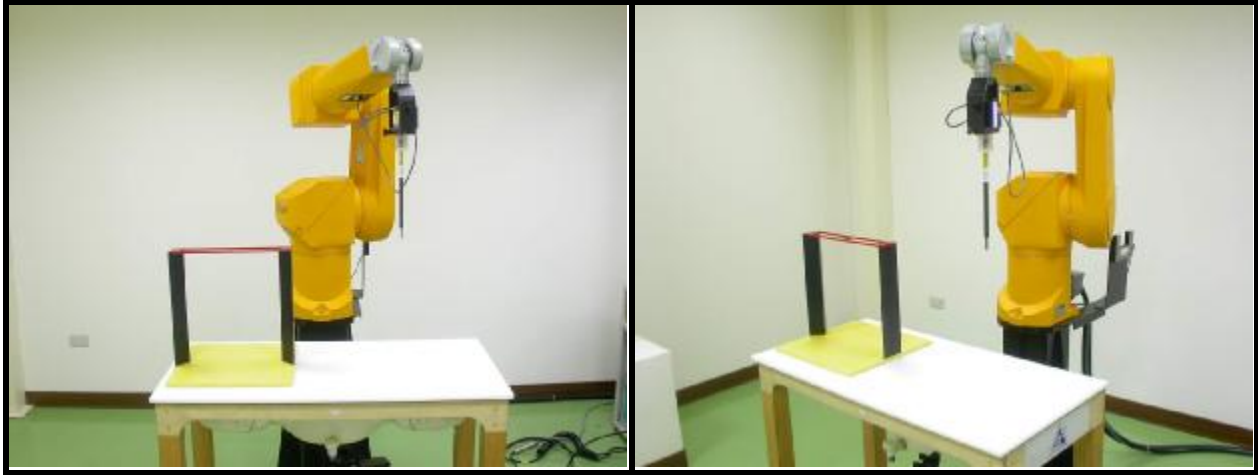


APPENDIX B: ADT SAR MEASUREMENT SYSTEM

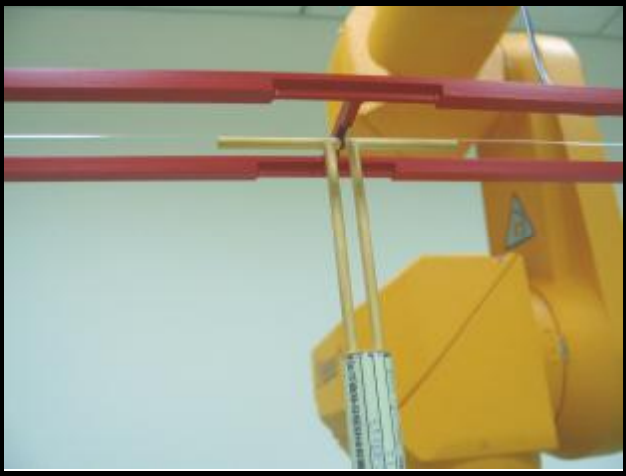
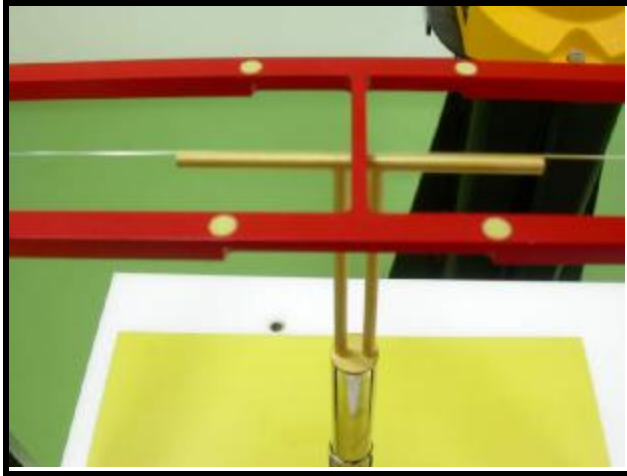


APPENDIX C: PHOTOGRAPHS OF SYSTEM VALIDATION

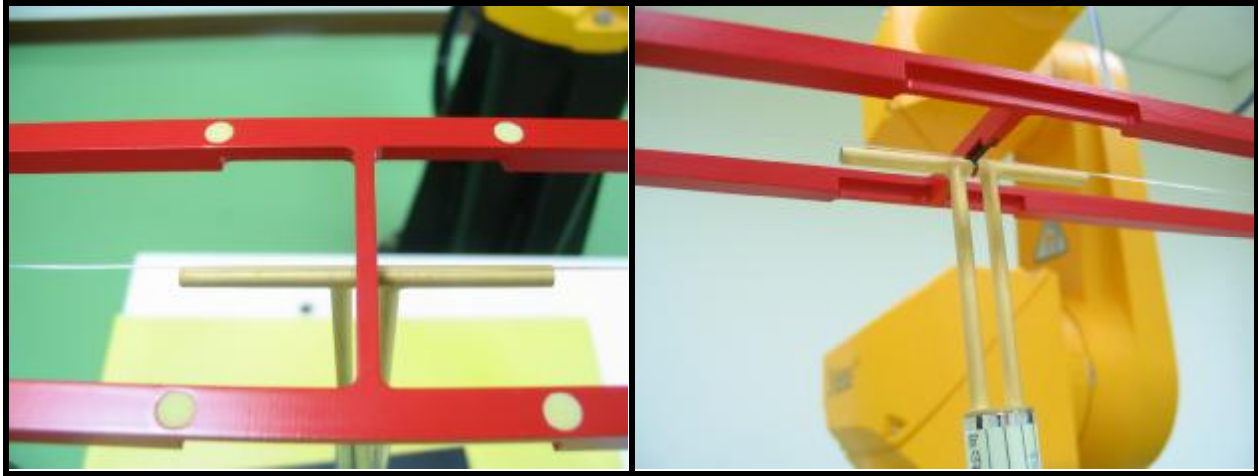
835MHz



1880MHz



2450MHz



APPENDIX D: SYSTEM CERTIFICATE & CALIBRATION

D1: DOSIMETRIC E-FIELD PROBE



D1: DOSIMETRIC E-FIELD PROBE



Accredited by the Swiss Federal Office of Metrology and Accreditation
The Swiss Accreditation Service is one of the signatories to the EA
Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 108**

Client **ADT (Auden)**

Certificate No: **ER3-2293_Jan07**

CALIBRATION CERTIFICATE

Object **ER3DV6 - SN:2293**

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

Calibration date: **January 23, 2007**

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)

Primary Standards	ID #	Cal Date (Calibrated by, Certificate No.)	Scheduled Calibration
Power meter E4419B	GB41293874	5-Apr-06 (METAS, No. 251-00557)	Apr-07
Power sensor E4412A	MY41495277	5-Apr-06 (METAS, No. 251-00557)	Apr-07
Power sensor E4412A	MY41498087	5-Apr-06 (METAS, No. 251-00557)	Apr-07
Reference 3 dB Attenuator	SN: S5054 (3c)	10-Aug-06 (METAS, No. 217-00592)	Aug-07
Reference 20 dB Attenuator	SN: S5086 (20b)	4-Apr-06 (METAS, No. 251-00558)	Apr-07
Reference 30 dB Attenuator	SN: S5129 (30b)	10-Aug-06 (METAS, No. 217-00593)	Aug-07
Reference Probe ER3DV6	SN: 2328	2-Oct-06 (SPEAG, No. ER3-2328_Oct06)	Oct-07
DAE4	SN: 654	21-Jun-06 (SPEAG, No. DAE4-654_Jun06)	Jun-07
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
RF generator HP 8648C	US3642U01700	4-Aug-99 (SPEAG, in house check Nov-05)	In house check: Nov-07
Network Analyzer HP 8753E	US37390585	18-Oct-01 (SPEAG, in house check Oct-06)	In house check: Oct-07

	Name	Function	Signature
Calibrated by:	Katja Pokovic	Technical Manager	
Approved by:	Niels Kuster	Quality Manager	

Issued: January 23, 2007

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**Calibration Laboratory of
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Zeughausstrasse 43, 8004 Zurich, Switzerland



S Schweizerischer Kalibrierdienst
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S Servizio svizzero di taratura
S Swiss Calibration Service

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Multilateral Agreement for the recognition of calibration certificates

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 DASY system to align probe sensor X to the robot coordinate system

Calibration is Performed According to the Following Standards:

- IEEE Std 1309-1996, "IEEE Standard for calibration of electromagnetic field sensors and probes, excluding antennas, from 9 kHz to 40 GHz", 1996.

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).

Probe ER3DV6

SN:2293

Manufactured:	October 1, 2002
Last calibrated:	September 22, 2005
Recalibrated:	January 23, 2007

Calibrated for DASY Systems

(Note: non-compatible with DASY2 system!)

DASY - Parameters of Probe: ER3DV6 SN:2293

Sensitivity in Free Space [$\mu\text{V}/(\text{V}/\text{m})^2$]		Diode Compression ^A	
NormX	1.27 ± 10.1 % (k=2)	DCP X	95 mV
NormY	1.06 ± 10.1 % (k=2)	DCP Y	95 mV
NormZ	1.42 ± 10.1 % (k=2)	DCP Z	96 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

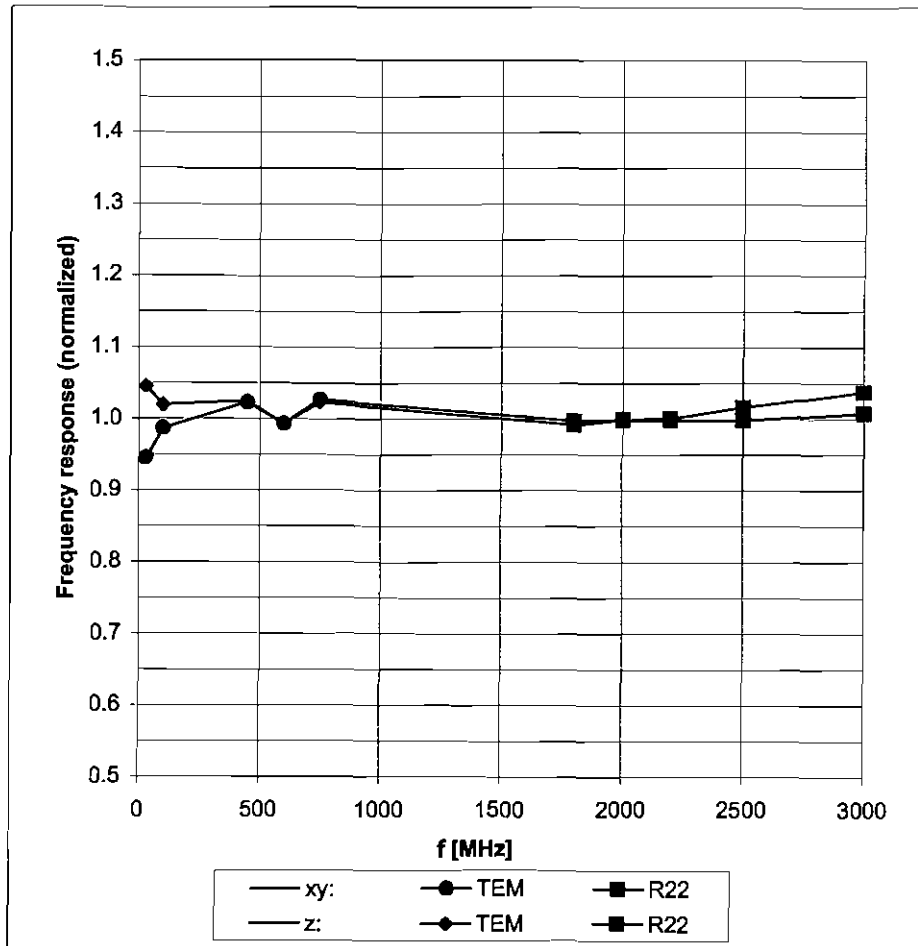
Connector Angle -12 °

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

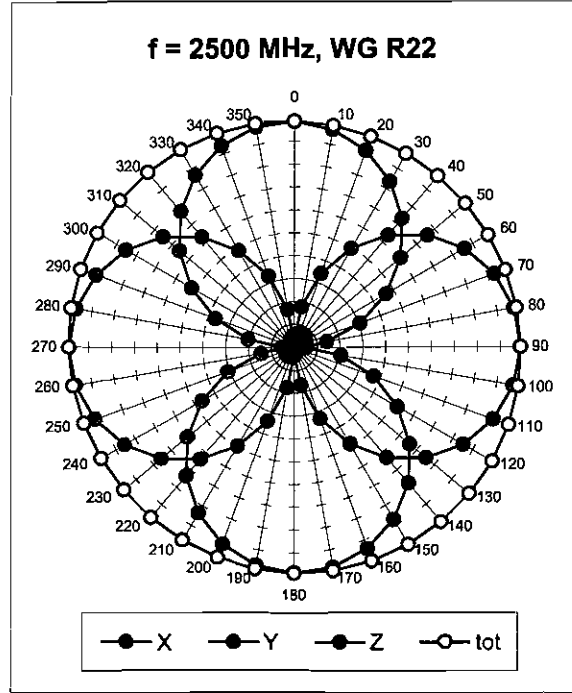
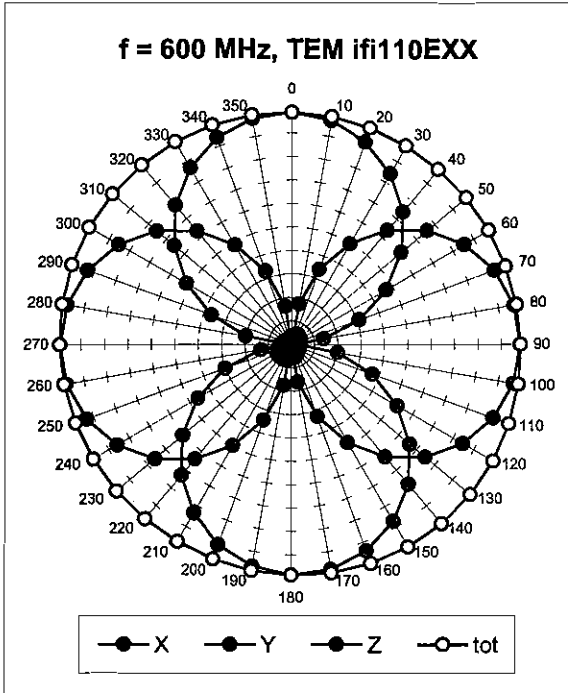
Frequency Response of E-Field

(TEM-Cell:ifi110 EXX, Waveguide R22)

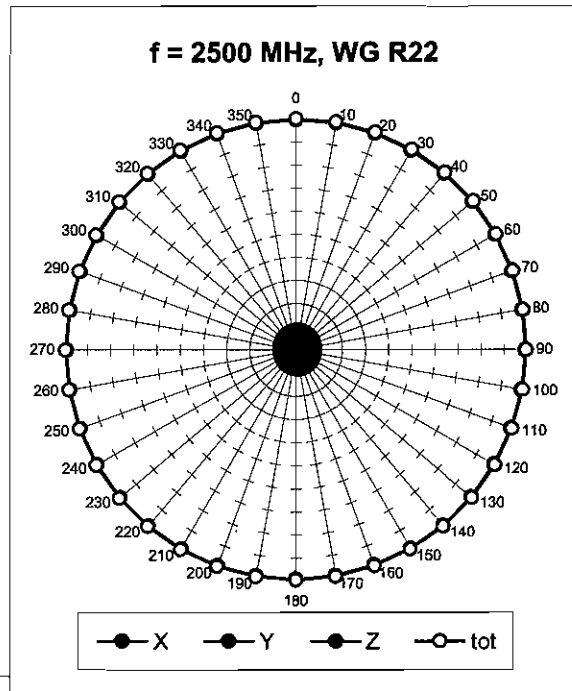
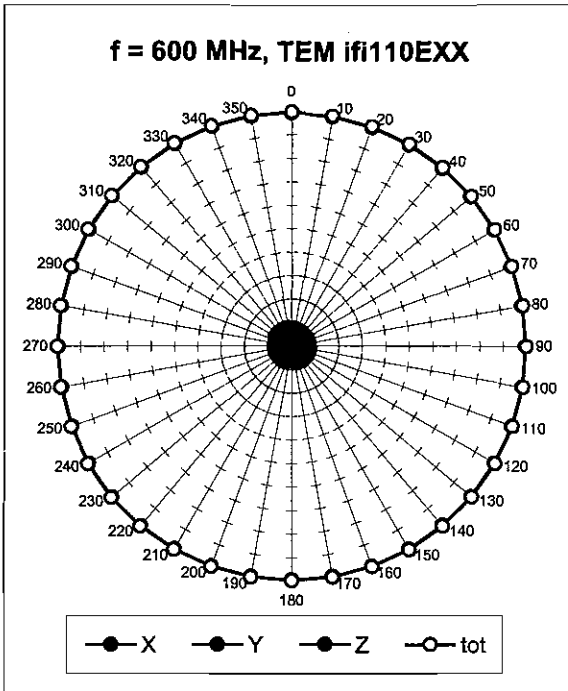


Uncertainty of Frequency Response of E-field: $\pm 6.3\%$ ($k=2$)

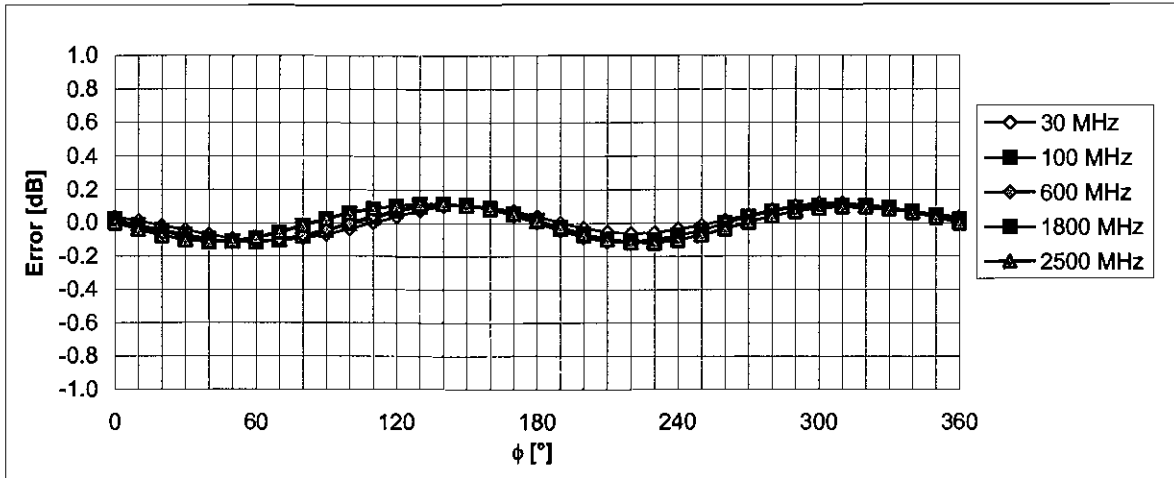
Receiving Pattern (ϕ), $\vartheta = 0^\circ$



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

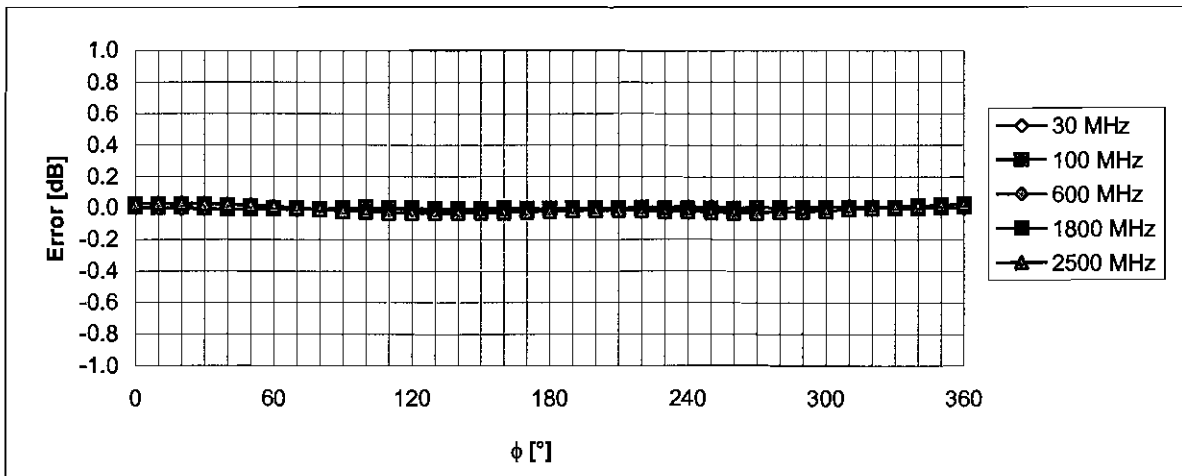


Receiving Pattern (ϕ), $\vartheta = 0^\circ$



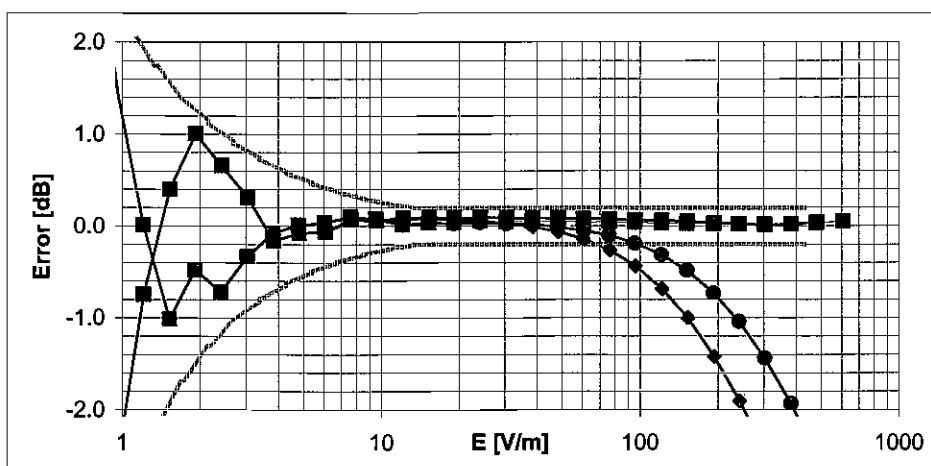
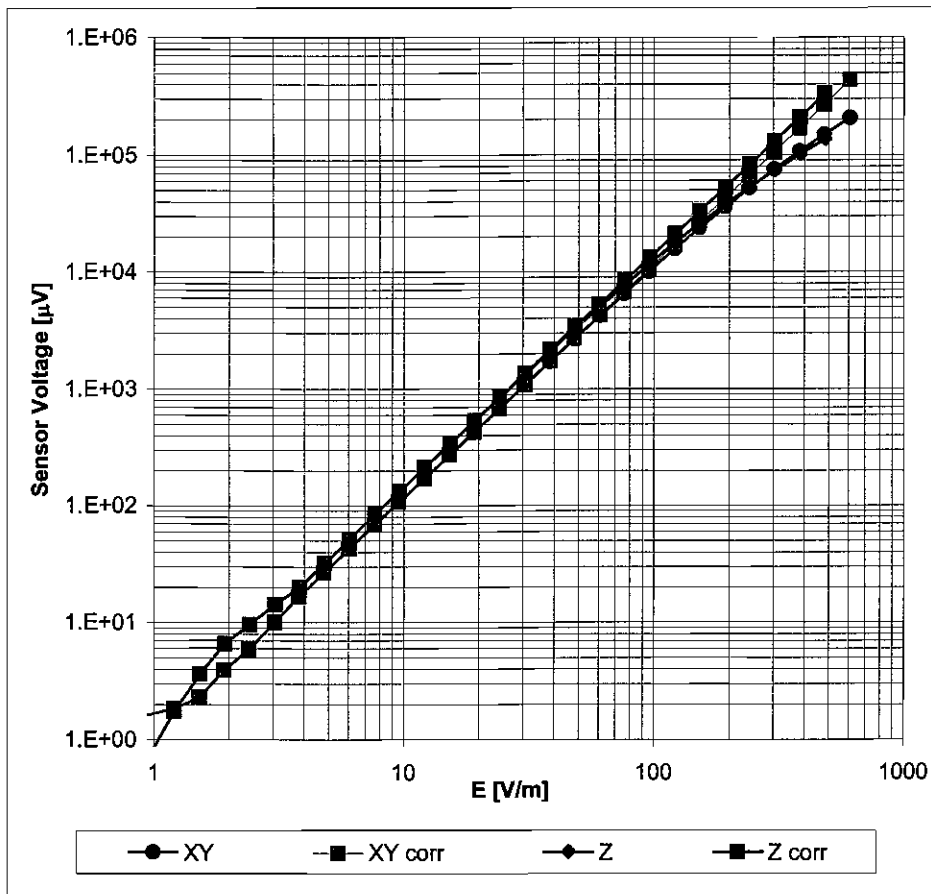
Uncertainty of Axial Isotropy Assessment: $\pm 0.5\%$ ($k=2$)

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



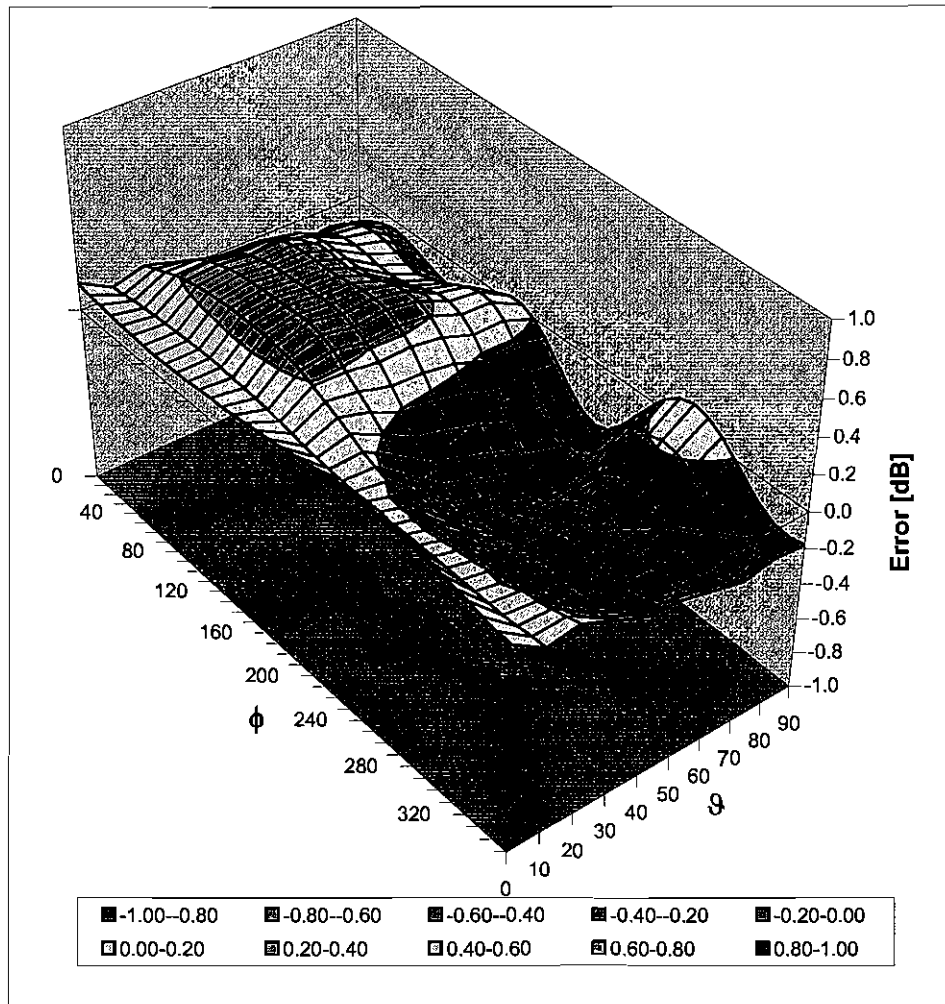
Uncertainty of Axial Isotropy Assessment: $\pm 0.5\%$ ($k=2$)

Dynamic Range f(E-field) (Waveguide R22, f = 1800 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: $\pm 2.6\%$ ($k=2$)



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Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 108**

Client **ADT (Auden)**

Certificate No: **H3-6124_Jan07**

CALIBRATION CERTIFICATE

Object **H3DV6 - SN:6124**

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

Calibration date: **January 23, 2007**

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)

Primary Standards	ID #	Cal Date (Calibrated by, Certificate No.)	Scheduled Calibration
Power meter E4419B	GB41293874	5-Apr-06 (METAS, No. 251-00557)	Apr-07
Power sensor E4412A	MY41495277	5-Apr-06 (METAS, No. 251-00557)	Apr-07
Power sensor E4412A	MY41498087	5-Apr-06 (METAS, No. 251-00557)	Apr-07
Reference 3 dB Attenuator	SN: S5054 (3c)	10-Aug-06 (METAS, No. 217-00592)	Aug-07
Reference 20 dB Attenuator	SN: S5086 (20b)	4-Apr-06 (METAS, No. 251-00558)	Apr-07
Reference 30 dB Attenuator	SN: S5129 (30b)	10-Aug-06 (METAS, No. 217-00593)	Aug-07
Reference Probe H3DV6	SN: 6182	2-Oct-06 (SPEAG, No. H3-6182_Oct06)	Oct-07
DAE4	SN: 654	21-Jun-06 (SPEAG, No. DAE4-654_Jun06)	Jun-07
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
RF generator HP 8648C	US3642U01700	4-Aug-99 (SPEAG, in house check Nov-05)	In house check: Nov-07
Network Analyzer HP 8753E	US37390585	18-Oct-01 (SPEAG, in house check Oct-06)	In house check: Oct-07

	Name	Function	Signature
Calibrated by:	Katja Pokovic	Technical Manager	
Approved by:	Niels Kuster	Quality Manager	

issued: January 23, 2007

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**Calibration Laboratory of
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Zeughausstrasse 43, 8004 Zurich, Switzerland



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Multilateral Agreement for the recognition of calibration certificates

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 DASY system to align probe sensor X to the robot coordinate system

Calibration is Performed According to the Following Standards:

- IEEE Std 1309-1996, "IEEE Standard for calibration of electromagnetic field sensors and probes, excluding antennas, from 9 kHz to 40 GHz", 1996.

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).

Probe H3DV6

SN:6124

Manufactured:	June 8, 2002
Last calibrated:	September 22, 2005
Recalibrated:	January 23, 2007

Calibrated for DASY Systems

(Note: non-compatible with DASY2 system!)

DASY - Parameters of Probe: H3DV6 SN:6124Sensitivity in Free Space [A/m / $\sqrt{(\mu\text{V})}$]

	a0	a1	a2
X	2.679E-03	-9.856E-5	5.307E-5 \pm 5.1 % (k=2)
Y	2.790E-03	-2.467E-4	3.051E-5 \pm 5.1 % (k=2)
Z	3.037E-03	-1.907E-4	1.047E-5 \pm 5.1 % (k=2)

Diode Compression¹

DCP X	86 mV
DCP Y	86 mV
DCP Z	88 mV

Sensor Offset

(Probe Tip to Sensor Center)

X	3.0 mm
Y	3.0 mm
Z	3.0 mm

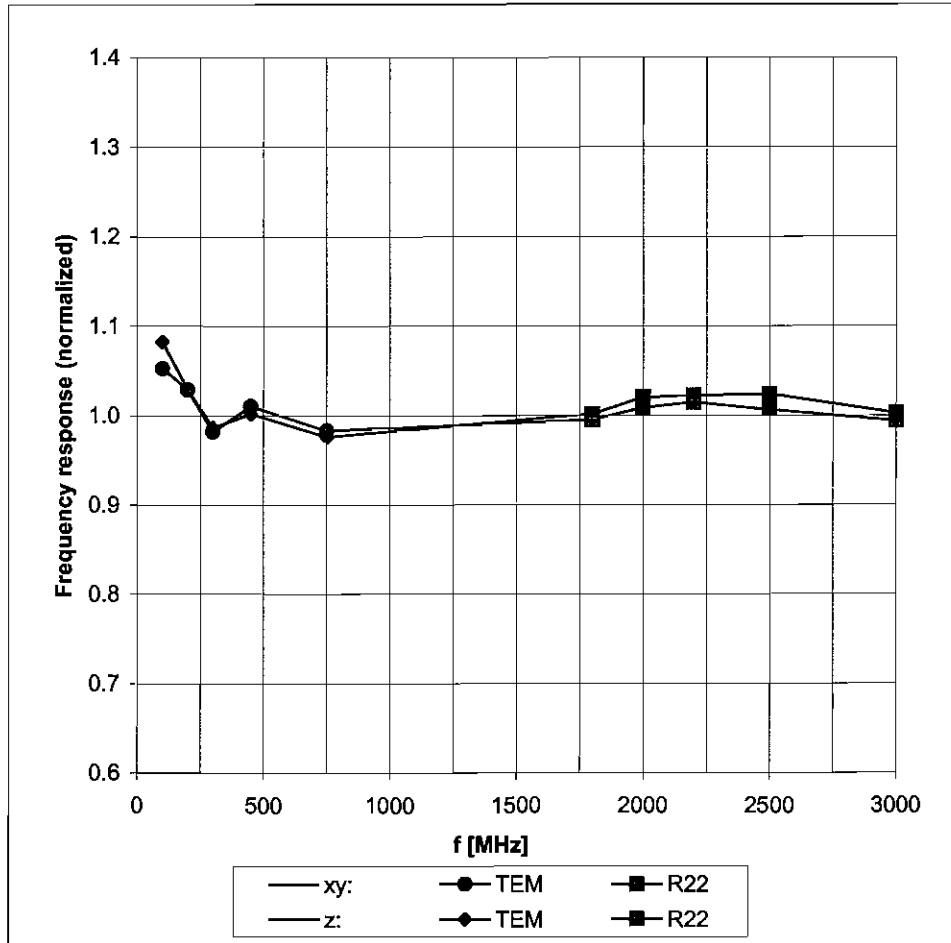
Connector Angle -25 °

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

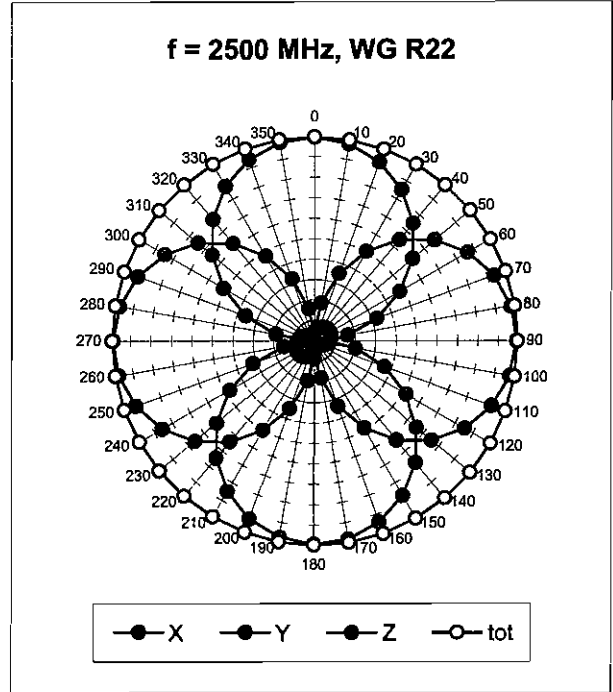
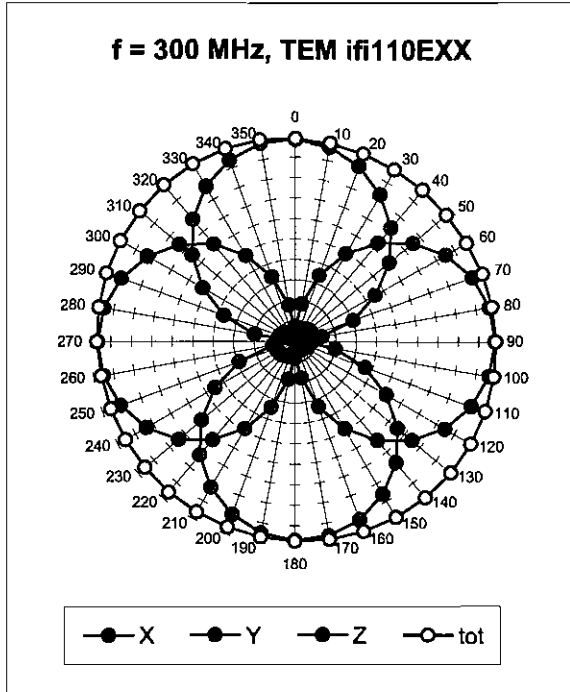
Frequency Response of H-Field

(TEM-Cell:ifi110, Waveguide R22)

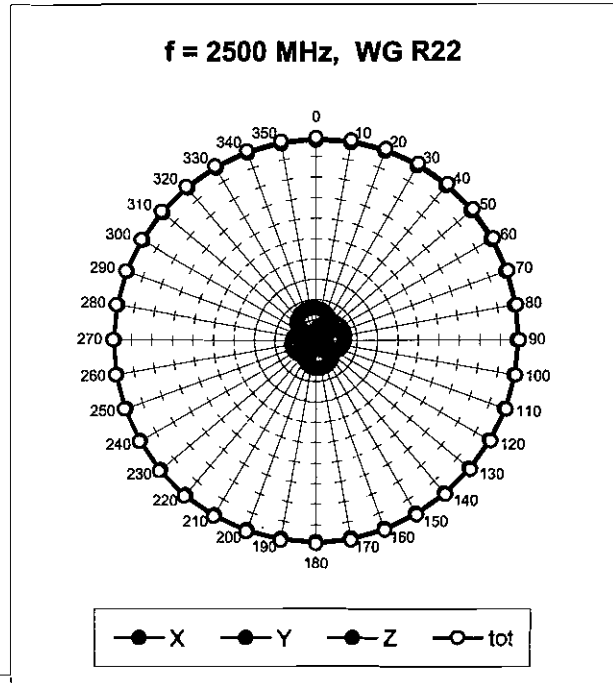
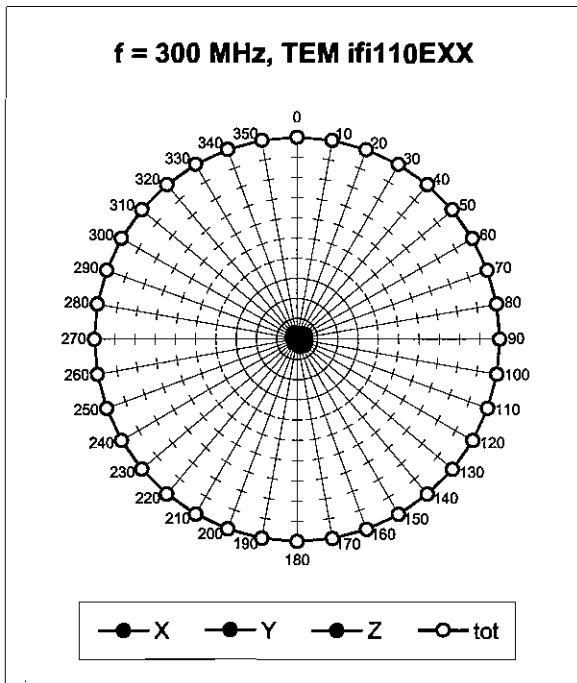


Uncertainty of Frequency Response of E-field: $\pm 6.3\%$ (k=2)

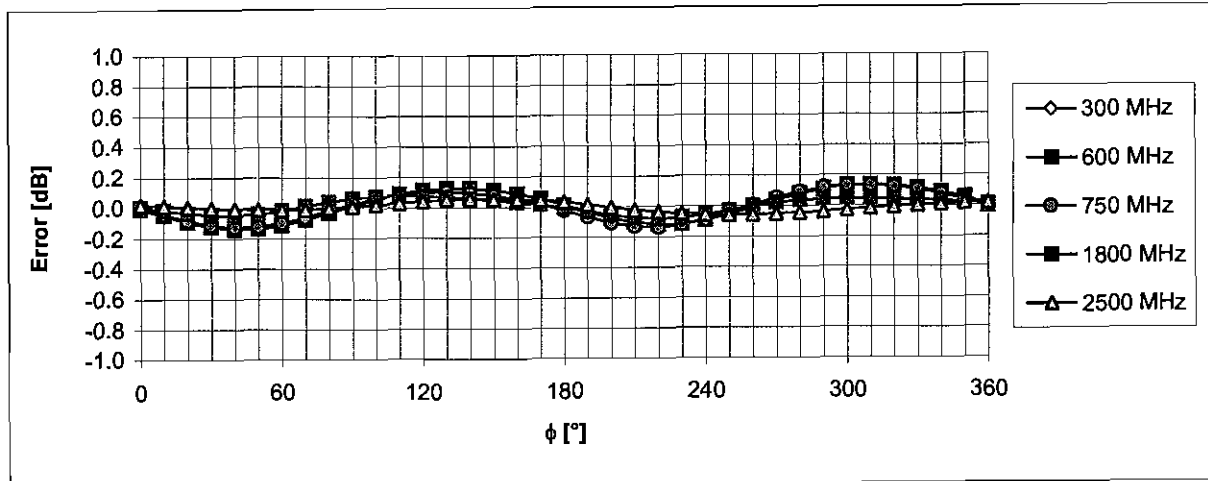
Receiving Pattern (ϕ), $\vartheta = 90^\circ$



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

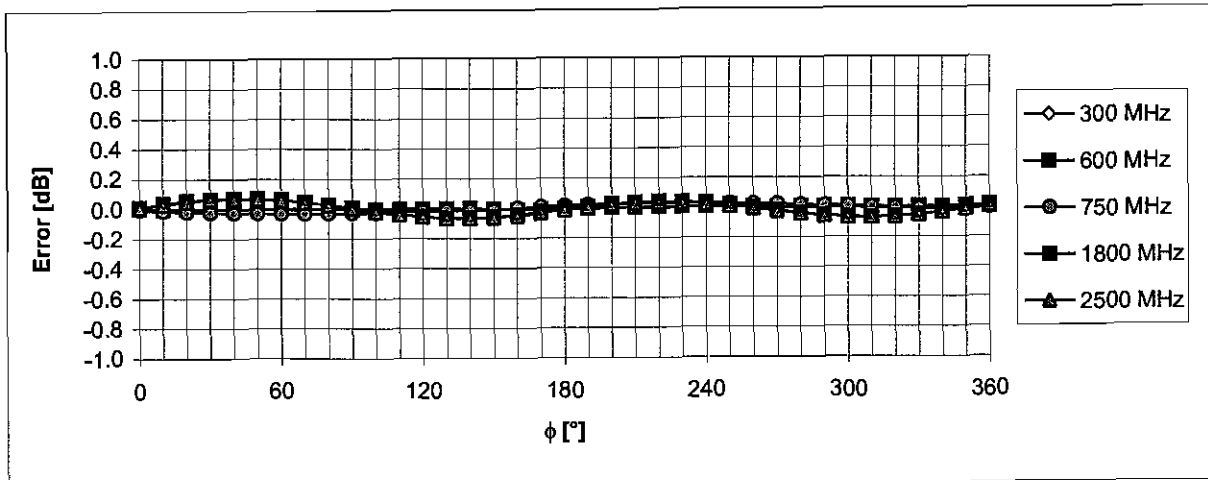


Receiving Pattern (ϕ), $\vartheta = 90^\circ$



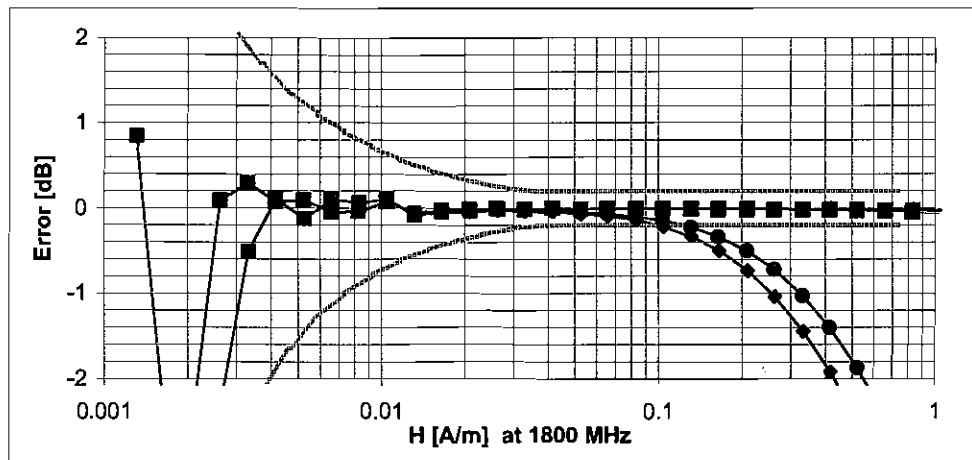
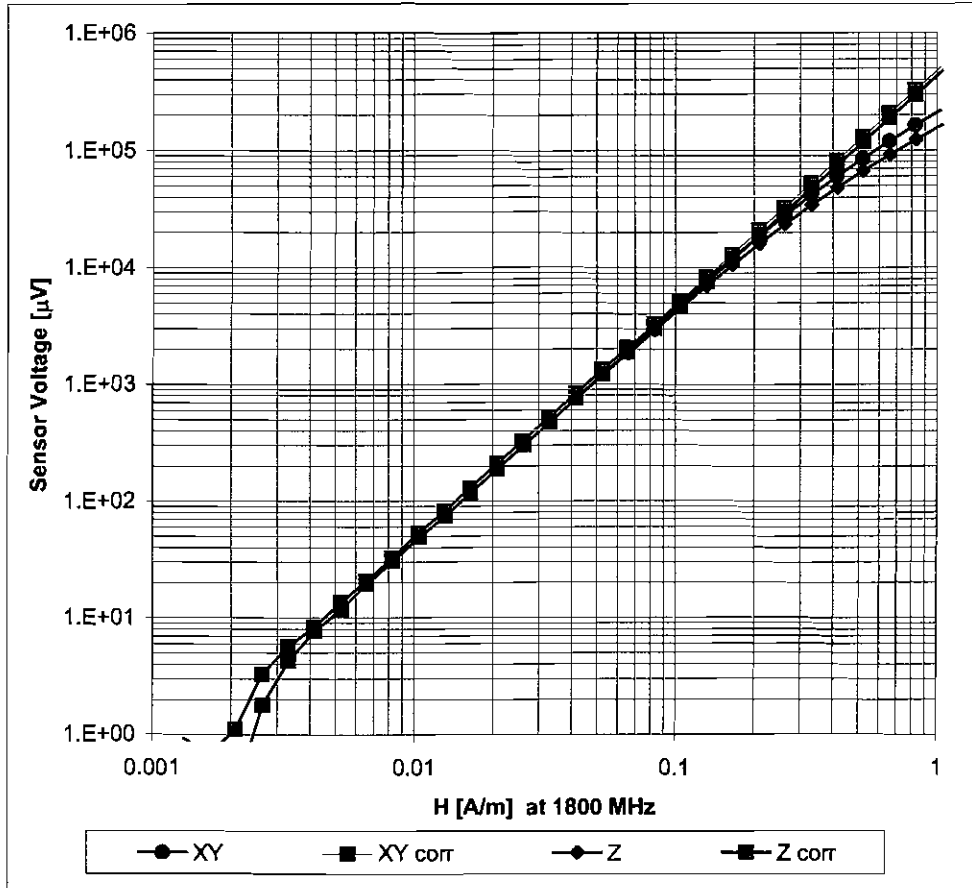
Uncertainty of Axial Isotropy Assessment: $\pm 0.5\%$ ($k=2$)

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



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

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



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



D2: DAE



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Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 108**

Client **ADT (Auden)**

Certificate No: **DAE3-510_Sep06**

CALIBRATION CERTIFICATE

Object **DAE3 - SD 000 D03 AA - SN: 510**

Calibration procedure(s) **QA CAL-06.v12
Calibration procedure for the data acquisition electronics (DAE)**

Calibration date: **September 07, 2006**

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)

Primary Standards	ID #	Cal Date (Calibrated by, Certificate No.)	Scheduled Calibration
Fluke Process Calibrator Type 702	SN: 6295803	7-Oct-05 (Sintrel, No.E-050073)	Oct-06
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Calibrator Box V1.1	SE UMS 006 AB 1002	15-Jun-06 (SPEAG, in house check)	In house check Jun-07

Calibrated by: **Name** Daniel Steinacher **Function** Technician **Signature** *Daniel Steinacher*

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

Issued: September 7, 2006

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Accreditation No.: **SCS 108**

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 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:** 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	404.194 \pm 0.1% (k=2)	404.254 \pm 0.1% (k=2)	404.622 \pm 0.1% (k=2)
Low Range	3.97522 \pm 0.7% (k=2)	3.96545 \pm 0.7% (k=2)	3.95957 \pm 0.7% (k=2)

Connector Angle

Connector Angle to be used in DASY system	42 $^{\circ}$ \pm 1 $^{\circ}$
---	----------------------------------

Appendix

1. DC Voltage Linearity

High Range		Input (μV)	Reading (μV)	Error (%)
Channel X	+ Input	200000	200000.2	0.00
Channel X	+ Input	20000	20007.72	0.04
Channel X	- Input	20000	-19999.52	0.00
Channel Y	+ Input	200000	199999.5	0.00
Channel Y	+ Input	20000	20005.14	0.03
Channel Y	- Input	20000	-20000.72	0.00
Channel Z	+ Input	200000	200000.5	0.00
Channel Z	+ Input	20000	20006.06	0.03
Channel Z	- Input	20000	-20002.05	0.01

Low Range		Input (μV)	Reading (μV)	Error (%)
Channel X	+ Input	2000	1999.9	0.00
Channel X	+ Input	200	200.02	0.01
Channel X	- Input	200	-200.32	0.16
Channel Y	+ Input	2000	2000.0	0.00
Channel Y	+ Input	200	199.46	-0.27
Channel Y	- Input	200	-200.72	0.36
Channel Z	+ Input	2000	1999.9	0.00
Channel Z	+ Input	200	199.12	-0.44
Channel Z	- Input	200	-201.06	0.53

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	17.19	16.90
	- 200	-16.29	-16.91
Channel Y	200	14.52	14.16
	- 200	-15.49	-15.51
Channel Z	200	-8.86	-9.32
	- 200	7.79	7.80

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	-	1.86	-0.06
Channel Y	200	0.60	-	4.31
Channel Z	200	-2.51	-0.39	-

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	15894	16343
Channel Y	16116	16300
Channel Z	16080	16129

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	0.39	-0.84	1.32	0.26
Channel Y	-1.02	-1.58	0.05	0.26
Channel Z	0.18	-0.50	1.13	0.28

6. Input Offset Current

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

7. Input Resistance

	Zeroing (MΩ)	Measuring (MΩ)
Channel X	0.2001	199.6
Channel Y	0.2001	198.3
Channel Z	0.2001	199.1

8. Low Battery Alarm Voltage (verified during pre test)

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

9. Power Consumption (verified during pre test)

Typical values	Switched off (mA)	Stand by (mA)	Transmitting (mA)
Supply (+ Vcc)	+0.0	+6	+14
Supply (- Vcc)	-0.01	-8	-9



D3: SYSTEM VALIDATION DIPOLE



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The Swiss Accreditation Service is one of the signatories to the EA
Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 108**

Client **Auden ADT**

Certificate No: **CD835V3-1041_May06**

CALIBRATION CERTIFICATE

Object **CD835V3 - SN: 1041**

Calibration procedure(s) **QA CAL-20.v4
Calibration procedure for dipoles in air**

Calibration date: **May 22, 2006**

Condition of the calibrated item **In Tolerance**

This calibration certificate documents the traceability to national standards, which realize the physical units of measurements (SI).
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 (Calibrated by, Certificate No.)	Scheduled Calibration
Power meter EPM-442A	GB37480704	04-Oct-05 (METAS, No. 251-00516)	Oct-06
Power sensor HP 8481A	US37292783	04-Oct-05 (METAS, No. 251-00516)	Oct-06
Reference 20 dB Attenuator	SN: 5086 (20g)	11-Aug-05 (METAS, No 251-00498)	Aug-06
Reference 10 dB Attenuator	SN: 5047.2 (10r)	11-Aug-05 (METAS, No 251-00498)	Aug-06
DAE4	SN: 660	1-Mar-06 (SPEAG, No. DAE4-660_Mar06)	Calibration, Mar-07
Probe ER3DV6	SN: 2336	20-Dec-05 (SPEAG, No. ER3-2336_Dec05)	Calibration, Dec-06
Probe H3DV6	SN: 6065	20-Dec-05 (SPEAG, No. H3-6065-Dec05)	Calibration, Dec-06
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power sensor HP 8481A	MY41092317	18-Oct-02 (SPEAG, in house check Oct-05)	In house check: Oct-07
RF generator Agilent E4421B	MY41000675	11-May-05 (SPEAG, in house check Nov-05)	In house check: Nov-07
Network Analyzer HP 8753E	US37390585 S4206	18-Oct-01 (SPEAG, in house check Nov-05)	In house check: Nov-06

Calibrated by: **Mike Meili** Laboratory Technician

Signature

Approved by: **Fin Bomholt** Technical Director

Issued: May 24, 2006

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Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 108**

References

- [1] ANSI-PC63.19-2001 (Draft 3.x, 2005)
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 standard [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 DASY4 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.

1 Measurement Conditions

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

DASY Version	DASY4	V4.7 B21
DASY PP Version	SEMCAD	V1.8 B165
Phantom	HAC Test Arch	SD HAC P01 BA, #1002
Distance Dipole Top - Probe Center	10 mm	
Scan resolution	dx, dy = 5 mm	area = 20 x 180 mm
Frequency	835 MHz ± 1 MHz	
Forward power at dipole connector	20.0 dBm = 100mW	
Input power drift	< 0.05 dB	

2 Maximum Field values

H-field 10 mm above dipole surface	condition	interpolated maximum
Maximum measured	100 mW forward power	0.457 A/m

Uncertainty for H-field measurement: 8.2% (k=2)

E-field 10 mm above dipole surface	condition	Interpolated maximum
Maximum measured above high end	100 mW forward power	171.0 V/m
Maximum measured above low end	100 mW forward power	161.7 V/m
Averaged maximum above arm	100 mW forward power	166.4 V/m

Uncertainty for E-field measurement: 12.8% (k=2)

3 Appendix

3.1 Antenna Parameters

Frequency	Return Loss	Impedance
800 MHz	16.2 dB	(40.4 – j10.3) Ohm
835 MHz	26.9 dB	(53.1 + j3.5) Ohm
900 MHz	17.7 dB	(50.9 – j13.3) Ohm
950 MHz	18.2 dB	(55.6 + j11.8) Ohm
960 MHz	14.6 dB	(66.8 + j14.1) Ohm

3.2 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.

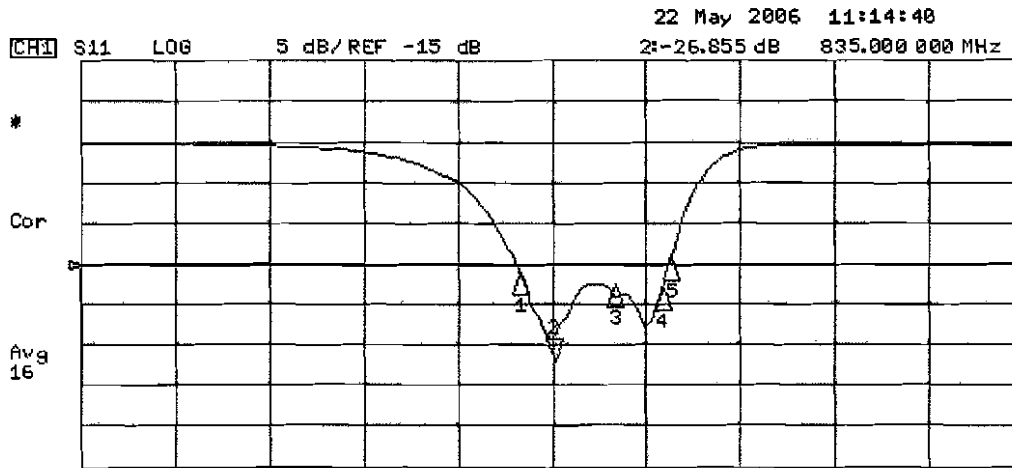
The dipole is built of standard semirigid coaxial cable. The internal matching line is open ended. The antenna is therefore open for DC signals.

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.

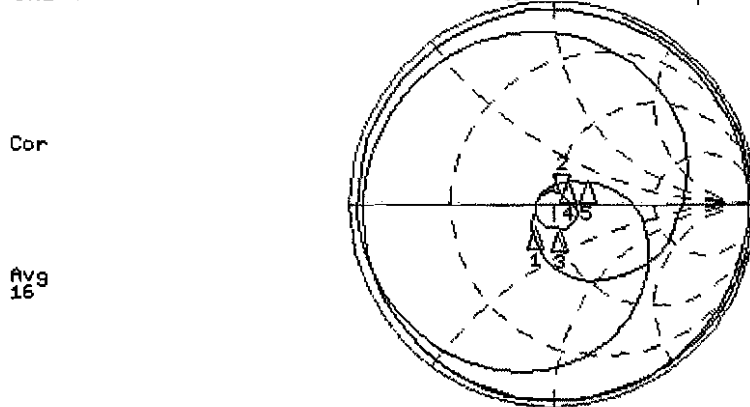
After long term use with 40W radiated power, only a slight warming of the dipole near the feedpoint can be measured.

3.3 Measurement Sheets

3.3.1 Return Loss and Smith Chart



CH2 S11 1 U FS 2: 53.088 Ω 3: 52.215 Ω 671.21 pF 835.000 000 MHz



CENTER 835.000 000 MHz

SPAN 1 000.000 000 MHz

3.3.2 DASY4 H-field result

Date/Time: 5/22/2006 6:50:07 PM

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: HAC-Dipole 835 MHz; Type: D835V3; Serial: 1041

Communication System: CW; Frequency: 835 MHz; Duty Cycle: 1:1

Medium: Air

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

Phantom section: H Dipole Section

DASY4 Configuration:

- Probe: H3DV6 - SN6065; Calibrated: 12/20/2005
- Sensor-Surface: (Fix Surface)
- Electronics: DAE4 Sn660; Calibrated: 3/1/2006
- Phantom: HAC Test Arch 4.6; Type: SD HAC P01 BA; Serial: 1002
- Measurement SW: DASY4, V4.7 Build 21; Postprocessing SW: SEMCAD, V1.8 Build 165

H Scan - Sensor Center 10mm above CD835 Dipole/Hearing Aid Compatibility Test (41x361x1):

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

Maximum value of peak Total field = 0.457 A/m

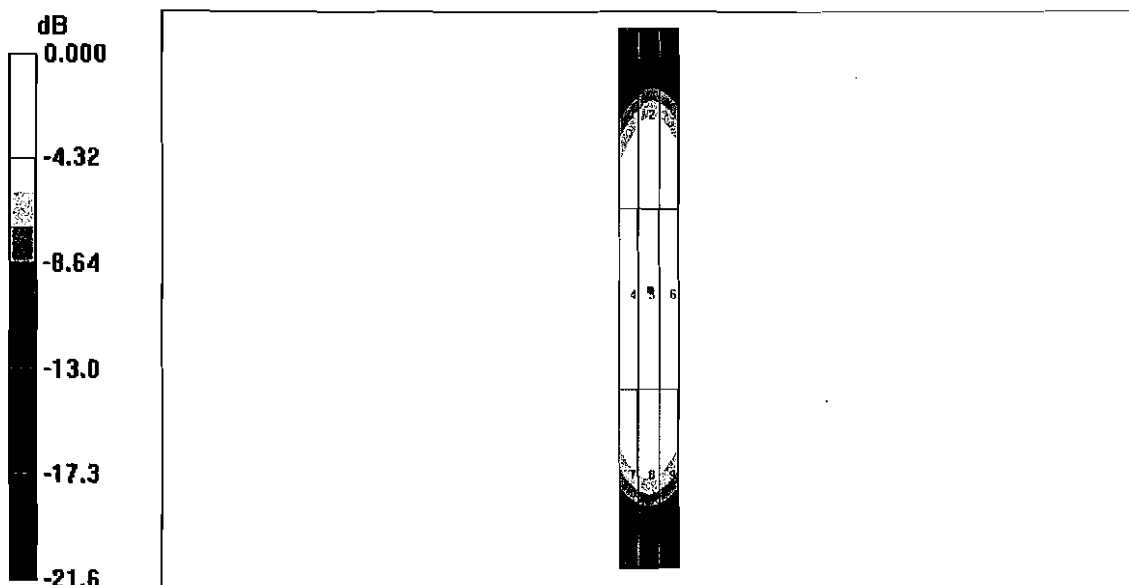
Probe Modulation Factor = 1.00

Reference Value = 0.485 A/m; Power Drift = 0.008 dB

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

Peak H-field in A/m

Grid 1	Grid 2	Grid 3
0.376	0.409	0.394
Grid 4	Grid 5	Grid 6
0.429	0.457	0.440
Grid 7	Grid 8	Grid 9
0.378	0.398	0.380



0 dB = 0.457A/m

3.3.3 DASY4 E-Field result

Date/Time: 5/22/2006 3:37:34 PM

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: HAC-Dipole 835 MHz; Type: D835V3; Serial: 1041

Communication System: CW; Frequency: 835 MHz; Duty Cycle: 1:1

Medium: Air

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

Phantom section: E Dipole Section

DASY4 Configuration:

- Probe: ER3DV6 - SN2336; ConvF(1, 1, 1); Calibrated: 12/20/2005
- Sensor-Surface: (Fix Surface)
- Electronics: DAE4 Sn660; Calibrated: 3/1/2006
- Phantom: HAC Test Arch 4.6; Type: SD HAC P01 BA; Serial: 1002
- Measurement SW: DASY4, V4.7 Build 21; Postprocessing SW: SEMCAD, V1.8 Build 165

E Scan - Sensor Center 10mm above CD835 Dipole/Hearing Aid Compatibility Test (41x361x1):

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

Maximum value of peak Total field = 161.7 V/m

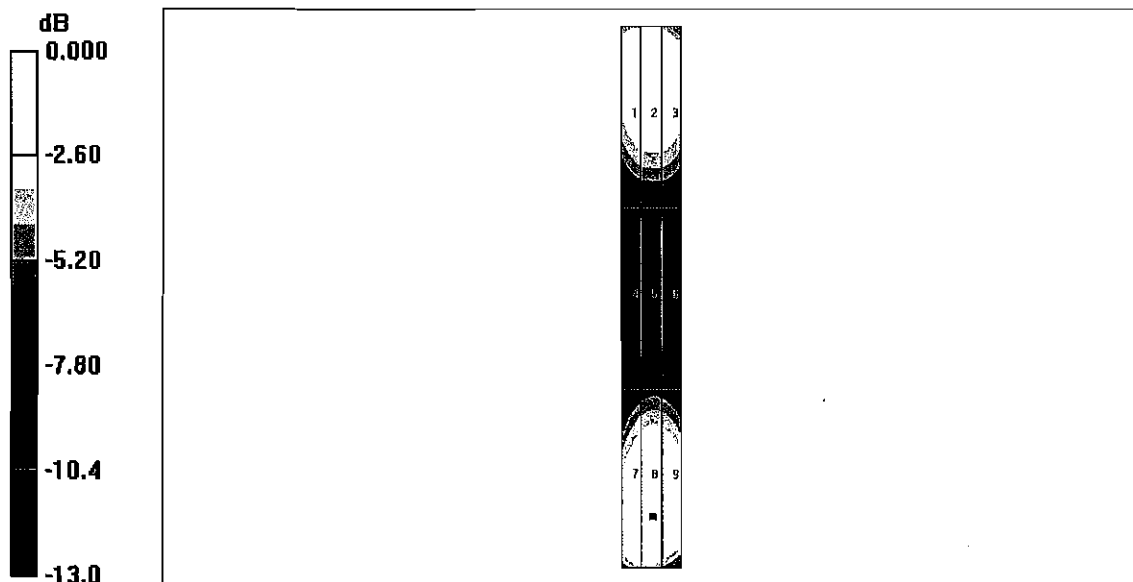
Probe Modulation Factor = 1.00

Reference Value = 121.2 V/m; Power Drift = -0.038 dB

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

Peak E-field in V/m

Grid 1	Grid 2	Grid 3
164.7	171.0	165.8
Grid 4	Grid 5	Grid 6
83.8	88.1	86.9
Grid 7	Grid 8	Grid 9
154.7	161.7	159.3



0 dB = 171.0V/m



D3: SYSTEM VALIDATION DIPOLE



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Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 108**

Client **ADT (Auden)**

Certificate No: **CD1880V3-1032_Jul06**

CALIBRATION CERTIFICATE

Object **CD1880V3 - SN: 1032**

Calibration procedure(s) **QA CAL-20.v4
Calibration procedure for dipoles in air**

Calibration date: **July 18, 2006**

Condition of the calibrated item **In Tolerance**

This calibration certificate documents the traceability to national standards, which realize the physical units of measurements (SI).
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 (Calibrated by, Certificate No.)	Scheduled Calibration
Power meter EPM-442A	GB37480704	04-Oct-05 (METAS, No. 251-00516)	Oct-06
Power sensor HP 8481A	US37292783	04-Oct-05 (METAS, No. 251-00516)	Oct-06
Reference 20 dB Attenuator	SN: 5086 (20g)	11-Aug-05 (METAS, No 251-00498)	Aug-06
Reference 10 dB Attenuator	SN: 5047.2 (10r)	11-Aug-05 (METAS, No 251-00498)	Aug-06
DAE4	SN: 660	1-Mar-06 (SPEAG, No. DAE4-660_Mar06)	Calibration, Mar-07
Probe ER3DV6	SN: 2336	20-Dec-05 (SPEAG, No. ER3-2336_Dec05)	Calibration, Dec-06
Probe H3DV6	SN: 6065	20-Dec-05 (SPEAG, No. H3-6065-Dec05)	Calibration, Dec-06

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power meter EPM-4419B	GB43310788	12-Aug-03 (SPEAG, in house check Oct-05)	In house check: Oct-06
Power sensor HP 8481A	MY41093312	10-Aug-03 (SPEAG, in house check Oct-05)	In house check: Oct-07
Power sensor HP 8481A	MY41093315	10-Aug-03 (SPEAG, in house check Oct-05)	In house check: Oct-06
Network Analyzer HP 8753E	US37390585	18-Oct-01 (SPEAG, in house check Nov-05)	In house check: Nov-06
RF generator R&S SMT06	SN: 100005	26-Jul-04 (SPEAG, in house check Nov-05)	In house check: Nov-07

Calibrated by: **Mike Melli** Name: **Mike Melli** Function: **Laboratory Technician** Signature: *[Signature]*

Approved by: **Fin Bomholt** Name: **Fin Bomholt** Technical Director: *[Signature]*

Issued: July 20, 2006

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Accreditation No.: **SCS 108**

References

- [1] ANSI-PC63.19-2001 (Draft 3.x, 2005)
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 standard [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 DASY4 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.

1 Measurement Conditions

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

DASY Version	DASY4	V4.7B44
DASY PP Version	SEMCAD	V1.8 B171
Phantom	HAC Test Arch	SD HAC P01 BA, #1002
Distance Dipole Top - Probe Center	10 mm	
Scan resolution	dx, dy = 5 mm	area = 20 x 90 mm
Frequency	1880 MHz ± 1 MHz	
Forward power at dipole connector	20.0 dBm = 100mW	
Input power drift	< 0.05 dB	

2 Maximum Field values

H-field 10 mm above dipole surface	condition	Interpolated maximum
Maximum measured	100 mW forward power	0.454 A/m

Uncertainty for H-field measurement: 8.2% (k=2)

E-field 10 mm above dipole surface	condition	Interpolated maximum
Maximum measured above high end	100 mW forward power	137.4 V/m
Maximum measured above low end	100 mW forward power	132.5 V/m
Averaged maximum above arm	100 mW forward power	135.0 V/m

Uncertainty for E-field measurement: 12.8% (k=2)

3 Appendix

3.1 Antenna Parameters

Frequency	Return Loss	Impedance
1710 MHz	21.6 dB	(50.3 + j8.4) Ohm
1880 MHz	21.2 dB	(51.9 + j8.7) Ohm
1900 MHz	21.8 dB	(54.0 + j7.5) Ohm
1950 MHz	26.8 dB	(54.8 + j0.3) Ohm
2000 MHz	22.4 dB	(43.3 + j2.3) Ohm

3.2 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.

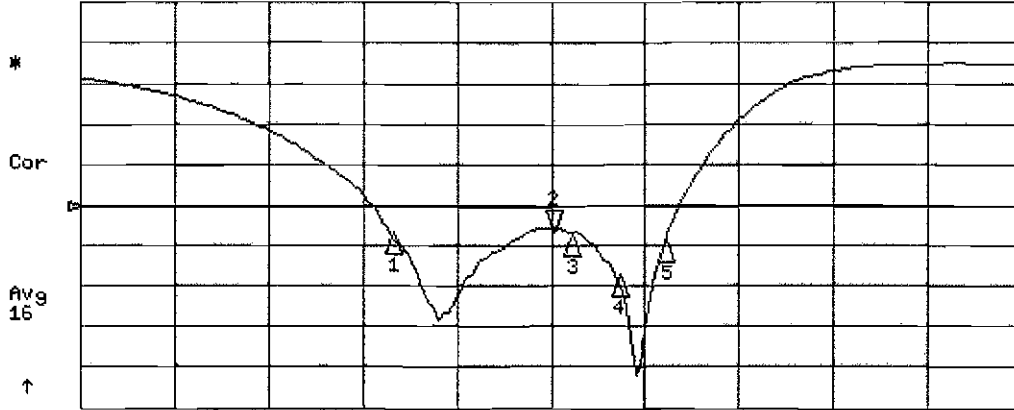
After long term use with 40W radiated power, only a slight warming of the dipole near the feedpoint can be measured.

3.3 Measurement Sheets

3.3.1 Return Loss and Smith Chart

17 Jul 2006 09:07:35

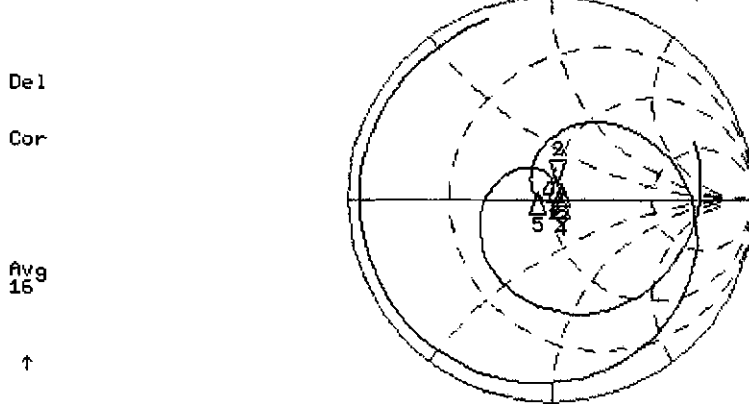
CH1 S11 LOG 5 dB/REF -18 dB 2:-21.161 dB 1 880.000 000 MHz



CH1 Markers

- 1:-21.556 dB
1.71000 GHz
- 3:-21.770 dB
1.90000 GHz
- 4:-26.784 dB
1.95000 GHz
- 5:-22.369 dB
2.00000 GHz

CH2 S11 1 U FS 2: 51.904 Ω 8.7402 Ω 739.92 μ H 1 880.000 000 MHz



CH2 Markers

- 1: 50.342 Ω
8.4043 Ω
1.71000 GHz
- 3: 54.004 Ω
7.5020 Ω
1.90000 GHz
- 4: 54.791 Ω
0.2500 Ω
1.95000 GHz
- 5: 43.264 Ω
2.2539 Ω
2.00000 GHz

START 1 380.000 000 MHz

STOP 2 380.000 000 MHz

3.3.2 DASY4 H-field result

Date/Time: 7/18/2006 10:03:46 AM

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: HAC Dipole 1880 MHz; Type: CD1880V3; Serial: 1032

Communication System: CW; Frequency: 1880 MHz; Duty Cycle: 1:1

Medium: Air

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

Phantom section: H Dipole Section

DASY4 Configuration:

- Probe: H3DV6 - SN6065; Calibrated: 12/20/2005
- Sensor-Surface: (Fix Surface)
- Electronics: DAE4 Sn660; Calibrated: 3/1/2006
- Phantom: HAC Test Arch 4.6; Type: SD HAC P01 BA; Serial: 1002
- Measurement SW: DASY4, V4.7 Build 44; Postprocessing SW: SEMCAD, V1.8 Build 171

H Scan - Sensor Center 10mm above CD1880V3 Dipole/Hearing Aid Compatibility Test (41x181x1):

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

Maximum value of peak Total field = 0.454 A/m

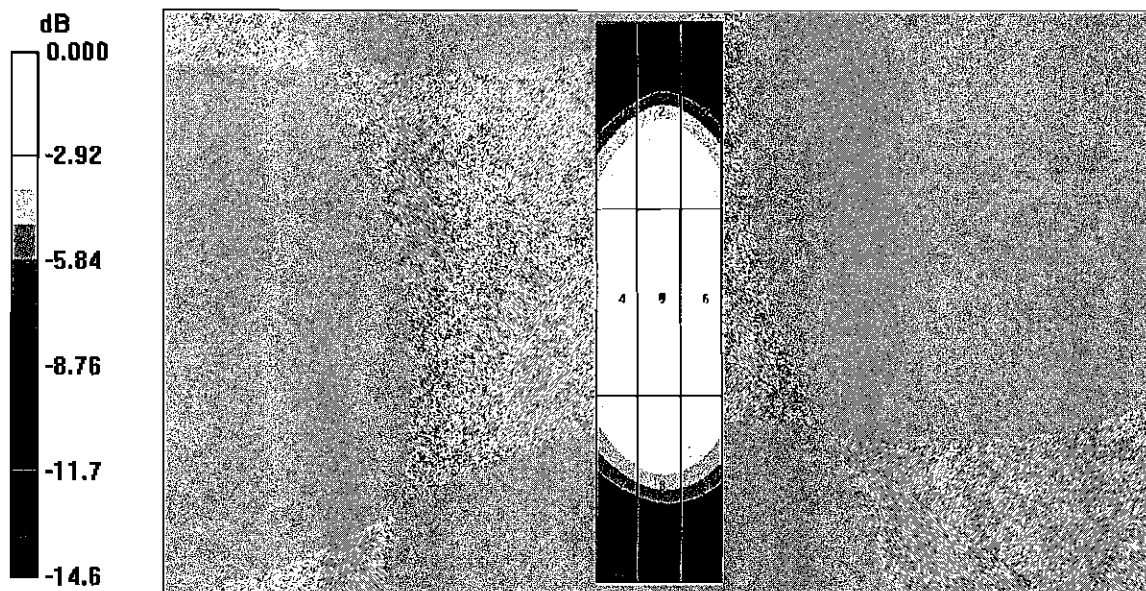
Probe Modulation Factor = 1.00

Reference Value = 0.479 A/m; Power Drift = -0.002 dB

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

Peak H-field in A/m

Grid 1	Grid 2	Grid 3
0.397	0.422	0.404
Grid 4	Grid 5	Grid 6
0.429	0.454	0.438
Grid 7	Grid 8	Grid 9
0.389	0.412	0.397



0 dB = 0.454A/m

3.3.3 DASY4 E-Field result

Date/Time: 7/18/2006 11:39:04 AM

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: HAC Dipole 1880 MHz; Type: CD1880V3; Serial: 1032

Communication System: CW; Frequency: 1880 MHz; Duty Cycle: 1:1

Medium: Air

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

Phantom section: E Dipole Section

DASY4 Configuration:

- Probe: ER3DV6 - SN2336; ConvF(1, 1, 1); Calibrated: 12/20/2005
- Sensor-Surface: (Fix Surface)
- Electronics: DAE4 Sn660; Calibrated: 3/1/2006
- Phantom: HAC Test Arch 4.6; Type: SD HAC P01 BA; Serial: 1002
- Measurement SW: DASY4, V4.7 Build 44; Postprocessing SW: SEMCAD, V1.8 Build 171

E Scan - Sensor Center 10mm above CD1880V3 Dipole/Hearing Aid Compatibility Test (41x181x1):

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

Maximum value of peak Total field = 137.4 V/m

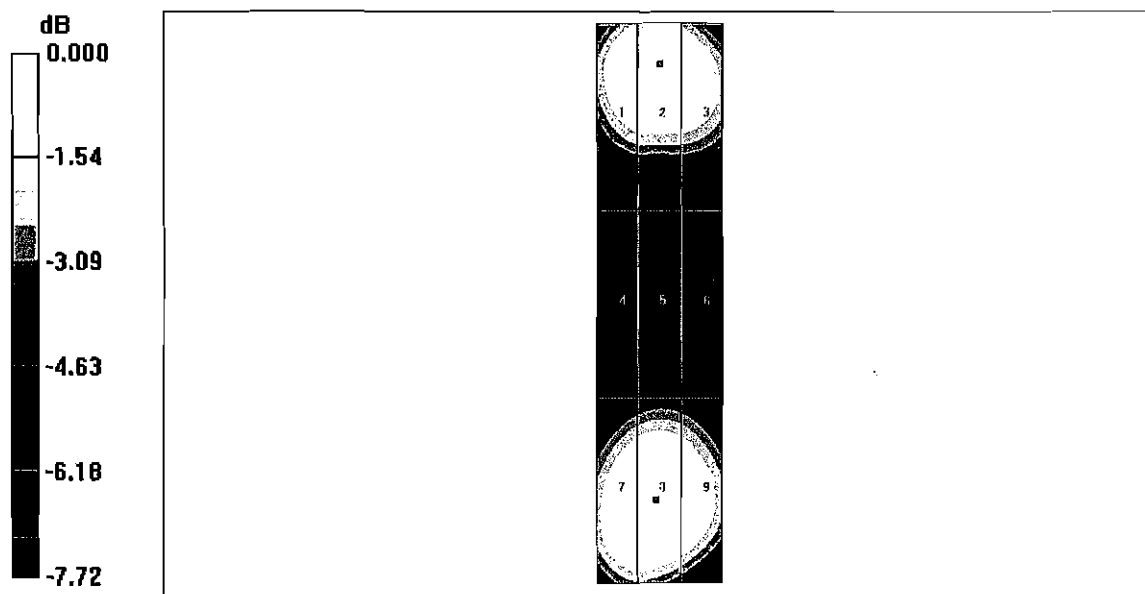
Probe Modulation Factor = 1.00

Reference Value = 132.3 V/m; Power Drift = -0.002 dB

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

Peak E-field in V/m

Grid 1	Grid 2	Grid 3
132.8	137.4	131.7
Grid 4	Grid 5	Grid 6
87.6	90.7	88.7
Grid 7	Grid 8	Grid 9
130.6	132.5	127.8



0 dB = 137.4V/m



D3: SYSTEM VALIDATION DIPOLE



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Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 108**

Client **ADT (Auden)**

Certificate No: **CD2450V3-1033_Jul06**

CALIBRATION CERTIFICATE

Object **CD2450V3 - SN: 1033**

Calibration procedure(s) **QA CAL-20.v4
Calibration procedure for dipoles in air**

Calibration date: **July 18, 2006**

Condition of the calibrated item **In Tolerance**

This calibration certificate documents the traceability to national standards, which realize the physical units of measurements (SI).
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 (Calibrated by, Certificate No.)	Scheduled Calibration
Power meter EPM-442A	GB37480704	04-Oct-05 (METAS, No. 251-00516)	Oct-06
Power sensor HP 8481A	US37292783	04-Oct-05 (METAS, No. 251-00516)	Oct-06
Reference 20 dB Attenuator	SN: 5086 (20g)	11-Aug-05 (METAS, No 251-00498)	Aug-06
Reference 10 dB Attenuator	SN: 5047.2 (10r)	11-Aug-05 (METAS, No 251-00498)	Aug-06
DAE4	SN: 660	1-Mar-06 (SPEAG, No. DAE4-660_Mar06)	Calibration, Mar-07
Probe ER3DV6	SN: 2336	20-Dec-05 (SPEAG, No. ER3-2336_Dec05)	Calibration, Dec-06
Probe H3DV6	SN: 6065	20-Dec-05 (SPEAG, No. H3-6065-Dec05)	Calibration, Dec-06
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power sensor HP 8481A	MY41092317	18-Oct-02 (SPEAG, in house check Oct-05)	In house check: Oct-07
RF generator Agilent E4421B	MY41000675	11-May-05 (SPEAG, in house check Nov-05)	In house check: Nov-07
Network Analyzer HP 8753E	US37390585 S4206	18-Oct-01 (SPEAG, in house check Nov-05)	In house check: Nov-06

Calibrated by: **Name** Mike Meili **Function** Laboratory Technician **Signature** *M. Meili*

Approved by: **Name** Fin Bornholt **Function** Technical Director **Signature** *F. Bornholt*

Issued: July 20, 2006

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Accreditation No.: **SCS 108**

References

- [1] ANSI-PC63.19-2001 (Draft 3.x, 2005)
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 standard [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 DASY4 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.

1 Measurement Conditions

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

DASY Version	DASY4	V4.7 B44
DASY PP Version	SEMCAD	V1.8 B171
Phantom	HAC Test Arch	SD HAC P01 BA, #1002
Distance Dipole Top - Probe Center	10 mm	
Scan resolution	dx, dy = 5 mm	area = 20 x 90 mm
Frequency	2450 MHz \pm 1 MHz	
Forward power at dipole connector	20.0 dBm = 100mW	
Input power drift	< 0.05 dB	

2 Maximum Field values

H-field 10 mm above dipole surface	condition	Interpolated maximum
Maximum measured	100 mW forward power	0.465 A/m

Uncertainty for H-field measurement: 8.2% (k=2)

E-field 10 mm above dipole surface	condition	Interpolated maximum
Maximum measured above high end	100 mW forward power	133.6 V/m
Maximum measured above low end	100 mW forward power	130.8 V/m
Averaged maximum above arm	100 mW forward power	132.2 V/m

Uncertainty for E-field measurement: 12.8% (k=2)

3 Appendix

3.1 Antenna Parameters

Frequency	Return Loss	Impedance
2250 MHz	16.6 dB	(58.4 + j13.8) Ohm
2350 MHz	27.6 dB	(54.4 - j0.1) Ohm
2450 MHz	29.8 dB	(53.1 - j1.4) Ohm
2550 MHz	33.9 dB	(51.9 + j0.8) Ohm
2650 MHz	17.3 dB	(64.4 - j6.0) Ohm

3.2 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.

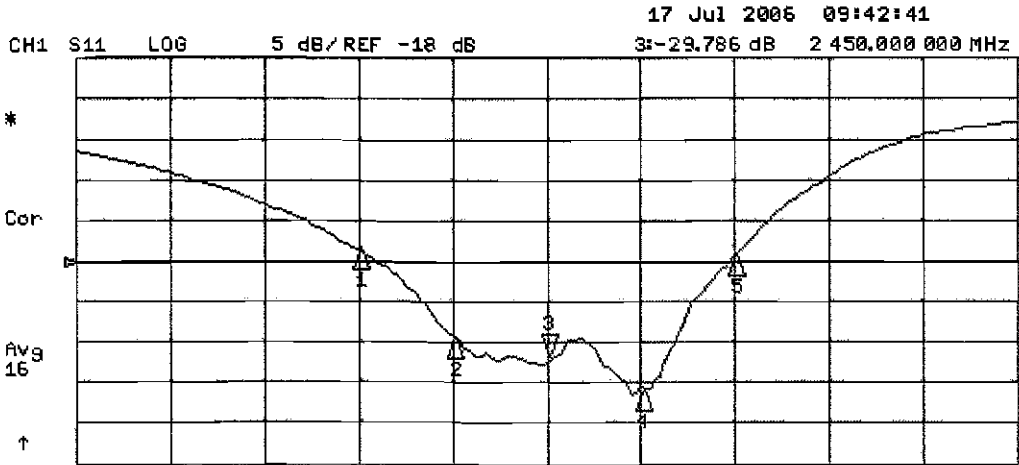
The dipole is built of standard semirigid coaxial cable. The internal matching line is open ended. The antenna is therefore open for DC signals.

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.

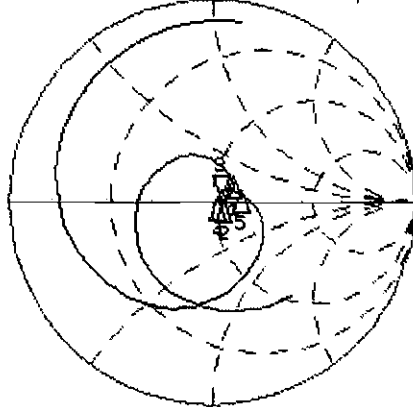
3.3 Measurement Sheets

3.3.1 Return Loss and Smith Chart



CH2 S11 1 U FS 3: 53.053 Ω 1.3574 Ω 88.180 ρ H 2 450.000 000 MHz

Del
Cor
Avg 16
↑



START 1 950.000 000 MHz

STOP 2 950.000 000 MHz

CH1 Markers

1: -16.618 dB
2.25000 GHz
2: -27.562 dB
2.35000 GHz
4: -33.862 dB
2.55000 GHz
5: -17.337 dB
2.65000 GHz

CH2 Markers

1: 53.053 Ω
13.781 Ω
2.25000 GHz
2: 54.357 Ω
-140.63 ρ H
2.35000 GHz
4: 51.916 Ω
0.7695 Ω
2.55000 GHz
5: 64.371 Ω
5.9648 Ω
2.65000 GHz

3.3.2 DASY4 H-field result

Date/Time: 18.07.2006 16:25:11

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: HAC Dipole 2450 MHz; Type: CD2450V3; Serial: CD2450V3 - SN:1033

Communication System: CW; Frequency: 2450 MHz; Duty Cycle: 1:1

Medium: Air

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

Phantom section: H Dipole Section

Measurement Standard: DASY4 (High Precision Assessment)

DASY4 Configuration:

- Probe: H3DV6 - SN6065; Calibrated: 20.12.2005
- Sensor-Surface: (Fix Surface)
- Electronics: DAE4 Sn660; Calibrated: 01.03.2006
- Phantom: HAC Test Arch 4.6; Type: SD HAC P01 BA;
- Measurement SW: DASY4, V4.7 Build 44; Postprocessing SW: SEMCAD, V1.8 Build 171

H Scan - Sensor Center 10mm above CD2450 Dipole/Hearing Aid Compatibility Test (41x181x1):

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

Maximum value of peak Total field = 0.465 A/m

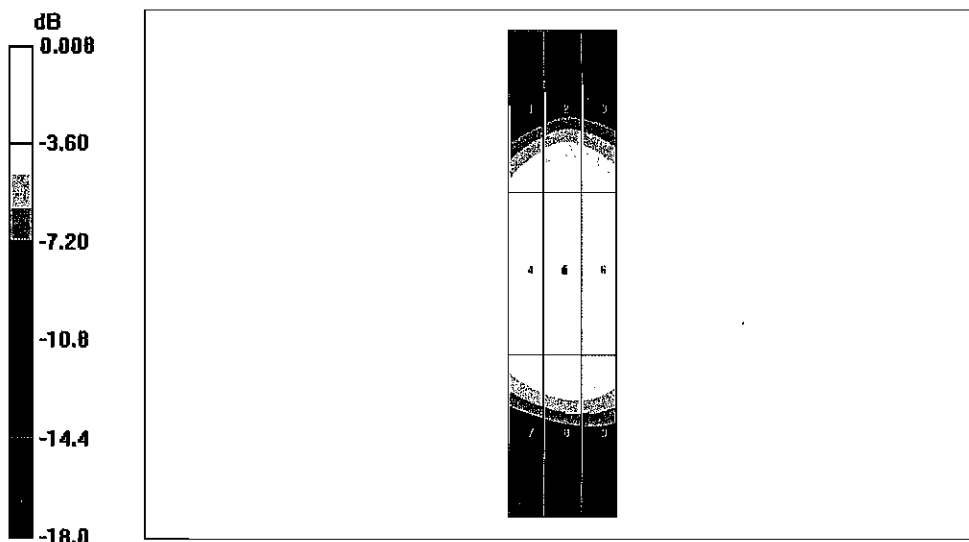
Probe Modulation Factor = 1.00

Reference Value = 0.492 A/m; Power Drift = -0.002 dB

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

Peak H-field in A/m

Grid 1	Grid 2	Grid 3
0.366	0.392	0.377
Grid 4	Grid 5	Grid 6
0.439	0.465	0.450
Grid 7	Grid 8	Grid 9
0.358	0.379	0.371



0 dB = 0.465 A/m

3.3.3 DASY4 E-Field result

Date/Time: 7/18/2006 2:04:16 PM

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: HAC Dipole 2450 MHz; Type: CD2450V3; Serial: CD2450V3 - SN:1033

Communication System: CW; Frequency: 2450 MHz; Duty Cycle: 1:1

Medium: Air

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

Phantom section: E Dipole Section

DASY4 Configuration:

- Probe: ER3DV6 - SN2336; ConvF(1, 1, 1); Calibrated: 12/20/2005
- Sensor-Surface: (Fix Surface)
- Electronics: DAE4 Sn660; Calibrated: 3/1/2006
- Phantom: HAC Test Arch 4.6; Type: SD HAC P01 BA; Serial: 1002
- Measurement SW: DASY4, V4.7 Build 44; Postprocessing SW: SEMCAD, V1.8 Build 171

E Scan - Sensor Center 10mm above CD2450 Dipole/Hearing Aid Compatibility Test (41x181x1):

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

Maximum value of peak Total field = 133.6 V/m

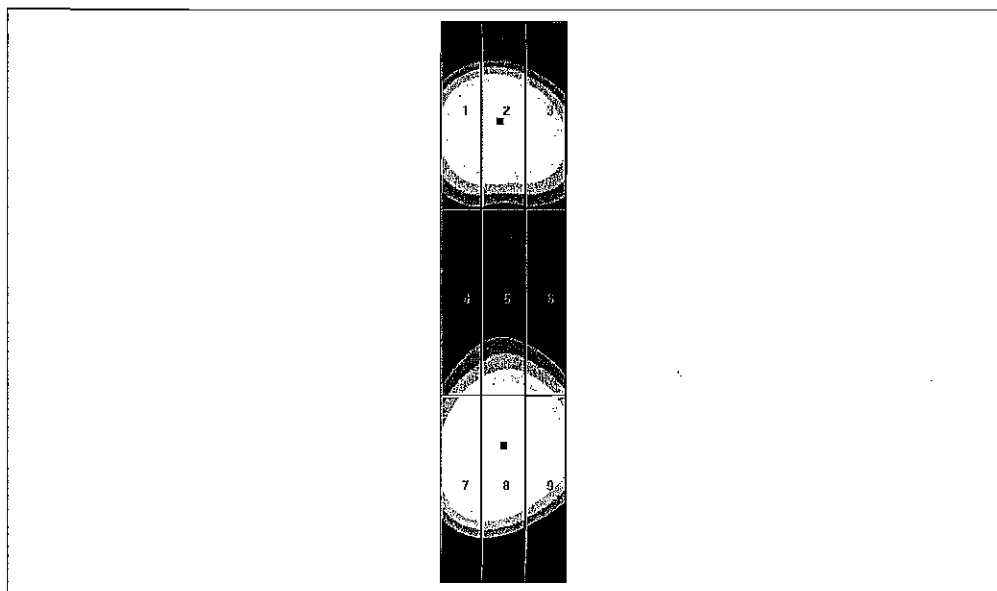
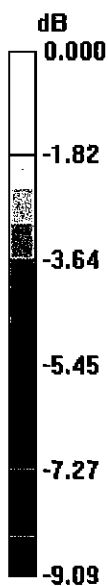
Probe Modulation Factor = 1.00

Reference Value = 79.2 V/m; Power Drift = 0.049 dB

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

Peak E-field in V/m

Grid 1	Grid 2	Grid 3
128.4	130.8	123.6
Grid 4	Grid 5	Grid 6
111.2	116.4	113.8
Grid 7	Grid 8	Grid 9
130.4	133.6	129.4



0 dB = 133.6 V/m