



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



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S Servizio svizzero di taratura
S Swiss Calibration Service

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Accreditation No.: SCS 108

Client ATL (Auden)

Certificate No: ER3-2256_Aug08

CALIBRATION CERTIFICATE

Object ER3DV6 - SN:2256
Calibration procedure(s) QA CAL-02.v5
Calibration procedure for E-field probes optimized for close near field evaluations in air
Calibration date: August 22, 2008
Condition of the calibrated item In Tolerance

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)

Table with 4 columns: Primary Standards, ID #, Cal Date (Certificate No.), Scheduled Calibration. Lists various power meters, sensors, attenuators, and probes with their respective IDs and calibration dates.

Table with 4 columns: Secondary Standards, ID #, Check Date (in house), Scheduled Check. Lists RF generator and Network Analyzer with their IDs and check dates.

Calibrated by: Katja Pokovic, Technical Manager
Approved by: Niels Kuster, Quality Manager

Issued: August 26, 2008

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Accreditation No.: SCS 108

Glossary:

NORM _{x,y,z}	sensitivity in free space
DCP	diode compression point
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 DASYS 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.

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 (no uncertainty required). DCP does not depend on frequency.
- 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).



ER3DV6 SN:2256

August 22, 2008

Probe ER3DV6

SN:2256

Manufactured:	March 15, 2001
Last calibrated:	August 21, 2007
Recalibrated:	August 22, 2008

Calibrated for DASY Systems

(Note: non-compatible with DASY2 system!)



ER3DV6 SN:2256

August 22, 2008

DASY - Parameters of Probe: ER3DV6 SN:2256

Sensitivity in Free Space [$\mu\text{V}/(\text{V}/\text{m})^2$]

NormX	2.20 ± 10.1 % (k=2)
NormY	1.57 ± 10.1 % (k=2)
NormZ	1.65 ± 10.1 % (k=2)

Diode Compression^A

DCP X	91 mV
DCP Y	93 mV
DCP Z	99 mV

Frequency Correction

X	0.0
Y	0.0
Z	0.0

Sensor Offset

(Probe Tip to Sensor Center)

X	2.5 mm
Y	2.5 mm
Z	2.5 mm

Connector Angle

-248 °

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%.

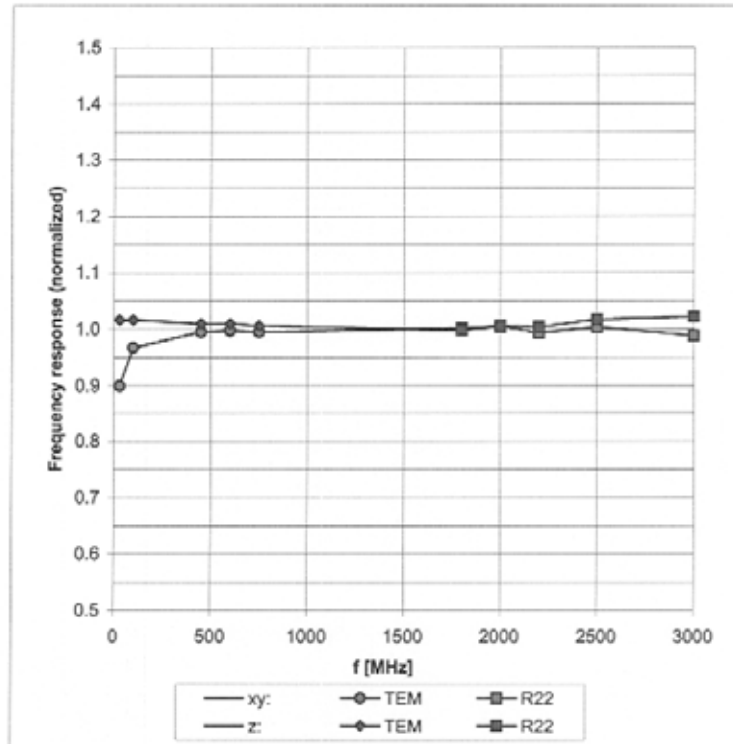
^A numerical linearization parameter: uncertainty not required



ER3DV6 SN:2256

August 22, 2008

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



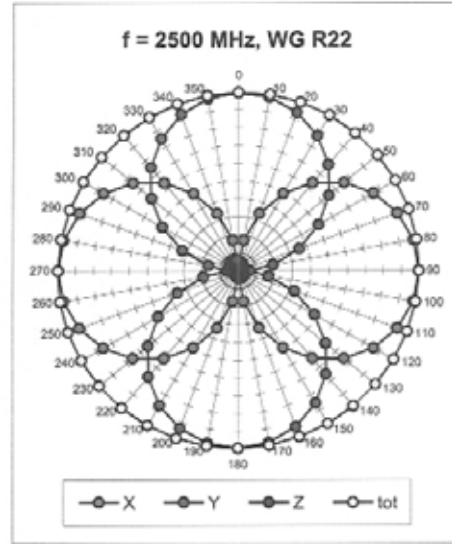
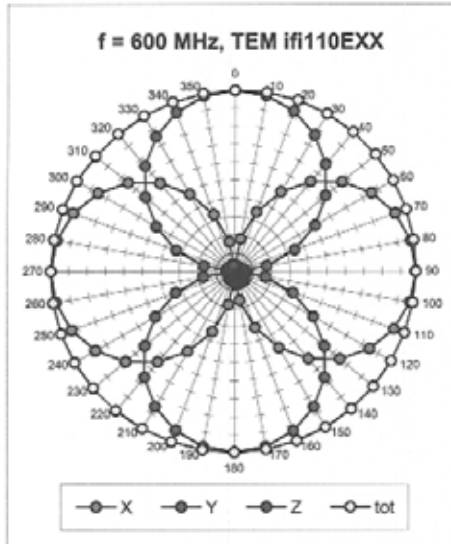
Uncertainty of Frequency Response of E-field: $\pm 6.3\%$ ($k=2$)



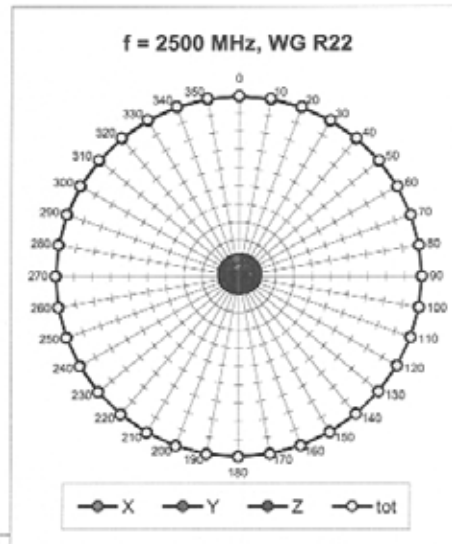
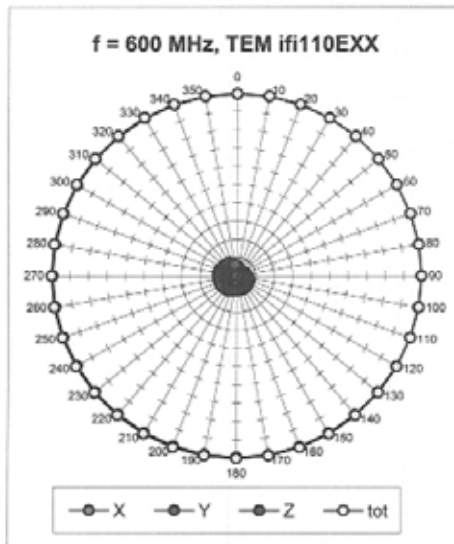
ER3DV6 SN:2256

August 22, 2008

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



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

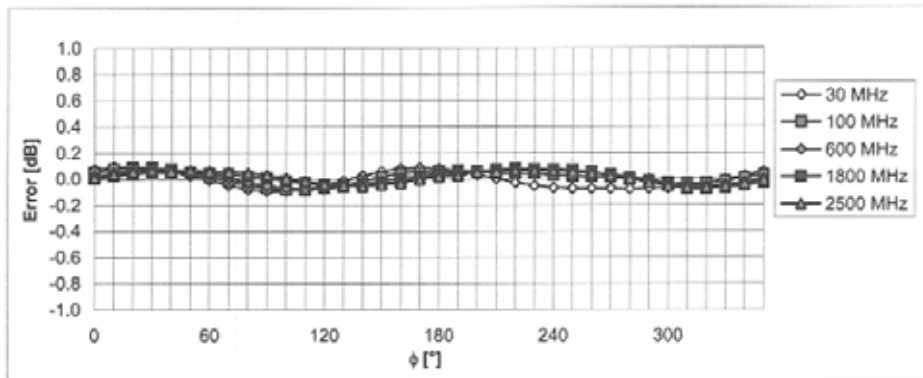




ER3DV6 SN:2256

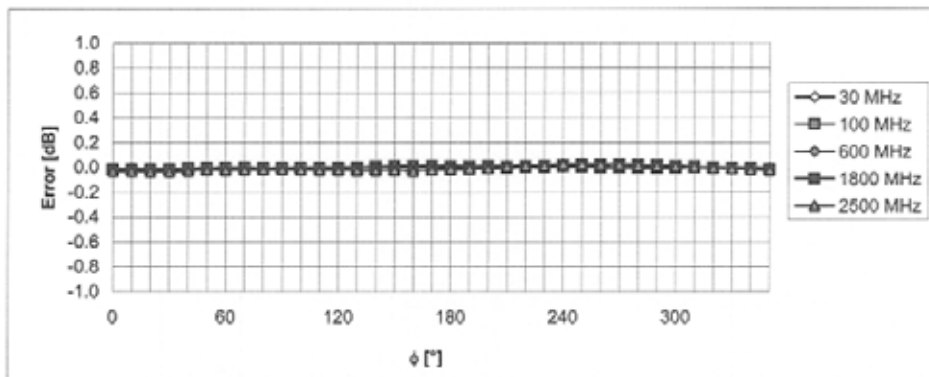
August 22, 2008

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



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

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



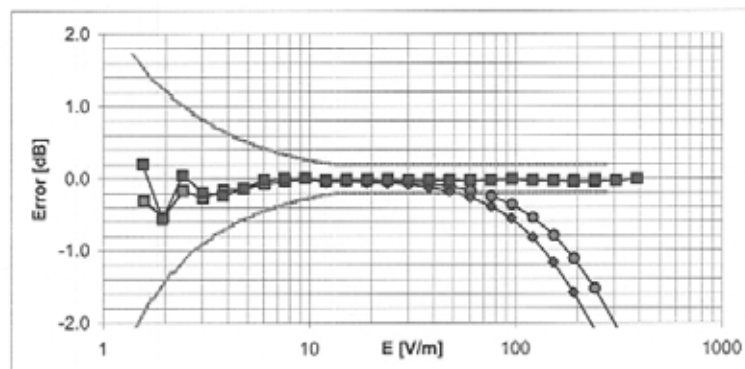
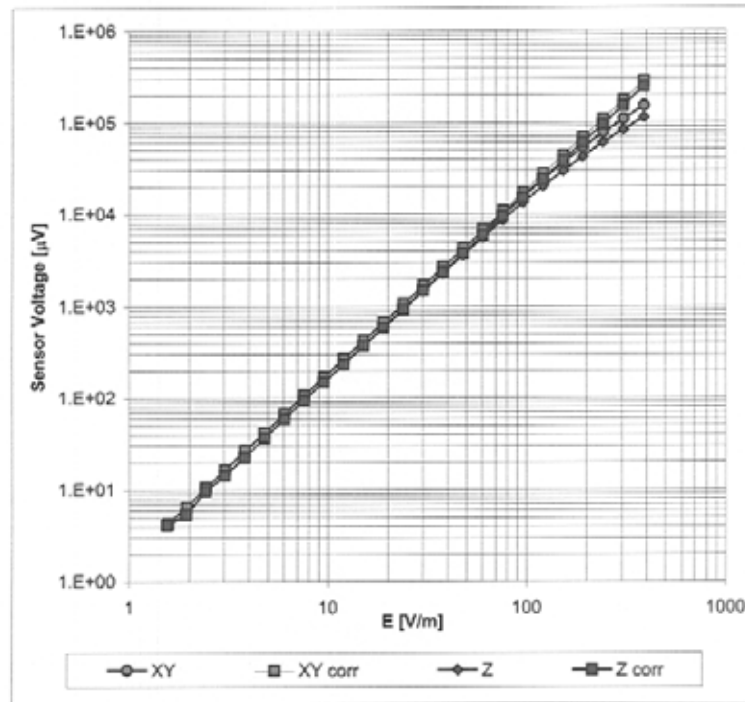
Uncertainty of Axial Isotropy Assessment: $\pm 0.5\%$ ($k=2$)



ER3DV6 SN:2256

August 22, 2008

Dynamic Range f(E-field) (Waveguide R22, f = 1800 MHz)



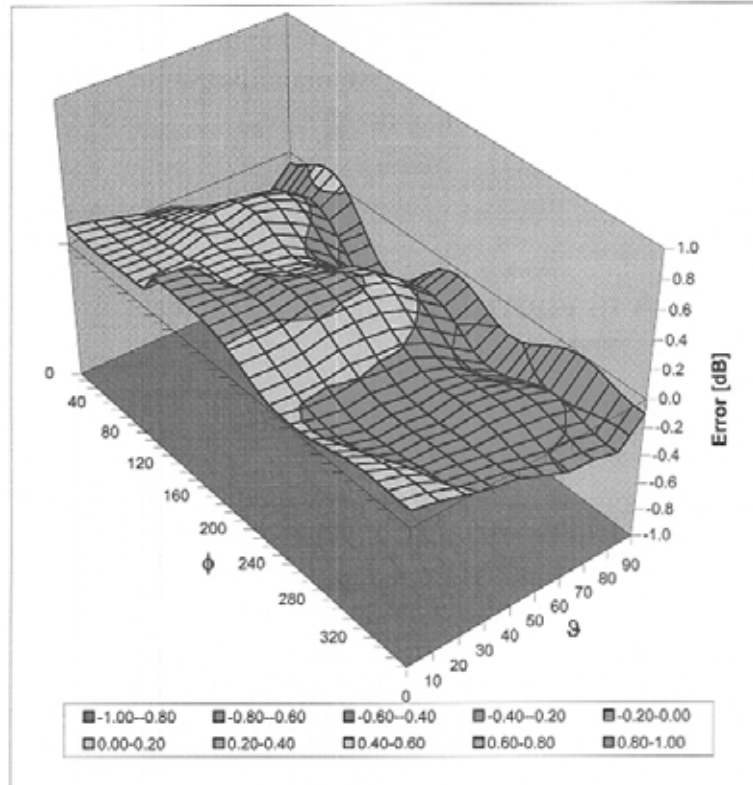
Uncertainty of Linearity Assessment: $\pm 0.6\%$ ($k=2$)



ER3DV6 SN:2256

August 22, 2008

Deviation from Isotropy in Air
Error (ϕ, θ), $f = 900$ MHz



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



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Accreditation No.: SCS 108

Client Sporton (Auden)

Certificate No: H3-6184_Jan09

CALIBRATION CERTIFICATE

Object H3DV6 - SN:6184
Calibration procedure(s) QA CAL-03.v5
Calibration procedure for H-field probes optimized for close near field evaluations in air
Calibration date: January 19, 2009
Condition of the calibrated item In Tolerance

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)

Table with 4 columns: Primary Standards, ID #, Cal Date (Certificate No.), Scheduled Calibration. Lists equipment like Power meter E4419B, Power sensor E4412A, Reference 3 dB Attenuator, etc.

Table with 4 columns: Secondary Standards, ID #, Check Date (in house), Scheduled Check. Lists equipment like RF generator HP 8648C, Network Analyzer HP 8753E.

Calibrated by: Katja Pokovic, Technical Manager
Approved by: Niels Kuster, Quality Manager

Handwritten signatures of Katja Pokovic and Niels Kuster.

Issued: January 20, 2009

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Accreditation No.: SCS 108

Glossary:

NORM_{x,y,z} sensitivity in free space
DCP diode compression point
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 DASYS 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.

Methods Applied and Interpretation of Parameters:

- X, Y, Z_{a0a1a2} : Assessed for E-field polarization $\vartheta = 90$ for XY sensors and $\vartheta = 0$ for Z sensor ($f \leq 900$ MHz in TEM-cell; $f > 1800$ MHz: R22 waveguide).
- $X, Y, Z(f)_{a0a1a2} = X, Y, Z_{a0a1a2} * \text{frequency_response}$ (see Frequency Response Chart).
- $DCP_{x,y,z}$: DCP are numerical linearization parameters assessed based on the data of power sweep (no uncertainty required). DCP does not depend on frequency.
- *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 X_{a0a1a2} (no uncertainty required).



H3DV6 SN:6184

January 19, 2009

Probe H3DV6

SN:6184

Manufactured:	June 8, 2004
Last calibrated:	January 28, 2008
Recalibrated:	January 19, 2009

Calibrated for DASYS Systems

(Note: non-compatible with DASYS2 system!)



H3DV6 SN:6184

January 19, 2009

DASY - Parameters of Probe: H3DV6 SN:6184

Sensitivity in Free Space [A/m / $\sqrt{(\mu V)}$]

	a0	a1	a2
X	2.489E-03	1.472E-6	1.050E-5 ± 5.1 % (k=2)
Y	2.547E-03	-9.311E-5	1.728E-6 ± 5.1 % (k=2)
Z	3.002E-03	-1.194E-4	6.741E-5 ± 5.1 % (k=2)

Diode Compression¹

DCP X	88 mV
DCP Y	80 mV
DCP Z	84 mV

Sensor Offset (Probe Tip to Sensor Center)

X	3.0 mm
Y	3.0 mm
Z	3.0 mm

Connector Angle -246 °

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%.

¹ numerical linearization parameter: uncertainty not required

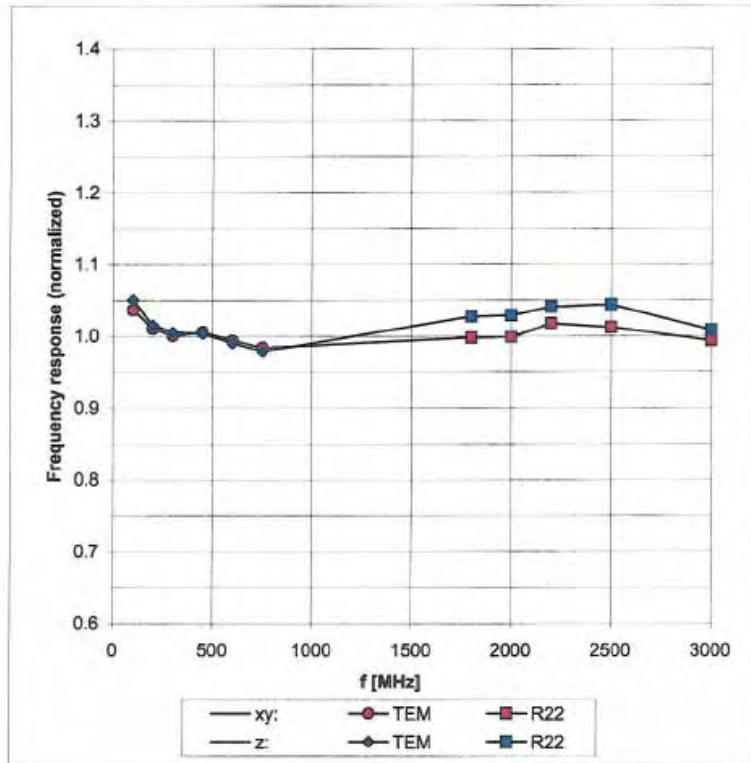


H3DV6 SN:6184

January 19, 2009

Frequency Response of H-Field

(TEM-Cell:ifi110 EXX, Waveguide R22)



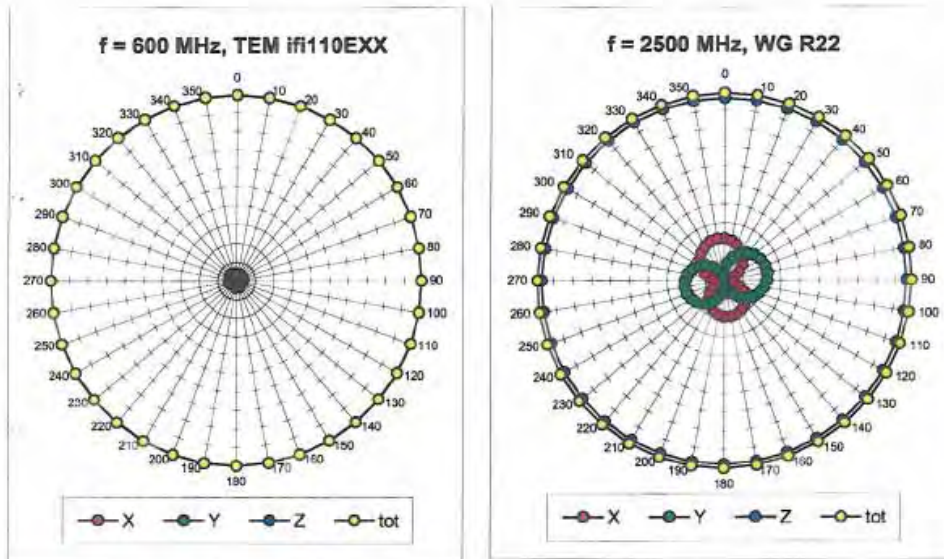
Uncertainty of Frequency Response of E-field: $\pm 6.3\%$ ($k=2$)



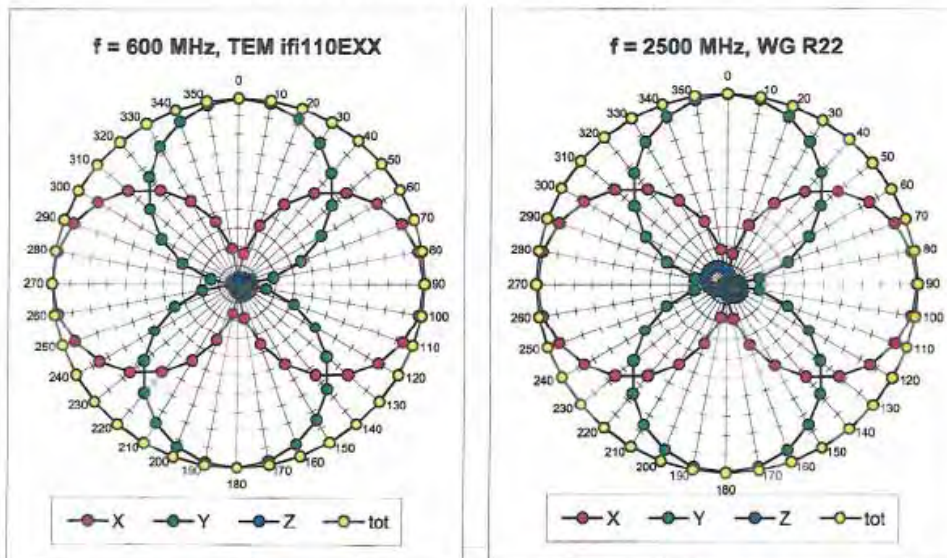
H3DV6 SN:6184

January 19, 2009

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



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

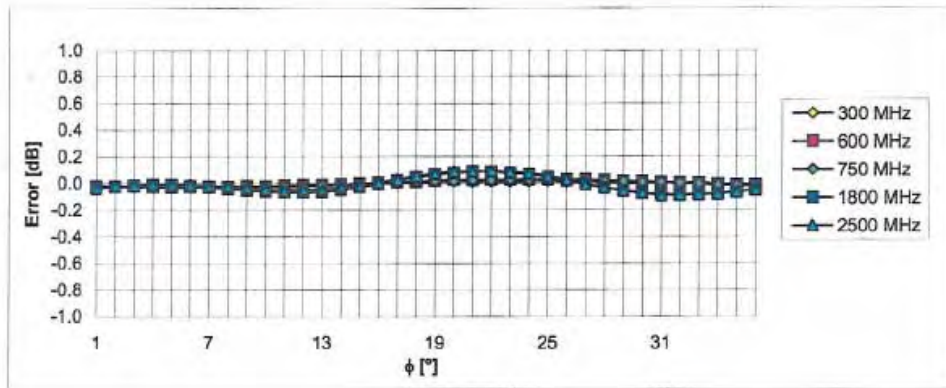




H3DV6 SN:6184

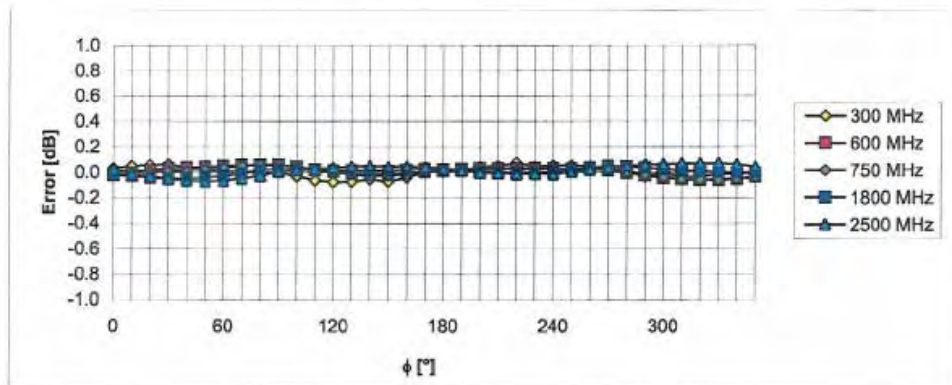
January 19, 2009

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



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

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



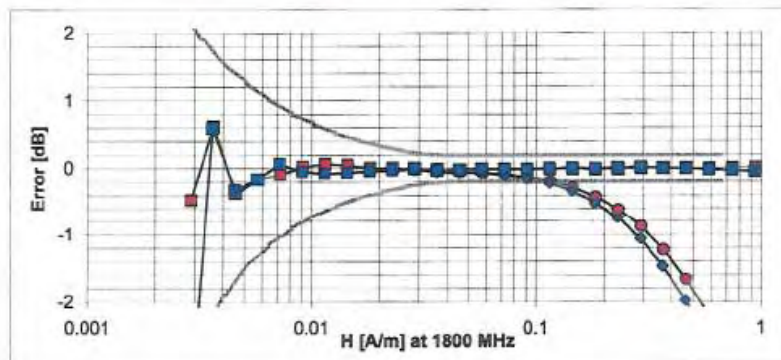
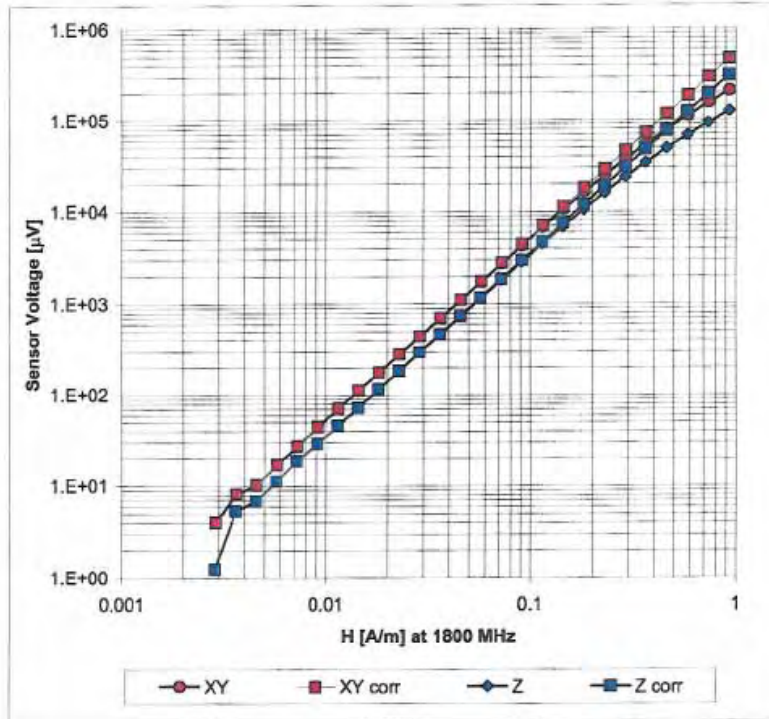
Uncertainty of Axial Isotropy Assessment: $\pm 0.5\%$ ($k=2$)



H3DV6 SN:6184

January 19, 2009

Dynamic Range f(H-field) (Waveguide R22, f = 1800 MHz)



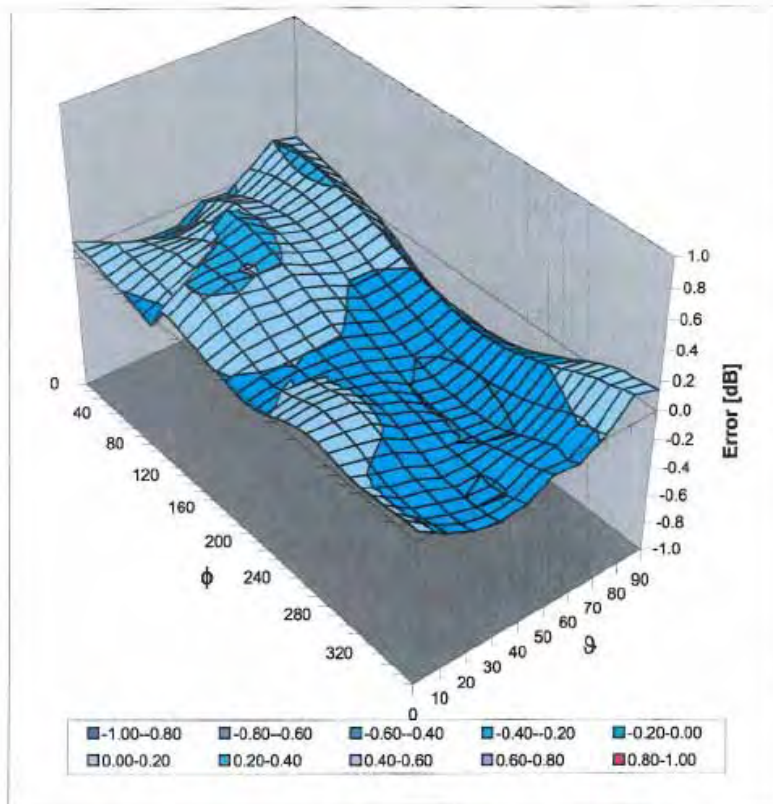
Uncertainty of Linearity Assessment: $\pm 0.6\%$ ($k=2$)



H3DV6 SN:6184

January 19, 2009

Deviation from Isotropy in Air Error (ϕ, θ), $f = 900$ MHz



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



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Accreditation No.: SCS 108

Client ATL (Auden)

Certificate No: H3-6076_Aug08

CALIBRATION CERTIFICATE

Object: H3DV6 - SN:6076
Calibration procedure(s): QA CAL-03.v5
Calibration date: August 22, 2008
Condition of the calibrated item: In Tolerance

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.

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Calibrated by: Katja Pokovic, Technical Manager
Approved by: Niels Kuster, Quality Manager

Issued: August 26, 2008

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Glossary:

NORM _{x,y,z}	sensitivity in free space
DCP	diode compression point
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
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Methods Applied and Interpretation of Parameters:

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- $X, Y, Z(f)_{a0a1a2} = X, Y, Z_{a0a1a2} \cdot \text{frequency_response}$ (see Frequency Response Chart).
- $DCP_{x,y,z}$: DCP are numerical linearization parameters assessed based on the data of power sweep (no uncertainty required). DCP does not depend on frequency.
- *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 X_{a0a1a2} (no uncertainty required).



H3DV6 SN:6076

August 22, 2008

Probe H3DV6

SN:6076

Manufactured:	October 2, 2000
Last calibrated:	August 23, 2007
Recalibrated:	August 22, 2008

Calibrated for DASY Systems

(Note: non-compatible with DASY2 system!)



H3DV6 SN:6076

August 22, 2008

DASY - Parameters of Probe: H3DV6 SN:6076

Sensitivity in Free Space [A/m / $\sqrt{(\mu V)}$]

	a0	a1	a2
X	2.898E-03	-1.635E-4	5.571E-5 ± 5.1 % (k=2)
Y	2.738E-03	-2.355E-4	2.000E-5 ± 5.1 % (k=2)
Z	3.074E-03	-4.905E-5	-1.673E-4 ± 5.1 % (k=2)

Diode Compression¹

DCP X	89 mV
DCP Y	93 mV
DCP Z	78 mV

Sensor Offset (Probe Tip to Sensor Center)

X	3.0 mm
Y	3.0 mm
Z	3.0 mm

Connector Angle 80 °

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%.

¹ numerical linearization parameter: uncertainty not required

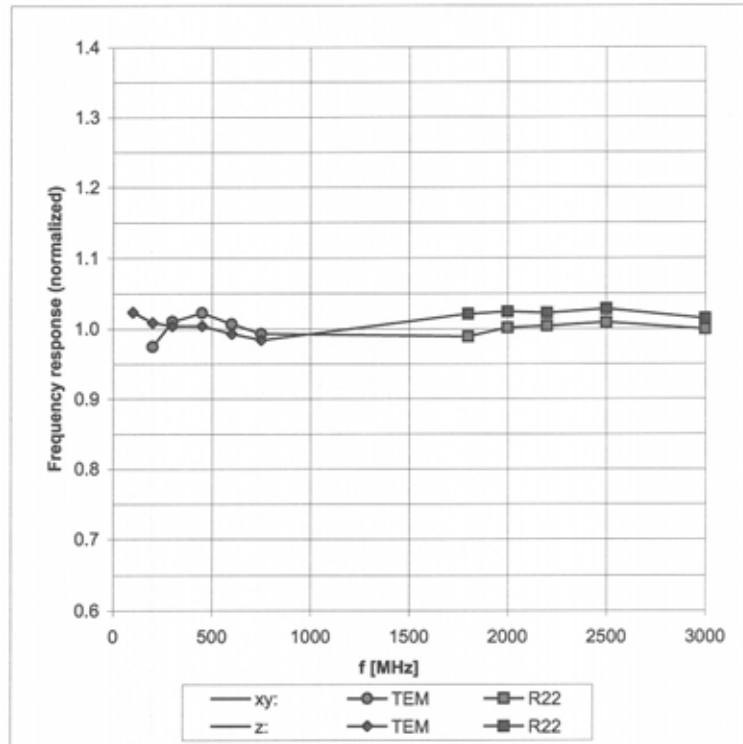


H3DV6 SN:6076

August 22, 2008

Frequency Response of H-Field

(TEM-Cell:ifi110 EXX, Waveguide R22)



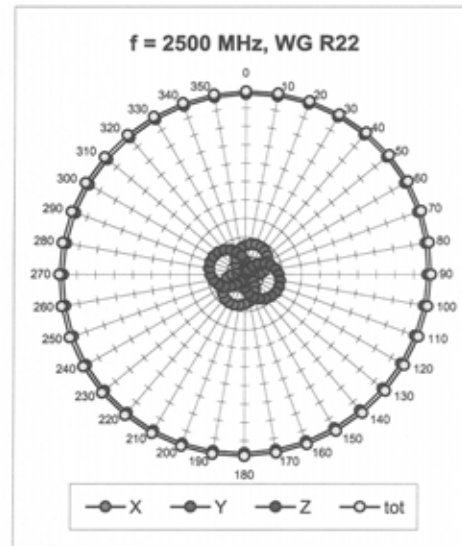
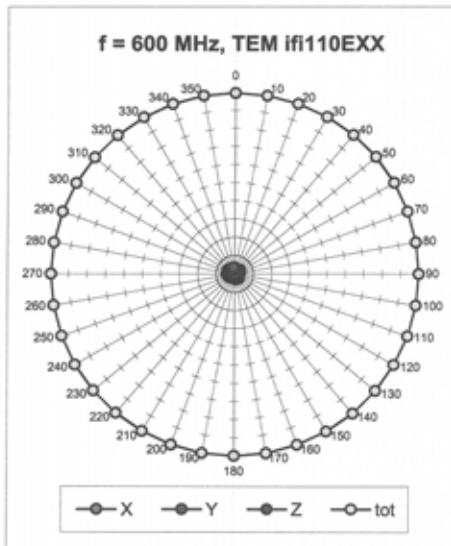
Uncertainty of Frequency Response of E-field: $\pm 6.3\%$ (k=2)



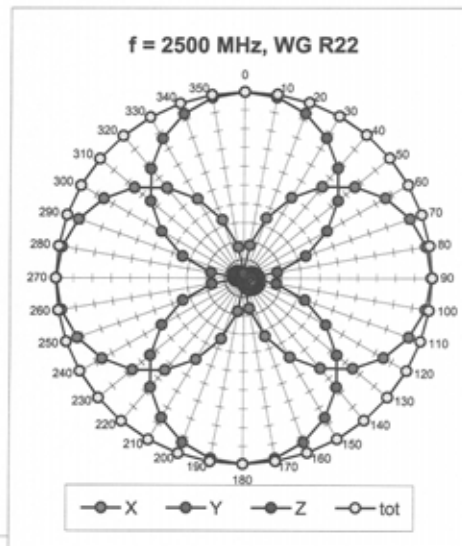
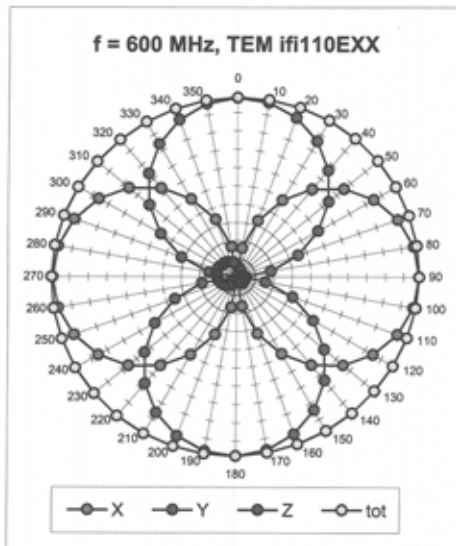
H3DV6 SN:6076

August 22, 2008

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



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

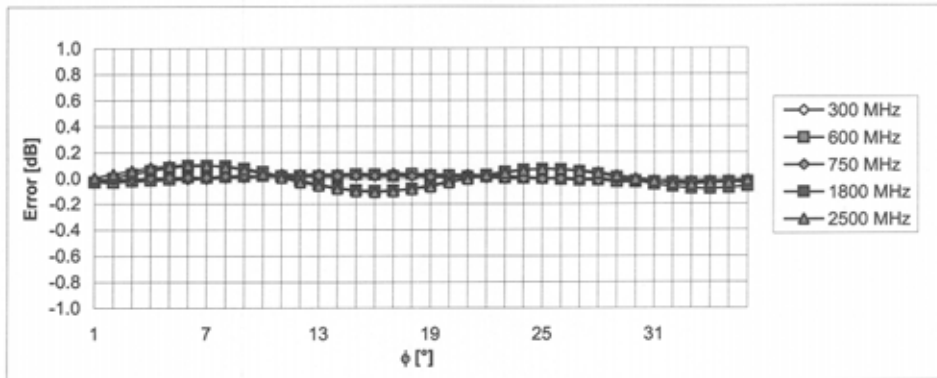




H3DV6 SN:6076

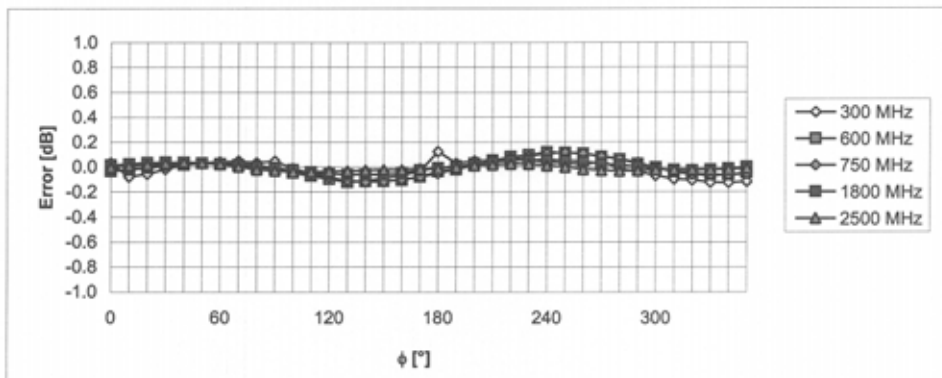
August 22, 2008

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



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

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



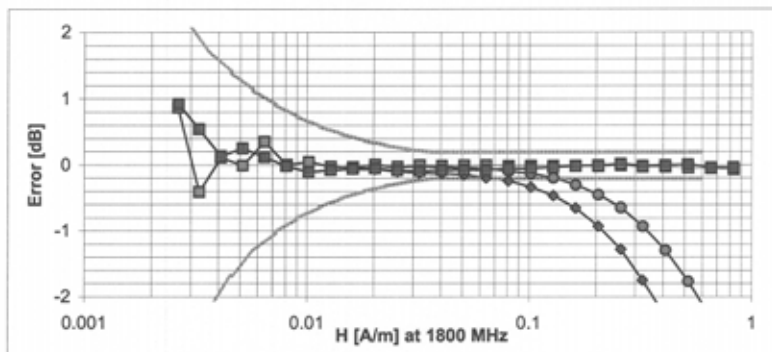
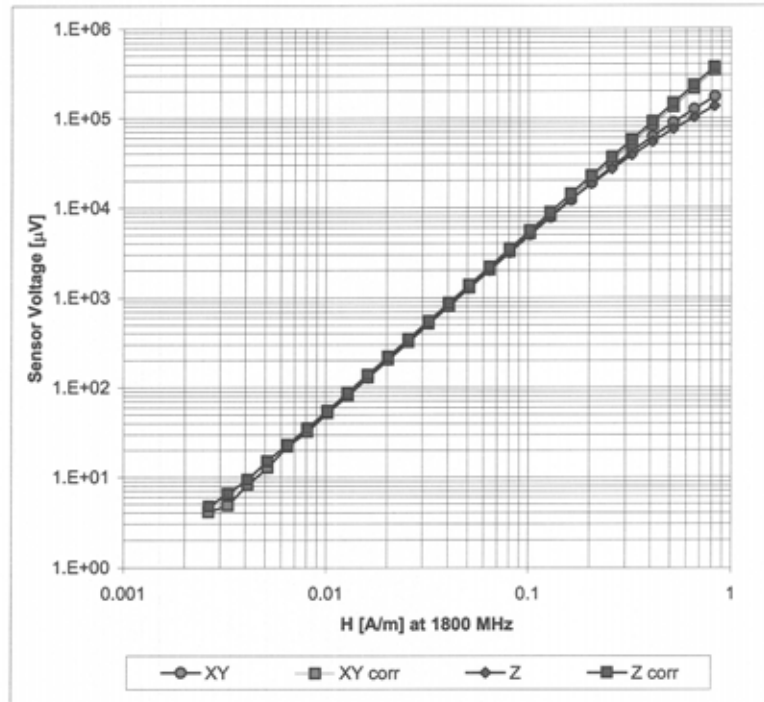
Uncertainty of Axial Isotropy Assessment: $\pm 0.5\%$ (k=2)



H3DV6 SN:6076

August 22, 2008

Dynamic Range f(H-field) (Waveguide R22, f = 1800 MHz)



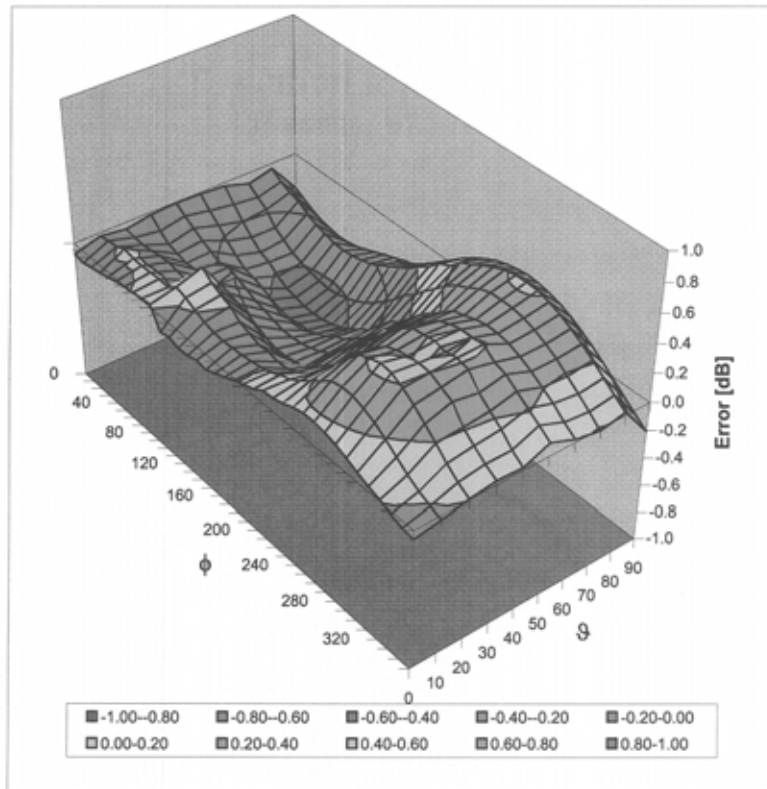
Uncertainty of Linearity Assessment: $\pm 0.6\%$ (k=2)



H3DV6 SN:6076

August 22, 2008

Deviation from Isotropy in Air Error (ϕ, ϑ), $f = 900$ MHz



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