

## RadiSense

### Product Manual



## Electric Field Sensors

With RadiSupply plug-In Card for the RadiCentre

Sensor Model:

RSS2010B    RSS2010H  
RSS2010I    RSS2010S

Card Model:

LPS2001B

## **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.

We ask that you read this manual 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.

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## WARNINGS & PRECAUTIONS



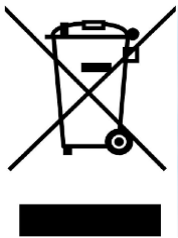
Read the contents of the product manual (including the manual for the RadiCentre system) and become familiar with the safety markings, instructions, operation and handling of the system.



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 fiber 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 fiber failure or accidental disconnection of the fibers, 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 fiber cables are installed correctly before activating the system. Do not activate the system if the fiber 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 continues 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 is 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.

Calibration factors - The RadiSense 10 field sensor can be loaded with correction factors which are determined during calibration of the sensor. Using a simple command (or setting a checkbox in RadiMation) the correction factors can be enabled and the sensor will return corrected E-field readings without the need of additional calculations<sup>1</sup>.

If a calibration is performed at DARE!! Calibrations, the correction factors will be loaded by DARE!! and your sensor is ready to be used with the most accurate results!

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<sup>1</sup> Please note that for the correct use of the calibration factor, the frequency of the field must be entered in the sensor.

## 2.2 Components

The RadiSense set is delivered with the following items:



### RadiSense E-field sensor (with fixed fiber 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.



### Fiber extension cable

Model: CBL2000A-10m

10 meter fiber extension cable with inline couplings. Other fiber lengths are available on request.



### Coupling set

Model: CPL2000A

Coupling set consisting of a FC/PC and ST/PC coupling to connect the extension fiber cable to the sensor fiber cable.

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



## 2.3 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 sensor can be delivered as single item or as set consisting of the sensor, laser plug-in card and extension fiber with coupling set.



### RadiSense system

Set consisting of:

- RadiSense RSS2010X sensor
- RadiSense LPS2001B Plug-in card
- RadiSense CBL2001A-10m
- RadiSense CPL2001A coupling set

### RadiSense RSS2010B

- RadiSense RSS2010B sensor only

The RadiSense is delivered with a small probe stand model PST200A. Refer to chapter 2.8 for more detail about the probe stand.

## 2.4 Fiber Optic Cables

Use an extension fiber to connect the sensors to the plug-in card mounted in the RadiCentre. This extension fiber is a robust duplex fiber cable and uses dissimilar connectors to avoid misconnections. The fiber optic cable with FC connectors feeds LASER light to the field sensor. The fiber optic cable with ST connectors is used for bi-directional data communication between the field sensor and the plug-in card. Refer to chapter 2.7 for fiber handling and maintenance. To ensure safe and correct operation of the sensor, only use the RadiSense with the original supplied or ordered fibers. Do not use other fibers than those supplied by DARE!! Instruments. Fiber extension cables with different lengths up to 100 meters are available on request. Contact your local reseller for more detailed information.

## 2.5 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 <sup>2</sup> . |
| LASER APERTURE:    | Connect to the E-field sensor through the fiber 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 fiber extension cable with ST connectors.      |

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<sup>2</sup> If the green LED is off, check the power supply and the interlock connection

## 2.6 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 invisible to the human eye.



Figure 1: LASER safety warning label

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



NEVER 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 fiber cables before activating the system.
- Do not activate the system if the fiber 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 fiber.
- 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.
- 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 'Start' button needs to be pressed for at least 3 seconds to activate the LASER. If you are interrupted during the activation process (and release the 'Start' button by accident), the LASER will not be activated.
- 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.

#### 2.6.1 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 2.7.2.)

To meet the LASER safety precaution, enter the LASER Code in the 'LASER Code' screen and press 'OK' for confirmation (see Figure 2).

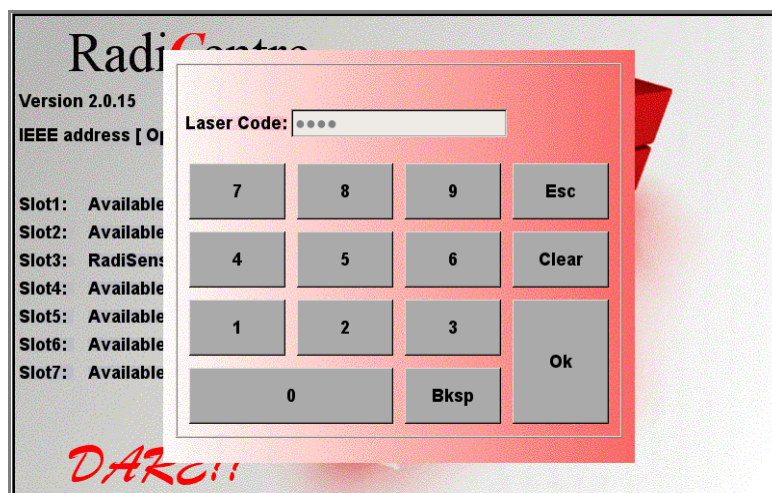


Figure 2: LASER code window

The default LASER code is: **3447**

This code can be changed by the customer in the main configuration screen (see Figure 3).

The screenshot shows a configuration interface with a red background. On the left, a list of settings is displayed: IEEE address: 1, IP address: 192.168.8.253, Subnet mask: 255.255.252.0, Gateway address: 192.168.8.1, Touchscreen Calibration, Laser Protection Code, Backplane Firmware, and HID Firmware. To the right of each setting is a button: Up/Down arrows for IEEE address, Change for IP, Subnet, and Gateway, Calibrate Screen for Touchscreen Calibration, Change for Laser Protection Code, and Update for Backplane and HID Firmware. On the far right, there are three buttons: Home, Back, and Info.

Figure 3: Change the laser protection code in the main configuration screen

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 Figure 4).

This screenshot is identical to Figure 3, but with a gray notification dialog box overlaid in the center. The dialog box contains a lightbulb icon, the text "Please enter the new laser code", and a "Close" button with an 'X' icon. The "Change" button for the Laser Protection Code is visible behind the dialog box.

Figure 4: 'Enter new code' notification.

### 2.6.2 LASER activation - RadiCentre Single

The RadiCentre Single does not have a touchscreen, as a result the LASER code safety feature (mentioned in chapter 2.7.1) cannot be used. Instead 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.
2. Five loud 'beeps' can be heard; four short followed by one long.
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.

## 2.7 Fiber Handling and Maintenance

The fiber 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.

### 2.7.1 Handling guidelines

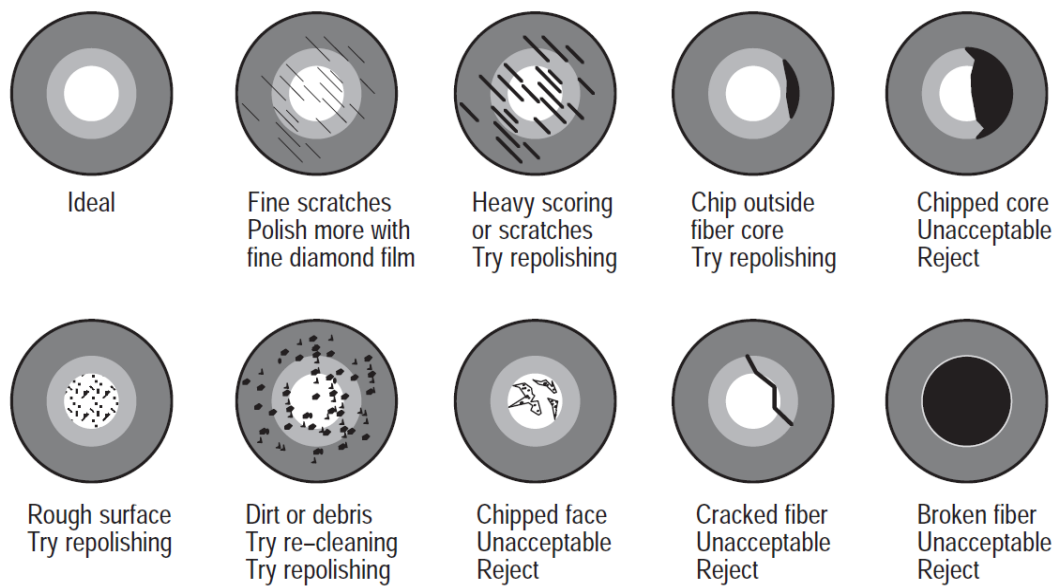
- Always place the plastic end-caps on the fiber connectors when they are not in use. Only use the supplied end caps.
- Never touch the tip of the fiber connector (core surface). If the tip of the connector is touched, use the supplied alcohol wipes to clean it before usage!
- Never drop the fiber connectors, as this may damage the core surface.
- Never bend the fibers (exceed the minimum bend radius <5 cm), as this will break the fiber core.
- Never pull the fiber 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 fibers.
- Do not apply mechanical stress (pull) to the fibers.
- Switch off the system before detaching the fibers.

### 2.7.2 Maintenance guideline

Clean the contact surface of the fibers with the lint-free alcohol wipes before installation. Do not use other solvents or wipes. Fibers 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.

### 2.7.3 Fiber conditions

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



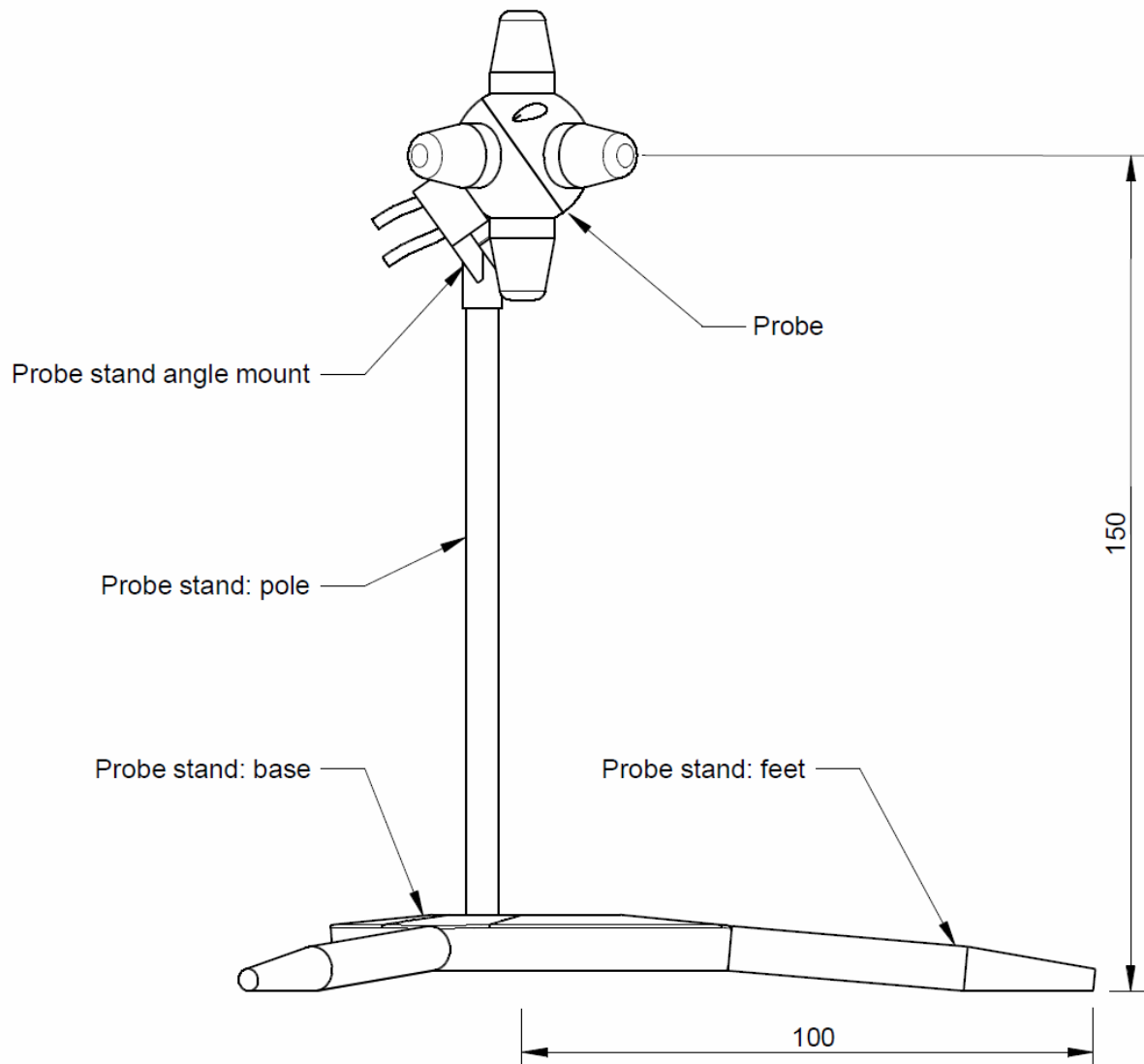
**Figure 5: Examples of fiber conditions and maintenance**



## 2.8 Probe stand

The RadiSense is supplied with a probe stand consisting of the following parts:

- Base
- Feet (3 pcs)
- Pole (2 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. Two poles with different size are delivered to mount the probe at either 150 mm or 100 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 100 mm or 150 mm 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.

## 3 Installation

### 3.1 Hardware Configuration

The hardware configuration<sup>3</sup> 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). See Figure 6.
3. Gently insert the plug-in card into the slot of the RadiCentre and reinsert the four screws. See Figure 6.



**Figure 6: Example of a (RadiSupply LPS2001B) plug-in card installation**

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.*

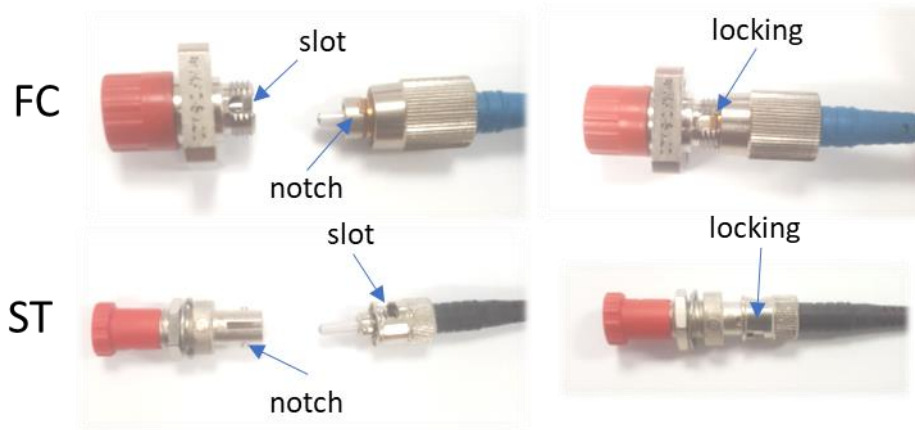
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<sup>3</sup> These are the basic steps in a plug-in card installation, the exact installation of your plug-in card might vary.

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 fibers 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).



**Figure 7: Slide the 'notch' correctly into the 'slot' to connect the FC and ST connectors**

6. Connect the RadiCentre system to your PC using any of the available interfaces of the RadiCentre system; USB, RS232, Ethernet or IEEE-488 (optional).
7. Place the interlock plug of the plug-in card into the interlock connector of the RadiCentre.

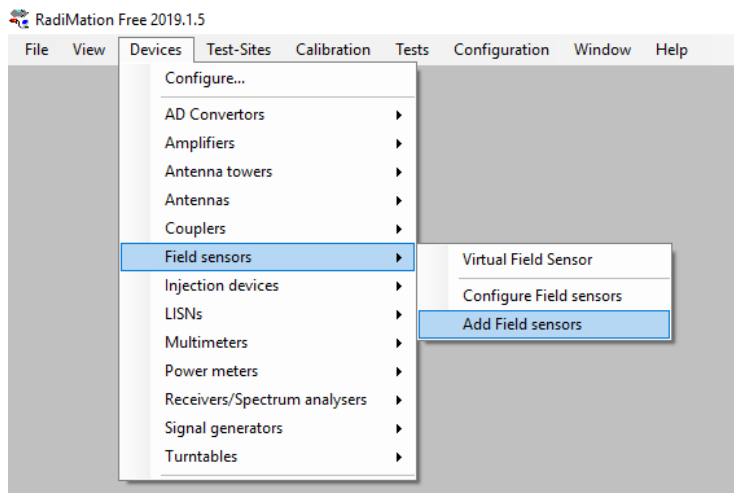
The hardware installation for the plug-in card is now complete. The user can control the plug-in card either through the touchscreen on the RadiCentre system (only available for the 2 and 7-slot versions), or by using the control commands in combination with an external software package such as the RadiMation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

## 3.2 Software Configuration

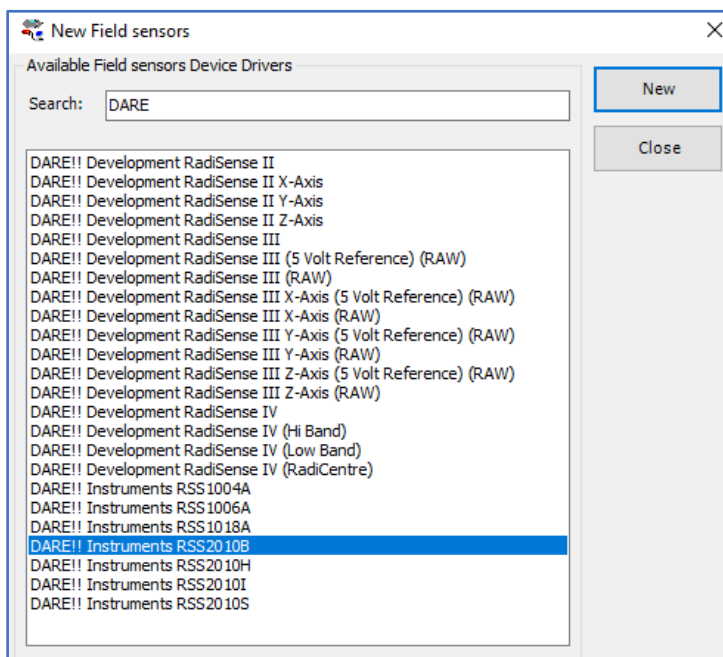
To control the RadiSense from a computer, one can use either custom made software or the RadiMation EMC software package from DARE!! Instruments, which can be downloaded from the DARE!! Instruments website. If the RadiSense is operated manually, this chapter can be skipped. If RadiMation software is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

### 3.2.1 RadiMation Freeware driver

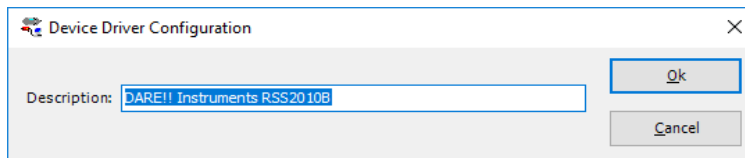
1. After the RadiMation software is installed and started, select 'Devices' in the menu screen and 'Add Field Sensor' to select the driver for the RadiSense / RadiCentre:



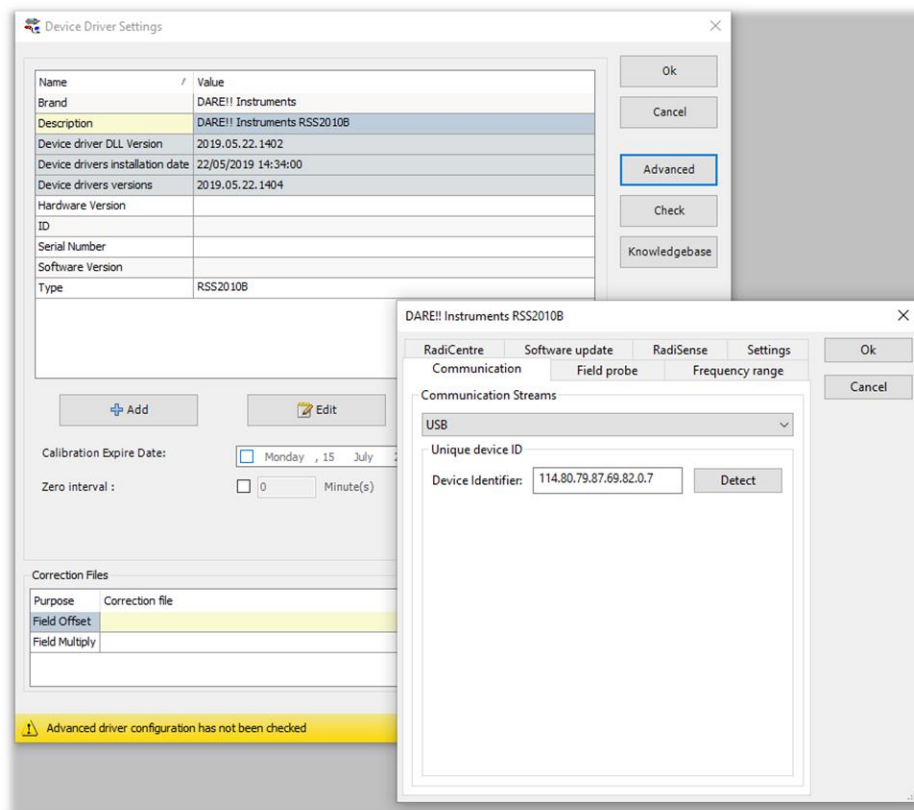
2. A new screen is shown, where the applicable product code of the RadiSense / RadiCentre can be selected. In this example, we add the RSS2010B driver for the RadiSense 10 field probe and click on 'New'.



Define the name of the new driver and save it by pressing 'OK'.

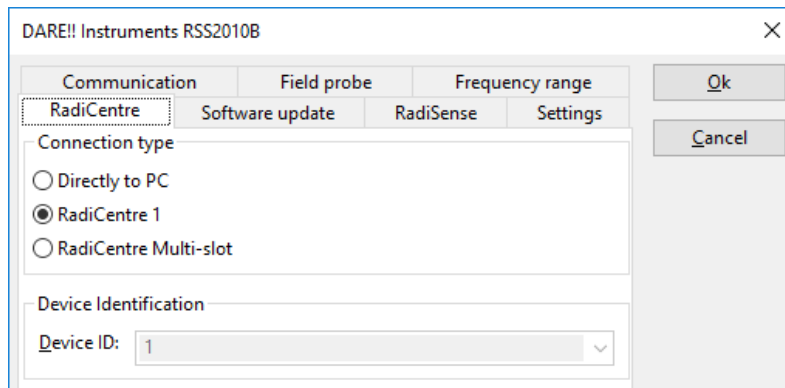


3. The new driver can be configured by double clicking the driver and press the 'Advanced' button. Another window opens, where you can select the communication tab and choose the control interface. In this example, we use USB.

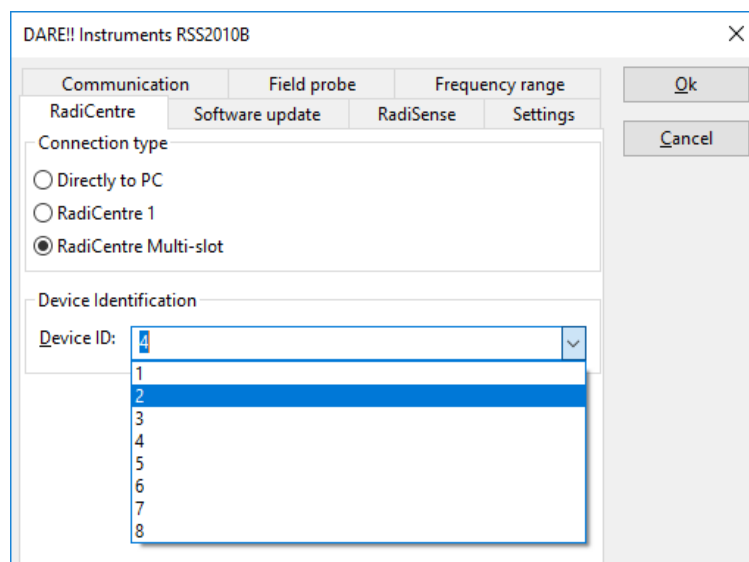


4. To enable the USB communication, make sure the RadiSense probe is connected to the PC USB port and press the 'Detect' button. After pressing 'Detect' the Device Identifier (ID) will be updated with the unique ID number. Make sure that there is no other DARE!! product connected to the same PC using USB.

- For controlling the RadiSense probe from a RadiCentre single slot (CTR1001S) select under the tab "RadiCentre" the "RadiCentre 1"



- For controlling the RadiSense probe from a RadiCentre 2-slot or 7-slot system (CTR1004B/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.



- Upon completion of the correct settings of the communication interface click on 'OK'.

8. 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.

DARE!! Instruments RSS2010B

Communication | Field probe | Frequency range

Levelling measurement settings

Pre Wait Time: 0 ms

Measure: 3 x

Wait Time: 75 ms

Max Difference: 0.5 V/m

Max. Measure: 10 x

Monitoring measurement settings

Pre Wait Time: 0 ms

Measure: 1 x

Wait Time: 0 ms

Max. Difference: 0.5 V/m

Max. Measure: 1 x

Ok

Cancel

9. Under the "Field probe" 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.

DARE!! Instruments RSS2010B

Communication | Field probe | Frequency range

Direction

☒ Isotropic

☐ X-Axis

☐ Y-Axis

☐ Z-Axis

☐ Software Isotropic

Filter Setting

Filter Dynamic

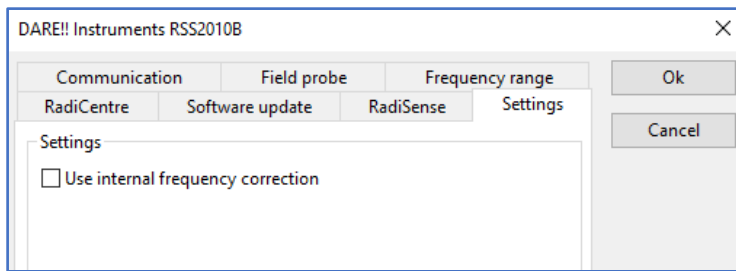
Ok

Cancel

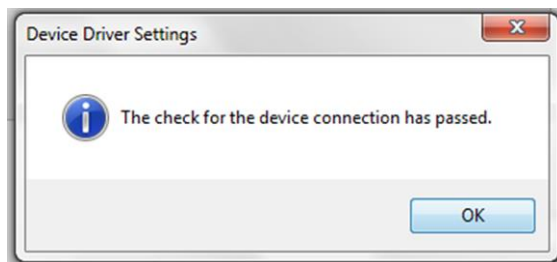
10. After clicking 'OK' you will go back into the device driver settings window. Under 'Settings' the internal frequency correction can be enabled or disabled.

Toevoegen wanneer deze functie aan/uit gezet dient te worden!!





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 below will be shown. If an error is shown, please check and repeat the previous software configuration steps 1 to 9.



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 5 '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 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.



Figure 8: Laser 'acknowledge' button in the main screen

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 "Please Zero" and a 'ZERO' button (figure 9) will appear directly behind the 'STATUS' box. Press 'ZERO' to start zeroing the probe. As soon as the probe is zeroed, the 'STATUS' box will turn green, and the measured field strength is displayed in the 'STATUS' box of the probe (figure 10).

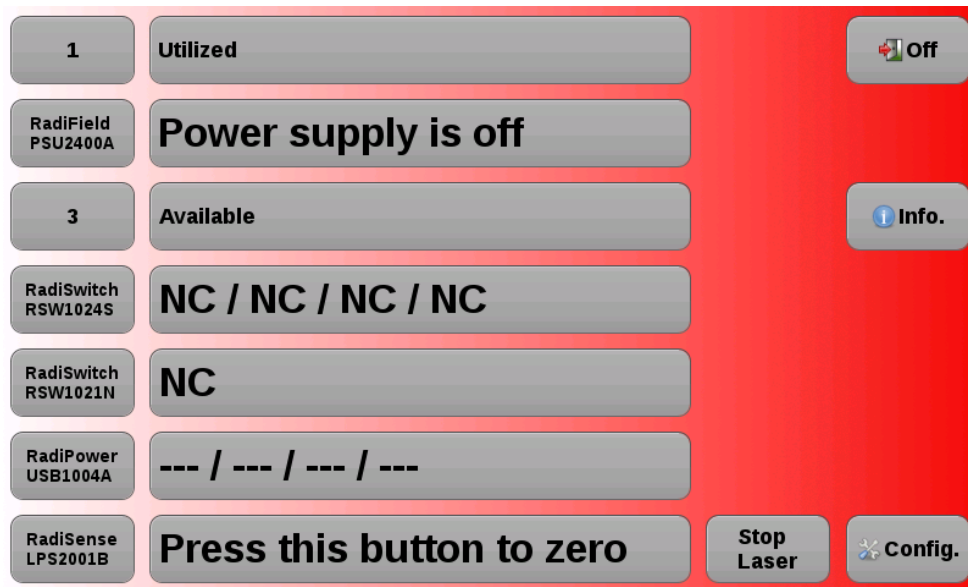


Figure 9: Zeroing the RadiSense probe in the main screen



Figure 10: Example of the RadiSense displaying control screen

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.

#### 4.1.3 Reading probe data

Readings from the probe can be taken directly from the TFT screen, 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.), one can go to the 'Instrument'-screen by pressing the 'STATUS' box of the required device from the main screen.



Figure 11: Example of the RadiSense control 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:

$$E_{\text{tot}} = \sqrt{E_x^2 + E_y^2 + E_z^2}$$

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

The 'Filter' button can be used to 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, where the factory frequency response and linearity data is stored inside the field probe.

Additionally, user correction data (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.

Please refer to paragraph 5 of this manual on further explanation on User correction data.

## 4.2 Remote Control

The RadiSense can be controlled remotely through the interfaces of the RadiCentre. The exact communication protocol can be found in the RadiCentre manual. The specific commands for the RadiSense are shown in chapter 5 'RadiSense Command Set'.

## 5 RadiSense calibration feature

The RS10 Series has the feature to store the calibration information in the probe. The calibration can be applied to the measured field in run time. This means that there is no longer a need to correct the measurement inside a measuring application like RadiMation.

The advantage of storing the calibration inside the probe is that the data is in one place. Making it easier to maintain the correct calibration information. When using the calibration option there are 3 parameters that need to be fulfilled:

1. A valid calibration programmed in the probe.
2. The calibration needs to be turned on in the probe.
3. The frequency information needs to be sent to the probe, so it can apply the correct factor.

The probe can store to 200 calibration points.

### 5.1 Calibration

During the calibration of the probe it is mandatory that the calibration is turned off. Not turning off the calibration during calibration will result in incorrect new calibration factors.

### 5.2 Programming calibration table

The procedure for sending the calibration information to the probe:

1. Write "CALSTORE" to the probe
2. Wait for OK or error response
3. Write the table to the probe,  
"<frequency>,<cfX>,<cfY>,<cfZ>;[...]<frequency>,<cfX>,<cfY>,<cfZ>;\r\n"  
frequency in Hz, cf ranging from 0.00 - 3.00 with a maximum of 2 decimal precision  
For example: "10000,0.93,0.95,0.95;20000,0.92,0.94,0.91;40000,0.92,0.93,0.91;\r\n"
4. Wait for OK or error response

Nadere uitleg / beschrijving geven over RM tool om data op te slaan en uit te lezen in de RadiSense 10 probe

## 6 RadiSense Command Set

### 6.1 General

Please refer to the RadiCentre manual for more information on the 'Device number'.

The RadiSense can be controlled remotely through the interfaces of the RadiCentre. The exact communication protocol can be found in the RadiCentre manual. The specific commands for the RadiSense are shown in this chapter.

#### Example RadiCentre ports:

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"

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

## 6.2 Commands

### 6.2.1 General commands for the RadiSense

Instruction	Command	Reply
Identity	<b>"*IDN?"</b>	Returns the identity string of the RadiSense. For example: <b>"D.A.R.E!!, RSS2010A, 1.0.0"</b>
Reset	<b>"RESET"</b>	<b>"OK"</b> 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	<b>"CLEAR"</b>	<b>"OK"</b> Clears any present errors
Local	<b>"LOCAL"</b>	<b>"OK"</b> Return to local mode
Serial number	<b>"ID_NUMBER?"</b>	Returns the unique s/n number. For example: <b>"1.58.95.146.21.0.0.124"</b>

*\*This table continues on the next page.*



## Commands, part 2

Instruction	Command	Reply
Get field	<b>"D3"</b>	<b>":Dxx.xx;yy.yy;zz.zz_V_"</b>  Where <b>xx.xx</b> , <b>yy.yy</b> and <b>zz.zz</b> are 4 digit floating point values of the electrical field measured by that axis. For example: <b>":D2.764;7453.;623.5_V_"</b>
Get field (long)	<b>"D5"</b>	<b>":Dxx.xx;yy.yy;zz.zz;cc.cc_V_"</b>  Same response as D3 with added <b>cc.cc</b> which is a 4 digit floating point value of the total isotropic field. For example: <b>":D2.764;7453.;623.5;9234._V_"</b>
Get field (short)	<b>"D6"</b>	<b>"cc.cc"</b>  Where <b>cc.cc</b> which is a 4 digit floating point value representing the total isotropic field. For example: <b>"23.85"</b>
Get multiple readings	<b>"BURST&lt;space&gt;&lt;n&gt;"</b>  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: <b>"23.85;23.56;23.45;23.65;23.75"</b> (burst of 5 measurements)
Measurement mode	<b>"MEASMODE&lt;space&gt;&lt;mode&gt;"</b>  Where <b>mode</b> is 0 for buffered measurements 1 for triggered measurements	<b>"OK"</b> or <b>"Error&lt;space&gt;&lt;number&gt;"</b>
Measurement query	<b>"MEASMODE?"</b>	<b>"0"</b> for buffered measurements <b>"1"</b> for triggered measurements or <b>"Error&lt;space&gt;&lt;number&gt;"</b>

*\*This table continues on the next page.*

### Commands, part 3

Instruction	Command	Reply
Filter / averaging	<b>"Filter?"</b>	<b>"DYN"</b> = dynamic (16 to 128 times depending on value) <b>"1"</b> = 4 times average <b>"2"</b> = 8 times average <b>"3"</b> = 16 times average <b>"4"</b> = 32 times average <b>"5"</b> = 64 times average <b>"6"</b> = 128 times average
Filter setting	<b>"Filter &lt;space&gt;&lt;a&gt; "</b> Where <b>a</b> is setting: <b>DYN</b> = dynamic (16 to 128 times depending on value) <b>1</b> = 4 times average <b>2</b> = 8 times average <b>3</b> = 16 times average <b>4</b> = 32 times average <b>5</b> = 64 times average <b>6</b> = 128 times average	<b>"OK"</b> or <b>"Error&lt;space&gt;&lt;number&gt;"</b>
Zero sensor	<b>"ZERO"</b>	<b>"OK"</b> or <b>"Error&lt;space&gt;&lt;number&gt;"</b>
Status	<b>"STATUS?"</b>	<b>"LASERON"</b> , <b>"STANDBY"</b> or <b>"Error&lt;space&gt;&lt;number&gt;"</b>
Temperature	<b>"TC?"</b> for degrees Celsius or <b>"TF?"</b> for degrees Fahrenheit	<b>"Tnn.nn"</b> Where <b>nn.nn</b> is a 4 digit number representing the temperature. For example: <b>"T15.4"</b>
Get sensor supply voltage	<b>"B"</b>	<b>"Bnn.nn"</b> Where <b>nn.nn</b> is a 4 digit number representing the supply voltage in the sensor. Typical around 6V. For example: <b>"B06.23"</b>

*\*This table continues on the next page.*

## Commands, part 4

Instruction	Command	Reply
Set frequency <sup>4 5</sup>	<b>"FREQ&lt;space&gt;&lt;f&gt;"</b> Where <b>f</b> is the frequency in Hz	<b>"OK"</b> or <b>"Error&lt;space&gt;&lt;number&gt;"</b>
Frequency query	<b>"FREQ?"</b>	Returns frequency in Hz, for example: <b>"100000000"</b> for 100 MHz
Min frequency	<b>"FREQ?&lt;space&gt;MIN"</b>	Return the minimum frequency of the sensor in Hz.
Max frequency	<b>"FREQ?&lt;space&gt;MAX"</b>	Returns the maximum frequency of the sensor in Hz.
Calibration <sup>6</sup>	<b>"CAL&lt;space&gt;&lt;state&gt;"</b> Where state is <b>ON</b> or <b>OFF</b>	<b>"OK"</b> or <b>"Error&lt;space&gt;&lt;number&gt;"</b>
Query calibration	<b>"CAL?"</b>	<b>"ON"</b> if calibration data is active <b>"OFF"</b> if calibration data is not used
Programming calibration table <sup>7</sup>	<b>"CALSTORE"</b>	<b>"OK"</b> or <b>"Error&lt;space&gt;&lt;number&gt;"</b> Then send the table <b>For example:</b> <b>"10000,0.93,0.95,0.95;20000,0.92,0.94,0.91;40000,0.92,0.93,0.91;\r\n"</b> With a maximum of 200 points.
Getting the calibration table	<b>"CALDUMP"</b>	<b>For example:</b> <b>"10000,0.93,0.95,0.95;20000,0.92,0.94,0.91;40000,0.92,0.93,0.91;\r\n"</b>

<sup>4</sup> Setting the frequency is mandatory for the RS2010I and RS2010S

<sup>5</sup> Setting the frequency is possible and mandatory for the RS201-B and RS2010H, when the calibration is on

<sup>6</sup> Calibration data can be stored in the sensor. With this command the correction can be enabled or disabled

<sup>7</sup> See chapter 5.2 Programming calibration table for more information

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

## 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

Please refer to the RadiCentre Service & Operating manual for the error codes of the RadiCentre.

Contact your local reseller in this case if other error numbers are returned.

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
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

## 7 RadiSense Specifications

Model	RadiSense 10 RSS2010B
<b>Electric Field</b>	
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)
<b>Accuracy</b>	
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	< ± 0,5 dB up to 1 GHz, typical 0,25 dB < ± 1 dB from 1 GHz up to 3 GHz < ± 5 dB from 3 GHz up to 10 GHz
Linearity	0,5 dB ±0,5 V/m
Shape	Spherical
Electrical measuring volume	117 cm <sup>3</sup> (25mm Ø)
Number of antennas	6 (2 per axis)
Measuring speed sensor	Max 1000 samples/sec <sup>8</sup>

*\*This table continues on the next page.*

<sup>8</sup> 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
<b>Electric Field</b>	
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)
<b>Accuracy</b>	
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 $\pm$ 0,5 V/m
Shape	Spherical
Electrical measuring volume	117 cm <sup>3</sup> (25mm Ø)
Number of antennas	6 (2 per axis)
Measuring speed sensor	Max 1000 samples/sec <sup>9</sup>

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<sup>9</sup> 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
<b>Electric Field</b>	
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)
<b>Accuracy</b>	
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 $\pm 0,5$ V/m
Shape	Spherical
Electrical measuring volume	117 cm <sup>3</sup> (25mm Ø)
Number of antennas	6 (2 per axis)
Measuring speed sensor	Max 100 samples/sec

Model	RadiSense 10 RSS2010S
<b>Electric Field</b>	
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)
<b>Accuracy</b>	
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 $\pm 0,5$ V/m
Shape	Spherical
Electrical measuring volume	117 cm <sup>3</sup> (25mm Ø)
Number of antennas	6 (2 per axis)
Measuring speed sensor	Max 100 samples/sec

Model	RadiSense 10
<b>Optical</b>	
LASER power	Max. 0,5 Watt output at aperture
Wavelength	808 nm
LASER connector	FC/PC
Data connector	ST/PC
Fibers	200/230 µm HCS, duplex
Standard Fiber length	1,5 m fixed to sensor, 10 m extension with couplings Other lengths available on request
<b>Safety</b>	
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
<b>Environmental conditions</b>	
Temperature range	0° to 40° Celsius
Relative humidity	10 – 90% (non-condensing)
<b>Warranty</b>	
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:

- Fiber 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 <sup>1</sup> 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;

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Date of issue: December 15<sup>th</sup>, 2017

Place of issue: Woerden, the Netherlands

Authorized by:   
P.W.J. Dijkstra

Title of authority: Director

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Conducted emission complies with Class B (household equipment)

