

RADIODETECTION APPLICATIONS MANUAL

Revision 0 - 06.97

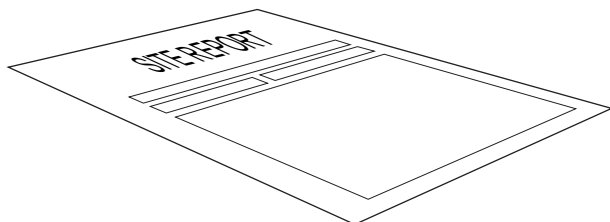
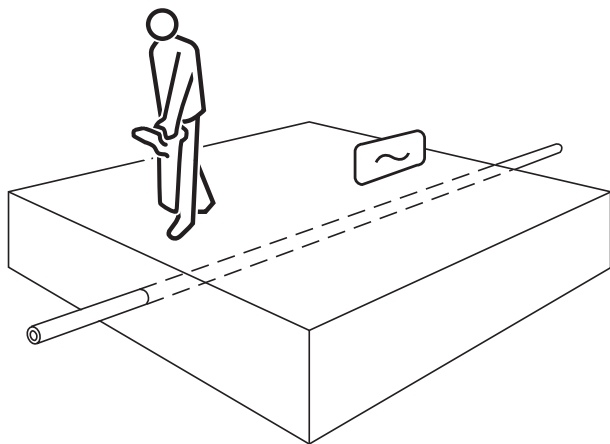
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1 INTRODUCTION

GENERAL USE

The Radiodetection locator (comprising a Transmitter and a Receiver) is designed for locating buried lines. Although simple, it is often used to define complex locating problems in confused situations which is the reason for the large variety of possible ways of using the equipment. Information in this Applications Manual combined with field experience will help select the most suitable method to obtain the best results.

Obtaining site plans or contacting the local utilities before locating is mandatory in some areas and is always advisable. Although the information obtained may not be accurate or complete, it usually warns what to expect.

A large number of optional accessories are available for Radiodetection locators to increase their usefulness and to widen their scope.

A knowledge of the theory of electromagnetic principles is useful, helping the user to take full advantage of the locator and to recognise its limitations. Locator users are advised to read Radiodetection's publication 'The Theory of Buried Pipe and Cable Location'.

SAFETY

Safe working on site is always the first priority and must never be neglected. Local and Company safety procedures should be strictly adhered to when using RD locators.

REPORTING

Sometimes there are situations when it is not possible to pinpoint a target, identify a line or provide correct information about a buried line. Experience will help the user decide on the quality of information obtained using the locator. This information can often be corroborated with aids from the site, e.g. visual indications of buried plant, site or system drawings etc.

Any doubts about precision or the correctness of locating information must always be included in reporting or staking out.

PRODUCT CARE

With the exception of the batteries, the locator has no parts which need regular replacement or servicing. If an instrument requires maintenance, please refer to Radiodetection for details of local repair facilities.

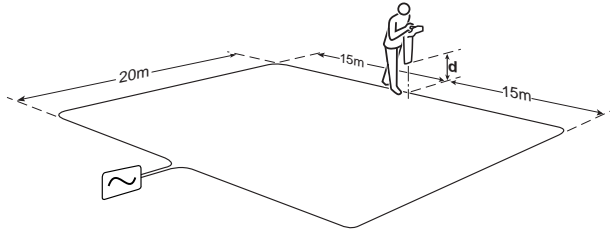
Safety Testing

If the locator is to be used for safety applications such as cable avoidance, it is good practice to undertake regular checks to confirm correct function.

The best and most reliable technique is to undertake a 'street' test. Familiarise yourself with the instrument and use it to detect some cables at convenient locations close to the workshop or depot.

Choose one or two sites where the Power and/or Radio signals give consistent response and use these as benchmark test sites. Ideally, try to find sites where the Power/Radio signal is relatively weak, i.e. where the line can only be found with the sensitivity control at, or near, maximum - any significant loss of performance can then be readily noticed.

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Depth Check

A reliable, accurate depth measurement is only certain when a good active signal is present on a single line. There must be no significant signal on adjacent lines and the target line must be straight and without tees for about ten paces to either side of the Receiver. Also, depth will not be accurate if measured within 30 paces range of a Transmitter in the induction mode.

If a suitable line (without the previously mentioned problems) is available whose depth is known at a particular point, use it as a benchmark test site to undertake regular checks. Alternatively, an above ground test loop can be used.

Choose an area known to be free of buried pipes/cables and metal structures.

Lay out a test loop as illustrated. It can be used to verify depth accuracy in the range 20 cm (8 in.) to 2 m (6.5 ft).

Cleaning

Do not use solvents for cleaning. If it is necessary to remove mud or grime, use a sponge dampened with warm water. A mild soap may be used to loosen ingrained dirt.

Periodically wipe the moving coil meter or LCD window with an anti-static fluid.

The Transmitters and Receivers incorporate weather-proof seals but they are not guaranteed to prevent ingress of water if immersed.

Batteries

Radiodetection recommends the use of Alkaline Manganese batteries. Cheaper Zinc Carbon batteries can be used but have a much shorter life (possibly 25% of Alkaline Manganese batteries).

Never change just some of the batteries - all or nothing is the rule.

Observe the correct battery polarity. The instruments are protected against being damaged by incorrect polarity.

Some Transmitter batteries are fitted inside two reducer tubes. Alternatively, the tubes can be discarded and the High Power Transmitter battery types can be used. This does not increase output power but gives a longer and more cost effective battery life.

Transmitter Fuses (STx, SDTx, HPTx and HCTx)

Battery Trays - A fuse is fitted which will blow if the battery tray terminals are inadvertently short circuited. Replace with a 2 A, quick blow 1.25 in. fuse.

In normal use, the fuse will only blow if the Transmitter has developed a fault; do not replace the fuse - arrange to have the unit repaired.

Output Fuse - Some High Power Transmitters have a fuse to protect the output lines in case of inadvertent connection to conductors carrying an excessive voltage.

The output fuse is fitted next to the connection socket.

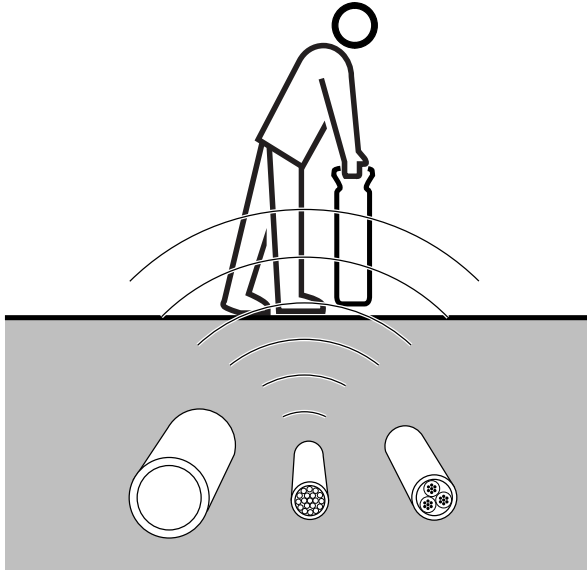
If a Transmitter fails to operate in Direct Connection mode, but operates in the Induction mode, check the output fuse.

Replace with a 315 mA quick blow fuse (630 mA 20 mm fuse for the HCTx-2)..

Types	All Receivers	STx, SDTx	HPTx, HCTx	LCTx	HCTx-2
Quantity	12	10	10	4	8
Description	AA 1.5V Alkaline	AA/D 1.5V Alkaline *	D 1.5V Alkaline	D 1.5V Alkaline	D 1.5V Alkaline
IEC Code	LR6	LR6/LR20	LR20	LR20	LR20
Mallory	AA	AA/D	D	D	D
Duracell	MN1500	MN1500/ MN1300	MN1300	MN1300	MN1300
Fuji	5300	5300/5100	5100	5100	5100
USA - EverReady	E91	E91/E95	E95	E95	E95

* AA cells are a low cost option for STx and SDTx Transmitters.

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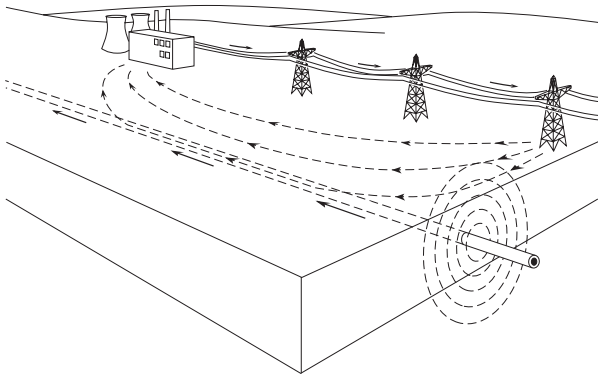
2 HOW TO USE A RECEIVER

There are a number of techniques available for locating unknown lines in an area. Use of these techniques are particularly important before digging in order to avoid damage to buried lines.

A buried line is located by applying the distinctive transmitter signal to it then tracing it with the Receiver.

The Receiver's Power and Radio passive modes are used to search an area for unknown power cables and other lines.

The Receiver's active modes enable the Transmitter signal to be traced by the Receiver.



2.1 PASSIVE AND ACTIVE SEARCHING

Passive mode

The passive modes, Power and Radio, provide a convenient means of searching for lines without the need to connect a Transmitter. Although the Power and Radio modes will not necessarily find all lines, much information can be gathered about complex sites. Always use both Power and Radio, **never** rely on just one.

The Power mode detects the 50/60 Hz energy present on buried cables and other lines.

The Radio mode detects very low frequency energy reradiated by buried cables and other lines.

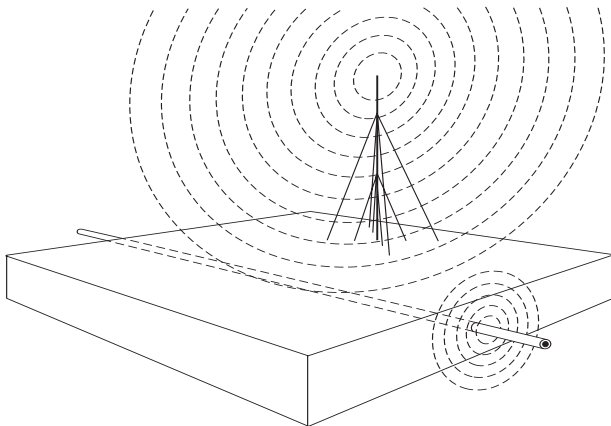
Radio signals may not be present in detectable strength at some locations. Where present, the Radio mode is a most useful method for locating buried lines, in particular long distance telephone lines and other lines not radiating a Power signal.

Passive Search

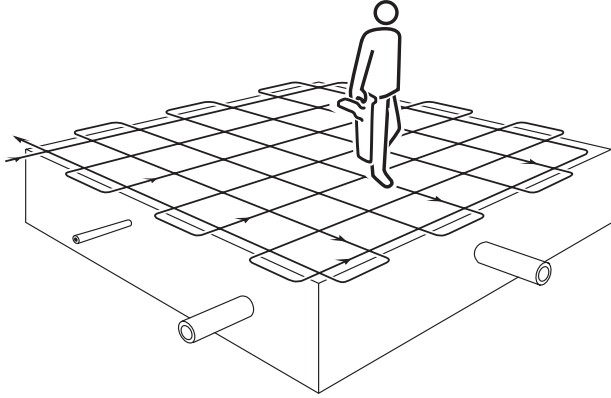
The site should be examined for covers, street lights and all other signs indicating the presence of buried pipes or cables before using the Receiver.

Define the area to be swept and include a generous margin around it.

Set the Receiver to the Power mode (Power+ for the RD400SL). Adjust the Receiver sensitivity to provide an indication of approximately 50%.



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Carry out a grid search of the area, holding the Receiver blade vertical and in line with the direction of movement.

Stop when the Receiver response indicates the presence of a line. Pinpoint the line and mark its position. Mark and trace the line out of the area being searched. Resume the grid search of the area to locate any other lines.

The 'Power+' mode (RD400SL only) has a sensitivity level which conforms to the National Utilities Group UK requirement for locator sensitivity. In some areas this mode may be too sensitive making it necessary to select the Power mode.

In some areas there may be a confusing amount of Power signals. Raise the Receiver 5 cm (2 in.) from the ground and continue the search.

Switch the Receiver to Radio, increase sensitivity to maximum and repeat the above grid search procedure over the area, tracing and marking any lines that are located.

In most areas the Radio mode will locate lines that do not radiate Power signals and any grid search should be carried out in both modes.

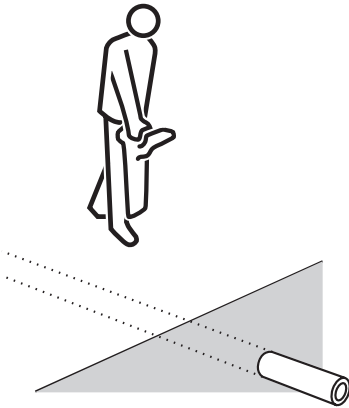
2.2 PINPOINTING A CABLE OR PIPE

Pinpointing defines the exact position and direction of a target line after it has been traced and its approximate position is known.

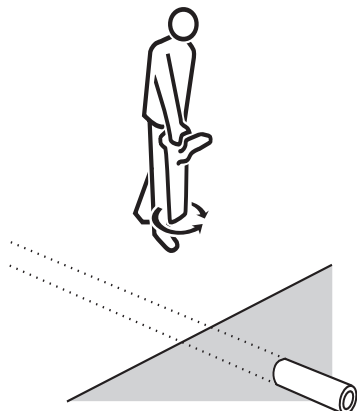
Procedure

Adjust the Receiver sensitivity for a mid scale indication. During the following pinpointing procedure it will be necessary to adjust the sensitivity to keep the indication on scale:

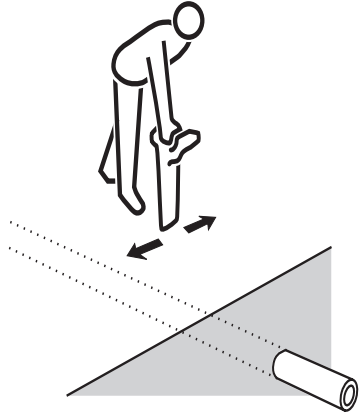
- (a) Move the Receiver left and right over the line and define the point of maximum response.



- (b) Hold the Receiver near the ground with the blade vertical. Rotate the Receiver and stop at the position of maximum response.



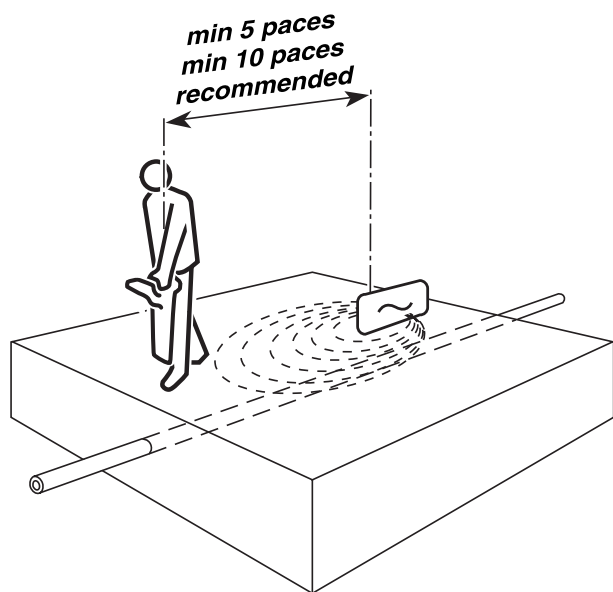
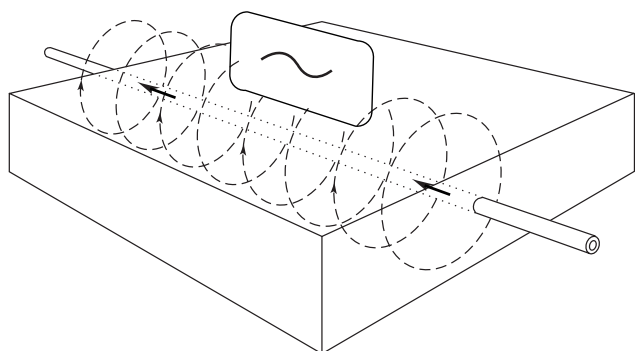
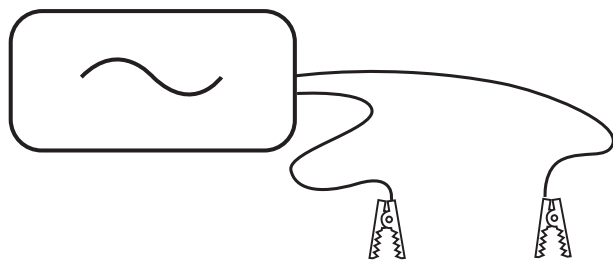
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- (c) Move the Receiver slowly from side to side to define the exact position of the peak response. The Receiver blade is now over the target line and at right angles to it. Mark the ground.

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3 HOW TO USE A TRANSMITTER

A number of application techniques are available for use in different site situations and the user must choose that which applies the best signal with minimum coupling to other lines. Field experience or the trial and error of working through the application techniques will determine the best method for applying the Transmitter signal.

Always use the lowest signal output level that provides an adequate tracing signal; this saves battery power and reduces the effects of coupling.

Start locating with the signal output level set high but reduce it to a low level when possible. Only use a high level for long periods when extra tracing range is required or for applying the signal to deep target lines.

Some transmitters also have an impedance match switch which enables the Transmitter to make most efficient use of the power available. Start with a low setting, if more signal is required, increase. Monitor to check for more signal, i.e. lower pitch tone. If loudspeaker tone does not change, return to lower setting.

Some transmitters offer a choice of frequencies.

Note: Always check that the Transmitter and Receiver are set to the same frequency.

3.1 INDUCTION

Transmitters incorporate an antenna which can radiate a signal that will be induced on to a line directly below it. Its' efficiency is poor on deep targets. Generally induction is only useful at depths down to 2 m (6 ft).

The signal can induce on to nearby lines as well as the target line. Part of the signal is lost in the surrounding soil. The Receiver cannot be used within a minimum of five paces from the Transmitter, and often much further if maximum Transmitter power is being used. It will not apply a signal to a well insulated line unless it is effectively grounded at each end.

Procedure

Switch on the Transmitter and place it directly above the buried cable or pipe (refer to the Transmitter section of the User Guide for correct Transmitter orientation).

Adjust the sensitivity of the Receiver to minimum and start locating the line at least ten paces away from the Transmitter.

Precautions

The induction signal is radiated in other directions as well as downwards towards the line and this may cause problems when trying to work close to the Transmitter or in congested areas.

To check, point the Receiver directly at the Transmitter. If the Receiver signal strength increases, either reduce the Transmitter power or increase the distance from the Transmitter.

If the Receiver signal strength decreases, the received signal is from the target line.

Induction cannot be used to apply a signal to a line below reinforced concrete.

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Active Search

The most certain technique for searching for buried lines requires two operators and is the induction sweep.

Define the area to be swept and the probable direction of lines crossing the area.

One operator holds the Transmitter (which must be in the induction mode) and the other holds the Receiver. The Transmitter induces a signal on to any lines it passes over which can then be detected by the Receiver 20 paces away.

Check the Receiver and the Transmitter are set to the same frequency.

Operator 1: Holding the Transmitter at the start of the area, stand 20 paces away from the Receiver along the probable path of the buried lines. Align the Transmitter handle or alignment arrows (according to model) with the assumed direction of the buried lines.

Operator 2: Hold the Receiver with the blade vertical and in line with the direction of movement. Set the Receiver sensitivity level as high as possible without picking up the signal directly from the Transmitter.

When the Transmitter is in line with the Receiver, both operators move slowly forward in parallel.

The Transmitter applies its signal to lines directly below it which are then located with the Receiver.

Mark the ground at the point of each peak signal detected with the receiver.

Repeat the sweep along any other possible paths of lines.

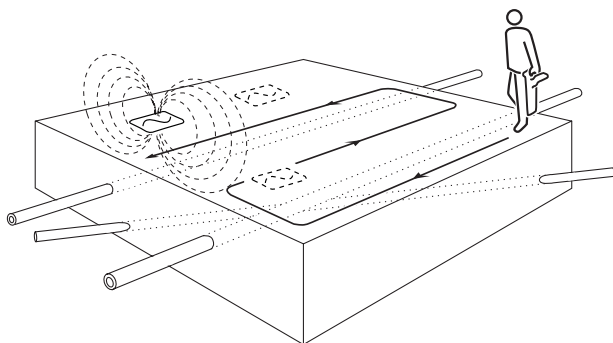
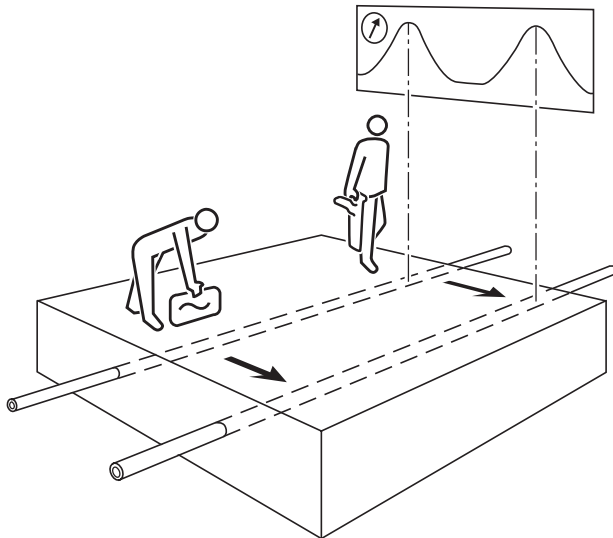
Once the position of the lines has been marked, reverse positions, placing the Transmitter over the marks and along their axis, then trace each of them out of the area being searched with the Receiver.

If only one operator is available, or if there is not sufficient space for the previous search procedure to be carried out, the following technique, although not as thorough as the previous procedure, can be used.

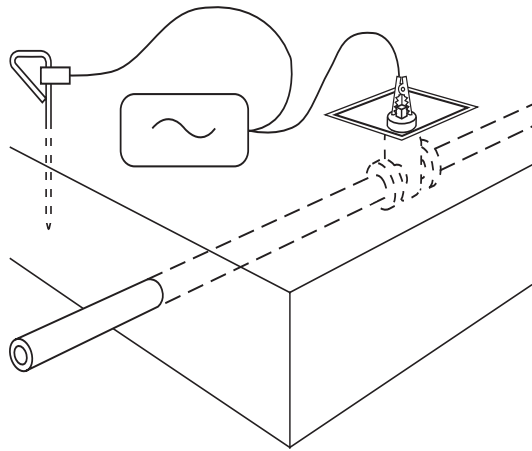
If possible lay the Transmitter on its side. The Transmitter will energise all the lines to either side but not lines running directly below the Transmitter.

Carry out a search with the Receiver at least 10 paces from the Transmitter. Pinpoint and mark any lines that are located.

Reposition the Transmitter at five pace intervals around the site, searching each time with the Receiver. Pinpoint and mark any lines that are located. Trace the line out of the area, marking its route.



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3.2 DIRECT CONNECTION

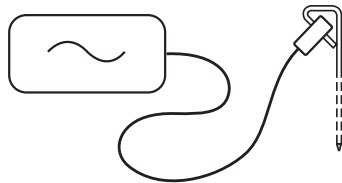
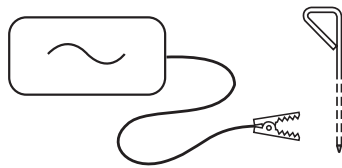
Suitable for use on continuous tracer wire, water and gas distribution systems, a telecom cable, and pipelines at a CP test or other access point.



Warning
Should only be used on a power cable sheath by qualified personnel.

Procedure

Plug the Connection Cable into the Transmitter and to the target line. If necessary clean off paint, rust or scale to ensure good connection.



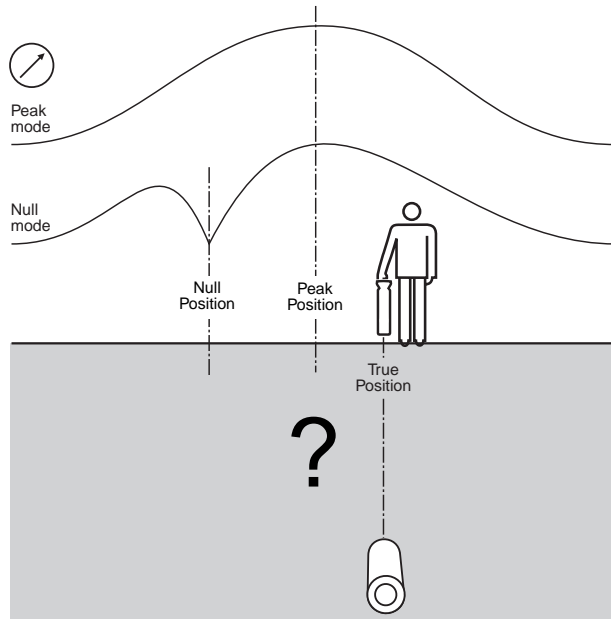
Clip the ground cable to an independent grounding point a few paces away and preferably at right angles to the probable route of the target line. Do not attach the ground cable to a water pipe or buried line which could carry the signal.

A change in audible tone or visual indication will confirm a satisfactory Transmitter connection. If there is no such indication, check the electrical contact and ground. If necessary change the position of the ground or tip water over the ground contact if placed in dry soil or sand.

Note: A Receiver can detect a signal many times weaker than that necessary for a satisfactory Transmitter connection indication and short distances can be traced without a tone change from the loudspeaker.

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4 HOW TO LOCATE AND TRACE

4.1 PINPOINTING WITH A PRECISION LOCATOR

Follow the procedure for pinpointing in the Peak mode (para 2.2) and mark the ground.

Select Null mode and pinpoint the position of the null then again mark the ground.

If the position of the marks from the Peak and Null pinpoints correspond, it can be assumed that the pinpoint is precise.

Note: Both marks will show an error to the same side. The true position will be close to the Peak pinpoint position.

Precautions

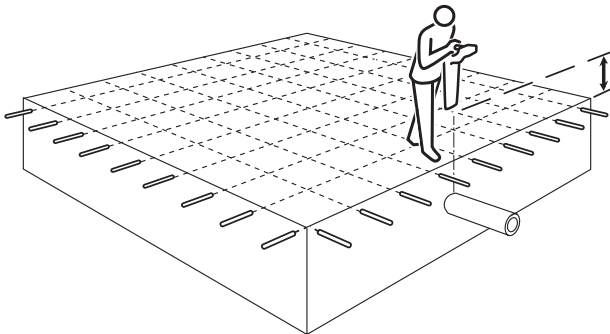
If the target line is close to another line, a portion of the Transmitter signal may couple to it and could affect the accuracy of the pinpoint.

Check by increasing the Receiver sensitivity and move the Receiver three paces to each side of the target line. No response from other than the target line, or a single peak response with equal signal reduction each side, confirms the accuracy of the pinpoint.

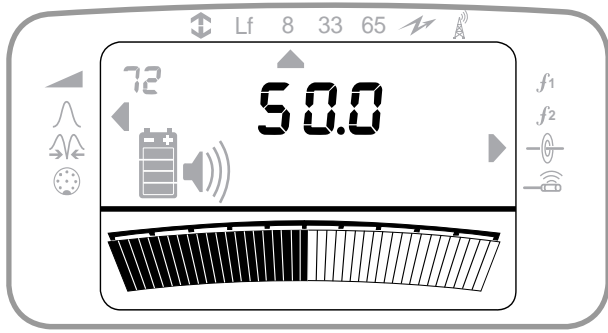
Alternatively, raise the Receiver by 30 cm (12 in.) and observe whether the apparent position of the target line shifts or not; if it doesn't, the locate is good.

If a signal is present on another nearby line or if the signal reduction either side of the peak is not equal, move further along the target line where interference is not present and carry out a pinpoint. When the target line signal has coupled to an adjacent line precision pinpointing is not possible.

Pinpointing over reinforced concrete areas may give confusing responses. Raise the Receiver 50 cm (20 in.) above the surface and repeat the pinpoint procedure, ensuring the blade is vertical. The signal level indication will respond to the signal from the target line and will not be affected by signals reradiated by the shallow rebars.



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4.1.1 High Resolution Pinpointing

Digital Display

A numeric representation of the meter deflection percentage is displayed above the bargraph on the LCD of Digital Receivers. This provides much higher resolution information about the Receiver's response to a signal than the bargraph.

Use the bargraph to find the approximate position of the target line then with much smaller movements of the Receiver use the numeric display to define the precise location of the signal peak.

Loudspeaker

Use the loudspeaker tone instead of the meter. The output from the loudspeaker (or headphones) switches off at lower signal levels. Use this function to obtain a precise narrow response at the point of the signal peak.

Gradually reduce the sensitivity causing the tone-on band to become narrower until the required response width is obtained.

4.2 TRACING A CABLE OR PIPE

The Receiver is used to trace a cable or pipe which is radiating a Transmitter signal. A target line can only be reliably traced when a Transmitter signal has been applied by direct connection, a Signal Clamp, a Live Cable Connector or a Live Plug Connector.

Apply the Transmitter signal at any access point to a buried pipe or cable such as a chamber, valve, street light or pedestal.

If the lines need to be identified trace them to a point where they surface, such as a cover, street light, fire hydrant etc., then apply the Transmitter signal and trace back to the area.

If there is no alternative, use the Transmitter in induction mode and trace the target line to a point of access, then connect directly or attach a Signal Clamp and trace the line back for identity confirmation.

4.2.1 Peak and Null Modes

Check that the Receiver and Transmitter are set to the same frequency.

Peak

Precision Receivers with a Peak/Null mode key should be switched to Peak. Receivers with no Peak/Null mode key operate in the Peak mode only.

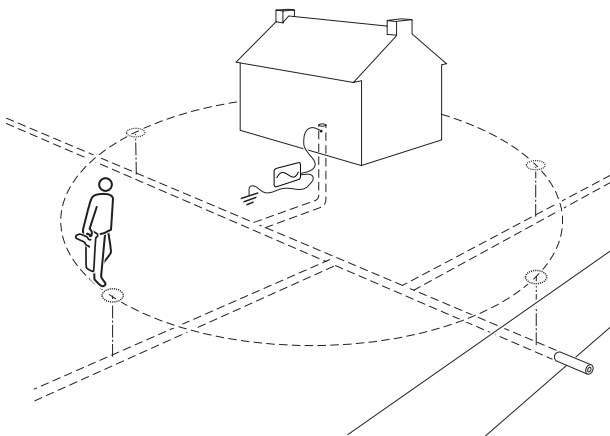
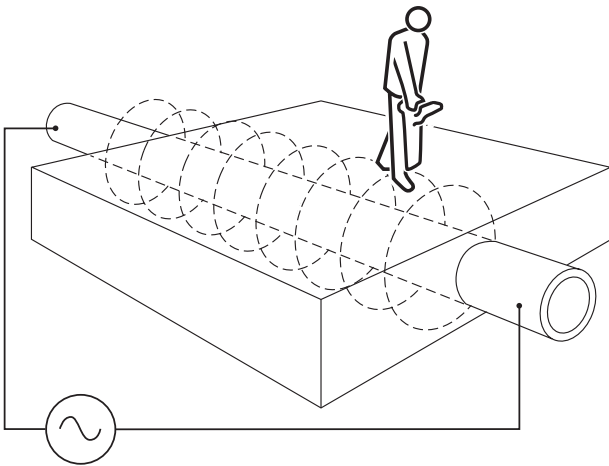
First it is necessary to locate the target line that is to be traced. If the Transmitter signal is applied by Direct Connection or with a Clamp stand at least four paces from the Transmitter. If the Transmitter signal is applied by induction stand at least ten paces from the Transmitter.

Holding the Receiver close to the ground, adjust the sensitivity to maximum.

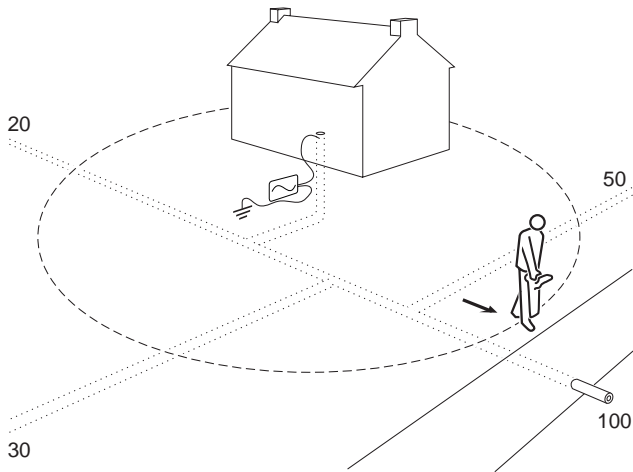
With the flat of the Receiver blade facing the Transmitter, walk in an arc around the Transmitter. Reduce the sensitivity as necessary to keep the indication on scale.

Stop at the point where the indication registers a peak response. Move the Receiver from side to side to establish the exact position of the peak response. Place the end of the receiver blade on the ground, again adjusting the sensitivity to keep the indication on scale.

Mark the ground and note the indicated response level.



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Continue the arc around the Transmitter with the Receiver blade facing the Transmitter and the sensitivity adjusted to give an indication near the top of the scale. Stop each time there is a response, reduce the sensitivity to give a narrow response, determine the position of the line, mark the ground and note the indicated response level.

If more than one signal is located, compare the response levels. The strongest signal will almost certainly be the target line to which the Transmitter signal has been applied.

Hold the Receiver over the target line. With the blade at right angles over the line, adjust the sensitivity to give an indicated response level of between 40 and 90%.

Walk away from the transmitter moving the Receiver left and right. A peak response with a reduced response either side indicates the position of the line.

Stop every 10 or 20 paces and carefully check the position of the peak response, then continue tracing.

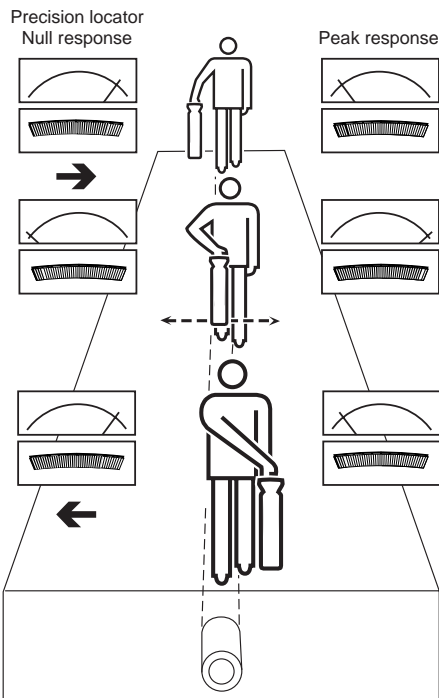
Check an area several paces either side to be certain that there are no other lines carrying a stronger signal.

Null

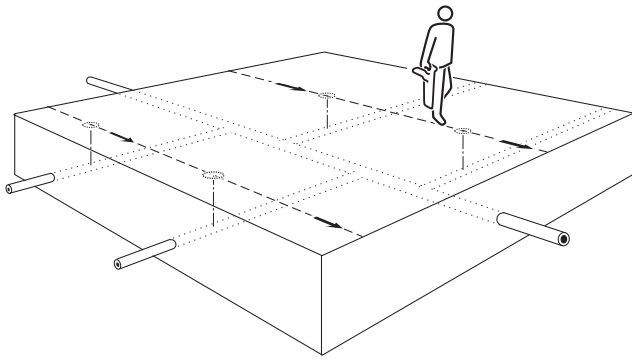
Line tracing speed can be increased by switching to the Null mode. The Receiver can be held in any orientation as its null response is not dependent on line direction. Walk along the path of the target line, moving the Receiver left and right. A null response with an increased response either side indicates the position of the line.

When using a Digital Receiver in the Null mode, and the Receiver blade is at right angles to the target cable or pipe, left/right arrows or null response will indicate the position of the cable.

Periodically switch back to Peak to verify the exact position of the target line.



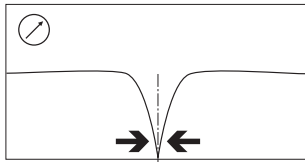
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4.2.2 Tracing Techniques

4.2.2.1 Locating Tees

With the Transmitter signal still applied after the path of a line has been traced and marked, move about one pace to side of the marked route. Holding the Receiver blade parallel to the line, follow the marked route. No signal (or very little) will be received from the previously traced line but branch connections (tees) should give clear responses.

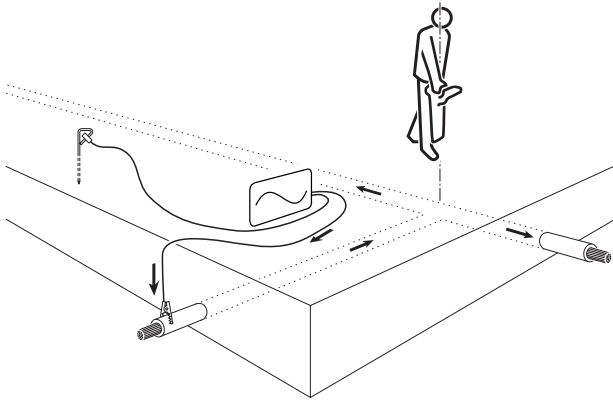


The most reliable method of pinpointing a tee is to apply the Transmitter signal to the end of the drop or service. The signal will flow to the main and then along in each direction. Tracing the signal along the main with the blade at right angles to the service will result in a null over the tee.

4.2.2.2 Tracing Cables from a Splice or Joint Chamber

Apply the Transmitter signal with a clamp, if available, otherwise, it will be necessary to remove the common bond from cables before applying the Transmitter signal in order to trace a target cable.

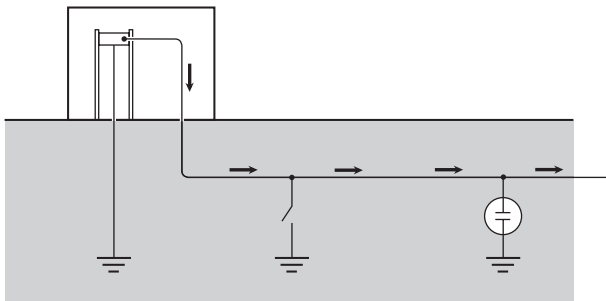
If it is required to trace all the cables from a chamber, the Transmitter in induction mode can be placed to one side of the chamber and in line with the cables to be traced.



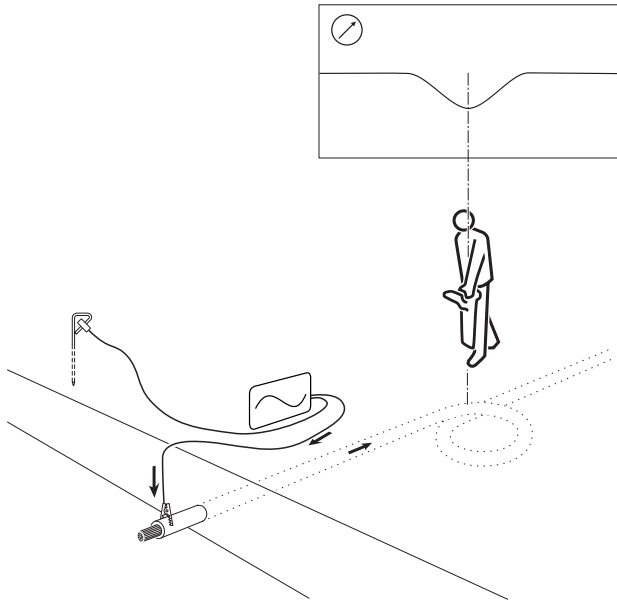
4.2.2.3 Tracing Long Distance Cables

A signal clamp can be used. However, it is preferable to use direct connection. When using direct connection it will be necessary to remove ground connections in order for the Transmitter signal to travel a sufficient distance.

When splices or joints are grounded for reasons of safety or for lightning protection, they can be permanently replaced by surge arrestors to allow uninterrupted locating and cable protection.



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4.2.2.4 Loop

A slack loop in a buried cable will sometimes cause a fall in response over the path of the cable which should be investigated.

Return to just behind the point of the change in the response and widen the arc of search. The Receiver will define all but the smallest loops in the cable.

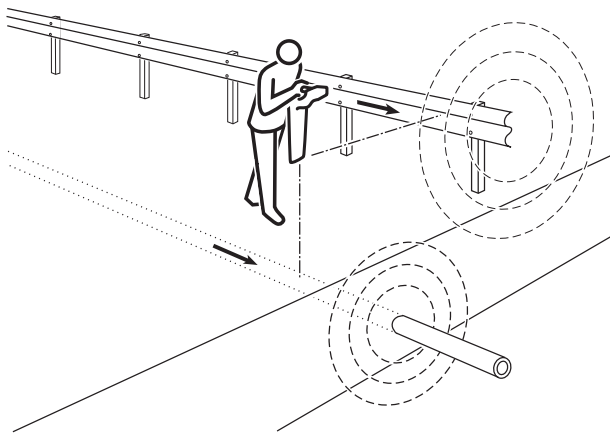
4.2.2.5 Splices

Most cable splices or joints will show up as a blip in the Receiver response. Local knowledge and experience will help the user know if the blip indicates a splice box.

4.2.2.6 Tracing Along a Highway

If the cable is buried close to a metal crash barrier, the signal may couple to it. This makes tracing difficult because of the proximity of the barrier to the aerials in the Receiver antenna blade.

The problem can be overcome by raising the Receiver so that the lower aerial in the end of the detection blade is level with the metal barrier.



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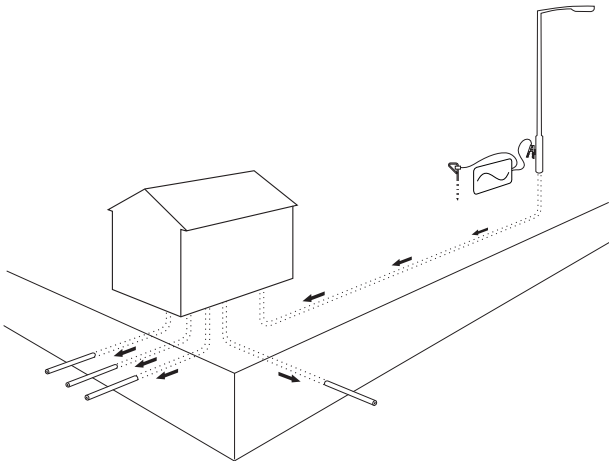
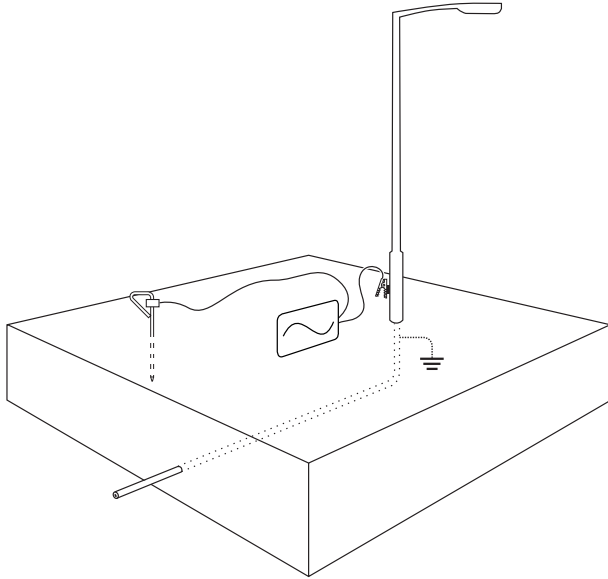
4.2.2.7 Street Lighting

Metal Columns

Connecting to a metal street lamp column is almost as effective as connecting to the cable sheath itself. Normally the cable sheath is bonded to the metal column, therefore a simple connection using the Magnetic Connection Clip on to the column enables the operator to locate the street lighting cable quickly and safely without having to call out the lighting department.

Concrete Columns

Connecting to the metal access cover of a street lamp column will induce a signal on to the cable even if the cover is not earthed. The Transmitter should be set to maximum power output and even then the signal on the line may be weak. The Transmitter frequency used must be 33 or 65 kHz as lower frequencies, in this situation, are less effective. The information gained regarding position and depth of lighting cables (plus feeds to other street furniture on the same system) are the benefits of this exercise. One connection point can energise cables over a considerable area.



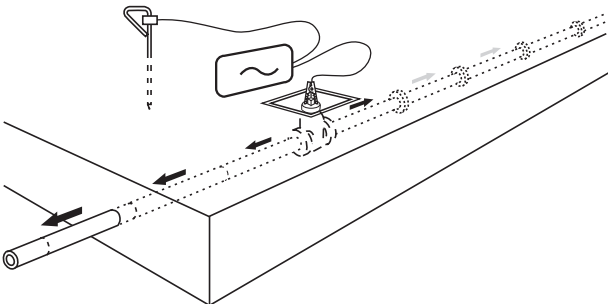
The use of a street light column as a means of applying a signal to other power cables is a possibility. The signal may be fairly weak when using this method because it may have travelled some distance back to the sub station and out again on the other cables. With the Transmitter set to a high sensitivity output it is often possible to locate a cable which would otherwise have been difficult or inconvenient to energise.

Cables running down a wood or concrete pole or lighting column can also be energised by standing the Transmitter at right angles to the ground in its induction mode against the pole.

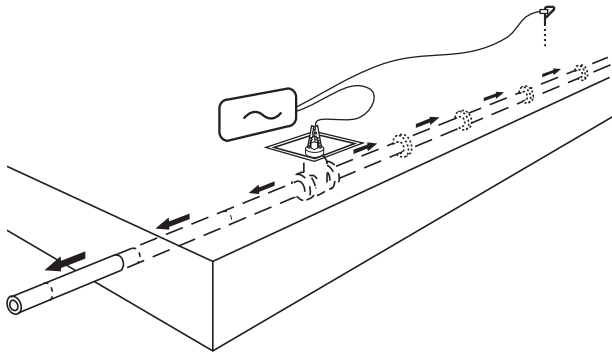
If authorised, and access to the cable is available, use a Signal Clamp (refer to the Procedure in para 4.6) or a Live Cable Connector (refer to the Procedure in para 4.7).

4.3 OVERCOMING PROBLEMS

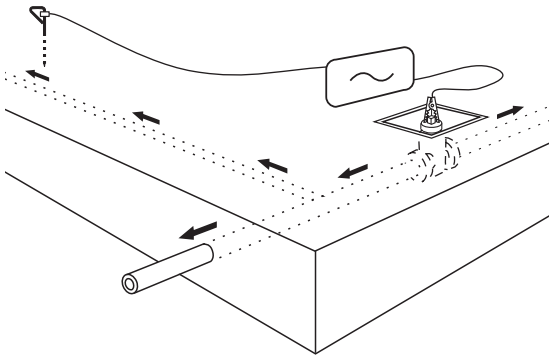
Sometimes when making a single ended connection to a service, the majority of signal travels not along the section to be located, but in the opposite direction. The cause could be the fact that there are different types of joints on the leg to be located than the joints in the opposite direction.



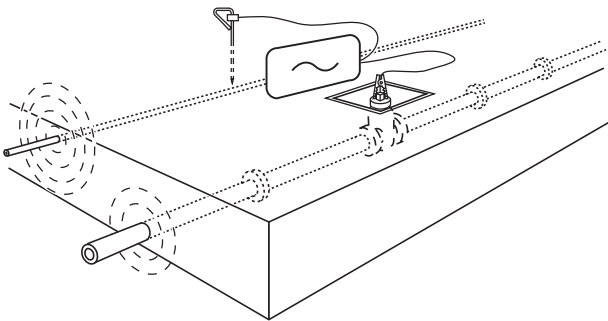
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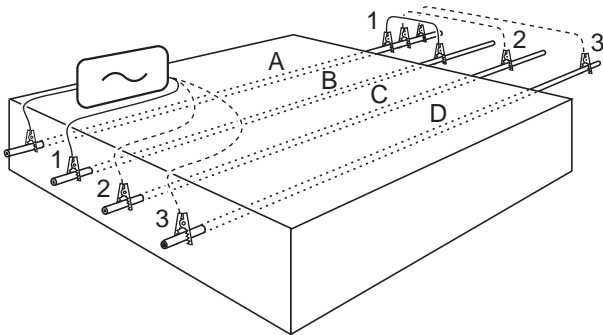
The situation can often be improved by moving the ground return to a position which encourages the signal to flow in the desired direction. This usually means positioning the ground stake in the general direction of the section to be located. Normally this is achieved using the standard ground return cable, but in a more difficult situation it may be necessary to use the optional 200 m extension reel to position the ground stake in the approximate vicinity of the conductor and as far from the Transmitter as possible.



This technique can be used to encourage the signal to take the required path from a tee or junction. The double ended connection would be used in preference when possible.

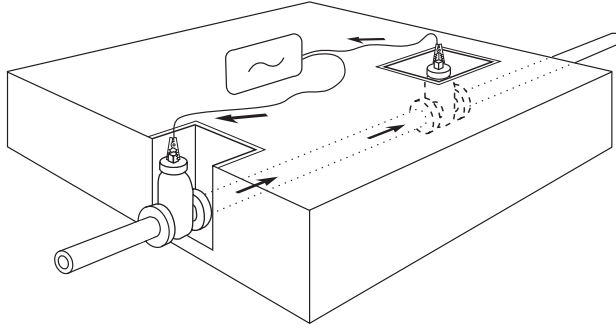


Ground return signals when using the single ended connection can often cause confusion by returning to the Transmitter along other services. The problem sometimes occurs when return signals appear stronger than on the actual target line usually because the target line is deeper than the conductor carrying the return signal and the return path may be a better electrical conductor than the target.



An adjacent parallel line can be used to an advantage, especially for long distance location. By making one Transmitter connection to the target line, the other connection to an adjacent line, and bonding the two lines together at a distant point (effectively a double ended connection), the signal will travel along the target line and return on the adjacent line, giving two definite locations. The use of visual clues plus depth measurements etc., should enable the user to make reasonable identification. Where there are many parallel conductors the task of identification becomes easier because by systematically using other lines as return paths, the location position of the target line will remain constant. By using a process of elimination the target line can be identified.

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4.4 ADDITIONAL TECHNIQUES

There are a number of techniques for applying the Transmitter signal to a target line in addition to those described in this section. Although these techniques may not be needed for general use, they can often be useful for applying a signal successfully to a target line in particular circumstances.

4.4.1 Double Ended Connection

A useful technique for positively tracing and identifying a target line in a situation where there are access points at each end of the line.

Procedure

Connect the Transmitter to an access point on the target line. The Transmitter ground socket is connected via an extension reel to another access point on the line. A complete circuit is achieved without using ground as a current return path.

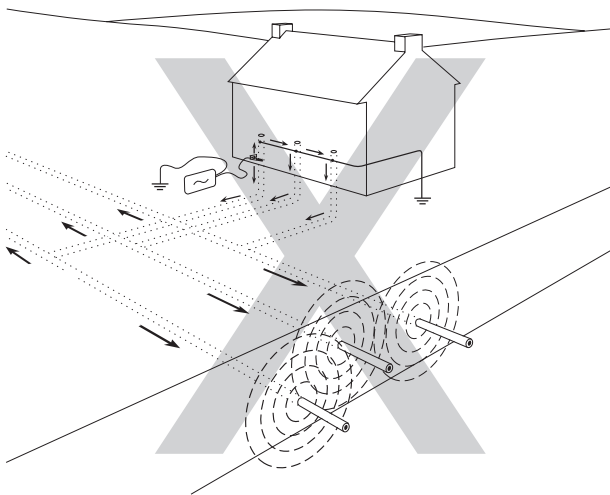
Note: The extension reel should be kept as far away as possible from the expected route of the line.

This method of applying the Transmitter signal is ideal for positive identification of a target line. When a connection has been made to two points on the same line, the same level of current should be detectable all round the circuit. The Receiver meter indication should therefore be constant if the depth of the line does not change.

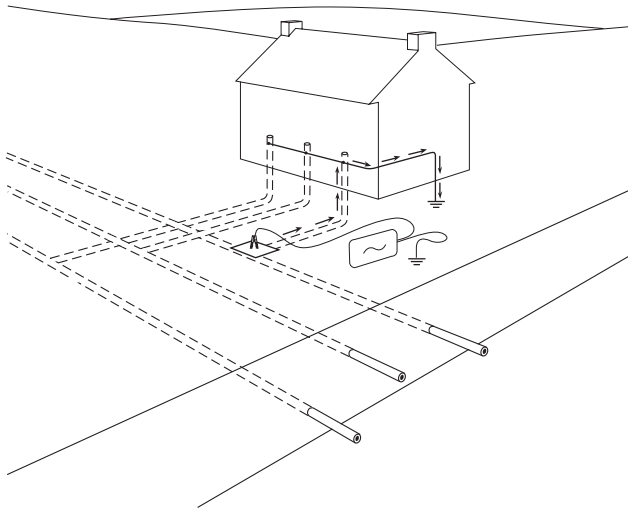
4.4.2 Unwanted Signal Coupling

Unwanted coupling of an active tracing signal to another line is one of the most common location problems. It leads either to an error in the marked position and depth of a target line or to marking the wrong line. A certain degree of coupling is unavoidable in many situations but there are ways in which a careful user can reduce coupling and increase location reliability.

Two situations can cause unwanted signal coupling:



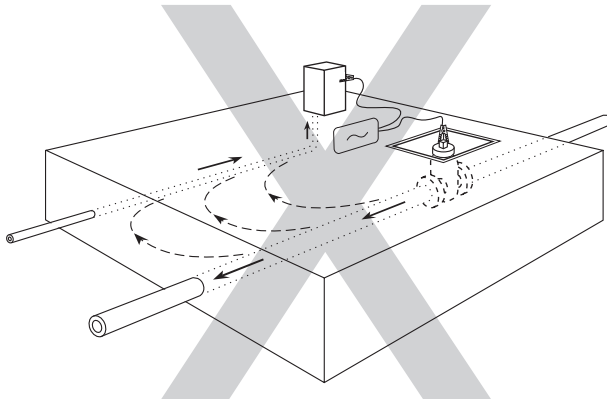
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- (a) Applying the signal to more than one line. Do not use induction. Use the Signal Clamp where possible.

Identify the points where different lines may be bonded or in close proximity. Work towards these points rather than away from them. For example if metallic gas and water services are bonded within a building, and it is required to trace the incoming lines, apply the signal at the stop taps or valves in the road rather than the building.

Reduce coupling to a parallel line by using a low frequency (Lf) signal if possible.



- (b) Return signal flowing on another line. Use a double ended connection to by-pass the ground if possible.

Choose a signal application point where the line is furthest from other lines; not a congested area.

When using a single ended connection, site the ground stake as far as possible from the target line and away from other buried lines.

Avoid using existing structures for ground connection if other buried lines could be bonded to them.

A bad ground or just laying the ground cable on the road surface at right angles to line may give less coupling than a good ground if long distance tracing is not required.

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4.4.3 Applying a Maximum Tracing Distance Signal

Several factors influence the distance that a line can be traced. The aim of any signal on the line is to get off the line and return to the Transmitter ground. This results in the familiar gradual decay of the signal strength with increasing distance from the Transmitter. It is therefore necessary to apply the strongest possible signal in the most effective manner.

A double ended connection (para 4.4.1), is a very effective way of applying a signal because the ground is effectively bypassed.

Another advantage of a double ended connection is that the signal is being applied to a short circuit so that the Transmitter output is at maximum.

Sometimes an effective double ended connection can be achieved over very long distances by applying the two Transmitter clips to converging lines. If two lines, water and gas for example, both follow roughly parallel paths to a distant building where it is known they will have a common bond.

A connection to both lines, if effectively double ended, should ensure a strong signal over a great distance. Caution must be taken when tracing to avoid confusing the two lines.

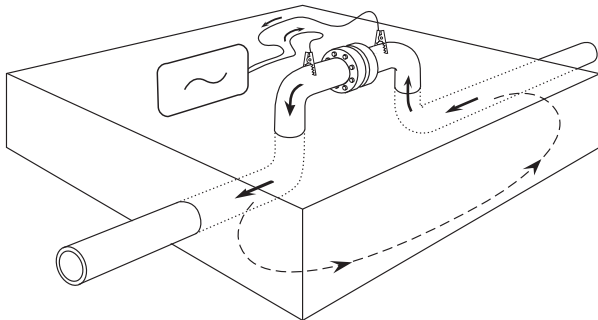
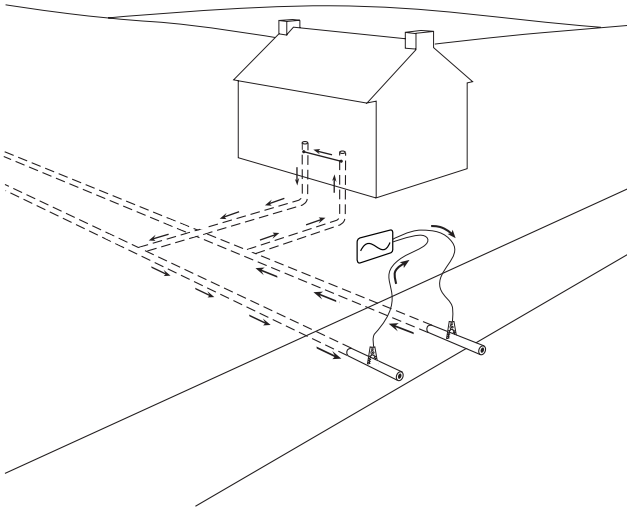
Improving the quality of the ground connection can increase the applied current and therefore the tracing signal. The grounding can be improved by careful positioning of the ground stake in damp soil, by hammering a long copper pipe into the ground or by connecting to an existing metallic earthed structure.

The best possible ground connection in any given situation will be the line itself. The only situation when it can be used is where the line has an insulated section effectively splitting it into two conductors. For example, a long distance pipeline which has an insulating flange; attaching the Transmitter clips to either side of the joint will apply the best possible signal.

This connection technique is essentially the same situation as when a Signal Clamp is placed around a continuous line and may often be more efficient than a conventional single ended connection, provided the signal 'sees' a good quality ground in both directions.

A single ended connection signal will apply a current in both directions on a line if connected to the middle rather than to one end. The signal can be doubled if it is possible to disconnect the line in the unwanted direction.

Induction should be avoided. It is an inefficient signal application technique because most of the Transmitter energy is wasted in the ground.

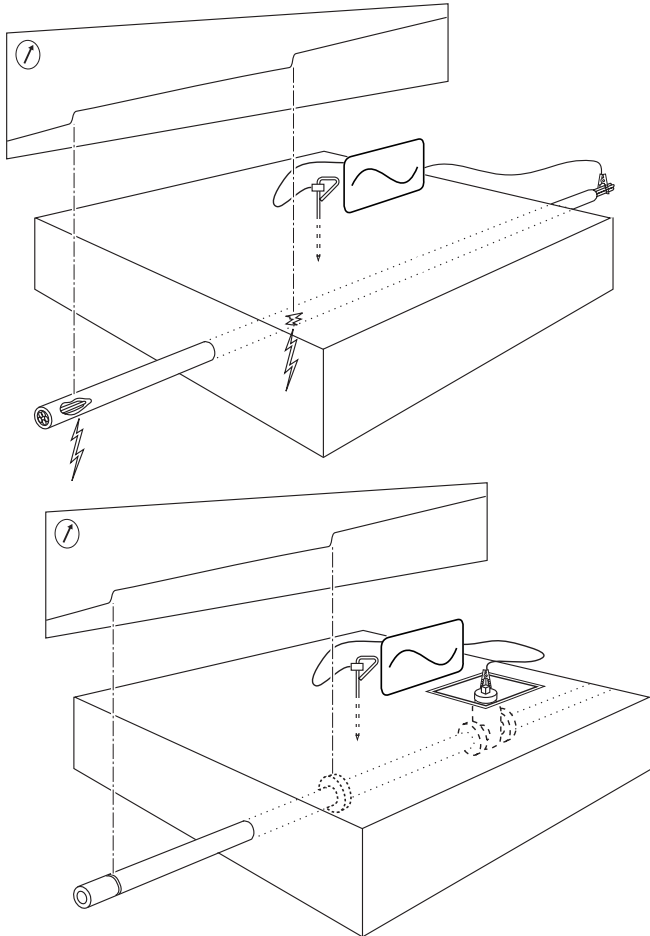


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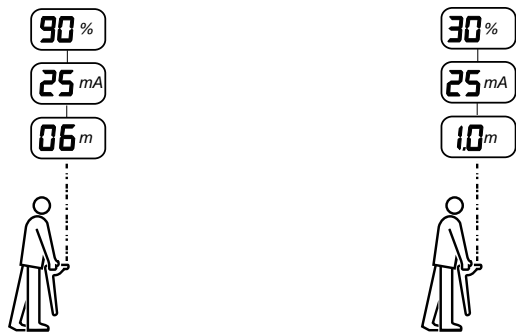
4.4.4 Anomalies on Lines

Some cable ground faults, pipe coating faults and even a circumferential crack in a cast iron pumping main can be detected with the Receiver.

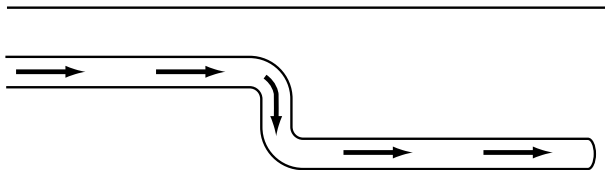
Apply the Transmitter signal to the target line. Select Peak (if Peak/Null option available) and adjust the Receiver sensitivity to give a near maximum signal strength indication when over the line. Trace the length of the line with the Receiver. Do not adjust the sensitivity any further and note the position of any sharp fall in response.



Closely monitor the depth to ensure the fall in signal response is not due to a change in depth.



Digital receivers with the Current Measurement feature will automatically compensate for the change in depth.



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4.5 CABLE IDENTIFICATION

The Receiver can be used to assist identifying a target cable at distant access points.

Apply the Transmitter signal with the Signal Clamp. Check if there are bonds between the cable and other cables or services and remove the bonds if possible.

Alternatively, qualified personnel can use the Live Cable Connector to apply a very selective Transmitter signal to a low voltage cable core.

Trace the cable following the instructions in para 4.2.1. Ensure that the cable being traced has the strongest signal. Trace the cable to the access point at which the cable identity has been established.

Connect the Clamp Antenna to the Receiver Accessory Socket and place the Clamp on each cable in turn, noting the response. Compare the strength of responses from each cable. The cable with the substantially strongest response will be the cable to which the Transmitter signal has been applied.

It may not be possible to place the Clamp Antenna around the cables because of congestion or because of inaccessibility. The large or small Stethoscope Antenna should be used in the place of the Clamp Antenna. Press the concave detector head against each cable and note the individual responses.

To check correct cable identification, reverse the position of the Transmitter and Receiver and repeat the identification routine.

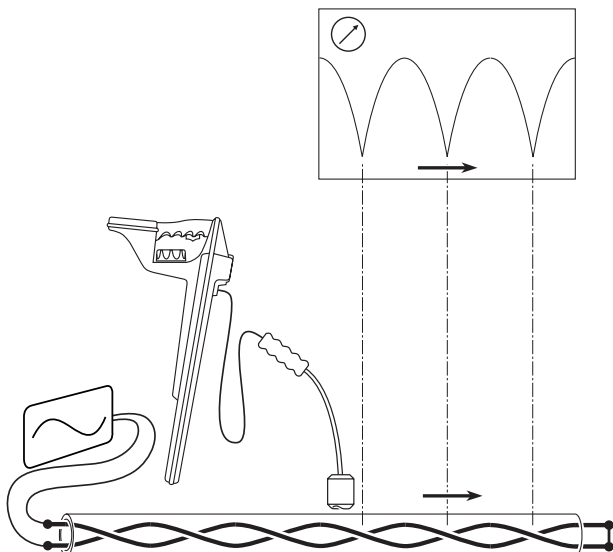
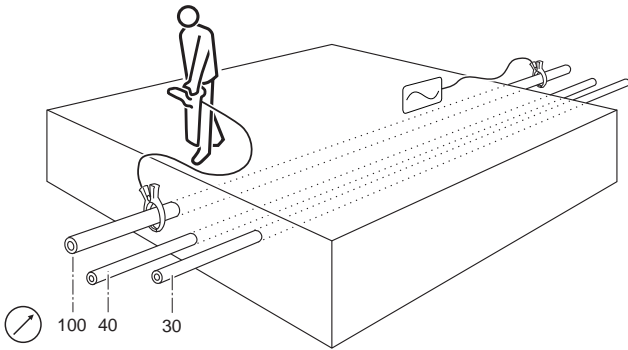
An alternative and superior method of identification uses the effect of cable twist to provide a precise 'signature'. This method should only be used by personnel licensed to work on live cables.

This technique cannot be used on live cables since it is necessary to arrange a short circuit at the far end.

Always use the Live Cable Connector to energise power cables, even when they are supposed to be isolated.

The twisted cores cause a 'corkscrew' signal. A Stethoscope Antenna when moved along the cable detects this distinctive rise and fall signal.

Other adjacent cables will not show the same effect and this is a positive method of cable identification.

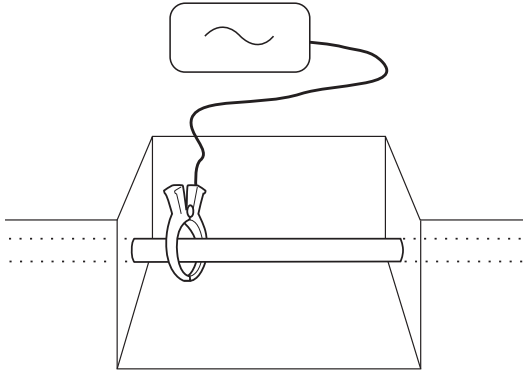


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4.6 CLAMPS

Radiodetection supply a range of signal clamps as optional accessories to apply the Transmitter signal to a cable or pipe. The standard 10 cm (4 in.) signal clamp is suitable for most applications. The 5 cm (2 in.) signal clamp is for use where access is restricted.

The signal clamp safely applies a signal to a live cable without interrupting the supply. It applies a very discriminating signal to a target line with reduced coupling.



Warning

To avoid the risk of electric shock, the signal clamp must be connected to the Transmitter before being placed around the pipe or cable.

Note: A signal applied with a signal clamp may not travel as far as a direct connected signal.

Procedure

Plug the signal clamp into the Transmitter output socket.

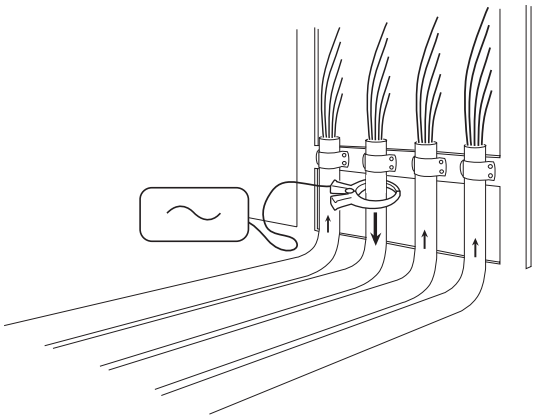
Place the signal clamp around the pipe or cable, making sure the jaws are closed. Switch on the Transmitter.

A disconnected pipe or cable cannot generally be located using a signal clamp.

The signal clamp may buzz or vibrate if around a power cable with significant net current flow. This is normal and will not harm the equipment. Do not touch the exposed pins of the plug when the clamp is around a power cable.

Using the signal clamp, the target line must carry the strongest signal - the other lines will carry the weaker return signal.

Note: If the system comprises only two pipes/cables they may carry equal signals.



4.7 LIVE CABLE CONNECTOR

The live cable connector is an optional accessory used to apply the Transmitter signal to a live cable.

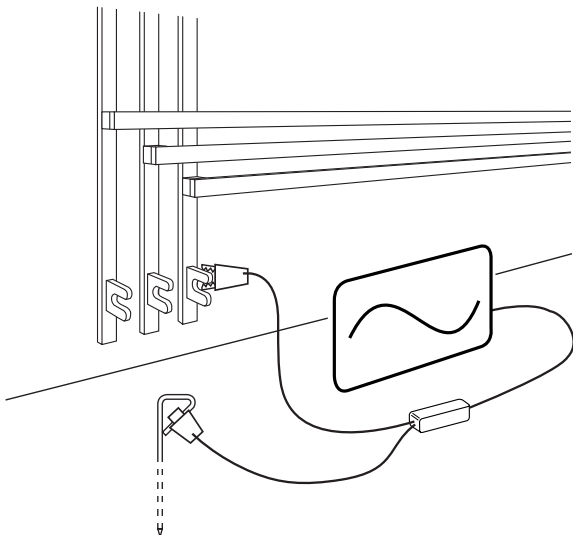
Warning

For use only by personnel licensed or permitted to work on live cables. Low voltage systems only.

Procedure

The live cable connector is plugged into the Transmitter. The red clip is connected to the live conductor and the black clip connected to neutral or ground as appropriate. The Transmitter changes tone when a satisfactory connection has been made.

Note: Do not connect the Transmitter to live cables without using either a Live Plug Connector or Live Cable Connector.



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For positive cable tracing and identification inside buildings, connect the red clip to terminal box connection. Remove the fuse if permitted by your Company procedure. Connect the black clip to an independent ground stake outside.

For street lighting cable tracing, connect the red clip to the incoming live cable. Connect the black clip to the lighting column if metal or to an independent ground stake.

The live cable connector can be used in a similar way to apply a signal directly to cables through live LV isolators, fuse boxes etc. on industrial sites.

The Transmitter and the user are protected against voltages of 500 V ac rms up to 60 Hz.

4.8 LIVE PLUG CONNECTOR

The live plug connector is an optional accessory used to apply the Transmitter signal to a live domestic power socket and, via the domestic wiring system, onto the service cable and supply cable in the street. The signal should be detectable on the supply system to a few hundred paces each side of the point of application. Use of this connector may cause an earth leakage circuit breaker to trip.

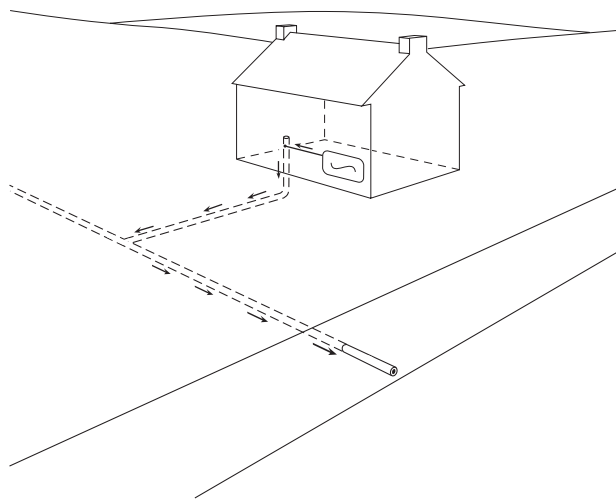
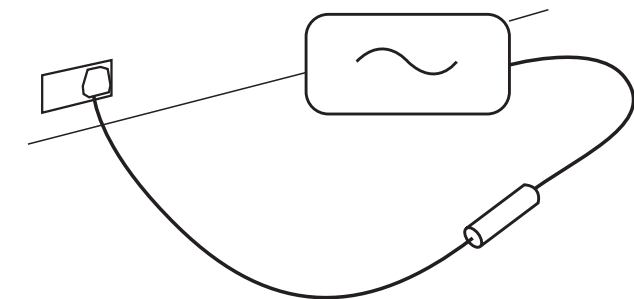


Warning
Do not connect the Transmitter to live cables without using either a Live Plug Connector or Live Cable Connector.

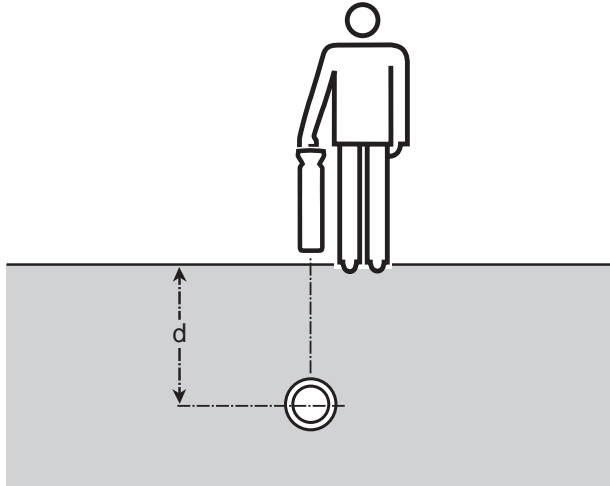
Procedure

Connect the Live Plug Connector to the Transmitter and to the live domestic power socket. Switch on the socket.

Note: The Live Plug Connector contains a protection unit to protect the user and the Transmitter from mains voltage up to 250 V.



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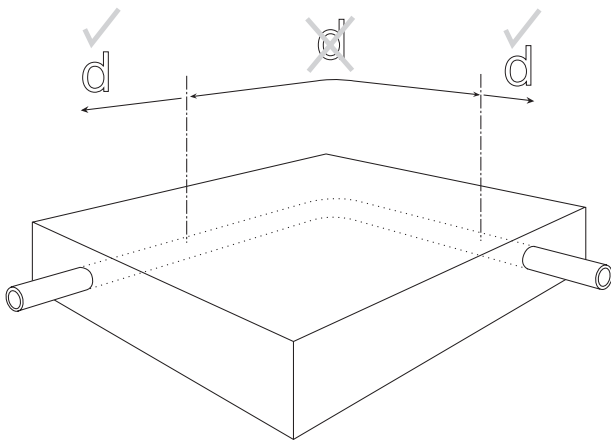


5 HOW TO MEASURE DEPTH

Push-button depth measurement to a line is possible down to depths of 4.6 m (15 ft) when the line has been energised with the Transmitter signal. Triangulation may be used for greater depths or to check the push-button method.

Measuring depth with the Receiver in the Power or Radio modes is not reliable.

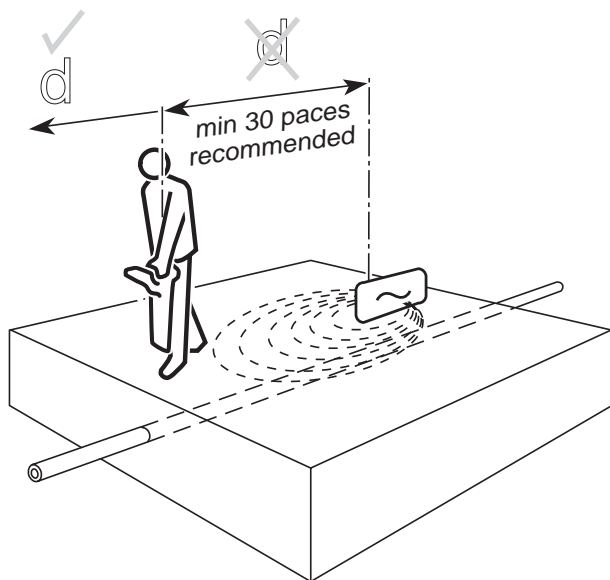
Measurement is to the centre of the pipe or cable. Depth of cover is therefore less than the reading, more so on large diameter pipes.



5.1 PRECAUTIONS

Do not make depth measurements near bends or tees in the line. Move at least five paces from a bend for best accuracy.

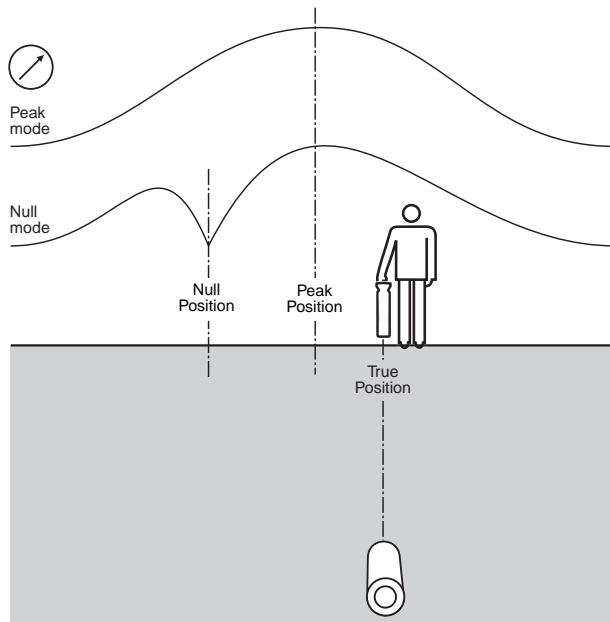
Depth measurement will not be accurate if there is severe interference or if part of the Transmitter signal has coupled to a nearby line.



Avoid applying the signal by induction. If there is no choice, the Transmitter should be at least 30 paces from the point of any depth measurement.

If the Transmitter signal is transferring to nearby lines, apply the signal with a double ended connection to the line.

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5.2 PROCEDURE FOR MEASURING DEPTH

Pinpoint the target line accurately with the Receiver.

Switch precision receivers to Peak mode.

If using a precision locator, first pinpoint using both Peak and Null. There is interference if the two positions do not correspond. Re-apply the Transmitter signal to eliminate the unwanted signal and try again. Alternatively, make the depth measurement at a point where the two signals correspond.

Check the Receiver is directly over the line with the blade at right angles to it and vertical. Adjust the sensitivity level to bring the meter indication on scale.

If the Receiver is fitted with a moving coil meter ensure the meter indication is in the red band. Press and hold the Depth push-button. After a few seconds, the meter will indicate depth on the Line scale.

If the Receiver is fitted with a liquid crystal display check Receiver is in Line mode. Press the Depth key, the depth will be displayed.

If the ground appears to radiate a strong field, perhaps near a radio station, check depth by holding the bottom of the Receiver blade 5 cm (2 in.) above the ground and deduct this from indicated depth.

5.3 DEPTH MEASUREMENT CONFIRMATION

A suspect or critical depth measurement can be checked by lifting the Receiver 50 cm (20 in.) above the ground and re-measuring. If the depth increases by the same amount it is a good indication that the depth measurement is correct.

Depth measurement should be accurate to 5% if the conditions are suitable. However, the user may not always know if the conditions are suitable so the following techniques should be used to check critical readings:

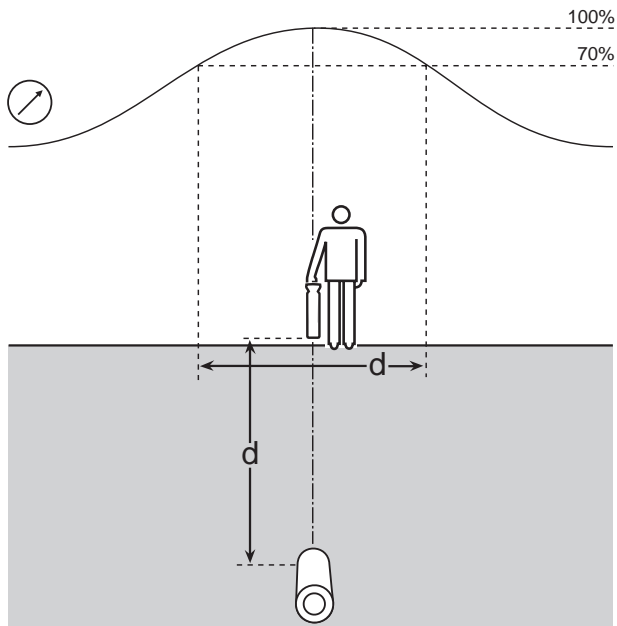
Check that the line's route is straight for at least five paces to either side of the measurement point.

Check that the signal is reasonably constant over the ten paces length and make depth measurements to either side of the original point.

Check that there are no adjacent lines carrying a significant signal within three or four paces of the target line. This is the most common and most serious source of error when depth measuring; a strong signal on an adjacent line can often introduce 50% error.

Make several measurements at points slightly displaced from the line's apparent position. The most shallow indication will be the most accurate and will also indicate the line's position most accurately.

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5.4 HOW TO MEASURE DEPTH USING TRIANGULATION

If there is any doubt about a push-button depth measurement, it should be checked by triangulation. This involves measuring the signal at different points and is an effective check because it is unlikely that a signal will suffer the same distortion in each direction.

When directly over the line set the meter to 100%. Holding the Receiver vertical with the tip of the blade close to the ground, move both left and right until the meter drops to 70%. Mark these points and measure the distance between them.

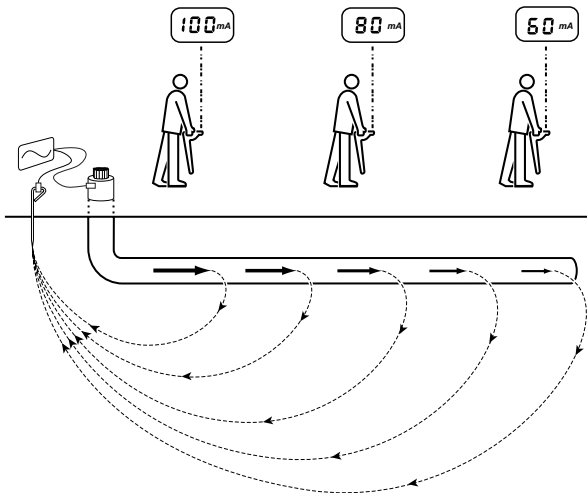
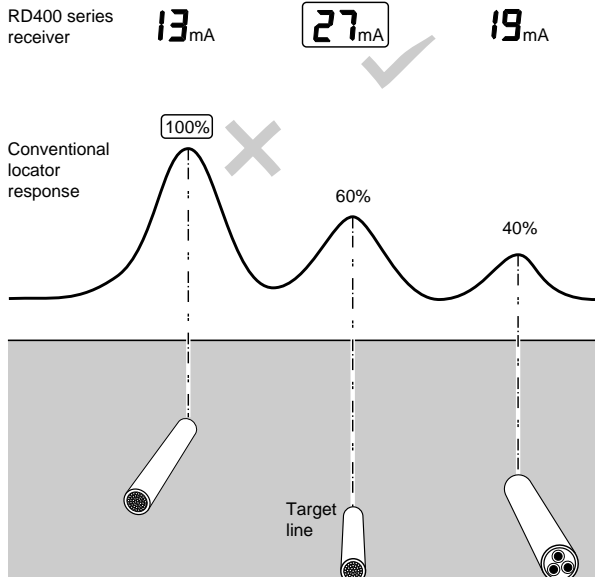
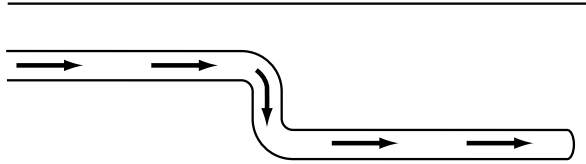
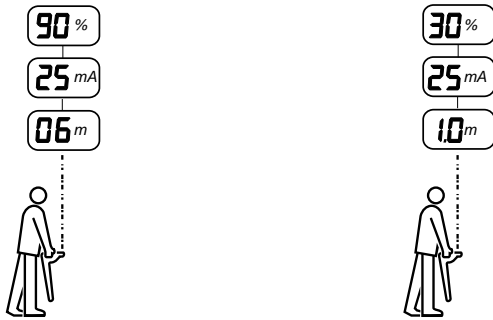
The distance between the two points is equal to the depth and the two points should be symmetrical either side of the line position. Do not use this technique for depths less than 20 cm (8 in.).

Accuracy of depth measurement is assured if all techniques give similar depth measurements.

Do not attempt to measure depth with the 45 degree technique advocated for other types of locator; it is often prone to erroneous readings due to signal distortions.

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6 HOW TO MEASURE CURRENT

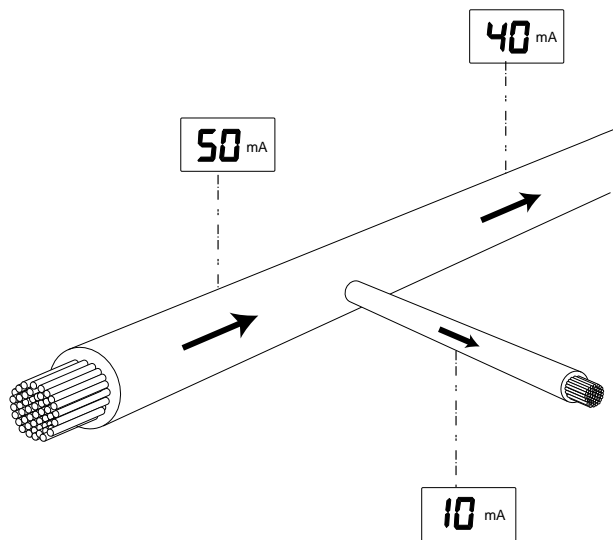
6.1 CURRENT MEASUREMENT

Current measurement of a target line provides additional information which is not available using standard techniques.

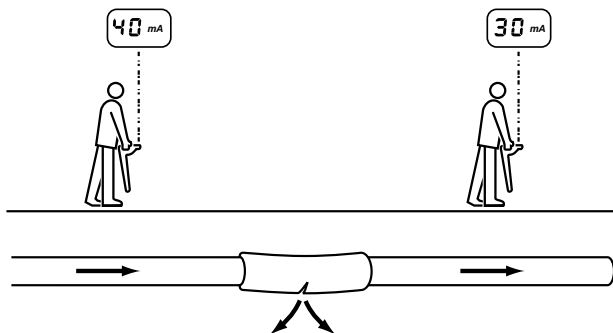
Measuring the applied signal current on a target line helps to confirm the identity of the line. In congested areas a locator often detects a strong signal from an adjacent line because the signal has coupled to it and it is nearer the surface. It is not possible to positively identify a target line unless the current is measured and compared with other lines radiating the signal. The line with the highest current measurement will normally be the target line to which the Transmitter signal has been applied.

The Transmitter applies a signal or current onto a target line and this current reduces in strength as the distance from the Transmitter increases. This rate of reduction or attenuation depends on the type of line and on soil conditions. Regardless of the type of line, the rate of attenuation should be regular with no sudden drops or changes. Any sudden or abrupt current drop indicates a change in the line or its condition.

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Measuring current provides useful information about the position of the tees. Measuring current after a tee will indicate which line is carrying the larger current.



Measuring current before and after a cable joint or splice indicates its integrity or if there is a leak to ground or an open fault.

6.1.1 Locating Faults in Cable Insulation or Pipeline Coating

A sharp drop in response while tracing a line indicates the presence of some anomaly. Measure current a few paces before the response change and a few paces after the change. No loss of current indicates that the response has changed due to a change in depth.

If there is a drop in current, check for a tee by sweeping with the locator in an arc four or five paces from the point of current drop.

If there is no tee and the depth of the line is constant, the fall in response indicates some anomaly on the line such as a coating defect, insulation failure or contact with another line. The user's experience will indicate if it is worth digging to investigate the reason for the current loss.

The current measurement capability of the locator can be used to monitor the state of the coating or insulation of a length of line. Readings taken along a line at regular time intervals will indicate if the condition of the coating or insulation has degraded.

6.2 ACCURACY OF CURRENT MEASUREMENT

In ideal conditions current measurements should be accurate to within 5% on lines buried at depths down to 1 m (3 ft) and 10% at greater depths. Changes in current readings of less than these tolerances should not be regarded as relevant.

Greater errors will occur on sites with high interference, stray currents and coupling to nearby lines.

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Adverse conditions that would normally affect accuracy of depth measurement will also affect accuracy of a current measurement. Make a precision pinpoint before attempting current measurement. Only make the measurement if the position of the responses from the peak and null modes correspond. Observe the precautions that are necessary for making an accurate depth measurement.

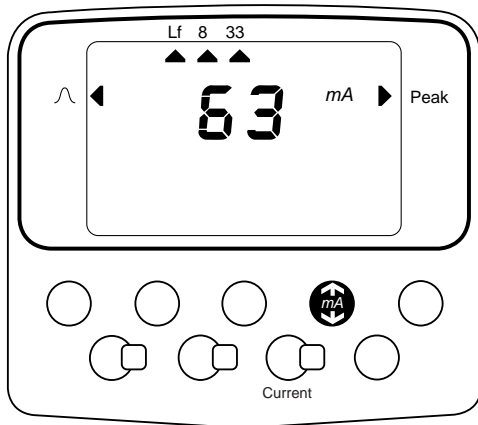
6.3 PROCEDURE FOR MEASURING CURRENT

The method of Transmitter signal application can be induction, direct connection or by clamp, in the same way as applying the signal for line tracing.

First pinpoint the line and confirm the accuracy of the peak pinpoint with a null pinpoint.

Check the Receiver is directly over the line with the blade at right angles to it and vertical. Adjust the sensitivity level to bring the meter indication on scale. Ensure the Receiver is in Line mode. Press the Current key. The LCD will display the current value in mA. Pressing the Current key again will return the display to indicating signal strength.

If the Transmitter signal is coupled to a nearby line, it may distort the accuracy of the measurement. If the reading is suspect sweep the area to check if other nearby lines are radiating a signal. If their signals cause interference it may be necessary to make the current measurement at another point along the line.



6.4 MONITORING AND INVESTIGATING PIPELINE COATING CONDITION

The corrosion engineer needs as much information as possible about the condition of the pipeline coating.

The technique for monitoring the condition of pipeline coating and locating coating defects or contacts is a current gradient survey.

The current gradient survey results should be used in conjunction with any cathodic protection potential survey information to confirm the severity of any coating defects. The cathodic protection potential survey results may be obtained from the periodical potential surveys or a full close interval potential survey (CIPS).

Active corrosion on the pipeline corresponds to a low resistance fault and consequent high current loss; the greater the amount of corrosion and electromechanical reaction the greater the loss of current. The current gradient system therefore gives a direct indication of the comparative importance of coating defects or contacts on a pipeline.

A current gradient survey indicates current loss over a particular section. A ground potential survey indicates voltage loss only at the point where it occurs.

A 50 km (30 mls) length of pipe can generally be surveyed by one man in one day using the current gradient technique. No further survey work may be needed if it is found that there is no serious loss of current.

The current gradient system takes readings at intervals and indicates that there is a loss of current between two points A and B. A and B may be 50 m (or yards) apart or up to 5 km (3 mls) apart.

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The current gradient system can be used to draw a profile of current loss for a complete pipeline from readings taken at points of around 3 or 4 km (2 or 2.5 mls) apart. Readings taken at intervals of one year, for example, will indicate any increase in the deterioration of the coating.

Current gradient readings may be taken through all types of soil or on all types of surfaces such as roads or crushed rock. Readings can even be taken from a boat on a river or shallow lake.

A useful feature of a current gradient survey is that during survey work the data from a reading may be evaluated against information obtained from a previous survey. If required intermediate or additional readings may be made before resuming the survey.

Making a current gradient survey along a pipeline indicates if any sections, and if so which, need more detailed investigation. This may be done by making a more detailed current gradient survey along the suspected length of pipeline

A Receiver measuring signal in decibels is required for conducting a current gradient survey. Current readings (mA) can be converted to decibels if the Receiver does not include a feature to provide decibel readings $dB=20 \log_{10} mA$.

Apply the signal to the pipeline with a direct connection to an insulating joint lead and use the far side of the insulating joint for the ground connection. Alternatively connect to a CP test point with a good remote ground connection.

Pinpoint the position of the pipe and take a decibel reading.

Proceed to the next convenient access point and repeat the pinpoint and decibel reading.

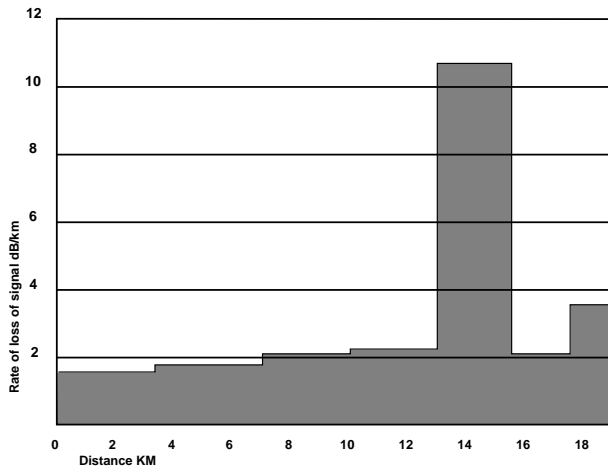
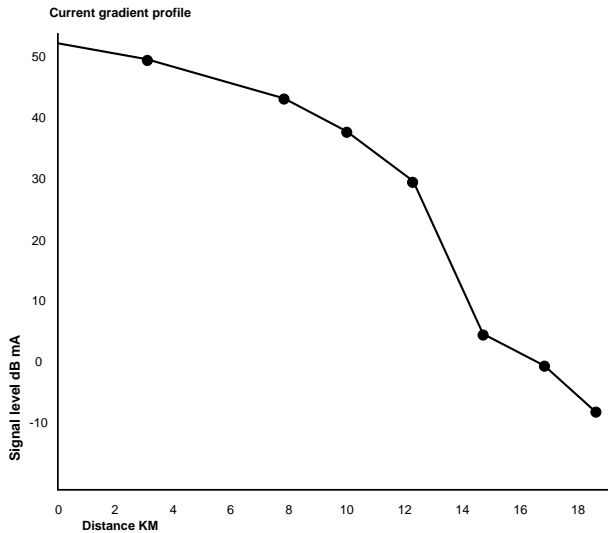
Continue taking readings at convenient access points to the pipeline. The example shows readings taken at 3, 7, 10 etc. kilometres from the Transmitter application.

Record the distance and the dB reading manually or in a data logger.

Draw a profile of the pipeline current gradient.

It may be useful to make a second graph to highlight sections with a high rate of current loss.

A more detailed current gradient survey can be made over suspect lengths of line by taking current measurements at convenient intervals, 100 paces, for example. The fault can then be located by repeating the current measurements at 1 m/yd intervals within a suspect 100 paces.



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7 HOW TO USE CURRENT DIRECTION (CD)

The importance of safeguarding critical pipes and cables is generally recognised. Location of these buried lines has ceased to be a problem other than in the most congested areas, but the identity of the line has often been mistaken particularly if other lines run adjacent to the target line.

CD is a feature that helps resolve the problem of providing the user with a positive means of cable or pipe identification.

The CD feature on the Receiver indicates the direction of current flow on a long line. Identity of the target line is established if the Receiver indicates that the current is flowing forward and away from the point of application of the Transmitter signal.

Signal that has coupled onto adjacent lines has found a return path back to the point of the original signal application and this is indicated by the Receiver display arrow pointing backwards toward the Transmitter. The forward arrow indicates the target line. The backward arrow indicates other nearby lines to which the signal has coupled.

If the CD signal is required to travel over very long distances it may be necessary to prevent the signal applied by the Transmitter being lost through known grounding points by fitting gas discharge tubes to supply low voltage isolation.

Procedure

The CD signal is applied using a Transmitter with the CD feature. The signal must be applied by a CD clamp or direct connection to the target line; not by induction.

The signal can also be applied by a Radiodetection Line Management System (LMS) Transmitter permanently installed, and connected to the line, at an access point.

It is necessary to reset the Receiver with a CD reference, before using the CD feature, to define Current Direction. After applying the Transmitter signal, trace the target cable for about 15 paces away from the Transmitter.

Referring to the appropriate Receiver User Guide and facing away from the Transmitter, select CD then carry out a CD Reset. During Reset 'rSt' will be displayed followed by a forward CD arrow.

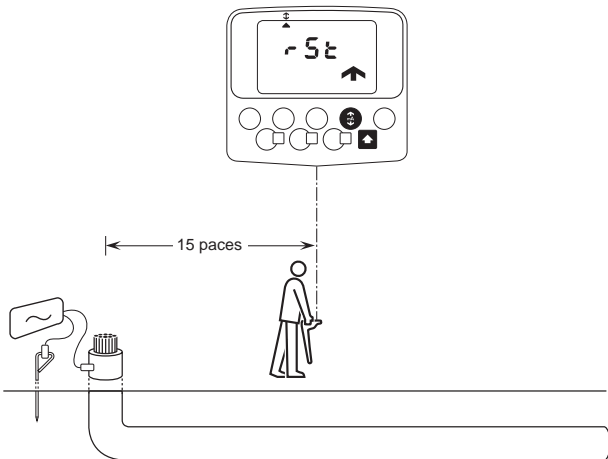
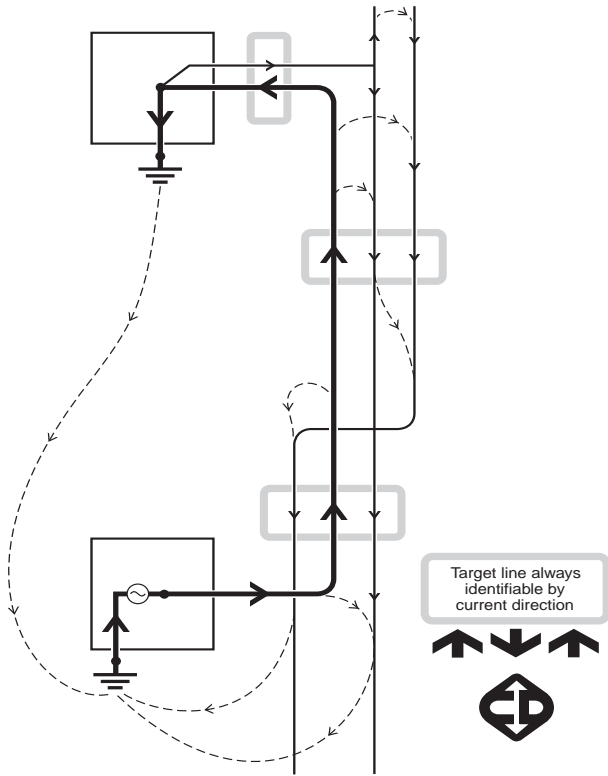
Carry out a CD Reset each time the Transmitter is switched off or if the Transmitter signal is disconnected then reconnected. It should not be necessary to reset the Receiver if it is used on the same line with an uninterrupted Transmitter signal.

If the Transmitter is distant, the reset procedure can be carried out next to a joint or splice box where the identity of the target line is certain.

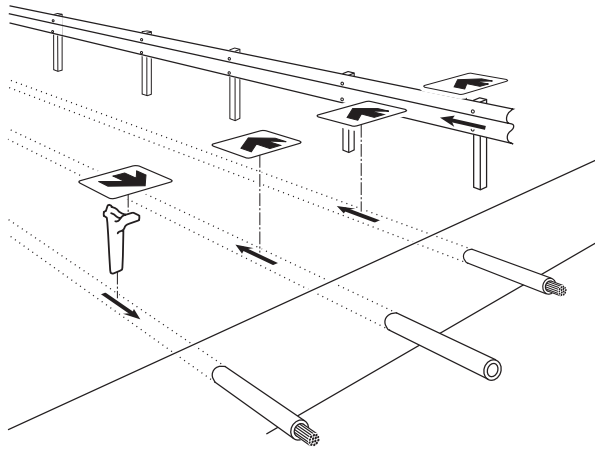
It may be difficult to determine the direction of a line for resetting the Receiver (whether the Transmitter is ahead or behind) when locating midway along a long line.

If this occurs, find a nearby conductor with a visible identity to which the signal has coupled. A railway line, a continuous metal fence or highway crash barrier are suitable.

Carry out a CD locate on the visible line. The arrow will point back towards the Transmitter.



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Pinpoint the target line. Check that the Receiver is directly over the line with the blade at right angles to it and vertical. Adjust the Receiver sensitivity level to bring meter indication on scale. Ensure the Receiver is in Line mode. Select CD and 'cd' will be displayed followed by a forward/backward arrow. The target line will be indicated by the CD arrow pointing away from the Transmitter's application of the signal.

If a nearby line also radiates the Transmitter signal, pinpoint it, then select CD to establish the current direction. If the arrow points towards the Transmitter the signal has coupled to it from the target line.

The combination of finding the line carrying the strongest signal current and confirming that there is a forward direction current flow with a forward pointing arrow will establish the identity of a target line.

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8 HOW TO FAULT FIND WITH AN A-FRAME

The A-Frame sheath fault finder is a simple tool for locating faults up to 2 Megohms on power and telecom cables.

The Accessory A-Frame is an antenna that connects to the Receiver, and the RD400FFL is an A-Frame fitted with its own signal processing unit and display.

A characterised signal is required and the signal Transmitter has to include a feature to provide a suitable signal for the A-Frame.

The A-Frame locates sheath faults on direct buried cables in permanent contact with the soil. It will not detect faults on lead covered cables.

Procedure

Locate and trace the suspect length of cable using an ordinary locator. Mark the route of the cable every two or three paces.

Always possible disconnect the ground bonds at each end of the suspect cable. The cable is then isolated leaving the fault as the only route to ground for the signal.

Direct connect the Transmitter signal to the cable sheath with a remote ground point.

Follow the cable route pushing the A-Frame spikes into the ground every two or three paces. The display will either indicate a forward arrow, or it will fluctuate.

A fluctuating display indicates that the A-Frame is not within range of the fault. Continue following the cable route spiking the ground every two or three paces until the display shows a positive backward or forward indication.

The A-Frame is now within range of the fault. Move the A-Frame in the direction indicated keeping it in line with the cable. Push the spikes into the ground every pace until the indication changes direction, indicating that the A-Frame has just passed the fault.

Go back to the point where the indication changes direction, and move small distances along the line to pinpoint the fault.

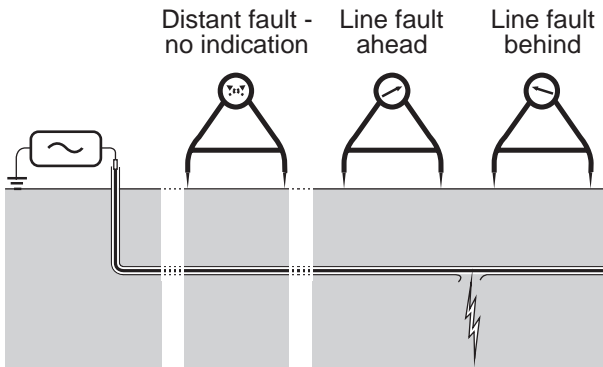
Turn the A-Frame at right angles to the cable direction and move it in the direction indicated by the arrow then repeat the above pinpoint actions.

The A-Frame is now directly over the fault and the cable.

To check the correct location of the fault, push one spike of the A-Frame into the ground directly over the fault. Rotate the other leg of the A-Frame around the grounded spike, pushing the spike into the ground every 90 degrees. The direction indicator should always point towards the leg over the fault.

It should be possible to locate a series of faults along a line depending on the resistance of the faults. However it may be necessary to expose and clean or repair any low resistance fault before continuing to locate other faults.

Continue along the path of the cable pushing in the spikes at intervals of no more than two paces. The indicator will fluctuate as soon as it leaves the area of the first fault and will then point to the next fault as it is approached.



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It is often possible to gauge the relative importance of faults. Repeat the A-Frame search on a path parallel to the cable but two to five paces away. Indication of middle and high resistance faults will be lost as a function of the distance away from the cable.

Check the cable with the A-Frame after the faults have been repaired. It may be possible to locate other faults which were masked by the low resistance faults that have now been repaired.

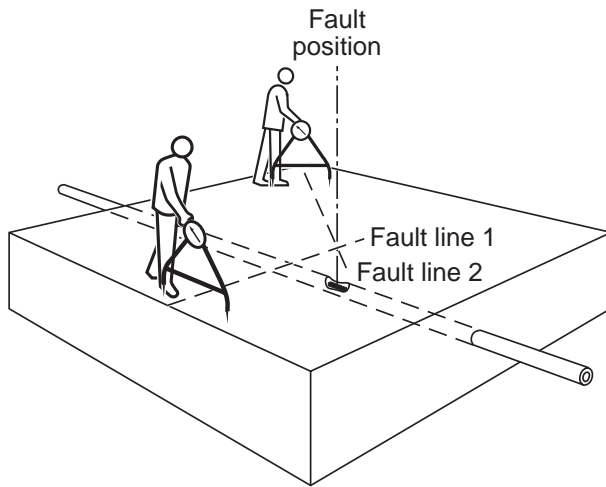
If the cable is buried under paving, concrete or road surface it may be possible to use the A-Frame by pouring water on the surface or securing damp sponges to the A-Frame spikes.

A more practical way is to locate and mark the line which lies under the paving, concrete or road surface, then use the A-Frame in the verge or other soft ground on a path parallel to the cable. The A-Frame fault locate procedure should be followed and all but the highest resistance faults will be located.

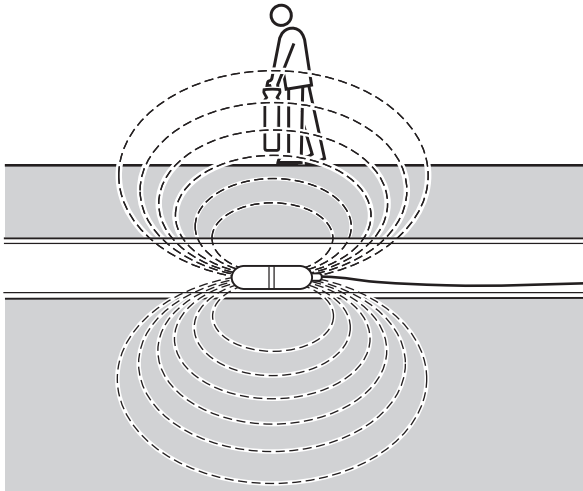
Alternatively, use the A-Frame to take bearings to the fault. Get as close as possible to the fault and then rotate the A-Frame, noting the Receiver meter responses, until the A-Frame is aligned so that a slight further rotation causes the meter to indication to reverse. A line drawn at right angles to, and midway between, the A-Frame spikes will lead directly to the fault.

Repeat at one or two positions and the fault is where the lines intersect.

When cable sheaths of individual cables are bonded together, increased capacitance can cause significant FaultFind signal leakage to ground. This signal leakage can interfere with the actual resistive fault causing 'phantom faults'.



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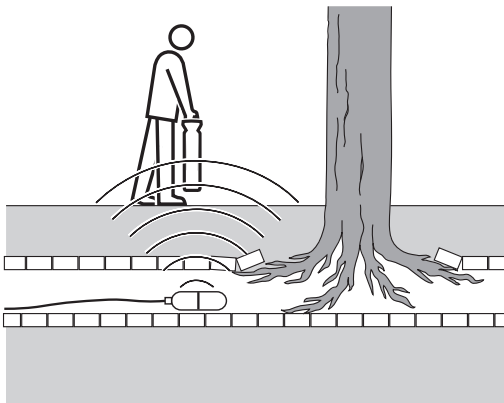
9 HOW TO USE SONDES

A Sonde is a small, waterproof, self-contained transmitter which will radiate a signal that is located by a Receiver.

The sonde can only be located in a non-metallic drain, sewer, pipe or duct. Metal pipes or covers shield the signal and prevent it being detected.

A range of Sondes is available including a 13 mm (0.5 in.) diameter unit with a range of 1.5 m (5 ft) to a unit detectable down to 18 m (60 ft).

In addition to tracing non-metallic pipes and ducts, Sondes can be used to pinpoint joints in iron gas pipes, locate leaks in plastic water pipes and monitor the progress of horizontal boring tools and other no-dig techniques.



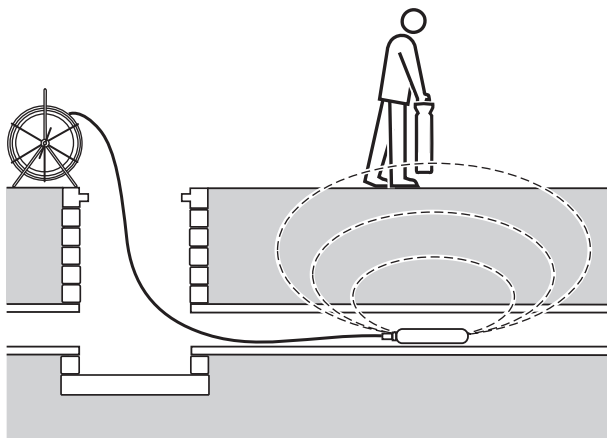
9.1 CHOOSING A SUITABLE SONDE

Check that the Sonde has sufficient range for the application and is dimensionally small enough and sufficiently robust for the application.

Sewer Sondes and Super Sondes are specially designed for tracing drains and sewers. These sondes have a heavy wall thickness to give a long working life in the sewer environment of shock and abrasive surfaces.

Check that the frequency of the Sonde corresponds with the Receiver frequency. The Receiver will not locate the Sonde unless the frequency is the same. Sondes are marked with their transmitting frequency.

Ensure that the means for propelling the Sonde are available together with the correct fitting or couplings.



9.2 PROPELLING THE SONDE

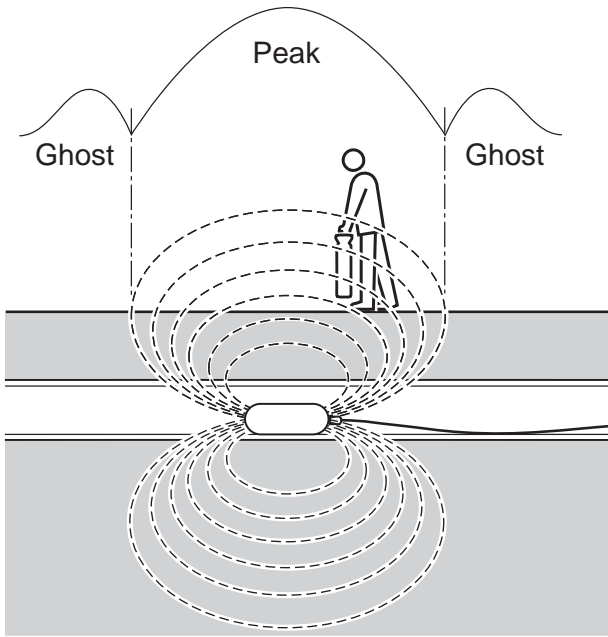
Sondes have a male M10 thread at one end for connecting to drain rods. The Radiodetection Flexrod or other devices are used to insert and propel the Sonde through the drain or duct.

It is advisable to fit the spring coupling between a rod and the Sonde to enable it to negotiate tight corners without damage.

A variety of rod adaptors are available.

Floats are available for fitting to the Sewer Sonde and Super Sonde allowing them to be floated along drains at the end of a tether. Sondes can be strapped to high pressure water jets or similar devices used for cleaning, maintaining or inspecting drains.

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9.3 LOCATING THE SONDE

Insert a new battery in the Sonde. A new battery or a freshly recharged battery should be fitted at the start of each day but preferably at the start of each new job.

Check that the Sonde and the Receiver are the same frequency and working correctly. Position the Sonde at a distance from the Receiver which is equal to the rated depth range.

Point the Receiver at the Sonde with the blade and Sonde in line (not at right angles to each other, as when locating a line) and check that the meter reading exceeds 50% at maximum sensitivity.

Insert the Sonde in the drain access point and locate it with the Receiver while it is still visible.

Hold the Receiver vertically and directly over the Sonde with the blade in line with the Sonde. Adjust the Receiver sensitivity to provide a meter reading of between 60 and 80%.

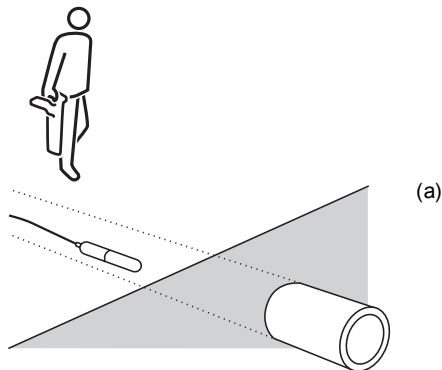
The Sonde radiates a peak field from the centre of its axis with a ghost peak either side.

Move the Receiver a small amount either side of the Sonde and along its axis to detect the ghost signals.

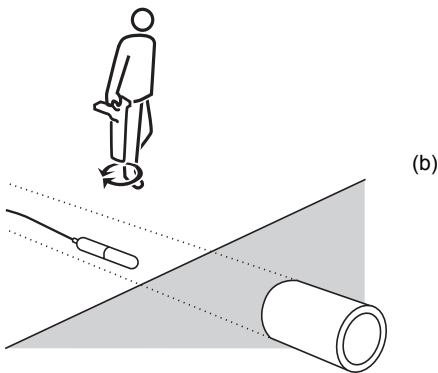
Deliberately look for the two ghost signals as finding them positively confirms the locate. If ghost signals are present, reduce the Receiver sensitivity to lose them but still indicate a clear peak response directly over the Sonde.

Do not adjust the Receiver sensitivity any further. Propel the Sonde three paces along the drain or duct and stop. Place the Receiver over the presumed position of the Sonde and proceed as follows:

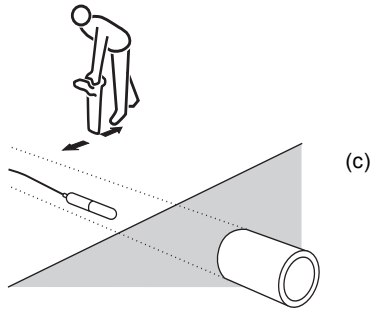
(a) Move the Receiver backwards and with the blade in line with the Sonde and stop when the meter indicates a peak.



(b) Rotate the Receiver blade and stop when the meter indicates a peak.



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- (c) Move the Receiver from side to side until the meter indicates a peak.
- (d) Repeat (a), (b) and (c) above with the blade vertical (check bubble level, if fitted) and resting on the ground. The Receiver blade should then be directly above and in line with the Sonde. Mark the ground with the Sonde position and direction.

Check that the main peak has been pinpointed rather than either of the ghost peaks.

Note: The Sonde provides a peak response when the Receiver blade is in line with it, unlike when locating a line.

Propel the Sonde a further three or four paces along the drain then pinpoint and mark. Repeat this pinpoint procedure at similar intervals along the line of the drain or duct.

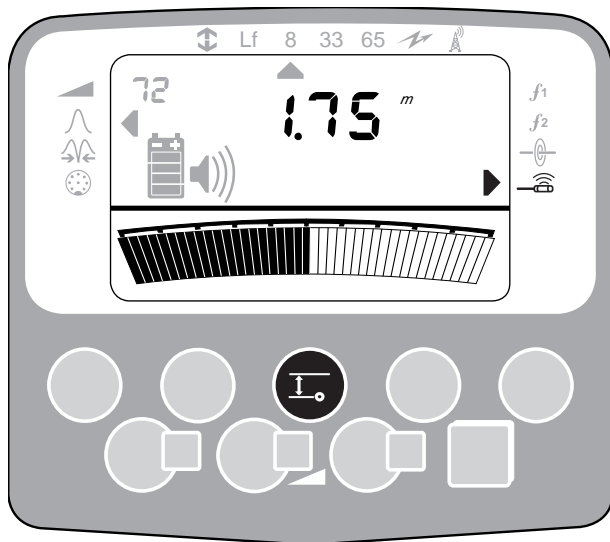
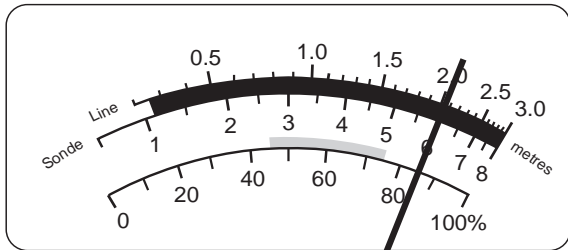
It should not be necessary to increase Receiver sensitivity while tracing the Sonde unless the depth or distance between the Sonde and the Receiver has increased.

The Receiver depth scale is calibrated to measure depth down to 8 m (26 ft). Greater depths can be calculated and the calculation procedure can also be used to confirm the accuracy of the meter reading.

9.4 DEPTH MEASUREMENT

Pinpoint the Sonde following the procedure in para 9.3 (a) to (d). Rest the blade on the ground holding it vertical and in line with the Sonde. Adjust the Receiver sensitivity to bring the indication on scale.

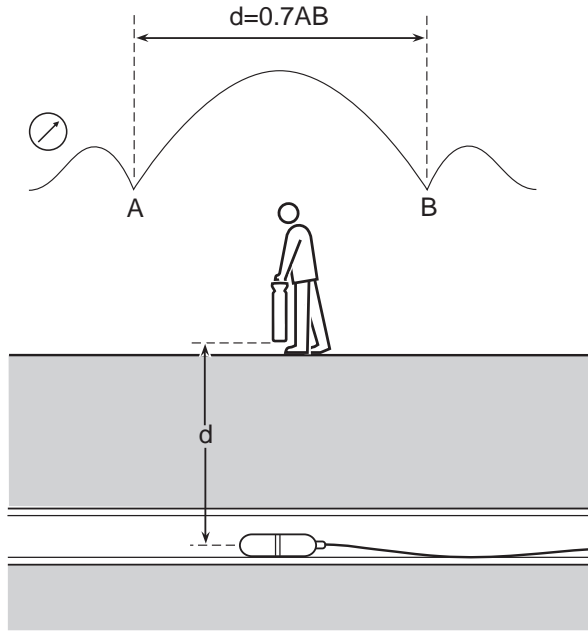
If the Receiver is fitted with a moving coil meter ensure the indication is in the Red Band. Press and hold the Depth push-button. After a few seconds, the meter will indicate depth on the Sonde scale.



If the Receiver is fitted with a liquid crystal display check Receiver is in Sonde mode. Press the Depth key, the depth will be displayed.

Note: The depth measurement is to the Sonde and not the drain or duct. Depth of cover will therefore be less than the depth measurement.

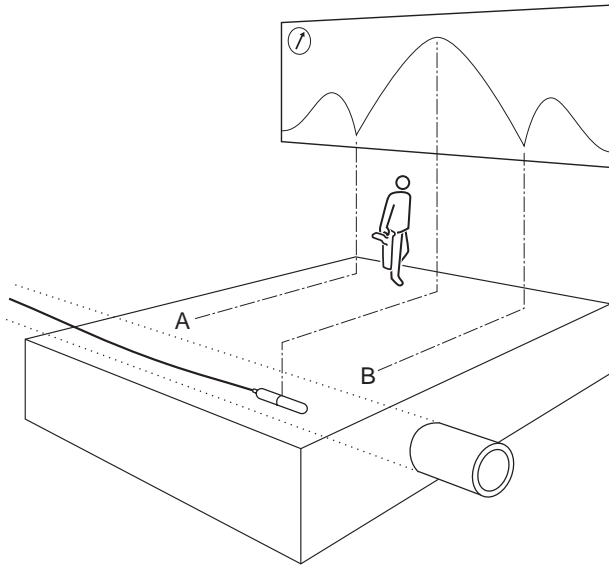
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Depth Calculation

Pinpoint the Sonde. Move the Receiver in front of, and in line with, the Sonde. Increase the sensitivity as necessary to find the peak of the ghost signal.

Move the Receiver behind, and in line with, the Sonde. Find the null positions A and B. Measure the distance between the null positions and multiply by 0.7 to find the approximate depth measurement.

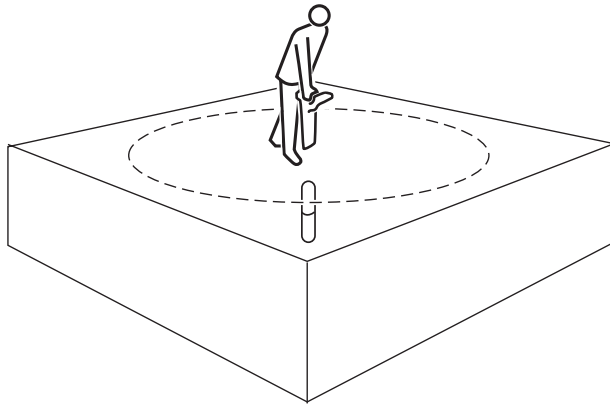
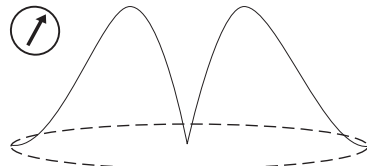
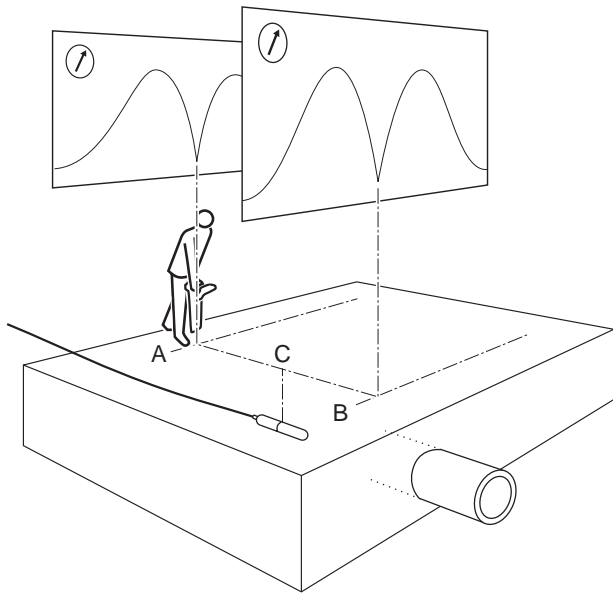


Techniques for Deep Sondes

The side to side movement when locating a Sonde (especially at greater depth) requires a clear area to move the Receiver. Sometimes when locating is carried out parallel to the side of a steep hill or close to a building wall, the side to side movement is restricted. This can be overcome by using the null points between the main and ghost peaks of the Sonde signal.

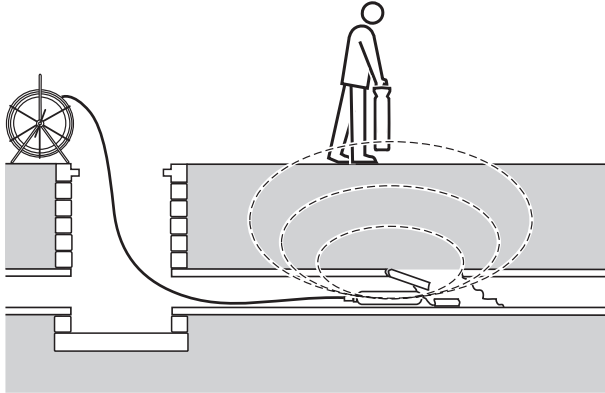
With the Receiver blade at right angles to the Sonde at these null points, another null can be found and by projecting a line through these points, the Sonde can be pinpointed accurately. Accurate depth measurement depends on good Sonde location.

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Another method in walk through sewers and culverts is to position the Sonde vertically. The Receiver on the surface will pick up a pool of signal with a null point in the centre. This is a very accurate method, but depends on the Sonde being absolutely vertical.

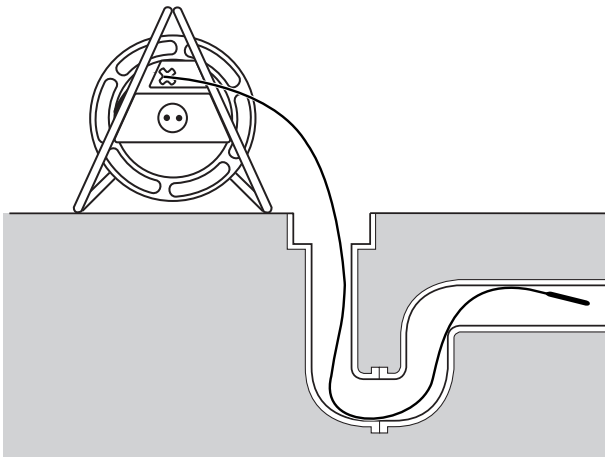
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9.5 PINPOINTING A DRAIN BLOCKAGE OR COLLAPSE

Propel the Sonde with rods, the Flexrod or other means along the drain, carrying out locates every three or four paces.

The Sonde should stop at the blockage. Pinpoint and mark the position.



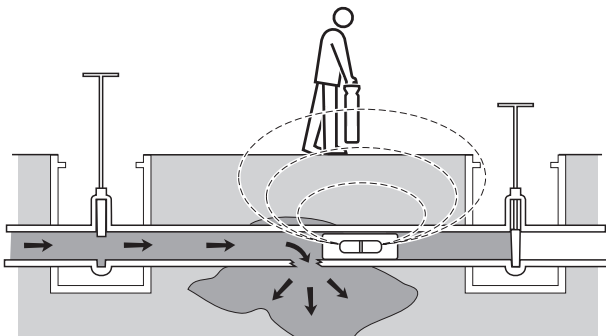
9.6 TRACING SMALL DIAMETER DRAINS OR PLASTIC PIPES

The FlexiTrace is a traceable flexible rod which incorporates an antenna at the head of the rod.

The FlexiTrace can be used for locating pipes and ducts down to 12 mm (0.47 in.) inner diameter and 250 mm (10 in.) minimum bend radius.

The FlexiTrace can be connected to the Transmitter in two ways to provide the following types of signal:

- (a) Tracing signal
Detectable along the entire length of the rod.
- (b) Sonde signal
Detectable only at the head of the rod.



9.7 LOCATING WATER LEAKS IN PLASTIC PIPES

This is a laborious method to locate leaks and is for use when traditional acoustic systems fail.

Procedure

Select a suitable Sonde and insert into an approved foam swab or pig. First, isolate the length of pipe by closing valves up and downstream of the leaking section. Cut into the pipe and insert the swab and Sonde which becomes a piston in the pipe.

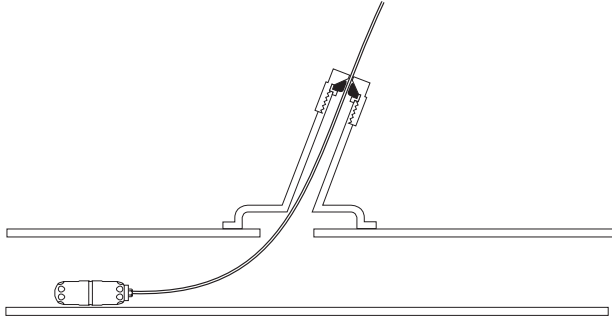
Close the downstream valve and open the upstream valve. The detectable Sonde piston will move along the pipe and stop at the point of the leak. It may be necessary to crack open the downstream valve to get the piston moving.

Correct setting of the valves is made easier if a flow meter is inserted close to the upstream valve.

Calculate the flow rate required to achieve a comfortable speed for the Sonde piston and adjust the valve as necessary. The flow rate should increase when the Sonde piston passes and stops at the leak. This provides a means for determining that the Sonde piston has stopped at the leak rather than being halted by an obstruction.

It may be possible to insert the Sonde piston into the pipe by pumping it down a fire hydrant or by removing a valve bonnet.

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9.8 PINPOINTING IRON GAS PIPE JOINTS

If a Sonde is inserted into an iron gas pipe the signal is shielded until it reaches a joint or other anomaly when it gives a peak signal to each side of the joint and a null precisely over it. The following procedure is suitable for locating joints for injecting anaerobic sealant from the surface.

Procedure

Using the Receiver trace and mark the position of the pipe. Mark lengths of 1 m (1 yd) along the path of the pipe.

Attach a Standard Sonde to the end of the Flexrod and feed it into the pipe through a special gland. Radiodetection can supply a complete insertion canopy to fit a Wask under pressure drill set or an insertion tube and gland for fitting to other type canopies.

Precision Receivers must be used in the peak mode to detect a null response.

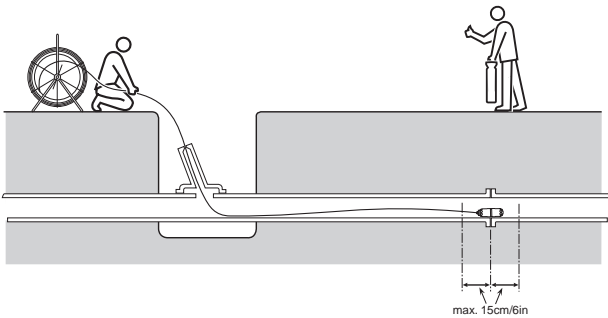
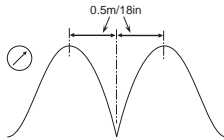
Align the Receiver directly above the Sonde then move 1 m (1 yd) along the main. Hold the Receiver blade stationary, directly above and in line with the main.

Push the Sonde 1 m (1 yd) along the main. Continue advancing the Receiver and the Sonde in alternate increments of 1 m (1 yd). When the Sonde passes a joint the Receiver will be in range to detect it and will give a peak response. Halt the Sonde.

When a joint has been detected and the Sonde halted, the joint position is accurately pinpointed by holding the Receiver above and with the blade parallel to the line of the pipe. Move the Receiver backwards and along the line of the pipe and it will give a sharp and precise null response directly above the pipe joint. It may be necessary to move the Sonde gently backwards or to obtain the null and two peak responses.

It should be possible to push the Flexrod and Sonde 120 m (360 ft) along the pipe and possible to survey 240 m (760 ft) for joints from a single insertion point.

Inserting a Sonde in a gas pipe should only be undertaken by qualified gas industry personnel taking the necessary safety precautions.



9.9 PINPOINTING A POSITION EACH SIDE OF A WALL

The Sonde gives a precise and easily defined null signal from its end.

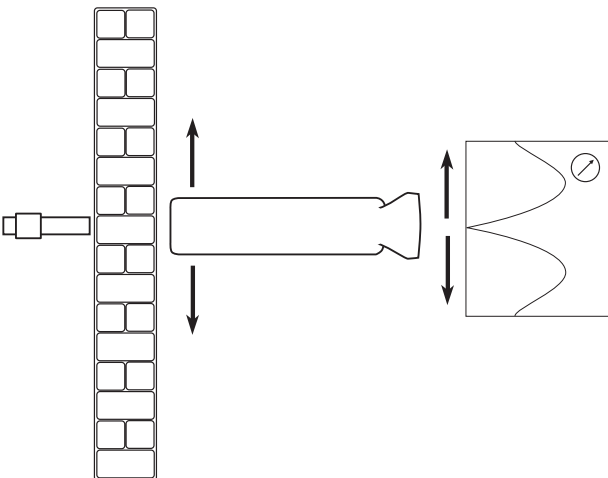
The position where a Sonde is placed end on to a wall can be pinpointed with great accuracy using the Receiver on the far side of the wall.

Procedure

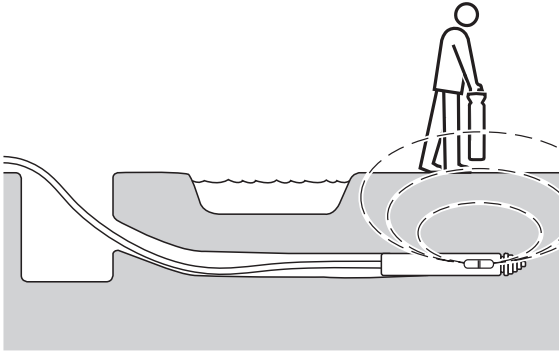
Position the Sonde. With the blade horizontal and pointing at the wall move the Receiver horizontally to detect a null response between two peaks.

With the Receiver at the null position and pointing at the wall, pivot at right angles so that the blade is vertical. Move the Receiver up and down to detect a null response.

Repeat the procedure for an accurate pinpoint.



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9.10 LOCATING BLOCKAGES CABLE PULLING

An obstruction in a non-metallic duct can be located from the surface if a Sonde is inserted in the cable pull stock.

9.11 MONITORING A HORIZONTAL BORING TOOL

Attaching or fitting a Sonde to a horizontal boring tool and to check if it is on course or if it has deviated and needs to be retrieved. A record can be made of the plan and depth profile of a bore under the highway.

The Sonde can be attached to the hose immediately behind the tool with duct tape or clips. Special hose couplings are available to accommodate the Small Sonde and the Slim Sonde.

Some manufacturers have modified the head of their boring tools to accommodate a special Sonde enabling the point of the tool to be pinpointed from the surface.

The technique to monitor a Sonde fitted to a boring tool is similar to locating and tracing a Sonde in a drain. Carry out a locate when the Sonde is visible in the launch pit to set the sensitivity level, and then carry out locates and depth measurements at short intervals.

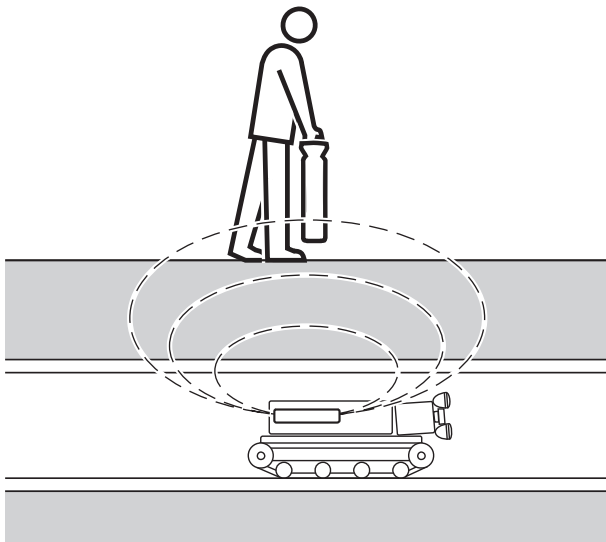
9.12 LOCATING INSPECTION CAMERAS

The purpose of an inspection camera is to provide information. Knowing the position of the camera from the surface enhances the value of the information. The ground can be marked directly over situations requiring remedial action or the position of the camera can be pinpointed if it is unable to proceed.

Some manufacturers of small camera systems incorporate the Sonde inside the camera housing and power it from the existing power supply.

A Sonde element can be fitted inside a large camera or a Standard Sonde can be attached to the outside housing of the camera.

In each case, the routine of monitoring the progress of the camera and pinpointing its position is the same as locating and tracing a Sonde in a drain.



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10 GLOSSARY

Certain terms are used and this Glossary explains their meaning in the context of this Manual.

Active signal

A signal applied to a line with a Radiodetection transmitter.

Cable sheath

A conductive layer usually surrounding the working conductors of a cable to provide electrical screening. Usually isolated from ground by a further layer of plastic or insulator. The sheath is generally terminated to a ground connection at the end of a cable length.

Coupling

When a signal applied to the target line transfers to other nearby lines.

FaultFind

To pinpoint the plan position of a sheath fault.

FaultFind signal

The detectable ground current flowing as a result of connecting a FaultFind transmitter to a cable sheath with a fault to ground.

LCD

Liquid Crystal Display. Multi purpose display used on the RD400 Digital Series receivers and the RD433HCTx-2 transmitter.

Lf

Low frequency. A range of transmitter and receiver frequencies from 440 Hz to 640 Hz.

Meter

A visual display which indicates receiver response to a signal. The RD400 Analogue Series receivers are fitted with a moving coil meter. The RD400 Digital Series receivers have an LCD that displays a meter-like curved bargraph.

Null

A receiver mode where maximum received signal level is displayed as a minimum meter indication. As the received signal level decreases so the meter indication increases.

Pace

A unit of measurement approximating to a metre or yard.

Passive signal

A signal that occurs 'naturally' on a buried metal pipe or cable such as 50/60 Hz power energy or very low frequency radio energy.

Peak

A receiver mode where maximum received signal level is displayed as a maximum meter indication. As the received signal level decreases so does the meter indication.

Pinpoint

Using the receiver to establish the exact position of a target line.

Precision locator

A receiver which is capable of providing a peak or a null response when over a target line.

Precision pinpoint

Using different locate modes to confirm the precision of a pinpoint.

Rebars

Metal bars used in concrete reinforcing.

Response

The indication on a meter or from the loudspeaker when a receiver detects a signal. The response can be varied for a given signal by adjusting the receiver sensitivity level.

Search

Using the receiver to find all buried lines in an area.

Sheath fault

Damage to the insulation surrounding a cable sheath such that there is an unintentional conductive path enabling current flow between the sheath and ground.

Signal

A flow of alternating electric current on a line resulting in a detectable magnetic field.

Sonde

A self-contained, waterproof, battery powered transmitter with a signal that can be located by a receiver. Sondes are commonly used for locating non-metallic drains or ducts for monitoring No-Dig procedures.

Sweep

Using the receiver to locate lines radiating active or passive signals. Sweeping an area is usually done in an orderly grid pattern to cover the whole area.

Target

A target line is a selected metal pipe or cable to which the transmitter signal has been applied and which is to be traced and pinpointed with a receiver.

Trace

Using the receiver to follow the route of a line.

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