

PCTEST

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HEARING AID COMPATIBILITY

Applicant Name:

Samsung Electronics Co., Ltd. 129, Samsung-ro, Maetan dong, Yeongtong-gu, Suwon-si Gyeonggi-do 16677, Korea Date of Testing:

08/02/2021 - 08/03/2021 **Test Site/Location:**

PCTEST, Columbia, MD, USA

Test Report Serial No.:

1M2108050088-02.A3L (Rev 1)

Date of Issue: 08/06/2021

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);

Flat Configuration Only)

Note: This revised Test Report 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 report and category only pertain to the flat configuration 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.







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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

Flat Configuration Testing

This device supports held to ear scenarios in both the folded (closed) and flat (open) configurations. The overall worst case configuration from the original certification test report (Report S/N: 1M2104020031-24-R1.A3L) was additionally evaluated in the flat (open) configuration for this report.

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Table 2-1 A3LSMF926U HAC Air Interfaces

			7.02	SWF9200 HAC All IIILEHA	 	
Air-Interface	Band (MHz)	Type Transport	HAC Tested	Simultaneous But Not Tested	Name of Voice Service	Audio Codec Evaluated
CDMA	835 1900	VO	No ³	Yes: WIFI or BT	CMRS Voice ¹	EVRC
	EvDO	VD	No ³	Yes: WIFI or BT	Google Duo ²	OPUS
	850		Yes ³			
GSM	1900	VO	No ³	Yes: WIFI or BT	CMRS Voice ¹	EFR
	GPRS/EDGE	VD	No ³	Yes: WIFI or BT	Google Duo²	OPUS
	850					
LINATO	1700	VD	No ³	Yes: WIFI or BT	CMRS Voice ¹	NB AMR
UMTS	1900					
	HSPA	VD	No ³	Yes: WIFI or BT	Google Duo²	OPUS
	680 (B71)					
	700 (B12)					
	780 (B13)					
	790 (B14)					
	850 (B5)					
LTE (FDD)	850 (B26)	VD	No ³	Yes: NR, WIFI or BT	VoLTE ¹ , Google Duo ²	Volte: NB AMR, WB AMR, EVS
LIE (FDD)	1700 (B4)	VD	NO Test Mi, Will of B1	Google Duo: OPUS		
	1700 (B66)					
	1900 (B2)					
	1900 (B25)					
	2300 (B30)					
	2500 (B7)					
	2600 (B38)					V-ITE NO ANAD MAD ANAD ENG
LTE (TDD)	2600 (B41)	VD	No ³	Yes: NR, WIFI or BT	VoLTE ¹ , Google Duo ²	Volte: NB AMR, WB AMR, EVS Google Duo: OPUS
	3600 (B48)					0008:0 - 00: 0: 0:
	680 (n71)					
	700 (n12)					
-	850 (n5)					
NR (FDD)	1700 (n66)	VD	No ³	Yes: LTE, WIFI or BT	Google Duo²	OPUS
	1900 (n2)					
	1900 (n25)					
	2300 (n30)					
	2600 (n41)					
	3500 (n77, DoD)		2			
NR (TDD)	3700 (n77)	VD	No ³	Yes: LTE, WIFI or BT	Google Duo ²	OPUS
	28000 (n261)					
	39000 (n260)					
	2450					
	5200 (U-NII 1)					
-	5300 (U-NII 2A)					
WIFI	5500 (U-NII 2C)	VD	No ³	Vec: CDMA GSM LIMITS LITE or ND	VoWIEI ² Google Duo ²	VoWIFI: NB AMR, WB AMR, EVS
VVIFI	5800 (U-NII 3)	۷D	INO	Yes: CDMA, GSM, UMTS, LTE, or NR	VoWIFI ² , Google Duo ²	Google Duo: OPUS
	6175 (U-NII 5) 6475 (U-NII 6)					
	6700 (U-NII 7)					
}	7000 (U-NII 8)					
ВТ	2450	DT	No	Yes: CDMA, GSM, UMTS, LTE, or NR	N/A	N/A
Type Transport			Notes:	,,,,,	.,,	,
VO = Voice Only	(O = Voice Only 1. Reference level in accordance with 7.4.2.1 of ANSI C63.19-2011 and July 2012 C63 VoLTE Interpretation.					ation.
	DT = Digital Data - Not intended for Voice Services 2. Reference level is -20dBm0 in accordance with FCC KDB 285076 D02 3. This report only pertains to GSM 850 mode. For full data, please refer to the Original Certification Test Report (Report S/N:					
v – Civiks and,	D = CMRS and/or IP Voice over Data Transport 3. This report only pertains to GSM 850 mode. For full data, please refer to the Original Certification Test Report (Report S/N: 1M2104020031-24-R1.A3L).					

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ANSI C63.19-2011 PERFORMANCE CATEGORIES 3.

I. MAGNETIC COUPLING

Axial and Radial Field Intensity

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

Frequency Response

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

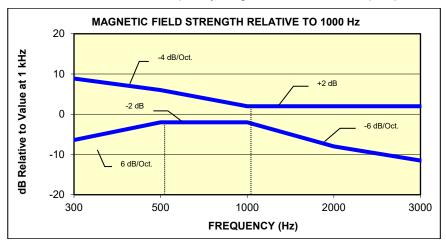
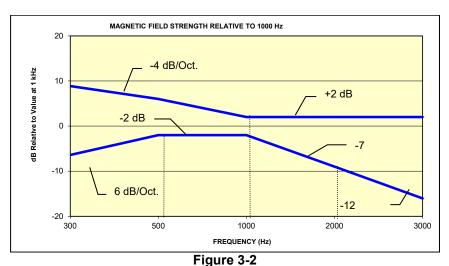


Figure 3-1 Magnetic field frequency response for Wireless Devices with an axial field ≤-15 dB(A/m) at 1 kHz



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

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

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

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

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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METHOD OF MEASUREMENT

Test Setup I.

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

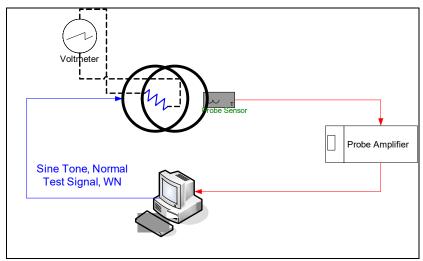


Figure 4-1 Validation Setup with Helmholtz Coil

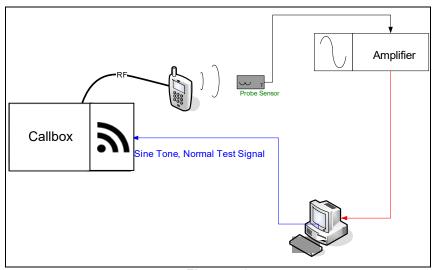


Figure 4-2 T-Coil Test Setup

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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)

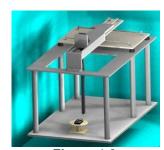


Figure 4-3 RF Near-Field Scanner

III. 3GPP2 Normal Test Signal (Speech)

Manufacturer: 3GPP2 (TIA 1042 §3.3.1)

Modified-IRS weighted, multi-talker speech signal, 4 Male and 4

Stimulus Type: Female speakers (alternating)

Single Sample Duration: 51.62 seconds

Activity Level: 77.4%

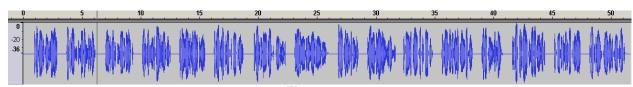


Figure 4-4
Temporal Characteristic of Normal Test Signal

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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.
 - Since this measurement was measured in the same method as ABM2 measurements, this level was verified to be more than 10 dB below the lowest measurement signal (which is the highest ABM2 measurement for a T4 WD). Therefore the maximum noise level for a T4 WD with an ABM1 = -18 dBA/m is:

- 2. Measurement System Validation (See Figure 4-1)
 - 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:

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

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 \pm 0.5 dB of the -10dB(A/m) value (see Page 18).

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:

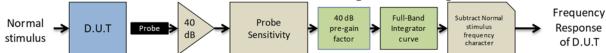


Figure 4-6 Frequency Response Validation

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

	HBI, A -	HBI, A -	
f (Hz)	Measured	Theoretical	dB Var.
	(dB re 1kHz)	(dB re 1kHz)	
100	-16.180	-16.170	-0.010
125	-13.257	-13.250	-0.007
160	-10.347	-10.340	-0.007
200	-8.017	-8.010	-0.007
250	-5.925	-5.920	-0.005
315	-4.045	-4.040	-0.005
400	-2.405	-2.400	-0.005
500	-1.212	-1.210	-0.002
630	-0.349	-0.350	0.001
800	0.071	0.070	0.001
1000	0.000	0.000	0.000
1250	-0.503	-0.500	-0.003
1600	-1.513	-1.510	-0.003
2000	-2.778	-2.780	0.002
2500	-4.316	-4.320	0.004
3150	-6.166	-6.170	0.004
4000	-8.322	-8.330	0.008
5000	-10.573	-10.590	0.017
6300	-13.178	-13.200	0.022
8000	-16.241	-16.270	0.029
10000	-19.495	-19.520	0.025

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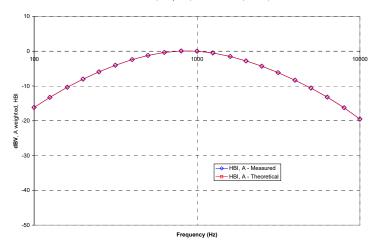
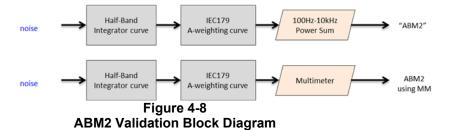


Figure 4-7
ABM2 Frequency Response Validation

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:



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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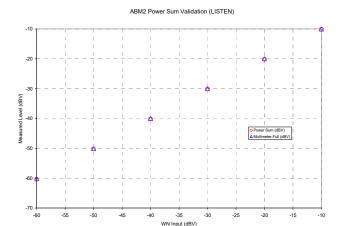
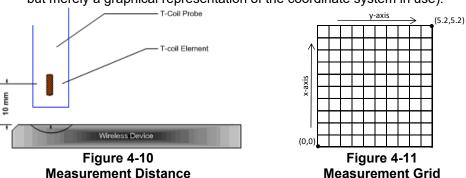


Figure 4-9 **ABM2 Power Sum Validation**

- 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):



- 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 TM	TDMA (22 and 11 Hz)	-18

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- 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.
 - 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

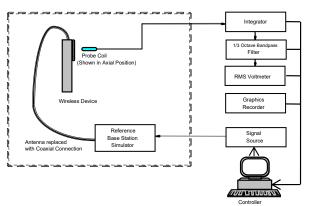


Figure 4-12
Audio Magnetic Field Test Setup

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.

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)			
Cellular 850				
190 (GSM)	836.60			

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IX. Test Flow

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

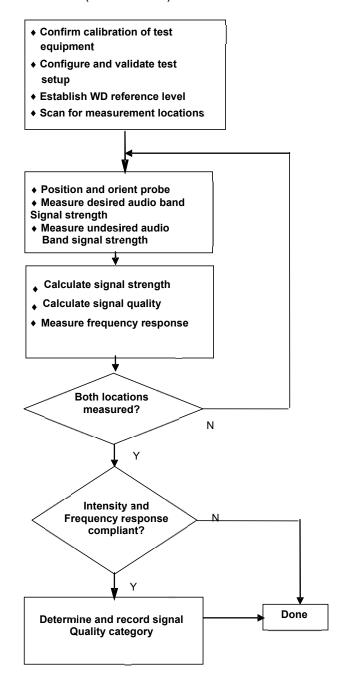


Figure 4-13 C63.19 T-Coil Signal Test Process

FCC ID: A3LSMF926U	PCTEST* Provide to be post of the demand	HAC (T-COIL) TEST REPORT	SAMSUNG	Approved by: Quality Manager
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5. T-COIL TEST SUMMARY

Table 5-1 Consolidated Tabled Results

		Freq. Response Margin		•	Magnetic Intensity Verdict		SNNR dict	Margin from FCC Limit	C63.19-2011
C62 10	9 Section	8.3	3.2	8.3	3.1	8.3	3.4	(dB)	Rating
C63. 18) Section	Axial	Radial	Axial	Radial	Axial	Radial		
GSM	Cellular	PASS	NA	PASS	PASS	PASS	PASS	-3.26	Т3

I. Raw Handset Data

Table 5-2 Raw Data Results for GSM – M1 Only

Mode	Orientation	Channel	Device Posture / Side	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	Test Coordinates
	Axial	190	FLAT - FRONT	4.23	-30.87	-62.21	2.00	35.10	20.00	-15.10	T4	1.6, 3.4
GSM850	Radial	190	FLAT - BACK	10.00	-19.45	-02.21	2.00	29.45	20.00	-9.45	Т3	1.6, 1.8
GSIVIOSU		128	FLAT - FRONT	-3.53	-26.79	-62 91	N/A	23.26	20.00	-3.26	Т3	1.6. 2.6
		128	FLAT - BACK	1.74	-31.57		IN/A	33.31	20.00	-13.31	T4	1.0, 2.0

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 modes.
- 6. The Margin from FCC limit column indicates a margin from the FCC limit for compliance (T3).

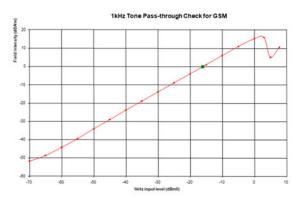
B. GSM

1. Power Configuration: GSM850: PCL=5,

2. Vocoder Configuration: EFR (GSM);

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II. 1 kHz Vocoder Application Check



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

III. T-Coil Validation Test Results

Table 5-3
Helmholtz Coil Validation Table of Results – 8/2/2021

ltem	Target	Result	Verdict
Axial			
Magnetic Intensity, -10 dBA/m	-10 ± 0.5 dB	-9.892	PASS
Environmental Noise	< -58 dBA/m	-62.21	PASS
Frequency Response, from limits	> 0 dB	0.50	PASS
Radial			
Magnetic Intensity, -10 dBA/m	-10 ± 0.5 dB	-10.158	PASS
Environmental Noise	< -58 dBA/m	-62.91	PASS
Frequency Response, from limits	> 0 dB 0.70		PASS

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IV. ABM1 Magnetic Field Distribution Scan Overlays

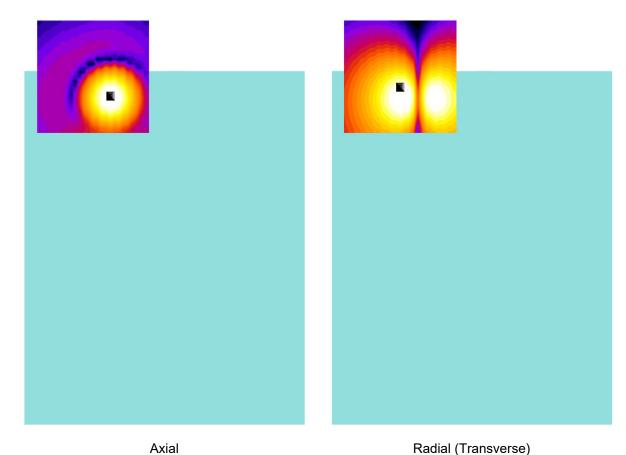


Figure 5-1 T-Coil Scan Overlay Magnetic Field Distributions (FLAT – FRONT)

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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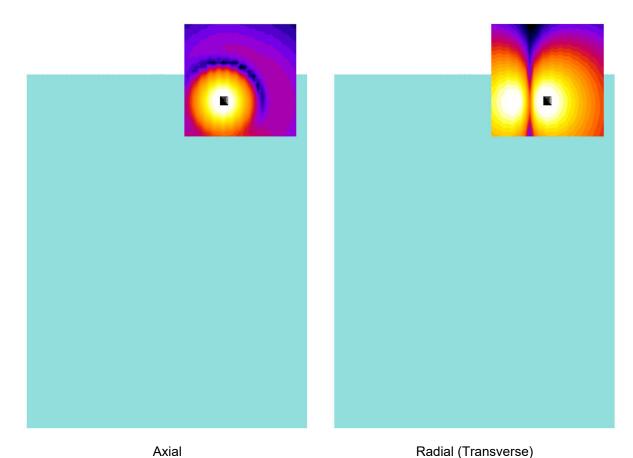


Figure 5-2
T-Coil Scan Overlay Magnetic Field Distributions (FLAT – BACK)

Notes:

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

FCC ID: A3LSMF926U	PCTEST: Proud to be port of a reserved	HAC (T-COIL) TEST REPORT	SAMSUNG	Approved by: Quality Manager
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MEASUREMENT UNCERTAINTY 6.

Table 6-1 **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%	
	(1 4)					17.7%	
Combined standard uncertainty, uc (k=1)							0.71
Expanded uncertainty (k=2), 95% confidence level							1.31

Notes:

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

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

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EQUIPMENT LIST

Table 7-1 **Equipment List**

		=406 =				
Manufacturer Model		Description		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	Wideband Radio Communication Tester	3/22/2021	Annual	3/22/2022	162125
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

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8. TEST DATA

FCC ID: A3LSMF926U	PCTEST: Proud to be port of @ sterners	HAC (T-COIL) TEST REPORT	SAMSUNG	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

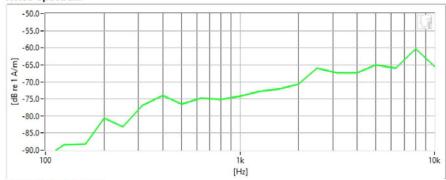
Measurement Standard: ANSI C63.19-2011

Equipment:

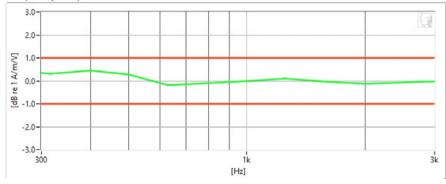
Probe: Axial T-Coil Probe – SN: TEM-1123; Calibrated: 9/23/2020

Helmholtz Coil – SN: SBI 1052; Calibrated: 9/23/2020

Noise Spectrum



Frequency Response



Results

Verification 1kHz Intensity	-9.892 dE	•	Max/Min	-9.5/-10.5
Verification ABM2	-62.21 dE	•	Maximum	-58.0
Frequency Response Margin	500m dE	•	Tolerance curves	Aligned Data

FCC ID: A3LSMF926U	PCTEST* Poul to be pet of the siment	HAC (T-COIL) TEST REPORT	SAMSUNG	Approved by: Quality Manager
Filename:	Test Dates:	DUT Type:		Page 24 of 42
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DUT: HH Coil - SN: SBI 1052

Type: HH Coil

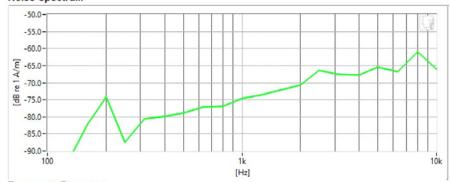
Serial: SBI 1052

Measurement Standard: ANSI C63.19-2011

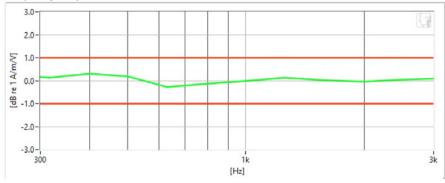
Equipment:

- 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	-10.158	dB	•	Max/Min	-9.5/-10.5
Verification ABM2	-62.91	dB	•	Maximum	-58.0
Frequency Response Margin	700m	dB	~	Tolerance curves	Aligned Data

FCC ID: A3LSMF926U	PCTEST* Proud to be part of the dement	HAC (T-COIL) TEST REPORT	SAMSUNG	Approved by: Quality Manager
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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

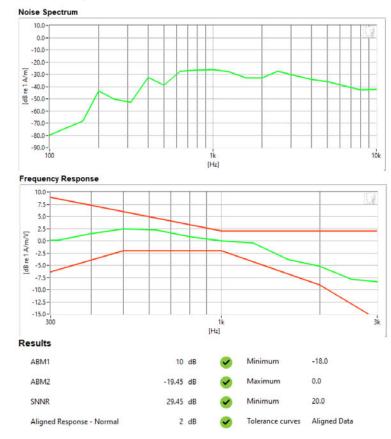
Test Configuration:

Mode: GSM850Channel: 190

Speech Signal: 3GPP2 Normal Test Signal

Device Posture / Side: FLAT - BACK

Antenna Config.: M1



FCC ID: A3LSMF926U	PCTEST* Provid to be post of ® element	HAC (T-COIL) TEST REPORT	SAMSUNG	Approved by: Quality Manager
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Treating-Aid Compatibility 13

DUT: A3LSMF926U Type: Portable Handset Serial: 0424M

Measurement Standard: ANSI C63.19-2011

Equipment:

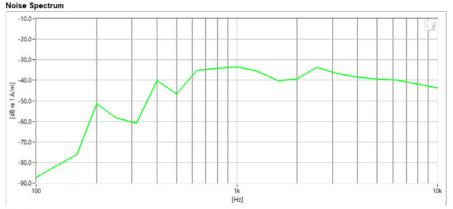
Probe: Radial T-Coil Probe – SN: TEM-1129; Calibrated: 9/23/2020

Test Configuration:

Mode: GSM850Channel: 128

Device Posture / Side: FLAT - FRONT

Antenna Config.: M1



Results

ABM1	-3.53	dB	lacksquare	Minimum	-18.0
ABM2	-26.79	dB	•	Maximum	0.0
SNNR	23.26	dB	~	Minimum	20.0

FCC ID: A3LSMF926U	PCTEST* Proud to be port of ® simmed	HAC (T-COIL) TEST REPORT	SAMSUNG	Approved by: Quality Manager
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9. CALIBRATION CERTIFICATES

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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. Ax

AXIAL T C TEM C

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

10/13/2020

Within (X)

tolerance of the indicated specification. See attached Report of Calibration. The information supplied relates to the calibrated item listed above and statment 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/NCSL 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

A Doc. #1051 Rev. 3.0 5/29/20 Certificate Page 1 of 1

ACCREDITED
Calibration Lab. Cert. # 1533.01

Calibration Laboratories, Inc.

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

1970 Gtate Floate 38, Victor, 147 14304, C.S.A.

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

 Filename:
 Test Dates:
 DUT Type:

 1M2108050088-02.A3L (Rev 1)
 08/02/2021 - 08/03/2021
 Portable Handset





ISO/IEC 17025: 2017

1575 State Route 96, Victor NY 14564

REPORT OF CALIBRATION

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

the number of turns on each coil;

the radius of each coil, in meters;

the current in the coils, in amperes.;

Helmholtz Coil;

10 No. 0.204 m 0.08

7.04

5.71

1000

Α A/m/V A/m

Hz.

Ambient Humidity: Ambient Pressure:

42.1 99.094

20.7

°C % RH

kPa

Calibration Date: 23-Sep-2020

Calibration Due:

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

Laboratory Environment:

Ambient Temperature:

Report Number:

31288 -2

Probe Sensitivity at was

Probe resistance

Helmholtz Coil Constant:

Helmholtz Coil magnetic field;

dBV/A/m -60.240.972 898

mV/A/m Ohms

Control Number:

31288

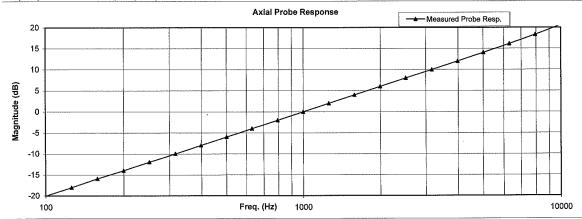
The above listed instrument meets or exceeds the tested manufacturer's specifications.

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 HCATEMC

Calibration was performed by West Caldwell Calibration Laboratories Inc. under Operating Procedures

intended to implement the requirements of ISO10012-1, IEC Guide 25, ANSI/NCSL Z540-1, (MIL-STD-45662A) and ISO 9001:2015, ISO 17025

Cal. Date: 23-Sep-2020

Measurements performed by:

James Zhu

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

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

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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

for

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

Model No.: Axial T Coil Probe

Serial No.: TEM-1123

Test	Function	Tolera	nce	Measured values			
······				Before	Out	Remarks	
1.0	Probe Sensitivity at	1000 Hz.	dBV/A/m	-60.24			
			dB				
2.0	Probe Level Linearity		6	6.03			
		Ref. (0 dB)	0	0.00			
			-6	-6.03			
			-12	-12.05			
			Hz				
3.0	Probe Frequency Response		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			
		Ref. (0 dB)	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 u	ised for calibration:		Date of Cal.	Traceablity 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

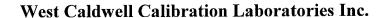
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Tested by: James Zhu

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

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FCC ID: A3LSMF926U	POTEST Proud to be part of the desired	HAC (T-COIL) TEST REPORT	SAMSUNG	Approved by: Quality Manager
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1M2108050088-02.A3L (Rev 1)	08/02/2021 - 08/03/2021	Portable Handset		Fage 31 01 42



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:

Submitted By:

Customer:

ANDREW HARWELL

31288

Company: Address:

PCTEST ENGINEERING LAB

6660-B DOBBIN ROAD

COLUMBIA

MD 21045

The subject instrument was calibrated to the indicated specification using standards traceable to the 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:

tolerance of the indicated specification. See attached Report of Calibration. The information supplied relates to the calibrated item listed above and statment 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 measurment 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/NCSL 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

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

Certificate Page 1 of 1

ACCREDITED

West Caldwell Calibration uncompromised calibration Laboratories. Inc.

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

Calibration Lab. Cert. # 1533.01

FCC ID: A3LSMF926U HAC (T-COIL) TEST REPORT SAMSUNG

Approved by: **Quality Manager**

Filename: 1M2108050088-02.A3L (Rev 1)

Test Dates: 08/02/2021 - 08/03/2021 **DUT Type:** Portable Handset

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ISO/IEC 17025: 2017 Calibration Lab. Cert. # 1533.01

1575 State Route 96, Victor NY 14564

REPORT OF CALIBRATION

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

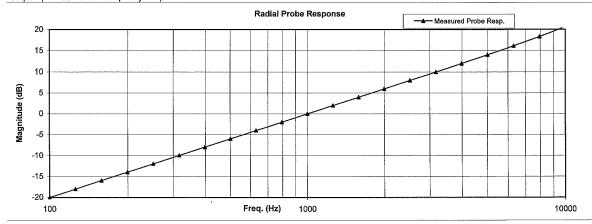
Model No.: Radial T Coil Probe

Serial No.: TEM-1129

I. D. No.: XXXX

Probe Sensitivity measured wit	h Helmhol	tz Coil			
Helmholtz Coil;		2 00	Before & after data same:	x	
the number of turns on each coil;	10	No.			
the radius of each coil, in meters;	0.204	m	Laboratory Environment:		
the current in the coils, in amperes.;	0.08	Α	Ambient Temperature:	20.7	°C
Helmholtz Coil Constant;	7.04	A/m/V	Ambient Humidity:	42.1	% RH
Helmholtz Coil magnetic field;	5.70	A/m	Ambient Pressure:	99.094	kPa
			Calibration Date:	23-Sep-2020)
Probe Sensitivity at	1000	Hz.	Re-calibration Due:		
was	-60.37	dBV/A/m	Report Number:	3128	8 -1
	0.959	mV/A/m	Control Number:	3128	8
Probe resistance	897	Ohms			
he above listed instrument meets or exceeds	the tested	manufacturer's	specifications.		
his Calibration is traceable through NIST test numbers	3:	684.07/O-0000	001126-20		
he expanded uncertainty of calibration: 0.30dB at 95% c	onfidence leve	el with a coverage fac	tor 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 17/9/25

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 HCRTEMC

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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

Function	Tolerance		Measured values		
			Before	Out	Remarks
Probe Sensitivity at	1000 Hz.	dBV/A/m	-60.37		
	=177.77.14.	dB			, , , , , , , , , , , , , , , , , , , ,
Probe Level Linearity		6	6.04		
	Ref. (0 dB)	0	0.00		
		-6	-6.03		
		-12	-12.05		
		Hz			
Probe Frequency Response			1		
•					
,					
	Ref. (0 dB)				
					1
		7943	18.3		
		10000	20.7		
	Probe Sensitivity at	Probe Sensitivity at 1000 Hz. Probe Level Linearity Ref. (0 dB)	Probe Sensitivity at 1000 Hz. dBV/A/m Probe Level Linearity Ref. (0 dB) 0 -6 -12 Probe Frequency Response 100 126 158 200 251 316 398 501 631 794 Ref. (0 dB) 1000 1259 1585 1995 2512 3162 3981 5012 6310 7943	Probe Sensitivity at 1000 Hz. dBV/A/m -60.37 Probe Level Linearity	Probe Sensitivity at 1000 Hz. dBV/A/m -60.37 Probe Level Linearity 6

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	PCTEST hould to be post of a closed	HAC (T-COIL) TEST REPORT	SAMSUNG	Approved by: Quality Manager
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10. CONCLUSION

The measurements indicate that the flat (open) configuration 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.

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11. REFERENCES

- ANSI C63.19-2011, American National Standard for Methods of Measurement of Compatibility between Wireless communication devices and Hearing Aids.", New York, NY, IEEE, May 2011
- FCC Office of Engineering and Technology KDB, "285076 D01 HAC Guidance v05," September 13, 2017
- FCC Office of Engineering and Technology KDB, "285076 D02 T-Coil Testing for CMRS IP v03," September 13, 2017
- 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
- 5. FCC 3G Review Guidance, Laboratory Division OET FCC, May/June 2006
- Berger, H. S., "Compatibility Between Hearing Aids and Wireless Devices," Electronic Industries Forum, Boston, MA, May, 1997
- 7. Berger, H. S., "Hearing Aid and Cellular Phone Compatibility: Working Toward Solutions," Wireless Telephones and Hearing Aids: New Challenges for Audiology, Gallaudet University, Washington, D.C., May, 1997 (To be reprinted in the American Journal of Audiology).
- 8. Berger, H. S., "Hearing Aid Compatibility with Wireless Communications Devices, " IEEE International Symposium on Electromagnetic Compatibility, Austin, TX, August, 1997.
- Bronaugh, E. L., "Simplifying EMI Immunity (Susceptibility) Tests in TEM Cells," in the 1990 IEEE International Symposium on Electromagnetic Compatibility Symposium Record, Washington, D.C., August 1990, pp. 488-491
- 10. Byme, D. and Dillon, H., The National Acoustics Laboratory (NAL) New Procedure for Selecting the Gain and Frequency Response of a Hearing Aid, Ear and Hearing 7:257-265, 1986.
- Crawford, M. L., "Measurement of Electromagnetic Radiation from Electronic Equipment using TEM Transmission Cells, " U.S. Department of Commerce, National Bureau of Standards, NBSIR 73-306, Feb. 1973.
- Crawford, M. L., and Workman, J. L., "Using a TEM Cell for EMC Measurements of Electronic Equipment," U.S. Department of Commerce, National Bureau of Standards. Technical Note 1013, July 1981.
- 13. EHIMA GSM Project, Development phase, Project Report (1st part) Revision A. Technical-Audiological Laboratory and Telecom Denmark, October 1993.
- 14. EHIMA GSM Project, Development phase, Part II Project Report. Technical-Audiological Laboratory and Telecom Denmark, June 1994.
- EHIMA GSM Project Final Report, Hearing Aids and GSM Mobile Telephones: Interference Problems, Methods of Measurement and Levels of Immunity. Technical-Audiological Laboratory and Telecom Denmark, 1995.
- 16. HAMPIS Report, Comparison of Mobile phone electromagnetic near field with an upscaled electromagnetic far field, using hearing aid as reference, 21 October 1999.

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- 17. Hearing Aids/GSM, Report from OTWIDAM, Technical-Audiological Laboratory and Telecom Denmark, April 1993.
- 18. IEEE 100, The Authoritative Dictionary of IEEE Standards Terms, Seventh Edition.
- 19. Joyner, K. H, et. al., Interference to Hearing Aids by the New Digital Mobile Telephone System, Global System for Mobile (GSM) Communication Standard, National Acoustic Laboratory, Australian Hearing Series, Sydney 1993.
- Joyner, K. H., et. al., Interference to Hearing Aids by the Digital Mobile Telephone System, Global System for Mobile Communications (GSM), NAL Report #131, National Acoustic Laboratory, Australian Hearing Series, Sydney, 1995.
- 21. Kecker, W. T., Crawford, M. L., and Wilson, W. A., "Contruction of a Transverse Electromagnetic Cell", U.S. Department of Commerce, National Bureau of Standards, Technical Note 1011, Nov. 1978.
- 22. Konigstein, D., and Hansen, D., "A New Family of TEM Cells with enlarged bandwidth and Optimized working Volume," in the Proceedings of the 7th International Symposium on EMC, Zurich, Switzerland, March 1987; 50:9, pp. 127-132.
- 23. Kuk, F., and Hjorstgaard, N. K., "Factors affecting interference from digital cellular telephones," Hearing Journal, 1997; 50:9, pp 32-34.
- 24. Ma, M. A., and Kanda, M., "Electromagnetic Compatibility and Interference Metrology," U.S. Department of Commerce, National Bureau of Standards, Technical Note 1099, July 1986, pp. 17-43.
- 25. Ma, M. A., Sreenivashiah, I., and Chang, D. C., "A Method of Determining the Emission and Susceptibility Levels of Electrically Small Objects Using a TEM Cell," U.S. Department of Commerce, National Bureau of Standards, Technial Note 1040, July 1981.
- 26. McCandless, G. A., and Lyregaard, P. E., Prescription of Gain/Output (POGO) for Hearing Aids, Hearing Instruments 1:16-21, 1983
- 27. Skopec, M., "Hearing Aid Electromagnetic Interference from Digital Wireless Telephones, "IEEE Transactions on Rehabilitation Engineering, vol. 6, no. 2, pp. 235-239, June 1998.
- 28. Technical Report, GSM 05.90, GSM EMC Considerations, European Telecommunications Standards Institute, January 1993.
- 29. Victorian, T. A., "Digital Cellular Telephone Interference and Hearing Aid Compatibility—an Update," Hearing Journal 1998; 51:10, pp. 53-60
- 30. Wong, G. S. K., and Embleton, T. F. W., eds., AIP Handbook of Condenser Microphones: Theory, Calibration and Measurements, AIP Press.

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