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S Schweizerischer Kalibrierdienst
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Swiss Calibration Service

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Accreditation No.: SCS 108

Client **UL CCS USA**

Certificate No: ER3-2540_Aug14

CALIBRATION CERTIFICATE

Object: ER3DV6 - SN:2540

Calibration procedure(s): QA CAL-02.v8, QA CAL-25.v6
Calibration procedure for E-field probes optimized for close near field evaluations in air

Calibration date: August 26, 2014

This calibration certificate documents the traceability to national standards, which realize the physical units of measurements (SI).
The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate.

All calibrations have been conducted in the closed laboratory facility: environment temperature (22 ± 3)°C and humidity < 70%.

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID	Cal Date (Certificate No.)	Scheduled Calibration
Power meter E4419B	GB41293874	03-Apr-14 (No. 217-01911)	Apr-15
Power sensor E4412A	MY41498087	03-Apr-14 (No. 217-01911)	Apr-15
Reference 3 dB Attenuator	SN: S5054 (3c)	03-Apr-14 (No. 217-01915)	Apr-15
Reference 20 dB Attenuator	SN: S5277 (20x)	03-Apr-14 (No. 217-01919)	Apr-15
Reference 30 dB Attenuator	SN: S5129 (30b)	03-Apr-14 (No. 217-01920)	Apr-15
Reference Probe ER3DV6	SN: 2328	10-Oct-13 (No. ER3-2328_Oct13)	Oct-14
DAE4	SN: 789	30-Apr-14 (No. DAE4-789_Apr14)	Apr-15
Secondary Standards	ID	Check Date (in house)	Scheduled Check
RF generator HP 8648C	US3642U01700	4-Aug-99 (in house check Apr-13)	In house check: Apr-16
Network Analyzer HP 8753E	US37390585	18-Oct-01 (in house check Oct-13)	In house check: Oct-14

	Name	Function	Signature
Calibrated by:	Jeton Kastrati	Laboratory Technician	
Approved by:	Katja Pokovic	Technical Manager	

Issued: August 26, 2014

Glossary:

NORMx,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
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:

a) IEEE Std 1309-2005, " IEEE Standard for calibration of electromagnetic field sensors and probes, excluding antennas, from 9 kHz to 40 GHz", December 2005
b) CTIA Test Plan for Hearing Aid Compatibility, April 2010.

Methods Applied and Interpretation of Parameters:

- *NORMx,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 = NORMx,y,z * frequency_response* (see Frequency Response Chart).
- *DCPx,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
- *Ax,y,z; Bx,y,z; Cx,y,z; Dx,y,z; VRx,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 *NORMx* (no uncertainty required).

Probe ER3DV6

SN:2540

Manufactured: July 27, 2010
Calibrated: August 26, 2014

Calibrated for DASY/EASY Systems
(Note: non-compatible with DASY2 system!)

DASY/EASY - Parameters of Probe: ER3DV6 - SN:2540

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm ($\mu V/(V/m)^2$)	1.49	1.22	1.28	± 10.1 %
DCP (mV)[B]	99.3	99.7	102.9	

Modulation Calibration Parameters

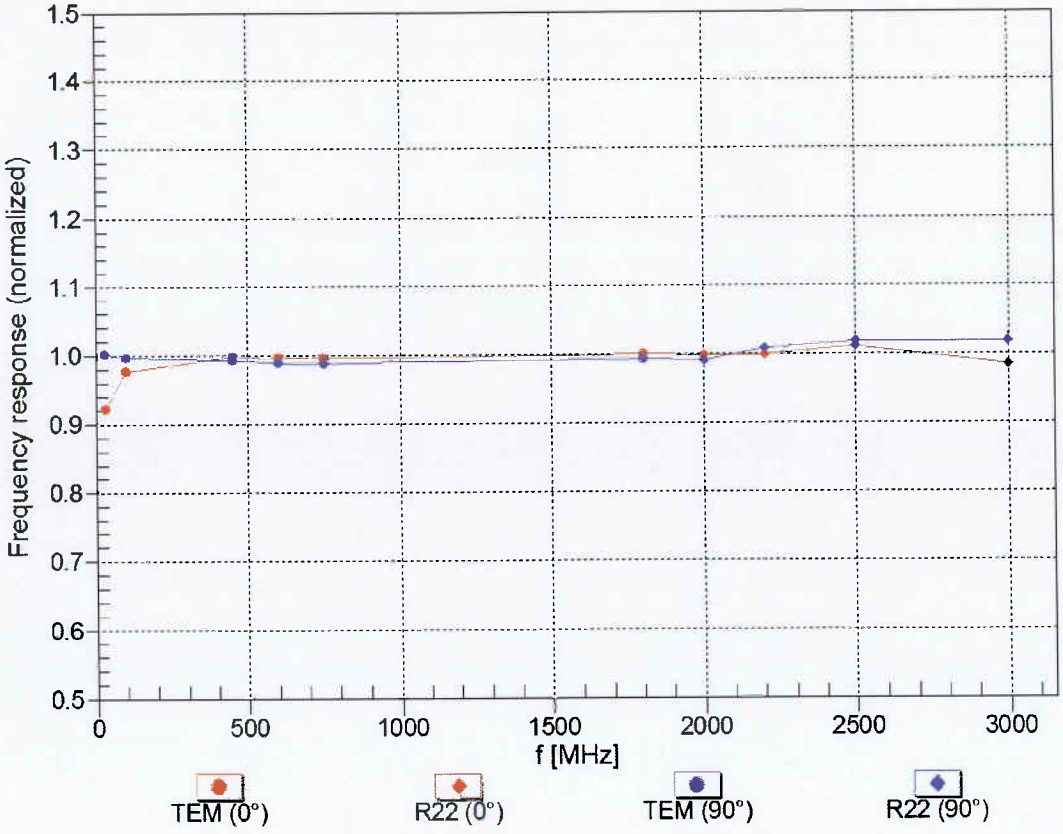
UID	Communication System Name		A dB	B dB√μV	C	D dB	VR mV	Unc[E] (k=2)
0	CW	X	0.0	0.0	1.0	0.00	141.1	±3.5 %
		Y	0.0	0.0	1.0		134.0	
		Z	0.0	0.0	1.0		168.3	
10021-DAB	GSM-FDD (TDMA, GMSK)	X	3.75	78.5	20.1	9.39	125.0	±1.9 %
		Y	5.81	85.0	23.0		122.7	
		Z	5.96	81.5	20.8		116.3	
10023-DAB	GPRS-FDD (TDMA, GMSK, TN 0)	X	4.83	82.8	21.7	9.57	119.5	±2.2 %
		Y	6.25	85.3	23.0		118.4	
		Z	8.42	87.4	23.2		144.6	
10024-DAB	GPRS-FDD (TDMA, GMSK, TN 0-1)	X	6.86	87.2	21.2	6.56	114.2	±2.5 %
		Y	18.28	99.3	25.1		113.2	
		Z	4.48	76.1	16.7		146.3	
10027-DAB	GPRS-FDD (TDMA, GMSK, TN 0-1-2)	X	9.52	86.4	18.4	4.80	133.2	±2.5 %
		Y	33.81	99.6	22.3		130.0	
		Z	42.52	99.6	22.0		121.7	
10028-DAB	GPRS-FDD (TDMA, GMSK, TN 0-1-2-3)	X	37.71	99.5	20.9	3.55	147.8	±2.2 %
		Y	33.15	99.5	21.7		141.3	
		Z	45.19	99.8	21.4		133.1	
10030-CAA	IEEE 802.15.1 Bluetooth (GFSK, DH1)	X	22.99	99.5	23.0	5.30	128.4	±2.2 %
		Y	23.14	99.5	23.6		125.1	
		Z	33.99	99.4	22.8		117.8	
10061-CAA	IEEE 802.11b WiFi 2.4 GHz (DSSS, 11 Mbps)	X	3.20	70.8	20.6	3.60	133.2	±1.2 %
		Y	3.93	74.9	22.6		127.1	
		Z	4.81	78.3	23.8		115.1	
10077-CAA	IEEE 802.11g WiFi 2.4 GHz (DSSS/OFDM, 54 Mbps)	X	10.71	72.2	26.4	11.00	120.3	±1.9 %
		Y	10.81	72.2	26.3		114.2	
		Z	10.31	70.1	24.5		103.2	
10173-CAB	LTE-TDD (SC-FDMA, 1 RB, 20 MHz, 16-QAM)	X	6.07	71.1	25.0	9.48	111.1	±3.5 %
		Y	7.39	77.1	28.7		141.4	
		Z	7.20	75.1	26.8		132.0	
10235-CAB	LTE-TDD (SC-FDMA, 1 RB, 10 MHz, 16-QAM)	X	6.98	76.2	28.3	9.48	145.9	±3.5 %
		Y	7.43	77.3	28.8		140.4	
		Z	7.16	74.9	26.6		131.9	

10238-CAB	LTE-TDD (SC-FDMA, 1 RB, 15 MHz, 16-QAM)	X	6.88	75.7	27.9	9.48	145.5	±3.3 %
		Y	7.35	76.9	28.6		140.6	
		Z	7.01	74.2	26.2		131.7	
10295-AAB	CDMA2000, RC1, SO3, 1/8th Rate 25 fr.	X	7.38	79.3	32.4	12.49	111.2	±1.4 %
		Y	8.44	83.0	34.3		109.4	
		Z	7.95	78.8	30.7		101.7	

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.

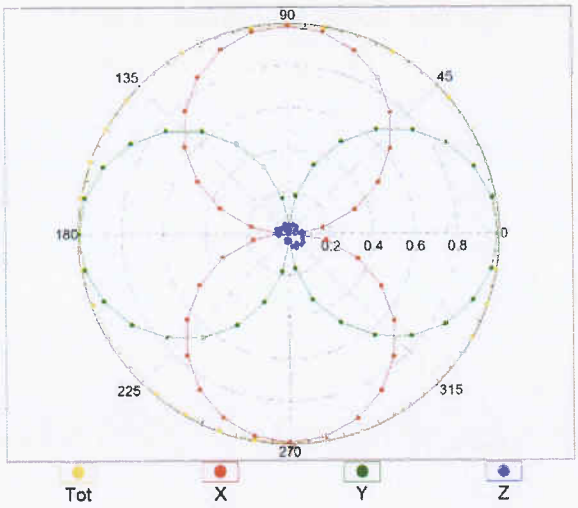
Frequency Response of E-Field
(TEM-Cell:ifi110 EXX, Waveguide: R22)



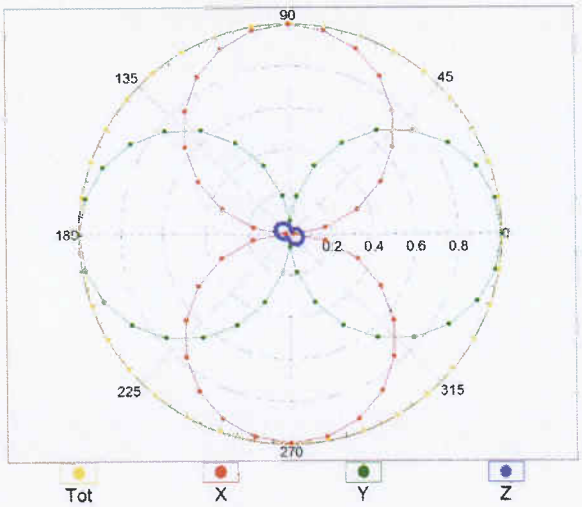
Uncertainty of Frequency Response of E-field: ± 6.3% (k=2)

Receiving Pattern (ϕ), ϑ = 0°

f=600 MHz,TEM,0°

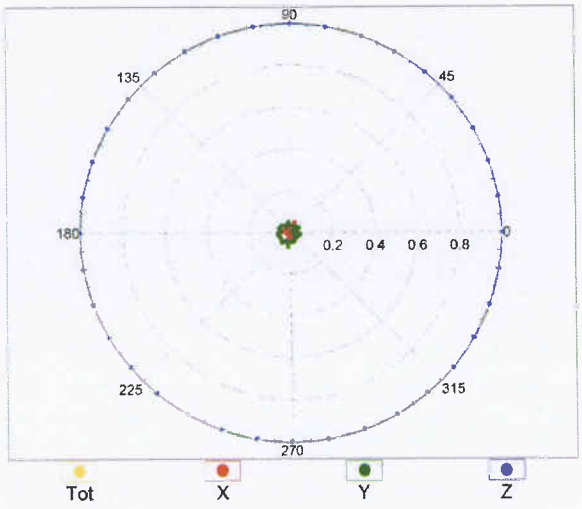


f=2500 MHz,R22,0°

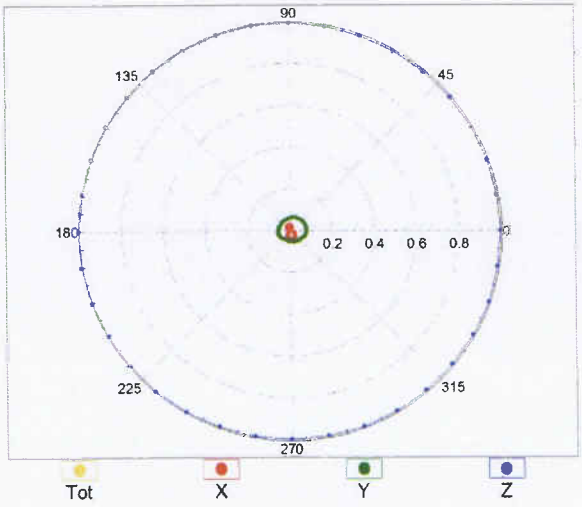


Receiving Pattern (ϕ), ϑ = 90°

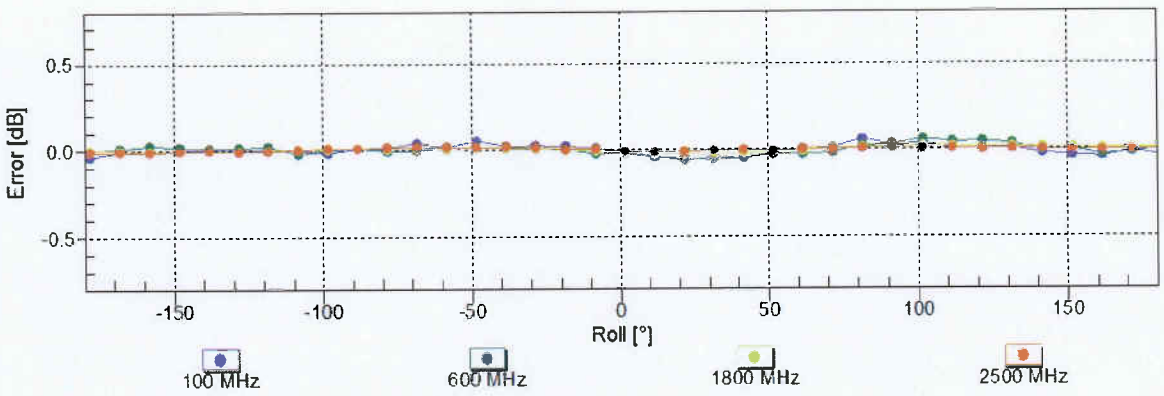
f=600 MHz,TEM,90°



f=2500 MHz,R22,90°

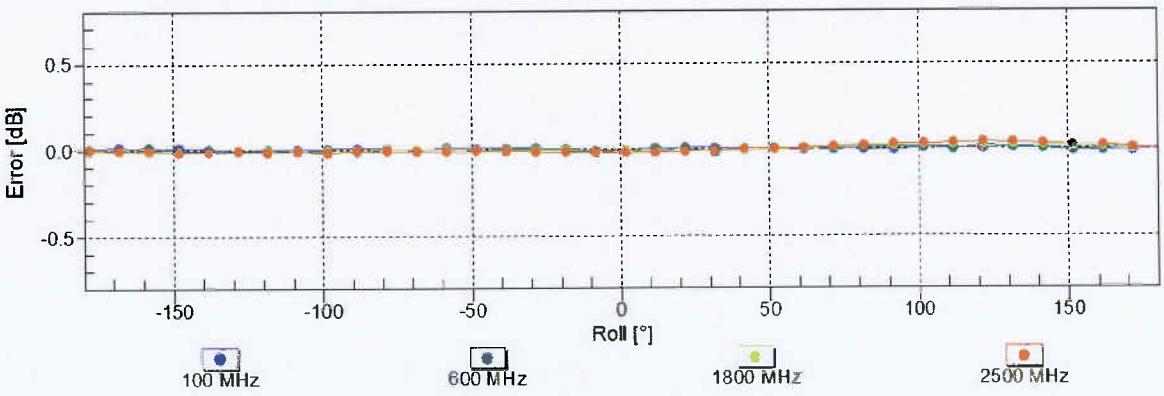


Receiving Pattern (ϕ), ϑ = 0°



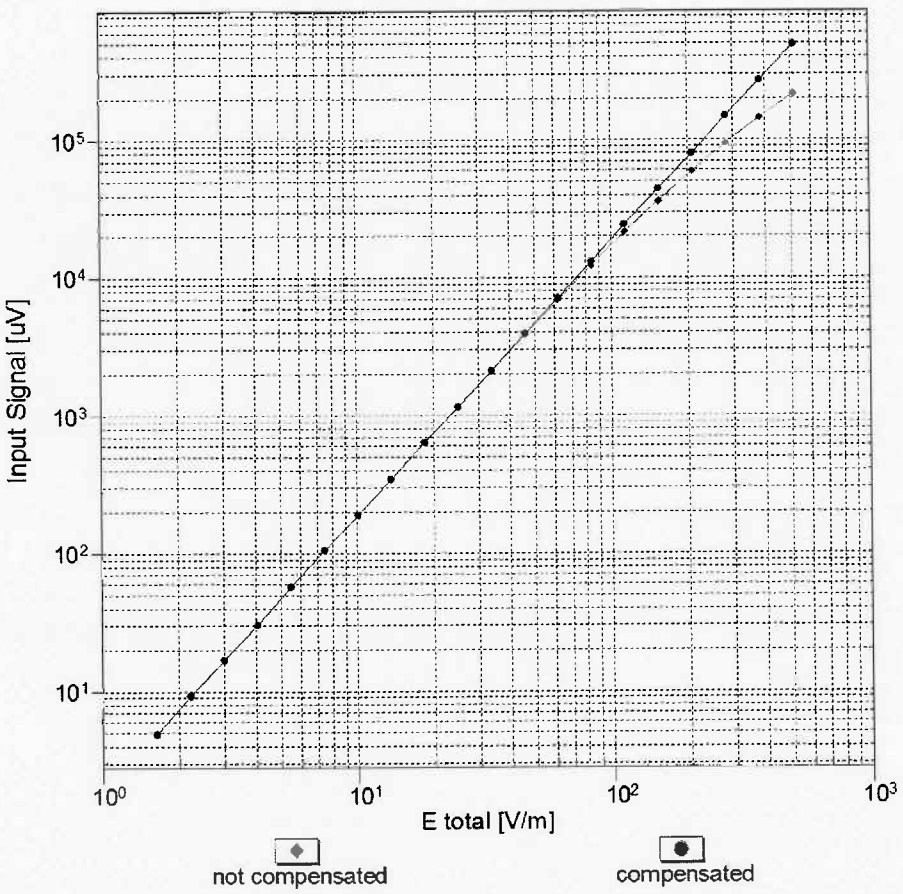
Uncertainty of Axial Isotropy Assessment: ± 0.5% (k=2)

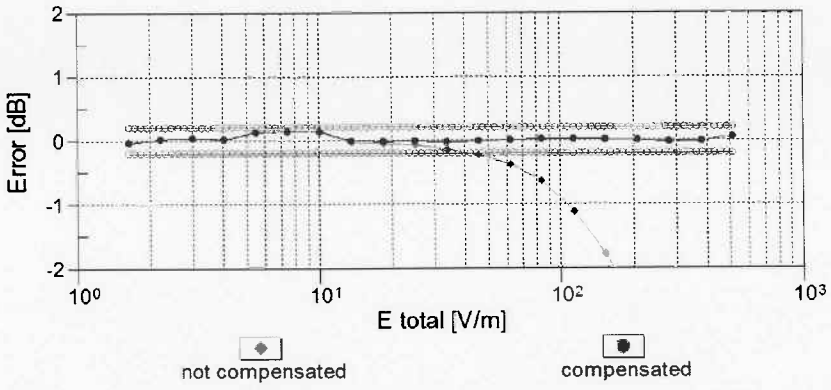
Receiving Pattern (ϕ), ϑ = 90°



Uncertainty of Axial Isotropy Assessment: ± 0.5% (k=2)

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

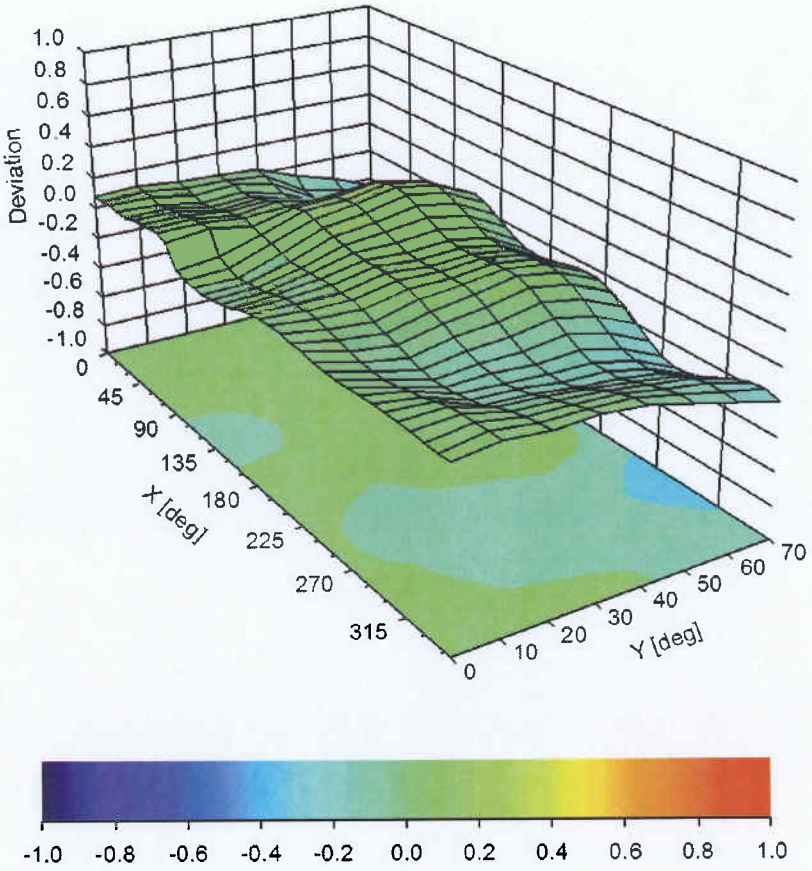




Uncertainty of Linearity Assessment: ± 0.6% (k=2)

Deviation from Isotropy in Air

Error (ϕ, ϑ), f = 900 MHz



Uncertainty of Spherical Isotropy Assessment: ± 2.6% (k=2)

DASY/EASY - Parameters of Probe: ER3DV6 - SN:2540

Other Probe Parameters

Sensor Arrangement	Rectangular
Connector Angle (°)	-58.3
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