Hearing Aid Compatibility (HAC) RF Emissions Test Report

APPLICANT	**: Reliance Communications, LLC**
EQUIPMENT	**: Cellphone**
BRAND NAME	**: Orbic**
MODEL NAME	**: RC2200L**
FCC ID	**: 2ABGH-RC2200L**
STANDARD	**: FCC 47 CFR §20.19 ANSI C63.19-2011**

The product was received on Jan. 28, 2019 and testing was completed on Mar. 16, 2019. We, Sporton International (Shenzhen) Inc., would like to declare that the tested sample has been evaluated in accordance with the procedures and had been in compliance with the applicable technical standards.

The test results in this report apply exclusively to the tested model / sample. Without written approval of Sporton International (Shenzhen) Inc., the test report shall not be reproduced except in full.

TESTING
NVLAP LAB CODE 600156-0

Approved by: Mark Qu / Manager

Sporton International (Shenzhen) Inc.
1/F, 2/F, Bldg 5, Shiling Industrial Zone, Xinwei Village, Xili, Nanshan, Shenzhen City, Guangdong Province 518055, China

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Revision History

REPORT NO.	VERSION	DESCRIPTION	ISSUED DATE
HA912802A	Rev. 01	Initial issue of report	Apr. 16, 2019

1. Attestation of Test Results

Applicant Name	Reliance Communications, LLC
Equipment Name	Cellphone
Brand Name	Orbic
Model Name	RC2200L
FCC ID	2ABGH-RC2200L
IMEI Code	353362100003117
HW Version	V1.1
SW Version	NA
EUT Stage	Production Unit
HAC Rating	M3
Date Tested	2019/3/16
Test Result	Pass

This device is compliance with HAC limits specified in guidelines FCC 47 CFR §20.19 and ANSI Standard ANSI C63.19.

2. Administration Data

Testing Site	
Test Site	Sporton International (Shenzhen) Inc.
Test Site Location	1/F, 2/F, Bldg 5, Shiling Industrial Zone, Xinwei Village, Xili, Nanshan, Shenzhen City, Guangdong Province 518055, China TEL: +86-755-8637-9589 FAX: +86-755-8637-9595
Test Site No.	Sporton Site No. : **SAR01-SZ**
Applicant	
Company Name	Reliance Communications, LLC
Address	555 Wireless BLVD, Hauppauge, NY 11788, USA
Manufacturer	
Company Name	Unimax
Address	Room 602, Floor 6th, Building B, Software Park T3,Hi-Tech Park South, Nanshan District, Shenzhen, P.R. China 518057

3. Equipment Under Test Information

3.1 General Information

Product Feature & Specification	
Wireless Technology and Frequency Range	GSM850: 824.2 MHz ~ 848.8 MHz GSM1900: 1850.2 MHz ~ 1909.8 MHz CDMA2000 BC0: 824.7 MHz ~ 848.31 MHz CDMA 2000 BC1: 1851.25 MHz ~ 1908.75 MHz LTE Band 2: 1850.7 MHz ~ 1909.3 MHz LTE Band 4: 1710.7 MHz ~ 1754.3 MHz LTE Band 5: 824.7 MHz ~ 848.3 MHz LTE Band 13: 779.5 MHz ~ 784.5 MHz WLAN 2.4GHz Band: 2412 MHz ~ 2462 MHz Bluetooth: 2402 MHz ~ 2480 MHz
Mode	GSM/GPRS/EGPRS CDMA2000 : 1xRTT/1xEv-Do(Rev.0)/1xEv-Do(Rev.A) LTE: QPSK, 16QAM WLAN 2.4GHz : 802.11b/g/n HT20 Bluetooth BR/EDR/LE

3.2 Air Interface and Operating Mode

Air Interface	Band MHz	Type	C63.19 Tested	Simultaneous Transmitter	Name of Voice Service	Power Reduction
GSM	GSM850	VO	Yes	WLAN, BT	CMRS Voice	No
	GSM1900			WLAN, BT		No
	EDGE850	DT	No	WLAN, BT	NA	No
	EDGE1900					
CDMA	BC0	VO	Yes	WLAN, BT	CMRS Voice	No
	BC1			WLAN, BT		No
	EVDO	DT	No	WLAN, BT	NA	No
LTE (FDD)	Band 2	VD	No(1)	WLAN, BT	VoLTE	No
	Band 4			WLAN, BT		No
	Band 5			WLAN, BT		No
	Band 13			WLAN, BT		No
Wi-Fi	2450	DT	No	GSM, CDMA,LTE	NA	No
						No
BT	2450	DT	No	GSM, CDMA,LTE	NA	No

Type Transport:
VO= Voice only
DT= Digital Transport only (no voice)
VD= CMRS and IP Voice Service over Digital Transport

Remark:
1. The air interface is exempted from testing by low power exemption that its average antenna input power plus its MIF is ≤17 dBm, and is rated as M4.

3.3 Applied Standards

- FCC CFR47 Part 20.19
- ANSI C63.19 2011-version
- FCC KDB 285076 D01 HAC Guidance v05
- FCC KDB 285076 D02 T-Coil testing v03
- FCC KDB 285076 D03 HAC FAQ v01

4. HAC RF Emission

FCC wireless hearing aid compatibility rules ensure that consumers with hearing loss are able to access wireless communications services through a wide selection of handsets without experiencing disabling radio frequency (RF) interference or other technical obstacles.

To define and measure the hearing aid compatibility of handsets, in CFR47 part 20.19 ANSI C63.19 is referenced. A handset is considered hearing aid-compatible for acoustic coupling if it meets a rating of at least M3 under ANSI C63.19, and A handset is considered hearing aid compatible for inductive coupling if it meets a rating of at least T3.

According to ANSI C63.19 2011 version, for acoustic coupling, the RF electric field emissions of wireless communication devices should be measured and rated according to the emission level as below.

Emission Categories	E-field emissions	
	<960Mhz	>960Mhz
M1	50 to 55 dB (V/m)	40 to 45 dB (V/m)
M2	45 to 50 dB (V/m)	35 to 40 dB (V/m)
M3	40 to 45 dB (V/m)	30 to 35 dB (V/m)
M4	<40 dB (V/m)	<30 dB (V/m)

Table 4.1 Telephone near-field categories in linear units

5. Measurement System Specification

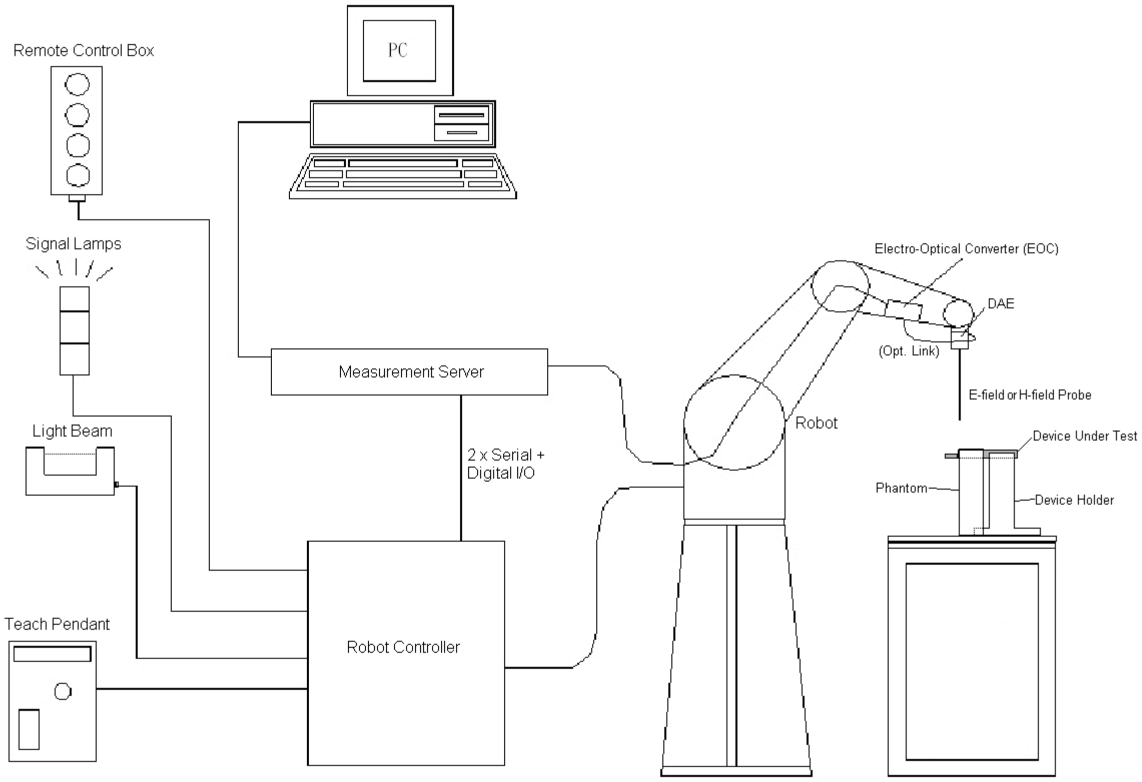
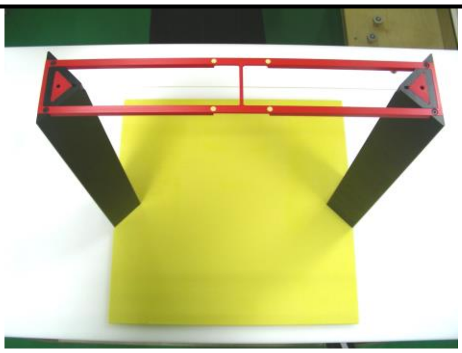


Fig 5.1 SPEAG DASY5 System Configurations

5.1 Test Arch Phantom

Construction :	Enables easy and well defined positioning of the phone and validation dipoles as well as simple teaching of the robot.	 **Fig 5.2 Photo of Arch Phantom**
Dimensions :	370 x 370 x 370 mm	

5.2 E-Field Probe System

E-Field Probe Specification
<ER3DV6>

Construction	One dipole parallel, two dipoles normal to probe axis Built-in shielding against static charges
Calibration	In air from 100 MHz to 3.0 GHz (absolute accuracy ±6.0%, k=2)
Frequency	100 MHz to 6 GHz; Linearity: ± 2.0 dB (100 MHz to 3 GHz)
Directivity	± 0.2 dB in air (rotation around probe axis) ± 0.4 dB in air (rotation normal to probe axis)
Dynamic Range	2 V/m to 1000 V/m (M3 or better device readings fall well below diode compression point)
Linearity	± 0.2 dB
Dimensions	Overall length: 330 mm (Tip: 16 mm) Tip diameter: 8 mm (Body: 12 mm) Distance from probe tip to dipole centers: 2.5 mm

Fig 5.3 Photo of E-field Probe

Probe Tip Description:

HAC field measurements take place in the close near field with high gradients. Increasing the measuring distance from the source will generally decrease the measured field values (in case of the validation dipole approx. 10%per mm).

5.3 System Hardware

DAE
The data acquisition electronics (DAE) consists of a highly sensitive electrometer-grade preamplifier with auto-zeroing, a channel and gain-switching multiplexer, a fast 16 bit AD-converter and a command decoder and control logic unit.
Robot
The SPEAG DASY system uses the high precision robots (DASY5: TX90XL) type from Stäubli SA (France). For the 6-axis controller system, the robot controller version (DASY5: CS8c) from Stäubli is used.

5.4 Data Storage and Evaluation

The DASY software stores the assessed data from the data acquisition electronics as raw data (in microvolt readings from the probe sensors), together with all the necessary software parameters for the data evaluation (probe calibration data, and device frequency and modulation data) in measurement files.

Probe parameters：	- Sensitivity	$Norm_i$, a_{i0}, a_{i1}, a_{i2}
	- Conversion factor	$ConvF_i$
	- Diode compression point	dcp_i
Device parameters：	- Frequency	f
	- Crest factor	cf
Media parameters：	- Conductivity	σ
	- Density	ρ

The formula for each channel can be given as：

$$\mathbf{V_i = U_i + U_i^2 \cdot \frac{cf}{dcp_i}}$$

with V_i = compensated signal of channel i, (i = x, y, z)
U_i = input signal of channel i, (i = x, y, z)
cf = crest factor of exciting field (DASY parameter)
dcp_i = diode compression point (DASY parameter)

From the compensated input signals, the primary field data for each channel can be evaluated：

E-field Probes：$\mathbf{E_i = \sqrt{\frac{V_i}{Norm_i \cdot ConvF}}}$

with V_i = compensated signal of channel i, (i = x, y, z)
$Norm_i$ = sensor sensitivity of channel i, (i = x, y, z), $\mu V/(V/m)^2$ for E-field Probes
ConvF = sensitivity enhancement in solution
f = carrier frequency [GHz]
E_i = electric field strength of channel i in V/m

The RSS value of the field components gives the total field strength (Hermitian magnitude)：

$$\mathbf{E_{tot} = \sqrt{E_x^2 + E_y^2 + E_z^2}}$$

The primary field data are used to calculate the derived field units.

5.5 Test Equipment List

Manufacturer	Name of Equipment	Type/Model	Serial Number	Calibration	
				Last Cal.	Due Date
SPEAG	835MHz Calibration Dipole	CD835V3	1184	2018/5/25	2019/5/24
SPEAG	1880MHz Calibration Dipole	CD1880V3	1170	2018/5/25	2019/5/24
SPEAG	Data Acquisition Electronics	DAE4	1437	2018/10/15	2019/10/14
SPEAG	Isotropic E-Field Probe	EF3DV3	4053	2018/3/19	2019/3/18
SPEAG	Phone Positioner	N/A	N/A	NCR	NCR
Anritsu	Power Senor	MA2411B	1306099	2018/7/30	2019/7/29
Anritsu	Power Meter	ML2495A	1349001	2018/7/26	2019/7/25
Agilent	Wireless Communication Test Set	E5515C	MY50267224	2018/9/11	2019/9/10
R&S	Base Station(Measure)	CMU200	112569	2018/7/30	2019/7/29
R&S	Base Station(Measure)	CMU500	150791	2018/7/18	2019/7/17
Agilent	Signal Generator	N5181A	MY50145381	2018/12/22	2019/12/21
Agilent	Dual Directional Coupler	778D	50422	NCR	NCR
Woken	Attenuator	WK0602-XX	N/A	NCR	NCR
AR	Power Amplifier	5S1G4M2	0328767	NCR	NCR
mini-circuits	Amplifier	ZHL-42W+	QA1341002	2018/4/19	2019/4/18
mini-circuits	Amplifier	ZVE-3W-83+	599201528	2018/4/19	2019/4/18
R&S	Spectrum Analyzer	FSP7	100818	2018/8/30	2019/8/29
Anritsu	Radio communication analyzer	MT8820C	6201300653	2018/7/18	2019/7/17

Table 5.1 Test Equipment List

Note: NCR: “No-Calibration Required”

6. Measurement System Validation

Each DASY system is equipped with one or more system validation kits. These units, together with the predefined measurement procedures within the DASY software, enable the user to conduct the system performance check and system validation. System validation kit includes a dipole, tripod holder to fix it underneath the test Arch and a corresponding distance holder.

6.1 Purpose of System Performance Check

The system performance check verifies that the system operates within its specifications. System and operator errors can be detected and corrected. It is recommended that the system performance check be performed prior to any usage of the system in order to guarantee reproducible results. The system performance check uses normal HAC measurements in a simplified setup with a well characterized source. This setup was selected to give a high sensitivity to all parameters that might fail or vary over time. The system check does not intend to replace the calibration of the components, but indicates situations where the system uncertainty is exceeded due to drift or failure.

6.2 System Setup

1. In the simplified setup for system evaluation, the EUT is replaced by a calibrated dipole and the power source is replaced by a continuous wave which comes from a signal generator.
2. The center point of the probe element(s) is 15mm from the closest surface of the dipole elements.
3. The calibrated dipole must be placed beneath the arch phantom. The equipment setup is shown below:

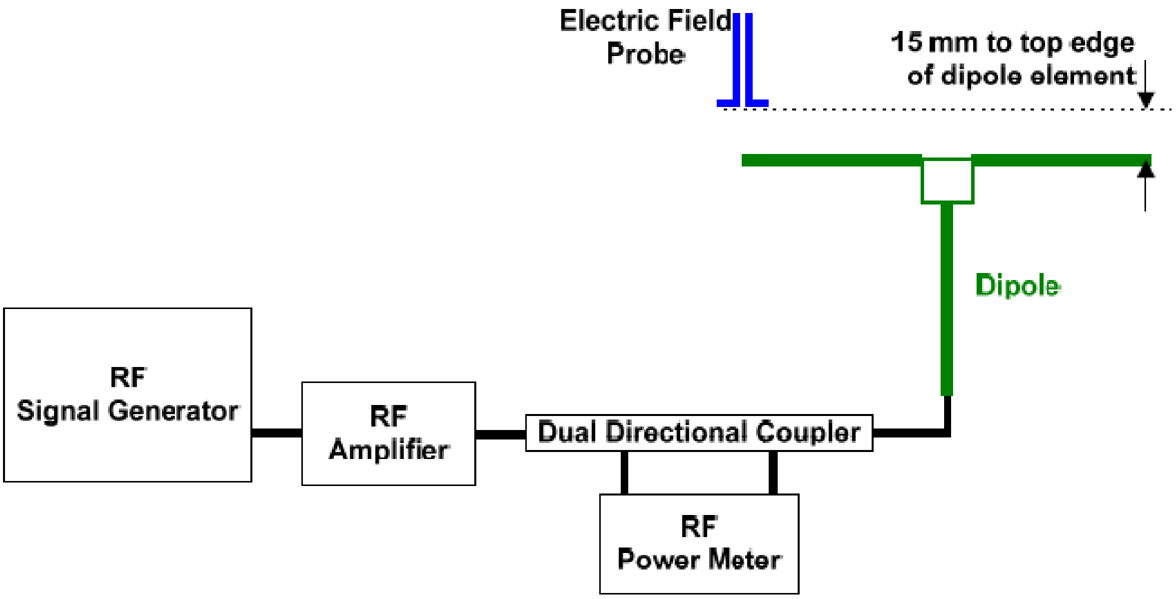


Fig. 6.1 System Validation Setup

The output power on dipole port must be calibrated to 20dBm (100mW) before dipole is connected.

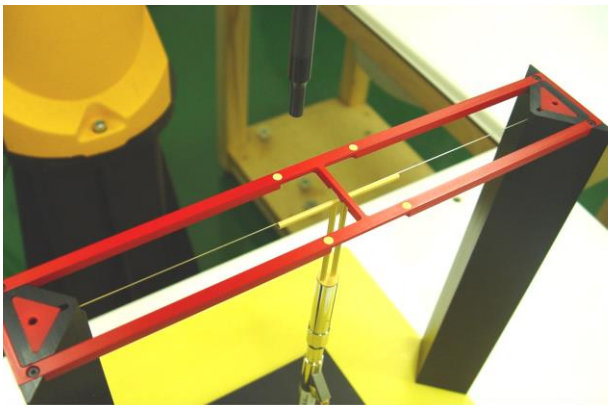


Fig 6.2 Dipole Setup

6.3 Verification Results

Comparing to the original E-field value provided by SPEAG, the verification data should be within its specification of 25 %. Table 6.1 shows the target value and measured value. The table below indicates the system performance check can meet the variation criterion and the plots can be referred to appendix A of this report.

Frequency (MHz)	Input Power (dBm)	Target Value (V/m)	E-Field above high end (V/m)	E-Field above low end (V/m)	Average Value (V/m)	Deviation (%)	Date
835	20	110.4	113.5	126.9	120.2	8.88	Mar. 16, 2019
1880	20	89.5	95.26	96.78	96.02	7.28	Mar. 16, 2019

Table 6.1 Test Results of System Validation

Note: Deviation = ((Average E-field Value) - (Target value)) / (Target value) * 100%

7. RF Emissions Test Procedure

Referenced from ANSI C63.19 -2011 section 5.5.1

a) Confirm the proper operation of the field probe, probe measurement system, and other instrumentation and the positioning system.

b) Position the WD in its intended test position.

c) Set the WD to transmit a fixed and repeatable combination of signal power and modulation characteristic that is representative of the worst case (highest interference potential) encountered in normal use. Transiently occurring start-up, changeover, or termination conditions, or other operations likely to occur less than 1% of the time during normal operation, may be excluded from consideration.

d) The center sub-grid shall be centered on the T-Coil mode perpendicular measurement point or the acoustic output, as appropriate. Locate the field probe at the initial test position in the 50 mm by 50 mm grid, which is contained in the measurement plane, refer to illustrated in Figure 8.2. If the field alignment method is used, align the probe for maximum field reception.

e) Record the reading at the output of the measurement system.

f) Scan the entire 50 mm by 50 mm region in equality spaced increments and record the reading at each measurement point, The distance between measurement points shall be sufficient to assure the identification of the maximum reading.

g) Identify the five contiguous sub-grids around the center sub-grid whose maximum reading is the lowest of all available choices. This eliminates the three sub-grids with the maximum readings. Thus, the six areas to be used to determine the WD's highest emissions are identified.

h) Identify the maximum reading within the non-excluded sub-grids identified in step g).

i) *Indirect measurement method*

   The RF audio interference level in dB (V/m) is obtained by adding the MIF (in dB) to the maximum steady-state rms field-strength reading, in dB (V/m)

j) Compare this RF audio interference level with the categories in ANSI C63.19-2011 clause 8 and record the resulting WD category rating.

k) For the T-Coil mode M-rating assessment, determine whether the chosen perpendicular measurement point is contained in an included sub-grid of the first scan. If so, then a second scan is not necessary. The first scan and resultant category rating may be used for the T-Coil mode M rating.

   Otherwise, repeat step a) through step i), with the grid shifted so that it is centered on the perpendicular measurement point. Record the WD category rating.

Referenced from ANSI C63.19 -2011 section 5.5.1

a) Confirm the proper operation of the field probe, probe measurement system, and other instrumentation and the positioning system.

b) Position the WD in its intended test position.

c) Set the WD to transmit a fixed and repeatable combination of signal power and modulation characteristic that is representative of the worst case (highest interference potential) encountered in normal use. Transiently occurring start-up, changeover, or termination conditions, or other operations likely to occur less than 1% of the time during normal operation, may be excluded from consideration.

d) The center sub-grid shall be centered on the T-Coil mode perpendicular measurement point or the acoustic output, as appropriate. Locate the field probe at the initial test position in the 50 mm by 50 mm grid, which is contained in the measurement plane, refer to illustrated in Figure 8.2. If the field alignment method is used, align the probe for maximum field reception.

e) Record the reading at the output of the measurement system.

f) Scan the entire 50 mm by 50 mm region in equality spaced increments and record the reading at each measurement point, The distance between measurement points shall be sufficient to assure the identification of the maximum reading.

g) Identify the five contiguous sub-grids around the center sub-grid whose maximum reading is the lowest of all available choices. This eliminates the three sub-grids with the maximum readings. Thus, the six areas to be used to determine the WD's highest emissions are identified.

h) Identify the maximum reading within the non-excluded sub-grids identified in step g).

i) *Indirect measurement method*

   The RF audio interference level in dB (V/m) is obtained by adding the MIF (in dB) to the maximum steady-state rms field-strength reading, in dB (V/m)

j) Compare this RF audio interference level with the categories in ANSI C63.19-2011 clause 8 and record the resulting WD category rating.

k) For the T-Coil perpendicular measurement location is ≥5.0 mm from the center of the acoustic output, then two different 50 mm by 50 mm areas may need to be scanned, the first for the microphone mode assessment and the second for the T-Coil assessment.

l) The second for the T-Coil assessment, with the grid shifted so that it is centered on the perpendicular measurement point. Record the WD category rating.

Test Instructions

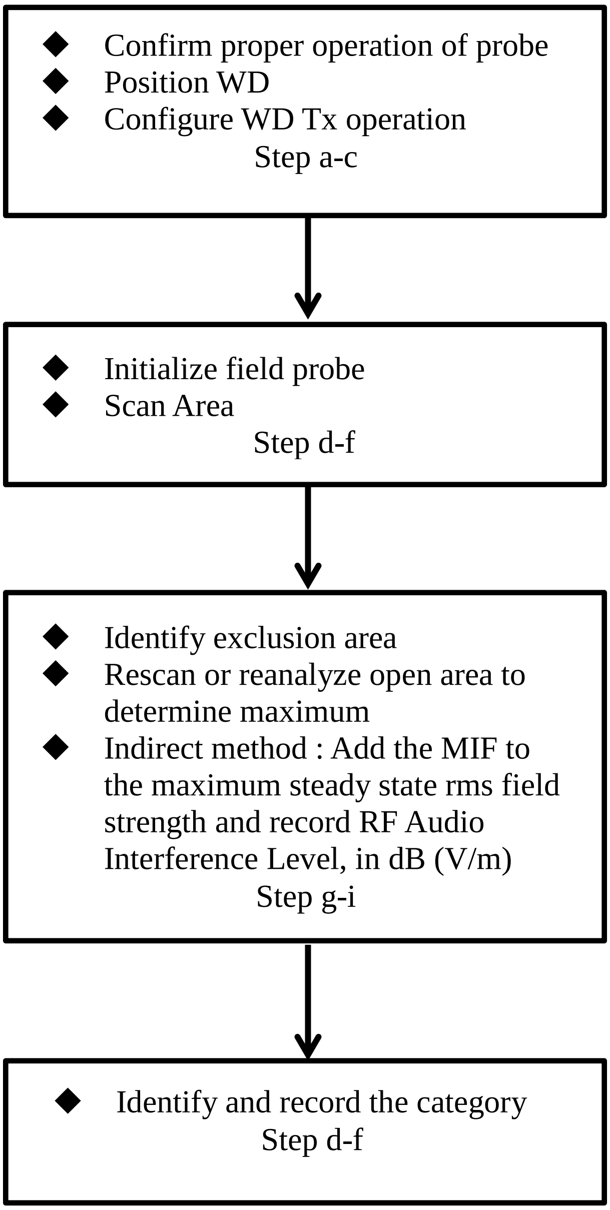


Fig 7.1 Flow Chart of HAC RF Emission

Fig 7.2 EUT reference and plane for HAC RF emission measurements

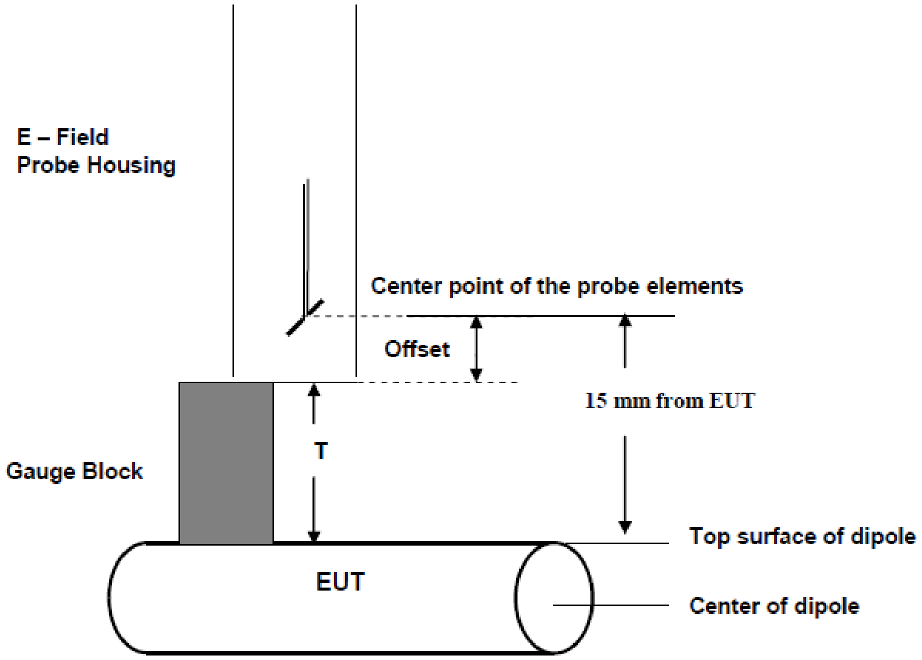


Fig. 7.3 Gauge block with E-field probe

8. Modulation Interference Factor

The HAC Standard ANSI C63.19-2011 defines a new scaling using the Modulation Interference Factor (MIF).

For any specific fixed and repeatable modulated signal, a modulation interference factor (MIF, expressed in dB) may be developed that relates its interference potential to its steady-state rms signal level or average power level. This factor is a function only of the audio-frequency amplitude modulation characteristics of the signal and is the same for field-strength and conducted power measurements. It is important to emphasize that the MIF is valid only for a specific repeatable audio-frequency amplitude modulation characteristic. Any change in modulation characteristic requires determination and application of a new MIF

The Modulation Interference factor (MIF, in dB) is added to the measured average E-field (in dBV/m) and converts it to the RF Audio Interference level (in dBV/m). This level considers the audible amplitude modulation components in the RF E-field. CW fields without amplitude modulation are assumed to not interfere with the hearing aid electronics. Modulations without time slots and low fluctuations at low frequencies have low MIF values, TDMA modulations with narrow transmission and repetition rates of few 100 Hz have high MIF values and give similar classifications as ANSI C63.19-2011.

ER3D, EF3D and EU2D E-field probes have a bandwidth <10 kHz and can therefore not evaluate the RF envelope in the full audio band. DASY52 is therefore using the indirect measurement method according to ANSI C63.19-2011 which is the primary method. These near field probes read the averaged E-field measurement. Especially for the new high peak-to-average (PAR) signal types, the probes shall be linearized by PMR calibration in order to not overestimate the field reading. Probe Modulation Response (PMR) calibration linearizes the probe response over its dynamic range for specific modulations which are characterized by their UID and result in an uncertainty specified in the probe calibration certificate. The MIF is characteristic for a given waveform envelope and can be used as a constant conversion factor if the probe has been PMR calibrated.

The evaluation method for the MIF is defined in ANSI C63.19-2011 section D.7. An RMS demodulated RF signal is fed to a spectral filter (similar to an A weighting filter) and forwarded to a temporal filter acting as a quasi-peak detector. The averaged output of these filtering is scaled to a 1 kHz 80% AM signal as reference. MIF measurement requires additional instrumentation and is not well suited for evaluation by the end user with reasonable uncertainty. It may alliteratively be determined through analysis and simulation, because it is constant and characteristic for a communication signal. DASY52 uses well-defined signals for PMR calibration. The MIF of these signals has been determined by simulation and it is automatically applied.

MIF values applied in this test report were provided by the HAC equipment provider, SPEAG, and the values are listed below

UID	Communication System Name	MIF(dB)
10021	GSM-FDD(TDMA,GMSK)	3.63
10025	EDGE-FDD (TDMA, 8PSK, TN 0)	3.75
10081	CDMA2000 (1xRTT, RC3)	-19.71
10295	CDMA2000 (1xRTT, RC1 SO3, 1/8th Rate 25 fr.)	3.26
10170	LTE-FDD(SC-FDMA,1RB,20MHz,16-QAM)	-9.76

The MIF measurement uncertainty is estimated as follows, declared by HAC equipment provider SPEAG, for modulation frequencies from slotted waveforms with fundamental frequency and at least 2 harmonics within 10 kHz:

i) 0.2 dB for MIF: -7 to +5 dB,

ii) 0.5 dB for MIF: -13 to +11 dB

iii) 1 dB for MIF: > -20 dB

9. Low-power Exemption

Mode		Average Power (dBm)
GSM	GSM850	33.50
	GSM1900	30.50
CDMA	BC0	24.50
	BC1	23.00
FDD LTE	Band 2	22.50
	Band 4	22.50
	Band 5	23.50
	Band 13	24.00

<Low Power Exemption>

Air Interface	Max Average Antenna Input Power (dBm)	Worst Case MIF (dB)	Power + MIF(dB)	C63.19 test required
GSM850	33.50	3.63	37.13	Yes
GSM1900	30.50	3.63	34.13	Yes
CDMA2000 BC0 (Full Frame Rate)	24.50	-19.71	4.79	No
CDMA2000 BC0 (1/8th Frame Rate)	24.50	3.26	27.76	Yes
CDMA2000 BC1 (Full Frame Rate)	23.00	-19.71	3.29	No
CDMA2000 BC1 (1/8th Frame Rate)	23.00	3.26	26.26	Yes
LTE - FDD	24.00	-9.76	14.24	No

General Note:

1. According to ANSI C63.19 2011-version, for WWAN RF air interface technology of a device is exempt from testing when its average antenna input power plus its MIF is ≤17 dBm for any of its operating modes.
2. Chose the maximum power of all bands to calculate low power exemption.
3. HAC RF rating is M4 for the air interface which meets the low power exemption.

10. Conducted RF Output Power (Unit: dBm)

Average Antenna Input Power(dBm)						
Air Interface	GSM850			GSM1900		
Channel	128	189	251	512	661	810
Frequency (MHz)	824.2	836.4	848.8	1850.2	1880.0	1909.8
GSM (GMSK, 1 Tx slot)	33.12	33.00	33.19	29.85	30.10	30.19

Average Antenna Input Power(dBm)						
Band	CDMA2000 BC0			CDMA2000 BC1		
TX Channel	1013	384	777	25	600	1175
Frequency (MHz)	824.7	836.52	848.31	1851.25	1880	1908.75
1xRTT RC1 SO3, 1/8th Rate	24.35	24.18	24.24	22.89	22.91	22.93

11. HAC RF Emission Test Results

Plot No.	Air Interface	Mode	Channel	Average Antenna Input Power (dBm)	MIF	E-Field (dBV/m)	Margin to FCC M3 limit (dB)	E-Field M Rating
1	GSM850	GSM Voice	128	33.12	3.63	38.93	6.07	M4
2	GSM850	GSM Voice	189	33.00	3.63	39.60	5.40	M4
3	GSM850	GSM Voice	251	33.19	3.63	39.79	5.21	M4
4	GSM1900	GSM Voice	512	29.85	3.63	28.69	6.31	M4
5	GSM1900	GSM Voice	661	30.10	3.63	28.31	6.69	M4
6	GSM1900	GSM Voice	810	30.19	3.63	27.70	7.30	M4
7	CDMA BC0	RC1 SO3 1/8th Rate	1013	24.35	3.26	40.38	4.62	M3
8	CDMA BC0	RC1 SO3 1/8th Rate	384	24.18	3.26	39.28	5.72	M4
9	CDMA BC0	RC1 SO3 1/8th Rate	777	24.24	3.26	38.17	6.83	M4
10	CDMA BC1	RC1 SO3 1/8th Rate	25	22.89	3.26	30.05	4.95	M3
11	CDMA BC1	RC1 SO3 1/8th Rate	600	22.91	3.26	29.74	5.26	M4
12	CDMA BC1	RC1 SO3 1/8th Rate	1175	22.93	3.26	29.92	5.08	M4

Remark:

1. The HAC measurement system applies MIF value onto the measured RMS E-field, which is indirect method in ANSI C63.19 2011 version, and reports the RF audio interference level.
2. There is no special HAC mode software on this EUT.

Test Engineer：Johnny Chen.

12. Uncertainty Assessment

The component of uncertainly may generally be categorized according to the methods used to evaluate them. The evaluation of uncertainly by the statistical analysis of a series of observations is termed a Type A evaluation of uncertainty. The evaluation of uncertainty by means other than the statistical analysis of a series of observation is termed a Type B evaluation of uncertainty. Each component of uncertainty, however evaluated, is represented by an estimated standard deviation, termed standard uncertainty, which is determined by the positive square root of the estimated variance.

The combined standard uncertainty of the measurement result represents the estimated standard deviation of the result. It is obtained by combining the individual standard uncertainties of both Type A and Type B evaluation using the usual “root-sum-squares” (RSS) methods of combining standard deviations by taking the positive square root of the estimated variances. Expanded uncertainty is a measure of uncertainty that defines an interval about the measurement result within which the measured value is confidently believed to lie. It is obtained by multiplying the combined standard uncertainty by a coverage factor. For purpose of this document, a coverage factor two is used, which corresponds to confidence interval of about 95 %. The DASY uncertainty Budget is showed in Table 12.1.

Error Description	Uncertainty Value (±%)	Probability	Divisor	(Ci) E	(Ci) H	Standard Uncertainty (E) (±%)
Measurement System						
Probe Calibration	5.1	N	1	1	1	5.1
Axial Isotropy	4.7	R	1.732	1	1	2.7
Sensor Displacement	16.5	R	1.732	1	0.145	9.5
Boundary Effects	2.4	R	1.732	1	1	1.4
Phantom Boundary Effect	7.2	R	1.732	1	0	4.2
Linearity	4.7	R	1.732	1	1	2.7
Scaling with PMR calibration	10.0	R	1.732	1	1	5.8
System Detection Limit	1.0	R	1.732	1	1	0.6
Readout Electronics	0.3	N	1	1	1	0.3
Response Time	2.6	R	1.732	1	1	1.5
Integration Time	2.6	R	1.732	1	1	1.5
RF Ambient Conditions	3.0	R	1.732	1	1	1.7
RF Reflections	12.0	R	1.732	1	1	6.9
Probe Positioner	1.2	R	1.732	1	0.67	0.7
Probe Positioning	4.7	R	1.732	1	0.67	2.7
Extrap. and Interpolation	1.0	R	1.732	1	1	0.6
Test Sample Related						
Device Positioning Vertical	4.7	R	1.732	1	0.67	2.7
Device Positioning Lateral	1.0	R	1.732	1	1	0.6
Device Holder and Phantom	2.4	R	1.732	1	1	1.4
Power Drift	5.0	R	1.732	1	1	2.9
Phantom and Setup Related						
Phantom Thickness	2.4	R	1.732	1	0.67	1.4
Combined Std. Uncertainty						16.4%
Coverage Factor for 95 %						K=2
Expanded STD Uncertainty						32.7%

Table 12.1 Uncertainty Budget of HAC free field assessment

Remark:

Worst-Case uncertainty budget for HAC free field assessment according to ANSIC63.19 [1], [2]. The budget is valid for the frequency range 700 MHz - 3 GHz and represents a worst case analysis.

13. References

[1] ANSI C63.19-2011, “American National Standard for Methods of Measurement of Compatibility between Wireless Communications Devices and Hearing Aids”, 27 May 2011.

[2] FCC KDB 285076 D01v05, “Equipment Authorization Guidance for Hearing Aid Compatibility”, Sep 2017

[3] FCC KDB 285076 D02v03, “Guidance for performing T-Coil tests for air interfaces supporting voice over IP (e.g., LTE and WiFi) to support CMRS based telephone services”, Sep 2017

[4] FCC KDB 285076 D03v01, “Hearing aid compatibility frequently asked questions”, Sep 2017

[5] SPEAG DASY System Handbook

Appendix A. Plots of System Performance Check

The plots are shown as follows.

HAC_E_Dipole_835_190316

DUT: HAC-Dipole 835 MHz

Communication System: UID 0, CW; Frequency: 835 MHz;Duty Cycle: 1:1
Medium: Air Medium parameters used: $\sigma = 0$ S/m, $\varepsilon_r = 1$; $\rho = 0$ kg/m^3
Ambient Temperature：23.4 ℃

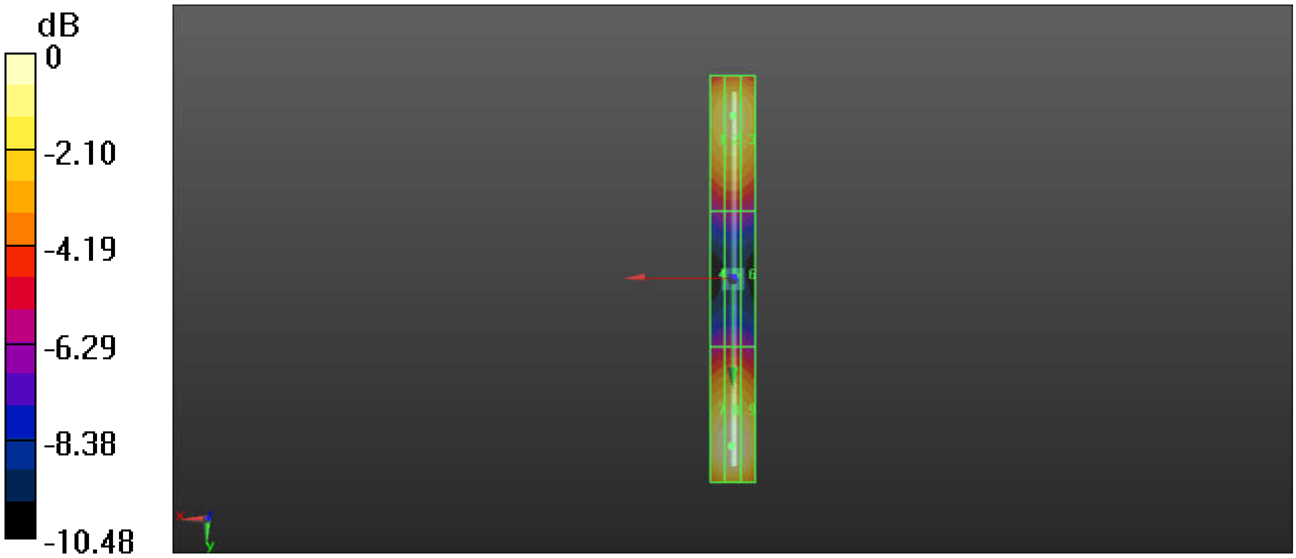
DASY5 Configuration:
- Probe: EF3DV3 - SN4053; ConvF(1, 1, 1); Calibrated: 2018.03.19;
- Sensor-Surface: (Fix Surface)
- Electronics: DAE4 Sn1437; Calibrated: 2018.10.15
- Phantom: HAC Test Arch with AMCC; Type: SD HAC P01 BA;
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

E Scan - measurement distance from the probe sensor center to CD835 = 15mm
Hearing Aid Compatibility Test at 15mm distance (41x361x1): Interpolated grid: dx=0.5000 mm, dy=0.5000 mm
Device Reference Point: 0, 0, -6.3 mm
Reference Value = 131.2 V/m; Power Drift = -0.03 dB
PMR not calibrated. PMF = 1.000 is applied.
E-field emissions = 126.9 V/m
Average value of Total=(113.5+126.9)/2=120.2 V/m

PMF scaled E-field

Grid 1 **M4** **111.1 V/m**	Grid 2 **M4** **113.5 V/m**	Grid 3 **M4** **111.3 V/m**
Grid 4 **M4** **64.74 V/m**	Grid 5 **M4** **65.43 V/m**	Grid 6 **M4** **64.10 V/m**
Grid 7 **M4** **124.3 V/m**	Grid 8 **M4** **126.9 V/m**	Grid 9 **M4** **123.1 V/m**

Cursor:
Total = 126.9 V/m
E Category: M4
Location: 0.5, 74, 9.7 mm



0 dB = 126.9 V/m = 42.07 dBV/m

HAC_E_Dipole_1880_190316

DUT: HAC-Dipole 1880 MHz

Communication System: UID 0, CW; Frequency: 1880 MHz;Duty Cycle: 1:1
Medium: Air Medium parameters used: $\sigma = 0$ S/m, $\varepsilon_r = 1$; $\rho = 0$ kg/m^3
Ambient Temperature：23.4 ℃

DASY5 Configuration:
- Probe: EF3DV3 - SN4053; ConvF(1, 1, 1); Calibrated: 2018.03.19;
- Sensor-Surface: (Fix Surface)
- Electronics: DAE4 Sn1437; Calibrated: 2018.10.15
- Phantom: HAC Test Arch with AMCC; Type: SD HAC P01 BA;
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

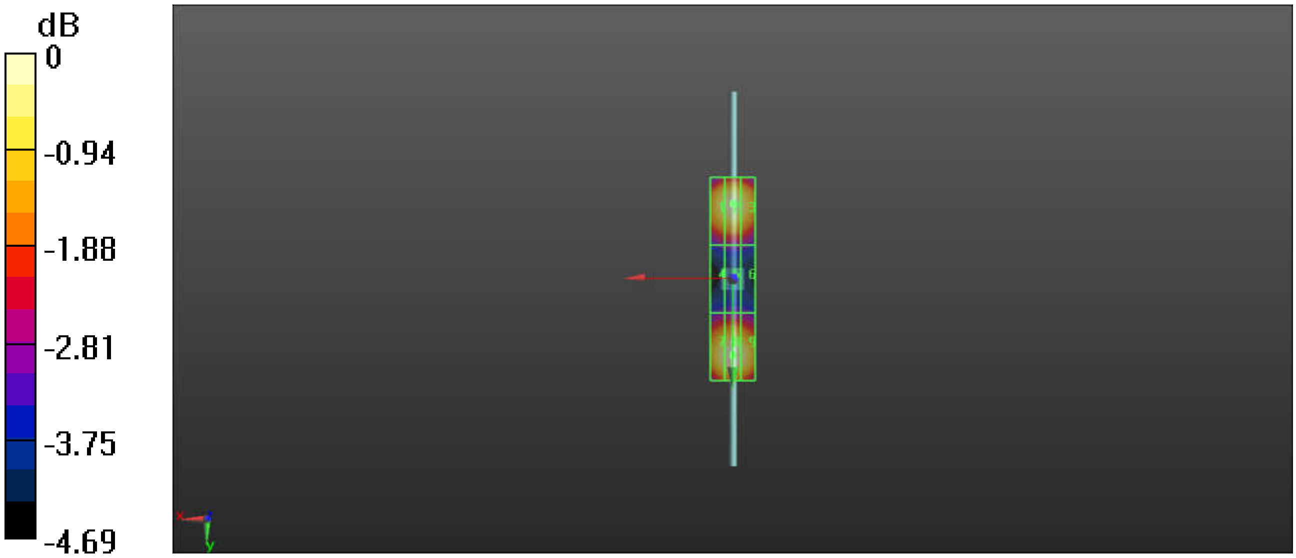
E Scan - measurement distance from the probe sensor center to CD1880 = 15mm

Hearing Aid Compatibility Test at 15mm distance (41x181x1): Interpolated grid: dx=0.5000 mm, dy=0.5000 mm
Device Reference Point: 0, 0, -6.3 mm
Reference Value = 162.6 V/m; Power Drift = -0.00 dB
PMR not calibrated. PMF = 1.000 is applied.
E-field emissions = 96.78 V/m
Average value of Total=(95.26+96.78)/2=96.02 V/m

PMF scaled E-field

Grid 1 **M3** **93.35 V/m**	Grid 2 **M3** **95.26 V/m**	Grid 3 **M3** **93.21 V/m**
Grid 4 **M3** **68.85 V/m**	Grid 5 **M3** **69.47 V/m**	Grid 6 **M3** **68.75 V/m**
Grid 7 **M3** **94.81 V/m**	Grid 8 **M3** **96.78 V/m**	Grid 9 **M3** **94.73 V/m**

Cursor:
Total = 96.78 V/m
E Category: M3
Location: 0, 34, 9.7 mm



0 dB = 96.78 V/m = 39.72 dBV/m

Appendix B. Plots of RF Emission Measurement

The plots are shown as follows.

01_HAC RF_GSM850_GSM Voice_Ch128_E

Communication System: UID 10021 - DAB, GSM-FDD (TDMA, GMSK); Frequency: 824.2 MHz;Duty Cycle: 1:8.3
Medium: Air Medium parameters used: $\sigma = 0$ S/m, $\varepsilon_r = 1$; $\rho = 0$ kg/m^3
Ambient Temperature：23.4 ℃

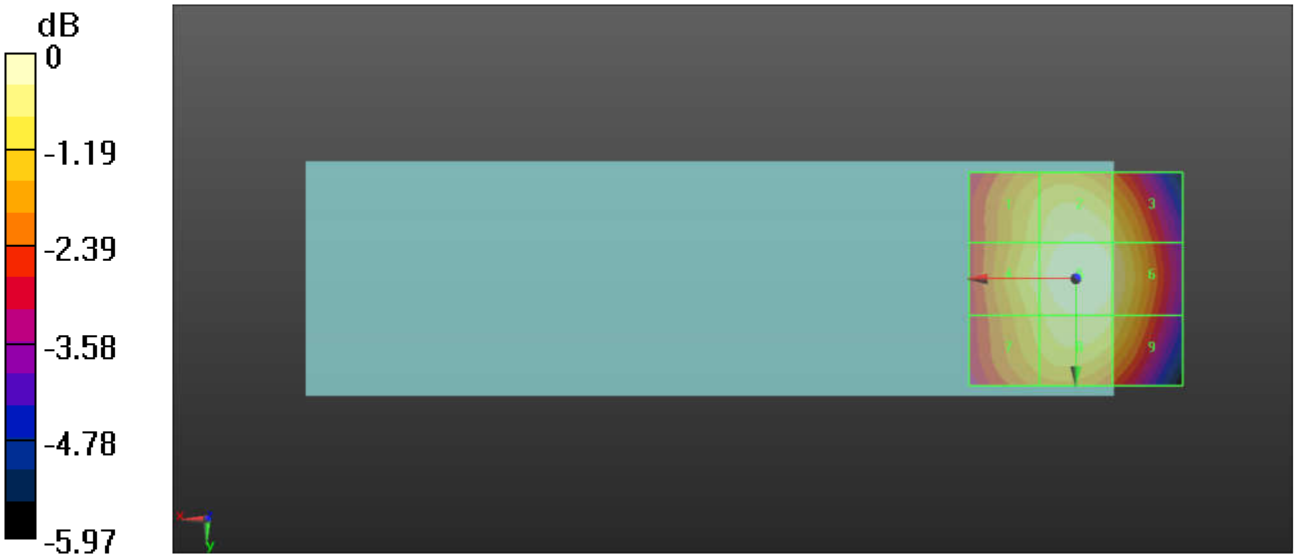
DASY5 Configuration:
- Probe: EF3DV3 - SN4053; ConvF(1, 1, 1); Calibrated: 2018.03.19;
- Sensor-Surface: (Fix Surface)
- Electronics: DAE4 Sn1437; Calibrated: 2018.10.15
- Phantom: HAC Test Arch with AMCC; Type: SD HAC P01 BA;
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Ch128/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 = 79.37 V/m; Power Drift = 0.02 dB
Applied MIF = 3.63 dB
RF audio interference level = 38.93 dBV/m
Emission category: M4

MIF scaled E-field

Grid 1 **M4** **38.13 dBV/m**	Grid 2 **M4** **38.65 dBV/m**	Grid 3 **M4** **38.27 dBV/m**
Grid 4 **M4** **38.38 dBV/m**	Grid 5 **M4** **38.93 dBV/m**	Grid 6 **M4** **38.58 dBV/m**
Grid 7 **M4** **38.03 dBV/m**	Grid 8 **M4** **38.55 dBV/m**	Grid 9 **M4** **38.23 dBV/m**

Total = 38.93 dBV/m
E Category: M4
Location: -1, -0.5, 8.7 mm



0 dB = 88.41 V/m = 38.93 dBV/m

02_HAC RF_GSM850_GSM Voice_Ch189_E

Communication System: UID 10021 - DAB, GSM-FDD (TDMA, GMSK); Frequency: 836.4 MHz;Duty Cycle: 1:8.3
Medium: Air Medium parameters used: $\sigma = 0$ S/m, $\varepsilon_r = 1$; $\rho = 0$ kg/m^3
Ambient Temperature：23.4 ℃

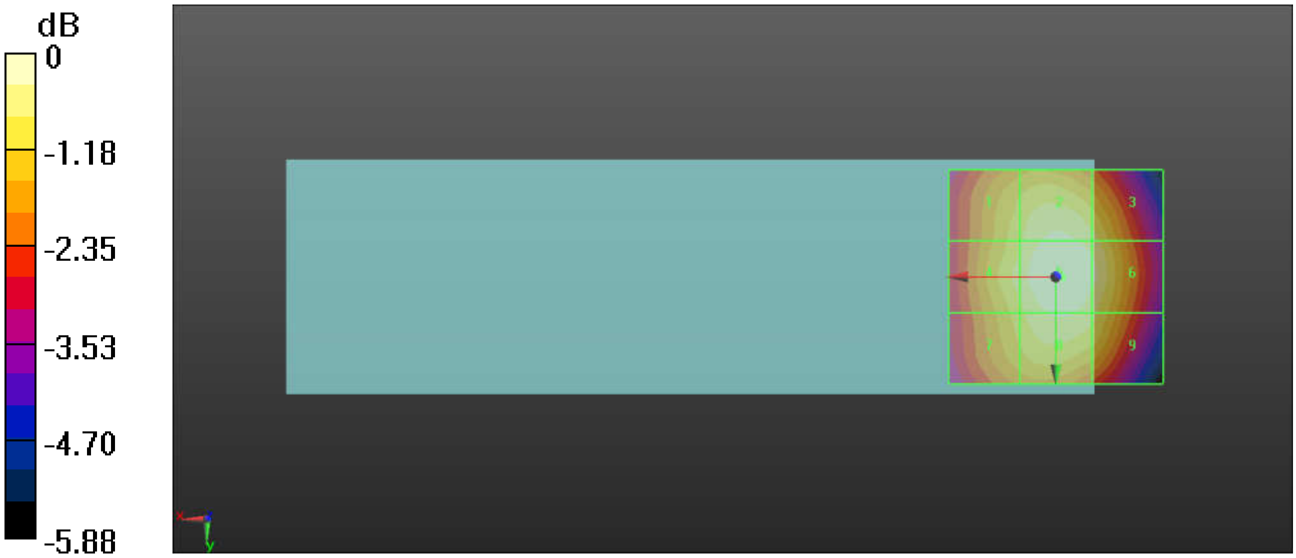
DASY5 Configuration:
- Probe: EF3DV3 - SN4053; ConvF(1, 1, 1); Calibrated: 2018.03.19;
- Sensor-Surface: (Fix Surface)
- Electronics: DAE4 Sn1437; Calibrated: 2018.10.15
- Phantom: HAC Test Arch with AMCC; Type: SD HAC P01 BA;
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Ch189/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 = 86.00 V/m; Power Drift = 0.06 dB
Applied MIF = 3.63 dB
RF audio interference level = 39.60 dBV/m
Emission category: M4

MIF scaled E-field

Grid 1 **M4** **38.77 dBV/m**	Grid 2 **M4** **39.33 dBV/m**	Grid 3 **M4** **39.01 dBV/m**
Grid 4 **M4** **39.02 dBV/m**	Grid 5 **M4** **39.6 dBV/m**	Grid 6 **M4** **39.34 dBV/m**
Grid 7 **M4** **38.68 dBV/m**	Grid 8 **M4** **39.27 dBV/m**	Grid 9 **M4** **38.97 dBV/m**

Total = 39.60 dBV/m
E Category: M4
Location: -1.5, 0, 8.7 mm



0 dB = 95.55 V/m = 39.60 dBV/m

03_HAC RF_GSM850_GSM Voice_Ch251_E

Communication System: UID 10021 - DAB, GSM-FDD (TDMA, GMSK); Frequency: 848.8 MHz;Duty Cycle: 1:8.3
Medium: Air Medium parameters used: σ = 0 S/m, $\varepsilon_r = 1$; ρ = 0 kg/m^3
Ambient Temperature：23.4 ℃

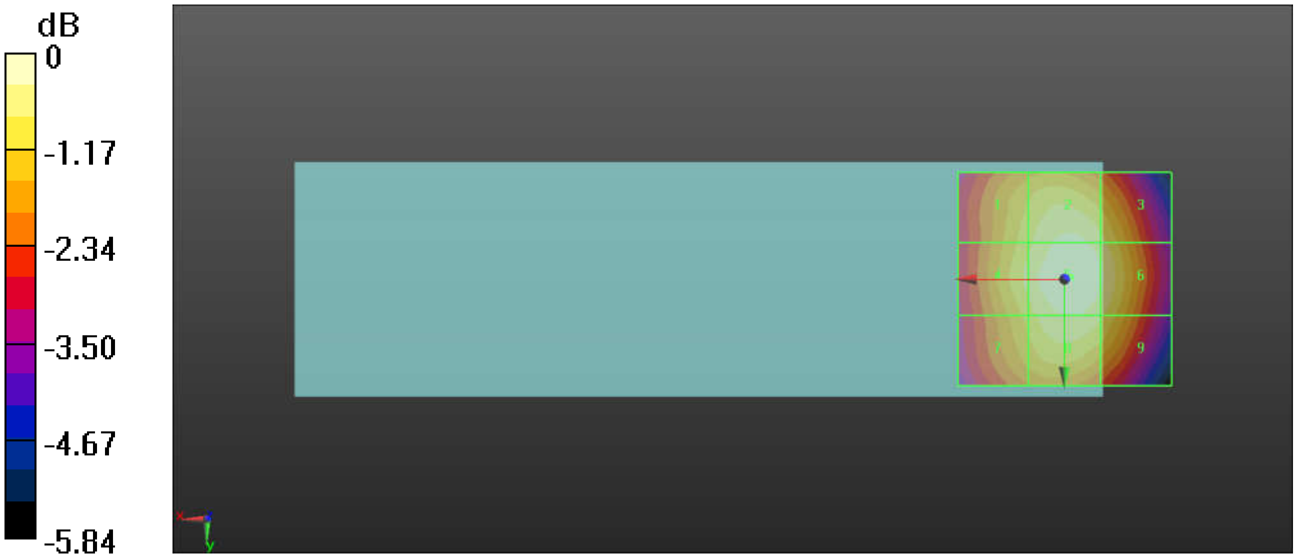
DASY5 Configuration:
- Probe: EF3DV3 - SN4053; ConvF(1, 1, 1); Calibrated: 2018.03.19;
- Sensor-Surface: (Fix Surface)
- Electronics: DAE4 Sn1437; Calibrated: 2018.10.15
- Phantom: HAC Test Arch with AMCC; Type: SD HAC P01 BA;
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Ch251/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 = 87.69 V/m; Power Drift = 0.06 dB
Applied MIF = 3.63 dB
RF audio interference level = 39.79 dBV/m
Emission category: M4

MIF scaled E-field

Grid 1 **M4** **38.92 dBV/m**	Grid 2 **M4** **39.52 dBV/m**	Grid 3 **M4** **39.18 dBV/m**
Grid 4 **M4** **39.15 dBV/m**	Grid 5 **M4** **39.79 dBV/m**	Grid 6 **M4** **39.48 dBV/m**
Grid 7 **M4** **38.79 dBV/m**	Grid 8 **M4** **39.41 dBV/m**	Grid 9 **M4** **39.09 dBV/m**

Total = 39.79 dBV/m
E Category: M4
Location: -1.5, -0.5, 8.7 mm



0 dB = 97.58 V/m = 39.79 dBV/m

04_HAC RF_GSM1900_GSM Voice_Ch512_E

Communication System: UID 10021 - DAB, GSM-FDD (TDMA, GMSK); Frequency: 1850.2 MHz;Duty Cycle: 1:8.3
Medium: Air Medium parameters used: $\sigma = 0$ S/m, $\varepsilon_r = 1$; $\rho = 0$ kg/m^3
Ambient Temperature：23.4 ℃

DASY5 Configuration:
- Probe: EF3DV3 - SN4053; ConvF(1, 1, 1); Calibrated: 2018.03.19;
- Sensor-Surface: (Fix Surface)
- Electronics: DAE4 Sn1437; Calibrated: 2018.10.15
- Phantom: HAC Test Arch with AMCC; Type: SD HAC P01 BA;
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Ch512/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 = 13.50 V/m; Power Drift = 0.12 dB
Applied MIF = 3.63 dB
RF audio interference level = 28.69 dBV/m
Emission category: M4

MIF scaled E-field

Grid 1 **M4** **28.36 dBV/m**	Grid 2 **M4** **28.69 dBV/m**	Grid 3 **M4** **28.22 dBV/m**
Grid 4 **M4** **25.6 dBV/m**	Grid 5 **M4** **27.17 dBV/m**	Grid 6 **M4** **27.13 dBV/m**
Grid 7 **M4** **26.31 dBV/m**	Grid 8 **M4** **24.33 dBV/m**	Grid 9 **M4** **24.49 dBV/m**

Total = 28.69 dBV/m
E Category: M4
Location: 1.5, -23, 8.7 mm

0 dB = 27.20 V/m = 28.69 dBV/m

05_HAC RF_GSM1900_GSM Voice_Ch661_E

Communication System: UID 10021 - DAB, GSM-FDD (TDMA, GMSK); Frequency: 1880 MHz;Duty Cycle: 1:8.3
Medium: Air Medium parameters used: $\sigma = 0$ S/m, $\varepsilon_r = 1$; $\rho = 0$ kg/m^3
Ambient Temperature：23.4 ℃

DASY5 Configuration:
- Probe: EF3DV3 - SN4053; ConvF(1, 1, 1); Calibrated: 2018.03.19;
- Sensor-Surface: (Fix Surface)
- Electronics: DAE4 Sn1437; Calibrated: 2018.10.15
- Phantom: HAC Test Arch with AMCC; Type: SD HAC P01 BA;
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Ch661/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 = 12.54 V/m; Power Drift = 0.06 dB
Applied MIF = 3.63 dB
RF audio interference level = 28.31 dBV/m
Emission category: M4

MIF scaled E-field

Grid 1 **M4** **27.79 dBV/m**	Grid 2 **M4** **28.31 dBV/m**	Grid 3 **M4** **27.98 dBV/m**
Grid 4 **M4** **24.94 dBV/m**	Grid 5 **M4** **26.89 dBV/m**	Grid 6 **M4** **26.89 dBV/m**
Grid 7 **M4** **26.6 dBV/m**	Grid 8 **M4** **25.04 dBV/m**	Grid 9 **M4** **24.42 dBV/m**

Total = 28.31 dBV/m
E Category: M4
Location: 0, -24, 8.7 mm

0 dB = 26.03 V/m = 28.31 dBV/m

06_HAC RF_GSM1900_GSM Voice_Ch810_E

Communication System: UID 10021 - DAB, GSM-FDD (TDMA, GMSK); Frequency: 1909.8 MHz;Duty Cycle: 1:8.3
Medium: Air Medium parameters used: $\sigma = 0$ S/m, $\varepsilon_r = 1$; $\rho = 0$ kg/m^3
Ambient Temperature：23.4 ℃

DASY5 Configuration:
- Probe: EF3DV3 - SN4053; ConvF(1, 1, 1); Calibrated: 2018.03.19;
- Sensor-Surface: (Fix Surface)
- Electronics: DAE4 Sn1437; Calibrated: 2018.10.15
- Phantom: HAC Test Arch with AMCC; Type: SD HAC P01 BA;
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Ch810/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 = 11.71 V/m; Power Drift = -0.09 dB
Applied MIF = 3.63 dB
RF audio interference level = 27.70 dBV/m
Emission category: M4

MIF scaled E-field

Grid 1 **M4** **27.2 dBV/m**	Grid 2 **M4** **27.7 dBV/m**	Grid 3 **M4** **27.22 dBV/m**
Grid 4 **M4** **24.11 dBV/m**	Grid 5 **M4** **26.01 dBV/m**	Grid 6 **M4** **25.98 dBV/m**
Grid 7 **M4** **26.71 dBV/m**	Grid 8 **M4** **25.32 dBV/m**	Grid 9 **M4** **23.8 dBV/m**

Total = 27.70 dBV/m
E Category: M4
Location: 0.5, -22.5, 8.7 mm

0 dB = 24.26 V/m = 27.70 dBV/m

07_HAC RF_CDMA BC0_RC1 SO3 1/8th Rate_Ch1013_E

Communication System: UID 10295 - AAB, CDMA2000, RC1, SO3, 1/8th Rate 25 fr.; Frequency: 824.7 MHz;Duty Cycle: 1:8
Medium: Air Medium parameters used: $\sigma = 0$ S/m, $\varepsilon_r = 1$; $\rho = 0$ kg/m^3
Ambient Temperature：23.4 ℃

DASY5 Configuration:
- Probe: EF3DV3 - SN4053; ConvF(1, 1, 1); Calibrated: 2018.03.19;
- Sensor-Surface: (Fix Surface)
- Electronics: DAE4 Sn1437; Calibrated: 2018.10.15
- Phantom: HAC Test Arch with AMCC; Type: SD HAC P01 BA;
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Ch1013/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 = 106.6 V/m; Power Drift = 0.00 dB
Applied MIF = 3.26 dB
RF audio interference level = 40.38 dBV/m
Emission category: M3

MIF scaled E-field

Grid 1 **M4** **39.68 dBV/m**	Grid 2 **M4** **39.96 dBV/m**	Grid 3 **M4** **39.23 dBV/m**
Grid 4 **M3** **40.06 dBV/m**	Grid 5 **M3** **40.38 dBV/m**	Grid 6 **M4** **39.66 dBV/m**
Grid 7 **M4** **39.59 dBV/m**	Grid 8 **M4** **39.92 dBV/m**	Grid 9 **M4** **39.24 dBV/m**

Total = 40.38 dBV/m
E Category: M3
Location: 2, 0, 8.7 mm

0 dB = 104.5 V/m = 40.38 dBV/m

08_HAC RF_CDMA BC0_RC1 SO3 1/8th Rate_Ch384_E

Communication System: UID 10295 - AAB, CDMA2000, RC1, SO3, 1/8th Rate 25 fr.; Frequency: 836.52 MHz;Duty Cycle: 1:8
Medium: Air Medium parameters used: $\sigma = 0$ S/m, $\varepsilon_r = 1$; $\rho = 0$ kg/m^3
Ambient Temperature：23.4 ℃

DASY5 Configuration:
- Probe: EF3DV3 - SN4053; ConvF(1, 1, 1); Calibrated: 2018.03.19;
- Sensor-Surface: (Fix Surface)
- Electronics: DAE4 Sn1437; Calibrated: 2018.10.15
- Phantom: HAC Test Arch with AMCC; Type: SD HAC P01 BA;
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Ch384/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 = 94.81 V/m; Power Drift = -0.12 dB
Applied MIF = 3.26 dB
RF audio interference level = 39.28 dBV/m
Emission category: M4

MIF scaled E-field

Grid 1 **M4** **38.56 dBV/m**	Grid 2 **M4** **38.87 dBV/m**	Grid 3 **M4** **38.24 dBV/m**
Grid 4 **M4** **38.9 dBV/m**	Grid 5 **M4** **39.28 dBV/m**	Grid 6 **M4** **38.72 dBV/m**
Grid 7 **M4** **38.44 dBV/m**	Grid 8 **M4** **38.83 dBV/m**	Grid 9 **M4** **38.22 dBV/m**

Total = 39.28 dBV/m
E Category: M4
Location: 0.5, -1, 8.7 mm

0 dB = 92.04 V/m = 39.28 dBV/m

09_HAC RF_CDMA BC0_RC1 SO3 1/8th Rate_Ch777_E

Communication System: UID 10295 - AAB, CDMA2000, RC1, SO3, 1/8th Rate 25 fr.; Frequency: 848.31 MHz;Duty Cycle: 1:8
Medium: Air Medium parameters used: σ = 0 S/m, ε_r = 1; ρ = 0 kg/m^3
Ambient Temperature：23.4 ℃

DASY5 Configuration:
- Probe: EF3DV3 - SN4053; ConvF(1, 1, 1); Calibrated: 2018.03.19;
- Sensor-Surface: (Fix Surface)
- Electronics: DAE4 Sn1437; Calibrated: 2018.10.15
- Phantom: HAC Test Arch with AMCC; Type: SD HAC P01 BA;
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Ch777/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 = 81.74 V/m; Power Drift = -0.03 dB
Applied MIF = 3.26 dB
RF audio interference level = 38.17 dBV/m
Emission category: M4

MIF scaled E-field

Grid 1 **M4** **37.38 dBV/m**	Grid 2 **M4** **37.79 dBV/m**	Grid 3 **M4** **37.17 dBV/m**
Grid 4 **M4** **37.71 dBV/m**	Grid 5 **M4** **38.17 dBV/m**	Grid 6 **M4** **37.53 dBV/m**
Grid 7 **M4** **37.24 dBV/m**	Grid 8 **M4** **37.69 dBV/m**	Grid 9 **M4** **37.11 dBV/m**

Total = 38.17 dBV/m
E Category: M4
Location: 0.5, -0.5, 8.7 mm

0 dB = 81.05 V/m = 38.17 dBV/m

10_HAC RF_CDMA BC1_RC1 SO3 1/8th Rate_Ch25_E

Communication System: UID 10295 - AAB, CDMA2000, RC1, SO3, 1/8th Rate 25 fr.; Frequency: 1851.25 MHz;Duty Cycle: 1:8
Medium: Air Medium parameters used: $\sigma = 0$ S/m, $\varepsilon_r = 1$; $\rho = 0$ kg/m^3
Ambient Temperature：23.4 ℃

DASY5 Configuration:
- Probe: EF3DV3 - SN4053; ConvF(1, 1, 1); Calibrated: 2018.03.19;
- Sensor-Surface: (Fix Surface)
- Electronics: DAE4 Sn1437; Calibrated: 2018.10.15
- Phantom: HAC Test Arch with AMCC; Type: SD HAC P01 BA;
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Ch25/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 = 20.13 V/m; Power Drift = 0.00 dB
Applied MIF = 3.26 dB
RF audio interference level = 30.05 dBV/m
Emission category: M3

MIF scaled E-field

Grid 1 **M4** **29.73 dBV/m**	Grid 2 **M3** **30.05 dBV/m**	Grid 3 **M4** **29.68 dBV/m**
Grid 4 **M4** **27.51 dBV/m**	Grid 5 **M4** **29.06 dBV/m**	Grid 6 **M4** **29.03 dBV/m**
Grid 7 **M4** **25 dBV/m**	Grid 8 **M4** **25.54 dBV/m**	Grid 9 **M4** **25.8 dBV/m**

Total = 30.05 dBV/m
E Category: M3
Location: 0.5, -22, 8.7 mm

0 dB = 31.79 V/m = 30.05 dBV/m

11_HAC RF_CDMA BC1_RC1 SO3 1/8th Rate_Ch600_E

Communication System: UID 10295 - AAB, CDMA2000, RC1, SO3, 1/8th Rate 25 fr.; Frequency: 1880 MHz;Duty Cycle: 1:8
Medium: Air Medium parameters used: $\sigma = 0$ S/m, $\varepsilon_r = 1$; $\rho = 0$ kg/m^3
Ambient Temperature：23.4 ℃

DASY5 Configuration:
- Probe: EF3DV3 - SN4053; ConvF(1, 1, 1); Calibrated: 2018.03.19;
- Sensor-Surface: (Fix Surface)
- Electronics: DAE4 Sn1437; Calibrated: 2018.10.15
- Phantom: HAC Test Arch with AMCC; Type: SD HAC P01 BA;
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Ch600/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 = 17.33 V/m; Power Drift = -0.02 dB
Applied MIF = 3.26 dB
RF audio interference level = 29.74 dBV/m
Emission category: M4

MIF scaled E-field

Grid 1 **M4** **29.23 dBV/m**	Grid 2 **M4** **29.74 dBV/m**	Grid 3 **M4** **29.37 dBV/m**
Grid 4 **M4** **26.7 dBV/m**	Grid 5 **M4** **28.49 dBV/m**	Grid 6 **M4** **28.47 dBV/m**
Grid 7 **M4** **25.75 dBV/m**	Grid 8 **M4** **24.38 dBV/m**	Grid 9 **M4** **24.99 dBV/m**

Total = 29.74 dBV/m
E Category: M4
Location: -0.5, -23, 8.7 mm

0 dB = 30.69 V/m = 29.74 dBV/m

12_HAC RF_CDMA BC1_RC1 SO3 1/8th Rate_Ch1175_E

Communication System: UID 10295 - AAB, CDMA2000, RC1, SO3, 1/8th Rate 25 fr.; Frequency: 1908.75 MHz;Duty Cycle: 1:8
Medium: Air Medium parameters used: $\sigma = 0$ S/m, $\varepsilon_r = 1$; $\rho = 0$ kg/m^3
Ambient Temperature：23.4 ℃

DASY5 Configuration:
- Probe: EF3DV3 - SN4053; ConvF(1, 1, 1); Calibrated: 2018.03.19;
- Sensor-Surface: (Fix Surface)
- Electronics: DAE4 Sn1437; Calibrated: 2018.10.15
- Phantom: HAC Test Arch with AMCC; Type: SD HAC P01 BA;
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Ch1175/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 = 18.44 V/m; Power Drift = -0.11 dB
Applied MIF = 3.26 dB
RF audio interference level = 29.92 dBV/m
Emission category: M4

MIF scaled E-field

Grid 1 **M4** **29.44 dBV/m**	Grid 2 **M4** **29.92 dBV/m**	Grid 3 **M4** **29.46 dBV/m**
Grid 4 **M4** **26.98 dBV/m**	Grid 5 **M4** **28.66 dBV/m**	Grid 6 **M4** **28.58 dBV/m**
Grid 7 **M4** **25.43 dBV/m**	Grid 8 **M4** **24.24 dBV/m**	Grid 9 **M4** **24.67 dBV/m**

Total = 29.92 dBV/m
E Category: M4
Location: 0, -22, 8.7 mm

0 dB = 31.33 V/m = 29.92 dBV/m

Appendix C. DASY Calibration Certificate

The DASY calibration certificates are shown as follows.

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

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

Client **Sporton**

Certificate No: CD835V3-1184_May18

CALIBRATION CERTIFICATE

Object	CD835V3 - SN: 1184
Calibration procedure(s)	QA CAL-20.v6 Calibration procedure for dipoles in air
Calibration date:	May 25, 2018

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	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 8753E	SN: US37390585	18-Oct-01 (in house check Oct-17)	In house check: Oct-18

	Name	Function	Signature
Calibrated by:	Leif Klysner	Laboratory Technician	
Approved by:	Katja Pokovic	Technical Manager	

Issued: May 28, 2018

References

[1] ANSI-C63.19-2011
American National Standard, Methods of Measurement of Compatibility between Wireless Communications Devices and Hearing Aids.

Methods Applied and Interpretation of Parameters:

- *Coordinate System:* y-axis is in the direction of the dipole arms. z-axis is from the basis of the antenna (mounted on the table) towards its feed point between the two dipole arms. x-axis is normal to the other axes. In coincidence with the standards [1], the measurement planes (probe sensor center) are selected to be at a distance of 15 mm above the top metal edge of the dipole arms.
- *Measurement Conditions:* Further details are available from the hardcopies at the end of the certificate. All figures stated in the certificate are valid at the frequency indicated. The forward power to the dipole connector is set with a calibrated power meter connected and monitored with an auxiliary power meter connected to a directional coupler. While the dipole under test is connected, the forward power is adjusted to the same level.
- *Antenna Positioning:* The dipole is mounted on a HAC Test Arch phantom using the matching dipole positioner with the arms horizontal and the feeding cable coming from the floor. The measurements are performed in a shielded room with absorbers around the setup to reduce the reflections.
  It is verified before the mounting of the dipole under the Test Arch phantom, that its arms are perfectly in a line. It is installed on the HAC dipole positioner with its arms parallel below the dielectric reference wire and able to move elastically in vertical direction without changing its relative position to the top center of the Test Arch phantom. The vertical distance to the probe is adjusted after dipole mounting with a DASY5 Surface Check job. Before the measurement, the distance between phantom surface and probe tip is verified. The proper measurement distance is selected by choosing the matching section of the HAC Test Arch phantom with the proper device reference point (upper surface of the dipole) and the matching grid reference point (tip of the probe) considering the probe sensor offset. The vertical distance to the probe is essential for the accuracy.
- *Feed Point Impedance and Return Loss:* These parameters are measured using a HP 8753E Vector Network Analyzer. The impedance is specified at the SMA connector of the dipole. The influence of reflections was eliminating by applying the averaging function while moving the dipole in the air, at least 70cm away from any obstacles.
- *E-field distribution:* E field is measured in the x-y-plane with an isotropic ER3D-field probe with 100 mW forward power to the antenna feed point. In accordance with [1], the scan area is 20mm wide, its length exceeds the dipole arm length (180 or 90mm). The sensor center is 15 mm (in z) above the metal top of the dipole arms. Two 3D maxima are available near the end of the dipole arms. Assuming the dipole arms are perfectly in one line, the average of these two maxima (in subgrid 2 and subgrid 8) is determined to compensate for any non-parallelity to the measurement plane as well as the sensor displacement. The E-field value stated as calibration value represents the maximum of the interpolated 3D-E-field, in the plane above the dipole surface.

The reported uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor k=2, which for a normal distribution corresponds to a coverage probability of approximately 95%.

Measurement Conditions

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

DASY Version	DASY5	V52.10.1
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	111.2 V/m = 40.92 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	**110.4 V/m ± 12.8 % (k=2)**

Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters

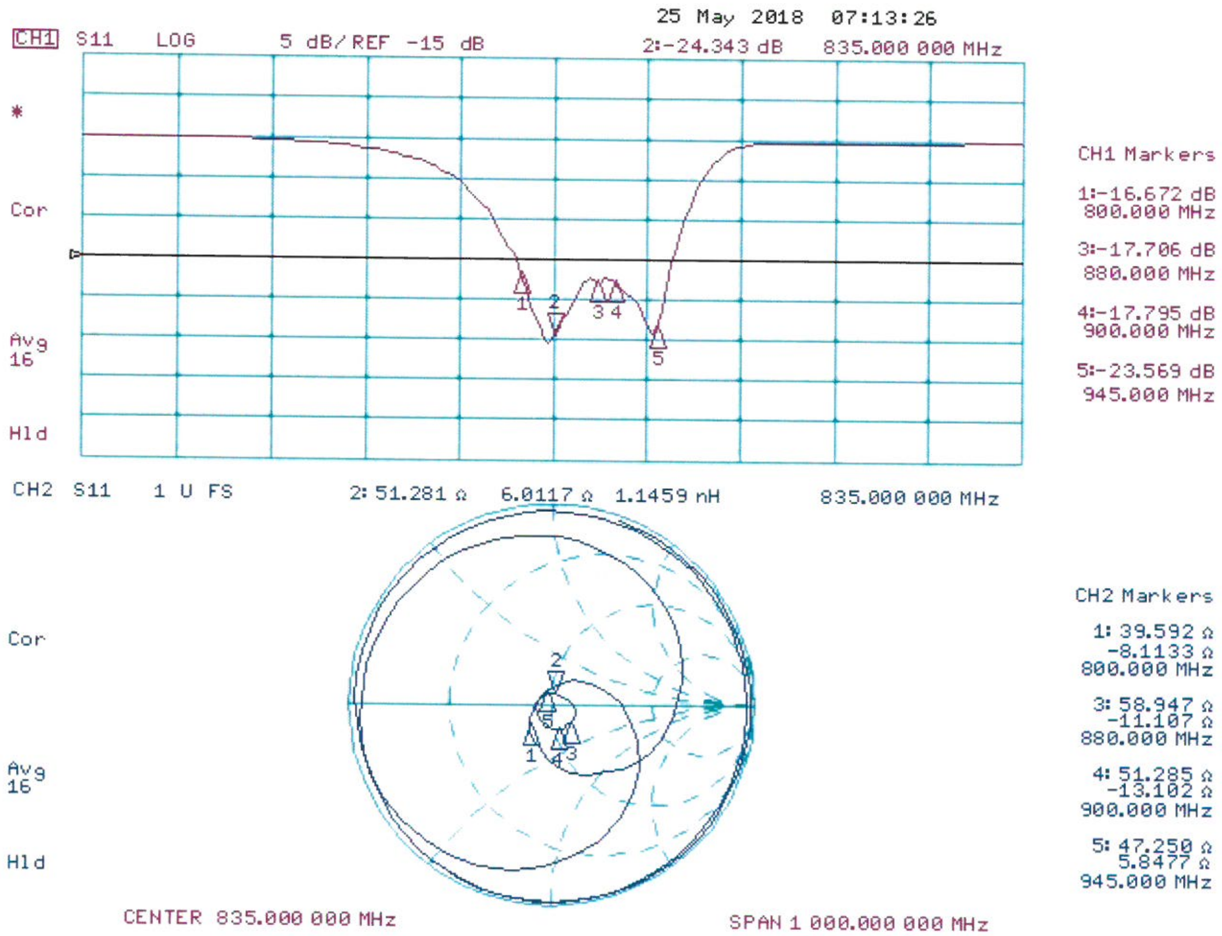
Frequency	**Return Loss**	**Impedance**
800 MHz	16.7 dB	39.6 Ω - 8.1 jΩ
835 MHz	24.3 dB	51.3 Ω + 6.0 jΩ
880 MHz	17.7 dB	58.9 Ω - 11.1 jΩ
900 MHz	17.8 dB	51.3 Ω - 13.1 jΩ
945 MHz	23.6 dB	47.3 Ω + 5.8 jΩ

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.

Impedance Measurement Plot



DASY5 E-field Result

Date: 25.05.2018

Test Laboratory: SPEAG Lab2

DUT: HAC-Dipole 835 MHz; Type: CD835V3; Serial: CD835V3 - SN: 1184

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

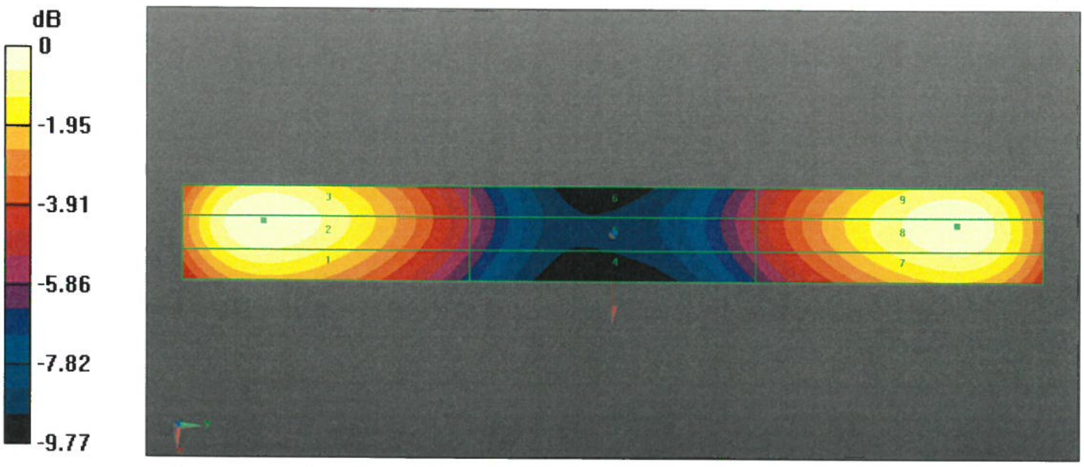
DASY52 Configuration:

- 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 = 130.4 V/m; Power Drift = 0.03 dB
Applied MIF = 0.00 dB
RF audio interference level = 40.92 dBV/m
Emission category: M3

MIF scaled E-field

Grid 1 **M3** **40.28 dBV/m**	Grid 2 **M3** **40.92 dBV/m**	Grid 3 **M3** **40.9 dBV/m**
Grid 4 **M4** **35.51 dBV/m**	Grid 5 **M4** **35.93 dBV/m**	Grid 6 **M4** **35.91 dBV/m**
Grid 7 **M3** **40.37 dBV/m**	Grid 8 **M3** **40.8 dBV/m**	Grid 9 **M3** **40.77 dBV/m**



0 dB = 111.2 V/m = 40.92 dBV/m

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

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

Client **Sporton**

Certificate No: CD1880V3-1170_May18

CALIBRATION CERTIFICATE

Object	CD1880V3 - SN: 1170
Calibration procedure(s)	QA CAL-20.v6 Calibration procedure for dipoles in air
Calibration date:	May 25, 2018

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	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 8753E	SN: US37390585	18-Oct-01 (in house check Oct-17)	In house check: Oct-18

	Name	Function	Signature
Calibrated by:	Leif Klysner	Laboratory Technician	
Approved by:	Katja Pokovic	Technical Manager	

Issued: May 28, 2018

References

[1] ANSI-C63.19-2011
American National Standard, Methods of Measurement of Compatibility between Wireless Communications Devices and Hearing Aids.

Methods Applied and Interpretation of Parameters:

- *Coordinate System:* y-axis is in the direction of the dipole arms. z-axis is from the basis of the antenna (mounted on the table) towards its feed point between the two dipole arms. x-axis is normal to the other axes. In coincidence with the standards [1], the measurement planes (probe sensor center) are selected to be at a distance of 15 mm above the top metal edge of the dipole arms.
- *Measurement Conditions:* Further details are available from the hardcopies at the end of the certificate. All figures stated in the certificate are valid at the frequency indicated. The forward power to the dipole connector is set with a calibrated power meter connected and monitored with an auxiliary power meter connected to a directional coupler. While the dipole under test is connected, the forward power is adjusted to the same level.
- *Antenna Positioning:* The dipole is mounted on a HAC Test Arch phantom using the matching dipole positioner with the arms horizontal and the feeding cable coming from the floor. The measurements are performed in a shielded room with absorbers around the setup to reduce the reflections.
  It is verified before the mounting of the dipole under the Test Arch phantom, that its arms are perfectly in a line. It is installed on the HAC dipole positioner with its arms parallel below the dielectric reference wire and able to move elastically in vertical direction without changing its relative position to the top center of the Test Arch phantom. The vertical distance to the probe is adjusted after dipole mounting with a DASY5 Surface Check job. Before the measurement, the distance between phantom surface and probe tip is verified. The proper measurement distance is selected by choosing the matching section of the HAC Test Arch phantom with the proper device reference point (upper surface of the dipole) and the matching grid reference point (tip of the probe) considering the probe sensor offset. The vertical distance to the probe is essential for the accuracy.
- *Feed Point Impedance and Return Loss:* These parameters are measured using a HP 8753E Vector Network Analyzer. The impedance is specified at the SMA connector of the dipole. The influence of reflections was eliminating by applying the averaging function while moving the dipole in the air, at least 70cm away from any obstacles.
- *E-field distribution:* E field is measured in the x-y-plane with an isotropic ER3D-field probe with 100 mW forward power to the antenna feed point. In accordance with [1], the scan area is 20mm wide, its length exceeds the dipole arm length (180 or 90mm). The sensor center is 15 mm (in z) above the metal top of the dipole arms. Two 3D maxima are available near the end of the dipole arms. Assuming the dipole arms are perfectly in one line, the average of these two maxima (in subgrid 2 and subgrid 8) is determined to compensate for any non-parallelity to the measurement plane as well as the sensor displacement. The E-field value stated as calibration value represents the maximum of the interpolated 3D-E-field, in the plane above the dipole surface.

The reported uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor k=2, which for a normal distribution corresponds to a coverage probability of approximately 95%.

Measurement Conditions

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

DASY Version	DASY5	V52.10.1
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	90.3 V/m = 39.11 dBV/m
Maximum measured above low end	100 mW input power	88.6 V/m = 38.95 dBV/m
Averaged maximum above arm	100 mW input power	**89.5 V/m ± 12.8 % (k=2)**

Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters

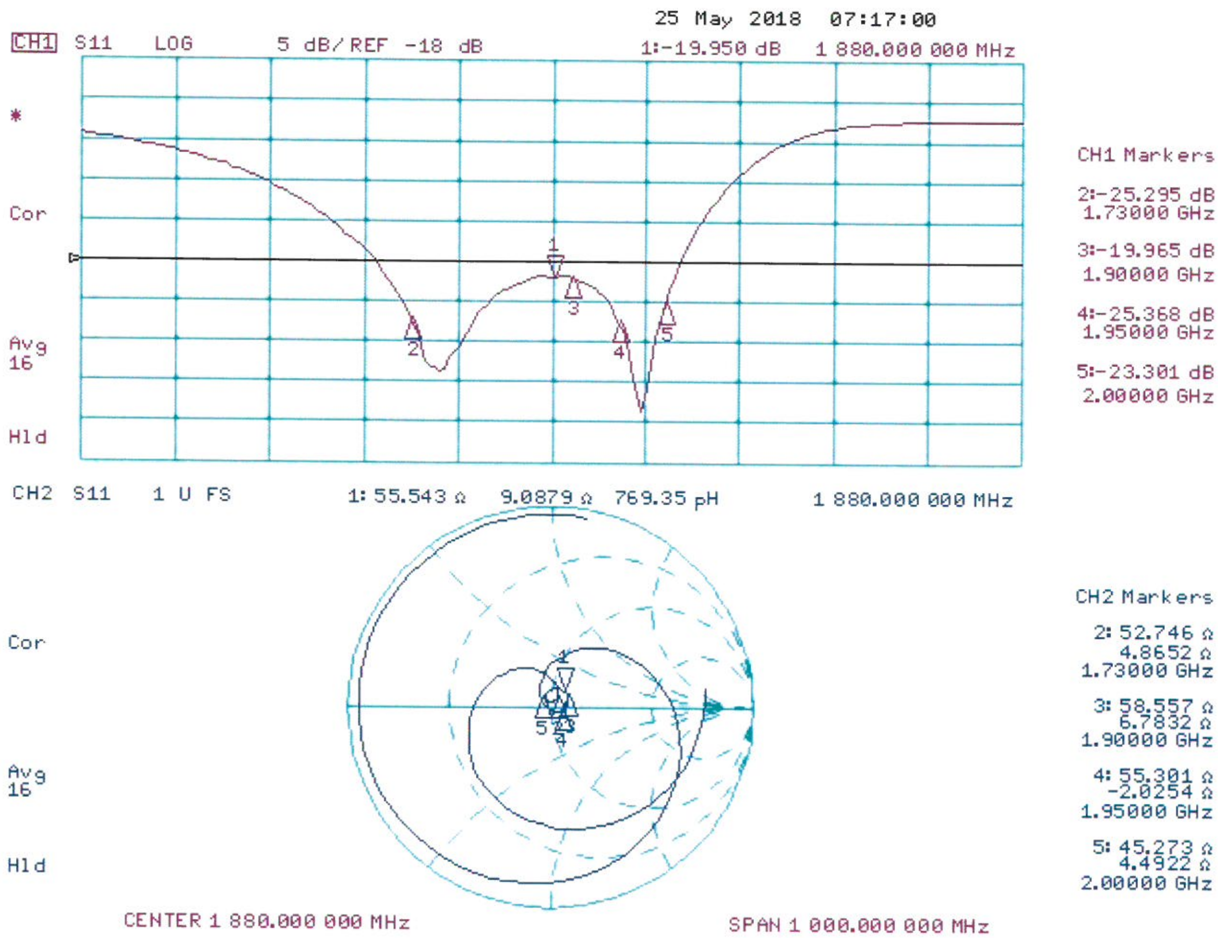
Frequency	**Return Loss**	**Impedance**
1730 MHz	25.3 dB	52.7 Ω + 4.9 jΩ
1880 MHz	20.0 dB	55.5 Ω + 9.1 jΩ
1900 MHz	20.0 dB	58.6 Ω + 6.8 jΩ
1950 MHz	25.4 dB	55.3 Ω - 2.0 jΩ
2000 MHz	23.3 dB	45.3 Ω + 4.5 jΩ

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: 25.05.2018

Test Laboratory: SPEAG Lab2

DUT: HAC Dipole 1880 MHz; Type: CD1880V3; Serial: CD1880V3 - SN: 1170

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

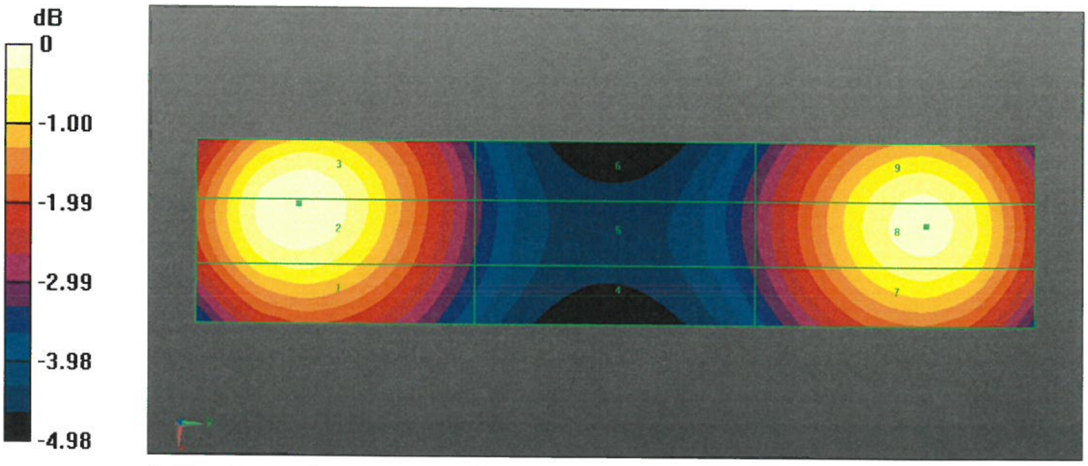
DASY52 Configuration:

- 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 = 157.4 V/m; Power Drift = -0.01 dB
Applied MIF = 0.00 dB
RF audio interference level = 39.11 dBV/m
Emission category: M2

MIF scaled E-field

Grid 1 **M2** **38.56 dBV/m**	Grid 2 **M2** **39.11 dBV/m**	Grid 3 **M2** **39.1 dBV/m**
Grid 4 **M2** **35.92 dBV/m**	Grid 5 **M2** **36.1 dBV/m**	Grid 6 **M2** **36.06 dBV/m**
Grid 7 **M2** **38.65 dBV/m**	Grid 8 **M2** **38.95 dBV/m**	Grid 9 **M2** **38.86 dBV/m**



0 dB = 90.26 V/m = 39.11 dBV/m

In Collaboration with
speag
CALIBRATION LABORATORY
CNAS 中国认可 国际互认 校准 CALIBRATION CNAS L0570
Add: No.51 Xueyuan Road, Haidian District, Beijing, 100191, China
Tel: +86-10-62304633-2512 Fax: +86-10-62304633-2504
E-mail: cttl@chinattl.com Http://www.chinattl.cn

Client : Sporton

Certificate No: Z18-60389

CALIBRATION CERTIFICATE

Object	DAE4 - SN: 1437
Calibration Procedure(s)	FF-Z11-002-01 Calibration Procedure for the Data Acquisition Electronics (DAEx)
Calibration date:	October 15, 2018

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(Calibrated by, Certificate No.)	Scheduled Calibration
Process Calibrator 753	1971018	20-Jun-18 (CTTL, No.J18X05034)	June-19

	Name	Function	Signature
Calibrated by:	Yu Zongying	SAR Test Engineer	
Reviewed by:	Lin Hao	SAR Test Engineer	
Approved by:	Qi Dianyuan	SAR Project Leader	

Issued: October 17, 2018

Add: No.51 Xueyuan Road, Haidian District, Beijing, 100191, China
Tel: +86-10-62304633-2512 Fax: +86-10-62304633-2504
E-mail: cttl@chinattl.com Http://www.chinattl.cn

Glossary:

DAE	data acquisition electronics
Connector angle	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.