DC Voltage Measurement

A/D - Converter Resolution nominal

High Range:	1LSB =	6.1μV ,	full range =	-100...+300 mV
Low Range:	1LSB =	61nV ,	full range =	-1.....+3mV

DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec

Calibration Factors	X	Y	Z
High Range	404.137 ± 0.02% (k=2)	404.963 ± 0.02% (k=2)	405.072 ± 0.02% (k=2)
Low Range	3.99939 ± 1.50% (k=2)	3.98266 ± 1.50% (k=2)	3.99957 ± 1.50% (k=2)

Connector Angle

Connector Angle to be used in DASY system	122.5 ° ± 1 °

Appendix (Additional assessments outside the scope of SCS0108)

1. DC Voltage Linearity

High Range		Reading (μV)	Difference (μV)	Error (%)
Channel X	+ Input	199991.86	-2.70	-0.00
Channel X	+ Input	20001.56	0.90	0.00
Channel X	- Input	-19999.14	1.73	-0.01
Channel Y	+ Input	199988.37	-6.13	-0.00
Channel Y	+ Input	19999.78	-0.97	-0.00
Channel Y	- Input	-20000.29	0.53	-0.00
Channel Z	+ Input	199992.91	-1.80	-0.00
Channel Z	+ Input	19999.00	-1.82	-0.01
Channel Z	- Input	-20001.26	-0.34	0.00

Low Range		Reading (μV)	Difference (μV)	Error (%)
Channel X	+ Input	2000.89	0.21	0.01
Channel X	+ Input	201.17	-0.00	-0.00
Channel X	- Input	-198.94	-0.16	0.08
Channel Y	+ Input	2001.04	0.23	0.01
Channel Y	+ Input	200.94	-0.35	-0.18
Channel Y	- Input	-198.65	0.00	-0.00
Channel Z	+ Input	2001.34	0.55	0.03
Channel Z	+ Input	200.34	-0.85	-0.42
Channel Z	- Input	-199.79	-1.03	0.52

2. Common mode sensitivity

DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec

	Common mode Input Voltage (mV)	High Range Average Reading (μV)	Low Range Average Reading (μV)
Channel X	200	-6.43	-7.81
	- 200	8.59	6.88
Channel Y	200	-9.24	-9.53
	- 200	8.64	8.82
Channel Z	200	12.32	11.91
	- 200	-14.23	-14.26

3. Channel separation

DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec

	Input Voltage (mV)	Channel X (μV)	Channel Y (μV)	Channel Z (μV)
Channel X	200	-	1.89	-4.39
Channel Y	200	8.48	-	2.69
Channel Z	200	9.38	6.78	-

4. AD-Converter Values with inputs shorted

DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec

	High Range (LSB)	Low Range (LSB)
Channel X	15958	16206
Channel Y	15960	16204
Channel Z	15870	16608

5. Input Offset Measurement

DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec

Input 10MΩ

	Average (μV)	min. Offset (μV)	max. Offset (μV)	Std. Deviation (μV)
Channel X	-0.29	-1.11	0.62	0.33
Channel Y	0.75	-0.38	2.27	0.47
Channel Z	-1.15	-1.99	0.07	0.40

6. Input Offset Current

Nominal Input circuitry offset current on all channels: <25fA

7. Input Resistance (Typical values for information)

	Zeroing (kOhm)	Measuring (MOhm)
Channel X	200	200
Channel Y	200	200
Channel Z	200	200

8. Low Battery Alarm Voltage (Typical values for information)

Typical values	Alarm Level (VDC)
Supply (+ Vcc)	+7.9
Supply (- Vcc)	-7.6

9. Power Consumption (Typical values for information)

Typical values	Switched off (mA)	Stand by (mA)	Transmitting (mA)
Supply (+ Vcc)	+0.01	+6	+14
Supply (- Vcc)	–0.01	-8	-9

Calibration Laboratory of
Schmid & Partner
Engineering AG
Zeughausstrasse 43, 8004 Zurich, Switzerland

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Accreditation No.: SCS 0108

Client **Sporton-KS (Auden)**

Certificate No: ER3-2476_Nov15

CALIBRATION CERTIFICATE

Object: ER3DV6 - SN:2476

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: November 25, 2015

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	01-Apr-15 (No. 217-02128)	Mar-16
Power sensor E4412A	MY41498087	01-Apr-15 (No. 217-02128)	Mar-16
Reference 3 dB Attenuator	SN: S5054 (3c)	01-Apr-15 (No. 217-02129)	Mar-16
Reference 20 dB Attenuator	SN: S5277 (20x)	01-Apr-15 (No. 217-02132)	Mar-16
Reference 30 dB Attenuator	SN: S5129 (30b)	01-Apr-15 (No. 217-02133)	Mar-16
Reference Probe ER3DV6	SN: 2328	12-Oct-15 (No. ER3-2328_Oct15)	Oct-16
DAE4	SN: 789	16-Mar-15 (No. DAE4-789_Mar15)	Mar-16
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-15)	In house check: Oct-16

	Name	Function	Signature
Calibrated by:	Israe Elnaouq	Laboratory Technician	
Approved by:	Katja Pokovic	Technical Manager	

Issued: November 26, 2015

Calibration Laboratory of
Schmid & Partner
Engineering AG
Zeughausstrasse 43, 8004 Zurich, Switzerland

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Accreditation No.: SCS 0108

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., ϑ = 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, Rev 3.0, November 2013

Methods Applied and Interpretation of Parameters:

- *NORMx,y,z:* Assessed for E-field polarization ϑ = 0 for XY sensors and ϑ = 90 for Z sensor (f ≤ 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:2476

Manufactured: March 31, 2009
Calibrated: November 25, 2015

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

DASY/EASY - Parameters of Probe: ER3DV6 - SN:2476

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm ($\mu V/(V/m)^2$)	1.92	1.70	2.21	± 10.1 %
DCP (mV)[B]	100.8	100.7	101.6	

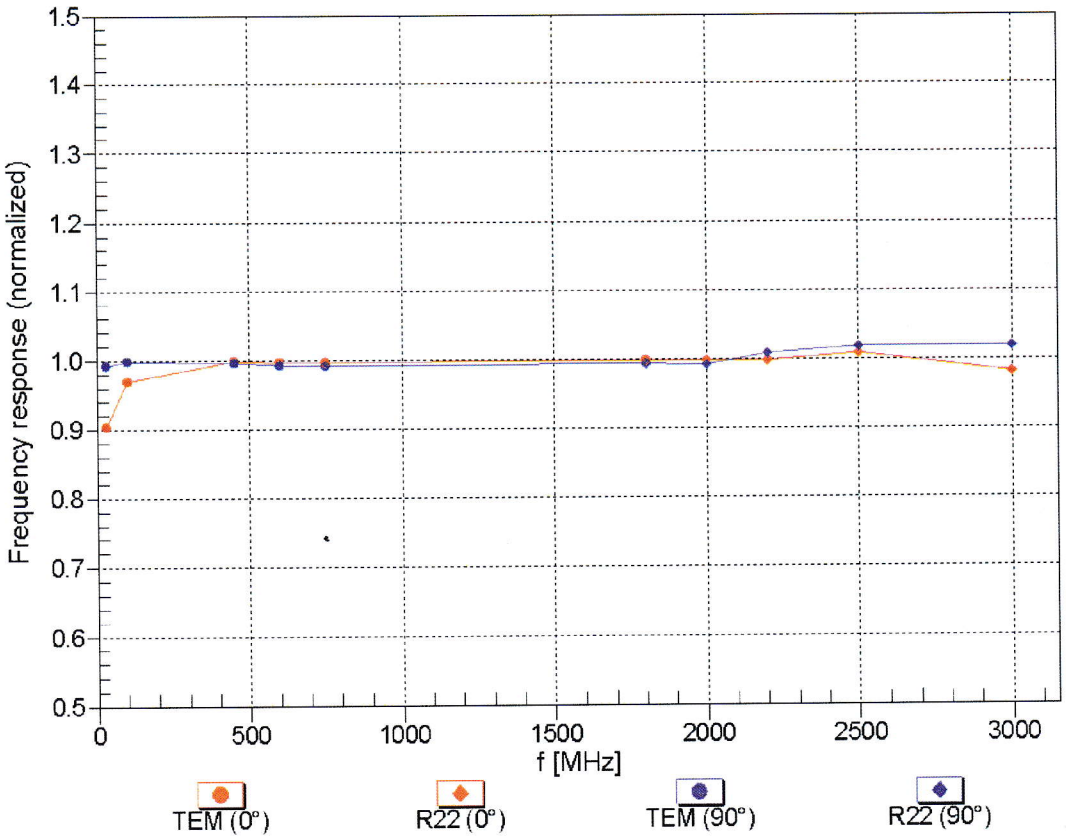
Modulation Calibration Parameters

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	183.5	±3.0 %
		Y	0.0	0.0	1.0		215.7	
		Z	0.0	0.0	1.0		167.5	
10011-CAB	UMTS-FDD (WCDMA)	X	3.36	67.8	19.3	2.91	148.5	±0.9 %
		Y	3.25	67.0	18.9		129.5	
		Z	3.30	67.5	19.1		135.5	
10021-DAB	GSM-FDD (TDMA, GMSK)	X	15.67	99.5	28.6	9.39	134.6	±1.2 %
		Y	16.21	99.9	28.8		116.7	
		Z	21.64	99.5	28.8		108.1	
10039-CAB	CDMA2000 (1xRTT, RC1)	X	4.98	68.3	20.3	4.57	147.9	±1.4 %
		Y	4.78	67.1	19.5		124.6	
		Z	4.71	67.0	19.4		134.7	
10081-CAB	CDMA2000 (1xRTT, RC3)	X	3.98	66.8	19.2	3.97	143.5	±0.7 %
		Y	3.86	65.9	18.7		120.9	
		Z	3.85	66.0	18.7		130.6	
10295-AAB	CDMA2000, RC1, SO3, 1/8th Rate 25 fr.	X	13.31	98.6	41.9	12.49	83.0	±2.7 %
		Y	14.28	99.8	42.0		98.4	
		Z	17.01	99.3	39.7		86.2	

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.

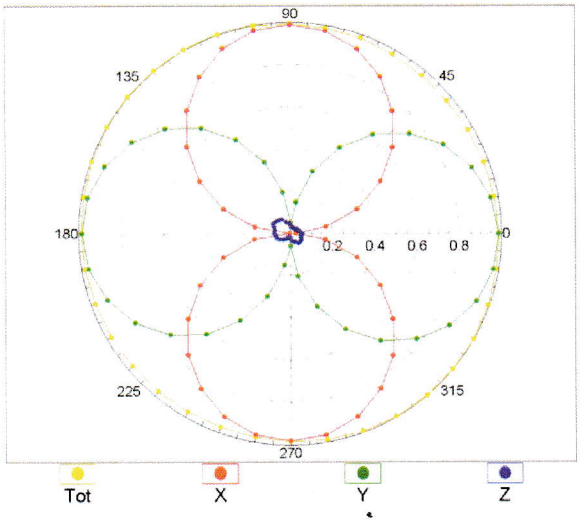
Frequency Response of E-Field
(TEM-Cell:ifi110 EXX, Waveguide: R22)



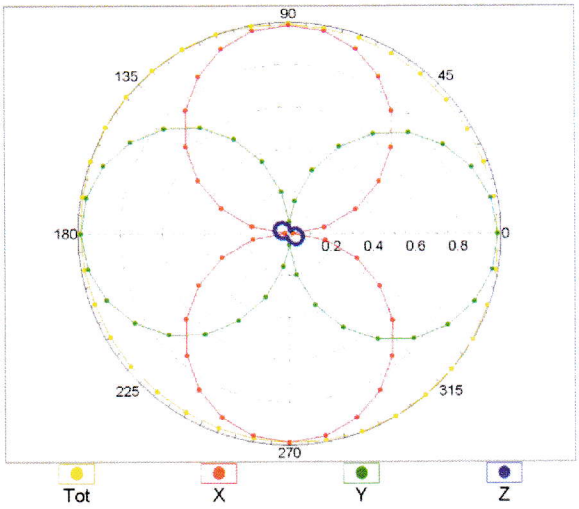
Uncertainty of Frequency Response of E-field: ± 6.3% (k=2)

Receiving Pattern (ϕ), ϑ = 0°

f=450 MHz,TEM,0°

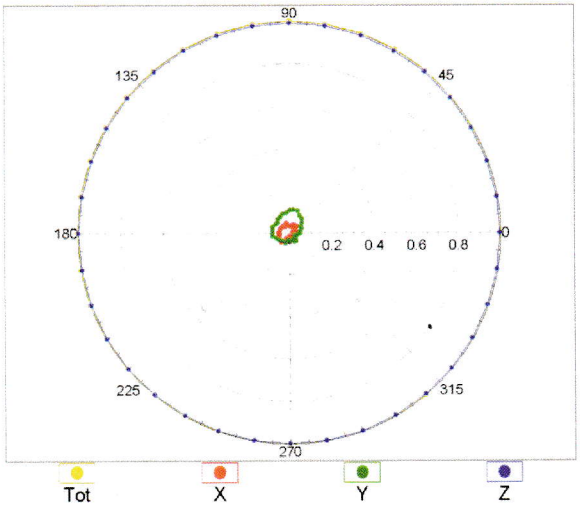


f=2500 MHz,R22,0°

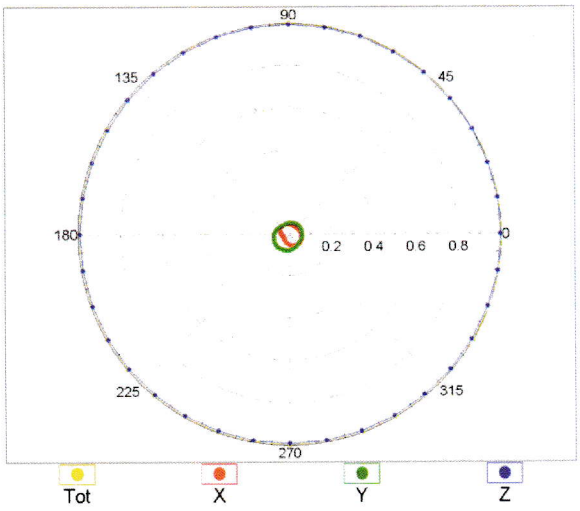


Receiving Pattern (ϕ), ϑ = 90°

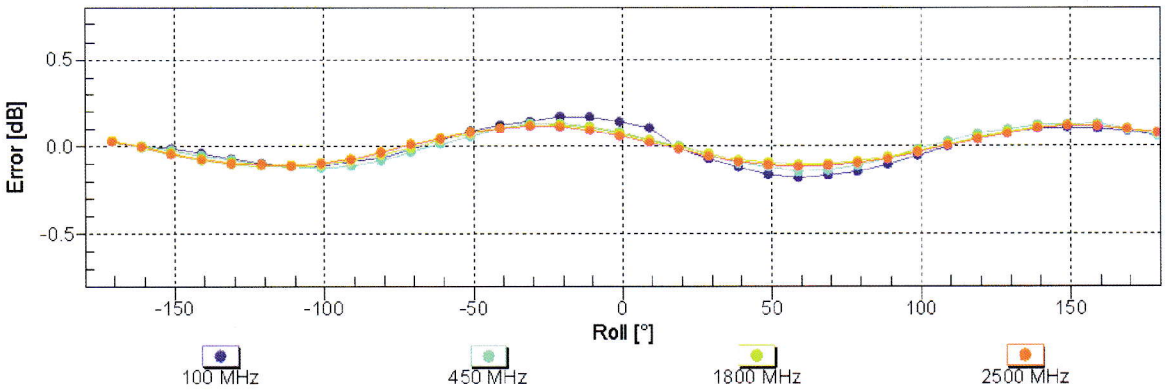
f=450 MHz,TEM,90°



f=2500 MHz,R22,90°

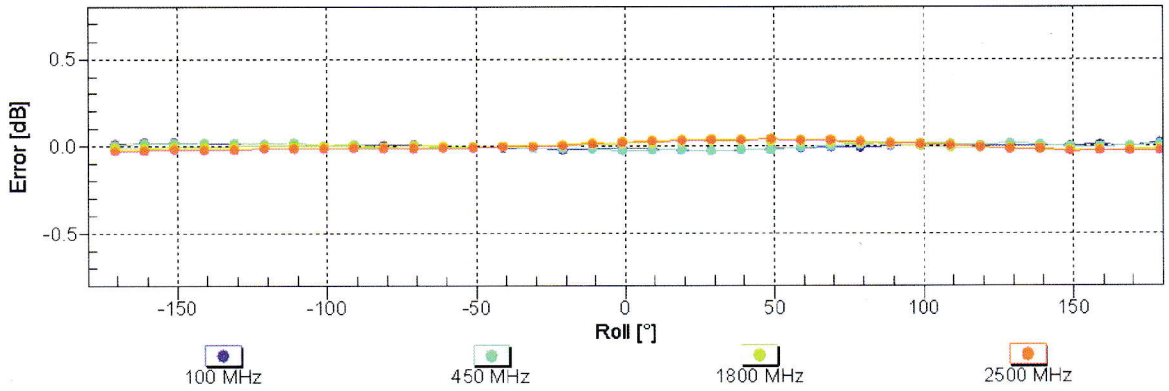


Receiving Pattern (ϕ), ϑ = 0°



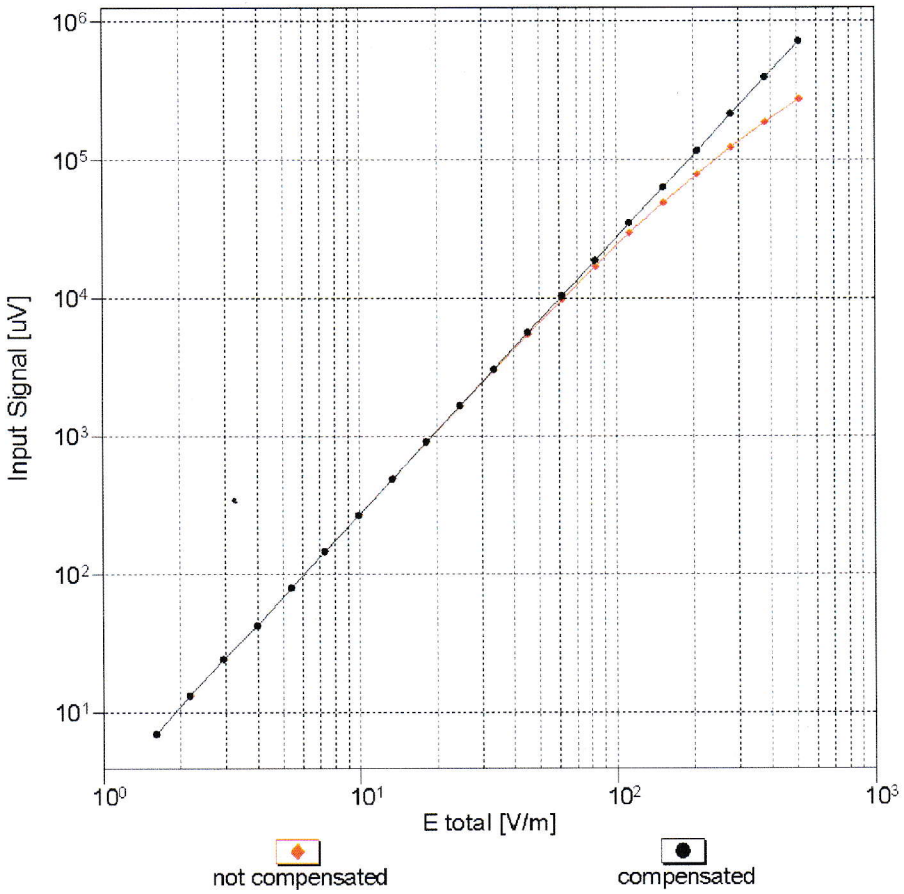
Uncertainty of Axial Isotropy Assessment: ± 0.5% (k=2)

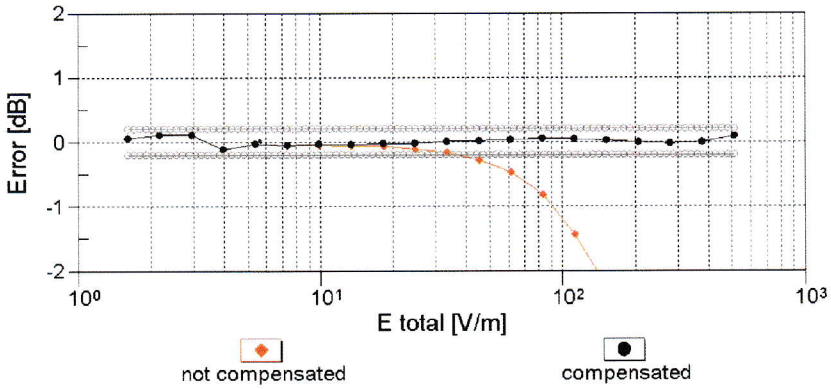
Receiving Pattern (ϕ), ϑ = 90°



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)