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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:
05/28/2026
Test Site/Location:
Element Washington DC LLC,
Columbia, MD, USA
Test Report Serial No.:
1M2605130037-03.A3L
Date of Issue:
05/28/2026

FCC ID:	**A3LSMA576U**
APPLICANT:	**SAMSUNG ELECTRONICS CO., LTD.**

Scope of Test:	Volume Control Testing
Application Type:	Class II Permissive Change
FCC Rule Part(s):	CFR §20.19(b)
HAC Standard:	ANSI C63.19-2019 ANSI/TIA-5050-2018 285076 D01 HAC Guidance v06 285076 D04 Volume Control v01
DUT Type:	Portable Handset
Model:	SM-A576U1
Additional Model:	SM-A576U
Test Device Serial No.:	*Pre-Production Sample* [S/N: 3788M]

HAC Compliance:	**PASS**

This report only pertains to LTE Band 71 and NR Band n71 on antenna E of this wireless portable device. This wireless portable device has been shown to be hearing-aid compatible as specified in ANSI/IEEE Std. C63.19-2019 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.

RI Ortanez
Executive Vice President

ACCREDITED
CERT #2041.01

TEST REPORT REVISION HISTORY

Rev. No.	Report S/N	Description	Issue Date
A	1M2605130037-03.A3L	Initial Release	05/28/2026
B	1M2605130037-03.A3L	Editorial Changes	05/28/2026
C	1M2605130037-03.A3L	Editorial Changes	05/28/2026
D	1M2605130037-03.A3L	Editorial Changes	05/29/2026
E	1M2605130037-03.A3L	Editorial Changes	05/29/2026

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1. INTRODUCTION

On July 10th, 2003, the Federal Communications Commission (FCC) adopted new rules requiring wireless manufacturers and service providers to provide digital wireless phones that are compatible with hearing aids. The FCC has modified the exemption for wireless phones under the Hearing Aid Compatibility Act of 1998 (HAC Act) in WT Docket 01-309 RM-8658[1] to extend the benefits of wireless telecommunications to individuals with hearing disabilities. These benefits encompass business, social and emergency communications, which increase the value of the wireless network for everyone. An estimated more than 10% of the population in the United States show signs of hearing impairment and of that percentage, almost 80% use hearing aids. Approximately five hundred million people worldwide and thirty million people in the United States suffer from hearing loss.

Ambient Conditions

- Ambient temperature: 23 °C ± 5 °C
- Relative humidity (RH): 0% < RH < 80%
- Baseband magnetic ambient noise: >10 dB below the measurement level, where applicable

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
- Volume Control, receive Conversational Gain performance
- Volume Control, receive distortion and noise performance
- Volume Control, receive acoustic frequency response performance

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 of a wireless communications device.

Figure 1-1 Hearing Aid *in-vitu*

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

2. DUT DESCRIPTION

FCC ID:	A3LSMA576U
Applicant:	Samsung Electronics Co., Ltd. 129, Samsung-ro, Maetan dong, Yeongtong-gu, Suwon-si Gyeonggi-do 16677, Korea
Model:	SM-A576U1
Additional Model:	SM-A576U
Serial Number:	*Pre-Production Sample* [S/N: 3788M]
HW Version:	REV1.0
SW Version:	A576U1.001
Antenna:	Internal Antenna
DUT Type:	Portable Handset

I. Band Selection

This device supports LTE/NR capabilities with overlapping transmission frequency ranges. When the supported frequency range of a band falls completely within a band with a larger transmission frequency range, both bands have the same target power (or the band with the larger transmission frequency range has a higher target power), and both bands share the same transmission path and signal characteristics, hearing aid compatibility compliance was only assessed for the band with the larger transmission frequency range.

Table 2-1
HAC Air Interfaces

Air-Interface	Band (MHz)	Type Transport	HAC Tested	Simultaneous But Not Tested	Name(s) of Voice Service(s)	Supported Codec(s)	Receive Volume Control Evaluated	Test Category		
								Receive Conversational Gain	Receive Distortion and Noise	Receive Frequency Response
GSM	850	VO	No[1,6]	Yes: WIFI or BT	CMRS Voice	EFR	Yes	FR V1, FR V2, HR V1	N/A	
	1900									
	GPRS/EDGE	VD	No[1]	Yes: WIFI or BT	Google Meet	OPUS[5]	No	N/A		
UMTS	850	VD	No[1,6]	Yes: WIFI or BT	CMRS Voice	AMR	Yes	NB AMR, WB AMR	N/A	
	1700									
	1900									
	HSPA	VD	No[1]	Yes: WIFI or BT	Google Meet	OPUS[5]	No	N/A		
LTE (FDD)	680 (B71)	VD	Yes[1,2]	Yes: NR, WIFI or BT	VoLTE, Google Meet	VoLTE: AMR, EVS Google Meet: OPUS[5]	Yes	NB AMR, WB AMR, NB EVS, WB EVS	NB EVS 13.2kbps, WB EVS 13.2kbps	NB EVS 13.2kbps, WB EVS 13.2kbps
	700 (B12)		No[1,2,6]							
	780 (B13)									
	790 (B14)									
	850 (B5)									
	850 (B26)									
	1700 (B4)									
	1700 (B66)									
	1900 (B2)									
	1900 (B25)									
	2300 (B30)									
	2500 (B7)									
LTE (TDD)	2600 (B41)	VD	No[1,2,6]	Yes: NR, WIFI or BT	VoLTE, Google Meet	VoLTE: AMR, EVS Google Meet: OPUS[5]	Yes	NB AMR, WB AMR, NB EVS, WB EVS	NB EVS 13.2kbps, WB EVS 13.2kbps	NB EVS 13.2kbps, WB EVS 13.2kbps
	2600 (B38)									
	3600 (B48)									
NR (FDD)	680 (n71)	VD	Yes[1,2]	Yes: LTE, WIFI or BT	VoNR, Google Meet	VoNR: AMR, EVS Google Meet: OPUS[5]	Yes	NB AMR, WB AMR, NB EVS, WB EVS	NB EVS 13.2kbps, WB EVS 13.2kbps	NB EVS 13.2kbps, WB EVS 13.2kbps
	850 (n5)		No[1,2,6]							
	1700 (n70)									
	1700 (n66)									
	1900 (n2)									
	1900 (n25)									
	2300 (n30)									
NR (TDD)	2600 (n41)	VD	No[1, 2,6]	Yes: LTE, WIFI or BT	VoNR, Google Meet	VoNR: AMR, EVS Google Meet: OPUS[5]	Yes	NB AMR, WB AMR, NB EVS, WB EVS	NB EVS 13.2kbps, WB EVS 13.2kbps	NB EVS 13.2kbps, WB EVS 13.2kbps
	3500 (n77, DoD)									
	3500 (n78, DoD)									
	3600 (n48)									
	3700 (n77)									
	3800 (n78)									
WIFI	2450	VD	No[1,6]	Yes: GSM, UMTS, LTE, or NR	VoWIFI, Google Meet	VoWIFI: AMR, EVS Google Meet: OPUS[5]	Yes	NB AMR, WB AMR, NB EVS, WB EVS	NB EVS 13.2kbps, WB EVS 13.2kbps	NB EVS 13.2kbps, WB EVS 13.2kbps
	5200 (U-NII 1)									
	5300 (U-NII 2A)									
	5500 (U-NII 2C)									
	5800 (U-NII 3)									
	5900 (U-NII 4)									
	6175 (U-NII 5)		No[1,2,3]							
	6475 (U-NII 6)		No[4,6]	Yes: GSM, UMTS, LTE, or NR	VoWIFI, Google Meet	VoWIFI: AMR, EVS Google Meet: OPUS[5]	No	N/A		
	6700 (U-NII 7)									
	7000 (U-NII 8)									
BT	2450	DT	No	Yes: GSM, UMTS, LTE, or NR	N/A					

Type Transport:
VO = Voice Only
DT = Digital Data - Not intended for Voice Services
VD = CMRS and/or IP Voice over Data Transport

Notes:
1. According to FCC guidance and waiver DA 23-914, all CMRS codecs supported by the model are tested for Conversational Gain.
2. According to FCC guidance and waiver DA 23-914, manufacturer has chosen NB EVS 13.2kbps and WB EVS 13.2kbps audio codecs and bitrate supported on this device for Frequency Response and Distortion evaluation.
3. WIFI U-NII band 5 was evaluated for operations which are entirely below 6 GHz. Operations partially or entirely above 6 GHz were not evaluated due to equipment limitations and being outside of the current scope of ANSI C63.19 and FCC HAC regulations.
4. WIFI U-NII bands 6 through 8 were not evaluated due to being outside the scope of ANSI C63.19 and FCC HAC regulations.
5. According to FCC guidance, AMR and EVS codecs were chosen for Volume Control evaluation. Other supported codecs were not evaluated.
6. This report only pertains to LTE Band 71 and NR Band n71 on antenna E of this wireless portable device. For full data, please refer to the original certification test report.

3. ANSI C63.19-2019 PERFORMANCE CATEGORIES

I. Acoustic Coupling Requirements

According to ANSI C63.19-2019 §7, devices shall comply with ANSI/TIA-5050-2018 in order to comply with C63.19-2019. No additional requirements are imposed, and no special allowances are made regarding testing in compliance with ANSI/TIA-5050-2018.

II. ANSI/TIA-5050-2018 Volume Control

All Volume Control requirements (i.e., Receive Conversational Gain, Receive Distortion and Noise, and Receive Frequency Response) shall be met for at least one volume control setting for narrowband as well as wideband (as applicable) per §5. All testing shall be performed with both a 2N mounting force and an 8N mounting force. The passing volume control setting may be different between narrowband and wideband tests as well as between 2N and 8N tests, but the setting may not change within a test in order to pass the separate performance criteria.

Note: The test data margins indicate a margin from the limit for compliance.

1. Receive Conversational Gain Performance

With a mounting force of 8N, the DUT shall have a Receive Conversational Gain of ≥18dB per §5.1.1, and with a mounting force of 2N, the DUT shall have a Receive Conversational Gain of ≥6dB per ANSI/TIA-5050-2018 §5.1.1.

2. Receive Distortion and Noise Performance

With a mounting force of 8N and 2N, the Pulsed Noise Signal-to-Distortion and Noise Ratio (PN-SDNR) of the DUT shall be ≥20dB when tested over the applicable 1/3 octave band center frequencies per ANSI/TIA-5050-2018 §5.2.1. For narrowband, the applicable 1/3 octave band center frequencies are from 400Hz to 3.15kHz; for wideband, the applicable 1/3 octave band center frequencies are from 250Hz to 5kHz.

3. Receive Acoustic Frequency Response Performance

With a mounting force of 8N and 2N, the Receive Frequency Response, as measured at the Drum Reference Point (DRP) in 1/12 octave bands and after translation to the diffuse field or free field, shall fall between the applicable upper and lower limits per ANSI/TIA-5050-2018 §5.3.1. See below for narrowband limits (Table 3-1 and Figure 3-1) and wideband limits (Table 3-2 and Figure 3-2).

Table 3-1
Narrowband Receive Frequency Response Limits

Lower Limit Frequency (Hz)	Lower Limit (dB)	Upper Limit Frequency (Hz)	Upper Limit (dB)
300	-6	100	+6
3400	-6	4000	+6

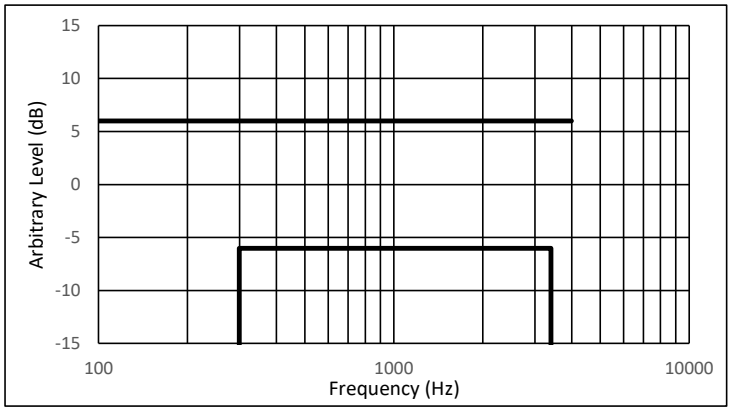


Figure 3-1
Narrowband Receive Frequency Response Limits

Table 3-2
Wideband Receive Frequency Response Limits

Lower Limit Frequency (Hz)	Lower Limit (dB)	Upper Limit Frequency (Hz)	Upper Limit (dB)
200	-10	100	+6
300	-6	1000	+6
5000	-6	2000	+8
6000	-12	8000	+8

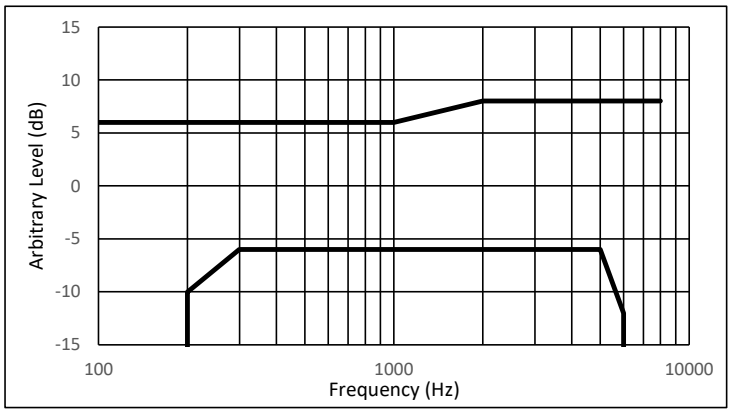


Figure 3-2
Wideband Receive Frequency Response Limits

4. METHOD OF MEASUREMENT

I. Test Setup

The equipment was connected as shown in an RF-shielded chamber:

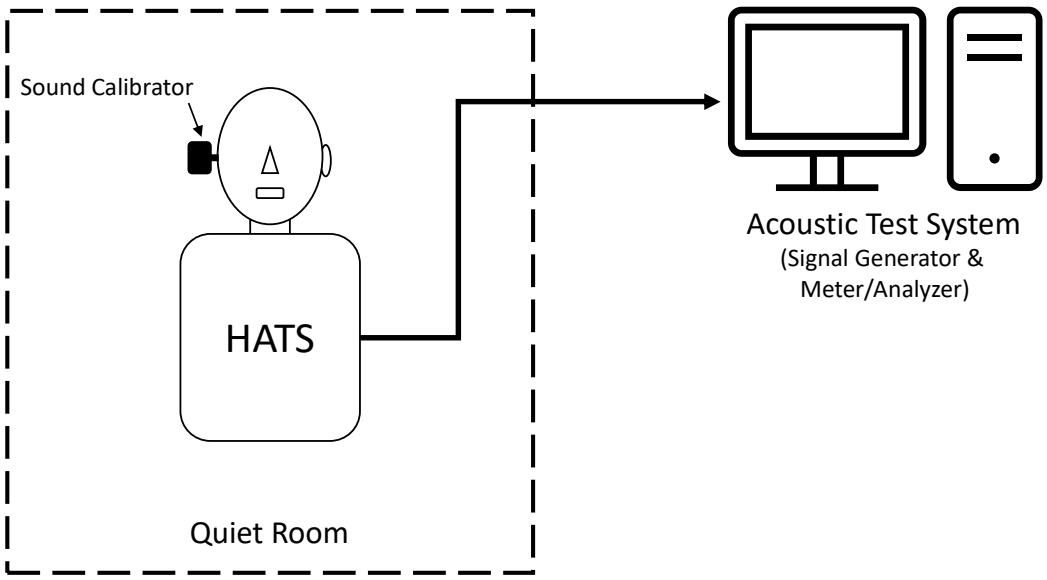


Figure 4-1
Verification Setup with Sound Calibrator

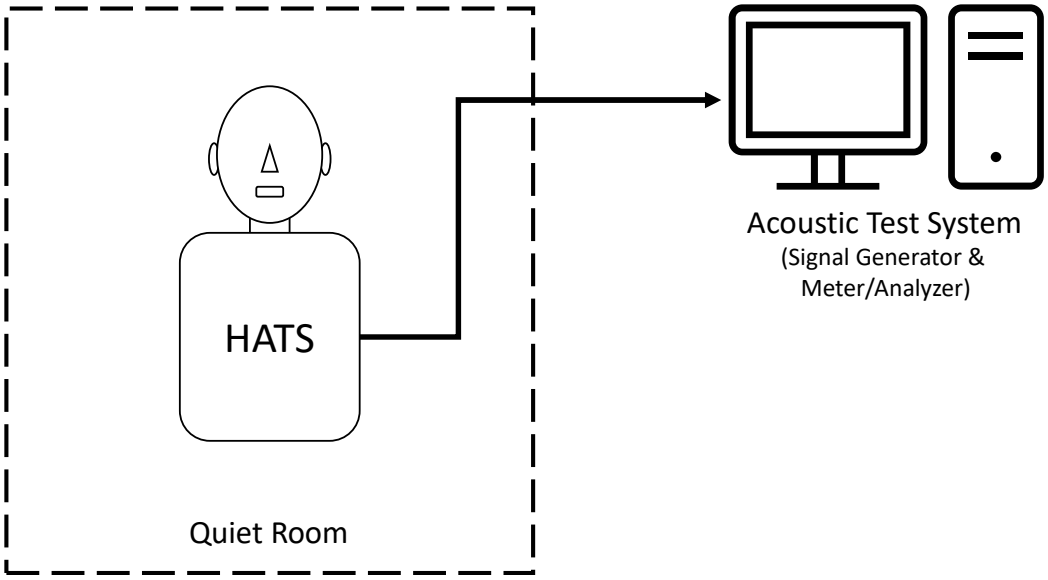


Figure 4-2
Ambient Noise Verification Setup

II. Head and Torso Simulator

Manufacturer:	Brüel & Kjær
Model:	Type 4128-D
Frequency Response:	Conforms to ITU-T Rec. P.58 up to 16 kHz
Ear Simulator:	ITU-T Rec. P.57 Type 3.3-based calibrated ear simulator complying with ITU-T Rec. P.57
Ear Simulator Output:	7-core, 3 m cable terminated with a Lemo® (1B) plug
Pressure-field Response:	±1 dB from 5 Hz to 7 kHz ±3 dB from 3.15 Hz to 20 kHz
Typical Noise Level	19 dBA at
Pinna Simulator:	Compliant with ITU-T Rec. P.58
Total Head and Torso Height:	695mm
HATS Dimensions:	Main dimensions comply with the dimensional requirements of ITU-T Rec. P.58
Handset Positioner:	Brüel & Kjær Type 4606
Positioner Angles:	Variable positions; ∠A adjustable from +15° to +35°, ∠B adjustable from +30° to –10°, ∠C adjustable from +20° to –20°; 0.5° resolution
Applied Ear Force:	Mounting force can be adjusted from 0 to 18 N

Figure 4-3
Heat and Torso Simulator
(with Handset Positioner)

III. IEEE Std 269 Uncompressed Real Male Speech

Manufacturer:	IEEE
Active Frequency Range:	100 Hz – 8 kHz
Stimulus Type:	Multi-talker speech signal, four male speakers
Single Sample Duration:	12 seconds
Activity Level:	84%

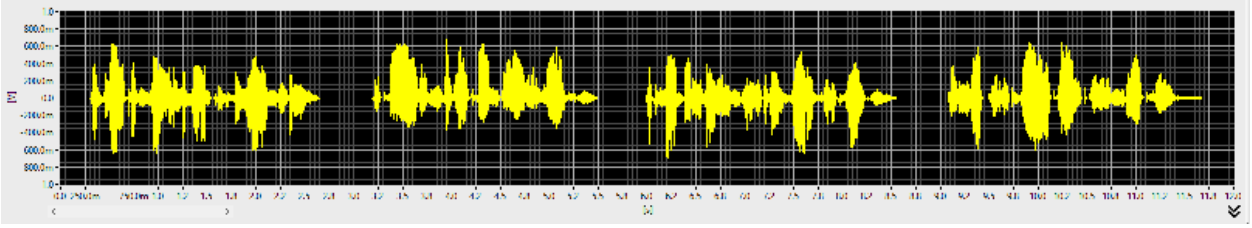


Figure 4-4
Temporal Characteristic of full IEEE 269

Volume Control Measurement Block Diagrams:

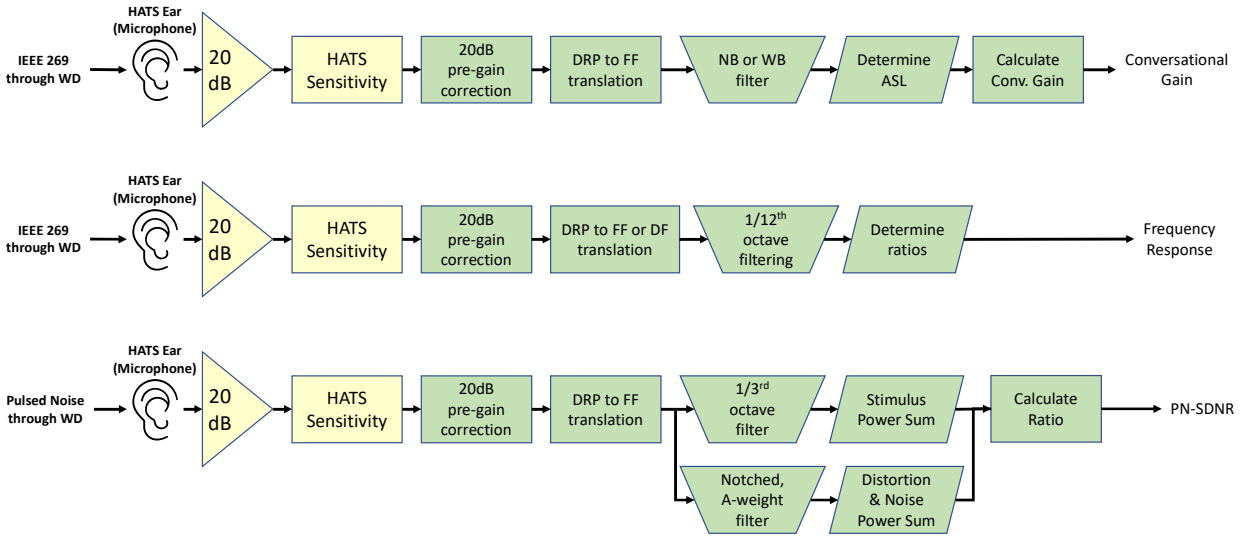


Figure 4-5 Acoustic Measurement Processing Steps

IV. Test Procedure

1. Ambient Noise Check per ANSI/TIA-5050-2018 §3.1 (See Figure 4-2)
   a. Ambient noise was monitored using a Real-Time Analyzer between 100-10,000 Hz with 1/12 octave filtering.
   b. "A-weighting" was applied to the measurements per the definition of a "quiet room" in ANSI/TIA-5050-2018. Below is the verification of the system processing A-weighting between system input to output within 0.5 dB of the theoretical result:

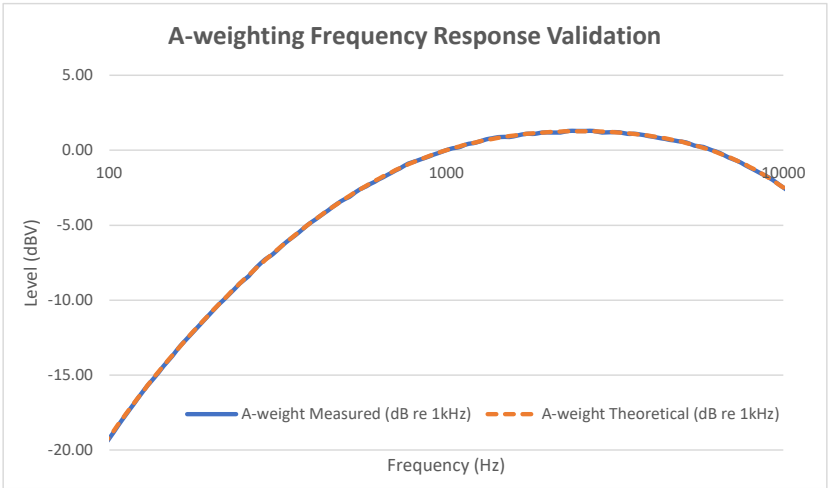


Figure 4-6
A-weighting Frequency Response Validation

Table 4-1
A-weighting Frequency Response Validation

f (Hz)	A-weight Measured (dB re 1kHz)	A-weight Theoretical (dB re 1kHz)	Deviation (dB)	f (Hz)	A-weight Measured (dB re 1kHz)	A-weight Theoretical (dB re 1kHz)	Deviation (dB)
97.2	-19.63	-19.54	-0.09	1030	0.10	0.09	0.01
103	-18.81	-18.74	-0.07	1090	0.20	0.25	-0.05
109	-18.01	-17.97	-0.04	1150	0.40	0.38	0.02
115	-17.31	-17.26	-0.05	1220	0.50	0.52	-0.02
122	-16.51	-16.50	-0.01	1300	0.70	0.66	0.04
130	-15.71	-15.70	-0.01	1370	0.80	0.76	0.04
137	-15.11	-15.06	-0.05	1450	0.89	0.85	0.04
145	-14.41	-14.38	-0.03	1540	0.89	0.94	-0.05
154	-13.71	-13.68	-0.03	1630	0.99	1.02	-0.03
163	-13.01	-13.04	0.03	1730	1.09	1.08	0.01
173	-12.40	-12.38	-0.02	1830	1.09	1.14	-0.05
183	-11.80	-11.77	-0.03	1940	1.19	1.18	0.01
194	-11.20	-11.16	-0.04	2050	1.18	1.22	-0.04
205	-10.60	-10.60	0.00	2180	1.19	1.24	-0.05
218	-10.00	-9.98	-0.02	2300	1.29	1.26	0.03
230	-9.50	-9.46	-0.04	2440	1.29	1.27	0.02
244	-8.90	-8.90	0.00	2590	1.29	1.27	0.02
259	-8.40	-8.35	-0.05	2740	1.29	1.26	0.03
274	-7.80	-7.84	0.04	2900	1.19	1.24	-0.05
290	-7.30	-7.35	0.05	3070	1.20	1.22	-0.02
307	-6.90	-6.86	-0.04	3250	1.20	1.18	0.02
325	-6.40	-6.39	-0.01	3450	1.10	1.13	-0.03
345	-5.90	-5.90	0.00	3650	1.10	1.08	0.02
365	-5.50	-5.46	-0.04	3870	1.00	1.01	-0.01
387	-5.00	-5.02	0.02	4100	0.90	0.93	-0.03
410	-4.60	-4.59	-0.01	4340	0.80	0.84	-0.04
434	-4.20	-4.19	-0.01	4600	0.70	0.73	-0.03
460	-3.80	-3.79	-0.01	4870	0.61	0.61	0.00
487	-3.40	-3.42	0.02	5160	0.51	0.48	0.03
516	-3.10	-3.05	-0.05	5460	0.31	0.33	-0.02
546	-2.70	-2.71	0.01	5790	0.21	0.16	0.05
579	-2.40	-2.37	-0.03	6130	0.01	-0.02	0.03
613	-2.10	-2.05	-0.05	6490	-0.19	-0.22	0.03
649	-1.80	-1.75	-0.05	6880	-0.49	-0.45	-0.04
688	-1.50	-1.47	-0.03	7290	-0.69	-0.70	0.01
729	-1.20	-1.20	0.00	7720	-0.99	-0.97	-0.02
772	-0.90	-0.94	0.04	8180	-1.30	-1.26	-0.04
818	-0.70	-0.71	0.01	8660	-1.59	-1.58	-0.01
866	-0.50	-0.49	-0.01	9170	-1.89	-1.92	0.03
917	-0.30	-0.28	-0.02	9720	-2.29	-2.30	0.01
972	-0.10	-0.09	-0.01	10300	-2.69	-2.70	0.01

c. The ambient room noise is a power sum of the A-weighted spectrum from 100-10,000 Hz. To verify the power sum measurement, a power sum over the full band was measured and verified to track with the source level. Therefore, the setup in this step was used to verify the power sum post-processing for measurements. See below block diagram:

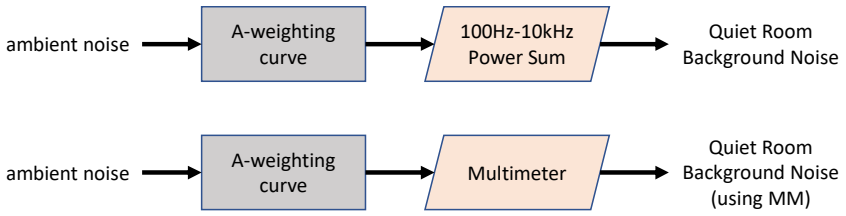


Figure 4-7
Power Sum Validation Block Diagram

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.

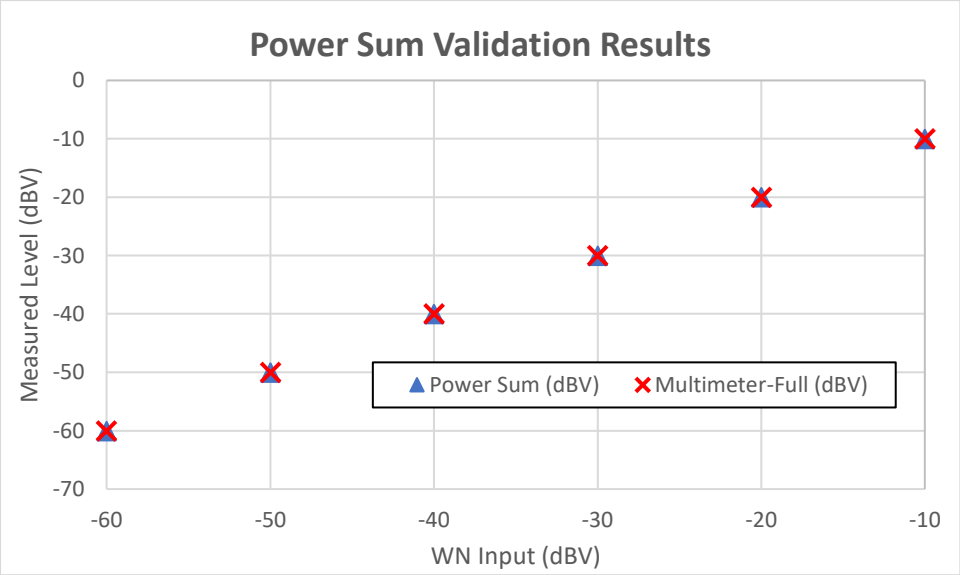


Figure 4-8
Power Sum Validation Results

Table 4-2
Power Sum Validation Results

WN Input (dBV)	Power Sum (dBV)	Multimeter-Full (dBV)	Dev (dB)
-60	-60.05	-60.03	0.02
-50	-50.04	-50.03	0.01
-40	-40.04	-40.02	0.02
-30	-30.04	-30.02	0.02
-20	-20.05	-20.03	0.02
-10	-10.05	-10.03	0.02

d. The maximum room noise inside the quiet room was recorded and verified to be less than or equal to 40dBA.

2. Measurement System Validation (See Figure 4-1)
   a. The measurement system including the HATS, pre-amplifier and acquisition system was validated as an entire system to ensure the reliability of test measurements.
   b. HATS Sensitivity Verification
   A pure tone of 1kHz was applied into the HATS ear (microphone) using a calibrated sound calibrator. The sound calibrator generates an expected sound pressure level of 97.1dBSPL at the HATS ear which was used to verify the measured signal from the HATS. This measured value was verified to be within ±0.2dB of the 97.1dBSPL expected value (see Page 29).

3. Measurement Test Setup
   a. Positioning DUT in HATS

i. According to ANSI/TIA-5050-2018 §4.2, a HATS which is ITU-T P.58 compliant and an ear simulator which is ITU-T P.57 type 3.3 compliant are used for Volume Control testing.
ii. Per ANSI/TIA-5050-2018 §4.3, the DUT is positioned on the HATS in the standard test position according to IEEE Std 269 or, alternatively, a recommended test position specified by the manufacturer. Manufacturer recommended positions must comply with the recommended test position requirements in IEEE Std 269 and, if used, are noted in this report.
iii. The DUT is mounted such that a certain force, in Newtons, is applied when the DUT is placed against the artificial pinna. ANSI/TIA-5050-2018 specifies a mounting force of either 2N or 8N, depending on the test. Mounting force is indicated for each test in this report.

b. Speech Signal Setup and Analysis
i. For testing in this report, the test signal is the uncompressed real male speech as published with IEEE Std 269 unless otherwise specified.
ii. The test signal is used with an Active Speech Level (ASL) of -20dBm0, and analysis is performed with 1/12 octave bands averaged over one complete sequence of the test signal unless otherwise specified.
iii. The acoustic listener reference point for testing is the Free Field (FF) for Receive Conversational Gain and PN-SDNR measurements. For Receive Frequency Response (FR) measurements, the acoustic listener reference point is either the Free Field or the Diffuse Field (DF); the chosen acoustic listener reference point for FR measurements in this report is indicated for each test.
iv. Per the Spring 2021 TCB Workshop, all supported audio voice codecs are tested for the DUT. For each codec, narrowband and wideband modes are tested if supported. For narrowband modes, a source coding bitrate of 12.2 kbps, or the closest available setting, is used. For wideband modes, a source coding bitrate of 12.65 kbps, or the closest available setting, is used.

c. DUT Radio Configuration
i. Each supported codec may be tested with any air interface which supports the codec being tested. Air interfaces used for testing in this report are noted with each test.

4. Measurement Data Analysis
a. Receive Conversational Gain
i. With the DUT at its maximum volume control setting and tone control set such that the DUT meets the FR requirements, the test signal is applied to the DUT, and the resulting acoustic output is measured at the Drum Reference Point (). A lower volume setting may be used if needed to meet the PN-SDNR requirements.
ii. The appropriate post processing is applied according to the system processing chain shown in Figure 4-5, and the Receive Conversational Gain is determined.
iii. Receive Conversational Gain is tested with both 8N and 2N mounting forces.

b. PN-SDNR
i. The DUT is tested for Receive Distortion and Noise using PN-SDNR which is the ratio of the signal power to the full, A-weighted distortion and noise power of the DUT output (in dB).
ii. The pulsed noise stimulus signal is a combination of the real speech test signal followed by a series of pink noise pulses from a 1/3 octave band. A stimulus signal is generated for each 1/3 octave band centered within the applicable frequency range for either narrowband or wideband.
iii. Each stimulus signal is applied to the DUT, and the resulting acoustic output is measured at the DRP.

iv. The appropriate post-processing is applied according to the system-processing chain shown in Figure 4-5, and the PN-SDNR is determined by subtracting the full, A-weighted distortion and noise power, from the signal power. This process is repeated to determine the PN-SDNR for all applicable 1/3 octave band frequencies.

v. PN-SDNR is tested with both 8N and 2N mounting force and may be repeated at volume levels below maximum if needed to get passing results. Note that Receive Conversational Gain must still receive passing results while at the lower volume level if such a lower level is used for PN-SDNR compliance.

c. Receive Frequency Response

i. Receive Frequency Response (FR) is measured with respect to the appropriate curves from either Figure 3-1, for narrowband modes, or Figure 3-2, for wideband modes. The measurement is taken over one full sequence of the test signal, although a 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 is applied according to the system processing chain shown in Figure 4-5, and the FR is determined. All 1/12 octave band center frequencies are plotted and aligned with respect to the applicable mask in a floating, or best fit, fashion.

iii. FR is tested with both 8N and 2N mounting force and may be repeated with tone control settings other than default if needed to get passing results. Note that Receive Conversational Gain must still receive passing results while using the non-default tone control settings if such non-default settings are used for FR compliance.

d. Speech Signal Setup to Base Station Simulator

i. See Section 6 and **Error! Reference source not found.** for more information regarding CMW500 audio level settings for Voice Over LTE (VoLTE) and Voice Over WIFI (VoWIFI) testing.

ii. See Section 7 for more information regarding CMX500 audio level settings for Voice Over NR (VoNR).

V. Test Setup

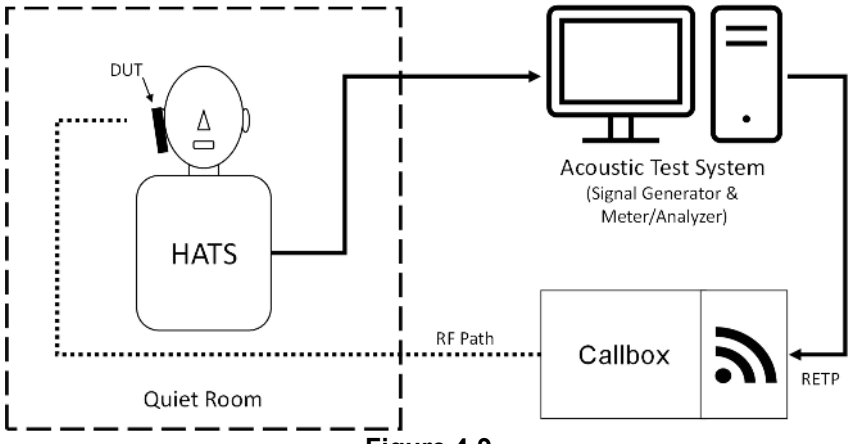


Figure 4-9
Volume Control Test Setup

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 ANSI/TIA-5050-2018 Test Procedure

Deviation from ANSI/TIA-5050-2018 Test Procedure to indicate guidance in FCC HAC waiver was followed.

VII. Air Interface Technologies Tested

According to ANSI/TIA-5050-2018, any air interface which supports voice capabilities over a managed CMRS or pre-installed OTT VoIP applications may be chosen for Volume Control testing. According to the Spring 2021 TCB Workshop, all voice codecs supported by the DUT must be tested for Volume Control. The air interfaces used during testing were chosen such that all voice codecs supported by the DUT were able to be tested. See Table 2-1 for more details regarding which modes were tested.

VIII. Wireless Device Channels and Frequencies

1. **4G (LTE) Modes**
   The middle channel for every band was tested for Receive Conversational Gain to confirm that the band configuration for VoLTE over IMS does not substantially affect the results. The default band was additionally tested for Receive Frequency Response and Receive Distortion and Noise. More information on default LTE test configuration chosen for testing can be found in Section 6. See Table 10-4 for full volume control evaluation.

2. **5G (NR) Modes**
   The middle channel for every band was tested for Receive Conversational Gain to confirm that the band configuration for VoNR over IMS does not substantially affect the results. The default band was additionally tested for Receive Frequency Response and Receive Distortion and Noise. More information on default NR test configuration chosen for testing can be found in Section 7. See Table 10-5 for full volume control evaluation.

IX. Test Flow

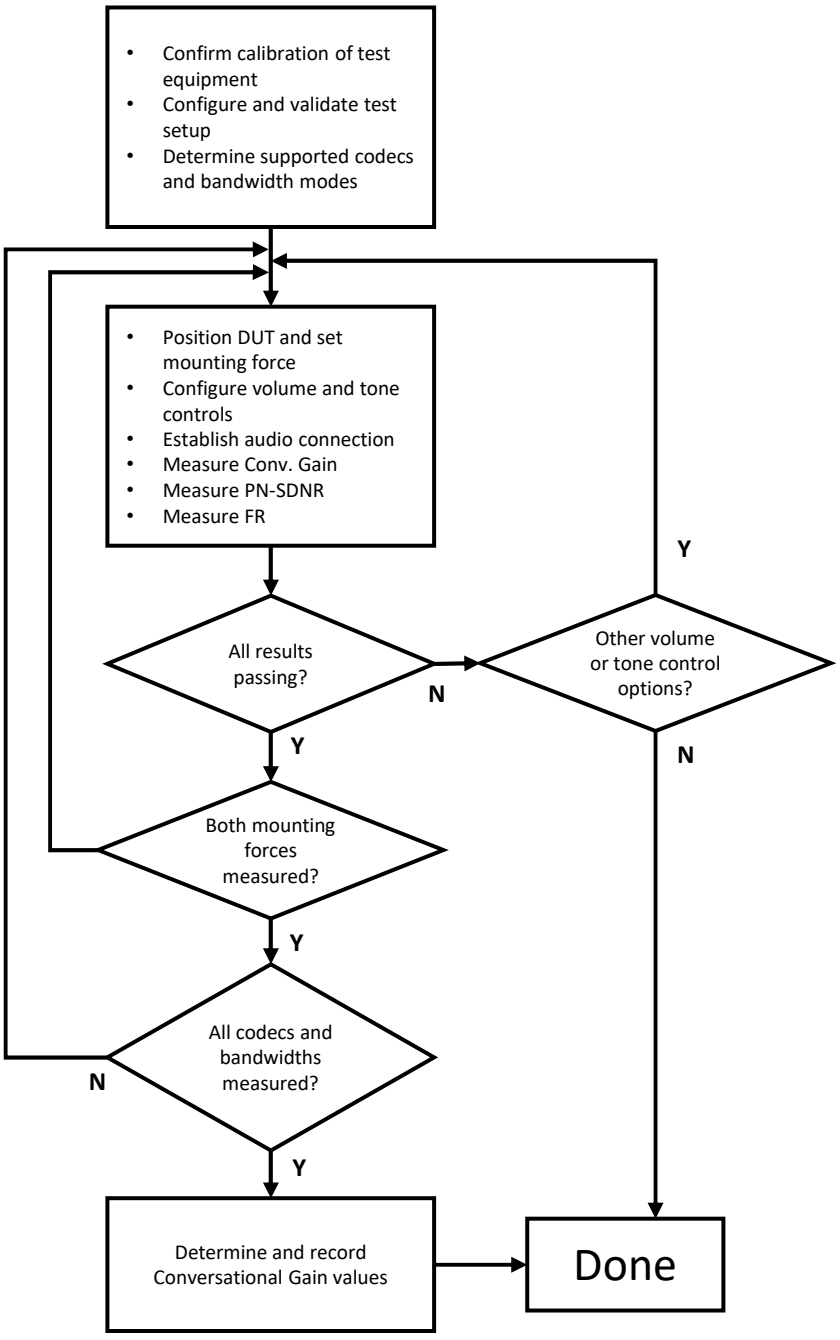


Figure 4-10
C63.19 Volume Control Test Process

5. VOLTE TEST SYSTEM SETUP AND DUT CONFIGURATION

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

1. Equipment Setup

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

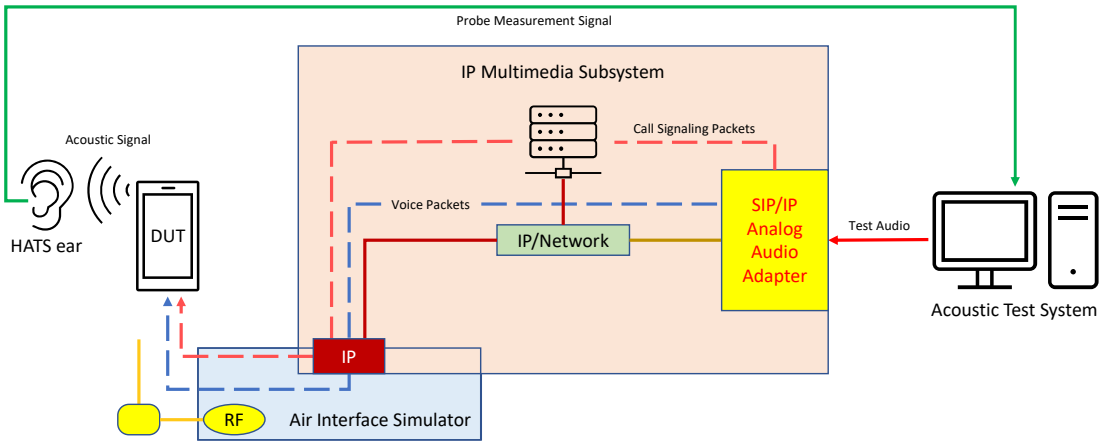


Figure 5-1
Test Setup for VoLTE over IMS Volume Control Measurements

2. Audio Level Settings

According to ANSI/TIA-5050-2018, the appropriate audio level to be used for VoLTE over IMS Volume Control testing is -20dBm0 (ASL) and shall be used for the normal speech input level. The CMW500 base station simulator was manually configured to ensure that the settings for speech input and full-scale levels resulted in the -20dBm0 (ASL) speech input level to the DUT for the VoLTE over IMS connection.

II. DUT Configuration for VoLTE over IMS Volume Control Testing

1. Radio Configuration

An investigation was performed to ensure the modulation and Resource Block (RB) configuration used for testing do not substantially affect the measurement results. The effects of modulation and RB configuration were found to be independent of band and bandwidth; therefore, only one band and bandwidth were used for this investigation. QPSK, 100% RB, 0RB Offset was used as the default testing configuration for the handset given the results of this investigation. See below for comparison between different radio configurations:

Table 5-1
VoLTE over IMS Results by Radio Configuration

LTE Radio Configuration Investigation							Sample: 0099M	
LTE Configuration: Band 25, 20MHz BW, Ch.26365					**Codec:** NB EVS, 13.2kbps			
DUT Audio Settings: Volume: Max-1, HAC Mode: On			**Ambient Noise:** 33.00dBA		**FCC Limits:**		CG: 6dB(2N)	
			Mounting Force: 2N				PN-SDNR: 20dB	
Radio Config			**Conversational Gain**		**Frequency Response**		**PN-SDNR**	
Mod.	**RB Size**	**RB Offset**	**Value (dB)**	**Margin (dB)**	**DRP**	**Margin (dB)**	**Value (dB)**	**Margin (dB)**
QPSK	1	0	17.54	**11.54**	DF	1.57	21.75	**1.75**
		50	17.48	**11.48**	DF	1.20	24.45	**4.45**
		99	17.45	**11.45**	DF	1.50	24.91	**4.91**
	50	0	17.39	**11.39**	DF	1.44	23.94	**3.94**
		25	17.34	**11.34**	DF	1.50	21.00	**1.00**
		50	17.33	**11.33**	DF	1.46	20.94	**0.94**
	100	0	17.37	**11.37**	DF	1.40	22.39	**2.39**
16QAM	1	0	17.27	**11.27**	DF	1.44	24.37	**4.37**
64QAM			17.20	**11.20**	DF	17.20	23.69	**3.69**
256QAM			17.25	**11.25**	DF	1.51	21.94	**1.94**

2. Band Configuration

An investigation was performed to ensure the LTE band used for testing does not substantially affect the measurement results. NB EVS 13.2kbps codec was used for evaluation. The effects of band configuration were found to be independent of radio configuration; therefore, only one radio configuration was used for this investigation. LTE B25 was used as the default test band for VoLTE over IMS Volume Control testing given the results of this investigation. See below for comparisons between different bands:

Table 5-2
VoLTE over IMS Results by Band

LTE Band Investigation								Sample: 3788M	
Radio Configuration: QPSK, 100 RB, 0 RB Offset						**Codec:** NB EVS, 13.2kbps			
DUT Audio Settings: Volume: Max-1, HAC Mode: On				**Ambient Noise:** 32.58dBA			**FCC Limits:**	CG: 6dB(2N)	
				Mounting Force: 2N				PN-SDNR: 20dB	
Band	**RF Bandwidth (MHz)**	**Channel**	**Antenna**	**Conversational Gain**		**Frequency Response**		**PN-SDNR**	
				Value (dB)	**Margin (dB)**	**DRP**	**Margin (dB)**	**Value (dB)**	**Margin (dB)**
71	20	133297	E	17.88	**11.88**	DF	1.55	24.39	**4.39**

6. VONR TEST SYSTEM SETUP AND DUT CONFIGURATION

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

1. Equipment Setup

The general test setup used for VoNR over IMS is shown below. The callbox used when performing VoNR over IMS Volume Control measurements is a CMX500. The Data Application Unit (DAU) of the CMX500 was used to simulate the IP Multimedia Subsystem (IMS) server. The CMX500 also provided the baseband signal to perform NR signaling. An external USB audio interface is used to perform the Analog-to-digital conversion and ensure proper speech input level to the DUT.

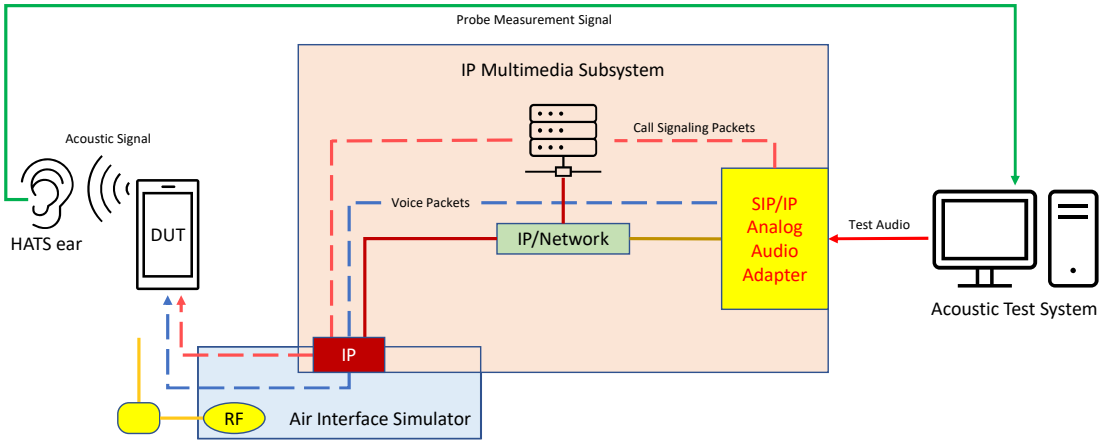


Figure 6-1
Test Setup for VoNR over IMS Volume Control Measurements

2. Audio Level Settings

According to ANSI/TIA-5050-2018, the appropriate audio level for VoNR over IMS Volume Control testing is -20dBm0 (ASL) and shall be used for the normal speech input level. The acoustic test system was manually configured to ensure that the settings for speech input and full-scale levels resulted in the -20dBm0 (ASL) speech input level to the DUT for the VoNR over IMS connection.

II. DUT Configuration for VoNR over IMS Volume Control Testing

1. Radio Configuration

An investigation was performed to ensure the waveform, modulation, and RB configuration used for testing do not substantially affect the measurement results. The effects of waveform, modulation, and RB configuration were found to be independent of band and bandwidth; therefore, only one band and bandwidth were used for this investigation. CP-OFDM, QPSK, 100% RB, 0RB Offset was used as the default testing configuration for the handset given the results of this investigation. See below for comparison between different radio configurations:

Table 6-1
VoNR over IMS Results by Radio Configuration

NR Radio Configuration Investigation									Sample: 0099M
NR Configuration: n25, 40MHz BW, Ch.376500					Codec: NB EVS, 13.2kbps				
DUT Audio Settings: Volume: Max-1, HAC Mode: On			Ambient Noise: 33.04dBA, Mounting Force: 2N		FCC Limits: CG: 6dB(2N), PN-SDNR: 20dB				
Waveform	Radio Config			Conversational Gain		Frequency Response		PN-SDNR	
	Mod.	RB Size	Starting RB	Value (dB)	Margin (dB)	DRP	Margin (dB)	Value (dB)	Margin (dB)
CP-OFDM	QPSK	1	1	18.16	**12.16**	DF	1.73	24.90	**4.90**
			108	17.97	**11.97**	DF	1.72	23.45	**3.45**
			214	17.32	**11.32**	DF	1.80	24.11	**4.11**
		108	0	17.48	**11.48**	DF	1.84	25.77	**5.77**
			54	17.47	**11.47**	DF	1.66	21.58	**1.58**
			108	17.42	**11.42**	DF	1.92	21.23	**1.23**
		216	0	17.42	**11.42**	DF	1.77	24.40	**4.40**
	16QAM	1	1	17.42	**11.42**	DF	1.67	21.94	**1.94**
	64QAM			17.43	**11.43**	DF	1.72	22.91	**2.91**
	256QAM			17.49	**11.49**	DF	1.73	24.96	**4.96**
DFT-s-OFDM	QPSK	1	1	17.47	**11.47**	DF	1.77	24.40	**4.40**
			108	17.36	**11.36**	DF	1.76	23.66	**3.66**
			214	17.29	**11.29**	DF	1.87	21.47	**1.47**
		108	0	17.24	**11.24**	DF	1.82	23.41	**3.41**
			54	17.27	**11.27**	DF	1.82	23.91	**3.91**
			108	17.32	**11.32**	DF	1.53	24.20	**4.20**
		216	0	17.29	**11.29**	DF	1.75	22.07	**2.07**
	16QAM	1	1	17.33	**11.33**	DF	1.81	22.18	**2.18**
	64QAM			17.32	**11.32**	DF	1.75	22.01	**2.01**
	256QAM			17.43	**11.43**	DF	1.66	23.98	**3.98**
	BPSK			17.32	**11.32**	DF	1.73	23.14	**3.14**

2. Band Configuration

An investigation was performed to ensure the NR band used for testing does not substantially affect the measurement results. NB EVS 13.2kbps codec was used for evaluation. The effects of band configuration were found to be independent of radio configuration; therefore, only one radio configuration was used for this investigation. NR n25, 40MHz, Channel 376500 was used as the default test band for VoNR over IMS Volume Control testing given the results of this investigation. See below for comparisons between different bands:

Table 6-2
VoNR over IMS Results

NR Band Investigation										Sample: 3788M
Radio Configuration: QPSK, 216 RB, 0 RB Offset						**Codec:** NB EVS, 13.2kbps				
DUT Audio Settings: Volume: Max-1, HAC Mode: On				**Ambient Noise:** 32.58dBA **Mounting Force:** 2N		**FCC Limits:** CG: 6dB(2N), PN-SDNR: 20dB				
Band	**RF Bandwidth (MHz)**	**Channel**	**Antenna**	**Conversational Gain**		**Frequency Response**		**PN-SDNR**		
				Value (dB)	**Margin (dB)**	**DRP**	**Margin (dB)**	**Value (dB)**	**Margin (dB)**	
n71	20	136100	E	17.86	**11.86**	DF	1.41	22.45	**2.45**	

7. INTERIM WAIVER DA 23-914

Under the Interim Waiver DA 23-914, only CMRS narrowband and CMRS wideband voice codecs are required to comply with the volume control requirements of the TIA 5050-2018 Volume Control Standard as amended as follows:

1. For the 2N mounting force test, one narrowband and one wideband voice codec embedded with the handset must pass with at least one volume control setting with a Receive Conversational Gain of ≥ 6 dB for all voice services, bands of operation and air interfaces over which it operates using one codec bit rate of the applicant's choosing.

2. For the 8N mounting force test, one narrowband and one wideband voice codec embedded with the handset must pass with at least one volume control setting with a Receive Conversational Gain of ≥ 6 dB for all voice services, bands of operation and air interfaces over which they operate but is not required to meet or exceed the full 18 dB of Receive Conversational Gain specified in section 5.1.1 of the TIA 5050 Volume Control Standard using one codec bit rate of the applicant's choosing.

3. For all other narrowband and wideband codecs not evaluated in 1.a. above, TIA 5050-2018 Receive Distortion and Noise Performance and Receive Acoustic Frequency Response Performance evaluations are not required; however, these codecs shall be assessed for Receive Conversational Gain and documented in the test report at the 2N and 8N levels with a gain of ≥ 6 dB for all voice services, bands of operation and air interfaces over which they operate. The handset volume setting used to comply with 1.a. shall be used for these other CMRS codec evaluations.

4. Any other codec for voice services embedded in the handset not identified in sections I and II above are not required to comply or demonstrate in the test reports for Receive Conversational Gain.

   Under the waiver, the manufacturer has chosen NB EVS 13.2kbps and WB EVS 13.2kbps audio codec bitrates for full evaluation.

8. VOLUME CONTROL TEST SUMMARY

I. Raw Handset Data

Table 8-1
Raw Data Results for VoLTE

LTE Codec Investigation									Sample: 0099M
LTE Configuration: Band 25, 20MHz BW, Ch.26365					Radio Configuration: QPSK, 100 RB, 0 RB Offset				
DUT Audio Settings: Volume: Max-1, HAC Mode: On				Ambient Noise: 33.00dBA			FCC Limits:	CG: 6dB(2N), 18dB(8N) PN-SDNR: 20dB	
Codec			Mounting Force (N)	Conversational Gain		Frequency Response		PN-SDNR	
Type	BW	Data Rate (kbps)		Value (dB)	Margin (dB)	DRP	Margin (dB)	Value (dB)	Margin (dB)
AMR	NB	4.75	2	17.13	**11.13**	-	-	-	-
			8	18.74	**0.74**	-	-	-	-
		12.2	2	17.68	**11.68**	-	-	-	-
			8	19.51	**1.51**	-	-	-	-
	WB	6.6	2	16.88	**10.88**	-	-	-	-
			8	18.70	**0.70**	-	-	-	-
		12.65	2	17.70	**11.70**	-	-	-	-
			8	19.22	**1.22**	-	-	-	-
		23.85	2	17.50	**11.50**	-	-	-	-
			8	19.33	**1.33**	-	-	-	-
EVS	NB	5.9	2	17.02	**11.02**	-	-	-	-
			8	18.77	**0.77**	-	-	-	-
		13.2	2	17.48	**11.48**	DF	1.52	23.51	**3.51**
			8	19.20	**1.20**	DF	1.34	23.26	**3.26**
	WB	5.9	2	16.59	**10.59**	-	-	-	-
			8	19.59	**1.59**	-	-	-	-
		13.2	2	17.22	**11.22**	DF	1.56	29.39	**9.39**
			8	19.06	**1.06**	DF	1.42	29.70	**9.70**

Table 8-2
Raw Data Results for VoNR

NR Codec Investigation									Sample: 0099M
NR Configuration: n25, 40MHz BW, Ch.376500					Radio Configuration: QPSK, 216 RB, 0 RB Offset				
DUT Audio Settings: Volume: Max-1, HAC Mode: On				Ambient Noise: 33.00dBA			FCC Limits:	CG: 6dB(2N), 18dB(8N) PN-SDNR: 20dB	
Codec			Mounting Force (N)	Conversational Gain		Frequency Response		PN-SDNR	
Type	BW	Data Rate (kbps)		Value (dB)	Margin (dB)	DRP	Margin (dB)	Value (dB)	Margin (dB)
AMR	NB	4.75	2	16.66	**10.66**	-	-	-	-
			8	18.54	**0.54**	-	-	-	-
		12.2	2	17.51	**11.51**	-	-	-	-
			8	19.45	**1.45**	-	-	-	-
	WB	6.6	2	17.17	**11.17**	-	-	-	-
			8	18.75	**0.75**	-	-	-	-
		12.65	2	17.36	**11.36**	-	-	-	-
			8	19.29	**1.29**	-	-	-	-
		23.85	2	17.28	**11.28**	-	-	-	-
			8	19.36	**1.36**	-	-	-	-
EVS	NB	5.9	2	16.79	**10.79**	-	-	-	-
			8	18.81	**0.81**	-	-	-	-
		13.2	2	17.33	**11.33**	DF	1.42	20.60	**0.60**
			8	19.23	**1.23**	DF	1.44	26.09	**6.09**
	WB	5.9	2	16.64	**10.64**	-	-	-	-
			8	18.67	**0.67**	-	-	-	-
		13.2	2	17.32	**11.32**	DF	1.06	30.34	**10.34**
			8	18.91	**0.91**	DF	1.30	29.82	**9.82**

II. Test Notes

A. General
1. DUT Condition: Mute off; Backlight off; Max Volume -1; Max Contrast
2. Test Signal: IEEE Std 269 uncompressed real male speech
3. Hearing Aid Mode: On (Menu Path: **Phone→Call Settings→Other Call Settings→Hearing aid compatibility**)
4. Bluetooth and WIFI were disabled while testing.
5. The Margin column indicates a margin from the FCC limit for compliance.

B. Voice over LTE
1. Power Configuration: TPC = "Max Power"
2. Radio Configuration: QPSK, 100RB, 0RB offset
3. Vocoder Configuration:
    a. NB AMR: 4.75kbps, 12.2kbps
    b. WB AMR: 6.60kbps,12.65kbps, 23.85kbps
    c. NB EVS: 5.9kbps,13.2kbps
    d. WB EVS: 5.9kbps,13.2kbps

C. Voice over NR
1. Power Configuration: TPC = "Max Power"
2. Radio Configuration: CP-OFDM, QPSK, 216RB, 1RB offset
3. Vocoder Configuration:
    a. NB AMR: 4.75kbps, 12.2kbps
    b. WB AMR: 6.60kbps,12.65kbps, 23.85kbps
    c. NB EVS: 5.9kbps,13.2kbps
    d. WB EVS: 5.9kbps,13.2kbps

III. Volume Control Verification Test Results

Table 6-1
Verification Results Table

Date of Testing	Test Location	Air Interface Equipment	Acoustical Calibrator	HATS Sens. [dB]	Ambient Noise (dBA)
5/28/2026	Whisper	CMW500	3033177	97.09	32.58

9. MEASUREMENT UNCERTAINTY

Table 9-1
Uncertainty Estimation Table

Receive Volume Control Requirement	Expanded uncertainty (k=2), 95% confidence level (dB)
Receive Conversational Gain	0.33
Receive Frequency Response (FF)	0.23
Receive Frequency Response (DF)	0.19
Receive Distortion and Noise	0.81

Notes:

1. Test equipment is calibrated according to techniques outlined in NIS81, NIS3003 and NIST Tech Note 1297.
2. All equipment has 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 DUT 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 must 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. The above uncertainties were estimated experimentally using the techniques contained in NIS 81 and NIS 3003.

10. EQUIPMENT LIST

Table 10-1
Equipment List

Manufacturer	Model	Description	Cal Date	Cal Interval	Cal Due	Serial Number
Listen	SoundConnect	Microphone Power Supply	1/8/2025	Biennial	1/8/2027	0899-PS150
RME	Fireface UC	Soundcheck Acoustic Analyzer External Audio Interface	1/8/2025	Biennial	1/8/2027	23792992
Rohde & Schwarz	CMX500	Radio Communication Tester	N/A		N/A	100298
YellowTec	YT4211	USB Audio Interface	N/A		N/A	20000365
Bruel & Kjaer (HBK)	4128-C-001	Head and Torso Simulator	5/21/2024	Biennial	4/29/2026	1947220
Bruel & Kjaer (HBK)	4231	Acoustical Calibrator Type 4231 with UA1546	8/28/2025	Biennial	8/28/2027	3033177
Bruel & Kjaer (HBK)	DZ-9769	Artificial Ear	5/15/2025	Triennial	5/15/2028	1005073

11. TEST DATA

Element Hearing Aid Compatibility Facility

Whisper Room 1 / HATS

Type: HATS 4128
Serial: 1947220
Verification Date: 5/28/2025

Measurement Standard: ANSI C63.19-2019

Equipment:

- Head and Torso Simulator Type 4128: SN: 1947220; Calibrated: 5/21/2026
- Acoustical Calibrator Type 4231 W/ UA1546: SN 3033177; Calibrated: 8/28/2025

System Verification CMRS

Ambient Noise Level	32.58 dB	✓	Maximum	40
CMW500 0dBm0 Level Check	493.9 mV	✓	Max/Min	518/468
HATS Sensitivity Check	97.09 dB	✓	Max/Min	97.3/96.9

ELEMENT Hearing Aid Compatibility Facility

DUT: A3LSMA576U
Type: Portable Handset
Serial: 3788M
Test Date: 5/28/2025

Measurement Standard: ANSI C63.19-2019; ANSI/TIA-5050-2018

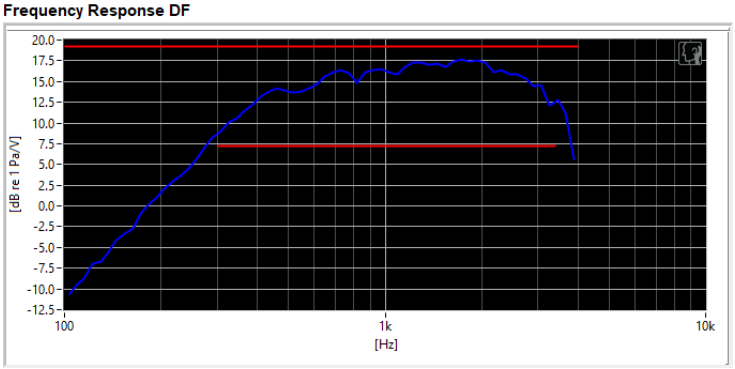
Equipment:

- Head and Torso Simulator: Bruel & Kjaer Model 4128: SN: 1947220; Calibrated: 5/21/2024
- Ear Simulator: Bruel & Kjaer Model 4158 – SN: 18862222; Calibrated: 4/29/2024

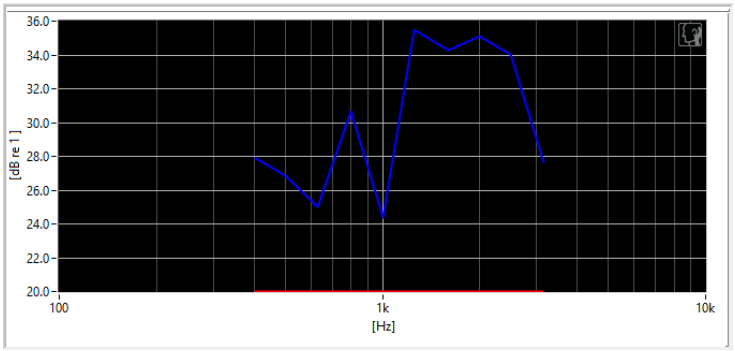
Test Configuration:

- Mode: LTE Band 71
- Bandwidth: 20MHz
- Channel: 133297
- Codec Bandwidth: Narrowband
- Mounting Force: 2N
- Antenna Configuration: E

Frequency Response DF



Distortion



Results DF

Conversational Gain (2N)	17.88 dB	✓	Minimum	6.00
Distortion Value (NB)	24.39 dB	✓	Minimum	20.00
Distortion Margin (NB)	4.39 dB	✓	Tolerance curves	Absolute Limits
FR Margin (DF, NB)	1.55 dB	✓	Tolerance curves	Floating Limits

ELEMENT Hearing Aid Compatibility Facility

DUT: A3LSMA576U
Type: Portable Handset
Serial: 3788M
Test Date: 5/28/2025

Measurement Standard: ANSI C63.19-2019; ANSI/TIA-5050-2018

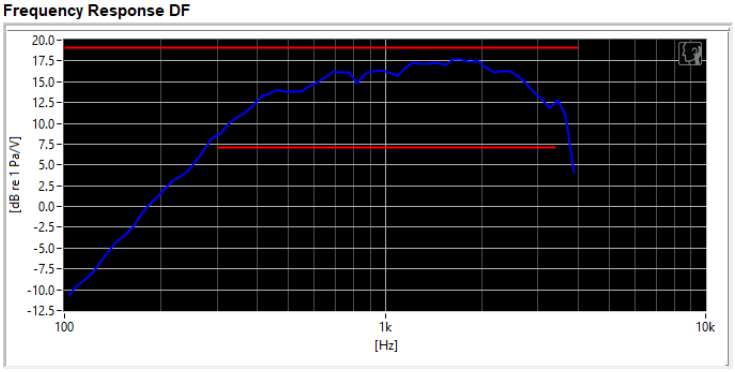
Equipment:

- Head and Torso Simulator: Bruel & Kjaer Model 4128: SN: 1947220; Calibrated: 5/21/2024
- Ear Simulator: Bruel & Kjaer Model 4158 – SN: 18862222; Calibrated: 4/29/2024

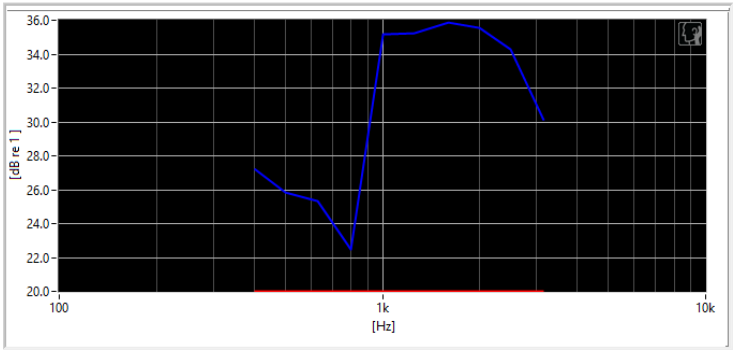
Test Configuration:

- Mode: NR n71
- Bandwidth: 20MHz
- Channel: 136100
- Codec Bandwidth: Narrowband
- Mounting Force: 2N
- Antenna Configuration: E

Frequency Response DF



Distortion



Results DF

Conversational Gain (2N)	17.86 dB	✓	Minimum	6.00
Distortion Value (NB)	22.45 dB	✓	Minimum	20.00
Distortion Margin (NB)	2.45 dB	✓	Tolerance curves	Absolute Limits
FR Margin (DF, NB)	1.41 dB	✓	Tolerance curves	Floating Limits

12. CALIBRATION CERTIFICATES

The Hottinger Brüel & Kjær Inc. Calibration Laboratory
3079 Premiere Parkway Suite 120
Duluth, GA 30097
Telephone: 770-209-6907
Fax: 770-447-4033
Website address: http//www.hbkworld.com

The Hottinger Brüel and Kjær Inc.
Service Center is Certified to ISO 9001:2015

CERTIFICATE OF CALIBRATION
No.: 489269-801

Calibration Of:
Model Number : 4128 Serial Number: 1947220

Customer:
Element Material Technology
7185 Oakland Mills Road
Columbia, MD 21046
justin.devos@element.com

5/29/26

CALIBRATION CONDITIONS:

Environment conditions	Air temperature :	22.8	°C
	Air pressure:	98.0	kPa
	Relative Humidity:	48	% RH

SPECIFICATIONS:
This document certifies that the instrument as listed under "Model Number" has been calibrated and unless otherwise indicated under "Final Data", meets acceptance criteria as prescribed by the referenced Procedure. Hottinger Brüel & Kjaer Inc. utilizes a simple acceptance decision rule as defined by ILAC G8 with measurement uncertainty value which will not exceed 50% of the tolerance. The calibration of the listed instrumentation was accomplished using a test system which conforms with the requirements of ISO/IEC 17025, ANSI/NCSL Z540-1, and guidelines of ISO 10012-1. For "as received" and "final" data, see the attached page(s). Items marked with one asterisk (*) are not covered by the scope of the current A2LA accreditation. This Certificate and attached data pages shall not be reproduced, except in full, without written approval of the Hottinger Brüel & Kjær Inc. Calibration Laboratory-Duluth, GA. Results relate only to the items tested. The Instrumentation has been calibrated using Measurement Standards with values traceable to the National Institute of Standards and Technology, National Measurement Institutes or derived from natural physical constants

PROCEDURE:
The calibration was performed according to procedure number :4128 DP Rev. 7.21

RESULTS:
"As Received" Physical Condition: Acceptable for Calibration

"As Received" Data: "As Received" = "Final Data" "Final Data": Within Acceptance Criteria

The reported expanded uncertainty is based on the standard uncertainty multiplied by a coverage factor k =2 providing a level of confidence of approximately 95%. The uncertainty evaluation has been carried out in accordance with EA-4/02 from elements originating from standards, calibration method, effect of environmental conditions and any short term contribution from the device under calibration.

Date of Calibration: 21-May-2026

Grant Kennedy

Calibration Technician

Certificate issued: 21-May-2026

John Avitabile

Quality Representative

CERTIFICATE OF CALIBRATION
No.: 489269-801 Page 2 of 2

Hottinger Brüel & Kjær Inc. Calibration Laboratory

RESULTS:

Rev 7.21

I. Bruel & Kjaer Torso Model 4128, Serial Number: 1947220.

As Received Data		Final Data		As Received = Final Data	X

	Acceptance Criteria	Actual
A. Speaker and Speaker Assembly Mechanical Check.	Pass/Fail	Pass
B. Protection Circuit	Acceptance Criteria	Actual
1. 6.4 VRMS 750 Hertz Input	Signal remains for more than 30 Seconds	Pass
2. 7.5 VRMS 750 Hertz Input	Signal disappears in 12 Seconds Pass/Fail	Pass
C. Ear Simulator		
1. See enclosed Calibration Results for 4158, serial number: 1886222.	Calibration Results Included Yes/No/NA	Yes
2. See enclosed Calibration Results for 4159, serial number: .	Calibration Results Included Yes/No/NA	NA

Reference Standards:

Model	Serial Number	Trace Number	Cal Due	Interval (mo)
HP 3458A	2823A20163	519832	31Aug26	12
HP 5315A	2032A04440	519600	31Aug27	24

HBK HOTTINGER BRÜEL & KJÆR
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Fax: 770-447-4033
Web site address: http://www.hbkworld.com

A2LA ACCREDITED
Calibration Certificate # 1568.01

CERTIFICATE OF CALIBRATION

No.: 489269-701

CALIBRATION OF:

Microphone:	Brüel & Kjær	Type	4158/2669/UA1345	Serial No.	1886222/2025786

CUSTOMER:

Element Material Technology
7185 Oakland Mills Road
Columbia, MD 21046
justin.devos@element.com

FP 5/29/26

CALIBRATION CONDITIONS:

Environment conditions:	Air temperature:	23.1	°C
	Air pressure:	98.39	kPa
	Relative Humidity:	46.8	%RH
Applied polarization voltage:	200 Vdc		

SPECIFICATIONS: This document certifies that the instrument as listed under "Type" has been calibrated and unless otherwise indicated under "Final Data", meets acceptance criteria as prescribed by the referenced Procedure. Hottinger Bruel & Kjaer Inc. utilizes a simple acceptance decision rule as defined by ILAC G8 with measurement uncertainty value which will not exceed 50% of the tolerance. The calibration of the listed transducer was accomplished using a test system which conforms to the requirements of ISO/IEC 17025, ANSI/NCSL Z540-1, and guidelines of ISO 10012-1. For "as received" and "final" data, see the attached page(s). Items marked with one asterisk (*) are not covered by the scope of the current A2LA accreditation. This Certificate and attached data pages shall not be reproduced, except in full, without written approval of the Hottinger Brüel & Kjær Inc. Calibration Laboratory-Duluth, GA. Results relate only to the items tested. The transducer has been calibrated using Measurement Standards with values traceable to the National Institute of Standards and Technology, National Measurement Institutes or derived from natural physical constants.

PROCEDURE: The measurements have been performed with the assistance of the Hottinger Brüel & Kjær Inc. Microphone Calibration System B&K 9721 with application software WT9649 and WT9650 version 5.3.0.11 using calibration procedure: 4158-2669-UA1345-S251; IH10108 Rev 01.12

RESULTS:

[X] "As Received" Data: Within Acceptance Criteria
[ ] "As Received" Data: Outside Acceptance Criteria
[X] "Final" Data : Within Acceptance Criteria
[ ] "Final" Data : Outside Acceptance Criteria

The reported expanded uncertainty is based on the standard uncertainty multiplied by a coverage factor $k=2$ providing a level of confidence of approximately 95%. The uncertainty evaluation has been carried out in accordance with EA-4/02 from elements originating from standards, calibration method, effect of environmental conditions and any short-term contribution from the device under calibration.

Date of Calibration: 21 May, 2026

Certificate issued: 21 May, 2026

Grant Kennedy

Can Phan
Calibration Technician

Quality Representative

CERTIFICATE OF CALIBRATION

No.: 489269-701

Type: 4158/2669/UA1345 Serial No.: Page 2 of 2
1886222/2025786

Sensitivity

Nominal sensitivity:	-38 dB re. 1V/Pa	+/-	2	dB
Sensitivity at calibration conditions:	-38.29 dB re. 1V/Pa	or	12.17	mV/Pa
Sensitivity at reference conditions:	-38.31 dB re. 1V/Pa	or	12.14	mV/Pa
Uncertainty:	+/- 0.08 dB			
Correction factor K at reference conditions:	12.31 dB			
Calibration Frequency:	251.19 Hz			

Reference Conditions:
Pressure: 101.3 kPa
Temperature: 23 °C
Relative Humidity: 50%

Traceable references

Type	Serial no	Cal. date	Due date	Calibrated by	Trace number
4180	2602426	2025-04-09	2027-04-30	DPLA	M2.10-1705-2.1

Condition "As Received": Good

Acoustic Pressure Response Results *

The results in this table are not covered by the current A2LA Scope of Accreditation *

Frequency in Hertz	Sound Pressure Level in dB	IEC 60318-4:2010 Tolerance in dB	Actual Result in dB
100	-0.3	± 0.7	-0.06
125	-0.2	± 0.7	-0.43
160	-0.2	± 0.7	0.10
200	-0.1	± 0.6	0.13
250	-0.1	± 0.6	0.30
315	-0.1	± 0.6	0.23
400	0	± 0.6	0.25
500	Ref	Ref	0.00
630	0.1	± 0.6	0.37
800	0.2	± 0.6	0.78
1,000	1.6	± 0.7	2.00
1,250	3.3	± 0.7	3.70
1,600	4.5	± 0.7	4.53
2,000	5.2	± 0.8	5.04
2,500	6	± 0.8	5.90
3,150	6.9	± 0.9	7.24
4,000	8	± 1.0	8.78
5,000	9.3	± 1.2	9.94
6,300	11.4	± 1.2	11.29
8,000	13.7	± 1.7	13.80
10,000	18	± 2.2	18.77

HBK HOTTINGER BRÜEL & KJÆR

The Calibration Laboratory
Teknikerbyen 28, DK-2830 Virum, Denmark

ilac-MRA DANAK CAL Reg.No. 307 Member of EA MLA

CERTIFICATE OF CALIBRATION

No: CDK2505668 Page 1 of 6

CALIBRATION OF

Calibrator:	Brüel & Kjær Type 4231	No: 3033177 Id: -
Acoustical Adaptor:	Brüel & Kjær Type UC-0210 (1/2" Adaptor)	
Pattern Approval:	DE-21-M-PTB-0029	

CUSTOMER

Element Materials Technology
7185 Oakland Mills Rd.
21046 Columbia
United States

CALIBRATION CONDITIONS

Preconditioning: 4 hours at 23°C ± 3°C

Environment conditions: *See actual values in **Environmental conditions** section.*

SPECIFICATIONS

The Calibrator Brüel & Kjær Type 4231 has been calibrated in accordance with the requirements as specified in IEC 60942:2017 Annex B - Microphone method. The accreditation assures the traceability to the international units system SI.

PROCEDURE

The measurements have been performed with the assistance of Brüel & Kjær Calibrator Calibration System 3630 with application software type 7763 (version 9.1 - DB: 9.10) by using procedure P_4231_4180_M_1_A01.

RESULTS

Calibration Mode: **Initial calibration.**

The reported expanded uncertainty is based on the standard uncertainty multiplied by a coverage factor $k = 2$ providing a level of confidence of approximately 95 %. The uncertainty evaluation has been carried out in accordance with EA-4/02 from elements originating from the standards, calibration method, effect of environmental conditions and any short time contribution from the device(s) under calibration. The results are only applicable for the specific device(s) listed above.

Date of calibration: 2025-08-28

Date of issue: 2025-08-28

SD 9/12

Susanne Jørgensen
Susanne Jørgensen
Calibration Technician

M. Önder
Mikail Önder
Approved Signatory

1. Calibration Note

n/a

2. Summary

4.1. Preliminary inspection	Passed
4.2. Environmental conditions	Passed
4.3. Ambient noise	Passed
4.4. Results - Level 94 dB	Passed
4.5. Results - Level 114 dB	Passed
4.6. Results - Frequency 94 dB	Passed
4.7. Results - Frequency 114 dB	Passed
4.8. Results - Distortion 94 dB	Passed
4.9. Results - Distortion 114 dB	Passed

As public evidence was available, from a testing organization responsible for approving the results of pattern evaluation test, to demonstrate that the model of sound calibration fully conformed to the requirements for pattern evaluation described in Annex A of IEC 60942:2017, the sound calibrator tested is considered to conform to all the class 1 requirements of IEC 60942:2017.

Conformance to the requirements of IEC 60942:2017, is demonstrated when the measured deviations do not exceed the applicable tolerance limits given in in IEC 60942:2017.

3. Instruments

	Instrument	Inventory No.
Preamplifier	Brüel & Kjær, Type 2673	122673033
Analyzer	Brüel & Kjær, Type 3160-A-042	123160046
Microphone	Brüel & Kjær, Type 4180	124180039
Environmental Values	Vaisala, Type Indigo 520	142908001

4. Measurements

4.1. Preliminary inspection

The unit is visually inspected to check the suitability for calibration (clause B.3).

	Result	
Preliminary inspection	OK	

4.2. Environmental conditions

Actual environmental conditions (clause B.4.3.1).

	Expected	Accept - Limit	Accept + Limit	Measured	
				[Deg / kPa / %RH]	
Air temperature	23.00	-3.00	3.00	23.50	
Air pressure	100.00	-20.00	5.00	100.33	
Relative humidity	50.00	-25.00	40.00	51.00	

4.3. Ambient noise

Ambient noise measured by the microphone after coupling to the sound calibrator, but with calibrator turned off. (clause B.4.2)

	Max	Measured	Deviation	Uncertainty	
	[dBSPL]	[dBSPL]	[dB]	[dB]	
Noise inside Calibrator	64.0	40.5	-23.5	1.00	

4.4. Results - Level 94 dB

Measured value of the Sound Pressure Level(s), at Reference Environmental Conditions. (clause B.4.6.3).
Sound Pressure Levels are stated in absolute terms.
Stated tolerances are in accordance with IEC 60942:2017 (Table 2).
Measured values of the Sound Pressure Level, reported at Reference Environmental Conditions.
marked rows are principal measurements, i.e. the average of three measurements.

	Expected	Measured	Normalised	Accept - Limit	Accept + Limit	Deviation	Uncertainty	
	[dBSPL]	[dBSPL]	[dBSPL]	[dB]	[dB]	[dB]	[dB]	
1000 Hz #	94.00	94.00	94.00	-0.25	0.25	0.00	0.08	

4.5. Results - Level 114 dB

Measured value of the Sound Pressure Level(s), at Reference Environmental Conditions. (clause B.4.6.3).
Sound Pressure Levels are stated in absolute terms.
Stated tolerances are in accordance with IEC 60942:2017 (Table 2).
Measured values of the Sound Pressure Level, reported at Reference Environmental Conditions.
marked rows are principal measurements, i.e. the average of three measurements.

	Expected	Measured	Normalised	Accept - Limit	Accept + Limit	Deviation	Uncertainty	
	[dBSPL]	[dBSPL]	[dBSPL]	[dB]	[dB]	[dB]	[dB]	
1000 Hz	114.00	114.05	114.05	-0.25	0.25	0.05	0.08	

4.6. Results - Frequency 94 dB

Measured value of actual frequency(ies) (clause B.4.7).
Stated tolerances are in accordance with IEC 60942:2017 (Table 4).
Measured values of the Actual Frequency(ies).
marked rows are principal measurements, i.e. the average of three measurements.

	Expected	Measured	Accept - Limit	Accept + Limit	Deviation	Uncertainty	
	[Hz]	[Hz]	[Hz]	[Hz]	[Hz]	[Hz]	
1000 Hz #	1000.00	1000.02	-7.00	7.00	0.02	0.03	

4.7. Results - Frequency 114 dB

Measured value of actual frequency(ies) (clause B.4.7).
Stated tolerances are in accordance with IEC 60942:2017 (Table 4).
Measured values of the Actual Frequency(ies).
marked rows are principal measurements, i.e. the average of three measurements.

	Expected	Measured	Accept - Limit	Accept + Limit	Deviation	Uncertainty	
	[Hz]	[Hz]	[Hz]	[Hz]	[Hz]	[Hz]	
1000 Hz	1000.00	1000.02	-7.00	7.00	0.02	0.03	

4.8. Results - Distortion 94 dB

Distortion is measured as Total distortion + noise (clause B.4.8).
Stated tolerances are in accordance with IEC 60942:2017 (Table 7).
Measured values of the Distortion.
marked rows are principal measurements, i.e. the average of three measurements.

	Max	Measured	Uncertainty	
	[%]	[%]	[%]	
1000 Hz #	2.50	0.41	0.25	

4.9. Results - Distortion 114 dB

Distortion is measured as Total distortion + noise (clause B.4.8).
Stated tolerances are in accordance with IEC 60942:2017 (Table 7).
Measured values of the Distortion.
marked rows are principal measurements, i.e. the average of three measurements.

	Max	Measured	Uncertainty	
	[%]	[%]	[%]	
1000 Hz	2.50	0.19	0.25	

HBK HOTTINGER BRÜEL & KJÆR

The Calibration Laboratory
Teknikerbyen 28, DK-2830 Virum, Denmark

CERTIFICATE OF CALIBRATION

No: CDK2505668

DANAK

DANAK is the national accreditation body in Denmark in compliance with Regulation (EC) No. 765/2008 of the European Parliament and of the Council.

DANAK is covered by the multilateral agreements for testing, medical examination, calibration, proficiency testing providers and reference material producers under European co-operation for Accreditation (EA) and under International Laboratory Accreditation Cooperation (ILAC) based on peer-evaluation. This implies that accredited reports and certificates issued by companies accredited by DANAK are recognized across borders by members of EA and ILAC equal to reports and certificates issued by companies accredited by these members.

The use of the accreditation symbol on reports and certificates or reference to accreditation, documents that the service is provided as an accredited service under the company's DANAK accreditation.

This calibration certificate is covered by DANAK accreditation and the multilateral agreements from EA and ILAC for calibration which ensures that measurements are metrologically traceable.

Comments/Questions or Complaints may be addressed to:
Your local HBK service representative

End of calibration certificate.

13. CONCLUSION

The measurements indicate that the wireless communications device complies with the HAC limits specified in accordance with the ANSI C63.19 Standard and FCC WT Docket No. 01-309 RM-8658. Precise laboratory measures were taken to assure repeatability of the tests. The tested device complies with the requirements in respect to all parameters specific to the test. The test results and statements relate only to the item(s) tested.

The measurement system and techniques presented in this evaluation are proposed in the ANSI standard as a means of best approximating wireless device compatibility with a hearing aid. The literature is under continual re-construction.

14. REFERENCES

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