

FUJI TECOM INC.

**PL960-AC
PIPELINE AND
CABLE LOCATOR
TRAINING MANUAL**

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PREFACE

The Fuji PL-960-AC Metal Pipe and Cable Locator is the most recent development of Fuji Tecom Inc. The PL960-AC is the result of an evolution from the original FUJI TECOM PL801 manufactured in 1967, and the original PL960 in 2000. This state-of-the-art tool accents ease of operation and accurate detection features to allow operators to confidently solve the numerous problems encountered in the field. This tool is ideally suited to the Underground Utility Locating Industry for the wide variety of applications this industry encounters.

The difference between the PL960 and the PL960-AC is, the PL960-AC now has the Live Cable Detection Mode, and the 334 kHz feature has been deleted. The PL960AC has more sensitivity and response than any of its predecessors.

This manual will enable the operator to derive maximum capabilities from the PL960-AC. Knowledge of the equipment functions, safe operating procedures, and accident prevention suggestions are detailed in this manual. Should the operator have any specific questions not covered in this manual, it is suggested the operator contact Alberta Locators Inc.

TESTING AND MAINTENANCE

This document details the recommended testing procedures for preventative maintenance and troubleshooting operations of Fuji Tecom Pipe Locators.

We recommend performing this procedure on a weekly basis, or prior to use if the tool has not been checked within the recommended weekly basis.

Test Procedures

***Test results should be retained in a log book.**

1. Set up a test location, with a known underground facility
2. Ensure you put fresh batteries in transmitter and receiver before conducting tests.
3. Examine all old batteries when replacing with new batteries for evidence of leakage
4. Put a permanent mark for transmitter location for initial test and all subsequent tests
5. Turn transmitter on and place over underground facility with correct orientation
6. Precise placement and orientation of the transmitter is necessary to repeat test results
7. Permanently mark 2-3 set distances from the transmitter (approx.. 20 feet apart) where readings will be taken with the receiver, for initial test and all subsequent tests
8. Using the receiver go to first marked receiver location on underground facility, place the footplate of the receiver on the ground over centerline of underground facility
9. Take a depth reading by pressing depth button, wait for prompt to pull up. With on foot on footplate, pull receiver upwards extending the slide pipe fully.
10. Allow receiver to compute the values
11. With the depth displayed, record all required information including, Depth, sensitivity and Current Measurement
12. Repeat at other pre-marked locations
13. Repeat steps 5-10 using locate tools additional frequencies by first changing the frequency on transmitter and then the receiver.
14. The locate tool should be tagged and sent in for service and calibration if a change is identified in the following readings.

Test Results

- **Any Location** change in the (X?Y orientation, or left or right over the test line) the Receiver should consistently read a maximum reading indication when directly above or on the test points
- **Depth** reading of +or – 10% (Z orientation or depth of test line)
- **Sensitivity** readings at the receiver are a function of output from the transmitter (it tells you if the transmitter is working properly). To test and confirm repeatability of sensitivity, the transmitter must be precisely placed in the exact location and orientation as of where the original test data was documented. Sensitivity reading may vary depending on the placement of the transmitter. The distance from the receiver to the transmitter will also vary significantly if the receiver is not precisely at the same location and orientation as the original test data points. Battery strength may affect sensitivity to some degree.
- **Current Measurement** readings at the receiver are a function of reception of the signal from the pipeline. The current measurement indication changes when moving along the test line away from the transmitter. Orientation of the transmitter to the receiver will change the current response. Distance from the transmitter to the receiver will change the current measurement. To replicate original test readings, precise placement of both transmitter and receiver is required.

Good Practices

- Remove batteries if the tool will not be used for extended periods of time
- Keep the tool in clean condition and specifically avoid metallic dust.

Troubleshooting known errors that may occur

“Push Down” is displayed when the receiver is at center of the line and the depth button pressed. This may indicate the footplate assembly has unthreaded, so check and screw it tight if it has become loose. Another possible cause is due to a dirty optic sensor. This will prevent the receiver from being able to read the position of the slide pipe

“Over Current” is displayed on the transmitter. This issue may stem from multiple issues, but this transmitter is not working to manufacturer specs.

Difficult to extend and depress slide pipe. The slide pipe should move freely, with minimal resistance and noise. Be sure to continually clean slide pipe of moisture and debris, to keep it from jamming up and bringing dust, dirt and water inside the housing of the receiver.

Acid Damage. When changing batteries always check that battery compartments are free of dirt, moisture and acid damage. All batteries and equipment should be taken inside during cold temperatures and you should never heat up cold batteries. Monitoring of the battery housing for traces of acid damage can help avoid serious damage, if an issue arises see below for “leaking Battery Procedure”

Weak Signal. This issue can occur in the transmitter or receiver and will be noticed during the testing by comparing it to previous values recorded. If a drastic change is noticed in location, depth or current measurement or sensitivity are found, the locate tool should be tagged and sent in for service / calibration.

Leaking Battery Procedure

Whenever replacing batteries, thoroughly examine dead or low batteries for evidence of leakage. Look in battery compartments and look for evidence of residue. Do not put new batteries in transmitter or receiver if any residue is observed. In the event of leaking batteries, remove them to reduce further damage.

If an incident has occurred:

1. Remove batteries. Do not replace with new batteries.
2. Neutralize and clean battery compartment with baking soda, 3-4 tablespoons in battery compartment.
3. Close battery compartment and shake
4. Open battery compartment shake out any excess baking soda and clean battery terminals with soft brush
5. The locate tool should be sent in for service/calibration after this procedure is complete.

Wet Locate Tool Procedure

Receiver

1. Remove the battery pack
2. Extend slide pipe fully out and towel off any moisture
3. Lay receiver on its side, in a warm dry environment
4. Do not place in close proximity of a heat source
5. Do not stand it right side up, or upside down, as any condensation may migrate to the circuit boards in the head or the top of the receiver

Transmitter:

1. Remove all batteries and towel out any moisture in the battery compartment or anywhere else on transmitter.
2. Lay transmitter flat with battery compartment open to dry, in warm dry environment.
3. Do not place in close proximity to a heat source
4. The locate tool should be tested after drying is complete

Prior to sending tool in for service and or calibration, call and explain issue to Fuji Pipe Locators Ltd . (403) 277-3300 or ben@leaklocate.com

PRECAUTIONS

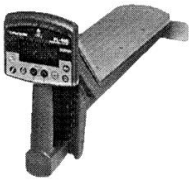
1. Equipment failure may occur from water infiltration, excessive moisture and/or dust contaminants.
2. Two personnel operation increases locating efficiency and transmitter protection.
3. Do not operate the PL-960-AC in EXTREME rainy environments. The PL960-AC Locator is not totally waterproof but can be operated in mild inclement conditions. Allow the tool to dry completely prior to enclosing in its carrying case should it get wet.
4. The PL-960-AC is not shockproof. Dropping or careless handling of the tool may cause damage.
5. External or internal damage may occur from prolonged periods of exposure to direct sunlight or high temperatures.
6. DAMAGE CAUSED BY LEAKING BATTERIES IS NOT COVERED BY WARRANTY
7. **BATTERY INFORMATION: The Fuji Tecom PL960AC warranty does not cover damage caused by battery acid.**
8. **Batteries** will leak if left neglected for extended periods of time in the tool.
9. Batteries will leak if heated up abruptly after being frozen. Do not heat up frozen batteries.
10. Place frozen batteries in room temperature environment and allow to reach ambient temperature naturally.
11. Placing any frozen transmitter in very close proximity to a vehicle heater is the primary cause of battery leakage.
12. **If BATTERY ACID IS observed, immediately turn off tool and remove batteries.**
13. **Dispose of batteries. Pour powdered BAKING SODA (available in any grocery store) in the battery compartment where acid is identified. This will neutralize the acid and arrest further acid damage.**
14. **Do not put new batteries into unit, as this will cause the leaked battery acid to migrate to components in the tool and may cause severe damage.**
15. **Send tool immediately in for repair by an authorized distributor.**

STANDARD EQUIPMENT

The Fuji Model PL-960AC Locator consists of the following standard equipment:



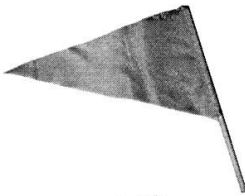
- **Transmitter:** Operates via a 12 volt DC power supply consisting of eight "D" size alkaline batteries. Weight: 2.5 kg.



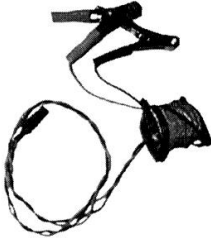
- **Receiver:** Operates via a 9 volt DC power supply consisting of six "AA" size Alkaline Batteries. Weight: 2.0 kg.



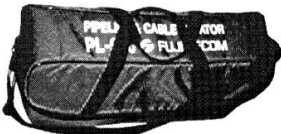
- **Ground Rod / Stake:** 30 cm long for the Direct Mode of Operation



- **Warning Flag:** That fits in the Transmitter as an aid to identify its presence on site.



- **Direct Mode Cable Apparatus:** Clamps for connecting directly to an underground cable or pipeline.

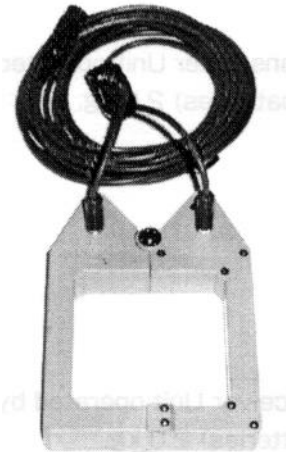


- **Soft Carrying Case:** To contain the PL960-AC.

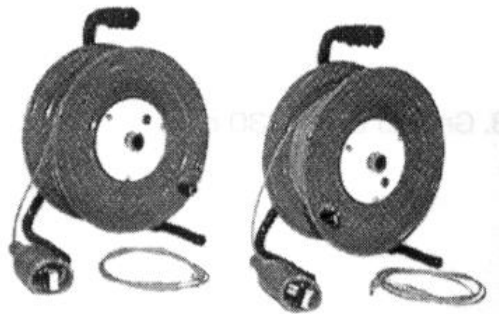
OPTIONAL ACCESSORIES

The following optional accessories are available for the PL-960-AC Locator.

- **The External Inductive Coil:** Utilized for locating cables and small diameter lines that have access points above ground.
- THIS ACCESSORY COMES WITH SOME TOOLS AS STANDARD EQUIPMENT ASK YOUR DEALER FOR DETAILS



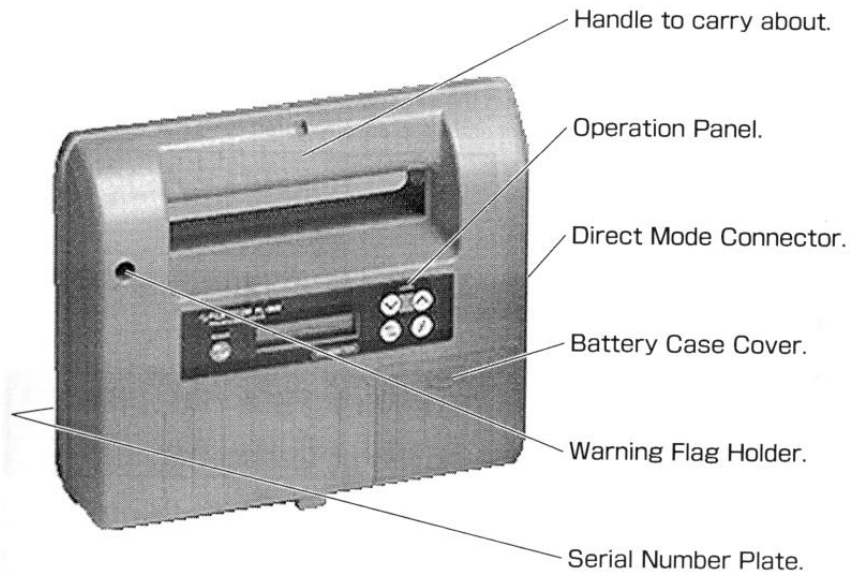
- **Cable Drum with 50 meters of Cable:** Required for the Loop Cable Mode of operation for energizing a bracketed section of line with access points at each end of the section being examined.



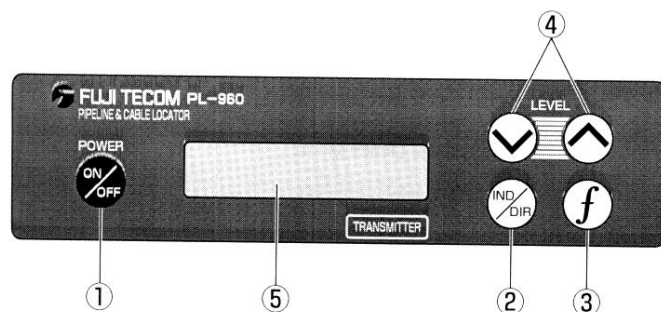
- **Sonde:** This accessory is a small Transmitter that can be inserted into a nonmetallic pipeline and can be used to determine the exact location of a given point in a pipeline by means of pushing or pulling the sonde through the section being inspected. The plumbing Industry commonly uses this device to determine obstructions or breaks in a pipeline
- **External Power Supply Cable:** Cables to connect to an external 12-volt source such as a vehicle battery.

OPERATION OF TRANSMITTER (1)

Transmitter Unit.

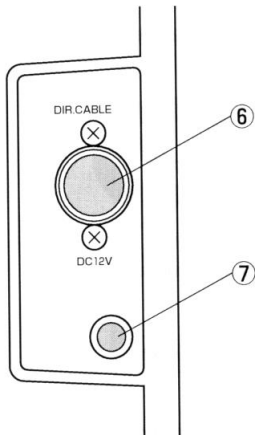


Operation Panel.



- ① Power Switch Key.
- ② Mode Selection Key.
- ③ Frequency Selection Key.
- ④ Output Power Control Key.
- ⑤ LCD.

OPERATION OF TRANSMITTER (2)



Connections.

□ Direct Mode Connector

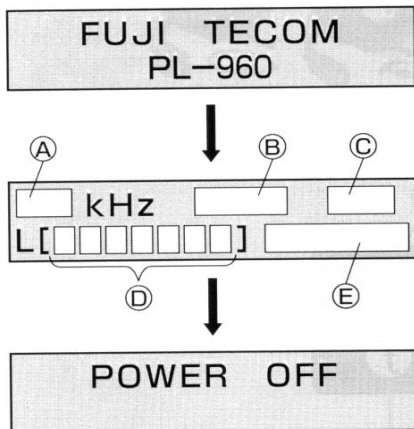
□ External Power Connector

When External Power is used, the optional External Power Supply Cable is required. This cable can be connected to a 12-volt power supply such as a vehicle battery.

LCD Display of Transmitter.

The PL-960-AC Transmitter displays the following information on the LCD display.

Push the **Power Switch Key** to turn on the tool. An audio signal "Tick - Tack" is repeated four times indicating the transmitter is in the "ON" position.



(A) Displays the frequency choice.

Induction Mode: 83 kHz or 27 kHz.

Direct Mode: 83 kHz or 27kHz or Live Cable

Mix: simultaneous output of both 83kHz and 27kHz.

(B) Displays the Output Mode

IND = Induction Mode.

DIR = Direct Mode.

(C) Displays the Power Source



= Internal battery operation



= Car battery operation

(D) Displays the **Output Power Strength** from "0" to Maximum "7"

(E) Displays the **Output Power Status** in the Direct Mode.

• POOR $\frac{\square}{\square}$ — Means "Power level is wrong".

• $\frac{\square}{\square} \sim \frac{\square}{\square} \frac{\square}{\square} \frac{\square}{\square}$ — Means "Power level is good".

Transmitter "Auto OFF" Function Mode: This is the Default Mode for the Transmitter when it is turned ON or OFF. This energy saving feature insures the batteries are not accidentally depleted during day to day operations. The Transmitter automatically shuts off after an hour of operation.

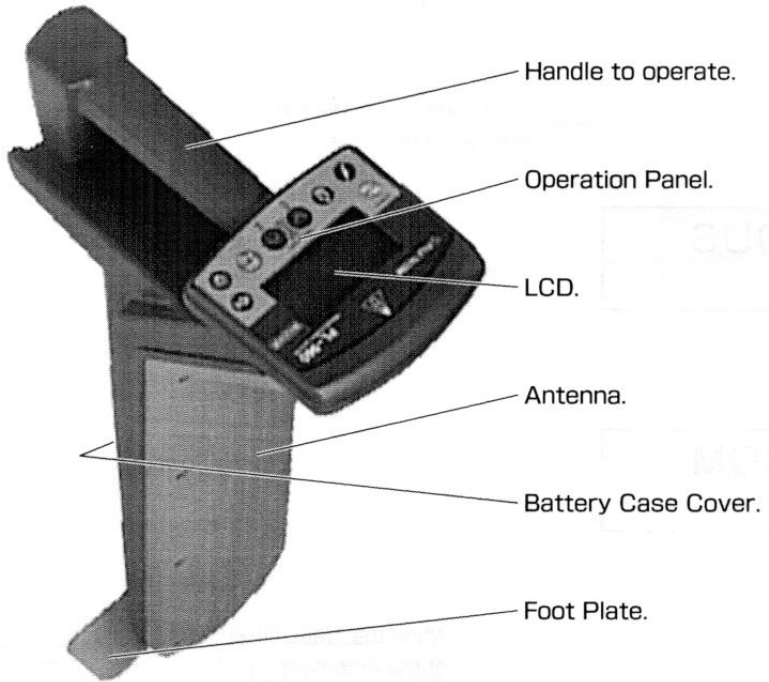
OPERATION OF TRANSMITTER (3)

The PL960AC Transmitter has a one-hour **Automatic Off** function to save power should the operator fail to manually turn off the Transmitter after use.

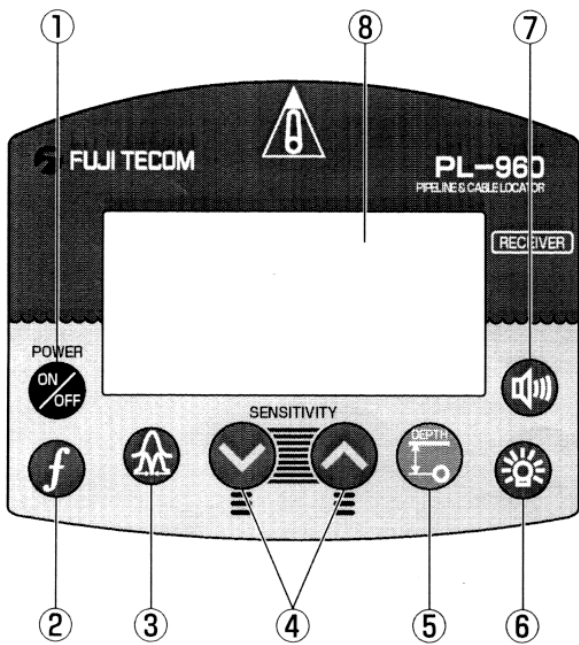
- When the transmitter is turned ON, the Transmitter is operating at 83Khz and in the INDUCTIVE MODE of operation, at Maximum Output.
- The Transmitter can be turned down in Output Power as required.
- The Transmitter can operate at 27Khz by changing the Frequency The Transmitter can operate at either Inductive IND or Direct DIR Mode of Operation.
- Inductive Mode utilizes the Internal Inductive Coil of the Transmitter to energize the Underground Facility.
- The Direct Mode bypasses the Internal Inductive Coil and requires the operator to connect directly to the Underground Facility at an access point such as a valve, test lead or tracer wire etc.
- In the Direct Mode of operation the Transmitter can be set to 83Khz, 27Khz or MIX. MIX allows the Transmitter to operate at both 27Khz and 83Khz simultaneously.
- This MIX Mode only operates in the DIRECT Mode of operation. In the MIX Mode the operator can change from 83Khz to 27Khz at the Receiver as required depending on field conditions.
- 83Khz is the default mode of operation, so when the tool is turned **ON**, this mode is ON, 83Khz Mode can detect most facilities and is most often used to locate underground facilities. A clear, tight signal is produced at 83Khz.
- 27 Khz allows the operator to detect lines longer distances than at 83Khz but the signal response is not as precise as at 83Khz. A wider less clear indication of the underground facility is noted at 27KHz.
- The Clarity of signal is affected by: Depth of Cover, Line Size, and Other Parallel Facilities in proximity to the line being detected.

OPERATION OF RECEIVER (1)

Receiver Unit.

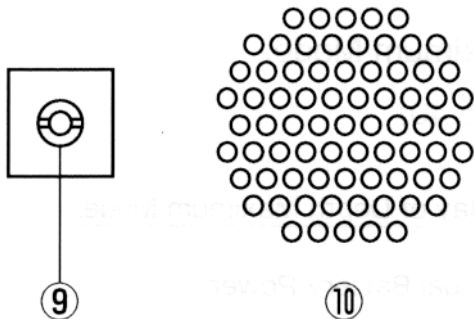


Receiver Operation Panel.



- ① Power Switch Key.
- ② Frequency Selection Key.
- ③ Mode Selection Key.
- ④ Sensitivity Adjustment Key.
- ⑤ Depth Measurement Key.
- ⑥ Back Light Key.
- ⑦ Sound Volume Control Key.
- ⑧ LCD.

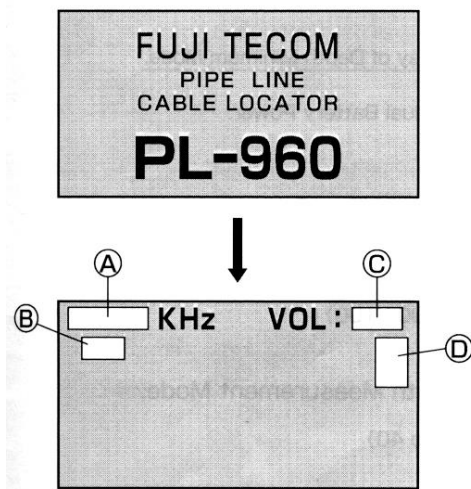
OPERATION OF RECEIVER (2)



9 Headphone Plug Connector is located on the backside of the Receiver.

10 Speaker Output Net is located on the backside of the Receiver.

LCD Display of Receiver.



The PL-960-AC Receiver displays the following information on the LCD screen.

Push the Power Switch Key to Turn On. "FUJI TECOM PIPELINE CABLE LOCATOR PL-960" is displayed. This indicates Power is **ON**.

(A) Displays the Frequencies of Choice.
83kHz or 27kHz or LIVE CABLE or RADIO.

(B) Displays the Modes of Choice.
THE PL960-AC HAS A LIVE CABLE MODE TO DETECT ELECTRICAL LINES AND CATHODIC PROTECTION LINES

Maximum Mode = (人)

Minimum Mode = (Y)

Bar Antenna Mode = (BAR)

Sonde Mode = (P)

(C) Displays the Sensitivity Level of the signal transmitted from the Transmitter.

(D) Displays of the residual Battery Power.

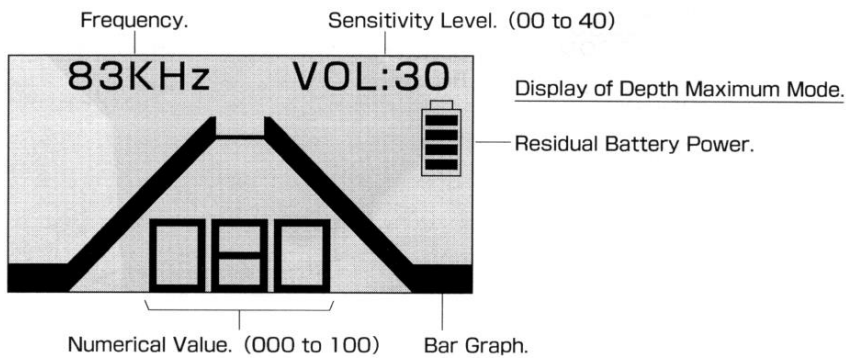


NOTE: When the keys are not operated for five minutes, the AUTOMATIC OFF function is enabled and the power to the unit is shut off, to save battery life.

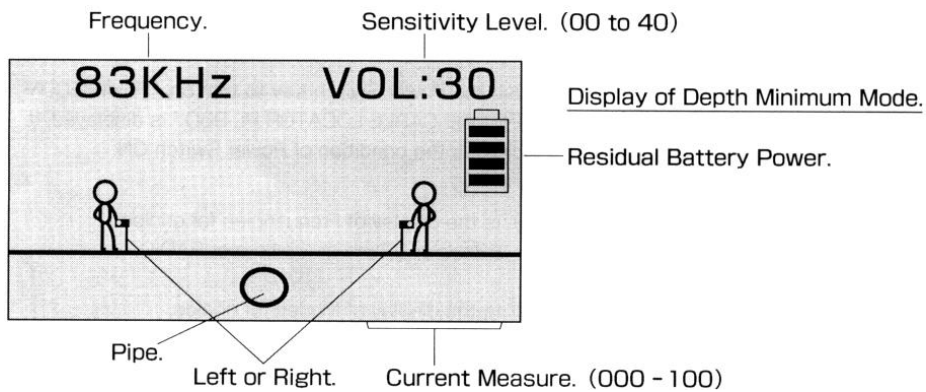
OPERATION OF RECEIVER (3)

Mode Displays (Maximum, Minimum, & Depth Measurement Modes).

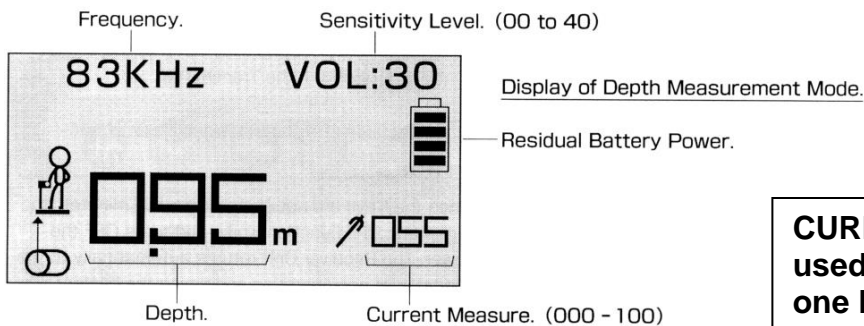
Maximum Mode.



Minimum Mode.



Depth Measurement Mode.



CURRENT MEASUREMENT is used to differentiate between one line and another.

OPERATION OF RECEIVER (4)

How to read CURRENT MEASUREMENT

When you take a depth measurement observe the numeric value next to the Depth. This is your CURRENT MEASUREMENT.

AS AN AID IN TRACKING LINES THAT ARE CLOSE TOGETHER:

When tracking a pipeline in a congested area, by taking **CURRENT READINGS** the Operator can differentiate between lines due to the fact each line has a different CURRENT READING.

AS AN AID IN DETERMINING THE MOST ACCURATE DEPTH MEASUREMENT:

current measure is a value displayed between 000 and 100 digitally converted from the electric current transmitted from the buried pipeline. The value between 000 and 100 is utilized to determine if the PL-960-AC Locator can measure the depth of a pipeline correctly. Try to obtain a reading of approximately 80 for determining depths. Placement of the Transmitter to the location of the depth point, the output of the Transmitter, and sensitivity of the Receiver will aid in depth processing.

NO DEPTH CAPABILITY IN BAR MODE OR MINIMUM MODE OR LIVE CABLE

NOTE: The Bar Mode and the Minimum Mode can not measure the depth of a pipeline. **Only in the Maximum Mode of operation can a depth measurement be successfully attempted. The Receiver display will inform the operator with the prompt "ILLEGAL FUNCTION" if a depth is attempted in the wrong mode of operation.**

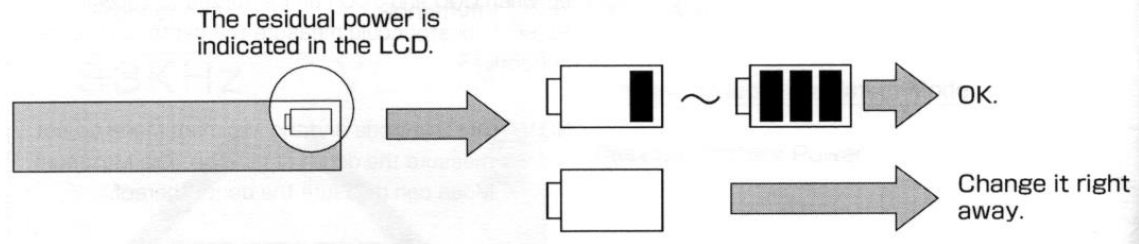
LIVE CABLE MODE OF OPERATION:

The PL960-AC will detect LIVE CABLES WITH THE RECEIVER ALONE. THE RECEIVER DETECTS THE ELECTRICAL FIELD WITHOUT THE AID OF THE TRANSMITTER. SET THE RECEIVER TO "LIVE CABLE" MODE AND SCAN FOR DETECTION INDICATION.

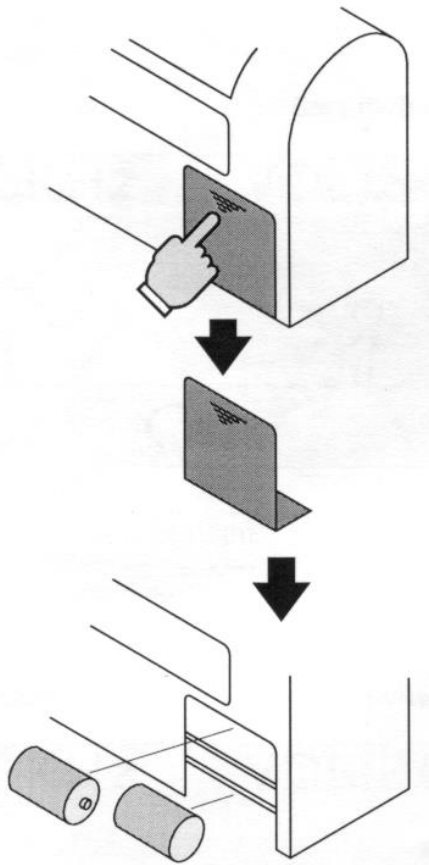
REPLACEMENT OF THE BATTERY

1. Transmitter.

When the battery mark displayed on the LCD is reduced to Zero as detailed below, replace batteries. When replacing batteries, insure all batteries are replaced at the same time.



How to change batteries.



Push on the non-skid part of the Battery Cover and then push the cover downwards as indicated by the arrow stamped on the cover. The battery cover is detachable.

NOTE: When the Direct Mode is used, you may experience a sudden reduction in the battery power supply, resulting in the unit shutting off. Confirm the battery status. If batteries are low, shut down will occur. Replace batteries, as each time the unit is grounded, a small residual power loss occurs as a result of grounding the transmitter. This drains the remaining power required to allow the Transmitter to function.

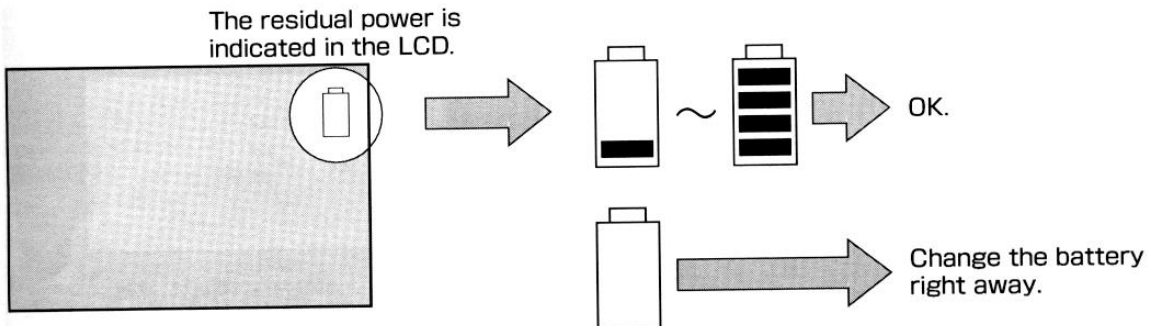
NOTE: When installing new batteries, insure the polarity of the battery is correct before insertion into the battery housing.

NOTE: When the battery mark is at ZERO, the Transmitter automatically shuts off.

REPLACEMENT OF THE BATTERY

2. Receiver

When the battery mark displayed on the LCD is reduced to Zero as detailed below, replace batteries. When replacing batteries, insure all batteries are replaced at the same time.



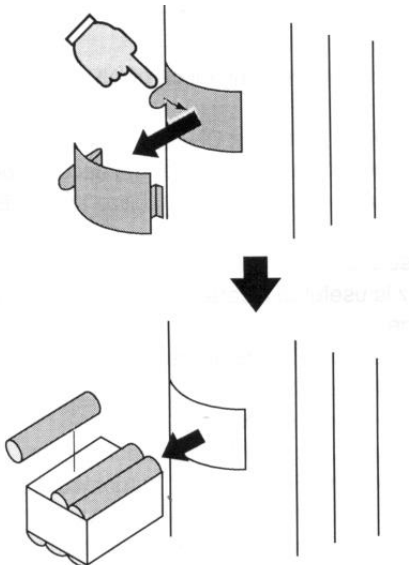
How to change the batteries.

Push the battery cover toward the right as shown by the small arrow mark and detach it towards the large arrow mark as detailed in the figure.

Pull out the battery housing to replace the batteries.

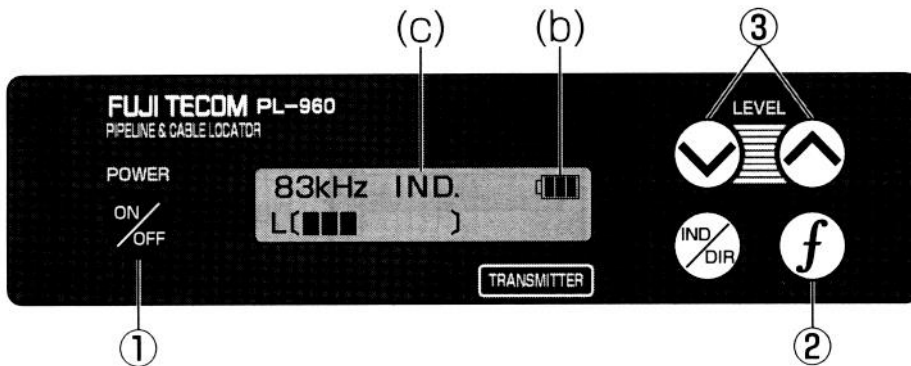
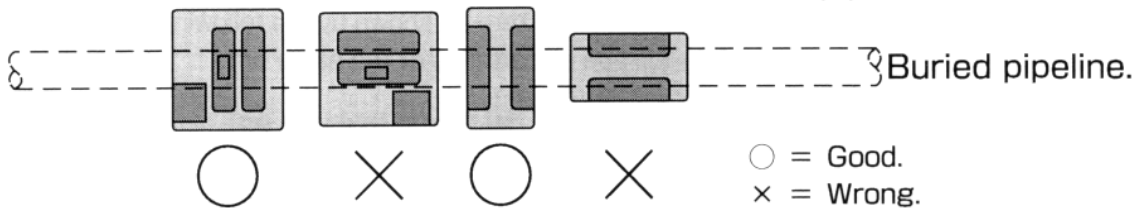
NOTE: When installing new batteries, confirm the polarity of the batteries is correct prior to insertion into the battery housing.

NOTE: When the battery mark is at Zero, the Receiver automatically shuts off.



HOW TO OPERATE THE TRANSMITTER

Induction Mode and the correct position of the Transmitter on the buried pipeline.



1. Push the Power Switch Key (1) and confirm the following:
 - a.) When the power switch works normally, a "Tick-Tack" is heard four times.
 - b.) Check the residual battery power by the graphic display (b) on the LCD display.
 - c.) Confirm the operation mode of IND (induction mode) at (c) on the LCD display.

NOTE: Prior to switching ON the Transmitter shortly after switching the Transmitter OFF, allow ten seconds before turning the unit ON again. This is required to allow the Primary Circuit Board to stabilize and reset itself.

2. Choose either 27kHz or 83 kHz frequency.
 - 27kHz is useful to locate straight and continuous pipelines.
 - 83kHz is useful for locating shorter lengths of pipeline of about 100m or so.

NOTE: Use the proper frequency in accordance with site conditions. When the unit is turned ON, **83kHz** frequency is the **default frequency**.

27 & 83kHz frequencies are used in the **INDUCTION MODE**.
LIVE CABLE MODE DOES NOT REQUIRE THE TRANSMITTER

3. Adjust the OUTPUT LEVEL.

When the power is turned On, the Output Level is displayed at the maximum setting. The "L" in the LCD display shows the output level in 8 steps or linear bars.

HOW TO OPERATE THE RECEIVER

1. Push the Power Switch Key (1).

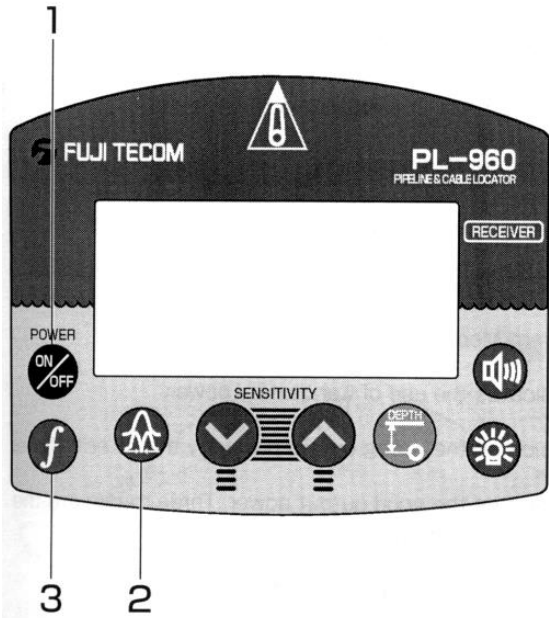
2. Choose one of the following modes.

Maximum Mode: This mode will locate the position most accurately.

Minimum Mode: This mode allows the locator to proceed quicker but positional accuracy of the pipe is diminished.

Bar Mode: This mode is used only when performing long distance tracking of a pipeline after the signal diminishes while using the Maximum Mode.

Sonde Mode: This mode utilizes the optional Sonde (probe) for Non metallic pipelines, such as PVC or other plastic pipes.





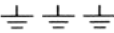
3. Select one frequency.

The Receiver frequency must match the Transmitter frequency for the PL960 to operate.

MESSAGE PROMPTS EXHIBITED ON THE LCD RECEIVER & TRANSMITTER DISPLAYS

The PL-96AC Transmitter and Receiver display the following message prompts:

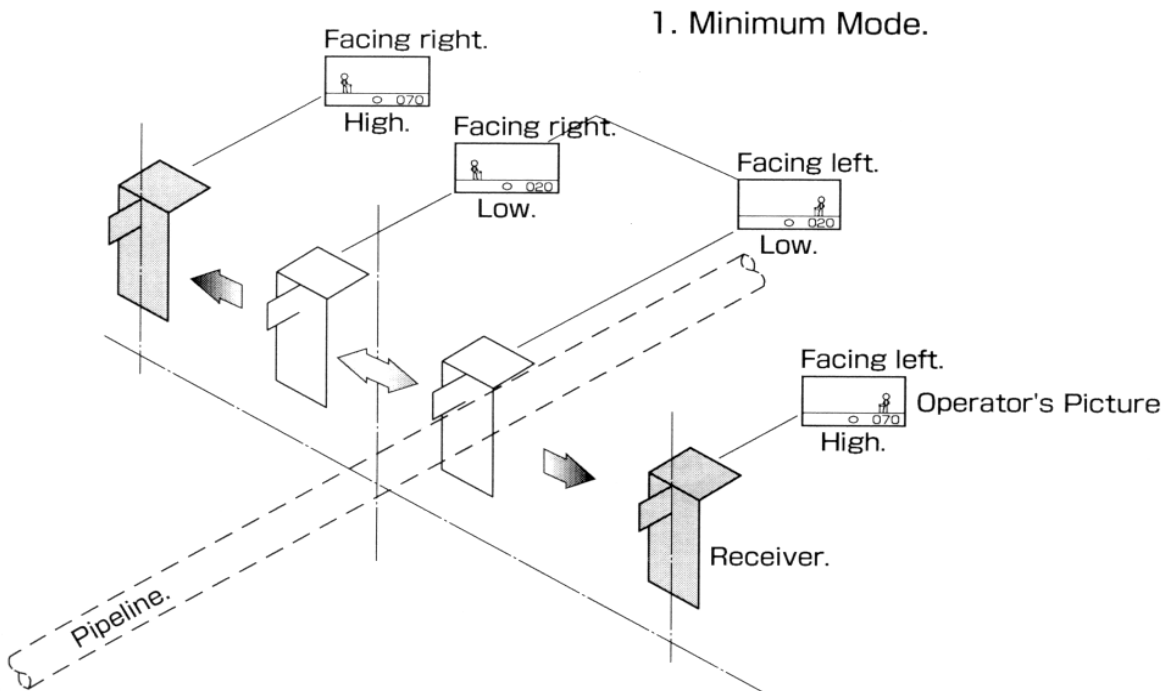
1. Transmitter display prompts:-

- **CHANGE BATT.** : Indicates time to change batteries.
- **OVER CURRENT** : If **OVERCURRENT** is displayed, turn the Power Switch Off and then On again. This insures the automatic adjustment is functioning.
- **IND.** : Induction Mode
: Direct Mode
- **DIR.** : Induction Mode
: Direct Mode
-  : Indicates an external power supply such as a vehicle battery source.
- **POOR**  : Indicates incorrect output power setting in the Direct Mode.
-  : Indicates good output power. Three marks indicate maximum output power.
- **CONTINUOUS** : Indicates the cancellation of "AUTOMATIC OFF" function.
- **POWER OFF** : Indicates "POWER OFF" after non-operation for one hour or when the Power Switch is turned OFF.

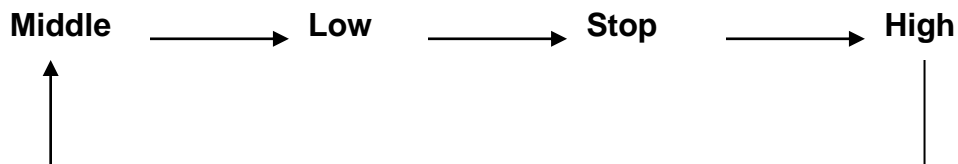
2. Receiver display prompts:-

- **OVERSIGNAL:** Indicates the gain signal is too high.
- **PUSH DOWN:** Indicates the antenna shaft / footplate is not pushed down properly.
- **DEPTH ERROR:** Indicates the depth of pipeline was not measured
- **ILLEGAL FUNCTION:** Indicates depth measurement was done in an improper mode.
- **NO SIGNAL:** Indicates the transmitter signal reception is too weak.
- **GAIN ERROR:** Indicates unstable condition of the gained signal.
- **WAIT:** Indicates the time when the automatic adjustment and depth measurement is being processed.
- **PULL UP:** Indicates to raise the antenna (shaft / footplate) to its full length to allow measurement of the depth of the pipe.
- **POWER OFF:** Indicates the Receiver unit is OFF as a result of non-operation over a period of 5 minutes in length.
- **CHANGE BATT.:** indicates to change Battery.

OPERATION ON SITE (1)



- Hold the receiver over the place presumed to be where the pipeline is situated. Insure the Receiver is facing the same direction that the pipeline is running.
- Adjust the sensitivity level with the "Sensitivity Adjustment Key" so that the level is around VOL:30.
- Adjust the sound level with the Sound Volume Control Key to a level high enough to be heard. The sound volume changes as follows:



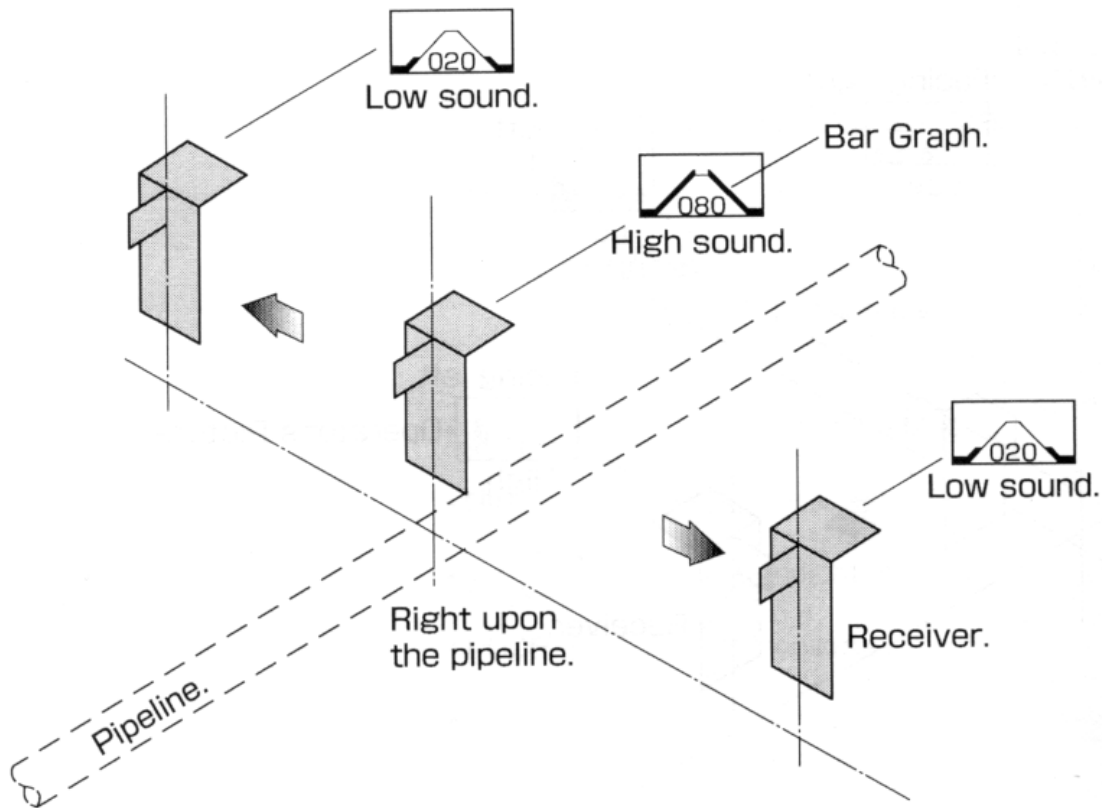
As shown above, when the receiver is moved from right to left and vice versa over the buried line, the sound level will be at its **LOWEST** directly over the line. The operator icon on the LCD screen indicates the direction to move in order to be directly above the pipeline. The icon either appears facing right or left, as shown in the above figure.

When the Operator icon flashes or changes sporadically, more than one pipeline is considered to be in close proximity. If this occurs, switch to MAXIMUM MODE.

NOTE: Depth readings can only be made in the **MAXIMUM MODE** of operation. Depths **can not** be made in the MINIMUM MODE.

OPERATION ON SITE (2)

2. Maximum Mode



The Maximum Mode indicates the location of the pipeline by the Bar Graph and the Numerical Value as shown in the figure above.

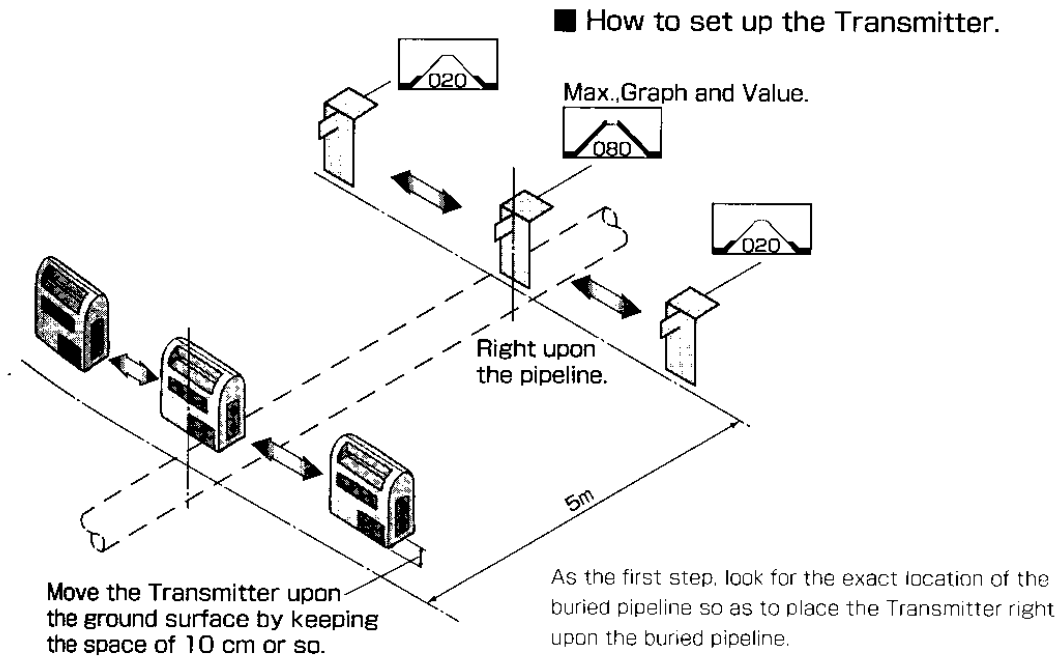
- a) The Bar Graph displayed on the LCD screen shows the location of the pipeline by a maximum bar graph reading. This corresponds with the numeric reading on the LCD display as in the figure above. Audio response is **highest** when the Receiver is above the line

The numerical value ranges from 000 to 100. When operating the tool reduce the sensitivity down from 100 when in proximity of the pipeline. A value of 80 or less allows the operator to clearly identify the correct location of the pipeline.

When the bar graph has a wide response more than one pipeline may be in close proximity or parallel to the pipe in question. For more details, refer to OPERATION ON SITE (12) Application (1) How to Locate parallel pipelines.

OPERATION ON SITE (3)

3. Induction Mode.



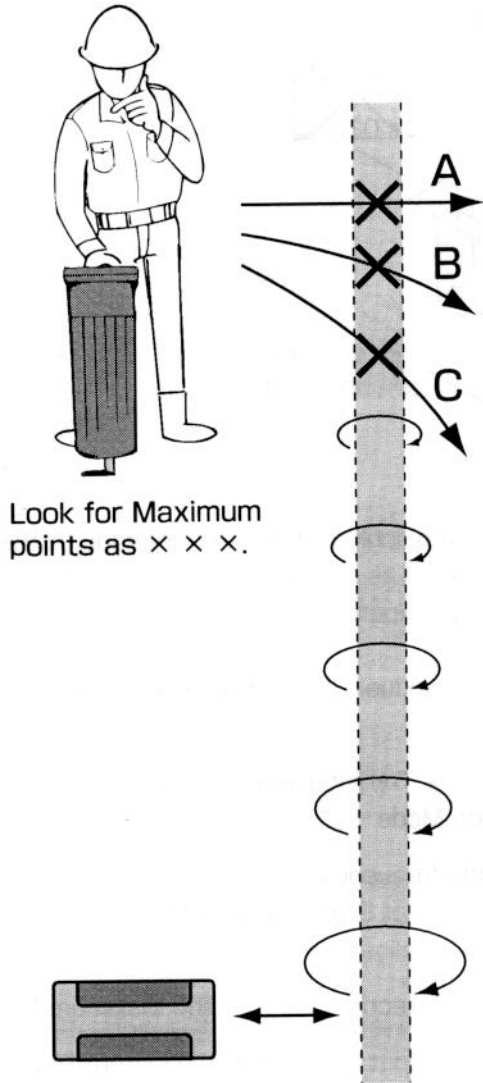
Place the Transmitter at the location where the buried pipeline is believed to be. Orientate the Transmitter to the assumed direction of the pipeline.

1. Check the residual battery power of the Transmitter and Receiver.
2. Confirm that the Transmitter is on Induction Mode = IND prompt.
3. Select the frequency for the transmitter and receiver. Use 83kHz initially to confirm the location of the pipeline.
4. Set the Detection Mode to MAXIMUM MODE.
5. Adjust the output power with the Output Power Control Key (4) to between level 2 and 5 on the bar display. Field conditions on site will dictate exactly what level is appropriate.
6. Move the Transmitter and Receiver simultaneously as detailed in the figure above utilizing two personnel.
7. When the Transmitter and Receiver are above the line in question, the Receiver will respond by giving a maximum bar graph and high numerical value and high audio response.
8. Set the Transmitter on the ground at the point where the Receiver displays the maximum bar graph value and the maximum numerical value.

NOTE: Insure the Transmitter and the Receiver are at least 5 meters apart. This prevents "air coupling" which is a condition where the Transmitter induces a signal directly to the Receiver rather than to the underground pipeline. The PL960AC can detect lines very well when less than 5 meters apart but it is best where possible to have separation of 5 meters.

OPERATION ON SITE (4)

For One-person operation of the PL960 use the following procedure.



Look for Maximum points as X X X.

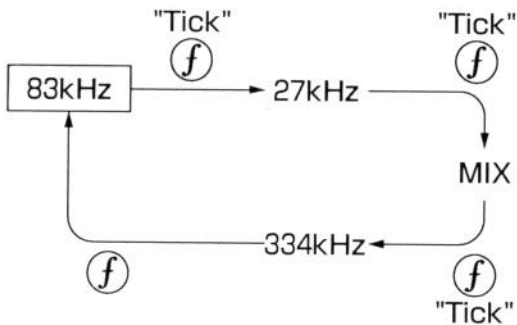
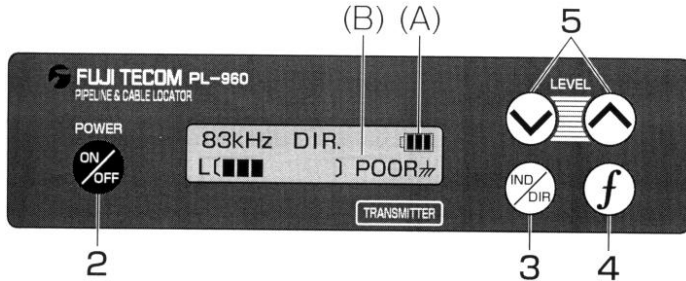
Move the Transmitter right upon the pipe.

1. Check the power level of the Transmitter and Receiver.
2. Set the transmitter to INDUCTION MODE = IND
3. Select the desired frequency. Use 83kHz initially.
4. Adjust the output power with the Output Power Control Key (4), to between 2 and 5 on the bar graph of the transmitter. Field conditions on site will dictate exactly what level is appropriate.
5. Turn on the Receiver and insure that the Receiver is on the same frequency as the Transmitter.
6. Insure the distance between the Transmitter and the Receiver is 5 meters apart. This prevents "air coupling" which is a condition where the Transmitter induces a signal directly to the Receiver rather than to the underground pipeline.
7. Insure the Receiver and Transmitter face one another.
8. Locate the point where the Receiver displays the maximum bar graph display and numerical value as shown in figures (A), (B), and (C). These points are directly over the line. Move the Transmitter to one of the points and proceed locating the line with the Receiver.

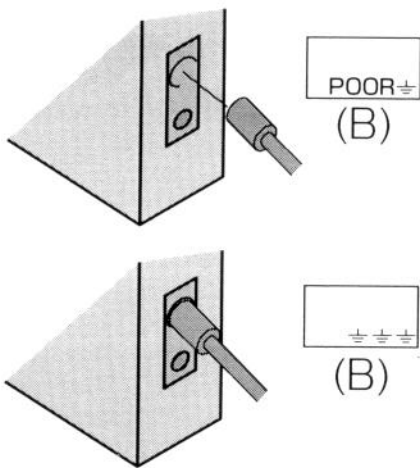
NOTE: Insure that the Transmitter is orientated in the correct direction to the pipeline being located (right angle to the line). This position matches the internal coil in the Transmitter to the underground line.

OPERATION ON SITE (5)

4. Direct Mode.



83kHz is chosen automatically when the Power Switch is turned on.

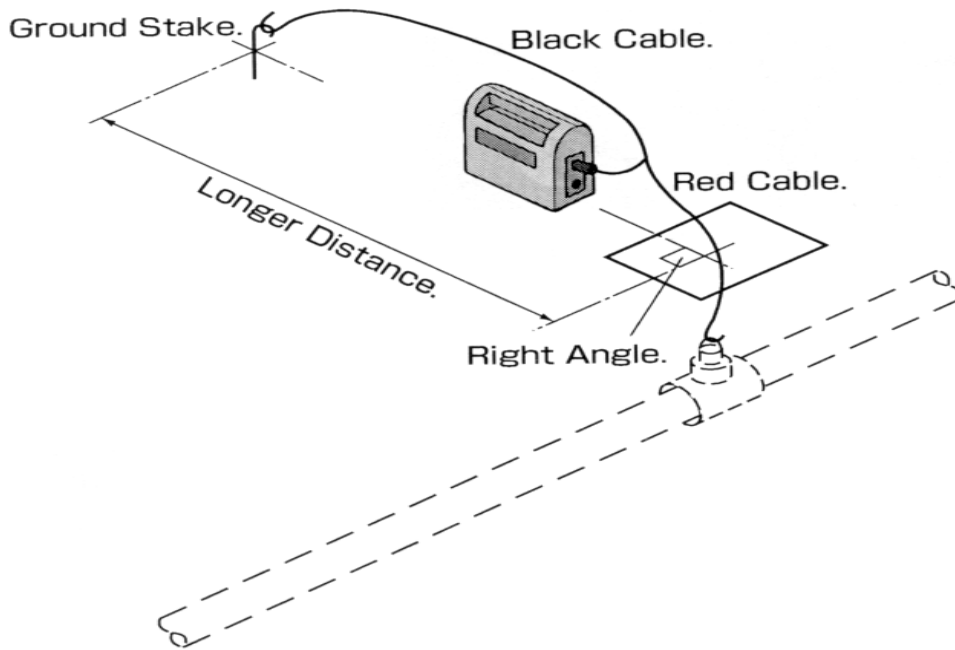


1. Connect the Red Cable to the direct contact access point of the pipeline. Connect the Black Cable to the Grounding Stake.
2. Turn ON the Power Switch (3) on the Transmitter. When the power switch is on, an audio sound "TICK-TACK" that repeats four times will be heard.
3. Confirm battery power (A).
4. Set the output power to DIRECT MODE = DIR
 - NOTE: An audio sound "TICK" will be heard when using the MODE SELECTING KEY (3) and the FREQUENCY SELECTING KEY (4) which indicates change in mode and frequency.
5. Choose one of the four frequencies, **27kHz, 83kHz, MIX, 334kHz IS NOT AVAILABLE ON THE PL960-AC.**
 - 27 kHz is useful for locating a straight pipeline over a long distance.
 - 83kHz is useful for locating a pipeline over a shorter distance under normal site conditions.
 - MIX is the simultaneous output mode of 27 & 83 kHz frequencies. The receiver chooses either of these two frequencies automatically according to site conditions.
6. Set up the output level with the LEVEL Key (5) as shown in the figure above.
7. Connect the Direct Mode Cable to the Transmitter.
 - When the Direct Mode Cable is **disconnected**, the "POOR" is displayed on the screen (B).
 - When the Direct Mode Cable is **connected correctly** "****" is displayed on the screen (B).

NOTE: When "POOR" is displayed, the ground stake may be improperly grounded. Check the Ground Rod placement. A wet location is ideal.

OPERATION ON SITE (6)

How to set up the Transmitter.



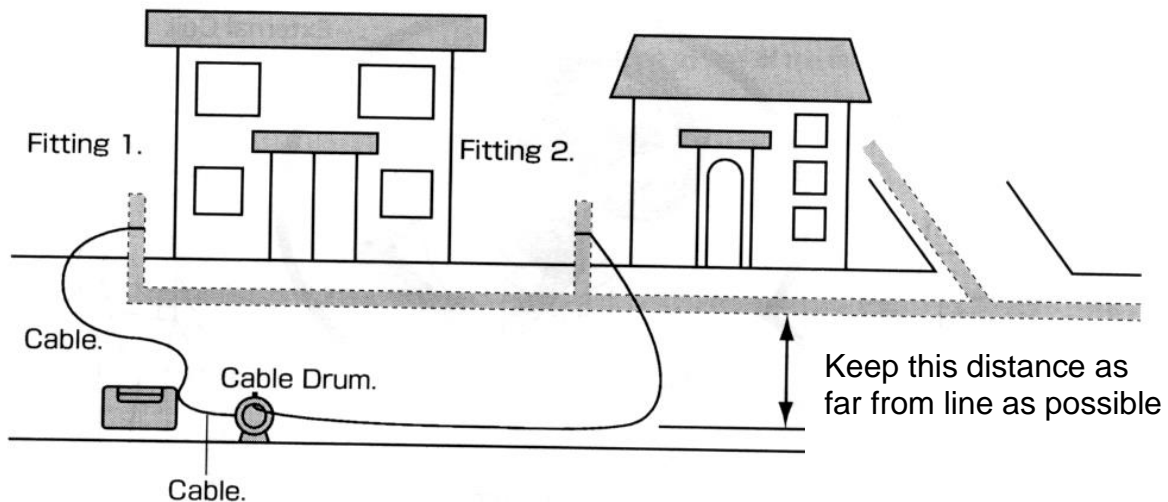
NOTE: In the Direct Mode of Operation, the transmitter must be orientated at a right angle to the direction of the pipeline. Residual power is present in the Transmitter, so this orientation is important.

NOTE: The ground stake should be placed as far away from the pipeline as possible to ensure a proper ground and produce maximum output capability. A wet area is ideal. Refer to figure above.

OPERATION ON SITE (7)

5. LOOP MODE.

How to set up the Transmitter.



NOTE: The Loop mode requires the Optional Cable Drum with 50 meter cable as shown by the above figure.

The Loop Mode of operation is useful when it is required to isolate one line in a congested area. A direct access point to each end of a section of cable or pipeline being detected is required to use this mode of operation.

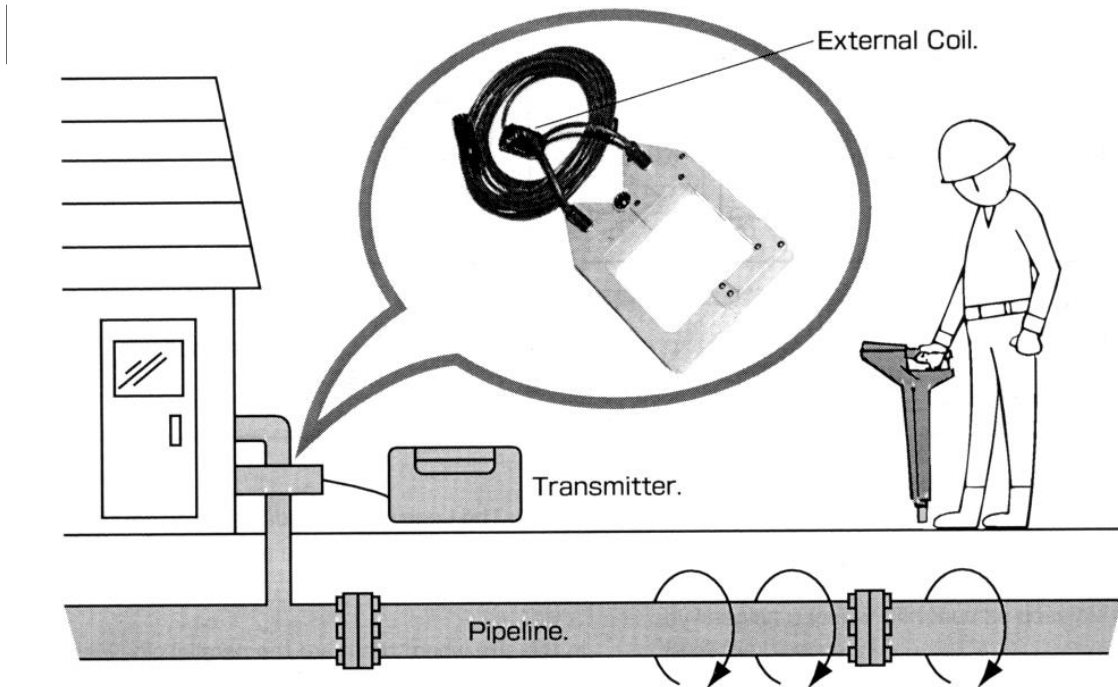
1. Identify the two access points as detailed above. Connect the Transmitter in the Direct Mode and attach the Cable Drum with 50-meter cable.
2. The buried line bracketed between the two access points as detailed in (1) and (2) above can then be located.

NOTE: The pipeline outside the bracketed section can not be located using the Loop Mode.

NOTE: Keep the Transmitter as far away as possible from the pipeline being located.

OPERATION ON SITE (8)

6. EXTERNAL COIL MODE.



NOTE: The External Coil Mode requires the optional **External Inductive Coil** as shown in the diagram above.

1. The External Coil Mode is useful for locating short branch lines, energized cables, telephone cables, and any cable housed in conduit that has access for the clamp.
3. Clamp the external coil on the pipeline or cable conduit as shown above.
3. Operate the Transmitter in the **83Khz** frequency in the **Direct Mode** of operation.

NOTE: Proper precautions should be taken when working on energized electrical cables.

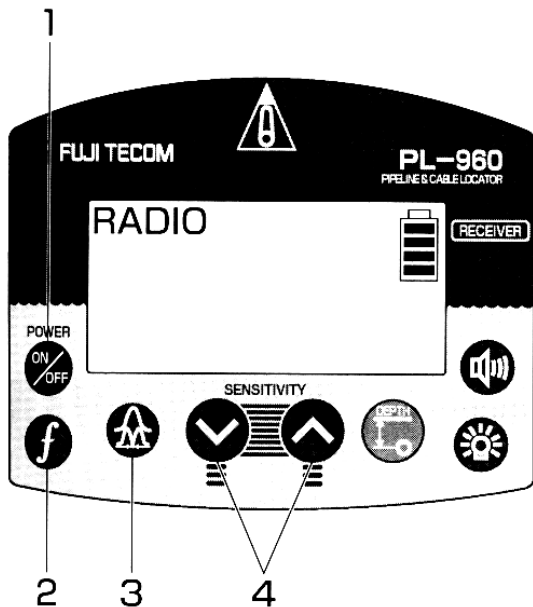
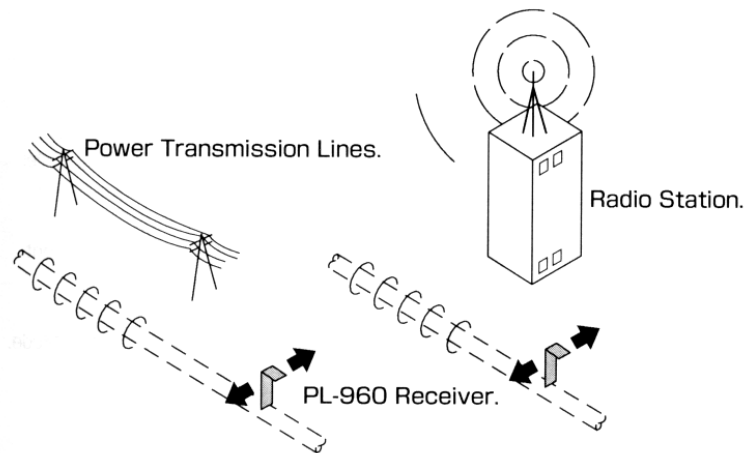
OPERATION ON SITE (9)

7. RADIO MODE AND LIVE CABLE (AC)

The **Radio Mode** AND “AC” MODE does not require the Transmitter. The electrical field from the energized power transmission line produces a magnetic field onto the buried cable or pipeline. In this mode of operation the PL-960-AC Receiver detects this electrical field that is present on the cable or pipeline.

NOTE: **RADIO MODE** IS FOR DETECTING FREQUENCIES OF 15KHZ TO 25KHZ

LIVE CABLE (AC) MODE IS FOR FREQUENCIES OF 50 TO 60 HZ. BEING MOST **LIVE (ENERGIZED)** ELECTRICAL LINES.



1. Push the receiver power switch to ON (1) and check the battery power status.
2. Push the frequency selection key to the “RADIO” prompt on the Receiver LCD screen. OR LIVE CABLE
3. Set the output to MAXIMUM via the mode selection key (3).
4. Adjust the sensitivity with Sensitivity Key (4)

NOTE: The depth of a pipeline **can not** be taken while in RADIO mode OR LIVE CABLE (AC)

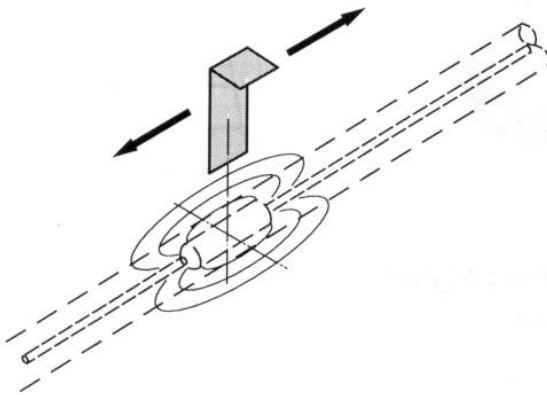
MAXIMUM Mode must be utilized when determining the depth of a pipeline or cable.

OPERATION ON SITE (10)

8. SONDE MODE

Note: The Sonde Mode requires the optional Sonde accessory.

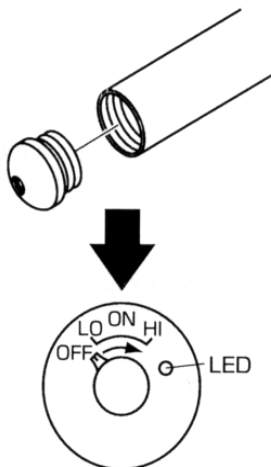
For detecting non-metallic pipelines such as PVC or asbestos cement pipelines, the optional Sonde is utilized. By introducing the Sonde into the pipeline as detailed in the following figure the line in question can be identified.



1. Turn On the receiver power switch (1) and check the battery power status.
2. Push the selection key to the "SONDE" prompt on the LCD screen (3) as referenced in figure on OPERATION ON SITE (9).

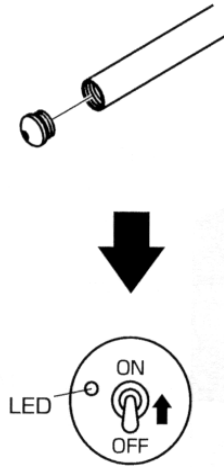
NOTE: The receiver must be orientated **parallel** to the pipeline as shown in the figure. The receiver is moved back and forth over the pipeline as detailed by the arrows in the figure. As the Sonde is moved along the pipeline the receiver identifies the location of the line in question.

Large Sonde.



Detectable Depth : 3.5 meters by LO (Low).
5 meters by HI (High).

Small Sonde.

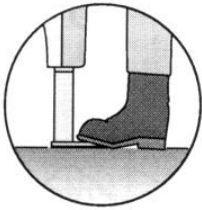


Detectable Depth : 3.5 meters.

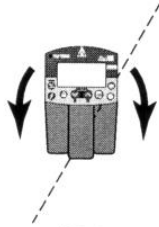
NOTE: The LED on the Sonde flashes on and off intermittently to confirm that there is battery power in the Sonde.

OPERATION ON SITE (11)

How to measure depths.



(A)



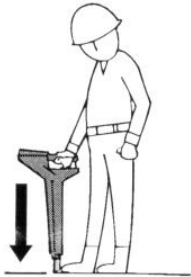
(B)

1. Transmitter Operation
Follow the same procedure as in OPERATION ON SITE (3) Induction Mode.
When utilizing the Sonde the Transmitter is not required.

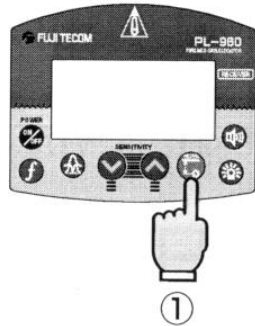
2. Operation of the Receiver.
Set the receiver in MAXIMUM MODE.

Hold the Receiver on the ground (A) with the toe plate and orientate the Receiver as shown by the arrow marks (B) to obtain the maximum bar graph, numeric reading on the LCD screen and audio response.

Insure the Receiver is on the ground above the line and the foot plate shaft that is utilized to take depths is not partially extended. Refer to figure (D).

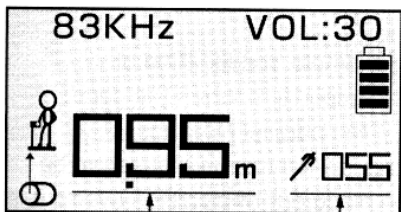
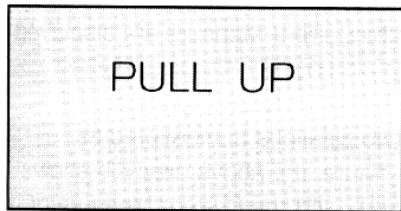


(D)



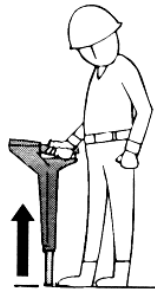
Push depth measurement key (1).

NOTE: Minimum Mode and Bar Mode cannot measure depths.



Depth.

Current Measure.
(000 - 100)



(E)

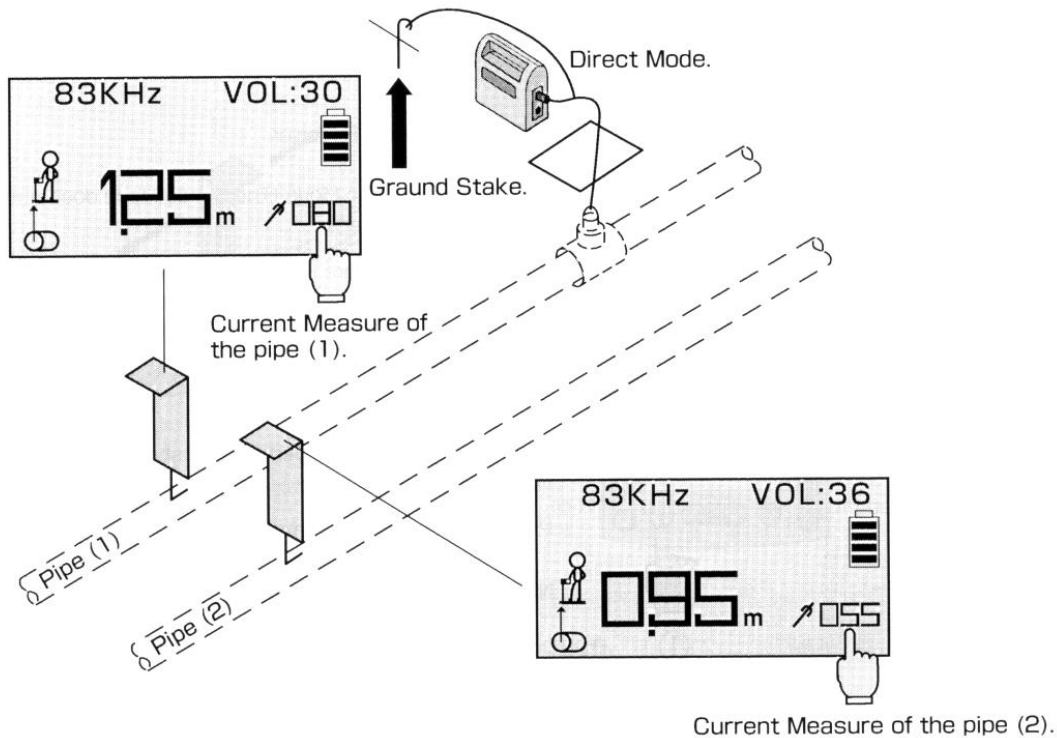
When "PULL UP" appears on screen, raise the receiver as shown in figure (E) to the full length of the footplate shaft. When raising the Receiver, insure that the tool is raised directly up without turning the receiver in a different orientation to the line in question. When the receiver is raised correctly an accurate pipeline depth is displayed on screen after a few moments.

The figure at left, displays the following:

- 0.95m = Depth of the pipeline to its center
- 83kHz = Frequency used for this operation
- VOL: 30 = Sensitivity Level between 00 and 40.
- 055 = Current Measurement between 000 and 100.

OPERATION ON SITE (12)

How to measure the depth of parallel lines.

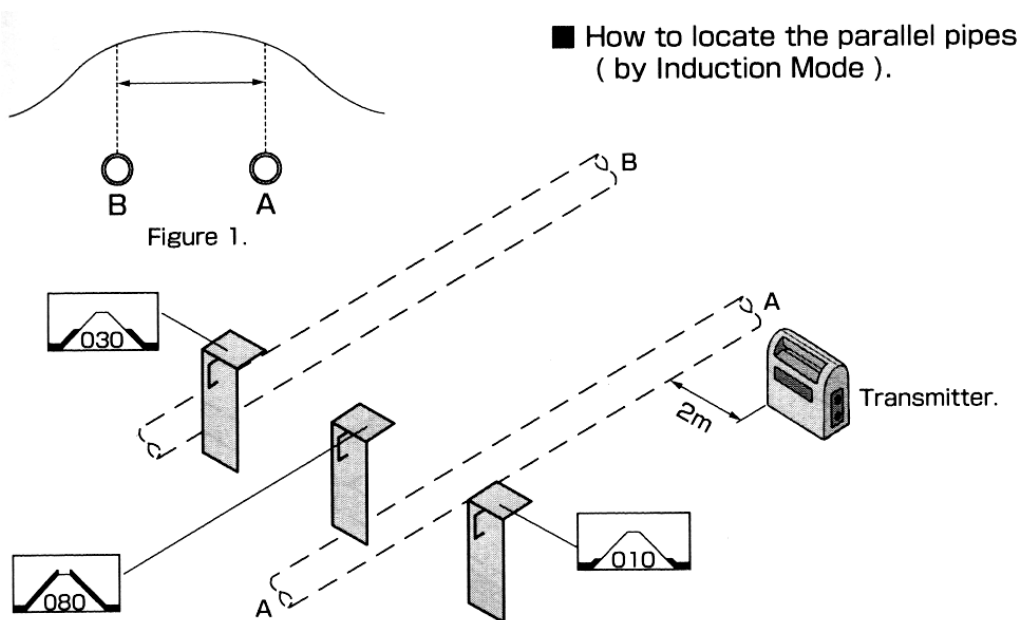


When taking the depth of parallel pipelines, pay special attention to the Current Measurement displayed on the LCD screen of the Receiver.

When the depth of two pipelines is measured as shown in the above figure, a depth of 1.25 meters and the Current Measure of 080 is displayed on the LCD. The higher Current Measurement value compared to Pipeline (2) Current Value indicates a correct depth of the pipeline (1) has been determined.

The correct placement of the Transmitter and Ground Rod is important. Insure that the **Transmitter is correctly orientated** to the Pipelines in question as detailed in the figure. The direction of the transmitter will affect depth results even in the Direct Mode of Operation. Insure the **Ground Rod is placed away** from the lines in question as detailed in the figure.

APPLICATION (1)



NOTE : When the parallel pipelines are located, the Direct Mode should be utilized as possible.

NOTE: When locating parallel pipelines, whenever possible, use the Direct Mode of Operation. The Minimum Mode may be used to locate parallel pipelines where precise accuracy is **not** required.

Induction Mode.

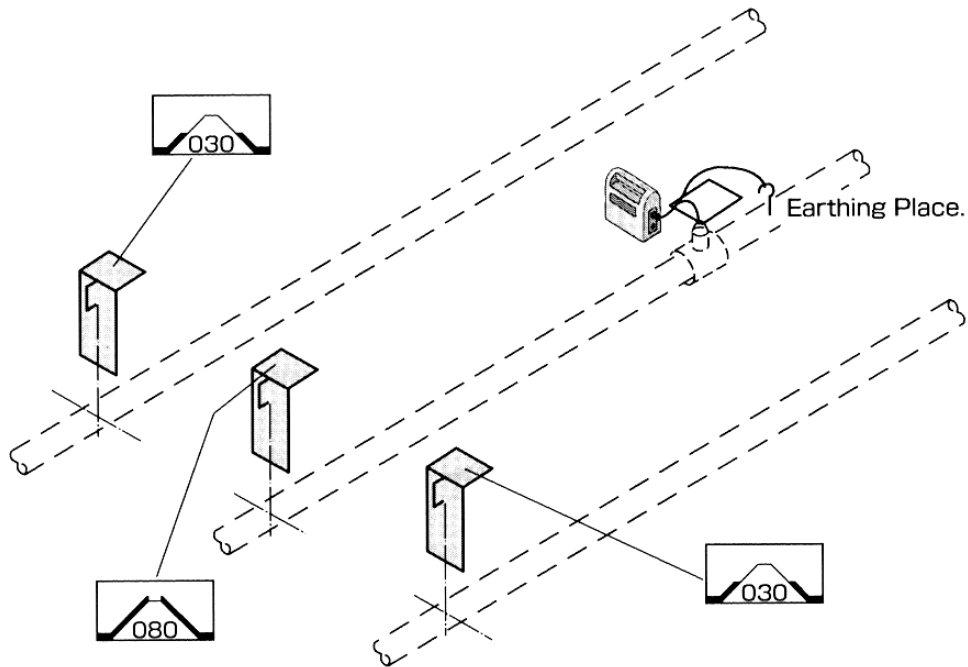
As detailed in figure (1) above, the Maximum Bar Graph and the Maximum Numerical Value identifies both pipeline (A) and (B). Confirm the location of lines A and B, and then track each line one at a time.

1. Set up the Transmitter away from pipeline (A) approximately 2 meters as detailed in the figure above. Depending on field conditions such as the **depth** of (A) and (B) and the **distance** between (A) and (B) will dictate the appropriate placement of the Transmitter.
2. With the Receiver orientated to the assumed direction of the Pipeline, walk slowly across the pipelines, starting from a point away from each line. Observe the Bar Graph, Numerical Value changes and audio intensity as the Receiver comes closer to each pipeline. Note the change in numeric value from 010 to 080 in the figure above.
3. When locating pipeline (B), move the Transmitter to the far side of Pipeline (B) and follow the same procedure.

NOTE: When more than two lines are in a Right of Way in close proximity to each other, the Inductive Mode accurately detects the outer most lines. Field conditions such as the depth of each parallel line, and the distance between lines will determine detection success. Where possible use the Direct Mode of Operation and track each individual line.

APPLICATION (2)

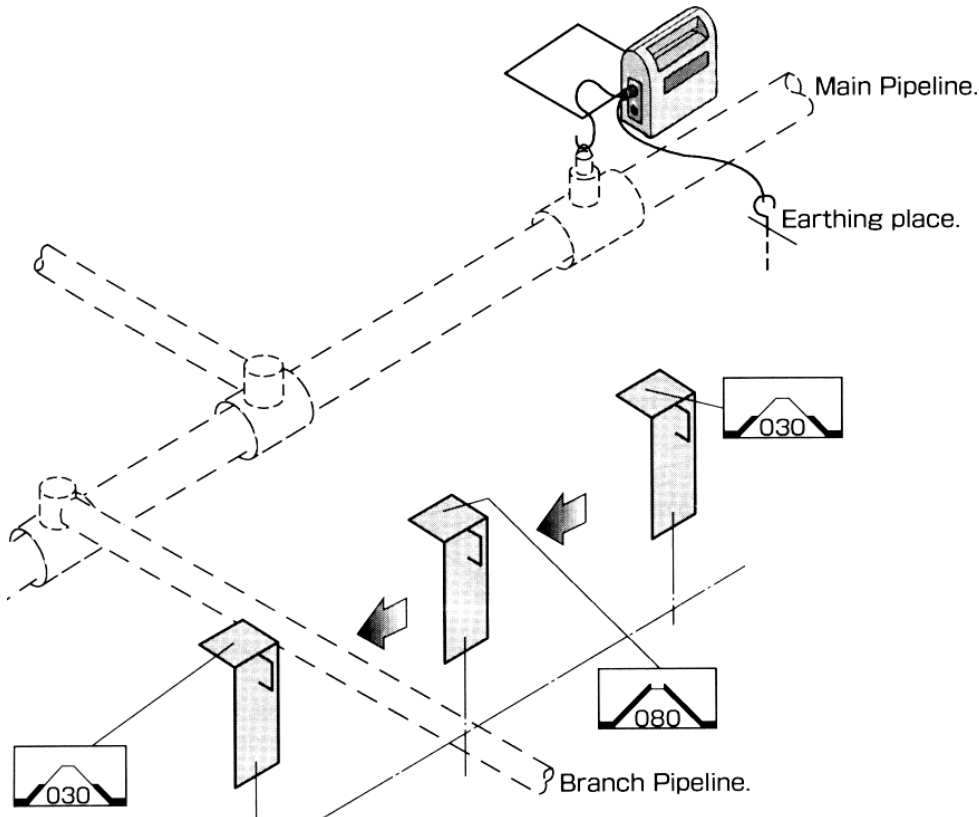
How to locate parallel lines (by Direct Mode).



1. For Parallel pipelines connect the Transmitter and Ground as detailed in the figure above.
2. Insure that the Transmitter is orientated to the pipelines as detailed in the figure above.
3. Note that the Ground Rod is placed directly above the line. This procedure prevents distortion when locating the lines on each side of pipeline that is connected in the Direct Mode of Operation. This placement of the Ground Rod will affect the maximum distance that the line can be tracked. As the signal dissipates, find another access point if possible.

APPLICATION (3)

How to locate branch lines (by Direct Mode).

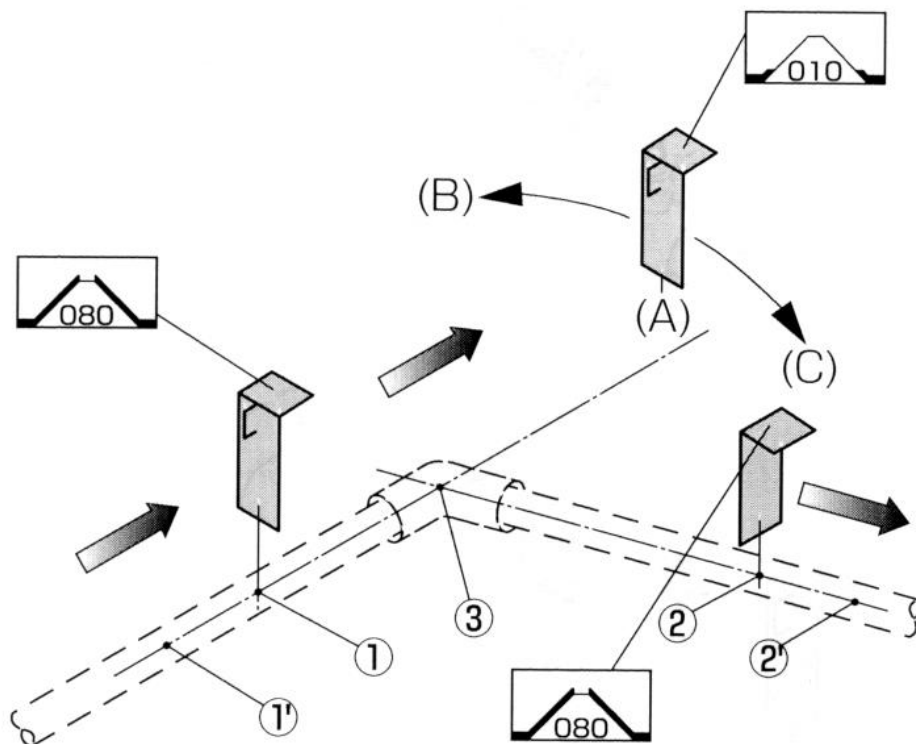


1. Use the Direct Mode of Operation.
2. Operate in the Maximum Mode of Operation.
3. Place the Ground Rod on the same side of the Branch line as detailed in the figure above.
4. Walk parallel to the Main Line **no less** than an interval of 1 meter away from the Main Line.
5. Move the receiver as detailed in the figure above.
6. As the Receiver reaches the Branch Line, observe the bar graph, numerical value and audio response increase. Refer to the figure above.

NOTE: For branch lines longer than 5 meters, use 83 kHz frequency.

APPLICATION (4)

How to locate pipeline bends (by Direct Mode or Induction Mode).

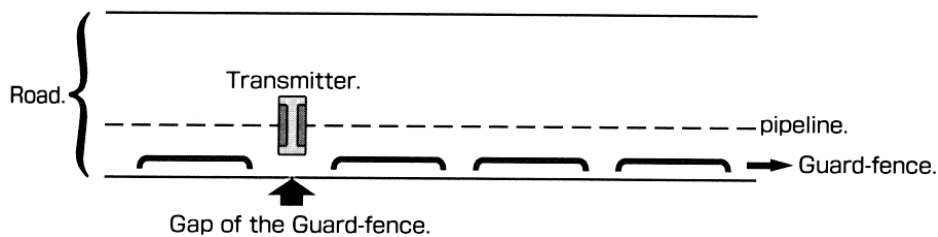


For locating bends in pipelines, the Induction Mode, Direct Mode, or External Coil may be utilized.

1. As detailed in the figure above track the line in the normal manner.
2. As the Receiver passes point (3) as shown by the above figure, the Bar Graph response drops off suddenly.
3. After passing point (3), move approximately two meters to the point (A). Move the Transmitter as detailed by (B) and (C) in a circular motion around point (3).
4. When the receiver reaches point (2), the Bar Graph and, the Numerical Value will return to the same response as at point (1) **080**.
5. By slowly passing the Receiver over points (1'), (1) and (2'), (2) an accurate identification of the Bend (3) can be determined as detailed in the figure.

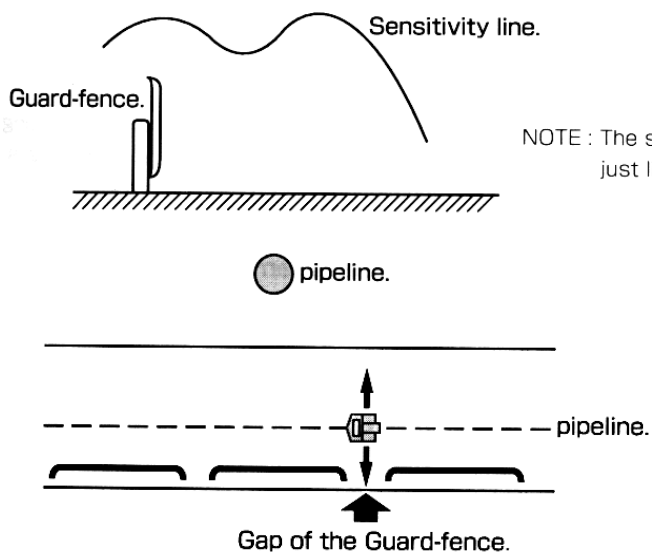
APPLICATION (5)

How to locate pipelines near metal guardrails and fences.



When tracking a Pipeline in close proximity to a metallic fence or guardrail, the Direct Mode of Operation should be employed. This Mode reduces the induction of the magnetic field produced via the Inductive Mode of Operation. If the Direct Mode of Operation can not be utilized, follow the detailed procedure in figure above.

1. Place the Transmitter at a point where the guardrail is not present as shown by the above figure.
2. Carefully observe the signal response of the Receiver as detailed in the figure.
3. Where possible observe the exact location of the line at a point where there is a gap in the guardrail or at the end of the metallic fence.



SUCCESSFUL OPERATION PROCEDURES ON SITE

1. MAXIMUM MODE

For the highest degree of accuracy when locating and measuring depths, use the MAXIMUM MODE.

2. MINIMUM MODE

For quick general locating of lines use the MINIMUM MODE. Accuracy is reduced in this mode of operation.

3. BAR MODE

For long distance tracking of lines use the BAR MODE. Location accuracy is reduced as the signal is diminished over a long distance. **Depths can not** be taken in the Bar Mode of Operation.

4. FREQUENCY SELECTION

The 83kHz is utilized at most sites.

The 27 kHz is utilized to locate long and straight pipelines.

LIVE CABLE WILL DETECT 50 & 60 HZ OR ENERGIZED ELECTRICAL CABLES

NOTE: When tracking branch lines for an extended distance, operate the Transmitter at 83kHz frequency.

5. DEPTH MEASUREMENT

When taking depths, to reduce possible electrical interference, turn off vehicles or machinery in close proximity to the depth location. In circumstances where traffic is present attempt to take depths when moving vehicles are a distance away from the site.

TROUBLESHOOTING (1)

When encountering the following symptoms while using the PL-960AC Locator follow these procedures:

1. Power will not turn on.

- a) Confirm batteries are installed correctly and mounted properly in their respective housings. Remove all batteries from the PL960-AC if tool is not in use for prolonged periods.
- b) Check the amount of residual battery strength on the LCD display. If there is little or no strength, install new batteries.
- c) When checking batteries, insure the polarity of each battery is correctly aligned in the housing.

2. The Receiver does not receive a signal from the Transmitter.

- a) Confirm batteries are properly installed and the power switch is on.
- b) Confirm both the Transmitter and Receiver are on the same frequency. The PL960AC will not function if the receiver and transmitter are set to different frequencies.

3. The Prompts do not respond when pushed while the transmitter or receiver are in the ON position.

Open battery compartment and remove one battery (in the transmitter) or the battery pack (in the receiver) replace the same and turn ON the Transmitter or Receiver. This resets the tool.

TROUBLESHOOTING (2)

4. When the sensitivity of the Receiver is incorrect.

- a) The Transmitter and Receiver must be a relative distance in proportion to one another, especially for accurate depth measurements. A weak signal from the Transmitter will affect the readings given by the Receiver. If this is experienced, move the Transmitter closer to the Receiver when performing a locate or depth.
- b) Do not set up the Transmitter on metallic objects such as manhole covers or other metal structures other than a pipeline being tracked. The Transmitter in the Induction Mode cannot induce its magnetic field onto a buried pipeline below such objects because the object absorbs a disproportionate amount of the signal generation.
- c) Insure the Transmitter is placed at right angles to the direction of the pipeline. Otherwise, the Transmitter can not induce a secondary field onto the pipeline being detected.
- d) Insure the Ground Rod is properly grounded. Remove and replace if necessary. A wet location is Ideal.

5. Unable to locate the pipeline.

- a) Confirm the pipeline is metallic. Does the metallic line have non-ferrous insulating joints? The magnetic field can not pass such insulators. Move the Transmitter to another point along the pipeline section.

6. When the depths cannot be measured.

- a) Confirm the mode of the Receiver and Transmitter. Depths **can not** be taken in Minimum Mode, Bar Mode, or Radio Mode.
- b) Insure the Receiver is in **MAXIMUM MODE** when taking depths.

WARRANTY

The Fuji Tecom warranty is one year commencing from the date of purchase. Extended Warranties are available through Alberta Locators Inc.

Your warranty is registered to your invoice date of purchase of your PL-960AC Locator. This warranty is non-transferable. Proof of sale record may be requested prior to any warranty related maintenance service being performed.

If your PL-960AC malfunctions during the normal course of ordinary use and handling, you may have it repaired free of charge during the warranty period.

It is suggested that you send the unit to a Fuji distributor without delay within the warranty period. When returning the PL960-AC, inform in detail the problem in writing in order to have the unit repaired promptly.

After the warranty period has expired, Fuji Tecom or one of its authorized distributors will service your PL-960AC for a reasonable cost.

CONFIRMATION OF CALIBRATION CERTIFICATION

Confirmation of Calibration Certification (CCC) is a part of your warranty. Fuji Tecom Inc. recommends CCC annually.

To learn more about the calibration certificate, please visit our website at www.leaklocate.com