

PL-2000

Operation Manual



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1. Transmitter Unit operated with 8 D batteries



2. Receiver Unit operated with 6 AA batteries



3. Direct Mode Cables and Ground Stake



4. Soft Carrying Case

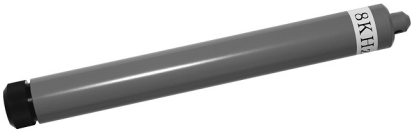
OPTIONAL ACCESSORIES



1. Inductive Clamp and Cables.
Use the inductive clamp (4 inch opening) for energizing telephone cables and power cables inductively.



2. Cable Drum with 50 meter cable.
It can be used in the Loop Cable mode to put a strong signal on a target line, or when you can't get a good ground. You can also make up your own Loop Cable if you prefer.



3. 8 KHz Sonde.
Locate plastic pipes, clay-pipe sewers, etc. by pushing/pulling a sonde transmitter through them.

4. Heavy-Duty ABS Plastic Hard Case.
Transport the PL-2000 in a custom-foam hard case for maximum protection.

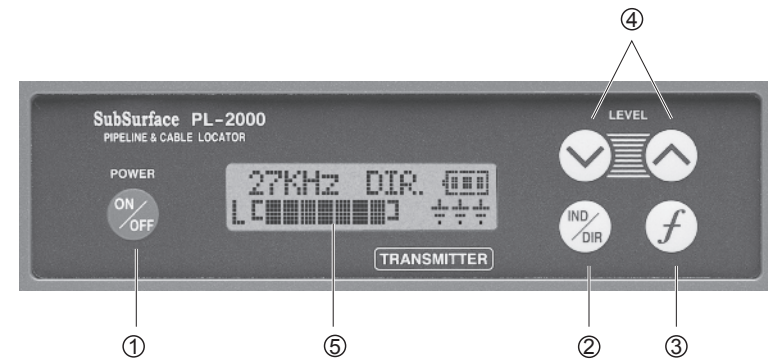


OPERATION OF TRANSMITTER

Transmitter Unit

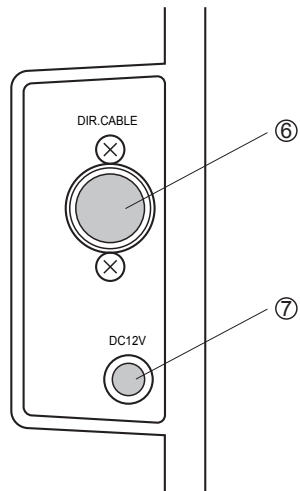


Operation Panel



- ① Power Switch, On/Off
- ② Mode Selection Switch
- ③ Frequency Selection Switch
- ④ Output Power Level Switches
- ⑤ LCD Display

OPERATION OF TRANSMITTER



■ Connections

- ⑥ Direct Mode Connection.
- ⑦ External Power Connection.
With the optional 12 volts DC power cables, the Transmitter can be powered from a truck or a car 12 volts battery.

■ Transmitter LCD Display

The PL-2000 Transmitter displays the following information:

To turn the TRANSMITTER ON, push the Power ON/OFF. The sounds "Tick-Tack" are repeated four times and indicate that the Power Switch is ON.

- Ⓐ Display Frequency:
Inductive Mode : 27kHz or 8kHz.
Direct Mode : 27kHz, 8kHz, 0.5kHz or MIX. MIX means the simultaneous output of 27kHz, 8kHz, and 0.5kHz.

- Ⓑ Output Mode Display:
IND = Inductive Mode
DIR = Direct Connection Mode

- Ⓒ Power Source Display:
 = D Cell Battery Operation
 = Car Battery Operation

- Ⓓ Display of Output Power from 0 to 7

- Ⓔ Display of the ground conductivity and the strength of the current flowing in the Direct Mode.

- POOR ≙ means "poor ground connectivity"
- ≙ ≙ ≙ means "signal level is good"

When the TRANSMITTER controls are not operated in the ON condition for one hour, the Automatic OFF Function turns OFF the power.

OPERATION OF TRANSMITTER

■ Automatic OFF Function

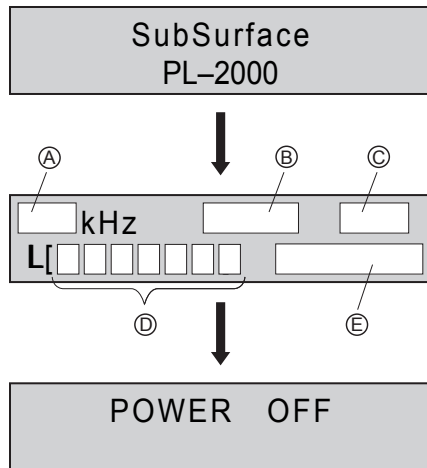
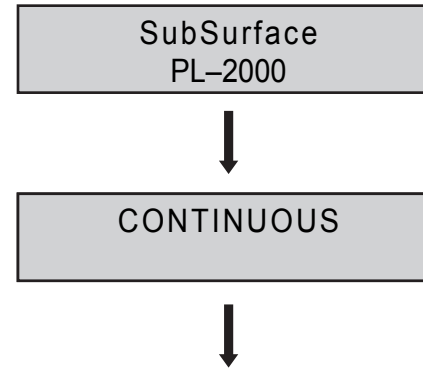
When the TRANSMITTER controls are not operated in the ON condition for one hour, the Automatic OFF Function turns OFF the power.

■ How to cancel the Automatic OFF Function

Normally the Automatic OFF Function is activated, but to deactivate this function, push the Frequency Selection Key and then push the Power ON/OFF Key.

When the Automatic OFF Function is deactivated, "CONTINUOUS" is displayed on the Transmitter display.

Note: The transmitter operates in the Automatic OFF mode every time you turn it on. If you wish to operate in the "Continuous" Mode, you must deactivate the Automatic OFF mode each time after the words "SUBSURFACE PL-2000" are displayed.

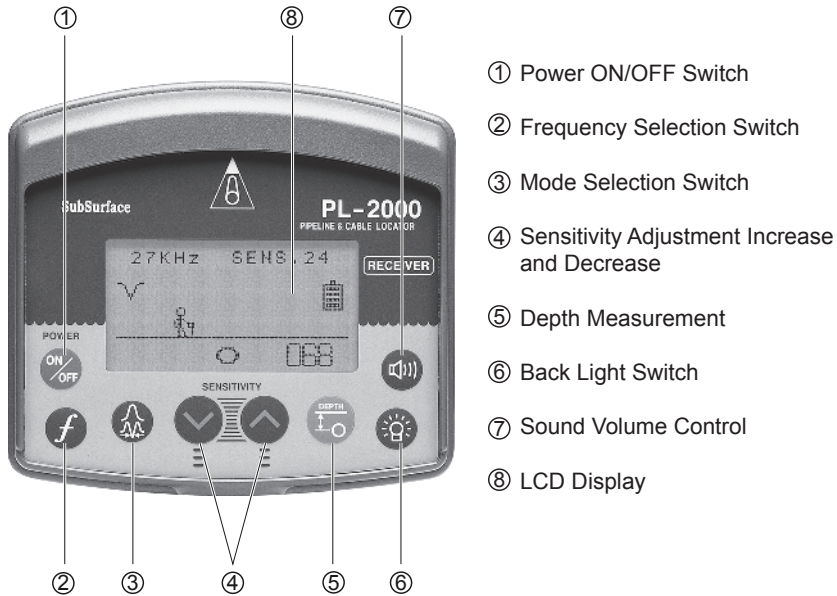


OPERATION OF RECEIVER

Receiver Unit

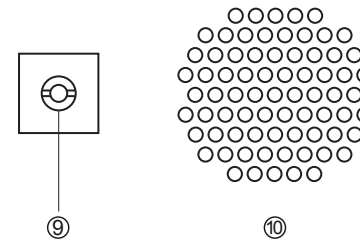


Receiver Operation Panel



OPERATION OF RECEIVER

Back of Receiver

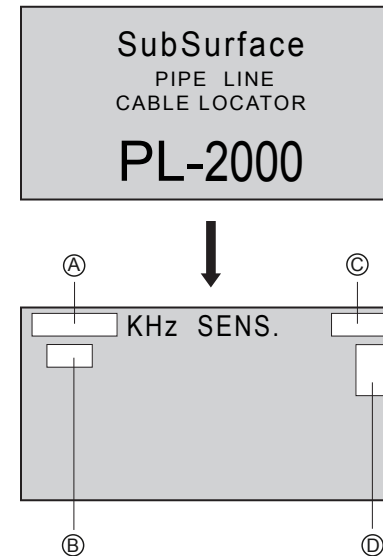


- ⑨ Headphone Jack located on the back of Receiver
- ⑩ Speaker located on the back of Receiver

LCD Display of Receiver

The PL-2000 Receiver displays the following information:

Push the ON/OFF Switch to turn ON and "SUBSURFACE PL-2000" is displayed.



- Ⓐ Frequency Display:
27 kHz or 8kHz or 0.5kHz or RADIO or CABLE. The PL-2000 always "boots" to 27kHz after four "CLICKING" sounds.
- Ⓑ Mode Display:
Peak Mode = \wedge
Null Mode = \vee
Long Distance Mode = (DIST)
Sonde Mode = \sphericalangle
- Ⓒ Sensitivity Level ranging from 0 to 40.
- Ⓓ Battery Power Display.

When the keys are not operated for five minutes, the Automatic OFF Function turns OFF the power to automatically save battery power.

OPERATION OF RECEIVER

■ Four Operating Modes in Receiver

The PL-2000 Receiver has 4 operating modes: Peak, Null, DIST, and Sonde.

1. Peak Mode

The “Peak” Mode employs the PL-2000’s patented differential antenna to produce the most accurate locates. Depth Measurement (+ or – 5% accuracy) is available in Peak Mode.

2. Null Mode

The PL-2000’s “Null” mode is a fast locating tool with “left-right” guidance in a cross-section view of the pipe and the user.

3. DIST Mode

The “DIST” Mode offers even longer distance locating than the Peak Mode, as much as 40% – 50% further. Locating accuracy is less in the DIST Mode, and Depth Measurement is not available.

4. Sonde Mode

The “Sonde” Mode allows the Receiver to locate sewer Sondes accurately and measure their depths correctly. Any 512 Hertz Sonde or the SubSurface 8 kHz Sonde can be used.

■ Three Active Frequencies and Two Passive Frequencies

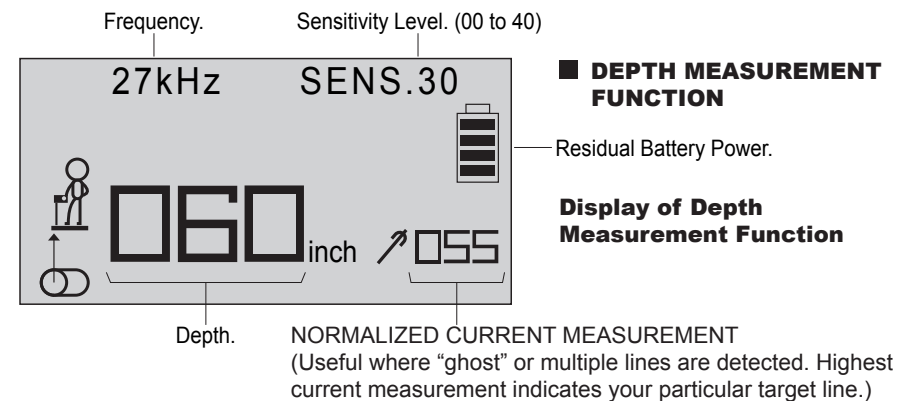
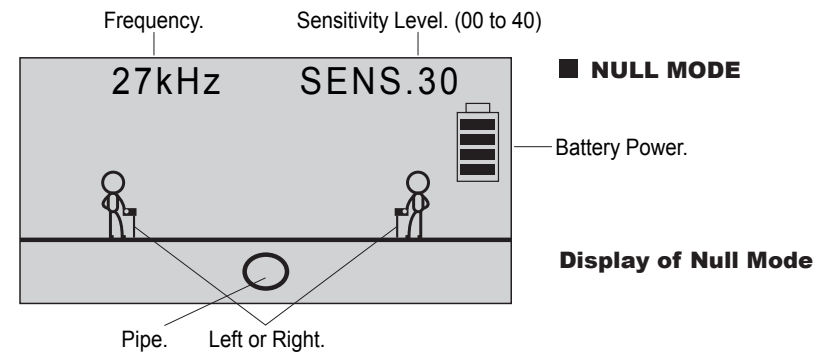
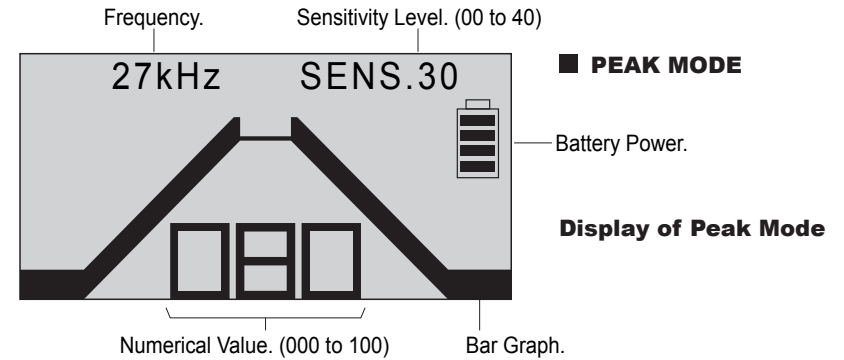
The PL-2000 Receiver has 3 “active” frequencies, meaning these frequencies are transmitted by the Transmitter and matched by the Receiver: 27kHz, 8kHz and 0.5kHz. Higher frequencies “bleed” off faster than lower frequencies, and lower frequencies will go longer distances down the pipes and cables. However, higher frequencies can be applied more

Continued on page 10

OPERATION OF RECEIVER

■ MODE AND FUNCTION DISPLAYS

(Peak Mode, Null Mode, and Depth Measurement Function)



OPERATION OF RECEIVER

Continued from page 8

easily in the Inductive Mode (Transmitter) than lower frequencies, and the 512 Hz frequency is so low that it can not be induced at all. The 512 Hz frequency must be used in the Transmitter's Direct Connection Mode only.

"Passive" frequencies are in the Receiver only, and the Transmitter is not used. The two "passive" frequencies are 50/60 Hz (current flowing A/C) and Radio (15 kHz – 25 kHz).

■ How to Read Current Measurement

The Current Measurement is the normalized value displayed between 000 and 100 converted from the signal transmitted in the buried pipeline or cable. The value between 000 and 100 tells the PL-2000 user whether he/she is locating the primary line or a secondary conductor. Induced currents on secondary conductors running parallel and close to the primary line always have lower current measurements.

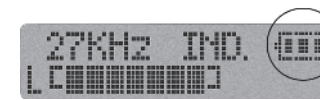
Note: The Current Measurement only appears in the Depth Measurement Function of the Peak Mode, and it is a relative measurement of the current flow.

REPLACEMENT OF BATTERIES

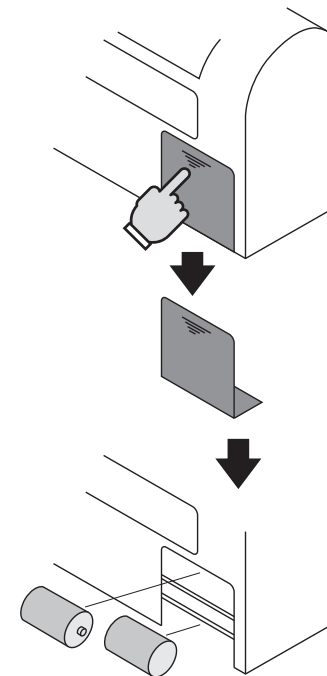
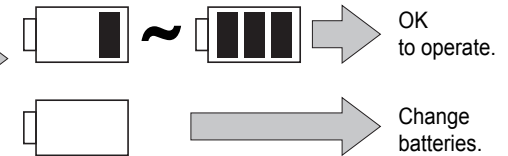
■ Transmitter Battery Power

When the battery mark displayed in the LCD is reduced to a blank icon, replace the batteries.

The residual power is indicated in the LCD.



Transmitter LCD Display



■ How to Change the Batteries

Push the Battery Cover in the direction indicated.

The Battery Cover will detach.

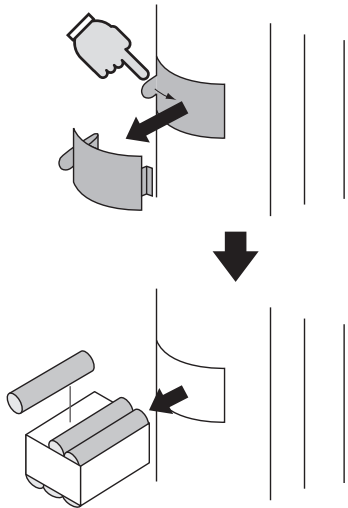
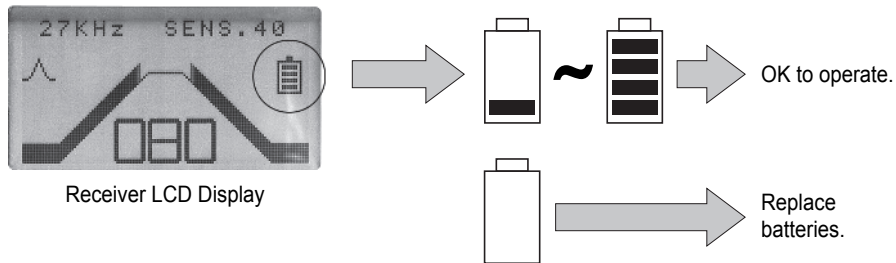
Install the 8 "D" cell batteries in the directions shown on the back wall of the battery compartment. The top row has positive poles facing right, and the bottom row has positive poles facing left.

REPLACEMENT OF BATTERIES

Receiver Battery Power

When the battery mark displayed in the LCD is reduced to a blank icon, replace the batteries.

The residual power is indicated in the LCD.



How to Change the Batteries

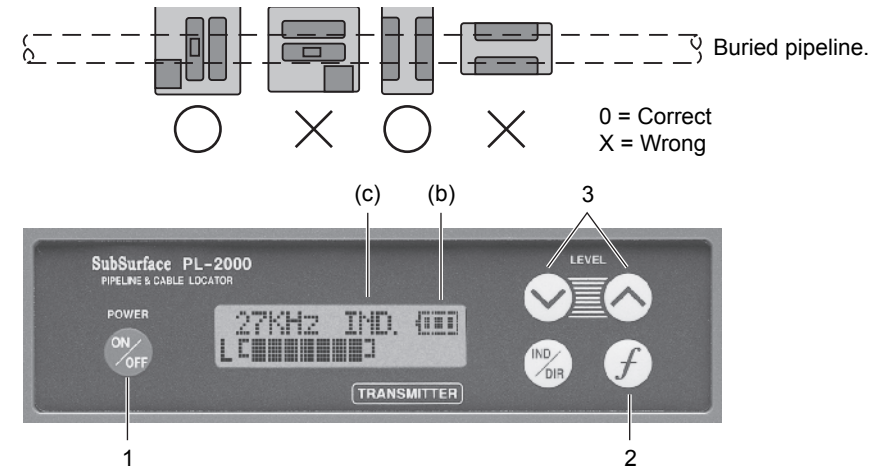
Push the Battery Cover in the direction indicated by a small Arrow Mark. The Battery Cover will detach.

Pull out the Battery Pack and replace all batteries. Install the 6 "AA" cell batteries in the directions shown on the bottom of the battery pack. Reinstall the battery pack inside the Receiver with the metal tabs contacting the battery pack connectors.

HOW TO OPERATE THE TRANSMITTER

Inductive Mode

- In the Inductive Mode, place the Transmitter in the correct position as shown below. The Transmitter should face in the direction of the pipeline. If the Transmitter is positioned parallel to the pipeline, no signal will be induced on to the pipeline.



- Push the Power ON/OFF Switch (1) and confirm the following:
 - Check the residual battery power by the indication of (b).
 - Confirm the operation mode of IND (Inductive Mode) (c).

Note: When switching ON again soon after switching OFF, wait for ten seconds before turning ON to allow the circuits to de-energize.

- In the inductive mode, choose the frequency 27 kHz or 8 kHz. 27 kHz is best for Inductive Mode, and 8 kHz is best for locating long pipelines.
- Adjust the power output level: When the Power ON/OFF Switch is turned ON, the output level is set near its maximum. The "L" in the LCD shows the power output level, ranging from 0 to 7 bars.

HOW TO OPERATE THE RECEIVER

■ How to Operate the Receiver

1. Push the Power ON/OFF Switch (1)
2. Choose one of the following modes at the Operating Mode Switch (2):

Peak Mode: Used to locate the pipeline with greatest accuracy.

Null Mode: Faster method for approximate pipeline location.

Dist Mode: Used to locate the pipeline over a long distance.

Sonde Mode: Used to locate non-metallic pipelines such as PVC pipes and asbestos/cement pipes with no tracer wire.

3. Choose a frequency (3). Switch the Receiver frequency to the same frequency as the Transmitter. The sensitivity level in the Receiver will be automatically set based upon the strength of the signal from the transmitter. Adjust the sensitivity up or down until the signal is shown on the sides of the pyramid in the display.

4. Adjust the sensitivity (4). If the words "Excess Sens" appear at the top of the pyramid, reduce the sensitivity (gain) using the down arrow key until the signal re-appears on both sides of the pyramid. As long as the words "Excess Sens" appear, the user cannot locate the pipeline position accurately.

If there are no bold bars on the sides of the pyramid, then increase the sensitivity using the up arrow key.






If the bold bars are partially up the pyramid, then the user is locating the line accurately.



MESSAGE DISPLAYED ON THE LCD

The PL-2000 Transmitter and Receiver display the following messages on the LCD.

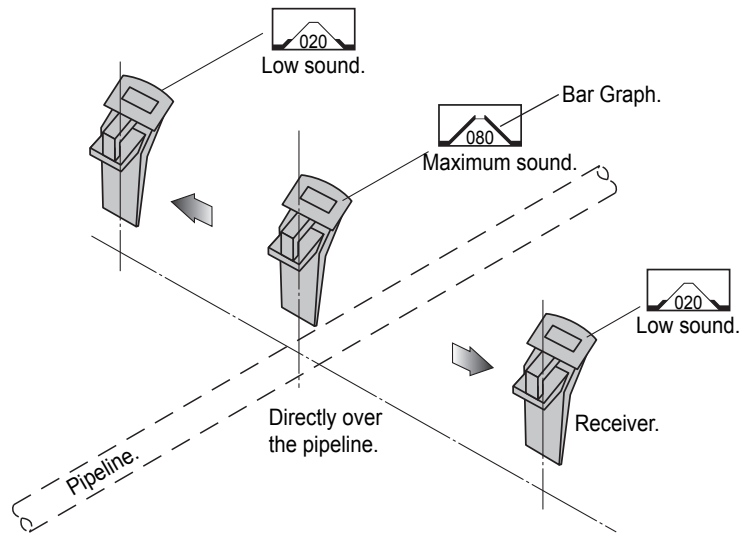
1. TRANSMITTER DISPLAYS

- **CHANGE BATT.** Indicates time to change the batteries.
- **OVER CURRENT** Indicates very low resistance to current flow in the pipeline in the Direct Mode. The Transmitter automatically adjusts the output power to reduce current.
- **IND.** Inductive Mode
- **DIR.** Direct Mode
-  Indicates the use of car battery power.
- **POOR**  Indicates poor ground conductivity or poor current flow because of a bad connection in the Direct Mode.
-    Indicates good ground conductivity and good connections in the Direct Mode.
- **CONTINUOUS** Indicates the cancellation of the "Automatic OFF" function. The Transmitter will operate continuously until turned OFF or the batteries are dead.
- **POWER OFF** Indicates "Power OFF" after non-operation of any controls for one hour or the Power Switch is turned OFF.

2. RECEIVER DISPLAYS

- **EXCESS SENS** Indicates excess sensitivity. Depress the down arrow key until the message disappears.
- **ERROR DEPTH** Indicates the pipeline depth could not be measured. Hold the Receiver still and directly over the line.
- **ILLEGAL FUNCTION** Indicates the depth measurement is not available in this operating mode (Null and DIST).
- **NO SIGNAL** Indicates the signal from the Transmitter is too weak.
- **GAIN ERROR** Indicates that the input signal to the Receiver is unstable, and the depth cannot be calculated. Increase the sensitivity at the Receiver or the output power at the Transmitter.
- **WAIT** "Processing...please wait"
- **POWER OFF** Indicates the Power ON/OFF Switch is turned off automatically after non-operation of any controls for five minutes.
- **CHANGE BATT.** Indicates time to change the batteries.

1. PEAK MODE

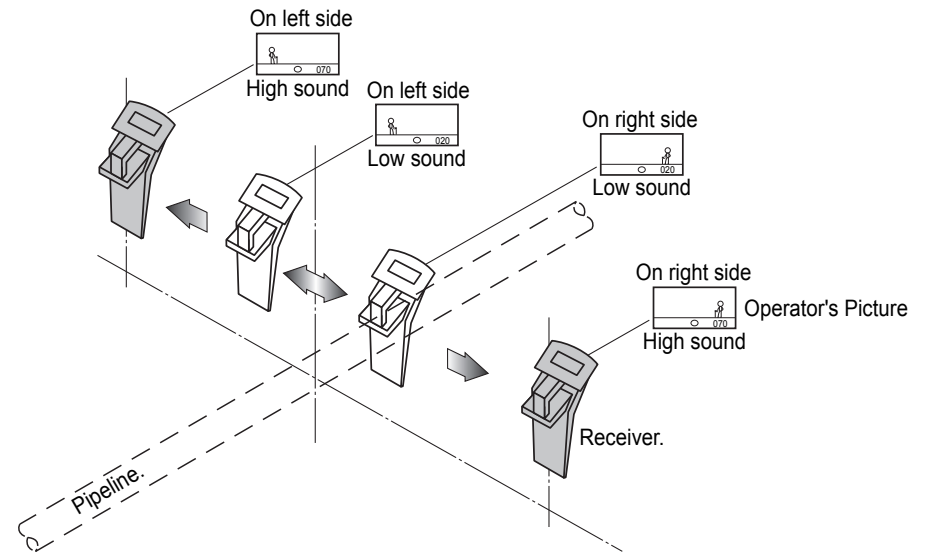


In the Peak Mode, the pipeline location is indicated by the “rising pyramid” bar graph, by the numerical display directly below it, and an increase in sound output.

The “rising pyramid” bar graph increases as the Receiver is moved closer to the pipeline from either side. If there is no “rising pyramid,” increase the sensitivity using the Up Arrow key. When the “rising pyramid” reaches a maximum, the Receiver is directly over the pipeline.

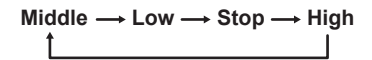
The numerical display beneath the “rising pyramid” and the audio sounds are also indications of the strength of the signal. Both are also at their maximums when the Receiver is directly over the pipeline. Often, small changes in the numbers displayed or in the audio are easier to detect than small changes in the height of the pyramid.

2. NULL MODE



a) Hold the Receiver directly over the pipeline and facing in the direction of the pipeline. Adjust the sensitivity with the Sensitivity Up/Down Arrows until the sensitivity level (upper right corner of display) is about 30.

b) Adjust the sound level with the Sound Volume Control Key to a level easily heard by the user. The sound volume cycles through 4 levels.

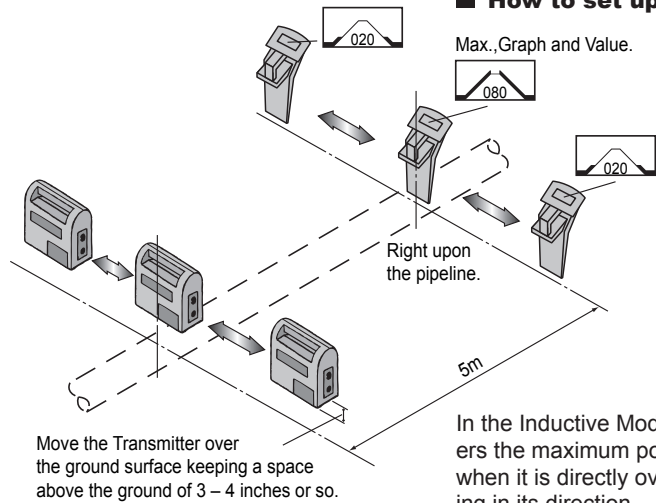


c) As the Receiver is moved closer to the pipeline from either side, the sound level decreases. Directly over the pipeline, the sound level is at its minimum, and the small figure jumps from one side of the pipe to the other very quickly. This minimum point is the “Null” location.

NOTE: There is no depth measurement function in the Null Mode.

3. INDUCTIVE MODE

■ How to set up the Transmitter



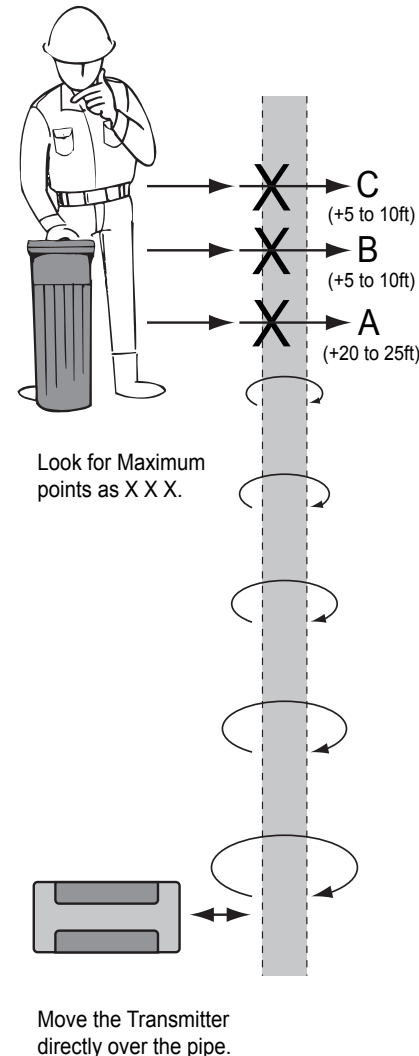
In the Inductive Mode the Transmitter delivers the maximum power level to the pipeline when it is directly over the pipeline and facing in its direction.

1. If the pipeline location is known, set the Transmitter down directly over it and facing in the direction of the pipeline's path. If the location is not known, try to set the Transmitter near it or ask your assistant to hold it close to the ground.
2. Choose either the 8 kHz or 27 kHz for both the Transmitter and Receiver.
3. Set the Receiver's Operating Mode to Peak Mode.
4. Set the Transmitter's output power to its maximum and the Receiver's sensitivity to a high level, such as 30 or 40.
5. With the Receiver, start at a location 20-25 feet away from the Transmitter, and walk in a circle around the Transmitter. If there is a suspected area for the pipeline, go there and rotate the Receiver until it indicates the direction of the pipeline. Otherwise, circle the Transmitter until the pipeline is detected. Rotate the Receiver to determine the direction of the pipeline. Now, ask your assistant to move the Transmitter over the pipeline. The Transmitter is directly over the pipeline when the Receiver's signal is the strongest.

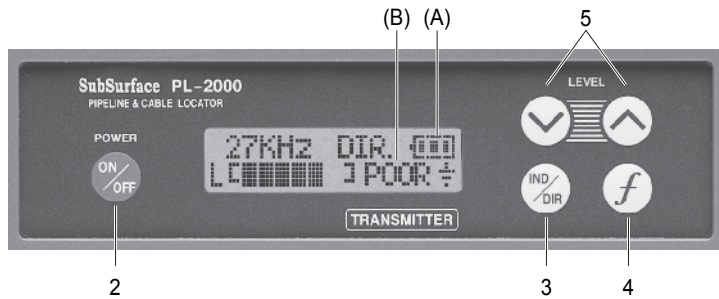
■ Finding the Optimum Transmitter Location with Only One Person

In the Inductive Mode, a single operator can find the optimum Transmitter location using the following procedure.

1. Choose either 8 kHz or 27 kHz for both the Transmitter and Receiver.
2. Set the Transmitter's output power to the maximum and the Receiver's sensitivity to a high level, such as 30 or 40.
3. Try to set the Transmitter near the pipeline, if possible, and facing in the direction of the path of the pipeline.
4. With the Receiver, start at a location (A) 20-25 feet away from the Transmitter. When the signal is detected, rotate the Receiver to determine the direction of the pipeline and position the Receiver directly over it. At this spot, place a flag or make a mark.
5. Move 5-10 feet further away from the Transmitter to (B), and find the maximum Receiver signal by rotating it and moving it back and forth over the top of the pipe. Mark the pipeline's spot again.
6. Move another 5-10 feet away to (C) and repeat locating the pipeline exactly. Now the three locations show the exact path of the line, and the Transmitter should be moved directly over the line.

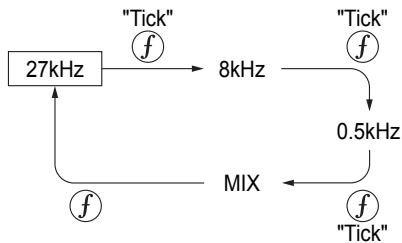


4. DIRECT CONNECTION MODE

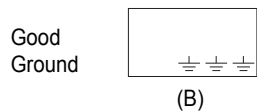
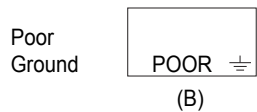


The Direct Mode is usually preferred if the pipeline or a fitting, like a hydrant, is exposed.

1. Plug the Direct Connection Mode cables into the Transmitter at the connector on its side. Connect the clamp of the red cable to the pipeline at a hydrant bolt, and connect the black cable to the ground stake, Locate the ground stake adjacent to the pipeline, 10-15 feet away.



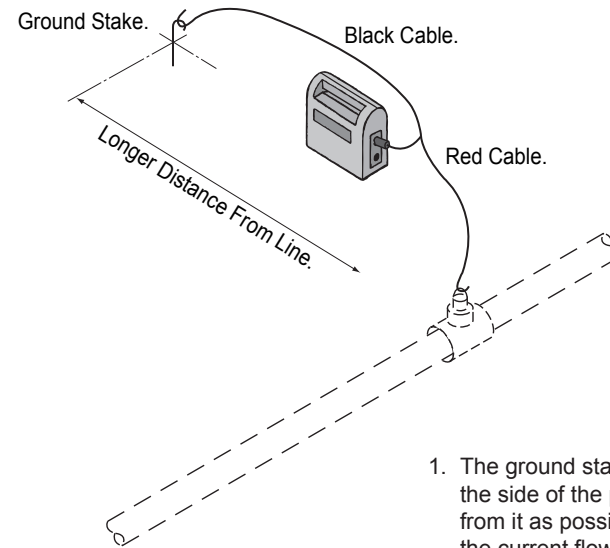
27kHz is chosen automatically when the Power Switch is turned on.



2. Set the output mode at DIR for Direct Mode.
3. Choose a frequency from among the four available 27kHz, 8kHz, .5kHz, or "Mix" (all 3), using these considerations.
 - For water pipelines and other gasketed pipes, choose 27 kHz or 8 kHz. In different systems, one frequency will be better than the other.
 - For continuous conductors like copper service lines and steel gas lines, choose .5 kHz.
 - For certain conductors, choose "Mix."
4. Set up the Power Output Level with the up/down arrow keys.
5. Check the Transmitter display for good ground conductivity and good clamp connections on the red cable and the black cable. If 2 or 3 "ground symbols" are shown, the current transmitted to the line is good. If "poor ground" is displayed, improve the clamp contact at the red cable or move the black cable and ground stake to a new location.

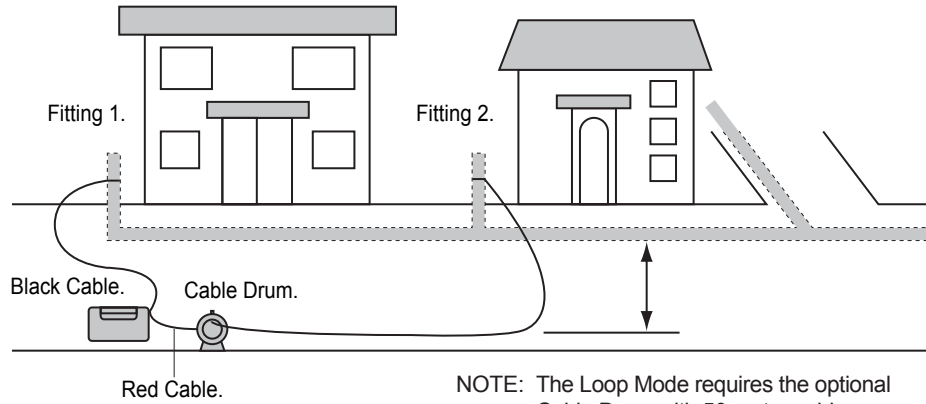
■ Finding the Optimum Transmitter Location

In the Direct Mode, the location of the ground stake can be critical to locating the line accurately.



1. The ground stake should be located to the side of the pipeline and as far away from it as possible in order to maximize the current flow in the line. The ground stake should not be located past the end of the line or close to an elbow. If these are nearby, move the ground stake in the opposite direction, away from them.
2. Check for multiple lines by moving the Receiver across the entire area between the ground stake and the red cable's clamp connection to the pipeline. If a second or third line is detected in the "straddle area," move the ground stake to the opposite side of the primary line to be located.
3. If multiple lines are present, use as low a frequency as possible, such as 8 kHz or .5 kHz, to minimize or eliminate "jumping" to other conductive lines.

5. LOOP MODE



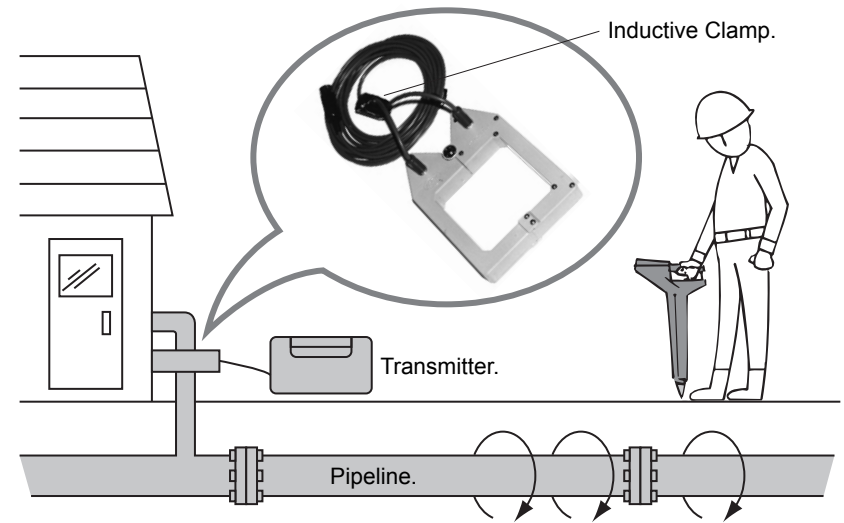
NOTE: The Loop Mode requires the optional Cable Drum with 50 meter cable, or make up your own length of wire cable.

The Loop Mode (or method) is often useful for locating water mains and service lines in areas with congested utilities. The Transmitter is operated in the Direct Connection Mode, and cables are used to directly connect the positive and negative leads from the Transmitter to the fittings that bracket the line to be located.

1. Look for two fittings/connections to the system that bracket the line to be located. Service line meters, hydrants, and valves are all suitable in water distribution systems, but the pipes must all be metal (and not plastic).
2. Connect the positive lead (red) cable down to the further-most fitting and the negative lead (black) cable to a nearby fitting.
3. Set the Transmitter to 8 kHz (or .5 kHz for completely continuous conductors) to minimize signal "jumping."
4. Locate the buried pipeline with the Receiver between the two fittings (1) and (2).

NOTE: Any pipelines beyond the fittings will not be located by use of the Loop Mode. The signal only flows between the two fittings.

■ INDUCTIVE CLAMP MODE



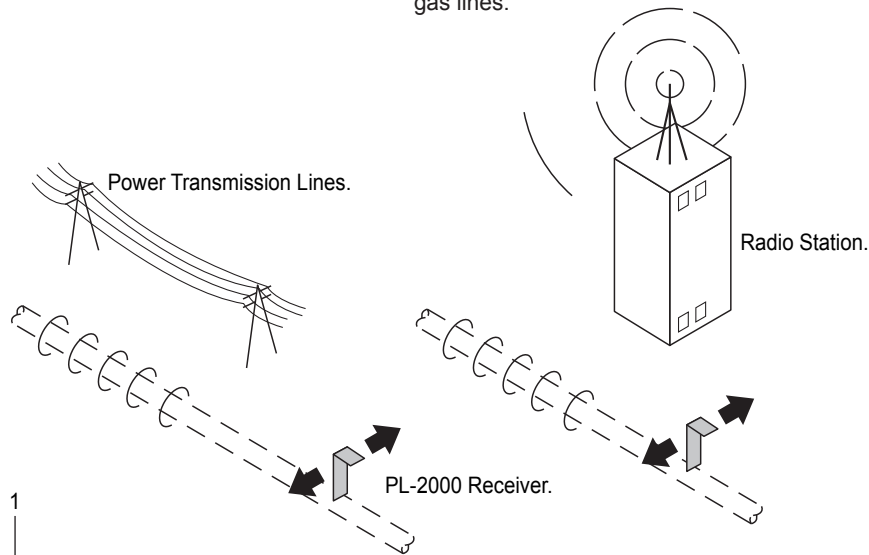
1. The Inductive Clamp Mode is used to energize insulated wires such as telephone lines and low power electric lines. The Transmitter is operated in the Direct Mode, and the cables for the Inductive Clamp must be plugged into the connector on the side of the Transmitter.
2. Open the jaws of the Inductive Clamp and close them around the insulated cable. The ground shield for the cable should be attached to ground at the opposite end of the line to be traced. Switch the Transmitter and Receiver to 27 kHz to induce the strongest signal in the insulated line.

NOTE: The Inductive Clamp Mode requires the optional Inductive Clamp as shown above.

NOTE: When the Inductive Clamp is clamped around a power cable, wear Rubber Gloves as a safety precaution to avoid electric shock.

7. RADIO MODE

The passive Radio Mode employs only the PL-2000 Receiver and the ambient radio signals emanating from power lines, radio stations, and other low frequency radio communications. These radio signals are present all over the earth and they often energize long pipelines, such as water and gas lines.



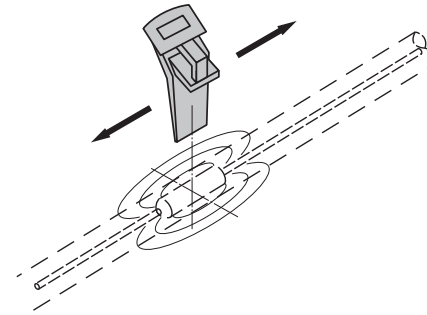
1. Press the Frequency Select key (2) until "Radio" is displayed on the receiver's screen.
2. At the Operating Mode key (3), choose the "Peak" Mode. The Radio Mode only works with "Peak" Mode.
3. Increase or decrease the Sensitivity (4) with the up/down arrow keys until the "signal pyramid" appears as two bars on the pyramid sides.

NOTE: The DEPTH function is not available in Radio Mode.



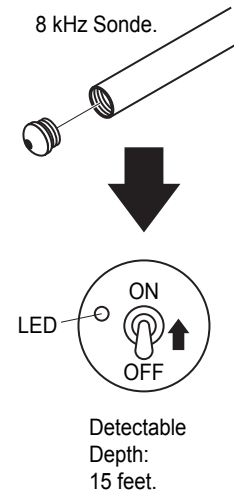
8. SONDE MODE

The Sonde Mode is useful for locating non-metallic pipelines, like PVC or asbestos/cement sewer pipes, clay pipes, concrete, etc., that do not have a "tracer wire." A "Sonde" is a small battery powered transmitter that can be attached to a sewer "snake," other flexible rod, or a "PIG," and pushed, or flushed through the pipe with a string attached to it.



Check the particular Sonde and PL-2000 Receiver together first outside of the pipe on the ground. Confirm that the Receiver is detecting the Sonde and measuring its depth correctly.

1. Turn ON the PL-2000 Receiver and press the Operating Mode key until a small Sonde appears in the upper left corner of the display.
2. At the Frequency Selection Key, choose 27 kHz, 8 kHz, or a .5 kHz, depending upon the frequency transmitted by the Sonde.
3. Turn ON the Sonde and lay it on its side. The PL-2000 receiver detects the Sonde from the side of the Sonde. When the Sonde moves through the pipe, the receiver is faced parallel to the pipe (and the Sonde) and not in the direction of the pipe (90 degrees from normal operation).
4. A Sonde makes 3 peaks: A large one directly over it and two "false" peaks, one off each end of the Sonde.



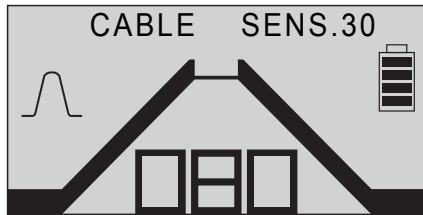
9. LIVE CABLE MODE

The Live Cable Mode is useful for scanning a job site for buried, live power cables with 50/60 Hz AC current flowing. The AC current must be flowing and not just be “potential” current. (The Power Line must be “USING” substantial current.)

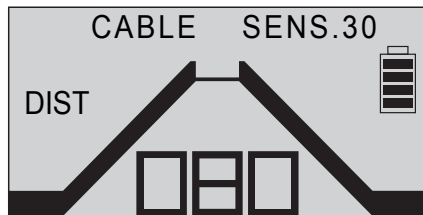
1. At the Frequency Selection key, choose “Cable.” At the Operating Mode Selection key, choose either “Peak” or “DIST.” In the “DIST” mode the distance located is greater but the locating accuracy is reduced. Adjust the sensitivity to the maximum with the UP arrow key (to level 40).
2. Use the PL-2000 Receiver to scan for the presence of live cables. When a live cable is detected, it can be traced with the Transmitter in the Inductive Mode and the Receiver switched to the matching frequency 27 kHz or 8 kHz.
3. In the Live Cable Mode, the PL-2000 Receiver’s depth function is not available, and the Transmitter is not used.



Display of Peak Mode



Display of DIST Mode



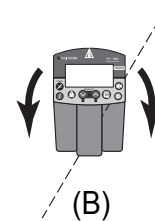
■ Depth Measurement in Peak and Sonde Modes

The Depth Measurement function is available in the Peak and Sonde Modes, and is nominally accurate to +/- 5%. Like all pipe and cable locators, there must be at least 70 feet between the Receiver and Transmitter in order for the Depth Measurement to be accurate, and there must be only one conductor.

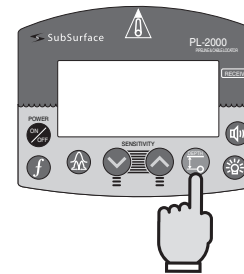
1. For Depth Measurement of a pipe or cable, select “Peak” at the Operating Mode key. Locate the line exactly over the top of it with the PL-2000 Receiver, and rest the rubber “foot” of the Receiver on the ground or street (see A).
2. Rotate the Receiver until it is directly facing in the direction of the line and the signal is the strongest (see B).
3. Depress the “Depth” key and hold the Receiver still for a few moments until the depth is displayed in inches (see C).
4. In the lower right corner of the depth display is the Current Measurement normalized between 0 and 100. If multiple lines are present, the primary line has the highest current.
5. If the message TX POWER DOWN appears on the Receiver, reduce the output power of the Transmitter.



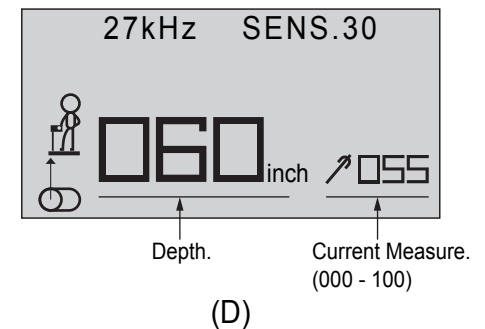
(A)



(B)

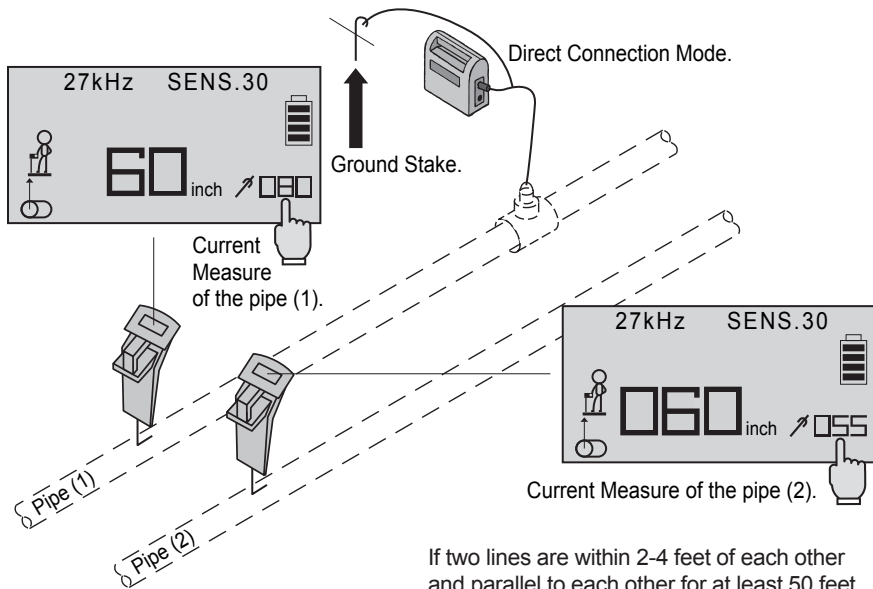


(C)



(D)

Current Measurement in Parallel Lines

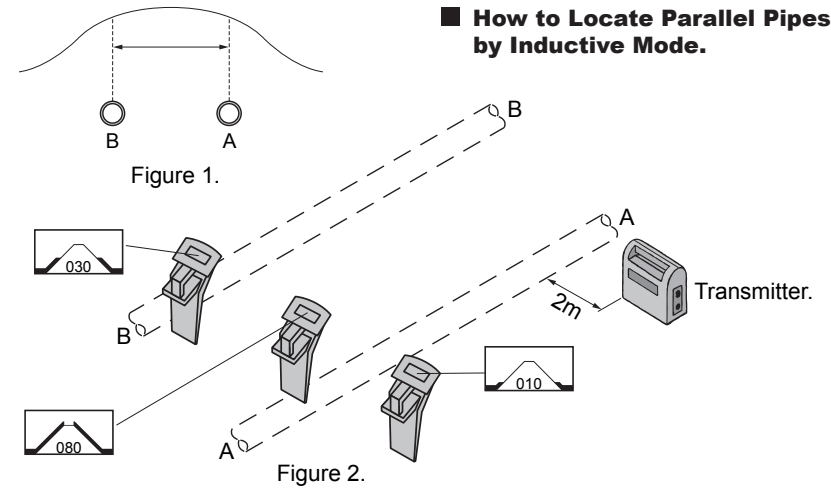


If two lines are within 2-4 feet of each other and parallel to each other for at least 50 feet or more, the primary line may induce a signal in the secondary line, particularly at higher frequencies (27 kHz).

The secondary line always has lower current flow than the primary line, which should be energized by the Direct Mode at the Transmitter to minimize "jumping."

1. Locate both lines exactly with the PL-2000 Receiver and press the Depth key with the Receiver directly over each line. Note the Current Measurement for each line.
2. The line with the larger Current Measurement value (0-100) is the primary line attached to the positive (red) Direct Connection cable from the Transmitter.
3. The ground stake should be moved as far away from the secondary line as possible. If the ground stake crosses over the secondary line, both lines may have the same (or similar) Current Measurements.

How to Locate Parallel Pipes by Inductive Mode.



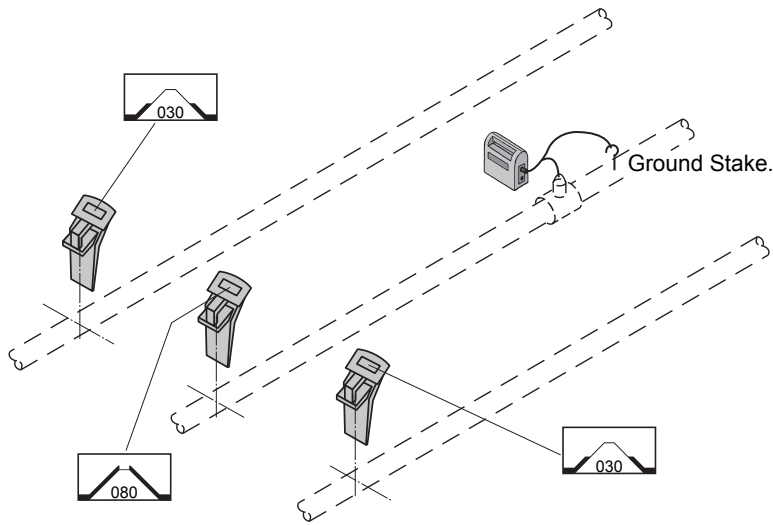
NOTE: When parallel pipelines are detected, the Direct Mode should be utilized when possible.

As shown in the above Figure 1, the Maximum Bar Graph and Maximum Numerical Value are continued between the points (A) and (B). In this case, the two pipelines (A) and (B) must be located separately.

1. Set up the Transmitter at the outside of the pipeline (A) keeping the distance of 2 meters or so to the pipeline (A) as shown by the above figure.
2. Move the Receiver from the outside of the pipeline (A) toward the pipeline (B). The Bar Graph and the Numerical Value will be changed as in the above example. The point of the Maximum Bar Graph and the Maximum Numerical Value of 080 is the location of the pipeline (A).
3. When the pipeline (B) is located, move the Transmitter to the outside of the pipeline (B).

NOTE: In cases where there are more than two parallel pipelines in a short interval, the Inductive Mode can locate only the two pipelines on the outsides.

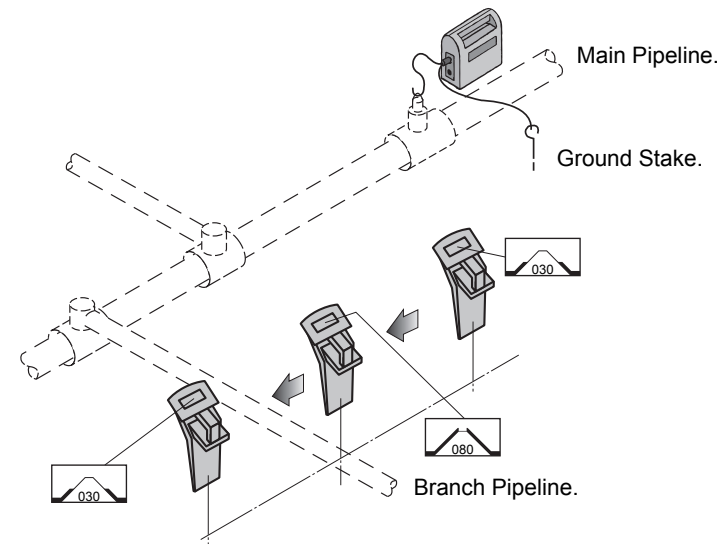
■ Locating Congested Utilities with the Direct Mode



The Direct Mode in the Transmitter together with the lowest frequency are the best strategy for locating lines in areas with congested utilities.

1. Select the Direct Mode in the PL-2000 Transmitter and choose either the 8 kHz or .5 kHz frequency. If the primary conductor to be located is continuous, like a steel gas line or a tracer wire, then choose the .5 kHz frequency. If the primary target is a water main, choose 8 kHz. For an insulated tracer wire, remember to ground the far end.
2. Connect the positive (red) cable to a metal fitting connection or valve in the target line. Position the ground stake for the negative (black) cable very close or directly over the top of the target line. This minimizes energizing the adjacent lines.
3. Because the ground stake is so close to the target line, the distance located will be relatively short.

■ Locating Branches in Pipelines and Water Services from the Main



Locating branches in pipelines and service lines from water mains can be done in the Direct Mode or the Inductive Mode, but usually the Direct Mode is preferred. In the Direct Mode at 8 kHz, the PL-2000 Transmitter has maximum power.

1. In the Direct Mode, select a location for the ground stake that is on the same side of the main as the branch pipeline or service line. Put the stake 10-15 feet away from the main to maximize the power delivered to both.
2. Use "Peak" Operating Mode to have the greatest accuracy for locating the branch line or service line.
3. Walk parallel to the water main 5-10 feet away from it in the area where the branch pipeline or service line is expected to be. Hold the PL-2000 Receiver parallel to the main and facing in the direction of the branch or service line. When the Receiver crosses over the line, it should respond immediately.

■ Warranty

SubSurface Locators and SubSurface Instruments, Inc. (SubSurface) warrants the PL-2000 and all of its accessories to be free from defects in material and/or workmanship for a period of thirty-six (36) months from the date of shipment by SubSurface to the original purchaser, subject to the following:

SubSurface's warranty obligation is, in its sole discretion, strictly and absolutely limited to repair or replacement of any product or part thereof. Any product for which a warranty claim is made must, as a condition precedent to warranty coverage, be returned to the factory, shipment prepaid, by the original purchaser and must be accompanied by a written explanation of the defect in material and/or workmanship. Additionally, and as a further condition precedent to warranty coverage, all serial numbers must be legible and all components of the product must be intact and not dis-assembled or opened by un-authorized repair individuals.

All other warranties, express or implied, including, but not limited to, any implied warranty of fitness for a particular purpose and any implied warranty of merchantability are specifically disclaimed. Specifically, and without limitation, damage to the product caused by abuse or misuse of the product, exposure of the product to or contact with battery acid, any caustic substance or water are specifically excluded from the warranty hereunder. Under no circumstance shall SubSurface be liable or responsible for any injury to any persons or any property or for any special, consequential, incidental, punitive or other damages of any kind whatsoever incurred by reason of the purchase or use of this SubSurface product. The Purchaser agrees, by accepting delivery, that it will forever keep, save and hold SubSurface and its officers, directors, employees, agents, parents, subsidiaries and affiliates, completely free and harmless from and against any and all such damages and any and all such costs, including, but not limited to, attorney's fees and legal costs arising therefrom.

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