

Instruction Manual

Model XTpc-33 kHz Pipe & Cable Locator

Manufactured By
Schonstedt Instrument Company

Made in USA

Preface

The Model XTpc® Pipe & Cable Locator is a product of over fifty years experience in producing the world's finest magnetometers, magnetic detectors, and Pipe & Cable locators, for aerospace, military and civilian applications. The XTpc® incorporates the knowledge obtained from manufacturing under the most rigid quality control standards.

February 2006

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Important Notice

Schonstedt believes the statements contained herein to be accurate and reliable. But their accuracy, reliability, or completeness is not guaranteed.

Schonstedt's only obligation shall be to repair or replace any instrument proved to be defective within seven years of purchase. Schonstedt shall not be responsible for any injury to persons or property, direct or consequential, arising from the use of any instrument.

Important FCC Notice

This unit has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This unit generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this unit does cause harmful interference to radio or television reception the user is encouraged to try to correct the interference by reorienting or relocating the receiving antenna, or by increasing the separation between the equipment and the receiver.

SECTION I: GENERAL

Introduction

The XTpc-33 kHz operates in passive mode, three different active modes (conductive, inductive and clamp), and a sonde mode. In the passive mode the receiver searches for 60 Hz or 50 Hz signals (factory preset). In the active modes the transmitter operates at a frequency of 33 kHz. In the sonde mode the receiver searches for the signal transmitted by a small sonde that has been routed through a pipe. The sonde must be of the same frequency as the active frequency. In addition, the receiver can determine the approximate depth of the target (except in passive mode), and has the ability to operate in manual or automatic gain modes.

Receiver

The receiver's front panel is designed to be intuitive and require a minimum of training for effective use of the instrument. The controls and the information display area are large and easy to understand. Yet they include everything necessary to control the unit with your thumb.

Control Buttons

ON/VOLUME - This switch powers up the unit and automatically sets the volume to Medium. Additional depressions of this switch will cycle the volume through High, Off (no sound) and Medium settings.



OFF - This switch removes power from the instrument.



UP/DOWN Arrows - When the receiver is operating in manual gain mode, pressing the UP or DOWN arrows will increase or decrease the gain from its current setting. When the receiver is operating in the automatic gain mode, the first press of the UP or DOWN arrow will switch the receiver to the manual gain mode.

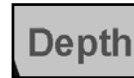


AUTO - When the receiver is operating in the manual gain mode, pressing the AUTO button will switch the receiver to operate in the Automatic gain mode. In this mode the receiver adjusts its sensitivity as a function of the strength of the detected signal.



NOTE: The automatic gain mode is not available in Passive or Sonde modes.

DEPTH - To determine the depth of the target place the receiver directly over the target, then press the depth button. There is a delay of 2.0 seconds between pressing the depth button and displaying the depth on the LCD. The measured depth will continue to be displayed on the LCD for as long as the button is depressed, otherwise (if the button is pressed and quickly released), the depth will show on the LCD momentarily, along with the word "DEPTH" on top of the LCD. Then the LCD will revert back to display signal strength. The XTpc-33 kHz can be factory set to display depth in feet and inches or in meters.



NOTE: Depth measurement is not available in Passive mode.

NOTE: See Section VII: Sonde Operation, for additional considerations regarding depth measurements when using a sonde.

SONDE - This switch toggles the receiver in and out of the Sonde mode of operation.



NOTE: When the receiver is already operating in Sonde mode, pressing the PASSIVE switch will also take the receiver out of Sonde mode and directly to Passive mode.

NOTE: See Section VII: Sonde Operation, for a description of this mode.

PASSIVE - This switch toggles the receiver in and out of the passive mode of operation, for detection of 50 or 60 Hz signals (factory preset).



NOTE: When the receiver is already operating in Passive mode, pressing the SONDE switch will also take the receiver out of Passive mode and directly to Sonde mode.

LCD Display

The LCD display has six general areas to display information to the user: a Battery Indicator, a Gain Indicator, a Frequency/Mode Indicator, a Direction Indicator, a Numeric Display and a Volume Indicator.

BATTERY INDICATOR - The "Battery" symbol indicates the receiver's battery status as follows: when all 3 segments inside the battery symbol are present, the battery is fully charged. When only 2 segments are present the battery has a medium charge. A single segment present signals a low battery. Always replace the receiver battery when only the bottom segment is visible. If there are NO segments present the battery is extremely low and you should replace it immediately.



GAIN INDICATOR - The "(Auto)" legend next to the "GAIN" legend indicates that the gain is in the automatic mode. In this mode the receiver adjusts its sensitivity as a function of the strength of the detected signal. No bar graph is shown in this mode.



If the "(Auto)" legend is not visible the receiver is operating in the manual gain mode, and therefore a means to show the user the gain setting is necessary. The bar graph indicates the relative strength of the gain, with each bar roughly representing one tenth of the full scale available. It takes approximately 2 presses of the UP arrow to add one bar to the graph, and approximately 2 presses of the DOWN arrow to delete one bar from the graph.

FREQUENCY/MODE INDICATOR - When the receiver is operating in one of the active modes, "33 kHz" is displayed. If the receiver is operating in the passive mode, the "Passive Arrow" is displayed instead. When the receiver operates in the sonde mode the word "SONDE" is displayed along with the active frequency.



DIRECTION INDICATOR - The purpose of the arrows and center bar in this indicator are to tell the operator in which direction to move the receiver in order to be directly over the target (see also "Alternate Directional Indication" Section).



Right Arrow - Receiver should be moved to the right to get closer to the target.

Left Arrow - Receiver should be moved to the left to get closer to the target.

Both Arrows and Bar - Receiver is placed directly over the target. This is also accompanied by a beeping sound.

NOTE: When all three elements of this indicator are OFF, the signal strength is not adequate to make a directional determination or you are not close to the pipe or cable being traced. Keep searching based on the signal strength indication (see below) and the audio feedback, until one of the arrows comes ON

NOTE: Direction Indicator is not available in Passive mode.

NUMERIC DISPLAY - The numeric display consists of 3 ½ digits (the leftmost half-digit can only be a "1" or be off) and it is used to display signal strength and depth.

Signal Strength - This is an indication of the relative signal level detected by the receiver and is a function of the gain setting. Good signal strength will typically be between 200 and 800. See also Section III - Operation - "Gain", for a better understanding on how to interpret the signal strength readings.

Depth Reading - When measuring depth the word DEPTH lights up above the numeric display. Then, after the calculation is done, the depth of the target in feet and inches (or meters) is displayed as shown below for as long as the button remains depressed, or just momentarily if the button was pressed and released:

12 4 Ft - in (factory set) or 4.10 m

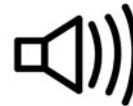
VOLUME INDICATOR - The Volume indicator consists of a speaker symbol with 3 sound wave bars (as shown at right). If the volume is off, the speaker symbol with NO bars is shown (see below), for medium volume the speaker symbol with 2 bars is shown (see below) and for maximum volume the speaker symbol with 3 bars is shown (see below).



Volume OFF



Medium Volume



High Volume

Speaker

The speaker produces an audible indication of signal strength. The pitch of the sound will increase with increasing signal strength. However, the volume is determined only by the VOLUME control, as explained above. See Section III - "Operation" - "Gain"- for additional hints on the effective use of the signal strength indicators (see also "Alternate Directional Indication" Section).

Alternate Directional Indication (ADI)

When operating in the line tracing mode (not in Sonde mode), the XTpc receiver is capable of presenting directional information to the user in a different way than the one described under the "Speaker" and "DIRECTION INDICATION" sections above. This alternate method is called ADI, and can be accessed at any time by simultaneously pressing the ON button and the UP arrow button.

When the receiver operates in ADI mode the sound emitted by the speaker is continuous when the Right Arrow is on, and interrupted or "beeping" when the Left Arrow is on. When both arrows and the center bar are on, the speaker is silenced. The speaker is also silenced when the signal strength is too weak to make an accurate directional indication.

The advantage of this mode is that the user can use the sound to know in what direction the instrument should be moved without looking at the display. A continuous tone means: "move to the right", a beeping tone means: "move to the left", and silence means: "you are right on the utility" (unless signal is too weak to make a determination).

The XTpc can be returned to the normal directional indication mode by simultaneously pressing the ON button and the Down arrow button.

Transmitter

To operate the transmitter the user needs only to connect the conductive clips, optional inductive clamp, or optional inductive antenna and then turn the unit ON. The transmitter will then automatically recognize which accessory is plugged in and adjust its operating mode and settings accordingly.

Controls

ON/OFF - This is a momentary push-button switch that toggles the power to the transmitter on and off. When power to the transmitter is ON, the LCD display will show several indicators as explained below.

NOTE: The ON/OFF switch needs to be pressed until the LCD indicators come on, then released, to turn the unit ON. Press the switch again until the LCD indicators go off to turn the unit OFF.



UP/DOWN ARROWS - In the conductive mode the output power can be adjusted manually up or down using these controls. See LCD Display / POWER INDICATOR section for a detailed discussion.

LCD Display

The LCD display has four general areas to display information to the user: a Battery Indicator, a Power Indicator, a Mode Indicator, and a Numeric Display.

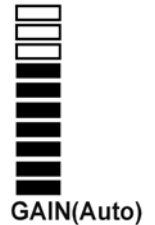
BATTERY INDICATOR - The "Battery" symbol indicates the transmitter's battery status as follows: when all 3 segments inside the battery symbol are present, the battery is fully charged. When only 2 segments are present the battery has a medium charge. A single segment present signals a low battery. Always recharge the transmitter battery when only one segment remains. If there are NO segments present the battery is extremely low and you should recharge it immediately.



In addition, the battery indicator is used to show that the charger is plugged in correctly. The battery box will be on, with all 3 segments rolling.

NOTE: See "Battery Charger" in this section for indication of battery charging.

POWER INDICATOR - The power indicator consists of a 10-bar graph located to the right of the word "POWER" on the faceplate, plus the legend (Auto) at the bottom and to the right of the bar graph. Its objective is to provide an indication of what type of power adjustment mode the transmitter is operating at and, if operating in manual adjustment mode, provide a relative indication of the output power being delivered to the load.



In the conductive mode the load is the circuit formed by the cable or pipe being traced, the soil return and the ground stake. In the inductive clamp mode the load is the internal coil in the clamp. In the inductive mode the load is the inductive antenna.

The inductive clamp and inductive antenna induce a current into the cable or pipe being traced. These modes automatically operate at the maximum power that the transmitter can deliver. For this reason in both of those modes the power adjustment mode does not need to be manual since the user can't increase or decrease the output power manually. As the power cannot be adjusted, the legend "(Auto)" will be on.

In the conductive mode the power delivered to the load is highly dependent on the external elements (soil, type of conductor, stake placements, etc.). The transmitter defaults to an automatic output power mode, which is indicated by the legend "(Auto)" being on, just as it is for the inductive and clamp modes. The auto mode tries to target a medium output current and maintain it through varying conditions.

But in some cases more power is desired to achieve more distance or depth, in others less power is desired to avoid bleeding to nearby conductors. Therefore in the conductive mode the user has the ability to adjust the output power manually by simply pressing the UP or DOWN arrows (see Controls section above). After the first press of an arrow, the power adjustment mode switches to manual, and the bar graph appears to give the user an indication of the setting. A total of 10 bars allow the manual adjustment to go above or below the typical output current target of the Auto mode. To return the transmitter to auto power, turn it OFF and then ON again.

NOTE: The current measurement feature provides another indication of the relative output power in the conductive mode. See NUMERIC DISPLAY section for details.

33kHz

MODE INDICATOR - The transmitter operates only at the factory set frequency of 33 kHz. When the transmitter is on and operational, the operating frequency will be displayed at the top left corner of the LCD.

The operating mode is automatically detected by the type of accessory plugged in. Once detected, the mode is indicated to the user by a combination of display indicators and legends, as shown in the table below:

Accessory Plugged In	Operating Mode	Mode Indicator
None	Not operational - Idle	Numeric Display Legend says "On" Battery Symbol = Lit Frequency Indicator = Lit Arrow indicators pointing to mode printed on the faceplate, along the right side edge of LCD, are all flashing
Battery Charger	Not operational - Mode indicted by charger LED's	Numeric Display Legend says "CHA" Battery Symbol = Rolling bars inside battery box Frequency Indicator = Lit Arrow indicators = All OFF
Conductive Clips	Conductive	Numeric Display Legend = Shows output current in mA Battery Symbol = Lit Frequency Indicator = Lit Arrow indicator = Pointing to CONDUCTIVE
Inductive Clamp	Clamp	Numeric Display Legend says "CLP" Battery Symbol = Lit Frequency Indicator = Lit Arrow indicator = Pointing to CLAMP
Inductive Antenna	Inductive	Numeric Display Legend says "Ind" Battery Symbol = Lit Frequency Indicator = Lit Arrow indicator = Pointing to INDUCTIVE

NUMERIC DISPLAY - The numeric display consists of 3 digits and it is used to display the current measurement (measured output current delivered to the circuit), as well as mode indications in the other operating modes.

Current measurement is only active in the CONDUCTIVE mode, and it measures the actual current flowing to the load from the transmitter. It is displayed in mA (milliamperes) and it can range from 0 to 180 mA (internally limited for safety and battery life considerations).

The current measurement provides an indication of how good a circuit the transmitter is hooked to. A low current reading can indicate a poor trace conductor, poor soil conductivity or poor ground stake contact or placement. Higher current readings indicate a better circuit and therefore a better chance to trace longer distances and deeper conductors.

If the current reading is low, you should try to improve the connection (check the cables, the clips, the ground stake, wet the ground, clean rust or dirt, etc.) to see if the current increases. However, in many cases the reason for the low current is the soil itself (sandy or very dry) and/or the composition of the pipe or cable you are trying to trace (cast iron pipes, rusted or broken wires, heavy insulation to ground, etc.). In that case you may not be able to improve the connection. This DOES NOT MEAN that you won't be able to locate, it just means that there is a smaller amount of current circulating in the circuit. You may try to increase the output power manually and/or increase your receiver gain.

Transmitter Connector

This circular, lock-type, 8-pin connector is used to connect the conductive clips, the optional inductive clamp, optional inductive antenna or the battery charger to the transmitter. The unit automatically detects what accessory has been plugged in and adjusts its operation and indicators accordingly.



- A - Inductive Signal Out
- B - N/C
- C - Signal GND
- D - Conductive / Clamp Signal Out
- E - Battery Charger +V
- F - Battery Temperature Sensor
- G - Battery Charger GND
- H - Accessory ID Resistor

NOTE: It is recommended that you turn the transmitter's power OFF before removing or inserting accessories from/into the connector.

Transmitter Time Out

The transmitter will turn itself off after idling with no accessories plugged into the transmitter connector for approximately 15 minutes. With an accessory plugged in, it will time out 2 hours after the last key was pressed.

Battery Charger

The battery charger is especially designed to charge the internal NiMH battery that runs the transmitter. It will typically charge a fully discharged battery in under 4 hrs and it has smart safety features to monitor the charge process.

The color LED indicator works as follows:

Flashing Red	Trickle Charge in progress
Solid Red	Fast Charge in progress
Green	Charge Complete

The charger can be powered by the included AC power supply or the included vehicle power supply. The AC power supply operates from a range of input voltages and frequencies to suit most countries. The vehicle power supply allows the battery to be recharged while driving from job to job. Its input voltage is 12 to 14.4 VDC from a car battery.

Inductive Clamps (Optional)

Three different clamp sizes are available for the XTpc-33 kHz, a 3-1/8" ID, 5" ID and 7" ID. The clamps are optimized for best results at 33kHz.

Inductive Antenna (Optional)

The inductive antenna can be used to trace a cable or pipe when it is physically impossible to do a direct connect or to use the inductive clamp. The inductive antenna is available in 33 kHz.

SECTION II : SPECIFICATIONS

(Specifications are subject to change without notice)

Receiver

Operating Frequency:	33 kHz (factory set)
Modulation Scheme:	BPSK
Battery:	9 V Alkaline single battery
Battery Life:	12 hrs intermittent use
Audio Output:	10 - 3000 Hz determined by signal strength 0 - 70 db SPL (Sound Pressure Level), volume controlled
Weight (incl. batteries):	Under 2.8 Lbs
Operating Temp.:	-4°F to 140°F (-20°C to 70°C)
Overall Dimensions:	Closed: 17.5 in x 3 in x 8.5 in (44 cm x 7.6 cm x 21.5 cm) Extended: 27.7 in x 3 in x 8.5 in (70 cm x 7.6 cm x 21.5 cm)
Max. Depth Capability:	19' (5.8 m) except in passive mode
Sensors:	Split angled sensors to derive peak and null signals

Transmitter

Operating Frequency	33 kHz (factory set)
Output Power:	1 W maximum on 75 ohm load (cond. mode)
Dimensions:	7.2 in x 2.2 in x 1.5 in (18.3 cm x 5.6 cm x 3.8 cm)
Battery Type:	Rechargeable NiMH (7.2 V)
Battery Life:	8 hours intermittent operation
Charging:	Smart charger powered by AC supply or vehicle supply
Outputs:	Circular CNC "smart" connector to: 1) Inductive antenna 2) Inductive clamp 3) Conductive clips
Weight:	Under 1.5 lbs
Operating Temp.:	-4°F to 140°F (-20°C to 70°C)

SECTION III : OPERATION

Follow these steps and tips to operate your XTpc-33 kHz Pipe and Cable Locator:

- 1) Determine which method is best to inject a signal onto the cable or pipe. The choices are one of the active modes (conductive, inductive, or inductive clamp), the passive mode, or the sonde mode. In the passive mode the transmitter does not inject the signal, but it is already there due to AC power lines. In the sonde mode a small transmitter (sonde) that has been routed inside the pipe to be traced emits the signal. Whenever possible use the conductive mode, which provides the strongest and best coupled signal.

Conductive Mode: Plug the conductive clips into the transmitter connector BEFORE TURNING THE POWER ON. Connect the red clip to the access point for the cable or pipe. Connect the black clip to the ground stake, which should be buried on a line perpendicular to the utility to be traced and as far from it as possible.

Inductive Mode: Plug the optional inductive antenna into the transmitter connector BEFORE TURNING THE POWER ON. Place the antenna tube (attached to the transmitter) over the buried cable or pipe in the direction indicated by the arrows on the antenna tube label.

Inductive Clamp Mode: Plug the optional Clamp into the transmitter connector BEFORE TURNING THE POWER ON. Open the jaws of the clamp and place it so that it completely encircles the desired cable or pipe. Make sure the clamp can fully close so that both ends touch.

Passive Mode: You don't need the transmitter. Simply start searching for the conductor by turning the receiver and placing it in the passive mode. Keep in mind that the arrows and depth are NOT functional in passive mode, a single NULL sensor provides an indication of the signal strength.

Sonde Mode: You don't need the transmitter. Simply start searching for the sonde by turning the receiver on and placing it in the sonde mode (see section VII: Sonde Operation, for additional details)

- 2) Turn on the transmitter, if necessary, by pressing the ON/OFF button on the transmitter and waiting for the LCD to light up.
- 3) If operating in conductive mode verify that a good circuit has been established by checking the output current from the transmitter. If necessary make adjustments to the ground stake or clips to improve the connection. In the conductive mode you can also manually adjust the output power to affect the output current.
- 4) Gain - The receiver gain is set manually by pressing the up or down arrows on the receiver. It can also be set automatically by pressing the AUTO button in the receiver (see Receiver Controls section). As a guideline, always operate at the minimum gain that shows a clear "peak" over the target (or the sharpest null in case of passive mode). Optimum results will most likely be obtained with a signal strength reading between 200 and 800. A reading of 999 indicates the signal is saturating the amplifiers and the gain should be reduced.
- 5) Locating Target with arrows - As the operator moves toward the buried target, one of the arrows will indicate in which direction to move. If the operator moves beyond the target, the other arrow will indicate that the operator should reverse direction. When the operator is right over the target the tone will reach maximum pitch and the digital reading will reach a maximum. Both arrows and the center bar on the display will be ON, and the receiver will start beeping (see also "Alternate Directional Indication" Section).
- 6) Depth Measurement - With the unit in the EXTENDED position, place the bottom of the arrow against the ground, and then push and hold the DEPTH button. The digital display will indicate the

approximate depth. The reading will show as long as the button is depressed. See Receiver - Control Buttons- Depth for more details.

Standard Accessories

The accessories that are included with this instrument are:

- "Carry All " Duffel Bag
- Padded Transmitter and Accessory Belt-Pouch w/ belt
- Belt Receiver Holder Cup
- Shoulder strap
- Ground stake
- Conductive clips
- Batteries
- Battery Charger
- Universal Desktop or U.S. AC Wall Mount Power Supply for Battery Charger
- Vehicle Power Supply for Battery Charge
- Operation Manual

Optional Accessories

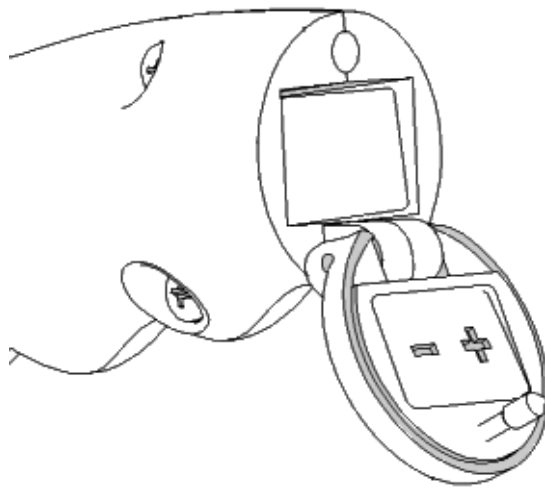
In addition to the inductive clamps (3", 5" and 7") and the inductive antenna, a few other accessories are available, such as larger clips, a cable reel and sondes. Please contact Schonstedt for details.



SECTION IV : BATTERY INSTALLATION

Receiver

The XTpc-33 kHz is powered by one 9-volt battery. The battery is located in the handle of the instrument and can be accessed by turning the screw counterclockwise by hand or with the use of a screwdriver or coin. To remove the battery, simply tilt the unit so that the handle is pointing down, and the battery will slide out. When replacing the battery, look at the inside of the battery door for the proper battery orientation. (The positive terminal should be on the right on the inside of the unit) As a safety measure the unit has been "Keyed" so that the battery will only make contact when in the correct orientation. For this reason you should never have to force the battery door closed. If the battery does not seem to be going in all the way, remove, reverse and then replace.



Transmitter

The batteries for the transmitter are rechargeable and need not be replaced. It is recommended to first charge the batteries for at least 4 hours before the initial use. If you suspect that the batteries are malfunctioning please contact Schonstedt Instrument Company.

SECTION V : TECHNICAL SUPPORT

Technical Support

Schonstedt offers technical support and sales. For any reason regarding usage and application please contact our technical support team at 888-32-TRACE (888-328-7223).

FOR SERVICE OR REPAIR

Please ship locator to:

Schonstedt Instrument Company
100 Edmond Road
Kearneysville, WV 25430
Attn: Service Dept.

SECTION VI : WARRANTY INFORMATION

Limited Warranty

The Schonstedt Instrument Company (Schonstedt) warrants each product of its manufacture to be free from defects in material and workmanship subject to the following terms and conditions. The warranty is effective for 3 years (with the return of the Customer Registration Card) after the shipment by Schonstedt to the original purchaser.

Schonstedt's obligation under the warranty is limited to servicing or adjusting any product returned to the factory for this purpose and to replacing any defective part thereof. Such product must be returned by the original purchaser, transportation charges prepaid, with proof in writing, to our satisfaction, of the defect. If the fault has been caused by misuse or abnormal conditions of operation, repairs will be billed at cost. Prior to repair, in this instance, a cost estimate will be submitted. Service or shipping information will be furnished upon notification of the difficulty encountered. Model and serial numbers must be supplied by user. Batteries are specifically excluded under the warranty.

Schonstedt shall not be liable for any injury to persons or property or for any other special or consequential damages sustained or expenses incurred by reason of the use of any Schonstedt product.

SECTION VII: SONDE OPERATION

(You must have a Schonstedt-Supported Sonde for this mode)

Introduction

Your XTpc-33 kHz unit is fitted with the sonde option and it supports the detection of these sondes:

- Schonstedt's 33 kHz sonde

This type of sonde is usually attached to devices that are sent through non-metallic sewer or water pipes. The emitted frequency easily passes through the walls of such pipes.

Since the signal being traced by the receiver is produced by the sonde, and not travelling along the pipes, there are some differences in the way the receiver is used. The following section explains how to use the XTpc-33 kHz receiver for sonde operation.

Setting the Receiver for Sonde Mode

The XTpc receiver is placed in the Sonde mode by depressing the SONDE button. An LCD indicator with the word "SONDE" will light up

Searching For the Sonde

Due to the nature and strength of the sonde signal, it is necessary to have some idea of where the sonde is, to narrow the search area to a circle of several feet radius centered at the sonde. This is usually not much of a problem, since the sonde is "guided" by a device under control of the work crew, often with a camera attached to it.

Once in the surroundings of the sonde, it is important to differentiate whether you are positioned along the axis of the sonde (the direction of the pipe) or off to either side. In the sonde mode the arrows are not functional, so the signal strength is the only indication available, and it will be "null" (very close to zero) if the receiver is placed on the axis of the sonde with the plane of the sensors perpendicular to it. Move away from the axis and follow the direction that results in increasing signal strength. Rotate the receiver back and forth and move in the direction that produces the maximum. As the receiver gets closer to the sonde the signal strength increases to a maximum when directly over the sonde, if the plane of the sensors is parallel to the axis of the sonde (approaching from a direction that is perpendicular to the direction of the pipe). A rotation of 90 degrees from this position should produce a null. To measure depth simply place the tip of the unit on the ground and press the DEPTH button when the signal strength is at a maximum. The achievable depth depends on a number of factors, but typically it is possible to read depth up to 5 to 8 feet.

