

PCTEST

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HEARING AID COMPATIBILITY

Applicant Name:

Samsung Electronics Co., Ltd. 129, Samsung-ro, Maetan dong, Yeongtong-gu, Suwon-si Gyeonggi-do 16677, Korea Date of Testing: 1/25/2021 - 2/4/2021 Test Site/Location: PCTEST, Columbia, MD, USA Test Report Serial No.: 1M2101040001-19-R1.A3L Date of Issue: 3/3/2021

FCC ID: A3LSMA426U

APPLICANT: SAMSUNG ELECTRONICS CO., LTD.

Scope of Test: Audio Band Magnetic Testing (T-Coil)

Application Type: Certification
FCC Rule Part(s): CFR §20.19(b)
HAC Standard: ANSI C63.19-2011

CTIA Test Plan for Hearing Aid Compatibility Rev 3.1.1, May 2017

285076 D01 HAC Guidance v05

285076 D02 T-Coil testing for CMRS IP v03

DUT Type: Portable Handset

Model: SM-A426U

Additional Model(s): SM-A426U1/DS, SM-S426DL, SM-A426U1 Test Device Serial No.: Pre-Production Sample [S/N: 13334]

C63.19-2011 HAC Category: T3 (SIGNAL TO NOISE CATEGORY)

Note: This revised Test Report (S/N: 1M2101040001-19-R1.A3L) supersedes and replaces the previously issued test report on the same subject device for the same type of testing as indicated. Please discard or destroy the previously issued test report(s) and dispose of it accordingly.

This wireless portable device has been shown to be hearing-aid compatible under the above rated category, specified in ANSI/IEEE Std. C63.19-2011 and has been tested in accordance with the specified measurement procedures. Test results reported herein relate only to the item(s) tested. Hearing-Aid Compatibility is based on the assumption that all production units will be designed electrically identical to the device tested in this report. North American Bands only.

I attest to the accuracy of data. All measurements reported herein were performed by me or were made under my supervision and are correct to the best of my knowledge and belief. I assume full responsibility for the completeness of these measurements and vouch for the qualifications of all persons taking them.





Authorized Test Lab





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1. INTRODUCTION

On July 10, 2003, the Federal Communications Commission (FCC) adopted new rules requiring wireless manufacturers and service providers to provide digital wireless phones that are compatible with hearing aids. The FCC has modified the exemption for wireless phones under the Hearing Aid Compatibility Act of 1998 (HAC Act) in WT Docket 01-309 RM-86581 to extend the benefits of wireless telecommunications to individuals with hearing disabilities. These benefits encompass business, social and emergency communications, which increase the value of the wireless network for everyone. An estimated more than 10% of the population in the United States show signs of hearing impairment and of that fraction, almost 80% use hearing aids. Approximately 500 million people worldwide and 30 million people in the United States suffer from hearing loss.

Compatibility Tests Involved:

The standard calls for wireless communications devices to be measured for:

- RF Electric-field emissions
- T-coil mode, magnetic-signal strength in the audio band
- T-coil mode, magnetic-signal frequency response through the audio band
- T-coil mode, magnetic-signal and noise articulation index

The hearing aid must be measured for:

- RF immunity in microphone mode
- RF immunity in T-coil mode

In the following tests and results, this report includes the evaluation for a wireless communications device.



Figure 1-1 Hearing Aid in-vitu

¹ FCC Rule & Order, WT Docket 01-309 RM-8658

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2. DUT DESCRIPTION



FCC ID: A3LSMA426U

Applicant: Samsung Electronics Co., Ltd.

129, Samsung-ro, Maetan dong,

Yeongtong-gu, Suwon-si Gyeonggi-do 16677, Korea

Model: SM-A426U

Additional Model(s): SM-A426U1/DS, SM-S426DL, SM-A426U1

Serial Number: 13334 HW Version: Rev.1.0

SW Version: A426USQU0AUA7
Antenna: Internal Antenna
DUT Type: Portable Handset

I. LTE Band Selection

This device supports the following pair of LTE bands with similar frequencies: LTE B66 & B4. LTE B66 has a higher target power thank B4 and shares the same transmission path. Since the supported frequency span for the smaller LTE band is completely covered by the larger LTE band, only the larger LTE band (LTE B66) was evaluated for hearing-aid compliance. LTE B5 and B2 are LTE anchor bands for dual connectivity (EN-DC) scenarios between LTE and NR so they were additionally evaluated as independent LTE bands.

II. NR Band Selection

This device supports the following pair of NR bands with similar frequencies: NR n2 & n25. This pair of NR bands has the same target power and shares the same transmission path. Since the supported frequency span for the smaller NR band is completely covered by the larger NR band, only the larger NR band (NR n25) was evaluated for hearing-aid compliance.

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Table 2-1 A3LSMA426U HAC Air Interfaces

Air-Interface	Band (MHz)	Туре Transport	HAC Tested	Simultaneous But Not Tested	Name of Voice Service	Audio Codec Evaluated
	835	VO	Yes	Yes: WIFI or BT	CMRS Voice ¹	EVRC
CDMA	1900			res. will of bi		
	EvDO	VD	Yes	Yes: WIFI or BT	Google Duo ²	OPUS
CCM	850	vo	Yes	Yes: WIFI or BT	CMRS Voice ¹	EFR
GSM	1900 GPRS/EDGE	VD	Yes	Yes: WIFI or BT	Google Duo ²	OPUS
	850	VD	res	Tes. WIFI OF BT	Google Duo	OF03
	1700	VD	Yes	Yes: WIFI or BT	CMRS Voice ¹	NB AMR
UMTS	1900					
	HSPA	VD	Yes	Yes: WIFI or BT	Google Duo ²	OPUS
	680 (B71)		Yes³			
	700 (B12)					
	780 (B13)					
	790 (B14)					Volte: NB AMR, WB AMR, EVS
	850 (B5)					
LTE (FDD)	850 (B26)	VD		Yes: WIFI or BT	VoLTE ¹ , Google Duo ²	
	1700 (B4)		Yes			Google Duo: OPUS
	1700 (B66)					
	1900 (B2) 1900 (B25)					
	2300 (B30)					
	2500 (B30) 2500 (B7)					
	2600 (B41)					Volte: NB AMR, WB AMR, EVS
LTE (TDD)	3600 (B48)	VD	Yes	Yes: WIFI or BT	VoLTE ¹ , Google Duo ²	Google Duo: OPUS
	680 (n71)		Yes ^{3,4}			
	850 (n5)					
NR (FDD)	1700 (n66)	VD	v. 4	Yes: WIFI or BT	Google Duo ²	OPUS
	1900 (n2)		Yes⁴			
	1900 (n25)					
	2600 (n41)		Yes ⁴			
NR (TDD)	3700 (n77)	VD		Yes: WIFI or BT	Google Duo ²	OPUS
` '	28000 (n261)		No ⁵			
	39000 (n260)					
	2450					
14/151	5200 (U-NII 1) 5300 (U-NII 2A)		V	Very COMA, COM LIMITS LITE on NO.	VoWIFI: NB AM	VoWIFI: NB AMR, WB AMR, EVS
WIFI	5500 (U-NII 2C)	VD	Yes	Yes: CDMA, GSM, UMTS, LTE, or NR	VoWIFI ² , Google Duo ²	Google Duo: OPUS
	5800 (U-NII 3)					
BT	2450	DT	No	Yes: CDMA, GSM, UMTS, LTE, or NR	N/A	N/A
Type Transport VO = Voice Only DT = Digital Dat		Voice Services	Notes: 1. Reference le 2. Reference le 3. LTE B71 and existing HAC p 4. NR was eval	evel in accordance with 7.4.2.1 of ANSI C63.19-20 evel is -20dBm0 in accordance with FCC KDB 285C I NR n71, while outside the scope of ANSI C63.19 rocedures with currently available test equipme luated using an interim procedure outlined in Se 261 are currently outside the scope of ANSI C63.	11 and July 2012 C63 VoLTE Interpret 176 D02 and FCC HAC regulations, were addi nt. ction 7.II.5.	tation.

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3. ANSI C63.19-2011 PERFORMANCE CATEGORIES

I. MAGNETIC COUPLING

Axial and Radial Field Intensity

All orientations of the magnetic field, in the axial and radial position along the measurement plane shall be \geq -18 dB(A/m) at 1 kHz in a 1/3 octave band filter per §8.3.1.

Frequency Response

The frequency response of the axial component of the magnetic field shall follow the response curve specified in EIA RS-504-1983, over the frequency range 300 Hz – 3000 Hz per §8.3.2.

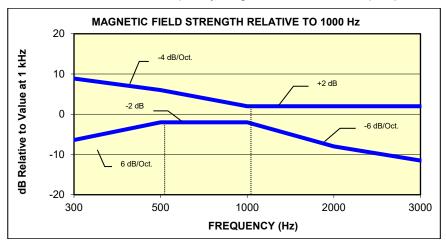


Figure 3-1
Magnetic field frequency response for Wireless Devices with an axial field ≤-15 dB(A/m) at 1 kHz

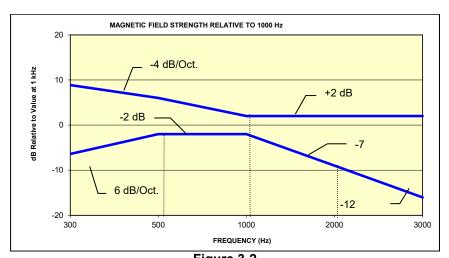


Figure 3-2
Magnetic Field frequency response for wireless devices with an axial field that exceeds
-15 dB(A/m) at 1 kHz

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Signal Quality

The table below provides the signal quality requirement for the intended audio magnetic signal from a wireless device. 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. The only criterion that can be measured is the RF immunity in T-coil mode. This is measured using the same procedure as the audio coupling mode at the same levels.

The signal quality of the axial and radial components of the magnetic field was used to determine the T-coil mode category.

Catagony	Telephone RF Parameters			
Category	Wireless Device Signal Quality [(Signal + Noise)-to-noise ratio in dB]			
T1	0 to 10 dB			
T2	10 to 20 dB			
Т3	20 to 30 dB			
T4	> 30 dB			
Table 3-1 Magnetic Coupling Parameters				

Note: The FCC limit for SNNR is 20dB and the test data margins will indicate a margin from the FCC limit for compliance.

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4. METHOD OF MEASUREMENT

I. Test Setup

The equipment was connected as shown in an acoustic/RF hemi-anechoic chamber:

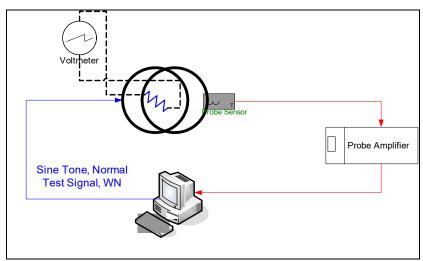


Figure 4-1
Validation Setup with Helmholtz Coil

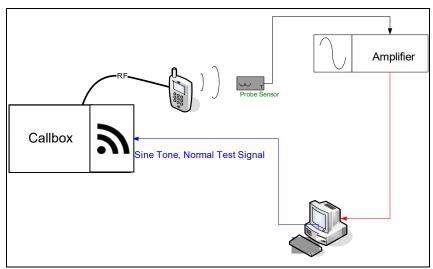


Figure 4-2 T-Coil Test Setup

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II. **Scanning Mechanism**

Manufacturer: TEM

Accuracy: ± 0.83 cm/meter

Minimum Step Size: 0.1 mm Maximum speed 6.1 cm/sec Line Voltage: 115 VAC Line Frequency: 60 Hz

Material Composite: Delrin (Acetal) Data Control: Parallel Port

45 x 31.75 x 47 cm Dynamic Range (X-Y-Z):

36" x 25" x 38" Dimensions: 36" x 49" x 55" Operating Area:

Reflections: < -20 dB (in anechoic chamber)

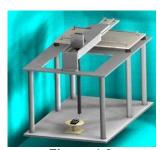


Figure 4-3 RF Near-Field Scanner

III. **3GPP2 Normal Test Signal (Speech)**

Manufacturer: 3GPP2 (TIA 1042 §3.3.1)

Modified-IRS weighted, multi-talker speech signal, 4 Male and 4

Stimulus Type: Female speakers (alternating)

Single Sample Duration: 51.62 seconds

Activity Level: 77.4%

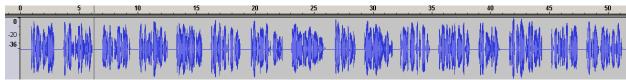
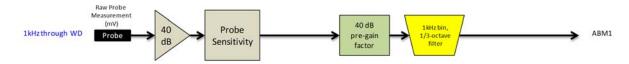


Figure 4-4 **Temporal Characteristic of Normal Test Signal**

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ABM2 Measurement Block Diagram:



Figure 4-5 Magnetic Measurement Processing Steps

IV. **Test Procedure**

- 1. Ambient Noise Check per C63.19 §7.3.1
 - Ambient interference was monitored using a Real-Time Analyzer between 100-10,000 Hz with 1/3 octave filtering.
 - "A-weighting" and Half-Band Integration was applied to the measurements.
 - Since this measurement was measured in the same method as ABM2 measurements, this level was verified to be more than 10 dB below the lowest measurement signal (which is the highest ABM2 measurement for a T4 WD). Therefore the maximum noise level for a T4 WD with an ABM1 = -18 dBA/m is:

- 2. Measurement System Validation (See Figure 4-1)
 - a. The measurement system including the probe, pre-amplifier and acquisition system were validated as an entire system to ensure the reliability of test measurements.
 - b. ABM1 Validation

The magnetic field at the center of the Helmholtz coil is given by the equation (per C63.19 Annex D.10.1):

$$H_c = \frac{NI}{r\sqrt{1.25^3}} = \frac{N(\frac{V}{R})}{r\sqrt{1.25^3}}$$

Where H_c = magnetic field strength in amperes per meter N = number of turns per coil

For the Helmholtz Coil, N=20; r=0.08m; R=10.2Ω and using V=18mV:

$$H_c = \frac{20 \cdot (\frac{0.018}{10.2})}{0.08 \cdot \sqrt{1.25^3}} = 0.316A/m \approx -10dB(A/m)$$

Therefore a pure tone of 1kHz was applied into the coils such that 18mV was observed across the resistor. The voltmeter used for measurement was verified to be capable of measurements in the audio band range. This theoretically generates an expected field of -10 dB(A/m) in the center of the Helmholtz coil which was used to validate the probe measurement at -10dB(A/m). This was verified to be within ± 0.5 dB of the -10dB(A/m) value (see Page 47 and 47).

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Frequency Response Validation
 The frequency response through the Helmholtz Coil was verified to be within 0.5 dB relative to 1kHz, between 300 – 3000 Hz using the Normal signal as shown below:



Figure 4-6 Frequency Response Validation

d. ABM2 Measurement Validation

WD noise measurements are filtered with A-weighting and Half-Band Integration over a frequency range of 100Hz – 10kHz to process ABM2 measurements. Below is the verification of the system processing A-weighting and Half-Band integration between system input to output within 0.5 dB of the theoretical result:

Table 4-1
ABM2 Frequency Response Validation

	HBI, A -	HBI, A -	
f (Hz)	Measured	Theoretical	dB Var.
	(dB re 1kHz)	(dB re 1kHz)	
100	-16.180	-16.170	-0.010
125	-13.257	-13.250	-0.007
160	-10.347	-10.340	-0.007
200	-8.017	-8.010	-0.007
250	-5.925	-5.920	-0.005
315	-4.045	-4.040	-0.005
400	-2.405	-2.400	-0.005
500	-1.212	-1.210	-0.002
630	-0.349	-0.350	0.001
800	0.071	0.070	0.001
1000	0.000	0.000	0.000
1250	-0.503	-0.500	-0.003
1600	-1.513	-1.510	-0.003
2000	-2.778	-2.780	0.002
2500	-4.316	-4.320	0.004
3150	-6.166	-6.170	0.004
4000	-8.322	-8.330	0.008
5000	-10.573	-10.590	0.017
6300	-13.178	-13.200	0.022
8000	-16.241	-16.270	0.029
10000	-19.495	-19.520	0.025

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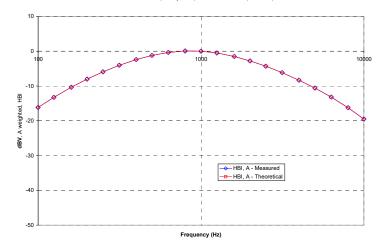
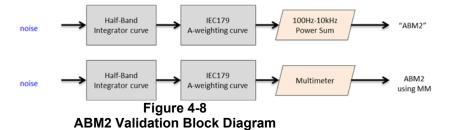


Figure 4-7
ABM2 Frequency Response Validation

The ABM2 result is a power sum from 100Hz to 10kHz with half-band integration and A-weighting. To verify the power sum measurement, a power sum over the full band was measured and verified to track with the source level (See Figure 4-8). Therefore the setup in this step was used to verify the power sum post-processing for ABM2 measurements. See below block diagram:



The power summed output results for a known input were compared to the multi-meter results to verify any deviation in the post-processing implemented with the power-sum.

Table 4-2
ABM2 Power Sum Validation

WN Input (dBV)	Power Sum (dBV)	Multimeter-Full (dBV)	Dev (dB)
-60	-60.36	-60.2	0.16
-50	-50.19	-50.13	0.06
-40	-40.14	-40.03	0.11
-30	-30.13	-30.01	0.12
-20	-20.12	-20	0.12
-10	-10.14	-10	0.14

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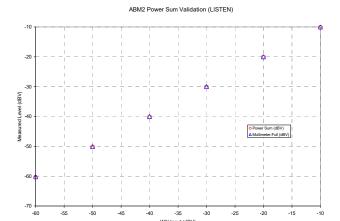
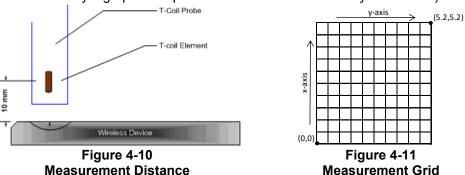


Figure 4-9 **ABM2 Power Sum Validation**

- 3. Measurement Test Setup
 - a. Fine scan above the WD (TEM)
 - i. A multitone signal was applied to the handset such that the phone acoustic output was stable within 1dB over the probe settling time and with the acoustic output level at the C63.19 specified levels (below). The measurement step size was in 2 mm increments at a distance of 10 mm between the surface of the wireless device as shown below (note that in Figure 4-11, the grid is not to scale but merely a graphical representation of the coordinate system in use):



- ii. After scanning, the planar field maximum point was determined. The position of the probe was moved to this location to setup the test using the SoundCheck system.
- iii. These steps were repeated for all T-coil orientations (axial and radial) per Figure 4-13 after a T-coil orientation was fully measured with the SoundCheck system.
- b. Speech Signal Setup to Base Station Simulator
 - i. C63.19 Table 7-1 states audio reference input levels for various technologies:

Standard	Technology	Input Level (dBm0)
TIA/EIA/IS-2000	CDMA	-18
J-STD-007	GSM (217)	-16
T1/T1P1/3GPP	UMTS (WCDMA)	-16
iDEN TM	TDMA (22 and 11 Hz)	-18

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- ii. See Section 5 and 6 for more information regarding CMW500 audio level settings for Voice Over LTE (VoLTE), and Voice Over WIFI (VoWIFI) testing.
- iii. See Section 7 for more information regarding audio level settings for Over-The-Top (OTT) Voice Over IP (VoIP) Testing.
- c. Real-Time Analyzer (RTA)
 - i. The Real-Time Analyzer was configured to analyze measurements using 1/3 Octave band weighted filtering.
- d. WD Radio Configuration Selection
 - i. The device was chosen to be tested in the worst-case ABM2 condition (See Section 8 for more information regarding worst-case configurations for CDMA and UMTS. LTE configuration information can be found in Section 5 and 7. NR configuration information can be found in Section 7. WIFI configuration information can be found in Section 6 and 7.)
 - ii. Supported GSM vocoders were investigated for the worst-case ABM2 condition. GSM-EFR was deemed the worst-case condition for the GSM air interface.
- 4. Signal Quality Data Analysis
 - a. Narrow-band Magnetic Intensity
 - i. The standard specifies a 1kHz 1/3 octave band minimum field intensity for a sine tone. The ABM1 measurements were evaluated at 1kHz with 1/3 octave band filtering over an averaged period of 10 seconds.
 - b. Frequency Response
 - i. The appropriate frequency response curve was measured to curves in Figure 3-1 or Figure 3-2 between 300 3000 Hz using digital linear averaging (limit lines chosen according to measurement found in step 4a). A linear average over 3x the length of the artificial voice signal (3x sampling) was performed. A 10 second delay was configured in the measurement process of the stimulus to ensure handset vocoder latency effects and echo cancellation devices (if any) were appropriately stabilized during measurements.
 - ii. The appropriate post-processing was applied according to the system processing chain illustrated in Figure 4-6. All R10 frequencies were plotted with respect to 0dB at 1kHz value and aligned with respect to the EIA-504 mask.
 - iii. The margin is represented by the closest measured data point on the curve to the EIA-504 limit lines, in dB.
 - c. Signal Quality Index
 - i. Ensuring the WD was at maximum RF power, maximum volume, backlight off, display on, maximum contrast setting, keypad lights on (when possible) with no audio signal through the vocoder, the WD was measured over at least 100 Hz 10,000 Hz, maximized over 5 seconds with a 50ms sample time for the ABM2 measurement (5 second time period is used in noise measurements under standards such as IEEE 269, etc.).
 - ii. After applying half-band integration and A-weighting to the result, a power sum was applied over each 1/3 octave bandwidth frequency for an ABM2 value.
 - iii. This result was subtracted from the ABM1 result in step a, to obtain the Signal Quality.

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V. Test Setup

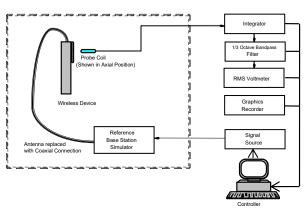


Figure 4-12
Audio Magnetic Field Test Setup

Environmental conditions such as temperature and relative humidity are monitored to ensure there are no impacts on system specifications. Proper voltage and power line frequency conditions are maintained with three phase power sources. Environmental noise and reflections are monitored through system checks.

VI. Deviation from C63.19 Test Procedure

Non-conducted RF connection due to inaccessible RF ports.

VII. Air Interface Technologies Tested

All air interfaces which support voice capabilities over a managed CMRS or pre-installed OTT VoIP applications were tested for T-coil unless otherwise noted. See Table 2-1 for more details regarding which modes were tested.

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VIII. Wireless Device Channels and Frequencies

1. 2G/3G Modes

The frequencies listed in the table below are those that lie in the center of the bands used for cellular telephony. Low, middle and high channels were tested in each band for FCC compliance evaluation to ensure the maximum emission is captured across the entire band. Only middle channels were evaluated for data modes.

Table 4-3
Center Channels and Frequencies

Ochter Onamiels and Frequencies				
Test frequencies & associated channels				
Channel	Frequency (MHz)			
Secondary Cellular 8	20			
564 (CDMA)	820.10			
Cellular 850				
384 (CDMA)	836.52			
190 (GSM)	836.60			
4183 (UMTS)	836.60			
AWS 1750				
1412 (UMTS)	1730.40			
PCS 1900				
600 (CDMA)	1880			
661 (GSM)	1880			
9400 (UMTS)	1880			

2. 4G (LTE) Modes

The middle channel for every band and bandwidth combination was tested for each probe orientation. The band and bandwidth combination from each probe orientation resulting in the worst-case SNNR was additionally tested using low and high channels for that band and bandwidth combination. Low-mid and mid-high channels are additionally tested for LTE TDD. The middle channel and supported bandwidths from the worst-case bands according to Tables 7-6 and 7-7 were additionally evaluated with OTT VoIP for each probe orientation. See Tables 9-5 to 9-17 and 9-25 to 9-26 for LTE bandwidths and channels.

3. 5G (NR) Modes

The middle channel and supported bandwidths from the worst-case NR FDD band according to Table 7-12 was evaluated with OTT VoIP for each probe orientation. NR TDD was additionally evaluated with OTT VoIP for each probe orientation according to the worst case from Table 7-13. The band and bandwidth combination from each probe orientation resulting in the worst-case SNNR was additionally tested using low and high channels for that band and bandwidth combination. Low-mid and mid-high channels are additionally tested for NR TDD. See Tables 9-27 and 9-29 for NR bandwidths and channels.

4. WIFI

The middle channel for each IEEE 802.11 standard was tested for each probe orientation. The 2.4GHz IEEE 802.11 standard from each probe orientation resulting in the worst-case SNNR was additionally tested using low and high channels. The 5GHz IEEE 802.11 standard from each probe orientation resulting in the worst-case SNNR was additionally tested on higher U-NII bands as well as applicable low and high channels. See Tables 9-18 to 9-21 and 9-31 to 9-34 for WIFI standards and channels.

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IX. **Test Flow**

The flow diagram below was followed (From C63.19):

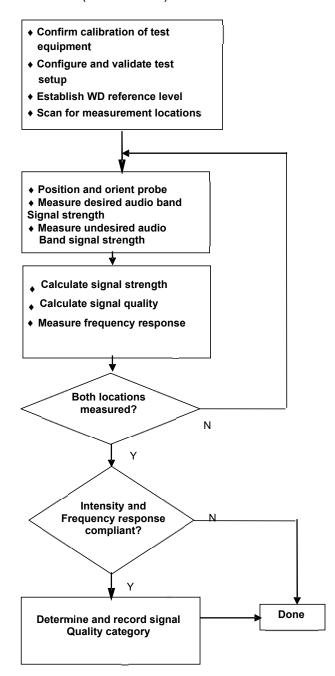


Figure 4-13 C63.19 T-Coil Signal Test Process

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5. VOLTE TEST SYSTEM SETUP AND DUT CONFIGURATION

I. Test System Setup for VoLTE over IMS T-coil Testing

1. Equipment Setup

The general test setup used for VoLTE over IMS is shown below. The callbox used when performing VoLTE over IMS T-coil measurements is a CMW500. The Data Application Unit (DAU) of the CMW500 was used to simulate the IP Multimedia Subsystem (IMS) server.

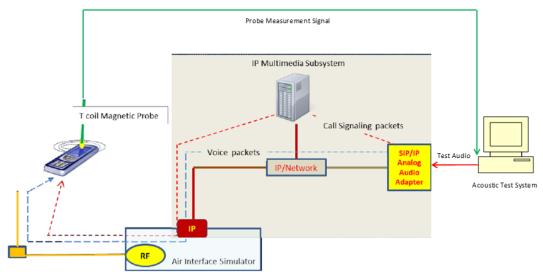


Figure 5-1
Test Setup for VoLTE over IMS T-Coil Measurements

2. Audio Level Settings

According to the July 2012 interpretations by the C63 Committee regarding the appropriate audio levels to be used for VoLTE over IMS T-coil testing, -16dBm0 shall be used for the normal speech input level*. The CMW500 base station simulator was manually configured to ensure that the settings for speech input and full scale levels resulted in the -16dBm0 speech input level to the DUT for the VoLTE over IMS connection.

* http://c63.org/documents/misc/posting/new_interpretations.htm

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II. **DUT Configuration for VoLTE over IMS T-coil Testing**

1. Radio Configuration

An investigation was performed to determine the modulation and RB configuration to be used for testing. The effects of modulation and RB configuration were found to be independent of band and bandwidth; therefore, only one band and bandwidth were used for this investigation. 16QAM, 1RB, 99%RB offset was used for the testing as the worst-case configuration for the handset. See below table for SNNR comparison between different radio configurations:

> Table 5-1 **VoLTE over IMS SNNR by Radio Configuration**

	VOLTE OVER INIO SHAND BY RADIO COINIGUIATION											
Band	Frequency [MHz]	Channel	Bandwidth [MHz]	Modulation	RB Size	RB Offset	ABM1 [dB(A/m)]	ABM2 [dB(A/m)]	SNNR [dB]			
66	1745.0	132322	20	QPSK	1	0	-1.97	-46.83	44.86			
66	1745.0	132322	20	QPSK	1	50	-2.00	-47.07	45.07			
66	1745.0	132322	20	QPSK	1	99	-2.03	-46.10	44.07			
66	1745.0	132322	20	QPSK	50	0	-2.20	-50.51	48.31			
66	1745.0	132322	20	QPSK	50	25	-2.24	-50.84	48.60			
66	1745.0	132322	20	QPSK	50	50	-2.23	-52.98	50.75			
66	1745.0	132322	20	QPSK	100	0	-2.22	-51.10	48.88			
66	1745.0	132322	20	16QAM	1	0	-2.11	-38.65	36.54			
66	1745.0	132322	20	16QAM	1	50	-2.13	-38.24	36.11			
66	1745.0	132322	20	16QAM	1	99	-2.08	-36.34	34.26			
66	1745.0	132322	20	16QAM	50	0	-2.09	-49.76	47.67			
66	1745.0	132322	20	16QAM	50	25	-2.08	-50.32	48.24			
66	1745.0	132322	20	16QAM	50	50	-2.10	-49.86	47.76			
66	1745.0	132322	20	16QAM	100	0	-2.08	-49.71	47.63			
66	1745.0	132322	20	64QAM	1	0	-2.11	-39.38	37.27			
66	1745.0	132322	20	64QAM	1	50	-2.13	-39.15	37.02			
66	1745.0	132322	20	64QAM	1	99	-2.10	-37.09	34.99			
66	1745.0	132322	20	64QAM	50	0	-2.11	-49.76	47.65			
66	1745.0	132322	20	64QAM	50	25	-2.13	-50.41	48.28			
66	1745.0	132322	20	64QAM	50	50	-2.12	-50.49	48.37			
66	1745.0	132322	20	64QAM	100	0	-2.08	-51.48	49.40			

2. Codec Configuration

An investigation was performed to determine the audio codec configuration to be used for testing. The effects of codec configuration were found to be independent of radio configuration; therefore, only one radio configuration was used for this investigation. The EVS SWB 24.4kbps setting was used for the audio codec on the CMW500 for VoLTE over IMS T-coil testing. See below table for comparisons between different codecs and codec data rates:

> Table 5-2 **AMR Codec Investigation – VoLTE over IMS**

Codec Setting:	WB AMR 23.85kbps	WB AMR 6.60kbps	NB AMR 12.2kbps	NB AMR 4.75kbps	Orientation	Band / BW	Channel
ABM1 (dBA/m)	6.68	5.47	10.90	10.77			132322
ABM2 (dBA/m)	-38.87	-38.78	-38.08	-38.24	Axial	Band 66 20MHz	
Frequency Response	Pass	Pass	Pass	Pass	Axiai		
S+N/N (dB)	45.55	44.25	48.98	49.01			

- Mute on; Backlight off; Max Volume; Max Contrast
- TPC = "Max Power"

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Table 5-3 **EVS Codec Investigation - VoLTE over IMS**

Codec Setting:	EVS Primary SWB 24.4kbps	EVS Primary SWB 9.6kbps	EVS Primary WB 24.4kbps	EVS Primary WB 5.9kbps	EVS Primary NB 24.4kbps	EVS Primary NB 5.9kbps	Orientation	Band / BW	Channel
ABM1 (dBA/m)	-1.74	-1.56	5.86	6.43	9.48	9.18		xial Band 66 20MHz	132322
ABM2 (dBA/m)	-38.40	-38.61	-38.37	-38.32	-38.65	-38.53	المشاء		
Frequency Response	Pass	Pass	Pass	Pass	Pass	Pass	Axiai		
S+N/N (dB)	36.66	37.05	44.23	44.75	48.13	47.71			

- Mute on; Backlight off; Max Volume; Max Contrast
- TPC = "Max Power"

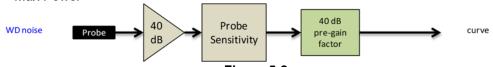


Figure 5-2 **Audio Band Magnetic Curve Measurement Block Diagram**

3. LTE TDD Uplink-Downlink Configuration Investigation for VoLTE over IMS

An investigation was performed to determine the worst-case Uplink-Downlink configuration for VoLTE over IMS T-Coil testing.

Per 3GPP TS 36.211, the total frame length for each TDD radio frame of length $T_f = 307200 \cdot T_s =$ 10 ms, where T_s is a number of time units equal to 1/(15000 x 2048) seconds. Additionally, each radio frame consists of 10 subframes, each of length 30720 · T_s = 1 ms, and subframes can be designated as uplink (U), downlink (D), or special subframe (S), depending on the Uplink-Downlink configuration as indicated in Table 4.2-2 of 3GPP TS 36.211. In the transmission duty factor calculation, the special subframe configuration with the shortest UpPTS duration within the special subframe is used and will be applied for measurement. From 3GPP TS 36.211 Table 4.2-1, the shortest UpPTS is 2192 · Ts which occurs in the normal cyclic prefix and special subframe configuration 4.

See table below outlining the calculated transmission duty cycles for each Uplink-Downlink configuration:

> Table 5-4 **Uplink-Downlink Configurations for Type 2 Frame Structures**

Uplink-downlink	Subframe number										Calculated Transmission	
configuration	Switch-point periodicity	0	1	2	3	4	5	6	7	8	9	Duty Cycle (%)
0	5 ms	D	S	U	U	U	D	S	U	U	U	61.4%
1	5 ms	D	S	U	U	D	D	S	U	U	D	41.4%
2	5 ms	D	S	U	D	D	D	S	U	D	D	21.4%
3	10 ms	D	S	U	U	U	D	D	D	D	D	30.7%
4	10 ms	D	S	U	U	D	D	D	D	D	D	20.7%
5	10 ms	D	S	U	D	D	D	D	D	D	D	10.7%
6	5 ms	D	S	U	U	U	D	S	U	U	D	51.4%

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a. Power Class 3 Uplink-Downlink Configuration Investigation

Power Class 3 was evaluated with the following radio configuration: channel 40620, 20MHz BW, 16QAM, 1RB, 99RB Offset. For Power Class 3, all configurations (0-6) are supported. The configuration which resulted in the worst SNNR was used for full testing. Uplink-Downlink configuration 1 was used as the worst-case configuration for Power Class 3 VoLTE over IMS T-Coil testing. See table below for the SNNR comparison between each Uplink-Downlink configuration:

Table 5-5 Power Class 3 VoLTE over IMS SNNR by UL-DL Configuration

Frequency [MHz]	Channel	Bandwidth [MHz]	Modulation	RB Size	RB Offset	UL-DL Configuration	ABM1 [dB(A/m)]	ABM2 [dB(A/m)]	SNNR [dB]
2593.0	40620	20	16QAM	1	99	0	-1.82	-31.18	29.36
2593.0	40620	20	16QAM	1	99	1	-1.84	-31.01	29.17
2593.0	40620	20	16QAM	1	99	2	-1.80	-31.10	29.30
2593.0	40620	20	16QAM	1	99	3	-1.79	-33.92	32.13
2593.0	40620	20	16QAM	1	99	4	-1.81	-34.04	32.23
2593.0	40620	20	16QAM	1	99	5	-1.80	-33.95	32.15
2593.0	40620	20	16QAM	1	99	6	-1.76	-31.20	29.44

b. Power Class 2 Uplink-Downlink Configuration Investigation

Power Class 2 was evaluated with the following radio configuration: channel 40620, 20MHz BW, 16QAM, 1RB, 99RB Offset. For Power Class 2, configurations 1-5 are supported. The configuration which resulted in the worst SNNR was used for full testing. Uplink-Downlink configuration 1 was used as the worst-case configuration for Power Class 2 VoLTE over IMS T-Coil testing. See table below for the SNNR comparison between each Uplink-Downlink configuration:

Table 5-6 Power Class 2 VoLTE over IMS SNNR by UL-DL Configuration

	: 0::0: 0::00 = 10=:= 0:0: ::::0 0::::::::::										
Frequency	Channel	Bandwidth	Modulation	RB Size	RB Offset	UL-DL Configuration	ABM1	ABM2	SNNR		
[MHz]		[MHz]				•	[dB(A/m)]	[dB(A/m)]	[dB]		
2593.0	40620	20	16QAM	1	99	1	-1.80	-26.51	24.71		
2593.0	40620	20	16QAM	1	99	2	-1.83	-27.22	25.39		
2593.0	40620	20	16QAM	1	99	3	-1.83	-29.98	28.15		
2593.0	40620	20	16QAM	1	99	4	-1.83	-30.18	28.35		
2593.0	40620	20	16QAM	1	99	5	-1.84	-30.27	28.43		

Note: LTE TDD B41 Power Class 2 only supports UL-DL configurations 1-5, not 0 or 6.

c. Conclusion

Per the investigations above, UL-DL Configuration 1 was used to evaluate Power Class 3 and Power Class 2 VoLTE over IMS.

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6. VOWIFI TEST SYSTEM SETUP AND DUT CONFIGURATION

I. Test System Setup for VoWIFI over IMS T-coil Testing

1. Equipment Setup

The general test setup used for VoWIFI over IMS, or CMRS WIFI Calling, is shown below. The callbox used when performing VoWIFI over IMS T-coil measurements is a CMW500. The Data Application Unit (DAU) of the CMW500 was used to simulate the IP Multimedia Subsystem (IMS) server.

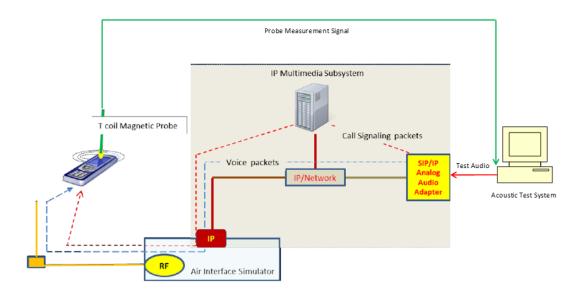


Figure 6-1
Test Setup for VoWIFI over IMS T-Coil Measurements

2. Audio Level Settings

According to KDB 285076 D02 released by the FCC OET regarding the appropriate audio levels to be used for VoWIFI over IMS T-Coil testing, -20dBm0 shall be used for the normal speech input level². The CMW500 base station simulator was manually configured to ensure that the settings for speech input and full scale levels resulted in the -20dBm0 speech input level to the DUT for the VoWIFI over IMS connection.

² FCC Office of Engineering and Technology KDB, "285076 D02 T-Coil Testing for CMRS IP v03," September 13, 2017

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II. DUT Configuration for VoWIFI over IMS T-coil Testing

1. Radio Configuration

An investigation was performed on all applicable data rates and modulations to determine the radio configuration to be used for testing. See tables below for SNNR comparison between radio configurations in each IEEE 802.11 standard:

Table 6-1
IEEE 802.11b SNNR by Radio Configuration

Mode	Channel	Modulation	Data Rate [Mbps]	ABM1 [dB(A/m)]	ABM2 [dB(A/m)]	SNNR [dB]
IEEE 802.11b	6	DSSS	1	-2.55	-37.25	34.70
IEEE 802.11b	6	DSSS	2	-2.38	-37.91	35.53
IEEE 802.11b	6	CCK	5.5	-2.41	-38.21	35.80
IEEE 802.11b	6	CCK	11	-2.35	-38.12	35.77

Table 6-2 IEEE 802.11g/a SNNR by Radio Configuration

<u> </u>								
Mode	Channel	Modulation	Data Rate [Mbps]	ABM1 [dB(A/m)]	ABM2 [dB(A/m)]	SNNR [dB]		
IEEE 802.11g	6	BPSK	6	-2.41	-42.57	40.16		
IEEE 802.11g	6	BPSK	9	-2.43	-41.54	39.11		
IEEE 802.11g	6	QPSK	12	-2.35	-41.68	39.33		
IEEE 802.11g	6	QPSK	18	-2.31	-41.58	39.27		
IEEE 802.11g	6	16QAM	24	-2.38	-42.15	39.77		
IEEE 802.11g	6	16QAM	36	-2.38	-42.80	40.42		
IEEE 802.11g	6	64QAM	48	-2.39	-42.05	39.66		
IEEE 802.11g	6	64QAM	54	-2.40	-41.57	39.17		

Table 6-3
IEEE 802.11n/ac 20MHz BW SNNR by Radio Configuration

IEEE 802.1111/ac 20MHz BW SINIK by Raulo Colliguration							
Mode	Bandwidth [MHz]	Channel	Modulation	MCS Index	ABM1 [dB(A/m)]	ABM2 [dB(A/m)]	SNNR [dB]
IEEE 802.11n	20	40	BPSK	0	-2.41	-46.90	44.49
IEEE 802.11n	20	40	QPSK	1	-2.39	-46.15	43.76
IEEE 802.11n	20	40	QPSK	2	-2.37	-46.79	44.42
IEEE 802.11n	20	40	16QAM	3	-2.40	-44.65	42.25
IEEE 802.11n	20	40	16QAM	4	-2.38	-45.17	42.79
IEEE 802.11n	20	40	64QAM	5	-2.38	-45.18	42.80
IEEE 802.11n	20	40	64QAM	6	-2.41	-45.90	43.49
IEEE 802.11n	20	40	64QAM	7	-2.42	-46.64	44.22
IEEE 802.11ac	20	40	256QAM	8	-2.45	-47.03	44.58

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Table 6-4 IEEE 802.11n/ac 40MHz BW SNNR by Radio Configuration

Mode	Bandwidth [MHz]	Channel	Modulation	MCS Index	ABM1 [dB(A/m)]	ABM2 [dB(A/m)]	SNNR [dB]
IEEE 802.11n	40	38	BPSK	0	-2.39	-46.13	43.74
IEEE 802.11n	40	38	QPSK	1	-2.40	-47.28	44.88
IEEE 802.11n	40	38	QPSK	2	-2.41	-47.30	44.89
IEEE 802.11n	40	38	16QAM	3	-2.50	-45.47	42.97
IEEE 802.11n	40	38	16QAM	4	-2.45	-47.07	44.62
IEEE 802.11n	40	38	64QAM	5	-2.42	-45.70	43.28
IEEE 802.11n	40	38	64QAM	6	-2.39	-43.39	41.00
IEEE 802.11n	40	38	64QAM	7	-2.40	-46.37	43.97
IEEE 802.11ac	40	38	256QAM	8	-2.47	-48.03	45.56
IEEE 802.11ac	40	38	256QAM	9	-2.37	-45.99	43.62

2. Codec Configuration

An investigation was performed to determine the audio codec configuration to be used for testing. The effects of codec configuration were found to be independent of radio configuration; therefore, only one radio configuration was used for this investigation. The EVS Primary SWB 24.4kbps setting was used for the audio codec on the CMW500 for VoWIFI over IMS T-coil testing. See below table for comparisons between different codecs and codec data rates:

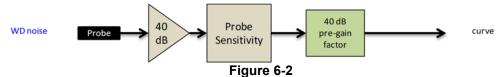
> Table 6-5 AMR Codec Investigation - VoWIFI over IMS

Amit codec investigation – vovin rover into								
Codec Setting:	WB AMR 23.85kbps	WB AMR 6.60kbps	NB AMR 12.2kbps	NB AMR 4.75kbps	Orientation	Band	Standard	Channel
ABM1 (dBA/m)	2.72	1.21	7.07	6.83			IEEE 802.11b	6
ABM2 (dBA/m)	-35.58	-35.78	-36.14	-36.03	Axial			
Frequency Response	Pass	Pass	Pass	Pass	Axiai	2.4GHz		
S+N/N (dB)	38.30	36.99	43.21	42.86				

Table 6-6 **EVS Codec Investigation – VoWIFI over IMS**

Codec Setting:	EVS Primary SWB 24.4kbps	EVS Primary SWB 9.6kbps	EVS Primary WB 24.4kbps	EVS Primary WB 5.9kbps	EVS Primary NB 24.4kbps	EVS Primary NB 5.9kbps	Orientation	Band	Standard	Channel
ABM1 (dBA/m)	-2.29	-2.14	1.79	2.47	6.76	6.23			IEEE 802.11b	6
ABM2 (dBA/m)	-36.95	-36.97	-36.87	-37.17	-35.52	-36.82	Axial	ial 2.4GHz		
Frequency Response	Pass	Pass	Pass	Pass	Pass	Pass	Axiai			
S+N/N (dB)	34.66	34.83	38.66	39.64	42.28	43.05				

Mute on; Backlight off; Max Volume; Max Contrast



Audio Band Magnetic Curve Measurement Block Diagram

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7. OTT VOIP TEST SYSTEM AND DUT CONFIGURATION

I. Test System Setup for OTT VoIP T-Coil Testing

1. OTT VoIP Application

Google Duo is a pre-installed application on the DUT which allows for VoIP calls in a held-to-ear scenario. Duo uses the OPUS audio codec and supports a bitrate range of 6kb/s to 75kb/s. All air interfaces capable of a data connection were evaluated with Google Duo.

2. Equipment Setup

A CMW500 callbox was used to perform OTT VoIP T-coil measurements. The Data Application Unit (DAU) of the CMW500 was connected to the internet and allowed for an IP data connection on the DUT. An auxiliary VoIP unit was used to initiate an OTT VoIP call to the DUT. The auxiliary VoIP unit allowed for the configuration and monitoring of the OTT VoIP codec bitrate during a call. Both high and low bitrate settings were evaluated in to determine the worst-case configuration.

3. Audio Level Settings

According to KDB 285076 D02, the average speech level of -20dBm0 shall be used for protocols not specifically listed in Table 7.1 of ANSI C63.19-2011 or the ANSI C63.19-2011 VoLTE interpretation³. The auxiliary VoIP unit allowed for monitoring the signal input level to ensure that the settings for speech input and full scale levels resulted in the -20dBm0 speech input level to the DUT for the OTT VoIP call.

Note: The green highlighted text is approved by FCC under the TCB PAG Re-Use Policy 388624 D01 IV. D. for T-Coil Testing for WI-FI calling and Google Duo.

II. DUT Configuration for OTT VoIP T-Coil Testing

1. Codec Configuration

An investigation was performed for each applicable data mode to determine the audio codec configuration to be used for testing. The effects of codec configuration were found to be independent of radio configuration; therefore, only one radio configuration for each applicable data mode was used for these investigations. The 75kbps codec setting was used for the audio codec on the auxiliary VoIP unit for OTT VoIP T-Coil testing. See below tables for comparisons between codec data rates on all applicable data modes:

Table 7-1
Codec Investigation – OTT VoIP (EvDO)

Codec Setting:	75kbps	6kbps	Orientation	Channel	
ABM1 (dBA/m)	5.56	5.17			
ABM2 (dBA/m)	-43.92	-45.22	Axial	600	
Frequency Response	Pass	Pass	Axiai		
S+N/N (dB)	49.48	50.39			

³ FCC Office of Engineering and Technology KDB, "285076 D02 T-Coil Testing for CMRS IP v03," September 13, 2017

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Table 7-2 Codec Investigation - OTT VoIP (EDGE)

Codec investigation – OTT voil (LDOL)							
Codec Setting:	75kbps	6kbps	Orientation	Channel			
ABM1 (dBA/m)	5.53	5.44					
ABM2 (dBA/m)	-21.36	-21.68	Axial	661			
Frequency Response	Pass	Pass	Axiai	001			
S+N/N (dB)	26.89	27.12					

Table 7-3 Codec Investigation - OTT VoIP (HSPA)

Codec Setting:	75kbps	6kbps	Orientation	Channel		
ABM1 (dBA/m)	5.59	5.54				
ABM2 (dBA/m)	-48.36	-49.84	Axial	9400		
Frequency Response	Pass	Pass	Axiai			
S+N/N (dB)	53.95	55.38				

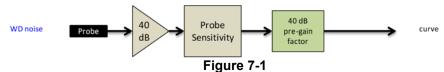
Table 7-4 Codec Investigation - OTT VoIP (LTE)

	ugauo	O	\ - · - /		
Codec Setting:	75kbps	6kbps	Orientation	Band / BW	Channel
ABM1 (dBA/m)	5.60	5.44			132322
ABM2 (dBA/m)	-36.23	-36.50	Axial	Band 66	
Frequency Response	Pass	Pass	Axiai	20MHz	
S+N/N (dB)	41.83	41.94			

Table 7-5 Codec Investigation - OTT VoIP (WIFI)

Codeo investigation CTT von (vvn)													
Codec Setting:	75kbps	6kbps	Orientation	Band	Standard	Channel							
ABM1 (dBA/m)	5.65	5.54											
ABM2 (dBA/m)	-35.30	-35.68	المشاء	2.4015	IEEE 000 44b	6							
Frequency Response	Pass	Pass	Axial	2.4GHz	IEEE 802.11b	6							
S+N/N (dB)	40.95	41.22											

- Mute on; Backlight off; Max Volume; Max Contrast
- Radio Configurations can be found in Section 9.II.H



Audio Band Magnetic Curve Measurement Block Diagram

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2. Radio Configuration for OTT VoIP (LTE)

An investigation was performed to determine the worst-case LTE FDD band to be used for OTT VoIP testing. LTE FDD Band 66 was used for the testing as the worst-case configuration for the handset. See below table for SNNR comparison between different LTE FDD bands:

Table 7-6
OTT VoIP (LTE FDD) SNNR by LTE Band

	011 1011 (212122) 0111111											
Band	Frequency [MHz]	Channel	Bandwidth [MHz]	Modulation	RB Size	RB Offset	ABM1 [dB(A/m)]	ABM2 [dB(A/m)]	SNNR [dB]			
71	680.5	133297	20	16QAM	1	99	5.54	-43.47	49.01			
12	707.5	23095	10	16QAM	1	49	5.56	-45.44	51.00			
13	782.0	23230	10	16QAM	1	49	5.53	-45.26	50.79			
14	793.0	23330	10	16QAM	1	49	5.52	-45.40	50.92			
26	831.5	26865	15	16QAM	1	74	5.53	-47.30	52.83			
5	836.5	20525	10	16QAM	1	49	5.57	-45.64	51.21			
66	1745.0	132322	20	16QAM	1	99	5.51	-36.28	41.79			
2	1880.0	18900	20	16QAM	1	99	5.47	-38.73	44.20			
25	1882.5	26365	20	16QAM	1	99	5.47	-37.66	43.13			
30	2310.0	27710	10	16QAM	1	49	5.52	-42.38	47.90			
7	2535.0	21100	20	16QAM	1	99	5.47	-39.71	45.18			

An investigation was performed to determine the worst-case LTE TDD band to be used for OTT VoIP testing. LTE TDD Band 41 (PC2) was used for the testing as the worst-case configuration for the handset. See below table for SNNR comparison between different LTE TDD bands:

Table 7-7
OTT VoIP (LTE TDD) SNNR by LTE Band

Band	Frequency [MHz]	Channel	Bandwidth [MHz]	Modulation	RB Size	RB Offset	ABM1 [dB(A/m)]	ABM2 [dB(A/m)]	SNNR [dB]
41 (PC3)	2593.0	40620	20	16QAM	1	99	5.58	-30.91	36.49
41 (PC2)	2593.0	40620	20	16QAM	1	99	5.53	-28.76	34.29
48	3625.0	55990	20	16QAM	1	99	5.48	-32.38	37.86

3. LTE FDD Uplink Carrier Aggregation for OTT VoIP

LTE FDD ULCA was evaluated to ensure LTE FDD standalone was the worst-case scenario. The configurations in Table 7-8 were determined from Table 7-6 and satisfy the configuration requirements as defined in 3GPP 36.101.

Table 7-8
LTE FDD SNNR for OTT VoIP Uplink Carrier Aggregation

				PCC							SCC						
Combination	PCC Band	PCC Bandwidth [MHz]	PCC (UL) Channel	PCC (UL) Frequency [MHz]	Modulation	PCC UL# RB	PCC UL RB Offset	SCC Band	SCC Bandwidth [MHz]	SCC (UL) Channel	SCC (UL) Frequency [MHz]	Modulation	SCC UL# RB	SCC UL RB Offset	ABM1 [dB(A/m)]	ABM2 [dB(A/m)]	SNNR [dB]
CA_5B	LTE B5	10	20525	836.5	16QAM	1	0	LTE B5	5	20453	829.3	16QAM	1	24	5.92	-47.32	53.24
CA_66B	LTE B66	10	132322	1745.0	16QAM	1	0	LTE B66	10	132223	1735.1	16QAM	1	49	6.18	-40.31	46.49
CA_66C	LTE B66	20	132322	1745.0	16QAM	1	0	LTE B66	20	132124	1725.5	16QAM	1	99	6.11	-39.13	45.24

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4. LTE TDD Uplink Carrier Aggregation for OTT VolP

LTE TDD ULCA was evaluated to ensure LTE TDD standalone was the worst-case scenario. The configurations in Table 7-9 were determined from Table 7-7 and satisfy the configuration requirements as defined in 3GPP 36.101.

> Table 7-9 LTE TDD SNNR for OTT VolP Uplink Carrier Aggregation

	PCC										SCC						
Combination	PCC Band	PCC Bandwidth [MHz]	PCC (UL/DL) Channel	PCC (UL/DL) Frequency [MHz]	Modulation	PCC UL# RB	PCC UL RB Offset	SCC Band	SCC Bandwidth [MHz]	SCC (UL/DL) Channel	SCC (UL/DL) Frequency [MHz]	Modulation	SCC UL# RB	SCC UL RB Offset	ABM1 [dB(A/m)]	ABM2 [dB(A/m)]	SNNR [dB]
CA_41C (PC3)	LTE B41	20	40620	2593.0	16QAM	1	0	LTE B41	20	40422	2573.2	16QAM	1	99	6.00	-30.74	36.74
CA_41C (PC2)	LTE B41	20	40620	2593.0	16QAM	1	0	LTE B41	20	40422	2573.2	16QAM	1	99	5.58	-29.86	35.44

5. Interim Procedure for evaluation OTT VoIP (NR)

The following procedure is used to evaluate OTT VoIP (NR) given equipment limitations.

- a. This procedure is applicable for OTT VoIP (NR) voice calls that use the same protocol, codec(s), and reference level as OTT VoIP (LTE) (i.e. -20dBm0).
- b. Establish the ABM1_{NR} value by using the ABM1_{LTE} magnetic intensity for an LTE call using a correlating LTE band through existing procedures and test equipment.
- Establish an ABM2_{NR} value using factory test mode (FTM) to simulate a NR connection for the desired NR band and channel under test.
- d. The following information is documented in Section 9:
 - i. ABM2_{LTE} and ABM2_{NR} for respective tests.
 - ii. Calculate SNNR:
 - 1. ABM1 = ABM1_{LTE}
 - 2. $ABM2 = ABM2_{NR}$
 - 3. $SNNR_{NR} = [ABM1_{LTE} ABM2_{NR}] 3dB$
 - a. A 3dB margin is built in to ensure conservative results with this interim procedure.

The above is only applicable for OTT VoIP scenarios, this device does not support VoNR over IMS.

The manufacturer has confirmed the handset as designed is expected to exhibit similar audio intensity levels between an OTT VoIP call placed over a 4G LTE and a 5G Sub-6GHz data connection.

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6. Radio Configuration for OTT VoIP (NR)

An investigation was performed to determine the waveform, modulation, and RB configuration to be used for testing. Due to equipment limitations, the procedure outlined in 7.II.5 was used to evaluate the SNNR for each radio configuration below. DFT-s-OFDM 16QAM, 1RB, 99%RB offset was determined to be the worst-case configuration for the handset and will be used for full testing in Section 9.

Table 7-10 NR OTT VoIP SNNR by Radio Configuration (CP-OFDM)

	Frequency		Bandwidth	J			· · · · ·	ABM1 _{LTE}	ABM2 _{NR}	SNNR _{NR}
Band	[MHz]	Channel	[MHz]	Waveform	Modulation	RB Size	RB Offset	[dB(A/m)]	[dB(A/m)]	[dB]
n66	1745.0	349000	20	CP-OFDM	QPSK	1	1	5.51	-44.50	50.01
n66	1745.0	349000	20	CP-OFDM	QPSK	1	53	5.51	-42.97	48.48
n66	1745.0	349000	20	CP-OFDM	QPSK	1	104	5.51	-42.52	48.03
n66	1745.0	349000	20	CP-OFDM	QPSK	53	0	5.51	-45.98	51.49
n66	1745.0	349000	20	CP-OFDM	QPSK	53	26	5.51	-46.90	52.41
n66	1745.0	349000	20	CP-OFDM	QPSK	53	53	5.51	-46.71	52.22
n66	1745.0	349000	20	CP-OFDM	QPSK	106	0	5.51	-46.80	52.31
n66	1745.0	349000	20	CP-OFDM	16QAM	1	1	5.51	-42.71	48.22
n66	1745.0	349000	20	CP-OFDM	16QAM	1	53	5.51	-42.56	48.07
n66	1745.0	349000	20	CP-OFDM	16QAM	1	104	5.51	-41.32	46.83
n66	1745.0	349000	20	CP-OFDM	16QAM	53	0	5.51	-45.72	51.23
n66	1745.0	349000	20	CP-OFDM	16QAM	53	26	5.51	-46.03	51.54
n66	1745.0	349000	20	CP-OFDM	16QAM	53	53	5.51	-46.01	51.52
n66	1745.0	349000	20	CP-OFDM	16QAM	106	0	5.51	-46.78	52.29
n66	1745.0	349000	20	CP-OFDM	64QAM	1	1	5.51	-44.04	49.55
n66	1745.0	349000	20	CP-OFDM	64QAM	1	53	5.51	-43.13	48.64
n66	1745.0	349000	20	CP-OFDM	64QAM	1	104	5.51	-42.50	48.01
n66	1745.0	349000	20	CP-OFDM	64QAM	53	0	5.51	-47.27	52.78
n66	1745.0	349000	20	CP-OFDM	64QAM	53	26	5.51	-49.43	54.94
n66	1745.0	349000	20	CP-OFDM	64QAM	53	53	5.51	-47.14	52.65
n66	1745.0	349000	20	CP-OFDM	64QAM	106	0	5.51	-46.63	52.14
n66	1745.0	349000	20	CP-OFDM	256QAM	1	1	5.51	-43.78	49.29
n66	1745.0	349000	20	CP-OFDM	256QAM	1	53	5.51	-44.36	49.87
n66	1745.0	349000	20	CP-OFDM	256QAM	1	104	5.51	-42.87	48.38
n66	1745.0	349000	20	CP-OFDM	256QAM	53	0	5.51	-45.08	50.59
n66	1745.0	349000	20	CP-OFDM	256QAM	53	26	5.51	-46.47	51.98
n66	1745.0	349000	20	CP-OFDM	256QAM	53	53	5.51	-47.19	52.70
n66	1745.0	349000	20	CP-OFDM	256QAM	106	0	5.51	-46.20	51.71

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Table 7-11
NR OTT VolP SNNR by Radio Configuration (DFT-s-OFDM)

MIX OTT VOIL SHARK BY RADIO CONTINUE ALIGN (DI 1-3-OT DIN)										
Band	Frequency [MHz]	Channel	Bandwidth [MHz]	Waveform	Modulation	RB Size	RB Offset	ABM1 _{LTE} [dB(A/m)]	ABM2 _{NR} [dB(A/m)]	SNNR _{NR} [dB]
n66	1745.0	349000	20	DFT-s-OFDM	π/2-BPSK	1	1	5.51	-44.17	49.68
n66	1745.0	349000	20	DFT-s-OFDM	π/2-BPSK	1	53	5.51	-45.75	51.26
n66	1745.0	349000	20	DFT-s-OFDM	π/2-BPSK	1	104	5.51	-46.20	51.71
n66	1745.0	349000	20	DFT-s-OFDM	π/2-BPSK	50	0	5.51	-46.90	52.41
n66	1745.0	349000	20	DFT-s-OFDM	π/2-BPSK	50	28	5.51	-47.11	52.62
n66	1745.0	349000	20	DFT-s-OFDM	π/2-BPSK	50	56	5.51	-45.11	50.62
n66	1745.0	349000	20	DFT-s-OFDM	π/2-BPSK	100	0	5.51	-46.26	51.77
n66	1745.0	349000	20	DFT-s-OFDM	QPSK	1	1	5.51	-44.83	50.34
n66	1745.0	349000	20	DFT-s-OFDM	QPSK	1	53	5.51	-44.96	50.47
n66	1745.0	349000	20	DFT-s-OFDM	QPSK	1	104	5.51	-44.31	49.82
n66	1745.0	349000	20	DFT-s-OFDM	QPSK	50	0	5.51	-47.19	52.70
n66	1745.0	349000	20	DFT-s-OFDM	QPSK	50	28	5.51	-46.89	52.40
n66	1745.0	349000	20	DFT-s-OFDM	QPSK	50	56	5.51	-47.97	53.48
n66	1745.0	349000	20	DFT-s-OFDM	QPSK	100	0	5.51	-47.98	53.49
n66	1745.0	349000	20	DFT-s-OFDM	16QAM	1	1	5.51	-40.29	45.80
n66	1745.0	349000	20	DFT-s-OFDM	16QAM	1	53	5.51	-40.81	46.32
n66	1745.0	349000	20	DFT-s-OFDM	16QAM	1	104	5.51	-38.30	43.81
n66	1745.0	349000	20	DFT-s-OFDM	16QAM	50	0	5.51	-46.13	51.64
n66	1745.0	349000	20	DFT-s-OFDM	16QAM	50	28	5.51	-47.73	53.24
n66	1745.0	349000	20	DFT-s-OFDM	16QAM	50	56	5.51	-46.32	51.83
n66	1745.0	349000	20	DFT-s-OFDM	16QAM	100	0	5.51	-46.34	51.85
n66	1745.0	349000	20	DFT-s-OFDM	64QAM	1	1	5.51	-40.72	46.23
n66	1745.0	349000	20	DFT-s-OFDM	64QAM	1	53	5.51	-41.95	47.46
n66	1745.0	349000	20	DFT-s-OFDM	64QAM	1	104	5.51	-39.54	45.05
n66	1745.0	349000	20	DFT-s-OFDM	64QAM	50	0	5.51	-45.95	51.46
n66	1745.0	349000	20	DFT-s-OFDM	64QAM	50	28	5.51	-46.84	52.35
n66	1745.0	349000	20	DFT-s-OFDM	64QAM	50	56	5.51	-46.67	52.18
n66	1745.0	349000	20	DFT-s-OFDM	64QAM	100	0	5.51	-46.61	52.12
n66	1745.0	349000	20	DFT-s-OFDM	256QAM	1	1	5.51	-43.96	49.47
n66	1745.0	349000	20	DFT-s-OFDM	256QAM	1	53	5.51	-44.67	50.18
n66	1745.0	349000	20	DFT-s-OFDM	256QAM	1	104	5.51	-42.27	47.78
n66	1745.0	349000	20	DFT-s-OFDM	256QAM	50	0	5.51	-46.89	52.40
n66	1745.0	349000	20	DFT-s-OFDM	256QAM	50	28	5.51	-47.01	52.52
n66	1745.0	349000	20	DFT-s-OFDM	256QAM	50	56	5.51	-47.51	53.02
n66	1745.0	349000	20	DFT-s-OFDM	256QAM	100	0	5.51	-45.80	51.31

An investigation was performed to determine the worst-case NR FDD band to be used for OTT VoIP testing. NR n66 was used for the testing as the worst-case configuration for the handset. See below table for SNNR comparison between different NR FDD bands:

Table 7-12
OTT VoIP (NR FDD) SNNR by Band

	• · · · · · · · · · · · · · · · · · · ·												
Band	Frequency [MHz]	Channel	Bandwidth [MHz]	Waveform	Modulation	RB Size	RB Offset	ABM1 _{LTE} [dB(A/m)]	ABM2 _{NR} [dB(A/m)]	SNNR _{NR} [dB]			
n71	680.5	136100	20	DFT-s-OFDM	16QAM	1	104	5.54	-44.63	50.17			
n5	836.5	167300	20	DFT-s-OFDM	16QAM	1	104	5.57	-50.17	55.74			
n66	1745.0	349000	20	DFT-s-OFDM	16QAM	1	104	5.51	-37.82	43.33			
n25	1882.5	376500	20	DFT-s-OFDM	16QAM	1	104	5.47	-40.19	45.66			

An investigation was performed to determine the worst-case NR TDD band to be used for OTT VoIP testing. NR n41 (PC3) was used for the testing as the worst-case configuration for the handset. See below table for SNNR comparison between different NR TDD bands:

Table 7-13
OTT VoIP (NR TDD) SNNR by Band

Band	Frequency [MHz]	Channel	Bandwidth [MHz]	Waveform	Modulation	RB Size	RB Offset	ABM1 _{LTE} [dB(A/m)]	ABM2 _{NR} [dB(A/m)]	SNNR _{NR} [dB]
n41 (PC3)	2593.0	518598	100	DFT-s-OFDM	16QAM	1	271	5.58	-23.95	29.53
n77	3840.0	656000	100	DFT-s-OFDM	16QAM	1	271	5.48	-25.21	30.69

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8. FCC 3G MEASUREMENTS

I. **CDMA Test Configurations**

Radio Configuration 1, Service Option 68 (thick, green data curve) was used for the testing as the worstcase configuration for the handset due to vocoder gating from the EVRC logic. See below plot for ABM noise comparison between operational field service options and radio configurations for a CDMA2000 handset:

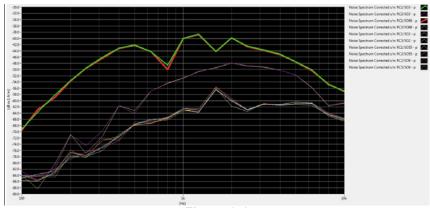
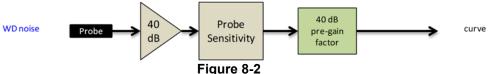


Figure 8-1 **CDMA Audio Band Magnetic Noise**

Table 8-1 FCC 3G ABM Measurements for A3LSMA426U (CDMA)

Configuration:	RC1/SO68	RC3/SO68	RC4/SO68	Orientation	Channel	
ABM1 (dBA/m)	7.52	7.59	7.48			
ABM2 (dBA/m)	-28.98	-50.08	-48.54	Axial	600	
Frequency Response	Pass	Pass	Pass	Axiai	800	
S+N/N (dB)	36.50	57.67	56.02			

- Mute on; Backlight off; Max Volume; Max Contrast
- Power Control Bits = "All Up"



Audio Band Magnetic Curve Measurement Block Diagram

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II. UMTS Test Configurations

AMR at 12.2kbps, 13.6kbps SRB (thick, purple data curve) was used for the testing as the worst-case configuration for the handset. See below plot for ABM noise comparison between vocoder rates:

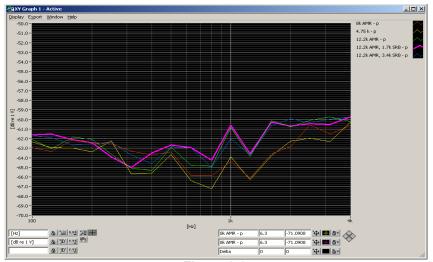
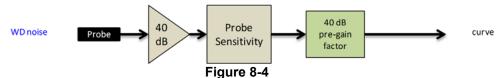


Figure 8-3
UMTS Audio Band Magnetic Noise

Table 8-2 Codec Investigation - UMTS

		co mvestigatio	11 0111110			
Codec Setting:	AMR 12.2kbps	AMR 7.95kbps	AMR 4.75kbps	Orientation	Channel	
ABM1 (dBA/m)	10.77	10.74	10.60			
ABM2 (dBA/m)	-48.23	-49.37	-49.86	Axial	9400	
Frequency Response	Pass	Pass	Pass	Axiai	9400	
S+N/N (dB)	59.00	60.11	60.46			

- · Mute on; Backlight off; Max Volume; Max Contrast
- · TPC="All 1s"



Audio Band Magnetic Curve Measurement Block Diagram

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Table 9-1 **Consolidated Tabled Results**

		Con	Sona	ateu i	abieu	Resu	แร		ı
			esponse rgin		netic / Verdict		SNNR dict	Margin from FCC Limit	C63.19-2011
C62 1	9 Section	8.3	3.2	8.	3.1	8.	3.4	(dB)	Rating
C03.1	9 Section	Axial	Radial	Axial	Radial	Axial	Radial		
	Secondary Cellular	PASS	NA	PASS	PASS	PASS	PASS		
CDMA	Cellular	PASS	NA	PASS	PASS	PASS	PASS	-15.91	T4
	PCS	PASS	NA	PASS	PASS	PASS	PASS		
	Secondary Cellular	PASS	NA	PASS	PASS	PASS	PASS		
EvDO (OTT VoIP)	Cellular	PASS	NA	PASS	PASS	PASS	PASS	-13.45	T4
(011 10)	PCS	PASS	NA	PASS	PASS	PASS	PASS		
GSM	Cellular	PASS	NA	PASS	PASS	PASS	PASS	-3.02	Т3
GOW	PCS	PASS	NA	PASS	PASS	PASS	PASS	-5.02	13
EDGE	Cellular	PASS	NA	PASS	PASS	PASS	PASS	-6.60	Т3
(OTT VoIP)	PCS	PASS	NA	PASS	PASS	PASS	PASS	-0.00	13
	Cellular	PASS	NA	PASS	PASS	PASS	PASS		
UMTS	AWS	PASS	NA	PASS	PASS	PASS	PASS	-38.06	T4
	PCS	PASS	NA	PASS	PASS	PASS	PASS		
	Cellular	PASS	NA	PASS	PASS	PASS	PASS		
HSPA (OTT VoIP)	AWS	PASS	NA	PASS	PASS	PASS	PASS	-13.06	T4
(3)	PCS	PASS	NA	PASS	PASS	PASS	PASS		
	B71	PASS	NA	PASS	PASS	PASS	PASS		
	B12	PASS	NA	PASS	PASS	PASS	PASS		
	B13	PASS	NA	PASS	PASS	PASS	PASS		
	B14	PASS	NA	PASS	PASS	PASS	PASS		
	B26	PASS	NA	PASS	PASS	PASS	PASS		
LTE FDD	B5	PASS	NA	PASS	PASS	PASS	PASS	-14.20	T4
	B66	PASS	NA	PASS	PASS	PASS	PASS		
	B2	PASS	NA	PASS	PASS	PASS	PASS		
	B25	PASS	NA	PASS	PASS	PASS	PASS		
	B30	PASS	NA	PASS	PASS	PASS	PASS		
	B7	PASS	NA	PASS	PASS	PASS	PASS		
LTE FDD (OTT VoIP)	B66	PASS	NA	PASS	PASS	PASS	PASS	-21.39	T4
	B41 (PC3)	PASS	NA	PASS	PASS	PASS	PASS		
LTE TDD	B41 (PC2)	PASS	NA	PASS	PASS	PASS	PASS	-3.67	Т3
	B48	PASS	NA	PASS	PASS	PASS	PASS		
LTE TDD (OTT VoIP)	B41 (PC2)	PASS	NA	PASS	PASS	PASS	PASS	-11.82	T4
NR FDD (OTT VoIP)	n66	NA	NA	PASS	PASS	PASS	PASS	-19.84	T4
NR TDD (OTT VoIP)	n41 (PC3)	NA	NA	PASS	PASS	PASS	PASS	-4.42	Т3
	IEEE 802.11b	PASS	NA	PASS	PASS	PASS	PASS		
WLAN	IEEE 802.11g	PASS	NA	PASS	PASS	PASS	PASS	-8.80	Т3
	IEEE 802.11n	PASS	NA	PASS	PASS	PASS	PASS		
	IEEE 802.11b	PASS	NA	PASS	PASS	PASS	PASS		
WLAN (OTT VoIP)	IEEE 802.11g	PASS	NA	PASS	PASS	PASS	PASS	-15.82	T4
(0 1011)	IEEE 802.11n	PASS	NA	PASS	PASS	PASS	PASS		
	IEEE 802.11a	PASS	NA	PASS	PASS	PASS	PASS		
U-NII	IEEE 802.11n	PASS	NA	PASS	PASS	PASS	PASS	-13.76	T4
	IEEE 802.11ac	PASS	NA	PASS	PASS	PASS	PASS		
	IEEE 802.11a	PASS	NA	PASS	PASS	PASS	PASS		
U-NII (OTT VoIP)	IEEE 802.11n	PASS	NA	PASS	PASS	PASS	PASS	-18.38	T4
(OTT VOIP)	IEEE 802.11ac	PASS	NA	PASS	PASS	PASS	PASS		

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I. Raw Handset Data

Table 9-2
Raw Data Results for CDMA

Mode	Orientation	Channel	ABM1 [dB(A/m)]	ABM2 [dB(A/m)]	Ambient Noise [dB(A/m)]	Frequency Response Margin (dB)	S+N/N (dB)	FCC Limit (dB)	Margin from FCC Limit (dB)	C63.19-2011 Rating	Test Coordinates
		476	7.47	-39.68		1.13	47.15	20.00	-27.15	T4	
	Axial	564	7.52	-40.11	-64.73	1.14	47.63	20.00	-27.63	T4	2.0, 1.4
Secondary		684	7.37	-40.06		1.14	47.43	20.00	-27.43	T4	
Cellular		476	-0.27	-43.88			43.61	20.00	-23.61	T4	
	Radial	564	-0.03	-44.13	-63.10	N/A	44.10	20.00	-24.10	T4	2.4, 2.4
		684	-0.05	-44.59			44.54	20.00	-24.54	T4	
	Axial	1013	7.47	-40.38	-64.73	1.12	47.85	20.00	-27.85	T4	2.0, 1.4
		384	7.44	-40.10		1.06	47.54	20.00	-27.54	T4	
Cellular		777	7.34	-39.71		1.12	47.05	20.00	-27.05	T4	
Celiulai		1013	0.01	-44.66	-63.10		44.67	20.00	-24.67	T4	
	Radial	384	-0.19	-44.71		-63.10 N/A	44.52	20.00	-24.52	T4	2.4, 2.4
		777	-0.01	-44.38			44.37	20.00	-24.37	T4	
											•
		25	7.36	-28.55		1.09	35.91	20.00	-15.91	T4	
	Axial	600	7.50	-28.96	-64.73	1.18	36.46	20.00	-16.46	T4	2.0, 1.4
PCS		1175	7.43	-28.95		1.12	36.38	20.00	-16.38	T4	
FCS		25	0.30	-41.40			41.70	20.00	-21.70	T4	
	Radial	600	-0.13	-42.35	-63.10	N/A	42.22	20.00	-22.22	T4	2.4, 2.4
		1175	-0.04	-42.37			42.33	20.00	-22.33	T4	

Table 9-3
Raw Data Results for GSM

					Jala Nesi		-				
Mode	Orientation	Channel	ABM1 [dB(A/m)]	ABM2 [dB(A/m)]	Ambient Noise [dB(A/m)]	Frequency Response Margin (dB)	S+N/N (dB)	FCC Limit (dB)	Margin from FCC Limit (dB)	C63.19-2011 Rating	Test Coordinates
		128	4.81	-20.76		1.74	25.57	20.00	-5.57	T3	
	Axial	190	4.41	-20.76	-64.73	1.76	25.17	20.00	-5.17	Т3	2.0, 1.4
GSM850		251	4.79	-20.85		1.73	25.64	20.00	-5.64	Т3	
GSIMIOSU		128	-3.01	-26.19			23.18	20.00	-3.18	Т3	
	Radial	190	-3.05	-26.55	-63.10	3.10 N/A	23.50	20.00	-3.50	Т3	2.4, 2.4
		251	-3.03	-26.05			23.02	20.00	-3.02	Т3	
		512	3.28	-31.76		1.73	35.04	20.00	-15.04	T4	
	Axial	661	3.17	-31.81	-64.73	1.71	34.98	20.00	-14.98	T4	2.6, 1.4
CSM4000		810	3.18	-31.53	1	1.83	34.71	20.00	-14.71	T4	
GSM1900		512	-3.05	-31.72			28.67	20.00	-8.67	Т3	
	Radial	661	-2.99	-30.99	-63.10	N/A	28.00	20.00	-8.00	Т3	2.4, 2.4
		810	-2.99	-31.56			28.57	20.00	-8.57	Т3	

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Table 9-4 **Raw Data Results for UMTS**

Mode	Orientation	Channel	ABM1 [dB(A/m)]	ABM2 [dB(A/m)]	Ambient Noise [dB(A/m)]	Frequency Response Margin (dB)	S+N/N (dB)	FCC Limit (dB)	Margin from FCC Limit (dB)	C63.19-2011 Rating	Test Coordinates
		4132	10.51	-50.11		1.52	60.62	20.00	-40.62	T4	
	Axial	4183	10.52	-50.59	-64.73	1.53	61.11	20.00	-41.11	T4	2.0, 1.4
UMTS V		4233	10.56	-50.86		1.52	61.42	20.00	-41.42	T4	
OM 10 V		4132	3.15	-58.44			61.59	20.00	-41.59	T4	
	Radial	4183	3.10	-55.82	-63.10	N/A	58.92	20.00	-38.92	T4	2.4, 2.4
		4233	3.13	-54.93			58.06	20.00	-38.06	T4	
		1312	10.58	-48.70		1.51	59.28	20.00	-39.28	T4	
	Axial	1412	10.51	-49.44	-64.73	1.56	59.95	20.00	-39.95	T4	2.0, 1.4
UMTS IV		1513	10.55	-49.12		1.54	59.67	20.00	-39.67	T4	
OW TO IV		1312	3.18	-58.30			61.48	20.00	-41.48	T4	
	Radial	1412	3.18	-57.99	-63.10	N/A	61.17	20.00	-41.17	T4	2.4, 2.4
		1513	3.14	-55.93			59.07	20.00	-39.07	T4	
		9262	10.58	-48.96		1.53	59.54	20.00	-39.54	T4	
	Axial	9400	10.63	-48.00	-64.73	1.56	58.63	20.00	-38.63	T4	2.0, 1.4
UMTS II		9538	10.58	-49.38		1.54	59.96	20.00	-39.96	T4	
OWISH		9262	3.13	-56.42		•	59.55	20.00	-39.55	T4	
	Radial	9400	3.20	-58.19	-63.10	N/A	61.39	20.00	-41.39	T4	2.4, 2.4
		9538	3.18	-55.66			58.84	20.00	-38.84	T4	1

Table 9-5 **Raw Data Results for LTE B71**

Mode	Orientation	Bandwidth	Channel	ABM1 [dB(A/m)]	ABM2 [dB(A/m)]	Ambient Noise [dB(A/m)]	Frequency Response Margin (dB)	S+N/N (dB)	FCC Limit (dB)	Margin from FCC Limit (dB)	C63.19-2011 Rating	Test Coordinates
		20MHz	133297	-1.71	-49.33		1.94	47.62	20.00	-27.62	T4	
	Axial	15MHz	133297	-1.73	-50.47	-64.73	1.71	48.74	20.00	-28.74	T4	2.0, 1.4
	Axiai	10MHz	133297	-1.74	-51.46	-04.73	1.80	49.72	20.00	-29.72	T4	2.0, 1.4
LTE Band 71		5MHz	133297	-1.73	-50.64		1.99	48.91	20.00	-28.91	T4	1
LIE Ballu / I		20MHz	133297	-8.48	-52.66			44.18	20.00	-24.18	T4	
	Padial	15MHz	133297	-8.54	-54.29	-62.39	N/A	45.75	20.00	-25.75	T4	2.4. 2.4
Radial -	10MHz	133297	-8.52	-52.70	-02.39	INA	44.18	20.00	-24.18	T4	2.4, 2.4	
	5MHz	133297	-8.51	-52.94			44.43	20.00	-24.43	T4		

Table 9-6 **Raw Data Results for LTE B12**

Mode	Orientation	Bandwidth	Channel	ABM1 [dB(A/m)]	ABM2 [dB(A/m)]	Ambient Noise [dB(A/m)]	Frequency Response Margin (dB)	S+N/N (dB)	FCC Limit (dB)	Margin from FCC Limit (dB)	C63.19-2011 Rating	Test Coordinates
		10MHz	23095	-1.68	-45.97		1.84	44.29	20.00	-24.29	T4	
	Axial	5MHz	23095	-1.65	-46.73	-64.73	1.91	45.08	20.00	-25.08	T4	2.0. 1.4
	Axiai	3MHz	23095	-1.65	-47.57	-04.73	1.71	45.92	20.00	-25.92	T4	2.0, 1.4
LTE Band 12	,	1.4MHz	23095	-1.64	-45.66		1.57	44.02	20.00	-24.02	T4	
LIE Ballu 12		10MHz	23095	-8.49	-52.82			44.33	20.00	-24.33	T4	
	Padial	5MHz	23095	-8.51	-54.17	-62.39	N/A	45.66	20.00	-25.66	T4	2.4. 2.4
Radial	3MHz	23095	-8.53	-54.96	-02.39	IVA	46.43	20.00	-26.43	T4	2.4, 2.4	
		1.4MHz	23095	-8.48	-54.69			46.21	20.00	-26.21	T4	

Table 9-7 **Raw Data Results for LTE B13**

Mode	Orientation	Bandwidth	Channel	ABM1 [dB(A/m)]	ABM2 [dB(A/m)]	Ambient Noise [dB(A/m)]	Frequency Response Margin (dB)	S+N/N (dB)	FCC Limit (dB)	Margin from FCC Limit (dB)	C63.19-2011 Rating	Test Coordinates
	Axial	10MHz	23230	-1.62	-43.65	-64.73	1.40	42.03	20.00	-22.03	T4	2.0, 1.4
LTE Band 13		5MHz	23230	-1.81	-44.13		1.99	42.32	20.00	-22.32	T4	2.0, 1.4
LIE Ballu 13		10MHz	23230	-8.51	-52.34	-62.39	N/A	43.83	20.00	-23.83	T4	2.4. 2.4
	Radial —	5MHz	23230	-8.50	-53.62	-62.39	IN/A	45.12	20.00	-25.12	T4	2.4, 2.4

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Table 9-8 Raw Data Results for LTE B14

Mode	Orientation	Bandwidth	Channel	ABM1 [dB(A/m)]	ABM2 [dB(A/m)]	Ambient Noise [dB(A/m)]	Frequency Response Margin (dB)	S+N/N (dB)	FCC Limit (dB)	Margin from FCC Limit (dB)	C63.19-2011 Rating	Test Coordinates
Axial	10MHz	23330	-1.71	-49.89	64.70	1.71	48.18	20.00	-28.18	T4	2.0, 1.4	
LTE Bond 4		5MHz	23330	-1.69	-50.07	-64.73	1.90	48.38	20.00	-28.38	T4	2.0, 1.4
LTE Band 14	10MHz	23330	-8.52	-53.39	-62.39	NI/A	44.87	20.00	-24.87	T4	2.4. 2.4	
F	Raulai	5MHz	23330	-8.46	-53.84	-02.39	N/A	45.38	20.00	-25.38	T4	2.4, 2.4

Table 9-9 Raw Data Results for LTE B26

					_ 0.00	ocuito io						
Mode	Orientation	Bandwidth	Channel	ABM1 [dB(A/m)]	ABM2 [dB(A/m)]	Ambient Noise [dB(A/m)]	Frequency Response Margin (dB)	S+N/N (dB)	FCC Limit (dB)	Margin from FCC Limit (dB)	C63.19-2011 Rating	Test Coordinates
		15MHz	26865	-1.75	-48.44		1.86	46.69	20.00	-26.69	T4	
		10MHz	26865	-1.71	-47.09		1.85	45.38	20.00	-25.38	T4	
	Axial	5MHz	26865	-1.72	-45.78	-64.73	1.83	44.06	20.00	-24.06	T4	2.0, 1.4
		3MHz	26865	-1.75	-48.19		1.85	46.44	20.00	-26.44	T4	
LTE Band 26		1.4MHz	26865	-1.79	-48.19		1.84	46.40	20.00	-26.40	T4	
LIE Ballu 20		15MHz	26865	-8.55	-54.88			46.33	20.00	-26.33	T4	
		10MHz	26865	-8.56	-53.82			45.26	20.00	-25.26	T4	
	Radial	5MHz	26865	-8.56	-54.56	-62.39	N/A	46.00	20.00	-26.00	T4	2.4, 2.4
		3MHz	26865	-8.56	-55.88			47.32	20.00	-27.32	T4	
		1.4MHz	26865	-8.59	-54.78			46.19	20.00	-26.19	T4	

Table 9-10 Raw Data Results for LTE B5

				-				-				
Mode	Orientation	Bandwidth	Channel	ABM1 [dB(A/m)]	ABM2 [dB(A/m)]	Ambient Noise [dB(A/m)]	Frequency Response Margin (dB)	S+N/N (dB)	FCC Limit (dB)	Margin from FCC Limit (dB)	C63.19-2011 Rating	Test Coordinates
		10MHz	20525	-1.70	-46.68		1.88	44.98	20.00	-24.98	T4	
	Axial	5MHz	20525	-1.98	-46.19	-64.73	2.00	44.21	20.00	-24.21	T4	2.0, 1.4
	Axiai	3MHz	20525	-1.77	-46.56	-62.39	1.89	44.79	20.00	-24.79	T4	2.0, 1.4
LTE Band 5		1.4MHz	20525	-2.03	-45.74		2.00	43.71	20.00	-23.71	T4	
LIE Banu 5		10MHz	20525	-8.49	-54.48			45.99	20.00	-25.99	T4	
	Radial -	5MHz	20525	-8.52	-54.64		N/A	46.12	20.00	-26.12	T4	2.4. 2.4
		3MHz	20525	-8.47	-53.52	-02.39	IVA	45.05	20.00	-25.05	T4	2.4, 2.4
		1.4MHz	20525	-8.46	-55.09			46.63	20.00	-26.63	T4	

Table 9-11 Raw Data Results for LTE B66

Mode	Orientation	Bandwidth	Channel	ABM1 [dB(A/m)]	ABM2 [dB(A/m)]	Ambient Noise [dB(A/m)]	Frequency Response Margin (dB)	S+N/N (dB)	FCC Limit (dB)	Margin from FCC Limit (dB)	C63.19-2011 Rating	Test Coordinates
		20MHz	132572	-1.80	-36.00		1.65	34.20	20.00	-14.20	T4	
		20MHz	132322	-2.12	-36.36		1.87	34.24	20.00	-14.24	T4	
	Axial	20MHz	132072	-1.73	-36.90		1.73	35.17	20.00	-15.17	T4	
		15MHz	132322	-2.01	-36.47	-64.73	1.94	34.46	20.00	-14.46	T4	2.0, 1.4
		10MHz	132322	-2.01	-36.65	-04.73	1.81	34.64	20.00	-14.64	T4	2.0, 1.4
	5MHz	132322	-1.75	-37.80		1.85	36.05	20.00	-16.05	T4		
		3MHz	132322	-1.81	-38.27		1.85	36.46	20.00	-16.46	T4	
LTE Band 66		1.4MHz	132322	-1.95	-39.28		1.61	37.33	20.00	-17.33	T4	
LIE Ballu 00		20MHz	132572	-8.58	-43.31			34.73	20.00	-14.73	T4	
		20MHz	132322	-8.55	-43.06			34.51	20.00	-14.51	T4	
		20MHz	132072	-8.57	-43.53			34.96	20.00	-14.96	T4	
	D	15MHz	132322	-8.55	-43.09	00.00	NI/A	34.54	20.00	-14.54	T4	04.04
	Radial	10MHz	132322	-8.55	-43.61	-62.39	N/A	35.06	20.00	-15.06	T4	2.4, 2.4
		5MHz	132322	-8.55	-43.73			35.18	20.00	-15.18	T4	
		3MHz	132322	-8.55	-44.18			35.63	20.00	-15.63	T4	
		1.4MHz	132322	-8.54	-45.08			36.54	20.00	-16.54	T4	

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Table 9-12 Raw Data Results for LTE B25

Mode	Orientation	Bandwidth	Channel	ABM1 [dB(A/m)]	ABM2 [dB(A/m)]	Ambient Noise [dB(A/m)]	Frequency Response Margin (dB)	S+N/N (dB)	FCC Limit (dB)	Margin from FCC Limit (dB)	C63.19-2011 Rating	Test Coordinates
		20MHz	26365	-1.82	-39.08		1.82	37.26	20.00	-17.26	T4	
		15MHz	26365	-1.81	-37.92		1.88	36.11	20.00	-16.11	T4	
	Axial	10MHz	26365	-1.80	-38.67	-64.73	1.87	36.87	20.00	-16.87	T4	2.0, 1.4
	Axiai	5MHz	26365	-1.77	-37.94	-04.73	1.87	36.17	20.00	-16.17	T4	2.0, 1.4
		3MHz	26365	-1.82	-38.94		1.82	37.12	20.00	-17.12	T4	
LTE Band 25		1.4MHz	26365	-1.77	-39.67		1.84	37.90	20.00	-17.90	T4	
LIE Ballu 25		20MHz	26365	-8.53	-45.34			36.81	20.00	-16.81	T4	
		15MHz	26365	-8.53	-44.98			36.45	20.00	-16.45	T4	
	Radial	10MHz	26365	-8.55	-45.19	-62.39	N/A	36.64	20.00	-16.64	T4	2.4, 2.4
		5MHz	26365	-8.54	-45.30	-02.39	IVA	36.76	20.00	-16.76	T4	2.4, 2.4
		3MHz	26365	-8.58	-45.20		_	36.62	20.00	-16.62	T4	
		1.4MHz	26365	-8.51	-46.12			37.61	20.00	-17.61	T4	

Table 9-13 Raw Data Results for LTE B2

Mode	Orientation	Bandwidth	Channel	ABM1 [dB(A/m)]	ABM2 [dB(A/m)]	Ambient Noise [dB(A/m)]	Frequency Response Margin (dB)	S+N/N (dB)	FCC Limit (dB)	Margin from FCC Limit (dB)	C63.19-2011 Rating	Test Coordinates
		20MHz	18900	-1.82	-39.14		1.90	37.32	20.00	-17.32	T4	
		15MHz	18900	-1.84	-38.79		1.87	36.95	20.00	-16.95	T4	
	Axial	10MHz	18900	-1.78	-38.80	-64.73	1.89	37.02	20.00	-17.02	T4	2.0, 1.4
	Axiai	5MHz	18900	-1.81	-38.50	-04.73	1.84	36.69	20.00	-16.69	T4	2.0, 1.4
		3MHz	18900	-1.80	-38.59		1.80	36.79	20.00	-16.79	T4	
LTE Band 2		1.4MHz	18900	-1.83	-40.26		1.84	38.43	20.00	-18.43	T4	
LIE Ballu Z		20MHz	18900	-8.54	-45.39			36.85	20.00	-16.85	T4	
		15MHz	18900	-8.54	-45.19			36.65	20.00	-16.65	T4	
	Radial	10MHz	18900	-8.53	-45.70	-62.39	2.39 N/A	37.17	20.00	-17.17	T4	24.24
	radiai	5MHz	18900	-8.55	-44.90	-62.39		36.35	20.00	-16.35	T4	2.4, 2.4
		3MHz	18900	-8.50	-44.83	3		36.33	20.00	-16.33	T4	
		1.4MHz	18900	-8.51	-45.52			37.01	20.00	-17.01	T4	

Table 9-14 Raw Data Results for LTE B30

	Mode	Orientation	Bandwidth	Channel	ABM1 [dB(A/m)]	ABM2 [dB(A/m)]	Ambient Noise [dB(A/m)]	Frequency Response Margin (dB)	S+N/N (dB)	FCC Limit (dB)	Margin from FCC Limit (dB)	C63.19-2011 Rating	Test Coordinates
	Axial - Radial -	Axial	10MHz	27710	-1.74	-43.08	-64.73	1.97	41.34	20.00	-21.34	T4 2.0, 1.4	20.14
		5MHz	27710	-1.78	-41.99	-64.73	1.91	40.21	20.00	-20.21	T4	2.0, 1.4	
		10MHz	27710	-8.48	-50.18	62.20	NI/A	41.70	20.00	-21.70	T4	2.4. 2.4	
		Radial	5MHz	27710	-8.52	-48.74	-62.39	N/A	40.22	20.00	-20.22	T4	2.4, 2.4

Table 9-15 Raw Data Results for LTE B7

Mode	Orientation	Bandwidth	Channel	ABM1 [dB(A/m)]	ABM2 [dB(A/m)]	Ambient Noise [dB(A/m)]	Frequency Response Margin (dB)	S+N/N (dB)	FCC Limit (dB)	Margin from FCC Limit (dB)	C63.19-2011 Rating	Test Coordinates
		20MHz	21100	-1.75	-41.62		1.94	39.87	20.00	-19.87	T4	
	Axial -	15MHz	21100	-1.75	-40.40	-64.73	1.94	38.65	20.00	-18.65	T4	2.0, 1.4
		10MHz	21100	-1.72	-41.41	-04.73	1.80	39.69	20.00	-19.69	T4	2.0, 1.4
LTE Band 7		5MHz	21100	-1.72	-43.35		1.88	41.63	20.00	-21.63	T4	
LIE Ballu /	Radial —	20MHz	21100	-8.49	-50.32	-62.39 N/A		41.83	20.00	-21.83	T4	
		15MHz	21100	-8.52	-49.52		NI/A	41.00	20.00	-21.00	T4	2.4. 2.4
		10MHz	21100	-8.50	-50.23		IWA	41.73	20.00	-21.73	T4	2.4, 2.4
		5MHz	21100	-8.51	-51.56			43.05	20.00	-23.05	T4	

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Table 9-16 Raw Data Results for LTE B41 Power Class 3

				Dutu I II					•			
Mode	Orientation	Bandwidth	Channel	ABM1 [dB(A/m)]	ABM2 [dB(A/m)]	Ambient Noise [dB(A/m)]	Frequency Response Margin (dB)	S+N/N (dB)	FCC Limit (dB)	Margin from FCC Limit (dB)	C63.19-2011 Rating	Test Coordinates
		20MHz	40620	-1.79	-31.25		1.84	29.46	20.00	-9.46	T3	
	Axial	15MHz	40620	-1.67	-30.87	-64.73	1.88	29.20	20.00	-9.20	T3	2.0, 1.4
	Axiai	10MHz	40620	-1.68	-30.43	-04.73	1.83	28.75	20.00	-8.75	Т3	2.0, 1.4
LTE Band 41		5MHz	40620	-1.63	-30.40		1.96	28.77	20.00	-8.77	Т3	
LIE Ballu 41	Radial —	20MHz	40620	-8.62	-38.72	-62.39		30.10	20.00	-10.10	T4	
		15MHz	40620	-8.58	-38.56			29.98	20.00	-9.98	Т3	2.4, 2.4
		10MHz	40620	-8.62	-38.20		-62.39 N/A	29.58	20.00	-9.58	Т3	2.4, 2.4
		5MHz	40620	-8.59	-38.00			29.41	20.00	-9.41	Т3	

Table 9-17 Raw Data Results for LTE B41 Power Class 2

Mode	Orientation	Bandwidth	Channel	ABM1 [dB(A/m)]	ABM2 [dB(A/m)]	Ambient Noise [dB(A/m)]	Frequency Response Margin (dB)	S+N/N (dB)	FCC Limit (dB)	Margin from FCC Limit (dB)	C63.19-2011 Rating	Test Coordinates
		20MHz	40620	-1.87	-26.96		1.95	25.09	20.00	-5.09	Т3	
		15MHz	40620	-1.75	-26.21		1.80	24.46	20.00	-4.46	Т3	
		10MHz	40620	-1.63	-26.26		1.83	24.63	20.00	-4.63	Т3	
	Axial	5MHz	41490	-1.52	-30.18	-64.73	1.83	28.66	20.00	-8.66	Т3	2.0, 1.4
	Axiai	5MHz	41055	-1.50	-25.38	-04.73	1.98	23.88	20.00	-3.88	Т3	2.0, 1.4
		5MHz	40620	-1.72	-25.72		1.96	24.00	20.00	-4.00	Т3	
		5MHz	40185	-1.55	-25.43		1.88	23.88	20.00	-3.88	Т3	
LTE Band 41		5MHz	39750	-1.70	-25.37		1.86	23.67	20.00	-3.67	T3	
LIE Band 41		20MHz	41490	-8.74	-39.64			30.90	20.00	-10.90	T4	
		20MHz	41055	-8.76	-36.59			27.83	20.00	-7.83	Т3	
		20MHz	40620	-8.61	-36.89			28.28	20.00	-8.28	Т3	
	Radial	20MHz	40185	-8.76	-35.50	62.20	N/A	26.74	20.00	-6.74	Т3	2.4, 2.4
	Radiai	20MHz	39750	-8.78	-36.97	-62.39	IWA	28.19	20.00	-8.19	Т3	2.4, 2.4
		15MHz	40620	-8.72	-37.66			28.94	20.00	-8.94	Т3	
		10MHz	40620	-8.76	-37.35		-	28.59	20.00	-8.59	Т3	
		5MHz	40620	-8.71	-37.56			28.85	20.00	-8.85	Т3	

Table 9-18 Raw Data Results for LTE B48

Mode	Orientation	Bandwidth	Channel	ABM1 [dB(A/m)]	ABM2 [dB(A/m)]	Ambient Noise [dB(A/m)]	Frequency Response Margin (dB)	S+N/N (dB)	FCC Limit (dB)	Margin from FCC Limit (dB)	C63.19-2011 Rating	Test Coordinates
		20MHz	55990	-1.75	-32.12		1.92	30.37	20.00	-10.37	T4	
	Axial	15MHz	55990	-1.66	-32.08	-64.73	1.82	30.42	20.00	-10.42	T4	2.0, 1.4
	Axiai	10MHz	55990	-1.65	-32.07	-04.73	1.82	30.42	20.00	-10.42	T4	2.0, 1.4
LTE Band 48		5MHz	55990	-1.64	-32.21		1.96	30.57	20.00	-10.57	T4	
LIE Ballu 40	Radial —	20MHz	55990	-8.61	-40.99	00.00	N/A	32.38	20.00	-12.38	T4	
		15MHz	55990	-8.64	-41.07			32.43	20.00	-12.43	T4	2.4. 2.4
		10MHz	55990	-8.68	-40.70	-62.39	IN/A	32.02	20.00	-12.02	T4	2.4, 2.4
		5MHz	55990	-8.63	-40.95			32.32	20.00	-12.32	T4	

Table 9-19 Raw Data Results for 2.4GHz WIFI

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Mode	Orientation	Channel	ABM1 [dB(A/m)]	ABM2 [dB(A/m)]	Ambient Noise [dB(A/m)]	Frequency Response Margin (dB)	S+N/N (dB)	FCC Limit (dB)	Margin from FCC Limit (dB)	C63.19-2011 Rating	Test Coordinates
		1	-2.32	-37.05		1.77	34.73	20.00	-14.73	T4	
	Axial	6	-2.62	-37.52	-61.90	1.81	34.90	20.00	-14.90	T4	2.0, 1.4
IEEE		11	-2.20	-38.18		1.82	35.98	20.00	-15.98	T4	
802.11b		1	-10.52	-39.32			28.80	20.00	-8.80	Т3	
	Radial	6	-10.49	-40.91	-62.39	N/A	30.42	20.00	-10.42	T4	2.4, 2.4
		11	-10.43	-39.66			29.23	20.00	-9.23	Т3	
IEEE	Axial	6	-2.51	-41.20	-61.90	1.80	38.69	20.00	-18.69	T4	2.0, 1.4
802.11g	Radial	6	-10.53	-42.93	-62.39	N/A	32.40	20.00	-12.40	T4	2.4, 2.4
IEEE	Axial	6	-2.42	-37.78	-61.90	1.76	35.36	20.00	-15.36	T4	2.0, 1.4
802.11n	Radial	6	-10.53	-42.17	-62.39	N/A	31.64	20.00	-11.64	T4	2.4, 2.4

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Table 9-20 Raw Data Results for 5GHz WIFI IEEE 802.11a

Mode	Orientation	Bandwidth	U-NII	Channel	ABM1 [dB(A/m)]	ABM2 [dB(A/m)]	Ambient Noise [dB(A/m)]	Frequency Response Margin (dB)	S+N/N (dB)	FCC Limit (dB)	Margin from FCC Limit (dB)	C63.19-2011	Test Coordinates
	Axial	20MHz	1	40	-2.19	-44.04	-61.90	1.75	41.85	20.00	-21.85	T4	2.0, 1.4
IEEE 802.11a	a												
	Radial	20MHz	1	40	-10.45	-45.14	-62.39	N/A	34.69	20.00	-14.69	T4	2.4, 2.4

Table 9-21 Raw Data Results for 5GHz WIFI IEEE 802.11n

Mode	Orientation	Bandwidth	U-NII	Channel	ABM1 [dB(A/m)]	ABM2 [dB(A/m)]	Ambient Noise [dB(A/m)]	Frequency Response Margin (dB)	S+N/N (dB)	FCC Limit (dB)	Margin from FCC Limit (dB)	C63.19-2011 Rating	Test Coordinates
		40MHz	1	38	-2.27	-43.18		1.77	40.91	20.00	-20.91	T4	
		40MHz	1	46	-2.26	-43.60		1.74	41.34	20.00	-21.34	T4	
		20MHz	1	40	-2.24	-44.20		1.77	41.96	20.00	-21.96	T4	
		40MHz	2A	54	-2.28	-45.23		1.77	42.95	20.00	-22.95	T4	
	Axial IEEE 802.11n	20MHz	2A	56	-2.27	-44.46	-61.90	1.78	42.19	20.00	-22.19	T4	2.0, 1.4
IEEE		40MHz	2C	118	-2.28	-44.68		2.00	42.40	20.00	-22.40	T4	
802.11n		20MHz	2C	120	-2.26	-44.61		1.67	42.35	20.00	-22.35	T4	
		40MHz	3	151	-2.27	-46.25		1.70	43.98	20.00	-23.98	T4	
		20MHz	3	157	-2.31	-44.90		1.81	42.59	20.00	-22.59	T4	
	Padial	40MHz	1	38	-10.38	-47.18	-62.39	-62.39 N/A	36.80	20.00	-16.80	T4	2.4. 2.4
	Radial	20MHz	1	40	-10.45	-44.97		INA	34.52	20.00	-14.52	T4	2.4, 2.4

Table 9-22 Raw Data Results for 5GHz WIFI IEEE 802.11ac

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Mode	Orientation	Bandwidth	U-NII	Channel	ABM1 [dB(A/m)]	ABM2 [dB(A/m)]	Ambient Noise [dB(A/m)]	Frequency Response Margin (dB)	S+N/N (dB)	FCC Limit (dB)	Margin from FCC Limit (dB)	C63.19-2011 Rating	Test Coordinates
	Axial	40MHz	1	38	-2.24	-45.14	-61.90	1.78	42.90	20.00	-22.90	T4	2.0, 1.4
	Axiai	20MHz	1	40	-2.19	-43.63	-61.90	1.76	41.44	20.00	-21.44	T4	2.0, 1.4
		40MHz	1	38	-10.36	-45.20			34.84	20.00	-14.84	T4	
		20MHz	1	36	-10.52	-44.28			33.76	20.00	-13.76	T4	
.EEE		20MHz	1	40	-10.37	-44.69			34.32	20.00	-14.32	T4	
IEEE 802.11ac		20MHz	1	48	-10.49	-44.25			33.76	20.00	-13.76	T4	
002.11ac	Radial	40MHz	2A	54	-10.33	-46.76	-62.39	N/A	36.43	20.00	-16.43	T4	2.4, 2.4
	Radiai	20MHz	2A	56	-10.34	-44.76	-02.39	IN/A	34.42	20.00	-14.42	T4	2.4, 2.4
		40MHz	2C	118	-10.39	-46.29			35.90	20.00	-15.90	T4	
		20MHz	2C	120	-10.36	-44.80			34.44	20.00	-14.44	T4	
		40MHz	3	151	-10.30	-46.36			36.06	20.00	-16.06	T4	
		20MHz	3	157	-10.30	-44.99			34.69	20.00	-14.69	T4	

Table 9-23 Raw Data Results for EvDO (OTT VoIP)

Orientation	Channel	ABM1 [dB(A/m)]	ABM2 [dB(A/m)]	Ambient Noise [dB(A/m)]	Frequency Response Margin (dB)	S+N/N (dB)	FCC Limit (dB)	Margin from FCC Limit (dB)	C63.19-2011 Rating	Test Coordinates
Axial	564	5.30	-48.18	-64.73	2.00	53.48	20.00	-33.48	T4	2.0, 1.4
Radial	564	-1.73	-35.22	-63.10	N/A	33.49	20.00	-13.49	T4	2.4, 2.4
Axial	384	5.10	-46.52	-64.73	2.00	51.62	20.00	-31.62	T4	2.0, 1.4
Radial	384	-1.70	-35.76	-63.10	N/A	34.06	20.00	-14.06	T4	2.4, 2.4
Axial	600	5.44	-44.04	-64.73	2.00	49.48	20.00	-29.48	T4	2.0, 1.4
Radial	600	-1.75	-35.20	-63.10	N/A	33.45	20.00	-13.45	T4	2.4, 2.4
	Axial Radial Axial Radial Axial	Axial 564 Radial 564 Axial 384 Radial 384 Axial 600	Axial 564 5.30 Radial 564 -1.73 Axial 384 5.10 Radial 384 -1.70 Axial 600 5.44	Axial 564 5.30 -48.18 Radial 564 -1.73 -35.22 Axial 384 5.10 -46.52 Radial 384 -1.70 -35.76 Axial 600 5.44 -44.04	Axial 564 5.30 -48.18 -64.73 Radial 564 -1.73 -35.22 -63.10 Axial 384 5.10 -46.52 -64.73 Radial 384 -1.70 -35.76 -63.10 Axial 600 5.44 -44.04 -64.73	Axial 564 5.30 -48.18 -64.73 2.00 Radial 564 -1.73 -35.22 -63.10 N/A Axial 384 5.10 -46.52 -64.73 2.00 Radial 384 -1.70 -35.76 -63.10 N/A Axial 600 5.44 -44.04 -64.73 2.00	Axial 564 5.30 -48.18 -64.73 2.00 53.48 Radial 564 -1.73 -35.22 -63.10 N/A 33.49 Axial 384 5.10 -46.52 -64.73 2.00 51.62 Radial 384 -1.70 -35.76 -63.10 N/A 34.06 Axial 600 5.44 -44.04 -64.73 2.00 49.48	Axial 384 5.10 -46.52 -64.73 2.00 51.62 20.00 Radial 384 -1.70 -35.76 -63.10 N/A 34.06 20.00 Axial 384 -1.70 -35.76 -63.10 N/A 34.06 20.00 Axial 600 5.44 -44.04 -64.73 2.00 49.48 20.00	Axial 384 5.10 -46.52 -64.73 2.00 51.62 20.00 -31.62 Radial 384 -1.70 -35.76 -63.10 N/A 34.06 20.00 -14.06 Axial 384 -1.70 -35.76 -63.10 N/A 34.06 20.00 -14.06	Axial 564 5.30 -48.18 -64.73 2.00 53.48 20.00 -33.48 T4 Radial 564 -1.73 -35.22 -63.10 N/A 33.49 20.00 -13.49 T4 Axial 384 5.10 -46.52 -64.73 2.00 51.62 20.00 -31.62 T4 Radial 384 -1.70 -35.76 -63.10 N/A 34.06 20.00 -14.06 T4 Axial 600 5.44 -44.04 -64.73 2.00 49.48 20.00 -29.48 T4

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Table 9-24 Raw Data Results for EDGE (OTT VoIP)

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Mode	Orientation	Channel	ABM1 [dB(A/m)]	ABM2 [dB(A/m)]	Ambient Noise [dB(A/m)]	Frequency Response Margin (dB)	S+N/N (dB)	FCC Limit (dB)	Margin from FCC Limit (dB)	C63.19-2011 Rating	Test Coordinates
EDGE850	Axial	190	5.71	-24.95	-64.73	2.00	30.66	20.00	-10.66	T4	2.0, 1.4
EDGE050	Radial	190	-1.96	-29.64	-63.10	N/A	27.68	20.00	-7.68	Т3	2.4, 2.4
EDGE1900	Axial	661	5.64	-20.96	-64.73	2.00	26.60	20.00	-6.60	Т3	2.0, 1.4
EDGE 1900	Radial	661	-1.73	-30.99	-63.10	N/A	29.26	20.00	-9.26	Т3	2.4, 2.4

Table 9-25 Raw Data Results for HSPA (OTT VoIP)

				Data it	counto ioi		JII V OII	,			
Mode	Orientation	Channel	ABM1 [dB(A/m)]	ABM2 [dB(A/m)]	Ambient Noise [dB(A/m)]	Frequency Response Margin (dB)	S+N/N (dB)	FCC Limit (dB)	Margin from FCC Limit (dB)	C63.19-2011	Test Coordinates
HSPA V	Axial	4183	5.23	-48.51	-64.73	2.00	53.74	20.00	-33.74	T4	2.0, 1.4
NOFA V	Radial	4183	-1.73	-34.92	-63.10	N/A	33.19	20.00	-13.19	T4	2.4, 2.4
HSPA IV	Axial	1412	5.01	-49.47	-64.73	2.00	54.48	20.00	-34.48	T4	2.0, 1.4
HOFAIV	Radial	1412	-1.71	-34.91	-63.10	N/A	33.20	20.00	-13.20	T4	2.4, 2.4
HSPA II	Axial	9400	5.49	-47.94	-64.73	2.00	53.43	20.00	-33.43	T4	2.0, 1.4
HOFAII	Radial	9400	-1.75	-34.81	-63.10	N/A	33.06	20.00	-13.06	T4	2.4, 2.4

Table 9-26 Raw Data Results for LTE B66 (OTT VoIP)

Mode	Orientation	Bandwidth	Channel	ABM1 [dB(A/m)]	ABM2 [dB(A/m)]	Ambient Noise [dB(A/m)]	Frequency Response Margin (dB)	S+N/N (dB)	FCC Limit (dB)	Margin from FCC Limit (dB)	C63.19-2011 Rating	Test Coordinates
		20MHz	132572	5.19	-36.25		2.00	41.44	20.00	-21.44	T4	
		20MHz	132322	5.55	-35.84		2.00	41.39	20.00	-21.39	T4	
		20MHz	132072	5.47	-36.25		2.00	41.72	20.00	-21.72	T4	
	Axial	15MHz	132322	5.51	-36.04	-64.73	2.00	41.55	20.00	-21.55	T4	2.0, 1.4
	Axiai	10MHz	132322	5.51	-36.59	-04.73	2.00	42.10	20.00	-22.10	T4	2.0, 1.4
		5MHz	132322	5.54	-37.69		2.00	43.23	20.00	-23.23	T4	
		3MHz	132322	5.48	-37.09		2.00	42.57	20.00	-22.57	T4	
LTE Band 66		1.4MHz	132322	5.48	-37.93		2.00	43.41	20.00	-23.41	T4	
LIE Ballu 00		20MHz	132322	-2.01	-46.55			44.54	20.00	-24.54	T4	
		15MHz	132322	-2.00	-46.77			44.77	20.00	-24.77	T4	
		10MHz	132322	-2.14	-46.79			44.65	20.00	-24.65	T4	
	Radial	5MHz	132322	-2.04	-46.74	-63.10	N/A	44.70	20.00	-24.70	T4	2.4, 2.4
	Raulai	3MHz	132322	-2.02	-46.89	-03.10	IVA	44.87	20.00	-24.87	T4	2.4, 2.4
		1.4MHz	132665	-2.07	-43.80			41.73	20.00	-21.73	T4	
		1.4MHz	132322	-2.05	-46.32			44.27	20.00	-24.27	T4	
		1.4MHz	131979	-2.06	-47.35			45.29	20.00	-25.29	T4	

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Table 9-27 Raw Data Results for LTE B41 (PC2) (OTT VoIP)

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Mode	Orientation	Bandwidth	Channel	ABM1 [dB(A/m)]	ABM2 [dB(A/m)]	Ambient Noise [dB(A/m)]	Frequency Response Margin (dB)	S+N/N (dB)	FCC Limit (dB)	Margin from FCC Limit (dB)	C63.19-2011 Rating	Test Coordinates
		20MHz	40620	5.50	-28.19		2.00	33.69	20.00	-13.69	T4	
		15MHz	40620	5.42	-27.56		2.00	32.98	20.00	-12.98	T4	
		10MHz	40620	5.40	-27.39		2.00	32.79	20.00	-12.79	T4	
	Axial	5MHz	41490	5.12	-29.96	-64.73	2.00	35.08	20.00	-15.08	T4	2.0, 1.4
	Axiai	5MHz	41055	5.25	-27.10	-04.73	2.00	32.35	20.00	-12.35	T4	2.0, 1.4
		5MHz	40620	5.28	-27.17		2.00	32.45	20.00	-12.45	T4	
		5MHz	40185	5.25	-26.58		2.00	31.83	20.00	-11.83	T4	
LTE Band 41		5MHz	39750	5.41	-26.41		2.00	31.82	20.00	-11.82	T4	
LIE Ballu 41		20MHz	41490	-1.14	-41.19			40.05	20.00	-20.05	T4	
		20MHz	41055	-1.16	-38.51			37.35	20.00	-17.35	T4	
		20MHz	40620	-1.14	-35.94			34.80	20.00	-14.80	T4	
	Radial	20MHz	40185	-1.17	-38.32	62.20	N/A	37.15	20.00	-17.15	T4	2.4, 2.4
	radiai	20MHz	39750	-1.17	-34.35	-62.39	IN/A	33.18	20.00	-13.18	T4	2.4, 2.4
		15MHz	40620	-1.13	-40.18			39.05	20.00	-19.05	T4	
		10MHz	40620	-1.15	-40.01			38.86	20.00	-18.86	T4	
		5MHz	40620	-1.15	-39.87			38.72	20.00	-18.72	T4	

Table 9-28 Raw Data Results for NR n66 (OTT VoIP)

							, 101 1111	1100 (0	, i i i i i i i	- /				
Mode	Orientation	Bandwidth	Channel	ABM1 _{LTE} [dB(A/m)]	ABM2 _{NR} [dB(A/m)]	ABM2 _{LTE} [dB(A/m)]	Ambient Noise [dB(A/m)]	Frequency Response Margin (dB)	S+N/N _{NR} (dB)	S+N/N _{NR} - 3 dB (dB)	FCC Limit (dB)	Margin from FCC Limit (dB)	C63.19-2011 Rating	Test Coordinates
		20MHz	349000	5.55	-39.36	-35.84			44.91	41.91	20.00	-21.91	T4	
		15MHz	349000	5.55	-37.96	-35.84			43.51	40.51	20.00	-20.51	T4	
	Axial	10MHz	349000	5.55	-37.74	-35.84	-61.90	N/A	43.29	40.29	20.00	-20.29	T4	2.0, 1.4
	Axiai	5MHz	355500	5.55	-37.29	-35.84	-01.90	INVA	42.84	39.84	20.00	-19.84	T4	2.0, 1.4
		5MHz	349000	5.55	-37.46	-35.84			43.01	40.01	20.00	-20.01	T4	
NR n66		5MHz	342500	5.55	-37.58	-35.84			43.13	40.13	20.00	-20.13	T4	
INK 1100		20MHz	354000	-2.01	-47.89	-46.55			45.88	42.88	20.00	-22.88	T4	
		20MHz	349000	-2.01	-46.98	-46.55			44.97	41.97	20.00	-21.97	T4	
	D#-I	20MHz	344000	-2.01	-47.76	-46.55	00.00	NUA	45.75	42.75	20.00	-22.75	T4	0404
	Radial	15MHz	349000	-2.01	-47.30	-46.55	-62.39	N/A	45.29	42.29	20.00	-22.29	T4	2.4, 2.4
		10MHz	349000	-2.01	-48.08	-46.55			46.07	43.07	20.00	-23.07	T4	
		5MHz	349000	-2.01	-48.62	-46.55			46.61	43.61	20.00	-23.61	T4	

Table 9-29 Raw Data Results for LTE B66 (OTT VoIP – Additional Measurements for NR)

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Mode	Orientation	Bandwidth	Channel	ABM1 _{LTE} [dB(A/m)]	ABM2 _{NR} [dB(A/m)]	ABM2 _{LTE} [dB(A/m)]	Ambient Noise [dB(A/m)]	Frequency Response Margin (dB)	S+N/N _{LTE} (dB)	S+N/N _{NR} - 3 dB (dB)	FCC Limit (dB)	Margin from FCC Limit (dB)	C63.19-2011 Rating	Test Coordinates
LTE Band	Axial	20MHz	132322	5.55	N/A	-35.84	-61.90	N/A	41.39	N/A	20.00	-21.39	T4	2.0, 1.4
66	Radial	20MHz	132322	-2.01	IVA	-46.55	-62.39	IVA	44.54	IVA	20.00	-24.54	T4	2.4, 2.4

Table 9-30 Raw Data Results for NR n41 (OTT VoIP)

				IXUV	Datai	Count	NI IOI	· 11-7-1 (C	, , , , , ,	' /				
Mode	Orientation	Bandwidth	Channel	ABM1 _{LTE} [dB(A/m)]	ABM2 _{NR} [dB(A/m)]	ABM2 _{LTE} [dB(A/m)]	Ambient Noise [dB(A/m)]	Frequency Response Margin (dB)	S+N/N _{NR} (dB)	S+N/N _{NR} - 3 dB (dB)	FCC Limit (dB)	Margin from FCC Limit (dB)	C63.19-2011 Rating	Test Coordinates
		100MHz	518598	5.99	-23.96	-31.88			29.95	26.95	20.00	-6.95	Т3	
		80MHz	518598	5.99	-23.35	-31.88			29.34	26.34	20.00	-6.34	Т3	
		60MHz	532002	5.99	-21.43	-31.88			27.42	24.42	20.00	-4.42	Т3	
		60MHz	525300	5.99	-24.67	-31.88			30.66	27.66	20.00	-7.66	T4	
	Axial	60MHz	518598	5.99	-23.32	-31.88	-61.90	N/A	29.31	26.31	20.00	-6.31	Т3	2.0, 1.4
		60MHz	511902	5.99	-25.46	-31.88			31.45	28.45	20.00	-8.45	T4	
		60MHz	505200	5.99	-23.35	-31.88			29.34	26.34	20.00	-6.34	Т3	
		40MHz	518598	5.99	-23.80	-31.88			29.79	26.79	20.00	-6.79	Т3	
NR n41		20MHz	518598	5.99	-25.35	-31.88			31.34	28.34	20.00	-8.34	T4	
NK 1141		100MHz	518598	-2.35	-40.31	-40.96			37.96	34.96	20.00	-14.96	T4	
		80MHz	518598	-2.35	-39.34	-40.96			36.99	33.99	20.00	-13.99	T4	
		60MHz	532002	-2.35	-37.43	-40.96			35.08	32.08	20.00	-12.08	T4	
		60MHz	525300	-2.35	-41.21	-40.96			38.86	35.86	20.00	-15.86	T4	
	Radial	60MHz	518598	-2.35	-39.05	-40.96	-62.39	N/A	36.70	33.70	20.00	-13.70	T4	2.4, 2.4
		60MHz	511902	-2.35	-41.92	-40.96			39.57	36.57	20.00	-16.57	T4	
		60MHz	505200	-2.35	-39.15	-40.96			36.80	33.80	20.00	-13.80	T4	
		40MHz	518598	-2.35	-39.16	-40.96			36.81	33.81	20.00	-13.81	T4	
		20MHz	518598	-2.35	-41.39	-40.96			39.04	36.04	20.00	-16.04	T4	

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Table 9-31 Raw Data Results for LTE B41 (PC3) (OTT VoIP – Additional Measurements for NR)

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Mode	Orientation	Bandwidth	Channel	ABM1 _{LTE} [dB(A/m)]	ABM2 _{NR} [dB(A/m)]	ABM2 _{LTE} [dB(A/m)]	Ambient Noise [dB(A/m)]	Frequency Response Margin (dB)	S+N/N _{LTE} (dB)	S+N/N _{NR} - 3 dB (dB)	FCC Limit (dB)	Margin from FCC Limit (dB)	C63.19-2011 Rating	Test Coordinates
LTE B41	Axial	20MHz	40620	5.99	N/A	-31.88	-61.90	NIA	37.87	N/A	20.00	-17.87	T4	2.0, 1.4
(PC3)	Radial	20MHz	40620	-2.35	IVA	-40.96	-62.39	N/A	38.61		20.00	-18.61	T4	2.4, 2.4

Table 9-32 Raw Data Results for 2.4GHz WIFI (OTT VoIP)

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Mode	Orientation	Channel	ABM1 [dB(A/m)]	ABM2 [dB(A/m)]	Ambient Noise [dB(A/m)]	Frequency Response Margin (dB)	S+N/N (dB)	FCC Limit (dB)	Margin from FCC Limit (dB)	C63.19-2011 Rating	Test Coordinates
		1	5.60	-35.42		2.00	41.02	20.00	-21.02	T4	
	Axial	6	5.65	-35.04	-61.90	2.00	40.69	20.00	-20.69	T4	2.0, 1.4
IEEE		11	5.69	-36.90		2.00	42.59	20.00	-22.59	T4	
802.11b	Radial	1	-2.26	-38.46	-62.39		36.20	20.00	-16.20	T4	
		6	-2.26	-39.43		N/A 37.17	37.17	20.00	-17.17	T4	2.4, 2.4
		11	-2.43	-38.25			35.82	20.00	-15.82	T4	
IEEE	Axial	6	5.63	-37.96	-61.90	2.00	43.59	20.00	-23.59	T4	2.0, 1.4
802.11g	Radial	6	-2.25	-40.03	-62.39	N/A	37.78	20.00	-17.78	T4	2.4, 2.4
IEEE	Axial	6	5.62	-35.79	-61.90	2.00	41.41	20.00	-21.41	T4	2.0, 1.4
802.11n	Radial	6	-2.25	-42.39	-62.39	N/A	40.14	20.00	-20.14	T4	2.4, 2.4

Table 9-33 Raw Data Results for 5GHz WIFI IEEE 802.11a (OTT VoIP)

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Mode	Orientation	Bandwidth	U-NII	Channel	ABM1 [dB(A/m)]	ABM2 [dB(A/m)]	Ambient Noise [dB(A/m)]	Frequency Response Margin (dB)	S+N/N (dB)	FCC Limit (dB)	Margin from FCC Limit (dB)	C63.19-2011 Rating	Test Coordinates
	Axial	20MHz	1	40	5.59	-44.90	-61.90	2.00	50.49	20.00	-30.49	T4	2.0, 1.4
		20MHz	1	40	-2.29	-41.84	-62.39) N/A	39.55	20.00	-19.55	T4	
IEEE		20MHz	2A	56	-2.27	-42.15			39.88	20.00	-19.88	T4	
802.11a	Radial	20MHz	2C	100	-2.27	-42.48			40.21	20.00	-20.21	T4	2.4. 2.4
	Radiai	20MHz	2C	120	-2.25	-40.63	-02.39	IWA	38.38	20.00	-18.38	T4	2.4, 2.4
		20MHz	2C	144	-2.29	-42.52			40.23	20.00	-20.23	T4	
		20MHz	3	157	-2.28	-42.07			39.79	20.00	-19.79	T4	

Table 9-34 Raw Data Results for 5GHz WIFI IEEE 802.11n (OTT VoIP)

Mode	Orientation	Bandwidth	U-NII	Channel	ABM1 [dB(A/m)]	ABM2 [dB(A/m)]	Ambient Noise [dB(A/m)]	Frequency Response Margin (dB)	S+N/N (dB)	FCC Limit (dB)	Margin from FCC Limit (dB)	C63.19-2011 Rating	Test Coordinates
		40MHz	1	38	5.70	-41.66		2.00	47.36	20.00	-27.36	T4	
		40MHz	1	46	5.38	-45.64		2.00	51.02	20.00	-31.02	T4	2.0, 1.4
	Axial	20MHz	1	40	5.67	-44.15	-61.90	2.00	49.82	20.00	-29.82	T4	
		40MHz	2A	54	5.66	-45.79		2.00	51.45	20.00	-31.45	T4	
		20MHz	2A	56	5.62	-45.10		2.00	50.72	20.00	-30.72	T4	
IEEE		40MHz	2C	118	5.67	-46.67		2.00	52.34	20.00	-32.34	T4	
802.11n		20MHz	2C	120	5.23	-45.25		2.00	50.48	20.00	-30.48	T4	
		40MHz	3	151	5.69	-44.70		2.00	50.39	20.00	-30.39	T4	1
		20MHz	3	157	5.68	-45.46		2.00	51.14	20.00	-31.14	T4	
	Radial	40MHz	1	38	-2.31	-44.42	-62.39	N/A	42.11	20.00	-22.11	T4	2.4, 2.4
	Natial	20MHz	1	40	-2.16	-43.58		-62.39 N/A	41.42	20.00	-21.42	T4	2.4, 2.4

Table 9-35 Raw Data Results for 5GHz WIFI IEEE 802.11ac (OTT VoIP)

	Mode	Orientation	Bandwidth	U-NII	Channel	ABM1 [dB(A/m)]	ABM2 [dB(A/m)]	Ambient Noise [dB(A/m)]	Frequency Response Margin (dB)	S+N/N (dB)	FCC Limit (dB)	Margin from FCC Limit (dB)	C63.19-2011	Test Coordinates
		Axial	40MHz	1	38	5.60	-45.29	-61.90	2.00	50.89	20.00	-30.89	T4	2.0. 1.4
	IEEE	Axidi	20MHz	1	40	5.68	-44.98	-01.90	2.00	50.66	20.00	-30.66	T4	2.0, 1.4
5	1EEE 302.11ac													
	,o <u>z.</u> 11ac	Dadiel	40MHz	1	38	-2.25	-45.12	60.00	NUA	42.87	20.00	-22.87	T4	2.4. 2.4
		Radial	20MHz	1	40	-2.25	-44.27	-62.39	-62.39 N/A	42.02	20.00	-22.02	T4	2.4, 2.4

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II. **Test Notes**

A. General

- 1. Phone Condition: Mute on; Backlight off; Max Volume; Max Contrast
- 2. 'Radial' orientation refers to radial transverse.
- 3. Hearing Aid Mode (Phone→Call Settings→Other call settings→Hearing aid compatibility) was set to ON for Frequency Response compliance
- 4. Speech Signal: 3GPP2 Normal Test Signal
- 5. Bluetooth and WIFI were disabled while testing 2G/3G/4G/5G modes.
- 6. Licensed data modes and Bluetooth were disabled while testing WIFI modes.
- 7. The Margin from FCC limit column indicates a margin from the FCC limit for compliance (T3).

B. CDMA

- 1. Power Configuration: Power Control Bits = "All Up"
- 2. Vocoder Configuration: RC1/SO68 (CDMA EVRC-B)

C. GSM

- 1. Power Configuration: GSM850: PCL=5, GSM1900: PCL=0;
- 2. Vocoder Configuration: EFR (GSM);

D. UMTS

- 1. Power Configuration: TPC= "All 1s";
- 2. Vocoder Configuration: AMR 12.2 kbps (UMTS);

E. LTE FDD

- 1. Power Configuration: TPC = "Max Power"
- 2. Radio Configuration: 16QAM, 1RB, 99%RB offset
- 3. Vocoder Configuration: EVS Primary SWB 24.4kbps
- 4. The worst-case band and bandwidth combination for each probe orientation is additionally tested on the low and high channels for those combinations. LTE Band 66 at 20MHz is the worst-case for the Axial and Radial probe orientation.

F. LTE TDD

- 1. Power Configuration: TPC = "Max Power"
- 2. Radio Configuration: 16QAM, 1RB, 99%RB offset
- 3. Power Class 3 Uplink-Downlink configuration: 1
- 4. Power Class 2 Uplink-Downlink configuration: 1
- 5. Vocoder Configuration: EVS Primary SWB 24.4kbps
- 6. The worst-case band and bandwidth combination for each probe orientation is additionally tested on the low, low-mid, high-mid, and high channels for those combinations. LTE Band 41 (Power Class 2) at 5MHz is the worst-case for the Axial probe orientation, LTE Band 41 (Power Class 2) at 20MHz is the worst-case for the Radial probe orientation.

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G. WIFI

- 1. Radio Configuration
 - a. IEEE 802.11b: DSSS, 1Mbps
 - b. IEEE 802.11q/a: BPSK. 9Mbps
 - c. IEEE 802.11n/ac 20MHz: 16QAM, MCS 3
 - d. IEEE 802.11n/ac 40MHz: 64QAM, MCS 6
- 2. Vocoder Configuration: EVS Primary SWB 24.4kbps
- 3. The worst-case standard for 2.4GHz WIFI in each probe orientation is additionally tested on the low and high channels. IEEE 802.11b is the worst-case for the Axial and Radial probe orientation.
- 4. The worst-case standard for 5GHz WIFI in each probe orientation is additionally tested on higher U-NII bands as well as applicable low and high channels. IEEE 802.11n 40MHz (U-NII 1) is the worst-case for the Axial probe orientation. IEEE 802.11ac 20MHz (U-NII 1) is the worst-case for the Radial probe orientation.

H. OTT VolP

- 1. Vocoder Configuration: 75kbps
- 2. EvDO Configuration
 - a. Revision: A
- 3. EDGE Configuration
 - a. MCS Index: 7
 - b. Number of TX slots: 2
- 4. HSPA Configuration:
 - a. Release: 6
 - b. 3GPP 34.121 Subtest 1
- 5. LTE FDD Configuration:
 - a. Power Configuration: TPC = "Max Power"
 - b. Radio Configuration: 16QAM, 1RB, 99%RB offset
 - c. LTE Band 66 was the worst-case band from Table 7-6 and was used to test both Axial and Radial probe orientations.
 - The worst-case band and bandwidth combination for each probe orientation is additionally tested on the low and high channels for those combinations. LTE Band 66 at 20MHz is the worst-case for the Axial probe orientation. LTE Band 66 at 1.4MHz bandwidth is the worst-case for the Radial probe orientation.
- 6. LTE TDD Configuration:
 - a. Power Configuration: TPC = "Max Power"
 - b. Radio Configuration: 16QAM, 1RB, 99%RB offset
 - c. Power Class 2 Uplink-Downlink configuration: 1
 - d. LTE Band 41 (PC2) was the worst-case band from Table 7-7 and was used to test both Axial and Radial probe orientations.
 - The worst-case band and bandwidth combination for each probe orientation is additionally tested on the low, low-mid, high-mid, and high channels for those combinations. LTE Band 41 (Power Class 2) at 5MHz is the worst-case for the Axial probe orientation. LTE Band 41 (Power Class 2) at 20MHz is the worst-case for the Radial probe orientation.
- 7. NR FDD Configuration
 - a. Power Configuration: TxAGC is set such that the DUT operates at max power.
 - b. Radio Configuration: DFT-s-OFDM, 16QAM, 1RB, 99%RB Offset.
 - Due to equipment limitations, ABM1 measurements were not possible. Therefore, the procedure outlined in Section 7.II.5 was followed to obtain SNNR values, Additionally. Frequency Response measurements were not possible due to equipment limitations.
 - NR Band n66 was the worst-case band from Table 7-12 and was used to test both Axial and Radial probe orientations.

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e. The worst-case band and bandwidth combination for each probe orientation is additionally tested on the low and high channels for those combinations. NR n66 at 5MHz is the worst-case for the Axial probe orientation. NR n66 at 20MHz bandwidth is the worst-case for the Radial probe orientation.

8. NR TDD Configuration

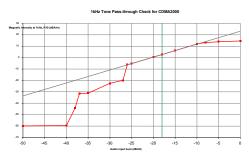
- a. Power Configuration: TxAGC is set such that the DUT operates at max power.
- b. Radio Configuration: DFT-s-OFDM, 16QAM, 1RB, 99%RB Offset.
- c. Due to equipment limitations, ABM1 measurements were not possible. Therefore, the procedure outlined in Section 7.II.5 was followed to obtain SNNR values. Additionally, Frequency Response measurements were not possible due to equipment limitations.
- d. NR Band n41 was the worst-case band from Table 7-13 and was used to test both Axial and Radial probe orientations.
- e. The worst-case band and bandwidth combination for each probe orientation is additionally tested on the low and high channels for those combinations. NR n41 at 60MHz is the worst-case for the Axial and Radial probe orientation.

9. WIFI Configuration:

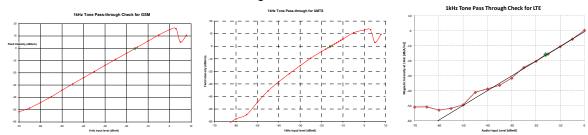
- a. Radio Configuration
 - i. IEEE 802.11b: DSSS, 1Mbps
 - ii. IEEE 802.11g/a: BPSK, 9Mbps
 - iii. IEEE 802.11n/ac 20MHz: 16QAM, MCS 3
 - iv. IEEE 802.11n/ac 40MHz: 64QAM, MCS 6
- b. The worst-case standard for 2.4GHz WIFI in each probe orientation is additionally tested on the low and high channels. IEEE 802.11b is the worst-case for the Axial and Radial probe orientation.
- c. The worst-case standard for 5GHz WIFI in each probe orientation is additionally tested on higher U-NII bands as well as applicable low and high channels. IEEE 802.11n 40MHz (U-NII 1) is the worst-case for the Axial probe orientation. IEEE 802.11a (U-NII 2C) is the worst-case for the Radial probe orientation.

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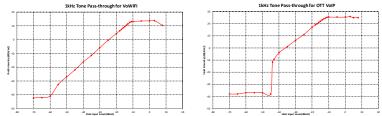
III. 1 kHz Vocoder Application Check



This model was verified to be within the linear region for ABM1 measurements at -18 dBm0 for CDMA. This measurement was taken in the axial configuration above the maximum location.



This model was verified to be within the linear region for ABM1 measurements at -16 dBm0 for GSM, UMTS, and VoLTE over IMS. This measurement was taken in the axial configuration above the maximum location.



This model was verified to be within the linear region for ABM1 measurements at -20 dBm0 for VoWIFI over IMS and OTT VoIP. This measurement was taken in the axial configuration above the maximum location.

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IV. T-Coil Validation Test Results

Table 9-36
Helmholtz Coil Validation Table of Results – 1/25/2021

ltem	Target	Result	Verdict
Axial			
Magnetic Intensity, -10 dBA/m	-10 ± 0.5 dB	-10.230	PASS
Environmental Noise	< -58 dBA/m	-64.73	PASS
Frequency Response, from limits	> 0 dB	0.70	PASS
Radial			
Magnetic Intensity, -10 dBA/m	-10 ± 0.5 dB	-10.286	PASS
Environmental Noise	< -58 dBA/m	-63.10	PASS
Frequency Response, from limits	> 0 dB	0.70	PASS

Table 9-37
Helmholtz Coil Validation Table of Results – 2/1/2021

ltem	Target	Result	Verdict
Axial			
Magnetic Intensity, -10 dBA/m	-10 ± 0.5 dB	-10.228	PASS
Environmental Noise	< -58 dBA/m	-61.90	PASS
Frequency Response, from limits	> 0 dB	0.70	PASS
Radial			
Magnetic Intensity, -10 dBA/m	-10 ± 0.5 dB	-10.296	PASS
Environmental Noise	< -58 dBA/m	-62.39	PASS
Frequency Response, from limits	> 0 dB	0.70	PASS

FCC ID: A3LSMA426U	PCTEST Provide to the desirence	HAC (T-COIL) TEST REPORT		Approved by: Quality Manager	
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V. ABM1 Magnetic Field Distribution Scan Overlays

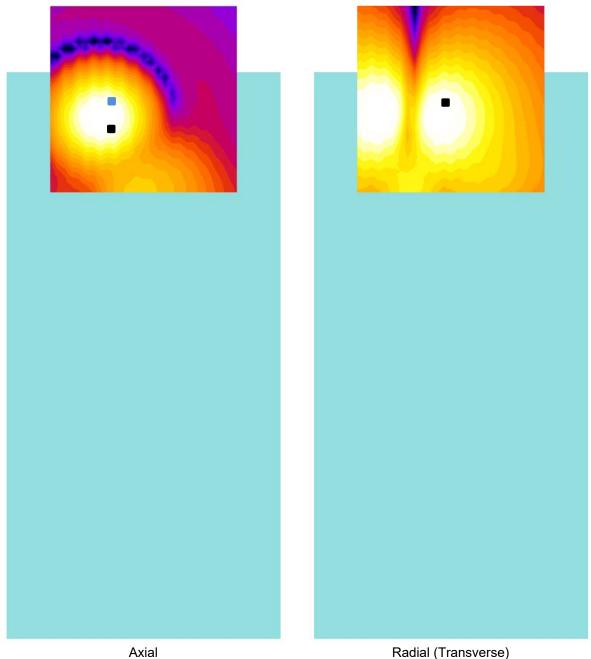


Figure 9-1
T-Coil Scan Overlay Magnetic Field Distributions

Notes:

- 1. Final measurement locations are indicated by a black cursor on the contour plots. The blue cursor represents the GSM1900 test location.
- 2. See Test Setup Photographs for actual WD overlay.

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MEASUREMENT UNCERTAINTY 10.

Table 10-1 Uncertainty Estimation Table

Contribution	Data +/- %	Data +/- dB	Data Type	Probability distribution	Divisor	Standard uncertainty	Standard Uncertainty (dB)
ABM Noise	7.0%	0.29	Std. Dev.	Normal k=1	1.00	7.0%	
RF Reflections	4.7%	0.20	Specification	Rectangular	1.73	2.7%	
Reference Signal Level	12.2%	0.50	Specification	Rectangular	1.73	7.0%	
Positioning Accuracy	10.0%	0.41	Uncertainty	Rectangular	1.73	5.8%	
Probe Coil Sensitivity	12.2%	0.50	Specification	Rectangular	1.73	7.0%	
Probe Linearity	2.4%	0.10	Std. Dev.	Normal k=1	1.00	2.4%	
Cable Loss	2.8%	0.12	Specification	Rectangular	1.73	1.6%	
Frequency Analyzer	5.0%	0.21	Specification	Rectangular	1.73	2.9%	
System Repeatability	5.0%	0.21	Std. Dev.	Normal k=1	1.00	5.0%	
WD Repeatability	9.0%	0.37	Std. Dev.	Normal k=1	1.00	9.0%	
Positioner Accuracy	1.0%	0.04	Specification	Rectangular	1.73	0.6%	
Combined standard uncertainty, uc (k=1)						17.7%	0.71
Expanded uncertainty (k=2), 95% confidence level						35.3%	1.31

Notes:

- Test equipments are calibrated according to techniques outlined in NIS81, NIS3003 and NIST Tech Note 1297.
- All equipments have traceability according to NIST. Measurement Uncertainties are defined in further detail in NIS 81 and NIST Tech Note 1297 and UKAS M3003.

Measurement uncertainty reflects the quality and accuracy of a measured result as compared to the true value. Such statements are generally required when stating results of measurements so that it is clear to the intended audience that the results may differ when reproduced by different facilities. Measurement results vary due to the measurement uncertainty of the instrumentation, measurement technique, and test engineer. Most uncertainties are calculated using the tolerances of the instrumentation used in the measurement, the measurement setup variability, and the technique used in performing the test. While not generally included, the variability of the equipment under test also figures into the overall measurement uncertainty. Another component of the overall uncertainty is based on the variability of repeated measurements (so-called Type A uncertainty). This may mean that the Hearing Aid compatibility tests may have to be repeated by taking down the test setup and resetting it up so that there are a statistically significant number of repeat measurements to identify the measurement uncertainty. By combining the repeat measurement results with that of the instrumentation chain using the technique contained in NIS 81 and NIS 3003, the overall measurement uncertainty was estimated.

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EQUIPMENT LIST 11.

Table 11-1 Equipment List

	Equipment Elst				
Model	Description	Cal Date	Cal Interval	Cal Due	Serial Number
4040	Temperature / Humidity Monitor	6/29/2019	Biennial	6/29/2021	192291470
Latitude E6540	SoundCheck Acoustic Analyzer Laptop	4/24/2019	Biennial	4/24/2021	7BFNM32
Fireface UC	Soundcheck Acoustic Analyzer External Audio Interface	4/24/2019	Biennial	4/24/2021	23528889
SoundConnect	Microphone Power Supply	4/22/2019	Biennial	4/22/2021	PS2612
CMW500	Wideband Radio Communication Tester	2/4/2020	Annual	2/4/2021	162125
CMW500	Wideband Radio Communication Tester	6/23/2020	Annual	6/23/2021	161662
NC-100	Torque Wrench (8" lb)	8/4/2020	Biennial	8/4/2022	N/A
	HAC System Controller with Software	N/A		N/A	N/A
	HAC Positioner	N/A		N/A	N/A
Helmholtz Coil	Helmholtz Coil	5/20/2019	Biennial	5/20/2021	925
Axial T-Coil Probe	Axial T-Coil Probe	5/17/2019	Biennial	5/17/2021	TEM-1124
Radial T-Coil Probe	Radial T-Coil Probe	5/17/2019	Biennial	5/17/2021	TEM-1130

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12. TEST DATA

FCC ID: A3LSMA426U	PCTEST Proof to be pest of @ seemed	HAC (T-COIL) TEST REPORT		Approved by: Quality Manager
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REV 3.5.M



DUT: HH Coil - SN: 925

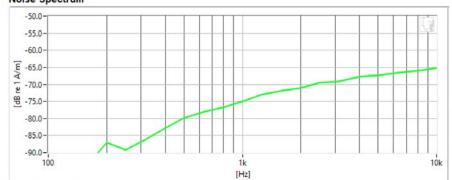
Type: HH Coil Serial: 925

Measurement Standard: ANSI C63.19-2011

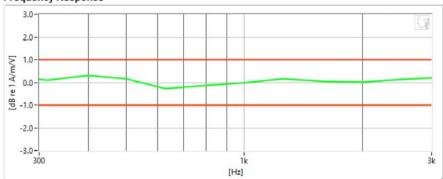
Equipment:

- Probe: Axial T-Coil Probe SN: TEM-1124; Calibrated: 05/17/2019
- Helmholtz Coil SN: 925; Calibrated: 05/20/2019

Noise Spectrum



Frequency Response



Results

Verification 1kHz Intensity	-10.23 dB		Max/Min	-9.5/-10.5
Verification ABM2	-64.73 dB	•	Maximum	-58.0
Frequency Response Margin	700m dB	•	Tolerance curves	Aligned Data

FCC ID: A3LSMA426U	PCTEST:	HAC (T-COIL) TEST REPORT		Approved by: Quality Manager
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REV 3.5.M



DUT: HH Coil - SN: 925

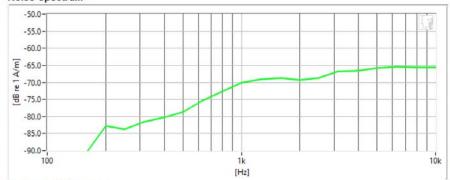
Type: HH Coil Serial: 925

Measurement Standard: ANSI C63.19-2011

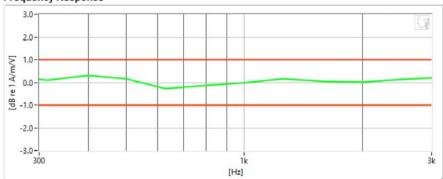
Equipment:

- Probe: Axial T-Coil Probe SN: TEM-1124; Calibrated: 05/17/2019
- Helmholtz Coil SN: 925; Calibrated: 05/20/2019

Noise Spectrum



Frequency Response



Results

Verification 1kHz Intensity	-10.228	dB	\checkmark	Max/Min	-9.5/-10.5
Verification ABM2	-61.9	dB	•	Maximum	-58.0
Frequency Response Margin	700m	dB		Tolerance curves	Aligned Data

FCC ID: A3LSMA426U	POTEST:	HAC (T-COIL) TEST REPORT		Approved by: Quality Manager
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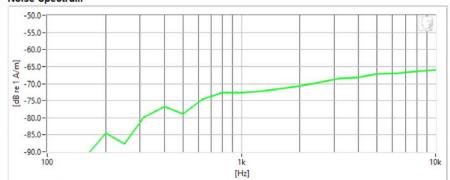
DUT: HH Coil - SN: 925 Type: HH Coil Serial: 925

Measurement Standard: ANSI C63.19-2011

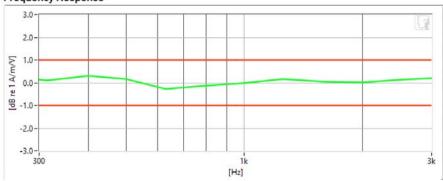
Equipment:

- Probe: Radial T-Coil Probe SN: TEM-1130; Calibrated: 05/17/2019
- Helmholtz Coil SN: 925; Calibrated: 05/20/2019

Noise Spectrum



Frequency Response



Results

Verification 1kHz Intensity	-10.286	dB		Max/Min	-9.5/-10.5
Verification ABM2	-63.1	dB	•	Maximum	-58.0
Frequency Response Margin	700m	dB	~	Tolerance curves	Aligned Data

FCC ID: A3LSMA426U	PCTEST*	HAC (T-COIL) TEST REPORT	SAMSUNG	Approved by: Quality Manager
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3k



PCTEST Hearing-Aid Compatibility Facility

DUT: HH Coil - SN: 925 Type: HH Coil

Serial: 925

Measurement Standard: ANSI C63.19-2011

Equipment:

-90.0-100

- Probe: Radial T-Coil Probe SN: TEM-1130; Calibrated: 05/17/2019
- Helmholtz Coil SN: 925; Calibrated: 05/20/2019

Noise Spectrum -50.0--55.0--60.0-E -65.0-置 -75.0 -85.0-

1k [Hz]

[Hz]

Frequency Response 3.0-2.0-[dB re 1 A/m/V] -2.0--3.0-

Results

300

Verification 1kHz Intensity	-10.296	dB	•	Max/Min	-9.5/-10.5
Verification ABM2	-62.39	dB	~	Maximum	-58.0
Frequency Response Margin	700m	dB	~	Tolerance curves	Aligned Data

FCC ID: A3LSMA426U	POTEST:	HAC (T-COIL) TEST REPORT	SAMSUNG	Approved by: Quality Manager
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Type: Portable Handset Serial: 13334

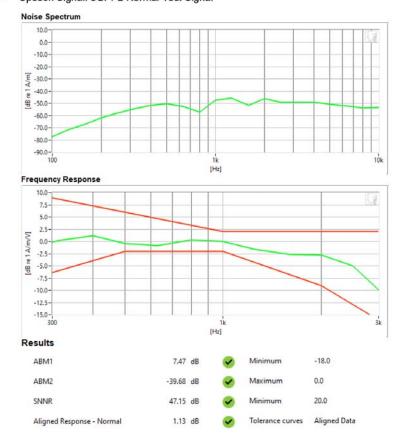
Measurement Standard: ANSI C63.19-2011 / CTIA HAC Test Plan v3.1.1

Equipment:

Probe: Axial T-Coil Probe – SN: TEM-1124; Calibrated: 05/17/2019

Test Configuration:

- Mode: Secondary Cellular CDMA
- Channel: 476
- Speech Signal: 3GPP2 Normal Test Signal



FCC ID: A3LSMA426U	PCTEST . Troub to be part of @ names	HAC (T-COIL) TEST REPORT	SAMSUNG	Approved by: Quality Manager
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Type: Portable Handset Serial: 13334

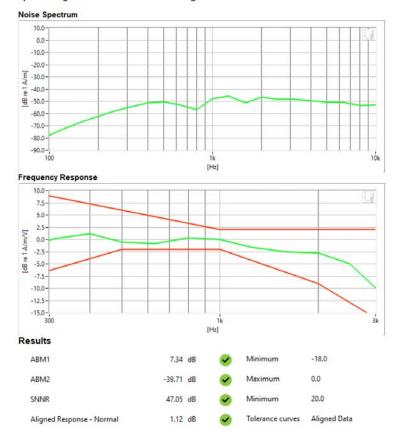
Measurement Standard: ANSI C63.19-2011 / CTIA HAC Test Plan v3.1.1

Equipment:

Probe: Axial T-Coil Probe – SN: TEM-1124; Calibrated: 05/17/2019

Test Configuration:

- Mode: Cellular CDMA
- Channel: 777
- Speech Signal: 3GPP2 Normal Test Signal



FCC ID: A3LSMA426U	PCTEST: Provid to the past of (6) removes	HAC (T-COIL) TEST REPORT	SAMSUNG	Approved by: Quality Manager
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Type: Portable Handset Serial: 13334

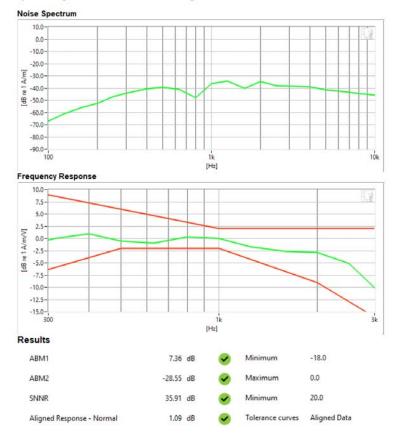
Measurement Standard: ANSI C63.19-2011 / CTIA HAC Test Plan v3.1.1

Equipment:

Probe: Axial T-Coil Probe – SN: TEM-1124; Calibrated: 05/17/2019

Test Configuration:

- Mode: PCS CDMA
- Channel: 25
- Speech Signal: 3GPP2 Normal Test Signal



FCC ID: A3LSMA426U	PCTEST:	HAC (T-COIL) TEST REPORT	SAMSUNG	Approved by: Quality Manager
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Type: Portable Handset Serial: 13334

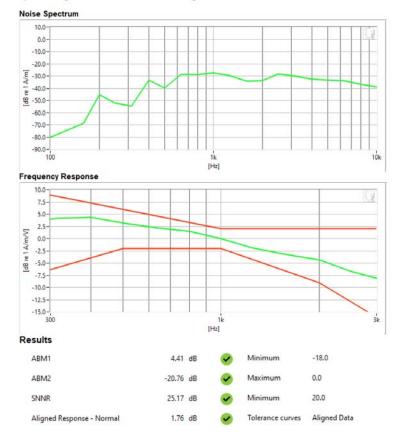
Measurement Standard: ANSI C63.19-2011

Equipment:

Probe: Axial T-Coil Probe – SN: TEM-1124; Calibrated: 05/17/2019

Test Configuration:

- Mode: GSM850 Channel: 190
- Speech Signal: 3GPP2 Normal Test Signal



FCC ID: A3LSMA426U	PCTEST . Troub to be part of @ names	HAC (T-COIL) TEST REPORT	SAMSUNG	Approved by: Quality Manager
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Type: Portable Handset Serial: 13334

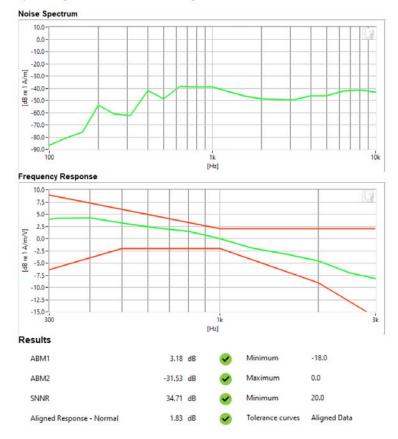
Measurement Standard: ANSI C63.19-2011

Equipment:

Probe: Axial T-Coil Probe – SN: TEM-1124; Calibrated: 05/17/2019

Test Configuration:

- Mode: GSM1900 Channel: 810
- Speech Signal: 3GPP2 Normal Test Signal



FCC ID: A3LSMA426U	PCTEST: Provid to the past of (6) removes	HAC (T-COIL) TEST REPORT	SAMSUNG	Approved by: Quality Manager
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Type: Portable Handset Serial: 13334

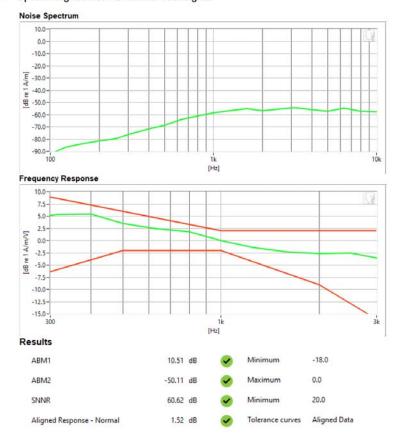
Measurement Standard: ANSI C63.19-2011

Equipment:

Probe: Axial T-Coil Probe – SN: TEM-1124; Calibrated: 05/17/2019

Test Configuration:

- Mode: UMTS V Channel: 4132
- Speech Signal: 3GPP2 Normal Test Signal



FCC ID: A3LSMA426U	PCTEST Proof to be pest of @ comment	HAC (T-COIL) TEST REPORT	SAMSUNG	Approved by: Quality Manager
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Type: Portable Handset Serial: 13334

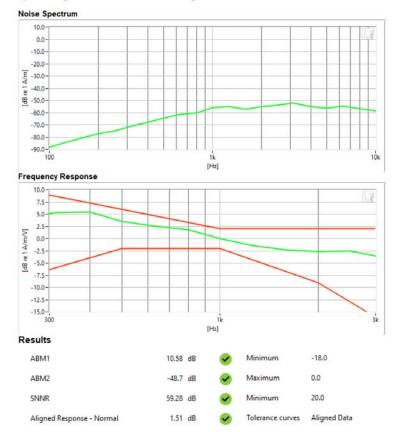
Measurement Standard: ANSI C63.19-2011

Equipment:

Probe: Axial T-Coil Probe – SN: TEM-1124; Calibrated: 05/17/2019

Test Configuration:

- Mode: UMTS IV Channel: 1312
- Speech Signal: 3GPP2 Normal Test Signal



FCC ID: A3LSMA426U	POTEST:	HAC (T-COIL) TEST REPORT	SAMSUNG	Approved by: Quality Manager
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Type: Portable Handset Serial: 13334

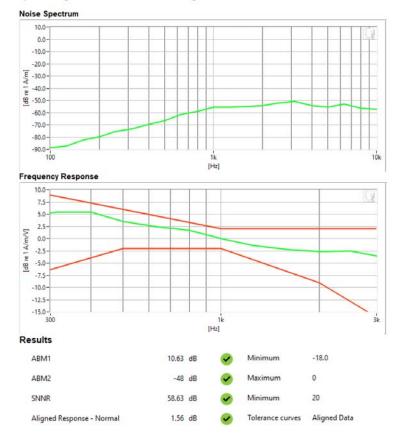
Measurement Standard: ANSI C63.19-2011

Equipment:

Probe: Axial T-Coil Probe – SN: TEM-1124; Calibrated: 05/17/2019

Test Configuration:

- Mode: UMTS II Channel: 9400
- Speech Signal: 3GPP2 Normal Test Signal



FCC ID: A3LSMA426U	PCTEST . Troub to be part of @ names	HAC (T-COIL) TEST REPORT	SAMSUNG	Approved by: Quality Manager
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Type: Portable Handset Serial: 13334

Measurement Standard: ANSI C63.19-2011 / CTIA HAC Test Plan v3.1.1

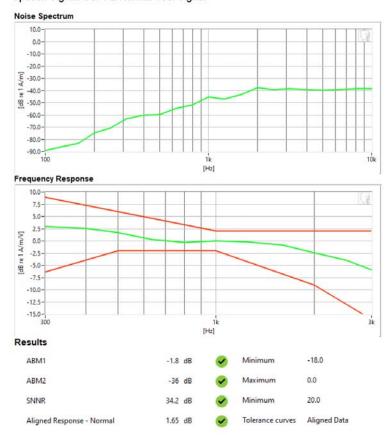
Equipment:

Probe: Axial T-Coil Probe – SN: TEM-1124; Calibrated: 05/17/2019

Test Configuration:

Mode: LTE FDD Band 66 Bandwidth: 20MHz Channel: 132572

Speech Signal: 3GPP2 Normal Test Signal



FCC ID: A3LSMA426U	PCTEST Thought be part of the remove	HAC (T-COIL) TEST REPORT	SAMSUNG	Approved by: Quality Manager
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Type: Portable Handset Serial: 13334

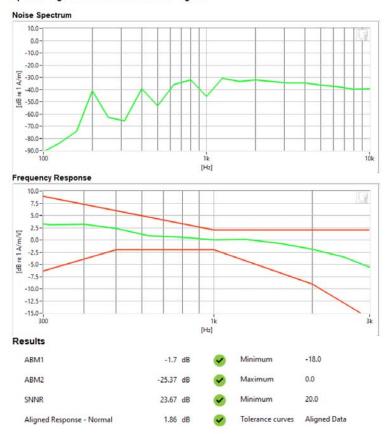
Measurement Standard: ANSI C63.19-2011 / CTIA HAC Test Plan v3.1.1

Equipment:

Probe: Axial T-Coil Probe – SN: TEM-1124; Calibrated: 05/17/2019

Test Configuration:

- Mode: LTE TDD Band 41 (PC2)
- Bandwidth: 5MHz Channel: 39750
- Speech Signal: 3GPP2 Normal Test Signal



FCC ID: A3LSMA426U	POTEST:	HAC (T-COIL) TEST REPORT		Approved by: Quality Manager
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Type: Portable Handset Serial: 13334

Measurement Standard: ANSI C63.19-2011

Equipment:

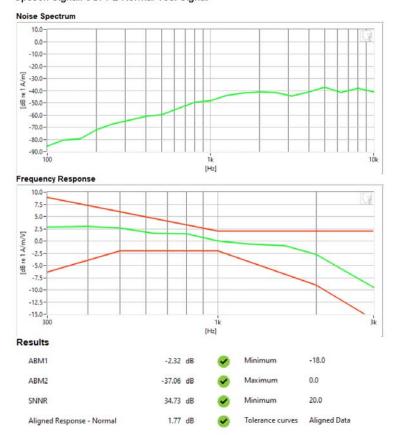
Probe: Axial T-Coil Probe – SN: TEM-1124; Calibrated: 05/17/2019

Test Configuration:

Mode: 2.4GHz WLAN Standard: IEEE 802.11b

Channel: 1

Speech Signal: 3GPP2 Normal Test Signal



FCC ID: A3LSMA426U	PCTEST:	HAC (T-COIL) TEST REPORT		Approved by: Quality Manager
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Type: Portable Handset Serial: 13334

Measurement Standard: ANSI C63.19-2011

Equipment:

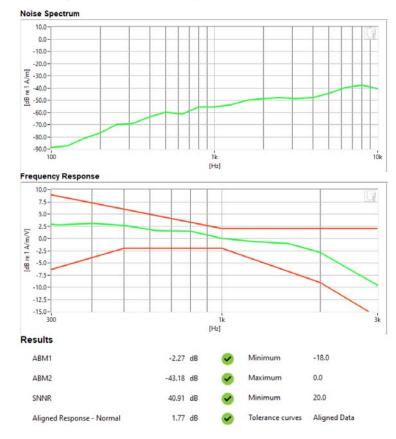
Probe: Axial T-Coil Probe – SN: TEM-1124; Calibrated: 05/17/2019

Test Configuration:

Mode: 5GHz WLAN Standard: IEEE 802.11n Bandwidth: 40MHz

Channel: 38

Speech Signal: 3GPP2 Normal Test Signal



FCC ID: A3LSMA426U	PCTEST . Troub to be part of @ names	HAC (T-COIL) TEST REPORT	HAC (T-COIL) TEST REPORT	
Filename:	Test Dates:	DUT Type:		Page 67 of 94
1M2101040001-19-R1.A3L	1/25/2021 - 2/4/2021	Portable Handset		rage 07 of 94



Type: Portable Handset Serial: 13334

Measurement Standard: ANSI C63.19-2011

Equipment:

Probe: Axial T-Coil Probe – SN: TEM-1124; Calibrated: 05/17/2019

Test Configuration:

· VolP Application: Google Duo Mode: NR TDD n41 Bandwidth: 60MHz



FCC ID: A3LSMA426U	PCTEST . Thought be part of @ senement	HAC (T-COIL) TEST REPORT		Approved by: Quality Manager
Filename:	Test Dates:	DUT Type:		Page 68 of 94
1M2101040001-19-R1.A3L	1/25/2021 - 2/4/2021	Portable Handset		rage 66 01 94



Type: Portable Handset Serial: 13334

Measurement Standard: ANSI C63.19-2011 / CTIA HAC Test Plan v3.1.1

Equipment:

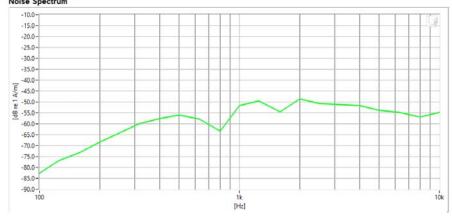
Probe: Radial T-Coil Probe – SN: TEM-1130; Calibrated: 05/17/2019

Test Configuration:

. Mode: Secondary Cellular CDMA

· Channel: 476

Noise Spectrum



Results

ABM1	-270m	dB	•	Minimum	-18.0
ABM2	-43.88	dB	•	Maximum	0.0
SNNR	43.61	dB	•	Minimum	20.0

FCC ID: A3LSMA426U	PCTEST . Troub to be part of @ names	HAC (T-COIL) TEST REPORT	HAC (T-COIL) TEST REPORT	
Filename:	Test Dates:	DUT Type:		Page 69 of 94
1M2101040001-19-R1.A3L	1/25/2021 - 2/4/2021	Portable Handset		rage 09 01 94



Type: Portable Handset Serial: 13334

Measurement Standard: ANSI C63.19-2011 / CTIA HAC Test Plan v3.1.1

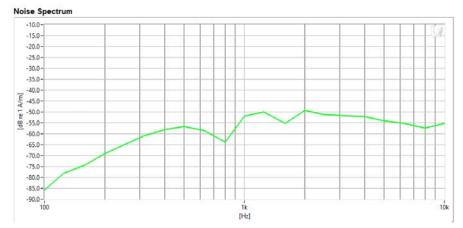
Equipment:

Probe: Radial T-Coil Probe – SN: TEM-1130; Calibrated: 05/17/2019

Test Configuration:

Mode: Cellular CDMA

Channel: 777



Results

ABM1	-10m	dB	•	Minimum	-18.0
ABM2	-44.39	dB	•	Maximum	0.0
SNNR	44.37	dB	•	Minimum	20.0

FCC ID: A3LSMA426U	PCTEST: Provid to the past of (6) removes	HAC (T-COIL) TEST REPORT	HAC (T-COIL) TEST REPORT	
Filename:	Test Dates:	DUT Type:		Page 70 of 94
1M2101040001-19-R1.A3L	1/25/2021 - 2/4/2021	Portable Handset		rage 70 of 94



Type: Portable Handset Serial: 13334

Measurement Standard: ANSI C63.19-2011 / CTIA HAC Test Plan v3.1.1

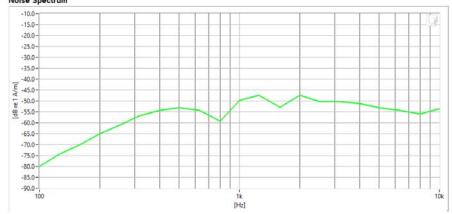
Equipment:

Probe: Radial T-Coil Probe – SN: TEM-1130; Calibrated: 05/17/2019

Test Configuration:

 Mode: PCS CDMA · Channel: 25

Noise Spectrum



Results

ABM1	30m	dB	•	Minimum	-18.0
ABM2	-41.67		•	Maximum	0
SNNR	41.7	dB	•	Minimum	20

FCC ID: A3LSMA426U	PCTEST Proved to the part of the removed	HAC (T-COIL) TEST REPORT	C-COIL) TEST REPORT	
Filename:	Test Dates:	DUT Type:		Page 71 of 94
1M2101040001-19-R1.A3L	1/25/2021 - 2/4/2021	Portable Handset		rage / 1 01 94



DUT: A3LSMA426U Type: Portable Handset

Serial: 13334

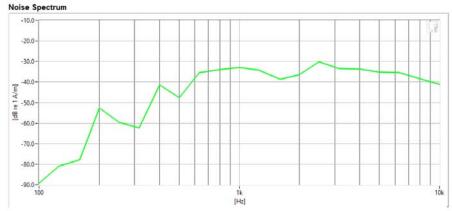
Measurement Standard: ANSI C63.19-2011

Equipment:

Probe: Radial T-Coil Probe – SN: TEM-1130; Calibrated: 05/17/2019

Test Configuration:

 Mode: GSM850 Channel: 251



Results

ABM1	-3.03	dB	\checkmark	Minimum	-18.0
ABM2	-26.05	dB	•	Maximum	0.0
SNNR	23.02	dB	•	Minimum	20.0

FCC ID: A3LSMA426U	PCTEST Proof to be pest of @ seemed	HAC (T-COIL) TEST REPORT		Approved by: Quality Manager
Filename:	Test Dates:	DUT Type:		Page 72 of 94
1M2101040001-19-R1.A3L	1/25/2021 - 2/4/2021	Portable Handset		rage / 2 01 94



Serial: 13334

Measurement Standard: ANSI C63.19-2011

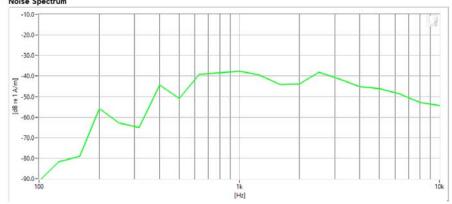
Equipment:

Probe: Radial T-Coil Probe – SN: TEM-1130; Calibrated: 05/17/2019

Test Configuration:

 Mode: GSM1900 · Channel: 661

Noise Spectrum



Results

ABM1	-2.99	dB	\checkmark	Minimum	-18.0
ABM2	-30.99	dB	~	Maximum	0.0
SNNR	28	dB	•	Minimum	20.0

FCC ID: A3LSMA426U	PCTEST Proved to the part of the removed	HAC (T-COIL) TEST REPORT	SAMSUNG	Approved by: Quality Manager
Filename:	Test Dates:	DUT Type:		Page 73 of 94
1M2101040001-19-R1.A3L	1/25/2021 - 2/4/2021	Portable Handset		Fage 73 01 94



Serial: 13334

Measurement Standard: ANSI C63.19-2011

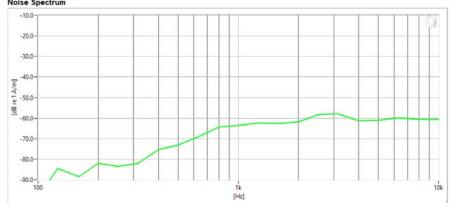
Equipment:

Probe: Radial T-Coil Probe – SN: TEM-1130; Calibrated: 05/17/2019

Test Configuration:

 Mode: UMTS V Channel: 4233

Noise Spectrum



Results

ABM1	3.13	dB	~	Minimum	-18.0
ABM2	-54.93	dB	~	Maximum	0.0
SNNR	58.06	dB	~	Minimum	20.0

FCC ID: A3LSMA426U	PCTEST Proved to the part of the removed	HAC (T-COIL) TEST REPORT	SAMSUNG	Approved by: Quality Manager
Filename:	Test Dates:	DUT Type:		Page 74 of 94
1M2101040001-19-R1.A3L	1/25/2021 - 2/4/2021	Portable Handset		Fage 74 01 94



Serial: 13334

Measurement Standard: ANSI C63.19-2011

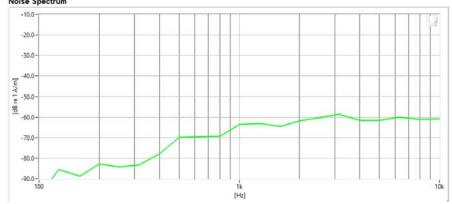
Equipment:

Probe: Radial T-Coil Probe – SN: TEM-1130; Calibrated: 05/17/2019

Test Configuration:

 Mode: UMTS IV Channel: 1513

Noise Spectrum



Results

ABM1	3.14	dB	~	Minimum	-18.0
ABM2	-55.92	dB	•	Maximum	0.0
SNNR	59.07	dB	~	Minimum	20.0

FCC ID: A3LSMA426U	PCTEST Proof to be pest of @ comment	HAC (T-COIL) TEST REPORT	SAMSUNG	Approved by: Quality Manager
Filename:	Test Dates:	DUT Type:		Dogo 75 of 04
1M2101040001-19-R1.A3L	1/25/2021 - 2/4/2021	Portable Handset		Page 75 of 94



Type: Portable Handset Serial: 13334

Measurement Standard: ANSI C63.19-2011

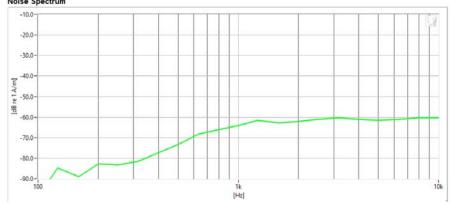
Equipment:

Probe: Radial T-Coil Probe – SN: TEM-1130; Calibrated: 05/17/2019

Test Configuration:

 Mode: UMTS II Channel: 9538

Noise Spectrum



Results

ABM1	3.18	dB	$ \checkmark $	Minimum	-18.0
ABM2	-55.66		•	Maximum	0.0
SNNR	58.84	dB	•	Minimum	20.0

FCC ID: A3LSMA426U	PCTEST Proved to the part of the removed	HAC (T-COIL) TEST REPORT	SAMSUNG	Approved by: Quality Manager
Filename:	Test Dates:	DUT Type:		Page 76 of 94
1M2101040001-19-R1.A3L	1/25/2021 - 2/4/2021	Portable Handset		Fage 70 01 94



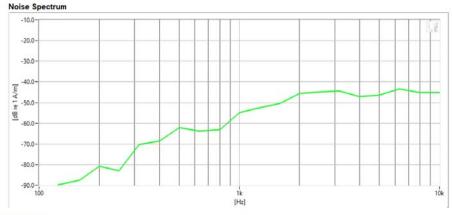
Measurement Standard: ANSI C63.19-2011

Equipment:

Probe: Radial T-Coil Probe – SN: TEM-1130; Calibrated: 05/17/2019

Test Configuration:

· Mode: LTE FDD Band 66 Bandwidth: 20MHz Channel: 132322



Results

ABM1	-8.55	dB	•	Minimum	-18.0
ABM2	-43.06	dB	~	Maximum	0.0
SNNR	34.51	dB	•	Minimum	20.0

FCC ID: A3LSMA426U	PCTEST Proof to be pest of @ comment	HAC (T-COIL) TEST REPORT	SAMSUNG	Approved by: Quality Manager
Filename:	Test Dates:	DUT Type:		Dogo 77 of 04
1M2101040001-19-R1.A3L	1/25/2021 - 2/4/2021	Portable Handset		Page 77 of 94



Type: Portable Handset Serial: 13334

Measurement Standard: ANSI C63.19-2011 / CTIA HAC Test Plan v3.1.1

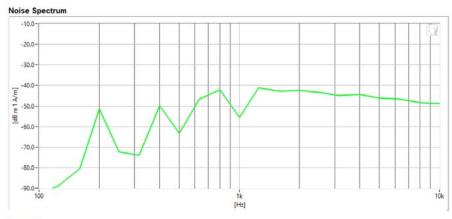
Equipment:

Probe: Radial T-Coil Probe – SN: TEM-1130; Calibrated: 05/17/2019

Test Configuration:

Mode: LTE TDD Band 41 (PC2)

Bandwidth: 20MHz Channel: 40185



Results

ABM1	-8.76	dB	•	Minimum	-18.0
ABM2	-35.51	dB	•	Maximum	0.0
SNNR	26.74	dB	~	Minimum	20.0

FCC ID: A3LSMA426U	PCTEST Proved to the part of the removed	HAC (T-COIL) TEST REPORT	SAMSUNG	Approved by: Quality Manager
Filename:	Test Dates:	DUT Type:		Page 78 of 94
1M2101040001-19-R1.A3L	1/25/2021 - 2/4/2021	Portable Handset		Fage 76 01 94



Type: Portable Handset Serial: 13334

Measurement Standard: ANSI C63.19-2011

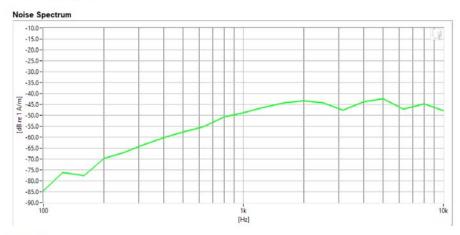
Equipment:

Probe: Radial T-Coil Probe – SN: TEM-1130; Calibrated: 05/17/2019

Test Configuration:

Mode: 2.4GHz WLAN Standard: IEEE 802.11b

Channel: 1



Results

ABM1	-10.52	dB		Minimum	-18.0
ABM2	-39.33	dB	•	Maximum	0.0
SNNR	28.8	dB	•	Minimum	20.0

FCC ID: A3LSMA426U	PCTEST Proved to the part of the removed	HAC (T-COIL) TEST REPORT	SAMSUNG	Approved by: Quality Manager
Filename:	Test Dates:	DUT Type:		Page 79 of 94
1M2101040001-19-R1.A3L	1/25/2021 - 2/4/2021	Portable Handset		Fage 19 01 94



Type: Portable Handset Serial: 13334

Measurement Standard: ANSI C63.19-2011

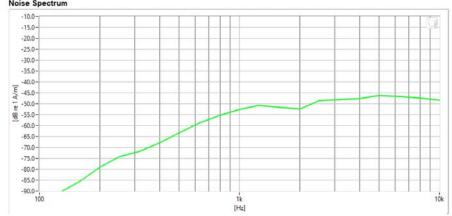
Equipment:

Probe: Radial T-Coil Probe – SN: TEM-1130; Calibrated: 05/17/2019

Test Configuration:

Mode: 5GHz WLAN Standard: IEEE 802.11ac Bandwidth: 20MHz Channel: 36

Noise Spectrum



...

Results

ABM1	-10.52	dB	\checkmark	Minimum	-18.0
ABM2	-44.28	dB	•	Maximum	0.0
SNNR	33.76	dB	•	Minimum	20.0

FCC ID: A3LSMA426U	PCTEST . Troub to be part of @ names	HAC (T-COIL) TEST REPORT	SAMSUNG	Approved by: Quality Manager
Filename:	Test Dates:	DUT Type:		Page 80 of 94
1M2101040001-19-R1.A3L	1/25/2021 - 2/4/2021	Portable Handset		rage 60 01 94



Serial: 13334

Measurement Standard: ANSI C63.19-2011

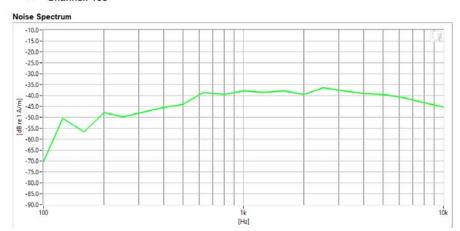
Equipment:

Probe: Radial T-Coil Probe – SN: TEM-1130; Calibrated: 05/17/2019

Test Configuration:

· VolP Application: Google Duo

Mode: EDGE850 Channel: 190



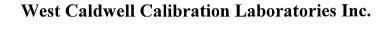
Results

ABM1	-1.96	dB	•	Minimum	-18.0
ABM2	-29.65	dB	9	Maximum	0.0
SNNR	27,68	dB	•	Minimum	20.0

FCC ID: A3LSMA426U	PCTEST: Provided to the peach of the resources	HAC (T-COIL) TEST REPORT	SAMSUNG	Approved by: Quality Manager
Filename:	Test Dates:	DUT Type:		Page 81 of 94
1M2101040001-19-R1.A3L	1/25/2021 - 2/4/2021	Portable Handset		rage of 01 94

CALIBRATION CERTIFICATES 13.

FCC ID: A3LSMA426U	PCTEST*	HAC (T-COIL) TEST REPORT	SAMSUNG	Approved by: Quality Manager
Filename:	Test Dates:	DUT Type:		Page 82 of 94
1M2101040001-19-R1.A3L	1/25/2021 - 2/4/2021	Portable Handset		Fage 62 01 94



Certificate of Calibration

for

AXIAL T COIL PROBE

Manufactured by:

TEM CONSULTING AXIAL T COIL PROBE

Model No: Serial No:

TEM-1124

Calibration Recall No:

29973

Submitted By:

Customer:

ANDREW HARWELL

Company:

PCTEST ENGINEERING LAB 6660-B DOBBIN ROAD

Address: 60

COLUMBIA

MD 21045

The subject instrument was calibrated to the indicated specification using standards traceable to the National Institute of Standards and Technology or to accepted values of natural physical constants. This document certifies that the instrument met the following specification upon its return to the submitter.

West Caldwell Calibration Laboratories Procedure No.

AXIAL T C TEM C

V K9F 6/4/2010

Upon receipt for Calibration, the instrument was found to be:

Within (X)

tolerance of the indicated specification. See attached Report of Calibration.
The information supplied relates to the calibrated item listed above.
West Caldwell Calibration Laboratories' calibration control system meets the requirements, ISO 10012-1 MIL-STD-45662A, ANSI/NCSL Z540-1, IEC Guide 25, ISO 9001:2015 and ISO 17025.

Note: With this Certificate, Report of Calibration is included.

Approved by:

Calibration Date:

17-May-19

James Zhu

Certificate No:

29973 -1

Quality Manager ISO/IEC 17025:2005

QA Doc. #1051 Rev. 2.0 10/1/01 Cer **West Caldwell**

Certificate Page 1 of 1

ACCREDITED

Calibration
uncompromised calibration Laboratories, Inc.

1575 State Route 96, Victor, NY 14564, U.S.A.

Calibration Lab. Cert. # 1533.01

FCC ID: A3LSMA426U

HAC (T-COIL) TEST REPORT

Approved by:
Quality Manager

Filename:
1M2101040001-19-R1.A3L
1/25/2021 - 2/4/2021
Portable Handset

Approved by:
Quality Manager

Page 83 of 94

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REV 3.5.M



Calibration Lab. Cert. # 1533.01

ISO/IEC 17025: 2005

1575 State Route 96, Victor NY 14564

REPORT OF CALIBRATION

TEM Consulting LP Axial T Coil Probe Company: PCTest Engineering Labs

Model No.: Axial T Coil Probe

Serial No.: TEM-1124

I. D. No.: XXXX

Probe Sensitivity measured wit	h Helmhol	tz Coil			
Helmholtz Coil;			Before & after data same:	X	
the number of turns on each coil;	10	No.			
the radius of each coil, in meters;	0.204	m	Laboratory Environment:		
the current in the coils, in amperes.;	0.09	Α	Ambient Temperature:	20.7	°C
Helmholtz Coil Constant;	7.09	A/m/V	Ambient Humidity:	42.7	% RH
Helmholtz Coil magnetic field;	5.96	A/m	Ambient Pressure:	98.256	kPa
			Calibration Date:	17-May-201	9
Probe Sensitivity at	1000	Hz.	Calibration Due:	17-May-202	0
was	-60.41	dBV/A/m	Report Number:	2997	'3 -1
	0.954	mV/A/m	Control Number:	2997	73
Probe resistance	903	Ohms			

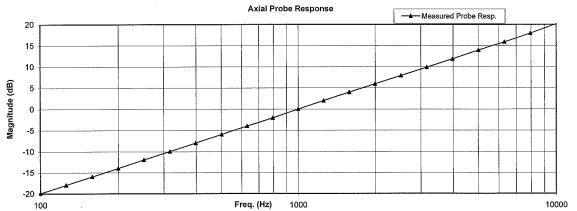
The above listed instrument meets or exceeds the tested manufacturer's specifications.

This Calibration is traceable through NIST test numbers:

683/290345-18

The expanded uncertainty of calibration: 0.30dB at 95% confidence level with a coverage factor of k=2.

Graph represents Probes Frequency Response.



The above listed instrument was checked using calibration procedure documented in West Caldwell

Calibration Laboratories Inc. procedure :

Rev. 7.0 Jan. 24, 2014 Doc. # 1038 HCATEMC

Calibration was performed by West Caldwell Calibration Laboratories Inc. under Operating Procedures

intended to implement the requirements of ISO10012-1, IEC Guide 25, ANSI/NCSL Z540-1, (MIL-STD-45662A) and ISO 17025

Cal. Date: 17-May-2019

Measurements performed by:

James Zhu

Calibrated on WCCL system type 9700

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Rev. 7.0 Jan. 24, 2014 Doc. # 1038 HCATEMC

Page 1 of 2

FCC ID: A3LSMA426U	POTEST:	HAC (T-COIL) TEST REPORT	SAMSUNG	Approved by: Quality Manager
Filename:	Test Dates:	DUT Type:		Page 84 of 94
1M2101040001-19-R1.A3L	1/25/2021 - 2/4/2021	Portable Handset		rage 64 01 94

HCATEMC_TEM-1124_May-17-2019

West Caldwell Calibration Laboratories Inc.

1575 State Route 96, Victor NY 14564 Tel. (585) 586-3900 FAX (585) 586-4327

Calibration Data Record

Mo

Model No.: Axial T Coil Probe

Serial No.: TEM-1124

TEM Consulting LP Axial T Coil Probe Company: PCTest Engineering Labs

Test	Function	Tolera	Measured values			
				Before	Out	Remarks
1.0	Probe Sensitivity at	1000 Hz.	dBV/A/m	-60.41		
			dB			
2.0	Probe Level Linearity		6	6.10		
		Ref. (0 dB)	0	0.00		
			-6	-6.00		
			-12	-12.00		
			Hz			
3.0	Probe Frequency Response		100	-19.9		
			126	-17.9		
			158	-16.0		
			200	-14.0		
			251	-12.0		
			316	-10.0		
			398	-8.0		
			501	-6.0		
			631	-3.9		
			794	-2.0		
		Ref. (0 dB)	1000	0.0		1
			1259	2.0		
			1585	4.0		
			1995	5.9		
			2512	7.9		İ
			3162	9.9		
			3981	11.9		
			5012	13.9		
			6310	15.9		
			7943	18.0		
			10000	20.2		
						1

Instruments used for o	alibration:		Date of Cal.	Traceability No.	Due Date
HP	34401A	S/N US360641	25-Jul-2018	,1010733	26-Jul-2019
HP	34401A	S/N US361024	25-Jul-2018	,1010733	26-Jul-2019
HP	33120A	S/N US360437	25-Jul-2018	,1010733	26-Jul-2019
B&K	2133	S/N 1583254	25-Jul-2018	683/290345-18	26-Jul-2019
1					

Cal. Date: 17-May-2019

Calibrated on WCCL system type 9700

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Tested by: James Zhu

Rev. 7.0 Jan. 24, 2014 Doc. # 1038 HCATEMC

Page 2 of 2

FCC ID: A3LSMA426U	POTEST:	HAC (T-COIL) TEST REPORT	SAMSUNG	Approved by: Quality Manager
Filename:	Test Dates:	DUT Type:		Page 85 of 94
1M2101040001-19-R1.A3L	1/25/2021 - 2/4/2021	Portable Handset		raye 63 01 94



Certificate of Calibration

RADIAL T COIL PROBE

Manufactured by:

TEM CONSULTING

Model No:

RADIAL T COIL PROBE TEM-1130

Serial No: Calibration Recall No:

29973

Submitted By:

Customer:

ANDREW HARWELL

Company: Address:

PCTEST ENGINEERING LAB

6660-B DOBBIN ROAD COLUMBIA

MD 21045

The subject instrument was calibrated to the indicated specification using standards traceable to the National Institute of Standards and Technology or to accepted values of natural physical constants. This document certifies that the instrument met the following specification upon its return to the submitter.

West Caldwell Calibration Laboratories Procedure No.

RADIAL T TEM C

Upon receipt for Calibration, the instrument was found to be:

Within (X)

tolerance of the indicated specification. See attached Report of Calibration. The information supplied relates to the calibrated item listed above. West Caldwell Calibration Laboratories' calibration control system meets the requirements, ISO 10012-1 MIL-STD-45662A, ANSI/NCSL Z540-1, IEC Guide 25, ISO 9001:2015 and ISO 17025.

Note: With this Certificate, Report of Calibration is Included.

Approved by:

Calibration Date:

James Zhu

Certificate No:

17-May-19 29973 -2

Quality Manager ISO/IEC 17025:2005

QA Doc. #1051 Rev. 2.0 10/1/01

Certificate Page 1 of 1

West Caldwell Calibration

ACCREDITED

uncompromised calibration Laboratories, Inc. 1575 State Route 96, Victor, NY 14564, U.S.A.

Calibration Lab. Cert. # 1533.01

SAMSUNG

Approved by: Quality Manager

Filename: 1M2101040001-19-R1.A3L Test Dates:

PCTEST

HAC (T-COIL) TEST REPORT

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FCC ID: A3LSMA426U

1/25/2021 - 2/4/2021 Portable Handset

DUT Type:



1575 State Route 96, Victor NY 14564



REPORT OF CALIBRATION

TEM Consulting LP Radial T Coil Probe Company: PCTest Engineering Labs

Model No.: Radial T Coil Probe

Serial No.: TEM-1130

I. D. No.: XXXX

Probe Sensitivity measured wit	th Helmhol	tz Coil			
Helmholtz Coil;			Before & after data same:	X	
the number of turns on each coil;	10	No.			
the radius of each coil, in meters;	0.204	m	Laboratory Environment:		
the current in the coils, in amperes.;	0.08	Α	Ambient Temperature:	20.7	°C
Helmholtz Coil Constant;	7.09	A/m/V	Ambient Humidity:	42.7	% RH
Helmholtz Coil magnetic field;	5.94	A/m	Ambient Pressure:	98.256	kPa
			Calibration Date:	17-May-2019	
Probe Sensitivity at	1000	Hz.	Calibration Due:	17-May-2020	
was	-60.37	dBV/A/m	Report Number:	29973	3 -2
	0.958	mV/A/m	Control Number:	29973	3
Probe resistance	895	Ohms			

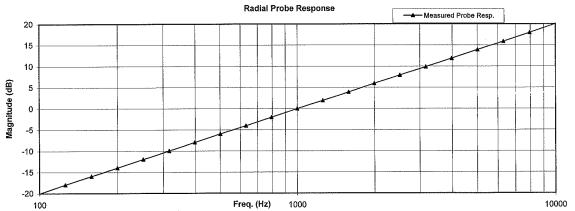
The above listed instrument meets or exceeds the tested manufacturer's specifications.

This Calibration is traceable through NIST test numbers:

683/290345-18

The expanded uncertainty of calibration: 0.30dB at 95% confidence level with a coverage factor of k=2.

Graph represents Probes Frequency Response.



The above listed instrument was checked using calibration procedure documented in West Caldwell

Calibration Laboratories Inc. procedure :

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Calibration was performed by West Caldwell Calibration Laboratories Inc. under Operating Procedures

intended to implement the requirements of ISO10012-1, IEC Guide 25, ANSI/NCSL Z540-1, (MIL-STD-45662A) and ISO 17025

Cal. Date: 17-May-2019

Measurements performed by:

James Zhu

Calibrated on WCCL system type 9700 This document shall not be reproduced, except in full, without the written approval from West Caldwell Cal. Labs. Inc.

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West Caldwell Calibration Laboratories Inc.

1575 State Route 96, Victor NY 14564 Tel. (585) 586-3900 FAX (585) 586-4327

Calibration Data Record

for

TEM Consulting LP Radial T Coil Probe Company: PCTest Engineering Labs

Model No.: Radial T Coil Probe

Serial No.: TEM-1130

Function			Measured values		
			Before	Out	Remarks
Probe Sensitivity at	1000 Hz.	dBV/A/m	-60.37		
		dB			
Probe Level Linearity		6	6.00		
	Ref. (0 dB)	0	0.00		
		-6	-6.10		
		-12	-12.10		
		Hz			
Probe Frequency Response		100	-20.0		
		126	-17.9		
		158	-16.0		
		200	-14.0		
		251	-12.0		
		316	-10.0		
		398	-8.0		
		501	-6.0		
		631	-4.0		1
		794	-2.0		1
	Ref. (0 dB)	1000	0.0		1
		1259	1.9		
		1585			
		1995	5.9		
		2512	7.9		
		3162	9.9		
		3981	11.9		
		5012	13.9		
		6310	15.9		
		7943	18.0		
		10000	20.1		
	Probe Level Linearity Probe Frequency Response	Ref. (0 dB)	Probe Level Linearity Ref. (0 dB) Probe Level Linearity Ref. (0 dB) Probe Level Linearity Ref. (0 dB)		

Instruments used for o	calibration:		Date of Cal.	Traceability No.	Due Date
HP	34401A	S/N US360641	25-Jul-2018	,1010733	26-Jul-2019
HP	34401A	S/N US361024	25-Jul-2018	,1010733	26-Jul-2019
HP	33120A	S/N US360437	25-Jul-2018	,1010733	26-Jul-2019
B&K	2133	S/N 1583254	25-Jul-2018	683/290345-18	26-Jul-2019

Cal. Date: 17-May-2019

Calibrated on WCCL system type 9700

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Tested by: James Zhu

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14. CONCLUSION

The measurements taken in accordance with the procedures provided in the CTIA Test Plan for Hearing Aid Compatibility Rev 3.1.1, May 2017, indicate that the wireless communications device complies with the HAC limits specified in the ANSI C63.19 Standard and FCC WT Docket No. 01-309 RM-8658. Precise laboratory measures were taken to assure repeatability of the tests. The tested device complies with the requirements in respect to all parameters specific to the test. The test results and statements relate only to the item(s) tested.

The measurement system and techniques presented in this evaluation are proposed in the ANSI standard as a means of best approximating wireless device compatibility with a hearing-aid. The literature is under continual re-construction.

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