



eoProbe™

Parents EP2035845 EP2035846
US7769250 US8264685
CA2655034 CA2655447

MAIN FEATURES

- Electric field probes without any metal and perturbation-free
- Absolute vector E-field measurement from mV/m up to MV/m
- For single shot, repetitive and CW signals from 50 Hz to 60 GHz and +
- For time-domain and frequency-domain measurements
- Ultra harsh environment compatibility like pressure, temperature, X rays and gamma rays
- 5 m optical fiber cord as standard
- For all media like plasma, liquids, biological tissues...
- Ultra high damage threshold (> 10 MV/m and 10 W/cm² permanent power density)
- Equivalent to UWB, EMI-free, ultra small antenna ($\lambda/10$ @ 60 GHz) with real time compensation of IL variations when used with optoelectronic converter eoSense™
- Intended for use with optoelectronic converters eoSense™

TYPICAL APPLICATIONS

- Antennas characterization
 - SAR assessment in phantoms
 - Plasma characterization
 - MRI compliance for electronic implants
 - Field mapping of high voltage devices
 - EMC malfunction diagnosis
 - EMP measurement
- Health
Science
Defence
Aerospace
Telecommunications

PRODUCTS LINE

Transverse probes ETX-xxx

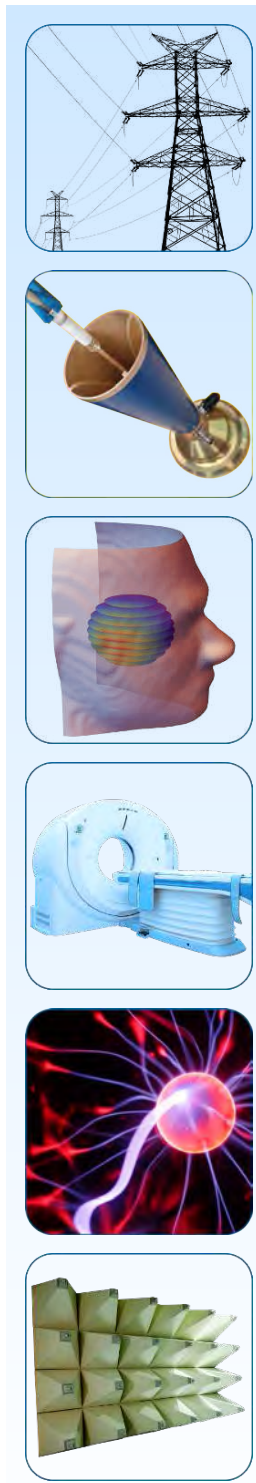
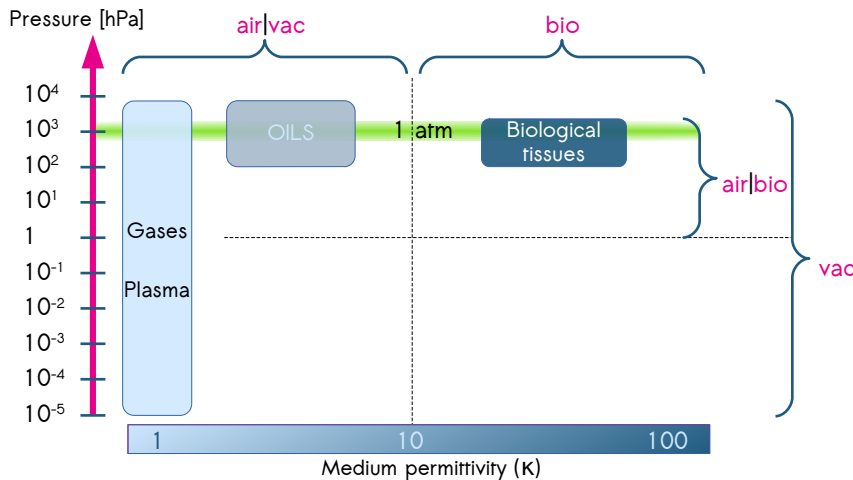
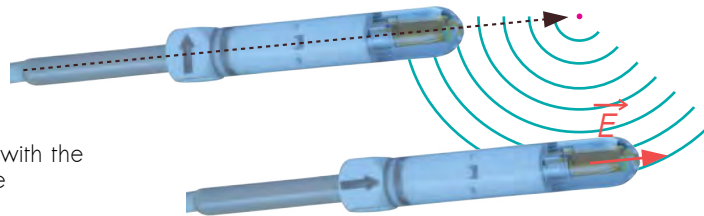
- easy to point the source
- easy access to main & cross polarizations

Longitudinal probes ELX-xxx

- perfect for precise alignment with the E field component to measure

Types of probe:

- **air** probes → measurements in plasma, gases and low κ liquids,
- **bio** probes for measurements in high κ liquids,
- **vac** probes for ultra low and high pressure measurements in low κ media.



Your key partner for electromagnetism in harsh environment

PERFORMANCE SPECIFICATIONS

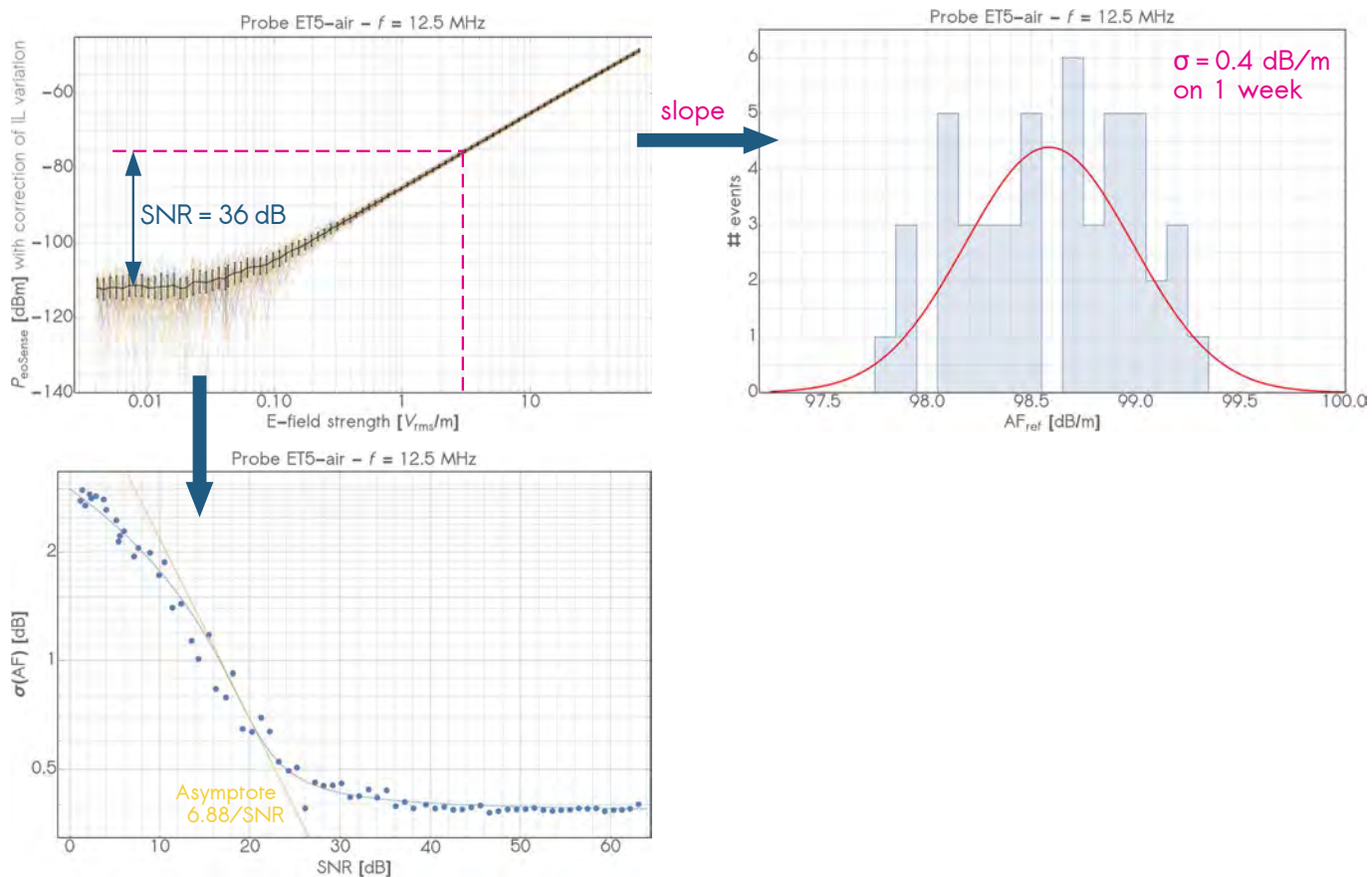
		Min	Typical	Max	Unit
Frequency bandwidth	EL5 & ET5 line	10	12		GHz
	EL1 & ET1 line	50	60		
Dynamic range		130	135		dB.Hz
Sensitivity ¹ in Time Domain (E_{min}^{TD}) for $f \geq 3$ kHz	EL5-bio probe		10	12.5	mV _{rms} /m.√Hz
	EL5-air vac probe		16	20	
	ET5-bio probe		16	20	
	EL1-bio probe		50	64	
	EL1-air vac line		64	80	
	ET5-air vac probe		80	100	
	ET1-bio probe		80	100	
	ET1-air vac probe		320	400	
Sensitivity ¹ in Frequency Domain (E_{min}^{FD}) for $f \geq 3$ kHz	EL5-bio probe		25	32	mV _{rms} /m.√Hz
	EL5-air vac probe		40	50	
	ET5-bio probe		40	50	
	EL1-bio probe		125	160	
	EL1-air vac line		160	200	
	ET5-air vac probe		200	250	
	ET1-bio probe		200	250	
	ET1-air vac probe		800	1 000	
Phase noise	@ 10 Hz from carrier			-70	dBc/Hz
Selectivity (orthog. components rejection)		50	60		dB
Isotropy defined from HPBW ²	below 100 MHz	300			°
	@ 20 GHz for ET5-air	70	80		
Damage threshold in terms of	E field strength	10			MV _{rms} /m
	perm. power density	10			W/cm ²
Measurement repeatability	for $E \geq 100 \times E_{min}$		0.15	0.2	dB
Measurement voxel (cylinder)	diameter		0.5	1	mm
	length for EX5 probe	4.8	5	5.2	
	length for EX1 probe	0.8	1	1.2	
P1dB (1-dB compression point)	EL5 line	50			kV _{rms} /m
	ET5-bio probe	80			
	EL1 line	200			
	ET5-air vac probe	250			
	ET1-bio probe	320			
	ET1-air vac probe	1 000			
Lower cut-off frequency			32	40	Hz
Effective relative permittivity (@ 10 MHz)	air vac probe line	3.2	3.6	4.0	
	bio probe line	26	30	34	
Insertion Loss			4.5	6	dB
Antenna factor AF (@ 500 MHz when probe used directly in combination with optoelectronic converter eoSense MF or HF0.1-XX)	EL5 line		90	100	dB/m
	ET5-bio probe		95	105	
	EL1 line		100	110	
	ET5-air vac probe		105	115	
	ET1-bio probe		105	115	
	ET1-air vac probe		120	130	

¹ For bio probe line, the sensitivity is given in pure water.

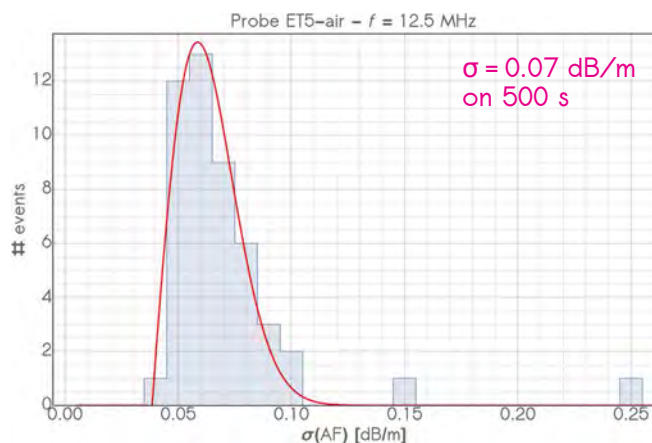
² Half Power Beam Width. HPBW is decreasing with frequency.

Repeatability

Long-term repeatability of probe E-field strength response with systematic probe connection and disconnection between measurements



Short-term repeatability of probe response (carried out on 1 hour)



	Min	Typical	Max	Unit
AF standard deviation $\sigma(AF)$ for SNR ≥ 36 dB		± 0.07	± 0.1	dB/m
		± 0.4	± 0.6	

³ including ASA (Automatic Spectrum Analyzer) digitizer short-term drift (± 0.007 dB on 500 s).

⁴ including probe connection and disconnection and ASA digitizer long-term drift.

USEFUL EQUATIONS

Equation⁴

Frequency domain E [dBV_{rms}/m] = AF [dB/m] + $P_{eoSense}$ [dBm] - 13.01

Time domain E [V/m] = AF [m⁻¹] × $V_{eoSense}$ [V]

Conversion of units AF [dB/m] = $20 \log_{10}(AF$ [m⁻¹])

E [V_{rms}/m] = $10^{(E$ [dBV_{rms}/m] / 20)

⁴ $P_{eoSense}$: power delivered by optoelectronic converter - $V_{eoSense}$: voltage at output of optoelectronic converter

MECHANICAL SPECIFICATIONS

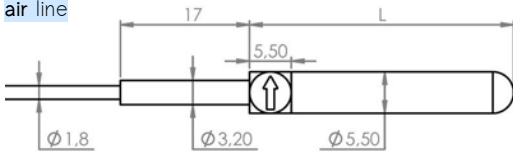
		Min	Typical	Max	Unit
Optical fiber cord length		4.5	5	5.5	m
Transducer weight			2		g
Overall weight	air/bio probe line	100	110	120	g
	vac probe line	120	140	160	
Probe axis marker (ETX)	angular deviation $ \delta\theta $		2	5	°
	selectivity versus axis marker	20	27		dB
Ingress Protection rating ⁵	except optical connector		IP67		



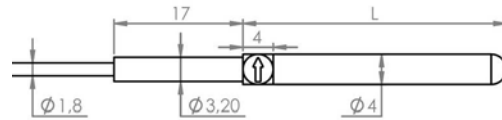
⁵ Max. 4h in a row in pure water and 1h in salty water

TRANSDUCER - Drawings at scale 1:1 - Dimensions in mm (± 0.1 mm on diameters unless otherwise noted) - Arrow indicating the measured E field component

air line

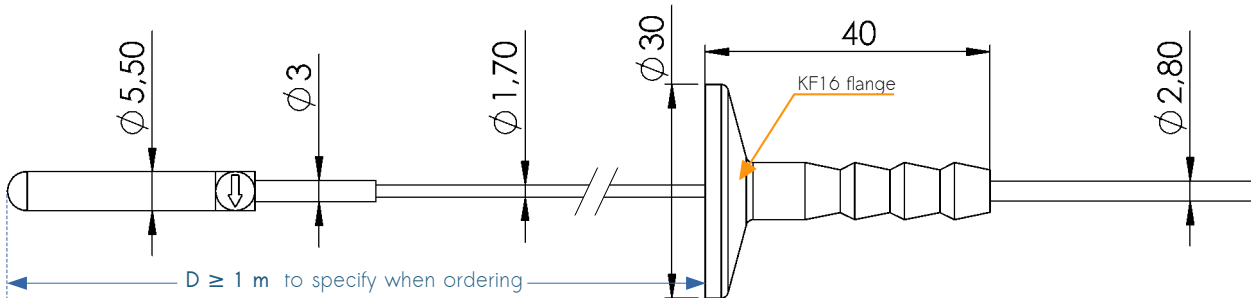


bio line



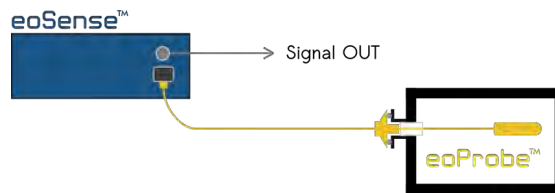
Transducer length (mm)	1	5
Overall length L ± 0.25 (mm)	31.75	34.75

vac line



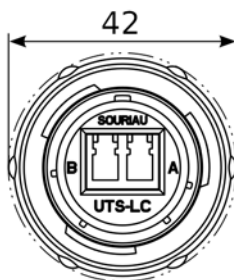
For use in vacuum chamber or in high pressure enclosure

- ultra low out-gassing properties
- down to 1 mPa (10^{-5} mbar)
- up to 700 kPa (7 bar or 100 psig)

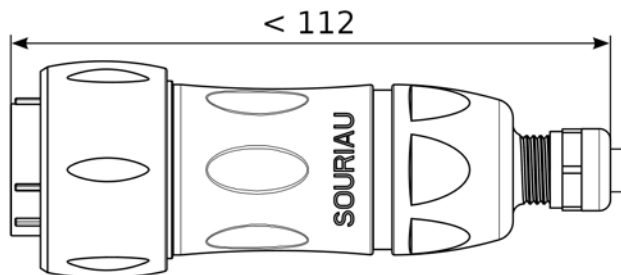


OPTICAL CONNECTOR - Drawings true to scale - Dimensions in mm (± 0.25 mm on diameters unless otherwise noted)

connector-to-eoSense™ front view



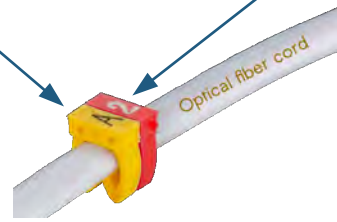
connector-to-eoSense™ side view



PROBE TAG

for pairing with eoPod™ holder
letter A → E

for pairing with eoSense™ converter
number 1 → 3



ENVIRONMENTAL SPECIFICATIONS

		Min	Typical	Max	Unit
Fiber bending radius	operating	40			mm
	storage	50			
Temperature	operating	10		50	°C
	storage	10		40	
Pressure	air/bio line	1		2 000	hPa
	vac line	10 ⁻⁵		7 000	
Out-gassing properties (vac line with PEEK sheath option: ECSS-Q-70-71A compliant)	CVCM ⁶			0.1	%
	RML ⁷			1	%
Relative humidity (non-condensing)				90	%
Storage pressure		690		1 075	hPa
Optical connector durability		500			mating
Storage	only in its original case in a clean, dry environment				
Probe cleaning	use cloth lightly moistened with isopropyl alcohol				

⁶ Collected Volatile Condensable Material

⁷ Recovered Mass Loss

PACKAGING INFORMATION

	Contents
eoProbe™ E-field probe	delivered with a routine test report
Probe protection for handling	protective foam
USB key	probe calibration file, eoSystem software, user guide & routine test report
Transport case (up to 3 probes)	drip-proof and dust-proof case (W x D x H = 430 x 330 x 110 mm - Weight: 2.2 kg)
Other parts (for vac line only)	1 KF16 O ring, 1 KF16 clamp
User guide	cf. eoSystem User Guide PDF file GU-eoSystem

COMPATIBLE DEVICES & ACCESSORIES

	Device-related data sheet	Use	Outline schematic
Optoelectronic converter eoSense™	FT20-eoSense-05.pdf	Recommended setup in most cases	<p>eoSense™</p> <p>Signal OUT</p> <p>5 m</p> <p>eoProbe™</p> <p>eoPod™</p>
Probe holder eoPod™	FT20-eoPod-05.pdf		
Optical fiber extension cord eoLink™	FT20-eoLink-05.pdf	Required setup for measurements over great distances, like outdoor conditions	<p>eoSense™</p> <p>Signal OUT</p> <p>95 m</p> <p>eoLink™</p> <p>eoProbe™</p> <p>eoPod™</p>
Probe calibration cell eoCal™	FT20-eoCal-05.pdf	Required setup for probe calibration in air or in any fluid	<p>eoSense™</p> <p>Signal OUT</p> <p>eoProbe™</p> <p>1m</p> <p>eoCal™</p>
Probe vacuum feed-through eoVac™	FT20-eoVac-05.pdf	Required setup to use air bio probe line for measurements down to 1 hPa	<p>eoSense™</p> <p>Signal OUT</p> <p>eoVac™</p> <p>eoProbe™</p>

OPTIONS AND CUSTOMIZATION FOR SPECIFIC APPLICATIONS

Application

Issue

Solution

EMP generation by laser-plasma interaction using PW lasers in vacuum chamber

intense UV, X and γ rays

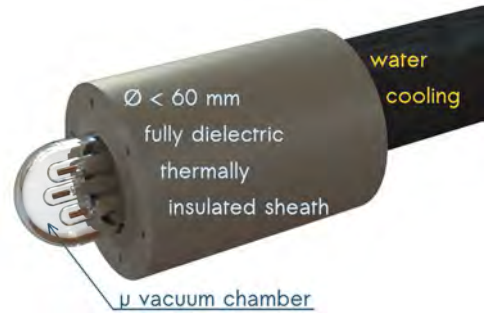
Additional protective sheath for vac probe



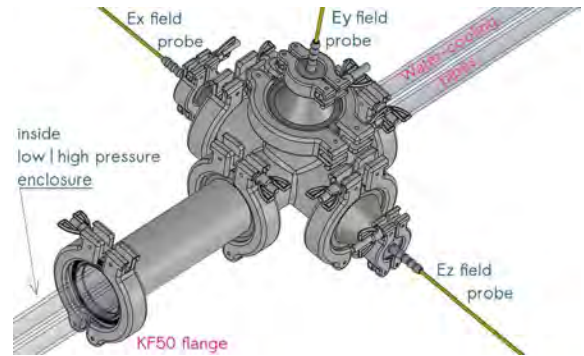
Measurement of the 3 E-field components in a pressurized hot gases environment

temperature $T > 100^{\circ}\text{C}$

Water-cooled device for vac probes



Low | high pressure feed-through



E-field mapping in phantoms for MRI applications and SAR assessment

permittivity matching

Underwater high κ holder for bio probes



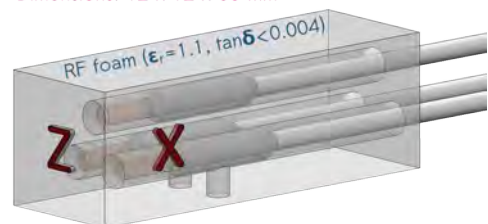
Ø 4 mm high κ bio-line probes

RF measurement of the 3 E-field components in small enclosures

high spatial resolution interference-free

Ultra low κ packaging incorporating 3 probes

Dimensions: 12 x 12 x 36 mm



TYPICAL CHARACTERISTICS

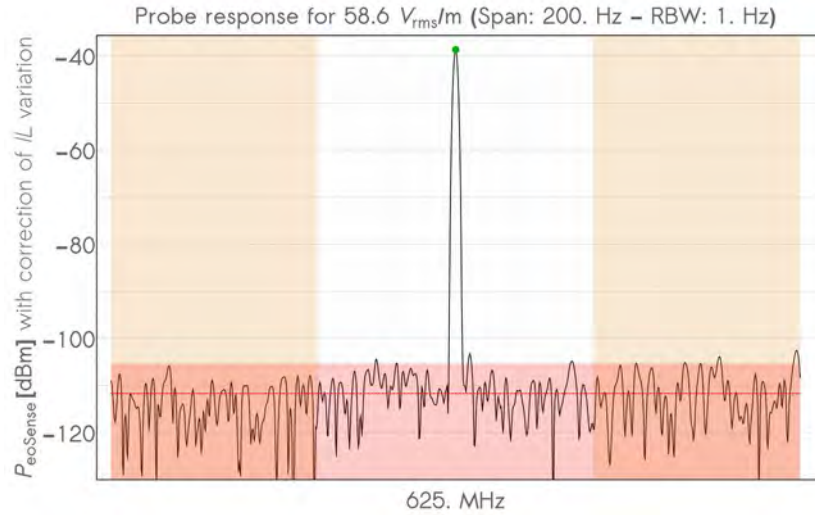
Probe response

DUT and Conditions⁸

Measurement

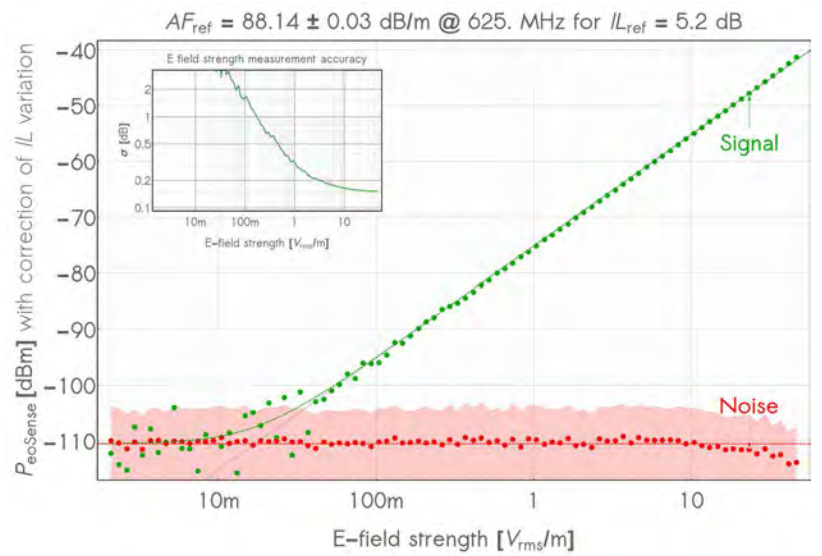
Spectral purity

probe **eoProbe EL5-air**
 converter **eoSense MF**
 E-field applicator **eoCal HF6**



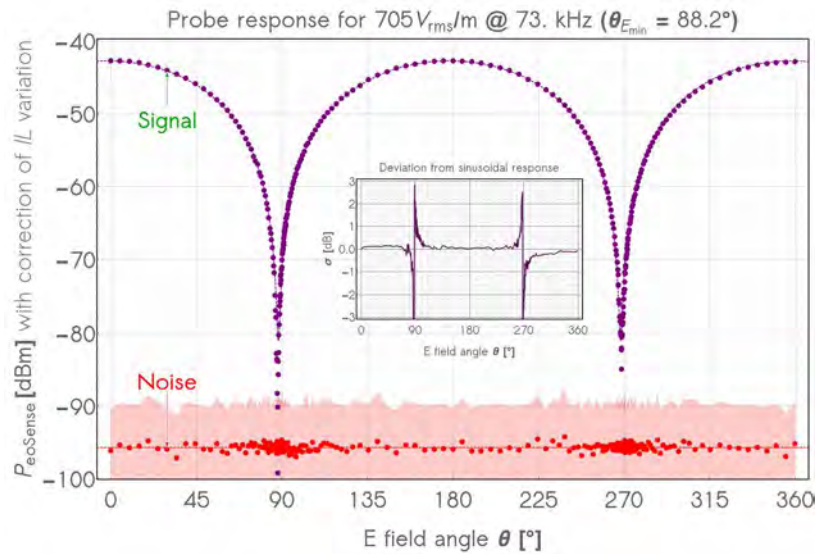
E-field strength

probe **eoProbe EL5-air**
 converter **eoSense MF**
 E-field applicator **eoCal HF6**



E-field polarization

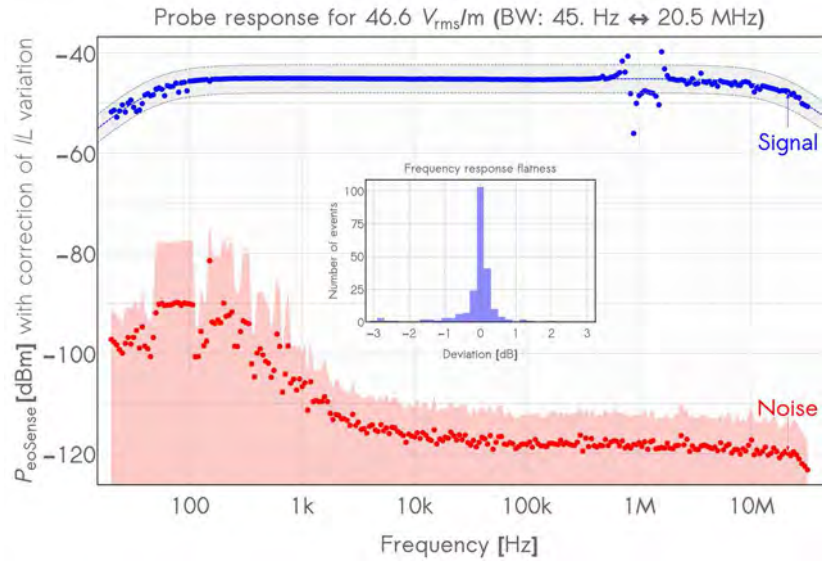
probe **eoProbe ET5-air**
 converter **eoSense LF**
 E-field applicator **eoCal LF- θ**



Low-Frequency

Stationary piezoelectric resonances around 1 MHz

probe **eoProbe EL5-air**
converter **eoSense LF**
@ high gain (restricted BW)
E-field applicator **eoCal HF6**



⁸ All measurements provided above were performed at the following conditions:

- Temperature of $22 \pm 2 \text{ }^\circ\text{C}$
- Pressure of $985 \pm 15 \text{ hPa}$
- Relative humidity of $55 \pm 20 \%$
- DUT warm up time of 30 min
- Test equipment warm up time of 1 hour

Area corresponding to power values $< \text{noise PSD}^9 + 3 \sigma(\text{noise PSD})^{10}$

Area above which a measuring point has a probability of 0.56% of being noise

⁹ Power Spectral Density [dBm/Hz] (red points)

¹⁰ Standard deviation



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