HAC (Volume Control) Test Report

Application No.:	SUCR2501000028WM
FCC ID:	2ACCJH190
Applicant:	TCL Communication Ltd.
Applicant Address:	5/F, Building 22E, 22 Science Park East Avenue, Hong Kong Science Park, Shatin, NT, Hong Kong
Manufacturer:	TCL Communication Ltd.
Manufacturer Address:	5/F, Building 22E, 22 Science Park East Avenue, Hong Kong Science Park, Shatin, NT, Hong Kong
Product Name:	Smartphone
Model No.(EUT):	T519N, T521N
Standards:	ANSI C63.19-2019 ANSI/TIA-5050-2018 47CFR Part 20.19 KDB 285076 D01 v06r04 KDB 285076 D04 v02 KDB 285076 D05 v01
Date of Receipt:	2025/01/08
Date of Test:	2025/01/08 to 2025/01/23
Date of Issue:	2025/02/13
Test conclusion:	**PASS ***

* In the configuration tested, the EUT detailed in this report complied with the standards specified above.

Revision Record			
Version	**Description**	**Date**	**Remark**
00	Original	2025-02-13	/

Authorized for issue by:				
Tested By		Hainan Sun **Hainan Sun/Project Engineer**		
Approved By		Nada Cao **Nada Cao/Reviewer**		

2 Test Summary of Minimum Conversational Gain

Mode	Band	Conv. Gain (dB)		Limit (dB)	Result
		2N	8N		
GSM	850	8.64	12.35		Pass
	1900	8.60	12.27		Pass
WCDMA	II	8.38	12.33		Pass
	IV	8.12	12.33		Pass
	V	8.28	12.27		Pass
LTE	B 2	8.31	11.97		Pass
	B 4	8.08	12.12		Pass
	B 5	8.38	12.33		Pass
	B 7	8.37	12.13		Pass
	B 12	8.30	12.10		Pass
	B 13	8.35	12.10		Pass
	B 14	8.39	12.07		Pass
	B 17	8.30	12.08		Pass
	B 25	8.28	12.17		Pass
	B 26	8.35	12.23		Pass
	B 38	8.36	12.14		Pass
	B 41	8.38	12.05		Pass
	B 42	8.36	12.11		Pass
	B 48	8.24	11.96		Pass
	B 66	8.25	11.92		Pass
	B 71	8.12	11.98		Pass
NR	N2	8.31	11.95		Pass
	N5	8.29	11.99		Pass
	N7	8.25	12.04		Pass
	N41	8.41	12.08		Pass
	N48	8.28	11.94		Pass
	N66	8.28	11.92		Pass
	N71	8.22	11.95		Pass
	N78	6.25	10.41		Pass
WLAN-2.4G	802.11b	7.64	11.64		Pass
	802.11g	7.92	11.86		Pass
	802.11n	7.96	11.69		Pass
	802.11ac	7.99	11.89		Pass
WLAN-5G	802.11a	7.57	11.27		Pass
	802.11n	7.42	11.13		Pass
	802.11ac	7.60	11.46		Pass
Minimum Conversational Gain		6.25	10.41		Pass

Remark:
T519N and T521N are identical except:
1. Change pin to pin memory from 4+128 to 6+256G
2. T521N add Eye protection coating on LCD
3. T521N adds an additional compatible charging IC chip, and the charging power is changed from 10W to 18W, and the peripheral circuitry remains unchanged
4. T521N add extra side key
Therefore, only T519N has been tested in this report.

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4 General Information

4.1 General Description of EUT

IMEI:	354924950003379/354924950003445		
Hardware Version:	06		
Software Version:	5JS8		
Antenna Type:	PIFA Antenna		
Frequency Bands:	Band	Tx (MHz)	Rx (MHz)
	GSM850	824 - 849	869 - 894
	GSM1900	1850 - 1910	1930 - 1990
	WCDMA Band II	1850 - 1910	1930 - 1990
	WCDMA Band IV	1710 - 1755	2110 - 2155
	WCDMA Band V	824 - 849	869 - 894
	LTE Band 2	1850 - 1910	1930 - 1990
	LTE Band 4	1710 - 1755	2110 - 2155
	LTE Band 5	824 - 849	869 - 894
	LTE Band 7	2500 - 2570	2620 - 2690
	LTE Band 12	699 - 716	729 - 746
	LTE Band 13	777 - 787	746 - 756
	LTE Band 14	788 - 798	758 - 768
	LTE Band 17	704 - 716	734 - 746
	LTE Band 25	1850 - 1915	1930 - 1995
	LTE Band 26	814 - 849	859 - 894
	LTE Band 66	1710 - 1780	2110 - 2200
	LTE Band 71	663-698	617-652
	LTE Band 38	2570 - 2620	2570 - 2620
	LTE Band 41	2496 - 2690	2496 - 2690
	LTE Band 42	3450 - 3600	3450 - 3600
	LTE Band 48	3550 - 3700	3550 - 3700
	NR Band n2	1850 - 1910	1930 - 1990
	NR Band n5	824 - 849	869 - 894
	NR Band n7	2500 - 2570	2620 - 2690
	NR Band n66	1710 - 1780	2110 - 2200
	NR Band n41(NSA only)	2496 - 2690	2496 - 2690
	NR Band n48(NSA only)	3550 - 3700	3550 - 3700
	NR Band n71	663 – 698	617 – 652
	NR Band n78	3450 - 3700	3450 - 3700
	Bluetooth	2400 - 2483.5	2400 - 2483.5
	Wi-Fi 2.4G	2412 - 2462	2412 - 2462
	Wi-Fi 5G	5180~5240MHz	5180~5240MHz
		5260~5320MHz	5260~5320MHz
		5500~5720MHz	5500~5720MHz
		5745~5825MHz	5745~5825MHz
	NFC	13.56MHz	13.56MHz

4.2 Air interfaces and Operation Mode.

Air Interface	Band (MHz)	Type	ANSI C63.19 Tested	Simultaneous Transmitter	Name of Voice Service	Power Reduction
GSM	850	VO	Yes	BT, Wi-Fi	CMRS Voice	NO
	1900					
	EDGE	VD	Yes		NO	
WCDMA	Band II	VO	Yes	BT, Wi-Fi	CMRS Voice	NO
	Band IV					
	Band V					
	HSPA	VD	Yes		Google Meet*	
LTE FDD	LTE band 2	VD	Yes	BT, Wi-Fi	VoLTE Google Meet*	NO
	LTE band 4					
	LTE band 5					
	LTE band 7					
	LTE band 12					
	LTE band 13					
	LTE band 14					
	LTE band 17					
	LTE band 25					
	LTE band 26					
	LTE band 66					
	LTE band 71					
LTE TDD	LTE band 38	VD	Yes	BT, Wi-Fi	VoLTE Google Meet*	NO
	LTE band 41					
	LTE band 42					
	LTE band 48					
FR1 FDD	FR1 n2	DT	Yes	BT, Wi-Fi	Google Meet*	NO
	FR1 n5					
	FR1 n7					
	FR1 n66					
	FR1 n71					
FR1 TDD	FR1 n41	DT	Yes	BT, Wi-Fi	Google Meet*	NO
	FR1 n48					
	FR1 n78					
Wi-Fi	2450	VD	Yes	WWAN	Google Meet*	NO
	5200					
	5300					
	5500					
	5800					
BT	2450	DT	No(1)	WWAN	NO	NO

VO: Legacy Cellular Voice Service
DT: Digital Transport (no voice)
*ANSI C63.19-2019 use table 6.1 to establish the Normal speech input level and NOTE 2 of table 6.1 identifies the group of VoIP voice services that use −16 dBm0 as the normal speech input level.
Remark:
1.The WLAN6GHz U-NII 6/7/8 were above 6GHz and were not evaluated due to outside of the current scope of ANSI C63.19 and FCC HAC regulations.
2.The WLAN6GHz UNI-5 was evaluated for operations which are entirely below 6GHz, above 6 GHz were not evaluated due outside of the current scope of ANSI C63.19 and FCC HAC regulations.
3. Because features of Google Meet allow the option of voice-only communications, Meet has been tested for HAC/T-Coil compatibility to ensure the best user experience.
4. The Google Meet and google Fi the audio path, parameter and audio codec are all the same, therefore, the Google Meet is evaluation for this device to show compliance.

EUT support Codec for Volume control test

Air interface	Audio Codec Evaluated
GSM	HR V1, FR V1, FR V2
WCDMA	AMR-NB,AMR-WB,EVS-NB,EVS-WB
LTE	AMR-NB,AMR-WB,EVS-NB,EVS-WB
NR	AMR-NB,AMR-WB,EVS-NB,EVS-WB
WLAN	AMR-NB,AMR-WB,EVS-NB,EVS-WB

Codec /Birate				
NB AMR	WB AMR		EVS NB	EVS WB
4.75 Kbps	6.60Kbps	18.25Kbps	5.9Kbps	5.9 Kbps
5.15Kbps	8.85Kbps	19.85Kbps	7.2Kbps	7.2Kbps
5.90Kbps	12.65Kbps	23.05Kbps	8.0Kbps	8.0Kbps
6.60Kbps	14.25Kbps	23.85Kbps	9.6Kbps	9.6Kbps
7.40 Kbps	15.85Kbps		13.2Kbps	13.2Kbps
7.95Kbps			16.4Kbps	16.4Kbps
10.20Kbps			24.4Kbps	24.4Kbps
12.20Kbps				

4.3 Test Environment

Temperature	Relative humidity
Relative humidity	54%
Atmospheric pressure	101.7kPa
Background Noise	15dB

4.4 Measurement Uncertainty

For ANSI/TIA-5050 testing, the EUT was linked and controlled by base station emulator. Communication between the EUT and the emulator was established by coaxial connection. The EUT was set from the emulator to radiate maximum output power during testing. Also EUT was set to backlight off during testing.

Test Item	Uncertainty
Receiving volume control	1.7dB
Recriving distortion and noise	1.7dB
Receiving frequency response	1.7dB

Note:

a) All uncertainty values are expanded standard uncertainty to give a confidence level of 95%, based on coverage factor k=2.

b) Depends on the microphone calibration.The value is valid if calibration is carried out with recommended pistonphone/calibrator in the HMS II.3 manual.

c) Time and frequency accuracies of labCORE determined by the internal clock accuracy. The time and frequency resolution and accuracy may change due to analysis of the digital signals in ACQUA or if an external clock is applied.

4.5 Test Location

All tests were performed at:
SGS-CSTC Standards Technical Services Co., Ltd. Suzhou Branch
No. 10, Weiye Road, Kunshan Development Zone, Suzhou, Jiangsu, China
No tests were sub-contracted.
Note:

a) SGS is not responsible for wrong test results due to incorrect information (e.g., max. internal working frequency, antenna gain, cable loss, etc) is provided by the applicant. (If applicable).

b) SGS is not responsible for the authenticity, integrity and the validity of the conclusion based on results of the data provided by applicant. (If applicable).

c) Sample(s) provided by customer.

4.6 Test Facility

The test facility is recognized, certified, or accredited by the following organizations:

• A2LA

SGS-CSTC Standards Technical Services Co., Ltd. Suzhou Branch is accredited by the American Association for Laboratory Accreditation (A2LA). Certificate No. 6706.01.

• FCC

SGS-CSTC Standards Technical Services Co., Ltd. Suzhou Branch has been recognized by FCC as an accredited testing laboratory. Designation Number: CN1387.

• ISED

SGS-CSTC Standards Technical Services Co., Ltd. Suzhou Branch has been recognized by ISED as an accredited testing laboratory. Company Number: 32368

5 Equipment list

Equipment	Model	Equipment No.	Cal Data	Cal Due Data
Microphone	46AE	KSES307108	2024-06-13	2025-06-14
Sound calibrator	GRAS 42AG	KSES304302a	2024-06-13	2025-06-14
HEAD Measurement System	HMS II.3-LN	KSES330101	/	/
Multi-channel audio Analyzer	Labcore	KSES304303	2024-06-13	2025-06-14
Radio communication tester	CMW 500	SUWI-01-16-05	2024-02-02	2025-02-03
Radio communication tester	CMX 500	SUWI-01-56-02	2024-01-30	2025-01-31
Acoustic Chamber	/	KSES330801	2023-02-05	2025-02-06

6 Volume Control Requirement

Conversational Gain

a) Per KDB 285076 D05, with a mounting force of 8N, the DUT shall have at least one volume control setting that will produce a conversational gain of ≥ 6dB.

b) Per KDB 285076 D05, with a mounting force of 2N, the DUT shall have at least one volume control setting that will produce a conversational gain of ≥ 6dB.

c) Calculate the Conversational Gain by subtracting 70 from the measures SPL.
[Conversational Gain = (Measured SPL Level-70dsSPL)]

Receive Distortion and Noise Performance:

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

a) Narrowband transmission mode: Each 1/3 octave band center frequency from 400Hz to 3150Hz.

b) Wideband transmission mode: Each 1/3 octave band center frequency from 250Hz to 5000Hz.

c) Per K 285076 D05, choose one narrowband and one wideband for all voice services, bands of operation and air interfaces over which it operates using one codec bit rate of the applicant's choosing to meet Receive Distortion and Noise Performance requirement.

Receive Acoustic Frequency Response Performance:

a) For the volume control settings determined in ANSI/TIA-5050 section 5.1.1 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,it shall fall between the applicable upper and lower limits.The exact limit values at any 1/12 octave band center frequency falling between two consecutive points specified in the table may be calculated using the formula given inEq 2 below:

$$X_f = X_1 + (X_2 - X_1) * \left(\frac{\log_{10} f - \log_{10} f_1}{\log_{10} f_2 - \log_{10} f_1}\right) \qquad \text{Eq 2}$$

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

b) For Narrowband: The 1/12 octave band frequency response after translation to the FF shall fall between the upper and lower limits (Arbitrary level) given the Table 1.

c) For wideband: The 1/12 octave band frequency response after translation to the FF shall fall between the upper and lower limits (Arbitrary level) given the Table 2.

Table 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

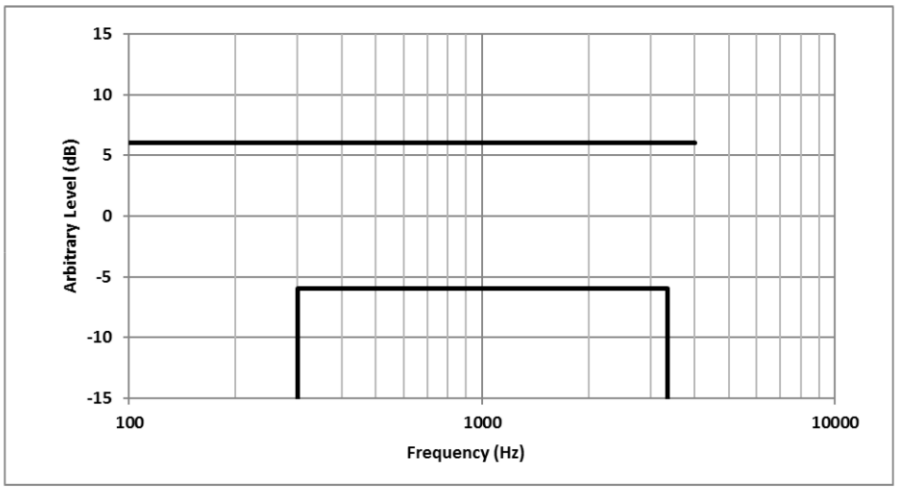


Figure 2 – Narrowband Receive Frequency Response Limits

Table 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
6300	-12	8000	+8

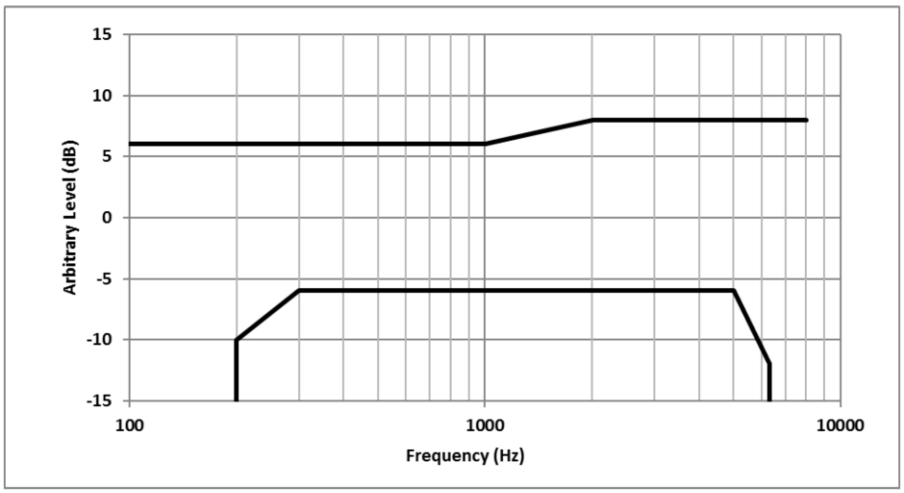


Figure 3 – Wideband Receive Frequency Response Limits

7 Measurement Procedure

According to ANSI /TIA-5050, the test procedure for wireless communications device is as below.

Conversational Gain

a) Configure the DUT with a mounting force of 8N and test equipment as shown in section 4 in an active call state with the applicable codec for the transmission mode under test.

b) Set the DUT volume control to the maximum setting.

c) If the DUT has an adjustable tone control feature, a tone control setting that meets the frequency response requirements in ANSI/TIA-5050 section 5.3.1shall be used.

d) The ACQUA system is apply the real speech test signal at a level of -20dBm0 at the RETP and measure the acoustic output at the Drum Reference Point (DRP) over one complete sequence of the test signal.

e) Translate the measurement made at DRP to Free Filed (FF) using the translation data in ANSI/TIA-5050 AnnexB.

f) Over the applicable frequency band, determine the ASL in SPL for the resulting sound pressure level in accordance with Method B of ITU-T Recommendation P.56,
Narrowband 100Hz through 4000 Hz
Wideband 100Hz through 7720 Hz
Calculate the Conversational Gain by subtracting 70 from the measured dBSPL.
[Conversational Gain = (Measured dBSPL Level – 70dBSPL) dB]

g) Measure output distortion per ANSI/TIA-5050 clause 5.2. 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 distorton failure.

h) Repeat steps 2-8 with a mounting force of 2N.

Receive Distortion and Noise Performance:

a) Configure the DUT with a mounting force of 8N and test equipment as shown in section in an active call state with the applicable codec for the transmission mode under test.

b) Receive distortion and noise is measured using the PN-SDNR procedure.

c) 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.

d) Translate the measurement made at DRP to the FF.

e) Calculate the acoustic out unweighted test signal power of the stimulus measurement band.

f) Calculate the notched A-weighting distortion and noise components.

g) Calculate the ratio of signal power to the total A-weighted distortion and noise power ad follow:

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

h) Repeat for each of the remaining 1/3 octave center frequencies based on the narrowband or wideband operating mode.

i) Repeat steps 2-8 with a mounting force of 2N.

j) The measured value that the system equipment will automatically calculate or converts to define whether it meets the requirements of ANSI/TIA-5050.

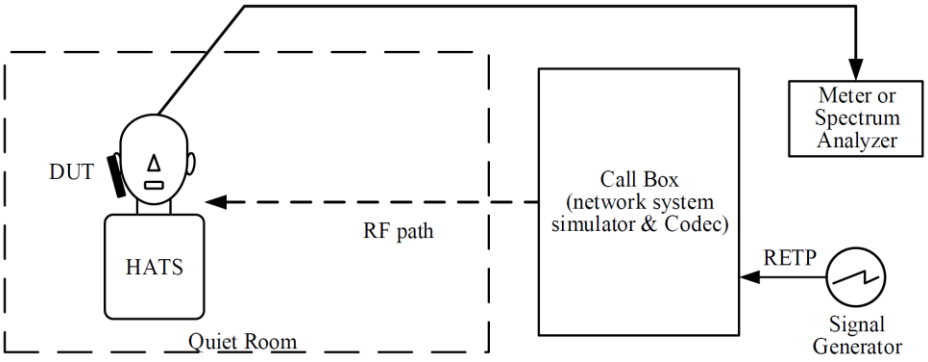
Receive Acoustic Frequency Response Performance:

a) 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.

b) If the DUT has an adjustable tone control feature the initial measurement is to be performed with the default tone control setting.

c) Apply the real speech test signal with a level of-20 dBm0 at the RETP.
d) 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.
e) Transform the DRP frequency spectrum measurement to the FF.
f) 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 (Pa/V).
g) Apply the applicable frequency response limits to determine compliance.
h) 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.
i) Repeat with a mounting force of 2N.
j) The receive acoustic frequency response performance was perform at max tone control setting.

8 System Description



Above is the measurement set-up diagram, and the sequence of the measurement is Volume Control testing procedure over a wireless communication device:

a) In order to satisfy the quiet room condition below 40 dBA background noise according to TIA-5050 standard, HATS and DUT were placed in Acoustic Chamber and the noise level was checked using Sound Level Meter 46AE.

b) 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.

c) 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. When testing NR calls using CMX500 Call box.

d) Handset Position, in all tests, handset was placed at the standard test position of IEEE std 269.

9 Test Result

Refer to Appendix A - Volume Control Test Data and Plots.

10 Test Setup Photo

Refer to Appendix - Test Setup Photo

11 EUT Constructional Details (EUT Photos)

Refer to Appendix - Photographs of EUT Constructional Details

--- End of the Report ---