DARE!! Instruments

EMC & RF Measurement equipment

Vijzelmolenlaan 3
3447 GX, Woerden
The Netherlands

Tel. +31 348 416 592
www.dare.eu
instruments@dare.eu

DARE!!

RadiSense

Product Manual

Electric Field Sensors

With RadiSupply plug-in card for the RadiCentre

Sensor Model:		Card Model:
RSS2010B	RSS2010H	LPS2001B
RSS2010I	RSS2010S	

RadiSense Product Manual

This service and operating manual pertains to the RadiSupply plug-in card and the RadiSense electric field sensors.

- Card model: LPS2001B
- Sensor models: RSS2010B, RSS2010H, RSS2010I, RSS2010S

Made by DARE!! Instruments.

The RadiSense electric field sensors are used in combination with the RadiCentre modular EMC test systems. Please refer to the operating manual of the RadiCentre for user information including an overview of all remote-control commands and listing of error codes.

We ask that you read both manuals carefully before operating your new product and adhere to any safety instructions it might contain.

A Quick Start Guide has been added to this product for your convenience. This double printed A4 sheet contains the basic start-up steps and the safety warnings for the RadiSense.

Please keep the Quick Start Guide (and this regular manual) close at hand when you operate your new RadiSense.

Please contact DARE!! Instruments or your local reseller if you have any questions.

Supplier Information

DARE!! Products B.V.
Vijzelmolenlaan 3
3447 GX, Woerden
The Netherlands

Tel.:   +31 348 200 100

Internet: www.dare.eu
Email: instruments@dare.eu

RadiSense manual v2.1
Published on: 2020-04-03
By: DARE!! Instruments

Table of Content

WARNINGS & PRECAUTIONS

Read the contents of the product manual (including the manual for the RadiCentre system) and become familiar with the safety markings, instructions, operation and handling of the system.

Only qualified service personnel is allowed to carry out adjustments, maintenance or repairs on the equipment.

This equipment is designed to be used as a plug-in card for the RadiCentre. Do not use this card in combination with any other main frame.

The RadiSense contains materials that can be recycled and reused to minimize material waste. At the 'end-of-life', specialized companies can dismantle the discarded system to collect the reusable and recyclable materials. If your product is discarded at its 'end-of-life', please return it to your local reseller for recycling.

The RadiSense contains no hazardous substances as described in the RoHS-directive.

This product contains embedded software, which can be upgraded in-the-field from the RadiCentre touchscreen display using the USB-A connection on the backside of the RadiCentre.

WARNINGS & PRECAUTIONS

The RadiSense system is a closed loop fibre system and therefore classified as a Class 1M laser system according to EN60825-1:2014 and EN60825-2:2005. In order to provide laser safety in case of a fibre failure or accidental disconnection of the fibres, the RadiSense system is provided with an Automatic Laser Shutdown (ALS) as described in the EN60825-2:2005.

> **INVISIBLE LASER RADIATION - DO NOT EXPOSE USERS OF TELESCOPIC OPTICS**
> **Class 1M LASER product**
> Max. 500 mW at 808 nm

Although the RadiSense system does not emit any laser light under normal circumstances, it is good common practice never to look into any of the fibre optic connectors.

As a safety precaution, products that use a LASER can only be turned on using a LASER Code. This code can be entered using the touchscreen of the RadiCentre system.
(In combination with the RadiCentre CTR1004B or CTR1009B)

As a safety precaution, products that use a LASER can only be turned on by pressing the 'START' button of the RadiCentre system for several seconds. An auditory warning will sound during this activation period.
(In combination with the RadiCentre CTR1001S)

Make sure that the fibre cables are installed correctly before activating the system. Do not activate the system if the fibre optic cables show any sign of damage or tampering.

To make the RadiSense as safe as possible, the plug-in card and sensors have their own safety interlock system that is designed to work with the RadiCentre.

1   Introduction

1.1 Product Introduction

The RadiSense 10 E-field sensor is the most accurate ultra-wideband sensor designed for electric field strength measurements. The sensor is small and fully optically isolated to minimize field perturbation.

Applications for the E-field sensor are:

- Radiated immunity field monitoring
- Anechoic chambers calibration
- Field homogeneity measurements
- RF broadcast and welding radiation-hazard monitoring
- Long term field monitoring

1.2 Related Products

RadiCentre system

The RadiCentre is a modular EMC test system that serves as the user and computer interface for all the RadiCentre plug-in cards and modules (such as the RadiSense field sensor).
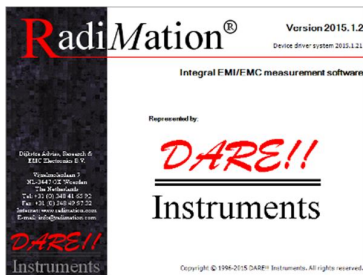
RadiMation software

RadiMation is the EMC software package from DARE!! Instruments used for remote control and automated testing of the RadiCentre plug-in cards and modules (such as the RadiSense field sensor).

2   The RadiSense

2.1 Product Characteristics

LASER Powered - The sensor is LASER powered without the need for batteries. This allows 24-7 continuous testing at maximum performance without the need to change or recharge batteries.

Superb Measurement Accuracy – To perform accurate field measurements, the E-field sensor dimensions must be as small as possible compared to the wavelength of the measured signal. There are two reasons for this:

- First, because large sensor dimensions cause the sensor to resonate at lower frequencies and therefore causes measurement inaccuracies.
- Secondly, to maintain field uniformity in an anechoic chamber. The smaller the sensor, the better the obtainable resolution for field homogeneity measurements.

In TEM and G-TEM cells, sensor dimensions above 10 cm are large compared to the dimensions of the homogenate field area.

The sensor dimensions of the RadiSense 10 are extremely small, increasing measurement accuracy. In addition, the RadiSense 10 is equipped with 2 antennas per axis (6 in total) to optimize isotropic performance and achieve best overall accuracy.

As part of the ISO9001 quality procedure each RadiSense 10 field sensor is factory adjusted and verified, where default linearity adjustment data is stored inside the RadiSense 10 field sensor.

User correction - calibration factors
Additionally, the RadiSense 10 field sensor has capabilities to store "user correction factors" inside the field sensor. By applying calibration factors in the sensor itself, there is no risk one forgets to apply the frequency correction data when performing manual or automated tests.

The frequency response correction factors which are determined during ISO17025 accredited calibration of the probe can be stored inside the field sensor using the RadiMation device driver. Please refer to paragraph 5 of this manual for further instructions.

When the user correction data is stored inside the probe the RadiSense 10 field sensor will return corrected E-field readings without the need of additional calculations[1]. Corrections will be applied inside the probe for each individual axis.

NOTE: If a calibration is performed at DARE!! Calibrations, the correction factors will **NOT** be loaded into the RadiSense 10 field sensor by default by DARE!!

---

[1] Please note, the frequency of the measured field must be send to the sensor in order to apply the correct, frequency dependent, "user calibration factor".

2.2 RadiSense models

The RadiSense 10 sensor is available in four models:
- RSS2010B   9 kHz to 10 GHz, high speed / 1000 measurements/second
- RSS2010H   20 MHz to 10 GHz, high speed / 1000 measurements/second
- RSS2010I   9 kHz to 10 GHz, best isotropy / 100 measurements/second
- RSS2010S   20 MHz to 10 GHz, best isotropy / 100 measurements/second

The RadiSense sensor can be delivered as single item or as SET.
The RadiSense SET consists of the following items:

RadiSense E-field sensor (with fixed fibre cables)
Model: RSS2010B, RSS2010H, RSS2010I, RSS2010S
Electric field sensors to be used together with the RadiSupply plug-in card including small probe stand model PST2000A with 10 cm and 15 cm poles.

RadiSupply plug-in card
Model: LPS2001B
An electric field sensor plug-in card to be used in the RadiCentre® system.

Fibre extension cable
Model: CBL2001-10m
10-meter fibre extension cable with inline couplings.
Other fibre lengths are available on request.

Coupling set
Model: CPL2001A
Coupling set consisting of a FC/PC and ST/PC coupling to connect the extension fibre cable to the sensor fibre cable.

Standard included supporting documentation in the form of:

- USB stick containing:
    - The (digital) User Manual and Quick Start Guide.
    - Factory verification certificate (DARE!! Instruments) or
    - Optional - The calibration certificate for the field sensor

        (if an ISO17025 accredited calibration certification was ordered).
- Hardcopy of the Quick Start Guide.
- IPA cleaning wipes

2.3 Fibre Optic Cables

Use an extension fibre to connect the sensors to the plug-in card mounted in the RadiCentre. This extension fibre is a robust duplex fibre cable and uses dissimilar connectors to avoid misconnections. The fibre optic cable with FC connectors feeds LASER light to the field sensor. The fibre optic cable with ST connectors is used for bi-directional data communication between the field sensor and the plug-in card.

Refer to chapter 2.6 for fibre handling and maintenance.

To ensure safe and correct operation of the sensor, only use the RadiSense with the original supplied or ordered fibres. Do not use other fibres than those supplied by DARE!! Instruments.

Fibre extension cables with different lengths up to 100 meters are available on request. Contact your local reseller for more detailed information.

2.4 RadiSupply Plug-In Card, Rear Panel

The following connections and indicators are found at the back panel of the RadiSupply plug-in card:

POWER ON:	This green LED lights up when the power is on and the interlock is closed[2].	
LASER APERTURE:	Connect to the E-field sensor through the fibre extension cable with FC connectors.	
LASER ON:	This red LED lights up when the LASER is active.	
OPTICAL DATA LINK:	Connect to the E-field sensor through the fibre extension cable with ST connectors.	

---

[2] If the green LED is off, check the power supply and the interlock connection

2.5 LASER Safety Measures

The RadiSense uses a high-power LASER to supply energy to a remote measuring device. The wavelength of this LASER is approximately 808nm. This infrared laser is <u>invisible to the human eye</u>.

INVISIBLE LASER RADIATION - DO NOT EXPOSE USERS OF TELESCOPIC OPTICS

Class 1M LASER product

Max. 500 mW at 808 nm

During normal operation, <u>exposure to LASER radiation is not possible</u> because the RadiSense uses a fibre-coupled closed loop system with Automatic Laser Shutdown (ALS). However, we ask that you comply with the following precautions for your own safety:

<u>NEVER</u> look into any of the fibre optic connectors. The LASER emits a beam that is invisible to the naked eye. Such light may cause permanent eye damage. Avoid eye or skin exposure to direct or scattered radiation.

- Assign a 'LASER safety officer' in your company. The 'LASER safety officer' is responsible for reviewing the safety precautions.

- Check and connect all fibre cables before activating the system.

- Do not activate the system if the fibre optic cables show any sign of damage or tampering.

- The RadiCentre system is equipped with a remote interlock system. This interlock system prevents inadvertent LASER radiation. For example, to prevent LASER radiation when someone enters a shielded room and steps on a fibre.

- The remote interlock connection should be connected to an 'emergency master disconnect' and in series with the room door or fixture interlocks.

- A visual 'LASER ON' indicator LED will light up when the LASER is activated. This LED on the front panel of the RadiCentre system serves as a reminder to the operator that one or more LASERS are switched on.

RadiCentre 2-slot and 7-slot specific:

- A 'LASER Code' is required to activate the RadiCentre 2-slot and 7-slot systems. This LASER code enables the power supply to all installed (LASER) modules.
- (Please refer to Chapter 3.2 for the default laser code).

- To prevent accidental activation of the LASER, an 'Acknowledge' button will appear directly after the LASER 'Start' button is pressed. The LASER will only be activated if this button is pressed within the '4 seconds timeframe'.

RadiCentre single-slot specific:

To start the RadiCentre 1-slot system (which has no touchscreen display),a specific activation procedure combined with auditory warnings is used.

To activate the LASER in the RadiCentre Single, follow these steps:

1. Press the 'Start' button on the back panel (of the RadiCentre) and hold it for at least 3 seconds.
2. Five loud 'beeps' can be heard; four short beeps followed by one long beep.
3. On the fifth 'beep' the LASER link is activated and the red 'LASER ON' LED (on the RadiSupply card) lights up.
4. Release the 'Start' button.

This means that:

- If you want to interrupt the activation process, all you have to do is release the 'Start' button (before the fifth 'beep'). The LASER will not be activated.

- If you are interrupted during the activation process (and release the 'Start' button by accident), the LASER will not be activated.

- If you press the button by accident (and do not wish to activate the LASER), the auditory warning will alert you to this action.

To prevent accidental activation of the LASER, an auditory warning will alert you of the LASER activation procedure (if the 'Start' button is being pressed). To interrupt the activation process, all you must do is release the 'Start' button.

2.6 Fibre Handling and Maintenance

The fibre optic cables in the RadiSense are a crucial part of the system. Improper handling and poor maintenance can cause deterioration or permanent damage. Please read the following handling and maintenance guidelines to ensure both your safety and the quality of the product.
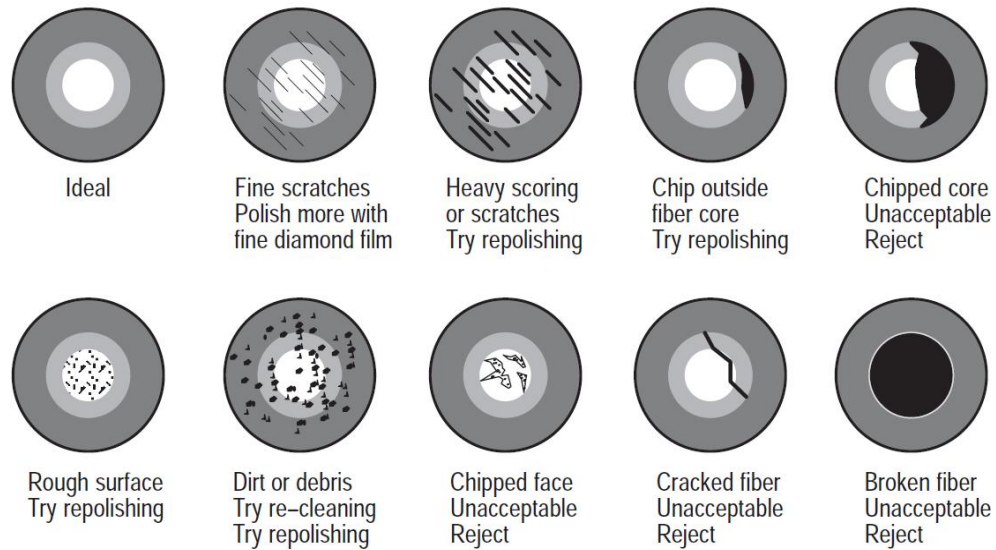
2.6.1   Handling guidelines

- Always place the plastic end-caps on the fibre connectors when they are not in use. Only use the supplied end caps.

- Never touch the tip of the fibre connector (core surface). If the tip of the connector is touched, use the supplied alcohol wipes to clean it before usage!

- Never drop the fibre connectors, as this may damage the core surface.

- Never bend the fibres (exceed the minimum bend radius <5 cm), as this will break the fibre core.

- Never pull the fibre connector out of a coupling by its orange jacket, always use the connector.

- Fasten the connectors by hand only, never use tools.

- Do not stand on or crush the fibres.

- Do not apply mechanical stress (pull) to the fibres.

- Switch off the system before detaching the fibres.

2.6.2   Maintenance guideline

Clean the contact surface of the fibres with the lint-free alcohol wipes before installation. Do not use other solvents or wipes. Fibres are clean and polished on delivery and do not need to be cleaned when installed for the first time, when the handling guidelines as defined in chapter 2.7.1 are properly followed.

2.6.3   Fibre conditions

Use the examples and instructions in the following figure as a guideline for further fibre maintenance. If you have doubts about the condition of the fibre optic cables, please contact your local reseller or DARE!! Instruments for assistance and/or advise.

Ideal

Fine scratches
Polish more with
fine diamond film

Heavy scoring
or scratches
Try repolishing

Chip outside
fiber core
Try repolishing

Chipped core
Unacceptable
Reject

Rough surface
Try repolishing

Dirt or debris
Try re–cleaning
Try repolishing

Chipped face
Unacceptable
Reject

Cracked fiber
Unacceptable
Reject

Broken fiber
Unacceptable
Reject

2.7 Probe stand

The RadiSense 10 is supplied with a PST2000A probe stand consisting of the following parts:
- Base
- Feet (3 pcs)
- Pole (3 pcs)
- Angle mount
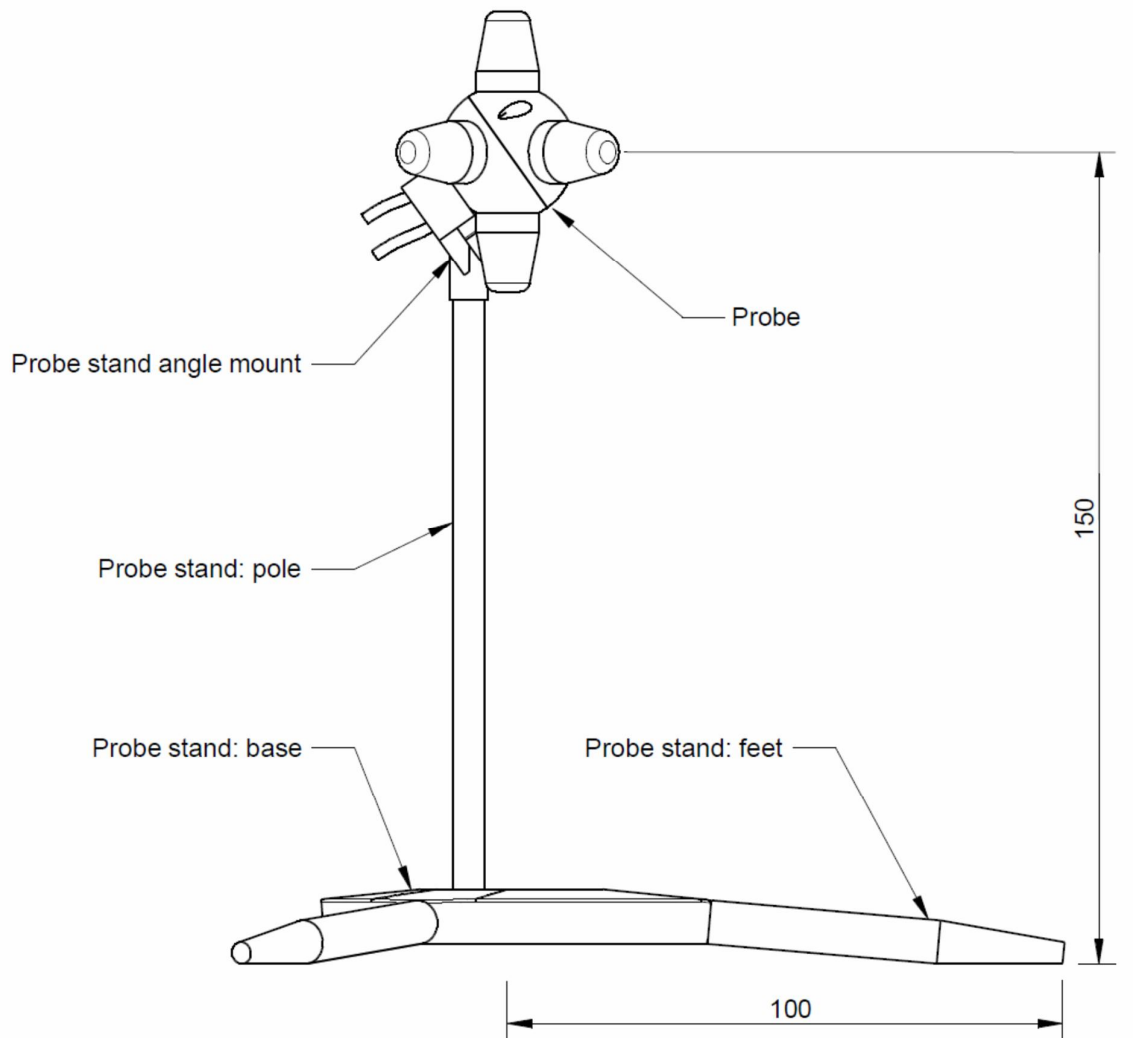
The probe stand parts can be easily assembled together. The 3 feet can be screwed into the side of the base. The probe stand can also be used without these feet. Three poles with different size are delivered to mount the probe at either 50 mm, 100 mm or 150 mm height. Screw the pole into one of the two holes of the base. Using this appropriate probe stand pole with the feet, the probe is automatically positioned at the desired height above the surface and can be easily positioned 100 mm from the edge of a table.

The use of the mounting angle is optional. For isotropic measurements of an electrical field of which the polarization is unknown (for example in reverb chamber / mode-stir chambers) the mounting angle is not needed, see left picture.

For accurate measurements of electrical field with a known polarization, the mounting angle can be used to position one axis of the RadiSense parallel to the field. See right picture.
In most situations, this is the way an E-field sensor is calibrated, axis by axis. Therefore, the probe should be used in the same way to obtain the most accurate results.

REMARK:
Please be noted that placing dielectric material in close proximity to the field sensor will influence the field and could cause measurement errors.

3 Installation

3.1 Hardware Configuration

The hardware configuration[3] is carried out in the following 7 steps:

1. Choose the slot of the RadiCentre system in which you want to install the plug-in card.

2. Remove the blind panel from this slot by removing the four screws of the panel (two on top and two at the bottom).

3. Gently insert the plug-in card into the slot of the RadiCentre and reinsert the four screws.

4. Switch on the RadiCentre system. The new plug-in card will automatically be detected and initialized by the RadiCentre.

Steps 5 to 7 of the hardware configuration are visible on the next page.

REMARK: For operation of the RadiSense 10 probe, the RadiCentre should have minimum firmware version 3.3.0 or higher.

---

[3] These are the basic steps in a plug-in card installation, the exact installation of your plug-in card might vary.

5. Connect the plug-in card to the desired device(s).

   Place the RadiSense E-field sensor where the field strength is to be measured.

   Clean the ends of the fibres and connect the cables to both the sensor and the plug-in card. Make sure the latching pin (notch) of the FC and ST connector fits correctly in the slot of the chassis connector (in line coupling).
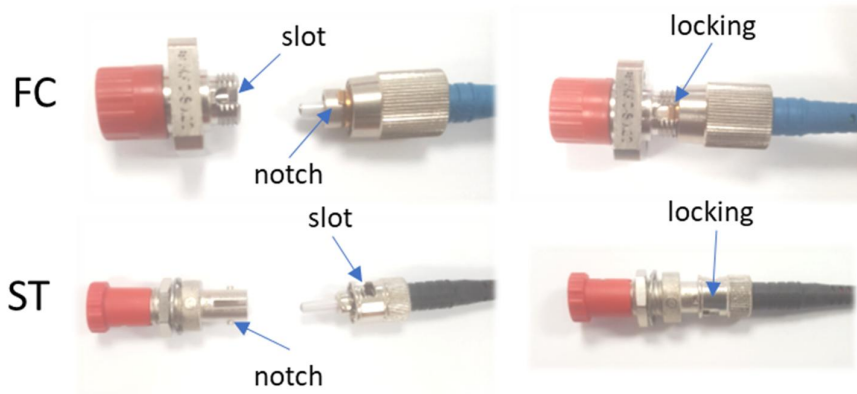
6. Connect the RadiCentre system to your PC using any of the available interfaces of the RadiCentre system; USB, Ethernet or IEEE-488 (optional).

7. Place the interlock plug into the interlock connector of the RadiCentre.

The hardware installation for the plug-in card is now complete. The user can control the plug-in card either through the touchscreen on the RadiCentre system (only available for the 2 and 7-slot versions), or by using the control commands in combination with an external software package such as the RadiMation EMC test software.

3.2 LASER code

As a safety precaution, products that use a LASER can only be turned on using a LASER Code. This code can be entered into the system by use of the touchscreen of the RadiCentre.

(This safety feature is linked to the RadiCentre 2- and 7-slot version. The LASER activation and safety is implemented differently in the RadiCentre Single, see chapter 2.5)

To meet the LASER safety precaution, enter the LASER Code in the 'LASER Code' screen and press 'OK' for confirmation.
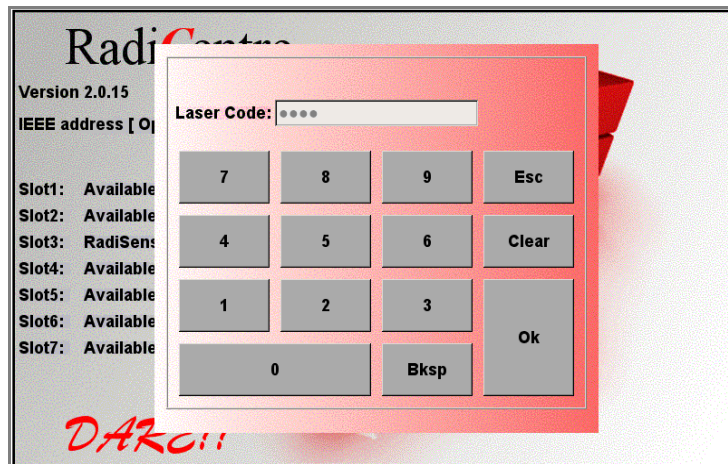
The default LASER code is: **3447**

This code can be changed by the customer in the main configuration screen (see below)).
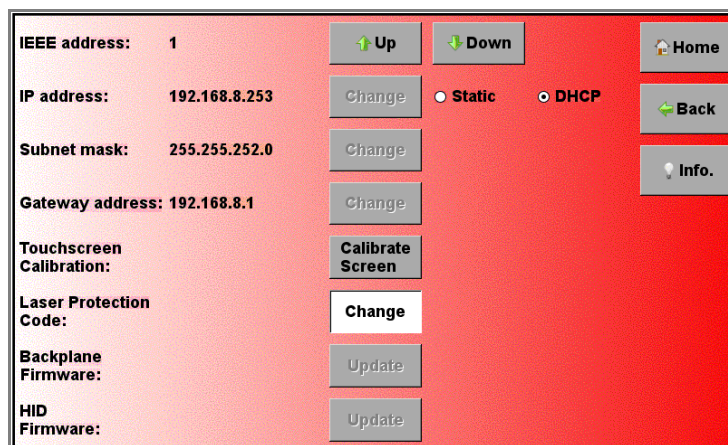
To change the laser code, the user will be asked to enter the current code once and the new code twice (for confirmation). Press 'Close' to leave each notification and enter the code in the following numeric window (see below).
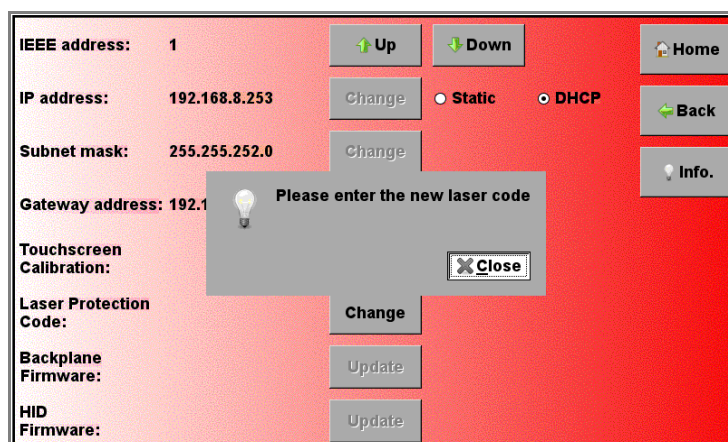
3.3 Software Configuration

To control the RadiSense from a computer, one can use either custom made software or the RadiMation EMC software package from DARE!! Instruments, which can be downloaded from the DARE!! Instruments website. If the RadiSense is operated manually, this chapter can be skipped. If RadiMation software is used; select the required device driver for the RadiSense.

3.3.1   RadiMation Freeware driver

1   After the RadiMation software is installed and started, select 'Devices' in the menu screen and 'Add Field Sensor' to select the driver for the RadiSense / RadiCentre:
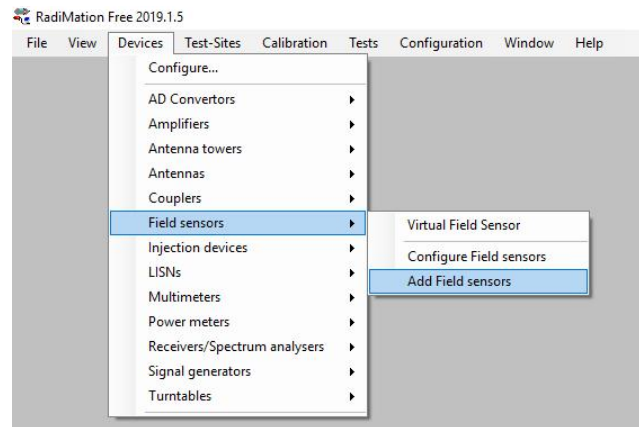
2   A new screen is shown, where the applicable product code of the RadiSense / RadiCentre can be selected. In this example, we add the RSS2010B driver for the RadiSense 10 field probe and click on 'New'.
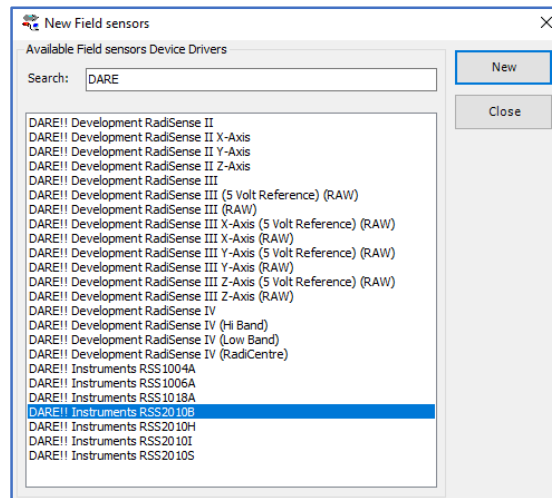
3   Define the name of the new driver and save it by pressing 'OK'.
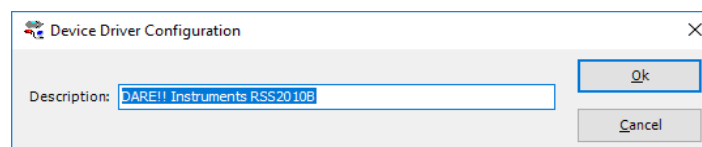
4   The new driver can be configured by double clicking the driver and press the 'Advanced' button. Another window opens, where you can select the communication tab and choose the control interface. In this example, we use USB.
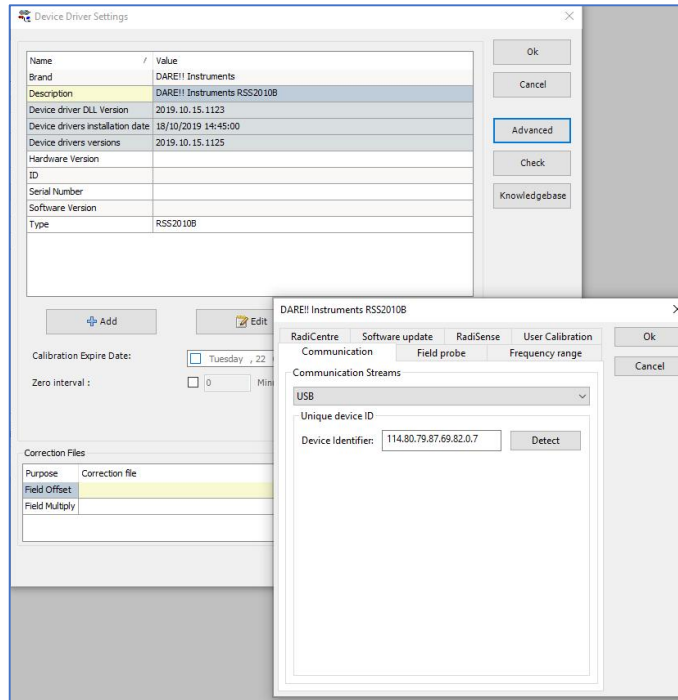
5   To enable the USB communication, make sure the RadiSense probe is connected to the PC USB port and press the 'Detect' button. After pressing 'Detect' the Device Identifier (ID) will be updated with the unique ID number. Make sure that there is no other DARE!! product connected to the same PC using USB.

6   For controlling the RadiSense probe from a RadiCentre single slot (CTR1001S) select under the tab "RadiCentre" the "RadiCentre 1"
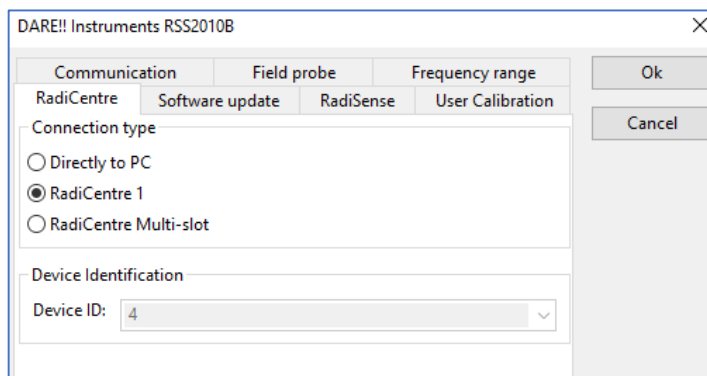
7   For controlling the RadiSense probe from a RadiCentre 2-slot or 7-slot system (CTR1004B or CTR1009B) select under the tab "RadiCentre" the "RadiCentre Multi-slot' and define the corresponding slot number in which the RadiSense probe is installed. In this example the probe is installed in slot number 4.
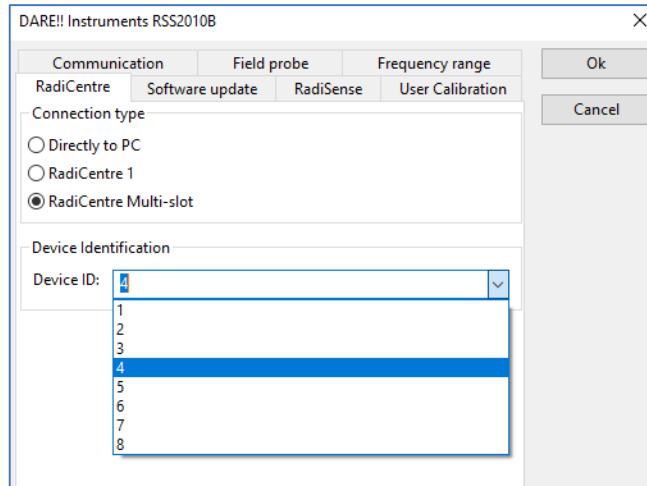
8   Upon completion of the correct settings of the communication interface click on 'OK'.

9   Under the 'Field probe' tab the measurement settings of the RadiSense 10 probe can be configured. The default settings are automatically taken and shown below. Different measurement settings can be defined by the user.
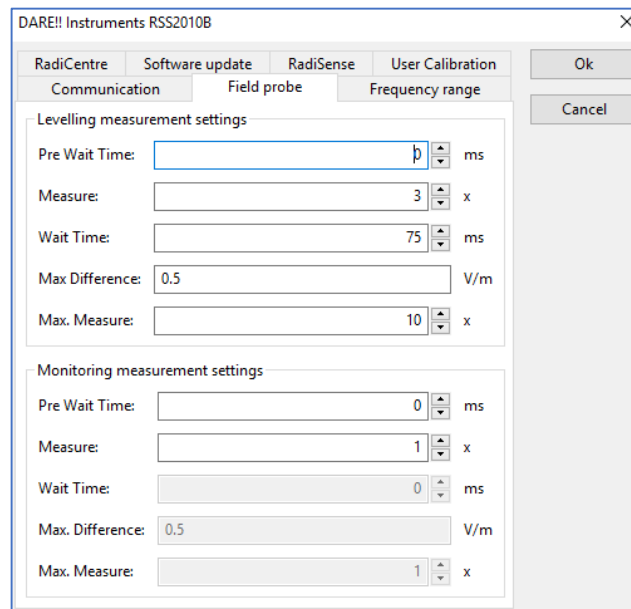
10 Under the "RadiSense' tab the RadiSense 10 can be configured to provide isotropic field strength measurements of all three axes or if individual (single) axis measurements are being performed. Furthermore, the filter settings can be configured.
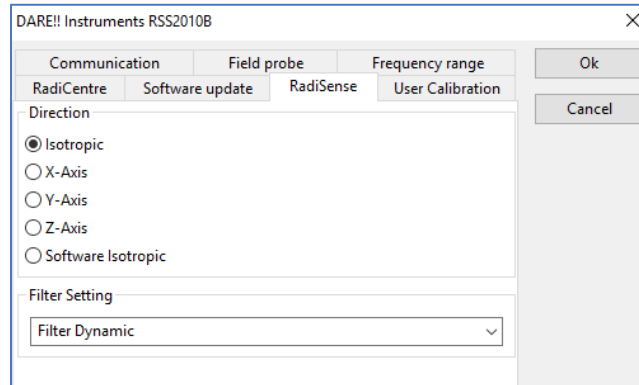
11 Upon completion of the settings click on 'OK'.

12 After clicking 'OK' you will go back into the device driver settings window. The communication can now be verified by clicking the 'Check' button on the right.

13 If all settings are correct, the message 'The check for the device connection has passed' will be shown. If an error is shown, please check and repeat the previous software configuration steps 1 to 12.
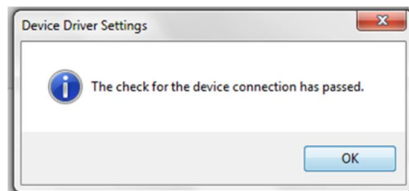
RadiMation is now ready for use with the RadiSense / RadiCentre field sensor.

The RadiMation software package verifies the field sensor at the beginning of each test (if a field sensor is selected).

If you are using the RadiSense / RadiCentre field sensor system with any other EMC test software package, we refer you to chapter 6 'RadiSense Command Set'.

4 Using the RadiSense

4.1 Manual Control

Once the RadiCentre is switched on, the RadiSense can be activated from the 'main' screen on the RadiCentre touchscreen.

4.1.1 Starting the LASER powered sensor

The LASER of the RadiSense 10 field sensor can be started from the 'main' window of the RadiCentre. To activate the sensor, press the 'Start' button for the required sensor and, within 4 seconds, the 'ACK' button. A short sound will be audible until the safety loop is closed successfully.

As long as the LASER is activated, the front and rear 'LASER ON'-LED's will light up to indicate LASER operation.

4.1.2 Zeroing the probe

The 'Status' box will now indicate "Press this button to zero" and after pressing this button the zeroing of the probe will be started.
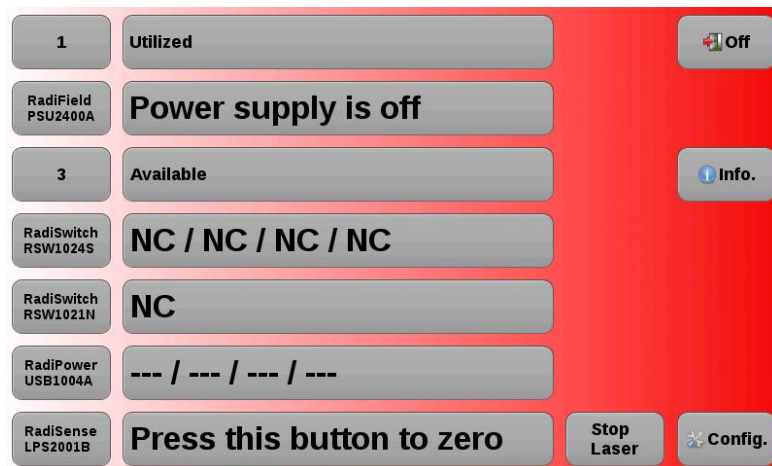
As soon as the probe is zeroed, the 'STATUS' box will display the measured field strength of the probe (see below).

The E-field sensor is now powered on and will return optical data to the RadiCentre system.
As long as the probe returns optical data, the LASER will continue to power the sensor. If the loop is interrupted, the LASER will switch off immediately.
For maximum accuracy, it is recommended to re-zero the probe whenever the probe temperature changes by more than 5 degrees Celsius.

4.1.3 Reading probe data

Readings from the probe can be taken directly from the touchscreen display, with the RadiMation EMC software or any other (custom made) software package.

4.1.4 Probe configuration and advanced measurement data

The 'STATUS' box in the main screen of the RadiCentre only displays the total isotropic field strength. When more advanced data is required (such as field strength of the separate axis, probe temperature, LASER current etc.). You can go into the 'Instrument'-screen by pressing the 'STATUS' box of the required device from the main screen.

The 'Instrument'-screen will display the isotropic field strength in a large font, together with the field strength data of each separate axis. In addition; probe information and LASER information are also displayed in the 'Instrument'-screen

The calculation of the isotropic field strength, is done according to the following formula:

$$E_{tot} = \sqrt{Ex^2 + Ey^2 + Ez^2}$$

With the 'Frequency' button the carrier frequency of the measured field strength can be defined.

The 'Filter' button can be used to the apply an averaging factor on the measurement reading. The available filter settings are:

DYN = dynamic (16 to 128 times depending on value)
1 = 4 times average
2 = 8 times average
3 = 16 times average
4 = 32 times average
5 = 64 times average
6 = 128 times average

Pressing the ' Zero' button will arrange that the RadiSense 10 sensor reading will be 'zero-ed'.

4.1.5   User correction data

Every new RadiSense 10 probe is factory adjusted and verified at DARE!! Instruments. All required correction data (among linearity data for each axis) is stored inside the field probe.

Additionally, "user correction factors" (for example ISO17025 calibration correction values) can be stored into the RadiSense 10 probe so that these corrections are automatically applied to the measurement readings of the probe. The user correction data must be stored in the probe by the user itself.

Please refer to chapter 5 of this manual on further explanation on "User correction factors".

5   RadiSense 10 User correction calibration data

The RadiSense 10 probe has the feature to store external (IS017025 accredited) calibration data as "user correction factors" inside the probe. This means that the correction data will be applied to the measured field in run time. Due to this, there is no longer a need to apply correction factors inside a measuring application, like RadiMation.

The advantage of storing the calibration data inside the probe as "user correction factors", is that the data is in one place and making it easier to maintain the correct calibration information. Apart from this, the corrections can be applied to each individual axis instead of using an average correction factor for the x-, y- and z-axis, as is done in most EMC test software.

When using the "user correction factors", there are 3 parameters that need to be fulfilled:
1. A valid calibration should be stored into the probe.
2. The calibration needs to be 'turned on' in the probe.
3. The measuring frequency needs to be sent to the probe when reading the field strength, in order to apply the applicable correction factor.

The RadiSense 10 probe can store up to 200 "user correction factor" points.

5.1 Manually create and upload of user correction file

In case the RadiSense 10 field sensor has been calibrated at DARE!! Calibrations, the frequency response correction factors are provided in Microsoft® Excel file format.

Use the following steps to create a correction file text string in the right format:

5.1.1   Modify Excel file

In the Excel file with the calibration correction factors place the correction data with the frequency next to each other. That can be done with references to the original data in the excel calibration file. For example, the following formulas can be used:

Frequency: "=A14*1000000"   "A14" is the cell where the frequency is stored in MHz

CF X: "=D14"   "D14" is the cell where the CF for the X-axis is stored

CF Y: "=J14"   "J14" is the cell where the CF for the Y-axis is stored

CF Z: "=P14"   "P14" is the cell where the CF for the Z-axis is stored

As an example, this will result into the following Excel table:

Collect the needed correction factors			
Freq (Hz)	cf X	cf Y	cf Z
9000	1,05	1,08	1,09
10000	1,04	1,07	1,08
20000	1,00	1,02	1,02
30000	0,99	1,01	1,00
40000	0,99	1,01	1,00
50000	0,98	1,00	0,99
60000	0,98	1,00	0,99
70000	0,98	1,00	0,98
80000	0,98	1,00	0,98
90000	0,98	1,00	0,98
100000	0,98	0,99	0,98
200000	0,97	0,99	0,97
300000	0,97	0,99	0,97
400000	0,97	0,98	0,97
500000	0,97	0,99	0,97
600000	0,97	0,98	0,97
700000	0,97	0,98	0,96
800000	0,98	0,98	0,96

5.1.2   Replace comma for a dot

Excel can't replace the comma for a dot in a reference. So, first copy the complete table and past it as text. Then using the "Find and Replace" (Control + F) function the ',' can be replaced with a '.'.

As an example, this will result into the following Excel table:

	Replaced comma with dot		
Freq (Hz)	cf X	cf Y	cf Z
9000	1.05	1.08	1.09
10000	1.04	1.07	1.08
20000	1.00	1.02	1.02
30000	0.99	1.01	1.00
40000	0.99	1.01	1.00
50000	0.98	1.00	0.99
60000	0.98	1.00	0.99
70000	0.98	1.00	0.98
80000	0.98	1.00	0.98
90000	0.98	1.00	0.98
100000	0.98	0.99	0.98
200000	0.97	0.99	0.97
300000	0.97	0.99	0.97
400000	0.97	0.98	0.97
500000	0.97	0.99	0.97
600000	0.97	0.98	0.97
700000	0.97	0.98	0.96
800000	0.98	0.98	0.96

5.1.3   Create the text string per frequency

This can be done using the following formula:

"=CONCAT(AD14;",";AE14;",";AF14;",";AG14;";")".

- "AD14" must be the cell where the frequency is stored
- "AE14" must be the cell where the CF of the X-axis is stored
- "AF14" must be the cell where the CF of the X-axis is stored
- "AG14" must be the cell where the CF of the X-axis is stored

As an example, this will result into the following:

Create string per frequency
9000,1.05,1.08,1.09;
10000,1.04,1.07,1.08;
20000,1.00,1.02,1.02;
30000,0.99,1.01,1.00;
40000,0.99,1.01,1.00;
50000,0.98,1.00,0.99;
60000,0.98,1.00,0.99;
70000,0.98,1.00,0.98;
80000,0.98,1.00,0.98;
90000,0.98,1.00,0.98;
100000,0.98,0.99,0.98;
200000,0.97,0.99,0.97;
300000,0.97,0.99,0.97;
400000,0.97,0.98,0.97;
500000,0.97,0.99,0.97;
600000,0.97,0.98,0.97;
700000,0.97,0.98,0.96;
800000,0.98,0.98,0.96;

5.1.4 Combine the text strings of the frequencies to one text string

This can be done by applying the following formula:

> "=CONCAT(AI14:AI106)"
> - "AI14" must be the cell which is the top of the list with text strings per frequency.
> - "AI106" must be the last cell of the list with text strings per frequency.

The result will be one cell with a long string. This string contains the correction factors (X, Y and Z) for all frequencies. In this format, the string can be send to the RadiSense 10 probe.

Combine all strings
9000,1.05,1.08,1.09;10000,1.04,1.07,1.08;20000,1.00,1.02,1.02;30000,0.99,1.01,1.00;40000,0.99,1.01,1.00;50000,0.98,1.00,0.99;60000,0.98

As an example, the complete string will look like the following:

"9000,1.05,1.08,1.09;10000,1.04,1.07,1.08;20000,1.00,1.02,1.02;30000,0.99,1.01,1.00;40000,0.99,1.01,1.00;50000,0.98,1.00,0.99;60000,0.98,1.00,0.99;70000,0.98,1.00,0.98;80000,0.98,1.00,0.98;90000,0.98,1.00,0.98;100000,0.98,0.99,0.98;200000,0.97,0.99,0.97;300000,0.97,0.99,0.97;400000,0.97,0.98,0.97;500000,0.97,0.99,0.97;600000,0.97,0.98,0.97;700000,0.97,0.98,0.96;800000,0.98,0.98,0.96;900000,0.98,0.98,0.96;1000000,0.98,0.98,0.97;2000000,0.99,0.99,0.97;3000000,1.00,1.00,0.98;4000000,1.00,1.01,1.00;5000000,1.00,1.00,1.00;6000000,1.01,1.00,1.00;7000000,1.01,1.00,1.01;8000000,1.00,1.00,1.00;9000000,1.00,1.00,1.00;10000000,1.00,1.00,1.00;20000000,0.98,0.99,0.99;30000000,0.99,1.00,1.00;40000000,1.00,1.01,1.01;50000000,1.00,1.01,1.01;60000000,1.00,1.00,1.01;70000000,1.00,1.00,1.00;80000000,1.00,0.99,1.00;90000000,0.99,0.99,0.98;100000000,0.98,0.97,0.96;150000000,0.95,0.97,0.96;200000000,0.95,0.96,0.96;250000000,0.94,0.95,0.95;300000000,0.93,0.93,0.93;350000000,0.91,0.92,0.92;400000000,0.93,0.94,0.94;450000000,0.91,0.92,0.92;500000000,0.89,0.90,0.90;550000000,0.87,0.88,0.88;600000000,0.90,0.91,0.91;650000000,0.91,0.92,0.92;700000000,0.88,0.89,0.90;750000000,0.90,0.90,0.91;800000000,0.86,0.87,0.87;850000000,0.85,0.86,0.85;900000000,0.85,0.87,0.87;950000000,0.87,0.89,0.89;1000000000,0.86,0.87,0.87;1200000000,0.88,0.88,0.89;1400000000,0.85,0.85,0.85;1600000000,0.80,0.80,0.80;1800000000,0.78,0.78,0.78;2000000000,0.79,0.80,0.79;2200000000,0.74,0.73,0.73;2400000000,0.73,0.73,0.73;2600000000,0.69,0.69,0.69;2800000000,0.70,0.70,0.70;3000000000,0.70,0.69,0.70;3200000000,0.73,0.73,0.74;3400000000,0.76,0.75,0.76;3600000000,0.76,0.76,0.77;3800000000,0.82,0.81,0.82;4000000000,0.85,0.85,0.85;4200000000,0.89,0.89,0.90;4400000000,0.92,0.92,0.94;4600000000,0.98,0.98,0.99;4800000000,1.02,1.02,1.04;5000000000,1.04,1.04,1.05;5200000000,1.09,1.09,1.11;5400000000,1.07,1.07,1.09;5600000000,1.08,1.07,1.09;5800000000,1.12,1.12,1.14;6000000000,1.12,1.11,1.15;6500000000,1.16,1.15,1.19;7000000000,1.13,1.12,1.17;7500000000,1.08,1.06,1.11;8000000000,1.06,1.05,1.10;8500000000,1.08,1.06,1.11;9000000000,1.07,1.05,1.09;9500000000,1.13,1.13,1.11;10000000000,1.09,1.18,1.10;10500000000,1.06,1.09,1.17;11000000000,1.07,1.07,1.19;11500000000,1.04,1.09,1.17;12000000000,1.06,1.24,1.18;"

5.1.5 Upload the user correction data

Download and install the program "Putty". It can be download from the following website:

https://www.chiark.greenend.org.uk/~sgtatham/putty/latest.html

Choose the 32- or 64-bit installer for Windows. Check your Windows to see of you need a 32- or 64-bit variant. *Note: Normally, the 32-bit installer will work on a 64-bit Windows as well, so this would be the safe option if you don't know if you have a 32 bit or 64 bit version.*
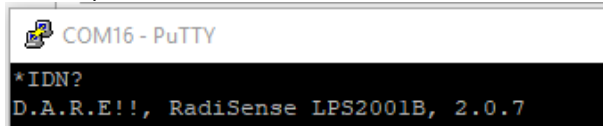
Start the program "Putty"

- Select the USB com port where the CTR1001S is connected to;

- Set the baudrate to 115200 baud;

- Select connection type: Serial

Then click on "Open" to open the serial port to the RadiSense 10 probe.
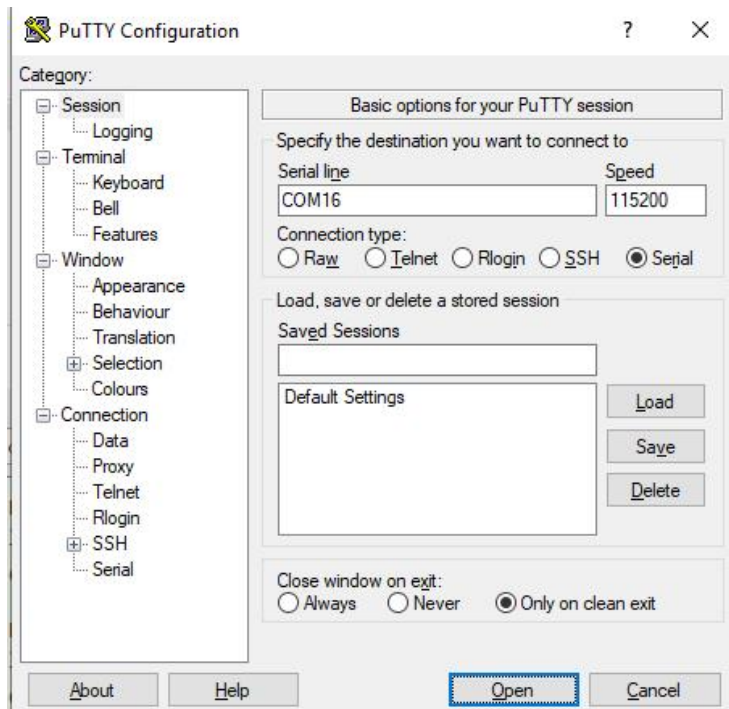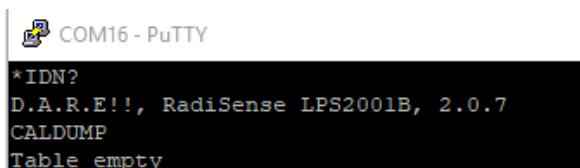
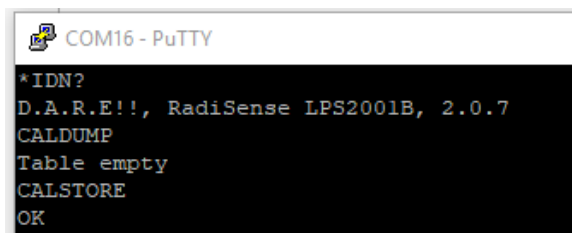

Type "*IDN?" and press ENTER.

The response should be: "D.A.R.E!!, RadiSense LPS2001B, 2.0.7"

Turn the laser ON. Send the "CALDUMP" command to check what the current correction table is. It is advised to back-up the current table. The response can be a table or "Table empty" when there is no table stored.

Send the "CALSTORE" command. The response should be: "OK".


```
COM16 - PuTTY
*IDN?
D.A.R.E!!, RadiSense LPS2001B, 2.0.7
CALDUMP
Table empty
CALSTORE
OK
```

Send the correction table, which is the text string we have created in Excel

Copy the text sting in Excel. With a right mouse click in "Putty" the text string can be pasted. After pasting, press ENTER.

As an example, the complete string will look like the following (without "):

"9000,1.05,1.08,1.09;10000,1.04,1.07,1.08;20000,1.00,1.02,1.02;30000,0.99,1.01,1.00;40000,0.99,1.01,1.00;50000,0.98,1.00,0.99;60000,0.98,1.00,0.99;70000,0.98,1.00,0.98;80000,0.98,1.00,0.98;90000,0.98,1.00,0.98;100000,0.98,0.99,0.98;200000,0.97,0.99,0.97;300000,0.97,0.99,0.97;400000,0.97,0.98,0.97;500000,0.97,0.99,0.97;600000,0.97,0.98,0.97;700000,0.97,0.98,0.96;800000,0.98,0.98,0.96;900000,0.98,0.98,0.96;1000000,0.98,0.98,0.97;2000000,0.99,0.99,0.97;3000000,1.00,1.00,0.98;4000000,1.00,1.01,1.00;5000000,1.00,1.00,1.00;6000000,1.01,1.00,1.00;7000000,1.01,1.00,1.01;8000000,1.00,1.00,1.00;9000000,1.00,1.00,1.00;10000000,1.00,1.00,1.00;20000000,0.98,0.99,0.99;30000000,0.99,1.00,1.00;40000000,1.00,1.01,1.01;50000000,1.00,1.01,1.01;60000000,1.00,1.00,1.01;70000000,1.00,1.00,1.00;80000000,1.00,0.99,1.00;90000000,0.99,0.99,0.98;100000000,0.98,0.97,0.96;150000000,0.95,0.97,0.96;200000000,0.95,0.96,0.96;250000000,0.94,0.95,0.95;300000000,0.93,0.93,0.93;350000000,0.91,0.92,0.92;400000000,0.93,0.94,0.94;450000000,0.91,0.92,0.92;500000000,0.89,0.90,0.90;550000000,0.87,0.88,0.88;600000000,0.90,0.91,0.91;650000000,0.91,0.92,0.92;700000000,0.88,0.89,0.90;750000000,0.90,0.90,0.91;800000000,0.86,0.87,0.87;850000000,0.85,0.86,0.85;900000000,0.85,0.87,0.87;950000000,0.87,0.89,0.89;1000000000,0.86,0.87,0.87;1200000000,0.88,0.88,0.89;1400000000,0.85,0.85,0.85;1600000000,0.80,0.80,0.80;1800000000,0.78,0.78,0.78;2000000000,0.79,0.80,0.79;2200000000,0.74,0.73,0.73;2400000000,0.73,0.73,0.73;2600000000,0.69,0.69,0.69;2800000000,0.70,0.70,0.70;3000000000,0.70,0.69,0.70;3200000000,0.73,0.73,0.74;3400000000,0.76,0.75,0.76;3600000000,0.76,0.76,0.77;3800000000,0.82,0.81,0.82;4000000000,0.85,0.85,0.85;4200000000,0.89,0.89,0.90;4400000000,0.92,0.92,0.94;4600000000,0.98,0.98,0.99;4800000000,1.02,1.02,1.04;5000000000,1.04,1.04,1.05;5200000000,1.09,1.09,1.11;5400000000,1.07,1.07,1.09;5600000000,1.08,1.07,1.09;5800000000,1.12,1.12,1.14;6000000000,1.12,1.11,1.15;6500000000,1.16,1.15,1.19;7000000000,1.13,1.12,1.17;7500000000,1.08,1.06,1.11;8000000000,1.06,1.05,1.10;8500000000,1.08,1.06,1.11;9000000000,1.07,1.05,1.09;9500000000,1.13,1.13,1.11;10000000000,1.09,1.18,1.10;10500000000,1.06,1.09,1.17;11000000000,1.07,1.07,1.19;11500000000,1.04,1.09,1.17;12000000000,1.06,1.24,1.18;"

Wait for the "OK" response.

```
COM16 - PuTTY                                                    —   □   ×
*IDN?
D.A.R.E!!, RadiSense LPS2001B, 2.0.7
CALDUMP
Table empty
CALSTORE
OK
9000,1.05,1.08,1.09;10000,1.04,1.07,1.08;20000,1.00,1.02,1.02;30000,0.99,1.01,1.
00;40000,0.99,1.01,1.00;50000,0.98,1.00,0.99;60000,0.98,1.00,0.99;70000,0.98,1.0
0,0.98;80000,0.98,1.00,0.98;90000,0.98,1.00,0.98;100000,0.98,0.99,0.98;200000,0.
97,0.99,0.97;300000,0.97,0.99,0.97;400000,0.97,0.98,0.97;500000,0.97,0.99,0.97;6
00000,0.97,0.98,0.97;700000,0.97,0.98,0.96;800000,0.98,0.98,0.96;900000,0.98,0.9
8,0.96;1000000,0.98,0.98,0.97;2000000,0.99,0.99,0.97;3000000,1.00,1.00,0.98;4000
000,1.00,1.01,1.00;5000000,1.00,1.00,1.00;6000000,1.01,1.00,1.00;7000000,1.01,1.
00,1.01;8000000,1.00,1.00,1.00;9000000,1.00,1.00,1.00;10000000,1.00,1.00,1.00;20
000000,0.98,0.99,0.99;30000000,0.99,1.00,1.00;40000000,1.00,1.01,1.01;50000000,1
.00,1.01,1.01;60000000,1.00,1.00,1.01;70000000,1.00,1.00,1.00;80000000,1.00,0.99
,1.00;90000000,0.99,0.99,0.98;100000000,0.98,0.97,0.96;150000000,0.95,0.97,0.96;
200000000,0.95,0.96,0.96;250000000,0.94,0.95,0.95;300000000,0.93,0.93,0.93;35000
0000,0.91,0.92,0.92;400000000,0.93,0.94,0.94;450000000,0.91,0.92,0.92;500000000,
0.89,0.90,0.90;550000000,0.87,0.88,0.88;600000000,0.90,0.91,0.91;650000000,0.91,
0.92,0.92;700000000,0.88,0.89,0.90;750000000,0.90,0.90,0.91;800000000,0.86,0.87,
0.87;850000000,0.85,0.86,0.85;900000000,0.85,0.87,0.87;950000000,0.87,0.89,0.89;
1000000000,0.86,0.87,0.87;1200000000,0.88,0.88,0.89;1400000000,0.85,0.85,0.85;16
00000000,0.80,0.80,0.80;1800000000,0.78,0.78,0.78;2000000000,0.79,0.80,0.79;2200
000000,0.74,0.73,0.73;2400000000,0.73,0.73,0.73;2600000000,0.69,0.69,0.69;280000
0000,0.70,0.70,0.70;3000000000,0.70,0.69,0.70;3200000000,0.73,0.73,0.74;34000000
00,0.76,0.75,0.76;3600000000,0.76,0.76,0.77;3800000000,0.82,0.81,0.82;4000000000
,0.85,0.85,0.85;4200000000,0.89,0.89,0.90;4400000000,0.92,0.92,0.94;4600000000,0
.98,0.98,0.99;4800000000,1.02,1.02,1.04;5000000000,1.04,1.04,1.05;5200000000,1.0
9,1.09,1.11;5400000000,1.07,1.07,1.09;5600000000,1.08,1.07,1.09;5800000000,1.12,
1.12,1.14;6000000000,1.12,1.11,1.15;6500000000,1.16,1.15,1.19;7000000000,1.13,1.
12,1.17;7500000000,1.08,1.06,1.11;8000000000,1.06,1.05,1.10;8500000000,1.08,1.06
,1.11;9000000000,1.07,1.05,1.09;9500000000,1.13,1.13,1.11;10000000000,1.09,1.18,
1.10;10500000000,1.06,1.09,1.17;11000000000,1.07,1.07,1.19;11500000000,1.04,1.09
,1.17;12000000000,1.06,1.24,1.18;^M^M
OK
```

Verify that the table is programmed correctly into the RadiSense 10 probe by dumping the table.

Send the "CALDUMP" command. The response should be the table which is programmed by the "CALSTORE" command.

```
CALDUMP
9000,1.05,1.08,1.09;10000,1.04,1.07,1.08;20000,1.00,1.02,1.02;30000,0.99,1.01,1.
00;40000,0.99,1.01,1.00;50000,0.98,1.00,0.99;60000,0.98,1.00,0.99;70000,0.98,1.0
0,0.98;80000,0.98,1.00,0.98;90000,0.98,1.00,0.98;100000,0.98,0.99,0.98;200000,0.
97,0.99,0.97;300000,0.97,0.99,0.97;400000,0.97,0.98,0.97;500000,0.97,0.99,0.97;6
00000,0.97,0.98,0.97;700000,0.97,0.98,0.96;800000,0.98,0.98,0.96;900000,0.98,0.9
8,0.96;1000000,0.98,0.98,0.97;2000000,0.99,0.99,0.97;3000000,1.00,1.00,0.98;4000
000,1.00,1.01,1.00;5000000,1.00,1.00,1.00;6000000,1.01,1.00,1.00;7000000,1.01,1.
00,1.01;8000000,1.00,1.00,1.00;9000000,1.00,1.00,1.00;10000000,1.00,1.00,1.00;20
000000,0.98,0.99,0.99;30000000,0.99,1.00,1.00;40000000,1.00,1.01,1.01;50000000,1
.00,1.01,1.01;60000000,1.00,1.00,1.01;70000000,1.00,1.00,1.00;80000000,1.00,0.99
,1.00;90000000,0.99,0.99,0.98;100000000,0.98,0.97,0.96;150000000,0.95,0.97,0.96;
200000000,0.95,0.96,0.96;250000000,0.94,0.95,0.95;300000000,0.93,0.93,0.93;35000
0000,0.91,0.92,0.92;400000000,0.93,0.94,0.94;450000000,0.91,0.92,0.92;500000000,
0.89,0.90,0.90;550000000,0.87,0.88,0.88;600000000,0.90,0.91,0.91;650000000,0.91,
0.92,0.92;700000000,0.88,0.89,0.90;750000000,0.90,0.90,0.91;800000000,0.86,0.87,
0.87;850000000,0.85,0.86,0.85;900000000,0.85,0.87,0.87;950000000,0.87,0.89,0.89;
1000000000,0.86,0.87,0.87;1200000000,0.88,0.88,0.89;1400000000,0.85,0.85,0.85;16
00000000,0.80,0.80,0.80;1800000000,0.78,0.78,0.78;2000000000,0.79,0.80,0.79;2200
000000,0.74,0.73,0.73;2400000000,0.73,0.73,0.73;2600000000,0.69,0.69,0.69;280000
0000,0.70,0.70,0.70;3000000000,0.70,0.69,0.70;3200000000,0.73,0.73,0.74;34000000
00,0.76,0.75,0.76;3600000000,0.76,0.76,0.77;3800000000,0.82,0.81,0.82;4000000000
,0.85,0.85,0.85;4200000000,0.89,0.89,0.90;4400000000,0.92,0.92,0.94;4600000000,0
.98,0.98,0.99;4800000000,1.02,1.02,1.04;5000000000,1.04,1.04,1.05;5200000000,1.0
9,1.09,1.11;5400000000,1.07,1.07,1.09;5600000000,1.08,1.07,1.09;5800000000,1.12,
1.12,1.14;6000000000,1.12,1.11,1.15;6500000000,1.16,1.15,1.19;7000000000,1.13,1.
12,1.17;7500000000,1.08,1.06,1.11;8000000000,1.06,1.05,1.10;8500000000,1.08,1.06
,1.11;9000000000,1.07,1.05,1.09;9500000000,1.13,1.13,1.11;10000000000,1.09,1.18,
1.10;10500000000,1.06,1.09,1.17;11000000000,1.07,1.07,1.19;11500000000,1.04,1.09
,1.17;12000000000,1.06,1.24,1.18;
```

Turn the correction factors ON. This can be done by using the "CAL ON" command.

The response should be: "OK"

```
CAL ON
OK
```

5.2 Create and upload user correction with RadiMation

In case the RadiSense 10 field sensor has been calibrated at DARE!! Calibrations, the frequency response correction factors are provided in Microsoft® Excel file format.

Use the following steps to create a correction file in RadiMation:

5.2.1   Create a User correction file

To create a new correction file, first start RadiMation.
 When RadiMation is started select File->New->Correction.
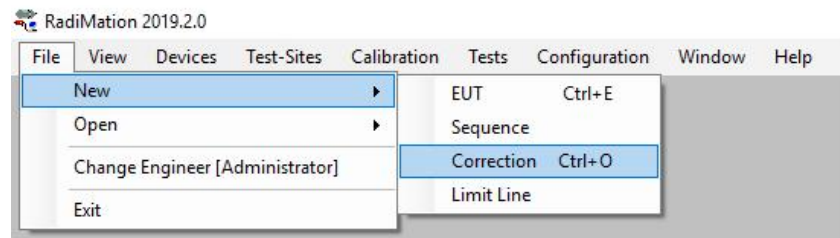
After selecting the new correction file the following screen shall be presented. To add the required X, Y and Z correction column press the 'Columns/Units' button shown on this screen.
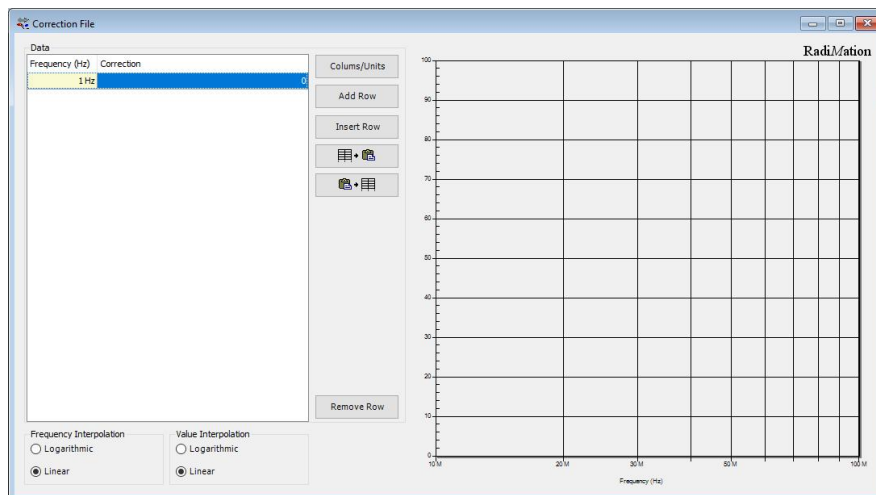
After pressing the Columns/Units button the following screen shall be presented.
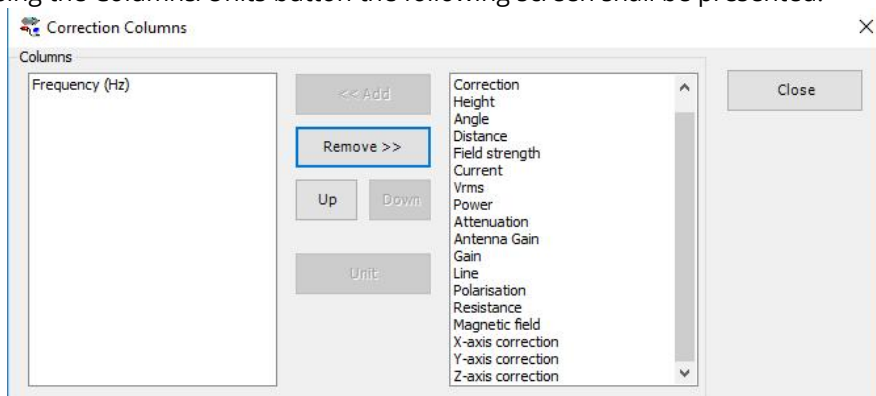
By individually selecting the X, Y and Z axis correction and pressing the 'Add' button, the requested column type shall be added to the list of columns in the correction file. When you are done adding the required columns, press 'close'.
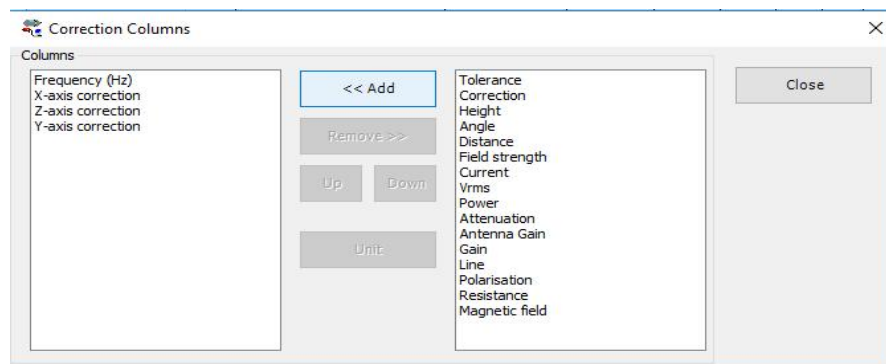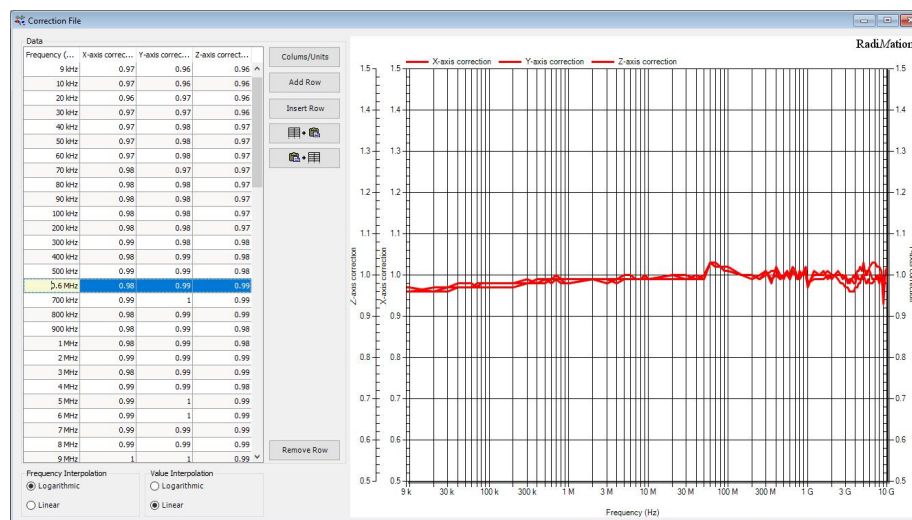

5.2.2 Add calibration data into the correction file

After adding the required column types the User correction data can be filled into the correction file. This can be done manually, by entering the determined calibration values, or by using the 'Copy/Paste' function when calibration data is available as a Microsoft® Excel file.

WARNING: Make sure that the correction file contains:

- Exactly and only the columns:
  "Frequency", "X-axis correction", "Y-axis correction" and "Z-axis correction"
- At least 1 frequency row, and at most 200 frequency rows
- The frequencies are listed in increasing order, and at least differ by 1 kHz
- The frequency values are between 1000 Hz and 99999 MHz
- Axis Correction values are between 0.01 and 3.00, with a maximum precision of 1/100. (so, 1.234 is too precise)

After filling in this data into the correction file, this could for example look like the following (typical RadiSense 10 frequency response calibration data).

5.2.3 Add calibration data into the correction file

When opening the device driver settings for the RadiSense 10 probe in RadiMation the following screen shall be presented.

Click on the Advanced button to open the advanced configuration dialog for the RadiSense 10 device driver. Then, select the 'User Calibration' tab. This will show the following screen:

5.2.4 Store calibration data into the correction file

Select 'Browse' to open a file picker and browse to the location of the RadiMation correction file and Select the file. After selecting the file, the file location shall be displayed in the text field.
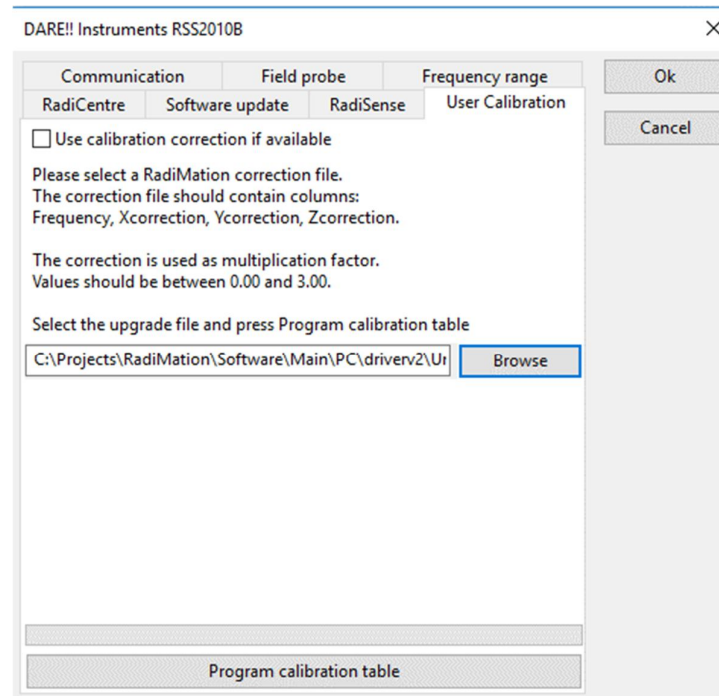
When the file has been added, press the 'Program calibration table' button. This will start the uploading of the correction file into a RadiSense 10 probe which is connected.

Any returned errors during the programming of the user correction table into the probe will be displayed underneath the file location field and in a pop-up message box.

5.2.5 Enabling the user correction file

To enable the use of the User Correction calibration table, check the "Use calibration correction if available" checkbox as shown on the previous image. This will enable the usage of the user calibration table during initialisation of the RadiSense 10 when starting a test.

6   RadiSense remote control and error codes

6.1 General

The RadiSense can be controlled remotely through the interfaces of the RadiCentre. The exact communication protocol, including the specific commands for the RadiSense probe and a listing of all error codes can be found in the RadiCentre manual.

Please note that every command must be terminated with a carriage return (CR).

Example RadiCentre 2 / 7:

To get a reading from the RadiSense card in slot 1, using the RadiCentre serial port or the GPIB port, the following command can be sent:

"1:D5"

To get a reading from the RadiSense card in slot 4, using the RadiCentre serial port or the GPIB port, the following command can be sent:

"4:D5"

Example RadiCentre 1:

To get a reading from the RadiSense card in a single slot RadiCentre, using the RS232 port or USB port, the following command can be sent:

"D5"

6.2 Commands

6.2.1 General commands for the RadiSense

Instruction	Command	Reply
Identity	**"*IDN?"**	Returns the identity string of the RadiSense. For example: **"DARE!!, RSS2010A, v1.0"**
Reset	**"RESET"**	**"OK"** Sets frequency to highest frequency if CAL is set to ON Sets frequency to 1 GHz if CAL is set to OFF Filter is set to "Filter 2" Any errors are cleared
Clear	**"CLEAR"**	**"OK"** Clears any present errors
Local	**"LOCAL"**	**"OK"** Return to local mode
Serial number	**"ID_NUMBER?"**	Returns the unique s/n number. For example: **"1.58.95.146.21.0.0.124"**

This table continues on the next page.

Instruction	Command	Reply
Get field	**"D3"**	**":Dxx.xx;yy.yy;zz.zz_V_"** Where **xx.xx**, **yy.yy** and **zz.zz** are 4 digit floating point values of the electrical field measured by that axis.
Get field (long)	**"D5"**	**":Dxx.xx;yy.yy;zz.zz;cc.cc_V_"** Same response as D3 with added **cc.cc** which is a 4 digit floating point value of the total isotropic field.
Get field (short)	**"D6"**	**"cc.cc"** Where **cc.cc** which is a 4 digit floating point value representing the total isotropic field.
Get multiple readings	**"BURST<space><n>"** Where n is the number of field measurements. Minimum 1 and maximum 60.000	Returns n number of field measurements in D6 format, separated by ";". For example: **"23.85;23.56;23.45;23.65;23.75"** (burst of 5 measurements)
Measurement mode	**"MEASMODE<space><mode>"** Where **mode** is 0 for buffered measurements 1 for triggered measurements	**"OK"** or **"Error <number>"**
Measurement query	**"MEASMODE?"**	**"0"** for buffered measurements **"1"** for triggered measurements or **"Error <number>"**

This table continues on the next page.

Commands, part 3

Instruction	Command	Reply
Filter / averaging	**"Filter?"**	**"DYN"** = dynamic (2 to 8 times depending on value) **"1"** = 4 times average **"2"** = 8 times average **"3"** = 16 times average **"4"** = 32 times average **"5"** = 64 times average **"6"** = 128 times average

Filter setting	**"Filter <space> a "**
	
	Where **a** is setting:
	    DYN = dynamic (16 to 64 times depending on value)
	    1 = 4 times average
	    2 = 8 times average
	    3 = 16 times average
	    4 = 32 times average
	    5 = 64 times average
	    6 = 128 times average
		"OK" or **"Error <number>"**

Zero sensor	**"ZERO"**	**"OK"** or **"Error <number>"**
Status	**"STATUS?"**	**"LASER ON", "STANDBY"** or **"Error <number>"**
Temperature	**"TC?"** for degrees Celsius or **"TF?"** for degrees Fahrenheit	**"Tnn.nn"** Where **nn.nn** is a 4 digit number representing the temperature.
Get sensor supply voltage	**"B"**	**"Bnn.nn"** Where **nn.nn** is a 4 digit number representing the supply voltage in the sensor. Typical around 6V.

This table continues on the next page.

Instruction	Command	Reply
Set frequency	**"FREQ\<space\>f"** Where **f** is the frequency in Hz	**"OK"** or **"Error \<number\>"**
Frequency query	**"FREQ?"**	Returns frequency in Hz, for example: **"100000000"** for 100 MHz
Min frequency	**"FREQ MIN"**	Return the minimum frequency of the sensor in Hz.
Max frequency	**"FREQ MAX"**	Returns the maximum frequency of the sensor in Hz.
Calibration[4]	**"CAL x"** Where is x is **ON** or **OFF**	**"OK"** or **"Error \<number\>"**
Query calibration	**"CAL?"**	**"ON"** if calibration data is active **"OFF"** if calibration data is not used

If calibration is set to "ON", stored correction factors will be applied to the measured field of the sensor. In order to get the right correction, it is mandatory to set the frequency of the measured field.

The total frequency band of the sensor is measured by two detectors, each covering a part of the full band. The low band detector starts at 9 kHz up to 50 MHz and the high band detector starts at 3 MHz and measures up to 12 GHz. With calibration set to "ON" and the frequency set, the corresponding detector is automatically used:
- 9 kHz to 3 MHz: low band detector
- 3 MHz to 50 MHz: low and high band detector
- Above 50 MHz: high band detector only

---

[4] Calibration data can be stored in the sensor. With this command the correction can be enabled of disabled

6.3   Error Codes

Probe specific errors:

Error code	Description
720	Justation already stopped
721	Potmeter fault
722	Justation point of 0 V/m not available
723	No valid calibration data available
724	Frequency lower than calibration table
725	Frequency higher than calibration table
726	No points stored
727	Justation fault
728	Calibration fault
729	Temperature correction fault
730	Flash fault
731	Serial number fault
732	Justation field not monotone
733	Justation adc not monotone

Plug-in card specific errors:

Error code	Description
700	Wrong identifier
701	Invalid target
702	Probe invalid reply
703	No update in time (Field is questioned but there is no valid field of the probe received in time.)
704	Invalid dataframe received
705	Probe not connected
706	MSP interlock tripped
707	Laser off through time out (Communication time out or startup probe timed out that caused laser to shut off)
708	Error during justation store
709	Software update fault
710	Flash fault
711	Serial Number fault
712	PWM fault
713	ADC fault
714	Binary data fault
715	Dump not received ok
716	Card type unknown
717	Probe type unknown
718	Safety controller card type fault
719	Safety controller probe type fault
737	Incorrect data frame CRC
738	Start aborted by user
739	Command not supported in software update mode
740	MSP too long no communication probe (longer than 5 ms)
741	SC (Safety Controller) IDN fault
742	SC (Safety Controller) HW version fault
743	SC (Safety Controller) not received start on RS232

Error code	Description
744	SC (Safety Controller) not received start on USB

Plug-in card specific errors continued:

Error code	Description
745	SC (Safety Controller) not received start on button
746	SC (Safety Controller) switch 2 not high
747	SC (Safety Controller) switch 2 not low
748	MSP switch 1 fault
749	MSP switch 2 fault
750	SC (Safety Controller) not responding
751	(not in use)
752	SC (Safety Controller) invalid reply
753	Laser turned on
754	3V3 out of range
755	5V out of range
756	12V out of range
757	Laser current out of range
758	Laser temperature out of range
759	Trigger not received
760	SC (Safety Controller) - too long no communication with Probe
761	SC (Safety Controller) - MSP switch 1 not high
762	SC (Safety Controller) - MSP switch 1 not low
763	SC (Safety Controller) - switch 1 fault
764	SC (Safety Controller) - switch 2 fault
765	SC (Safety Controller) - MSP not questioning
766	SC (Safety Controller) - interlock tripped
767	SC (Safety Controller) - Trigger received outside window
768	SC (Safety Controller) - Start source not received
769	SC (Safety Controller) - Trigger not received
770	SC (Safety Controller) - Current out of limits

771	SC (Safety Controller) - 3V3 LPC out of limits
772	SC (Safety Controller) - 3V3 MSP out of limits

User correction data error codes:

Error message	Cause
Incorrect column amount	A wrong number of columns is used in the correction file.
Incorrect precision	A value in the correction file has a too high precision.
Correction factor out of range	A value in the correction file is greater than 3.00.
Wrong columns available	A wrong column is used in the correction file.
Incorrect number of rows	Too much frequency points are used in the correction file.
Contains negative values	A value in the correction file is negative.
Frequencies are incorrectly sorted	One or more of the frequencies are sorted from high to low.
Multiple same frequencies	Multiple of the same frequencies are used in the correction file
Correction file is not found	The selected correction file could not be found.
CAL Dump is not matching	The uploaded correction file does not match the returned table from the RadiSense 10
Correction file could not be opened	The selected correction file could not be opened.
Correction file is empty	The selected correction file is empty.
Invalid low frequency	The selected correction file contains a too low frequency.
Frequencies within rounding distance	Multiple frequencies shall be rounded to the same frequency
Invalid upper frequency	The selected correction file contains a too high frequency.
RadiSense 10 is an old firmware version	The firmware of the connected RadiSense 10 is less than "2.0.6"
RadiSense 10 CAL dump is not returned	The RadiSense 10 failed to return the uploaded calibration table back.
RadiSense 10 CAL table is invalid	The RadiSense 10 could not validate the stored calibration table.

7   RadiSense Specifications

Model	RadiSense 10 RSS2010B
Electric Field	
Field measurement range	1 to 750 V/m
Max input level before damage	1000 V/m
Frequency range	9 kHz to 10 GHz (usable to 12 GHz)
Accuracy	
Frequency response 9 kHz to 10 MHz 10 MHz to 1 GHz 1 GHz to 10 GHz	- 3 dB to + 1 dB - 1 dB to + 1,5 dB - 3 dB to + 3,5 dB
Isotropy	$< \pm$ 0,5 dB up to 1 GHz, typical 0,25 dB $< \pm$ 1 dB from 1 GHz up to 3 GHz $< \pm$ 5 dB from 3 GHz up to 10 GHz
Linearity	0,5 dB $\pm$ 0,5 V/m
Temperature error (23˚C $\pm$ 5˚C)	0.1 dB/˚C (after zeroing)
Shape	Spherical
Electrical measuring volume	117 cm^3 (25mm Ø)
Number of antennas	6 (2 per axis)
Measuring speed sensor	Max 1000 samples/sec[5]

This table continues on the next page.

---

[5] This speed can be obtained using the BURST command with FILTER=1, CAL FACTOR=ON and FREQUENCY is set between 50 MHz and 6 GHz

Model	RadiSense 10 RSS2010H
Electric Field	
Field measurement range	1 to 750 V/m
Max input level before damage	1000 V/m
Frequency range	20 MHz to 10 GHz (usable to 12 GHz)
Accuracy	
Frequency response 20 MHz to 1 GHz 1 GHz to 10 GHz	- 1 dB to + 1,5 dB - 3 dB to + 3,5 dB
Isotropy	$< \pm$ 0,5 dB up to 1 GHz, typical 0,25 dB $< \pm$ 1 dB from 1 GHz up to 3 GHz $< \pm$ 5 dB from 3 GHz up to 10 GHz
Linearity	0,5 dB ±0,5 V/m
Temperature error $(23 °C \pm 5 °C)$	0.1 dB/°C (after zeroing)
Shape	Spherical
Electrical measuring volume	117 cm^3 (25mm Ø)
Number of antennas	6 (2 per axis)
Measuring speed sensor	Max 1000 samples/sec[6]

---

[6] This speed can be obtained using the BURST command with FILTER=1, CAL FACTOR=ON and FREQUENCY is set between 50 MHz and 6 GHz

Model	RadiSense 10 RSS2010I
Electric Field	
Field measurement range	1 to 750 V/m
Max input level before damage	1000 V/m
Frequency range	9 kHz to 10 GHz (usable to 12 GHz)
Accuracy	
Frequency response 9 kHz to 10 GHz	$\pm$ 1 dB
Isotropy	< $\pm$ 0,25 dB up to 1 GHz < $\pm$ 0,5 dB from 1 GHz up to 3 GHz < $\pm$ 1 dB from 3 GHz up to 6 GHz < $\pm$ 2 dB from 6 GHz up to 10 GHz
Linearity	0,5 dB ±0,5 V/m
Temperature error (23˚C $\pm$ 5˚C)	0.1 dB/˚C (after zeroing)
Shape	Spherical
Electrical measuring volume	117 cm^3 (25mm Ø)
Number of antennas	6 (2 per axis)
Measuring speed sensor	Max 100 samples/sec

Model	RadiSense 10 RSS2010S
Electric Field	
Field measurement range	1 to 750 V/m
Max input level before damage	1000 V/m
Frequency range	20 MHz to 10 GHz (usable to 12 GHz)
Accuracy	
Frequency response 20 MHz to 10 GHz	$\pm$ 1 dB
Isotropy	< $\pm$ 0,25 dB up to 1 GHz < $\pm$ 0,5 dB from 1 GHz up to 3 GHz < $\pm$ 1 dB from 3 GHz up to 6 GHz < $\pm$ 2 dB from 6 GHz up to 10 GHz
Linearity	0,5 dB ±0,5 V/m
Temperature error (23˚C ± 5˚C)	0.1 dB/˚C (after zeroing)
Shape	Spherical
Electrical measuring volume	117 cm^3 (25mm Ø)
Number of antennas	6 (2 per axis)
Measuring speed sensor	Max 100 samples/sec

Model	RadiSense 10
Optical	
LASER power	Max. 0,5 Watt output at aperture
Wavelength	808 nm
LASER connector	FC/PC
Data connector	ST/PC
Fibres	200/230 µm HCS, duplex
Standard Fibre length	1,5 m fixed to sensor, 10 m extension with couplings Other lengths available on request
Safety	
LASER product classification	Class 1M according to EN 60825-1 and EN60825-2
Safety measures	Code (RadiCentre), Remote interlock system (RadiCentre), LED indications for LASER ON, Audible warning signals Redundant closed loop safety system
LASER switch on time	approx. 50 ms
LASER switch off time	< 10 ms
Environmental conditions	
Temperature range	0° to 40° Celsius
Relative humidity	10 – 90% (non-condensing)
Warranty	
Warranty	3 years (misuse excluded)

7.1 WARRANTY CONDITIONS

DARE!! Instruments offers a standard warranty term of three years on their products, starting from the shipping date. This warranty is applicable to all EMC test & measurement products, such as:

- RadiCentre modular / multifunctional EMC test systems
- RadiControl antenna tower/turntable controllers
- RadiField Triple A field generators
- RadiGen signal generators
- RadiPower RF power meters
- RadiSense laser powered E-field probes
- RadiSwitch RF coaxial switches

If a defect occurs within the warranty term, a Return Material Authorization (RMA) 'Warranty Repair' request can be issued using the RMA link at http://rma.dare.eu. The defective product can then be shipped to DARE!! Instrument for repair by our service department.
There will be no charge for repair services (materials or labor) within the warranty term. The customer will need to cover the costs for returning the product to DARE!!, such as shipping and/or any applicable duties and taxes. DARE!! Instruments will arrange the courier and cover the costs for the return shipment.

These warranty terms are not applicable to:

- Fibre optic cables
- Products that have been improperly used
- Products that have been used outside their specified range
- Products that have been improperly installed and/or maintained
- Products that have been modified without approval of DARE!! Instruments
- Calibration and/or re-calibration of the product
- Consumable products such as batteries, ink etc.

Repair services on products that are not covered by the DARE!! warranty will be charged to the customer. If a defect occurs to our product outside the warranty period, a RMA repair and/or re-calibration request must be issued using the RMA link at http://rma.dare.eu.
The repairs (outside the original warranty period) have a warranty limited to six months. Shipping conditions are the same as with repairs within the original warranty period.

7.2 EUROPEAN DECLARATION OF CONFORMITY

We, DARE!! Instruments declare under our sole responsibility that the product;

RadiSense
Plug-in card model LPS2001B, with Electric field sensor models RSS2010B, RSS2010H, RSS2010I, RSS2010S

to which this declaration relates, is in accordance with the following Directives:

> EMC-Directive 2014/30/EU
> Low Voltage Directive 2015/35/EU
> RoHS-Directive: 2011/65/EG

Per the provisions of the applicable requirements of the following harmonized standards:

> Emission: EN 61326-1:2013, Class A[1]
>   Electrical equipment for measurement, control and laboratory use.
> Immunity: EN 61326-1:2013, Industrial level, performance criteria A
>   Electrical equipment for measurement, control and laboratory use.
> Safety: EN 61010-1:2010, Safety requirements for electrical equipment
>   for measurement, control, and laboratory use

The Technical Construction Files are maintained at;

> DARE!! Instruments B.V.
> Vijzelmolenlaan 7
> NL-3447 GX Woerden
> The Netherlands
> Tel: +31 348 416 592
> Email: instruments@dare.nl

Date of issue: December 15th, 2017

Place of issue: Woerden, the Netherlands

Authorized by:

P.W.J. Dijkstra

Title of authority: Director

_____
 Conducted emission complies with Class B (household equipment)