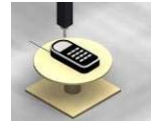




PCTEST ENGINEERING LABORATORY, INC.

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Tel. 410.290.6652 / Fax 410.290.6654
http://www.pctestlab.com



HEARING AID COMPATIBILITY

Applicant Name:
Samsung Electronics, Co. Ltd.
129, Samsung-ro, Maetan dong,
Yeongtong-gu, Suwon-si
Gyeonggi-do 443-742, Korea

Date of Testing:
12/22/2014
Test Site/Location:
PCTEST Lab, Columbia, MD, USA
Test Report Serial No.:
0Y1411052082-R2.A3L

FCC ID: A3LSMG360V

APPLICANT: SAMSUNG ELECTRONICS, CO. LTD.

Scope of Test: Audio Band Magnetic Testing (T-Coil)
Application Type: Certification
FCC Rule Part(s): CFR § 20.19(b)
HAC Standard: ANSI C63.19-2011
CTIA Test Plan for Hearing Aid Compatibility Rev 3.0, November 2013
EUT Type: Portable Handset
Model(s): SM-G360V; SM-S820L
Test Device Serial No.: Pre-Production Sample [S/N: HAC#1]

C63.19-2011 HAC Category: T4 (SIGNAL TO NOISE CATEGORY)

This revised Test Report (S/N: 0Y1411052082-R2.A3L) supersedes and replaces the previously issued test report on the same subject device for the same type of testing as indicated. Please discard or destroy the previously issued test report(s) and dispose of it accordingly.

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. Hearing-Aid Compatibility is based on the assumption that all production units will be designed electrically identical to the device tested in this report. Test results reported herein relate only to the item(s) tested. For 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



FCC ID: A3LSMG360V		HAC (T-COIL) TEST REPORT		Reviewed by: Quality Manager
Filename: 0Y1411052082-R2.A3L	Test Dates: 12/22/2014	EUT Type: Portable Handset		Page 1 of 36

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Filename: 0Y1411052082-R2.A3L	Test Dates: 12/22/2014	EUT Type: Portable Handset	Page 2 of 36	

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. 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
- RF Magnetic-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. TEST SITE LOCATION

I. Test Facility / Accreditations:

Measurements were performed at an independent accredited PCTEST Engineering Lab located in Columbia, MD 21046, U.S.A.



- PCTEST Lab is accredited to ISO 17025-2005 by the American Association for Laboratory Accreditation (A2LA) in Specific Absorption Rate (SAR) testing, Hearing-Aid Compatibility (HAC), CTIA Test Plans, and wireless testing for FCC and Industry Canada Rules.
- PCTEST Lab is accredited to ISO 17025 by U.S. National Institute of Standards and Technology (NIST) under the National Voluntary Laboratory Accreditation Program (NVLAP Lab code: 100431-0) in EMC, FCC and Telecommunications.
- PCTEST facility is an FCC registered (PCTEST Reg. No. 90864) test facility with the site description report on file and has met all the requirements specified in Section 2.948 of the FCC Rules and Industry Canada (IC-2451).
- PCTEST Lab is a recognized U.S. Conformity Assessment Body (CAB) in EMC and R&TTE (n.b. 0982) under the U.S.-EU Mutual Recognition Agreement (MRA).
- PCTEST TCB is a Telecommunication Certification Body (TCB) accredited to ISO/IEC Guide 65 by the American National Standards Institute (ANSI) in all scopes of FCC Rules and all Industry Canada Standards (RSS).
- PCTEST facility is an IC registered (IC-2451) test laboratory with the site description on file at Industry Canada.
- PCTEST is a CTIA Authorized Test Laboratory (CATL) for AMPS and CDMA, and EvDO mobile phones.
- PCTEST is a CTIA Authorized Test Laboratory (CATL) for Over-the-Air (OTA) Antenna Performance testing for AMPS, CDMA, GSM, GPRS, EGPRS, UMTS (W-CDMA), CDMA 1xEVDO Data, CDMA 1xRTT Data.

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3. EUT DESCRIPTION



FCC ID: A3LSMG360V
 Applicant: Samsung Electronics, Co. Ltd.
 129, Samsung-ro, Maetan dong,
 Yeongtong-gu, Suwon-si
 Gyeonggi-do 443-742, Korea
 Model(s): SM-G360V; SM-S820L
 Serial Number: HAC#1
 HW Version: N/A
 SW Version: S820LUDU0ANJ10
 Antenna: Internal Antenna
 HAC Test Configurations: Cell. CDMA, 1013, 384, 777, BT Off, WLAN Off, LTE Off
 PCS CDMA, 25, 600, 1175, BT Off, WLAN Off, LTE Off
 EUT Type: Portable Handset

Air-Interface	Band (MHz)	Type Transport	HAC Tested	Simultaneous But Not Tested	Voice over Digital Transport OTT Capability	WIFI Low Power	Additional GSM Power Reduction
CDMA	835	VO	Yes	Yes: WIFI or BT	N/A	N/A	N/A
	1900	VO	Yes	Yes: WIFI or BT	N/A	N/A	N/A
	EVDO	DT	No	Yes: WIFI or BT	Yes	N/A	N/A
LTE	700	VD ¹	No ²	Yes: WIFI or BT	Yes	N/A	N/A
	1700						
	1900						
WIFI	2450	DT	No	Yes: CDMA or LTE	Yes	N/A	N/A
	5200						
	5300						
	5500						
	5800						
BT	2450	DT	No	Yes: CDMA or LTE	N/A	N/A	N/A
Type Transport VO = Voice Only DT = Digital Data - Not intended for CMRS Service VD = CMRS and Data Transport			Notes: 1. The 3GPP VoLTE CMRS service is defined by GSMA in PRD IR.92 for IP Voice Service and Digital Transport. 2. Not tested in accordance with the guidance issued by OET in KDB publication 285076 D02 T-Coil testing for CMRS IP.				

Table 3-1: SM-G360V HAC Air Interfaces

Air-Interface	Band (MHz)	Type Transport	HAC Tested	Simultaneous But Not Tested	Voice over Digital Transport OTT Capability	WIFI Low Power	Additional GSM Power Reduction
CDMA	835	VO	Yes	Yes: WIFI or BT	N/A	N/A	N/A
	1900	VO	Yes	Yes: WIFI or BT	N/A	N/A	N/A
	EVDO	DT	No	Yes: WIFI or BT	Yes	N/A	N/A
LTE	700	DT	No	Yes: WIFI or BT	Yes	N/A	N/A
	1700						
	1900						
WIFI	2450	DT	No	Yes: CDMA or LTE	Yes	N/A	N/A
	5200						
	5300						
	5500						
	5800						
BT	2450	DT	No	Yes: CDMA or LTE	N/A	N/A	N/A
Type Transport VO = Voice Only DT = Digital Data - Not intended for CMRS Service							

Table 3-2: SM-S820L HAC Air Interfaces

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4. ANSI C63.19-2011 PERFORMANCE CATEGORIES

I. MAGNETIC COUPLING

Axial and Radial Field Intensity

All orientations of the magnetic field, in the axial, horizontal and vertical position along the measurement plane shall be ≥ -18 dB(A/m) at 1 kHz in a 1/3 octave band filter per 7.3.1.

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 7.3.2.

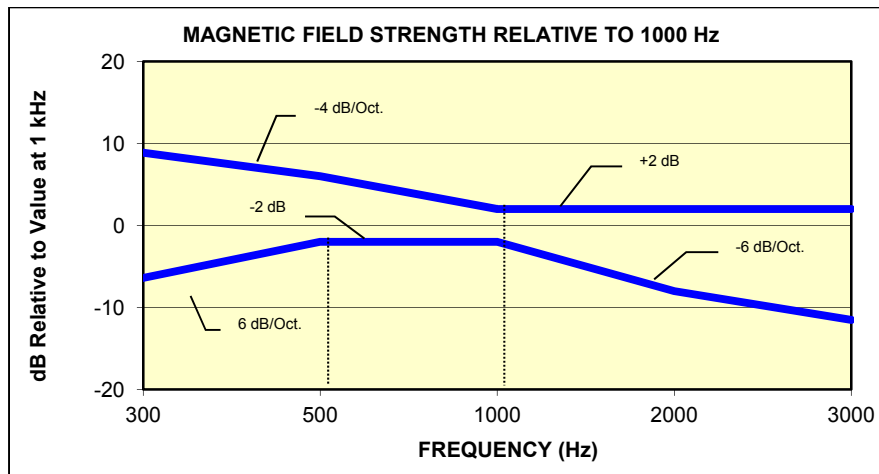


Figure 4-1
Magnetic field frequency response for Wireless Devices with an axial field ≤ -15 dB(A/m) at 1 kHz

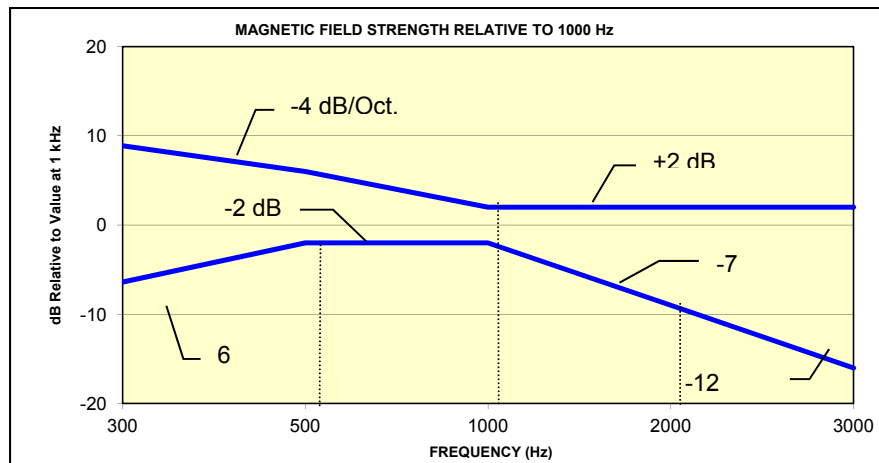




Figure 4-2
Magnetic Field frequency response for wireless devices with an axial field that exceeds -15 dB(A/m) at 1 kHz

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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 4-1
Magnetic Coupling Parameters

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5. METHOD OF MEASUREMENT

I. Test Setup

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

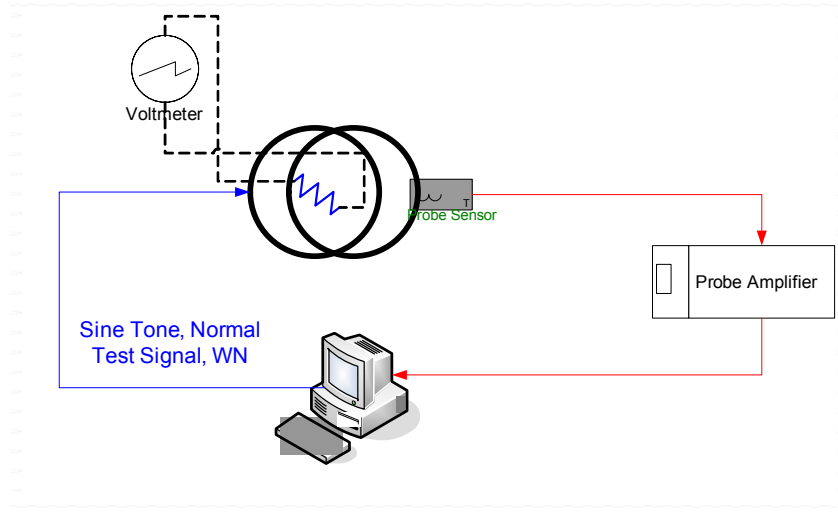


Figure 5-1
Validation Setup with Helmholtz Coil

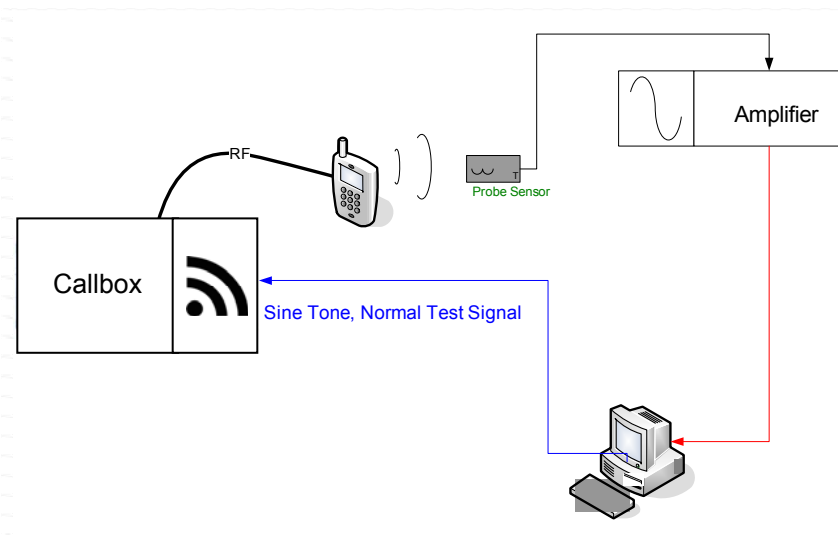




Figure 5-2
T-Coil Test Setup

FCC ID: A3LSMG360V		HAC (T-COIL) TEST REPORT		Reviewed by: Quality Manager
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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)

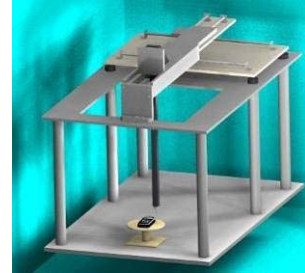


Figure 5-3
RF Near-Field Scanner

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%

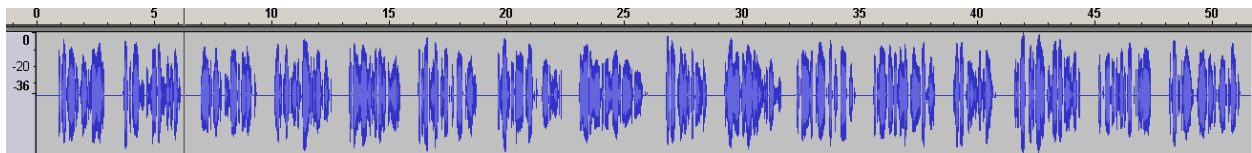


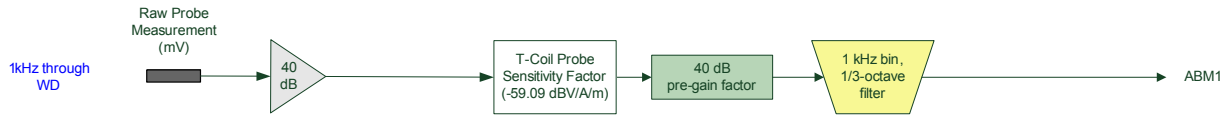


Figure 5-4
Temporal Characteristic of Normal Test Signal

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ABM1 Measurement Block Diagram :



ABM2 Measurement Block Diagram :

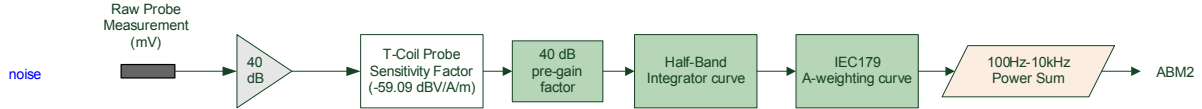


Figure 5-5 Magnetic Measurement Processing Steps

IV. Test Procedure

1. Ambient Noise Check per C63.19 §6.2.1
 - 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 less 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 5-1)

- a. The measurement system including the probe, pre-amplifier and acquisition system were validated as an entire system to ensure the reliability of test measurements.
- b. ABM1 Validation
 The magnetic field at the center of the Helmholtz coil is given by the equation (per C63.19 Annex D.9.1):



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

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=10.193Ω and using V=57mV:

$$H_c = \frac{20 \cdot \left(\frac{0.057}{10.193}\right)}{0.08 \cdot \sqrt{1.25^3}} = 1.0003 \text{ A/m}$$

Therefore a pure tone of 1kHz was applied into the coils such that 57 mV was observed across the 10 Ω 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 1 A/m in the center of the Helmholtz coil which was used to validate the probe measurement at 1 A/m. This was verified to be within ± 0.5 dB of the 1 A/m value (see Page 21).

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c. Frequency Response Validation

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

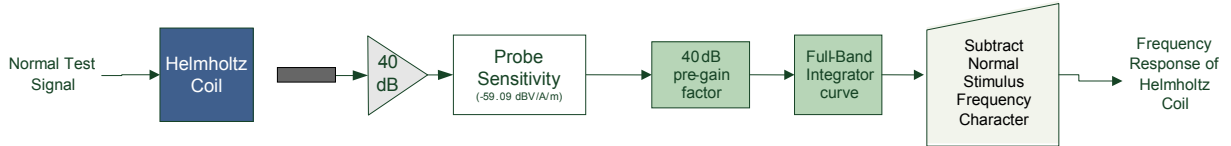




Figure 5-6 Frequency Response Validation

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 5-1
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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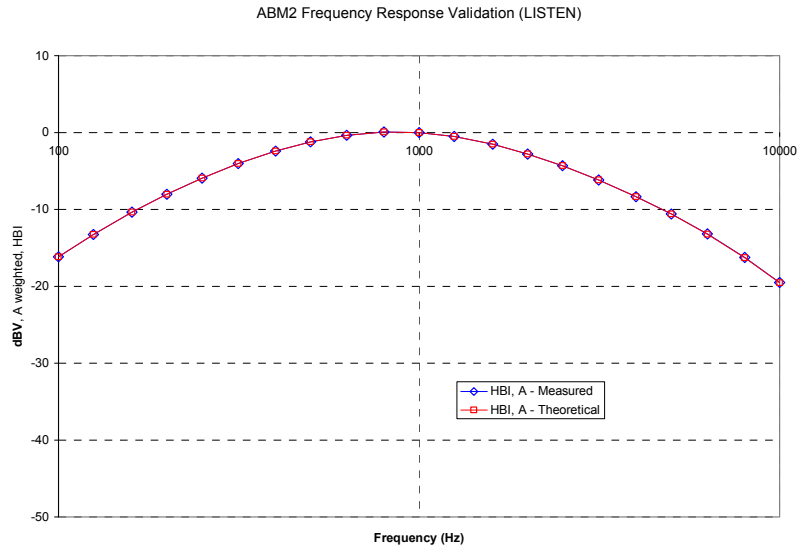


Figure 5-7
ABM2 Frequency Response Validation



The ABM2 result is a power sum from 100 Hz to 10 kHz with half-band integration and A-weighting. To verify the power sum measurement, a power sum over the full band was measured and verified to track with the source level (See Figure 5-8). Therefore the setup in this step was used to verify the power sum post-processing for ABM2 measurements. See below block diagram:

Figure 5-8
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 5-2
ABM2 Power Sum Validation

WN Input (dBV)	Power Sum (dBV)	Multimeter-Full (dBV)	Dev (dB)
-60	-60.36	-60.2	0.16
-50	-50.19	-50.13	0.06
-40	-40.14	-40.03	0.11
-30	-30.13	-30.01	0.12
-20	-20.12	-20	0.12
-10	-10.14	-10	0.14

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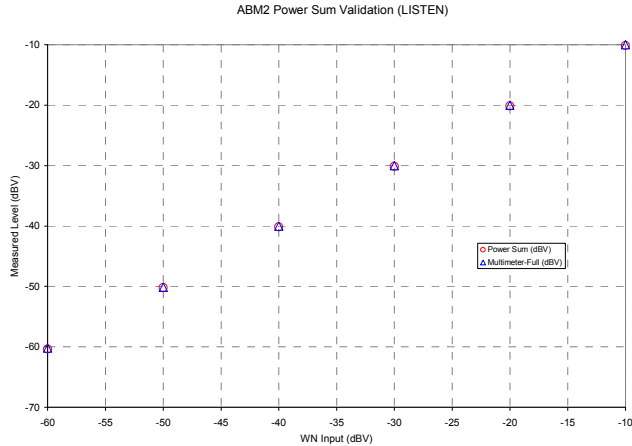


Figure 5-9
ABM2 Power Sum Validation

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:

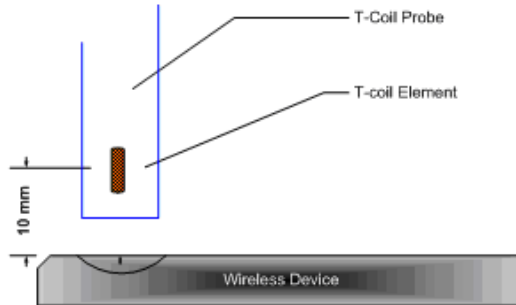




Figure 5-10
Measurement Distance

- ii. After scanning, the planar field maximum point was determined. The position of the probe was moved to this location to setup the test using the Sound Check system.
- iii. These steps were repeated for the other T-coil orientations (of axial or radial transverse) per Figure 5-13 after a T-coil orientation was fully measured with the Sound Check system.

b. Speech Signal Setup to Base Station Simulator

- i. C63.19 Table 6-1 states audio reference input levels for various technologies:

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

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

**Table 5-3
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)

- 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 6 for more information regarding worst-case configuration for CDMA)
- 4. Signal Quality Data Analysis
 - a. Narrow-band Magnetic Intensity
 - i. The standard specifies a 1 kHz 1/3 octave band minimum field intensity for a sine tone. The ABM1 measurements were evaluated at 1 kHz 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 4-1 or Figure 4-2 between 300 – 3000 Hz using digital linear averaging (limit lines chosen according to measurement found in step 3.d.ia.) A linear average over 3x the length of the speech signal (3x sampling) was performed. A 10 second delay was configured in the measurement process of the stimulus to ensure handset vocoder latency effects and echo cancellation devices (if any) were appropriately stabilized during measurements.
 - ii. The appropriate post-processing was applied according to the system processing chain illustrated in Figure 5-11. All R10 frequencies were plotted with respect to 0dB at 1 kHz value and aligned with respect to the EIA-504 mask.

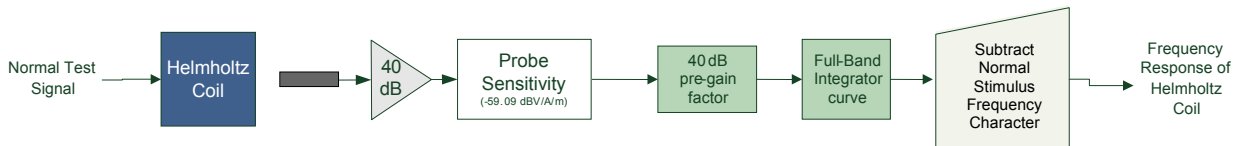




Figure 5-11 Frequency Response Block Diagram

- iii. The margin is represented by the closest measured data point on the curve to the EIA-504 limit lines, in dB.
- c. Signal Quality Index
 - i. Ensuring the WD was at maximum RF power, maximum volume, backlight on, display on, maximum contrast setting, keypad lights on (when possible) with no audio signal through the vocoder, the WD was measured over at least 100 Hz – 10,000 Hz, maximized over 5 seconds with a 50ms sample time for the ABM2 measurement (5 second time period is used in noise measurements under standards such as IEEE 269, etc.)
 - ii. After applying half-band integration and A-weighting to the result, a power sum was applied over each 1/3 octave bandwidth frequency to obtain 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. Deviation from C63.19 Test Procedure

Non-conducted RF connection to account for effects of metallic shielding in the battery cover.

VI. Air Interface Technologies Tested

1. SM-G360V
 - a. WIFI and all 3G packet services were not tested for this device since they are considered 'Over-the-Top' applications and are not within the current definition of a managed CMRS service.
 - b. VoLTE air interfaces were not tested in accordance with the guidance issued by OET in KDB publication 285076 D02 T-Coil testing for CMRS IP.
2. SM-S820L
 - a. WIFI and all 3G/4G packet services were not tested for this device since they are considered 'Over-the-Top' applications and are not within the current definition of a managed CMRS service.

VII. Wireless Device Channels and Frequencies

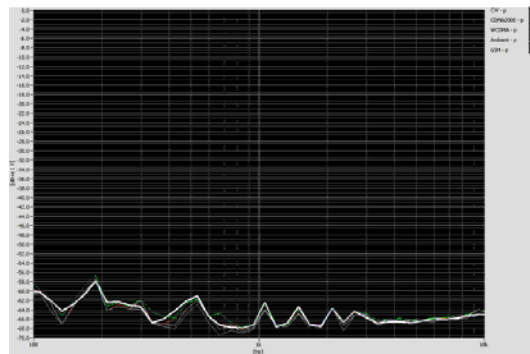
The frequencies listed in the table below are those that lie in the center of the bands used for cellular telephony. Low, middle and high channels were tested in each band for compliance evaluation to ensure the maximum emission is captured across the entire band

To facilitate setting of a base station simulator for ABM measurements, specific band plan channel numbers are listed that may be used in lieu of the band center frequencies.



**Table 5-4
Center Channels and Frequencies**

Test frequencies & associated channels	
Channel	Frequency (MHz)
Cellular 850	
384 (CDMA)	836.52
PCS 1900	
600 (CDMA)	1880

VIII. RF Emission Effect on T-coil Measurements

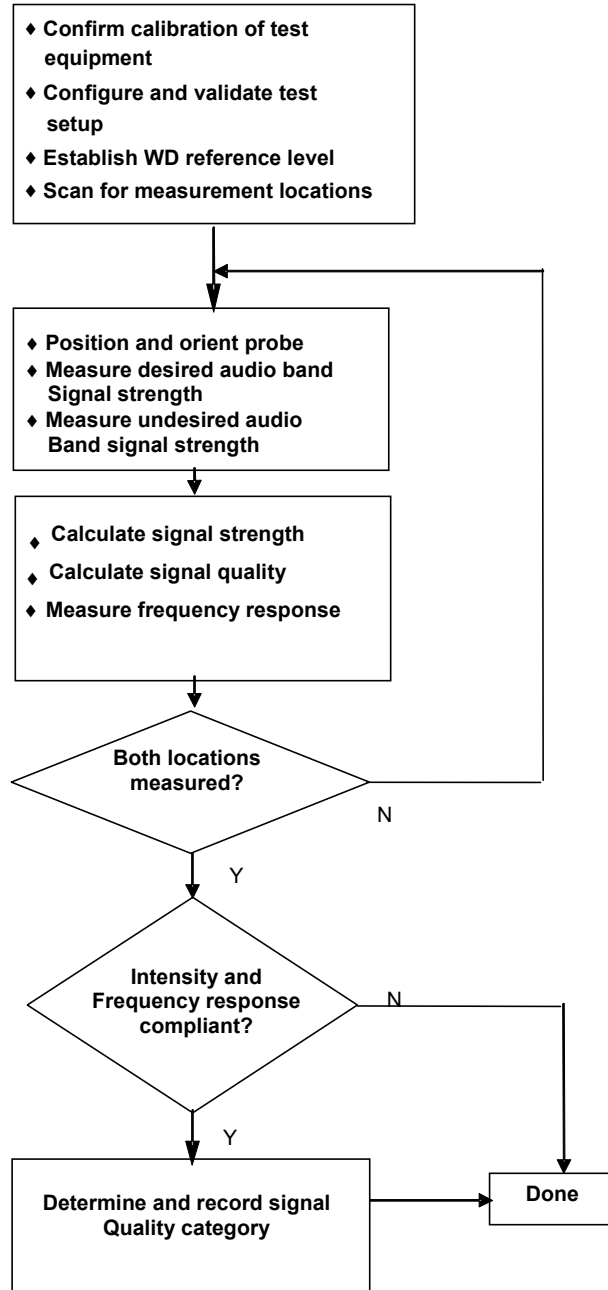


**Figure 5-12
High power RF Emissions Effect with HAC Dipole on the T-coil Probe System 10mm between dipole maximum and magnetic probe**



FCC ID: A3LSMG360V	 PCTEST This office is development, etc.	HAC (T-COIL) TEST REPORT		Reviewed by: Quality Manager
Filename: 0Y1411052082-R2.A3L	Test Dates: 12/22/2014	EUT Type: Portable Handset	Page 15 of 36	

IX. Test Flow

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



**Figure 5-13
C63.19 T-Coil Signal Test Process**

FCC ID: A3LSMG360V		HAC (T-COIL) TEST REPORT		Reviewed by: Quality Manager
Filename: 0Y1411052082-R2.A3L	Test Dates: 12/22/2014	EUT Type: Portable Handset		Page 16 of 36

6. FCC 3G MEASUREMENTS

I. CDMA Test Configuration

Radio Configuration 1, Service Option 68 was used for the testing according to the CTIA Test Plan and also 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:

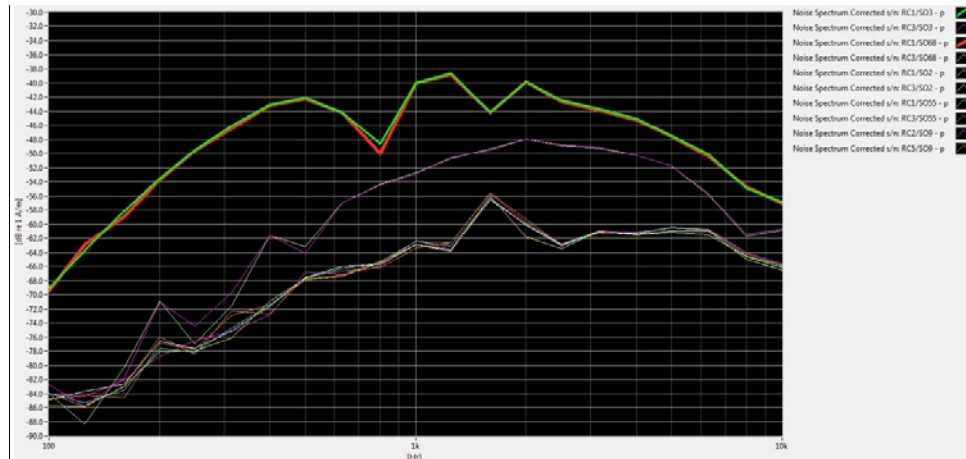


Figure 6-1
CDMA Audio Band Magnetic Noise

II. ABM Measurements

Table 6-1
FCC 3G ABM Measurements for A3LSMG360V (CDMA)

ABM1 Pre-Test (dBA/m)

RC1/SO68	RC3/SO68	RC4/SO68	Orientation	Channel
-6.26	-6.65	-6.59	Radial	777



ABM2 Pre-Test (dBA/m), A, HBI

RC1/SO68	RC3/SO68	RC4/SO68	Orientation	Channel
-48.810	-50.210	-51.810	Radial	777

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



Figure 6-2
Audio Band Magnetic Curve Measurement Block Diagram

FCC ID: A3LSMG360V		HAC (T-COIL) TEST REPORT		Reviewed by: Quality Manager
Filename: 0Y1411052082-R2.A3L	Test Dates: 12/22/2014	EUT Type: Portable Handset		Page 17 of 36

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
				<i>dBa/m</i>	<i>dBa/m</i>	<i>PASS/FAIL</i>
8.3.1	CDMA	Cellular	Intensity, Axial	-18	3.0	PASS
8.3.1			Intensity, Radial	-18	-6.1	PASS
8.3.4			Signal-to-Noise/Noise, Axial	20	50.2	PASS
8.3.4			Signal-to-Noise/Noise, Radial	20	35.6	PASS
8.3.2			Frequency Response, Axial	0	0.1	PASS
8.3.1	CDMA	PCS	Intensity, Axial	-18	3.2	PASS
8.3.1			Intensity, Radial	-18	-5.8	PASS
8.3.4			Signal-to-Noise/Noise, Axial	20	51.8	PASS
8.3.4			Signal-to-Noise/Noise, Radial	20	36.2	PASS
8.3.2			Frequency Response, Axial	0	0.2	PASS

Note: The above summary table represents the worst-case numerical values according to configurations in Table 7-3.

**Table 7-2
Consolidated Tabled Results**

	Volume Setting	Cellular		PCS	
		Axial	Radial	Axial	Radial
Freq. Response Margin	Maximum	PASS	N/A	PASS	N/A
Magnetic Intensity Verdict		PASS	PASS	PASS	PASS
FCC SNR Verdict		PASS	PASS	PASS	PASS

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

FCC ID: A3LSMG360V	 PCTEST This Office is Accredited, NIST	HAC (T-COIL) TEST REPORT		Reviewed by: Quality Manager
Filename: 0Y1411052082-R2.A3L	Test Dates: 12/22/2014	EUT Type: Portable Handset		Page 18 of 36



II. Raw Handset Data

**Table 7-3
Raw Data Results for CDMA**

		Volume	Cellular Band					
			Axial			Radial		
			1013	384	777	1013	384	777
ABM1, dBA/m	Maximum		3.06	3.04	3.38	-5.65	-5.73	-6.09
ABM2, dBA/m			-47.11	-48.06	-47.58	-41.66	-41.39	-41.72
Ambient Noise, dBA/m			-59.35	-59.35	-59.35	-58.56	-58.56	-58.56
Freq. Response Margin (dB)			0.23	0.26	0.12	N/A	N/A	N/A
S+N/N (dB)			50.17	51.10	50.96	36.01	35.66	35.63
S+N/N per orientation (dB)			50.17			35.63		
C63.19-2011 Rating per orientation			T4			T4		
		Volume	PCS Band					
			Axial			Radial		
			25	600	1175	25	600	1175
ABM1, dBA/m	Maximum		3.28	3.35	3.23	-5.82	-5.77	-5.75
ABM2, dBA/m			-49.19	-49.41	-48.57	-42.97	-43.50	-41.95
Ambient Noise, dBA/m			-59.35	-59.35	-59.35	-58.56	-58.56	-58.56
Freq. Response Margin (dB)			0.34	0.24	0.22	N/A	N/A	N/A
S+N/N (dB)			52.47	52.76	51.80	37.15	37.73	36.20
S+N/N per orientation (dB)			51.80			36.20		
C63.19-2011 Rating per orientation			T4			T4		
T-coil Coordinates (cm)	[x,y] from bottom left		2.6, 2.6			2.6, 1.8		

Notes:

1. Power Configuration: Power Control Bits="All Up"
2. Phone Condition: Mute on; Backlight on; Max Volume, Max Contrast
3. Vocoder Configuration: RC1/SO68 (CDMA - EVRC)
4. 'Radial' orientation refers to radial transverse
5. Speech Signal: 3GPP2 Normal Test Signal

FCC ID: A3LSMG360V	 PCTEST Engineering Laboratory, Inc.	HAC (T-COIL) TEST REPORT		Reviewed by: Quality Manager
Filename: 0Y1411052082-R2.A3L	Test Dates: 12/22/2014	EUT Type: Portable Handset		Page 19 of 36

III. Frequency Response Graph

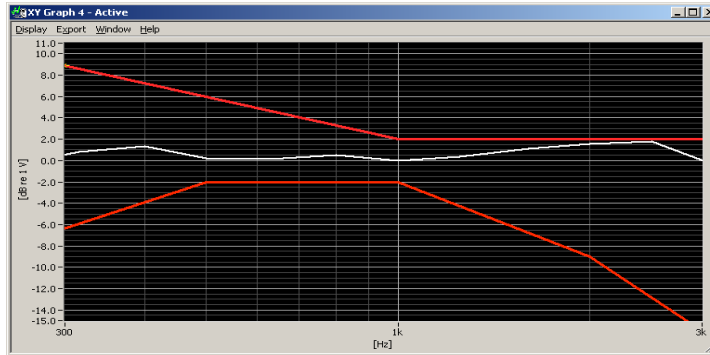
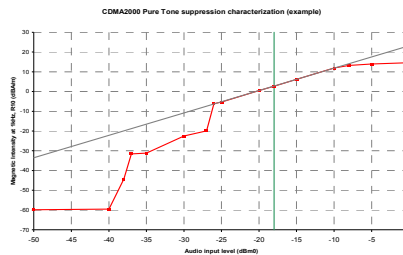


Figure 7-1

Axial Frequency Response

Note: User T-coil Mode (**Settings**→**Call**→**Additional Settings**→**Hearing aids**) was set to ON for Frequency Response compliance. This frequency response represents the worst-case ABM2 test configuration according to Table 7-3.

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.

V. Undesirable Audio Magnetic Band Plots (ABM2)

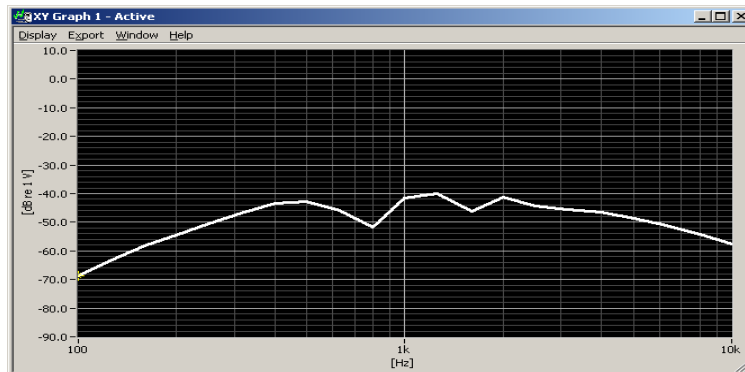




Figure 7-2

Worst-case ABM2 Plot for WD, CDMA

Note: This plot represents the data from the location/configuration resulting in the highest ABM2 result shown in Table 7-3.

FCC ID: A3LSMG360V		HAC (T-COIL) TEST REPORT		Reviewed by: Quality Manager
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VI. T-Coil Validation Test Results

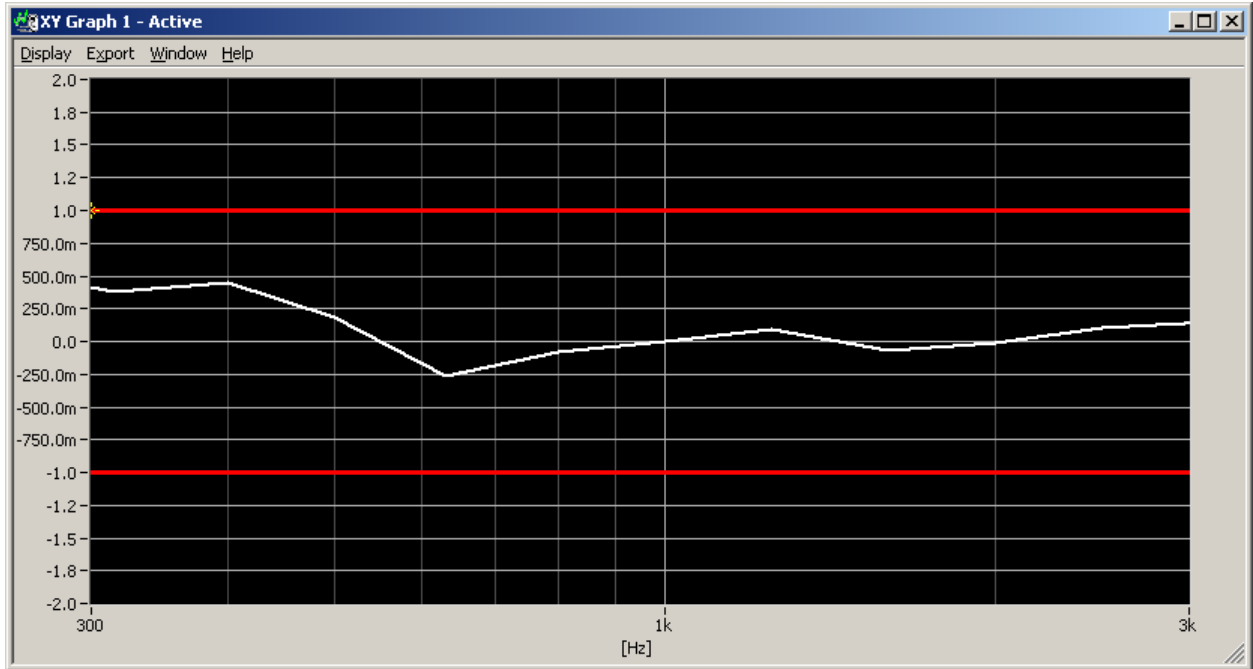




Figure 7-3
Helmholtz Coil Validation for Frequency Response

Table 7-4
Helmholtz Coil Validation Table of Results

Item	Target	Result	Verdict
Signal Validation			
Frequency Response, from limits	$> 0 \text{ dB}$	0.74	PASS
Magnetic Intensity, -10 dBA/m	$-10 \pm 0.5 \text{ dB}$	-9.607	PASS
Noise Validation			
Axial Environmental Noise	$< - 58 \text{ dBA/m}$	-59.35	PASS
Radial Environmental Noise	$< - 58 \text{ dBA/m}$	-58.56	PASS

FCC ID: A3LSMG360V	 PCTEST EMC TEST AND DEVELOPMENT, INC.	HAC (T-COIL) TEST REPORT	 SAMSUNG	Reviewed by: Quality Manager
Filename: 0Y1411052082-R2.A3L	Test Dates: 12/22/2014	EUT Type: Portable Handset	Page 21 of 36	

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.

FCC ID: A3LSMG360V	 <small>THE OFFICE OF DEVELOPMENT, INC.</small>	HAC (T-COIL) TEST REPORT		Reviewed by: Quality Manager
Filename: 0Y1411052082-R2.A3L	Test Dates: 12/22/2014	EUT Type: Portable Handset	Page 22 of 36	



9. EQUIPMENT LIST

**Table 9-1
Equipment List**

Manufacturer	Model	Description	Cal Date	Cal Interval	Cal Due	Serial Number
Control Company	36934-158	Wall-Mounted Thermometer	4/29/2014	Biennial	4/29/2016	122014488
Listen	SoundCheck	Acoustic Analyzer System	10/17/2014	Annual	10/17/2015	01-20-03368
Listen	SoundConnect	Microphone Power Supply	3/14/2014	Annual	3/14/2015	PS2612
NI	4474	Data Acquisition Card	N/A		N/A	N/A
Rohde & Schwarz	CMU200	Base Station Simulator	4/24/2014	Annual	4/24/2015	836371/0079
TEM	Axial T-Coil Probe	Axial T-Coil Probe	2/17/2014	Annual	2/17/2015	TEM-1123
TEM	Radial T-Coil Probe	Radial T-Coil Probe	2/17/2014	Annual	2/17/2015	TEM-1129
TEM	C63.19	Helmholtz Coil	3/8/2014	Annual	3/8/2015	925
TEM		HAC System Controller with Software	N/A		N/A	N/A
TEM		HAC Positioner	N/A		N/A	N/A

FCC ID: A3LSMG360V	 PCTEST This Office is Accredited, NIST	HAC (T-COIL) TEST REPORT		Reviewed by: Quality Manager
Filename: 0Y1411052082-R2.A3L	Test Dates: 12/22/2014	EUT Type: Portable Handset		Page 23 of 36

10. CALIBRATION CERTIFICATES

FCC ID: A3LSMG360V	 PCTEST <small>Engineering Laboratory, Inc.</small>	HAC (T-COIL) TEST REPORT		Reviewed by: Quality Manager
Filename: 0Y1411052082-R2.A3L	Test Dates: 12/22/2014	EUT Type: Portable Handset		Page 24 of 36

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-1123
Calibration Recall No: 23889

Submitted By:

Customer: JUSTIN CHAO
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 Coil TEM

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

Within (X) see attached Report of Calibration.

the tolerance of the indicated specification.

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

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

Approved by:

Calibration Date: 17-Feb-14

Certificate No: 23889 - 1

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



Certificate Page 1 of 1

JSC
4/4/14
FC
Felix Christopher (QA Mgr.)
ISO/IEC 17025:2005

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



Calibration Lab. Cert. # 1533.01

FCC ID: A3LSMG360V	 PCTEST THE BEST IN DEVELOPMENT, NY	HAC (T-COIL) TEST REPORT		Reviewed by: Quality Manager
Filename: 0Y1411052082-R2.A3L	Test Dates: 12/22/2014	EUT Type: Portable Handset		Page 25 of 36



ISO/IEC 17025: 2005



Calibration Lab. Cert. # 1533.01

REPORT OF CALIBRATION

TEM Consulting LP Axial T Coil Probe

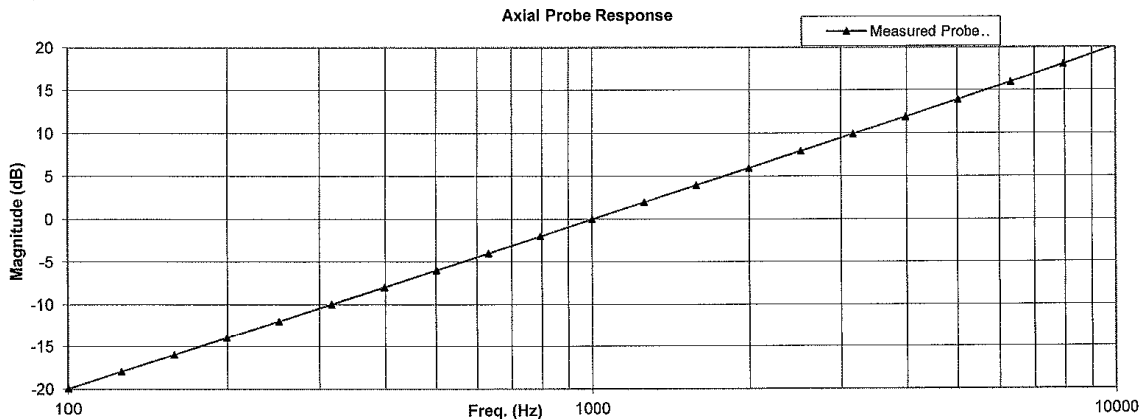
Model No.: Axial T Coil Probe

Serial No.: TEM-1123

Company : PCTEST Engineering Lab.

I. D. No: 80582

Calibration results:		Before data:	After data:
Probe Sensitivity measured with Helmholtz Coil		Before & after data same: ...X.....	
<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.;	0.09	A	
<i>Helmholtz Coil Constant;</i>			
	7.09	A/m/V	
<i>Helmholtz Coil magnetic field;</i>			
	5.98	A/m	
Probe Sensitivity at			
	1000	Hz.	
was	-60.20	dBV/A/m	
	0.977	mV/A/m	
Probe resistance			
	894	Ohms	
		Laboratory Environment:	
		Ambient Temperature:	21.2 °C
		Ambient Humidity:	29.1 % RH
		Ambient Pressure:	100.7 kPa
		Calibration Date:	17-Feb-14
		Re-calibration Due:	17-Feb-15
		Report Number:	23889 -1
		Control Number:	23889
<p>The above listed instrument meets or exceeds the tested manufacturer's specifications.</p> <p>This Calibration is traceable through NIST test numbers: ,287708</p> <p>The expanded uncertainty of calibration: 0.30dB at 95% confidence level with a coverage factor of k=2.</p> <p>Graph represents Probes Frequency Response.</p>			



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/NCCL Z540-1, (MIL-STD-45662A) and ISO 9001:2008, ISO 17025

Cal. Date: 17-Feb-2014
 Calibrated on WCCL system type 9700

Measurements performed by:
Felix Christopher

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

FCC ID: A3LSMG360V		HAC (T-COIL) TEST REPORT		Reviewed by: Quality Manager
Filename: 0Y1411052082-R2.A3L	Test Dates: 12/22/2014	EUT Type: Portable Handset		Page 26 of 36

HCATEMC_TEM-1123_Feb-17-2014

West Caldwell Calibration Laboratories Inc.

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



Calibration Data Record

TEM Consulting LP Axial T Coil Probe for Model No.: Axial T Coil Probe Serial No.: TEM-1123
Company : PCTEST Engineering Lab.

Test	Function	Tolerance	Measured values			
			Before	Out	Remarks	
1.0	Probe Sensitivity at	1000 Hz. dBV/A/m	-60.20			
2.0	Probe Level Linearity					
			6	6.03		
		Ref. (0 dB)	0	0.00		
			-6	-6.02		
		-12	-12.05			
3.0	Probe Frequency Response					
			100	-19.9		
			126	-17.9		
			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	8-Oct-2013	,287708	8-Oct-2014
HP	34401A	S/N 36102471	8-Oct-2013	,287708	8-Oct-2014
HP	33120A	S/N 36043716	8-Oct-2013	,287708	8-Oct-2014
Brüel & Kjær	2133	S/N 1583254	6-Jan-2014	683/284413-14	7-Jan-2015

Cal. Date: 17-Feb-2014 Tested by: Felix Christopher
Calibrated on WCCL system type 9700
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FCC ID: A3LSMG360V		HAC (T-COIL) TEST REPORT		Reviewed by: Quality Manager
Filename: 0Y1411052082-R2.A3L	Test Dates: 12/22/2014	EUT Type: Portable Handset		Page 27 of 36

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-1129
Calibration Recall No: 23889

Submitted By:

Customer: JUSTIN CHAO
Company: PCTEST ENGINEERING LAB
Address: 6660-B DOBBIN ROAD COLUMBIA MD 21045

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

West Caldwell Calibration Laboratories Procedure No. Radial T C TEM

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

Within (X) see attached Report of Calibration.

the tolerance of the indicated specification.

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

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

Approved by:

Calibration Date: 17-Feb-14

Certificate No: 23889 - 2

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

Certificate Page 1 of 1



JSC
4/4/14

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

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



Calibration Lab. Cert. # 1533.01

FCC ID: A3LSMG360V	 PCTEST THE BEST IN DEVELOPMENT, NY	HAC (T-COIL) TEST REPORT		Reviewed by: Quality Manager
Filename: 0Y1411052082-R2.A3L	Test Dates: 12/22/2014	EUT Type: Portable Handset		Page 28 of 36



ISO/IEC 17025: 2005



Calibration Lab. Cert. # 1533.01

REPORT OF CALIBRATION

TEM Consulting LP Radial T Coil Probe

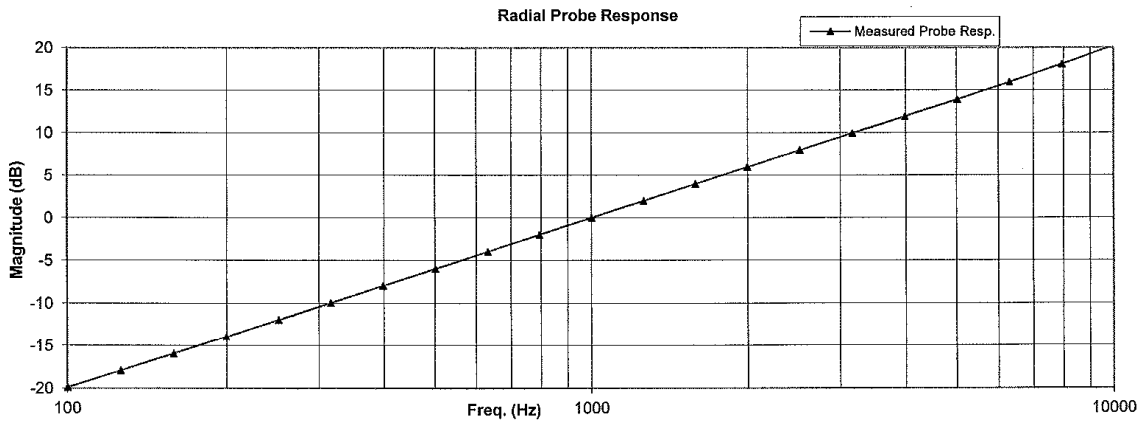
Model No.: Radial T Coil Probe

Serial No.: TEM-1129

Company : PCTEST Engineering Lab.

I. D. No: 80583

Calibration results:	Before data:	After data:
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.;	0.09	A
<i>Helmholtz Coil Constant;</i>	7.09	A/m/V
<i>Helmholtz Coil magnetic field;</i>	5.98	A/m
Probe Sensitivity at	1000	Hz.
was	-60.38	dBV/A/m
	0.957	mV/A/m
Probe resistance	900	Ohms
		Before & after data same: ...X.....
		Laboratory Environment:
		Ambient Temperature: 21.2 °C
		Ambient Humidity: 29.1 % RH
		Ambient Pressure: 100.7 kPa
		Calibration Date: 17-Feb-14
		Re-calibration Due: 17-Feb-15
		Report Number: 23889 -2
		Control Number: 23889
<p>The above listed instrument meets or exceeds the tested manufacturer's specifications.</p> <p>This Calibration is traceable through NIST test numbers: ,287708</p> <p>The expanded uncertainty of calibration: 0.30dB at 95% confidence level with a coverage factor of k=2.</p> <p>Graph represents Probes Frequency Response.</p>		



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: 17-Feb-2014
 Calibrated on WCCL system type 9700

Measurements performed by: *[Signature]*
Felix Christopher

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

FCC ID: A3LSMG360V		HAC (T-COIL) TEST REPORT		Reviewed by: Quality Manager
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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

TEM Consulting LP Radial T Coil Probe for Model No.: Radial T Coil Probe Serial No.: TEM-1129
Company : PCTEST Engineering Lab.

Test	Function	Tolerance	Measured values			
			Before	Out	Remarks	
1.0	Probe Sensitivity at	1000 Hz. dBV/A/m	-60.38			
2.0	Probe Level Linearity					
			6	6.04		
		Ref. (0 dB)	0	0.00		
			-6	-6.03		
			-12	-12.05		
3.0	Probe Frequency Response					
			100	-19.9		
			126	-17.9		
			158	-15.9		
			200	-13.9		
			251	-12.0		
			316	-10.0		
			398	-8.0		
			501	-6.0		
			631	-4.0		
			794	-2.0		
			Ref. (0 dB)	1000	0.0	
				1259	2.0	
				1585	4.0	
				1995	6.0	
				2512	7.9	
				3162	9.9	
		3981	11.9			
		5012	13.9			
		6310	16.0			
		7943	18.0			
		10000	20.2			

Instruments used for calibration:			Date of Cal.	Traceability No.	Due Date
HP	34401A	S/N 36064102	8-Oct-2013	,287708	8-Oct-2014
HP	34401A	S/N 36102471	8-Oct-2013	,287708	8-Oct-2014
HP	33120A	S/N 36043716	8-Oct-2013	,287708	8-Oct-2014
Brüel & Kjær	2133	S/N 1583254	6-Jan-2014	683/284413-14	7-Jan-2015



Cal. Date: 17-Feb-2014 Tested by: Felix Christopher
 Calibrated on WCCL system type 9700
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11. CONCLUSION



The measurements taken in accordance with the procedures provided in the CTIA Test Plan for Hearing Aid Compatibility Rev 2.0, April 2010, indicate that the wireless communications device complies with the HAC limits specified in 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.



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