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Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: SCS 108

Client **Huawei (Auden)**

Certificate No: DAE4-852_Nov11

CALIBRATION CERTIFICATE

Object **DAE4 - SD 000 D04 BJ - SN: 852**

Calibration procedure(s) **QA CAL-06.v23
Calibration procedure for the data acquisition electronics (DAE)**

Calibration date: **November 16, 2011**

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 $(22 \pm 3)^\circ\text{C}$ and humidity $< 70\%$.

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Keithley Multimeter Type 2001	SN: 0810278	28-Sep-11 (No:11450)	Sep-12
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Calibrator Box V1.1	SE UMS 006 AB 1004	08-Jun-11 (in house check)	In house check: Jun-12

Calibrated by:	Name Andrea Guntli	Function Technician	Signature
Approved by:	Name Fin Bomholt	Function R&D Director	Signature

Issued: November 16, 2011

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Glossary

DAE	data acquisition electronics
Connector angle	information used in DASY system to align probe sensor X to the robot coordinate system.

Methods Applied and Interpretation of Parameters

- *DC Voltage Measurement:* Calibration Factor assessed for use in DASY system by comparison with a calibrated instrument traceable to national standards. The figure given corresponds to the full scale range of the voltmeter in the respective range.
- *Connector angle:* The angle of the connector is assessed measuring the angle mechanically by a tool inserted. Uncertainty is not required.
- The following parameters as documented in the Appendix contain technical information as a result from the performance test and require no uncertainty.
 - *DC Voltage Measurement Linearity:* Verification of the Linearity at +10% and -10% of the nominal calibration voltage. Influence of offset voltage is included in this measurement.
 - *Common mode sensitivity:* Influence of a positive or negative common mode voltage on the differential measurement.
 - *Channel separation:* Influence of a voltage on the neighbor channels not subject to an input voltage.
 - *AD Converter Values with inputs shorted:* Values on the internal AD converter corresponding to zero input voltage
 - *Input Offset Measurement:* Output voltage and statistical results over a large number of zero voltage measurements.
 - *Input Offset Current:* Typical value for information; Maximum channel input offset current, not considering the input resistance.
 - *Input resistance:* Typical value for information; DAE input resistance at the connector, during internal auto-zeroing and during measurement.
 - *Low Battery Alarm Voltage:* Typical value for information. Below this voltage, a battery alarm signal is generated.
 - *Power consumption:* Typical value for information. Supply currents in various operating modes.

DC Voltage Measurement

A/D - Converter Resolution nominal

High Range: 1LSB = 6.1 μ V, 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	405.143 \pm 0.1% (k=2)	405.167 \pm 0.1% (k=2)	403.956 \pm 0.1% (k=2)
Low Range	3.95820 \pm 0.7% (k=2)	3.98623 \pm 0.7% (k=2)	3.95475 \pm 0.7% (k=2)

Connector Angle

Connector Angle to be used in DASY system	157.5 $^{\circ}$ \pm 1 $^{\circ}$
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Appendix

1. DC Voltage Linearity

High Range	Reading (μV)	Difference (μV)	Error (%)
Channel X + Input	199994.2	-10.75	-0.01
Channel X + Input	19999.95	0.05	0.00
Channel X - Input	-19993.83	5.47	-0.03
Channel Y + Input	200002.0	-1.85	-0.00
Channel Y + Input	19999.79	-0.01	-0.00
Channel Y - Input	-20001.19	-1.29	0.01
Channel Z + Input	199992.2	-0.69	-0.00
Channel Z + Input	19999.14	-0.76	-0.00
Channel Z - Input	-20000.87	-0.97	0.00

Low Range	Reading (μV)	Difference (μV)	Error (%)
Channel X + Input	1999.8	-0.02	-0.00
Channel X + Input	200.25	0.15	0.08
Channel X - Input	-200.00	-0.10	0.05
Channel Y + Input	2001.0	0.98	0.05
Channel Y + Input	199.76	-0.34	-0.17
Channel Y - Input	-200.31	-0.41	0.20
Channel Z + Input	2000.3	0.27	0.01
Channel Z + Input	199.81	-0.39	-0.19
Channel Z - Input	-201.59	-1.59	0.79

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	-5.47	-7.14
	-200	6.77	4.93
Channel Y	200	-10.85	-10.79
	-200	9.83	9.73
Channel Z	200	-6.38	-6.60
	-200	5.09	5.04

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	-	3.28	0.14
Channel Y	200	3.20	-	5.04
Channel Z	200	3.47	-0.96	-

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	15475	15808
Channel Y	15881	15535
Channel Z	16738	15888

5. Input Offset Measurement

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

Input 10M Ω

	Average (μ V)	min. Offset (μ V)	max. Offset (μ V)	Std. Deviation (μ V)
Channel X	-0.03	-1.09	1.17	0.53
Channel Y	-0.73	-2.54	0.39	0.59
Channel Z	-0.96	-2.29	0.58	0.62

6. Input Offset Current

Nominal Input circuitry offset current on all channels: <251A

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



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Accreditation No.: **SCS 108**

Client **Huawei (Auden)**

Certificate No: **CD1880V3-1100_Nov11**

CALIBRATION CERTIFICATE

Object **CD1880V3 - SN: 1100**

Calibration procedure(s) **QA CAL-20.v5
Calibration procedure for dipoles in air**

Calibration date: **November 15, 2011**

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 EPM-442A	GB37480704	05-Oct-11 (No. 217-01451)	Oct-12
Power sensor HP 8481A	US37292783	05-Oct-11 (No. 217-01451)	Oct-12
Probe ER3DV6	SN: 2336	29-Dec-10 (No. ER3-2336_Dec10)	Dec-11
Probe H3DV6	SN: 6065	29-Dec-10 (No. H3-6065_Dec10)	Dec-11
DAE4	SN: 781	20-Apr-11 (No. DAE4-781_Apr11)	Apr-12
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power meter Agilent 4419B	SN: GB42420191	09-Oct-09 (in house check Oct-11)	In house check: Oct-12
Power sensor HP 8482H	SN: 3318A09450	09-Oct-09 (in house check Oct-11)	In house check: Oct-12
Power sensor HP 8482A	SN: US37295597	09-Oct-09 (in house check Oct-11)	In house check: Oct-12
Network Analyzer HP 8753E	US37390585	18-Oct-01 (in house check Oct-11)	In house check: Oct-12
RF generator E4433B	MY 41000675	03-Nov-04 (in house check Oct-11)	In house check: Oct-13

Calibrated by: **Name** Claudio Leubler **Function** Laboratory Technician

Signature

Approved by: **Name** Fin Bornholt **Function** R&D Director

Signature

Issued: November 16, 2011

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References

- [1] ANSI-C63.19-2007
American National Standard for Methods of Measurement of Compatibility between Wireless Communications
Devices and Hearing Aids.

Methods Applied and Interpretation of Parameters:

- *Coordinate System:* y-axis is in the direction of the dipole arms, z-axis is from the basis of the antenna (mounted on the table) towards its feed point between the two dipole arms. x-axis is normal to the other axes. In coincidence with the standards [1], the measurement planes (probe sensor center) are selected to be at a distance of 10 mm above the top edge of the dipole arms.
- *Measurement Conditions:* Further details are available from the hardcopies at the end of the certificate. All figures stated in the certificate are valid at the frequency indicated. The forward power to the dipole connector is set with a calibrated power meter connected and monitored with an auxiliary power meter connected to a directional coupler. While the dipole under test is connected, the forward power is adjusted to the same level.
- *Antenna Positioning:* The dipole is mounted on a HAC Test Arch phantom using the matching dipole positioner with the arms horizontal and the feeding cable coming from the floor. The measurements are performed in a shielded room with absorbers around the setup to reduce the reflections. It is verified before the mounting of the dipole under the Test Arch phantom, that its arms are perfectly in a line. It is installed on the HAC dipole positioner with its arms parallel below the dielectric reference wire and able to move elastically in vertical direction without changing its relative position to the top center of the Test Arch phantom. The vertical distance to the probe is adjusted after dipole mounting with a DASY5 Surface Check job. Before the measurement, the distance between phantom surface and probe tip is verified. The proper measurement distance is selected by choosing the matching section of the HAC Test Arch phantom with the proper device reference point (upper surface of the dipole) and the matching grid reference point (tip of the probe) considering the probe sensor offset. The vertical distance to the probe is essential for the accuracy.
- *Feed Point Impedance and Return Loss:* These parameters are measured using a HP 8753E Vector Network Analyzer. The impedance is specified at the SMA connector of the dipole. The influence of reflections was eliminated by applying the averaging function while moving the dipole in the air, at least 70cm away from any obstacles.
- *E-field distribution:* E field is measured in the x-y-plane with an isotropic ER3D-field probe with 100 mW forward power to the antenna feed point. In accordance with [1], the scan area is 20mm wide, its length exceeds the dipole arm length (180 or 90mm). The sensor center is 10 mm (in z) above the top of the dipole arms. Two 3D maxima are available near the end of the dipole arms. Assuming the dipole arms are perfectly in one line, the average of these two maxima (in subgrid 2 and subgrid 8) is determined to compensate for any non-parallelity to the measurement plane as well as the sensor displacement. The E-field value stated as calibration value represents the maximum of the interpolated 3D-E-field, 10mm above the dipole surface.
- *H-field distribution:* H-field is measured with an isotropic H-field probe with 100mW forward power to the antenna feed point, in the x-y-plane. The scan area and sensor distance is equivalent to the E-field scan. The maximum of the field is available at the center (subgrid 5) above the feed point. The H-field value stated as calibration value represents the maximum of the interpolated H-field, 10mm above the dipole surface at the feed point.

Measurement Conditions

DASY system configuration, as far as not given on page 1.

DASY Version	DASY5	V52.6.2
Extrapolation	Advanced Extrapolation	
Phantom	HAC Test Arch	
Distance Dipole Top - Probe Center	10 mm	
Scan resolution	dx, dy = 5 mm	
Frequency	1880 MHz \pm 1 MHz	
Input power drift	< 0.05 dB	

Maximum Field values

H-field 10 mm above dipole surface	condition	interpolated maximum
Maximum measured	100 mW input power	0.466 A / m \pm 8.2 % (k=2)

E-field 10 mm above dipole surface	condition	Interpolated maximum
Maximum measured above high end	100 mW input power	135.1 V / m
Maximum measured above low end	100 mW input power	134.6 V / m
Averaged maximum above arm	100 mW input power	134.9 V / m \pm 12.8 % (k=2)

Appendix

Antenna Parameters with Head TSL

Frequency	Return Loss	Impedance
1730 MHz	26.3 dB	49.9 Ω + 4.9 j Ω
1880 MHz	19.8 dB	48.8 Ω + 10.1 j Ω
1900 MHz	20.3 dB	52.1 Ω + 9.7 j Ω
1950 MHz	26.2 dB	54.8 Ω + 2.0 j Ω
2000 MHz	22.2 dB	42.8 Ω + 0.8 j Ω

Antenna Design and Handling

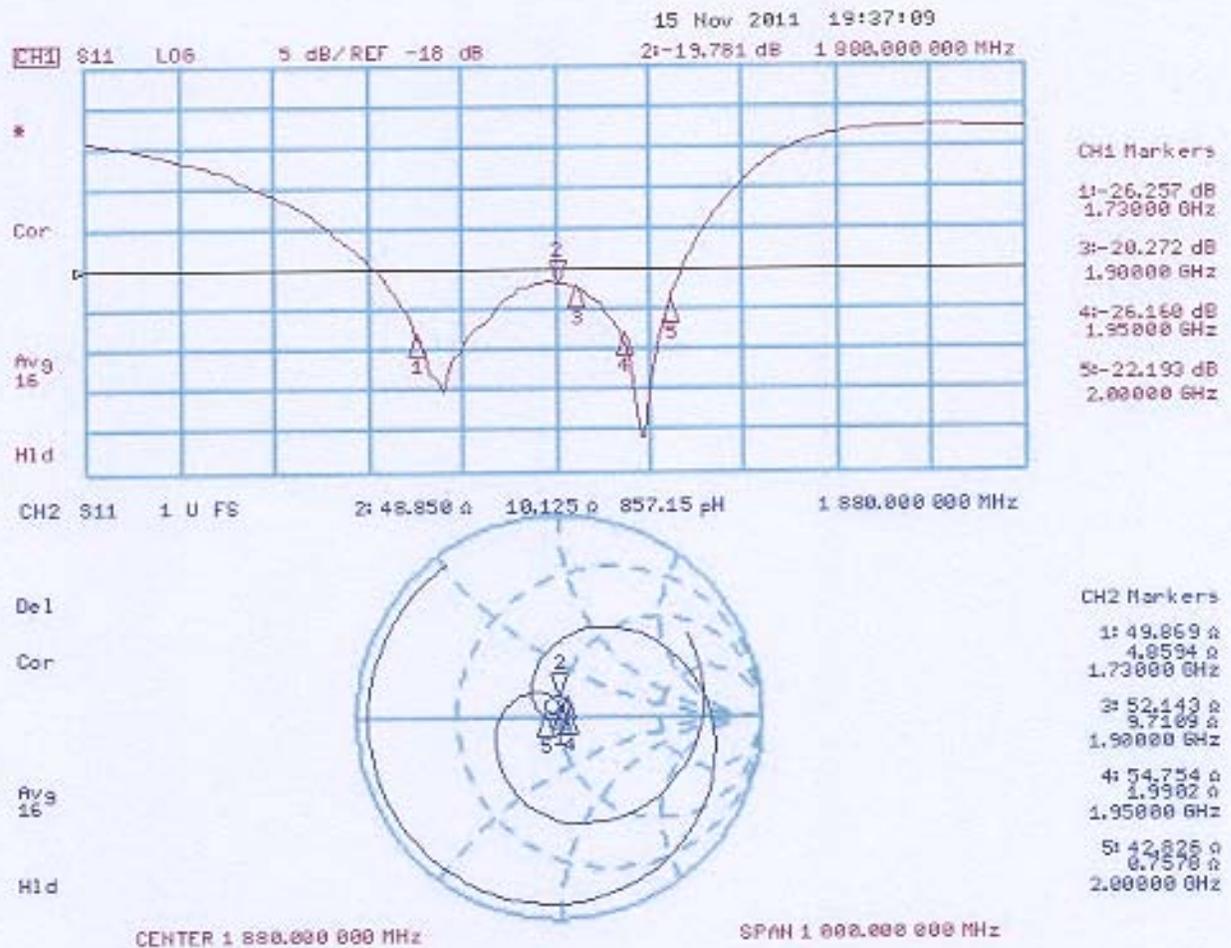
The calibration dipole has a symmetric geometry with a built-in two stub matching network, which leads to the enhanced bandwidth.

The dipole is built of standard semirigid coaxial cable. The internal matching line is open ended. The antenna is therefore open for DC signals.

Do not apply force to dipole arms, as they are liable to bend. The soldered connections near the feedpoint may be damaged. After excessive mechanical stress or overheating, check the impedance characteristics to ensure that the internal matching network is not affected.

After long term use with 40W radiated power, only a slight warming of the dipole near the feedpoint can be measured.

Impedance Measurement Plot



DASY4 H-field Result

Date/Time: 15.11.2011 11:19:58

Test Laboratory: SPEAG Lab2

DUT: HAC Dipole 1880 MHz; Type: CD1880V3; Serial: CD1880V3 - SN: 1100

Communication System: CW; Frequency: 1880 MHz

Medium parameters used: $\sigma = 0$ mho/m, $\epsilon_r = 1$; $\rho = 1$ kg/m³

Phantom section: RF Section

Measurement Standard: DASY5 (IEEE/TEC/ANSI C63.19-2007)

DASY Configuration:

- Probe: H3DV6 - SN6065; ; Calibrated: 29.12.2010
- Sensor-Surface: (Fix Surface)
- Electronics: DAE4 Sn781; Calibrated: 20.04.2011
- Phantom: HAC Test Arch with AMCC; Type: SD HAC P01 BA; Serial: 1070
- DASY52 52.6.2(482); SEMCAD X 14.4.5(3634)

Dipole H-Field measurement @ 1880MHz/H-Scan - 1880MHz d=10mm/Hearing Aid Compatibility Test (41x181x1):

Measurement grid: dx=5mm, dy=5mm

Maximum value of peak Total field = 0.466 A/m

Probe Modulation Factor = 1.000

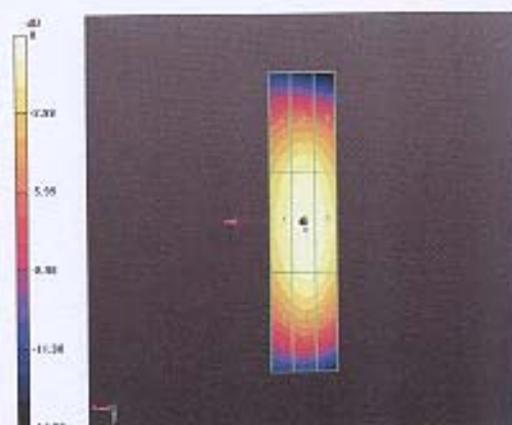
Device Reference Point: 0, 0, -6.3 mm

Reference Value = 0.492 A/m; Power Drift = 0.01 dB

Hearing Aid Near-Field Category: M2 (AWF 0 dB)

Peak H-field in A/m

Grid 1 0.393 M2	Grid 2 0.419 M2	Grid 3 0.406 M2
Grid 4 0.435 M2	Grid 5 0.466 M2	Grid 6 0.453 M2
Grid 7 0.400 M2	Grid 8 0.434 M2	Grid 9 0.421 M2



0 dB = 0.470 A/m

DASY4 E-field Result

Date/Time: 15.11.2011 15:24:27

Test Laboratory: SPEAG Lab2

DUT: HAC Dipole 1880 MHz; Type: CD1880V3; Serial: CD1880V3 - SN: 1100

Communication System: CW; Frequency: 1880 MHz

Medium parameters used: $\sigma = 0$ mho/m, $\epsilon_r = 1$; $\rho = 1000$ kg/m³

Phantom section: RF Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY Configuration:

- Probe: ER3DV6 - SN2336; ConvF(1, 1, 1); Calibrated: 29.12.2010
- Sensor-Surface: (Fix Surface)
- Electronics: DAE4 Sn781; Calibrated: 20.04.2011
- Phantom: HAC Test Arch with AMCC; Type: SD HAC P01 BA; Serial: 1070
- DASY52 52.6.2(482); SEMCAD X 14.4.5(3634)

Dipole E-Field measurement @ 1880MHz/E-Scan - 1880MHz d=10mm/Hearing Aid Compatibility Test (41x181x1):

Measurement grid: dx=5mm, dy=5mm

Maximum value of peak Total field = 135.1 V/m

Probe Modulation Factor = 1.000

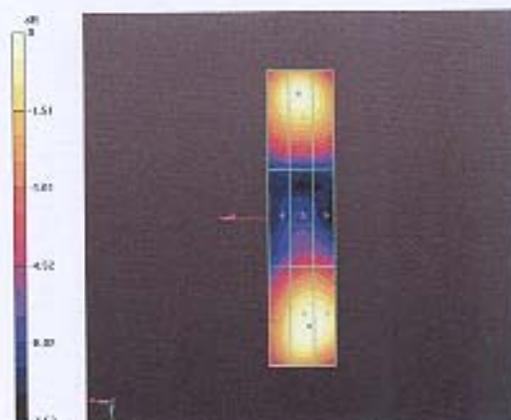
Device Reference Point: 0, 0, -6.3 mm

Reference Value = 141.2 V/m; Power Drift = -0.0019 dB

Hearing Aid Near-Field Category: M2 (AWF 0 dB)

Peak E-field in V/m

Grid 1 130.7 M2	Grid 2 134.6 M2	Grid 3 128.7 M2
Grid 4 81.183 M3	Grid 5 89.304 M3	Grid 6 89.231 M3
Grid 7 124.0 M2	Grid 8 135.1 M2	Grid 9 134.5 M2



0 dB = 135.1 V/m



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Accreditation No.: **SCS 108**

Client **Huawei (Auden)**

Certificate No: **CD835V3-1114_Nov11**

CALIBRATION CERTIFICATE

Object **CD835V3 - SN: 1114**

Calibration procedure(s) **QA CAL-20.v5
Calibration procedure for dipoles in air**

Calibration date: **November 15, 2011**

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DAE4	SN: 781	20-Apr-11 (No. DAE4-781_Apr11)	Apr-12
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
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Power sensor HP 8482H	SN: 3318A09450	09-Oct-09 (in house check Oct-11)	In house check: Oct-12
Power sensor HP 8482A	SN: US37295597	09-Oct-09 (in house check Oct-11)	In house check: Oct-12
Network Analyzer HP 8753E	US37390585	18-Oct-01 (in house check Oct-11)	In house check: Oct-12
RF generator E4433B	MY 41000675	03-Nov-04 (in house check Oct-11)	In house check: Oct-13

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Approved by:	Name Fin Bornholt	Function R&D Director	Signature

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DASY system configuration, as far as not given on page 1.

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Extrapolation	Advanced Extrapolation	
Phantom	HAC Test Arch	
Distance Dipole Top - Probe Center	10 mm	
Scan resolution	dx, dy = 5 mm	
Frequency	835 MHz \pm 1 MHz	
Input power drift	< 0.05 dB	

Maximum Field values

H-field 10 mm above dipole surface	condition	interpolated maximum
Maximum measured	100 mW input power	0.465 A / m \pm 8.2 % (k=2)

E-field 10 mm above dipole surface	condition	interpolated maximum
Maximum measured above high end	100 mW input power	169.6 V / m
Maximum measured above low end	100 mW input power	166.1 V / m
Averaged maximum above arm	100 mW input power	167.9 V / m \pm 12.8 % (k=2)

Appendix

Antenna Parameters with Head TSL

Frequency	Return Loss	Impedance
800 MHz	15.3 dB	42.3 Ω - 14.1 j Ω
835 MHz	24.4 dB	50.9 Ω + 6.0 j Ω
900 MHz	15.9 dB	56.8 Ω - 16.0 j Ω
950 MHz	20.2 dB	41.6 Ω + 3.2 j Ω
960 MHz	18.3 dB	46.0 Ω + 11.1 j Ω

Antenna Design and Handling

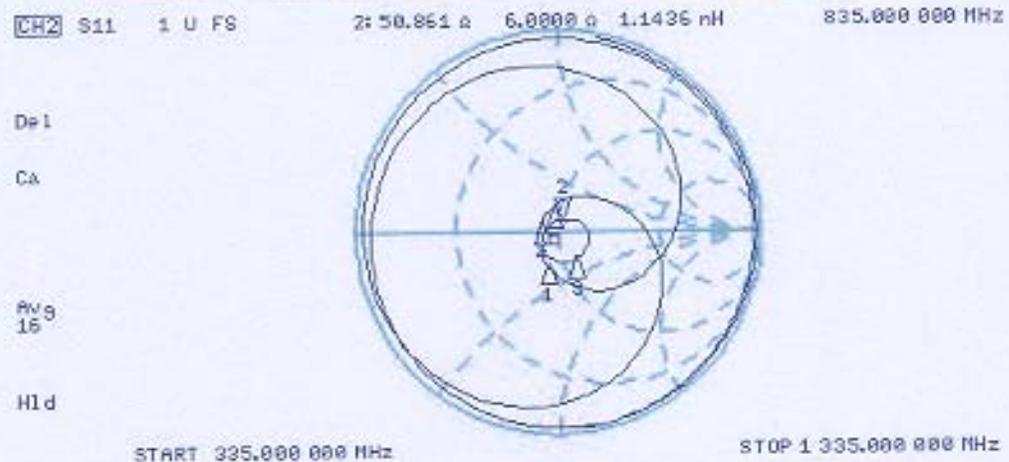
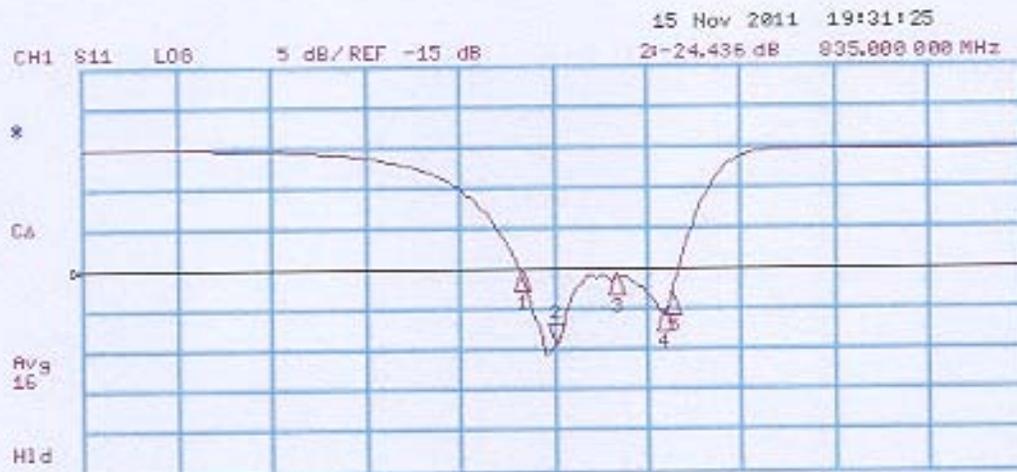
The calibration dipole has a symmetric geometry with a built-in two stub matching network, which leads to the enhanced bandwidth.

The dipole is built of standard semirigid coaxial cable. The internal matching line is open ended. The antenna is therefore open for DC signals.

Do not apply force to dipole arms, as they are liable to bend. The soldered connections near the feedpoint may be damaged. After excessive mechanical stress or overheating, check the impedance characteristics to ensure that the internal matching network is not affected.

After long term use with 40W radiated power, only a slight warming of the dipole near the feedpoint can be measured.

Impedance Measurement Plot



DASY4 H-field Result

Date/Time: 15.11.2011 09:53:10

Test Laboratory: SPEAG Lab2

DUT: HAC-Dipole 835 MHz; Type: CD835V3; Serial: CD835V3 - SN: 1114

Communication System: CW; Frequency: 835 MHz
Medium parameters used: $\sigma = 0$ mho/m, $\epsilon_r = 1$; $\rho = 1$ kg/m³
Phantom section: RF Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY Configuration:

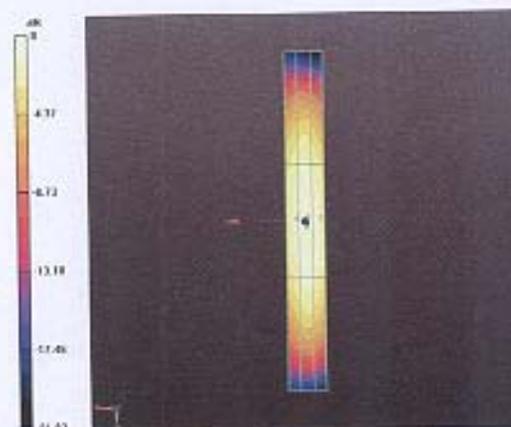
- Probe: H3DV6 - SN6065; ; Calibrated: 29.12.2010
- Sensor-Surface: (Fix Surface)
- Electronics: DAE4 Sn781; Calibrated: 20.04.2011
- Phantom: HAC Test Arch with AMCC; Type: SD HAC P01 BA; Serial: 1070
- DASY52 52.6.2(482); SEMCAD X 14.4.5(3634)

Dipole H-Field measurement @ 835MHz/H-Scan - 835MHz d=10mm/Hearing Aid Compatibility Test (41x361x1):

Measurement grid: dx=5mm, dy=5mm
Maximum value of peak Total field = 0.465 A/m
Probe Modulation Factor = 1.000
Device Reference Point: 0, 0, -6.3 mm
Reference Value = 0.492 A/m; Power Drift = 0.01 dB
Hearing Aid Near-Field Category: M4 (AWF 0 dB)

Peak H-field in A/m

Grid 1 0.381 M4	Grid 2 0.406 M4	Grid 3 0.388 M4
Grid 4 0.430 M4	Grid 5 0.465 M4	Grid 6 0.449 M4
Grid 7 0.386 M4	Grid 8 0.419 M4	Grid 9 0.403 M4



0 dB = 0.460 A/m

DASY4 E-field Result

Date/Time: 15.11.2011 16:45:34

Test Laboratory: SPEAG Lab2

DUT: HAC-Dipole 835 MHz; Type: CD835V3; Serial: CD835V3 - SN: 1114

Communication System: CW; Frequency: 835 MHz

Medium parameters used: $\sigma = 0$ mho/m, $\epsilon_r = 1$; $\rho = 1000$ kg/m³

Phantom section: RF Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY Configuration:

- Probe: ER3DV6 - SN2336; ConvF(1, 1, 1); Calibrated: 29.12.2010
- Sensor-Surface: (Fix Surface)
- Electronics: DAE4 Sn781; Calibrated: 20.04.2011
- Phantom: HAC Test Arch with AMCC; Type: SD HAC P01 BA; Serial: 1070
- DASY52 52.6.2(482); SEMCAD X 14.4.5(3634)

Dipole E-Field measurement @ 835MHz/E-Scan - 835MHz d=10mm/Hearing Aid Compatibility Test (41x361x1):

Measurement grid: dx=5mm, dy=5mm

Maximum value of peak Total field = 169.6 V/m

Probe Modulation Factor = 1.000

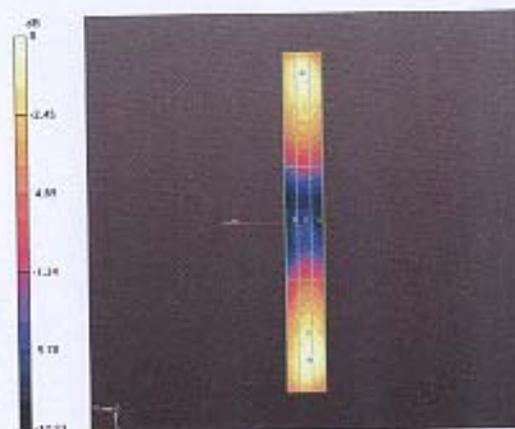
Device Reference Point: 0, 0, -6.3 mm

Reference Value = 123.0 V/m; Power Drift = 0.02 dB

Hearing Aid Near-Field Category: M4 (AWF 0 dB)

Peak E-field in V/m

Grid 1 162.7 M4	Grid 2 169.6 M4	Grid 3 163.7 M4
Grid 4 83.294 M4	Grid 5 89.694 M4	Grid 6 88.927 M4
Grid 7 154.3 M4	Grid 8 166.1 M4	Grid 9 164.3 M4



0 dB = 169.6V/m



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Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 108**

Client **Huawei (Auden)**

Certificate No: **ER3-2441_Nov11**

CALIBRATION CERTIFICATE

Object: **ER3DV6 - SN:2441**

Calibration procedure(s): **QA CAL-02.v6, QA CAL-25.v4**
Calibration procedure for E-field probes optimized for close near field evaluations in air

Calibration date: **November 11, 2011**

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 $(22 \pm 3)^\circ\text{C}$ and humidity $< 70\%$.

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID	Cal Date (Certificate No.)	Scheduled Calibration
Power meter E4419B	GB41293874	31-Mar-11 (No. 217-01372)	Apr-12
Power sensor E4412A	MY41498087	31-Mar-11 (No. 217-01372)	Apr-12
Reference 3 dB Attenuator	SN: S5054 (3c)	29-Mar-11 (No. 217-01369)	Apr-12
Reference 20 dB Attenuator	SN: S5086 (20b)	29-Mar-11 (No. 217-01367)	Apr-12
Reference 30 dB Attenuator	SN: S5129 (30b)	29-Mar-11 (No. 217-01370)	Apr-12
Reference Probe ER3DV6	SN: 2328	11-Oct-11 (No. ER3-2328_Oct11)	Oct-12
DAE4	SN: 789	6-Apr-11 (No. DAE4-789_Apr11)	Apr-12
Secondary Standards	ID	Check Date (in house)	Scheduled Check
RF generator HP 8648C	US3642U01700	4-Aug-99 (in house check Apr-11)	In house check: Apr-13
Network Analyzer HP 8753E	US37390585	18-Oct-01 (in house check Oct-11)	In house check: Oct-12

	Name	Function	Signature
Calibrated by:	Claudio Leubler	Laboratory Technician	
Approved by:	Katja Pokovic	Technical Manager	

Issued: November 14, 2011

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Accreditation No.: SCS 108

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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	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., $\theta = 0$ 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.

Methods Applied and Interpretation of Parameters:

- NORM_{x,y,z}**: Assessed for E-field polarization $\theta = 0$ for XY sensors and $\theta = 90$ 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}; VR_{x,y,z}**: A, B, C 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).

Probe ER3DV6

SN:2441

Manufactured: November 27, 2007
Calibrated: November 11, 2011

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

DASY/EASY - Parameters of Probe: ER3DV6 - SN:2441

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm ($\mu\text{V}/(\text{V}/\text{m})^2$)	1.38	1.57	1.77	$\pm 10.1\%$
DCP (mV) ^b	91.1	97.1	99.0	

Modulation Calibration Parameters

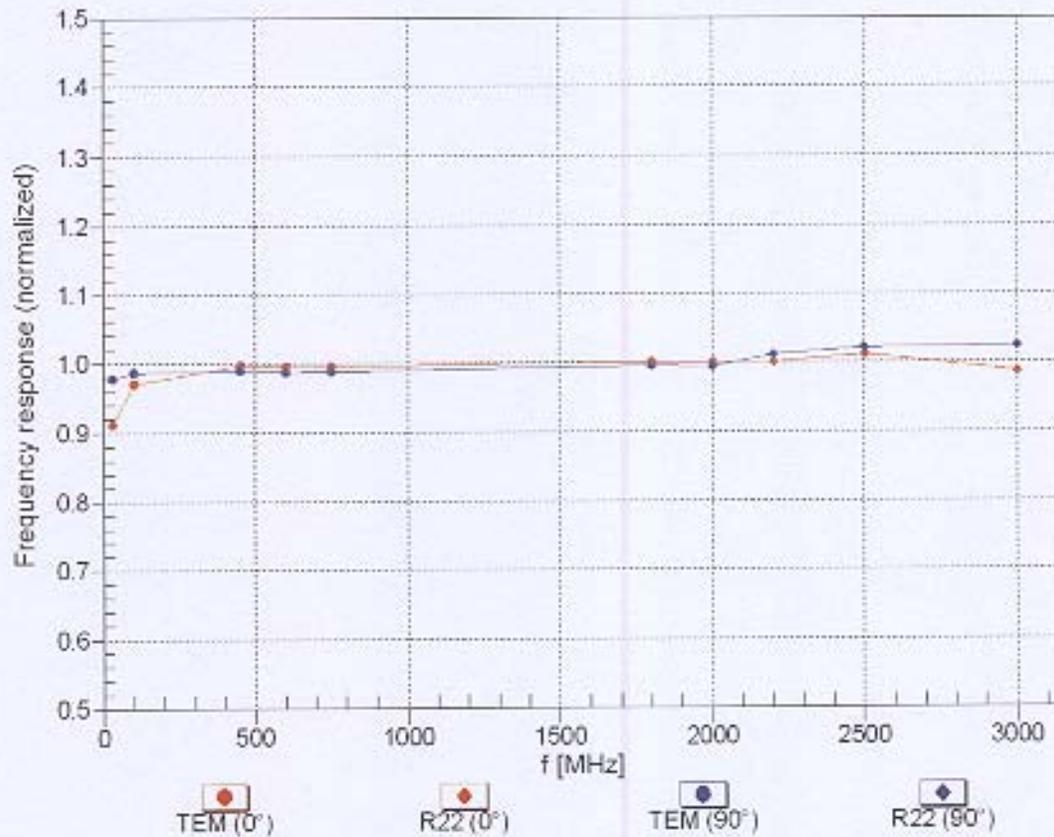
UID	Communication System Name	PAR		A dB	B dB	C dB	VR mV	Unc ^c (k=2)
10000	CW	0.00	X	0.00	0.00	1.00	130.0	$\pm 2.7\%$
			Y	0.00	0.00	1.00	114.9	
			Z	0.00	0.00	1.00	145.3	

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%.

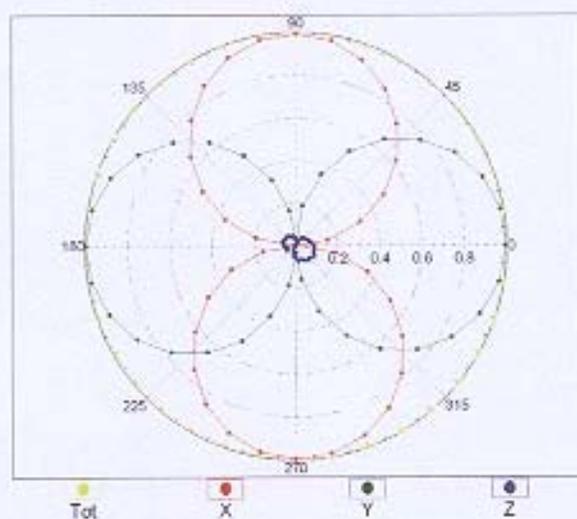
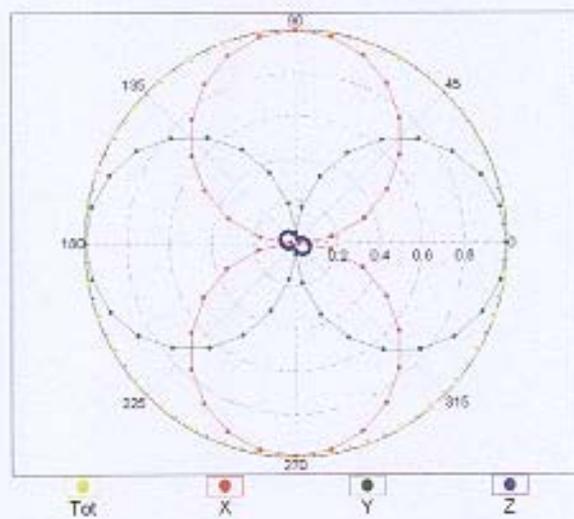
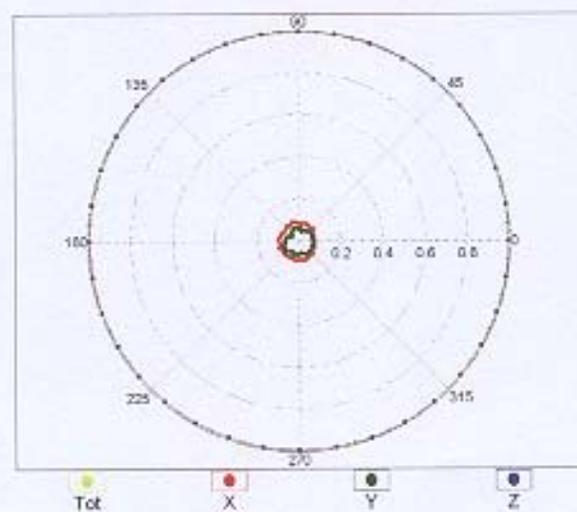
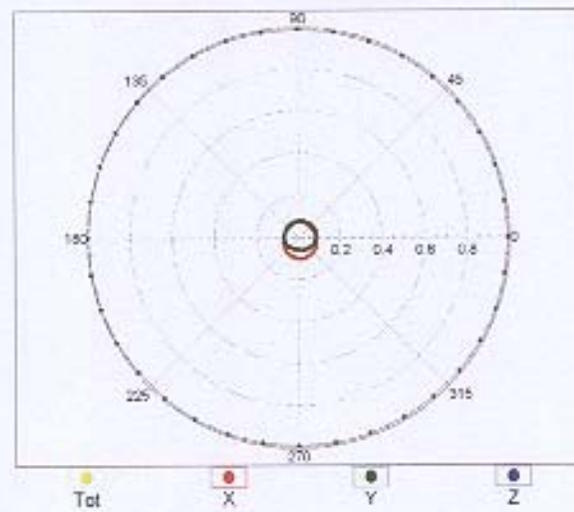
^a Numerical linearization parameter; uncertainty not required.

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

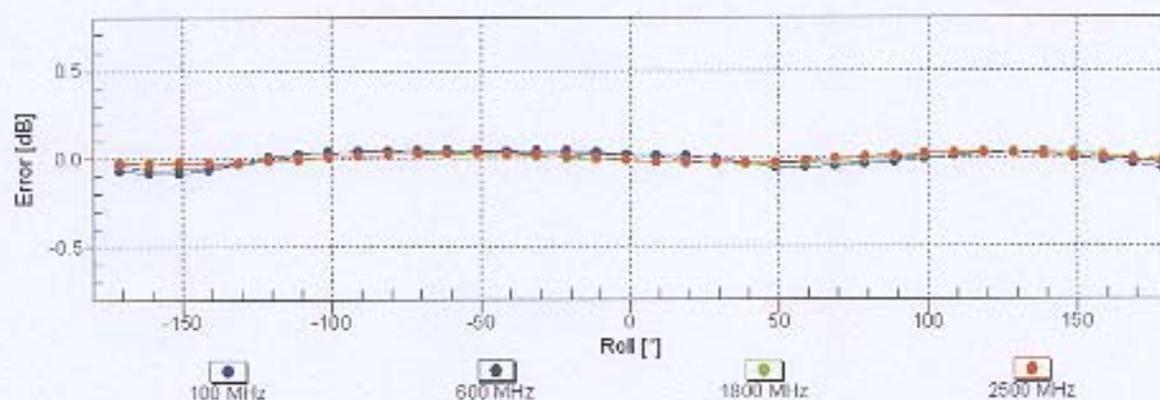
Frequency Response of E-Field (TEM-Cell: ifi110 EXX, Waveguide: R22)



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

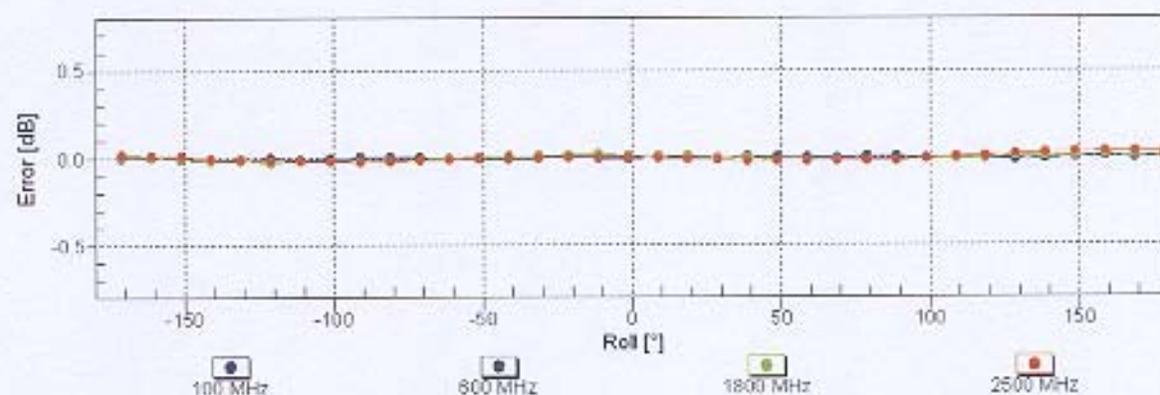
Receiving Pattern (ϕ), $\vartheta = 0^\circ$ f=600 MHz, TEM, 0° f=2500 MHz, R22, 0° **Receiving Pattern (ϕ), $\vartheta = 90^\circ$** f=600 MHz, TEM, 90° f=2500 MHz, R22, 90° 

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



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

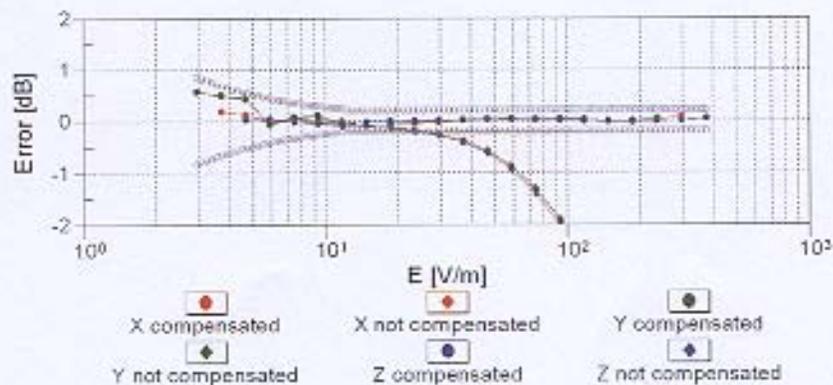
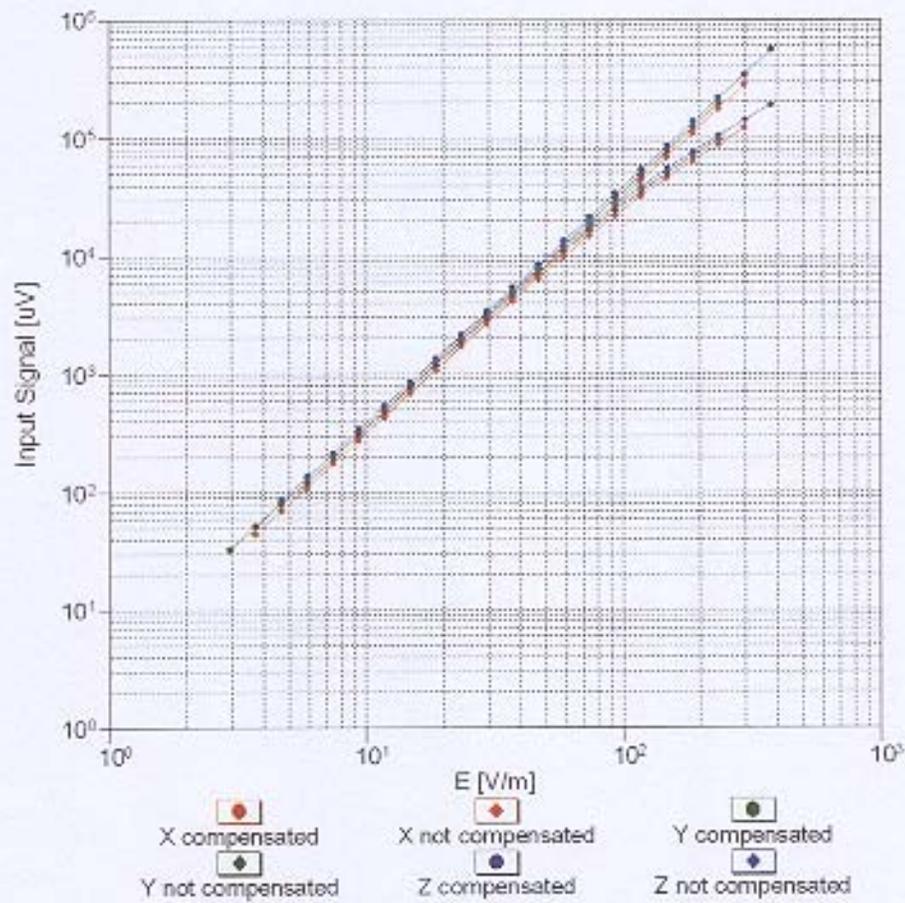
Receiving Pattern (ϕ), $\vartheta = 90^\circ$



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

Dynamic Range f(E-field)

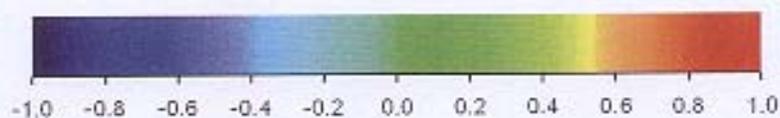
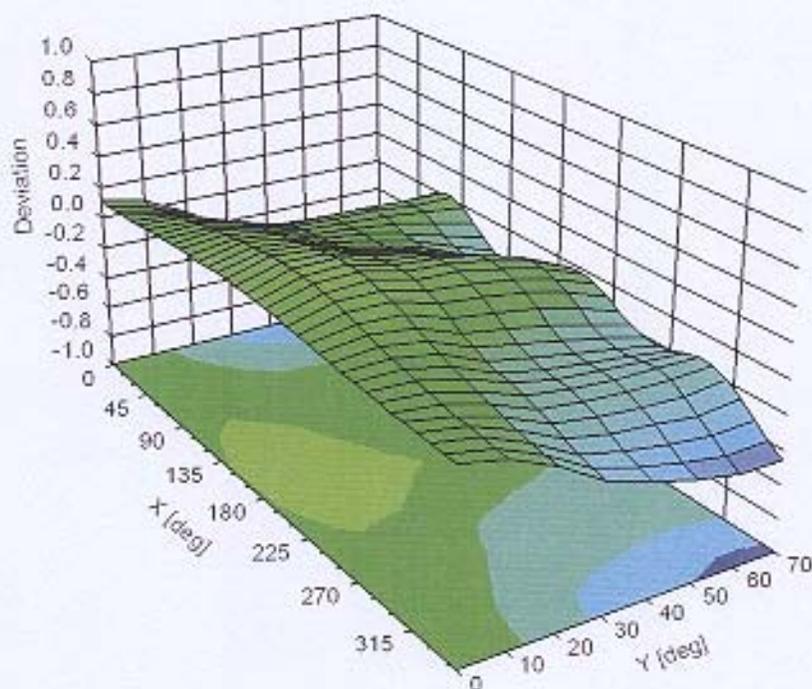
(TEM cell, $f = 900$ MHz)



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: $\pm 2.6\%$ ($k=2$)

DASY/EASY - Parameters of Probe: ER3DV6 - SN:2441**Other Probe Parameters**

Sensor Arrangement	Rectangular
Connector Angle (°)	-21.3
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



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Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: SCS 108

Client **Huawei (Auden)**

Certificate No: H3-6270 Nov11

CALIBRATION CERTIFICATE

Object **H3DV6 - SN:6270**

Calibration procedure(s) **QA CAL-03.v6, QA CAL-25.v4
Calibration procedure for H-field probes optimized for close near field
evaluations in air**

Calibration date: **November 21, 2011**

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	31-Mar-11 (No. 217-01372)	Apr-12
Power sensor E4412A	MY41498087	31-Mar-11 (No. 217-01372)	Apr-12
Reference 3 dB Attenuator	SN: S5054 (3c)	29-Mar-11 (No. 217-01369)	Apr-12
Reference 20 dB Attenuator	SN: S5086 (20b)	29-Mar-11 (No. 217-01367)	Apr-12
Reference 30 dB Attenuator	SN: S5129 (30b)	29-Mar-11 (No. 217-01370)	Apr-12
Reference Probe H3DV6	SN: 6162	11-Oct-11 (No. H3-6162_Oct11)	Oct-12
DAE4	SN: 789	6-Apr-11 (No. DAE4-789_Apr11)	Apr-12
Secondary Standards	ID	Check Date (in house)	Scheduled Check
RF generator HP 8648C	US3642U01700	4-Aug-99 (in house check Apr-11)	In house check: Apr-13
Network Analyzer HP 8753E	US37390585	18-Oct-01 (in house check Oct-11)	In house check: Oct-12

	Name	Function	Signature
Calibrated by:	Jeton Kastrati	Laboratory Technician	
Approved by:	Katja Pokovic	Technical Manager	
			Issued: November 21, 2011

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Accreditation No.: SCS 108

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	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:

- 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).
- X,Y,Z(f)*: $X, Y, Z = X, Y, Z_{\text{ref}} \cdot \text{frequency_response}$ (see Frequency Response Chart).
- DCP_{x,y,z}*: DCP are numerical linearization parameters assessed based on the data of power sweep 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}; VR_{x,y,z}*: A, B, C 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 *X_{ref}* (no uncertainty required).

Probe H3DV6

SN:6270

Manufactured: November 30, 2007
Calibrated: November 21, 2011

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

DASY/EASY - Parameters of Probe: H3DV6 - SN:6270

Basic Calibration Parameters

		Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm (A/m / $\sqrt{\text{mV}}$)	a0	2.50E-003	2.60E-003	2.99E-003	$\pm 5.1 \%$
Norm (A/m / $\sqrt{\text{mV}}$)	a1	-9.81E-005	-1.17E-004	-1.88E-004	$\pm 5.1 \%$
Norm (A/m / $\sqrt{\text{mV}}$)	a2	3.74E-006	3.30E-006	1.82E-005	$\pm 5.1 \%$
DCP (mV) ^a		92.7	88.3	95.6	

Modulation Calibration Parameters

UID	Communication System Name	PAR		A dB	B dB	C dB	VR mV	Unc ^c (k=2)
10000	CW	0.00	X	0.00	0.00	1.00	105.6	$\pm 3.0 \%$
			Y	0.00	0.00	1.00	100.7	
			Z	0.00	0.00	1.00	97.8	

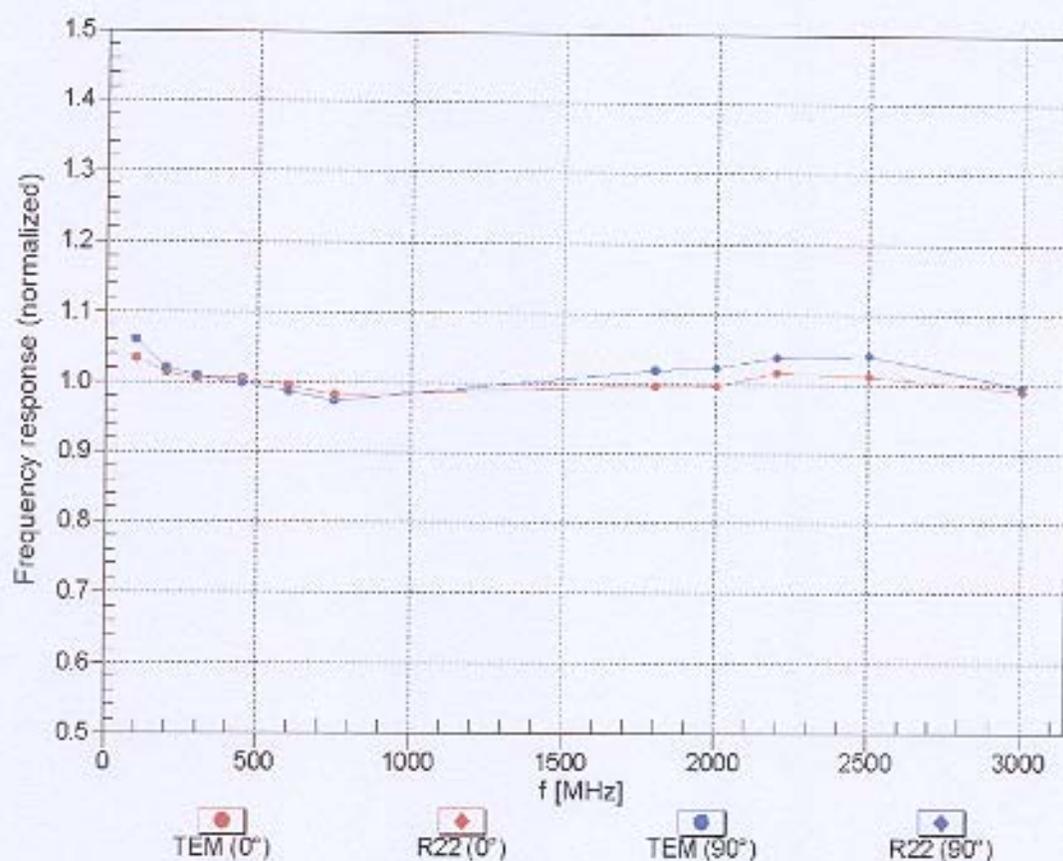
The reported uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor $k=2$, which for a normal distribution corresponds to a coverage probability of approximately 95%.

^a Numerical linearization parameter: uncertainty not required.

^c 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 H-Field

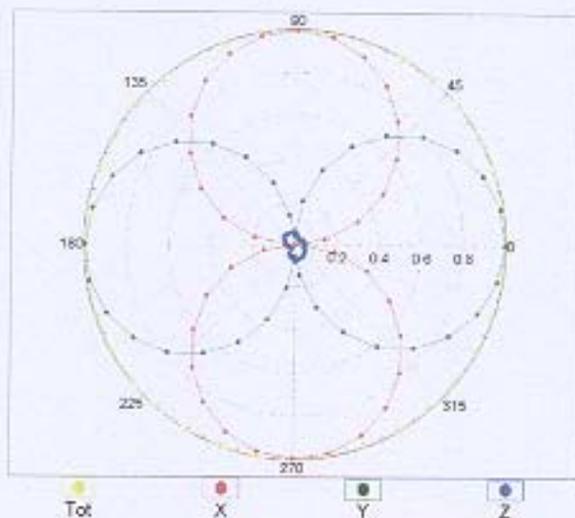
(TEM-Cell:ifi110 EXX, Waveguide: R22)



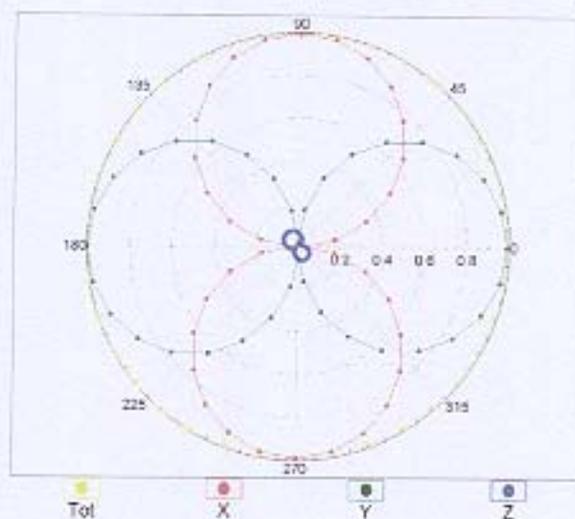
Uncertainty of Frequency Response of H-field: $\pm 6.3\%$ (k=2)

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

f=600 MHz, TEM, 0°

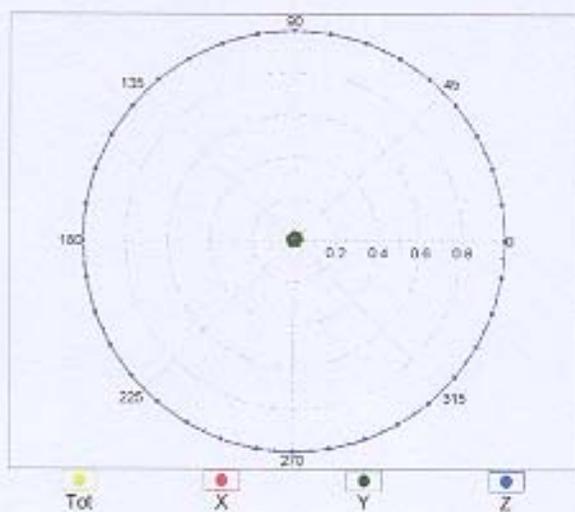


f=2500 MHz, R22, 0°

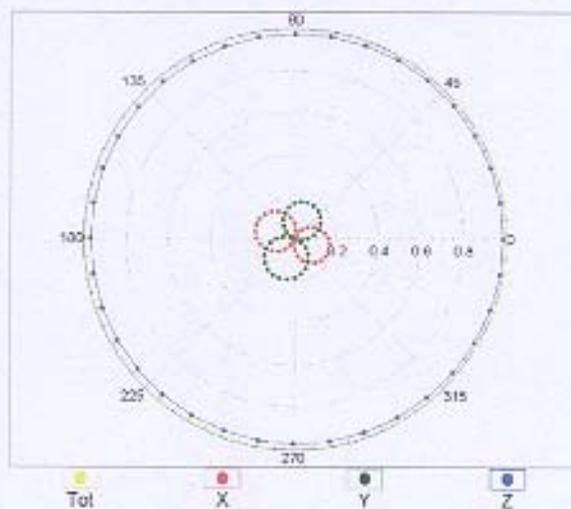


Receiving Pattern (ϕ), $\vartheta = 90^\circ$

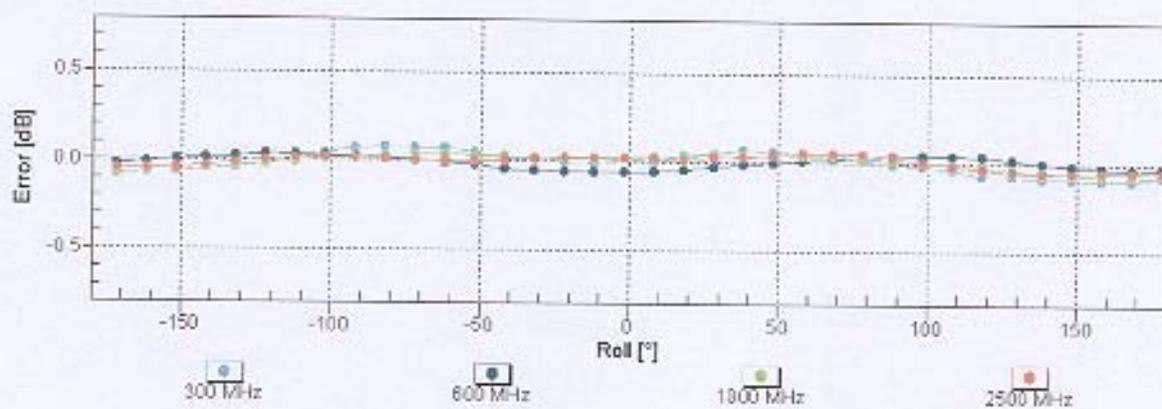
f=600 MHz, TEM, 90°



f=2500 MHz, R22, 90°

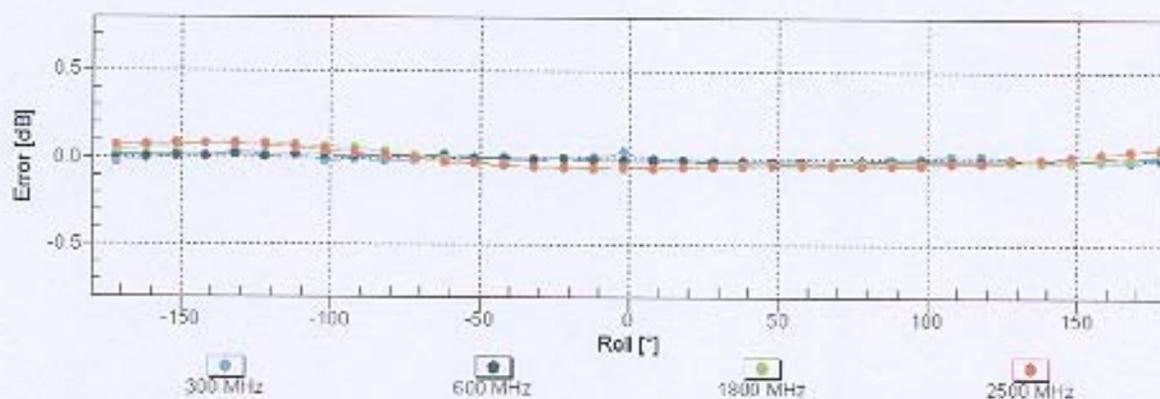


Receiving Pattern (ϕ), $\vartheta = 0^\circ$



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

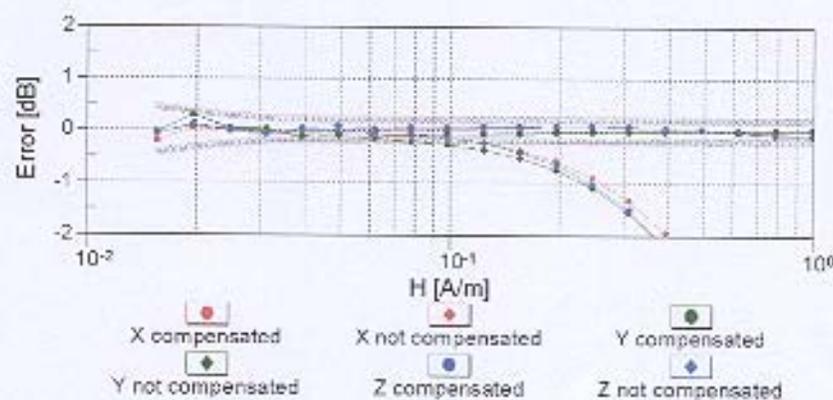
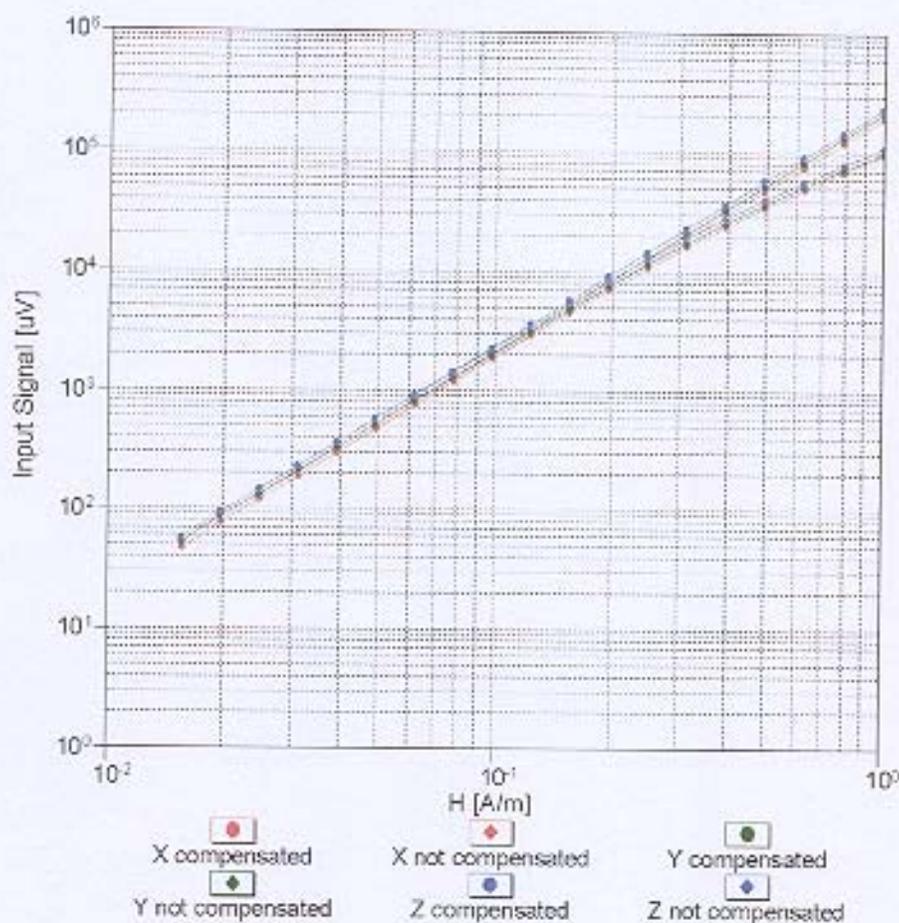
Receiving Pattern (ϕ), $\vartheta = 90^\circ$



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

Dynamic Range f(H-field)

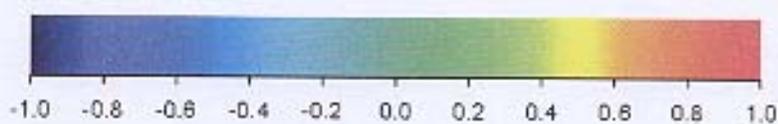
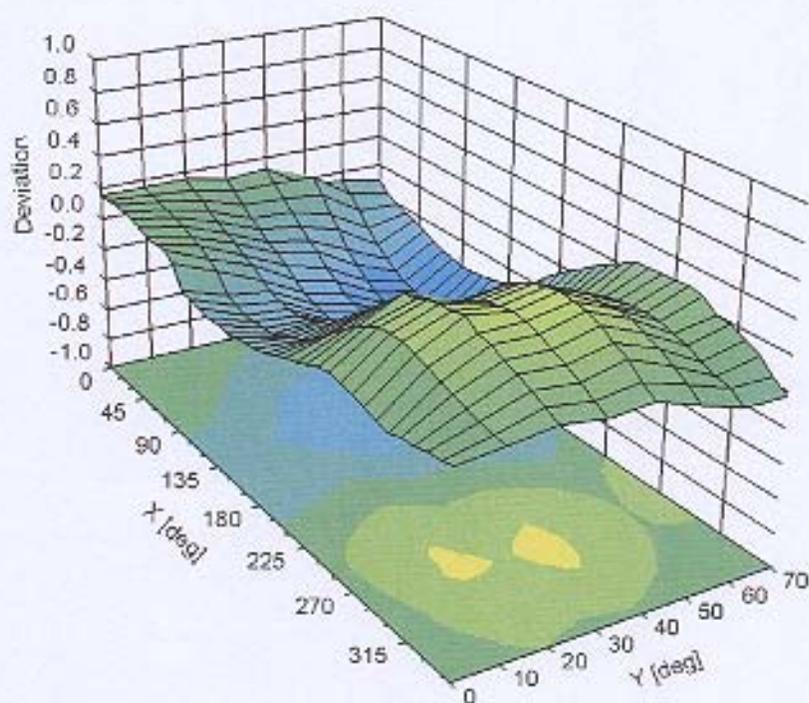
(TEM cell, f = 900 MHz)



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: $\pm 2.6\%$ ($k=2$)

DASY/EASY - Parameters of Probe: H3DV6 - SN:6270**Other Probe Parameters**

Sensor Arrangement	Rectangular
Connector Angle (°)	-152
Mechanical Surface Detection Mode	enabled
Optical Surface Detection Mode	disabled
Probe Overall Length	337 mm
Probe Body Diameter	10 mm
Tip Length	20 mm
Tip Diameter	6 mm
Probe Tip to Sensor X Calibration Point	3 mm
Probe Tip to Sensor Y Calibration Point	3 mm
Probe Tip to Sensor Z Calibration Point	3 mm