HEARING AID COMPATIBILITY RF EMISSIONS TEST REPORT

FCC ID	: IHDT56XP1
Equipment	: Mobile Cellular Phone
Brand Name	: Motorola
M-Rating	: M4
Applicant	: Motorola Mobility LLC 222 W,Merchandise Mart Plaza, Chicago IL 60654 USA
Manufacturer	: Motorola Mobility LLC 222 W,Merchandise Mart Plaza, Chicago IL 60654 USA
Standard	: FCC 47 CFR §20.19 ANSI C63.19-2011

The product was received on Sep. 28, 2018 and testing was started from Oct. 06, 2018 and completed on Oct. 06, 2018. We, SPORTON INTERNATIONAL INC., would like to declare that the tested sample has been evaluated in accordance with the test procedures and has been in compliance with the applicable technical standards.

The report must not be used by the client to claim product certification, approval, or endorsement by TAF or any agency of government.

The test results in this variant report apply exclusively to the tested model / sample. Without written approval of SPORTON INTERTIONAL INC. EMC & Wireless Communications Laboratory, the test report shall not be reproduced except in full.

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Approved by: Cona Huang / Deputy Manager

SPORTON INTERNATIONAL INC. EMC & Wireless Communications Laboratory
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History of this test report

Report No.	Version	Description	Issued Date
HA890804A	Rev. 01	Initial issue of report	Oct. 26, 2018

1. General Information

Product Feature & Specification	
Applicant Name	Motorola Mobility LLC
Equipment Name	Mobile Cellular Phone
Brand Name	Motorola
FCC ID	IHDT56XP1
HW Version	DVT1B
SW Version	river-userdebug 9 PPO29.62 6ffa8intcfg, test-keys
EUT Stage	Identical Prototype
Date Tested	2018/10/06
Frequency Band	GSM850: 824.2 MHz ~ 848.8 MHz GSM1900: 1850.2 MHz ~ 1909.8 MHz WCDMA Band II: 1852.4 MHz ~ 1907.6 MHz WCDMA Band IV: 1712.4 MHz ~ 1752.6 MHz WCDMA Band V: 826.4 MHz ~ 846.6 MHz CDMA2000 BC0: 824.7 MHz ~ 848.31 MHz CDMA 2000 BC1: 1851.25 MHz ~ 1908.75 MHz CDMA 2000 BC10: 817.9 MHz ~ 823.1 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 7: 2502.5 MHz ~ 2567.5 MHz LTE Band 12: 699.7 MHz ~ 715.3 MHz LTE Band 13: 779.5 MHz ~ 784.5 MHz LTE Band 17: 706.5 MHz ~ 713.5 MHz LTE Band 25: 1850.7 MHz ~ 1914.3 MHz LTE Band 26: 814.7 MHz ~ 848.3 MHz LTE Band 38: 2572.5 MHz ~ 2617.5 MHz LTE Band 41: 2498.5 MHz ~ 2687.5 MHz LTE Band 66: 1710.7 MHz ~ 1779.3 MHz WLAN 2.4GHz Band: 2412 MHz ~ 2462 MHz WLAN 5.2GHz Band: 5180 MHz ~ 5240 MHz WLAN 5.3GHz Band: 5260 MHz ~ 5320 MHz WLAN 5.5GHz Band: 5500 MHz ~ 5700 MHz WLAN 5.8GHz Band: 5745 MHz ~ 5825 MHz Bluetooth: 2402 MHz ~ 2480 MHz
Mode	GSM/GPRS/EGPRS AMR / RMC 12.2Kbps HSDPA HSUPA CDMA2000 : 1xRTT/1xEv-Do(Rev.0)/1xEv-Do(Rev.A) LTE: QPSK, 16QAM 802.11a/b/g/n HT20/HT40 Bluetooth BR/EDR/LE

Reviewed by: Jason Wang
Report Producer: Wan Liu

2. *Testing Location*

Sporton Lab is accredited to ISO 17025 by Taiwan Accreditation Foundation (TAF code: 1190) and the FCC designation No. TW1190 under the FCC 2.948(e) by Mutual Recognition Agreement (MRA) in FCC test.

Testing Laboratory	
Test Site	SPORTON INTERNATIONAL INC.
Test Site Location	No. 52, Huaya 1st Rd., Guishan Dist., Taoyuan City, Taiwan (R.O.C.) TEL: +886-3-327-3456 FAX: +886-3-328-4978
Test Site No.	Sporton Site No.: **SAR04-HY**

3. *Applied Standards*

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

4. *RF Audio Interference Level*

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 5.1 Telephone near-field categories in linear units

5. *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	VD	Yes	WLAN, BT	Google Duo	No
	EDGE1900			WLAN, BT		No
WCDMA	850	VO	No(1)	WLAN, BT	CMRS Voice	No
	1750			WLAN, BT		No
	1900			WLAN, BT		No
	HSPA	VD	No(1)	WLAN, BT	Google Duo	No
CDMA	BC0	VO	Yes	WLAN, BT	CMRS Voice	No
	BC1			WLAN, BT		No
	BC10			WLAN, BT		No
	EVDO	VD	No(1)	WLAN, BT	Google Duo	No
LTE (FDD)	Band 2	VD	No(1)	WLAN, BT	VoLTE / Google Duo	No
	Band 4			WLAN, BT		No
	Band 5			WLAN, BT		No
	Band 7			WLAN, BT		No
	Band 12			WLAN, BT		No
	Band 13			WLAN, BT		No
	Band 17			WLAN, BT		No
	Band 25			WLAN, BT		No
	Band 26			WLAN, BT		No
	Band 66			WLAN, BT		No
LTE (TDD)	Band 38	VD	Yes	WLAN, BT	VoLTE / Google Duo	No
	Band 41			WLAN, BT		No
Wi-Fi	2450	VD	No(1)	GSM,CDMA,WCDMA,LTE	VoWiFi / Google Duo	No
	5200			GSM,CDMA,WCDMA,LTE		No
	5300			GSM,CDMA,WCDMA,LTE		No
	5500			GSM,CDMA,WCDMA,LTE		No
	5800			GSM,CDMA,WCDMA,LTE		No
BT	2450	DT	No	GSM,CDMA,WCDMA,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.
2. The device have similar frequency in some LTE bands: LTE B38/41, since the supported frequency spans for the smaller LTE bands are completely cover by the larger LTE bands, therefore, only larger LTE bands were required to be tested for hearing-aid compliance.

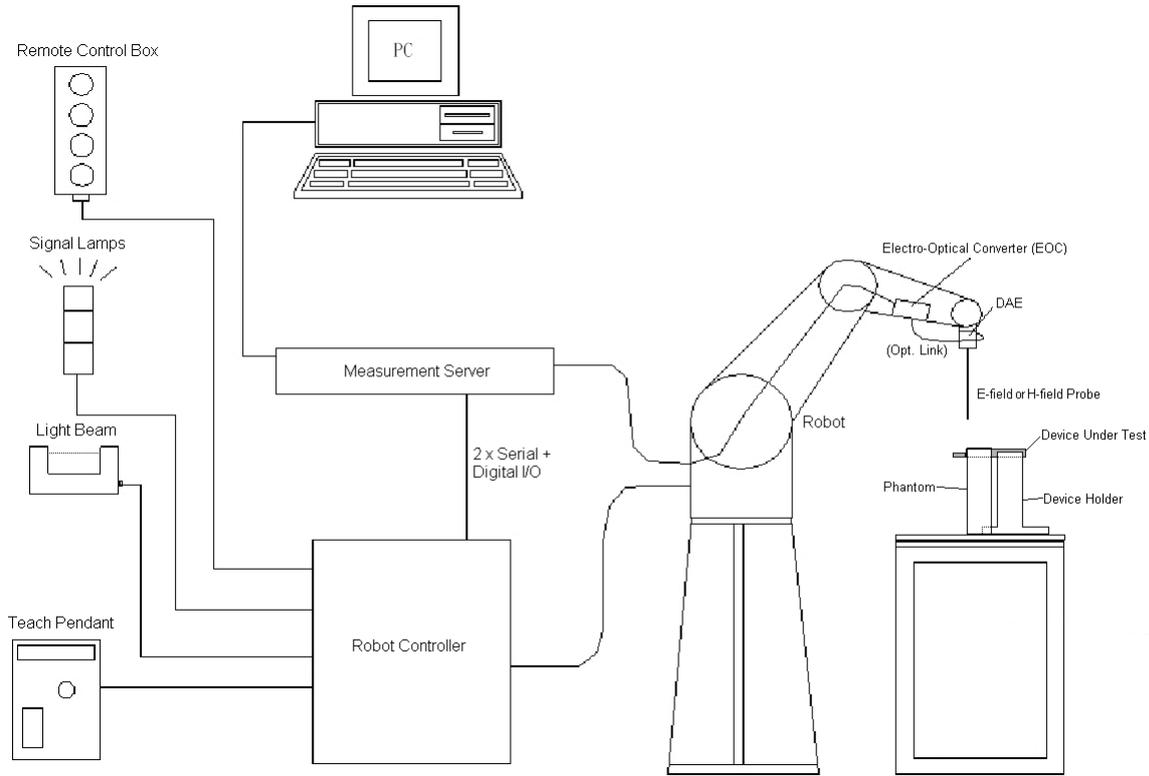# 6. *Measurement System Specification*

Fig 5.1 System Configurations

6.1 *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 5.2 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).

6.2 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：

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

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：

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

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)：

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

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

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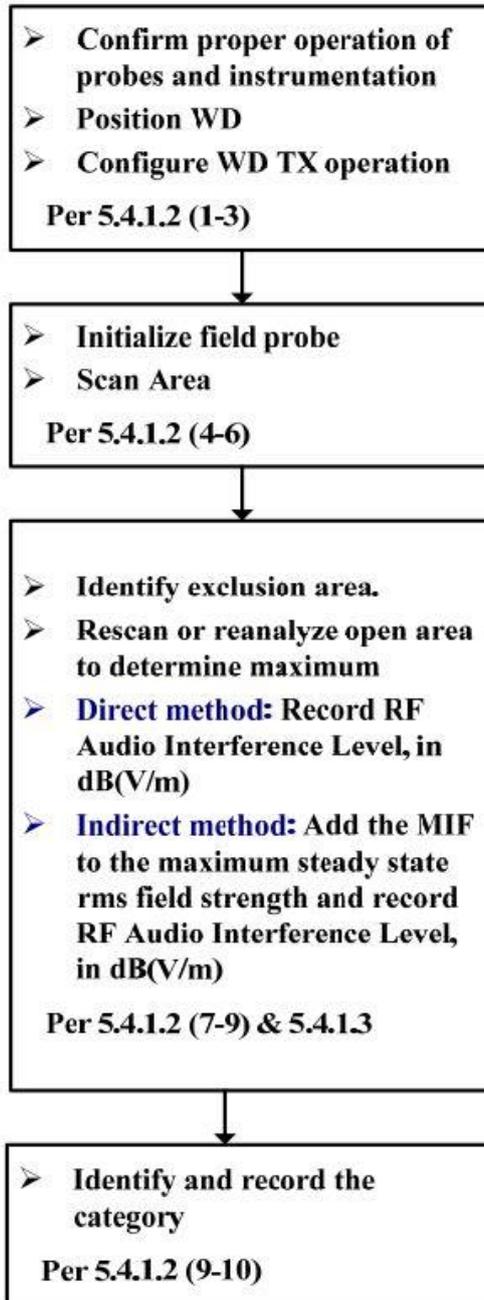
Test Instructions

> - Confirm proper operation of probes and instrumentation
> - Position WD
> - Configure WD TX operation
>
> Per 5.4.1.2 (1-3)

> - Initialize field probe
> - Scan Area
>
> Per 5.4.1.2 (4-6)

> - Identify exclusion area.
> - Rescan or reanalyze open area to determine maximum
> - **Direct method:** Record RF Audio Interference Level, in dB(V/m)
> - **Indirect method:** Add the MIF to the maximum steady state rms field strength and record RF Audio Interference Level, in dB(V/m)
>
> Per 5.4.1.2 (7-9) & 5.4.1.3

> - Identify and record the category
>
> Per 5.4.1.2 (9-10)
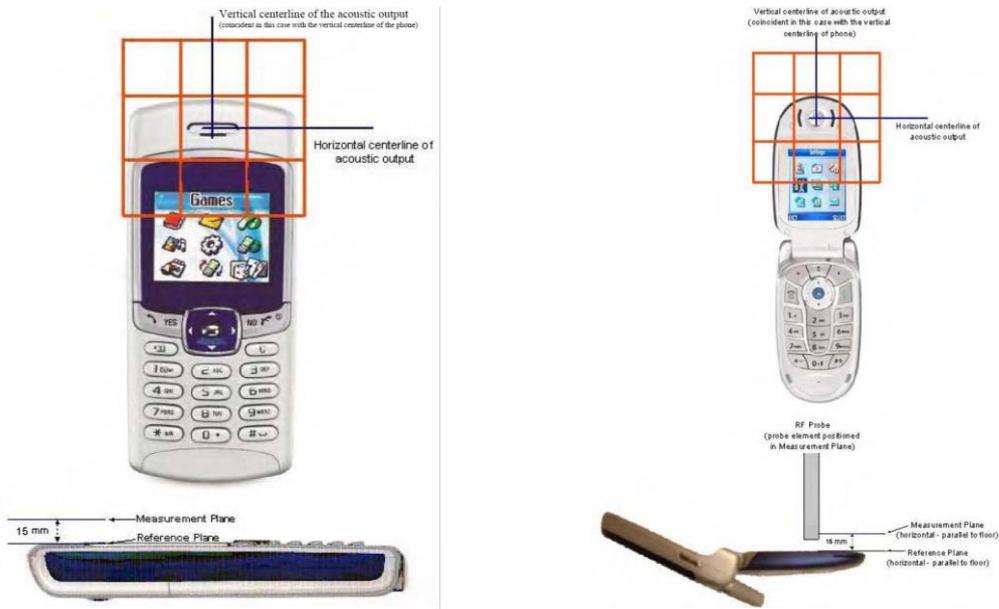
Figure 8.1 RF Emissions Flow Chart

Fig 8.2 EUT reference and plane for HAC RF emission measurements
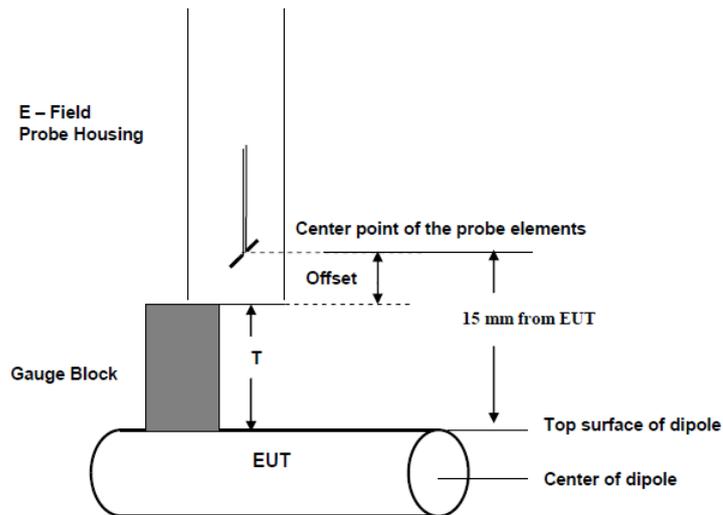

Fig. 8.3 Gauge block with E-field probe

8. *Test Equipment List*

Manufacturer	Name of Equipment	Type/Model	Serial Number	Calibration	
				Last Cal.	Due Date
SPEAG	835MHz Calibration Dipole	CD835V3	1030	Jun. 21, 2018	Jun. 20, 2019
SPEAG	1880MHz Calibration Dipole	CD1880V3	1023	Jun. 21, 2018	Jun. 20, 2019
SPEAG	2600Mhz Calibration Dipole	CD2600V3	1010	Nov. 22, 2017	Nov. 21, 2018
SPEAG	Isotropic E-Field Probe	ER3DV6	2358	Jan. 19, 2018	Jan. 18, 2019
SPEAG	Data Acquisition Electronics	DAE4	854	Jun. 14, 2018	Jun. 13, 2019
Gencom	Thermometer	TE1	TM225-1	Mar. 16, 2018	Mar. 15, 2019
SPEAG	Test Arch Phantom	N/A	N/A	NCR	NCR
SPEAG	Phone Positoiner	N/A	N/A	NCR	NCR
Anritsu	Power Meter	ML2495A	1419002	May. 18, 2018	May. 19, 2019
Anritsu	Power Sensor	MA2411B	1339124	May. 18, 2018	May. 19, 2019
Anritsu	Signal Generator	MG3710A	6201502524	Dec. 07, 2017	Dec. 06, 2018
R&S	Base Station	CMW500	115793	May. 24, 2018	May. 23, 2019
ATM	Dual Directional Coupler	C122H-10	P610410z-02	NCR	NCR
Woken	Attenuator	WK0602-XX	N/A	NCR	NCR
Mini-Circuits	Power Amplifier	ZVE-8G+	6382	Aug. 09, 2018	Aug. 08, 2019
Mini-Circuits	Power Amplifier	ZHL-42W+	15542	Aug. 09, 2018	Aug. 08, 2019

Note:
1. NCR: "No-Calibration Required"

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9. *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.

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.

<u>**<Test Setup>**</u>

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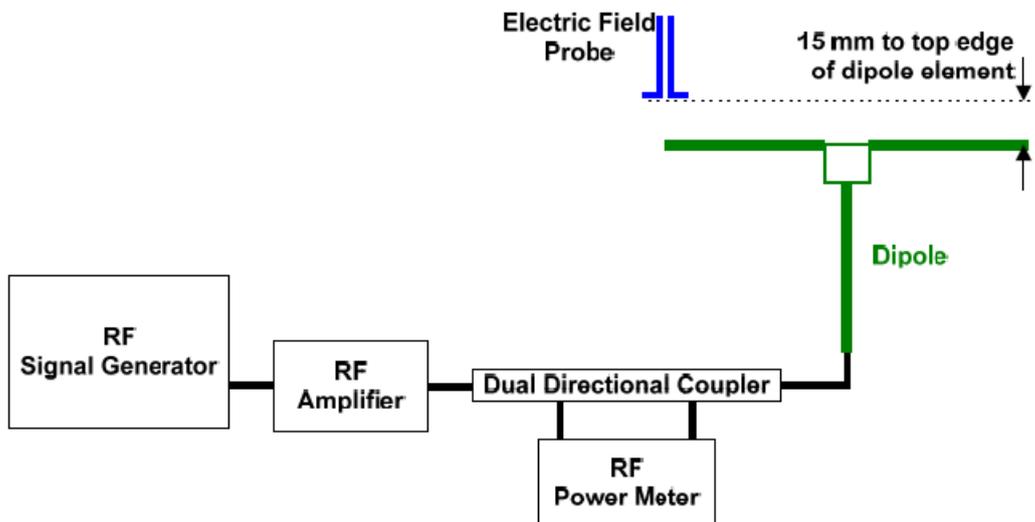

Fig. 7.1 Setup Diagram

<u>**<Validation Results>**</u>

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.

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

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	110.5	109.6	107.6	108.6	-1.72	Oct 06, 2018
1880	20	88.6	91.53	93.41	92.47	4.37	Oct 06, 2018
2600	20	85.4	84.48	92.42	88.45	3.57	Oct 06, 2018

10. *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.

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:

1.   0.2 dB for MIF: -7 to +5 dB
2.   0.5 dB for MIF: -13 to +11 dB
3.   1 dB for MIF: > -20 dB

MIF values applied in this test report were provided by the HAC equipment provider of SPEAG, and the worst values for all air interface are listed below to be determine the Low-power Exemption.

UID	Communication System Name	MIF(dB)
10021	GSM-FDD(TDMA,GMSK)	3.63
10025	EDGE-FDD (TDMA, 8PSK, TN 0)	3.75
10460	UMTS-FDD(WCDMA, AMR)	-25.43
10225	UMTS-FDD (HSPA+)	-20.39
10081	CDMA2000 (1xRTT, RC3)	-19.71
10295	CDMA2000 (1xRTT, RC1 SO3, 1/8th Rate 25 fr.)	3.26
10403	CDMA2000 (1xEV-DO, Rev. 0)	-17.67
10170	LTE-FDD(SC-FDMA,1RB,20MHz,16-QAM)	-9.76
10172	LTE-TDD (SC-FDMA, 1 RB, 20 MHz, QPSK)	-1.62
10173	LTE-TDD (SC-FDMA, 1 RB, 20 MHz, 16-QAM)	-1.44
10061	IEEE 802.11b WiFi 2.4 GHz (DSSS, 11 Mbps)	-2.02
10077	IEEE 802.11g WiFi 2.4 GHz (DSSS/OFDM, 54 Mbps)	0.12
10427	IEEE 802.11n (HT Greeneld, 150 Mbps, 64-QAM)	-13.44
10069	IEEE 802.11a/h WiFi 5 GHz (OFDM, 54 Mbps)	-3.15

11. Low-power Exemption

<Max Tune-up Limit>

Mode		Average Power (dBm)
GSM	GSM850	33.5
	EDGE850	27.5
	GSM1900	30.5
	EDGE1900	27.0
WCDMA	Band II	23.5
	Band IV	23.5
	Band V	23.5
	HSPA	23.5
CDMA	BC0	24.5
	BC1	24.5
	BC10	24.5
FDD LTE	Band 2	23.5
	Band 4	23.5
	Band 5	23.5
	Band 7	23.5
	Band 12	23.5
	Band 13	23.5
	Band 17	23.5
	Band 25	23.5
	Band 26	23.5
	Band 66	23.5
TDD LTE	Band 38	24.0
	Band 41_PC2	26.5
	Band 41_PC3	24.5
2.4GHz WLAN	802.11b	16.5
	802.11g	16.5
	802.11n-HT20	16.5
5GHz WLAN	802.11a	19.0
	802.11n-HT20	19.0
	802.11n-HT40	18.0

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<Low Power Exemption>

Air Interface		Max Average Antenna Input Power (dBm)	Worst Case MIF (dB)	Power + MIF(dB)	C63.19 test required
GSM850		33.5	3.63	37.13	Yes
EDGE850		27.5	3.75	31.25	Yes[1]
GSM1900		30.5	3.63	34.13	Yes
EDGE1900		27.0	3.75	30.75	Yes[1]
WCDMA		23.5	-25.43	-1.93	No
WCDMA - HSPA		23.5	-20.39	3.11	No
CDMA Full Frame Rate		24.5	-19.71	4.79	No
CDMA 1/8th Frame Rate		24.5	3.26	27.76	Yes
CDMA - EVDO		24.5	-17.67	6.83	No
LTE - FDD		23.5	-9.76	13.74	No
LTE – TDD - PC2	QPSK	26.5	-1.62	24.88	Yes
	16QAM	26.0	-1.44	24.56	Yes[1]
LTE – TDD - PC3	QPSK	24.5	-1.62	22.88	Yes
	16QAM	24.0	-1.44	22.56	Yes[1]
802.11b		16.5	-2.02	14.48	No
802.11g		16.5	0.12	16.62	No
802.11n-HT20		16.5	-13.44	3.06	No
802.11a		19.0	-3.15	15.85	No
802.11n-HT20		19.0	-13.44	5.56	No
802.11n-HT40		18.0	-13.44	4.56	No

General Note:
1. EDGE data modes and TDD 16QAM are not necessary due the GSM Voice mode and TDD QPSK are the worst case.
2. According to ANSI C63.19 2011-version, for the 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.
3. HAC RF rating is M4 for the air interface which meets the low power exemption.

12. *Conducted RF Output Power (Unit: dBm)*

Average Antenna Input Power(dBm)						
Band	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)	33.33	32.87	32.90	29.67	29.80	29.67

Band	CDMA BC0			CDMA BC1			CDMA BC10		
TX Channel	1013	384	777	25	600	1175	476	580	684
Frequency (MHz)	824.7	836.52	848.31	1851.25	1880	1908.75	817.9	820.5	823.1
RC1 SO55	24.16	24.17	24.23	24.03	24.03	23.84	24.19	24.25	24.20

<TDD LTE Band 41> (LTE TDD Power Class 3)

BW [MHz]	Modulation	RB Size	RB Offset	Power Low Ch. / Freq.	Power Low Middle Ch. / Freq.	Power Middle Ch. / Freq.	Power High Middle Ch. / Freq.	Power High Ch. / Freq.
Channel				39750	40185	40620	41055	41490
Frequency (MHz)				2506	2549.5	2593	2636.5	2680
20	QPSK	1	0	24.26	24.36	24.28	24.38	24.23

<TDD LTE Band 41> (LTE TDD Power Class 2)

BW [MHz]	Modulation	RB Size	RB Offset	Power Low Ch. / Freq.	Power Low Middle Ch. / Freq.	Power Middle Ch. / Freq.	Power High Middle Ch. / Freq.	Power High Ch. / Freq.
Channel				39750	40185	40620	41055	41490
Frequency (MHz)				2506	2549.5	2593	2636.5	2680
20	QPSK	1	0	26.10	25.89	26.00	25.97	25.75

13. *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	33.33	3.63	36.52	8.48	M4
2	GSM850	GSM Voice	189	32.87	3.63	37.30	7.70	M4
3	GSM850	GSM Voice	251	32.90	3.63	36.34	8.66	M4
4	GSM1900	GSM Voice	512	29.67	3.63	24.88	10.12	M4
5	GSM1900	GSM Voice	661	29.80	3.63	25.07	9.93	M4
6	GSM1900	GSM Voice	810	29.67	3.63	26.10	8.90	M4
7	CDMA BC0	1xRTT, RC1 SO3, 1/8th Rate	1013	24.16	3.26	29.66	15.34	M4
8	CDMA BC0	1xRTT, RC1 SO3, 1/8th Rate	384	24.17	3.26	30.17	14.83	M4
9	CDMA BC0	1xRTT, RC1 SO3, 1/8th Rate	777	24.23	3.26	27.93	17.07	M4
10	CDMA BC1	1xRTT, RC1 SO3, 1/8th Rate	25	24.03	3.26	20.12	14.88	M4
11	CDMA BC1	1xRTT, RC1 SO3, 1/8th Rate	600	24.03	3.26	20.05	14.95	M4
12	CDMA BC1	1xRTT, RC1 SO3, 1/8th Rate	1175	23.84	3.26	19.90	15.10	M4
13	CDMA BC10	1xRTT, RC1 SO3, 1/8th Rate	476	24.19	3.26	28.93	16.07	M4
14	CDMA BC10	1xRTT, RC1 SO3, 1/8th Rate	580	24.25	3.26	29.16	15.84	M4
15	CDMA BC10	1xRTT, RC1 SO3, 1/8th Rate	684	24.20	3.26	29.72	15.28	M4
16	LTE Band 41_PC3	20M_QPSK_1RB_0Offset	39750	24.26	-1.62	25.94	9.06	M4
17	LTE Band 41_PC3	20M_QPSK_1RB_0Offset	40185	24.36	-1.62	26.16	8.84	M4
18	LTE Band 41_PC3	20M_QPSK_1RB_0Offset	40620	24.28	-1.62	26.35	8.65	M4
19	LTE Band 41_PC3	20M_QPSK_1RB_0Offset	41055	24.38	-1.62	24.68	10.32	M4
20	LTE Band 41_PC3	20M_QPSK_1RB_0Offset	41490	24.23	-1.62	25.80	9.20	M4
21	LTE Band 41_PC2	20M_QPSK_1RB_0Offset	39750	26.10	-1.62	25.23	9.77	M4
22	LTE Band 41_PC2	20M_QPSK_1RB_0Offset	40185	25.89	-1.62	25.49	9.51	M4
23	LTE Band 41_PC2	20M_QPSK_1RB_0Offset	40620	26.00	-1.62	25.86	9.14	M4
24	LTE Band 41_PC2	20M_QPSK_1RB_0Offset	41055	25.97	-1.62	25.97	9.03	M4
25	LTE Band 41_PC2	20M_QPSK_1RB_0Offset	41490	25.75	-1.62	25.83	9.17	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. Phone Condition: Mute on; Backlight off; Max Volume

Test Engineer：Steven Chang.

14. *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 Distribution	Divisor	Ci (E)	Standard Uncertainty (E)
Measurement System					
Probe Calibration	5.1	Normal	1	1	± 5.1 %
Axial Isotropy	4.7	Rectangular	$\sqrt{3}$	1	± 2.7 %
Sensor Displacement	16.5	Rectangular	$\sqrt{3}$	1	± 9.5 %
Boundary Effects	2.4	Rectangular	$\sqrt{3}$	1	± 1.4 %
Phantom Boundary Effects	7.2	Rectangular	$\sqrt{3}$	1	± 4.1 %
Linearity	4.7	Rectangular	$\sqrt{3}$	1	± 2.7 %
Scaling with PMR Calibration	10.0	Rectangular	$\sqrt{3}$	1	± 5.77 %
System Detection Limit	1.0	Rectangular	$\sqrt{3}$	1	± 0.6 %
Readout Electronics	0.3	Normal	1	1	± 0.3 %
Response Time	0.8	Rectangular	$\sqrt{3}$	1	± 0.5 %
Integration Time	2.6	Rectangular	$\sqrt{3}$	1	± 1.5 %
RF Ambient Conditions	3.0	Rectangular	$\sqrt{3}$	1	± 1.7 %
RF Reflections	12.0	Rectangular	$\sqrt{3}$	1	± 6.9 %
Probe Positioner	1.2	Rectangular	$\sqrt{3}$	1	± 0.7 %
Probe Positioning	4.7	Rectangular	$\sqrt{3}$	1	± 2.7 %
Extrap. and Interpolation	1.0	Rectangular	$\sqrt{3}$	1	± 0.6 %
Test Sample Related					
Device Positioning Vertical	4.7	Rectangular	$\sqrt{3}$	1	± 2.7 %
Device Positioning Lateral	1.0	Rectangular	$\sqrt{3}$	1	± 0.6 %
Device Holder and Phantom	2.4	Rectangular	$\sqrt{3}$	1	± 1.4 %
Power Drift	5.0	Rectangular	$\sqrt{3}$	1	± 2.9 %
Phantom and Setup Related					
Phantom Thickness	2.4	Rectangular	$\sqrt{3}$	1	± 1.4 %
Combined Standard Uncertainty					± 16.30 %
Coverage Factor for 95 %					K = 2
Expanded Std. Uncertainty on Power					**± 32.6 %**
Expanded Std. Uncertainty on Field					**± 16.3 %**

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.

15. 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_181006

DUT: HAC-Dipole 835 MHz

Communication System: CW; Frequency: 835 MHz;Duty Cycle: 1:1
Medium: Air Medium parameters used: σ = 0 S/m, $ε_r$ = 1; ρ = 0 kg/m^3
Ambient Temperature：23.2 ℃

DASY5 Configuration:
- Probe: ER3DV6 - SN2358; ConvF(1, 1, 1); Calibrated: 2018/1/19;
- Sensor-Surface: (Fix Surface)
- Electronics: DAE4 Sn854; Calibrated: 2018/6/14
- Phantom: HAC Test Arch with AMCC; Type: SD HAC P01 BA;
- Measurement SW: DASY52, Version 52.10 (0);SEMCAD X Version 14.6.10 (7417)

E Scan - measurement distance from the probe sensor center to CD835 = 10mm & 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 = 123.4 V/m; Power Drift = -0.07 dB
PMR not calibrated. PMF = 1.000 is applied.
E-field emissions = 109.6 V/m
Average value of Total=(109.6+107.6) / 2 = 108.6 V/m

PMF scaled E-field

Grid 1 **M4** 106.1 V/m	Grid 2 **M4** 109.6 V/m	Grid 3 **M4** 108.3 V/m
Grid 4 **M4** 62.70 V/m	Grid 5 **M4** 63.77 V/m	Grid 6 **M4** 63.09 V/m
Grid 7 **M4** 106.0 V/m	Grid 8 **M4** 107.6 V/m	Grid 9 **M4** 106.0 V/m

Cursor:
Total = 109.6 V/m
E Category: M4
Location: -1, -75.5, 9.7 mm
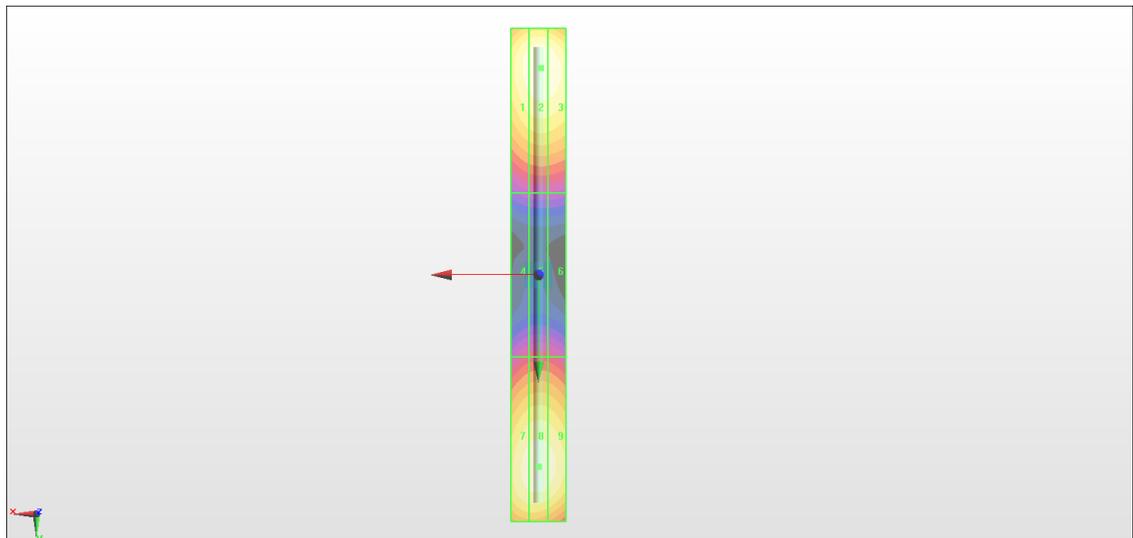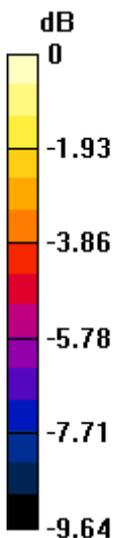
0 dB = 109.6 V/m = 40.80 dBV/m

HAC_E_Dipole_1880_181006

DUT: HAC Dipole 1880 MHz

Communication System: 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：23.2 ℃

DASY5 Configuration:
- Probe: ER3DV6 - SN2358; ConvF(1, 1, 1); Calibrated: 2018/1/19;
- Sensor-Surface: (Fix Surface)
- Electronics: DAE4 Sn854; Calibrated: 2018/6/14
- Phantom: HAC Test Arch with AMCC; Type: SD HAC P01 BA;
- Measurement SW: DASY52, Version 52.10 (0);SEMCAD X Version 14.6.10 (7417)

E Scan - measurement distance from the probe sensor center to CD1880 = 10mm & 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 = 145.0 V/m; Power Drift = 0.10 dB

PMR not calibrated. PMF = 1.000 is applied.

E-field emissions = 93.41 V/m

Average value of Total=(91.53+93.41) / 2 = 92.47 V/m

PMF scaled E-field

Grid 1 **M3** 90.26 V/m	Grid 2 **M3** 91.53 V/m	Grid 3 **M3** 90.07 V/m
Grid 4 **M3** 70.92 V/m	Grid 5 **M3** 72.30 V/m	Grid 6 **M3** 71.53 V/m
Grid 7 **M3** 91.64 V/m	Grid 8 **M3** 93.41 V/m	Grid 9 **M3** 91.47 V/m

Cursor:
Total = 93.41 V/m
E Category: M3
Location: 0, 31, 9.7 mm
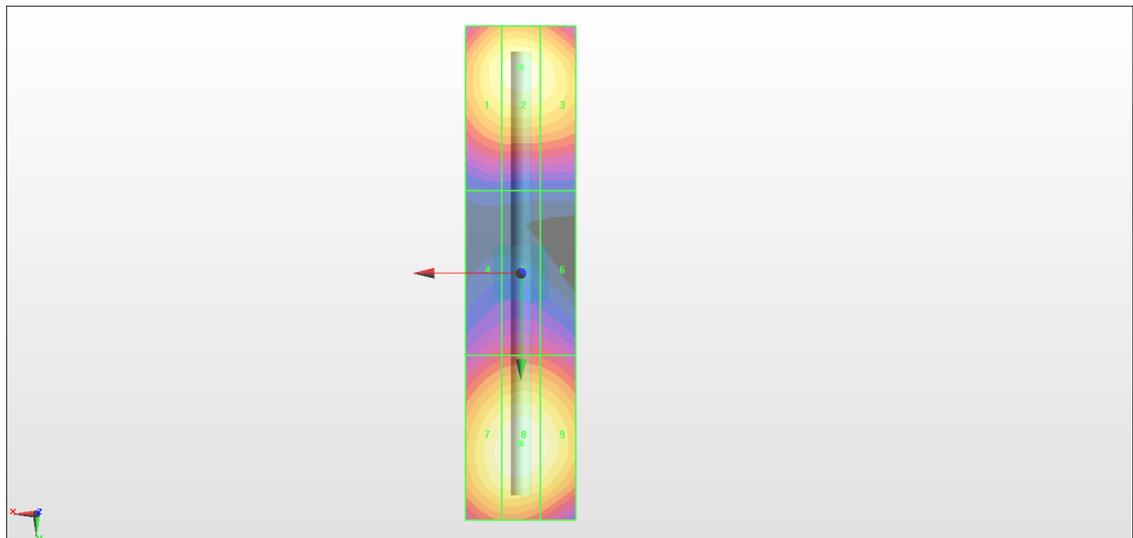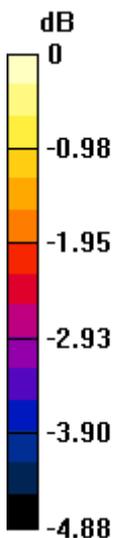
0 dB = 93.41 V/m = 39.41 dBV/m

HAC_E_Dipole_2600_181006

DUT: HAC Dipole 2600 MHz

Communication System: CW ; Frequency: 2600 MHz;Duty Cycle: 1:1

Medium: Air Medium parameters used: σ = 0 S/m, ε$_r$ = 1; ρ = 0 kg/m^3

Ambient Temperature：23.2 ℃

DASY5 Configuration:
- Probe: ER3DV6 - SN2358; ConvF(1, 1, 1); Calibrated: 2018/1/19;
- Sensor-Surface: (Fix Surface)
- Electronics: DAE4 Sn854; Calibrated: 2018/6/14
- Phantom: HAC Test Arch with AMCC; Type: SD HAC P01 BA;
- Measurement SW: DASY52, Version 52.10 (0);SEMCAD X Version 14.6.10 (7417)

E Scan - measurement distance from the probe sensor center to CD2600 = 10mm & 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 = 72.65 V/m; Power Drift = 0.01 dB

PMR not calibrated. PMF = 1.000 is applied.

E-field emissions = 92.42 V/m

Average value of Total=(84.48+92.42) / 2 = 88.45 V/m

PMF scaled E-field

Grid 1 **M3** 83.96 V/m	Grid 2 **M3** 84.48 V/m	Grid 3 **M3** 82.68 V/m
Grid 4 **M3** 87.60 V/m	Grid 5 **M3** 89.30 V/m	Grid 6 **M3** 88.26 V/m
Grid 7 **M3** 90.82 V/m	Grid 8 **M3** 92.42 V/m	Grid 9 **M3** 91.00 V/m

Cursor:
Total = 92.42 V/m
E Category: M3
Location: 0, 20, 9.7 mm
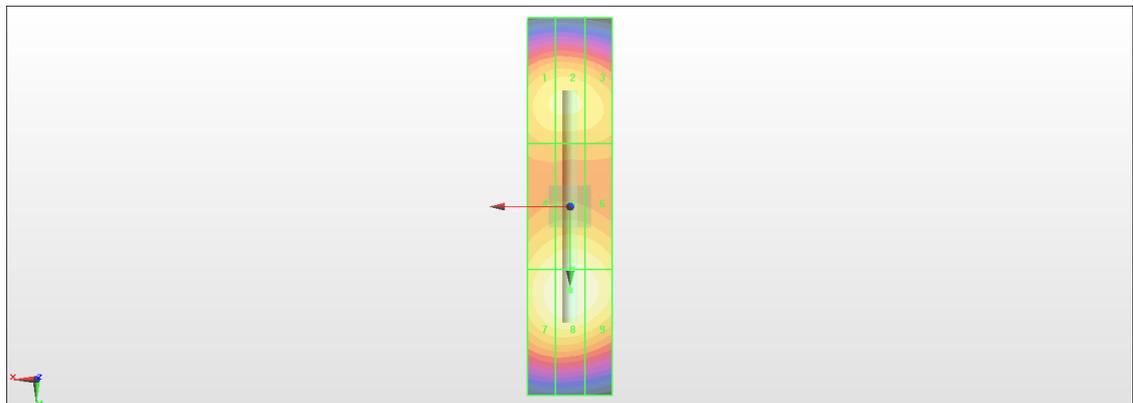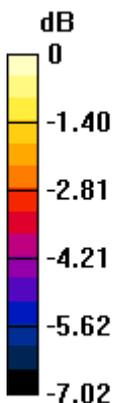
0 dB = 92.42 V/m = 39.32 dBV/m

Appendix B.   Plots of RF Emission Measurement

The plots are shown as follows.

#01_HAC_E_GSM850_GSM Voice_Ch128

Communication System: GSM-FDD (TDMA, GMSK); Frequency: 824.2 MHz;Duty Cycle: 1:8.6896

Medium: Air Medium parameters used: $\sigma = 0$ S/m, $\varepsilon_r = 1$; $\rho = 0$ kg/m^3

Ambient Temperature：23.2 ℃

DASY5 Configuration:
- Probe: ER3DV6 - SN2358; ConvF(1, 1, 1); Calibrated: 2018/1/19;
- Sensor-Surface: (Fix Surface)
- Electronics: DAE4 Sn854; Calibrated: 2018/6/14
- Phantom: HAC Test Arch with AMCC; Type: SD HAC P01 BA;
- Measurement SW: DASY52, Version 52.10 (0);SEMCAD X Version 14.6.10 (7417)

E Scan - ER3D: 15 mm from Probe Center to the Device/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 = 52.59 V/m; Power Drift = -0.07 dB

Applied MIF = 3.63 dB

RF audio interference level = 36.52 dBV/m

**Emission category: M4**

MIF scaled E-field

Grid 1 **M4** **36.18 dBV/m**	Grid 2 **M4** **36.52 dBV/m**	Grid 3 **M4** **35.91 dBV/m**
Grid 4 **M4** **35.63 dBV/m**	Grid 5 **M4** **36 dBV/m**	Grid 6 **M4** **35.64 dBV/m**
Grid 7 **M4** **35.12 dBV/m**	Grid 8 **M4** **35.47 dBV/m**	Grid 9 **M4** **34.83 dBV/m**

Cursor:
Total = 36.52 dBV/m
E Category: M4
Location: 4, -25, 8.7 mm
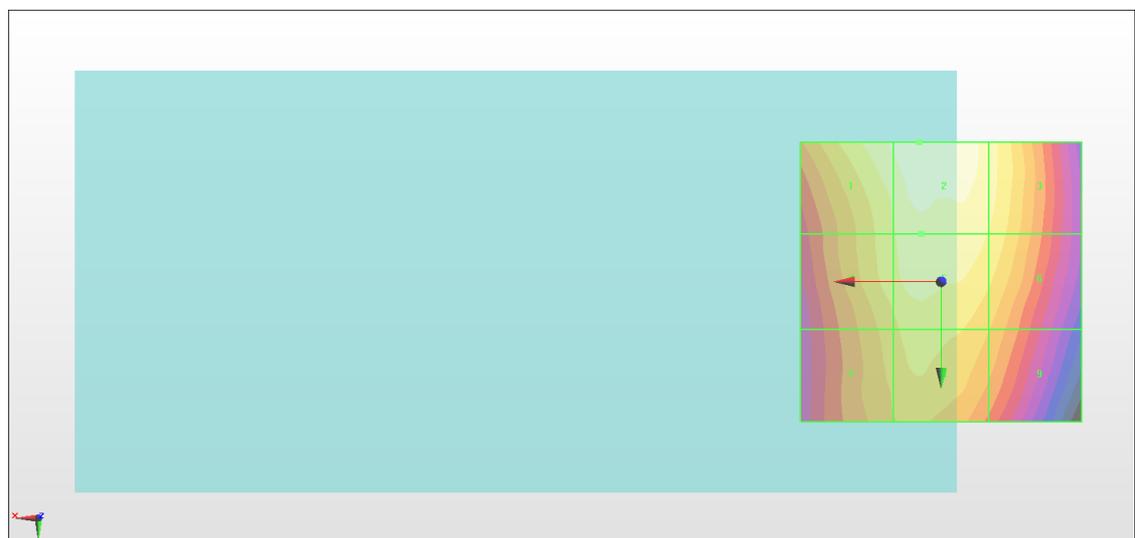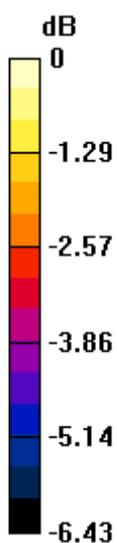
0 dB = 67.00 V/m = 36.52 dBV/m

#02_HAC_E_GSM850_GSM Voice_Ch189

Communication System: GSM-FDD (TDMA, GMSK); Frequency: 836.4 MHz;Duty Cycle: 1:8.6896

Medium: Air Medium parameters used: $\sigma = 0$ S/m, $\varepsilon_r = 1$; $\rho = 0$ kg/m^3

Ambient Temperature：23.2 ℃

DASY5 Configuration:
- Probe: ER3DV6 - SN2358; ConvF(1, 1, 1); Calibrated: 2018/1/19;
- Sensor-Surface: (Fix Surface)
- Electronics: DAE4 Sn854; Calibrated: 2018/6/14
- Phantom: HAC Test Arch with AMCC; Type: SD HAC P01 BA;
- Measurement SW: DASY52, Version 52.10 (0);SEMCAD X Version 14.6.10 (7417)

E Scan - ER3D: 15 mm from Probe Center to the Device/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 = 53.14 V/m; Power Drift = 0.11 dB

Applied MIF = 3.63 dB

RF audio interference level = 37.30 dBV/m

**Emission category: M4**

MIF scaled E-field

Grid 1 **M4** **36.82 dBV/m**	Grid 2 **M4** **37.3 dBV/m**	Grid 3 **M4** **36.74 dBV/m**
Grid 4 **M4** **35.92 dBV/m**	Grid 5 **M4** **36.57 dBV/m**	Grid 6 **M4** **36.24 dBV/m**
Grid 7 **M4** **35.11 dBV/m**	Grid 8 **M4** **35.69 dBV/m**	Grid 9 **M4** **35.22 dBV/m**

Cursor:
Total = 37.30 dBV/m
E Category: M4
Location: 0, -25, 8.7 mm
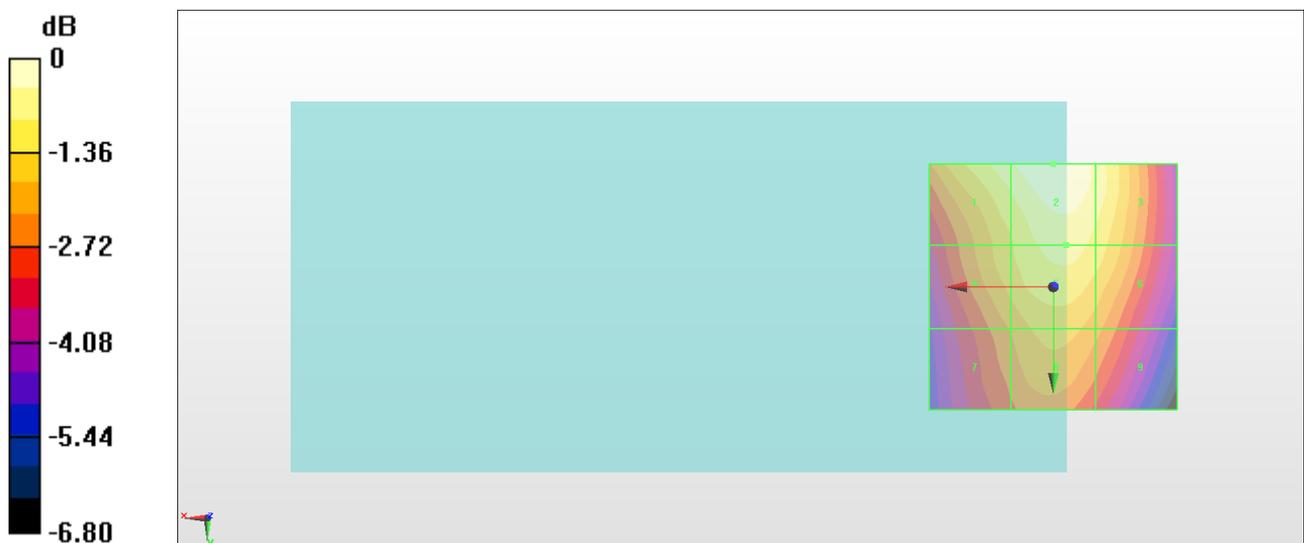
0 dB = 73.32 V/m = 37.30 dBV/m

#03_HAC_E_GSM850_GSM Voice_Ch251

Communication System: GSM-FDD (TDMA, GMSK); Frequency: 848.8 MHz;Duty Cycle: 1:8.6896

Medium: Air Medium parameters used: $\sigma = 0$ S/m, $\varepsilon_r = 1$; $\rho = 0$ kg/m^3

Ambient Temperature：23.2 ℃

DASY5 Configuration:
- Probe: ER3DV6 - SN2358; ConvF(1, 1, 1); Calibrated: 2018/1/19;
- Sensor-Surface: (Fix Surface)
- Electronics: DAE4 Sn854; Calibrated: 2018/6/14
- Phantom: HAC Test Arch with AMCC; Type: SD HAC P01 BA;
- Measurement SW: DASY52, Version 52.10 (0);SEMCAD X Version 14.6.10 (7417)

E Scan - ER3D: 15 mm from Probe Center to the Device/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 = 49.60 V/m; Power Drift = -0.09 dB

Applied MIF = 3.63 dB

RF audio interference level = 36.34 dBV/m

**Emission category: M4**

MIF scaled E-field

Grid 1 **M4** **35.69 dBV/m**	Grid 2 **M4** **36.34 dBV/m**	Grid 3 **M4** **35.9 dBV/m**
Grid 4 **M4** **34.78 dBV/m**	Grid 5 **M4** **35.66 dBV/m**	Grid 6 **M4** **35.42 dBV/m**
Grid 7 **M4** **34 dBV/m**	Grid 8 **M4** **34.79 dBV/m**	Grid 9 **M4** **34.47 dBV/m**

Cursor:
Total = 36.34 dBV/m
E Category: M4
Location: -1.5, -25, 8.7 mm
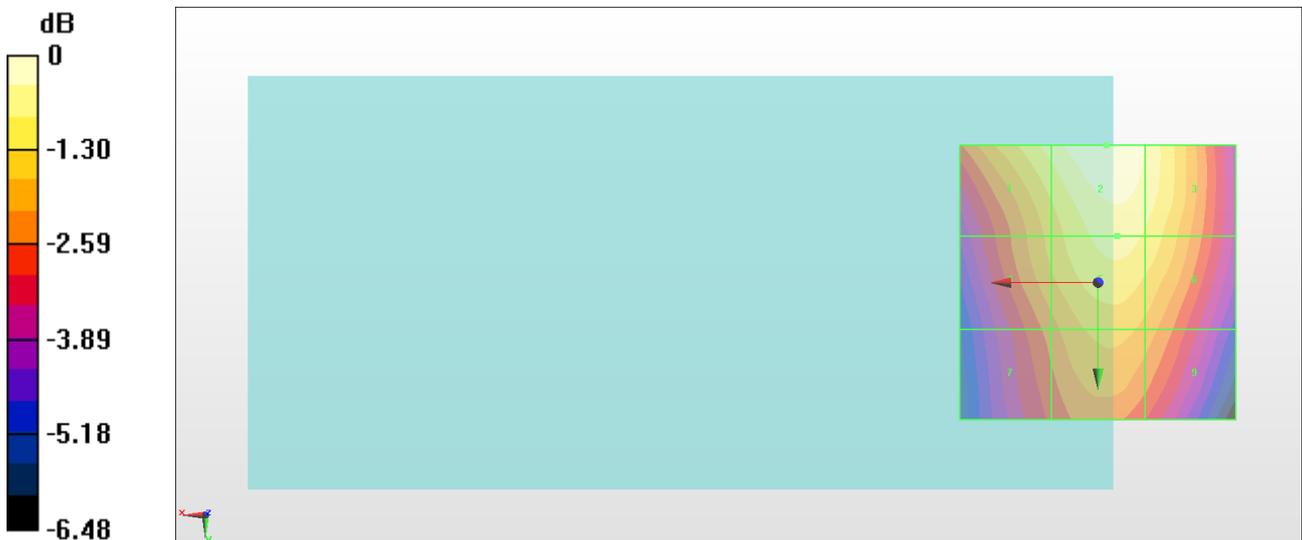
0 dB = 65.65 V/m = 36.34 dBV/m

#04_HAC_E_GSM1900_GSM Voice_Ch512

Communication System: GSM-FDD (TDMA, GMSK); Frequency: 1850.2 MHz;Duty Cycle: 1:8.6896

Medium: Air Medium parameters used: $\sigma = 0$ S/m, $\varepsilon_r = 1$; $\rho = 0$ kg/m^3

Ambient Temperature：23.2 ℃

DASY5 Configuration:
- Probe: ER3DV6 - SN2358; ConvF(1, 1, 1); Calibrated: 2018/1/19;
- Sensor-Surface: (Fix Surface)
- Electronics: DAE4 Sn854; Calibrated: 2018/6/14
- Phantom: HAC Test Arch with AMCC; Type: SD HAC P01 BA;
- Measurement SW: DASY52, Version 52.10 (0);SEMCAD X Version 14.6.10 (7417)

E Scan - ER3D: 15 mm from Probe Center to the Device/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 = 5.690 V/m; Power Drift = -0.08 dB

Applied MIF = 3.63 dB

RF audio interference level = 24.88 dBV/m

Emission category: M4

MIF scaled E-field

Grid 1 **M4** **24.43 dBV/m**	Grid 2 **M4** **24.88 dBV/m**	Grid 3 **M4** **24.1 dBV/m**
Grid 4 **M4** **19.81 dBV/m**	Grid 5 **M4** **20.43 dBV/m**	Grid 6 **M4** **20.24 dBV/m**
Grid 7 **M4** **21.85 dBV/m**	Grid 8 **M4** **22.25 dBV/m**	Grid 9 **M4** **21.41 dBV/m**

Cursor:
Total = 24.88 dBV/m
E Category: M4
Location: 0.5, -25, 8.7 mm
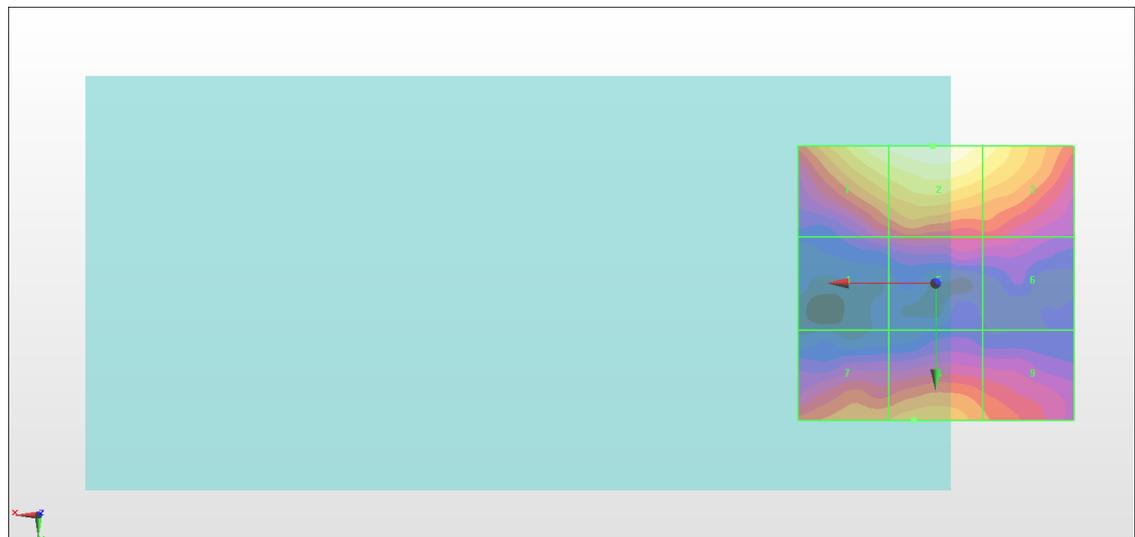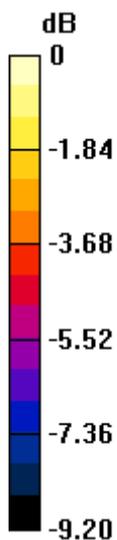
0 dB = 17.54 V/m = 24.88 dBV/m

#05_HAC_E_GSM1900_GSM Voice_Ch661

Communication System: GSM-FDD (TDMA, GMSK); Frequency: 1880 MHz;Duty Cycle: 1:8.6896

Medium: Air Medium parameters used: $\sigma = 0$ S/m, $\varepsilon_r = 1$; $\rho = 0$ kg/m^3

Ambient Temperature：23.2 ℃

DASY5 Configuration:
- Probe: ER3DV6 - SN2358; ConvF(1, 1, 1); Calibrated: 2018/1/19;
- Sensor-Surface: (Fix Surface)
- Electronics: DAE4 Sn854; Calibrated: 2018/6/14
- Phantom: HAC Test Arch with AMCC; Type: SD HAC P01 BA;
- Measurement SW: DASY52, Version 52.10 (0);SEMCAD X Version 14.6.10 (7417)

E Scan - ER3D: 15 mm from Probe Center to the Device/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 = 6.201 V/m; Power Drift = -0.08 dB

Applied MIF = 3.63 dB

RF audio interference level = 25.07 dBV/m

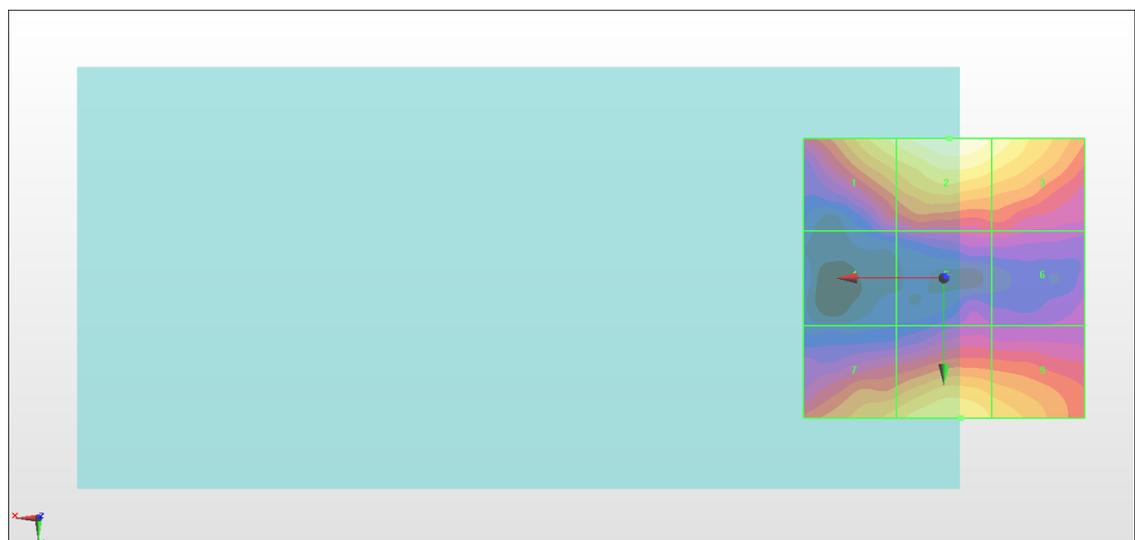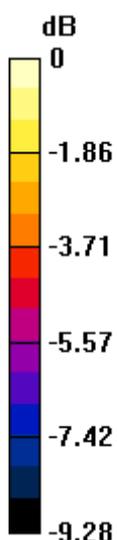**Emission category: M4**

MIF scaled E-field

Grid 1 **M4** **24.13 dBV/m**	Grid 2 **M4** **25.07 dBV/m**	Grid 3 **M4** **24.46 dBV/m**
Grid 4 **M4** **19.1 dBV/m**	Grid 5 **M4** **20.12 dBV/m**	Grid 6 **M4** **20.15 dBV/m**
Grid 7 **M4** **22.95 dBV/m**	Grid 8 **M4** **23.68 dBV/m**	Grid 9 **M4** **23.2 dBV/m**

Cursor:
Total = 25.07 dBV/m
E Category: M4
Location: -1, -25, 8.7 mm

0 dB = 17.93 V/m = 25.07 dBV/m

#06_HAC_E_GSM1900_GSM Voice_Ch810

Communication System: GSM-FDD (TDMA, GMSK); Frequency: 1909.8 MHz;Duty Cycle: 1:8.6896

Medium: Air Medium parameters used: $\sigma = 0$ S/m, $\varepsilon_r = 1$; $\rho = 0$ kg/m^3

Ambient Temperature：23.2 ℃

DASY5 Configuration:
- Probe: ER3DV6 - SN2358; ConvF(1, 1, 1); Calibrated: 2018/1/19;
- Sensor-Surface: (Fix Surface)
- Electronics: DAE4 Sn854; Calibrated: 2018/6/14
- Phantom: HAC Test Arch with AMCC; Type: SD HAC P01 BA;
- Measurement SW: DASY52, Version 52.10 (0);SEMCAD X Version 14.6.10 (7417)

E Scan - ER3D: 15 mm from Probe Center to the Device/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 = 6.691 V/m; Power Drift = -0.08 dB

Applied MIF = 3.63 dB

RF audio interference level = 26.10 dBV/m

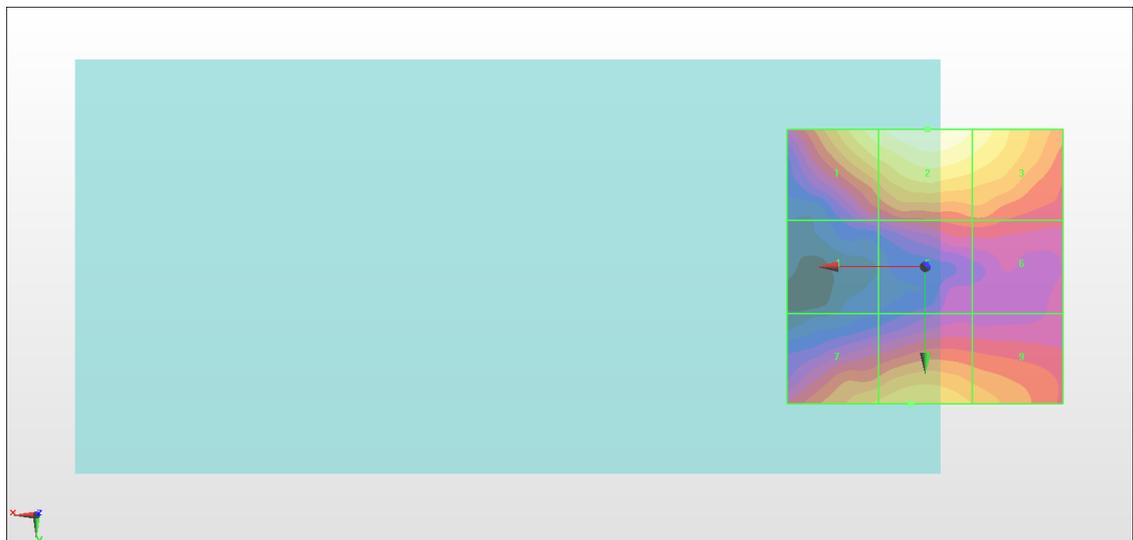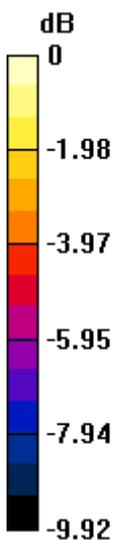**Emission category: M4**

MIF scaled E-field

Grid 1 **M4** **25.29 dBV/m**	Grid 2 **M4** **26.1 dBV/m**	Grid 3 **M4** **25.48 dBV/m**
Grid 4 **M4** **20.36 dBV/m**	Grid 5 **M4** **21.96 dBV/m**	Grid 6 **M4** **21.99 dBV/m**
Grid 7 **M4** **23.65 dBV/m**	Grid 8 **M4** **24.07 dBV/m**	Grid 9 **M4** **23.46 dBV/m**

Cursor:
Total = 26.10 dBV/m
E Category: M4
Location: -0.5, -25, 8.7 mm

0 dB = 20.17 V/m = 26.09 dBV/m

#07_HAC_E_CDMA BC0_ 1xRTT, RC1 SO3_Ch1013

Communication System: CDMA2000, RC1, SO3, 1/8th Rate; Frequency: 824.7 MHz;Duty Cycle: 1:17.7419

Medium: Air Medium parameters used: $\sigma = 0$ S/m, $\varepsilon_r = 1$; $\rho = 0$ kg/m^3

Ambient Temperature：23.2 ℃

DASY5 Configuration:
- Probe: ER3DV6 - SN2358; ConvF(1, 1, 1); Calibrated: 2018/1/19;
- Sensor-Surface: (Fix Surface)
- Electronics: DAE4 Sn854; Calibrated: 2018/6/14
- Phantom: HAC Test Arch with AMCC; Type: SD HAC P01 BA;
- Measurement SW: DASY52, Version 52.10 (0);SEMCAD X Version 14.6.10 (7417)

E Scan - ER3D: 15 mm from Probe Center to the Device/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 = 20.29 V/m; Power Drift = 0.06 dB

Applied MIF = 3.26 dB

RF audio interference level = 29.66 dBV/m
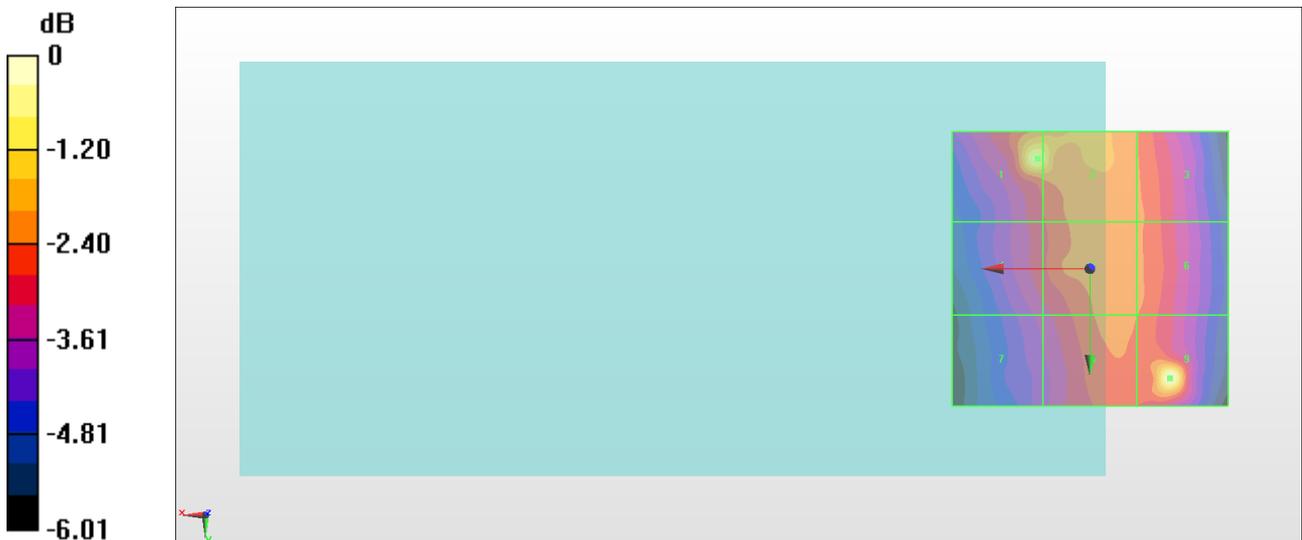
Emission category: M4

MIF scaled E-field

Grid 1 **M4** **29.02 dBV/m**	Grid 2 **M4** **28.72 dBV/m**	Grid 3 **M4** **27.38 dBV/m**
Grid 4 **M4** **26.82 dBV/m**	Grid 5 **M4** **27.63 dBV/m**	Grid 6 **M4** **27.38 dBV/m**
Grid 7 **M4** **26.28 dBV/m**	Grid 8 **M4** **27.49 dBV/m**	Grid 9 **M4** **29.66 dBV/m**

Cursor:
Total = 29.66 dBV/m
E Category: M4
Location: -14.5, 20, 8.7 mm

0 dB = 30.42 V/m = 29.66 dBV/m

#08_HAC_E_CDMA BC0_ 1xRTT, RC1 SO3_Ch384

Communication System: CDMA2000, RC1, SO3, 1/8th Rate; Frequency: 836.52 MHz;Duty Cycle: 1:17.7419

Medium: Air Medium parameters used: $\sigma = 0$ S/m, $\varepsilon_r = 1$; $\rho = 0$ kg/m^3

Ambient Temperature：23.2 ℃

DASY5 Configuration:
- Probe: ER3DV6 - SN2358; ConvF(1, 1, 1); Calibrated: 2018/1/19;
- Sensor-Surface: (Fix Surface)
- Electronics: DAE4 Sn854; Calibrated: 2018/6/14
- Phantom: HAC Test Arch with AMCC; Type: SD HAC P01 BA;
- Measurement SW: DASY52, Version 52.10 (0);SEMCAD X Version 14.6.10 (7417)

E Scan - ER3D: 15 mm from Probe Center to the Device/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 = 19.04 V/m; Power Drift = -0.08 dB
Applied MIF = 3.26 dB
RF audio interference level = 30.17 dBV/m
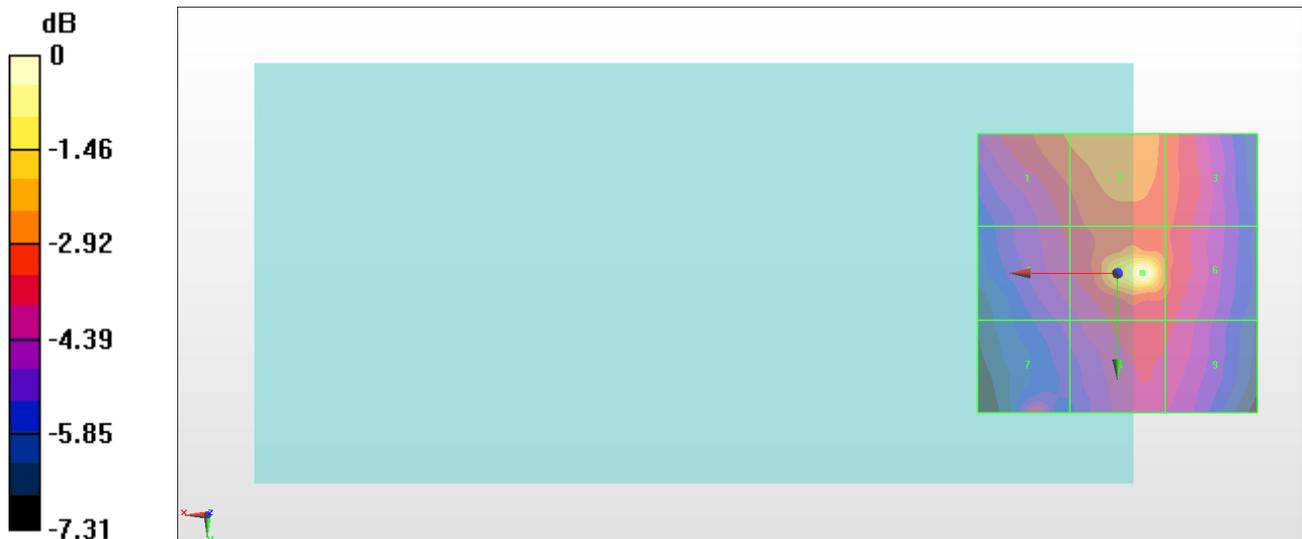**Emission category: M4**

MIF scaled E-field

Grid 1 **M4**	Grid 2 **M4**	Grid 3 **M4**
27.35 dBV/m	**27.75 dBV/m**	**27.15 dBV/m**
Grid 4 **M4**	Grid 5 **M4**	Grid 6 **M4**
26.45 dBV/m	**30.17 dBV/m**	**27.25 dBV/m**
Grid 7 **M4**	Grid 8 **M4**	Grid 9 **M4**
26.66 dBV/m	**26.67 dBV/m**	**26.46 dBV/m**

Cursor:
Total = 30.17 dBV/m
E Category: M4
Location: -4.5, 0, 8.7 mm

0 dB = 32.24 V/m = 30.17 dBV/m

#09_HAC_E_CDMA BC0_ 1xRTT, RC1 SO3_Ch777

Communication System: CDMA2000, RC1, SO3, 1/8th Rate; Frequency: 848.31 MHz;Duty Cycle: 1:17.7419

Medium: Air Medium parameters used: $\sigma = 0$ S/m, $\varepsilon_r = 1$; $\rho = 0$ kg/m^3

Ambient Temperature：23.2 ℃

DASY5 Configuration:
- Probe: ER3DV6 - SN2358; ConvF(1, 1, 1); Calibrated: 2018/1/19;
- Sensor-Surface: (Fix Surface)
- Electronics: DAE4 Sn854; Calibrated: 2018/6/14
- Phantom: HAC Test Arch with AMCC; Type: SD HAC P01 BA;
- Measurement SW: DASY52, Version 52.10 (0);SEMCAD X Version 14.6.10 (7417)

E Scan - ER3D: 15 mm from Probe Center to the Device/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 = 18.84 V/m; Power Drift = 0.01 dB

Applied MIF = 3.26 dB

RF audio interference level = 27.93 dBV/m
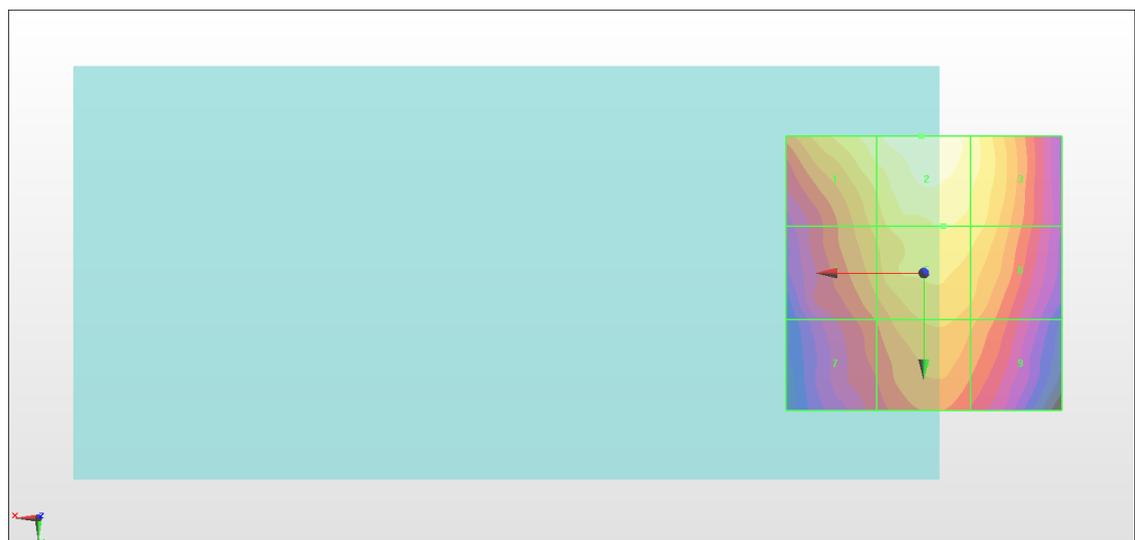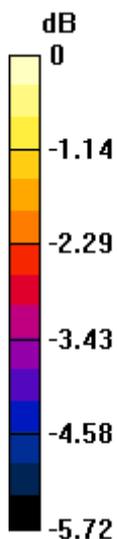
Emission category: M4

MIF scaled E-field

Grid 1 **M4** 27.45 dBV/m	Grid 2 **M4** 27.93 dBV/m	Grid 3 **M4** 27.39 dBV/m
Grid 4 **M4** 26.55 dBV/m	Grid 5 **M4** 27.19 dBV/m	Grid 6 **M4** 27.03 dBV/m
Grid 7 **M4** 25.69 dBV/m	Grid 8 **M4** 26.49 dBV/m	Grid 9 **M4** 26.16 dBV/m

Cursor:
Total = 27.93 dBV/m
E Category: M4
Location: 0.5, -25, 8.7 mm

0 dB = 24.91 V/m = 27.93 dBV/m

#10_HAC_E_CDMA BC1_ 1xRTT, RC1 SO3_Ch25

Communication System: CDMA2000, RC1, SO3, 1/8th Rate ; Frequency: 1851.25 MHz;Duty Cycle: 1:17.7419

Medium: Air Medium parameters used: $\sigma = 0$ S/m, $\varepsilon_r = 1$; $\rho = 0$ kg/m^3

Ambient Temperature：23.2 ℃

DASY5 Configuration:
- Probe: ER3DV6 - SN2358; ConvF(1, 1, 1); Calibrated: 2018/1/19;
- Sensor-Surface: (Fix Surface)
- Electronics: DAE4 Sn854; Calibrated: 2018/6/14
- Phantom: HAC Test Arch with AMCC; Type: SD HAC P01 BA;
- Measurement SW: DASY52, Version 52.10 (0);SEMCAD X Version 14.6.10 (7417)

E Scan - ER3D: 15 mm from Probe Center to the Device/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 = 4.696 V/m; Power Drift = -0.19 dB

Applied MIF = 3.26 dB

RF audio interference level = 20.12 dBV/m
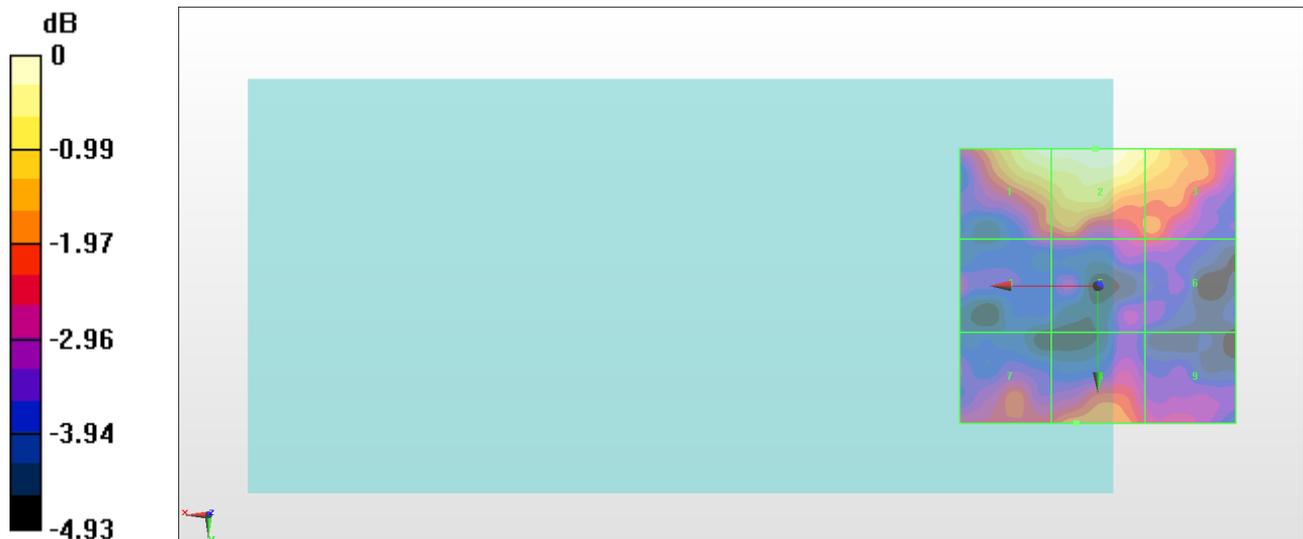
Emission category: M4

MIF scaled E-field

Grid 1 **M4**	Grid 2 **M4**	Grid 3 **M4**
19.99 dBV/m	**20.12 dBV/m**	**19.53 dBV/m**
Grid 4 **M4**	Grid 5 **M4**	Grid 6 **M4**
17.32 dBV/m	**17.68 dBV/m**	**17.77 dBV/m**
Grid 7 **M4**	Grid 8 **M4**	Grid 9 **M4**
18.11 dBV/m	**18.41 dBV/m**	**17.49 dBV/m**

Cursor:
Total = 20.12 dBV/m
E Category: M4
Location: 0.5, -25, 8.7 mm

0 dB = 10.14 V/m = 20.12 dBV/m

#11_HAC_E_CDMA BC1_ 1xRTT, RC1 SO3_Ch600

Communication System: CDMA2000, RC1, SO3, 1/8th Rate 25 fr.; Frequency: 1880 MHz;Duty Cycle: 1:17.7419

Medium: Air Medium parameters used: $\sigma = 0$ S/m, $\varepsilon_r = 1$; $\rho = 0$ kg/m^3

Ambient Temperature：23.2 ℃

DASY5 Configuration:
- Probe: ER3DV6 - SN2358; ConvF(1, 1, 1); Calibrated: 2018/1/19;
- Sensor-Surface: (Fix Surface)
- Electronics: DAE4 Sn854; Calibrated: 2018/6/14
- Phantom: HAC Test Arch with AMCC; Type: SD HAC P01 BA;
- Measurement SW: DASY52, Version 52.10 (0);SEMCAD X Version 14.6.10 (7417)

E Scan - ER3D: 15 mm from Probe Center to the Device/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 = 4.967 V/m; Power Drift = -0.10 dB

Applied MIF = 3.26 dB

RF audio interference level = 20.05 dBV/m

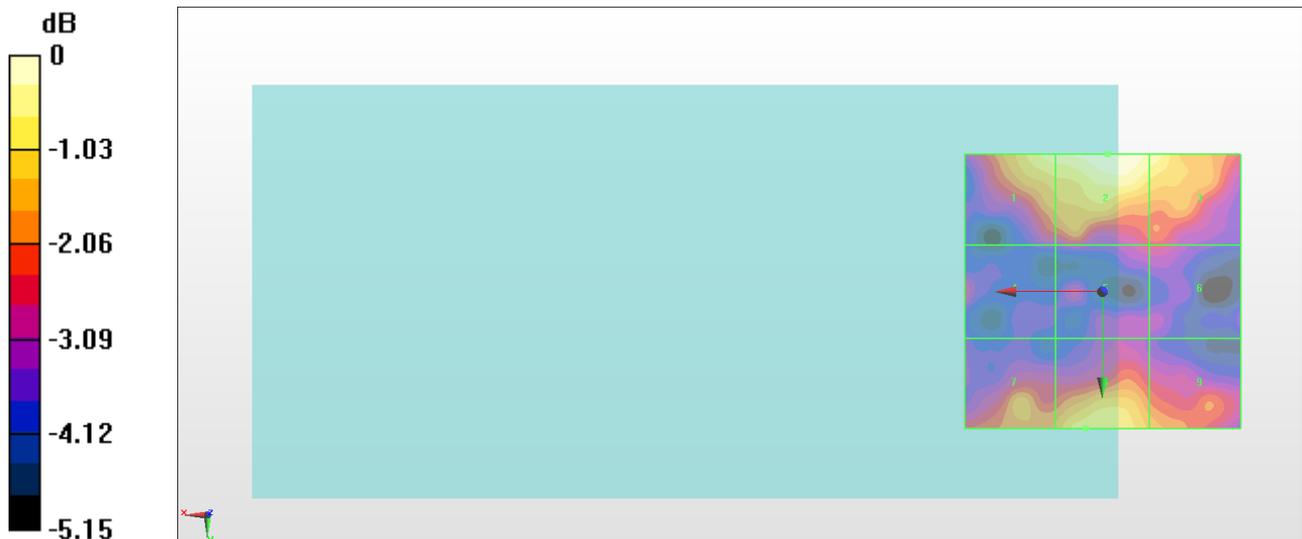**Emission category: M4**

MIF scaled E-field

Grid 1 **M4** **19.63 dBV/m**	Grid 2 **M4** **20.05 dBV/m**	Grid 3 **M4** **19.64 dBV/m**
Grid 4 **M4** **17.49 dBV/m**	Grid 5 **M4** **17.44 dBV/m**	Grid 6 **M4** **17.5 dBV/m**
Grid 7 **M4** **18.59 dBV/m**	Grid 8 **M4** **19.25 dBV/m**	Grid 9 **M4** **18.62 dBV/m**

Cursor:
Total = 20.05 dBV/m
E Category: M4
Location: -1, -25, 8.7 mm

0 dB = 10.05 V/m = 20.04 dBV/m

#12_HAC_E_CDMA BC1_ 1xRTT, RC1 SO3_Ch1175

Communication System: CDMA2000, RC1, SO3, 1/8th Rate; Frequency: 1908.75 MHz;Duty Cycle: 1:17.7419

Medium: Air Medium parameters used: σ = 0 S/m, ε_r = 1; ρ = 0 kg/m^3

Ambient Temperature：23.2 ℃

DASY5 Configuration:
- Probe: ER3DV6 - SN2358; ConvF(1, 1, 1); Calibrated: 2018/1/19;
- Sensor-Surface: (Fix Surface)
- Electronics: DAE4 Sn854; Calibrated: 2018/6/14
- Phantom: HAC Test Arch with AMCC; Type: SD HAC P01 BA;
- Measurement SW: DASY52, Version 52.10 (0);SEMCAD X Version 14.6.10 (7417)

E Scan - ER3D: 15 mm from Probe Center to the Device/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 = 4.765 V/m; Power Drift = 0.10 dB

Applied MIF = 3.26 dB

RF audio interference level = 19.90 dBV/m

Emission category: M4

MIF scaled E-field

Grid 1 **M4** **19.25 dBV/m**	Grid 2 **M4** **19.9 dBV/m**	Grid 3 **M4** **19.54 dBV/m**
Grid 4 **M4** **17.18 dBV/m**	Grid 5 **M4** **17.96 dBV/m**	Grid 6 **M4** **18.06 dBV/m**
Grid 7 **M4** **18.17 dBV/m**	Grid 8 **M4** **18.62 dBV/m**	Grid 9 **M4** **17.74 dBV/m**

Cursor:
Total = 19.90 dBV/m
E Category: M4
Location: -3, -25, 8.7 mm
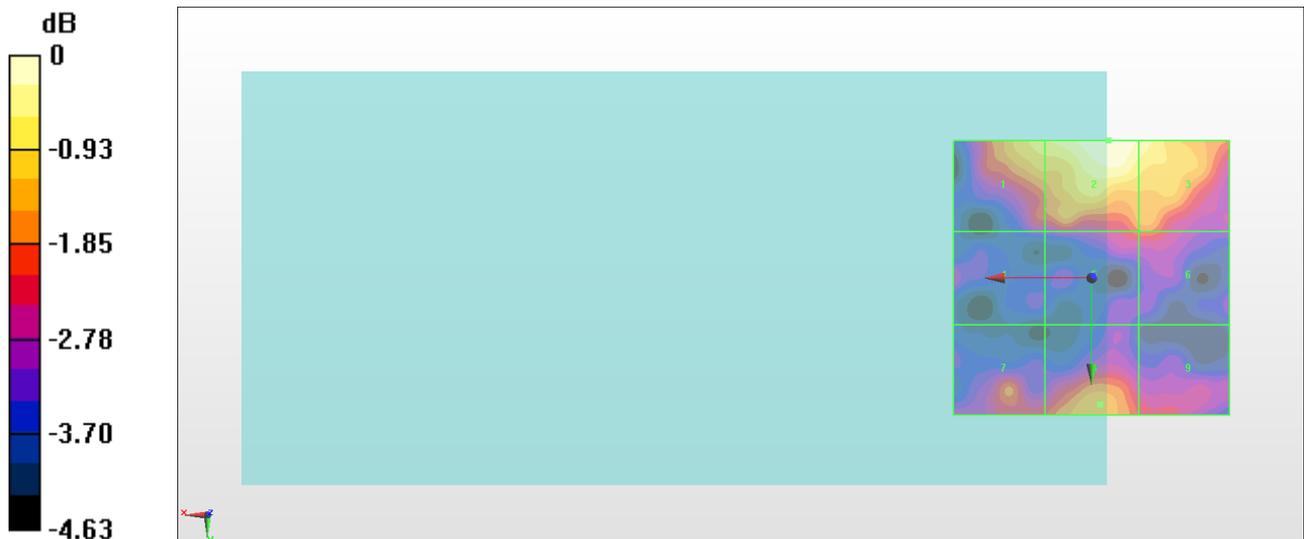
0 dB = 9.881 V/m = 19.90 dBV/m

#13_HAC_E_CDMA BC10_ 1xRTT, RC1 SO3_Ch476

Communication System: CDMA2000, RC1, SO3, 1/8th Rate; Frequency: 817.9 MHz;Duty Cycle: 1:17.7419

Medium: Air Medium parameters used: $\sigma = 0$ S/m, $\varepsilon_r = 1$; $\rho = 0$ kg/m^3

Ambient Temperature：23.2 ℃

DASY5 Configuration:
- Probe: ER3DV6 - SN2358; ConvF(1, 1, 1); Calibrated: 2018/1/19;
- Sensor-Surface: (Fix Surface)
- Electronics: DAE4 Sn854; Calibrated: 2018/6/14
- Phantom: HAC Test Arch with AMCC; Type: SD HAC P01 BA;
- Measurement SW: DASY52, Version 52.10 (0);SEMCAD X Version 14.6.10 (7417)

E Scan - ER3D: 15 mm from Probe Center to the Device/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 = 19.81 V/m; Power Drift = -0.09 dB

Applied MIF = 3.26 dB

RF audio interference level = 28.93 dBV/m

Emission category: M4

MIF scaled E-field

Grid 1 **M4**	Grid 2 **M4**	Grid 3 **M4**
27.37 dBV/m	**27.96 dBV/m**	**27.2 dBV/m**
Grid 4 **M4**	Grid 5 **M4**	Grid 6 **M4**
28.48 dBV/m	**27.74 dBV/m**	**27.17 dBV/m**
Grid 7 **M4**	Grid 8 **M4**	Grid 9 **M4**
28.93 dBV/m	**27.49 dBV/m**	**26.98 dBV/m**

Cursor:
Total = 28.93 dBV/m
E Category: M4
Location: 25, 15, 8.7 mm
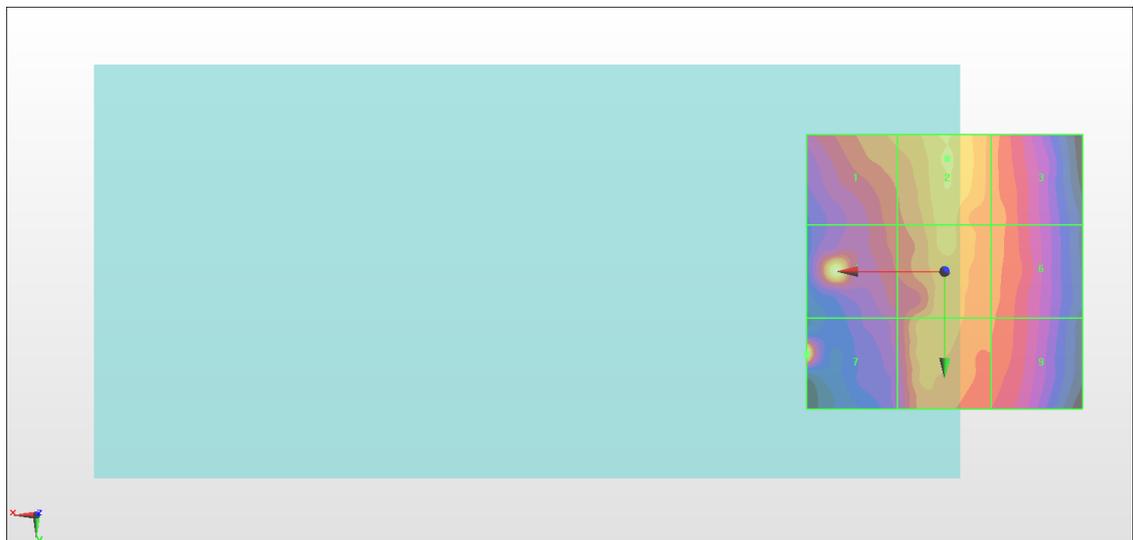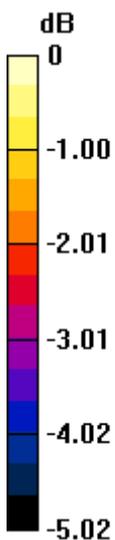
0 dB = 27.97 V/m = 28.93 dBV/m

#14_HAC_E_CDMA BC10_ 1xRTT, RC1 SO3_Ch580

Communication System: CDMA2000, RC1, SO3, 1/8th Rate; Frequency: 820.5 MHz;Duty Cycle: 1:17.7419

Medium: Air Medium parameters used: $\sigma = 0$ S/m, $\varepsilon_r = 1$; $\rho = 0$ kg/m^3

Ambient Temperature：23.2 ℃

DASY5 Configuration:
- Probe: ER3DV6 - SN2358; ConvF(1, 1, 1); Calibrated: 2018/1/19;
- Sensor-Surface: (Fix Surface)
- Electronics: DAE4 Sn854; Calibrated: 2018/6/14
- Phantom: HAC Test Arch with AMCC; Type: SD HAC P01 BA;
- Measurement SW: DASY52, Version 52.10 (0);SEMCAD X Version 14.6.10 (7417)

E Scan - ER3D: 15 mm from Probe Center to the Device/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 = 19.99 V/m; Power Drift = -0.18 dB

Applied MIF = 3.26 dB

RF audio interference level = 29.16 dBV/m

Emission category: M4

MIF scaled E-field

Grid 1 **M4** **27.43 dBV/m**	Grid 2 **M4** **27.99 dBV/m**	Grid 3 **M4** **27.21 dBV/m**
Grid 4 **M4** **26.87 dBV/m**	Grid 5 **M4** **27.78 dBV/m**	Grid 6 **M4** **27.09 dBV/m**
Grid 7 **M4** **26.32 dBV/m**	Grid 8 **M4** **29.16 dBV/m**	Grid 9 **M4** **26.98 dBV/m**

Cursor:
Total = 29.16 dBV/m
E Category: M4
Location: 0, 15, 8.7 mm
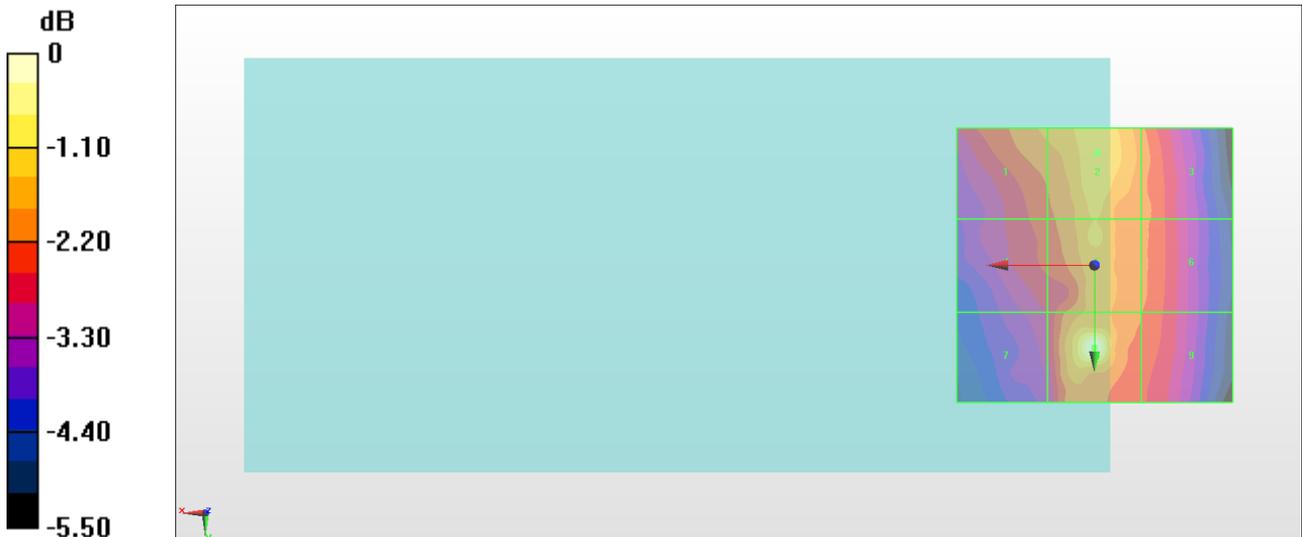
0 dB = 28.70 V/m = 29.16 dBV/m

#15_HAC_E_CDMA BC10_ 1xRTT, RC1 SO3_Ch684

Communication System: CDMA2000, RC1, SO3, 1/8th Rate; Frequency: 823.1 MHz;Duty Cycle: 1:17.7419

Medium: Air Medium parameters used: $\sigma = 0$ S/m, $\varepsilon_r = 1$; $\rho = 0$ kg/m^3

Ambient Temperature：23.2 ℃

DASY5 Configuration:
- Probe: ER3DV6 - SN2358; ConvF(1, 1, 1); Calibrated: 2018/1/19;
- Sensor-Surface: (Fix Surface)
- Electronics: DAE4 Sn854; Calibrated: 2018/6/14
- Phantom: HAC Test Arch with AMCC; Type: SD HAC P01 BA;
- Measurement SW: DASY52, Version 52.10 (0);SEMCAD X Version 14.6.10 (7417)

E Scan - ER3D: 15 mm from Probe Center to the Device/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 = 19.80 V/m; Power Drift = -0.06 dB

Applied MIF = 3.26 dB

RF audio interference level = 29.72 dBV/m

Emission category: M4

MIF scaled E-field

Grid 1 **M4** **29.72 dBV/m**	Grid 2 **M4** **27.97 dBV/m**	Grid 3 **M4** **28.05 dBV/m**
Grid 4 **M4** **28.41 dBV/m**	Grid 5 **M4** **27.64 dBV/m**	Grid 6 **M4** **26.98 dBV/m**
Grid 7 **M4** **26.36 dBV/m**	Grid 8 **M4** **27.61 dBV/m**	Grid 9 **M4** **26.88 dBV/m**

Cursor:
Total = 29.72 dBV/m
E Category: M4
Location: 25, -10, 8.7 mm
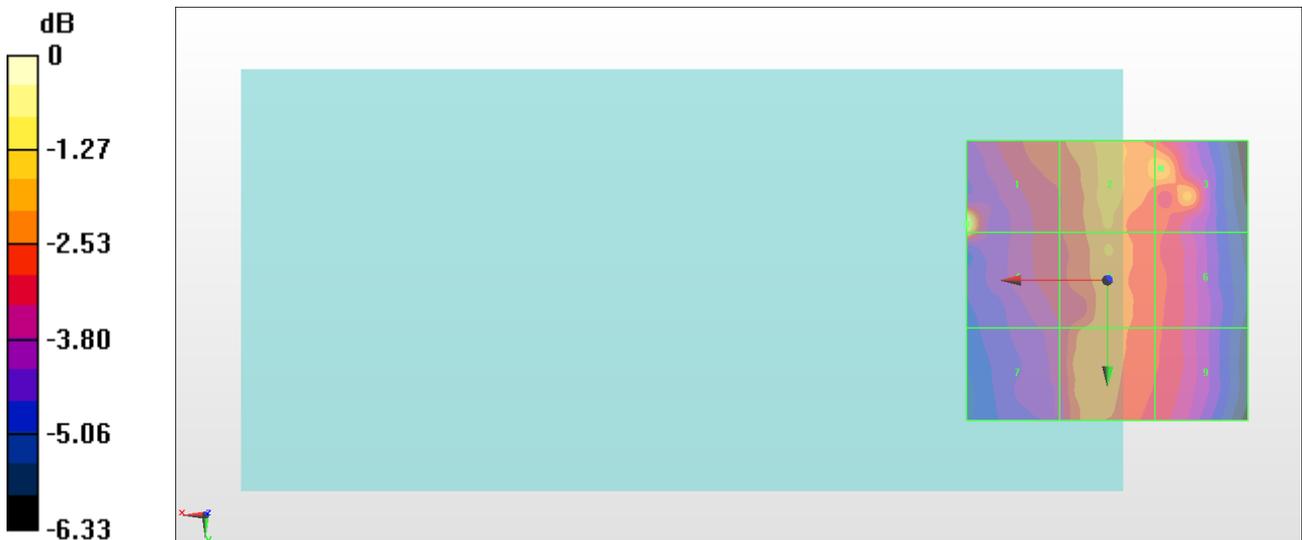
0 dB = 30.61 V/m = 29.72 dBV/m

#16_HAC_E_LTE Band 41_20M_QPSK_1_0_Ch39750

Communication System: LTE-TDD (SC-FDMA, 1 RB, 20 MHz, QPSK); Frequency: 2506 MHz;Duty Cycle: 1:8.33681

Medium: Air Medium parameters used: $\sigma = 0$ S/m, $\varepsilon_r = 1$; $\rho = 0$ kg/m^3

Ambient Temperature：23.2 ℃

DASY5 Configuration:
- Probe: ER3DV6 - SN2358; ConvF(1, 1, 1); Calibrated: 2018/1/19;
- Sensor-Surface: (Fix Surface)
- Electronics: DAE4 Sn854; Calibrated: 2018/6/14
- Phantom: HAC Test Arch with AMCC; Type: SD HAC P01 BA;
- Measurement SW: DASY52, Version 52.10 (0);SEMCAD X Version 14.6.10 (7417)

E Scan - ER3D: 15 mm from Probe Center to the Device/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 = 19.26 V/m; Power Drift = -0.01 dB

Applied MIF = -1.62 dB

RF audio interference level = 25.94 dBV/m

**Emission category: M4**

MIF scaled E-field

Grid 1 **M4** **18.61 dBV/m**	Grid 2 **M4** **20.05 dBV/m**	Grid 3 **M4** **19.99 dBV/m**
Grid 4 **M4** **21.45 dBV/m**	Grid 5 **M4** **24.26 dBV/m**	Grid 6 **M4** **24.19 dBV/m**
Grid 7 **M4** **24.08 dBV/m**	Grid 8 **M4** **25.94 dBV/m**	Grid 9 **M4** **25.73 dBV/m**

Cursor:
Total = 25.94 dBV/m
E Category: M4
Location: -4.5, 25, 8.7 mm
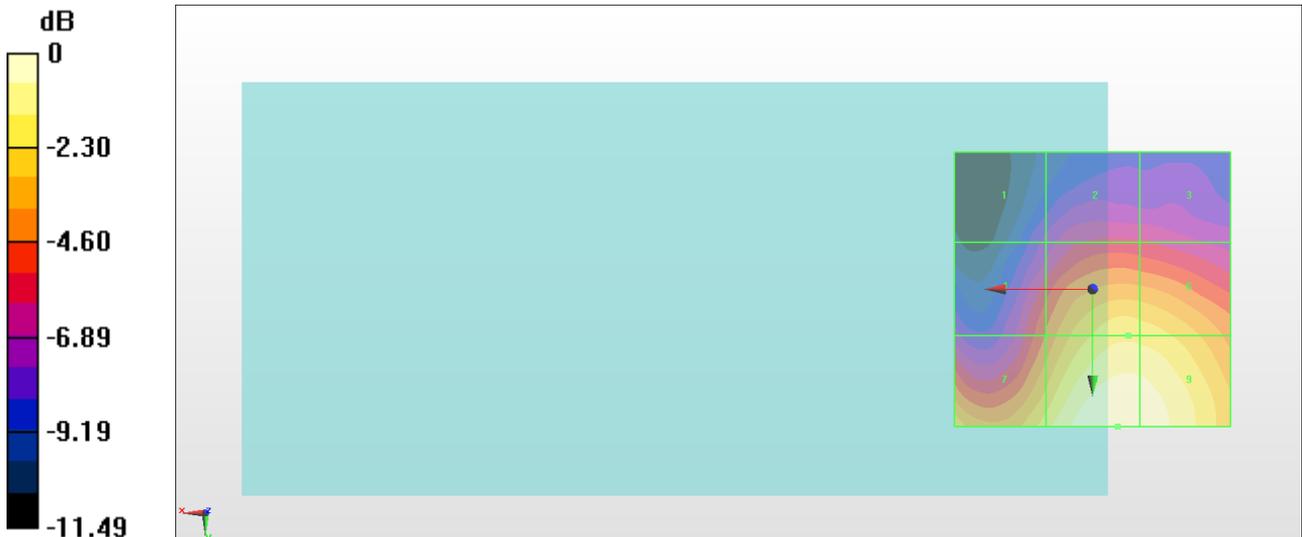
0 dB = 19.82 V/m = 25.94 dBV/m

#17_HAC_E_LTE Band 41_20M_QPSK_1_0_Ch40185

Communication System:LTE-TDD (SC-FDMA, 1 RB, 20 MHz, QPSK); Frequency: 2549.5 MHz;Duty Cycle: 1:8.33681

Medium: Air Medium parameters used: $\sigma = 0$ S/m, $\varepsilon_r = 1$; $\rho = 0$ kg/m^3

Ambient Temperature：23.2 ℃

DASY5 Configuration:
- Probe: ER3DV6 - SN2358; ConvF(1, 1, 1); Calibrated: 2018/1/19;
- Sensor-Surface: (Fix Surface)
- Electronics: DAE4 Sn854; Calibrated: 2018/6/14
- Phantom: HAC Test Arch with AMCC; Type: SD HAC P01 BA;
- Measurement SW: DASY52, Version 52.10 (0);SEMCAD X Version 14.6.10 (7417)

E Scan - ER3D: 15 mm from Probe Center to the Device/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 = 18.88 V/m; Power Drift = 0.04 dB

Applied MIF = -1.62 dB

RF audio interference level = 26.16 dBV/m

**Emission category: M4**

MIF scaled E-field

Grid 1 **M4**	Grid 2 **M4**	Grid 3 **M4**
18.59 dBV/m	**21.4 dBV/m**	**21.4 dBV/m**
Grid 4 **M4**	Grid 5 **M4**	Grid 6 **M4**
21.35 dBV/m	**24.5 dBV/m**	**24.48 dBV/m**
Grid 7 **M4**	Grid 8 **M4**	Grid 9 **M4**
24.77 dBV/m	**26.16 dBV/m**	**25.76 dBV/m**

Cursor:
Total = 26.16 dBV/m
E Category: M4
Location: -2, 25, 8.7 mm
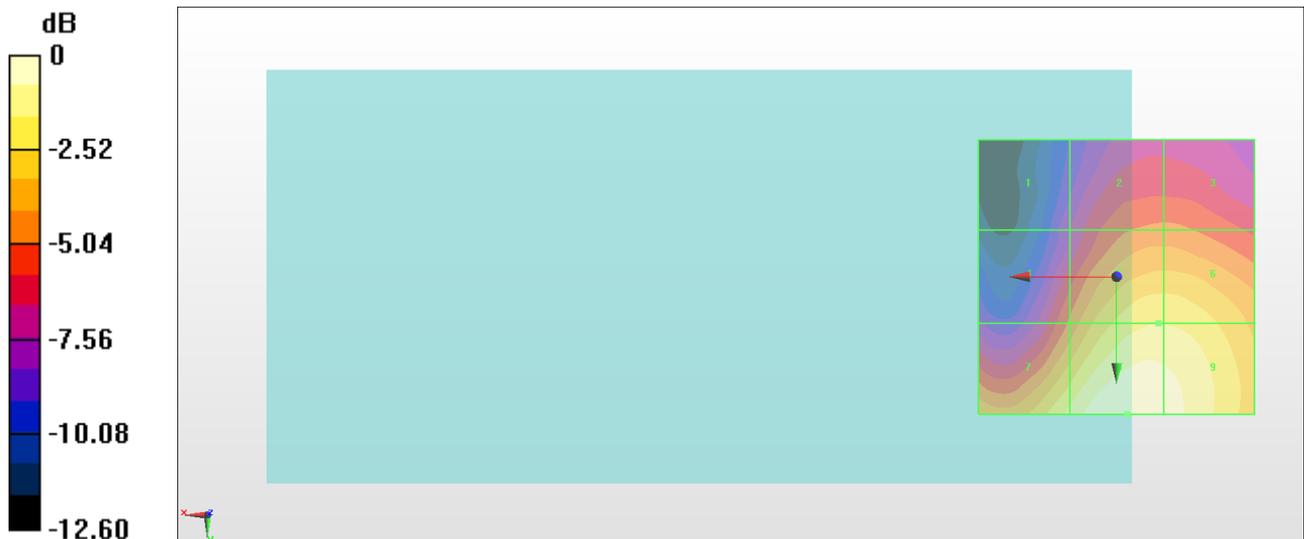
0 dB = 20.33 V/m = 26.16 dBV/m

#18_HAC_E_LTE Band 41_20M_QPSK_1_0_Ch40620

Communication System: LTE-TDD (SC-FDMA, 1 RB, 20 MHz, QPSK); Frequency: 2593 MHz;Duty Cycle: 1:8.33681

Medium: Air Medium parameters used: $\sigma = 0$ S/m, $\varepsilon_r = 1$; $\rho = 0$ kg/m^3

Ambient Temperature：23.2 ℃

DASY5 Configuration:
- Probe: ER3DV6 - SN2358; ConvF(1, 1, 1); Calibrated: 2018/1/19;
- Sensor-Surface: (Fix Surface)
- Electronics: DAE4 Sn854; Calibrated: 2018/6/14
- Phantom: HAC Test Arch with AMCC; Type: SD HAC P01 BA;
- Measurement SW: DASY52, Version 52.10 (0);SEMCAD X Version 14.6.10 (7417)

E Scan - ER3D: 15 mm from Probe Center to the Device/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 = 18.21 V/m; Power Drift = -0.07 dB

Applied MIF = -1.62 dB

RF audio interference level = 26.35 dBV/m

**Emission category: M4**

MIF scaled E-field

Grid 1 **M4** **18.24 dBV/m**	Grid 2 **M4** **20.73 dBV/m**	Grid 3 **M4** **20.73 dBV/m**
Grid 4 **M4** **21.79 dBV/m**	Grid 5 **M4** **24.47 dBV/m**	Grid 6 **M4** **24.42 dBV/m**
Grid 7 **M4** **24.76 dBV/m**	Grid 8 **M4** **26.35 dBV/m**	Grid 9 **M4** **26.03 dBV/m**

Cursor:
Total = 26.35 dBV/m
E Category: M4
Location: -3, 25, 8.7 mm
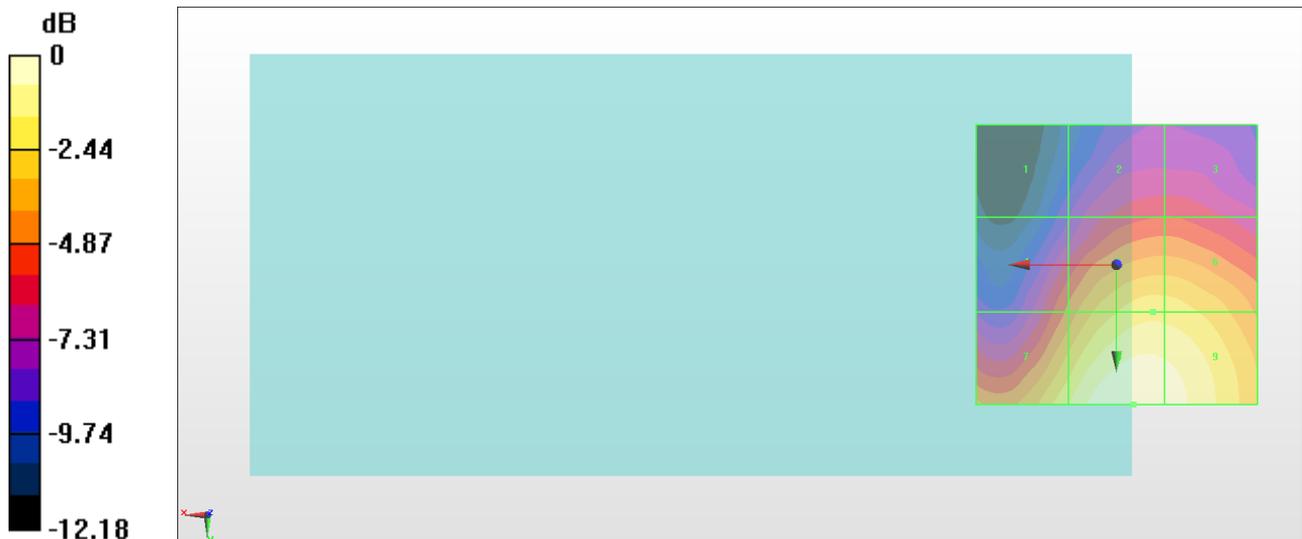
0 dB = 20.76 V/m = 26.34 dBV/m

#19_HAC_E_LTE Band 41_20M_QPSK_1_0_Ch41055

Communication System: LTE-TDD (SC-FDMA, 1 RB, 20 MHz, QPSK); Frequency: 2636.5 MHz;Duty Cycle: 1:8.33681

Medium: Air Medium parameters used: $\sigma = 0$ S/m, $\varepsilon_r = 1$; $\rho = 0$ kg/m^3

Ambient Temperature：23.2 ℃

DASY5 Configuration:
- Probe: ER3DV6 - SN2358; ConvF(1, 1, 1); Calibrated: 2018/1/19;
- Sensor-Surface: (Fix Surface)
- Electronics: DAE4 Sn854; Calibrated: 2018/6/14
- Phantom: HAC Test Arch with AMCC; Type: SD HAC P01 BA;
- Measurement SW: DASY52, Version 52.10 (0);SEMCAD X Version 14.6.10 (7417)

E Scan - ER3D: 15 mm from Probe Center to the Device/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 = 16.86 V/m; Power Drift = -0.11 dB

Applied MIF = -1.62 dB

RF audio interference level = 24.68 dBV/m

**Emission category: M4**

MIF scaled E-field

Grid 1 **M4**	Grid 2 **M4**	Grid 3 **M4**
16.56 dBV/m	**18.61 dBV/m**	**19.65 dBV/m**
Grid 4 **M4**	Grid 5 **M4**	Grid 6 **M4**
18.93 dBV/m	**23.17 dBV/m**	**22.98 dBV/m**
Grid 7 **M4**	Grid 8 **M4**	Grid 9 **M4**
23.59 dBV/m	**24.68 dBV/m**	**24.67 dBV/m**

Cursor:
Total = 24.68 dBV/m
E Category: M4
Location: 0, 21, 8.7 mm
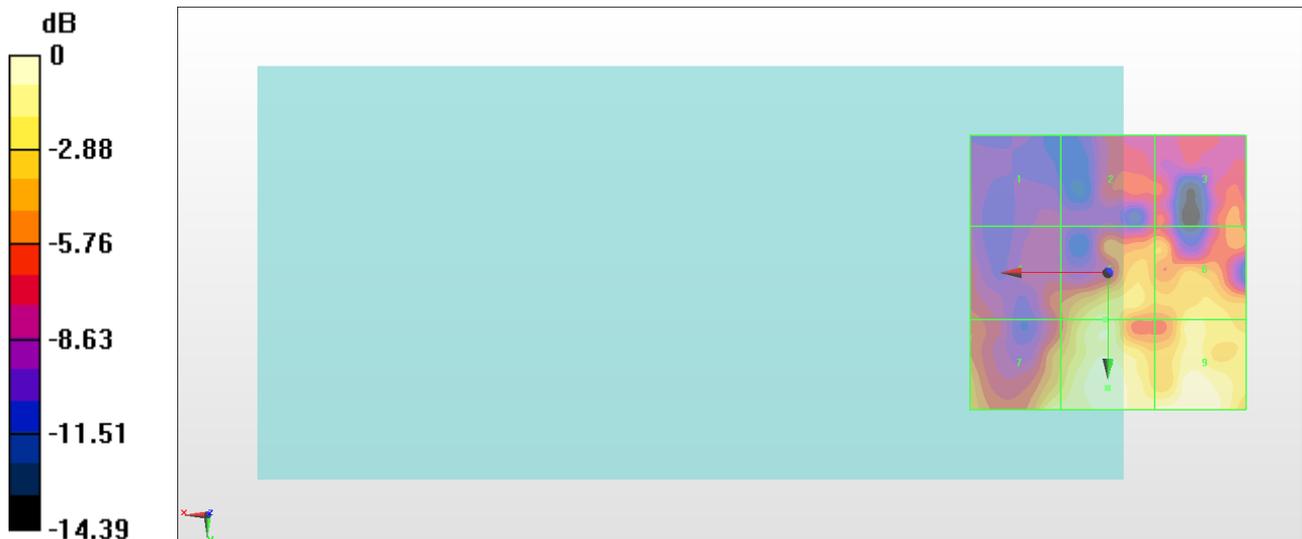
0 dB = 17.14 V/m = 24.68 dBV/m

#20_HAC_E_LTE Band 41_20M_QPSK_1_0_Ch41490

Communication System: LTE-TDD (SC-FDMA, 1 RB, 20 MHz, QPSK); Frequency: 2680 MHz;Duty Cycle: 1:8.33681

Medium: Air Medium parameters used: $\sigma = 0$ S/m, $\varepsilon_r = 1$; $\rho = 0$ kg/m^3

Ambient Temperature：23.2 ℃

DASY5 Configuration:
- Probe: ER3DV6 - SN2358; ConvF(1, 1, 1); Calibrated: 2018/1/19;
- Sensor-Surface: (Fix Surface)
- Electronics: DAE4 Sn854; Calibrated: 2018/6/14
- Phantom: HAC Test Arch with AMCC; Type: SD HAC P01 BA;
- Measurement SW: DASY52, Version 52.10 (0);SEMCAD X Version 14.6.10 (7417)

E Scan - ER3D: 15 mm from Probe Center to the Device/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 = 16.88 V/m; Power Drift = 0.03 dB

Applied MIF = -1.62 dB

RF audio interference level = 25.80 dBV/m

**Emission category: M4**

MIF scaled E-field

Grid 1 **M4**	Grid 2 **M4**	Grid 3 **M4**
19.63 dBV/m	**20.1 dBV/m**	**20.11 dBV/m**
Grid 4 **M4**	Grid 5 **M4**	Grid 6 **M4**
20.57 dBV/m	**23.58 dBV/m**	**23.51 dBV/m**
Grid 7 **M4**	Grid 8 **M4**	Grid 9 **M4**
24.07 dBV/m	**25.8 dBV/m**	**25.29 dBV/m**

Cursor:
Total = 25.80 dBV/m
E Category: M4
Location: -1, 25, 8.7 mm
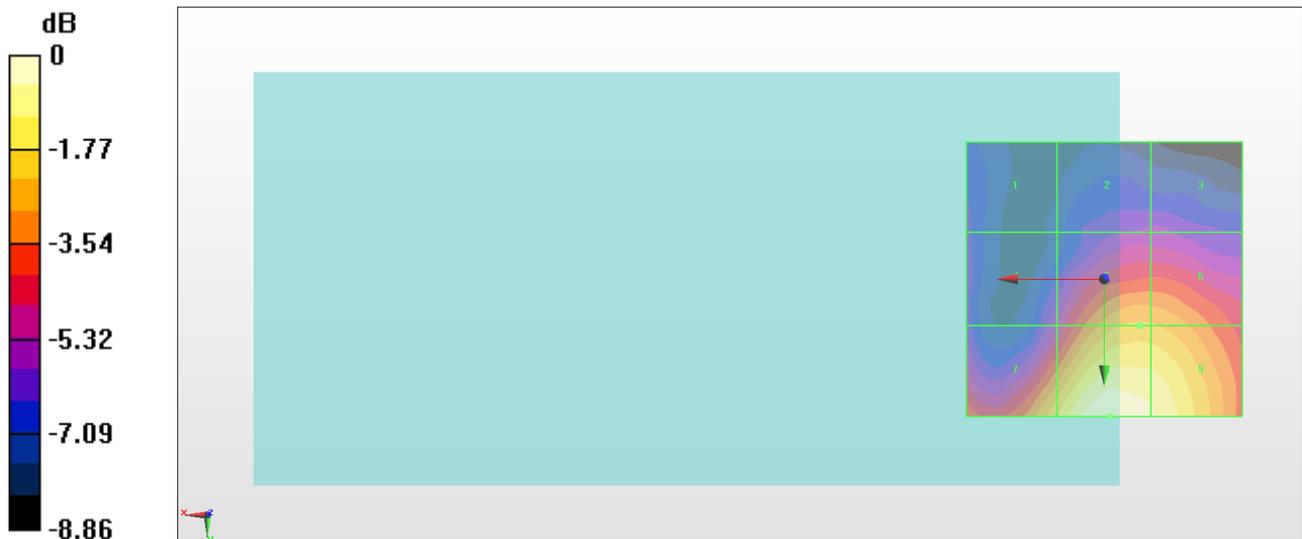
0 dB = 19.49 V/m = 25.80 dBV/m

#21_HAC_E_LTE Band 41_20M_QPSK_1_0_Ch39750

Communication System: LTE-TDD (SC-FDMA, 1 RB, 20 MHz, QPSK); Frequency: 2506 MHz;Duty Cycle: 1:8.33681

Medium: Air Medium parameters used: $\sigma = 0$ S/m, $\varepsilon_r = 1$; $\rho = 0$ kg/m^3

Ambient Temperature：23.2 ℃

DASY5 Configuration:
- Probe: ER3DV6 - SN2358; ConvF(1, 1, 1); Calibrated: 2018/1/19;
- Sensor-Surface: (Fix Surface)
- Electronics: DAE4 Sn854; Calibrated: 2018/6/14
- Phantom: HAC Test Arch with AMCC; Type: SD HAC P01 BA;
- Measurement SW: DASY52, Version 52.10 (0);SEMCAD X Version 14.6.10 (7417)

E Scan - ER3D: 15 mm from Probe Center to the Device/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 = 16.29 V/m; Power Drift = -0.00 dB

Applied MIF = -1.62 dB

RF audio interference level = 25.23 dBV/m

**Emission category: M4**

MIF scaled E-field

Grid 1 **M4**	Grid 2 **M4**	Grid 3 **M4**
17.3 dBV/m	**18.78 dBV/m**	**18.79 dBV/m**
Grid 4 **M4**	Grid 5 **M4**	Grid 6 **M4**
19.92 dBV/m	**23.16 dBV/m**	**23.12 dBV/m**
Grid 7 **M4**	Grid 8 **M4**	Grid 9 **M4**
23.13 dBV/m	**25.23 dBV/m**	**25.04 dBV/m**

Cursor:
Total = 25.23 dBV/m
E Category: M4
Location: -5, 25, 8.7 mm
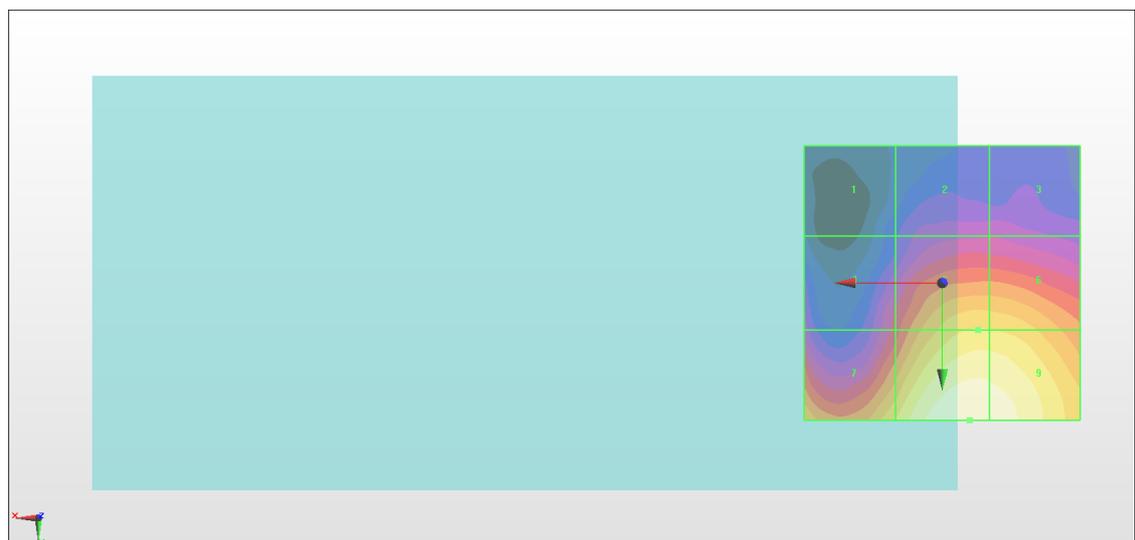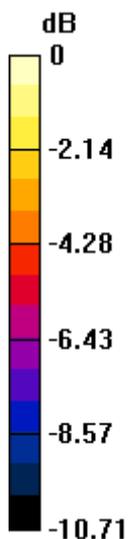
0 dB = 18.25 V/m = 25.23 dBV/m

#22_HAC_E_LTE Band 41_20M_QPSK_1_0_Ch40185

Communication System: LTE-TDD (SC-FDMA, 1 RB, 20 MHz, QPSK); Frequency: 2549.5 MHz;Duty Cycle: 1:8.33681

Medium: Air Medium parameters used: $\sigma = 0$ S/m, $\varepsilon_r = 1$; $\rho = 0$ kg/m^3

Ambient Temperature：23.2 ℃

DASY5 Configuration:
- Probe: ER3DV6 - SN2358; ConvF(1, 1, 1); Calibrated: 2018/1/19;
- Sensor-Surface: (Fix Surface)
- Electronics: DAE4 Sn854; Calibrated: 2018/6/14
- Phantom: HAC Test Arch with AMCC; Type: SD HAC P01 BA;
- Measurement SW: DASY52, Version 52.10 (0);SEMCAD X Version 14.6.10 (7417)

E Scan - ER3D: 15 mm from Probe Center to the Device/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 = 16.25 V/m; Power Drift = 0.00 dB

Applied MIF = -1.62 dB

RF audio interference level = 25.49 dBV/m

**Emission category: M4**

MIF scaled E-field

Grid 1 **M4** **17.77 dBV/m**	Grid 2 **M4** **20.5 dBV/m**	Grid 3 **M4** **20.52 dBV/m**
Grid 4 **M4** **20.04 dBV/m**	Grid 5 **M4** **23.61 dBV/m**	Grid 6 **M4** **23.6 dBV/m**
Grid 7 **M4** **23.85 dBV/m**	Grid 8 **M4** **25.49 dBV/m**	Grid 9 **M4** **25.12 dBV/m**

Cursor:
Total = 25.49 dBV/m
E Category: M4
Location: -2.5, 25, 8.7 mm
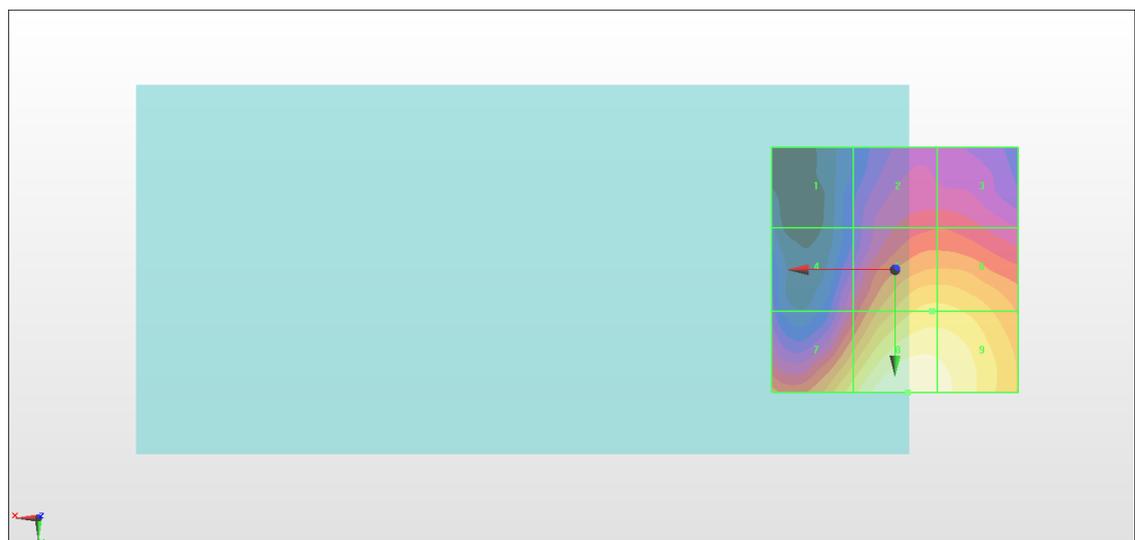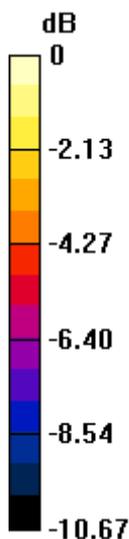
0 dB = 18.81 V/m = 25.49 dBV/m

#23_HAC_E_LTE Band 41_20M_QPSK_1_0_Ch40620

Communication System: LTE-TDD (SC-FDMA, 1 RB, 20 MHz, QPSK); Frequency: 2593 MHz;Duty Cycle: 1:8.33681

Medium: Air Medium parameters used: $\sigma = 0$ S/m, $\varepsilon_r = 1$; $\rho = 0$ kg/m^3

Ambient Temperature：23.2 ℃

DASY5 Configuration:
- Probe: ER3DV6 - SN2358; ConvF(1, 1, 1); Calibrated: 2018/1/19;
- Sensor-Surface: (Fix Surface)
- Electronics: DAE4 Sn854; Calibrated: 2018/6/14
- Phantom: HAC Test Arch with AMCC; Type: SD HAC P01 BA;
- Measurement SW: DASY52, Version 52.10 (0);SEMCAD X Version 14.6.10 (7417)

E Scan - ER3D: 15 mm from Probe Center to the Device/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 = 15.66 V/m; Power Drift = 0.07 dB

Applied MIF = -1.62 dB

RF audio interference level = 25.86 dBV/m

Emission category: M4

MIF scaled E-field

Grid 1 **M4** **17.52 dBV/m**	Grid 2 **M4** **19.71 dBV/m**	Grid 3 **M4** **19.73 dBV/m**
Grid 4 **M4** **20.85 dBV/m**	Grid 5 **M4** **23.6 dBV/m**	Grid 6 **M4** **23.58 dBV/m**
Grid 7 **M4** **24.17 dBV/m**	Grid 8 **M4** **25.86 dBV/m**	Grid 9 **M4** **25.51 dBV/m**

Cursor:
Total = 25.86 dBV/m
E Category: M4
Location: -2.5, 25, 8.7 mm
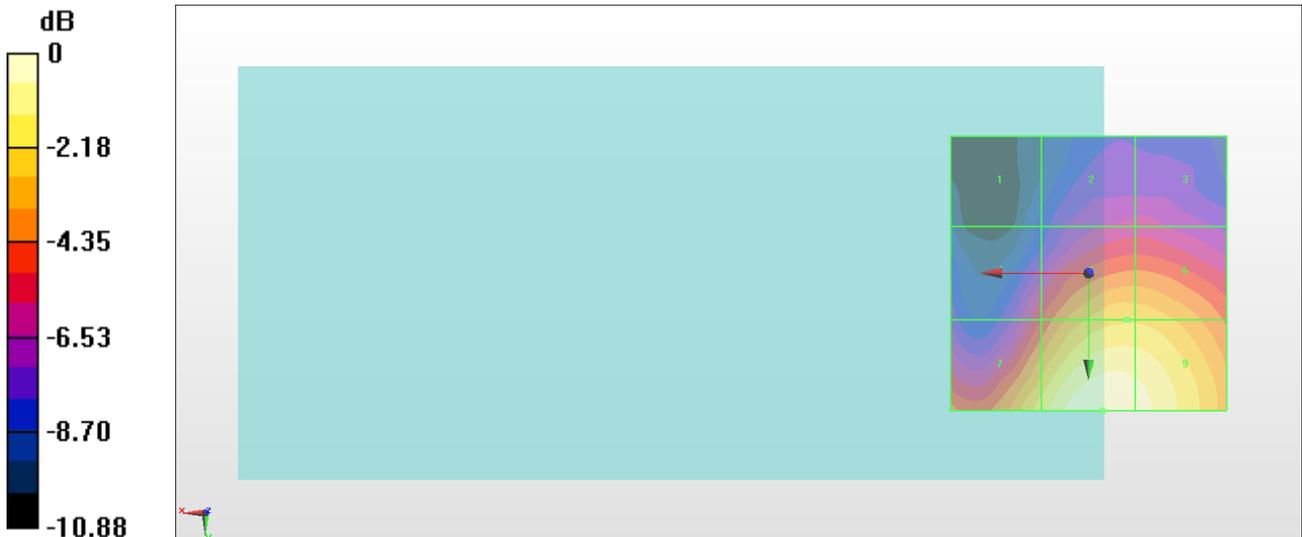
0 dB = 19.64 V/m = 25.86 dBV/m

#24_HAC_E_LTE Band 41_20M_QPSK_1_0_Ch41055

Communication System: LTE-TDD (SC-FDMA, 1 RB, 20 MHz, QPSK); Frequency: 2636.5 MHz;Duty Cycle: 1:8.33681

Medium: Air Medium parameters used: $\sigma = 0$ S/m, $\varepsilon_r = 1$; $\rho = 0$ kg/m^3

Ambient Temperature：23.2 ℃

DASY5 Configuration:
- Probe: ER3DV6 - SN2358; ConvF(1, 1, 1); Calibrated: 2018/1/19;
- Sensor-Surface: (Fix Surface)
- Electronics: DAE4 Sn854; Calibrated: 2018/6/14
- Phantom: HAC Test Arch with AMCC; Type: SD HAC P01 BA;
- Measurement SW: DASY52, Version 52.10 (0);SEMCAD X Version 14.6.10 (7417)

E Scan - ER3D: 15 mm from Probe Center to the Device/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 = 16.28 V/m; Power Drift = 0.08 dB

Applied MIF = -1.62 dB

RF audio interference level = 25.97 dBV/m

**Emission category: M4**

MIF scaled E-field

Grid 1 **M4**	Grid 2 **M4**	Grid 3 **M4**
17.39 dBV/m	**19.45 dBV/m**	**19.47 dBV/m**
Grid 4 **M4**	Grid 5 **M4**	Grid 6 **M4**
20.34 dBV/m	**23.58 dBV/m**	**23.52 dBV/m**
Grid 7 **M4**	Grid 8 **M4**	Grid 9 **M4**
23.9 dBV/m	**25.97 dBV/m**	**25.7 dBV/m**

Cursor:
Total = 25.97 dBV/m
E Category: M4
Location: -3.5, 25, 8.7 mm
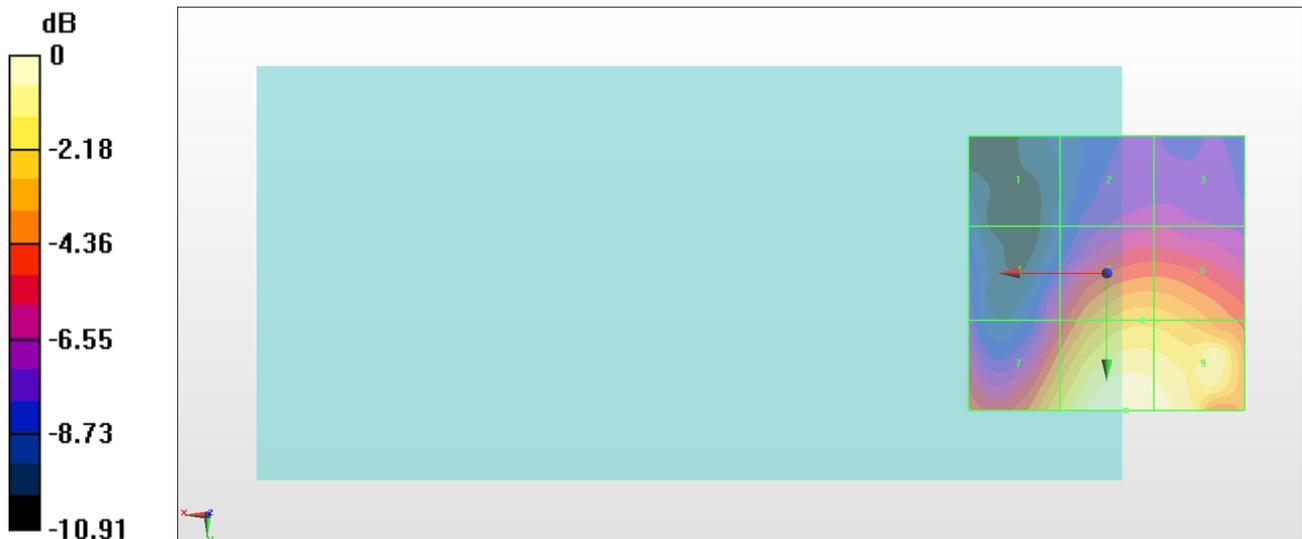
0 dB = 19.88 V/m = 25.97 dBV/m

#25_HAC_E_LTE Band 41_20M_QPSK_1_0_Ch41490

Communication System: LTE-TDD (SC-FDMA, 1 RB, 20 MHz, QPSK); Frequency: 2680 MHz;Duty Cycle: 1:8.33681

Medium: Air Medium parameters used: $\sigma = 0$ S/m, $\varepsilon_r = 1$; $\rho = 0$ kg/m^3

Ambient Temperature：23.2 ℃

DASY5 Configuration:
- Probe: ER3DV6 - SN2358; ConvF(1, 1, 1); Calibrated: 2018/1/19;
- Sensor-Surface: (Fix Surface)
- Electronics: DAE4 Sn854; Calibrated: 2018/6/14
- Phantom: HAC Test Arch with AMCC; Type: SD HAC P01 BA;
- Measurement SW: DASY52, Version 52.10 (0);SEMCAD X Version 14.6.10 (7417)

E Scan - ER3D: 15 mm from Probe Center to the Device/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 = 17.09 V/m; Power Drift = -0.00 dB

Applied MIF = -1.62 dB

RF audio interference level = 25.83 dBV/m

**Emission category: M4**

MIF scaled E-field

Grid 1 **M4**	Grid 2 **M4**	Grid 3 **M4**
18.82 dBV/m	**20.2 dBV/m**	**20.21 dBV/m**
Grid 4 **M4**	Grid 5 **M4**	Grid 6 **M4**
20.36 dBV/m	**23.66 dBV/m**	**23.6 dBV/m**
Grid 7 **M4**	Grid 8 **M4**	Grid 9 **M4**
24.05 dBV/m	**25.83 dBV/m**	**25.43 dBV/m**

Cursor:
Total = 25.83 dBV/m
E Category: M4
Location: -2, 25, 8.7 mm
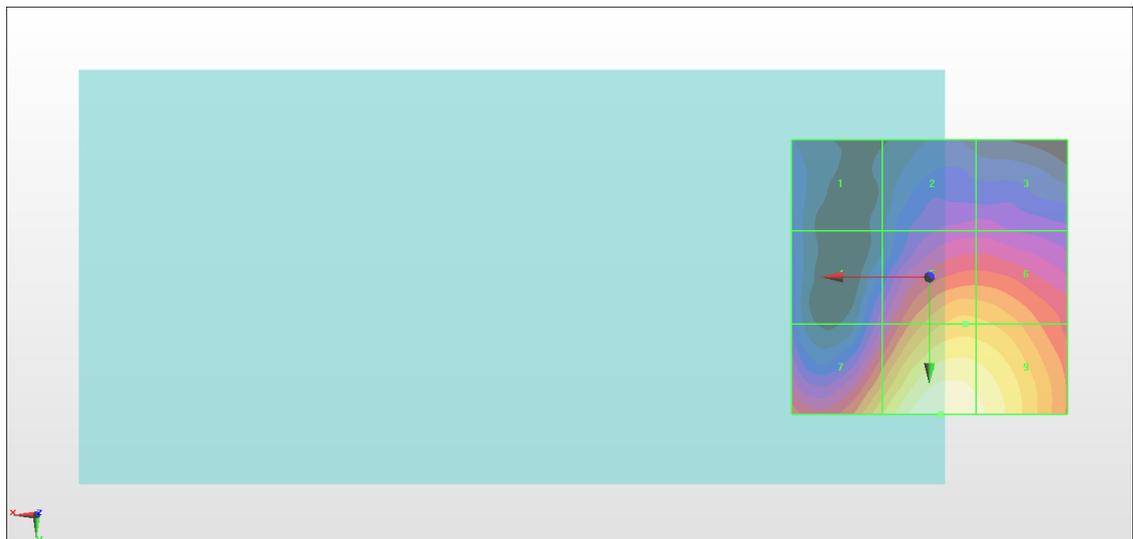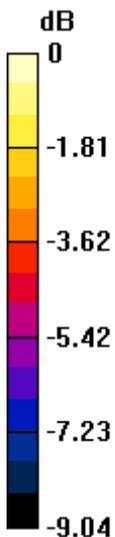
0 dB = 19.58 V/m = 25.84 dBV/m

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

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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   **Auden**

Certificate No: **CD835V3-1030_Jun18**

CALIBRATION CERTIFICATE

Object	CD835V3 - SN: 1030
Calibration procedure(s)	QA CAL-20.v6 Calibration procedure for dipoles in air
Calibration date:	June 21, 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: June 22, 2018

This calibration certificate shall not be reproduced except in full without written approval of the laboratory.

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

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S Schweizerischer Kalibrierdienst
C Service suisse d'étalonnage
S Servizio svizzero di taratura
S 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

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	110.8 V/m = 40.89 dBV/m
Maximum measured above low end	100 mW input power	110.2 V/m = 40.84 dBV/m
Averaged maximum above arm	100 mW input power	**110.5 V/m ± 12.8 % (k=2)**

Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters

Frequency	Return Loss	Impedance
800 MHz	17.2 dB	40.4 Ω - 8.0 jΩ
835 MHz	24.0 dB	52.0 Ω + 6.1 jΩ
880 MHz	17.3 dB	63.0 Ω - 8.5 jΩ
900 MHz	19.2 dB	53.7 Ω - 10.8 jΩ
945 MHz	19.1 dB	54.6 Ω + 10.6 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

CH1 S11   LOG   5 dB/ REF -15 dB   21 Jun 2018 13:29:05
                                                    2:-24.003 dB   835.000 000 MHz

CH1 Markers

1:-17.240 dB
 800.000 MHz

3:-17.262 dB
 880.000 MHz

4:-19.246 dB
 900.000 MHz

5:-19.139 dB
 945.000 MHz

CH2 S11   1 U FS   2: 51.979 Ω   6.1289 Ω   1.1682 nH   835.000 000 MHz

CH2 Markers

1: 40.426 Ω
  -7.9941 Ω
 800.000 MHz

3: 62.998 Ω
  -8.5000 Ω
 880.000 MHz

4: 53.662 Ω
  -10.760 Ω
 900.000 MHz

5: 54.607 Ω
  10.650 Ω
 945.000 MHz

CENTER 835.000 000 MHz   SPAN 1 000.000 000 MHz

DASY5 E-field Result

DUT: HAC-Dipole 835 MHz; Type: CD835V3; Serial: CD835V3 - SN: 1030

Communication System: UID 0, CW (0); 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)

DASY Configuration:

- Probe: EF3DV3 - SN4013; ConvF(1, 1, 1) @ 835 MHz;
- 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 = 133.6 V/m; Power Drift = -0.01 dB
Applied MIF = 0.00 dB
RF audio interference level = 40.89 dBV/m
Emission category: M3

MIF scaled E-field

Grid 1 **M3**	Grid 2 **M3**	Grid 3 **M3**
40.44 dBV/m	40.89 dBV/m	40.82 dBV/m
Grid 4 **M4**	Grid 5 **M4**	Grid 6 **M4**
35.69 dBV/m	36.02 dBV/m	35.99 dBV/m
Grid 7 **M3**	Grid 8 **M3**	Grid 9 **M3**
40.52 dBV/m	40.84 dBV/m	40.79 dBV/m

0 dB = 110.8 V/m = 40.89 dBV/m

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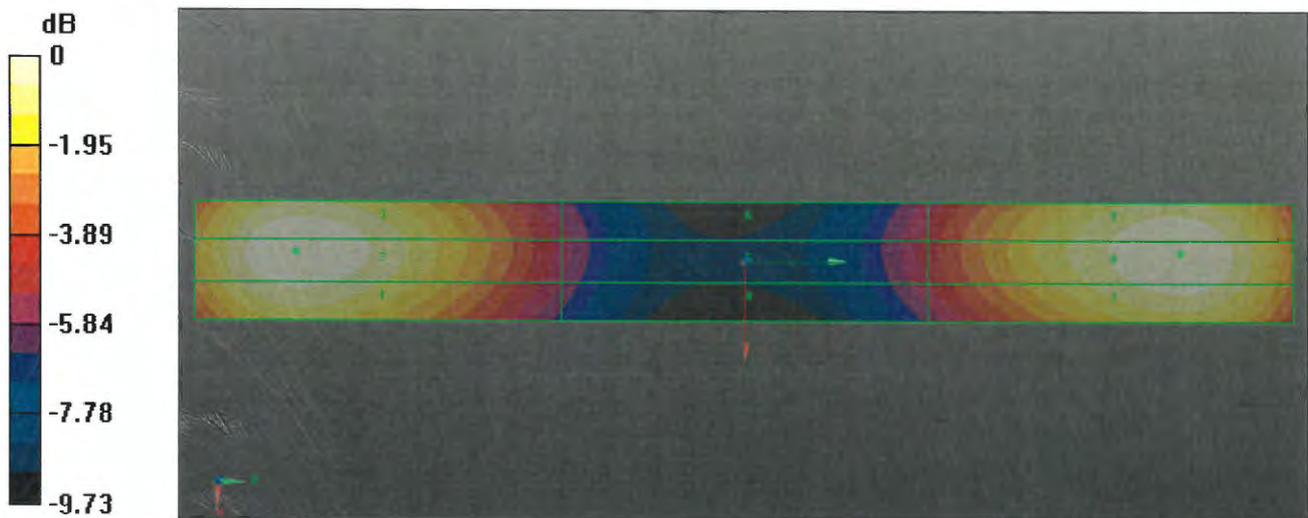
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Accreditation No.: **SCS 0108**

Client   **Auden**

Certificate No: **CD1880V3-1023_Jun18**

CALIBRATION CERTIFICATE

Object	CD1880V3 - SN: 1023
Calibration procedure(s)	**QA CAL-20.v6** **Calibration procedure for dipoles in air**
Calibration date:	**June 21, 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: June 22, 2018

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Accreditation No.: **SCS 0108**

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.

Measurement Conditions

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

DASY Version	DASY5	V52.10.1
Phantom	HAC Test Arch	
Distance Dipole Top - Probe Center	15 mm	
Scan resolution	dx, dy = 5 mm	
Frequency	1880 MHz ± 1 MHz	
Input power drift	< 0.05 dB	

Maximum Field values at 1880 MHz

E-field 15 mm above dipole surface	condition	Interpolated maximum
Maximum measured above high end	100 mW input power	89.9 V/m = 39.08 dBV/m
Maximum measured above low end	100 mW input power	87.2 V/m = 38.81 dBV/m
Averaged maximum above arm	100 mW input power	**88.6 V/m ± 12.8 % (k=2)**

Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters

Frequency	Return Loss	Impedance
1730 MHz	22.4 dB	55.8 Ω + 5.6 jΩ
1880 MHz	21.3 dB	58.9 Ω + 3.2 jΩ
1900 MHz	21.7 dB	58.9 Ω + 0.5 jΩ
1950 MHz	28.8 dB	51.5 Ω - 3.4 jΩ
2000 MHz	19.8 dB	44.0 Ω + 7.5 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

21 Jun 2018   13:33:23

CH1 S11   LOG   5 dB/ REF -18 dB   1:-21.254 dB   1 880.000 000 MHz

*

Cor

Avg
16

Hld

CH1 Markers

2:-22.395 dB
   1.73000 GHz

3:-21.701 dB
   1.90000 GHz

4:-28.833 dB
   1.95000 GHz

5:-19.819 dB
   2.00000 GHz

CH2 S11   1 U FS   1: 58.865 Ω   3.2109 Ω   271.83 pH   1 880.000 000 MHz

Cor

Avg
16

Hld

CH2 Markers

2: 55.766 Ω
   5.5977 Ω
   1.73000 GHz

3: 58.941 Ω
   0.4512 Ω
   1.90000 GHz

4: 51.459 Ω
   -3.3652 Ω
   1.95000 GHz

5: 43.963 Ω
   7.4961 Ω
   2.00000 GHz

CENTER 1 880.000 000 MHz   SPAN 1 000.000 000 MHz

DASY5 E-field Result

DUT: HAC Dipole 1880 MHz; Type: CD1880V3; Serial: CD1880V3 - SN: 1023

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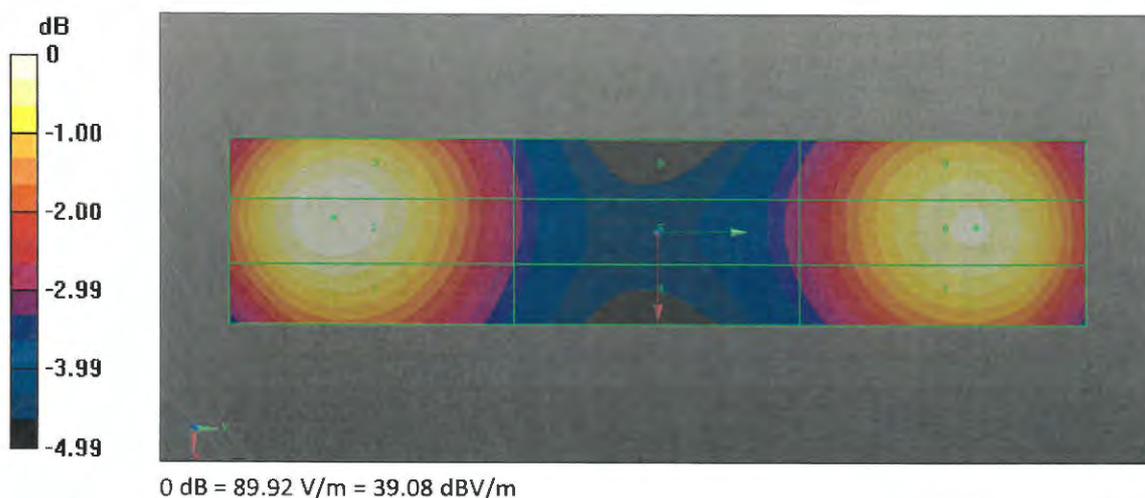Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY Configuration:

- Probe: EF3DV3 - SN4013; ConvF(1, 1, 1) @ 1880 MHz;
- 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 = 153.7 V/m; Power Drift = -0.01 dB
Applied MIF = 0.00 dB
RF audio interference level = 39.08 dBV/m
Emission category: M2

MIF scaled E-field

Grid 1 **M2**	Grid 2 **M2**	Grid 3 **M2**
38.64 dBV/m	39.08 dBV/m	39.03 dBV/m
Grid 4 **M2**	Grid 5 **M2**	Grid 6 **M2**
35.93 dBV/m	36.07 dBV/m	36.02 dBV/m
Grid 7 **M2**	Grid 8 **M2**	Grid 9 **M2**
38.57 dBV/m	38.81 dBV/m	38.7 dBV/m

0 dB = 89.92 V/m = 39.08 dBV/m

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Accreditation No.: **SCS 0108**

Client **Sporton-TW (Auden)**

Certificate No: **CD2600V3-1010_Nov17**

CALIBRATION CERTIFICATE

Object	CD2600V3 - SN: 1010
Calibration procedure(s)	**QA CAL-20.v6** **Calibration procedure for dipoles in air**
Calibration date:	**November 22, 2017**

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-17 (No. 217-02521/02522)	Apr-18
Power sensor NRP-Z91	SN: 103244	04-Apr-17 (No. 217-02521)	Apr-18
Power sensor NRP-Z91	SN: 103245	04-Apr-17 (No. 217-02522)	Apr-18
Reference 20 dB Attenuator	SN: 5058 (20k)	07-Apr-17 (No. 217-02528)	Apr-18
Type-N mismatch combination	SN: 5047.2 / 06327	07-Apr-17 (No. 217-02529)	Apr-18
Probe EF3DV3	SN: 4013	14-Jun-17 (No. EF3-4013_Jun17)	Jun-18
DAE4	SN: 781	13-Jul-17 (No. DAE4-781_Jul17)	Jul-18

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: November 23, 2017

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Accreditation No.: SCS 0108

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.

Measurement Conditions

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

DASY Version	DASY5	V52.10.0
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	85.8 V/m = 38.67 dBV/m
Maximum measured above low end	100 mW input power	84.9 V/m = 38.58 dBV/m
Averaged maximum above arm	100 mW input power	**85.4 V/m ± 12.8 % (k=2)**

Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters

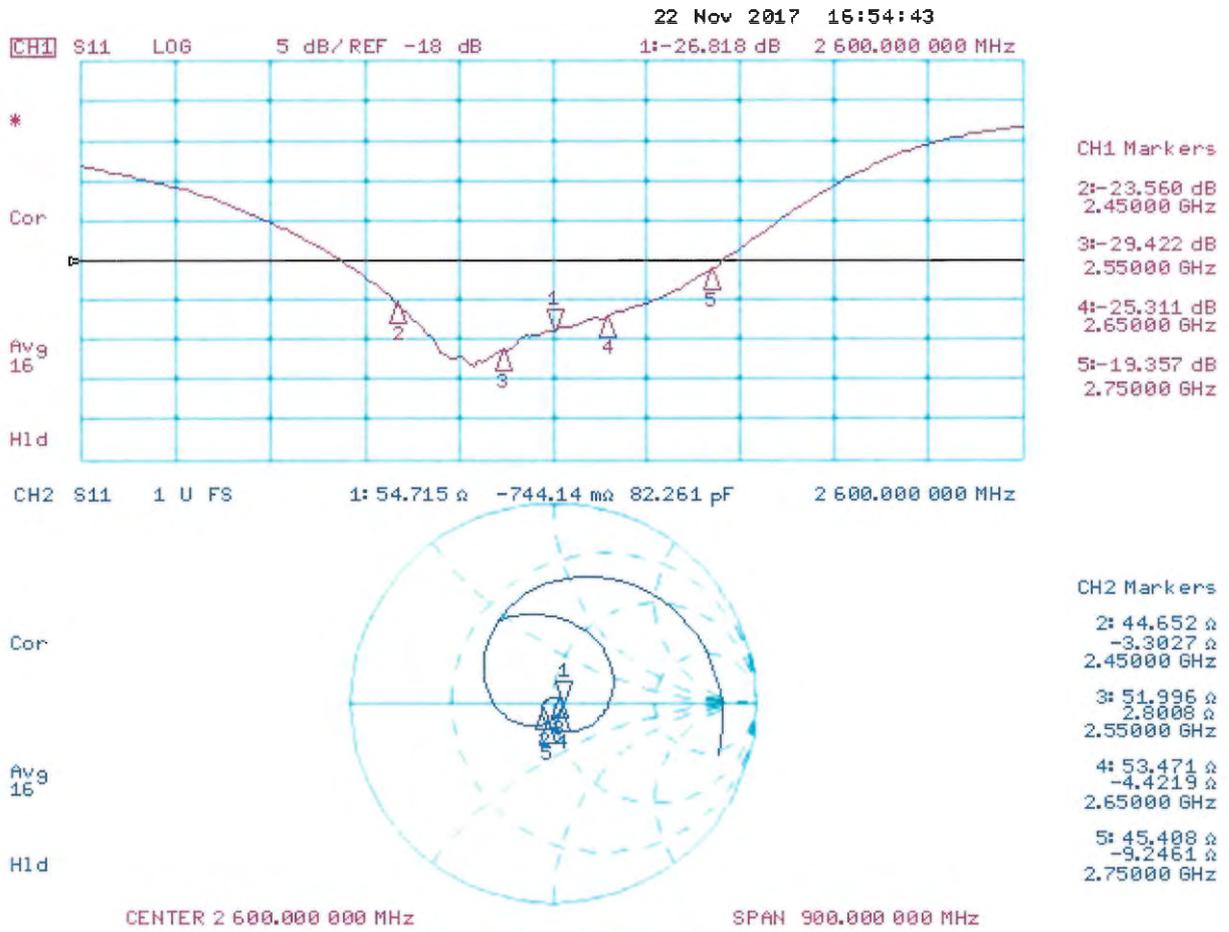| Frequency	Return Loss	Impedance
2450 MHz	23.6 dB	44.6 Ω - 3.3 jΩ
2550 MHz	29.4 dB	52.0 Ω + 2.8 jΩ
2600 MHz	26.8 dB	54.7 Ω - 0.7 jΩ
2650 MHz	25.3 dB	53.5 Ω - 4.4 jΩ
2750 MHz	19.4 dB	45.4 Ω - 9.2 jΩ

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

22 Nov 2017 16:54:43

CH1 S11 LOG 5 dB/REF -18 dB 1:-26.818 dB 2 600.000 000 MHz

CH1 Markers

2:-23.560 dB
2.45000 GHz

3:-29.422 dB
2.55000 GHz

4:-25.311 dB
2.65000 GHz

5:-19.357 dB
2.75000 GHz

CH2 S11 1 U FS 1: 54.715 Ω -744.14 mΩ 82.261 pF 2 600.000 000 MHz

CH2 Markers

2: 44.652 Ω
-3.3027 Ω
2.45000 GHz

3: 51.996 Ω
2.8008 Ω
2.55000 GHz

4: 53.471 Ω
-4.4219 Ω
2.65000 GHz

5: 45.408 Ω
-9.2461 Ω
2.75000 GHz

CENTER 2 600.000 000 MHz   SPAN 900.000 000 MHz

DASY5 E-field Result

Test Laboratory: SPEAG Lab2

DUT: HAC Dipole 2600 MHz; Type: CD2600V3; Serial: CD2600V3 - SN: 1010

Communication System: UID 0 - CW ; Frequency: 2600 MHz
Medium parameters used: $\sigma = 0$ S/m, $\varepsilon_r = 1$; $\rho = 1000$ kg/m^3
Phantom section: RF Section
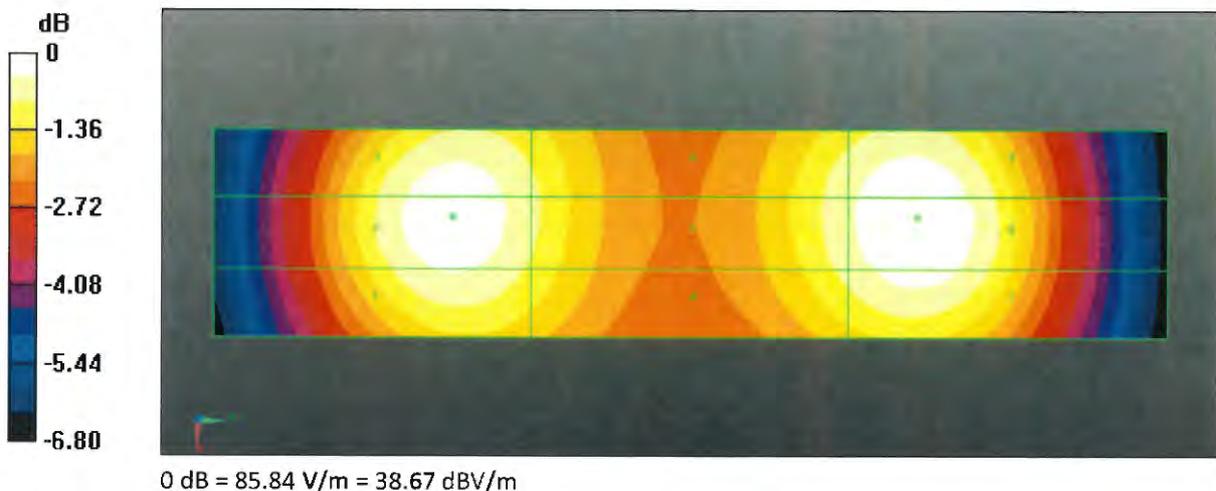Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EF3DV3 - SN4013; ConvF(1, 1, 1); Calibrated: 14.06.2017;
- Sensor-Surface: (Fix Surface)
- Electronics: DAE4 Sn781; Calibrated: 13.07.2017
- Phantom: HAC Test Arch with AMCC; Type: SD HAC P01 BA; Serial: 1070
- DASY52 52.10.0(1446); SEMCAD X 14.6.10(7417)

Dipole E-Field measurement @ 2600MHz - with EF_4013/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 = 64.99 V/m; Power Drift = -0.04 dB
Applied MIF = 0.00 dB
RF audio interference level = 38.67 dBV/m
Emission category: M2

MIF scaled E-field

Grid 1 **M2**	Grid 2 **M2**	Grid 3 **M2**
38.26 dBV/m	38.58 dBV/m	38.53 dBV/m
Grid 4 **M2**	Grid 5 **M2**	Grid 6 **M2**
37.93 dBV/m	38.15 dBV/m	38.12 dBV/m
Grid 7 **M2**	Grid 8 **M2**	Grid 9 **M2**
38.42 dBV/m	38.67 dBV/m	38.61 dBV/m

0 dB = 85.84 V/m = 38.67 dBV/m

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Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 0108**

Client   **Sporton (Auden)**

Certificate No: **ER3-2358_Jan18**

CALIBRATION CERTIFICATE

Object	ER3DV6 - SN:2358
Calibration procedure(s)	**QA CAL-02.v8, QA CAL-25.v6** **Calibration procedure for E-field probes optimized for close near field evaluations in air**
Calibration date:	**January 19, 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-17 (No. 217-02521/02522)	Apr-18
Power sensor NRP-Z91	SN: 103244	04-Apr-17 (No. 217-02521)	Apr-18
Power sensor NRP-Z91	SN: 103245	04-Apr-17 (No. 217-02525)	Apr-18
Reference 20 dB Attenuator	SN: S5277 (20x)	07-Apr-17 (No. 217-02528)	Apr-18
Reference Probe ER3DV6	SN: 2328	10-Oct-17 (No. ER3-2328_Oct17)	Oct-18
DAE4	SN: 789	2-Aug-17 (No. DAE4-789_Aug17)	Aug-18
Secondary Standards	ID	Check Date (in house)	Scheduled Check
Power meter E4419B	SN: GB41293874	06-Apr-16 (in house check Jun-16)	In house check: Jun-18
Power sensor E4412A	SN: MY41498087	06-Apr-16 (in house check Jun-16)	In house check: Jun-18
Power sensor E4412A	SN: 000110210	06-Apr-16 (in house check Jun-16)	In house check: Jun-18
RF generator HP 8648C	SN: US3642U01700	04-Aug-99 (in house check Jun-16)	In house check: Jun-18
Network Analyzer HP 8753E	SN: US37390585	18-Oct-01 (in house check Oct-17)	In house check: Oct-18

	Name	Function	Signature
Calibrated by:	Michael Weber	Laboratory Technician	
Approved by:	Katja Pokovic	Technical Manager	

Issued: January 24, 2018

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Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 0108**

Glossary:

NORMx,y,z	sensitivity in free space
DCP	diode compression point
CF	crest factor (1/duty_cycle) of the RF signal
A, B, C, D	modulation dependent linearization parameters
Polarization φ	φ rotation around probe axis
Polarization ϑ	ϑ rotation around an axis that is in the plane normal to probe axis (at measurement center), i.e., ϑ = 0 is normal to probe axis
Connector Angle	information used in DASY system to align probe sensor X to the robot coordinate system

Calibration is Performed According to the Following Standards:

a) IEEE Std 1309-2005, " IEEE Standard for calibration of electromagnetic field sensors and probes, excluding antennas, from 9 kHz to 40 GHz", December 2005
b) CTIA Test Plan for Hearing Aid Compatibility, Rev 3.0, November 2013

Methods Applied and Interpretation of Parameters:

- *NORMx,y,z:* Assessed for E-field polarization ϑ = 0 for XY sensors and ϑ = 90 for Z sensor (f ≤ 900 MHz in TEM-cell; f > 1800 MHz: R22 waveguide).

- *NORM(f)x,y,z = NORMx,y,z * frequency_response* (see Frequency Response Chart).

- *DCPx,y,z:* DCP are numerical linearization parameters assessed based on the data of power sweep with CW signal (no uncertainty required). DCP does not depend on frequency nor media.

- *PAR:* PAR is the Peak to Average Ratio that is not calibrated but determined based on the signal characteristics

- *Ax,y,z; Bx,y,z; Cx,y,z; Dx,y,z; VRx,y,z:* A, B, C, D are numerical linearization parameters assessed based on the data of power sweep for specific modulation signal. The parameters do not depend on frequency nor media. *VR* is the maximum calibration range expressed in RMS voltage across the diode.

- *Spherical isotropy (3D deviation from isotropy):* in a locally homogeneous field realized using an open waveguide setup.

- *Sensor Offset:* The sensor offset corresponds to the offset of virtual measurement center from the probe tip (on probe axis). No tolerance required.

- *Connector Angle:* The angle is assessed using the information gained by determining the *NORMx* (no uncertainty required).

Probe ER3DV6

SN:2358

Manufactured: July 7, 2005
Calibrated: January 19, 2018

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

DASY/EASY - Parameters of Probe: ER3DV6 - SN:2358

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm (μV/(V/m)^2)	1.66	1.51	1.54	± 10.1 %
DCP (mV)^B	99.2	100.2	100.5	

Modulation Calibration Parameters

UID	Communication System Name		A dB	B dB√μV	C	D dB	VR mV	Unc^E (k=2)
0	CW	X	0.0	0.0	1.0	0.00	226.7	±3.3 %
		Y	0.0	0.0	1.0		199.5	
		Z	0.0	0.0	1.0		190.1	
10021-DAC	GSM-FDD (TDMA, GMSK)	X	19.82	99.3	27.8	9.39	121.6	±2.2 %
		Y	14.37	93.3	26.1		106.4	
		Z	12.91	89.7	24.8		137.0	
10172-CAD	LTE-TDD (SC-FDMA, 1 RB, 20 MHz, QPSK)	X	10.00	85.0	32.5	9.21	147.1	±2.2 %
		Y	8.48	79.0	29.0		126.2	
		Z	7.90	75.6	26.6		117.5	
10173-CAD	LTE-TDD (SC-FDMA, 1 RB, 20 MHz, 16-QAM)	X	10.28	85.1	32.5	9.48	147.0	±2.2 %
		Y	8.76	79.2	29.0		125.8	
		Z	8.31	76.5	27.1		117.3	
10174-CAD	LTE-TDD (SC-FDMA, 1 RB, 20 MHz, 64-QAM)	X	10.72	84.7	33.4	10.25	147.7	±2.5 %
		Y	9.41	79.5	30.2		126.5	
		Z	8.84	76.3	27.8		117.9	
10295-AAB	CDMA2000, RC1, SO3, 1/8th Rate 25 fr.	X	14.87	99.4	41.3	12.49	110.4	±1.9 %
		Y	15.41	99.6	41.0		95.8	
		Z	11.45	87.5	34.5		87.4	

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

^{B} Numerical linearization parameter: uncertainty not required.
^{E} Uncertainty is determined using the max. deviation from linear response applying rectangular distribution and is expressed for the square of the field value.
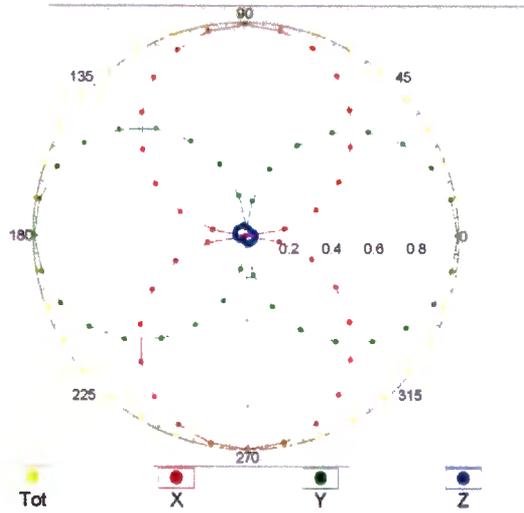
Frequency Response of E-Field
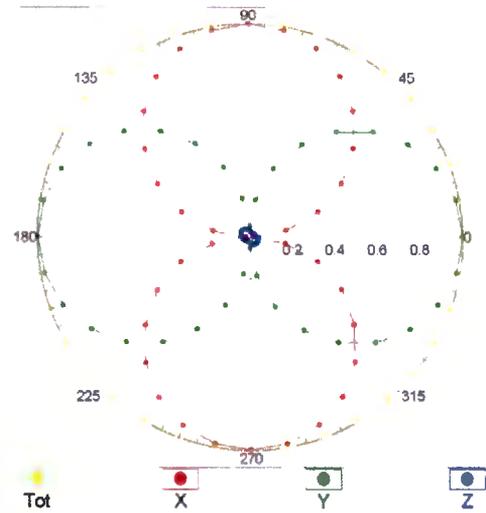## (TEM-Cell:ifi110 EXX, Waveguide: R22)
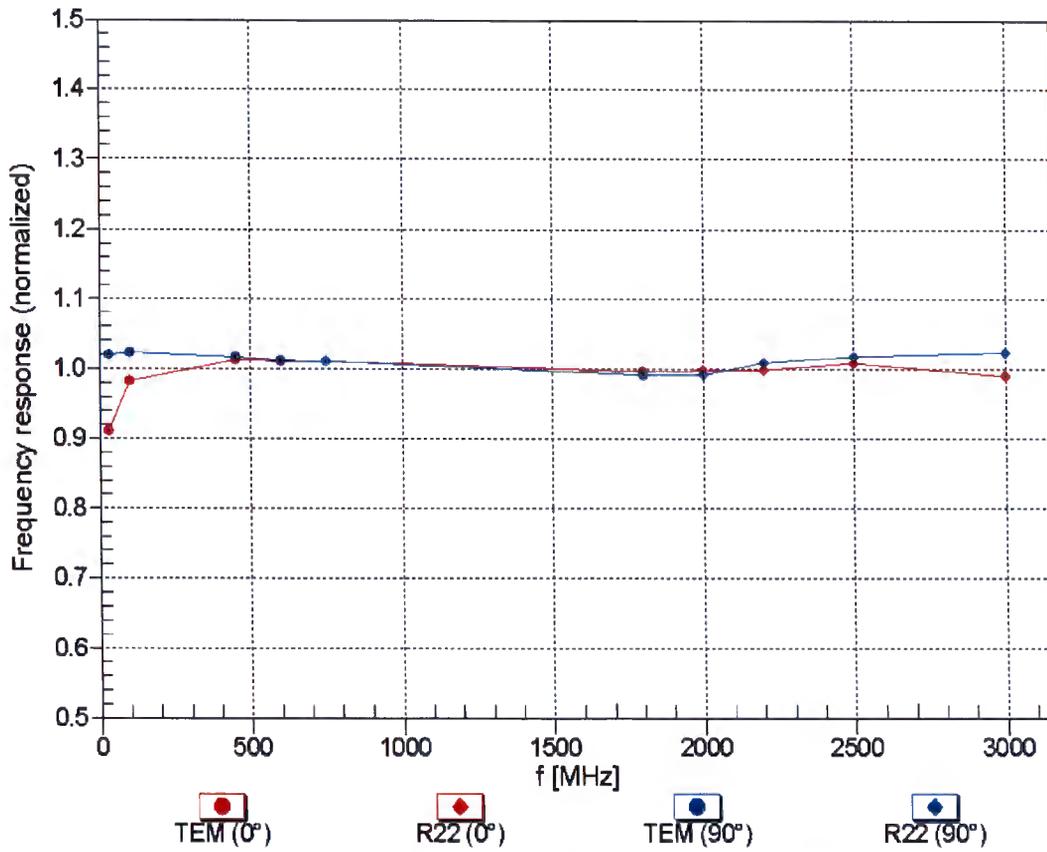
Uncertainty of Frequency Response of E-field: ± 6.3% (k=2)
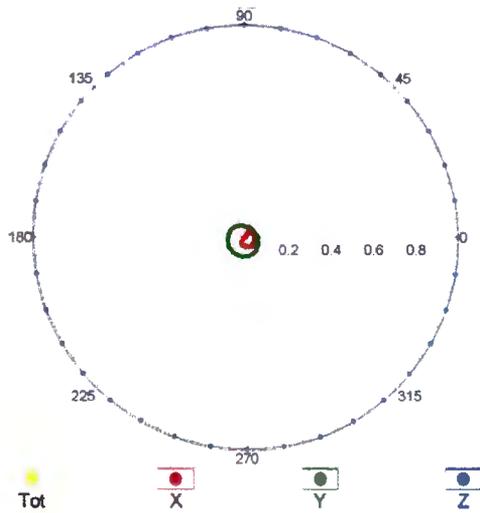
Receiving Pattern (φ), ϑ = 0°

f=600 MHz,TEM,0°

Tot   X   Y   Z

f=2500 MHz,R22,0°

Tot   X   Y   Z

Receiving Pattern (φ), ϑ = 90°

f=600 MHz,TEM,90°

Tot   X   Y   Z

f=2500 MHz,R22,90°

Tot   X   Y   Z
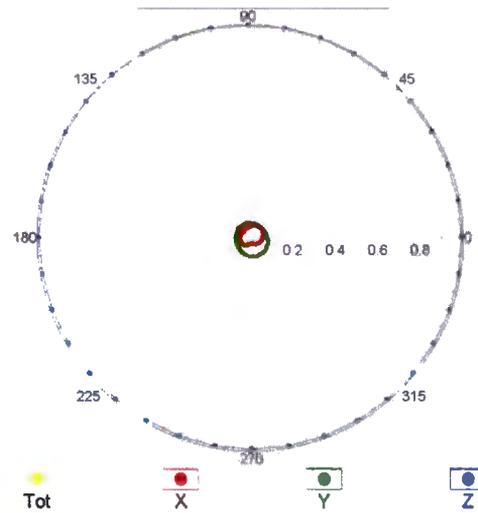
Receiving Pattern (φ), ϑ = 0°
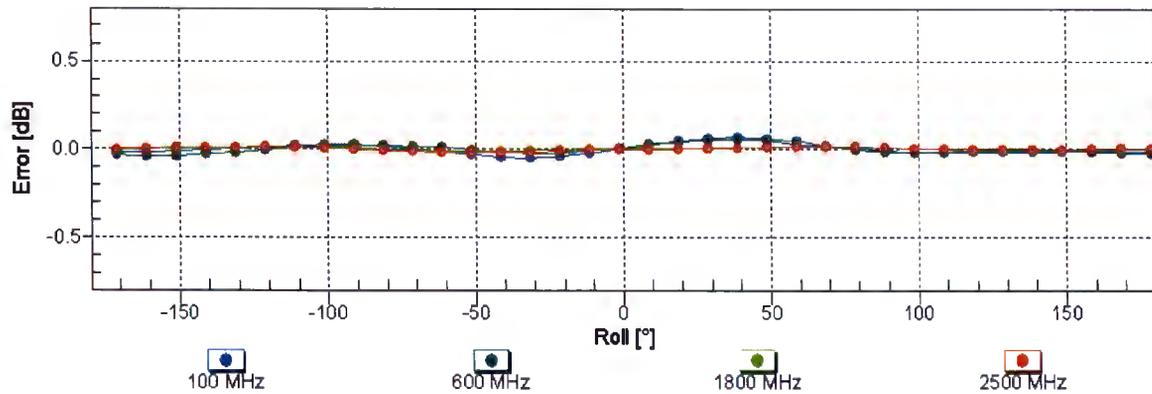
Uncertainty of Axial Isotropy Assessment: ± 0.5% (k=2)

Receiving Pattern (φ), ϑ = 90°
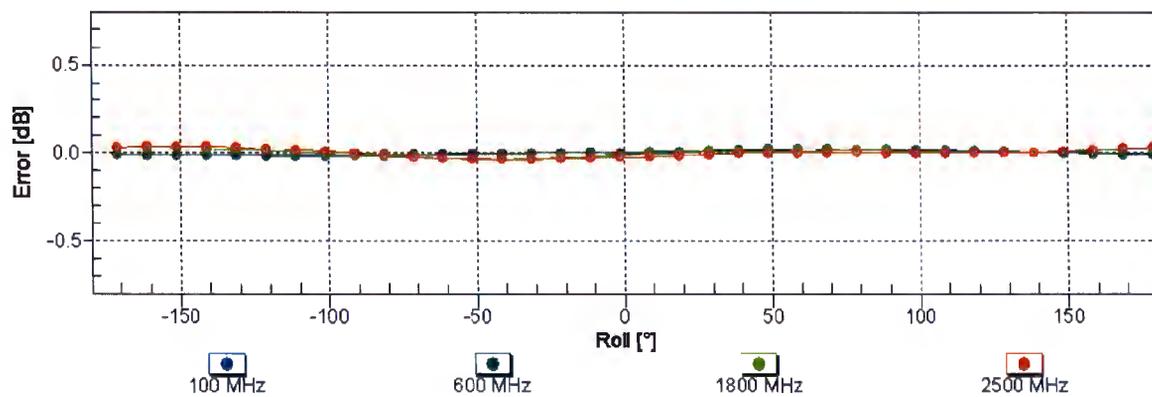
Uncertainty of Axial Isotropy Assessment: ± 0.5% (k=2)

Dynamic Range f(E-field)
(TEM cell , f = 900 MHz)

not compensated   compensated

not compensated   compensated
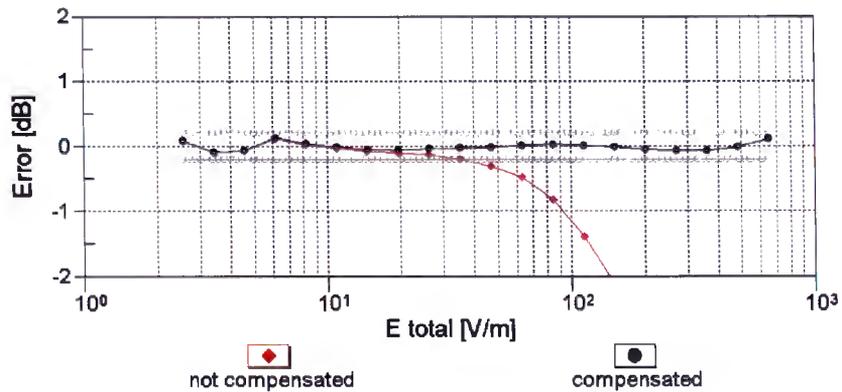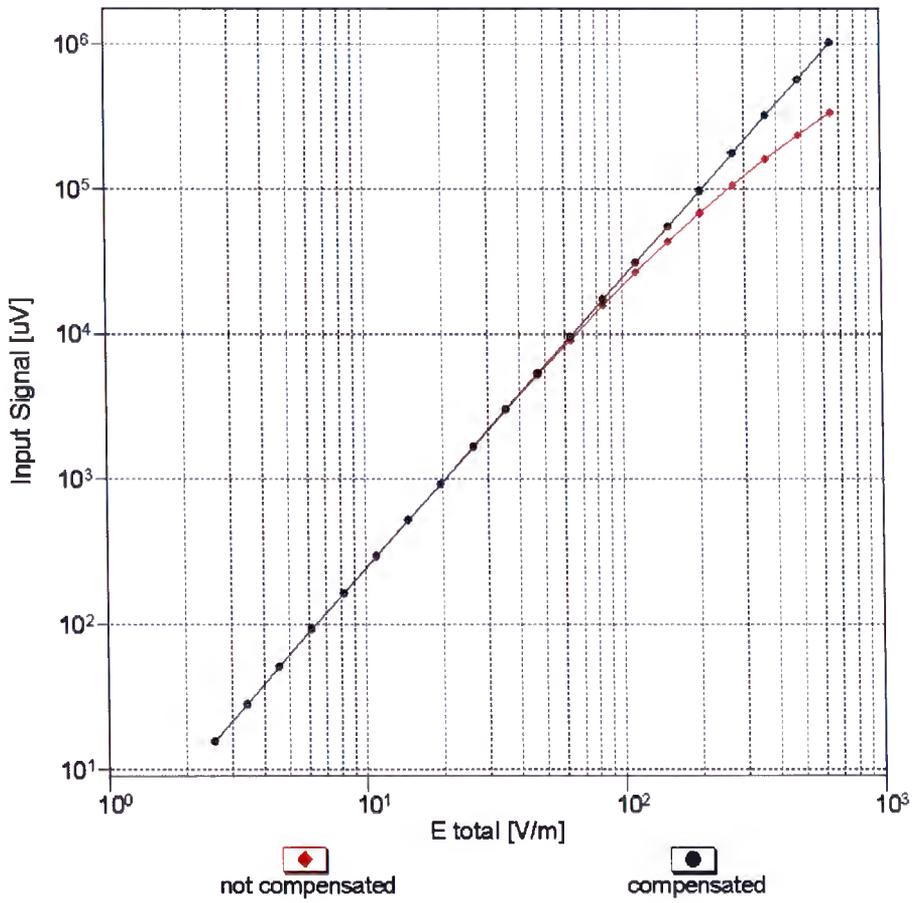
Uncertainty of Linearity Assessment: ± 0.6% (k=2)

Deviation from Isotropy in Air
Error (ϕ, ϑ), f = 900 MHz
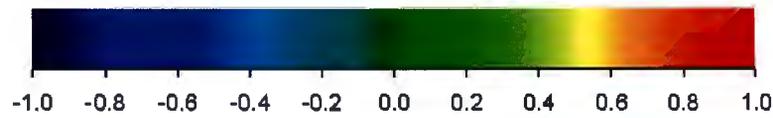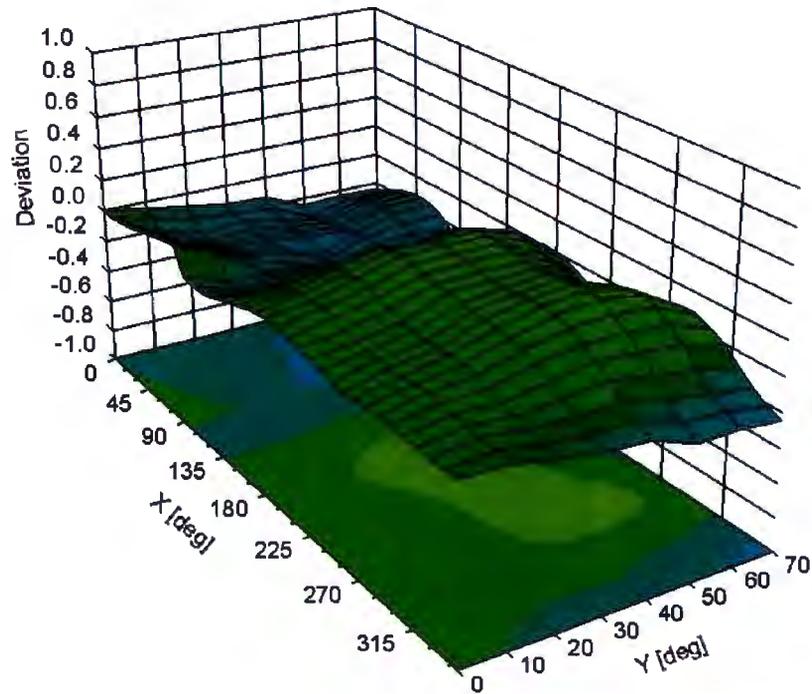
Uncertainty of Spherical Isotropy Assessment: ± 2.6% (k=2)

DASY/EASY - Parameters of Probe: ER3DV6 - SN:2358

Other Probe Parameters

Sensor Arrangement	Rectangular
Connector Angle (°)	118.7
Mechanical Surface Detection Mode	enabled
Optical Surface Detection Mode	disabled
Probe Overall Length	337 mm
Probe Body Diameter	10 mm
Tip Length	10 mm
Tip Diameter	8 mm
Probe Tip to Sensor X Calibration Point	2.5 mm
Probe Tip to Sensor Y Calibration Point	2.5 mm
Probe Tip to Sensor Z Calibration Point	2.5 mm

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Accreditation No.: **SCS 0108**

Client   **Sporton**

Certificate No: **DAE4-854_Jun18**

CALIBRATION CERTIFICATE

Object	DAE4 - SD 000 D04 BM - SN: 854
Calibration procedure(s)	QA CAL-06.v29 Calibration procedure for the data acquisition electronics (DAE)
Calibration date:	June 14, 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
Keithley Multimeter Type 2001	SN: 0810278	31-Aug-17 (No:21092)	Aug-18

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Auto DAE Calibration Unit	SE UWS 053 AA 1001	04-Jan-18 (in house check)	In house check: Jan-19
Calibrator Box V2.1	SE UMS 006 AA 1002	04-Jan-18 (in house check)	In house check: Jan-19

	Name	Function	Signature
Calibrated by:	Eric Hainfeld	Laboratory Technician	
Approved by:	Sven Kühn	Deputy Manager	

Issued: June 14, 2018

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Accreditation No.: **SCS 0108**

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 following parameters as documented in the Appendix contain technical information as a result from the performance test and require no uncertainty.

  - *DC Voltage Measurement Linearity:* Verification of the Linearity at +10% and -10% of the nominal calibration voltage. Influence of offset voltage is included in this measurement.

  - *Common mode sensitivity:* Influence of a positive or negative common mode voltage on the differential measurement.

  - *Channel separation:* Influence of a voltage on the neighbor channels not subject to an input voltage.

  - *AD Converter Values with inputs shorted:* Values on the internal AD converter corresponding to zero input voltage

  - *Input Offset Measurement:* Output voltage and statistical results over a large number of zero voltage measurements.

  - *Input Offset Current:* Typical value for information; Maximum channel input offset current, not considering the input resistance.

  - *Input resistance:* Typical value for information: DAE input resistance at the connector, during internal auto-zeroing and during measurement.

  - *Low Battery Alarm Voltage:* Typical value for information. Below this voltage, a battery alarm signal is generated.

  - *Power consumption:* Typical value for information. Supply currents in various operating modes.

DC Voltage Measurement

A/D - Converter Resolution nominal

High Range:	1LSB =	6.1μV ,	full range =	-100...+300 mV
Low Range:	1LSB =	61nV ,	full range =	-1.......+3mV

DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec

Calibration Factors	X	Y	Z
High Range	404.937 ± 0.02% (k=2)	404.730 ± 0.02% (k=2)	405.829 ± 0.02% (k=2)
Low Range	3.97284 ± 1.50% (k=2)	3.94535 ± 1.50% (k=2)	3.99553 ± 1.50% (k=2)

Connector Angle

Connector Angle to be used in DASY system	325.0 ° ± 1 °

Appendix (Additional assessments outside the scope of SCS0108)

1. DC Voltage Linearity

High Range		Reading (µV)	Difference (µV)	Error (%)
Channel X	+ Input	200033.40	-4.54	-0.00
Channel X	+ Input	20004.28	-1.77	-0.01
Channel X	- Input	-20002.65	2.58	-0.01
Channel Y	+ Input	200036.32	-2.03	-0.00
Channel Y	+ Input	20002.05	-3.86	-0.02
Channel Y	- Input	-20005.10	0.28	-0.00
Channel Z	+ Input	200036.91	-1.46	-0.00
Channel Z	+ Input	20003.85	-2.05	-0.01
Channel Z	- Input	-20005.17	0.36	-0.00

Low Range		Reading (µV)	Difference (µV)	Error (%)
Channel X	+ Input	2002.16	0.22	0.01
Channel X	+ Input	202.15	0.38	0.19
Channel X	- Input	-198.29	-0.31	0.16
Channel Y	+ Input	2001.95	0.27	0.01
Channel Y	+ Input	201.01	-0.63	-0.31
Channel Y	- Input	-198.91	-0.79	0.40
Channel Z	+ Input	2001.73	-0.08	-0.00
Channel Z	+ Input	200.57	-1.12	-0.56
Channel Z	- Input	-199.68	-1.47	0.74

2. Common mode sensitivity

DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec

	Common mode Input Voltage (mV)	High Range Average Reading (µV)	Low Range Average Reading (µV)
Channel X	200	-11.94	-13.63
	- 200	15.47	13.71
Channel Y	200	-8.45	-8.32
	- 200	7.64	7.27
Channel Z	200	16.23	16.03
	- 200	-18.86	-19.07

3. Channel separation

DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec

	Input Voltage (mV)	Channel X (µV)	Channel Y (µV)	Channel Z (µV)
Channel X	200	-	1.45	-3.45
Channel Y	200	7.54	-	3.39
Channel Z	200	9.04	5.14	-

4. AD-Converter Values with inputs shorted

DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec

	High Range (LSB)	Low Range (LSB)
Channel X	16138	16479
Channel Y	16030	14603
Channel Z	15846	16180

5. Input Offset Measurement

DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec
Input 10MΩ

	Average (μV)	min. Offset (μV)	max. Offset (μV)	Std. Deviation (μV)
Channel X	0.51	-0.22	1.41	0.30
Channel Y	1.02	-0.44	1.87	0.35
Channel Z	0.62	-0.69	1.46	0.38

6. Input Offset Current .

Nominal Input circuitry offset current on all channels: <25fA

7. Input Resistance (Typical values for information)

	Zeroing (kOhm)	Measuring (MOhm)
Channel X	200	200
Channel Y	200	200
Channel Z	200	200

8. Low Battery Alarm Voltage (Typical values for information)

Typical values	Alarm Level (VDC)
Supply (+ Vcc)	+7.9
Supply (- Vcc)	-7.6

9. Power Consumption (Typical values for information)

Typical values	Switched off (mA)	Stand by (mA)	Transmitting (mA)
Supply (+ Vcc)	+0.01	+6	+14
Supply (- Vcc)	−0.01	-8	-9