HEARING AID COMPATIBILITY RF EMISSIONS TEST REPORT

FCC ID	**: U4G-SGVNRNA**
Equipment	**: Mobile Computer/Barcode Reader**
Brand Name	**: Datalogic**
Model Name	**: SGVNRNA**
WD Emission Result	**: PASS**
Applicant	**: Datalogic S.r.l. Via San Vitalino 13, 40012 Lippo di Calderara di Reno (BO) – Italy**
Manufacturer	**: Datalogic S.r.l. Via San Vitalino 13, 40012 Lippo di Calderara di Reno (BO) – Italy**
Standard	**: FCC 47 CFR §20.19 ANSI C63.19-2019**

The product was received on Apr. 17, 2024 and testing was started from May 22, 2024 and completed on May 22, 2024. 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 63.19-2019 / 47 CFR Part 20.19 and has been pass the FCC requirement.

Cona Huang

Approved by: Cona Huang / Deputy Manager

ilac-MRA TAF Testing Laboratory 3786

Sporton International Inc. Wensan Laboratory

No.58, Aly. 75, Ln. 564, Wenhua 3rd, Rd., Guishan Dist., Taoyuan City 333010, Taiwan

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History of this test report

Report No.	Version	Description	Issued Date
HA440146A	Rev. 01	Initial issue of report	Jul. 02, 2024

1. General Information

Product Feature & Specification	
Applicant Name	Datalogic S.r.l.
Equipment Name	Mobile Computer/Barcode Reader
Brand Name	Datalogic
Model Name	SGVNRNA
FCC ID	U4G-SGVNRNA
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 13: 777 MHz ~ 787 MHz LTE Band 14: 788 MHz ~ 798 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 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 n13 : 777 MHz ~ 787 MHz 5G NR n14 : 788 MHz ~ 798 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 n77: 3700 MHz ~ 3980 MHz, 3450MHz ~ 3550MHz 5G NR n78: 3700 MHz ~ 3800 MHz, 3450MHz ~ 3550MHz WLAN 2.4 GHz Band: 2400 MHz ~ 2483.5 MHz WLAN 5.2 GHz Band: 5150 MHz ~ 5250 MHz WLAN 5.3 GHz Band: 5250 MHz ~ 5350 MHz WLAN 5.6 GHz Band: 5470 MHz ~ 5725 MHz WLAN 5.8 GHz Band: 5725 MHz ~ 5850 MHz WLAN 5.9 GHz Band: 5850 MHz ~ 5895 MHz WLAN 6E: 5925 MHz ~ 6425 MHz, 6425 MHz ~ 6525 MHz, 6525 MHz ~ 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 Bluetooth BR/EDR/LE NFC: ASK
HW Version	DVT2
SW Version	dl4490_gms-userdebug_1.04.001.20240520_a13_qfil_fastboot
EUT Stage	Production Unit

Reviewed by: Jason Wang
Report Producer: Daisy Peng

2. Testing Location

Sporton Lab is accredited to ISO 17025 by Taiwan Accreditation Foundation (TAF code: 3786) and the FCC designation No. TW3786 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.58, Aly. 75, Ln. 564, Wenhua 3rd, Rd., Guishan Dist., Taoyuan City 333010, Taiwan TEL:+886-3-327-0838 FAX: +886-3-327-0855
Test Site No.	Sporton Site No.: **SAR015-HY**

3. Applied Standards

- FCC CFR47 Part 20.19
- ANSI C63.19-2019
- FCC KDB 285076 D01 HAC Guidance v06r04
- FCC KDB 285076 D03 HAC FAQ v01r06

4. Air Interfaces

<table>
<tr><th>Air Interface</th><th>Band MHz</th><th>Type</th><th>C63.19 Tested</th><th>Simultaneous Transmitter</th><th>Name of Voice Service</th><th>Power State for HAC Compliance</th></tr>
<tr><td rowspan="4">GSM</td><td>GSM850</td><td rowspan="2">VO</td><td rowspan="2">Yes</td><td rowspan="4">WLAN, BT</td><td rowspan="2">CMRS Voice</td><td rowspan="4">Pmax[5]</td></tr>
<tr><td>GSM1900</td></tr>
<tr><td>EDGE850</td><td rowspan="2">VD</td><td rowspan="2">Yes</td><td rowspan="2">Google Meet</td></tr>
<tr><td>EDGE1900</td></tr>
<tr><td rowspan="4">WCDMA</td><td>Band 2</td><td rowspan="3">VO</td><td rowspan="3">No[1]</td><td rowspan="4">WLAN, BT</td><td rowspan="3">CMRS Voice</td><td rowspan="4">Pmax[5]</td></tr>
<tr><td>Band 4</td></tr>
<tr><td>Band 5</td></tr>
<tr><td>HSPA</td><td>VD</td><td>No[1]</td><td>Google Meet</td></tr>
<tr><td rowspan="12">LTE
(FDD)</td><td>Band 2</td><td rowspan="12">VD</td><td rowspan="12">No[1]</td><td rowspan="15">5G NR, WLAN, BT</td><td rowspan="15">VoLTE
/
Google Meet</td><td rowspan="15">Pmax[5]</td></tr>
<tr><td>Band 4</td></tr>
<tr><td>Band 5</td></tr>
<tr><td>Band 7</td></tr>
<tr><td>Band 12</td></tr>
<tr><td>Band 13</td></tr>
<tr><td>Band 14</td></tr>
<tr><td>Band 17</td></tr>
<tr><td>Band 25</td></tr>
<tr><td>Band 26</td></tr>
<tr><td>Band 30</td></tr>
<tr><td>Band 66</td></tr>
<tr><td rowspan="3">LTE
(TDD)</td><td>Band 38</td><td rowspan="3">VD</td><td rowspan="3">Yes</td></tr>
<tr><td>Band 41</td></tr>
<tr><td>Band 48</td></tr>
<tr><td rowspan="9">5G NR
(FDD)</td><td>n5</td><td rowspan="9">VD</td><td rowspan="9">No[1]</td><td rowspan="9">LTE, WLAN, BT</td><td rowspan="14">VoNR
/
Google Meet</td><td rowspan="14">Pmax[5]</td></tr>
<tr><td>n7</td></tr>
<tr><td>n12</td></tr>
<tr><td>n13</td></tr>
<tr><td>n14</td></tr>
<tr><td>n2/25</td></tr>
<tr><td>n26</td></tr>
<tr><td>n30</td></tr>
<tr><td>n66</td></tr>
<tr><td rowspan="5">5G NR
(TDD)</td><td>n38</td><td rowspan="5">VD</td><td rowspan="5">Yes</td><td rowspan="5">LTE, WLAN, BT</td></tr>
<tr><td>n41</td></tr>
<tr><td>n48</td></tr>
<tr><td>n77</td></tr>
<tr><td>n78</td></tr>
<tr><td rowspan="9">Wi-Fi</td><td>2450</td><td rowspan="5">VD</td><td rowspan="5">No[1]</td><td>GSM, WCDMA, LTE, 5G NR, BT</td><td rowspan="5">VoWiFi
/
Google Meet</td><td rowspan="9">Head[5]</td></tr>
<tr><td>5200</td><td rowspan="8">GSM, WCDMA, LTE, 5G NR, BT</td></tr>
<tr><td>5300</td></tr>
<tr><td>5500</td></tr>
<tr><td>5800 / 5900</td></tr>
<tr><td>UNII-5</td><td rowspan="4">VD</td><td rowspan="4">No[1,2]</td><td rowspan="4">VoWiFi
/
Google Meet</td></tr>
<tr><td>UNII-6</td></tr>
<tr><td>UNII-7</td></tr>
<tr><td>UNII-8</td></tr>
<tr><td>BT</td><td>2450</td><td>DT</td><td>No</td><td>GSM, WCDMA, LTE, 5G NR, WLAN</td><td>NA</td><td></td></tr>
<tr><td colspan="7">Type Transport:
VO= Voice only
DT= Digital Transport only (no voice)
VD= CMRS and IP Voice Service over Digital Transport</td></tr>
<tr><td colspan="7">Remark:
1. The air interface max power plus MIF is complies with ANSI63.19-2019 Table 4.1 RF_{AIPL}
2. The WiFi 6E above 6GHz portion is currently not within the scope of FCC Part 20.19, and therefore not evaluated.
3. Because features of Google Meet allow the option of voice-only communications, Meet has been tested for HAC/T-Coil compatibility to ensure the best user experience.
4. The device have similar frequency in some LTE and NR bands: LTE 12/17, 25/2, 26/5, 66/4, 38/41 and NR 26/5, 38/41, 77/78 since the supported frequency spans for the smaller LTE and NR bands are completely cover by the larger LTE and NR bands, therefore, only larger LTE and NR bands were required to be tested for hearing-aid compliance.
5. The product only 2G/3G/4G/5G support Time average SAR feature, therefore2G/3G/4G/5G HAC were tested at highest instantons Pmax power level, however, due the WiFi operation doesn't support Time average SAR feature, therefore, WiFi operation were assessment at head power level to meet HAC compliance.</td></tr>
</table>

5. *WD Emission Requirements*

The WD's conducted power must be at or below either the stated RFAIPL (Table 4.1) or the stated peak power level (Table 4.2), or the average near-field emissions over the measurement area must be at or below the stated RFAIL (Table 4.3), or the stated peak field strength (Table 4.4). The WD may demonstrate compliance by meeting any of these four requirements, but it must do so in each of its operating bands at its established worst-case normal speech-mode operating condition.

Table 4.1 - Wireless device RF audio interference power level	
Frequency range (MHz)	RF_{AIPL} (dBm)
< 960	29
960 - 2000	26
> 2000	25

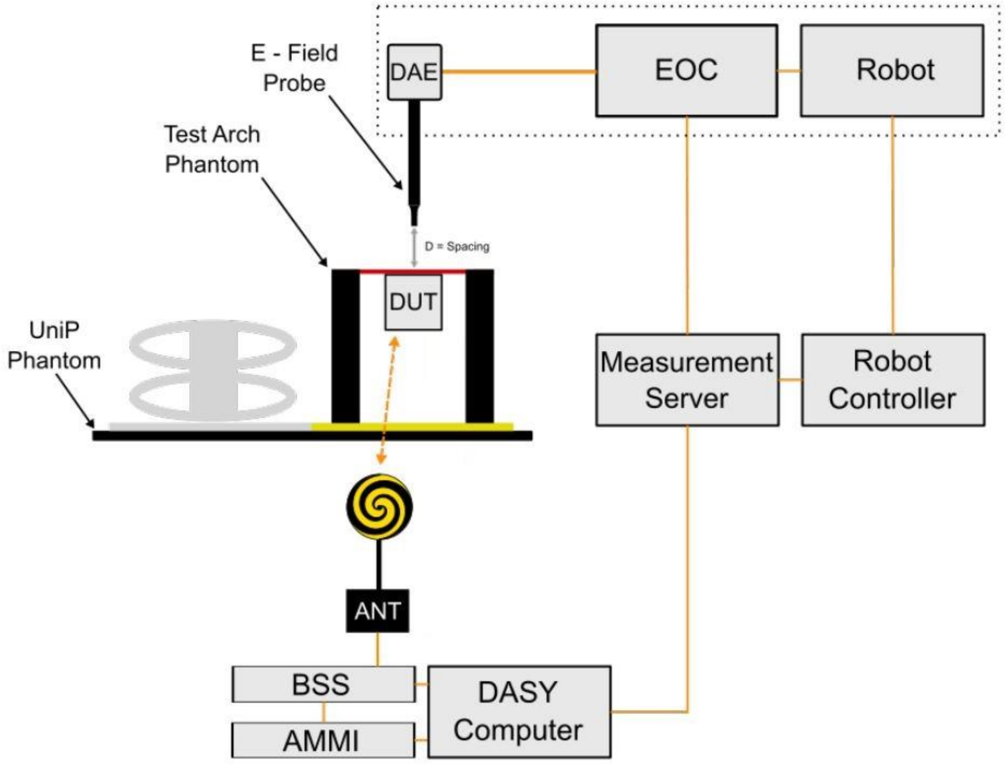
Table 4.2 - Wireless device RF peak power level	
Frequency range (MHz)	$RF_{Peak\ Power}$ (dBm)
< 960	35
960 - 2000	32
> 2000	31

Table 4.3 - Wireless device RF audio interference level	
Frequency range (MHz)	RF_{AIL} [dB(V/m)]
< 960	39
960 - 2000	36
> 2000	35

Table 4.4 - Wireless device RF peak near-field level	
Frequency range (MHz)	RF_{Peak} [dB(V/m)]
< 960	45
960 - 2000	42
> 2000	41

6. System Description and Operation

<System Components>



Remark:

A typical al DASY system for HAC measurements consists of

- 6-axis robotic arm (Staubli TX2-60L/ TX2-90XL) for positioning the probe
- Mounting Platform for keeping the phantoms at a field location relative to the robot
- Measurement Server for handling all time-critical tasks, such as measurement data acquisition and supervision of safety features
- EOC (Electrical to Optical Converter) for converting the optical signal from the Data Acquisition Electronics (DAE) to electrical before being transmitted to the measurement server
- LB (Light Beam unit) for probe alignment (measurement of the exact probe length and eccentricity)
- Test Arch for Device Under Test (DUT) testing
- DAE that reads the probe voltages and transmits them to the DASY PC. It is also used to detect probe touch and collision signals
- Device Holder for positioning the DUT beneath the phantom
- ANT (wideband Antenna) for broadcasting the downlink signals emitted by base station simulators (BSS) to the WD
- Operator PC for running the DASY software to define/execute the measurements.

The following components are needed for RFail measurements only:

- Modulation Interference Factor (MIF)
- Isotropic E-field, free-space probe (e.g., EF3DVx)
- Radiofrequency (RF) emission calibration dipoles for system check / validation purposes.

<EF3DV3 E-Field Probe Specification>

Construction	One dipole parallel, two dipoles normal to probe axis Interleaved sensors Built-in shielding against static charges PEEK enclosure material
Calibration	In air from 30 MHz to 6.0 GHz (absolute accuracy ±5.1%, k=2)
Frequency	30 MHz – 6 GHz Linearity: ±0.2 dB (100 MHz – 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 – >1000 V/m
Linearity	± 0.2 dB
Dimensions	Overall length: 337 mm (tip: 20 mm) Tip diameter: 3.9 mm (body: 12 mm) Distance from probe tip to dipole centers: 1.5 mm Sensor displacement to probe's calibration point: <0.7 mm

Voltage to E-field Conversion

The measured voltage is first linearized to a quantity proportional to the square of the E-field using the (a, b, c, d) set of parameters specific to the communication system and sensor：

$$\mathbf{V_{compi} = U_i + U_i^2 \cdot \frac{10^{\frac{d}{10}}}{dcp_i}}$$

where V_{compi} = compensated signal of channel i (μV) (i = x, y, z)
U_i = input signal of channel i (μV) (i = x, y, z)
d = PMR factor d (dB) (Probe parameter)
dcp_i = diode compression point of channel i (μV) (Probe parameter, i = x, y, z)

$$\mathbf{V_{compi\,dB\sqrt{\mu V}} = 10 + \log_{10}\left(V_{compi}\right)}$$

$$\mathbf{corr_i = a_i \cdot e - \left(\frac{V_{compi\,dB\sqrt{\mu V}}^{\;-b_i}}{C_i}\right)^2}$$

where $coor_i$ = correction factor of channel i (dB) (i = x, y, z)
$V_{compi\ dB\sqrt{\mu V}}$ = compensated voltage of channel i (dB√μV) (i = x, y, z)
a_i = PMR factor a of channel i (dB) (Probe parameter, i = x,y,z)
b_i = PMR factor b of channel i (dB√μV) (Probe parameter, i = x,y,z)
c_i = PMR factor c of channel i (Probe parameter, i = x,y,z)

The voltage $V_{idB\sqrt{\mu V}}$ is the linearized voltage in dB√μV：

$$\mathbf{V_{i\,dB\sqrt{\mu V}} = V_{compi\,dB\sqrt{\mu V}} - corr_i}$$

where $V_{i\ dB\sqrt{\mu V}}$ = linearized voltage of channel i (dB√μV) (i = x,y,z)
$V_{compi\ dB\sqrt{\mu V}}$ = compensated voltage of channel i (dB√μV) (i = x,y,z)
$Corr_i$ = correction factor of channel i (dB) (i = x,y,z)

Finally, the linearized voltage is converted in µV：

$$\mathbf{V_i} = \mathbf{10}^{\frac{\mathbf{V_{i\,dB\sqrt{\mu V}}}}{\mathbf{10}}}$$

where V_i = linearized voltage of channel i (µV) (i = x,y,z)
$V_{i\ dB\sqrt{\ }\mu V}$ = linearized voltage of channel i (dB$\sqrt{\ }$µV (i = x,y,z)

The E-field data for each channel are calculated using the linearized voltage：

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

where V_i = compensated signal of channel i, (i = x, y, z)
$Norm_i$ = sensor sensitivity (µV/(V/m)^2 of channel i (i = x, y, z)
ConvF = sensitivity enhancement in solution
E_i = electric field strength of channel i in V/m

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

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

Averaged E-field Calculation

The averaged E-field is defined by

$$\mathbf{E_{avg}} = \frac{\mathbf{1}}{\mathbf{n}} \cdot \sum_{\mathbf{i=1}}^{\mathbf{n}} \mathbf{E_i}$$

where n = = the number of measurement grid point
E_i = the E-field measured at point i

RFail Calculation

The RFail is finally computed with

$$\boldsymbol{RFail[dB(V/m)] = 20 \cdot \log_{10}(E_{avg}) + MIF}$$

where RFail = the Radio Frequency Audio Interference Level in dB(V/m)
E_{avg} = the averaged E-field in (V/m) calculated
MIF = the Modulation Interference Factor in dB.

7. RF Emissions Test Procedure

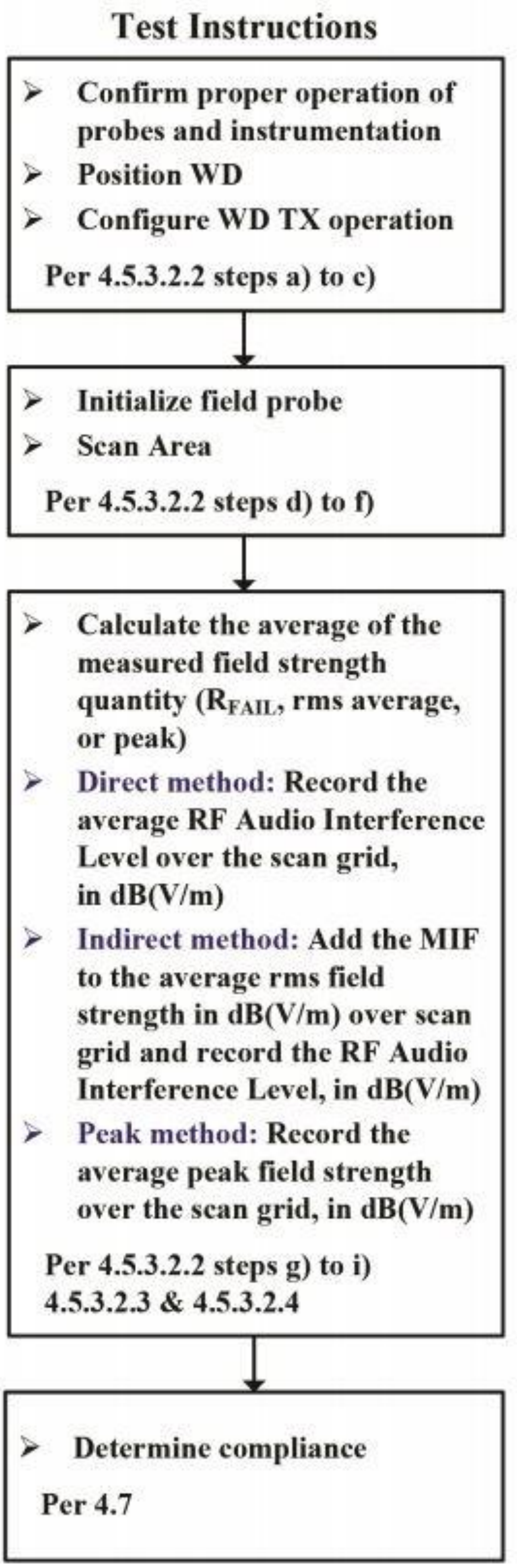
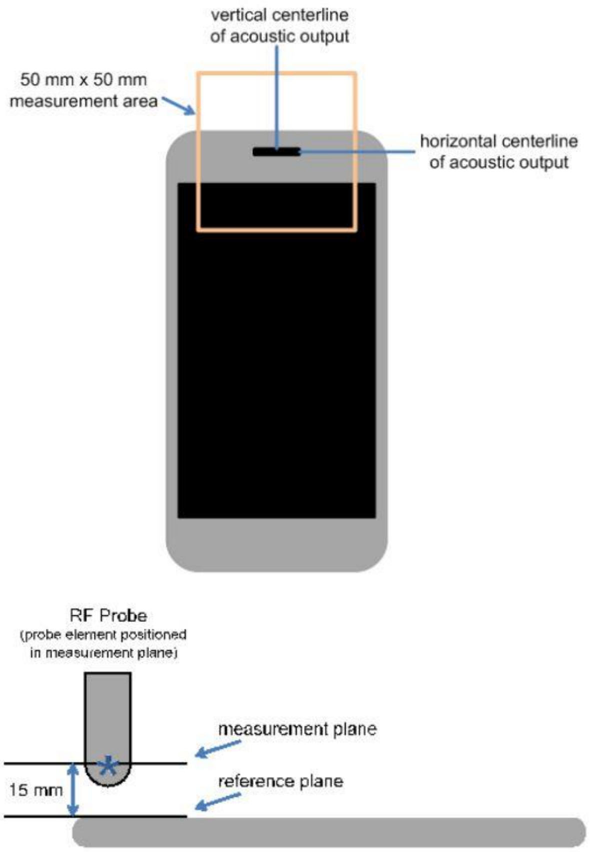
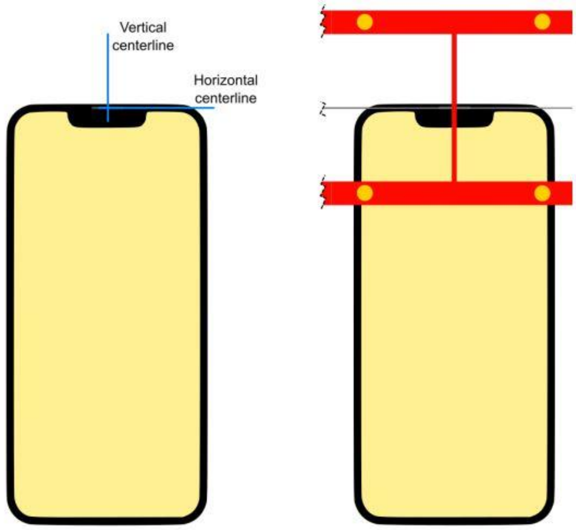


Figure of WD near-field emission scan flowchart according to ANSI 63.19:2019



The references and reference plane that shall be used in the WD emissions measurement



Device Under Test Positioning under the Test Arch

Test procedure: Indirect measurement—preferred

a. The measurement procedure using a probe and instrumentation chain with a response of <10 kHz (see ANSI63.19-2019 section4.5.1) is identical to the direct measurement method of ANSI63.19-2019 section4.5.3.2.2: however, because of the bandwidth limitations, it cannot include the direct use of the spectral and temporal weighting functions. The output of such measurement systems must be readings of steady state rms field strength in dB(V/m).
b. The RF audio interference level in dB(V/m) is obtained by adding the Modulation Interference Factor (in decibels) to the average steady state rms field strength reading over the measurement area, in dB(V/m), from Step c). Use this result to determine the WD's compliance per ANSI 63.19-2019 section4.7.
c. Scan the entire 50 mm by 50 mm measurement area in equally spaced step sizes and record the reading at each measurement point. The step size shall meet the specification for step size in ANSI 63.19:2019 section 4.5.3.
d. Calculate the average of the measurements taken in Step c
e. Convert the average value found in Step d) to RF audio interference level, in volts per meter, by taking the square root of the reading and then dividing it by the measurement system transfer function, as established in ANSI 63.19:2019 section4.5.3.2.1 pre-test procedure. Convert the result to dB(V/m) by taking the base-10 logarithm and multiplying it by 20. Expressed as a formula

RF audio interference level in db(V/M) 20 * log($R_{ave}^{1/2}$ / TF)
where
R_{ave} is the average reading

f. Compare this RF audio interference level to the limits in ANSI 63.19:2019 section4.7 and record the result
g. Per ANSI63.19-2019 section4.6, WDs capable of operating multiple transmitters shall be subject to emissions requirements for all such transmitters expected to be operated when the WD is in voice mode operation positioned at a user's ear. Each qualified transmitter is tested individually using the method of Clause 4. Other WD transmitters shall be temporarily disabled or reduced in power level such that their average antenna input power is at least 6 dB lower than the average antenna input power of the transmitter under test. The transmitter under test is set to the fixed and repeatable combination of power and modulation characteristic that is representative of the worst case (highest interference potential) likely to be encountered while the WD is experiencing normal voice mode operation. The limiting measurement for device qualification is the highest RF audio interference potential measured for any of the WD transmitters. If the highest interference measurement is from a transmitter that is not required for normal voice mode operation, a secondary rating may be given that applies when that transmitter is disabled.

8. Test Equipment List

Manufacturer	Name of Equipment	Type/Model	Serial Number	Calibration	
				Last Cal.	Due Date
SPEAG	835MHz Calibration Dipole(2)	CD835V3	1045	Sep. 27, 2021	Sep. 24, 2024
SPEAG	1880MHz Calibration Dipole(2)	CD1880V3	1038	Sep. 27, 2021	Sep. 24, 2024
SPEAG	3500Mhz Calibration Dipole	CD3500V3	1022	Jun. 08, 2023	Jun. 07, 2024
SPEAG	Data Acquisition Electronics	DAE3	577	Sep. 14, 2023	Sep. 13, 2024
SPEAG	Isotropic E-Field Probe	EF3DV3	4088	Aug. 15, 2023	Aug. 14, 2024
Testo	Hygro meter	608-H1	45196600	Nov. 02, 2023	Nov. 01, 2024
R&S	Wideband Radio Communication Tester	CMW500	115793	Nov. 20, 2023	Nov. 19, 2024
R&S	Wideband Radio Communication Tester	CMX500	101931	Sep. 12, 2023	Sep. 11, 2024
SPEAG	Test Arch Phantom	N/A	N/A	NCR	NCR
SPEAG	Phone Positioner	N/A	N/A	NCR	NCR
Anritsu	Signal Generator	MG3710A	6201502524	Sep. 27, 2023	Sep. 26, 2024
Anritsu	Power Meter	ML2495A	1419002	Aug. 17, 2023	Aug. 16, 2024
Anritsu	Power Sensor	MA2411B	1911176	Aug. 18, 2023	Aug. 17, 2024
ATM	Dual Directional Coupler	C122H-10	P610410z-02	NCR	NCR
Warison	Directional Coupler	WCOU-10-50S-10	WR889BMC4B1	NCR	NCR
Woken	Attenuator	WK0602-XX	N/A	NCR	NCR
Anritsu	Spectrum Analyzer	MS2830A	6201396378	Jul. 10, 2023	Jul. 09, 2024
Anritsu	Spectrum Analyzer	N9010A	MY53470118	Jan. 10, 2024	Jan. 09, 2025
Mini-Circuits	Power Amplifier	ZVE-8G+	6418	Oct. 16, 2023	Oct. 15, 2024
Mini-Circuits	Power Amplifier	ZHL-42W+	QA1344002	Oct. 13, 2023	Oct. 12, 2024

Note:

1. NCR: “No-Calibration Required”
2. The dipole calibration interval can be extended to 3 years with justification. 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. System Validation

Obtaining accurate measurements and relevant quantities in Module HAC depends on the proper functioning of many components and the correct parameter settings. Faulty results due to drift, failures, or incorrect parameters might not be recognized, as the differences might not be obvious in the measurements.
SPEAG DASY incorporates a system check, also called system verification procedure, to test for the proper functioning of the system based on the tests described in ANSI C63.19-2019: the RF interference potential test setup is verified with RF Emission Calibration Dipoles.

<Test Setup>

1. Set the RF signal generator for either CW. Set its output power so the peak power applied to the antenna is equal to that recorded for the real or emulated signal using the WD modulation format
2. Average input power P = 100 mW (20 dBm) after adjustment for return loss. An input power that generates field levels similar to those from the WD or other suitable level may also be used
3. The test fixture should meet the two-wavelength separation criterion
4. The probe-to-dipole separation, which is measured from closest surface of the dipole to the center point of the probe sensor element, should be 15 mm

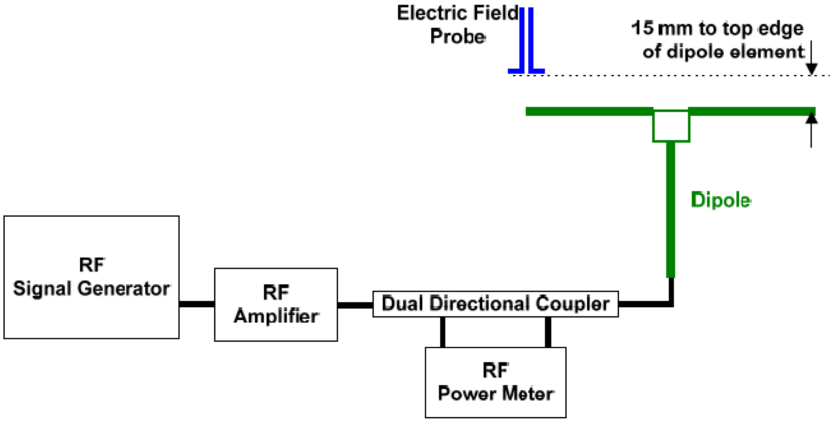


Figure of Setup Diagram

<Validation Procedure>

Place a dipole antenna meeting the requirements given in ANSI 63.19: 2019 D.11 in the position normally occupied by the WD. The dipole antenna serves as a known source for an electrical and magnetic output. Position the E-field probe so that:

a. The probe and its cable are parallel to the coaxial feed of the dipole antenna
b. The probe cable and the coaxial feed of the dipole antenna approach the measurement area from opposite directions; and
c. The center point of the probe element(s) is 15 mm from the closest surface of the dipole elements

Scan the length of the dipole with the E-field probe and record the two maximum values found near the dipole ends. Average the two readings and compare the reading to expected value in the calibration certificate or expected value in this standard.

Frequency (MHz)	Input Power (dBm)	Target Value (V/m)	Emax (V/m)	Deviation (%)	Date	Dipole S/N	Probe S/N	DAE S/N
835	20	106.8	110	3.00	May 22, 2024	1045	4088	577
1880	20	85.5	89.3	4.44	May 22, 2024	1038	4088	577
3500	20	82.6	87.2	5.57	May 22, 2024	1022	4088	577

10. Modulation Interference Factor

For any specific fixed and repeatable modulated signal, a Modulation Interference Factor (MIF, expressed in decibels) 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 or 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.
MIF may be determined using a radiated RF field, a conducted RF signal, or, in a preliminary stage, a mathematical analysis of a modeled RF signal.

a. Verify the slope accuracy and dynamic range capability over the desired operating frequency band of a fast probe or sensor, square-law detector, as specified in ANSI 63.19: 2019 D.3, and weighting system as specified in ANSI 63.19: 2019 D.4 and ANSI 63.19: 2019 D.5. For the probe and instrumentation included in the measurement of MIF, additional calibration and application of calibration factors are not required.
b. Using RF illumination, or conducted coupling, apply the specific modulated signal in question to the measurement system at a level within its confirmed operating dynamic range
c. Measure the steady-state rms level at the output of the fast probe or sensor
d. Measure the steady-state average level at the weighting output
e. Without changing the square-law detector or weighting system, and using RF illumination, or conducted coupling, substitute for the specific modulated signal a 1 kHz, 80% amplitude modulated carrier at the same frequency and adjust its strength until the level at the weighting output equals the Step d) measurement
f. Without changing the carrier level from Step e), remove the 1 kHz modulation and again measure the steady-state rms level indicated at the output of the fast probe or sensor.
g. The MIF for the specific modulation characteristic is given by the ratio of the Step f) measurement to the Step c) measurement, expressed in decibels (20*log(step6/step3)

In practice, Step e) and Step f) need not be repeated for each MIF determination if the relationship between the two measurements has been pre-established for the measurement system over the operating frequency and dynamic ranges. In such cases, only the modulation characteristic being tested needs to be available during WD testing Since indirect measurement procedure was using for RF audio interference power level evaluation, the 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 Wireless device RF audio interference power level.

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
10170	LTE-FDD(SC-FDMA,1RB,20MHz,16-QAM)	-9.76
10173	LTE-TDD (SC-FDMA, 1 RB, 20 MHz, 16-QAM)	-1.44
10769	5G NR (CP-OFDM, 1 RB, 15 MHz, QPSK, 15 kHz)	-12.08
10973	5G NR (DFT-s-OFDM, 1 RB, 100 MHz, QPSK, 30 kHz)	-1.64
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
10616	IEEE 802.11ac WiFi (40MHz, MCS0, 90pc duty cycle)	-5.57
10671	IEEE 802.11ax (20MHz, MCS0, 90pc duty cycle)	-5.58

11. Evaluation of WD RF interference potential

General Note:

1. In this report, max conducted power from each air interface was first used to evaluate whether it complies with ANSI63.19-2019 Table 4.1 RF_{AIPL}, compliance with table 4.1 means compliance with WD emission requirements. the RF_{AIPL} evaluation refer to section 11.1 for detail.
2. If there some air interface were not meet ANSI63.19-2019 table 4.1 requirement, these air interfaces were further evaluation ANSI63.19-2019 Table 4.3 RF_{AIL} requirement. And the RF_{AIL} evaluation result refer to section11.2

11.1 Evaluation RF_{AIPL}

<WWAN Max Tune-up Limit>

Radio Tech	Band Number	Average Power (dBm)					
		Ant 0	Ant 1	Ant 4	Ant 5	Ant 7	Ant 6+7
GSM/GPRS 1TX	850	34					
GSM/GPRS 1TX	1900		31				
UMTS/HSPA	B2		25				
UMTS/HSPA	B4		25				
UMTS/HSPA	B5	25					
LTE	B2		24.5				
LTE	B4		24.5				
LTE	B5	24.5					
LTE	B7		24.5				
LTE	B12	24.5					
LTE	B13	24.5					
LTE	B14	24.5					
LTE	B17	24.5					
LTE	B25		24.5				
LTE	B26	24.5					
LTE	B30		24.5				
LTE	B38/41		24.5				
LTE	B48					24.5	
LTE	B66		24.5				
5G FR1	n7		25				
5G FR1	n12	25					
5G FR1	n13	25					
5G FR1	n14	25					
5G FR1	n2/25		25				
5G FR1	n5/26	25					
5G FR1	n30		25				
5G FR1 PC3	n38/n41		25				
5G FR1	n48			24.9	24.9	25	25
5G FR1	n66		25				
5G FR1 PC3	n77/n78			23.9	23.9	24.0	24.0
5G FR1 PC2	n77/n78			26.9	26.9	27.0	27.0

<Evaluation RF audio interference power level>

General Note:

1. Use maximum power plus worst case MIF to determine whether it complies with RF_{AIPL}
2. If maximum power plus worst case MIF does not complies with RF_{AIPL}, then further evaluation RF_{AIL} include in section 11.2.
3. According to ANSI C63.19 2019, if maximum power plus worst case MIF is complies with RF_{AIPL}, means compliance with WD emission requirements.

Ant 0					
Air Interface	Max Average Antenna Input Power (dBm)	Worst Case MIF (dB)	Power + MIF(dB)	C63.19 Lowest RF_{AIPL} (dBm)	C63.19 test required
GSM850	34.00	3.63	37.63	26	Yes
WCDMA	25.00	-25.43	-0.43	26	No
WCDMA - HSPA	25.00	-20.39	4.61	26	No
LTE - FDD	24.50	-9.76	14.74	25	No
5G FR1 - FDD	25.00	-12.08	12.92	25	No

Ant 1					
Air Interface	Max Average Antenna Input Power (dBm)	Worst Case MIF (dB)	Power + MIF(dB)	C63.19 Lowest RF_{AIPL} (dBm)	C63.19 test required
GSM1900	31.00	3.63	34.63	26	Yes
WCDMA	25.00	-25.43	-0.43	26	No
WCDMA - HSPA	25.00	-20.39	4.61	26	No
LTE - FDD	24.50	-9.76	14.74	25	No
LTE – TDD	24.50	-1.44	23.06	25	No
5G FR1 - FDD	25.00	-12.08	12.92	25	No
5G FR1 - TDD	25.00	-1.64	23.36	25	No

Ant 4					
Air Interface	Max Average Antenna Input Power (dBm)	Worst Case MIF (dB)	Power + MIF(dB)	C63.19 Lowest RF_{AIPL} (dBm)	C63.19 test required
5G FR1 – TDD PC3	24.90	-1.64	23.26	25	No
5G FR1 – TDD PC2	26.90	-1.64	25.26	25	Yes

Ant 5					
Air Interface	Max Average Antenna Input Power (dBm)	Worst Case MIF (dB)	Power + MIF(dB)	C63.19 Lowest RF_{AIPL} (dBm)	C63.19 test required
5G FR1 – TDD PC3	24.90	-1.64	23.26	25	No
5G FR1 – TDD PC2	26.90	-1.64	25.26	25	Yes

Ant 7					
Air Interface	Max Average Antenna Input Power (dBm)	Worst Case MIF (dB)	Power + MIF(dB)	C63.19 Lowest RF_{AIPL} (dBm)	C63.19 test required
5G FR1 – TDD PC3	25.00	-1.64	23.36	25	No
5G FR1 – TDD PC2	27.00	-1.64	25.36	25	Yes

Ant 6+7					
Air Interface	Max Average Antenna Input Power (dBm)	Worst Case MIF (dB)	Power + MIF(dB)	C63.19 Lowest RF_{AIPL} (dBm)	C63.19 test required
5G FR1 – TDD PC3	25.00	-1.64	23.36	25	No
5G FR1 – TDD PC2	27.00	-1.64	25.36	25	Yes

Ant 6+7					
Air Interface	Max Average Antenna Input Power (dBm)	Worst Case MIF (dB)	Power + MIF(dB)	C63.19 Lowest RF_{AIPL} (dBm)	C63.19 test required
5G FR1 – TDD Duty(100%)	25.00	-12.08	12.92	25	No
5G FR1 – TDD Duty(50%)	27.00	-1.64	25.36	25	Yes

< WLAN Max Tune-up Limit>

Antenna		Ant 9	Ant 8+9
2.4GHz WLAN	802.11b	18.70	21.70
	802.11g	18.70	21.70
	802.11n-HT20	18.70	21.70
	802.11n-HT40	18.70	21.70
	802.11ac-VHT20	18.70	21.70
	802.11ac-VHT40	18.70	21.70
	802.11ax-HE20	18.70	21.70
	802.11ax-HE40	18.70	21.70
	802.11be-EHT20		21.70
	802.11be-EHT40		21.70
5GHz WLAN	802.11a		20.20
	802.11n-HT20		20.20
	802.11n-HT40		20.20
	802.11ac-VHT20		20.20
	802.11ac-VHT40		20.20
	802.11ac-VHT80		20.20
	802.11ac-VHT160		20.20
	802.11ax-HE20		20.20
	802.11ax-HE40		20.20
	802.11ax-HE80		20.20
	802.11ax-HE160		20.20

<Evaluation RF audio interference power level>

General Note:

1. Use maximum power plus worst case MIF to determine whether it complies with RF_{AIPL}
2. According to ANSI C63.19 2019, if maximum power plus worst case MIF is complies with RF_{AIPL}, means compliance with WD emission requirements.

Ant 9					
Air Interface	Max Average Antenna Input Power (dBm)	Worst Case MIF (dB)	Power + MIF(dB)	C63.19 Lowest RF_{AIPL} (dBm)	C63.19 test required(2019)
802.11b	18.70	-2.02	16.68	25	No
802.11g	18.70	0.12	18.82	25	No
802.11n-HT20	18.70	-13.44	5.26	25	No
802.11n-HT40	18.70	-13.44	5.26	25	No
802.11ac-VHT20	18.70	-5.57	13.13	25	No
802.11ac-VHT40	18.70	-5.57	13.13	25	No
802.11ax-HE20	18.70	-5.58	13.12	25	No
802.11ax-HE40	18.70	-5.58	13.12	25	No

Ant 8+9					
Air Interface	Max Average Antenna Input Power (dBm)	Worst Case MIF (dB)	Power + MIF(dB)	C63.19 Lowest RF_{AIPL} (dBm)	C63.19 test required(2019)
802.11b	21.70	-2.02	19.68	25	No
802.11g	21.70	0.12	21.82	25	No
802.11n-HT20	21.70	-13.44	8.26	25	No
802.11n-HT40	21.70	-13.44	8.26	25	No
802.11ac-VHT20	21.70	-5.57	16.13	25	No
802.11ac-VHT40	21.70	-5.57	16.13	25	No
802.11ax-HE20	21.70	-5.58	16.12	25	No
802.11ax-HE40	21.70	-5.58	16.12	25	No
802.11be-EHT20	21.70	-28.73	-7.03	25	No
802.11be-EHT40	21.70	-28.73	-7.03	25	No
802.11a	20.20	-3.15	17.05	25	No
802.11n-HT20	20.20	-13.44	6.76	25	No
802.11n-HT40	20.20	-13.44	6.76	25	No
802.11ac-VHT20	20.20	-5.57	14.63	25	No
802.11ac-VHT40	20.20	-5.57	14.63	25	No
802.11ac-VHT80	20.20	-5.57	14.63	25	No
802.11ac-VHT160	20.20	-5.57	14.63	25	No
802.11ax-HE20	20.20	-5.58	14.62	25	No
802.11ax-HE40	20.20	-5.58	14.62	25	No
802.11ax-HE80	20.20	-5.58	14.62	25	No
802.11ax-HE160	20.20	-5.58	14.62	25	No

11.2 Evaluation RF_{AIL}

General Note:

1. The HAC measurement system applies MIF value onto the measured RMS E-field, which is indirect method in ANSI C63.19-2019 version, and reports the RF audio interference level.
2. Phone Condition: Mute on; Backlight off; Max Volume
3. Since the NR n77 power class 3 maximum power plus MIF is complies with ANSI63.19-2019 Table 4.1 RF_{AIPL}, therefore, only power class2 evaluated RF_{AIL}.
4. Since the FR1 n77 that the maximum channel bandwidth does not support three non-overlapping channels in the frequency band, the middle channel of the group of overlapping channels were selected for testing.

Plot No.	Air Interface	Modulation / Mode	Channel	Transmit Ant.	Average Antenna Input Power (dBm)	MIF	RF AIL (dBV/m)
1	GSM850	Voice	128	Ant 0	32.40	3.63	14.58
2	GSM850	Voice	189	Ant 0	32.78	3.63	16.32
3	GSM850	Voice	251	Ant 0	32.66	3.63	18.22
4	GSM1900	Voice	512	Ant 1	30.05	3.63	23.81
5	GSM1900	Voice	661	Ant 1	30.27	3.63	25.15
6	GSM1900	Voice	810	Ant 1	30.11	3.63	26.16
7	n77_HPUE	100M_BPSK_1_1	656000	Ant 4	25.22	-1.64	17.15
8	n77_HPUE	100M_BPSK_1_1	633332	Ant 4	25.69	-1.64	18.03
9	n77_HPUE	100M_BPSK_1_1	656000	Ant 5	25.67	-1.64	16.11
10	n77_HPUE	100M_BPSK_1_1	633332	Ant 5	25.81	-1.64	19.14
11	n77_HPUE	100M_BPSK_1_1	656000	Ant 7	25.31	-1.64	18.42
12	n77_HPUE	100M_BPSK_1_1	633332	Ant 7	25.36	-1.64	17.71
13	n77_HPUE	100M_BPSK_1_1	656000	Ant 6+7	26.53	-1.64	23.90
14	n77_HPUE	100M_BPSK_1_1	633332	Ant 6+7	26.14	-1.64	22.49

Test Engineer： Charles Shen and Sam Lin

12. Uncertainty Assessment

The component of uncertainly may generally be categorized according to the methods used to evaluate them. The evaluation of uncertainly by the statistical analysis of a series of observations is termed a Type A evaluation of uncertainty. The evaluation of uncertainty by means other than the statistical analysis of a series of observation is termed a Type B evaluation of uncertainty. Each component of uncertainty, however evaluated, is represented by an estimated standard deviation, termed standard uncertainty, which is determined by the positive square root of the estimated variance.
The combined standard uncertainty of the measurement result represents the estimated standard deviation of the result. It is obtained by combining the individual standard uncertainties of both Type A and Type B evaluation using the usual "root-sum-squares" (RSS) methods of combining standard deviations by taking the positive square root of the estimated variances. Expanded uncertainty is a measure of uncertainty that defines an interval about the measurement result within which the measured value is confidently believed to lie. It is obtained by multiplying the combined standard uncertainty by a coverage factor. For purpose of this document, a coverage factor two is used, which corresponds to confidence interval of about 95 %. The DASY uncertainty Budget is showed below Table
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)
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
Combined Std. Uncertainty					**± 16.30 %**
Coverage Factor for 95 %					**K = 2**
Expanded STD Uncertainty					**± 32.6 %**

Uncertainty Budget of HAC free field assessment

13. References

[1] ANSI C63.19:2019, "American National Standard for Methods of Measurement of Compatibility between Wireless Communications Devices and Hearing Aids", Aug. 2019.

[2] FCC KDB 285076 D01v06r04, "Equipment Authorization Guidance for Hearing Aid Compatibility", Sep. 2023.

[3] FCC KDB 285076 D03v01r06, "Hearing aid compatibility frequently asked questions", Jul. 2022

[4] SPEAG DASY System Handbook