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





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SGS (Auden)

Calibration procedure(s)

Accreditation No.: SCS 108 Certificate No: H3-6142_Apr09

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CALIBRATION CERTIFICATE H3DV6 - SN:6142 Object

QA CAL-03.v5

Calibration procedure for H-field probes optimized for close near field

evaluations in air

Calibration date April 27, 2009

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 (Certificate No.)	Scheduled Calibration
Power meter E4419B	GB41293874	1-Apr-09 (No. 217-01030)	Apr-10
Power sensor E4412A	MY41495277	1-Apr-09 (No. 217-01030)	Apr-10
Power sensor E4412A	MY41498087	1-Apr-09 (No. 217-01030)	Apr-10
Reference 3 dB Attenuator	SN: S5054 (3c)	31-Mar-09 (No. 217-01026)	Mar-10
Reference 20 dB Attenuator	SN: S5086 (20b)	31-Mar-09 (No. 217-01028)	Mar-10
Reference 30 dB Attenuator	SN: S5129 (30b)	31-Mar-09 (No. 217-01027)	Mar-10
Reference Probe H3DV6	SN: 6182	1-Oct-08 (No. H3-6182_Oct08)	Oct-09
DAE4	SN: 789	19-Dec-08 (No. DAE4-789_Dec08)	Dec-09
Secondary Standards	ID#	Check Date (in house)	Scheduled Check
RF generator HP 8648C	US3642U01700	4-Aug-99 (in house check Oct-07)	In house check: Oct-09
Network Analyzer HP 8753E	US37390585	18-Oct-01 (in house check Oct-08)	In house check: Oct-09
	Name	Function	Signature
Calibrated by:	Katja Pokovic	Technical Manager	Soft- lef
Approved by:	Niels Kuster	Quality Manager	111
			V. / 2005
			Issued: April 27, 2009
This calibration and forter to the U	in the second control of the second	n full without written approval of the laboratory.	

Certificate No: H3-6142 Apr09

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Glossary:

NORMx,y,z sensitivity in free space DCP diode compression point Polarization o φ rotation around probe axis

Polarization 9 9 rotation around an axis that is in the plane normal to probe axis (at

measurement center), i.e., 9 = 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.

Methods Applied and Interpretation of Parameters:

- X, Y, Z_a0a1a2: Assessed for E-field polarization $\theta = 90$ for XY sensors and $\theta = 0$ for Z sensor (f ≤ 900 MHz in TEM-cell; f > 1800 MHz: R22 waveguide).
- X,Y,Z(f) a0a1a2= X,Y,Z a0a1a2* frequency response (see Frequency Response Chart).
- DCPx,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).

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H3DV6 SN:6142

April 27, 2009



Probe H3DV6

SN:6142

Manufactured: Last calibrated: Recalibrated:

July 3, 2002 April 21, 2008 April 27, 2009

Calibrated for DASY Systems

(Note: non-compatible with DASY2 system!)

Certificate No: H3-6142_Apr09

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H3DV6 SN:6142

April 21, 2008



Probe H3DV6

SN:6142

Manufactured: Last calibrated: Recalibrated:

July 3, 2002 April 20, 2007 April 21, 2008

Calibrated for DASY Systems

(Note: non-compatible with DASY2 system!)

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台灣檢驗科技股份有限公司

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H3DV6 SN:6142

April 27, 2009

DASY - Parameters of Probe: H3DV6 SN:6142

Sensitivity in Free Space [A/m / √(µV)]

	a0 a	a1	a2		
X	2.743E-03	-1.034E-4	-1.138E-5	± 5.1	% (k=2)
Y	2.722E-03	-1.151E-4	1.011E-5	± 5.1	% (k=2)
Z	3.121E-03	-3.459E-4	4.339E-5	± 5.1	% (k=2)

Diode Compression¹

DCP X 82 mV DCP Y 89 mV DCP Z 82 mV

Sensor Offset (Probe Tip to Sensor Center)

> 3.0 mm X Y 3.0 mm Z 3.0 mm

Connector Angle -248 °

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

numerical linearization parameter: uncertainty not required

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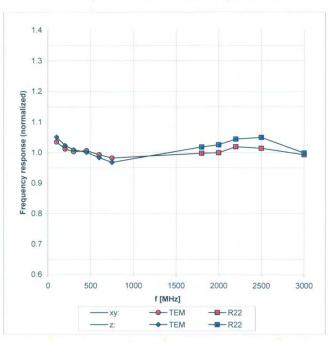
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H3DV6 SN:6142

April 27, 2009

Frequency Response of H-Field

(TEM-Cell:ifi110 EXX, Waveguide R22)



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

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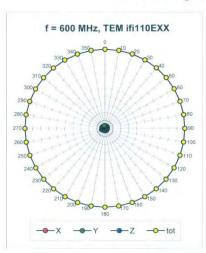


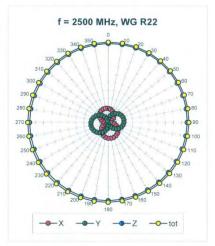
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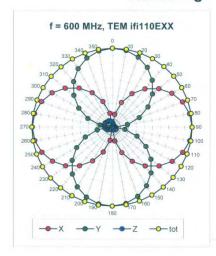
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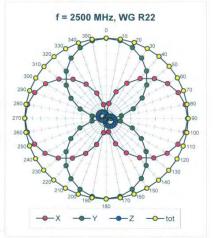
Receiving Pattern (ϕ), θ = 90°





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





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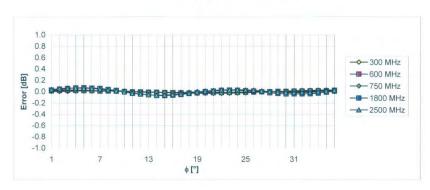


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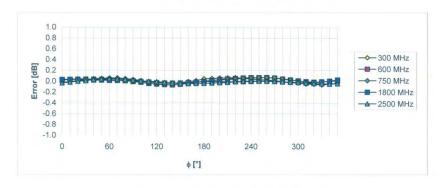
April 27, 2009

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



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

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



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

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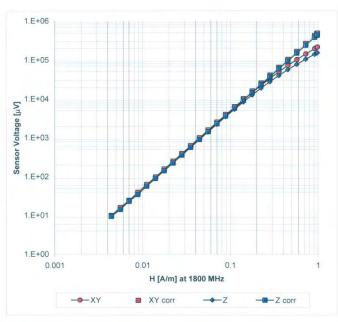
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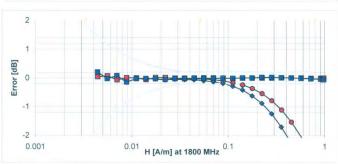
H3DV6 SN:6142

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Dynamic Range f(H-field)

(Waveguide R22, f = 1800 MHz)





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

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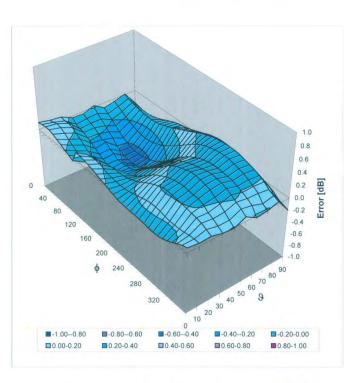


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Deviation from Isotropy in Air Error (ϕ, ϑ) , f = 900 MHz



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

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16. Uncertainty Analysis

HAC-Extension Setup Performance Test Using SPEAG Calibration Dipoles

Error Description	Uncertainty value	Prob. Dist.	Div.	(c_i)	(c_i) Π	Std. Unc.	Std. Unc.
Measurement System							
Probe Calibration	15.1%	N	1	1	T .	1.5.1 %	±5.1%
Axial Isotropy	14.7%	R	$\sqrt{3}$	1	1	±2.7%	±2.7%
Sensor Displacement	116.5%	R	$\sqrt{3}$	1	0.145	19.5%	±1.4%
Boundary Effects	±2.4 %	R	$\sqrt{3}$	1	1	±1.4%	±1.4%
Linearity	±4.7%	R	$\sqrt{3}$	1	1	±2.7%	±2.7%
Scaling to Peak Envelope Power	±0%	R	$\sqrt{3}$	1	1	±0%	±0%
System Detection Limit	±1.0%	R	$\sqrt{3}$	1	1	±0.6%	±0.6%
Readout Electronics	±0.3%	У	1	1	1	±0.3%	±0.3 %
Response Time	±0%	R	$\sqrt{3}$	1	1	±0%	±0%
Integration Time	±0%	R	$\sqrt{3}$	1	1	±0%	±0%
RF Ambient Conditions	13.0%	R	$\sqrt{3}$	1	1	±1.7%	11.7%
RF Reflections	16.0%	R	$\sqrt{3}$	1	1	±3.5 %	+3.5 %
Probe Positioner	±1.2%	R	$\sqrt{3}$	-1-	0.67	±0.7%	±0.5 %
Probe Positioning	±4.7%	R	$\sqrt{3}$	1	0.67	±2.7%	±1.8%
Extrap. and Interpolation	11.0%	R	$\sqrt{3}$	1	J	10.6%	+0.6%
Dipole Related							
Distance Dipole - Scanning Plane	±5.2%	R.	$\sqrt{3}$	1	0.3	±3.0%	±0.9%
Input power	±4.7%	N	1	1	1	±4.7%	=4.7%
Combined Std. Uncertainty		4				±13.7 %	±9.3 %
Expanded Std. Uncertainty or		L. ii				27.4 %	18.6 %
Expanded Std. Uncertainty or	ı Field					±13.7 %	=9.3 %

Table 28.1: Uncertainty budget for HAC setup performance test. The budget is valid for the frequency range 800 MHz - 3 GHz and represents a worst-case analysis with respect to power uncertainty of the field. Some of the parameters are dependent on the user situations and need adjustment according to the actual laboratory conditions.

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17. System Validation from Original equipment supplier

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





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Certificate No: CD835V3-1052_Apr09

CALIBRATION CERTIFICATE CD835V3 - SN: 1052 Calibration procedure(s) QA CAL-20.v4 Calibration procedure for dipoles in air April 22, 2009 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) ID# Cal Date (Certificate No.) Scheduled Calibration Primary Standards GB37480704 Power meter EPM-442A 08-Oct-08 (No. 217-00898) Oct-09 Power sensor HP 8481A US37292783 08-Oct-08 (No. 217-00898) Oct-09 Probe ER3DV6 SN: 2336 22-Dec-08 (No. ER3-2336 Dec08) Dec-09 22-Dec-08 (No. H3-6065_-Dec08) Dec-09 Probe H3DV6 SN: 6065 DAE4 SN: 781 20-Feb-09 (No. DAE4-781_Feb09) Feb-10 Secondary Standards Check Date (in house) Scheduled Check SN: 101748 23-Sep-08 (in house check Dec-08) In house check: Dec-10 Power meter R&S NRP Power sensor R&S NRP-Z91 SN: 100711 25-Aug-08 (in house check Dec-08) In house check: Dec-10 Power sensor R&S NRP-Z91 SN: 100712 25-Aug-08 (in house check Dec-08) In house check: Dec-10 US37390585 Network Analyzer HP 8753E 18-Oct-01 (in house check Oct-08) In house check: Oct-09 RF generator E4433B MY 41310391 03-Nov-04 (in house check Oct-07) Calibrated by: Mike Meili Laboratory Technician Approved by: Issued: April 27, 2009 This calibration certificate shall not be reproduced except in full without written approval of the laboratory

Certificate No: CD835V3-1052 Apr09

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3.3.2 DASY4 H-field Result

Date/Time: 21.04.2009 12:38:12

Test Laboratory: SPEAG Lab 2

DUT: HAC-Dipole 835 MHz; Type: D835V3; Serial: 1052

Communication System: CW; Frequency: 835 MHz; Duty Cycle: 1:1 Medium parameters used: $\sigma=0$ mho/m, $\epsilon_r=1$; $\rho=1$ kg/m³

Phantom section: RF Section Measurement Standard: DASY4 (High Precision Assessment)

DASY4 Configuration:

Probe: H3DV6 - SN6065: : Calibrated: 22.12.2008

Sensor-Surface: (Fix Surface)

Electronics: DAE4 Sn781; Calibrated: 20.02.2009

Phantom: HAC Test Arch with AMCC; Type: SD HAC P01 BA; Serial: 1070

Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

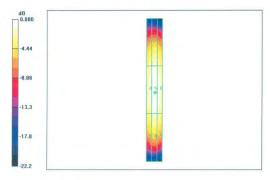
H Scan - measurement distance from the probe sensor center to CD835 Dipole =

10mm/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 Device Reference Point: 0.000, 0.000, -6.30 mm

Reference Value = 0.486 A/m; Power Drift = -0.014 dB Hearing Aid Near-Field Category: M4 (AWF 0 dB)

Peak H-field in A/m

Grid 1	Grid 2	Grid 3
0.380 M4	0.403 M4	0.383 M4
Grid 4	Grid 5	Grid 6
0.427 M4	0.457 M4	0.437 M4
Grid 7	Grid 8	Grid 9
0.378 M4	0.409 M4	0.391 M4



0 dB = 0.457 A/m

Certificate No: CD835V3-1052 Apr09

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3.3.3 DASY4 E-field Result

Date/Time: 22.04.2009 13:19:44

Test Laboratory: SPEAG Lab 2

DUT: HAC-Dipole 835 MHz; Type: D835V3; Serial: 1052 Communication System: CW; Frequency: 835 MHz; Duty Cycle: 1:1 Medium parameters used: $\sigma=0$ mho/m, $\epsilon_r=1$; $\rho=1000$ kg/m³ Phantom section: RF Section

Measurement Standard: DASY4 (High Precision Assessment)

DASY4 Configuration:

Probe: ER3DV6 - SN2336; ConvF(1, 1, 1); Calibrated: 22.12.2008

Sensor-Surface: (Fix Surface)

Electronics: DAE4 Sn781; Calibrated: 20.02.2009

Phantom: HAC Test Arch with AMCC; Type: SD HAC P01 BA; Serial: 1070

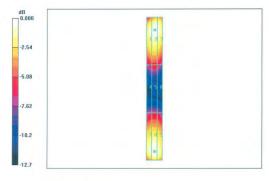
Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

E Scan - measurement distance from the probe sensor center to CD835 Dipole = 10mm/Hearing Aid Compatibility Test (41x361x1):

Measurement grid: dx=5mm, dy=5mm Maximum value of peak Total field = 168.7 V/m Probe Modulation Factor = 1.00 Device Reference Point: 0.000, 0.000, -6.30 mm Reference Value = 109.0 V/m; Power Drift = -0.002 dB Hearing Aid Near-Field Category: M4 (AWF 0 dB)

Peak E-field in V/m

Grid 1	Grid 2	Grid 3
162.3 M4	168.3 M4	164.0 M4
Grid 4	Grid 5	Grid 6
86.8 M4	89.2 M4	86.0 M4
Grid 7	Grid 8	Grid 9
161.9 M4	168.7 M4	163.6 M4



0 dB = 168.7 V/m

Certificate No: CD835V3-1052_Apr09

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





Schweizerischer Kalibrierdienst S Service suisse d'étalonnage C 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

SGS (Auden)

Certificate No: CD1880V3-1044_Apr09

Accreditation No.: SCS 108

CALIBRATION CERTIFICATE CD1880V3 - SN: 1044 Object QA CAL-20.v4 Calibration procedure(s) Calibration procedure for dipoles in air April 22, 2009 Calibration date: 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) Cal Date (Certificate No.) Scheduled Calibration Primary Standards Oct-09 GB37480704 08-Oct-08 (No. 217-00898) Power meter EPM-442A 08-Oct-08 (No. 217-00898) Oct-09 US37292783 Power sensor HP 8481A 22-Dec-08 (No. ER3-2336_Dec08) Dec-09 SN: 2336 Probe ER3DV6 SN: 6065 22-Dec-08 (No. H3-6065_-Dec08) Dec-09 Probe H3DV6 DAE4 SN 781 20-Feb-09 (No. DAE4-781_Feb09) Feb-10 ID# Check Date (in house) Scheduled Check Secondary Standards Power meter R&S NRP SN: 101748 23-Sep-08 (in house check Dec-08) In house check: Dec-10 Power sensor R&S NRP-Z91 SN: 100711 25-Aug-08 (in house check Dec-08) In house check: Dec-10 In house check: Dec-10 Power sensor R&S NRP-Z91 SN: 100712 25-Aug-08 (in house check Dec-08) US37390585 In house check: Oct-09 Network Analyzer HP 8753E 18-Oct-01 (in house check Oct-08) In house check: Oct-09 MY 41310391 22-Nov-04 (in house check Oct-07) RF generator E4433B Function Name Mike Meili Calibrated by: Laboratory Technician Technical Director Approved by: Issued: April 27, 2009 This calibration certificate shall not be reproduced except in full without written approval of the laboratory

Certificate No: CD1880V3-1044 Apr09

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3.3.2 DASY4 H-Field Result

Date/Time: 21.04.2009 15:31:24

Test Laboratory: SPEAG Lab 2

DUT: HAC Dipole 1880 MHz; Type: CD1880V3; Serial: 1044 Communication System: CW; Frequency: 1880 MHz; Duty Cycle: 1:1 Medium parameters used: $\sigma=0$ mho/m, $\epsilon_r=1$; $\rho=1$ kg/m³ Phantom section: RF Section

Measurement Standard: DASY4 (High Precision Assessment)

DASY4 Configuration:

- Probe: H3DV6 SN6065; ; Calibrated: 22.12.2008
- Sensor-Surface: (Fix Surface)
- Electronics: DAE4 Sn781; Calibrated: 20.02.2009
- Phantom: HAC Test Arch with AMCC; Type: SD HAC P01 BA; Serial: 1070
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

H Scan - measurement distance from the probe sensor center to CD1880 Dipole =

10mm/Hearing Aid Compatibility Test (41x181x1):

Measurement grid: dx=5mm, dy=5mmMaximum value of peak Total field = 0.463 A/m Probe Modulation Factor = 1.00

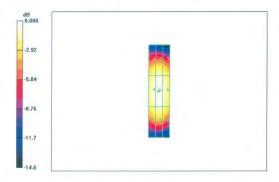
Device Reference Point: 0.000, 0.000, -6.30 mm

Reference Value = 0.490 A/m; Power Drift = -0.003 dB

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

Peak H-field in A/m

Grid 1	Grid 2	Grid 3
0.404 M2	0.421 M2	0.399 M2
Grid 4	Grid 5	Grid 6
0.444 M2	0.463 M2	0.438 M2
Grid 7	Grid 8	Grid 9
0.406 M2	0.427 M2	0.402 M2



0 dB = 0.463 A/m

Certificate No: CD1880V3-1044 Apr09

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3.3.3 DASY4 E-Field Result

Date/Time: 22.04.2009 14:56:09

Test Laboratory: SPEAG Lab 2

DUT: HAC Dipole 1880 MHz; Type: CD1880V3; Serial: 1044 Communication System: CW; Frequency: 1880 MHz; Duty Cycle: 1:1 Medium parameters used: $\sigma=0$ mho/m, $\epsilon_r=1$; $\rho=1000$ kg/m³ Phantom section: RF Section Measurement Standard: DASY4 (High Precision Assessment)

DASY4 Configuration:

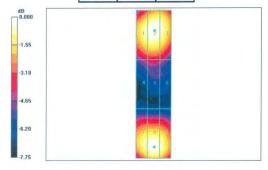
- Probe: ER3DV6 SN2336; ConvF(1, 1, 1); Calibrated: 22.12.2008
- Sensor-Surface: (Fix Surface)
- Electronics: DAE4 Sn781; Calibrated: 20.02.2009
- Phantom: HAC Test Arch with AMCC; Type: SD HAC P01 BA; Serial: 1070
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

E Scan - measurement distance from the probe sensor center to CD1880 Dipole =

10mm/Hearing Aid Compatibility Test (41x181x1):
Measurement grid: dx=5mm, dy=5mm
Maximum value of peak Total field = 138.3 V/m
Probe Modulation Factor = 1.00
Device Reference Point: 0.000, 0.000, -6.30 mm Reference Value = 155.4 V/m; Power Drift = 0.019 dB Hearing Aid Near-Field Category: M2 (AWF 0 dB)

Peak E-field in V/m

Grid 1	Grid 2	Grid 3
132.8 M2	137.9 M2	134.6 M2
Grid 4	Grid 5	Grid 6
89.3 M3	91.9 M3	88.1 M3
Grid 7	Grid 8	Grid 9
131.5 M2	138.3 M2	133.9 M2



0 dB = 138.3 V/m

Certificate No: CD1880V3-1044_Apr09

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End of 1st part of report

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