

EF3DV3 - SN:4060

June 12, 2018

Appendix (Additional assessments outside the scope of SCS 0108)

Calibration Parameters for 3-4 GHz

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm $(\mu V/(V/m)^2)^X$	0.79	0.75	1.35	± 10.1 %
DCP (mV) ^B	95.7	94.8	94.0	

Calibration Parameters for 5-6 GHz

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm $(\mu V/(V/m)^2)^X$	0.86	0.81	1.48	± 10.1 %
DCP (mV) ^B	95.7	94.8	94.0	

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.
^X Calibration procedure for frequencies above 3 GHz is pending accreditation.

Certificate No: EF3-4060_Jun18

Page 11 of 39



ANNEX E DIPOLE CALIBRATION CERTIFICATE

Dipo	le	835	MHz

Zeughausstrasse 43, 8004 Zurich		the annual scott	Service suisse d'étalonnage Servizio svizzero di taratura Swiss Calibration Service
Accredited by the Swiss Accreditati The Swiss Accreditation Service Multilateral Agreement for the red	is one of the signatorie	es to the EA	Accreditation No.: SCS 0108
Client CTTL (Auden)			lo: CD835V3-1023_Aug18
CALIBRATION C	ERTIFICAT	E	
Object	CD835V3 - SN:	1023	
Calibration procedure(s)	QA CAL-20.v6 Calibration proce	edure for dipoles in air	
Calibration date:	August 28, 2018		
Calibration Equipment used (M&T	E critical for calibration)	ry facility: environment temperature $(22 \pm 3)^{\circ}$	C and humidity < 70%.
Primary Standards Power meter NRP	ID # SN: 104778	Cal Date (Certificate No.)	Scheduled Calibration
Power sensor NRP-Z91	SN: 104778	04-Apr-18 (No. 217-02672/02673) 04-Apr-18 (No. 217-02672)	Apr-19
	SN: 103245	04-Apr-18 (No. 217-02673)	Apr-19
Power sensor NRP-Z91			Apr-19
Reference 20 dB Attenuator	SN: 5058 (20k)	04-Apr-18 (No. 217-02682)	Apr-19 Apr-19
Reference 20 dB Attenuator Type-N mismatch combination	SN: 5047.2 / 06327	 Second control of the second se	
Reference 20 dB Attenuator Type-N mismatch combination Probe EF3DV3	and a second sec	04-Apr-18 (No. 217-02682)	Apr-19
Reference 20 dB Attenuator Type-N mismatch combination Probe EF3DV3 DAE4	SN: 5047.2 / 06327 SN: 4013	04-Apr-18 (No. 217-02682) 04-Apr-18 (No. 217-02683) 05-Mar-18 (No. EF3-4013_Mar18) 17-Jan-18 (No. DAE4-781_Jan18)	Apr-19 Apr-19 Mar-19 Jan-19
Reference 20 dB Attenuator Type-N mismatch combination Probe EF3DV3 DAE4 Secondary Standards	SN: 5047.2 / 06327 SN: 4013 SN: 781	04-Apr-18 (No. 217-02682) 04-Apr-18 (No. 217-02683) 05-Mar-18 (No. EF3-4013_Mar18)	Apr-19 Apr-19 Mar-19 Jan-19 Scheduled Check
Reference 20 dB Attenuator Type-N mismatch combination Probe EF3DV3 DAE4 Secondary Standards Power meter Agilent 4419B Power sensor HP E4412A	SN: 5047.2 / 06327 SN: 4013 SN: 781	04-Apr-18 (No. 217-02682) 04-Apr-18 (No. 217-02683) 05-Mar-18 (No. EF3-4013_Mar18) 17-Jan-18 (No. DAE4-781_Jan18) Check Date (in house)	Apr-19 Apr-19 Mar-19 Jan-19
Reference 20 dB Attenuator Type-N mismatch combination Probe EF3DV3 DAE4 Secondary Standards Power meter Agilent 4419B Power sensor HP E4412A Power sensor HP 8482A	SN: 5047.2 / 06327 SN: 4013 SN: 781 ID # SN: GB42420191 SN: US38485102 SN: US37295597	04-Apr-18 (No. 217-02682) 04-Apr-18 (No. 217-02683) 05-Mar-18 (No. EF3-4013_Mar18) 17-Jan-18 (No. DAE4-781_Jan18) Check Date (in house) 09-Oct-09 (in house check Oct-17) 05-Jan-10 (in house check Oct-17) 09-Oct-09 (in house check Oct-17)	Apr-19 Apr-19 Mar-19 Jan-19 Scheduled Check In house check: Oct-20
Reference 20 dB Attenuator Type-N mismatch combination Probe EF3DV3 DAE4 Secondary Standards Power meter Agilent 4419B Power sensor HP E4412A Power sensor HP 8482A RF generator R&S SMT-06	SN: 5047.2 / 06327 SN: 4013 SN: 781 ID # SN: GB42420191 SN: US38485102	04-Apr-18 (No. 217-02682) 04-Apr-18 (No. 217-02683) 05-Mar-18 (No. EF3-4013_Mar18) 17-Jan-18 (No. DAE4-781_Jan18) Check Date (in house) 09-Oct-09 (in house check Oct-17) 05-Jan-10 (in house check Oct-17)	Apr-19 Apr-19 Mar-19 Jan-19 Scheduled Check In house check: Oct-20 In house check: Oct-20
Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Probe EF3DV3 DAE4 Secondary Standards Power sensor HP E4412A Power sensor HP E4412A Power sensor HP 8482A RF generator R&S SMT-06 Network Analyzer Agilent E8358A Calibrated by:	SN: 5047.2 / 06327 SN: 4013 SN: 781 SN: GB42420191 SN: US38485102 SN: US37295597 SN: 832283/011 SN: US41080477 Name	04-Apr-18 (No. 217-02682) 04-Apr-18 (No. 217-02683) 05-Mar-18 (No. EF3-4013_Mar18) 17-Jan-18 (No. DAE4-781_Jan18) Check Date (in house) 09-Oct-09 (in house check Oct-17) 05-Jan-10 (in house check Oct-17) 09-Oct-09 (in house check Oct-17) 27-Aug-12 (in house check Oct-17) 31-Mar-14 (in house check Oct-17) Function	Apr-19 Apr-19 Mar-19 Jan-19 Scheduled Check In house check: Oct-20 In house check: Oct-20 In house check: Oct-20 In house check: Oct-20
Reference 20 dB Attenuator Type-N mismatch combination Probe EF3DV3 DAE4 Secondary Standards Power meter Agilent 4419B Power sensor HP E4412A Power sensor HP E4412A RF generator R&S SMT-06 Network Analyzer Agilent E8358A	SN: 5047.2 / 06327 SN: 4013 SN: 781 ID # SN: GB42420191 SN: US38485102 SN: US37295597 SN: 832283/011 SN: US41080477	04-Apr-18 (No. 217-02682) 04-Apr-18 (No. 217-02683) 05-Mar-18 (No. EF3-4013_Mar18) 17-Jan-18 (No. DAE4-781_Jan18) Check Date (in house) 09-Oct-09 (in house check Oct-17) 05-Jan-10 (in house check Oct-17) 09-Oct-09 (in house check Oct-17) 27-Aug-12 (in house check Oct-17) 31-Mar-14 (in house check Oct-17)	Apr-19 Apr-19 Mar-19 Jan-19 Scheduled Check In house check: Oct-20 In house check: Oct-20 In house check: Oct-20 In house check: Oct-20 In house check: Oct-18
Reference 20 dB Attenuator Type-N mismatch combination Probe EF3DV3 DAE4 Secondary Standards Power meter Agilent 4419B Power sensor HP E4412A Power sensor HP 8482A RF generator R&S SMT-06 Network Analyzer Agilent E8358A Calibrated by:	SN: 5047.2 / 06327 SN: 4013 SN: 781 SN: GB42420191 SN: US38485102 SN: US37295597 SN: 832283/011 SN: US41080477 Name	04-Apr-18 (No. 217-02682) 04-Apr-18 (No. 217-02683) 05-Mar-18 (No. EF3-4013_Mar18) 17-Jan-18 (No. DAE4-781_Jan18) Check Date (in house) 09-Oct-09 (in house check Oct-17) 05-Jan-10 (in house check Oct-17) 09-Oct-09 (in house check Oct-17) 27-Aug-12 (in house check Oct-17) 31-Mar-14 (in house check Oct-17) Function	Apr-19 Apr-19 Mar-19 Jan-19 Scheduled Check In house check: Oct-20 In house check: Oct-20 In house check: Oct-20 In house check: Oct-20 In house check: Oct-18
Reference 20 dB Attenuator Type-N mismatch combination Probe EF3DV3 DAE4 Secondary Standards Power meter Agilent 4419B Power sensor HP E4412A Power sensor HP 8482A RF generator R&S SMT-06 Network Analyzer Agilent E8358A Calibrated by:	SN: 5047.2 / 06327 SN: 4013 SN: 781 SN: GB42420191 SN: US38485102 SN: US37295597 SN: 832283/011 SN: US41080477 Name Leif Klysner Katja Pokovic	04-Apr-18 (No. 217-02682) 04-Apr-18 (No. 217-02683) 05-Mar-18 (No. EF3-4013_Mar18) 17-Jan-18 (No. DAE4-781_Jan18) Check Date (in house) 09-Oct-09 (in house check Oct-17) 05-Jan-10 (in house check Oct-17) 09-Oct-09 (in house check Oct-17) 27-Aug-12 (in house check Oct-17) 31-Mar-14 (in house check Oct-17) Function Laboratory Technician	Apr-19 Apr-19 Mar-19 Jan-19 Scheduled Check In house check: Oct-20 In house check: Oct-20 In house check: Oct-20 In house check: Oct-20 In house check: Oct-18 Signature Sed Magaa Magaa Suped: August 28, 2018



No.I19Z60613-SEM01 Page 78 of 92

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



Heading a school

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

Accreditation No.: SCS 0108

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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

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%.

Certificate No: CD835V3-1023_Aug18

Page 2 of 5



Measurement Conditions

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

DASY Version	DASY5	V52.10.1
Phantom	HAC Test Arch	
Distance Dipole Top - Probe Center	15 mm	
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	111.0 V/m = 40.91 dBV/m
Maximum measured above low end	100 mW input power	109.6 V/m = 40.80 dBV/m
Averaged maximum above arm	100 mW input power	110.3 V/m ± 12.8 % (k=2)

Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters

Frequency	Return Loss	Impedance
800 MHz	18.1 dB	42.6 Ω - 9.0 jΩ
835 MHz	23.3 dB	53.6 Ω + 6.1 jΩ
880 MHz	15.6 dB	65.0 Ω - 11.8 jΩ
900 MHz	17.7 dB	53.6 Ω - 13.1 jΩ
945 MHz	25.0 dB	46.5 Ω + 4.1 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.

Certificate No: CD835V3-1023_Aug18

Page 3 of 5



Impedance Measurement Plot

		Sweep	Calibration	Trace	<u>S</u> cale	Marker	System	Window	Help		
10.00 5.00	dB S11								1:	800.000000 MHz	-18.052 dl
5.00									>2:	835.00000 MHz	23.283 dl
0.00									3:	880.000000 MHz	-15.635 dl
5.00					-				5	900.000000 MHz 945.000000 MHz	-17.723 di
					1	\		1		340 THURSON WHS	-25.031 dl
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15.00				_		1		1			
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35.00											
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					Å	X			>2: 3:	800.000000 MHz 22.098 pF 835.000000 MHz 1.1658 nH 880.000000 MHz 15.268 pF	42.614.0 -9.0028.0 53.633.0 6.1164.0 64.993.0 -11.846.0
					Å	X			>2:	800.000000 MHz 22.038 pF 835.00000 MHz 1.1658 nH 880.000000 MHz 15.268 pF 900.00000 MHz	42.614.0 -9.0028.0 53.633.0 6.1164.0 64.993.0 -11.846.0 53.610.0
					4	X			>2: 3:	800.000000 MHz 22.098 pF 835.000000 MHz 1.1658 nH 880.000000 MHz 15.268 pF	42.614 (-9.0028 (53.633 (6.1164 (64.993 (-11.846 (53.610 (-13.084 (
						XXX			≥2: 3: 4:	800.000000 MHz 22.088 pF 835.000000 MHz 1.1658 nH 880.000000 MHz 15.268 pF 900.000000 MHz 13.516 pF	
Ch1: St	Ch 1 Avg = art 335.000 M		_						≥2: 3: 4:	800.00000 MHz 22.098 pF 835.000000 MHz 1.1658 nH 880.000000 MHz 15.268 pF 900.00000 MHz 13.516 pF 945.000000 MHz 689.85 pH	42.614 -9.0028 53.633 6.1164 64.993 -11.846 53.610 -13.084 46.466

Certificate No: CD835V3-1023_Aug18

Page 4 of 5



DASY5 E-field Result

Date: 28.08.2018

Test Laboratory: SPEAG Lab2

DUT: HAC-Dipole 835 MHz; Type: CD835V3; Serial: CD835V3 - SN: 1023

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

DASY52 Configuration:

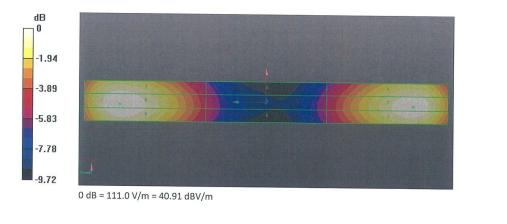
- Probe: EF3DV3 SN4013; ConvF(1, 1, 1) @ 835 MHz; Calibrated: 05.03.2018
- Sensor-Surface: (Fix Surface)
- Electronics: DAE4 Sn781; Calibrated: 17.01.2018
- Phantom: HAC Test Arch with AMCC; Type: SD HAC P01 BA; Serial: 1070
- DASY52 52.10.1(1476); SEMCAD X 14.6.11(7439)

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 = 132.3 V/m; Power Drift = -0.03 dB Applied MIF = 0.00 dB RF audio interference level = 40.91 dBV/m

MIE scaled E-field

Emission category: M3

win Scaled L-II	eiu	
Grid 1 M3	Grid 2 M3	Grid 3 M3
40.37 dBV/m	40.8 dBV/m	40.73 dBV/m
Grid 4 M4	Grid 5 M4	Grid 6 M4
35.58 dBV/m	35.93 dBV/m	35.91 dBV/m
Grid 7 M3	Grid 8 M3	Grid 9 M3
40.56 dBV/m	40.91 dBV/m	40.85 dBV/m



Certificate No: CD835V3-1023_Aug18

Page 5 of 5



No.I19Z60613-SEM01 Page 82 of 92

Dipole 1880 MHz

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Accreditation No.: SCS 0108

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

ent CTTL (Auden)			lo: CD1880V3-1018_Aug1
CALIBRATION C	ERTIFICAT	2	
Object	CD1880V3 - SN	: 1018	
Calibration procedure(s)	QA CAL-20.v6	edure for dipoles in air	
	Campration proof		
Calibration date:	August 28, 2018		
The measurements and the uncert	ainties with confidence p	ional standards, which realize the physical u robability are given on the following pages a ry facility: environment temperature (22 ± 3)	and are part of the certificate.
Calibration Equipment used (M&TE	E critical for calibration)		
Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter NRP	SN: 104778	04-Apr-18 (No. 217-02672/02673)	Apr-19
ower sensor NRP-Z91	SN: 103244	04-Apr-18 (No. 217-02672)	Apr-19
ower sensor NRP-Z91	SN: 103245	04-Apr-18 (No. 217-02673)	Apr-19
Reference 20 dB Attenuator	SN: 5058 (20k)	04-Apr-18 (No. 217-02682)	Apr-19
ype-N mismatch combination	SN: 5047.2 / 06327	04-Apr-18 (No. 217-02683)	Apr-19
Probe EF3DV3	SN: 4013	05-Mar-18 (No. EF3-4013_Mar18)	Mar-19
DAE4	SN: 781	17-Jan-18 (No. DAE4-781_Jan18)	Jan-19
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power meter Agilent 4419B	SN: GB42420191	09-Oct-09 (in house check Oct-17)	In house check: Oct-20
ower sensor HP E4412A	SN: US38485102	05-Jan-10 (in house check Oct-17)	In house check: Oct-20
ower sensor HP 8482A	SN: US37295597	09-Oct-09 (in house check Oct-17)	In house check: Oct-20
F generator R&S SMT-06	SN: 832283/011	27-Aug-12 (in house check Oct-17)	In house check: Oct-20
letwork Analyzer Agilent E8358A	SN: US41080477	31-Mar-14 (in house check Oct-17)	In house check: Oct-18
alibrated by:	Name Loif Klyppor	Function	Signature
andrated by.	Leif Klysner	Laboratory Technician	Sel Illy
Approved by:	Katja Pokovic	Technical Manager	blitty
			Issued: August 28, 2018

Certificate No: CD1880V3-1018_Aug18

Page 1 of 5



No.I19Z60613-SEM01 Page 83 of 92

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

Accreditation No.: SCS 0108

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

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%.

Certificate No: CD1880V3-1018_Aug18

Page 2 of 5



Measurement Conditions

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

DASY Version	DASY5	V52.10.1
Phantom	HAC Test Arch	
Distance Dipole Top - Probe Center	15 mm	
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	89.2 V/m = 39.01 dBV/m
Maximum measured above low end	100 mW input power	88.5 V/m = 38.94 dBV/m
Averaged maximum above arm	100 mW input power	88.9 V/m ± 12.8 % (k=2)

Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters

Frequency	Return Loss	Impedance
1730 MHz	31.6 dB	52.7 Ω - 0.4 jΩ
1880 MHz	23.8 dB	54.4 Ω + 5.1 jΩ
1900 MHz	23.6 dB	56.1 Ω + 3.4 jΩ
1950 MHz	32.5 dB	52.0 Ω - 1.3 jΩ
2000 MHz	20.3 dB	47.3 Ω + 9.1 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.

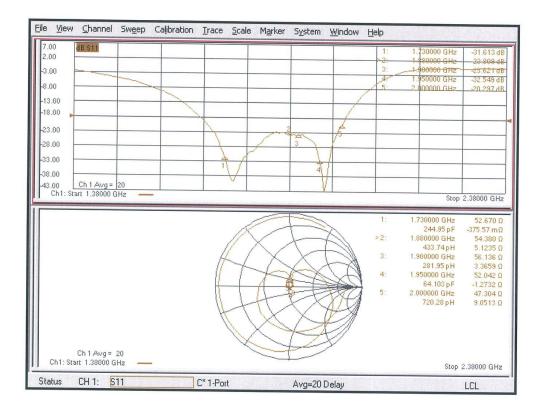
Do not apply force to dipole arms, as they are liable to bend. The soldered connections near the feedpoint may be damaged. After excessive mechanical stress or overheating, check the impedance characteristics to ensure that the internal matching network is not affected.

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

Page 3 of 5



Impedance Measurement Plot



Page 4 of 5



DASY5 E-field Result

Date: 28.08.2018

Test Laboratory: SPEAG Lab2

DUT: HAC Dipole 1880 MHz; Type: CD1880V3; Serial: CD1880V3 - SN: 1018

Communication System: UID 0 - CW ; Frequency: 1880 MHz Medium parameters used: $\sigma = 0$ S/m, $\epsilon_r = 1$; $\rho = 0$ kg/m³ Phantom section: RF Section Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

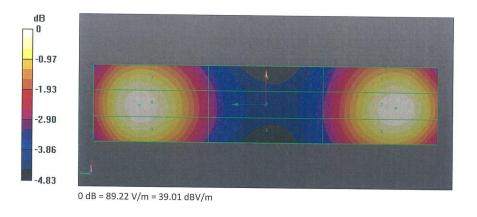
- Probe: EF3DV3 SN4013; ConvF(1, 1, 1) @ 1880 MHz; Calibrated: 05.03.2018
- Sensor-Surface: (Fix Surface)
- Electronics: DAE4 Sn781; Calibrated: 17.01.2018
- Phantom: HAC Test Arch with AMCC; Type: SD HAC P01 BA; Serial: 1070
- DASY52 52.10.1(1476); SEMCAD X 14.6.11(7439)

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 = 154.3 V/m; Power Drift = -0.01 dB Applied MIF = 0.00 dB RF audio interference level = 39.01 dBV/m

Emission category: M2

MIF scaled E-field

Grid 1 M2	Grid 2 M2	Grid 3 M2
38.68 dBV/m	39.01 dBV/m	38.9 dBV/m
Grid 4 M2	Grid 5 M2	Grid 6 M2
36.09 dBV/m	36.25 dBV/m	36.21 dBV/m
Grid 7 M2	Grid 8 M2	Grid 9 M2
38.7 dBV/m	38.94 dBV/m	38.84 dBV/m



Certificate No: CD1880V3-1018_Aug18

Page 5 of 5



Dipole 2600 MHz

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



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 Swiss Calibration Service

Accreditation No.: SCS 0108

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

Client CTTL-BJ (Auden)

Certificate No: CD2600V3-1017_Aug18

CALIBRATION CERTIFICATE			
Object	CD2600V3 - SN: 1017		
Calibration procedure(s)	QA CAL-20.v6 Calibration proce	dure for dipoles in air	
Calibration date:	August 22, 2018		
The measurements and the uncer	tainties with confidence p	onal standards, which realize the physical unitrobability are given on the following pages and y facility: environment temperature $(22 \pm 3)^{\circ}$ C	d are part of the certificate.
Calibration Equipment used (M&T	Law.		
Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter NRP	SN: 104778	04-Apr-18 (No. 217-02672/02673)	Apr-19
Power sensor NRP-Z91	SN: 103244	04-Apr-18 (No. 217-02672)	Apr-19
Power sensor NRP-Z91	SN: 103245	04-Apr-18 (No. 217-02673)	Apr-19
Reference 20 dB Attenuator	SN: 5058 (20k)	04-Apr-18 (No. 217-02682)	Apr-19
Type-N mismatch combination	SN: 5047.2 / 06327	04-Apr-18 (No. 217-02683)	Apr-19
Probe EF3DV3	SN: 4013	05-Mar-18 (No. EF3-4013_Mar18)	Mar-19
DAE4	SN: 781	17-Jan-18 (No. DAE4-781_Jan18)	Jan-19
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power meter Agilent 4419B	SN: GB42420191	09-Oct-09 (in house check Oct-17)	In house check: Oct-20
Power sensor HP E4412A	SN: US38485102	05-Jan-10 (in house check Oct-17)	In house check: Oct-20
Power sensor HP 8482A	SN: US37295597	09-Oct-09 (in house check Oct-17)	In house check: Oct-20
RF generator R&S SMT-06	SN: 832283/011	27-Aug-12 (in house check Oct-17)	In house check: Oct-20
Network Analyzer HP 8358A	SN: US41080477	31-Mar-14 (in house check Oct-17)	In house check: Oct-18
	Name	Function	Signature
Calibrated by:	Jeton Kastrati	Laboratory Technician	te fe
Approved by:	Katja Pokovic	Technical Manager	lette
This calibration certificate shall no	t be reproduced except in	full without written approval of the laboratory.	Issued: August 23, 2018

Certificate No: CD2600V3-1017_Aug18

Page 1 of 5



No.I19Z60613-SEM01 Page 88 of 92

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





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

Accreditation No.: SCS 0108

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

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%.

Certificate No: CD2600V3-1017_Aug18

Page 2 of 5



Measurement Conditions

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

DASY Version	DASY5	V52.10.1
Phantom	HAC Test Arch	
Distance Dipole Top - Probe Center	15 mm	
Scan resolution	dx, dy = 5 mm	
Frequency	2600 MHz ± 1 MHz	
Input power drift	< 0.05 dB	

Maximum Field values at 2600 MHz

E-field 15 mm above dipole surface	condition	Interpolated maximum
Maximum measured above high end	100 mW input power	86.3 V/m = 38.72 dBV/m
Maximum measured above low end	100 mW input power	85.4 V/m = 38.63 dBV/m
Averaged maximum above arm	100 mW input power	85.8 V/m ± 12.8 % (k=2)

Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters

Frequency	Return Loss	Impedance
2450 MHz	24.4 dB	44.5 Ω + 1.6 jΩ
2550 MHz	21.8 dB	57.4 Ω + 4.7 jΩ
2600 MHz	20.6 dB	59.7 Ω - 3.3 jΩ
2650 MHz	19.8 dB	55.1 Ω - 9.5 jΩ
2750 MHz	16.0 dB	41.7 Ω - 12.1 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.

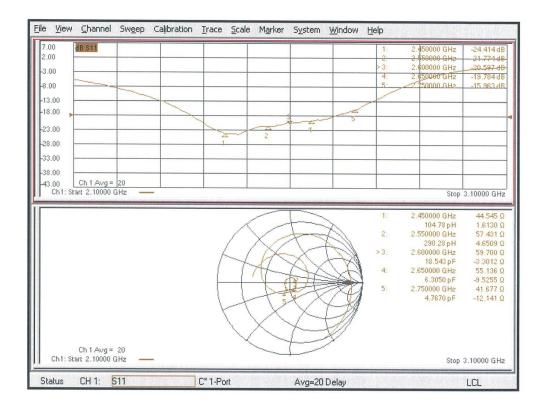
The dipole is built of standard semirigid coaxial cable. The internal matching line is open ended. The antenna is therefore open for DC signals.

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





DASY5 E-field Result

Date: 22.08.2018

Test Laboratory: SPEAG Lab2

DUT: HAC Dipole 2600 MHz; Type: CD2600V3; Serial: CD2600V3 - SN: 1017

Communication System: UID 0 - CW ; Frequency: 2600 MHz Medium parameters used: $\sigma = 0$ S/m, $\epsilon_r = 1$; $\rho = 0$ kg/m³ Phantom section: RF Section Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

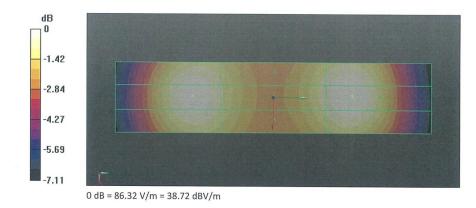
- Probe: EF3DV3 SN4013; ConvF(1, 1, 1) @ 2600 MHz; Calibrated: 05.03.2018
- Sensor-Surface: (Fix Surface)
- Electronics: DAE4 Sn781; Calibrated: 17.01.2018
- Phantom: HAC Test Arch with AMCC; Type: SD HAC P01 BA; Serial: 1070
- DASY52 52.10.1(1476); SEMCAD X 14.6.11(7439)

Dipole E-Field measurement @ 2600MHz/E-Scan - 2600MHz 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 = 65.15 V/m; Power Drift = 0.00 dB Applied MIF = 0.00 dB

RF audio interference level = 38.72 dBV/m Emission category: M2

MIF scaled E-field

Grid 1 M2	Grid 2 M2	Grid 3 M2
38.38 dBV/m	38.62 dBV/m	38.53 dBV/m
Grid 4 M2	Grid 5 M2	Grid 6 M2
37.9 dBV/m	38.12 dBV/m	38.07 dBV/m
Grid 7 M2	Grid 8 M2	Grid 9 M2
38.5 dBV/m	38.72 dBV/m	38.63 dBV/m



Certificate No: CD2600V3-1017_Aug18

Page 5 of 5



The photos of HAC test are presented in the additional document:

Appendix to test report No.I19Z60613-SEM01/02

The photos of HAC test