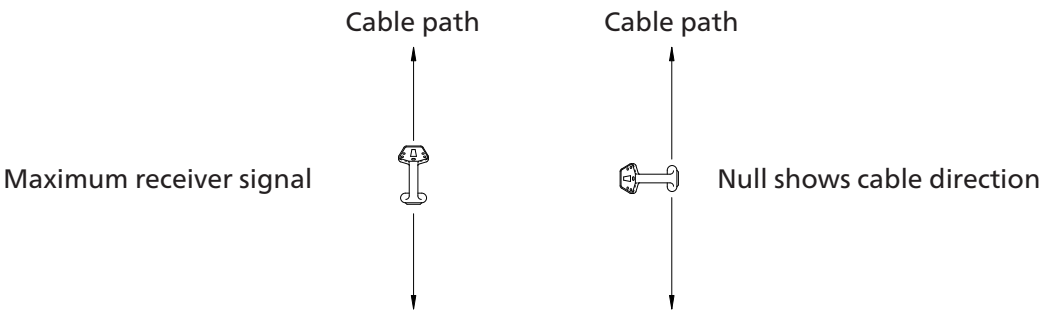
1. Move the receiver left to right across the path.
2. When the receiver is directly above the cable or pipe, rotate the receiver for a maximum signal.

   As you move the receiver away from the cable path, the meter reading (and audio frequency response) will drop off. The left/right arrows operate off of the Null reading.

   By utilizing the left/right arrows while in *Peak* mode the user can simultaneously locate in both modes thus quickly identifying the match or discrepancy between the *Peak* and the *Null* reading.



If you rotate the receiver while over the cable, a sharp Null will identify the cable's direction. It is aligned with the flat side of the receiver.



Peak Mode Locating

1. Trace the path by walking away from the transmitter at a moderate pace.
2. Move the receiver to the left and right while walking, following the *Peak* indications.
   As you trace the path, the meter reading may slowly fade as you move away from the transmitter.
3. Press and release the  buttons as needed to compensate for changes in level (higher or lower).

One of the following may have occured at areas of detected signal loss:

- a junction where the signal divides and goes several directions
- a break in the cable or shield
- a change in the depth of the cable or pipe
- an insulated pipe fitting
- a slack loop of cable

If you can no longer trace the path, even with the gain set to maximum, connect the transmitter to the far end of the path and trace back to the point where you lost the signal.

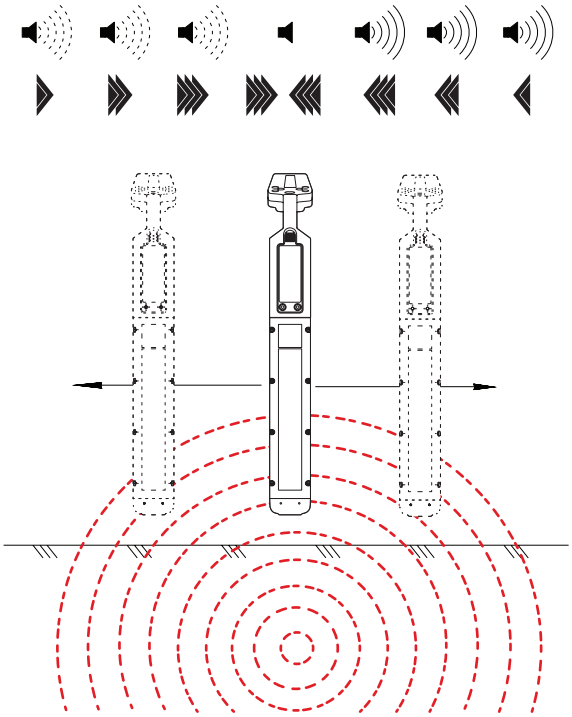
Mark the straight sections of the path every meter. Mark sharp curves, loops, and cable bundles every few inches. Sharp changes in the path cause the receiver's peak and null indications to behave differently than when tracing a straight path. Practice on the path that you know has turns and laterals in it. This will help you to recognize the conditions within the field.

Null Mode Locating

1. Move the receiver left to right across the cable path.
   When the receiver is directly above the cable or pipe, a Null (lowest meter reading and lowest audio tone) will occur. When moving the receiver to left or right of the Null point, the meter reading will rise to a maximum point (peak). The audio tone will also be at its highest pitch. When the receiver is moved beyond the peak, the meter reading will begin to fade.
2. Trace the path by walking away from the transmitter at a moderate pace.
3. Move the receiver to the left and right when walking, following the Null indications.

It is expected that in areas of distortion and interference the *Null* locating mode will have a greater error rate than the *Peak* locating mode.

Directional Locating with Right/Left Indication



In this mode the unit will display directional arrows to the conductor. The audio indicator will provide a solid tone on one side of the conductor and a pulsed tone on the opposite side of the conductor. When the unit is centered in the electromagnetic field the tone will null and the depth will briefly display at the top of the LCD. This mode is gain-independent.

The left/right arrows operate off of the Null reading and will have the same error rate as the *Null* locating mode. By utilizing the left/right arrows with the absolute signal strength reading the user can simultaneously locate with both *Peak* and *Null* modes, thus quickly identifying the match or discrepancy between the peak and the null reading.

Absolute Signal Strength

The CL 20 receiver provides the operator with a direct measurement of the receiver's signal strength. The measurement is displayed with three numerical digits (e.g.: **485**) located at the top of the LC display. The measurement range is from 0 to 999 indicating a very weak signal (0) to a very strong signal (999). Absolute signal strength is independent of the gain setting or meter reading. It gives the operator information about the actual amount of signal being radiated from the conductor and received by the receiver.

Measuring absolute signal strength at any time is done by reading the number at the top of the LC display. The absolute signal strength will not be displayed if the meter reading is too high or too low. Adjust the gain to move the meter reading to mid-scale. The numerical display will change from **'---'** to a valid measurement.

Absolute signal strength measurements are more sensitive to signal changes than the meter display. Peaks and Nulls can be more precisely pin-pointed. This measurement can also be used to monitor signal loss as the conductor is being traced.

Gain Level Indication

The buttons are used to increase and decrease the gain in small amounts. If the meter reading is very low, pressing the button will center the meter reading to mid-scale. Likewise, if the meter reading is very high, pressing the button will center the meter reading to mid-scale.

Passive 50/60 Hz Locating

The CL 20 receiver is capable of locating power utility frequencies. This mode is useful for locating underground primary and secondary power utilities. In certain circumstances, this mode will also locate water pipes, sewer lines, TV, and telephone cables. The reason is that common electrical grounds are sometimes found among these various utilities. Select 50 Hz or 60 Hz frequency on the receiver. *Pinpoint peak* mode will automatically be selected as the preferred method to locate the conductor in passive power mode.

This method is useful because of its speed and convenience. Start at a known reference point and keep in mind that other conductors in the area may produce this same locating signal.

The transmitter is not required to locate in this mode.

Note: The unit of depth measurement determines the selection of either 50 Hz or 60 Hz passive mode. The unit is configured for 50 Hz when in metric measurement mode and 60 Hz when in English measurement mode. To change unit of measurement press and hold the  button for 10 s. When the button is released the unit will toggle measurement units.

Passive Radio Frequency Locating

The CL 20 receiver is capable of passively locating metallic utilities where radio frequencies have coupled to the utility. This mode is useful for sweeping a green area for utilities. In certain circumstances, this mode will locate water pipes, gas lines, TV, and telephone cables. This locating option does not always detect buried utilities even when radio frequencies are present. This method is useful because of its speed and convenience. Start at a known reference point and keep in mind that other conductors in the area may produce this same locating signal.

The transmitter is not required to locate in this mode.

Passive Rectifier CP Locating

The CL 20 receiver is capable of locating the rectified signal of cathodically protected (CP) utilities at 120 Hz and 100 Hz. This method is useful because of its speed and convenience.

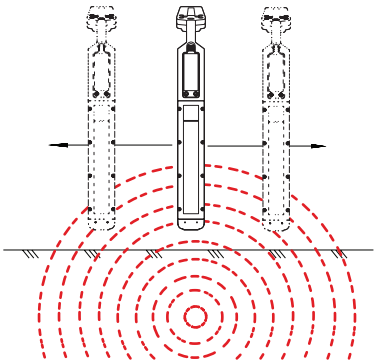
» Start at a known reference point and keep in mind that other conductors in the area may produce this same locating signal.

  Note: The unit of depth measurement determines the selection of either 100 Hz or 120 Hz passive mode. The unit is configured for 100 Hz when in metric measurement mode (for 50 Hz power) and 120 Hz (for 60 Hz power) when in English measurement mode.

» To change unit of measurement press and hold the  button for 10 s. When the button is released the unit will toggle measurement units.

The transmitter is not required to locate in this mode.

Push Button Depth



- Peak & Null readings match
- From the peak/null location take several readings across cable.
- Mark position indicated by lowest depth reading.
- While stationary take multiple depth readings.

The only way to be sure of the depth of a utility is to expose the utility.
At any given time, the depth readout may be inaccurate.

The CL 20 receiver can perform digital depth measurement. The depth is displayed at the top of the LC display in centimeters or feet and inches. Push button depth is useful in quickly estimating the depth of the conductor during path locating.

Begin this measurement by locating the path of the cable or pipe.

1. Stay at least 4.5 meters away from the transmitter.
2. Pin-point this location as accurately as possible

   Further information:
   - Chapter "Peak Mode Locating" on page 16
   - Chapter "Null Mode Locating" on page 17
   - Chapter "Absolute Signal Strength" on page 18.
3. Place the receiver vertically over the conductor and rest the foot of the locator on the ground.
4. While holding the receiver vertical, press and release the button.

   The receiver will briefly indicate a measurement is being performed and then display the depth at the top of the LC display.

Caution must be exercised when using the push button depth feature, as tilted magnetic fields and adjacent conductors can significantly influence this measurement. The operator should periodically check for adjacent conductors and tilted magnetic fields when taking push button depth readings.

Further information on identifying tilted magnetic fields:

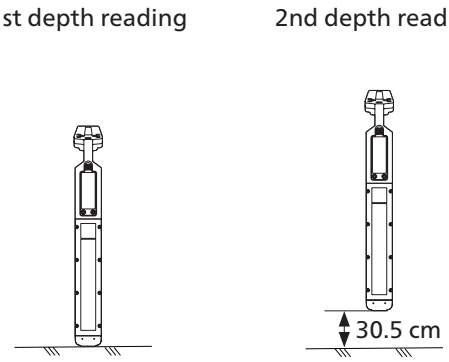
- Chapter "Tilted Magnetic Field Identification" on page 23

Depth is determined by reading the electromagnetic field radiating from the conductor. The field must be even and circular for the most accurate reading. Interference of this field may be caused by bends in the cable, faults on the target conductor and signals radiating from adjacent non-target conductors. Interference will warp the field and skew the depth reading. The only way to be sure of the depth of a utility is to expose the utility. At any given time, the depth readout may be inaccurate.

Push Button Depth

The following are methods and procedures that will aid in increasing the reliability and testing the accuracy of the depth reading:

- Take depth readings at least 4.5 m from cable bends or depth changes. Follow the cable both forward 4.5 m and backward 4.5 m, ensuring the line is straight and there is a consistent signal strength reading.
- Check for non-target conductors within 4.5 m of the target cable. Sweep the area looking for coupled signals into both the tracks and adjacent cables. Adjacent conductors carrying the locate signal can result in a 50% error rate of the depth reading.
- Test for interference in the magnetic field by comparing the peak location to the null location. The determined cable position by these methods should be within 7.5 cm of each other. A greater disparity will indicate interference resulting in inaccurate depth.
- Place the receiver vertically over the conductor and perpendicular to the conductor. Rest the foot of the locator on the ground. Take several depth readings moving slightly across the perpendicular plane to the conductor looking for the lowest depth reading.
- Once the lowest depth reading is found, take several readings. Each reading should be within 1 cm of the other reading. Wider variation will indicate interference resulting in inaccurate depth.
- Lift the receiver up 30.5 cm and take a depth reading. The reading should reflect the change in distance accordingly. If not, interference is present resulting in inaccurate depth.



Current Measurement

The CL 20 receiver contains a feature that is very useful in identifying a desired cable in a field of various conductors and/or utilities. It is not unusual for the target conductor (the conductor connected to the transmitter) to induce a signal into nearby conductors in a crowded field. In these instances, the radiated signal on the conductors close to the surface of the earth, may be stronger than the transmitter signal on the target conductor buried deep in the ground. The operator will find two or more paths and must determine which is the target conductor. By using the current measurement feature of the CL 20 receiver, the operator can determine the amount of 815 Hz, 8 kHz, 33 kHz or 82 kHz current flowing on the conductors, regardless of the depth. The highest current flow indicates the target conductor.

1. Place the receiver vertically over one of the conductor marks and rest the foot of the locator on the ground.
2. Holding the receiver vertical, press and release the *SHIFT* and *DEPTH* buttons simultaneously.
3. When the meter changes from a “thermometer” type display to a “bar” type display, hold the receiver still until the measurement stabilizes.
4. The blinking bar indicates the signal level on the cable (adjusted for depth).
5. Next, move to the second cable and repeat the measurement.

   The blinking bar will show the signal level on the conductor. In addition, the previous reading is shown as a solid bar. The higher of these two readings will show which conductor is carrying the greatest locating signal.

Tilted Magnetic Field Identification

When adjacent cables or pipes are present, they will sometimes create locating errors. Some of the Transmitter signal is picked up by the adjacent conductors and is redirected so that it combines with the original signal. The result is a tilted magnetic field. This is often the reason that numeric depth readouts are sometimes created in error.

The operator can verify the accuracy of path locate by performing the following test: Test for interference in the magnetic field by comparing the peak location to the null location. The determined cable position by these methods should be within 7.5 cm of each other. A greater disparity will indicate interference resulting in inaccurate depth.

Note: The left/right arrows operate off of the Null reading. By utilizing the left/right arrows while in peak mode the user can simultaneously locate in both modes thus quickly identifying the match or discrepancy between the peak and the null reading.

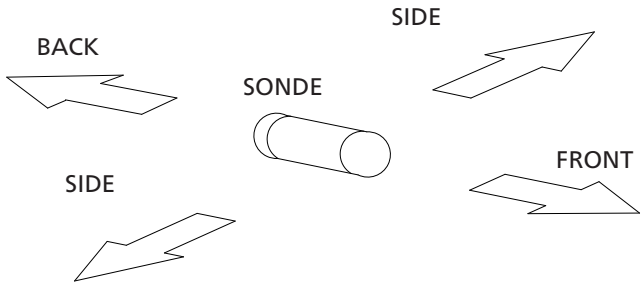
This is an important technique that should be used to ensure the most accurate location possible.

Locating a Sonde or Camera Head

Before you begin, you must choose a sonde or camera head that will match the same frequency as the receiver. You will need a sonde with a frequency of 512 Hz, 640 Hz, 815 Hz, 8 kHZ or 33 kHz to use with the CL 20 receiver.

» To select the *Sonde* locating mode press and hold the button for 5 seconds.
When the button is released the sonde icon will be displayed on the LCD. Once in *Sonde* mode the button will select the available sonde frequencies.

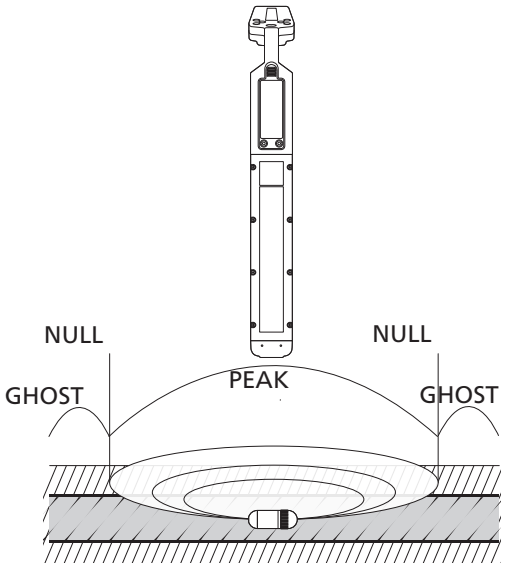
The key to *Sonde* locating success is practice and patience. Before going out on your first locate, it is a good idea to take your receiver and sonde out and try locating the sonde and calculating the depth.



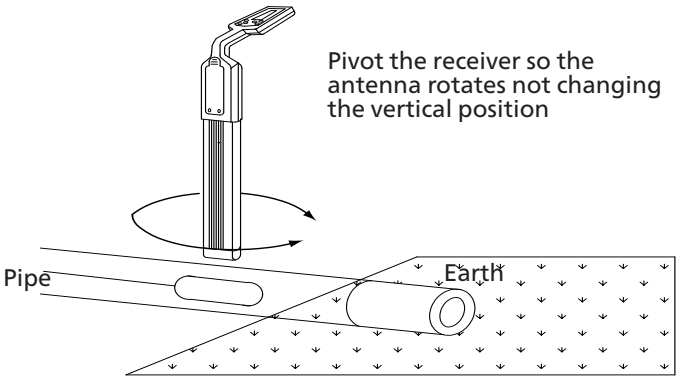
Locating a Sonde

Hold the receiver antenna directly above and in line with the sonde, as shown below. The receiver sensitivity needs to be adjusted for a meter reading indication between 60% to 80%.

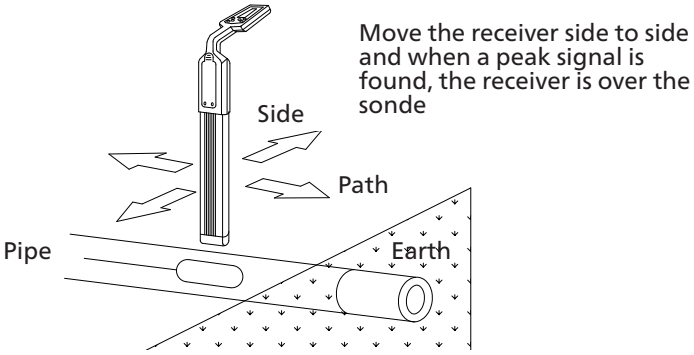
The radiation pattern of the sonde is shown below. The peak signal is when the receiver is held directly over the sonde with the antenna in line with the sonde. Both ghost signals can be located behind and in front of the sonde. By locating the ghost signals, the user is confirming the accuracy of the locate.



Start by following the suspected path of the pipe. Stop locating when the peak reading is found. Then rotate the receiver as shown in the figure below. When pivoting the receiver, do not change the vertical position. The receiver will indicate a peak when the antenna is in line with the sonde.



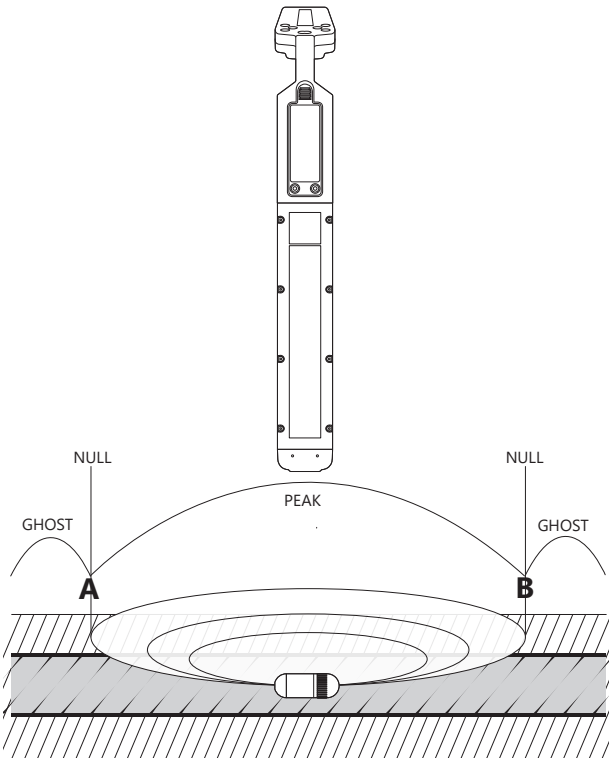
Now move the receiver side to side (across the path of the pipe) as shown below. When the peak is found, the receiver is directly over the sonde. Mark this location. Next, check for ghost signals in front of and in back of the sonde to confirm the location.



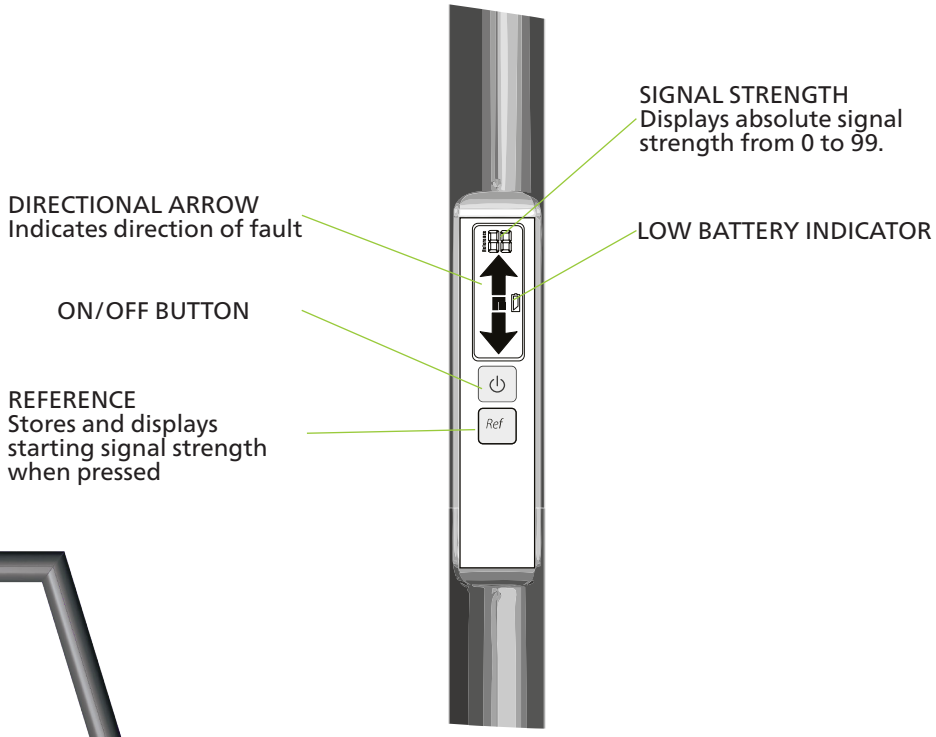
Depth Measurement of Camera Head or Sonde

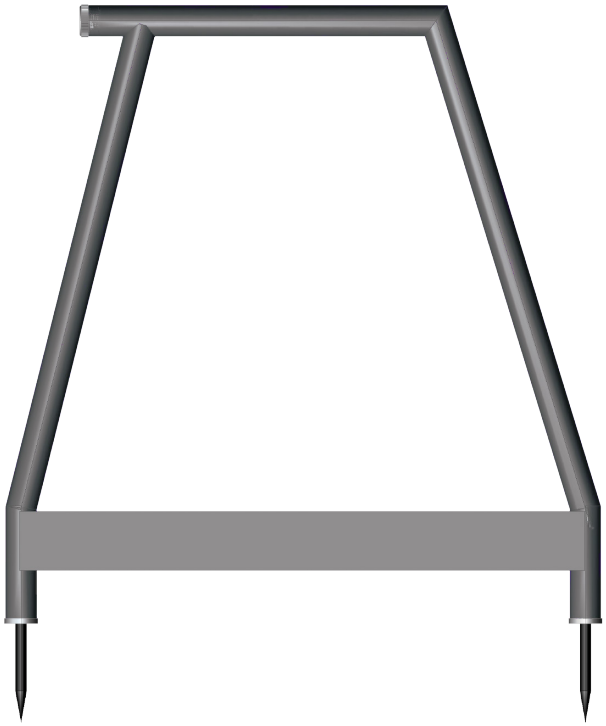
Once the line has been located, the depth can then be found. Refer to the figure below for a reference. Start by moving the receiver along the path behind the sonde with the antenna in line with the sonde and find a null between the peak ghost signals. Mark this point (A). Then move the receiver along the path in front of the sonde and find another null. Mark this point (B). Next, measure the distance between these two points. The depth of the pipe is 0.7 times the distance between the two points.

Distance between **A** and **B** times 0.7 equals depth of sonde.



STAFF A-Frame (optional) – Receiver Controls & Indicators





Fault Locating with STAFF A-Frame – Principle

Fault locating determines the position of an insulated break on an underground conductor. In the event of a cable sheath fault, part of the transmitter signal flows back over the fault position to the earth spike or station earth. An unusually high signal loss occurs during location due to this return flow of the transmitter signal.

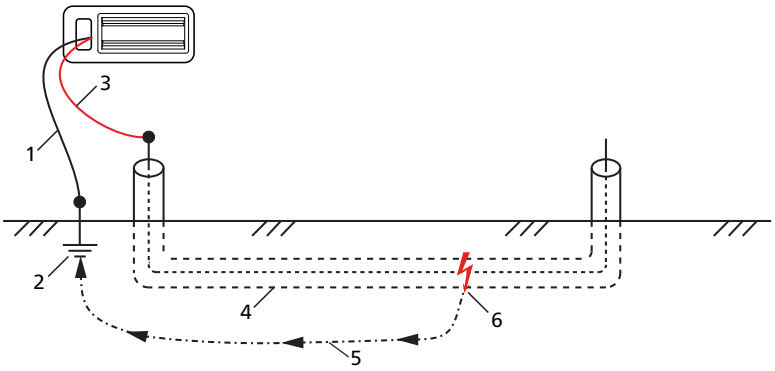
It is generally recommended to locate the conductor path before attempting to locate a fault.

If, during the path locate, an unusual amount of signal loss occurs, this may indicate signal loss to ground within the immediate area. Lower frequencies will show a greater signal loss at a fault, but higher frequencies may be needed to locate if the resistance is too high.

Note: Signal will ground at a grounded splice point, which would act as a fault during the path and fault locate.

Once the path is determined, the far access point needs to be disconnected and isolated.

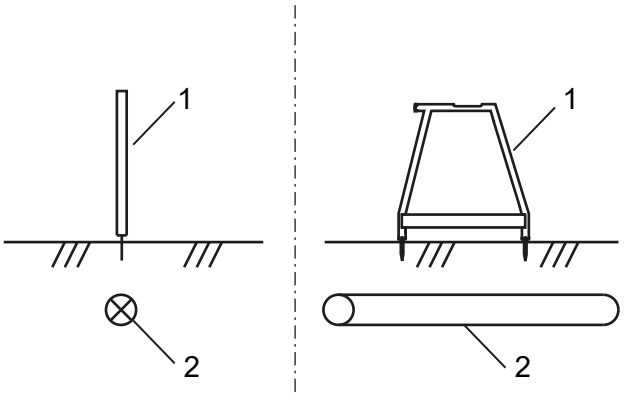
Since the signal has no path to ground at the far access point, the signal will be forced to ground at the fault. This increases the current in the soil at the fault and eases the detection of the fault.



1 Black connection cable
2 Earth spike / station earth
3 Red connection cable
4 Buried cable
5 Return current in ground
6 Cable sheath fault

During the cable sheath fault location, the STAFF A-Frame must be pressed into the ground to a uniform depth. A current path is formed for the return current flowing into the earth between the two measuring tips of the STAFF A-Frame. The return current enters one measuring tip and exits from the other. After the return current has exited from the STAFF A-Frame, it flows back to the earth spike or station earth of the transmitter.

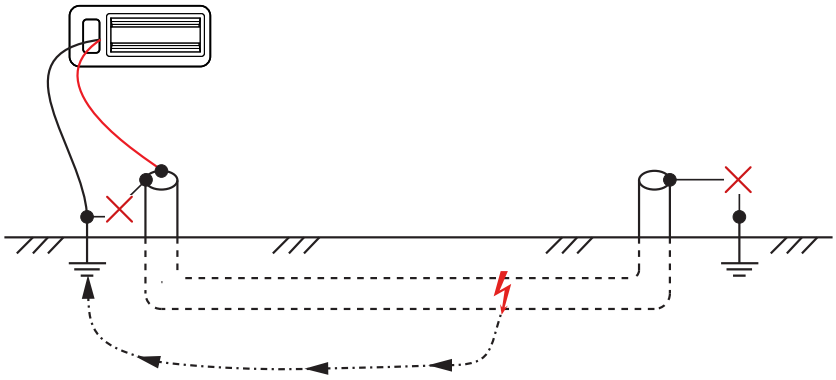
The receiver measures the current portion that flows through the STAFF A-Frame. The signal strength recorded by the receiver increases in the vicinity of a high current density in the ground, e.g. at the earth spike or station earth of the transmitter or at the cable sheath fault.



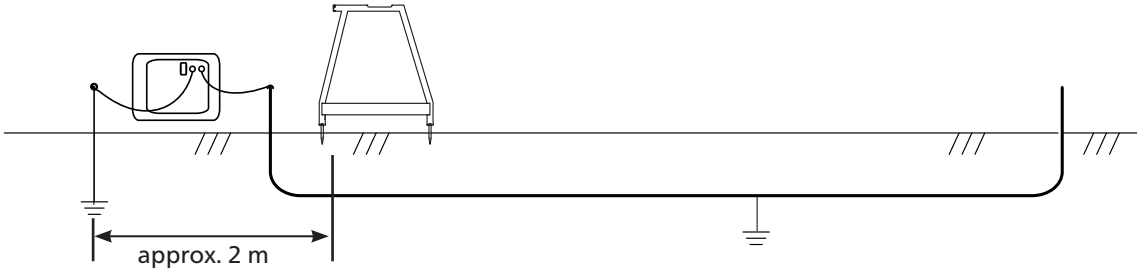
1 STAFF A-Frame
2 Buried cable

Locating Faults with STAFF A-Frame (optional)

1. Locate path of faulted conductor.
2. Remove power from faulted conductor & disconnect loads and ground from both ends of target conductor and neighbouring conductors.



3. With transmitter off, connect red lead to the faulted conductor or screen. Connect black lead to station earth or independent earth spike placed behind and in line with the conductor path.
4. Turn the transmitter on and set to *DFF* mode by pressing and holding the ⏻ button for 10 s.
5. Place STAFF A-Frame in soil with back spike approx. 2 m from earthing point and front spike toward suspected fault.

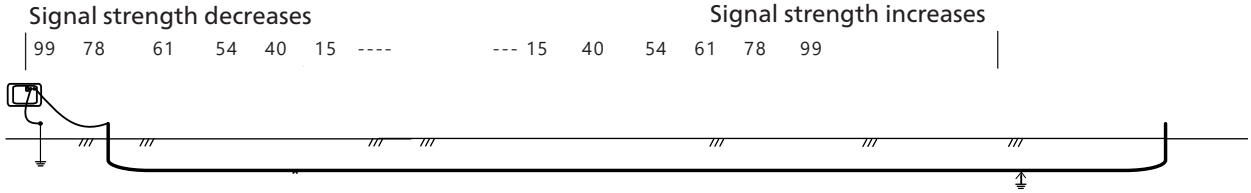


6. Turn the STAFF A-Frame receiver on.
7. At the transmitter, toggle the mode out of *DFF* and then trough the modes until *DFF* is displayed again.
8. Place the STAFF A-Frame every 3 to 4 steps along the length of the route to be located.

   The directional arrows will indicate the fault direction. Note the acoustic signal: The STAFF A-Frame receiver issues a pulsing tone when getting closer to or further away from the fault, and a continuous tone when the STAFF A-Frame is directly above the fault. Note numeric reading on receiver as reference to signal strength near fault.

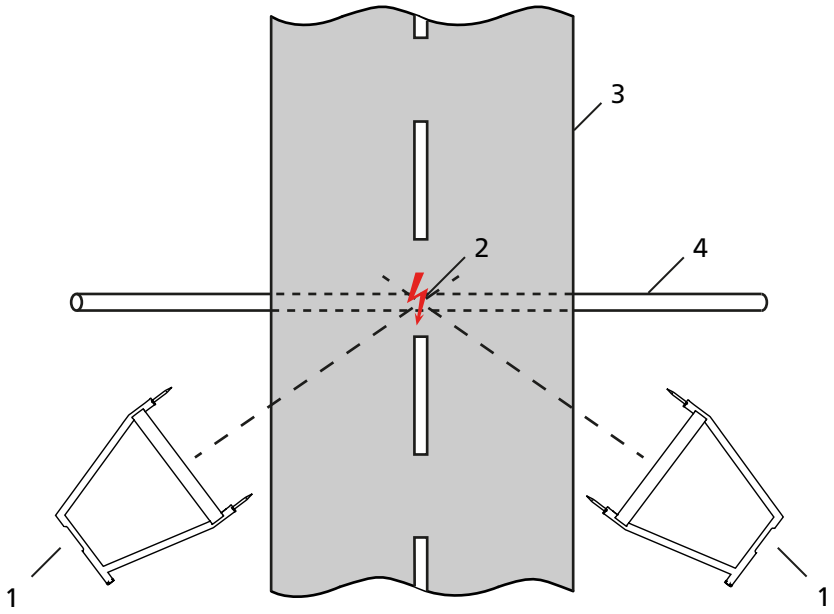
   Signal strength will fall as leaving the earthing point until passing half-way between earthing point and fault. Signal will start to rise from half-way point to fault. If the distance is great the signal strength may fall to non-detectable level and arrows may not stabilize through the center section.

   At the fault the signal strength will be equal to the signal strength at the earthing point. The arrows will distinctly flip forward and backward as the fault is passed.



Faults Beneath Paved Surfaces

Faults beneath a paved surface can be difficult to locate. In this case, the STAFF A-Frame will be used in the ground at the side of the paved area. Since the return current in the soil begins its return from the fault – like the spokes of a wheel laying on the ground – equal amounts of current will enter the STAFF A-Frame if it is placed on the ground and positioned broadside to the fault. At the point where the directional indication changes the fault will lie on a straight line projected at a right angle from the center of the STAFF A-Frame. Adjustments can be made by slightly rotating the STAFF A-Frame to find the directional change. The operator should record this line over the paved area. By repeating this procedure from another location near the paved area, another line will be produced. The intersection of the two lines is the location of the fault.



1 STAFF A-Frame
2 Cable sheath fault
3 Paved or asphalt street
4 Buried cable

Technical Data

Transmitter

Operating frequencies	815 Hz, 8 kHz, 33 kHz, 82 kHz, 2 kHz, 10 KHz, 491 Hz, 512 Hz, 640 Hz, 982 Hz, 1090 kHz, 8440 kHz, 9820 kHz, 32,768 kHz
Load adjustment	5 – 25,000 Ohm (automatic)
Output power	10 power settings Low & medium frequency range: 0.2 W – 10 W High frequencies (above 44 kHz) : 0.2 W – 1 W
Display indicators	AC load assistance measurement, relative ohms, voltage, live voltage output, current output, power level, frequency, mode, battery indication alert, low battery indicator audio/visual with modulated low battery warning transmitted to receiver
Power supply (battery type)	10.8 V, 10 Ah, 84.24 Wh lithium-ion battery
Battery life	Continuous: 8-20 hours (dependant on load, frequency, power setting) Intermittent: 40-60 hours
Degree of protection	IP65
Ambient temperature (operational)	-20° C to +55° C
Storage temperature	-20° C to +55° C
Dimensions (W x H x D)	410 mm x 160 mm x 150 mm
Weight	2.7 kg

Technical Data

Receiver

Operating frequency	Active: 815 Hz, 8 kHz, 33 kHz, 82 kHz, 2 kHz, 10 KHz, 491 Hz, 512 Hz, 640 Hz, 982 Hz, 1090 Hz, 8440 Hz, 9820 Hz, 32,768 Hz Passive: 50 Hz, 150 Hz, 250 Hz, 350 Hz, 450 Hz, 60 Hz, 180 Hz, 300 Hz, 420 Hz, 540 Hz; LiveSound TM; Radio Frequency; Rectified CP 50 Hz & Rectified CP 60 Hz
Operating modes	Pinpoint peak method Peak method Null method Simultaneous peak/null Tracing in left/right directional guidance mode
Display indicators	Backlit segmented LCD bar graph, battery condition, continuous mode signal strength, depth measurement, line orientation, left/right line guidance, operating mode, volume level & function indicators
Audio indication	Variable pitch & Live Sound, 4 volume selections including mute
Signal strengh	LCD bar display Digital absolute value 0 – 999
Current measurement	Display of current level of target and nearby conductors
Gain adjustment	Left/right guidance mode: Automatic All other locate modes: Manual gain adjustment & automatic centering
Dynamic Range	126 dB
Depth Measurement	Digital: 0.02 – 15 m with accuracy > 5% of depth
Power supply (battery type)	10.8 V, 5.2 Ah, 56.16 Wh lithium-ion battery
Battery Life	Continuous: approx. 30 hours Intermittent: approx. 82 hours
Degree of protection	IP65
Ambient Temperature (operational)	-20° C to +55° C
Storage temperature	-20° C to +55° C
Dimensions (W x H)	770 mm x 240 mm
Weight	1.9 kg

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