# RD533

Radiodetection's advanced water leak correlator

Operation Manual  l  Issue 2  l  June 2009

**Radiodetection**
AN SPX COMPANY

# Preface

## Before you begin

Thank you for your interest in Radiodetection's RD533 water leak correlator.

Please read this user manual before attempting to use the RD533 system.

Radiodetection products, including this manual, are under continuous development. The information contained within is accurate at time of publication; however the RD533, this manual and all its contents are subject to change.

Radiodetection Limited reserves the right to modify the product without notice and some product changes may have taken place after this user manual was published.

Contact your local Radiodetection dealer or visit www.radiodetection.com for the latest information about the RD533 product family, including this manual.

## Important notices

### General

This instrument, or family of instruments, will not be permanently damaged by reasonable electrostatic discharge and has been tested in accordance with IEC 801-2. However, in extreme cases temporary malfunction may occur. If this happens, switch off, wait and switch on again. If the instrument still malfunctions, disconnect the batteries for a few seconds.

### Safety

This equipment should be used by fully qualified and trained personnel only.

Reduce audio level before using headphones to avoid damaging your hearing.

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

## Training

Radiodetection provides training services for most Radiodetection products. Our qualified instructors will train equipment operators or other personnel at your preferred location or at Radiodetection headquarters.

For more information go to www.radiodetection.com or contact your local Radiodetection representative.

## Trademarks

RD533 is a trademark of Radiodetection Ltd.

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# Table of contents

# Section 1 – Introduction

## 1.1 Overview

The RD533 correlator is a multi-function system that is designed to detect leaks and trace pipeline topography of water supply networks. When used with a transmitter, the RD533 can trace a pipeline's route underground.

The system features a highly sensitive ground microphone that can pinpoint minute leaks. The automatic frequency search function coupled with automatic and manual digital filtering allows the operator to locate leaks rapidly with minimal error.

The RD533 Leak Noise Correlator is based on at least two outstations which are deployed on suitable fittings surrounding an area of interest.

The outstations have an extremely sensitive accelerometer which detects and quantifies leak noise and sends it wirelessly to the Central Unit.

Measurements are saved to the central unit, allowing the operator to compare readings over time. With simple one-button operation and a display that automatically adjusts brightness, the RD533 leak noise correlator is the ideal leak detection RD533 for a wide variety of industry applications.
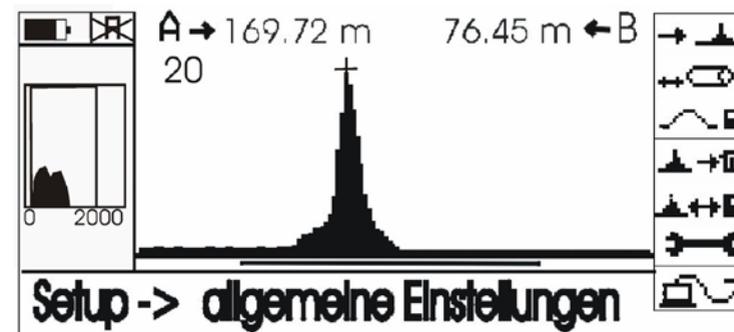


**Figure 1: Correlation Manager**

By pressing the arrow keys or turning the adjustment control, the requested windows on the display will be activated and displayed inadvertently. The selected submenu will then be opened by pressing E.

# Section 2 – Measurement procedures

## 2.1 Setting pipe parameters



| A | Material | ○‡ | ⊟ | ⊣⊩m/s |
|---|----------|----|----|-------|
| → | Guss | 80 mm | 15.5 m | 1327 |
| → | Stahl | 100 mm | 87.3 m | 1265 |
| → | ( leer ) | | | |
| → | | | | |
| B | F2: löschen | | ↻ ändern | F1:⎍ |

**Figure 2: Setting pipe parameters**

Input fields such as pipe section length, pipe material, or pipe diameter are activated through the arrow keys. Once selected, the user can update that data by pressing E. The RD533 is capable of handling up to 4 sections within a measured distance.

The user must select the appropriate pipe material for the pipe under survey.

Pipe material: The materials are selected through the up and down key or through the adjustment control.

Pipe diameter: The diameter is selected using the up and down keys or the adjustment control.

Pipe length: The user can set the pipe length by pressing the up and down arrow keys for a short while or by setting the length through the adjustment control. Fine adjustment is made by incremental taps of the arrow keys.

The arrow keys are activated and deactivated by pressing E. This is indicated by the display.

## 2.2 Input of Measurement Parameters

The measurement parameters High-Pass Filter and Low-Pass Filter can be input either automatically or manually.

Automatic Measurement Mode

Manual Input
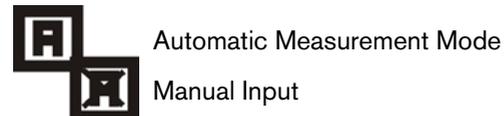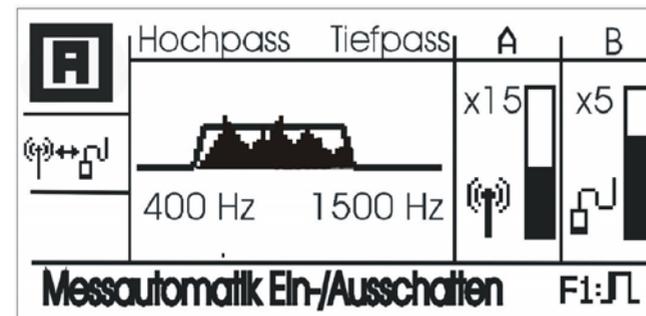
### 2.2.1 Setting analogue filters



**Figure 3: Set High-Pass and Low-Pass Filters**

The RD533 features analogue filters to optimize the leakage-borne energy for correlation purposes. These filters are to be set according to the length and the material of the particular pipe section. For example, plastic pipelines, and long metal pipes require the application of low-pass filters. Short metal sections usually generate high frequencies and thus demand high-pass filter settings for correlation.

**Example 1:     pipe material: grey cast iron, diameter of 150mm, length of 100m**

| setting: | High-Pass | 250Hz |
|----------|-----------|-------|
| | Low-Pass | 1,200Hz |

**Example 2:     pipe material PVC, diameter of 100, length of 50 m**

| setting: | High-Pass | 16Hz |
|----------|-----------|------|
| | Low-Pass | 280Hz |

The filter requested is activated by pressing the right and left keys respectively. Use the high and low symbol keys or the adjustment control to select a filter.

## 2.3 Measurement Procedure

### 2.3.1 General issues

The user must select the operating mode, automatic or manual, using the Filter and Amplify menu before taking a measurement.
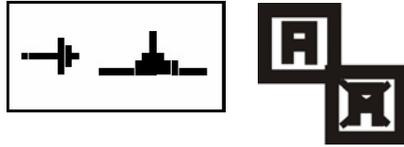
If manual mode is selected, the user can select either the High-Pass or Low-Pass filters manually.

### 2.3.2 Measuring with Automatic Mode

In automatic mode all measurement parameters such as High-Pass and Low-Pass Filter or amplification are set automatically by the RD533. The RD533 checks the set parameters during the measurement procedure and modifies the settings, if required.

As soon as the distance between the leakage and the boxes A and B is shown on the display, the measurement procedure is completed.

### 2.3.3 Measuring in Manual Mode

In manual mode, the user can use the High-Pass Filter and Low-Pass Filter measurement settings to suit their preferences (see 1.2 above). The filters are configured so that the high-frequency part of the coherence will be used for the calculation of the correlation.

incorrect            correct

The measurement is completed when the distance between the leakage spot and the boxes A and B is shown on the display.

# Section 3 – Managing data

## 3.1 Save, load or delete data

### 3.1.1 General issues

The RD533 is capable of performing 20 different measurement procedures simultaneously. The date and time of the measurement as well as all measurement parameters and the graphical display are saved by the RD533.
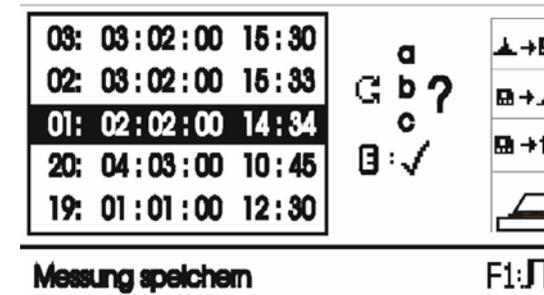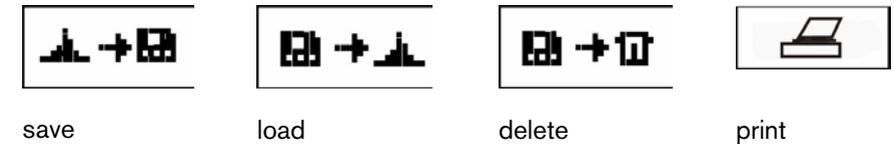


**Figure 6: Management of measurement-related data**

By pressing the up or the down key, the operator can call the menu Save Measurement / Load.

save            load            delete            print

The corresponding memory location is activated through the right or left arrow keys or through the adjustment control. It is displayed inadvertently, and the process will be executed by pressing the Enter key.

### 3.2.1 Print Data

The printer is connected to the RD533 via the printer interface. For best results, use a Hewlett Packard printer. When the printer is connected, press the Print key to print the details of the current measurement (see Appendix 1).

# Section 4 – Setting the number of radio sections

The RD533 can be operated with one or with two radio sections.

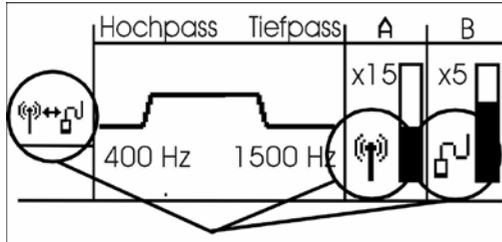NOTE: Please make sure that always the correct number of sections has been set.



**Figure 7: Setting of cable / radio control**

The user can change the way data is transmitted by activating the ⟨image⟩ window and pressing Enter. The current radio channel is displayed as channel A / B by the display.
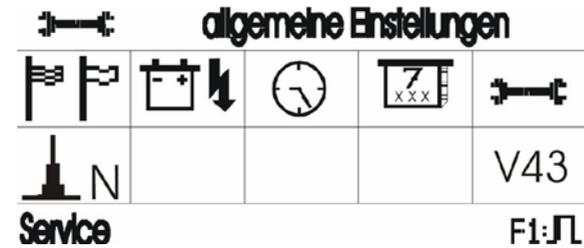
# Section 5 – General settings



**Figure 8: Change system parameters**

The operator can activate the requested window through the arrow keys. Pressing Enter will then open the sub-menu.
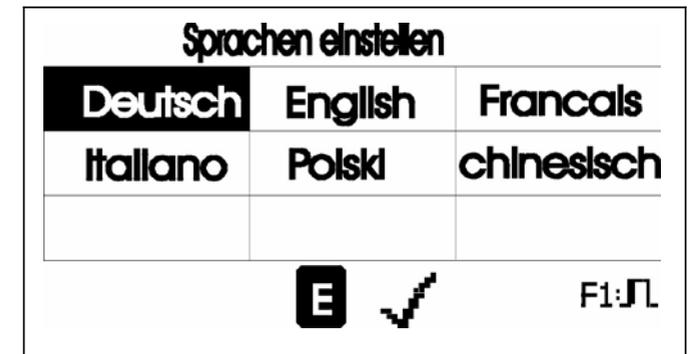
## 5.1 Language



**Figure 9: Select language**

The user can change the language settings by using the arrow keys to scroll through the list of option and pressing Enter to accept the change.

## 5.2 Battery charge



Figure 10: Displaying the battery voltage

Permissible values:

battery fully charged:          approx.  8.4 volt

low battery:                    approx.  7.1 volt
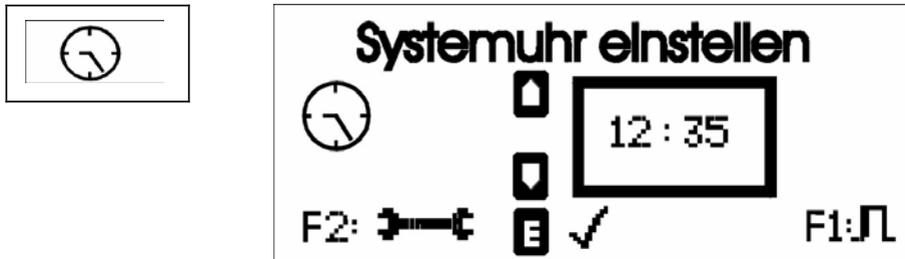
## 5.3 Time



Figure 11: Setting the time

The user can set the time using the arrow keys. Once the correct time is displayed, press the Enter key to accept the change.

## 5.4 Date
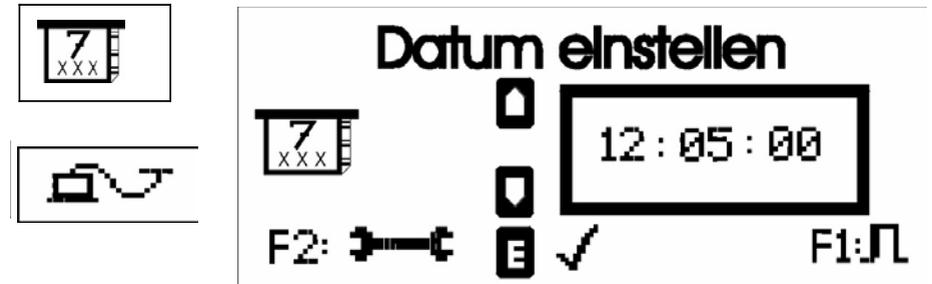


Figure 12: Setting the date

The user can set the date using the arrow keys. Once the correct date is displayed, press the Enter key to accept the change.

## 5.5 Service

The service menu is for service and maintenance technicians only.
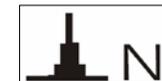
## 5.6 Number of means (N)

Usually, the means of 20 measurements are sufficient to generate an accurate correlation image. In case of plastic pipes, however, we recommend more measurements for greater accuracy.

When the window is activated, the actual number of means will flash on the display. This number can be modified in increments of 10 by pressing the up and down arrow keys. Press Enter to accept the new number of means.

# Section 6 – Using a geophone

To use the geophone, the user can access **Geophone Operation** menu in the Correlation Manager.



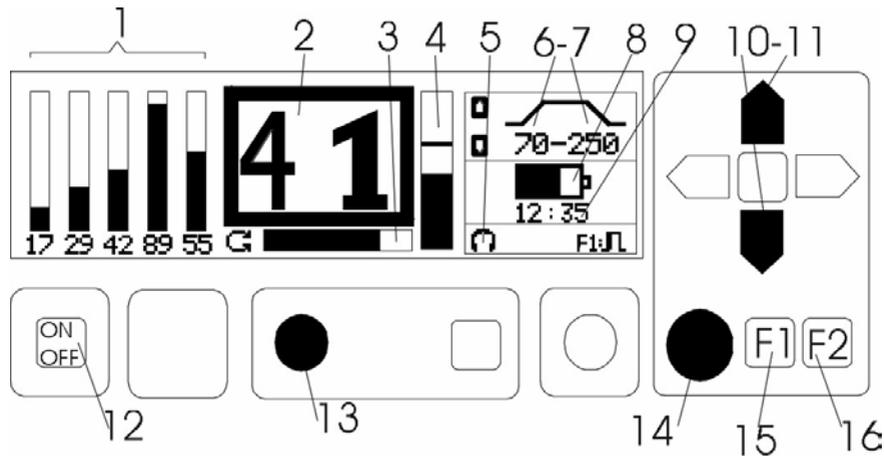**Figure 13: Measuring with a geophone**

1        Saved measurements (minimum values).

2        Numerical display of the current measurement (minimum value).

3        Display sensitivity.

4        Graphical display of current values (minimum level / current level).

5        Headphone connected.

6-7     High-Pass / Low-Pass Filters.

8        Battery voltage.

9        Present time.

10-11   Setting of High-Pass / Low-Pass Filters.

12      Switch on / off.

13      Volume.

14      Adjustment control for processing sensitivity.

15      F1 – back to Correlation Manager.

16      F2 – Start measurement procedure.

## 6.1 Settings

### 6.1.1 Frequency / Mode of Operation

The operator can select the operation mode and the frequency using the arrow keys or the adjustment control.

| Settings | Application | Description |
|---|---|---|
| 70 – 4,000<br>250 – 2,000<br>250 – 1,000 | Locating pipe fractures | Testrod:<br>receiving high frequencies |
| 200 - 800<br>100 - 500<br>70 - 250 | Pinpointing pipe fracture | Ground microphone:<br>receiving low frequencies |
| GTX | Search for pipes -> gas pipelines<br><br>- RECEIVER - | The gas pipe is exposed to sound through the loudspeakers. The ground microphone can locate the signal directly above the pipeline. |
| PWG | Search for pipes -> water pipes (PWG Pulse Wave Generator) - RECEIVER - | The PWG generates blast waves on the pipeline. This pulsing noise can be easily located by the geo-RD533 and differs clearly from environmental noises. |
| COR | Search for pipe fractures -> automatic setting of frequency – analysis of correlation measurement | The most appropriate frequency for searching the defective pipeline section will be set according to the previous correlation. |

### 6.1.2 Volume

The volume for the headphones is adjusted through the regulator (13).

### 6.1.3 Indication of Noise Level

The signal received is shown graphically (4) and numerically (2) on the LCD. The level indication is adjusted with the adjustment control (14) or through the arrow keys.

### 6.1.4 Automatic modulation

The level sensitivity is automatically set when Enter is pressed either during or after a measurement procedure.

## 6.2 Measurement procedure

### 6.2.1 General issues

Any pressurized pipeline system generates a leak noise at a fracture point. This noise differs according to the size and geometry of the leakage and can be picked up over the pipeline (leakage spot) or at the fittings (valves, hydrants, water meters, etc.)

### 6.2.2 Pre-locating the leakage spot

The area of the leakage is determined with the testrod or the RD533.

Pre-locating with testrod — the pipe section between the two noisiest valves has to be checked with a ground microphone (Figure 14).

Pre-locating with RD533 — Usually, +/- 4 meters have to be checked with the ground microphone.
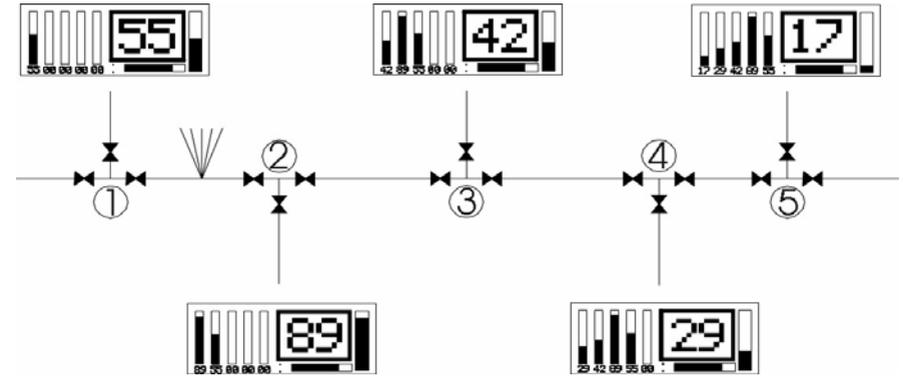


Figure 14: Successfully locating a leak

### 6.2.3 Precise calibration

The distance between the measurement points must be selected according to the pipe material (see Figure 15).

cast iron pipes = 1.5 m          steel pipes = 1.0 m          plastic pipes = 0.5 m
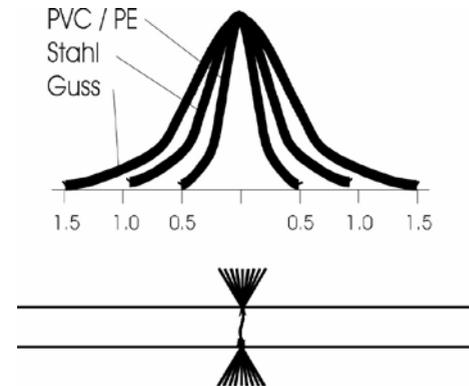


Figure 15: material-dependent noise propagation

At the beginning of a measurement procedure, a low frequency (70 Hz – 250 Hz) is selected. If the crack on the pipeline can be heard over a wide range, a higher frequency can be set. Normally, this results in a more precise determination of the leakage spot.

# Section 7 – Charging the central unit

## 7.1 General issues

When fully charged, the batteries have an approximate operation life 20 hours. Recharging takes approximately 4 hrs. The RD533 automatically switches off as soon as the voltage falls below 7.1 volt (see Section 4.2).

NOTE: The RD533 is inoperative while charging is under way.

## 7.2 Memory Effect

Memory effect is rather poor due to the application of NiMH batteries. However, the user should make sure that the RD533 is not charged before the battery capacity has fallen below 25%. The current capacity is displayed graphically on the LCD.

## 7.3 Power Supply

The RD533 can be charged through the recharger or using12v vehicle cigarette lighter. Power supply is required to be between 12 and 14 volt, and a charging current of 2.5 ampère is needed to charge the RD533.

# Section 8 – Appendix

## 8.1 Technical specifications

| | |
|---|---|
| Batteries | nickel / metal / hydride<br>charge indication through menu<br>batteries feature high-speed charging |
| Case | portable, tough aluminium case<br>membrane keyboard with pulse rotary encoder<br>dimensions : 17 x 11 x 27 cm<br>weight : 3.2 kg |
| Clock | integrated real-time |
| Connections | RS232: for communication with PC<br>BNC: cable entry for pick-up<br>5-pole: ground microphone / testrod<br>jack plug: for headphones<br>2-pole pin: power supply |
| RD533 | state-of-the-art time domain RD533 with coherence indicator<br>maximum resolution: 5 cm<br>acquired measurement points: 50,000 |
| CPU | order processing time: 5,000,000 orders per second |
| Display | LCD 64 x 240 pkt resolution, illuminated |
| Filter | automatically / manually selectable analog filters to suppress disturbing noises. The measurement routine independently sets the most appropriate filter.<br>HP filter 1 – 1,600 Hz (16 levels)<br>TP filter 35 – 3,500 Hz (16 levels) |

| | |
|---|---|
| Geophone Functions | fully-applicable geophone<br>- 6 frequencies for leak detection purposes<br>receiver for:<br>- leak detection in gas pipelines<br>- leak detection in metal and non-metal water pipelines |
| Headphones | 16 - 32 ohm |
| Input | through cable or radio, depending on model |
| Internal Amplification | 8 steps : 1x1 to 1 * 15 |
| Languages | German, English, Polish, Italian, French, Chinese, Norwegian, Danish |
| Material Input | 12 different material parameters can be input :<br>    4 different pipe materials<br>    4 different pipe diameters<br>    4 different pipe section lengths<br>Sound velocity is calculated automatically by the RD533 on the basis of the input parameters.<br>Material list: steel, cast iron, AZ, PVC, PE hard, PE soft, lead, copper, glass-fibre reinforced material |
| Memory | 20 measurements |
| Power Supply | 12-14 volt DC, approx. 0.25 ampère of current consumption, permanent operation time of batteries: approx. 20 hrs, maximum time required for charging: 4 hrs. |

| | |
|---|---|
| Radio Transmitter | transmitter power (500 mW) designed for frequencies related to leakage detection procedures.<br>BZT license<br>frequencies: 433.65 and 434.75 MHz<br>temperature range : -10°C up to +60° C |
| Temperature Range | -5°C up to +55°C |
| Trans-Auto | automatic integration of measurement signal to detect disturbing noises during the measurement |
| User Guidance | simple and clear due to logical symbols |

## 8.2 Radio Licence Requirements

The measurement boxes for the RD533 are equipped with radio transmitters. Due to their power, these radio modules have to be registered with the competent supervisory authority for telecommunication.

**Technical data:**

Power: 500 mW

Frequency transmitter A: 433.65 MHz

Frequency transmitter B: 434.75 MHz

The radio modules have been checked for conformity by CETECOM ICT Service GmbH:

Please apply for a licence for the equipment as soon as possible.

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