



Accredited by the Swiss Accreditation Service (SAS)

Accreditation No.: **SCS 0108**

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 Multilateral Agreement for the recognition of calibration certificates

Glossary:

NORM _{x,y,z}	sensitivity in free space
DCP	diode compression point
CF	crest factor (1/duty_cycle) of the RF signal
A, B, C, D	modulation dependent linearization parameters
En	incident E-field orientation normal to probe axis
Ep	incident E-field orientation parallel to probe axis
Polarization φ	φ rotation around probe axis
Polarization ϑ	ϑ rotation around an axis that is in the plane normal to probe axis (at measurement center), i.e., $\vartheta = 0$ is normal to probe axis
Connector Angle	information used in DASY system to align probe sensor X to the robot coordinate system

Calibration is Performed According to the Following Standards:

- IEEE Std 1309-2005, "IEEE Standard for calibration of electromagnetic field sensors and probes, excluding antennas, from 9 kHz to 40 GHz", December 2005
- CTIA Test Plan for Hearing Aid Compatibility, Rev 3.1.1, May 2017

Methods Applied and Interpretation of Parameters:

- NORM_{x,y,z}**: Assessed for E-field polarization $\vartheta = 0$ for XY sensors and $\vartheta = 90$ for Z sensor ($f \leq 900$ MHz in TEM-cell; $f > 1800$ MHz: R22 waveguide).
- NORM(f)_{x,y,z}** = NORM_{x,y,z} * frequency_response (see Frequency Response Chart).
- DCP_{x,y,z}**: DCP are numerical linearization parameters assessed based on the data of power sweep with CW signal (no uncertainty required). DCP does not depend on frequency nor media.
- PAR**: PAR is the Peak to Average Ratio that is not calibrated but determined based on the signal characteristics
- A_{x,y,z}; B_{x,y,z}; C_{x,y,z}; D_{x,y,z}; VR_{x,y,z}**: A, B, C, D are numerical linearization parameters assessed based on the data of power sweep for specific modulation signal. The parameters do not depend on frequency nor media. VR is the maximum calibration range expressed in RMS voltage across the diode.
- Spherical isotropy (3D deviation from isotropy)**: in a locally homogeneous field realized using an open waveguide setup.
- Sensor Offset**: The sensor offset corresponds to the offset of virtual measurement center from the probe tip (on probe axis). No tolerance required.
- Connector Angle**: The angle is assessed using the information gained by determining the NORM_x (no uncertainty required).

DASY/EASY - Parameters of Probe: ER3DV6 - SN:2368

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm ($\mu\text{V}/(\text{V}/\text{m})^2$)	1.71	1.62	1.82	$\pm 10.1\%$
DCP (mV) ^B	98.5	100.0	102.3	

Calibration results for Frequency Response (30 MHz – 3 GHz)

Frequency MHz	Target E-Field V/m	Measured E-field (En) V/m	Deviation E-normal in %	Measured E-field (Ep) V/m	Deviation E-normal in %	Unc (k=2) %
30	77.1	76.4	-1.0%	77.3	0.3%	$\pm 5.1\%$
100	77.1	78.5	1.9%	77.8	0.9%	$\pm 5.1\%$
450	77.2	78.7	2.0%	77.9	1.0%	$\pm 5.1\%$
600	77.1	78.4	1.6%	77.7	0.7%	$\pm 5.1\%$
750	77.1	78.2	1.5%	77.8	0.9%	$\pm 5.1\%$
1800	142.9	141.4	-1.0%	140.9	-1.5%	$\pm 5.1\%$
2000	135.1	134.2	-0.7%	133.5	-1.2%	$\pm 5.1\%$
2200	127.6	125.8	-1.4%	127.2	-0.3%	$\pm 5.1\%$
2500	125.4	125.6	0.2%	127.1	1.4%	$\pm 5.1\%$
3000	79.4	77.9	-1.8%	80.9	2.0%	$\pm 5.1\%$

Calibration Results for Modulation Response

UID	Communication System Name		A dB	B dB $\sqrt{\mu\text{V}}$	C	D dB	VR mV	Max dev.	Unc ^E (k=2)
0	CW	X	0.0	0.0	1.0	0.00	166.4	$\pm 3.0\%$	$\pm 4.7\%$
		Y	0.0	0.0	1.0		199.3		
		Z	0.0	0.0	1.0		204.0		
10021-DAC	GSM-FDD (TDMA, GMSK)	X	20.94	99.5	28.1	9.39	136.2	$\pm 2.2\%$	$\pm 4.7\%$
		Y	8.73	84.8	23.0		114.6		
		Z	26.26	99.6	28.0		146.5		
10172-CAG	LTE-TDD (SC-FDMA, 1 RB, 20 MHz, QPSK)	X	7.82	75.6	27.3	9.21	106.2	$\pm 3.8\%$	$\pm 4.7\%$
		Y	9.12	81.0	30.1		130.7		
		Z	11.49	85.4	31.1		145.0		
10173-CAG	LTE-TDD (SC-FDMA, 1 RB, 20 MHz, 16-QAM)	X	8.29	76.5	27.8	9.48	105.5	$\pm 3.8\%$	$\pm 4.7\%$
		Y	9.50	81.4	30.3		130.8		
		Z	12.51	87.3	32.1		145.8		

The reported uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor k=2, which for a normal distribution corresponds to a coverage probability of approximately 95%.

^B Numerical linearization parameter: uncertainty not required.

^E Uncertainty is determined using the max. deviation from linear response applying rectangular distribution and is expressed for the square of the field value.

DASY/EASY - Parameters of Probe: ER3DV6 - SN:2368

Sensor Frequency Model Parameters

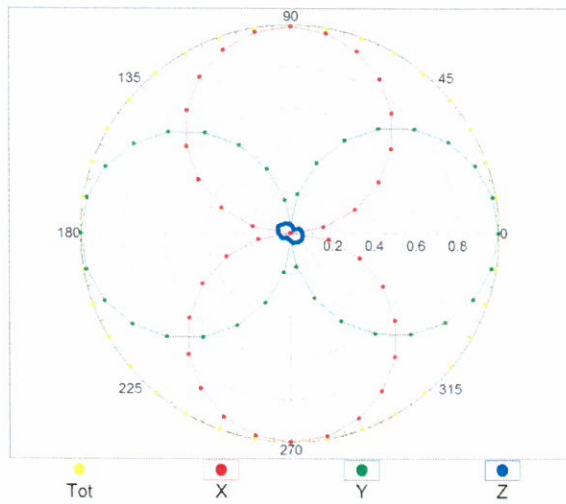
	Sensor X	Sensor Y	Sensor Z
Frequency Corr. (LF)	-1.72	-1.37	0.42
Frequency Corr. (HF)	0.00	0.00	0.00

Other Probe Parameters

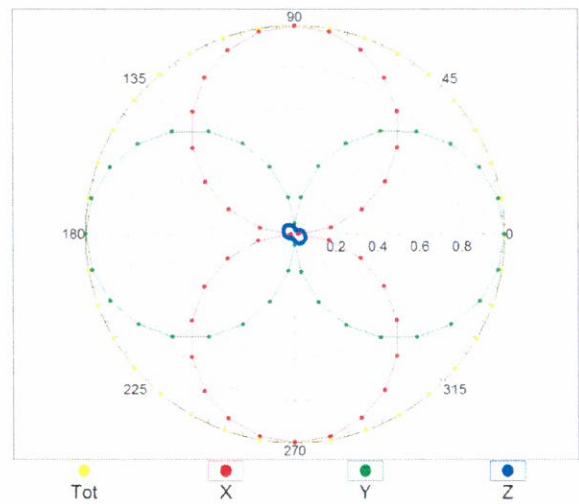
Sensor Arrangement	Rectangular
Connector Angle (°)	-67
Mechanical Surface Detection Mode	enabled
Optical Surface Detection Mode	disabled
Probe Overall Length	337 mm
Probe Body Diameter	10 mm
Tip Length	10 mm
Tip Diameter	8 mm
Probe Tip to Sensor X Calibration Point	2.5 mm
Probe Tip to Sensor Y Calibration Point	2.5 mm
Probe Tip to Sensor Z Calibration Point	2.5 mm

Receiving Pattern (ϕ), $\vartheta = 0^\circ$

f=600 MHz, TEM, 0°

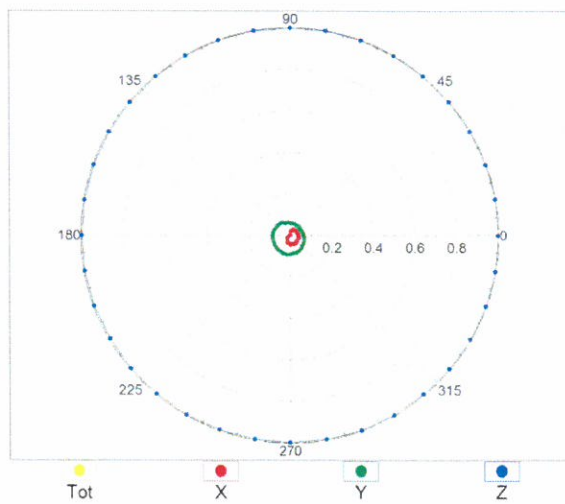


f=2500 MHz, R22, 0°

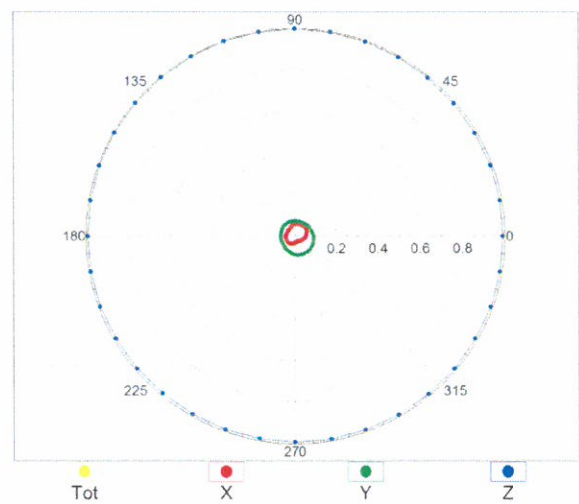


Receiving Pattern (ϕ), $\vartheta = 90^\circ$

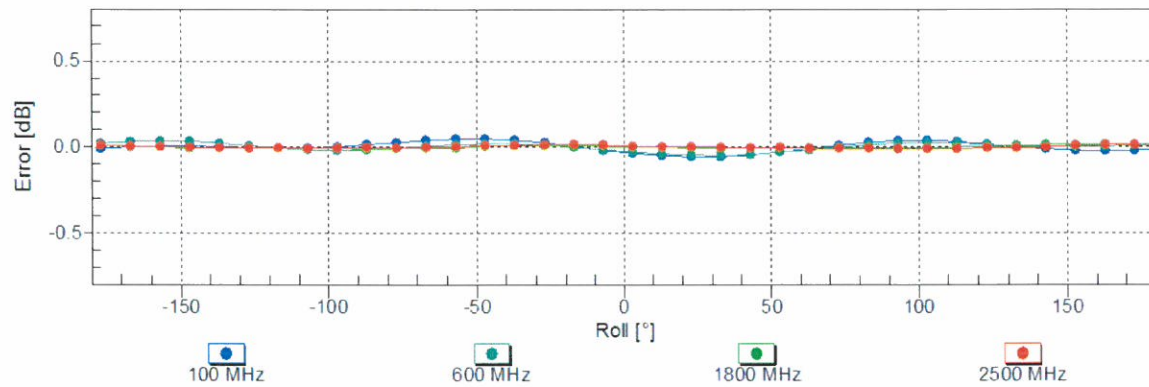
f=600 MHz, TEM, 90°



f=2500 MHz, R22, 90°

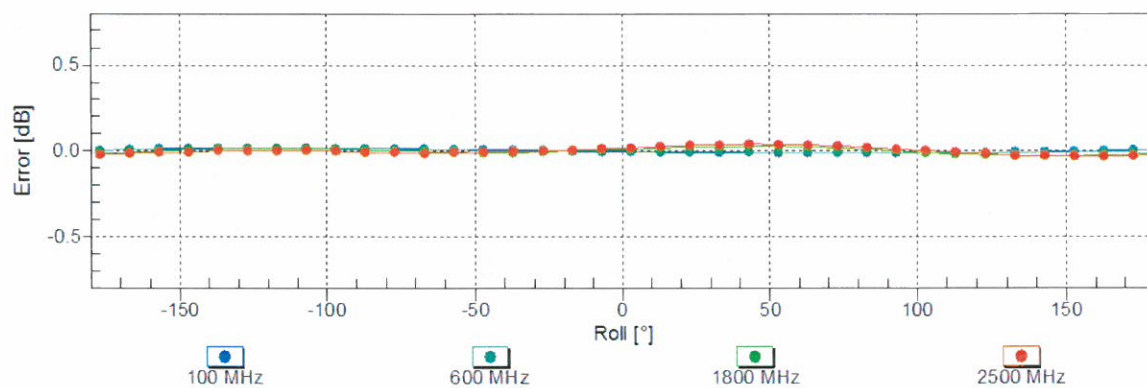


Receiving Pattern (ϕ), $\vartheta = 0^\circ$



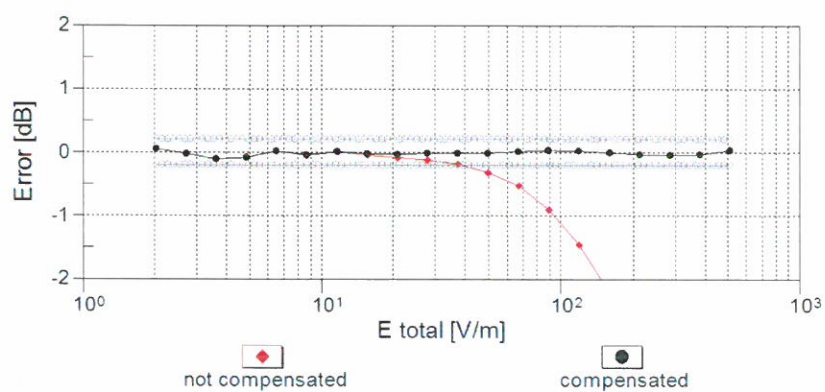
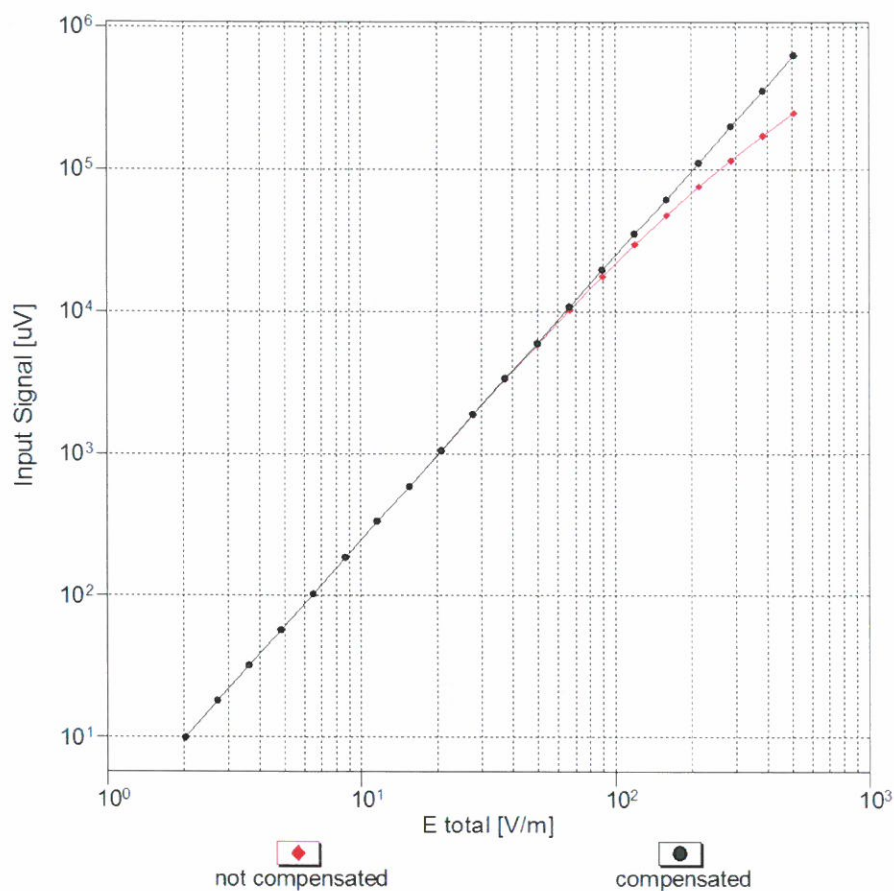
Uncertainty of Axial Isotropy Assessment: $\pm 0.5\%$ ($k=2$)

Receiving Pattern (ϕ), $\vartheta = 90^\circ$



Uncertainty of Axial Isotropy Assessment: $\pm 0.5\%$ ($k=2$)

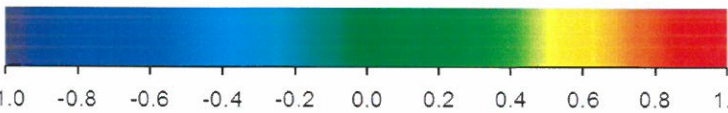
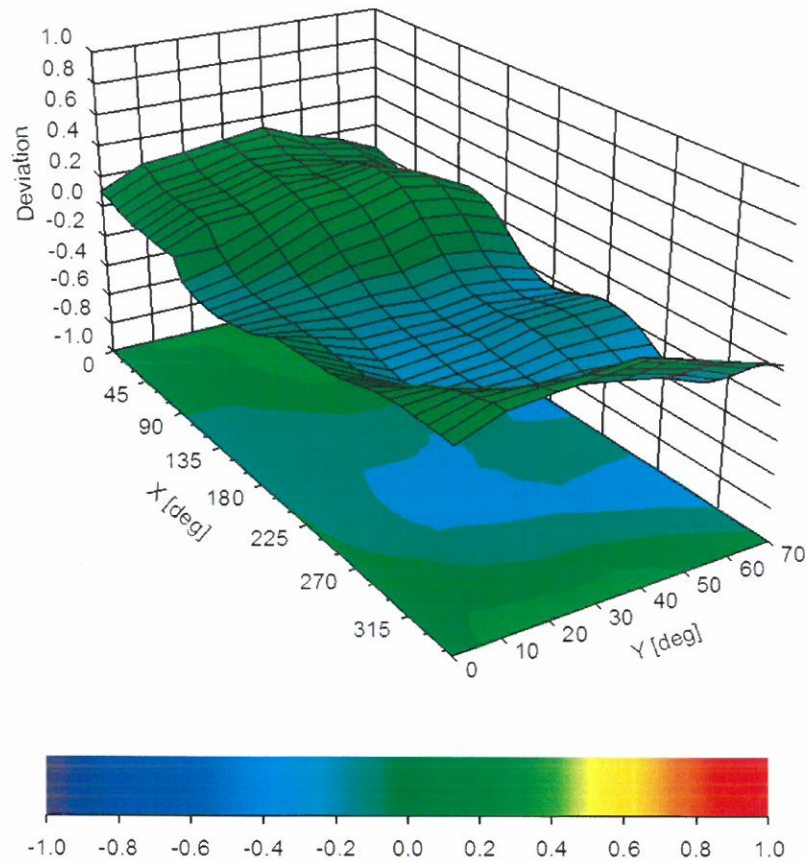
Dynamic Range f(E-field) (TEM cell, f = 900 MHz)



Uncertainty of Linearity Assessment: $\pm 0.6\%$ (k=2)

Deviation from Isotropy in Air

Error (ϕ , θ), $f = 900$ MHz



Uncertainty of Spherical Isotropy Assessment: $\pm 2.6\%$ ($k=2$)