

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: 01/19/2016 - 01/20/2016 Test Site/Location: PCTEST Lab, Columbia, MD, USA Test Report Serial No.:

0Y1601180107.ZNF

FCC ID: ZNFL81AL

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

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

Application Type: Class II Permissive Change

FCC Rule Part(s): CFR §20.19(b)

HAC Standard: ANSI C63.19-2011

EUT Type: Portable Handset

Model(s): LG-L81AL, LGL81AL, L81AL, LG-K540, LGK540, K540

Test Device Serial No.: Pre-Production Sample [S/N: 03595]

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

Original Grant Date: 01/21/2016

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.







FCC ID: ZNFL81AL	PCTEST*	HAC (T-COIL) TEST REPORT	① LG	Reviewed by: Quality Manager
Filename:	Test Dates:	EUT Type:		Dogo 1 of 52
0Y1601180107.ZNF	01/19/2016 - 01/20/2016	Portable Handset		Page 1 of 52

TABLE OF CONTENTS

1.	INTRODUCTION	3
2.	TEST SITE LOCATION	4
3.	EUT DESCRIPTION	5
4.	ANSI C63.19-2011 PERFORMANCE CATEGORIES	6
5.	METHOD OF MEASUREMENT	8
6.	FCC 3G MEASUREMENTS	18
7.	TEST SUMMARY	19
8.	MEASUREMENT UNCERTAINTY	25
9.	EQUIPMENT LIST	26
10.	TEST DATA	27
11.	CALIBRATION CERTIFICATES	40
12.	CONCLUSION	47
13.	REFERENCES	48
14.	TEST SETUP PHOTOGRAPHS	50

FCC ID: ZNFL81AL	PCTEST*	HAC (T-COIL) TEST REPORT	① LG	Reviewed by: Quality Manager
Filename:	Test Dates:	EUT Type:		Page 2 of 52
0Y1601180107.ZNF	01/19/2016 - 01/20/2016	Portable Handset		Fage 2 01 52

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

FCC ID: ZNFL81AL	PCTEST*	HAC (T-COIL) TEST REPORT	① LG	Reviewed by: Quality Manager
Filename:	Test Dates:	EUT Type:		Page 3 of 52
0Y1601180107.ZNF	01/19/2016 - 01/20/2016	Portable Handset		Page 3 01 32

2. TEST SITE LOCATION

I. Introduction

The map at the right shows the location of the PCTEST LABORATORY in Columbia, Maryland. It is in proximity to the FCC Laboratory, the Baltimore-Washington International (BWI) airport, the city of Baltimore and Washington, DC (See Figure 2-1).

These measurement tests were conducted at the PCTEST Engineering Laboratory, Inc. facility in Stonewood Business Center, Guilford Industrial Park, Columbia, Maryland. The site address is 7185 Oakland Mills Road, Columbia, MD 21046. The test site is one of the highest points in the Columbia area with an elevation of 390 feet above mean sea level. The site coordinates are 39° 10' 24" N latitude and 76° 49' 50" W longitude. The facility is 0.4 miles North of the FCC laboratory, and the ambient signal and ambient signal strength are approximately equal to those of the FCC laboratory.



Figure 2-1
Map of the Greater Baltimore and Metropolitan
Washington, D.C. area

FCC ID: ZNFL81AL	PCTEST*	HAC (T-COIL) TEST REPORT	① LG	Reviewed by: Quality Manager
Filename:	Test Dates:	EUT Type:		Page 4 of 52
0Y1601180107.ZNF	01/19/2016 - 01/20/2016	Portable Handset		Fage 4 01 52

3. EUT DESCRIPTION



FCC ID: ZNFL81AL

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

1000 Sylvan Avenue

Englewood Cliffs, NJ 07632

United States

Model(s): LG-L81AL, LGL81AL, L81AL, LG-K540, LGK540, K540

Serial Number: 03595 HW Version: 1.0

SW Version: L81AL08p

Antenna: Internal Antenna

HAC Test Configurations: 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 IV, 1312, 1412, 1513, BT Off, WLAN Off, LTE Off UMTS II, 9262, 9400, 9538, BT Off, WLAN Off, LTE Off

EUT Type: Portable Handset

Air-Interface	Band (MHz)	Type Transport	HAC Tested	Simultaneous But Not Tested	Voice over Digital Transport OTT Capability	WIFI Low Power	Additional GSM Power Reduction
	850	VO	Yes	Yes: WIFI or BT	N/A	N/A	No
GSM	1900	٧٥	res	res: WiFi or B1	N/A	N/A	NO
	GPRS/EDGE	DT	No	Yes: WIFI or BT	Yes	N/A	No
	850						
UMTS	1700	VD	Yes	Yes: WIFI or BT	N/A	N/A	N/A
UIVITS	1900						
	HSPA	DT	No	Yes: WIFI or BT	Yes	N/A	N/A
	700 (B12)						
	700 (B17)						
LTE (FDD)	850 (B5)	DT	No	Yes: WIFI or BT	Yes	N/A	N/A
	1700 (B4)						
	1900 (B2)						
WIFI	2450	DT	No	Yes: GSM, UMTS, or LTE	Yes	N/A	N/A
BT	2450	DT	No	Yes: GSM, UMTS, or LTE	N/A	N/A	N/A

Type Transport

VO = Voice Only

DT = Digital Data - Not intended for CMRS Service

VD = CMRS and Data Transport

Table 3-1: ZNFL81AL HAC Air Interfaces

FCC ID: ZNFL81AL	PCTEST*	HAC (T-COIL) TEST REPORT	① LG	Reviewed by: Quality Manager
Filename:	Test Dates:	EUT Type:		Page 5 of 52
0Y1601180107.ZNF	01/19/2016 - 01/20/2016	Portable Handset		Page 5 01 52

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REV 3.1.M

4. 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.

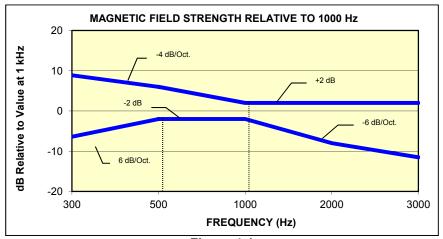


Figure 4-1
Magnetic field frequency response for Wireless Devices with an axial field ≤-15 dB(A/m) at 1 kHz

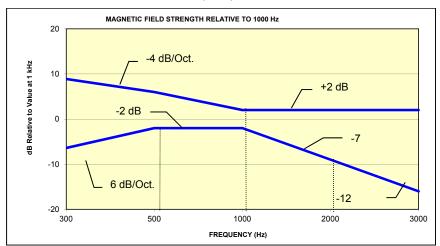


Figure 4-2
Magnetic Field frequency response for wireless devices with an axial field that exceeds
-15 dB(A/m) at 1 kHz

FCC ID: ZNFL81AL	PCTEST	HAC (T-COIL) TEST REPORT	① LG	Reviewed by: Quality Manager
Filename:	Test Dates:	EUT Type:		Page 6 of 52
0Y1601180107.ZNF	01/19/2016 - 01/20/2016	Portable Handset		rage 6 01 52

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REV 3.1.M 12/9/2015

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 4-1 Magnetic Coupling Parameters				

FCC ID: ZNFL81AL	PCTEST*	HAC (T-COIL) TEST REPORT	① LG	Reviewed by: Quality Manager
Filename:	Test Dates:	EUT Type:		Page 7 of 52
0Y1601180107.ZNF	01/19/2016 - 01/20/2016	Portable Handset		Faye / 0152

5. METHOD OF MEASUREMENT

I. Test Setup

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

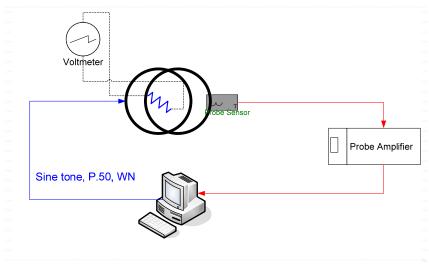
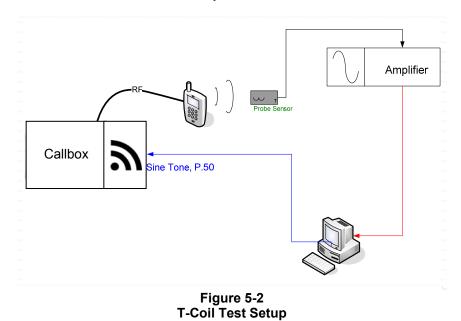


Figure 5-1 Validation Setup with Helmholtz Coil



FCC ID: ZNFL81AL

HAC (T-COIL) TEST REPORT

Filename:
0Y1601180107.ZNF

O1/19/2016 - 01/20/2016

Page 8 of 52

Reviewed by:
Quality Manager
Page 8 of 52

II. **Scanning Mechanism**

Manufacturer: TEM

Accuracy: ± 0.83 cm/meter

Minimum Step Size: 0.1 mm

Maximum speed 6.1 cm/sec 115 VAC Line Voltage: 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)

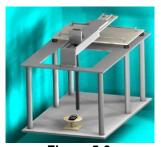


Figure 5-3 RF Near-Field Scanner

ITU-T P.50 Artificial Voice III.

Manufacturer: ITU-T

Active Frequency 100 Hz - 8 kHz Range:

Stimulus Type: Male and Female, no spaces

Single Sample 20.96 seconds

Duration:

Activity Level: 100%

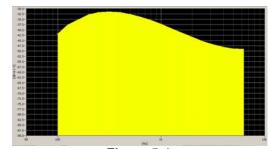


Figure 5-4 Spectral Characteristic of full P.50

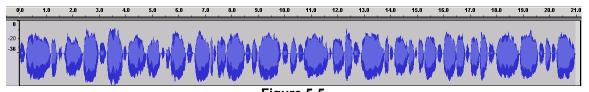


Figure 5-5 Temporal Characteristic of full P.50

FCC ID: ZNFL81AL	PCTEST*	HAC (T-COIL) TEST REPORT	LG	Reviewed by: Quality Manager
Filename:	Test Dates:	EUT Type:		Page 9 of 52
0Y1601180107.ZNF	01/19/2016 - 01/20/2016	Portable Handset		Fage 9 01 52



ABM2 Measurement Block Diagram:



Figure 5-6 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 5-1)
 - 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 $-10 \, \text{dB}(A/m)$ in the center of the Helmholtz coil which was used to validate the probe measurement at $-10 \, \text{dB}(A/m)$. This was verified to be within $\pm 0.5 \, \text{dB}$ of the $-10 \, \text{dB}(A/m)$ value (see Page 23).

FCC ID: ZNFL81AL	PCTEST*	HAC (T-COIL) TEST REPORT	LG	Reviewed by: Quality Manager
Filename:	Test Dates:	EUT Type:		Page 10 of 52
0Y1601180107.ZNF	01/19/2016 - 01/20/2016	Portable Handset		Fage 10 01 52

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c. Frequency Response Validation

The frequency response through the Helmholtz Coil was verified to be within 0.5 dB relative to 1kHz, between 300 – 3000 Hz using the P.50 signal as shown below:

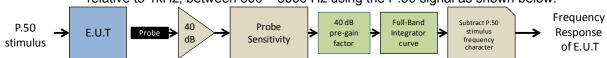


Figure 5-7 Frequency Response Validation

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 5-1 **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

FCC ID: ZNFL81AL	PCTEST*	HAC (T-COIL) TEST REPORT	① LG	Reviewed by: Quality Manager
Filename:	Test Dates:	EUT Type:		Page 11 of 52
0Y1601180107.ZNF	01/19/2016 - 01/20/2016	Portable Handset		Page 11 01 52



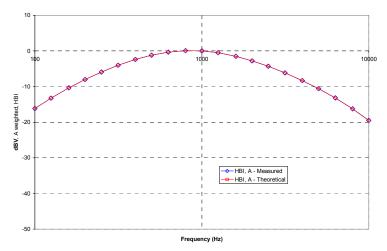
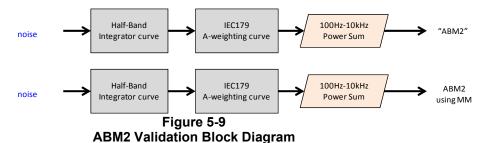


Figure 5-8
ABM2 Frequency Response Validation

The ABM2 result is a power sum from 100Hz to 10kHz with half-band integration and A-weighting. To verify the power sum measurement, a power sum over the full band was measured and verified to track with the source level (See Figure 5-9). 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 5-2
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

FCC ID: ZNFL81AL	PCTEST	HAC (T-COIL) TEST REPORT	① LG	Reviewed by: Quality Manager
Filename:	Test Dates:	EUT Type:		Page 12 of 52
0Y1601180107.ZNF	01/19/2016 - 01/20/2016	Portable Handset		Fage 12 01 52

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REV 3.1.M

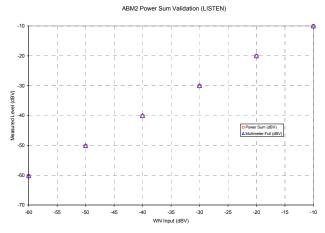


Figure 5-10
ABM2 Power Sum Validation

- 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:

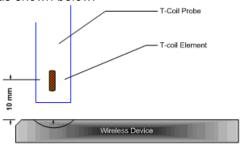


Figure 5-11 Measurement Distance

- 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 5-15 after a T-coil orientation was fully measured with the SoundCheck system.
- b. Speech Signal Setup to Base Station Simulator
 - i. C63.19 Table 7-1 states audio reference input levels for various technologies:

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

FCC ID: ZNFL81AL	PCTEST	HAC (T-COIL) TEST REPORT	① LG	Reviewed by: Quality Manager
Filename:	Test Dates:	EUT Type:		Page 13 of 52
0Y1601180107.ZNF	01/19/2016 - 01/20/2016	Portable Handset		Fage 13 01 32

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REV 3.1.M

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 5-3 **CMU200 Voltage Input Levels for Audio**

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
	Voltage		
dBm0 Ref.	Volt	age	Notes
dBm0 Ref. 3.14 dBm0	Volt	0.58 dBV	Notes From UMTS "DECODER CAL". (What is needed through Encoder for FS)

- 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 below for GSM, see Section 6 for more information regarding worst-case configurations for UMTS.):

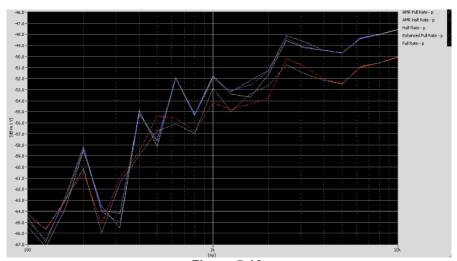


Figure 5-12 **Vocoder Analysis for ABM Noise for GSM**

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

FCC ID: ZNFL81AL	PCTEST*	HAC (T-COIL) TEST REPORT	① LG	Reviewed by: Quality Manager
Filename:	Test Dates:	EUT Type:		Page 14 of 52
0Y1601180107.ZNF	01/19/2016 - 01/20/2016	Portable Handset		Fage 14 01 52

b. Frequency Response

- i. The appropriate frequency response curve was measured to curves in Figure 4-1 or Figure 4-2 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 5-7. 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 on, display on, maximum contrast setting, keypad lights on (when possible) with no audio signal through the vocoder, the WD was measured over at least 100 Hz -10,000 Hz, maximized over 5 seconds with a 50ms sample time for the ABM2 measurement (5 second time period is used in noise measurements under standards such as IEEE 269, etc.).
- ii. After applying half-band integration and A-weighting to the result, a power sum was applied over each 1/3 octave bandwidth frequency for an ABM2 value.
- iii. This result was subtracted from the ABM1 result in step a, to obtain the Signal Quality.

V. Test Setup

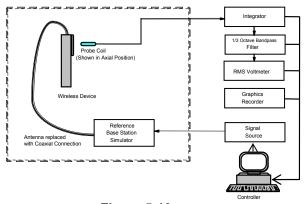


Figure 5-13 **Audio Magnetic Field Test Setup**

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

None.

FCC ID: ZNFL81AL	PCTEST	HAC (T-COIL) TEST REPORT	① LG	Reviewed by: Quality Manager
Filename:	Test Dates:	EUT Type:		Page 15 of 52
0Y1601180107.ZNF	01/19/2016 - 01/20/2016	Portable Handset		Page 15 01 52

VII. Air Interface Technologies Tested

All air interfaces which support voice capabilities over a managed CMRS were tested for T-coil. See Table 3-1 for more details regarding which modes were tested.

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

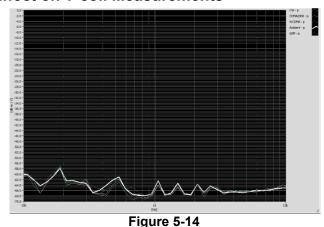
VIII. Wireless Device Channels and Frequencies

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 5-4 Center Channels and Frequencies

Test frequencies & associated channels				
Channel	Frequency (MHz)			
Cellular 850				
190 (GSM)	836.60			
4183 (UMTS)	836.60			
PCS 1900				
661 (GSM)	1880			
9400 (UMTS)	1880			
AWS 1750				
1412 (UMTS)	1730.40			

IX. RF Emission Effect on T-coil Measurements



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

FCC ID: ZNFL81AL	PCTEST"	HAC (T-COIL) TEST REPORT	LG	Reviewed by: Quality Manager
Filename:	Test Dates:	EUT Type:		Dogo 16 of 52
0Y1601180107.ZNF	01/19/2016 - 01/20/2016	Portable Handset		Page 16 of 52

X. **Test Flow**

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

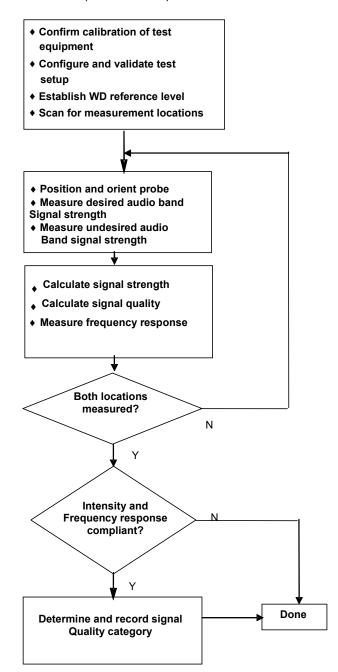


Figure 5-15 **C63.19 T-Coil Signal Test Process**

FCC ID: ZNFL81AL	PCTEST*	HAC (T-COIL) TEST REPORT	① LG	Reviewed by: Quality Manager
Filename:	Test Dates:	EUT Type:		Page 17 of 52
0Y1601180107.ZNF	01/19/2016 - 01/20/2016	Portable Handset		Page 17 01 52

6. FCC 3G MEASUREMENTS

I. 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:

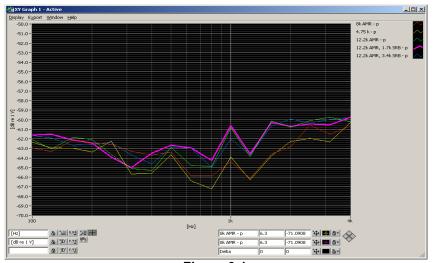


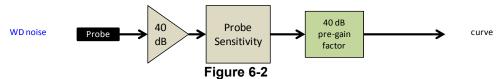
Figure 6-1
UMTS Audio Band Magnetic Noise

II. ABM Measurements

Table 6-1 FCC 3G ABM Measurements for ZNFL81AL (UMTS)

1.00.00712							
Codec Setting:	AMR 12.2kbps	AMR 7.95kbps	AMR 4.75kbps	Orientation	Channel		
ABM1 Pre-test (dBA/m)	3.96	3.94	3.69				
ABM2 Pre-test (dBA/m) (A-weight, Half-Band Int.)		-45.49	-45.49	Radial	4233		
S+N/N (dB)	48.92	49.43	49.18				

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



Audio Band Magnetic Curve Measurement Block Diagram

FCC ID: ZNFL81AL	PCTEST*	HAC (T-COIL) TEST REPORT	LG	Reviewed by: Quality Manager
Filename:	Test Dates:	EUT Type:		Page 18 of 52
0Y1601180107.ZNF	01/19/2016 - 01/20/2016	Portable Handset		Page 16 01 52

7. TEST SUMMARY

T-Coil Test Summary I.

Table 7-1 **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	10.0	PASS
8.3.1			Intensity, Radial	-18	4.2	PASS
8.3.4	GSM	Cellular	Signal-to-Noise/Noise, Axial	20	39.8	PASS
8.3.4			Signal-to-Noise/Noise, Radial	20	27.7	PASS
8.3.2			Frequency Response, Axial	0	2.0	PASS
8.3.1			Intensity, Axial	-18	10.0	PASS
8.3.1			Intensity, Radial	-18	4.2	PASS
8.3.4	GSM	PCS	Signal-to-Noise/Noise, Axial	20	43.9	PASS
8.3.4			Signal-to-Noise/Noise, Radial	20	31.8	PASS
8.3.2			Frequency Response, Axial	0	2.0	PASS

Note: The above summary table represents the worst-case numerical values according to configurations in Table 7-4.

Table 7-2 **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	9.5	PASS
8.3.1			Intensity, Radial	-18	3.9	PASS
8.3.4	UMTS	Cellular	Signal-to-Noise/Noise, Axial	20	54.2	PASS
8.3.4			Signal-to-Noise/Noise, Radial	20	49.0	PASS
8.3.2			Frequency Response, Axial	0	2.0	PASS
8.3.1			Intensity, Axial	-18	9.4	PASS
8.3.1			Intensity, Radial	-18	3.9	PASS
8.3.4	UMTS	AWS	Signal-to-Noise/Noise, Axial	20	54.6	PASS
8.3.4			Signal-to-Noise/Noise, Radial	20	49.8	PASS
8.3.2			Frequency Response, Axial	0	2.0	PASS
8.3.1			Intensity, Axial	-18	9.4	PASS
8.3.1			Intensity, Radial	-18	3.9	PASS
8.3.4	UMTS	PCS	Signal-to-Noise/Noise, Axial	20	54.5	PASS
8.3.4			Signal-to-Noise/Noise, Radial	20	49.6	PASS
8.3.2			Frequency Response, Axial	0	2.0	PASS

Note: The above summary table represents the worst-case numerical values according to configurations in Table 7-5.

FCC ID: ZNFL81AL	POTEST*	HAC (T-COIL) TEST REPORT	① LG	Reviewed by: Quality Manager
Filename:	Test Dates:	EUT Type:		Page 19 of 52
0Y1601180107.ZNF	01/19/2016 - 01/20/2016	Portable Handset		Fage 19 01 52

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REV 3.1.M

Table 7-3
Consolidated Tabled Results

		Freq. Re	esponse rgin	•	Intensity		SNNR dict	C63.19- 2011 RATING
		Axial	Radial	Axial	Radial	Axial	Radial	KATINO
GSM	Cellular	PASS	NA	PASS	PASS	PASS	PASS	Т3
GSIVI	PCS	PASS	NA	PASS	PASS	PASS	PASS	13
	Cellular	PASS	NA	PASS	PASS	PASS	PASS	
UMTS	AWS	PASS	NA	PASS	PASS	PASS	PASS	T4
	PCS	PASS	NA	PASS	PASS	PASS	PASS	

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

FCC ID: ZNFL81AL	PCTEST*	HAC (T-COIL) TEST REPORT	① LG	Reviewed by: Quality Manager
Filename:	Test Dates:	EUT Type:		Page 20 of 52
0Y1601180107.ZNF	01/19/2016 - 01/20/2016	Portable Handset		Fage 20 01 52

II. **Raw Handset Data**

Table 7-4 **Raw Data Results for GSM**

	Cellular Volume			r Band			
	Volunte		Axial		Radial		
		128	190	251	128	190	251
ABM1, dBA/m		9.95	9.95	9.97	4.25	4.22	4.25
ABM2, dBA/m		-30.87	-29.95	-29.80	-23.70	-23.53	-23.49
Ambient Noise, dBA/m		-63.62	-63.62	-63.62	-63.47	-63.47	-63.47
Freq. Response Margin (dB)		2.00	2.00	2.00	N/A	N/A	N/A
S+N/N (dB)	Maximum	40.82	39.90	39.77	27.95	27.75	27.74
S+N/N per orientation (dB)			39.77			27.74	
C63.19-2011 Rating per orientation			T4			Т3	
	Volume			PCS	Band		
	Volumo		Axial			Radial	
		512	661	810	512	661	810
ABM1, dBA/m		9.98	9.95	9.96	4.25	4.24	4.26
ABM2, dBA/m		-33.95	-35.20	-36.73	-27.67	-27.51	-27.75
Ambient Noise, dBA/m		-63.62	-63.62	-63.62	-63.47	-63.47	-63.47
Freq. Response Margin (dB)		2.00	2.00	2.00	N/A	N/A	N/A
S+N/N (dB)	Maximum	43.93	45.15	46.69	31.92	31.75	32.01
S+N/N per orientation (dB)			43.93			31.75	
C63.19-2011 Rating per orientation		T4		T4 T4			
T-coil Coordinates (cm)	[x,y] from bottom left	2.4, 3.6 2.4, 4.4					

Notes:

- 1. Power Configuration: GSM850: PCL=5, GSM1900: PCL=0;
- 2. Phone Condition: Mute on; Backlight on; Max Volume; Max Contrast
- 3. Vocoder Configuration: EFR (GSM);
- 'Radial' orientation refers to radial transverse.
- 5. Speech Signal: ITU-T P.50 Artificial Voice
- 6. Hearing Aid Compatibility mode (Call-Call Settings-Hearing Aids) was set to ON for Frequency Response compliance

FCC ID: ZNFL81AL	PCTEST*	HAC (T-COIL) TEST REPORT	① LG	Reviewed by: Quality Manager
Filename:	Test Dates:	EUT Type:		Page 21 of 52
0Y1601180107.ZNF	01/19/2016 - 01/20/2016	Portable Handset		Fage 21 01 52

Table 7-5 **Raw Data Results for UMTS**

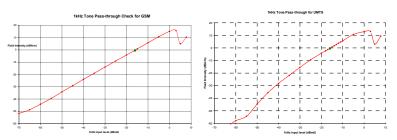
	law Dai						
	Volume			Cellula	r Band		
			Axial			Radial	
		4132	4183	4233	4132	4183	4233
ABM1, dBA/m		9.48	9.49	9.50	3.95	3.94	3.90
ABM2, dBA/m		-45.13	-44.82	-44.67	-45.32	-45.20	-45.11
Ambient Noise, dBA/m		-63.62	-63.62	-63.62	-63.47	-63.47	-63.47
Freq. Response Margin (dB)	Maximum	2.00	2.00	2.00	N/A	N/A	N/A
S+N/N (dB)		54.61	54.31	54.17	49.27	49.14	49.01
S+N/N per orientation (dB)			54.17			49.01	
C63.19-2011 Rating per orientation			T4			T4	
	Volume			AWS	Band		
	Volume		Axial			Radial	
		1312	1412	1513	1312	1412	1513
ABM1, dBA/m		9.43	9.46	9.47	3.94	3.91	3.96
ABM2, dBA/m		-45.18	-45.18	-45.41	-45.85	-46.08	-45.94
Ambient Noise, dBA/m		-63.62	-63.62	-63.62	-63.47	-63.47	-63.47
Freq. Response Margin (dB)		2.00	2.00	2.00	N/A	N/A	N/A
S+N/N (dB)	Maximum	54.61	54.64	54.88	49.79	49.99	49.90
S+N/N per orientation (dB)			54.61			49.79	
C63.19-2011 Rating per orientation			T4			T4	
				PCS	Band		
	Volume		Axial			Radial	
		9262	9400	9538	9262	9400	9538
ABM1, dBA/m		9.44	9.41	9.44	3.93	3.97	3.95
ABM2, dBA/m	l	-45.05	-45.29	-45.24	-45.67	-45.71	-45.68
Ambient Noise, dBA/m	1	-63.62	-63.62	-63.62	-63.47	-63.47	-63.47
Freq. Response Margin (dB)	Maximum	2.00	2.00	2.00	N/A	N/A	N/A
S+N/N (dB)		54.49	54.70	54.68	49.60	49.68	49.63
S+N/N per orientation (dB)			54.49			49.60	
C63.19-2011 Rating per orientation			T4			T4	
T-coil Coordinates (cm)	[x,y] from bottom left		2.4, 3.6	_		2.4, 4.4	

Notes:

- 1. Power Configuration: TPC="All 1s";
- 2. Phone Condition: Mute on; Backlight on; Max Volume; Max Contrast
- 3. Vocoder Configuration: AMR 12.2 kbps (UMTS);4. 'Radial' orientation refers to radial transverse.
- 5. Speech Signal: ITU-T P.50 Artificial Voice
- 6. Hearing Aid Compatibility mode (Call→Call Settings→Hearing Aids) was set to ON for Frequency Response compliance

FCC ID: ZNFL81AL	PCTEST*	HAC (T-COIL) TEST REPORT	① LG	Reviewed by: Quality Manager
Filename:	Test Dates:	EUT Type:		Page 22 of 52
0Y1601180107.ZNF	01/19/2016 - 01/20/2016	Portable Handset		Fage 22 01 52

1 kHz Vocoder Application Check III.



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.

T-Coil Validation Test Results IV.

Table 7-6 **Helmholtz Coil Validation Table of Results**

Item	Target	Result	Verdict
Axial			
Magnetic Intensity, -10 dBA/m	-10 ± 0.5 dB	-10.088	PASS
Environmental Noise	< -58 dBA/m	-63.62	PASS
Frequency Response, from limits	> 0 dB	0.80	PASS
Radial			
Magnetic Intensity, -10 dBA/m	-10 ± 0.5 dB	-10.220	PASS
Environmental Noise	< -58 dBA/m	-63.47	PASS
Frequency Response, from limits	> 0 dB	0.80	PASS

FCC ID: ZNFL81AL	PCTEST*	HAC (T-COIL) TEST REPORT		Reviewed by: Quality Manager
Filename:	Test Dates:	EUT Type:		Page 23 of 52
0Y1601180107.ZNF	01/19/2016 - 01/20/2016	Portable Handset		Fage 23 01 32

ABM1 Magnetic Field Distribution Scan Overlays ٧.

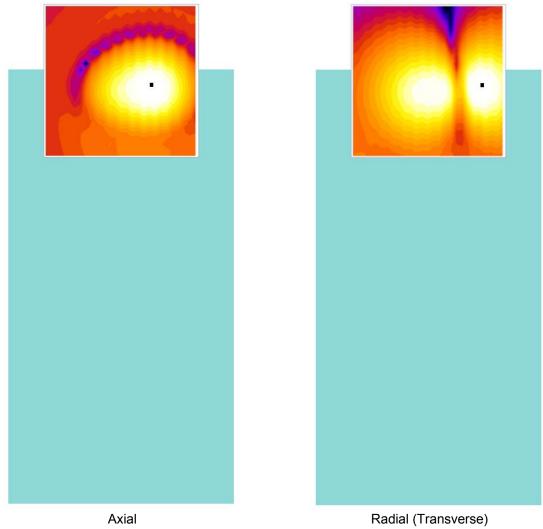


Figure 7-1 **T-Coil Scan Overlay Magnetic Field Distributions**

Notes:

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

FCC ID: ZNFL81AL	PCTEST*	HAC (T-COIL) TEST REPORT		Reviewed by: Quality Manager
Filename:	Test Dates:	EUT Type:		Page 24 of 52
0Y1601180107.ZNF	01/19/2016 - 01/20/2016	Portable Handset		Fage 24 01 52

8. **MEASUREMENT UNCERTAINTY**

Table 8-1 **Uncertainty Estimation Table**

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

Notes:

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

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

FCC ID: ZNFL81AL	PCTEST*	HAC (T-COIL) TEST REPORT		Reviewed by: Quality Manager
Filename:	Test Dates:	EUT Type:		Page 25 of 52
0Y1601180107.ZNF	01/19/2016 - 01/20/2016	Portable Handset		Fage 23 01 52

9. EQUIPMENT LIST

Table 9-1 Equipment List

	Equipment List							
Manufacturer	Model	Description	Cal Date	Cal Interval	Cal Due	Serial Number		
Listen	SoundConnect	Microphone Power Supply	11/13/2015	Annual	11/13/2016	PS2612		
Listen	SoundCheck	Acoustic Analyzer System	1/27/2015	Annual	1/27/2016	04-06-5876-SC2850		
NI	4474	Data Acquisition Card	N/A		N/A	N/A		
Rohde & Schwarz	CMU200	Base Station Simulator	12/2/2015	Annual	12/2/2016	833855/0010		
TEM	C63.19	Helmholtz Coil	1/29/2015	Annual	1/29/2016	925		
TEM		HAC System Controller with Software	N/A		N/A	N/A		
TEM		HAC Positioner	N/A		N/A	N/A		
TEM	Axial T-Coil Probe	Axial T-Coil Probe	1/29/2015	Annual	1/29/2016	TEM-1123		
TEM	Radial T-Coil Probe	Radial T-Coil Probe	1/29/2015	Annual	1/29/2016	TEM-1129		

FCC ID: ZNFL81AL	PCTEST	HAC (T-COIL) TEST REPORT	① LG	Reviewed by: Quality Manager
Filename:	Test Dates:	EUT Type:		Page 26 of 52
0Y1601180107.ZNF	01/19/2016 - 01/20/2016	Portable Handset		Fage 20 01 52

FCC ID: ZNFL81AL	PCTEST*	HAC (T-COIL) TEST REPORT	AC (T-COIL) TEST REPORT	
Filename:	Test Dates:	EUT Type:		Page 27 of 52
0Y1601180107.ZNF	01/19/2016 - 01/20/2016	Portable Handset		Fage 27 01 52



PCTEST Hearing-Aid Compatibility Facility

DUT: HH Coil - SN925

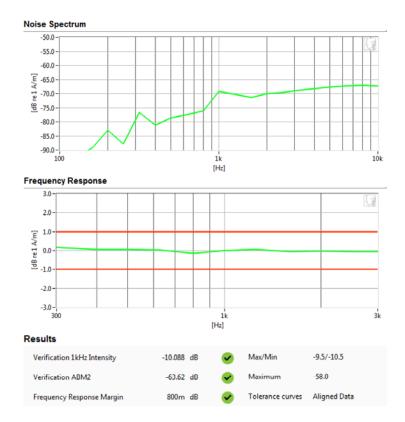
Type: HH Coil Serial: 925

Measurement Standard: ANSI C63.19-2011

Equipment:

Probe: Axial T-Coil Probe – SN: TEM-1123; Calibrated: 01/29/2015

• Helmholtz Coil - SN: 925; Calibrated: 01/29/2015



FCC ID: ZNFL81AL	POTEST*	HAC (T-COIL) TEST REPORT	HAC (T-COIL) TEST REPORT	
Filename:	Test Dates:	EUT Type:		Page 28 of 52
0Y1601180107.ZNF	01/19/2016 - 01/20/2016	Portable Handset		Faye 20 01 52



PCTEST Hearing-Aid Compatibility Facility

DUT: HH Coil - SN925

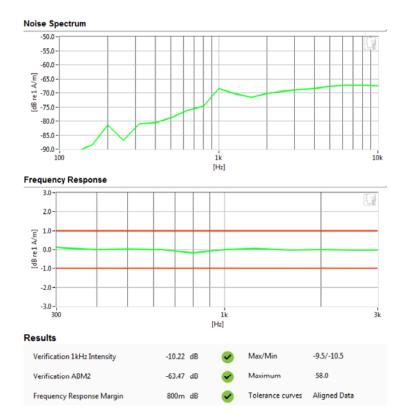
Type: HH Coil Serial: 925

Measurement Standard: ANSI C63.19-2011

Equipment:

Probe: Radial T-Coil Probe – SN: TEM-1129; Calibrated: 01/29/2015

• Helmholtz Coil - SN: 925; Calibrated: 01/29/2015



FCC ID: ZNFL81AL	POTEST*	HAC (T-COIL) TEST REPORT	IL) TEST REPORT LG	
Filename:	Test Dates:	EUT Type:		Page 29 of 52
0Y1601180107.ZNF	01/19/2016 - 01/20/2016	Portable Handset		Faye 29 01 52



DUT: ZNFL81AL

Type: Portable Handset Serial: 03595

Measurement Standard: ANSI C63.19-2011

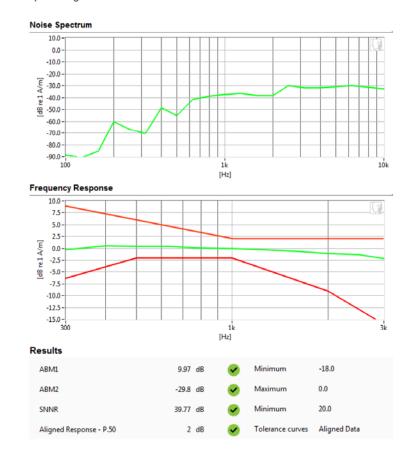
Equipment:

Probe: Axial T-Coil Probe – SN: TEM-1123; Calibrated: 01/29/2015

Test Configuration:

Mode: GSM850Channel: 251

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



FCC ID: ZNFL81AL	PCTEST*	HAC (T-COIL) TEST REPORT	HAC (T-COIL) TEST REPORT	
Filename:	Test Dates:	EUT Type:		Page 30 of 52
0Y1601180107.ZNF	01/19/2016 - 01/20/2016	Portable Handset		rage 30 01 32



DUT: ZNFL81AL

Type: Portable Handset Serial: 03595

Measurement Standard: ANSI C63.19-2011

Equipment:

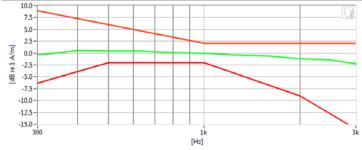
Probe: Axial T-Coil Probe – SN: TEM-1123; Calibrated: 01/29/2015

Test Configuration:

Mode: GSM1900Channel: 512

Speech Signal: ITU-T P.50 Artificial Voice

Noise Spectrum 10.0-0.0 -10.0 -20.0 -20.0 --20.0 --20.0 --20.0 --60.0 -70.0 --80.0 -90.0 **-**[Hz] Frequency Response 10.0 7.5 5.0 -2.5



Results				
ABM1	9.98 dB	•	Minimum	-18.0
ABM2	-33.95 dB	•	Maximum	0.0
SNNR	43.93 dB	V	Minimum	20.0
Aligned Response - P.50	2 dB	✓	Tolerance curves	Aligned Data

FCC ID: ZNFL81AL	PCTEST*	HAC (T-COIL) TEST REPORT	LG	Reviewed by: Quality Manager
Filename:	Test Dates:	EUT Type:		Page 31 of 52
0Y1601180107.ZNF	01/19/2016 - 01/20/2016	Portable Handset		Page 31 01 52



PCTEST Hearing-Aid Compatibility Facility

DUT: ZNFL81AL

Type: Portable Handset Serial: 03595

Measurement Standard: ANSI C63.19-2011

Equipment:

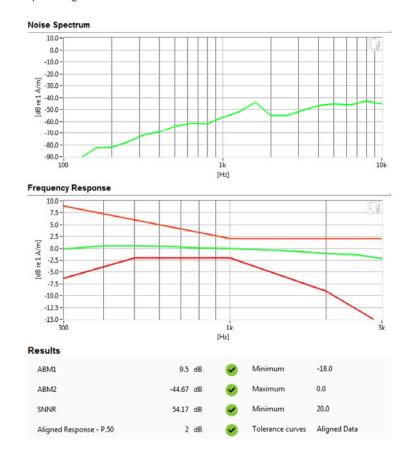
Probe: Axial T-Coil Probe – SN: TEM-1123; Calibrated: 01/29/2015

Test Configuration:

Mode: UMTS Band 5

Channel: 4233

Speech Signal: ITU-T P.50 Artificial Voice



FCC ID: ZNFL81AL	PCTEST*	HAC (T-COIL) TEST REPORT	① LG	Reviewed by: Quality Manager
Filename:	Test Dates:	EUT Type:		Page 32 of 52
0Y1601180107.ZNF	01/19/2016 - 01/20/2016	Portable Handset		Fage 32 01 32



DUT: ZNFL81AL

Type: Portable Handset Serial: 03595

Measurement Standard: ANSI C63.19-2011

Equipment:

Probe: Axial T-Coil Probe – SN: TEM-1123; Calibrated: 01/29/2015

Test Configuration:

Mode: UMTS Band 4Channel: 1312

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

Noise Spectrum 10.0 0.0 -10.0 -20.0 -20.0 --40.0 --50.0 --60.0 -70.0 -80.0 -90.0 **-**[Hz] 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 -12.. -15.0 -300 1k [Hz] Results ABM1 9.43 dB

-45.17 dB

54.61 dB

2 dB

Maximum

Minimum

0.0

20.0

Tolerance curves Aligned Data

PCTEST 2016

FCC ID: ZNFL81AL	POTEST*	HAC (T-COIL) TEST REPORT	① LG	Reviewed by: Quality Manager
Filename:	Test Dates:	EUT Type:		Page 33 of 52
0Y1601180107.ZNF	01/19/2016 - 01/20/2016	Portable Handset		raye 33 01 52

ABM2

SNNR

Aligned Response - P.50



DUT: ZNFL81AL

Type: Portable Handset Serial: 03595

Measurement Standard: ANSI C63.19-2011

Equipment:

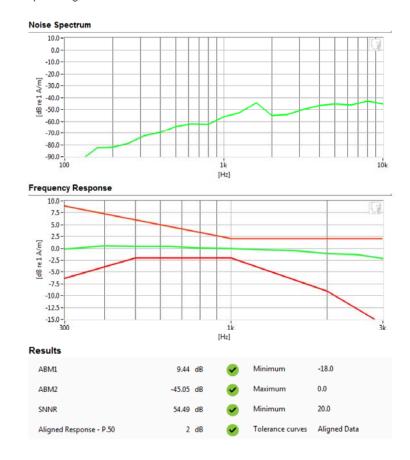
Probe: Axial T-Coil Probe – SN: TEM-1123; Calibrated: 01/29/2015

Test Configuration:

Mode: UMTS Band 2

Channel: 9262

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



FCC ID: ZNFL81AL	PCTEST*	HAC (T-COIL) TEST REPORT	LG	Reviewed by: Quality Manager
Filename:	Test Dates:	EUT Type:		Page 34 of 52
0Y1601180107.ZNF	01/19/2016 - 01/20/2016	Portable Handset		raye 34 01 52



PCTEST Hearing-Aid Compatibility Facility

DUT: ZNFL81AL

Type: Portable Handset Serial: 03595

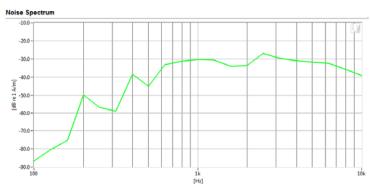
Measurement Standard: ANSI C63.19-2011

Equipment:

Probe: Radial T-Coil Probe – SN: TEM-1129; Calibrated: 01/29/2015

Test Configuration:

Mode: GSM850Channel: 251



Results

ABM1	4.25 dB	\checkmark	Minimum	-18.0
ABM2	-23.5 dB	✓	Maximum	0.0
SNNR	27.74 dB	\checkmark	Minimum	20.0

FCC ID: ZNFL81AL	PCTEST*	HAC (T-COIL) TEST REPORT	① LG	Reviewed by: Quality Manager
Filename:	Test Dates:	EUT Type:		Page 35 of 52
0Y1601180107.ZNF	01/19/2016 - 01/20/2016	Portable Handset		Fage 35 01 52



PCTEST Hearing-Aid Compatibility Facility

DUT: ZNFL81AL

Type: Portable Handset Serial: 03595

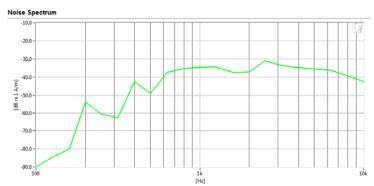
Measurement Standard: ANSI C63.19-2011

Equipment:

Probe: Radial T-Coil Probe – SN: TEM-1129; Calibrated: 01/29/2015

Test Configuration:

Mode: GSM1900Channel: 661



Results

ABM1	4.24	dB	\checkmark	Minimum	-18.0
ABM2	-27.51	dB	\checkmark	Maximum	0.0
SNNR	31.75	dB	•	Minimum	20.0

FCC ID: ZNFL81AL	POTEST*	HAC (T-COIL) TEST REPORT	① LG	Reviewed by: Quality Manager
Filename:	Test Dates:	EUT Type:		Page 36 of 52
0Y1601180107.ZNF	01/19/2016 - 01/20/2016	Portable Handset		raye 30 01 52



PCTEST Hearing-Aid Compatibility Facility

DUT: ZNFL81AL

Type: Portable Handset Serial: 03595

Measurement Standard: ANSI C63.19-2011

Equipment:

Probe: Radial T-Coil Probe – SN: TEM-1129; Calibrated: 01/29/2015

Test Configuration:

SNNR

Mode: UMTS Band 5Channel: 4233



49.01 dB

20.0

Minimum

PCTEST 2016

FCC ID: ZNFL81AL	POTEST*	HAC (T-COIL) TEST REPORT	① LG	Reviewed by: Quality Manager
Filename:	Test Dates:	EUT Type:		Page 37 of 52
0Y1601180107.ZNF	01/19/2016 - 01/20/2016	Portable Handset		Fage 37 01 32



PCTEST Hearing-Aid Compatibility Facility

DUT: ZNFL81AL

Type: Portable Handset Serial: 03595

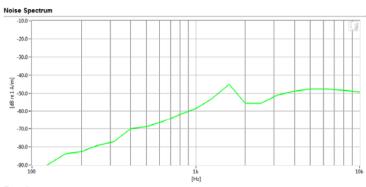
Measurement Standard: ANSI C63.19-2011

Equipment:

Probe: Radial T-Coil Probe – SN: TEM-1129; Calibrated: 01/29/2015

Test Configuration:

Mode: UMTS Band 4Channel: 1312



Results

ABM1	3.94	dB	\checkmark	Minimum	-18.0
ABM2	-45.85	dB	•	Maximum	0.0
SNNR	49.79	dB	•	Minimum	20.0

PCTEST 2016

FCC ID: ZNFL81AL	PCTEST*	HAC (T-COIL) TEST REPORT	① LG	Reviewed by: Quality Manager
Filename:	Test Dates:	EUT Type:		Page 38 of 52
0Y1601180107.ZNF	01/19/2016 - 01/20/2016	Portable Handset		raye 30 01 52



PCTEST Hearing-Aid Compatibility Facility

DUT: ZNFL81AL

Type: Portable Handset Serial: 03595

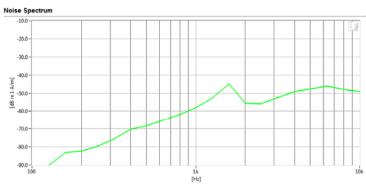
Measurement Standard: ANSI C63.19-2011

Equipment:

Probe: Radial T-Coil Probe – SN: TEM-1129; Calibrated: 01/29/2015

Test Configuration:

Mode: UMTS Band 2Channel: 9262



Results

ABM1	3.93	dB	\checkmark	Minimum	-18.0
ABM2	-45.67	dB	\checkmark	Maximum	0.0
SNNR	49.6	dB	\checkmark	Minimum	20.0

PCTEST 2016

FCC ID: ZNFL81AL	PCTEST*	HAC (T-COIL) TEST REPORT	① LG	Reviewed by: Quality Manager
Filename:	Test Dates:	EUT Type:		Page 39 of 52
0Y1601180107.ZNF	01/19/2016 - 01/20/2016	Portable Handset		Fage 39 01 52

11. CALIBRATION CERTIFICATES

FCC ID: ZNFL81AL	PCTEST	HAC (T-COIL) TEST REPORT	① LG	Reviewed by: Quality Manager
Filename:	Test Dates:	EUT Type:		Page 40 of 52
0Y1601180107.ZNF	01/19/2016 - 01/20/2016	Portable Handset		Fage 40 01 52



Certificate of Calibration

for

Axial T Coil Probe

Manufactured by:

TEM CONSULTING

Model No:

Axial T Coil Probe

Serial No: Calibration Recall No: TEM-1123 24931

Submitted By:

Customer:

ANDREW HARWELL

Company: Address: PCTEST ENGINEERING LAB

6660-B DOBBIN ROAD

COLUMBIA

MD 21045

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

West Caldwell Calibration Laboratories Procedure No.

Axial T Coi TEM

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

Within (X

VASH

3/17/2015

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

West Caldwell Calibration Laboratories' calibration control system meets the requirements, ISO 10012-1 MIL-STD-45662A, ANSI/NCSL Z540-1, IEC Guide 25, ISO 9001:2008 and ISO 17025.

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

Approved by:

Calibration Date:

29-Jan-15

FC

Certificate No:

24931 - 1

Felix Christopher (QA Mgr.) ISO/IEC 17025:2005

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

Certificate Page 1 of 1

ACCREDITED

West Caldwell
Calibration
uncompromised calibration Laboratories, Inc.

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

Calibration Lab. Cert. # 1533.01

 FCC ID: ZNFL81AL
 HAC (T-COIL) TEST REPORT
 Reviewed by: Quality Manager

 Filename:
 Test Dates:
 EUT Type:

 0Y1601180107.ZNF
 01/19/2016 - 01/20/2016
 Portable Handset

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REV 3.1.M



ACCREDITED

Calibration Lab. Cert. # 1533.01

ISO/IEC 17025: 2005

tor NY 14564 Calibr

1575 State Route 96, Victor NY 14564

REPORT OF CALIBRATION

fo

Model No.: Axial T Coil Probe

Serial No.: TEM-1123

Company: PCTEST Engineering Lab.

TEM Consulting LP Axial T Coil Probe

I. D. No: 80582

Calibration results:			Before data:	After data	:
Probe Sensitivity measured wit	h Helmholt	z Coil			
Helmholtz Coil;			Before & after	er data same	:X
the number of turns on each coil;	10	No.			
the radius of each coil, in meters;	0.204	m	Laboratory Environ	ment:	
the current in the coils, in amperes.;	0.09	Α	Ambient Temperature:	21.0	°C
Helmholtz Coil Constant;	7.09	A/m/V	Ambient Humidity:	25.4	% RH
Helmholtz Coil magnetic field;	6.08	A/m	Ambient Pressure:	99.5	kPa
			Calibration Date:	29-Jan-15	
Probe Sensitivity at	1000	Hz.	Re-calibration Due:	29-Jan-16	
was	-60.13	dBV/A/m	Report Number:	24931	-1
	0.985	mV/A/m	Control Number:	24931	
Probe resistance	892	Ohms			

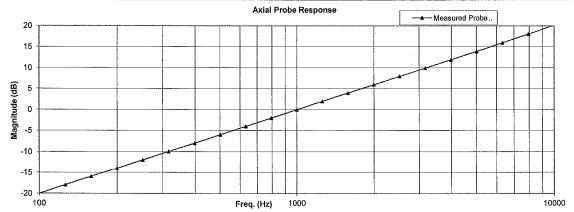
The above listed instrument meets or exceeds the tested manufacturer's specifications.

This Calibration is traceable through NIST test numbers:

683/284413-14

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

Graph represents Probes Frequency Response.



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

Calibration Laboratories Inc. procedure:

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: 29-Jan-2015 Calibrated on WCCL system type 9700 Measurements performed by:

Felix Christopher

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

Page 1 of 2

FCC ID: ZNFL81AL	PCTEST*	HAC (T-COIL) TEST REPORT	① LG	Reviewed by: Quality Manager
Filename:	Test Dates:	EUT Type:		Page 42 of 52
0Y1601180107.ZNF	01/19/2016 - 01/20/2016	Portable Handset		Fage 42 01 52

HCATEMC_TEM-1123_Jan-29-2015

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

Model No.: Axial T Coil Probe

Serial No.: TEM-1123

Company: PCTEST Engineering Lab.

Test Function		Tolera	nce	Measured values			
				Before	Out	Remarks	
1.0	Probe Sensitivity at	1000 Hz.	dBV/A/m	-60.13			
	-11-11		dB				
2.0	Probe Level Linearity		6	5.57			
		Ref. (0 dB)	0	0.00			
			-6	-5.95			
			-12	-11.95			
	*******		Hz				
3.0	Probe Frequency Response		100	-20.0			
		126	-17.9				
			158	-15.9			
		200	-14.0				
			251	-12.0			
			316	-10.0			
			398	-8.0			
			501	-6.0			
			631	-4.0			
			794	-2.0			
		Ref. (0 dB)	1000	0.0			
			1259	2.0			
			1585	4.0			
			1995	6.0			
			2512	7.9			
			3162	9.9			
			3981	11.9			
			5012	13.9			
			6310	15.9			
			7943	18.0			
			10000	20.2			
						1	

Instruments used for calibration:				Date of Cal.	Traceablity No.	Due Date
HP	34401A	S/N 3	6064102	6-Oct-2014	,287708	6-Oct-2015
HP	34401A	S/N 3	6102471	6-Oct-2014	,287708	6-Oct-2015
HP	33120A	S/N 3	6043716	6-Oct-2014	,287708	6-Oct-2015
B&K	2133	S/N 1	583254	8-Jan-2015	683/284413-14	9-Jan-2016

Cal. Date: 29-Jan-2015

Calibrated on WCCL system type 9700

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Tested by: Felix Christopher

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

Page 2 of 2

FCC ID: ZNFL81AL	PCTEST*	HAC (T-COIL) TEST REPORT	① LG	Reviewed by: Quality Manager
Filename:	Test Dates:	EUT Type:		Page 43 of 52
0Y1601180107.ZNF	01/19/2016 - 01/20/2016	Portable Handset		raye 43 01 52



Certificate of Calibration

Radial T Coil Probe

Manufactured by:

TEM CONSULTING Radial T Coil Probe

Model No: Serial No:

TEM-1129

24931 Calibration Recall No:

Submitted By:

Customer:

ANDREW HARWELL

Company:

PCTEST ENGINEERING LAB

Address:

6660-B DOBBIN ROAD

COLUMBIA MD 21045

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

West Caldwell Calibration Laboratories Procedure No.

Radial T C TEM

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

VASH 3/17/2015

(X) Within

West Caldwell Calibration Laboratories' calibration control system meets the requirements, ISO 10012-1 MIL-STD-45662A, ANSI/NCSL Z540-1, IEC Guide 25, ISO 9001:2008 and ISO 17025.

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

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

Approved by:

Calibration Date:

29-Jan-15

Certificate No:

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

24931 - 2

Certificate Page 1 of 1

Felix Christopher (QA Mgr.) ISO/IEC 17025:2005

Calibration Lab. Cert. # 1533.01

West Caldwell Calibration uncompromised calibration Laboratories, Inc.

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

FCC ID: ZNFL81AL

HAC (T-COIL) TEST REPORT

Reviewed by:

Quality Manager

EUT Type:

Portable Handset

Page 44 of 52

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HCRTEMC_TEM-1129_Jan-29-2015



ISO/IEC 17025: 2005

ACCREDITED

Calibration Lab. Cert. # 1533.01

1575 State Route 96, Victor NY 14564

REPORT OF CALIBRATION

for

TEM Consulting LP Radial T Coil Probe

Model No.: Radial T Coil Probe

Serial No.: TEM-1129

Company: PCTEST Engineering Lab.

I. D. No: 80583

alibration results:			Before data:	After data	:
Probe Sensitivity measured wi	th Helmholf	tz Coil			
Helmholtz Coil;			Before & after	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	nment:	
the current in the coils, in amperes.;	0.09	Α	Ambient Temperature:	21.0	°C
Helmholtz Coil Constant;	7.09	A/m/V	Ambient Humidity:	25.4	% RH
Helmholtz Coil magnetic field;	5.99	A/m	Ambient Pressure:	99.5	kPa
			Calibration Date:	29-Jan-15	
Probe Sensitivity at	1000	Hz.	Re-calibration Due:	29-Jan-16	
was	-60.44	dBV/A/m	Report Number:	24931	-2
	0.950	mV/A/m	Control Number:	24931	
Probe resistance	892	Ohms			

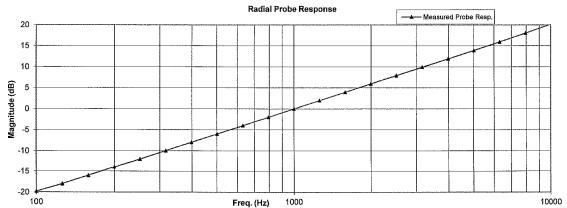
The above listed instrument meets or exceeds the tested manufacturer's specifications.

This Calibration is traceable through NIST test numbers:

683/284413-14

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

Graph represents Probes Frequency Response.



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

Calibration Laboratories Inc. procedure:

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: 29-Jan-2015

Calibrated on WCCL system type 9700

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

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Page 1 of 2

FCC ID: ZNFL81AL	PCTEST*	HAC (T-COIL) TEST REPORT	① LG	Reviewed by: Quality Manager
Filename:	Test Dates:	EUT Type:		Page 45 of 52
0Y1601180107.ZNF	01/19/2016 - 01/20/2016	Portable Handset		Fage 45 01 52

HCRTEMC_TEM-1129_Jan-29-2015

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

Model No.: Radial T Coil Probe

Serial No.: TEM-1129

Company: PCTEST Engineering Lab.

Function	Tolerance		Measured values		
			Before	Out	Remarks
Probe Sensitivity at	1000 Hz.	dBV/A/m	-60.44		
		dB			
Probe Level Linearity		6	5.99		
	Ref. (0 dB)	0	0.00		
		-6	-6.02		
		-12	-12.04		
		Hz			
Probe Frequency Response			1		
					1
					İ
			1 1		
			1 1		
	Ref. (0 dB)				
			1 1		
			1 1		
		10000	20.2		
	Probe Sensitivity at	Probe Sensitivity at 1000 Hz. Probe Level Linearity Ref. (0 dB)	Probe Sensitivity at 1000 Hz. dBV/A/m Probe Level Linearity 6 Ref. (0 dB) 0 -6 -12 Hz Probe Frequency Response 100 126 158 200 251 316 398 501 631 794	Probe Sensitivity at 1000 Hz. dBV/A/m -60.44 Probe Level Linearity 6 5.99 Ref. (0 dB) 0 0.00 -6 -6.02 -12 -12.04 Probe Frequency Response 100 -19.8 126 -18.0 158 -16.0 200 -13.9 251 -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 1585 4.0 1995 6.0 2512 7.9 3162 9.9 3981 11.9 5012 13.9 6310 16.0 7943 18.0	Probe Sensitivity at 1000 Hz. dBV/A/m -60.44 Probe Level Linearity Ref. (0 dB) R

Instruments used for calibrati	on:		Date of Cal.	Traceability No.	Due Date
HP	34401A	S/N 36064102	6-Oct-2014	,287708	6-Oct-2015
HP	34401A	S/N 36102471	6-Oct-2014	,287708	6-Oct-2015
HP	33120A	S/N 36043716	6-Oct-2014	,287708	6-Oct-2015
B&K	2133	S/N 1583254	8-Jan-2015	683/284413-14	9-Jan-2016

Cal. Date: 29-Jan-2015

Calibrated on WCCL system type 9700

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Tested by: Felix Christopher

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

Page 2 of 2

FCC ID: ZNFL81AL	HAC (T-COIL) TEST REPORT		① LG	Reviewed by: Quality Manager
Filename:	Test Dates:	EUT Type:		Page 46 of 52
0Y1601180107.ZNF	01/19/2016 - 01/20/2016	Portable Handset		raye 40 01 52

12. 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: ZNFL81AL	PCTEST	HAC (T-COIL) TEST REPORT	① LG	Reviewed by: Quality Manager
Filename:	Test Dates:	EUT Type:		Page 47 of 52
0Y1601180107.ZNF	01/19/2016 - 01/20/2016	Portable Handset		Fage 47 01 52

13. REFERENCES

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FCC ID: ZNFL81AL	PCTEST	HAC (T-COIL) TEST REPORT	① LG	Reviewed by: Quality Manager
Filename:	Test Dates:	EUT Type:		Page 48 of 52
0Y1601180107.ZNF	01/19/2016 - 01/20/2016	Portable Handset		Fage 46 01 52

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FCC ID: ZNFL81AL	PCTEST*	HAC (1-COIL) TEST REPORT		Reviewed by: Quality Manager
Filename:	Test Dates:	EUT Type:		Page 49 of 52
0Y1601180107.ZNF	01/19/2016 - 01/20/2016	Portable Handset		Fage 49 01 52