



#### **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	87.1 V/m = 38.80 dBV/m
Maximum measured above low end	100 mW input power	86.1 V/m = 38.70 dBV/m
Averaged maximum above arm	100 mW input power	86.6 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 + 0.2 jΩ
1880 MHz	21.6 dB	55.0 Ω + 7.1 jΩ
1900 MHz	22.6 dB	56.8 Ω + 4.1 jΩ
1950 MHz	34.0 dB	52.0 Ω - 0.1 jΩ
2000 MHz	19.4 dB	47.1 Ω + 10.1 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.

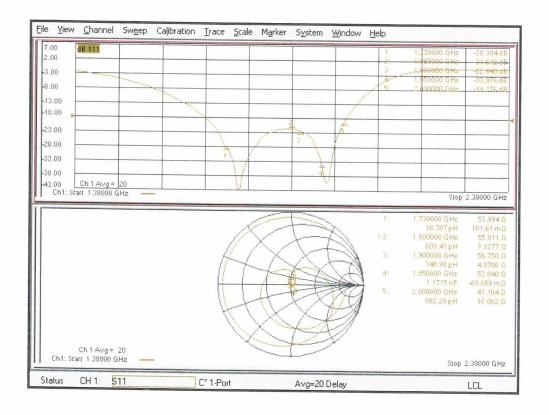
Do not apply force to dipole arms, as they are liable to bend. The soldered connections near the feedpoint may be damaged. After excessive mechanical stress or overheating, check the impedance characteristics to ensure that the internal matching network is not affected.

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



Certificate No: CD1880V3-1018\_Aug21





#### **DASY5 E-field Result**

Date: 24.08.2021

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,  $\varepsilon_r = 1$ ;  $\rho = 0$  kg/m<sup>3</sup>

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: 28.12.2020
- Sensor-Surface: (Fix Surface)
- Electronics: DAE4 Sn781; Calibrated: 23.12.2020
- Phantom: HAC Test Arch with AMCC; Type: SD HAC P01 BA; Serial: 1070
- DASY52 52.10.4(1535); SEMCAD X 14.6.14(7501)

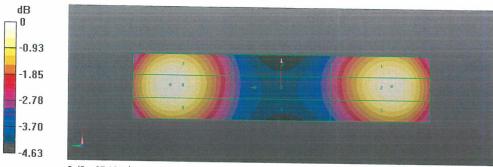
# Dipole E-Field measurement @ 1880MHz/E-Scan - 1880MHz d=15mm/Hearing Aid Compatibility Test (41x181x1):

Interpolated grid: dx=0.5000 mm, dy=0.5000 mm Device Reference Point: 0, 0, -6.3 mm Reference Value = 155.6 V/m; Power Drift = 0.00 dB Applied MIF = 0.00 dBRF audio interference level = 38.80 dBV/m

Emission category: M2

MIF scaled E-field

Grid 1 M2	Grid 2 <b>M2</b>	Grid 3 M2
38.62 dBV/m	38.7 dBV/m	38.43 dBV/m
Grid 4 <b>M2</b>	Grid 5 M2	Grid 6 M2
35.91 dBV/m	35.94 dBV/m	35.82 dBV/m
Grid 7 M2	Grid 8 <b>M2</b>	Grid 9 <b>M2</b>
38.69 dBV/m	38.8 dBV/m	38.53 dBV/m



0 dB = 87.13 V/m = 38.80 dBV/m

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## Dipole 2450 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) The Swiss Accreditation Service is one of the signatories to the EA Multilateral Agreement for the recognition of calibration certificates

Client

CTTL (Auden)

Certificate No: CD2450V3-1021 Aug21

#### **CALIBRATION CERTIFICATE** Object CD2450V3 - SN: 1021 **QA CAL-20.v7** Calibration procedure(s) Calibration Procedure for Validation Sources in air August 24, 2021 Calibration date: This calibration certificate documents the traceability to national standards, which realize the physical units of measurements (SI). The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate. All calibrations have been conducted in the closed laboratory facility: environment temperature (22 ± 3)°C and humidity < 70%. Calibration Equipment used (M&TE critical for calibration) Primary Standards ID# Cal Date (Certificate No.) Scheduled Calibration Power meter NRP SN: 104778 09-Apr-21 (No. 217-03291/03292) Apr-22 Power sensor NRP-Z91 SN: 103244 09-Apr-21 (No. 217-03291) Apr-22 Power sensor NRP-Z91 SN: 103245 09-Apr-21 (No. 217-03292) Apr-22 Reference 20 dB Attenuator SN: BH9394 (20k) 09-Apr-21 (No. 217-03343) Apr-22 Type-N mismatch combination SN: 310982 / 06327 09-Apr-21 (No. 217-03344) Apr-22 Probe EF3DV3 SN: 4013 28-Dec-20 (No. EF3-4013 Dec20) Dec-21 DAE4 SN: 781 23-Dec-20 (No. DAE4-781\_Dec20) Dec-21 Secondary Standards Check Date (in house) Scheduled Check Power meter Agilent 4419B SN: GB42420191 09-Oct-09 (in house check Oct-20) In house check: Oct-23 Power sensor HP E4412A SN: US38485102 05-Jan-10 (in house check Oct-20) In house check: Oct-23 Power sensor HP 8482A SN: US37295597 09-Oct-09 (in house check Oct-20) In house check: Oct-23 RF generator R&S SMT-06 SN: 837633/005 10-Jan-19 (in house check Oct-20) In house check: Oct-23 Network Analyzer Agilent E8358A SN: US41080477 31-Mar-14 (in house check Oct-20) In house check: Oct-21 Name Function Signature Calibrated by: Leif Klysner Laboratory Technician Approved by: Katja Pokovic Technical Manager Issued: August 25, 2021 This calibration certificate shall not be reproduced except in full without written approval of the laboratory.

Certificate No: CD2450V3-1021\_Aug21

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#### References

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 nonparallelity 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	2450 MHz ± 1 MHz	
Input power drift	< 0.05 dB	

## Maximum Field values at 2450 MHz

E-field 15 mm above dipole surface	condition	Interpolated maximum
Maximum measured above high end	100 mW input power	85.9 V/m = 38.68 dBV/m
Maximum measured above low end	100 mW input power	84.5 V/m = 38.54 dBV/m
Averaged maximum above arm	100 mW input power	85.2 V/m ± 12.8 % (k=2)

## Appendix (Additional assessments outside the scope of SCS 0108)

#### **Antenna Parameters**

Frequency	Return Loss	Impedance
2250 MHz	18.3 dB	63.1 Ω + 4.0 jΩ
2350 MHz	29.5 dB	52.5 Ω - 2.4 jΩ
2450 MHz	29.8 dB	53.2 Ω - 1.1 jΩ
2550 MHz	31.8 dB	50.7 Ω - 2.5 jΩ
2650 MHz	18.6 dB	61.1 Ω - 6.8 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.

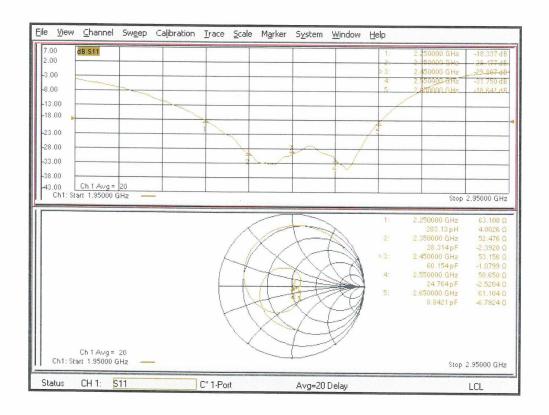
After long term use with 40W radiated power, only a slight warming of the dipole near the feedpoint can be measured.

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## Impedance Measurement Plot



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## DASY5 E-field Result

Date: 24.08.2021

Test Laboratory: SPEAG Lab2

## DUT: HAC Dipole 2450 MHz; Type: CD2450V3; Serial: CD2450V3 - SN: 1021

Communication System: UID 0 - CW; Frequency: 2450 MHz Medium parameters used:  $\sigma = 0$  S/m,  $\epsilon_r = 1$ ;  $\rho = 0$  kg/m<sup>3</sup>

Phantom section: RF Section

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

## DASY52 Configuration:

- Probe: EF3DV3 SN4013; ConvF(1, 1, 1) @ 2450 MHz; Calibrated: 28.12.2020
- Sensor-Surface: (Fix Surface)
- Electronics: DAE4 Sn781; Calibrated: 23.12.2020
- 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 @ 2450MHz/E-Scan - 2450MHz 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 = 74.90 V/m; Power Drift = -0.00 dB

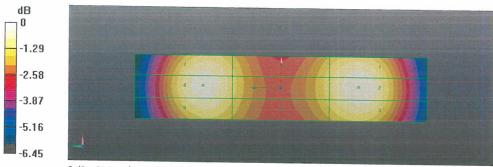
Applied MIF = 0.00 dB

RF audio interference level = 38.68 dBV/m

Emission category: M2

MIF scaled E-field

Grid 1 <b>M2</b>	Grid 2 <b>M2</b>	Grid 3 M2
38.52 dBV/m	38.68 dBV/m	38.44 dBV/m
Grid 4 <b>M2</b>	Grid 5 M2	Grid 6 M2
37.64 dBV/m	37.71 dBV/m	37.55 dBV/m
Grid 7 M2	Grid 8 <b>M2</b>	Grid 9 <b>M2</b>
38.42 dBV/m	38.54 dBV/m	38.3 dBV/m



0 dB = 85.91 V/m = 38.68 dBV/m

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## Dipole 2600 MHz

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





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Client

CTTL (Auden)

Certificate No: CD2600V3-1017\_Aug21

#### CALIBRATION CERTIFICATE CD2600V3 - SN: 1017 Object QA CAL-20.v7 Calibration procedure(s) Calibration Procedure for Validation Sources in air August 24, 2021 Calibration date: This calibration certificate documents the traceability to national standards, which realize the physical units of measurements (SI). The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate. All calibrations have been conducted in the closed laboratory facility: environment temperature (22 ± 3)°C and humidity < 70%. Calibration Equipment used (M&TE critical for calibration) Scheduled Calibration Cal Date (Certificate No.) ID# Primary Standards Apr-22 09-Apr-21 (No. 217-03291/03292) SN: 104778 Power meter NRP Apr-22 09-Apr-21 (No. 217-03291) SN: 103244 Power sensor NRP-Z91 09-Apr-21 (No. 217-03292) Apr-22 SN: 103245 Power sensor NRP-Z91 Apr-22 SN: BH9394 (20k) 09-Apr-21 (No. 217-03343) Reference 20 dB Attenuator Apr-22 09-Apr-21 (No. 217-03344) SN: 310982 / 06327 Type-N mismatch combination Dec-21 28-Dec-20 (No. EF3-4013\_Dec20) SN: 4013 Probe FF3DV3 23-Dec-20 (No. DAE4-781\_Dec20) Dec-21 SN: 781 DAF4 Scheduled Check Check Date (in house) Secondary Standards In house check: Oct-23 09-Oct-09 (in house check Oct-20) SN: GB42420191 Power meter Agilent 4419B In house check: Oct-23 05-Jan-10 (in house check Oct-20) SN: US38485102 Power sensor HP E4412A In house check: Oct-23 09-Oct-09 (in house check Oct-20) SN: US37295597 Power sensor HP 8482A In house check: Oct-23 10-Jan-19 (in house check Oct-20) SN: 837633/005 RF generator R&S SMT-06 In house check: Oct-21 31-Mar-14 (in house check Oct-20) SN: US41080477 Network Analyzer Agilent E8358A Signature Function Name Laboratory Technician Leif Klysner Calibrated by: Technical Manager Katja Pokovic Approved by: Issued: August 25, 2021 This calibration certificate shall not be reproduced except in full without written approval of the laboratory.

Certificate No: CD2600V3-1017\_Aug21

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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

#### 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.

on page 1.	
DASY5	V52.10.4
HAC Test Arch	
15 mm	
dx, dy = 5 mm	
2600 MHz ± 1 MHz	
< 0.05 dB	
	DASY5  HAC Test Arch  15 mm  dx, dy = 5 mm  2600 MHz ± 1 MHz

#### 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	85.5 V/m = 38.64 dBV/m
Maximum measured above low end	100 mW input power	85.0 V/m = 38.59 dBV/m
Averaged maximum above arm	100 mW input power	85.2 V/m ± 12.8 % (k=2)

## Appendix (Additional assessments outside the scope of SCS 0108)

#### **Antenna Parameters**

Frequency	Return Loss	Impedance
2450 MHz	24.2 dB	44.3 Ω + 1.2 jΩ
2550 MHz	22.5 dB	57.0 Ω + 3.9 jΩ
2600 MHz	20.8 dB	59.5 Ω - 3.2 jΩ
2650 MHz	19.6 dB	55.3 Ω - 9.7 jΩ
2750 MHz	15.3 dB	41.0 Ω - 12.9 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.

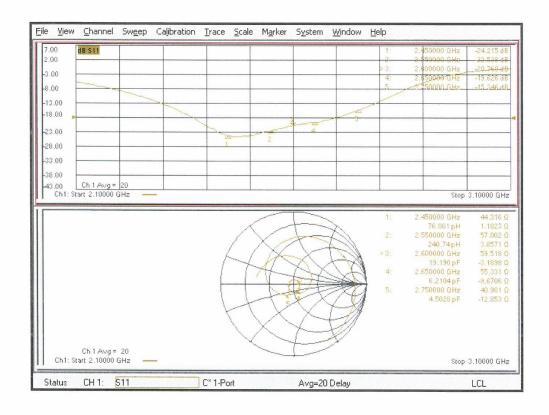
The dipole is built of standard semirigid coaxial cable. The internal matching line is open ended. The antenna is therefore open for DC signals.

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**



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#### **DASY5 E-field Result**

Date: 24.08.2021

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: 28.12.2020
- Sensor-Surface: (Fix Surface)
- Electronics: DAE4 Sn781; Calibrated: 23.12.2020
- Phantom: HAC Test Arch with AMCC; Type: SD HAC P01 BA; Serial: 1070
- DASY52 52.10.4(1535); SEMCAD X 14.6.14(7501)

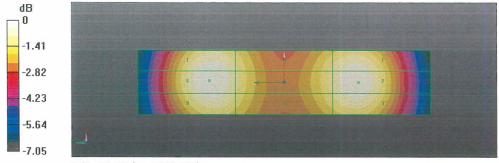
## Dipole~E-Field~measurement~@~2600MHz/E-Scan-2600MHz~d=15mm/Hearing~Aid~Compatibility~Test~(41x181x1):

Interpolated grid: dx=0.5000 mm, dy=0.5000 mm Device Reference Point: 0, 0, -6.3 mm Reference Value = 67.89 V/m; Power Drift = 0.01 dB Applied MIF = 0.00 dB RF audio interference level = 38.64 dBV/m

Emission category: M2

MIF scaled E-field

Grid 1 M2	Grid 2 <b>M2</b>	Grid 3 M2
38.44 dBV/m	38.59 dBV/m	38.37 dBV/m
Grid 4 M2	Grid 5 M2	Grid 6 M2
37.84 dBV/m	37.9 dBV/m	37.76 dBV/m
Grid 7 <b>M2</b>	Grid 8 <b>M2</b>	Grid 9 <b>M2</b>
38.53 dBV/m	38.64 dBV/m	38.39 dBV/m



0 dB = 85.46 V/m = 38.64 dBV/m

Certificate No: CD2600V3-1017\_Aug21

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

Appendix to test report No.I22Z60845-SEM07/08

The photos of HAC test