

PCTEST ENGINEERING LABORATORY, INC.

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HEARING AID COMPATIBILITY

Applicant Name:

LG Electronics MobileComm U.S.A. Inc. 1000 Sylvan Avenue Englewood Cliffs, NJ 07632 United States Date of Testing: 4/14/2018 - 4/20/2018 Test Site/Location:

PCTEST Lab, Columbia, MD, USA

Test Report Serial No.: 1M1804040064-12-R1.ZNF

FCC ID: ZNFV350A

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

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

Application Type: Class II Permissive Change

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-V350AWM

Additional Model(s): LMV350AWM, V350AWM, LM-V350AWA, LMV350AWA, V350AWA,

LM-V350AWS, LMV350AWS, V350AWS, LM-V350ULA,

LMV350ULA, V350ULA, LM-V350ULM, LMV350ULM, V350ULM,

LM-V350ULS, LMV350ULS, V350ULS

Test Device Serial No.: Pre-Production Sample [S/N: 19226, 19218]

Class II Permissive Change(s): See FCC Change Document

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

Note: This revised Test Report (S/N: 1M1804040064-12-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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REV 3.2.M

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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: ZNFV350A

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

1000 Sylvan Avenue

Englewood Cliffs, NJ 07632

United States

LM-V350AWM Model:

> LMV350AWM, V350AWM, LM-V350AWA, LMV350AWA, V350AWA, LM-V350AWS, LMV350AWS, V350AWS, LM-

V350ULA, LMV350ULA, V350ULA, LM-V350ULM,

LMV350ULM, V350ULM, LM-V350ULS, LMV350ULS,

V350ULS

Serial Number: 19226, 19218

HW Version: Rev.1.0

SW Version: V3550AWM07z pre1 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 B17 & B12, LTE B5 & B26, LTE B4 & B66, and LTE B2 & B25. These pairs of LTE bands each have the same target power and share 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 B12, LTE B26, LTE B66, and LTE B25) were evaluated for hearing-aid compliance.

II. Device Serial Numbers

Several samples with identical hardware were used to support HAC testing. The manufacturer has confirmed that the device(s) tested have the same physical, mechanical, and thermal characteristics are within operational tolerances expected for production units. The serial numbers used for each test are indicated alongside the results in Section 9.

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Table 2-1 ZNFV350A HAC Air Interfaces

Air-Interface	Band (MHz)	Type Transport	HAC Tested	Simultaneous But Not Tested	Name of Voice Service	
	835	VO	Yes	Yes: WIFI or BT	CMRS Voice*	
CDMA	1900	••	163	res. Will of B1	CIVINO VOICE	
	EvDO	VD	Yes	Yes: WIFI or BT	Google Duo**	
	850	VO	Yes	Yes: WIFI or BT	CMRS Voice*	
GSM	1900	***	103	res. will of B1	CIVINS VOICE	
	GPRS/EDGE	VD	Yes	Yes: WIFI or BT	Google Duo**	
	850					
UMTS	1700	VD	Yes	Yes: WIFI or BT	CMRS Voice*	
UIVITS	1900					
	HSPA	VD	Yes	Yes: WIFI or BT	Google Duo**	
-	700 (B12)	VD		Yes: WIFI or BT	VoLTE*, Google Duo**	
	700 (B17)					
	780 (B13)					
	790 (B14)					
	850 (B5)					
(50.0)	850 (B26)		.,			
LTE (FDD)	1700 (B4)		Yes			
	1700 (B66)					
	1900 (B2)					
ľ	1900 (B25)					
Ì	2300 (B30)					
Ì	2500 (B7)					
LTE (TDD)	2600 (B41)	VD	Yes	Yes: WIFI or BT	VoLTE*, Google Duo**	
	2450					
Ì	5200 (U-NII 1)					
WIFI	5300 (U-NII 2A)	VD	Yes	Yes: CDMA, GSM, UMTS, or LTE	VoWIFI**, Google Duo**	
	5500 (U-NII 2C)				- -	
	5800 (U-NII 3)					
ВТ	2450	DT	No	Yes: CDMA, GSM, UMTS, or LTE	N/A	
Type Transport VO = Voice Onl	у		Notes: * Reference le	evel in accordance with 7.4.2.1 of ANSI C63.19-20	11 and July 2012 C63 VoLTE	

DT = Digital Data - Not intended for CMRS Service

VD = CMRS and IP Voice over Data Transport

* Reference level in accordance with 7.4.2.1 of ANSI C63.19-2011 and July 2012 C63 VoLTE Interpretation.

** Reference level is -20dBm0 in accordance with FCC KDB 285076 D02

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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.

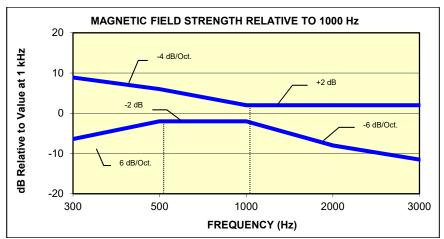


Figure 3-1
Magnetic field frequency response for Wireless Devices with an axial field ≤-15 dB(A/m) at 1 kHz

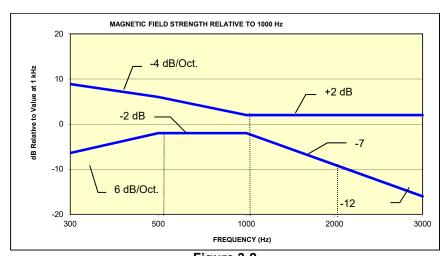


Figure 3-2
Magnetic Field frequency response for wireless devices with an axial field that exceeds
-15 dB(A/m) at 1 kHz

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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.

Category	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:

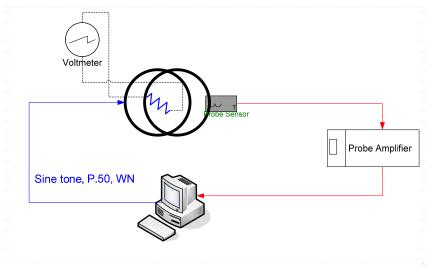


Figure 4-1
Validation Setup with Helmholtz Coil

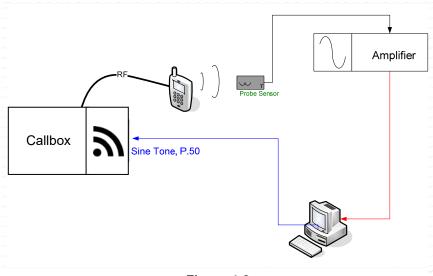


Figure 4-2 T-Coil Test Setup

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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)

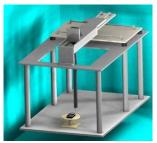


Figure 4-3 RF Near-Field Scanner

III. ITU-T P.50 Artificial Voice

Manufacturer: ITU-T

Active Frequency 100 Hz – 8 kHz

Range:

Stimulus Type: Male and Female, no spaces

Single Sample 20.96 seconds Duration:

Activity Level: 100%

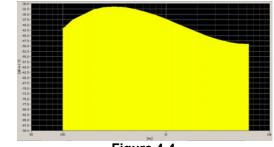


Figure 4-4 Spectral Characteristic of full P.50

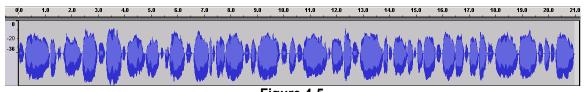


Figure 4-5
Temporal Characteristic of full P.50

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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=0.08m; R=10.2Ω and using V=18mV:

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

Therefore a pure tone of 1kHz was applied into the coils such that 18mV was observed across the resistor. The voltmeter used for measurement was verified to be capable of measurements in the audio band range. This theoretically generates an expected field of $-10 \ dB(A/m)$ in the center of the Helmholtz coil which was used to validate the probe measurement at $-10 \ dB(A/m)$. This was verified to be within $\pm 0.5 \ dB$ of the $-10 \ dB(A/m)$ value (see Page 40).

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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:

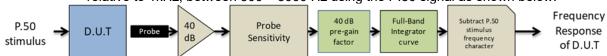


Figure 4-7 Frequency Response Validation

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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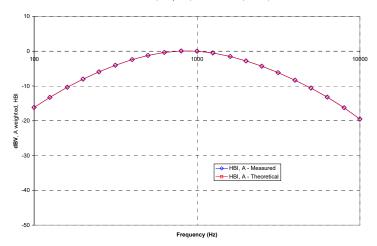
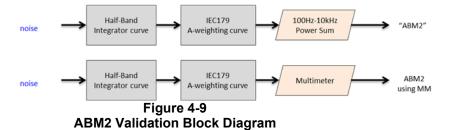


Figure 4-8 **ABM2 Frequency Response Validation**

The ABM2 result is a power sum from 100Hz to 10kHz with half-band integration and Aweighting. 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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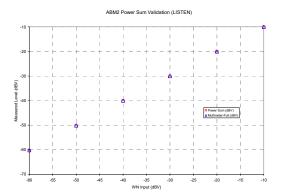


Figure 4-10 **ABM2 Power Sum Validation**

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):

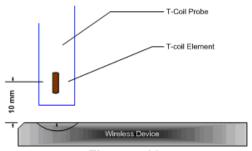


Figure 4-11 **Measurement Distance**

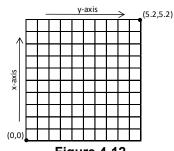


Figure 4-12 **Measurement Grid**

- 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.
- These steps were repeated for all T-coil orientations (axial and radial) per Figure iii. 4-15 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™	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.

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 below for GSM, see Section 8 for more information regarding worst-case configurations for CDMA and UMTS. LTE configuration information can be found in Section 5. WIFI configuration information can be found in Section 6 and 7):

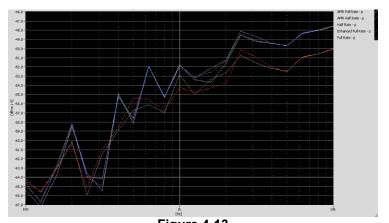


Figure 4-13 Vocoder Analysis for ABM Noise for GSM

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.

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.

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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.
- This result was subtracted from the ABM1 result in step a, to obtain the Signal Quality.

V. Test Setup

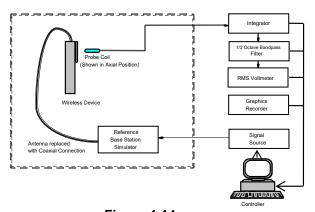


Figure 4-14
Audio Magnetic Field Test Setup

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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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 since circuit-switched voice modes were worst-case.

> Table 4-3 Center Channels and Frequencies

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

2. 4G (LTE) Modes

The middle channel for every band and bandwidth combination was tested for each probe orientation. The band and bandwidth combination from each probe orientation resulting in the worst-case SNNR was additionally tested using low and high channels for that band and bandwidth combination. Low-mid and mid-high channels are additionally tested for LTE TDD. The middle channel and supported bandwidths from the worst-case band according to Table 7-6 was additionally evaluated with OTT VoIP for each probe orientation. See Tables 9-5 to 9-13 and 9-21 to 9-22 for LTE bandwidths and channels.

3. WIFI

The middle channel for each 802.11 standard was tested for each probe orientation. The 2.4GHz 802.11 standard from each probe orientation resulting in the worst-case SNNR was additionally tested using low and high channels. The 5GHz 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 9-14 to 9-17 and 9-23 to 9-26 for WIFI standards and channels.

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IX. Test Flow

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

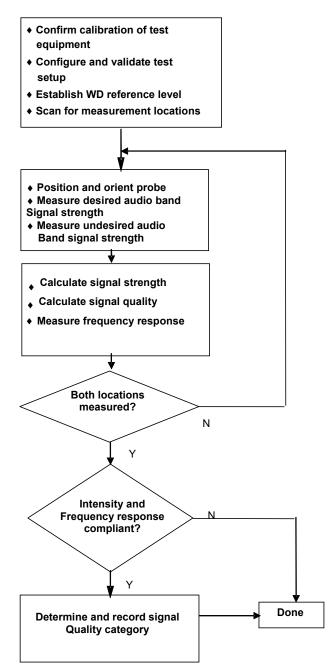


Figure 4-15 **C63.19 T-Coil Signal Test Process**

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VOLTE TEST SYSTEM SETUP AND DUT CONFIGURATION 5.

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

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.

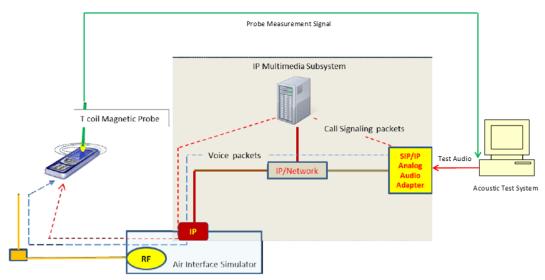


Figure 5-1 Test Setup for VoLTE over IMS T-Coil Measurements

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. 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 Vol.TE over IMS SNNR by Radio Configuration

	•		I IIVIO OIV	INIX DY I	vaulo C	oningara		
Frequency [MHz]	Channel	Bandwidth [MHz]	Modulation	RB Size	RB Offset	ABM1 [dB(A/m)]	ABM2 [dB(A/m)]	SNNR [dB]
707.5	23095	10	QPSK	1	0	2.64	-44.53	47.17
707.5	23095	10	QPSK	1	25	2.31	-44.73	47.04
707.5	23095	10	QPSK	1	49	2.44	-44.83	47.27
707.5	23095	10	QPSK	25	0	2.61	-45.66	48.27
707.5	23095	10	QPSK	25	12	2.30	-45.97	48.27
707.5	23095	10	QPSK	25	25	2.33	-45.59	47.92
707.5	23095	10	QPSK	50	0	2.29	-44.85	47.14
707.5	23095	10	16QAM	1	0	2.38	-41.82	44.20
707.5	23095	10	16QAM	1	25	2.16	-42.23	44.39
707.5	23095	10	16QAM	1	49	2.34	-42.35	44.69
707.5	23095	10	16QAM	25	0	2.34	-45.68	48.02
707.5	23095	10	16QAM	25	12	2.32	-45.61	47.93
707.5	23095	10	16QAM	25	25	2.25	-45.70	47.95
707.5	23095	10	16QAM	50	0	2.18	-44.05	46.23
707.5	23095	10	64QAM	1	0	2.53	-41.70	44.23
707.5	23095	10	64QAM	1	25	2.53	-42.48	45.01
707.5	23095	10	64QAM	1	49	2.57	-41.94	44.51
707.5	23095	10	64QAM	25	0	2.53	-44.39	46.92
707.5	23095	10	64QAM	25	12	2.51	-44.65	47.16
707.5	23095	10	64QAM	25	25	2.38	-44.22	46.60
707.5	23095	10	64QAM	50	0	2.53	-44.70	47.23

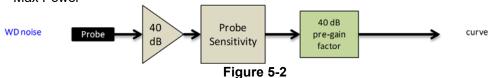
2. Codec Configuration

An investigation was performed to determine the audio codec configuration to be used for testing. The NB AMR 4.75kbps 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

7 time o doo in too tigation to 2 i 2 o to i into										
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)	2.19	1.44	1.09	0.76		Band 12 10MHz BW	23095			
ABM2 (dBA/m)	-46.43	-46.50	-46.42	-45.42	— Δvial					
Frequency Response	Pass	Pass	Pass	Pass						
S+N/N (dB)	48.62	47.94	47.51	46.18						

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



Audio Band Magnetic Curve Measurement Block Diagram

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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 $1/(15000 \times 2048)$ 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 · 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 5-3 **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		1	2	3	4	5	6	7	8	9	Duty Cycle (%)
0	5 ms	D	S	٦	כ	U	D	S	٦	٦	٦	61.4%
1	5 ms	D	S	٦	כ	D	D	S	٦	٦	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	٦	כ	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%

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 1 was used as the worst-case configuration for Power Class 3 VoLTE over IMS T-Coil testing. See table below for the SNNR comparison between each Uplink-Downlink configuration:

Table 5-4 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	2.72	-31.78	34.50
2593.0	40620	20	16QAM	1	0	1	2.90	-31.13	34.03
2593.0	40620	20	16QAM	1	0	2	2.75	-31.53	34.28
2593.0	40620	20	16QAM	1	0	3	2.75	-34.55	37.30
2593.0	40620	20	16QAM	1	0	4	2.96	-34.16	37.12
2593.0	40620	20	16QAM	1	0	5	3.06	-34.72	37.78
2593.0	40620	20	16QAM	1	0	6	2.81	-31.67	34.48

b. Conclusion

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

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VOWIFI TEST SYSTEM SETUP AND DUT CONFIGURATION 6.

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

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.

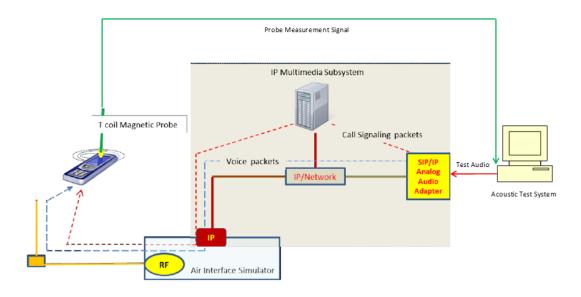


Figure 6-1 Test Setup for VoWIFI over IMS T-Coil Measurements

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 802.11 standard:

> Table 6-1 802.11b SNNR by Radio Configuration

Mode	Channel	Modulation	Data Rate [Mbps]	ABM1 [dB(A/m)]	ABM2 [dB(A/m)]	SNNR [dB]
802.11b	6	DSSS	1	-1.51	-38.22	36.71
802.11b	6	DSSS	2	-1.59	-39.22	37.63
802.11b	6	CCK	5.5	-1.59	-38.50	36.91
802.11b	6	CCK	11	-1.50	-39.35	37.85

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

Mode	Channel	Modulation	Data Rate [Mbps]	ABM1 [dB(A/m)]	ABM2 [dB(A/m)]	SNNR [dB]
802.11g	6	BPSK	6	-1.76	-42.05	40.29
802.11g	6	BPSK	9	-1.44	-42.98	41.54
802.11g	6	QPSK	12	-1.72	-43.17	41.45
802.11g	6	QPSK	18	-1.38	-42.86	41.48
802.11g	6	16-QAM	24	-1.63	-44.48	42.85
802.11g	6	16-QAM	36	-1.49	-43.41	41.92
802.11g	6	64-QAM	48	-1.23	-43.90	42.67
802.11g	6	64-QAM	54	-1.61	-43.48	41.87

Table 6-3 802 11n/ac 20MHz RW SNNR by Radio Configuration

802.1 Ill/ac 20MHZ BW SNINK by Radio Configuration										
Mode	Bandwidth [MHz]	Channel	Modulation	Data Rate [Mbps]	ABM1 [dB(A/m)]	ABM2 [dB(A/m)]	SNNR [dB]			
802.11n	20	40	BPSK	6.5	-1.65	-43.42	41.77			
802.11n	20	40	QPSK	13	-1.51	-45.73	44.22			
802.11n	20	40	QPSK	19.5	-1.61	-46.15	44.54			
802.11n	20	40	16-QAM	26	-1.32	-43.85	42.53			
802.11n	20	40	16-QAM	39	-1.28	-45.42	44.14			
802.11n	20	40	64-QAM	52	-1.49	-44.17	42.68			
802.11n	20	40	64-QAM	58.5	-1.74	-46.14	44.40			
802.11n	20	40	64-QAM	65	-1.40	-47.05	45.65			
802.11ac	20	40	256-QAM	78	-1.51	-47.35	45.84			

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

		002111111111111111111111111111111111111	TOWN IZ DVV O		tare comingare			
Mode	Bandwidth [MHz]	Channel Modulation Data Rate ABM1 [Mbps] [dB(A/m)]		ABM2 [dB(A/m)]	SNNR [dB]			
802.11n	40	38	BPSK	13.5	-1.46	-43.74	42.28	
802.11n	40	38	QPSK	27	-1.58	-43.89	42.31	
802.11n	40	38	QPSK	40.5	-1.71	-46.23	44.52	
802.11n	40	38	16-QAM	54	-1.50	-46.44	44.94	
802.11n	40	38	16-QAM	81	-1.62	-44.45	42.83	
802.11n	40	38	64-QAM	108	-1.77	-46.34	44.57	
802.11n	40	38	64-QAM	121.5	-1.33	-46.39	45.06	
802.11n	40	38	64-QAM	135	-1.51	-45.49	43.98	
802.11ac	40	38	256-QAM	162	-1.55	-46.18	44.63	
802.11ac	40	38	256-QAM	180	-1.24	-46.07	44.83	

2. Codec Configuration

An investigation was performed to determine the audio codec configuration to be used for testing. The NB AMR 4.75kbps 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

		AIVIN COU	te ilivestiy	ation – vo	WILL OVE	IIVIS		
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)	-0.19	-1.23	-1.29	-1.35				6
ABM2 (dBA/m)	-38.68	-37.79	-37.68	-37.51	Axial	2.4GHz	802.11b	
Frequency Response	Pass	Pass	Pass	Pass	Axiai	2.4GHZ	802.110	
S+N/N (dB)	38.49	36.56	36.39	36.16				

Mute on; Backlight off; Max Volume; Max Contrast

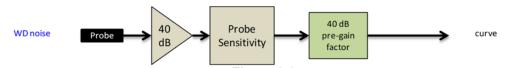


Figure 6-2 **Audio Band Magnetic Curve Measurement Block Diagram**

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OTT VOIP TEST SYSTEM AND DUT CONFIGURATION 7.

I. Test System Setup for OTT VolP 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 64kb/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.

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.

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 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 VolP (EvDO)

Oddco					
Codec Setting:	64kbps	6kbps	Orientation	Channel	
ABM1 (dBA/m)	7.85	7.69			
ABM2 (dBA/m)	-46.19	-46.17	Axial	600	
Frequency Response	Pass	Pass	Axiai	000	
S+N/N (dB)	54.04	53.86			

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)

	nvestigativ	<u> </u>	OII (EDGE	'/	
Codec Setting:	64kbps	6kbps	Orientation	Channel	
ABM1 (dBA/m)	7.00	7.25			
ABM2 (dBA/m)	-29.37	-27.84	Axial	661	
Frequency Response	Pass	Pass	Axiai	001	
S+N/N (dB)	36.37	35.09			

Table 7-3 **Codec Investigation – OTT VolP (HSPA)**

Court in the transfer of the t										
Codec Setting:	64kbps	6kbps	Orientation	Channel						
ABM1 (dBA/m)	7.46	7.32								
ABM2 (dBA/m)	-46.65	-46.76	Axial	9400						
Frequency Response	Pass	Pass	Axiai	9400						
S+N/N (dB)	54.11	54.08								

Table 7-4 Codec Investigation - OTT VolP (LTF)

	Codec livestigation - OTT voir (LTE)												
Codec Setting:	64kbps	6kbps	Orientation	Band / BW	Channel								
ABM1 (dBA/m)	7.46	7.34											
ABM2 (dBA/m)	-43.13	-42.11	Axial	Band 12	23095								
Frequency Response	Pass	Pass	Axiai	Danu 12									
S+N/N (dB)	50.59	49.45											

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

Codec Setting:	64kbps	6kbps	Orientation	Band	Standard	Channel	
ABM1 (dBA/m)	7.72	7.48					
ABM2 (dBA/m)	-36.51	-35.67	Axial	2.4GHz	802.11b	6	
Frequency Response	Pass	Pass	Axiai			Ü	
S+N/N (dB)	44.23	43.15					

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

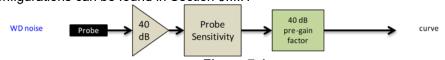


Figure 7-1 **Audio Band Magnetic Curve Measurement Block Diagram**

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2. Radio Configuration for OTT VoIP (LTE)

An investigation was performed to determine the worst-case LTE band to be used for OTT VoIP testing. LTE Band 25 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) SNNR by LTE Band

Band	Frequency [MHz]	· · · I Channel I		Modulation	RB Size	RB Offset	ABM1 [dB(A/m)]	ABM2 [dB(A/m)]	SNNR [dB]				
5	836.5	20525	10	16QAM	1	0	7.07	-41.54	48.61				
12	707.5	23095	10	16QAM	1	0	7.28	-41.85	49.13				
13	782.0	23230	10	16QAM	1	0	7.26	-39.50	46.76				
14	793.0	23330	10	16QAM	1	0	7.23	-39.22	46.45				
26	831.5	26865	10	16QAM	1	0	7.34	-40.68	48.02				
66	1745.0	132322	20	16QAM	1	0	7.33	-40.17	47.50				
25	1882.5	26365	20	16QAM	1	0	7.30	-38.50	45.80				
30	2310.0	27710	10	16QAM	1	0	7.22	-38.62	45.84				
7	2535.0	21100	20	16QAM	1	0	7.26	-41.47	48.73				

3. LTE FDD Uplink Carrier Aggregation for OTT VolP

LTE FDD ULCA was evaluated with the worst-case bandwidth and channel combination from Table 7-6. The PCC radio configuration was channel 20525, 10MHz BW, 16QAM, 1RB, 0RB Offset. The SCC radio configuration was channel 20453, 5MHz BW, 16QAM, 1RB, 24RB Offset. This radio configuration satisfied the configuration requirements of the applicable LTE CA combination. See results below:

> Table 7-7 LTF FDD SNNR for OTT VolP Unlink Carrier Aggregation

					D 011	111110		1011	Opin	iii Oui	1101 /	יטיפפי	guuoi	•			
	PCC							SCC									
Combination	PCC Band	PCC Bandwidth [MHz]	PCC (UL/DL) Channel	PCC (UL/DL) Frequency [MHz]		PCC UL# RB	PCC UL RB Offset	SCC Band	SCC Bandwidth [MHz]	SCC (UL/DL) Channel	SCC (UL/DL) Frequency [MHz]		SCC UL# RB	SCC UL RB Offset	ABM1 [dB(A/m)]	ABM2 [dB(A/m)]	SNNR [dB]
CA 5B	LTF B5	10	20525	836.5	16QAM	1	0	LTF R5	5	20453	829.3	16QAM	1	24	7.04	-44 36	51.40

4. LTE TDD Uplink Carrier Aggregation for OTT VoIP

LTE TDD ULCA was evaluated with the worst-case bandwidth and channel combination from Table 9-22. The PCC radio configuration was channel 40620, 10MHz BW, 16QAM, 1RB, 0RB Offset. The SCC radio configuration was channel 40476, 20MHz BW, 16QAM, 1RB, 99RB Offset. UL-DL configuration 1 was used for evaluation. This radio configuration satisfied the configuration requirements of the applicable LTE CA combination. See results below:

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

ſ			PCC					SCC										
	Combination	PCC Band	PCC Bandwidth [MHz]		PCC (UL/DL) Frequency [MHz]		PCC UL# RB	PCC UL RB Offset	SCC Band	SCC Bandwidth [MHz]	SCC (III /DL)	SCC (UL/DL) Frequency [MHz]		SCC UL# RB	SCC UL RB Offset	ABM1 [dB(A/m)]	ABM2 [dB(A/m)]	SNNR [dB]
Ī	CA_41C	LTE B41	10	40620	2593.0	16QAM	1	0	LTE B41	20	40476	2578.6	16QAM	1	99	7.08	-33.26	40.34

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FCC 3G MEASUREMENTS 8.

I. CDMA Test Configurations

Radio Configuration 1, Service Option 3 (thick, green data curve) was used for the testing as the worstcase configuration for the handset due to vocoder gating from the EVRC logic. See below plot for ABM noise comparison between operational field service options and radio configurations for a CDMA2000 handset:

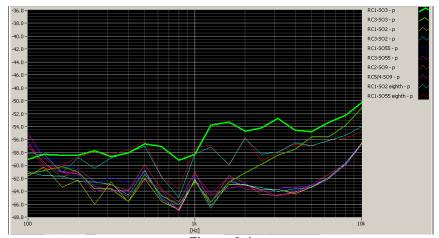
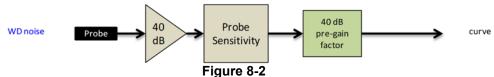


Figure 8-1 **CDMA Audio Band Magnetic Noise**

Table 8-1 FCC 3G ABM Measurements for ZNFV350A (CDMA)

=	00 00 / (Bill III					
Configuration:	RC1/SO3	RC3/SO3	RC4/SO3	Orientation	Channel	
ABM1 (dBA/m)	-6.81	-6.82	-6.82			
ABM2 (dBA/m)	-38.63	-43.57	-43.17	Axial	384	
Frequency Response	Pass	Pass	Pass	Axiai	304	
S+N/N (dB)	31.82	36.75	36.35			

- 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 was used for the testing as the worst-case configuration for the handset. See below plot for ABM noise comparison between vocoder rates:

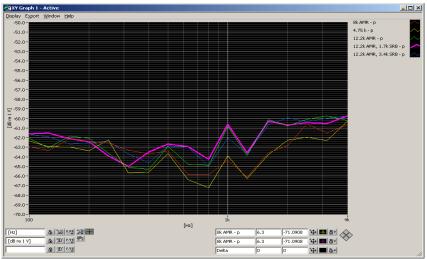
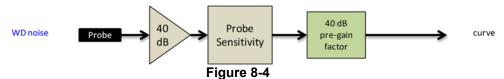


Figure 8-3
UMTS Audio Band Magnetic Noise

Table 8-2 Codec Investigation - UMTS

Codec Setting:	AMR 12.2kbps	AMR 7.95kbps	AMR 4.75kbps	Orientation	Channel	
ABM1 (dBA/m)	5.82	5.79	5.78			
ABM2 (dBA/m)	-33.28	-35.89	-37.04	Axial	9400	
Frequency Response	Pass	Pass	Pass	Axiai	3400	
S+N/N (dB)	39.10	41.68	42.82			

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



Audio Band Magnetic Curve Measurement Block Diagram

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_			iisoiia	ated i	abica	Nesuit	<u> </u>		
			esponse rgin	•	netic / Verdict		SNNR dict	Margin from FCC Limit	C63.19-2011
222.4		8.3	3.2	8.3	3.1	8.3	3.4	(dB)	Rating
C63.1	9 Section	Axial	Radial	Axial	Radial	Axial	Radial	, ,	
	Secondary Cellular	PASS	NA	PASS	PASS	PASS	PASS		
CDMA	Cellular	PASS	NA	PASS	PASS	PASS	PASS	-8.88	Т3
	PCS	PASS	NA	PASS	PASS	PASS	PASS		
	Secondary Cellular	PASS	NA	PASS	PASS	PASS	PASS		
EvDO (OTT VoIP)	Cellular	PASS	NA	PASS	PASS	PASS	PASS	-22.80	T4
(011 7011)	PCS	PASS	NA	PASS	PASS	PASS	PASS		
	Cellular	PASS	NA	PASS	PASS	PASS	PASS		
GSM	PCS	PASS	NA	PASS	PASS	PASS	PASS	-8.20	Т3
EDGE	Cellular	PASS	NA	PASS	PASS	PASS	PASS		
(OTT VoIP)	PCS	PASS	NA	PASS	PASS	PASS	PASS	-12.22	T4
	Cellular	PASS	NA	PASS	PASS	PASS	PASS		
UMTS	AWS	PASS	NA	PASS	PASS	PASS	PASS	-27.74	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	-26.63	T4
(011 7011)	PCS	PASS	NA	PASS	PASS	PASS	PASS		
	B12	PASS	NA	PASS	PASS	PASS	PASS		
	B13	PASS	NA	PASS	PASS	PASS	PASS		
	B14	PASS	NA	PASS	PASS	PASS	PASS		
	B26	PASS	NA	PASS	PASS	PASS	PASS		
LTE FDD	B66	PASS	NA	PASS	PASS	PASS	PASS	-18.90	T4
	B25	PASS	NA	PASS	PASS	PASS	PASS		
	B30	PASS	NA	PASS	PASS	PASS	PASS		
	B7	PASS	NA	PASS	PASS	PASS	PASS		
LTE FDD (OTT VoIP)	B25	PASS	NA	PASS	PASS	PASS	PASS	-24.76	Т4
LTE TDD	B41	PASS	NA	PASS	PASS	PASS	PASS	-12.81	T4
LTE TDD (OTT VoIP)	B41	PASS	NA	PASS	PASS	PASS	PASS	-16.80	Т4
	802.11b	PASS	NA	PASS	PASS	PASS	PASS		
WLAN	802.11g	PASS	NA	PASS	PASS	PASS	PASS	E 00	To
WLAN	802.11n	PASS	NA	PASS	PASS	PASS	PASS	-5.82	Т3
	802.11ac	PASS	NA	PASS	PASS	PASS	PASS		
	802.11b	PASS	NA	PASS	PASS	PASS	PASS		
WLAN	802.11g	PASS	NA	PASS	PASS	PASS	PASS	12.40	Τ.4
(OTT VoIP)	802.11n	PASS	NA	PASS	PASS	PASS	PASS	-12.40	T4
	802.11ac	PASS	NA	PASS	PASS	PASS	PASS		
	802.11a	PASS	NA	PASS	PASS	PASS	PASS		
U-NII	802.11n	PASS	NA	PASS	PASS	PASS	PASS	-15.48	T4
	802.11ac	PASS	NA	PASS	PASS	PASS	PASS		
	802.11a	PASS	NA	PASS	PASS	PASS	PASS		
U-NII (OTT VoIP)	802.11n	PASS	NA	PASS	PASS	PASS	PASS	-20.59	T4
(2)		PASS	NA	PASS	PASS	PASS	PASS		

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I. Raw Handset Data

Table 9-2
Raw Data Results for CDMA

Mode	Orientation	Channel	Device SN	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	19226	-6.79	-37.64		2.00	30.85	20.00	-10.85	T4			
	Axial	564	19226	-6.52	-37.85	-60.17	2.00	31.33	20.00	-11.33	T4	2.6, 2.8		
Secondary		684	19226	-6.38	-38.25		2.00	31.87	20.00	-11.87	T4			
Cellular		476	19226	-10.45	-46.41	-59.87		35.96	20.00	-15.96	T4			
	Radial	564	19226	-9.88	-46.63		-59.87 N/A	36.75	20.00	-16.75	T4	2.2, 2.0		
		684	19226	-10.07	-47.09			37.02	20.00	-17.02	T4			
	Axial	1013	19226	-6.54	-38.30	-60.17	2.00	31.76	20.00	-11.76	T4			
		384	19226	-6.31	-38.40		2.00	32.09	20.00	-12.09	T4	2.6, 2.8		
Cellular		777	19226	-6.31	-38.09		2.00	31.78	20.00	-11.78	T4			
Celiulai		1013	19226	-9.96	-46.77	-59.87		36.81	20.00	-16.81	T4			
	Radial	384	19226	-9.84	-47.35		-59.87	-59.87	N/A	37.51	20.00	-17.51	T4	2.2, 2.0
		777	19226	-10.36	-47.26			36.90	20.00	-16.90	T4			
		25	19226	-6.66	-35.54		2.00	28.88	20.00	-8.88	Т3			
	Axial	600	19226	-6.30	-36.69	-60.17	2.00	30.39	20.00	-10.39	T4	2.6, 2.8		
PCS		1175	19226	-6.81	-37.94		2.00	31.13	20.00	-11.13	T4			
PUS		25	19226	-10.24	-40.70			30.46	20.00	-10.46	T4			
	Radial	600	19226	-10.57	-44.09	-59.87	-59.87	N/A	33.52	20.00	-13.52	T4	2.2, 2.0	
		1175	19226	-10.49	-46.18			35.69	20.00	-15.69	T4			

Table 9-3
Raw Data Results for GSM

Mode	Orientation	Channel	Device SN	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	19218	6.02	-23.48		2.00	29.50	20.00	-9.50	T3		
	Axial	190	19218	6.28	-23.32	-60.17	2.00	29.60	20.00	-9.60	T3	2.6, 2.8	
GSM850		251	19218	6.31	-21.89		2.00	28.20	20.00	-8.20	T3		
GSIVIOSU		128	19218	3.36	-32.49	-59.87		35.85	20.00	-15.85	T4		
	Radial	190	19218	3.60	-32.26		-59.87 N/A	35.86	20.00	-15.86	T4	2.2, 2.0	
		251	19218	3.62	-31.24			34.86	20.00	-14.86	T4		
		512	19218	6.66	-23.94		2.00	30.60	20.00	-10.60	T4		
	Axial	661	19218	6.38	-24.72	-60.17	2.00	31.10	20.00	-11.10	T4	2.6, 2.8	
GSM1900		810	19218	6.31	-26.85		2.00	33.16	20.00	-13.16	T4		
G3W1900		512	19218	3.36	-32.10			35.46	20.00	-15.46	T4		
	Radial	661	19218	3.60	-31.90	-59.87	-59.87 N/A	N/A	35.50	20.00	-15.50	T4	2.2, 2.0
		810	19218	3.60	-33.88			37.48	20.00	-17.48	T4		

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Table 9-4 Raw Data Results for UMTS

Mode	Orientation	Channel	Device SN	ABM1 [dB(A/m)]	ABM2 [dB(A/m)]	Ambient Noise [dB(A/m)]	Frequency Response Margin (dB)	S+N/N (dB)	FCC Limit (dB)	Margin from FCC Limit (dB)	C63.19-2011 Rating	Test Coordinates	
		4132	19218	1.15	-49.69		2.00	50.84	20.00	-30.84	T4		
	Axial	4183	19218	1.10	-50.00	-60.17	2.00	51.10	20.00	-31.10	T4	2.6, 2.8	
UMTS V		4233	19218	1.12	-49.68		2.00	50.80	20.00	-30.80	T4		
OWISV		4132	19218	-1.68	-51.07	-59.87		49.39	20.00	-29.39	T4		
	Radial	4183	19218	-1.69	-51.46		-59.87 N	N/A	49.77	20.00	-29.77	T4	2.2, 2.0
		4233	19218	-1.69	-51.53			49.84	20.00	-29.84	T4		
	Axial	1312	19218	1.06	-50.41	-60.17	2.00	51.47	20.00	-31.47	T4		
		1412	19218	1.08	-50.45		2.00	51.53	20.00	-31.53	T4	2.6, 2.8	
UMTS IV		1513	19218	1.08	-49.97		2.00	51.05	20.00	-31.05	T4		
OWITSTV		1312	19218	-1.65	-51.54	-59.87		49.89	20.00	-29.89	T4		
	Radial	1412	19218	-1.67	-52.22		-59.87	N/A	50.55	20.00	-30.55	T4	2.2, 2.0
		1513	19218	-1.68	-51.70			50.02	20.00	-30.02	T4		
		9262	19218	1.06	-47.77		2.00	48.83	20.00	-28.83	T4		
	Axial	9400	19218	1.14	-48.12	-60.17	2.00	49.26	20.00	-29.26	T4	2.6, 2.8	
UMTS II		9538	19218	1.09	-49.06		2.00	50.15	20.00	-30.15	T4		
OWISH		9262	19218	-1.59	-49.33			47.74	20.00	-27.74	T4		
	Radial	9400	19218	-1.60	-50.92	-59.87 N/A	-59.87	N/A	49.32	20.00	-29.32	T4	2.2, 2.0
		9538	19218	-1.63	-50.48		48.85	20.00	-28.85	T4			

Table 9-5 Raw Data Results for LTE B12

Mode	Orientation	Bandwidth	Channel	Device SN	ABM1 [dB(A/m)]	ABM2 [dB(A/m)]	Ambient Noise [dB(A/m)]	Frequency Response Margin (dB)	S+N/N (dB)	FCC Limit (dB)	FCC Limit	C63.19-2011 Rating	Test Coordinates
		10MHz	23095	19218	1.02	-44.96		1.98	45.98	20.00	(dB) -25.98	T4	
					_					20.00	-25.15	T4	
	Axial	5MHz	23095	19218	0.95	-44.20	-60.17	1.92	45.15				2.6, 2.8
		3MHz	23095	19218	1.23	-45.30		1.89	46.53	20.00	-26.53	T4	,
LTE Band		1.4MHz	23095	19218	1.06	-44.11		1.97	45.17	20.00	-25.17	T4	
12		10MHz	23095	19218	-1.68	-46.94			45.26	20.00	-25.26	T4	
	Radial	5MHz	23095	19218	-1.78	-46.11	-59.87	N/A	44.33	20.00	-24.33	T4	2.2. 2.0
	Naulai	3MHz	23095	19218	-1.65	-46.99	-59.67	IN/A	45.34	20.00	-25.34	T4	2.2, 2.0
		1.4MHz	23095	19218	-1.88	-46.09			44.21	20.00	-24.21	T4	

Table 9-6 Raw Data Results for LTE B13

	Mode	Orientation	Bandwidth	Channel	Device SN	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)		Test Coordinates
	LTE Band Axial	Avial	10MHz	23230	19218	1.56	-40.92	-60.17	1.88	42.48	20.00	-22.48	T4	2.6, 2.8
		Axiai	5MHz	23230	19218	1.42	-42.08	-00.17	1.92	43.50	20.00	-23.50	T4	2.0, 2.6
	13	Radial	10MHz	23230	19218	-1.83	-43.74	-59.87	N/A	41.91	20.00	-21.91	T4	2.2. 2.0
		Raulai	5MHz	23230	19218	-1.90	-46.00	-59.67	IN/A	44.10	20.00	-24.10	T4	2.2, 2.0

Table 9-7 Raw Data Results for LTE B14

	Mode	Orientation	Bandwidth	Channel	Device SN	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
	LTE Band Axial	Andel	10MHz	23330	19218	2.50	-41.27	-60.17	2.00	43.77	20.00	-23.77	T4	2.6, 2.8
		5MHz	23330	19218	2.53	-41.53	-00.17	1.82	44.06	20.00	-24.06	T4	2.0, 2.0	
	14		10MHz	23330	19218	-1.93	-43.79	-59.87	N/A	41.86	20.00	-21.86	T4	2.2. 2.0
		Naulai	5MHz	23330	19218	-1.61	-42.41	-59.67	IN/A	40.80	20.00	-20.80	T4	2.2, 2.0

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Table 9-8 **Raw Data Results for LTE B26**

Mode	Orientation	Bandwidth	Channel	Device SN	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	19218	2.75	-41.31		2.00	44.06	20.00	-24.06	T4	
		10MHz	26865	19218	2.66	-41.70		2.00	44.36	20.00	-24.36	T4	
	Axial	5MHz	26865	19218	2.21	-42.30	-60.17	2.00	44.51	20.00	-24.51	T4	2.6, 2.8
		3MHz	26865	19218	2.09	-43.49		1.98	45.58	20.00	-25.58	T4	
LTE Band		1.4MHz	26865	19218	2.57	-43.86		1.90	46.43	20.00	-26.43	T4	
26		15MHz	26865	19218	-1.80	-44.68			42.88	20.00	-22.88	T4	
		10MHz	26865	19218	-1.93	-45.87			43.94	20.00	-23.94	T4	
	Radial	5MHz	26865	19218	-1.83	-46.23	-59.87	N/A	44.40	20.00	-24.40	T4	2.2, 2.0
		3MHz	26865	19218	-1.78	-46.41			44.63	20.00	-24.63	T4	
		1.4MHz	26865	19218	-2.04	-44.79			42.75	20.00	-22.75	T4	

Table 9-9 **Raw Data Results for LTE B66**

Mode	Orientation	Bandwidth	Channel	Device SN	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	19218	2.79	-41.91		2.00	44.70	20.00	-24.70	T4	
		15MHz	132322	19218	2.55	-42.94		1.99	45.49	20.00	-25.49	T4	
	Axial	10MHz	132322	19218	2.53	-42.64	-60.17	1.96	45.17	20.00	-25.17	T4	2.6, 2.8
	Axidi	5MHz	132322	19218	2.63	-42.94	-00.17	1.92	45.57	20.00	-25.57	T4	2.0, 2.0
		3MHz	132322	19218	2.76	-41.85		1.90	44.61	20.00	-24.61	T4	
LTE Band		1.4MHz	132322	19218	2.61	-41.25		1.89	43.86	20.00	-23.86	T4	
66		20MHz	132322	19218	-1.97	-42.99			41.02	20.00	-21.02	T4	
		15MHz	132322	19218	-2.10	-42.33			40.23	20.00	-20.23	T4	
	Radial	10MHz	132322	19218	-1.94	-44.33	-59.87	N/A	42.39	20.00	-22.39	T4	2.2, 2.0
	Natial	5MHz	132322	19218	-1.79	-43.65	-59.67	IWA	41.86	20.00	-21.86	T4	2.2, 2.0
		3MHz	132322	19218	-1.79	-42.35			40.56	20.00	-20.56	T4	
		1.4MHz	132322	19218	-2.01	-43.22			41.21	20.00	-21.21	T4	

Table 9-10 Raw Data Results for LTE B25

				1 7 6	AVV Date	ittesui	is ioi L	LDE					
Mode	Orientation	Bandwidth	Channel	Device SN	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	19218	2.50	-42.48		1.90	44.98	20.00	-24.98	T4	
		15MHz	26365	19218	2.65	-41.44		1.85	44.09	20.00	-24.09	T4	
	Axial	10MHz	26365	19218	2.70	-42.06	-60.17	1.87	44.76	20.00	-24.76	T4	2.6, 2.8
	Axiai	5MHz	26365	19218	2.50	-42.22	-00.17	1.94	44.72	20.00	-24.72	T4	2.0, 2.0
		3MHz	26365	19218	2.17	-42.90		1.93	45.07	20.00	-25.07	T4	
LTE Band		1.4MHz	26365	19218	2.21	-42.49		1.91	44.70	20.00	-24.70	T4	
25		20MHz	26365	19218	-2.07	-43.48			41.41	20.00	-21.41	T4	
		15MHz	26365	19218	-1.89	-43.24			41.35	20.00	-21.35	T4	
	Radial	10MHz	26365	19218	-1.59	-43.74	-59.87	N/A	42.15	20.00	-22.15	T4	2.2. 2.0
	Naulai	5MHz	26365	19218	-1.91	-44.34	-59.67	IN/A	42.43	20.00	-22.43	T4	2.2, 2.0
		3MHz	26365	19218	-1.92	-44.63			42.71	20.00	-22.71	T4	
		1.4MHz	26365	19218	-1.66	-43.37			41.71	20.00	-21.71	T4	

Table 9-11 Raw Data Results for LTE B30

				170	AVV Date	iivosui	Naw Data Nesults for LTL B30													
Mode	Orientation	Bandwidth	Channel	Device SN	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	27710	19218	2.71	-40.34		1.88	43.05	20.00	-23.05	T4								
	Axial	5MHz	27735	19218	2.86	-37.47	-60.17	1.89	40.33	20.00	-20.33	T4	2.6, 2.8							
	Axiai	5MHz	27710	19218	2.49	-38.56	-60.17	2.00	41.05	20.00	-21.05	T4	2.0, 2.0							
LTE Band		5MHz	27685	19218	2.69	-38.58		1.96	41.27	20.00	-21.27	T4								
30		10MHz	27710	19218	-2.04	-41.86			39.82	20.00	-19.82	T4								
	Radial	5MHz	27735	19218	-1.72	-41.73	-59.87	N/A	40.01	20.00	-20.01	T4	2.2. 2.0							
	Naulai	5MHz	27710	19218	-1.82	-40.72	-59.67	IN/A	38.90	20.00	-18.90	T4	2.2, 2.0							
		5MHz	27685	19218	-1.88	-40.85			38.97	20.00	-18.97	T4								

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Table 9-12 Raw Data Results for LTE B7

Mode	Orientation	Bandwidth	Channel	Device SN	ABM1 [dB(A/m)]	ABM2 [dB(A/m)]	Ambient Noise [dB(A/m)]	Frequency Response Margin (dB)	S+N/N (dB)	FCC Limit (dB)	Margin from FCC Limit (dB)	C63.19-2011 Rating	Test Coordinates
		20MHz	21100	19218	2.54	-43.86		1.87	46.40	20.00	-26.40	T4	
	Axial	15MHz	21100	19218	2.46	-44.21	-60.17	1.91	46.67	20.00	-26.67	T4	2.6. 2.8
	Axiai	10MHz	21100	19218	2.84	-44.08	-60.17	1.93	46.92	20.00	-26.92	T4	2.0, 2.0
LTE Band 7	,	5MHz	21100	19218	2.80	-43.29		1.92	46.09	20.00	-26.09	T4	
LIE Ballu /		20MHz	21100	19218	-2.05	-47.75			45.70	20.00	-25.70	T4	
	Radial	15MHz	21100	19218	-1.93	-46.56	-59.87	N/A	44.63	20.00	-24.63	T4	2.2. 2.0
	Radiai	10MHz	21100	19218	-1.93	-46.54	-59.67	IN/A	44.61	20.00	-24.61	T4	2.2, 2.0
		5MHz	21100	19218	-2.14	-45.26			43.12	20.00	-23.12	T4	

Table 9-13 Raw Data Results for LTE B41 Power Class 3

Mode	Orientation	Bandwidth	Channel	Device SN	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	19218	2.83	-31.74		1.98	34.57	20.00	-14.57	T4	
		15MHz	41490	19218	2.77	-30.94		2.00	33.71	20.00	-13.71	T4	
		15MHz	41055	19218	2.75	-30.35		1.96	33.10	20.00	-13.10	T4	
	Axial	15MHz	40620	19218	2.87	-30.64	-60.17	1.94	33.51	20.00	-13.51	T4	2.6, 2.8
	Axiai	15MHz	40185	19218	2.79	-31.00	-00.17	1.93	33.79	20.00	-13.79	T4	2.0, 2.0
		15MHz	39750	19218	2.75	-30.06		1.91	32.81	20.00	-12.81	T4	
		10MHz	40620	19218	2.75	-31.16		2.00	33.91	20.00	-13.91	T4	
LTE Band		5MHz	40620	19218	2.65	-31.53		2.00	34.18	20.00	-14.18	T4	
41		20MHz	40620	19218	-1.92	-43.79			41.87	20.00	-21.87	T4	
		15MHz	40620	19218	-1.75	-44.37			42.62	20.00	-22.62	T4	
		10MHz	41490	19218	-2.08	-43.22			41.14	20.00	-21.14	T4	
	Radial	10MHz	41055	19218	-1.95	-42.34	-59.87	N/A	40.39	20.00	-20.39	T4	2220
	Radiai	10MHz	40620	19218	-1.96	-42.96	-59.67	IN/A	41.00	20.00	-21.00	T4	2.2, 2.0
		10MHz	40185	19218	-1.91	-42.59			40.68	20.00	-20.68	T4	
		10MHz	39750	19218	-2.08	-42.12			40.04	20.00	-20.04	T4	
		5MHz	40620	19218	-2.08	-43.22			41.14	20.00	-21.14	T4	

Table 9-14 Raw Data Results for 2.4GHz WIFI

	France Marcin from													
Mode	Orientation	Channel	Device SN	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	19218	-1.18	-36.65		1.80	35.47	20.00	-15.47	T4			
	Axial	6	19218	-1.58	-37.86	-60.17	1.84	36.28	20.00	-16.28	T4	2.6, 2.8		
WLAN		11	19218	-1.51	-38.35		1.86	36.84	20.00	-16.84	T4			
802.11b		1	19218	-6.42	-32.52			26.10	20.00	-6.10	T3			
	Radial	6	19218	-6.28	-33.40	-59.87	N/A	27.12	20.00	-7.12	Т3	2.2, 2.0		
		11	19218	-6.54	-32.36			25.82	20.00	-5.82	Т3			
WLAN	Axial	6	19218	-1.51	-42.40	-60.17	1.91	40.89	20.00	-20.89	T4	2.6, 2.8		
802.11g	Radial	6	19218	-6.42	-35.94	-59.87	N/A	29.52	20.00	-9.52	Т3	2.2, 2.0		
WLAN	Axial	6	19218	-1.53	-43.64	-60.17	1.91	42.11	20.00	-22.11	T4	2.6, 2.8		
802.11n	Radial	6	19218	-6.25	-37.24	-59.87	N/A	30.99	20.00	-10.99	T4	2.2, 2.0		
WLAN	Axial	6	19218	-1.50	-42.32	-60.17	1.88	40.82	20.00	-20.82	T4	2.6, 2.8		
802.11ac	Radial	6	19218	6.49	-22.09	-59.87	N/A	28.58	20.00	-8.58	Т3	2.2, 2.0		

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

					, Data	· voo a i c	J . O. O.	OI 12 ***								
Mode	Orientation	Bandwidth	U-NII	Channel	Device SN	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		
		20MHz	1	40	19218	-1.69	-42.23		1.85	40.54	20.00	-20.54	T4			
		20MHz	2A	56	19218	-1.72	-43.49		1.83	41.77	20.00	-21.77	T4			
	Axial	20MHz	2C	120	19218	-1.39	-43.40	-60.17	1.91	42.01	20.00	-22.01	T4	2.6, 2.8		
	Axiai	20MHz	3	149	19218	-1.48	-42.55	-00.17	1.95	41.07	20.00	-21.07	T4	2.0, 2.0		
		20MHz	3	157	19218	-1.67	-41.48		1.92	39.81	20.00	-19.81	T4			
		20MHz	3	165	19218	-1.64	-42.42				1.86	40.78	20.00	-20.78	T4	
802.11a	1a															
		20MHz	1	40	19218	-6.50	-42.78			36.28	20.00	-16.28	T4			
		20MHz	2A	56	19218	-6.32	-42.65	5		36.33	20.00	-16.33	T4			
	Radial	20MHz	2C	120	19218	-6.32	-43.38		N/A	37.06	20.00	-17.06	T4	2.2, 2.0		
	Naulai	20MHz	3	149	19218	-6.52	-42.70	-53.67	INA	36.18	20.00	-16.18	T4	2.2, 2.0		
		20MHz	3	157	19218	-6.56	-42.04			ı		35.48	20.00	-15.48	T4	
		20MHz	3	165	19218	-6.49	-42.32			35.83	20.00	-15.83	T4			

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

Mode	Orientation	Bandwidth	U-NII	Channel	Device SN	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			
	Avial	40MHz	1	38	19218	-1.47	-44.35	-60.17	1.92	42.88	20.00	-22.88	T4	2.6, 2.8			
Axial	Axidi	20MHz	1	40	19218	-1.70	-43.27	-60.17	-00.17	1.86	41.57	20.00	-21.57	T4	2.0, 2.0		
802.11n																	
Radial	Padial	40MHz	1	38	19218	-6.26	-42.92	50.07	N/A	36.66	20.00	-16.66	T4	2.2. 2.0			
	Naulai	20MHz	1	40	19218	-6.72	-44.41	-59.87	-59.87	-59.87	-59.87	INA	37.69	20.00	-17.69	T4	2.2, 2.0

Table 9-17 Raw Data Results for 5GHz WIFI 802.11ac

	Mode	Orientation	Bandwidth	U-NII	Channel	Device SN	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			
ſ		Avial	40MHz	1	38	19218	-1.67	-42.47	-60.17	1.88	40.80	20.00	-20.80	T4	2.6, 2.8			
	Axial	20MHz	1	40	19218	-1.75	-42.39	-00.17	-00:17	1.85	40.64	20.00	-20.64	T4	2.0, 2.0			
	802.11ac																	
		Radial	40MHz	1	38	19218	-6.65	-44.11	50.97	N/A	37.46	20.00	-17.46	T4	2.2. 2.0			
		radiai	20MHz	1	40	19218	-6.49	-44.66	-59.87	-59.87	-59.87	-59.87	IVA	38.17	20.00	-18.17	T4	2.2, 2.0

Table 9-18
Raw Data Results for EvDO (OTT VoIP)

Mode	Orientation	Channel	Device SN	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	19226	7.51	-48.18	-60.17	1.59	55.69	20.00	-35.69	T4	2.6, 2.8
EvDO	Radial	564	19226	3.05	-42.23	-59.87	N/A	45.28	20.00	-25.28	T4	2.2, 2.0
Cellular	Axial	384	19226	7.29	-47.12	-60.17	1.60	54.41	20.00	-34.41	T4	2.6, 2.8
EvDO	Radial	384	19226	2.77	-40.03	-59.87	N/A	42.80	20.00	-22.80	T4	2.2, 2.0
PCS	Axial	600	19226	7.49	-46.17	-60.17	1.53	53.66	20.00	-33.66	T4	2.6, 2.8
EvDO	Radial	600	19226	3.01	-42.09	-59.87	N/A	45.10	20.00	-25.10	T4	2.2, 2.0

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

	Train Data Robatio for EDGE (OTT VOIL)													
Mode	Orientation	Channel	Device SN	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		
EDCESEO	Axial	190	19218	7.12	-25.10	-60.17	1.68	32.22	20.00	-12.22	T4	2.6, 2.8		
EDGE850	Radial	190	19218	1.82	-37.72	-59.87	N/A	39.54	20.00	-19.54	T4	2.2, 2.0		
EDCE4000	Axial	661	19218	7.34	-27.64	-60.17	1.57	34.98	20.00	-14.98	T4	2.6, 2.8		
EDGE1900	Radial	661	19218	2.25	-37.20	-59.87	N/A	39.45	20.00	-19.45	T4	2.2, 2.0		

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Table 9-20 Raw Data Results for HSPA (OTT VoIP)

						0 101 110		7 0.1. /					
Mode	Orientation	Channel	Device SN	ABM1 [dB(A/m)]	ABM2 [dB(A/m)]	Ambient Noise [dB(A/m)]	Frequency Response Margin (dB)	S+N/N (dB)	FCC Limit (dB)	Margin from FCC Limit (dB)	C63.19-2011	Test Coordinates	
HSPA V	Axial	4183	19218	7.24	-45.07	-60.17	1.53	52.31	20.00	-32.31	T4	2.6, 2.8	
HOPA V	Radial	4183	19218	2.42	-44.21	-59.87	N/A	46.63	20.00	-26.63	T4	2.2, 2.0	
HSPA IV	Axial	1412	19218	7.19	-45.72	-60.17	1.52	52.91	20.00	-32.91	T4	2.6, 2.8	
HSPAIV	Radial	1412	19218	2.38	-47.49	-59.87	N/A	49.87	20.00	-29.87	T4	2.2, 2.0	
HSPAII	Axial	9400	19218	7.29	-45.63	-60.17	1.48	52.92	20.00	-32.92	T4	2.6, 2.8	
HSPAII	Radial	9400	19218	2.39	-45.34	-59.87	N/A	47.73	20.00	-27.73	T4	2.2, 2.0	

Table 9-21 Raw Data Results for LTE B25 (OTT VoIP)

Mode	Orientation	Bandwidth	Channel	Device SN	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	19218	7.15	-39.13		1.51	46.28	20.00	-26.28	T4			
		15MHz	26615	19218	7.23	-38.35		1.45	45.58	20.00	-25.58	T4			
		15MHz	26365	19218	7.08	-38.96		1.61	46.04	20.00	-26.04	T4			
	Axial	15MHz	26115	19218	6.97	-37.79	-60.17	1.76	44.76	20.00	-24.76	T4	2.6, 2.8		
	Axidi	10MHz	26365	19218	7.12	-39.30	-00.17	1.61	46.42	20.00	-26.42	T4	2.0, 2.6		
LTE Band		5MHz	26365	19218	7.01	-40.26		1.78	47.27	20.00	-27.27	T4			
		3MHz	26365	19218	7.03	-40.50		1.39	47.53	20.00	-27.53	T4			
		1.4MHz	26365	19218	6.98	-39.58		1.35	46.56	20.00	-26.56	T4			
25		20MHz	26365	19218	2.43	-45.06					47.49	20.00	-27.49	T4	
		15MHz	26615	19218	2.39	-42.90			45.29	20.00	-25.29	T4	1		
		15MHz	26365	19218	2.31	-43.99			46.30	20.00	-26.30	T4	1		
	Radial	15MHz	26115	19218	2.33	-43.07	50.07		N/A	45.40	20.00	-25.40	T4	2.2, 2.0	
	Natial	10MHz	26365	19218	2.34	-44.39	-59.87	IWA	46.73	20.00	-26.73	T4	2.2, 2.0		
		5MHz	26365	19218	2.27	-45.35			47.62	20.00	-27.62	T4			
		3MHz	26365	19218	2.37	-44.20			46.57	20.00	-26.57	T4			
		1.4MHz	26365	19218	2.38	-44.38			46.76	20.00	-26.76	T4			

Table 9-22 Raw Data Results for LTE B41 Power Class 3 (OTT VolP)

			Yaw Da	ia Nesu	119 101 1	- L D4	1 Power	Class	3 (011	v Oii <i>j</i>			
Mode	Orientation	Bandwidth	Channel	Device SN	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
		20MHz	40620	19218	7.25	-30.49		1.52	37.74	20.00	-17.74	T4	
		15MHz	40620	19218	7.11	-30.18		1.57	37.29	20.00	-17.29	T4	
		10MHz	40620	19218	7.11	-30.12		1.50	37.23	20.00	-17.23	T4	
	Axial	5MHz	41490	19218	7.10	-29.91	-60.17	1.59	37.01	20.00	-17.01	T4	2.6, 2.8
	Axiai	5MHz	41055	19218	7.18	-29.62	-00.17	1.53	36.80	20.00	-16.80	T4	2.0, 2.0
		5MHz	40620	19218	7.18	-30.01		1.50	37.19	20.00	-17.19	T4	
		5MHz	40185	19218	7.03	-30.40		1.70	37.43	20.00	-17.43	T4	
LTE Band		5MHz	39750	19218	7.13	-30.09		1.56	37.22	20.00	-17.22	T4	
41		20MHz	40620	19218	2.49	-41.13			43.62	20.00	-23.62	T4	
		15MHz	40620	19218	2.45	-40.68			43.13	20.00	-23.13	T4	
		10MHz	41490	19218	2.44	-39.85			42.29	20.00	-22.29	T4	
	Radial	10MHz	41055	19218	2.57	-40.19	-59.87	N/A	42.76	20.00	-22.76	T4	2.2, 2.0
	ixaulai	10MHz	40620	19218	2.40	-39.62	-53.67	IN/PA	42.02	20.00	-22.02	T4	2.2, 2.0
		10MHz	40185	19218	2.52	-40.84			43.36	20.00	-23.36	T4	
		10MHz	39750	19218	2.51	-39.12			41.63	20.00	-21.63	T4	
		5MHz	40620	19218	2.38	-40.28			42.66	20.00	-22.66	T4	

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Table 9-23 Raw Data Results for 2.4GHz WIFI (OTT VoIP)

Mode	Orientation	Channel	Device SN	ABM1 [dB(A/m)]	ABM2 [dB(A/m)]	Ambient Noise	Frequency Response	S+N/N	FCC Limit	Margin from FCC Limit	C63.19-2011 Rating	Test Coordinates
				[db(Am)]	[db(Am)]	[db(Am)]	Margin (dB)	(dB)	(dB)	(dB)	Rating	Coordinates
		1	19218	7.52	-36.00		1.47	43.52	20.00	-23.52	T4	
	Axial	6	19218	7.51	-35.83	-60.17	1.53	43.34	20.00	-23.34	T4	2.6, 2.8
WLAN		11	19218	7.49	-34.90		1.50	42.39	20.00	-22.39	T4	
802.11b		1	19218	2.69	-29.71			32.40	20.00	-12.40	T4	
	Radial	6	19218	2.95	-30.35	-59.87	N/A	33.30	20.00	-13.30	T4	2.2, 2.0
		11	19218	2.68	-30.85			33.53	20.00	-13.53	T4	
WLAN	Axial	6	19218	7.43	-38.45	-60.17	1.55	45.88	20.00	-25.88	T4	2.6, 2.8
802.11g	Radial	6	19218	3.04	-32.77	-59.87	N/A	35.81	20.00	-15.81	T4	2.2, 2.0
WLAN	Axial	6	19218	7.50	-38.74	-60.17	1.50	46.24	20.00	-26.24	T4	2.6, 2.8
802.11n	Radial	6	19218	2.63	-32.73	-59.87	N/A	35.36	20.00	-15.36	T4	2.2, 2.0
WLAN	Axial	6	19218	7.10	-43.45	-60.17	1.42	50.55	20.00	-30.55	T4	2.6, 2.8
802.11ac	Radial	6	19218	3.17	-34.63	-59.87	N/A	37.80	20.00	-17.80	T4	2.2, 2.0

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

Mode	Orientation	Bandwidth	U-NII	Channel	Device SN	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
		20MHz	1	40	19218	7.51	-38.94		1.66	46.45	20.00	-26.45	T4	2.6, 2.8
		20MHz	2A	56	19218	7.49	-38.98		1.45	46.47	20.00	-26.47	T4	
	Axial	20MHz	2C	100	19218	7.57	-39.03	-60.17	1.64	46.60	20.00	-26.60	T4	
		20MHz	2C	120	19218	7.38	-38.62		1.54	46.00	20.00	-26.00	T4	
		20MHz	2C	144	19218	7.60	-38.59		1.52	46.19	20.00	-26.19	T4	
		20MHz	3	157	19218	7.43	-39.00		1.59	46.43	20.00	-26.43	T4	
802.11a														
	Radial	20MHz	1	40	19218	2.66	-39.25	-59.87	N/A	41.91	20.00	-21.91	T4	
		20MHz	2A	56	19218	2.42	-38.99			41.41	20.00	-21.41	T4	
		20MHz	2C	120	19218	2.41	-38.96			41.37	20.00	-21.37	T4	2.2, 2.0
		20MHz	3	149	19218	2.47	-39.22			41.69	20.00	-21.69	T4	2.2, 2.0
		20MHz	3	157	19218	2.57	-38.02			40.59	20.00	-20.59	T4	
		20MHz	3	165	19218	2.59	-40.01			42.60	20.00	-22.60	T4	

Table 9-25 Raw Data Results for 5GHz WIFI 802.11n (OTT VoIP)

	Mode	Orientation	Bandwidth	U-NII	Channel	Device SN	ABM1 [dB(A/m)]	ABM2 [dB(A/m)]	Ambient Noise [dB(A/m)]	Frequency Response Margin (dB)	S+N/N (dB)	FCC Limit (dB)	Margin from FCC Limit (dB)	C63.19-2011	Test Coordinates
		Axial	40MHz	1	38	19218	7.52	-39.81	-60.17	1.88	47.33	20.00	-27.33	T4	2.6, 2.8
		Aviai	20MHz	1	40	19218	7.21	-39.49	-00.17	1.78	46.70	20.00	-26.70	T4	2.0, 2.0
8	02.11n														
		Radial	40MHz	1	38	19218	2.64	-42.46	-59.87	N/A	45.10	20.00	-25.10	T4	2.2. 2.0
			20MHz	1	40	19218	2.58	-42.92			45.50	20.00	-25.50	T4	2.2, 2.0

Table 9-26 Raw Data Results for 5GHz WIFI 802.11ac (OTT VoIP)

11411 2414 11004110 101 00112 1111 100211140 (011 1011)														
Mode	Orientation	Bandwidth	U-NII	Channel	Device SN	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	19218	7.53	-43.51	-60.17	1.70	51.04	20.00	-31.04	T4	2.6, 2.8
		20MHz	1	40	19218	7.42	-43.11	-00.17	1.60	50.53	20.00	-30.53	T4 2.	2.0, 2.0
802.11ac														
	Radial	40MHz	1	38	19218	2.57	-41.39	-59.87	N/A	43.96	20.00	-23.96	T4	2.2. 2.0
		20MHz	1	40	19218	2.58	-42.43			45.01	20.00	-25.01	T4	2.2, 2.0

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II. Test Notes

A. General

- 1. Phone Condition: Mute on; Backlight off; Max Volume; Max Contrast
- 2. 'Radial' orientation refers to radial transverse.
- Hearing Aid Mode (Phone→Settings→More Settings→Hearing aids) as well as Noise Suppression (Phone→Settings→More Settings→Noise Suppression)was set to ON for Frequency Response compliance.
- 4. Speech Signal: ITU-T P.50 Artificial Voice
- 5. Bluetooth and WIFI were disabled for 2G/3G/4G modes while testing.
- 6. Licensed data modes and Bluetooth were disabled for WIFI modes while testing.
- 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)

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: NB AMR 4.75kbps
- 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 30 at 5MHz is the worst-case for both Axial and Radial Probe orientations.

F. LTE TDD

- 1. Power Configuration: TPC = "Max Power"
- 2. Radio Configuration: 16QAM, 1RB, 0RB offset
- 3. Power Class 3 Uplink-Downlink configuration: 1
- 4. Vocoder Configuration: NB AMR 4.75kbps
- 5. Speech Signal: ITU-T P.50 Artificial Voice
- 6. The worst-case band and bandwidth combination for each probe orientation is additionally tested on the low, low-mid, mid-high and high channels for those combinations. LTE Band 41 at 15MHz is the worst-case for the Axial probe orientation. LTE Band 41 at 10MHz bandwidth is the worstcase for the Radial probe orientation.

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G. WIFI

- 1. Radio Configuration
 - a. 802.11b: DSSS, 1Mbps
 - b. 802.11g/a: BPSK, 6Mbps
 - c. 802.11n/ac 20MHz: BPSK, 6.5Mbps
 - d. 802.11n/ac 40MHz: BPSK, 13.5Mbps
- 2. Vocoder Configuration: NB AMR 4.75kbps
- 3. The worst-case standard for 2.4GHz WIFI in each probe orientation is additionally tested on the low and high channels. 802.11b is the worst-case for both 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. 802.11a (U-NII 3) is the worst-case for both Axial and Radial probe orientations.

H. OTT VolP

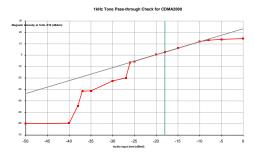
- 1. Vocoder Configuration: 6kbps
- 2. EvDO Configuration
 - a. Revision: A
- 3. EDGE Configuration
 - a. MCS Index: 7
 - b. Number of TX slots: 2
- 4. HSPA Configuration:
 - a. Release: 6
 - b. 3GPP 34.121 Subtest 1
- 5. LTE FDD Configuration:
 - a. Power Configuration: TPC = "Max Power"
 - b. Radio Configuration: 16QAM, 1RB, 0RB offset
 - c. LTE Band 25 was the worst-case band from Table 7-6 and was used for testing 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 25 at 15MHz is the worst-case for both Axial and Radial probe orientations.
- 6. LTE TDD Configuration:
 - a. Power Configuration: TPC = "Max Power"
 - b. Radio Configuration: 16QAM, 1RB, 0RB offset
 - c. Power Class 3 Uplink-Downlink configuration: 1
 - d. 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 (Powers Class 3) at 5MHz is the worst-case for the Axial probe orientation and LTE Band 41 (Power Class 3) at 10MHz is the Radial probe orientation.

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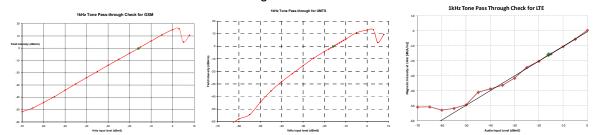
7. WIFI Configuration:

- a. Radio Configuration
 - i. 802.11b: DSSS, 1Mbps
 - ii. 802.11g/a: BPSK, 6Mbps
 - iii. 802.11n/ac 20MHz: BPSK, 6.5Mbps
 - iv. 802.11n/ac 40MHz: BPSK, 13.5Mbps
- b. The worst-case standard for 2.4GHz WIFI in each probe orientation is additionally tested on the low and high channels. 802.11b is the worst-case for both Axial and Radial probe orientation.
- c. The worst-case standard for 5GHz WIFI in each probe orientation is additionally tested on higher U-NII bands as well as applicable low and high channels. 802.11a (U-NII 2C) is the worst-case for the Axial probe orientation. 802.11a (U-NII 3) is the worst-case for the Radial probe orientation.

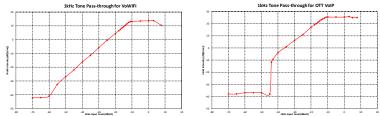
III. 1 kHz Vocoder Application Check



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



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



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

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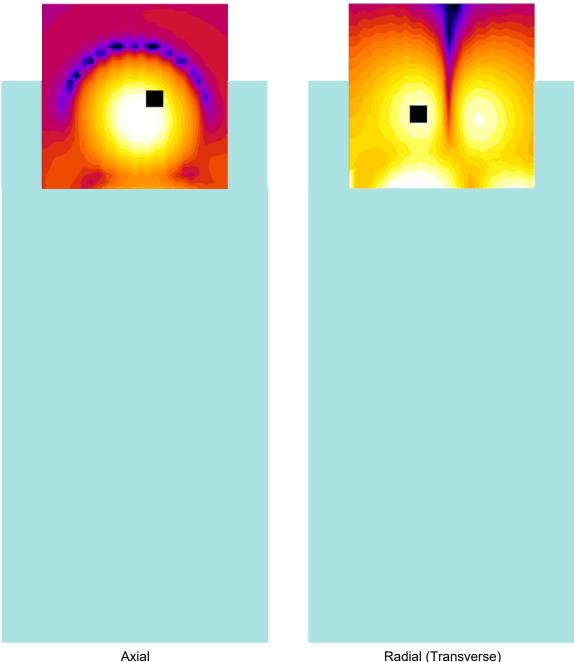
IV. T-Coil Validation Test Results

Table 9-27
Helmholtz Coil Validation Table of Results

Item	Target	Result	Verdict			
Axial						
Magnetic Intensity, -10 dBA/m	-10 ± 0.5 dB	-10.175	PASS			
Environmental Noise	< -58 dBA/m	-60.17	PASS			
Frequency Response, from limits	> 0 dB	0.80	PASS			
Radial						
Magnetic Intensity, -10 dBA/m	-10 ± 0.5 dB	-10.265	PASS			
Environmental Noise	< -58 dBA/m	-59.87	PASS			
Frequency Response, from limits	> 0 dB	0.80	PASS			

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V. ABM1 Magnetic Field Distribution Scan Overlays



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.

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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.	Std. Dev. Normal k=1		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), 95% confidence level							1.31	

Notes:

- 1. 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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11. EQUIPMENT LIST

Table 11-1 Equipment List

	Equipment List						
Model	Description	Cal Date	Cal Interval	Cal Due	Serial Number		
Latitude E6540	SoundCheck Acoustic Analyzer Laptop	4/11/2017	Biennial	4/11/2019	7BFNM32		
SoundConnect	Microphone Power Supply	N/A		N/A	0899-PS150		
SoundConnect	Microphone Power Supply	12/2/2016	Biennial	12/2/2018	PS2612		
Fireface UC	Soundcheck Acoustic Analyzer External Audio Interface	4/11/2017	Biennial	4/11/2019	23528889		
CMW500	Wideband Radio Communication Tester	1/19/2018	Annual	1/19/2019	162125		
CMW500	Wideband Radio Communication Tester	7/14/2017	Annual	7/14/2018	140144		
NC-100	Torque Wrench (8" lb)	9/1/2016	Biennial	9/1/2018	21053		
C63.19	Helmholtz Coil	12/7/2016	Biennial	12/7/2018	925		
Radial T-Coil Probe	Radial T-Coil Probe	12/7/2016	Biennial	12/7/2018	TEM-1130		
Axial T-Coil Probe	Axial T-Coil Probe	12/7/2016	Biennial	12/7/2018	TEM-1124		
	HAC System Controller with Software	N/A		N/A	N/A		
	HAC Positioner	N/A		N/A	N/A		

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12. TEST DATA

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DUT: HH Coil - SN:925

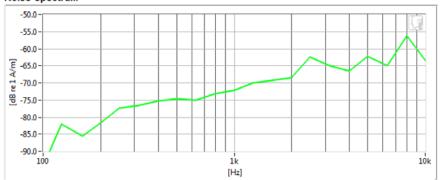
Type: HH Coil Serial: 925

Measurement Standard: ANSI C63.19-2011

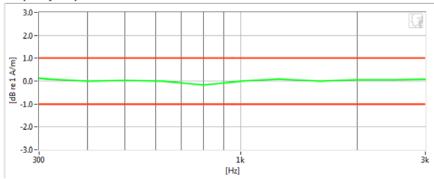
Equipment:

- Probe: Axial T-Coil Probe SN: TEM-1124; Calibrated: 12/07/2016
- Helmholtz Coil SN: 925; Calibrated: 12/07/2016

Noise Spectrum



Frequency Response



Results

Verification 1kHz Intensity	-10.175 dB	V	Max/Min	-9.5/-10.5	
Verification ABM2	-60.17 dB	\checkmark	Maximum	-58.0	
Frequency Response Margin	800m dB	\checkmark	Tolerance curves	Aligned Data	

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DUT: HH Coil - SN:925

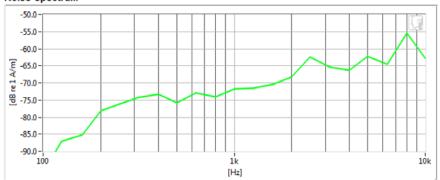
Type: HH Coil Serial: 925

Measurement Standard: ANSI C63.19-2011

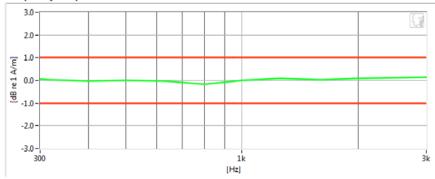
Equipment:

- Probe: Radial T-Coil Probe SN: TEM-1130; Calibrated: 12/07/2016
- Helmholtz Coil SN: 925; Calibrated: 12/07/2016

Noise Spectrum



Frequency Response



Results

Verification 1kHz Intensity	-10.265 dB	•	Max/Min	-9.5/-10.5
Verification ABM2	-59.87 dB	•	Maximum	-58.0
Frequency Response Margin	800m dB	•	Tolerance curves	Aligned Data

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Type: Portable Handset Serial: 19226

Measurement Standard: ANSI C63.19-2011

Equipment:

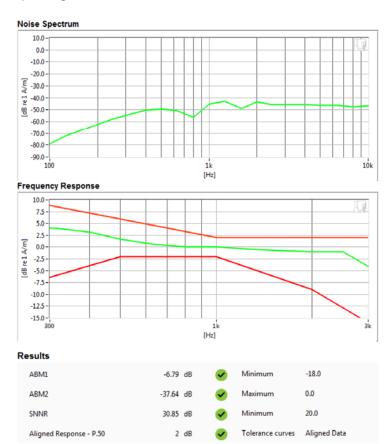
Probe: Axial T-Coil Probe – SN: TEM-1124; Calibrated: 12/07/2016

Test Configuration:

Mode: CDMA Sec. Cell.

Channel: 476

Speech Signal: ITU-T P.50 Artificial Voice



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Type: Portable Handset Serial: 19226

Measurement Standard: ANSI C63.19-2011

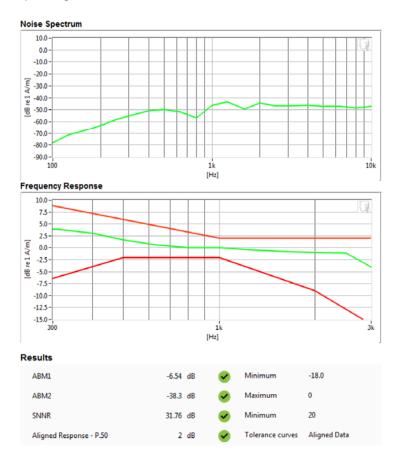
Equipment:

Probe: Axial T-Coil Probe – SN: TEM-1124; Calibrated: 12/07/2016

Test Configuration:

Mode: CDMA Cell.Channel: 1013

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



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1M1804040064-12-R1.ZNF	4/14/2018 - 4/20/2018	Portable Handset		Faye 40 01 03



Type: Portable Handset Serial: 19226

Measurement Standard: ANSI C63.19-2011

Equipment:

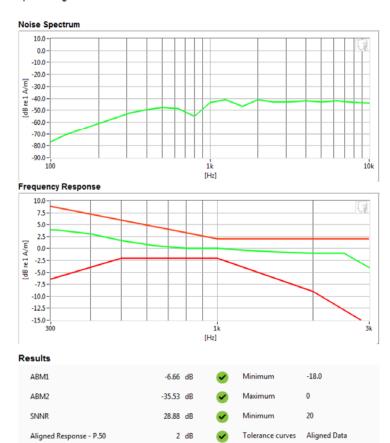
Probe: Axial T-Coil Probe – SN: TEM-1124; Calibrated: 12/07/2016

Test Configuration:

Mode: CDMA PCS

Channel: 25

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



FCC ID: ZNFV350A	PCTEST	HAC (T-COIL) TEST REPORT	(t) LG	Approved by: Quality Manager
Filename:	Test Dates:	DUT Type:		Page 49 of 85
1M1804040064-12-R1.ZNF	4/14/2018 - 4/20/2018	Portable Handset		Faye 49 01 00



Type: Portable Handset Serial: 19218

Measurement Standard: ANSI C63.19-2011

Equipment:

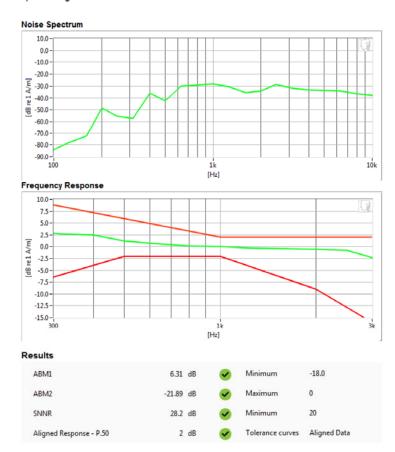
Probe: Axial T-Coil Probe – SN: TEM-1124; Calibrated: 12/07/2016

Test Configuration:

Mode: GSM 850

Channel: 251

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



FCC ID: ZNFV350A	PCTEST	HAC (T-COIL) TEST REPORT	(†) LG	Approved by: Quality Manager
Filename:	Test Dates:	DUT Type:		Page 50 of 85
1M1804040064-12-R1.ZNF	4/14/2018 - 4/20/2018	Portable Handset		Fage 50 01 05



Type: Portable Handset Serial: 19218

Measurement Standard: ANSI C63.19-2011

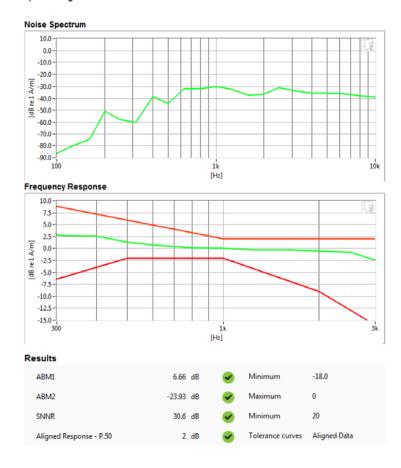
Equipment:

Probe: Axial T-Coil Probe – SN: TEM-1124; Calibrated: 12/07/2016

Test Configuration:

Mode: GSM 1900Channel: 512

Speech Signal: ITU-T P.50 Artificial Voice



FCC ID: ZNFV350A	PCTEST	HAC (T-COIL) TEST REPORT	(†) LG	Approved by: Quality Manager
Filename:	Test Dates:	DUT Type:		Page 51 of 85
1M1804040064-12-R1.ZNF	4/14/2018 - 4/20/2018	Portable Handset		Faye 31 01 03



Type: Portable Handset Serial: 19218

Measurement Standard: ANSI C63.19-2011

Equipment:

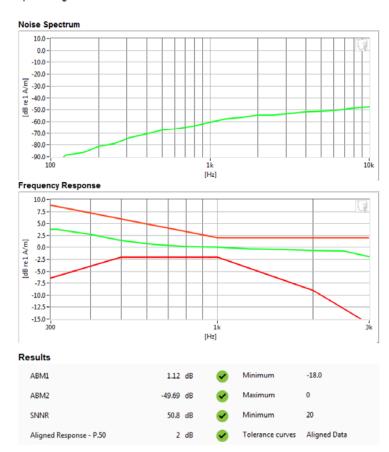
Probe: Axial T-Coil Probe – SN: TEM-1124; Calibrated: 12/07/2016

Test Configuration:

Mode: UMTS Band V

Channel: 4233

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



FCC ID: ZNFV350A	PCTEST	HAC (T-COIL) TEST REPORT	(†) LG	Approved by: Quality Manager
Filename:	Test Dates:	DUT Type:		Page 52 of 85
1M1804040064-12-R1.ZNF	4/14/2018 - 4/20/2018	Portable Handset		Fage 32 01 63



Type: Portable Handset Serial: 19218

Measurement Standard: ANSI C63.19-2011

Equipment:

Probe: Axial T-Coil Probe – SN: TEM-1124; Calibrated: 12/07/2016

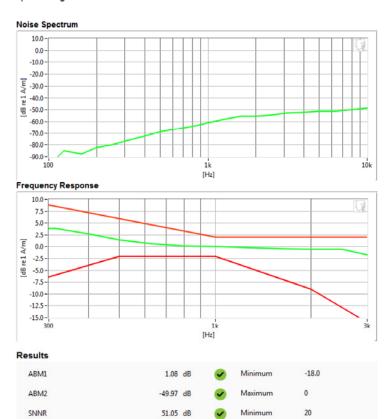
Test Configuration:

Mode: UMTS Band IV

Aligned Response - P.50

Channel: 1513

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



PCTEST 2018

FCC ID: ZNFV350A	PCTEST	HAC (T-COIL) TEST REPORT	⊕ LG	Approved by: Quality Manager
Filename:	Test Dates:	DUT Type:		Page 53 of 85
1M1804040064-12-R1.ZNF	4/14/2018 - 4/20/2018	Portable Handset		Fage 33 01 63

2 dB

Tolerance curves Aligned Data



Type: Portable Handset Serial: 19218

Measurement Standard: ANSI C63.19-2011

Equipment:

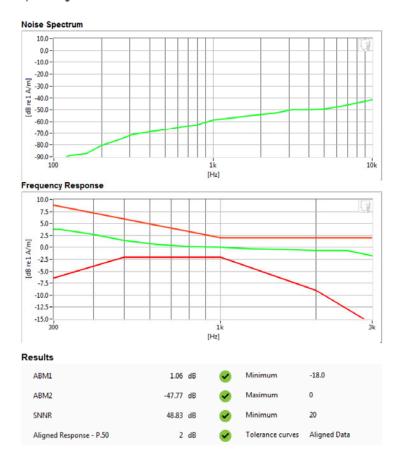
Probe: Axial T-Coil Probe – SN: TEM-1124; Calibrated: 12/07/2016

Test Configuration:

Mode: UMTS Band II

Channel: 9262

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



FCC ID: ZNFV350A	PCTEST	HAC (T-COIL) TEST REPORT	(1) LG	Approved by: Quality Manager
Filename:	Test Dates:	DUT Type:		Page 54 of 85
1M1804040064-12-R1.ZNF	4/14/2018 - 4/20/2018	Portable Handset		Faye 54 01 65



Type: Portable Handset Serial: 19218

Measurement Standard: ANSI C63.19-2011

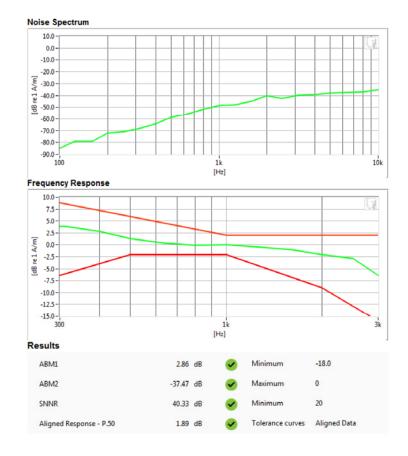
Equipment:

Probe: Axial T-Coil Probe – SN: TEM-1124; Calibrated: 12/07/2016

Test Configuration:

Mode: LTE FDD Band 30Bandwidth: 5MHzChannel: 27735

Speech Signal: ITU-T P.50 Artificial Voice



FCC ID: ZNFV350A	PCTEST*	HAC (T-COIL) TEST REPORT	(1) LG	Approved by: Quality Manager
Filename:	Test Dates:	DUT Type:		Page 55 of 85
1M1804040064-12-R1.ZNF	4/14/2018 - 4/20/2018	Portable Handset		Fage 33 01 63



Type: Portable Handset Serial: 19218

Measurement Standard: ANSI C63.19-2011

Equipment:

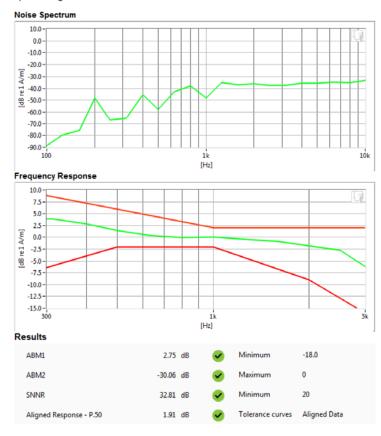
Probe: Axial T-Coil Probe – SN: TEM-1124; Calibrated: 12/07/2016

Test Configuration:

Mode: LTE TDD Band 41Bandwidth: 15MHz

Channel: 39750

Speech Signal: ITU-T P.50 Artificial Voice



FCC ID: ZNFV350A	PCTEST	HAC (T-COIL) TEST REPORT	(t) LG	Approved by: Quality Manager
Filename:	Test Dates:	DUT Type:		Page 56 of 85
1M1804040064-12-R1.ZNF	4/14/2018 - 4/20/2018	Portable Handset		F age 30 01 03



Type: Portable Handset Serial: 19218

Measurement Standard: ANSI C63.19-2011

Equipment:

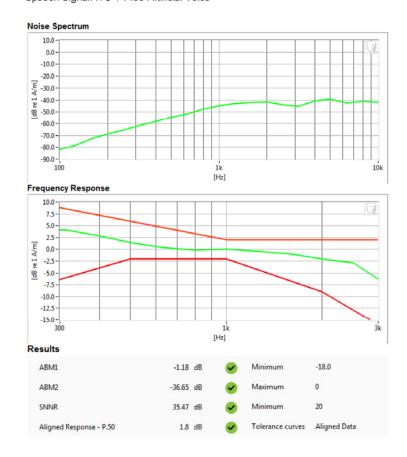
Probe: Axial T-Coil Probe – SN: TEM-1124; Calibrated: 12/07/2016

Test Configuration:

Mode: 2.4GHz WIFIStandard: IEEE 802.11b

Channel: 1

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



FCC ID: ZNFV350A	PCTEST*	HAC (T-COIL) TEST REPORT	⊕ LG	Approved by: Quality Manager
Filename:	Test Dates:	DUT Type:		Page 57 of 85
1M1804040064-12-R1.ZNF	4/14/2018 - 4/20/2018	Portable Handset		Fage 37 01 03



Type: Portable Handset Serial: 19218

Measurement Standard: ANSI C63.19-2011

Equipment:

Probe: Axial T-Coil Probe – SN: TEM-1124; Calibrated: 12/07/2016

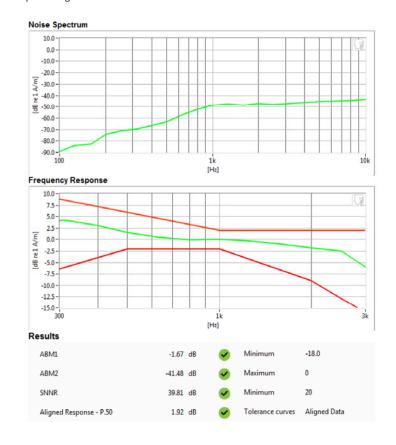
Test Configuration:

Mode: 5GHz WIFIBandwidth: 20MHz

Standard: IEEE 802.11a (UNII-3)

Channel: 157

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



FCC ID: ZNFV350A	PCTEST	HAC (T-COIL) TEST REPORT	(†) LG	Approved by: Quality Manager
Filename:	Test Dates:	DUT Type:		Page 58 of 85
1M1804040064-12-R1.ZNF	4/14/2018 - 4/20/2018	Portable Handset		Page 56 01 65



Type: Portable Handset Serial: 19218

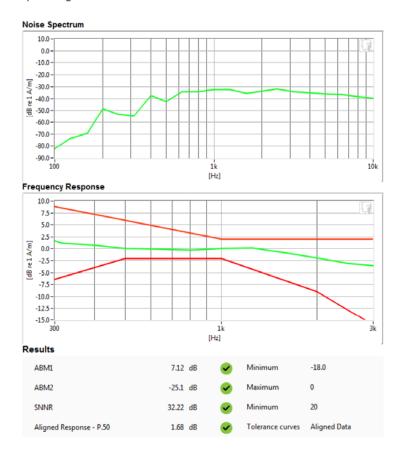
Measurement Standard: ANSI C63.19-2011

Equipment:

Probe: Axial T-Coil Probe – SN: TEM-1124; Calibrated: 12/07/2016

Test Configuration:

- VolP Application: Google Duo
- Mode: EDGE 850
- Channel: 190
- Speech Signal: ITU-T P.50 Artificial Voice



FCC ID: ZNFV350A	PETEST VANISHEEMS LANGESTON, INC.	HAC (T-COIL) TEST REPORT	(1) LG	Approved by: Quality Manager
Filename:	Test Dates:	DUT Type:		Page 59 of 85
1M1804040064-12-R1.ZNF	4/14/2018 - 4/20/2018	Portable Handset		Fage 39 01 03



Type: Portable Handset Serial: 19226

Measurement Standard: ANSI C63.19-2011

Equipment:

Probe: Radial T-Coil Probe – SN: TEM-1130; Calibrated: 12/07/2016

Test Configuration:

Mode: CDMA Sec. Cell.

· Channel: 476



FCC ID: ZNFV350A	PCTEST	HAC (T-COIL) TEST REPORT	(t) LG	Approved by: Quality Manager
Filename:	Test Dates:	DUT Type:		Page 60 of 85
1M1804040064-12-R1.ZNF	4/14/2018 - 4/20/2018	Portable Handset		rage 00 01 05



Type: Portable Handset Serial: 19226

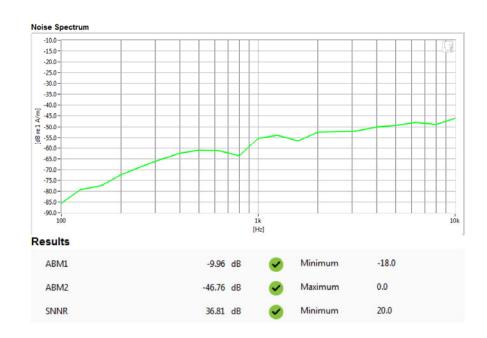
Measurement Standard: ANSI C63.19-2011

Equipment:

Probe: Radial T-Coil Probe – SN: TEM-1130; Calibrated: 12/07/2016

Test Configuration:

Mode: CDMA Cell.Channel: 1013



FCC ID: ZNFV350A	PCTEST*	HAC (T-COIL) TEST REPORT	⊕ LG	Approved by: Quality Manager
Filename:	Test Dates:	DUT Type:		Page 61 of 85
1M1804040064-12-R1.ZNF	4/14/2018 - 4/20/2018	Portable Handset		Fage 01 01 00



Type: Portable Handset Serial: 19226

Measurement Standard: ANSI C63.19-2011

Equipment:

Probe: Radial T-Coil Probe – SN: TEM-1130; Calibrated: 12/07/2016

Test Configuration:

Mode: CDMA PCSChannel: 25



FCC ID: ZNFV350A	PETEST VANISHEEMS LANGESTON, INC.	HAC (T-COIL) TEST REPORT	(1) LG	Approved by: Quality Manager
Filename:	Test Dates:	DUT Type:		Page 62 of 85
1M1804040064-12-R1.ZNF	4/14/2018 - 4/20/2018	Portable Handset		Fage 02 01 00



Type: Portable Handset Serial: 19226

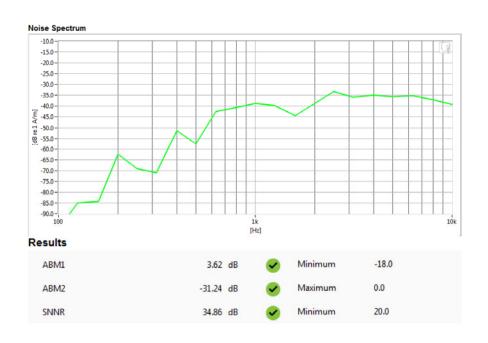
Measurement Standard: ANSI C63.19-2011

Equipment:

Probe: Radial T-Coil Probe – SN: TEM-1130; Calibrated: 12/07/2016

Test Configuration:

Mode: GSM 850Channel: 251



FCC ID: ZNFV350A	PCTEST	HAC (T-COIL) TEST REPORT	(t) LG	Approved by: Quality Manager
Filename:	Test Dates:	DUT Type:		Page 63 of 85
1M1804040064-12-R1.ZNF	4/14/2018 - 4/20/2018	Portable Handset		Fage 03 01 03



Type: Portable Handset Serial: 19218

Measurement Standard: ANSI C63.19-2011

Equipment:

Probe: Radial T-Coil Probe – SN: TEM-1130; Calibrated: 12/07/2016

Test Configuration:

Mode: GSM 1900Channel: 512



FCC ID: ZNFV350A	PCTEST	HAC (T-COIL) TEST REPORT	(1) LG	Approved by: Quality Manager
Filename:	Test Dates:	DUT Type:		Page 64 of 85
1M1804040064-12-R1.ZNF	4/14/2018 - 4/20/2018	Portable Handset		Faye 04 01 00



Type: Portable Handset Serial: 19218

Measurement Standard: ANSI C63.19-2011

Equipment:

SNNR

Probe: Radial T-Coil Probe – SN: TEM-1130; Calibrated: 12/07/2016

Test Configuration:

Mode: UMTS Band VChannel: 4132

Noise Spectrum -10.0 --15.0--20.0 --25.0 --30.0--35.0 --40.0 --45.0-E -55.0-E -55.0--60.0--65.0--70.0 --75.0 --80.0--85.0--90.0 -100 1k [Hz] Results ABM1 -1.68 dB Minimum -18.0 0.0 ABM2 -51.07 dB Maximum

49.39 dB

Minimum

20.0

FCC ID: ZNFV350A	PCTEST*	HAC (T-COIL) TEST REPORT	(1) LG	Approved by: Quality Manager
Filename:	Test Dates:	DUT Type:		Page 65 of 85
1M1804040064-12-R1.ZNF	4/14/2018 - 4/20/2018	Portable Handset		Fage 03 01 03



Type: Portable Handset Serial: 19218

Measurement Standard: ANSI C63.19-2011

Equipment:

SNNR

Probe: Radial T-Coil Probe – SN: TEM-1130; Calibrated: 12/07/2016

Test Configuration:

Mode: UMTS Band IVChannel: 1312

Noise Spectrum -10.0 --15.0--20.0 --25.0 --30.0--35.0 --40.0 --45.0-E -55.0-E -55.0--60.0--65.0--70.0 --75.0 --80.0--85.0--90.0 -100 1k [Hz] Results ABM1 -1.65 dB Minimum -18.0 0.0 ABM2 -51.54 dB Maximum

49.89 dB

Minimum

20.0

FCC ID: ZNFV350A	PETEST VANISHEEMS LANGESTON, INC.	HAC (T-COIL) TEST REPORT	(1) LG	Approved by: Quality Manager
Filename:	Test Dates:	DUT Type:		Page 66 of 85
1M1804040064-12-R1.ZNF	4/14/2018 - 4/20/2018	Portable Handset		Fage 00 01 00



Type: Portable Handset Serial: 19218

Measurement Standard: ANSI C63.19-2011

Equipment:

Probe: Radial T-Coil Probe – SN: TEM-1130; Calibrated: 12/07/2016

Test Configuration:

Mode: UMTS Band IIChannel: 9262



FCC ID: ZNFV350A	PCTEST	HAC (T-COIL) TEST REPORT	(1) LG	Approved by: Quality Manager
Filename:	Test Dates:	DUT Type:		Page 67 of 85
1M1804040064-12-R1.ZNF	4/14/2018 - 4/20/2018	Portable Handset		Fage 07 01 00



Type: Portable Handset Serial: 19218

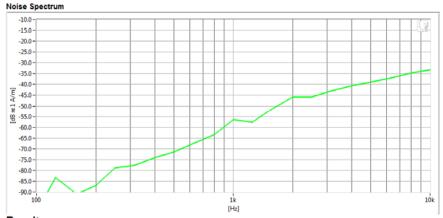
Measurement Standard: ANSI C63.19-2011

Equipment:

Probe: Radial T-Coil Probe – SN: TEM-1130; Calibrated: 12/07/2016

Test Configuration:

Mode: LTE FDD Band 30Bandwidth: 5MHzChannel: 27710



Results

ABM1	-1.82	dB	\checkmark	Minimum	-18.0
ABM2	-40.73	dB	\checkmark	Maximum	0.0
SNNR	38.9	dB	•	Minimum	20.0

FCC ID: ZNFV350A	PCTEST	HAC (T-COIL) TEST REPORT	(t) LG	Approved by: Quality Manager
Filename:	Test Dates:	DUT Type:		Page 68 of 85
1M1804040064-12-R1.ZNF	4/14/2018 - 4/20/2018	Portable Handset		Fage 00 01 00



Type: Portable Handset Serial: 19218

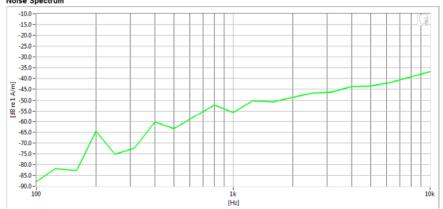
Measurement Standard: ANSI C63.19-2011

Probe: Radial T-Coil Probe – SN: TEM-1130; Calibrated: 12/07/2016

Test Configuration:

 Mode: LTE TDD Band 41 Bandwidth: 10MHz Channel: 39750

Noise Spectrum



Results

ABM1	-2.08 dB	\checkmark	Minimum	-18.0
ABM2	-42.11 dB	\checkmark	Maximum	0.0
SNNR	40.04 dB	\checkmark	Minimum	20.0

FCC ID: ZNFV350A	PCTEST	HAC (T-COIL) TEST REPORT	(1) LG	Approved by: Quality Manager
Filename:	Test Dates:	DUT Type:		Page 69 of 85
1M1804040064-12-R1.ZNF	4/14/2018 - 4/20/2018	Portable Handset		Fage 09 01 00



Type: Portable Handset Serial: 19218

Measurement Standard: ANSI C63.19-2011

Equipment:

ABM2

SNNR

Probe: Radial T-Coil Probe – SN: TEM-1130; Calibrated: 12/07/2016

Test Configuration:

Mode: 2.4GHz WIFIStandard: IEEE 802.11b

Channel: 11

Noise Spectrum -15.0 --20.0 -25.0--30.0 -35.0 -40.0 ₹ -45.0--55.0-B -55.0--60.0--65.0--70.0 --75.0 -80.0--85.0--90.0 -100 [Hz] Results -6.54 dB Minimum -18.0 ABM1

-32.36 dB

25.82 dB

Maximum

Minimum

0.0

20.0

FCC ID: ZNFV350A	PCTEST	HAC (T-COIL) TEST REPORT	(†) LG	Approved by: Quality Manager
Filename:	Test Dates:	DUT Type:		Page 70 of 85
1M1804040064-12-R1.ZNF	4/14/2018 - 4/20/2018	Portable Handset		Page 70 01 65



Type: Portable Handset Serial: 19218

Measurement Standard: ANSI C63.19-2011

Equipment:

Probe: Radial T-Coil Probe – SN: TEM-1130; Calibrated: 12/07/2016

Test Configuration:

Mode: 5GHz WIFIBandwidth: 20MHz

Standard: IEEE 802.11a (UNII-3)

Channel: 157



FCC ID: ZNFV350A	PCTEST*	HAC (T-COIL) TEST REPORT	(1) LG	Approved by: Quality Manager
Filename:	Test Dates:	DUT Type:		Page 71 of 85
1M1804040064-12-R1.ZNF	4/14/2018 - 4/20/2018	Portable Handset		Fage / 1 01 00



Type: Portable Handset Serial: 19218

Measurement Standard: ANSI C63.19-2011

Equipment:

Probe: Radial T-Coil Probe – SN: TEM-1130; Calibrated: 12/07/2016

Test Configuration:

VoIP Application: Google Duo
Mode: 2.4GHz WIFI
Standard: IEEE 802.11b

Channel: 1



-90.0 -

-85.0-

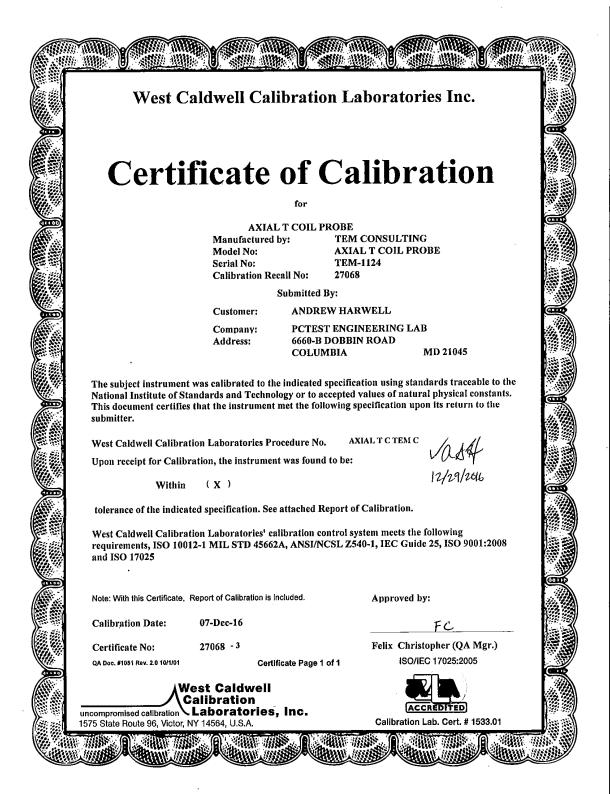
ABM1	2.69	dB	\checkmark	Minimum	-18.0
ABM2	-29.71	dB	✓	Maximum	0.0
SNNR	32.4	dB	✓	Minimum	20.0

[Hz]

FCC ID: ZNFV350A	PCTEST	HAC (T-COIL) TEST REPORT	(1) LG	Approved by: Quality Manager
Filename:	Test Dates:	DUT Type:		Page 72 of 85
1M1804040064-12-R1.ZNF	4/14/2018 - 4/20/2018	Portable Handset		Fage 12 01 00

13. CALIBRATION CERTIFICATES

FCC ID: ZNFV350A	PCTEST*	HAC (T-COIL) TEST REPORT	(1) LG	Approved by: Quality Manager
Filename:	Test Dates:	DUT Type:		Page 73 of 85
1M1804040064-12-R1.ZNF	4/14/2018 - 4/20/2018	Portable Handset		Fage 13 01 00



FCC ID: ZNFV350A	PETEST'	HAC (T-COIL) TEST REPORT	(1) LG	Approved by: Quality Manager
Filename:	Test Dates:	DUT Type:		Page 74 of 85
1M1804040064-12-R1.ZNF	4/14/2018 - 4/20/2018	Portable Handset		Faye 14 01 00

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REV 3.2.M

HCATEMC_TEM 1124_Dec-07-2016



ISO/IEC 17025: 2005 Calibration Lab. Cert. # 1533.01

1575 State Route 96, Victor NY 14564

REPORT OF CALIBRATION

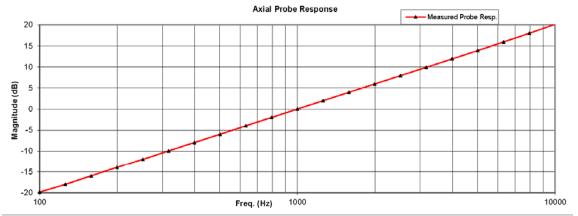
TEM Consulting LP Axial T Coil Probe Model No.: Axial T Coil Probe Serial No.: TEM 1124

Company: PCTEST Engineering Lab. I. D. No: 80578

Probe Sensitivity measured with	n Helmhalt	z Call			
Helmholtz Coil;			Botoro & ate	r data same	: X
the number of turns on each coil;	10	No.			
the radius of each coil, in meters;	0.204	m	Laboratory Environ	ment:	
the current in the coils, in amperes.;	0.09	Α	Ambient Temperature:	20.2	°C
Helmholtz Coil Constant;	7.09	A/m/V	Ambient Humidity:	31.4	% RH
Helmholtz Coil magnetic field;	5.98	A/m	Ambient Pressure:	99.1	κP«
			Calibration Date:	7-D••-16	
Probe Sensitivity at	1000	Hz.			
Was	-60.23	aBV/A/™	Report Number:	27068	-3
	0.974	m V/A/m	Control Number:	27068	
Probe resistance	904	Oh m .			
The above listed instrument meets or e	xceeds th	ne tested manufact	urer's specifications.		
his 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 : Rev. 7.0 Jan. 24, 2014 Doc. # 1038 HCATEMC

Calibration was performed by West Caldwell Calibration Laboratories Inc. under Operating Procedures intended to implement the requirements or ISO10012-1, IEC Guide 25, ANSI/NCSL Z540-1, (MIL-STD-45662A) and ISO 9001:2008, ISO 17025

Cal. Date: 7-Dec-2016 Calibrated on WCCL system type 9700 Felix Christopher Rev. 7.0 Jan. 24, 2014 Doc. # 1038 HCATEMC

Page 1 of 2

FCC ID: ZNFV350A	PCTEST	HAC (T-COIL) TEST REPORT	(1) LG	Approved by: Quality Manager
Filename:	Test Dates:	DUT Type:		Page 75 of 85
1M1804040064-12-R1.ZNF	4/14/2018 - 4/20/2018	Portable Handset		Fage 13 01 03

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HCATEMC_TEM 1124_Dec-07-2016

West Caldwell Calibration Laboratories Inc.

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

Calibration Data Record

Model No.: Axial T Coil Probe TEM Consulting LP Axial T Coil Probe Serial No.: TEM 1124

Company: PCTEST Engineering Lab.

Test Function		Tolera	Measured values			
				Before	Out	Remarks
1.0	Probe Sensitivity at	1000 Hz.	a BV/A/m	-60.23		
2.0	Probe Level Linearity	Rof. (0 a B)	a B 6 0 -6 -12	6.03 0.00 -6.03 -12.05		
3.0	Probe Frequency Response	Rer. (0 a B)	H ₂ 100 126 158 200 251 316 398 501 631 794 1000 1259 1585 1995 2512 3162 3981 5012 6310 7943 10000	-19.8 -18.0 -16.0 -13.9 -12.0 -9.9 -8.0 -6.0 -4.0 -2.0 0.0 2.0 4.0 6.0 7.9 9.9 11.9 13.9 15.9 18.0 20.2		

Instruments used for calibration	ın:		Date of Cal.	Tracesbilty No.	Due Dete
HP	34401A	S/N 36064102	1-Oct-2016	,287708	1-Oct-2017
HP	34401A	S/N 36102471	1-Oet-2016	,287708	1-Oct-2017
HP	33120A	S/N 36043716	1-Oct-2016	.287708	1-Oct-2017
B&K	2133	S/N 1583254	1-Oat-2016	683/284413-14	1-Oat-2017

Cal. Date: 7-Dec-2016

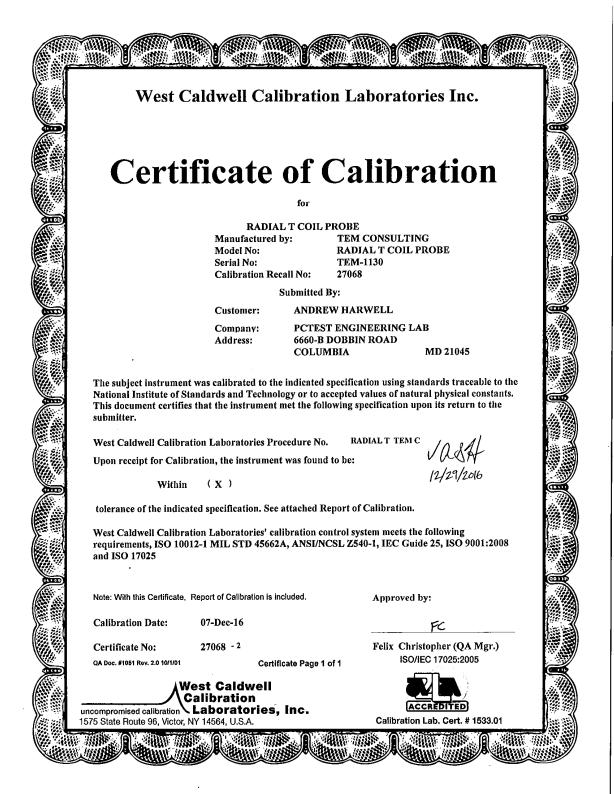
Tested by: Felix Christopher

Calibrated on WCCL system type 9700

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

Page 2 of 2

FCC ID: ZNFV350A	PCTEST	HAC (T-COIL) TEST REPORT	(1) LG	Approved by: Quality Manager
Filename:	Test Dates:	DUT Type:		Page 76 of 85
1M1804040064-12-R1.ZNF	4/14/2018 - 4/20/2018	Portable Handset		Fage 10 01 00



FCC ID: ZNFV350A	PCTEST*	HAC (T-COIL) TEST REPORT	(1) LG	Approved by: Quality Manager
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REV 3.2.M



ISO/IEC 17025: 2005

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Calibration Lab. Cert. # 1533.01

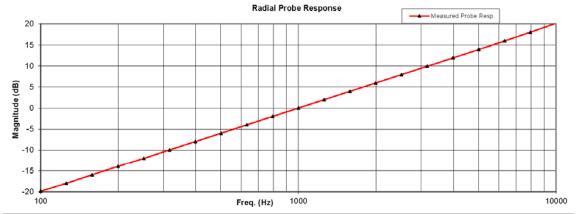
REPORT OF CALIBRATION

TEM Consulting LP Radial T Coil Probe Model No.: Radial T Coil Probe Serial No.: TEM-1130

Company: PCTEST Engineering Lab. I. D. No: 80579

Proba Sansitivity measured wit	h Helmhelt	z Coli			
Helmholtz Coil;			Batora & ate	r data sam s	: X
the number of turns on each coil;	10	No.			
the radius of each coil, in meters;	0.204	m	Laboratory Environ	ment:	
the current in the coils, in amperes.;	0.09	Α	Ambient Temperature:	20.2	°C
Helmholtz Coil Constant;	7.09	A/m/V	Ambient Humidity:	31.4	% RH
Helmholtz Coil magnetic field;	5.98	A/m	Ambient Pressure:	99.1	κP«
			Calibration Date:	7-D••-16	
Probe Sensitivity at	1000	Hz.			
Was	-60.27	aBV/A/™	Report Number:	27068	-2
	0.969	m V/A/m	Control Number:	27068	
Proberesistance	902	Ohm .			
The above listed instrument meets or e	exceeds tl	ne tested manufact	urer's specifications.		
his Celibration is traceable through NIST test number:	s:	683/284413-14			
The expanded uncertainty of calibration: 0.30dB at 95% c	onfidence leve	el with a coverage factor of k	k=2.		

Graph represents Probes Frequency Response.



The above listed instrument was checked using calibration procedure documented in West Caldwell Calibration Laboratories Inc. procedure : Rev. 7.0 Jan. 24, 2014 Doc. # 1038 HCRTEMC

Calibration was performed by West Caldwell Calibration Laboratories Inc. under Operating Procedures intended to implement the requirements or ISO10012-1, IEC Guide 25, ANSI/NCSL Z540-1, (MIL-STD-45662A) and ISO 9001:2008, ISO 17025

Cal. Date: 7-Dec-2016 Calibrated on WCCL system type 9700 Felix Christopher

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

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HCRTEMC_TEM-1130_Dec-07-2016

West Caldwell Calibration Laboratories Inc.

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

Calibration Data Record

Model No.: Radial T Coil Probe TEM Consulting LP Radial T Coil Probe Serial No.: TEM-1130

Company: PCTEST Engineering Lab.

Test	Function	Tolera	Tolerance		Measured values		
				Before	Out	Remarks	
1.0	Probe Sensitivity at	1000 Hz.	d BV/A/m	-60.27			
2.0	Probe Level Linearity	Ref. (0 d B)	₄B 6 0 -6 -12	6.03 0.00 -6.03 -12.06			
3.0	Probe Frequency Response	Ror. (0 d B)	H ₂ 100 126 158 200 251 316 398 501 631 794 1000 1259 1585 1995 2512 3162 3981 5012 6310 7943 10000	-19.9 -18.0 -16.0 -13.9 -12.0 -10.0 -8.0 -6.0 -4.0 -2.0 0.0 2.0 4.0 6.0 7.9 9.9 11.9 13.9 15.9 18.0 20.2			

Instruments used for calibration: HP HP HP	34401A 34401A 33120A	S/N 36064102 S/N 36102471 S/N 36043716	Date or Cal. 1-Oct-2016 1-Oct-2016 1-Oct-2016	Treceability No., 287708, 287708, 287708, 287708	Due Dete 1-Oct-2017 1-Oct-2017 1-Oct-2017
B&K	2133	S/N 1583254	1-Oet-2016	683/284413-14	1-Oct-2017

Cal. Date: 7-Dec-2016 Calibrated on WCCL system type 9700

Tested by: Felix Christopher

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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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15. REFERENCES

- ANSI C63.19-2011, American National Standard for Methods of Measurement of Compatibility between Wireless communication devices and Hearing Aids.", New York, NY, IEEE, May 2011
- FCC Office of Engineering and Technology KDB, "285076 D01 HAC Guidance v05," September 13, 2017
- FCC Office of Engineering and Technology KDB, "285076 D02 T-Coil Testing for CMRS IP v03," September 13, 2017
- FCC Public Notice DA 06-1215, Wireless Telecommunications Bureau and Office of Engineering and Technology Clarify Use of Revised Wireless Phone Hearing Aid Compatibility Standard, June 6, 2006
- 5. FCC 3G Review Guidance, Laboratory Division OET FCC, May/June 2006
- Berger, H. S., "Compatibility Between Hearing Aids and Wireless Devices," Electronic Industries Forum, Boston, MA, May, 1997
- Berger, H. S., "Hearing Aid and Cellular Phone Compatibility: Working Toward Solutions," Wireless Telephones and Hearing Aids: New Challenges for Audiology, Gallaudet University, Washington, D.C., May, 1997 (To be reprinted in the American Journal of Audiology).
- 8. Berger, H. S., "Hearing Aid Compatibility with Wireless Communications Devices, " IEEE International Symposium on Electromagnetic Compatibility, Austin, TX, August, 1997.
- Bronaugh, E. L., "Simplifying EMI Immunity (Susceptibility) Tests in TEM Cells," in the 1990 IEEE International Symposium on Electromagnetic Compatibility Symposium Record, Washington, D.C., August 1990, pp. 488-491
- 10. Byme, D. and Dillon, H., The National Acoustics Laboratory (NAL) New Procedure for Selecting the Gain and Frequency Response of a Hearing Aid, Ear and Hearing 7:257-265, 1986.
- Crawford, M. L., "Measurement of Electromagnetic Radiation from Electronic Equipment using TEM Transmission Cells, " U.S. Department of Commerce, National Bureau of Standards, NBSIR 73-306, Feb. 1973.
- Crawford, M. L., and Workman, J. L., "Using a TEM Cell for EMC Measurements of Electronic Equipment," U.S. Department of Commerce, National Bureau of Standards. Technical Note 1013, July 1981.
- 13. EHIMA GSM Project, Development phase, Project Report (1st part) Revision A. Technical-Audiological Laboratory and Telecom Denmark, October 1993.
- 14. EHIMA GSM Project, Development phase, Part II Project Report. Technical-Audiological Laboratory and Telecom Denmark, June 1994.
- EHIMA GSM Project Final Report, Hearing Aids and GSM Mobile Telephones: Interference Problems, Methods of Measurement and Levels of Immunity. Technical-Audiological Laboratory and Telecom Denmark, 1995.
- 16. HAMPIS Report, Comparison of Mobile phone electromagnetic near field with an upscaled electromagnetic far field, using hearing aid as reference, 21 October 1999.

FCC ID: ZNFV350A	PCTEST VENEZIANE LADDATORY, INC.	HAC (T-COIL) TEST REPORT	⊕ LG	Approved by: Quality Manager
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- Hearing Aids/GSM, Report from OTWIDAM, Technical-Audiological Laboratory and Telecom Denmark, April 1993.
- 18. IEEE 100, The Authoritative Dictionary of IEEE Standards Terms, Seventh Edition.
- 19. Joyner, K. H, et. al., Interference to Hearing Aids by the New Digital Mobile Telephone System, Global System for Mobile (GSM) Communication Standard, National Acoustic Laboratory, Australian Hearing Series, Sydney 1993.
- Joyner, K. H., et. al., Interference to Hearing Aids by the Digital Mobile Telephone System, Global System for Mobile Communications (GSM), NAL Report #131, National Acoustic Laboratory, Australian Hearing Series, Sydney, 1995.
- 21. Kecker, W. T., Crawford, M. L., and Wilson, W. A., "Contruction of a Transverse Electromagnetic Cell", U.S. Department of Commerce, National Bureau of Standards, Technical Note 1011, Nov. 1978.
- Konigstein, D., and Hansen, D., "A New Family of TEM Cells with enlarged bandwidth and Optimized working Volume," in the Proceedings of the 7th International Symposium on EMC, Zurich, Switzerland, March 1987; 50:9, pp. 127-132.
- 23. Kuk, F., and Hjorstgaard, N. K., "Factors affecting interference from digital cellular telephones," Hearing Journal, 1997; 50:9, pp 32-34.
- 24. Ma, M. A., and Kanda, M., "Electromagnetic Compatibility and Interference Metrology," U.S. Department of Commerce, National Bureau of Standards, Technical Note 1099, July 1986, pp. 17-43.
- 25. Ma, M. A., Sreenivashiah, I., and Chang, D. C., "A Method of Determining the Emission and Susceptibility Levels of Electrically Small Objects Using a TEM Cell," U.S. Department of Commerce, National Bureau of Standards, Technial Note 1040, July 1981.
- McCandless, G. A., and Lyregaard, P. E., Prescription of Gain/Output (POGO) for Hearing Aids, Hearing Instruments 1:16-21, 1983
- 27. Skopec, M., "Hearing Aid Electromagnetic Interference from Digital Wireless Telephones, "IEEE Transactions on Rehabilitation Engineering, vol. 6, no. 2, pp. 235-239, June 1998.
- 28. Technical Report, GSM 05.90, GSM EMC Considerations, European Telecommunications Standards Institute, January 1993.
- Victorian, T. A., "Digital Cellular Telephone Interference and Hearing Aid Compatibility—an Update," Hearing Journal 1998; 51:10, pp. 53-60
- 30. Wong, G. S. K., and Embleton, T. F. W., eds., AIP Handbook of Condenser Microphones: Theory, Calibration and Measurements, AIP Press.

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