Calibration Laboratory of
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S Schweizerischer Kalibrierdienst
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Accreditation No.: SCS 108

Client **CCS (Auden)**

Certificate No: CD2450V3-1026_Apr09

CALIBRATION CERTIFICATE

Object	CD2450V3 - SN: 1026
Calibration procedure(s)	QA CAL-20.v4 Calibration procedure for dipoles in air
Calibration date:	April 22, 2009
Condition of the calibrated item	In Tolerance

This calibration certificate documents the traceability to national standards, which realize the physical units of measurements (SI).
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	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
Probe H3DV6	SN: 6065	22-Dec-08 (No. H3-6065_-Dec08)	Dec-09
DAE4	SN 781	20-Feb-09 (No. DAE4-781_Feb09)	Feb-10

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
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
Power sensor R&S NRP-Z91	SN: 100712	25-Aug-08 (in house check Dec-08)	In house check: Dec-10
Network Analyzer HP 8753E	US37390585	18-Oct-01 (in house check Oct-08)	In house check: Oct-09
RF generator E4433B	MY 41310391	22-Nov-04 (in house check Oct-07)	In house check: Oct-09

	Name	Function	Signature
Calibrated by:	Mike Meili	Laboratory Technician	
Approved by:	Fin Bomholt	Technical Director	

Issued: April 27, 2009

References

[1] ANSI-C63.19-2006
American National Standard for Methods of Measurement of Compatibility between Wireless Communications Devices and Hearing Aids.

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

Methods Applied and Interpretation of Parameters:

- *Coordinate System:* y-axis is in the direction of the dipole arms. z-axis is from the basis of the antenna (mounted on the table) towards its feed point between the two dipole arms. x-axis is normal to the other axes. In coincidence with the standards [1, 2], 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 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, 2], 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 B80
DASY PP Version	SEMCAD	V1.8 B186
Phantom	HAC Test Arch	SD HAC P01 BA, #1070
Distance Dipole Top - Probe Center	10 mm	
Scan resolution	dx, dy = 5 mm	area = 20 x 90 mm
Frequency	**2450 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	**0.485 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	135.9 V/m
Maximum measured above low end	100 mW forward power	133.8 V/m
Averaged maximum above arm	100 mW forward power	**134.9 V/m**

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

3 Appendix

3.1 Antenna Parameters

Frequency	**Return Loss**	**Impedance**
2250 MHz	17.0 dB	(56.7 + j13.7) Ohm
2350 MHz	28.2 dB	(54.0 + j0.8) Ohm
2450 MHz	**28.6 dB**	**(53.7 + j1.0) Ohm**
2550 MHz	51.1 dB	(50.2 – j0.1) Ohm
2650 MHz	17.3 dB	(62.5 + j9.1) Ohm

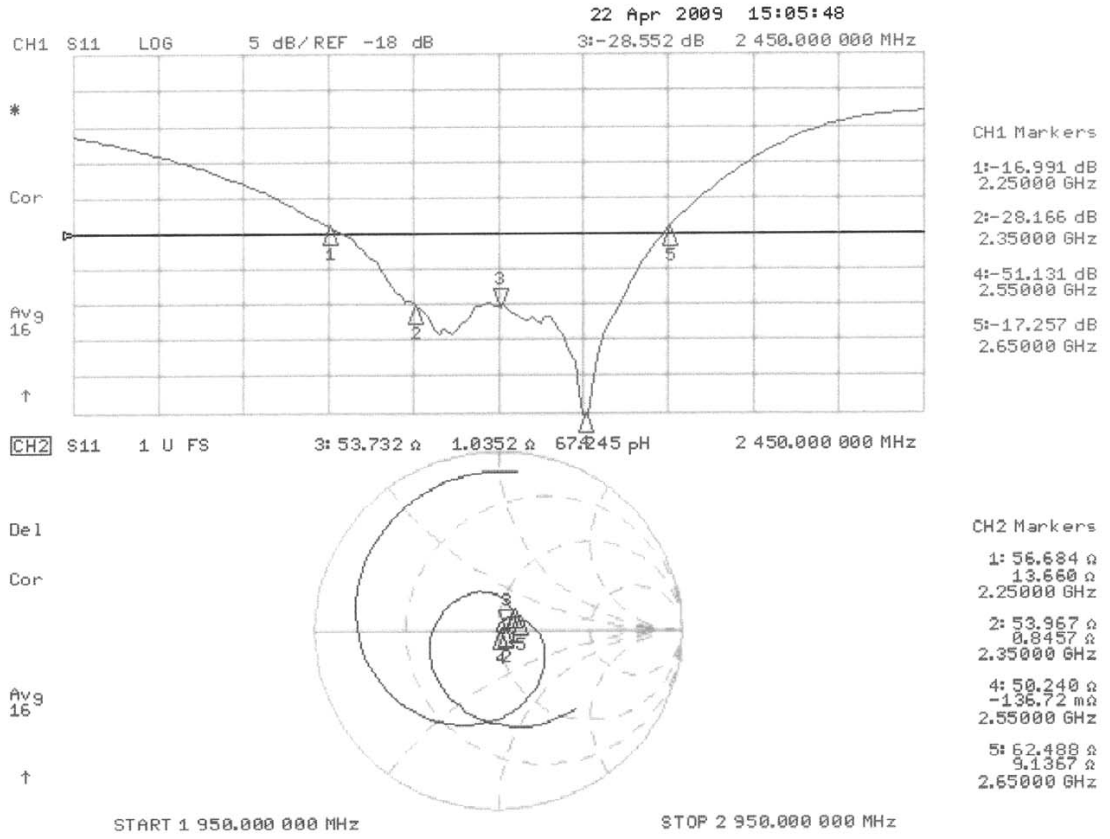
3.2 Antenna Design and Handling

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



3.3.3 DASY4 H-Field Result

Date/Time: 21.04.2009 16:56:32

Test Laboratory: SPEAG Lab 2

DUT: HAC Dipole 2450 MHz; Type: CD2450V3; Serial: 1026
Communication System: CW; Frequency: 2450 MHz; Duty Cycle: 1:1
Medium parameters used: $\sigma = 0$ mho/m, $\varepsilon_r = 1$; $\rho = 1$ kg/m^3
Phantom section: RF Section
Measurement Standard: DASY4 (High Precision Assessment)

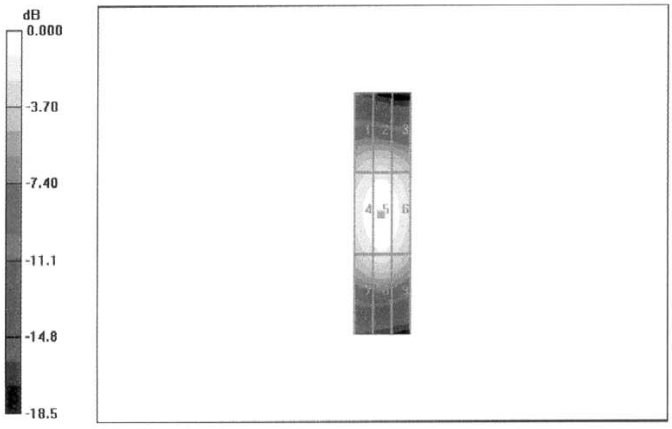
DASY4 Configuration:

- 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 CD2450 Dipole = 10mm/Hearing Aid Compatibility Test (41x181x1):
Measurement grid: dx=5mm, dy=5mm
Maximum value of peak Total field = 0.485 A/m
Probe Modulation Factor = 1.00
Device Reference Point: 0.000, 0.000, -6.30 mm
Reference Value = 0.515 A/m; Power Drift = -0.042 dB
Hearing Aid Near-Field Category: M2 (AWF 0 dB)

Peak H-field in A/m

Grid 1 **0.384 M2**	Grid 2 **0.397 M2**	Grid 3 **0.375 M2**
Grid 4 **0.464 M2**	Grid 5 **0.485 M2**	Grid 6 **0.457 M2**
Grid 7 **0.388 M2**	Grid 8 **0.408 M2**	Grid 9 **0.381 M2**



0 dB = 0.485A/m

3.3.3 DASY4 E-Field Result

Date/Time: 22.04.2009 15:59:49

Test Laboratory: SPEAG Lab 2

DUT: HAC Dipole 2450 MHz; Type: CD2450V3; Serial: CD2450V3 - SN:1026
Communication System: CW; Frequency: 2450 MHz; Duty Cycle: 1:1
Medium parameters used: $\sigma = 0$ mho/m, $\varepsilon_r = 1$; $\rho = 1000$ kg/m^3
Phantom section: RF Section
Measurement Standard: DASY4 (High Precision Assessment)

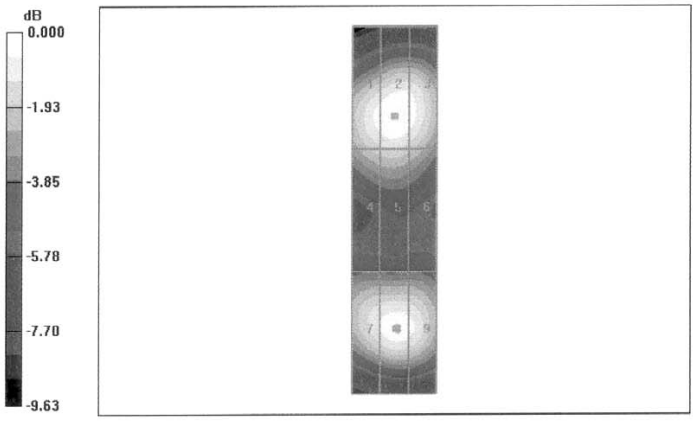
DASY4 Configuration:

- 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 CD2450 Dipole = 10mm/Hearing Aid Compatibility Test (41x181x1):
Measurement grid: dx=5mm, dy=5mm
Maximum value of peak Total field = 135.9 V/m
Probe Modulation Factor = 1.00
Device Reference Point: 0.000, 0.000, -6.30 mm
Reference Value = 83.9 V/m; Power Drift = -0.019 dB
Hearing Aid Near-Field Category: M2 (AWF 0 dB)

Peak E-field in V/m

Grid 1 **130.8 M2**	Grid 2 **135.9 M2**	Grid 3 **131.7 M2**
Grid 4 **114.6 M2**	Grid 5 **118.2 M2**	Grid 6 **112.1 M3**
Grid 7 **126.7 M2**	Grid 8 **133.8 M2**	Grid 9 **130.1 M2**



0 dB = 135.9V/m

儀器資料卡

廠商名稱：	SPEAG	儀器名稱：	SAR Dipole
型號：	CD2450v3	序號：	1026
放置位置：	SAR	購入日期：	2005.07.05
備註：			

校正紀錄					維修紀錄				
送校日期	取回日期	校驗單位	承辦人	主管	送修日期	取回日期	維修單位	承辦人	主管
2007 04.09	2007 05.17	SPEAG 2007.04.26	[illegible]	Ren.Lai					

儀器外校申請書

申請日期: **04 / 02 / 2007**
儀器名稱: **SAR Dipole Validation Kits**
儀器廠牌: **SPEAG**
儀器型號: **CD2450V3**
財產編號: **W3010213**
儀器目前位置: **SAR Test Room**
申請校驗原因: **校驗到期**
校驗標準: **HAC calibration in AIR**
申請人: **Anson Lu**
主管（簽核): Rex.Lai