

Appendix (Additional assessments outside the scope of SCS0108)

1. DC Voltage Linearity

High Range	Reading (μV)	Difference (μV)	Error (%)
Channel X + Input	200035.75	-1.80	-0.00
Channel X + Input	20007.51	2.80	0.01
Channel X - Input	-20001.63	3.90	-0.02
Channel Y + Input	200030.83	-6.19	-0.00
Channel Y + Input	20004.83	0.29	0.00
Channel Y - Input	-20005.66	-0.01	0.00
Channel Z + Input	200034.33	-0.91	-0.00
Channel Z + Input	20003.13	-1.43	-0.01
Channel Z - Input	-20007.32	-1.61	0.01

Low Range	Reading (μV)	Difference (μV)	Error (%)
Channel X + Input	2001.02	-0.05	-0.00
Channel X + Input	201.05	0.05	0.02
Channel X - Input	-198.91	0.03	-0.02
Channel Y + Input	2000.91	-0.12	-0.01
Channel Y + Input	199.93	-1.02	-0.51
Channel Y - Input	-199.75	-0.65	0.33
Channel Z + Input	2001.74	0.80	0.04
Channel Z + Input	200.96	0.20	0.10
Channel Z - Input	-200.50	-1.29	0.65

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	4.32	3.09
	- 200	-2.46	-3.34
Channel Y	200	-10.35	-10.45
	- 200	9.22	8.99
Channel Z	200	-7.41	-7.20
	- 200	4.46	4.61

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	-	-0.30	-3.06
Channel Y	200	5.80	-	0.94
Channel Z	200	8.69	3.61	-

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	15484	16859
Channel Y	15889	15164
Channel Z	16761	16036

5. Input Offset Measurement

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

Input 10M Ω

	Average (μ V)	min. Offset (μ V)	max. Offset (μ V)	Std. Deviation (μ V)
Channel X	0.23	-1.77	1.89	0.64
Channel Y	0.69	-0.91	2.41	0.77
Channel Z	0.26	-2.08	2.98	0.79

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



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 Huawei-SZ (Auden)

Certificate No: CD835V3-1114_Nov14

CALIBRATION CERTIFICATE

Object CD835V3 - SN: 1114

Calibration procedure(s) QA CAL-20.v6
Calibration procedure for dipoles in air

Calibration date: November 17, 2014

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	07-Oct-14 (No. 217-02020)	Oct-15
Power sensor HP 8481A	US37292783	07-Oct-14 (No. 217-02020)	Oct-15
Power sensor HP 8481A	MY41092317	07-Oct-14 (No. 217-02021)	Oct-15
Reference 10 dB Attenuator	SN: 5047.2 / 06327	03-Apr-14 (No. 217-01921)	Apr-15
Probe ER3DV6	SN: 2336	30-Dec-13 (No. ER3-2336_Dec13)	Dec-14
Probe H3DV6	SN: 6065	30-Dec-13 (No. H3-6065_Dec13)	Dec-14
DAE4	SN: 601	18-Aug-14 (No. DAE4-601_Aug14)	Aug-15
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power meter Agilent 4419B	SN: GB42420191	09-Oct-09 (in house check Sep-14)	In house check: Sep-16
Power sensor HP E4412A	SN: US38485102	05-Jan-10 (in house check Sep-14)	In house check: Sep-16
Power sensor HP 8482A	SN: US37295597	09-Oct-09 (in house check Sep-14)	In house check: Sep-16
Network Analyzer HP 8753E	US37390585	18-Oct-01 (in house check Oct-14)	In house check: Oct-15
RF generator R&S SMT-06	SN: 832283/011	27-Aug-12 (in house check Oct-13)	In house check: Oct-16

	Name	Function	Signature
Calibrated by:	Leif Klysner	Laboratory Technician	
Approved by:	Fin Bornholt	Deputy Technical Manager	

Issued: November 19, 2014

This calibration certificate shall not be reproduced except in full without written approval of the laboratory.



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**

References

- [1] 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 15 mm 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], the scan area is 20mm wide, its length exceeds the dipole arm length (180 or 90mm). The sensor center is 15 mm (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.

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	V52.8.8
Phantom	HAC Test Arch	
Distance Dipole Top - Probe Center	10mm	
Scan resolution	dx, dy = 5 mm	
Frequency	835 MHz ± 1 MHz	
Input power drift	< 0.05 dB	

Maximum Field values at 835 MHz

E-field 15 mm above dipole surface	condition	Interpolated maximum
Maximum measured above high end	100 mW input power	106.8 V/m = 40.57 dBV/m
Maximum measured above low end	100 mW input power	105.8 V/m = 40.49 dBV/m
Averaged maximum above arm	100 mW input power	106.3 V/m ± 12.8 % (k=2)

Appendix (Additional assessments outside the scope of SCS108)

Antenna Parameters

Frequency	Return Loss	Impedance
800 MHz	17.7 dB	45.2 Ω - 11.5 jΩ
835 MHz	29.0 dB	51.2 Ω + 3.4 jΩ
900 MHz	16.2 dB	54.5 Ω - 15.7 jΩ
950 MHz	22.0 dB	43.2 Ω + 2.8 jΩ
960 MHz	18.7 dB	47.4 Ω + 11.1 jΩ

3.2 Antenna Design and Handling

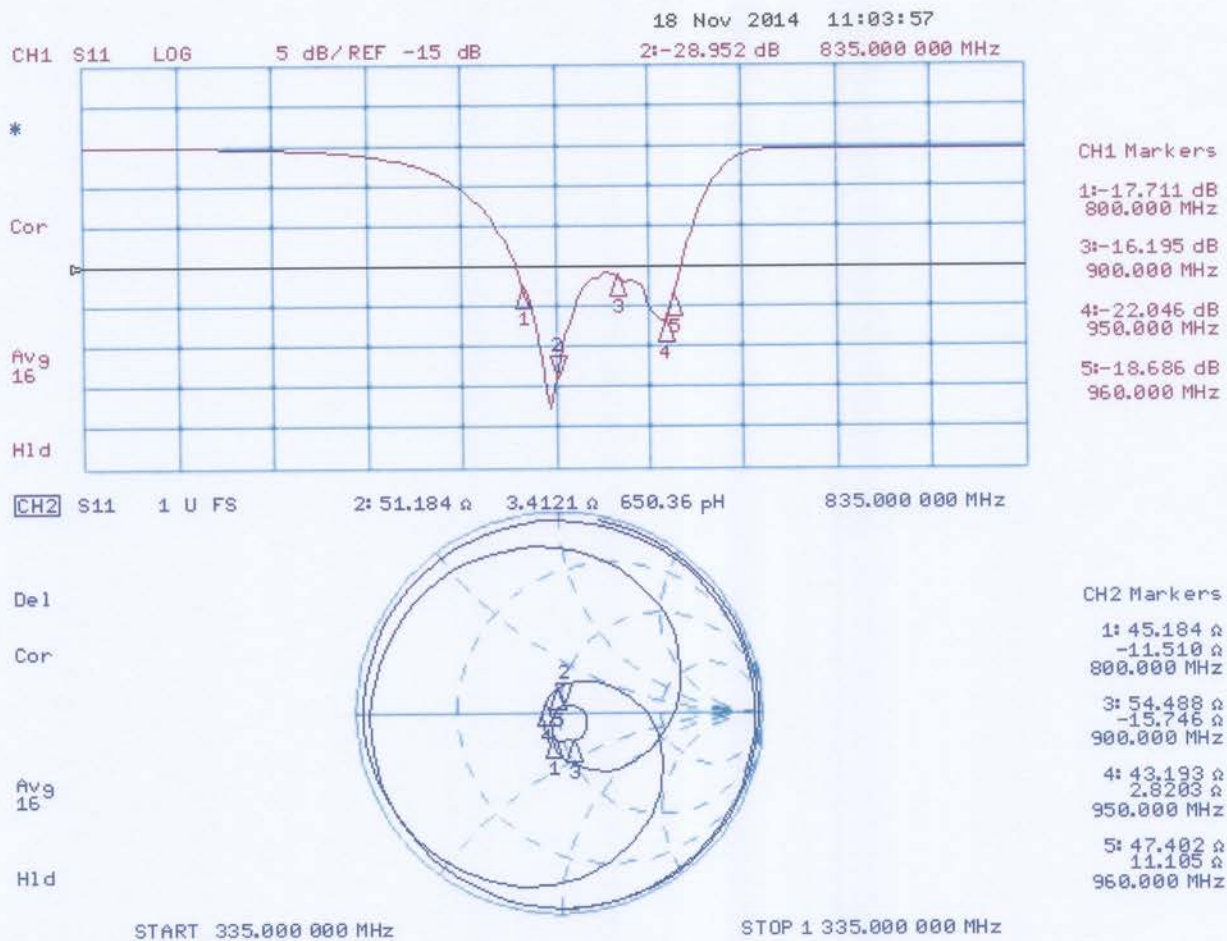
The calibration dipole has a symmetric geometry with a built-in two stub matching network, which leads to the enhanced bandwidth.

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



Test Laboratory: SPEAG Lab2

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

Communication System: UID 0 - CW ; Frequency: 835 MHz
Medium parameters used: $\sigma = 0$ S/m, $\epsilon_r = 1$; $\rho = 1000$ kg/m³
Phantom section: RF Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

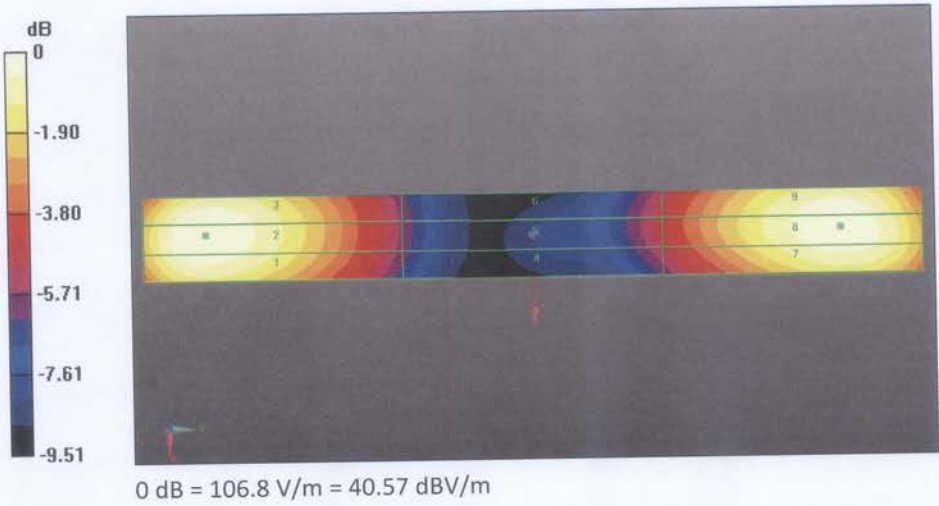
- Probe: ER3DV6 - SN2336; ConvF(1, 1, 1); Calibrated: 30.12.2013;
- Sensor-Surface: (Fix Surface)
- Electronics: DAE4 Sn601; Calibrated: 18.08.2014
- Phantom: HAC Test Arch with AMCC; Type: SD HAC P01 BA; Serial: 1070
- DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

Dipole E-Field measurement @ 835MHz/E-Scan - 835MHz d=15mm/Hearing Aid Compatibility Test (41x361x1):

Interpolated grid: dx=0.5000 mm, dy=0.5000 mm
Device Reference Point: 0, 0, -6.3 mm
Reference Value = 119.8 V/m; Power Drift = 0.00 dB
Applied MIF = 0.00 dB
RF audio interference level = 40.57 dBV/m
Emission category: M3

MIF scaled E-field

Grid 1 M3	Grid 2 M3	Grid 3 M3
40.32 dBV/m	40.57 dBV/m	40.5 dBV/m
Grid 4 M4	Grid 5 M4	Grid 6 M4
35.54 dBV/m	35.89 dBV/m	35.85 dBV/m
Grid 7 M3	Grid 8 M3	Grid 9 M3
40.2 dBV/m	40.49 dBV/m	40.42 dBV/m



Justification of the extended calibration of Dipole CD835V3 SN: 1114

Per KDB 865664, we have Measured the Impedance and Return Loss as below, and the return loss is <-20dB, with 20% of prior calibration; the real or imaginary parts of the impedance is with 5 ohm of prior calibration. Therefore the verification result should support extended calibration.

Frequency	Target Value		Measured Value		Difference	
	Impedance	Return Loss	Impedance	Return Loss	Impedance	Return Loss
800 MHz	45.2Ω-11.5jΩ	-17.7dB	42.32Ω-11.12jΩ	-16.37dB	R=-2.88Ω, X=3.8Ω	7.5%
835 MHz	51.2Ω+3.4jΩ	-29.0dB	53.62Ω+3.45jΩ	-28.28dB	R=2.42Ω, X=-0.05Ω	2.48%
900 MHz	54.5Ω-15.7jΩ	-16.2dB	51.72Ω-13.84jΩ	-16.93dB	R=-2.78Ω, X=2.86Ω	-4.5%
950 MHz	43.2Ω+2.8jΩ	-22.0dB	43.98Ω+4.26jΩ	-22.29dB	R=0.78Ω, X=1.46Ω	-1.32%
960 MHz	47.4Ω+11.1jΩ	-18.7dB	51.00Ω+12.19jΩ	-18.36dB	R=3.6Ω, X=1.09Ω	1.82%
Measured Date	2014-11-17		2015-11-13		-----	
Impedance Test			Return Loss Test			



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 Huawei-SZ (Auden)

Certificate No: CD1880V3-1100_Nov14

CALIBRATION CERTIFICATE

Object	CD1880V3 - SN: 1100
Calibration procedure(s)	QA CAL-20.v6 Calibration procedure for dipoles in air
Calibration date:	November 17, 2014

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	07-Oct-14 (No. 217-02020)	Oct-15
Power sensor HP 8481A	US37292783	07-Oct-14 (No. 217-02020)	Oct-15
Power sensor HP 8481A	MY41092317	07-Oct-14 (No. 217-02021)	Oct-15
Reference 10 dB Attenuator	SN: 5047.2 / 06327	03-Apr-14 (No. 217-01921)	Apr-15
Probe ER3DV6	SN: 2336	30-Dec-13 (No. ER3-2336_Dec13)	Dec-14
Probe H3DV6	SN: 6065	30-Dec-13 (No. H3-6065_Dec13)	Dec-14
DAE4	SN: 601	18-Aug-14 (No. DAE4-601_Aug14)	Aug-15
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power meter Agilent 4419B	SN: GB42420191	09-Oct-09 (in house check Sep-14)	In house check: Sep-16
Power sensor HP E4412A	SN: US38485102	05-Jan-10 (in house check Sep-14)	In house check: Sep-16
Power sensor HP 8482A	SN: US37295597	09-Oct-09 (in house check Sep-14)	In house check: Sep-16
Network Analyzer HP 8753E	US37390585	18-Oct-01 (in house check Oct-14)	In house check: Oct-15
RF generator R&S SMT-06	SN: 832283/011	27-Aug-12 (in house check Oct-13)	In house check: Oct-16

Calibrated by:	Name Leif Klysner	Function Laboratory Technician	Signature
Approved by:	Fin Bomholt	Deputy Technical Manager	

Issued: November 19, 2014

This calibration certificate shall not be reproduced except in full without written approval of the laboratory.



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**

References

[1] 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 15 mm 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], the scan area is 20mm wide, its length exceeds the dipole arm length (180 or 90mm). The sensor center is 15 mm (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.

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	V52.8.8
Phantom	HAC Test Arch	
Distance Dipole Top - Probe Center	10mm	
Scan resolution	dx, dy = 5 mm	
Frequency	1880 MHz ± 1 MHz	
Input power drift	< 0.05 dB	

Maximum Field values at 1880 MHz

E-field 15 mm above dipole surface	condition	Interpolated maximum
Maximum measured above high end	100 mW input power	88.6 V/m = 38.95 dBV/m
Maximum measured above low end	100 mW input power	87.4 V/m = 38.83 dBV/m
Averaged maximum above arm	100 mW input power	88.0 V/m ± 12.8 % (k=2)

Appendix (Additional assessments outside the scope of SCS108)

Antenna Parameters

Frequency	Return Loss	Impedance
1730 MHz	26.8 dB	49.3 Ω + 4.5 jΩ
1880 MHz	19.7 dB	48.4 Ω + 10.2 jΩ
1900 MHz	20.3 dB	51.3 Ω + 9.8 jΩ
1950 MHz	26.2 dB	54.8 Ω + 1.8 jΩ
2000 MHz	21.8 dB	42.6 Ω + 1.2 jΩ

3.2 Antenna Design and Handling

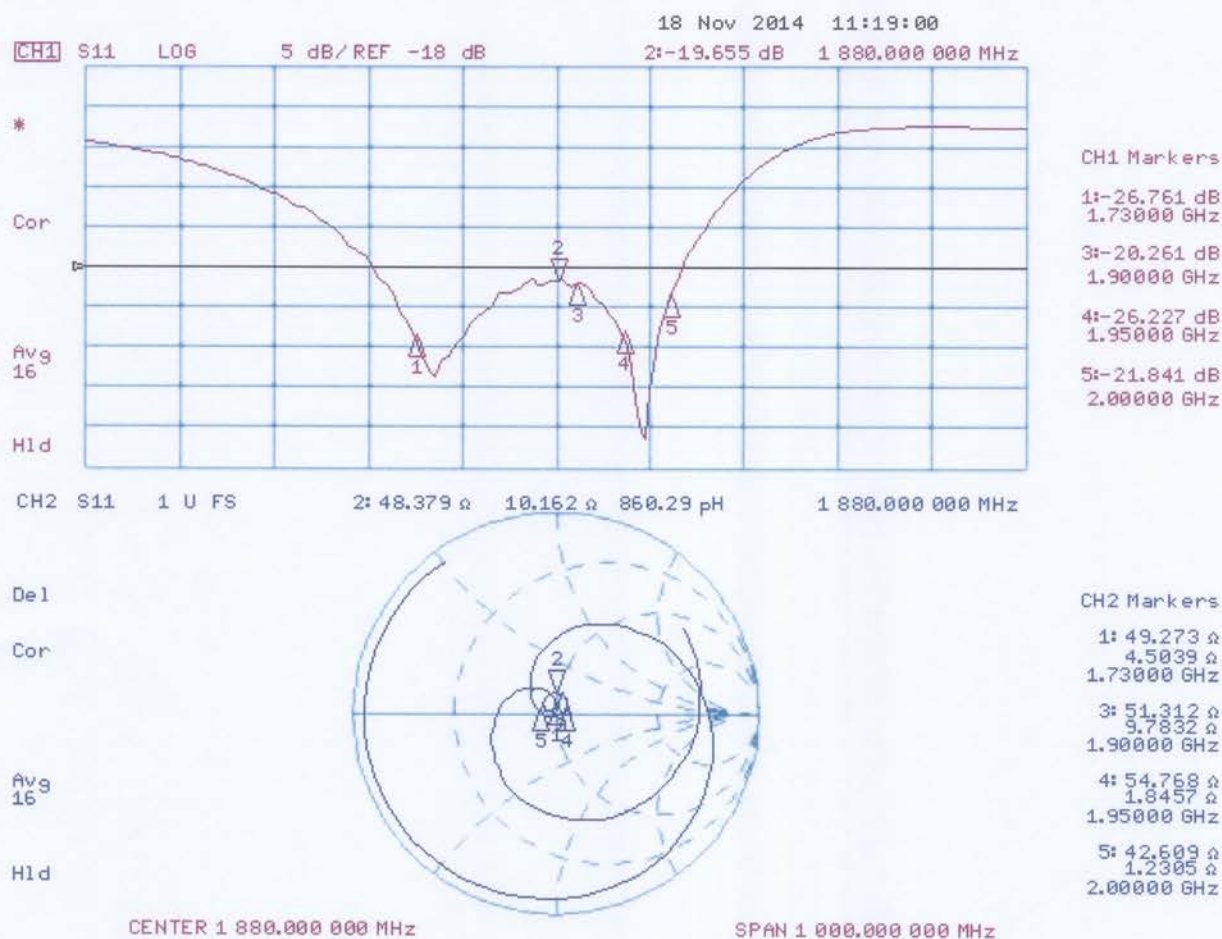
The calibration dipole has a symmetric geometry with a built-in two stub matching network, which leads to the enhanced bandwidth.

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 E-field Result

Date: 17.11.2014

Test Laboratory: SPEAG Lab2

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

Communication System: UID 0 - CW ; Frequency: 1880 MHz
Medium parameters used: $\sigma = 0 \text{ S/m}$, $\epsilon_r = 1$; $\rho = 1000 \text{ kg/m}^3$
Phantom section: RF Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: ER3DV6 - SN2336; ConvF(1, 1, 1); Calibrated: 30.12.2013;
- Sensor-Surface: (Fix Surface)
- Electronics: DAE4 Sn601; Calibrated: 18.08.2014
- Phantom: HAC Test Arch with AMCC; Type: SD HAC P01 BA; Serial: 1070
- DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

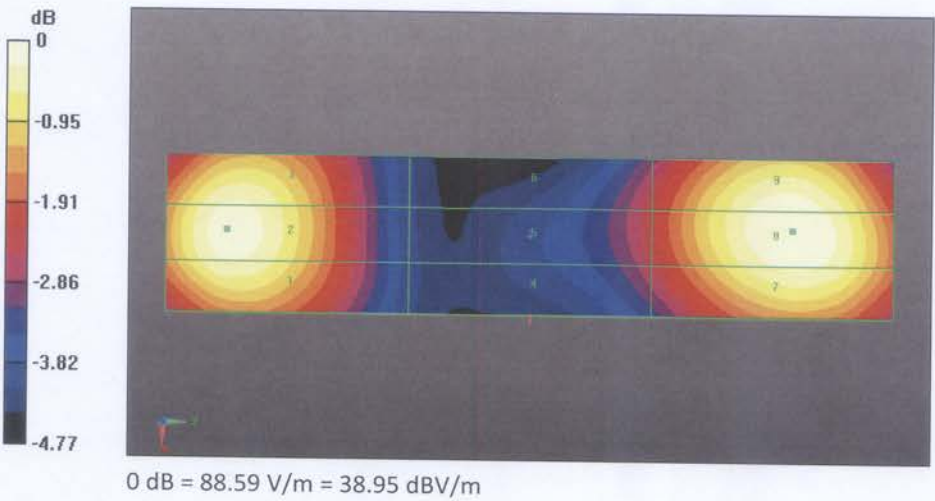
Dipole E-Field measurement @ 1880MHz/E-Scan - 1880MHz d=15mm/Hearing Aid Compatibility Test (41x181x1):
Interpolated grid: dx=0.5000 mm, dy=0.5000 mm

Device Reference Point: 0, 0, -6.3 mm
Reference Value = 140.7 V/m; Power Drift = -0.01 dB
Applied MIF = 0.00 dB
RF audio interference level = 38.95 dBV/m

Emission category: M2

MIF scaled E-field

Grid 1 M2	Grid 2 M2	Grid 3 M2
38.62 dBV/m	38.83 dBV/m	38.7 dBV/m
Grid 4 M2	Grid 5 M2	Grid 6 M2
36.39 dBV/m	36.64 dBV/m	36.61 dBV/m
Grid 7 M2	Grid 8 M2	Grid 9 M2
38.69 dBV/m	38.95 dBV/m	38.88 dBV/m



Justification of the extended calibration of Dipole CD1880V3 SN: 1100

Per KDB 865664, we have Measured the Impedance and Return Loss as below, and the return loss is <-20dB, with 20% of prior calibration; the real or imaginary parts of the impedance is with 5 ohm of prior calibration. Therefore the verification result should support extended calibration.

Frequency	Target Value		Measured Value		Difference	
	Impedance	Return Loss	Impedance	Return Loss	Impedance	Return Loss
1730 MHz	49.3Ω+4.5jΩ	-26.8dB	50.50Ω+7.95jΩ	-26.38dB	R=1.20Ω, X=3.45Ω	1.57%
1880 MHz	48.4Ω+10.2jΩ	-19.7dB	52.59Ω+6.26jΩ	-19.48dB	R=4.19Ω, X=-3.94Ω	1.11%
1900 MHz	51.3Ω+9.8jΩ	-20.3dB	52.32Ω+8.10jΩ	-19.25dB	R=1.02Ω, X=-1.70Ω	5.17%
1950 MHz	54.8Ω+1.8jΩ	-26.2dB	58.66Ω+1.40jΩ	-26.44dB	R=3.86Ω, X=-0.40Ω	-1.76%
2000 MHz	42.6Ω+1.2jΩ	-21.8dB	46.79Ω+5.88jΩ	-21.34dB	R=4.19Ω, X=4.68Ω	2.11%
Measured Date	2014-11-17		2015-11-13		-----	

Impedance Test	Return Loss Test
