Pipe, Cable and Sonde Locator

Patents Pending

WARNING!
Read this Operator’s Manual carefully before using this tool. Failure to understand and follow the contents of this manual may result in electrical shock, fire and/or serious personal injury.
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Pipe and Cable Locator

Patents Pending

SeekTech® SR-20

Record Serial Number below and retain product serial number for your records.
See information screen for serial number and software version.

Serial No. ________________________________
Software Version __________________________

Test Equipment Depot - 800.517.8431 - 99 Washington Street Melrose, MA 02176 - TestEquipmentDepot.com
General Safety Information

**WARNING**
Read and understand all instructions. Failure to follow all instructions listed below may result in electric shock, fire, and/or serious personal injury.

**SAVE THESE INSTRUCTIONS!**

**Work Area Safety**
- Keep your work area clean and well lit. Cluttered benches and dark areas may cause accidents.
- Do not operate electrical devices or power tools in explosive atmospheres, such as in the presence of flammable liquids, gases, or heavy dust. Electrical devices or power tools create sparks which may ignite the dust or fumes.
- Keep bystanders, children, and visitors away while operating a tool. Distractions can cause you to lose control.

**Electrical Safety**
- Do not operate the system with electrical components removed. Exposure to internal parts increases the risk of injury.
- Avoid exposure to rain or wet conditions. Keep battery out of direct contact with water. Water entering electrical devices increases the risk of electric shock.
- Do not probe high voltage line.

**Battery Precautions**
- Use only the size and type of battery specified. Do not mix cell types (e.g., do not use alkaline with rechargeable). Do not use partly discharged and fully charged cells together (e.g., do not mix old and new).
- Recharge batteries with charging units specified by the battery manufacturer. Using an improper charger can overheat and rupture the battery.
- Properly dispose of the batteries. Exposure to high temperatures can cause the battery to explode, so do not dispose of in a fire. Some countries have regulations concerning battery disposal. Please follow all applicable regulations.

**Personal Safety**
- Stay alert, watch what you are doing and use common sense. Do not use diagnostic tool while tired or under the influence of drugs, alcohol, or medications. A moment of inattention while operating tools may result in serious personal injury.
- Gloves should always be worn for health and safety reasons. Sewer lines are unsanitary and may contain harmful bacteria and viruses.
- Do not overreach. Keep proper footing and balance at all times. Proper footing and balance enables better control of the tool in unexpected situations.
- Use safety equipment. Always wear eye protection. Dust mask, non-skid safety shoes, hard hat, or hearing protection must be used for appropriate conditions.
- Use proper accessories. Do not place this product on any unstable cart or surface. The product may fall causing serious injury to a child or adult or serious damage to the product.
- Prevent object and liquid entry. Never spill liquid of any kind on the product. Liquid increases the risk of electrical shock and damage to the product.
- Avoid Traffic. Pay close attention to moving vehicles when using on or near roadways. Wear visible clothing or reflector vests. Such precautions may prevent serious injury.

**SR-20 Use and Care**
- Use equipment only as directed. Do not operate the SR-20 unless you have read the owner manual and been trained in its use.
- Do not immerse the antennas in water. Store in a dry place. This will reduce the risk of electric shock and instrument damage.
- Store idle equipment out of the reach of children and other untrained persons. Equipment is dangerous in the hands of untrained users.
- Maintain the instrument with care. Properly maintained diagnostic instruments are less likely to cause injury.
- Check for breakage of parts, and any other conditions that may affect the SR-20’s operation. If damaged, have the instrument serviced before using. Many accidents are caused by poorly maintained tools.
- Use only accessories that are recommended by the manufacturer for the SR-20. Accessories that may be suitable for one instrument may become hazardous when used on another.
- Keep handles dry and clean; free from oil and grease. Allows for better control of the instrument.
- Protect against excessive heat. The product should be situated away from heat sources such as radiators, heat registers, stoves or other products (including amplifiers) that produce heat.
Service

- Diagnostic instrument service must be performed only by qualified repair personnel. Service or maintenance performed by unqualified repair personnel could result in injury.

- When servicing a tool, use only identical replacement parts. Follow instructions in the Maintenance Section of this manual. Use of unauthorized parts or failure to follow maintenance instructions may create a risk of electrical shock or injury.

- Follow instructions for changing accessories. Accidents are caused by poorly maintained tools.

- Provide proper cleaning. Remove battery before cleaning. Do not use liquid cleaners or aerosol cleaners. Use a damp cloth for cleaning.

- Conduct a safety check. Upon completion of any service or repair of this product, ask the service technician to perform safety checks to determine that the product is in proper operating condition.

- Damage to the product that requires service. Refer servicing to qualified service personnel under any of the following conditions:
  - If liquid has been spilled or objects have fallen into product;
  - If product does not operate normally by following the operating instructions;
  - If the product has been dropped or damaged in any way;
  - When the product exhibits a distinct change in performance.

- CAUTION
  Remove batteries entirely before shipping.

Specific Safety Information

⚠ WARNING
Read this operator’s manual carefully before using the SR-20. Failure to understand and follow the contents of this manual may result in electrical shock, fire and/or severe personal injury.

Important Notice
The SR-20 is a diagnostic tool that senses electromagnetic fields emitted by objects underground. It is meant to aide the user in locating these objects by recognizing characteristics of the field lines and displaying them on the screen. As electromagnetic field lines can be distorted and interfered with, it is important to verify the location of underground objects before digging.

Several utilities may be underground in the same area. Be sure to follow local guidelines and one-call service procedures.

Exposing the utility is the only way to verify its existence, location, and depth.

Ridge Tool Co., its affiliates and suppliers, will not be liable for any injury or any direct, indirect, incidental or consequential damages sustained or incurred by reason of the use of the SR-20.

Specifications and Standard Equipment

Specifications

Weight w/batteries............4 lbs. (1.8 kg.)
Weight w/o batteries........3.3 lbs. (1.5 kg.)

Dimensions:
Length .........................11.2” (28.4 cm.)
Width ............................4.3” (1.3 cm.)
Height ...........................31.1” (78.9 cm.)

Power Source...............4 C-size batteries, 1.5V
                        Alkaline (ANSI/NEDA 14A,
                        IEC LR14) or 1.2V NiMH or
                        NiCad rechargeable batteries

Power Rating:.............6V, 550mA

Signal Strength........Non-linear in function. 2000 is
                        10x higher than 1000, 3000 is
                        10x higher then 2000, etc.
Operating Environment
- Temperature: -4°F to 122°F (-20°C to 50°C)
- Humidity: 5% to 95% RH
- Storage Temperature: -4°F to 140°F (-20°C to 60°C)

Default Settings
The default settings for the locator are:
- Measured Depth units = Feet & Inches
- Volume = 2 (two settings above mute)
- Proximity Threshold = 30 feet (10m)
- 33 kHz (Active Line Trace Mode)

Standard Equipment

<table>
<thead>
<tr>
<th>Catalog No.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>21893</td>
<td>SR-20 Locator</td>
</tr>
<tr>
<td>12543</td>
<td>Markers and Mast Holder</td>
</tr>
<tr>
<td>—</td>
<td>Operator’s Manual</td>
</tr>
<tr>
<td>—</td>
<td>4 C-cell batteries (alkaline)</td>
</tr>
<tr>
<td>—</td>
<td>Training Video (DVD)</td>
</tr>
</tbody>
</table>

Optional Equipment

<table>
<thead>
<tr>
<th>Catalog No.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>12543</td>
<td>Additional Pole/Sonde Markers</td>
</tr>
<tr>
<td>21898</td>
<td>ST-305 Transmitter</td>
</tr>
<tr>
<td>21903</td>
<td>ST-510 Transmitter</td>
</tr>
<tr>
<td>20973</td>
<td>Inductive Clamp (4.75”)</td>
</tr>
<tr>
<td>16728</td>
<td>Remote Sonde</td>
</tr>
<tr>
<td>19788</td>
<td>Float Sonde (package of 2)</td>
</tr>
</tbody>
</table>

Frequencies

The following table shows the frequencies available in the SR-20. The default frequencies shown are in Checked-Active status in the instrument as shipped. Optional frequencies may be added to the activated set as described on page 25.

<table>
<thead>
<tr>
<th>Default Frequencies</th>
</tr>
</thead>
<tbody>
<tr>
<td>Active Line Trace.......128Hz, 1kHz, 8kHz, 33kHz</td>
</tr>
<tr>
<td>Power Line Trace ......60Hz (9th), &lt;4kHz</td>
</tr>
<tr>
<td>Radio Frequencies ....Low (4-15kHz), High (&gt;15kHz)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Optional Frequencies</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sonde ........................16Hz, 512Hz, 640Hz, 850Hz 8kHz, 16kHz, 33kHz</td>
</tr>
<tr>
<td>Passive Line Trace.....50Hz, 50 Hz (5th), 50Hz (9th) 60Hz, 60Hz (5th), 100Hz, 120Hz</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Exact Frequency Values (SR-20)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Sonde</strong></td>
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<td></td>
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<tr>
<td></td>
</tr>
<tr>
<td><strong>Active Line Trace</strong></td>
</tr>
<tr>
<td></td>
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<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td><strong>Passive Line Trace</strong></td>
</tr>
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<td></td>
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<tr>
<td></td>
</tr>
</tbody>
</table>
Icon Legend

Keypad Icons

- Up Arrow
- Menu Select
- Down Arrow

Display Icons

- Sonde Frequency
- Active Trace Frequency
- Radio Frequency
- Passive Line Trace Frequency
- Measured Distance/Depth
- Signal Angle Indicator
- Milliamp, Current
- Proximity Threshold Control
- Pole Icon
- Tracing Line
- Distortion Line
- Equator
- Pipe Direction
- 2Hz

Menu Icons

- Power ON/OFF Key
- Menu Key
- Frequency Key
- Sound Key

- Factory Default Reset
- Menu Check Box
- Tools Menu
- Backlight Settings
- Screen Contrast Adjust
- Display Elements
- Frequency Selection Control
- Information Screen
- Menu Timeout Counter
- Go Up One Level (Press Menu Key)

Depth

- Depth Greater Than 3 Feet/1 Meter Threshold
- Depth Greater Than 10 Feet/3 Meter Threshold
- Depth Greater Than 30 Feet/10 Meter Threshold
- Depth Greater Than 99 Feet/30 Meter Threshold
SR-20 Components

NOTE: USB/Serial Ports are for loading new software.

Figure 1

Figure 2

Figure 3
Introduction to the SR-20

Installing/Changing Batteries
To install batteries into the SR-20 turn the unit over to access the battery compartment. Turn the knob on the battery cover counter clockwise. Pull straight up on the knob to remove the cover. Insert the batteries as shown on the inside decal and make sure they drop to full contact. Fit the cover into the case and turn the knob clockwise while lightly pressing down to close. The battery cover can be installed in either orientation.

SR-20 Modes
The SR-20 operates in three distinct modes. They are:

1. Active Line Trace Mode, used when a chosen frequency can be put onto a long conductor using a Line Transmitter, for locating conductive pipes, lines, or cables.
2. Passive Trace Mode, used for tracing electrical lines that are already carrying 60 Hz current (U.S.), 50 Hz current (Europe), or radio frequencies.
3. Sonde Mode, used for locating Sondes in pipes, conduits, or tunnels that are nonconductive or cannot otherwise be traced.

Note that the two Tracing modes, Active and Passive, are identical except for the frequencies used. No transmitter is used in Passive Trace mode.

Display Elements
The “basic features” of the SR-20 are ON by default. They can be customized easily to suit the user’s requirements.

Folding Mast
To begin operation, unfold the antenna mast and lock the folding joint into place. When locating is complete, press the red release lever to fold the antenna mast for storage.

CAUTION
Do not allow debris or moisture into battery compartment. Debris or moisture may short the battery contacts, leading to rapid discharge of the batteries, which could result in electrolyte leakage or risk of fire.

IMPORTANT! Do not snap or whip the SR-20 mast to open or close it. Open it and close it by hand only.

NOTE! Avoid dragging the lower antenna node on the ground while locating with the SR-20. It may cause signal noise which will interfere with results, and may eventually damage the antenna.
The display screen in Active Line Trace, Passive Line Trace or Sonde mode will show the following features:

**Active View Area** – The area inside the circle on the SR-20 display where the Tracing Line, Guidance Arrows, and crosshairs are displayed.

**mA Current Strength** – Proportional to current on the line. Switches to Signal Angle when Signal Angle is greater than 35°.

**Signal Angle** – Field tilt from the horizontal; angle toward the field’s center; numeric value displayed in degrees.

**Battery Level** – Indicates level of remaining battery capacity.

**Measured Depth/Distance** – Displays the measured depth when receiver is touching the ground directly over signal source. Displays computed distance when the antenna mast is pointed at a signal source in some other manner. Displays feet/inches (U.S.A. default) or meters (European default).

**Mode** – Icon for Sonde , Line Trace , Power (Passive Line Trace) or Radio Frequency mode.

**Frequency** – Shows current frequency setting in hertz or kilohertz.

**+ Crosshairs (Map Center)** – shows operator’s position relative to the target center.

**Display Elements: Active Line Trace Mode**

![Display Elements: (Line Trace Mode)](image)

In Active Line Trace Mode, the following features will also be displayed:

**Proximity Signal** – Numerical indication showing how close the signal source is to the locator. Displays from 1 to 999. (Line Trace modes only)

**Signal Strength** – Strength of signal as sensed by the lower antenna mode.

**Tracing Line** – The Tracing Line represents the approximate axis of the detected field. It represents detected distortion in the field by appearing less focused. (See page 25 for information on setting the sensitivity and how to enable or disable the distortion response in the Tracing Line.)

**Distortion Line** – If the normal distortion response of the Tracing Line is disabled, a second line is shown, which represents the signal from the upper antenna node. By comparing the two lines, the user can estimate the degree of distortion present in a signal. (See page 26.)

**Guidance Arrows** – The Guidance Arrows serve to steer the operator toward the center of the detected field, both arrows are displayed on the screen when crossing the center of an undistorted field. If the signals are unequal, the Guidance Arrows show which way the field appears to be relative to the receiver.

**NOTE!** The Tracing Line reflects the approximate axis of the conductor being traced. The Tracing Line will appear to grow unfocused in proportion to the distortion in the field being detected.

It represents the best possible calculation of the location and bearing of the line combined with the degree of distortion sensed by the receiver’s Omnidirectional Antennas.

The distortion response feature of the Tracing Line can be disabled. When it is, the screen displays two lines – a solid Tracing Line (——) representing the axis of the detected conductor’s field as seen by the lower antenna node, and a distortion line (-----) representing the same field as seen by the upper antenna node.

(For more information about distortion, see pages 12 and 26.)
Display Elements: Passive Trace Mode
The screen elements in Passive Trace Mode are the same as those seen in Active Line Trace mode.

**NOTE!** Mode is determined by the type of target source (Sonde or Line). A frequency must be selected from the correct category if it appears in more than one category, such as 33 kHz.

Display Elements: Sonde Mode
In Sonde mode, the screen elements include several features that are unique to Sonde locating.

**Pipe Direction** – Represents the approximate direction of the pipe in which the Sonde is lying.

**Sonde Icon** – Appears when approaching the location of a Sonde.

**Equator** – Represents the mid-line of the Sonde’s field perpendicular to the axis of the Poles. *(See page 18).*

**Pole Icon** – Represents the location of either of the two Poles of the Sonde’s dipole field. *(See page 18).*

**Zoom Ring** – Appears when the locator moves close to a Pole.

Currently available frequencies in default setting include:

- **Sonde Mode**
  - 512 Hz

- **Active Line Trace Mode**
  - 128 Hz
  - 1 kHz
  - 8 kHz
  - 33 kHz

- **Passive Line Trace Mode**
  - 60 Hz (9th)
  - < 4 kHz

Radio Frequency
- 4 kHz – 15 kHz (L)
- > 15 kHz (L)

Default Frequencies
The SR-20 contains a large set of frequencies. The frequencies which are currently available appear on the Main Menu when the Menu Key is pressed. Additional frequencies can be added to the Main Menu by checking them active in the Frequency Sub Menu.

Currently available frequencies that are checked active in the Main Menu can be cycled through by simply pressing the Frequency Key. *(see Figure 9).*

Keypad

**Power On/Off Key** – Powers SR-20 on. Powers the SR-20 down after a 3-second countdown. The countdown can be interrupted before shutdown by pressing any key.

**Up and Down Keys** – Used for locating choices during menu selection.

**Select Key** – Used to make a choice during Menu selection.

**Menu Key** – Used to display a “tree” of choices *(see Page 27 for a complete listing of menu choices).* Used while in a menu to move up one level.

**Volume Control Key** – Used to raise or lower the volume setting; will cycle the volume from current setting by steps, increasing to maximum and then mute. Volume can also be raised and lowered using the Up and Down Keys when the Volume screen is open.

**Frequency Key** – Used to cycle through the Checked-Active frequencies. The list of frequencies that have been set to Checked- Active status can be modified via the Menu Key.
**Light Sensor** – In Automatic mode, the light sensor controls when the backlight goes on or off depending on ambient light. Placing a thumb over the light sensor will force the backlight on.

**Operation Time**

Using alkaline cells, typical operation time is from about 12 to 24 hours depending on sound volume and how often the backlight is on. Other factors that affect the operation time will include chemistry of the battery (many of the new high performance batteries, such as the “Duracell® ULTRA” last 10%-20% longer than conventional alkaline cells under high demand applications). Operation at lower temperatures will also reduce battery life.

The SR-20 display can also show random symbols when the battery power is too low. This is remedied by simply putting fresh batteries into the unit.

To preserve battery life, the SR-20 will automatically shut down after 1 hour of no key presses. Simply power the unit on to resume use.

**Low Battery Warning**

When the battery gets low, a battery icon will periodically appear in the map area on the screen. This indicates that the batteries need to be changed and that the unit will soon shut down. A tone will sound at ten-minute intervals.

![Figure 10 – Low-Battery Warning](image)

Just before complete shut down there will be a noninterruptible power down sequence. An extended buzz will sound when the SR-20 is about to go into shutdown sequence.

NOTE! Voltage on rechargeable batteries may sometimes drop so quickly that the unit will just shut down. The unit will power down and restart. Just replace the batteries and power the unit back on.

**Starting Up**

After pressing the Power Key on the keypad, the RIDGID® logo displays, and the software version number will appear on the left of the screen.

![Figure 11 – Start-up Screen](image)

Make a note of the software version in the box on page 1. If technical support from Ridge is needed it will be helpful to have it available.

**Set Up**

Once the SR-20 is up and running the next step is to set up the frequencies needed that match the transmitter or line to be located. Each frequency is selected for use by choosing it from a list in the Main Menu. If the box on the Main Menu for that frequency is checked, the frequency is in Checked-Active status.

Checked-Active frequencies are already selected for use and appear in sequence by pressing the Frequency Key. (For example, in Figure 12, the line trace frequency of 33 kHz is available by pressing the Frequency Key.)

![Figure 12 – Frequency Key](image)
Figure 13 – Line Trace Frequency Selected with Frequency Key
(This screen will flash briefly when a new frequency is chosen.)

Activating Frequencies
Each frequency is activated by choosing it from a list in the Main Menu (See Figure 15). Frequencies are grouped by category:

- Sonde
- Active Line Trace
- Passive Line Trace
- Radio

1. Push the Menu Key:

Figure 14 – Menu Key

The Main Menu is then activated:

Figure 15 – Main Menu

2. Using the up and down arrows, highlight the frequency desired. In Figure 16, below, the operator is activating a 128 Hz frequency.

Figure 16 – Highlighting a Desired Frequency (128 Hz)

3. Press the Select Key (Figure 17) to check the box for each frequency intended for use.

Figure 17 – Select Key

4. Frequencies that have been selected for use will show a check in the box next to them.

Figure 18 – Desired Frequency Checked

5. Press the Menu Key again to accept the choices and exit.
Sounds of the SR-20

The sound level is driven by the proximity to the target. The closer to the target, the higher the sound pitch will be. A rising tone indicates increasing signal.

In Line Tracing modes, the default distortion response also activates an audio signal proportionate to the distortion in the detected field. When there is no distortion present, the sound of the SR-20 is a clear warbling sound when on the left side of the detected field, with a slight click added when on the right side of the detected field. If distortion is detected a sound similar to AM radio static sound can be heard, which gets stronger as the degree of distortion increases. If the distortion response feature is disabled, the static sound does not occur.

In Sonde Mode, if the sound level reaches its highest point, it will “re-scale” to a medium level and continue signaling from the new starting point. Moving away from the Sonde, it will drop to a lower pitch and remain there as long as one moves away from the Sonde. Moving back toward the Sonde it will resume rising in steps starting from the level it had reached previously.

If desired, force the sound to re-center at a medium level (in any mode) by pressing the Select Key during operation.

Keys to locating with the SR-20

SIGNAL STRENGTH represents the strength of the field being detected by the lower antenna node of the SR-20. In a clear and undistorted field, you can locate based on Signal Strength alone.

PROXIMITY SIGNAL reflects the proximity of the locator to the target utility; the closer the locator moves to the center of the detected field, the higher the Proximity Signal number gets. The Proximity Signal is calculated from the ratio of the signals received at the lower and upper antennas, adjusted for scalability.

DISTORTION is the degree to which the field detected is deformed from the simple circular shape. If multiple fields are present, the detected field is pushed or pulled out of shape and the different antennas will pick up different field strengths.

GUIDANCE ARROWS are driven by the signals received at the side antennas of the SR-20. When the fields detected by these side antennas are equal, the arrows will center. If one is receiving a stronger field signal than the other, the arrows will point toward the probable center of the target conductor.

Line Tracing with the SR-20

There are two major ways to look for lines underground with the SR-20. They are called Active and Passive. The difference is that in Active Line Tracing, a current is placed on a conductor using a transmitter, and that specific signal is then sought for using the locator. Passive tracing does not use a transmitter and listens for any signal that may be picked up at particular frequencies.

Active Line Tracing

In active line tracing, underground lines are energized with a Line Transmitter. This active signal is then traced using the SR-20. A Line Transmitter is different from a Sonde in that it is used for tracing an energized line, rather than acting as a target for a locate. Line transmitters energize lines by direct connection with clips, by directly inducing the signal using a clamp, or by inducing the signal using inductive coils built into the transmitter.

WARNING
Connect the ground lead and the power lead of the transmitter before powering the transmitter on, to avoid electric shock.

1. Energize the target conductor according to the transmitter manufacturer’s instructions. Select the transmitter frequency. Set the frequency used on the SR-20 to the same frequency used on the transmitter.

Direct Connect Method: The transmitter is attached by direct metal-to-metal connection to the target conductor at some access point such as a valve, a meter, or other point.

IMPORTANT! The connection between the transmitter and the conductor must be a clean, firm connection. The transmitter must also be connected to a ground with a strong open path to ground.

Inductive Clamp Mode: The transmitter is connected to an inductive clamp which is then closed around a pipe or cable. The transmitter energizes the clamp, which then induces a current in the conductor.
**Inductive Mode:** The transmitter is placed over the conductor per Manufacturer’s Instructions. The internal coils of the transmitter generate a strong field through the ground which induce a current on the underground conductive lines within the vicinity.

**IMPORTANT!** If the transmitter is too close to the SR-20 in this mode, it can cause “air-coupling” which means the locator is reading only sign from the transmitter, not the target conductor.

2. Observe the Proximity Signal to ensure that the receiver is picking up the transmitted signal. The Proximity Signal should peak over the line and drop off on either side.

3. When tracing, the direction the pipe or cable is running will be shown on the screen by the Tracing Line. The Tracing Line will be a clear, single line if the field being detected is undistorted.

![Figure 20 – Tracing Line Showing Low Distortion](image)

**The Tracing Line** has three important functions. It represents the location, and the direction, of the signal being traced. It reflects changes in direction of the target utility — when the utility makes a turn, for example. And it helps recognize signal distortion. It does this by becoming cloudier as distortion increases.

![Figure 21 – Tracing Line Showing High Distortion](image)

**Use the Guidance Arrows, Proximity Number, Signal Strength, and Tracing Line** to guide the line trace. These pieces of information are generated from discrete signal characteristics to help the operator understand the quality of the locate. An undistorted signal emitted from a line is strongest directly over that line. In an undistorted signal, the Guidance Arrows should balance over the crosshairs at the same time the line centers on the crosshairs.

**NOTE!** Unlike the Signal Trace lines, the guidance arrows require that the user orient the locator so that the guidance arrows point 90 degrees to the Signal Trace line. (See Figure 20).

Confidence in the accuracy of a locate can be increased to the degree that the signal characteristics agree. If all four agree, confidence can be high in the quality of the locate. If the trace line and the Guidance Arrows do not agree, maximize the Proximity Number and the Signal Strength. To the degree that Guidance Arrows, Maximum Proximity Number—Maximum Signal Strength agree (are all located in close proximity to each other), the degree of confidence there can be in the accuracy of the locate.

![Figure 22 – High Probability Locate](image)

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**WARNING**

Care should be taken to watch for signal interference that may give inaccurate readings. The Tracing Line is only representative of the position of the buried utility if the field is UNDISTORTED. Do NOT base a locate solely on the Tracing Line.

Always cross check the locate by ensuring that:

- The Tracing Line shows little or no distortion response (blurriness).
- The Proximity Signal and the Signal strength maximize when the Tracing Line crosses the map center.
- The Measured Depth increases appropriately as the unit is raised vertically and the Tracing Line remains aligned.

**Measured Depth readings should be taken as estimates and actual depths should be independently verified by visual inspection prior to digging.**

As always, the only way to be certain of the location of a utility is through visual confirmation by exposing the utility. The accuracy of position and depth measurement improves as the SR-20 lower antenna node is placed closer and closer to the target utility.
Rechecking the Measured Depth and position periodically during the excavation process can help avoid damage to a target utility and may identify additional utility signals that were not noticed prior to excavation.

When line tracing, it is important to remember that tees, curves, other conductors in the vicinity, and nearby masses of metal can add distortion to the field, requiring closer scrutiny of the data to determine the true path of the target utility.

Clarifying the situation can be done by assessing whether the distortion is due to a poor signal that needs to be improved, a local interference such as a near-by car, or a tee or turn in the line.

(See below for tips on improving the signal.)

Circling the last location of a clear signal at a distance of about 20 feet (6.5 m) can clarify if the distortion is coming from a local turn or tee in the line, and enable the operator to again pick up the line nearby.

If the signal is clear, the SR-20 will often show a straight signal line with very little distortion right up to a 90-degree tee, show a small amount of distortion as it follows around the curve, and then show a clear signal again as it resumes its travel after the tee.

Operating Tips for Active Line Tracing

The SR-20 quickly identifies distorted fields. If the guidance arrows are centered on the screen, and the Trace Line is not centered (or if the Proximity Signal number and Signal Strength are not maximized where the Trace Line centers), then distortion is creating a complex non-circular field.

To improve the tracing circuit:

a) Try changing the frequency.

b) Move the ground stake position. Use a larger ground contact surface (e.g., a shovel blade)

c) Make sure that the line is not commonly bonded to another utility. (Undo common bonds only if safe to do so).

d) Move the transmitter to a different point on the line, if possible.

If the Tracing Line will not center or if it moves across the screen erratically, then the SR-20 may not be receiving a clear signal. The Measured Depth and the Proximity Signal may also be unstable under these circumstances.

a) Check that the SR-20 and transmitter are operating on the same frequency.

d) Try different frequencies, starting with the lowest, until the line can be picked up dependably. Using lower frequencies can overcome bleedover problems.

e) Re-locate the ground connection for a better circuit. Ensure there is enough contact (ground stake is sufficiently deep) especially in dryer soils.

f) In extremely dry soil, wetting the area around the ground stake will improve the circuit. Be aware the moisture will dissipate and evaporate, reducing the quality of the circuit over time.

Using the numeric Signal Angle Indicator is another way to check for distorted signals.

![Figure 23 – Checking for Distortion](image)

Move the SR-20 to either side of the traced line until the numeric Signal Angle indicator reads 45 degrees. Be sure to keep the lower antenna node at the same height, and the locator mast vertical. If there is little or no distortion the traced line should be in the middle and the distance to each 45 degree point should be approximately equal on either side. If the signal is undistorted, then the distance from the line center to the 45° point is approximately equal to the depth.

Another variation of this technique is to move the same distance to the right and left of the traced line, say 24 inches (60 cm) and check that the Signal Strength readings are similar or that the Signal Angles are similar.
While tracing, the Proximity Signal and Signal Strength should maximize, at the same place where the guidance arrows center on the display. If this is not the case, the utility may be changing direction or other coupled signals may be present.

Higher frequencies bleed over to adjacent utilities more readily, but may be needed to overcome breaks in tracer wires or go over insulating couplers. If the line is ungrounded at the far end, higher frequencies may be the only means to make the line traceable. *(See Informational Locating on page 27.)*

When using the transmitter inductively, be sure to begin the locate about 30 feet (10m) away to avoid “direct coupling” (also known as air coupling). This occurs when the SR-20 picks up the signal from the transmitter directly through the air and not from the line being traced. An unrealistic Measured Depth reading when over the line can also indicate air coupling is occurring.

When using Inductive Mode it is always possible to move the transmitter to a different point along the target line. This will sometimes improve the circuit and provide a better signal.

While tracing, the mapping display operates best under the following conditions:

- The line is level.
- The SR-20 Locator is above the target utility elevation.
- The SR-20 antenna mast is held approximately vertical.

If these conditions are not met, pay close attention to maximizing Signal Strength.

In general, if the SR-20 is used in a zone over the target line within a sweep area of about two “depths” of the line, the map will be useful and accurate. Be aware of this when using the map if the target or line is very shallow.

**Measuring Depth (Line Tracing Modes)**

The SR-20 calculates Measured Depth by comparing the strength of the signal at the lower antenna to that at the upper antenna.

Measured Depth is measured correctly in an undistorted field when the bottom antenna is touching the ground directly above the signal source and the antenna mast is vertical.

1. To measure depth, place the locator on the ground, directly above the Sonde or the line.
2. Measured Depth will be shown in the lower left hand corner.
3. A Measured Depth reading can be forced by pressing the Select Key.
4. Measured Depth will be accurate only if the signal is undistorted and the antenna mast is held vertical.

Testing for the consistency of the Measured Depth reading can be done by raising the SR-20 a known distance (say, 12 inches (33 cm)) and observing whether the Measured Depth indicator increases by the same amount. Small variation is acceptable, but if the Measured Depth does not change, or changes drastically, it is an indication of a “distorted” field, or very low current on the line.

**Current and Signal Angle Reading**

The Current Strength (mA) and Signal Angle indicator (°) in the upper right corner of the screen will display the current detected on the traced line, in milliamps, when the angle to the center of the detected field is less than 35° and the SR-20 crosses the center of the field as sensed by the guidance arrows.

When moving across the center of the field the current display will retain the displayed current value until the guidance arrows reverse again, at which point the current value will be updated.

When the angle to the center exceeds 35°, the Signal Angle indicator will display the angle to the center of the detected field.

**Clipping (Tracing Modes)**

Occasionally the Signal Strength will be strong enough that the receiver will be unable to process the whole signal, a condition known as “clipping”. When this occurs, a warning symbol will appear on the screen. It means that the signal is particularly strong. If clipping persists, remedy it by increasing the distance between the antennas and the target line OR by reducing the strength of the current from the transmitter.

**NOTE!** Measured Depth Display is disabled under clipping conditions.

**Passive Line Tracing**

In passive mode, the SR-20 is looking for electromagnetic “noise” that has found its way onto a buried utility line by any available means. Electromagnetic signals can get onto buried utility lines in a variety of ways.

The most common reason is by means of direct connection to some signal source. All operating electronic de-
Vices that are connected to AC power will radiate a certain amount of electronic “noise” back onto the power lines they are connected to. Examples of such devices include computers, copy machines, refrigerators, anything with an electric motor, TV sets, air conditioning units etc.

Another common way electromagnetic noise can get onto the line is by way of induction that can operate without any direct physical connection to the buried line. In some areas for example, buried utilities act as antennas for high powered, low frequency radio transmissions (submarine navigational and communication signals in the UK for example) and will reradiate these signals. These reradiated signals can be very useful for locating.

Similarly, buried lines that run side by side near each other, particularly for longer distances will tend to bleed signals onto each other. This effect is more pronounced for higher frequencies. Due to coupling (either through induction or through capacitance), all metallic lines in an area may be energized. Because of this, it is possible to locate lines passively, but it is difficult to identify which line the locator is tracing.

1. Select a Passive Line Trace Frequency (horizontal icon).

2. The SR-20 has multiple Passive Line Trace frequency settings. Power frequencies (identified with the power icon) are used to locate signals generated as the result of power transmissions, usually 50 or 60 Hz. To reduce the effects of inherent noise from line-load or neighboring devices the SR-20 can be set to locate various multiples (or harmonics) of the base 50/60 Hz frequency up to 4,000 Hz.

The 9x multiple is the setting most commonly used to locate 50/60 Hz signal. In well balanced high voltage electric distribution systems, the 5x multiple may
work better. The 100 Hz (in 50 Hz countries) and 120 Hz (in 60 Hz countries) frequency settings are particularly useful for pipelines that have been equipped with cathodic protection using rectifiers.

3. There are also two additional radio frequency bands to help locate lines passively. They are:
   - 4kHz to 15kHz (LF)
   - > 15kHz (HF)

The Radio Frequency and <4 kHz bands can be useful in discriminating when tracing in a noisy environment. They are also very helpful in finding lines on blind searches.

When searching over a wide area where the location of targets is unknown, one useful approach is to have multiple frequencies selected for use and to check the area at a number of frequencies in sequence looking for meaningful signals.

In general, directly connected Active Line Tracing is more reliable than Passive Line Tracing.

WARNING

In Passive Line tracing, or when signals are extremely weak, the Measured Depth will generally read too DEEP and the actual buried depth may be MUCH shallower.

Operating Tips for Passive Line Tracing

1. In Passive Locating if you are looking for a known line, be sure you are using the best frequency for the line in question. This may be, for example, be 60 Hz (1) for a power line, or it may turn out that 60 Hz (9) produces a more reliable response on a particular line.

2. If seeking a cathode-protected pipe in Passive Mode, higher-frequencies (greater than 4kHz) may also pick up harmonics.

3. Remember that pipes can carry currents that will show up on a Passive Trace as well as cables; the only guarantee of a locate is inspection.

4. In general, Passive Trace locating is less reliable than Active Line Tracing because Active Line Tracing offers the positive identification of the signal from the transmitter.

5. Especially in Passive Line Tracing, knowing that you have found something is not the same as knowing what you have found. It is essential to use all the indicators available, such as Measured Depth, Signal Strength, etc., to confirm a locate. If it is possible energize using a transmitter and positively trace.

6. While Passive Line Trace is most often used on 50/60Hz power lines, other cables such as phone lines, CATV lines, etc., can be energized by transient radio frequencies in the region and may appear on Passive Line Trace searches.

Sonde Locating

The SR-20 can be used to locate the signal of a Sonde (transmitter) in a pipe, so that its location can be identified above ground. Sondes can be placed at a problem point in the pipe using a camera, push rod, or cable. They can also be flushed down the pipe. A Sonde is often used for locating non-conducting pipe and conduit.

IMPORTANT! Signal strength is the key factor in determining the Sonde's location. Take care to maximize the Signal Strength prior to marking an area for excavation.

The following assumes that the Sonde is in a horizontal pipe, the ground is approximately level and the SR-20 is held with the antenna mast vertical.

The field of a Sonde is different in form from the circular field around a long conductor such as a pipe or cable. It is a dipole field like the field around the Earth, with a North Pole and a South Pole.

Figure 26 – Earth’s Dipole Field

In the Sonde’s field, the SR-20 will detect the points at either end where the field lines curve down toward the vertical, and it will mark these points on the map display with a “Pole” icon ( ). The SR-20 will also show a line at 90 degrees to the Sonde, centered between the Poles, known as the “Equator”, much like the Equator on a map of the Earth if the planet were viewed sideways (See Figure 27).

Note that because of the SR-20’s Omnidirectional antennas, the signal stays stable regardless of orientation. This means the signal will increase smoothly when approaching the Sonde, and decrease smoothly when moving away.
NOTE! A Pole is found where field lines turn vertical. The Equator occurs when the field lines are horizontal.

When locating a Sonde, first set up the locate:

Activate the Sonde before putting it in the line. Select the same Sonde frequency on the SR-20 and make sure it is receiving the signal.

After the Sonde has been sent into the pipe, go to the suspected Sonde location. If the direction of the pipe is unknown, push the Sonde a shorter distance into the line (~15 feet (5m) from the access is a good starting point).

Location Methods

There are three major parts to locating a Sonde. The first step is to localize the Sonde. The second part is pinpointing. The third is verifying its location.

Step 1: Localize the sonde

- Hold the SR-20 so the antenna mast is pointing outward. Sweep the antenna mast in the suspected direction of the Sonde while observing the Signal Strength and listening to the sound. The signal will be highest when the antenna mast is pointing in the direction of the Sonde.

- Lower the SR-20 to its normal operating position (antenna mast vertical) and walk in the direction of the Sonde. Approaching the Sonde, the Signal Strength will increase and the audio tone will rise in pitch. Use the Signal Strength and the sound to maximize the signal.

- Maximize the Signal Strength. When it appears to be at its highest point, place the SR-20 close to the ground over the high signal point. Be careful to hold the receiver at a constant height above the ground as distance affects Signal Strength.

- Note the Signal Strength and move away from the high point in all directions. Move the SR-20 far enough in all directions to verify that the Signal Strength drops significantly on all sides. Mark the point of highest Signal Strength with a yellow Sonde Marker (clipped to antenna mast for convenience). This is the suspected Sonde location.

Step 2: Pinpoint the Sonde

The Poles should appear on either side of the maximum signal point, an equal distance on either side if the Sonde is level. If they are not visible on the screen at the point of maximum Signal Strength, move from the maximum point perpendicular to the dotted line (Equator) until one appears. Center the locator over the Pole.

Where the Poles occur depends on the Sonde’s depth. The deeper the Sonde, the further away from it the Poles will be.

The dotted line represents the Equator of the Sonde. If the Sonde is not tilted, the Equator will intersect the Sonde at maximum Signal Strength and minimum Measured Depth.

NOTE! Being on the Equator does not mean that the locator is over the Sonde. Always verify the locate by maximizing Signal Strength and marking both Poles.

- Mark the first Pole location found with a red triangular Pole marker. After centering on the Pole, a double-line indicator will appear. This line represents how the Sonde is lying underground, and in most cases also represents the pipe’s approximate direction.

- When the locator gets close to a Pole, a zoom ring will appear centered on the Pole, allowing precision centering.
• The second Pole will be a similar distance from the Sonde location in the opposite direction. Locate it in the same manner and mark it with a red triangular marker.

• If the Sonde is level, the three markers should be aligned and the red Pole markers should be similar distances from the yellow Sonde marker. If they are not, a tilted Sonde may be indicated. (See “Tilted Sonde” on page 20.) It is generally true that the Sonde will be on the line between the two Poles, unless there is extreme distortion present.

**Step 3: Verify the locate**

• It is important to verify the Sonde’s location by cross-checking the receiver’s information and maximizing Signal Strength. Move the SR-20 away from the maximum Signal Strength, to make sure that the signal drops off on all sides. Make sure to move the unit far enough to see a significant signal drop in each direction.

• Double-check the two Pole locations.

• Notice that the Measured Depth reading at the maximum Signal Strength location is reasonable and consistent. If it seems far too deep or too shallow, recheck that there is an actual maximum Signal Strength at that location.

Figure 29 – Sonde Locate: Equator

Figure 30 – Screen Display in Different Locations (Sonde)
• Notice that the poles and the point of highest Signal Strength lie on a straight line.

**IMPORTANT!** Remember that being on the Equator does not mean one is over the Sonde. Seeing two Poles aligned on the display is not a substitute for centering over each Pole separately and marking their locations as described above.

If the Poles are not visible, extend the search.

For best accuracy the SR-20 should be held with the mast oriented vertically. The antenna mast must be vertical when marking the Poles and Equator, or their locations will be less accurate.

**Tilted Sondes**

If the Sonde is tilted, one Pole will move closer to the Sonde and the other farther away so that the Sonde location no longer lies midway between the two Poles. The Signal Strength of the nearer Pole becomes much higher than that of the more distant Pole.

If the Sonde is vertical only a single Pole at the point of maximum Signal Strength will be seen on the screen.

It is important to realize that a severely tilted Sonde can cause the Pole locations and the Equator to appear offset because of the angle of the Sonde; but maximizing the Signal Strength will still guide to the best location for the Sonde.

**Floating Sondes**

Some Sondes are designed to be flushed or to drift down a pipe pushed by water flow. Because these Sondes swing much more freely than a torpedoshaped Sonde in a pipe, they can be oriented any which way. This means the Equator may be distorted by tilting, and the location of the Poles may vary. Locate a floating Sonde by maximizing the Signal Strength and double-checking that the signal falls away on every side of the maximum signal location.

**Figure 31 – Tilted Sonde, Poles and Equator**

Note the right-hand Pole is closer to the Equator, due to tilt.
**Measuring Depth (Sonde Mode)**

The SR-20 calculates Measured Depth by comparing the strength of the signal at the lower antenna to the upper antenna. Measured Depth is approximate; it will usually reflect the physical depth when the mast is held vertical and the bottom antenna is touching the ground directly above the signal source, assuming no distortion is present.

1. To measure depth, place the locator on the ground, directly above the Sonde or the line.
2. Measured Depth will be shown in the lower left hand corner of the SR-20’s display screen.
3. A Measured Depth reading can be forced by pressing the Select Key during a locate.
4. Measured Depth will be accurate only if the signal is undistorted.

**Clipping (Sonde Mode)**

Occasionally the Signal Strength will be strong enough that the receiver will be unable to process the entire signal, a condition known as “clipping”. When this occurs, a warning symbol will appear on the screen. It means that the signal is particularly strong.

**NOTE!** Measured Depth Display is disabled under clipping conditions.

**Menus and Settings**

Pressing the Menu Key brings up a series of choices which let the operator configure the SR-20 as preferred (See Figure 33).

![Figure 32 – Main Menu](image)

In sequence from the top of the menu down, the Main Menu presents the following items:

1. **Currently Available Sonde frequencies** (Checked - Active or not).
2. **Currently Available Active Line Trace frequencies** (Checked-Active or not).
3. **Currently Available Passive Line Trace frequencies** (Checked-Active or not).
4. **Currently Available Radio Frequencies (Low and High)** (Checked-Active or not).
5. **Depth Measurement Units Setting**
6. **Backlight Control**.
7. **LCD Contrast Control**
8. **Display Elements Control** (Sub-menus will display when selected for Sonde or line tracing modes.)
9. **Frequency Selection Control** (Sub-menus will display for categories of frequencies that can be selected.)
10. **Information Menu** including software version and unit serial number (sub-menu for restoring factory defaults will display on Information screen).

See the Menu Tree on page 27 for a complete list.

**Auto Menu Exit Count-down Timer**

While traversing the menu tree, a counter appears at the bottom of the screen counting down. When it reaches zero, it will automatically move back up one level of the menu tree until it reaches the operating screen again. It resets to nine with each key press, or each time it goes up one menu level, until it reaches the operating screen.

**Currently Available Sonde Frequencies**

Frequencies that have been set to “Checked-Active” status appear with a check box next to them. If the checkbox is checked, the frequency can be accessed using the Frequency Key. Frequencies are checked or unchecked by highlighting them and pressing the Select Key. To return to the operating screen, press the Menu Key.

Possible included frequencies are:

- 16 Hz
- 512 Hz*
- 640 Hz
- 850 Hz
- 8 kHz
- 16 kHz
- 33 kHz

* = Set to “Currently Available” by default.
Currently Available Active Line Trace Frequencies
As with Sonde frequency categories, these items will appear in the “Checked-Active” set when checked.
Possible included frequencies are:
128 Hz*
1 kHz*
8 kHz*
33 kHz*
* = Set to “Currently Available” by default.

Currently Available Passive Line Trace Frequencies
As with Sonde frequency categories, these items will appear in the “Checked-Active” set when checked.
Possible included frequencies are:
50 Hz  60 Hz  100 Hz
50 Hz x5  60 Hz x5  120 Hz
50 Hz x9  60Hz x9*  <4kHz*
* = Set to “Currently Available” by default.
NOTE! Superscripts indicate harmonics; e.g., 60⁹ = 540Hz and 50 Hz ⁹ = 450 Hz.

Currently Available Radio Frequencies
As with other Sonde categories, these items will appear in the “Checked-Active” set when checked.
Possible included frequencies are:
4kHz-15kHz (L)*
>15 kHz (H)* (38 kHz maximum)
* = Set to “Currently Available” by default.
(See “Frequencies Selection Control” on page 25, to add any frequencies to the Main Menu that do not appear on it because they have not been set to “Currently Available” status.)

Change of Depth Units
The SR-20 can display Measured Depth in either Feet or Meters (Figure 34). Feet are shown in feet and inches format; meters are in decimal format. To change these settings, highlight the Depth Units selection in the menu and press the Select Key to toggle between feet or meters. Use the Menu Key to save the section and exit.

Back Light Control
A light detector built into the upper left corner of the keypad senses low light levels. The backlight can be forced on by blocking the light to this sensor.
The automatic LCD backlight is factory set to only switch on under fairly dark conditions. This is to conserve battery power. As the batteries near depletion, the backlight will appear dim.
To set the backlight to be always off, highlight the light bulb icon in the tools section of the menu. Press the Select Key to toggle it between Auto, always ON and always OFF.

LCD Contrast
When this is selected by pressing the Select Key, the contrast can be adjusted (Figure 36). Use the Up and Down Keys to make the screen lighter or darker. Extreme temperature changes may make the LCD appear dark (hot) or light (cold). Setting the contrast to extreme dark or light may make the LCD difficult to read.
Optional Features

Optional Features in the Display Elements Menu include:

Race Track and Watermark

The “Race Track” is a circular track around the center of the Active View Area on the screen. The Watermark is a marker which appears in the outer ring of the display, traveling along the Race Track (Figure 39). The Watermark is a graphic representation of the highest Signal Strength reached (in Sonde mode) or the highest Proximity Signal level reached (in Line Tracing modes). It is “chased” by a solid Level Pointer which shows the current Signal Strength.

This provides an additional, visual way to track the maximum signal. If you are trying to trace a line by noticing its highest Signal Strength level, the Watermark serves as a visual aid.

Figure 38 – “Race-track” with Watermark and Level Pointer

No-Signal Icon (Suppression)

When the SR-20 is not receiving any meaningful signal on the selected frequency it will display the mode sign with a line through it, indicating no signal is being detected (Figure 40). This reduces the confusion of trying to interpret the random noise that some locators display in the absence of a signal.

- Depth suppression – If the Measured Depth is greater than the threshold depth (by default, 99'/30m in Sonde mode and 30'/10m in Line Trace mode), the map is suppressed. (In Line Trace mode, the Proximity Threshold control may be used to change the threshold depth setting).

- Noise suppression – If the signal is seen to be too noisy, the map may also be suppressed.
Selecting this option in the Menu Selection screen will force the number representing Signal Strength to be displayed in the center of the display area anytime when a Proximity Signal is not available (Figure 40). This may occur when signal is weak, or when filtering by the Proximity Threshold control is on. When a Proximity Signal again becomes available, the Signal Strength number returns to the lower right corner of the screen as usual. (Line Trace Mode only).

When it is activated, the Proximity Threshold is controlled by a long press (greater than 1/2 second) on the Up Key to set a higher threshold, or by the Down Key to lower the threshold.

The settings on the Proximity Threshold control the depth thresholding of the Proximity Signal as follows.

(Lowest) Signal Strength mode. Moves Signal Strength to screen center, map display suppressed, allows negative depth to display. Audio signal reflects Signal Strength.

3’ (1m) Displays Proximity Threshold for detections where Measured Depth is three feet (1m) or less.

10’ (3m) Displays Proximity Threshold for detections where Measured Depth is ten feet (3m) or less.

33’ (10m) Displays Proximity Threshold for detections where Measured Depth is thirty feet (10m) or less (Default setting).

99’ (30m) Displays Proximity Threshold for detections where Measured Depth is 99 feet (30m) or less.

(Highest) Wide-open Proximity Mode. No threshold, no suppression, allows negative depth display.

The Proximity Threshold Control is particularly valuable if you need to eliminate signals from outside a well-defined distance for clarity.

The threshold for Proximity detection in the SR-20 can be adjusted. This helps to constrain the locating to a certain range from the instrument. The SR-20 compares the Measured Depth reading to the selected Proximity Threshold level and determines whether or not to display a Proximity Signal. If the Measured Depth of the target is greater than the user-selected threshold value, the Proximity Signal will read zero. If the Measured Depth is less than the threshold that has been set, the SR-20 will display a Proximity Signal value. (Line Trace Mode only.)
Figure 42 – Signal Focus Control

Note this means that when using a more narrow Signal Focus Control setting, it is necessary to move the receiver along the line more slowly. This is a trade-off for the improved focus, and will avoid missing data updates at the slower rate.

When it is selected on, the Signal Focus Control is changed to narrower or wider settings using the Up (narrower) and Down (wider) Keys.

Signal Focus Control is useful when you need to focus in on a particular signal with detail.

Sound Muting
This option enables the automatic muting of the sound when the Measured Depth is greater than the setting of the Proximity Threshold setting. If the Proximity Threshold is not selected on, this option automatically mutes sound when Measured Depth is greater than 99 feet (30m). If it is unchecked, the sound will not mute automatically.

Tracing Line Response
The Tracing Line distortion response checkbox sets the sensitivity of the Target Line’s distortion display to low, medium, or high – or disables it altogether. The higher the setting, the more sensitive the “distortion cloud” around the Tracing Line becomes.

If the distortion response is disabled, the Tracing Line will become a single solid line, and the screen will show a second, dashed, line called the Distortion Line. (See page 26 for a description of using this alternative display.)

Frequencies Selection Control
Additional available frequencies on the Master Frequency Menu can be added to the Main Menu list of available frequencies by going to the Frequency Selection Control submenu and selecting the desired mode. All frequencies available in the SR-20 for that mode will be displayed. Checked frequencies are already “Currently Available” – that is, selected to appear in the Main Menu. From there, they can be set to “Checked-Active” status to make them available by use of the Frequency Key.

To select additional frequencies, highlight and select the Frequency Selection sub-menu. Highlight the category of the desired frequency (Figure 43). Press the Select Key.

Figure 43 – Selecting a Frequency Category

Then use the Up and Down Keys to scroll through the available frequencies. Highlight the desired frequency to add it to the currently available list (Figure 44).

Figure 44 – Highlighting a Frequency to Activate

Checking a frequency (using the Select Key) will enable it to be included in the “Currently Available” list of frequencies on the Main Menu (Figure 45). Once on the Main Menu, it can be set to “Checked-Active” status, and then be put into use using the Frequency Key.

Figure 45 – Setting a Frequency to “Currently Available” Status

To switch to a “Currently Available” frequency that is not yet “Checked-Active”, press the Menu Key and scroll down to the desired frequency; if it is not checked, press the Select Key to toggle the checkbox to “checked”. This
sets the status of that frequency to “Checked-Active”. Press the Menu Key to return to the operating display, which will now be set to the frequency just activated. The SR-20 will show the chosen frequency and its icon on the left of the screen.

Selected frequencies in the Checked-Active set can be switched while the SR-20 is in use, by pressing the Frequency Key. The SR-20 will cycle down the list through the set of active frequencies from low to high, group by group, and repeat. Unchecking a frequency in the Main Menu will deactivate it, and it will then not appear when pressing the Frequency Key.

**Information Screen and Restoring Defaults**

**Information Screen**
The information screen appears at the bottom of the menus choices list. Pressing the Select Key displays information about your locator, including software version, serial number of the receiver, and its calibration date (Figure 46).

![Figure 46 – Information Screen](image1)

**Restore Factory Defaults**
Pressing Select a second time will display the Restore Factory Defaults option. (See Figure 47.)

![Figure 47 – Restore Defaults Option](image2)

Use the Up and Down Keys to highlight either the “check” symbol to restore factory defaults, or the “X” symbol to NOT restore them.

![Figure 48 – Defaults Restored (Line Trace Mode)](image3)

Pressing the Menu Key without changing either checkbox will exit the option and leave things as they were.

**Operating With the Distortion Line**
If the Tracing Line’s distortion response (blurring) is disabled, the detected field will be shown with two lines, one solid (the Tracing Line ———) and one dashed (the Distortion Line - - - - -). (The dashed Distortion Line can be separately selected to be on or off in the Display Elements menu.) The dashed Distortion Line is the signal as seen by the upper antenna node and the solid Tracing Line is the signal as seen by the lower node.

![Figure 49 – Screen Display with Distortion Line (Line Trace Mode)](image4)

The Tracing Line without the dynamic distortion response (blurring) still represents the approximate location, and the direction, of the signal being traced. It still reflects changes in direction of the target utility. And it helps recognize signal distortion, when compared to the dashed Distortion Line — if something is interfering with the signal and distorting its shape, the Distortion Line could be significantly offset or skewed.

The Tracing Line represents the signal received by the lower antenna node. The Distortion Line represents the signal received by the upper antenna node. If these two do not align, or they do not reflect the same information as the Guidance Arrows about where the center of the field is, then the operator knows he is looking at some kind of distortion.
The two lines may also move randomly if a weak signal is being received, indicating that the locator circuit needs to be improved (see page 14 for tips on improving the signal). The balance of the Tracing Line and the Distortion line combine to give the operator much the same information as the Tracing Line with its distortion response enabled, but in a different graphical form. Advanced operators may find this more useful in discriminating the primary signal from the impact of distortion.

Menu Tree
The graphic shows a summary of the options and controls built into the SR-20 menus. Move through the choices using the Up and Down Keys. Pressing the Select Key when any choice is highlighted will show that sub-menu.

**Informational Locating**

The normal shape of a field around a long conductor such as a pipe or cable is circular (cylindrical in three dimensions). When over the center of a circular field, the operator can observe the following indicators:

- Maximum Signal Strength
- Maximum Proximity Signal (Line Trace Mode)
- Centered Tracing line with minimized distortion
- Guidance arrows centered, agreeing with Tracing line
- Minimum Measured Depth
- Sound pitch and volume will increase until they maximize over the target utility.

![Figure 51 – Over a Circular Field](image)

Tracing a line which is near other large conductors such as power lines, phone lines, gas mains, rebar, or even buried scrap metal can lead to questions.

By comparing the Guidance Arrows, the Tracing Line, Signal Strength, Signal Angle, Measured Depth, and Proximity Signal, an operator can learn more about the field being distorted. Comparing the field information with an educated view of the ground, noticing where transformers, meters, junction boxes, manholes, and other indicators are located can help in understanding what is causing field distortion. It is important to remember, especially in complex situations, that the only guarantee of the location of a particular line or pipe is visual inspection, such as by potholing.

Compound or complex fields will produce different indications on the SR-20 that will show what is happening. Some examples might be:

- Disagreement between guidance arrows, Tracing Line and Distortion Indicator
- Inconsistent or unrealistic Measured Depth signal
- Fluctuating random indications (also caused by very weak signal)
- Inconsistent Proximity Signal compared to guidance arrows (Active or Passive Line Trace modes)
- Signal strength maximizing off to one side of the conductor.
Figure 52 – Over a Distorted Field

Generally, distortion is likely to be worse at higher frequencies, compared to lower frequencies. This is due to the tendency of higher frequency signals to "jump" to adjacent conductors. Large iron and steel objects such as vault and manhole covers, trench plates, structural supports, rebar and vehicles can significantly distort even the lowest frequencies. In general, passive locating is more subject to distortion than active locating, especially in regards to depth measurements. Power transformers, buried and overhead power lines are a common source of strong distortion. It may be impossible to get an accurate locate close to a large power transformer.

Notes on Accuracy

Measured Depth, Proximity, and Signal Strength measurements rely on a strong signal being received by the SR-20. The SR-20 is used above ground to sense electromagnetic fields emitted from underground lines (electrical conductors like metal cables and pipes) or Sondes (actively transmitting beacons). When the fields are simple and undistorted, then the information from sensed fields is representative of the buried object.

If those fields are distorted and there are multiple interacting fields, it will cause the SR-20 to locate inaccurately. Locating is not an exact science. It does require the operator to use judgment and look for all the information available beyond what the instrument readings may be. The SR-20 will give the user more information, but it is up to the operator to interpret that information correctly. No locator manufacturer will claim that an operator should follow the information from their instrument exclusively. A wise operator treats the information gained as a partial solution to the problem of locating and combines it with knowledge of the environment, utilities practices, visual observation, and familiarity with the instrument to arrive at an informed conclusion. Locating accuracy should not be assumed under the following conditions:

- **When other cables or utilities are present.** "Bleed over" may produce distorted fields and illuminate cables or pipes unintentionally. Use lower frequencies when possible and if possible eliminate connections between the two cables (such as common bonding to ground).

- **When tees, turns, or splits are present in the line.** When following a clear signal that suddenly becomes ambiguous, try seeking in a circle of about 20' around the last known point to see whether the signal picks up again. This may reveal a branch, joint, or some other change in the line. Be alert to "split opportunities" or sudden changes of direction in the utility being traced. Turns or tees can cause a sudden increase in the Distortion Indicator response.

- **When Signal Strength is low.** A strong signal is necessary for accurate locating. A weak signal can be improved by changing the grounding of the circuit, frequency, or transmitter connection. Worn or damaged insulation, bare-concentric cables, and iron pipes exposed to ground will compromise Signal Strength through leakage to ground.

- **Far-end grounding** will change Signal Strength significantly. Where far-end grounding cannot be established a higher frequency will provide a stronger signal. Improving ground conditions for the locating circuit is a primary remedy to a poor signal.

- **When soil conditions vary.** Extremes in moisture, either very dry or water-saturated, may affect measurements. For example, ground that is saturated with salty water will shield the signal severely and be very difficult to locate in, especially at high frequencies. In contrast, adding water to very dry soil around a ground stake can make a major improvement in signal.

- **In the presence of large metal objects.** Simply walking past a parked car during a trace, for example, can cause an unexpected increase or decrease in Signal Strength, which will revert to normal when past the distorting object. This effect is stronger at high frequencies, which "couple" more readily onto other objects.
The SR-20 cannot change the underlying conditions of a difficult locate, but changing frequency, grounding conditions, transmitter location, or isolating the target line from a common ground can change the results, by making a better ground connection, avoiding signal splits, or reducing distortion. Other locating receivers will give an indication that they may be over the line but they have less ability to determine the quality of the locate.

The SR-20 provides more information. If all of the indicators are aligned and in agreement, mark-outs can be made with more confidence. If the field is distorted it shows immediately. This allows the operator to do something to isolate the target line, change the grounding, connection point, move the transmitter or change the frequency to get better reception with less distortion. For extra certainty, take steps to inspect the situation, such as by requesting potholing.

In the final analysis, there is one “most important” component in the locating task – the operator. The SR-20 provides an unprecedented amount of information to be able to make the correct decision rapidly and accurately.

A Better Way of Locating

What the SR-20 Does

The SR-20 is used above ground to sense and trace electromagnetic fields emitted from underground or hidden lines (electrical conductors like metal cables and pipes) or Sondes (actively transmitting beacons).

When the fields are undistorted, the information from the sensed fields gives an accurate picture of the buried object. When the situation is made complex by interference from more than one line, or other factors, the SR-20 provides a display of information that shows multiple measurements of the detected field. This data can make it easier to understand where the problem is, by providing clues as to whether a locate is good or bad, questionable or reliable. Instead of just laying paint in the wrong place, the operator can see clearly when a difficult locate needs reevaluation.

The SR-20 provides more of the critical information the operator needs to understand the situation underground.

What It Does Not Do

The SR-20 does not directly detect buried utilities and sondes. Instead, the SR-20 locates by sensing electromagnetic fields surrounding conductive objects; it does not sense the underground objects directly. It provides more information about the shape, orientation, and direction of fields than other locators but it does not magically interpret that information or provide an x-ray image of underground objects.

A distorted, complex field in a noisy environment requires intelligent human thought to analyze correctly. The SR-20 cannot change the results of a difficult locate, even though it shows all the information about those results. Using what the SR-20 shows, a good operator can improve locating results by “making the circuit better”, changing frequency, grounding or the transmitter’s location on the target line.

Advantages of the Omnidirectional Antenna

Unlike the coils used in many simple locator devices, the Omnidirectional antenna detects fields on three separate axes, and can combine these signals into a “picture” of the apparent strength, orientation, and direction of the complete field. Omnidirectional antennas offer definite advantages:

The Mapping Display

The mapping display enabled by the Omnidirectional antennas provides a graphic view of a signal’s characteristics and a bird’s eye view of the signal from underground. It is used as a guide for tracing underground cables and pipes, and can be used to better pinpoint Sondes. It can also be used to provide more information for complex locates.

Figure 54 – Mapping Display

The use of lines (representing the signals sensed by upper and lower antennas) and guidance arrows (pointing toward the center of the detected field) combine to give the locator a graphic picture of the receiver’s location, and where the target utility or Sonde is. At the same time the operating screen provides all the information needed to understand what is happening with the field being located – its Signal Strength, continuous distance, Signal Angle, and proximity to the target. The information available at one moment on the SR-20 would take multiple sample readings with some conventional locators. A distorted or compound field will be easier to interpret when all the information is in a single display as it is with the SR-20.
Orientation to the Signal
Because of the multiple signals being processed by each Omnidirectional antenna, the target’s signal always gets stronger as the receiver gets closer to the target. How the unit is held does not affect Signal Strength. The user can approach from any direction and does not need to know the orientation or direction of the pipe or wire.

Locating Sondes
Used with a Sonde, the SR-20 eliminates Nulls and "Ghost Peaks". A conventional locator signal often sees a signal increase followed by a null (better described as no signal registering on the antenna) and then a peak. This can confuse the operator who may interpret a smaller peak as the target.

![False Peaks](image)

**Figure 55** – The signal from a Sonde as “seen” by a conventional locator

The main peak is in the center, and two false peaks are outside the two nulls.

The SR-20 uses measurements of the complete field to direct the user to the target. Finding a Sonde using Signal Strength is a very direct process.

![Peaks](image)

**Figure 56** – Sonde signal as “seen” by the SR-20

The only way to go is “up” toward the maximum signal.

Proximity Signal
The SR-20’s Proximity Signal tells the operator how close the instrument is to the target. Using the Proximity

Strength in line locating allows for a much more defined “peak” than using Signal Strength.

SR-20 Maintenance
Transportation and Storage
Before transporting, make sure that the unit is off to preserve battery power.

When transporting, make sure that the unit is secure and does not bounce around or get bumped by loose equipment.

The SR-20 should be stored in a cool dry place.

NOTE! If storing the SR-20 for an extended period, remove the batteries completely.

If shipping the SR-20, remove the batteries entirely from the unit.

Installing/Using Accessories
The SR-20 also comes with Sonde and Pole Markers that can be used to mark Pole or Sonde locations above ground. There are two (2) red markers to mark the Poles and one (1) yellow marker to mark the Sonde. The markers can also be used to temporarily mark points to come back to while scouting a target area or tracing a line.

![Peaks](image)

Maintenance and Cleaning
1. Keep the SR-20 clean with a damp cloth and some mild detergent. Do not immerse in water.

2. When cleaning, do not use scraping tools or abrasives as they may permanently scratch the display. NEVER USE SOLVENTS to clean any part of the system. Substances like acetone and other harsh chemicals can cause cracking of the Case.

Locating Faulty Components
For troubleshooting suggestions, please refer to the trouble-shooting guide on page 34.
Service and Repair

⚠️ WARNING

Instrument should be taken to a RIDGID Independent Authorized Service Center or returned to the factory. Remove batteries entirely before shipping. All repairs made by Ridge service facilities are warranted against defects in material and workmanship.

⚠️ CAUTION Remove batteries entirely before shipping.
# Troubleshooting Chart

<table>
<thead>
<tr>
<th>PROBLEM</th>
<th>PROBABLE FAULT LOCATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>SR-20 locks up during use.</td>
<td>Power the unit off, and then back on. Remove the batteries if the unit will not switch off. If batteries are low, replace them.</td>
</tr>
<tr>
<td>SR-20 will not pick up the signal.</td>
<td>Check that the correct mode and frequency is set. Examine circuit for possible improvements. Relocate transmitter, change grounding, frequency, etc.; modify Proximity Threshold (page 24) and/or Signal Focus Control settings (page 24).</td>
</tr>
<tr>
<td>While tracing, lines are “jumping” all over the screen in the mapping display.</td>
<td>This indicates that the SR-20 is not picking up the signal or there is interference. Make sure that the transmitter is well connected and grounded. Point the SR-20 at either lead to be sure that there is a complete circuit. Try a higher frequency, or connecting to a different point in the line, or switching to inductive mode. Try to determine the source of any noise and eliminate it (Bonded, grounding, etc.). Check SR-20 batteries are fresh and fully charged.</td>
</tr>
<tr>
<td>While locating a Sonde, lines are “jumping” all over the screen.</td>
<td>Check the batteries in the Sonde to see that they are working. Sonde may be too far away; try starting with it closer in if possible, or do an area search. Verify signal by placing lower antenna close to Sonde. NOTE – Sondes have difficulty emitting signals through cast iron and ductile iron lines. Increase Proximity Threshold and try lower settings of Signal Focus Control to improve “focus” on weaker signals. Sonde may be tilted or there may be a cast iron to plastic transition.</td>
</tr>
<tr>
<td>Distance between Sonde and Poles is not equal.</td>
<td>Batteries may be low. Replace with fresh batteries and power ON.</td>
</tr>
<tr>
<td>Unit acts erratic, won’t power down.</td>
<td>Power the unit off and then back on. Adjust the LCD screen contrast. Adjust the sound level in the sound menu. Verify Proximity Signal is greater than zero.</td>
</tr>
<tr>
<td>Display appears completely dark, or completely light when it is turned on.</td>
<td>Check orientation of batteries. Check that the batteries are charged. Check to see that the battery contacts are OK.</td>
</tr>
<tr>
<td>There is no sound.</td>
<td>Unit may have blown a fuse (Factory service is required).</td>
</tr>
</tbody>
</table>