PCTEST ENGINEERING LABORATORY, INC.

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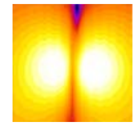


HEARING AID COMPATIBILITY

Applicant Name:
LG Electronics MobileComm U.S.A. Inc.
1000 Sylvan Avenue
Englewood Cliffs, NJ 07632
United States

Date of Testing:
08/14/2017 - 08/17/2017
Test Site/Location:
PCTEST Lab, Columbia, MD, USA
Test Report Serial No.:
1M1708030234-11.ZNF

FCC ID:	**ZNFG011C**
APPLICANT:	**LG ELECTRONICS MOBILECOMM U.S.A. INC.**

Scope of Test:	Audio Band Magnetic Testing (T-Coil)
Application Type:	Class II Permissive Change
FCC Rule Part(s):	CFR §20.19(b)
HAC Standard:	ANSI C63.19-2011 285076 D01 HAC Guidance v04 285076 D02 T-Coil testing for CMRS IP v02
DUT Type:	Portable Handset
Model:	G011C
Test Device Serial No.:	*Pre-Production Sample* [S/N: 15164]
Class II Permissive Change(s):	See FCC Change Document

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

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

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

Randy Ortanez
President

ACCREDITED
TESTING CERT#2041.01

TABLE OF CONTENTS

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-8658[1] 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.

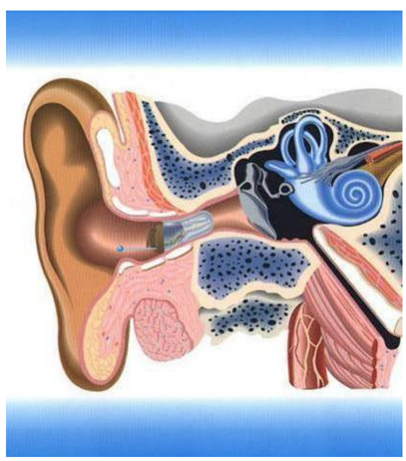


Figure 1-1 Hearing Aid *in-vitu*

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

2. DUT DESCRIPTION

FCC ID:	ZNFG011C
Applicant:	LG Electronics MobileComm U.S.A. Inc. 1000 Sylvan Avenue Englewood Cliffs, NJ 07632 United States
Model:	G011C
Serial Number:	15164
HW Version:	Rev.1.0
SW Version:	G011C05h
Antenna:	Internal Antenna
HAC Test Configurations:	Secondary Cellular CDMA, 476, 564, 684, BT Off, WLAN Off, LTE Off 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 IV, 1312, 1412, 1513, BT Off, WLAN Off, LTE Off UMTS II, 9262, 9400, 9538, BT Off, WLAN Off, LTE Off LTE FDD B7; BW's: 20MHz, 15MHz, 10MHz, 5MHz; BT Off, WLAN Off LTE FDD B12; BW's: 10MHz, 5MHz, 3MHz, 1.4MHz; BT Off, WLAN Off LTE FDD B13; BW's: 10MHz, 5MHz; BT Off, WLAN Off LTE FDD B25; BW's: 20MHz, 15MHz, 10MHz, 5MHz, 3MHz, 1.4MHz; BT Off, WLAN Off LTE FDD B26; BW's: 15MHz, 10MHz, 5MHz, 3MHz, 1.4MHz; BT Off, WLAN Off LTE FDD B30; BW's: 10MHz, 5MHz; BT Off, WLAN Off LTE FDD B66; BW's: 20MHz, 15MHz, 10MHz, 5MHz, 3MHz, 1.4MHz; BT Off, WLAN Off LTE TDD B41; BW's: 20MHz, 15MHz, 10MHz, 5MHz; BT Off, WLAN Off * Note: LTE test channels for different bands and bandwidths can be found in Sect. 7.II
DUT Type:	Portable Handset

Table 2-1: ZNFG011C HAC Air Interfaces

Air-Interface	Band (MHz)	Type Transport	HAC Tested	Simultaneous But Not Tested	Voice over Digital Transport OTT Capability	Additional GSM Power Reduction
CDMA	835	VO	Yes	Yes: WIFI or BT	N/A	N/A
	1900					
	EVDO	DT	No	Yes: WIFI or BT	Yes	N/A
GSM	850	VO	Yes	Yes: WIFI or BT	N/A	No
	1900					
	GPRS/EDGE	DT	No	Yes: WIFI or BT	Yes	No
UMTS	850	VD	Yes	Yes: WIFI or BT	N/A	N/A
	1700					
	1900					
	HSPA	DT	No	Yes: WIFI or BT	Yes	N/A
LTE (FDD)	700 (B12)	VD	Yes	Yes: WIFI or BT	Yes	N/A
	700 (B17)					
	780 (B13)					
	850 (B5)					
	850 (B26)					
	1700 (B4)					
	1700 (B66)					
	1900 (B2)					
	1900 (B25)					
	2300 (B30)					
	2500 (B7)					
LTE (TDD)	2600 (B41)	VD	Yes	Yes: WIFI or BT	Yes	N/A
WIFI	2450	VD	No[1]	Yes: CDMA, GSM, UMTS, or LTE	Yes	N/A
	5200					
	5300					
	5500					
	5800					
BT	2450	DT	No	Yes: CDMA, GSM, UMTS, or LTE	N/A	N/A

Type Transport
VO = Voice Only
DT = Digital Data - Not intended for CMRS Service
VD = CMRS and Data Transport

Notes:
1. Not tested in accordance with the guidance issued by OET in KDB publication 285076 D02 T-Coil testing for CMRS IP.

I. LTE Band Selection

This device supports the following pairs of LTE bands with similar frequencies: LTE B12 & B17, B26 & B5, B66 & B4 and B25 & 2. These pairs of LTE bands have the same target power and share the same transmission path. Since the supported frequency spans for the smaller LTE bands are completely covered by the larger LTE bands, only the larger LTE bands (LTE B12, B26, B66 and B25) were evaluated for hearing-aid compliance.

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 ≥ -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.

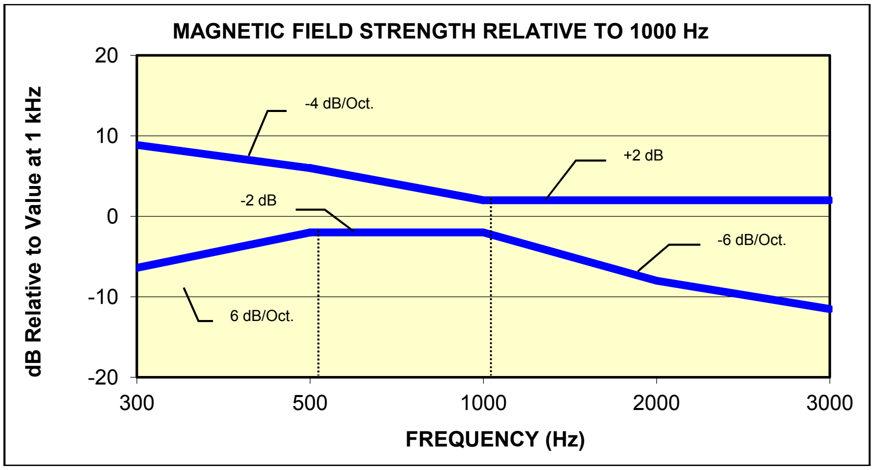


Figure 3-1
Magnetic field frequency response for Wireless Devices with an axial field ≤-15 dB(A/m) at 1 kHz

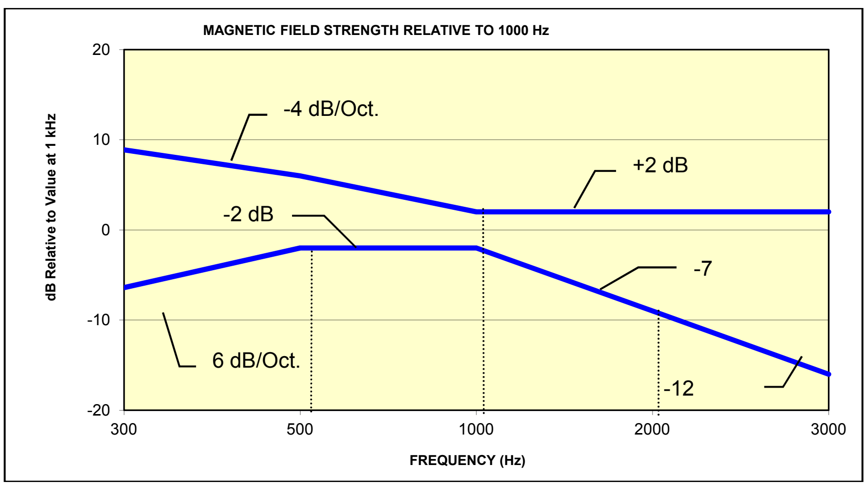


Figure 3-2
Magnetic Field frequency response for wireless devices with an axial field that exceeds -15 dB(A/m) at 1 kHz

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
	Wireless Device Signal Quality [(Signal + Noise)-to-noise ratio in dB]
T1	0 to 10 dB
T2	10 to 20 dB
T3	20 to 30 dB
T4	> 30 dB

Table 3-1
Magnetic Coupling Parameters

4. METHOD OF MEASUREMENT

I. Test Setup

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

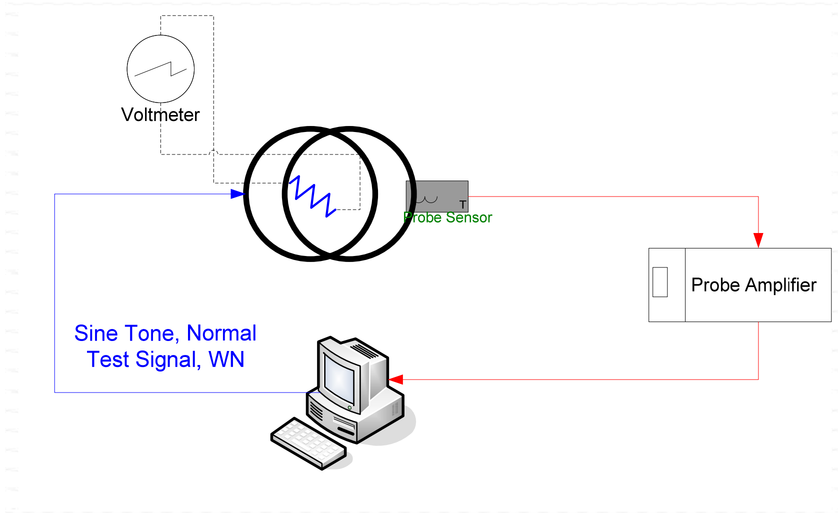


Figure 4-1
Validation Setup with Helmholtz Coil

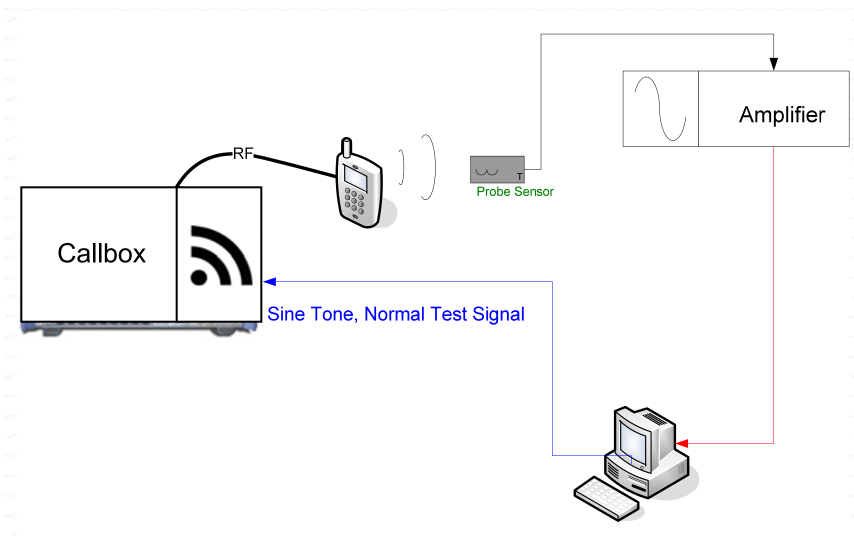


Figure 4-2
T-Coil Test Setup

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)

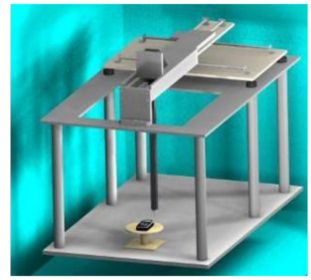


Figure 4-3
RF Near-Field Scanner

III. 3GPP2 Normal Test Signal (Speech)

Manufacturer:	3GPP2 (TIA 1042 §3.3.1)
Stimulus Type:	Modified-IRS weighted, multi-talker speech signal, 4 Male and 4 Female speakers (alternating)
Single Sample Duration:	51.62 seconds
Activity Level:	77.4%

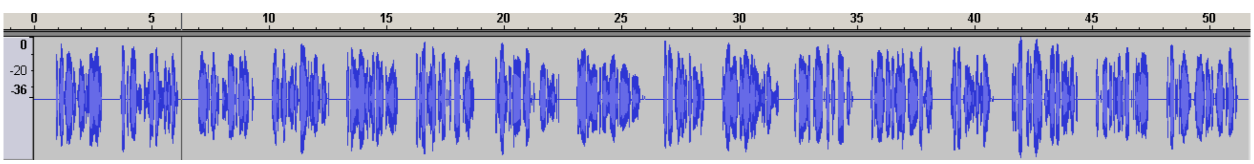
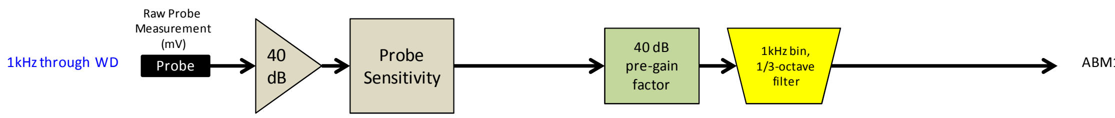


Figure 4-4
Temporal Characteristic of Normal Test Signal

ABM1 Measurement Block Diagram:



ABM2 Measurement Block Diagram:

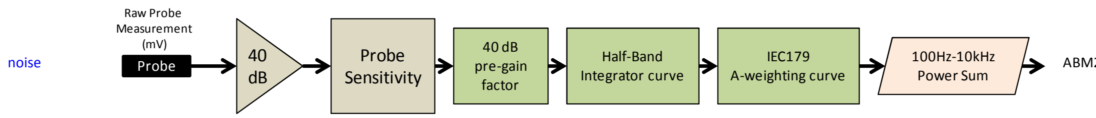


Figure 4-5 Magnetic Measurement Processing Steps

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:
   -18 - 30 - 10= -58 dBA/m

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:

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

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 ± 0.5 dB of the -10dB(A/m) value (see Page 34).

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 Normal signal as shown below:

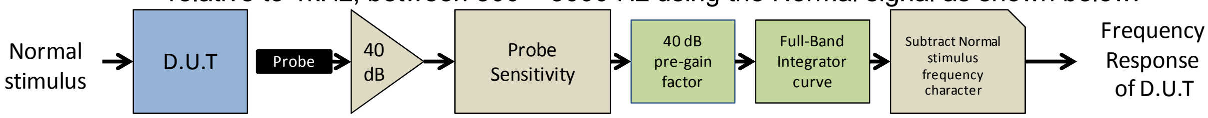


Figure 4-6 Frequency Response Validation

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

f (Hz)	HBI, A - Measured (dB re 1kHz)	HBI, A - Theoretical (dB re 1kHz)	dB Var.
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

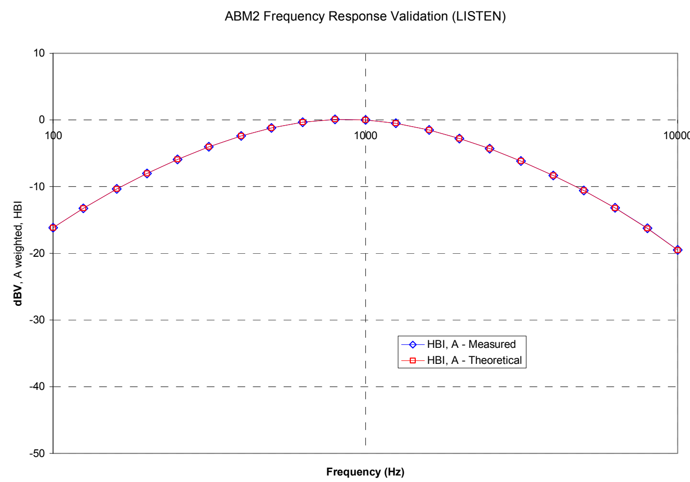


Figure 4-7
ABM2 Frequency Response Validation

The ABM2 result is a power sum from 100Hz to 10kHz with half-band integration and A-weighting. To verify the power sum measurement, a power sum over the full band was measured and verified to track with the source level (See Figure 4-8). Therefore the setup in this step was used to verify the power sum post-processing for ABM2 measurements. See below block diagram:

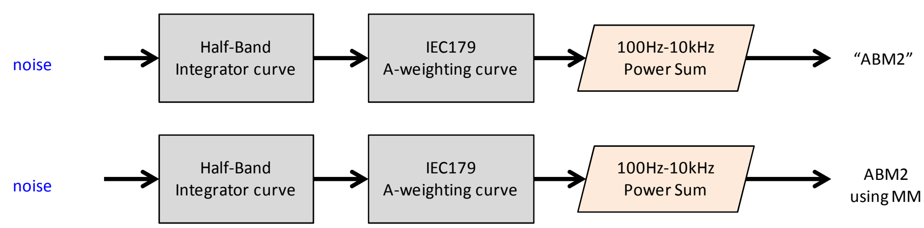


Figure 4-8
ABM2 Validation Block Diagram

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

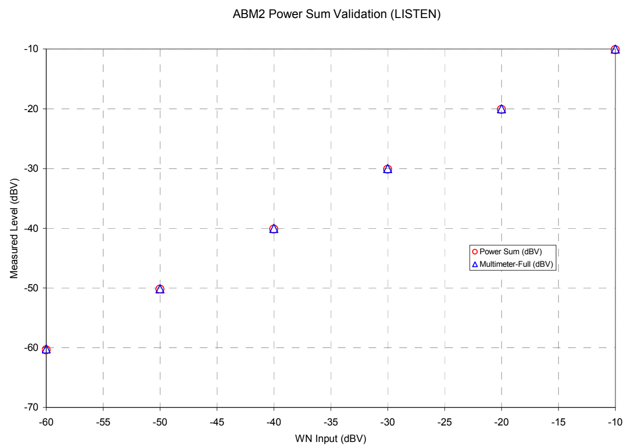


Figure 4-9
ABM2 Power Sum Validation

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 4-11, the grid is not to scale but merely a graphical representation of the coordinate system in use):

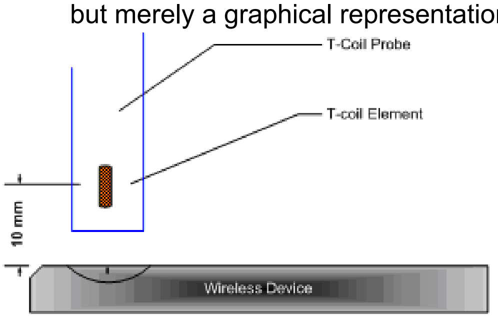


Figure 4-10
Measurement Distance

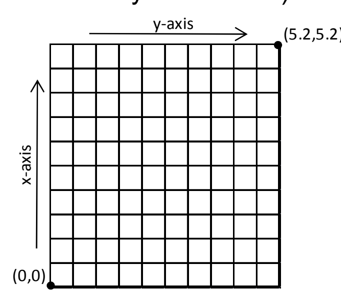


Figure 4-11
Measurement Grid

      ii. After scanning, the planar field maximum point was determined. The position of the probe was moved to this location to setup the test using the SoundCheck system.
      iii. These steps were repeated for all T-coil orientations (axial and radial) per Figure 4-15 after a T-coil orientation was fully measured with the SoundCheck system.
   b. Speech Signal Setup to Base Station Simulator
      i. C63.19 Table 7-1 states audio reference input levels for various technologies:

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

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

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.	Voltage		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

ii. See Section 5 for more information regarding CMW500 audio level settings for Voice Over LTE (VoLTE) testing.

c. Real-Time Analyzer (RTA)
   i. The Real-Time Analyzer was configured to analyze measurements using 1/3 Octave band weighted filtering.

d. WD Radio Configuration Selection
   i. The device was chosen to be tested in the worst-case ABM2 condition (see below for GSM, see Section 6 for more information regarding worst-case configurations for CDMA and UMTS. LTE configuration information can be found in Section 5):

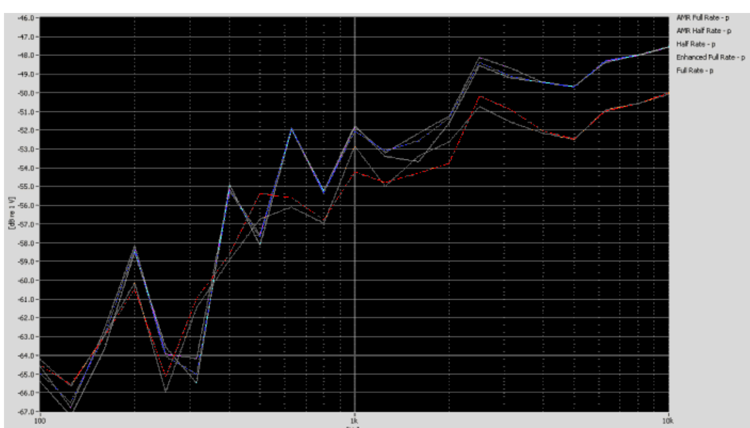


Figure 4-12
Vocoder Analysis for ABM Noise for GSM

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.
    b. Frequency Response
        i. The appropriate frequency response curve was measured to curves in Figure 3-1 or Figure 3-2 between 300 – 3000 Hz using digital linear averaging (limit lines chosen according to measurement found in step 4a). A linear average over 3x the length of the artificial voice signal (3x sampling) was performed. A 10 second delay was configured in the measurement process of the stimulus to ensure handset vocoder latency effects and echo cancellation devices (if any) were appropriately stabilized during measurements.
        ii. The appropriate post-processing was applied according to the system processing chain illustrated in Figure 4-6. All R10 frequencies were plotted with respect to 0dB at 1kHz value and aligned with respect to the EIA-504 mask.
        iii. The margin is represented by the closest measured data point on the curve to the EIA-504 limit lines, in dB.
    c. Signal Quality Index
        i. Ensuring the WD was at maximum RF power, maximum volume, backlight off, display on, maximum contrast setting, keypad lights on (when possible) with no audio signal through the vocoder, the WD was measured over at least 100 Hz – 10,000 Hz, maximized over 5 seconds with a 50ms sample time for the ABM2 measurement (5 second time period is used in noise measurements under standards such as IEEE 269, etc.).
        ii. After applying half-band integration and A-weighting to the result, a power sum was applied over each 1/3 octave bandwidth frequency for an ABM2 value.
        iii. This result was subtracted from the ABM1 result in step a, to obtain the Signal Quality.

V. Test Setup

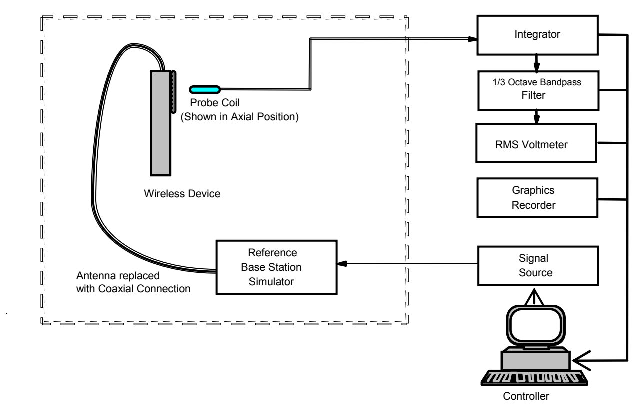


Figure 4-13
Audio Magnetic Field Test Setup

VI. Deviation from C63.19 Test Procedure

Non-conducted RF connection due to shielding effects of battery cover.

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, OTT data services are outside the current definition of a managed CMRS service and are currently not required to be evaluated.

VoIP over WIFI CMRS 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

1. 2G/3G Modes

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

Table 4-4
Center Channels and Frequencies

Test frequencies & associated channels	
Channel	**Frequency (MHz)**
Secondary Cellular 820	
564 (CDMA)	820.10
Cellular 850	
384 (CDMA)	836.52
190 (GSM)	836.60
4183 (UMTS)	836.60
AWS 1750	
1412 (UMTS)	1730.40
PCS 1900	
600 (CDMA)	1880
661 (GSM)	1880
9400 (UMTS)	1880

2. 4G (LTE) Modes

The middle channel for every band and bandwidth combination was tested for each probe orientation. The band and bandwidth combination from each probe orientation resulting in the worst-case SNNR was additionally tested using low and high channels for that band and bandwidth combination. Low mid and mid high channels are additionally tested for LTE TDD Band 41. See Tables 7-10 to 7-18 for LTE bandwidths and channels.

IX. RF Emission Effect on T-coil Measurements

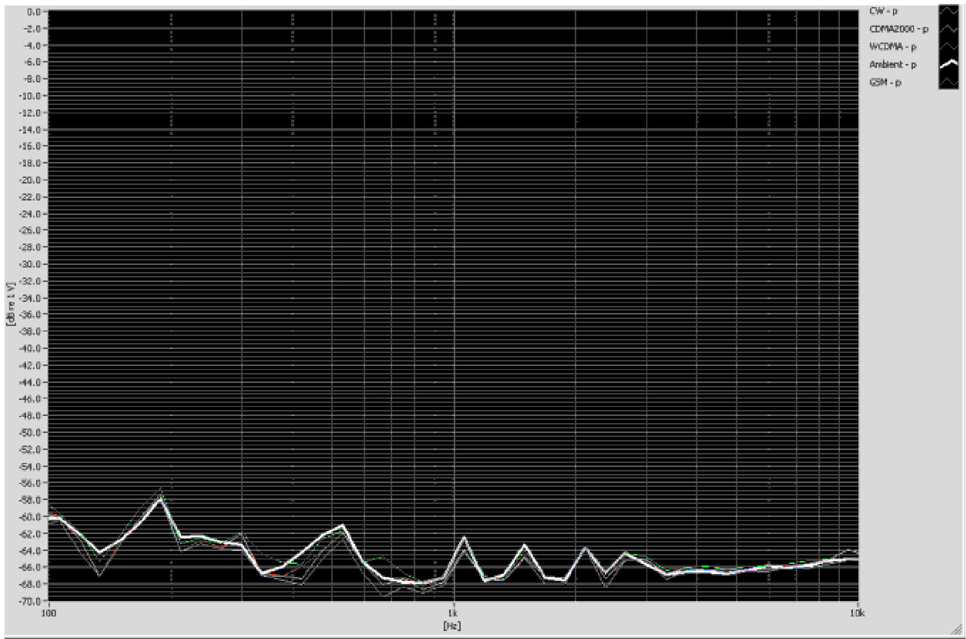


Figure 4-14
High power RF Emissions Effect with HAC Dipole on the T-coil Probe System 10mm between dipole maximum and magnetic probe

X. Test Flow

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

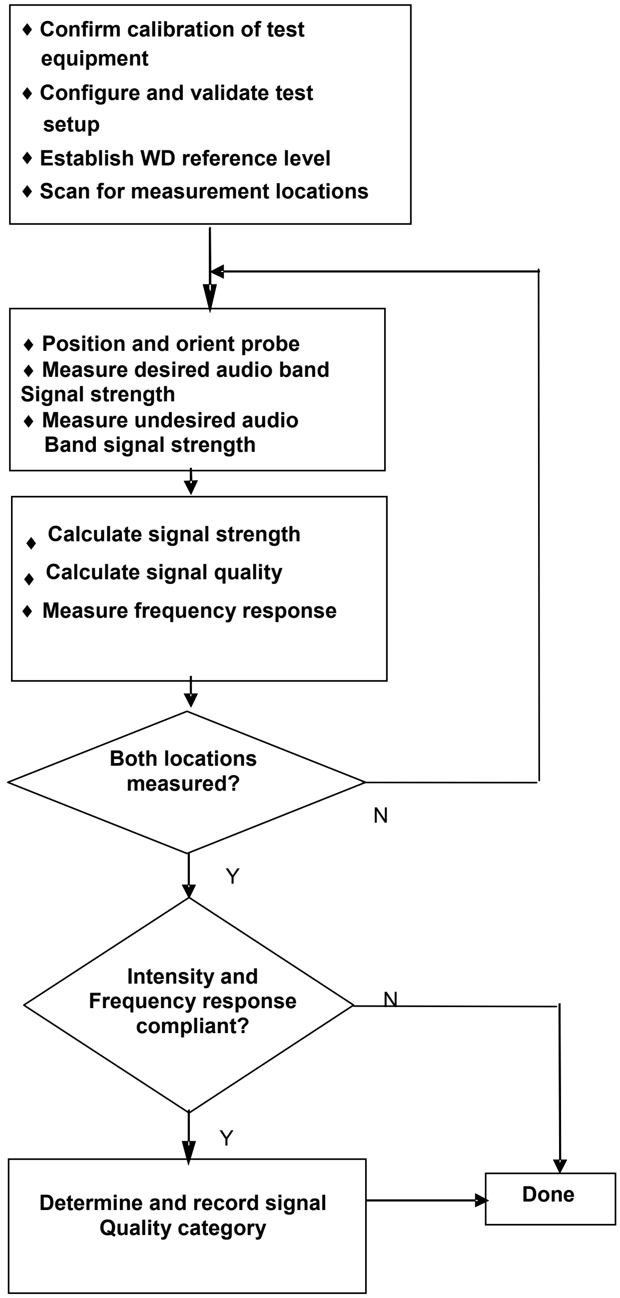


Figure 4-15
C63.19 T-Coil Signal Test Process

5. VOLTE TEST SYSTEM SETUP AND DUT CONFIGURATION

I. Test System Setup for VoLTE T-coil Testing

1. Equipment Setup

The general test setup used for VoLTE is shown below (adopted from FCC KDB 285076 D02). The callbox used when performing VoLTE T-coil measurements is a CMW500. The Data Application Unit (DAU) of the CMW500 was used to simulate the IP Multimedia Subsystem (IMS) server.

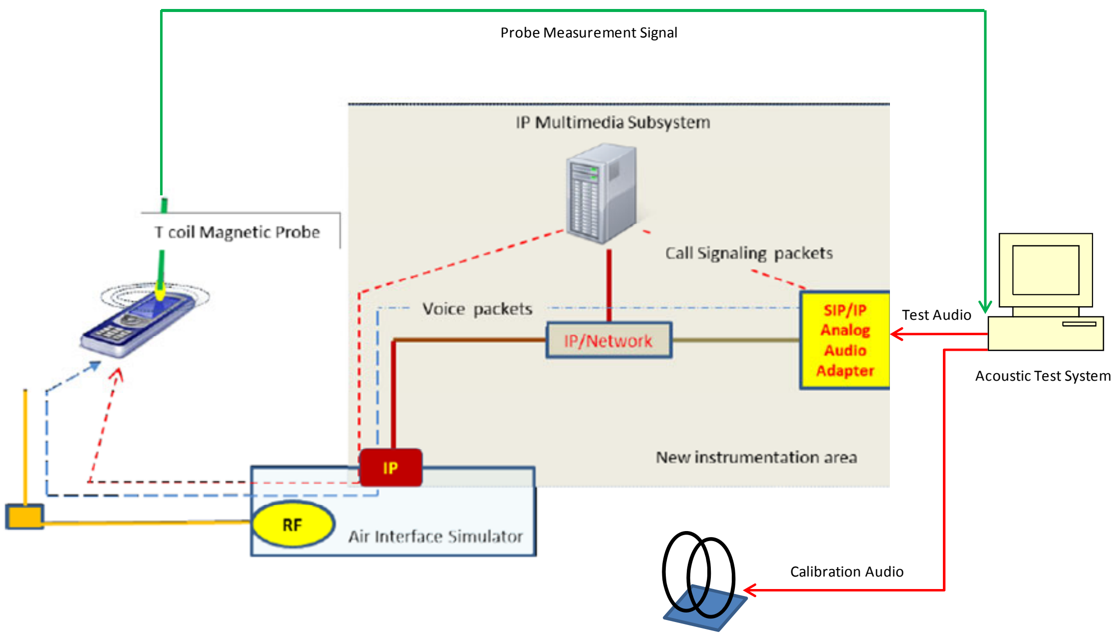


Figure 5-1
Test Setup for VoLTE T-Coil Measurements

2. Audio Level Settings

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

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

II. DUT Configuration for VoLTE T-coil Testing

1. Radio Configuration

An investigation was performed on the worst-case LTE Band and bandwidth combination to determine the modulation and RB configuration to be used for testing. While this device supports 64QAM, this modulation was not evaluated to due to test equipment limitations. 16QAM, 1RB, 0RB offset was used for the testing as the worst-case configuration for the handset. See below table for SNNR comparison between different radio configurations:

Table 5-1
LTE SNNR by Radio Configuration

Frequency [MHz]	Channel	Bandwidth [MHz]	Modulation	RB Size	RB Offset	ABM1 [dB(A/m)]	ABM2 [dB(A/m)]	SNNR [dB]
2593.0	40620	15	QPSK	1	0	15.44	-26.40	41.84
2593.0	40620	15	QPSK	1	36	15.47	-27.13	42.60
2593.0	40620	15	QPSK	1	74	15.31	-26.50	41.81
2593.0	40620	15	QPSK	36	0	15.20	-27.05	42.25
2593.0	40620	15	QPSK	36	18	15.28	-27.48	42.76
2593.0	40620	15	QPSK	36	37	15.46	-27.33	42.79
2593.0	40620	15	QPSK	75	0	15.49	-26.82	42.31
2593.0	40620	15	16QAM	1	0	15.23	-26.16	**41.39**
2593.0	40620	15	16QAM	1	36	15.49	-27.64	43.13
2593.0	40620	15	16QAM	1	74	15.50	-27.62	43.12
2593.0	40620	15	16QAM	36	0	15.48	-28.21	43.69
2593.0	40620	15	16QAM	36	18	15.17	-28.42	43.59
2593.0	40620	15	16QAM	36	37	15.22	-28.22	43.44
2593.0	40620	15	16QAM	75	0	15.15	-27.50	42.65

2. Codec Configuration

An investigation was performed on the worst-case LTE Band and bandwidth combination to determine the audio codec configuration to be used for testing. The NB AMR 4.75kbps setting was used for the audio codec on the CMW500 for VoLTE T-coil testing. See below table for ABM1 and ABM2 comparisons between different codecs and codec data rates:

Table 5-2
FCC 4G ABM Measurements for ZNFG011C

Codec Setting:	WB AMR 23.85kbps	WB AMR 6.60kbps	NB AMR 12.2kbps	NB AMR 4.75kbps	Orientation	Band / BW	Channel
ABM1 Pre-test (dBA/m)	17.56	16.82	15.50	15.26	Axial	Band 41 (PC2) 15MHz BW	40620
ABM2 Pre-test (dBA/m) (A-weight, Half-Band Int.)	-27.32	-27.10	-27.27	-26.28			
S+N/N (dB)	44.88	43.92	42.77	**41.54**			

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

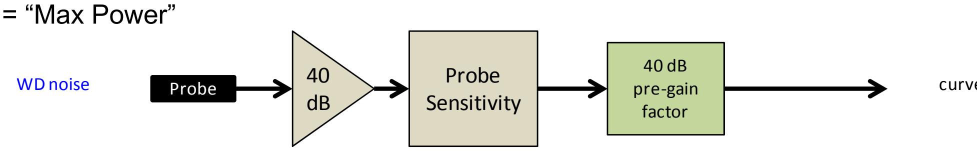


Figure 5-2
Audio Band Magnetic Curve Measurement Block Diagram

3. LTE TDD Uplink-Downlink Configuration Investigation

An investigation was performed to determine the worst-case Uplink-Downlink configuration for LTE TDD T-Coil testing.

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

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

Table 5-3
Uplink-Downlink Configurations for Type 2 Frame Structures

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

a. Power Class 3 Uplink-Downlink Configuration Investigation

LTE TDD was evaluated with the following radio configuration: channel 40620, 20MHz BW, 16QAM, 1RB, 0RB Offset. For Power Class 3, all configurations (0-6) are supported. The configuration which resulted in the worst SNNR was used for full testing. Uplink-Downlink configuration 0 was used as the worst-case configuration for LTE TDD T-Coil testing. See table below for the SNNR comparison between each Uplink-Downlink configuration:

Table 5-4
LTE TDD Power Class 3 SNNR by UL-DL Configuration

Frequency [MHz]	Channel	Bandwidth [MHz]	Modulation	RB Size	RB Offset	UL-DL Configuration	ABM1 [dB(A/m)]	ABM2 [dB(A/m)]	SNNR [dB]
2593.0	40620	20	16QAM	1	0	0	15.12	-25.89	**41.01**
2593.0	40620	20	16QAM	1	0	1	15.28	-26.82	42.10
2593.0	40620	20	16QAM	1	0	2	15.46	-27.03	42.49
2593.0	40620	20	16QAM	1	0	3	15.31	-29.04	44.35
2593.0	40620	20	16QAM	1	0	4	15.35	-28.26	43.61
2593.0	40620	20	16QAM	1	0	5	15.26	-29.34	44.60
2593.0	40620	20	16QAM	1	0	6	15.41	-26.31	41.72

b. Power Class 3 Uplink-Downlink Configuration Investigation

LTE TDD was evaluated with the following radio configuration: channel 40620, 20MHz BW, 16QAM, 1RB, 0RB Offset. For Power Class 2, only configurations 1-5 are supported. The configuration which resulted in the worst SNNR was used for full testing. Uplink-Downlink configuration 1 was used as the worst-case configuration for LTE TDD T-Coil testing. See table below for the SNNR comparison between each Uplink-Downlink configuration:

Table 5-5
LTE TDD Power Class 2 SNNR by UL-DL Configuration

Frequency [MHz]	Channel	Bandwidth [MHz]	Modulation	RB Size	RB Offset	UL-DL Configuration	ABM1 [dB(A/m)]	ABM2 [dB(A/m)]	SNNR [dB]
2593.0	40620	20	16QAM	1	0	1	15.49	-25.78	**41.27**
2593.0	40620	20	16QAM	1	0	2	15.25	-26.90	42.15
2593.0	40620	20	16QAM	1	0	3	15.30	-28.23	43.53
2593.0	40620	20	16QAM	1	0	4	15.53	-29.05	44.58
2593.0	40620	20	16QAM	1	0	5	15.49	-28.62	44.11

c. Conclusion

Per the investigations above, UL-DL Configuration 0 was used to evaluate LTE TDD Power Class 3 and UL-DL Configuration 1 was used to evaluate LTE TDD Power Class 2.

6. 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:

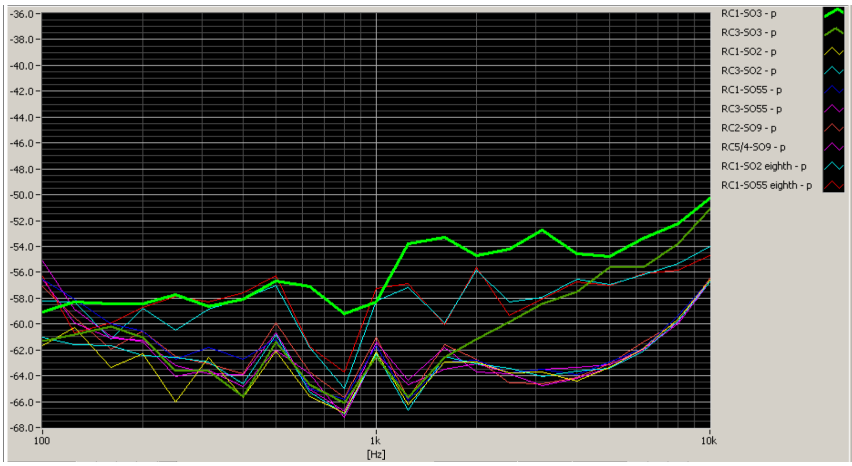


Figure 6-1
CDMA Audio Band Magnetic Noise

Table 6-1
FCC 3G ABM Measurements for ZNFG011C (CDMA)

Codec Setting:	RC1/SO3	RC3/SO3	RC4/SO3	Orientation	Channel
ABM1 Pre-test (dBA/m)	16.68	16.85	16.54	Axial	684
ABM2 Pre-test (dBA/m) (A-weight, Half-Band Int.)	-28.45	-37.18	-37.33		
S+N/N (dB)	**45.13**	54.03	53.87		

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

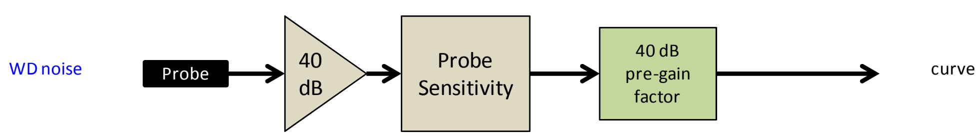


Figure 6-2
Audio Band Magnetic Curve Measurement Block Diagram

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:

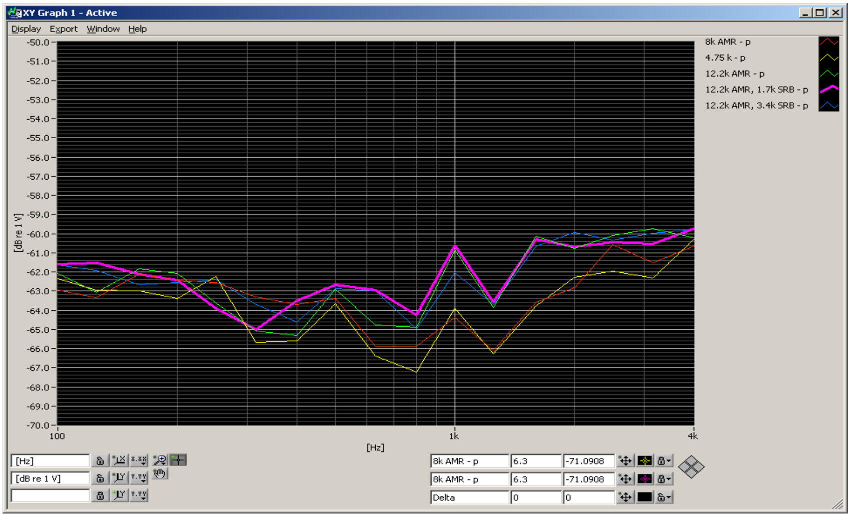


Figure 6-3
UMTS Audio Band Magnetic Noise

Table 6-2
FCC 3G ABM Measurements for ZNFG011C (UMTS)

Codec Setting:	AMR 12.2kbps	AMR 7.95kbps	AMR 4.75kbps	Orientation	Channel
ABM1 Pre-test (dBA/m)	7.20	7.60	6.90	Radial	9538
ABM2 Pre-test (dBA/m) (A-weight, Half-Band Int.)	-47.55	-47.85	-48.64		
S+N/N (dB)	**54.75**	55.45	55.54		

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

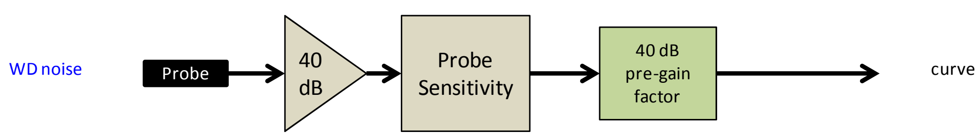


Figure 6-4
Audio Band Magnetic Curve Measurement Block Diagram

7. TEST SUMMARY

I. T-Coil Test Summary

Table 7-1
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	CDMA	Secondary Cellular	Intensity, Axial	-18	16.3	PASS
8.3.1			Intensity, Radial	-18	7.5	PASS
8.3.4			Signal-to-Noise/Noise, Axial	20	45.1	PASS
8.3.4			Signal-to-Noise/Noise, Radial	20	55.2	PASS
8.3.2			Frequency Response, Axial	0	0.4	PASS
8.3.1	CDMA	Cellular	Intensity, Axial	-18	16.2	PASS
8.3.1			Intensity, Radial	-18	7.5	PASS
8.3.4			Signal-to-Noise/Noise, Axial	20	48.0	PASS
8.3.4			Signal-to-Noise/Noise, Radial	20	55.9	PASS
8.3.2			Frequency Response, Axial	0	0.3	PASS
8.3.1	CDMA	PCS	Intensity, Axial	-18	16.5	PASS
8.3.1			Intensity, Radial	-18	7.7	PASS
8.3.4			Signal-to-Noise/Noise, Axial	20	47.0	PASS
8.3.4			Signal-to-Noise/Noise, Radial	20	50.9	PASS
8.3.2			Frequency Response, Axial	0	0.3	PASS

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

Table 7-2
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	GSM	Cellular	Intensity, Axial	-18	19.4	PASS
8.3.1			Intensity, Radial	-18	10.6	PASS
8.3.4			Signal-to-Noise/Noise, Axial	20	34.3	PASS
8.3.4			Signal-to-Noise/Noise, Radial	20	27.2	PASS
8.3.2			Frequency Response, Axial	0	0.1	PASS
8.3.1	GSM	PCS	Intensity, Axial	-18	19.4	PASS
8.3.1			Intensity, Radial	-18	10.6	PASS
8.3.4			Signal-to-Noise/Noise, Axial	20	36.6	PASS
8.3.4			Signal-to-Noise/Noise, Radial	20	35.7	PASS
8.3.2			Frequency Response, Axial	0	0.1	PASS

Note: The above summary table represents the worst-case numerical values according to configurations in Table 7-8.

Table 7-3
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	UMTS	Band 5	Intensity, Axial	-18	16.2	PASS
8.3.1			Intensity, Radial	-18	7.3	PASS
8.3.4			Signal-to-Noise/Noise, Axial	20	56.4	PASS
8.3.4			Signal-to-Noise/Noise, Radial	20	56.7	PASS
8.3.2			Frequency Response, Axial	0	1.2	PASS
8.3.1	UMTS	Band 4	Intensity, Axial	-18	16.2	PASS
8.3.1			Intensity, Radial	-18	7.3	PASS
8.3.4			Signal-to-Noise/Noise, Axial	20	56.1	PASS
8.3.4			Signal-to-Noise/Noise, Radial	20	56.4	PASS
8.3.2			Frequency Response, Axial	0	1.1	PASS
8.3.1	UMTS	Band 2	Intensity, Axial	-18	16.1	PASS
8.3.1			Intensity, Radial	-18	7.3	PASS
8.3.4			Signal-to-Noise/Noise, Axial	20	55.5	PASS
8.3.4			Signal-to-Noise/Noise, Radial	20	54.9	PASS
8.3.2			Frequency Response, Axial	0	1.1	PASS

Note: The above summary table represents the worst-case numerical values according to configurations in Table 7-9.

Table 7-4
Table of Results for LTE FDD

C63.19 Sec.	Mode	Band	Test Description	Minimum Limit*	Measured	Verdict
				dBA/m	*dBA/m*	*PASS/FAIL*
8.3.1	LTE FDD	Band 12	Intensity, Axial	-18	15.2	**PASS**
8.3.1			Intensity, Radial	-18	7.4	**PASS**
8.3.4			Signal-to-Noise/Noise, Axial	20	46.8	**PASS**
8.3.4			Signal-to-Noise/Noise, Radial	20	52.4	**PASS**
8.3.2			Frequency Response, Axial	0	1.3	**PASS**
8.3.1	LTE FDD	Band 13	Intensity, Axial	-18	15.2	**PASS**
8.3.1			Intensity, Radial	-18	7.7	**PASS**
8.3.4			Signal-to-Noise/Noise, Axial	20	42.3	**PASS**
8.3.4			Signal-to-Noise/Noise, Radial	20	51.2	**PASS**
8.3.2			Frequency Response, Axial	0	1.3	**PASS**
8.3.1	LTE FDD	Band 26	Intensity, Axial	-18	14.9	**PASS**
8.3.1			Intensity, Radial	-18	7.4	**PASS**
8.3.4			Signal-to-Noise/Noise, Axial	20	46.5	**PASS**
8.3.4			Signal-to-Noise/Noise, Radial	20	51.7	**PASS**
8.3.2			Frequency Response, Axial	0	1.3	**PASS**
8.3.1	LTE FDD	Band 66	Intensity, Axial	-18	14.9	**PASS**
8.3.1			Intensity, Radial	-18	7.4	**PASS**
8.3.4			Signal-to-Noise/Noise, Axial	20	46.3	**PASS**
8.3.4			Signal-to-Noise/Noise, Radial	20	52.3	**PASS**
8.3.2			Frequency Response, Axial	0	1.2	**PASS**
8.3.1	LTE FDD	Band 25	Intensity, Axial	-18	15.0	**PASS**
8.3.1			Intensity, Radial	-18	7.4	**PASS**
8.3.4			Signal-to-Noise/Noise, Axial	20	46.5	**PASS**
8.3.4			Signal-to-Noise/Noise, Radial	20	52.7	**PASS**
8.3.2			Frequency Response, Axial	0	1.1	**PASS**
8.3.1	LTE FDD	Band 30	Intensity, Axial	-18	15.2	**PASS**
8.3.1			Intensity, Radial	-18	7.4	**PASS**
8.3.4			Signal-to-Noise/Noise, Axial	20	48.2	**PASS**
8.3.4			Signal-to-Noise/Noise, Radial	20	53.4	**PASS**
8.3.2			Frequency Response, Axial	0	1.2	**PASS**
8.3.1	LTE FDD	Band 7	Intensity, Axial	-18	14.9	**PASS**
8.3.1			Intensity, Radial	-18	7.4	**PASS**
8.3.4			Signal-to-Noise/Noise, Axial	20	45.4	**PASS**
8.3.4			Signal-to-Noise/Noise, Radial	20	51.1	**PASS**
8.3.2			Frequency Response, Axial	0	1.2	**PASS**

Note: The above summary table represents the worst-case numerical values according to configurations in Table 7-10 through Table 7-16.

Table 7-5
Table of Results for LTE TDD

C63.19 Sec.	Mode	Band	Test Description	Minimum Limit*	Measured	Verdict
				dBA/m	dBA/m	PASS/FAIL
8.3.1	LTE TDD	Band 41	Intensity, Axial	-18	15.1	PASS
8.3.1			Intensity, Radial	-18	7.1	PASS
8.3.4			Signal-to-Noise/Noise, Axial	20	40.4	PASS
8.3.4			Signal-to-Noise/Noise, Radial	20	45.4	PASS
8.3.2			Frequency Response, Axial	0	1.1	PASS

Note: The above summary table represents the worst-case numerical values according to configurations in Table 7-17 and Table 7-18.

Table 7-6
Consolidated Tabled Results

		Freq. Response Margin		Magnetic Intensity Verdict		FCC SNNR Verdict		FCC Margin (dB)	C63.19-2011 Rating
		Axial	Radial	Axial	Radial	Axial	Radial		
CDMA	Secondary Cellular	PASS	NA	PASS	PASS	PASS	PASS	-25.06	T4
	Cellular	PASS	NA	PASS	PASS	PASS	PASS		
	PCS	PASS	NA	PASS	PASS	PASS	PASS		
GSM	Cellular	PASS	NA	PASS	PASS	PASS	PASS	-7.23	T3
	PCS	PASS	NA	PASS	PASS	PASS	PASS		
UMTS	Cellular	PASS	NA	PASS	PASS	PASS	PASS	-34.92	T4
	AWS	PASS	NA	PASS	PASS	PASS	PASS		
	PCS	PASS	NA	PASS	PASS	PASS	PASS		
LTE FDD	B12	PASS	NA	PASS	PASS	PASS	PASS	-22.27	T4
	B13	PASS	NA	PASS	PASS	PASS	PASS		
	B26	PASS	NA	PASS	PASS	PASS	PASS		
	B66	PASS	NA	PASS	PASS	PASS	PASS		
	B25	PASS	NA	PASS	PASS	PASS	PASS		
	B30	PASS	NA	PASS	PASS	PASS	PASS		
	B7	PASS	NA	PASS	PASS	PASS	PASS		
LTE TDD	B41	PASS	NA	PASS	PASS	PASS	PASS	-20.38	T4

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

II. Raw Handset Data

Table 7-7
Raw Data Results for CDMA

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
Secondary Cellular	Axial	476	16.31	-31.01	-63.04	0.40	47.32	20.00	-27.32	T4	1.6, 1.2
		564	16.44	-30.74		0.35	47.18	20.00	-27.18	T4	
		684	16.50	-28.56		0.36	45.06	20.00	-25.06	T4	
	Radial	476	7.91	-47.73	-62.94	N/A	55.64	20.00	-35.64	T4	1.6, 2.4
		564	7.50	-47.78			55.28	20.00	-35.28	T4	
		684	7.71	-47.49			55.20	20.00	-35.20	T4	
Cellular	Axial	1013	16.27	-32.07	-63.04	0.37	48.34	20.00	-28.34	T4	1.6, 1.2
		384	16.20	-32.06		0.32	48.26	20.00	-28.26	T4	
		777	16.20	-31.79		0.39	47.99	20.00	-27.99	T4	
	Radial	1013	8.13	-47.75	-62.94	N/A	55.88	20.00	-35.88	T4	1.6, 2.4
		384	7.51	-48.53			56.04	20.00	-36.04	T4	
		777	7.66	-48.34			56.00	20.00	-36.00	T4	
PCS	Axial	25	16.60	-30.36	-63.04	0.27	46.96	20.00	-26.96	T4	1.6, 1.2
		600	16.48	-31.24		0.33	47.72	20.00	-27.72	T4	
		1175	16.47	-30.66		0.37	47.13	20.00	-27.13	T4	
	Radial	25	7.83	-43.08	-62.94	N/A	50.91	20.00	-30.91	T4	1.6, 2.4
		600	7.96	-45.02			52.98	20.00	-32.98	T4	
		1175	7.68	-45.24			52.92	20.00	-32.92	T4	

Table 7-8
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
GSM850	Axial	128	19.38	-14.87	-63.04	0.17	34.25	20.00	-14.25	T4	1.6, 1.2
		190	19.38	-15.53		0.16	34.91	20.00	-14.91	T4	
		251	19.40	-16.36		0.14	35.76	20.00	-15.76	T4	
	Radial	128	10.61	-16.62	-62.94	N/A	27.23	20.00	-7.23	T3	1.6, 2.4
		190	10.67	-17.77			28.44	20.00	-8.44	T3	
		251	10.59	-19.13			29.72	20.00	-9.72	T3	
GSM1900	Axial	512	19.42	-18.71	-63.04	0.14	38.13	20.00	-18.13	T4	1.6, 1.2
		661	19.48	-17.76		0.16	37.24	20.00	-17.24	T4	
		810	19.43	-17.16		0.12	36.59	20.00	-16.59	T4	
	Radial	512	10.59	-27.09	-62.94	N/A	37.68	20.00	-17.68	T4	1.6, 2.4
		661	10.58	-25.73			36.31	20.00	-16.31	T4	
		810	10.60	-25.09			35.69	20.00	-15.69	T4	

Table 7-9
Raw Data Results for UMTS

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
UMTS V	Axial	4132	16.21	-40.30	-63.04	1.15	56.51	20.00	-36.51	T4	1.6, 1.2
		4183	16.25	-40.16		1.18	56.41	20.00	-36.41	T4	
		4233	16.19	-40.84		1.15	57.03	20.00	-37.03	T4	
	Radial	4132	7.34	-49.33	-62.94	N/A	56.67	20.00	-36.67	T4	1.6, 2.4
		4183	7.42	-49.89			57.31	20.00	-37.31	T4	
		4233	7.40	-50.04			57.44	20.00	-37.44	T4	
UMTS IV	Axial	1312	16.19	-39.90	-63.04	1.14	56.09	20.00	-36.09	T4	1.6, 1.2
		1412	16.18	-40.25		1.18	56.43	20.00	-36.43	T4	
		1513	16.19	-40.47		1.14	56.66	20.00	-36.66	T4	
	Radial	1312	7.34	-49.17	-62.94	N/A	56.51	20.00	-36.51	T4	1.6, 2.4
		1412	7.34	-49.07			56.41	20.00	-36.41	T4	
		1513	7.35	-49.53			56.88	20.00	-36.88	T4	
UMTS II	Axial	9262	16.14	-40.22	-63.04	1.15	56.36	20.00	-36.36	T4	1.6, 1.2
		9400	16.17	-39.28		1.14	55.45	20.00	-35.45	T4	
		9538	16.14	-39.33		1.19	55.47	20.00	-35.47	T4	
	Radial	9262	7.35	-48.10	-62.94	N/A	55.45	20.00	-35.45	T4	1.6, 2.4
		9400	7.36	-49.18			56.54	20.00	-36.54	T4	
		9538	7.34	-47.58			54.92	20.00	-34.92	T4	

Table 7-10
Raw Data Results for LTE B12

Mode	Orientation	Bandwidth	Channel	ABM1 [dB(A/m)]	ABM2 [dB(A/m)]	Ambient Noise [dB(A/m)]	Frequency Response Margin (dB)	S+N/N (dB)	FCC Limit (dB)	FCC Margin (dB)	C63.19-2011 Rating	Test Coordinates
LTE Band 12	Axial	10MHz	23095	15.18	-31.66	-63.04	1.25	46.84	20.00	-26.84	T4	1.6, 1.2
		5MHz	23095	15.38	-31.91		1.30	47.29	20.00	-27.29	T4	
		3MHz	23095	15.47	-31.31		1.30	46.78	20.00	-26.78	T4	
		1.4MHz	23095	15.38	-31.57		1.36	46.95	20.00	-26.95	T4	
	Radial	10MHz	23095	7.55	-47.16	-62.94	N/A	54.71	20.00	-34.71	T4	1.6, 2.4
		5MHz	23095	7.47	-45.35			52.82	20.00	-32.82	T4	
		3MHz	23095	7.37	-45.26			52.63	20.00	-32.63	T4	
		1.4MHz	23095	7.49	-44.91			52.40	20.00	-32.40	T4	

Table 7-11
Raw Data Results for LTE B13

Mode	Orientation	Bandwidth	Channel	ABM1 [dB(A/m)]	ABM2 [dB(A/m)]	Ambient Noise [dB(A/m)]	Frequency Response Margin (dB)	S+N/N (dB)	FCC Limit (dB)	FCC Margin (dB)	C63.19-2011 Rating	Test Coordinates
LTE Band 13	Axial	10MHz	23230	15.32	-26.95	-63.04	1.43	42.27	20.00	-22.27	T4	1.6, 1.2
		5MHz	23230	15.20	-28.94		1.29	44.14	20.00	-24.14	T4	
	Radial	10MHz	23230	7.67	-47.04	-62.94	N/A	54.71	20.00	-34.71	T4	1.6, 2.4
		5MHz	23230	7.67	-43.53			51.20	20.00	-31.20	T4	

Table 7-12
Raw Data Results for LTE B26

Mode	Orientation	Bandwidth	Channel	ABM1 [dB(A/m)]	ABM2 [dB(A/m)]	Ambient Noise [dB(A/m)]	Frequency Response Margin (dB)	S+N/N (dB)	FCC Limit (dB)	FCC Margin (dB)	C63.19-2011 Rating	Test Coordinates
LTE Band 26	Axial	15MHz	26865	15.16	-31.36	-63.04	1.38	46.52	20.00	-26.52	T4	1.6, 1.2
		10MHz	26865	14.90	-32.30		1.38	47.20	20.00	-27.20	T4	
		5MHz	26865	15.36	-32.90		1.36	48.26	20.00	-28.26	T4	
		3MHz	26865	15.16	-32.36		1.41	47.52	20.00	-27.52	T4	
		1.4MHz	26865	15.34	-32.46		1.30	47.80	20.00	-27.80	T4	
	Radial	15MHz	26865	7.75	-46.00	-62.94	N/A	53.75	20.00	-33.75	T4	1.6, 2.4
		10MHz	26865	7.41	-46.35			53.76	20.00	-33.76	T4	
		5MHz	26865	7.53	-45.04			52.57	20.00	-32.57	T4	
		3MHz	26865	7.46	-44.28			51.74	20.00	-31.74	T4	
		1.4MHz	26865	7.62	-45.17			52.79	20.00	-32.79	T4	

Table 7-13
Raw Data Results for LTE B66

Mode	Orientation	Bandwidth	Channel	ABM1 [dB(A/m)]	ABM2 [dB(A/m)]	Ambient Noise [dB(A/m)]	Frequency Response Margin (dB)	S+N/N (dB)	FCC Limit (dB)	FCC Margin (dB)	C63.19-2011 Rating	Test Coordinates
LTE Band 66	Axial	20MHz	132322	14.96	-32.57	-63.04	1.36	47.53	20.00	-27.53	T4	1.6, 1.2
		15MHz	132322	14.91	-31.41		1.31	46.32	20.00	-26.32	T4	
		10MHz	132322	15.27	-31.94		1.29	47.21	20.00	-27.21	T4	
		5MHz	132322	15.22	-32.11		1.20	47.33	20.00	-27.33	T4	
		3MHz	132322	15.24	-31.61		1.32	46.85	20.00	-26.85	T4	
		1.4MHz	132322	15.24	-31.40		1.19	46.64	20.00	-26.64	T4	
	Radial	20MHz	132322	7.40	-46.89	-62.94	N/A	54.29	20.00	-34.29	T4	1.6, 2.4
		15MHz	132322	7.39	-45.44			52.83	20.00	-32.83	T4	
		10MHz	132322	7.52	-46.98			54.50	20.00	-34.50	T4	
		5MHz	132322	7.47	-46.26			53.73	20.00	-33.73	T4	
		3MHz	132322	7.42	-46.03			53.45	20.00	-33.45	T4	
		1.4MHz	132322	7.44	-44.87			52.31	20.00	-32.31	T4	

Table 7-14
Raw Data Results for LTE B25

Mode	Orientation	Bandwidth	Channel	ABM1 [dB(A/m)]	ABM2 [dB(A/m)]	Ambient Noise [dB(A/m)]	Frequency Response Margin (dB)	S+N/N (dB)	FCC Limit (dB)	FCC Margin (dB)	C63.19-2011 Rating	Test Coordinates
LTE Band 25	Axial	20MHz	26365	15.13	-31.91	-63.04	1.37	47.04	20.00	-27.04	T4	1.6, 1.2
		15MHz	26365	15.36	-32.30		1.13	47.66	20.00	-27.66	T4	
		10MHz	26365	15.23	-31.27		1.27	46.50	20.00	-26.50	T4	
		5MHz	26365	15.02	-31.64		1.18	46.66	20.00	-26.66	T4	
		3MHz	26365	15.25	-31.40		1.25	46.65	20.00	-26.65	T4	
		1.4MHz	26365	14.96	-31.58		1.37	46.54	20.00	-26.54	T4	
	Radial	20MHz	26365	7.74	-44.99	-62.94	N/A	52.73	20.00	-32.73	T4	1.6, 2.4
		15MHz	26365	7.69	-47.37			55.06	20.00	-35.06	T4	
		10MHz	26365	7.66	-46.81			54.47	20.00	-34.47	T4	
		5MHz	26365	7.75	-46.38			54.13	20.00	-34.13	T4	
		3MHz	26365	7.69	-46.23			53.92	20.00	-33.92	T4	
		1.4MHz	26365	7.41	-46.17			53.58	20.00	-33.58	T4	

Table 7-15
Raw Data Results for LTE B30

Mode	Orientation	Bandwidth	Channel	ABM1 [dB(A/m)]	ABM2 [dB(A/m)]	Ambient Noise [dB(A/m)]	Frequency Response Margin (dB)	S+N/N (dB)	FCC Limit (dB)	FCC Margin (dB)	C63.19-2011 Rating	Test Coordinates
LTE Band 30	Axial	10MHz	27710	15.22	-32.96	-63.04	1.32	48.18	20.00	-28.18	T4	1.6, 1.2
		5MHz	27710	15.25	-33.95		1.24	49.20	20.00	-29.20	T4	
	Radial	10MHz	27710	7.47	-46.67	-62.94	N/A	54.14	20.00	-34.14	T4	1.6, 2.4
		5MHz	27710	7.42	-45.95			53.37	20.00	-33.37	T4	

Table 7-16
Raw Data Results for LTE B7

Mode	Orientation	Bandwidth	Channel	ABM1 [dB(A/m)]	ABM2 [dB(A/m)]	Ambient Noise [dB(A/m)]	Frequency Response Margin (dB)	S+N/N (dB)	FCC Limit (dB)	FCC Margin (dB)	C63.19-2011 Rating	Test Coordinates
LTE Band 7	Axial	20MHz	21100	15.24	-31.20	-63.04	1.29	46.44	20.00	-26.44	T4	1.6, 1.2
		15MHz	21100	15.16	-30.41		1.19	45.57	20.00	-25.57	T4	
		10MHz	21100	14.94	-30.41		1.32	45.35	20.00	-25.35	T4	
		5MHz	21100	15.05	-30.46		1.26	45.51	20.00	-25.51	T4	
	Radial	20MHz	21350	7.40	-44.57	-62.94	N/A	51.97	20.00	-31.97	T4	1.6, 2.4
		20MHz	21100	7.56	-43.56			51.12	20.00	-31.12	T4	
		20MHz	20850	7.42	-43.68			51.10	20.00	-31.10	T4	
		15MHz	21100	7.43	-45.05			52.48	20.00	-32.48	T4	
		10MHz	21100	7.45	-46.52			53.97	20.00	-33.97	T4	
		5MHz	21100	7.44	-45.67			53.11	20.00	-33.11	T4	

Table 7-17
Raw Data Results for LTE B41 – Power Class 3

Mode	Orientation	Bandwidth	Channel	ABM1 [dB(A/m)]	ABM2 [dB(A/m)]	Ambient Noise [dB(A/m)]	Frequency Response Margin (dB)	S+N/N (dB)	FCC Limit (dB)	FCC Margin (dB)	C63.19-2011 Rating	Test Coordinates
LTE Band 41	Axial	20MHz	40620	15.41	-25.95	-63.04	1.23	41.36	20.00	-21.36	T4	1.6, 1.2
		15MHz	40620	15.33	-26.40		1.23	41.73	20.00	-21.73	T4	
		10MHz	40620	15.11	-26.98		1.11	42.09	20.00	-22.09	T4	
		5MHz	40620	15.15	-27.28		1.27	42.43	20.00	-22.43	T4	
	Radial	20MHz	40620	7.16	-38.92	-62.94	N/A	46.08	20.00	-26.08	T4	1.6, 2.4
		15MHz	40620	7.75	-38.84			46.59	20.00	-26.59	T4	
		10MHz	40620	7.75	-38.76			46.51	20.00	-26.51	T4	
		5MHz	40620	7.12	-39.31			46.43	20.00	-26.43	T4	

Table 7-18
Raw Data Results for LTE B41 – Power Class 2

Mode	Orientation	Bandwidth	Channel	ABM1 [dB(A/m)]	ABM2 [dB(A/m)]	Ambient Noise [dB(A/m)]	Frequency Response Margin (dB)	S+N/N (dB)	FCC Limit (dB)	FCC Margin (dB)	C63.19-2011 Rating	Test Coordinates
LTE Band 41	Axial	20MHz	40620	15.23	-25.96	-63.04	1.37	41.19	20.00	-21.19	T4	1.6, 1.2
		15MHz	41490	15.19	-25.97		1.30	41.16	20.00	-21.16	T4	
		15MHz	41055	15.13	-26.08		1.21	41.21	20.00	-21.21	T4	
		15MHz	40620	15.14	-25.24		1.30	40.38	20.00	-20.38	T4	
		15MHz	40185	15.21	-27.27		1.28	42.48	20.00	-22.48	T4	
		15MHz	39750	15.13	-27.23		1.35	42.36	20.00	-22.36	T4	
		10MHz	40620	15.21	-27.52		1.25	42.73	20.00	-22.73	T4	
		5MHz	40620	15.13	-26.74		1.26	41.87	20.00	-21.87	T4	
	Radial	20MHz	40620	7.89	-37.56	-62.94	N/A	45.45	20.00	-25.45	T4	1.6, 2.4
		15MHz	41490	7.61	-39.58			47.19	20.00	-27.19	T4	
		15MHz	41055	7.85	-37.72			45.57	20.00	-25.57	T4	
		15MHz	40620	7.52	-37.87			45.39	20.00	-25.39	T4	
		15MHz	40185	7.71	-39.77			47.48	20.00	-27.48	T4	
		15MHz	39750	7.64	-40.22			47.86	20.00	-27.86	T4	
		10MHz	40620	7.59	-38.61			46.20	20.00	-26.20	T4	
		5MHz	40620	7.85	-39.40			47.25	20.00	-27.25	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 (**Phone→Settings→Accessibility→Hearing aids**) was set to ON for Frequency Response compliance
4. Speech Signal: 3GPP2 Normal Test Signal

B. CDMA

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

C. GSM

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

D. UMTS

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

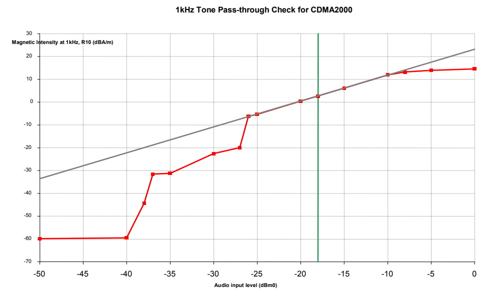
E. LTE FDD

1. Power Configuration: TPC = “Max Power”
2. Radio Configuration: 16QAM, 1RB, 0RB offset
3. Vocoder Configuration: NB AMR 4.75kbps
4. The worst case band and bandwidth combination for each probe orientation is additionally tested on the low and high channels for those combinations. LTE Band 13 at 10MHz is the worst case for the Axial probe orientation. LTE Band 7 at 20MHz is the worst case for the Radial probe orientation.

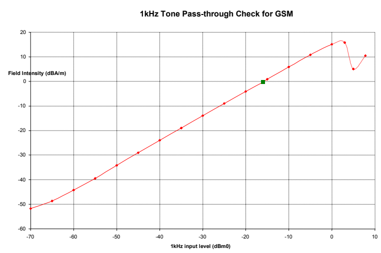
F. LTE TDD

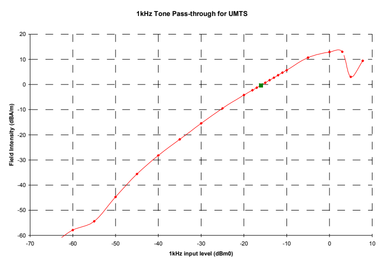
1. Power Configuration: TPC = “Max Power”
2. Radio Configuration: 16QAM, 1RB, 0RB offset
3. Uplink-Downlink Configuration for Power Class 3: 0
4. Uplink-Downlink Configuration for Power Class 2: 1
5. Vocoder Configuration: NB AMR 4.75kbps
6. The worst case band and bandwidth combination for each probe orientation is additionally tested on the low, low mid, mid high and high channels for those combinations. LTE Band 41, Power Class 2, at 15MHz is the worst case for both Axial and Radial probe orientations.

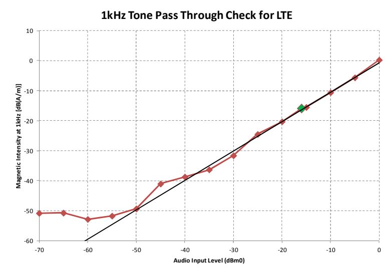
IV. 1 kHz Vocoder Application Check



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.







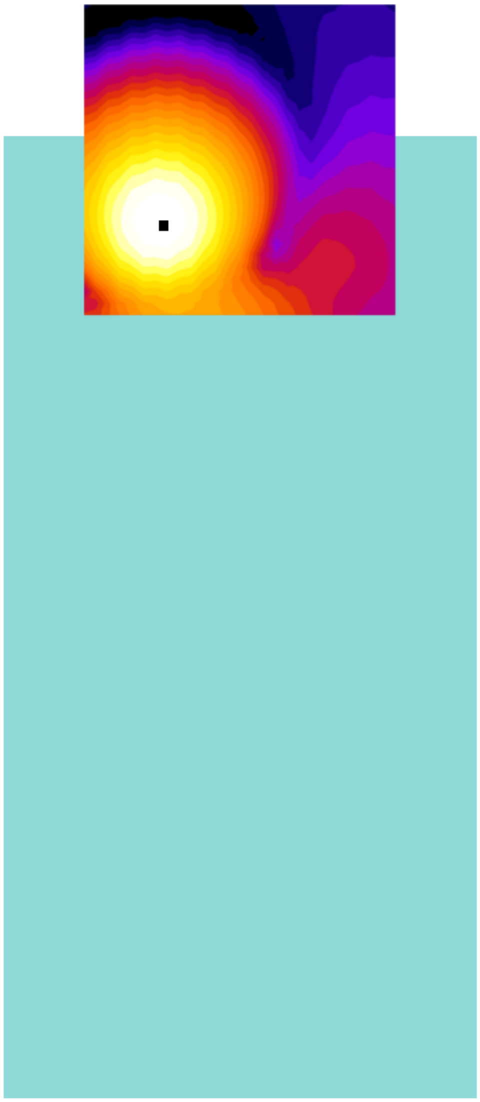
This model was verified to be within the linear region for ABM1 measurements at -16 dBm0 for GSM, UMTS, and VoLTE. This measurement was taken in the axial configuration above the maximum location.

V. T-Coil Validation Test Results

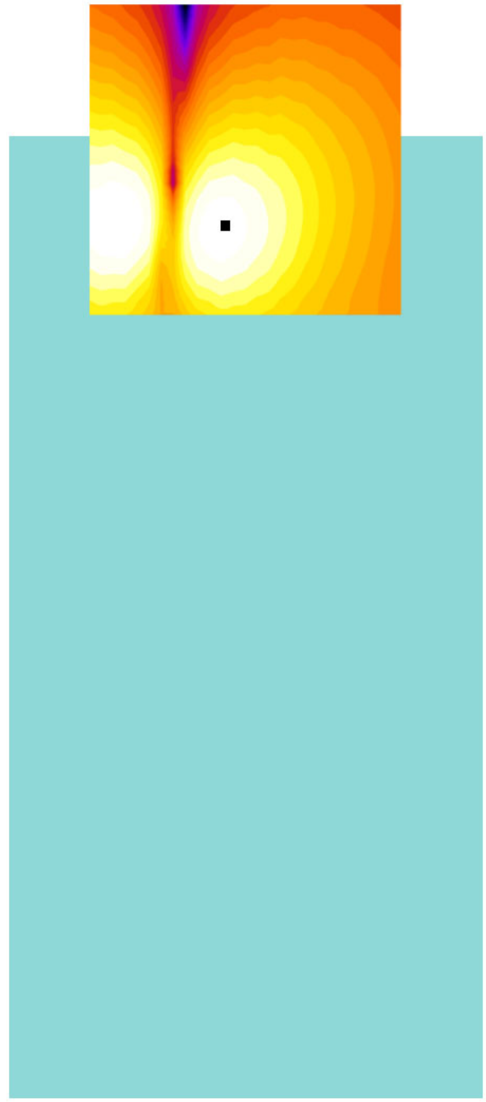
Table 7-19
Helmholtz Coil Validation Table of Results

Item	Target	Result	Verdict
Axial			
Magnetic Intensity, -10 dBA/m	*-10 ± 0.5 dB*	-10.191	**PASS**
Environmental Noise	< -58 dBA/m	-63.04	**PASS**
Frequency Response, from limits	*> 0 dB*	0.70	**PASS**
Radial			
Magnetic Intensity, -10 dBA/m	*-10 ± 0.5 dB*	-10.298	**PASS**
Environmental Noise	< -58 dBA/m	-62.94	**PASS**
Frequency Response, from limits	*> 0 dB*	0.70	**PASS**

VI. ABM1 Magnetic Field Distribution Scan Overlays



Axial



Radial (Transverse)

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.

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

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

9. EQUIPMENT LIST

Table 9-1
Equipment List

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	CMW500	Wideband Radio Communication Tester	4/12/2017	Annual	4/12/2018	128635
Rohde & Schwarz	CMU200	Radio Communication Tester	N/A	N/A	N/A	107826
Rohde & Schwarz	CMU200	Radio Communication Tester	4/11/2017	Annual	4/11/2018	836371/079
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	Helmholtz Coil	Helmholtz Coil	12/7/2016	Annual	12/7/2017	925
TEM		HAC System Controller with Software	N/A	N/A	N/A	N/A
TEM		HAC Positioner	N/A	N/A	N/A	N/A

10. TEST DATA

PCTEST Hearing-Aid Compatibility Facility

DUT: HH Coil – SN: 925

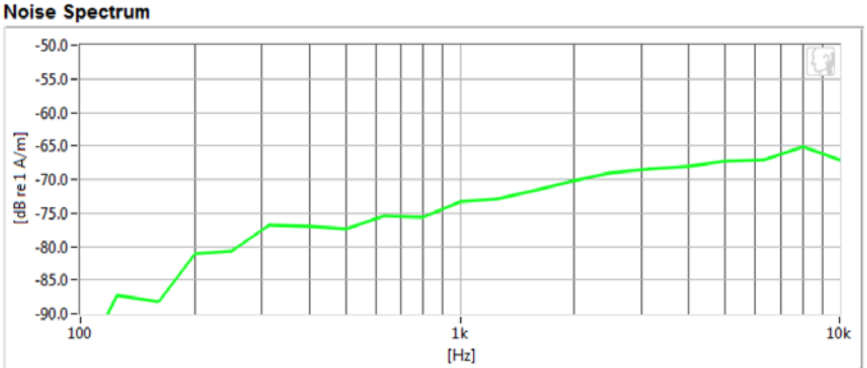
Type: HH Coil
Serial: 925

Measurement Standard: ANSI C63.19-2011

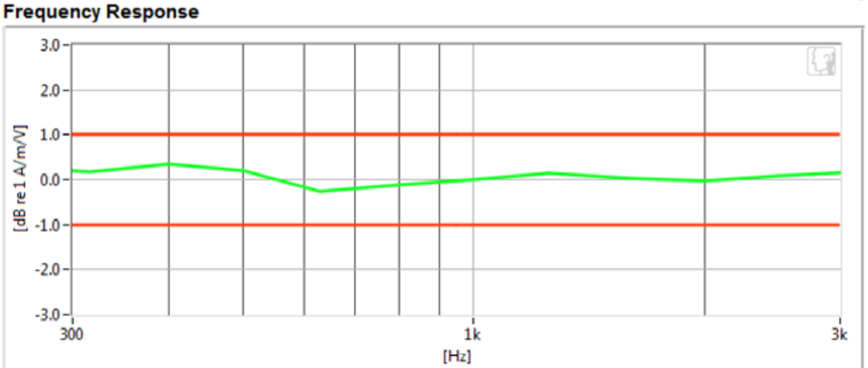
Equipment:

- 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	-10.191	dB	✔	Max/Min	-9.5/-10.5
Verification ABM2	-63.04	dB	✔	Maximum	-58.0
Frequency Response Margin	700m	dB	✔	Tolerance curves	Aligned Data

PCTEST 2017

PCTEST Hearing-Aid Compatibility Facility

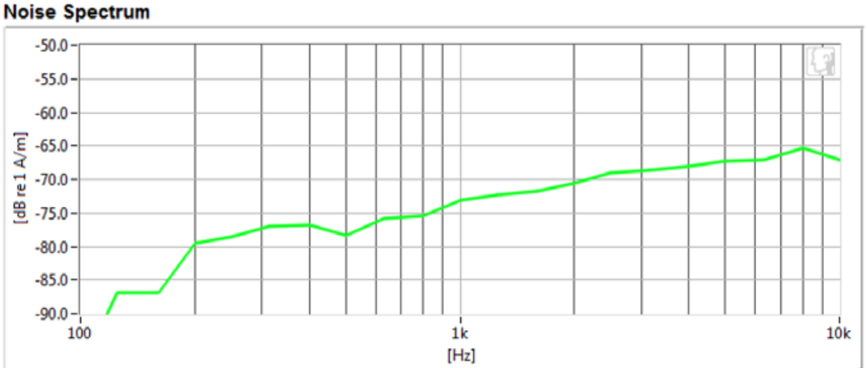
DUT: HH Coil – SN: 925

Type: HH Coil
Serial: 925

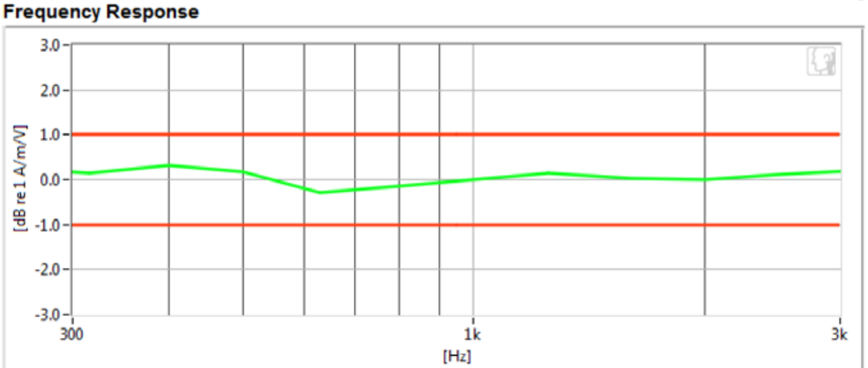
Measurement Standard: ANSI C63.19-2011

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	-10.298	dB	✔	Max/Min	-9.5/-10.5
Verification ABM2	-62.94	dB	✔	Maximum	-58.0
Frequency Response Margin	700m	dB	✔	Tolerance curves	Aligned Data

PCTEST 2017

PCTEST ENGINEERING LABORATORY, INC.

PCTEST Hearing-Aid Compatibility Facility

DUT: ZNFG011C

Type: Portable Handset
Serial: 15164

Measurement Standard: ANSI C63.19-2011

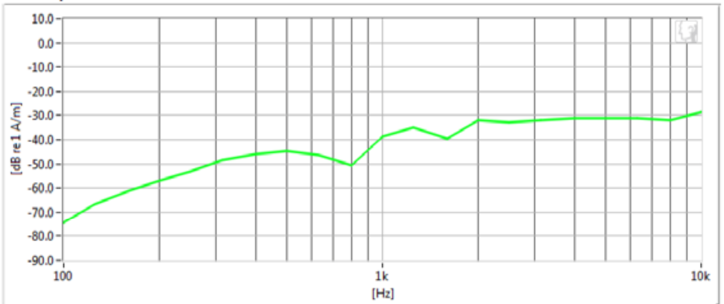
Equipment:

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

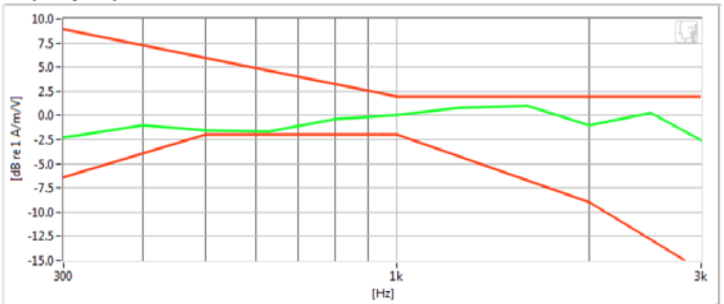
Test Configuration:

- Mode: Extended Cellular CDMA
- Channel: 684
- Speech Signal: 3GPP2 Normal Test Signal

Noise Spectrum



Frequency Response



Results

ABM1	16.5 dB	✔	Minimum	-18.0
ABM2	-28.55 dB	✔	Maximum	0.0
SNNR	45.06 dB	✔	Minimum	20.0
Aligned Response - Normal	360m dB	✔	Tolerance curves	Aligned Data

PCTEST 2017

PCTEST Hearing-Aid Compatibility Facility

DUT: ZNFG011C

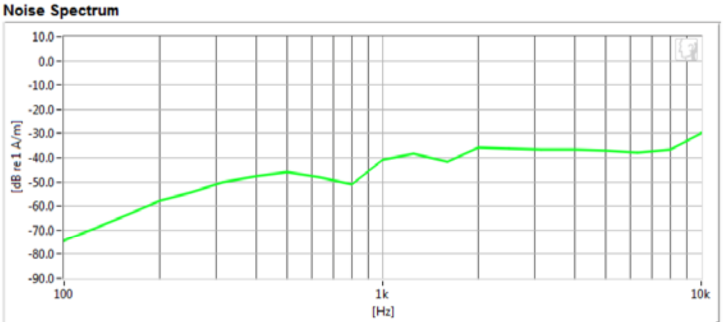
Type: Portable Handset
Serial: 15164

Measurement Standard: ANSI C63.19-2011

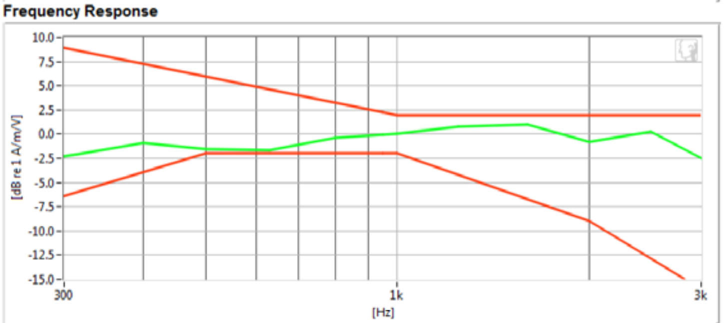
Equipment:
- Probe: Axial T-Coil Probe – SN: TEM-1124; Calibrated: 12/07/2016

Test Configuration:
- Mode: Cellular CDMA
- Channel: 777
- Speech Signal: 3GPP2 Normal Test Signal

Noise Spectrum



Frequency Response



Results

ABM1	16.2 dB	✓	Minimum	-18.0
ABM2	-31.79 dB	✓	Maximum	0.0
SNNR	47.99 dB	✓	Minimum	20.0
Aligned Response - Normal	390m dB	✓	Tolerance curves	Aligned Data

PCTEST 2017

PCTEST ENGINEERING LABORATORY, INC.

PCTEST Hearing-Aid Compatibility Facility

DUT: ZNFG011C

Type: Portable Handset
Serial: 15164

Measurement Standard: ANSI C63.19-2011

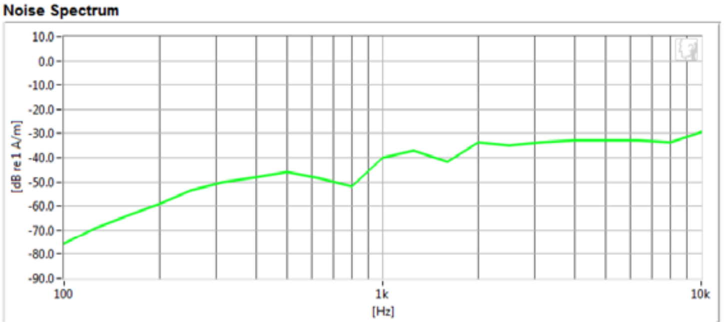
Equipment:

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

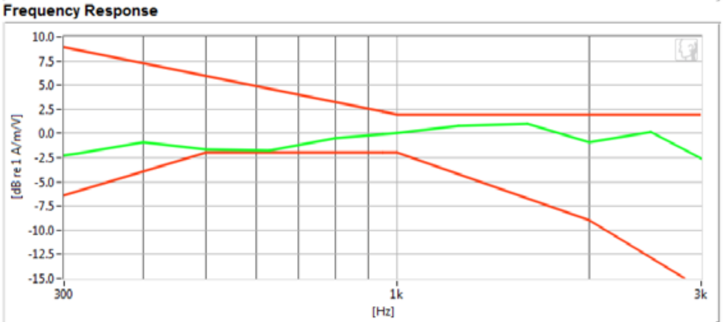
Test Configuration:

- Mode: PCS CDMA
- Channel: 25
- Speech Signal: 3GPP2 Normal Test Signal

Noise Spectrum



Frequency Response



Results

ABM1	16.6 dB	✔	Minimum	-18.0
ABM2	-30.36 dB	✔	Maximum	0.0
SNNR	46.96 dB	✔	Minimum	20.0
Aligned Response - Normal	270m dB	✔	Tolerance curves	Aligned Data

PCTEST 2017

PCTEST ENGINEERING LABORATORY, INC.

PCTEST Hearing-Aid Compatibility Facility

DUT: ZNFG011C

Type: Portable Handset
Serial: 15164

Measurement Standard: ANSI C63.19-2011

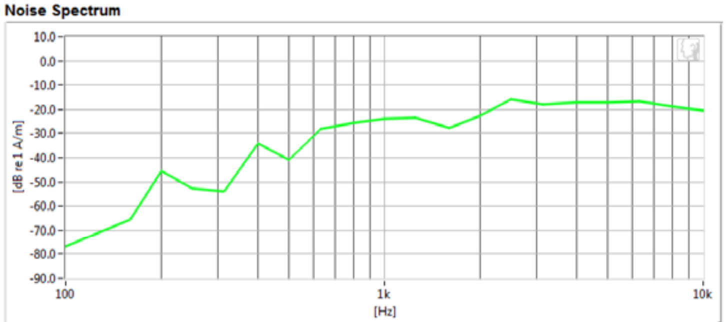
Equipment:

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

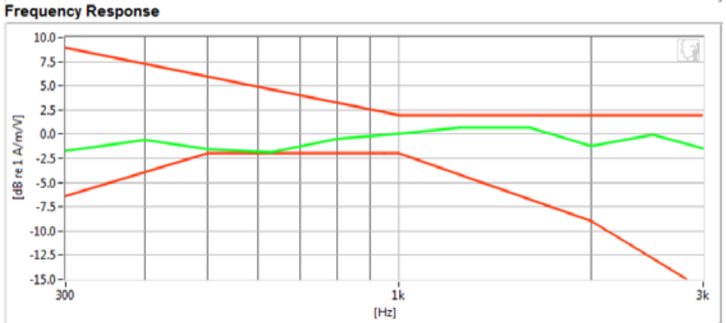
Test Configuration:

- Mode: GSM850
- Channel: 128
- Speech Signal: 3GPP2 Normal Test Signal

Noise Spectrum



Frequency Response



Results

ABM1	19.38 dB	✔	Minimum	-18.0
ABM2	-14.87 dB	✔	Maximum	0.0
SNNR	34.25 dB	✔	Minimum	20.0
Aligned Response - Normal	170m dB	✔	Tolerance curves	Aligned Data

PCTEST 2017

8/14/2017

PCTEST Hearing-Aid Compatibility Facility

DUT: ZNFG011C

Type: Portable Handset
Serial: 15164

Measurement Standard: ANSI C63.19-2011

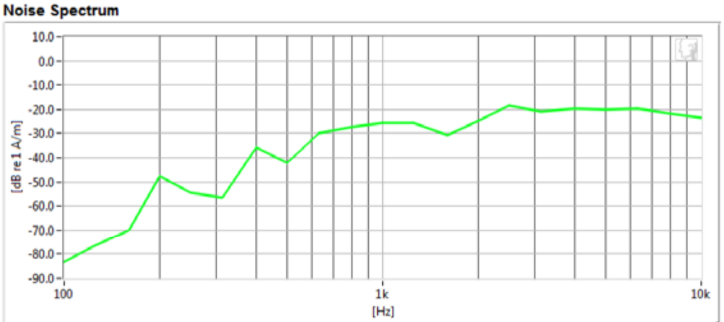
Equipment:

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

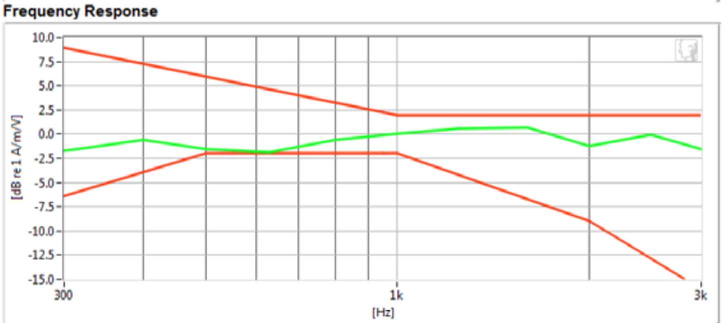
Test Configuration:

- Mode: GSM1900
- Channel: 810
- Speech Signal: 3GPP2 Normal Test Signal

Noise Spectrum



Frequency Response



Results

ABM1	19.43 dB	✔	Minimum	-18.0
ABM2	-17.17 dB	✔	Maximum	0.0
SNNR	36.59 dB	✔	Minimum	20.0
Aligned Response - Normal	120m dB	✔	Tolerance curves	Aligned Data

PCTEST 2017

PCTEST Hearing-Aid Compatibility Facility

DUT: ZNFG011C

Type: Portable Handset
Serial: 15164

Measurement Standard: ANSI C63.19-2011

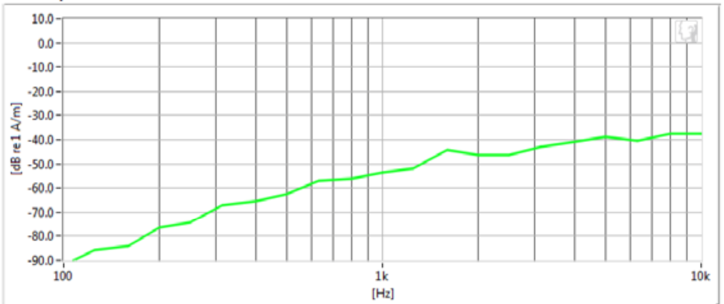
Equipment:

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

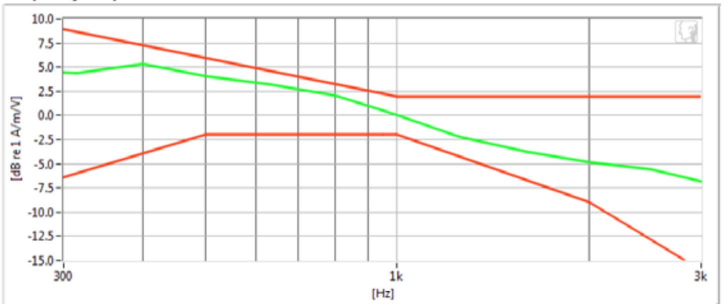
Test Configuration:

- Mode: UMTS Band V
- Channel: 4183
- Speech Signal: 3GPP2 Normal Test Signal

Noise Spectrum



Frequency Response



Results

ABM1	16.25 dB	✔	Minimum	-18.0
ABM2	-40.17 dB	✔	Maximum	0.0
SNNR	56.41 dB	✔	Minimum	20.0
Aligned Response - Normal	1.18 dB	✔	Tolerance curves	Aligned Data

PCTEST 2017

PCTEST Hearing-Aid Compatibility Facility

DUT: ZNFG011C

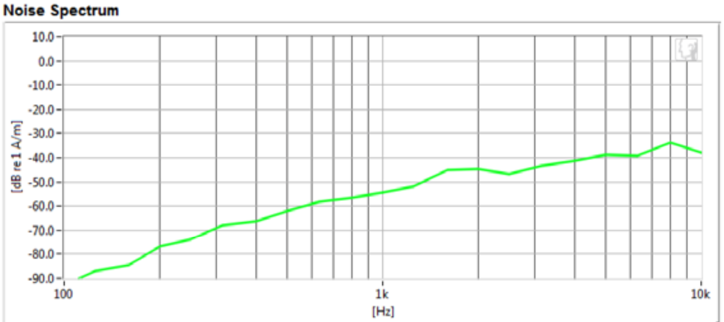
Type: Portable Handset
Serial: 15164

Measurement Standard: ANSI C63.19-2011

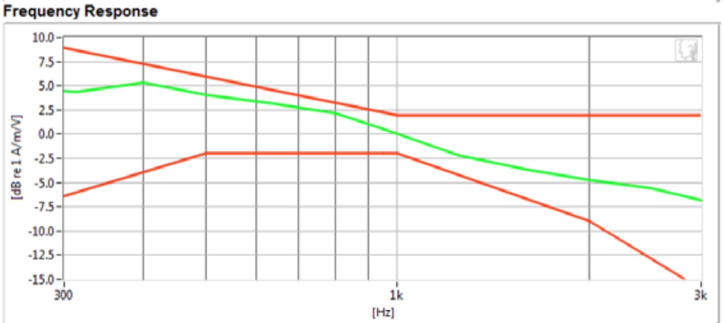
Equipment:
- Probe: Axial T-Coil Probe – SN: TEM-1124; Calibrated: 12/07/2016

Test Configuration:
- Mode: UMTS Band IV
- Channel: 1312
- Speech Signal: 3GPP2 Normal Test Signal

Noise Spectrum



Frequency Response



Results

ABM1	16.19 dB	✔	Minimum	-18.0
ABM2	-39.9 dB	✔	Maximum	0.0
SNNR	56.09 dB	✔	Minimum	20.0
Aligned Response - Normal	1.14 dB	✔	Tolerance curves	Aligned Data

PCTEST 2017

PCTEST Hearing-Aid Compatibility Facility

DUT: ZNFG011C

Type: Portable Handset
Serial: 15164

Measurement Standard: ANSI C63.19-2011

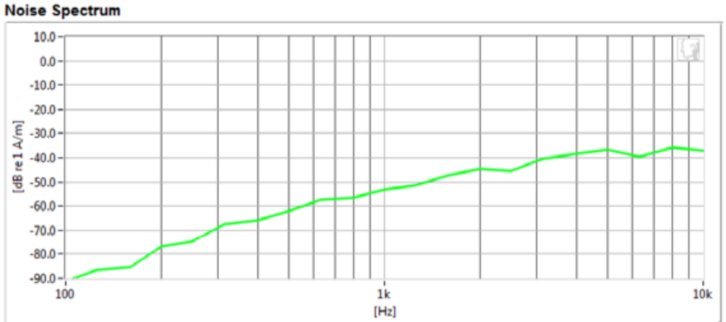
Equipment:

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

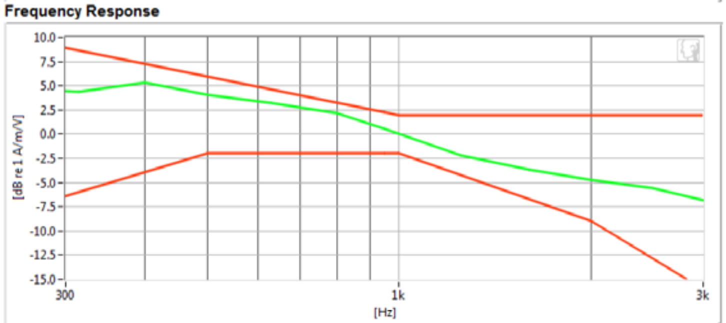
Test Configuration:

- Mode: UMTS Band II
- Channel: 9400
- Speech Signal: 3GPP2 Normal Test Signal

Noise Spectrum



Frequency Response



Results

ABM1	16.17 dB	✔	Minimum	-18.0
ABM2	-39.27 dB	✔	Maximum	0.0
SNNR	55.45 dB	✔	Minimum	20.0
Aligned Response - Normal	1.14 dB	✔	Tolerance curves	Aligned Data

PCTEST 2017

PCTEST Hearing-Aid Compatibility Facility

DUT: ZNFG011C

Type: Portable Handset
Serial: 15164

Measurement Standard: ANSI C63.19-2011

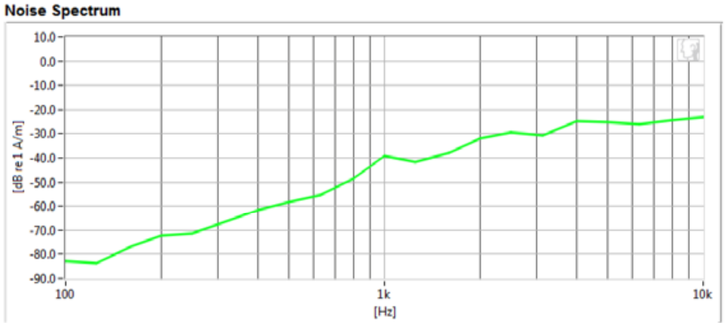
Equipment:

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

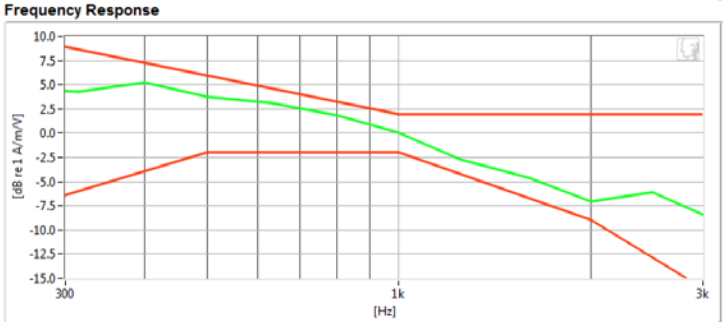
Test Configuration:

- Mode: LTE FDD Band 13
- Bandwidth: 10MHz
- Channel: 23230
- Speech Signal: 3GPP2 Normal Test Signal

Noise Spectrum



Frequency Response



Results

ABM1	15.32	dB	✔	Minimum	-18.0
ABM2	-26.94	dB	✔	Maximum	0.0
SNNR	42.27	dB	✔	Minimum	20.0
Aligned Response - Normal	1.43	dB	✔	Tolerance curves	Aligned Data

PCTEST 2017

8/17/2017

PCTEST Hearing-Aid Compatibility Facility

DUT: ZNFG011C

Type: Portable Handset
Serial: 15164

Measurement Standard: ANSI C63.19-2011

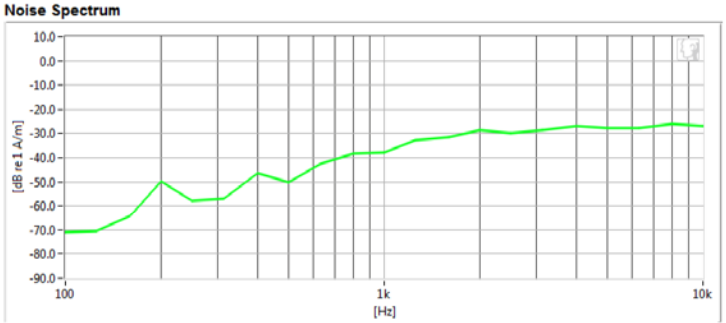
Equipment:

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

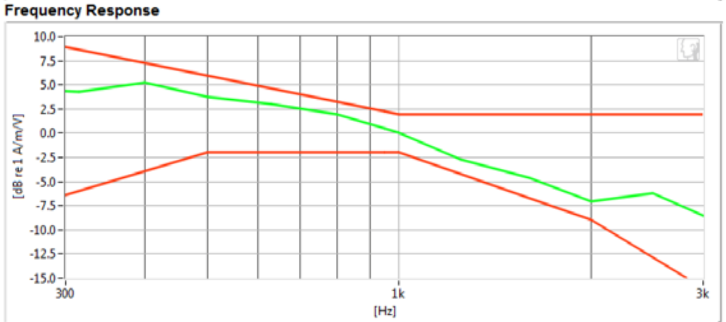
Test Configuration:

- Mode: LTE TDD Band 41 (PC2)
- Bandwidth: 15MHz
- Channel: 40620
- Speech Signal: 3GPP2 Normal Test Signal

Noise Spectrum



Frequency Response



Results

ABM1	15.14	dB	✔	Minimum	-18.0
ABM2	-25.24	dB	✔	Maximum	0.0
SNNR	40.38	dB	✔	Minimum	20.0
Aligned Response - Normal	1.3	dB	✔	Tolerance curves	Aligned Data

PCTEST 2017

PCTEST Hearing-Aid Compatibility Facility

DUT: ZNFG011C

Type: Portable Handset
Serial: 15164

Measurement Standard: ANSI C63.19-2011

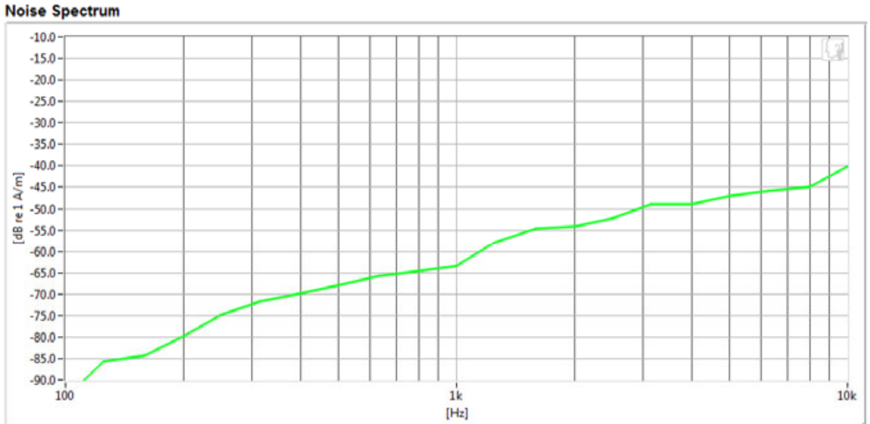
Equipment:

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

Test Configuration:

- Mode: Extended Cellular CDMA
- Channel: 684

Noise Spectrum



Results

ABM1	7.71 dB	✔	Minimum	-18.0
ABM2	-47.49 dB	✔	Maximum	0.0
SNNR	55.2 dB	✔	Minimum	20.0

PCTEST 2017

PCTEST Hearing-Aid Compatibility Facility

DUT: ZNFG011C

Type: Portable Handset
Serial: 15164

Measurement Standard: ANSI C63.19-2011

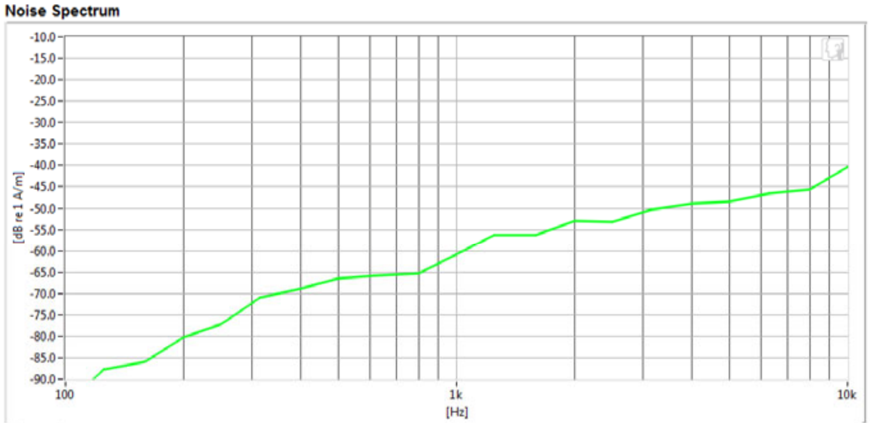
Equipment:

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

Test Configuration:

- Mode: Cellular CDMA
- Channel: 1013

Noise Spectrum



Results

ABM1	8.13	dB	✔	Minimum	-18.0
ABM2	-47.75	dB	✔	Maximum	0.0
SNNR	55.88	dB	✔	Minimum	20.0

PCTEST Hearing-Aid Compatibility Facility

DUT: ZNFG011C

Type: Portable Handset
Serial: 15164

Measurement Standard: ANSI C63.19-2011

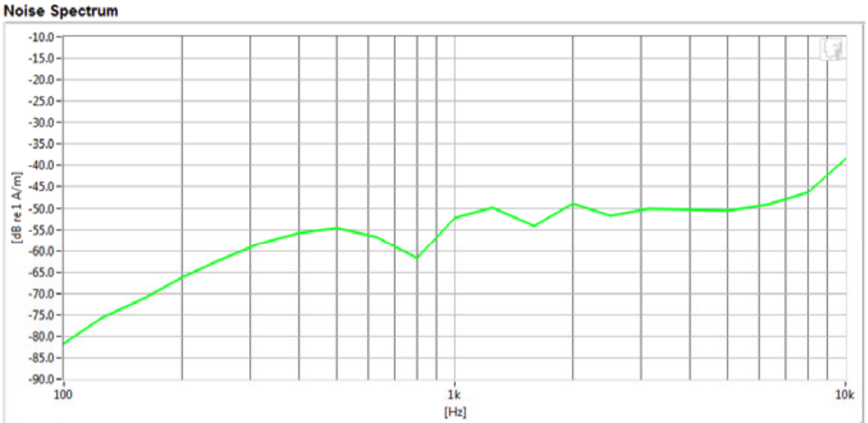
Equipment:

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

Test Configuration:

- Mode: PCS CDMA
- Channel: 25

Noise Spectrum



Results

ABM1	7.83	dB	✓	Minimum	-18.0
ABM2	-43.08	dB	✓	Maximum	0.0
SNNR	50.91	dB	✓	Minimum	20.0

PCTEST 2017

PCTEST Hearing-Aid Compatibility Facility

DUT: ZNFG011C

Type: Portable Handset
Serial: 15164

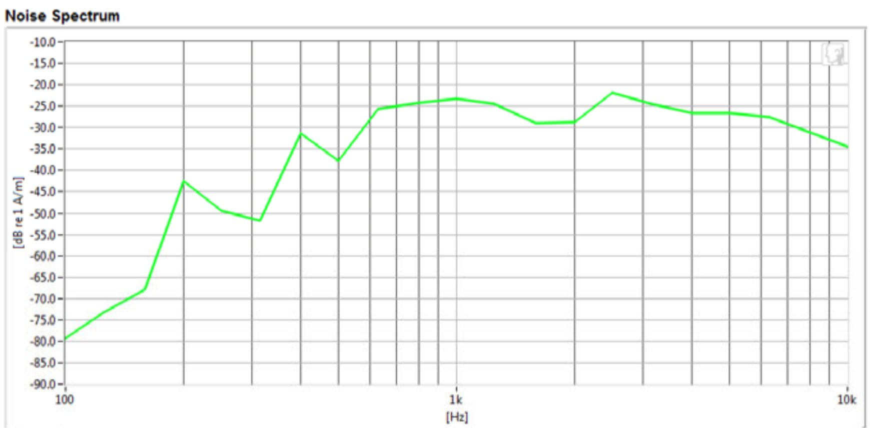
Measurement Standard: ANSI C63.19-2011

Equipment:

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

Test Configuration:

- Mode: GSM850
- Channel: 128



Results

ABM1	10.61 dB	✓	Minimum	-18.0
ABM2	-16.63 dB	✓	Maximum	0.0
SNNR	27.23 dB	✓	Minimum	20.0

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PCTEST Hearing-Aid Compatibility Facility

DUT: ZNFG011C

Type: Portable Handset
Serial: 15164

Measurement Standard: ANSI C63.19-2011

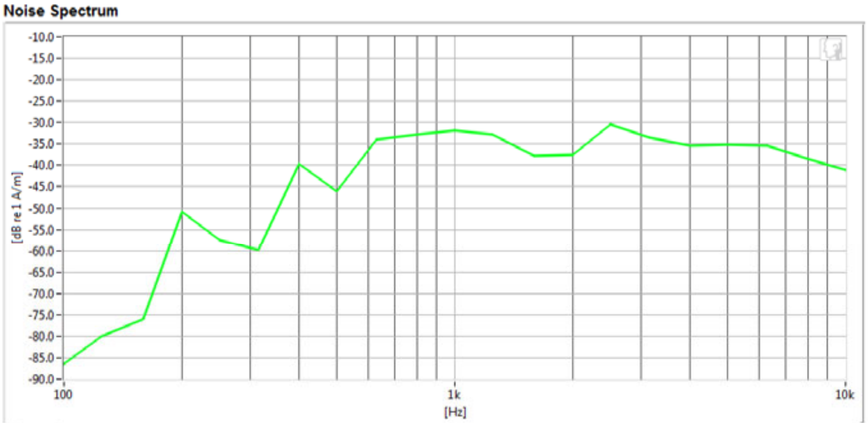
Equipment:

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

Test Configuration:

- Mode: GSM1900
- Channel: 810

Noise Spectrum



Results

ABM1	10.6	dB	✔	Minimum	-18.0
ABM2	-25.09	dB	✔	Maximum	0.0
SNNR	35.69	dB	✔	Minimum	20.0

PCTEST 2017

PCTEST Hearing-Aid Compatibility Facility

DUT: ZNFG011C

Type: Portable Handset
Serial: 15164

Measurement Standard: ANSI C63.19-2011

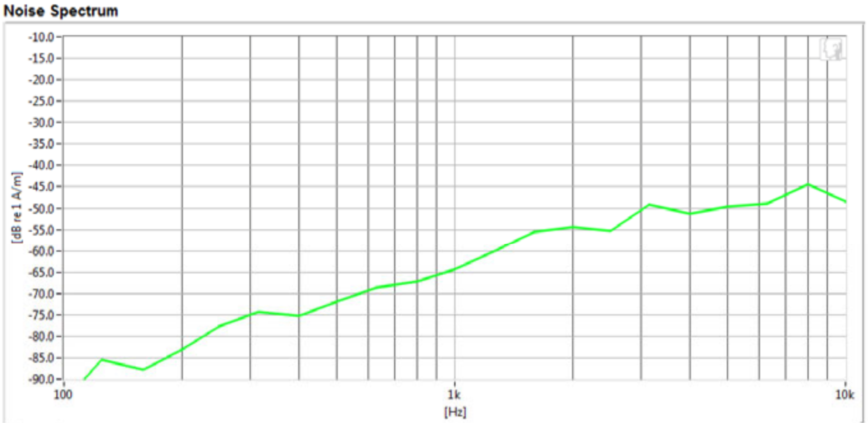
Equipment:

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

Test Configuration:

- Mode: UMTS Band V
- Channel: 4132

Noise Spectrum



Results

ABM1	7.34	dB	✓	Minimum	-18.0
ABM2	-49.33	dB	✓	Maximum	0.0
SNNR	56.67	dB	✓	Minimum	20.0

8/15/2017

PCTEST ENGINEERING LABORATORY, INC.

PCTEST Hearing-Aid Compatibility Facility

DUT: ZNFG011C

Type: Portable Handset
Serial: 15164

Measurement Standard: ANSI C63.19-2011

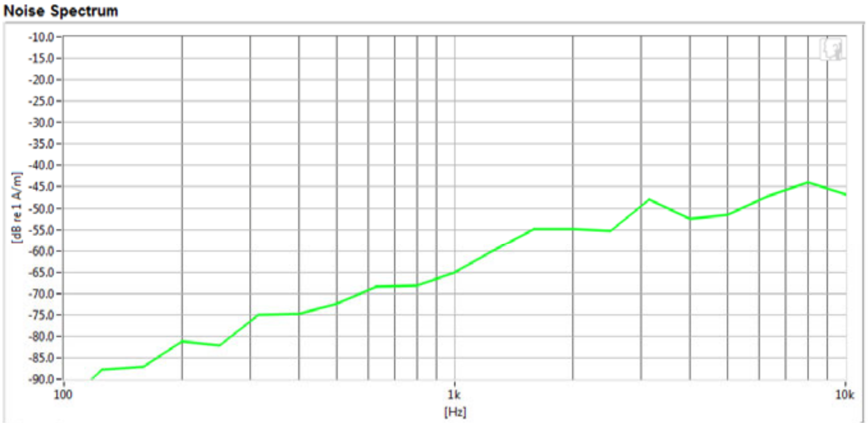
Equipment:

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

Test Configuration:

- Mode: UMTS Band IV
- Channel: 1412

Noise Spectrum



Results

ABM1	7.34	dB	✔	Minimum	-18.0
ABM2	-49.07	dB	✔	Maximum	0.0
SNNR	56.41	dB	✔	Minimum	20.0

PCTEST 2017

8/15/2017

PCTEST Hearing-Aid Compatibility Facility

DUT: ZNFG011C

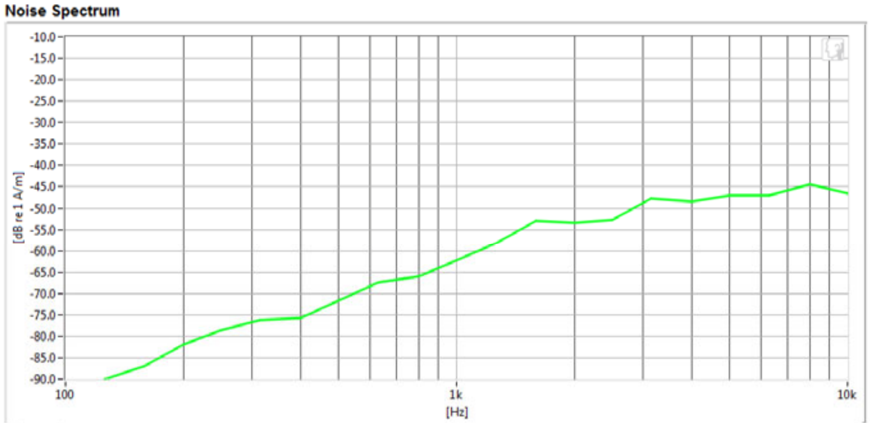
Type: Portable Handset
Serial: 15164

Measurement Standard: ANSI C63.19-2011

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

Test Configuration:
- Mode: UMTS Band II
- Channel: 9538

Noise Spectrum



Results

ABM1	7.34	dB	✓	Minimum	-18.0
ABM2	-47.58	dB	✓	Maximum	0.0
SNNR	54.92	dB	✓	Minimum	20.0

PCTEST 2017

PCTEST ENGINEERING LABORATORY, INC.

PCTEST Hearing-Aid Compatibility Facility

DUT: ZNFG011C

Type: Portable Handset
Serial: 15164

Measurement Standard: ANSI C63.19-2011

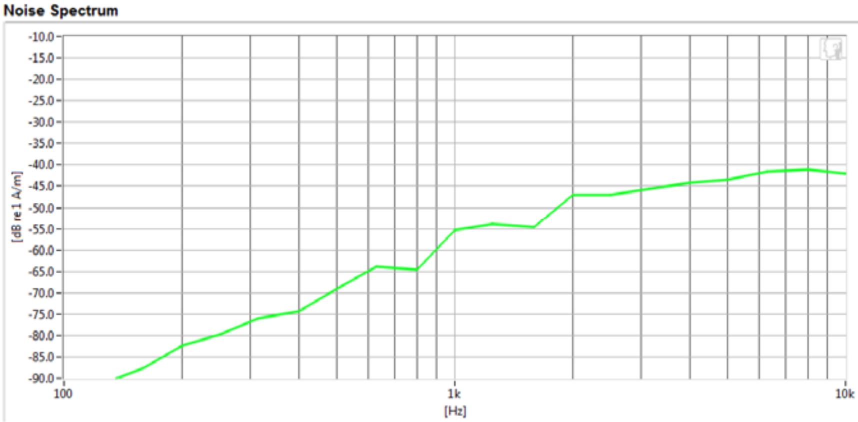
Equipment:

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

Test Configuration:

- Mode: LTE FDD Band 7
- Bandwidth: 20MHz
- Channel: 20850

Noise Spectrum



Results

ABM1	7.42 dB	✔	Minimum	-18.0
ABM2	-43.68 dB	✔	Maximum	0.0
SNNR	51.1 dB	✔	Minimum	20.0

PCTEST Hearing-Aid Compatibility Facility

DUT: ZNFG011C

Type: Portable Handset
Serial: 15164

Measurement Standard: ANSI C63.19-2011

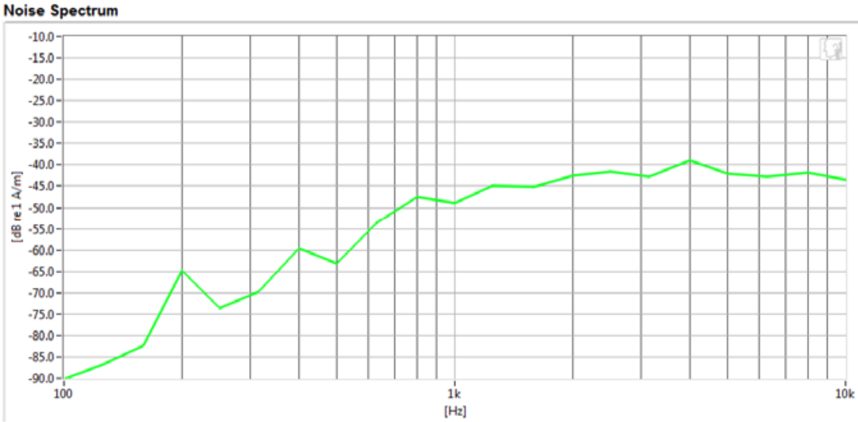
Equipment:

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

Test Configuration:

- Mode: LTE TDD Band 41 (PC2)
- Bandwidth: 15MHz
- Channel: 40620

Noise Spectrum



Results

ABM1	7.52	dB	✓	Minimum	-18.0
ABM2	-37.87	dB	✓	Maximum	0.0
SNNR	45.39	dB	✓	Minimum	20.0

PCTEST 2017

11. CALIBRATION CERTIFICATES

West Caldwell Calibration Laboratories Inc.

Certificate of Calibration

for

AXIAL T COIL PROBE

Manufactured by:	TEM CONSULTING
Model No:	AXIAL T COIL PROBE
Serial No:	TEM-1124
Calibration Recall No:	27068

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. AXIAL T C TEM C

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

Within (X)

12/29/2016

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

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

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

Approved by:

Calibration Date: 07-Dec-16

FC

Certificate No: 27068 - 3

Felix Christopher (QA Mgr.)

ISO/IEC 17025:2005

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

Certificate Page 1 of 1

West Caldwell Calibration Laboratories, Inc.
uncompromised calibration
1575 State Route 96, Victor, NY 14564, U.S.A.

ACCREDITED
Calibration Lab. Cert. # 1533.01

West Caldwell Calibration Laboratories, Inc.
uncompromised calibration
1575 State Route 96, Victor NY 14564

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

REPORT OF CALIBRATION

for

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**

Calibration results:

Probe Sensitivity measured with Helmholtz Coil

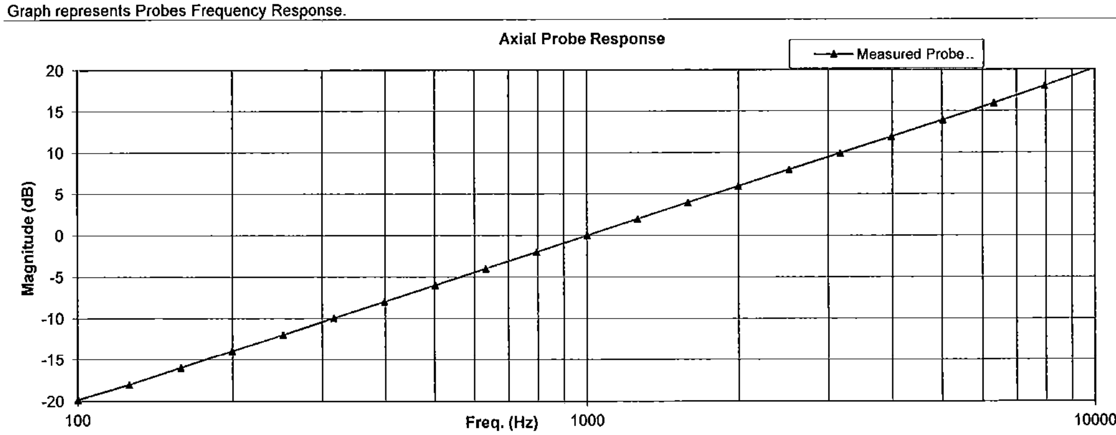
Helmholtz Coil;			Before & after data same:	...X......	
the number of turns on each coil;	10	No.			
the radius of each coil, in meters;	0.204	m	Laboratory Environment:		
the current in the coils, in amperes.;	0.09	A	Ambient Temperature:	20.2	°C
Helmholtz Coil Constant;	7.09	A/m/V	Ambient Humidity:	31.4	% RH
Helmholtz Coil magnetic field;	5.98	A/m	Ambient Pressure:	99.1	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			

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: 7-Dec-2016

Measurements performed by: ....
Felix Christopher

Calibrated on WCCL system type 9700

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

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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 1124

Company : PCTEST Engineering Lab.

Test	Function		Tolerance		Measured values Before	Out	Remarks
1.0	Probe Sensitivity at	1000 Hz.		dBV/A/m	-60.23		
2.0	Probe Level Linearity			dB			
				6	6.03		
			Ref. (0 dB)	0	0.00		
				-6	-6.03		
				-12	-12.05		
3.0	Probe Frequency Response			Hz			
				100	-19.8		
				126	-18.0		
				158	-16.0		
				200	-13.9		
				251	-12.0		
				316	-9.9		
				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		

Instruments used for calibration:			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

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

West Caldwell Calibration Laboratories Inc.

Certificate of Calibration

for

RADIAL T COIL PROBE

Manufactured by:	TEM CONSULTING
Model No:	RADIAL T COIL PROBE
Serial No:	TEM-1130
Calibration Recall No:	27068

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 TEM C

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

VA&H
12/29/2016

Within (X)

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

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

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

Approved by:

Calibration Date: 07-Dec-16

FC

Certificate No: 27068 - 2

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

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

Certificate Page 1 of 1

West Caldwell Calibration Laboratories, Inc.
uncompromised calibration
1575 State Route 96, Victor, NY 14564, U.S.A.

A2LA ACCREDITED
Calibration Lab. Cert. # 1533.01

West Caldwell Calibration Laboratories, Inc.
uncompromised calibration
1575 State Route 96, Victor NY 14564

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

REPORT OF CALIBRATION

for

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

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

Calibration results:

Probe Sensitivity measured with Helmholtz Coil

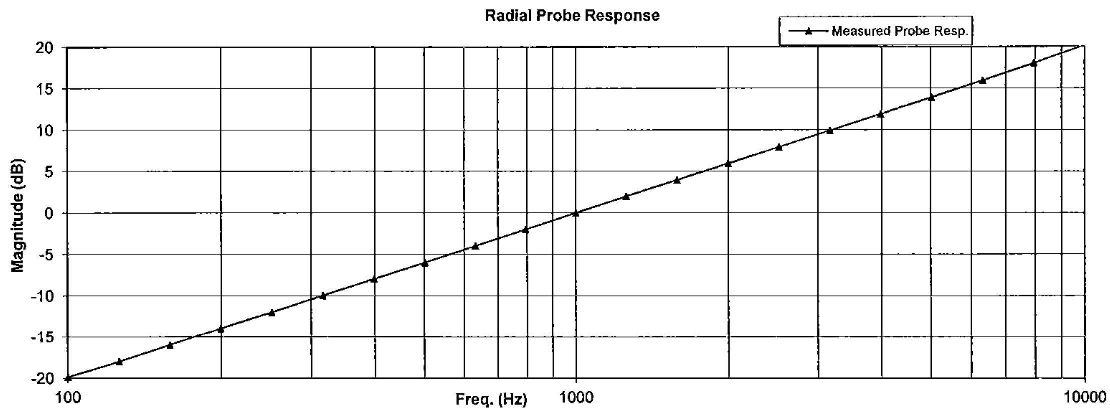
Helmholtz Coil;			Before & after data same:	...X......	
the number of turns on each coil;	10	No.			
the radius of each coil, in meters;	0.204	m	Laboratory Environment:		
the current in the coils, in amperes.;	0.09	A	Ambient Temperature:	20.2	°C
Helmholtz Coil Constant;	7.09	A/m/V	Ambient Humidity:	31.4	% RH
Helmholtz Coil magnetic field;	5.98	A/m	Ambient Pressure:	99.1	kPa
			Calibration Date:	7-Dec-16	
Probe Sensitivity at	1000	Hz.	Re-calibration Due:	7-Dec-17	
was	-60.27	dBV/A/m	Report Number:	27068	-2
	0.969	mV/A/m	Control Number:	27068	
Probe resistance	902	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: 7-Dec-2016

Measurements performed by: ....

Calibrated on WCCL system type 9700

Felix Christopher

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

Page 1 of 2

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-1130

Company : PCTEST Engineering Lab.

Test	Function		Tolerance	Measured values Before	Out	Remarks
1.0	Probe Sensitivity at	1000 Hz.	dBV/A/m	-60.27		
2.0	Probe Level Linearity		dB			
			6	6.03		
		Ref. (0 dB)	0	0.00		
			-6	-6.03		
			-12	-12.06		
3.0	Probe Frequency Response		Hz			
			100	-19.9		
			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	15.9		
			7943	18.0		
			10000	20.2		

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

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

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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.

13. REFERENCES

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