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

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Accreditation No.: SCS 108

Client Sporton-TW (Auden)

Certificate No: **ER3-2358_Jun12**

CALIBRATION CERTIFICATE

Object	ER3DV6 - SN:2358
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:	June 21, 2012

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	29-Mar-12 (No. 217-01508)	Apr-13
Power sensor E4412A	MY41498087	29-Mar-12 (No. 217-01508)	Apr-13
Reference 3 dB Attenuator	SN: S5054 (3c)	27-Mar-12 (No. 217-01531)	Apr-13
Reference 20 dB Attenuator	SN: S5086 (20b)	27-Mar-12 (No. 217-01529)	Apr-13
Reference 30 dB Attenuator	SN: S5129 (30b)	27-Mar-12 (No. 217-01532)	Apr-13
Reference Probe ER3DV6	SN: 2328	11-Oct-11 (No. ER3-2328_Oct11)	Oct-12
DAE4	SN: 789	30-Jan-12 (No. DAE4-789_Jan12)	Jan-13
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: June 21, 2012

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Accreditation No.: **SCS 108**

Glossary:

NORMx,y,z	sensitivity in free space
DCP	diode compression point
CF	crest factor (1/duty_cycle) of the RF signal
A, B, C	modulation dependent linearization parameters
Polarization φ	φ rotation around probe axis
Polarization ϑ	ϑ rotation around an axis that is in the plane normal to probe axis (at measurement center), i.e., $\vartheta = 0$ is normal to probe axis
Connector Angle	information used in DASY system to align probe sensor X to the robot coordinate system

Calibration is Performed According to the Following Standards:

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

Methods Applied and Interpretation of Parameters:

- *NORMx,y,z:* Assessed for E-field polarization $\vartheta = 0$ for XY sensors and $\vartheta = 90$ for Z sensor (f $\leq$ 900 MHz in TEM-cell; f > 1800 MHz: R22 waveguide).
- *NORM(f)x,y,z = NORMx,y,z * frequency_response* (see Frequency Response Chart).
- *DCPx,y,z:* DCP are numerical linearization parameters assessed based on the data of power sweep with CW signal (no uncertainty required). DCP does not depend on frequency nor media.
- *PAR:* PAR is the Peak to Average Ratio that is not calibrated but determined based on the signal characteristics
- *Ax,y,z; Bx,y,z; Cx,y,z, VRx,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 *NORMx* (no uncertainty required).

Probe ER3DV6

SN:2358

Manufactured: July 7, 2005
Calibrated: June 21, 2012

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

DASY/EASY - Parameters of Probe: ER3DV6 - SN:2358

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm (µV/(V/m)^2)	1.70	1.55	1.57	± 10.1 %
DCP (mV)[B]	98.8	99.0	102.3	

Modulation Calibration Parameters

UID	Communication System Name	PAR		A dB	B dB	C dB	VR mV	Unc[E] (k=2)
0	CW	0.00	X	0.00	0.00	1.00	204.2	±3.8 %
			Y	0.00	0.00	1.00	201.7	
			Z	0.00	0.00	1.00	188.3	
10011	UMTS-FDD (WCDMA)	3.40	X	3.49	65.8	18.4	120.1	±0.5 %
			Y	3.47	65.8	18.4	120.4	
			Z	3.31	65.1	17.9	110.1	
10021	GSM-FDD (TDMA, GMSK)	9.40	X	19.88	99.9	28.7	121.6	±1.9 %
			Y	20.54	100.0	28.7	125.4	
			Z	17.30	94.8	26.8	121.8	
10039	CDMA2000 (1xRTT, RC1)	4.57	X	4.72	66.3	19.1	119.0	±0.9 %
			Y	4.69	66.2	18.9	120.7	
			Z	4.75	67.2	19.4	147.6	
10042	IS-54 / IS-136 FDD (TDMA/FDM, PI/4-DQPSK, Halfrate)	7.78	X	28.22	95.6	24.2	102.8	±2.5 %
			Y	11.67	82.8	20.0	104.6	
			Z	13.01	83.3	20.2	98.4	
10056	UMTS-TDD (TD-SCDMA, 1.28 Mcps)	11.01	X	13.97	98.8	37.5	141.8	±3.5 %
			Y	14.17	98.9	37.4	144.4	
			Z	15.22	98.9	36.6	135.8	
10081	CDMA2000 (1xRTT, RC3)	3.96	X	3.83	65.3	18.4	118.3	±0.7 %
			Y	3.82	65.5	18.4	119.4	
			Z	3.99	67.0	19.2	147.7	
10082	IS-54 / IS-136 FDD (TDMA/FDM, PI/4-DQPSK, Fullrate)	4.77	X	45.52	99.5	22.7	117.8	±2.7 %
			Y	56.03	99.6	22.2	119.8	
			Z	50.02	99.8	22.6	109.6	
10100	LTE-FDD (SC-FDMA, 100% RB, 20 MHz, QPSK)	5.66	X	6.65	68.5	20.6	134.6	±2.2 %
			Y	6.62	68.5	20.6	136.4	
			Z	6.25	67.1	19.7	119.9	
10101	LTE-FDD (SC-FDMA, 100% RB, 20 MHz, 16-QAM)	6.41	X	7.82	69.0	21.2	146.1	±3.0 %
			Y	7.78	69.0	21.2	147.3	
			Z	7.37	67.6	20.2	129.8	
10108	LTE-FDD (SC-FDMA, 100% RB, 10 MHz, QPSK)	5.79	X	6.49	67.9	20.4	133.5	±2.2 %
			Y	6.51	68.1	20.5	134.9	
			Z	6.07	66.6	19.5	119.0	
10109	LTE-FDD (SC-FDMA, 100% RB, 10 MHz, 16-QAM)	6.42	X	7.56	68.7	21.1	142.7	±2.7 %
			Y	7.53	68.6	21.0	143.0	
			Z	7.10	67.3	20.1	126.7	

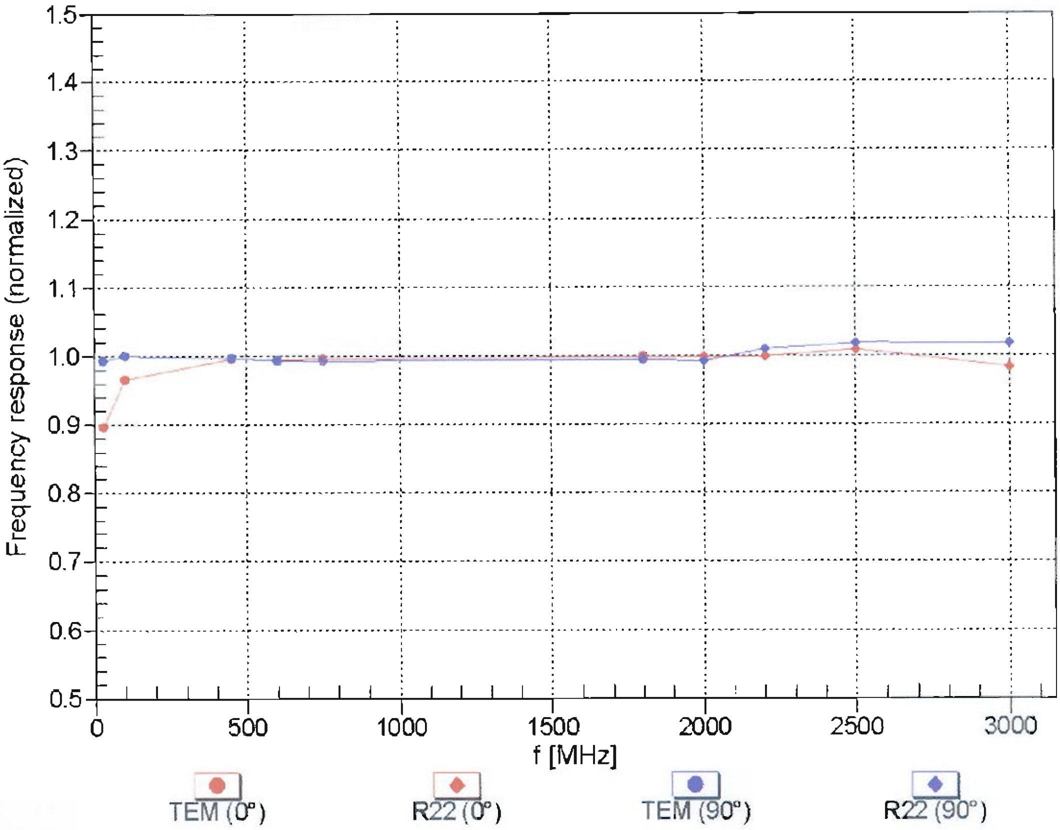
10110	LTE-FDD (SC-FDMA, 100% RB, 5 MHz, QPSK)	5.75	X	6.20	67.5	20.3	131.4	±1.9 %
			Y	6.13	67.2	20.1	131.1	
			Z	5.77	66.1	19.3	116.7	
10111	LTE-FDD (SC-FDMA, 100% RB, 5 MHz, 16-QAM)	6.44	X	7.26	68.2	20.9	138.5	±2.7 %
			Y	7.24	68.2	20.9	139.0	
			Z	6.83	67.1	20.0	123.0	
10139	LTE-FDD (SC-FDMA, 100% RB, 15 MHz, QPSK)	6.14	X	7.30	69.0	21.1	140.1	±2.7 %
			Y	7.27	68.9	21.1	140.4	
			Z	6.81	67.3	20.0	124.7	
10140	LTE-FDD (SC-FDMA, 100% RB, 15 MHz, 16-QAM)	6.49	X	8.03	69.2	21.4	148.3	±3.3 %
			Y	7.99	69.1	21.3	148.7	
			Z	7.56	67.8	20.4	132.2	
10142	LTE-FDD (SC-FDMA, 100% RB, 3 MHz, QPSK)	5.73	X	6.00	67.1	20.0	128.3	±1.7 %
			Y	5.99	67.1	20.1	129.3	
			Z	5.58	65.8	19.2	114.2	
10143	LTE-FDD (SC-FDMA, 100% RB, 3 MHz, 16-QAM)	6.35	X	7.02	68.1	20.8	135.3	±2.7 %
			Y	7.00	68.0	20.8	136.5	
			Z	6.56	66.9	19.9	119.4	
10145	LTE-FDD (SC-FDMA, 100% RB, 1.4 MHz, QPSK)	5.76	X	5.74	66.7	19.9	124.5	±1.7 %
			Y	5.70	66.6	19.8	126.2	
			Z	5.38	65.8	19.2	110.7	
10146	LTE-FDD (SC-FDMA, 100% RB, 1.4 MHz, 16-QAM)	6.42	X	6.76	68.0	20.8	129.3	±2.5 %
			Y	6.72	67.9	20.7	131.3	
			Z	6.31	66.9	20.0	113.6	
10148	LTE-FDD (SC-FDMA, 50% RB, 20 MHz, QPSK)	5.83	X	6.59	68.1	20.6	133.8	±2.2 %
			Y	6.61	68.2	20.6	135.5	
			Z	6.15	66.6	19.6	119.0	
10149	LTE-FDD (SC-FDMA, 50% RB, 20 MHz, 16-QAM)	6.42	X	7.58	68.8	21.2	141.8	±3.0 %
			Y	7.49	68.5	21.0	143.7	
			Z	7.09	67.3	20.1	125.4	
10154	LTE-FDD (SC-FDMA, 50% RB, 10 MHz, QPSK)	5.76	X	6.20	67.4	20.3	130.1	±1.9 %
			Y	6.19	67.4	20.2	131.5	
			Z	5.75	66.0	19.3	115.4	
10155	LTE-FDD (SC-FDMA, 50% RB, 10 MHz, 16-QAM)	6.43	X	7.28	68.3	21.0	138.5	±2.7 %
			Y	7.25	68.2	20.9	139.0	
			Z	6.79	66.9	20.0	122.1	
10156	LTE-FDD (SC-FDMA, 50% RB, 5 MHz, QPSK)	5.79	X	5.98	67.1	20.2	127.4	±1.9 %
			Y	5.94	66.9	20.0	127.7	
			Z	5.56	65.8	19.3	112.8	
10157	LTE-FDD (SC-FDMA, 50% RB, 5 MHz, 16-QAM)	6.49	X	7.06	68.2	21.0	134.2	±2.7 %
			Y	7.01	68.1	20.9	133.4	
			Z	6.54	66.8	19.9	117.2	
10160	LTE-FDD (SC-FDMA, 50% RB, 15 MHz, QPSK)	5.81	X	6.64	68.0	20.4	135.9	±2.2 %
			Y	6.61	67.9	20.4	135.1	
			Z	6.20	66.6	19.5	121.1	

10161	LTE-FDD (SC-FDMA, 50% RB, 15 MHz, 16-QAM)	6.42	X	7.61	68.7	21.1	143.4	±3.0 %
			Y	7.57	68.6	21.0	141.9	
			Z	7.14	67.4	20.1	127.4	
10163	LTE-FDD (SC-FDMA, 50% RB, 3 MHz, QPSK)	5.68	X	5.81	67.0	20.0	125.7	±1.7 %
			Y	5.74	66.7	19.8	125.4	
			Z	5.41	65.8	19.2	112.7	
10164	LTE-FDD (SC-FDMA, 50% RB, 3 MHz, 16-QAM)	6.44	X	6.90	68.1	20.9	130.8	±2.5 %
			Y	6.87	68.0	20.8	130.7	
			Z	6.41	66.9	20.0	115.8	
10166	LTE-FDD (SC-FDMA, 50% RB, 1.4 MHz, QPSK)	5.45	X	5.08	66.0	19.4	118.9	±1.4 %
			Y	5.10	66.2	19.5	119.3	
			Z	5.23	67.3	20.1	149.7	
10167	LTE-FDD (SC-FDMA, 50% RB, 1.4 MHz, 16-QAM)	6.21	X	6.19	67.8	20.7	121.9	±2.2 %
			Y	6.13	67.6	20.5	123.4	
			Z	5.77	66.6	19.7	109.5	

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

[B] Numerical linearization parameter: uncertainty not required.
[E] Uncertainty is determined using the max. deviation from linear response applying rectangular distribution and is expressed for the square of the field value.

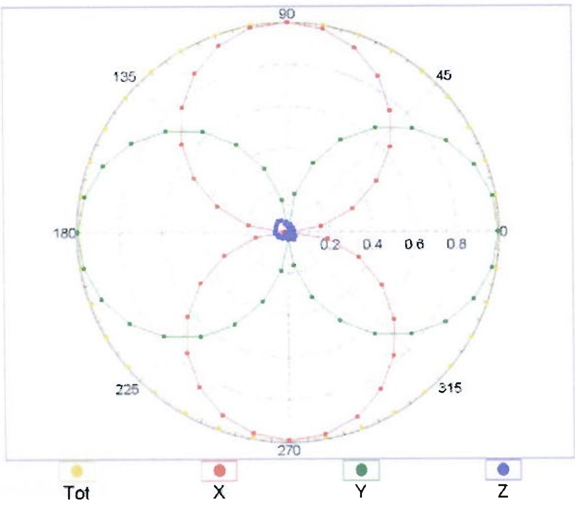
Frequency Response of E-Field
(TEM-Cell:ifi110 EXX, Waveguide: R22)



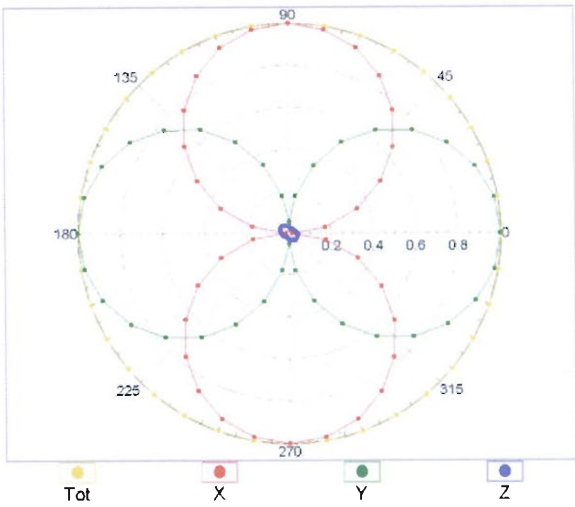
Uncertainty of Frequency Response of E-field: ± 6.3% (k=2)

Receiving Pattern (ϕ), $\vartheta = 0°$

f=600 MHz,TEM,0°

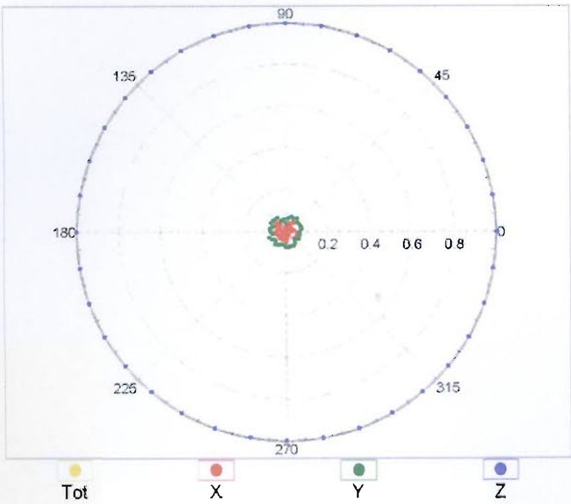


f=2500 MHz,R22,0°

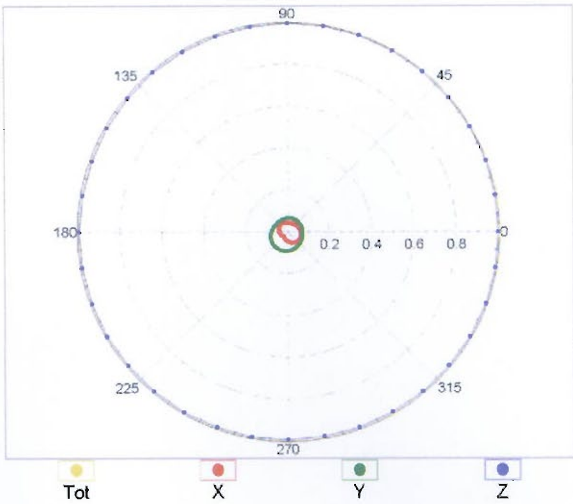


Receiving Pattern (ϕ), $\vartheta = 90°$

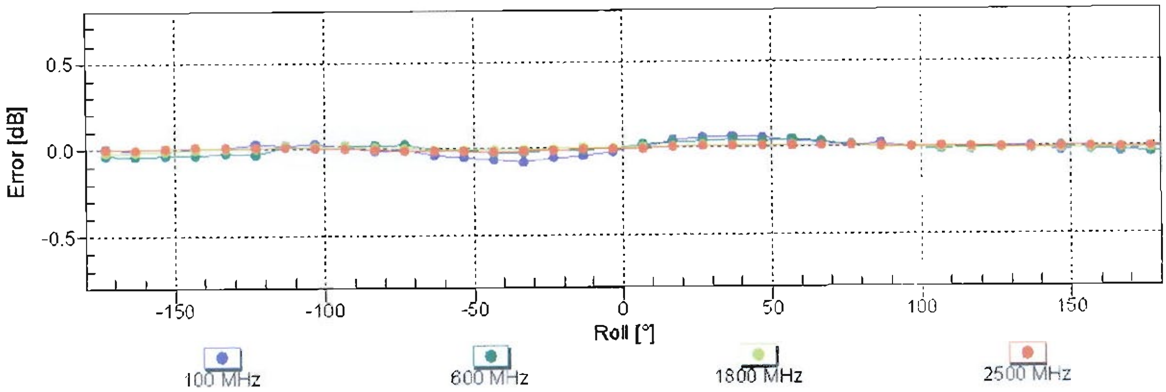
f=600 MHz,TEM,90°



f=2500 MHz,R22,90°

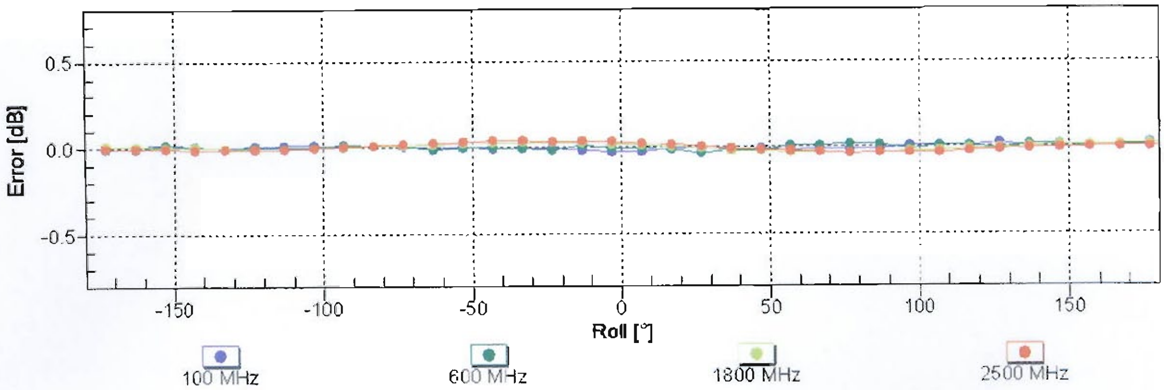


Receiving Pattern (ϕ), ϑ = 0°



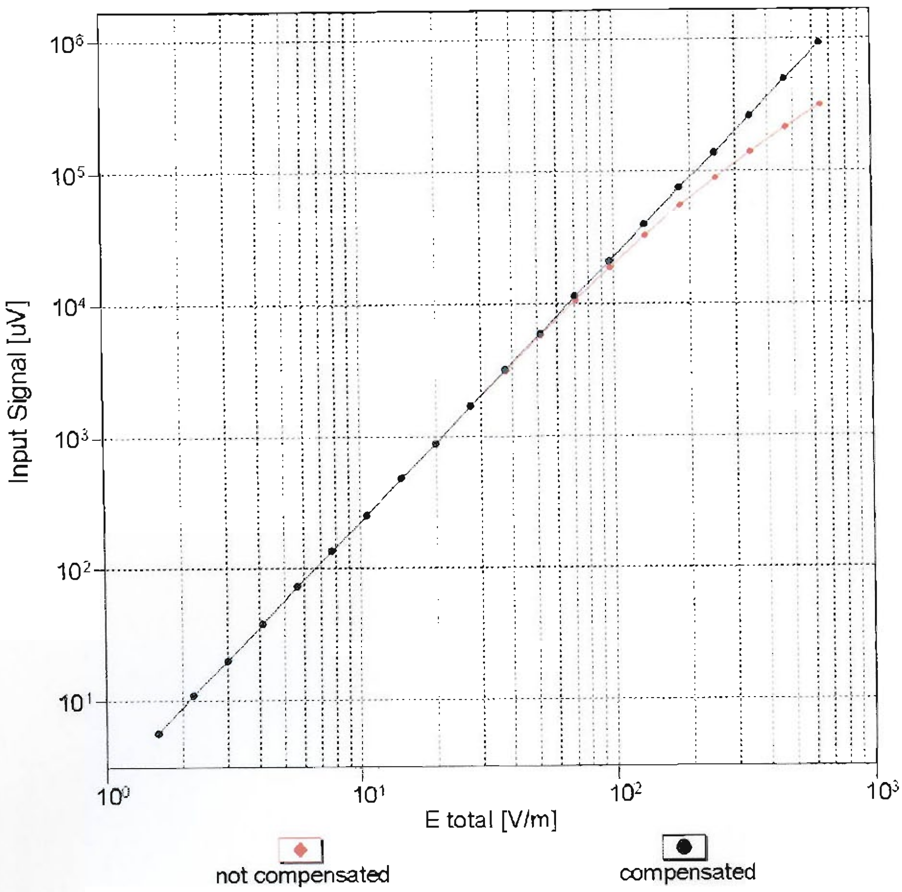
Uncertainty of Axial Isotropy Assessment: ± 0.5% (k=2)

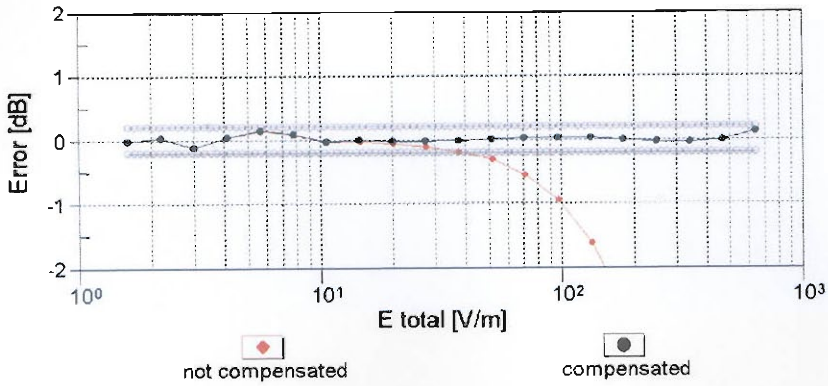
Receiving Pattern (ϕ), ϑ = 90°



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

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

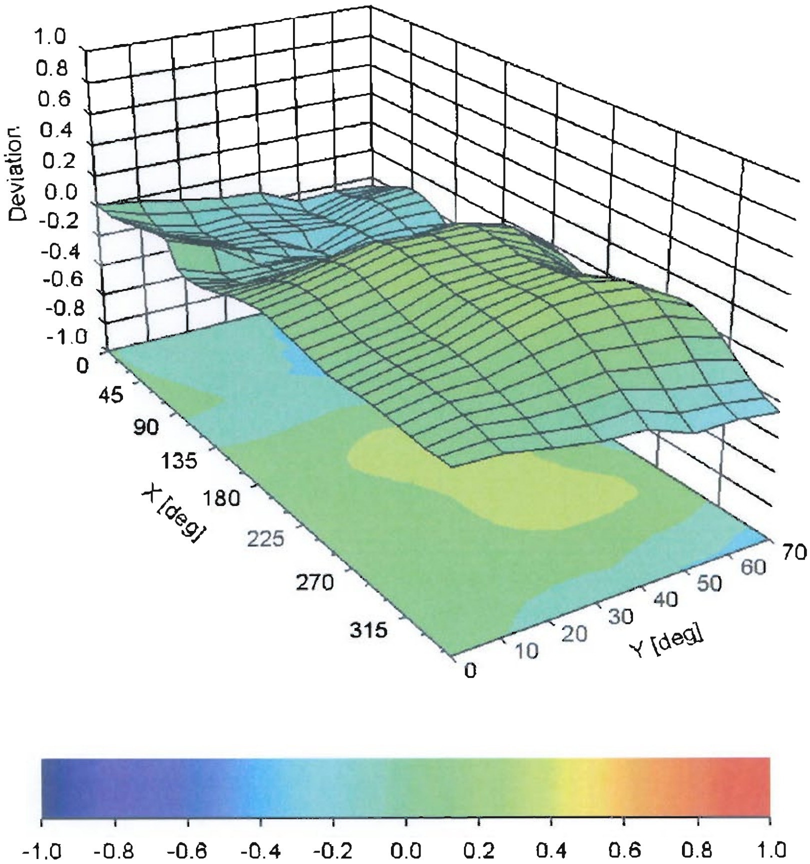




Uncertainty of Linearity Assessment: ± 0.6% (k=2)

Deviation from Isotropy in Air

Error (ϕ, ϑ), f = 900 MHz



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

DASY/EASY - Parameters of Probe: ER3DV6 - SN:2358

Other Probe Parameters

Sensor Arrangement	Rectangular
Connector Angle (°)	-63.2
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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Accreditation No.: SCS 108

Client Sporton-TW (Auden)

Certificate No: CD835V3-1045_Jun12

CALIBRATION CERTIFICATE

Object	CD835V3 - SN: 1045
Calibration procedure(s)	QA CAL-20.v6 Calibration procedure for dipoles in air
Calibration date:	June 14, 2012

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-11 (No. ER3-2336_Dec11)	Dec-12
Probe H3DV6	SN: 6065	29-Dec-11 (No. H3-6065_Dec11)	Dec-12
DAE4	SN: 781	29-May-12 (No. DAE4-781_May12)	May-13

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

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

Issued: June 18, 2012

References

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

[2] ANSI-C63.19-2011
American National Standard, 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 (15 mm for [2]) above the top metal 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 eliminating 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] and [2], the scan area is 20mm wide, its length exceeds the dipole arm length (180 or 90mm). The sensor center is 10 mm (15 mm for [2]) (in z) above the metal 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, in the plane 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.

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 cresponds to a coverage probability of approximately 95%.

Measurement Conditions

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

DASY Version	DASY5	V52.8.1
Extrapolation	Advanced Extrapolation	
Phantom	HAC Test Arch	
Distance Dipole Top - Probe Center	10mm 15mm	
Scan resolution	dx, dy = 5 mm	
Frequency	835 MHz ± 1 MHz	
Input power drift	< 0.05 dB	

Maximum Field values at 835 MHz

H-field 10 mm above dipole surface	condition	**interpolated maximum**
Maximum measured	100 mW input power	**0.455 A / m ± 8.2 % (k=2)**

E-field 10 mm above dipole surface	condition	**Interpolated maximum**
Maximum measured above high end	100 mW input power	173.2 V / m
Maximum measured above low end	100 mW input power	162.0 V / m
Averaged maximum above arm	100 mW input power	**167.6 V / m ± 12.8 % (k=2)**

E-field 15 mm above dipole surface	condition	**Interpolated maximum**
Maximum measured above high end	100 mW input power	109.5 V / m
Maximum measured above low end	100 mW input power	105.8 V / m
Averaged maximum above arm	100 mW input power	**107.7 V / m ± 12.8 % (k=2)**

Appendix

Antenna Parameters

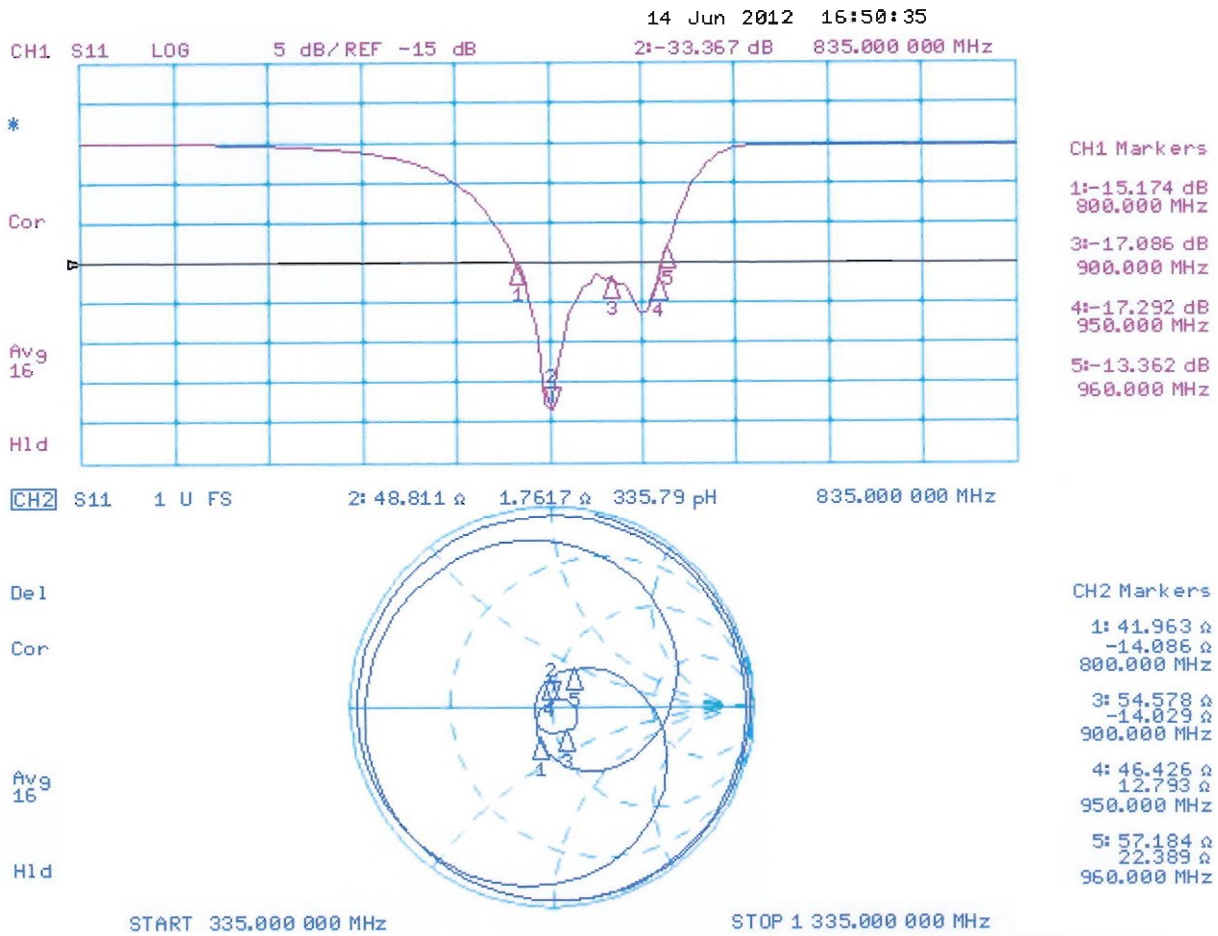
Frequency	Return Loss	Impedance
800 MHz	15.2 dB	42.0 Ω - 14.1 jΩ
835 MHz	33.4 dB	48.8 Ω + 1.8 jΩ
900 MHz	17.1 dB	54.6 Ω - 14.0 jΩ
950 MHz	17.3 dB	46.4 Ω + 12.8 jΩ
960 MHz	13.4 dB	57.2 Ω + 22.4 jΩ

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.

Impedance Measurement Plot



DASY4 H-field Result

Date: 14.06.2012

Test Laboratory: SPEAG Lab2

DUT: HAC-Dipole 835 MHz; Type: CD835V3; Serial: CD835V3 - SN: 1045

Communication System: CW; Frequency: 835 MHz
Medium parameters used: $\sigma = 0$ mho/m, $\varepsilon_r = 1$; $\rho = 1$ kg/m^3
Phantom section: RF Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

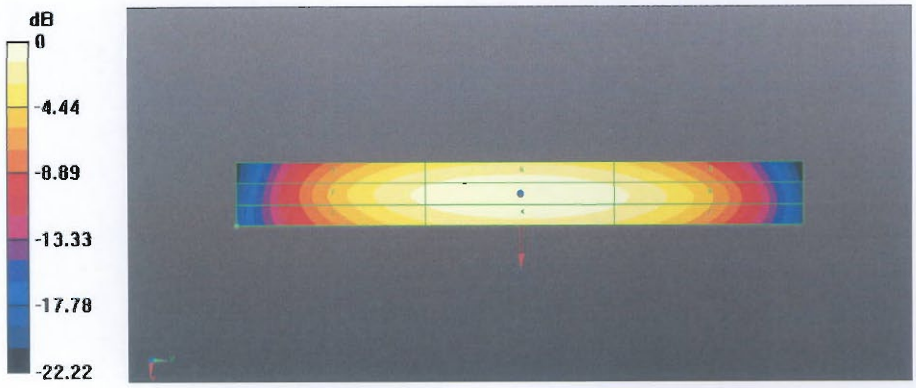
DASY52 Configuration:

- Probe: H3DV6 - SN6065; ; Calibrated: 29.12.2011
- Sensor-Surface: (Fix Surface)
- Electronics: DAE4 Sn781; Calibrated: 29.05.2012
- Phantom: HAC Test Arch with AMCC; Type: SD HAC P01 BA; Serial: 1070
- DASY52 52.8.1(838); SEMCAD X 14.6.5(6469)

Dipole H-Field measurement @ 835MHz/H-Scan - 835MHz d=10mm/Hearing Aid Compatibility Test (41x361x1):
Measurement grid: dx=5mm, dy=5mm
Device Reference Point: 0, 0, -6.3 mm
Reference Value = 0.4840 A/m; Power Drift = 0.01 dB
PMR not calibrated. PMF = 1.000 is applied.
H-field emissions = 0.4547 A/m
Near-field category: M4 (AWF 0 dB)

PMF scaled H-field

Grid 1 **M4** **0.386 A/m**	Grid 2 **M4** **0.403 A/m**	Grid 3 **M4** **0.376 A/m**
Grid 4 **M4** **0.437 A/m**	Grid 5 **M4** **0.455 A/m**	Grid 6 **M4** **0.423 A/m**
Grid 7 **M4** **0.391 A/m**	Grid 8 **M4** **0.403 A/m**	Grid 9 **M4** **0.370 A/m**



0 dB = 0.4547 A/m = -6.85 dB A/m

DASY4 E-field Result

Date: 14.06.2012

Test Laboratory: SPEAG Lab2

DUT: HAC-Dipole 835 MHz; Type: CD835V3; Serial: CD835V3 - SN: 1045

Communication System: CW; Frequency: 835 MHz
Medium parameters used: $\sigma = 0$ mho/m, $\varepsilon_r = 1$; $\rho = 1000$ kg/m^3
Phantom section: RF Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

- Probe: ER3DV6 - SN2336; ConvF(1, 1, 1); Calibrated: 29.12.2011;
- Sensor-Surface: (Fix Surface)
- Electronics: DAE4 Sn781; Calibrated: 29.05.2012
- Phantom: HAC Test Arch with AMCC; Type: SD HAC P01 BA; Serial: 1070
- DASY52 52.8.1(838); SEMCAD X 14.6.5(6469)

Dipole E-Field measurement @ 835MHz/E-Scan - 835MHz d=10mm/Hearing Aid Compatibility Test (41x361x1):
Measurement grid: dx=5mm, dy=5mm
Device Reference Point: 0, 0, -6.3 mm
Reference Value = 110.5 V/m; Power Drift = -0.01 dB
PMR not calibrated. PMF = 1.000 is applied.
E-field emissions = 173.2 V/m
Near-field category: M4 (AWF 0 dB)

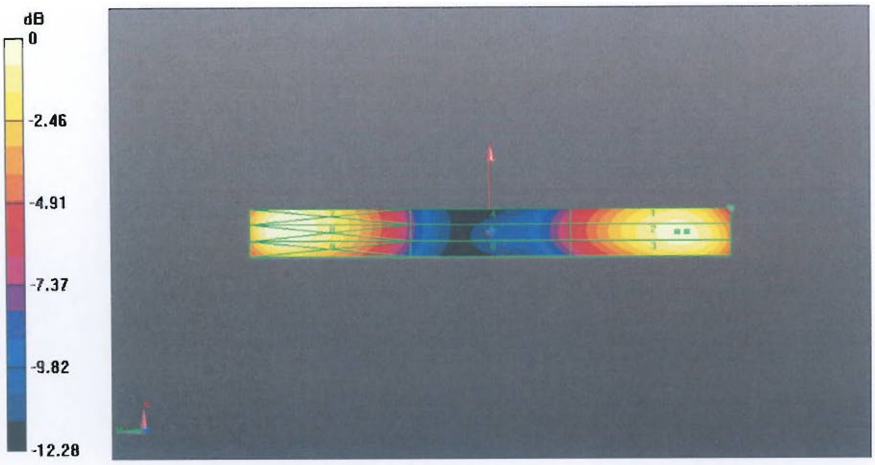
PMF scaled E-field

Grid 1 **M4** **156.7 V/m**	Grid 2 **M4** **162.0 V/m**	Grid 3 **M4** **157.7 V/m**
Grid 4 **M4** **85.93 V/m**	Grid 5 **M4** **87.68 V/m**	Grid 6 **M4** **83.94 V/m**
Grid 7 **M4** **171.2 V/m**	Grid 8 **M4** **173.2 V/m**	Grid 9 **M4** **158.0 V/m**

Dipole E-Field measurement @ 835MHz/E-Scan - 835MHz d=15mm/Hearing Aid Compatibility Test (41x361x1):
Measurement grid: dx=5mm, dy=5mm
Device Reference Point: 0, 0, -6.3 mm
Reference Value = 110.4 V/m; Power Drift = -0.01 dB
PMR not calibrated. PMF = 1.000 is applied.
E-field emissions = 105.8 V/m
Near-field category: M4 (AWF 0 dB)

PMF scaled E-field

Grid 1 **M4** **103.8 V/m**	Grid 2 **M4** **105.8 V/m**	Grid 3 **M4** **104.5 V/m**
Grid 4 **M4** **62.22 V/m**	Grid 5 **M4** **62.87 V/m**	Grid 6 **M4** **61.54 V/m**
Grid 7 **M4** **109.1 V/m**	Grid 8 **M4** **109.5 V/m**	Grid 9 **M4** **104.3 V/m**



0 dB = 173.2 V/m = 44.77 dB V/m

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

S Schweizerischer Kalibrierdienst
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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 Sporton-TW (Auden)

Certificate No: CD1880V3-1038_Jun12

CALIBRATION CERTIFICATE

Object	CD1880V3 - SN: 1038
Calibration procedure(s)	QA CAL-20.v6 Calibration procedure for dipoles in air
Calibration date:	June 14, 2012

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-11 (No. ER3-2336_Dec11)	Dec-12
Probe H3DV6	SN: 6065	29-Dec-11 (No. H3-6065_Dec11)	Dec-12
DAE4	SN: 781	29-May-12 (No. DAE4-781_May12)	May-13

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

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

Issued: June 18, 2012

References

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

[2] ANSI-C63.19-2011
American National Standard, 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 (15 mm for [2]) above the top metal 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 eliminating 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] and [2], the scan area is 20mm wide, its length exceeds the dipole arm length (180 or 90mm). The sensor center is 10 mm (15 mm for [2]) (in z) above the metal 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, in the plane 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.

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 cresponds to a coverage probability of approximately 95%.

Measurement Conditions

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

DASY Version	DASY5	V52.8.1
Extrapolation	Advanced Extrapolation	
Phantom	HAC Test Arch	
Distance Dipole Top - Probe Center	10mm 15mm	
Scan resolution	dx, dy = 5 mm	
Frequency	1880 MHz ± 1 MHz	
Input power drift	< 0.05 dB	

Maximum Field values at 1880 MHz

H-field 10 mm above dipole surface	condition	**interpolated maximum**
Maximum measured	100 mW input power	**0.463 A / m ± 8.2 % (k=2)**

E-field 10 mm above dipole surface	condition	**Interpolated maximum**
Maximum measured above high end	100 mW input power	139.9 V / m
Maximum measured above low end	100 mW input power	138.1 V / m
Averaged maximum above arm	100 mW input power	**139.0 V / m ± 12.8 % (k=2)**

E-field 15 mm above dipole surface	condition	**Interpolated maximum**
Maximum measured above high end	100 mW input power	90.4 V / m
Maximum measured above low end	100 mW input power	88.0 V / m
Averaged maximum above arm	100 mW input power	**89.2 V / m ± 12.8 % (k=2)**

Appendix

Antenna Parameters

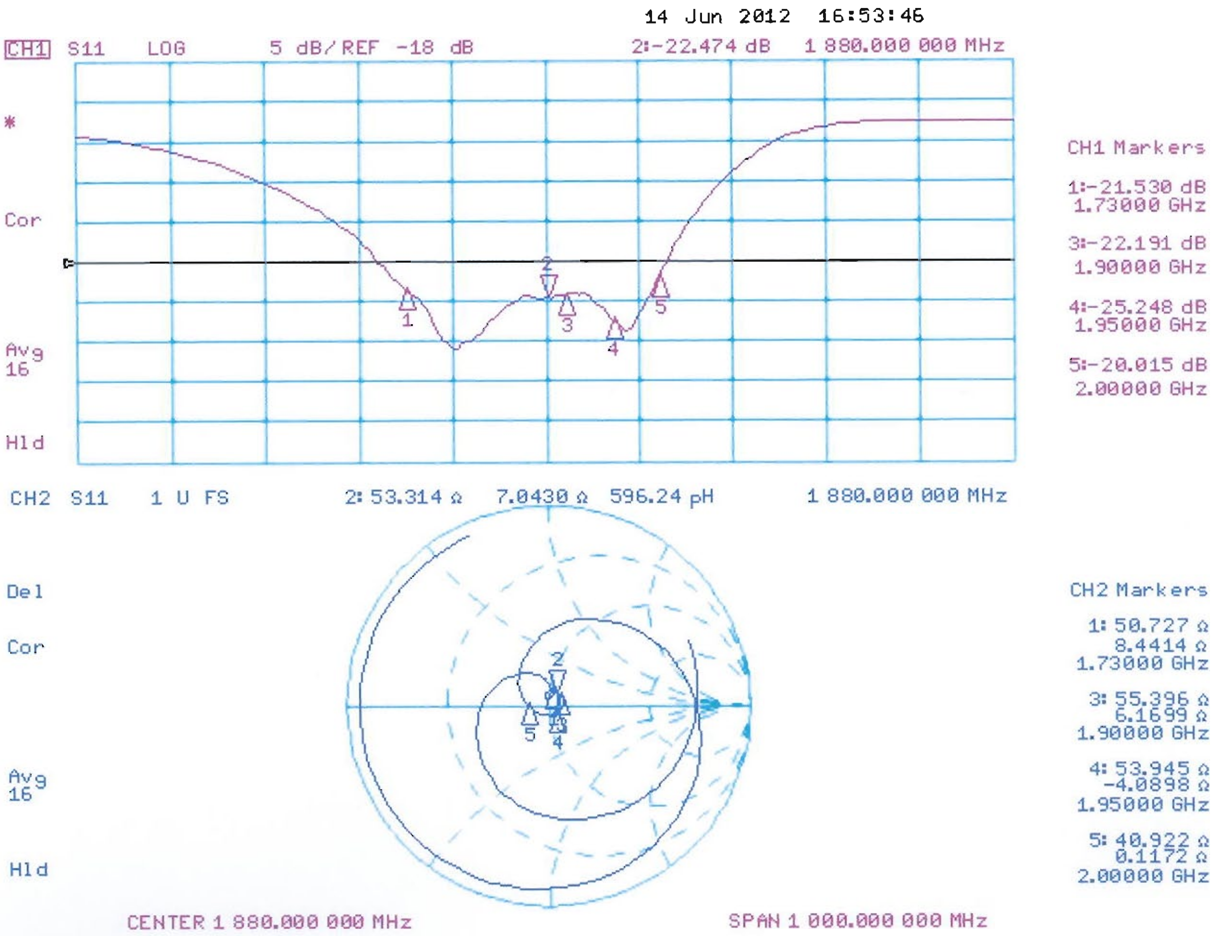
Frequency	Return Loss	Impedance
1730 MHz	21.5 dB	50.7 Ω + 8.4 jΩ
1880 MHz	22.5 dB	53.3 Ω + 7.0 jΩ
1900 MHz	22.2 dB	55.4 Ω + 6.2 jΩ
1950 MHz	25.2 dB	53.9 Ω - 4.1 jΩ
2000 MHz	20.0 dB	40.9 Ω + 0.1 jΩ

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.

Impedance Measurement Plot



DASY4 H-field Result

Date: 14.06.2012

Test Laboratory: SPEAG Lab2

DUT: HAC Dipole 1880 MHz; Type: CD1880V3; Serial: CD1880V3 - SN: 1038

Communication System: CW; Frequency: 1880 MHz
Medium parameters used: $\sigma = 0$ mho/m, $\varepsilon_r = 1$; $\rho = 1$ kg/m^3
Phantom section: RF Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

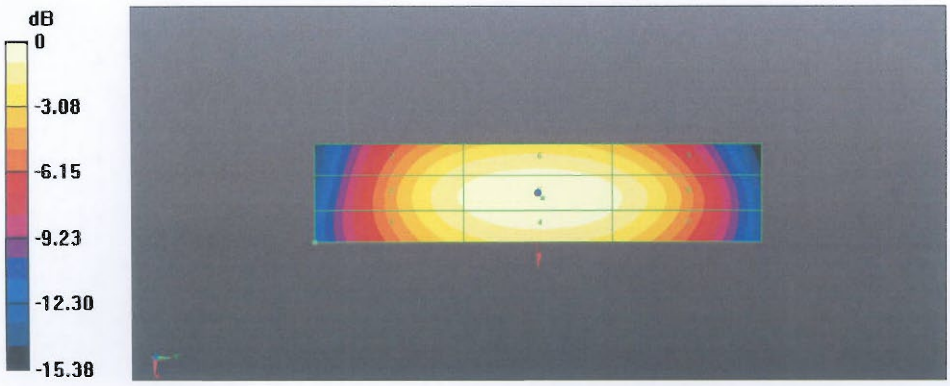
DASY52 Configuration:

- Probe: H3DV6 - SN6065; ; Calibrated: 29.12.2011
- Sensor-Surface: (Fix Surface)
- Electronics: DAE4 Sn781; Calibrated: 29.05.2012
- Phantom: HAC Test Arch with AMCC; Type: SD HAC P01 BA; Serial: 1070
- DASY52 52.8.1(838); SEMCAD X 14.6.5(6469)

Dipole H-Field measurement @ 1880MHz/H-Scan - 1880MHz d=10mm/Hearing Aid Compatibility Test (41x181x1):
Measurement grid: dx=5mm, dy=5mm
Device Reference Point: 0, 0, -6.3 mm
Reference Value = 0.4900 A/m; Power Drift = 0.01 dB
PMR not calibrated. PMF = 1.000 is applied.
H-field emissions = 0.4633 A/m
Near-field category: M2 (AWF 0 dB)

PMF scaled H-field

Grid 1 **M2** 0.409 A/m	Grid 2 **M2** 0.420 A/m	Grid 3 **M2** 0.394 A/m
Grid 4 **M2** 0.451 A/m	Grid 5 **M2** 0.463 A/m	Grid 6 **M2** 0.432 A/m
Grid 7 **M2** **0.415 A/m**	Grid 8 **M2** 0.427 A/m	Grid 9 **M2** 0.393 A/m



0 dB = 0.4633 A/m = -6.68 dB A/m

DASY4 E-field Result

Date: 14.06.2012

Test Laboratory: SPEAG Lab2

DUT: HAC Dipole 1880 MHz; Type: CD1880V3; Serial: CD1880V3 - SN: 1038

Communication System: CW; Frequency: 1880 MHz
Medium parameters used: $\sigma = 0$ mho/m, $\varepsilon_r = 1$; $\rho = 1000$ kg/m^3
Phantom section: RF Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

- Probe: ER3DV6 - SN2336; ConvF(1, 1, 1); Calibrated: 29.12.2011
- Sensor-Surface: (Fix Surface)
- Electronics: DAE4 Sn781; Calibrated: 29.05.2012
- Phantom: HAC Test Arch with AMCC; Type: SD HAC P01 BA; Serial: 1070
- DASY52 52.8.1(838); SEMCAD X 14.6.5(6469)

Dipole E-Field measurement @ 1880MHz/E-Scan - 1880MHz d=10mm/Hearing Aid Compatibility Test (41x181x1):
Measurement grid: dx=5mm, dy=5mm
Device Reference Point: 0, 0, -6.3 mm
Reference Value = 157.8 V/m; Power Drift = -0.00 dB
PMR not calibrated. PMF = 1.000 is applied.
E-field emissions = 139.9 V/m
Near-field category: M2 (AWF 0 dB)

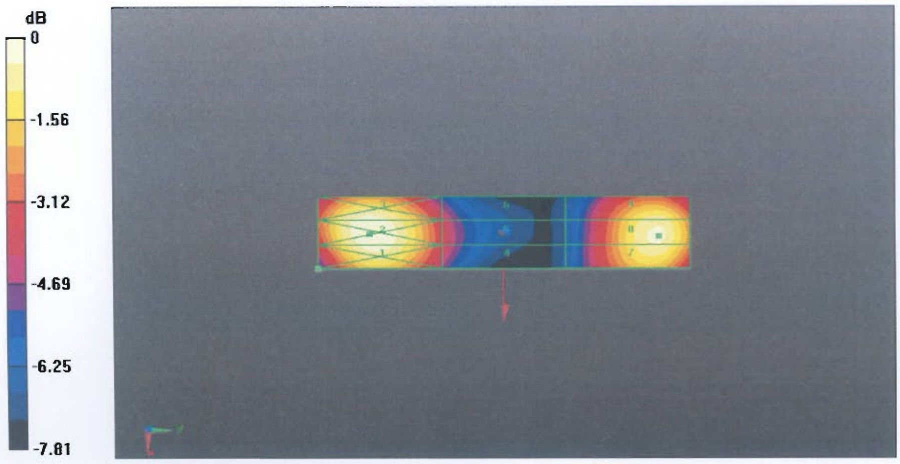
PMF scaled E-field

Grid 1 **M2** **134.4 V/m**	Grid 2 **M2** **138.1 V/m**	Grid 3 **M2** **133.2 V/m**
Grid 4 **M3** **89.96 V/m**	Grid 5 **M3** **91.35 V/m**	Grid 6 **M3** **86.69 V/m**
Grid 7 **M2** **136.5 V/m**	Grid 8 **M2** **139.9 V/m**	Grid 9 **M2** **132.2 V/m**

Dipole E-Field measurement @ 1880MHz/E-Scan - 1880MHz d=15mm/Hearing Aid Compatibility Test (41x181x1):
Measurement grid: dx=5mm, dy=5mm
Device Reference Point: 0, 0, -6.3 mm
Reference Value = 157.7 V/m; Power Drift = 0.02 dB
PMR not calibrated. PMF = 1.000 is applied.
E-field emissions = 87.97 V/m
Near-field category: M3 (AWF 0 dB)

PMF scaled E-field

Grid 1 **M3** 89.00 V/m	Grid 2 **M3** 90.38 V/m	Grid 3 **M3** 88.77 V/m
Grid 4 **M3** 69.82 V/m	Grid 5 **M3** 70.24 V/m	Grid 6 **M3** 68.73 V/m
Grid 7 **M3** 87.06 V/m	Grid 8 **M3** 87.97 V/m	Grid 9 **M3** 85.67 V/m



0 dB = 139.9 V/m = 42.92 dB V/m

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

S **Schweizerischer Kalibrierdienst**
C **Service suisse d'étalonnage**
S **Servizio svizzero di taratura**
Swiss Calibration Service

Accredited by the Swiss Accreditation Service (SAS)
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 **Sporton-TW (Auden)**

Certificate No: CD1880V3-1038_Nov12

CALIBRATION CERTIFICATE

Object	CD1880V3 - SN: 1038
Calibration procedure(s)	QA CAL-20.v6 Calibration procedure for dipoles in air
Calibration date:	November 13, 2012

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	01-Nov-12 (No. 217-01640)	Oct-13
Power sensor HP 8481A	US37292783	01-Nov-12 (No. 217-01640)	Oct-13
Reference 10 dB Attenuator	SN: 5047.2 (10q)	27-Mar-12 (No. 217-01527)	Apr-13
Probe ER3DV6	SN: 2336	29-Dec-11 (No. ER3-2336_Dec11)	Dec-12
Probe H3DV6	SN: 6065	29-Dec-11 (No. H3-6065_Dec11)	Dec-12
DAE4	SN: 781	29-May-12 (No. DAE4-781_May12)	May-13

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power meter Agilent 4419B	SN: GB42420191	09-Oct-09 (in house check Oct-12)	In house check: Oct-13
Power sensor HP E4412A	SN: MY41495277	01-Apr-08 (in house check Oct-12)	In house check: Oct-13
Power sensor HP 8482A	SN: US37295597	09-Oct-09 (in house check Oct-12)	In house check: Oct-13
Network Analyzer HP 8753E	US37390585	18-Oct-01 (in house check Oct-12)	In house check: Oct-13
RF generator R&S SMT-06	SN: 832283/011	27-Aug-12 (in house check Oct-12)	In house check: Oct-14

	Name	Function	Signature
Calibrated by:	Dimce Iliev	Laboratory Technician	D. Iliev
Approved by:	Fin Bomholt	R&D Director	F. Bomholt

Issued: November 14, 2012

References

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

[2] ANSI-C63.19-2011
American National Standard, 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 (15 mm for [2]) above the top metal 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 eliminating 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] and [2], the scan area is 20mm wide, its length exceeds the dipole arm length (180 or 90mm). The sensor center is 10 mm (15 mm for [2]) (in z) above the metal 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, in the plane 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.

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%.

Measurement Conditions

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

DASY Version	DASY5	V52.8.3
Extrapolation	Advanced Extrapolation	
Phantom	HAC Test Arch	
Distance Dipole Top - Probe Center	10mm + 15mm	
Scan resolution	dx, dy = 5 mm	
Frequency	1730 MHz ± 1 MHz	
Input power drift	< 0.05 dB	

Maximum Field values at 1730 MHz

H-field 10 mm above dipole surface	condition	**interpolated maximum**
Maximum measured	100 mW input power	**0.496 A / m ± 8.2 % (k=2)**

E-field 10 mm above dipole surface	condition	**Interpolated maximum**
Maximum measured above high end	100 mW input power	153.5 V / m
Maximum measured above low end	100 mW input power	150.1 V / m
Averaged maximum above arm	100 mW input power	**151.8 V / m ± 12.8 % (k=2)**

E-field 15 mm above dipole surface	condition	**Interpolated maximum**
Maximum measured above high end	100 mW input power	98.4 V / m
Maximum measured above low end	100 mW input power	97.6 V / m
Averaged maximum above arm	100 mW input power	**98.0 V / m ± 12.8 % (k=2)**

Appendix

Antenna Parameters

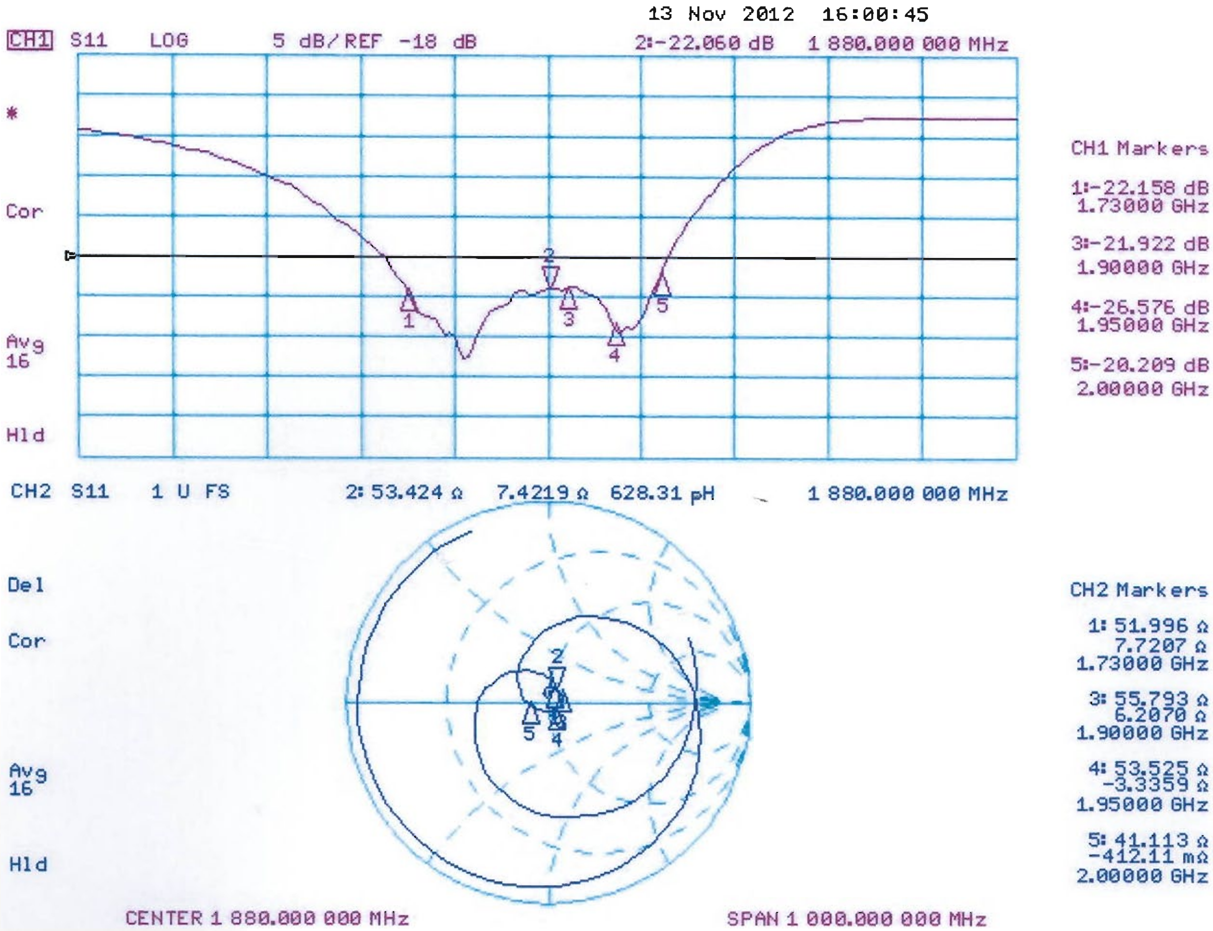
Frequency	Return Loss	Impedance
1730 MHz	22.2 dB	52.0 Ω + 7.7 jΩ
1880 MHz	22.1 dB	53.4 Ω + 7.4 jΩ
1900 MHz	21.9 dB	55.8 Ω + 6.2 jΩ
1950 MHz	26.6 dB	53.5 Ω - 3.3 jΩ
2000 MHz	20.2 dB	41.1 Ω - 0.4 jΩ

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.

Impedance Measurement Plot



DASY5 H-field Result

Date: 13.11.2012

Test Laboratory: SPEAG Lab2

DUT: HAC Dipole 1880 MHz; Type: CD1880V3; Serial: CD1880V3 - SN: 1038

Communication System: CW; Frequency: 1730 MHz
Medium parameters used: $\sigma = 0$ mho/m, $\varepsilon_r = 1$; $\rho = 1$ kg/m^3
Phantom section: RF Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

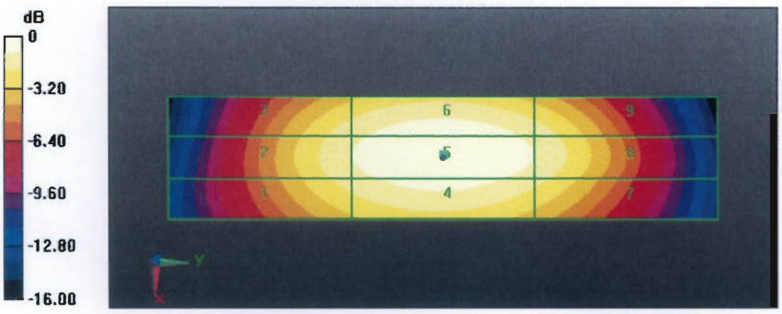
DASY52 Configuration:

- Probe: H3DV6 - SN6065; ; Calibrated: 29.12.2011
- Sensor-Surface: (Fix Surface)
- Electronics: DAE4 Sn781; Calibrated: 29.05.2012
- Phantom: HAC Test Arch with AMCC; Type: SD HAC P01 BA; Serial: 1070
- DASY52 52.8.3(988); SEMCAD X 14.6.7(6848)

Dipole H-Field measurement @ 1880MHz/H-Scan - 1730MHz d=10mm/Hearing Aid Compatibility Test (41x181x1): Interpolated grid: dx=0.5000 mm, dy=0.5000 mm
Device Reference Point: 0, 0, -6.3 mm
Reference Value = 0.5260 A/m; Power Drift = 0.01 dB
PMR not calibrated. PMF = 1.000 is applied.
H-field emissions = 0.4960 A/m
Near-field category: M2 (AWF 0 dB)

PMF scaled H-field

Grid 1 **M2** **0.413 A/m**	Grid 2 **M2** **0.437 A/m**	Grid 3 **M2** **0.422 A/m**
Grid 4 **M2** **0.463 A/m**	Grid 5 **M2** **0.496 A/m**	Grid 6 **M2** **0.480 A/m**
Grid 7 **M2** **0.405 A/m**	Grid 8 **M2** **0.438 A/m**	Grid 9 **M2** **0.422 A/m**



0 dB = 0.4960 A/m = -6.09 dBA/m

DASY5 E-field Result

Date: 13.11.2012

Test Laboratory: SPEAG Lab2

DUT: HAC Dipole 1880 MHz; Type: CD1880V3; Serial: CD1880V3 - SN: 1038

Communication System: CW; Frequency: 1730 MHz
Medium parameters used: $\sigma = 0$ mho/m, $\varepsilon_r = 1$; $\rho = 1000$ kg/m^3
Phantom section: RF Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007 / IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: ER3DV6 - SN2336; ConvF(1, 1, 1); Calibrated: 29.12.2011;
- Sensor-Surface: (Fix Surface)
- Electronics: DAE4 Sn781; Calibrated: 29.05.2012
- Phantom: HAC Test Arch with AMCC; Type: SD HAC P01 BA; Serial: 1070
- DASY52 52.8.3(988); SEMCAD X 14.6.7(6848)

Dipole E-Field measurement @ 1880MHz/E-Scan - 1730MHz d=10mm/Hearing Aid Compatibility Test (41x181x1): Interpolated grid: dx=0.5000 mm, dy=0.5000 mm
Device Reference Point: 0, 0, -6.3 mm
Reference Value = 168.9 V/m; Power Drift = -0.01 dB
PMR not calibrated. PMF = 1.000 is applied.
E-field emissions = 153.5 V/m
Near-field category: M2 (AWF 0 dB)

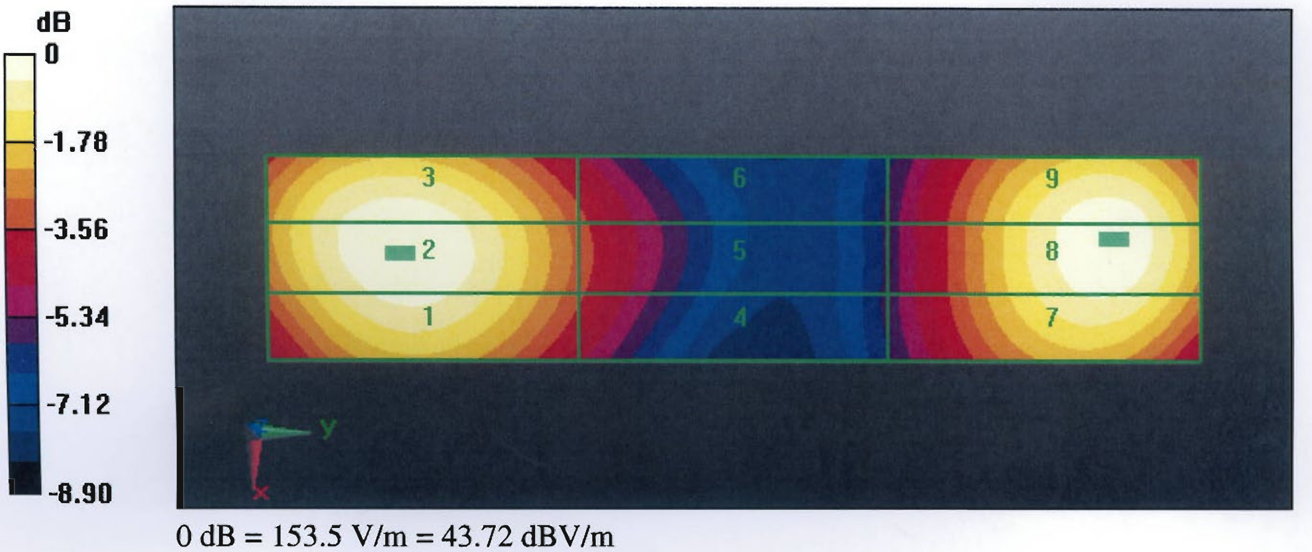
PMF scaled E-field

Grid 1 **M2** **143.2 V/m**	Grid 2 **M2** **150.1 V/m**	Grid 3 **M2** **147.5 V/m**
Grid 4 **M3** **99.65 V/m**	Grid 5 **M3** **103.3 V/m**	Grid 6 **M3** **100.4 V/m**
Grid 7 **M2** **142.9 V/m**	Grid 8 **M2** **153.5 V/m**	Grid 9 **M2** **151.9 V/m**

Dipole E-Field measurement @ 1880MHz/E-Scan - 1730MHz d=15mm/Hearing Aid Compatibility Test (41x181x1): Interpolated grid: dx=0.5000 mm, dy=0.5000 mm
Device Reference Point: 0, 0, -6.3 mm
Reference Value = 168.9 V/m; Power Drift = -0.01 dB
PMR not calibrated. PMF = 1.000 is applied.
E-field emissions = 98.39 V/m
Near-field category: M3 (AWF 0 dB)

PMF scaled E-field

Grid 1 **M3** **95.58 V/m**	Grid 2 **M3** **98.39 V/m**	Grid 3 **M3** **97.31 V/m**
Grid 4 **M3** **75.77 V/m**	Grid 5 **M3** **77.30 V/m**	Grid 6 **M3** **76.33 V/m**
Grid 7 **M3** **94.38 V/m**	Grid 8 **M3** **97.64 V/m**	Grid 9 **M3** **97.12 V/m**



0 dB = 153.5 V/m = 43.72 dBV/m

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

S Schweizerischer Kalibrierdienst
C Service suisse d'étalonnage
Servizio svizzero di taratura
S Swiss Calibration Service

Accredited by the Swiss Accreditation Service (SAS)
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 Sporton-TW (Auden)

Certificate No: DAE4-778_Aug12

CALIBRATION CERTIFICATE

Object	DAE4 - SD 000 D04 BJ - SN: 778
Calibration procedure(s)	QA CAL-06.v25 Calibration procedure for the data acquisition electronics (DAE)
Calibration date:	August 27, 2012

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
Keithley Multimeter Type 2001	SN: 0810278	28-Sep-11 (No:11450)	Sep-12
Secondary Standards	**ID #**	**Check Date (in house)**	**Scheduled Check**
Calibrator Box V2.1	SE UWS 053 AA 1001	05-Jan-12 (in house check)	In house check: Jan-13

	Name	Function	Signature
Calibrated by:	Dominique Steffen	Technician	
Approved by:	Fin Bomholt	R&D Director	i.V.

Issued: August 27, 2012

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 = $6.1\mu V$, 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	404.663 ± 0.1% (k=2)	403.465 ± 0.1% (k=2)	405.010 ± 0.1% (k=2)
Low Range	3.98578 ± 0.7% (k=2)	3.96516 ± 0.7% (k=2)	3.99894 ± 0.7% (k=2)

Connector Angle

Connector Angle to be used in DASY system	283 ° ± 1 °

Appendix

1. DC Voltage Linearity

High Range		Reading (μV)	Difference (μV)	Error (%)
Channel X	+ Input	200000.39	2.63	0.00
Channel X	+ Input	20001.58	1.36	0.01
Channel X	- Input	-19998.48	2.54	-0.01
Channel Y	+ Input	200000.90	3.34	0.00
Channel Y	+ Input	20000.55	0.30	0.00
Channel Y	- Input	-19999.91	1.23	-0.01
Channel Z	+ Input	199999.59	1.90	0.00
Channel Z	+ Input	19998.55	-1.57	-0.01
Channel Z	- Input	-20004.33	-3.11	0.02

Low Range		Reading (μV)	Difference (μV)	Error (%)
Channel X	+ Input	2000.71	0.06	0.00
Channel X	+ Input	201.15	0.23	0.11
Channel X	- Input	-198.08	0.92	-0.46
Channel Y	+ Input	2000.36	-0.13	-0.01
Channel Y	+ Input	199.81	-0.98	-0.49
Channel Y	- Input	-200.22	-1.21	0.61
Channel Z	+ Input	2000.89	0.54	0.03
Channel Z	+ Input	200.06	-0.72	-0.36
Channel Z	- Input	-199.79	-0.68	0.34

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	-4.83	-5.89
	- 200	7.67	5.93
Channel Y	200	-1.95	-2.63
	- 200	-0.79	-0.35
Channel Z	200	-8.43	-9.27
	- 200	8.42	8.08

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	-	-1.46	-2.45
Channel Y	200	9.44	-	0.28
Channel Z	200	4.92	6.59	-

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	16053	16715
Channel Y	16161	14601
Channel Z	16434	15429

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	1.04	0.34	1.84	0.34
Channel Y	-1.10	-2.50	0.04	0.56
Channel Z	-0.63	-1.70	1.29	0.47

6. Input Offset Current

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

7. Input Resistance (Typical values for information)

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

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

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

9. Power Consumption (Typical values for information)

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