HAC T-COIL SIGNAL TEST REPORT

FCC CFR47 PART 20.19
ANSI C63.19-2011

For
Smartphone

FCC ID: BCG-E3219A
Model Name: A1921, A2104, A2103

Report Number: 12124122-S2V2
Issue Date: 8/14/2018

Prepared for
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NVLAP LAB CODE 200065-0

Revision History

Rev.	Date	Revisions	Revised By
V1	8/8/2018	Initial Issue	--
V2	8/14/2018	Updated §8.1	Nathan Sousa

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1. Attestation of Test Results

Applicant Name	APPLE, INC.
FCC ID	BCG-E3219A
Model Name	A1921, A2104, A2103
Applicable Standards	FCC 47 CFR § 20.19 ANSI C63.19-2011
HAC Rating	T4
Date Tested	5/15/2018 to 7/12/2018
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:
	
Dave Weaver Operations Leader UL Verification Services Inc.	Nathan Sousa 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 and FCC published procedure

KDB 285076 D01 HAC Guidance v05
KDB 285076 D02 T-Coil testing for CMRS IP v03
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 used to perform the tests documented in this report has been calibrated in accordance with the manufacturers' recommendations, and is traceable to recognized national standards.

Name of Equipment	Manufacturer	Type/Model	Serial No.	Cal. Due Date
ABM Probe	SPEAG	AM1DV3	3083	1/15/2019
ABM Probe	SPEAG	AM1DV3	3092	7/20/2018
Data Acquisition Electronics	SPEAG	DAE4	1357	2/8/2019
Radio Communication Tester	R & S	CMW 500	125236	3/28/2019
iMac	Apple	21.5-inch, Late 2015	FNQS83J5GG77	N/A
AP	Apple	AirPort Express	C86J4AC0DV2R	N/A
DAC	Sound Devices	USBPre 2	HB11173410003	N/A
AP	Cisco	AIR-CAP3702I-A-K9	FCW1925NNPJ	N/A
Series Wireless Controller	Cisco	WLAN 2500 Series Controller	PSZ1901CMV	N/A
Network Hub	Linksys	NH1005	R8730G403203	N/A
Switch	Netgear	ProSafe Plus Switch	29B9273A50BF5	N/A

4.2. Measurement Uncertainty

Measurement Uncertainty for Audio Band Magnetic Measurement

Error Description	Uncertainty values (±%)	Probe Dist.	Div.	c_i ABM1	c_i ABM2	Std. Unc.	
						ABM1 (±%)	ABM2 (±%)
Probe Sensitivity							
Reference level	3.0	N	1	1	1	3.0	3.0
AMCC geometry	0.4	R	√3	1	1	0.2	0.2
AMCC current	1.0	R	√3	1	1	0.6	0.6
Probe positioning during calibration	0.1	R	√3	1	1	0.1	0.1
Noise contribution	0.7	R	√3	0.0143	1	0.0	0.4
Frequency slope	5.9	R	√3	0.1	1.00	0.3	3.5
Probe System							
Repeatability / drift	1.0	R	√3	1	1	0.6	0.6
Linearity / Dynamic range	0.6	R	√3	1	1	0.4	0.4
Acoustic noise	1.0	R	√3	0.1	1	0.1	0.6
Probe angle	2.3	R	√3	1	1	1.4	1.4
Spectral processing	0.9	R	√3	1	1	0.5	0.5
Integration time	0.6	N	1	1	5	0.6	3.0
Field disturbation	0.2	R	√3	1	1	0.1	0.1
Test Signal							
Reference signal spectral response	0.6	R	√3	0	1	0.0	0.4
Positioning							
Probe positioning	1.9	R	√3	1	1	1.1	1.1
Phantom positioning	0.9	R	√3	1	1	0.5	0.5
EUT positioning	1.9	R	√3	1	1	1.1	1.1
External Contributions							
RF interference	0.0	R	√3	1	0.3	0.0	0.0
Test signal variation	2.0	R	√3	1	1	1.2	1.2
Combined Std. Uncertainty (ABM field)						4.1	6.1
Expanded Std. Uncertainty (%)						8.1	12.3

Notes for table
1. N - Nomal
2. R - Rectangular
3. Div. - Divisor used to obtain standard uncertainty

5. Test Procedure

ANSI C63.19-2011, Section 7

This document describes the procedures used to measure the ABM (T-Coil) performance of the WD. In addition to measuring the absolute signal levels, the A-weighted magnitude of the unintended signal shall also be determined. In order to assure that the required signal quality is measured, the measurement of the intended signal and the measurement of the unintended signal must be made at the same location for all measurement positions. In addition, the RF field strength at each measurement location must be at or below that required for the assigned category.

Measurements shall not include undesired properties from the WD's RF field; therefore, use of a coaxial connection to a base station simulator or non-radiating load may be necessary. However, even then with a coaxial connection to a base station simulator or non-radiating load there may still be RF leakage from the WD, which may interfere with the desired measurement. Pre-measurement checks should be made to avoid this possibility. All measurements shall be done with the WD operating on battery power with an appropriate normal speech audio signal input level given in Table 7.1. If the device display can be turned off during a phone call then that may be done during the measurement as well.

Measurements shall be performed at two locations specified in A.3, with the correct probe orientation for a particular location, in a multistage sequence by first measuring the field intensity of the desired T-Coil signal (ABM1) that is useful to a hearing aid T-Coil. The undesired magnetic components (ABM2) must be measured at the same location as the desired ABM or T-Coil signal (ABM1), and the ratio of desired to undesired ABM signals must be calculated. For the perpendicular field location, only the ABM1 frequency response shall be determined in a third measurement stage. The flow chart in Figure 7.3 illustrates this three-stage, two orientation process.

The following steps summarize the basic test flow for determining ABM1[1] and ABM2[2]. These steps assume that a sine wave or narrowband 1/3 octave signal can be used for the measurement of ABM1.

a. A validation of the test setup and instrumentation may be performed using a TMFS or Helmholtz coil. Measure the emissions and confirm that they are within the specified tolerance.

b. Position the WD in the test setup and connect the WD RF connector to a base station simulator or a non-radiating load as shown in Figure 7.1 or Figure 7.2. Confirm that equipment that requires calibration has been calibrated, and that the noise level meets the requirements given in 7.3.1.

c. The drive level to the WD is set such that the reference input level specified in Table 7.1 is input to the base station simulator (or manufacturer's test mode equivalent) in the 1 kHz, 1/3 octave band. This drive level shall be used for the T-Coil signal test (ABM1) at *f* = 1 kHz. Either a sine wave at 1025 Hz or a voice-like signal, band-limited to the 1 kHz 1/3 octave, as defined in 7.4.2, shall be used for the reference audio signal. If interference is found at 1025 Hz an alternative nearby reference audio signal frequency may be used.46 The same drive level will be used for the ABM1 frequency response measurements at each 1/3 octave band center frequency. The WD volume control may be set at any level up to maximum, provided that a signal at any frequency at maximum modulation would not result in clipping or signal overload.

d. Determine the magnetic measurement locations for the WD device (A.3), if not already specified by the manufacturer, as described in 7.4.4.1.1 and 7.4.4.2.

[1] **Audio Band Magnetic signal - desired (ABM1):** Measured quantity of the desired magnetic signal

[2] A**udio Band Magnetic signal - undesired (ABM2):** Measured quantity of the undesired magnetic signal, such as interference from battery current and similar non-signal elements.

e. At each measurement location, measure and record the desired T-Coil magnetic signals (ABM1 at f_i) as described in 7.4.4.2 in each individual ISO 266-1975 R10 standard 1/3 octave band. The desired audio band input frequency (f_i) shall be centered in each 1/3 octave band maintaining the same drive level as determined in item c) and the reading taken for that band.

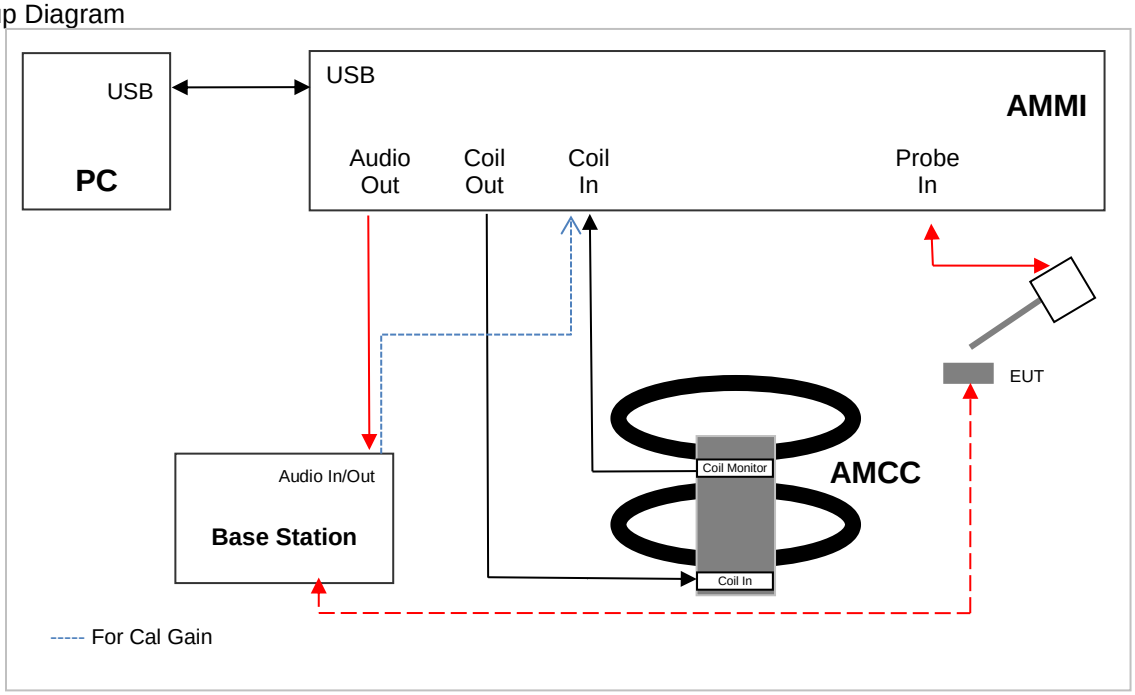
Equivalent methods of determining the frequency response may also be employed, such as fast Fourier transform (FFT) analysis using noise excitation or input–output comparison using simulated speech. The full-band integrated or half-band integrated probe output, as specified in D.9, may be used, as long as the appropriate calibration curve is applied to the measured result, so as to yield an accurate measurement of the field magnitude. (The resulting measurement shall be an accurate measurement in dB A/m.)

All measurements of the desired signal shall be shown to be of the desired signal and not of an undesired signal. This may be shown by turning the desired signal ON and OFF with the probe measuring the same location. If the scanning method is used the scans shall show that all measurement points selected for the ABM1 measurement meet the ambient and test system noise criteria in 7.3.1.

f. At the measurement location for each orientation, measure and record the undesired broadband audio magnetic signal (ABM2) as specified in 7.4.4.4 with no audio signal applied (or digital zero applied, if appropriate) using A-weighting and the half-band integrator. Calculate the ratio of the desired to undesired signal strength (i.e., signal quality).

g. Obtain the data from the postprocessor, SEMCAD, and determine the category that properly classifies the signal quality based on Table 8.5.

Test Setup Diagram

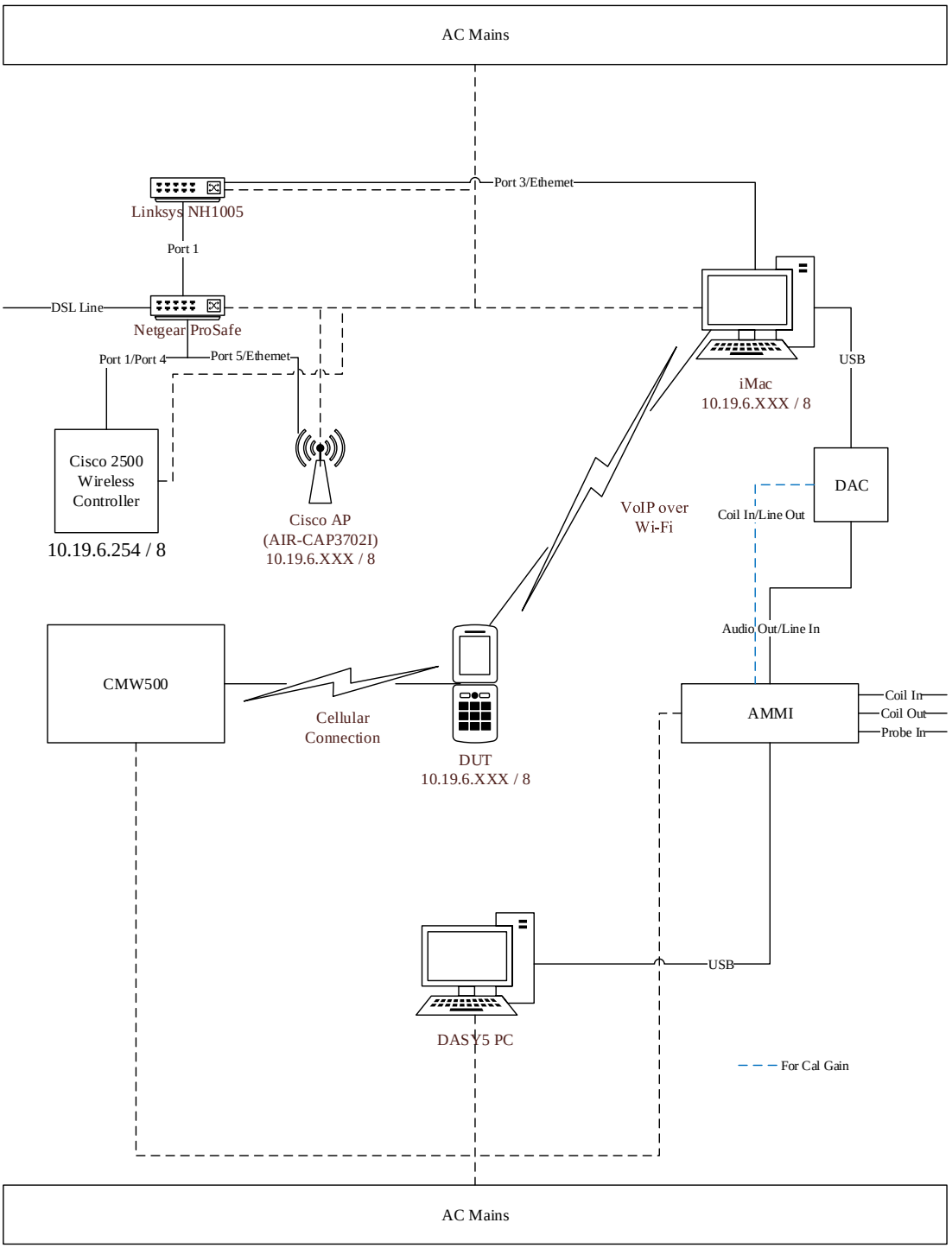


5.1. Over the Top (OTT)

The test procedure for OTT testing is identical to the section above, except for how the signal is sent to the DUT, as outlined in the diagram below.

The AMMI is connected to an external ADC (Analog to Digital Converter) and the ADC is connected to the iMac via USB. The iMac is connected to the Internet via Ethernet and the DUT is connected to the Internet via Wi-Fi. Using the DUT's OTT application, a VoIP call is established with the iMac. The test signal is sent from the DASY5 PC to the AMMI, from the AMMI to the ADC, from the ADC to the iMac, and finally to the DUT.

To exercise the license antenna, the DUT was simultaneously connected to an external AP and to a mobile base station. This is essentially the manufacturer's test mode method (C63.19 2007 §6.2.3) but with the audio wired signal injection replaced by the Wi-Fi connection.



6. Audio Level and Gain Measurements

CDMA

No correction gain factors were measured for CDMA due to the Rohde & Schwarz CMW500, hosting a calibrated audio board. The gains used to measure CDMA are set to 100.

W-CDMA/GSM

No correction gain factors were measured for W-CDMA/GSM due to the Rohde & Schwarz CMW500, hosting a calibrated audio board. The gains used to measure W-CDMA/GSM are set to 100.

VoLTE

No correction gain factors were measured for VoLTE due to the Rohde & Schwarz CMW500, hosting a calibrated audio board. The gains used to measure VoLTE are set to100.

The following software/firmware was used to simulate the VoLTE server for testing:

Firmware	License Keys	Software Name
V3.7.30 for LTE	KS500	LTE FDD R8 SIG BASIC
	KS550	LTE TDD R8 SIG BASIC
	KA100	IP APPL ENABLING IPv4
	KA150	IP APPL ENABLING IPv6
V3.7.20 for Audio	KAA20	IP APPL IMS BASIC
	KM050	DATA APPL MEAS
	KS104	EVS SPEECH CODEC

VoWi-Fi

No correction gain factors were measured for VoWi-Fi due to the Rohde & Schwarz CMW500, hosting a calibrated audio board. The gains used to measure VoWi-Fi are set to100.

Firmware	License Keys	Software Name
V3.7.30 for WLAN	KS650	WLAN A/B/G SIG BASIC
	KS651	WLAN N SIG BASIC
	KA100	IP APPL ENABLING IPv4
	KA150	IP APPL ENABLING IPv6
V3.7.20 for Audio	KAA20	IP APPL IMS BASIC
	KM050	DATA APPL MEAS
	KS104	EVS SPEECH CODEC

Over the Top (OTT)

For EDGE, HSPA, Ev-Do, LTE, and Wi-Fi, the linear gain levels listed below were used. The results below are based on a reference input level of -20 dBm0. Granted, the C63.19-2011 interpretation for T-coil audio levels for LTE states that an input reference level of -16 dBm0 should be used, we, the test lab, opted for -20 dBm0 for LTE due to it being a more conservative input reference level.

The adjusted gain measurements are based on an external Analogue to Digital Converter (ADC), where the signal is sent from the AMMI to the ADC, then to the DUT via Wi-Fi.

To calibrate the ADC, three *.wav* audio files (sine wave, 1 kHz voice, and 300 to 3 kHz voice) are sent from the DASY5 PC to the AMMI, then to the ADC. The Helmholtz resonator measures the field strength, which represents the AMMI to ADC input sensitivity. After determining the input sensitivity, the adjusted linear gain values can then be calculated.

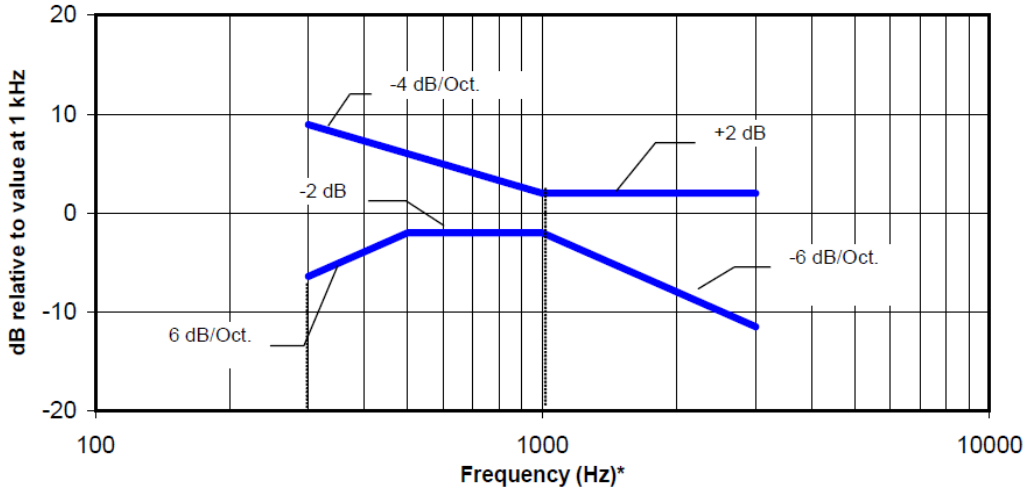
Signal Type	Audio Level [dBm0]	Gain [dB]	Gain [linear]
Voice 1 kHz	-20.00	29.72	**30.62**
Voice 300 - 3 kHz	-20.00	35.57	**60.05**

7. T-coil Measurement Criteria

7.1. Frequency Response

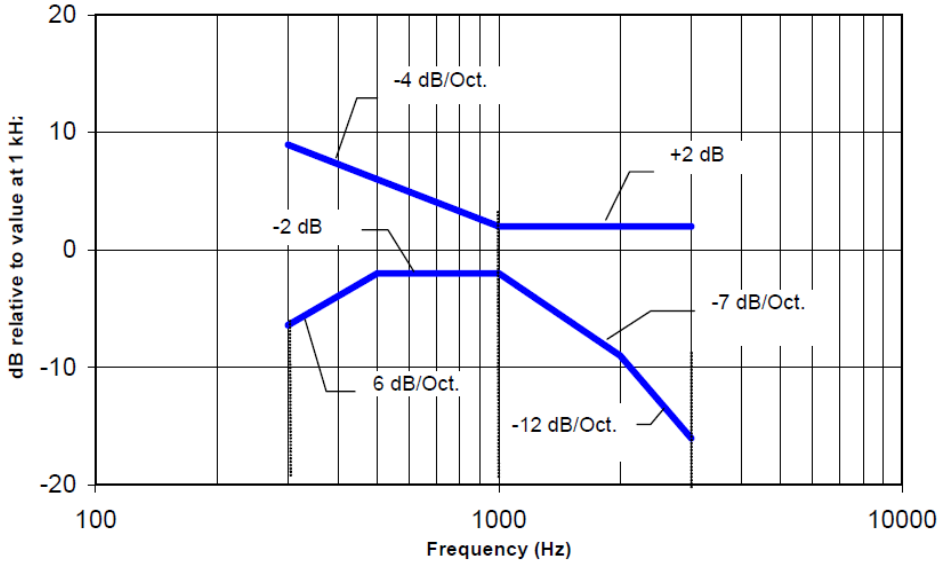
The frequency response of the axial component of the magnetic field, measured in 1/3 octave bands, shall follow the response curve, over the frequency range 300 Hz to 3000 Hz.

Figure 8.1 and Figure 8.2 provide the boundaries for the specified frequency. These response curves are for true field strength measurements of the T-Coil signal. Thus the 6 dB/octave probe response has been corrected from the raw readings.



NOTE—The frequency response is between 300 Hz and 3000 Hz.

Figure 8.1—Magnetic field frequency response for WDs with field strength ≤ –15 dB (A/m) at 1 kHz



NOTE—The frequency response is between 300 Hz and 3000 Hz.

Figure 8.2—Magnetic field frequency response for WDs with a field that exceeds –15 dB(A/m) at 1 kHz

7.2. Signal to Noise

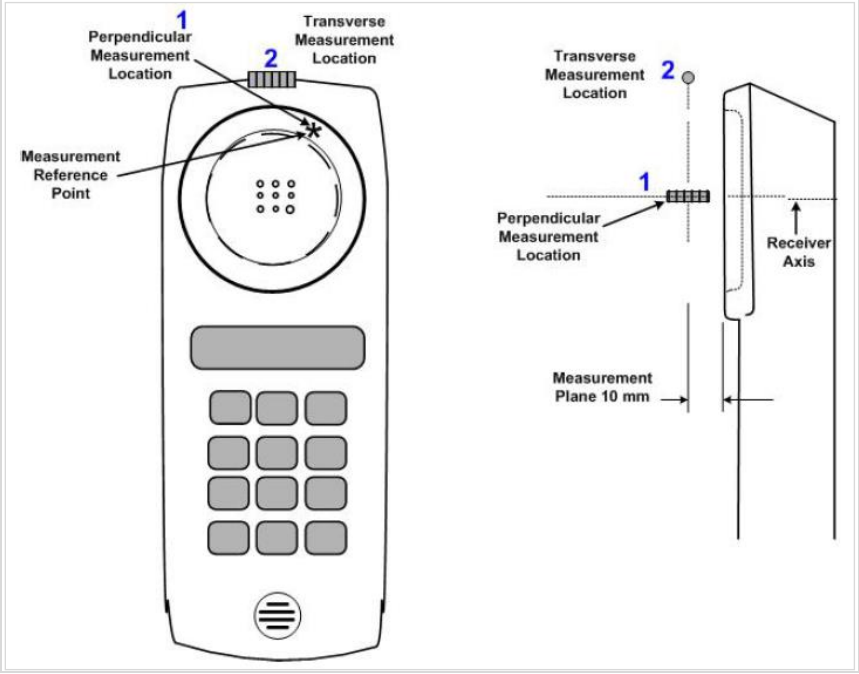
This specifies the signal-to-noise quality requirement for the intended T-Coil signal from a WD. The worst signal to noise of the two T-Coil signal measurements, as determined in Clause 7, shall be used to determine the T-Coil mode category per Table 8.5.

Only the RF immunity of the hearing aid is measured in T-Coil mode. It is assumed that a hearing aid can have no immunity to an interference signal in the audio band, which is the intended reception band for this mode. So, the only criterion that can be measured is the RF immunity in T-Coil Mode. This is measured using the same procedure as for the audio coupling mode and at the same levels as specified in 6.4.

Table 8.5—T-Coil signal-to-noise categories

Category	Telephone parameters WD signal quality [(signal + noise)-to-noise ratio in decibels]
Category T1	0 dB to 10 dB
Category T2	10 dB to 20 dB
Category T3	20 dB to 30 dB
Category T4	>30 dB

Measurement locations and reference plane to be used for the T-coil measurements



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	Yes	Wi-Fi and BT	Yes FaceTime[2]	NA
W-CDMA (UMTS)	850	VO	Yes	Wi-Fi and BT	NA	NA
	1700					
	1900					
	HSPA	VD	Yes	Wi-Fi and BT	Yes FaceTime[2]	NA
CDMA	800	VO	Yes	Wi-Fi and BT	NA	NA
	1900					
	EVDO	VD	Yes	Wi-Fi and BT	Yes FaceTime[2]	NA
LTE - FDD	700 (B12/13/14/17)	VD	Yes	Wi-Fi and BT	Yes[1] FaceTime[2]	NA
	850 (B5/26)					
	1700 (B4/66)					
	1900 (B2/25)					
	2300 (B30)					
	2600 (B7)					
LTE - TDD	2500 (B38/41)	VD	Yes	Wi-Fi and BT	Yes[1] FaceTime[2]	NA
Wi-Fi	2450	VD	Yes	WWAN and BT	Yes Wi-Fi calling FaceTime[2]	NA
	5200 (U-NII-1)					
	5300 (U-NII-2A)					
	5500 (U-NII-2C)					
	5800 (U-NII-3)					
BT	2450	DT	NA	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] Ref Lev in accordance with the July 2012 VoLTE interpretation
[2] Ref Lev −20 dBm0

9. HAC (T-coil) Test Results

9.1. Antenna Investigation

All testing was performed on the Upper Antennas (ANT2 for WWAN, ANT4 for WLAN 2.4GHz, and ANT 6 for WLAN 5GHz). Spot checks were performed on the Lower Antennas (ANT1 for WWAN, ANT3 for WWAN and WLAN 2.4GHz, ANT5 for WLAN 5GHz) and one (1) Upper Antenna (ANT4 for WWAN), when applicable, to confirm that there were no unexpected variations between the antennas, a difference of 3dB was used as the threshold.

Mode:	Channel and Frequency	Bandwidth/ Data Rate	Antenna	Orientation	ABM1 dB(A/m)	ABM2 dB(A/m)	Ambient Noise dB(A/m)	Freq. Response (dB)	ABM SNR (dB)	T-Rating	Delta (UAT v. LAT)
GSM 1900 Voice Coder Speechcodec Low	661 1880 MHz	N/A	ANT2	z (Axial)	17.59	-15.11	-41.82	1.70	53.31	T4	-1.17
				y (Transverse)	9.88	-14.61	-49.65		**45.41**	T4	
			ANT1	z (Axial)	16.56	-21.74	-55.59	2.00	49.40	T4	
				y (Transverse)	5.85	-19.59	-55.47		46.58	T4	
			ANT3	z (Axial)	20.60	-22.01	-55.75	1.41	53.26	T4	-7.85
				y (Transverse)	11.08	-25.82	-55.59		55.63	T4	
			ANT4	z (Axial)	20.87	-23.78	-55.75	1.81	54.82	T4	-9.41
				y (Transverse)	10.79	-27.47	-55.59		56.10	T4	
W-CDMA Band IV VoiceWideband AMR Codec: 6.6 kbit/s	1413 1732.6 MHz	N/A	ANT2	z (Axial)	19.60	-30.93	-41.82	0.51	62.34	T4	-0.31
				y (Transverse)	10.25	-28.80	-49.65		**55.85**	T4	
			ANT1	z (Axial)	14.86	-31.93	-55.84	2.00	59.85	T4	
				y (Transverse)	8.92	-30.67	-55.66		56.16	T4	
CDMA2000 BC10 RC1 / SO3 1/8 FR Voice Coder: 8K EVRC Low	580 820.5 MHz	ANT2	ANT2	z (Axial)	17.05	-29.15	-55.59	2.00	60.05	T4	0.28
				y (Transverse)	10.65	-27.32	-55.47		55.36	T4	
			ANT1	z (Axial)	17.70	-29.66	-55.59	2.00	60.65	T4	
				y (Transverse)	10.58	-27.96	-55.47		**55.08**	T4	
LTE Band 7 EVS 2.8/5.9 kbit/s	21100 20 MHz BW	20 MHz QPSK	ANT2	z (Axial)	13.40	-29.10	-55.78	1.74	57.87	T4	-3.73
				y (Transverse)	8.62	-32.95	-55.52		**53.57**	T4	
			ANT1	z (Axial)	15.20	-29.47	-55.78	1.84	59.98	T4	
				y (Transverse)	57.30	-26.94	-55.52		57.30	T4	
			ANT3	z (Axial)	17.77	-28.92	-55.75	2.00	62.36	T4	-2.27
				y (Transverse)	10.14	-29.39	-55.59		55.84	T4	
			ANT4	z (Axial)	17.56	-30.27	-55.75	1.92	60.46	T4	-2.65
				y (Transverse)	10.62	-30.90	-55.59		56.22	T4	
LTE Band 41 EVS 2.8/5.9 kbit/s	41490 2680 MHz	20 MHz QPSK	ANT2	z (Axial)	14.26	-22.31	-28.78	2.00	56.66	T4	-3.64
				y (Transverse)	8.59	-22.28	-27.23		**48.83**	T4	
			ANT1	z (Axial)	18.88	-21.93	-28.78	2.00	59.19	T4	
				y (Transverse)	11.70	-23.54	-27.23		52.47	T4	
			ANT3	z (Axial)	18.10	-29.90	-55.75	1.87	61.74	T4	-5.93
				y (Transverse)	9.52	-29.22	-55.59		54.76	T4	
			ANT4	z (Axial)	17.74	-27.06	-55.75	2.00	61.89	T4	-6.45
				y (Transverse)	9.19	-28.49	-55.59		55.28	T4	
802.11b Voice Narrow band AMR Codec: 4.75 kbit/s	1 2412 MHz	CCK 5.5 Mbps	ANT4	z (Axial)	19.37	-28.93	-55.79	1.77	61.50	T4	1.05
				y (Transverse)	9.96	-26.91	-55.66		55.75	T4	
			ANT3	z (Axial)	16.36	-29.43	-55.75	0.97	59.17	T4	
				y (Transverse)	8.43	-28.05	-55.59		**54.70**	T4	
802.11n 20 MHz Voice Narrow band AMR Codec: 4.75 kbit/s	36 5180 MHz	MCS0 6.5 Mbps	ANT6	z (Axial)	17.83	-28.16	-55.79	1.67	61.41	T4	-5.97
				y (Transverse)	8.20	-27.78	-55.66		**52.74**	T4	
			ANT5	z (Axial)	16.38	-31.72	-55.75	0.47	60.83	T4	
				y (Transverse)	8.78	-32.46	-55.59		58.71	T4	

9.2. Codec Investigation

An investigation between the various codec configurations (Low/Mid/High bit rates for Narrowband, Wideband, and EVS) and specific parameters are documented (ABM1, ABM2, S+N/N, frequency response) to determine the worst-case bit rates for each voice service type. The table below compares the varying codec configurations.

A full codec investigation was performed on one LTE FDD and one LTE TDD band; another full codec investigation was performed on one W-CDMA band. Spot checks were then performed on the worst case bit rate from Narrowband, Wideband, and EVS to confirm that there were minimal variations between frequencies/bands.

The highlighted results below were determined to be the worst case codec configuration(s) for LTE and W-CDMA.

Codec Investigation											
Codec State	AMR-NB (kbit/s)			AMR-WB (kbit/s)			EVS (kbit/s)			Orientation	Band/Channel/ Bandwidth
	4.75	7.4	12.2	6.6	15.85	23.85	2.8/5.9	9.6	24.4		
ABM1 (dB/m)	16.40	17.89	16.46	19.93	17.58	18.48				z (Axial)	W-CDMA Band II CH. 9400
ABM2 (dBA/m)	-33.11	-32.89	-30.46	-31.42	-30.35	-33.11					
SNR (dB)	61.42	62.60	61.56	62.78	61.24	62.59					
Freq. Resposne (dB)	1.06	1.71	1.59	2.00	1.99	1.26					
ABM1 (dB/m)	7.83	10.54	11.56	11.15	11.82	12.28				y (Transverse)	W-CDMA Band II CH. 9400
ABM2 (dBA/m)	-33.35	-32.20	-31.23	-28.36	-31.25	-28.94					
SNR (dB)	**55.68**	57.66	58.78	56.65	58.82	59.74					
ABM1 (dB/m)	16.59			19.60						z (Axial)	W-CDMA Band IV CH. 1413
ABM2 (dBA/m)	-29.42			-30.93							
SNR (dB)	59.86			62.34							
Freq. Resposne (dB)	1.94			0.51							
ABM1 (dB/m)	9.13			10.25						y (Transverse)	W-CDMA Band IV CH. 1413
ABM2 (dBA/m)	-29.04			-28.80							
SNR (dB)	56.15			**55.85**							
ABM1 (dB/m)	16.81			18.87						z (Axial)	W-CDMA Band V CH. 4183
ABM2 (dBA/m)	-31.47			-31.68							
SNR (dB)	60.05			62.38							
Freq. Resposne (dB)	2.00			1.96							
ABM1 (dB/m)	8.61			11.23						y (Transverse)	W-CDMA Band V CH. 4183
ABM2 (dBA/m)	-29.28			-29.01							
SNR (dB)	**56.10**			57.35							
ABM1 (dB/m)	19.14			18.65			14.44			z (Axial)	LTE Band 4 CH. 20175 20 MHz BW
ABM2 (dBA/m)	-30.24			-30.04			-28.74				
SNR (dB)	61.64			62.02			58.31				
Freq. Resposne (dB)	1.57			1.93			2.00				
ABM1 (dB/m)	11.42			11.67			8.92			y (Transverse)	LTE Band 4 CH. 20175 20 MHz BW
ABM2 (dBA/m)	-27.27			-27.91			-28.44				
SNR (dB)	57.32			57.26			**55.07**				

Codec Investigation (continued)

Codec Investigation											
Codec State	AMR-NB (kbit/s)			AMR-WB (kbit/s)			EVS (kbit/s)			Orientation	Band/Channel/ Bandwidth
	4.75	7.4	12.2	6.6	15.85	23.85	2.8/5.9	9.6	24.4		
ABM1 (dB/m)	18.70	20.02	19.95	18.65	19.79	20.23	13.40	18.42	20.79	z (Axial)	LTE Band 7 CH. 21100 20 MHz BW
ABM2 (dBA/m)	-31.92	-18.15	-30.29	-30.02	-27.39	-29.85	-29.10	-32.45	-33.15		
SNR (dB)	63.24	59.99	63.85	61.06	62.48	62.36	57.87	64.33	62.42		
Freq. Resposne (dB)	2.00	2.00	1.44	2.00	1.75	1.99	1.74	2.00	2.00		
ABM1 (dB/m)	10.22	11.32	11.87	10.95	11.62	12.09	8.62	12.65	11.63	y (Transverse)	LTE Band 7 CH. 21100 20 MHz BW
ABM2 (dBA/m)	-28.69	-28.82	-27.84	-28.20	-27.84	-27.86	-32.95	-32.30	-30.34		
SNR (dB)	56.22	57.59	57.16	58.25	59.08	59.88	**53.57**	58.09	56.42		
ABM1 (dB/m)	17.97			19.47			15.34			z (Axial)	LTE Band 12 CH. 23095 10 MHz BW
ABM2 (dBA/m)	-27.79			-29.65			-30.54				
SNR (dB)	61.72			61.91			58.27				
Freq. Resposne (dB)	1.73			1.87			2.00				
ABM1 (dB/m)	11.57			11.80			10.05			y (Transverse)	LTE Band 12 CH. 23095 10 MHz BW
ABM2 (dBA/m)	-26.88			-28.11			-28.56				
SNR (dB)	56.93			57.08			**56.06**				
ABM1 (dB/m)	18.11			20.18			13.45			z (Axial)	LTE Band 26 CH. 26865 15 MHz BW
ABM2 (dBA/m)	-26.31			-27.91			-30.69				
SNR (dB)	61.37			62.69			58.23				
Freq. Resposne (dB)	1.98			2.00			1.28				
ABM1 (dB/m)	11.45			11.02			8.12			y (Transverse)	LTE Band 26 CH. 26865 15 MHz BW
ABM2 (dBA/m)	-28.09			-28.09			-28.47				
SNR (dB)	56.33			57.43			**53.73**				
ABM1 (dB/m)	18.83	20.54	20.05	19.63	21.54	19.89	15.86	17.68	17.91	z (Axial)	LTE Band 41 CH. 40620 20 MHz BW
ABM2 (dBA/m)	-23.36	-26.10	-25.21	-25.71	-26.71	-26.86	-23.37	-24.00	-23.07		
SNR (dB)	60.89	62.09	62.33	61.11	63.12	62.20	55.49	58.58	57.66		
Freq. Resposne (dB)	1.04	1.26	1.16	0.86	1.25	0.85	2.00	2.00	2.00		
ABM1 (dB/m)	9.15	11.96	11.67	10.48	11.13	11.55	6.19	7.61	5.35	y (Transverse)	LTE Band 41 CH. 40620 20 MHz BW
ABM2 (dBA/m)	-26.99	-25.91	-25.12	-26.78	-27.06	-26.66	-22.70	-23.01	-23.23		
SNR (dB)	53.61	54.82	53.83	54.00	53.82	54.87	**49.05**	51.15	50.46		

9.3. VoLTE Air Interface Investigation

Using the data from §9.2, further testing was performed on the LTE bands where a complete codec bit rate investigation was performed. The objective of these measurements is to ensure that changing the frequency and modulation, whilst using the worst case codec configuration for that particular band, yields no unexpected variation.

Mode:	Channel and Frequency	Bandwidth (if applicable)	Modulation	Orientation	ABM1 dB(A/m)	ABM2 dB(A/m)	Ambient Noise dB(A/m)	Freq. Response (dB)	ABM SNR (dB)	T-Rating
LTE Band 7 EVS 2.8/5.9 kbit/s	20850 2510 MHz	20 MHz	QPSK	z (Axial)	14.13	-28.65	-55.78	2.00	59.85	T4
				y (Transverse)	9.19	-28.10	-55.52		54.71	T4
	21100 2535 MHz	20 MHz	QPSK	z (Axial)	13.40	-29.10	-55.78	1.74	57.87	T4
				y (Transverse)	8.62	-32.95	-55.52		**53.57**	T4
	21350 2560 MHz	20 MHz	QPSK	z (Axial)	16.45	-31.06	-55.78	1.71	59.60	T4
				y (Transverse)	9.19	-26.65	-55.52		54.64	T4
	21100 2535 MHz	20 MHz	16QAM	z (Axial)	17.12	-30.77	-55.78	1.62	58.18	T4
				y (Transverse)	10.50	-28.45	-55.52		56.05	T4
LTE Band 41 EVS 2.8/5.9 kbit/s	39750 2506 MHz	20 MHz	QPSK	z (Axial)	18.61	-20.58	-28.78	2.00	57.42	T4
				y (Transverse)	12.20	-20.90	-27.23		51.32	T4
	40185 2549.5 MHz	20 MHz	QPSK	z (Axial)	16.05	-22.66	-28.78	1.46	55.68	T4
				y (Transverse)	11.79	-21.98	-27.23		51.81	T4
	40620 2593 MHz	20 MHz	QPSK	z (Axial)	15.86	-23.37	-28.78	2.00	55.49	T4
				y (Transverse)	6.19	-22.70	-27.23		49.05	T4
	41055 2636.5 MHz	20 MHz	QPSK	z (Axial)	15.53	-21.24	-28.78	2.00	58.19	T4
				y (Transverse)	7.68	-22.50	-27.23		51.35	T4
	41490 2680 MHz	20 MHz	QPSK	z (Axial)	14.26	-22.31	-28.78	2.00	56.66	T4
				y (Transverse)	8.59	-22.28	-27.23		**48.83**	T4
	41490 2680 MHz	20 MHz	16QAM	z (Axial)	18.17	-21.85	-28.78	1.91	57.07	T4
				y (Transverse)	9.03	-23.14	-27.23		51.96	T4

9.4. VoWi-Fi Codec Investigation

An investigation between the various codec configurations (NB, WB, and EVS) and specific parameters are documented (ABM1, ABM2, S+N/N, frequency response) to determine the worst-case bit rates for each voice service type. The table below compares the varying codec configurations.

Using the data from §9.2, it has been established that the Low codec configurations for Narrowband, Wideband, and EVS bit rates were the worst case for IP based telephony; thus we limited our investigation to the lowest bit rates for Narrowband, Wideband, and EVS in the U-NII Bands.

Mode	Channel and Frequency	Modulation	Data Rate	Antenna	Orientation	ABM1 dB(A/m)	ABM2 dB(A/m)	Ambient Noise dB(A/m)	Freq. Response (dB)	ABM SNR (dB)	T-Rating
802.11a Voice Wideband AMR Codec: 6.6 kbit/s	36 5180 MHz	BPSK	6 Mbps	ANT6	z (Axial)	16.86	-30.38	-55.79	1.53	62.61	T4
					y (Transverse)	9.40	-30.10	-55.66		53.91	T4
802.11a Voice Narrow band AMR Codec: 4.75 kbit/s	36 5180 MHz	BPSK	6 Mbps	ANT6	z (Axial)	15.02	-30.06	-55.79	1.40	61.07	T4
					y (Transverse)	9.77	-28.90	-55.66		**52.89**	T4
802.11a EVS 2.8/5.9 kbit/s	36 5180 MHz	BPSK	6 Mbps	ANT6	z (Axial)	13.12	-30.47	-55.70	1.38	60.46	T4
					y (Transverse)	8.80	-32.43	-55.55		57.78	T4

9.5. VoWi-Fi Air Interface Investigation

Using the data from §9.4, further testing was performed on the remaining 802.11 modes. The objective of these measurements is to ensure that changing the modulation, bandwidth, and data rate, whilst using the worst case codec configuration measured in §9.4, yields no unexpected variations.

Mode	Channel and Frequency	Modulation	Data Rate	Antenna	Orientation	ABM1 dB(A/m)	ABM2 dB(A/m)	Ambient Noise dB(A/m)	Freq. Response (dB)	ABM SNR (dB)	T-Rating
802.11b Voice Narrow band AMR Codec: 4.75 kbit/s	1 2412 MHz	DSSS	1 Mbps	ANT4	z (Axial)	18.94	-30.37	-55.79	1.83	61.19	T4
					y (Transverse)	10.59	-28.22	-55.66		57.37	T4
802.11b Voice Narrow band AMR Codec: 4.75 kbit/s	1 2412 MHz	CCK	5.5 Mbps	ANT4	z (Axial)	19.37	-28.93	-55.79	1.77	61.50	T4
					y (Transverse)	9.96	-26.91	-55.66		**55.75**	T4
802.11b Voice Narrow band AMR Codec: 4.75 kbit/s	1 2412 MHz	CCK	11 Mbps	ANT4	z (Axial)	18.58	-28.91	-55.79	1.95	61.39	T4
					y (Transverse)	10.75	-27.05	-55.66		55.90	T4
802.11a Voice Narrow band AMR Codec: 4.75 kbit/s	36 5180 MHz	QPSK	18 Mbps	ANT6	z (Axial)	16.33	-29.02	-55.79	1.56	61.53	T4
					y (Transverse)	7.73	-28.02	-55.66		52.85	T4
802.11a Voice Narrow band AMR Codec: 4.75 kbit/s	36 5180 MHz	64QAM	54 Mbps	ANT6	z (Axial)	16.28	-28.96	-55.79	2.00	61.52	T4
					y (Transverse)	9.08	-28.02	-55.66		53.16	T4
802.11n 20 MHz Voice Narrow band AMR Codec: 4.75 kbit/s	36 5180 MHz	MCS0	6.5 Mbps	ANT6	z (Axial)	17.83	-28.16	-55.79	1.67	61.41	T4
					y (Transverse)	8.20	-27.78	-55.66		**52.74**	T4
802.11n 20 MHz Voice Narrow band AMR Codec: 4.75 kbit/s	36 5180 MHz	MCS3	26 Mbps	ANT6	z (Axial)	17.29	-32.50	-55.79	1.62	63.36	T4
					y (Transverse)	9.49	-32.08	-55.66		59.73	T4
802.11n 20 MHz Voice Narrow band AMR Codec: 4.75 kbit/s	36 5180 MHz	MCS7	65 Mbps	ANT6	z (Axial)	16.74	-31.68	-55.79	1.59	63.37	T4
					y (Transverse)	9.69	-31.29	-55.66		59.17	T4
802.11n 40 MHz Voice Narrow band AMR Codec: 4.75 kbit/s	38 5190 MHz	MCS0	6.5 Mbps	ANT6	z (Axial)	17.27	-31.56	-55.79	1.11	63.32	T4
					y (Transverse)	8.83	-31.36	-55.66		58.53	T4
802.11n 40 MHz Voice Narrow band AMR Codec: 4.75 kbit/s	38 5190 MHz	MCS3	26 Mbps	ANT6	z (Axial)	16.44	-31.75	-55.79	2.00	62.11	T4
					y (Transverse)	9.42	-31.77	-55.66		59.07	T4
802.11n 40 MHz Voice Narrow band AMR Codec: 4.75 kbit/s	38 5190 MHz	MCS7	65 Mbps	ANT6	z (Axial)	16.58	-31.69	-55.79	1.61	63.27	T4
					y (Transverse)	10.25	-31.65	-55.66		60.06	T4
802.11n 20 MHz Voice Narrow band AMR Codec: 4.75 kbit/s	48 5240 MHz	MCS0	6.5 Mbps	ANT6	z (Axial)	18.22	-28.04	-55.79	1.69	59.39	T4
					y (Transverse)	11.82	-28.20	-55.66		57.01	T4

Note:

802.11g mode is covered by 802.11a/n mode for having the same data rates.
802.11ac was not investigated as the modulations and bandwidths are covered by the tested modes.

9.6. OTT

The DUT's nested OTT application only supports one (1) codec bit rate, thus no codec investigation is needed.

Mode:	Channel and Frequency	Bandwidth/ Data Rate	Antenna	Orientation	ABM1 dB(A/m)	ABM2 dB(A/m)	Ambient Noise dB(A/m)	Freq. Response (dB)	ABM SNR (dB)	T-Rating	Plot Page #
GSM 850 EDGE 2 Slots FaceTime	190 836.6 MHz	N/A	ANT2	z (Axial)	5.44	-24.65	-55.55	2.00	51.02	T4	1-2
				y (Transverse)	-1.72	-28.74	-55.54		40.26	T4	3
GSM 1900 EDGE 2 Slots FaceTime	661 1880 MHz	N/A	ANT2	z (Axial)	5.53	-25.78	-55.55	2.00	50.27	T4	4-5
				y (Transverse)	-3.80	-26.61	-55.54		40.78	T4	6
W-CDMA Band II HSPA FaceTime	9400 1880 MHz	N/A	ANT2	z (Axial)	5.68	-26.54	-55.55	2.00	49.94	T4	7-8
				y (Transverse)	-3.10	-26.94	-55.54		40.96	T4	9
W-CDMA Band IV HSPA FaceTime	1413 1732.6 MHz	N/A	ANT2	z (Axial)	5.45	-25.50	-54.88	2.00	49.90	T4	10-11
				y (Transverse)	-3.57	-26.91	-55.54		40.23	T4	12
W-CDMA Band V HSPA FaceTime	4183 836.6 MHz	N/A	ANT2	z (Axial)	5.14	-25.77	-54.88	2.00	49.26	T4	13-14
				y (Transverse)	-1.78	-26.86	-55.54		40.09	T4	15
CDMA2000 BC0 Ev-Do Rev 0 FaceTime	384 836.52 MHz	N/A	ANT2	z (Axial)	8.12	-23.41	-55.78	2.00	50.45	T4	16-17
				y (Transverse)	-1.15	-28.05	-55.52		41.43	T4	18
CDMA2000 BC1 Ev-Do Rev 0 FaceTime	600 1880 MHz	N/A	ANT2	z (Axial)	5.30	-24.59	-55.78	2.00	50.70	T4	19-20
				y (Transverse)	-1.52	-28.24	-55.52		41.91	T4	21
CDMA2000 BC10 Ev-Do Rev 0 FaceTime	580 820.5 MHz	N/A	ANT2	z (Axial)	7.98	-24.59	-55.78	2.00	51.86	T4	22-23
				y (Transverse)	-1.51	-29.21	-55.52		42.15	T4	24
LTE Band 7 QPSK FaceTime	21100 2535 MHz	20 MHz	ANT2	z (Axial)	9.68	-23.97	-55.78	2.00	51.48	T4	25-26
				y (Transverse)	-0.93	-27.85	-55.52		42.37	T4	27
LTE Band 41 QPSK FaceTime	40620 2593 MHz	20 MHz	ANT2	z (Axial)	9.87	-23.11	-55.78	2.00	51.35	T4	28-29
				y (Transverse)	1.30	-25.67	-55.52		42.62	T4	30
802.11b FaceTime	1 2412 MHz	Dynamic OFDM-CCK 5.5 Mbps	ANT4	z (Axial)	5.42	-31.98	-55.70	2.00	50.35	T4	31-32
				y (Transverse)	-1.07	-32.49	-55.38		44.82	T4	33
802.11n 20 MHz FaceTime	36 5180 MHz	MCS0	ANT6	z (Axial)	7.54	-19.48	-55.70	2.00	50.30	T4	34-35
				y (Transverse)	-0.94	-24.03	-55.38		**38.61**	T4	36
802.11n 20 MHz FaceTime	52 5260 MHz	MCS0	ANT6	z (Axial)	5.79	-19.88	-55.70	2.00	50.48	T4	37-38
				y (Transverse)	-0.15	-24.17	-55.38		40.40	T4	39
802.11n 20 MHz FaceTime	100 5500 MHz	MCS0	ANT6	z (Axial)	6.05	-19.87	-55.70	2.00	50.12	T4	40-41
				y (Transverse)	-0.62	-24.29	-55.38		39.40	T4	42
802.11n 20 MHz FaceTime	149 5745 MHz	MCS0	ANT6	z (Axial)	6.09	-21.73	-55.70	2.00	50.43	T4	43-44
				y (Transverse)	-0.64	-26.14	-55.38		40.93	T4	45

9.7. Summary of HAC (T-coil) Test Results

Mode:	Channel and Frequency	Bandwidth/ Modulation/ Data Rate	Antenna	Orientation	ABM1 dB(A/m)	ABM2 dB(A/m)	Ambient Noise dB(A/m)	Freq. Response (dB)	ABM SNR (dB)	T-Rating	Plot Page #
GSM 850 Voice Coder Speechcodec Low	190 836.6 MHz	N/A	ANT2	z (Axial)	16.44	-15.60	-41.82	1.74	52.05	T4	1-2
				y (Transverse)	9.68	-15.09	-49.65		45.42	T4	3
GSM 1900 Voice Coder Speechcodec Low	661 1880 MHz	N/A	ANT2	z (Axial)	17.59	-15.11	-41.82	1.70	53.31	T4	4-5
				y (Transverse)	9.88	-14.61	-49.65		45.41	T4	6
W-CDMA Band II Voice Narrow band AMR Codec: 4.75 kbit/s	9400 1880 MHz	N/A	ANT2	z (Axial)	16.40	-33.11	-28.78	1.06	61.42	T4	7-8
				y (Transverse)	7.83	-33.35	-27.23		55.68	T4	9
W-CDMA Band IV Voice Wideband AMR Codec: 6.6 kbit/s	1413 1732.6 MHz	N/A	ANT2	z (Axial)	19.60	-30.93	-41.82	0.51	62.34	T4	10-11
				y (Transverse)	10.25	-28.80	-49.65		55.85	T4	12
W-CDMA Band V Voice Narrow band AMR Codec: 4.75 kbit/s	4183 836.6 MHz	N/A	ANT2	z (Axial)	16.81	-31.47	-28.78	2.00	60.05	T4	13-14
				y (Transverse)	8.61	-29.28	-27.23		56.10	T4	15
CDMA2000 BC0 RC1 / SO3 1/8 FR Voice Coder: 8K EVRC Low	384 836.52 MHz	N/A	ANT2	z (Axial)	18.72	-31.67	-41.82	2.00	63.79	T4	16-17
				y (Transverse)	11.47	-32.09	-49.65		58.86	T4	18
CDMA2000 BC1 RC1 / SO3 1/8 FR Voice Coder: 8K EVRC Low	600 1880 MHz	N/A	ANT2	z (Axial)	17.50	-31.80	-41.82	1.83	63.24	T4	19-20
				y (Transverse)	11.54	-32.53	-49.65		58.78	T4	21
CDMA2000 BC10 RC1 / SO3 1/8 FR Voice Coder: 8K EVRC Low	580 820.5 MHz	N/A	ANT2	z (Axial)	17.70	-29.66	-55.59	2.00	60.65	T4	22-23
				y (Transverse)	10.58	-27.96	-55.47		55.08	T4	24
LTE Band 4 EVS 2.8/5.9 kbit/s	20175 1732.5 MHz	20 MHz	ANT2	z (Axial)	14.44	-28.74	-55.78	2.00	58.31	T4	25-26
				y (Transverse)	8.92	-28.44	-55.52		55.07	T4	27

Note:

The radial longitudinal (x axis) measurements are no longer required per ANSI C63.19

Summary of HAC (T-coil) Test Results (continued)

Mode:	Channel and Frequency	Bandwidth/ Modulation/ Data Rate	Antenna	Orientation	ABM1 dB(A/m)	ABM2 dB(A/m)	Ambient Noise dB(A/m)	Freq. Response (dB)	ABM SNR (dB)	T-Rating	Plot Page #
LTE Band 7 EVS 2.8/5.9 kbit/s	21100 2535 MHz	20 MHz	ANT2	z (Axial)	13.40	-29.10	-55.78	1.74	57.87	T4	28-29
				y (Transverse)	8.62	-32.95	-55.52		53.57	T4	30
LTE Band 12 EVS 2.8/5.9 kbit/s	23095 707.5 MHz	10 MHz	ANT2	z (Axial)	15.34	-30.54	-55.78	2.00	58.27	T4	31-32
				y (Transverse)	10.05	-28.56	-55.52		56.06	T4	33
LTE Band 26 EVS 2.8/5.9 kbit/s	26865 831.5 MHz	15 MHz	ANT2	z (Axial)	13.45	-30.69	-55.78	1.28	58.23	T4	34-35
				y (Transverse)	8.12	-28.47	-55.52		53.73	T4	36
LTE Band 41 EVS 2.8/5.9 kbit/s	41490 2680 MHz	20 MHz	ANT2	z (Axial)	14.26	-22.31	-28.78	2.00	56.66	T4	37-38
				y (Transverse)	8.59	-22.28	-27.23		48.83	T4	39
802.11b Voice Narrow band AMR Codec: 4.75 kbit/s	1 2412 MHz	CCK 5.5 Mbps	ANT4	z (Axial)	19.37	-28.93	-55.79	1.77	61.50	T4	40-41
				y (Transverse)	9.96	-26.91	-55.66		55.75	T4	42
802.11n 20 MHz Voice Narrow band AMR Codec: 4.75 kbit/s	36 5180 MHz	MCS0 6.5 Mbps	ANT6	z (Axial)	17.83	-28.16	-55.79	1.67	61.41	T4	43-44
				y (Transverse)	8.20	-27.78	-55.66		52.74	T4	45
802.11n 20 MHz Voice Narrow band AMR Codec: 4.75 kbit/s	52 5260 MHz	MCS0 6.5 Mbps	ANT6	z (Axial)	17.72	-31.51	-55.79	1.70	61.37	T4	46-47
				y (Transverse)	9.69	-28.53	-55.66		56.71	T4	48
802.11n 20 MHz Voice Narrow band AMR Codec: 4.75 kbit/s	100 5500 MHz	MCS0 6.5 Mbps	ANT6	z (Axial)	17.15	-24.37	-55.79	2.00	61.66	T4	49-50
				y (Transverse)	10.41	-28.78	-55.66		56.56	T4	51
802.11n 20 MHz Voice Narrow band AMR Codec: 4.75 kbit/s	149 5745 MHz	MCS0 6.5 Mbps	ANT6	z (Axial)	18.59	-31.47	-55.79	0.95	61.68	T4	52-53
				y (Transverse)	10.23	-28.65	-55.66		56.39	T4	54

Note:

The radial longitudinal (x axis) measurements are no longer required per ANSI C63.19

9.8. Worst Case T-Coil Test Plot

Test Laboratory: UL Verification Services Inc., SAR Lab 2 Date: 6/25/2018

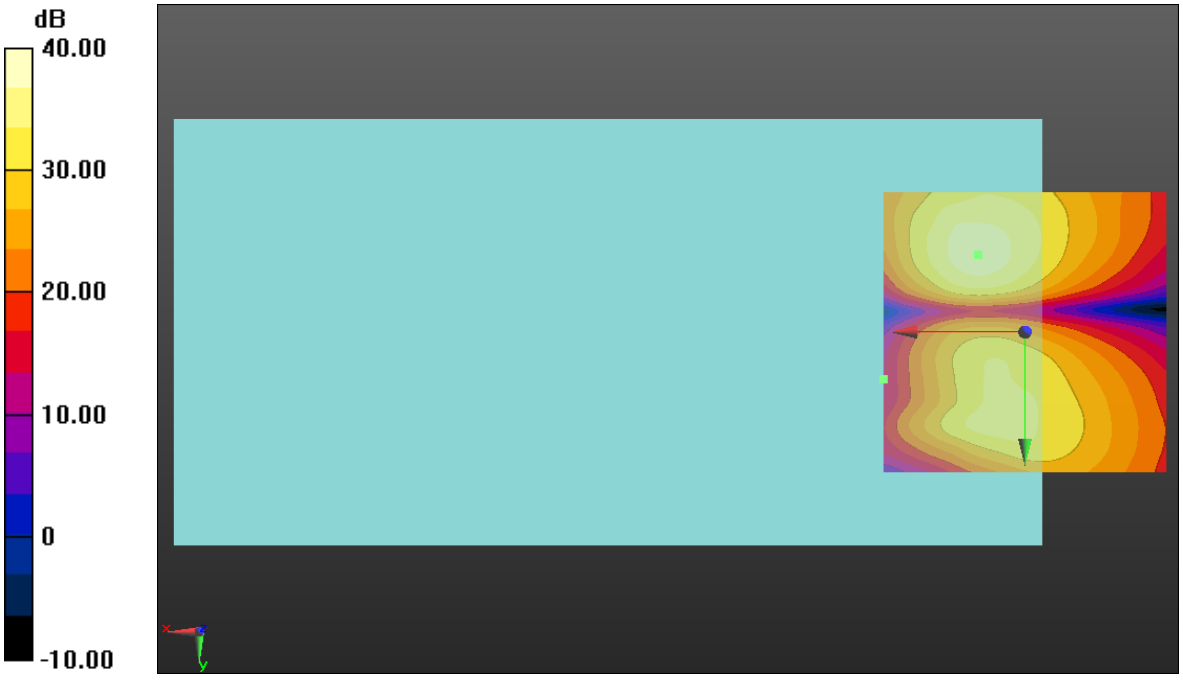
802.11n_ac 20

Communication System: UID 0, IEEE 802.11a/n/ac 5 GHz Band (0); Frequency: 5180 MHz; Duty Cycle: 1:1
Phantom section: TCoil Section
DASY5 Configuration:
- Probe: AM1DV3 - 3092; ; Calibrated: 7/20/2017
- Sensor-Surface: 0mm (Fix Surface)
- Electronics: DAE4 Sn1357; Calibrated: 2/8/2018
- Phantom: HAC Test Arch with AMCC; Type: SD HAC P01 BB
- Measurement SW: DASY52, Version 52.10 (0);SEMCAD X Version 14.6.10 (7417)

T-Coil scan (scan for ANSI C63.19 2011 compliance)/802.11n HT 20 MC0 ch 36/y (transversal) 4.2mm 50 x 50/ABM Interpolated SNR(x,y,z) (121x121x1): Interpolated grid:

dx=1.000 mm, dy=1.000 mm
Signal Type: Audio File (.wav) 48k_voice_1kHz_1s.wav
Output Gain: 30.62
Measure Window Start: 300ms
Measure Window Length: 1000ms
BWC applied: 0.16 dB
Device Reference Point: 0, 0, -6.3 mm

Cursor:
ABM1/ABM2 = 38.61 dB
ABM1 comp = -0.94 dBA/m
BWC Factor = 0.16 dB
Location: 8.3, -13.8, 3.7 mm
ABM2 = -24.03 dBA/m
Location: 25, 8.3, 3.7 mm



0 dB = 1.000 = 0.00 dB

Appendix

Refer to separated files for the following appendixes

12124122-S2V2 Appendix A: HAC T-Coil Setup Photo

12124122-S2V2 Appendix B: Frequency Response & SNR Test Plots (OTT)

12124122-S2V2 Appendix C: Frequency Response & SNR Test Plots (T-coil)

12124122-S2V2 Appendix D: HAC T-Coil Probe Calibration Certificates

END OF REPORT