



Measurement Conditions

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

DASY Version	DASY5	V52.10.4
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	87.2 V/m = 38.81 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	86.3 V/m ± 12.8 % (k=2)

Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters

Frequency	Return Loss	Impedance
1730 MHz	28.3 dB	54.0 Ω - 0.5 jΩ
1880 MHz	23.1 dB	55.4 Ω + 5.1 jΩ
1900 MHz	22.9 dB	56.8 Ω + 3.4 jΩ
1950 MHz	30.8 dB	52.8 Ω - 1.0 jΩ
2000 MHz	20.0 dB	48.5 Ω + 9.8 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.

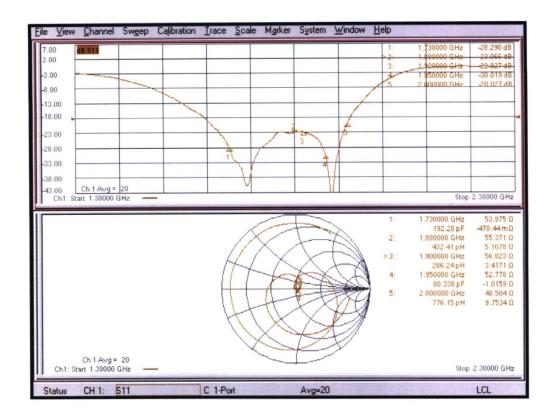
Do not apply force to dipole arms, as they are liable to bend. The soldered connections near the feedpoint may be damaged. After excessive mechanical stress or overheating, check the impedance characteristics to ensure that the internal matching network is not affected.

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

Certificate No: CD1880V3-1018_Aug23



Impedance Measurement Plot



Certificate No: CD1880V3-1018_Aug23

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DASY5 E-field Result

Date: 15.08.2023

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: 30.12.2022
- Sensor-Surface: (Fix Surface)
- Electronics: DAE4 Sn781; Calibrated: 03.01.2023
- Phantom: HAC Test Arch with AMCC; Type: SD HAC P01 BA; Serial: 1070
- DASY52 52.10.4(1535); SEMCAD X 14.6.14(7501)

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 = 150.8 V/m; Power Drift = 0.01 dB

Applied MIF = 0.00 dB

RF audio interference level = 38.81 dBV/m

Emission category: M2

MIF scaled E-field

Grid 2 M2 38.81 dBV/m	
Grid 5 M2 36.09 dBV/m	
Grid 8 M2 38.63 dBV/m	Control of the Control



0 dB = 87.25 V/m = 38.81 dBV/m

Certificate No: CD1880V3-1018_Aug23





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

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Client CTTL

Certificate No. CD2600V3-1017_Aug23

Dbject	CD2600V3 - SN:	1017	
Calibration procedure(s)	QA CAL-20.v7	dura for Validation Courses in sir	
	Calibration Proce	dure for Validation Sources in air	
Calibration date:	August 15, 2023		
		onal standards, which realize the physical unit robability are given on the following pages and	
		y 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 NRP2	SN: 104778	30-Mar-23 (No. 217-03804/03805)	Mar-24
Power sensor NRP-Z91	SN: 103244	30-Mar-23 (No. 217-03804)	Mar-24
Power sensor NRP-Z91	SN: 103245	30-Mar-23 (No. 217-03805)	Mar-24
	SN: 103245 SN: BH9394 (20k)	30-Mar-23 (No. 217-03805) 30-Mar-23 (No. 217-03809)	Mar-24 Mar-24
Reference 20 dB Attenuator	AND THE PERSON NAMED IN COLUMN TWO	and the same of th	
Reference 20 dB Attenuator Type-N mismatch combination	SN: BH9394 (20k)	30-Mar-23 (No. 217-03809)	Mar-24
Reference 20 dB Attenuator Type-N mismatch combination Probe EF3DV3	SN: BH9394 (20k) SN: 310982 / 06327	30-Mar-23 (No. 217-03809) 30-Mar-23 (No. 217-03810)	Mar-24 Mar-24
Reference 20 dB Attenuator Type-N mismatch combination Probe EF3DV3 DAE4	SN: BH9394 (20k) SN: 310982 / 06327 SN: 4013	30-Mar-23 (No. 217-03809) 30-Mar-23 (No. 217-03810) 30-Dec-22 (No. EF3-4013_Dec22) 03-Jan-23 (No. DAE4-781_Jan23)	Mar-24 Mar-24 Dec-23 Jan-24
Reference 20 dB Attenuator Type-N mismatch combination Probe EF3DV3 DAE4 Secondary Standards	SN: BH9394 (20k) SN: 310982 / 06327 SN: 4013 SN: 781	30-Mar-23 (No. 217-03809) 30-Mar-23 (No. 217-03810) 30-Dec-22 (No. EF3-4013_Dec22) 03-Jan-23 (No. DAE4-781_Jan23) Check Date (in house)	Mar-24 Mar-24 Dec-23
Reference 20 dB Attenuator Type-N mismatch combination Probe EF3DV3 DAE4 Secondary Standards Power meter Agilent 4419B	SN: BH9394 (20k) SN: 310982 / 06327 SN: 4013 SN: 781 ID # SN: GB42420191	30-Mar-23 (No. 217-03809) 30-Mar-23 (No. 217-03810) 30-Dec-22 (No. EF3-4013_Dec22) 03-Jan-23 (No. DAE4-781_Jan23) Check Date (in house) 09-Oct-09 (in house check Oct-20)	Mar-24 Mar-24 Dec-23 Jan-24 Scheduled Check In house check: Oct-23
Reference 20 dB Attenuator Type-N mismatch combination Probe EF3DV3 DAE4 Secondary Standards Power meter Agilent 4419B Power sensor HP E4412A	SN: BH9394 (20k) SN: 310982 / 06327 SN: 4013 SN: 781 ID # SN: GB42420191 SN: US38485102	30-Mar-23 (No. 217-03809) 30-Mar-23 (No. 217-03810) 30-Dec-22 (No. EF3-4013_Dec22) 03-Jan-23 (No. DAE4-781_Jan23) Check Date (in house) 09-Oct-09 (in house check Oct-20) 05-Jan-10 (in house check Oct-20)	Mar-24 Mar-24 Dec-23 Jan-24 Scheduled Check In house check: Oct-23 In house check: Oct-23
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: BH9394 (20k) SN: 310982 / 06327 SN: 4013 SN: 781 ID # SN: GB42420191	30-Mar-23 (No. 217-03809) 30-Mar-23 (No. 217-03810) 30-Dec-22 (No. EF3-4013_Dec22) 03-Jan-23 (No. DAE4-781_Jan23) Check Date (in house) 09-Oct-09 (in house check Oct-20) 05-Jan-10 (in house check Oct-20) 09-Oct-09 (in house check Oct-20)	Mar-24 Mar-24 Dec-23 Jan-24 Scheduled Check In house check: Oct-23
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: BH9394 (20k) SN: 310982 / 06327 SN: 4013 SN: 781 ID # SN: GB42420191 SN: US38485102 SN: US37295597	30-Mar-23 (No. 217-03809) 30-Mar-23 (No. 217-03810) 30-Dec-22 (No. EF3-4013_Dec22) 03-Jan-23 (No. DAE4-781_Jan23) Check Date (in house) 09-Oct-09 (in house check Oct-20) 05-Jan-10 (in house check Oct-20)	Mar-24 Mar-24 Dec-23 Jan-24 Scheduled Check In house check: Oct-23 In house check: Oct-23 In house check: Oct-23
Power sensor NRP-Z91 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	SN: BH9394 (20k) SN: 310982 / 06327 SN: 4013 SN: 781 ID # SN: GB42420191 SN: US38485102 SN: US37295597 SN: 837633/005 SN: US41080477 Name	30-Mar-23 (No. 217-03809) 30-Mar-23 (No. 217-03810) 30-Dec-22 (No. EF3-4013_Dec22) 03-Jan-23 (No. DAE4-781_Jan23) Check Date (in house) 09-Oct-09 (in house check Oct-20) 05-Jan-10 (in house check Oct-20) 10-Jan-19 (in house check Oct-20) 31-Mar-14 (in house check Oct-22) Function	Mar-24 Mar-24 Dec-23 Jan-24 Scheduled Check In house check: Oct-23
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: BH9394 (20k) SN: 310982 / 06327 SN: 4013 SN: 781 ID # SN: GB42420191 SN: US38485102 SN: US37295597 SN: 837633/005 SN: US41080477	30-Mar-23 (No. 217-03809) 30-Mar-23 (No. 217-03810) 30-Dec-22 (No. EF3-4013_Dec22) 03-Jan-23 (No. DAE4-781_Jan23) Check Date (in house) 09-Oct-09 (in house check Oct-20) 05-Jan-10 (in house check Oct-20) 09-Oct-09 (in house check Oct-20) 10-Jan-19 (in house check Oct-20) 31-Mar-14 (in house check Oct-22)	Mar-24 Mar-24 Dec-23 Jan-24 Scheduled Check In house check: Oct-23 In house check: Oct-23 In house check: Oct-23 In house check: Oct-23 In house check: Oct-24

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The Swiss Accreditation Service is one of the signatories to the EA Multilateral Agreement for the recognition of calibration certificates

References

[1] ANSI-C63.19-2019 (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
- Feed Point Impedance and Return Loss: These parameters are measured using a 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 E-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	V52.10.4
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	25.2 dB	44.9 Ω +1.0 jΩ
2550 MHz	22.5 dB	$57.4 \Omega + 3.1 j\Omega$
2600 MHz	20.8 dB	59.0 Ω - 4.1 jΩ
2650 MHz	19.8 dB	55.2 Ω - 9.5 jΩ
2750 MHz	15.9 dB	41.9 Ω - 12.4 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.

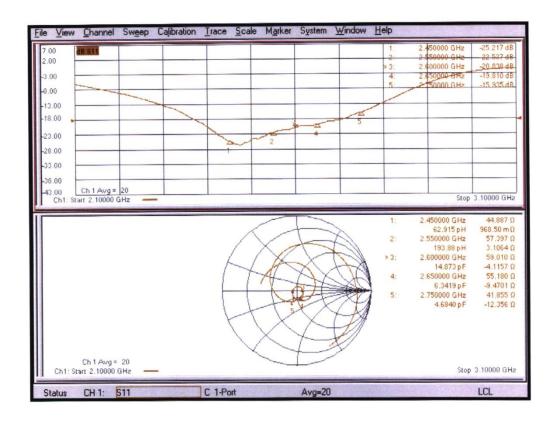
Do not apply force to dipole arms, as they are liable to bend. The soldered connections near the feedpoint may be damaged. After excessive mechanical stress or overheating, check the impedance characteristics to ensure that the internal matching network is not affected.

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: 15.08.2023

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: 30.12.2022

Sensor-Surface: (Fix Surface)

Electronics: DAE4 Sn781; Calibrated: 03.01.2023

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

DASY52 52.10.4(1535); SEMCAD X 14.6.14(7501)

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 = 69.31 V/m; Power Drift = 0.01 dB

Applied MIF = 0.00 dB

RF audio interference level = 38.72 dBV/m

Emission category: M2

MIF scaled E-field

Grid 1 M2 38.58 dBV/m	
Grid 4 M2 37.99 dBV/m	
Grid 7 M2 38.64 dBV/m	



0 dB = 86.27 V/m = 38.72 dBV/m

Certificate No: CD2600V3-1017_Aug23

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Dipole 3500 MHz

Calibration Laboratory of

Schmid & Partner Engineering AG Zeughausstrasse 43, 8004 Zurich, Switzerland





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Accreditation No.: SCS 0108

Accredited by the Swiss Accreditation Service (SAS)

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Multilateral Agreement for the recognition of calibration certificates

Client CTTL Beiling Certificate No. CD3500V3-1008_Aug23

Dbject	CD3500V3 - SN:	1008	
Calibration procedure(s)	QA CAL-20.v7 Calibration Proce	dure for Validation Sources in air	
Calibration date:	August 16, 2023		
		onal standards, which realize the physical unit	
he measurements and the uncerta	inties with confidence pr	obability are given on the following pages and	d are part of the certificate.
All calibrations have been conducte	d in the closed laborator	y 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
	SN: 104778		
		30-Mar-23 (No. 217-03804/03805)	Mar-24
		30-Mar-23 (No. 217-03804/03805) 30-Mar-23 (No. 217-03804)	Mar-24 Mar-24
Power sensor NRP-Z91	SN: 103244	30-Mar-23 (No. 217-03804)	
Power sensor NRP-Z91 Power sensor NRP-Z91	SN: 103244 SN: 103245	30-Mar-23 (No. 217-03804) 30-Mar-23 (No. 217-03805)	Mar-24
Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator	SN: 103244	30-Mar-23 (No. 217-03804) 30-Mar-23 (No. 217-03805) 30-Mar-23 (No. 217-03809)	Mar-24 Mar-24
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Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Probe EF3DV3	SN: 103244 SN: 103245 SN: BH9394 (20k) SN: 310982 / 06327	30-Mar-23 (No. 217-03804) 30-Mar-23 (No. 217-03805) 30-Mar-23 (No. 217-03809)	Mar-24 Mar-24 Mar-24 Mar-24
Power meter NRP2 Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Probe EF3DV3 DAE4 Secondary Standards	SN: 103244 SN: 103245 SN: BH9394 (20k) SN: 310982 / 06327 SN: 4013	30-Mar-23 (No. 217-03804) 30-Mar-23 (No. 217-03805) 30-Mar-23 (No. 217-03809) 30-Mar-23 (No. 217-03810) 30-Dec-22 (No. EF3-4013_Dec22)	Mar-24 Mar-24 Mar-24 Mar-24 Dec-23
Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Probe EF3DV3 DAE4 Secondary Standards	SN: 103244 SN: 103245 SN: BH9394 (20k) SN: 310982 / 06327 SN: 4013 SN: 781	30-Mar-23 (No. 217-03804) 30-Mar-23 (No. 217-03805) 30-Mar-23 (No. 217-03809) 30-Mar-23 (No. 217-03810) 30-Dec-22 (No. EF3-4013_Dec22) 03-Jan-23 (No. DAE4-781_Jan23)	Mar-24 Mar-24 Mar-24 Mar-24 Dec-23 Jan-24
Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Probe EF3DV3 DAE4 Secondary Standards Power meter Agilent 4419B	SN: 103244 SN: 103245 SN: BH9394 (20k) SN: 310982 / 06327 SN: 4013 SN: 781	30-Mar-23 (No. 217-03804) 30-Mar-23 (No. 217-03805) 30-Mar-23 (No. 217-03809) 30-Mar-23 (No. 217-03810) 30-Dec-22 (No. EF3-4013_Dec22) 03-Jan-23 (No. DAE4-781_Jan23)	Mar-24 Mar-24 Mar-24 Mar-24 Dec-23 Jan-24 Scheduled Check
Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Probe EF3DV3 DAE4 Secondary Standards Power meter Agilent 4419B Power sensor HP E4412A	SN: 103244 SN: 103245 SN: BH9394 (20k) SN: 310982 / 06327 SN: 4013 SN: 781	30-Mar-23 (No. 217-03804) 30-Mar-23 (No. 217-03805) 30-Mar-23 (No. 217-03809) 30-Mar-23 (No. 217-03810) 30-Dec-22 (No. EF3-4013_Dec22) 03-Jan-23 (No. DAE4-781_Jan23) Check Date (in house) 09-Oct-09 (in house check Oct-20)	Mar-24 Mar-24 Mar-24 Mar-24 Dec-23 Jan-24 Scheduled Check In house check: Oct-23
Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator Power sensor NRP-Z91 Reference 20 dB Attenuator Power sensor NRP-Z91 Reference 20 dB Attenuator Power sensor HP E4412A Power sensor HP E4412A	SN: 103244 SN: 103245 SN: BH9394 (20k) SN: 310982 / 06327 SN: 4013 SN: 781 ID # SN: GB42420191 SN: US38485102	30-Mar-23 (No. 217-03804) 30-Mar-23 (No. 217-03805) 30-Mar-23 (No. 217-03809) 30-Mar-23 (No. 217-03810) 30-Dec-22 (No. EF3-4013_Dec22) 03-Jan-23 (No. DAE4-781_Jan23) Check Date (in house) 09-Oct-09 (in house check Oct-20) 05-Jan-10 (in house check Oct-20)	Mar-24 Mar-24 Mar-24 Mar-24 Dec-23 Jan-24 Scheduled Check In house check: Oct-23 In house check: Oct-23
Power sensor NRP-Z91 Power sensor NRP-Z91 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: 103244 SN: 103245 SN: BH9394 (20k) SN: 310982 / 06327 SN: 4013 SN: 781 ID # SN: GB42420191 SN: US38485102 SN: US37295597	30-Mar-23 (No. 217-03804) 30-Mar-23 (No. 217-03805) 30-Mar-23 (No. 217-03809) 30-Mar-23 (No. 217-03810) 30-Dec-22 (No. EF3-4013_Dec22) 03-Jan-23 (No. DAE4-781_Jan23) Check Date (in house) 09-Oct-09 (in house check Oct-20) 05-Jan-10 (in house check Oct-20) 09-Oct-09 (in house check Oct-20)	Mar-24 Mar-24 Mar-24 Mar-24 Dec-23 Jan-24 Scheduled Check In house check: Oct-23 In house check: Oct-23 In house check: Oct-23
Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator Probe EF3DV3 POWER STANDARD REFERENCE S	SN: 103244 SN: 103245 SN: BH9394 (20k) SN: 310982 / 06327 SN: 4013 SN: 781 ID # SN: GB42420191 SN: US38485102 SN: US37295597 SN: US37295597 SN: US41080477 Name	30-Mar-23 (No. 217-03804) 30-Mar-23 (No. 217-03805) 30-Mar-23 (No. 217-03809) 30-Mar-23 (No. 217-03810) 30-Dec-22 (No. EF3-4013_Dec22) 03-Jan-23 (No. DAE4-781_Jan23) Check Date (in house) 09-Oct-09 (in house check Oct-20) 05-Jan-10 (in house check Oct-20) 10-Jan-19 (in house check Oct-20) 31-Mar-14 (in house check Oct-22) Function	Mar-24 Mar-24 Mar-24 Mar-24 Dec-23 Jan-24 Scheduled Check In house check: Oct-23 In house check: Oct-23 In house check: Oct-23 In house check: Oct-23
Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Probe EF3DV3 DAE4	SN: 103244 SN: 103245 SN: BH9394 (20k) SN: 310982 / 06327 SN: 4013 SN: 781 ID # SN: GB42420191 SN: US38485102 SN: US37295597 SN: 837633/005 SN: US41080477	30-Mar-23 (No. 217-03804) 30-Mar-23 (No. 217-03805) 30-Mar-23 (No. 217-03809) 30-Mar-23 (No. 217-03810) 30-Dec-22 (No. EF3-4013_Dec22) 03-Jan-23 (No. DAE4-781_Jan23) Check Date (in house) 09-Oct-09 (in house check Oct-20) 05-Jan-10 (in house check Oct-20) 10-Jan-19 (in house check Oct-20) 31-Mar-14 (in house check Oct-22)	Mar-24 Mar-24 Mar-24 Mar-24 Dec-23 Jan-24 Scheduled Check In house check: Oct-23 In house check: Oct-23 In house check: Oct-23 In house check: Oct-24

Certificate No: CD3500V3-1008_Aug23

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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

References

[1] ANSI-C63.19-2019 (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
- Feed Point Impedance and Return Loss: These parameters are measured using a 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 E-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	V52.10.4
Phantom	HAC Test Arch	
Distance Dipole Top - Probe Center	15 mm	
Scan resolution	dx, dy = 5 mm	
Frequency	3500 MHz ± 1 MHz	
Input power drift	< 0.05 dB	

Maximum Field values at 3500 MHz

E-field 15 mm above dipole surface	condition	Interpolated maximum
Maximum measured above high end	100 mW input power	84.1 V/m = 38.50 dBV/m
Maximum measured above low end	100 mW input power	83.3 V/m = 38.41 dBV/m
Averaged maximum above arm	100 mW input power	83.7 V/m ± 12.8 % (k=2)

Maximum Field values at 3900 MHz

E-field 15 mm above dipole surface	condition	Interpolated maximum
Maximum measured above high end	100 mW input power	81.0 V/m = 38.17 dBV/m
Maximum measured above low end	100 mW input power	79.5 V/m = 38.00 dBV/m
Averaged maximum above arm	100 mW input power	80.2 V/m ± 12.8 % (k=2)

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Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters

Frequency	Return Loss	Impedance
3300 MHz	19.2 dB	$61.8 \Omega + 3.5 j\Omega$
3400 MHz	24.1 dB	55.4 Ω - 3.8 jΩ
3500 MHz	25.1 dB	52.2 Ω - 5.2 jΩ
3600 MHz	22.4 dB	47.4 Ω - 7.0 jΩ
3950 MHz	19.4 dB	52.4 Ω + 10.7 jΩ

Additional Frequencies

Frequency	Return Loss	Impedance
3900 MHz	20.8 dB	48.9 Ω + 9.0 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.

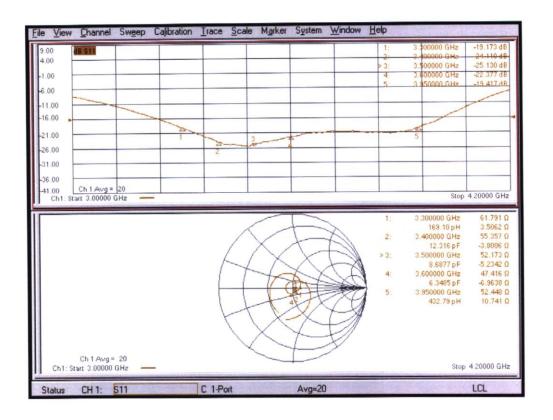
Do not apply force to dipole arms, as they are liable to bend. The soldered connections near the feedpoint may be damaged. After excessive mechanical stress or overheating, check the impedance characteristics to ensure that the internal matching network is not affected.

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: 16.08.2023

Test Laboratory: SPEAG Lab2

DUT: HAC Dipole 3500 MHz; Type: CD3500V3; Serial: CD3500V3 - SN: 1008

Communication System: UID 0 - CW; Frequency: 3500 MHz, Frequency: 3900 MHz

Medium parameters used: $\sigma = 0$ S/m, $\varepsilon_r = 1$; $\rho = 0$ kg/m³

Phantom section: RF Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EF3DV3 SN4013; ConvF (1, 1, 1) @ 3500 MHz, ConvF (1, 1, 1) @ 3900 MHz; Calibrated: 30.12.2022
- Sensor-Surface: (Fix Surface)
- Electronics: DAE4 Sn781; Calibrated: 03.01.2023
- Phantom: HAC Test Arch with AMCC; Type: SD HAC P01 BA; Serial: 1070

• DASY52 52.10.4(1535); SEMCAD X 14.6.14(7501)

Reference Dipole E-Field measurement @ 3500MHz/E-Scan - 3500MHz d=15mm/Hearing Aid Compatibility Test

(41x121x1): Interpolated grid: dx=0.5000 mm, dy=0.5000 mm

Device Reference Point: 0, 0, -6.3 mm

Reference Value = 36.14 V/m; Power Drift = -0.00 dB

Applied MIF = 0.00 dB

RF audio interference level = 38.50 dBV/m

Emission category: M2

MIF scaled E-field

Grid 1 M2 38.46 dBV/m		Grid 3 M2 38.22 dBV/m
Contract of the Contract of th	Grid 5 M2 38.21 dBV/m	Grid 6 M2 37.97 dBV/m
	Grid 8 M2 38.41 dBV/m	Grid 9 M2 38.14 dBV/m

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Reference Dipole E-Field measurement @ 3500 MHz/E-Scan 3900 MHz, d=15mm/Hearing Aid Compatibility Test (41x121x1): Interpolated grid: dx=0.5000 mm, dy=0.5000 mm

Device Reference Point: 0, 0, -6.3 mm

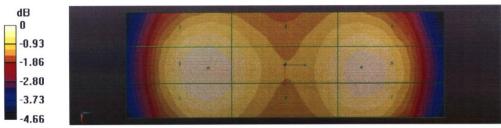
Reference Value = 33.41 V/m; Power Drift = -0.05 dB

Applied MIF = 0.00 dB RF audio interference level = 38.17 dBV/m

Emission category: M2

MIF scaled E-field

Grid 1 M2 38.12 dBV/m		
	Grid 5 M2 37.93 dBV/m	
Grid 7 M2 37.93 dBV/m		Grid 9 M2 37.78 dBV/m



0 dB = 84.13 V/m = 38.50 dBV/m

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