RF-Emission Test Report

Application No.:	SEWM2308000313RG
Applicant:	Shenzhen Tinno Mobile Technology Corp.
Manufacturer:	Shenzhen Tinno Mobile Technology Corp.
Product Name:	Smart Phone
Model No.(EUT):	Celero3 5G+
FCC ID:	XD6U695DS
Standards:	ANSI C63.19-2011 CFR 47 FCC Part 20
Date of Receipt:	2023-08-14
Date of Test:	2023-09-11 to 2023-09-11
Date of Issue:	2023-10-18
Test conclusion:	**PASS ***

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

Authorized Signature:

Well Wei

Wireless Laboratory Manager

REVISION HISTORY

Revision Record				
Version	Chapter	Date	Modifier	Remark
01		2023-10-18		Original

TEST SUMMARY

Frequency Band	HAC RF Emission Test result*		M-rating
GSM850	E-Field dB(V/m)	36.10	M4
GSM1900	E-Field dB(V/m)	29.44	M4
WCDMA Band II	E-Field dB(V/m)	/	M4
WCDMA Band IV	E-Field dB(V/m)	/	M4
WCDMA Band V	E-Field dB(V/m)	/	M4
LTE Band 2	E-Field dB(V/m)	/	M4
LTE Band 4	E-Field dB(V/m)	/	M4
LTE Band 5	E-Field dB(V/m)	/	M4
LTE Band 12	E-Field dB(V/m)	/	M4
LTE Band 14	E-Field dB(V/m)	/	M4
LTE Band 17	E-Field dB(V/m)	/	M4
LTE Band 26	E-Field dB(V/m)	/	M4
LTE Band 30	E-Field dB(V/m)	/	M4
LTE Band 66	E-Field dB(V/m)	/	M4
LTE Band 71	E-Field dB(V/m)	/	M4
LTE Band 48	E-Field dB(V/m)	28.92	M4
FR1 n2	E-Field dB(V/m)	/	M4
FR1 n5	E-Field dB(V/m)	/	M4
FR1 n25	E-Field dB(V/m)	/	M4
FR1 n26	E-Field dB(V/m)	/	M4
FR1 n30	E-Field dB(V/m)	/	M4
FR1 n41	E-Field dB(V/m)	/	M4
FR1 n48	E-Field dB(V/m)	/	M4
FR1 n66	E-Field dB(V/m)	/	M4
FR1 n70	E-Field dB(V/m)	/	M4
FR1 n71	E-Field dB(V/m)	/	M4
FR1 n77	E-Field dB(V/m)	/	M4
WI-FI(2.4GHz)	E-Field dB(V/m)	25.83	M4
WI-FI(5GHz)	E-Field dB(V/m)	/	M4
HAC Rate Category: M4			

Note:

1) This portable wireless equipment has been shown to be hearing-aid compatible under the above rated category, specified in ANSI/IEEE Std.C63.19-2011 and had been tested in accordance with the specified measurement procedures, Hear-Aid Compatibility is based on the assumption that all production units will be designed electrically identical to the device tested in this report. Test results reported herein relate only to the item(s) tested and are for North American Bands only.

2) *- HAC RF Emission Test for low power exemption according to ANSI C63.19-2011 and HAC RF Emission rating is M4 (Refer to Section 9.3 for details).

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Reviewed by	Prepared by
Nick Hu (signature)	Leon Xu (signature)
Nick Hu	Leon Xu

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Inspection & Testing Services
SGS-CSTC Standards Technical Services (Suzhou) Co., Ltd.

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Wireless Laboratory

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1 General Information

1.1 Introduction

The purpose of the Hearing Aid Compatibility is to enable measurements of the near electric fields generated by wireless communication devices in the region controlled for use by a hearing aid in accordance with ANSI-C63.19-2011

The purpose of this standard is to establish categories for hearing aids and for WD (wireless communications devices) that can indicate to health care practitioners and hearing aid users which hearing aids are compatible with which WD, and to provide tests that can be used to assess the electromagnetic characteristics of hearing aids and WD and assign them to these categories. The various parameters required, in order to demonstrate compatibility and accessibility are measured. The design of the standard is such that when a hearing aid and WD achieve one of the categories specified, as measured by the methodology of this standard, the indicated performance is realized.

In order to provide for the usability of a hearing aid with a WD, several factors must be coordinated:
a) Radio frequency (RF) measurements of the near-field electric fields emitted by a WD to categorize these emissions for correlation with the RF immunity of a hearing aid.

Hence, the following are measurements made for the WD:
RF E-Field emissions

The measurement plane is parallel to, and 1.5cm in front of, the reference plane.

Applications for certification of equipment operation under part 20, that a manufacturer is seeking to certify as hearing aid compatible, as set forth in §20.19 of that part, shall include a statement indication compliance with the test requirements of §20.19 and indicating the appropriate U-rating for the equipment. The manufacturer of the equipment shall be responsible for maintaining the test results.

1.2 Details of Client

Applicant:	Shenzhen Tinno Mobile Technology Corp.
Address:	27-001, South Side of Tianlong Mobile Headquarters Building, Tongfa South Road, Xili Community, Xili Street, Nanshan District, Shenzhen ,PRC
Manufacturer:	Shenzhen Tinno Mobile Technology Corp.
Address:	27-001, South Side of Tianlong Mobile Headquarters Building, Tongfa South Road, Xili Community, Xili Street, Nanshan District, Shenzhen ,PRC

1.3 Test Location

Company:	SGS-CSTC Standards Technical Services (Suzhou) Co., Ltd.
Address:	South of No. 6 Plant, No. 1, Runsheng Road, Suzhou Industrial Park, Suzhou Area, China (Jiangsu) Pilot Free Trade Zone
Post code:	215000
Test Engineer:	Leon Liu

1.4 Test Facility

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

- **A2LA (Certificate No. 6336.01)**

SGS-CSTC STANDARDS TECHNICAL SERVICES (SUZHOU) CO., LTD. is accredited by the American Association for Laboratory Accreditation(A2LA). Certificate No. 6336.01.

- **Innovation, Science and Economic Development Canada**

SGS-CSTC STANDARDS TECHNICAL SERVICES (SUZHOU) CO., LTD. has been recognized by ISED as an accredited testing laboratory.

CAB identifier: CN0120.

IC#: 27594.

- **FCC –Designation Number: CN1312**

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1.5 General Description of EUT

Device Type :	portable device		
Exposure Category:	uncontrolled environment / general population		
Product Name:	Smart Phone		
Model No.(EUT):	Celero3 5G+		
FCC ID:	XD6U695DS		
Trade Mark:	Celero3 5G+		
Product Phase:	Identical Prototype		
IMEI:	1# 867222065004733		
	2# 867222065004857		
	3# 867222065004865		
Hardware Version:	V1.0		
Software Version:	U695DSV01.01.10		
Device Operating Configurations :			
Modulation Mode:	**GSM:** GMSK, 8PSK; **WCDMA:** QPSK,16QAM;		
	LTE: QPSK,16QAM,64QAM,256QAM;		
	5G NR: DFT-s-OFDM (PI/2 BPSK, QPSK, 16QAM, 64QAM, 256QAM),		
	CP-OFDM (QPSK, 16QAM, 64QAM, 256QAM)		
	WIFI: DSSS, OFDM, OFDMA; **BT:** GFSK, π/4DQPSK,8DPSK		
Device Class:	B		
GPRS Multi-slots Class:	12	EGPRS Multi-slots Class:	12
HSDPA UE Category:	10	HSUPA UE Category	6
DC-HSDPA UE Category:	24		
Power Class	4,tested with power level 5(GSM850)		
	1,tested with power level 0(GSM1900)		
	3, tested with power control “all 1”(WCDMA Band)		
	3, tested with power control Max Power(LTE Band)		
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 12	699-716	729-746
	LTE Band 14	788-798	758-768

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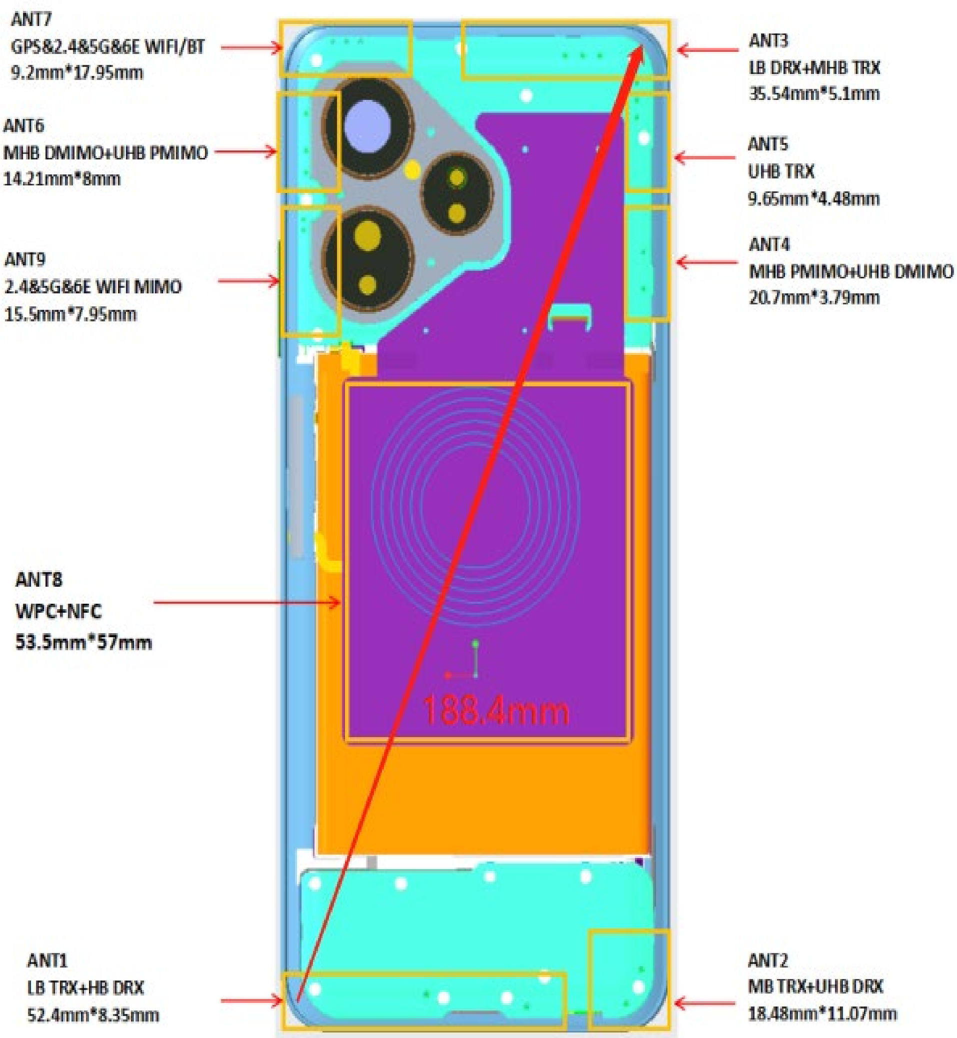
	LTE Band 17	704-716	734-746
	LTE Band 26	814-849	859-894
	LTE Band 30	2305-2315	2350-2360
	LTE Band 48	3550-3700	3550-3700
	LTE Band 66	1710-1780	2110-2200
	LTE Band 71	663-698	617-652
	NR Band n2	1850-1910	1930-1990
	NR Band n5	824-849	869-894
	NR Band n25	1850-1915	1930-1995
	NR Band n26	814-849	859-894
	NR Band n30	2305-2315	2350-2360
	NR Band n41	2496~2690	2496~2690
	NR Band n48	3550-3700	3550-3700
	NR Band n66	1710~1780	2110~2200
	NR Band n70	1695-1710	1995-2020
	NR Band n71	663-698	617-652
	NR Band n77	3450~3550	3450~3550
		3700~3980	3700~3980
	Bluetooth	2400~2483.5	2400~2483.5
	Wi-Fi 2.4G	2402~2462	2402~2462
	Wi-Fi 5G	5150~5250	5150~5250
		5250~5350	5250~5350
		5470~5725	5470~5725
		5725~5850	5725~5850
		5725~5850	5725~5850
	WIF 6E	5925-6425	5925-6425
		6425-6525	6425-6525
		6525-6875	6525-6875
		6875-7125	6875-7125
RF Cable:	Provided by the aplicant Provided by the laboratory		
1# Battery Information:	Model:	486786	
	Normal Voltage:	+3.85V	
	Typical capacity:	4900mAh	
	Manufacturer:	Guangdong Fenghua New Energy Co.,Ltd.	
Note: *Since the above data and/or information is provided by the client relevant results or conclusions of this report are only made for these data and/or information, SGS is not responsible for the authenticity, integrity and results of the data and information and/or the validity of the conclusion.			
Remark:			
As above information is provided and confirmed by the applicant. SGS is not liable to the accuracy, suitability, reliability or/and integrity of the information.			

1.5.1 DUT Antenna Locations



Note:
1) The diversity Antenna does not support transmitter function.

1.5.2 List of air interfaces/frequency bands

Air Interface	Band (MHz)	Type	ANSI C63.19 Tested	Simultaneous Transmitter	Name of Voice Service	Power Reduction
GSM	850	VO	NA	BT, Wi-Fi	CMRS Voice	NA
	1900					
	EDGE	VD	NA		Google Duo*	
WCDMA	Band II	VO	Yes	BT, Wi-Fi	CMRS Voice	NA
	Band IV					
	Band V					
	HSPA	VD	Yes		Google Duo*	
LTE (FDD)	LTE Band 2	VD	Yes	BT, Wi-Fi	VoLTE Google Duo*	NA
	LTE Band 4					
	LTE Band 5					
	LTE Band 12					
	LTE Band 14					
	LTE Band 17					
	LTE Band 26					
	LTE Band 30					
	LTE Band 66					
	LTE Band 71					
LTE (TDD)	Band 48	VD	Yes	BT, Wi-Fi	VoLTE Google Duo*	NA
5G NR (FDD)	NR Band n2	VD	Yes	BT, Wi-Fi	VoNR Google Duo*	NA
	NR Band n5					
	NR Band n25					
	NR Band n26					
	NR Band n30					
	NR Band n66					
	NR Band n70					
	NR Band n71					
5G NR (FDD	NR Band n41	VD	Yes	BT, Wi-Fi	VoNR Google Duo*	NA
	NR Band n48					
	NR Band n77					
Wi-Fi	2450	VD	Yes	WWAN	Google Duo*	NA
BT	2450	DT	NA	WWAN	NA	NA

VO: Legacy Cellular Voice Service from Table 7.1 in 7.4.2.1 of ANSI C63.19-2011
DT: Digital Transport (no voice)
VD: IP Voice Service over Digital Transport
* For protocols not listed in Table 7.1 of ANSI C63.19-2011 or the ANSI C63.19-2011 VoLTE interpretation, the average speech level of −20 dBm0 should be used.

1.6 Test Specification

Identity	Document Title
CFR 47 FCC Part 20	§20.19 Hearing aid-compatible mobile handsets.
ANSI C63.19-2011	American National Standard for Methods of Measurement of Compatibility between Wireless Communication Devices
KDB 285076 D01	HAC Guidance v05r01

1.7 ANSI C63.19-2011 limits

Emission Categories	E-field emissions dB(V/m)	
	< 960 MHz	> 960 MHz
Category M1	50-55	40-45
Category M2	45-50	35-40
Category M3	40-45	30-45
Category M4	<40	<30

Table 1: Telephone near-field categories in linear units

2 Calibration certificate

Temperature	Min. = 18°C, Max. = 25 °C
Relative humidity	Min. = 30%, Max. = 70%

Table 2: The Ambient Conditions

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3 HAC (T Coil) Measurement System

3.1 Measurement System Diagram for SPEAG Robotic

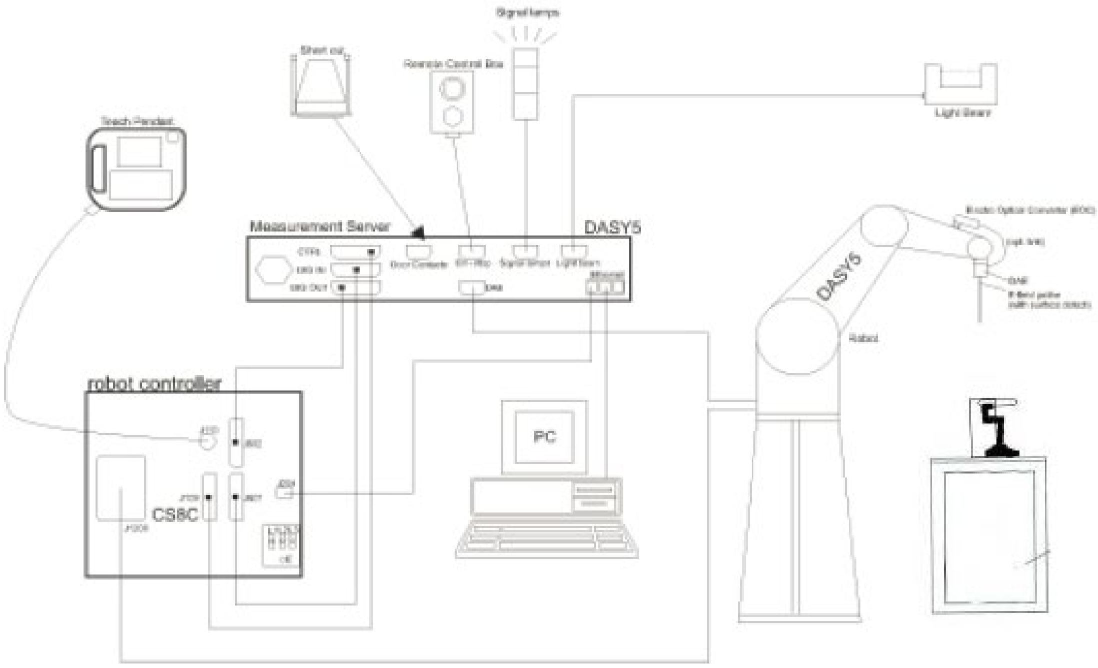


Fig. 1. The SPEAG Robotic Diagram

The DASY5 system for performing compliance tests consists of the following items:

- A standard high precision 6-axis robot (Stabile RX family) with controller, teach pendant and software. An arm extension is for accommodating the data acquisition electronics (DAE).
- An Audio Magnetic probe.
- A data acquisition electronics (DAE) which performs the signal amplification, signal multiplexing, AD-conversion, offset measurements, mechanical surface detection, collision detection, etc. The unit is battery powered with standard or rechargeable batteries. The signal is optically transmitted to the EOC.
- The Electro-optical converter (EOC) performs the conversion between optical and electrical of the signals for the digital communication to the DAE and for the analog signal from the optical surface detection. The EOC is connected to the measurement server.
- The function of the measurement server is to perform the time critical tasks such as signal filtering, control of the robot operation and fast movement interrupts.
- A probe alignment unit which improves the (absolute) accuracy of the probe positioning.
- A computer operating Windows 7.
- DASY5 software.
- Remote control with teach pendant and additional circuitry for robot safety such as warning lamps, etc.
- The Test Arch SAM phantom
- The device holder for handheld mobile phones.
- Validation dipole kits allowing to validate the proper functioning of the system.

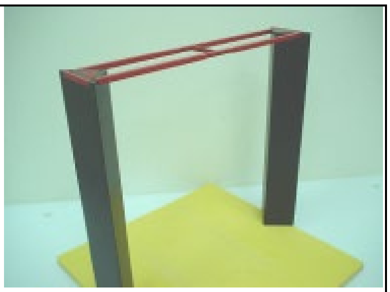
3.2 E-Field Probe

Construction	One dipole parallel, two dipoles normal to probe axis Built-in shielding against static charges PEEK enclosure material
Calibration	In air from 100 MHz to 6.0 GHz (absolute accuracy ±6.0%, k=2)
Frequency	(extended to 20 MHz for MRI), Linearity: ± 0.2 dB (100 MHz to 6 GHz)
Directivity	± 0.2 dB in air (rotation around probe axis) ± 0.4 dB in air (rotation normal to probe axis)
Dynamic Range	2 V/m to > 1000 V/m; Linearity: ± 0.2 dB
Dimensions	Tip diameter: 8 mm Distance from probe tip to dipole centers: 2.5 mm

EF3DV3 E-Field Probe

3.3 Test Arch

Description	Enables easy and well defined positioning of the phone and validation dipoles as well as simple teaching of the robot.
Dimensions	length: 370 mm width: 370 mm height: 370 mm



Test Arch

3.4 Phone Holder

Description	Supports accurate and reliable positioning of any phone Effect on near field <+/- 0.5 dB

Phone Holder

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4 Measurement uncertainty evaluation

Uncertainty Component	Uncertainty Value (%)	Probability Distribution	Divisor	ci €	Standard Uncertainty € (%)
Measurement system					
Probe calibration	±5.1	N	1	1	±5.1
Axial isotropy	±4.7	R	$\sqrt{3}$	1	±2.7
Sensor position	±16.5	R	$\sqrt{3}$	1	±9.5
Boundary effect	±2.4	R	$\sqrt{3}$	1	±1.4
Phantom Boundary Effect	±7.2	R	$\sqrt{3}$	1	±4.1
Linearity	±4.7	R	$\sqrt{3}$	1	±2.7
Scaling with PMR calibration	±10.0	R	$\sqrt{3}$	1	±5.8
System Detection limit	±1.0	R	$\sqrt{3}$	1	±0.6
Readout Electronics	±0.3	N	1	1	±0.3
Response time	±0.8	R	$\sqrt{3}$	1	±0.5
Integration time	±2.6	R	$\sqrt{3}$	1	±1.5
RF ambient conditions	±3.0	R	$\sqrt{3}$	1	±1.7
RF reflection	±12.0	R	$\sqrt{3}$	1	±6.9
Probe positioner	±1.2	R	$\sqrt{3}$	1	±0.7
Probe positioning	±4.7	R	$\sqrt{3}$	1	±2.7
Extrapolation and interpolation	±1.0	R	$\sqrt{3}$	1	±0.6
Related to test samples					
Device Positioning Vertical	±4.7	R	$\sqrt{3}$	1	±2.7
Device Positioning Lateral	±1.0	R	$\sqrt{3}$	1	±0.6
Device Holder and Phantom	±2.4	R	$\sqrt{3}$	1	±1.4
Power drift	±5.0	R	$\sqrt{3}$	1	±2.9
Phantom and Setup Related					
Phantom Thickness	±2.4	R	$\sqrt{3}$	1	±1.4
Combined Std. Uncertainty	$u_c' = \sqrt{\sum_{i=1}^{21} c_i^2 u_i^2}$				**±16.3**
Expanded Std. Uncertainty on Power (K=2)					**±32.6**
Expanded Std. Uncertainty on Field (K=2)					**±16.3**

Table 3： Measurement uncertainties for RF

5 RF Emission Measurements Reference and Plane

Fig.3 illustrate the references and reference plane that shall be used in a typical EUT emissions measurement. The principle of this section is applied to EUT with similar geometry. Please refer to Appendix C for the setup photographs.

◆ The area is 5 cm by 5 cm.

◆ The area is centered on the audio frequency output transducer of the EUT.

◆ The area is in a reference plane, which is defined as the planar area that contains the highest point in the area of the phone that normally rests against the user's ear. It is parallel to the centerline of the receiver area of the phone and is defined by the points of the receiver-end of the EUT handset, which, in normal handset use, rest against the ear.

◆ The measurement plane is parallel to, and 10 mm in front of, the reference plane.

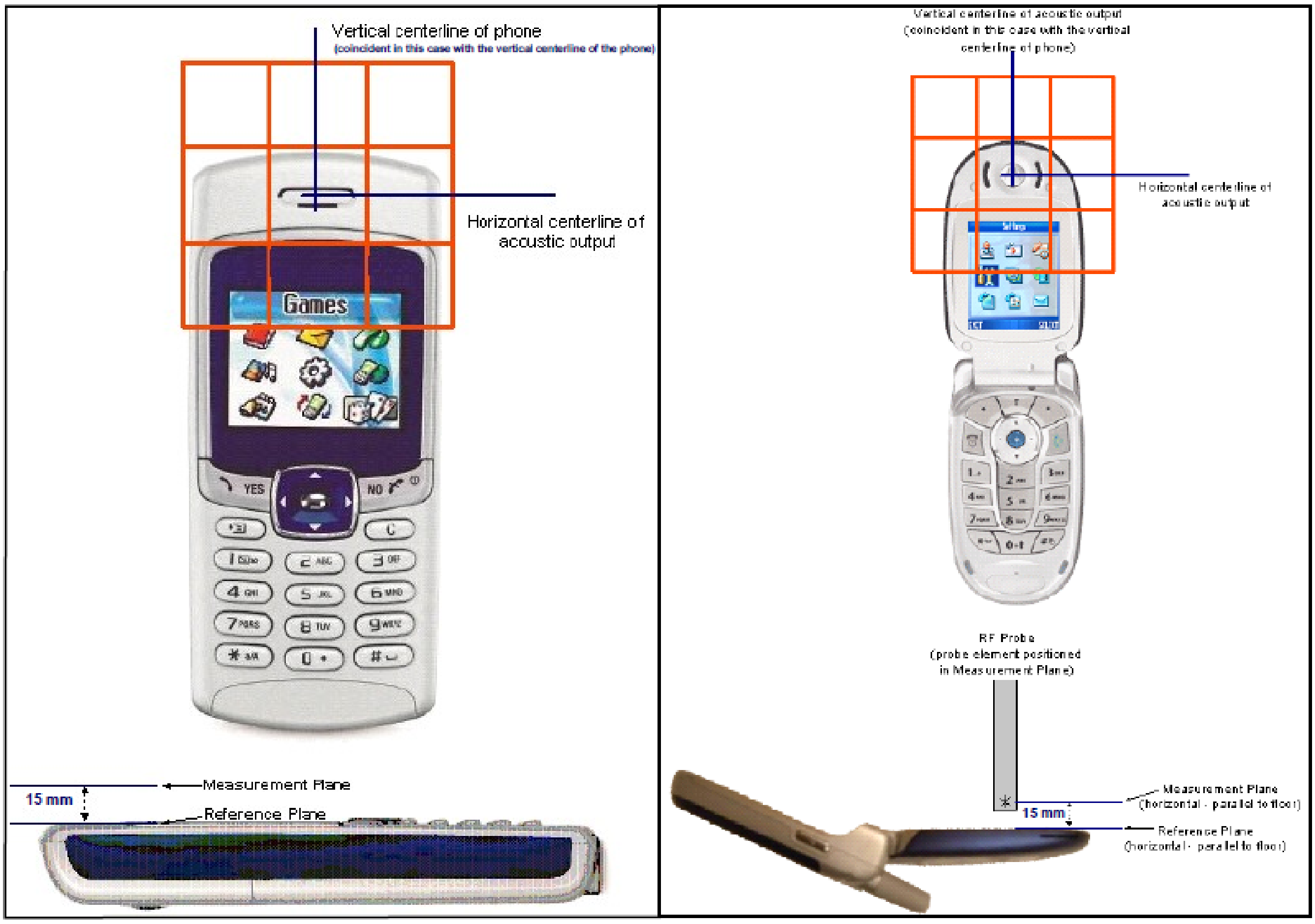

Fig.3 WD reference and plane for RF emission measurements

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6 System Verification Procedure

6.1 System Check

Place a dipole antenna meeting the requirements given in ANSI C63.19-2011 in the position normally occupied by the WD. The dipole antenna serves as a known source for an electrical and magnetic output. Position the E-field probe so that the following occurs:

• The probes and their cables are parallel to the coaxial feed of the dipole antenna
• The probe cables and the coaxial feed of the dipole antenna approach the measurement area from opposite directions
• The center point of the probe element(s) are 15 mm from the closest surface of the dipole elements.

Scan the length of the dipole with the E-field probe and record the two maximum values found near the dipole ends. Average the two readings and compare the reading to the expected value in the calibration certificate or the expected value in this standard.

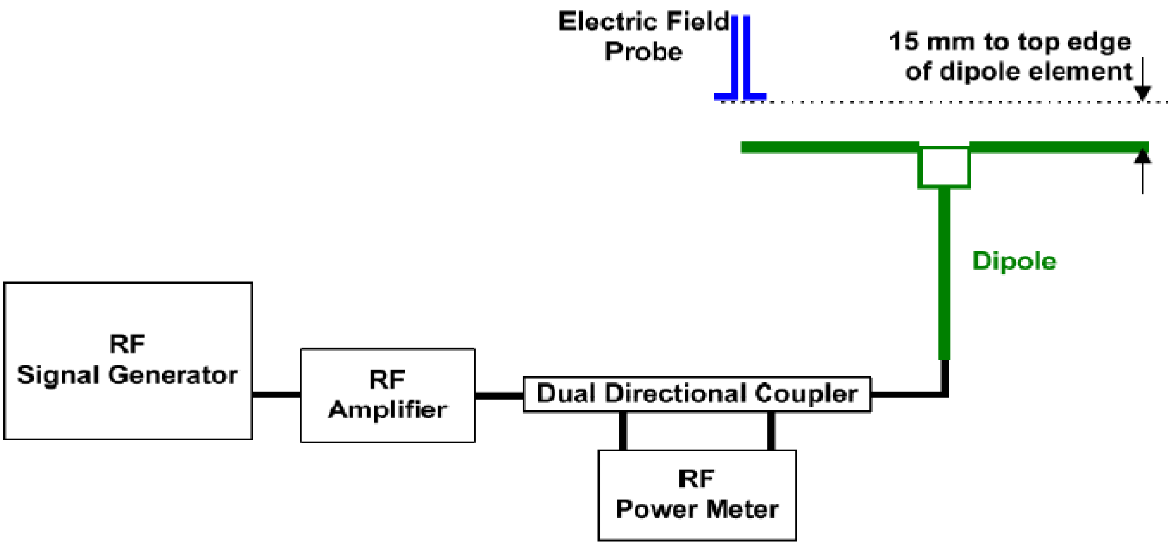

Fig.4 System verification

6.2 System Check Result

Mode	Frequency (MHz)	Input Power (mW)	E-Field 1 (V/m)	E-Field 2 (V/m)	Average Value (V/m)	Target Value (V/m)	Deviation (%)	Limit (%)	Test Date
CW	835	100	100.80	96.32	98.56	110.4	-10.72	±18	2023/9/11
CW	1880	100	82.71	84.71	83.71	86.5	-3.23	±18	2023/9/11
CW	2450	100	84.76	86.62	85.69	85.2	0.58	±18	2023/9/11
CW	3500	100	87.22	87.67	87.45	83.7	4.47	±18	2023/9/11

Note:
* Please refer to the appendix A for detailed measurement data and plot.
** Target value is provided by SPEAD in the calibration certificate of specific dipoles.
*** Deviation (%) = 100 * (Measured value minus Target value) divided by Target value.
**** ANSI C63.19 requires values within ± 18% are acceptable.

7 Modulation Interference Factor

The HAC Standard ANSI C63.19-2011 defines a new scaling using the Modulation Interference Factor (MIF). For any specific fixed and repeatable modulated signal, a modulation interference factor (MIF, expressed in dB) may be developed that relates its interference potential to its steady-state rms signal level or average power level. This factor is a function only of the audio-frequency amplitude modulation characteristics of the signal and is the same for field-strength and conducted power measurements. It is important to emphasize that the MIF is valid only for a specific repeatable audio-frequency amplitude modulation characteristic. Any change in modulation characteristic requires determination and application of a new MIF
The Modulation Interference factor (MIF, in dB) is added to the measured average E-field (in dBV/m) and converts it to the RF Audio Interference level (in dBV/m). This level considers the audible amplitude modulation components in the RF E-field. CW fields without amplitude modulation are assumed to not interfere with the hearing aid electronics.
Modulations without time slots and low fluctuations at low frequencies have low MIF values, TDMA modulations with narrow transmission and repetition rates of few 100 Hz have high MIF values and give similar classifications as ANSI C63.19-2011.
ER3D, EF3D and EU2D E-field probes have a bandwidth <10 kHz and can therefore not evaluate the RF envelope in the full audio band. DASY52 is therefore using the indirect measurement method according to ANSI C63.19-2011 which is the primary method. These near field probes read the averaged E-field measurement. Especially for the new high peak-to-average (PAR) signal types, the probes shall be linearized by PMR calibration in order to not overestimate the field reading. Probe Modulation Response (PMR) calibration linearizes the probe response over its dynamic range for specific modulations which are characterized by their UID and result in an uncertainty specified in the probe calibration certificate. The MIF is characteristic for a given waveform envelope and can be used as a constant conversion factor if the probe has been PMR calibrated.
The evaluation method for the MIF is defined in ANSI C63.19-2011 section D.7. An RMS demodulated RF signal is fed to a spectral filter (similar to an A weighting filter) and forwarded to a temporal filter acting as a quasi-peak detector. The averaged output of these filtering is scaled to a 1 kHz 80% AM signal as reference. MIF measurement requires additional instrumentation and is not well suited for evaluation by the end user with reasonable uncertainty.
It may alliteratively be determined through analysis and simulation, because it is constant and characteristic for a communication signal. DASY52 uses well-defined signals for PMR calibration. The MIF of these signals has been determined by simulation and it is automatically applied.

The MIF measurement uncertainty is estimated as follows, declared by HAC equipment provider SPEAG, for modulation frequencies from slotted waveforms with fundamental frequency and at least 2 harmonics within 10 kHz:
1. 0.2 dB for MIF: -7 to +5 dB
2. 0.5 dB for MIF: -13 to +11 dB
3. 1 dB for MIF: > -20 dB
MIF values applied in this test report were provided by the HAC equipment provider of SPEAG, and the worst values for all air interface are listed below to be determine the Low-power Exemption.

SPEAG UID	UID version	Communication system	MIF(dB)
10021	DAC	GSM-FDD (TDMA,GMSK)	3.63
10025	DAC	EDGE-FDD (TDMA, 8PSK, TN 0)	3.75
10460	AAA	UMTS-FDD (WCDMA, AMR)	-25.43
10225	AAA	UMTS-FDD (HSPA+)	-20.39
10169	CAE	LTE-FDD (SC-FDMA, 1 RB, 20 MHz, QPSK)	-15.63
10170	CAE	LTE-FDD (SC-FDMA,1RB, 20 MHz,16-QAM)	-9.76
10172	CAG	LTE-TDD (SC-FDMA, 1 RB, 20 MHz, QPSK)	-1.62
10173	CAG	5G NR (CP-OFDM, 1 RB, 15 MHz, QPSK, 15 kHz)	-12.08

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10173	CAG	LTE-TDD (SC-FDMA,1RB, 20 MHz,16-QAM)	-1.44
10061	CAB	IEEE 802.11b WiFi 2.4 GHz (DSSS, 11 Mbps)	-2.02
10077	CAB	IEEE 802.11g WiFi 2.4 GHz (DSSS-OFDM, 54 Mbps)	0.12
10427	AAB	IEEE 802.11n (HT Green eld, 150 Mbps, 64-QAM)	-13.44
10069	CAC	IEEE 802.11a/h WiFi 5 GHz (OFDM, 54 Mbps)	-3.15
10616	AAB	IEEE 802.11ac WiFi (40MHz, MCS0, 90pc duty cycle)	-5.57
10671	AAB	IEEE 802.11ax WiFi (20MHz, MCS0, 90pc duty cycle)	-5.58

8 HAC Measurement Procedure

The evaluation was performed with the following procedure:
a) Confirm the proper operation of the field probe, probe measurement system, and other instrumentation and the positioning system.
b) Position the WD in its intended test position.
c) Set the WD to transmit a fixed and repeatable combination of signal power and modulation characteristic that is representative of the worst case (highest interference potential) encountered in normal use. Transiently occurring start-up, changeover, or termination conditions, or other operations likely to occur less than 1% of the time during normal operation, may be excluded from consideration.
d) The center subgrid shall be centered on the T-Coil mode perpendicular measurement point or the acoustic output, as appropriate. Locate the field probe at the initial test position in the 50 mm by 50 mm grid, which is contained in the measurement plane, refer to illustrated in Figure 3. If the field alignment method is used, align the probe for maximum field reception.
e) Record the reading at the output of the measurement system.
f) Scan the entire 50 mm by 50 mm region in equally spaced increments and record the reading at each measurement point. The distance between measurement points shall be sufficient to assure the identification of the maximum reading.
g) Identify the five contiguous subgrids around the center subgrid whose maximum reading is the lowest of all available choices. This eliminates the three subgrids with the maximum readings. Thus, the six areas to be used to determine the WD's highest emissions are identified.
h) Identify the maximum reading within the nonexcluded subgrids identified in step g).
i) Convert the maximum reading identified in step h) to RF audio interference level, in, V/m, by taking the square root of the reading and then dividing it by the measurement system transfer function, established in 5.5.1.1. Convert the result to dB(V/m) by taking the base-10 logarithmand multiplying it by 20.
Indirect measurement method
Replacing step i) of 5.5.1.2, the RF audio interference level in dB(V/m) is obtained by adding the MIF (in dB) to the maximum steady-state rms field-strength reading, in dB(V/m), from step h). Use this result to determine the category rating.
j) Compare this RF audio interference level with the categories in Clause 8 and record the resulting WD category rating.
k) For the T-Coil mode M-rating assessment, determine whether the chosen perpendicular measurement point is contained in an included subgrid of the first scan. If so, then a second scan is not necessary. The first scan and resultant category rating may be used for the T-Coil mode M rating.
Otherwise, repeat step a) through step i), with the grid shifted so that it is centered on the perpendicular measurement point. Record the WD category rating.

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9 HAC RF Measurement Results

9.1 Max Tune-up

Frequency Band		Antenna	Tune-up (dBm)
GSM	GSM850 GPRS	Ant1	33.3
	GSM850 EDGE		27.3
	GSM1900 GPRS	Ant2	30.3
	GSM1900 EDGE		26.3
WCDMA II	WCDMA Band2	Ant.2	23.8
	WCDMA Band4	Ant.2	23.8
	WCDMA Band5	Ant.1	23.8
	HSPA	-	22.8
LTE	LTE2	Ant.3	24.3
	LTE4	Ant.3	24.3
	LTE5	Ant.1	24.8
	LTE12	Ant.1	24.8
	LTE14	Ant.1	24.8
	LTE17	Ant.1	23.8
	LTE26	Ant.1	24.8
	LTE30	Ant.3	22.8
	LTE48	Ant.5	23.8
	LTE66	Ant.3	24.3
	LTE71	Ant.1	24.8
	LTE2	Ant.2	24.3
	LTE 4	Ant.2	24.3
	LTE5	Ant.3	24.8
	LTE30	Ant.1	23.0
	LTE66	Ant.2	24.3
5G NR	n2	Ant.3	24.3
	n5	Ant.1	24.8
	n25	Ant.3	24.3
	n26	Ant.1	24.8
	n30	Ant.3	22.8
	n41_PC2	Ant.3	26.8
	n41_PC3	Ant.3	23.8
	n48	Ant.5	23.8
	n66	Ant.3	24.3
	n70	Ant.3	24.3
	n71	Ant.1	24.8
	n77 L_PC2	Ant.5	27.5
	n77 L_PC3	Ant.5	23.8
	N2	Ant.2	23.1

	N25	Ant.2	23.1
	N66	Ant.2	23.5
	N70	Ant.2	23.5

9.2 Conducted RF Output Power

GSM 850 Ant 1					
Burst Output Power(dBm)					Tune up
Channel		128	190	251	
GSM(GMSK)	GSM	32.50	32.57	32.55	33.30
GPRS/EGPRS (GMSK)	1 TX Slot	32.40	32.44	32.46	33.30
	2 TX Slots	30.67	30.76	30.72	31.30
	3 TX Slots	28.77	28.72	28.72	29.30
	4 TX Slots	26.70	26.73	26.67	28.30
EGPRS(8PSK)	1 TX Slot	26.75	26.73	26.79	27.30
	2 TX Slots	24.49	24.47	24.43	25.30
	3 TX Slots	22.47	22.40	22.47	23.30
	4 TX Slots	20.37	20.42	20.35	21.30

GSM 1900 Ant 2					
Burst Output Power(dBm)					Tune up
Channel		512	661	810	
GSM(GMSK)	GSM	29.58	29.59	29.62	30.30
GPRS/EGPRS (GMSK)	1 TX Slot	29.62	29.65	29.55	30.30
	2 TX Slots	27.74	27.74	27.69	28.30
	3 TX Slots	25.72	25.65	25.64	26.30
	4 TX Slots	23.61	23.63	23.62	25.30
EGPRS(8PSK)	1 TX Slot	25.35	25.27	25.30	26.30
	2 TX Slots	22.86	22.83	22.82	24.30
	3 TX Slots	20.67	20.68	20.67	22.30
	4 TX Slots	18.44	18.40	18.45	20.30

LTE Band 48 Ant 5				Conducted Power(dBm)				
Bandwidth	Modulation	RB size	RB offset	Channel 55340	Channel 55830	Channel 56150	Channel 56640	Tune up
20MHz	QPSK	1	0	22.77	22.82	22.72	22.75	23.80
		1	50	22.66	22.66	22.65	22.58	23.80
		1	99	22.70	22.71	22.69	22.72	23.80
		50	0	21.76	21.87	21.84	21.82	22.80
		50	25	21.71	21.71	21.78	21.81	22.80
		50	50	21.66	21.63	21.80	21.77	22.80
		100	0	21.75	21.80	21.64	21.78	22.80
	16QAM	1	0	21.85	21.88	21.90	21.76	22.80
		1	50	21.82	21.80	21.84	21.89	22.80
		1	99	21.81	21.79	21.75	21.81	22.80
		50	0	20.87	20.86	20.83	20.92	21.80
		50	25	20.84	20.85	20.96	20.81	21.80
		50	50	20.86	20.88	20.89	20.87	21.80
		100	0	20.92	20.89	20.92	20.86	21.80
	64QAM	1	0	20.87	20.88	20.93	20.89	21.80
		1	50	20.80	20.88	20.96	20.90	21.80
		1	99	20.87	20.90	20.91	20.96	21.80
		50	0	19.94	19.93	19.98	19.99	20.80
		50	25	20.00	19.96	19.89	20.03	20.80
		50	50	20.03	19.98	19.96	20.02	20.80
		100	0	19.93	19.96	19.91	19.95	20.80
	256QAM	1	0	18.11	18.07	18.10	18.10	18.80

		1	50	18.11	18.05	18.13	18.13	18.80
		1	99	18.14	18.13	18.04	18.08	18.80
		50	0	18.11	18.06	18.13	18.12	18.80
		50	25	18.06	18.12	18.15	18.08	18.80
		50	50	18.10	18.06	18.09	18.08	18.80
		100	0	18.09	18.05	18.07	18.07	18.80

WIFI 2.4G Ant 7					
Mode	Channel	Frequency(MHz)	Data Rate(Mbps)	Full Power	
				Average Power (dBm)	Tune-up (dBm)
802.11b	1	2412	1	18.36	19.00
	6	2437		18.52	19.00
	11	2462		18.47	19.00
802.11g	1	2412	6	18.28	19.00
	6	2437		18.39	19.00
	11	2462		18.34	19.00
802.11n HT20	1	2412	6.5	18.25	19.00
	6	2437		18.35	19.00
	11	2462		18.33	19.00
802.11AX 20	1	2412	6.5	18.28	19.00
	6	2437		18.36	19.00
	11	2462		18.29	19.00

WIFI 2.4G Ant 9 Full Power					
Mode	Channel	Frequency(MHz)	Data Rate(Mbps)	Average Power (dBm)-ANT2	Tune-up (dBm)-ANT2
802.11b	1	2412	1	20.68	21.00
	6	2437		20.69	21.00
	11	2462		20.57	21.00
802.11g	1	2412	6	18.63	19.50
	6	2437		18.76	19.50
	11	2462		18.75	19.50
802.11n HT20	1	2412	6.5	18.32	19.00
	6	2437		18.37	19.00
	11	2462		18.32	19.00
802.11AX 20	1	2412	6.5	18.26	19.00
	6	2437		18.39	19.00
	11	2462		18.31	19.00

9.3 Low-power Exemption

According to ANSI C63.19-2011, a RF air interface technology of a device is exempt from testing when its average antenna input power plus its MIF is ≤17 dBm for any of its operation modes.

Air Interface (Ant)		Max Average Antenna Input Power (dBm)	Worst Case MIF (dB)	Power + MIF(dB)	C63.19 test required
GSM850		33.3	3.63	36.93	Yes
EDGE850		27.3	3.75	31.05	Yes
GSM1900		30.3	3.63	33.93	Yes
EDGE1900		26.3	3.75	30.05	Yes
WCDMA		23.8	-25.43	-1.63	No
WCDMA - HSPA		22.8	-20.39	2.41	No
LTE - FDD		24.8	-9.76	15.04	No
LTE - TDD	QPSK	23.8	25.38	49.18	Yes
	16QAM	22.8	24.56	47.36	Yes
5GFR1		27.5	-12.08	15.42	No
Ant 7	802.11b	19	-2.02	16.98	No
	802.11g	19	0.12	19.12	Yes
	802.11a	18	-3.15	14.85	No
	802.11n-HT20	19	-13.44	5.56	No
	802.11n-HT40	16	-13.44	2.56	No
	802.11ac-VHT20	17	-5.57	11.43	No
	802.11ac-VHT40	16	-5.57	10.43	No
	802.11ac-VHT80	16	-5.57	10.43	No
	802.11ax-VHT20	19	-5.58	13.42	No
	802.11ax-VHT40	17	-5.58	11.42	No
	802.11ax-VHT80	16	-5.58	10.42	No
Ant 9	802.11b	21	-2.02	18.98	Yes
	802.11g	19.5	0.12	19.62	Yes
	802.11a	18	-3.15	14.85	No
	802.11n-HT20	19	-13.44	5.56	No
	802.11n-HT40	16	-13.44	2.56	No
	802.11ac-VHT20	17	-5.57	11.43	No
	802.11ac-VHT40	16	-5.57	10.43	No
	802.11ac-VHT80	16	-5.57	10.43	No
	802.11ax-VHT20	19	-5.58	13.42	No
	802.11ax-VHT40	17	-5.58	11.42	No
	802.11ax-VHT80	16	-5.58	10.42	No

General Note:
1. According to ANSI C63.19 2011-version, for the air interface technology of a device is exempt from testing when its average antenna input power plus its MIF is ≤17 dBm for any of its operating modes.
2. HAC RF rating is M4 for the air interface which meets the low power exemption.

9.4 HAC RF Emission Test Results

Band	Test Mode	Channel	Frequency (MHz)	MIF (dB)	Audio Interference Level (dBV/m)	Margin to the next Level (dBV/m)	Power Drift (dB)	Category
GSM850	GSM Voice	128	824.2	3.63	36.10	3.90	0.06	M4
GSM850	GSM Voice	190	836.6	3.63	34.09	5.91	0.03	M4
GSM850	GSM Voice	251	848.8	3.63	32.85	7.15	0.02	M4
GSM1900	GSM Voice	512	1850.2	3.63	29.36	0.64	-0.03	M4
GSM1900	GSM Voice	661	1880	3.63	28.49	1.51	-0.01	M4
GSM1900	GSM Voice	810	1909.8	3.63	29.44	0.56	0.13	M4
LTE Band 48	20M QPSK 1RB_0	55340	3560	-1.62	28.92	1.08	-0.17	M4
LTE Band 48	20M QPSK 1RB_0	55830	3609	-1.62	28.29	1.71	-0.07	M4
LTE Band 48	20M QPSK 1RB_0	56150	3641	-1.62	28.62	1.38	0.05	M4
LTE Band 48	20M QPSK 1RB_0	56640	3690	-1.62	28.16	1.84	-0.01	M4
WiFi 2.4G Ant7	802.11g	1	2412	0.12	25.83	4.17	-0.08	M4
WiFi 2.4G Ant7	802.11g	6	2437	0.12	22.87	7.13	-0.01	M4
WiFi 2.4G Ant7	802.11g	11	2462	0.12	23.27	6.73	-0.18	M4
WiFi 2.4G Ant9	802.11g	1	2412	0.12	17.15	12.85	0.07	M4
WiFi 2.4G Ant9	802.11g	6	2437	0.12	17.14	12.86	-0.03	M4
WiFi 2.4G Ant9	802.11g	11	2462	0.12	17.10	12.90	0.03	M4

Remark:

1. The detail RF Emission results please refer to appendix B.

10 Equipment list

	Equipment	Manufacturer	Model	Serial Number	Calibration Date	Due date of calibration
☒	Software	SPEAG	DASY52 52.10.4	NA	NCR	NCR
☒	DAE	SPEAG	DAE4	1324	2022-10-17	2023-10-16
☒	E-Field Probe	SPEAG	EF3DV3	4051	2023-06-02	2024-06-01
☒	Validation Kits	SPEAG	CD835V3	1052	2022-05-25	2025-05-24
☒	Validation Kits	SPEAG	CD1880V3	1044	2022-05-25	2025-05-24
☒	Validation Kits	SPEAG	CD2450V3	1044	2022-05-25	2025-05-24
☒	Validation Kits	SPEAG	CD3500V3	1010	2020-09-16	2023-09-15
☒	Test Arch SD HAC	SPEAG	NA	NA	NCR	NCR
☒	Universal Radio Communication Tester	R&S	CMW500	111637	2022-09-16	2023-09-15
☒	Signal Generator	R&S	SMB100A	182393	2023-02-06	2024-02-05
☒	Preamplifier	Qiji	YX28980933	202104001	NCR	NCR
☒	Power Sensor	Keysight	U2002H	MY5639004	2022-09-16	2023-09-15
☒	Power Sensor	Agilent	U2002H	MY48200110	2022-11-23	2023-11-22
☒	Coaxial low pass filter	Mini-Circuits	VLF-2500(+)	NA	NCR	NCR
☒	Coaxial low pass filter	Microlab Fxr	LA-F13	NA	NCR	NCR
☒	DC POWER SUPPLY	SAKO	SK1730SL5A	NA	NCR	NCR
☒	Humidity and Temperature Indicator	Funade	Funade	692020268168	2022-09-16	2023-09-15

Note:
1. All the equipments are within the valid period when the tests are performed.

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