

TEST REPORT

FCC Volume Control Test for SM-F766U
Class II Permissive Change

APPLICANT
SAMSUNG Electronics Co., Ltd.

REPORT NO.
HCT-TE-2505-FC001

DATE OF ISSUE
May 21, 2025

Tested by
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FCC ID

A3LSMF766U

Applicant

SAMSUNG Electronics Co., Ltd.

129, Samsung-ro, Yeongtong-gu, Suwon-Si, Gyeonggi-do, 16677,
Rep. of Korea

Product Name

Mobile Phone

Model Name

SM-F766U

Multi Model Name

SM-F766U1

Date of Test

May 07, 2025 ~ May 20, 2025

Location of Test

☒ Permanent Testing Lab ☐ On Site Testing Lab

(Address : 74, Seoicheon-ro 578beon-gil, Majang-myeon, Icheon-si,
Gyeonggi-do, Republic of Korea)

Test Standard

FCC 47 CFR § 20.19

ANSI C63.19-2019

ANSI/TIA-5050:2018

Test Results

Refer to test summary of clause 6

REVISION HISTORY

The revision history for this test report is shown in table.

Revision No.	Date of Issue	Description
0	May 21, 2025	Initial Release

Notice

Content

The results shown in this test report only apply to the sample(s), as received, provided by the applicant, unless otherwise stated.

The test results have only been applied with the test methods required by the standard(s).

The laboratory is not accredited for the test results marked *.

Information provided by the applicant is marked **.

Test results provided by external providers are marked ***.

When confirmation of authenticity of this test report is required, please contact www.hct.co.kr

The test results in this test report are not associated with the ((KS Q) ISO/IEC 17025) accreditation by KOLAS (Korea Laboratory Accreditation Scheme) / A2LA (American Association for Laboratory Accreditation) that are under the ILAC (International Laboratory Accreditation Cooperation) Mutual Recognition Agreement (MRA).

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1. Test Regulations

The results in this report apply only to sample tested.

The tests were performed according to the following regulations:

FCC Rule Part(s)	FCC 47 CFR § 20.19, ANSI C63.19-2019
Test Standard	ANSI C63.19-2019 ANSI/TIA-5050:2018 KDB 285076 D01 HAC Guidance v06r04 KDB 285076 D03 HAC FAQ v01r06 KDB 285076 D04 Volume Control v02 KDB 285076 D05 HAC Waiver DA 23-914 v01 TCB workshop updates

Under the revised KDB 285076 D04 Volume Control v02 on September 29, 2023, we demonstrate compliance to a Volume Control requirement using amended test method by the waiver DA23-914.

Further details on application of the waiver DA23-914 are described in section 4.2.3 of this report.

2. Test Location

2.1 Test Laboratory

Company Name	HCT Co., Ltd.
Address	2-6, 73, 74, Seoicheon-ro 578beon-gil, Majang-myeon, Icheon-si, Gyeonggi-do, Republic of Korea
Telephone	031-645-6300
Fax	031-645-6401

2.2 Test Facilities

Our laboratories are accredited and approved by the following approval agencies according to ISO/IEC 17025.

National Radio Research Agency	Designation No. KR0032 (Including MRA: CANADA, Vietnam, USA)
KOLAS	Accreditations No. KT197
A2LA	Certificate Number: 4114.01

3. Device Under Test Description

3.1 DUT General Specification

Brand	SAMSUNG
Product Name	Mobile Phone
Model Name	SM-F766U
Multi Model Name	SM-F766U1
Hardware Version	REV1.0
Software Version	F766U.001
Serial Number	YDL2357G

3.2 DUT Wireless Specification

Air Interface	Bands (MHz)	Type	Volume Control Tested	Voice Service	Audio Codec Evaluated		
GSM	850	VO	Yes	-	<u>HR V1, FR V1, FR V2</u>		
	1900						
	GPRS/EDGE	VD	No	Google Meet	OPUS		
WCDMA (UMTS)	850 (B5)	VO	Yes	-	<u>AMR-NB, AMR-WB</u>		
	1700 (B4)						
	1900 (B2)						
	HSPA	VD	No	Google Meet	OPUS		
LTE-FDD	680 (B71)	VD	Yes	VoLTE / Google Meet	<u>AMR-NB, AMR- WB, EVS- NB, EVS-WB, EVS-SWB</u> / OPUS		
	700 (B12/13/14)						
	850 (B5/26)						
	1700 (B4/66)						
	1900 (B2/25)						
	2300 (B30)						
	2500 (B7)						
LTE-TDD	2600 (B41(B38))	VD	Yes				
	3600 (B48)						
NR-FDD	680 (n71)	VD	Yes	VoNR / Google Meet	<u>AMR-NB, AMR- WB, EVS- NB, EVS-WB, EVS-SWB</u> / OPUS		
	700 (n12/n14)						
	850 (n5/n26)						
	1700 (n66/n70)						
	1900 (n2/25)						
	2300 (n30)						
	2500 (n7)						
NR-TDD	2600 (n41(n38))	VD	Yes				
	3500 (n48)						
	3800 (n77/78)						
	25000 (n258)		No	Google Meet	OPUS		
	28000 (n261)						
	39000 (n260)						
Wi-Fi	2450	VD	Yes	Wi-Fi Calling / Google Meet	<u>AMR-NB, AMR- WB, EVS- NB, EVS-WB, EVS-SWB</u> / OPUS		
	5200 (U-NII-1)						
	5300 (U-NII-2A)						
	5500 (U-NII-2C)						
	5800 (U-NII-3)						
	5900 (U-NII-4)		No				
	6200 (U-NII-5)						
	6500 (U-NII-6)						
	6700 (U-NII-7)						
	7000 (U-NII-8)						
BT	2450	DT	No	-	-		
VO: Legacy Cellular Voice Service DT: Digital Transport only (no voice) VD: IP Voice service over Digital Transport			Note: n251, n260, n261, Wi-Fi 6 GHz are currently outside the scope of ANSI C63.19 and FCC HAC regulations and UNII band 5 was evaluated for operations which are entirely below 6 GHz.				

-. In accordance with KDB 285076 D05 HAC Waiver DA 23-914 v01, Volume Control test was performed only on CMRS narrowband and CMRS wideband voice codecs operating over licensed-frequency bands and Wi-Fi Calling. Additionally, in accordance with same waiver, super-wideband codec and OTT codecs had not been confirmed to comply with TIA-5050 standard.

4. Test Descriptions

4.1 Test Information

4.1.1 General Test Condition

Device Transmit Power	Maximum Level ^{Note1}
Tone Control	HAC Mode ON
Acoustic Interface	Type 3.3 Ear Simulator (HATS)
Test Signal	IEEE 269-2010 Male mono 48 kHz
Test Signal Level	-20 dBm0 to RETP ^{Note2}
Volume Setting	-1 volume from maximum level
Back ground Noise (Chamber ambient noise)	<u>21.4 dBA</u>

Note1. P_{max} results were referred to FCC SAR Test Report.

Note2. The RETP (Receive Electrical Test Point) is the point in the device test arrangement where signals are applied to the DUT in the receive direction.

4.1.2 Mounting Force

Mounting Force is the force against the artificial ear pinna simulator when handset is placed standard test position. And the 2 N force is used for testing requirements related to use by persons with hearing devices and 8 N force is used for testing requirements related to use by persons without hearing device, test is performed on each side.

4.1.3 Frequency band for transmission modes

Test Item	Narrowband Band (Hz)	Wideband Band (Hz)
Receiving volume control	100 ~ 4 000	100 ~ 7 720
Receiving distortion and noise	400 ~ 3 150	250 ~ 5 000
Receiving frequency response	100 ~ 4 000	100 ~ 8 000

4.1.4 Conversational Gain Calculation

Conversational gain for volume control measurement is calculated by formula below.

$$\text{Monoaural Conversational Gain} = (\text{Measured dB SPL Level} - 70 \text{ dB SPL}) \text{ dB}$$

4.1.5 Stimulus signal for distortion test

- 1) Random pink noise for stimulus signal has 250 ms 'on' and 150 ms 'off' cycle.
- 2) PN-SDNR (Pulsed Noise Signal to Distortion and Noise Ratio) is calculated by formula below.

$$\text{PN-SDNR (dB)} = 20 * \log \left[\frac{\text{measured stimulus amplitude}}{\text{measured distortion amplitude}} \right]$$

- 3) Lower and upper edge for stimulus measurements are shown in table below.

Stimulus Measurement Lower Band Edge	Stimulus Lower Band Edge	Nominal Center Frequency	Stimulus Upper Band Edge	Stimulus Measurement Upper Band Edge	Handset Operating Mode
190	225	250	280	315	Wideband only
245	280	315	355	390	
320	355	400	445	480	Narrowband & Wideband
410	445	500	560	595	
525	560	630	710	745	
675	710	800	890	925	
855	890	1 000	1 120	1 155	
1 085	1 120	1 250	1 415	1 450	
1 375	1 410	1 600	1 780	1 815	
1 745	1 780	2 000	2 240	2 275	
2 205	2 240	2 500	2 820	2 855	
2 785	2 820	3 150	3 550	3 585	
3 515	3 550	4 000	4 465	4 500	Wideband only
4 430	4 465	5 000	5 625	5 660	

4.1.6 Definition of Frequency Response

The receive frequency response is the ratio of the output of sound pressure at the listener reference point to the voltage input to the reference codec, or digital bit stream equivalent, as shown in follow formula for each frequency or frequency band.

$$S_{JE} = 20 \log_{10}(P_E/V_R) \text{ dB re 1 Pa/V}$$

Where

S_{JE} = Receive Sensitivity, Juntion to Ear, at f_i

P_E = LRP sound pressure measured by ear simlator at DRP and translated to the FF or DF, at f_i

V_R = RMS input voltage to the reference codec, or digital bit stream equivalent, at f_i

4.1.7 DRP to FF and DF Transformation Value at 1/12 Octave Center Frequencies

Function	Freq. (Hz)	DRP to FF (dB)	Freq. (Hz)	DRP to FF (dB)	Freq. (Hz)	DRP to FF (dB)	Freq. (Hz)	DRP to FF (dB)
DRP to FF	91.7	0.00	290	-0.70	917	-4.94	2 900	-17.48
	97.2	0.00	307	-0.83	972	-5.07	3 070	-17.43
	103	0.00	325	-0.98	1 030	-5.07	3 250	-17.13
	109	0.00	345	-1.16	1 090	-5.03	3 450	-16.59
	115	0.00	365	-1.36	1 150	-4.96	3 650	-15.94
	122	0.00	387	-1.58	1 220	-4.94	3 870	-15.11
	130	-0.01	410	-1.77	1 300	-5.09	4 100	-14.20
	137	-0.01	434	-1.94	1 370	-5.30	4 340	-13.25
	145	-0.01	460	-2.10	1 450	-5.65	4 600	-12.35
	154	-0.02	487	-2.27	1 540	-6.19	4 870	-11.60
	163	-0.03	516	-2.45	1 630	-6.95	5 160	-11.04
	173	-0.05	546	-2.59	1 730	-8.04	5 460	-10.31
	183	-0.08	579	-2.69	1 830	-9.33	5 790	-9.55
	194	-0.11	613	-2.80	1 940	-10.67	6 130	-8.70
	205	-0.16	649	-2.94	2 050	-11.86	6 490	-7.80
	218	-0.22	688	-3.19	2 180	-13.39	6 880	-6.67
	230	-0.29	729	-3.52	2 300	-14.76	7 290	-5.08
	244	-0.39	772	-3.92	2 440	-15.89	7 720	-3.61
	259	-0.48	818	-4.35	2 590	-16.79	8 180	-2.97
	274	-0.59	866	-4.69	2 740	-17.34	8 660	-3.42
DRP to DF	91.7	0.00	290	-0.63	917	-3.99	2 900	-13.98
	97.2	0.00	307	-0.72	972	-4.21	3 070	-13.88
	103	0.00	325	-0.81	1 030	-4.45	3 250	-13.77
	109	0.00	345	-0.93	1 090	-4.66	3 450	-13.48
	115	-0.01	365	-1.05	1 150	-4.86	3 650	-13.01
	122	-0.03	387	-1.19	1 220	-5.10	3 870	-12.29
	130	-0.05	410	-1.32	1 300	-5.43	4 100	-11.54
	137	-0.06	434	-1.44	1 370	-5.80	4 340	-10.95
	145	-0.07	460	-1.58	1 450	-6.29	4 600	-10.32
	154	-0.07	487	-1.78	1 540	-6.95	4 870	-9.64
	163	-0.07	516	-2.04	1 630	-7.73	5 160	-9.03
	173	-0.09	546	-2.32	1 730	-8.60	5 460	-8.40
	183	-0.11	579	-2.63	1 830	-9.39	5 790	-7.85
	194	-0.15	613	-2.87	1 940	-10.24	6 130	-7.36
	205	-0.19	649	-3.07	2 050	-11.07	6 490	-6.91
	218	-0.24	688	-3.21	2 180	-11.95	6 880	-6.39
	230	-0.30	729	-3.32	2 300	-12.76	7 290	-6.00
	244	-0.36	772	-3.45	2 440	-13.49	7 720	-6.23
	259	-0.46	818	-3.59	2 590	-13.84	8 180	-7.17
	274	-0.55	866	-3.78	2 740	-13.99	8 660	-7.74

4.2 Test Configuration

4.2.1 Test Diagram

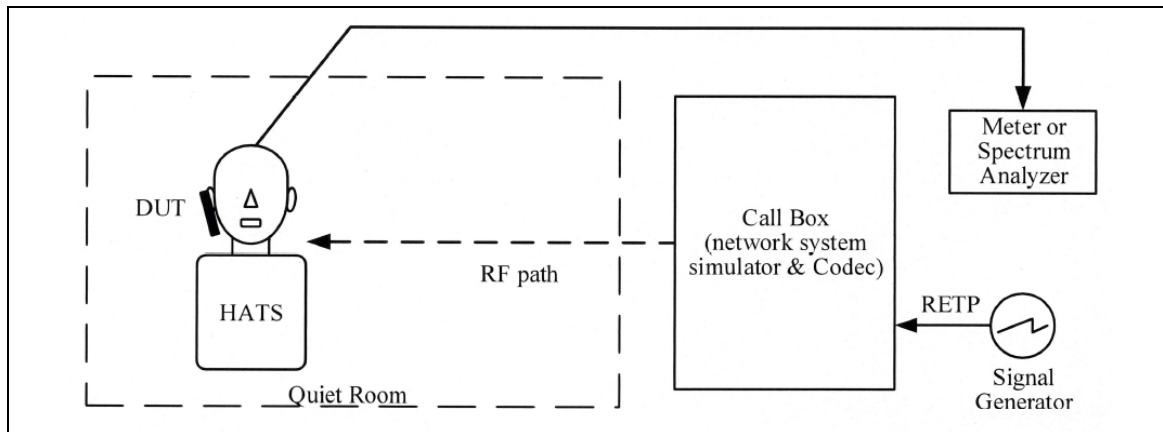


Figure 1. Volume Control Test Set-up

1) In order to satisfy the quiet room condition below 40 dBA background noise according to TIA-5050 standard, HATS and DUT were placed in Anechoic Chamber and the noise level was checked using Sound Level Meter Type 2250.

2) labCORE equipment is used for signal generator and meter. This equipment directly provided operating voltage for HATS's microphone and -20 dBm0 sound source to Call Box RETP Point.

3) CMW500 Call box was used for GSM, WCDMA, LTE and WIFI call tests, where the audio input level was set to 1.572 V so that the signal source level supplied from labCORE to RETP matched -20 dBm0.

4) When testing NR calls using UXM Call box, we used USB audio JIG U8903B-UAM because equipment does not provide direct audio input. In addition, since JIG output is connected to MIC input of SIP virtual terminal software called IMS Client, equipment microphone level was set to equivalent to the level of CMW 500, which already RETP condition was known. Finally, we conducted NR call test after confirming CMW500 LTE Call and UMX NSA mode have same level of measurement results.

4.2.2 Handset Positioning

In all tests, handset was placed at the STP (Standard Test Position) of IEEE std 269 and ITU-T P.64 annex E by adjusting the handset positioner Type 4606 of HATS Type 4821C.

4.2.3 Waiver DA23-914 for Volume Control Test

This test report demonstrate compliance with Volume Control requirements of TIA-5050 standard relaxed by applying Waiver DA23-914. And for detailed information on test application, refer to Technical testing guidance of KDB 285076 D05 HAC Waiver DA 23-914 v01:

2.a. Under the waiver, 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

→ According to this content, test codec is limited to AMR and EVS codecs.

2.a.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 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.

→ According to this content, only EVS-NB 24.4 kbps and EVS-WB 24.4 kbps codecs were tested for all air interface and bands of DUT.

2.a.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 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 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.

→ According to this content, we reported conversational gain result even if it less than 18 dB for 8 N mounting force test.

2.b. For all other narrowband and wideband codecs not evaluated in 2.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 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 2.a. shall be used for these other CMRS codec evaluations.

→ According to this, Conversational Gain tests were performed for different bit rates of EVS-NB and WB. And other codecs such as FR V2 for GSM and AMR-NB, WB were also tested.

2.c. Any other codec for voice services embedded in the handset, not identified in 2.a. and 2.b. above, is not required to comply or demonstrate in the test reports for conversational gain.

→ According to this content, we did not test 'Google Meet' supported by DUT.

4.2.4 Test Condition of Class II Permissive Change

1) DUT has changed the upper OMH LPAMID, and the affected Antenna I (Sub5) bands are as follows:

[Only for Sub5 Antenna, n41 SRS and NTN TRX]

GSM DRX1 1800/1900

WCDMA DRX1 B1/2/4

LTE DRX1 B1/2/3/4/7/25/30/38/39/40/41/66

NR DRX1 n1/2/3/7/25/30/38/41/66/70

WCDMA TX(PS) B1/2/4

LTE TX(PS) B1/2/3/4/7/25/30/38/39/40/41/66

NR TX(PS) n1/2/3/7/25/30/38/41/66/70

SRS #1(Main2)/2(Sub3)/3(Main3) of n41(Alternative(PS) TX)

SRS #1(Sub5)/3(Sub3) of n41(Main TX)

NB-IoT NTN B255 TRX

2) The applicant's chosen codec tests were performed for the following worst-case band as per existing test report HCT-TE-2504-FC001.

Air Interface	Band (Antenna)	Channel	Frequency (MHz)	Bandwidth (MHz)	Modulation		RB	Codec
LTE FDD	B30 (Ant.I)	CH.27710	2 310	10	16QAM		1/49	EVS-NB 24.4 kbps
								EVS-WB 24.4 kbps
LTE TDD	B41 PC3 (Ant.I)	CH.40620	2 593	20	QPSK		50/25	EVS-NB 24.4 kbps
								EVS-WB 24.4 kbps
NR FDD	n25 (Ant.I)	CH.376500	1 882.5	40	DFT-s-OFDM	QPSK	1/108	EVS-NB 24.4 kbps
								EVS-WB 24.4 kbps
NR TDD	n38 (Ant.I)	CH.519000	2 595	20	CP-OFDM	QPSK	1/0	EVS-NB 24.4 kbps
								EVS-WB 24.4 kbps

3) Since the investigation of codec bit-rate for conversational gain was already performed in test report HCT-TE-2054-FC001, this report quotes it and performs conversational gain test only for the following codecs in the 2) band:

Air Interface	Band (Antenna)	Channel	Frequency (MHz)	Bandwidth (MHz)	Modulation		RB	Codec
WCDMA	B2 (Ant.I)	CH.9400	1 880					AMR-NB 4.75 kbps
								AMR-WB 6.6 kbps
LTE FDD	B30 (Ant.I)	CH.27710	2 310	10	16QAM		1/49	AMR-NB 4.75 kbps
								EVS-NB 24.4 kbps
								AMR-WB 6.6 kbps
								EVS-WB 24.4 kbps
LTE TDD	B41 PC3 (Ant.I)	CH.40620	2 593	20	QPSK		50/25	AMR-NB 4.75 kbps
								EVS-NB 24.4 kbps
								AMR-WB 6.6 kbps
								EVS-WB 24.4 kbps
NR FDD	n25 (Ant.I)	CH.376500	1 882.5	40	DFT-s-OFDM	QPSK	1/108	AMR-NB 4.75 kbps
								EVS-NB 24.4 kbps
								AMR-WB 6.6 kbps
								EVS-WB 24.4 kbps
NR TDD	n38 (Ant.I)	CH.519000	2 595	20	CP-OFDM	QPSK	1/0	AMR-NB 4.75 kbps
								EVS-NB 24.4 kbps
								AMR-WB 6.6 kbps
								EVS-WB 24.4 kbps

4.3 Measurement Uncertainty

Test Item	Uncertainty
Receiving volume control	1.3 dB
Receiving distortion and noise	1.4 dB
Receiving frequency response	1.3 dB
NOTE : All uncertainty values are expanded standard uncertainty to give a confidence level of 95 %, based on coverage factor $k=2$	

4.4 Test Environment

Temperature	$(23.6 \pm 1.0) ^\circ\text{C}$
Relative humidity	$(54.5 \pm 3.0) \%$
Atmospheric pressure	$(99.4 \pm 1.0) \text{ kPa}$

5. Measuring Instrument Calibration

The measuring equipment used to perform the tests documented in this report has been calibrated in accordance with the manufacturers' recommendations and is traceable to recognized national standards.

Name of Equipment	Manufacturer	Type/Model	Serial No.	Cal. Due Date (M.D.Y)
Head and Torso Simulator	B&K	Type 4128C	2515986	N/A
Anechoic Chamber	B&K	N/A	N/A	N/A
Sound Level Meter	B&K	Type 2250	2506747	02.14.2026
Sound Calibrator	B&K	Type 4231	2513225	11.29.2025
ACQUA compact	Head Acoustic	labCORE	77000427	05.29.2025
Radio Communication Tester	R & S	CMW 500	127521	04.21.2026
Radio Communication Tester	R & S	CMW 500	167918	03.18.2026
UXM 5G Wireless Test Set	KEYSIGHT	E7515B	MY58460166	07.30.2025
USB Audio Module	KEYSIGHT	U8903B-UAM	101006	N/A

6. Test Result Summary

6.1 TIA-5050 full test results for codecs of applicant's choosing

According to sections 2.a. of KDB 285076 D05 HAC Waiver DA 23-014 v01, only the highest bit rate of EVS-NB and EVS-WB codecs selected by the applicant were tested.

All tests were performed with EUT volume set to MAX -1 level and HAC tone control mode turned on.

Mount Force	Trans. Mode	Air Inter.	Band (Ant.)	Channel	Freq. (MHz)	BW (MHz)	Modulation		RB	Conv. Gain (dB)	Min PN-SDNR (dB)	Frequency Response	
												LRP	Margin (dB)
2N	NB	LTE FDD	B30 (Ant.I)	CH.27710	2 310	10	16QAM		1/49	12.01	29.42	FF	2.05
		LTE TDD	B41 PC3 (Ant.I)	CH.40620	2 593	20	QPSK		50/25	12.12	29.99	FF	1.94
		NR FDD	n25 (Ant.I)	CH.376500	1 882.5	40	DFT-s-OFDM	QPSK	1/108	11.92	28.91	FF	1.10
		NR TDD	n38 (Ant.I)	CH.519000	2 595	20	CP-OFDM	QPSK	1/0	11.92	30.04	FF	1.46
	WB	LTE FDD	B30 (Ant.I)	CH.27710	2 310	10	16QAM		1/49	14.87	28.29	FF	1.01
		LTE TDD	B41 PC3 (Ant.I)	CH.40620	2 593	20	QPSK		50/25	14.91	25.38	FF	1.01
		NR FDD	n25 (Ant.I)	CH.376500	1 882.5	40	DFT-s-OFDM	QPSK	1/108	15.09	27.50	FF	1.37
		NR TDD	n38 (Ant.I)	CH.519000	2 595	20	CP-OFDM	QPSK	1/0	14.72	25.47	FF	1.31
8N	NB	LTE FDD	B30 (Ant.I)	CH.27710	2 310	10	16QAM		1/49	14.14	32.11	FF	1.84
		LTE TDD	B41 PC3 (Ant.I)	CH.40620	2 593	20	QPSK		50/25	14.28	32.09	FF	1.96
		NR FDD	n25 (Ant.I)	CH.376500	1 882.5	40	DFT-s-OFDM	QPSK	1/108	13.95	31.40	FF	1.76
		NR TDD	n38 (Ant.I)	CH.519000	2 595	20	CP-OFDM	QPSK	1/0	13.89	30.49	FF	1.35
	WB	LTE FDD	B30 (Ant.I)	CH.27710	2 310	10	16QAM		1/49	16.73	28.55	FF	1.01
		LTE TDD	B41 PC3 (Ant.I)	CH.40620	2 593	20	QPSK		50/25	16.94	26.00	FF	1.02
		NR FDD	n25 (Ant.I)	CH.376500	1 882.5	40	DFT-s-OFDM	QPSK	1/108	16.77	27.18	FF	1.24
		NR TDD	n38 (Ant.I)	CH.519000	2 595	20	CP-OFDM	QPSK	1/0	16.58	25.93	FF	1.47

6.2 Conversational Gain for other codecs

According to section 2.b. of KDB 285076 D05 HAC Waiver DA 23-914 v01, only conversational gain was tested for codecs not evaluated in section 6.1.

All tests were performed with EUT volume set to MAX -1 level and HAC tone control mode turned on.

Mount Force	Trans. Mode	Air Inter.	Codec	Band	Channel	BW	Modulation	RB	Limit (dB)	Conv. Gain (dB)
2 N	NB	WCDMA	AMR-NB 4.75 kbps	B2 (Ant.I)	CH.9400				6	12.00
		LTE FDD	AMR-NB 4.75 kbps	B30 (Ant.I)	CH.27710	10	16QAM	1/49		11.79
			EVS-NB 5.9 kbps	B30 (Ant.I)	CH.27710	10	16QAM	1/49		11.84
		LTE TDD	AMR-NB 4.75 kbps	B41 PC3 (Ant.I)	CH.40620	20	QPSK	50/25		11.70
			EVS-NB 5.9 kbps	B41 PC3 (Ant.I)	CH.40620	20	QPSK	50/25		11.82
		NR FDD	AMR-NB 4.75 kbps	n25 (Ant.I)	CH.376500	40	DFT-s-OFDM QPSK	1/108		11.73
			EVS-NB 5.9 kbps	n25 (Ant.I)	CH.376500	40	DFT-s-OFDM QPSK	1/108		11.83
		NR TDD	AMR-NB 4.75 kbps	n38 (Ant.I)	CH.519000	20	CP-OFDM QPSK	1/0		11.86
			EVS-NB 5.9 kbps	n38 (Ant.I)	CH.519000	20	CP-OFDM QPSK	1/0		11.90
	WB	WCDMA	AMR-WB 6.6 kbps	B2 (Ant.I)	CH.9400				6	13.44
		LTE FDD	AMR-WB 6.6 kbps	B30 (Ant.I)	CH.27710	10	16QAM	1/49		14.13
			EVS-WB 5.9 kbps	B30 (Ant.I)	CH.27710	10	16QAM	1/49		14.43
		LTE TDD	AMR-WB 6.6 kbps	B41 PC3 (Ant.I)	CH.40620	20	QPSK	50/25		14.18
			EVS-WB 5.9 kbps	B41 PC3 (Ant.I)	CH.40620	20	QPSK	50/25		14.69
		NR FDD	AMR-WB 6.6 kbps	n25 (Ant.I)	CH.376500	40	DFT-s-OFDM QPSK	1/108		14.61
			EVS-WB 5.9 kbps	n25 (Ant.I)	CH.376500	40	DFT-s-OFDM QPSK	1/108		14.50
		NR TDD	AMR-WB 6.6 kbps	n38 (Ant.I)	CH.519000	20	CP-OFDM QPSK	1/0		14.28
			EVS-WB 5.9 kbps	n38 (Ant.I)	CH.519000	20	CP-OFDM QPSK	1/0		14.42
8 N	NB	WCDMA	AMR-NB 4.75 kbps	B2 (Ant.I)	CH.9400				6	13.55
		LTE FDD	AMR-NB 4.75 kbps	B30 (Ant.I)	CH.27710	10	16QAM	1/49		13.63
			EVS-NB 5.9 kbps	B30 (Ant.I)	CH.27710	10	16QAM	1/49		13.67
		LTE TDD	AMR-NB 4.75 kbps	B41 PC3 (Ant.I)	CH.40620	20	QPSK	50/25		13.71
			EVS-NB 5.9 kbps	B41 PC3 (Ant.I)	CH.40620	20	QPSK	50/25		14.15
		NR FDD	AMR-NB 4.75 kbps	n25 (Ant.I)	CH.376500	40	DFT-s-OFDM QPSK	1/108		13.71
			EVS-NB 5.9 kbps	n25 (Ant.I)	CH.376500	40	DFT-s-OFDM QPSK	1/108		13.78
		NR TDD	AMR-NB 4.75 kbps	n38 (Ant.I)	CH.519000	20	CP-OFDM QPSK	1/0		13.81
			EVS-NB 5.9 kbps	n38 (Ant.I)	CH.519000	20	CP-OFDM QPSK	1/0		13.55
	WB	WCDMA	AMR-WB 6.6 kbps	B2 (Ant.I)	CH.9400				6	16.07
		LTE FDD	AMR-WB 6.6 kbps	B30 (Ant.I)	CH.27710	10	16QAM	1/49		16.06
			EVS-WB 5.9 kbps	B30 (Ant.I)	CH.27710	10	16QAM	1/49		16.20
		LTE TDD	AMR-WB 6.6 kbps	B41 PC3 (Ant.I)	CH.40620	20	QPSK	50/25		16.28
			EVS-WB 5.9 kbps	B41 PC3 (Ant.I)	CH.40620	20	QPSK	50/25		16.70
		NR FDD	AMR-WB 6.6 kbps	n25 (Ant.I)	CH.376500	40	DFT-s-OFDM QPSK	1/108		16.33
			EVS-WB 5.9 kbps	n25 (Ant.I)	CH.376500	40	DFT-s-OFDM QPSK	1/108		16.34
		NR TDD	AMR-WB 6.6 kbps	n38 (Ant.I)	CH.519000	20	CP-OFDM QPSK	1/0		16.38
			EVS-WB 5.9 kbps	n38 (Ant.I)	CH.519000	20	CP-OFDM QPSK	1/0		16.36

7. Test Details

7.1 Receive Volume Control Performance

7.1.1 Test Limit

- 1) With a mounting force of 8N, the DUT shall have at least one volume control setting that will produce a conversational gain of ≥ 18 dB with the output distortion and frequency response meeting the requirements.
- 2) With a mounting force of 2N, the DUT shall have at least one volume control setting that will produce a conversational gain of ≥ 6 dB with the output distortion and frequency response meeting the requirements.

** Because the 18 dB limit for 8 N mounting force test is waived by waiver DA23-914, this test report only confirmed the 6 dB limit for the entire codecs.*

7.1.2 Test Procedure

- 1) Configure the DUT with a mounting force of 8N and test equipment as shown in Figure 1 in an active call state with the applicable codec for the transmission mode under test.
- 2) Set the DUT volume control to the maximum setting.
- 3) If the DUT has an adjustable tone control feature, a tone control setting that meets the frequency response requirements.
- 4) Apply the real speech test signal at a level of -20 dBm0 at the RETP and measure the acoustic output at the Drum Reference Point (DRP) over one complete sequence of the test signal.
- 5) Translate the measurement made at the DRP to the Free Field (FF) using the translation data.
- 6) Over the applicable frequency band, determine the ASL in dBSPL for the resulting sound pressure level in accordance with Method B of ITU-T Recommendation P. 56:
 - a. Narrowband 100 Hz through 4 000 Hz.
 - b. Wideband 100 Hz through 7 720 Hz.
- 7) Calculate the Conversational Gain by subtracting 70 dB from the measured dBSPL.

8) Measure the output distortion. If a distortion failure occurs at the maximum volume control setting, reduce the volume control setting and repeat the measurement to determine if a setting can be found for which the conversational gain requirement is met without a distortion failure.

9) Repeat steps 2) to 8) with a mounting force of 2N.

7.1.3 Test Result

All tests were performed with EUT volume set to MAX -1 level and HAC tone control mode turned on.

Mount Force	Trans. Mode	Air Inter.	Codec	Band	Channel	BW (MHz)	Modulation	RB	Limit (dB)	Conv. Gain (dB)
2N	NB	WCDMA	AMR-NB 4.75 kbps	B2 (Ant.I)	CH.9400				6	12.00
		LTE FDD	AMR-NB 4.75 kbps	B30 (Ant.I)	CH.27710	10	16QAM	1/49		11.79
			EVS-NB 5.9 kbps	B30 (Ant.I)	CH.27710	10	16QAM	1/49		11.84
		LTE TDD	AMR-NB 4.75 kbps	B41 PC3 (Ant.I)	CH.40620	20	QPSK	50/25		11.70
			EVS-NB 5.9 kbps	B41 PC3 (Ant.I)	CH.40620	20	QPSK	50/25		11.82
		NR FDD	AMR-NB 4.75 kbps	n25 (Ant.I)	CH.376500	40	DFT-s-OFDM QPSK	1/108		11.73
			EVS-NB 5.9 kbps	n25 (Ant.I)	CH.376500	40	DFT-s-OFDM QPSK	1/108		11.83
		NR TDD	AMR-NB 4.75 kbps	n38 (Ant.I)	CH.519000	20	CP-OFDM QPSK	1/0		11.86
			EVS-NB 5.9 kbps	n38 (Ant.I)	CH.519000	20	CP-OFDM QPSK	1/0		11.90
	WB	WCDMA	AMR-WB 6.6 kbps	B2 (Ant.I)	CH.9400				6	13.44
		LTE FDD	AMR-WB 6.6 kbps	B30 (Ant.I)	CH.27710	10	16QAM	1/49		14.13
			EVS-WB 5.9 kbps	B30 (Ant.I)	CH.27710	10	16QAM	1/49		14.43
		LTE TDD	AMR-WB 6.6 kbps	B41 PC3 (Ant.I)	CH.40620	20	QPSK	50/25		14.18
			EVS-WB 5.9 kbps	B41 PC3 (Ant.I)	CH.40620	20	QPSK	50/25		14.69
		NR FDD	AMR-WB 6.6 kbps	n25 (Ant.I)	CH.376500	40	DFT-s-OFDM QPSK	1/108		14.61
			EVS-WB 5.9 kbps	n25 (Ant.I)	CH.376500	40	DFT-s-OFDM QPSK	1/108		14.50
		NR TDD	AMR-WB 6.6 kbps	n38 (Ant.I)	CH.519000	20	CP-OFDM QPSK	1/0		14.28
			EVS-WB 5.9 kbps	n38 (Ant.I)	CH.519000	20	CP-OFDM QPSK	1/0		14.42
8N	NB	WCDMA	AMR-NB 4.75 kbps	B2 (Ant.I)	CH.9400				6	13.55
		LTE FDD	AMR-NB 4.75 kbps	B30 (Ant.I)	CH.27710	10	16QAM	1/49		13.63
			EVS-NB 5.9 kbps	B30 (Ant.I)	CH.27710	10	16QAM	1/49		13.67
		LTE TDD	AMR-NB 4.75 kbps	B41 PC3 (Ant.I)	CH.40620	20	QPSK	50/25		13.71
			EVS-NB 5.9 kbps	B41 PC3 (Ant.I)	CH.40620	20	QPSK	50/25		14.15
		NR FDD	AMR-NB 4.75 kbps	n25 (Ant.I)	CH.376500	40	DFT-s-OFDM QPSK	1/108		13.71
			EVS-NB 5.9 kbps	n25 (Ant.I)	CH.376500	40	DFT-s-OFDM QPSK	1/108		13.78
		NR TDD	AMR-NB 4.75 kbps	n38 (Ant.I)	CH.519000	20	CP-OFDM QPSK	1/0		13.81
			EVS-NB 5.9 kbps	n38 (Ant.I)	CH.519000	20	CP-OFDM QPSK	1/0		13.55
	WB	WCDMA	AMR-WB 6.6 kbps	B2 (Ant.I)	CH.9400				6	16.07
		LTE FDD	AMR-WB 6.6 kbps	B30 (Ant.I)	CH.27710	10	16QAM	1/49		16.06
			EVS-WB 5.9 kbps	B30 (Ant.I)	CH.27710	10	16QAM	1/49		16.20
		LTE TDD	AMR-WB 6.6 kbps	B41 PC3 (Ant.I)	CH.40620	20	QPSK	50/25		16.28
			EVS-WB 5.9 kbps	B41 PC3 (Ant.I)	CH.40620	20	QPSK	50/25		16.70
		NR FDD	AMR-WB 6.6 kbps	n25 (Ant.I)	CH.376500	40	DFT-s-OFDM QPSK	1/108		16.33
			EVS-WB 5.9 kbps	n25 (Ant.I)	CH.376500	40	DFT-s-OFDM QPSK	1/108		16.34
		NR TDD	AMR-WB 6.6 kbps	n38 (Ant.I)	CH.519000	20	CP-OFDM QPSK	1/0		16.38
			EVS-WB 5.9 kbps	n38 (Ant.I)	CH.519000	20	CP-OFDM QPSK	1/0		16.36

7.2 Receive Distortion and Noise Performance

7.2.1 Test Limit

With a mounting force of 8N and 2N, the ratio of the stimulus signal power to the 100 Hz to 8000 Hz total A-weighted distortion and noise power shall be ≥ 20 dB when tested over the range of 1/3 octave band center frequencies:

- 1) Narrowband transmission mode: Each 1/3 octave band center frequency from 400 Hz to 3150 Hz.
- 2) Wideband transmission mode: Each 1/3 octave band center frequency from 250 Hz to 5000 Hz.

* According to waiver DA23-914, distortion test is only performed for EVS-NB 24.4 kbps and EVS-WB 24.4 kbps.

7.2.2 Test Procedure

- 1) Configure the DUT with a mounting force of 8N and test equipment as shown in Figure 1 in an active call state with the applicable codec for the transmission mode under test with the volume control at the setting.
- 2) Receive distortion and noise is measured using the PN-SDNR procedure.
- 3) To ensure DUT activation, apply the real speech test signal at a level of -20 dBm0 followed immediately by the initial 1/3 octave center frequency PN test signal based on the narrowband or wideband operating mode. Measure the acoustic output at the DRP over the complete sequence of the PN test signal.
- 4) Translate the measurement made at the DRP to the FF using the translation data.
- 5) Calculate the acoustic output unweighted total signal power of the stimulus measurement band.
- 6) Calculate the notched A-weighting distortion and noise components.
- 7) Calculate the ratio of the signal power to the total A-weighted distortion and noise power.
- 8) Repeat for each of the remaining 1/3 octave center frequencies based on the narrowband or wideband operating mode.
- 9) Repeat steps 2-8 with a mounting force of 2N.

7.2.3 Test Result

All tests were performed with EUT volume set to MAX -1 level and HAC tone control mode turned on.

This report contains only the worst case of Section 6.1 test results.

Codec	Mount Force	Air Inter.	Band	Channel	Freq. (MHz)	BW (MHz)	Modulation	RB	Dst. Center Freq. (MHz)	Limit (dB)	PN-SDNR (dB)
EVS-NB 24.4 kbps	2N	NR FDD	n25 (Ant.I)	CH.376500	1 882.5	40	DFT-s_OFDM QPSK	1/108	400	20	31.39
									500		33.98
									630		35.93
									800		28.91
									1 000		31.03
									1 250		34.60
									1 600		40.98
									2 000		36.59
	8N	NR TDD	n38 (Ant.I)	CH.519000	2 595	20	CP-OFDM QPSK	1/0	2 500	20	36.82
									3 150		39.64
									400		30.49
									500		33.63
									630		36.41
									800		36.74
									1 000		35.71
									1 250		34.53
EVS-WB 24.4 kbps	2N	LTE TDD	B41 PC3 (Ant.I)	CH.40620	2 593	20	QPSK	50/25	1 600	20	40.88
									2 000		39.09
									2 500		36.03
									3 150		39.21
									250		28.14
									315		30.83
									400		32.91
									500		35.27
									630		34.66
									800		35.01
									1 000		33.30
									1 250		33.35
	8N	NR TDD	n38 (Ant.I)	CH.519000	2 595	20	CP-OFDM QPSK	1/0	1 600		38.10
									2 000		25.38
									2 500		44.92
									3 150		32.16
									4 000		41.83
									5 000		42.94
									250	20	25.93
									315		27.89
									400		30.42
									500		31.44
									630		32.02
									800		33.45
									1 000		34.59
									1 250		34.97
									1 600		36.14
									2 000		37.20
									2 500		31.46
									3 150		31.33
									4 000		31.62
									5 000		31.67

7.3 Receive Acoustic Frequency Response Performance

7.3.1 Test Limit

For the volume control settings determined with a mounting force of 8N and 2N, the receive frequency response shall be measured at the DRP in 1/12 octave bands. After translation to the FF or DF, it shall fall between the applicable upper and lower limits.

The exact limit value at any 1/12 octave band center frequency falling between two consecutive points specified in the table may be calculated using the formula follow:

$$X_f = X_1 + (X_2 - X_1) * \left(\frac{\log_{10} f - \log_{10} f_1}{\log_{10} f_2 - \log_{10} f_1} \right)$$

Where

X_f = limit value at frequency f

X_1 = limit value at frequency f_1 as given in table

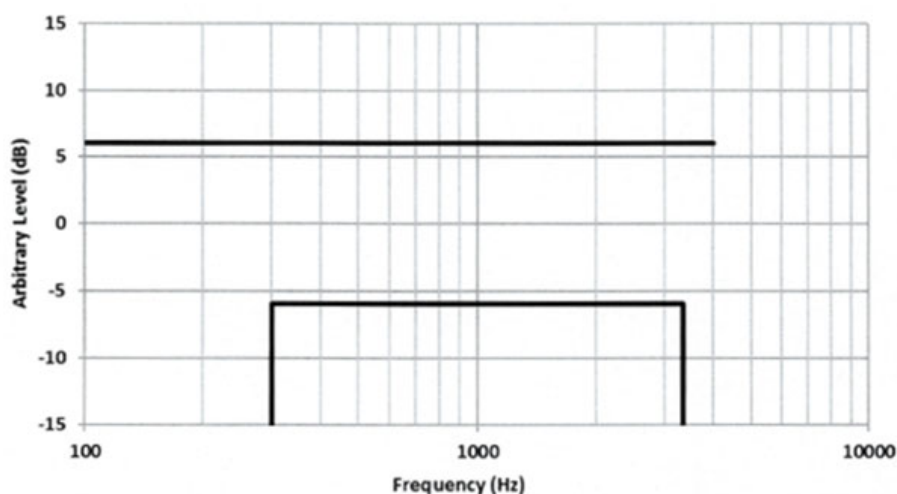
X_2 = limit value at frequency f_2 as given in table

The results for each 1/12 octave band measurement are to be evaluated against the upper and lower limit values only at the center frequency point for that band (i.e., not the entire width of the band). For graphical purposes, the individual 1/12 octave band measurement results are plotted as points on a linear dB scale (y-axis) versus the band's center frequency on a logarithmic frequency scale (x-axis). The frequency response limits are floating or "best fit" (i.e., the maximum and minimum deviations from the upper and lower limits should be equidistant from those limits).

* According to waiver DA23-914, Frequency Response test is only performed for EVS-NB 24.4 kbps and EVS-WB 24.4 kbps.

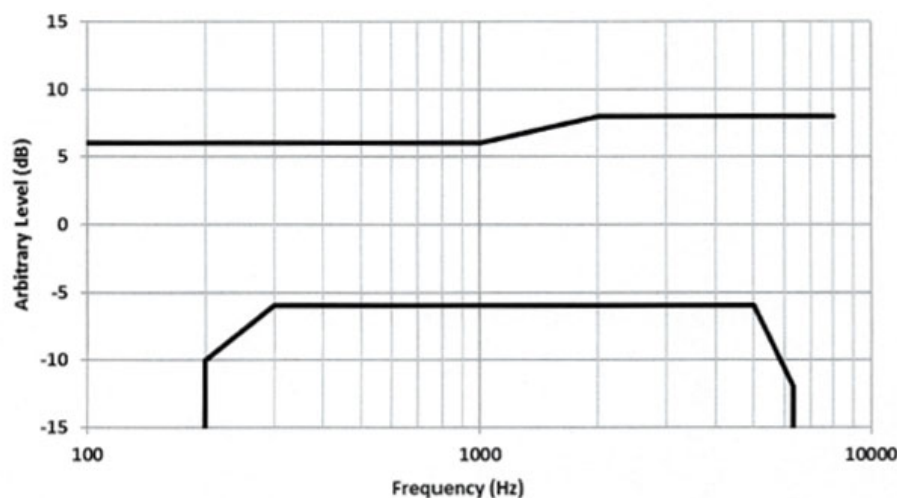
1) Narrowband Receive Frequency Response Limits

Lower Limit Frequency (Hz)	Lower Limit (dB)	Upper Limit Frequency (Hz)	Upper Limit (dB)
300	-6	100	+6
3 400	-6	4 000	+6



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	1 000	+6
5 000	-6	2 000	+8
6 300	-12	8 000	+8



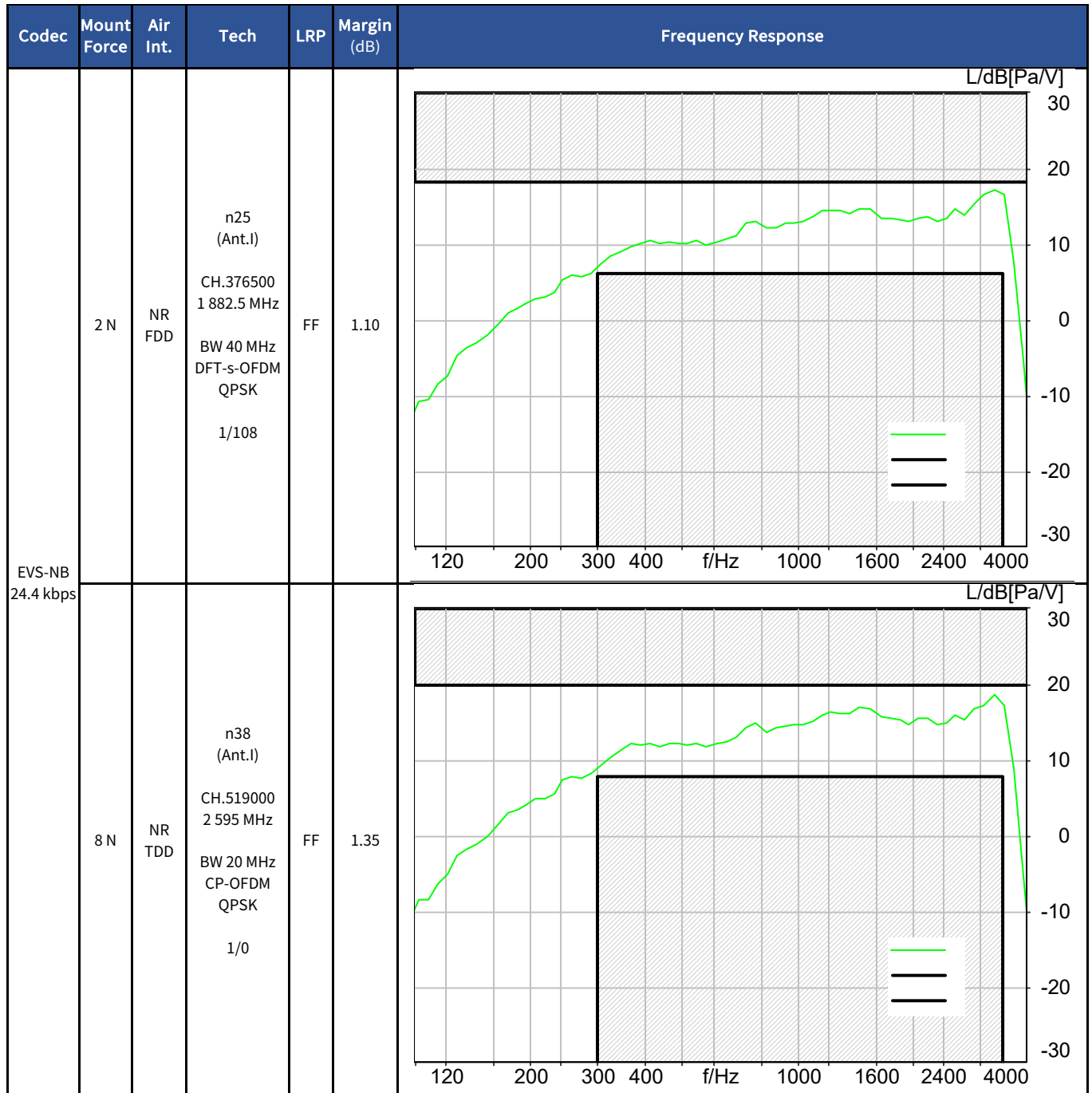
7.3.2 Test Procedure

- 1) Configure the DUT with mounting force of 8N and test equipment as shown in Figure 1 in an active call state with the applicable codec for the transmission mode under test with the volume control setting.
- 2) If the DUT has an adjustable tone control feature the initial measurement is to be performed with the default tone control setting.
- 3) Apply the real speech test signal with a level of -20 dBm0 at the RETP.
- 4) Capture the frequency spectrum at the DRP of the HATS using real-time analysis with 1/12 octave bands over the frequency range from 100 Hz to 4000 Hz for narrowband measurements, or over the frequency range from 100 Hz to 8000 Hz for wideband measurements, averaged over the entire duration of the test signal.
- 5) Transform the DRP frequency spectrum measurement to the FF or DF.
- 6) Divide the 1/12 octave measurement data by the 1/12 octave frequency spectrum of the test signal at the RETP and present the measurement in terms of dB (Pa/V).
- 7) Apply the applicable frequency response limits to determine compliance.
- 8) If the default tone control setting does not meet the requirement, repeat the above steps for other tone control settings to determine a tone control setting that meets the requirements.
- 9) Repeat with a Mounting force of 2N

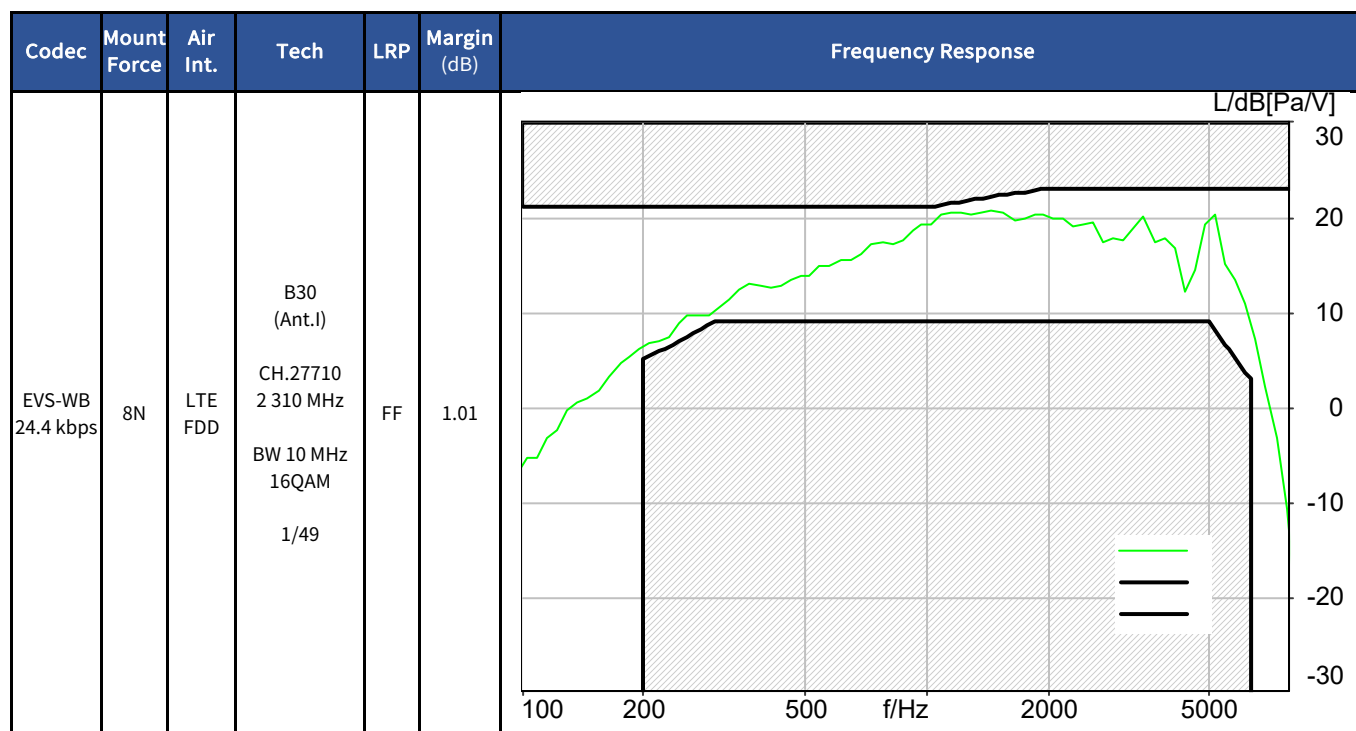
7.3.3 Test Result

All tests were performed with EUT volume set to MAX -1 level and HAC tone control mode turned on.

This report contains only the worst case of Section 6.1 test results.



Codec	Mount Force	Air Int.	Tech	LRP	Margin (dB)	Frequency Response
EVS-WB 24.4 kbps	2 N	LTE FDD	B30 (Ant.I) CH.27710 2 310 MHz BW 10 MHz 16QAM 1/49	FF	1.01	
		LTE TDD	B41 PC3 (Ant.I) CH.40620 2 593 MHz BW 20 MHz QPSK 50/25	FF	1.01	



End of Report