



# HEARING AID COMPATIBILITY RF EMISSIONS TEST REPORT

FCC ID : MSQAI2205  
Equipment : ASUS Phone (Mobile Phone)  
Brand Name : ASUS  
Model Name : ASUS\_AI2205\_E 、 ASUS\_AI2205\_F  
M-Rating : M3  
Applicant : ASUSTeK COMPUTER INC.  
1F., No. 15, Lide Rd., Beitou Dist., Taipei City 112, Taiwan  
Manufacturer : ASUSTeK COMPUTER INC.  
1F., No. 15, Lide Rd., Beitou Dist., Taipei City 112, Taiwan  
Standard : FCC 47 CFR §20.19  
ANSI C63.19-2011

The product was received on Jan. 06, 2023 and testing was started from Mar. 02, 2023 and completed on Mar. 17, 2023. We, SPORTON INTERNATIONAL INC., would like to declare that the tested sample provide by manufacturer and the test data has been evaluated in accordance with the test procedures given in ANSI 63.19-2011 / 47 CFR Part 20.19 and has been pass the FCC requirement.

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

Approved by: Cona Huang / Deputy Manager

**SPORTON INTERNATIONAL INC. EMC & Wireless Communications Laboratory**  
No. 52, Huaya 1st Rd., Guishan Dist., Taoyuan City



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### History of this test report

Report No.	Version	Description	Issued Date
HA2D2824A	Rev. 01	Initial issue of report	Mar. 31, 2023



1. General Information

Product Feature & Specification	
Applicant Name	ASUSTeK COMPUTER INC.
Equipment Name	ASUS Phone (Mobile Phone)
Brand Name	ASUS
Model Name	ASUS_AI2205_E \ ASUS_AI2205_F
FCC ID	MSQAI2205
S/N	NCAIOCN06267RRX
Frequency Band	GSM850: 824.2 MHz ~ 848.8 MHz GSM1900: 1850.2 MHz ~ 1909.8 MHz WCDMA Band II: 1850 MHz ~ 1910 MHz WCDMA Band IV: 1710 MHz ~ 1755 MHz WCDMA Band V: 824 MHz ~ 849 MHz LTE Band 2: 1850 MHz ~ 1910 MHz LTE Band 4: 1710 MHz ~ 1755 MHz LTE Band 5: 824 MHz ~ 849 MHz LTE Band 7: 2500 MHz ~ 2570 MHz LTE Band 12: 699 MHz ~ 716 MHz LTE Band 17: 704 MHz ~ 716 MHz LTE Band 25: 1850 MHz ~ 1915 MHz LTE Band 26: 814 MHz ~ 849 MHz LTE Band 30: 2305 MHz ~ 2315 MHz LTE Band 38: 2570 MHz ~ 2620 MHz LTE Band 41: 2496 MHz ~ 2690 MHz LTE Band 48: 3550 MHz ~ 3700 MHz LTE Band 66: 1710 MHz ~ 1780 MHz LTE Band 71: 663 MHz ~ 698 MHz 5G NR n2 : 1850 MHz ~ 1910 MHz 5G NR n5 : 824 MHz ~ 849 MHz 5G NR n7 : 2500 MHz ~ 2570 MHz 5G NR n12 : 699 MHz ~ 716 MHz 5G NR n25 : 1850 MHz ~ 1915 MHz 5G NR n26 : 814 MHz ~ 849 MHz 5G NR n30 : 2305 MHz ~ 2315 MHz 5G NR n38 : 2570 MHz ~ 2620 MHz 5G NR n41 : 2496 MHz ~ 2690 MHz 5G NR n48 : 3550 MHz ~ 3700 MHz 5G NR n66 : 1710 MHz ~ 1780 MHz 5G NR n71 : 663 MHz ~ 698 MHz 5G NR n77: 3700 MHz ~ 3980 MHz, 3450MHz ~ 3550MHz WLAN 2.4GHz Band: 2400 MHz ~ 2483.5 MHz WLAN 5.2G Band: 5150 MHz ~ 5250 MHz WLAN 5.3G Band: 5250 MHz ~ 5350 MHz WLAN 5.5G Band: 5470 MHz ~ 5725 MHz WLAN 5.8G Band: 5725 MHz ~ 5850 MHz WLAN 6E: 5925MHz~6425MHz, 6425MHz~6525MHz, 6525MHz~6875 MHz, 6875 MHz~7125 MHz Bluetooth: 2400 MHz ~ 2483.5 MHz NFC : 13.56 MHz
Mode	GSM/GPRS/EGPRS RMC/AMR 12.2Kbps HSDPA HSUPA DC-HSDPA LTE: QPSK, 16QAM, 64QAM, 256QAM 5G NR: DFT-s-OFDM/CP-OFDM, Pi/2 BPSK/QPSK/16QAM/64QAM/256QAM WLAN: 802.11a/b/g/n/ac/ax/be HT20/HT40/VHT20/VHT40/VHT80/VHT160/HE20/HE40/HE80/HE160/EHT20/EHT40/EHT80/EHT160 Bluetooth BR/EDR/LE NFC:ASK
HW Version	R2.0
SW Version	Android 13

Reviewed by: Jason Wang  
Report Producer: Paula Chen



Sample	Sample 1	Sample 2	Sample 3	Sample 4
Model name	ASUS_AI2205_F	ASUS_AI2205_E	ASUS_AI2205_F	ASUS_AI2205_E
Config.	US(Pro)	US(Entry)	US(Pro)	US(Entry)
RF module board	US(Pro)	US(Entry)	US(Pro)	US(Entry)
LCD+Touch front frame	AI2205 FRONT CASE ASSY WW	AI2205 FRONT CASE ASSY WW	AI2205 FRONT CASE ASSY WW	AI2205 FRONT CASE ASSY WW
DDR	16G(Micron) Micron / MT62F2G64D8CL-023 WT:B	16G(Micron) Micron / MT62F2G64D8CL-023 WT:B	16G(Micron) Micron / MT62F2G64D8CL-023 WT:B	16G(Micron) Micron / MT62F2G64D8CL-023 WT:B
UFS	512G(Kioxia)(UFS4.0) Kioxia / THGJFJT2T85BAT0	512G(Samsung)(UFS4.0) Samsung / KLUFG8RHHD-B0G1	512G(Kioxia)(UFS4.0) Kioxia / THGJFJT2T85BAT0	512G(Samsung)(UFS4.0) Samsung / KLUFG8RHHD-B0G1
MB	AI2205_MB	AI2205_MB	AI2205_MB	AI2205_MB
Back Cover SKU	WW-Dark-Ult	WW-Light-Entry	WW-Dark-Ult	WW-Light-Entry
Battery	SCUD / C21P2101	SWD / C21P2101	SWD / C21P2101	SCUD / C21P2101
Rear Camera 50+13M	SHINETECH/CDN60B	TRIPLEWIN/CASDA-002A1	TRIPLEWIN/CASDA-002A1	SHINETECH/CDN60B
Front Camera 32M	TSPRECISION/TVHF2170	SHINETECH/ST-CMG07B	SHINETECH/ST-CMG07B	TSPRECISION/TVHF2170
Rear Camera 5M	HUNAN KINGCOME/KBFE378	TSPRECISION/TV8F2224	TSPRECISION/TV8F2224	HUNAN KINGCOME/KBFE378
PCB	COMPEQ	COMPEQ	COMPEQ	COMPEQ
CPU	QUALCOMM MPSP1581 / SM-8550 MPSP1581 CS	QUALCOMM MPSP1581 / SM-8550 MPSP1581 CS	QUALCOMM MPSP1581 / SM-8550 MPSP1581 CS	QUALCOMM MPSP1581 / SM-8550 MPSP1581 CS



### 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 TEL: +886-3-327-3456 FAX: +886-3-328-4978
Test Site No.	Sporton Site No.: <b>SAR04-HY</b>

### 3. Applied Standards

- FCC CFR47 Part 20.19
- ANSI C63.19-2011
- FCC KDB 285076 D01 HAC Guidance v06r02
- FCC KDB 285076 D03 HAC FAQ v01r06

### 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)

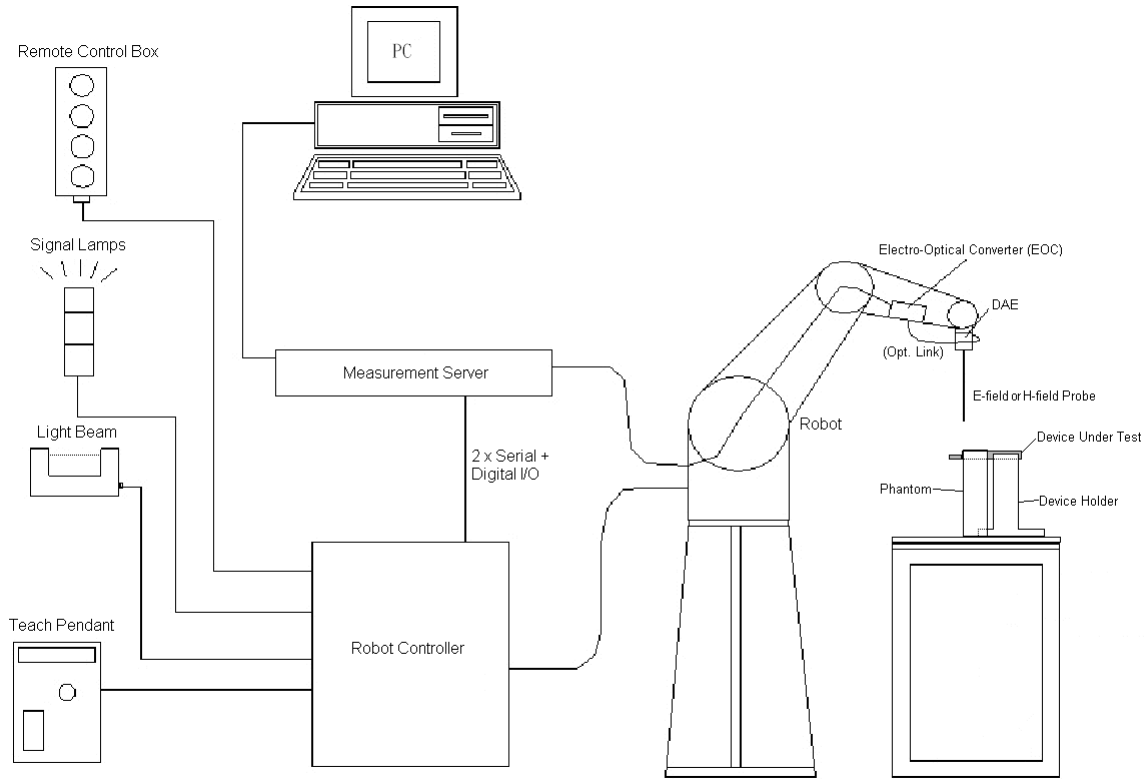
Table 5.1 Telephone near-field categories in linear units



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		
WCDMA	Band II	VO	No <sup>(1)</sup>	WLAN, BT	CMRS Voice	No
	Band IV			WLAN, BT		No
	Band V	VD	No <sup>(1)</sup>	WLAN, BT	Google Duo	No
	HSPA			WLAN, BT		No
LTE (FDD)	Band 2	VD	No <sup>(1)</sup>	5G NR, WLAN, BT	VoLTE / Google Duo	No
	Band 4			5G NR, WLAN, BT		No
	Band 5			5G NR, WLAN, BT		No
	Band 7			5G NR, WLAN, BT		No
	Band 12			5G NR, WLAN, BT		No
	Band 17			5G NR, WLAN, BT		No
	Band 25			5G NR, WLAN, BT		No
	Band 26			5G NR, WLAN, BT		No
	Band 30			5G NR, WLAN, BT		No
	Band 66			5G NR, WLAN, BT		No
	Band 71			5G NR, WLAN, BT		No
LTE (TDD)	Band 38	VD	Yes	5G NR, WLAN, BT	VoLTE / Google Duo	No
	Band 41			5G NR, WLAN, BT		No
	Band 48			5G NR, WLAN, BT		No
5G NR (FDD)	n2	VD	No <sup>(1)</sup>	LTE, WLAN, BT	Google Duo	No
	n5			LTE, WLAN, BT		No
	n7			LTE, WLAN, BT		No
	n12			LTE, WLAN, BT		No
	n25			LTE, WLAN, BT		No
	n26			LTE, WLAN, BT		No
	n30			LTE, WLAN, BT		No
	n66			LTE, WLAN, BT		No
n71	LTE, WLAN, BT	No				
5G NR (TDD)	n38	VD	No <sup>(1)</sup>	LTE, WLAN, BT	Google Duo	No
	n41		Yes	LTE, WLAN, BT		No
	n48		No <sup>(1)</sup>	LTE, WLAN, BT		No
	n77		Yes	LTE, WLAN, BT		No
Wi-Fi	2450	VD	Yes	GSM,WCDMA,LTE,5G NR,5G/6G WLAN	VoWiFi / Google Duo	No
	5200			GSM,WCDMA,LTE,5G NR,2.4G WLAN, BT		No
	5300			GSM,WCDMA,LTE,5G NR,2.4G WLAN, BT		No
	5500			GSM,WCDMA,LTE,5G NR,2.4G WLAN, BT		No
	5800	GSM,WCDMA,LTE,5G NR,2.4G WLAN, BT	No			
	U-NII 5	VD	Yes <sup>(3)</sup>	GSM,WCDMA,LTE,5G NR,2.4G WLAN, BT	VoWiFi / Google Duo	No
	U-NII 6		No <sup>(2)</sup>	GSM,WCDMA,LTE,5G NR,2.4G WLAN, BT		No
	U-NII 7			GSM,WCDMA,LTE,5G NR,2.4G WLAN, BT		No
U-NII 8	GSM,WCDMA,LTE,5G NR,2.4G WLAN, BT			No		
BT	2450	DT	No	GSM,WCDMA,LTE,5G NR,5G/6G WLAN	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 U-NII 6/7/8 were above 6GHz and were not evaluated due to outside of the current scope of ANSI C63.19 and FCC HAC regulations. 3. The UNII-5 was evaluated for operations which are entirely below 6 GHz, above 6 GHz were not evaluated due outside of the current scope of ANSI C63.19 and FCC HAC regulations.						

## 6. Measurement System Specification



**Fig 5.1 System Configurations**

### 6.1 E-Field Probe System

#### E-Field Probe Specification

<ER3DV6>

<b>Construction</b>	One dipole parallel, two dipoles normal to probe axis Built-in shielding against static charges
<b>Calibration</b>	In air from 100 MHz to 3.0 GHz (absolute accuracy $\pm 6.0\%$ , $k=2$ )
<b>Frequency</b>	100 MHz to 6 GHz; Linearity: $\pm 2.0$ dB (100 MHz to 3 GHz)
<b>Directivity</b>	$\pm 0.2$ dB in air (rotation around probe axis) $\pm 0.4$ dB in air (rotation normal to probe axis)
<b>Dynamic Range</b>	2 V/m to 1000 V/m (M3 or better device readings fall well below diode compression point)
<b>Linearity</b>	$\pm 0.2$ dB
<b>Dimensions</b>	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 DASYS 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.

<b>Probe parameters :</b>	- Sensitivity	Norm <sub>i</sub> , a <sub>i0</sub> , a <sub>i1</sub> , a <sub>i2</sub>
	- Conversion factor	ConvF <sub>i</sub>
	- Diode compression point	dcp <sub>i</sub>
<b>Device parameters :</b>	- Frequency	f
	- Crest factor	cf
<b>Media parameters :</b>	- 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<sub>i</sub> = compensated signal of channel i, (i = x, y, z)
- U<sub>i</sub> = input signal of channel i, (i = x, y, z)
- cf = crest factor of exciting field (DASY parameter)
- dcp<sub>i</sub> = diode compression point (DASY parameter)

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

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

- with V<sub>i</sub> = compensated signal of channel i, (i = x, y, z)
- Norm<sub>i</sub> = sensor sensitivity of channel i, (i = x, y, z), μV/(V/m)<sup>2</sup> for E-field Probes
- ConvF = sensitivity enhancement in solution
- f = carrier frequency [GHz]
- E<sub>i</sub> = 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.

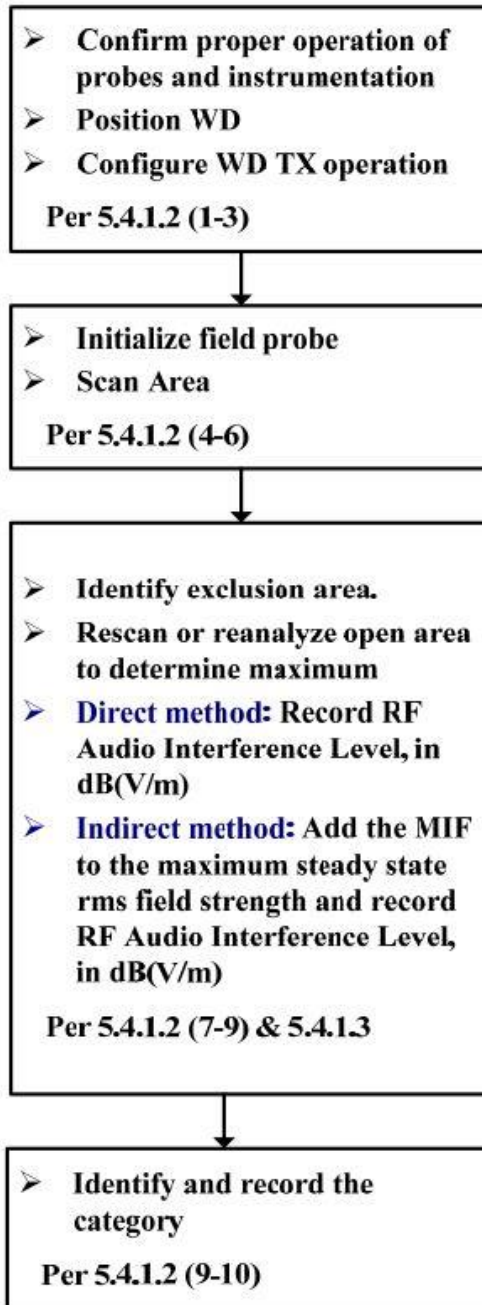


## **7. RF Emissions Test Procedure**

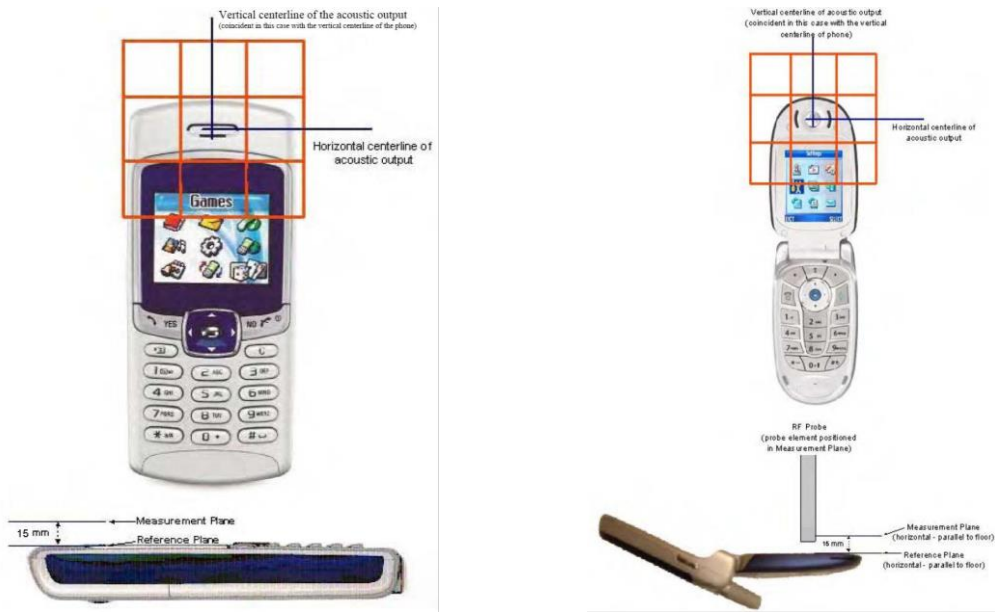
Referenced from ANSI C63.19 -2011 section 5.5.1

- 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  $\geq 5.0$  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.

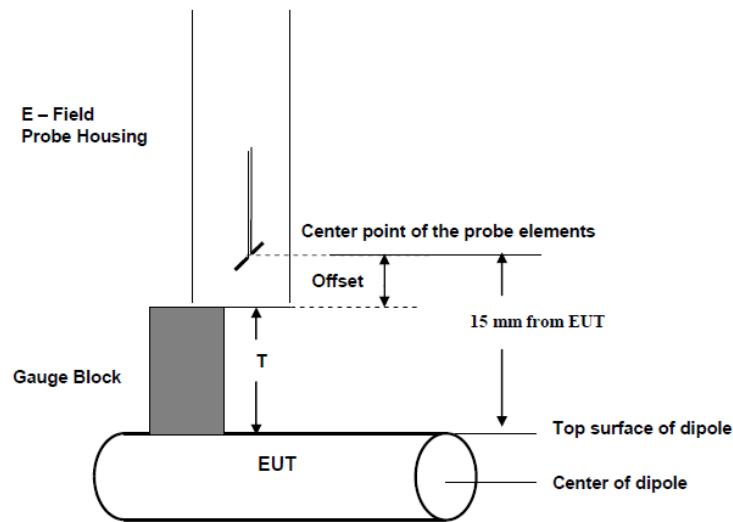
**Test Instructions**



**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	1182	Apr. 20, 2022	Apr. 19, 2023
SPEAG	1880MHz Calibration Dipole	CD1880V3	1168	Apr. 20, 2022	Apr. 19, 2023
SPEAG	2450MHz Calibration Dipole	CD2450V3	1039	Apr. 20, 2022	Apr. 19, 2023
SPEAG	2600Mhz Calibration Dipole	CD2600V3	1010	Apr. 20, 2022	Apr. 19, 2023
SPEAG	3500Mhz Calibration Dipole	CD3500V3	1009	Mar. 03, 2022	Mar. 02, 2023
SPEAG	5500Mhz Calibration Dipole	CD5500V3	1024	Sep. 05, 2022	Sep. 04, 2023
SPEAG	Data Acquisition Electronics	DAE4	376	Oct. 19, 2022	Oct. 18, 2023
SPEAG	Isotropic E-Field Probe	EF3DV3	4047	Jan. 17, 2023	Jan. 16, 2024
SPEAG	Audio Magnetic 1D Field Probe	AM1DV3	3130	Aug. 26, 2022	Aug. 25, 2023
Testo	Hygro meter	608-H1	45196600	Nov. 02, 2022	Nov. 01, 2023
R&S	Wideband Radio Communication Tester	CMW500	169351	Oct. 18, 2022	Oct. 17, 2023
SPEAG	Test Arch Phantom	N/A	N/A	NCR	NCR
SPEAG	Phone Positioner	N/A	N/A	NCR	NCR
Anritsu	Signal Generator	MG3710A	6201502524	Oct. 12, 2022	Oct. 11, 2023
Anritsu	Power Meter	ML2495A	1419002	Aug. 16, 2022	Aug. 15, 2023
Anritsu	Power Sensor	MA2411B	1911176	Aug. 16, 2022	Aug. 15, 2023
Anritsu	Power Meter	ML2496A	2119003	Jun. 22, 2022	Jun. 21, 2023
Anritsu	Power Sensor	MA2411B	1726150	Oct. 17, 2022	Oct. 16, 2023
ATM	Dual Directional Coupler	C122H-10	P610410z-02	NCR	NCR
Woken	Attenuator	WK0602-XX	N/A	NCR	NCR
Anritsu	Spectrum Analyzer	MS2830A	6201396378	Jul. 21, 2022	Jul. 20, 2023
Anritsu	Spectrum Analyzer	N9010A	MY53470118	Jan. 10, 2023	Jan. 09, 2024
Mini-Circuits	Power Amplifier	ZVE-8G+	6418	Oct. 14, 2022	Oct. 13, 2023
Mini-Circuits	Power Amplifier	ZVE-8G+	479102029	Sep. 15, 2022	Sep. 14, 2023

**Note:**

1. NCR: "No-Calibration Required"
2. The dipole calibration interval can be extended to 3 years with justification according to KDB 865664 D01. The dipoles are also not physically damaged, or repaired during the interval. The justification data in appendix C can be found which the return loss is < -20dB, within 20% of prior calibration, the impedance is within 5 ohm of prior calibration for each dipole.

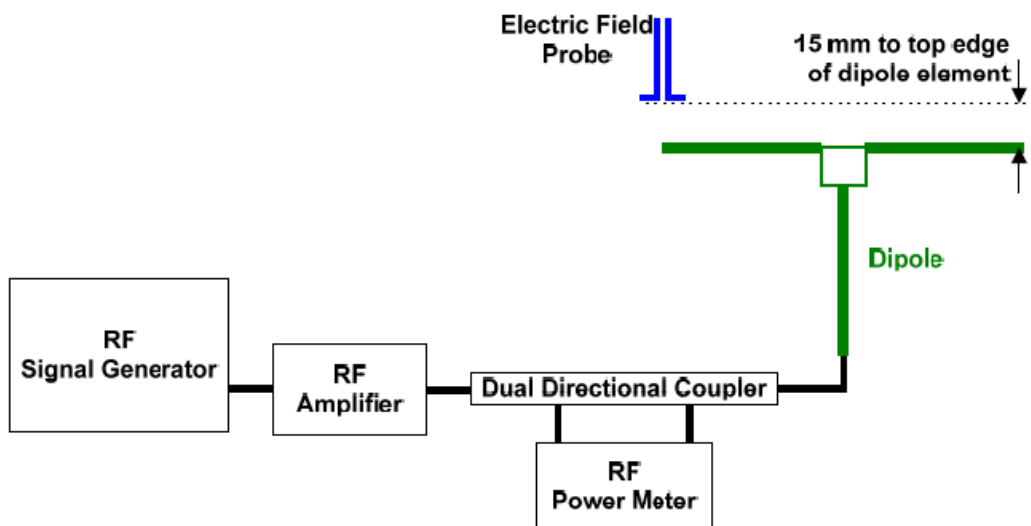
## 9. Measurement System Validation

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.

### <Test Setup>

1. In the simplified setup for system evaluation, the EUT is replaced by a calibrated dipole and the power source is replaced by a continuous wave which comes from a signal generator.
2. The center point of the probe element(s) is 15mm from the closest surface of the dipole elements.
3. The calibrated dipole must be placed beneath the arch phantom. The equipment setup is shown below:
4. The output power on dipole port must be calibrated to 20dBm (100mW) before dipole is connected.



**Fig. 7.1 Setup Diagram**

### <Validation Results>

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

$$\text{Deviation} = ((\text{Average E-field Value}) - (\text{Target value})) / (\text{Target value}) * 100\%$$

Frequency (MHz)	Input Power (dBm)	Target Value (V/m)	E-Field 1 (V/m)	E-Field 2 (V/m)	Average Value (V/m)	Deviation (%)	Date
835	20	109.9	120.3	112.6	116.45	5.96	Mar. 02, 2023
1880	20	86.6	91.61	88.55	90.08	4.02	Mar. 02, 2023
2450	20	85.5	88.69	87.55	88.12	3.06	Mar. 15, 2023
2450	20	85.5	88.78	87.24	88.01	2.94	Mar. 17, 2023
2600	20	82.9	88.41	86.77	87.59	5.66	Mar. 02, 2023
3500	20	83.4	85.79	86.23	86.01	3.13	Mar. 02, 2023
5500	20	100.2	89.98	95.18	92.58	-7.60	Mar. 15, 2023



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 alternatively 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.

Table with 3 columns: UID, Communication System Name, MIF(dB). Rows include GSM-FDD, EDGE-FDD, UMTS-FDD, LTE-FDD, LTE-TDD, and various 5G NR and IEEE WiFi standards.



**11. Low-power Exemption**

<Max Tune-up Limit>

Modem B		
	Frequency Band	Average Power (dBm)
GSM	GSM850_Ant 0	34.50
	EDGE850_Ant 0	28.50
	GSM1900_Ant 1	31.50
	EDGE1900_Ant 1	27.50
WCDMA	Band II_Ant 1	26.00
	Band IV_Ant 1	26.00
	Band V_Ant 0	26.00
	HSPA	25.00
FDD LTE	Band 2_Ant 1	26.00
	Band 4_Ant 1	26.00
	Band 5_Ant 0	26.00
	Band 7_Ant 1	26.00
	Band 12_Ant 0	26.00
	Band 17_Ant 0	26.00
	Band 25_Ant 1	26.00
	Band 26_Ant 0	26.00
	Band 30_Ant 1	23.50
	Band 66_Ant 1	26.00
TDD LTE	Band 71_Ant 0	26.00
	Band 38_Ant 1	26.00
	Band 41_Ant 1	26.00
	Band 41 HPUE_Ant 1	27.50
5G NR FDD	Band 48_Ant 8	23.50
	n2_Ant 1	26.00
	n5_Ant 0	26.00
	n7_Ant 1	26.00
	n12_Ant 0	26.00
	n25_Ant 1	26.00
	n26_Ant 0	26.00
	n30_Ant 1	22.50
n66_Ant 1	26.00	
5G NR TDD	n71_Ant 0	26.00
	n38_Ant 8	26.00
	n41_Ant 8	26.00
	n41 HPUE_Ant 8(50% Duty)	27.50
	n41_MIMO_Ant 8+1	23.00
	n48_Ant 8	22.50
n77_Ant 8	26.00	
	n77 HPUE_Ant 8(50% Duty)	27.50





Modem C		
Frequency Band		Average Power (dBm)
WCDMA	Band II_Ant 2	26.00
	Band IV_Ant 2	26.00
	Band V_Ant 2	25.00
	HSPA	25.00
FDD LTE	Band 2_Ant 2	26.00
	Band 4_Ant 2	26.00
	Band 5_Ant 2	26.00
	Band 7_Ant 2	20.50
	Band 12_Ant 2	26.00
	Band 17_Ant 2	26.00
	Band 25_Ant 2	26.00
	Band 26_Ant 2	26.00
	Band 30_Ant 2	23.50
	Band 66_Ant 2	26.00
	Band 71_Ant 2	26.00
TDD LTE	Band 38_Ant 2	21.50
	Band 41_Ant 2	21.50
	Band 41 HPUE_Ant 2	23.00
	Band 48_Ant 7	23.50
5G NR FDD	n2_Ant 2	26.00
	n5_Ant 2	26.00
	n7_Ant 2	20.50
	n12_Ant 2	26.00
	n25_Ant 2	26.00
	n26_Ant 2	26.00
	n30_Ant 2	22.50
	n66_Ant 2	26.00
n71_Ant 2	26.00	
5G NR TDD	n41_MIMO_Ant 8+2	23.00
	n41 HPUE_MIMO_Ant 8+2(50% Duty)	24.50
	n48_Ant 9	22.50
	n77_Ant 7	22.00
	n77 HPUE_Ant 7(50% Duty)	23.50



Modem D		
Frequency Band		Average Power (dBm)
TDD LTE	Band 48_Ant 9	23.50
5G NR TDD	n38_Ant 7	19.00
	n41_Ant 7	19.00
	n41 HPUE_Ant 7(50% Duty)	20.50
	n41_MIMO_Ant 7+1	17.50
	n41 HPUE_MIMO_Ant 7+1(50% Duty)	19.00
	n48_Ant 7	22.50
	n77_Ant 9	26.00
	n77 HPUE_Ant 9(50% Duty)	27.50

Modem E		
Frequency Band		Average Power (dBm)
TDD LTE	Band 48_Ant 10	22.00
5G NR TDD	n41_MIMO_Ant 7+2	18.00
	n41 HPUE_MIMO_Ant 7+2(50% Duty)	19.50
	n48_Ant 10	21.50
	n77_Ant 10	20.50
	n77 HPUE_Ant 10(50% Duty)	22.00

Modem F		
Frequency Band		Average Power (dBm)
FDD LTE	Band 2_Ant 7	21.00
	Band 4_Ant 7	22.00
	Band 25_Ant 7	21.00
	Band 30_Ant 7	22.50
	Band 66_Ant 7	22.00
5G NR FDD	n2_Ant 7	21.00
	n25_Ant 7	21.00
	n30_Ant 7	22.00
	n66_Ant 7	23.50



**<Low Power Exemption>  
WWAN**

**General Note:**

1. EDGE data modes is not necessary due the GSM Voice mode is 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  $\leq 17$  dBm for any of its operating modes.
3. HAC RF rating is M4 for the air interface which meets the low power exemption.

Modem B				
Air Interface	Max Average Antenna Input Power (dBm)	Worst Case MIF (dB)	Power + MIF(dB)	C63.19 test required
GSM850	34.50	3.63	38.13	Yes
EDGE850	28.50	3.75	32.25	Yes <sup>(1)</sup>
GSM1900	31.50	3.63	35.13	Yes
EDGE1900	27.50	3.75	31.25	Yes <sup>(1)</sup>
WCDMA	26.00	-25.43	0.57	No
WCDMA - HSPA	26.00	-20.39	5.61	No
LTE - FDD	26.00	-9.76	16.24	No
LTE – TDD – PC3	26.00	-1.44	24.56	Yes
LTE – TDD – PC2	27.50	-1.44	26.06	Yes
5G FR1 – FDD	26.00	-12.08	13.92	No
5G NR – TDD– PC3	26.00	-12.08	13.92	No
5G NR – TDD– PC2 (50% Duty)	27.50	-1.64	25.86	Yes

Modem C				
Air Interface	Max Average Antenna Input Power (dBm)	Worst Case MIF (dB)	Power + MIF(dB)	C63.19 test required
WCDMA	26.00	-25.43	0.57	No
WCDMA - HSPA	26.00	-20.39	5.61	No
LTE - FDD	26.00	-9.76	16.24	No
LTE – TDD – PC3	23.50	-1.44	22.06	Yes
LTE – TDD – PC2	23.00	-1.44	21.56	Yes
5G FR1 – FDD	26.00	-12.08	13.92	No
5G NR – TDD– PC3	23.00	-12.08	10.92	No
5G NR – TDD – PC2 (50% Duty)	24.50	-1.64	22.86	Yes

Modem D				
Air Interface	Max Average Antenna Input Power (dBm)	Worst Case MIF (dB)	Power + MIF(dB)	C63.19 test required
LTE – TDD	23.50	-1.44	22.06	Yes
5G NR – TDD– PC3	26.00	-12.08	13.92	No
5G NR – TDD – PC2 (50% Duty)	27.50	-1.64	25.86	Yes

Modem E				
Air Interface	Max Average Antenna Input Power (dBm)	Worst Case MIF (dB)	Power + MIF(dB)	C63.19 test required
LTE – TDD	22.00	-1.44	20.56	Yes
5G NR – TDD– PC3	21.50	-12.08	9.42	No
5G NR - TDD – PC2 (50% Duty)	22.00	-1.64	20.36	Yes

Modem F				
Air Interface	Max Average Antenna Input Power (dBm)	Worst Case MIF (dB)	Power + MIF(dB)	C63.19 test required
LTE – FDD	22.50	-9.76	12.74	No
5G FR1 - FDD	23.50	-12.08	11.42	No



**WLAN**

Band	Mode	Average Power (dBm)
2.4GHz WLAN	802.11b_Ant 5	21.50
	802.11g_Ant 5	22.00
	802.11n-HT20_Ant 5	22.00
	802.11n-HT40_Ant 5	22.00
	802.11ac-VHT20_Ant 5	22.00
	802.11ac-VHT40_Ant 5	22.00
	802.11ax-HE20_Ant 5	22.00
	802.11ax-HE40_Ant 5	22.00
	802.11be-EHT20_Ant 5	22.00
802.11be-EHT40_Ant 5	22.00	
5GHz WLAN	802.11a_Ant 5	20.50
	802.11n-HT20_Ant 5	20.50
	802.11n-HT40_Ant 5	20.50
	802.11ac-VHT20_Ant 5	20.50
	802.11ac-VHT40_Ant 5	20.50
	802.11ac-VHT80_Ant 5	20.50
	802.11ac-VHT160_Ant 5	20.50
	802.11ax-HE20_Ant 5	20.50
	802.11ax-HE40_Ant 5	20.50
	802.11ax-HE80_Ant 5	20.50
	802.11ax-HE160_Ant 5	20.50
	802.11be-EHT20_Ant 5	20.50
	802.11be-EHT40_Ant 5	20.50
	802.11be-EHT80_Ant 5	20.50
802.11be-EHT160_Ant 5	20.50	
U-NII 5	802.11a_Ant 5	7.50
	802.11n-HT20_Ant 5	8.50
	802.11n-HT40_Ant 5	12.00
	802.11ac-VHT20_Ant 5	8.50
	802.11ac-VHT40_Ant 5	12.00
	802.11ac-VHT80_Ant 5	14.00
	802.11ac-VHT160_Ant 5	14.50
	802.11ax-HE20_Ant 5	8.50
	802.11ax-HE40_Ant 5	12.00
	802.11ax-HE80_Ant 5	14.00
	802.11ax-HE160_Ant 5	14.50
	802.11be-EHT20_Ant 5	8.50
	802.11be-EHT40_Ant 5	12.00
	802.11be-EHT80_Ant 5	14.00
802.11be-EHT160_Ant 5	14.50	



Band	Mode	Average Power (dBm)
2.4GHz WLAN	802.11b_Ant 4	18.50
	802.11g_Ant 4	18.50
	802.11n-HT20_Ant 4	18.50
	802.11n-HT40_Ant 4	18.50
	802.11ac-VHT20_Ant 4	18.50
	802.11ac-VHT40_Ant 4	18.50
	802.11ax-HE20_Ant 4	18.50
	802.11ax-HE40_Ant 4	18.50
	802.11be-EHT20_Ant 4	18.50
802.11be-EHT40_Ant 4	18.50	
5GHz WLAN	802.11a_Ant 4	18.00
	802.11n-HT20_Ant 4	18.00
	802.11n-HT40_Ant 4	18.00
	802.11ac-VHT20_Ant 4	18.00
	802.11ac-VHT40_Ant 4	18.00
	802.11ac-VHT80_Ant 4	18.00
	802.11ac-VHT160_Ant 4	18.00
	802.11ax-HE20_Ant 4	18.00
	802.11ax-HE40_Ant 4	18.00
	802.11ax-HE80_Ant 4	18.00
	802.11ax-HE160_Ant 4	18.00
	802.11be-EHT20_Ant 4	18.00
	802.11be-EHT40_Ant 4	18.00
	802.11be-EHT80_Ant 4	18.00
802.11be-EHT160_Ant 4	18.00	
U-NII 5	802.11a_Ant 4	8.50
	802.11n-HT20_Ant 4	8.50
	802.11n-HT40_Ant 4	12.00
	802.11ac-VHT20_Ant 4	8.50
	802.11ac-VHT40_Ant 4	12.00
	802.11ac-VHT80_Ant 4	14.00
	802.11ac-VHT160_Ant 4	14.50
	802.11ax-HE20_Ant 4	8.50
	802.11ax-HE40_Ant 4	12.00
	802.11ax-HE80_Ant 4	14.00
	802.11ax-HE160_Ant 4	14.50
	802.11be-EHT20_Ant 4	8.50
	802.11be-EHT40_Ant 4	12.00
	802.11be-EHT80_Ant 4	14.00
802.11be-EHT160_Ant 4	14.50	



**<Low Power Exemption>**

**WLAN**

**General Note:**

1. 802.11b modes is not necessary due the 802.11g mode is 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  $\leq 17$  dBm for any of its operating modes.
3. HAC RF rating is M4 for the air interface which meets the low power exemption.

WLAN Ant 5					
Air Interface		Max Average Antenna Input Power (dBm)	Worst Case MIF (dB)	Power + MIF(dB)	C63.19 test required
2.4GHz WLAN	802.11b	21.50	-2.02	19.48	Yes <sup>(1)</sup>
	802.11g	22.00	0.12	22.12	Yes
	802.11n-HT20	22.00	-13.44	8.56	No
	802.11n-HT40	22.00	-13.44	8.56	No
	802.11ac-VHT20	22.00	-5.57	16.43	No
	802.11ac-VHT40	22.00	-5.57	16.43	No
	802.11ax-HE20 / 802.11be-EHT20	22.00	-5.58	16.42	No
	802.11ax-HE40 / 802.11be-EHT40	22.00	-5.58	16.42	No
5GHz WLAN	802.11a	20.50	-3.15	17.35	Yes
	802.11n-HT20	20.50	-13.44	7.06	No
	802.11n-HT40	20.50	-13.44	7.06	No
	802.11ac-VHT20	20.50	-5.57	14.93	No
	802.11ac-VHT40	20.50	-5.57	14.93	No
	802.11ac-VHT80	20.50	-5.57	14.93	No
	802.11ac-VHT160	20.50	-5.57	14.93	No
	802.11ax-HE20 / 802.11be-EHT20	20.50	-5.58	14.92	No
	802.11ax-HE40 / 802.11be-EHT40	20.50	-5.58	14.92	No
	802.11ax-HE80 / 802.11be-EHT80	20.50	-5.58	14.92	No
802.11ax-HE160 / 802.11be-EHT160	20.50	-5.58	14.92	No	
U-NII 5	802.11a	7.50	-3.15	4.35	No
	802.11n-HT20	8.50	-13.44	-4.94	No
	802.11n-HT40	12.00	-13.44	-1.44	No
	802.11ac-VHT20	8.50	-5.57	2.93	No
	802.11ac-VHT40	12.00	-5.57	6.43	No
	802.11ac-VHT80	14.00	-5.57	8.43	No
	802.11ac-VHT160	14.50	-5.57	8.93	No
	802.11ax-HE20 / 802.11be-EHT20	8.50	-5.58	2.92	No
	802.11ax-HE40 / 802.11be-EHT40	12.00	-5.58	6.42	No
	802.11ax-HE80 / 802.11be-EHT80	14.00	-5.58	8.42	No
	802.11ax-HE160 / 802.11be-EHT160	14.50	-5.58	8.92	No
	802.11be-EHT160	8.50	-5.58	2.92	No



		WLAN Ant 4			
Air Interface		Max Average Antenna Input Power (dBm)	Worst Case MIF (dB)	Power + MIF(dB)	C63.19 test required
2.4GHz WLAN	802.11b	18.50	-2.02	16.48	No
	802.11g	18.50	0.12	18.62	Yes
	802.11n-HT20	18.50	-13.44	5.06	No
	802.11n-HT40	18.50	-13.44	5.06	No
	802.11ac-VHT20	18.50	-5.57	12.93	No
	802.11ac-VHT40	18.50	-5.57	12.93	No
	802.11ax-HE20 / 802.11be-EHT20	18.50	-5.58	12.92	No
	802.11ax-HE40 / 802.11be-EHT40	18.50	-5.58	12.92	No
5GHz WLAN	802.11a	18.00	-3.15	14.85	No
	802.11n-HT20	18.00	-13.44	4.56	No
	802.11n-HT40	18.00	-13.44	4.56	No
	802.11ac-VHT20	18.00	-5.57	12.43	No
	802.11ac-VHT40	18.00	-5.57	12.43	No
	802.11ac-VHT80	18.00	-5.57	12.43	No
	802.11ac-VHT160	18.00	-5.57	12.43	No
	802.11ax-HE20 / 802.11be-EHT20	18.00	-5.58	12.42	No
	802.11ax-HE40 / 802.11be-EHT40	18.00	-5.58	12.42	No
	802.11ax-HE80 / 802.11be-EHT80	18.00	-5.58	12.42	No
802.11ax-HE160 / 802.11be-EHT160	18.00	-5.58	12.42	No	
U-NII 5	802.11a	8.50	-3.15	5.35	No
	802.11n-HT20	8.50	-13.44	-4.94	No
	802.11n-HT40	12.00	-13.44	-1.44	No
	802.11ac-VHT20	8.50	-5.57	2.93	No
	802.11ac-VHT40	12.00	-5.57	6.43	No
	802.11ac-VHT80	14.00	-5.57	8.43	No
	802.11ac-VHT160	14.50	-5.57	8.93	No
	802.11ax-HE20 / 802.11be-EHT20	8.50	-5.58	2.92	No
	802.11ax-HE40 / 802.11be-EHT40	12.00	-5.58	6.42	No
	802.11ax-HE80 / 802.11be-EHT80	14.00	-5.58	8.42	No
802.11ax-HE160 / 802.11be-EHT160	14.50	-5.58	8.92	No	



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

**<GSM850\_Ant 0>**

GSM850		Burst Average Power (dBm)		
TX Channel	128	189	251	
Frequency (MHz)	824.2	836.4	848.8	
GSM 1 Tx slot	33.18	32.67	33.34	

**<GSM1900\_Ant 1>**

GSM1900		Burst Average Power (dBm)		
TX Channel	512	661	810	
Frequency (MHz)	1850.2	1880	1909.8	
GSM 1 Tx slot	30.37	29.76	30.43	

**<TDD LTE Band 41\_Ant 1>**

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	24.77	25.02	25.01	25.12	24.85

**<TDD LTE Band 41 HPUE\_Ant 1>**

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	26.87	26.97	27.19	27.21	26.93

**<TDD LTE Band 41\_Ant 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	20.40	20.38	20.38	20.47	20.45

**<TDD LTE Band 41 HPUE\_Ant 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	22.54	22.48	22.55	22.57	22.52





<TDD LTE Band 48\_Ant 7>

BW [MHz]	Modulation	RB Size	RB Offset	Power Low Ch. / Freq.	Power Low Middle Ch. / Freq.	Power High Middle Ch. / Freq.	Power High Ch. / Freq.
Channel				55340	55830	56150	56640
Frequency (MHz)				3560	3609	3641	3690
20	QPSK	1	0	22.34	22.41	22.48	22.56

<TDD LTE Band 48\_Ant 8>

BW [MHz]	Modulation	RB Size	RB Offset	Power Low Ch. / Freq.	Power Low Middle Ch. / Freq.	Power High Middle Ch. / Freq.	Power High Ch. / Freq.
Channel				55340	55830	56150	56640
Frequency (MHz)				3560	3609	3641	3690
20	QPSK	1	0	22.34	22.41	22.48	22.56

<TDD LTE Band 48\_Ant 9>

BW [MHz]	Modulation	RB Size	RB Offset	Power Low Ch. / Freq.	Power Low Middle Ch. / Freq.	Power High Middle Ch. / Freq.	Power High Ch. / Freq.
Channel				55340	55830	56150	56640
Frequency (MHz)				3560	3609	3641	3690
20	QPSK	1	0	22.34	22.41	22.48	22.56

<TDD LTE Band 48\_Ant 10>

BW [MHz]	Modulation	RB Size	RB Offset	Power Low Ch. / Freq.	Power Low Middle Ch. / Freq.	Power High Middle Ch. / Freq.	Power High Ch. / Freq.
Channel				55340	55830	56150	56640
Frequency (MHz)				3560	3609	3641	3690
20	QPSK	1	0	20.42	20.41	20.40	20.45

<5G NR n41 HPUE\_Ant 7>

BW [MHz]	Modulation	RB Size	RB Offset	Power Low Ch. / Freq.	Power Middle Ch. / Freq.	Power High Ch. / Freq.
Channel				509202	518598	528000
Frequency (MHz)				2546.01	2592.99	2640
100	QPSK	1	1	18.93	19.00	18.98

<5G NR n41 HPUE\_Ant 8>

BW [MHz]	Modulation	RB Size	RB Offset	Power Low Ch. / Freq.	Power Middle Ch. / Freq.	Power High Ch. / Freq.
Channel				509202	518598	528000
Frequency (MHz)				2546.01	2592.99	2640
100	QPSK	1	1	26.12	26.14	26.03

<5G NR n41 HPUE UL MIMO\_Ant 1>

BW [MHz]	Modulation	RB Size	RB Offset	Power Low Ch. / Freq.	Power Middle Ch. / Freq.	Power High Ch. / Freq.
Channel				509202	518598	528000
Frequency (MHz)				2546.01	2592.99	2640
100	QPSK	1	1	23.03	23.12	22.99

<5G NR n41 HPUE UL MIMO\_Ant 2>

BW [MHz]	Modulation	RB Size	RB Offset	Power Low Ch. / Freq.	Power Middle Ch. / Freq.	Power High Ch. / Freq.
Channel				509202	518598	528000
Frequency (MHz)				2546.01	2592.99	2640
100	QPSK	1	1	18.14	18.22	18.15



<5G NR n77 270 HPUE\_Ant 7>

BW [MHz]	Modulation	RB Size	RB Offset	Power Low Ch. / Freq.	Power Middle Ch. / Freq.	Power High Ch. / Freq.
Channel				650000	656000	662000
Frequency (MHz)				3750	3840	3930
100	QPSK	1	1	21.67	21.69	21.64

<5G NR n77 27Q HPUE\_Ant 7>

BW [MHz]	Modulation	RB Size	RB Offset	Power Low Ch. / Freq.	Power Middle Ch. / Freq.	Power High Ch. / Freq.
Channel					633332	
Frequency (MHz)					3499.98	
100	QPSK	1	1		21.66	

<5G NR n77 270 HPUE\_Ant 8>

BW [MHz]	Modulation	RB Size	RB Offset	Power Low Ch. / Freq.	Power Middle Ch. / Freq.	Power High Ch. / Freq.
Channel				650000	656000	662000
Frequency (MHz)				3750	3840	3930
100	QPSK	1	1	25.99	26.12	26.05

<5G NR n77 27Q HPUE\_Ant 8>

BW [MHz]	Modulation	RB Size	RB Offset	Power Low Ch. / Freq.	Power Middle Ch. / Freq.	Power High Ch. / Freq.
Channel					633332	
Frequency (MHz)					3499.98	
100	QPSK	1	1		26.11	

<5G NR n77 270 HPUE\_Ant 9>

BW [MHz]	Modulation	RB Size	RB Offset	Power Low Ch. / Freq.	Power Middle Ch. / Freq.	Power High Ch. / Freq.
Channel				650000	656000	662000
Frequency (MHz)				3750	3840	3930
100	QPSK	1	1	25.99	26.12	26.05

<5G NR n77 27Q HPUE\_Ant 9>

BW [MHz]	Modulation	RB Size	RB Offset	Power Low Ch. / Freq.	Power Middle Ch. / Freq.	Power High Ch. / Freq.
Channel					633332	
Frequency (MHz)					3499.98	
100	QPSK	1	1		26.11	

<5G NR n77 270 HPUE\_Ant 10>

BW [MHz]	Modulation	RB Size	RB Offset	Power Low Ch. / Freq.	Power Middle Ch. / Freq.	Power High Ch. / Freq.
Channel				650000	656000	662000
Frequency (MHz)				3750	3840	3930
100	QPSK	1	1	20.48	20.54	20.51

<5G NR n77 27Q HPUE\_Ant 10>

BW [MHz]	Modulation	RB Size	RB Offset	Power Low Ch. / Freq.	Power Middle Ch. / Freq.	Power High Ch. / Freq.
Channel					633332	
Frequency (MHz)					3499.98	
100	QPSK	1	1		20.66	



<WLAN 2.4GHz\_Ant 5>

2.4GHz WLAN	Mode	Channel	Frequency (MHz)	Average power (dBm)
2.4GHz WLAN	802.11g 6Mbps	1	2412	19.80
		6	2437	20.20
		11	2462	17.70

<WLAN 2.4GHz\_Ant 4>

2.4GHz WLAN	Mode	Channel	Frequency (MHz)	Average power (dBm)
2.4GHz WLAN	802.11g 6Mbps	1	2412	16.80
		6	2437	17.10
		11	2462	16.70

<WLAN 5GHz\_Ant 5>

5.2GHz WLAN	Mode	Channel	Frequency (MHz)	Average power (dBm)
5.2GHz WLAN	802.11a 6Mbps	36	5180	18.74
		40	5200	19.81
		44	5220	18.66
		48	5240	18.67

5.3GHz WLAN	Mode	Channel	Frequency (MHz)	Average power (dBm)
5.3GHz WLAN	802.11a 6Mbps	52	5260	18.62
		56	5280	19.82
		60	5300	18.60
		64	5320	19.18

5.5GHz WLAN	Mode	Channel	Frequency (MHz)	Average power (dBm)
5.5GHz WLAN	802.11a 6Mbps	100	5500	18.90
		116	5580	19.48
		132	5660	18.28
		140	5700	19.23

5.8GHz WLAN	Mode	Channel	Frequency (MHz)	Average power (dBm)
5.8GHz WLAN	802.11a 6Mbps	149	5745	18.52
		157	5785	18.48
		165	5825	18.43



**13. HAC RF Emission Test Results**

Plot No.	Air Interface	BW (MHz)	Modulation / Mode	RB Size	RB offset	Channel	Sample	DUT Status	Transmit Ant.	Average Antenna Input Power (dBm)	MIF	E-Field (dBV/m)	Margin to FCC M3 limit (dB)	E-Field M Rating
1	GSM850	-	Voice	-	-	128	Sample 1	Normal	Ant 0	33.18	3.63	29.87	15.13	M4
2	GSM850	-	Voice	-	-	189	Sample 1	Normal	Ant 0	32.67	3.63	32.75	12.25	M4
3	GSM850	-	Voice	-	-	251	Sample 1	Normal	Ant 0	33.34	3.63	32.62	12.38	M4
4	GSM1900	-	Voice	-	-	512	Sample 1	Normal	Ant 1	30.37	3.63	24.46	10.54	M4
5	GSM1900	-	Voice	-	-	661	Sample 1	Normal	Ant 1	29.76	3.63	26.28	8.72	M4
6	GSM1900	-	Voice	-	-	810	Sample 1	Normal	Ant 1	30.43	3.63	26.83	8.17	M4
7	LTE Band 41	20M	QPSK	1	0	39750	Sample 1	Normal	Ant 1	24.77	-1.44	18.24	16.76	M4
8	LTE Band 41	20M	QPSK	1	0	40620	Sample 1	Normal	Ant 1	25.01	-1.44	19.13	15.87	M4
9	LTE Band 41	20M	QPSK	1	0	41490	Sample 1	Normal	Ant 1	24.85	-1.44	20.27	14.73	M4
10	LTE Band 41_HPUE	20M	QPSK	1	0	41490	Sample 1	Normal	Ant 1	26.93	-1.44	20.51	14.49	M4
11	LTE Band 41	20M	QPSK	1	0	39750	Sample 1	Normal	Ant 2	20.4	-1.44	17.38	17.62	M4
12	LTE Band 41	20M	QPSK	1	0	40620	Sample 1	Normal	Ant 2	20.38	-1.44	19.72	15.28	M4
13	LTE Band 41	20M	QPSK	1	0	41490	Sample 1	Normal	Ant 2	20.45	-1.44	22.59	12.41	M4
14	LTE Band 41_HPUE	20M	QPSK	1	0	41490	Sample 1	Normal	Ant 2	22.52	-1.44	22.57	12.43	M4
15	LTE Band 48	20M	QPSK	1	0	55340	Sample 1	Normal	Ant 8	22.34	-1.44	27.25	7.75	M4
16	LTE Band 48	20M	QPSK	1	0	55830	Sample 1	Normal	Ant 8	22.41	-1.44	27.17	7.83	M4
17	LTE Band 48	20M	QPSK	1	0	56640	Sample 1	Normal	Ant 8	22.56	-1.44	21.28	13.72	M4
18	LTE Band 48	20M	QPSK	1	0	55340	Sample 1	Normal	Ant 7	22.34	-1.44	25.48	9.52	M4
19	LTE Band 48	20M	QPSK	1	0	55830	Sample 1	Normal	Ant 7	22.41	-1.44	25.40	9.60	M4
20	LTE Band 48	20M	QPSK	1	0	56640	Sample 1	Normal	Ant 7	22.56	-1.44	23.83	11.17	M4
21	LTE Band 48	20M	QPSK	1	0	55340	Sample 1	Normal	Ant 9	22.34	-1.44	12.27	22.73	M4
22	LTE Band 48	20M	QPSK	1	0	55830	Sample 1	Normal	Ant 9	22.41	-1.44	12.13	22.87	M4
23	LTE Band 48	20M	QPSK	1	0	56640	Sample 1	Normal	Ant 9	22.56	-1.44	11.71	23.29	M4
24	LTE Band 48	20M	QPSK	1	0	55340	Sample 1	Normal	Ant 10	20.42	-1.44	24.25	10.75	M4
25	LTE Band 48	20M	QPSK	1	0	55830	Sample 1	Normal	Ant 10	20.41	-1.44	23.67	11.33	M4
26	LTE Band 48	20M	QPSK	1	0	56640	Sample 1	Normal	Ant 10	20.45	-1.44	23.61	11.39	M4
27	FR1 n41_HPUE	100M	QPSK	1	1	518598	Sample 1	Normal	Ant 8	26.14	-1.64	5.69	29.31	M4
28	FR1 n41_HPUE	100M	QPSK	1	1	518598	Sample 1	Normal	Ant 7	19	-1.64	-2.94	37.94	M4
29	FR1 n41_HPUE UL MIMO	100M	QPSK	1	1	518598	Sample 1	Normal	Ant 1	23.12	-1.64	1.23	33.77	M4
30	FR1 n41_HPUE UL MIMO	100M	QPSK	1	1	518598	Sample 1	Normal	Ant 2	18.22	-1.64	-1.79	36.79	M4
31	FR1_n77_27O_HPUE	100M	QPSK	1	1	656000	Sample 1	Normal	Ant 8	26.12	-1.64	24.22	10.78	M4
32	FR1_n77_27Q_HPUE	100M	QPSK	1	1	633332	Sample 1	Normal	Ant 8	26.11	-1.64	22.65	12.35	M4
33	FR1_n77_27O_HPUE	100M	QPSK	1	1	656000	Sample 1	Normal	Ant 7	21.69	-1.64	18.78	16.22	M4
34	FR1_n77_27Q_HPUE	100M	QPSK	1	1	633332	Sample 1	Normal	Ant 7	21.66	-1.64	17.45	17.55	M4
35	FR1_n77_27O_HPUE	100M	QPSK	1	1	656000	Sample 1	Normal	Ant 9	26.12	-1.64	24.56	10.44	M4
36	FR1_n77_27Q_HPUE	100M	QPSK	1	1	633332	Sample 1	Normal	Ant 9	26.11	-1.64	22.63	12.37	M4
37	FR1_n77_27O_HPUE	100M	QPSK	1	1	656000	Sample 1	Normal	Ant 10	20.54	-1.64	19.05	15.95	M4
38	FR1_n77_27Q_HPUE	100M	QPSK	1	1	633332	Sample 1	Normal	Ant 10	20.66	-1.64	17.48	17.52	M4



Plot No.	Air Interface	Modulation / Mode	Channel	Sample	DUT Status	Transmit Ant.	Average Antenna Input Power (dBm)	MIF	E-Field (dBV/m)	Margin to FCC M3 limit (dB)	E-Field M Rating
39	WLAN2.4GHz	802.11g 6Mbps	1	Sample 1	Normal	Ant 5	19.8	0.12	24.72	10.28	M4
40	WLAN2.4GHz	802.11g 6Mbps	6	Sample 1	Normal	Ant 5	20.2	0.12	24.97	10.03	M4
41	WLAN2.4GHz	802.11g 6Mbps	11	Sample 1	Normal	Ant 5	17.7	0.12	22.12	12.88	M4
42	WLAN2.4GHz	802.11g 6Mbps	1	Sample 1	Normal	Ant 4	16.8	0.12	29.17	5.83	M4
43	WLAN2.4GHz	802.11g 6Mbps	6	Sample 1	Normal	Ant 4	17.1	0.12	30.66	4.34	M3
44	WLAN2.4GHz	802.11g 6Mbps	6	Sample 3	Normal	Ant 4	17.1	0.12	28.01	6.99	M4
45	WLAN2.4GHz	802.11g 6Mbps	6	Sample 4	Normal	Ant 4	17.1	0.12	28.40	6.60	M4
46	WLAN2.4GHz	802.11g 6Mbps	6	Sample 2	Normal	Ant 4	17.1	0.12	28.43	6.57	M4
47	WLAN2.4GHz	802.11g 6Mbps	6	Sample 1 + Fan	Normal	Ant 4	17.1	0.12	28.02	6.98	M4
48	WLAN2.4GHz	802.11g 6Mbps	11	Sample 1	Normal	Ant 4	16.7	0.12	30.20	4.80	M3
49	WLAN5GHz	802.11a 6Mbps	36	Sample 1	Normal	Ant 5	18.74	-3.15	22.56	12.44	M4
50	WLAN5GHz	802.11a 6Mbps	40	Sample 1	Normal	Ant 5	19.81	-3.15	23.28	11.72	M4
51	WLAN5GHz	802.11a 6Mbps	48	Sample 1	Normal	Ant 5	18.67	-3.15	22.74	12.26	M4
52	WLAN5GHz	802.11a 6Mbps	52	Sample 1	Normal	Ant 5	18.62	-3.15	24.07	10.93	M4
53	WLAN5GHz	802.11a 6Mbps	56	Sample 1	Normal	Ant 5	19.82	-3.15	24.24	10.76	M4
54	WLAN5GHz	802.11a 6Mbps	64	Sample 1	Normal	Ant 5	19.18	-3.15	22.59	12.41	M4
55	WLAN5GHz	802.11a 6Mbps	100	Sample 1	Normal	Ant 5	18.90	-3.15	20.59	14.41	M4
56	WLAN5GHz	802.11a 6Mbps	116	Sample 1	Normal	Ant 5	19.48	-3.15	22.37	12.63	M4
57	WLAN5GHz	802.11a 6Mbps	140	Sample 1	Normal	Ant 5	19.23	-3.15	20.64	14.36	M4
58	WLAN5GHz	802.11a 6Mbps	149	Sample 1	Normal	Ant 5	18.52	-3.15	20.91	14.09	M4
59	WLAN5GHz	802.11a 6Mbps	157	Sample 1	Normal	Ant 5	18.48	-3.15	20.94	14.06	M4
60	WLAN5GHz	802.11a 6Mbps	165	Sample 1	Normal	Ant 5	18.43	-3.15	20.94	14.06	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
3. The device support different usage mode, and only normal mode operate at head exposure condition.

Test Engineer : Carter Jhuang



### 14. Uncertainty Assessment

The component of uncertainty may generally be categorized according to the methods used to evaluate them. The evaluation of uncertainty 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.

The judgment of conformity in the report is based on the measurement results excluding the measurement uncertainty.

Error Description	Uncertainty Value (±%)	Probability Distribution	Divisor	Ci (E)	Standard Uncertainty (E)
<b>Measurement System</b>					
Probe Calibration	5.1	Normal	1	1	± 5.1 %
Axial Isotropy	4.7	Rectangular	√3	1	± 2.7 %
Sensor Displacement	16.5	Rectangular	√3	1	± 9.5 %
Boundary Effects	2.4	Rectangular	√3	1	± 1.4 %
Phantom Boundary Effects	7.2	Rectangular	√3	1	± 4.1 %
Linearity	4.7	Rectangular	√3	1	± 2.7 %
Scaling with PMR Calibration	10.0	Rectangular	√3	1	± 5.77 %
System Detection Limit	1.0	Rectangular	√3	1	± 0.6 %
Readout Electronics	0.3	Normal	1	1	± 0.3 %
Response Time	0.8	Rectangular	√3	1	± 0.5 %
Integration Time	2.6	Rectangular	√3	1	± 1.5 %
RF Ambient Conditions	3.0	Rectangular	√3	1	± 1.7 %
RF Reflections	12.0	Rectangular	√3	1	± 6.9 %
Probe Positioner	1.2	Rectangular	√3	1	± 0.7 %
Probe Positioning	4.7	Rectangular	√3	1	± 2.7 %
Extrap. and Interpolation	1.0	Rectangular	√3	1	± 0.6 %
<b>Test Sample Related</b>					
Device Positioning Vertical	4.7	Rectangular	√3	1	± 2.7 %
Device Positioning Lateral	1.0	Rectangular	√3	1	± 0.6 %
Device Holder and Phantom	2.4	Rectangular	√3	1	± 1.4 %
Power Drift	5.0	Rectangular	√3	1	± 2.9 %
<b>Phantom and Setup Related</b>					
Phantom Thickness	2.4	Rectangular	√3	1	± 1.4 %
<b>Combined Standard Uncertainty</b>					± 16.30 %
<b>Coverage Factor for 95 %</b>					K = 2
<b>Combined Std. Uncertainty</b>					± 16.30 %
<b>Coverage Factor for 95 %</b>					K = 2
<b>Expanded STD Uncertainty</b>					± 32.6 %
Declaration of Conformity: The test results with all measurement uncertainty excluded are presented in accordance with the regulation limits or requirements declared by manufacturers.					
Comments and Explanations: The declared of product specification for EUT presented in the report are provided by the manufacturer, and the manufacturer takes all the responsibilities for the accuracy of product specification.					

**Uncertainty Budget of HAC free field assessment**



## **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 D01v06r02, "Equipment Authorization Guidance for Hearing Aid Compatibility", Sep. 2022.
- [3] FCC KDB 285076 D03v01r06, "Hearing aid compatibility frequently asked questions", Jul. 2022
- [4] SPEAG DASY System Handbook