

RF-Emission Test Report

Application No.: SUCR2410000403WM
Applicant: Sonim Technologies, Inc.
Address of Applicant: 4445 Eastgate Mall, Suite 200, San Diego, CA 92121, USA
Manufacturer: Sonim Technologies, Inc.
Address of Manufacturer: 4445 Eastgate Mall, Suite 200, San Diego, CA 92121, USA
EUT Description: Smart Phone
Model No: X800
Type No.: S1003/S1001/S1004/S1005/S1006/S1010
FCC ID: WYPS1003
Trade Mark: Sonim
Standards: ANSI C63.19-2019
CFR 47 FCC Part 20
Date of Receipt: 2024-10-15
Date of Test: 2024-12-12 to 2024-12-14
Date of Issue: 2024-12-15

Test Result :	PASS *
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* In the configuration tested, the EUT detailed in this report complied with the standards specified above.



Prepared by: Leon Liu/ Project Manager



Approved by: Nick HU/ Technical Manager
(Title)

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SGS-CSTC Standards Technical Services (Suzhou) Co., Ltd

Report No.: SUCR241000040301

Rev.: 01

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Revision Record

Version	Description	Date	Remark
01		2024-12-15	Original

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TEST SUMMARY

Frequency Band	HAC RF Emission Test result*		Results
GSM 850	E-Field dB(V/m)	35.65	PASS
PCS 1900	E-Field dB(V/m)	21.59	PASS
WCDMA band 2	E-Field dB(V/m)	/	PASS
WCDMA band 4	E-Field dB(V/m)	/	PASS
WCDMA band 5	E-Field dB(V/m)	/	PASS
LTE band 2	E-Field dB(V/m)	/	PASS
LTE band 4	E-Field dB(V/m)	/	PASS
LTE band 5	E-Field dB(V/m)	/	PASS
LTE band 7	E-Field dB(V/m)	/	PASS
LTE band 12	E-Field dB(V/m)	/	PASS
LTE band 13	E-Field dB(V/m)	/	PASS
LTE band 14	E-Field dB(V/m)	/	PASS
LTE band 25	E-Field dB(V/m)	/	PASS
LTE band 26	E-Field dB(V/m)	/	PASS
LTE band 30	E-Field dB(V/m)	/	PASS
LTE band 66	E-Field dB(V/m)	/	PASS
LTE band 71	E-Field dB(V/m)	/	PASS
LTE band 38	E-Field dB(V/m)	/	PASS
LTE band 41	E-Field dB(V/m)	22.48	PASS
LTE band 42	E-Field dB(V/m)	/	PASS
LTE band 43	E-Field dB(V/m)	/	PASS
LTE band 48	E-Field dB(V/m)	/	PASS
FR1 n2	E-Field dB(V/m)	/	PASS
FR1 n5	E-Field dB(V/m)	/	PASS
FR1 n7	E-Field dB(V/m)	/	PASS
FR1 n14	E-Field dB(V/m)	/	PASS
FR1 n25	E-Field dB(V/m)	/	PASS
FR1 n26	E-Field dB(V/m)	/	PASS
FR1 n30	E-Field dB(V/m)	/	PASS
FR1 n38	E-Field dB(V/m)	/	PASS
FR1 n41	E-Field dB(V/m)	18.5	PASS
FR1 n48	E-Field dB(V/m)	/	PASS
FR1 n66	E-Field dB(V/m)	/	PASS
FR1 n70	E-Field dB(V/m)	/	PASS
FR1 n71	E-Field dB(V/m)	/	PASS
FR1 n77	E-Field dB(V/m)	22.29	PASS
FR1 n78	E-Field dB(V/m)	22.48	PASS
WLAN2.4GHz	E-Field dB(V/m)	/	PASS
WLAN5GHz	E-Field dB(V/m)	/	PASS
WLAN6GHz	E-Field dB(V/m)	/	PASS
HAC Results: PASS			

Note:

- 1) This portable wireless equipment has been shown to be hearing-aid compatible under the above rated category, specified in ANSI/IEEE Std.C63.19-2019 and had been tested in accordance with the specified measurement procedures, Hear-Aid Compatibility is based on the assumption that all production units will be designed electrically identical to the device tested in this report. Test results reported herein relate only to the item(s) tested and are for North American Bands only.
- 2) *- HAC RF Emission Test for low power exemption according to ANSI C63.19-2019 and HAC RF Emission rating is PASS.

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1 General Information

1.1 Introduction

The purpose of the Hearing Aid Compatibility is to enable measurements of the near electric fields generated by wireless communication devices in the region controlled for use by a hearing aid in accordance with ANSI-C63.19-2019.

The purpose of this standard is to establish categories for hearing aids and for WD (wireless communications devices) that can indicate to health care practitioners and hearing aid users which hearing aids are compatible with which WD, and to provide tests that can be used to assess the electromagnetic characteristics of hearing aids and WD and assign them to these categories. The various parameters required, in order to demonstrate compatibility and accessibility are measured. The design of the standard is such that when a hearing aid and WD achieve one of the categories specified, as measured by the methodology of this standard, the indicated performance is realized.

In order to provide for the usability of a hearing aid with a WD, several factors must be coordinated:

a) Radio frequency (RF) measurements of the near-field electric fields emitted by a WD to categorize these emissions for correlation with the RF immunity of a hearing aid.

Hence, the following are measurements made for the WD:
RF E-Field emissions

The measurement plane is parallel to, and 1.5cm in front of, the reference plane.

Applications for certification of equipment operation under part 20, that a manufacturer is seeking to certify as hearing aid compatible, as set forth in §20.19 of that part, shall include a statement indication compliance with the test requirements of §20.19 and indicating the appropriate U-rating for the equipment. The manufacturer of the equipment shall be responsible for maintaining the test results.

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Manufacturer:	Sonim Technologies, Inc.
Address:	4445 Eastgate Mall, Suite 200, San Diego, CA 92121, USA

1.3 Test Location

Company:	SGS-CSTC Standards Technical Services (Suzhou) Co., Ltd.
Address:	South of No. 6 Plant, No. 1, Runsheng Road, Suzhou Industrial Park, Suzhou Area, China (Jiangsu) Pilot Free Trade Zone
Post code:	215000
Test Engineer:	Alger Du

1.4 Test Facility

The test facility is recognized, certified, or accredited by the following organizations:

- **A2LA (Certificate No. 6336.01)**

SGS-CSTC STANDARDS TECHNICAL SERVICES (SUZHOU) CO., LTD. is accredited by the American Association for Laboratory Accreditation(A2LA). Certificate No. 6336.01.

- **Innovation, Science and Economic Development Canada**

SGS-CSTC STANDARDS TECHNICAL SERVICES (SUZHOU) CO., LTD. has been recognized by ISED as an accredited testing laboratory.

CAB identifier: CN0120.

IC#: 27594.

- **FCC –Designation Number: CN1312**

SGS-CSTC STANDARDS TECHNICAL SERVICES (SUZHOU) CO., LTD. has been recognized as an accredited testing laboratory.

Designation Number: CN1312.

Test Firm Registration Number: 717327

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1.5 General Description of EUT

Device Type :	portable device		
Exposure Category:	uncontrolled environment / general population		
Product Name:	XP Pro		
Model No.(EUT):	X800		
Trade Mark:	Sonim		
FCC ID:	WYPS1003		
Product Phase:	Identical Prototype		
IMEI:	016582000011097/01 016582000011105/01		
Hardware Version:	V1.0		
Software Version:	X80.0-01-14.0-19.40.01		
Antenna Type:	PIFA Antenna		
Modulation Mode:	GSM: GMSK, 8PSK; WCDMA: QPSK;16QAM;		
	LTE: QPSK,16QAM,64QAM,256QAM;		
	NR: BPSK,QPSK,16QAM,64QAM,256QAM,CP-OFDM		
	WIFI: DSSS, OFDM; BT: GFSK, π/4DQPSK,8DPSK		
Device Class:	B		
GPRS Multi-slots Class:	12	EGPRS Multi-slots Class:	33
HSDPA UE Category:	10	HSUPA UE Category	6
Power Class	4, tested with power level 5(GSM850)		
	1, tested with power level 0(GSM1900)		
	3, tested with power control "all 1"(WCDMA Band)		
	3, tested with power control Max Power(LTE Band)		
Frequency Bands:	Band	Tx (MHz)	Rx (MHz)
	GSM 850	824 - 849 MHz	869 - 894 MHz
	PCS 1900	1850 - 1910 MHz	1930 - 1990 MHz
	WCDMA band 2	1850 -1910 MHz	1930 - 1990 MHz
	WCDMA band 4	1710 -1755MHz	2110 - 2155MHz
	WCDMA band 5	824 - 849MHz	869 - 894MHz
	LTE band 2	1850 - 1910 MHz	1930 - 1990 MHz
	LTE band 4	1710 - 1755 MHz	2110 - 2155 MHz

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LTE band 5	824 - 849 MHz	869 - 894 MHz
LTE band 7	2500 - 2570 MHz	2620 - 2690 MHz
LTE band 12	699 - 716 MHz	729 - 746 MHz
LTE band 13	777 - 787 MHz	746 - 756 MHz
LTE band 14	788 - 798 MHz	758 - 768 MHz
LTE band 25	1850 - 1915 MHz	1930 - 1995 MHz
LTE band 26	814 - 849 MHz	859 - 894 MHz
LTE band 30	2305 - 2315 MHz	2350 - 2360 MHz
LTE band 38	2570 - 2620 MHz	2570 - 2620 MHz
LTE band 41	2496 - 2690 MHz	2496 - 2690 MHz
LTE band 42	3400 - 3600 MHz	3400 - 3600 MHz
LTE band 43	3600 - 3800 MHz	3600 - 3800 MHz
LTE band 48	3550 - 3700 MHz	3550 - 3700 MHz
LTE band 66	1710 - 1780 MHz	2110 - 2200 MHz
LTE band 71	663 - 698 MHz	617 - 652 MHz
FR1 n2	1850 - 1910 MHz	1930 - 1990 MHz
FR1 n5	824 - 849 MHz	869 - 894 MHz
FR1 n7	2500 - 2570 MHz	2620 - 2690 MHz
FR1 n14	788 - 798 MHz	758 - 768 MHz
FR1 n25	1850 - 1915 MHz	1930 - 1995 MHz
FR1 n26	814 - 849 MHz	859 - 894 MHz
FR1 n30	2305 - 2315 MHz	2350 - 2360 MHz
FR1 n38	2570 - 2620 MHz	2570 - 2620 MHz
FR1 n41	2496 - 2690 MHz	2496 - 2690 MHz
FR1 n48	3550 - 3700 MHz	3550 - 3700 MHz
FR1 n66	1710 - 1780 MHz	2110 - 2200 MHz
FR1 n70	1695 - 1710 MHz	1995 - 2020 MHz
FR1 n71	663 - 698 MHz	617 - 652 MHz
FR1 n77	3300 - 4200 MHz	3300 - 4200 MHz
FR1 n78	3300 - 3800 MHz	3300 - 3800 MHz
WLAN2.4GHZ	2412-2462 MHz	2412-2462 MHz
WLAN5GHZ	5180~5240MHz	5180~5240MHz
	5260~5320MHz	5260~5320MHz

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		5500~5720MHz	5500~5720MHz
		5745~5825MHz	5745~5825MHz
	WLAN6GHz	5925-6425MHz	5925-6425MHz
	Bluetooth	2400~2483.5	2400~2483.5
Battery Information:	Model:	BAT-05000-21S	
	Normal Voltage:	3.87V	
	Rated capacity:	5000 mAh	
	Manufacturer:	Shenzhen Aerospace Electronic Co., Ltd.	

Note:

*Since the above data and/or information is provided by the client relevant results or conclusions of this report are only made for these data and/or information, SGS is not responsible for the authenticity, integrity and results of the data and information and/or the validity of the conclusion.

Remark:

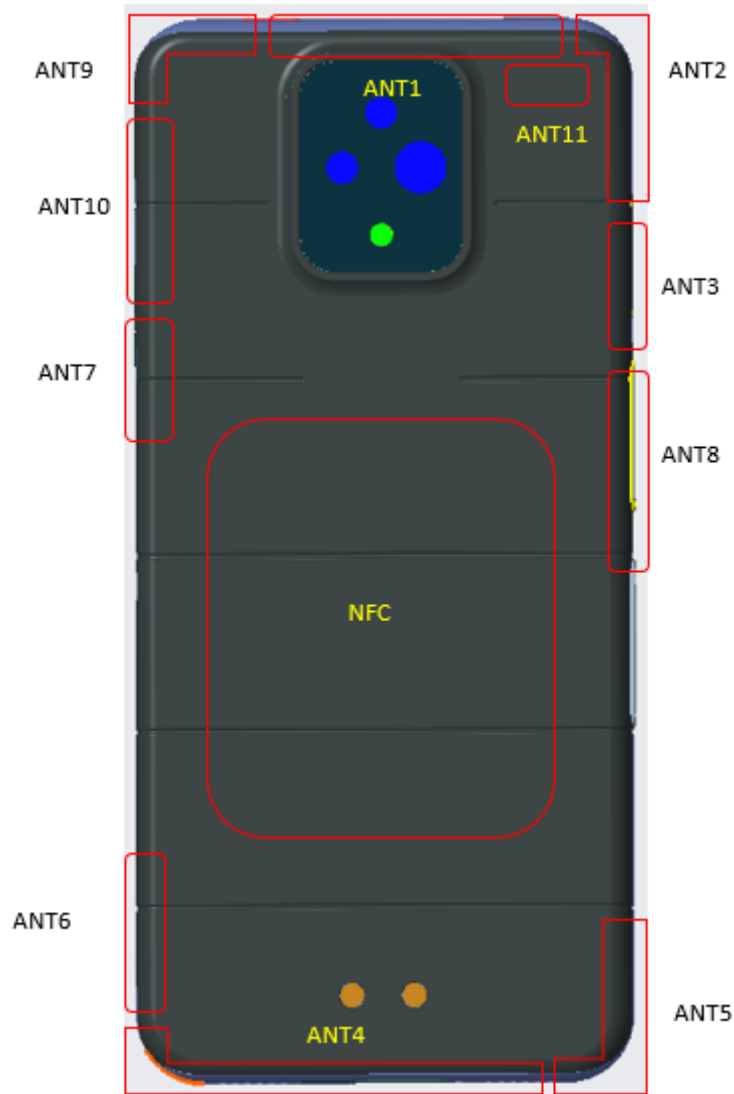
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1.5.1 DUT Antenna Locations



Note:

- 1) The diversity Antenna does not support transmitter function.

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1.5.2 List of air interfaces/frequency bands

Air Interface	Band (MHz)	Type	ANSI C63.19	Simultaneous Transmitter	Name of Voice Service	Power Reduction
			Tested			
GSM	850	VO	Yes	BT, Wi-Fi	CMRS Voice	NO
	1900					
	EDGE	VD	Yes		Google Meet*	
WCDMA	Band II	VO	Yes	BT, Wi-Fi	CMRS Voice	NO
	Band IV					
	Band V					
	HSPA	VD	Yes		Google Meet*	
LTE FDD	LTE band 2	VD	Yes	BT, Wi-Fi	VoLTE Google Meet*	NO
	LTE band 4					
	LTE band 5					
	LTE band 7					
	LTE band 12					
	LTE band 13					
	LTE band 14					
	LTE band 25					
	LTE band 26					
	LTE band 30					
	LTE band 66					
	LTE band 71					
LTE TDD	LTE band 38	VD	Yes	BT, Wi-Fi	VoLTE Google Meet*	NO
	LTE band 41					
	LTE band 42					
	LTE band 43					
	LTE band 48					
FR1 FDD	FR1 n2	DT	Yes	BT, Wi-Fi	Google Meet*	NO
	FR1 n5					
	FR1 n7					
	FR1 n14					
	FR1 n25					
	FR1 n26					
	FR1 n30					
	FR1 n66					
	FR1 n70					
FR1 n71						
FR1 TDD	FR1 n38	DT	Yes	BT, Wi-Fi	Google Meet*	NO
	FR1 n41					
	FR1 n48					

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	FR1 n77					
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Wi-Fi	2450	VD	Yes	WWAN	Google Meet*	NO
	5200					
	5300					
	5500					
	5800					
	U-NII 5					
BT	2450	DT	No(1)	WWAN	NA	NO

VO: Legacy Cellular Voice Service
 DT: Digital Transport (no voice)
 *ANSI C63.19-2019 use table 6.1 to establish the Normal speech input level and NOTE 2 of table 6.1 identifies the group of VoIP voice services that use -16 dBm0 as the normal speech input level.
 Remark:
 1.The WLAN6GHz 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.
 2.The WLAN6GHz UNI-5 was evaluated for operations which are entirely below 6GHz, above 6 GHz were not evaluated due outside of the current scope of ANSI C63.19 and FCC HAC regulations.
 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 Google Meet and google Fi the audio path, parameter and audio codec are all the same, therefore, the Google Meet is evaluation for this device to show compliance.

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1.6 Test Specification

Identity	Document Title
CFR 47 FCC Part 20	§20.19 Hearing aid-compatible mobile handsets.
ANSI C63.19-2019	American National Standard for Methods of Measurement of Compatibility between Wireless Communication Devices
KDB 285076 D01	HAC Guidance v06r04

1.7 ANSI C63.19-2019 limits

Emission Categories	E-field emissions dB(V/m)		
	< 960 MHz	960MHz-2000MHz	>2000 MHz
E field level	<= 39dB (V/m)	<= 36dB (V/m)	<= 35dB (V/m)

Table 1: Telephone near-field categories in linear units

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2 Calibration certificate

Temperature	Min. = 18°C, Max. = 25 °C
Relative humidity	Min. = 30%, Max. = 70%

Table 2: The Ambient Conditions

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3 HAC (T Coil) Measurement System

3.1 Measurement System Diagram for SPEAG Robotic

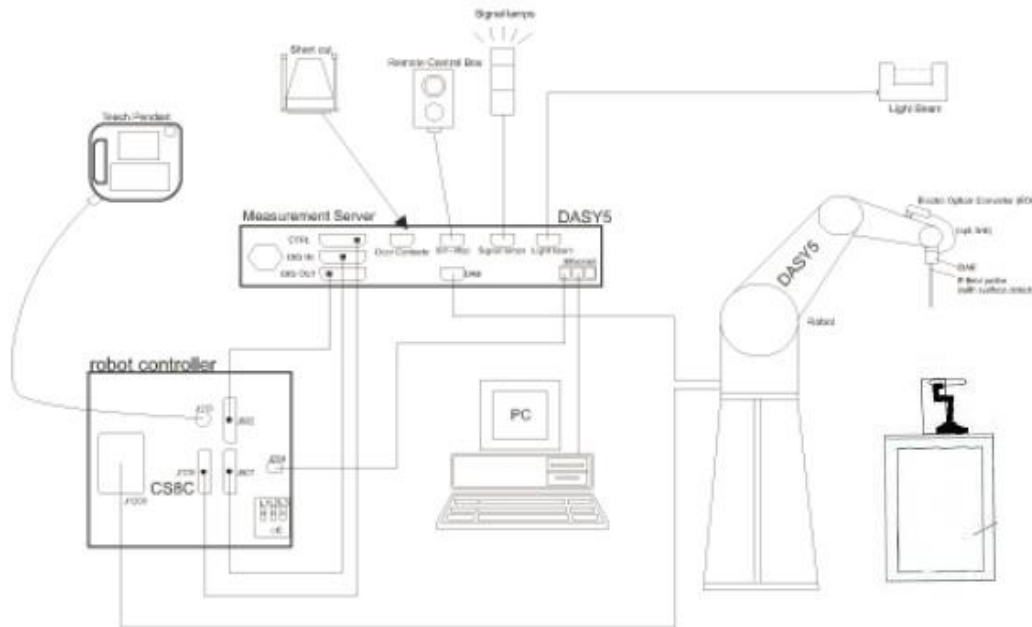


Fig. 1. The SPEAG Robotic Diagram

The DASY8 system for performing compliance tests consists of the following items:


- A standard high precision 6-axis robot (Stabile RX family) with controller, teach pendant and software. An arm extension is for accommodating the data acquisition electronics (DAE).
- An Audio Magnetic probe.
- A data acquisition electronics (DAE) which performs the signal amplification, signal multiplexing, AD-conversion, offset measurements, mechanical surface detection, collision detection, etc. The unit is battery powered with standard or rechargeable batteries. The signal is optically transmitted to the EOC.
- The Electro-optical converter (EOC) performs the conversion between optical and electrical of the signals for the digital communication to the DAE and for the analog signal from the optical surface detection. The EOC is connected to the measurement server.
- The function of the measurement server is to perform the time critical tasks such as signal filtering, control of the robot operation and fast movement interrupts.
- A probe alignment unit which improves the (absolute) accuracy of the probe positioning.
- A computer operating Windows 7.
- DASY8 software.
- Remote control with teach pendant and additional circuitry for robot safety such as warning lamps, etc.
- The Test Arch SAM phantom
- The device holder for handheld mobile phones.
- Validation dipole kits allowing to validate the proper functioning of the system.

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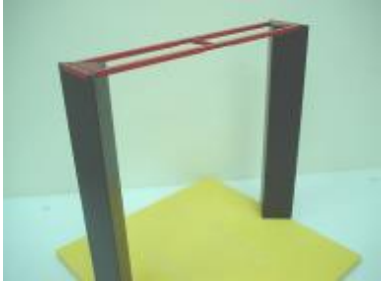
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3.2 E-Field Probe

Construction	One dipole parallel, two dipoles normal to probe axis Built-in shielding against static charges PEEK enclosure material	 <p>EF3DV3 E-Field Probe</p>
Calibration	In air from 100 MHz to 6.0 GHz (absolute accuracy $\pm 6.0\%$, $k=2$)	
Frequency	(extended to 20 MHz for MRI), Linearity: ± 0.2 dB (100 MHz to 6 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; Linearity: ± 0.2 dB	
Dimensions	Tip diameter: 8 mm Distance from probe tip to dipole centers: 2.5 mm	

3.3 Test Arch

Description	Enables easy and well defined positioning of the phone and validation dipoles as well as simple teaching of the robot.	 <p>Test Arch</p>
Dimensions	length: 370 mm width: 370 mm height: 370 mm	

3.4 Phone Holder

Description	Supports accurate and reliable positioning of any phone Effect on near field $< \pm 0.5$ dB	 <p>Phone Holder</p>
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4 Measurement uncertainty evaluation

Uncertainty Component	Uncertainty Value (%)	Probability Distribution	Divisor	ci €	Standard Uncertainty € (%)
Measurement system					
Probe calibration	±5.1	N	1	1	±5.1
Axial isotropy	±4.7	R	$\sqrt{3}$	1	±2.7
Sensor position	±16.5	R	$\sqrt{3}$	1	±9.5
Boundary effect	±2.4	R	$\sqrt{3}$	1	±1.4
Phantom Boundary Effect	±7.2	R	$\sqrt{3}$	1	±4.1
Linearity	±4.7	R	$\sqrt{3}$	1	±2.7
Scaling with PMR calibration	±10.0	R	$\sqrt{3}$	1	±5.8
System Detection limit	±1.0	R	$\sqrt{3}$	1	±0.6
Readout Electronics	±0.3	N	$\sqrt{3}$	1	±0.3
Response time	±0.8	R	$\sqrt{3}$	1	±0.5
Integration time	±2.6	R	$\sqrt{3}$	1	±1.5
RF ambient conditions	±3.0	R	$\sqrt{3}$	1	±1.7
RF reflection	±12.0	R	$\sqrt{3}$	1	±6.9
Probe positioner	±1.2	R	$\sqrt{3}$	1	±0.7
Probe positioning	±4.7	R	$\sqrt{3}$	1	±2.7
Extrapolation and interpolation	±1.0	R	$\sqrt{3}$	1	±0.6
Related to test samples					
Device Positioning Vertical	±4.7	R	$\sqrt{3}$	1	±2.7
Device Positioning Lateral	±1.0	R	$\sqrt{3}$	1	±0.6
Device Holder and Phantom	±2.4	R	$\sqrt{3}$	1	±1.4
Power drift	±5.0	R	$\sqrt{3}$	1	±2.9
Phantom and Setup Related					
Phantom Thickness	±2.4	R	$\sqrt{3}$	1	±1.4
Combined Std. Uncertainty	$u'_c = \sqrt{\sum_{i=1}^{21} c_i^2 u_i^2}$				±16.3
Expanded Std. Uncertainty on Power (K=2)					±32.6
Expanded Std. Uncertainty on Field (K=2)					±16.3

Table 3: Measurement uncertainties for RF

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5 RF Emission Measurements Reference and Plane

Fig.3 illustrate the references and reference plane that shall be used in a typical EUT emissions measurement. The principle of this section is applied to EUT with similar geometry. Please refer to Appendix C for the setup photographs.

- ◆ The area is 5 cm by 5 cm.
- ◆ The area is centered on the audio frequency output transducer of the EUT.
- ◆ The area is in a reference plane, which is defined as the planar area that contains the highest point in the area of the phone that normally rests against the user's ear. It is parallel to the centerline of the receiver area of the phone and is defined by the points of the receiver-end of the EUT handset, which, in normal handset use, rest against the ear.
- ◆ The measurement plane is parallel to, and 10 mm in front of, the reference plane.



Fig.3 WD reference and plane for RF emission measurements

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6 System Verification Procedure

6.1 System Check

Place a dipole antenna meeting the requirements given in ANSI C63.19-2019 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 the following occurs:

- The probes and their cables are parallel to the coaxial feed of the dipole antenna
- The probe cables and the coaxial feed of the dipole antenna approach the measurement area from opposite directions
- The center point of the probe element(s) are 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 the expected value in the calibration certificate or the expected value in this standard.

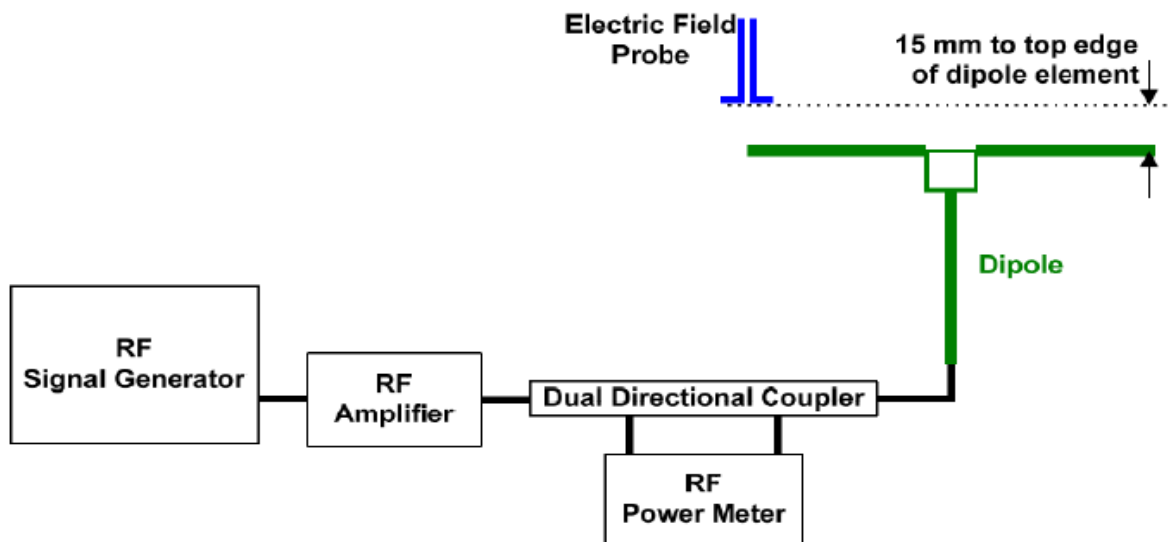


Fig.4 System verification

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6.2 System Check Result

Mode	Frequency (MHz)	Input Power (mW)	E-Field (V/m)	Target Value (V/m)	Deviation (%)	Limit (%)	Test Date
CW	835	100	105.9	112.2	-5.61	±12.8	2024/12/12
CW	1880	100	84.1	86.6	-2.89	±12.8	2024/12/12
CW	2600	100	85.6	86.0	-0.47	±12.8	2024/12/12
CW	3500	100	82.3	84.1	-2.14	±12.8	2024/12/12

Note:

- * Please refer to the appendix A for detailed measurement data and plot.
- ** Target value is provided by SPEAD in the calibration certificate of specific dipoles.
- *** Deviation (%) = 100 * (Measured value minus Target value) divided by Target value.
- **** ANSI C63.19 requires values within ± 18% are acceptable.

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7 Modulation Interference Factor

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 C63.19-2019.

DASY8 is therefore using the indirect measurement method according to ANSI C63.19-2019 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 C63.19-2019 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. DASY8 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

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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.

SPEAG UID	UID version	Communication system	MIF(dB)
10021	DAC	GSM-FDD (TDMA,GMSK)	3.63
10025	DAC	EDGE-FDD (TDMA, 8PSK, TN 0)	3.75
10460	AAA	UMTS-FDD (WCDMA, AMR)	-25.43
10225	AAA	UMTS-FDD (HSPA+)	-20.39
10169	CAE	LTE-FDD (SC-FDMA, 1 RB, 20 MHz, QPSK)	-15.63
10170	CAE	LTE-FDD (SC-FDMA,1RB, 20 MHz,16-QAM)	-9.76
10172	CAG	LTE-TDD (SC-FDMA, 1 RB, 20 MHz, QPSK)	-1.62
10173	CAG	5G NR (CP-OFDM, 1 RB, 15 MHz, QPSK, 15 kHz)	-12.08
10173	CAG	LTE-TDD (SC-FDMA,1RB, 20 MHz,16-QAM)	-1.44
10061	CAB	IEEE 802.11b WiFi 2.4 GHz (DSSS, 11 Mbps)	-2.02
10077	CAB	IEEE 802.11g WiFi 2.4 GHz (DSSS-OFDM, 54 Mbps)	0.12
10427	AAB	IEEE 802.11n (HT Green eld, 150 Mbps, 64-QAM)	-13.44
10069	CAC	IEEE 802.11a/h WiFi 5 GHz (OFDM, 54 Mbps)	-3.15
10616	AAB	IEEE 802.11ac WiFi (40MHz, MCS0, 90pc duty cycle)	-5.57
10671	AAB	IEEE 802.11ax WiFi (20MHz, MCS0, 90pc duty cycle)	-5.58

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8 HAC Measurement Procedure

The evaluation was performed with the following procedure:

- 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 subgrid 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 3. 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 equally 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 subgrids around the center subgrid whose maximum reading is the lowest of all available choices. This eliminates the three subgrids 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 nonexcluded subgrids identified in step g).
- i) Convert the maximum reading identified in step h) to RF audio interference level, in, V/m, by taking the square root of the reading and then dividing it by the measurement system transfer function, established in 5.5.1.1. Convert the result to dB(V/m) by taking the base-10 logarithm and multiplying it by 20.
Indirect measurement method
Replacing step i) of 5.5.1.2, 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), from step h). Use this result to determine the category rating.
- j) Compare this RF audio interference level with the categories in Clause 8 and record the resulting WD category rating.
- k) For the T-Coil mode M-rating assessment, determine whether the chosen perpendicular measurement point is contained in an included subgrid of the first scan. If so, then a second scan is not necessary. The first scan and resultant category rating may be used for the T-Coil mode M rating. Otherwise, repeat step a) through step i), with the grid shifted so that it is centered on the perpendicular measurement point. Record the WD category rating.

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9 HAC RF Measurement Results

9.1 Max Tune-up

Ant 1				
Frequency Band		Channel	Frequency(MHz)	Tune up Power (dBm)
GSM	GSM850	190	836.6	33.00
	EDGE850	190	836.6	27.00
WCDMA	Band V	4183	836.6	25.00
	HSPA	4183	836.6	22.00
LTE FDD	Band 5	20525	836.5	25.00
	Band 12	23095	707.5	25.00
	Band 13	23230	782	25.00
	Band 14	23790	710	25.00
	Band 26	26865	831.5	25.00
	Band 71	133297	680.5	25.00
5G NR FDD	N5	167300	836.5	25.00
	N14	158600	793	25.00
	N26	166300	836.5	25.00
	N71	136100	680.5	25.00

Ant 2				
Frequency Band		Channel	Frequency(MHz)	Tune up Power (dBm)
GSM	GSM1900	661	1880	31.00
	EDGE1900	661	1880	27.00
WCDMA	Band II	9400	1880	25.00
	HSPA	9400	1880	22.50
	Band IV	1412	1732.4	24.50
	HSPA	1412	1732.4	22.00
LTE FDD	Band 2	18900	1880	25.00
	Band 4	20175	1732.5	24.50
	Band 7	21100	2535	24.50
	Band 25	26365	1882.5	24.50
	Band 30	27710	2310	24.50
	Band 66	132322	1745	24.50
LTE TDD	Band 38	38000	2595	25.00
	Band 41	40620	2593	27.00
FR1 FDD	N2	375960	1879.8	25.00
	N7	507000	2535	25.00
	N25	376520	1882.6	25.00
	N30	462000	2310	25.50
	N66	349000	1745	25.00
FR1 TDD	N38	519000	2595	25.00
	N41	518598	2592.99	28.00

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Ant 3				
Frequency Band		Channel	Frequency(MHz)	Tune up Power (dBm)
LTE TDD	Band 42	42590	3500	25.00
	Band 43	44590	3700	25.00
	Band 48	55990	3625	24.00
5G NR TDD	N48	641666	3624.99	24.00
	N77	656000	3840	27.00
	N78	636666	3549.99	27.00

Ant 5				
Frequency Band		Channel	Frequency(MHz)	Tune up Power (dBm)
LTE FDD	Band 2	18900	1880	24.00
	Band 4	20175	1732.5	25.00
	Band 7	21100	2535	25.00
	Band 25	26365	1882.5	24.00
	Band 66	132322	1745	25.00
LTE TDD	Band 38	38000	2595	25.00
	Band 41	40620	2593	25.00
5G NR FDD	N7	507000	2535	25.00
	N70	340500	1702.5	24.00
5G NR TDD	N41	518598	2592.99	26.00

Ant 7				
Frequency Band		Channel	Frequency(MHz)	Tune up Power (dBm)
5G NR TDD	n77	656000	3840	28.00
	n78	636666	3549.99	27.00

Ant 9+10				
Frequency Band		Channel	Frequency(MHz)	Tune up Power (dBm)
2.4GHz WLAN	802.11b	6	2437	21.50
	802.11g	6	2437	13.50
	802.11n-HT20	6	2437	13.50
	802.11n-HT40	6	2437	13.50
	802.11ax-HE20	6	2437	13.50
	802.11ax-HE40	6	2437	13.50
5GHz WLAN	802.11a	40	5200	22.00
	802.11n-HT20	40	5200	21.50
	802.11n-HT40	54	5270	21.00
	802.11ac-VHT20	40	5200	21.00
	802.11ac-VHT40	54	5270	21.00
	802.11ac-VHT80	138	5690	22.00
	802.11ac-VHT160	50	5250	18.50
	802.11ax-HE20	40	5200	21.00
	802.11ax-HE40	54	5270	21.00
	802.11ax-HE80	138	5690	22.00
802.11ax-HE160	50	5250	18.50	

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6GHz WLAN	802.11ax-HE20	5	5975	11.00
	802.11ax-HE40	5	5975	13.00
	802.11ax-HE80	5	5975	16.00
	802.11ax-HE160	5	5975	19.00

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9.2 Conducted RF Output Power

GSM 850 Ant 1					
Burst Output Power(dBm)					
Channel		128	190	251	Tune up
GSM(GMSK)	GSM	31.01	31.49	31.41	33.00
EGPRS (8PSK)	4 TX Slots	20.86	20.64	20.74	21.00

GSM 1900 Ant 2					
Burst Output Power(dBm)					
Channel		512	661	810	Tune up
GSM(GMSK)	GSM	29.26	29.76	29.55	31.00
EGPRS (8PSK)	4 TX Slots	21.33	21.30	21.26	22.00

LTE Band 41 PC2 Ant 2				Conducted Power(dBm)					
Bandwidth	Modulation	RB size	RB offset	Channel 39750	Channel 40185	Channel 40620	Channel 41055	Channel 41490	Tune up
20MHz	QPSK	1	0	25.76	25.65	25.83	25.23	25.37	27.00

N41 PC2 Ant 2				Conducted Power(dBm)					
				SCS 30kHz					
Bandwidth	Modulation	RB size	RB offset	Channel 509202	Channel 513900	Channel 518598	Channel 523302	Channel 528000	Tune up
100MHz	DFT-s-OFDM QPSK	1	1	26.60	26.86	26.88	26.96	26.93	28.00

N77 PC2 Ant 3				Conducted Power(dBm)								
				SCS 30kHz(3700~3980)								
Bandwidth	Modulation	RB size	RB offset	Channel 650000	Channel 652400	Channel 654800	Channel 657200	Channel 659600	Channel 662000	Tune up		
100MHz	DFT-s-OFDM QPSK	135	69	26.66	25.78	26.20	26.69	26.71	26.78	27.00		

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N78 PC2 Ant 3				Conducted Power(dBm)			
SCS 30kHz(3450~3550)							
Bandwidth	Modulation	RB size	RB offset	Channel	Channel	Channel	Tune up
				/	633334	/	
				/	3500.01	/	
100MHz	DFT-s-OFDM QPSK	1	1	/	25.78	/	27.00

N77 PC2 Ant 7				Conducted Power(dBm)						
SCS 30kHz(3700~3980)										
Bandwidth	Modulation	RB size	RB offset	Channel	Channel	Channel	Channel	Channel	Channel	Tune up
				650000	652400	654800	657200	659600	662000	
				3750.00	3786.00	3822.00	3858.00	3894.00	3930.00	
100MHz	DFT-s-OFDM QPSK	135	69	25.89	25.45	25.69	26.24	26.03	25.96	27.00

N78 PC2 Ant 7				Conducted Power(dBm)			
SCS 30kHz(3450~3550)							
Bandwidth	Modulation	RB size	RB offset	Channel	Channel	Channel	Tune up
				/	633334	/	
				/	3500.01	/	
100MHz	DFT-s-OFDM QPSK	1	1	/	25.91	/	27.00

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9.3 Low-power Exemption

The primary method for establishing the RF interference potential of a WD is based on conducted power to the antenna. The waveform-specific modulation interference factor (MIF) is measured separately and added to the measured average conducted power, in dBm.

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

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An analysis shall be performed following the guidance of the RF air interface technology being evaluated. Factors that will affect the RF interference potential shall be evaluated, and the worst-case operating mode shall be identified and used in the evaluation. Any factor that can affect the RF interference potential shall be evaluated.

Examples of such factors are those that will change the RF signal envelope, such as discontinuous transmission due to data load, power management, or configuration options of the RF air interface technology.

RF audio interference power level is compared to the limits in Sec.5 Table 4.1.

Ant 1				
Air Interface	Max Average Antenna Input Power (dBm)	Worst Case MIF (dB)	Power + MIF(dB)	C63.19 test required
GSM850	33.00	3.63	36.63	YES
EDGE850	27.00	3.75	30.75	YES
WCDMA	25.00	-25.43	-0.43	NO
WCDMA - HSPA	22.00	-20.39	1.61	NO
LTE - FDD	25.00	-9.76	15.24	NO
5G FR1 - FDD	25.00	-12.08	12.92	NO

Note: Select tests with highest Power+MIF values for the same frequency band.

Ant 2				
Air Interface	Max Average Antenna Input Power (dBm)	Worst Case MIF (dB)	Power + MIF(dB)	C63.19 test required
GSM1900	31.00	3.63	34.63	YES
EDGE1900	27.00	3.75	30.75	YES
WCDMA	25.00	-25.43	-0.43	NO
WCDMA - HSPA	22.50	-20.39	2.11	NO
LTE - FDD	25.00	-9.76	15.24	NO
LTE - TDD B41	27.00	-1.44	25.56	YES
FR1 - FDD	25.50	-12.08	13.42	NO
FR1 - TDD N41	28.00	-1.64	26.36	YES

Note: Select tests with highest Power+MIF values for the same frequency band.

Ant 3				
Air Interface	Max Average Antenna Input Power (dBm)	Worst Case MIF (dB)	Power + MIF(dB)	C63.19 test required
LTE - TDD	25.00	-1.44	23.56	NO
5G FR1 - TDD N77	27.00	-1.64	25.36	YES
5G FR1 - TDD N78	27.00	-1.64	25.36	YES

Note: Select tests with highest Power+MIF values for the same frequency band.

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Ant 5				
Air Interface	Max Average Antenna Input Power (dBm)	Worst Case MIF (dB)	Power + MIF(dB)	C63.19 test required
LTE - FDD	25.00	-9.76	15.24	NO
LTE - TDD	25.00	-1.44	23.56	NO
5G FR1 - FDD	25.00	-12.08	12.92	NO
5G FR1 - TDD	26.00	-1.64	24.36	NO

Note: Select tests with highest Power+MIF values for the same frequency band.

Ant 7				
Air Interface	Max Average Antenna Input Power (dBm)	Worst Case MIF (dB)	Power + MIF(dB)	C63.19 test required
5G FR1 - TDD N77	28.00	-1.64	26.36	YES
5G FR1 - TDD N78	27.00	-1.64	25.36	YES

Note: Select tests with highest Power+MIF values for the same frequency band.

Ant 9+10				
Air Interface	Max Average Antenna Input Power (dBm)	Worst Case MIF (dB)	Power + MIF(dB)	C63.19 test required
802.11b	21.50	-2.02	19.48	NO
802.11g	13.50	0.12	13.62	NO
802.11n	13.50	-13.44	0.06	NO
802.11a	22.00	-3.15	18.85	NO
802.11ac	22.00	-5.57	16.43	NO
802.11ax	22.00	-5.58	16.42	NO

Note: Select tests with highest Power+MIF values for the same frequency band.

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9.4 HAC RF Emission Test Results

Air Interface	BW	Modulation / Mode	RB Size	RB offset	Channel	Frequency(MHz)	Ant	Average Antenna Input Power (dBm)	MIF	E-Field (dBV/m)	RF Pass/Fail	Date
GSM850	-	GSM Voice	-	-	128	824.2	Ant 1	31.01	3.63	35.36	PASS	2024/12/14
GSM850	-	GSM Voice	-	-	190	836.6	Ant 1	31.49	3.63	35.65	PASS	2024/12/14
GSM850	-	GSM Voice	-	-	251	848.8	Ant 1	31.41	3.63	34.86	PASS	2024/12/14
GSM850	-	EDGE 4 TX Slots	-	-	128	824.2	Ant 1	20.86	3.75	33.39	PASS	2024/12/14
GSM850	-	EDGE 4 TX Slots	-	-	190	836.6	Ant 1	20.64	3.75	33.69	PASS	2024/12/14
GSM850	-	EDGE 4 TX Slots	-	-	251	848.8	Ant 1	20.74	3.75	32.90	PASS	2024/12/14
GSM1900	-	GSM Voice	-	-	512	1850.2	Ant 2	29.26	3.63	21.59	PASS	2024/12/14
GSM1900	-	GSM Voice	-	-	661	1880	Ant 2	29.76	3.63	21.29	PASS	2024/12/14
GSM1900	-	GSM Voice	-	-	810	1909.8	Ant 2	29.55	3.63	21.05	PASS	2024/12/14
GSM1900	-	EDGE 4 TX Slots	-	-	512	1850.2	Ant 2	21.33	3.75	21.50	PASS	2024/12/14
GSM1900	-	EDGE 4 TX Slots	-	-	661	1880	Ant 2	21.30	3.75	21.28	PASS	2024/12/14
GSM1900	-	EDGE 4 TX Slots	-	-	810	1909.8	Ant 2	21.26	3.75	21.12	PASS	2024/12/14
LTE Band 41	20M	QPSK	1	0	39750	2506	Ant 2	25.76	-1.44	21.61	PASS	2024/12/14
LTE Band 41	20M	QPSK	1	0	40185	2549.5	Ant 2	25.65	-1.44	21.94	PASS	2024/12/14
LTE Band 41	20M	QPSK	1	0	40620	2593	Ant 2	25.83	-1.44	22.48	PASS	2024/12/14
LTE Band 41	20M	QPSK	1	0	41055	2636.5	Ant 2	25.23	-1.44	22.28	PASS	2024/12/14
LTE Band 41	20M	QPSK	1	0	41490	2680	Ant 2	25.37	-1.44	22.36	PASS	2024/12/14
FR1 n41	100M	QPSK	1	1	509202	2546.01	Ant 2	26.60	-1.64	16.95	PASS	2024/12/13
FR1 n41	100M	QPSK	1	1	513900	2569.5	Ant 2	26.86	-1.64	17.31	PASS	2024/12/13
FR1 n41	100M	QPSK	1	1	518598	2592.99	Ant 2	26.88	-1.64	17.53	PASS	2024/12/13
FR1 n41	100M	QPSK	1	1	523302	2616.51	Ant 2	26.96	-1.64	18.23	PASS	2024/12/13
FR1 n41	100M	QPSK	1	1	528000	2640	Ant 2	26.93	-1.64	18.50	PASS	2024/12/13

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FR1 n77	100M	QPSK	1	1	650000	3750	Ant 3	26.66	-1.64	20.68	PASS	2024/12/13
FR1 n77	100M	QPSK	1	1	652400	3786	Ant 3	25.78	-1.64	20.94	PASS	2024/12/13
FR1 n77	100M	QPSK	1	1	654800	3822	Ant 3	26.20	-1.64	21.17	PASS	2024/12/13
FR1 n77	100M	QPSK	1	1	657200	3858	Ant 3	26.69	-1.64	21.56	PASS	2024/12/13
FR1 n77	100M	QPSK	1	1	659600	3894	Ant 3	26.71	-1.64	21.88	PASS	2024/12/13
FR1 n77	100M	QPSK	1	1	662000	3930	Ant 3	26.78	-1.64	22.29	PASS	2024/12/13
FR1 n78	100M	QPSK	1	1	633334	3500.01	Ant 3	25.78	-1.64	22.48	PASS	2024/12/13
FR1 n77	100M	QPSK	1	1	650000	3750	Ant 7	25.89	-1.64	17.90	PASS	2024/12/13
FR1 n77	100M	QPSK	1	1	652400	3786	Ant 7	25.45	-1.64	18.06	PASS	2024/12/13
FR1 n77	100M	QPSK	1	1	654800	3822	Ant 7	25.69	-1.64	18.17	PASS	2024/12/13
FR1 n77	100M	QPSK	1	1	657200	3858	Ant 7	26.24	-1.64	18.24	PASS	2024/12/13
FR1 n77	100M	QPSK	1	1	659600	3894	Ant 7	26.03	-1.64	18.85	PASS	2024/12/13
FR1 n77	100M	QPSK	1	1	662000	3930	Ant 7	25.96	-1.64	19.27	PASS	2024/12/13
FR1 n78	100M	QPSK	1	1	633334	3500.01	Ant 7	25.91	-1.64	20.10	PASS	2024/12/13

Remark:

1. The detail RF Emission results please refer to appendix B.

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10 Equipment list

Test Equipment	Manufacturer	Model No.	Inventory No.	Cal. Date	Cal. Due date
<input checked="" type="checkbox"/> Software	SPEAG	D8 HAC V1.2	NA	NCR	NCR
<input checked="" type="checkbox"/> DAE	SPEAG	DAE4	1374	2024-10-30	2025-10-29
<input checked="" type="checkbox"/> E-Field Probe	SPEAG	EF3DV3	4051	2024-08-14	2025-08-13
<input checked="" type="checkbox"/> Validation Kits	SPEAG	CD835V3	1052	2022-05-25	2025-05-24
<input checked="" type="checkbox"/> Validation Kits	SPEAG	CD1880V3	1044	2022-05-25	2025-05-24
<input checked="" type="checkbox"/> Test Arch SD HAC	SPEAG	NA	NA	NCR	NCR
<input checked="" type="checkbox"/> Universal Radio Communication Tester	R&S	CMW500	111637	2024-09-10	2025-09-09
<input checked="" type="checkbox"/> Signal Generator	R&S	SMB100A	182393	2024-02-05	2025-02-04
<input checked="" type="checkbox"/> Preamplifier	Qiji	YX28980933	202104001	NCR	NCR
<input checked="" type="checkbox"/> Power Sensor	Keysight	U2002H	MY5639004	2024-09-10	2025-09-09
<input checked="" type="checkbox"/> Power Sensor	Agilent	U2002H	MY48200110	2024-11-21	2025-11-20
<input checked="" type="checkbox"/> Coaxial low pass filter	Mini-Circuits	VLF-2500(+)	NA	NCR	NCR
<input checked="" type="checkbox"/> Coaxial low pass filter	Microlab Fxr	LA-F13	NA	NCR	NCR
<input checked="" type="checkbox"/> DC POWER SUPPLY	SAKO	SK1730SL5A	NA	NCR	NCR
<input checked="" type="checkbox"/> Humidity and Temperature Indicator	MingGao	MingGao	NA	2024-06-14	2025-06-13

Note: All the equipments are within the valid period when the tests are performed.

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11 Calibration certificate

Please see the Appendix C

12 Photographs

Please see the Appendix D

13 EUT Constructional Details

Please see the Appendix E

Appendix A: Detailed System Check Results

Appendix B: Detailed Test Results

Appendix C: Calibration certificate

Appendix D: Photographs

Appendix E: EUT Constructional Details

---End of Report---

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