



Utility Line Locator



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ISO 9001 CERTIFIED

Metrotech has received ISO 9001 Quality Management System Certification.

Metrotech adheres to the quality standard guidelines of ISO 9001 and ensures quality in its design/development, production, installation, and servicing disciplines.

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1 INTRODUCTION

This manual describes the Metrotech Model 9800XT Utility Line Locator. Included is an equipment description, product specifications, checkout procedures, operating procedures, application information and maintenance instructions.

The Model 9800XT is a series of state-of-the-art utility line locators precisely designed with many powerful features to provide you with optimum information about your locate situation.

2 SAFETY PRECAUTIONS

- 1 Metrotech Utility Line Locators are intended for use by utility and contractor professionals. Safety hazards for underground utility access areas include electrical shock, explosive gases, and toxic fumes as well as potential influence on communications and control systems such as traffic control and railroad crossings.
- 2 Familiarize yourself with all required safety practices of the local utility company, or other owner of the plant before entering an access area or connecting a Metrotech transmitter.
- 3 Before connecting the transmitter directly to any conductor, make sure that the line is de-energized and out of service. Never make a direct connection to a live power cable.
- 4 If you use the Metroclamp on energized electrical or control lines follow appropriate safety procedures to avoid the risk of injury.
- 5 Pay special attention when using a locator in high traffic areas.

3 9800XT QUICK START GUIDE FOR THE EXPERIENCED USER

- 1 **Check Batteries** – Turn Transmitter to “L”. If the battery status is low (less than 5 bars) replace or recharge the battery. Turn Transmitter “ON”. Check battery status. If low (less than 1 bar) replace or recharge batteries. **CAUTION:** Do **NOT** attempt to recharge non-rechargeable D-cell batteries. Damage to the transmitter will occur.
- 2 **Connect Transmitter to Conductor** - Turn Transmitter “OFF”. Plug the Conductive Attachment into Transmitter. Clamp red lead to target conductor. Stretch black lead 90 degrees away from conductor. Push ground rod into the earth. Clamp black lead to grounding rod. Turn Transmitter “ON”. Select power output and frequency.

- 3 **Adjust Receiver Controls** - Turn Receiver “ON” and select frequency. By default, the unit will operate in “Auto” gain mode.

- 4 **Sweep Area Around Transmitter** – Circle Transmitter with Receiver at a distance of 10 feet (3 m). Left/Right display and Receiver signal strength will indicate location of buried conductors.

- 5 **Locate Line - Follow** your target conductor, sweeping left and right as you walk away from the Transmitter. Mark the centerline on the ground.

- 6 **Measure Depth** - Hold the Receiver over the centerline and push the depth button. The LCD will display the depth and current measurement.

4 MODEL 9800XT EQUIPMENT

4.1 Standard Equipment

<u>Part/Model #</u>	<u>Description</u>	<u>Remarks</u>
9860XT*	9.82kHz, 82kHz	Transmitter
9890XT*	982Hz, 9.82kHz, 82kHz	Transmitter
9860XT	9.82kHz, 82kHz, 50/60Hz, 14-22kHz	Receiver
9890XT	982Hz, 9.82kHz, 82kHz, 50/60Hz, 14-22kHz	Receiver
400A139	Conductive Attachment Assembly	Direct Connect Ground Rod Ground Plate
500B524	Safety Flag	
400C299	Carrying Case	
10162	Operation Manual	

* All models are available with optional 4.8Hz transmitting capability for sheath fault locating.

4.2 Optional Features on Standard Equipment - Any standard model can be ordered with any combination of the following optional features:

Rechargeable Transmitter Batteries -
 US/Canada: Includes Wall Mount charger P/N
 500A717. International versions available - please contact factory.

Sheath Fault Locating Capability -
 Includes SFL-2 Receiver and output cables

Figure 4-1: Model 9800XT Utility Line Locator - Standard and Optional Equipment



Standard:

- 1. 9800XT Receiver
- 2. 9800XT Transmitter
- 3. Conductive Attachment
- 4. Ground Rod
- 5. Ground Plate
- 6. Safety Flag
- 7. Carrying Case

Options:

- 8. SFL – 2 Receiver

Accessories:

- 9. MetroClamp
- 10. Flex-Sonde
- 11. High Power Sonde
- 12. Standard Power Sonde

4.3 Accessories

<u>Part/Model #</u>	<u>Description</u>	<u>Remarks</u>
4290	2" Metroclamp and jumper cable	For Inductive Coupling or

		Cable ID
4490	4" Metroclamp and jumper cable	For Inductive Coupling or Cable ID
4890	8" Metroclamp and jumper cable	For Inductive Coupling or Cable ID
400B246	Conductive Attachment	Telephone style Clips
400A132	100' Ground Lead Extension	
400B252	Vehicle Mount Charger	For use with rechargeable transmitter batteries
183048	Head Phones	For use in high noise level areas
10126	Live Power Connector	Use at 9.8kHz
158084	Search Coil	For Cable and Pair ID

4.4 Technical Specifications

TRANSMITTER

Output Frequencies: Model Frequencies

9860XT*	9.82kHz, 82kHz
9890XT*	982Hz, 9.82kHz, 82kHz

* Optional 4.8Hz for simultaneous sheath fault locating available on all models.

Automatic "Best" Frequency Selection

Ohmmeter: 0-2 kOhm

Nominal Output Power

Conductive Mode: Model Watts

9860XT	3*
9890XT	3*

* Output power limited to .7W at 82kHz

Power Settings: Low, Medium, High (all models)

Battery Type: Ten D Cells

Optional Rechargeable NiCd

Battery Life: Alkaline 28-70 hours
NiCd 9-22 hours Continuous use,
depending on power and Frequency selection.

Battery Check: Automatic at start up

Operation

Temperature: -4° to +122° F (-20° to +50° C)

Dimensions: 14.25"L x 9.25"W x 5.25"H
(36.2 cm x 23.5 cm x 13.3 cm)

Weight: 8.9 lbs. (4 kg)

Technical Specifications (4.4 cont'd)

RECEIVER

Receiving

Frequencies:	Model	Frequencies
	9860XT	Active - 9.82kHz, 82kHz Passive - 50/60Hz, 14-22kHz
	9890XT	Active - 982Hz, 9.82kHz, 82kHz Passive - 50/60Hz, 14-22kHz

Depth

Readout

Accuracy: Passive- $\pm(5\% + 2")$ under normal conditions
Active- $\pm(5\% + 2")$ under normal conditions

Distance Sensitive Left/Right Guidance™

Real-Time Continuous Gain Adjustment™ and Manual Gain Control

Simultaneous Peak and Null Display™

Current Measurement

Backlighting: Standard on all 9800XT receivers

Serial link: RS232

Battery Type: Six AA Cells

Battery Life: 30 hours continuous use
24 hours continuous backlit use

Battery Check: Continuous Automatic Operation
Temperature: -4° to +122° F (-20° to +50° C)

Dimensions: 27"L x 7"W x 9"H
(68.6 cm x 17.8 cm x 22.9 cm)

Weight: 5.4 lbs. (2.35 kg)

4.5 Transmitter: Controls, Indicators, and Features

4.5.1 Transmitter Controls and Indicators - See Figure 4-2 for the location of the controls and indicators described below:

OUTPUT JACK - Insert the Direct Connect cable or the Metroclamp cable into this jack. (Located on the left inside wall of the Transmitter).

CONDUCTOR ARROW - Align this arrow with your targeted conductor when you are locating in the Inductive mode.

CHARGE JACK (Optional Feature) - If you have purchased a 9800 XT with the Rechargeable NiCd Battery feature, your Transmitter will have a jack for connecting the Wall Mount Charger or the Vehicle Mount Charger. The Jack is located on the right inside wall of the Transmitter.

FREQUENCY (Hz) KNOB - Model 9860XT offers dual frequency output. Model 9890XT can transmit up to three active frequencies.

Frequencies on 9860XT and 9890XT Transmitter:

"AUTO" - Automatic frequency select

82kHz - Radio frequency

9.8kHz - Audio frequency

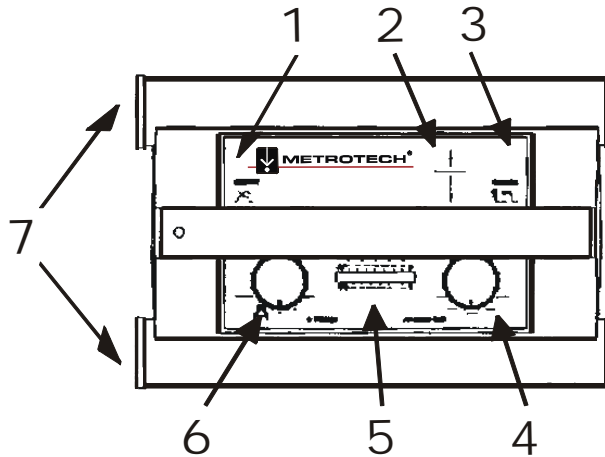
982Hz - Low audio (9890XT only)

"ALL" - All frequencies are transmitted onto your conductor simultaneously.

BATTERY ACCESS CAPS - Remove end caps to gain access to the batteries. Note battery polarity, which is indicated on the bottom of the Transmitter and batteries.

9800XT TRANSMITTER

Figure 4-2: 9800XT Transmitter: Controls and Indicators



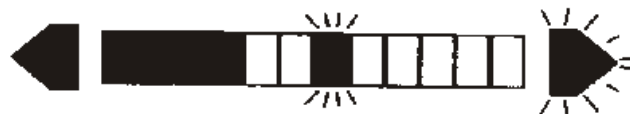
- 1 Output Jack
- 2 Conductor Arrow
- 3 Charge Jack
- 4 Frequency Knob
- 5 LCD Display
- 6 Power Knob
- 7 Battery Access Caps

LCD BARGRAPH DISPLAY - The bargraph indicates four types of information:

BATTERY STATUS - First 3 seconds the amount of Transmitter battery charge is indicated by the number of bars illuminated.



CIRCUIT RESISTANCE - The blinking bar indicates, in ohms, the amount of signal resistance on your conductor.



OUTPUT LEVEL - The solid bars indicate the amount of signal strength (current output) on your conductor.



POOR CONDUCTOR AND IMPROPER SELECTION - Entire display blinks and Transmitter beeps very fast or emits a constant beeping tone.



SPEAKER (not shown) - Transmitter audio tone changes according to operating function:

<u>Speaker Tone</u>	<u>Description</u>
Every 5 seconds	Good transmitter connection
Very fast	Low battery warning and poor conductor alert
Constant	Improper selection alert

POWER KNOB - The amount of transmitter signal output for each power setting changes according to which frequency you are using:

Power Setting	Frequency		
	982Hz	9.82kHz	82kHz
L-Low	0.3 watts	0.3 watts	0.15 watts
M-Medium	1 watt	1 watt	0.25 watts
H-High	3 watts	3 watts	3 watts
Sheath Fault Locating*		0.5 watts	0.35 watts (keep same units watts)

*Sheath Fault Locating - (Optional on all 9860XT and 9890XT models) Set at this option for simultaneous sheath fault locating capability. The SFL-2 A-Frame will receive the 4.8Hz sheath fault locating frequency; the 9800XT Receiver will receive the selected active frequency.

4.5.2 Transmitter Features

Automatic Best Frequency Selection - Chooses the lowest frequency that provides reliable Receiver response in a typical 500 ft. locate.

Poor Conductor Alert - Warns the user that no frequency will produce a reliable Receiver response.

Automatic Impedance Matching - Automatically matches the Transmitter to the line impedance to provide maximum output in all situations.

3 Watt Output - High power output for low frequencies and long distance locating.

Simultaneous Frequency Output - Transmits several frequencies simultaneously to provide locate confirmation and selection flexibility.

Output Level Indicator - Provides information on actual signal transmitted on the conductor.

Loop Resistance Measurement - Provides information to confirm improvement in ground connection and identification of problem locate situations.

Optional Rechargeable Batteries - Provides money saving power supply for the full time professional user.

Safety Flag - Reduces repair costs from collision damage by increasing Transmitter visibility.

Low Battery Alert Transmitted to Receiver - Alerts the user on the Receiver display that the Transmitter has only approximately 20 minutes of power remaining.

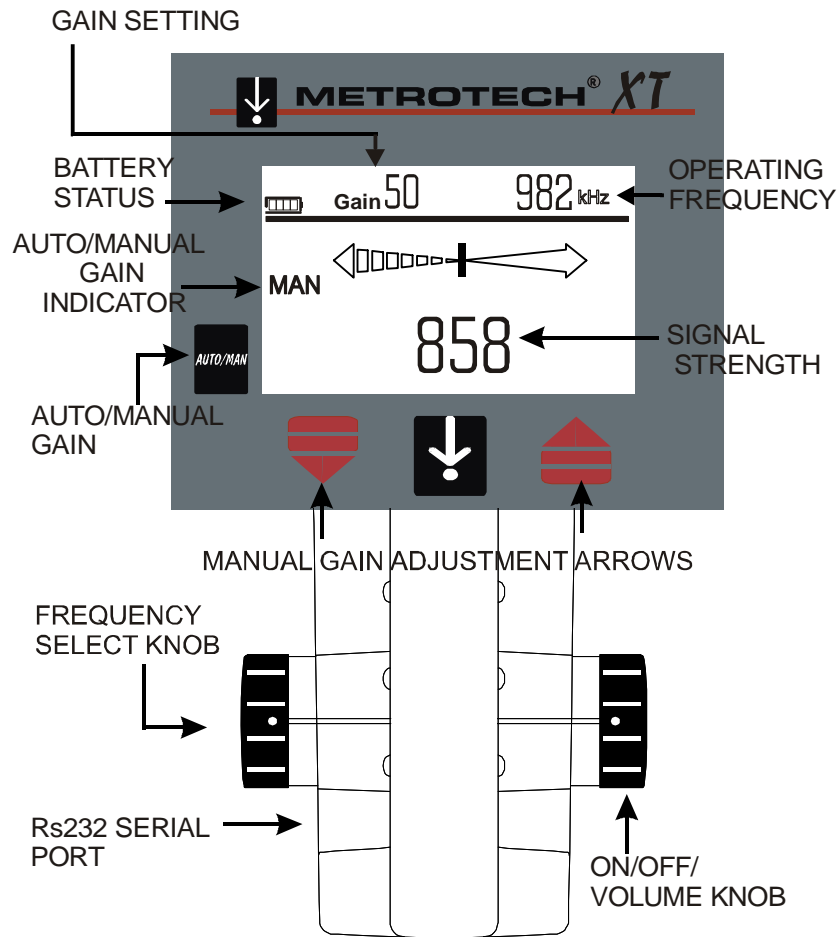
Improper Selection Alert - Warns the user that an improper Transmitter mode has been selected.

Inductive Antenna - Provides locating capability where utility access is not available.

Multiple Power Levels - Provides maximum flexibility for all locating jobs from high congestion to long distance tracing.

9800XT RECEIVER

Figure 4-3: 9800XT Receiver - Controls and Indicators



4.6 Receiver: Controls and Indicators, Features

4.6.1 Receiver Controls and Indicators

See Figure 4.3 for the location of the controls and indicators described below:

ON/OFF VOLUME KNOB - Turn clockwise to turn unit "ON". Also controls volume of audio sound.

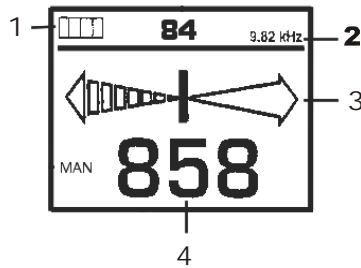
FREQUENCY SETTING KNOB - Your frequency choice depends on which 9800XT model you have purchased.

"RF" Locates carriers of reradiated radio frequencies.

- ⚡ Detects 50/60Hz
- 82K Radio frequency
- 9.8K Audio frequency
- 982 Low audio (Model 9890XT only)

LCD DISPLAY (Liquid Crystal Display) - Displays the battery status, operating frequency, Distance Sensitive Left/Right Guidance™, gain setting, and signal strength.

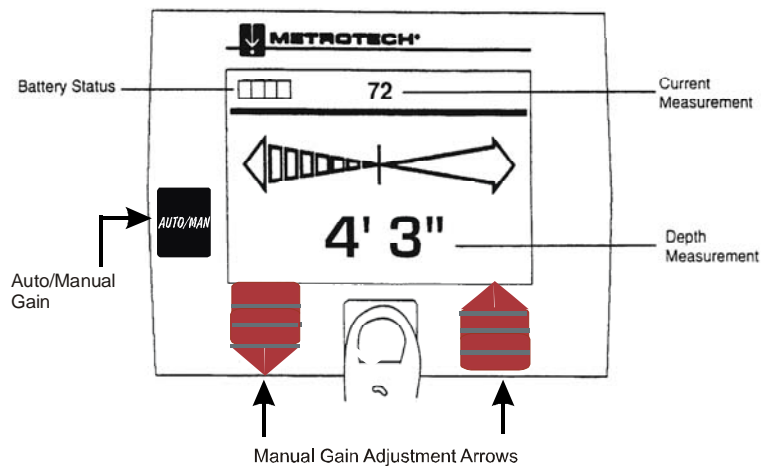
Figure 4-4: 9800XT Receiver LCD Display



- 1 **Battery Status**
- 2 **Operating Frequency**
- 3 **Distance Sensitive Left/Right Guidance**
- 4 **Signal Strength**

In the Depth Measurement mode it displays the battery status, current measurement, and depth measurement.

Figure 4-5: 9800XT Receiver LCD Display: Depth Measurement Mode



AUX JACK (Left side under display head) - Plug Metroclamp into this jack. Used to identify one conductor out of a group of conductors.

HEADPHONE JACK (Right side under display head) - Plug headphones into this jack.

SPEAKER (Under the display head) - Emits audio tone to guide operator toward the targeted conductor.

BATTERY ACCESS SCREWS - Turn spring-loaded quarter-turn screws to release battery housing cover and gain access to the batteries.

RS232 SERIAL PORT PROTECTIVE COVER - Remove protective cover to gain access to RS 232 serial port.

4.6.2 Receiver Features

Distance Sensitive Left/Right Guidance™ -Provides visual and audible direction and distance information to guide you to the conductor.

Peak Mode – Provides a curtain display of the signal strength to locate the cable by maximum signal strength instead of Left/Right Guidance. This mode is useful in special applications and provides additional capability to the user.

Current Measurement - Doesn't vary with depth, assists in positive line identification, and helps identify T's and laterals, large faults and holidays.

Battery Level Display - Continuously displays remaining battery life and provides flashing low power alert.

Push Button Depth - Provides depth measurement in feet and inches (or in cm) in both active and passive modes.

Real-Time Continuous Gain Adjustment™ - Automatic gain continuously optimizes the sensitivity of the Receiver in a fully automatic way and eliminates the need for any user adjustment.

Manual Gain Control - Provides higher sensitivity in particularly tough locate situations. Dedicated gain up/down buttons provide maximum efficiency.

Simultaneous Peak and Null Display™ - Provides information on peak signal and centerline simultaneously.

Battery Saving Automatic Power Down - After five minutes of no activity, the Receiver shuts down to save battery life. Imminent shutdown is indicated by a warble tone. To prevent shutdown, push any button while the tone is warbling.

Depth Measurement to 20 Feet (6 m) - Depth measurement range is up to 20 feet (6 m) to provide information for deep locates.

RS232 Serial Communication Port - Provides data transfer capability for calibration and service.

Not mention conversion of 50Hz to 60Hz until works on 9890XT?

5 CHECKOUT PROCEDURE

To ensure proper operation of the Model 9800XT Utility Line Locator, use the checkout procedure below at the following times:

- upon receiving the equipment
 - before each job, preferably before you leave for the site
 - if problems arise during a locate
- 1 Turn the Transmitter "ON" and place it on the ground. Note battery charge status at power up. If charge is low, replace or recharge Transmitter batteries. **CAUTION:** Do **NOT** attempt to recharge non-rechargeable D-Cell batteries. Damage to the Transmitter will occur.
 - 2 Transmitter bargraph displays two flashing arrows and speaker beeps every 5 seconds.
 - 3 Plug conductive attachment leads into the Transmitter, and attach them to one another. The bargraph display should read less than 5 ohms and maximum output level in high power setting. See Figure 5-1
 - 4 Turn the Receiver "ON" and set to an active frequency. Set Receiver to same frequency. Make sure that Receiver is operating in "Auto" gain control mode. Aim the Receiver at the Transmitter and move it back and forth. The Left/Right Guidance System display should respond. The signal strength should also respond to the movement and be at its highest when pointed directly at the transmitter. See Figure 5-2.

Figure 5-1: Connect Transmitter Leads

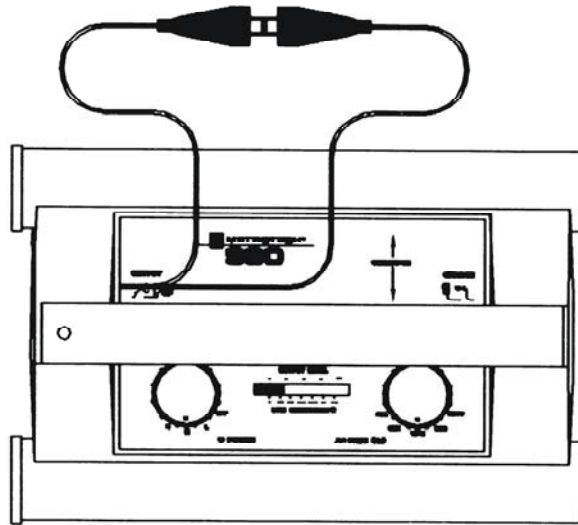
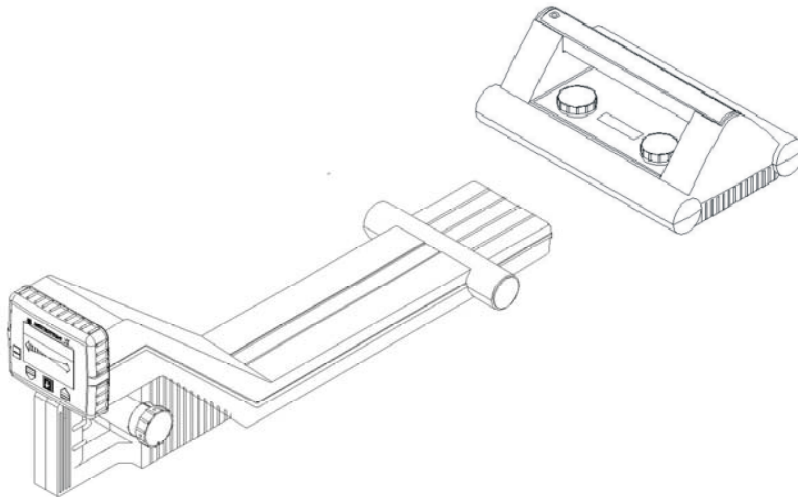


Figure 5-2: Aim Receiver at Transmitter



6 OPERATION

Follow the Checkout Procedure described in Section 5 before operating the equipment. To operate the 9800XT Utility Line Locator use the Transmitter to apply the signal to the conductor, and use the Receiver to trace the signal from the conductor.

6.1 Transmitter Set-up

6.1.1 Check the Battery - Turn the Transmitter “ON” by turning the left knob to “L” (low). Battery status will be indicated by the number of bars on the LCD.

100% charge - 11-12 bars

50% charge - 5-6 bars

25% charge - 1-3 bars

The audio tone will also indicate the battery status - a slow beep indicates the batteries are sufficiently charged. A fast beep indicates the batteries are low. Turn the Transmitter “OFF”. **CAUTION:** Do **NOT** attempt to recharge non-rechargeable D-Cell batteries. Damage to the Transmitter may occur.

6.1.2 Hook the Transmitter Up - The three methods of applying the signal to the conductor are - Direct Connect, Inductive Coupling, and Inductive. Following is a description of each method and instruction of use.

A Direct (Conductive) Connection - This is the preferred mode of operation because the Transmitter is connected directly to a metallic part of the conductor (hydrant, meter, riser, valves, sheath, and tracer wire), allowing maximum signal to reach the conductor. In this operating mode the Receiver can be closer to the Transmitter, and adjacent buried conductor interference is reduced.

WARNING

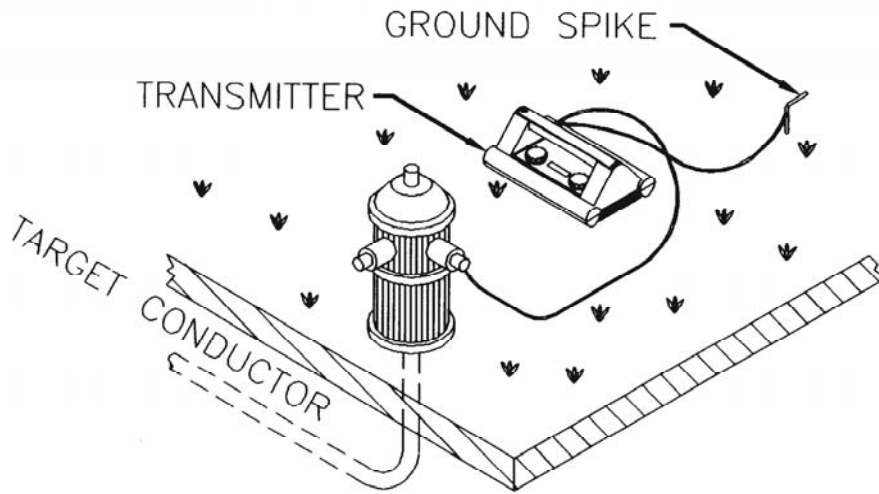
Never make a direct connection to a live power cable. Always make sure the power cable has been taken out of service, is fully discharged and grounded before you make a direct connection to it. If you use the Metroclamp on energized electrical or control lines, follow appropriate safety procedures to avoid the risk of injury.

- 1 Insert the Conductive Attachment** - Turn the Transmitter off. Plug the Direct Connect Cable into the OUTPUT JACK on the Transmitter.
- 2 Connect to your conductor** - Connect the RED lead of the Direct Connect Cable to the targeted conductor.
- 3 Set up and connect to a ground** - Extend the BLACK lead of the Direct Connect Cable as far as possible from the conductor, at a right angle. Look for a convenient existing ground, such as a metal street sign. Be careful not to get close to or cross any adjacent buried conductors. If no existing ground is available, use the ground spike. Drive the ground spike as far into the ground as possible, and attach the BLACK lead. If the ground surface is too hard, place the ground plate on the ground and attach the BLACK lead. To

improve conductivity, put water and/or a weight on the plate. See Figure 6-1.

- 4 **Select a frequency** - The 9860XT Transmitter offers two active frequencies - 9.82kHz and 82kHz. The 9890XT Transmitter has three active frequencies - 982Hz, 9.82kHz, and 82kHz.

Figure 6-1: Direct (Conductive) Connection



The Auto and ALL selections behave differently according to the mode of locating you are working in (see chart). If you are directly connected to your conductor, set the frequency knob to "AUTO" and the Transmitter will automatically pick the lowest frequency that provides solid reliable Receiver response in a typical 500 ft. locate.

**Transmitter Frequency Output
Transmitter Behavior - Direct Connection**

<u>Switch Position</u>	<u>Direct</u>
Auto	Picks best frequency
982Hz (9890XT Transmitter only)	Use on good conductors and for long distance tracing
9.82kHz	Good general purpose frequency in congested areas
82kHz	Good for general purpose locating on pipes with non-metallic joints
All (9860XT Transmitter)	Simultaneous 9.82kHz, and 82kHz

5 Select Transmitter output power - All 9800XT

Transmitter models have three output power settings - Low, Medium, and High. Power output will change according to the frequency selected. As shown on the next page.

<u>Setting</u>	<u>Transmitter Output</u>		
	<u>982Hz</u>	<u>9.82kHz</u>	<u>82kHz</u>
Low	0.3 watts	0.3 watts	0.15 watts
Medium	1 watt	1 watt	0.25 watts
High	3 watts	3 watts	0.7 watts

Poor Conductor Alert - If none of the frequencies meet minimum standards for Receiver response, the Transmitter display will flash and the tone will “warble”. This indicates no frequency will produce a reliable locate. If this occurs, try to improve the ground connection. If this fails, move the Transmitter to a new connection point with lower loop resistance.

After selecting the power level, the Transmitter will display battery life. If you selected Auto, the Transmitter will check all available frequencies and transmit the best one.

6 Check the resistance - After the 3 second battery status, the LCD will display the amount of signal strength on your conductor and the amount of line resistance. The solid bars represent the signal strength; the flashing bar indicates the line resistance.

The higher the resistance, the less signal is on your target conductor. Any indication above 2kOhms, or a flashing right arrow on the LCD, is too high for a successful locate. By improving the ground connection and/or the quality of the direct connection, you can reduce the amount of resistance and improve the signal strength on your target conductor.

If necessary, move your ground connection around until you find the lowest resistance measurement in your locate area. Wetting the area around your ground rod will also reduce the resistance.

B Inductive Coupling with the Metroclamp - If direct connection is not possible, Inductive Coupling is the next best method of getting signal onto your target conductor.

Place an inductive Metroclamp around the conductor. The Transmitter clamps are available for use with the 9800XT.

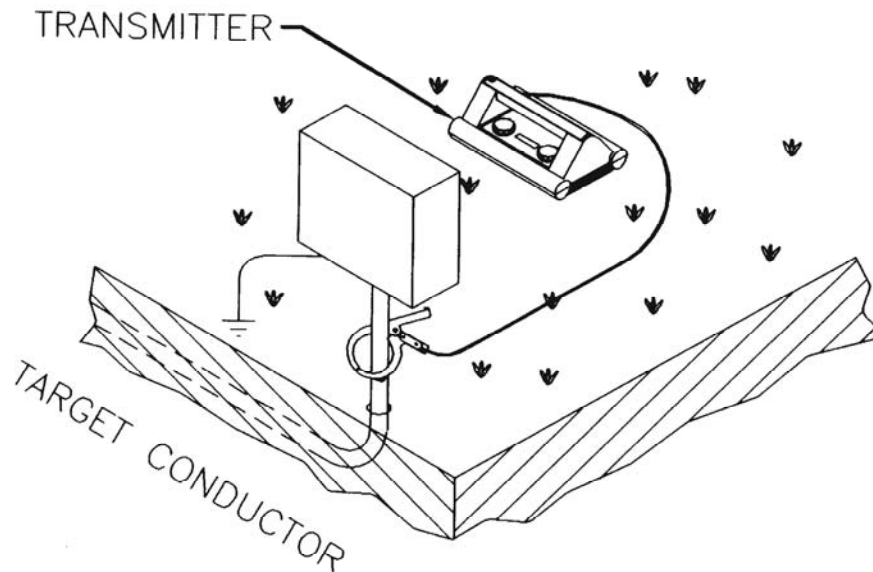
Metroclamp Ground Requirements - If you are using the Metroclamp around a cable, both ends of the cable must be grounded. This ensures a ground return path for optimum current flow (signal strength). Power lines and telephone sheaths are generally grounded. When tracing lines that have insulators (i.e. gas meters), the insulators should be temporarily bypassed, using the supplied jumper cable.

- 1 **Connect the clamp** - Turn the Transmitter "OFF". Plug the Metroclamp cable into the OUTPUT JACK on the 9800XT Transmitter.
- 2 **Position the clamp** - Place the Metroclamp around the conductor, below the electrical ground. Make sure the clamp jaws are completely closed and touching each other. See Figure 6-2.
- 3 **Select a frequency Transmitter**

**Frequency Output
Transmitter Behavior - Inductive Coupling**

<u>Switch Position</u>	<u>Clamp</u>
Auto	Defaults to 82kHz
982Hz (9890XT Transmitter only)	Very weak signal not recommended
9.82kHz	Good for cables
82kHz	Best Inductive Frequency
All	Simultaneous 9.82kHz, and 82kHz

Figure 6-2: Inductive Coupling with the Metroclamp



- 4 Turn the Transmitter to “L” - The Transmitter will** first display battery life. Then the display will show blinking right and left arrows.
- 5 Trace your conductor** - Refer to Section 6.2 for tracing instructions.

C Inductive (Indirect Method) - This is the least effective method of applying signal to isolate one conductor. The signal is broadcast in all directions and can couple to every nearby conductor through electromagnetic induction.

Sometimes it is not possible to gain access to the pipe or cable to make a direct connection or to use the Metroclamp. In these cases use the Transmitter's internal antenna.

When the Transmitter is “ON”, it will broadcast the signal from the internal antenna. No ground connection is needed when a signal is induced onto the target conductor.

NOTE: In this mode, the conductive attachment and Metroclamp should be removed.

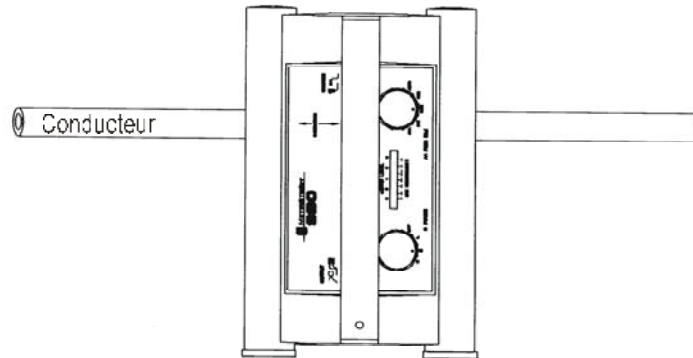
CAUTION:

Do not operate the Transmitter in the Inductive Mode while it is resting on or near a metal surface or large metal object. Incorrect test readings and damage to the Transmitter may result.

- 1 Position the Transmitter** - Remove any cable or clamp from the OUTPUT JACK. Position the Transmitter across the buried conductor as indicated by the arrow on the

Transmitter. Make sure the arrow is directly over the targeted conductor. See Figure 6-3.

Figure 6-3: Transmitter Position for Inductive Tracing



2 Select a frequency -

Transmitter Behavior - Inductive Mode

<u>Switch Position</u>	<u>Inductive</u>
Auto	Defaults to 82kHz
982Hz	No output - do not use
9.82kHz	Good for cables
82kHz	Best Inductive Frequency
All	Non Operational Tone

3 Turn the Transmitter to "L" - The Transmitter will first display battery life. Then it will show blinking right and left arrows.

4 Trace your conductor - Refer to Section 6.2

6.2 Receiver Operation - When tracing a conductor, always be alert to surrounding conditions which could interfere with the accuracy of your locate. Adjacent conductors pull the signal away from your target conductor and can mislead you in both position and depth of your conductor. As you locate, periodically sweep to each side of your conductor to check for the presence of other conductors. The Receiver Left/Right Guidance System will indicate a second centerline, or will behave erratically if there is signal interference.

6.2.1 Receiver Set-up

1 Turn the Receiver "ON" - Turn the right hand knob clockwise to turn the Receiver "ON". This knob also controls the Receiver audio volume.

2 Check battery status - The amount of battery charge will appear in the battery symbol in the upper left corner of the Receiver LCD. Replace the batteries if the symbol flashes. See Section 8.3 for battery replacement.

- 3 Set the frequency** - Turn the left hand knob to set the Receiver to the desired frequency. The selected frequency will appear in the upper right hand corner of the LCD display.

If you are locating actively, you need to match the frequency to that of the Transmitter. If you have set the Transmitter on "AUTO", dial through the active frequencies on your Receiver and set it to the frequency with the highest signal strength.

- 4 Select automatic gain control mode** - For maximum productivity and ease of use, make sure that the receiver is operating in "Auto" gain mode. If the LCD shows the "MAN" indicator,

push the "Auto/Man" button once to select to "Auto" mode. "MAN" will disappear from the display confirming you are no longer in manual gain mode.

- 5 Sweep the area** - Hold the Receiver in front of you at a comfortable angle and make a 360-degree sweep 8 to 10 feet (2.5 to 3 m) around your connection point. As you make this sweep, stop at each centerline, note the signal strength, and measure the current. To do this, make sure the signal strength is below "999", then position the Receiver over the centerline and push the depth arrow button. The current measurement will appear at the top of the LCD screen. The maximum current measurement reading will normally be on your target conductor. Unlike signal strength, current measurement should not vary with target depth.
- 6 Check for air coupling (Inductive mode only)** - If you are using the inductive method, make sure the Receiver is not air coupled to the Transmitter. This can occur from 8 to 50 feet (2.5 to 15 m) from the Transmitter. To determine if you are air coupled, find a centerline and lift the Receiver straight up. If the signal strength decreases smoothly, you are not air coupled. If it stays the same, or increases, you are air coupled. Move further away from or switch to a lower power setting on the Transmitter until you achieve the desired result.
- 7 Trace the path of your conductor** - Hold the 9800XT Receiver in front of you at a comfortable angle. See Figure 6-4. Move it from side to side. Three features will guide you to your conductor.

Figure 6-4: Receiver Position for Tracing



Distance Sensitive Left/Right Guidance™ - will visually guide you to your conductor. When the bar is to the left, move to the left. When the bar is to the right, move to the right. When you are centered over the conductor, the vertical bar will be centered between the arrows.

Audible Tone - will guide you to your conductor. When the tone is pulsing move to the left. When the tone is steady, move to the right. When you are centered over your conductor, the tone is silent.

Signal Strength the numerical signal strength should be the highest when you are over your conductor.

8 Mark your conductor path - When you have confirmed the conductor's location, mark it as required. See Appendix for APWA color markings.

9 If signal strength drops - If you note a sudden drop in signal strength and a loss of Left/Right Guidance, your conductor may have changed direction. If this happens, stop and check the current measurement. The current measurement reading you took at the start of the locate should remain consistent (it will decrease slightly as you move further away from your Transmitter) throughout your locate. Sweep the area to find the centerline and shoot a depth to check the current measurement to get back on line.

If current measurement decreases suddenly, you may have passed a "T" or lateral in your conductor. Make a 360 degree sweep of the area for additional center lines to confirm the conductor split.

If the depth and signal strength change, but Left/Right Guidance remains the same, your conductor may have changed depth. Check the current measurement. If it has remained steady, continue on, you are still on the conductor. The current measurement reading tells you that a change in depth caused the change in signal strength.

10 Switching between automatic and manual gain control mode - To adjust the gain manually, push the "Auto/Man" button once. "MAN" appears on the display when in the manual gain control mode. Adjust the gain up or down using the red up/down arrow buttons.

Push the "Auto/Man" button again to terminate the manual gain control mode and launch automatic gain control mode. "MAN" will disappear from the display window confirming you are no longer in manual gain control mode. Using automatic gain control mode, the receiver now adjusts the gain in a fully automatic way.

11 Switching between Left/Right Guidance and Peak Modes – To switch from Left/Right Guidance Mode to Peak Mode, press the "Auto/Man" button twice quickly in succession. The Left/Right Indicator will disappear and will be replaced by a "curtain" display as in the passive mode (see 6.2.3). Use the "Up" and "Down" buttons to change the gain and open and close the curtain. When in Peak Mode the 9800XT will measure depth is high enough to generate a sound from the speaker. If the signal strength is not high enough to allow for a measurement of depth, no sound is heard and depth cannot be measured. To change back to Left/Right Guidance Mode from Peak Mode, simply press the "Auto/Man" button once. Alternatively, turn the unit off and then on again.

12 To activate the backlighting feature and Sonde mode- Hold down the depth button, and turn the unit on. Wait for the LCD to stabilize, release the button. The Receiver LCD will first display "Sonde" to the right of the signal strength and then "BL" in place of the signal strength. If you want to activate the backlight, push the depth button when the feature is displayed. To deactivate, turn the unit off.

13 Turn the Transmitter and Receiver off - Disconnect the accessories when you have finished your locate.

6.2.2 Determining the Depth of a Conductor - The depth of a conductor can be determined in any of the Transmitter hook-up modes. When determining depth in the Inductive Mode, move at least 35 feet (12 m) from the Transmitter to prevent air coupling with the transmitter signal. Signal strength should be greater than 250 for reliable depth calculation.

Keep in mind that depth measurements are affected by soil conditions, overhead lines, adjacent conductors, and the conductor material. Most water and gas pipes are deeper than CATV and telephone cable. Use the depth measurement as a verification that you are still on your target conductor.

1 Position yourself over the conductor - Stand so you are facing down the length of the conductor and are directly over it. See figure 6-5.

2 Take the depth reading - Hold the Receiver vertically over the centerline with the tip to ground. Push and release the depth arrow button. The LCD will display the depth in feet and inches (or centimeters) and the current measurement (top center of LCD) for 3 seconds and then revert to the tracing display.

When determining depth in an active mode, the Receiver Left/Right Guidance System must be centered within 3 bars from the centerline in order to get a depth reading. If it is not, the unit will beep and display “CL” (center line) when you push the depth arrow button.

If the signal strength is less than 100 when measuring depth, the Receiver will display “Err”. If the conductor is deeper than 20 ft. (600 cm) the Receiver will display a flashing “20” (“600”).

Figure 6-5: Receiver Position When Determining Depth



6.2.3 Passive Mode Locating - Both the 9860XT and 9890XT Receivers have two passive locating frequencies:

RF Detects radio frequency originating from distant radio transmitters, a signal that penetrates the ground and is reradiated by buried lines. It can be used to verify the location of utility lines with good conductivity.

50Hz/ Locates presence or absence of active power

60Hz lines in your locate area, and to double check previously located lines. Use only for verification - sufficiently strong 50/60 Hz current must be present to accurately detect and locate the line.

Receiver operation in the passive frequencies is the same as in the active frequencies with the exception of the following:

Left/Right Guidance System - The Left/Right Guidance indicator will change to a “curtain” display - your centerline becomes the closing point of the two “curtains” coming together. When the curtain closes more than half way, the Receiver will begin to beep.

Gain Adjustment - In either passive mode the 9800XT Receiver does not operate in the fully automatic gain adjustment mode. The gain needs to be adjusted manually. Adjust the gain downwards pressing the red gain down arrow button when the “curtain” closes

completely and the audible tone is continuous (gain is too high). Adjust the gain upwards pressing the red gain up arrow button if the “curtain” displays nothing and there is no tone (gain is too low). The selected gain setting will be indicated on the Receiver LCD display in the upper left corner. “0” is the minimum gain setting, “100” is the maximum gain setting.

Depth Measurement - To determine depth in either passive setting, position the Receiver vertically over the conductor (tip to ground) and push the depth button. A depth measurement cannot be taken when the signal strength is equal to 99.

6.2.4 Triangulating to Determine Depth - If the depth of your conductor suddenly changes to a much different measurement, or you are locating a conductor that is buried in a common trench, triangulate to confirm depth. This process will confirm that you are tracing and measuring the depth of your target conductor.

Triangulation is based on the principle that two sides of a 45-degree right triangle are equal. See Figure 6-6.

To triangulate the depth:

- 1 Tilt the Receiver away from the conductor at a 45-degree angle** - Sight down the slant lines on the Receiver instruction decal. See Figure 6-7.
- 2 Move away from the conductor at a right angle**- The Left/Right Guidance System will indicate another centerline. Mark this spot on the ground. See Figure 6-8.
- 3 Repeat this process on the opposite side of the conductors.**
- 4 Calculate depth** - One half the distance between the two centerlines is the approximate depth of your conductor.

NOTE: This method uses the Left/Right feature, rather than the upper and lower antennae, to determine depth.

Figure 6-6: Principle of Triangulation

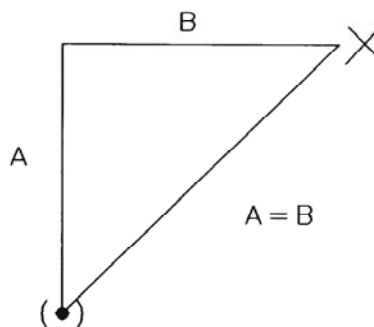


Figure 6-7: Receiver Position for Triangulation

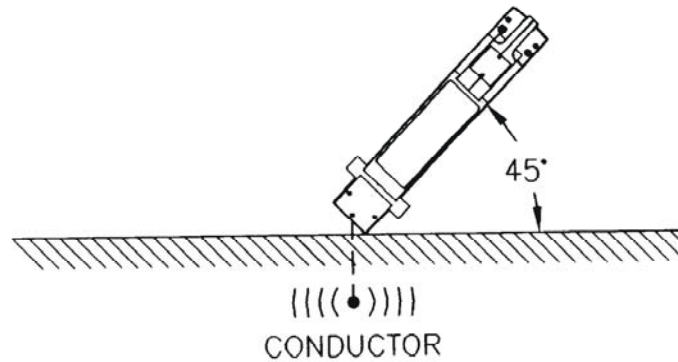
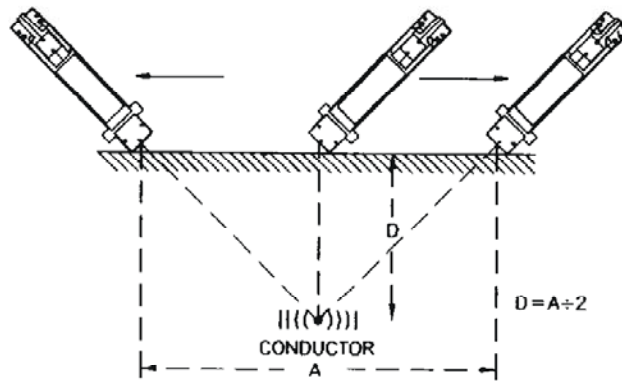


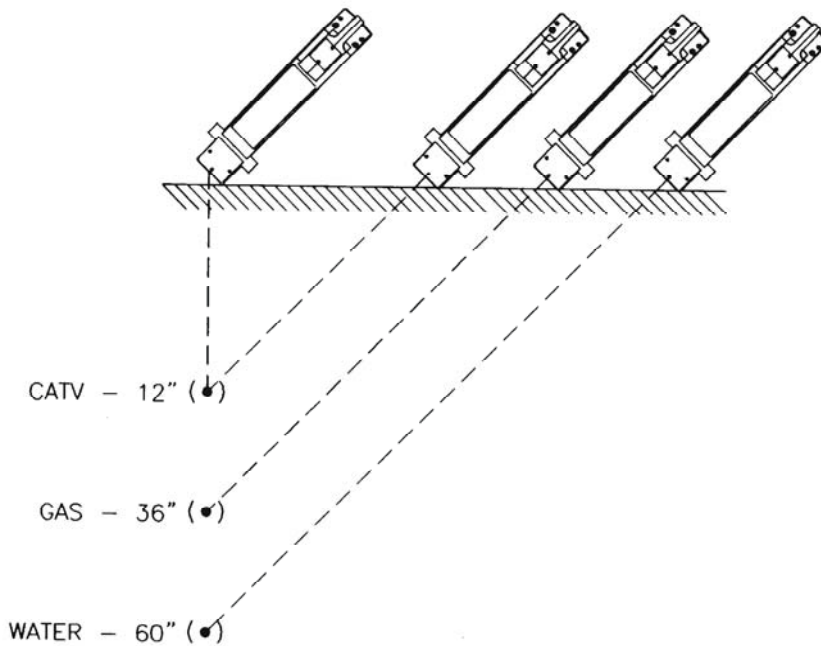
Figure 6-8: Locate Centerline



6.2.5 Triangulation for Confirming Presence of Common Trench Conductors - If you are locating a conductor in a common trench, your signal may induce onto a more shallow or better conductor. When this occurs, you may get an unlikely depth reading using the Receiver push button depth measurement function. (Example: a water main at a depth of 9" or 20 cm).

Use triangulation to confirm the presence and depth of multiple conductors. Find the depth of the first conductor and then continue to move away from the conductor, marking each conductor depth. Repeat the process to the other side and then calculate the depth of each conductor. See figure 6-9.

Figure 6-9: Multiple Conductors in a Common Trench



7 ADVANCED TECHNIQUES

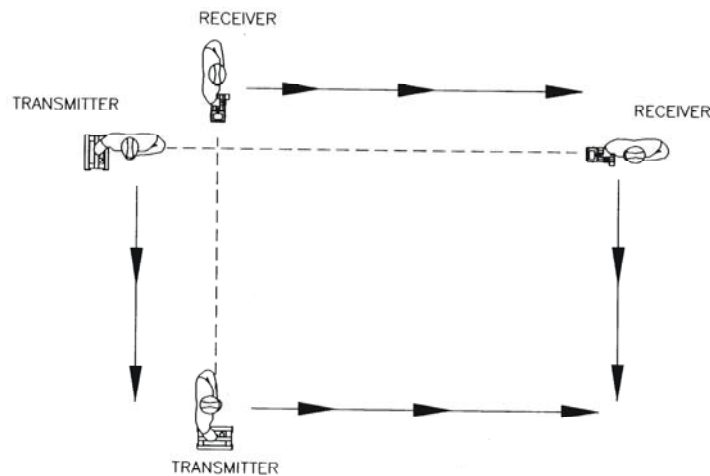
7.1 Ground Survey - Regulations at construction sites often require a ground survey before any excavation is done. This prevents damaging underground utilities. A ground survey is a process to locate all the underground conductors within a particular area. It includes standard locating and a blind search. A blind search is a search for conductors with unknown sources and endings. The 9800XT must be operated in the Inductive Mode using a systematic grid approach.

7.1.1 Locating Conductors - First use one of the three modes of operation (Direct Connect most accurate) to locate the known utilities and mark their location on the ground. Follow the procedures outlined in Section 6.

7.1.2 Blind Search - The 82kHz frequency is best for blind searches. Two operators are required for a blind search. One carries the Transmitter, the other operates the Receiver. Starting approximately 35 feet (12 m) apart, the two operators move in parallel across and then down the survey area, parallel to one another.

- 1 Operator 1 holds the Transmitter at his/her side and level with the ground.
- 2 Operator 2 holds the Receiver vertically at his/her side with the top surface of the Receiver facing the Transmitter.
- 3 Walk together across the search area. The Receiver Left/Right and the signal strength reading will indicate the presence of a conductor under the ground as the operators pass over it. Mark the location of each conductor along your search path. See Figure 7-1.

Figure 7-1: Blind Search Parallel Pattern



- 4 Repeat this process until you have covered the entire width of the area. Then change your direction of travel 90 degrees and search across the same area. After executing this procedure in both directions, go back and use the standard inductive mode (Section 6.1.2, C) to trace the path of each conductor you have marked.

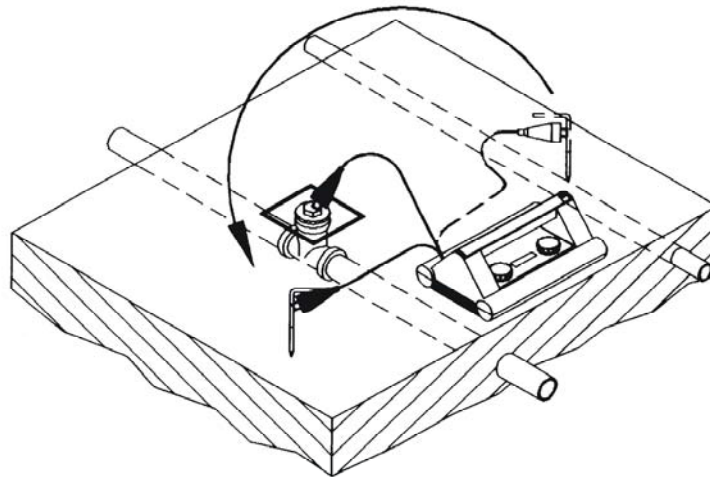
7.1.3 Subdividing Large Search Areas - If you are working in a large search area, subdivide it into several smaller areas. Then complete the blind search as outlined above for each smaller area before going on to the next one.

7.2 Adjacent Conductors - When the signal strength drops off more on one side of the conductor than it does on the other, the Receiver may be picking up interference from an adjacent or parallel conductor. In most cases, the conductor with the stronger signal is the target conductor. Confirm the exact location of the adjacent conductors. Place your ground lead so that it *does not cross over any adjacent conductors*, is perpendicular to, but as far away from your target conductor as possible. See Figure 7-2.

Look for evidence of other underground utilities in the area, such as transformers, pedestals, hydrants, meters, etc. which indicate the presence of other underground conductors.

Figure 7-2: Adjacent Conductors - Position of Ground Lead

Move Ground Away From PPE



7.3 Deep Conductor - Signals picked up by the Receiver from deeply buried pipes are weaker and not as directionally distinct as those from pipes closer to the surface. In addition, the signal strength will only change by small increments in relation to moving the Receiver antenna.

Using the Inductive (Indirect) Method of coupling signal to the conductor may be difficult if the target conductor is buried four feet (1.3 m) or more. For best results, use the Direct (Conductive) Connection method.

7.4 Tracing Long Runs - Signals picked up by the Receiver get weaker as you move farther away from the Transmitter coupling point, especially on long pipe runs. To get a stronger signal, move the Transmitter coupling point closer to the Receiver. If it is necessary to use the Inductive mode, your tracing job will be easier if an assistant follows behind with the Transmitter as you trace with the Receiver.

7.5 Locating a Service Lateral - After you have traced the main, you may want to go back and locate the service laterals off the main. Service laterals are easiest to find using the Inductive Mode. Two operators are required for this procedure. Operator 1 remains stationary holding the Receiver as if to trace the main. Operator 2 carries the Transmitter, holding it parallel to the main line and maintaining a minimum of 100 ft. (30 m) between himself/herself and the Receiver. He/she walks parallel to and 5 feet (1.5 m) from the main on the side he/she expects to find the service laterals. See Figure 7-3. The Receiver signal strength will increase as Operator 2 crosses over the service lateral with the Transmitter. Each time the meter reading increases, Operator 1 signals Operator 2 and he/she marks the lateral locations on the ground.

7.6 Locating a Bend or Dead End - While tracing a line, you may find that the signal strength drops off suddenly, and that there is no distinct reading when the Receiver antenna is moved left or right. Stand in place and continue sweeping the antenna from side to side but at the same time slowly pivot your body.

If you find a pivot angle at which the signal strength picks up again, it means you have located a bend and can resume tracing in the new direction. See Figure 7-4.

If you pivot all the way around (360 degrees), without getting any noticeable signal strength, it means you have reached a dead end. See Figure 7-5.

7.7 Valves, Manhole Cover, T's and Risers - If the signal strength suddenly increases and then falls back while tracing a pipe you have probably passed over a buried valve, manhole cover, T, or riser.

Figure 7-3: Locating Service Laterals

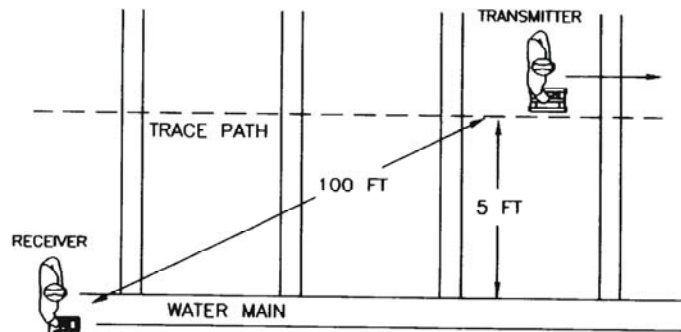


Figure 7-4: Locating a Bend

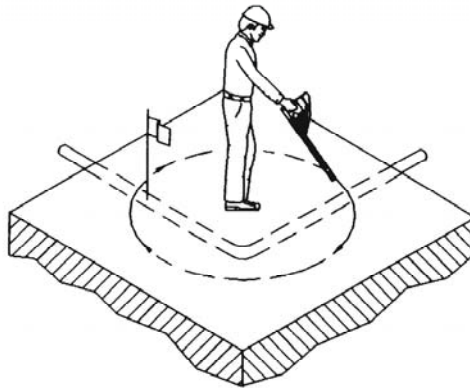
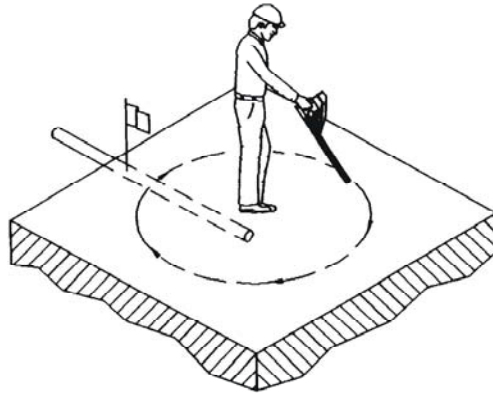


Figure 7-5: Locating a Dead End



7.8 Common Bonded Conductors - Telephone, power, and CATV sometimes use a common ground bond. If other conductors are connected to your target conductor, putting a signal on the target can cause all the conductors to carry the same signal, making it difficult to identify the target conductor.

To verify that you are tracing the targeted conductors, note the field strength at a known location of the conductor. As you trace, any change in field strength should be gradual. If either reading changes abruptly you are probably no longer over your targeted conductor.

7.9 Conductor Identification Using a Second Metroclamp - When exposed multiple conductors are present, for example in conduits or ducts, use the method described below to identify a specific conductor.

- 1 Plug a second Metroclamp cable into the jack under the Receiver LCD display.
- 2 Turn the Transmitter on and set the Receiver to the transmitted frequency.
- 3 Place the Metroclamp around each conductor in succession, making sure that the jaws are fully closed. The conductor with the highest field strength reading is the target conductor.

NOTE: This method will work only if there is no cross bonding on the length of the conductor between the conductor and the Receiver.

7.10 Congested Areas - If you suspect that coupling from adjacent conductors is causing interference in the signal picked up by the Receiver, *try increasing the strength of the signal on your conductor and decreasing the strength of signal from the interfering conductors by:*

- 1 Changing to a different transmitter coupling point or coupling mode. Try another approach. Move the Transmitter so you are locating from a less congested area into the congested area. See Figures 7-6 and 7-7.
- 2 Improving the ground connection or moving the grounding point.

- 3 Determine the location of the adjacent conductors. Then check to be sure that neither the direct connect cable or the ground cable cross over any of the adjacent conductors. Reposition them if necessary.
- 4 If you are inducing, you can decrease the interfering signal by changing the position of the Transmitter. Find the location of the interfering conductor. Stand the Transmitter on its end (vertically) over the interfering conductor. This will reduce or eliminate signal on this line.
- 5 Set the receiver to manual gain control and adjust the gain setting to a level that is just enough to see the target conductor. Adjacent conductors carrying a weaker signal will most likely be ignored by the Receiver display if you have adjusted the gain manually using this procedure.

Figure 7-6: Incorrect Coupling for Congested Area

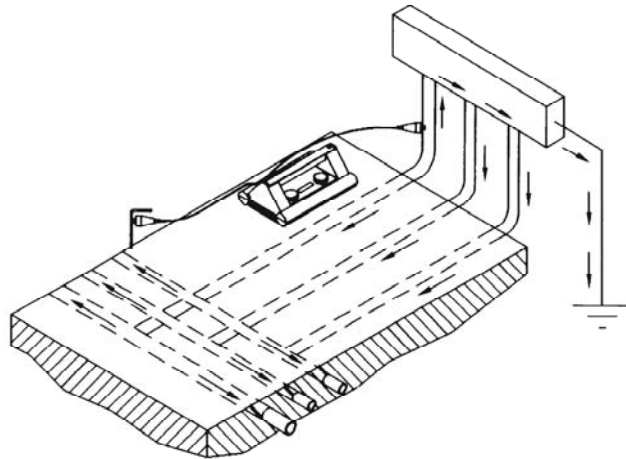
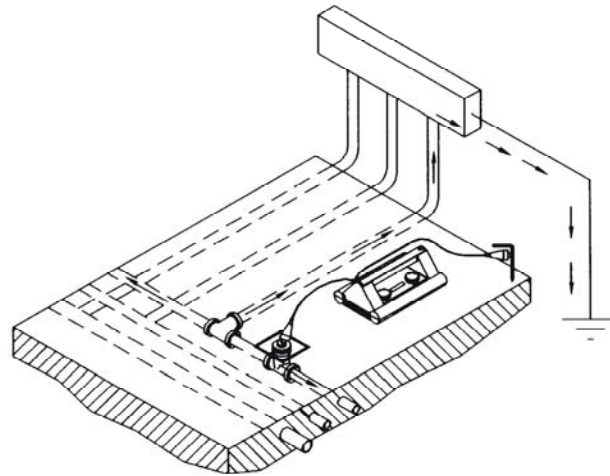


Figure 7-7: Correct Coupling for Congested Area



7.11 Determining If You Have a “Ghost” Conductor - If there is another conductor near your target conductor, it too may pick up signal from the Transmitter. When this occurs, there will seem to be a “ghost” between the two conductors. You are likely to have a “ghost” trace if any of the following phenomena occur:

- 1 The Left/Right Guidance bar moves in the same direction you move the Receiver. (Normally the Left/Right moves in the opposite direction.)
- 2 The signal strength drops as you move toward the “ghost” conductor.
- 3 When you take a push button depth reading, you get an illogical depth, or no depth at all.

The Receiver reads a “ghost” conductor when each Left/Right antenna coil receives an equal amount of signal from two separate conductors. The location of the “ghost” may vary according to the soil conditions and the size, depth, and conductivity of adjacent conductors.

Use one of the methods for improving your signal as given in Section 7.10, Congested Areas.

7.12 Pipes with Insulated Junctions - The high 82kHz radio frequency signal will cross pipe insulators, however, the signal will decrease proportionately each time it crosses an insulator. When possible, such as when tracing a pipe with a meter, bypass the meter (insulator) by using a jumper cable. Attach each end of the jumper cable on opposite sides of the insulator.

7.13 Distribution Systems - To locate short gas services on a gas distribution system, you should temporarily ground the end of the service. This can be accomplished by temporarily connecting a jumper cable

to a ground spike at the end of a service, where the pipe or tracer wire comes out of the earth. Be sure to remove the ground connection after completing the locate so as not to defeat the cathodic protection system.

7.14 Non-Metallic Pipes - To trace nonmetallic pipe (sewer line) or duct, send the signal through the pipe by inserting the appropriate Metrotech Sonde (according to the operating frequency you are using). For accurate depth readings with Sonde, make sure Receiver is in Sonde mode. An alternate method is to insert a snake or fishtape into the pipe and connecting the Direct Connect Cable from the Transmitter to one end of it. See section 6.2.1,11.

7.15 Tracer Wire - When using tracer wire to trace nonmetallic pipe, keep in mind that the far end of the tracer wire must be grounded. This provides a return path for the signal.

8 MAINTENANCE - The only routine maintenance required for the equipment and accessories is to test and recharge or replace, if necessary, the batteries in the Transmitter and the Receiver. Both possess battery test features, making it easy to check the condition of the batteries at any time.

The 9800XT is designed for rugged outdoor use, but rough handling should be avoided. Keep the equipment dry, clean, and free of grit. Make sure the RS 232 serial port is protected by its cover when not in use. Store the 9800XT (in its carrying case) in a cool, dry place. Do not expose to excessive temperatures.

We recommend checking the Transmitter and Receiver batteries before each use, preferably before leaving for the job site.

8.1 Replacing the 9800XT Non-rechargeable D-Cell Transmitter Batteries - See Figure 8-1.

- 1 Have ready ten D-Cell batteries.
- 2 Unscrew each of the end caps on the 9800XT Transmitter.
- 3 Remove and replace all five batteries in each of the two battery housings, positive first. (Polarity direction is molded into the battery housing).
- 4 Replace the end caps.

CAUTION: Do **NOT** attempt to recharge non-rechargeable D-Cell batteries. Damage to the Transmitter will occur.

Figure 8-1: Replacing the Non-rechargeable D-Cell Transmitter Batteries

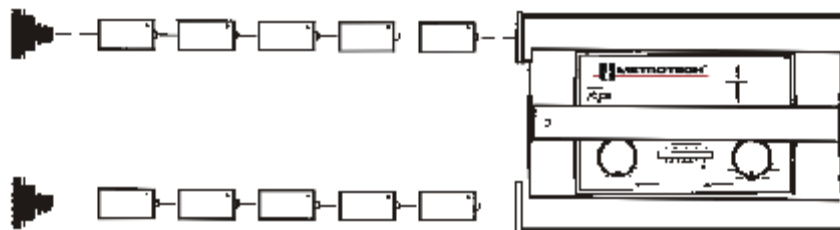
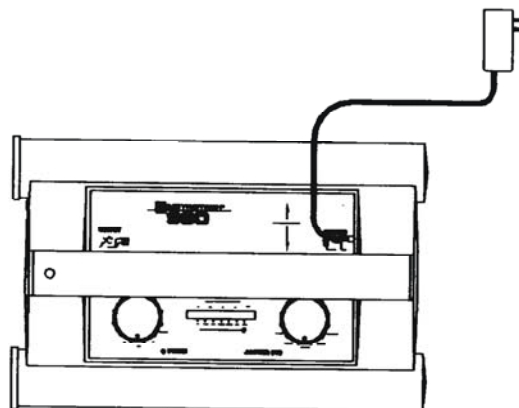


Figure 8-2: Recharging the Rechargeable NiCd Transmitter Battery with the Wall Mount Charger



8.2 Recharging the 9800XT Transmitter NiCd Rechargeable Battery - If you have purchased a 9800XT with a rechargeable NiCd Transmitter battery, you will have received a Wall Mount Charger. If you remove the battery, be sure to replace it positive end first. The Vehicle Mount Charger is an optional accessory.

CAUTION: Do **NOT** attempt to recharge non-rechargeable D-Cell batteries. Damage to the Transmitter will occur.

8.2.1 Wall Mount Charger - The Wall Mount Charger is provided for overnight recharging of your rechargeable NiCd Transmitter battery. It will take 12-14 hours to fully recharge your rechargeable NiCd Transmitter battery. See Figure 8-2.

- 1 Turn the Transmitter "OFF".
- 2 Plug the Wall Mount cube into a 3 prong 120V socket. (Contact the factory for other available charger versions specific to the country where you are operating the equipment).
- 3 Plug the wall mount plug into the CHARGER JACK on the right inside wall of the Transmitter. Leave overnight.

- 4 To check the amount of Transmitter charge, unplug the wall mount from the Transmitter and turn the Transmitter to "L". The LCD bars will indicate the amount of charge in the Transmitter.

8.2.2 Vehicle Mount Charger (VMC) - The Vehicle Mount Charger provides an "at the site" method of fast charging your rechargeable NiCd Transmitter batteries. The rule of thumb is to double the charging time to determine how much operating time you will have. For example: 10 minutes of charging will give you 20 minutes of locating time. See Figure 8-3.

- 1 With the engine running, turn the Transmitter "OFF".
- 2 Plug the receptacle plug into the vehicle lighter receptacle. The red LED on the front of the charger should light up.
- 3 Plug the second charger plug into the CHARGER JACK on the right inside wall of the Transmitter.
- 4 If the battery charge is very low, the VMC will slow charge for the first 20% and quick charge for the remaining 80%. The LED lamp will indicate which mode it is operating in:

Slow flash - Slow charge
Solid light - Quick charge
Fast flash - Charge Complete

- 5 To check the amount of charge, unplug the receptacle plug from the Transmitter and turn the Transmitter to "L". The LCD bars will indicate the amount of charge in the Transmitter.

Figure 8-3: Recharging the Rechargeable NiCd Transmitter Battery with the Vehicle Mount Charger

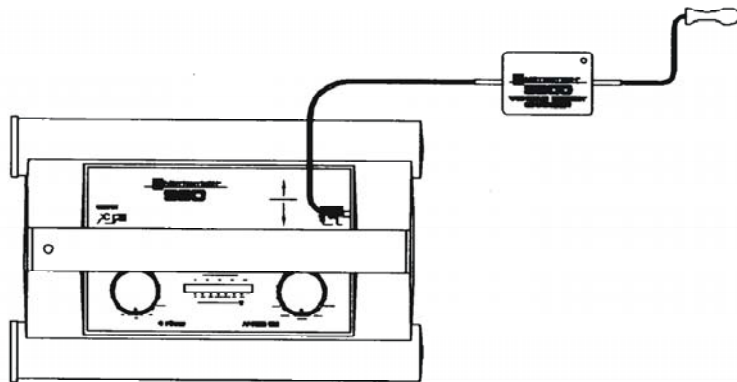
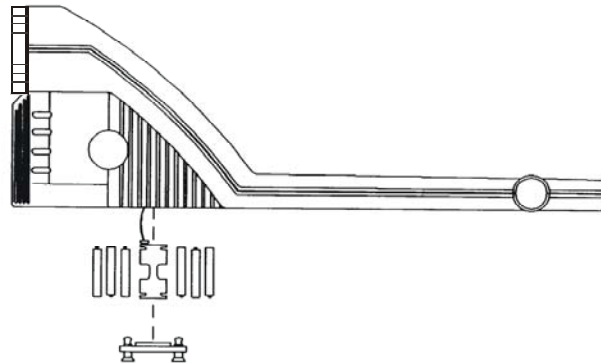


Figure 8-4: Replacing the 9800XT Receiver Batteries



8.3 Replacing the 9800XT Receiver Batteries - See Figure 8-4.

- 1 Have ready six AA batteries.
- 2 Using a screwdriver or dime, turn the two spring-loaded quarter-turn screws on the underside of the 9800XT Receiver handle and remove the battery housing cover.
- 3 Carefully pull the battery pack out of the unit and unsnap from the cable connection.
- 4 To remove batteries from battery pack, pull the middle battery out first by pressing down on the positive end and popping it out. (The negative end always contacts with the spring.) Then remove the side batteries. Turn the housing over and remove second set of batteries as above. Always remove all of the batteries before replacing any of them to avoid confusion as to which are fresh and which are depleted.
- 5 Replace batteries, noting polarity.
- 6 Snap housing onto Receiver connection and reseal in battery well.
- 7 Replace battery cover and screw into place.

8.4 Service Center Information - If the equipment does not function properly, replace the batteries as described above. If the equipment still malfunctions, contact one of the Metrotech Customer Service departments:

Metrotech West Coast Service Center
3251 Olcott Street
Santa Clara, CA 95054
Tel: 1-800-638-7682
(International: 1-408-734-1400)
Fax: 1-408-734-1415
Email: service@metrotech.com
Internet: www.metrotech.com

Metrotech East Coast Service Center
1824 Murfreesboro Road, Suite 104
Nashville, TN 37217
Tel: 1-800-624-6210
TN: 1-615-366-7323
Fax: 1-615-360-9855
Email: nashville@metrotech.com

European Service Center
SebaKMT
Dr.-Herbert-lann-St. 6
D-96148 Baunach, Germany
Tel: +49-9544-680
Fax: +49-9544-2273
Email: service@sebakmt.com

Or call the factory for the nearest authorized Metrotech repair station.

Additional Metrotech Instruments: Pipe and Cable Locators, Ferromagnetic Locators, Fiber Optic Cable Locating System, Sheath Fault Locators, Acoustic Water Leak Detectors, Electronic Marker Locators.

APPENDIX

A1 APWA Marking Colors - The following color markings have been established by the American Public Works Association (APWA):

<u>Conductor</u>	<u>Color</u>
Electric power lines, cables, or conduits	Red
Communication lines, cables, conduits, CATV	Orange
Gas, oil, petroleum, or other gaseous materials	Yellow
Sewers, storm and sanitary, drain lines	Green
Water, irrigation, or slurry lines	Blue

Note: If you have any questions regarding marking requirements or procedures in the United States, please call you local One Call Center. International customers: please check with your local regulatory authorities or utility companies required color markings may vary between different countries.

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