

EMSense 10/40 Laser Powered Electric Field Probe

With EMSense 10/40 Plug-In Card for EMCenter

Product Manual



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NOTES, CAUTIONS, AND WARNINGS

	<p>Note: Denotes helpful information intended to provide tips for better use of the product.</p>
	<p>Caution: Denotes a hazard. Failure to follow instructions could result in minor personal injury and/or property damage. Included text gives proper procedures.</p>
	<p>Warning: Denotes a hazard. Failure to follow instructions could result in SEVERE personal injury and/or property damage. Included text gives proper procedures.</p>





SAFETY INFORMATION

	<p>Refer to Manual: When product is marked with this symbol, see the instruction manual for additional information. If the instruction manual has been misplaced, download it from ETS-Lindgren.com, or contact ETS-Lindgren Customer Service.</p>
	<p>High Voltage: Indicates presence of hazardous voltage. Unsafe practice could result in severe personal injury or death.</p>
	<p>High Voltage: Indicates presence of hazardous voltage. Unsafe practice could result in severe personal injury or death.</p>
	<p>Protective Earth Ground (Safety Ground): Indicates protective earth terminal. You should provide uninterruptible safety earth ground from the main power source to the product input wiring terminals, power cord, or supplied power cord set.</p>
	<p>LASER: Indicates presence of invisible LASER radiation. Class 1M LASER product. NEVER look into any of the fiber 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.</p>



See the ETS-Lindgren **Product Information Bulletin** for safety, regulatory, and other product marking information.

GENERAL SAFETY CONSIDERATIONS

	<p>Before power is applied to this instrument, ground it properly through the protective conductor of the AC power cable to a power source provided with the protective earth contact. Any interruption of the protective (grounding) conductor, inside or outside the instrument, or disconnection of the protective earth terminal could result in personal injury.</p>
 	<p>Before servicing: contact ETS-Lindgren – servicing (or modifying) the unit by yourself may void your warranty. If you attempt to service the unit by yourself, disconnect all electrical power before starting. There are voltages at many points in the instrument which could, if contacted, cause personal injury. Only trained service personnel should perform adjustments and/or service procedures upon this instrument. Capacitors inside this instrument may still be CHARGED even when instrument is disconnected from its power source.</p>
	<p>Only qualified personnel should operate (or service) this equipment.</p>

1.0 INTRODUCTION

1.1 Product Introduction

The EMSense 10/40 electric field sensors are the most accurate ultra-wideband sensors designed for electric field strength measurements. The sensors are 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



EMSense 10

EMSense 40

1.2 Related Products



EMCenter System (2-Slot and 7-Slot)

The EMCenter is a modular EMC test system that serves as the user and computer interface for all the EMCenter plug-in cards and modules, such as the EMSense 10/40 field sensors. EMCenter units are available in 2-slot and 7-slot versions.

EMCenter 1 Unit

The EMCenter 1 is a 1-slot unit that can be used to control the EMSense 10/40 from a computer.

ProbeView V Software

ProbeView V is a simple software package available for download at ETS-Lindgren.com. ProbeView V provides real-time display, logging, and analysis of probe data as a support tool for EMF measurements.

TILE! - Totally Integrated Laboratory Environment System

EMSense 10 and EMSense 40 are fully supported by TILE! software.

2.0 EMSENSE 10/40

2.1 2-Slot and 7-Slot EMCenter Processor Requirement



The 2-slot and 7-slot EMCenter require an ARM processor board and firmware version 3.3.3 or higher to operate the EMSense 10/40 field probe and interface card. 2-slot and 7-slot EMCenter systems utilizing an X86 processor board or and/or firmware version 3.3.0 or older are not supported and will not communicate with the EMSense interface card.

To view the 2-slot or 7-slot EMCenter version information, navigate to the main screen and press the Info button. Slot 8 indicates the processor version of this EMCenter as shown in the example below.



If the EMCenter is not operating the 7000-008 or 7000-009 processor card, contact ETS-Lindgren to purchase a new 2-slot or 7-slot EMCenter or a new processor card compatible with EMSense.

Processor Cards		
Model	Part Number	Description
7000-008	1611365	EMCENTER PROCESSOR BOARD STD (ARM)
7000-009	1695739	EMCENTER PROCESSOR BOARD + GPIB (ARM)

2.2 EMSense 10/40 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.

Compact Sensors

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 EMSense 10/40 are extremely small, increasing measurement accuracy.

In addition, the EMSense 10 is equipped with 2 antennas per axis (6 in total) to optimize isotropic performance and achieve best overall accuracy.

User Correction - Calibration factors – Additionally, the EMSense 10/40 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 of the measured field must be sent to the probe in order to apply the correct, frequency dependent, user calibration factor.

The frequency response correction factors which are determined during ISO17025 accredited calibration of the probe can be stored inside the field sensor.

When the user correction data is stored inside the probe the EMSense 10/40 field sensor will return corrected E-field readings without the need of additional calculations. Corrections will be applied inside the probe for each individual axis.



If a calibration is performed at ETS-Lindgren Calibrations, the correction factors will be loaded into the EMSense 10/40 field sensor by default by ETS-Lindgren.



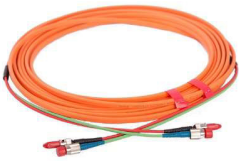
2.3 EMSense 10 Field Probe and Kits

The EMSense 10 sensor can be purchased as a stand-alone item or as part of a kit.




2.3.1 Field Probe Kits For Use with 2-Slot or 7-Slot EMCenter



Kits 1714963 and 1714964 do not include an EMCenter unit.
2-Slot and 7-Slot EMCenter units sold separately.

KIT 1714963 7007-201 10 M KIT, PROBE + CARD + 10 M FIBER CABLE		
		
1710780	1702423	1702414
7007-201 EMSense 10 Field Sensor 10 kHz - 10 GHz	7007-200 EMSense 10/40 Plug-In Card	10 Meter Fiber Extension Cable FC/ST

*1702417 - Coupling Set FC/ST included





KIT 1714964 7007-201 20 M KIT, PROBE + CARD + 20 M FIBER CABLE		
		
1710780	1702423	1702415
7007-201 EMSense 10 Field Sensor 10 kHz - 10 GHz	7007-200 EMSense 10/40 Plug-In Card	20 Meter Fiber Extension Cable FC/ST

*1702417 - Coupling Set FC/ST included





2.3.2 EMSense 10 Field Probe Kits For Use with EMCenter 1



Kits 1714959 and 1714961 include an EMCenter 1 unit for connection to a PC.

KIT 1714959 7007-201 10 M KIT, PROBE + CARD + EMCENTER 1 + 10 M FIBER CABLE			
			
1710780	1702423	1703647	1702414
7007-201 EMSense 10 Field Sensor 10 kHz - 10 GHz	7007-200 EMSense 10/40 Plug-In Card	7000-012 EMCenter 1 RS232, USB	10 Meter Fiber Extension Cable FC/ST

*1702417 - Coupling Set FC/ST included

KIT 1714961 7007-201 20 M KIT, PROBE + CARD + EMCENTER 1 + 20 M FIBER CABLE			
			
1710780	1702423	1703647	1702415
7007-201 EMSense 10 Field Sensor 10 kHz - 10 GHz	7007-200 EMSense 10/40 Plug-In Card	7000-012 EMCenter 1 RS232, USB	20 Meter Fiber Extension Cable FC/ST

*1702417 - Coupling Set FC/ST included



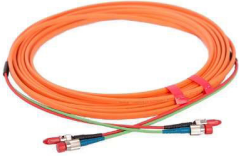
2.4 EMSense 40 Field Probe and Kits



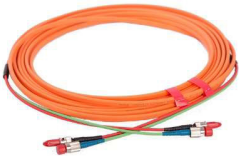
The EMSense 40 sensor can be purchased as a stand-alone item or as part of a kit.

2.4.1 Field Probe Kits For Use with 2-Slot or 7-Slot EMCenter



Kits 1741724 and 1741725 do not include an EMCenter unit.
2-Slot and 7-Slot EMCenter units sold separately.





KIT 1741724 7007-203 10 M KIT, PROBE + CARD + 10 M FIBER CABLE		
		
1738260	1702423	1702414
7007-203 EMSense 40 Field Sensor 10 MHz - 40 GHz	7007-200 EMSense 10/40 Plug-In Card	10 Meter Fiber Extension Cable FC/ST





KIT 1741725 7007-203 20 M KIT, PROBE + CARD + 20 M FIBER CABLE		
		
1738260	1702423	1702415
7007-203 EMSense 40 Field Sensor 10 MHz - 40 GHz	7007-200 EMSense 10/40 Plug-In Card	20 Meter Fiber Extension Cable FC/ST

2.4.2 EMSense 40 Field Probe Kits For Use with EMCenter 1



Kits 1741726 and 1741727 include an EMCenter 1 unit for connection to a PC.

KIT 1741726 7007-203 10 M KIT, PROBE + CARD + EMCENTER 1 + 10 M FIBER CABLE			
			
1738260	1702423	1703647	1702414
7007-203 EMSense 40 Field Sensor 10 MHz - 40 GHz	7007-200 EMSense 10/40 Plug-In Card	7000-012 EMCenter 1 RS232, USB	10 Meter Fiber Extension Cable FC/ST

KIT 1741727 7007-203 20 M KIT, PROBE + CARD + EMCENTER 1 + 20 M FIBER CABLE			
			
1738260	1702423	1703647	1702415
7007-203 EMSense 40 Field Sensor 10 MHz - 40 GHz	7007-200 EMSense 10/40 Plug-In Card	7000-012 EMCenter 1 RS232, USB	20 Meter Fiber Extension Cable FC/ST

2.5 Individual Parts



EMSense 10 E-field sensor (with fixed fiber cables)

Model: 7007-201

Part Number: 1710780

Electric field sensors to be used together with the plug-in card including small probe stand.



EMSense 40 E-field sensor (with fixed fiber cables)

Model: 7007-203

Part Number: 1738260

Electric field sensors to be used together with the plug-in card including small probe stand.

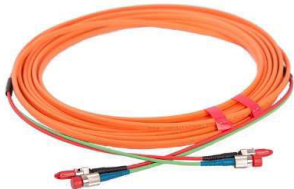


Plug-In Card

Model: 7007-200

Part Number: 1712423

An electric field sensor plug-in card to be used in the EMCenter or EMCenter 1 system.



Fiber Extension Cable

10 Meter Cable Part Number: 1702414

20 Meter Cable Part Number: 1702415

Additional fiber lengths are available upon request.



Coupling Set

Part Number: 1702417

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

2.6 Product Documentation

- Product Information Bulletin
- User Manual available online at ETS-Lindgren.com
- Calibration certificate for field sensor

2.7 Fiber Optic Cables

Use an extension fiber to connect the sensor to the plug-in card mounted in the EMCenter. This extension fiber is a duplex fiber cable and uses dissimilar connectors to avoid incorrect connections. 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.

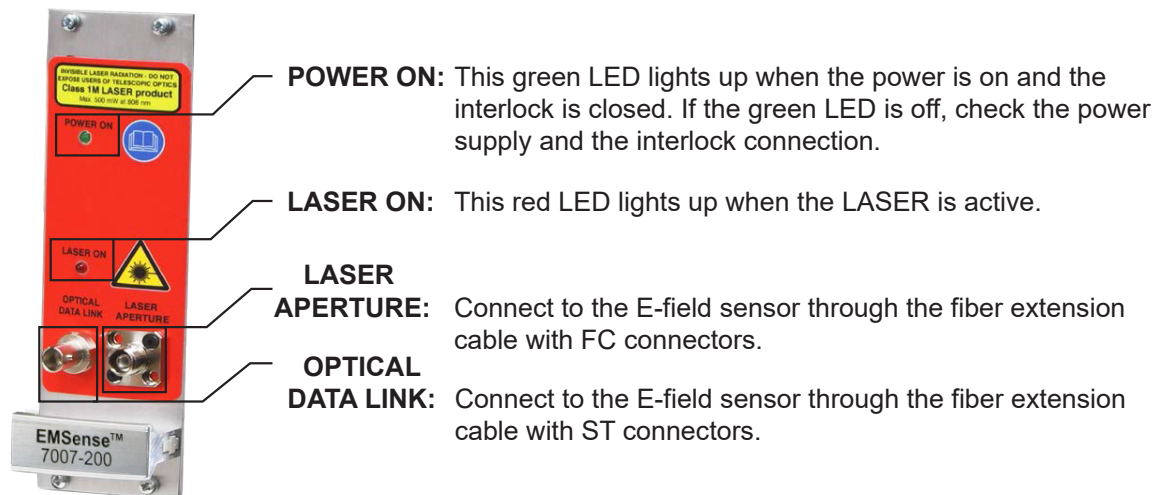
Refer to section **2.10** for fiber handling and maintenance.

To ensure safe and correct operation of the sensor, only use the EMSense 10/40 with the original supplied or ordered fibers. Do not use other fibers than those supplied by ETS-Lindgren.

Fiber extension cables with different lengths up to 100 meters are available on request. Contact ETS-Lindgren for more detailed information.

2.8 Plug-In Card Connector Panel

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



2.9 LASER Safety Measures

The EMSense 10/40 uses a 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.



During normal operation, exposure to LASER radiation is not possible because the EMSense 10/40 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 fiber 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 EMCenter 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 EMCenter system serves as a reminder to the operator that one or more LASERS are switched on.

EMCenter (2-Slot And 7-Slot Specific):

- A 'LASER Code' is required to activate the EMCenter 2-slot and 7-slot systems. This LASER code enables the power supply to all installed (LASER) modules.
- Please refer to Section 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 time frame'.

EMCenter 1 (Single-Slot Specific):

To start the EMCenter 1, which has no touchscreen display, a specific activation procedure combined with auditory warnings is used.

To activate the LASER in the EMCenter 1, follow these steps:

1. Press the 'Start' button on the back panel (of the EMCenter 1) 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 EMSense 10/40 Supply 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.

2.10 Fiber Handling and Maintenance

The fiber optic cables in the EMSense 10/40 are a crucial part of the system. Fiber optic connectors and cables can be damaged by airborne particles, humidity, moisture, oils from the human body, and debris from the connectors they plug into. Improper handling and poor maintenance can cause deterioration or permanent damage. Always handle connectors and cables in accordance with the following guidelines.

2.10.1 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 2 in or 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.

2.10.2 Maintenance Guidelines

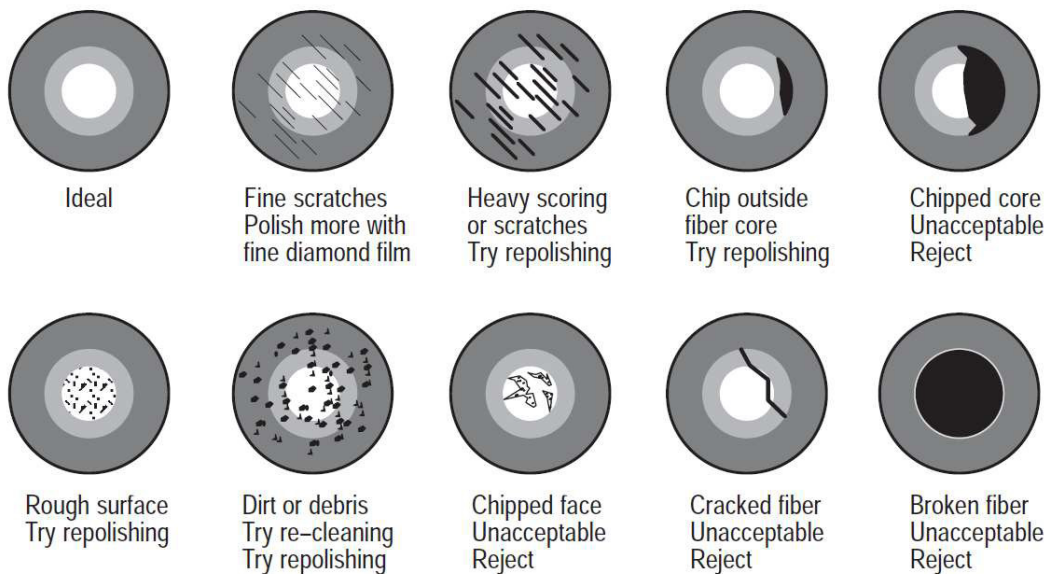
CAUTION

Before performing any maintenance, disconnect the fiber optic cables from the unit and turn off power. Failure to perform these tasks may result in damage to the fiber optic connectors or cables.

- When disconnecting fiber optic cables, apply the included dust caps to the ends to protect them from damage.
- Before connecting fiber optic cables, clean the connector tips and in-line connectors.
- Before attaching in-line connectors, clean them with moisture-free compressed air.
- Clean the contact surface of the fibers with the lint-free alcohol wipes before installation. Do not use other solvents or wipes.

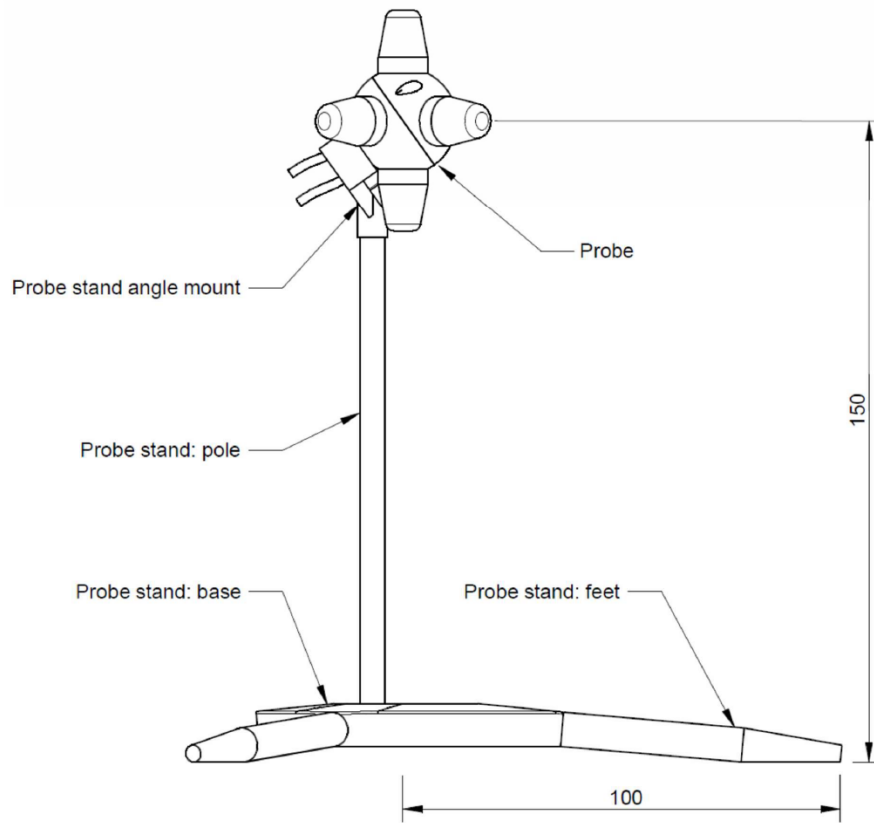
2.10.3 Fiber Conditions

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 ETS-Lindgren for assistance and/or advice.



2.11 EMSense 10 Probe Stand

The EMSense 10 is supplied with a probe stand consisting of the following parts:



The probe stand parts can be easily assembled together. The 3 feet can be screwed into the side of the base. Screw the pole into the M4 internally threaded hole in the base top. Using this probe stand pole with feet, the probe is positioned at the desired height above the surface and can be easily positioned 100mm from a table edge.

The probe stand can also be used without the feet. The assembly can be mounted on a separate probe stand (not included) via the 1/4 - 20 UNC internal thread hole located in the center of the base.

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.



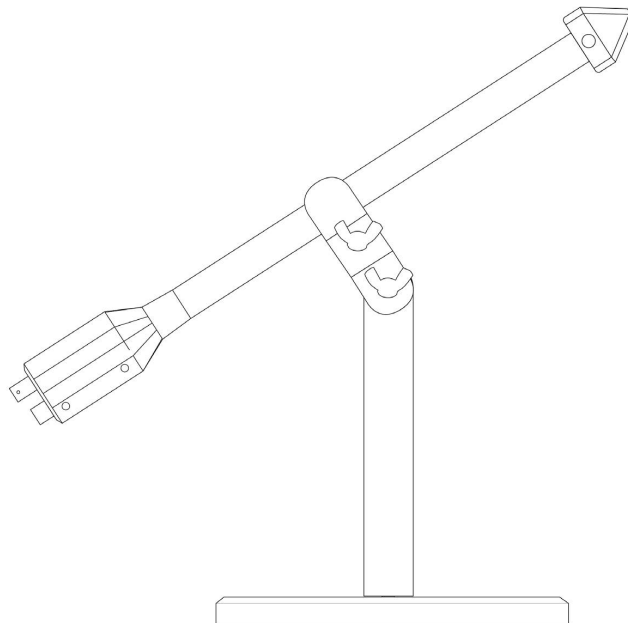
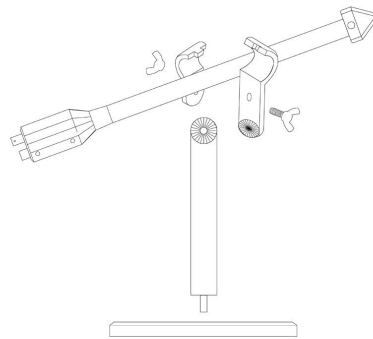
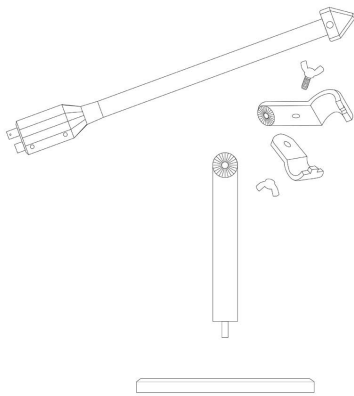
For accurate measurements of electrical field with a known polarization, the mounting angle can be used to position one axis of the EMSense 10 parallel to the field. See right picture. In most situations, this is the way an E-field sensor is calibrated, axis by axis. Therefore, the probe should be used in the same way to obtain the most accurate results. Failure to perform these tasks may result in damage to the fiber optic connectors or cables.



Placing any material in close proximity to the field sensor will influence the field and could cause measurement errors.

2.12 EMSense 40 Probe Stand

The EMSense 40 is supplied with a probe stand to position the EMSense 40 at a defined height and angle. See the drawings below that provide instructions on how the EMSense 40 probe can be mounted on the probe stand.



3.0 INSTALLATION

3.1 Hardware Configuration

CAUTION

Before connecting any components, follow the safety information in the ETS-Lindgren Product Information Bulletin included with your shipment.



Always unplug the unit before starting maintenance to prevent electrical shock. Maintenance includes removal of the plug-in cards or the top panel.

CAUTION

Leave an empty slot or space 1U in height beneath the EMCenter to allow sufficient cooling through the bottom air inlets of the cabinet.



Ensure power is removed before beginning plug-in card installation or hardware configuration.



When working on hardware installation, place all components on an anti-static surface and wear an anti-static grounding strap connected to a metal surface on the chassis.

The slots as seen from the back of the EMCenter are numbered from left to right 1-7. The last two on the far right are the #8 processor card (2 USB and Ethernet port) and the main power cord port and switch.



These are the basic steps in a plug-in card installation, the exact installation of your plug-in card might vary. The hardware configuration is carried out in the following 7 steps:

1. Choose the slot of the EMCenter 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 EMCenter and reinsert the four screws.
4. Switch on the EMCenter system. The new plug-in card will automatically be detected and initialized by the EMCenter.

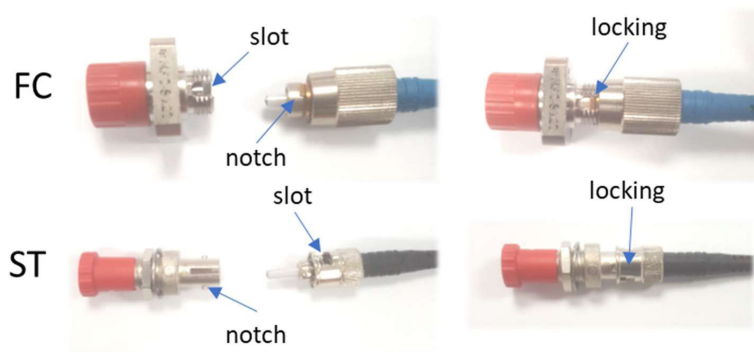


For operation of the EMSense 10/40 probes, the EMCenter should have minimum firmware version 3.3.3 or higher and meet the requirements of section 3.1.

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

Place the EMSense 10/40 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).



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

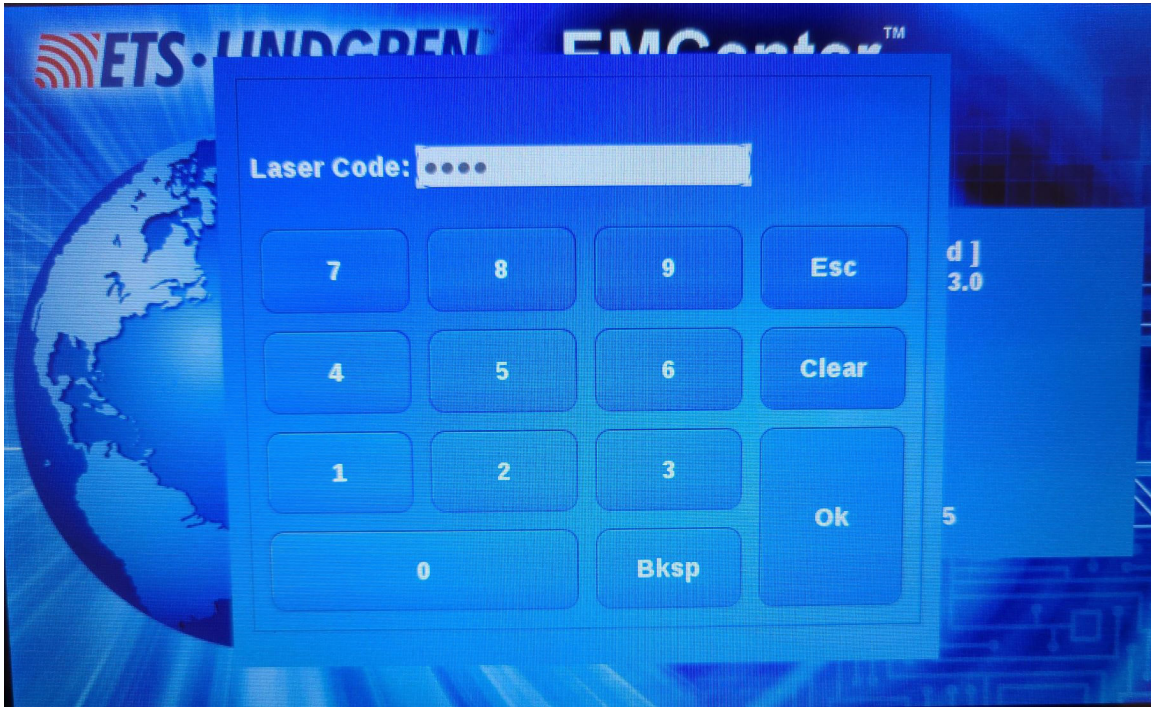
The hardware installation for the plug-in card is now complete. The user can control the plug-in card either through the touchscreen on the EMCenter system (only available for the 2-slot and 7-slot versions), or by using the control commands in combination with an external software package.

3.2 LASER Code for 2-slot and 7-slot EMCenter

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 EMCenter.

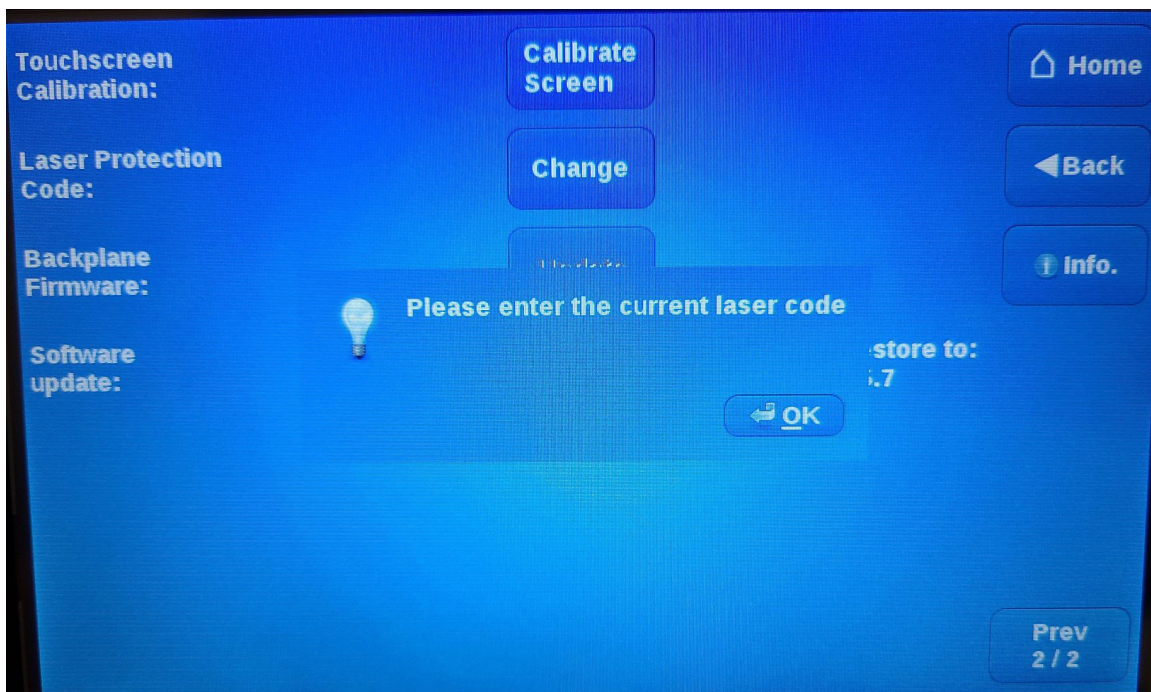
(This safety feature is linked to the EMCenter 2-slot and 7-slot version. The LASER activation and safety is implemented differently in the EMCenter 1.)

To meet the LASER safety precaution, enter the LASER Code in the 'LASER Code' screen and press 'OK' for confirmation.

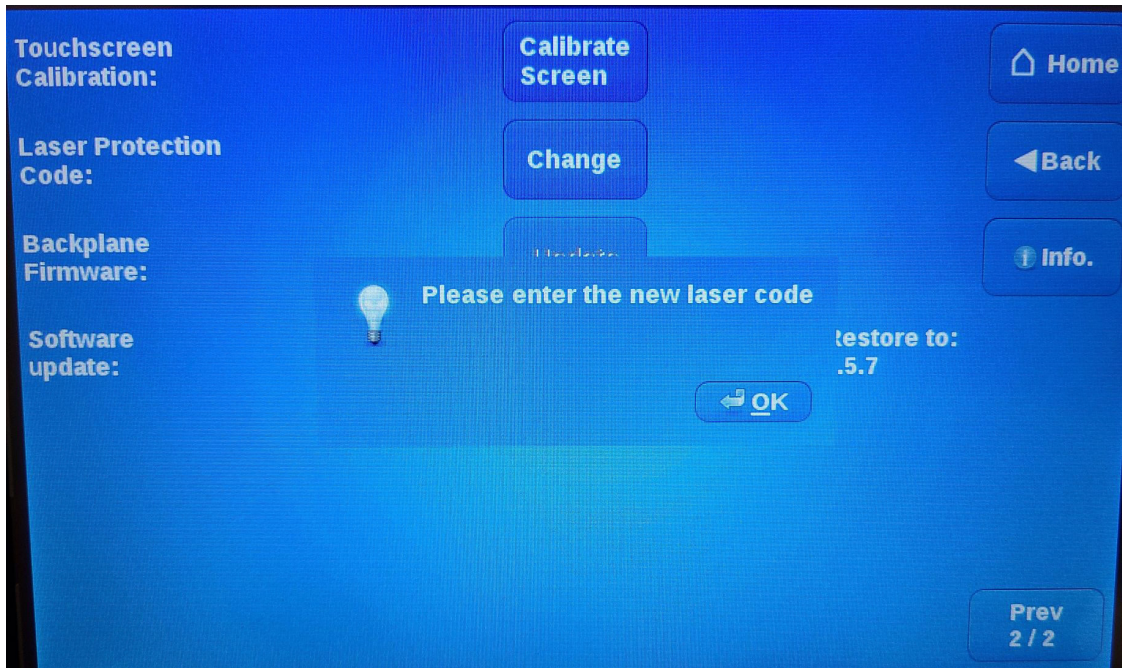


The default LASER code is: **3447**

This code can be changed by the customer in the main configuration screen.

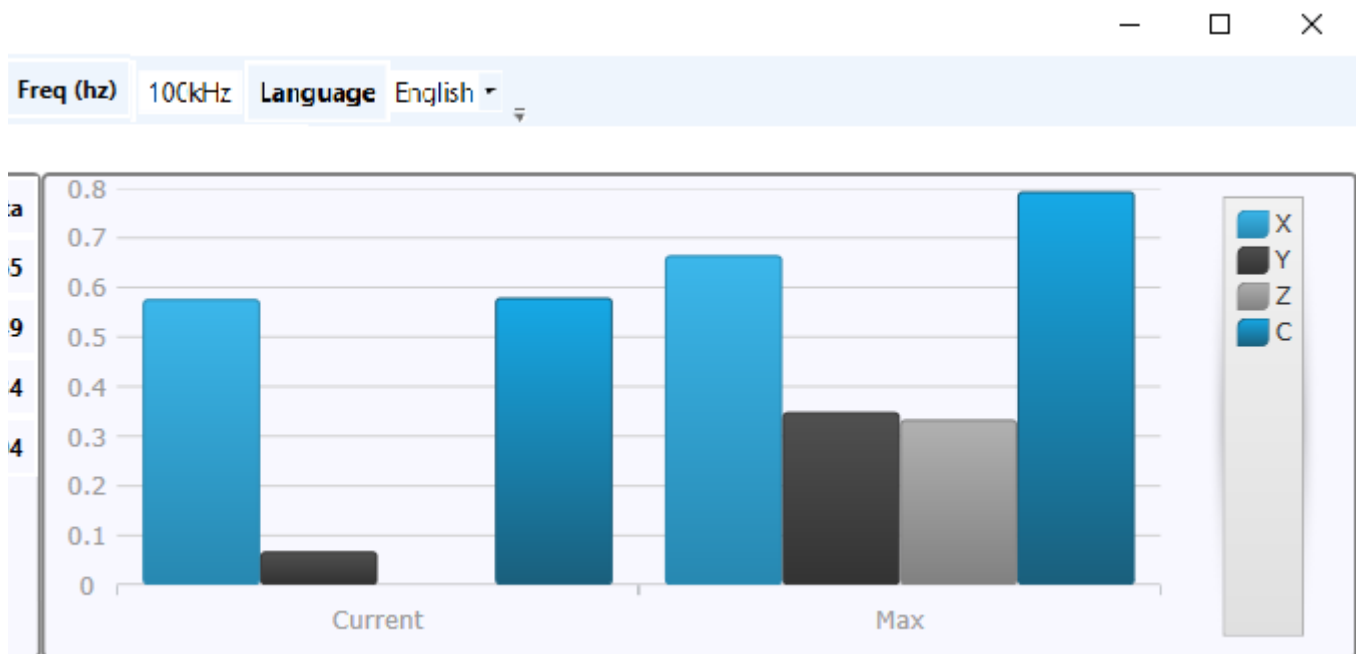


To change the laser code, the user will be asked to enter the current code once and the new code twice (for confirmation). Press 'Close' to leave each notification and enter the code in the following numeric window.



3.3 Software Configuration For EMCenter 1

To control the EMSense 10/40 from a computer, custom-made software can be used. ProbeView V is a simple software package available for download at ETS-Lindgren.com that provides real-time display, logging, and analysis of probe data as a support tool for EMF measurements. The software displays a variety of test information, both numerically and graphically.



3.3.1 Required Components

- Microsoft Windows PC with one available Serial/COM or USB port
- EMCenter 1
- EMSense 10/40 Electric Field Probe
- EMSense 10/40 interface card
- Fiber Cable
- Optional ProbeView V Software or TILE!

3.3.2 Setup



If you already have a version of ProbeView on your PC, uninstall it before installing ProbeView V.

1. Download and install ProbeView V Software
2. Accept all the license agreements and select FINISH.
3. Connect the fiber optic cable from the fiber optic ports on the probe to the EMSense 10/40 in the EMCenter and then connect the EMCenter to the PC.
4. Turn on the EMCenter and then the probe.
5. Start ProbeView V.
6. Check probe connection with NI_Max.
7. Add a probe configuration to ProbeView V using NI_Max settings.

4.0 USING THE EMSense 10/40

4.1 Commands



The EMSense 10/40 requires the user to set the frequency prior to reading the field probe for accurate readings.

The EMSense 10/40 laser card inserted in the EMCenter 1 can act as a USB device on your computer. A virtual COM-port will appear after installation of the USB driver. Use the following port settings for this port:

Word Length	8 bits
Stop Bits	1
Baud Rate	115,200
Parity	None

4.1.1 EMSense 10/40 General Commands

Instruction	Command	Reply
Identity	"*IDN?"	Returns the identity string of the EMSense 10/40 card. For example: "ETS-Lindgren, EMSense 10/40 7007-200, 2.0.7"
Identity	"!0*IDN?"	Returns the identity string of the EMSense 10/40 probe. For example: "ETS-Lindgren, EMSense 10/40 7007-201, 2.1.0"
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 card S/N number. For example: "1.6.57.136.26.0.0.29"
Serial number	"!0ID_NUMBER?"	Returns the unique probe S/N number. For example: "209.145.57.81.24.0.12.0"

*Setting the frequency is mandatory for the EMSense 10/40 to send corrected readings

Instruction	Command	Reply
Get field *	"H3"	<p>":Hxx.xx;yy.yy;zz.zz_V_"</p> <p>Where xx.xx, yy.yy and zz.zz are 4 digit floating point values of the electrical field measured by that axis.</p> <p>For example:</p> <p>":H2.764;74.53.;623.5_V_"</p>
Get field (long) *	"H5"	<p>":Hxx.xx;yy.yy;zz.zz;cc.cc_V_"</p> <p>Same response as H3 with added cc.cc which is a 4 digit floating point value of the total electric field.</p> <p>For example:</p> <p>":H2.764;74.53.;623.5;627.9_V_"</p>
Get field (short) *	"H6"	<p>"cc.cc"</p> <p>Where cc.cc which is a 4 digit floating point value representing the total electric field.</p> <p>For example:</p> <p>":H627.9_V_"</p>
Filter / averaging	"Filter?"	<p>"DYN" = dynamic (16 to 128 times depending on value)</p> <p>"1" = 4 times average</p> <p>"2" = 8 times average</p> <p>"3" = 16 times average</p> <p>"4" = 32 times average</p> <p>"5" = 64 times average</p> <p>"6" = 128 times average</p> <p>"7" = 256 times average</p> <p>"8" = 512 times average</p> <p>"9" = 1024 times average</p> <p>"10" = 2048 times average</p> <p>"11" = 4096 times average</p> <p>"12" = 8192 times average</p>

*Setting the frequency is mandatory for the EMSense 10/40 to send corrected readings

Instruction	Command	Reply
Filter setting	"Filter <space><a> " Where a is setting: 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 7 = 256 times average 8 = 512 times average 9 = 1024 times average 10 = 2048 times average 11 = 4096 times average 12 = 8192 times average	"OK" or "Error<space><number>"
Zero sensor	"ZERO"	"OK" or "Error<space><number>"
Status	"STATUS?"	"LASERON", "STANDBY" or "Error<space><number>"
Temperature	"TC" for degrees Celsius or "TF" for degrees Fahrenheit	":Tnn.n" Where nn.nn is a 4 digit number representing the temperature. For example: ":T15.4"
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. For example: ":B06.23"
Set frequency *	"FREQ<space><f>" Where f is the frequency in Hz	"OK" or "Error<space><number>"
Frequency query	"FREQ?"	Returns frequency in Hz, for example: "100000000" for 100 MHz
Min frequency	"FREQ?<space>MIN"	Return the minimum frequency of the sensor in Hz.
Max frequency	"FREQ?<space>MAX"	Returns the maximum frequency of the sensor in Hz.
Query calibration	"CAL?"	"ON" if calibration data is active "OFF" if calibration data is not used

Instruction	Command	Reply
Getting the calibration table	"CALDUMP"	For example: "10000,0.93,0.95,0.95;20000,0.92,0.9 4,0.91;40000,0.92,0.93,0.91;\r\n"

*Setting the frequency is mandatory for the EMSense 10/40 to send corrected readings

4.2 Example Of How To Get A Calibrated Field Reading From Emsense 10/40

The EMSense 10/40 can be controlled remotely through the interfaces of the EMCenter. The exact communication protocol, including the specific commands for the EMSense 10/40 probe and a listing of all error codes can be found in the EMCenter manual.

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

Example 2-slot and 7-slot EMCenter:



Frequency is set to 1 MHz in this example.

To get a reading from the EMSense 10/40 with the interface card in slot 1, using the EMCenter serial port or the GPIB port, assuming the desired frequency measurement is for 1 MHz send the following commands:

"FREQ 1000000" then "1:H5"

To get a reading from the EMSense 10/40 with the interface card in slot 4, using the EMCenter serial port or the GPIB port, assuming the desired frequency measurement is for 1 MHz send the following commands:

"FREQ 1000000" then "4:H5"

Example EMCenter 1:



Frequency is set to 1 MHz in this example.

To get a reading from the EMSense 10/40 card in an EMCenter 1, using the RS232 port or USB port, assuming the desired frequency measurement is for 1 MHz send the following commands:

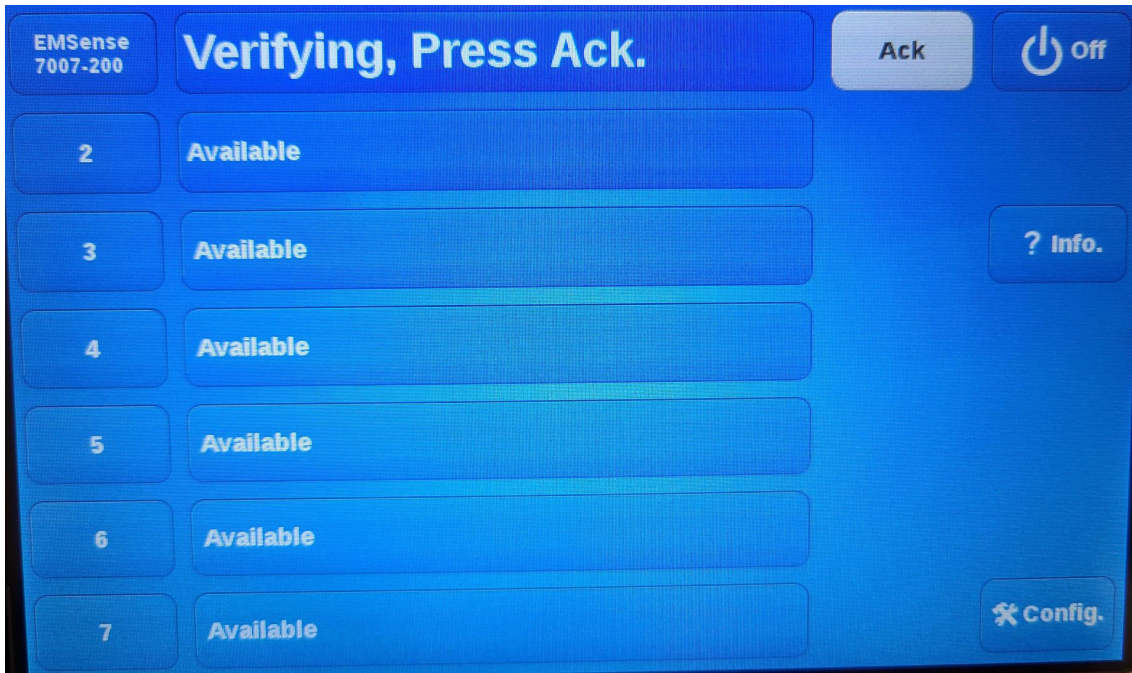
"FREQ 1000000" then "H5"

4.3 Manual Control for 2-Slot or 7-Slot EMCenter

Once the EMCenter is switched on, the EMSense 10/40 can be activated from the 'main' screen on the EMCenter touchscreen.

4.3.1 Starting the LASER Powered Sensor

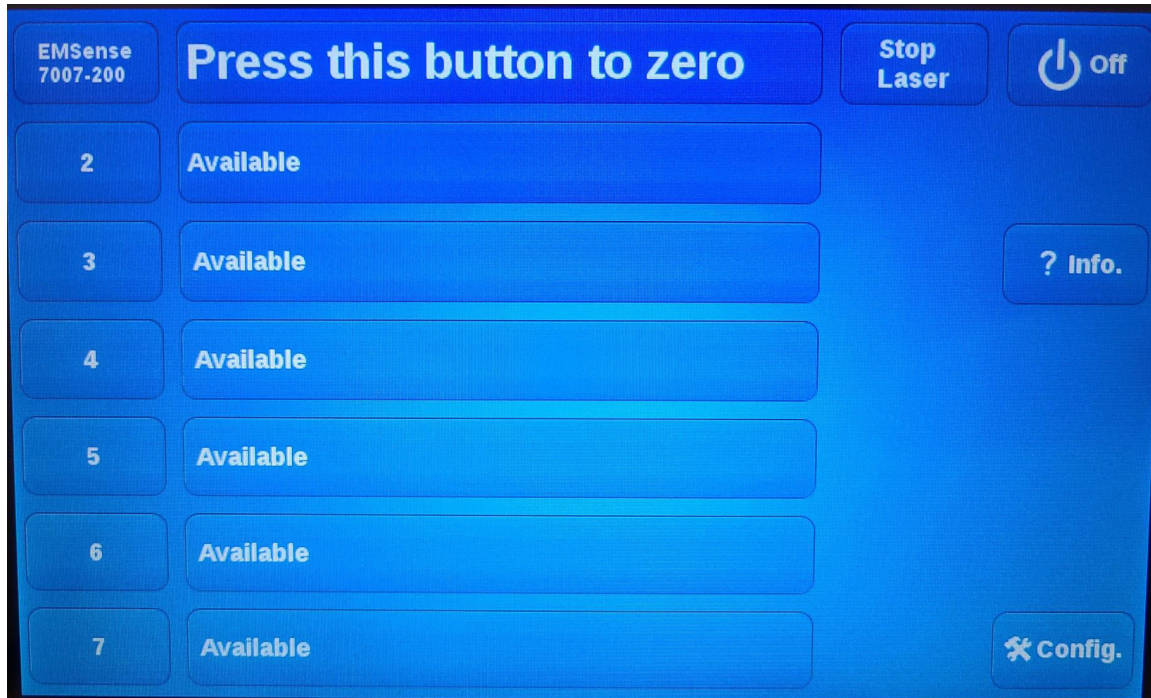
The LASER of the EMSense 10/40 field sensor can be started from the 'main' window of the EMCenter. To activate the sensor, press the 'Start' button for the required sensor and, within 4 seconds, the 'ACK' button. A short sound will be audible until the safety loop is closed successfully.



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

4.3.2 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.

The E-field sensor is now powered on and will return optical data to the EMCenter 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 as determined by using the TC command from section 4.1.1.

4.3.3 Reading Probe Data

Readings from the probe can be taken directly from the 2-slot or 7-slot EMCenter screen. The status box tells you the E_{tot} value in V/m.



4.3.4 Probe Configuration and Advanced Measurement Data

The 'STATUS' box in the main screen of the EMCenter 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.), navigate to the 'Instrument'-screen by pressing the 'STATUS' box of the required device from the main screen.



The “Instrument’-screen will display the 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 summed 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) (this is the default setting)

1 = 4 times average

2 = 8 times average

3 = 16 times average

4 = 32 times average

5 = 64 times average

6 = 128 times average

7 = 256 times average

8 = 512 times average

9 = 1024 times average

10 = 2048 times average

11 = 4096 times average

12 = 8192 times average



Ensure the amplifier is turned off prior to zeroing the field probe.

Pressing the ‘Zero’ button will arrange that the EMSense 10/40 sensor reading will be ‘zero-ed’.

4.3.5 User Correction Data

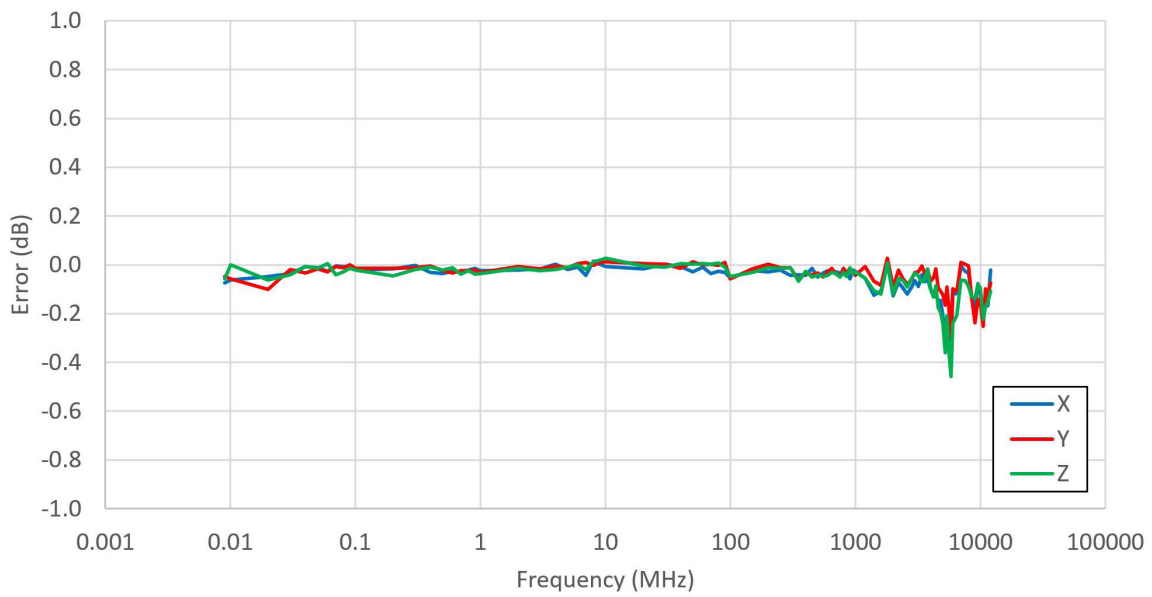
Every new EMSense 10/40 probe is factory adjusted and verified. All required correction data is stored inside the field probe.

Additionally, user correction factors are stored in the EMSense 10/40 probe so that these corrections are automatically applied to the measurement readings of the probe at the specified frequency.

Please refer to section 6 of this manual on further explanation on user correction factors.

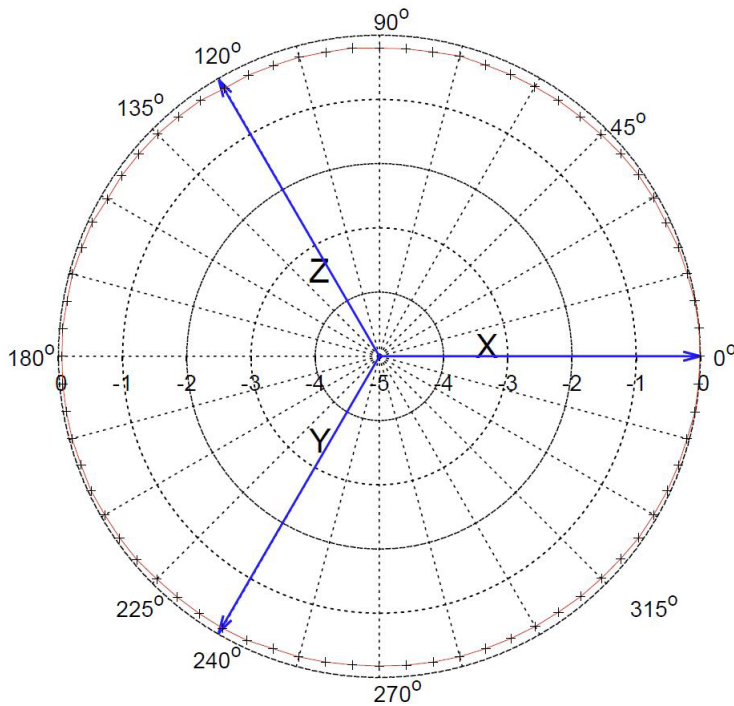
5.0 EMSENSE 10 TYPICAL PERFORMANCE

5.1 Typical Frequency Response

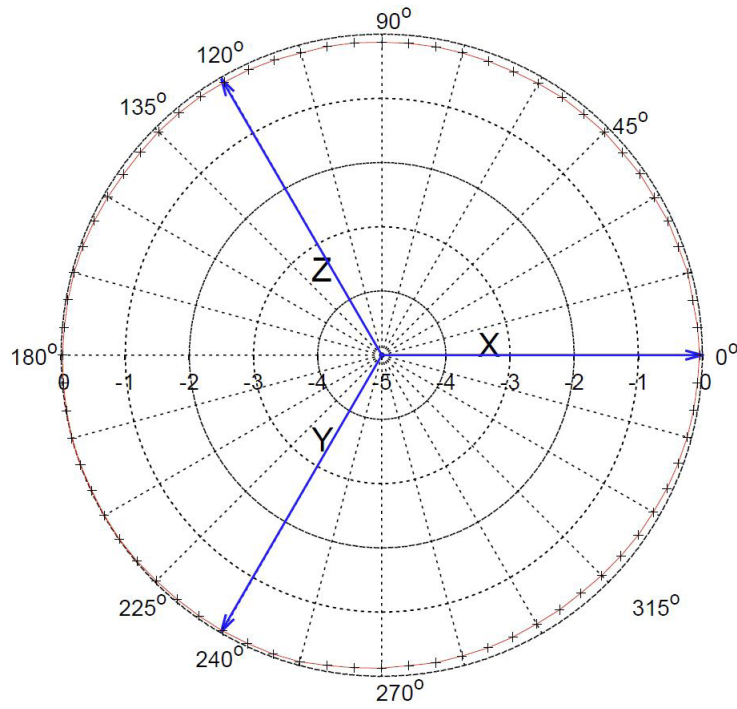


5.2 Typical Probe Rotational Response

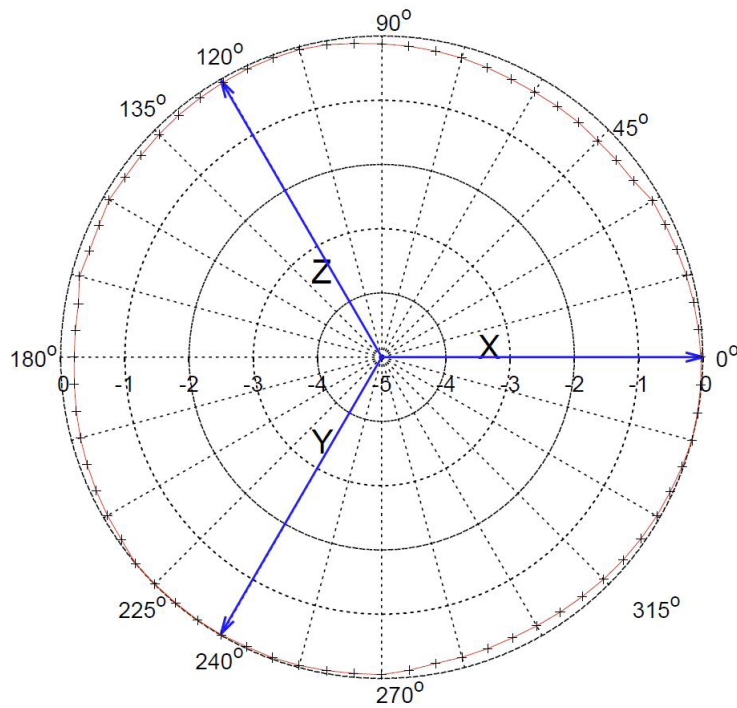
5.2.1 Typical Probe Isotropic Response at 400 MHz



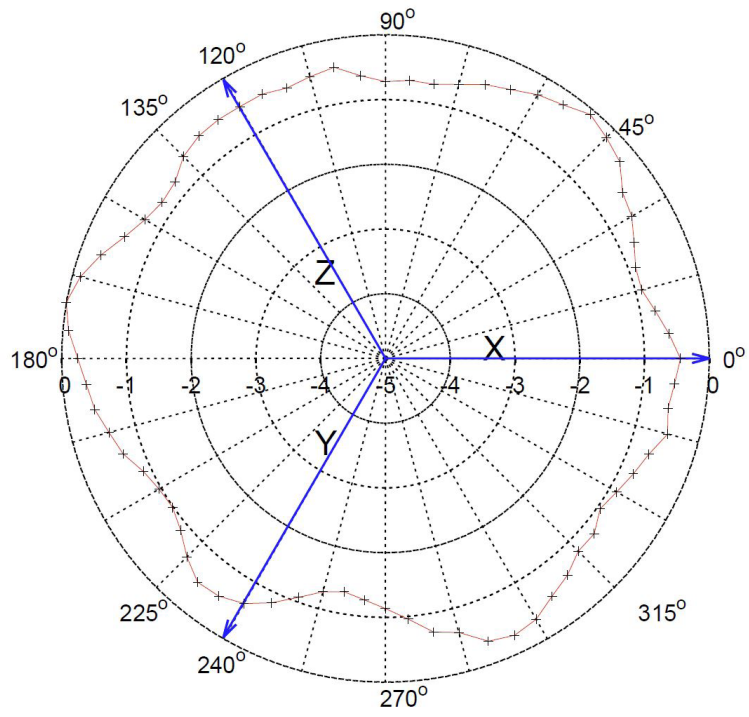
5.2.2 Typical Probe Isotropic Response at 1000 MHz



5.2.3 Typical Probe Isotropic Response at 3000 MHz

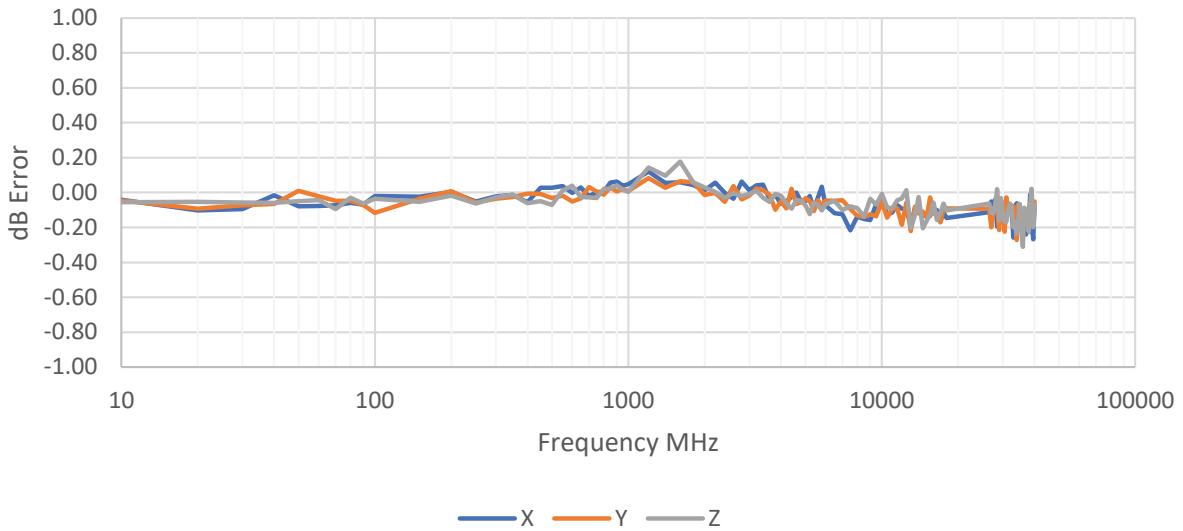


5.3.4 Typical Probe Isotropic Response at 6000 MHz



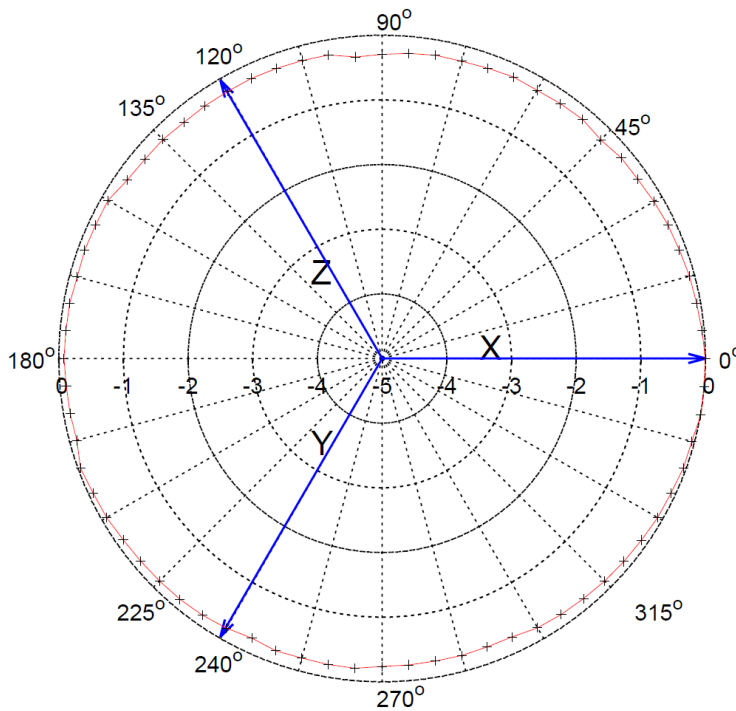
6.0 EMSENSE 40 TYPICAL PERFORMANCE

6.1 Typical Frequency Response

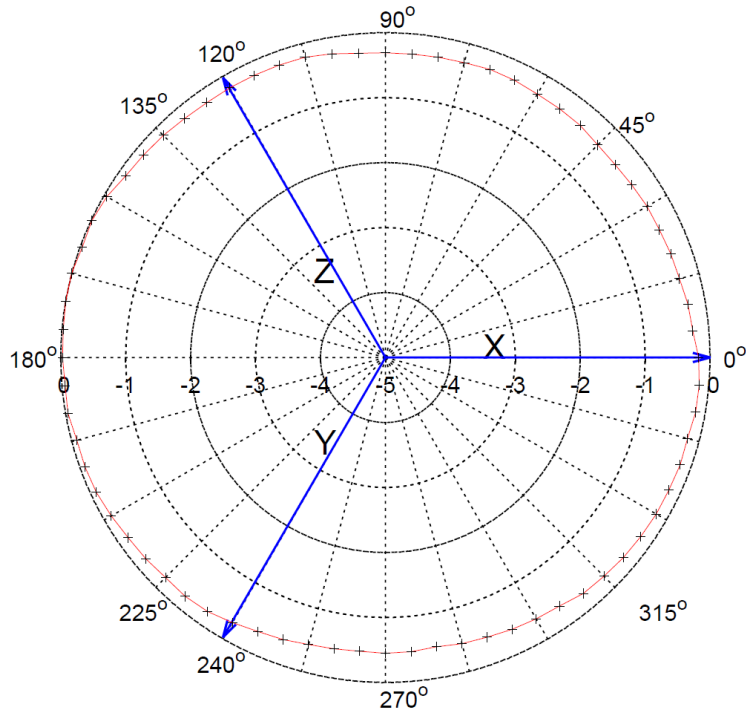


6.2 Typical Probe Rotational Response

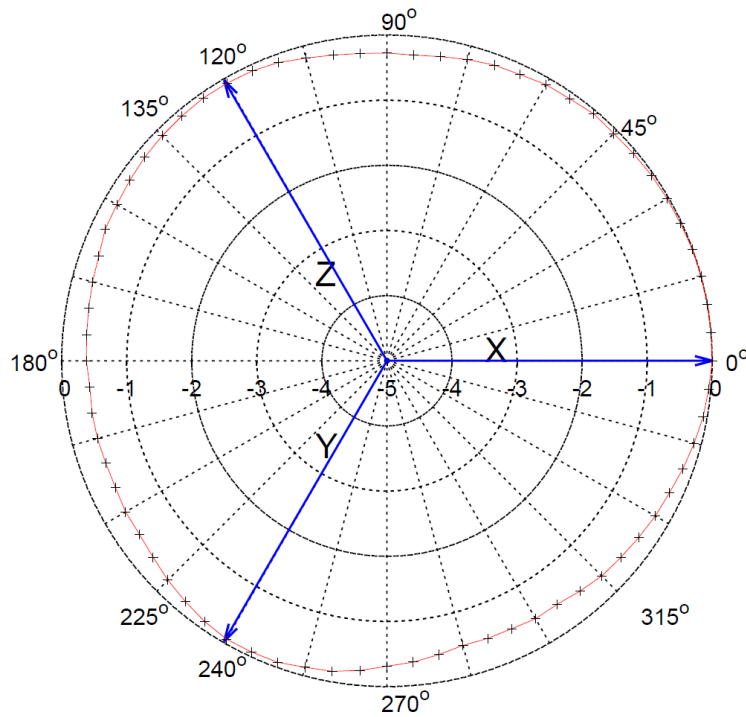
6.2.1 Typical Probe Isotropic Response at 1000 MHz



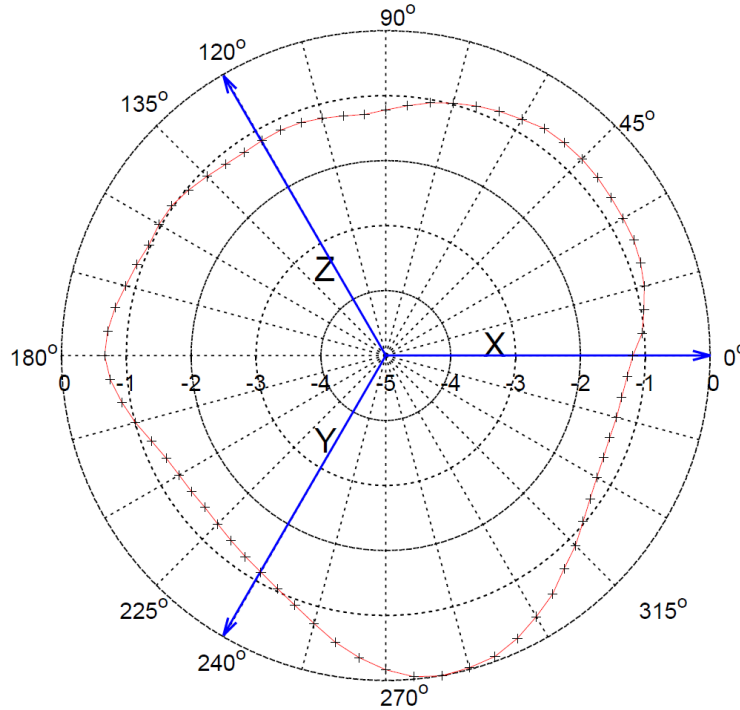
6.2.2 Typical Probe Isotropic Response at 4000 MHz



6.2.3 Typical Probe Isotropic Response at 8000 MHz



6.2.4 Typical Probe Isotropic Response at 16000 MHz



7.0 EMSENSE 10/40 USER CORRECTION CALIBRATION DATA

The EMSense 10/40 probe has the feature to store external 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.

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.



When using the “user correction factors”, the measuring frequency needs to be sent to the probe when reading the field strength in order to apply the applicable correction factor.

8.0 SPECIFICATIONS

8.1 EMSense 10 Specifications

8.1.1 Electrical Specifications	
Field measurement range	1 to 750 V/m
Max input level before damage	1000 V/m
Frequency range	10 kHz to 10 GHz (usable to 12 GHz)
Frequency response 10 kHz to 10 GHz (with internal correction)	± 1 dB
Resolution	0.01 V/m
Linearity	± 0.5 dB ± 0.5 V/m
Isotropy	< ± 0.3 dB up to 1 GHz < ± 0.5 dB up to 3 GHz < ± 1 dB up to 6 GHz < ± 2 dB up to 10 GHz
Number of antennas	6 (2 per axis)
Measuring speed	Max 100 measurements/sec
Temperature error (23°C ± 5°C)	0.1 dB/°C (after zeroing)
8.1.2 Physical Specifications	
Shape of housing	Spherical
Diameter of housing	0.98 in (2.5 cm)
Weight	1.77 oz (65 g)
Electrical dimensions	6.9 in ³ (117 cm ³)
Temperature range (operating)	32° F to 104° F (0° C to 40° C)
Relative humidity (operating)	10% – 90% (non-condensing)
8.1.3 Optical	
LASER power	Max. 0.5 Watt output at aperture
Wavelength	808 nm
LASER connector	FC/FC
Data connector	ST/ST
Fibers	200/230 µm HCS, duplex
Standard fiber length	2.5 m fixed to sensor 10 m or 20 m extension with couplings (Other lengths available on request)

8.1.4 Safety	
LASER product classification	Class 1M according to EN 60825-1 and EN60825-2
Safety measures	Code (EMCenter), Remote interlock system (EMCenter), LED indications for LASER ON, Audible warning signals Redundant closed loop safety system
LASER switch on time	Approximately 50 ms
LASER switch off time	< 10 ms
8.1.5 Calibration	
Factory accredited calibration	Internally stored, ISO17025 calibration

8.2 EMSense 40 Specifications

8.2.1 Electrical Specifications	
Field measurement range	2 to 1000 V/m
Max input level before damage	2000 V/m
Frequency range	10 MHz to 40 GHz
Frequency response 10 MHz to 40 GHz (with internal correction)	± 1.2 dB
Resolution	0.001 V/m 2 - 10 V/m 0.01 V/m 10 - 100 V/m 0.1 V/m 100 – 1000 V/m
Linearity	± 0.5 dB ± 0.5 Vim
Isotropic Deviation	± 0.5 dB @ 1 GHz
Number of antennas	3 dipoles
Measuring speed	Max 100 measurements/sec
Temperature error (23°C ± 5°C)	0.1 dB/°C (after zeroing)
8.2.2 Physical Specifications	
Shape of housing	Stalk Probe
Diameter of housing	0.57 in (1.5 cm)
Weight	3.2 oz (91 g)
Electrical dimensions	6.9 in ³ (117 cm ³)
Temperature range (operating)	32° F to 104° F (0° C to 40° C)
Relative humidity (operating)	10% – 90% (non-condensing)

8.2.3 Optical	
LASER power	Max. 0.5 Watt output at aperture
Wavelength	808 nm
LASER connector	FC/FC
Data connector	ST/ST
Fibers	200/230 µm HCS, duplex
Standard fiber length	10 m optional 20 and 30 m Maximum 100 m (Other lengths available on request)
8.2.4 Safety	
LASER product classification	Class 1M according to EN 60825-1 and EN60825-2
Safety measures	Code (EMCenter), Remote interlock system (EMCenter), LED indications for LASER ON, Audible warning signals Redundant closed loop safety system
LASER switch on time	Approximately 50 ms
LASER switch off time	< 10 ms
8.2.5 Calibration	
Factory accredited calibration	Internally stored, ISO17025 calibration

9.0 EUROPEAN CONFORMITY INFORMATION

ETS-Lindgren Inc. declares these products to be in conformity with the following standards, following the provisions of EMC-Directive 2004/30/EU, Low Voltage Directive 2006/35/EU, and RoHS-Directive 2011/65/EG:

EMSense 10/40 Electric Field Probes

- Emission:** EN 61326-1:2013, Class A
Electrical equipment for measurement, control, and laboratory use.
- Note:** Conducted emission complies with Class B (household equipment).
- 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.

Technical Construction Files are available upon request.



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