HAC RF EMISSIONS TEST REPORT

FCC 47 CFR § 20.19
ANSI C63.19-2011

For
SMARTPHONE

FCC ID: BCG-E3220A
Model Name: A1984, A2108, and A2107

Report Number: 12162294-S4V1
Issue Date: 8/23/2018

Prepared for
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NVLAP LAB CODE 200065-0

Revision History

Rev.	Date	Revisions	Revised By
V1	8/23/2018	Initial Issue	--

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1. Attestation of Test Results

Applicant Name	APPLE, INC.
FCC ID	BCG-E3220A
Model Name	A1984, A2108, and A2107
Difference in Model Name	Model A2108, A2107 is electrically identical to Model A1984. Three model numbers are allocated for marketing and logistic purposes only.
Applicable Standards	FCC 47 CFR § 20.19 ANSI C63.19-2011
HAC Rating	M3
Date Tested	7/19/2018 to 7/21/2018
Test Results	Pass

UL Verification Services Inc. 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 Verification Services Inc. 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 Verification Services Inc. and all revisions are duly noted in the revisions section. Any alteration of this document not carried out by UL Verification Services Inc. 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 NVLAP, NIST, any agency of the Federal Government, or any agency of any government (NIST Handbook 150, Annex A). This report is written to support regulatory compliance of the applicable standards stated above.

Approved & Released By:	Prepared By:
Devin Chang Senior Test Engineer UL Verification Services Inc.	Chakrit Thammanavarat Test Engineer UL Verification Services Inc.

2. Test Methodology

The tests documented in this report were performed in accordance with ANSI C63.19-2011 Methods of Measurement of Compatibility between Wireless Communications Devices and Hearing Aids abd FCC Published procedure

KDB 285076 D01 HAC Guidance v05
KDB 285076 D03 HAC FAQ v01
TCB workshop updates

3. Facilities and Accreditation

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

47173 Benicia Street	47266 Benicia Street
SAR Lab C	SAR Lab 2

UL Verification Services Inc. is accredited by NVLAP, Laboratory Code 200065-0.

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
Synthesized Signal Generator	Agilent	N5181A	MY50140630	5/25/2019
Power Meter	HP	437B	3125U12345	8/10/2018
Power Meter	HP	437B	3125U11347	8/15/2018
Power Sensor	HP	8481A	1926A27048	8/10/2018
Power Sensor	HP	8481A	3318A92374	8/15/2018
Amplifier	MITEQ	AMF-4D-00400600-50-30P	1795092	N/A
Directional coupler	Werlatone	C8060-102	2141	N/A
DC Power Supply	HP	1611	215-02292	N/A
Data Acquisition Electronics	SPEAG	DAE4	1472	3/8/2019
E-Field Probe*	SPEAG	EF3DV3	4041	3/16/2019
Calibration Dipole	SPEAG	CD835V3	1014	2/8/2019
Calibration Dipole	SPEAG	CD1880V3	1122	2/8/2019
Calibration Dipole	SPEAG	CD2450V3	1014	2/8/2019
Calibration Dipole	SPEAG	CD2600V3	1014	8/18/2018
Calibration Dipole	SPEAG	CD5500V3	1008	5/16/2019
Radio Communication Tester	R &S	CMW 500	125236	2/21/2019

Note(s):

*: 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 can therefore be used as a constant value if the probe has been PMR calibrated.

4.2. Measurement Uncertainty

Error Description	Uncertainty value (±%)	Probe Dist.	Div.	(Ci) E	Std. Unc.(±%) E
Measurement System					
Probe Calibration	5.1	N	1	1	5.1
Axial Isotropy	4.7	R	1.732	1	2.7
Sensor Displacement	16.5	R	1.732	1	9.5
Boundary Effects	2.4	R	1.732	1	1.4
Phantom Boundary Effects	7.2	R	1.732	1	4.1
Linearity	4.7	R	1.732	1	2.7
Scaling to PMR Calibration	10.0	R	1.732	1	5.8
System Detection Limit	1.0	R	1.732	1	0.6
Readout Electronics	0.3	N	1	1	0.3
Response Time	0.8	R	1.732	1	0.5
Integration Time	2.6	R	1.732	1	1.5
RF Ambient Conditions	3.0	R	1.732	1	1.7
RF Reflections	12.0	R	1.732	1	6.9
Probe Positioner	1.2	R	1.732	1	0.7
Probe Positioning	4.7	R	1.732	1	2.7
Extrapolation and Interpolation	1.0	R	1.732	1	0.6
Test sample Related					
Test Positioning Vertical	4.7	R	1.732	1	2.7
Test Positioning Lateral	1.0	R	1.732	1	0.6
Device Holder and Phantom	2.4	R	1.732	1	1.4
Power Drift	5.0	R	1.732	1	2.9
Phantom and Setup Related					
Phantom Thickness	2.4	R	1.732	1	1.4
Combined Std. Uncertainty					16.3
Expanded Std. Uncertainty on Power (Coverage Factor for 95%, k = 2)					**32.6**
Expanded Std. Uncertainty on Field					**16.3**

Notesfor table
1. N - Nomal
2. R - Rectangular
3. Div. - Divisor used to obtain standard uncertainty
4. Ci - is te sensitivity coefficient

5. System Specifications

E-field measurements are performed using the DASY52 automated dosimetric assessment system. The DASY52 is made by Schmid & Partner Engineering AG (SPEAG) in Zurich, Switzerland.

The DASY52 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 100 MHz to 3.0 GHz (absolute accuracy ±6.0%, k=2) ISO/IEC 17025 calibration service available.
Frequency:	40 MHz – >6 GHz (can be extended to < 20 MHz); 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

6. 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:

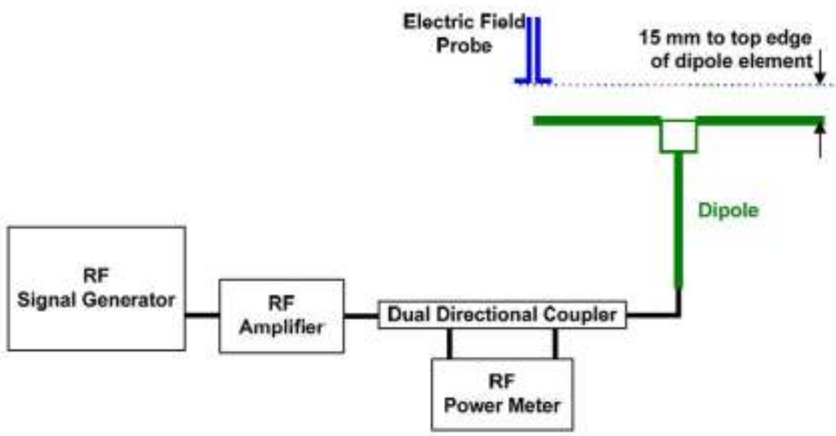
Place a dipole antenna meeting the requirements given in ANSI C63.19 in the normally occupied by the WD.

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



6.1. System Validation Results

SAR Lab	Date	Dipole Type_Serial #_Freq.	Dipole Cal. Due Data	Max. measured from		Average max. above arm (V/m)	Target (V/m) (From SPEAG)	Deviation (note 1) ± %	Plot No.
				above high end (V/m)	above low end (V/m)				
C	7/19/2018	CD835V3_SN:1014_(835 MHz)	2/8/2019	117.00	112.90	114.95	108.90	5.56	1
C	7/19/2018	CD1880V3_SN:1122_(1880 MHz)	2/8/2019	89.42	94.26	91.84	88.40	3.89	2
C	7/19/2018	CD2600V3_SN:1014_(2600 MHz)	8/18/2018	94.49	93.28	93.89	87.30	7.54	3
C	7/19/2018	CD2450V3_SN:1014_(2450 MHz)	2/8/2019	93.60	93.93	93.77	88.00	6.55	4
C	7/19/2018	CD5500V3_SN:1008_(5500 MHz)	5/16/2019	100.80		100.80	98.90	1.92	5

Notes:

1) Delta (Deviation) % = 100 * (Measured value minus Target value) divided by the Target value. Deltas within ±25% are acceptable, of which 12% is deviation and 13% is measurement uncertainty.
2) The maximum E-field or 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.

7. Average Antenna Input Power & Evaluation for Low-power Exemption

An RF air interface technology of a device is exempt from testing when its average antenna input power(Max tune-up limit) plus its **MIF is ≤17 dBm** for any of its operating modes. If a device supports multiple RF air interfaces, each RF air interface shall be evaluated individually.

Power measurements were performed in accordance to the device's two power modes, Mode A and Mode B for each antenna. Mode A power is used when the device is used against the user's head or away from the body. Mode B power is used when the device is used in a Body-worn configuration by the user.
The selection between antennas ANT1, ANT2, ANT4 and ANT5 in the application is based on RSSI based antenna selection. The full details of power selections are described in the operational description.

7.1. ANT1

Air-Interface	Average Antenna Input Power (dBm)	Worst Case MIF (dB)	Input Power plus its MIF (dBm)	HAC Tested
GSM850	33.0	3.63	36.63	Yes
GSM1900	31.5	3.63	35.13	Yes
W-CDMA Band II	25.5	-27.23	-1.73	No
W-CDMA Band IV	25.5	-27.23	-1.73	No
W-CDMA Band V	25.5	-27.23	-1.73	No
CDMA BC0	25.5	3.26	28.76	Yes
CDMA BC1	25.5	3.26	28.76	Yes
CDMA BC10	25.5	3.26	28.76	Yes
LTE Band 2	25.5	-9.76	15.74	No
LTE Band 4	25.5	-9.76	15.74	No
LTE Band 5	25.5	-9.76	15.74	No
LTE Band 7	25.5	-9.76	15.74	No
LTE Band 12	25.5	-9.76	15.74	No
LTE Band 13	25.5	-9.76	15.74	No
LTE Band 14	25.5	-9.76	15.74	No
LTE Band 17	25.5	-9.76	15.74	No
LTE Band 25	25.5	-9.76	15.74	No
LTE Band 26	25.5	-9.76	15.74	No
LTE Band 30	23.5	-9.76	13.74	No
LTE Band 41 PC3	25.5	-1.44	24.06	Yes
LTE Band 41 PC2	27.0	-1.44	25.56	Yes
LTE Band 66	25.5	-9.76	15.74	No
LTE Band 71	25.5	-9.76	15.74	No
LTE CA_7C[1]	25.0	-9.76	15.24	No
LTE CA_41C PC3[1]	25.0	-1.44	23.56	No

Notes:
1. Testing for ULCA is not required because it uses same Tx band, modulations, and output power is equal or less than non-CA modes.

7.2. ANT2

Air-Interface	Average Antenna Input Power (dBm)	Worst Case MIF (dB)	Input Power plus its MIF (dBm)	HAC Tested
GSM850	31.0	3.63	34.63	Yes
GSM1900	29.0	3.63	32.63	Yes
W-CDMA Band II	19.5	-27.23	-7.73	No
W-CDMA Band IV	20.7	-27.23	-6.53	No
W-CDMA Band V	24.2	-27.23	-3.03	No
CDMA BC0	24.2	3.26	27.46	Yes
CDMA BC1	19.5	3.26	22.76	Yes
CDMA BC10	24.2	3.26	27.46	Yes
LTE Band 2	19.5	-9.76	9.74	No
LTE Band 4	20.7	-9.76	10.94	No
LTE Band 5	23.5	-9.76	13.74	No
LTE Band 7	19.7	-9.76	9.94	No
LTE Band 12	24.2	-9.76	14.44	No
LTE Band 13	23.7	-9.76	13.94	No
LTE Band 14	24.2	-9.76	14.44	No
LTE Band 17	24.2	-9.76	14.44	No
LTE Band 25	19.5	-9.76	9.74	No
LTE Band 26	23.5	-9.76	13.74	No
LTE Band 30	19.5	-9.76	9.74	No
LTE Band 41 PC3	21.2	-1.44	19.76	Yes
LTE Band 41 PC2[2]	21.2	-1.44	19.76	No
LTE Band 66	20.7	-9.76	10.94	No
LTE Band 71	24.2	-9.76	14.44	No
LTE CA_7C[1]	19.7	-9.76	9.94	No
LTE CA_41C PC3[1]	21.2	-1.44	19.76	No
802.11b	19.75	-2.02	17.73	Yes
802.11g	19.75	0.12	19.87	Yes

Notes:

1. Testing for ULCA is not required because it uses same Tx band, modulations, and output power is equal or less than non-CA modes.
2. LTE band 41 PC2 testing is not required because PC2 has the same power limit but a lower duty cycle than PC3.

7.3. ANT4

Air-Interface	Average Antenna Input Power (dBm)	Worst Case MIF (dB)	Input Power plus its MIF (dBm)	HAC Tested
802.11a (U-NII-1)	21.00	-3.15	17.85	Yes
802.11a (U-NII-2A)	21.00	-3.15	17.85	Yes
802.11a (U-NII-2C)	21.00	-3.15	17.85	Yes
802.11a (U-NII-3)	21.50	-3.15	18.35	Yes

7.4. ANT5

Air-Interface	Average Antenna Input Power (dBm)	Worst Case MIF (dB)	Input Power plus its MIF (dBm)	HAC Tested
802.11b	22.0	-2.02	19.98	Yes
802.11g	21.5	0.12	21.62	Yes
802.11a (U-NII-1)	21.0	-3.15	17.85	Yes
802.11a (U-NII-2A)	21.0	-3.15	17.85	Yes
802.11a (U-NII-2C)	21.0	-3.15	17.85	Yes
802.11a (U-NII-3)	21.5	-3.15	18.35	Yes

8. Device Under Test

Normal operation	Held to head
Back Cover	The Back Cover is not removable

8.1. Air Interfaces and Operating Mode

Air Interface	Bands (MHz)	Type	C63.19 Tested	Simultaneous Transmitter	OTT Testing Required? Name of Voice Service	GSM 1900 MHz Power Reduction
GSM	850	VO	Yes	Wi-Fi and BT	NA	NA
	1900					No
	GPRS/EDGE	VD	No	Wi-Fi and BT	Yes, Facetime	NA
W-CDMA (UMTS)	850	VO	No[1]	Wi-Fi and BT	NA	NA
	1700					
	1900					
	HSPA	VD	No	Wi-Fi and BT	Yes, Facetime	NA
CDMA	800	VO	Yes	Wi-Fi and BT	NA	NA
	1700					
	1900					
	EVDO	VD	No	Wi-Fi and BT	Yes, Facetime	NA
LTE - FDD	700	VD	No[1]	Wi-Fi and BT	Yes, Facetime	NA
	850					
	1700					
	1900					
	2300					
	2600					
LTE - TDD	2500	VD	Yes	Wi-Fi and BT	Yes, Facetime	NA
Wi-Fi	2450	VD	Yes	WWAN and BT	Yes, Facetime	NA
	5200 (U-NII-1)					
	5300 (U-NII-2A)					
	5500 (U-NII-2C)					
	5800 (U-NII-3)					
BT	2450	DT	No	WWAN and Wi-Fi	NA	NA

Type
VO: legacy Cellular Voice Service
DT: Digital Transport only (no voice)
VD: IP Voice Service over Digital Transport
BT: Bluetooth

Note:
1. Evaluated for MIF and low power exemption.

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. DASY52 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. DASY52 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, CDMA, LTE). 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-CAB	UMTS-FDD (WCDMA)	-27.23
10295-AAB	CDMA2000 (1xRTT, RC1, SO3, 1/8th Rate 25 fr.)	3.26
10170-CAD	LTE-FDD (SC-FDMA, 1 RB, 20 MHz, 16QAM)	-9.76
10182-CAD	LTE-FDD (SC-FDMA, 1 RB, 15 MHz, 16QAM)	-9.76
10176-CAE	LTE-FDD (SC-FDMA, 1 RB, 10 MHz, 16QAM)	-9.76
10173-CAD	LTE-TDD (SC-FDMA, 1 RB, 20 MHz, 16QAM)	-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
10069-CAC	IEEE 802.11a/n WiFi 5 GHz (OFDM, 54 Mbps)	-3.15

A PMR calibrated probe is linearized for the selected waveform over the full dynamic range within the uncertainty specified in its calibration certificate. E-field probes have a bandwidth <10 kHz and can therefore not evaluate the RF envelope in the full audio band. DASY52 is therefore using the \indirect" measurement method according to ANSI C63.19 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.

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. HAC RF Emissions Test Procedure

The following are step-by-step test procedures.

a) Confirm proper operation of the field probe, probe measurement system and other instrumentation and the positioning system.

b) Position the WD in its intended test position.

c) Set the WD to transmit a fixed and repeatable combination of signal power and modulation characteristic that is representative of the worst case (highest interference potential) encountered in normal use. Transiently occurring start-up, changeover, or termination conditions, or other operations likely to occur less than 1% of the time during normal operation, may be excluded from consideration.

d) The center sub-grid shall be centered on the T-Coil mode perpendicular measurement point or the acoustic output, as appropriate. Locate the field probe at the initial test position in the 50 mm by 50 mm grid, which is contained in the measurement plane, refer to illustrated in Figure 1. 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 sub-grids around the center sub-grid whose maximum reading is the lowest of all available choices. This eliminates the three sub-grids with the maximum readings. Thus, the six areas to be used to determine the WD’s highest emissions are identified.

h) Identify the maximum reading within the non-excluded sub-grids identified in step g).

i) Convert the highest field reading within 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 this result to dB(V/m) by taking the base-10 logarithm and multiplying by 20.

   Indirect measurement method

   Replacing step i), 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 (ANSI C63.19) 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 sub-grid 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.

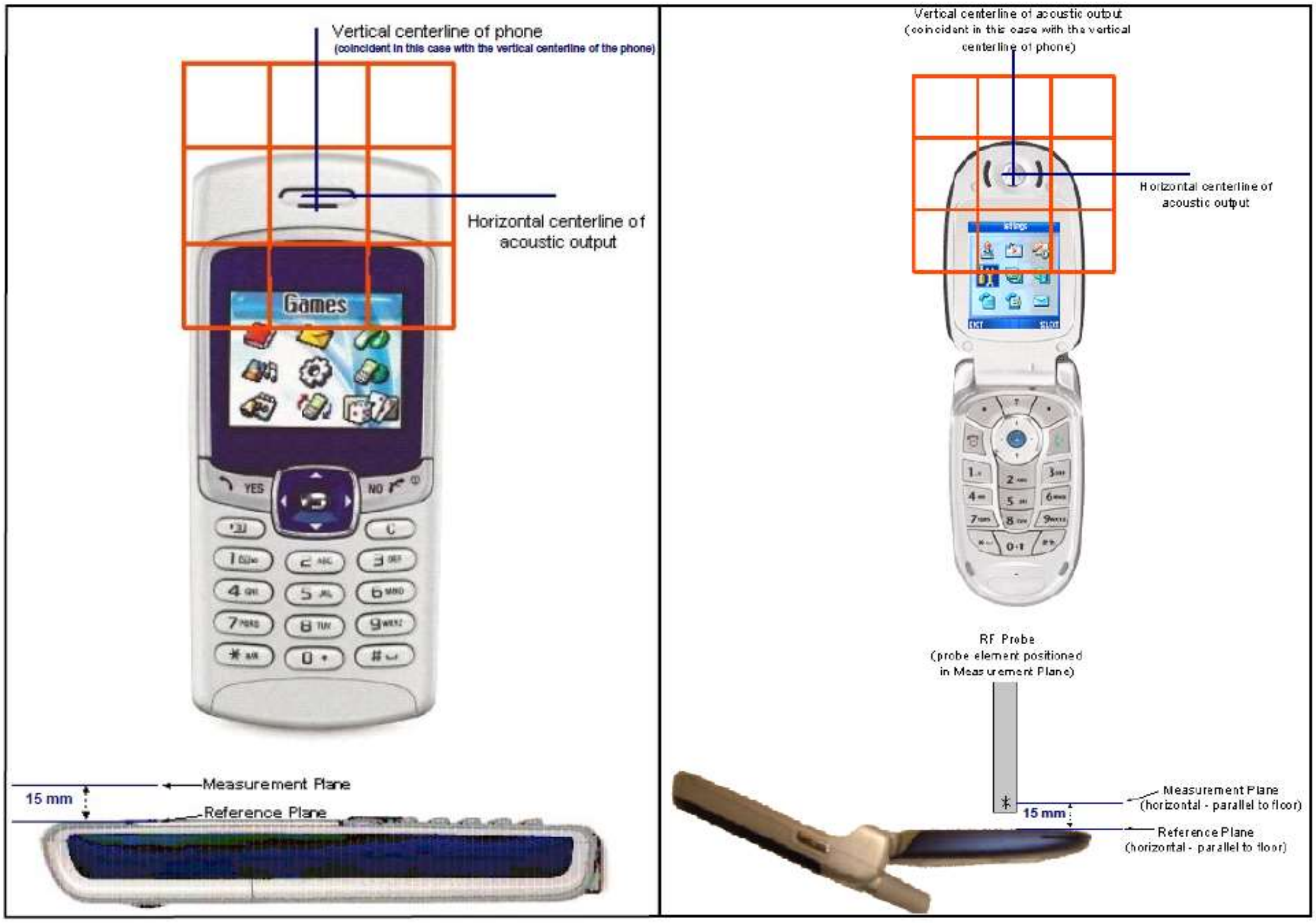
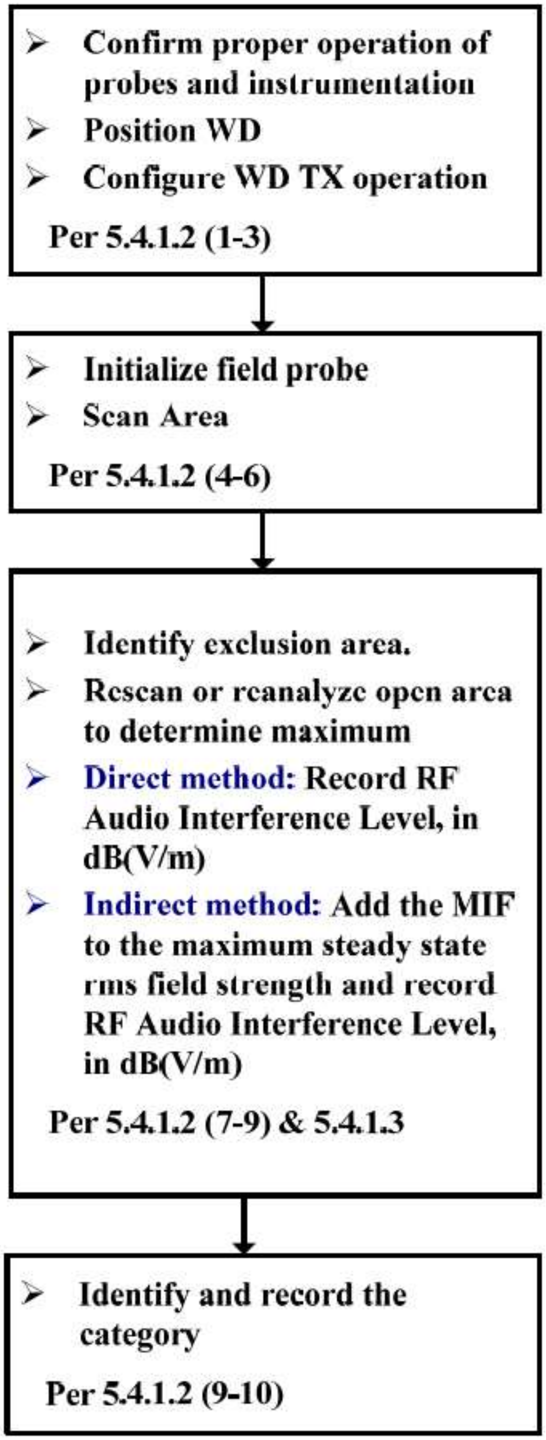


Figure 1 - WD reference and plane for RF emission measurements

Test flowchart Per ANSI-63.19-2011



11. RF Emissions Measurement Criteria

WD RF audio interference level caterories in logarithmic units

Emission Categories	E-field emissions	
	< 960 MHz	> 960 MHz
Category M1	50 to 55 dB (V/m)	40 to 45 dB (V/m)
Category M2	45 to 50 dB (V/m)	35 to 40 dB (V/m)
Category M3	40 to 45 dB (V/m)	30 to 35 dB (V/m)
Category M4	<40 dB (V/m)	<30 dB (V/m)

12. HAC (RF Emissions) Test Results

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.

Refer to Section 7 Evaluation for Low-power Exemption. RF Emission testing for this device is required only for GSM, CDMA voice modes, LTE-TDD, Wi-Fi and Bluetooth. All other applicable air-interfaces are exempt from testing in accordance with C63.19 Clause 4.4 and are rated M4.

12.1. ANT1

Air-Interface	Ch. No.	Freq. (MHz)	Results* (dB V/m)	Results plus 0.2dB uncertaninty (dB V/m)	Margin (dB)	M-Rating	Plots Page #
GSM850	128	824.4	34.50	34.70	5.30	M4	1
	190	836.6	34.64	34.84	5.16	M4	2
	251	848.6	34.92	35.12	4.88	M4	3
GSM1900	512	1850.2	32.60	32.80	2.20	M3	4
	661	1880	32.74	32.94	2.06	M3	5
	810	1909.8	32.20	32.40	2.60	M3	6
CDMA2000 BC0	1013	824.7	27.91	28.11	11.89	M4	7
	384	836.6	27.82	28.02	11.98	M4	8
	777	848.31	28.32	28.52	11.48	M4	9
CDMA2000 BC1	25	1851.25	26.53	26.73	3.27	M4	10
	600	1880	26.14	26.34	3.66	M4	11
	1175	1908.75	26.53	26.73	3.27	M4	12
CDMA2000 BC10	450	817.3	28.24	28.44	11.56	M4	13
	560	820	28.54	28.74	11.26	M4	14
	670	822.75	28.96	29.16	10.84	M4	15
LTE-TDD Band 41 PC3	39750	2506	21.57	21.77	8.23	M4	16
	40185	2549.5	22.21	22.41	7.59	M4	17
	40620	2593	21.78	21.98	8.02	M4	18
	41055	2636.5	20.96	21.16	8.84	M4	19
	41490	2680	19.89	20.09	9.91	M4	20
LTE-TDD Band 41 PC2	39750	2506	22.58	22.78	7.22	M4	77
	40185	2549.5	23.10	23.30	6.70	M4	78
	40620	2593	22.78	22.98	7.02	M4	79
	41055	2636.5	22.05	22.25	7.75	M4	80
	41490	2680	20.81	21.01	8.99	M4	81

Note(s):

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

12.2. ANT2

Air-Interface	Ch. No.	Freq. (MHz)	Results* (dB V/m)	Results plus 0.2dB uncertaninty (dB V/m)	Margin (dB)	M-Rating	Plots Page #
GSM850	128	824.4	37.56	37.76	2.24	M4	21
	190	836.6	37.38	37.58	2.42	M4	22
	251	848.6	36.70	36.90	3.10	M4	23
GSM1900	512	1850.2	29.91	30.11	4.89	M3	24
	661	1880	29.79	29.99	0.01	M4	25
	810	1909.8	30.06	30.26	4.74	M3	26
CDMA2000 BC0	1013	824.7	33.82	34.02	5.98	M4	27
	384	836.6	33.20	33.40	6.60	M4	28
	777	848.31	32.47	32.67	7.33	M4	29
CDMA2000 BC1	25	1851.25	28.76	28.96	1.04	M4	30
	600	1880	28.35	28.55	1.45	M4	31
	1175	1908.75	28.70	28.90	1.10	M4	32
CDMA2000 BC10	450	817.3	33.66	33.86	6.14	M4	33
	560	820	33.74	33.94	6.06	M4	34
	670	822.75	33.80	34.00	6.00	M4	35
LTE-TDD Band 41 PC3	39750	2506	32.32	32.52	2.48	M3	36
	40185	2549.5	31.96	32.16	2.84	M3	37
	40620	2593	31.00	31.20	3.80	M3	38
	41055	2636.5	29.74	29.94	0.06	M4	39
	41490	2680	29.00	29.20	0.80	M4	40
802.11b	2	2417	31.63	31.83	3.17	M3	41
	6	2437	30.76	30.96	4.04	M3	42
	11	2462	30.53	30.73	4.27	M3	43
802.11g	**3**	**2422**	**33.37**	**33.57**	**1.43**	**M3**	**44**
	6	2437	32.10	32.30	2.70	M3	45
	9	2452	32.66	32.86	2.14	M3	46

Note(s):

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

12.3. ANT4

Air-Interface	Ch. No.	Freq. (MHz)	Results* (dB V/m)	Results plus 0.2dB uncertaninty (dB V/m)	Margin (dB)	M-Rating	Plots Page #
802.11 a (5.2 GHz)	40	5200	21.61	21.81	8.19	M4	47
	44	5220	21.63	21.83	8.17	M4	48
	48	5240	21.69	21.89	8.11	M4	49
802.11 a (5.3 GHz)	52	5260	21.77	21.97	8.03	M4	50
	56	5280	22.04	22.24	7.76	M4	51
	60	5300	22.17	22.37	7.63	M4	52
802.11 a (5.5 GHz)	104	5520	20.65	20.85	9.15	M4	53
	124	5620	21.29	21.49	8.51	M4	54
	144	5720	22.67	22.87	7.13	M4	55
802.11 a (5.8 GHz)	149	5745	22.80	23.00	7.00	M4	56
	157	5785	22.94	23.14	6.86	M4	57
	165	5825	23.39	23.59	6.41	M4	58

Note(s):

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

12.4. ANT5

Air-Interface	Ch. No.	Freq. (MHz)	Results* (dB V/m)	Results plus 0.2dB uncertaninty (dB V/m)	Margin (dB)	M-Rating	Plots Page #
802.11b	2	2417	22.41	22.61	7.39	M4	59
	6	2437	23.34	23.54	6.46	M4	60
	11	2462	23.34	23.54	6.46	M4	61
802.11g	3	2422	24.00	24.20	5.80	M4	62
	6	2437	25.04	25.24	4.76	M4	63
	9	2452	25.83	26.03	3.97	M4	64
802.11a (5.2 GHz)	40	5200	18.91	19.11	10.89	M4	65
	44	5220	18.33	18.53	11.47	M4	66
	48	5240	17.89	18.09	11.91	M4	67
802.11a (5.3 GHz)	52	5260	17.64	17.84	12.16	M4	68
	56	5280	16.41	16.61	13.39	M4	69
	60	5300	16.91	17.11	12.89	M4	70
802.11a (5.5 GHz)	104	5520	17.43	17.63	12.37	M4	71
	124	5620	18.73	18.93	11.07	M4	72
	144	5720	18.02	18.22	11.78	M4	73
802.11a (5.8 GHz)	149	5745	17.20	17.40	12.60	M4	74
	157	5785	15.75	15.95	14.05	M4	75
	165	5825	15.22	15.42	14.58	M4	76

Note(s):

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

12.5. Worst Case RF Emission Test Plot

Test Laboratory: UL Verification Services Inc. SAR Lab C Date: 7/20/2018

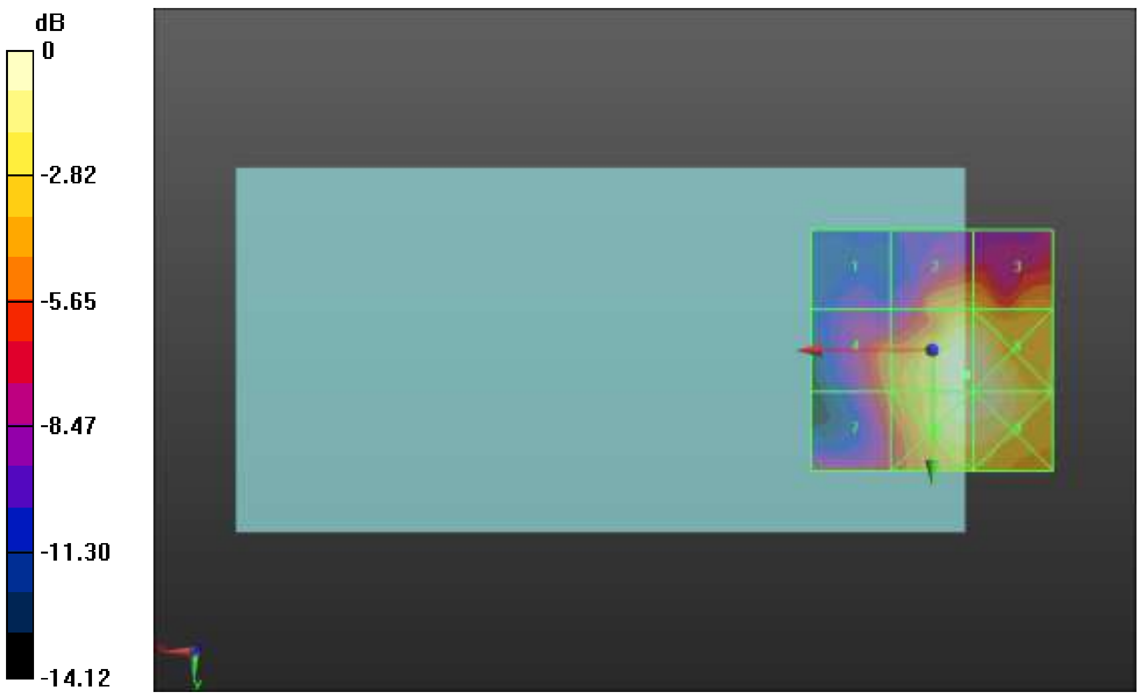
HAC-RF Emission ANT 2

Communication System: UID 10077 - CAB, IEEE 802.11g WiFi 2.4 GHz (DSSS/OFDM, 54 Mbps); Frequency: 2422 MHz; Duty Cycle: 1:12.5893
Phantom section: RF Section
DASY5 Configuration:
- Probe: EF3DV3 - SN4041; ConvF(1, 1, 1); Calibrated: 3/16/2018;
- Sensor-Surface: (Fix Surface)
- Electronics: DAE4 Sn1472; Calibrated: 3/8/2018
- Phantom: HAC Test Arch with AMCC; Type: SD HAC P01 BB
- Measurement SW: DASY52, Version 52.8 (7);SEMCAD X Version 14.6.10 (7164)

802.11g E-Field measurement/IEEE 802.11g_OFDM 54 Mbps_ch 3/Hearing Aid Compatibility Test (101x101x1): Interpolated grid: dx=0.5000 mm, dy=0.5000 mm
Device Reference Point: 0, 0, -6.3 mm
Reference Value = 66.65 V/m; Power Drift = -0.06 dB
Applied MIF = 0.12 dB
RF audio interference level = 33.37 dBV/m
Emission category: M3

MIF scaled E-field

Grid 1 **M4** **24.27 dBV/m**	Grid 2 **M3** **30.34 dBV/m**	Grid 3 **M3** **30.31 dBV/m**
Grid 4 **M4** **28.9 dBV/m**	Grid 5 **M3** **33.37 dBV/m**	Grid 6 **M3** **33.3 dBV/m**
Grid 7 **M4** **28.53 dBV/m**	Grid 8 **M3** **33.21 dBV/m**	Grid 9 **M3** **33.18 dBV/m**



0 dB = 46.62 V/m = 33.37 dBV/m

Appendixes

Refer to separated files for the following appendixes

12162294-S4V1 Appendix A: HAC RF Emission Setup Photo

12162294-S4V1 Appendix B: System Validation Plots

12162294-S4V1 Appendix C: HAC RF Emission Test Plots

12162294-S4V1 Appendix D: MIF Attestation Letter

12162294-S4V1 Appendix E: Probe Calibration Certificates

12162294-S4V1 Appendix F: Dipole Calibration Certificates

12162294-S4V1 Appendix G: UID Specifications

END OF REPORT