

PCTEST ENGINEERING LABORATORY, INC.

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HEARING AID COMPATIBILITY

Applicant Name:

LG Electronics MobileComm U.S.A. Inc. 1000 Sylvan Avenue Englewood Cliffs, NJ 07632 United States Date of Testing: 06/16/2017 - 06/20/2017 Test Site/Location: PCTEST Lab, Columbia, MD, USA

Test Report Serial No.:

1M1706130193-08.ZNF

FCC ID: ZNFUN220

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

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

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

285076 D01 HAC Guidance v04

285076 D02 T-Coil testing for CMRS IP v02

DUT Type: Portable Handset

Model: LG-UN220

Additional Model(s): LGUN220, UN220

Test Device Serial No.: Pre-Production Sample [S/N: 00167]

C63.19-2011 HAC Category: T4 (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.

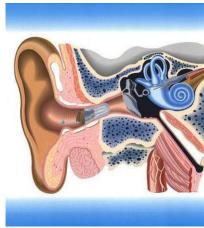


Figure 1-1 Hearing Aid in-vitu

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

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DUT DESCRIPTION 2.



FCC ID: ZNFUN220

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

1000 Sylvan Avenue

Englewood Cliffs, NJ 07632

United States

Model: LG-UN220

Additional Model(s): LGUN220, UN220

Serial Number: 00167 HW Version: Rev.1.0 SW Version: UN2200Cd

Antenna: Internal Antenna

HAC Test Configurations: Cellular CDMA, 1013, 384, 777, BT Off, WLAN Off, LTE Off

> PCS CDMA, 25, 600, 1175, BT Off, WLAN Off, LTE Off GSM 850, 128, 190, 251, BT Off, WLAN Off, LTE Off GSM 1900, 512, 661, 810, BT Off, WLAN Off, LTE Off UMTS V, 4132, 4183, 4233, BT Off, WLAN Off, LTE Off UMTS II, 9262, 9400, 9538, BT Off, WLAN Off, LTE Off

DUT Type: Portable Handset

Table 2-1: 7NFLIN220 HAC Air Interfaces

Air-Interface	Band (MHz)	Type Transport	HAC Tested	Simultaneous But Not Tested	Voice over Digital Transport OTT Capability	Additional GSM Power
	835	VO	Yes	Yes: WIFI or BT	N/A	N1/A
CDMA	1900	٧٥	res	res: WiFi or B1	N/A	N/A
	EVDO	DT	No	Yes: WIFI or BT	Yes	N/A
	850	VO	Yes	Yes: WIFI or BT	N/A	No
GSM	1900	VO	162	res. WIFI OF BT		
	GPRS/EDGE	DT	No	Yes: WIFI or BT	Yes	No
	850	- VD	Yes	Yes: WIFI or BT	N/A	N/A
UMTS	1900					
	HSPA	DT	No	Yes: WIFI or BT	Yes	N/A
	700 (B12)				BT Yes	N/A
	850 (B5)			Yes: WIFI or BT		
LTE (FDD)	1700 (B4)	VD	No ¹			
	1900 (B2)					
190	1900 (B25)					
WIFI	2450	DT	No	Yes: CDMA, GSM, UMTS, or LTE	Yes	N/A
ВТ	2450	DT	No	Yes: CDMA, GSM, UMTS, or LTE	N/A	N/A
Type Transport			Notes:	·	·	

VO = Voice Only

1. Not tested in accordance with the guidance issued by OET in KDB publication 285076 D02 T-DT = Digital Data - Not intended for CMRS Service Coil testing for CMRS IP.

VD = CMRS and Data Transport

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3. ANSI C63.19-2011 PERFORMANCE CATEGORIES

I. MAGNETIC COUPLING

Axial and Radial Field Intensity

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

Frequency Response

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

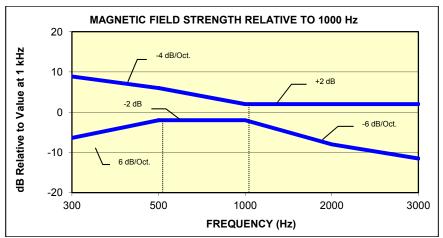


Figure 3-1
Magnetic field frequency response for Wireless Devices with an axial field ≤-15 dB(A/m) at 1 kHz

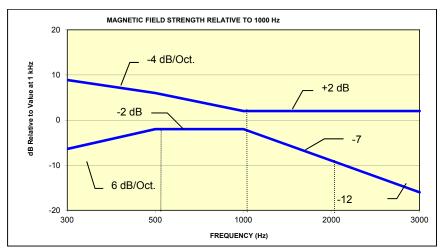


Figure 3-2
Magnetic Field frequency response for wireless devices with an axial field that exceeds
-15 dB(A/m) at 1 kHz

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Signal Quality

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

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

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

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4. METHOD OF MEASUREMENT

I. Test Setup

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

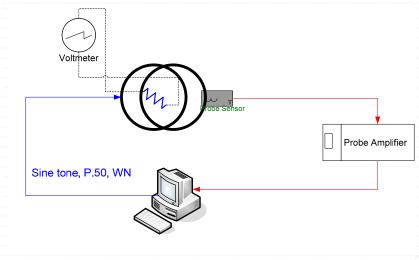
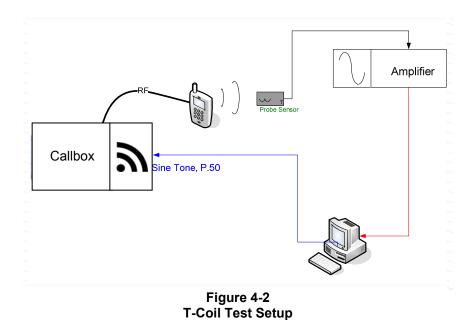


Figure 4-1 Validation Setup with Helmholtz Coil



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II. Scanning Mechanism

Manufacturer: TEM

Accuracy: ± 0.83 cm/meter

Minimum Step Size: 0.1 mm

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

Material Composite: Delrin (Acetal)

Data Control: Parallel Port

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

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

Reflections: < -20 dB (in anechoic chamber)

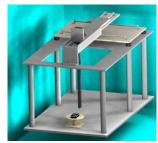


Figure 4-3 RF Near-Field Scanner

III. ITU-T P.50 Artificial Voice

Manufacturer: ITU-T

Active Frequency 100 Hz – 8 kHz

Range:

Stimulus Type: Male and Female, no spaces

Single Sample 20.96 seconds

Duration: 20.90 S Activity Level: 100%

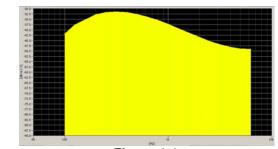


Figure 4-4 Spectral Characteristic of full P.50

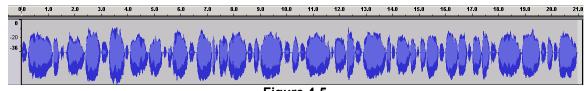


Figure 4-5
Temporal Characteristic of full P.50

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ABM2 Measurement Block Diagram:



Figure 4-6 Magnetic Measurement Processing Steps

IV. Test Procedure

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

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

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

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

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

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

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

Therefore a pure tone of 1kHz was applied into the coils such that 18mV was observed across the resistor. The voltmeter used for measurement was verified to be capable of measurements in the audio band range. This theoretically generates an expected field of -10 dB(A/m) in the center of the Helmholtz coil which was used to validate the probe measurement at -10dB(A/m). This was verified to be within \pm 0.5 dB of the -10dB(A/m) value (see Page 22).

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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:

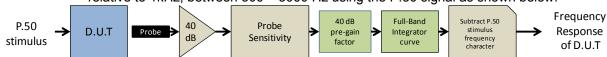


Figure 4-7 Frequency Response Validation

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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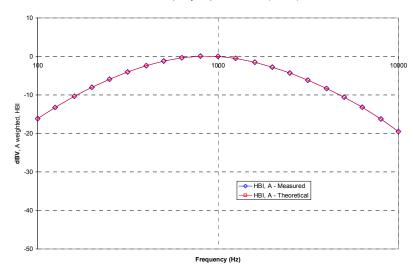
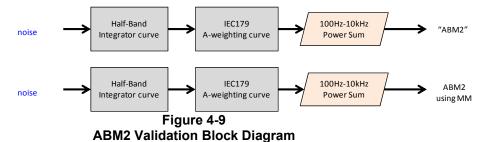


Figure 4-8 **ABM2 Frequency Response Validation**

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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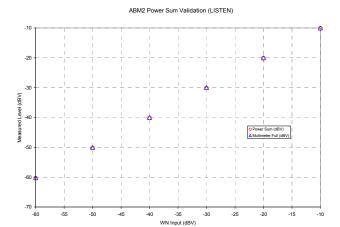
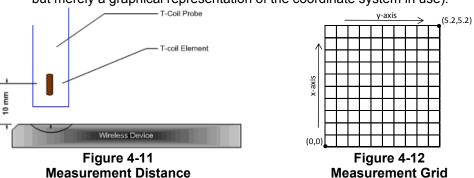


Figure 4-10 **ABM2 Power Sum Validation**

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
- iii. These steps were repeated for all T-coil orientations (axial and radial) per Figure 4-16 after a T-coil orientation was fully measured with the SoundCheck system.
- b. Speech Signal Setup to Base Station Simulator
 - i. C63.19 Table 7-1 states audio reference input levels for various technologies:

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

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The CMU200 audio levels were determined using base station simulator manufacturer calibration procedures resulting in the below corresponding voltages relative to handset test point level (in dBm0):

Table 4-3
CMU200 Voltage Input Levels for Audio

CMO200 Voltage input Levels for Addio					
dBm0 Ref.	Input Voltage		Notes		
3.14 dBm0	1052.0 mV	0.4 dBV	From CDMA2K "DECODER CAL". (What is needed through Encoder for FS)		
-18 dBm0	92.260 mV	-20.7 dBV	For 8k Enhanced (Low)		
dBm0 Ref.	Voltage		Notes		
3.14 dBm0	990.5 mV	-0.08 dBV	From GSM "DECODER CAL". (What is needed through Encoder for FS)		
-16 dBm0	109.4 mV	-19.2 dBV	For Speechcod/Handset Low		
dBm0 Ref.	Volt	age	Notes		
3.14 dBm0	1068.5 mV	0.58 dBV	From UMTS "DECODER CAL". (What is needed through Encoder for FS)		
-16 dBm0	118.0 mV	-18.6 dBV	For Handset Low		

- c. Real-Time Analyzer (RTA)
 - The Real-Time Analyzer was configured to analyze measurements using 1/3 Octave band weighted filtering.
- d. WD Radio Configuration Selection
 - i. The device was chosen to be tested in the worst-case ABM2 condition (see below for GSM, see Section 5 for more information regarding worst-case configurations for CDMA and UMTS):

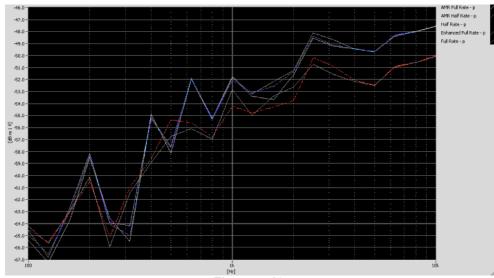


Figure 4-13
Vocoder Analysis for ABM Noise for GSM

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4. Signal Quality Data Analysis

- a. Narrow-band Magnetic Intensity
 - The standard specifies a 1kHz 1/3 octave band minimum field intensity for a sine tone. The ABM1 measurements were evaluated at 1kHz with 1/3 octave band filtering over an averaged period of 10 seconds.

Frequency Response

- 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.

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.

٧. **Test Setup**

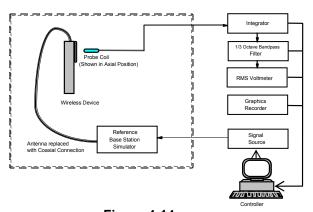


Figure 4-14 **Audio Magnetic Field Test Setup**

VI. **Deviation from C63.19 Test Procedure**

Non-conducted RF connection due to inaccessibility of RF ports with battery installed.

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VII. Air Interface Technologies Tested

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

According to the April 2013 TCB workshop slides, WIFI and other OTT data services are outside the current definition of a managed CMRS service and are currently not required to be evaluated.

VoLTE air interfaces were not tested in accordance with the guidance issued by OET in KDB publication 285076 D02 T-Coil testing for CMRS IP.

VIII. Wireless Device Channels and Frequencies

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.

Table 4-4 Center Channels and Frequencies

Test frequencies & associated channels				
Channel	Frequency (MHz)			
Cellular 850				
384 (CDMA)	836.52			
190 (GSM)	836.60			
4183 (UMTS)	836.60			
PCS 1900				
600 (CDMA)	1880			
661 (GSM)	1880			
9400 (UMTS)	1880			

IX. RF Emission Effect on T-coil Measurements

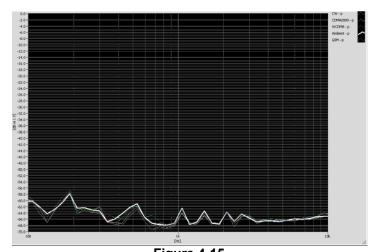


Figure 4-15 High power RF Emissions Effect with HAC Dipole on the T-coil Probe System 10mm between dipole maximum and magnetic probe

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X. Test Flow

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

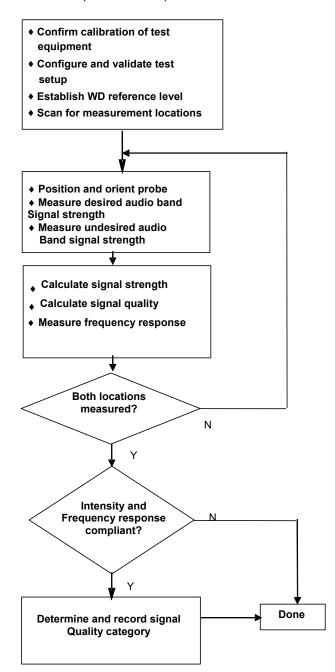


Figure 4-16 C63.19 T-Coil Signal Test Process

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5. 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:

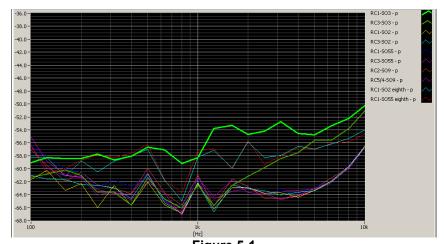
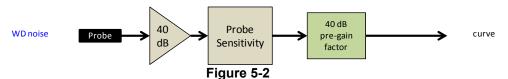


Figure 5-1 CDMA Audio Band Magnetic Noise

Table 5-1 FCC 3G ABM Measurements for ZNFUN220 (CDMA)

Codec Setting:	RC1/SO3	RC3/SO3	RC4/SO3	Orientation	Channel
ABM1 Pre-test (dBA/m)	-2.38	-2.72	-2.23		
ABM2 Pre-test (dBA/m) (A-weight, Half-Band Int.)		-59.66	-60.10	Radial	384
S+N/N (dB)	56.89	56.94	57.87		

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



Audio Band Magnetic Curve Measurement Block Diagram

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II. UMTS Test Configurations

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

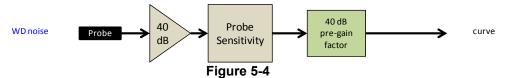


Figure 5-3
UMTS Audio Band Magnetic Noise

Table 5-2 FCC 3G ABM Measurements for ZNFUN220 (UMTS)

1 30 30 ADM Medadrements for Life States (Cliffs)												
Codec Setting:	AMR 12.2kbps	AMR 7.95kbps	AMR 4.75kbps	Orientation	Channel							
ABM1 Pre-test (dBA/m)	-0.74	-0.75	-0.93									
ABM2 Pre-test (dBA/m) (A-weight, Half-Band Int.)	בי ארי-	-59.14	-59.10	Radial	9538							
S+N/N (dB)	57.77	58.39	58.17									

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



Audio Band Magnetic Curve Measurement Block Diagram

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6. TEST SUMMARY

I. T-Coil Test Summary

Table 6-1
Table of Results for CDMA

C63.19 Sec.	Mode	Band	Test Description	Minimum Limit*	Measured	Verdict
				dBA/m	dBA/m	PASS/FAIL
8.3.1			Intensity, Axial	-18	5.6	PASS
8.3.1			Intensity, Radial	-18	-2.9	PASS
8.3.4	CDMA	Cellular	Signal-to-Noise/Noise, Axial	20	61.3	PASS
8.3.4			Signal-to-Noise/Noise, Radial	20	56.9	PASS
8.3.2			Frequency Response, Axial	0	1.5	PASS
8.3.1			Intensity, Axial	-18	5.7	PASS
8.3.1			Intensity, Radial	-18	-2.7	PASS
8.3.4	CDMA	PCS	Signal-to-Noise/Noise, Axial	20	62.0	PASS
8.3.4			Signal-to-Noise/Noise, Radial	20	57.4	PASS
8.3.2			Frequency Response, Axial	0	1.4	PASS

Note: The above summary table represents the worst-case numerical values according to configurations in Table 6-5.

Table 6-2
Table of Results for GSM

C63.19 Sec.	Mode	Band	Test Description	Minimum Limit*	Measured	Verdict
				dBA/m	dBA/m	PASS/FAIL
8.3.1			Intensity, Axial	-18	7.7	PASS
8.3.1			Intensity, Radial	-18	-0.5	PASS
8.3.4	GSM	Cellular	Signal-to-Noise/Noise, Axial	20	54.6	PASS
8.3.4			Signal-to-Noise/Noise, Radial	20	49.6	PASS
8.3.2			Frequency Response, Axial	0	1.3	PASS
8.3.1			Intensity, Axial	-18	7.4	PASS
8.3.1			Intensity, Radial	-18	-0.5	PASS
8.3.4	GSM	PCS	Signal-to-Noise/Noise, Axial	20	57.4	PASS
8.3.4			Signal-to-Noise/Noise, Radial	20	58.0	PASS
8.3.2			Frequency Response, Axial	0	1.3	PASS

Note: The above summary table represents the worst-case numerical values according to configurations in Table 6-6.

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Table 6-3 **Table of Results for UMTS**

C63.19 Sec.	Mode	Band	Test Description	Minimum Limit*	Measured	Verdict
				dBA/m	dBA/m	PASS/FAIL
8.3.1			Intensity, Axial	-18	7.3	PASS
8.3.1			Intensity, Radial	-18	-0.8	PASS
8.3.4	UMTS	Band 5	Signal-to-Noise/Noise, Axial	20	64.9	PASS
8.3.4			Signal-to-Noise/Noise, Radial	20	58.8	PASS
8.3.2			Frequency Response, Axial	0	1.4	PASS
8.3.1			Intensity, Axial	-18	7.4	PASS
8.3.1			Intensity, Radial	-18	-0.8	PASS
8.3.4	UMTS	Band 2	Signal-to-Noise/Noise, Axial	20	64.4	PASS
8.3.4			Signal-to-Noise/Noise, Radial	20	57.7	PASS
8.3.2			Frequency Response, Axial	0	1.4	PASS

Note: The above summary table represents the worst-case numerical values according to configurations in Table 6-7.

> Table 6-4 Consolidated Tabled Results

	Consolidated Tabled Results										
		Freq. Response Margin		•	Magnetic Intensity Verdict		SNNR	FCC Margin (dB)	C63.19-2011 Rating		
		Axial	Radial	Axial	Radial	Axial	Radial				
CDMA	Cellular	PASS	NA	PASS	PASS	PASS	PASS	-36.86	T4		
CDIVIA	PCS	PASS	NA	PASS	PASS	PASS	PASS	-30.00	14		
GSM	Cellular	PASS	NA	PASS	PASS	PASS	PASS	-29.56	T4		
GSW	PCS	PASS	NA	PASS	PASS	PASS	PASS	-29.56	14		
UMTS	Cellular	PASS	NA	PASS	PASS	PASS	PASS	-37.74	T4		
OWITS	PCS	PASS	NA	PASS	PASS	PASS	PASS	-37.74	14		

Note: Result shown is for T-coil category only.

II. **Raw Handset Data**

Table 6-5 **Raw Data Results for CDMA**

	Naw Data Negation Oblina										
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)	FCC Margin (dB)	C63.19-2011 Rating	Test Coordinates
		1013	5.64	-55.64		1.64	61.28	20.00	-41.28	T4	
	Axial	384	5.74	-55.64	-60.79	1.49	61.38	20.00	-41.38	T4	2.6, 2.8
0-11-1		777	5.63	-56.19		1.60	61.82	20.00	-41.82	T4	
Cellular		1013	-2.67	-59.85			57.18	20.00	-37.18	T4	
	Radial	384	-2.26	-59.12	-59.76	9.76 N/A	56.86	20.00	-36.86	T4	2.6, 3.6
		777	-2.94	-60.02			57.08	20.00	-37.08	T4	
		25	5.80	-56.90		1.53	62.70	20.00	-42.70	T4	
	Axial	600	5.67	-56.30	-60.79	1.43	61.97	20.00	-41.97	T4	2.6, 2.8
DOS		1175	5.87	-56.14		1.60	62.01	20.00	-42.01	T4	
P05	PCS	25	-2.51	-60.18			57.67	20.00	-37.67	T4	
	Radial	600	-2.66	-60.27	-59.76	N/A	57.61	20.00	-37.61	T4	2.6, 3.6
		1175	-2.23	-59.64			57.41	20.00	-37.41	T4	

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Table 6-6 **Raw Data Results for GSM**

Mode	Orientation	Channel	ABM1 [dB(A/m)]	ABM2 [dB(A/m)]	Ambient Noise [dB(A/m)]	Frequency Response Margin (dB)	S+N/N (dB)	FCC Limit (dB)	FCC Margin (dB)	C63.19-2011 Rating	Test Coordinates
		128	7.66	-47.50		1.27	55.16	20.00	-35.16	T4	
	Axial	190	7.96	-47.01	-60.79	1.26	54.97	20.00	-34.97	T4	2.6, 2.8
GSM850		251	7.95	-46.67		1.28	54.62	20.00	-34.62	T4	
GSIVIOSU		128	-0.16	-55.07			54.91	20.00	-34.91	T4	
	Radial	190	-0.10	-52.76	-59.76	N/A	52.66	20.00	-32.66	T4	2.6, 3.6
		251	-0.48	-50.04			49.56	20.00	-29.56	T4	
		512	7.45	-50.06		1.28	57.51	20.00	-37.51	T4	
	Axial	661	7.69	-50.27	-60.79	1.29	57.96	20.00	-37.96	T4	2.6, 2.8
GSM1900		810	7.42	-49.99		1.27	57.41	20.00	-37.41	T4	
G3W1900		512	-0.47	-59.11			58.64	20.00	-38.64	T4	
	Radial	661	-0.45	-58.49	-59.76	N/A	58.04	20.00	-38.04	T4	2.6, 3.6
		810	-0.44	-58.49			58.05	20.00	-38.05	T4	

Table 6-7 **Raw Data Results for UMTS**

	Naw Bata Results for Ollife										
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)	FCC Margin (dB)	C63.19-2011 Rating	Test Coordinates
		4132	7.25	-57.66		1.44	64.91	20.00	-44.91	T4	
	Axial	4183	7.26	-57.64	-60.79	1.42	64.90	20.00	-44.90	T4	2.6, 2.8
UMTS V	UMTC V	4233	7.38	-57.74		1.43	65.12	20.00	-45.12	T4	
UNITSV		4132	-0.74	-59.54		-59.76 N/A	58.80	20.00	-38.80	T4	
	Radial	4183	-0.75	-59.64	-59.76		58.89	20.00	-38.89	T4	2.6, 3.6
		4233	-0.75	-59.77			59.02	20.00	-39.02	T4	
		9262	7.37	-57.01		1.42	64.38	20.00	-44.38	T4	
	Axial	9400	7.39	-57.59	-60.79	1.45	64.98	20.00	-44.98	T4	2.6, 2.8
LIMTS II		9538	7.42	-57.00		1.44	64.42	20.00	-44.42	T4	
UMTS II	9262	-0.75	-59.67			58.92	20.00	-38.92	T4		
	Radial	9400	-0.75	-59.16	-59.76	N/A	58.41	20.00	-38.41	T4	2.6, 3.6
		9538	-0.73	-58.47			57.74	20.00	-37.74	T4	

III. **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 (Settings -> Accessibility -> Hearing Aids) was set to ON for Frequency Response compliance
- 4. Speech Signal: ITU-T P.50 Artificial Voice

B. CDMA

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

C. GSM

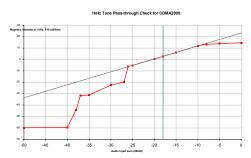
- 1. Power Configuration: GSM850: PCL=5, GSM1900: PCL=0;
- 2. Vocoder Configuration: EFR (GSM);

D. UMTS

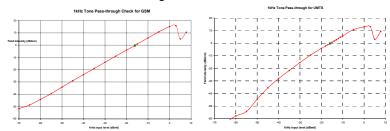
- 1. Power Configuration: TPC="All 1s";
- 2. Vocoder Configuration: AMR 12.2 kbps (UMTS);

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IV. 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 and UMTS. This measurement was taken in the axial configuration above the maximum location.

V. T-Coil Validation Test Results

Table 6-8
Helmholtz Coil Validation Table of Results

Tioninion John Vandation Table of Results						
Item	Target Result		Verdict			
Axial						
Magnetic Intensity, -10 dBA/m	-10 ± 0.5 dB	-10.171	PASS			
Environmental Noise	< -58 dBA/m	-60.79	PASS			
Frequency Response, from limits	> 0 dB 0.70		PASS			
Radial						
Magnetic Intensity, -10 dBA/m	-10 ± 0.5 dB	-10.270	PASS			
Environmental Noise	< -58 dBA/m	-59.76	PASS			
Frequency Response, from limits	> 0 dB	0.70	PASS			

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VI. ABM1 Magnetic Field Distribution Scan Overlays

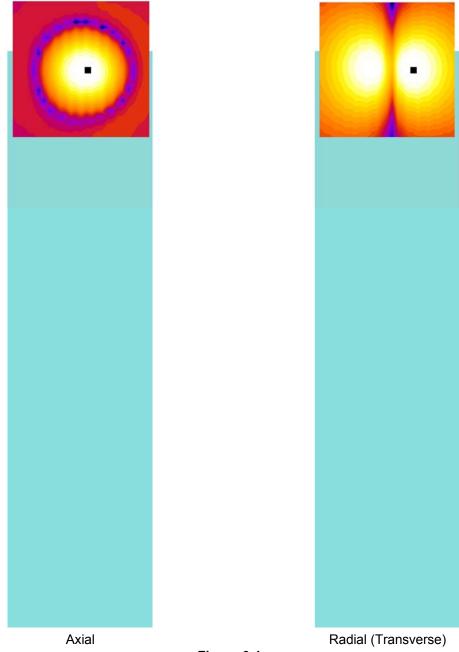


Figure 6-1
T-Coil Scan Overlay Magnetic Field Distributions

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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7. MEASUREMENT UNCERTAINTY

Table 7-1
Uncertainty Estimation Table

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

Notes:

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

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

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8. EQUIPMENT LIST

Table 8-1 Equipment List

		Equipment Elst				
Manufacturer	Model	Description	Cal Date	Cal Interval	Cal Due	Serial Number
Dell	Latitude E6540	SoundCheck Acoustic Analyzer Laptop	4/11/2017	Annual	4/11/2018	7BFNM32
Listen	SoundConnect	Microphone Power Supply	12/2/2016	Annual	12/2/2017	PS2612
RME	Fireface UC	Soundcheck Acoustic Analyzer External Audio Interface	4/11/2017	Annual	4/11/2018	23528889
Rohde & Schwarz	CMU200	Base Station Simulator	4/11/2017	Annual	4/11/2018	836371/0079
Rohde & Schwarz	CMU200	Base Station Simulator	N/A	N/A	N/A	107826
Seekonk	NC-100	Torque Wrench (8" lb)	9/1/2016	Biennial	9/1/2018	21053
TEM	C63.19	Helmholtz Coil	12/7/2016	Annual	12/7/2017	925
TEM	Radial T-Coil Probe	Radial T-Coil Probe	12/7/2016	Annual	12/7/2017	TEM-1130
TEM	Axial T-Coil Probe	Axial T-Coil Probe	12/7/2016	Annual	12/7/2017	TEM-1124
TEM		HAC System Controller with Software	N/A		N/A	N/A
TEM		HAC Positioner	N/A		N/A	N/A

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DUT: HH Coil - SN: 925

Type: HH Coil Serial: 925

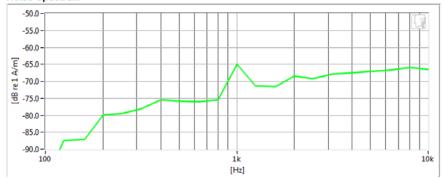
Measurement Standard: ANSI C63.19-2011

Equipment:

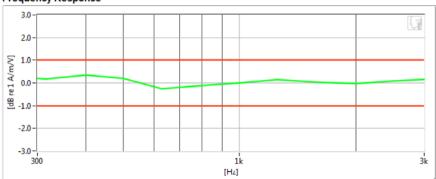
Probe: Axial T-Coil Probe – SN: TEM-1124; Calibrated: 12/07/2016

Helmholtz Coil – SN: 925; Calibrated: 12/07/2016

Noise Spectrum



Frequency Response



Results

Verification 1kHz Intensity	-10.171 dB	\checkmark	Max/Min	-9.5/-10.5
Verification ABM2	-60.79 dB	\checkmark	Maximum	-58.0
Frequency Response Margin	700m dB	\checkmark	Tolerance curves	Aligned Data

FCC ID: ZNFUN220	PCTEST	HAC (T-COIL) TEST REPORT	⊕ LG	Approved by: Quality Manager
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DUT: HH Coil - SN: 925

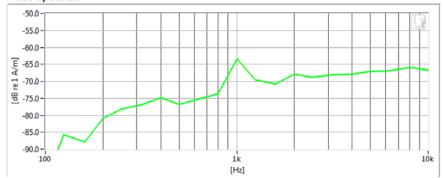
Type: HH Coil Serial: 925

Measurement Standard: ANSI C63.19-2011

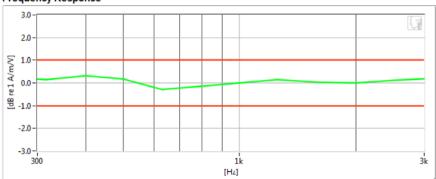
Equipment:

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

Noise Spectrum



Frequency Response



Results

Verification 1kHz Intensity	-10.27 dB	✓	Max/Min	-9.5/-10.5
Verification ABM2	-59.76 dB	•	Maximum	-58.0
Frequency Response Margin	700m dB	\checkmark	Tolerance curves	Aligned Data

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Type: Portable Handset Serial: 00167

Measurement Standard: ANSI C63.19-2011

Equipment:

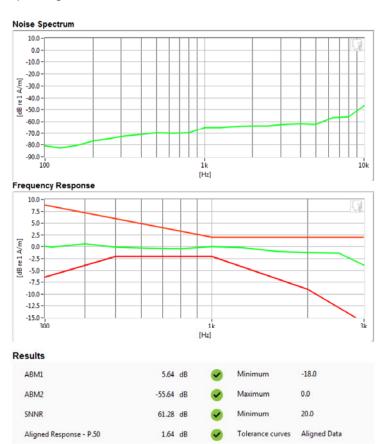
Probe: Axial T-Coil Probe – SN: TEM-1124; Calibrated: 12/07/2016

Test Configuration:

Mode: Cellular CDMA

Channel: 1013

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



FCC ID: ZNFUN220	PCTEST	HAC (T-COIL) TEST REPORT	டுட	Approved by: Quality Manager
Filename:	Test Dates:	DUT Type:		Page 29 of 53
1M1706130193-08.ZNF	06/16/2017 - 06/20/2017	Portable Handset		Fage 29 01 55



Type: Portable Handset Serial: 00167

Measurement Standard: ANSI C63.19-2011

Equipment:

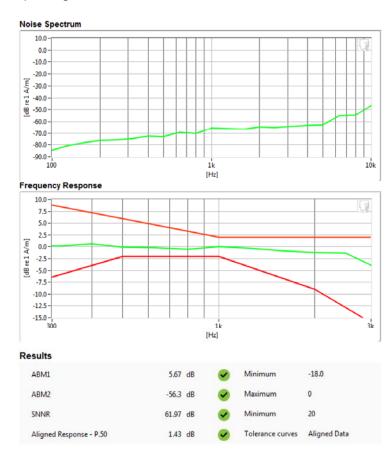
Probe: Axial T-Coil Probe – SN: TEM-1124; Calibrated: 12/07/2016

Test Configuration:

Mode: PCS CDMA

Channel: 600

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



FCC ID: ZNFUN220	PCTEST*	HAC (T-COIL) TEST REPORT	⊕ LG	Approved by: Quality Manager
Filename:	Test Dates:	DUT Type:		Page 30 of 53
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Type: Portable Handset Serial: 00167

Measurement Standard: ANSI C63.19-2011

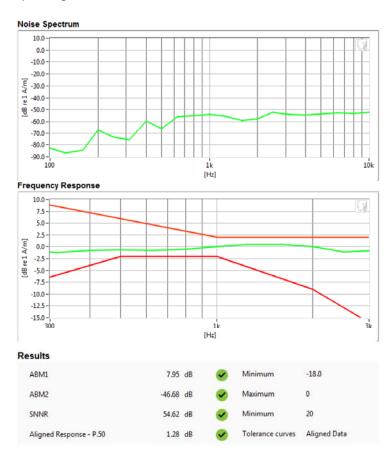
Equipment:

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

Test Configuration:

Mode: GSM850Channel: 251

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



FCC ID: ZNFUN220	PCTEST	HAC (T-COIL) TEST REPORT	⊕ LG	Approved by: Quality Manager
Filename:	Test Dates:	DUT Type:		Dogo 21 of 52
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Type: Portable Handset Serial: 00167

Measurement Standard: ANSI C63.19-2011

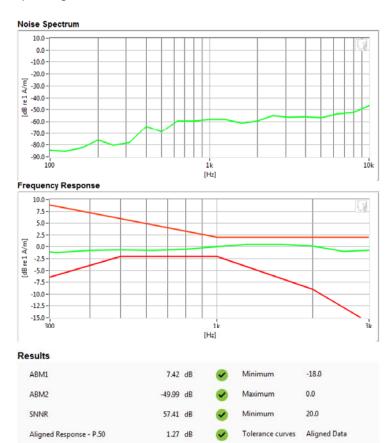
Equipment:

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

Test Configuration:

Mode: GSM1900Channel: 810

Speech Signal: ITU-T P.50 Artificial Voice



FCC ID: ZNFUN220	PCTEST	HAC (T-COIL) TEST REPORT	⊕ LG	Approved by: Quality Manager
Filename:	Test Dates:	DUT Type:		Page 32 of 53
1M1706130193-08.ZNF	06/16/2017 - 06/20/2017	Portable Handset		Fage 32 01 53



Type: Portable Handset Serial: 00167

Measurement Standard: ANSI C63.19-2011

Equipment:

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

Test Configuration:

Mode: UMTS Band V

Channel: 4183

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

Noise Spectrum 10.0 0.0 -10.0 -20.0 -30.0 -40.0 · g -50.0--60.0 -70.0 -80.0 -90.0 -100 Frequency Response 10.0 7.5 5.0 2.5 [dB re 1 A/m] 0.0 -2.5 -5.0 -7.5 -10.0 -12.5 -15.0 [Hz] Results ABM1 7.26 dB Minimum -18.0 ABM2 0 -57.64 dB Maximum 64.9 dB Aligned Response - P.50 1.42 dB Tolerance curves Aligned Data

FCC ID: ZNFUN220	PCTEST	HAC (T-COIL) TEST REPORT	⊕ LG	Approved by: Quality Manager
Filename:	Test Dates:	DUT Type:		Page 33 of 53
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Type: Portable Handset Serial: 00167

Measurement Standard: ANSI C63.19-2011

Equipment:

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

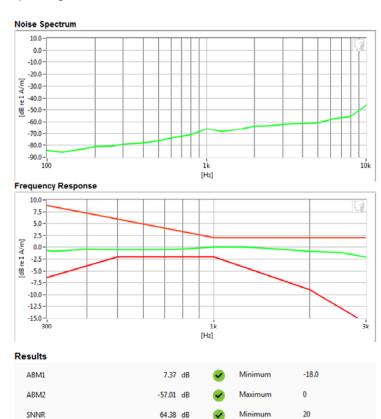
Test Configuration:

Mode: UMTS Band II

Aligned Response - P.50

Channel: 9262

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



PCTEST 2017

FCC ID: ZNFUN220	PCTEST	HAC (T-COIL) TEST REPORT	⊕ LG	Approved by: Quality Manager
Filename:	Test Dates:	DUT Type:		Page 34 of 53
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1.42 dB

Tolerance curves

Aligned Data



Type: Portable Handset Serial: 00167

Measurement Standard: ANSI C63.19-2011

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

Test Configuration:

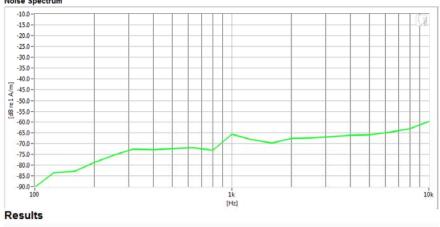
 Mode: Cellular CDMA • Channel: 384

Noise Spectrum

ABM1

ABM2

SNNR



-2.26 dB

-59.12 dB

56.86 dB

Minimum

Maximum

Minimum

-18.0

0.0

20.0

FCC ID: ZNFUN220	PCTEST	HAC (T-COIL) TEST REPORT	டுட	Approved by: Quality Manager
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Type: Portable Handset Serial: 00167

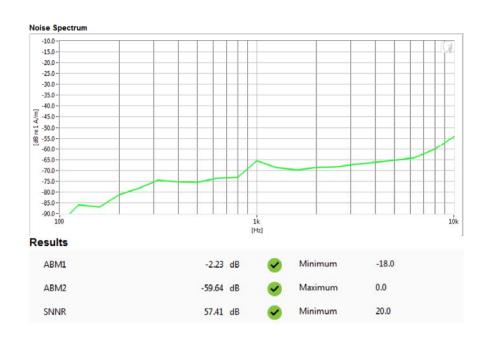
Measurement Standard: ANSI C63.19-2011

Equipment:

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

Test Configuration:

Mode: PCS CDMAChannel: 1175



FCC ID: ZNFUN220	PCTEST*	HAC (T-COIL) TEST REPORT	⊕ LG	Approved by: Quality Manager
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Type: Portable Handset Serial: 00167

Measurement Standard: ANSI C63.19-2011

Equipment:

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

Test Configuration:

Mode: GSM850Channel: 251



FCC ID: ZNFUN220	PCTEST	HAC (T-COIL) TEST REPORT	⊕ LG	Approved by: Quality Manager
Filename:	Test Dates:	DUT Type:		Dogo 27 of 52
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Type: Portable Handset Serial: 00167

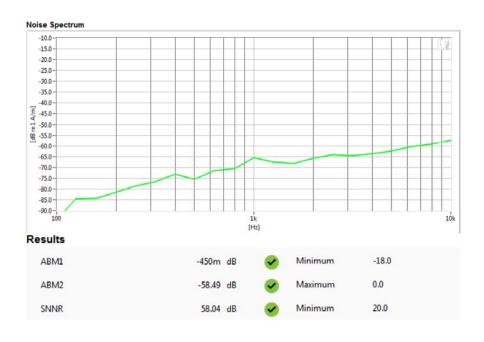
Measurement Standard: ANSI C63.19-2011

Equipment:

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

Test Configuration:

Mode: GSM1900Channel: 661



FCC ID: ZNFUN220	PCTEST	HAC (T-COIL) TEST REPORT	(1) LG	Approved by: Quality Manager
Filename:	Test Dates:	DUT Type:		Dogg 20 of 52
1M1706130193-08.ZNF	06/16/2017 - 06/20/2017	Portable Handset		Page 38 of 53



Type: Portable Handset Serial: 00167

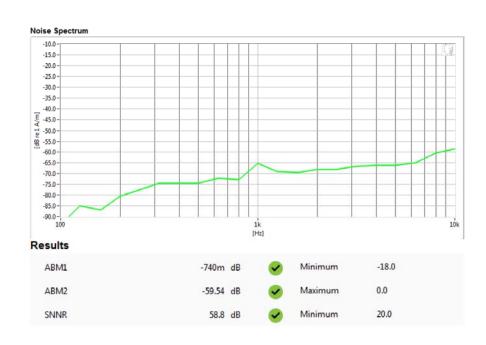
Measurement Standard: ANSI C63.19-2011

Equipment:

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

Test Configuration:

Mode: UMTS Band VChannel: 4132



FCC ID: ZNFUN220	PCTEST*	HAC (T-COIL) TEST REPORT	€ LG	Approved by: Quality Manager
Filename:	Test Dates:	DUT Type:		Dogg 20 of 52
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Type: Portable Handset Serial: 00167

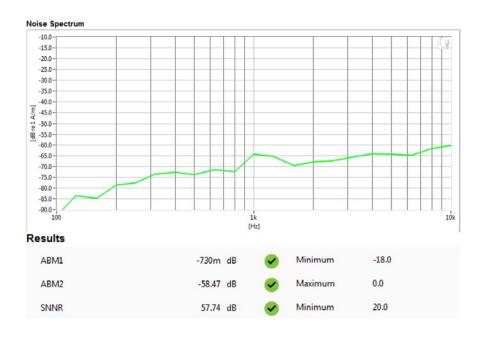
Measurement Standard: ANSI C63.19-2011

Equipment:

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

Test Configuration:

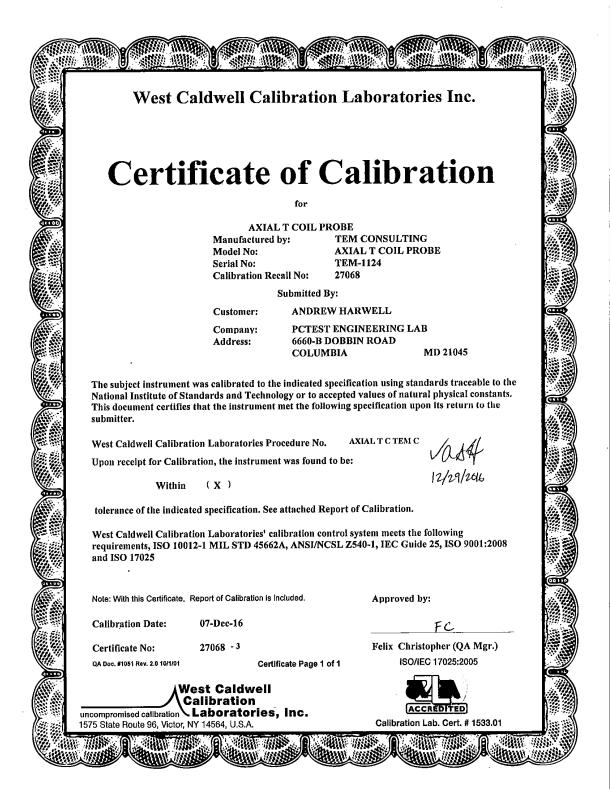
Mode: UMTS Band IIChannel: 9538



FCC ID: ZNFUN220	PCTEST	HAC (T-COIL) TEST REPORT	⊕ LG	Approved by: Quality Manager
Filename:	Test Dates:	DUT Type:		Dog 40 of 52
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10. CALIBRATION CERTIFICATES

FCC ID: ZNFUN220	PCTEST	HAC (T-COIL) TEST REPORT	⊕ LG	Approved by: Quality Manager
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FCC ID: ZNFUN220	PCTEST'	HAC (T-COIL) TEST REPORT	(E) LG	Approved by: Quality Manager
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REV 3.1.M 05/15/2017

HCATEMC_TEM 1124_Dec-07-2016



ISO/IEC 17025: 2005

1575 State Route 96, Victor NY 14564

Calibration Lab. Cert. # 1533.01

REPORT OF CALIBRATION

TEM Consulting LP Axial T Coil Probe

Model No.: Axial T Coil Probe

Serial No.: TEM 1124

Company: PCTEST Engineering Lab.

I. D. No: 80578

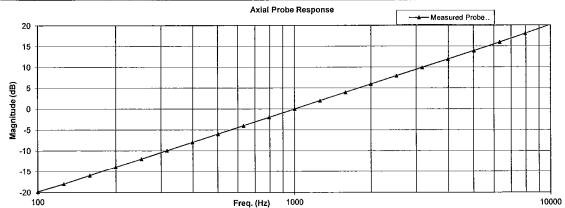
Probe Sensitivity measured wit	h Heimholf	z Coil			
Helmholtz Coil;		Before & afte	er data same	:X	
the number of turns on each coil;	10	No.			
the radius of each coil, in meters;	0.204	m	Laboratory Enviror	ment:	
the current in the coils, in amperes.;	0.09	Α	Ambient Temperature:	20.2	°C
Helmholtz Coll Constant;	7.09	A/m/V	Ambient Humidity:	31.4	% RH
Helmholtz Coll magnetic field;	5.98	A/m	Ambient Pressure:	99.1	kPa
			Calibration Date:	7-Dec-16	
Probe Sensitivity at	1000	Hz.	Re-calibration Due:	7-Dec-17	
was	-60.23	dBV/A/m	Report Number:	27068	-3
	0.974	mV/A/m	Control Number:	27068	
Probe resistance	904	Ohms			

This Calibration is traceable through NIST test numbers:

683/284413-14

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

Graph represents Probes Frequency Response.



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

Calibration Laboratories Inc. procedure :

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 9001:2008, ISO 17025

Cal. Date: 7-Dec-2016

Measurements performed by:

Felix Christopher

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

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

Page 1 of 2

FCC ID: ZNFUN220	PCTEST	HAC (T-COIL) TEST REPORT	(E) LG	Approved by: Quality Manager
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HCATEMC_TEM 1124_Dec-07-2016

West Caldwell Calibration Laboratories Inc.

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

Calibration Data Record

TEM Consulting LP Axial T Coil Probe

for Model No.: Axial T Coil Probe

Serial No.: TEM 1124

Company: PCTEST Engineering Lab.

Test	Function	Tolerai	Measured values			
				Before	Out	Remarks
1.0	Probe Sensitivity at	1000 Hz.	dBV/A/m	-60.23		
		<u> </u>	dB			
2.0	Probe Level Linearity		6	6.03		
		Ref. (0 dB)	0	0.00		
		` '	-6	-6.03		1
			-12	-12.05		
	<u>, </u>		Hz	-		
3.0	Probe Frequency Response		100	-19.8		ļ
			126	-18.0		
			158	-16.0		
			200	-13.9		
			251	-12.0		
			316	-9.9		ļ
			398	-8.0		
			501	-6.0		
			631	-4.0		
			794	-2.0		
		Ref. (0 dB)	1000	0.0		ļ
			1259	2.0		1
			1585	4.0		1
			1995	6.0		1
			2512	7.9		
			3162	9.9		
			3981	11.9		
			5012	13.9		
			6310	15.9		1
			7943	18.0		
			10000	20.2		

Instruments used for calibrati	on:		Date of Cal.	Traceablity No.	Due Date
HP	34401A	S/N 36064102	1-Oct-2016	,287708	1-Oct-2017
HP	34401A	S/N 36102471	1-Oct-2016	,287708	1-Oct-2017
HP	33120A	S/N 36043716	1-Oct-2016	,287708	1-Oct-2017
B&K	2133	S/N 1583254	1-Oct-2016	683/284413-14	1-Oct-2017

Cal. Date:

7-Dec-2016

Tested by: Felix Christopher

Calibrated on WCCL system type 9700

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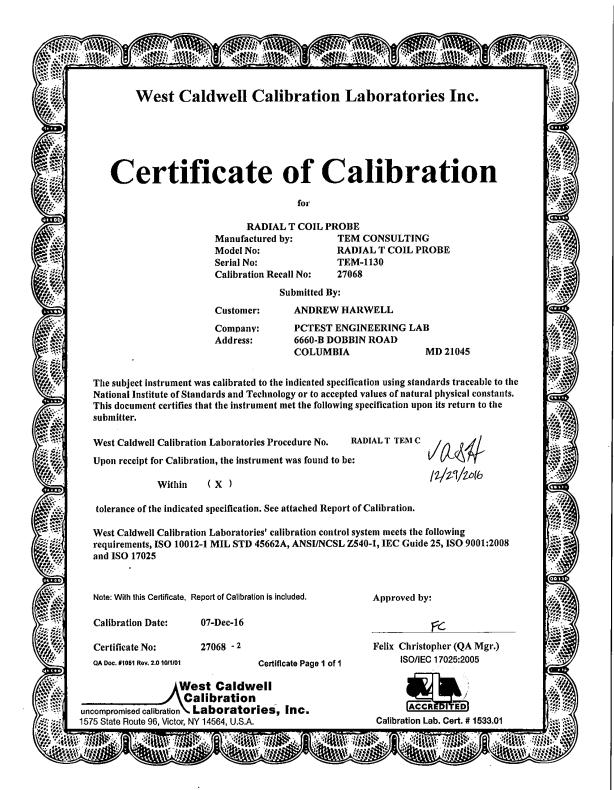
Rev. 7.0 Jan. 24, 2014 Doc. # 1038 HCATEMC

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FCC ID: ZNFUN220	PCTEST	HAC (T-COIL) TEST REPORT	(LG	Approved by: Quality Manager
Filename:	Test Dates:	DUT Type:		Dogg 44 of 52
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REV 3.1.M 05/15/2017



FCC ID: ZNFUN220	PCTEST	HAC (T-COIL) TEST REPORT	⊕ LG	Approved by: Quality Manager
Filename:	Test Dates:	DUT Type:		Page 45 of 53
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HCRTEMC_TEM-1130_Dec-07-2016



ACCREDITED

ISO/IEC 17025: 2005

1575 State Route 96, Victor NY 14564

Calibration Lab. Cert. # 1533.01

REPORT OF CALIBRATION

TEM Consulting LP Radial T Coil Probe

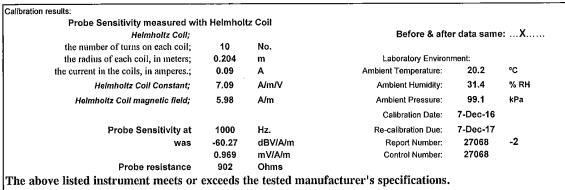
Model No.: Radial T Coil Probe

Serial No.: TEM-1130

1.1

Company: PCTEST Engineering Lab.

I. D. No: 80579

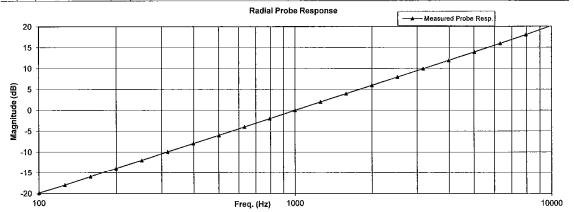


This Calibration is traceable through NIST test numbers:

683/284413-14

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

Graph represents Probes Frequency Response.



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

Calibration Laboratories Inc. procedure :

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 9001:2008, ISO 17025

Cal. Date: 7-Dec-2016

Measurements performed by:

Felix Christopher

Calibrated on WCCL system type 9700

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

Page 1 of 2

FCC ID: ZNFUN220	PCTEST	HAC (T-COIL) TEST REPORT	⊕ LG	Approved by: Quality Manager
Filename:	Test Dates:	DUT Type:		Dogg 46 of 52
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REV 3.1.M

HCRTEMC_TEM-1130_Dec-07-2016

West Caldwell Calibration Laboratories Inc.

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

Calibration Data Record

TEM Consulting LP Radial T Coil Probe

for Model No.: Radial T Coil Probe

Serial No.: TEM-1130

Company: PCTEST Engineering Lab.

Function	nction Tolerance		Measured values			
			Before	Out	Remarks	
Probe Sensitivity at	1000 Hz.	dBV/A/m	-60.27		:	
		dB				
Probe Level Linearity		6				
	Ref. (0 dB)					
			-6.03			
		-12	-12.06			
		Hz				
Probe Frequency Response						
					1	
					1	
					1	
					1	
					1	
	Ref. (0 dB)					
					İ	
		1995	6.0			
			7.9			
		3981	11.9			
		5012	13.9			
		6310	15.9			
		7943	18.0			
		10000	20.2			
		Probe Sensitivity at 1000 Hz. Probe Level Linearity Ref. (0 dB)	Probe Sensitivity at 1000 Hz. dBV/A/m Probe Level Linearity	Probe Sensitivity at 1000 Hz. dBV/A/m -60.27 Probe Level Linearity	Probe Sensitivity at 1000 Hz. dBV/A/m -60.27 Probe Level Linearity	

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

Cal. Date: 7-Dec-2016

Tested by: Felix Christopher

Calibrated on WCCL system type 9700

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

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FCC ID: ZNFUN220	PCTEST	HAC (T-COIL) TEST REPORT	⊕ LG	Approved by: Quality Manager
Filename:	Test Dates:	DUT Type:		Dogo 47 of 52
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11. 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: ZNFUN220	PCTEST	HAC (T-COIL) TEST REPORT	(E) LG	Approved by: Quality Manager
Filename:	Test Dates:	DUT Type:		Dogo 40 of 52
1M1706130193-08.ZNF	06/16/2017 - 06/20/2017	Portable Handset		Page 48 of 53

12. REFERENCES

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FCC ID: ZNFUN220	PCTEST*	HAC (T-COIL) TEST REPORT	(t) LG	Approved by: Quality Manager
Filename:	Test Dates:	DUT Type:		Dog 40 of 52
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