

HAC RF E-Field GSM 1900 Low Date: 2018-10-8 Electronics: DAE4 Sn1525 Medium: Air Medium parameters used: $\sigma = 0$ mho/m, $\varepsilon_r = 1$; $\rho = 1000$ kg/m³ Ambient Temperature: 22.0°C Communication System: DCS 1900; Frequency: 1850.2 MHz; Duty Cycle: 1:8.3 Probe: ER3DV6 - SN2272;ConvF(1, 1, 1)

E Scan - ER3DV6 - 2011: 15 mm from Probe Center to the Device 3/Hearing Aid Compatibility Test (101x101x1): Interpolated grid: dx=0.5000 mm, dy=0.5000 mm Device Reference Point: 0, 0, -6.3 mm Reference Value = 18.43 V/m; Power Drift = 0.11 dB Applied MIF = 3.45 dB RF audio interference level = 29.82 dBV/m Emission category: M4

MIF scaled E-field

Grid 1 M4	Grid 2 M4	Grid 3 M4
28.41 dBV/m	27.58 dBV/m	27.67 dBV/m
Grid 4 M4	Grid 5 M4	Grid 6 M4
26.96 dBV/m	29.82 dBV/m	29.85 dBV/m
Grid 7 M4	Grid 8 M3	Grid 9 M3
29.05 dBV/m	30.97 dBV/m	30.96 dBV/m



0 dB = 23.91 V/m = 27.57 dBV/m

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Fig B.6 HAC RF E-Field GSM 1900 Low

ANNEX C SYSTEM VALIDATION RESULT

E SCAN of Dipole 835 MHz

Date: 2018-10-8 Electronics: DAE4 Sn1525 Medium: Air Medium parameters used: $\sigma = 0$ mho/m, $\epsilon r = 1$; $\rho = 1000$ kg/m3 Communication System: CW; Frequency: 835 MHz; Duty Cycle: 1:1 Probe: ER3DV6 - SN2272;ConvF(1, 1, 1)

E Scan - measurement distance from the probe sensor center to CD835 Dipole = **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 = 107.9 V/m; Power Drift = -0.03 dB Applied MIF = 0.00 dB RF audio interference level = 40.61 dBV/mEmission category: M3

MIF scaled E-field

Grid 1 M3	Grid 2 M3	Grid 3 M3
40.39 dBV/m	40.51 dBV/m	40.33 dBV/m
Grid 4 M4	Grid 5 M4	Grid 6 M4
35.93 dBV/m	36.04 dBV/m	35.88 dBV/m
Grid 7 M3	Grid 8 M3	Grid 9 M3
40.34 dBV/m	40.61 dBV/m	40.46 dBV/m



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0 dB = 40.61 dBV/mE SCAN of Dipole 1880 MHz Date: 2018-10-8 Electronics: DAE4 Sn1525 Medium: Air Medium parameters used: $\sigma = 0$ mho/m, $\varepsilon_r = 1$; $\rho = 1000$ kg/m³ Communication System: CW; Frequency: 1880 MHz; Duty Cycle: 1:1 Probe: ER3DV6 - SN2272;ConvF(1, 1, 1) E Scan - measurement distance from the probe sensor center to CD1880 Dipole = 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 = 154.9 V/m; Power Drift = 0.02 dB Applied MIF = 0.00 dBRF audio interference level = 39.32 dBV/m**Emission category: M2** MIF scaled E-field

Grid 1M2Grid 2M2Grid 3M2**39.21 dBV/m39.32 dBV/m39.31 dBV/m**Grid 4M2Grid 5M2Grid 6M2**37.22 dBV/m37.36 dBV/m37.26 dBV/m**Grid 7M2Grid 8M2Grid 9M2**38.78 dBV/m39.05dBV/m38.98 dBV/m**



 $0 \, dB = 39.32 \, dBV/m$



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ANNEX D PROBE CALIBRATION CERTIFICATE

E_Probe ER3DV6

Client

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

CTTL (Auden)



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 0108

Certificate No: ER3-2272_Dec17

Dbject ER3DV6 - Calibration procedure(s) QA CAL-0 Calibration evaluation: Calibration date: December Calibration certificate documents the traceability of the measurements and the uncertainties with conference with conference and the uncertainties with conference of the measurement and the uncertainties of the measurement of th	SN:2272 2.v8, QA CAL-25.v6 procedure for E-field probes optimized in air 19, 2017 / to national standards, which realize the physical un dence probability are given on the following pages ar aboratory facility: environment temperature (22 ± 3)% ation)	d for close near field hits of measurements (SI). nd are part of the certificate. C and humidity < 70%.
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Power sensor NRP-Z91 SN: 103245 Reference 20 dB Attenuator SN: S5277 (20x Reference Probe ER3DV6 SN: 2328 DAE4 SN: 789 Secondary Standards ID Power meter E4419B SN: GB412938; Power sensor E4412A SN: 000110210 RF generator HP 8648C SN: US364200 Vetwork Analyzer HP 8753E SN: US3739058	04-Apr-17 (No. 217-02521)	Apr-18
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DAE4 SN: 789 Secondary Standards ID Power meter E4419B SN: GB412938; Power sensor E4412A SN: MY4149800 Power sensor E4412A SN: 000110210 RF generator HP 8648C SN: US3642U0 Network Analyzer HP 8753E SN: US3739058 Name alibrated by: Jeton Kastrati	10-Oct-17 (No. ER3-2328_Oct17)	Oct-18
Secondary Standards ID Power meter E4419B SN: GB4129387 Power sensor E4412A SN: MY4149800 Power sensor E4412A SN: 000110210 RF generator HP 8648C SN: US3642U0 vetwork Analyzer HP 8753E SN: US3739058 Alibrated by: Jeton Kastrati	2-Aug-17 (No. DAE4-789_Aug17)	Aug-18
Power meter E4419B SN: GB412938; Power sensor E4412A SN: MY4149800; Power sensor E4412A SN: 000110210 RF generator HP 8648C SN: US3642U0 Network Analyzer HP 8753E SN: US3739056 Name Jeton Kastrati	Check Date (in house)	Scheduled Check
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Network Analyzer HP 8753E SN: US3739056 Name Calibrated by: Jeton Kastrati	700 04-Aug-99 (in house check Jun-16)	In house check: Jun-18
Name Calibrated by: Jeton Kastrati	5 18-Oct-01 (in house check Oct-17)	In house check: Oct-18
Calibrated by: Jeton Kastrati	Eurotion	Signatura
	Laboratory Technician	
pproved by: Katja Pokovic	Technical Manager	fletty.
		Issued: December 20, 2017

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



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

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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

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, D	modulation dependent linearization parameters
Polarization φ	φ rotation around probe axis
Polarization &	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:

- 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, Rev 3.0, November 2013

Methods Applied and Interpretation of Parameters:

- 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; Dx,y,z; VRx,y,z: A, B, C, D 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).

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Probe ER3DV6

SN:2272

Manufactured: November 29, 2001 Calibrated: December 19, 2017

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

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DASY/EASY - Parameters of Probe: ER3DV6 - SN:2272

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm $(\mu V/(V/m)^2)$	1.60	1.67	1.72	± 10.1 %
DCP (mV) ^B	101.0	97.8	100.7	

Modulation Calibration Parameters

	Communication System Name		A dB	Β dB√μV	С	D dB	VR mV	Unc [≞] (k=2)
0	CW	X	0.0	0.0	1.0	0.00	200.2	±3.5 %
		Y	0.0	0.0	1.0		165.8	
		Z	0.0	0.0	1.0		197.0	

Note: For details on UID parameters see Appendix.

Sensor Model Parameters

	C1 fF	C2 fF	α V ⁻¹	T1 ms.V ⁻²	T2 ms.V ⁻¹	T3 ms	T4 V⁻²	T5 V ⁻¹	T6
X	94.34	448.4	35.94	25.97	1.333	5.10	0.00	0.662	1.014
Y	100.1	483.8	36.93	26.47	1.401	5.10	0.00	0.669	1 019
Z	83.01	396.9	36.42	29.84	3.892	5.10	0.00	0.874	1.016

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%.

⁸ 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.

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



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

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

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



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100

150

2500 MHz



ER3DV6 - SN:2272

-0.5

-150

100 MHz

-100

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Roll [°]

1800 MHz

-50

600 MHz

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



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

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

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DASY/EASY - Parameters of Probe: ER3DV6 - SN:2272

Other Probe Parameters

Sensor Arrangement	Rectangular
Connector Angle (°)	112.9
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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ANNEX E DIPOLE CALIBRATION CERTIFICATE

Dipole 835 MHz

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The Swiss Accreditation Service Jultilateral Agreement for the re-	ion Service (SAS) is one of the signatorie cognition of calibration	es to the EA certificates	Accreditation No.: SCS 0108
lient CTTL (Auden)		Certificate N	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		
This calibration certificate docume The measurements and the uncer All calibrations have been conduct Calibration Equipment used (M&T)	ents the traceability to nat tainties with confidence p ted in the closed laborato	ional standards, which realize the physical u robability are given on the following pages a ry facility: environment temperature (22 \pm 3) ^o	nits of measurements (SI). Ind are part of the certificate. °C and humidity < 70%.
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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%.

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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.

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Impedance Measurement Plot

e <u>V</u> iew	Channel	Sw <u>e</u> ep	Calibration	Irace	<u>S</u> cale	Marker	System	Window	Help	No. of the second	
10.00	dB S11							1	1:	800.000000 MHz	-18.052 d
5.00					-			-	2:	835.00000 MHz	23.283 d
0.00					_				3:	880.000000 MHz	-15.635 di
5.00				-	~				4	900.000000 MHz	-17.723 d
					1	< · · · · · · · · · · · · · · · · · · ·		1		395 HUILIII MH2	-25.031 d
0.00					-	1			_		
5.00						1					
0.00						7	134	1			
						11 3	4	VI			
5.00						1		25			
0.00				_				5			
5 00											
0.00	Ch 1 Ava =	20									
Ch1: Sta	rt 335.000 h	dHz —	-							Stop	1.33500 GF
					V++	X			1: >2: 3: 4: 5:	800.00000 MHz 22.098 pF 835.000000 MHz 1.1658 nH 880.000000 MHz 15.268 pF 900.000000 MHz 13.518 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 4.0961
Ch1: Star	Ch 1 Avg = rt 335.000 N	20 1Hz —	-				Constant			Stop	1.33500 GH
alus	LH 1: 5	11	San Daris	C* 1-Port			Ava=201	Delau			101

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DASY5 E-field Result

Date: 28.08.2018

Test Laboratory: SPEAG Lab2

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

 $\begin{array}{l} \mbox{Communication System: UID 0 - CW ; Frequency: 835 MHz} \\ \mbox{Medium parameters used: } \sigma = 0 \ S/m, \ \epsilon_r = 1; \ \rho = 0 \ kg/m^3 \\ \mbox{Phantom section: } RF \ Section \\ \mbox{Measurement Standard: } DASY5 \ (IEEE/IEC/ANSI \ C63.19-2011) \\ \end{array}$

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 Emission category: M3

MIF scaled E-fi	eld	
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



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Dipole 1880 MHz

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



Schweizerischer Kalibrierdienst S Service suisse d'étalonnage С 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

Object CD1880V3 - SN: 1018 Calibration procedure(s) QA CAL-20.v6 Calibration procedure for dipoles in air Calibration date: August 28, 2018 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 certificat 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 # Cel Date (Certificate No.) Scheduled Calibr Power sensor NRP-291 Power sensor NRP-291 SN: 104778 04-Apr-18 (No. 217-02672) Apr-19 Power sensor NRP-291 SN: 103244 04-Apr-18 (No. 217-02673) Apr-19 Power sensor NRP-291 SN: 103245 04-Apr-18 (No. 217-02683) Apr-19 Prower sensor NRP-291 SN: 103245 04-Apr-18 (No. 217-02683) Apr-19 Prower sensor NRP-291 SN: 103245 04-Apr-18 (No. 217-02683) Apr-19 SN: 0508 (20k) 04-Apr-18 (No. 217-02683) Apr-19 SN: 4013 05-Mar-18 (No. 217-02683) Apr-19 SN: 0413 05-Mar-18 (No. DAE4-781_Jan18) Jan-19 <		ERTIFICAT	E	
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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%.

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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.

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Impedance Measurement Plot



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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



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ANNEX F DAE CALIBRATION CERTIFICATE

	CALIB	RATION LABORATORY	CMRA CNA	S 校准
Add: No.51 Xu Tel: +86-10-62 E-mail: cttl@cl	leyuan Road, Haidian 304633-2512 Fa hinattl.com <u>H</u>	District, Beijing, 100191, China xx: +86-10-62304633-2504 ttp://www.chinattl.cn	Maladada V	CALIBRATI CNAS L05
Client : CT	TL	Certi	ificate No: Z18-60359	
CALIBRATION	CERTIFIC	ATE		
Object	DAE	E4 - SN: 1525		
Calibration Procedure(s)		711 000 01		
	Cali (DA	bration Procedure for the Data Ex)	Acquisition Electronics	
Calibration date:	Sep	tember 18. 2018		
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Glossary: DAE Connector angle

data acquisition electronics 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 report provide only calibration results for DAE, it does not contain other . performance test results.

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 Http://www.chinattl.cn
 E-mail: cttl@chinattl.com

DC Voltage Measurement A/D - Converter Resolution nominal High Range: 1LSB = 6.1μV, full range = -100...+300 m Low Range: 1LSB = 61nV, full range = -1......+3mV DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec -100...+300 mV

Calibration Factors	х	Y	z
High Range	$405.933 \pm 0.15\% \text{ (k=2)}$	$405.969 \pm 0.15\%$ (k=2)	405.417 ± 0.15% (k=2)
Low Range	3.99161 ± 0.7% (k=2)	$4.01041 \pm 0.7\%$ (k=2)	3.99418 ± 0.7% (k=2)

Connector Angle

Connector Angle to be used in DASY system	53°±1°
Connector Angle to be used in DAST system	53°±1°

Certificate No: Z18-60359

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

Appendix to test report No.I18Z61354-SEM02/03

The photos of HAC test