

RD4000 Locating System User Manual

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FCC, CANADIAN, AND EUROPEAN SAFETY NOTICES

Receiver

USA

The product complies with the general conditions of operation, pursuant to part 15 of the FCC Rules.

Caution: Changes or modifications not expressly approved by the manufacturer could void the user's authority to operate the product.

Canada

Equipment is for use by trained operators only and not for general household use. Usage duration shall be as short as possible to prevent possible radio interference to authorized services, especially the 100 kHz Loran-C frequency.

Operation is subject to the following two conditions: (1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.

Europe

Hereby, Radiodetection declares that this receiver is in compliance with the essential requirements and other relevant provisions of Directive 1999/5/EC.

Transmitter (RD4000T3, RD4000T3F and RD4000T10)

USA

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

Caution: Changes or modifications not expressly approved by Radiodetection could void the user's authority to operate the product.

Canada

Equipment is for use by trained operators only and not for general household use. Usage duration shall be as short as possible to prevent possible radio interference to authorized services, especially the 100 kHz Loran- C frequency.

Operation is subject to the following two conditions: (1) this device may not cause interference, and (2) this device must accept any interference that may cause undesired operation of the device.

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The carrier frequency and the RF output power are as follows:

Frequency band	Peak output power
9kHz to < 45kHz	10W (RD4000T10), 3W (RD4000T3 and RD4000T3F)
45kHz to 490kHz	1W

Europe

Hereby, Radiodetection declares that this transmitter complies with the essential requirements and other relevant provisions of Directive 1999/5/EC.

Warnings, Cautions and Notes.



WARNING. Warnings are given where a procedure can cause personal injury if not carried out correctly.

Caution. Cautions are given where a procedure can cause damage to equipment if not carried out correctly.

Notes. Notes are used to give supplementary information and useful tips.

Read the warning or caution information carefully and follow any instructions that may be given.

Patent information

Features of this product may be protected by the following granted patents and other pending applications:

US 5,260,659 US 5,576,973 US 5,920,194 US 6,127,827 US 6,268,731 EP 0,457,809
EP 0,758,457 EP 0,769,153

The Microsoft Windows operating system is a registered trademark of Microsoft Corporation in the United States and/or other countries.

CONTACT INFORMATION

When reporting any problem to your Radiodetection Dealer/Supplier it is important to quote the following:

Equipment Serial Number. On the transmitters, the serial number is located on the transmitter side labels. On the receiver, it is on the front blade label.

Software Revision Number. The software revision number is shown on the display (RD4000T10 and RD4000 receiver only) for approximately five seconds after the receiver or transmitter is switched on.

For technical assistance contact:

Radiodetection Limited
Western Drive
Bristol BS14 0AF
UK
Tel: +44 (0) 117 976 7776
Fax: +44 (0) 117 976 7775
<http://www.radiodetection.com>

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Note. Radiodetection receivers detect almost all buried cables and most conductors. However, some cables and conductors do not radiate signals and cannot be detected by Radiodetection receivers. Radiodetection receivers do not indicate whether a signal is from a single cable, several cables buried side by side or one cable above another.

The operation of any cable and pipe locator may be adversely affected when used in close proximity to ferrous materials such as manhole covers and parked cars. Keep a two-metre/six feet distance from these objects when taking critical measurements such as depth and current. Standing too close to the receiver if you are wearing steel toe capped boots may also affect the readings



WARNING. This equipment is NOT approved for use in areas where hazardous gases may be present.

WARNING. When using the RD4000 receiver reduce audio level before using headphones.

Dispose of batteries in accordance with your Company's work practice, and the relevant law or guidelines in your country.

Caution: If the equipment is used in a manner not specified by Radiodetection, the protection provided by the equipment may be impaired.

The RD4000 system is for use by suitably trained operators only.

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SYSTEM INTRODUCTION

About this manual

Before operating the equipment read this manual first. The manual is divided into the following sections:

- Safety notices.
- System introduction.
- Preparation for use.
- RD4000Rx receiver operation.
- RD4000MRx receiver option.
- RD4000T3, RD4000T3F, and RD4000T10 transmitter operation.
- Accessories.
- Locating tips.
- Web enabling.

System overview

The RD4000 locating system offers a choice of two receivers and three transmitters. These are designated as follows:

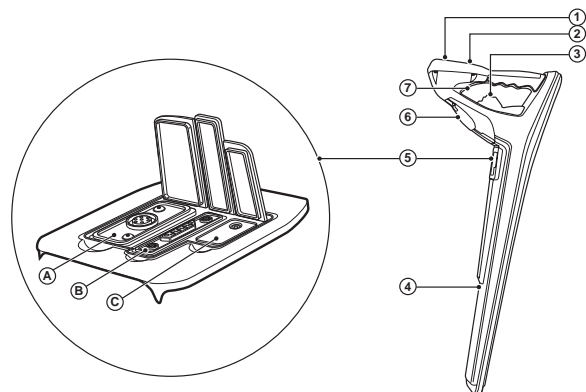
Receivers

RD4000Rx. The standard receiver.

RD4000MRx. This has the same features as the standard receiver but with the addition of an Electronic Marker System (EMS) antenna for locating marker balls. Both receivers feature web-enabling capability.

Layout of controls and connectors

- (1) Display.
- (2) Keypad.
- (3) Gain paddle.
- (4) Receiver blade.
- (5) Accessories housing.
 - A. Accessory connector.
 - B. RS232 connector.
 - C. Headphone socket.
- (6) Battery housing.
- (7) Sounder.



Notes: 1. The accessory connector on the receiver has a different keyway orientation to that of the transmitter. This ensures that receiver accessories will only fit the receiver and transmitter accessories will only fit the transmitter.

2. For ease of identification all transmitter accessories have 4 pin connectors and all receiver accessories have 8 pin connectors.

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The RD4000 features:

- LCD display
- Ease of operation
- Auto backlight
- Web enabling capability

Transmitters

Three transmitters are available:

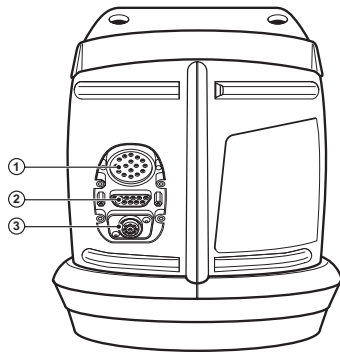
- RD4000T3 The entry-level transmitter
- RD4000T3F This has the same features as the T3 but with FaultFind
- RD4000T10 Fully web-configurable transmitter

RD4000T3

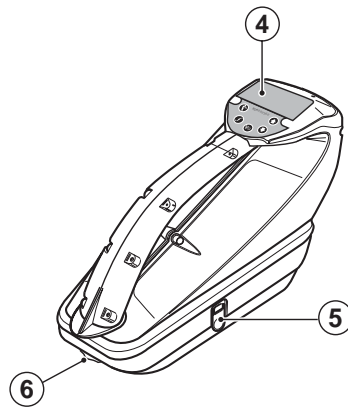
The RD4000T3 features:

- LED display
- Three-watt power output
- Three locate frequencies
- One induction frequency.

Layout of controls and connectors



- (1) Sounder
- (2) RS232 connector
- (3) Accessory connection socket
- (4) LED function indicators



- (5) External power supply and optional charging point
- (6) Battery housing-release catch

RD4000T3F

The RD4000T3F is identical to the RD4000 T3 with addition of FaultFind.

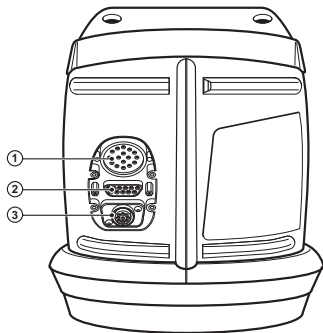
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RD4000T10

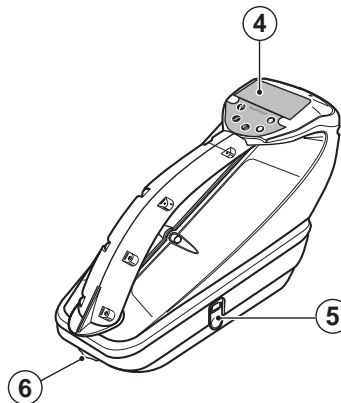
The RD4000T10 features:

- LCD display
- Ten-watt power output
- Web-enabling capability enabling the features to be upgraded using the dedicated Web site
- Multi-meter functions for checking integrity of cables before and after fault finding
- Up to 16 locate frequencies
- One or two induction frequencies
- FaultFind as standard
- Compatibility with the Radiodetection Pipeline Current Mapper (PCM)
- Compatibility with Absolute Current Identification- Multi (ACID-M)
- Auto backlight (activated when a key is pressed).

Layout of controls and connectors



- (1) Sounder
- (2) RS232 connector
- (3) Accessory connection socket



- (4) LCD display
- (5) External power supply and optional charging point
- (6) Battery housing-release catch

Accessories

A wide range of RD4000 accessories is available and increases the usefulness and scope of the system. Accessories and sondes are described later in the manual.

Auto backlight

The RD4000 receiver features an auto backlight, which automatically illuminates the display in poor lighting conditions. The backlight cannot be manually switched on or off.

The T10 transmitter backlight automatically illuminates when a key is pressed, regardless of the ambient light level. The light will stay illuminated for 30 seconds, unless further key presses are made, in which case it will extinguish 30 seconds after the last key press.

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Web enabling features

The RD4000 receivers and RD4000T10 transmitters are web enabled, allowing you to register equipment on-line, configure the equipment, and download frequency and feature upgrades quickly and easily via an Internet connection.

Note: The RD4000T3 and RD4000T3F transmitters are not Web enabled.

By connecting a transmitter or receiver to a computer and accessing the Radiodetection website, you will be able to do the following:

- Register new equipment
- Un-register a receiver or transmitter (for example, if it is sold on)
- Configure equipment
- Purchase and download new features
- Perform diagnostics and self-test procedures
- Check when servicing of a receiver or transmitter is due
- Link to the Radiodetection Frequently Asked Questions (FAQ) page
- Change the transmitter or receiver language
- Download updated firmware/software.

The Web enabling features are available through the Radiodetection Website at:
<http://www.radiodetection.com>

PC requirements

You will need a personal computer (PC) or laptop computer running Microsoft Windows 98, Windows 2000, Windows NT, or XP, and the supplied RS232 communication connection lead. The PC or laptop must have Internet access through Microsoft Internet Explorer version 5.5 or later, and the Java plug-in, copies of which are included on the supplied RD4000 training CD.

Caution: Only install Internet Explorer if you feel confident to do so. If you are not sure, check with your Information Technology (IT) department or seek assistance from IT professional.

Note: Netscape is not supported in this release but may be supported in later versions.

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How to use the web enabling features

- Lift up the dust cover (marked RS232) on the receiver, or remove the dust cover from the RS232 connector on the T10 transmitter and plug the male end of the supplied RS232 communication lead into the RS232 socket.
- Plug the female end of the cable into the serial port, (normally COM 1) of the computer.
- Switch on the computer and receiver or transmitter, access the Internet and in the address bar type: <http://engineering.radiodetection.com>. You will also find a link to this site at Radiodetection.com.

Once you are connected to the website, follow the on-line instructions for using the site.

Data logging

During a survey, depth and current can be logged from the RD4000 receiver to an external data logger for later analysis. Data is presented to the RS232 socket after the depth button is pressed and after the auto timeout period returns the locator to locate mode.

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Display and function keys

RD4000 receiver



- (1) On/off key.
The on/off key has two functions: it switches the receiver on and off and it is used to select the menu.



- (2) Frequency key.
Press and release the frequency key to select the next frequency.
Press and hold down the frequency key to scroll through the available frequencies in sequence. Release the key when the required frequency is displayed.
Press to change EMS marker types on the MRx version.



- (3) Gain paddle.
Increases or decreases the signal strength. To reduce signal strength, lightly push the paddle anti-clockwise, to increase the signal strength lightly push the paddle clockwise. A bar graph reading of approximately 50% is suitable for most uses.
(The gain paddle has a secondary function of menu scrolling when the menu key is pressed.)



- (4) Depth and measurement key.
When pressed, displays depth to target line and the current. Also used for data logging when an external data logger is attached.



- (5) Antenna select key.
Press and release the peak/null/single key to select the required mode.



- (6) Bargraph.
Displays signal strength.



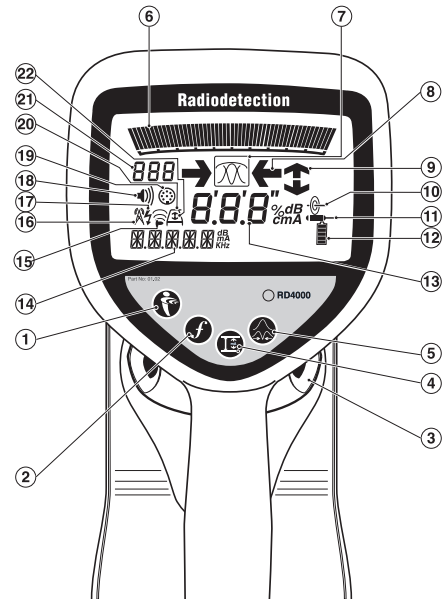
- (7) Antenna display.
Wide (single horizontal antenna) peak.
Narrow (twin horizontal antenna) peak.
Null (single vertical antenna).



- (8) Left/right arrows.
Indicate if the target line is to the left or right of the receiver when the receiver is in null mode.



- (9) Current direction (CD) arrows .
Indicate current direction when an allocated CD frequency is in use and the fault direction when using FaultFind.



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- (10) Line selected indication.
Displayed when line measurement is selected.



- (11) Sonde indication.
Displayed when sonde measurement is selected.
Note: The sonde option is not available when using some frequencies.



- (12) Battery level indication.
Displays receiver battery level.



- (13) Numeric display.
Indicates the receiver response to a signal. Also provides information from other functions.



- (14) Selected frequency indication.
Displays selected frequency.

- (15) Electronic Marker System (EMS) mode symbol (RD4000 MRx option only).
The EMS symbol is displayed when EMS is selected.



- (16) Radio mode symbol.
This symbol is displayed when radio mode is selected.



- (17) Power mode symbol.
This symbol is displayed when power mode is selected.



- (18) Volume level.
Shows volume level (off, low, mid, high).



- (19) Accessory indication.
The symbol is displayed when an accessory is fitted.



- (20) Fault find mode.
The symbol is displayed when an A-frame is plugged into the accessory socket.



- (21) Numeric display.
Displays gain-setting value.



- (22) CD mode indication.
The arrows are displayed when the CD frequency is selected.

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RD4000T3 and RD4000T3F transmitters



- (1) On/off key.
Used to switch the transmitter on and off.
The on/off key is also used to select one of two volume levels, which are only selectable when switching the transmitter on. To select the higher volume when switching on, press and release the on/off key. To select the lower volume, when switching on, press the on/off key for approximately two seconds. To change to the higher volume, switch the transmitter off and then on.



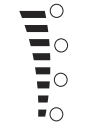
- (2) Frequency selection key.
Press to select required frequency.



- (3) Down arrow key.
Press to reduce power output level.



- (4) Up arrow key.
Press to increase output power level.



- (5) Power output indication LED's.
When the up or down arrows are pressed, the four LED's illuminate or extinguish in turn to indicate the selected output power level. If the demanded output level can be achieved, the LED's up to and including the one representing the demanded output level will illuminate and will remain on. If the demanded output level cannot be achieved, the LED representing the achieved output will illuminate and remain on. The LED's between the achieved level and the required level will flash on and off.



- (6) Induction indication LED.
Indicates that induction mode is selected. The induction frequency is indicated by one of the three frequency LED's. The illuminated LED represents the induction frequency. Induction mode is automatically selected if there is not an accessory plugged in to the transmitter.



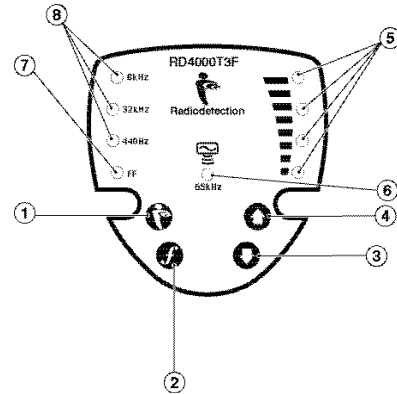
- (7) FaultFind (FF) indication (RD4000T3F only).
Indicates that FF mode is selected.



- (8) Frequency indicators.
Indicate selected frequency.



Note: Frequencies shown are examples only and may not be the same as those on your transmitter.



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RD4000T10 transmitter



- (1) On/off and menu select key.
Switches the transmitter on/off and is used to select transmitter menu.



- (2) Frequency select key.
Used to select required frequency.



- (3) Measurement unit select key.
Used to select volts, ohms, or amps.



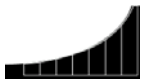
- (4) Output power decrease and menu scroll key.
Press to decrease output power.
Used to scroll down through menu options and available operating modes when using the menu.



- (5) Output power increase and menu scroll key.
Press to increase output power.
Used to scroll up through menu options and available operating modes when using the menu.



- (6) Battery charge level indicator.
Displays transmitter battery level.



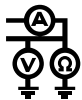
- (7) Output signal indicator.
Displays a visual indication of demanded output signal. The segments of the bargraph up to and including the one representing the demanded output level will be black and remain on. The actual current or power output is numerically displayed below the bargraph.



- (8) Numeric display.
Displays measurement value and measurement units.



- (9) Live cable warning indication.
Flashes on and off if there are more than 30 volts on the line.



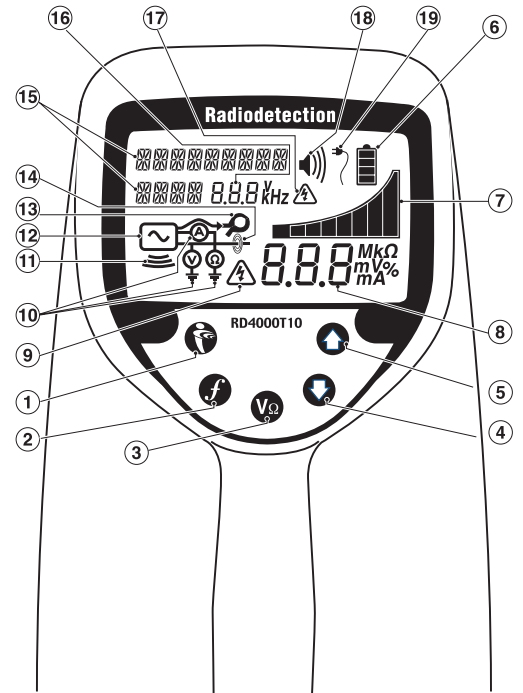
- (10) Measurement units. (Amps, volts, ohms).
Displays the selected measurement in use. In locate mode the output current reading is displayed but pressing the amps/volts/ohms key displays the voltage reading for as long as the key is pressed. To read ohms, first select 'MEASURE'. The measurement is displayed in volts. To read ohms, press the amps/ volts/ohms key. The ohms reading is displayed for as long as the key is pressed.



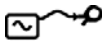
- (11) Induction mode indication.
Indication that induction mode is selected.



- (12) Transmitter indication.
Is displayed the whole time the transmitter is switched on.



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- (13) Clamp connected indicator.
Symbol is displayed when a clamp is connected to the transmitter.



- (14) Direct connection indication.
Shows that the transmitter is connected to the line by direct connection.

LOCATE

- (15) Text display.
Displays operating mode, frequency submode, and menus/alarms. Also scrolls the text 'HI POWER' from right to left when the transmitter is generating more than 5 watts.

220 Hz

- (16) Numeric indicator.
Displays output frequency.



- (17) HI VOLTS warning indicator.
Indicates that the transmitter is capable of outputting more than 30 volts. When switched on, the transmitter has HI VOLTS set to OFF and the transmitter cannot output more than 30 volts. Use the transmitter menu to select HI VOLTS ON.



- (18) Volume level.
Indicates the volume that the sounder is set to (off, low, mid, and high).



- (19) External power supply indicator.
Indicates that an external power supply is connected to the transmitter.

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PREPARATION FOR USE

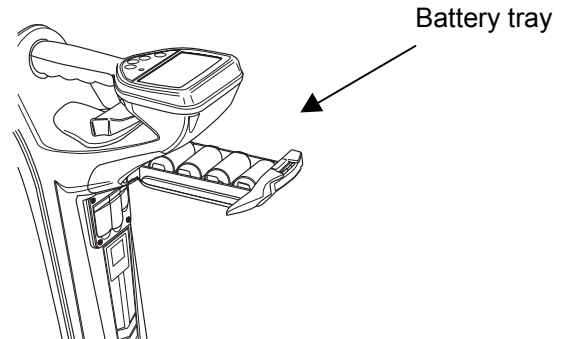
RD4000 receiver

This section describes the available RD4000 receiver power supply options and gives instructions on fitting, replacing, and charging batteries.

The RD4000 receiver is powered by four D-size (LR20) alkaline batteries or by an optional rechargeable battery pack.

Internal alkaline batteries

The four batteries are housed in a battery tray, which slots into the front of the receiver. The tray is clearly marked with the correct battery orientation.



Fitting and replacing alkaline batteries



Warning. Do not mutilate, puncture, or dispose of batteries by placing them in a fire. The batteries can burst or explode, releasing hazardous chemicals. Discard used batteries in accordance with the manufacturer's instructions and your local regulations.

Caution. When replacing batteries always ensure that the correct type of batteries is fitted. Keep the battery tray dry whilst changing the batteries.

- To remove the battery pack tray, place your fingers under the battery pack release catch, and pull the battery pack towards you from the RD4000 housing
- Remove the batteries and dispose of them in accordance with local regulations
- Fit new batteries in accordance with the polarity diagram in the battery housing
- Insert the battery pack tray into the RD4000 battery pack housing and push the battery pack tray until it clicks into the housing
- Switch the receiver on. If the display does not illuminate, ensure that the batteries are correctly oriented.

Note: To ensure maximum performance from the RD4000 receiver always replace the batteries as a set.

Rechargeable battery pack

The rechargeable battery pack is an interchangeable replacement for the standard battery pack and is supplied complete with four Nickel-Metal-Hydrate (NiMH) rechargeable batteries.

Fitting the rechargeable pack

Remove the standard battery housing and fit the rechargeable pack housing, complete with rechargeable batteries.

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Charging rechargeable batteries

Caution. If the batteries are being recharged from a vehicle cigarette lighter and the vehicle is being driven, the battery packs must be removed from the transmitter or receiver whilst charging takes place.

Do not use the receiver while the battery pack is being charged with the battery pack fitted to the receiver.

Note: When charging batteries for the first time, charge them for 16 hours regardless of the indicated battery level.

The rechargeable battery pack can be recharged via a vehicle cigarette lighter or via a mains power adaptor with the pack fitted to the receiver or with the pack removed. However, we recommend that you remove the battery pack from the receiver for recharging, particularly in hot ambient conditions. This will increase the post-charge battery capacity and enhance overall battery life. Ideally, the battery pack should be charged at an ambient temperature of between 0^o C and 30^o C.

To charge the batteries, remove the rubber protection cover from the front of the battery pack housing and plug the charger lead (supplied) into the receiver connector. Plug the other end into the vehicle cigarette lighter socket or plug the mains power adaptor (contact Radiodetection for adaptor details) into an appropriate power supply and switch the power supply on. Follow the manufacturer's instructions for operating the charger. When charging is finished ensure that you re-fit the rubber protection cover.

Note: It is normal for the battery pack to become warm during charging.

RD4000 Rx Battery Charging LED Indications

Under normal charging conditions, the battery charge status indicator LED illuminates and is coloured red. Once the batteries have finished charging the LED colour changes to green to indicate that charging is complete.

If the battery pack is completely discharged, or has been left in hot ambient temperatures, and the batteries have become hot, the LED will flash red/green as soon as the battery charger is plugged in and may continue to flash for sometime. In the case of a hot battery pack, the LED will turn red once the battery pack has cooled down, indicating that the batteries are charging normally. The LED will turn green once charging is finished.

If the LED is flashing red/green because the batteries are completely discharged, the LED will continue to flash red/green and trickle charge the batteries until they have reached a pre-determined charge level. The LED will then turn red, indicating that the batteries are charging normally. The LED will turn green once charging is finished.

The battery pack can be safely removed from charge at any stage in the charging cycle without affecting the battery life. However, the batteries will only be partially charged.

The rechargeable batteries are not replaceable. If a fault occurs with the rechargeable battery pack, it must be returned to Radiodetection for repair.

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Battery low level warning



As the battery level falls, the battery indicator black segments will extinguish in turn. When only the bottom segment is visible, it will start flashing on and off and eventually only the battery outline will be visible. The outline will start to flash on and off and 'BAT' will be displayed. Shortly after this the receiver will shut off.

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RD4000T3, RD4000T3F and RD4000T10 Transmitters

The power supply options and battery recharging methods for the RD4000T3, RD4000T3F, and RD4000T10 transmitters are the same. Additionally, the RD4000T10 transmitter features a graphical display of the recharging status. This section describes the available power supply options and gives instructions for fitting, replacing, and charging batteries.

Power supply

The transmitter can be powered by either:

- Internal alkaline batteries
- A rechargeable battery pack (optional)
- A 12-volt battery supply
- A mains operated battery charger/eliminator.

Internal alkaline batteries

The transmitter houses 12 D-size (LR20) alkaline batteries fitted into a battery tray at the base of the transmitter housing. The housing incorporates plastic polarity indicators.

Rechargeable battery pack (optional)

An optional Radiodetection rechargeable battery pack containing 12 Nickel-Metal-Hydride (NiMH) batteries is available for the RD4000T3, RD4000T3F, and RD4000T10 transmitters and is fully interchangeable with the standard battery pack housing.

The rechargeable battery pack can be charged from either a 12-volt supply or mains power supply and the transmitter can be operated whilst charging.

The rechargeable batteries are not user replaceable. If a fault occurs with the rechargeable pack, it must be returned to Radiodetection for repair.

External 12 volt battery supply

The transmitter can be powered by a 12-volt vehicle battery. A socket is provided in the battery pack housing for this purpose.

Mains operated battery charger/eliminator

Using a mains operated battery charger/eliminator enables the transmitter to be used at the same time as the batteries are charging (rechargeable batteries only). The pack can also be recharged with the pack removed from the transmitter.

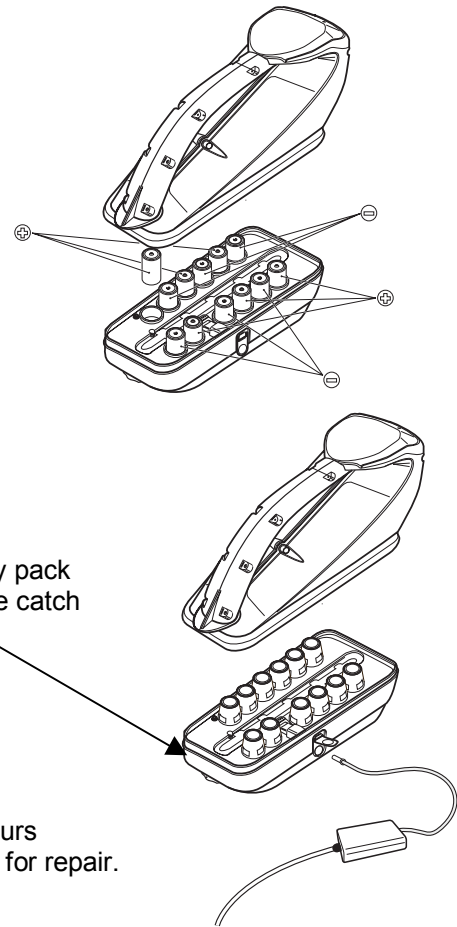
Battery low level warning

RD4000T3 and RD4000 T3F

There is no battery level indication on the RD4000T3.

When the batteries have approximately 30 minutes or less use remaining, the speaker tone and transmitter output signal will switch off for one second in every five seconds. When the batteries have insufficient charge remaining to ensure correct operation the unit will switch off. In FF mode (T3F only) the output signal will not switch off and on but will continue until the batteries have insufficient charge and the T3F switches off.

Note: Ensure that you always have enough battery charge available to complete the task.



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RD4000T10



As the battery level depletes, the battery indicator black segments extinguish in turn. When only the bottom segment is visible, it starts flashing on and off and eventually only the battery outline is visible. The outline starts to flash off for one second and on for four seconds and the sounder emits a warning beep tone every five seconds. At this stage, the transmitter defaults to one-watt maximum power output and '1 WATT' scrolls across the top of the display. If the batteries are not changed or recharged at this point, the unit will eventually switch off. The locate signal also pulses on and off at the same rate except when using PPL, FF, A.C.ID and PCM modes. When using these modes the locate signal continues without pulsing until the batteries are completely flat.

RD4000T10 battery life consumption

Using the T10 transmitter at its higher power output levels, increases battery consumption. To indicate when high power is being used 'HI POWER' scrolls from right to left across the top of the screen whenever the transmitter is generating more than 5 watts output power. If possible reduce power below 5 watts output to conserve battery life.



Fitting and replacing transmitter batteries

Warning. Do not mutilate, puncture, or dispose of batteries by placing them in a fire. The batteries can burst or explode, releasing hazardous chemicals.

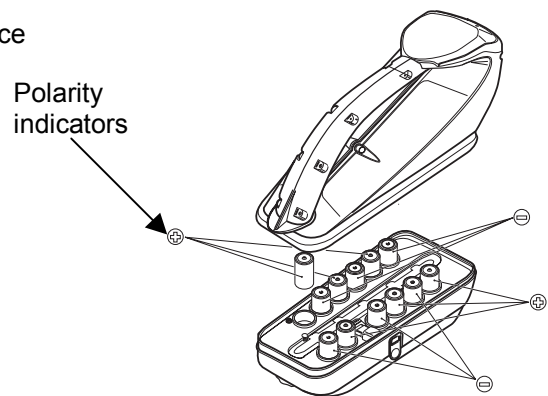
Discard used batteries in accordance with the manufacturer's instructions and your local regulations.

Caution. When replacing batteries always ensure that the correct type of batteries are fitted.
Keep the battery tray dry whilst changing the batteries.

Alkaline batteries

Always fit or replace batteries as a set. If the T10 transmitter batteries are not replaced as a set, the battery level indicator will not give a reliable indication of battery level.

- To remove the battery-housing, place the transmitter on a level surface and push down the battery housing retaining clip at the rear of the transmitter (see illustration). Lift off the transmitter top and place it to one side
- Remove the batteries and dispose of them in accordance with local regulations
- Fit the new batteries, ensuring that they are placed in the tray in the correct polarity orientation (refer to illustration). The orientation is also marked in the battery housing
- Replace the transmitter top onto the battery housing and push down on the carrying handle until the retaining clip clicks into place
- Switch the transmitter on. If the transmitter does not activate, ensure that the batteries are correctly oriented in the battery housing.



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Fitting the rechargeable battery pack

Remove the battery pack housing and fit the rechargeable pack, complete with batteries, onto the transmitter.

Charging rechargeable batteries

The rechargeable pack can be charged with the pack fitted to, or removed from, the transmitter.

Charging options

Caution. If the batteries are being recharged from a vehicle cigarette lighter and the vehicle is being driven, rechargeable battery packs must not be recharged whilst attached to transmitter or receiver units.

Caution. When charging batteries from a battery charger, always ensure that the battery charger is suitable for the batteries being charged.

Note: When charging batteries for the first time they should be charged for 16 hours regardless of any indicated charge state. For subsequent charges the batteries can be removed from charge once the green light is illuminated.

Under normal charging conditions, the battery charge status indicator LED illuminates and is coloured red. Once the batteries have finished charging the LED colour changes to green to indicate that charging is complete.

If the battery pack is completely discharged, or has been left in hot ambient temperatures, and the batteries have become hot, the LED will flash red/green as soon as the battery charger is plugged in, and may continue to flash for sometime. In the case of a hot battery pack, the LED will turn red once the battery pack has cooled down, indicating that the batteries are charging normally. The LED will turn green once charging is finished.

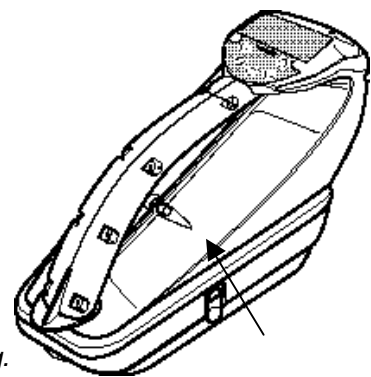
If the LED is flashing red/green because the batteries are completely discharged, the LED will continue to flash red/green and trickle charge the batteries until they have reached a pre-determined charge level. The LED will then turn red, indicating that the batteries are charging normally. The LED will turn green once charging is finished.

The battery pack can be safely removed from charge at any stage in the charging cycle without affecting the battery life. However, the batteries will only be partially charged.

The rechargeable batteries are not replaceable. If a fault occurs with the rechargeable battery pack, it must be returned to Radiodetection for repair.

The rechargeable battery pack can be recharged via a vehicle cigarette lighter of a stationary vehicle, or from a mains power adaptor (contact Radiodetection for details). To charge the battery pack, lift the battery pack connector cover and plug the charger lead into the transmitter connector. Plug the other end into the vehicle cigarette lighter socket or plug the mains power adaptor into an appropriate power supply and switch the power supply on. It takes approximately 8 hours to fully charge the batteries if the transmitter is switched off during charging.

Note: It is normal for the battery pack to become warm during charging.



Battery charging connector

RD4000RX RECEIVER OPERATION



Switching on/off

To switch the receiver on, press and release the on/off key.

To switch off the receiver, press the on/off key until the LCD display clears.



Checking battery level

The battery level indicator is situated at the bottom right hand side of the display and is made up of five black segments that extinguish as the battery life depletes. Ensure that you always have enough serviceable batteries available to complete the task.



Menu

To select the menu, press and release the on/off key.

To cycle through the menu options, momentarily flick the gain paddle clockwise or anticlockwise and release it.

Once an option is displayed, press the on/off key to select it.

Menu options are:

Line, Sonde (L/S)

- Select menu
 - Use the gain paddle to select L/S
 - When L/S is displayed, press and release the on/off key
 - Use the gain paddle to select either line or sonde
 - Press and release the on/off key to confirm the selection and return the display to locate mode
- The appropriate line or sonde symbol is displayed on the LCD.

Note: The Line/sonde option is not available in all modes.



Volume (VOL)

There are four volume levels:

1. Off.
2. Low.
3. Mid.
4. High.

To select the required volume:

- Select menu
 - Use the gain paddle to select volume (VOL)
 - Press and release the on/off key
 - Use the gain paddle to select the required volume level
 - Press and release the on/off key to confirm the selection and return the display to locate mode.
- The selected volume level is displayed on the LCD.

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Test

In this mode the receiver performs a functional self-test. If the unit fails the functional-test, indication of failure is displayed on the LCD but the receiver is still be able to locate. If the receiver fails the self-test, move the receiver to another area and try the test again. If the receiver fails the self-test three times note the error message and either:

- Contact the Radiodetection Technical Support Department for further advice or:
- Connect the receiver to the Radiodetection Website and run the diagnostics program

Note: The self-test does not perform a calibration test of the receiver and does not guarantee receiver accuracy.

Before performing a self-test, ensure that the receiver is not in an area of interference where other power sources could influence the test result. For example, do not perform the self-test next to a transmitter or computer visual display unit (VDU).

To run the self-test proceed as follows:

- Select menu
- Use the gain paddle to select TEST
- Press and release the on/off key. The receiver will perform a self-test (the test takes approximately 30 seconds)

At the end of the test, pass or fail will be displayed on the LCD.

- Press and release the on/off key to return to locate mode.



Selecting a frequency

- Switch on the unit
- Press the frequency key to select the required frequency.

Note: Ensure that the receiver frequency is the same as that set on the transmitter.

Bandwidth

Some frequencies are available in:

- Narrow bandwidth
The frequency mode is made more selective but less responsive.
- Medium bandwidth
The frequency mode has average selectivity and responsiveness.
- Wide bandwidth
This frequency mode is made less selective but more responsive.

Responsiveness is a measure of how readily the receiver will respond to detecting a signal. Selectivity is a measure of the frequency range of signals that can be picked up. A selective mode will only detect the desired frequency. A less selective mode may detect other signal frequencies that are close to the desired frequency.

Selecting peak mode

The RD4000 has two peak mode selections; single (wide band) and twin (narrow band) antenna modes. Single antenna mode provides the most sensitive locate but there is a broadened peak response directly over the cable. Twin antenna mode provides a sharp peak response with a corresponding small decrease in sensitivity.

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To select a peak mode:

- Press and release the on/off key to switch the receiver on
- Press the antenna select key until the required peak mode is displayed.

Use wide band if the pipe or cable is too deep to be located using the narrow band antenna. Wide band will locate the pipe or cable but will not pinpoint it. In wide band, it is not possible to take a depth reading.

Selecting null mode

To select null mode:

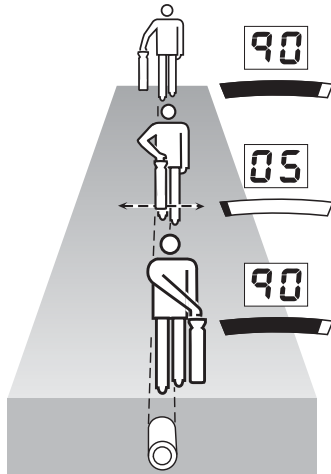
- Press and release the on/off key to switch the receiver on
- Press the antenna select key until null mode is displayed.

Null mode gives a null response when it is directly over the line. The sharp, null response is easier to use than the peak response but is vulnerable to interference and should not be used for locating, except in areas where there is no interference present. In null mode, the receiver will indicate line position but not its orientation.

Locating the cable/pipe

There are three techniques for locating pipes and cables. They are:

- Trace
- Pinpoint
- Sweep and search.



Trace

Line tracing can be speeded up by switching the receiver to null response.

Move the receiver left and right while walking along the path of the line to observe the null directly over the line and a peak response to each side of the line. As you move the receiver over the line the left and right arrows indicate if the target line is to the left or right of the receiver.

Periodically switch to peak mode, locate the target line, and verify its exact position.

Pinpoint

Pinpointing a target line in peak, narrow mode, defines the exact position of a target line after it has been traced and its position is approximately known. Start with medium output power from the transmitter, medium frequency on the transmitter and receiver, and peak mode on the receiver.

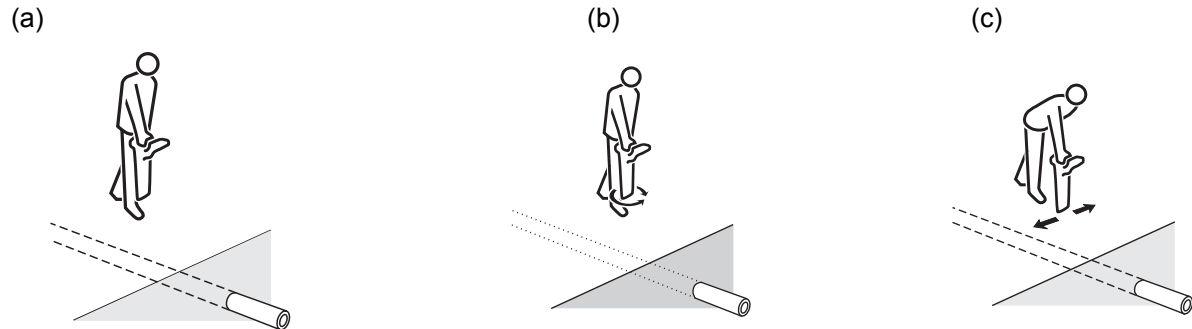
Set the receiver sensitivity to half scale.

Note: it may be necessary to adjust the sensitivity level throughout the pinpointing to keep the bargraph on scale.

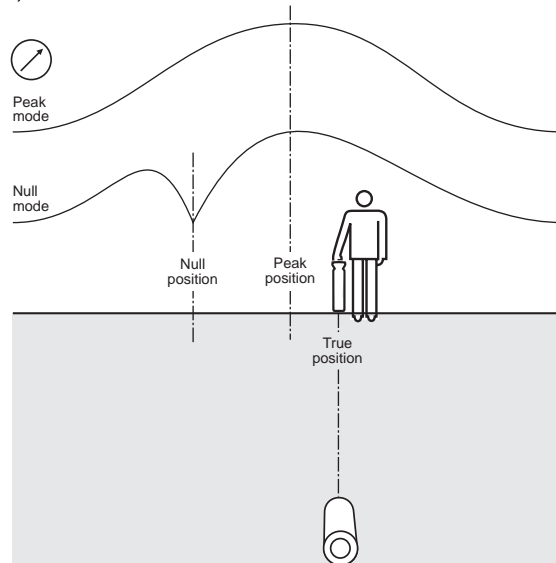
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- With the antenna at right angles to the line, make traverses across the line. Define the point of maximum response.
- Without moving the receiver, turn it round as if it is on a pivot. Stop at the point of maximum response.
- Hold the receiver vertical with the antenna just above the ground and move the receiver from side to side across the line. Stop at the point of maximum response.
- With the end of the antenna close to the ground, repeat (b).
- Repeat (c).
- Mark the position and direction of the line.

Repeat the steps of the procedure to increase pinpoint accuracy.



Switch to null response mode and move the receiver to find the null position. If the position of the peak and the null pinpoints correspond, it can be assumed that the pinpoint is precise. The pinpoint is not precise if the marks do not correspond, but both marks will show an error to the same side. True line position will be close to peak position.



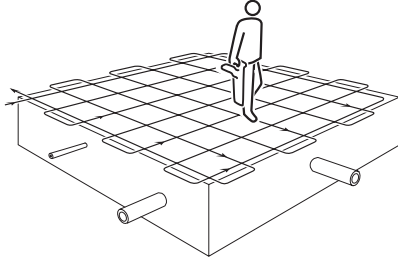
The line lies half as far to the other side of the peak position as the distance between the peak and the null positions.

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Sweep and search

There are a number of techniques available for locating unknown lines in an area. Use of these techniques is particularly important before digging to ensure that buried lines are not damaged during digging.

Passive Sweep



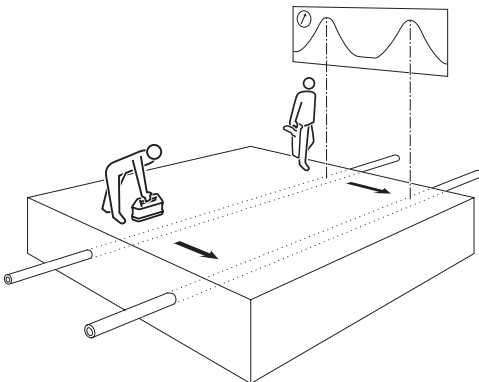
- Switch the receiver to power mode.
- Adjust the sensitivity to maximum; reduce the sensitivity to keep the bargraph on scale when there is a response.
- Traverse the area in a grid search, at a steady walk, and hold the receiver comfortably with the antenna in line with the direction of movement and at right angles to any lines that may be crossed.
- Stop when the receiver response rises to indicate the presence of a line. Pinpoint the line and mark its position. Trace the line out of the area being searched. Resume grid search in the area.

In some areas there may be a confusing amount of 50/60Hz power signals. Lift the receiver 5cm/2in from the ground and continue the sweep.

Switch the receiver to 'Radio' if the receiver has a radio detect mode. Increase sensitivity to maximum and repeat the above grid search procedure over the area, pinpointing, marking, and tracing out any lines that are located.

In most, but not all areas, radio mode will locate lines that do not radiate power signals and a grid search should be made in both power and radio modes.

Sweep and search (inductive search)



An inductive search procedure is the most certain technique for locating unknown lines. This type of search requires a transmitter and receiver and two people. This type of search is referred to as a 'two person sweep'. Before starting the sweep, define the area of search and the probable direction of lines crossing the area. The transmitter is switched on in induction mode.

The first person operates the transmitter and the second person operates the receiver. The transmitter induces a signal onto lines as it passes over them and the lines are then detected with the receiver 20 paces upstream or downstream of the transmitter. Hold the transmitter with its length aligned with the assumed direction of any lines.

The second person holds the receiver at the start of the area to be searched and with the receiver antennas at right angles to the probable direction of the buried lines. Set the receiver sensitivity level as high as possible without the receiver picking up any airborne signal directly from the transmitter.

When the transmitter and receiver are in line both operators start to move forward in parallel. The operator with the receiver sweeps it backwards and forwards, keeping the receiver vertical, as he proceeds in parallel with the transmitter. This method allows for misalignment of the transmitter, receiver, and buried line.

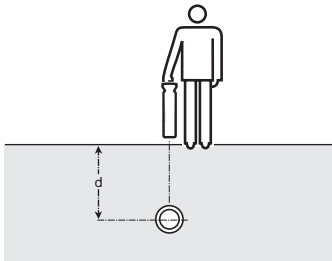
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The transmitter applies its signal most strongly to the lines directly below it, which are then located with the receiver. Move the transmitter from side to side to establish the highest signal which indicates that the transmitter is also directly above the line(s).

Mark the ground at the point of each peak signal detected with the receiver. Repeat the search along any other possible paths of lines.

Once the positions of any lines have been marked, reverse positions, place the transmitter over and along each line in turn, and trace the line out of the search area.

Taking depth readings



Electronic depth measurement to a line is possible down to depths of 3m/10ft when the line has been energized with the transmitter signal.

Passive signals on lines are not suitable for measuring depth because accuracy is questionable due to the passive signal being present on more than one line.

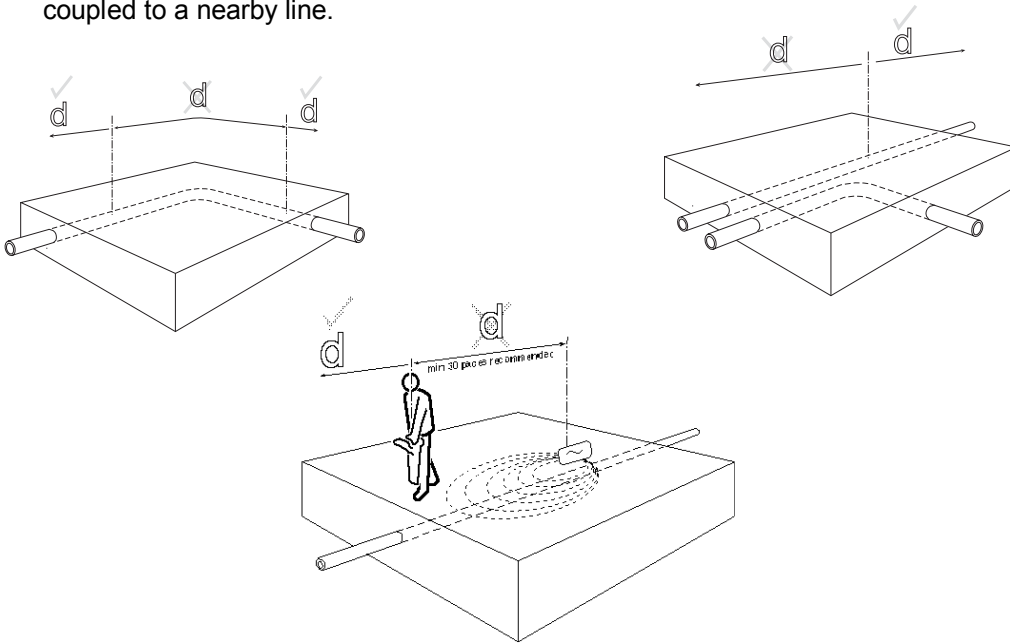
Measurement is to the centre of the pipe or cable. Depth of cover is necessarily less than the reading, possibly critically so on large diameter pipes.

Precautions: Do not make depth measurements near bends or tees in the line. Go at least 5 metres/16 feet from a bend for best accuracy.

To avoid signal distortion, do not apply the signal by induction. If there is no choice, place the transmitter at least 30 paces from the point of any depth measurement.

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



Confirming the peak position coincides with a null position indicates that the position is suitable for making a depth measurement.

- Pinpoint the target line accurately with the receiver
- Check the receiver is directly over the line, the antennas are at right angles to it and the receiver is vertical. Adjust sensitivity level to bring the bargraph indication on scale
- Press the depth measurement button and read the depth from the receiver display.



If the ground appears to radiate a strong field, perhaps near a radio station, check depth by holding the bottom of the antenna 5cm/2in above the ground and subtract this measurement from the indicated depth.

Verifying a depth measurement

Check a suspect or critical depth measurement by lifting the receiver 0.5m/18 inches above the ground and repeating the measurement. If the measured 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 conditions are suitable. However, you may not always know if the conditions are suitable so the following techniques should be used to check critical readings:

- Check that the route of the line is straight for at least five paces to either side of the measurement point
- Check that the signal response 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 source of error of depth measurements as a strong signal coupled to an adjacent line can often introduce +/- 50% error
- Make several depth measurements at points slightly displaced from the line's apparent position. The shallowest indication will be the most accurate and will also indicate the line's position most accurately.

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Rough depth calibration check

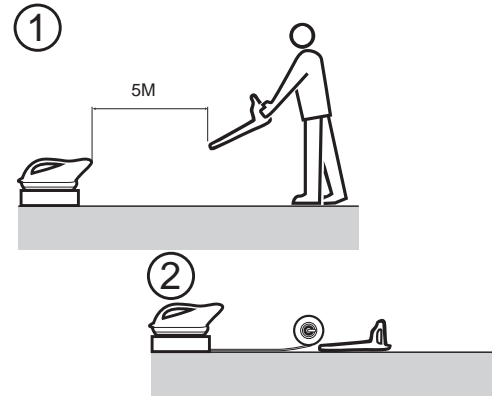
This check is a quick and easy way of verifying that the depth reading on the receiver is within acceptable limits. It can be used if you are getting inaccurate depth readings from a cable or pipe for which you know the approximate depth. Inaccurate depth readings could be the result of the receiver picking up a stronger signal such as another cable or pipe running in close parallel to the target pipe or cable.

There are two ways of checking the calibration of the receiver in the field. Both methods require the use of a transmitter:

Method 1

Refer to illustration 1

- Place the transmitter on top of a non-metallic object, such as a cardboard box, on the ground and away from any buried lines. Switch the transmitter on, ensuring that no accessories are connected and that the transmitter is in induction mode. To reduce the effects of ground coupling the transmitter, when it is placed on the box, must be more than half a metre/18 inches above the ground
- Hold the receiver with the blade horizontal and pointing towards the front of the transmitter and approximately five metres/16 feet from the front of the transmitter.
- Switch the receiver on
- Select the same induction frequency as is selected on the transmitter
- Select sonde mode on the receiver.



Refer to illustration 2.

Move the receiver from left to right and when the maximum signal is obtained place the receiver on top of a non-metallic object, such as a cardboard box, on the ground. Ensure that the blade is horizontal and pointing towards the transmitter. To reduce the effects of ground coupling the receiver, when it is placed on the box, must be more than half a metre/18 inches above the ground

- Press the depth/current key on the receiver
- Using a tape measure, measure the distance from the base of the receiver to the centre of the transmitter
- Compare this reading with the depth reading on the receiver.

The receiver can be considered accurate if the difference between the depth reading on the receiver and the distance measured with the tape is less than 10%.

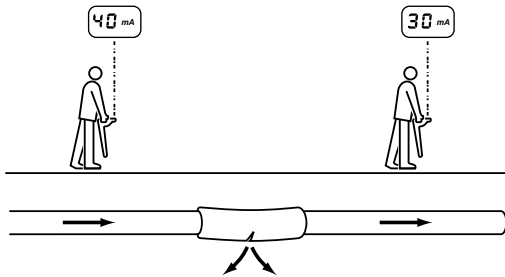
Method 2.

1. Apply a signal to a cable or pipe of known depth
2. Locate the cable or pipe and press the depth key
3. Compare the depth reading on the receiver with the actual depth.

Taking current readings

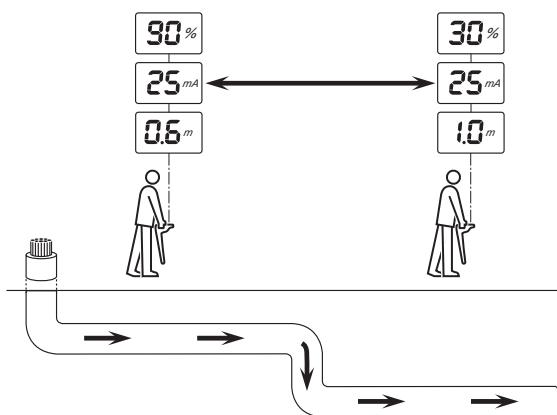
Using current measurement to aid identification

Measuring current value on a line helps confirm the identity of the line and provides information about the condition of cable insulation or pipe coating.



The principle of current measurement

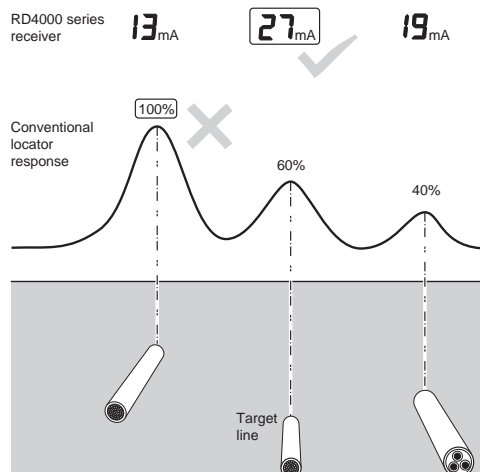
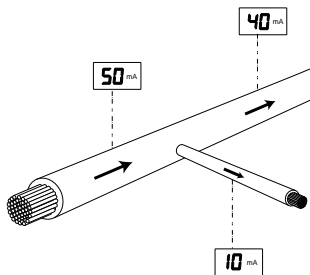
The transmitter applies a signal or current onto a target line. The current decreases in strength as the distance from the transmitter increases. This rate of decrease depends on the type of line and on soil conditions. Regardless of the type of line and the frequency being used the rate of decrease should be regular with no sudden drops or changes. Any sudden or abrupt current change indicates that the line or its condition has changed.



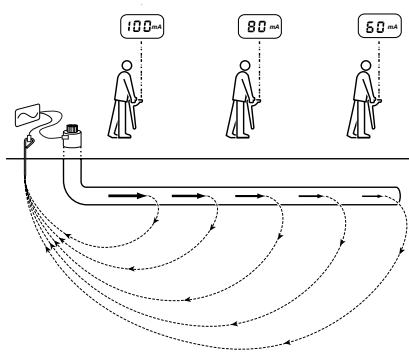
In congested areas, where there is more than one line, the receiver may sometimes detect a stronger signal from an adjacent line to which the signal has coupled or shares common grounding because it is nearer the surface. Although current measurement compensates for depth, signal response will be less as the depth increases.

The line with the highest current measurement, rather than the line giving the strongest response, is the target line to which the transmitter signal has been applied.

Measuring current provides useful information about the position of tees and bends. Measuring current after a tee will indicate the main line that pulls more current along its greater length.



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Applying the transmitter signal

The transmitter signal can be connected, clamped or induced to the target line in the same way as the signal for line tracing is applied.

Measuring current

- 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 antennas at right angles to it and vertical
- Press depth/current key. Depth will be displayed for approximately five seconds, and then the depth and current value in milli-amps will be displayed for five seconds

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

Both antennas are needed to make a current measurement and receiver accessory antennas such as a normal clamp or stethoscope cannot be used. Because current measurement is a function of depth, it is only available in the locating modes. It is also available with Current Direction (CD) clamps.

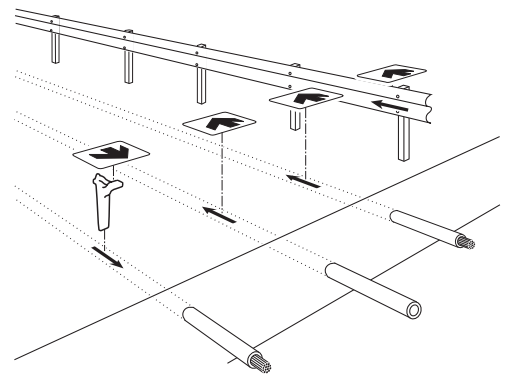
Current direction (CD)

Understanding CD

Current direction recognition is a feature that helps to positively identify a line at points distant from the application of the signal. It is highly desirable, if not essential, for positive identification of long distance lines. These lines can be traced and positively identified through congested areas or when running parallel to other lines.

The CD feature on the RD400 receiver indicates the direction of the current flow on a line. Identity of the target line is established if the receiver display 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 finds a return path to the point of the original signal application. This is indicated by the receiver arrow pointing back towards the transmitter. This is in contrast to the forward pointing arrow indicating the target line.



The CD transmitter signal must be directly coupled to the target line and with a remote ground connection. It cannot be applied by normal clamp or induction but can be applied with a transmitter CD clamp.

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Using Current Direction (CD) to aid identification

The RD4000 receiver and RD4000T10 transmitters can be supplied with CD frequencies already installed or they can be purchased over the Internet by using the web-enabling feature. The RD4000T3 and T3F transmitters do not support the CD feature.

Note: The transmitter and receiver must both have the same CD frequency or frequencies installed to enable the feature to be used. If you have more than one CD frequency installed ensure that the transmitter and receiver are both set to the same CD frequency.

To select the CD frequency proceed as follows:

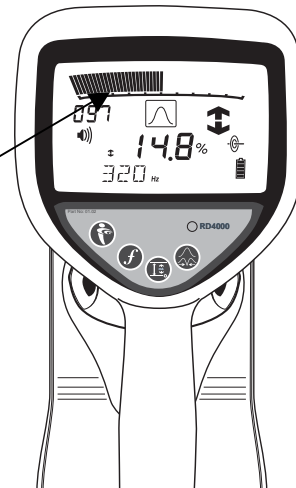
RD4000T10 transmitter

- Connect the transmitter to the conductor to be located, either by direct connection or by the use of a CD clamp
- Switch the transmitter on
- Select Locate mode
- Press the frequency key until the CD frequency is displayed 'CD' plus frequency). CD is a combination of two frequencies, a CD frequency and a locate frequency. The transmitter display will show CD and alternately display the two frequencies.

RD4000 receiver

- Switch the receiver on
- Press the frequency key until the CD frequency is displayed, indicated by the two small arrows above the frequency value (see illustration opposite)
- The receiver will switch back to locating mode.

CD frequency arrows



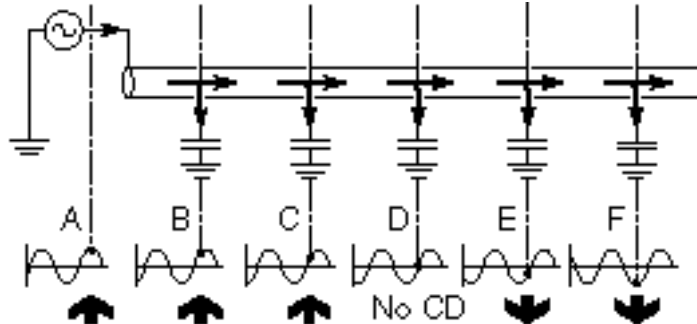
RD4000 Locating System User Manual

Using CD

CD reset

Why CD reset is necessary

As you trace a very long line the signal on the transmitter gradually 'leaks' into the ground by capacitance, so the phase angle of the remaining signal gradually changes. This is referred to as phase-shift and can occur whenever an alternating current signal is flowing in a system of conductors that have a significant capacitance or inductance. The relative phase angle between the two frequencies will alter, but only over extended distances. This can be best illustrated by reference to the illustration below.



This is a diagram of a buried line with significant capacitance to ground. It illustrates the gradual phase-shift that occurs along the line. The diagram shows a reference point on each waveform. At first, the reference point occurs right on the peak of a positive half cycle (A). It gradually moves towards the zero crossing point (D) and ends up on the peak of a negative half cycle (F). The direction has shifted from forwards to backwards. At the intermediate point (D) the current flow cannot be determined. At this point the CD arrows on the RD4000 receiver will flash on and off. In the example shown in the illustration, by returning to (C) which is the last point at which a CD reading was achieved, and performing a CD reset the response at (C) will be equivalent to that of (A).

In most cases the phase angle shift does not occur until many miles/kilometres from the transmitter and in some cases a CD rest may only be required every 20 kilometres (14 miles)

When to perform a CD reset

After connecting the transmitter signal, trace the target line about 15 metres/16 yards away from the transmitter and with the transmitter behind you perform a CD reset.

If the CD arrow flashes on and off, return to the last point at which a good CD reading was achieved and perform a CD reset. Check the phase angle reading on the receiver. If it is near 0° and the arrow has stopped flashing the CD reset has been successful. If the arrow is still flashing it could be a sign of a weak transmitter signal, possibly caused by the transmitter signal leaking onto another line. In any case the cause of the weak signal should be investigated.

To perform a CD reset proceed as follows:

- Pinpoint the line by holding the receiver facing forward with its foot on the ground and the transmitter behind you.
- Press menu, the phase angle in degrees is displayed. In the bottom left corner of the screen the word 'RESET' will also be displayed.
- Press any key other than menu key to return to CD locate without performing a reset, or Press menu again to perform a CD reset.

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- If CD reset is successful, the screen returns to the normal locate screen.
- If CD reset not successful, 'INFO 13' is displayed, indicating that the receiver and transmitter frequencies are not matched or the transmitter connection leads are wrongly connected. Check that the receiver display indicates a forward pointing arrow after the reset and phase angle is 0⁰.
- Reset the receiver CD reference each time the transmitter is turned off and on or the signal is disconnected and reconnected or when changing from direct connection to a CD clamp.
- Reset the CD reference at intervals of several kilometres/miles tracing distance or when a direction arrow flashes off and on. This reset procedure can be carried out near a joint or splice box where the identity of the target line is certain. Do not perform a CD reset over a splice box where cables may be looped.

When locating midway along a long line it may be difficult to define if the transmitter is ahead of or behind the line when resetting the receiver. 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 conductors. Make a CD locate on the visible line. The arrow should point back toward the transmitter. Then pinpoint the target line to check that there is a forward pointing arrow on the display.

- Reset the CD reference after pinpointing the target line
- If a nearby line also radiates a transmitter signal, pinpoint it and activate the CD feature to establish the current direction. The arrow will point back toward the transmitter if the signal has coupled to it from the target line.

Because the cable shields are bonded and the outward CD signal travels over the bond, CD is only effective on multiple cable installations as far as the following splice box.

Using a CD clamp or stethoscope

When using either of these accessories it is important to RESET the CD at a known point, near the transmitter, before making any identification measurements. On both the CD/CM clamp and the CD stethoscope there is an arrow that indicates which way the clamp or stethoscope is facing in relation to the transmitter. If the arrow is pointing away from the transmitter when the CD reset is performed the receiver display shows 000 and the bargraph reads 100%. If the arrow is pointing towards the transmitter, the receiver display shows 111 and there is no bargraph reading.

Data logging

Using the data logging facility depth and current can be logged and transmitted to an external data logger or Global Positioning System (GPS) device for later analysis. When logging data the external data logger must be connected to the RD4000 receiver, as the receiver does not have an internal data log store. Connect the data logger to the RD4000 receiver accessory socket by means of an RS232 lead.

Data is logged by means of the depth button as follows:

- Press and release the depth button to display the depth
- Do not touch any other button for five seconds and the depth and current will be automatically logged. After this time the receiver will switch back to locate mode.

If you do not wish to log the data, press the depth button within five seconds to cancel logging. The receiver will switch back to locate mode without logging.

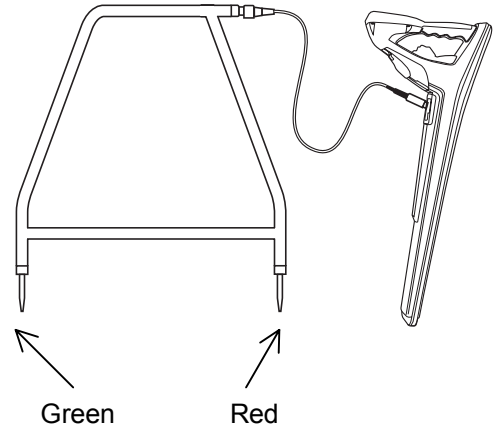
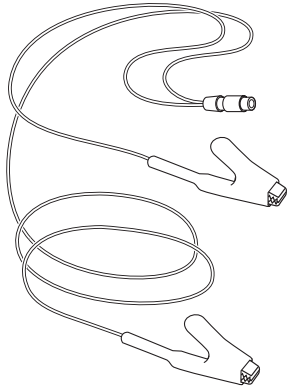
RD4000 Locating System User Manual

FAULTFINDING

Using the A-frame to locate cable sheath faults (FaultFinding)

The A-frame is used to locate cable sheath faults on power and telecom cables. To use FaultFind you will need the following equipment:

- RD4000Rx or RD4000MRx with FaultFind (FF) option
- RD4000T10 transmitter with FF option or RD4000T3F transmitter
- Accessory A-frame connection leads.



Preparation

Using RD4000 standard locating techniques, locate the cable for a short distance and trace and mark its route. Remove all earth bonds from the line to be traced during FaultFinding.

Connecting the transmitter

- Ensure the transmitter is switched off
- Push the connector plug into the transmitter accessory socket
- Clip the red connection lead to the cable or cable sheath ensuring that the area around the connection is clean
- Extend the black connection lead as far away as possible and at 90° to the probable route of the target cable and clip the connector to the ground stake.

Note: Always connect the black connection lead to a ground stake and not a water pipe or buried cable, as these may carry the signal.

Using the VΩ function to confirm a fault (RD4000T10 transmitter only)

If using the RD4000T10 transmitter, use the VΩ function to confirm the presence of a fault. Before performing this procedure, REMOVE ALL EARTH BONDS from the cable.

- Connect the transmitter
- Switch the transmitter on and using the up and down arrows, scroll through the menu until 'MEASURE' is displayed on the screen
- Press and hold the VΩ key to select ohms and take the resistance reading. A low resistance (typically less than two Megohms) indicates a fault.

RD4000 Locating System User Manual

Obtaining a reference reading

It is useful to obtain a reference reading from the ground stake.

This will provide you with two pieces of information:

- Severity of fault
- Survey interval.

Before taking the reference reading set up the transmitter and receiver as follows:

Setting FF on the transmitter (RD4000T3F)

- Switch the transmitter on by pressing the on/off key
- Press the frequency key repeatedly until the FF LED is illuminated.

Setting FF on the Transmitter (RD4000T10)

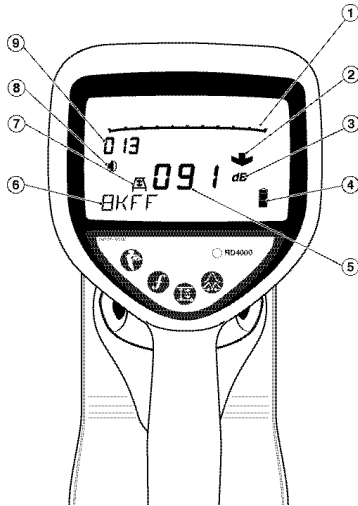
- Switch the transmitter on by pressing the on/off key
- Press the on/off key again to select menu
- Press the up arrow or down arrow to select 'FAULTFIND' mode
- Press the on/off key again to confirm selection. The FaultFind screen is displayed indicating that the FaultFind signal is being applied to the cable
- Press the up arrow to select 100% (boost). Press the down arrow to select 50% (normal). Use boost only if the fault is high resistance or if the cable to be surveyed is long. Using boost in other circumstances will reduce battery life.

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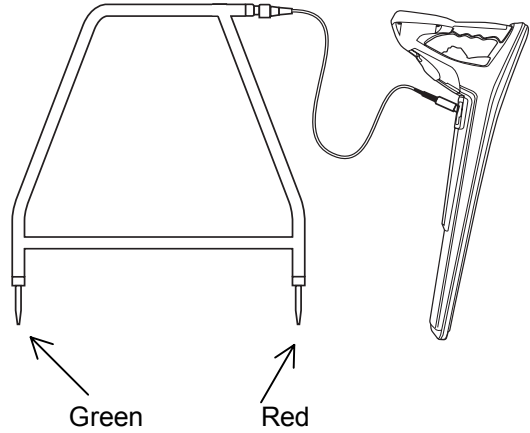
Connecting the A-frame to the receiver

- Plug one end of the connection lead into the A-frame socket
- Plug the other end into the receiver accessory socket
- Switch the receiver on by pressing the on/off key.

The receiver will automatically recognise that an A-frame has been connected and the FaultFind screen will be displayed (see illustration).



Receiver FF display



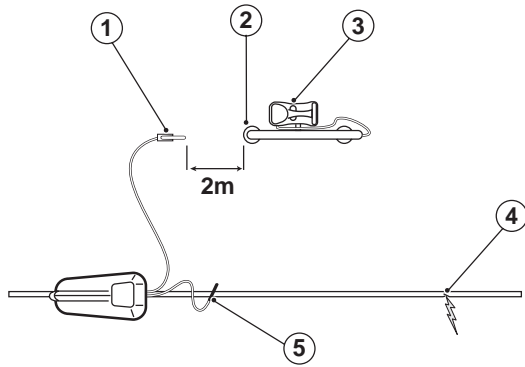
A-frame connected to the RD4000 receiver

- (1) Bargraph (disabled in FF)
- (2) Fault direction indication arrow
- (3) Measurement units
- (4) Battery level indicator
- (5) FaultFind signal strength
- (6) FaultFind frequency
- (7) A-frame connected indicator
- (8) Volume level
- (9) Locate signal gain level.

Note: Both the bargraph and audio output are disabled during FF.

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How to obtain a reference reading:



- (1) Transmitter to Ground stake (black connector)
- (2) A-frame green spike
- (3) Receiver (facing green spike)
- (4) Fault
- (5) Transmitter to cable sheath (red connector)

Applying the correct FF signal to the line.

- Ensure that the transmitter is switched on and is connected to a ground stake
- Connect the A-frame to the receiver accessory socket and switch the receiver on
- Position the receiver approximately two metres/six feet from the ground stake and push the A-frame spikes into the ground with the green spike towards the ground stake
- Attach the receiver to the A-frame by the retention hook. (If you are holding the receiver separately, make sure that the receiver is in line with the A-frame and is pointing towards the green spike.) The fault direction arrow should be pointing away from the ground stake. If it is not, make sure that the transmitter is connected correctly (red connector to the cable and black to the ground stake)
- Take the dB reading and keep it for reference. If there is a single fault on the cable, it will be approximately the same dB value as the reference reading.

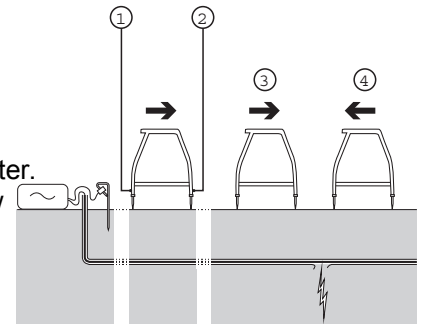
Tip. To establish how often to take readings on the cable, move away from the ground stake and take further readings until the arrow has difficulty in locking and the dB reading is low. Measure the distance that the receiver is now away from the ground stake. This is the distance that you can safely use between taking readings on the cable to ensure that you do not miss the fault.

Finding a fault

Starting from the transmitter, walk along the cable route pushing the spikes into the ground with the green spike pointing away from the transmitter. Where there are no faults the dB reading will be low and the direction arrow may flicker forward and back.

Note: Flickering arrows may also indicate that you may be too far away from the fault or ground stake (or both) for the receiver to lock on.

If you are trying to locate high resistance faults or there is a long distance between faults, carry on with the survey and the receiver will lock on when you get closer to the fault.



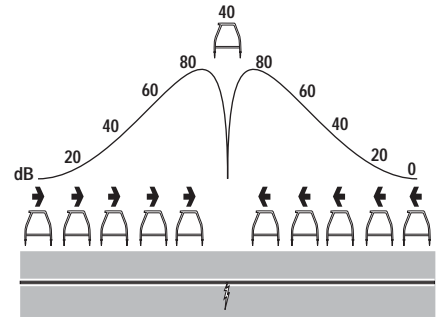
1. Red spike
2. Green spike
3. Fault ahead
4. Fault behind

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Take readings at the survey intervals determined by the reference reading. To locate the cable during a FaultFind survey, press the peak/null antenna button once and the receiver will switch to 8kHz null mode. Locate the cable using the normal null mode technique. Press the peak/null antenna button again to return to FaultFind mode.

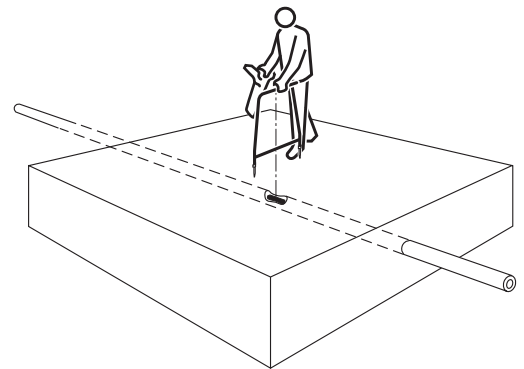
As a fault is approached the FaultFind direction arrow will lock on to the fault signal and point forward and the dB readings will increase. When the fault is passed the arrow will point back towards the transmitter. Take readings at smaller survey intervals to determine the exact point of the fault.

When the A-frame is directly over the fault the dB reading will drop as shown opposite.



Note: The values given are for illustration purposes only and may not be the same as those obtained in other situations.

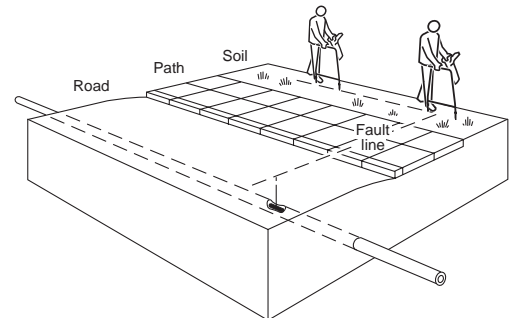
To pinpoint the fault, turn the A-frame 90° to the cable and FaultFind until the exact point is found where the arrow direction changes. The centre line of the A-frame is now directly over the fault.



Mark the ground to show the position of the fault. Find the maximum dB reading in front of the fault by pushing the A-frame into the ground at small intervals. Note the dB reading. If the reading is approximately the same as the reference reading, you can assume that there is only one fault. If the reading is less than the reference reading, keep surveying the cable for other faults.

Replace the bonds between the sheath and ground at each end of the line once the faultfinding survey has been completed.

Tip. If the cable runs under a road, use the equipment as normal on the road surface as it can sometimes detect signals when working on blacktop, concrete, or paved surfaces. If necessary, try wetting the road surface. Pouring a very small amount of water around the bottom of the A-frame spikes before each FaultFind will generally ensure a good ground connection.



Tip. If the cable runs under a paved surface, the fault can often be pinpointed by fault finding in the grass/soil adjacent to the paving. Reduce the distance between placing the A-frame spikes in the ground to allow for the increased distance to the actual fault position.

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RD4000MRx OPTION

The RD4000 M option enables users to locate all Electronic Marker System (EMS) and Omni™ markers. Folding down the special antenna activates the EMS function. In EMS mode, the receiver can be used to locate a buried conductor and a marker simultaneously or locate markers independently. In dual mode, the left/right arrows indicate the buried conductor position while the bargraph, numeric display, and audio response indicate the amplitude of the received marker signal.

The full range of markers, as listed below, can be located without the need to change to a different antenna. EMS markers are available in six frequencies and six different industry colours for all utility applications.

Application	Colour	Frequency
Power	Red	169.8 kHz
Water	Blue	145.7k Hz
Sanitary	Green	122.5 kHz
Telephone	Orange	101.4 kHz
Gas	Yellow	83.0 kHz
Cable TV	Orange/Black	77.0 kHz

The RD4000M option is compatible with 3M™ and ScotchMark™ EMS markers, Omni™ markers, pegs, or any other electronic marker tuned to the accepted frequency.

Selecting EMS mode

- Press the on/off key to switch the receiver on
- Fold down the EMS antenna. The receiver will enter display mode and display the last type of marker that was selected.

Changing EMS marker type

- Press the frequency key to select the marker you wish to locate. The abbreviations for each type of marker are displayed as:

PWR (Power)
H2O (Water)
SAN (Sanitary)
TEL (Telephone)
GAS (Gas)
CTV (Cable television)

Locating EMS markers

Dual mode locating

Use this mode when locating the marker and conductor simultaneously. To locate the conductor the transmitter applies a signal to the cable. In EMS marker mode the receiver has two gain levels, (high and low) indicated at the top left of the display. The high and low levels are selected using the gain paddle (clockwise for high, anticlockwise for low). The default sensitivity is high. The buried conductor signal gain is controlled automatically in this mode and is automatically set to null locate using the left/.

RD4000 Locating System User Manual

To set up the system for dual locating proceed as follows:

- (1) Connect the transmitter to the conductor.
- (2) Switch the transmitter on and select locate mode.
- (3) Select a standard locating frequency.
- (4) Switch the receiver on and select the same frequency as that selected the transmitter on.
- (5) Pull down the EMS antenna on the receiver. The EMS symbol is displayed.
- (6) Press the frequency key to select the type of marker you are trying to locate.
- (7) Press the peak/null key to select dual mode. The display shows the null symbol and location arrows, and the locate frequency is shown in place of the marker type.
- (8) Locate the conductor using the left/right arrows as normal but sweep the area either side of the conductor to ensure that all markers are located. When a marker is located the volume on the receiver will increase and the bargraph reading will increase. When you go past the marker the volume and bargraph reading will decrease.
- (9) Use the gain paddle to set the receiver sensitivity to low and pinpoint the marker.
- (10) Use the left and right arrows to locate the conductor.

Note: If you cannot locate the marker ensure that you have selected the correct marker type for the marker you are trying to locate.

Single mode locating

Use this mode when locating the marker only. For example, use single mode when locating markers used with plastic water or gas pipes.

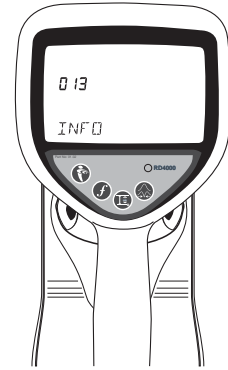
Proceed as follows:

- (1) Pull down the EMS antenna on the receiver.
- (2) Switch the receiver on.
- (3) Press the frequency key to select the type of marker you are trying to locate.
- (4) Carry out a sweep of the area in which the markers are located to ensure that all markers are located.

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RD4000 receiver information codes

The RD4000 incorporates several information codes that are displayed to show that a requested operation can not be performed. The information screen will be displayed for approximately five seconds and clear. The codes and their meanings are:



Code	Meaning
02	On switch-on, the receiver could not restore the previous settings. This means that when the receiver is switched on it will switch on in its default settings rather than those in which it was last switched off. This is not critical, as the receiver will function normally in all other respects.
05	During a depth reading the top antenna signal is greater than the bottom antenna. The receiver may be under overhead power cables. Take a depth reading in another location.
07	While computing the depth a signal has caused one or both antennas to 'clip' thus invalidating the depth reading. Repeat the measurement.
010	An accessory that is not supported by the current receiver software has been connected to the receiver. The receiver requires a software update before the accessory can be used.
011	Some 'intelligent' accessories have an identification code that tells the receiver the type of accessory that is connected to the receiver. Code 011 indicates that the identification code has been lost. Re-try the connection. If this is unsuccessful, the accessory needs re-programming.
013	A CD reset has been attempted but there is no valid CD signal. Try to reset again. If unsuccessful, ensure the transmitter connections are the correct way round.

RD4000 Locating System User Manual

RD4000T3, RD4000T3F, AND RD4000T10 TRANSMITTER OPERATION

This section gives guidelines on selecting the correct frequency, applying the transmitter signal and how to connect a transmitter. The principles that are common to all transmitters are explained first and specific information is then given for each transmitter.

Applying the transmitter signal

The transmitter is used to apply an easily identified signal to the target line so that the line can be traced, identified, and accurately located using the receiver. A number of application techniques are available for use in different location situations and you must choose the technique that applies the most appropriate signal to the line without the signal coupling to another line. Field experience, or the trial and error method of working through the application techniques, will help you determine the best method of applying the transmitter signal for a given situation.

Selecting the correct frequency

As high frequencies couple best onto other services they are usually used for applying the locate signal in induction mode. Note they will couple to everything in the vicinity so induction mode is usually best used as an avoidance technique rather than tracing technique.

Try to keep the power of the applied signal to the minimum required to do the job. Increase the power until a clear signal is located on the line you wish to trace. Increasing the power beyond this level will couple more signal to adjacent lines, make it more difficult to identify the target line, and will drain the batteries on the transmitter unnecessarily.

Do not connect the transmitter to cables carrying live voltages. Always use a signal clamp or plug connector.

Selecting the correct frequency for the job has an element of trial and error attached to it. There can be no hard and fast rules but a few guidelines are given below:

- Use high frequencies of 33kHz and above for high resistance lines such as: telecom lines, pipes with insulated flanges, and cast iron pipes. Be aware that the higher the frequency the more tendency there is for the signal to couple onto other services. Because of capacitance the signal will also be lost over a shorter distance.
- Use medium frequencies such as 8kHz and 33kHz for general locating of pipes and cables. These frequencies will travel quite long distances and will not couple too much onto other services.
- Low frequencies such as 640Hz or 512Hz should be used for long distance tracing. Low frequencies travel long distances without coupling to other lines. Low frequencies are also useful to locate long distance well-insulated transmission pipelines.

Transmitter Connection methods

Direct connection

In this method, the transmitter is directly connected to the target line by means of direct connection leads and crocodile type clips. By using direct connection, the target line can be identified from the application point to the point of interest. Direct connection is suitable for use on continuous tracer wire, water and gas distribution systems, telecom pair, power cable sheath (qualified personnel only), or to a pipeline at a cathodic protection (CP) test point or other access point.

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Connecting the leads

WARNING. Always connect the leads before switching the transmitter on. Do not touch the lead ends with the transmitter switched on but not connected to the earth stake.



WARNING. Before inserting a ground stake carry out a passive sweep of the area to ensure there are no buried cables where you are going to insert the ground stake.

- Plug the one end of the direct connection lead into the transmitter accessory socket and connect the red lead to the target line.
- Push a ground stake into the ground and clip the black ground lead to it. If possible position the ground stake four or five paces away from the transmitter, and preferably at right angles to the probable route of the target line.

Do not attach the ground lead to a water pipe or other buried line, which would then carry the transmitter signal. Use the receiver passive mode to check that there are no lines buried between the ground stake and transmitter as they could pick up the signal and confuse the locate survey.

Switch the transmitter on only after direct connection and ground connection have been made.

Adjusting the signal current level

- Select the required frequency
- Press the up and down arrows to select the required output.

The optimum output power level for a particular set of circumstances is best found by experience and trial and error.

Confirming a good connection

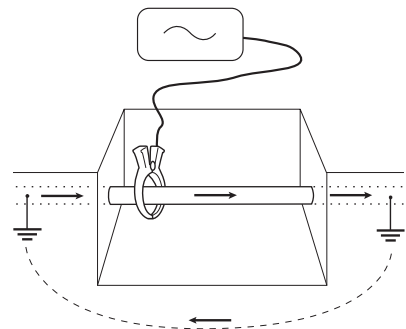
A tone change from the transmitter sounder indicates a good connection and that a strong signal has been applied to the target line. The lower the tone the better the connection will be.

Check there is a change in tone by switching the transmitter on with the lead connected and disconnected. If there is no tone change, try wetting the area around the bottom of the ground stake.

Transmitter clamps

Transmitter clamps are used to apply the transmitter signal to a cable or pipe without interrupting the supply and with reduced coupling. The clamp is easy to apply but the signal may not travel as far as if it was applied by direct connection. When using a clamp it is best if the target line is grounded at each end.

It is not necessary to make a ground connection from the transmitter when using a clamp but the line should be grounded on each side of the clamp for the signal to transfer to the line.



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Connecting a transmitter clamp

- Plug the clamp connector into the transmitter accessory socket
- Close the clamp around the pipe or cable, making sure the jaws are closed
- Switch the transmitter on
- Select required frequency and output power level.

Plug connector

The plug connector applies the transmitter signal to a live domestic power socket, and via the domestic wiring system, onto the service cable and the supply cable in the street. The signal should be detectable on the supply system a few hundred paces each side of the point of application. If access can be gained to the premises to apply the plug connector this is the most certain system to locate a power distribution system in the street.



Live cable connector

WARNING. THE LIVE CABLE CONNECTOR IS FOR USE ONLY BY OPERATORS LICENSED OR PERMITTED TO WORK ON LIVE CABLES.

The live cable connector is used to apply the transmitter signal to a live cable.

Induction

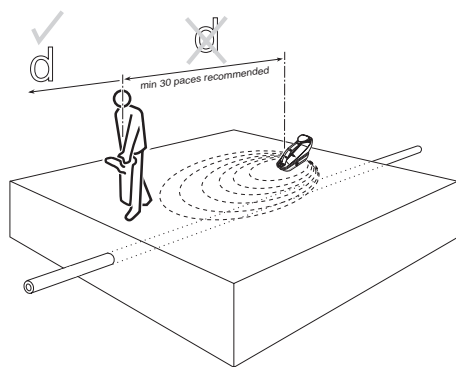
The RD4000T3, T3F, and RD4000T10 transmitters contain an antenna that will induce a signal onto a line directly below the transmitter. Induction efficiency is poor on deep targets and is useful at depths down to two metres/6 feet. The induction signal can be applied without access to the line and is very simple and quick to apply.

The signal can induce onto nearby lines as well as the target. A substantial part of the signal strength is lost in the surrounding soil. The receiver should not be used within a minimum of 30 paces from the transmitter, and often much further if high power is being used from the transmitter. Induction should not be used to apply a signal to a line that is below a metal cover or reinforced concrete (rebar), as the signal will be shielded by the metal cover and the reinforcing mesh. Induction will not apply a signal to a well-insulated line unless the line is effectively grounded at each end.

Positioning the transmitter

Position the transmitter over the target pipe or cable with the carrying handle in line with the pipe or cable.

Induction tips



Keeping distance from transmitter

In induction mode the transmitter radiates a signal into the atmosphere as well as onto the line and this may cause problems when trying to work close to the transmitter. To check that the receiver is locating the line rather than picking up the transmitter signal directly, move the transmitter a pace or two to one side. If the line appears to move too it indicates that the receiver is too close to the transmitter. Another method of determining if the receiver is picking up the transmitter signal is to point the receiver directly at the transmitter.

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If the receiver bargraph response is the same or increases it indicates that the receiver is picking up airborne signals.

In either case reduce the transmitter power and reduce the receiver sensitivity. It may also be necessary to move the receiver as much as 25 or 30 paces from the transmitter.

Do not place the transmitter on a manhole cover as this prevents the signal from reaching the line.

RD4000T3 AND RD4000T3F OPERATION



Switching the transmitter on/off

To switch the transmitter on, press and release the on/off key.

To switch the transmitter off, press the on/off key until the LEDs go off.

Holding down the on/off key for 2-3 seconds while switching on the transmitter reduces the transmitter volume level. (Depending on the model, the volume is either reduced or set to zero).

Selecting a frequency (direct connection)

The RD4000T3 transmitter is supplied with three frequencies and induction mode. In addition, the RD4000T3F has a FaultFind frequency.

The frequencies are those chosen by the customer at the time of transmitter purchase. If the values of the frequencies require changing when the unit is in-service, the unit must be returned to Radiodetection for re-configuration.

- To select a frequency, ensure that an accessory is plugged into the transmitter. The induction mode LED will extinguish.
- Press the frequency key to select the next available frequency. The selected frequency LED will illuminate. Further key presses cycle through all available frequencies.

Selecting induction

Switch the transmitter on. Induction mode is automatically selected if no accessory is plugged in. The induction mode LED illuminates.

Note: You can switch between induction and direct connection modes whilst the transmitter is operating by removing or plugging in an accessory.

Selecting a power output level/induction level

- Select the required frequency
- Press the up arrow key to select a higher output level and press the down arrow to select a lower output level. The LEDs will illuminate to show that the transmitter is supplying the requested signal current. A flashing LED indicates that the transmitter cannot supply the requested output, but is supplying as much signal current as possible. Restricted signal current may be because the connected line has high resistance on it. Improving the ground connection may increase the output.

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The power output levels are:

	Direct connection	Induction
One LED lit	5 mA	25%
Two LEDs lit	10 mA	50%
Three LEDs lit	30 mA	75%
Four LEDs lit	100 mA*	100%

* Limiting current reduced to 60mA for frequencies less than 1kHz. At 45kHz and above the output power is limited to 1W to comply with current legislation.

The sounder tone indicates connection quality. A lower tone indicates a better connection (more output on the line).

FF mode (RD4000T3F only)

Press the frequency key to select FaultFind. The red FF LED and all four output power LED's will illuminate.

Note: In FF mode, it is not possible to alter the output power level.

RD4000T10 OPERATION

Switching the transmitter on/off

Press the on/off key once to switch the transmitter on. Press the key again to enter the menu mode.

To switch the unit off, press the on/off button until the LCD display clears.

Checking battery level



The battery level indicator is situated at the top right hand side of the display and is made up of four segments. As the remaining battery life reduces the segments change colour from black to clear to indicate the amount of battery life left. When there is one black segment left the 'Almost Discharged' indication will flash and the battery discharge alarm will sound until the battery is discharged.

Note: Ensure that you always have enough batteries available to complete the task.

Selecting a frequency in locate mode

The frequencies are those chosen by the customer at the time of transmitter purchase. If the values of the frequencies require changing when the unit is in-service, the unit can be re-configured by using the web-enabling feature (does not apply to induction frequencies).

- Switch on the unit
- Press the frequency key to scroll through the available frequencies. The selected frequency is displayed.

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Selecting a power output level

- Select the required frequency.
- Press the up arrow key to select a higher output level and press the down arrow to select a lower output level. The power output indicator will display a visual indication of achieved output level.

Output levels for each segment of the indicator are shown in the following table:

NUMBER OF SEGMENTS	Direct - Locate	Direct - ACID	Direct - FaultFind	Induction + All Others
Outline	10mA			
1 bar	30mA	30mA		(25%)
2 bar	60mA			
3 bar	100mA	100mA	Normal (50%)	(50%)
4 bar	200mA			
5 bar	400mA	400mA		(75%)
6 bar	700mA			
7 bar	1A	1A	Boost (100%)	(100%)

Note: If the transmitter is outputting less than 10mA the display flashes "10mA" to indicate that better connections are required.

Selecting induction

Ensure that there is not an accessory plugged into the transmitter. Switch the transmitter on. Induction mode is automatically selected and the induction mode symbol is displayed. There can be two induction frequencies available in the RD4000T10. Use the frequency key to select the induction frequency required.

Using the VΩ function

In locate mode the line output voltage can be measured by pressing and holding down the VΩ key.

In measure mode DC resistance on the line can be measured by pressing and holding down the VΩ key. Measure mode can be used for frequencies up to dc 200KHz on lines up to 30V (SELV) only.

To access measure mode and take a resistance reading:

- Press on/off to select the menu and scroll using the down arrow to select Measure.
- Press on/off again to confirm selection.
- Press and hold down the measurement key to select ohms and take a resistance reading.

Selecting FF mode

- Switch the transmitter on
- Ensure the direct connection leads are plugged in
- Press the menu key and press the up or down arrow until 'FaultFind' is displayed.

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Selecting high voltages (above SELV-Safety Extra-Low Voltage)



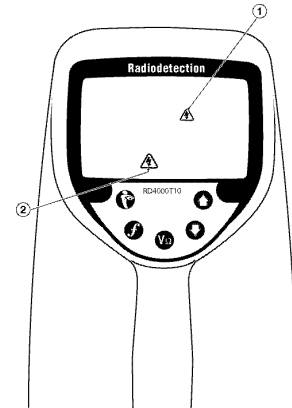
WARNING. With 'HI VOLTS' selected, high voltages can be applied to the line.
In FaultFind mode the transmitter can produce high voltage even with 'HI VOLTS' off.

The RD4000T10 is capable of outputting more than 30 volts but under normal operation is limited to an output of less than 30 volts. When the transmitter is switched on, it defaults to 'HI VOLTS' off which means that it is not possible for the transmitter to supply more than 30 volts.

To allow more than 30 volts to be applied proceed as follows:

- Switch the transmitter on
- Press the on/off key to select menu
- Press the up arrow to select 'HI VOLTS'
- Press the menu key
- Press the up arrow to select 'HI VOLTS ON'
- Press the menu key to confirm selection.

The 'HI VOLTS' icon (number 1 on illustration) is displayed.



If there are more than 30 volts on the line the second HI VOLTS symbol (number 2 on illustration) flashes on and off.

Connection using a signal clamp

- Plug the clamp into the accessory socket
- Switch the transmitter on.

The clamp symbol is displayed.

Using the web-enabling features

Lift up the transmitter RS232 dust cover, and plug the male end of the (supplied) RS232 communication lead into the RS232 socket. Plug the female end of the cable into the computer serial port (normally COM 1).

Switch on the computer and transmitter, access the Internet and in the address bar type:
<http://engineering.radiodetection.com>. You will also find a link to this site at Radiodetection.com.

Once you are connected to the website, follow the on-line instructions for using the site.

Transmitter error codes

Error codes are displayed to inform you that the software has failed in some way. Error codes are displayed as either 'ERR' (error) or 'FATAL ERR' (fatal error) followed by a number between 1 and 23. If an error occurs, the transmitter will not necessarily switch off. If a fatal error occurs, the transmitter will switch off 10 seconds after the fatal error code is displayed. If 'ERR' or 'FATAL ERR' is displayed perform the following procedure:

1. In the case of an error code, switch the transmitter off and then on again. If a fatal error is displayed and the transmitter has switched itself off, switch it on again. If the error code is not displayed download the current configuration (see 2), as the transmitter may have defaulted to its basic configuration.
2. If the error code is still displayed, use the web-enabling feature to download the transmitter current configuration.
3. Switch the transmitter on again.
4. If the error code is still displayed or the transmitter keeps switching itself off, contact Radiodetection for further advice.

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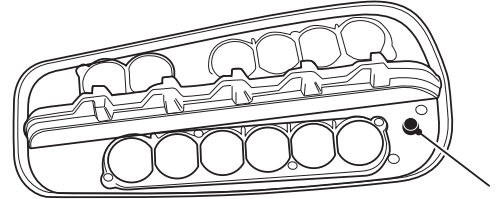
T10 TRANSMITTER TRIP SWITCH

Note: This feature and procedure apply only to some models. Other models do not have this feature fitted.

If the transmitter is being used to generate a signal on a mains power cable, and the power supply is accidentally switched on, the transmitter will sense that power has been applied and will operate the trip circuit to protect the transmitter from damage. If this happens 'TRIPPED' will be displayed on the screen and all transmitter functions will be disabled.

To reset the transmitter proceed as follows:

1. Switch off the transmitter.
2. Remove the power source from the cable.
3. Disconnect the transmitter from the cable.
4. Remove the battery housing.
5. Using a pen, press the reset switch, ensuring that it clicks when pressed. The reset switch is located in the transmitter housing (see illustration)
6. Replace the battery housing.
7. Switch the transmitter on.
8. Ensure that the transmitter does not display 'TRIPPED'.



If the power source is not removed from the cable, it will not be possible to reset the transmitter.

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ACCESSORIES

Note: For ease of identification all transmitter accessories have 4 pin connectors and all receiver accessories have 8 pin connectors.

Receiver Accessories

Receiver accessories include:

- | | |
|---------------|--|
| a) Headphones | d) Stethoscopes |
| b) Clamps | e) Submersible antennas (for underwater use) |
| c) Sondes | f) Accessory A-frame |



Summer headphones and winter headphones

Headphones are useful in noisy environments such as that caused by heavy traffic and enable the user to hear the audio response from the receiver. Radiodetection headphones are lightweight or heavyweight for use in different climatic conditions.

Clamps

A receiver clamp is used to positively locate and identify a cable when several cables are running close together. A target cable can be identified in a chamber, on a tray or other access point by fitting a clamp to the receiver and examining each cable in turn. Signal strength response shown on the receiver display should be noted for each cable.

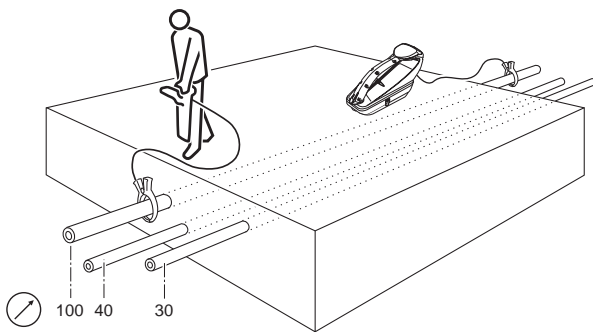
When to use clamps

Clamps can be used where:

- Several cables or pipes run in close proximity to each other
- A cable or pipe is accessible at an inspection hole or manhole.

Note: The standard clamp cannot be used with CM or CD. A special CM/CD clamp is available.

Connecting the clamp



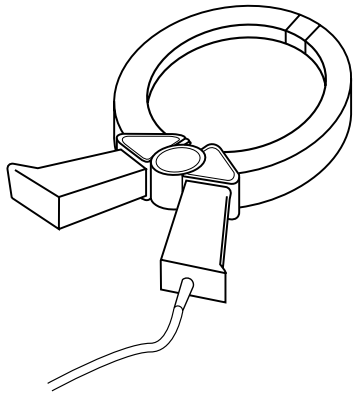
Put the clamp connector into the accessory socket on the front of the RD4000.
Place the clamp around the pipe or cable and switch the receiver on.
Set the frequency to the same as that on the transmitter.
Put the clamp around each cable in turn and note the bargraph response. Compare the strength of response from each cable. The cable with a substantially stronger response than the others will be the cable to which the transmitter signal has been applied.

To ensure that the target cable has been correctly identified, reverse the positions of the transmitter and receiver and check that the strongest response is still received from the target cable by the receiver in its new position.

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Types and range of receiver clamps

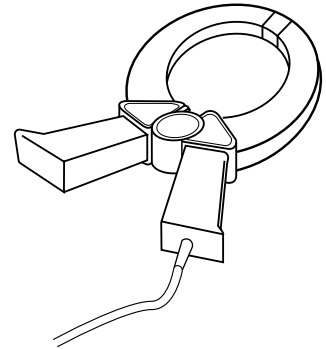
Standard clamp



The clamp plugs into the receiver accessory socket and is used for cable identification at points where the cable can be accessed. The standard clamp is suitable for cables up to 10cm/4-inch diameter.

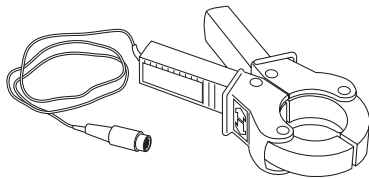
Small clamp

The small clamp performs the same function as the standard clamp but is useful in cramped situations where there is insufficient access for the standard clamp. The small clamp is suitable for cables up to 5cm/2-inch diameter.



Current Direction (CD) and Current Measurement (CM) clamp

The CD/CM clamp plugs into the accessory socket of the receiver and enables CD and CM measurements to be made on individual cables.



Sondes

When to use a sonde

A sonde transmitter is a small self-contained signal transmitter designed for insertion into non-metallic ducts, drains, or sewers so that it may be located and traced with a receiver. A wide range of transmitting sondes is available to suit different applications. 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.

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. Ensure that the frequency of the sonde corresponds with the receiver frequency, as the receiver will not locate the sonde unless the frequencies are the same. Sondes are marked with their transmitting frequency. Ensure that the means of propelling the sonde is available together with the correct fittings and couplings.

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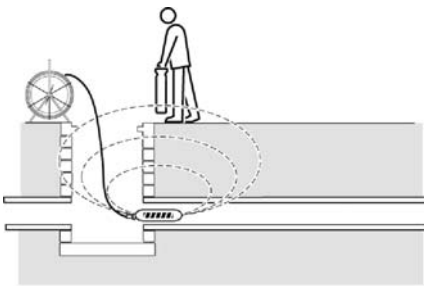
Preparation

Insert a new battery into the sonde. A new battery or a freshly recharged battery should be used at the beginning of each day and preferably at the start of each new job.

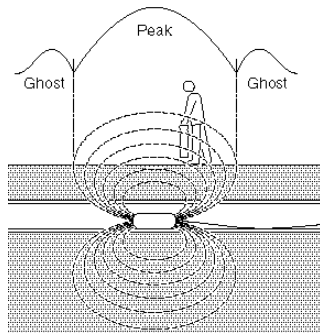
Before inserting the sonde, check that the sonde and receiver are at the same frequency and working correctly. To do this, place the sonde on the ground at a distance from the receiver that equal to the rated depth of the sonde. Point the receiver at the sonde with the antenna in line with the sonde (the opposite of using the receiver to locate a line) and check that the bargraph reading exceeds 50% at maximum sensitivity.

Propelling a sonde

Sondes have a male thread at one end for connecting to drain rods, or to other devices for inserting and propelling the sonde along a drain or duct. Sondes may be floated along drains at the end of a tether and floats are available for fitting to the sewer sonde and super sonde. Sondes can be strapped to high-pressure water jets or similar devices used for cleaning, maintaining and inspecting drains. Sondes used in underground drilling and boring operations are normally housed in the boring or drill head behind the boring or drill bit.

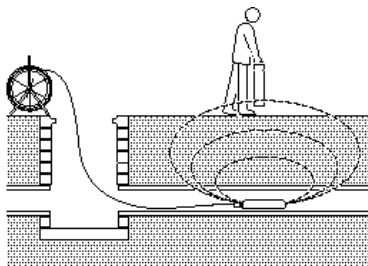


Insert the sonde in the drain or duct access and locate it while it is still just in view at the drain or duct entrance. Hold the receiver vertical directly over the sonde with the antenna in line with the sonde. Adjust the receiver sensitivity so the bargraph reads between 60% and 80%.



The sonde radiates a peak field from the centre of its axis with a ghost signal at each end of the peak. Move the receiver a little way behind and then in front of the axis of the sonde to detect the ghost signals. Finding the two ghost signals positively confirms the locate. Reduce the receiver sensitivity to lose the ghost signals but still indicate a clear peak response directly over the sonde. Receiver sensitivity is now set for tracing the duct or drain unless the distance between sonde and receiver changes.

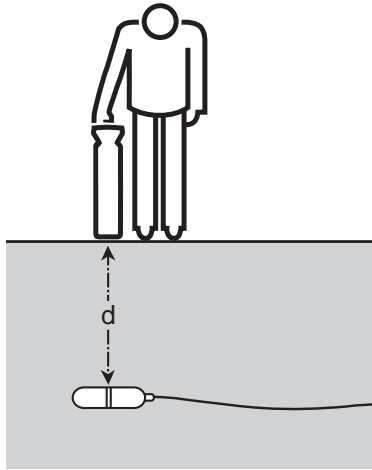
Propel the sonde three paces along the drain or duct and stop. Place the receiver over the supposed position of the sonde. Do not adjust the sensitivity level.



1. Move the receiver backwards and forwards with the blade in line with the sonde and stop when the bargraph indicates a peak.
2. Rotate the receiver as if the blade is a pivot. Stop when the bargraph indicates a peak.
3. Move the receiver from side to side until the bargraph indicates a peak.
4. Repeat 1, 2, and 3 with the antenna vertical and resting on or just above the ground. The receiver should then be directly above the sonde with the antenna in-line with it. Mark the position of the sonde and its direction.
5. Propel the sonde a further three or four paces, pinpoint, and mark the position. Repeat this pinpoint procedure at similar intervals along the line of the drain or duct until the survey is completed.

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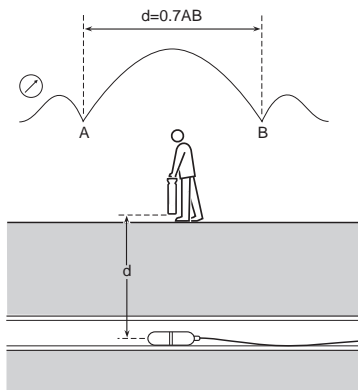
Checking the depth of a sonde



Electronic depth measurement.

Pinpoint the sonde following procedures 1-4 above. Adjust sensitivity to bring the bargraph indication on scale. Switch the receiver to sonde depth indication. Depress the depth measurement key and read the depth on the display.

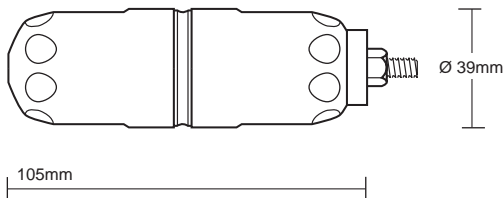
Note: If the receiver is not set to sonde mode, the unit will still work but the depth indication will not be correct.



Calculation method.

Pinpoint the sonde. Move the receiver in front of the sonde and still with the antenna in line with it, increase sensitivity to find the peak of the ghost signal. Move the receiver to behind the sonde ensuring that the receiver blade is always in line with the sonde. Find the null positions A and B. Measure the distance between them and multiply by 0.7 to give an approximate depth measurement.

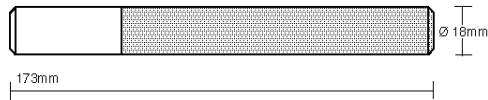
Types and range of sondes



Standard sonde.

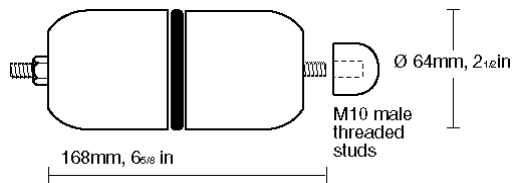
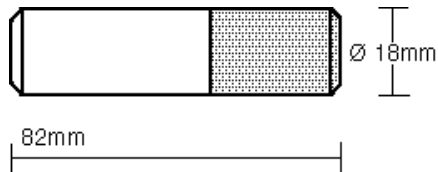
The standard sonde combines compact size with a strong signal and is the standard sonde for most applications unless a smaller size, greater depth, or rugged construction sonde is required.

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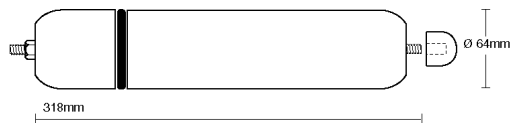
Super small sonde.

This is a specialised sonde particularly suitable for no-dig applications. This type of sonde has interchangeable battery housings so that the length of the sonde can be altered. Shortening the length of the sonde means that fewer batteries can be accommodated and this will affect battery life.



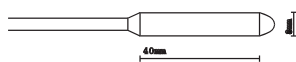
Sewer sonde.

This sonde incorporates a very strong housing and makes the sonde suitable for use in municipal sewer systems. The sonde has a long life for daily use in all conditions.



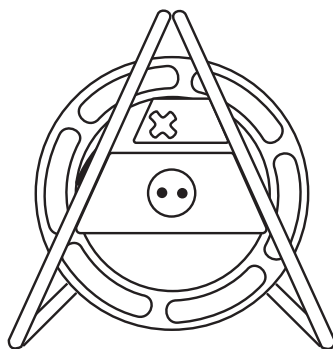
Super sonde.

A particularly rugged sonde for use in deep sewers.



FlexiTrace.

The FlexiTrace is a traceable plastic covered fibreglass rod incorporating wire conductors and is used for locating small diameter, non-metallic pipes to a depth of to 3 metres/10 feet. The FlexiTrace can be inserted into a pipe or duct as small as 12 mm/0.5 inch internal diameter with a minimum bend radius of 250 mm/10 inches. Batteries are not required, as the FlexiTrace is powered by a compatible RD4000 transmitter.

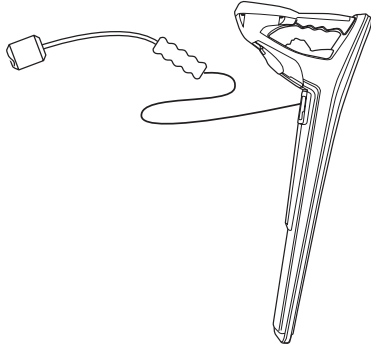


The FlexiTrace can be used in two modes: Sonde mode or Line mode. In Sonde mode only the tip of the FlexiTrace is energised whilst in Line mode its whole length is energised.

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To use as a sonde, connect both transmitter leads to the FlexiTrace stud terminals. As the FlexiTrace terminals are not colour code it does not matter which terminals the leads are connected to.
To use the FlexiTrace in line mode, connect the red transmitter lead to a FlexiTrace terminal and ground the black lead.

Stethoscopes



When to use a stethoscope

At times, it may not be possible to put a clamp around a cable because of congestion or because of inaccessibility. A stethoscope antenna should be used in the place of the clamp to identify cables.

How to use a stethoscope

Plug the stethoscope into the receiver accessory socket. Press the concave head against each cable in turn to detect a maximum signal.

Types of stethoscope

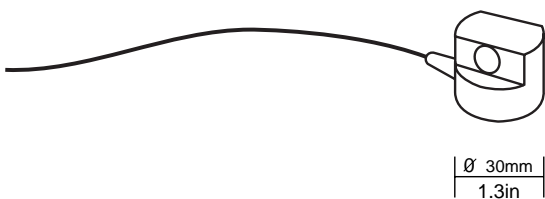
Large stethoscope antenna

The large stethoscope antenna, which plugs into the receiver accessory socket, is used for cable identification in situations where the cable is exposed. It is particularly useful for identifying heavy cables lying in a tray where it is not possible to fit a clamp. The concave detector head on the end of the insulated, flexible gooseneck is placed firmly against the cable to be identified. If there are a number of cables, the stethoscope antenna will give the strongest response from the cable to which the transmitter signal has been applied.



Small stethoscope antenna

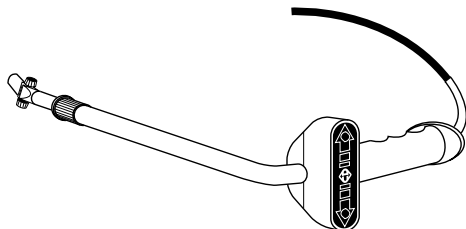
The small stethoscope antenna has a 25mm/1in concave head at the end of a 2m/78 inch lead. The small stethoscope can be screwed into an extension rod or used at the end of several extension rods joined together for identifying inaccessible small cables.



Miniature hi-gain stethoscope

The miniature stethoscope is similar to the small stethoscope but has no handle or facility for extension rods.

The miniature stethoscope can also be used as a miniature antenna for locations where the bulk of the receiver makes it inconvenient for use, such as locating pipes or cables in walls.

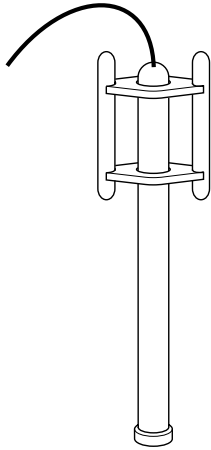


CD stethoscope

In restricted areas, the CD stethoscope can be used to obtain current direction but not current measurement.

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Submersible double depth antenna



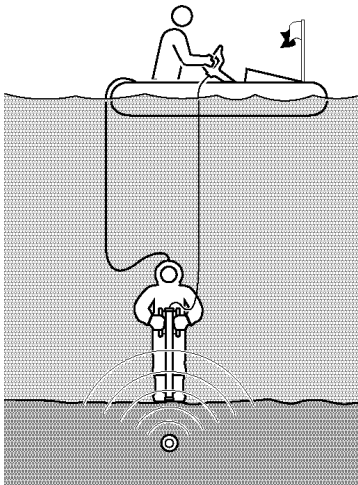
When to use the submersible double depth antenna

Tracing buried pipes and cables across waterways and estuaries are frequent and critical locating applications. Less frequent but equally important is tracing and locating lines between the mainland and offshore islands. When locating pipes and cables the receiver sensing antennas should be as close as possible to the target line so it is not practical to locate lines buried under a river or seabed from the surface. In most cases, it is necessary to measure the depth of cover to ensure the line is protected from dragging anchors or other underwater hazards.

The submersible, double depth antenna is suitable for use under water for tracing pipes or cables. There is a weight at the bottom of the antenna for stability and the unit has been pressure tested to IP68 to a depth of 100m.

The antenna is supplied with 10m of submersible marine umbilical cable as standard, but lengths of up to 100m can be supplied. The extra length enables the antenna to be carried by a diver on a riverbed or seabed while the receiver is used in a surface vessel. It is crucial to have effective communication between the operator with the receiver and the diver with the antenna.

Alternatively the antenna can be fastened to the end of a non-metallic boom from a barge and lowered to the riverbed or seabed.



How to use a submersible double depth antenna.

Apply the transmitter signal to the target line at an access point on the shore. The submersible antenna line for tracing the line underwater is plugged into accessory socket of the receiver, which is used on board a boat, which is positioned directly over the line. The transmitting signal should be by direct connection with the strongest possible signal and a low frequency (less than 1kHz). Make a ground connection about 100 paces from the transmitter. Test the quality of signal on the line before locating on the water.

Note: The submersible antenna is calibrated to work at one frequency.

Tips for using the submersible double depth antenna

The user in the boat should be a specialist or have considerable experience using a receiver so that he or she can give concise instructions to the diver and avoid needless waste of expensive time in trial and error.

It is prudent for the pair to practice working together on dry land before attempting to locate underwater. Using the antenna the diver should locate and trace a known line blindfold receiving directions from the user with the receiver out of sight of the line and the diver.

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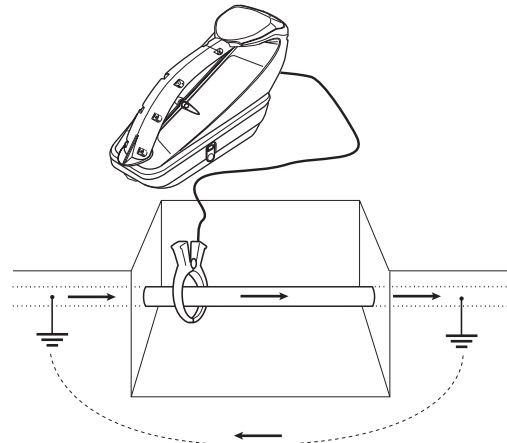
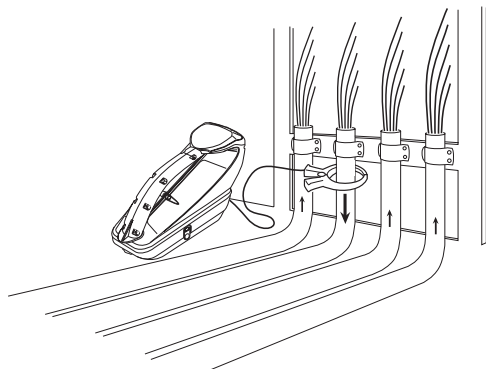
Because of rapid signal loss and a combination of large surface area and very conductive soil there may be problems applying a suitable signal for tracing a large diameter pipe. It may be necessary to use a high power, low frequency tracing signal.

It is necessary to define a method of recording target line position and depth before starting work in the boat or on the seabed.

Transmitter Accessories

Clamps

The transmitter clamp fits around a pipe or cable and safely applies a signal to a live cable without interrupting or disconnecting the supply. The clamp applies a very discriminating signal to a target line with reduced coupling to other lines. A clamp can sometimes be a more effective method of applying the signal than direct connection.



WARNING. WHEN CLAMPING AROUND A POWER CABLE ENSURE THAT THE CLAMP IS CONNECTED TO THE TRANSMITTER AT ALL TIMES.

The clamp may buzz or vibrate if it is placed around a power cable that has significant net current flow. This is normal and does not harm the equipment.

The target line will carry the strongest signal. The other lines will carry the weaker return signal. If the system comprises only two conductors, they may carry equal signals.

Connecting the clamp

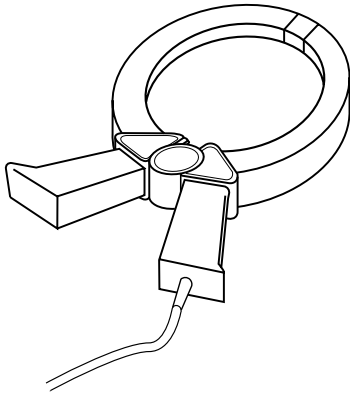
- Plug the clamp into the transmitter output socket.
- Put the clamp around the pipe or cable and ensure that the jaws are closed. Switch the transmitter on.

The line should be grounded (earthed) on each side of the clamp for the signal to transfer to the line. Ground the line if necessary. An insulated cable may be traced even if it has no actual ground connection, providing a reasonable length is buried either side of the clamp to provide capacitive coupling to ground (earth).

Note: It is not necessary to make a ground connection from the transmitter when using the clamp.

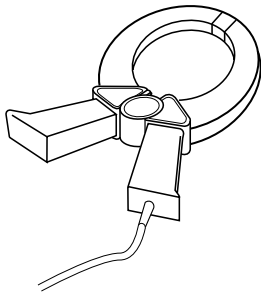
Types and range of transmitter clamps

Although transmitter and receiver clamps look the same, they have different internal windings. To prevent the wrong clamp being connected, transmitters and receiver clamps have plugs of a different orientation.



Standard signal clamp

The standard clamp applies the transmitter signal very selectively and effectively to a target cable up to 10cm/4-inch diameter at 8 /33kHz frequency or up to 75mm/3-inch diameter cable at 512 Hz. The standard and small clamps have a double spring action for positive toroidal contact.

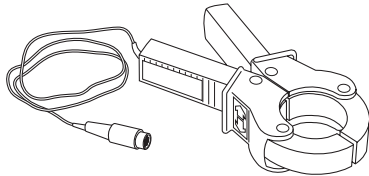


Small signal clamp

The small signal clamp is useful for applying an 8 kHz and 33kHz signal to a target cable in a pedestal or other place with limited space. The clamp is suitable for cables up to 5cm/2-inch diameter.

Current Direction (CD) and Current Measurement (CM) clamp

The CD/CM clamp plugged into the accessory socket of the transmitter enables CD and CM signals to be applied to individual cables.

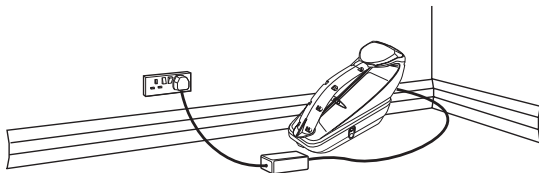


WARNING. The transmitter must only be connected to live services using the appropriate accessory such as a plug connector or live cable connector.

Plug connector

A plug connector applies the transmitter signal to a live domestic socket onto the service cable and the distribution cable in the street. The 8kHz/33kHz signal is applied between the live and ground conductors on a three-pin plug. The connector can also be fitted with a 2-pin plug with the signal applied across the live and neutral.

The plug type must be specified at the time of order.



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When to use a plug connector

The plug connector is used when it is necessary to put a signal onto a line to trace it from the domestic plug to the service cable and there is access to a live domestic socket. The plug connector applies an 8kHz/33kHz transmitter signal to a live domestic power socket and, via the domestic wiring system, onto the service cable and the supply cable in the street.

How to use a plug connector

- Insert the plug connector to the transmitter accessory socket and fit the plug to a live domestic power socket. The socket must be live for signal application.
- Switch on the socket.

The signal is applied between the live and ground conductors on a three-pin plug. The connector can also be fitted with a two-pin plug with the signal applied across the live and neutral.

The user and the transmitter are fully protected from supply voltages up to 300V, DC to 65Hz.

Live cable connector

Safety precautions



WARNING. THE LIVE CABLE CONNECTOR IS TO BE USED ONLY BY OPERATORS LICENSED OR PERMITTED TO WORK ON LIVE CABLES.

Authorisation

The live cable connector applies the transmitter signal to a live cable. It must only be used by personnel licensed or permitted to work on live cables and who are trained in the safety precautions related to working on live cables.

When to use a live cable connector

The live cable connector applies an 8kHz/33kHz tracing signal safely to live low voltage cables. The live cable connector is used to trace and identify cables and locate simple cable faults by connecting directly to a live conductor at a domestic cut out, street lamp, junction box, or substation low voltage busbar.

Introduction to the live cable connector

The live cable connector consists of a box with a transmitter connection cable at one end and two output cables at the other end. One cable terminates in a red connector and the other cable terminates in a black connector. The two output connectors each incorporate a 1-amp fuse, which can be accessed by screwing the connector head from the connector body.

How to use a live cable connector

Plug the transmitter connection cable into the accessories connector on the transmitter. Connect the red connector to the live conductor and connect the black connector to neutral or ground as appropriate. The transmitter indicates by change in tone or on the display when a satisfactory connection has been made. The user and transmitter are fully protected from supply voltages up to 500V, DC to 65Hz.

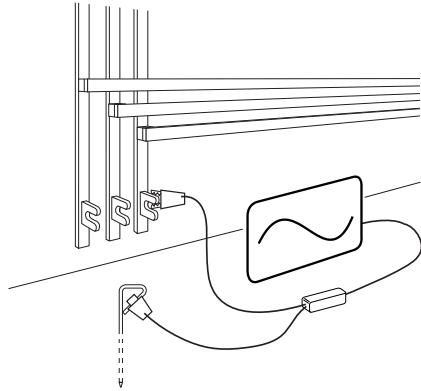
Positive cable tracing and identification in a domestic house:

- Connect the red clip to a terminal box connection. Remove fuse if necessary
- Connect the black clip to an independent ground point outside.

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Street-light cable tracing:

- Connect red clip to the incoming live cable
- Connect black clip to the lighting column if metal or to an independent ground point.



The live cable connector can be used in a similar way to apply a signal directly to cables through live Low Voltage (LV) isolators, such as fuse boxes in industrial sites.

LOCATING TIPS

Eliminating services

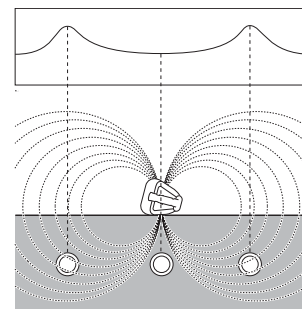
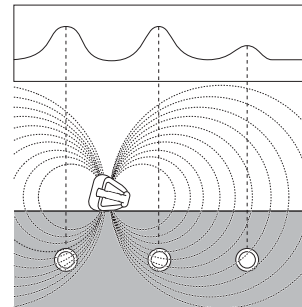
Induction

If several conductors are running parallel and it is not possible to connect a transmitter, each line may be located separately. Proceed as follows:

- Perform a sweep of the area to find the position and number of conductors in the area
- Map the direction in which the conductors are going

To trace the lines:

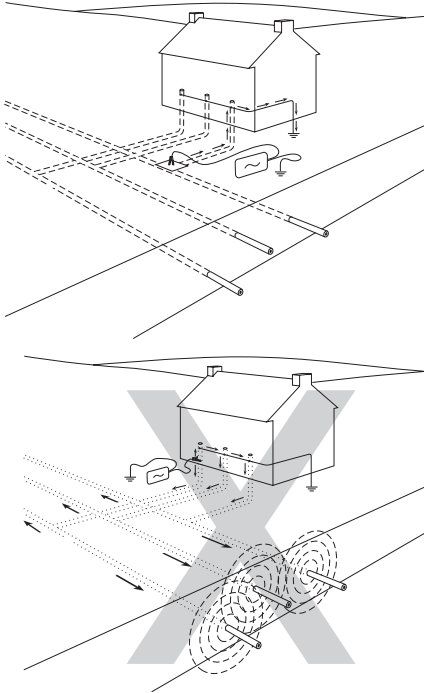
- Select induction mode on the transmitter
- Select the same frequency as on the receiver
- Place the transmitter on its side and in line with a conductor
- Ensure the conductor is directly below the transmitter
- This will null the signal directly below the transmitter and, in addition, enable the other conductors to be located
- Locate each conductor and mark its position
- Move the transmitter down the route and continue locating and marking
- Trace each conductor out of the search area until the target line can be accurately located.



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Unwanted signal coupling

Unwanted coupling of the signal from the target line to another nearby line is one of the most common location problems. It leads either to an error in the marked position and depth of the 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.



- ❑ Avoid applying the signal by induction. The signal may be coupling to more than one line directly from the transmitter. Use the signal clamp where possible.
- ❑ Identify points where lines may be bonded or in close proximity to each other. Work toward these points rather than away from them. For example, if gas and water pipes are bonded within a building, apply the signal at the valves or access points in the road rather than in the building.
- ❑ Reduce coupling to a parallel line by using a low signal frequency where available.
- ❑ Return signal flowing on another line. Use a double-ended connection to by-pass the ground return if possible.
- ❑ Choose a signal application point where the line is furthest from other lines and not a congested area.
- ❑ When using single-ended connection, site the ground stake as far from the target line as possible and away from other buried lines.
- ❑ Avoid using existing structures for ground connections; other buried lines may be bonded to them.

A bad ground connection or just laying the ground lead on the surface at right angles to the line may result in less coupling than a good ground provided long distance tracing is not required.

Manhole cover as ground

Sometimes when locating, it is not possible to insert the ground stake into the earth, for example, when locating on hard ground such as roads. In this case, the ground return can be made by attaching the ground lead to the metal frame of a manhole.

Using lighting columns

Direct 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 onto the column enables the user to locate the street lighting quickly and safely without having to call out a technician from the lighting company.

If the lighting column is made from concrete make the transmitter connection to the cable sheath unless the cable is earthed to the inspection doorframe. Connection to the cable sheath applies the transmitter signal for a considerable distance enabling the receiver to trace cables feeding illuminated street furniture as well as other street lights.



WARNING. THE LIVE CABLE CONNECTOR IS FOR USE ONLY BY OPERATORS LICENSED OR PERMITTED TO WORK ON LIVE CABLES.

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When the cable is not grounded at the column, open the inspection door and connect the live cable connector to the live or neutral conductor.

The use of a street light column as a means of applying a signal to other power cables on the same electric circuit is a possibility. The signal may be weak using this method because it may have travelled some distance back to the sub-station and out again on the other system. With the receiver used on a high sensitivity setting it is often possible to locate a cable, which would otherwise have been difficult or inconvenient to energise with the transmitter signal.

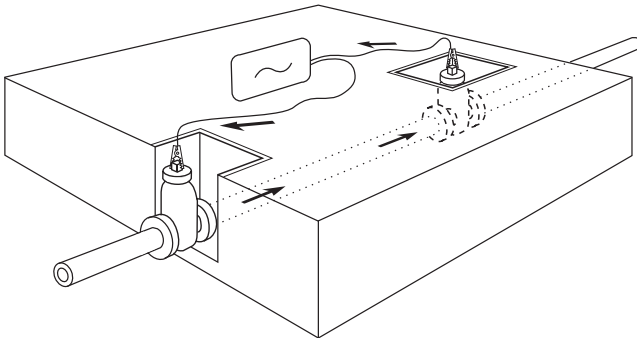
Finding a good ground point

When using a direct connection, it is important get the best possible grounding for the transmitter. This provides the lowest resistance ground path and the best output signal. If it is not possible to use the ground stake the following are examples of good alternative ground points:

- Metal manhole covers
- Metal drainage grates
- Metal railings
- Metal fence posts

Double ended connections

Large diameter water pipes and gas distribution pipes that are laid in sections sometimes have insulated joints between the sections and can be difficult to locate using a single ended connect. This is because when using a single ended connection ground return, signals can often cause confusion by returning to the transmitter along other lines. The problem sometimes occurs when return signals appear stronger than on the target line, usually because the target line is deeper than the line carrying the return signal, or the return path may be a better electrical conductor than the target line.



Applying a double-ended transmitter connection is a useful technique for positively tracing and identifying a target line in a situation such as a heavily congested industrial site, provided there are access points at each end of the line.

Connect the transmitter to an access point on the target line. The transmitter ground is connected with a long cable to another access point further along the line. A complete circuit is achieved without using ground as a current return path. The long cable should be kept as far away as possible from the expected route of the line.

Making a double ended connection

Connect the transmitter to an access point on the target line. The transmitter ground is connected with a long cable to another access point further along the line. A complete circuit is achieved without using ground as a current return path. The long cable should be kept as far away as possible from the expected route of the line. Radiodetection supplies 50 metre/54 yard and 200 metre/218 yard extension cables for this purpose.

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 display should remain constant if the depth of the line does not change.

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TECHNICAL SPECIFICATIONS

The following pages contain the technical specifications for the RD4000 T3 and T3F transmitter, RD4000 T10 transmitter, and the RD4000 Rx and MRx receivers.

RD4000 Locating System User Manual

RD4000 Locating System User Manual

RD4000T3 and T3F Transmitters Technical Specification

Description: RD4000 transmitter

Part No: 10/T3 -* (*=version)
10/T3F -* (*=version)



Physical:

Construction High Impact thermoplastic injection moulded case sealed to IP55 (excludes all battery tray variants)

Ruggedness Withstands one metre drop onto concrete (BS EN 60068-2)

Dimensions Approximately 180mm/7.1"(D) x 350mm/13.78"(W) x 230mm/9"(H)

Weight Approximately 4.2kg/9.26lb

Available Operating Modes:

Locate mode by Induction
Locate Mode by Direct Connection
FaultFind Mode by Direct Connection (T3F only)

Available Frequencies ($\pm 3\text{Hz}$)

1 Induction Frequency from the following: 8.192kHz, 32.768kHz, 65.536kHz, 83.000kHz or 200.000kHz – factory configurable
Up to 3 Direct Connection Frequencies from RD standard range 440Hz – 200kHz – factory configurable

FaultFind Output (RD4000T3F Only)

FaultFind frequency 8.192kHz/8Hz composite signal compatible with existing Radiodetection fault finding equipment
FaultFind Voltage 120V at 8mA maximum.

Audio Indication

Transmitter On	1 second tone at switch on
Connection Quality	Sliding Tone from 40-400Hz lower tone equals more current on line (i.e. better connection)
Low Battery Alarm Condition	Connection Tone pulses off 1 second in 5 2 second warning tone

Visual Indication

Nine LEDs provide feedback of transmitter operation	
Output Level indicator	Four Red LEDs
Induction selected	One Red LED
Frequency/Mode selection	Four Green LEDs

All nine LEDs illuminate for 2 seconds at switch on as a lamp check function

Output Protection

Output protected from inadvertent connection to 240V AC RMS.

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Signal Output

Continuous sinusoidal output waveform of selected frequency or FaultFind composite waveform if selected. Output pulses off 1 second in 5 (synchronised to connection tone) to indicate low battery conditions in normal modes of operation. To enable continued locating, FaultFind output does not pulse with low batteries

Performance

Connection Performance

Output Level	Open Circuit Voltage	Limiting Current	Maximum Power
1	30V RMS	5mA	0.15W
2	30V RMS	10mA	0.30W
3	30V RMS	30mA	0.90W
4	30V RMS	100mA*	3.00W**

* Limiting current reduced to 60mA for frequencies less than 1kHz

** At 45kHz and above the output power is limited to 1W to comply with current legislation

Induction Performance

Output adjustable in four steps: 25%, 50% 75% and 100%

At 45kHz and above the output power is limited to 1W to comply with current legislation

Batteries

12 off LR20 (D) Alkaline 1.5V cells

>8 hours continuous life at maximum output power (3W) at 20°C

External 12V input socket for external power supply

Optional rechargeable pack

External Connectors

RS232

Accessory outlet

Standard accessories

- Direct connection lead
- External 12 volt supply lead
- Earth (ground) stake

Optional accessories

- 2" and 4" clamps
- Carry bag
- Earth extension lead
- Live plug connector
- Live cable connector

Temperature Range

Operating temperature: -20°C to +50°C

Storage temperature: -40°C to +70°C

Quality Control

BS5750/ISO 9001/EN29001.

Approvals

CE Complies with European R&TTE Directive 1999/5/EC

Complies with FCC Rules Part 15

Warranty

12 months.

RD4000 Locating System User Manual

RD4000 T10 Transmitter Technical Specification

Description RD4000 T10 Transmitter

Part No. 11/T10 -* (*=version)

Physical Construction High Impact thermoplastic injection moulded case sealed to IP55 (excludes all battery tray variants)

Ruggedness Withstands one metre drop onto concrete (BS EN 60068-2)

Dimensions Approximately 180mm/7.1"(D) x 350mm/13.78"(W) x 230mm/9"(H)

Weight 4.3kg/9.5lb



Operating Modes:

Locate mode by Induction

FaultFind Mode by Direct Connection

Locate Mode by Direct Connection

(Optional) ACID-M Mode by Direct Connection

Measure Mode (DVM/AVO operation)

(Optional) Pipeline Mode by Direct Connection

Connected accessory is identified automatically and available modes/frequencies are set. Power restrictions for connected accessory are also set automatically. If no accessory is plugged in the unit defaults to induction mode.

Available Frequencies ($\pm 3\text{Hz}$)

Up to 2 Induction Frequencies from 8.192kHz, 32.768kHz, and 65.536kHz, or two from 65.536kHz, 83.000kHz and 200.000kHz – factory configurable

Other Modes*

Up to 16 direct connect frequencies

CD: up to 14 CD pairs may be used per accessory

Frequency configuration is factory/dealer configured but can be user modified by use of the RD Web-based configuration tool. Induction frequencies must be specified at time of order as they are factory configured

*Note: Not all frequencies are available for all modes and accessories; some accessories will place restrictions upon the band of frequency available for use (e.g. signal clamps)

FaultFind Output

FaultFind Frequency 8.192kHz/8Hz composite signal compatible with existing Radiodetection fault finding equipment – other FaultFind locate frequencies may be available at a later date.

FaultFind Voltage—120VRMS at 8mA maximum.

Audio Indication

Volume Adjustable in four levels: Mute, low, med, high via user interface menu.

Indication Tones

Connection Quality Sliding Tone from 40-400Hz. A lower tone equals more current on line (i.e. better connection)

Low Battery Connection Quality Tone pulses off 1 second in 5 and alert tone sounded of 6 rapid beeps

Error Condition Warning tone

Invalid Selection 1 short 200Hz beep

Live-Cable Warning Alternating Warning Tone sounded whilst cable energised

Visual Indication

- Custom transfective LCD with automatic backlight. LCD displays the following information:
- Line current/voltage/resistance
- Operating mode and frequency
- Demand Level
- Battery/External Power status
- Audio volume setting
- Connection graphic to show how signal applied to target line
- Warnings for SELV limited output and live cable

Output Protection

Output protected from inadvertent connection to 240V AC RMS via user resettable trip. LCD display gives user feedback that trip has operated. In FF mode the trip will not operate but the unit is still protected against inadvertent connection to 240 V AC.

RD4000 Locating System User Manual

Signal Output

Continuous sinusoidal output waveform of selected frequency or composite waveform if selected. Output pulses off 1 second in 5 (synchronised to connection tone) to indicate low battery conditions

Connection Performance

Output Level	Open Circuit Voltage*	Limiting Current	Maximum Power**
1	30V/50V RMS	10mA	0.50W
2	30V/50V RMS	30mA	1.50W
3	30V/50V RMS	60mA	3.00W
4	30V/50V RMS	100mA	5.00W
5	30V/50V RMS	200mA	10.00W
6	30V/50V RMS	400mA	10.00W
7	30V/50V RMS	700mA	10.00W
8	30V/50V RMS	1A	10.00W

Voltage can be increased from default 30V to 50V by menu selection. Voltage defaults to back to 30V each time unit is turned on.

**Output power maximum 10W, display shows HI POWER when output power greater than 5W. This allows user to maximise battery life if 10W maximum output power is not required.

At 45kHz and above the output power is limited to 1W to comply with current legislation.

Induction Performance

Output adjustable in four steps: 25%, 50% 75% and 100%

At 45kHz and above the output power is limited to 1W to comply with current legislation

Batteries 12 off LR20 (D)

Alkaline 1.5V cells

Optional High Capacity Rechargeable battery pack

Battery Life

Power output	Battery life (alkaline cells at 20°C and continuous use)
10W	> 4 hours
5W	>15 hours
1W	> 24 hours

External Connectors

RS232

Accessory outlet

Accessories

Accessories are automatically identified by the RD4000T10 when connected. The transmitter automatically selects mode and power/frequency limits based upon accessory fitted, and updates connection graphic on LCD display.

Standard accessories

- Direct connection lead
- External 12 volt supply lead
- Earth (ground) stake

Optional accessories

Carry bag Earth extension lead
2" and 4" clamps Live plug connector
CD clamps Live cable connector

Temperature Range

Operating temperature: -20°C to +50°C
Storage temperature: -40°C to +70°C

Quality Control

BS5750/ISO 9001/EN29001

Approvals

☐ Complies with European R&TTE Directive 1999/5/EC
Complies with FCC Rules Part 15

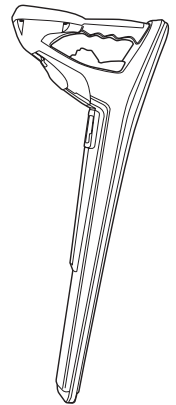
Warranty

12 months.

RD4000 Locating System User Manual

RD4000RX Technical Specification

Description:	RD4000 Precision Locator
Part No:	11/4KRx —* (*= version) 11/4KMRx —* (*= EMS version)
Physical:	
Construction	High impact thermoplastic, weatherproof to NEMA 3R and IP54
Ruggedness	Withstands one metre drop onto concrete (BS EN 60068-2)
Dimensions	Approximately 690mm/27" x 280mm/11" x 123 mm/4.8"
Weight	Standard version: 2.8 kg/6lb EMS version: 3.2 kg/7lb



Mode	Frequency	Bandwidth / Hz	Sensitivity* @ 1 m	Locating Depth Guide (meters/yards)	
				Good Conditions	Poor Conditions
Power	40 Hz – 700 Hz	500	7.5 mA	3	2
Radio	14 kHz – 26 kHz	10,000	20 µA	2	1
Active frequencies	8 kHz–100 kHz	10 ,20 or 40	25 µA	5	2
Active frequencies	100 kHz –200 kHz	10, 20, or 40	50 µA	3	2
CD	up to 1024 Hz	10, 20 or 40	250 µA	5	2
Lf	up to 2048 Hz	10, 20 or 40	250 µA	5	2
CPS	100 Hz or 120 Hz	10, 20 or 40	10mA	3	2
Fault-Find (via optional external A-frame accessory)	8 Hz and 8.192 kHz	10 or 20 10	2 µV @ 1MΩ 100 µA	3 --	2 --

* Sensitivity specified for Peak mode

Operating Modes:

Locate Accuracy:	5% of depth (depending on depth – see below)
Current Accuracy:	5% of actual current (depending on depth – see below)
Depth Accuracy	5% of depth on undistorted signal with no adjacent signals
Depth Range	Line — up to 3m @ 5% depth accuracy, 5% current accuracy up to 5m @ 10% depth accuracy, 10% current accuracy Sonde – up to 8m (with SuperSonde)

Visual Indication:

Liquid crystal display indicating the following:

Signal Strength %	Line Depth	Sonde Depth
Line signal current	Gain Level	Operating Mode
Line/sonde mode	Peak/Null/Single mode	Left/Right direction arrows
Battery Status	Speaker Volume	CD direction arrows
Accessory connected		

Audio Indication:

Audio signal output through water resistant speaker or optional headphones.

Search Antennas:

2 x dual wound horizontal and 1 vertical.

Antenna Configurations:

Single horizontal for Wide response operation
Dual horizontal for Peak operation
Horizontal and vertical for Null operation

Gain Control:

Rotary touch gain paddle

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- Batteries:** 4 x Alkaline size D (IEC: LR20)
Optional rechargeable battery pack with four NiMH rechargeable batteries
- Battery life** RX: greater than 16 hours @20°C (non-EMS modes)
MRx: greater than 8 hours @20°C (EMS mode)
- Temperature Range:** Operating temperature: -20°C to +50°C
Storage temperature: -40°C to +70°C
- External Connectors** RS232 connector (web-enabling/data logging)
Accessory socket
Headphone socket

Standard accessories

- RS232 lead

Optional accessories

- | | |
|---------------------|--|
| Carry bag | Sondes |
| 2" and 4" clamps | Stethoscopes (CD and standard) |
| CD clamps | Headphones (summer and winter) |
| Submersible antenna | Rechargeable battery pack (complete with external 12 volt charging lead) |
| A-frame | Data logger |

Automatic Accessory Detection

The following accessories are automatically identified by the RD4000 receiver when connected to the accessory socket. The receiver automatically selects operating mode(s) as appropriate to the accessory.

- | | |
|--------------------------|--------------------------------|
| Clamps (CD and standard) | Submersible Antenna |
| Sondes | Stethoscopes (CD and standard) |
| A-frame | |

Receiver Options:

Electronic Marker-Ball Detection:

(RD4000MRx)

Operation : Detection of any 1 of 6 marker types buried to a depth of 1.4m,
Detection of large deep markers to a depth of 3m,
Bar-graph and variable pitch tone to indicate signal strength
Manual EMS Gain Control – High / Low

Dedicated Marker Detection

Dual Mode Operation: Narrow Band Cable Location (Null Mode only) combined with
Marker Ball Detection


Marker Types

Application	Colour	Frequency
Power	Red	169.8 kHz
Water	Blue	145.7k Hz
Sanitary	Green	122.5 kHz
Telephone	Orange	101.4 kHz
Gas	Yellow	83.0 kHz
Cable TV	Orange/Black	77.0 kHz

Compatibility Recommended for use with Radiodetection T3, T3F, T10, PTX-3 transmitters and LMS

Also backward compatible with obsolete Radiodetection transmitters.

Quality Control BS5750/ISO 9001/EN29001.

Approvals  Complies with European R&TTE Directive 1999/5/EC
Complies with FCC Rules Part 15

Warranty 12 months.

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