HAC - RF INTERFERENCE POTENTIAL TEST REPORT

FCC 47 CFR § 20.19
ANSI C63.19-2019

For

GSM/WCDMA/LTE/5G NR Phone + BT/BLE, DTS/UNII a/b/g/n/ac/ax, NFC and WPT

MODEL NUMBER : SM-F956U, SM-F956U1

FCC ID: A3LSMF956U

REPORT NUMBER: 4791196575-S6V3

ISSUE DATE: 5/16/2024

Prepared for
SAMSUNG ELECTRONICS CO., LTD.
129 SAMSUNG-RO, YEONGTONG-GU, SUWON-SI,
GYEONGGI-DO, 16677, KOREA

Prepared by

UL Korea, Ltd.

26th floor, 152, Teheran-ro, Gangnam-gu Seoul, 06236, Korea

Suwon Test Site: UL Korea, Ltd. Suwon Laboratory
218 Maeyeong-ro, Yeongtong-gu,
Suwon-si, Gyeonggi-do, 16675, Korea
TEL: (031) 337-9902
FAX: (031) 213-5433

Testing Laboratory

TL-637

Revision History

Rev.	Date	Revisions	Revised By
V1	4/26/2024	Initial Issue	-
V2	5/3/2024	Removed NR Band n38/41 Ant.E with normal mode in Sec.8. Removed RF near-field test result of n41 Ant.E in Sec.12. Removed test plots of n41 Ant.E in Appendix C.	Eunji Choi
V3	5/16/2024	Added note about transmit power in Sec.10.1.	Eunji Choi

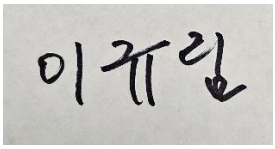
Table of Contents

1. Attestation of Test Results

Applicant Name	SAMSUNG ELECTRONICS CO., LTD.
FCC ID	A3LSMF956U
Model Name	SM-F956U, SM-F956U1
Applicable Standards	FCC 47 CFR § 20.19 ANSI C63.19-2019
Date Tested	4/25/2024
Test Results	Pass

UL Korea, Ltd. tested the above equipment in accordance with the requirements set forth in the above standards. All indications of Pass/Fail in this report are opinions expressed by UL Korea, Ltd. based on interpretations and/or observations of test results. Measurement Uncertainties were not taken into account and are published for informational purposes only. The test results show that the equipment tested is capable of demonstrating compliance with the requirements as documented in this report..

Note: The results documented in this report apply only to the tested sample, under the conditions and modes of operation as described herein. This document may not be altered or revised in any way unless done so by UL Korea, Ltd. and all revisions are duly noted in the revisions section. Any alteration of this document not carried out by UL Korea, Ltd. will constitute fraud and shall nullify the document. This report must not be used by the client to claim product certification, approval, or endorsement by IAS, any agency of the Federal Government, or any agency of any government.

Approved & Released By:	Prepared By:
	
Justin Park Operations Leader UL Korea, Ltd. Suwon Laboratory	Gyurim Lee Laboratory Engineer UL Korea, Ltd. Suwon Laboratory

2. Test Methodology

The tests documented in this report were performed in accordance with ANSI C63.19-2019 Methods of Measurement of Compatibility between Wireless Communications Devices and Hearing Aids abd FCC Published procedure.

KDB 285076 D01 HAC Guidance v06r04
KDB 285076 D03 HAC FAQ v01r06
TCB workshop updates

3. Facilities and Accreditation

The test sites and measurement facilities used to collect data are located at

Suwon
SAR 6 Room (HAC)

UL Korea, Ltd. is accredited by IAS, Laboratory Code TL-637.
The full scope of accreditation can be viewed at https://www.iasonline.org/wp-content/uploads/2017/05/TL-637 - cert-New.pdf.

4. Calibration and Uncertainty

4.1. Measuring Instrument Calibration

The measuring equipment utilized to perform the tests documented in this report has been calibrated in accordance with the manufacturer's recommendations, and is traceable to recognized national standards.

Name of Equipment	Manufacturer	Type/Model	Serial No.	Cal. Due Date
MXG Analog Signal Generator	KEYSIGHT	N5173B	MY59101083	7-27-2024
Power Sensor	KEYSIGHT	U2000A	MY60180020	7-26-2024
Power Sensor	KEYSIGHT	U2000A	MY61010010	7-25-2024
Power Amplifier	EXODUS	AMP2027ADB	10002	1-5-2025
Power Amplifier	MINI-CIRCUITS	TVA-R5-13A+	2111006	1-3-2025
Directional Coupler	KRYTAR	100318010	215541	1-4-2025
Low Pass Filter	WAINWRIGHT	WLKX10-11000-13640-21000-60TS	1	7-25-2024
Low Pass Filter	MINI-CIRCUITS	VLF-3000+	S0143	7-25-2024
Attenuator	MINI-CIRCUITS	BW-S3W10+	SUW-S0217	1-4-2025
Data Acquisition Electronics	SPEAG	DAE4	1343	6-30-2024
E-Field Probe	SPEAG	EF3DV3	4066	7-12-2024
Thermometer	Lutron	MHB-382SD	AK.18789	7-31-2024
Wireless Radio Communication Tester	R & S	CMW500	150314	7-26-2024
UXM 5G Wireless Test Platform	KEYSIGHT	E7515B	MY57510596	7-27-2024

Notes:
According to SPEAG's Technical Report, "MIF Verification", Doc # TR-FB-12.09.04-1, issued date: 9/4/2012. E-field probes are calibrated with specified uncertainty according to ISO 17025 as described in their calibration certificate. The MIF according to the definition in ANSI C63.19 is specific for a modulation and therefore can be used as a constant value if the probe has been PMR calibrated.

4.2. Measurement Uncertainty

Measurement Uncertainty for Radio Frequency Emissions Measurement

Error Description	Explanation	Uncertainty value (±%) for ANSI C63.19-2019	Probe Dist.	Divisor	(Ci) E	(Ci) H	Std. Unc.(±%) for ANSI C63.19-2019 E
Measurement System							
Probe Calibration	A.1	**5.10**	Normal	1	1	1	5.10
Axial Isotropy	A.2	**4.70**	Rectangular	1.732	1	1	2.71
Sensor Displacement	A.3	**7.20**	Rectangular	1.732	1	0.145	4.16
Boundary Effects	A.4	**2.40**	Rectangular	1.732	1	1	1.39
Phantom Boundary Effects	A.5	**7.20**	Rectangular	1.732	1	0	4.16
Linearity	A.6	**4.70**	Rectangular	1.732	1	1	2.71
Scaling to PMR Calibration	A.7	**10.00**	Rectangular	1.732	1	1	5.77
System Detection Limit	A.8	**1.00**	Rectangular	1.732	1	1	0.58
Readout Electronics	A.9	**0.30**	Normal	1	1	1	0.30
Response Time	A.10	**0.80**	Rectangular	1.732	1	1	0.46
Integration Time	A.11	**2.60**	Rectangular	1.732	1	1	1.50
RF Ambient Conditions	A.12	**3.00**	Rectangular	1.732	1	1	1.73
RF Reflections	A.13	**12.00**	Rectangular	1.732	1	1	6.93
Probe Positioner	A.14	**1.20**	Rectangular	1.732	1	0.67	0.69
Probe Positioning	A.15	**3.00**	Rectangular	1.732	1	0.67	1.73
Extrapolation and Interpolation	A.16	**1.00**	Rectangular	1.732	1	1	0.58
Test sample Related							
Test Positioning Vertical	A.17	**4.70**	Rectangular	1.732	1	0.67	2.71
Test positioning Lateral	A.18	**1.00**	Rectangular	1.732	1	1	0.58
Device Holder and Phantom	A.19	**2.40**	Rectangular	1.732	1	1	1.39
Power Drift	A.20	**5.00**	Rectangular	1.732	1	1	2.89
Phantom and Setup Related							
Phantom Thickness	A.21	**2.40**	Rectangular	1.732	1	0.67	1.39
Combined Std. Uncertainty							**13.72**
Expanded Std. Uncertainty on Power							**27.43**
Expanded Std. Uncertainty on Field							**13.72**

Notes for table
1. Ci - is te sensitivity coefficient
2. Expanded Std. Uncertainty on Power, Coverage Factor = 2, > 95% Confidence
3. Expanded Std. Uncertainty on Field is half value of Expanded Std. Uncertainty on power

4.3. Decision Rule

Decision rule for statement(s) of conformity is based on Procedure 2, Clause 4.4.3 in IEC Guide 115:2021.

5. WD RF Emission Requirements

The WD's conducted power must be at or below either the stated **RF_{AIPL} (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 **RF_{AIL} (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 Specifications

E-field measurements are performed using the DASY8 automated dosimetric assessment system. The DASY8 is made by Schmid & Partner Engineering AG (SPEAG) in Zurich, Switzerland.

The DASY8 HAC Extension consists of the following parts:

Test Arch Phantom

The specially designed Test Arch allows high precision positioning of both the device and any of the validation dipoles.

EF3DV3 Isotropic E-Field Probe

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 5.8 GHz (absolute accuracy ±5.1%, k=2) ISO/IEC 17025 calibration service available.
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 V/m to > 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
Application:	General near-field measurements up to 6 GHz HAC measurements up to 6 GHz Field component measurements Fast automatic scanning in phantoms

7. System Validation

The test setup was validated when first configured and verified periodically thereafter to ensure proper function. The procedure provided in this section is a validation procedure using dipole antennas for which the field levels were computed by numeric modeling.

Procedure:

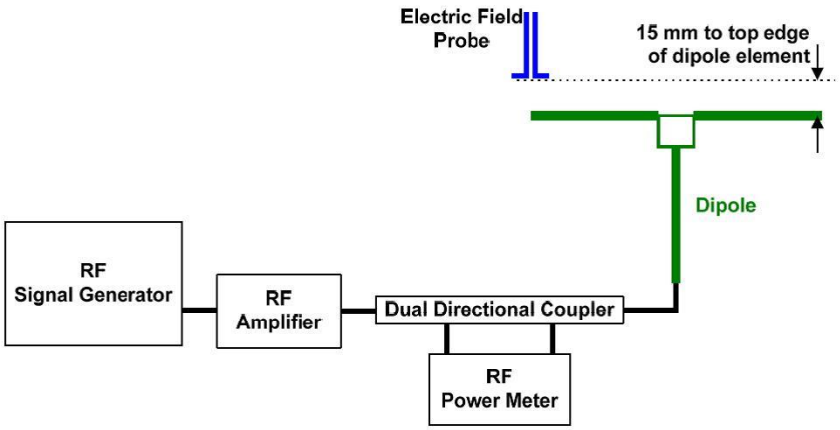
Place a dipole antenna meeting the requirements given in ANSI C63.19 in the normally occupied by the WD.

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) 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 the expected value in the calibration certificate or the expected value in this standard.

Setup diagram



7.1. System Validation Results

SAR Lab	Date	Dipole Type_Serial #_Freq.	Dipole Cal. Due Data	Max. measured from		Avg. Emax (V/m)	Target (V/m) (From SPEAG)	Deviation (note 1) ± %	Plot No.
				Emax 1 (V/m)	Emax 2 (V/m)				
SAR 6	2024-04-25	CD835V3	1000	107.00	104.00	105.50	111.30	-5.21	1
SAR 6	2024-04-25	CD1880V3	1000	88.30	87.80	88.05	85.20	3.35	2
SAR 6	2024-04-25	CD2600V3	1009	87.70	86.70	87.20	86.00	1.40	3
SAR 6	2024-04-25	CD3500V3	1011	84.70	86.10	85.40	83.30	2.52	4

Notes:

1) Delta (Deviation) % = 100 * (Measured value minus Target value) divided by the Target value. Deltas within ±18% are acceptable, of which 12% is deviation and 13% is measurement uncertainty.
2) The maximum E-field were evaluated and compared to the target values provided by SPEAG in the calibration certificate of specific dipoles.
3) Please refer to the appendix for detailed measurement data and plots.

8. Evaluation for RF Audio Interference Power Level (RF_{AIPL})

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.

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.

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

Air-Interface	Antenna	Average Antenna Input Power (dBm)[1]	Worst Case MIF (dB)	RF_{AIPL} (dBm)	RF_{AIPL} Limit (dBm)	RF_{AIPL}
GSM 850	Ant.A, Ant.A+B	33.3	3.63	36.93	29	Measurement
GSM 850	Ant.D	33.3	3.63	36.93	29	Measurement
GSM 1900	Ant.B	30.5	3.63	34.13	26	Measurement
WCDMA Band 2	Ant.B	24.8	-27.23	-2.43	26	Pass
WCDMA Band 4	Ant.B	24.5	-27.23	-2.73	26	Pass
WCDMA Band 5	Ant.A, Ant.A+B	25.3	-27.23	-1.93	29	Pass
WCDMA Band 5	Ant.D	25.3	-27.23	-1.93	29	Pass
LTE Band 2	Ant.B	25.0	-9.76	15.24	26	Pass
LTE Band 2	Ant.E	25.0	-9.76	15.24	26	Pass
LTE Band 4	Ant.B	25.0	-9.76	15.24	26	Pass
LTE Band 4	Ant.E	25.0	-9.76	15.24	26	Pass
LTE Band 5	Ant.A, Ant.A+B	25.5	-9.76	15.74	29	Pass
LTE Band 5	Ant.D	25.5	-9.76	15.74	29	Pass
LTE Band 7	Ant.B	25.0	-9.76	15.24	25	Pass
LTE Band 7	Ant.E	25.0	-9.76	15.24	25	Pass
LTE Band 12	Ant.A, Ant.A+B	25.2	-9.76	15.44	29	Pass
LTE Band 12	Ant.D	25.2	-9.76	15.44	29	Pass
LTE Band 13	Ant.A, Ant.A+B	25.5	-9.76	15.74	29	Pass
LTE Band 13	Ant.D	25.5	-9.76	15.74	29	Pass
LTE Band 14	Ant.A, Ant.A+B	25.5	-9.76	15.74	29	Pass
LTE Band 14	Ant.D	25.5	-9.76	15.74	29	Pass
LTE Band 25	Ant.B	25.0	-9.76	15.24	26	Pass
LTE Band 25	Ant.E	25.0	-9.76	15.24	26	Pass
LTE Band 26	Ant.A, Ant.A+B	25.5	-9.76	15.74	29	Pass
LTE Band 26	Ant.D	25.5	-9.76	15.74	29	Pass
LTE Band 30	Ant.B	24.0	-9.76	14.24	25	Pass
LTE Band 30	Ant.E	24.0	-9.76	14.24	25	Pass
LTE Band 66	Ant.B	25.0	-9.76	15.24	26	Pass
LTE Band 66	Ant.E	25.0	-9.76	15.24	26	Pass
LTE Band 66 UL CA	Ant.B	25.0	-9.76	15.24	26	Pass
LTE Band 66 UL CA	Ant.E	25.0	-9.76	15.24	26	Pass

Note(s):

1. Max tune-up limit.
2. Evaluated with Pmax RCV - highest transmit power in a held to the ear mode.
3. Testing for all UL CA is not required because it uses same Tx band, modulations, and output power is equal or less than non-CA modes.

Evaluation for RF Audio Interference Power Level (RF_{AIPL}) (Continued)

Air-Interface	Antenna	Average Antenna Input Power (dBm)[1]	Worst Case MIF (dB)	RF_{AIPL} (dBm)	RF_{AIPL} Limit (dBm)	RF_{AIPL}
LTE Band 71	Ant.A, Ant.A+B	25.2	-9.76	15.44	29	Pass
LTE Band 71	Ant.D	25.2	-9.76	15.44	29	Pass
LTE Band 38	Ant.B	25.0	-1.44	23.56	25	Pass
LTE Band 41 PC3	Ant.B	25.0	-1.44	23.56	25	PASS/Measurement *
LTE Band 41 PC3 UL CA	Ant.B	25.0	-1.44	23.56	25	Pass
LTE Band 41 PC2	Ant.B	26.5	-1.44	25.06	25	Measurement
LTE Band 41 PC2 UL CA	Ant.B	26.5	-1.44	25.06	25	Pass
LTE Band 48	Ant.E	23.3	-1.44	21.86	25	Pass
LTE Band 48 UL CA	Ant.E	23.3	-1.44	21.86	25	Pass
NR Band n2	Ant.B	24.5	-15.07	9.43	26	Pass
NR Band n2	Ant.E	24.5	-15.07	9.43	26	Pass
NR Band n5	Ant.A, Ant.A+B	25.0	-15.06	9.94	29	Pass
NR Band n5	Ant.D	25.0	-15.06	9.94	29	Pass
NR Band n7	Ant.B	24.0	-15.07	8.93	25	Pass
NR Band n7	Ant.E	24.0	-15.07	8.93	25	Pass
NR Band n12	Ant.A, Ant.A+B	25.0	-15.06	9.94	29	Pass
NR Band n12	Ant.D	25.0	-15.06	9.94	29	Pass
NR Band n25	Ant.B	24.5	-15.07	9.43	26	Pass
NR Band n25	Ant.E	24.5	-15.07	9.43	26	Pass
NR Band n26	Ant.A, Ant.A+B	25.0	-15.06	9.94	29	Pass
NR Band n26	Ant.D	25.0	-15.06	9.94	29	Pass
NR Band n30	Ant.B	23.5	-15.06	8.44	25	Pass
NR Band n30	Ant.E	23.5	-15.06	8.44	25	Pass
NR Band n66	Ant.B	24.5	-15.07	9.43	26	Pass
NR Band n66	Ant.E	24.5	-15.07	9.43	26	Pass
NR Band n70	Ant.B	24.0	-15.06	8.94	26	Pass
NR Band n70	Ant.E	24.0	-15.06	8.94	26	Pass
NR Band n71	Ant.A, Ant.A+B	25.0	-15.06	9.94	29	Pass
NR Band n71	Ant.D	25.0	-15.06	9.94	29	Pass
NR Band n38 - RCV	Ant.E	24.5	-1.64	22.86	25	Pass
NR Band n41 PC2 - RCV	Ant.E	24.5	-1.64	22.86	25	Pass
NR Band n41 PC2	Ant.B	26.0	-1.64	24.36	25	PASS/Measurement *
NR Band n48	Ant.E	23.3	-1.64	21.66	25	Pass
NR Band n77	Ant.E	27.0	-1.64	25.36	25	Measurement
NR Band n78	Ant.E	27.0	-1.64	25.36	25	Pass

Note(s):

1. Max tune-up limit.
2. Evaluated with Pmax RCV - highest transmit power in a held to the ear(RCV) mode.
3. Testing for all UL CA is not required because it uses same Tx band, modulations, and output power is equal or less than non-CA modes.
4. * : Level is passed, but performed additional test due to manufacturer's request.
5. LTE Band 38 is covered by LTE Band 41, as LTE Band 41 is a superset and contains all the channels from LTE Band 38, using the same modulations, bandwidths and power limits.
6. NR Band n78 is covered by NR Band n77, as NR Band n77 is a superset and contains all the channels from NR Band n78, using the same modulations, bandwidths and power limits.

Evaluation for RF Audio Interference Power Level (RF_{AIPL}) (Continued)

Air-Interface	Antenna	Average Antenna Input Power (dBm)[1]	Worst Case MIF (dB)	RF_{AIPL} (dBm)	RF_{AIPL} Limit (dBm)	RF_{AIPL}
WiFi 2.4GHz 802.11b	Antenna 1	20.0	-2.02	17.98	25	Pass
WiFi 2.4GHz 802.11g	Antenna 1	18.0	0.12	18.12	25	Pass
WiFi 2.4GHz 802.11n	Antenna 1	18.0	-5.59	12.41	25	Pass
WiFi 2.4GHz 802.11ac	Antenna 1	18.0	-5.6	12.4	25	Pass
WiFi 2.4GHz 802.11ax	Antenna 1	18.0	-5.58	12.42	25	Pass
WiFi 5GHz 802.11a	Antenna 1	18.0	-3.15	14.85	25	Pass
WiFi 5GHz 802.11n	Antenna 1	18.0	-5.59	12.41	25	Pass
WiFi 5GHz 802.11ac	Antenna 1	18.0	-5.56	12.44	25	Pass
WiFi 5GHz 802.11ax	Antenna 1	18.0	-5.58	12.42	25	Pass
WiFi 2.4GHz 802.11b	Antenna 2	20.0	-2.02	17.98	25	Pass
WiFi 2.4GHz 802.11g	Antenna 2	18.0	0.12	18.12	25	Pass
WiFi 2.4GHz 802.11n	Antenna 2	18.0	-5.59	12.41	25	Pass
WiFi 2.4GHz 802.11ac	Antenna 2	18.0	-5.6	12.4	25	Pass
WiFi 2.4GHz 802.11ax	Antenna 2	18.0	-5.58	12.42	25	Pass
WiFi 5GHz 802.11a	Antenna 2	18.0	-3.15	14.85	25	Pass
WiFi 5GHz 802.11n	Antenna 2	18.0	-5.59	12.41	25	Pass
WiFi 5GHz 802.11ac	Antenna 2	18.0	-5.56	12.44	25	Pass
WiFi 5GHz 802.11ax	Antenna 2	18.0	-5.58	12.42	25	Pass
WiFi 2.4GHz 802.11b	MIMO	23.0	-2.02	20.98	25	Pass
WiFi 2.4GHz 802.11g	MIMO	21.0	0.12	21.12	25	Pass
WiFi 2.4GHz 802.11n	MIMO	21.0	-5.59	15.41	25	Pass
WiFi 2.4GHz 802.11ac	MIMO	21.0	-5.6	15.4	25	Pass
WiFi 2.4GHz 802.11ax	MIMO	21.0	-5.58	15.42	25	Pass
WiFi 5GHz 802.11a	MIMO	21.0	-3.15	17.85	25	Pass
WiFi 5GHz 802.11n	MIMO	21.0	-5.59	15.41	25	Pass
WiFi 5GHz 802.11ac	MIMO	21.0	-5.56	15.44	25	Pass
WiFi 5GHz 802.11ax	MIMO	21.0	-5.58	15.42	25	Pass

Note(s):

1. Max tune-up limit.
2. Evaluated with Pmax RCV - highest transmit power in a held to the ear mode.

9. Modulation Interference Factor (MIF)

The HAC Standard ANSI C63.19 defines a new scaling using the Modulation Interference Factor (MIF) which replaces the need for the Articulation Weighting Factor (AWF) during the evaluation and is applicable to any modulation scheme.

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.

Definitions

E-field probes have a bandwidth <10 kHz and can therefore not evaluate the RF envelope in the full audio band. DASY8 is therefore using the “indirect” measurement method according to ANSI C63.19 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 probe modulation response (PMR) calibration in order to not overestimate the field reading.

The evaluation method or the MIF is defined in ANSI C63.19 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 called 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 constraint 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 is automatically applied.

MIF values were not tested by a probe or as specified in the standards but are based on analysis provided by SPEAG for all the air interfaces (GSM, WCDMA, LTE, NR and Wi-Fi). The data included in this report are for the worst case operating modes. The UIDs used are listed below:

UID	Communication System Name	MIF (dB)
10021-DAC	GSM-FDD (TDMA, GMSK)	3.63
10011-CAC	UMTS-FDD (WCDMA)	-27.23
10170-CAF	LTE-FDD (SC-FDMA, 1 RB, 20 MHz, 16-QAM)	-9.76
10182-CAF	LTE-FDD (SC-FDMA, 1 RB, 15 MHz, 16-QAM)	-9.76
10176-CAH	LTE-FDD (SC-FDMA, 1 RB, 10 MHz, 16-QAM)	-9.76
10173-CAH	LTE-TDD (SC-FDMA, 1 RB, 20 MHz, 16-QAM)	-1.44
10934-AAC	5G NR (DFT-s-OFDM, 1 RB, 40 MHz, QPSK, 15 kHz)	-15.07
10931-AAC	5G NR (DFT-s-OFDM, 1 RB, 20 MHz, QPSK, 15 kHz)	-15.06
10930-AAC	5G NR (DFT-s-OFDM, 1 RB, 15 MHz, QPSK, 15 kHz)	-15.06
10929-AAD	5G NR (DFT-s-OFDM, 1 RB, 10 MHz, QPSK, 15 kHz)	-15.06
10973-AAD	5G NR (DFT-s-OFDM, 1 RB, 100 MHz, QPSK, 30 kHz) 5G NR (DFT-s-OFDM, 1 RB, 40 MHz, QPSK, 30 kHz)	-1.64
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
10069-CAD	IEEE 802.11a/h WiFi 5 GHz (OFDM, 54 Mbps)	-3.15
10591-AAC	IEEE 802.11n (HT Mixed, 20MHz, MCS0, 90pc duty cycle)	-5.59
10599-AAC	IEEE 802.11n (HT Mixed, 40MHz, MCS0, 90pc duty cycle)	-5.59
10607-AAC	IEEE 802.11ac WiFi (20MHz, MCS0, 90pc duty cycle)	-5.6
10616-AAC	IEEE 802.11ac WiFi (40MHz, MCS0, 90pc duty cycle)	-5.57
10626-AAC	IEEE 802.11ac WiFi (80MHz, MCS0, 90pc duty cycle)	-5.64
10636*-AAD	IEEE 802.11ac WiFi (160MHz, MCS0, 90pc duty cycle)	-5.56
10671-AAC	IEEE 802.11ax (20MHz, MCS0, 90pc duty cycle)	-5.58
10695-AAC	IEEE 802.11ax (40MHz, MCS0, 90pc duty cycle)	-6.01
10719-AAC	IEEE 802.11ax (80MHz, MCS0, 90pc duty cycle)	-6.04
10743*-AAC	IEEE 802.11ax (160MHz, MCS0, 90pc duty cycle)	-6.6

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

- *0.2 dB for MIF -7 to +5 dB,*
- *0.5 dB for MIF -13 to +11 dB*
- *1 dB for MIF > -20 dB*

10. Device Under Test

Normal operation	Held to head	
Back Cover	The Back Cover is not removable	
Test sample information	**S/N**	**Notes**
	R3CX309QPXD	RF Audio Interference Level Test

10.1. Air Interfaces and Operating Mode

Air Interface	Bands (MHz)	Type	Evaluation	Simultaneous Transmitter	Name of Voice Service
GSM	850	VO	RF_{AIL}	Wi-Fi and BT	CMRS
	1900				
	GPRS/EDGE	VD	No	Wi-Fi and BT	Google Meet
W-CDMA (UMTS)	850 (V)	VO	RF_{AIPL}	Wi-Fi and BT	CMRS
	1750 (IV)				
	1900 (II)				
	HSPA	VD	No	Wi-Fi and BT	Google Meet
LTE - FDD	680 (B71)	VD	RF_{AIPL}	NR, Wi-Fi and BT	VoLTE Google Meet
	700 (B12)				
	780 (B13)				
	790 (B14)				
	850 (B5/26)				
	1700 (B4/66)				
	1900 (B2/25)				
	2300 (B30)				
	2600 (B7)				
LTE - TDD	2600 (B38/41)	VD	RF_{AIPL}, RF_{AIL}	NR, Wi-Fi and BT	VoLTE Google Meet
	3600 (B48)				
NR - FDD	680 (n71)	VD	RF_{AIPL}	LTE, Wi-Fi and BT	VoNR Google Meet
	700 (n12)				
	850 (n5/26)				
	1700 (n66)				
	1700 (n70)				
	1900 (n2/25)				
	2300 (n30)				
	2600 (n7)				
NR - TDD	2600 (n38/n41)	VD	RF_{AIPL}, RF_{AIL}	LTE, Wi-Fi and BT	VoNR Google Meet
	3600 (n48)				
	3500 (n77 DoD)				
	3700 (n77)				
Wi-Fi	2450	VD	RF_{AIPL}	WWAN, BT and U-NII	VoWiFi Google Meet
	5200 (U-NII-1)			WWAN, BT and WiFi 2.4GHz	
	5300 (U-NII-2A)				
	5500 (U-NII-2C)				
	5800 (U-NII-3)				
	5900 (U-NII-4)				
	6175 (U-NII-5)	VD	RF_{AIPL}	WWAN, BT and WiFi 2.4GHz	VoWiFi Google Meet
	6475 (U-NII-6)		N/A		N/A
	6700 (U-NII-7)				
	7000 (U-NII-8)				
BT	2450	DT	N/A	WWAN and U-NII	N/A

Type

VO: Legacy Cellular Voice Service

DT: Digital Transport only (no voice)

VD: IP Voice Service over Digital Transport

CMRS: Commercial Mobile Radio Service

BT: Bluetooth

Note:

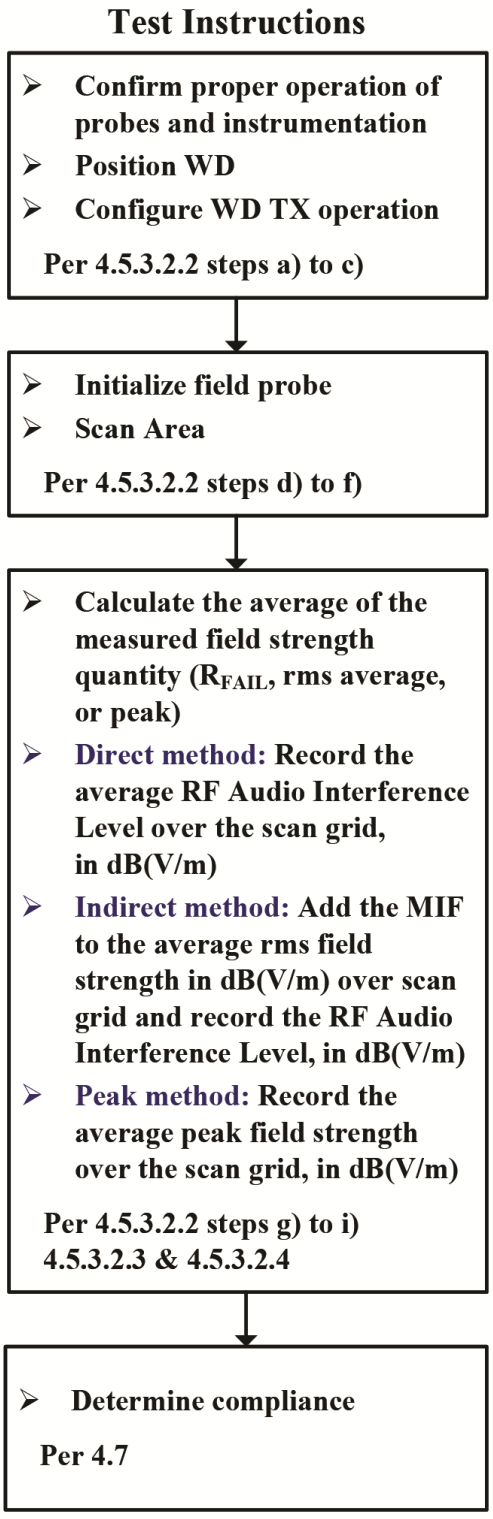
1. ANSI C63.19 only requires HAC evaluations for Frequncies under 6GHz.

Note(s):

All tests were performed with the transmit power set to the maximum power for held-to-head conditions (RCV active). For air interfaces with a Time Averaged SAR (TAS) algorithm Pmax is considered the maximum power.

11. RF Near-field Test Procedure (RF Audio Interference Level, RF_{AIL})

WD near-field RF emission scan flowchart Per ANSI-63.19-2019



The following steps, included in the depiction of flowchart above, shall be followed when using this test procedure:

a) Confirm proper operation of the field probe, probe measurement system, spectral and temporal weighting filters, 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 operation likely to occur less than 1% of the time during normal operation, may be excluded from consideration.

d) The measurement area shall be centered on the acoustic output or the T-Coil mode measurement reference point, as appropriate. Locate the field probe at the initial test position in the 50 mm by 50 mm measurement area, which is contained in the measurement plane. 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 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 ≤ 10mm.

g) Calculate the average of the measurements taken in Step f).

h) Convert the average value found in Step g) 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. 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 x log($R_{avg}^{1/2}$ / TF) (3)

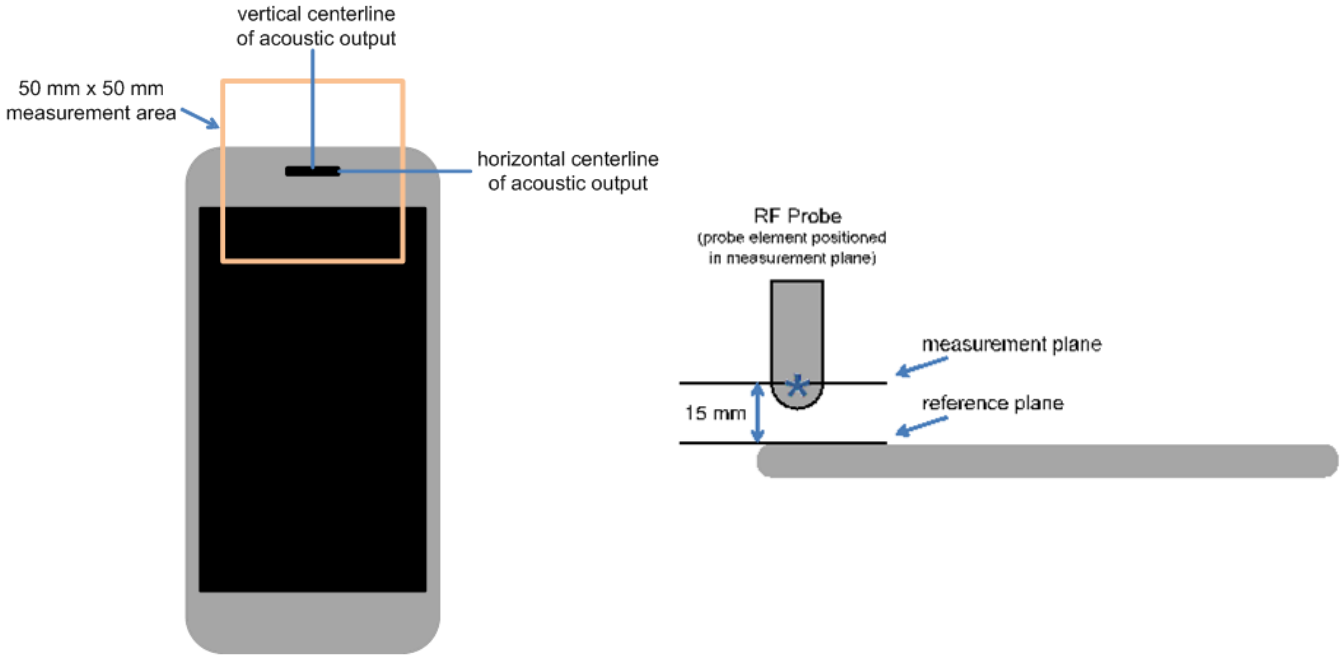
where, R_{avg} is the average reading

i) Compare this RF audio interference level to the limits in Sec.5 and record the result.

The picture below illustrates the references and reference plane that shall be used in the WD RF emissions measurement.

The measurement area is 50.0 mm by 50.0 mm and centered on the audio frequency output transducer of the WD (speaker or T-Coil signal) and the area in a reference plane, which is defined as the planar area tangent to 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 WD handset, which, in normal handset use, rest against the ear.

The measurement plane is parallel to, and 15.0 mm in front of, the reference plane.



WD reference and plane for RF Near-field measurements

12. RF Near-field Test Results (RF Audio Interference Level, RF_{AIL})

MIF values were not tested by a probe or as specified in the standards but are based on analysis provided by SPEAG for the following User Identifiers and air interfaces.

The data included in this report are for the worst case operating modes. Refer to Appendix D and G for the MIF vales that represent the worst case operation modes.

Mode / Band	Antenna	Ch. No.	Freq. (MHz)	Results* (dB V/m)	Results plus 0.2dB uncertainty (dB V/m)	RF_{AIL} Limit (dB V/m)	Margin (dB)	RF_{AIL} Pass/Fail	Plot No.
GSM 850	Ant.A	128	824.2	33.19	33.39	39.00	5.61	Pass	1
		190	836.6	28.58	28.78	39.00	10.22	Pass	2
		251	848.6	27.67	27.87	39.00	11.13	Pass	3
GSM 850	Ant.A+B	128	824.2	32.86	33.06	39.00	5.94	Pass	4
		190	836.6	33.34	33.54	39.00	**5.46**	Pass	5
		251	848.6	32.67	32.87	39.00	6.13	Pass	6
GSM 850	Ant.D	128	824.2	31.38	31.58	39.00	7.42	Pass	7
		190	836.6	32.05	32.25	39.00	6.75	Pass	8
		251	848.6	31.43	31.63	39.00	7.37	Pass	9
GSM 1900	Ant.B	512	1850.2	22.35	22.55	36.00	13.45	Pass	10
		661	1880	22.75	22.95	36.00	13.05	Pass	11
		810	1909.8	21.42	21.62	36.00	14.38	Pass	12
LTE Band 41 PC2	Ant.B	39750	2506	15.32	15.52	35.00	19.48	Pass	13
		40185	2549.5	15.23	15.43	35.00	19.57	Pass	14
		40620	2593	14.09	14.29	35.00	20.71	Pass	15
		41055	2636.5	15.63	15.83	35.00	19.17	Pass	16
		41490	2680	14.90	15.10	35.00	19.90	Pass	17
LTE Band 41 PC3	Ant.B	39750	2506	15.12	15.32	35.00	19.68	Pass	18
		40185	2549.5	15.49	15.69	35.00	19.31	Pass	19
		40620	2593	14.08	14.28	35.00	20.72	Pass	20
		41055	2636.5	15.93	16.13	35.00	18.87	Pass	21
		41490	2680	15.58	15.78	35.00	19.22	Pass	22
NR-TDD Band n41	Ant.B	509202	2546.01	12.62	12.82	35.00	22.18	Pass	23
		518598	2592.99	12.99	13.19	35.00	21.81	Pass	24
		528000	2640	12.11	12.31	35.00	22.69	Pass	25
NR-TDD Band n77	Ant.E	633334	3500.01	21.48	21.68	35.00	13.32	Pass	26
		650000	3750	22.96	23.16	35.00	11.84	Pass	27
		662000	3930	23.35	23.55	35.00	11.45	Pass	28

Note(s):

*: Measured Audio Interference level in dB (V/m): indirect method (max rms field strength Plus MIF)

HAC (RF Emissions) Test Results (Continued)

Folder Closed Configuration – Worst case

Mode / Band	Antenna	Ch. No.	Freq. (MHz)	Results* (dB V/m)	Results plus 0.2dB uncertainty (dB V/m)	RF_{AIL} Limit (dB V/m)	Margin (dB)	RF_{AIL} Pass/Fail	Plot No.
GSM 850	Ant.A+B	190	836.6	33.34	33.54	39.00	**5.46**	Pass	5
LTE Band 41 PC3	Ant.B	41055	2636.5	15.93	16.13	35.00	18.87	Pass	21
NR-TDD Band n77	Ant.E	662000	3930	23.35	23.55	35.00	11.45	Pass	28

Additional Test - Folder Opened Configuration

Mode / Band	Antenna	Ch. No.	Freq. (MHz)	Results* (dB V/m)	Results plus 0.2dB uncertainty (dB V/m)	RF_{AIL} Limit (dB V/m)	Margin (dB)	RF_{AIL} Pass/Fail	Plot No.
GSM 850	Ant.A+B	190	836.6	31.93	32.13	39.00	**6.87**	Pass	29
LTE Band 41 PC3	Ant.B	41055	2636.5	14.44	14.64	35.00	20.36	Pass	30
NR-TDD Band n77	Ant.E	662000	3930	23.28	23.48	35.00	11.52	Pass	31

Note:

Additional tests were performed with folder opened condition using worst case in folder closed for each technology.

12.1. Worst Case of RF Near-field Test Plot (RF Audio Interference Level, RF_{AIL})

RF Interference Potential Test Report

Measurement performed on April 25, 2024 at 10:59

Device Under Test

Manufacturer	Model	Dimensions[mm]	Speaker Position [mm]
Samsung Electronics	SM-F956U	153.47 x 67.9 x 11.91	152.47

Hardware Setup

Probe Name	Probe Calibration Date	DAE Name	DAE Calibration Date
EF3DV3 - SN4066	July 12, 2023	DAE4 Sn1343	June 30, 2023

Communication Systems

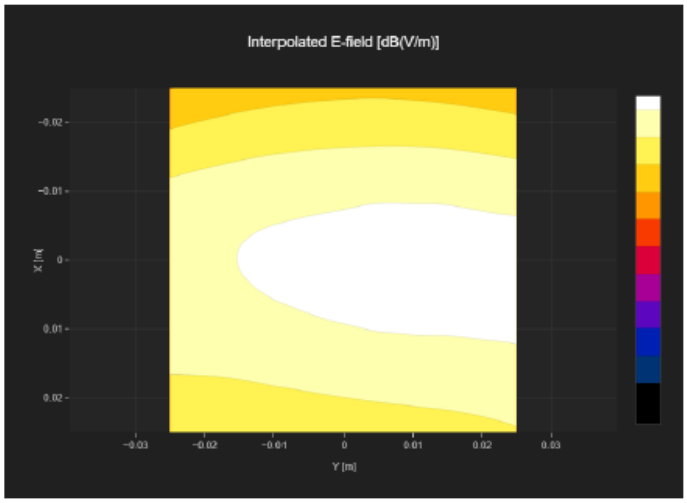
Band Name	Communication Systems Name	Channel	Frequency [MHz]
GSM 850	GSM-FDD (TDMA, GMSK)	190	836.6

Grid Settings

Extent X [mm]	Extent Y [mm]	Step X [mm]	Step Y [mm]	Distance [mm]
50.0	50.0	10.0	10.0	15.0

Results

Emax [dB(V/m)]	Eavg50x50 max [dB(V/m)]	MIF [dB]	RFail [dB(V/m)]
31.4	29.71	3.63	33.34



Appendixes

Refer to separated files for the following appendixes

4791196575-S6 Appendix A: Setup Photo

4791196575-S6 Appendix B: System Validation Plots

4791196575-S6 Appendix C: Test Plots

4791196575-S6 Appendix D: MIF Attestation Letter

4791196575-S6 Appendix E: Probe Certificates

4791196575-S6 Appendix F: Dipole Certificates

4791196575-S6 Appendix G: UID Specifications

END OF REPORT