

PCTEST

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HEARING AID COMPATIBILITY

Applicant Name:

LG Electronics U.S.A, Inc. 111 Sylvan Avenue, North Building Englewood Cliffs, NJ 07632 United States Date of Testing: 1/11/2021 - 1/20/2021 Test Site/Location:

PCTEST, Columbia, MD, USA **Test Report Serial No.:** 1M2012230208-11.ZNF

Date of Issue: 02/05/2021

FCC ID: ZNFK420TM

APPLICANT: LG ELECTRONICS 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-K420TM

Additional Model(s): LMK420TM, K420TM, LM-K420MM, LMK420MM, K420MM, LM-

K420PM, LMK420PM, K420PM, LG L560DL, LGL560DL, L560DL, LM-K420QM, LMK420QM, K420QM, LM-K420QM5, LMK420QM6, LMK4QM6, LMK4QM

K420QM6, LM-K420QA, LMK420QA, K420QA

Test Device Serial No.: Pre-Production Sample [S/N: 18798]

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

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

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

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







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1. INTRODUCTION

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

Compatibility Tests Involved:

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

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

The hearing aid must be measured for:

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

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



Figure 1-1 Hearing Aid in-vitu

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

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2. DUT DESCRIPTION



FCC ID: ZNFK420TM

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

111 Sylvan Avenue, North Building

Englewood Cliffs, NJ 07632

United States

Model: LM-K420TM

 $\mathsf{LMK420TM},\,\mathsf{K420TM},\,\mathsf{LM\text{-}K420MM},\,\mathsf{LMK420MM},\,\mathsf{K420MM},$

LM-K420PM, LMK420PM, K420PM, LG L560DL, LGL560DL,

Additional Model(s): L560DL, LM-K420QM, LMK420QM, K420QM, LM-K420QM5,

LMK420QM5, K420QM5, LM-K420QM6, LMK420QM6,

K420QM6, LM-K420QA, LMK420QA, K420QA

Serial Number: 18798
HW Version: Rev.1.0
SW Version: K420TM07j
Antenna: Internal Antenna
DUT Type: Portable Handset

I. LTE Band Selection

This device supports the following pairs of LTE bands with similar frequencies: LTE B26 & B5, LTE B66 & B4, as well as B25 & B2. Each pair of LTE bands 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 B26, B66 and B25) were evaluated for hearing aid compliance.

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Table 2-1 ZNFK420TM HAC Air Interfaces

				FR4201WITIAC All IIILEITAC		
Air-Interface	Band (MHz)	Type Transport	HAC Tested	Simultaneous But Not Tested	Name of Voice Service	Audio Codec Evaluated
	835	VO	Yes	Voc. WIFL or DT	CMRS Voice ¹	EVRC
CDMA	1900	VO	res	Yes: WIFI or BT	CIVIKS VOICE	EVRC
	EvDO	VD	Yes	Yes: WIFI or BT	Google Duo ²	OPUS
	850	vo	Yes	Yes: WIFI or BT	CMRS Voice ¹	EFR
GSM	1900	VO	163	res. Will of B1	CIVINS VOICE	LIK
	GPRS/EDGE	VD	Yes	Yes: WIFI or BT	Google Duo ²	OPUS
	850					
UMTS	1700	VD	Yes	Yes: WIFI or BT	CMRS Voice ¹	NB AMR
OWITS	1900					
	HSPA	VD	Yes	Yes: WIFI or BT	Google Duo ²	OPUS
	680 (B71)		Yes ³			
	700 (B12) 780 (B13)					Volte: NB AMR, WB AMR, EVS Google Duo: OPUS
	850 (B5)			Yes: WIFI or BT	VoLTE ¹ , Google Duo ²	
LTE (FDD)	850 (B26)	VD	Yes			
	1700 (B4)		162			
	1700 (B66)					
	1900 (B2)					
	1900 (B25)					
LTE (TDD)	2600 (B41)	VD	Yes	Yes: WIFI or BT	VoLTE ¹ , Google Duo ²	Volte: NB AMR, WB AMR, EVS Google Duo: OPUS
	2450					
	5200 (U-NII 1)					
WIFI	5300 (U-NII 2A)	VD	Yes	Yes: CDMA, GSM, UMTS, or LTE	VoWIFI², Google Duo²	VoWIFI: NB AMR, WB AMR, EVS Google Duo: OPUS
	5500 (U-NII 2C)]				Google Duo. OF03
	5800 (U-NII 3)]				
BT	2450	DT	No	Yes: CDMA, GSM, UMTS, or LTE	N/A	N/A
Type Transport VO = Voice Only DT = Digital Dat						

VD = CMRS and/or IP Voice over Data Transport

3. LTE B71, while outside the scope of ANSI C63.19 and FCC HAC regulations, was additionally tested according to the existing HAC procedures with currently available test equipment.

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3. ANSI C63.19-2011 PERFORMANCE CATEGORIES

I. MAGNETIC COUPLING

Axial and Radial Field Intensity

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

Frequency Response

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

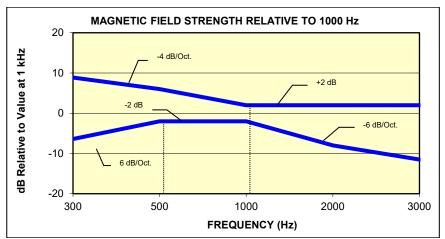
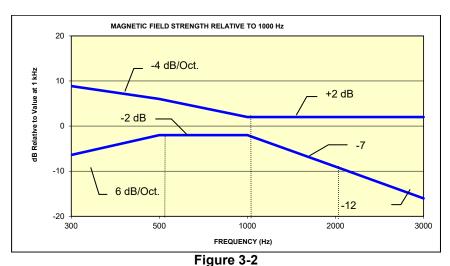


Figure 3-1
Magnetic field frequency response for Wireless Devices with an axial field ≤-15 dB(A/m) at 1 kHz



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

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Signal Quality

The table below provides the signal quality requirement for the intended audio magnetic signal from a wireless device. Only the RF immunity of the hearing aid is measured in T-coil mode. It is assumed that a hearing aid can have no immunity to an interference signal in the audio band, which is the intended reception band for this mode. The only criterion that can be measured is the RF immunity in T-coil mode. This is measured using the same procedure as the audio coupling mode at the same levels.

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

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

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

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4. METHOD OF MEASUREMENT

I. Test Setup

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

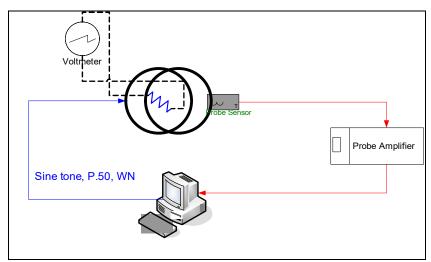


Figure 4-1
Validation Setup with Helmholtz Coil

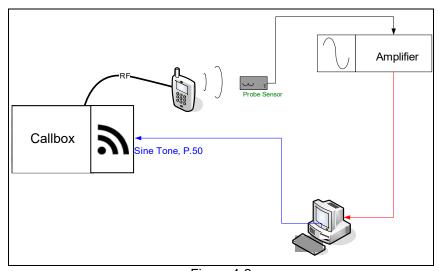


Figure 4-2 **T-Coil Test Setup**

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II. Scanning Mechanism

Manufacturer: TEM

Accuracy: ± 0.83 cm/meter

Minimum Step Size: 0.1 mm

Maximum speed 6.1 cm/sec
Line Voltage: 115 VAC
Line Frequency: 60 Hz

Material Composite: Delrin (Acetal)

Data Control: Parallel Port

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

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

Reflections: < -20 dB (in anechoic chamber)

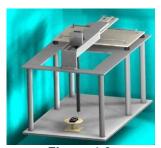


Figure 4-3 RF Near-Field Scanner

III. ITU-T P.50 Artificial Voice

Manufacturer: ITU-T

Active Frequency Range: 100 Hz – 8 kHz

Stimulus Type: Male and Female, no spaces

Single Sample 20.96 seconds

Duration: 20.96 S Activity Level: 100% e, no spaces

Spectral Characteristic of full P.50

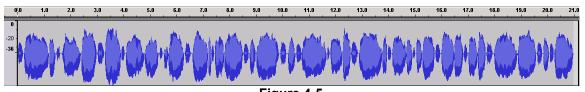
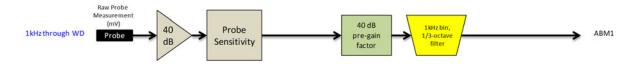


Figure 4-5
Temporal Characteristic of full P.50

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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.
 - "A-weighting" and Half-Band Integration was applied to the measurements.
 - Since this measurement was measured in the same method as ABM2 measurements, this level was verified to be more than 10 dB below the lowest measurement signal (which is the highest ABM2 measurement for a T4 WD). Therefore the maximum noise level for a T4 WD with an ABM1 = -18 dBA/m is:

- 2. Measurement System Validation (See Figure 4-1)
 - a. The measurement system including the probe, pre-amplifier and acquisition system were validated as an entire system to ensure the reliability of test measurements.
 - ABM1 Validation The magnetic field at the center of the Helmholtz coil is given by the equation (per C63.19 Annex D.10.1):

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

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

For the Helmholtz Coil, N=20; r=0.13m; R=10.193Ω and using V=29mV:

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

Therefore a pure tone of 1kHz was applied into the coils such that 29mV was observed across the resistor. The voltmeter used for measurement was verified to be capable of measurements in the audio band range. This theoretically generates an expected field of -10 dB(A/m) in the center of the Helmholtz coil which was used to validate the probe measurement at -10dB(A/m). This was verified to be within ± 0.5 dB of the -10dB(A/m) value (see Page 40).

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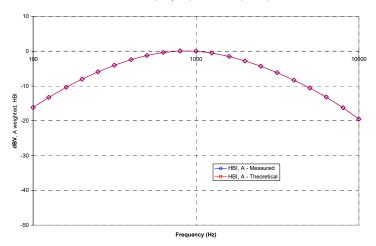
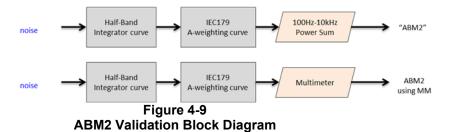


Figure 4-8 **ABM2 Frequency Response Validation**

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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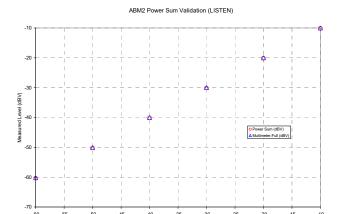
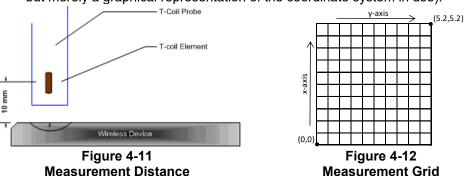


Figure 4-10 **ABM2 Power Sum Validation**

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):



- ii. After scanning, the planar field maximum point was determined. The position of the probe was moved to this location to setup the test using the SoundCheck system.
- iii. These steps were repeated for all T-coil orientations (axial and radial) per Figure 4-14 after a T-coil orientation was fully measured with the SoundCheck system.
- b. Speech Signal Setup to Base Station Simulator
 - i. C63.19 Table 7-1 states audio reference input levels for various technologies:

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

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

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V. Test Setup

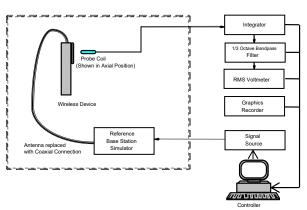


Figure 4-13
Audio Magnetic Field Test Setup

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

VI. Deviation from C63.19 Test Procedure

Non-conducted RF connection due to inaccessible RF ports.

VII. Air Interface Technologies Tested

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

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VIII. Wireless Device Channels and Frequencies

1. 2G/3G Modes

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

Table 4-3
Center Channels and Frequencies

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

2. 4G (LTE) Modes

The middle channel for every band and bandwidth combination was tested for each probe orientation. The band and bandwidth combination from each probe orientation resulting in the worst-case SNNR was additionally tested using low and high channels for that band and bandwidth combination. Low-mid and mid-high channels are additionally tested for LTE TDD. The middle channel and supported bandwidths from the worst-case bands according to Table 7-6 & 7-7 was additionally evaluated with OTT VoIP for each probe orientation. See Tables 9-5 to 9-12, and Tables 9-20 & 9-21 for LTE bandwidths and channels.

3. WIFI

The middle channel for each IEEE 802.11 standard was tested for each probe orientation. The 2.4GHz IEEE 802.11 standard from each probe orientation resulting in the worst-case SNNR was additionally tested using low and high channels. The 5GHz IEEE 802.11 standard from each probe orientation resulting in the worst-case SNNR was additionally tested on higher U-NII bands as well as applicable low and high channels. See Tables 9-13 to 9-16, and Tables 9-22 to 9-25 for WIFI standards and channels.

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IX. Test Flow

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

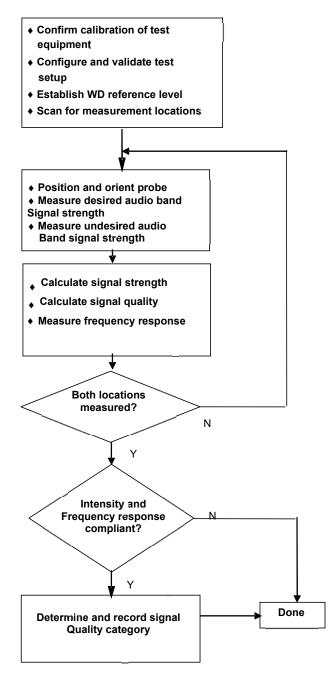


Figure 4-14 C63.19 T-Coil Signal Test Process

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5. VOLTE TEST SYSTEM SETUP AND DUT CONFIGURATION

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

1. Equipment Setup

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

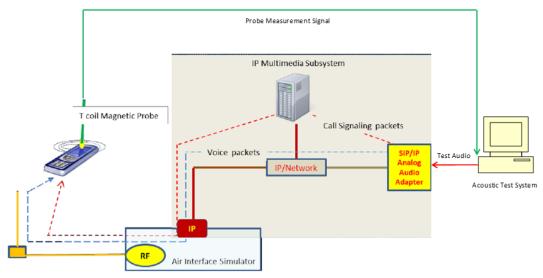


Figure 5-1
Test Setup for VoLTE over IMS T-Coil Measurements

2. Audio Level Settings

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

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

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

1. Radio Configuration

An investigation was performed to determine the modulation and RB configuration to be used for testing. The effects of modulation and RB configuration were found to be independent of band and bandwidth; therefore, only one band and bandwidth were used for this investigation. 64QAM, 1RB, 99% RB offset was used for the testing as the worst-case configuration for the handset. See below table for SNNR comparison between different radio configurations:

Table 5-1
VoLTE over IMS SNNR by Radio Configuration

	VOLTE OVER INIO CITATE BY Readio Configuration											
Band	Frequency [MHz]	Channel	Bandwidth [MHz]	Modulation	RB Size	RB Offset	ABM1 [dB(A/m)]	ABM2 [dB(A/m)]	SNNR [dB]			
66	1745.0	132322	20	QPSK	1	0	0.02	-48.26	48.28			
66	1745.0	132322	20	QPSK	1	50	0.04	-47.94	47.98			
66	1745.0	132322	20	QPSK	1	99	0.04	-47.27	47.31			
66	1745.0	132322	20	QPSK	50	0	0.00	-48.19	48.19			
66	1745.0	132322	20	QPSK	50	25	0.03	-48.20	48.23			
66	1745.0	132322	20	QPSK	50	50	0.07	-47.56	47.63			
66	1745.0	132322	20	QPSK	100	0	0.02	-47.86	47.88			
66.0	1745.0	132322	20	16QAM	1	0	0.05	-46.14	46.19			
66.0	1745.0	132322	20	16QAM	1	50	0.04	-45.24	45.28			
66.0	1745.0	132322	20	16QAM	1	99	0.02	-45.02	45.04			
66.0	1745.0	132322	20	16QAM	50	0	0.03	-47.81	47.84			
66.0	1745.0	132322	20	16QAM	50	25	0.06	-47.62	47.68			
66.0	1745.0	132322	20	16QAM	50	50	0.03	-47.47	47.50			
66.0	1745.0	132322	20	16QAM	100	0	0.04	-48.12	48.16			
66.0	1745.0	132322	20	64QAM	1	0	0.02	-46.18	46.20			
66.0	1745.0	132322	20	64QAM	1	50	0.05	-44.88	44.93			
66.0	1745.0	132322	20	64QAM	1	99	0.03	-44.83	44.86			
66.0	1745.0	132322	20	64QAM	50	0	0.03	-48.22	48.25			
66.0	1745.0	132322	20	64QAM	50	25	-0.04	-47.98	47.94			
66.0	1745.0	132322	20	64QAM	50	50	0.03	-47.68	47.71			
66.0	1745.0	132322	20	64QAM	100	0	0.05	-47.53	47.58			

2. Codec Configuration

An investigation was performed to determine the audio codec configuration to be used for testing. The effects of codec configuration were found to be independent of radio configuration; therefore, only one radio configuration was used for this investigation. The EVS Primary NB 13.2kbps setting was used for the audio codec on the CMW500 for VoLTE over IMS T-coil testing. See below table for comparisons between different codecs and codec data rates:

Table 5-2
AMR Codec Investigation – VoLTE over IMS

Codec Setting:	WB AMR 23.85kbps	WB AMR 6.60kbps	NB AMR 12.2kbps	NB AMR 4.75kbps	Orientation	Band / BW	Channel
ABM1 (dBA/m)	0.81	2.20	-1.07	-1.01	- Axial	LTE Band 66 20MHz	132322
ABM2 (dBA/m)	-48.67	-48.52	-48.27	-48.61			
Frequency Response	Pass	Pass	Pass	Pass			
S+N/N (dB)	49.48	50.72	47.20	47.60			

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

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

Codec Setting:	EVS Primary WB 13.2kbps	EVS Primary WB 5.9kbps	EVS Primary NB 13.2kbps	EVS Primary NB 5.9kbps	Orientation	Band / BW	Channel
ABM1 (dBA/m)	2.41	1.30	0.01	0.10			132322
ABM2 (dBA/m)	-46.64	-46.35	-46.38	-46.35	۵.۵-۱	LTE Band 66 20MHz	
Frequency Response	Pass	Pass	Pass	Pass	Axial		
S+N/N (dB)	49.05	47.65	46.39	46.45			

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

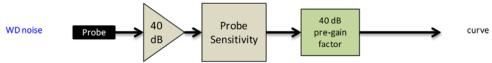


Figure 5-2 **Audio Band Magnetic Curve Measurement Block Diagram**

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

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

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

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

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

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

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a. Power Class 3 Uplink-Downlink Configuration Investigation

Power Class 3 was evaluated with the following radio configuration: channel 40620, 20MHz BW, 64QAM, 1RB, 99% RB 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 6 was used as the worst-case configuration for Power Class 3 VoLTE over IMS T-Coil testing. See table below for the SNNR comparison between each Uplink-Downlink configuration:

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

Frequency [MHz]	Channel	Bandwidth [MHz]	Modulation	RB Size	RB Offset	UL-DL Configuration	ABM1 [dB(A/m)]	ABM2 [dB(A/m)]	SNNR [dB]
2593.0	40620	20	64QAM	1	99	0	0.05	-37.93	37.98
2593.0	40620	20	64QAM	1	99	1	0.03	-38.15	38.18
2593.0	40620	20	64QAM	1	99	2	0.03	-37.91	37.94
2593.0	40620	20	64QAM	1	99	3	0.03	-40.53	40.56
2593.0	40620	20	64QAM	1	99	4	0.02	-40.89	40.91
2593.0	40620	20	64QAM	1	99	5	0.02	-40.49	40.51
2593.0	40620	20	64QAM	1	99	6	0.00	-37.89	37.89

b. Power Class 2 Uplink-Downlink Configuration Investigation

Power Class 2 was evaluated with the following radio configuration: channel 40620, 20MHz BW, 64QAM, 1RB, 99% RB Offset. For Power Class 2, configurations 1-5 are supported. The configuration which resulted in the worst SNNR was used for full testing. Uplink-Downlink configuration 2 was used as the worst-case configuration for Power Class 2 VoLTE over IMS T-Coil testing. See table below for the SNNR comparison between each Uplink-Downlink configuration:

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

Frequency [MHz]	Channel	Bandwidth [MHz]	Modulation	RB Size	RB Offset	UL-DL Configuration	ABM1 [dB(A/m)]	ABM2 [dB(A/m)]	SNNR [dB]			
2593.0	40620	20	64QAM	1	99	1	0.02	-33.73	33.75			
2593.0	40620	20	64QAM	1	99	2	-0.01	-33.72	33.71			
2593.0	40620	20	64QAM	1	99	3	0.03	-36.66	36.69			
2593.0	40620	20	64QAM	1	99	4	0.00	-37.11	37.11			
2593.0	40620	20	64QAM	1	99	5	0.07	-36.56	36.63			

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

c. Conclusion

Per the investigations above. UL-DL Configuration 6 was used to evaluate Power Class 3 VoLTE over IMS and UL-DL Configuration 2 was used to evaluate Power Class 2 VoLTE over IMS.

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6. **VOWIFI TEST SYSTEM SETUP AND DUT CONFIGURATION**

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

1. Equipment Setup

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

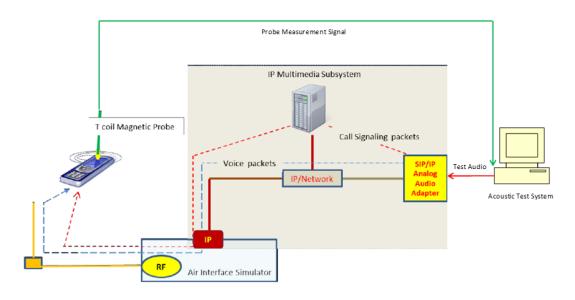


Figure 6-1 Test Setup for VoWIFI over IMS T-Coil Measurements

2. Audio Level Settings

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

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

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

1. Radio Configuration

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

Table 6-1
IEEE 802.11b SNNR by Radio Configuration

Mode	Channel	Modulation	Data Rate [Mbps]	ABM1 [dB(A/m)]	ABM2 [dB(A/m)]	SNNR [dB]
IEEE 802.11b	6	DSSS	1	-6.20	-38.42	32.22
IEEE 802.11b	6	DSSS	2	-6.18	-38.23	32.05
IEEE 802.11b	6	CCK	5.5	-6.13	-38.60	32.47
IEEE 802.11b	6	CCK	11	-6.21	-38.62	32.41

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

Mode	Ohamad	Ma dulation	Data Rate	ABM1	ABM2	SNNR
Mode	Channel	Modulation	[Mbps]	[dB(A/m)]	[dB(A/m)]	[dB]
IEEE 802.11g	6	BPSK	6	-6.06	-39.37	33.31
IEEE 802.11g	6	BPSK	9	-6.17	-44.70	38.53
IEEE 802.11g	6	QPSK	12	-6.18	-41.49	35.31
IEEE 802.11g	6	QPSK	18	-6.56	-42.41	35.85
IEEE 802.11g	6	16QAM	24	-6.24	-39.87	33.63
IEEE 802.11g	6	16QAM	36	-6.11	-40.44	34.33
IEEE 802.11g	6	64QAM	48	-6.73	-41.40	34.67
IEEE 802.11g	6	64QAM	54	-6.17	-41.88	35.71

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

Mode	Bandwidth [MHz]	Channel	Modulation	MCS Index	ABM1 [dB(A/m)]	ABM2 [dB(A/m)]	SNNR [dB]
IEEE 802.11n	20	40	BPSK	0	-6.26	-42.60	36.34
IEEE 802.11n	20	40	QPSK	1	-6.05	-41.14	35.09
IEEE 802.11n	20	40	QPSK	2	-6.05	-41.92	35.87
IEEE 802.11n	20	40	16QAM	3	-5.91	-41.22	35.31
IEEE 802.11n	20	40	16QAM	4	-6.36	-41.82	35.46
IEEE 802.11n	20	40	64QAM	5	-6.32	-41.84	35.52
IEEE 802.11n	20	40	64QAM	6	-6.31	-41.86	35.55
IEEE 802.11n	20	40	64QAM	7	-6.30	-42.42	36.12
IEEE 802.11ac	20	40	256QAM	8	-6.50	-42.49	35.99

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

	IEEE 002.1 Thrac 40MHz BW SWINK by Nadio Configuration								
Mode	Bandwidth [MHz]	Channel	Modulation	MCS Index	ABM1 [dB(A/m)]	ABM2 [dB(A/m)]	SNNR [dB]		
IEEE 802.11n	40	38	BPSK	0	-6.18	-45.55	39.37		
IEEE 802.11n	40	38	QPSK	1	-6.30	-41.42	35.12		
IEEE 802.11n	40	38	QPSK	2	-6.58	-42.14	35.56		
IEEE 802.11n	40	38	16QAM	3	-6.32	-41.13	34.81		
IEEE 802.11n	40	38	16QAM	4	-6.35	-41.34	34.99		
IEEE 802.11n	40	38	64QAM	5	-6.35	-42.35	36.00		
IEEE 802.11n	40	38	64QAM	6	-6.08	-42.05	35.97		
IEEE 802.11n	40	38	64QAM	7	-6.06	-42.77	36.71		
IEEE 802.11ac	40	38	256QAM	8	-5.89	-42.36	36.47		
IEEE 802.11ac	40	38	256QAM	9	-6.14	-42.20	36.06		

2. Codec Configuration

An investigation was performed to determine the audio codec configuration to be used for testing. The effects of codec configuration were found to be independent of radio configuration; therefore, only one radio configuration was used for this investigation. The 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:

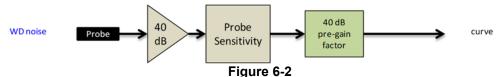
Table 6-5
AMR Codec Investigation – VoWIFI over IMS

	Aint oddec investigation – vovni rover imo								
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)	-3.75	-3.12	-6.29	-6.42					
ABM2 (dBA/m)	-39.71	-39.76	-40.03	-39.27	Axial	2.4GHz		6	
Frequency Response	Pass	Pass	Pass	Pass	Axiai	2.4⊍⊓∠	IEEE 802.11b	0	
S+N/N (dB)	35.96	36.64	33.74	32.85					

Table 6-6
EVS Codec Investigation – VoWIFI over IMS

= 10 00000 m1000 ganon 1011 m10								
Codec Setting:	EVS Primary WB 13.2kbps	EVS Primary WB 5.9kbps	EVS Primary NB 13.2kbps	EVS Primary NB 5.9kbps	Orientation	Band	Standard	Channel
ABM1 (dBA/m)	-2.82	-3.89	-5.21	-6.95				
ABM2 (dBA/m)	-40.17	-39.66	-39.78	-39.83	Axial	2.4GHz	IEEE 802.11b	6
Frequency Response	Pass	Pass	Pass	Pass	Axiai	2.4002	IEEE 802.11D	0
S+N/N (dB)	37.35	35.77	34.57	32.88				

Mute on; Backlight off; Max Volume; Max Contrast



Audio Band Magnetic Curve Measurement Block Diagram

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7. OTT VOIP TEST SYSTEM AND DUT CONFIGURATION

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

1. OTT VoIP Application

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

2. Equipment Setup

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

3. Audio Level Settings

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

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

II. DUT Configuration for OTT VoIP T-Coil Testing

1. Codec Configuration

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

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

Codec Setting:	75kbps	6kbps	Orientation	Channel			
ABM1 (dBA/m)	4.86	4.62					
ABM2 (dBA/m)	-47.73	-48.95	Axial	600			
Frequency Response	Pass	Pass	Axiai				
S+N/N (dB)	52.59	53.57					

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)

Ocace iiiv	oodee iiivestigation oi						
Codec Setting:	75kbps	6kbps	Orientation	Channel			
ABM1 (dBA/m)	4.54	4.54	4.54				
ABM2 (dBA/m)	-35.06	-35.57	Axial	661			
Frequency Response	Pass	Pass	Axiai	001			
S+N/N (dB)	39.60	40.11					

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

Codec ilive	zougauo	''' — O i i	וו) ווטע	01 A)	
Codec Setting:	75kbps	6kbps	Orientation	Channel	
ABM1 (dBA/m)	4.54	4.55			
ABM2 (dBA/m)	-45.97	-45.97	Axial	9400	
Frequency Response	Pass	Pass	Axiai		
S+N/N (dB)	50.51	50.52			

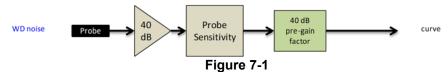
Table 7-4
Codec Investigation – OTT VoIP (LTE)

	•			· - · - /	
Codec Setting:	75kbps	6kbps	Orientation	Band / BW	Channel
ABM1 (dBA/m)	5.17	4.99			
ABM2 (dBA/m)	-45.04	-45.39	Axial	LTE Band 66	
Frequency Response	Pass	Pass	Axiai	20MHz	132322
S+N/N (dB)	50.21	50.38			

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

C	ouec iiiv	cougan	UII — U I	I VOIF (/	
Codec Setting:	75kbps	6kbps	Orientation	Band	Standard	Channel
ABM1 (dBA/m)	4.39	4.06			IEEE 802.11b	6
ABM2 (dBA/m)	-33.67	-34.34	Axial	2.4GHz		
Frequency Response	Pass	Pass	Axiai	2.4GHZ		
S+N/N (dB)	38.06	38.40				

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



Audio Band Magnetic Curve Measurement Block Diagram

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2. Radio Configuration for OTT VoIP (LTE)

An investigation was performed to determine the worst-case LTE FDD band to be used for OTT VoIP testing. LTE FDD Band 26 was used for the testing as the worst-case configuration for the handset. See below table for SNNR comparison between different LTE FDD bands:

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

Band	Frequency [MHz]	Channel	Bandwidth [MHz]	Modulation	RB Size	RB Offset	ABM1 [dB(A/m)]	ABM2 [dB(A/m)]	SNNR [dB]
71	680.5	133297	20	64QAM	1	99	4.85	-46.25	51.10
12	707.5	23095	10	64QAM	1	49	4.90	-46.58	51.48
13	782.0	23230	10	64QAM	1	49	5.13	-46.60	51.73
26	831.5	26865	15	64QAM	1	74	4.92	-44.83	49.75
66	1745.0	132322	20	64QAM	1	99	5.14	-45.10	50.24
25	1882.5	26365	20	64QAM	1	99	4.97	-45.32	50.29

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

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

Band	Frequency [MHz]	Channel	Bandwidth [MHz]	Modulation	RB Size	RB Offset	ABM1 [dB(A/m)]	ABM2 [dB(A/m)]	SNNR [dB]
41 (PC3)	2593.0	40620	20	64QAM	1	99	4.96	-38.07	43.03
41 (PC2)	2593.0	40620	20	64QAM	1	99	5.19	-34.13	39.32

3. LTE TDD Uplink Carrier Aggregation for OTT VoIP

LTE TDD ULCA was additionally evaluated. The configurations in Table 7-8 satisfy the configuration requirements as defined in 3GPP 36.101.

Table 7-8

LTE TDD SNNR for OTT VoIP Uplink Carrier Aggregation

				PCC				scc									
Combination	PCC Band	PCC Bandwidth [MHz]	PCC (UL/DL) Channel	PCC (UL/DL) Frequency [MHz]	Modulation	PCC UL# RB	PCC UL RB Offset	SCC Band	SCC Bandwidth [MHz]	SCC (UL/DL) Channel	SCC (UL/DL) Frequency [MHz]	Modulation	SCC UL# RB	SCC UL RB Offset	ABM1 [dB(A/m)]	ABM2 [dB(A/m)]	SNNR [dB]
CA_41C (PC3)	LTE B41	20	40620	2593.0	16QAM	1	0	LTE B41	20	40422	2573.2	16QAM	1	99	4.94	-36.49	41.43
CA_41C (PC2)	LTE B41	20	40620	2593.0	16QAM	1	0	LTE B41	20	40422	2573.2	16QAM	1	99	4.31	-33.71	38.02

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8. FCC 3G MEASUREMENTS

I. CDMA Test Configurations

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

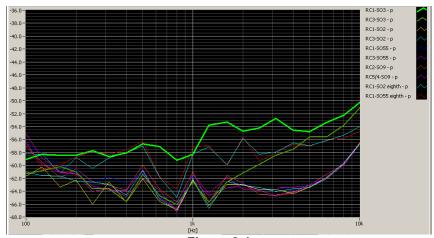
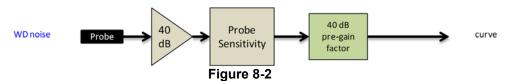


Figure 8-1
CDMA Audio Band Magnetic Noise

Table 8-1 FCC 3G ABM Measurements for ZNFK420TM (CDMA)

1 00 00 ABIN moderations for Eth 14-20 Fin (OBINA)												
Configuration:	RC1/SO3	RC3/SO3	RC4/SO3	Orientation	Channel							
ABM1 (dBA/m)	-4.45	-4.97	-4.74									
ABM2 (dBA/m)	-42.72	-55.16	-54.93	Axial	600							
Frequency Response	Pass	Pass	Pass	Axiai								
S+N/N (dB)	38.27	50.19	50.19									

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



Audio Band Magnetic Curve Measurement Block Diagram

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II. UMTS Test Configurations

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

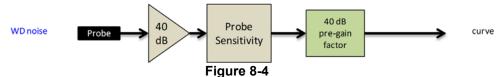


Figure 8-3
UMTS Audio Band Magnetic Noise

Table 8-2 Codec Investigation - UMTS

		co mvestigatio	11 0111110				
Codec Setting:	AMR 12.2kbps	AMR 7.95kbps	AMR 4.75kbps	Orientation	Channel		
ABM1 (dBA/m)	-1.37	-1.39	-1.39				
ABM2 (dBA/m)	-53.61	-54.01	-53.92	Axial	9400		
Frequency Response	Pass	Pass	Pass	Axiai			
S+N/N (dB)	52.24	52.62	52.53				

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



Audio Band Magnetic Curve Measurement Block Diagram

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T-COIL TEST SUMMARY

Table 9-1 **Consolidated Tabled Results**

		Freq. Re	esponse	Mag	netic	FCC SNNR Verdict		Margin from	
			rgin		y Verdict			FCC Limit	C63.19-2011 Rating
C63.19	9 Section		3.2		3.1		3.4	(dB)	3
		Axial	Radial	Axial	Radial	Axial	Radial		
	Secondary Cellular	PASS	NA	PASS	PASS	PASS	PASS		
CDMA	Cellular	PASS	NA	PASS	PASS	PASS	PASS	-9.81	Т3
	PCS	PASS	NA	PASS	PASS	PASS	PASS		
EvDO	Secondary Cellular	PASS	NA	PASS	PASS	PASS	PASS		
(OTT VoIP)	Cellular	PASS	NA	PASS	PASS	PASS	PASS	-24.06	T4
	PCS	PASS	NA	PASS	PASS	PASS	PASS		
GSM	Cellular	PASS	NA	PASS	PASS	PASS	PASS	-2.32	Т3
	PCS	PASS	NA	PASS	PASS	PASS	PASS		
EDGE	Cellular	PASS	NA	PASS	PASS	PASS	PASS	-15.10	T4
(OTT VoIP)	PCS	PASS	NA	PASS	PASS	PASS	PASS	15.10	
	Cellular	PASS	NA	PASS	PASS	PASS	PASS		
UMTS	AWS	PASS	NA	PASS	PASS	PASS	PASS	-23.19	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	-21.53	T4
(011 10)	PCS	PASS	NA	PASS	PASS	PASS	PASS		
	B71	PASS	NA	PASS	PASS	PASS	PASS		
	B12	PASS	NA	PASS	PASS	PASS	PASS		
	B13	PASS	NA	PASS	PASS	PASS	PASS		
LTE FDD	B26	PASS	NA	PASS	PASS	PASS	PASS	-16.29	T4
	B66	PASS	NA	PASS	PASS	PASS	PASS	1	
	B25	PASS	NA	PASS	PASS	PASS	PASS		
LTE FDD (OTT VoIP)	B26	PASS	NA	PASS	PASS	PASS	PASS	-19.34	T4
	B41 (PC3)	PASS	NA	PASS	PASS	PASS	PASS		
LTE TDD	B41 (PC2)	PASS	NA	PASS	PASS	PASS	PASS	-9.34	Т3
LTE TDD (OTT VoIP)	B41 (PC2)	PASS	NA	PASS	PASS	PASS	PASS	-13.75	T4
	IEEE 802.11b	PASS	NA	PASS	PASS	PASS	PASS		
WLAN	IEEE 802.11g	PASS	NA	PASS	PASS	PASS	PASS	-3.71	Т3
	IEEE 802.11n	PASS	NA	PASS	PASS	PASS	PASS		
	IEEE 802.11b	PASS	NA	PASS	PASS	PASS	PASS		
WLAN	IEEE 802.11g	PASS	NA	PASS	PASS	PASS	PASS	-15.05	T4
(OTT VoIP)	IEEE 802.11n	PASS	NA	PASS	PASS	PASS	PASS		
	IEEE 802.11a	PASS	NA	PASS	PASS	PASS	PASS		
U-NII	IEEE 802.11n	PASS	NA	PASS	PASS	PASS	PASS	-8.58	Т3
	IEEE 802.11ac	PASS	NA	PASS	PASS	PASS	PASS		
	IEEE 802.11a	PASS	NA NA	PASS	PASS	PASS	PASS		
U-NII	IEEE 802.11n	PASS	NA NA	PASS	PASS	PASS	PASS	-18.02	T4
(OTT VoIP)	IEEE 802.11ac	PASS	NA NA	PASS	PASS	PASS	PASS	15.02	
	ILLE 602.11ac	FASS	INA	FASS	FASS	FMOO	FASS		

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I. Raw Handset Data

Table 9-2
Raw Data Results for CDMA

ABM1 ABM2 Ambient Noise Frequency S+N/N FCC Limit Margin from C63.19-2011 Test												
Mode	Orientation	Channel	ABM1 [dB(A/m)]	ABM2 [dB(A/m)]	Ambient Noise [dB(A/m)]	Frequency Response Margin (dB)	S+N/N (dB)	FCC Limit (dB)	Margin from FCC Limit (dB)	C63.19-2011 Rating	Test Coordinates	
		476	-4.34	-40.91		1.71	36.57	20.00	-16.57	T4		
	Axial	564	-4.60	-40.87	-61.81	1.75	36.27	20.00	-16.27	T4	2.4, 1.6	
Secondary		684	-5.00	-42.27		1.74	37.27	20.00	-17.27	T4		
Cellular		476	-11.76	-43.00			31.24	20.00	-11.24	T4		
	Radial	564	-11.94	-42.41	-63.75	N/A	30.47	20.00	-10.47	T4	2.0, 2.4	
		684	-11.68	-43.39			31.71	20.00	-11.71	T4		
		1013	-4.68	-42.62	-61.81	1.59	37.94	20.00	-17.94	T4		
	Axial	384	-4.85	-40.51		1.77	35.66	20.00	-15.66	T4	2.4, 1.6	
Cellular		777	-4.88	-39.18		1.77	34.30	20.00	-14.30	T4		
Celiulai		1013	-11.98	-44.72			32.74	20.00	-12.74	T4		
	Radial	384	-11.84	-42.99	-63.75	-63.75 N/A	31.15	20.00	-11.15	T4	2.0, 2.4	
		777	-12.16	-43.10			30.94	20.00	-10.94	T4		
		25	-4.85	-41.55		1.70	36.70	20.00	-16.70	T4		
	Axial	600	-4.52	-42.46	-61.81	1.77	37.94	20.00	-17.94	T4	2.4, 1.6	
PCS		1175	-4.52	-41.39		1.53	36.87	20.00	-16.87	T4		
F-0-5		25	-12.60	-43.53			30.93	20.00	-10.93	T4		
	Radial	600	-12.35	-45.07	-63.75	N/A	32.72	20.00	-12.72	T4	2.0, 2.4	
		1175	-12.24	-42.05			29.81	20.00	-9.81	T3		

Table 9-3
Raw Data Results for GSM

	ADM4 ADM5 Anticological Frequency Column Recolumn Margin from Constant Total													
Mode	Orientation	Channel	ABM1 [dB(A/m)]	ABM2 [dB(A/m)]	Ambient Noise [dB(A/m)]	Frequency Response Margin (dB)	S+N/N (dB)	FCC Limit (dB)	Margin from FCC Limit (dB)	C63.19-2011 Rating	Test Coordinates			
		128	-0.94	-27.33		1.58	26.39	20.00	-6.39	T3				
	Axial	190	-0.92	-29.03	-58.55	1.59	28.11	20.00	-8.11	Т3	2.4, 1.6			
GSM850		251	-0.85	-30.91		1.63	30.06	20.00	-10.06	T4				
GSIVIOSU		128	-7.70	-30.02			22.32	20.00	-2.32	T3				
	Radial	190	-7.63	-31.58	-63.75	N/A	23.95	20.00	-3.95	Т3	2.0, 2.4			
		251	-7.70	-31.16			23.46	20.00	-3.46	Т3				
		512	-0.90	-30.33		1.59	29.43	20.00	-9.43	T3				
	Axial	661	-0.99	-32.24	-58.55	1.55	31.25	20.00	-11.25	T4	2.4, 1.6			
GSM1900		810	-0.95	-34.24		1.73	33.29	20.00	-13.29	T4				
G3W1900		512	-7.28	-31.84			24.56	20.00	-4.56	T3				
	Radial	661	-7.52	-33.08	-63.75	N/A	25.56	20.00	-5.56	T3	2.0, 2.4			
		810	-7.70	-35.40			27.70	20.00	-7.70	Т3				

Table 9-4
Raw Data Results for UMTS

TRAW Data Results for OWITO											
Mode	Orientation	Channel	ABM1 [dB(A/m)]	ABM2 [dB(A/m)]	Ambient Noise [dB(A/m)]	Frequency Response Margin (dB)	S+N/N (dB)	FCC Limit (dB)	Margin from FCC Limit (dB)	C63.19-2011 Rating	Test Coordinates
		4132	-1.36	-54.57		1.88	53.21	20.00	-33.21	T4	
	Axial	4183	-1.39	-54.27	-58.55	1.70	52.88	20.00	-32.88	T4	2.4, 1.6
UMTS V		4233	-1.39	-54.20		1.77	52.81	20.00	-32.81	T4	
OWISV		4132	-8.14	-51.83			43.69	20.00	-23.69	T4	
	Radial	4183	-8.15	-51.76	-63.75	N/A	43.61	20.00	-23.61	T4	2.0, 2.4
		4233	-8.18	-51.68			43.50	20.00	-23.50	T4	
		1312	-1.33	-53.75	-58.55	1.73	52.42	20.00	-32.42	T4	
	Axial	1412	-1.34	-53.49		1.85	52.15	20.00	-32.15	T4	2.4, 1.6
UMTS IV		1513	-1.35	-54.23		1.68	52.88	20.00	-32.88	T4	
OIII TO IV		1312	-8.20	-51.80			43.60	20.00	-23.60	T4	
	Radial	1412	-8.23	-51.86	-63.75	N/A	43.63	20.00	-23.63	T4	2.0, 2.4
		1513	-8.25	-51.82			43.57	20.00	-23.57	T4	
		9262	-1.37	-53.16		1.79	51.79	20.00	-31.79	T4	
	Axial	9400	-1.42	-53.91	-58.55	1.94	52.49	20.00	-32.49	T4	2.4, 1.6
UMTS II		9538	-1.34	-52.89		1.76	51.55	20.00	-31.55	T4	
Om 13 ii		9262	-8.24	-51.70			43.46	20.00	-23.46	T4	
	Radial	9400	-8.26	-51.57	-63.75	N/A	43.31	20.00	-23.31	T4	2.0, 2.4
		9538	-8.27	-51.46			43.19	20.00	-23.19	T4	

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Table 9-5 Raw Data Results for LTE B71

Mode	Orientation	Bandwidth	Channel	ABM1 [dB(A/m)]	ABM2 [dB(A/m)]	Ambient Noise [dB(A/m)]	Frequency Response Margin (dB)	S+N/N (dB)	FCC Limit (dB)	Margin from FCC Limit (dB)	C63.19-2011 Rating	Test Coordinates	
		20MHz	133297	0.04	-48.32		1.80	48.36	20.00	-28.36	T4		
	Axial	15MHz	133297	0.06	-47.17	-61.81	1.95	47.23	20.00	-27.23	T4	2.4. 1.6	
	Axiai	10MHz	133297	0.04	-47.03	-01.01	1.81	47.07	20.00	-27.07	T4	2.4, 1.0	
		5MHz	133297	0.03	-47.09		1.81	47.12	20.00	-27.12	T4		
I TE Band 74		20MHz	133297	-6.29	-45.27			38.98	20.00	-18.98	T4		
LIE Ballu / I	TE Band 71 Radial	15MHz	133297	-6.34	-44.31			37.97	20.00	-17.97	T4	1	
		10MHz	133422	-6.43	-44.19	-63.75 N/A	37.76	20.00	-17.76	T4	2.0. 2.4		
		10MHz	133297	-6.37	-42.66		-63.75	IVA	36.29	20.00	-16.29	T4	2.0, 2.4
		10MHz	133172	-6.46	-45.24			38.78	20.00	-18.78	T4	1	
		5MHz	133297	-6.35	-44.36			38.01	20.00	-18.01	T4		

Table 9-6 Raw Data Results for LTE B12

Mode	Orientation	Bandwidth	Channel	ABM1 [dB(A/m)]	ABM2 [dB(A/m)]	Ambient Noise [dB(A/m)]	Frequency Response Margin (dB)	S+N/N (dB)	FCC Limit (dB)	Margin from FCC Limit (dB)	C63.19-2011 Rating	Test Coordinates		
		10MHz	23095	0.01	-47.78		1.72	47.79	20.00	-27.79	T4			
	Axial	5MHz	23095	0.07	-47.91	-61.81	1.64	47.98	20.00	-27.98	T4	2.4. 1.6		
	Axiai	3MHz	23095	0.03	-46.98	-01.01	1.75	47.01	20.00	-27.01	T4	2.4, 1.0		
I TE Bond 12	LTE Band 12	1.4MHz	23095	0.00	-47.73		1.80	47.73	20.00	-27.73	T4			
LIE Ballu 12	TE Band 12	10MHz	23095	-6.31	-44.31	-63.75		38.00	20.00	-18.00	T4			
	Radial	5MHz	23095	-6.31	-44.49		-63.75	C2 75	N/A 38.	38.18	20.00	-18.18	T4	2.0. 2.4
	radiai	3MHz	23095	-6.35	-44.04			IVA	37.69	20.00	-17.69	T4	2.0, 2.4	
		1.4MHz	23095	-6.41	-44.58			38.17	20.00	-18.17	T4			

Table 9-7 Raw Data Results for LTE B13

Mode	Orientation	Bandwidth	Channel	ABM1 [dB(A/m)]	ABM2 [dB(A/m)]	Ambient Noise [dB(A/m)]	Frequency Response Margin (dB)	S+N/N (dB)	FCC Limit (dB)	Margin from FCC Limit (dB)	C63.19-2011	Test Coordinates
	Axial	10MHz	23230	0.03	-47.67	-61.81	1.79	47.70	20.00	-27.70	T4	2.4. 1.6
LTE Band 13		5MHz	23230	0.04	-47.51	-01.01	1.72	47.55	20.00	-27.55	T4	2.4, 1.0
LIE Band 13		10MHz	23230	-6.40	-44.81	CO 75	NVA	38.41	20.00	-18.41	T4	2.0. 2.4
Radial	5MHz	23230	-6.33	-44.51	-63.75	N/A 38.18		20.00	-18.18	T4	2.0, 2.4	

Table 9-8 Raw Data Results for LTE B26

Mode	Orientation	Bandwidth	Channel	ABM1 [dB(A/m)]	ABM2 [dB(A/m)]	Ambient Noise [dB(A/m)]	Frequency Response Margin (dB)	S+N/N (dB)	FCC Limit (dB)	Margin from FCC Limit (dB)	C63.19-2011 Rating	Test Coordinates
		15MHz	26865	0.06	-45.62		1.93	45.68	20.00	-25.68	T4	
		10MHz	26865	0.10	-45.27		1.84	45.37	20.00	-25.37	T4	
	Axial	5MHz	26865	0.08	-46.72	-61.81	1.66	46.80	20.00	-26.80	T4	2.4, 1.6
		3MHz	26865	0.05	-46.27		2.00	46.32	20.00	-26.32	T4	j
LTE Band 26	TE Bond 26	1.4MHz	26865	0.05	-47.37		1.72	47.42	20.00	-27.42	T4	
LIE Band 26		15MHz	26865	-6.38	-43.44			37.06	20.00	-17.06	T4	
		10MHz	26865	-6.32	-43.07			36.75	20.00	-16.75	T4	
	Radial	5MHz	26865	-6.35	-44.01	-63.75 N/A	N/A	37.66	20.00	-17.66	T4	2.0, 2.4
		3MHz	26865	-6.30	-43.97			37.67	20.00	-17.67	T4	
		1.4MHz	26865	-6.33	-45.57			39.24	20.00	-19.24	T4	

Table 9-9 Raw Data Results for LTE B66

Mode	Orientation	Bandwidth	Channel	ABM1 [dB(A/m)]	ABM2 [dB(A/m)]	Ambient Noise [dB(A/m)]	Frequency Response Margin (dB)	S+N/N (dB)	FCC Limit (dB)	Margin from FCC Limit (dB)	C63.19-2011 Rating	Test Coordinates
		20MHz	132572	0.03	-45.37		1.77	45.40	20.00	-25.40	T4	
		20MHz	132322	0.07	-44.56		1.64	44.63	20.00	-24.63	T4	
		20MHz	132072	0.04	-45.80		1.65	45.84	20.00	-25.84	T4	
	Axial	15MHz	132322	0.02	-45.62	-61.81	1.77	45.64	20.00	-25.64	T4	2.4, 1.6
	Axiai	10MHz	132322	0.06	-46.11	-01.01	1.78	46.17	20.00	-26.17	T4	2.4, 1.0
		5MHz	132322	-0.06	-45.23		1.75	45.17	20.00	-25.17	T4	
LTE Band 66		3MHz	132322	-0.21	-46.76		1.97	46.55	20.00	-26.55	T4	
LIE Ballu 66		1.4MHz	132322	0.11	-44.53		1.74	44.64	20.00	-24.64	T4	
		20MHz	132322	-6.38	-43.99			37.61	20.00	-17.61	T4	
		15MHz	132322	-6.40	-43.53			37.13	20.00	-17.13	T4	
	Radial	10MHz	132322	-6.42	-43.47	60.75	N/A	37.05	20.00	-17.05	T4	2.0. 2.4
	Radiai	5MHz	132322	-6.42	-44.10	-63.75	INVA	37.68	20.00	-17.68	T4	2.0, 2.4
		3MHz	132322	-6.36	-43.68			37.32	20.00	-17.32	T4	
		1.4MHz	132322	-6.46	-45.17			38.71	20.00	-18.71	T4	

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Table 9-10 Raw Data Results for LTE B25

				<u> </u>									
Mode	Orientation	Bandwidth	Channel	ABM1 [dB(A/m)]	ABM2 [dB(A/m)]	Ambient Noise [dB(A/m)]	Frequency Response Margin (dB)	S+N/N (dB)	FCC Limit (dB)	Margin from FCC Limit (dB)	C63.19-2011 Rating	Test Coordinates	
		20MHz	26365	0.04	-45.09		1.79	45.13	20.00	-25.13	T4		
		15MHz	26365	0.04	-45.13		1.73	45.17	20.00	-25.17	T4	1	
	Axial	10MHz	26365	0.04	-45.96	-61.81	1.76	46.00	20.00	-26.00	T4	2.4, 1.6	
	Axidi	5MHz	26365	0.04	-46.47	-01.01	1.70	46.51	20.00	-26.51	T4	2.4, 1.0	
		3MHz	26365	0.03	-46.70		1.79	46.73	20.00	-26.73	T4	Ī	
. TE D 05		1.4MHz	26365	0.03	-47.33		1.67	47.36	20.00	-27.36	T4		
LIE Band 25	Band 25	20MHz	26365	-6.38	-44.07			37.69	20.00	-17.69	T4		
		15MHz	26365	-6.35	-43.58			37.23	20.00	-17.23	T4	Ī	
	5.51	10MHz	26365	-6.42	-43.38	60.75	NUA	36.96	20.00	-16.96	T4	0004	
	Radial	5MHz	26365	-6.35	-44.13	-63.75	N/A	37.78	20.00	-17.78	T4	2.0, 2.4	
		3MHz	26365	-6.36	-44.25	1	_		37.89	20.00	-17.89	T4	Ī
		1.4MHz	26365	-6.44	-45.52			39.08	20.00	-19.08	T4		

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

	Frequency Margin from Margin from													
Mode	Orientation	Bandwidth	Channel	ABM1 [dB(A/m)]	ABM2 [dB(A/m)]	Ambient Noise [dB(A/m)]	Frequency Response Margin (dB)	S+N/N (dB)	FCC Limit (dB)	Margin from FCC Limit (dB)	C63.19-2011 Rating	Test Coordinates		
		20MHz	40620	-0.01	-37.89		1.68	37.88	20.00	-17.88	T4			
	Axial	15MHz	40620	0.02	-38.11	-61.81	1.80	38.13	20.00	-18.13	T4	2.4. 1.6		
	Axial LTE Band 41 Radial	10MHz	40620	0.01	-38.13	-01.01	1.77	38.14	20.00	-18.14	T4	2.4, 1.0		
I TE Band		5MHz	40620	0.01	-37.59		1.84	37.60	20.00	-17.60	T4			
LIE Ballu		20MHz	40620	-6.36	-42.32	-63.75		35.96	20.00	-15.96	T4			
		15MHz	40620	-6.36	-42.37		-63.75	NA	36.01	20.00	-16.01	T4	2.0. 2.4	
	Radial	10MHz	40620	-6.36	-42.82			IWA	36.46	20.00	-16.46	T4	2.0, 2.4	
		5MHz	40620	-6.32	-41.38			35.06	20.00	-15.06	T4			

Table 9-12 Raw Data Results for LTE B41 Power Class 2

		1 144	w Date	u	u				iuoo i	_				
Mode	Orientation	Bandwidth	Channel	ABM1 [dB(A/m)]	ABM2 [dB(A/m)]	Ambient Noise [dB(A/m)]	Frequency Response Margin (dB)	S+N/N (dB)	FCC Limit (dB)	Margin from FCC Limit (dB)	C63.19-2011 Rating	Test Coordinates		
		20MHz	41490	0.09	-33.38		1.60	33.47	20.00	-13.47	T4			
		20MHz	41055	0.07	-32.38		1.72	32.45	20.00	-12.45	T4			
		20MHz	40620	0.09	-33.91		1.64	34.00	20.00	-14.00	T4			
	Axial	20MHz	40185	0.07	-34.35	-61.81	1.77	34.42	20.00	-14.42	T4	2.4, 1.6		
	Axiai	20MHz	39750	0.05	-34.41	-01.01	1.80	34.46	20.00	-14.46	T4	2.4, 1.0		
	-	15MHz	40620	0.06	-34.23		1.71	34.29	20.00	-14.29	T4			
		10MHz	40620	0.07	-34.23		1.70	34.30	20.00	-14.30	T4			
LTE Band 41		5MHz	40620	0.12	-34.50		1.69	34.62	20.00	-14.62	T4			
LIE Band 41		20MHz	40620	-6.36	-39.25			32.89	20.00	-12.89	T4			
		15MHz	40620	-6.29	-38.37			32.08	20.00	-12.08	T4			
		10MHz	40620	-6.28	-38.53			32.25	20.00	-12.25	T4			
	Radial	5MHz	41490	-6.47	-37.12	60.75	N/A	30.65	20.00	-10.65	T4	2.0, 2.4		
	Radiai	5MHz	41055	-6.41	-35.75	-63.75 B	-63.75	-63 75 N	INVA	29.34	20.00	-9.34	T3	2.0, 2.4
		5MHz	40620	-6.37	-38.08			31.71	20.00	-11.71	T4			
		5MHz	40185	-6.36	-38.79			32.43	20.00	-12.43	T4			
		5MHz	39750	-6.36	-39.17			32.81	20.00	-12.81	T4			

Table 9-13 Raw Data Results for 2.4GHz WIFI

	Trave Data Results 101 2.40112 VVII 1													
Mode	Orientation	Channel	ABM1 [dB(A/m)]	ABM2 [dB(A/m)]	Ambient Noise [dB(A/m)]	Frequency Response Margin (dB)	S+N/N (dB)	FCC Limit (dB)	Margin from FCC Limit (dB)	C63.19-2011 Rating	Test Coordinates			
		1	-6.36	-37.10		1.71	30.74	20.00	-10.74	T4				
	Axial	6	-6.34	-37.37	-61.81	1.42	31.03	20.00	-11.03	T4	2.4, 1.6			
IEEE		11	-6.07	-35.64		1.62	29.57	20.00	-9.57	Т3				
802.11b		1	-11.84	-35.55			23.71	20.00	-3.71	Т3				
	Radial	6	-11.61	-36.49	-63.75	N/A	24.88	20.00	-4.88	Т3	2.0, 2.4			
		11	-11.96	-35.84			23.88	20.00	-3.88	T3				
IEEE	Axial	6	-6.23	-40.13	-61.81	1.19	33.90	20.00	-13.90	T4	2.4, 1.6			
802.11g	Radial	6	-11.56	-40.02	-63.75	N/A	28.46	20.00	-8.46	Т3	2.0, 2.4			
IEEE	Axial	6	-6.32	-40.59	-61.81	1.45	34.27	20.00	-14.27	T4	2.4, 1.6			
802.11n	Radial	6	-11.68	-39.80	-63.75	N/A	28.12	20.00	-8.12	T3	2.0, 2.4			

Table 9-14 Raw Data Results for 5GHz WIFI IEEE 802.11a

Mode	Orientation	Bandwidth	U-NII	Channel	ABM1 [dB(A/m)]	ABM2 [dB(A/m)]	Ambient Noise [dB(A/m)]	Frequency Response Margin (dB)	S+N/N (dB)	FCC Limit (dB)	Margin from FCC Limit (dB)	C63.19-2011	Test Coordinates
	Axial	20MHz	1	40	-6.47	-41.91	-61.81	1.62	35.44	20.00	-15.44	T4	2.4, 1.6
EEE 802.11a													
	Radial	20MHz	1	40	-11.78	-43.64	-63.75	N/A	31.86	20.00	-11.86	T4	2.0, 2.4

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

Mode	Orientation	Bandwidth	U-NII	Channel	ABM1 [dB(A/m)]	ABM2 [dB(A/m)]	Ambient Noise [dB(A/m)]	Frequency Response Margin (dB)	S+N/N (dB)	FCC Limit (dB)	Margin from FCC Limit (dB)	C63.19-2011 Rating	Test Coordinates
	Axial	40MHz	1	38	-6.48	-41.71	-61.81	1.34	35.23	20.00	-15.23	T4	2.4. 1.6
	Axidi	20MHz	1	40	-6.26	-41.97	-01.01	1.28	35.71	20.00	-15.71	T4	2.4, 1.0
		40MHz	1	38	-11.62	-42.10			30.48	20.00	-10.48	T4	
	IEEE	20MHz	1	36	-11.74	-43.24			31.50	20.00	-11.50	T4	
.ccc		20MHz	1	40	-11.65	-40.23			28.58	20.00	-8.58	T3	
802.11n		20MHz	1	48	-11.55	-41.84			30.29	20.00	-10.29	T4	
002.1111	Radial	40MHz	2A	54	-11.48	-42.66	-63.75	NΑ	31.18	20.00	-11.18	T4	2.0. 2.4
	Radiai	20MHz	2A	56	-11.58	-42.41	-03.75	IWA	30.83	20.00	-10.83	T4	2.0, 2.4
		40MHz	2C	118	-11.51	-42.45			30.94	20.00	-10.94	T4	
		20MHz	2C	120	-11.55	-42.43	6		30.88	20.00	-10.88	T4]
		40MHz	3	151	-11.65	-42.16			30.51	20.00	-10.51	T4	1
		20MHz	3	157	-11.55	-42.33			30.78	20.00	-10.78	T4	

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

Mode	Orientation	Bandwidth	U-NII	Channel	ABM1 [dB(A/m)]	ABM2 [dB(A/m)]	Ambient Noise [dB(A/m)]	Frequency Response Margin (dB)	S+N/N (dB)	FCC Limit (dB)	Margin from FCC Limit (dB)	C63.19-2011 Rating	Test Coordinates
		40MHz	1	38	-6.60	-41.49		1.12	34.89	20.00	-14.89	T4	
		20MHz	1	36	-6.59	-38.02		1.45	31.43	20.00	-11.43	T4	
		20MHz	1	40	-6.48	-40.45		1.38	33.97	20.00	-13.97	T4	
		20MHz	1	48	-6.51	-37.05		1.39	30.54	20.00	-10.54	T4	
	Axial	40MHz	2A	54	-6.39	-42.82	-61.81	1.28	36.43	20.00	-16.43	T4	2.4. 1.6
IEEE	Axidi	20MHz	2A	56	-6.26	-42.39	-01.01	1.12	36.13	20.00	-16.13	T4	2.4, 1.0
802.11ac	EEE 2.11ac	40MHz	2C	118	-6.74	-42.82		1.17	36.08	20.00	-16.08	T4	
002.1140		20MHz	2C	120	-6.57	-41.66		1.23	35.09	20.00	-15.09	T4	
		40MHz	3	151	-6.40	-42.28		1.68	35.88	20.00	-15.88	T4	Ī
		20MHz	3	157	-6.55	-41.42		1.24	34.87	20.00	-14.87	T4	
	Radial	40MHz	1	38	-11.74	-42.85	-63 75	NIA	31.11	20.00	-11.11	T4	2.0. 2.4
	Radial	20MHz	1	40	-11.67	-41.52		83.75 N/A	29.85	20.00	-9.85	T3	2.0, 2.4

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

	Fraguency Marsin from													
Mode	Orientation	Channel	ABM1 [dB(A/m)]	ABM2 [dB(A/m)]	Ambient Noise [dB(A/m)]	Frequency Response Margin (dB)	S+N/N (dB)	FCC Limit (dB)	Margin from FCC Limit (dB)	C63.19-2011 Rating	Test Coordinates			
Secondary Cellular	Axial	564	4.76	-49.46	-61.81	1.50	54.22	20.00	-34.22	T4	2.4, 1.6			
EvDO	Radial	564	-1.62	-46.05	-63.75	N/A	44.43	20.00	-24.43	T4	2.0, 2.4			
Cellular	Axial	384	4.82	-49.21	-61.81	1.53	54.03	20.00	-34.03	T4	2.4, 1.6			
EvDO	Radial	384	-1.83	-46.05	-63.75	N/A	44.22	20.00	-24.22	T4	2.0, 2.4			
PCS	Axial	600	4.76	-48.78	-61.81	1.51	53.54	20.00	-33.54	T4	2.4, 1.6			
EvDO	Radial	600	-1.62	-45.68	-63.75	N/A	44.06	20.00	-24.06	T4	2.0, 2.4			

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

Mode	Orientation	Channel	ABM1 [dB(A/m)]	ABM2 [dB(A/m)]	Ambient Noise [dB(A/m)]	Frequency Response Margin (dB)	S+N/N (dB)	FCC Limit (dB)	Margin from FCC Limit (dB)	C63.19-2011 Rating	Test Coordinates
EDGE850	Axial	190	4.41	-34.57	-58.55	1.43	38.98	20.00	-18.98	T4	2.4, 1.6
EDGE050	Radial	190	-1.71	-37.14	-63.75	N/A	35.43	20.00	-15.43	T4	2.0, 2.4
EDGE1900	Axial	661	4.55	-35.47	-58.55	1.62	40.02	20.00	-20.02	T4	2.4, 1.6
EDGE1900	Radial	661	-1.48	-36.58	-63.75	N/A	35.10	20.00	-15.10	T4	2.0, 2.4

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

Mode	Orientation	Channel	ABM1 [dB(A/m)]	ABM2 [dB(A/m)]	Ambient Noise [dB(A/m)]	Frequency Response Margin (dB)	S+N/N (dB)	FCC Limit (dB)	Margin from FCC Limit (dB)	C63.19-2011 Rating	Test Coordinates
HSPA V	Axial	4183	4.77	-47.78	-58.55	1.58	52.55	20.00	-32.55	T4	2.4, 1.6
nora v	Radial	4183	-1.35	-45.33	-63.75	N/A	43.98	20.00	-23.98	T4	2.0, 2.4
HSPA IV	Axial	1412	4.70	-47.91	-58.55	1.55	52.61	20.00	-32.61	T4	2.4, 1.6
погату	Radial	1412	-1.42	-45.53	-63.75	N/A	44.11	20.00	-24.11	T4	2.0, 2.4
HSPA II	Axial	9400	4.58	-45.44	-58.55	1.59	50.02	20.00	-30.02	T4	2.4, 1.6
пораш	Radial	9400	-1.30	-42.83	-63.75	N/A	41.53	20.00	-21.53	T4	2.0, 2.4

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Table 9-20
Raw Data Results for LTE B26 (OTT VoIP)

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Mode	Orientation	Bandwidth	Channel	ABM1 [dB(A/m)]	ABM2 [dB(A/m)]	Ambient Noise [dB(A/m)]	Frequency Response Margin (dB)	S+N/N (dB)	FCC Limit (dB)	Margin from FCC Limit (dB)	C63.19-2011 Rating	Test Coordinates	
		15MHz	26865	5.03	-44.94		1.54	49.97	20.00	-29.97	T4		
		10MHz	26990	4.92	-44.94		1.53	49.86	20.00	-29.86	T4		
		10MHz	26865	4.84	-44.48		1.53	49.32	20.00	-29.32	T4		
	Axial	10MHz	26740	5.00	-46.25	-61.81	1.53	51.25	20.00	-31.25	T4	2.4, 1.6	
	-	5MHz	26865	5.06	-45.05		1.54	50.11	20.00	-30.11	T4		
		3MHz	26865	5.05	-45.70		1.58	50.75	20.00	-30.75	T4		
LTE Band 26		1.4MHz	26865	4.85	-45.83		1.61	50.68	20.00	-30.68	T4		
LIE Ballu 26		15MHz	26965	-1.29	-40.63			39.34	20.00	-19.34	T4		
		15MHz	26865	-1.38	-41.09			39.71	20.00	-19.71	T4		
		15MHz	26765	-1.40	-42.42			41.02	20.00	-21.02	T4		
	Radial	10MHz	26865	-1.23	-41.60	-63.75 N/A 15 86	N/A	40.37	20.00	-20.37	T4	2.0, 2.4	
		5MHz	26865	-1.29	-42.15		2.15		40.86	20.00	-20.86	T4	
		3MHz	26865	-1.41	-41.86			40.45	20.00	-20.45	T4		
		1.4MHz	26865	-1.32	-41.68			40.36	20.00	-20.36	T4		

Table 9-21
Raw Data Results for LTE B41 (PC2) (OTT VoIP)

			Dutu				(-, (-,		
Mode	Orientation	Bandwidth	Channel	ABM1 [dB(A/m)]	ABM2 [dB(A/m)]	Ambient Noise [dB(A/m)]	Frequency Response Margin (dB)	S+N/N (dB)	FCC Limit (dB)	Margin from FCC Limit (dB)	C63.19-2011 Rating	Test Coordinates
		20MHz	40620	5.13	-34.16		1.53	39.29	20.00	-19.29	T4	
		15MHz	40620	4.99	-34.47		1.56	39.46	20.00	-19.46	T4	
		10MHz	40620	4.97	-34.38		1.52	39.35	20.00	-19.35	T4	
	Axial	5MHz	41490	5.00	-32.74	-61.81	1.55	37.74	20.00	-17.74	T4	2.4, 1.6
	Axial	5MHz	41055	4.97	-32.27	-01.01	1.55	37.24	20.00	-17.24	T4	2.4, 1.0
		5MHz	40620	4.96	-34.10		1.57	39.06	20.00	-19.06	T4	
		5MHz	40185	4.96	-33.89		1.53	38.85	20.00	-18.85	T4	
LTE Band 41		5MHz	39750	4.97	-34.12		1.53	39.09	20.00	-19.09	T4	
LIE Band 41		20MHz	41490	-1.35	-36.59			35.24	20.00	-15.24	T4	
		20MHz	41055	-1.26	-35.01			33.75	20.00	-13.75	T4	
		20MHz	40620	-1.01	-37.36			36.35	20.00	-16.35	T4	
	Radial	20MHz	40185	-1.25	-36.94	-63.75	N/A	35.69	20.00	-15.69	T4	2.0, 2.4
	radial	20MHz	39750	-1.35	-37.51	-03.75	IVA	36.16	20.00	-16.16	T4	2.0, 2.4
		15MHz	40620	-1.15	-37.71	1 3		36.56	20.00	-16.56	T4	
		10MHz	40620	-1.26	-37.78			36.52	20.00	-16.52	T4	
		5MHz	40620	-1.24	-37.64			36.40	20.00	-16.40	T4	

Table 9-22 Raw Data Results for 2.4GHz WIFI (OTT VoIP)

	Raw Data Results for 2.4GHZ WIFT (OTT VOIP)												
Mode	Orientation	Channel	ABM1 [dB(A/m)]	ABM2 [dB(A/m)]	Ambient Noise [dB(A/m)]	Frequency Response Margin (dB)	S+N/N (dB)	FCC Limit (dB)	Margin from FCC Limit (dB)	C63.19-2011 Rating	Test Coordinates		
		1	4.63	-36.63		1.56	41.26	20.00	-21.26	T4			
	Axial	6	4.38	-32.33	-61.81	1.53	36.71	20.00	-16.71	T4	2.4, 1.6		
IEEE		11	4.51	-36.92		1.55	41.43	20.00	-21.43	T4	1		
802.11b		1	-1.22	-36.27			35.05	20.00	-15.05	T4			
	Radial	6	-1.27	-36.69	-63.75	N/A	35.42	20.00	-15.42	T4	2.0, 2.4		
		11	-1.36	-37.09			35.73	20.00	-15.73	T4	ĺ		
IEEE	Axial	6	4.76	-40.24	-61.81	1.53	45.00	20.00	-25.00	T4	2.4, 1.6		
802.11g	Radial	6	-1.70	-40.44	-63.75	N/A	38.74	20.00	-18.74	T4	2.0, 2.4		
IEEE	Axial	6	4.63	-39.30	-61.81	1.59	43.93	20.00	-23.93	T4	2.4, 1.6		
802.11n	Radial	6	-1.51	-40.53	-63.75	N/A	39.02	20.00	-19.02	T4	2.0, 2.4		

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

	Mode	Orientation	Bandwidth	U-NII	Channel	ABM1 [dB(A/m)]	ABM2 [dB(A/m)]	Ambient Noise [dB(A/m)]	Frequency Response Margin (dB)	S+N/N (dB)	FCC Limit (dB)	Margin from FCC Limit (dB)	C63.19-2011	Test Coordinates
ı		Axial	20MHz	1	40	4.44	-42.34	-61.81	1.55	46.78	20.00	-26.78	T4	2.4, 1.6
	IEEE 802.11a													
	802.11a	Radial	20MHz	1	40	-1.35	-42.18	-63.75	N/A	40.83	20.00	-20.83	T4	2.0, 2.4

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

	Mode	Orientation	Bandwidth	U-NII	Channel	ABM1 [dB(A/m)]	ABM2 [dB(A/m)]	Ambient Noise [dB(A/m)]	Frequency Response Margin (dB)	S+N/N (dB)	FCC Limit (dB)	Margin from FCC Limit (dB)	C63.19-2011	Test Coordinates
ı	IEEE 802.11n	Axial	40MHz	1	38	4.55	-41.43	-61.81	1.50	45.98	20.00	-25.98	T4	2.4, 1.6
			20MHz	1	40	4.42	-42.20		1.49	46.62	20.00	-26.62	T4	
		Radial	40MHz	1	38	-1.72	-41.69	-63.75		39.97	20.00	-19.97	T4	2.0. 2.4
		Radial	20MHz	1	40	-1.26	-41.23	-03.75	N/A	39.97	20.00	-19.97	T4	2.0, 2.4

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

Mode	Orientation	Bandwidth	U-NII	Channel	ABM1 [dB(A/m)]	ABM2 [dB(A/m)]	Ambient Noise [dB(A/m)]	Frequency Response Margin (dB)	S+N/N (dB)	FCC Limit (dB)	Margin from FCC Limit (dB)	C63.19-2011 Rating	Test Coordinates
		40MHz	1	38	4.60	-42.79		1.54	47.39	20.00	-27.39	T4	2.4, 1.6
		20MHz	1	40	4.42	-39.52		1.57	43.94	20.00	-23.94	T4	
		40MHz	2A	54	4.54	-42.27		1.58	46.81	20.00	-26.81	T4	
		20MHz	2A	56	4.38	-39.45		1.54	43.83	20.00	-23.83	T4	
	Axial	40MHz	2C	118	4.41	-41.29	-61.81	1.55	45.70	20.00	-25.70	T4	
	Axidi	20MHz	2C	100	4.28	-40.37	-01.01	1.55	44.65	20.00	-24.65	T4	
		20MHz	2C	120	4.18	-38.33		1.54	42.51	20.00	-22.51	T4	
		20MHz	2C	144	4.22	-39.78		1.54	44.00	20.00	-24.00	T4	
		40MHz	3	151	4.40	-41.52		1.54	45.92	20.00	-25.92	T4	
IEEE		20MHz	3	157	4.26	-39.46		1.52	43.72	20.00	-23.72	T4	
802.11ac													
002.1100		40MHz	1	38	-1.31	-41.84			40.53	20.00	-20.53	T4	
		20MHz	1	36	-1.30	-40.46			39.16	20.00	-19.16	T4	
		20MHz	1	40	-1.30	-39.32			38.02	20.00	-18.02	T4	
		20MHz	1	48	-1.33	-40.10			38.77	20.00	-18.77	T4	2.0, 2.4
	Radial	40MHz	2A	54	-1.23	-44.03	-63.75	N/A	42.80	20.00	-22.80	T4	
	radiai	20MHz	2A	56	-1.15	-40.21		IVA	39.06	20.00	-19.06	T4	
		40MHz	2C	118	-1.15	-42.67			41.52	20.00	-21.52	T4	
		20MHz	2C	120	-1.25	-40.80			39.55	20.00	-19.55	T4	
		40MHz	3	151	-1.13	-42.57			41.44	20.00	-21.44	T4	
		20MHz	3	157	-1.10	-39.42			38.32	20.00	-18.32	T4	

II. Test Notes

A. General

- 1. Phone Condition: Mute on; Backlight off; Max Volume; Max Contrast
- 2. 'Radial' orientation refers to radial transverse.
- 3. Hearing Aid Mode (Phone→Call Settings→Additional Settings→Hearing aids) was set to ON for Frequency Response compliance
- 4. Speech Signal: ITU-T P.50 Artificial Voice
- 5. Bluetooth and WIFI were disabled while testing 2G/3G/4G modes.
- 6. Licensed data modes and Bluetooth were disabled while testing WIFI modes.
- 7. The Margin from FCC limit column indicates a margin from the FCC limit for compliance (T3).

B. CDMA

- 1. Power Configuration: Power Control Bits = "All Up"
- 2. Vocoder Configuration: RC1/SO3 (CDMA EVRC)

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: 64QAM, 1RB, 99% RB offset
- 3. Vocoder Configuration: EVS Primary NB 13.2kbps
- 4. The worst-case band and bandwidth combination for each probe orientation is additionally tested on the low and high channels for those combinations. LTE Band 66 at 20MHz is the worst-case for the Axial probe orientation. LTE Band 71 at 10MHz bandwidth is the worst-case for the Radial probe orientation.

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F. LTE TDD

- 1. Power Configuration: TPC = "Max Power"
- 2. Radio Configuration: 64QAM, 1RB, 99%RB offset
- 3. Power Class 3 Uplink-Downlink configuration: 6
- 4. Power Class 2 Uplink-Downlink configuration: 2
- 5. Vocoder Configuration: EVS Primary NB 13.2kbps
- 6. The worst-case band and bandwidth combination for each probe orientation is additionally tested on the low, low-mid, high-mid, and high channels for those combinations. LTE Band 41 (Power Class 2) at 20MHz is the worst-case for Axial probe orientation. LTE Band 41 (Power Class 2) at 5MHz is the worst-case for Radial probe orientation.

G. WIFI

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

H. OTT VolP

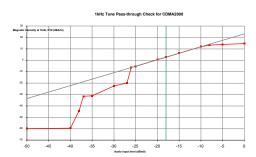
- 1. Vocoder Configuration: 75kbps
- 2. EvDO Configuration
 - a. Revision: A
- 3. EDGE Configuration
 - a. MCS Index: 7
 - b. Number of TX slots: 2
- 4. HSPA Configuration:
 - a. Release: 6
 - b. 3GPP 34.121 Subtest 1
- 5. LTE FDD Configuration:
 - a. Power Configuration: TPC = "Max Power"
 - b. Radio Configuration: 64QAM, 1RB, 99% RB offset
 - LTE Band 26 was the worst-case band from Table 7-6 and was used to test both Axial and Radial probe orientations.
 - The worst-case band and bandwidth combination for each probe orientation is additionally tested on the low and high channels for those combinations. LTE Band 26 at 10MHz is the worst-case for the Axial probe orientation. LTE Band 26 at 15MHz bandwidth is the worst-case for the Radial probe orientation.
- LTE TDD Configuration:
 - a. Power Configuration: TPC = "Max Power"
 - b. Radio Configuration: 64QAM, 1RB, 99% RB offset
 - c. Power Class 2 Uplink-Downlink configuration: 2

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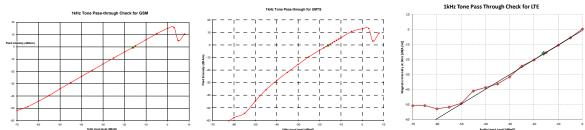
- d. LTE Band 41 (Power Class 2) was the worst-case band from Table 7-7 and was used to test both Axial and Radial probe orientations.
- e. The worst-case band and bandwidth combination for each probe orientation is additionally tested on the low, low-mid, high-mid, and high channels for those combinations. LTE Band 41 (Power Class 2) at 5MHz is the worst-case for the Axial probe orientation. LTE Band 41 (Power Class 2) at 20MHz is the worst-case for the Radial probe orientation.
- 7. WIFI Configuration:
 - a. Radio Configuration
 - i. IEEE 802.11b: DSSS, 2Mbps
 - ii. IEEE 802.11g/a: BPSK, 6Mbps
 - iii. IEEE 802.11n/ac 20MHz: QPSK, MCS 1
 - iv. IEEE 802.11n/ac 40MHz: 16QAM, MCS 3
 - b. The worst-case standard for 2.4GHz WIFI in each probe orientation is additionally tested on the low and high channels. IEEE 802.11b is the worst-case for both the Axial and Radial probe orientations.
 - c. The worst-case standard for 5GHz WIFI in each probe orientation is additionally tested on higher U-NII bands as well as applicable low and high channels. IEEE 802.11ac 20MHz (U-NII 2C) is the worst-case for the Axial probe orientation. IEEE 802.11ac 20MHz (U-NII 1) is the worst-case for the Radial probe orientation.

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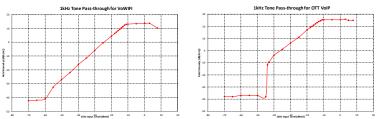
III. 1 kHz Vocoder Application Check



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



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



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

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IV. T-Coil Validation Test Results

Table 9-26
Helmholtz Coil Validation Table of Results – 1/11/2021

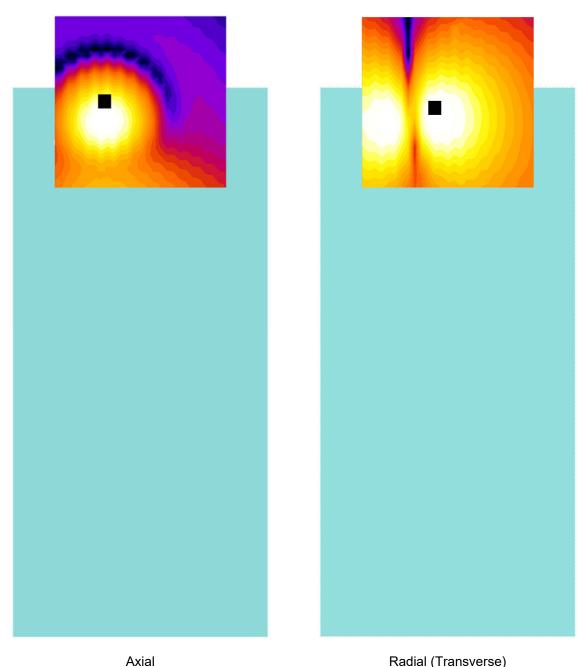
Heilinoitz Con Validation Table of Results = 1/11/2021					
ltem	Target	Result	Verdict		
Axial					
Magnetic Intensity, -10 dBA/m	-10 ± 0.5 dB	-9.842	PASS		
Environmental Noise	< -58 dBA/m	-58.55	PASS		
Frequency Response, from limits	> 0 dB	0.80	PASS		
Radial					
Magnetic Intensity, -10 dBA/m	-10 ± 0.5 dB	-10.123	PASS		
Environmental Noise	< -58 dBA/m	-59.07	PASS		
Frequency Response, from limits	> 0 dB	0.80	PASS		

Table 9-27
Helmholtz Coil Validation Table of Results – 1/18/2021

Item	Target	Result	Verdict
Axial			
Magnetic Intensity, -10 dBA/m	-10 ± 0.5 dB	-9.913	PASS
Environmental Noise	< -58 dBA/m	-61.81	PASS
Frequency Response, from limits	> 0 dB	0.50	PASS
Radial			
Magnetic Intensity, -10 dBA/m	-10 ± 0.5 dB	-10.111	PASS
Environmental Noise	< -58 dBA/m	-63.75	PASS
Frequency Response, from limits	> 0 dB	0.70	PASS

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ABM1 Magnetic Field Distribution Scan Overlays ٧.



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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10. MEASUREMENT UNCERTAINTY

Table 10-1 Uncertainty Estimation Table

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

Notes:

- 1. Test equipments are calibrated according to techniques outlined in NIS81, NIS3003 and NIST Tech Note 1297.
- 2. 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 Liet							
Manufacturer	Model	Description	Cal Date	Cal Interval	Cal Due	Serial Number	
Dell	Latitude E6540	SoundCheck Acoustic Analyzer Laptop	9/29/2020	Biennial	9/29/2022	2655082910	
Listen	SoundConnect	Microphone Power Supply	9/24/2020	Biennial	9/24/2022	0899-PS150	
RME	Fireface UC	Soundcheck Acoustic Analyzer External Audio Interface	9/29/2020	Biennial	9/29/2022	23792992	
Rohde & Schwarz	CMW500	Radio Communication Tester	5/21/2020	Annual	5/21/2021	128635	
Rohde & Schwarz	CMW500	Radio Communication tester	9/4/2020	Annual	9/4/2021	140144	
Rohde & Schwarz	CMW500	Wideband Radio Communication Tester	2/4/2020	Annual	2/4/2021	162125	
Rohde & Schwarz	CMW500	Wideband Radio Communication Tester	6/23/2020	Annual	6/23/2021	161662	
Seekonk	NC-100	Torque Wrench (8" lb)	8/4/2020	Biennial	8/4/2022	21053	
TEM		HAC Positioner	N/A		N/A	N/A	
TEM		HAC System Controller with Software	N/A		N/A	N/A	
TEM	Helmholtz Coil	Helmholtz Coil	9/23/2020	Biennial	9/23/2022	SBI 1052	
TEM	Radial T-Coil Probe	Radial T-Coil Probe	9/23/2020	Biennial	9/23/2022	TEM-1129	
TEM	Axial T-Coil Probe	Axial T-Coil Probe	9/23/2020	Biennial	9/23/2022	TEM-1123	

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12. TEST DATA

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DUT: HH Coil - SN: SBI 1052

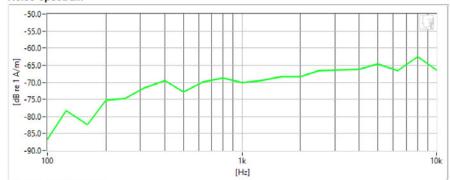
Type: HH Coil Serial: SBI 1052

Measurement Standard: ANSI C63.19-2011

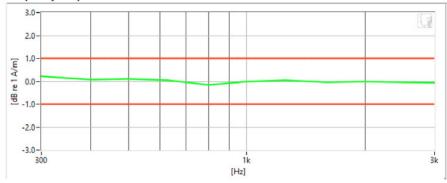
Equipment:

- Probe: Axial T-Coil Probe SN: TEM-1123; Calibrated: 09/23/2020
- Helmholtz Coil SN: SBI 1052; Calibrated: 09/23/2020

Noise Spectrum



Frequency Response



Results

Verification 1kHz Intensity	-9.842 dB	\checkmark	Max/Min	-9.5/-10.5
Verification ABM2	-58.55 dB	•	Maximum	-58.0
Frequency Response Margin	800m dB	~	Tolerance curves	Aligned Data

FCC ID: ZNFK420TM	PCTEST . Thoul to be pet of a sement	HAC (T-COIL) TEST REPORT	LG	Approved by: Quality Manager
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PCTEST Hearing-Aid Compatibility Facility

DUT: HH Coil - SN: SBI 1052

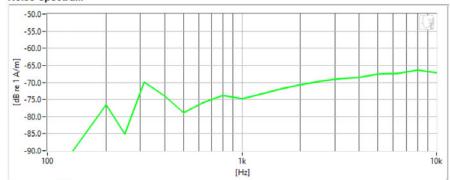
Type: HH Coil Serial: SBI 1052

Measurement Standard: ANSI C63.19-2011

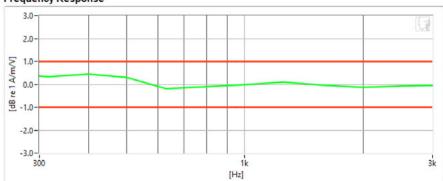
Equipment:

- Probe: Axial T-Coil Probe SN: TEM-1123; Calibrated: 09/23/2020
- Helmholtz Coil SN: SBI 1052; Calibrated: 09/23/2020

Noise Spectrum



Frequency Response



Results

Verification 1kHz Intensity	-9.913 dB	\checkmark	Max/Min	-9.5/-10.5
Verification ABM2	-61.81 dB	•	Maximum	-58.0
Frequency Response Margin	500m dB	✓	Tolerance curves	Aligned Data

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DUT: HH Coil - SN: SBI 1052

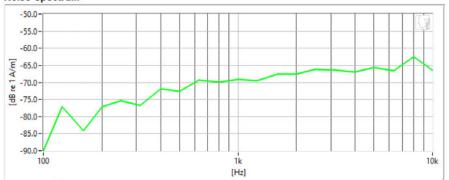
Type: HH Coil Serial: SBI 1052

Measurement Standard: ANSI C63.19-2011

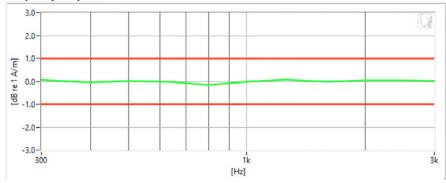
Equipment:

- Probe: Radial T-Coil Probe SN: TEM-1129; Calibrated: 09/23/2020
- Helmholtz Coil SN: SBI 1052; Calibrated: 09/23/2020

Noise Spectrum



Frequency Response



Results

Verification 1kHz Intensity	-10.123	dB	\checkmark	Max/Min	-9.5/-10.5
Verification ABM2	-59.07	dB	•	Maximum	-58.0
Frequency Response Margin	800m	dB	•	Tolerance curves	Aligned Data

FCC ID: ZNFK420TM	PCTEST hould to be post of a sement	HAC (T-COIL) TEST REPORT	LG	Approved by: Quality Manager
Filename:	Test Dates:	DUT Type:		Page 47 of 87
1M2012230208-11.ZNF	1/11/2021 - 1/20/2021	Portable Handset		rage 47 01 07



DUT: HH Coil - SN: SBI 1052

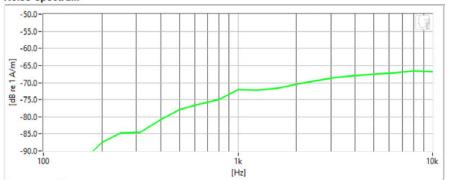
Type: HH Coil Serial: SBI 1052

Measurement Standard: ANSI C63.19-2011

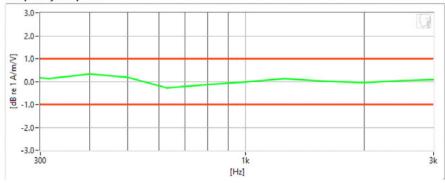
Equipment:

- Probe: Radial T-Coil Probe SN: TEM-1129; Calibrated: 09/23/2020
- Helmholtz Coil SN: SBI 1052; Calibrated: 09/23/2020

Noise Spectrum



Frequency Response



Results

Verification 1kHz Intensity	-10.111	dB	\checkmark	Max/Min	-9.5/-10.5
Verification ABM2	-63.75	dB	\checkmark	Maximum	-58.0
Frequency Response Margin	700m	dB	~	Tolerance curves	Aligned Data

FCC ID: ZNFK420TM	POTEST Poul to be port of the second	HAC (T-COIL) TEST REPORT	(LG	Approved by: Quality Manager
Filename:	Test Dates:	DUT Type:		Dogo 49 of 97
1M2012230208-11.ZNF	1/11/2021 - 1/20/2021	Portable Handset		Page 48 of 87



DUT: ZNFK420TM

Type: Portable Handset Serial: 18798

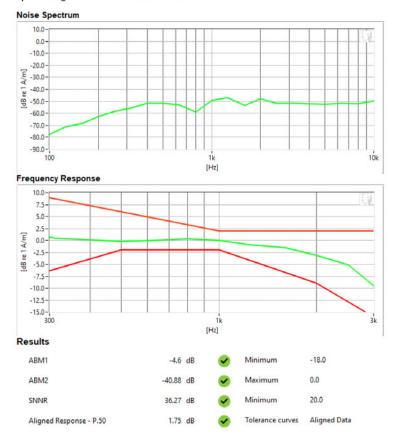
Measurement Standard: ANSI C63.19-2011

Equipment:

Probe: Axial T-Coil Probe – SN: TEM-1123; Calibrated: 09/23/2020

Test Configuration:

- . Mode: CDMA Secondary Cellular
- Channel: 564
- · Speech Signal: ITU-T P.50 Artificial Voice



FCC ID: ZNFK420TM	PCTEST Proof to be post of the determined	HAC (T-COIL) TEST REPORT	(LG	Approved by: Quality Manager
Filename:	Test Dates:	DUT Type:		Page 49 of 87
1M2012230208-11.ZNF	1/11/2021 - 1/20/2021	Portable Handset		Fage 49 01 07

REV 3.5.M



DUT: ZNFK420TM Type: Portable Handset

pe: Portable Handset Serial: 18798

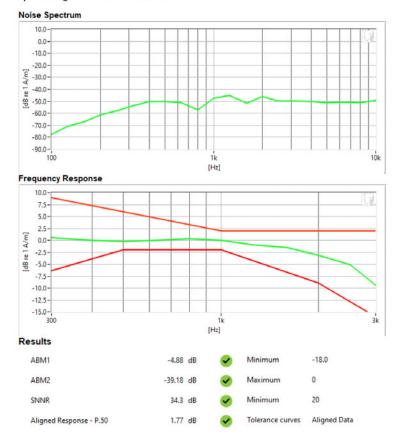
Measurement Standard: ANSI C63.19-2011

Equipment:

Probe: Axial T-Coil Probe – SN: TEM-1123; Calibrated: 09/23/2020

Test Configuration:

- Mode: CDMA Cellular
- Channel: 777
- . Speech Signal: ITU-T P.50 Artificial Voice



FCC ID: ZNFK420TM	POTEST Poul to be port of the second	HAC (T-COIL) TEST REPORT	€ LG	Approved by: Quality Manager
Filename:	Test Dates:	DUT Type:		Page 50 of 87
1M2012230208-11.ZNF	1/11/2021 - 1/20/2021	Portable Handset		Fage 50 01 67



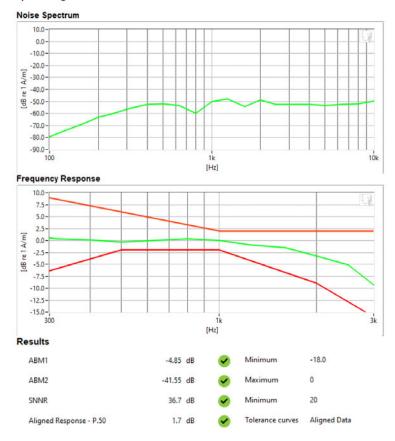
Measurement Standard: ANSI C63.19-2011

Equipment:

Probe: Axial T-Coil Probe – SN: TEM-1123; Calibrated: 09/23/2020

Test Configuration:

- Mode: CDMA PCS
- Channel: 25
- Speech Signal: ITU-T P.50 Artificial Voice



FCC ID: ZNFK420TM	PCTEST Proof to be post of a sensed	HAC (T-COIL) TEST REPORT	(LG	Approved by: Quality Manager
Filename:	Test Dates:	DUT Type:		Page 51 of 87
1M2012230208-11.ZNF	1/11/2021 - 1/20/2021	Portable Handset		rage 51 01 67



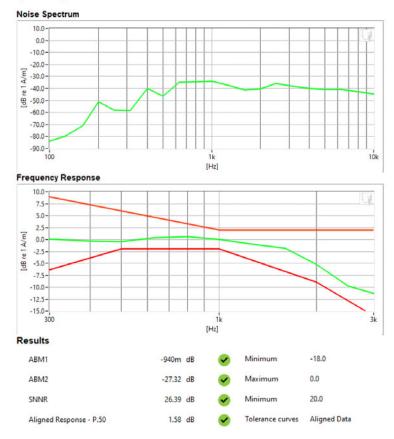
Measurement Standard: ANSI C63.19-2011

Equipment:

Probe: Axial T-Coil Probe – SN: TEM-1123; Calibrated: 09/23/2020

Test Configuration:

- Mode: GSM 850 Channel: 128
- Speech Signal: ITU-T P.50 Artificial Voice



FCC ID: ZNFK420TM	PCTEST Provided to the post of the province of the post of the pos	HAC (T-COIL) TEST REPORT	LG	Approved by: Quality Manager
Filename:	Test Dates:	DUT Type:		Page 52 of 87
1M2012230208-11.ZNF	1/11/2021 - 1/20/2021	Portable Handset		Fage 52 01 67



Serial: 18798

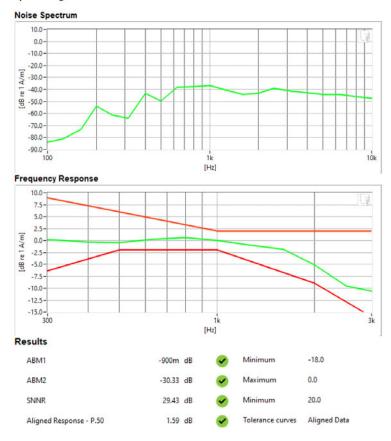
Measurement Standard: ANSI C63.19-2011

Equipment:

Probe: Axial T-Coil Probe – SN: TEM-1123; Calibrated: 09/23/2020

Test Configuration:

- Mode: GSM 1900
- Channel: 512
- · Speech Signal: ITU-T P.50 Artificial Voice



FCC ID: ZNFK420TM	PCTEST MAC (T-COIL) TEST REPORT		HAC (I-COIL) TEST REPORT	
Filename:	Test Dates:	DUT Type:		Dogo 52 of 97
1M2012230208-11.ZNF	1/11/2021 - 1/20/2021	Portable Handset		Page 53 of 87



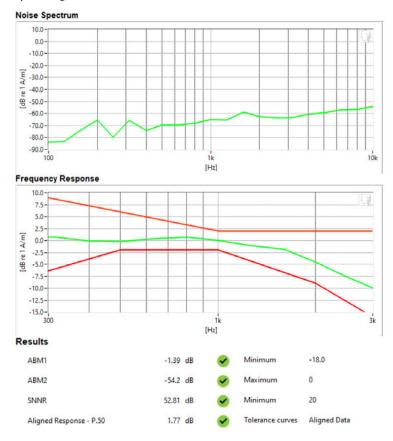
Measurement Standard: ANSI C63.19-2011

Equipment:

Probe: Axial T-Coil Probe – SN: TEM-1123; Calibrated: 09/23/2020

Test Configuration:

- . Mode: UMTS Band V
- Channel: 4233
- Speech Signal: ITU-T P.50 Artificial Voice



FCC ID: ZNFK420TM	PCTEST MAC (T-COIL) TEST REPORT		HAC (I-COIL) TEST REPORT	
Filename:	Test Dates:	DUT Type:		Dogo 54 of 97
1M2012230208-11.ZNF	1/11/2021 - 1/20/2021	Portable Handset		Page 54 of 87



Serial: 18798

Measurement Standard: ANSI C63.19-2011

Equipment:

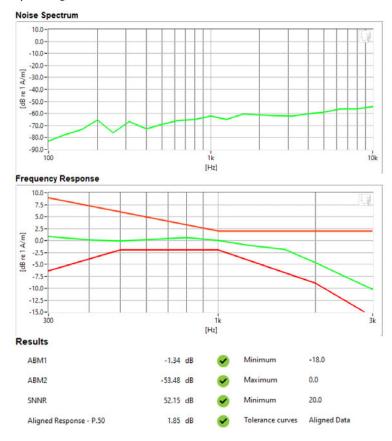
Probe: Axial T-Coil Probe – SN: TEM-1123; Calibrated: 09/23/2020

Test Configuration:

Mode: UMTS Band IV

Channel: 1412

Speech Signal: ITU-T P.50 Artificial Voice



FCC ID: ZNFK420TM	PCTEST: HAC (T-COIL) TEST REPORT		HAC (I-COIL) TEST REPORT	
Filename:	Test Dates:	DUT Type:		Dogo 55 of 97
1M2012230208-11.ZNF	1/11/2021 - 1/20/2021	Portable Handset		Page 55 of 87



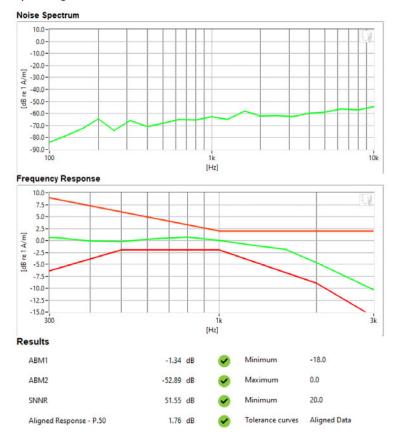
Measurement Standard: ANSI C63.19-2011

Equipment:

Probe: Axial T-Coil Probe – SN: TEM-1123; Calibrated: 09/23/2020

Test Configuration:

- Mode: UMTS Band II
- Channel: 9538
- Speech Signal: ITU-T P.50 Artificial Voice



FCC ID: ZNFK420TM	PCTEST: HAC (T-COIL) TEST REPORT		€ LG	Approved by: Quality Manager
Filename:	Test Dates:	DUT Type:		Dogo 56 of 97
1M2012230208-11.ZNF	1/11/2021 - 1/20/2021	Portable Handset		Page 56 of 87



Measurement Standard: ANSI C63.19-2011

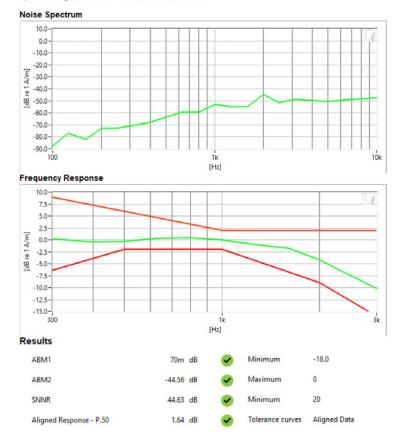
Equipment:

Probe: Axial T-Coil Probe – SN: TEM-1123; Calibrated: 09/23/2020

Test Configuration:

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

Speech Signal: ITU-T P.50 Artificial Voice



FCC ID: ZNFK420TM	PCTEST: HAC (T-COIL) TEST REPORT		HAC (I-COII) IEST REPORT	
Filename:	Test Dates:	DUT Type:		Dags 57 of 97
1M2012230208-11.ZNF	1/11/2021 - 1/20/2021	Portable Handset		Page 57 of 87



DUT: ZNFK420TM

Type: Portable Handset Serial: 18798

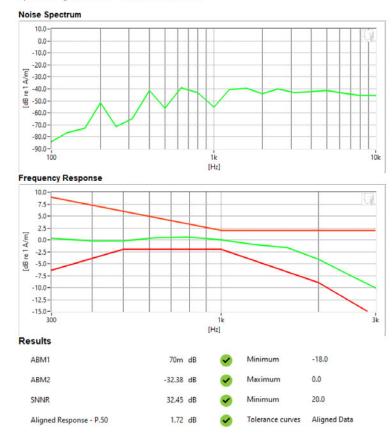
Measurement Standard: ANSI C63.19-2011

Equipment:

Probe: Axial T-Coil Probe – SN: TEM-1123; Calibrated: 09/23/2020

Test Configuration:

- Mode: LTE TDD Band 41 (PC2)
- Bandwidth: 20MHz
- Channel: 41055
- Speech Signal: ITU-T P.50 Artificial Voice



FCC ID: ZNFK420TM	PCTEST: HAC (T-COIL) TEST REPORT		(LG	Approved by: Quality Manager
Filename:	Test Dates:	DUT Type:		Dags 50 of 97
1M2012230208-11.ZNF	1/11/2021 - 1/20/2021	Portable Handset		Page 58 of 87



DUT: ZNFK420TM

Type: Portable Handset Serial: 18798

Measurement Standard: ANSI C63.19-2011

Equipment:

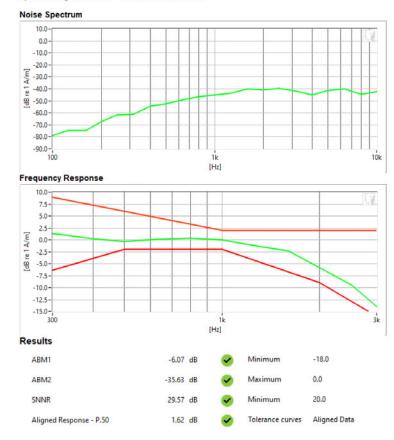
Probe: Axial T-Coil Probe – SN: TEM-1123; Calibrated: 09/23/2020

Test Configuration:

Mode: 2.4GHz WIFI
Standard: IEEE 802.11b

Channel: 11

Speech Signal: ITU-T P.50 Artificial Voice



FCC ID: ZNFK420TM	PCTEST: HAC (T-COIL) TEST REPORT		EPORT	
Filename:	Test Dates:	DUT Type:		Page 59 of 87
1M2012230208-11.ZNF	1/11/2021 - 1/20/2021	Portable Handset		rage 39 01 67



Serial: 18798

Measurement Standard: ANSI C63.19-2011

Equipment:

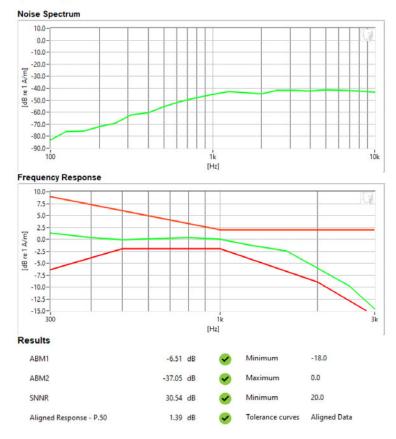
Probe: Axial T-Coil Probe – SN: TEM-1123; Calibrated: 09/23/2020

Test Configuration:

Mode: 5GHz WIFIStandard: IEEE 802.11acBandwidth: 20MHz

Channel: 48

Speech Signal: ITU-T P.50 Artificial Voice



FCC ID: ZNFK420TM	HAC (T-COIL) TEST REPORT		REPORT	
Filename:	Test Dates:	DUT Type:		Page 60 of 87
1M2012230208-11.ZNF	1/11/2021 - 1/20/2021	Portable Handset		rage ou oi or



Serial: 18798

Measurement Standard: ANSI C63.19-2011

Equipment:

Probe: Axial T-Coil Probe – SN: TEM-1123; Calibrated: 09/23/2020

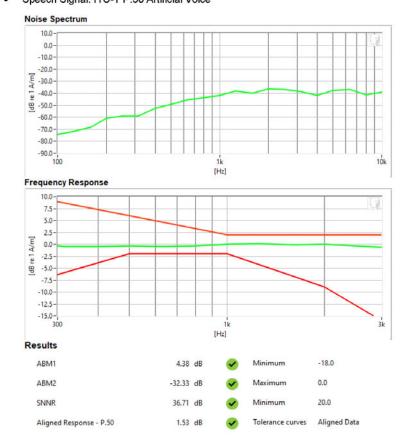
Test Configuration:

· VolP Application: Google Duo

Mode: 2.4GHz WIFI Standard: IEEE 802.11b

Channel: 6

Speech Signal: ITU-T P.50 Artificial Voice



FCC ID: ZNFK420TM	PCTEST hould to be part of a connect	HAC (1-COIL) TEST REPORT		HAC (T-COIL) TEST REPORT		Approved by: Quality Manager
Filename:	Test Dates:	DUT Type:		Page 61 of 87		
1M2012230208-11.ZNF	1/11/2021 - 1/20/2021	Portable Handset		rage of or or		

REV 3.5.M



DUT: ZNFK420TM Type: Portable Handset Serial: 18798

Measurement Standard: ANSI C63.19-2011

Equipment:

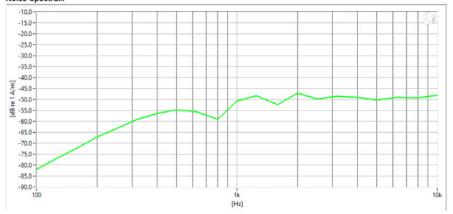
Probe: Radial T-Coil Probe – SN: TEM-1129; Calibrated: 09/23/2020

Test Configuration:

Mode: CDMA Secondary Cellular

Channel: 564

Noise Spectrum



Results

ABM1	-11.94	dB	\checkmark	Minimum	-18.0
ABM2	-42.41	dB	✓	Maximum	0.0
SNNR	30.47	dB	✓	Minimum	20.0

FCC ID: ZNFK420TM	HAC (T-COIL) TEST REPORT		LG	Approved by: Quality Manager
Filename:	Test Dates:	DUT Type:		Page 62 of 87
1M2012230208-11.ZNF	1/11/2021 - 1/20/2021	Portable Handset		rage 02 01 07



Type: Portable Handse Serial: 18798

Measurement Standard: ANSI C63.19-2011

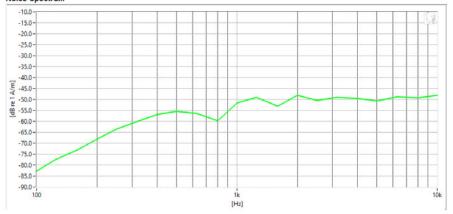
Equipment:

Probe: Radial T-Coil Probe – SN: TEM-1129; Calibrated: 09/23/2020

Test Configuration:

Mode: CDMA CellularChannel: 777

Noise Spectrum



Results

ABM1	-12.16	dB	•	Minimum	-18.0
ABM2	-43.1	dB	•	Maximum	0.0
SNNR	30.94	dB	~	Minimum	20.0

FCC ID: ZNFK420TM	PCTEST hould to be post of a remed	HAC (T-COIL) TEST REPORT	LG	Approved by: Quality Manager
Filename:	Test Dates:	DUT Type:		Page 63 of 87
1M2012230208-11.ZNF	1/11/2021 - 1/20/2021	Portable Handset		Page 03 01 07



Measurement Standard: ANSI C63.19-2011

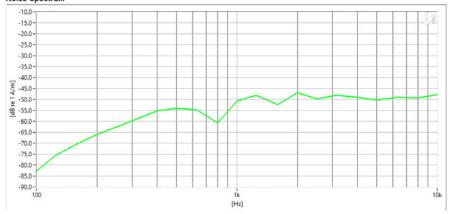
Equipment:

Probe: Radial T-Coil Probe – SN: TEM-1129; Calibrated: 09/23/2020

Test Configuration:

 Mode: CDMA PCS Channel: 1175

Noise Spectrum



Results

ABM1	-12.24	dB	\checkmark	Minimum	-18.0
ABM2	-42.05	dB	•	Maximum	0.0
SNNR	29.81	dB	✓	Minimum	20.0

FCC ID: ZNFK420TM	PCTEST Proof to be post of a seinment	HAC (T-COIL) TEST REPORT	(LG	Approved by: Quality Manager
Filename:	Test Dates:	DUT Type:		Page 64 of 87
1M2012230208-11.ZNF	1/11/2021 - 1/20/2021	Portable Handset		rage 04 01 07



Serial: 18798

Measurement Standard: ANSI C63.19-2011

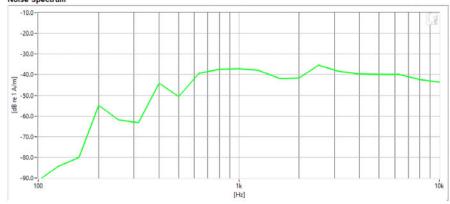
Equipment:

Probe: Radial T-Coil Probe – SN: TEM-1129; Calibrated: 09/23/2020

Test Configuration:

 Mode: GSM 850 Channel: 128

Noise Spectrum



Results

ABM1	-7.7	dB	\checkmark	Minimum	-18.0
ABM2	-30.02	dB	•	Maximum	0.0
SNNR	22.32	dB	✓	Minimum	20.0

FCC ID: ZNFK420TM	PCTEST hould to be post of a sement	HAC (T-COIL) TEST REPORT	LG	Approved by: Quality Manager
Filename:	Test Dates:	DUT Type:		Page 65 of 87
1M2012230208-11.ZNF	1/11/2021 - 1/20/2021	Portable Handset		rage 05 01 67



Serial: 18798

Measurement Standard: ANSI C63.19-2011

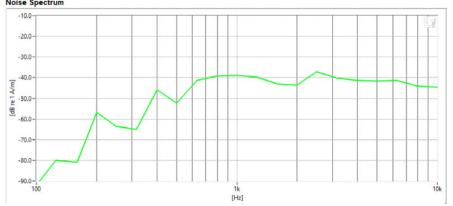
Equipment:

Probe: Radial T-Coil Probe – SN: TEM-1129; Calibrated: 09/23/2020

Test Configuration:

 Mode: GSM 1900 Channel: 512

Noise Spectrum



Results

ABM1	-7.28	dB	lacksquare	Minimum	-18.0
ABM2	-31.84	dB	•	Maximum	0.0
SNNR	24.56	dB	•	Minimum	20.0

FCC ID: ZNFK420TM	PCTEST Proof to be post of a seinment	HAC (T-COIL) TEST REPORT	(LG	Approved by: Quality Manager
Filename:	Test Dates:	DUT Type:		Page 66 of 87
1M2012230208-11.ZNF	1/11/2021 - 1/20/2021	Portable Handset		rage 00 01 67



Measurement Standard: ANSI C63.19-2011

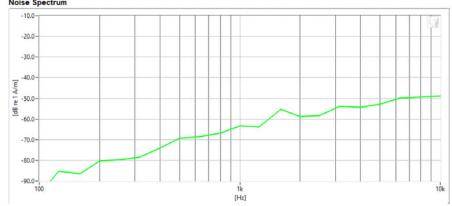
Equipment:

Probe: Radial T-Coil Probe – SN: TEM-1129; Calibrated: 09/23/2020

Test Configuration:

. Mode: UMTS Band V Channel: 4233

Noise Spectrum



Results

ABM1	-8.18	dB	$ \checkmark $	Minimum	-18.0
ABM2	-51.68	dB	•	Maximum	0.0
SNNR	43.5	dB	•	Minimum	20.0

PCTEST 2021

FCC ID: ZNFK420TM	PCTEST Proof to be post of the determined	HAC (T-COIL) TEST REPORT	LG	Approved by: Quality Manager
Filename:	Test Dates:	DUT Type:		Page 67 of 87
1M2012230208-11.ZNF	1/11/2021 - 1/20/2021	Portable Handset		rage or or or

REV 3.5.M



Measurement Standard: ANSI C63.19-2011

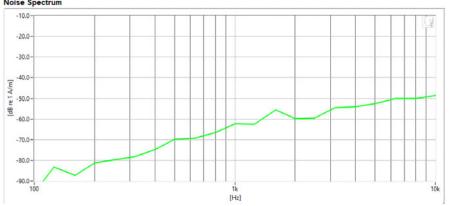
Equipment:

Probe: Radial T-Coil Probe – SN: TEM-1129; Calibrated: 09/23/2020

Test Configuration:

. Mode: UMTS Band IV Channel: 1513

Noise Spectrum



Results

,	ABM1	-8.25	dB	lacksquare	Minimum	-18.0
,	ABM2	-51.82	dB	•	Maximum	0.0
	SNNR	43.57	dB	•	Minimum	20.0

FCC ID: ZNFK420TM	PCTEST Proof to be post of the determined	HAC (T-COIL) TEST REPORT	LG	Approved by: Quality Manager
Filename:	Test Dates:	DUT Type:		Page 68 of 87
1M2012230208-11.ZNF	1/11/2021 - 1/20/2021	Portable Handset		rage 00 01 07



Measurement Standard: ANSI C63.19-2011

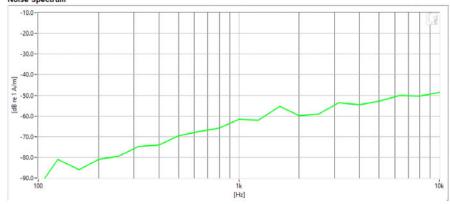
Equipment:

Probe: Radial T-Coil Probe – SN: TEM-1129; Calibrated: 09/23/2020

Test Configuration:

. Mode: UMTS Band II Channel: 9538

Noise Spectrum



Results

ABM	1 -8.27	dB	$ \bigcirc $	Minimum	-18.0
ABM	2 -51.46	dB	•	Maximum	0.0
SNN	R 43.19	dB	✓	Minimum	20.0

FCC ID: ZNFK420TM	PCTEST Proof to be post of a seinment	HAC (T-COIL) TEST REPORT	(L)	Approved by: Quality Manager
Filename:	Test Dates:	DUT Type:		Page 69 of 87
1M2012230208-11.ZNF	1/11/2021 - 1/20/2021	Portable Handset		rage 09 01 01



Serial: 18798

Measurement Standard: ANSI C63.19-2011

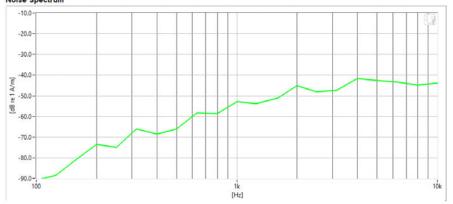
Equipment:

Probe: Radial T-Coil Probe – SN: TEM-1129; Calibrated: 09/23/2020

Test Configuration:

Mode: LTE FDD Band 71Bandwidth: 10MHzChannel: 133297

Noise Spectrum



Results

ABM1	-6.37	dB	•	Minimum	-18.0
ABM2	-42.66	dB	•	Maximum	0.0
SNNR	36.29	dB	~	Minimum	20.0

FCC ID: ZNFK420TM	PCTEST Proof to be post of the determined	HAC (T-COIL) TEST REPORT	LG	Approved by: Quality Manager
Filename:	Test Dates:	DUT Type:		Page 70 of 87
1M2012230208-11.ZNF	1/11/2021 - 1/20/2021	Portable Handset		rage 70 01 67



Measurement Standard: ANSI C63.19-2011

Equipment:

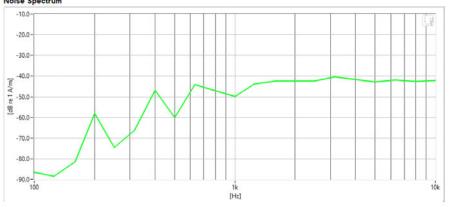
Probe: Radial T-Coil Probe – SN: TEM-1129; Calibrated: 09/23/2020

Test Configuration:

Mode: LTE TDD Band 41 (PC2)

Bandwidth: 5MHz Channel: 41055

Noise Spectrum



Results

AB	BM1	-6.41	dB	\checkmark	Minimum	-18.0
AB	BM2	-35.75	dB	•	Maximum	0.0
SN	INR	29.34	dB	~	Minimum	20.0

FCC ID: ZNFK420TM	PCTEST Provided to the post of the province of the post of the pos	HAC (T-COIL) TEST REPORT	LG	Approved by: Quality Manager
Filename:	Test Dates:	DUT Type:		Page 71 of 87
1M2012230208-11.ZNF	1/11/2021 - 1/20/2021	Portable Handset		rage / 1 01 07



Serial: 18798

Measurement Standard: ANSI C63.19-2011

Equipment:

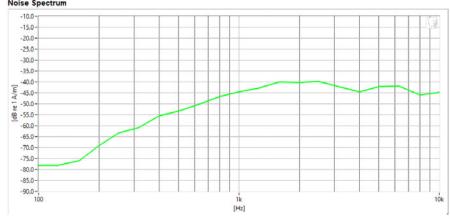
Probe: Radial T-Coil Probe – SN: TEM-1129; Calibrated: 09/23/2020

Test Configuration:

 Mode: 2.4GHz WIFI Standard: IEEE 802.11b

Channel: 1





Results

ABM1	-11.84	dB	\checkmark	Minimum	-18.0
ABM2	-35.55	dB	\checkmark	Maximum	0.0
SNNR	23.71	dB	•	Minimum	20.0

FCC ID: ZNFK420TM	PCTEST . Thoul to be pet of a sement	HAC (T-COIL) TEST REPORT	LG	Approved by: Quality Manager
Filename:	Test Dates:	DUT Type:		Page 72 of 87
1M2012230208-11.ZNF	1/11/2021 - 1/20/2021	Portable Handset		rage 12 01 01



DUT: ZNFK420TM Type: Portable Handset Serial: 18798

Measurement Standard: ANSI C63.19-2011

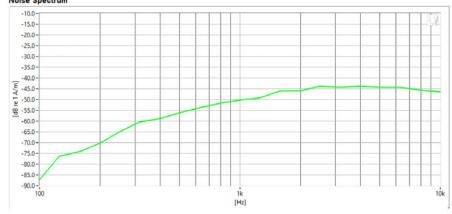
Equipment:

Probe: Radial T-Coil Probe – SN: TEM-1129; Calibrated: 09/23/2020

Test Configuration:

Mode: 5GHz WIFI Standard: IEEE 802.11n Bandwidth: 20MHz Channel: 40

Noise Spectrum



Results

ABM1	-11.65	dB	\checkmark	Minimum	-18.0
ABM2	-40.22	dB	•	Maximum	0.0
SNNR	28.58	dB	\checkmark	Minimum	20.0

PCTEST 2020

FCC ID: ZNFK420TM	PCTEST . Though to be perfort in the desired.	HAC (T-COIL) TEST REPORT	LG	Approved by: Quality Manager
Filename:	Test Dates:	DUT Type:		Dog 72 of 07
1M2012230208-11.ZNF	1/11/2021 - 1/20/2021	Portable Handset		Page 73 of 87



DUT: ZNFK420TM Type: Portable Handset Serial: 18798

Measurement Standard: ANSI C63.19-2011

Equipment:

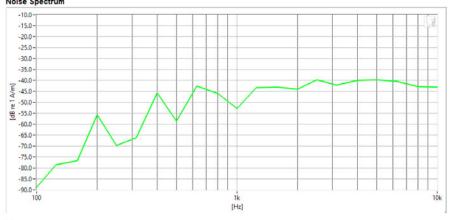
Probe: Radial T-Coil Probe – SN: TEM-1129; Calibrated: 09/23/2020

Test Configuration:

VolP Application: Google Duo
 Mode: LTE TDD Band 41 (PC2)

Bandwidth: 20MHzChannel: 41055

Noise Spectrum



Results

ABM1	-1.26	dB	\checkmark	Minimum	-18.0
ABM2	-35.01	dB	✓	Maximum	0.0
SNNR	33.75	dB	✓	Minimum	20.0

PCTEST 2021

FCC ID: ZNFK420TM	PCTEST Proof to be post of the determined	HAC (T-COIL) TEST REPORT	LG	Approved by: Quality Manager
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CALIBRATION CERTIFICATES 13.

FCC ID: ZNFK420TM	PCTEST hould to be part of a simment	HAC (T-COIL) TEST REPORT	(LG	Approved by: Quality Manager
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Certificate of Conformance

AXIAL T COIL PROBE

Manufactured by: TEM CONSULTING Model No: AXIAL T COIL PROBE

Serial No: TEM-1123 Calibration Recall No: 31288

Submitted By:

ANDREW HARWELL Customer:

PCTEST ENGINEERING LAB Company: Address:

6660-B DOBBIN ROAD COLUMBIA MD 21045

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

West Caldwell Calibration Laboratories Procedure No.

AXIAL T C TEM C

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

tolerance of the indicated specification. See attached Report of Calibration. The information supplied relates to the calibrated item listed above and statment of conformance for ALL given specifications and standards fall under the decision rule: A=(L-(U95)), where A is acceptance limit, L is manufacturer specifications and U95 is confidence level of 95% at k=2. This includes but not limited to:1. Measured value does not meet manufacturer's tolerance, 2.Manufacturer's tolerance is too small compared to calibration and measurment capability uncertainties, 3. Test uncertainty ratio does not meet the 4:1 ratio due to test instrumentation limitations. The decision rule has been communicated and approved by customer during contract

West Caldwell Calibration Laboratories' calibration control system meets the following requirements, ISO 10012-1 MIL STD 45662A, ANSI/NCSL Z540-1, IEC Guide 25, ISO 9001:2015, and ISO 17025

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

Approved by:

Calibration Date: 23-Sep-20 James Zhu

31288 - 2

Quality Manager ISO/IEC 17025:2017

Certificate No:

QA Doc. #1051 Rev. 3.0 5/29/20 Certificate Page 1 of 1 West Caldwell

> ACCREDITED Calibration Lab. Cert. # 1533.01

Calibration uncompromised calibration Laboratories, Inc.

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

Approved by: FCC ID: ZNFK420TM HAC (T-COIL) TEST REPORT LG LG Quality Manager Filename: **DUT Type:** Test Dates: Page 76 of 87 1M2012230208-11.ZNF 1/11/2021 - 1/20/2021 Portable Handset

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Helmholtz Coil Constant:

Helmholtz Coil magnetic field;

ISO/IEC 17025: 2017 ACCREDITED Calibration Lab. Cert. # 1533.01

1575 State Route 96, Victor NY 14564

REPORT OF CALIBRATION

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

Model No.: Axial T Coil Probe

Serial No.: TEM-1123

I. D. No.: XXXX

°C

% RH

kPa

Calibration results: Probe Sensitivity measured with Helmholtz Coil Helmholtz Coil; Before & after data same: ... X ... the number of turns on each coil; 10 No. Laboratory Environment: the radius of each coil, in meters; 0.204 m the current in the coils, in amperes.;

Ambient Temperature: 20.7 0.08 Α 7.04 A/m/V Ambient Humidity: 42.1 99.094 5.71 A/m Ambient Pressure:

Calibration Date: 23-Sep-2020

Calibration Due: Probe Sensitivity at 1000 Hz. was

31288 -2 dBV/A/m Report Number: -60.240.972 mV/A/m Control Number: 31288

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

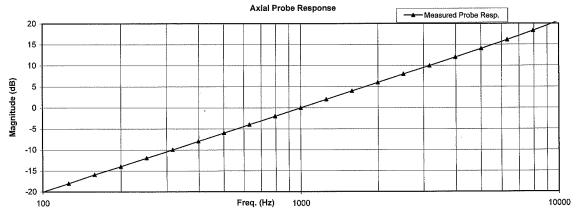
898

684.07/O-0000001126-20 This Calibration is traceable through NIST test numbers:

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

Probe resistance

Graph represents Probes Frequency Response.



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

Calibration Laboratories Inc. procedure:

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

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

intended to implement the requirements of ISO10012-1, IEC Guide 25, ANSI/NCSL Z540-1, (MIL-STD-45662A) and ISO 9001:2015) ISO 17025

Cal. Date: 23-Sep-2020 Calibrated on WCCL system type 9700

Measurements performed by:

James Zhu

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

Page 1 of 2

FCC ID: ZNFK420TM	PCTEST* Provid to be pert of @ connect	HAC (T-COIL) TEST REPORT	LG	Approved by: Quality Manager
Filename:	Test Dates:	DUT Type:		Page 77 of 87
1M2012230208-11.ZNF	1/11/2021 - 1/20/2021	Portable Handset		. ago o. o.

HCATEMC_TEM-1123_Sep-23-2020

West Caldwell Calibration Laboratories Inc.

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

Calibration Data Record

for

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

Model No.: Axial T Coil Probe

Serial No.: TEM-1123

Test	Function	Tolerance		Measured values			
				Before	Out	Remarks	
1.0	Probe Sensitivity at	1000 Hz.	dBV/A/m	-60.24			
			dB				
2.0	Probe Level Linearity		6	6.03			
		Ref. (0 dB)	0	0.00			
			-6	-6.03			
			-12	-12.05			
			Hz				
3.0	Probe Frequency Response		100	-20.0		}	
			126	-18.0			
			158	-15.9			
			200	-14.0			
			251	-12.0			
			316	-10.0			
			398	-8.0		i	
			501	-6.0			
			631	-4.0			
			794	-2.0			
		Ref. (0 dB)	1000	0.0			
			1259	2.0			
			1585	4.0			
			1995	6.0			
			2512	8.0			
			3162	10.0			
			3981	12.0			
			5012	14.0			
			6310	16.1			
			7943	18.3			
			10000	20.7			

Instruments u	sed for calibration:		Date of Cal.	Traceablity No.	Due Date
HP	34401A	S/N US360641	2-Jul-2020	,610119	2-Jul-2021
HP	34401A	S/N US361024	2-Jul-2020	,610119	2-Jul-2021
HP	33120A	S/N US360437	2-Jul-2020	.610119	2-Jul-2021
B&K	2133	S/N 1583254	1-Jul-2020	684.07/O-0000001126-20	1-Jul-2021

Cal. Date: 23-Sep-2020

Calibrated on WCCL system type 9700

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Tested by: James Zhu

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

Page 2 of 2

FCC ID: ZNFK420TM	PCTEST Proud to be port of the determined	HAC (T-COIL) TEST REPORT	LG	Approved by: Quality Manager
Filename:	Test Dates:	DUT Type:		Page 78 of 87
1M2012230208-11.ZNF	1/11/2021 - 1/20/2021	Portable Handset		raye 10 01 01



Certificate of Conformance

for

RADIAL T COIL PROBE

Manufactured by:

TEM CONSULTING

Model No:

RADIAL T COIL PROBE

Serial No:

TEM-1129

Calibration Recall No:

Submitted By:

COLUMBIA

Customer:

ANDREW HARWELL

31288

Company: Address: PCTEST ENGINEERING LAB

6660-B DOBBIN ROAD

MD 21045

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

its return to the submitter.

RADIAL T TEM C

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

West Caldwell Calibration Laboratories Procedure No.

10/13/2020

Within (X

tolerance of the indicated specification. See attached Report of Calibration.

The information supplied relates to the calibrated item listed above and statment of conformance for ALL given specifications and standards fall under the decision rule: A=(L-(U95)), where A is acceptance limit, L is manufacturer specifications and U95 is confidence level of 95% at k=2. This includes but not limited to:1. Measured value does not meet manufacturer's tolerance, 2.Manufacturer's tolerance is too small compared to calibration and measurment capability uncertainties, 3. Test uncertainty ratio does not meet the 4:1 ratio due to test instrumentation limitations. The decision rule has been communicated and approved by customer during contract

West Caldwell Calibration Laboratories' calibration control system meets the following requirements, ISO 10012-1 MIL STD 45662A, ANSI/NCSL Z540-1, IEC Guide 25, ISO 9001:2015, and ISO 17025

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

Approved by:

Calibration Date:

23-Sep-20

James Zhu

Certificate No:

31288 -1

West Caldwell

Quality Manager ISO/IEC 17025:2017

QA Doc. #1051 Rev. 3.0 5/29/20

Certificate Page 1 of 1

ACCREDITED

Calibration uncompromised calibration Laboratories. Inc.

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

Calibration Lab. Cert. # 1533.01

FCC ID: ZNFK420TM

PCTEST

HAC (T-COIL) TEST REPORT

Filename:

Test Dates:

1/11/2021 - 1/20/2021

DUT Type:

Portable Handset

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REV 3.5.M 8/18/2020



1575 State Route 96, Victor NY 14564



REPORT OF CALIBRATION

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

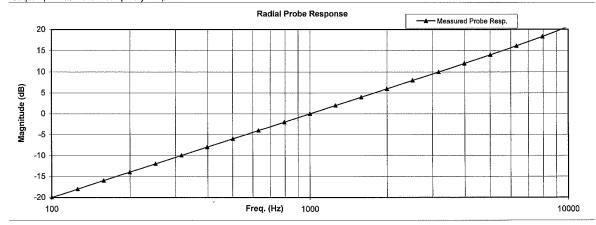
Model No.: Radial T Coil Probe

Serial No.: TEM-1129

I. D. No.: XXXX

Probe Sensitivity measured wit	h Helmhol	tz Coil					
Helmholtz Coil:	ar riciniiloi	2 0011	Before & after data same:	Y			
		No.					
the radius of each coil, in meters;	0.204	m	Laboratory Environment:				
the current in the coils, in amperes.;	0.08	A	Ambient Temperature:	20.7	°C		
Helmholtz Coil Constant;	7.04	A/m/V	Ambient Humidity:	42.1	% RH		
Helmholtz Coil magnetic field;	5.70	A/m	Ambient Pressure:	99.094	kPa		
			Calibration Date:	23-Sep-2020			
Probe Sensitivity at	1000	Hz.	Re-calibration Due:				
was	-60.37	dBV/A/m	Report Number:	3128	B -1		
	0.959	mV/A/m	Control Number:	3128	В		
Probe resistance	897	Ohms					
The above listed instrument meets or exceeds	the tested	manufacturer's sp	pecifications.				
This Calibration is traceable through NIST test numbers	3:	684.07/O-00000	01126-20				
The expanded uncertainty of calibration: 0,30dB at 95% of	onfidence lev	el with a coverage facto	or 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 HCRTEMC

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 of ISO10012-1, IEC Guide 25, ANSI/NCSL Z540-1, (MIL-STD-45662A) and ISO 9001:2015, ISO 17/9/25

Cal. Date: 23-Sep-2020

Measurements performed by:

Calibrated on WCCL system type 9700

James Zhu

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Page 1 of 2

FCC ID: ZNFK420TM	PCTEST* Proud to be port of the imment	HAC (T-COIL) TEST REPORT	€ LG	Approved by: Quality Manager
Filename:	Test Dates:	DUT Type:		Page 80 of 87
1M2012230208-11.ZNF	1/11/2021 - 1/20/2021	Portable Handset		rage ou oi or

HCRTEMC_TEM-1129_Sep-23-2020

West Caldwell Calibration Laboratories Inc.

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

Calibration Data Record

for

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

Model No.: Radial T Coil Probe

Serial No.: TEM-1129

Function	Tolera	Tolerance		Measured values		
			Before	Out	Remarks	
Probe Sensitivity at	1000 Hz.	dBV/A/m	-60.37			
		dB			-	
Probe Level Linearity		6	6.04			
	Ref. (0 dB)	0	0.00			
		-6	-6.03			
		-12	-12.05			
		Hz				
Probe Frequency Response			1			
•						
]	
	Ref. (0 dB)				•	
		10000	20.7			
	**************************************	Probe Sensitivity at 1000 Hz. Probe Level Linearity Ref. (0 dB)	Probe Sensitivity at 1000 Hz. dBV/A/m Probe Level Linearity 6 Ref. (0 dB) 0 -6 -12 Probe Frequency Response 100 126 158 200 251 316 398 501 631 794	Probe Sensitivity at 1000 Hz. dBV/A/m -60.37 Probe Level Linearity 6 6 6.04 Ref. (0 dB) 0 0.00 -6 -6.03 -12 -12.05 Probe Frequency Response 100 -20.0 158 -16.0 200 -14.0 251 -12.0 316 -10.0 398 -8.0 501 -6.0 631 -4.0 794 -2.0 Ref. (0 dB) 1000 0.0 1259 2.0 Ref. (0 dB) 1000 0.0 1259 2.0 1585 4.0 1995 6.0 2512 8.0 3162 10.0 3981 12.0 5012 14.0 5012 14.0 6310 16.1 7943 18.3	Probe Sensitivity at 1000 Hz. dBV/A/m -60.37 Probe Level Linearity 6	

Instrument	ts used for calibration:		Date of Cal.	Traceability No.	Due Date
HP	34401A	S/N US360641	2-Jul-2020	,610119	2-Jul-2021
HP	34401A	S/N US361024	2-Jul-2020	,610119	2-Jul-2021
HP	33120A	S/N US360437	2-Jul-2020	.610119	2-Jul-2021
B&K	2133	S/N 1583254	1-Jul-2020	684.07/O-0000001126-20	1-Jul-2021

Cal. Date: 23-Sep-2020

Calibrated on WCCL system type 9700

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Tested by: James Zhu

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

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FCC ID: ZNFK420TM	POTEST Poul to be port of the second	HAC (T-COIL) TEST REPORT	€ LG	Approved by: Quality Manager
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1M2012230208-11.ZNF	1/11/2021 - 1/20/2021	Portable Handset		Page 81 of 87

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.

FCC ID: ZNFK420TM	PCTEST* Proud to be port of the simmed	HAC (T-COIL) TEST REPORT	LG	Approved by: Quality Manager
Filename: 1M2012230208-11.ZNF	Test Dates: 1/11/2021 - 1/20/2021	DUT Type: Portable Handset		Page 82 of 87

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FCC ID: ZNFK420TM	PCTEST*	HAC (T-COIL) TEST REPORT		Approved by: Quality Manager
Filename:	Test Dates:	DUT Type:		Dogg 02 of 07
1M2012230208-11.ZNF	1/11/2021 - 1/20/2021	Portable Handset		Page 83 of 87

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FCC ID: ZNFK420TM	PCTEST Provid to be port of the statement	HAC (T-COIL) TEST REPORT	(LG	Approved by: Quality Manager
Filename:	Test Dates:	DUT Type:		Page 84 of 87
1M2012230208-11.ZNF	1/11/2021 - 1/20/2021	Portable Handset		