

HEARING AID COMPATIBILITY

Applicant Name:
 Samsung Electronics Co., Ltd.
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 Yeongtong-gu, Suwon-si
 Gyeonggi-do 16677, Korea

Date of Testing:
 7/19/2021 - 7/27/2021
Test Site/Location:
 PCTEST, Columbia, MD, USA
Test Report Serial No.:
 1M2106280073-07.A3L
Date of Issue:
 7/30/2021

FCC ID: **A3LSMF926U**

APPLICANT: **SAMSUNG ELECTRONICS CO., LTD.**

Scope of Test: Audio Band Magnetic Testing (T-Coil)
Application Type: Class II Permissive Change
FCC Rule Part(s): CFR §20.19(b)
HAC Standard: ANSI C63.19-2011
 285076 D01 HAC Guidance v05
 285076 D02 T-Coil testing for CMRS IP v03
DUT Type: Portable Handset
Model: SM-F926U
Additional Model(s): SM-F926U1
Test Device Serial No.: Pre-Production Sample [S/N: 0424M]
Class II Permissive Change(s): See FCC Change Document

C63.19-2011 HAC Category: **T3 (SIGNAL TO NOISE CATEGORY);
 CDMA BC10/0, GSM850, UMTS B5, LTE Band
 71/12/13/14/5/26, and NR n71/12/5 Only)**

This report and category only pertain to CDMA BC10/0, GSM850, UMTS B5, LTE Bands 71/12/13/14/5/26, and NR n71/12/5 modes supported by this wireless portable device. The overall category rating of the device is determined by the lowest rating obtained over all air interfaces supported by the device. 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



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1. INTRODUCTION

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

Compatibility Tests Involved:

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

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

The hearing aid must be measured for:

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

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

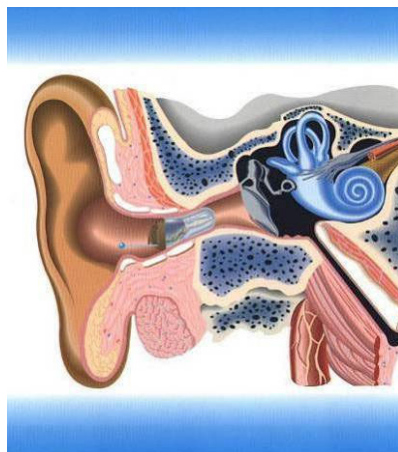


Figure 1-1 Hearing Aid *in-vitu*

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

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2. DUT DESCRIPTION



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Applicant: Samsung Electronics Co., Ltd.
129, Samsung-ro, Maetan dong,
Yeongtong-gu, Suwon-si
Gyeonggi-do 16677, Korea
Model: SM-F926U
Additional Model(s): SM-F926U1
Serial Number: 0424M
HW Version: REV1.0
SW Version: F926USQU1AUGFb
Antenna: Internal Antenna
DUT Type: Portable Handset

I. LTE Band Selection

LTE B5 is an LTE anchor band for dual connectivity (EN-DC) scenarios between LTE and NR so they were additionally evaluated as independent LTE bands.

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Table 2-1
A3LSMF926U HAC Air Interfaces

Air-Interface	Band (MHz)	Type Transport	HAC Tested	Simultaneous But Not Tested	Name of Voice Service	Audio Codec Evaluated
CDMA	835	VO	Yes	Yes: WIFI or BT	CMRS Voice ¹	EVRC
	1900		No ⁵			
	EvDO	VD	Yes	Yes: WIFI or BT	Google Duo ²	OPUS
GSM	850	VO	Yes	Yes: WIFI or BT	CMRS Voice ¹	EFR
	1900		No ⁵			
	GPRS/EDGE	VD	Yes	Yes: WIFI or BT	Google Duo ²	OPUS
UMTS	850	VD	Yes	Yes: WIFI or BT	CMRS Voice ¹	NB AMR
	1700		No ⁵			
	1900					
	HSPA	VD	Yes	Yes: WIFI or BT	Google Duo ²	OPUS
LTE (FDD)	680 (B71)	VD	Yes ³	Yes: NR, WIFI or BT	VoLTE ¹ , Google Duo ²	VoLTE: NB AMR, WB AMR, EVS Google Duo: OPUS
	700 (B12)		Yes			
	780 (B13)					
	790 (B14)					
	850 (B5)					
	850 (B26)					
	1700 (B4)		No ⁵			
	1700 (B66)					
	1900 (B2)					
	1900 (B25)					
	2300 (B30)					
	2500 (B7)					
LTE (TDD)	2600 (B38)	VD	No ⁵	Yes: NR, WIFI or BT	VoLTE ¹ , Google Duo ²	VoLTE: NB AMR, WB AMR, EVS Google Duo: OPUS
	2600 (B41)					
	3600 (B48)					
NR (FDD)	680 (n71)	VD	Yes ^{3,4}	Yes: LTE, WIFI or BT	Google Duo ²	OPUS
	700 (n12)		Yes ⁴			
	850 (n5)		No ⁵			
	1700 (n66)					
	1900 (n2)					
	1900 (n25)					
	2300 (n30)					
NR (TDD)	2600 (n41)	VD	No ⁵	Yes: LTE, WIFI or BT	Google Duo ²	OPUS
	3500 (n77, DoD)					
	3700 (n77)					
	28000 (n261)					
	39000 (n260)					
WIFI	2450	VD	No ⁵	Yes: CDMA, GSM, UMTS, LTE, or NR	VoWIFI ² , Google Duo ²	VoWIFI: NB AMR, WB AMR, EVS Google Duo: OPUS
	5200 (U-NII 1)					
	5300 (U-NII 2A)					
	5500 (U-NII 2C)					
	5800 (U-NII 3)					
	6175 (U-NII 5)					
	6475 (U-NII 6)					
	6700 (U-NII 7)					
7000 (U-NII 8)						
BT	2450	DT	No	Yes: CDMA, GSM, UMTS, LTE, or NR	N/A	N/A
Type Transport VO = Voice Only DT = Digital Data - Not intended for Voice Services VD = CMRS and/or IP Voice over Data Transport			Notes: 1. Reference level in accordance with 7.4.2.1 of ANSI C63.19-2011 and July 2012 C63 VoLTE Interpretation. 2. Reference level is -20dBm0 in accordance with FCC KDB 285076 D02 3. LTE B71 and NR n71, while outside the scope of ANSI C63.19 and FCC HAC regulations, were additionally tested according to the existing HAC procedures with currently available test equipment. 4. NR was evaluated using an interim procedure outlined in Section 6.II.3 5. This report only pertains to CDMA BC10/0, GSM850, UMTS B5, LTE Bands 71/12/13/14/5/26, NR n71/12/5 modes. For full data, please refer to the Original Certification Test Report (Report S/N: 1M2104020031-24-R1.A3L).			

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3. ANSI C63.19-2011 PERFORMANCE CATEGORIES

I. MAGNETIC COUPLING

Axial and Radial Field Intensity

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

Frequency Response

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

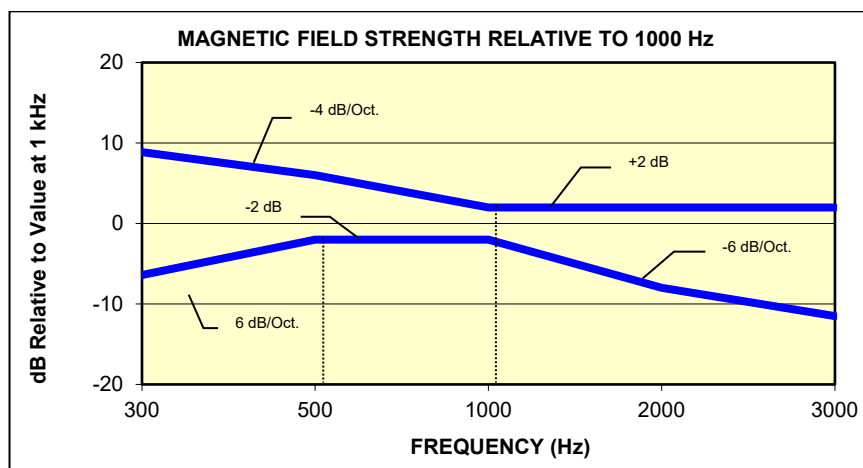


Figure 3-1
Magnetic field frequency response for Wireless Devices with an axial field ≤ -15 dB(A/m) at 1 kHz

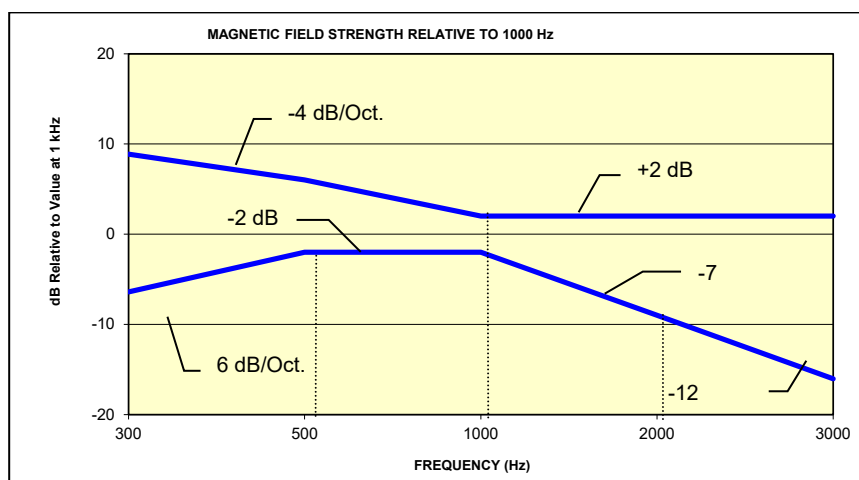


Figure 3-2
Magnetic Field frequency response for wireless devices with an axial field that exceeds -15 dB(A/m) at 1 kHz

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Signal Quality

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

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

Category	Telephone RF Parameters
	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

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

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4. METHOD OF MEASUREMENT

I. Test Setup

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

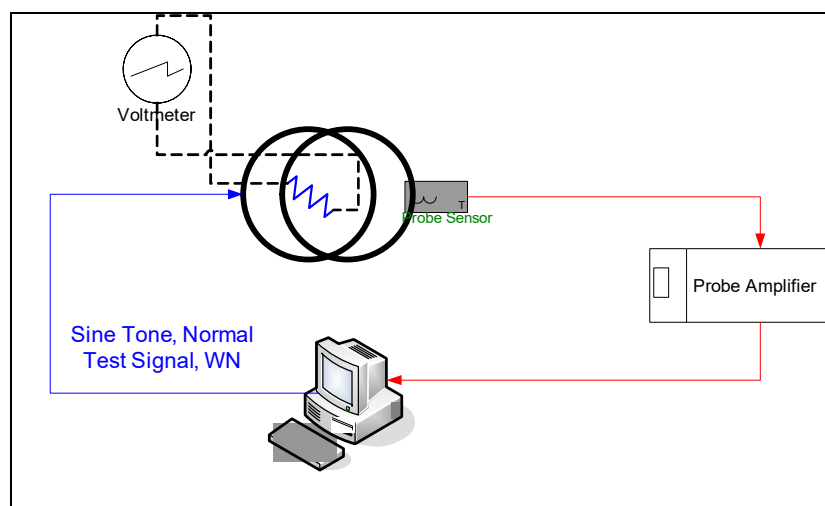


Figure 4-1
Validation Setup with Helmholtz Coil

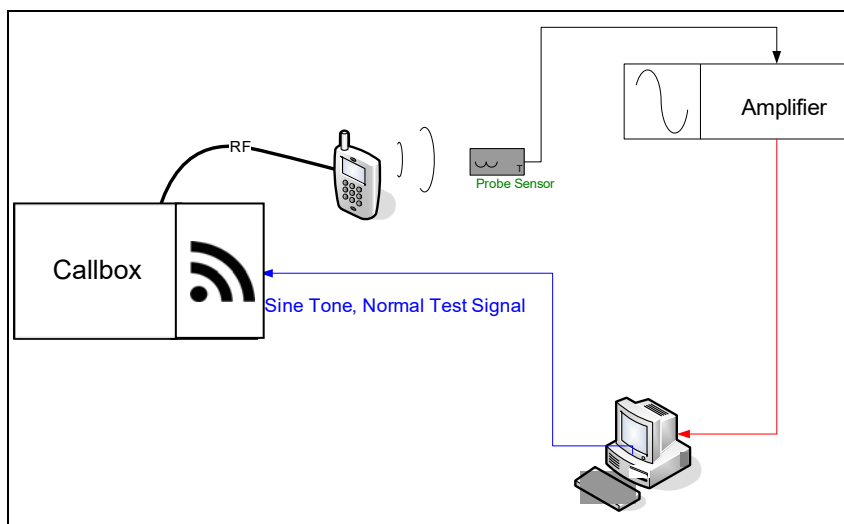


Figure 4-2
T-Coil Test Setup

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II. Scanning Mechanism

Manufacturer:	TEM
Accuracy:	± 0.83 cm/meter
Minimum Step Size:	0.1 mm
Maximum speed	6.1 cm/sec
Line Voltage:	115 VAC
Line Frequency:	60 Hz
Material Composite:	Delrin (Acetal)
Data Control:	Parallel Port
Dynamic Range (X-Y-Z):	45 x 31.75 x 47 cm
Dimensions:	36" x 25" x 38"
Operating Area:	36" x 49" x 55"
Reflections:	< -20 dB (in anechoic chamber)

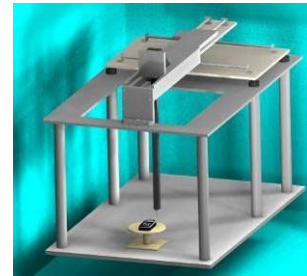


Figure 4-3
RF Near-Field Scanner

III. 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%

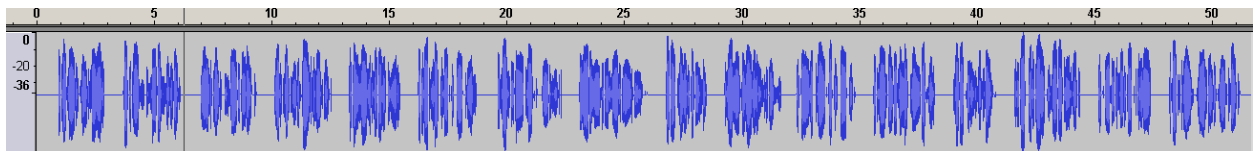
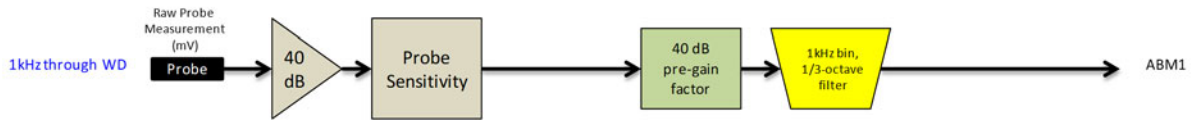


Figure 4-4
Temporal Characteristic of Normal Test Signal

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ABM1 Measurement Block Diagram:



ABM2 Measurement Block Diagram:

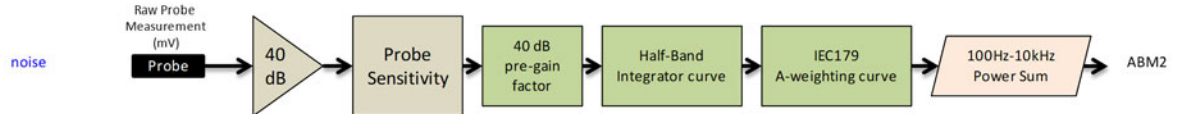


Figure 4-5 Magnetic Measurement Processing Steps

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:

$$-18 - 30 - 10 = -58 \text{ dBA/m}$$
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=0.13m; R=10.193Ω and using V=29mV:

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

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

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measurement at -10dB(A/m). This was verified to be within ± 0.5 dB of the -10dB(A/m) value (see Page 31).

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:

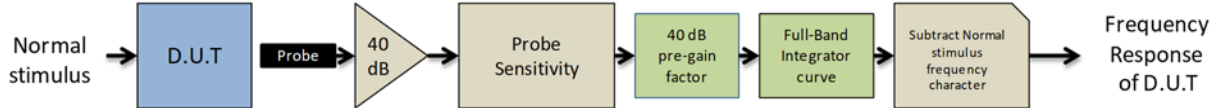


Figure 4-6 Frequency Response Validation

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

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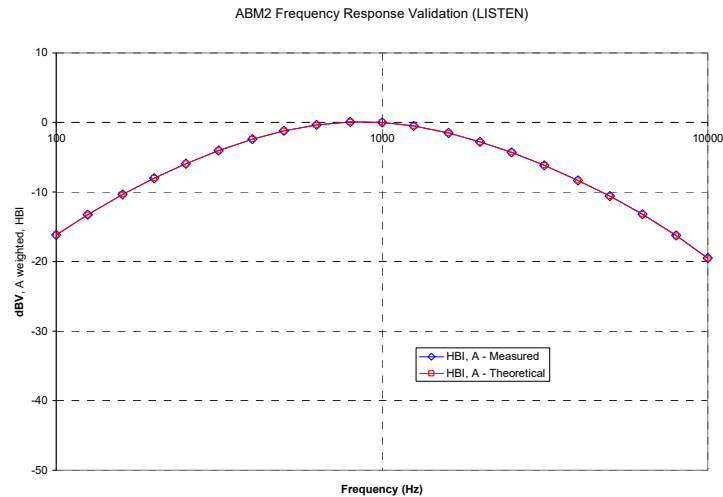


Figure 4-7
ABM2 Frequency Response Validation

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:

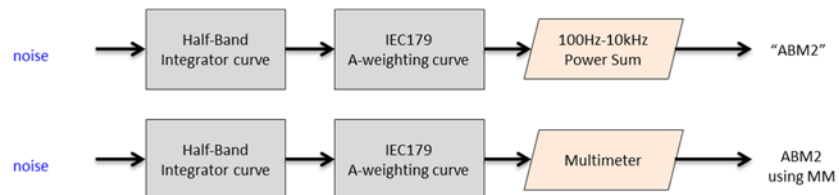


Figure 4-8
ABM2 Validation Block Diagram

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

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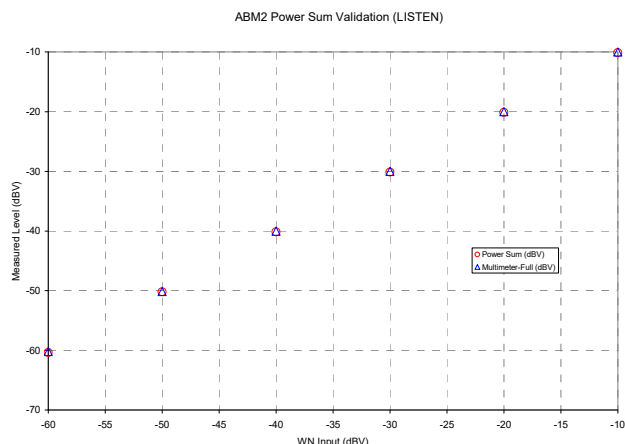


Figure 4-9
ABM2 Power Sum Validation

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):

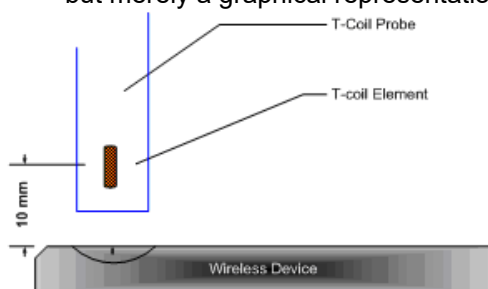


Figure 4-10
Measurement Distance

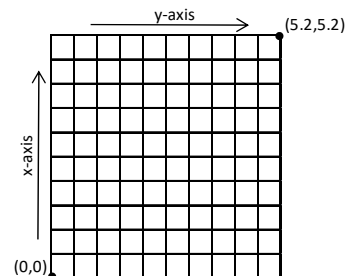


Figure 4-11
Measurement Grid

- 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 4-13 after a T-coil orientation was fully measured with the SoundCheck system.
- #### b. Speech Signal Setup to Base Station Simulator
- i. C63.19 Table 7-1 states audio reference input levels for various technologies:

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

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- ii. See Section 5 and 6 for more information regarding CMW500 audio level settings for Voice Over LTE (VoLTE).
 - iii. See Section 6 for more information regarding audio level settings for Over-The-Top (OTT) Voice Over IP (VoIP) Testing.
 - c. Real-Time Analyzer (RTA)
 - i. The Real-Time Analyzer was configured to analyze measurements using 1/3 Octave band weighted filtering.
 - d. WD Radio Configuration Selection
 - i. The device was chosen to be tested in the worst-case ABM2 condition (See Section 7 for more information regarding worst-case configurations for CDMA and UMTS. LTE configuration information can be found in Section 5 and 6. NR configuration information can be found in Section 6.)
 - ii. Supported GSM vocoders were investigated for the worst-case ABM2 condition. GSM-EFR was deemed the worst-case condition for the GSM air interface.
- 4. Signal Quality Data Analysis
 - a. Narrow-band Magnetic Intensity
 - i. The standard specifies a 1kHz 1/3 octave band minimum field intensity for a sine tone. The ABM1 measurements were evaluated at 1kHz with 1/3 octave band filtering over an averaged period of 10 seconds.
 - b. Frequency Response
 - i. The appropriate frequency response curve was measured to curves in Figure 3-1 or Figure 3-2 between 300 – 3000 Hz using digital linear averaging (limit lines chosen according to measurement found in step 4a). A linear average over 3x the length of the artificial voice signal (3x sampling) was performed. A 10 second delay was configured in the measurement process of the stimulus to ensure handset vocoder latency effects and echo cancellation devices (if any) were appropriately stabilized during measurements.
 - ii. The appropriate post-processing was applied according to the system processing chain illustrated in Figure 4-6. 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.

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V. Test Setup

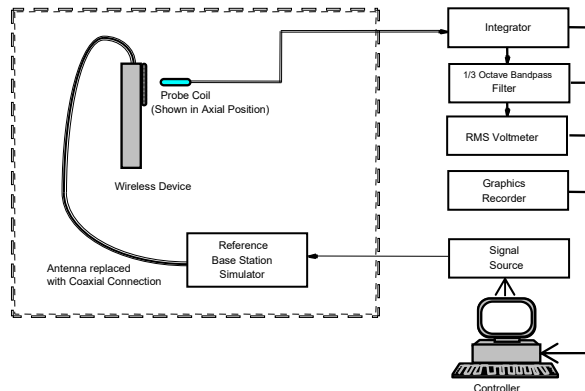


Figure 4-12
Audio Magnetic Field Test Setup

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

VI. Deviation from C63.19 Test Procedure

Non-conducted RF connection due to inaccessible RF ports.

VII. Air Interface Technologies Tested

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

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VIII. Wireless Device Channels and Frequencies

1. 2G/3G Modes

The frequencies listed in the table below are those that lie in the center of the bands used for cellular telephony. Please refer to the Original Certification for full evaluation on 2G/3G mode.

Table 4-3
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

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. The middle channel and supported bandwidths from the worst-case band according to Table 6-1 were additionally evaluated with OTT VoIP for each probe orientation. See Tables 8-8 to 8-19, and 8-23 for LTE bandwidths and channels. Please refer to the Original Certification for full evaluation on 4G (LTE) mode.

3. 5G (NR) Modes

The middle channel and highest supported bandwidth from the worst-case NR FDD band according to Table 6-2 was evaluated with OTT VoIP for each probe orientation. See Table 8-24 for NR evaluation. Please refer to the Original Certification for full evaluation on 5G (NR) mode.

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IX. Test Flow

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

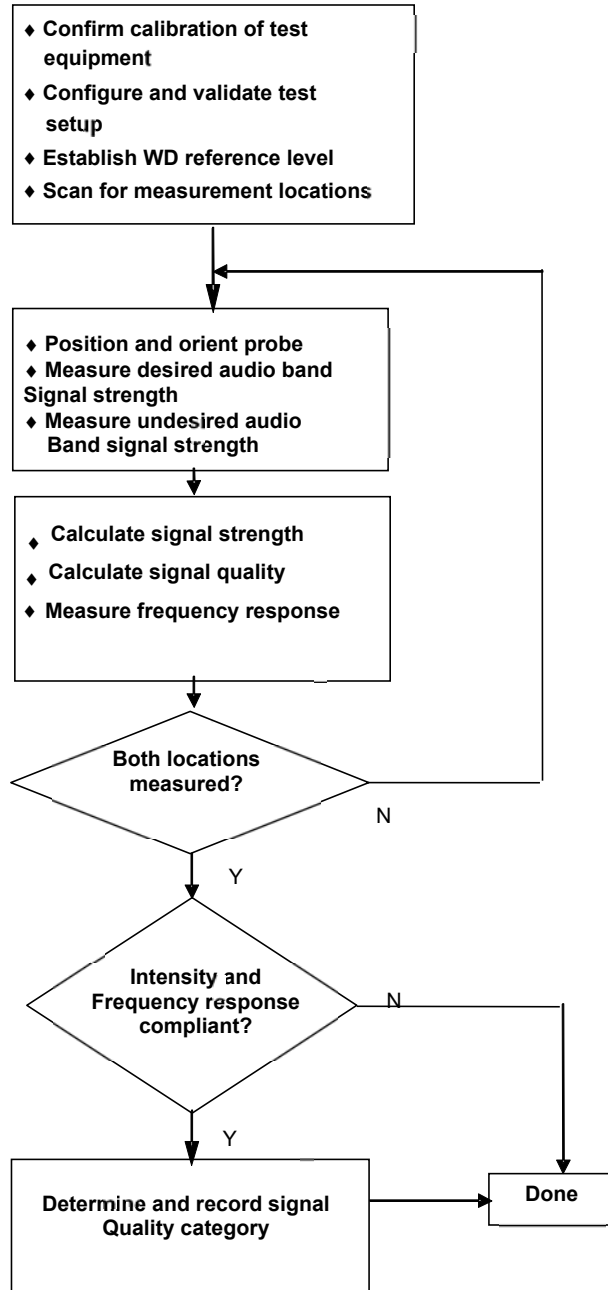


Figure 4-13
C63.19 T-Coil Signal Test Process

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5. VOLTE TEST SYSTEM SETUP AND DUT CONFIGURATION

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

1. Equipment Setup

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

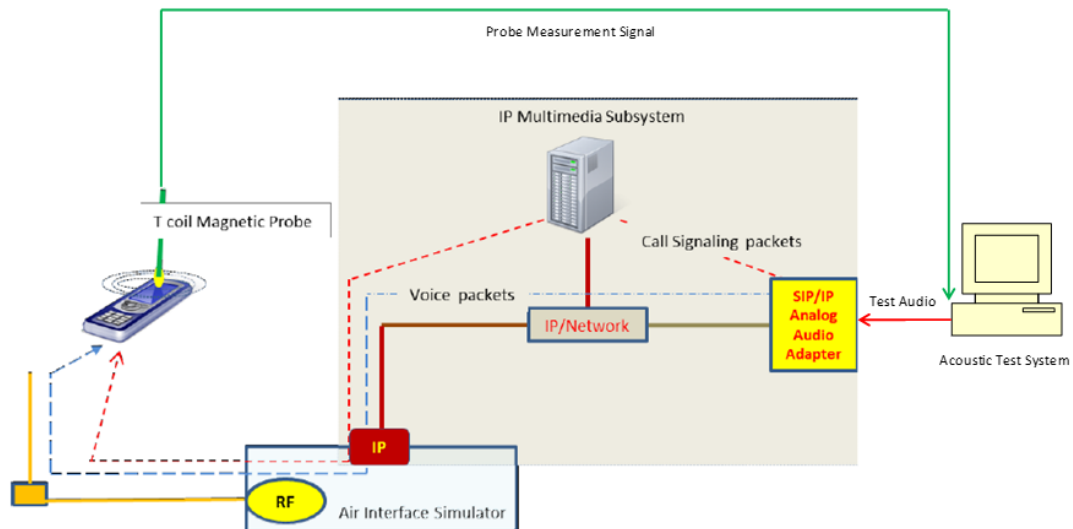


Figure 5-1
Test Setup for VoLTE over IMS T-Coil Measurements

2. Audio Level Settings

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

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

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

1. Radio Configuration

An investigation was performed to determine the modulation and RB configuration to be used for testing. The effects of modulation and RB configuration were found to be independent of band and bandwidth; therefore, only one band and bandwidth were used for this investigation. 16QAM, 1RB, 0 RB offset was used for the testing as the worst-case configuration for the handset. Please refer to the Original Certification test report for more information regarding radio configuration selection.

2. Codec Configuration

An investigation was performed to determine the audio codec configuration to be used for testing. The effects of codec configuration were found to be independent of radio configuration; therefore, only one radio configuration was used for this investigation. The NB AMR 4.75kbps setting was used for the audio codec on the CMW500 for VoLTE over IMS T-coil testing. Please refer to the Original Certification test report for more information regarding codec configuration selection.

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6. OTT VOIP TEST SYSTEM AND DUT CONFIGURATION

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

1. OTT VoIP Application

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

2. Equipment Setup

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

3. Audio Level Settings

According to KDB 285076 D02, the average speech level of -20dBm0 shall be used for protocols not specifically listed in Table 7.1 of ANSI C63.19-2011 or the ANSI C63.19-2011 VoLTE interpretation². The auxiliary VoIP unit allowed for monitoring the signal input level to ensure that the settings for speech input and full scale levels resulted in the -20dBm0 speech input level to the DUT for the OTT VoIP call.

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

II. DUT Configuration for OTT VoIP T-Coil Testing

1. Codec Configuration

An investigation was performed for each applicable data mode to determine the audio codec configuration to be used for testing. The effects of codec configuration were found to be independent of radio configuration; therefore, only one radio configuration for each applicable data mode was used for these investigations. The 6kbps codec setting was used for the audio codec on the auxiliary VoIP unit for OTT VoIP T-Coil testing. Please refer to the Original Certification test report for more information regarding codec configuration selection.

2. Radio Configuration for OTT VoIP (LTE)

An investigation was performed to determine the worst-case LTE FDD band to be used for OTT VoIP testing. LTE FDD Band 13 was used for the testing as the worst-case configuration for the handset. See below table for SNNR comparison between different LTE FDD bands:

Table 6-1
OTT VoIP (LTE FDD) SNNR by LTE Band

Band	Frequency [MHz]	Channel	Bandwidth [MHz]	Modulation	RB Size	RB Offset	ABM1 [dB(A/m)]	ABM2 [dB(A/m)]	SNNR [dB]
71	680.5	133297	20	16QAM	1	0	11.32	-38.85	50.17
12	707.5	23095	10	16QAM	1	0	11.48	-41.22	52.70
13	782.0	23230	10	16QAM	1	0	11.22	-37.21	48.43
14	793.0	23330	10	16QAM	1	0	11.29	-39.68	50.97
26	831.5	26865	15	16QAM	1	0	11.47	-42.22	53.69
5	836.5	20525	10	16QAM	1	0	11.51	-39.40	50.91

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

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3. Interim Procedure for evaluation OTT VoIP (NR)

The following procedure is used to evaluate OTT VoIP (NR) given equipment limitations.

- a. This procedure is applicable for OTT VoIP (NR) voice calls that use the same protocol, codec(s), and reference level as OTT VoIP (LTE) (i.e. -20dBm0).
- b. Establish the $ABM1_{NR}$ value by using the $ABM1_{LTE}$ magnetic intensity for an LTE call using a correlating LTE band through existing procedures and test equipment.
- c. Establish an $ABM2_{NR}$ value using factory test mode (FTM) to simulate a NR connection for the desired NR band and channel under test.
- d. The following information is documented in Section 9:
 - i. $ABM2_{LTE}$ and $ABM2_{NR}$ for respective tests.
 - ii. Calculate SNNR:
 1. $ABM1 = ABM1_{LTE}$
 2. $ABM2 = ABM2_{NR}$
 3. $SNNR_{NR} = [ABM1_{LTE} - ABM2_{NR}] - 3dB$
 - a. A 3dB margin is built in to ensure conservative results with this interim procedure.

The above is only applicable for OTT VoIP scenarios, this device does not support VoNR over IMS.

The manufacturer has confirmed the handset as designed is expected to exhibit similar audio intensity levels between an OTT VoIP call placed over a 4G LTE and a 5G Sub-6GHz data connection.

4. Radio Configuration for OTT VoIP (NR)

An investigation was performed to determine the waveform, modulation, and RB configuration to be used for testing. Due to equipment limitations, the procedure outlined in 6.II.3 was used to evaluate the SNNR for each radio configuration below. DFT-s-OFDM 256QAM, 1RB, 50%RB offset was determined to be the worst-case configuration for the handset and will be used for full testing in Section 7. Please refer to the Original Certification test report for more information regarding radio configuration selection.

An investigation was performed to determine the worst-case NR FDD band to be used for OTT VoIP testing. NR n71 - M1+M2 was used for the testing as the worst-case configuration for the handset. See below table for SNNR comparison between different NR FDD bands:

Table 6-2
OTT VoIP (NR FDD) SNNR by Band

Band	Frequency [MHz]	Channel	Bandwidth [MHz]	Waveform	Modulation	RB Size	RB Offset	$ABM1_{LTE}$ [dB(A/m)]	$ABM2_{NR}$ [dB(A/m)]	$SNNR_{NR}$ [dB]
n71 - M1 + M2	680.5	136100	20	DFT-s-OFDM	256QAM	1	53	11.32	-44.99	56.31
n71 - M1	680.5	136100	20	DFT-s-OFDM	256QAM	1	53	11.32	-45.41	56.73
n12 - M1 + M2	707.5	141500	15	DFT-s-OFDM	256QAM	1	40	11.48	-46.41	57.89
n12 - M1	707.5	141500	15	DFT-s-OFDM	256QAM	1	40	11.48	-48.14	59.62
n5 - M1 + M2	836.5	167300	20	DFT-s-OFDM	256QAM	1	53	11.51	-46.71	58.22
n5 - M1	836.5	167300	20	DFT-s-OFDM	256QAM	1	53	11.51	-45.42	56.93

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7. FCC 3G MEASUREMENTS

I. CDMA Test Configurations

Radio Configuration 1, Service Option 68 was used for the testing and as one of the worst-case configuration for the handset due to vocoder gating from the EVRC logic. See below plot for an example of ABM noise comparison between operational field service options and radio configurations for a CDMA2000 handset:

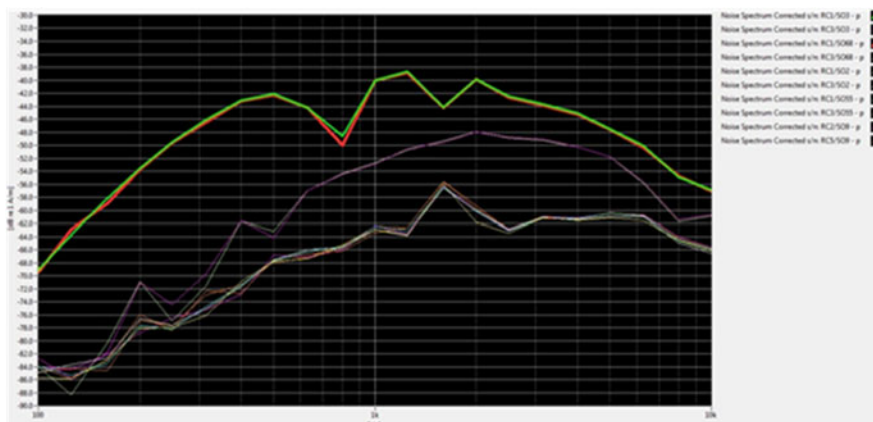


Figure 7-1
CDMA Audio Band Magnetic Noise

Table 7-1
FCC 3G ABM Measurements for A3LSMF926U (CDMA)

Configuration:	RC1/SO68	RC3/SO68	RC4/SO68	Orientation	Channel
ABM1 (dBA/m)	2.15	2.01	1.91	Axial	384
ABM2 (dBA/m)	-35.96	-49.34	-53.16		
Frequency Response	Pass	Pass	Pass		
S+N/N (dB)	38.11	51.35	55.07		

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

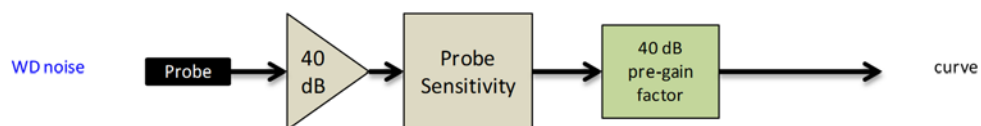


Figure 7-2
Audio Band Magnetic Curve Measurement Block Diagram

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II. UMTS Test Configurations

AMR at 4.75kbps, 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:

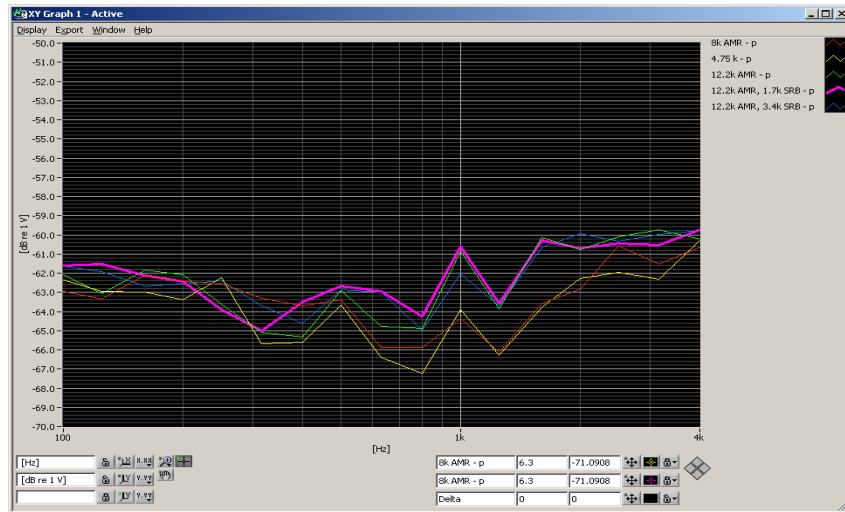


Figure 7-3
UMTS Audio Band Magnetic Noise

Table 7-2
Codec Investigation - UMTS

Codec Setting:	WB AMR 23.85kbps	WB AMR 6.60kbps	NB AMR 12.2kbps	NB AMR 4.75kbps	Orientation	Channel
ABM1 (dBA/m)	14.49	13.57	9.40	9.35	Axial	4183
ABM2 (dBA/m)	-51.99	-51.57	-51.30	-51.27		
Frequency Response	Pass	Pass	Pass	Pass		
S+N/N (dB)	66.48	65.14	60.70	60.62		

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

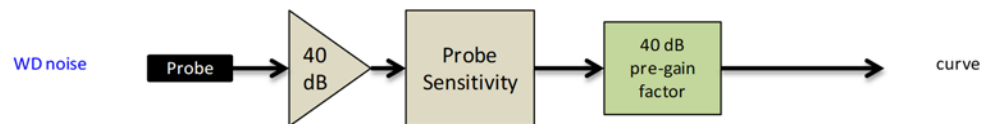


Figure 7-4
Audio Band Magnetic Curve Measurement Block Diagram

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8. T-COIL TEST SUMMARY

Table 8-1
Consolidated Tabled Results

		Freq. Response Margin		Magnetic Intensity Verdict		FCC SNNR Verdict		Margin from FCC Limit (dB)	C63.19-2011 Rating
C63.19 Section		8.3.2		8.3.1		8.3.4			
		Axial	Radial	Axial	Radial	Axial	Radial		
CDMA	Secondary Cellular	PASS	NA	PASS	PASS	PASS	PASS	-15.20	T4
	Cellular	PASS	NA	PASS	PASS	PASS	PASS		
EvDO (OTT VoIP)	Secondary Cellular	PASS	NA	PASS	PASS	PASS	PASS	-36.33	T4
	Cellular	PASS	NA	PASS	PASS	PASS	PASS		
GSM	Cellular	PASS	NA	PASS	PASS	PASS	PASS	-3.79	T3
EDGE (OTT VoIP)	Cellular	PASS	NA	PASS	PASS	PASS	PASS	-8.50	T3
UMTS	Cellular	PASS	NA	PASS	PASS	PASS	PASS	-40.37	T4
HSPA (OTT VoIP)	Cellular	PASS	NA	PASS	PASS	PASS	PASS	-36.58	T4
LTE FDD	B71	PASS	NA	PASS	PASS	PASS	PASS	-26.02	T4
	B12	PASS	NA	PASS	PASS	PASS	PASS		
	B13	PASS	NA	PASS	PASS	PASS	PASS		
	B14	PASS	NA	PASS	PASS	PASS	PASS		
	B26	PASS	NA	PASS	PASS	PASS	PASS		
	B5	PASS	NA	PASS	PASS	PASS	PASS		
LTE FDD (OTT VoIP)	B13	PASS	NA	PASS	PASS	PASS	PASS	-28.36	T4
NR FDD (OTT VoIP)	n71	NA	NA	PASS	PASS	PASS	PASS	-31.97	T4

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I. Raw Handset Data

Table 8-2
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)	Margin from FCC Limit (dB)	C63.19-2011 Rating	Test Coordinates
Secondary Cellular	Axial	476	2.45	-33.59	-58.63	2.00	36.04	20.00	-16.04	T4	1.6, 1.8
	Radial	476	-5.68	-41.36	-59.02	N/A	35.68	20.00	-15.68	T4	1.6, 2.6
Cellular	Axial	777	2.28	-34.26	-58.63	2.00	36.54	20.00	-16.54	T4	1.6, 1.8
	Radial	777	-5.65	-41.02	-59.02	N/A	35.37	20.00	-15.37	T4	1.6, 2.6

Table 8-3
Raw Data Results for CDMA – Ant M1 + M2 Spot-check

Mode	Orientation	Channel	ABM1 [dB(A/m)]	ABM2 [dB(A/m)]	Ambient Noise [dB(A/m)]	Frequency Response Margin (dB)	S+N/N (dB)	FCC Limit (dB)	Margin from FCC Limit (dB)	C63.19-2011 Rating	Test Coordinates
Secondary Cellular	Axial	476	2.20	-34.04	-58.63	2.00	36.24	20.00	-16.24	T4	1.6, 1.8
	Radial	564	-5.80	-41.53	-59.02	N/A	35.73	20.00	-15.73	T4	1.6, 2.6
Cellular	Axial	777	2.09	-35.04	-58.63	2.00	37.13	20.00	-17.13	T4	1.6, 1.8
	Radial	777	-5.63	-40.83	-59.02	N/A	35.20	20.00	-15.20	T4	1.6, 2.6

Table 8-4
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)	Margin from FCC Limit (dB)	C63.19-2011 Rating	Test Coordinates
GSM850	Axial	128	10.12	-15.56	-58.63	2.00	25.68	20.00	-5.68	T3	1.6, 1.8
		190	10.48	-15.25		2.00	25.73	20.00	-5.73	T3	
		251	10.34	-17.63		2.00	27.97	20.00	-7.97	T3	
	Radial	128	2.20	-22.67	-59.02	N/A	24.87	20.00	-4.87	T3	1.6, 2.6
		190	2.07	-22.93			25.00	20.00	-5.00	T3	
		251	2.27	-22.96			25.23	20.00	-5.23	T3	

Table 8-5
Raw Data Results for GSM – Ant M1 + M2 Spot-check

Mode	Orientation	Channel	ABM1 [dB(A/m)]	ABM2 [dB(A/m)]	Ambient Noise [dB(A/m)]	Frequency Response Margin (dB)	S+N/N (dB)	FCC Limit (dB)	Margin from FCC Limit (dB)	C63.19-2011 Rating	Test Coordinates
GSM850	Axial	128	10.19	-14.07	-58.63	2.00	24.26	20.00	-4.26	T3	1.6, 1.8
		190	10.20	-15.13		2.00	25.33	20.00	-5.33	T3	
		251	10.24	-16.28		2.00	26.52	20.00	-6.52	T3	
	Radial	128	2.39	-21.40	-59.02	N/A	23.79	20.00	-3.79	T3	1.6, 2.6
		190	2.40	-22.53			24.93	20.00	-4.93	T3	
		251	2.59	-23.18			25.77	20.00	-5.77	T3	

Table 8-6
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)	Margin from FCC Limit (dB)	C63.19-2011 Rating	Test Coordinates
UMTS V	Axial	4132	9.51	-51.76	-58.63	2.00	61.27	20.00	-41.27	T4	1.6, 1.8
	Radial	4132	1.82	-58.55	-59.02	N/A	60.37	20.00	-40.37	T4	1.6, 2.6

Table 8-7
Raw Data Results for UMTS – Ant M1 + M2 Spot-check

Mode	Orientation	Channel	ABM1 [dB(A/m)]	ABM2 [dB(A/m)]	Ambient Noise [dB(A/m)]	Frequency Response Margin (dB)	S+N/N (dB)	FCC Limit (dB)	Margin from FCC Limit (dB)	C63.19-2011 Rating	Test Coordinates
UMTS V	Axial	4233	9.52	-51.25	-58.63	2.00	60.77	20.00	-40.77	T4	1.6, 1.8
	Radial	4183	2.31	-58.06	-59.02	N/A	60.37	20.00	-40.37	T4	1.6, 2.6

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Table 8-8
Raw Data Results for LTE B71

Mode	Orientation	Bandwidth	Channel	ABM1 [dB(A/m)]	ABM2 [dB(A/m)]	Ambient Noise [dB(A/m)]	Frequency Response Margin (dB)	S+N/N (dB)	FCC Limit (dB)	Margin from FCC Limit (dB)	C63.19-2011 Rating	Test Coordinates
LTE Band 71	Axial	5MHz	133297	9.69	-40.78	-58.63	2.00	50.47	20.00	-30.47	T4	1.6, 1.8
	Radial	5MHz	133297	1.42	-45.52	-59.02	N/A	46.94	20.00	-26.94	T4	1.6, 2.6

Table 8-9
Raw Data Results for LTE B71 – M1 Spot-check

Mode	Orientation	Bandwidth	Channel	ABM1 [dB(A/m)]	ABM2 [dB(A/m)]	Ambient Noise [dB(A/m)]	Frequency Response Margin (dB)	S+N/N (dB)	FCC Limit (dB)	Margin from FCC Limit (dB)	C63.19-2011 Rating	Test Coordinates
LTE Band 71	Axial	15MHz	133297	9.19	-38.84	-58.63	1.92	48.03	20.00	-28.03	T4	1.6, 1.8
	Radial	15MHz	133297	1.44	-47.23	-59.02	N/A	48.67	20.00	-28.67	T4	1.6, 2.6

Table 8-10
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)	Margin from FCC Limit (dB)	C63.19-2011 Rating	Test Coordinates
LTE Band 12	Axial	3MHz	23095	9.53	-42.11	-58.63	2.00	51.64	20.00	-31.64	T4	1.6, 1.8
	Radial	10MHz	23095	1.37	-47.73	-59.02	N/A	49.10	20.00	-29.10	T4	1.6, 2.6

Table 8-11
Raw Data Results for LTE B12 – M1 Spot-check

Mode	Orientation	Bandwidth	Channel	ABM1 [dB(A/m)]	ABM2 [dB(A/m)]	Ambient Noise [dB(A/m)]	Frequency Response Margin (dB)	S+N/N (dB)	FCC Limit (dB)	Margin from FCC Limit (dB)	C63.19-2011 Rating	Test Coordinates
LTE Band 12	Axial	5MHz	23095	9.41	-41.64	-58.63	2.00	51.05	20.00	-31.05	T4	1.6, 1.8
	Radial	5MHz	23095	1.40	-47.69	-59.02	N/A	49.09	20.00	-29.09	T4	1.6, 2.6

Table 8-12
Raw Data Results for LTE B13

Mode	Orientation	Bandwidth	Channel	ABM1 [dB(A/m)]	ABM2 [dB(A/m)]	Ambient Noise [dB(A/m)]	Frequency Response Margin (dB)	S+N/N (dB)	FCC Limit (dB)	Margin from FCC Limit (dB)	C63.19-2011 Rating	Test Coordinates
LTE Band 13	Axial	10MHz	23230	9.18	-37.10	-58.63	2.00	46.28	20.00	-26.28	T4	1.6, 1.8
		5MHz	23230	9.33	-39.35		2.00	48.68	20.00	-28.68	T4	
		10MHz	23230	1.61	-44.41	-59.02	N/A	46.02	20.00	-26.02	T4	1.6, 2.6
	Radial	5MHz	23230	1.56	-46.35			47.91	20.00	-27.91	T4	
		10MHz	23230	1.61	-44.41			46.02	20.00	-26.02	T4	
		5MHz	23230	1.56	-46.35			47.91	20.00	-27.91	T4	

Table 8-13
Raw Data Results for LTE B13 – M1 Spot-check

Mode	Orientation	Bandwidth	Channel	ABM1 [dB(A/m)]	ABM2 [dB(A/m)]	Ambient Noise [dB(A/m)]	Frequency Response Margin (dB)	S+N/N (dB)	FCC Limit (dB)	Margin from FCC Limit (dB)	C63.19-2011 Rating	Test Coordinates
LTE Band 13	Axial	10MHz	23230	9.42	-38.07	-58.63	2.00	47.49	20.00	-27.49	T4	1.6, 1.8
	Radial	10MHz	23230	1.39	-46.58	-59.02	N/A	47.97	20.00	-27.97	T4	1.6, 2.6

Table 8-14
Raw Data Results for LTE B14

Mode	Orientation	Bandwidth	Channel	ABM1 [dB(A/m)]	ABM2 [dB(A/m)]	Ambient Noise [dB(A/m)]	Frequency Response Margin (dB)	S+N/N (dB)	FCC Limit (dB)	Margin from FCC Limit (dB)	C63.19-2011 Rating	Test Coordinates
LTE Band 14	Axial	5MHz	23330	9.20	-39.94	-58.63	2.00	49.14	20.00	-29.14	T4	1.6, 1.8
	Radial	5MHz	23330	1.36	-47.67	-59.02	N/A	49.03	20.00	-29.03	T4	1.6, 2.6

Table 8-15
Raw Data Results for LTE B14 – M1 Spot-check

Mode	Orientation	Bandwidth	Channel	ABM1 [dB(A/m)]	ABM2 [dB(A/m)]	Ambient Noise [dB(A/m)]	Frequency Response Margin (dB)	S+N/N (dB)	FCC Limit (dB)	Margin from FCC Limit (dB)	C63.19-2011 Rating	Test Coordinates
LTE Band 14	Axial	5MHz	23330	9.14	-38.25	-58.63	2.00	47.39	20.00	-27.39	T4	1.6, 1.8
	Radial	10MHz	23330	1.30	-47.08	-59.02	N/A	48.38	20.00	-28.38	T4	1.6, 2.6

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Table 8-16
Raw Data Results for LTE B26

Mode	Orientation	Bandwidth	Channel	ABM1 [dB(A/m)]	ABM2 [dB(A/m)]	Ambient Noise [dB(A/m)]	Frequency Response Margin (dB)	S+N/N (dB)	FCC Limit (dB)	Margin from FCC Limit (dB)	C63.19-2011 Rating	Test Coordinates
LTE Band 26	Axial	5MHz	26865	9.17	-42.18	-58.63	2.00	51.35	20.00	-31.35	T4	1.6, 1.8
	Radial	5MHz	26865	1.24	-49.63	-59.02	N/A	50.87	20.00	-30.87	T4	1.6, 2.6

Table 8-17
Raw Data Results for LTE B26 – Ant M1 + M2 Spot-check

Mode	Orientation	Bandwidth	Channel	ABM1 [dB(A/m)]	ABM2 [dB(A/m)]	Ambient Noise [dB(A/m)]	Frequency Response Margin (dB)	S+N/N (dB)	FCC Limit (dB)	Margin from FCC Limit (dB)	C63.19-2011 Rating	Test Coordinates
LTE Band 26	Axial	1.4MHz	26865	9.27	-40.51	-58.63	2.00	49.78	20.00	-29.78	T4	1.6, 1.8
	Radial	15MHz	26865	1.37	-47.71	-59.02	N/A	49.08	20.00	-29.08	T4	1.6, 2.6

Table 8-18
Raw Data Results for LTE B5

Mode	Orientation	Bandwidth	Channel	ABM1 [dB(A/m)]	ABM2 [dB(A/m)]	Ambient Noise [dB(A/m)]	Frequency Response Margin (dB)	S+N/N (dB)	FCC Limit (dB)	Margin from FCC Limit (dB)	C63.19-2011 Rating	Test Coordinates
LTE Band 5	Axial	5MHz	20525	9.26	-40.03	-58.63	2.00	49.29	20.00	-29.29	T4	1.6, 1.8
	Radial	5MHz	20525	1.38	-47.94	-59.02	N/A	49.32	20.00	-29.32	T4	1.6, 2.6

Table 8-19
Raw Data Results for LTE B5 – Ant M1 + M2 Spot-check

Mode	Orientation	Bandwidth	Channel	ABM1 [dB(A/m)]	ABM2 [dB(A/m)]	Ambient Noise [dB(A/m)]	Frequency Response Margin (dB)	S+N/N (dB)	FCC Limit (dB)	Margin from FCC Limit (dB)	C63.19-2011 Rating	Test Coordinates
LTE Band 5	Axial	10MHz	20525	9.25	-39.37	-58.63	2.00	48.62	20.00	-28.62	T4	1.6, 1.8
	Radial	5MHz	20525	1.42	-47.31	-59.02	N/A	48.73	20.00	-28.73	T4	1.6, 2.6

Table 8-20
Raw Data Results for EvDO (OTT VoIP)

Mode	Orientation	Channel	ABM1 [dB(A/m)]	ABM2 [dB(A/m)]	Ambient Noise [dB(A/m)]	Frequency Response Margin (dB)	S+N/N (dB)	FCC Limit (dB)	Margin from FCC Limit (dB)	C63.19-2011 Rating	Test Coordinates
Secondary Cellular EvDO	Axial	564	11.45	-45.64	-58.63	1.21	57.09	20.00	-37.09	T4	1.6, 1.8
	Radial	564	3.80	-52.53	-59.02	N/A	56.33	20.00	-36.33	T4	1.6, 2.6
Cellular EvDO	Axial	384	11.64	-46.00	-58.63	1.40	57.64	20.00	-37.64	T4	1.6, 1.8
	Radial	384	3.86	-53.27	-59.02	N/A	57.13	20.00	-37.13	T4	1.6, 2.6

Table 8-21
Raw Data Results for EDGE (OTT VoIP)

Mode	Orientation	Channel	ABM1 [dB(A/m)]	ABM2 [dB(A/m)]	Ambient Noise [dB(A/m)]	Frequency Response Margin (dB)	S+N/N (dB)	FCC Limit (dB)	Margin from FCC Limit (dB)	C63.19-2011 Rating	Test Coordinates
EDGE850	Axial	190	11.32	-22.00	-61.66	2.00	33.32	20.00	-13.32	T4	1.6, 1.8
	Radial	190	3.71	-24.79	-62.66	N/A	28.50	20.00	-8.50	T3	1.6, 2.6

Table 8-22
Raw Data Results for HSPA (OTT VoIP)

Mode	Orientation	Channel	ABM1 [dB(A/m)]	ABM2 [dB(A/m)]	Ambient Noise [dB(A/m)]	Frequency Response Margin (dB)	S+N/N (dB)	FCC Limit (dB)	Margin from FCC Limit (dB)	C63.19-2011 Rating	Test Coordinates
HSPA V	Axial	4183	11.51	-49.92	-58.63	1.13	61.43	20.00	-41.43	T4	1.6, 1.8
	Radial	4183	4.33	-52.25	-59.02	N/A	56.58	20.00	-36.58	T4	1.6, 2.6

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Table 8-23
Raw Data Results for LTE B13 (OTT VoIP)

Mode	Orientation	Bandwidth	Channel	ABM1 [dB(A/m)]	ABM2 [dB(A/m)]	Ambient Noise [dB(A/m)]	Frequency Response Margin (dB)	S+N/N _{ref} (dB)	FCC Limit (dB)	Margin from FCC Limit (dB)	C63.19-2011 Rating	Test Coordinates
LTE Band 13	Axial	10MHz	23230	10.95	-37.41	-58.63	1.23	48.36	20.00	-28.36	T4	1.6, 1.8
		5MHz	23230	11.16	-39.18		1.37	50.34	20.00	-30.34		
	Radial	10MHz	23230	3.88	-44.99	-59.02	N/A	48.87	20.00	-28.87	T4	1.6, 2.6
		5MHz	23230	4.10	-45.72			49.82	20.00	-29.82		

Table 8-24
Raw Data Results for NR n71 (OTT VoIP)

Mode	Orientation	Bandwidth	Channel	ABM1 _{1TE} [dB(A/m)]	ABM2 _{ref} [dB(A/m)]	ABM2 _{1TE} [dB(A/m)]	Ambient Noise [dB(A/m)]	Frequency Response Margin (dB)	S+N/N _{ref} (dB)	S+N/N _{ref} - 3 dB (dB)	FCC Limit (dB)	Margin from FCC Limit (dB)	C63.19-2011 Rating	Test Coordinates
NR n71	Axial	20MHz	136100	11.54	-44.79	-38.93	-58.63	N/A	56.33	53.33	20.00	-33.33	T4	1.6, 1.8
	Radial	20MHz	136100	3.96	-51.01	-46.45	-59.02	N/A	54.97	51.97	20.00	-31.97	T4	1.6, 2.6

Table 8-25
Raw Data Results for LTE B71 (OTT VoIP – Additional Measurements for NR)

Mode	Orientation	Bandwidth	Channel	ABM1 _{1TE} [dB(A/m)]	ABM2 _{ref} [dB(A/m)]	ABM2 _{1TE} [dB(A/m)]	Ambient Noise [dB(A/m)]	Frequency Response Margin (dB)	S+N/N _{1TE} (dB)	S+N/N _{ref} - 3 dB (dB)	FCC Limit (dB)	Margin from FCC Limit (dB)	C63.19-2011 Rating	Test Coordinates
LTE Band 71	Axial	20MHz	133297	11.54	N/A	-38.93	-58.63	N/A	50.47	N/A	20.00	-30.47	T4	1.6, 1.8
	Radial	20MHz	133297	3.96		-46.45	-59.02		50.41		20.00	-30.41	T4	1.6, 2.6

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→Other Call Settings→Hearing aid compatibility**) was set to ON for Frequency Response compliance
4. Speech Signal: 3GPP2 Normal Test Signal
5. Bluetooth and WIFI were disabled while testing 2G/3G/4G/5G modes.
6. The Margin from FCC limit column indicates a margin from the FCC limit for compliance (T3).

B. CDMA

1. Power Configuration: Power Control Bits = "All Up"
2. Vocoder Configuration: RC1/SO68 (CDMA – EVRC—B)

C. GSM

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

D. UMTS

1. Power Configuration: TPC= "All 1s";
2. Vocoder Configuration: NB AMR 4.75 kbps (UMTS);

E. LTE FDD

1. Power Configuration: TPC = "Max Power"
2. Radio Configuration: 16QAM, 1RB, 0RB offset
 - a. Please refer to the Original Certification test report for more information regarding radio configuration selection.

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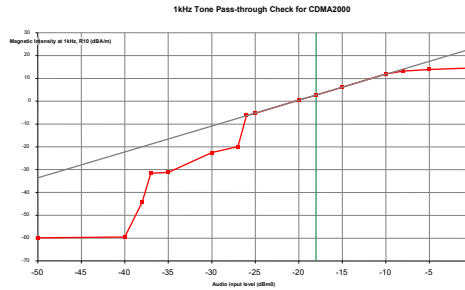
3. Vocoder Configuration: NB AMR 4.75kbps
 - a. Please refer to the Original Certification test report for more information regarding vocoder configuration selection.
4. The worst-case band and bandwidth combination for each probe orientation is additionally tested on the low and high channels for those combinations. LTE Band 13 at 10MHz is the worst-case for the Axial and Radial probe orientation, however, because Band 13 at 10MHz bandwidth supports only one channel, additional testing was not performed.

F. OTT VoIP

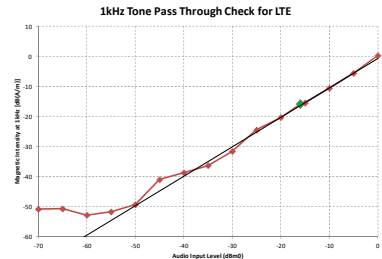
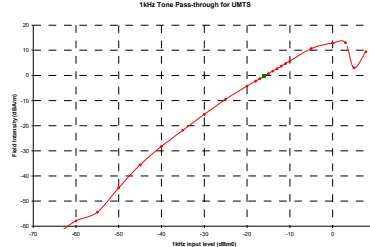
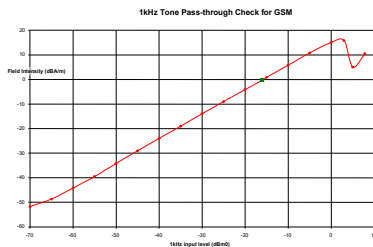
1. Vocoder Configuration: 6kbps
2. EvDO Configuration
 - a. Revision: A
3. EDGE Configuration
 - a. MCS Index: 7
 - b. Number of TX slots: 2
4. HSPA Configuration:
 - a. Release: 6
 - b. 3GPP 34.121 Subtest 1
5. LTE FDD Configuration:
 - a. Power Configuration: TPC = "Max Power"
 - b. Radio Configuration: 16QAM, 1RB, 0RB offset
 - i. Please refer to the Original Certification test report for more information regarding radio configuration selection.
 - c. LTE Band 13 was the worst-case band from Table 6-1 and was used to test both Axial and Radial probe orientations.
 - d. The worst-case band and bandwidth combination for each probe orientation is additionally tested on the low and high channels for those combinations. LTE Band 13 at 10MHz is the worst-case for the Axial and Radial probe orientation, however, because Band 13 at 10MHz bandwidth supports only one channel, additional testing was not performed.
6. NR FDD Configuration
 - a. Power Configuration: TxAGC is set such that the DUT operates at max power.
 - b. Radio Configuration: DFT-s-OFDM, 256QAM, 1RB, 50% RB Offset
 - i. Please refer to the Original Certification test report for more information regarding radio configuration selection.
 - c. Due to equipment limitations, ABM1 measurements were not possible. Therefore, the procedure outlined in Section 6.II.3 was followed to obtain SNNR values. Additionally, Frequency Response measurements were not possible due to equipment limitations.
 - d. NR Band n71 was the worst-case band from Table 6-2 and was used to test both Axial and Radial probe orientations. Please refer to the Original Certification test report for full evaluation.

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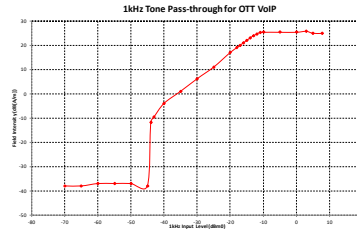
II. 1 kHz Vocoder Application Check



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



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



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

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III. T-Coil Validation Test Results

Table 8-26
Helmholtz Coil Validation Table of Results – 7/19/2021

Item	Target	Result	Verdict
Axial			
Magnetic Intensity, -10 dBA/m	$-10 \pm 0.5 \text{ dB}$	-9.941	PASS
Environmental Noise	< -58 dBA/m	-58.63	PASS
Frequency Response, from limits	> 0 dB	0.70	PASS
Radial			
Magnetic Intensity, -10 dBA/m	$-10 \pm 0.5 \text{ dB}$	-10.178	PASS
Environmental Noise	< -58 dBA/m	-59.02	PASS
Frequency Response, from limits	> 0 dB	0.80	PASS

Table 8-27
Helmholtz Coil Validation Table of Results -7/26/2021

Item	Target	Result	Verdict
Axial			
Magnetic Intensity, -10 dBA/m	$-10 \pm 0.5 \text{ dB}$	-9.917	PASS
Environmental Noise	< -58 dBA/m	-61.66	PASS
Frequency Response, from limits	> 0 dB	0.50	PASS
Radial			
Magnetic Intensity, -10 dBA/m	$-10 \pm 0.5 \text{ dB}$	-10.132	PASS
Environmental Noise	< -58 dBA/m	-62.66	PASS
Frequency Response, from limits	> 0 dB	0.70	PASS

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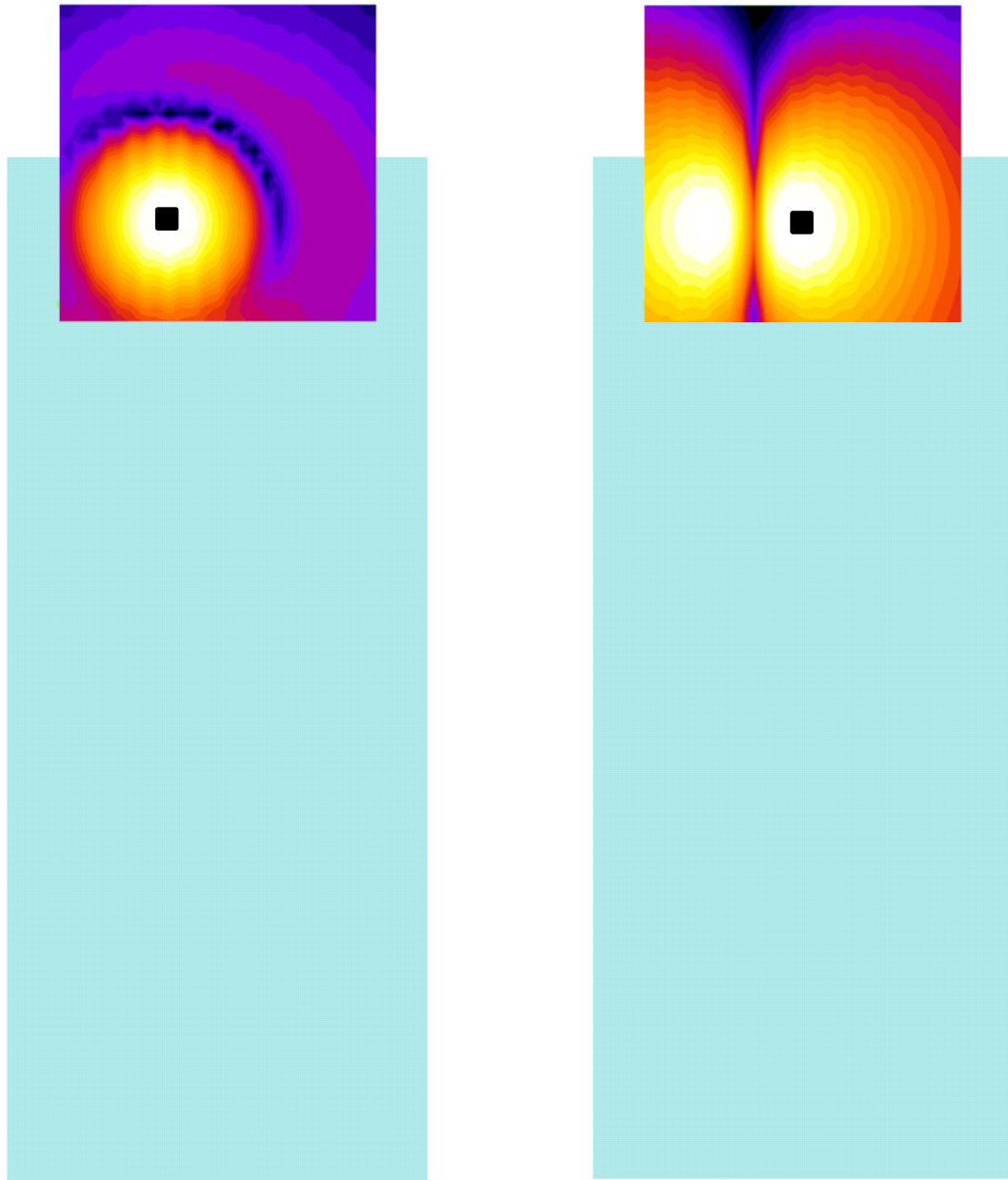
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IV. ABM1 Magnetic Field Distribution Scan Overlays



Axial

Radial (Transverse)

Figure 8-1
T-Coil Scan Overlay Magnetic Field Distributions

Notes:

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

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9. MEASUREMENT UNCERTAINTY

Table 9-1
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, u_c (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.

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10. EQUIPMENT LIST

**Table 10-1
Equipment List**

Manufacturer	Model	Description	Cal Date	Cal Interval	Cal Due	Serial Number
Dell	Latitude E6540	SoundCheck Acoustic Analyzer Laptop	9/29/2020	Biennial	9/29/2022	2655082910
Listen	SoundConnect	Microphone Power Supply	9/24/2020	Biennial	9/24/2022	0899-PS150
RME	Fireface UC	Soundcheck Acoustic Analyzer External Audio Interface	9/29/2020	Biennial	9/29/2022	23792992
Rohde & Schwarz	CMW500	Radio Communication tester	9/4/2020	Annual	9/4/2021	140144
Rohde & Schwarz	CMW500	Wideband Radio Communication Tester	3/22/2021	Annual	3/22/2022	162125
Rohde & Schwarz	CMW500	Wideband Radio Communication Tester	2/10/2021	Annual	2/10/2022	161662
Seekonk	NC-100	Torque Wrench (8" lb)	8/4/2020	Biennial	8/4/2022	21053
TEM	Axial T-Coil Probe	Axial T-Coil Probe	9/23/2020	Biennial	9/23/2022	TEM-1123
TEM	Radial T-Coil Probe	Radial T-Coil Probe	9/23/2020	Biennial	9/23/2022	TEM-1129
TEM		HAC Positioner	N/A		N/A	N/A
TEM		HAC System Controller with Software	N/A		N/A	N/A
TEM	Helmholtz Coil	Helmholtz Coil	9/23/2020	Biennial	9/23/2022	SBI 1052

FCC ID: A3LSMF926U	 PCTEST Rely on the part of the network	HAC (T-COIL) TEST REPORT		Approved by: Quality Manager
Filename: 1M2106280073-07.A3L	Test Dates: 7/19/2021 - 7/27/2021	DUT Type: Portable Handset		Page 34 of 64

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11. TEST DATA

FCC ID: A3LSMF926U	 PCTEST Head to the point of demand	HAC (T-COIL) TEST REPORT		Approved by: Quality Manager
Filename: 1M2106280073-07.A3L	Test Dates: 7/19/2021 - 7/27/2021	DUT Type: Portable Handset		Page 35 of 64

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7/19/2021



PCTEST Hearing-Aid Compatibility Facility

DUT: HH Coil – SN: SBI 1052

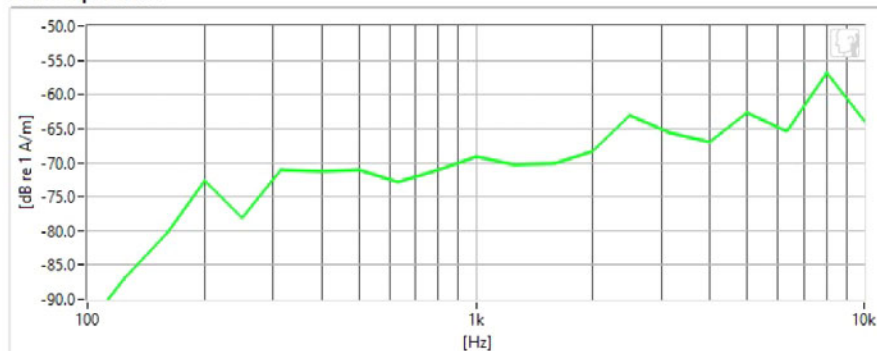
Type: HH Coil
Serial: SBI 1052

Measurement Standard: ANSI C63.19-2011

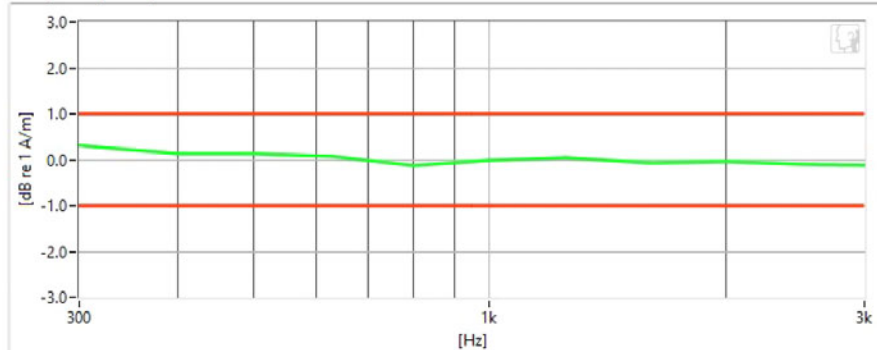
Equipment:

- Probe: Axial T-Coil Probe – SN: TEM-1123; Calibrated: 9/23/2020
- Helmholtz Coil – SN: SBI 1052; Calibrated: 9/23/2020

Noise Spectrum



Frequency Response



Results

Verification 1kHz Intensity	-9.941 dB	✓	Max/Min	-9.5/-10.5
Verification ABM2	-58.63 dB	✓	Maximum	-58.0
Frequency Response Margin	700m dB	✓	Tolerance curves	Aligned Data

FCC ID: A3LSMF926U	PCTEST Proud to be part of element	HAC (T-COIL) TEST REPORT		Approved by: Quality Manager
Filename: 1M2106280073-07.A3L	Test Dates: 7/19/2021 - 7/27/2021	DUT Type: Portable Handset		Page 36 of 64

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PCTEST Hearing-Aid Compatibility Facility

DUT: HH Coil – SN: SBI 1052

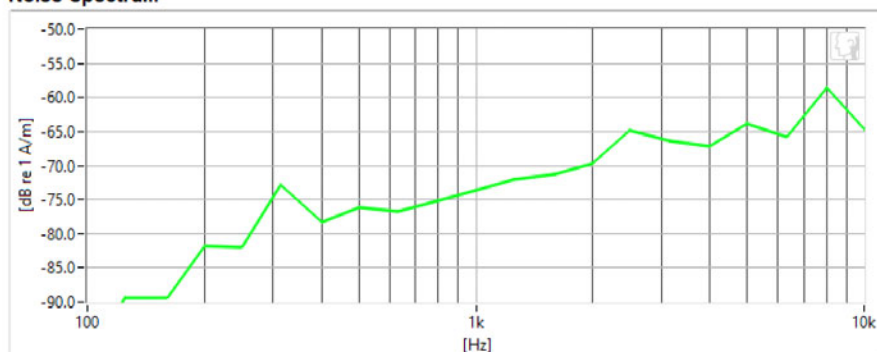
Type: HH Coil
Serial: SBI 1052

Measurement Standard: ANSI C63.19-2011

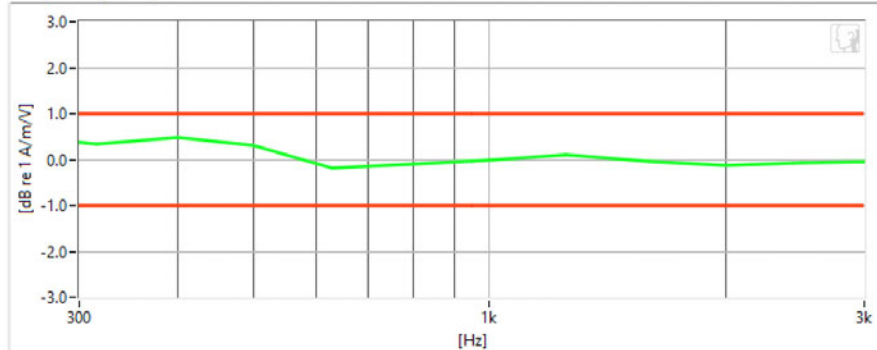
Equipment:

- Probe: Axial T-Coil Probe – SN: TEM-1123; Calibrated: 9/23/2020
- Helmholtz Coil – SN: SBI 1052; Calibrated: 9/23/2020

Noise Spectrum



Frequency Response



Results

Verification 1kHz Intensity	-9.917 dB	✓	Max/Min	-9.5/-10.5
Verification ABM2	-61.66 dB	✓	Maximum	-58.0
Frequency Response Margin	500m dB	✓	Tolerance curves	Aligned Data

FCC ID: A3LSMF926U		HAC (T-COIL) TEST REPORT		Approved by: Quality Manager
Filename: 1M2106280073-07.A3L	Test Dates: 7/19/2021 - 7/27/2021	DUT Type: Portable Handset		Page 37 of 64

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PCTEST Hearing-Aid Compatibility Facility

DUT: HH Coil – SN: SBI 1052

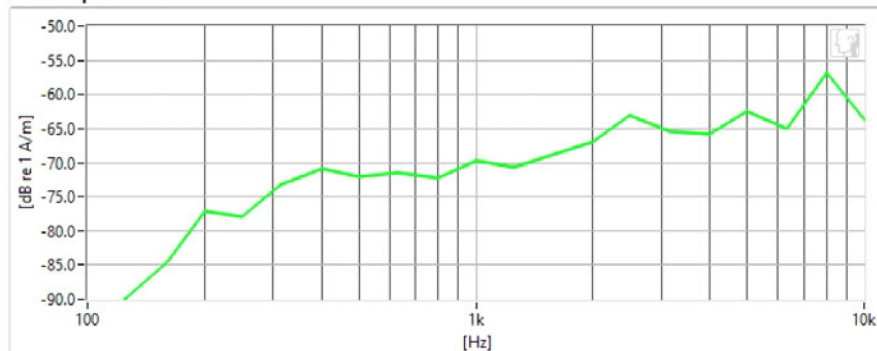
Type: HH Coil
Serial: SBI 1052

Measurement Standard: ANSI C63.19-2011

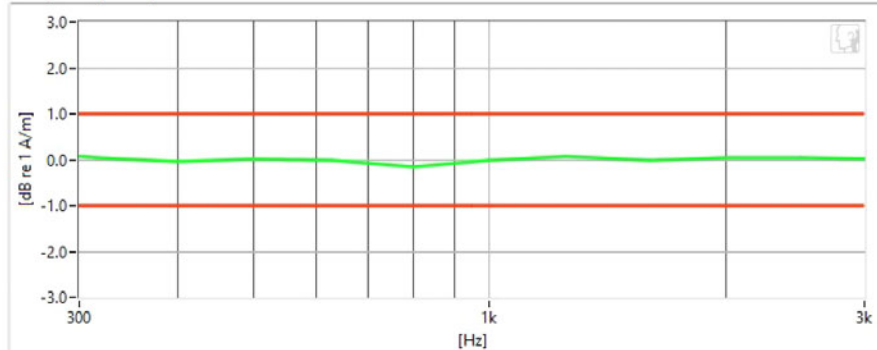
Equipment:

- Probe: Radial T-Coil Probe – SN: TEM-1129; Calibrated: 9/23/2020
- Helmholtz Coil – SN: SBI 1052; Calibrated: 9/23/2020

Noise Spectrum



Frequency Response



Results

Verification 1kHz Intensity	-10.178 dB	✓	Max/Min	-9.5/-10.5
Verification ABM2	-59.02 dB	✓	Maximum	-58.0
Frequency Response Margin	800m dB	✓	Tolerance curves	Aligned Data

FCC ID: A3LSMF926U	PCTEST Proud to be part of element	HAC (T-COIL) TEST REPORT		Approved by: Quality Manager
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PCTEST Hearing-Aid Compatibility Facility

DUT: HH Coil – SN: SBI 1052

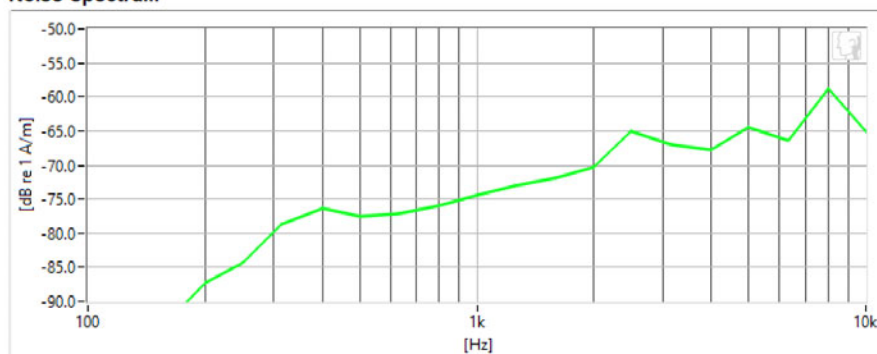
Type: HH Coil
Serial: SBI 1052

Measurement Standard: ANSI C63.19-2011

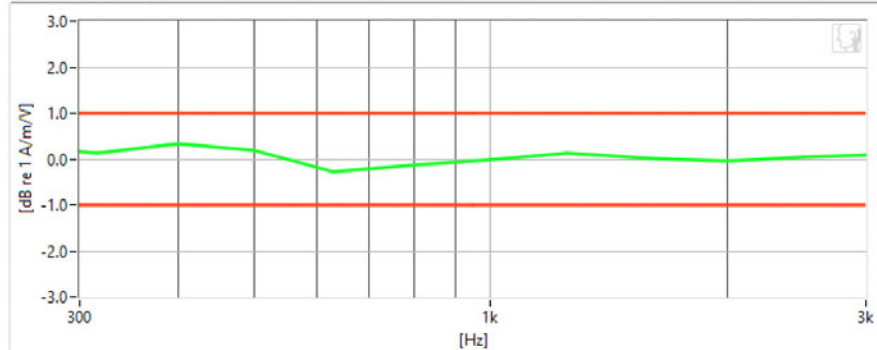
Equipment:

- Probe: Radial T-Coil Probe – SN: TEM-1129; Calibrated: 9/23/2020
- Helmholtz Coil – SN: SBI 1052; Calibrated: 9/23/2020

Noise Spectrum



Frequency Response



Results

Verification 1kHz Intensity	-10.132 dB	✓	Max/Min	-9.5/-10.5
Verification ABM2	-62.66 dB	✓	Maximum	-58.0
Frequency Response Margin	700m dB	✓	Tolerance curves	Aligned Data

FCC ID: A3LSMF926U	PCTEST Proud to be part of element	HAC (T-COIL) TEST REPORT	SAMSUNG	Approved by: Quality Manager
Filename: 1M2106280073-07.A3L	Test Dates: 7/19/2021 - 7/27/2021	DUT Type: Portable Handset		Page 39 of 64

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PCTEST Hearing-Aid Compatibility Facility

DUT: A3LSMF926U

Type: Portable Handset
Serial: 0424M

Measurement Standard: ANSI C63.19-2011

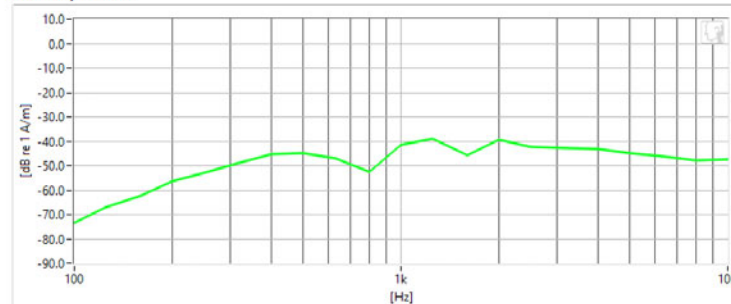
Equipment:

- Probe: Axial T-Coil Probe – SN: TEM-1123; Calibrated: 9/23/2020

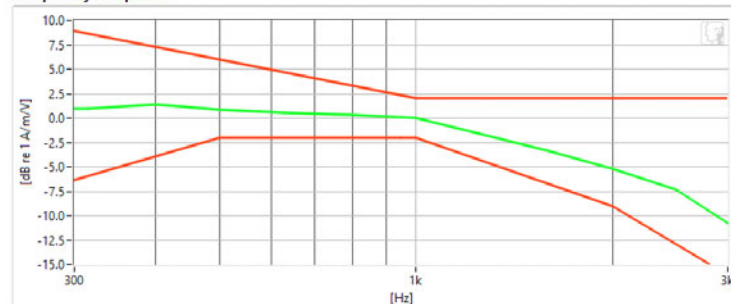
Test Configuration:

- Mode: Secondary Cellular CDMA
- Channel: 476
- Speech Signal: 3GPP2 Normal Test Signal
- Antenna Config.: M1

Noise Spectrum



Frequency Response



Results

ABM1	2.45 dB	✓	Minimum	-18.0
ABM2	-33.59 dB	✓	Maximum	0.0
SNNR	36.04 dB	✓	Minimum	20.0
Aligned Response - Normal	2 dB	✓	Tolerance curves	Aligned Data

FCC ID: A3LSMF926U		HAC (T-COIL) TEST REPORT		Approved by: Quality Manager
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PCTEST Hearing-Aid Compatibility Facility

DUT: A3LSMF926U

Type: Portable Handset
Serial: 0424M

Measurement Standard: ANSI C63.19-2011

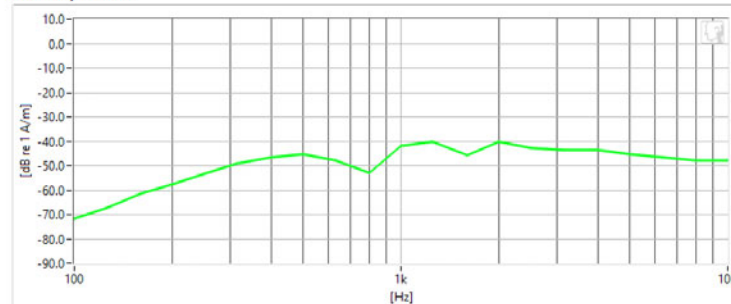
Equipment:

- Probe: Axial T-Coil Probe – SN: TEM-1123; Calibrated: 9/23/2020

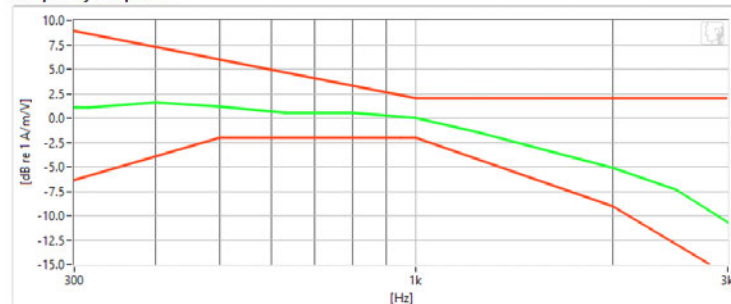
Test Configuration:

- Mode: Cellular CDMA
- Channel: 777
- Speech Signal: 3GPP2 Normal Test Signal
- Antenna Config.: M1

Noise Spectrum



Frequency Response



Results

ABM1	2.28 dB	✓	Minimum	-18.0
ABM2	-34.26 dB	✓	Maximum	0.0
SNNR	36.54 dB	✓	Minimum	20.0
Aligned Response - Normal	2 dB	✓	Tolerance curves	Aligned Data

FCC ID: A3LSMF926U		HAC (T-COIL) TEST REPORT		Approved by: Quality Manager
Filename: 1M2106280073-07.A3L	Test Dates: 7/19/2021 - 7/27/2021	DUT Type: Portable Handset		Page 41 of 64

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PCTEST Hearing-Aid Compatibility Facility

DUT: A3LSMF926U

Type: Portable Handset
Serial: 0424M

Measurement Standard: ANSI C63.19-2011

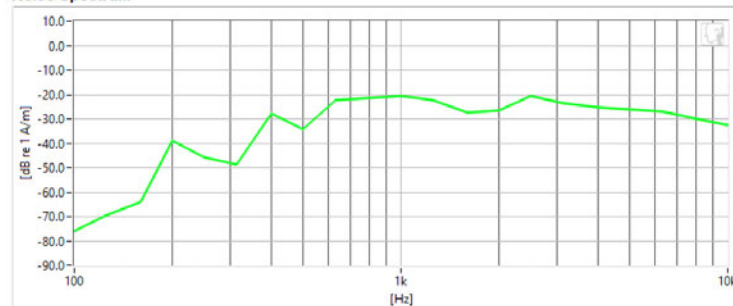
Equipment:

- Probe: Axial T-Coil Probe – SN: TEM-1123; Calibrated: 9/23/2020

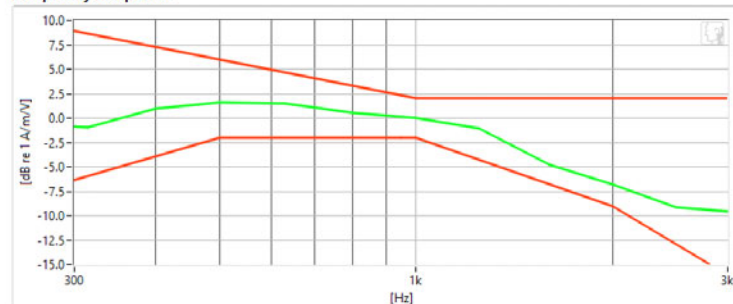
Test Configuration:

- Mode: GSM850
- Channel: 128
- Speech Signal: 3GPP2 Normal Test Signal
- Antenna Config.: M1+M2

Noise Spectrum



Frequency Response



Results

ABM1	10.19 dB	✓	Minimum	-18.0
ABM2	-14.07 dB	✓	Maximum	0.0
SNNR	24.26 dB	✓	Minimum	20.0
Aligned Response - Normal	2 dB	✓	Tolerance curves	Aligned Data

FCC ID: A3LSMF926U		HAC (T-COIL) TEST REPORT		Approved by: Quality Manager
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PCTEST Hearing-Aid Compatibility Facility

DUT: A3LSMF926U

Type: Portable Handset
Serial: 0424M

Measurement Standard: ANSI C63.19-2011

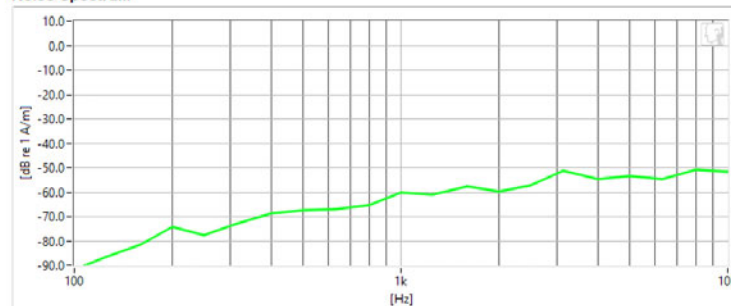
Equipment:

- Probe: Axial T-Coil Probe – SN: TEM-1123; Calibrated: 9/23/2020

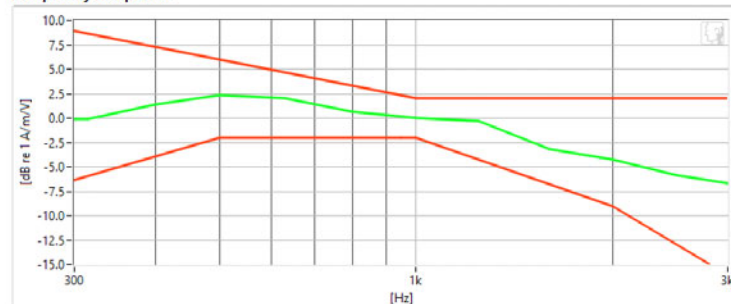
Test Configuration:

- Mode: UMTS V
- Channel: 4233
- Speech Signal: 3GPP2 Normal Test Signal
- Antenna Config.: M1+M2

Noise Spectrum



Frequency Response



Results

ABM1	9.52 dB	✓	Minimum	-18.0
ABM2	-51.25 dB	✓	Maximum	0.0
SNNR	60.77 dB	✓	Minimum	20.0
Aligned Response - Normal	2 dB	✓	Tolerance curves	Aligned Data

FCC ID: A3LSMF926U		HAC (T-COIL) TEST REPORT		Approved by: Quality Manager
Filename: 1M2106280073-07.A3L	Test Dates: 7/19/2021 - 7/27/2021	DUT Type: Portable Handset		Page 43 of 64

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PCTEST Hearing-Aid Compatibility Facility

DUT: A3LSMF926U

Type: Portable Handset
Serial: 0424M

Measurement Standard: ANSI C63.19-2011

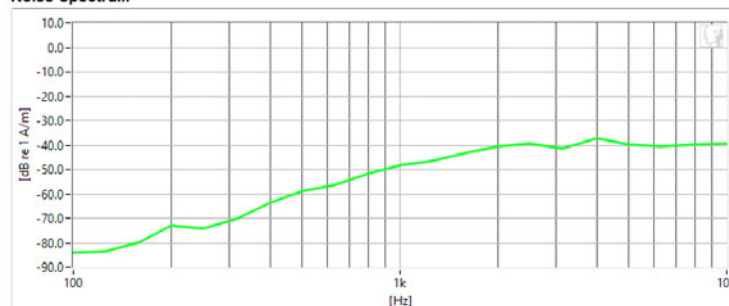
Equipment:

- Probe: Axial T-Coil Probe – SN: TEM-1123; Calibrated: 9/23/2020

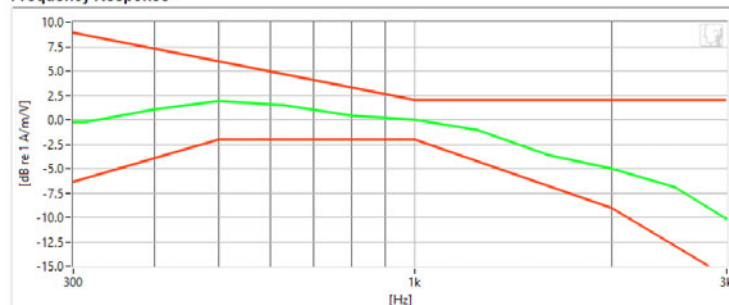
Test Configuration:

- Mode: LTE FDD Band 13
- Bandwidth: 10MHz
- Channel: 23230
- Speech Signal: 3GPP2 Normal Test Signal
- Antenna Config.: M1+M2

Noise Spectrum



Frequency Response



Results

ABM1	9.18 dB	✓	Minimum	-18.0
ABM2	-37.1 dB	✓	Maximum	0.0
SNNR	46.28 dB	✓	Minimum	20.0
Aligned Response - Normal	2 dB	✓	Tolerance curves	Aligned Data

FCC ID: A3LSMF926U		HAC (T-COIL) TEST REPORT		Approved by: Quality Manager
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7/27/2021

PCTEST Hearing-Aid Compatibility Facility

DUT: A3LSMF926U

Type: Portable Handset
Serial: 0424M

Measurement Standard: ANSI C63.19-2011

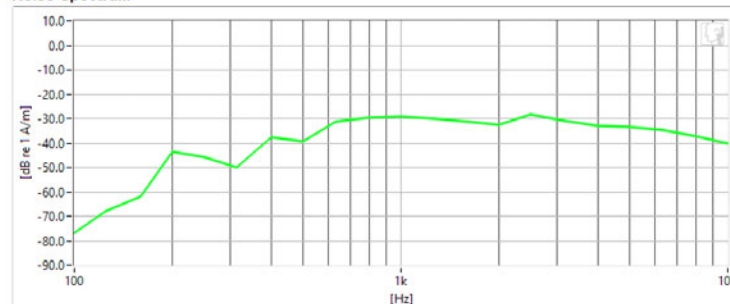
Equipment:

- Probe: Axial T-Coil Probe – SN: TEM-1123; Calibrated: 9/23/2020

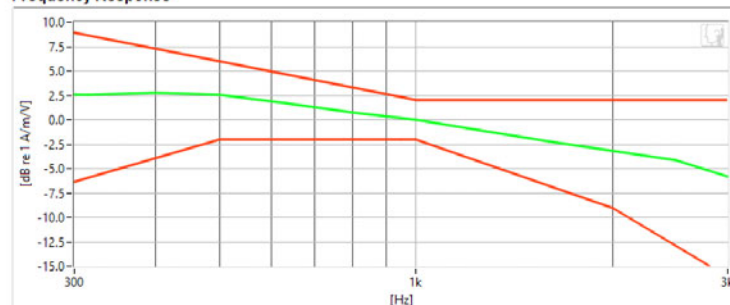
Test Configuration:

- VoIP Application: Google Duo
- Mode: EDGE850
- Channel: 190
- Speech Signal: 3GPP2 Normal Test Signal
- Antenna Config.: M1+M2

Noise Spectrum



Frequency Response



Results

ABM1	11.32 dB	✓	Minimum	-18.0
ABM2	-22 dB	✓	Maximum	0.0
SNNR	33.32 dB	✓	Minimum	20.0
Aligned Response - Normal	2 dB	✓	Tolerance curves	Aligned Data

FCC ID: A3LSMF926U		HAC (T-COIL) TEST REPORT		Approved by: Quality Manager
Filename: 1M2106280073-07.A3L	Test Dates: 7/19/2021 - 7/27/2021	DUT Type: Portable Handset		Page 45 of 64

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7/21/2021

PCTEST Hearing-Aid Compatibility Facility

DUT: A3LSMF926U

Type: Portable Handset
Serial: 0424M

Measurement Standard: ANSI C63.19-2011

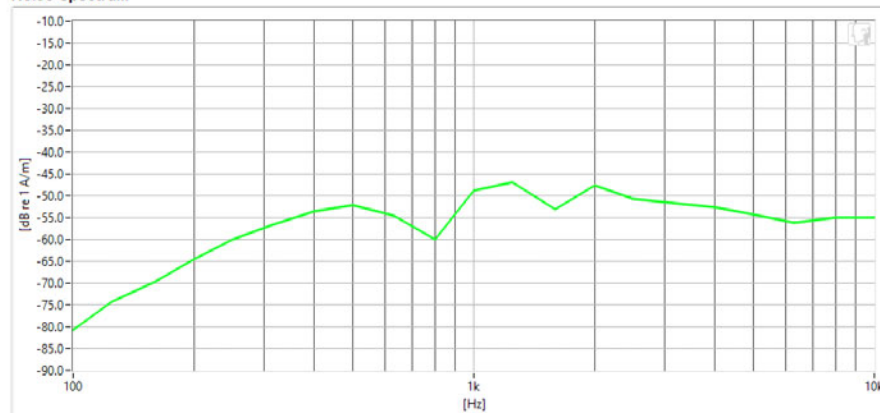
Equipment:

- Probe: Radial T-Coil Probe – SN: TEM-1129; Calibrated: 9/23/2020

Test Configuration:

- Mode: Secondary Cellular CDMA
- Channel: 476
- Antenna Config.: M1

Noise Spectrum



Results

ABM1	-5.68 dB	✓	Minimum	-18.0
ABM2	-41.35 dB	✓	Maximum	0.0
SNNR	35.68 dB	✓	Minimum	20.0

FCC ID: A3LSMF926U		HAC (T-COIL) TEST REPORT		Approved by: Quality Manager
Filename: 1M2106280073-07.A3L	Test Dates: 7/19/2021 - 7/27/2021	DUT Type: Portable Handset		Page 46 of 64

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7/21/2021

PCTEST Hearing-Aid Compatibility Facility

DUT: A3LSMF926U

Type: Portable Handset
Serial: 0424M

Measurement Standard: ANSI C63.19-2011

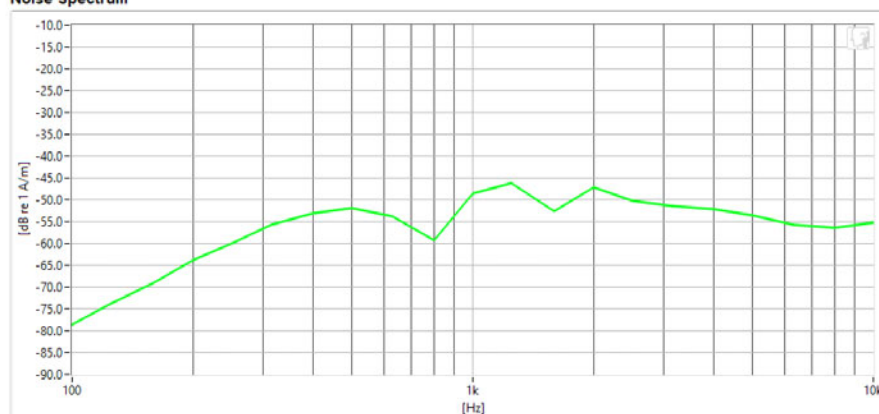
Equipment:

- Probe: Radial T-Coil Probe – SN: TEM-1129; Calibrated: 9/23/2020

Test Configuration:

- Mode: Cellular CDMA
- Channel: 777
- Antenna Config.: M1+M2

Noise Spectrum



Results

ABM1	-5.63 dB	✓	Minimum	-18.0
ABM2	-40.83 dB	✓	Maximum	0.0
SNNR	35.2 dB	✓	Minimum	20.0

FCC ID: A3LSMF926U		HAC (T-COIL) TEST REPORT		Approved by: Quality Manager
Filename: 1M2106280073-07.A3L	Test Dates: 7/19/2021 - 7/27/2021	DUT Type: Portable Handset		Page 47 of 64

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PCTEST Hearing-Aid Compatibility Facility

DUT: A3LSMF926U

Type: Portable Handset
Serial: 0424M

Measurement Standard: ANSI C63.19-2011

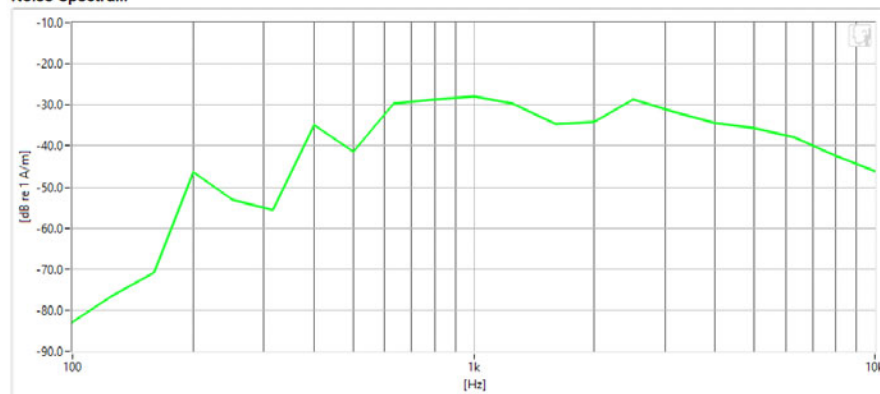
Equipment:

- Probe: Radial T-Coil Probe – SN: TEM-1129; Calibrated: 9/23/2020

Test Configuration:

- Mode: GSM850
- Channel: 128
- Antenna Config.: M1+M2

Noise Spectrum



Results

ABM1	2.39 dB	✓	Minimum	-18.0
ABM2	-21.4 dB	✓	Maximum	0.0
SNNR	23.79 dB	✓	Minimum	20.0

FCC ID: A3LSMF926U		HAC (T-COIL) TEST REPORT		Approved by: Quality Manager
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7/21/2021

PCTEST Hearing-Aid Compatibility Facility

DUT: A3LSMF926U

Type: Portable Handset
Serial: 0424M

Measurement Standard: ANSI C63.19-2011

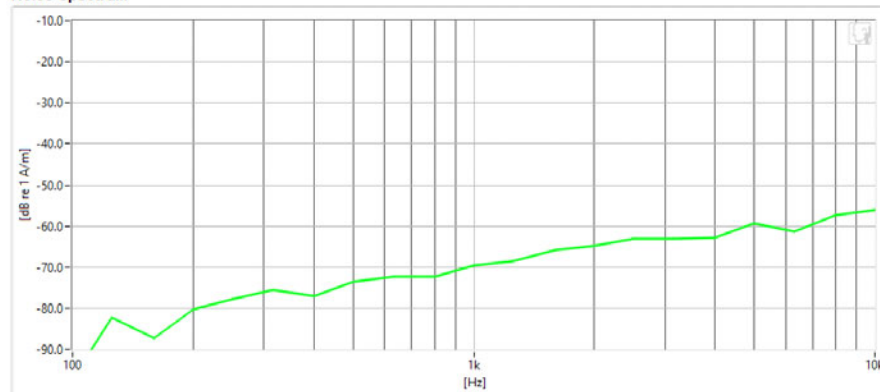
Equipment:

- Probe: Radial T-Coil Probe – SN: TEM-1129; Calibrated: 9/23/2020

Test Configuration:

- Mode: UMTS V
- Channel: 4132
- Antenna Config.: M1

Noise Spectrum



Results

ABM1	1.82 dB	✓	Minimum	-18.0
ABM2	-58.54 dB	✓	Maximum	0.0
SNNR	60.37 dB	✓	Minimum	20.0

FCC ID: A3LSMF926U		HAC (T-COIL) TEST REPORT		Approved by: Quality Manager
Filename: 1M2106280073-07.A3L	Test Dates: 7/19/2021 - 7/27/2021	DUT Type: Portable Handset	Page 49 of 64	

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7/21/2021

PCTEST Hearing-Aid Compatibility Facility

DUT: A3LSMF926U

Type: Portable Handset
Serial: 0424M

Measurement Standard: ANSI C63.19-2011

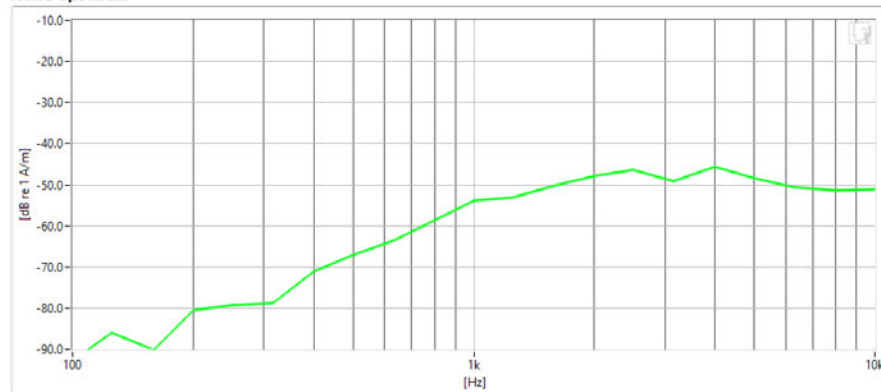
Equipment:

- Probe: Radial T-Coil Probe – SN: TEM-1129; Calibrated: 9/23/2020

Test Configuration:

- Mode: LTE FDD Band 13
- Bandwidth: 10MHz
- Channel: 23230
- Antenna Config.: M1+M2

Noise Spectrum



Results

ABM1	1.61 dB	✓	Minimum	-18.0
ABM2	-44.41 dB	✓	Maximum	0.0
SNR	46.02 dB	✓	Minimum	20.0

FCC ID: A3LSMF926U		HAC (T-COIL) TEST REPORT		Approved by: Quality Manager
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7/27/2021

PCTEST Hearing-Aid Compatibility Facility

DUT: A3LSMF926U

Type: Portable Handset
Serial: 0424M

Measurement Standard: ANSI C63.19-2011

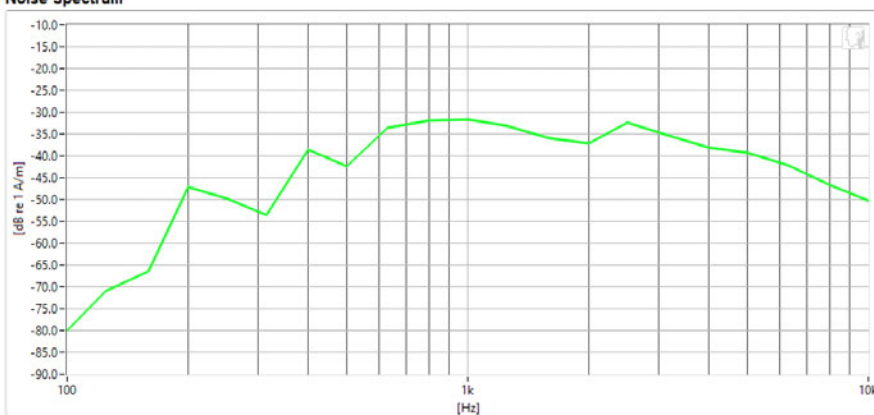
Equipment:

- Probe: Radial T-Coil Probe – SN: TEM-1129; Calibrated: 9/23/2020

Test Configuration:

- VoIP Application: Google Duo
- Mode: EDGE850
- Channel: 190
- Antenna Config.: M1+M2

Noise Spectrum



Results

ABM1	3.71 dB	✓	Minimum	-18.0
ABM2	-24.79 dB	✓	Maximum	0.0
SNNR	28.5 dB	✓	Minimum	20.0

FCC ID: A3LSMF926U		HAC (T-COIL) TEST REPORT		Approved by: Quality Manager
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12. CALIBRATION CERTIFICATES

FCC ID: A3LSMF926U	 PCTEST Return to the point of purchase	HAC (T-COIL) TEST REPORT		Approved by: Quality Manager
Filename: 1M2106280073-07.A3L	Test Dates: 7/19/2021 - 7/27/2021	DUT Type: Portable Handset		Page 52 of 64

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West Caldwell Calibration Laboratories Inc.

Certificate of Conformance

for

AXIAL T COIL PROBE

Manufactured by: TEM CONSULTING
Model No: AXIAL T COIL PROBE
Serial No: TEM-1123
Calibration Recall No: 31288

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 SI through the National Institute of Standards and Technology or to accepted values of natural physical constants. This document certifies that the instrument met the following specification upon its return to the submitter.

West Caldwell Calibration Laboratories Procedure No. AXIAL T C TEM C

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

Within (X)

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

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

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

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

Approved by:

Calibration Date: 23-Sep-20

James Zhu

Certificate No: 31288 - 2

Quality Manager
ISO/IEC 17025:2017

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

Certificate Page 1 of 1

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



Calibration Lab. Cert. # 1533.01

FCC ID: A3LSMF926U		HAC (T-COIL) TEST REPORT		Approved by: Quality Manager
Filename: 1M2106280073-07.A3L	Test Dates: 7/19/2021 - 7/27/2021	DUT Type: Portable Handset		Page 53 of 64

REPORT OF CALIBRATION

for

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

Model No.: Axial T Coil Probe

Serial No.: TEM-1123
I. D. No.: XXXX

Calibration results:

Probe Sensitivity measured with Helmholtz Coil

Helmholtz Coil;

the number of turns on each coil; 10 No.
the radius of each coil, in meters; 0.204 m
the current in the coils, in amperes.; 0.08 A
Helmholtz Coil Constant; 7.04 A/m/V
Helmholtz Coil magnetic field; 5.71 A/m

Before & after data same: ...X...

Laboratory Environment:

Ambient Temperature: 20.7 °C
Ambient Humidity: 42.1 % RH
Ambient Pressure: 99.094 kPa

Calibration Date: 23-Sep-2020

Calibration Due:

Report Number: 31288 -2

Control Number: 31288

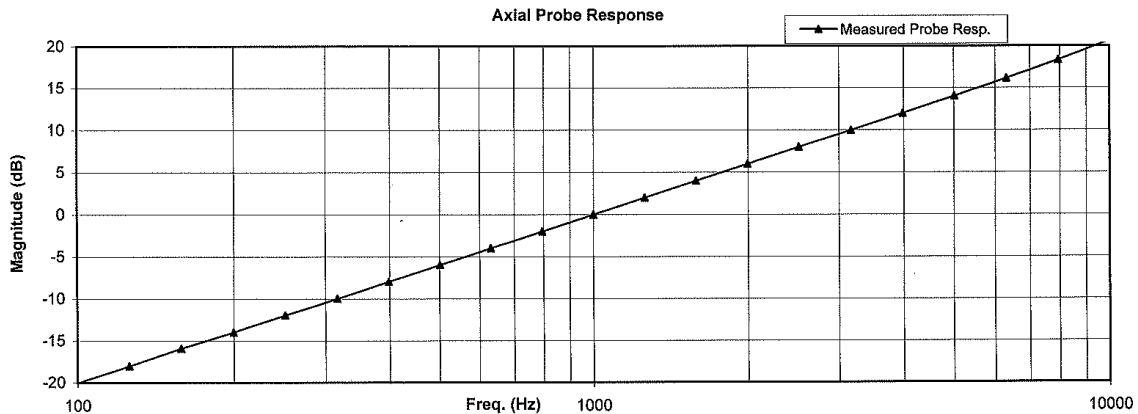
Probe Sensitivity at 1000 Hz.
was -60.24 dBV/A/m
0.972 mV/A/m
Probe resistance 898 Ohms

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

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

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 ISO 10012-1, IEC Guide 25, ANSI/NCSL Z540-1, (MIL-STD-45662A) and ISO 9001:2015, ISO 17025

Cal. Date: 23-Sep-2020

Measurements performed by:

Calibrated on WCCL system type 9700

James Zhu

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

Page 1 of 2

FCC ID: A3LSMF926U	PCTEST Proud to be part of the network	HAC (T-COIL) TEST REPORT	SAMSUNG	Approved by: Quality Manager
Filename: 1M2106280073-07.A3L	Test Dates: 7/19/2021 - 7/27/2021	DUT Type: Portable Handset		Page 54 of 64

HCATEMC_TEM-1123_Sep-23-2020

West Caldwell Calibration Laboratories Inc.

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

Calibration Data Record

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

for
Model No.: Axial T Coil Probe

Serial No.: TEM-1123

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

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

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

Tested by: James Zhu

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

FCC ID: A3LSMF926U		HAC (T-COIL) TEST REPORT		Approved by: Quality Manager
Filename: 1M2106280073-07.A3L	Test Dates: 7/19/2021 - 7/27/2021	DUT Type: Portable Handset		Page 55 of 64

West Caldwell Calibration Laboratories Inc.

Certificate of Conformance

for

RADIAL T COIL PROBE

Manufactured by: TEM CONSULTING
Model No: RADIAL T COIL PROBE
Serial No: TEM-1129
Calibration Recall No: 31288

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 SI through the National Institute of Standards and Technology or to accepted values of natural physical constants. This document certifies that the instrument met the following specification upon its return to the submitter.

West Caldwell Calibration Laboratories Procedure No. RADIAL T TEM C

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

Within (X)

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

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

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

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

Approved by:

Calibration Date: 23-Sep-20

James Zhu

Certificate No: 31288 - 1

Quality Manager
ISO/IEC 17025:2017

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

Certificate Page 1 of 1

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



Calibration Lab. Cert. # 1533.01

FCC ID: A3LSMF926U	 PCTEST Proud to be part of Samsung	HAC (T-COIL) TEST REPORT		Approved by: Quality Manager
Filename: 1M2106280073-07.A3L	Test Dates: 7/19/2021 - 7/27/2021	DUT Type: Portable Handset		Page 56 of 64

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REPORT OF CALIBRATION

for

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

Model No.: Radial T Coil Probe

Serial No.: TEM-1129
I. D. No.: XXXX

Calibration results:

Probe Sensitivity measured with Helmholtz Coil

<i>Helmholtz Coil;</i>		
the number of turns on each coil;	10	No.
the radius of each coil, in meters;	0.204	m
the current in the coils, in amperes.;	0.08	A
<i>Helmholtz Coil Constant;</i>	7.04	A/m/V
<i>Helmholtz Coil magnetic field;</i>	5.70	A/m

Before & after data same: ...X...

Probe Sensitivity at	1000	Hz.
was	-60.37	dBV/A/m
	0.959	mV/A/m
Probe resistance	897	Ohms

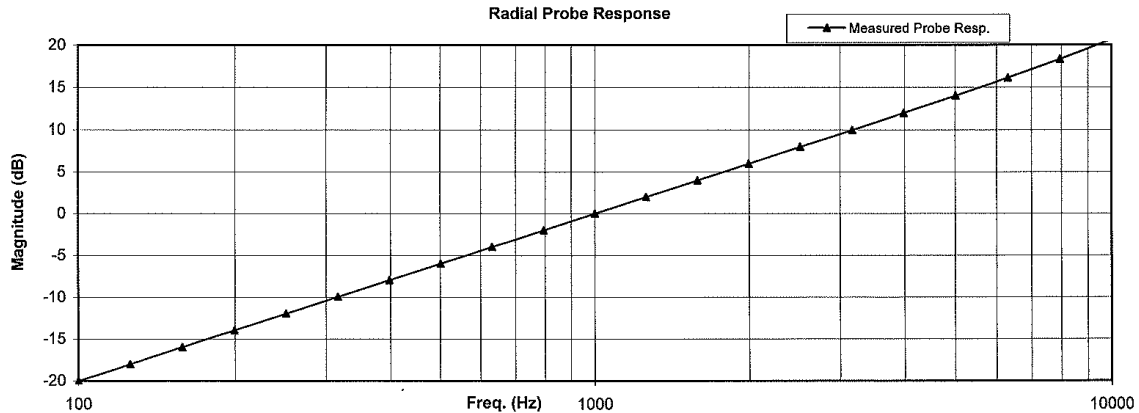
Laboratory Environment:	
Ambient Temperature:	20.7 °C
Ambient Humidity:	42.1 % RH
Ambient Pressure:	99.094 kPa
Calibration Date:	23-Sep-2020
Re-calibration Due:	
Report Number:	31288 -1
Control Number:	31288

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

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

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 9001:2015, ISO 17025

Cal. Date: 23-Sep-2020

Measurements performed by: *[Signature]*

Calibrated on WCCL system type 9700

James Zhu

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

FCC ID: A3LSMF926U	PCTEST Proud to be part of Samsung	HAC (T-COIL) TEST REPORT	SAMSUNG	Approved by: Quality Manager
Filename: 1M2106280073-07.A3L	Test Dates: 7/19/2021 - 7/27/2021	DUT Type: Portable Handset		Page 57 of 64

HCRTEMC_TEM-1129_Sep-23-2020

West Caldwell Calibration Laboratories Inc.

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

Calibration Data Record

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

for
Model No.: Radial T Coil Probe

Serial No.: TEM-1129

Test	Function	Tolerance	Measured values		
			Before	Out	Remarks
1.0	Probe Sensitivity at	1000 Hz. dBV/A/m	-60.37		
2.0	Probe Level Linearity	dB			
		6	6.04		
		0	0.00		
		-6	-6.03		
		-12	-12.05		
3.0	Probe Frequency Response	Hz			
		100	-20.0		
		126	-18.0		
		158	-16.0		
		200	-14.0		
		251	-12.0		
		316	-10.0		
		398	-8.0		
		501	-6.0		
		631	-4.0		
		794	-2.0		
		1000	0.0		
		1259	2.0		
		1585	4.0		
		1995	6.0		
		2512	8.0		
		3162	10.0		
		3981	12.0		
		5012	14.0		
		6310	16.1		
		7943	18.3		
		10000	20.7		

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

Cal. Date: 23-Sep-2020
Calibrated on WCCL system type 9700
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Tested by: James Zhu

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

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FCC ID: A3LSMF926U		HAC (T-COIL) TEST REPORT		Approved by: Quality Manager
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13. CONCLUSION

The measurements indicate that CDMA BC10/0, GSM850, UMTS B5, LTE Bands 71/12/13/14/5/26, and NR n71/12/5 modes for the referenced 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: A3LSMF926U	 PCTEST Rely on the part of the device	HAC (T-COIL) TEST REPORT		Approved by: Quality Manager
Filename: 1M2106280073-07.A3L	Test Dates: 7/19/2021 - 7/27/2021	DUT Type: Portable Handset		Page 59 of 64

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14. REFERENCES

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4. FCC Public Notice DA 06-1215, *Wireless Telecommunications Bureau and Office of Engineering and Technology Clarify Use of Revised Wireless Phone Hearing Aid Compatibility Standard*, June 6, 2006
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FCC ID: A3LSMF926U		HAC (T-COIL) TEST REPORT		Approved by: Quality Manager
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