

PCTEST

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HEARING AID COMPATIBILITY

Applicant Name:

LG Electronics U.S.A, Inc. 1000 Sylvan Avenue Englewood Cliffs, NJ 07632 United States Date of Testing: 04/13/2020 - 04/22/2020 Test Site/Location: PCTEST, Columbia, MD, USA Test Report Serial No.: 1M2003310054-03-R1.ZNF

Date of Issue: 05/12/2020

FCC ID: ZNFQ730VM

APPLICANT: LG ELECTRONICS U.S.A, INC.

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

285076 D01 HAC Guidance v05

285076 D02 T-Coil testing for CMRS IP v03

DUT Type: Portable Handset **Model**: LM-Q730VM

Additional Model(s): LM-Q730QM, LM-Q730QM5, LM-Q730QM6, LM-Q730QN,

LM-Q730UM, LMQ730VM, LMQ730QM, LMQ730QM5, LMQ730QM6, LMQ730QN, LMQ730UM, Q730VM, Q730QM,

Q730QM5, Q730QM6, Q730QN, Q730UM

Test Device Serial No.: Pre-Production Sample [S/N: 01920]

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

Note: This revised Test Report (S/N: 1M2003310054-03-R1.ZNF) 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.







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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: ZNFQ730VM

Applicant: LG Electronics U.S.A, Inc.

1000 Sylvan Avenue

Englewood Cliffs, NJ 07632

United States

Model: LM-Q730VM

LM-Q730QM, LM-Q730QM5, LM-Q730QM6, LM-Q730QN,

LM-Q730UM, LMQ730VM, LMQ730QM, LMQ730QM5,

LMQ730QM6, LMQ730QN, LMQ730UM, Q730VM, Q730QM,

Q730QM5, Q730QM6, Q730QN, Q730UM

Serial Number: 01920 HW Version: Rev.1.1

SW Version: Q730QM0Fe
Antenna: Internal Antenna
DUT Type: Portable Handset

I. LTE Band Selection

Additional Model(s):

This device supports the following pairs of LTE bands with similar frequencies: LTE B5 & B26, B4 & B66, and B2 & B25. Each pair of LTE bands has the same target power and shares the same transmission path. Since the supported frequency spans for the smaller LTE bands are completely covered by the larger LTE bands, only the larger LTE bands (LTE B26, B66, and B25) were evaluated for hearing-aid compliance.

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Table 2-1 **ZNFQ730VM HAC Air Interfaces**

Air-Interface	Band (MHz)	Type 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		.,	V 145	0 1 0 2	OB.US
	EvDO	VD	Yes	Yes: WIFI or BT	Google Duo ²	OPUS
	850	vo	Yes	Yes: WIFI or BT	CMRS Voice ¹	EFR
GSM	1900	1/0	V	V M/IFI PT	Coords Deep?	ODUC
	GPRS/EDGE	VD	Yes	Yes: WIFI or BT	Google Duo ²	OPUS
	850 1700	VD	Vee	Yes: WIFI or BT	CMRS Voice ¹	NB AMR
UMTS		VD	Yes	Yes: WIFI OF BI	CIVIRS VOICE	NR AMK
	1900	1/0	V	Very MUST on DT	Carata Dura?	ODUC
	HSPA	VD	Yes	Yes: WIFI or BT	Google Duo ²	OPUS
	680 (B71)		Yes ³	-	ward a said	
	700 (B12)					VoLTE: NB AMR, WB AMR, EVS Google Duo: OPUS
	780 (B13)					
/ >	850 (B5)					
LTE (FDD)	850 (B26)	VD	Yes	Yes: WIFI or BT	VoLTE ¹ , Google Duo ²	
	1700 (B4)					
	1700 (B66)					
	1900 (B2)					
	1900 (B25)					
LTE (TDD)	2600 (B41)	VD	Yes	Yes: WIFI or BT	VoLTE ¹ , Google Duo ²	VoLTE: NB AMR, WB AMR, EVS Google Duo: OPUS
	2450					
	5200 (U-NII 1)					
WIFI	5300 (U-NII 2A)	VD	Yes	Yes: CDMA, GSM, UMTS, or LTE	VoWIFI², Google Duo²	VoWIFI: NB AMR, WB AMR, EVS Google Duo: OPUS
	5500 (U-NII 2C)					Google Duo. OPO3
	5800 (U-NII 3)					
BT	2450	DT	No	Yes: CDMA, GSM, UMTS, or LTE	N/A	N/A
DT = Digital Dat	Fype Transport //O = Voice Only T = Digital Data - Not intended for Voice Services //D = CMRS and/or IP Voice over Data Transport 1. Reference level in accordance with 7.4.2.1 of ANSI C63.19-2011 and July 2012 C63 VoLTE Interpretation. 2. Reference level is -200Bm0 in accordance with FCC KDB 285076 D02 3. LTE B71, while outside the scope of ANSI C63.19 and FCC HAC regulations, was additionally tested according to the existing HAC precedures with currently available for toxiciprost.					

procedures with currently available test equipment.

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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.

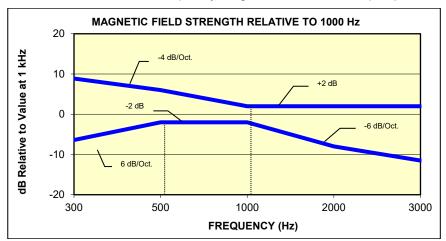


Figure 3-1
Magnetic field frequency response for Wireless Devices with an axial field ≤-15 dB(A/m) at 1 kHz

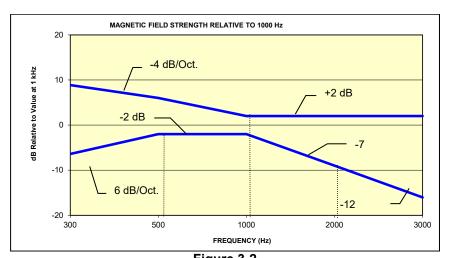


Figure 3-2
Magnetic Field frequency response for wireless devices with an axial field that exceeds
-15 dB(A/m) at 1 kHz

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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.

Catagory	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:

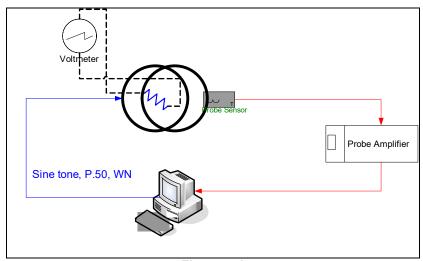


Figure 4-1 Validation Setup with Helmholtz Coil

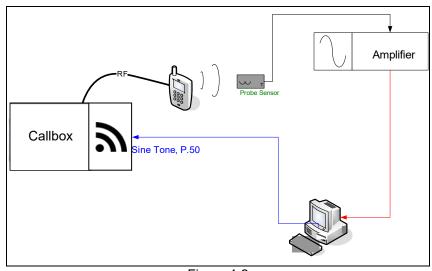


Figure 4-2 **T-Coil Test Setup**

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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

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

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

Reflections: < -20 dB (in anechoic chamber)

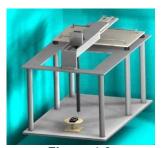


Figure 4-3 RF Near-Field Scanner

III. ITU-T P.50 Artificial Voice

Manufacturer: ITU-T

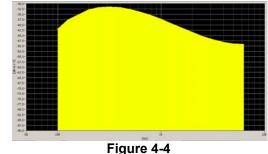
Active Frequency Range: 100 Hz – 8 kHz

Stimulus Type: Male and Female, no spaces

Single Sample 20.96 seconds

Duration: 20.96

Activity Level: 100%



Spectral Characteristic of full P.50

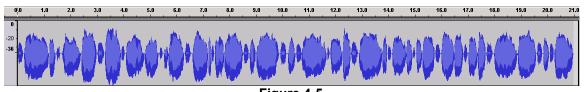
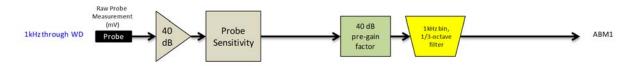


Figure 4-5
Temporal Characteristic of full P.50

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ABM2 Measurement Block Diagram:



Figure 4-6 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.
 - b. "A-weighting" and Half-Band Integration was applied to the measurements.
 - c. 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=0.13m; R=10.193Ω and using V=29mV:

$$H_c = \frac{20 \cdot (\frac{0.029}{10.193})}{0.13 \cdot \sqrt{1.25^3}} = 0.316A/m \approx -10dB(A/m)$$

Therefore a pure tone of 1kHz was applied into the coils such that 29mV 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 $-10 \, dB(A/m)$. This was verified to be within $\pm 0.5 \, dB$ of the $-10 \, dB(A/m)$ value (see Page 41).

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c. 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 P.50 signal as shown below:

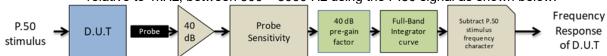


Figure 4-7 Frequency Response Validation

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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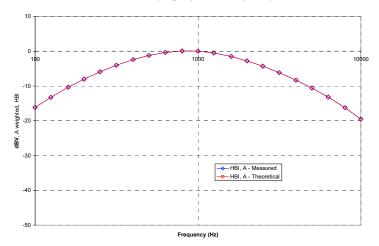
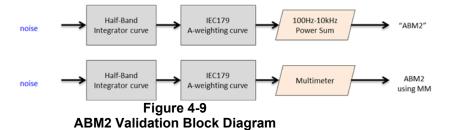


Figure 4-8
ABM2 Frequency Response Validation

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 4-9). 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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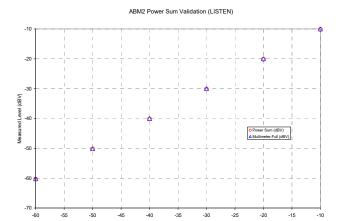
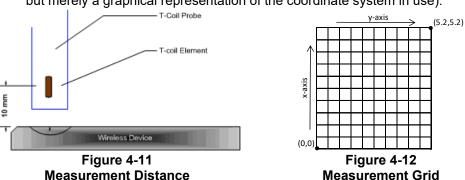


Figure 4-10 **ABM2 Power Sum Validation**

- 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 4-12, 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 4-14 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. 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 4-7. 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**

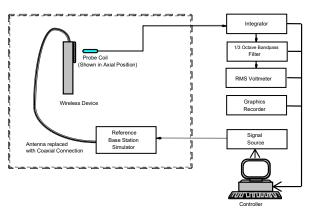


Figure 4-13 **Audio Magnetic Field Test Setup**

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

Ocitici Onamicis and Frequencies					
Test frequencies & associated channels					
Channel	Frequency (MHz)				
Secondary Cellular 8	20				
564 (CDMA)	820.10				
Cellular 850	Cellular 850				
384 (CDMA)	836.52				
190 (GSM)	836.60				
4183 (UMTS)	836.60				
AWS 1750					
1412 (UMTS)	1730.40				
PCS 1900	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 each of Table 7-6 and 7-7 were additionally evaluated with OTT VoIP for each probe orientation. See Tables 9-5 to 9-12 as well as Tables 9-20 to 9-21 for LTE bandwidths and channels.

3. 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 9-13 to 9-16 as well as 9-22 to 9-25 for WIFI standards and channels.

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IX. Test Flow

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

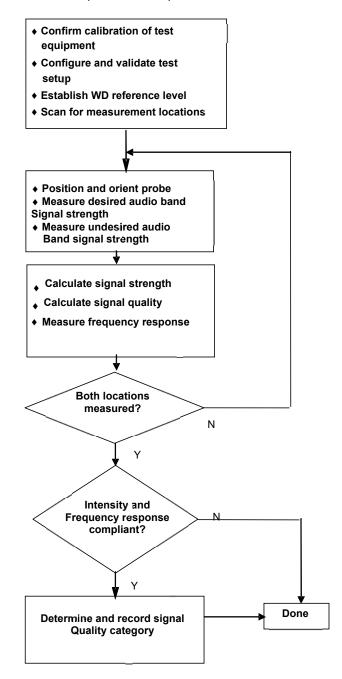


Figure 4-14 C63.19 T-Coil Signal Test Process

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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.

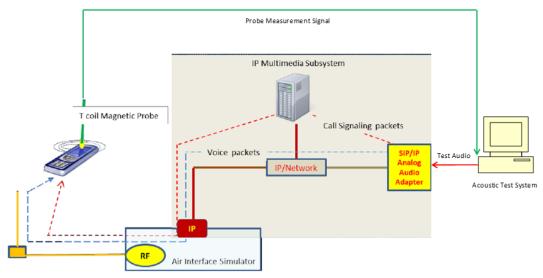


Figure 5-1
Test Setup for VoLTE over IMS T-Coil Measurements

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, 0RB 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

		102	IL OVEI IIV	0 0111111 0	y itaaio	Cominge	11 411011		
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	9.50	-49.01	58.51
66	1745.0	132322	20	QPSK	1	50	9.46	-48.70	58.16
66	1745.0	132322	20	QPSK	1	99	9.48	-49.15	58.63
66	1745.0	132322	20	QPSK	50	0	9.46	-50.10	59.56
66	1745.0	132322	20	QPSK	50	25	9.48	-50.00	59.48
66	1745.0	132322	20	QPSK	50	50	9.47	-50.01	59.48
66	1745.0	132322	20	QPSK	100	0	9.48	-49.54	59.02
66	1745.0	132322	20	16QAM	1	0	9.48	-43.45	52.93
66	1745.0	132322	20	16QAM	1	50	9.46	-43.63	53.09
66	1745.0	132322	20	16QAM	1	99	9.45	-44.99	54.44
66	1745.0	132322	20	16QAM	50	0	9.43	-48.93	58.36
66	1745.0	132322	20	16QAM	50	25	9.48	-49.22	58.70
66	1745.0	132322	20	16QAM	50	50	9.46	-49.60	59.06
66	1745.0	132322	20	16QAM	100	0	9.50	-49.34	58.84
66	1745.0	132322	20	64QAM	1	0	9.47	-43.67	53.14
66	1745.0	132322	20	64QAM	1	50	9.49	-43.70	53.19
66	1745.0	132322	20	64QAM	1	99	9.46	-45.10	54.56
66	1745.0	132322	20	64QAM	50	0	9.48	-49.09	58.57
66	1745.0	132322	20	64QAM	50	25	9.48	-49.83	59.31
66	1745.0	132322	20	64QAM	50	50	9.50	-49.50	59.00
66	1745.0	132322	20	64QAM	100	0	9.47	-49.24	58.71

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 13.2kbps 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)	9.54	10.82	12.65	12.36			23095
ABM2 (dBA/m)	-42.05	-42.00	-41.80	-41.93	- Axial	Band 12 10MHz	
Frequency Response	Pass	Pass	Pass	Pass			
S+N/N (dB)	51.59	52.82	54.45	54.29			

- 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 13.2kbps	Orientation	Band / BW	Channel	
ABM1 (dBA/m)	9.45				
ABM2 (dBA/m)	-41.90	Axial	Band 12 10MHz	23095	
Frequency Response	Pass				
S+N/N (dB)	51.35				

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

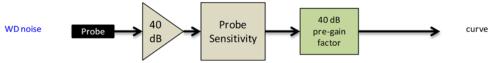


Figure 5-2
Audio Band Magnetic Curve Measurement Block Diagram

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 \cdot 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 \cdot 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 configuration	Downlink-to-Uplink Switch-point periodicity	Subframe number						Calculated Transmission				
comiguration	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	J	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, 0RB 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 2 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	0	0	9.45	-30.36	39.81
2593.0	40620	20	16QAM	1	0	1	9.45	-31.11	40.56
2593.0	40620	20	16QAM	1	0	2	9.44	-28.13	37.57
2593.0	40620	20	16QAM	1	0	3	9.41	-31.17	40.58
2593.0	40620	20	16QAM	1	0	4	9.45	-30.86	40.31
2593.0	40620	20	16QAM	1	0	5	9.39	-30.87	40.26
2593.0	40620	20	16QAM	1	0	6	9.40	-38.69	48.09

b. Power Class 2 Uplink-Downlink Configuration Investigation

Power Class 2 was evaluated with the following radio configuration: channel 40620, 20MHz BW, 16QAM, 1RB, 0RB 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 2 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

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	0	1	9.38	-25.98	35.36
2593.0	40620	20	16QAM	1	0	2	9.39	-25.74	35.13
2593.0	40620	20	16QAM	1	0	3	9.39	-28.94	38.33
2593.0	40620	20	16QAM	1	0	4	9.42	-29.32	38.74
2593.0	40620	20	16QAM	1	0	5	9.40	-28.47	37.87

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 2 was used to evaluate both 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.

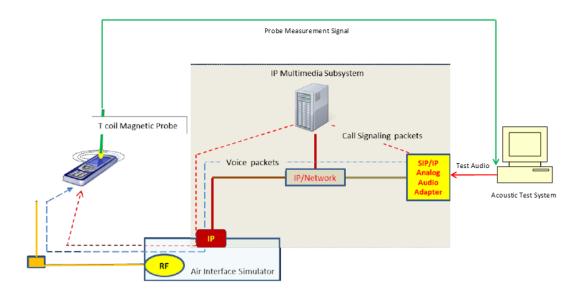


Figure 6-1 Test Setup for VoWIFI over IMS T-Coil Measurements

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	5.34	-48.08	53.42
IEEE 802.11b	6	DSSS	2	5.33	-48.14	53.47
IEEE 802.11b	6	CCK	5.5	5.24	-48.08	53.32
IEEE 802.11b	6	CCK	11	5.27	-47.87	53.14

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

i=== oo=i ig.a oiiii ay itaano oomiganaanii							
Mode	Channel	Modulation	Data Rate [Mbps]	ABM1 [dB(A/m)]	ABM2 [dB(A/m)]	SNNR [dB]	
IEEE 802.11g	6	BPSK	6	5.27	-50.09	55.36	
IEEE 802.11g	6	BPSK	9	5.17	-48.72	53.89	
IEEE 802.11g	6	QPSK	12	5.24	-50.56	55.80	
IEEE 802.11g	6	QPSK	18	5.17	-49.14	54.31	
IEEE 802.11g	6	16QAM	24	5.15	-51.46	56.61	
IEEE 802.11g	6	16QAM	36	5.10	-51.90	57.00	
IEEE 802.11g	6	64QAM	48	5.11	-52.17	57.28	
IEEE 802.11g	6	64QAM	54	5.15	-52.11	57.26	

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

TELE 602.1 Thrac 20MHz BW SMMX by Kadio Configuration							
Mode	Bandwidth [MHz]	Channel	Modulation	MCS Index	ABM1 [dB(A/m)]	ABM2 [dB(A/m)]	SNNR [dB]
IEEE 802.11n	20	40	BPSK	0	5.16	-49.22	54.38
IEEE 802.11n	20	40	QPSK	1	5.11	-49.30	54.41
IEEE 802.11n	20	40	QPSK	2	5.17	-49.99	55.16
IEEE 802.11n	20	40	16QAM	3	5.16	-48.70	53.86
IEEE 802.11n	20	40	16QAM	4	5.12	-49.81	54.93
IEEE 802.11n	20	40	64QAM	5	5.11	-50.29	55.40
IEEE 802.11n	20	40	64QAM	6	5.15	-48.32	53.47
IEEE 802.11n	20	40	64QAM	7	5.17	-50.81	55.98
IEEE 802.11ac	20	40	256QAM	8	5.04	-50.36	55.40

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

ILLE 602.1 Thrac 40MHz BW SWIN 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	5.07	-49.94	55.01
IEEE 802.11n	40	38	QPSK	1	5.33	-50.41	55.74
IEEE 802.11n	40	38	QPSK	2	5.32	-50.46	55.78
IEEE 802.11n	40	38	16QAM	3	5.30	-50.18	55.48
IEEE 802.11n	40	38	16QAM	4	5.27	-50.46	55.73
IEEE 802.11n	40	38	64QAM	5	5.32	-50.81	56.13
IEEE 802.11n	40	38	64QAM	6	5.25	-50.09	55.34
IEEE 802.11n	40	38	64QAM	7	5.33	-49.83	55.16
IEEE 802.11ac	40	38	256QAM	8	5.29	-50.71	56.00
IEEE 802.11ac	40	38	256QAM	9	5.27	-50.66	55.93

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 13.2kbps 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:

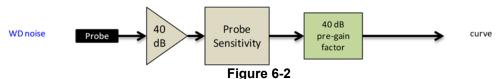
Table 6-5
AMR Codec Investigation – VoWIFI over IMS

		Ami Cou	o mitosing	ution vo	******	11410			
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)	5.64	6.15	8.57	8.53					
ABM2 (dBA/m)	-48.29	-48.36	-47.93	-48.31	Axial	2.4GHz		IEEE 802.11b	
Frequency Response	Pass	Pass	Pass	Pass	Axiai	2.4002	IEEE 802.11D	6	
S+N/N (dB)	53.93	54.51	56.50	56.84					

Table 6-6
EVS Codec Investigation – VoWIFI over IMS

,	conganon		OVCI IIVIO		
Codec Setting:	EVS Primary SWB 13.2kbps	Orientation	Band	Standard	Channel
ABM1 (dBA/m)	5.43				
ABM2 (dBA/m)	-47.56	Axial	2.4GHz	IEEE 802.11b	6
Frequency Response	Pass	Axiai			
S+N/N (dB)	52.99				

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 6kbps 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)	23.29	22.63		
ABM2 (dBA/m)	-51.62	-51.28		600
Frequency Response	Pass	Pass	- Axial	
S+N/N (dB)	74.91	73.91		

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 (LDGL)						
Codec Setting:	75kbps	6kbps	Orientation	Channel		
ABM1 (dBA/m)	23.20	21.85				
ABM2 (dBA/m)	-24.40	-23.23	Axial	190		
Frequency Response	Pass	Pass	Allai	190		
S+N/N (dB)	47.60	45.08				

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

Codec Setting:	75kbps	6kbps	Orientation	Channel
ABM1 (dBA/m)	23.93	22.31		
ABM2 (dBA/m)	-51.19	-52.03	المشاء	9400
Frequency Response	Pass	Pass	— Axial	
S+N/N (dB)	75.12	74.34		

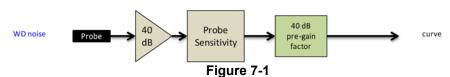
Table 7-4 Codec Investigation - OTT VoIP (LTE)

•	400 III V 03	O 1 1 1 0 11	(- : - <i>)</i>		
Codec Setting:	75kbps	6kbps	Orientation	Band / BW	Channel
ABM1 (dBA/m)	23.41	22.82		Band 12 10MHz	
ABM2 (dBA/m)	-43.31	-43.17	Axial		23095
Frequency Response	Pass	Pass	AXIAI		23093
S+N/N (dB)	66.72	65.99			

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

Couco investigation OTT von (VVIII)											
Codec Setting:	75kbps	6kbps	Orientation	Band	Standard	Channel					
ABM1 (dBA/m)	25.33	22.97		0.400	IEEE 802.11b						
ABM2 (dBA/m)	-44.78	-45.09	Axial			6					
Frequency Response	Pass	Pass	Axiai	2.4GHz		0					
S+N/N (dB)	70.11	68.06				<u> </u>					

- 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

FCC ID: ZNFQ730VM	PCTEST hour to be port of ® senses	HAC (T-COIL) TEST REPORT	(LG	Approved by: Quality Manager	
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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 71 was used for the testing as the worst-case configuration for the handset. See below table for SNNR comparison between different LTE bands:

> Table 7-6 OTT VoIP (LTE FDD) 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]
71	680.5	133297	20	16QAM	1	0	22.17	-40.82	62.99
12	707.5	23095	10	16QAM	1	0	22.35	-43.13	65.48
13	782.0	23230	10	16QAM	1	0	22.46	-42.18	64.64
26	831.5	26865	15	16QAM	1	0	22.31	-43.27	65.58
66	1745.0	132322	20	16QAM	1	0	22.55	-40.84	63.39
25	1882.5	26365	20	16QAM	1	0	22.43	-41.44	63.87

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	0	22.90	-25.93	48.83
41 (PC2)	2593.0	40620	20	16QAM	1	0	22.55	-23.82	46.37

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8. FCC 3G MEASUREMENTS

I. CDMA Test Configurations

Radio Configuration 1, Service Option 3 (thick, green data curve) was used for the testing as the worst-case 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:

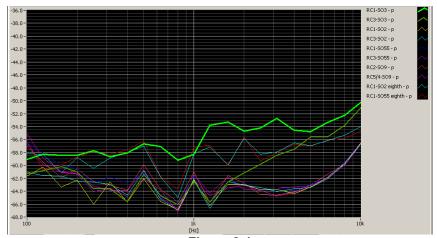
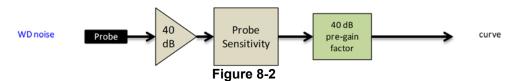


Figure 8-1
CDMA Audio Band Magnetic Noise

Table 8-1 FCC 3G ABM Measurements for ZNFQ730VM (CDMA)

1.0000712111111000001011101101101111(1001111(1001111)											
Configuration:	RC1/SO3	RC3/SO3	RC4/SO3	Orientation	Channel						
ABM1 (dBA/m)	8.66	8.94	8.64		000						
ABM2 (dBA/m)	-36.33	-54.28	-54.72	Axial							
Frequency Response	Pass	Pass	Pass	Axiai	600						
S+N/N (dB)	44.99	63.22	63.36								

- 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:

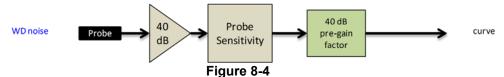


Figure 8-3
UMTS Audio Band Magnetic Noise

Table 8-2 Codec Investigation - UMTS

	Odde iiivestigation - Oiii O										
Codec Setting:	AMR 12.2kbps	AMR 7.95kbps	AMR 4.75kbps	Orientation	Channel						
ABM1 (dBA/m)	10.10	10.08	9.99		9400						
ABM2 (dBA/m)	-54.30	-55.54	-55.14	Axial							
Frequency Response	Pass	Pass	Pass	Axiai							
S+N/N (dB)	64.40	65.62	65.13								

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



Audio Band Magnetic Curve Measurement Block Diagram

FCC ID: ZNFQ730VM	PCTEST hour to be port of ® senses	HAC (T-COIL) TEST REPORT	(LG	Approved by: Quality Manager
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T-COIL TEST SUMMARY

Table 9-1 **Consolidated Tabled Results**

		Freq. Re	esponse	_	netic	FCC :	SNNR	Margin from	
			rgin		/ Verdict		dict	FCC Limit	C63.19-2011 Rating
C63.19	9 Section		3.2		3.1		3.4	(dB)	3
		Axial	Radial	Axial	Radial	Axial	Radial		
	Secondary Cellular	PASS	NA	PASS	PASS	PASS	PASS	22.22	
CDMA	Cellular	PASS	NA	PASS	PASS	PASS	PASS	-23.62	T4
	PCS	PASS	NA	PASS	PASS	PASS	PASS		
EvDO	Secondary Cellular	PASS	NA	PASS	PASS	PASS	PASS		
(OTT VoIP)	Cellular	PASS	NA	PASS	PASS	PASS	PASS	-50.84	T4
	PCS	PASS	NA	PASS	PASS	PASS	PASS		
GSM	Cellular	PASS	NA	PASS	PASS	PASS	PASS	-8.75	Т3
	PCS	PASS	NA	PASS	PASS	PASS	PASS		
EDGE	Cellular	PASS	NA	PASS	PASS	PASS	PASS	-25.24	T4
(OTT VoIP)	PCS	PASS	NA	PASS	PASS	PASS	PASS		
	Cellular	PASS	NA	PASS	PASS	PASS	PASS		
UMTS	AWS	PASS	NA	PASS	PASS	PASS	PASS	-38.45	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	-51.41	T4
,	PCS	PASS	NA	PASS	PASS	PASS	PASS		
	B71	PASS	NA	PASS	PASS	PASS	PASS		
	B12	PASS	NA	PASS	PASS	PASS	PASS		
LTE FDD	B13	PASS	NA	PASS	PASS	PASS	PASS	-31.17	T4
LIEFDD	B26	PASS	NA	PASS	PASS	PASS	PASS	-31.17	14
	B66	PASS	NA	PASS	PASS	PASS	PASS		
	B25	PASS	NA	PASS	PASS	PASS	PASS		
LTE FDD (OTT VoIP)	B71	PASS	NA	PASS	PASS	PASS	PASS	-41.88	T4
	B41 (PC3)	PASS	NA	PASS	PASS	PASS	PASS	45.40	
LTE TDD	B41 (PC2)	PASS	NA	PASS	PASS	PASS	PASS	-15.19	T4
LTE TDD (OTT VoIP)	B41 (PC2)	PASS	NA	PASS	PASS	PASS	PASS	-26.04	T4
	IEEE 802.11b	PASS	NA	PASS	PASS	PASS	PASS		
WLAN	IEEE 802.11g	PASS	NA	PASS	PASS	PASS	PASS	-31.90	T4
	IEEE 802.11n	PASS	NA	PASS	PASS	PASS	PASS		
	IEEE 802.11b	PASS	NA	PASS	PASS	PASS	PASS		
WLAN (OTT Volp)	IEEE 802.11g	PASS	NA	PASS	PASS	PASS	PASS	-44.61	T4
(OTT VoIP)	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	-32.01	T4
	IEEE 802.11ac	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	-47.46	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

					ala Nesu		, 1417 (
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	8.53	-36.31		2.00	44.84	20.00	-24.84	T4	
	Axial	564	8.41	-35.67	-58.80	2.00	44.08	20.00	-24.08	T4	2.0, 4.0
Cellular Radial		684	8.45	-35.31		2.00	43.76	20.00	-23.76	T4	
		476	0.14	-54.26			54.40	20.00	-34.40	T4	
	564	0.22	-54.10	-60.25	25 N/A	54.32	20.00	-34.32	T4	1.8, 3.0	
		684	0.37	-54.04			54.41	20.00	-34.41	T4	
Axial		1013	8.34	-35.87		2.00	44.21	20.00	-24.21	T4	
	Axial	384	8.61	-36.19	-58.80	2.00	44.80	20.00	-24.80	T4	2.0, 4.0
Cellular		777	8.62	-35.00		2.00	43.62	20.00	-23.62	T4	
Celiulai		1013	0.44	-53.82		N/A	54.26	20.00	-34.26	T4	
	Radial	384	0.35	-54.41	-60.25		54.76	20.00	-34.76	T4	1.8, 3.0
		777	0.58	-53.14			53.72	20.00	-33.72	T4	
		25	8.59	-36.78		2.00	45.37	20.00	-25.37	T4	
	Axial	600	8.50	-36.35	-58.80	2.00	44.85	20.00	-24.85	T4	2.0, 4.0
PCS		1175	8.47	-36.08		2.00	44.55	20.00	-24.55	T4	
-03		25	0.34	-54.52			54.86	20.00	-34.86	T4	
Radial	Radial	600	0.47	-53.95	-60.25	N/A	54.42	20.00	-34.42	T4	1.8, 3.0
		1175	0.22	-54.48			54.70	20.00	-34.70	T4	

Table 9-3
Raw Data Results for GSM

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	9.37	-19.38		2.00	28.75	20.00	-8.75	Т3	
	Axial	190	9.41	-19.40	-58.80	2.00	28.81	20.00	-8.81	Т3	2.0, 4.0
GSM850		251	9.37	-20.88		2.00	30.25	20.00	-10.25	T4	
GSIVIOSU		128	1.24	-39.66			40.90	20.00	-20.90	T4	
	Radial	190	1.15	-39.85	-60.25	N/A	41.00	20.00	-21.00	T4	1.8, 3.0
		251	1.19	-37.57			38.76	20.00	-18.76	T4	
		512	9.40	-24.93		2.00	34.33	20.00	-14.33	T4	
	Axial	661	9.48	-24.18	-58.80	2.00	33.66	20.00	-13.66	T4	2.0, 4.0
GSM1900		810	9.39	-23.66		2.00	33.05	20.00	-13.05	T4	
G3W11900		512	1.11	-46.98			48.09	20.00	-28.09	T4	
	Radial	661	1.09	-46.14	-60.25	N/A	47.23	20.00	-27.23	T4	1.8, 3.0
		810	1.21	-45.35			46.56	20.00	-26.56	T4	

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Table 9-4 Raw Data Results for UMTS

			ABM1	ABM2	Ambient Noise	Frequency	S+N/N	FCC Limit	Margin from	C63.19-2011	Test
Mode	Orientation	Channel	[dB(A/m)]	[dB(A/m)]	[dB(A/m)]	Response Margin (dB)	(dB)	(dB)	FCC Limit (dB)	Rating	Coordinates
		4132	10.08	-53.18		2.00	63.26	20.00	-43.26	T4	
	Axial	4183	10.05	-54.65	-58.80	2.00	64.70	20.00	-44.70	T4	2.0, 4.0
UMTS V		4233	10.05	-54.49		2.00	64.54	20.00	-44.54	T4	
OWITS V		4132	1.64	-57.51			59.15	20.00	-39.15	T4	
	Radial	4183	1.64	-57.87	-60.25	N/A	59.51	20.00	-39.51	T4	1.8, 3.0
		4233	1.64	-57.73			59.37	20.00	-39.37	T4	
		1312	10.06	-53.92		2.00	63.98	20.00	-43.98	T4	
	Axial	1412	10.08	-54.13	-58.80	2.00	64.21	20.00	-44.21	T4	2.0, 4.0
UMTS IV		1513	10.09	-53.80	-30.00	2.00	63.89	20.00	-43.89	T4	
UNITSIV		1312	1.64	-57.88			59.52	20.00	-39.52	T4	
	Radial	1412	1.63	-57.92	-60.25	N/A	59.55	20.00	-39.55	T4	1.8, 3.0
		1513	1.62	-57.84			59.46	20.00	-39.46	T4	
		9262	10.10	-55.02		2.00	65.12	20.00	-45.12	T4	
	Axial	9400	10.10	-54.27	-58.80	2.00	64.37	20.00	-44.37	T4	2.0, 4.0
UMTS II		9538	10.09	-54.47		2.00	64.56	20.00	-44.56	T4	
OWISH		9262	1.61	-56.84			58.45	20.00	-38.45	T4	
	Radial	9400	1.63	-56.86	-60.25	N/A	58.49	20.00	-38.49	T4	1.8, 3.0
		9538	1.62	-57.92			59.54	20.00	-39.54	T4	

Table 9-5 Raw Data Results for LTE B71

					Duta IX							
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	9.47	-41.77		1.48	51.24	20.00	-31.24	T4	
	Axial	15MHz	133297	9.38	-42.71	-58.80	1.52	52.09	20.00	-32.09	T4	2.0, 4.0
	Axiai	10MHz	133297	9.40	-41.78	-36.60	1.49	51.18	20.00	-31.18	T4	2.0, 4.0
LTE Band 71		5MHz	133297	9.39	-42.03		1.49	51.42	20.00	-31.42	T4	
LIE Ballu / I		20MHz	133297	0.35	-55.96			56.31	20.00	-36.31	T4	
	Radial	15MHz	133297	0.59	-56.31	-60.25	N/A	56.90	20.00	-36.90	T4	1.8, 3.0
	Naulai	10MHz	133297	0.62	-55.87	-00.25	INA	56.49	20.00	-36.49	T4	1.0, 3.0
		5MHz	133297	0.61	-55.56			56.17	20.00	-36.17	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	9.50	-41.93		1.50	51.43	20.00	-31.43	T4		
	Axial	5MHz	23095	9.42	-42.93	-58.80	1.46	52.35	20.00	-32.35	T4	2.0, 4.0	
	Axiai	3MHz	23095	9.47	-44.76	-36.60	1.45	54.23	20.00	-34.23	T4	2.0, 4.0	
LTE Band 12		1.4MHz	23095	9.44	-45.60		1.46	55.04	20.00	-35.04	T4		
LIE Ballu 12		10MHz	23095	0.58	-54.85			55.43	20.00	-35.43	T4		
	Radial	5MHz	23095	0.54	-56.06	-60.25	N/A	56.60	20.00	-36.60	T4	1.8, 3.0	
	radiai	3MHz	23095	0.51	-56.74	-00.25	IWA	57.25	20.00	-37.25	T4	1.0, 3.0	
		1.4MHz	23095	0.50	-57.27		1		57.77	20.00	-37.77	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	9.44	-41.73	-58.80	1.52	51.17	20.00	-31.17	T4	2.0, 4.0
LTE Band 1		5MHz	23230	9.44	-43.83	-50.00	1.50	53.27	20.00	-33.27	T4	2.0, 4.0
LIE Band 1	Radial	10MHz	23230	0.62	-53.67	-60.25	N/A	54.29	20.00	-34.29	T4	1.8, 3.0
	Radiai	5MHz	23230	0.60	-54.67	-60.25	IN/A	55.27	20.00	-35.27	T4	1.0, 3.0

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Table 9-8 Raw Data Results for LTE B26

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	9.45	-44.15		1.52	53.60	20.00	-33.60	T4	
		10MHz	26865	9.45	-43.89		1.52	53.34	20.00	-33.34	T4	
	Axial	5MHz	26865	9.47	-43.63	-58.80	1.49	53.10	20.00	-33.10	T4	2.0, 4.0
		3MHz	26865	9.47	-44.46		1.52	53.93	20.00	-33.93	T4	
LTE Band 26		1.4MHz	26865	9.45	-44.36		1.49	53.81	20.00	-33.81	T4	
LIE Ballu 26		15MHz	26865	0.61	-54.93			55.54	20.00	-35.54	T4	
		10MHz	26865	0.59	-56.47			57.06	20.00	-37.06	T4	
	Radial	5MHz	26865	0.60	-55.97	-60.25	N/A	56.57	20.00	-36.57	T4	1.8, 3.0
		3MHz	26865	0.55	-55.55			56.10	20.00	-36.10	T4	
		1.4MHz	26865	0.55	-55.73			56.28	20.00	-36.28	T4	1

Table 9-9 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	132322	9.50	-43.74		1.48	53.24	20.00	-33.24	T4	
		15MHz	132322	9.46	-45.11		1.45	54.57	20.00	-34.57	T4	
	Axial	10MHz	132322	9.48	-44.73	-58.80	1.52	54.21	20.00	-34.21	T4	2.0, 4.0
	Axiai	5MHz	132322	9.45	-43.75	-50.60	1.50	53.20	20.00	-33.20	T4	2.0, 4.0
		3MHz	132322	9.41	-45.47		1.50	54.88	20.00	-34.88	T4	
LTE Band 66		1.4MHz	132322	9.42	-45.00		1.52	54.42	20.00	-34.42	T4	
LIE Ballu 66		20MHz	132322	0.67	-54.61			55.28	20.00	-35.28	T4	
		15MHz	132322	0.69	-55.26			55.95	20.00	-35.95	T4	
	Radial	10MHz	132322	0.68	-55.27	-60.25	N/A	55.95	20.00	-35.95	T4	1.8, 3.0
	Radiai	5MHz	132322	0.64	-54.20	-60.25	N/A	54.84	20.00	-34.84	T4	1.0, 3.0
		3MHz	132322	0.67	-55.42			56.09	20.00	-36.09	T4	
		1.4MHz	132322	0.65	-54.71			55.36	20.00	-35.36	T4	

Table 9-10 Raw Data Results for LTE B25

					Data it	souito 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
		20MHz	26365	9.46	-43.44		1.54	52.90	20.00	-32.90	T4	
		15MHz	26365	9.40	-45.50		1.49	54.90	20.00	-34.90	T4	
	Axial	10MHz	26365	9.43	-46.27	-58.80	1.52	55.70	20.00	-35.70	T4	2.0, 4.0
	Axiai	5MHz	26365	9.41	-46.08	-36.60	1.52	55.49	20.00	-35.49	T4	2.0, 4.0
		3MHz	26365	9.38	-48.13		1.45	57.51	20.00	-37.51	T4	
LTE Band 25		1.4MHz	26365	9.38	-47.33		1.50	56.71	20.00	-36.71	T4	
LIE Ballu 25		20MHz	26365	0.60	-55.19			55.79	20.00	-35.79	T4	
		15MHz	26365	0.61	-55.09			55.70	20.00	-35.70	T4	
	Radial	10MHz	26365	0.61	-56.04	-60.25	N/A	56.65	20.00	-36.65	T4	1.8, 3.0
	Naulai	5MHz	26365	0.63	-55.89	-00.23	INA	56.52	20.00	-36.52	T4	1.6, 5.0
		3MHz	26365	0.65	-56.22			56.87	20.00	-36.87	T4	
		1.4MHz	26365	0.67	-56.45			57.12	20.00	-37.12	T4	

Table 9-11 Raw Data Results for LTE B41 Power Class 3

		New Bulla Research Co. E. E. E. San St. Co. March Co.											
	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	9.42	-28.60		1.56	38.02	20.00	-18.02	T4	
		Axial	15MHz	40620	9.46	-29.93	-58.80	1.54	39.39	20.00	-19.39	T4	2.0, 4.0
		Axiai	10MHz	40620	9.43	-28.97	-30.00	1.50	38.40	20.00	-18.40	T4	2.0, 4.0
	E Band 41		5MHz	40620	9.40	-27.14		1.50	36.54	20.00	-16.54	T4	
	E Ballu 41		20MHz	40620	0.63	-46.28			46.91	20.00	-26.91	T4	
		Radial	15MHz	40620	0.57	-46.05	60.25	N/A	46.62	20.00	-26.62	T4	1.8. 3.0
		Naulai	10MHz	40620	0.62	-46.53	-60.25	INA	47.15	20.00	-27.15	T4	1.0, 3.0
			5MHz	40620	0.59	-46.76			47.35	20.00	-27.35	T4	

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Table 9-12 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	9.40	-25.91		1.53	35.31	20.00	-15.31	T4				
		15MHz	41490	9.44	-27.72		1.49	37.16	20.00	-17.16	T4				
		15MHz	41055	9.43	-27.16		1.48	36.59	20.00	-16.59	T4				
	Axial	15MHz	40620	9.44	-25.75	-58.80	1.53	35.19	20.00	-15.19	T4	2.0, 4.0			
	LTE Band 41	15MHz	40185	9.47	-26.16	-30.60	1.53	35.63	20.00	-15.63	T4	2.0, 4.0			
		15MHz	39750	9.46	-32.97		1.52	42.43	20.00	-22.43	T4				
		10MHz	40620	9.40	-26.60		1.53	36.00	20.00	-16.00	T4				
I TE Band 41		5MHz	40620	9.46	-25.74		1.54	35.20	20.00	-15.20	T4				
LIE Ballu 41		20MHz	40620	0.60	-44.16			44.76	20.00	-24.76	T4				
		15MHz	41490	0.61	-45.83			46.44	20.00	-26.44	T4				
		15MHz	41055	0.57	-46.00	-60.25 N/A		46.57	20.00	-26.57	T4				
	Radial	15MHz	40620	0.62	-44.05		N/A	44.67	20.00	-24.67	T4	1.8, 3.0			
		15MHz	40185	0.61	-44.34		-60.25 N/A	-60.25 N	-60.25	IN/A	44.95	20.00	-24.95	T4	1.0, 3.0
		15MHz	39750	0.61	-50.33					50.94	20.00	-30.94	T4		
		10MHz	40620	0.61	-44.39			45.00	20.00	-25.00	T4				
		5MHz	40620	0.61	-44.40			45.01	20.00	-25.01	T4				

Table 9-13 Raw Data Results for 2.4GHz WIFI

				uw Dutu	IVESUITS	101 2.701	12 7711 1				
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	5.30	-47.76		1.55	53.06	20.00	-33.06	T4	
	Axial	6	5.34	-47.25	-58.91	1.49	52.59	20.00	-32.59	T4	2.0, 4.0
IEEE		11	5.32	-46.96		1.56	52.28	20.00	-32.28	T4	
802.11b		1	-3.38	-55.28			51.90	20.00	-31.90	T4	
	Radial	6	-3.45	-56.57	-60.19	N/A	53.12	20.00	-33.12	T4	1.8, 3.0
		11	-3.36	-55.66			52.30	20.00	-32.30	T4	
IEEE	Axial	6	5.32	-48.97	-58.91	1.51	54.29	20.00	-34.29	T4	2.0, 4.0
802.11g	Radial	6	-3.43	-56.91	-60.19	N/A	53.48	20.00	-33.48	T4	1.8, 3.0
IEEE	Axial	6	5.42	-49.65	-58.91	1.56	55.07	20.00	-35.07	T4	2.0, 4.0
802.11n	Radial	6	-3.42	-57.03	-60.19	N/A	53.61	20.00	-33.61	T4	1.8, 3.0

Table 9-14 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 Rating	Test Coordinates
		20MHz	1	40	5.31	-47.10		1.48	52.41	20.00	-32.41	T4	
		20MHz	2A	56	5.28	-46.94		1.52	52.22	20.00	-32.22	T4	
	Axial	20MHz	2C	100	5.29	-46.84	-58.91	1.52	52.13	20.00	-32.13	T4	2.0, 4.0
		20MHz	2C	120	5.30	-46.71	-56.91	1.52	52.01	20.00	-32.01	T4	2.0, 4.0
		20MHz	2C	144	5.32	-46.78		1.43	52.10	20.00	-32.10	T4	
		20MHz	3	157	5.31	-47.18		1.47	52.49	20.00	-32.49	T4	
IEEE 802.11a													
	Radial	20MHz	1	40	-3.39	-57.07			53.68	20.00	-33.68	T4	
		20MHz	2A	52	-3.38	-57.62			54.24	20.00	-34.24	T4	
		20MHz	2A	56	-3.36	-56.58	60.10	NVA	53.22	20.00	-33.22	T4	1.8, 3.0
		20MHz	2A	64	-3.39	-56.36	-60.19 N/A	52.97	20.00	-32.97	T4	1.0, 3.0	
		20MHz	2C	120	-3.36	-57.10				53.74	20.00	-33.74	T4
		20MHz	3	157	-3.37	-57.24		53.87	20.00	-33.87	T4		

Table 9-15 Raw Data Results for 5GHz WIFI IEEE 802.11n

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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
	Avial	40MHz	1	38	5.27	-48.67	-58.91	1.56	53.94	20.00	-33.94	T4	2.0, 4.0
IEEE	Axial	20MHz	1	40	5.27	-48.00	-56.91	1.48	53.27	20.00	-33.27	T4	2.0, 4.0
802.11n													
002.1111		40MHz	1	38	-3.41	-57.35	60.40	NVA	53.94	20.00	-33.94	T4	1.8, 3.0
	Radial	20MHz	1	40	-3.39	-57.55	-60.19	-60.19 N/A	54.16	20.00	-34.16	T4	1.6, 3.0

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Table 9-16 Raw Data Results for 5GHz WIFI IEEE 802.11ac

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
	Avial	40MHz	1	38	5.30	-49.93	-58.91	1.51	55.23	20.00	-35.23	T4	2.0, 4.0
IFFF	Axial	20MHz	1	40	5.30	-48.21	-56.91	1.47	53.51	20.00	-33.51	T4	2.0, 4.0
802.11ac													
002.1140	.11ac Radial	40MHz	1	38	-3.39	-58.27	60.10	NI/A	54.88	20.00	-34.88	T4	1.8. 3.0
	Radial	20MHz	1	40	-3.38	-58.78	-58.78	-60.19 N/A	55.40	20.00	-35.40	T4	1.0, 3.0

Table 9-17 Raw Data Results for EvDO (OTT VoIP)

	Naw Data Results for EVDO (CTT VOIF)											
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	
Secondary Cellular	Axial	564	22.65	-51.65	-58.80	2.00	74.30	20.00	-54.30	T4	2.0, 4.0	
EvDO	Radial	564	15.16	-57.68	-60.25	N/A	72.84	20.00	-52.84	T4	1.8, 3.0	
Cellular	Axial	384	22.37	-51.67	-58.80	2.00	74.04	20.00	-54.04	T4	2.0, 4.0	
EvDO	Radial	384	15.26	-56.07	-60.25	N/A	71.33	20.00	-51.33	T4	1.8, 3.0	
PCS	Axial	600	22.24	-51.56	-58.80	1.93	73.80	20.00	-53.80	T4	2.0, 4.0	
EvDO	Radial	600	15.19	-55.65	-60.25	N/A	70.84	20.00	-50.84	T4	1.8, 3.0	

Table 9-18 Raw Data Results for FDGF (OTT VolP)

	Naw Data Results for EDGE (OTT VOII)												
	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	
-	CE850	Axial	190	21.96	-23.28	-58.80	1.97	45.24	20.00	-25.24	T4	2.0, 4.0	
	EDGE850	Radial	190	14.93	-43.66	-60.25	N/A	58.59	20.00	-38.59	T4	1.8, 3.0	
E	GE1900	Axial	661	21.88	-26.37	-58.80	1.93	48.25	20.00	-28.25	T4	2.0, 4.0	
LL	EDGE1900	Radial	661	14.91	-48.08	-60.25	N/A	62.99	20.00	-42.99	T4	1.8, 3.0	

Table 9-19 Raw Data Results for HSPA (OTT VoIP)

				Data IX		110171	, , , , , , , , , , , , , , , , , , , 				
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
HSPA V	Axial	4183	22.35	-50.97	-58.80	1.81	73.32	20.00	-53.32	T4	2.0, 4.0
nora v	Radial	4183	15.13	-56.28	-60.25	N/A	71.41	20.00	-51.41	T4	1.8, 3.0
HSPA IV	Axial	1412	22.39	-51.42	-58.80	1.92	73.81	20.00	-53.81	T4	2.0, 4.0
HOPAIV	Radial	1412	15.19	-56.79	-60.25	N/A	71.98	20.00	-51.98	T4	1.8, 3.0
HSPA II	Axial	9400	22.72	-51.79	-58.80	2.00	74.51	20.00	-54.51	T4	2.0, 4.0
HOFAII	Radial	9400	15.34	-56.86	-60.25	N/A	72.20	20.00	-52.20	T4	1.8, 3.0

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Table 9-20 Raw Data Results for LTE FDD B71 (OTT VoIP)

					oanto no			<u> </u>						
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	133372	22.18	-41.22		1.95	63.40	20.00	-43.40	T4			
		20MHz	133297	22.48	-39.78		2.00	62.26	20.00	-42.26	T4			
	Axial	20MHz	133222	22.12	-39.76	-58.80	2.00	61.88	20.00	-41.88	T4	2.0, 4.0		
	LTE Band 71	15MHz	133297	22.54	-42.13	-50.00	1.89	64.67	20.00	-44.67	T4	2.0, 4.0		
		10MHz	133297	22.36	-41.91		2.00	64.27	20.00	-44.27	T4			
LTE Band 74		5MHz	133297	22.26	-40.43		1.83	62.69	20.00	-42.69	T4			
LIE Ballu / I		20MHz	133297	15.55	-54.53	-60.25		70.08	20.00	-50.08	T4			
		15MHz	133397	15.16	-55.04			70.20	20.00	-50.20	T4			
	Radial	15MHz	133297	15.31	-53.81		-60.25	NI/A	69.12	20.00	-49.12	T4	1.8, 3.0	
	Naulai	15MHz	133197	15.72	-54.88			-60.25 N/A	IVA	70.60	20.00	-50.60	T4	1.0, 3.0
		10MHz	133297	15.34	-54.35					69.69	20.00	-49.69	T4	
		5MHz	133297	15.47	-54.07			69.54	20.00	-49.54	T4			

Table 9-21 Raw Data Results for LTE TDD B41 (PC2) (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	40620	22.52	-23.75		2.00	46.27	20.00	-26.27	T4			
		15MHz	41490	22.39	-25.11		2.00	47.50	20.00	-27.50	T4			
		15MHz	41055	22.19	-25.49		2.00	47.68	20.00	-27.68	T4			
	Axial	15MHz	40620	22.25	-23.79	-58.80	2.00	46.04	20.00	-26.04	T4	2.0, 4.0		
	Axiai	15MHz	40185	22.42	-23.84	-36.60	1.83	46.26	20.00	-26.26	T4	2.0, 4.0		
		15MHz	39750	22.88	-30.08		2.00	52.96	20.00	-32.96	T4			
	10MHz	40620	22.45	-23.76		2.00	46.21	20.00	-26.21	T4				
LTE Band 41		5MHz	40620	22.80	-24.02		1.83	46.82	20.00	-26.82	T4			
LIE Ballu 41		20MHz	40620	15.49	-45.06			60.55	20.00	-40.55	T4			
		15MHz	40620	15.75	-44.18			59.93	20.00	-39.93	T4			
		10MHz	41490	15.56	-45.05	15 2 -60.25 N		60.61	20.00	-40.61	T4			
	Radial	10MHz	41055	15.53	-45.12		N/A	60.65	20.00	-40.65	T4	1.8, 3.0		
		10MHz	40620	15.46	-44.11		-60.25 N/A 8.63	-60.25	-60.25	-60.25 N/A	59.57	20.00	-39.57	T4
		10MHz	40185	15.76	-43.63					59.39	20.00	-39.39	T4	
		10MHz	39750	15.46	-46.05			61.51	20.00	-41.51	T4			
		5MHz	40620	15.87	-44.26			60.13	20.00	-40.13	T4			

Table 9-22 Raw Data Results for 2 AGHz WIFL (OTT VolD)

Raw Data Results for 2.4GHz WIFI (OTT VOIP)												
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	
IEEE 802.11b	Axial	1	22.71	-44.44	-58.91	1.91	67.15	20.00	-47.15	T4		
		6	22.99	-43.00		2.00	65.99	20.00	-45.99	T4	2.0, 4.0	
		11	23.09	-41.52		2.00	64.61	20.00	-44.61	T4		
	Radial	1	15.80	-54.60	-60.19	N/A	70.40	20.00	-50.40	T4	1.8, 3.0	
		6	15.46	-54.75			70.21	20.00	-50.21	T4		
		11	15.26	-54.34			69.60	20.00	-49.60	T4		
IEEE	Axial	6	23.47	-47.08	-58.91	2.00	70.55	20.00	-50.55	T4	2.0, 4.0	
802.11g	Radial	6	15.23	-55.87	-60.19	N/A	71.10	20.00	-51.10	T4	1.8, 3.0	
IEEE	Axial	6	22.72	-45.94	-58.91	2.00	68.66	20.00	-48.66	T4	2.0, 4.0	
802.11n	Radial	6	15.30	-56.39	-60.19	N/A	71.69	20.00	-51.69	T4	1.8, 3.0	

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Table 9-23 Raw Data Results for 5GHz WIFI IEEE 802.11a (OTT VoIP)

			u	ata i too	a.to .o.	UU:	/ /			• • • • • • • • • • • • • • • • • • • •			
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
		20MHz	1	40	22.98	-44.95		2.00	67.93	20.00	-47.93	T4	2.0, 4.0
		20MHz	2A	52	22.86	-46.07		2.00	68.93	20.00	-48.93	T4	
	Axial	20MHz	2A	56	22.66	-44.80	-58.91 7	1.83	67.46	20.00	-47.46	T4	
	Axidi	20MHz	2A	64	22.58	-46.12		1.79	68.70	20.00	-48.70	T4	
		20MHz	2C	120	22.98	-45.07		2.00	68.05	20.00	-48.05	T4	
IEEE		20MHz	3	157	22.45	-45.62		1.99	68.07	20.00	-48.07	T4	
802.11a													
002.114		20MHz	1	40	15.43	-55.60			71.03	20.00	-51.03	T4	
		20MHz	2A	52	15.49	-54.02			69.51	20.00	-49.51	T4	
	Radial	20MHz	2A	56	14.96	-55.53	-60.19	N/A	70.49	20.00	-50.49	T4	1.8, 3.0
	Natial	20MHz	2A	64	15.87	-55.69	-55.69 -55.75	IVA	71.56	20.00	-51.56	T4	1.0, 3.0
		20MHz	2C	120	15.03	-55.75			70.78	20.00	-50.78	T4	
		20MHz	3	157	15.02	-56.05			71.07	20.00	-51.07	T4	

Table 9-24 Raw Data Results for 5GHz WIFI IEEE 802.11n (OTT VoIP)

			u D.	utu itosi		· · · · ·			(•	,			
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
Avial	Axial	40MHz	1	38	22.84	-46.93	-58.91	1.99	69.77	20.00	-49.77	T4	2.0. 4.0
IEEE	Axidi	20MHz	1	40	22.88	-46.75	75	1.97	69.63	20.00	-49.63	T4	T4
802.11n													
002.1111	Radial	40MHz	1	38	15.18	-56.54	-60.19	N/A	71.72	20.00	-51.72	T4	1.8, 3.0
	Naulai	20MHz	1	40	15.59	-56.54	-00.19	-60.19 N/A	72.13	20.00	-52.13	T4	1.6, 3.0

Table 9-25 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 Rating	Test Coordinates
Axial	40MHz	1	38	23.20	-47.75	-58.91	1.90	70.95	20.00	-50.95	T4	2.0, 4.0	
IEEE		20MHz	1	40	22.77	-46.96	-30.91	1.92	69.73	20.00	-49.73	T4	Γ4 2.0, 4.0
802.11	_												
002.11	Radial	40MHz	1	38	15.37	-56.32	-60.19	N/A	71.69	20.00	-51.69	T4	1.8, 3.0
	rtadiai	20MHz	1	40	15.46	-56.19	-60.19 N/A	71.65	20.00	-51.65	T4	1.0, 3.0	

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→Additional settings→Hearing aids) was set to ON for Frequency Response compliance
- 4. Speech Signal: ITU-T P.50 Artificial Voice
- 5. Bluetooth and WIFI were disabled while testing 2G/3G/4G 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/SO3 (CDMA – EVRC)

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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, 0RB offset
- 3. Vocoder Configuration: EVS Primary SWB 13.2kbps
- 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 13 at 10MHz is the worst-case for both the Axial and Radial probe orientations; however, LTE Band 13 at 10MHz bandwidth only supports one channel. Therefore, no additional channels were evaluated.

F. LTE TDD

- 1. Power Configuration: TPC = "Max Power"
- 2. Radio Configuration: 16QAM, 1RB, 0RB offset
- 3. Power Class 3 Uplink-Downlink configuration: 2
- 4. Power Class 2 Uplink-Downlink configuration: 2
- 5. Vocoder Configuration: EVS Primary SWB 13.2kbps
- 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 15MHz is the worst-case for both the Axial and Radial probe orientations.

G. WIFI

- 1. Radio Configuration
 - a. IEEE 802.11b: CCK, 11Mbps
 - b. IEEE 802.11g/a: BPSK, 9Mbps
 - c. IEEE 802.11n/ac 20MHz: 64QAM, MCS 6
 - d. IEEE 802.11n/ac 40MHz: BPSK, MCS 0
- 2. Vocoder Configuration: EVS Primary SWB 13.2kbps
- 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 both the Axial and Radial probe orientations.
- 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 802.11a (U-NII 2C) is the worst-case for the Axial probe orientation. IEEE 802.11a (U-NII 2A) is the worst-case for the Radial probe orientation.

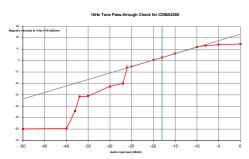
FCC ID: ZNFQ730VM	PCTEST Total to be post of Sements	HAC (T-COIL) TEST REPORT	LG	Approved by: Quality Manager
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H. OTT VoIP

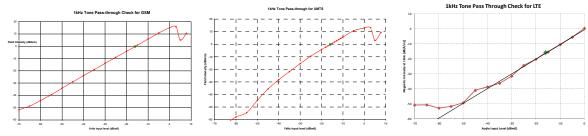
- 1. Vocoder Configuration: 6kbps
- 2. EvDO Configuration
 - a. Revision: A
- 3. EDGE Configuration
 - a. MCS Index: 7
 - b. Number of TX slots: 2
- 4. HSPA Configuration:
 - a. Release: 6
 - b. 3GPP 34.121 Subtest 1
- 5. LTE FDD Configuration:
 - a. Power Configuration: TPC = "Max Power"
 - b. Radio Configuration: 16QAM, 1RB, 0RB offset
 - c. LTE Band 71 was the worst-case band from Table 7-6 and was used to test both Axial and Radial probe orientations.
 - d. 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 71 at 20MHz is the worst-case for the Axial probe orientation. LTE Band 71 at 15MHz 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, 0RB offset
 - c. Power Class 2 Uplink-Downlink configuration: 2
 - d. LTE Band 41 (Power Class 2) was the worst-case band from Table 7-7 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, low-mid, high-mid, and high channels for those combinations. LTE Band 41 (Power Class 2) at 15MHz is the worst-case for the Axial probe orientation. LTE Band 41 (Power Class 2) at 10MHz is the worst-case for the Radial probe orientation.
- 7. WIFI Configuration:
 - a. Radio Configuration
 - i. IEEE 802.11b: CCK, 11Mbps
 - ii. IEEE 802.11g/a: BPSK, 9Mbps
 - iii. IEEE 802.11n/ac 20MHz: 64QAM, MCS 6
 - iv. IEEE 802.11n/ac 40MHz: BPSK. MCS 0
 - 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 both the Axial and Radial probe orientations.
 - 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 802.11a (U-NII 2A) is the worst-case for both the Axial and Radial probe orientations.

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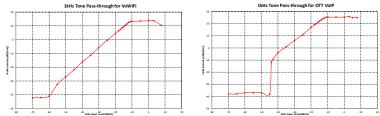
III. 1 kHz Vocoder Application Check



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.

FCC ID: ZNFQ730VM	PCTEST	HAC (T-COIL) TEST REPORT	(LG	Approved by: Quality Manager
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IV. T-Coil Validation Test Results

Table 9-26
Helmholtz Coil Validation Table of Results – 04/13/2020

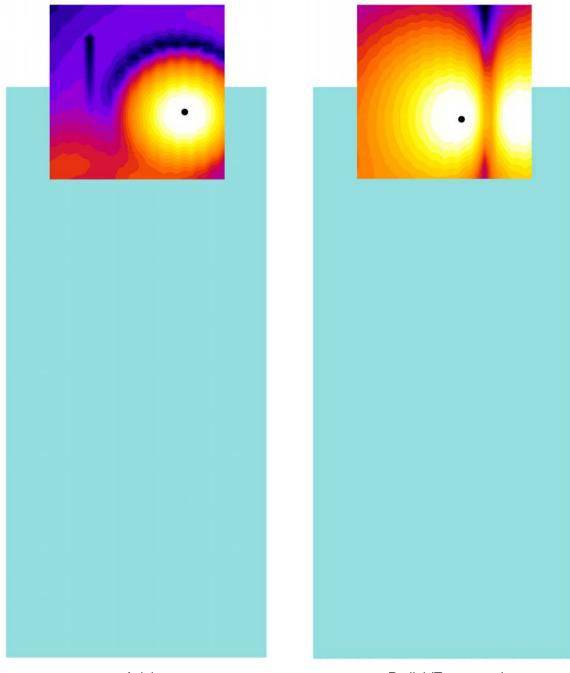
Item	Target	Result	Verdict
Axial			
Magnetic Intensity, -10 dBA/m	-10 ± 0.5 dB	-9.924	PASS
Environmental Noise	< -58 dBA/m	-58.80	PASS
Frequency Response, from limits	> 0 dB	0.80	PASS
Radial			
Magnetic Intensity, -10 dBA/m	-10 ± 0.5 dB	-10.142	PASS
Environmental Noise	< -58 dBA/m	-60.25	PASS
Frequency Response, from limits	> 0 dB	0.80	PASS

Table 9-27
Helmholtz Coil Validation Table of Results – 04/20/2020

Item	Target	Result	Verdict
Axial			
Magnetic Intensity, -10 dBA/m	-10 ± 0.5 dB	-9.936	PASS
Environmental Noise	< -58 dBA/m	-58.91	PASS
Frequency Response, from limits	> 0 dB 0.80		PASS
Radial			
Magnetic Intensity, -10 dBA/m	-10 ± 0.5 dB	-10.166	PASS
Environmental Noise	< -58 dBA/m	-60.19	PASS
Frequency Response, from limits	> 0 dB	0.80	PASS

FCC ID: ZNFQ730VM	PCTEST: Noted to be part of @ secured	HAC (T-COIL) TEST REPORT	LG	Approved by: Quality Manager
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ABM1 Magnetic Field Distribution Scan Overlays ٧.



Axial Radial (Transverse)

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

Notes:

- 1. Final measurement locations are indicated by a cursor on the contour plots.
- 2. See Test Setup Photographs for actual WD overlay.

FCC ID: ZNFQ730VM	PCTEST: Houd to be part of & receiver	HAC (T-COIL) TEST REPORT	LG	Approved by: Quality Manager
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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	Combined standard uncertainty, uc (k=1)								
Expanded uncertainty (k=2),	Expanded uncertainty (k=2), 95% confidence level								

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

		=406=				
Manufacturer	Model	Description	Cal Date	Cal Interval	Cal Due	Serial Number
Control Company	4040	Temperature / Humidity Monitor	2/28/2018	Biennial	2/28/2020	150761911
Dell	Latitude E6540	SoundCheck Acoustic Analyzer Laptop	9/6/2018	Biennial	9/6/2020	2655082910
Listen	SoundConnect	Microphone Power Supply	9/6/2018	Biennial	9/6/2020	0899-PS150
RME	Fireface UC	Soundcheck Acoustic Analyzer External Audio Interface	9/6/2018	Biennial	9/6/2020	23792992
Rohde & Schwarz	CMW500	Wideband Radio Communication Tester	1/30/2019	Annual	1/30/2020	162125
Rohde & Schwarz	CMW500	Radio Communication Tester	5/17/2019	Annual	5/17/2020	128635
Seekonk	NC-100	Torque Wrench (8" lb)	5/10/2018	Biennial	5/10/2020	21053
TEM		HAC System Controller with Software	N/A		N/A	N/A
TEM		HAC Positioner	N/A		N/A	N/A
TEM	Helmholtz Coil	Helmholtz Coil	10/10/2018	Biennial	10/10/2020	SBI 1052
TEM	Radial T-Coil Probe	Radial T-Coil Probe	9/19/2018	Biennial	9/19/2020	TEM-1129
TEM	Axial T-Coil Probe	Axial T-Coil Probe	9/19/2018	Biennial	9/19/2020	TEM-1123

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12. TEST DATA

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REV 3.5.M



PCTEST Hearing-Aid Compatibility Facility

DUT: HH Coil - SN: SBI 1052

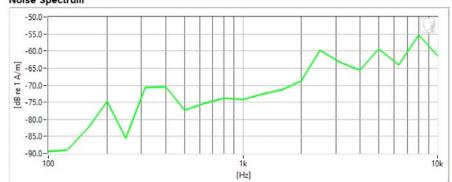
Type: HH Coil Serial: SBI 1052

Measurement Standard: ANSI C63.19-2011

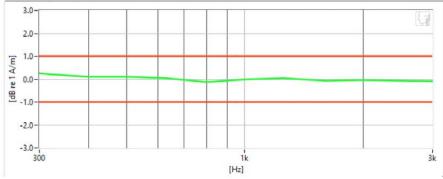
Equipment:

- Probe: Axial T-Coil Probe SN: TEM-1123; Calibrated: 09/19/2018
- Helmholtz Coil SN: SBI 1052; Calibrated: 10/10/2018

Noise Spectrum



Frequency Response



Results

Verification 1kHz Intensity	-9.924	dB		Max/Min	-9.5/-10.5
Verification ABM2	-58.8	dB	•	Maximum	-58.0
Frequency Response Margin	800m	dB	~	Tolerance curves	Aligned Data

FCC ID: ZNFQ730VM	PCTEST	HAC (T-COIL) TEST REPORT	LG	Approved by: Quality Manager
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PCTEST Hearing-Aid Compatibility Facility

DUT: HH Coil - SN: SBI 1052

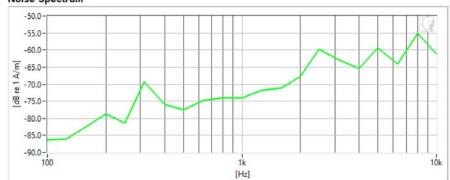
Type: HH Coil Serial: SBI 1052

Measurement Standard: ANSI C63.19-2011

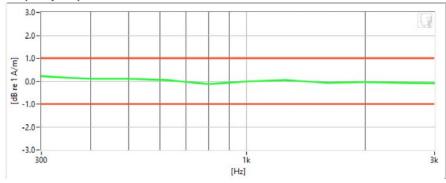
Equipment:

- Probe: Axial T-Coil Probe SN: TEM-1123; Calibrated: 09/19/2018
- Helmholtz Coil SN: SBI 1052; Calibrated: 10/10/2018

Noise Spectrum



Frequency Response



Results

Verification 1kHz Intensity	-9.936 dB	~	Max/Min	-9.5/-10.5
Verification ABM2	-58.91 dB	~	Maximum	-58.0
Frequency Response Margin	800m dB	•	Tolerance curves	Aligned Data

FCC ID: ZNFQ730VM	PCTEST	HAC (T-COIL) TEST REPORT	LG	Approved by: Quality Manager
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PCTEST Hearing-Aid Compatibility Facility

DUT: HH Coil - SN: SBI 1052

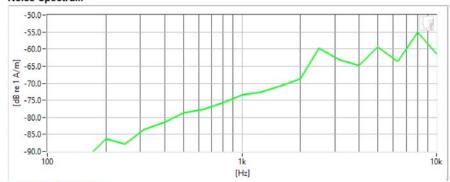
Type: HH Coil Serial: SBI 1052

Measurement Standard: ANSI C63.19-2011

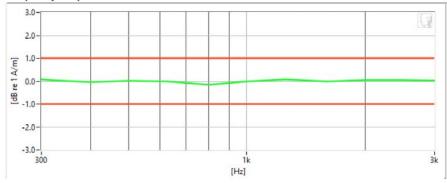
Equipment:

- Probe: Radial T-Coil Probe SN: TEM-1129; Calibrated: 09/19/2018
- Helmholtz Coil SN: SBI 1052; Calibrated: 10/10/2018

Noise Spectrum



Frequency Response



Results

Verification 1kHz Intensity	-10.142	dB		Max/Min	-9.5/-10.5
Verification ABM2	-60.25	dB	•	Maximum	-58.0
Frequency Response Margin	800m	dB	•	Tolerance curves	Aligned Data

FCC ID: ZNFQ730VM	PCTEST hour to be port of @ sensored	HAC (T-COIL) TEST REPORT	(LG	Approved by: Quality Manager
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DUT: HH Coil - SN: SBI 1052

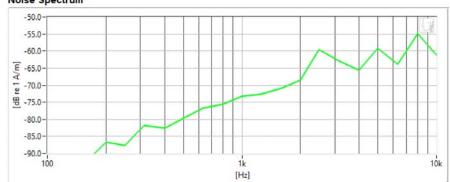
Type: HH Coil Serial: SBI 1052

Measurement Standard: ANSI C63.19-2011

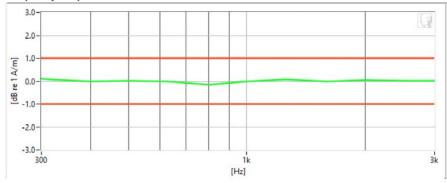
Equipment:

- Probe: Radial T-Coil Probe SN: TEM-1129; Calibrated: 09/19/2018
- Helmholtz Coil SN: SBI 1052; Calibrated: 10/10/2018

Noise Spectrum



Frequency Response



Results

Verification 1kHz Intensity	-10.166	dB	•	Max/Min	-9.5/-10.5
Verification ABM2	-60.19	dB	~	Maximum	-58.0
Frequency Response Margin	800m	dB	•	Tolerance curves	Aligned Data

FCC ID: ZNFQ730VM	PCTEST	HAC (T-COIL) TEST REPORT	LG	Approved by: Quality Manager
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Type: Portable Handset Serial: 01920

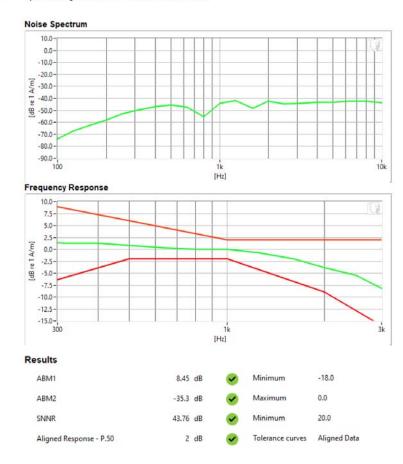
Measurement Standard: ANSI C63.19-2011

Equipment:

Probe: Axial T-Coil Probe – SN: TEM-1123; Calibrated: 09/19/2018

Test Configuration:

- . Mode: Secondary Cellular CDMA
- Channel: 684
- Speech Signal: ITU-T P.50 Artificial Voice



FCC ID: ZNFQ730VM	PCTEST	HAC (T-COIL) TEST REPORT	LG	Approved by: Quality Manager
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Type: Portable Handset Serial: 01920

Measurement Standard: ANSI C63.19-2011

Equipment:

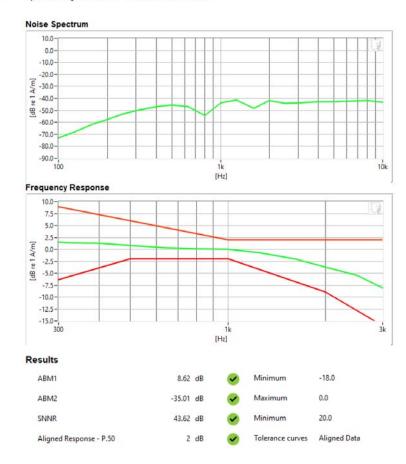
Probe: Axial T-Coil Probe – SN: TEM-1123; Calibrated: 09/19/2018

Test Configuration:

Mode: Cellular CDMA

Channel: 777

· Speech Signal: ITU-T P.50 Artificial Voice



FCC ID: ZNFQ730VM	PCTEST	HAC (T-COIL) TEST REPORT	(LG	Approved by: Quality Manager
Filename:	Test Dates:	DUT Type:		Page 51 of 88
1M2003310054-03-R1.ZNF	04/13/2020 - 04/22/2020	Portable Handset		Fage 310100



Type: Portable Handset Serial: 01920

Measurement Standard: ANSI C63.19-2011

Equipment:

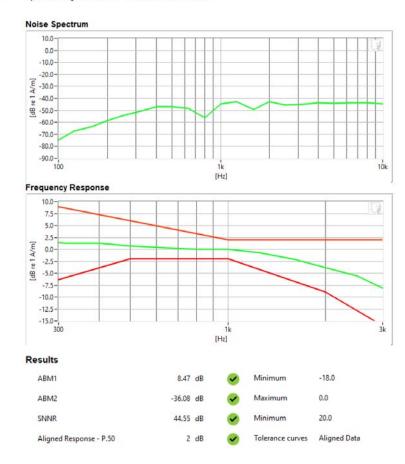
Probe: Axial T-Coil Probe – SN: TEM-1123; Calibrated: 09/19/2018

Test Configuration:

Mode: PCS CDMA

Channel: 1175

· Speech Signal: ITU-T P.50 Artificial Voice



FCC ID: ZNFQ730VM	PCTEST	HAC (T-COIL) TEST REPORT	LG	Approved by: Quality Manager
Filename:	Test Dates:	DUT Type:		Page 52 of 88
1M2003310054-03-R1.ZNF	04/13/2020 - 04/22/2020	Portable Handset		raye 32 01 00



Type: Portable Handset Serial: 01920

Measurement Standard: ANSI C63.19-2011

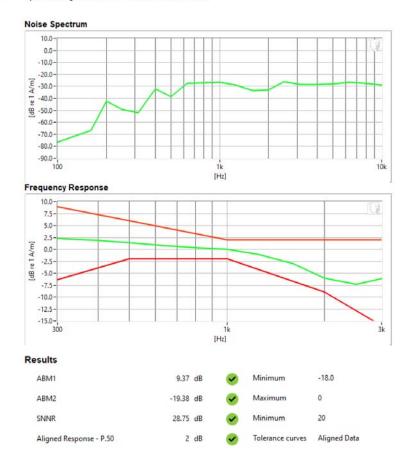
Equipment:

Probe: Axial T-Coil Probe – SN: TEM-1123; Calibrated: 09/19/2018

Test Configuration:

 Mode: GSM850 Channel: 128

Speech Signal: ITU-T P.50 Artificial Voice



FCC ID: ZNFQ730VM	PCTEST hour to be port of ® senses	HAC (T-COIL) TEST REPORT	(LG	Approved by: Quality Manager
Filename:	Test Dates:	DUT Type:		Page 53 of 88
1M2003310054-03-R1.ZNF	04/13/2020 - 04/22/2020	Portable Handset		rage 33 01 66



Type: Portable Handset Serial: 01920

Measurement Standard: ANSI C63.19-2011

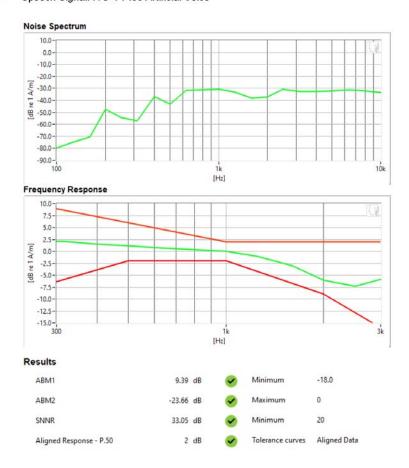
Equipment:

Probe: Axial T-Coil Probe – SN: TEM-1123; Calibrated: 09/19/2018

Test Configuration:

Mode: GSM1900Channel: 810

· Speech Signal: ITU-T P.50 Artificial Voice



FCC ID: ZNFQ730VM	PCTEST	HAC (T-COIL) TEST REPORT	(LG	Approved by: Quality Manager
Filename:	Test Dates:	DUT Type:		Page 54 of 88
1M2003310054-03-R1.ZNF	04/13/2020 - 04/22/2020	Portable Handset		Fage 34 01 00



Measurement Standard: ANSI C63.19-2011

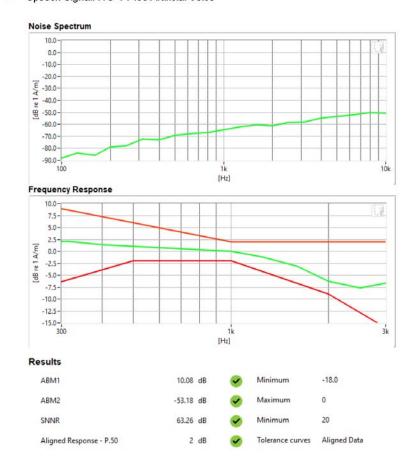
Equipment:

Probe: Axial T-Coil Probe – SN: TEM-1123; Calibrated: 09/19/2018

Test Configuration:

Mode: UMTS VChannel: 4132

· Speech Signal: ITU-T P.50 Artificial Voice



FCC ID: ZNFQ730VM	PCTEST hours to be port of the second	HAC (T-COIL) TEST REPORT	LG	Approved by: Quality Manager
Filename:	Test Dates:	DUT Type:		Page 55 of 88
1M2003310054-03-R1.ZNF	04/13/2020 - 04/22/2020	Portable Handset		rage 55 01 66



Measurement Standard: ANSI C63.19-2011

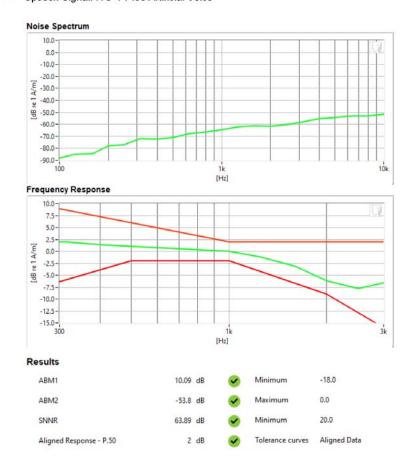
Equipment:

Probe: Axial T-Coil Probe – SN: TEM-1123; Calibrated: 09/19/2018

Test Configuration:

Mode: UMTS IVChannel: 1513

. Speech Signal: ITU-T P.50 Artificial Voice



FCC ID: ZNFQ730VM	PCTEST	HAC (T-COIL) TEST REPORT	LG	Approved by: Quality Manager
Filename:	Test Dates:	DUT Type:		Page 56 of 88
1M2003310054-03-R1.ZNF	04/13/2020 - 04/22/2020	Portable Handset		rage 50 01 00



Measurement Standard: ANSI C63.19-2011

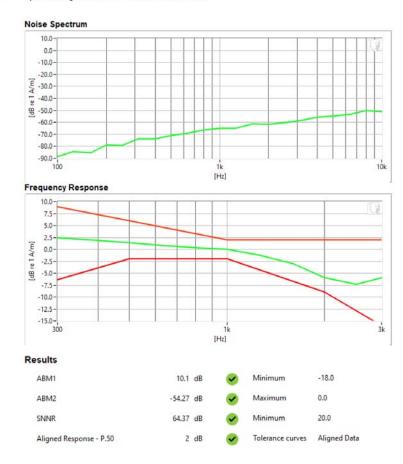
Equipment:

Probe: Axial T-Coil Probe – SN: TEM-1123; Calibrated: 09/19/2018

Test Configuration:

Mode: UMTS IIChannel: 9400

. Speech Signal: ITU-T P.50 Artificial Voice



FCC ID: ZNFQ730VM	PCTEST	HAC (T-COIL) TEST REPORT	(LG	Approved by: Quality Manager
Filename:	Test Dates:	DUT Type:		Page 57 of 88
1M2003310054-03-R1.ZNF	04/13/2020 - 04/22/2020	Portable Handset		rage 37 01 66



Type: Portable Handset Serial: 01920

Measurement Standard: ANSI C63.19-2011

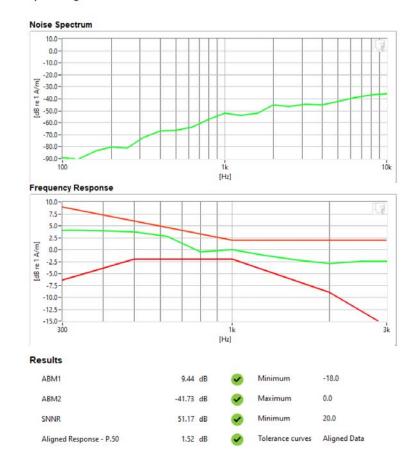
Equipment:

Probe: Axial T-Coil Probe – SN: TEM-1123; Calibrated: 09/19/2018

Test Configuration:

Mode: LTE FDD Band 13Bandwidth: 10MHzChannel: 23230

Speech Signal: ITU-T P.50 Artificial Voice



FCC ID: ZNFQ730VM	PCTEST	HAC (T-COIL) TEST REPORT	LG	Approved by: Quality Manager
Filename:	Test Dates:	DUT Type:		Page 58 of 88
1M2003310054-03-R1.ZNF	04/13/2020 - 04/22/2020	Portable Handset		rage 30 01 00

REV 3.5.M



DUT: ZNFQ730VM

Type: Portable Handset Serial: 01920

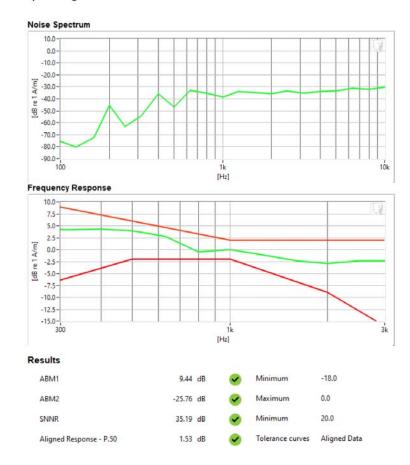
Measurement Standard: ANSI C63.19-2011

Equipment:

Probe: Axial T-Coil Probe – SN: TEM-1123; Calibrated: 09/19/2018

Test Configuration:

- Mode: LTE TDD Band 41 (PC2)
- Bandwidth: 15MHz
- Channel: 40620
- Speech Signal: ITU-T P.50 Artificial Voice



FCC ID: ZNFQ730VM	PCTEST	HAC (T-COIL) TEST REPORT	(LG	Approved by: Quality Manager
Filename:	Test Dates:	DUT Type:		Page 59 of 88
1M2003310054-03-R1.ZNF	04/13/2020 - 04/22/2020	Portable Handset		rage 39 01 66



Type: Portable Handset Serial: 01920

Measurement Standard: ANSI C63.19-2011

Equipment:

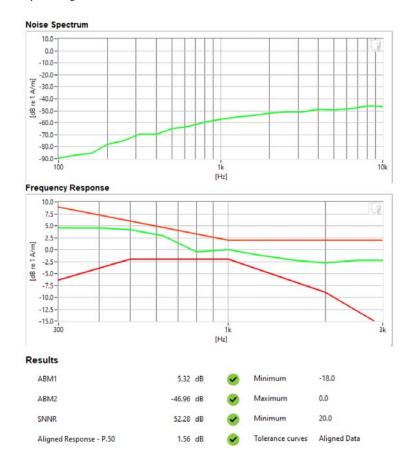
Probe: Axial T-Coil Probe – SN: TEM-1123; Calibrated: 09/19/2018

Test Configuration:

Mode: 2.4GHz WIFIStandard: IEEE 802.11b

· Channel: 11

· Speech Signal: ITU-T P.50 Artificial Voice



FCC ID: ZNFQ730VM	PCTEST	HAC (T-COIL) TEST REPORT	LG	Approved by: Quality Manager
Filename:	Test Dates:	DUT Type:		Page 60 of 88
1M2003310054-03-R1.ZNF	04/13/2020 - 04/22/2020	Portable Handset		rage ou oi oo



Type: Portable Handset Serial: 01920

Measurement Standard: ANSI C63.19-2011

Equipment:

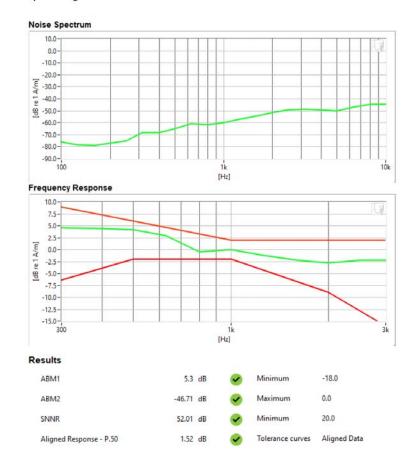
Probe: Axial T-Coil Probe – SN: TEM-1123; Calibrated: 09/19/2018

Test Configuration:

Mode: 5GHz WIFIStandard: IEEE 802.11a

Channel: 120

Speech Signal: ITU-T P.50 Artificial Voice



FCC ID: ZNFQ730VM	PCTEST	HAC (T-COIL) TEST REPORT	LG	Approved by: Quality Manager
Filename:	Test Dates:	DUT Type:		Page 61 of 88
1M2003310054-03-R1.ZNF	04/13/2020 - 04/22/2020	Portable Handset		rage 01 01 00



Type: Portable Handset Serial: 01920

Measurement Standard: ANSI C63.19-2011

Equipment:

Probe: Axial T-Coil Probe – SN: TEM-1123; Calibrated: 09/19/2018

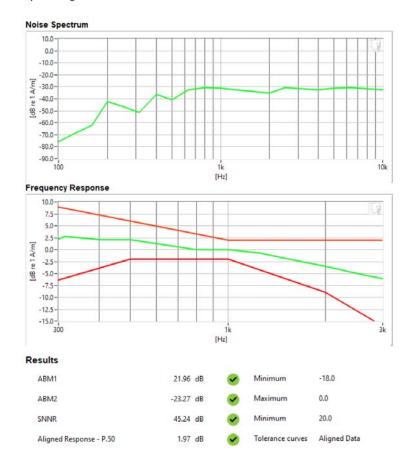
Test Configuration:

VolP Application: Google Duo

Mode: EDGE850

Channel: 190

Speech Signal: ITU-T P.50 Artificial Voice



FCC ID: ZNFQ730VM	PCTEST	HAC (T-COIL) TEST REPORT	LG	Approved by: Quality Manager
Filename:	Test Dates:	DUT Type:		Page 62 of 88
1M2003310054-03-R1.ZNF	04/13/2020 - 04/22/2020	Portable Handset		Fage 02 01 00



Measurement Standard: ANSI C63.19-2011

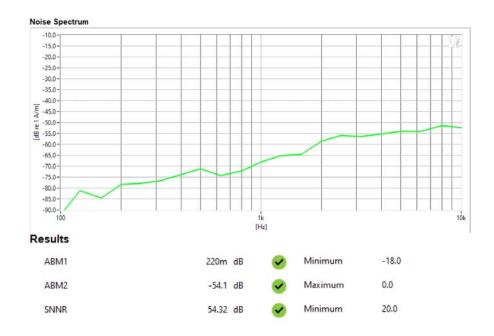
Equipment:

Probe: Radial T-Coil Probe – SN: TEM-1129; Calibrated: 09/19/2018

Test Configuration:

Mode: Secondary Cellular CDMA

Channel: 564



FCC ID: ZNFQ730VM	PCTEST	HAC (T-COIL) TEST REPORT	LG	Approved by: Quality Manager
Filename:	Test Dates:	DUT Type:		Page 63 of 88
1M2003310054-03-R1.ZNF	04/13/2020 - 04/22/2020	Portable Handset		rage 03 01 00



Measurement Standard: ANSI C63.19-2011

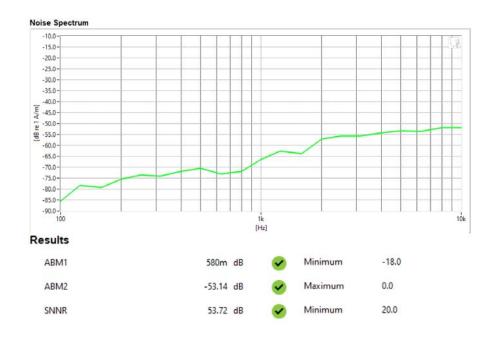
Equipment:

Probe: Radial T-Coil Probe – SN: TEM-1129; Calibrated: 09/19/2018

Test Configuration:

Mode: Cellular CDMA

Channel: 777



FCC ID: ZNFQ730VM	PCTEST	HAC (T-COIL) TEST REPORT	LG	Approved by: Quality Manager
Filename:	Test Dates:	DUT Type:		Page 64 of 88
1M2003310054-03-R1.ZNF	04/13/2020 - 04/22/2020	Portable Handset		Fage 04 01 00



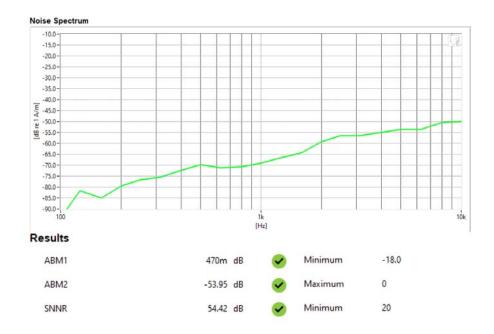
Measurement Standard: ANSI C63.19-2011

Equipment:

Probe: Radial T-Coil Probe – SN: TEM-1129; Calibrated: 09/19/2018

Test Configuration:

 Mode: PCS CDMA Channel: 600



FCC ID: ZNFQ730VM	PCTEST	HAC (T-COIL) TEST REPORT	LG	Approved by: Quality Manager
Filename:	Test Dates:	DUT Type:		Page 65 of 88
1M2003310054-03-R1.ZNF	04/13/2020 - 04/22/2020	Portable Handset		Fage 03 01 00



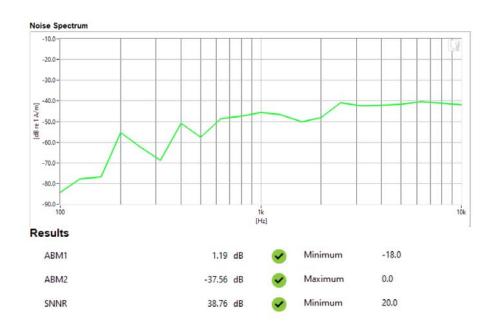
Measurement Standard: ANSI C63.19-2011

Equipment:

Probe: Radial T-Coil Probe – SN: TEM-1129; Calibrated: 09/19/2018

Test Configuration:

Mode: GSM850Channel: 251



FCC ID: ZNFQ730VM	PCTEST	HAC (T-COIL) TEST REPORT	(LG	Approved by: Quality Manager
Filename:	Test Dates:	DUT Type:		Page 66 of 88
1M2003310054-03-R1.ZNF	04/13/2020 - 04/22/2020	Portable Handset		rage 00 01 00



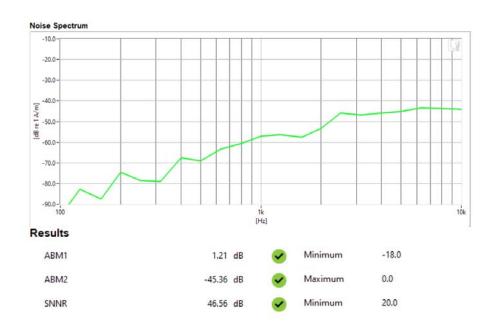
Measurement Standard: ANSI C63.19-2011

Equipment:

Probe: Radial T-Coil Probe – SN: TEM-1129; Calibrated: 09/19/2018

Test Configuration:

Mode: GSM1900
 Channel: 810



FCC ID: ZNFQ730VM	PCTEST	HAC (T-COIL) TEST REPORT	① LG	Approved by: Quality Manager
Filename:	Test Dates:	DUT Type:		Page 67 of 88
1M2003310054-03-R1.ZNF	04/13/2020 - 04/22/2020	Portable Handset		raye 07 01 00



Measurement Standard: ANSI C63.19-2011

Equipment:

Probe: Radial T-Coil Probe – SN: TEM-1129; Calibrated: 09/19/2018

Test Configuration:

 Mode: UMTS V Channel: 4132



FCC ID: ZNFQ730VM	PCTEST: Hood to be port of @ memore	HAC (T-COIL) TEST REPORT	LG	Approved by: Quality Manager
Filename:	Test Dates:	DUT Type:		Page 68 of 88
1M2003310054-03-R1.ZNF	04/13/2020 - 04/22/2020	Portable Handset		rage 00 01 00



Measurement Standard: ANSI C63.19-2011

Equipment:

Probe: Radial T-Coil Probe – SN: TEM-1129; Calibrated: 09/19/2018

Test Configuration:

Mode: UMTS IVChannel: 1513



FCC ID: ZNFQ730VM	PCTEST Total to be part of the recommend	HAC (T-COIL) TEST REPORT	LG	Approved by: Quality Manager
Filename:	Test Dates:	DUT Type:		Page 69 of 88
1M2003310054-03-R1.ZNF	04/13/2020 - 04/22/2020	Portable Handset		rage 09 01 00



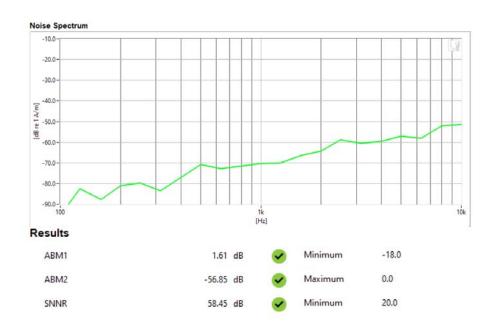
Measurement Standard: ANSI C63.19-2011

Equipment:

Probe: Radial T-Coil Probe – SN: TEM-1129; Calibrated: 09/19/2018

Test Configuration:

 Mode: UMTS II Channel: 9262



FCC ID: ZNFQ730VM	PCTEST	HAC (T-COIL) TEST REPORT	LG	Approved by: Quality Manager
Filename:	Test Dates:	DUT Type:		Page 70 of 88
1M2003310054-03-R1.ZNF	04/13/2020 - 04/22/2020	Portable Handset		rage 70 01 00



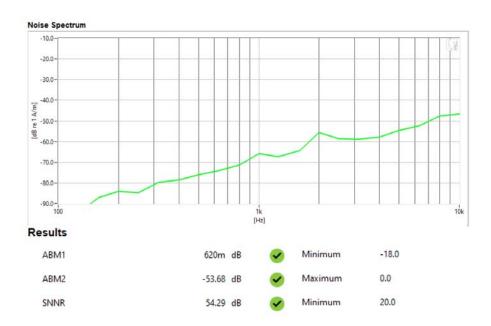
Measurement Standard: ANSI C63.19-2011

Equipment:

Probe: Radial T-Coil Probe – SN: TEM-1129; Calibrated: 09/19/2018

Test Configuration:

Mode: LTE FDD Band 13 Bandwidth: 10MHz Channel: 23230



FCC ID: ZNFQ730VM	PCTEST*	HAC (T-COIL) TEST REPORT	LG	Approved by: Quality Manager
Filename:	Test Dates:	DUT Type:		Dogo 71 of 99
1M2003310054-03-R1.ZNF	04/13/2020 - 04/22/2020	Portable Handset		Page 71 of 88



Measurement Standard: ANSI C63.19-2011

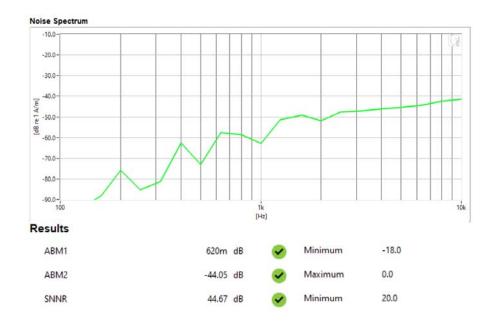
Equipment:

Probe: Radial T-Coil Probe – SN: TEM-1129; Calibrated: 09/19/2018

Test Configuration:

Mode: LTE TDD Band 41 (PC2)

Bandwidth: 15MHz Channel: 40620



FCC ID: ZNFQ730VM	PCTEST	HAC (T-COIL) TEST REPORT	LG	Approved by: Quality Manager
Filename:	Test Dates:	DUT Type:		Page 72 of 88
1M2003310054-03-R1.ZNF	04/13/2020 - 04/22/2020	Portable Handset		Fage 72 01 00



DUT: ZNFQ730VM Type: Portable Handset

Serial: 01920

Measurement Standard: ANSI C63.19-2011

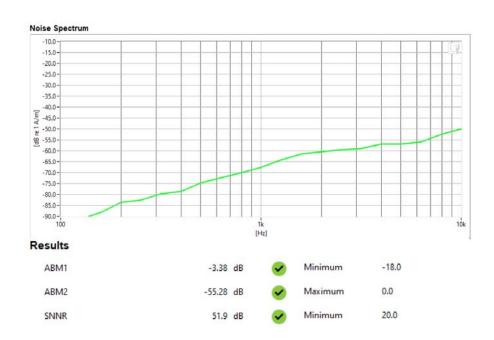
Equipment:

Probe: Radial T-Coil Probe – SN: TEM-1129; Calibrated: 09/19/2018

Test Configuration:

Mode: 2.4GHz WIFI Standard: IEEE 802.11b

Channel: 1



PCTEST 2020

FCC ID: ZNFQ730VM	PCTEST Total to be post of the received	HAC (T-COIL) TEST REPORT	LG	Approved by: Quality Manager
Filename:	Test Dates:	DUT Type:		Page 73 of 88
1M2003310054-03-R1.ZNF	04/13/2020 - 04/22/2020	Portable Handset		rage 73 01 00



DUT: ZNFQ730VM Type: Portable Handset

Serial: 01920

Measurement Standard: ANSI C63.19-2011

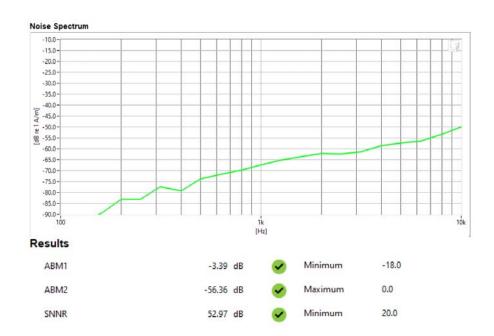
Equipment:

Probe: Radial T-Coil Probe – SN: TEM-1129; Calibrated: 09/19/2018

Test Configuration:

Mode: 5GHz WIFI Standard: IEEE 802.11a

Channel: 64



PCTEST 2020

FCC ID: ZNFQ730VM	PCTEST Total to be part of the recent of the second of the	HAC (T-COIL) TEST REPORT	LG	Approved by: Quality Manager
Filename:	Test Dates:	DUT Type:		Page 74 of 88
1M2003310054-03-R1.ZNF	04/13/2020 - 04/22/2020	Portable Handset		Fage 74 01 00



DUT: ZNFQ730VM Type: Portable Handset

Serial: 01920

Measurement Standard: ANSI C63.19-2011

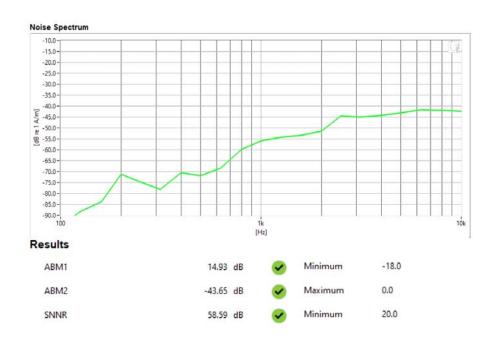
Equipment:

Probe: Radial T-Coil Probe – SN: TEM-1129; Calibrated: 09/19/2018

Test Configuration:

· VolP Application: Google Duo

Mode: EDGE850 Channel: 190



PCTEST 2020

FCC ID: ZNFQ730VM	PCTEST Total to be part of the recent of the second of the	HAC (T-COIL) TEST REPORT	LG	Approved by: Quality Manager
Filename:	Test Dates:	DUT Type:		Page 75 of 88
1M2003310054-03-R1.ZNF	04/13/2020 - 04/22/2020	Portable Handset		Fage 75 01 66

13. CALIBRATION CERTIFICATES

FCC ID: ZNFQ730VM	PCTEST Total to be port of the receiver	HAC (T-COIL) TEST REPORT	LG	Approved by: Quality Manager
Filename:	Test Dates:	DUT Type:		Page 76 of 88
1M2003310054-03-R1.ZNF	04/13/2020 - 04/22/2020	Portable Handset		Fage / 0 01 00



Certificate of Calibration

for

AXIAL T COIL PROBE

Manufactured by:

TEM CONSULTING LP

Model No:

AXIAL T COIL PROBE

Serial No: Calibration Recall No: TEM-1123 29156

Submitted By:

Customer:

Andrew Harwell

Company: Address:

PCTest Engineering Lab 6660-B Dobbin Road

66

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

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

V OLAF 12/4/2018

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 9001:2008 and ISO 17025.

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

Approved by: Fc

Calibration Date:

19-Sep-18

Felix Christopher (QA Mgr.)

Certificate No:

29156 -2

West Caldwell

ISO/IEC 17025:2005

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

Certificate Page 1 of 1

ACCREDITED

Calibration Laboratories, Inc.

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

Calibration Lab. Cert. # 1533.01

FCC ID: ZNFQ730VM

Filename:

1M2003310054-03-R1.ZNF

Test Dates:

04/13/2020 - 04/22/2020

DUT Type:

Portable Handset

Page 77 of 88

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REV 3.5.M



Calibration Lab. Cert. # 1533.01

1575 State Route 96, Victor NY 14564

ISO/IEC 17025: 2005

REPORT OF CALIBRATION

TEM Consulting LP Axial T Coil Probe Company: PCTest Enginering Lab

Model No.: Axial T Coil Probe

Serial No.: TEM-1123 I. D. No.: XXXX

Calibration results: Probe Sensitivity measured with Helmholtz Coil Helmholtz Coil; Before & after data same: ...X.:. the number of turns on each coil; 10 No. 0.204 Laboratory Environment: the radius of each coil, in meters; Ambient Temperature: °C 0.08 22.7 Α the current in the coils, in amperes.; 7.09 A/m/V Ambient Humidity: % RH Helmholtz Coil Constant; Helmholtz Coil magnetic field; 5.95 A/m Ambient Pressure: 99.326 Calibration Date: 19-Sep-2018 Calibration Due: Probe Sensitivity at 1000 Hъ -59.89 dBV/A/m. Report Number: 29156 -2 was 1.013 mV/A/m Control Number: 29156 903 Ohms Probe resistance

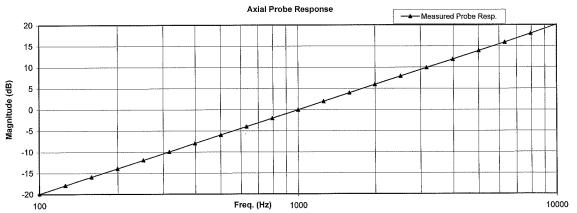
The above listed instrument meets or exceeds the tested manufacturer's specifications.

This Calibration is traceable through NIST test numbers:

683/284413-14

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

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

intended to implement the requirements of ISO10012-1, IEC Guide 25, ANSI/NCSL Z540-1, (MIL-STD-45662A) and ISO 9001:2008, IŞØ)17025

Cal. Date: 19-Sep-2018

Measurements performed by:

Calibrated on WCCL system type 9700

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

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Page 1 of 2

FCC ID: ZNFQ730VM	PCTEST:	HAC (T-COIL) TEST REPORT	① LG	Approved by: Quality Manager
Filename:	Test Dates:	DUT Type:		Page 78 of 88
1M2003310054-03-R1.ZNF	04/13/2020 - 04/22/2020	Portable Handset		rage 76 01 66

HCATEMC_TEM-1123_Sep-19-2018

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 Axial T Coil Probe Company: PCTest Enginering Lab

Model No.: Axial T Coil Probe

Serial No.: TEM-1123

Function	Tolerance		Measured values		
			Before	Out	Remarks
Probe Sensitivity at	1000 Hz.	dBV/A/m	-59.89		
	,	dB			
Probe Level Linearity		6	6.03		
	Ref. (0 dB)	0	0.00		
		-6	-6.03		
		-12	-12.05		
······································		Hz		· · · · · · · · · · · · · · · · · · ·	
Probe Frequency Response		100	-19.9		
		126	-17.9		
		158	-15.9		
		200	-13.9		
		251	-11.9		
		316	-9.9		
		398	-7.9		
		501	-6.0		
		631	-4.0		
		794	-2.0		
	Ref. (0 dB)	1000	0.0		
		1259	2.0		
		1585	4.0		
		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 Sensitivity at Probe Level Linearity	Probe Sensitivity at 1000 Hz. Probe Level Linearity Ref. (0 dB)	Probe Sensitivity at 1000 Hz. dBV/A/m Probe Level Linearity Ref. (0 dB) Ref. (0 dB) O -6 -12 Probe Frequency Response Hz Probe Frequency Response 100 126 158 200 251 316 398 501 631 794 Ref. (0 dB) 1000 1259 1585 1995 2512 3162 3981 5012 6310 7943	Probe Sensitivity at 1000 Hz. dBV/A/m -59.89 Probe Level Linearity 6 6 6.03 Ref. (0 dB) 0 0.00 -6 -6.03 -12 -12.05 Probe Frequency Response 100 -19.9 158 -15.9 200 -13.9 251 -11.9 316 -9.9 398 -7.9 501 -6.0 631 -4.0 794 -2.0 Ref. (0 dB) 1000 0.0 1259 2.0 Ref. (0 dB) 1000 0.0 1259 2.0 1585 4.0 1995 5.9 2512 7.9 3162 9.9 3981 11.9 5012 13.9 6310 15.9 7943 18.0	Probe Sensitivity at 1000 Hz. dBV/A/m -59.89 Probe Level Linearity Ref. (0 dB) 0 0.00 -6 6.03 -12 -12.05 Hz Probe Frequency Response 100 -19.9 126 -17.9 158 -15.9 200 -13.9 251 -11.9 316 -9.9 398 -7.9 501 -6.0 631 -4.0 794 -2.0 Ref. (0 dB) 1000 0.0 1259 2.0 1855 4.0 1995 5.9 2512 7.9 3162 9.9 3981 11.9 5012 13.9 6310 15.9 7943 18.0

Instruments used for o	alibration:		Date of Cal.	Traceablity No.	Due Date
HP	34401A	S/N US360641	25-Jul-2018	,287708	25-Jul-2019
HP	34401A	S/N US361024	25-Jul-2018	,287708	25-Jul-2019
HP	33120A	S/N US360437	25-Jul-2018	,287708	25-Jul-2019
B&K	2133	S/N 1583254	25-Jul-2018	683/284413-14	25-Jul-2019

Cal. Date: 19-Sep-2018

Calibrated on WCCL system type 9700

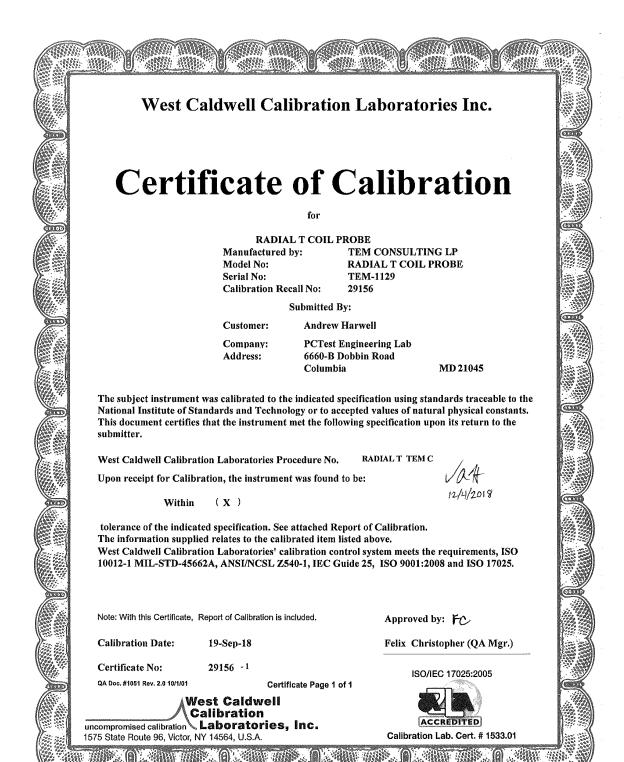
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Tested by: James Zhu

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FCC ID: ZNFQ730VM	PCTEST	HAC (T-COIL) TEST REPORT	① LG	Approved by: Quality Manager
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HCRTEMC_TEM-1129_Sep-19-2018



1575 State Route 96, Victor NY 14564



REPORT OF CALIBRATION

TEM Consulting LP Radial T Coil Probe ,Company: PCTest Engineering Lab

Model No.: Radial T Coil Probe

Serial No.: TEM-1129

I. D. No.: XXXX

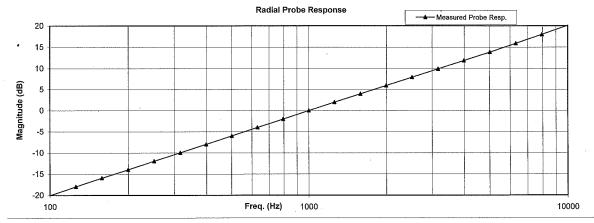
Probe Sensitivity measured wit	h Helmhol	tz Coil			
Helmholtz Coil;			Before & after data same:	X	
the number of turns on each coil;	10	No.			
the radius of each coil, in meters;	0.204	m	Laboratory Environment:		
the current in the coils, in amperes.;	0.08	Α	Ambient Temperature:	22.7	°C
Helmholtz Coil Constant;	7.09	A/m/V	Ambient Humidity:	52.1	% RH
Helmholtz Coil magnetic field;	5.95	A/m	Ambient Pressure:	99.326	kPa
			Calibration Date:	19-Sep-2018	
Probe Sensitivity at	1000	Hz.	Re-calibration Due:		
was	-60.37	dBV/A/m	Report Number:	29156	-1
	0.958	mV/A/m	Control Number:	29156	i
Probe resistance	886	Ohms		*	

This Calibration is traceable through NIST test numbers:

683/284413-14

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 9001:2008, ISQ 17025

Cal. Date: 19-Sep-2018

Measurements performed by:

James Zhu

Calibrated on WCCL system type 9700

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FCC ID: ZNFQ730VM	PCTEST	HAC (T-COIL) TEST REPORT	(LG	Approved by: Quality Manager
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HCRTEMC_TEM-1129_Sep-19-2018

West Caldwell Calibration Laboratories Inc.

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

Calibration Data Record

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

for Model No.: Radial T Coil Probe

Serial No.: TEM-1129

Function	Tolera	Measured values			
and the second s			Before	Out	Remarks
Probe Sensitivity at	1000 Hz.	dBV/A/m	-60.37		
		dB			
Probe Level Linearity		6	6.03		
	Ref. (0 dB)	0	0.00		
		-6	-6.03		
		-12	-12.05		
		Hz			
Probe Frequency Response			-20.0		
			-17.9		
			I I		
		501			
		631	-4.0		
		794	-2.0		
	Ref. (0 dB)	1000	0.0		
		1259	2.0		
		1585	4.0		
		1995	6.0		
			7.9		
		3162	9.9		
		3981	11.9		
		5012	13.9		
		6310	15.9		
		7943	18.0		
		10000	20.1		
	Probe Sensitivity at	Probe Sensitivity at 1000 Hz. Probe Level Linearity Ref. (0 dB)	Probe Sensitivity at 1000 Hz. dBV/A/m Probe Level Linearity Ref. (0 dB) Ref. (0 dB) O -6 -12 Probe Frequency Response Hz Probe Frequency Response 100 126 158 200 251 316 398 501 631 794 Ref. (0 dB) 1000 1259 1585 1995 2512 3162 3981 5012 6310 7943	Probe Sensitivity at 1000 Hz. dBV/A/m -60.37 Probe Level Linearity 6 6 6.03 Ref. (0 dB) 0 0.00 -6 -6.03 -12 -12.05 Probe Frequency Response 100 -20.0 126 -17.9 158 -15.9 200 -14.0 251 -12.0 316 -10.0 398 -8.0 501 -6.0 631 -4.0 794 -2.0 Ref. (0 dB) 1000 0.0 1259 2.0 Ref. (0 dB) 1000 0.0 1259 2.0 1585 4.0 1995 6.0 2512 7.9 3162 9.9 3981 11.9 5012 13.9 6310 15.9 7943 18.0	Probe Sensitivity at 1000 Hz. dBV/A/m -60.37 Probe Level Linearity 6

nstruments used for calibration:		Date of Cal.		Traceability No.	Due Date
' HP	34401A	S/N US360641	25-Jul-2018	,287708	25-Jul-2019
HP	34401A	S/N US361024	25-Jul-2018	,287708	25-Jul-2019
HP	33120A	S/N US360437	25-Jul-2018	,287708	25-Jul-2019
B&K	2133	S/N 1583254	25-Jul-2018	683/284413-14	25-Jul-2019

Cal. Date: 19-Sep-2018

Calibrated on WCCL system type 9700

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Tested by: James Zhu

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

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14. CONCLUSION

The measurements indicate that the wireless communications device complies with the HAC limits specified in accordance with 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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