

Prüfbericht-Nr.: <i>Test report no.:</i>	CN240AWJ 001	Auftrags-Nr.: <i>Order no.:</i>	168492453	Seite 1 von 22 <i>Page 1 of 22</i>
Kunden-Referenz-Nr.: <i>Client reference no.:</i>	N/A	Auftragsdatum: <i>Order date:</i>	2024-07-03	
Auftraggeber: <i>Client:</i>	Beijing Roborock Technology Co., Ltd. Room 1001, Floor 10, Building 3, Yard 17, Anju Road, Changping District, Beijing, P.R. China			
Prüfgegenstand: <i>Test item:</i>	Robotic Vacuum Cleaner			
Bezeichnung / Typ-Nr.: <i>Identification / Type no.:</i>	QC0CRL (Trademark: roborock)			
Auftrags-Inhalt: <i>Order content:</i>	Test Report			
Prüfgrundlage: <i>Test specification:</i>	CFR47 FCC Part 15: Subpart C Section 15.247 CFR47 FCC Part 15: Subpart C Section 15.207 CFR47 FCC Part 15: Subpart C Section 15.209 RSS-Gen Issue 5, Amendment 2, February 2021 RSS-247 Issue 3 August 2023 RSS-102 Issue 6, December 15, 2023 ANSI C63.10: 2013			
Wareneingangsdatum: <i>Date of sample receipt:</i>	2024-06-13	Please refer to Photo Document		
Prüfmuster-Nr.: <i>Test sample no.:</i>	A003738824-001~002 A003757610-001~002 A003757728-001			
Prüfzeitraum: <i>Testing period:</i>	2024-07-04 - 2024-07-05			
Ort der Prüfung: <i>Place of testing:</i>	Refer to section 2.1			
Prüflaboratorium: <i>Testing laboratory:</i>	TÜV Rheinland (Shenzhen) Co., Ltd.			
Prüfergebnis*: <i>Test result*:</i>	Pass			
geprüft von: <i>tested by:</i>	genehmigt von: <i>authorized by:</i>			
Datum: <i>Date:</i> 2024-08-01	Ausstellungsdatum: <i>Issue date:</i> 2024-08-01			
Stellung / Position:	Sachverständige(r)/Expert	Stellung / Position:	Sachverständige(r)/Expert	
Sonstiges / <i>Other:</i>	FCC ID: 2AN20-QC0CRL01 IC: 23317-QC0CRL01, HVIN: QC0CRL-FNF8			
Zustand des Prüfgegenstandes bei Anlieferung: <i>Condition of the test item at delivery:</i>	Prüfmuster vollständig und unbeschädigt <i>Test item complete and undamaged</i>			
* Legende: <i>* Legend:</i>	P(ass) = entspricht o.g. Prüfgrundlage(n) <i>P(ass) = passed a.m. test specification(s)</i>			
	F(ail) = entspricht nicht o.g. Prüfgrundlage(n) <i>F(ail) = failed a.m. test specification(s)</i>			
	N/A = nicht anwendbar <i>N/A = not applicable</i>			
	N/T = nicht getestet <i>N/T = not tested</i>			
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Anmerkungen
Remarks

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3	Prüfklausel mit der Note * wurden an qualifizierte Unterauftragnehmer vergeben und sind unter der jeweiligen Prüfklausel des Berichts beschrieben. Abweichungen von Prüfspezifikation(en) oder Kundenanforderungen sind in der jeweiligen Prüfklausel im Bericht aufgeführt. <i>Test clauses with remark of * are subcontracted to qualified subcontractors and described under the respective test clause in the report. Deviations of testing specification(s) or customer requirements are listed in specific test clause in the report.</i>
4	Die Entscheidungsregel für Konformitätserklärungen basierend auf numerischen Messergebnissen in diesem Prüfbericht basiert auf der "Null-Grenzwert-Regel" und der "Einfachen Akzeptanz" gemäß ILAC G8:2019 und IEC Guide 115:2021, es sei denn, in der auf Seite 1 dieses Berichts genannten angewandten Norm ist etwas anderes festgelegt oder vom Kunden gewünscht. Dies bedeutet, dass die Messunsicherheit nicht berücksichtigt wird und daher auch nicht im Prüfbericht angegeben wird. Zu weiteren Informationen bezüglich des Risikos durch diese Entscheidungsregel siehe ILAC G8:2019. <i>The decision rule for statements of conformity, based on numerical measurement results, in this test report is based on the "Zero Guard Band Rule" and "Simple Acceptance" in accordance with ILAC G8:2019 and IEC Guide 115:2021, unless otherwise specified in the applied standard mentioned on Page 1 of this report or requested by the customer. This means that measurement uncertainty is not taken in account and hence also not declared in the test report. For additional information to the resulting risk based of this decision rule please refer to ILAC G8:2019.</i>

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Test Summary

5.1.1 ANTENNA REQUIREMENT

RESULT: Pass

5.1.2 MAXIMUM PEAK CONDUCTED OUTPUT POWER

RESULT: Pass

5.1.3 CONDUCTED POWER SPECTRAL DENSITY

RESULT: Pass

5.1.4 99%dB BANDWIDTH

RESULT: Pass

5.1.5 6dB BANDWIDTH

RESULT: Pass

5.1.6 CONDUCTED SPURIOUS EMISSIONS MEASURED IN 100 KHz BANDWIDTH

RESULT: Pass

5.1.7 RADIATED SPURIOUS EMISSION

RESULT: Pass

5.1.8 CONDUCTED EMISSION ON AC MAINS

RESULT: Pass

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1 General Remarks

1.1 Complementary Materials

All attachments are integral parts of this test report. This applies especially to the following appendix:

Appendix A: Test Results of 2.4GHz Wi-Fi.

Appendix B: Photographs of the Test Set-up.

2 Test Sites

2.1 Test Facilities

1. TÜV Rheinland (Shenzhen) Co., Ltd.

No.362, Huanguan Middle Road, Songyuansha Community, Guanhu Subdistrict, Longhua District, Shenzhen 518110, Guangdong, China

FCC Accreditation Designation No.: 694916

ISED wireless device testing laboratory: 25069

2. TÜV Rheinland (Suzhou) Co., Ltd.

No.14 building and north half of No.10 workshop building, No.525, Yuewang Lingang South Road, Pingqian (Taicang) Modern Industrial Park, Shaxi Town, Taicang City, Jiangsu Province, China

A2LA accreditation certification number: 4301.04

2.2 List of Test and Measurement Instruments

Table 1: List of Test and Measurement Equipment

TÜV Rheinland (Shenzhen) Co., Ltd.

Radio Spectrum Testing (TS8997)					
Equipment	Manufacturer	Model	Serial No.	Cal. Date	Cal. until
Signal Analyzer	R&S	FSV 40	101441	2023-07-26	2024-07-25
OSP	R&S	OSP 150	101017	2023-11-14	2024-11-13
Control PC	DELL	OptiPlex 7050	FTJZ9P2	N/A	N/A
Test Software	R&S	WMS32 (V11.00.00)	N/A	N/A	N/A
Power Meter	R&S	NRP2	107105	2023-11-14	2024-11-13
Wideband Power Sensor	R&S	NRP-Z81	105677	2023-07-26	2024-07-25
Shielding Room 8#	Albatross	SR8	APC17151-SR8	2024-06-21	2025-06-20
Unwanted Emission Testing (TS9975)					
Equipment	Manufacturer	Model	Serial No.	Cal. Date	Cal. until
EMI Test Receiver	R&S	ESR 7	102021	2023-07-26	2024-07-25
Signal Analyzer	R&S	FSV 40	101439	2023-07-26	2024-07-25
System Controller Interface	R&S	SCI-100	S10010038	N/A	N/A
Filterbank	R&S	Wlan	100759	2023-07-26	2024-07-25
OSP	R&S	OSP 120	102040	N/A	N/A
Pre-amplifier	R&S	SCU08F1	08320031	2023-07-26	2024-07-25
Amplifier	R&S	SCU-18F	180070	2023-07-26	2024-07-25
Amplifier	R&S	SCU40A	100475	2023-07-26	2024-07-25
Trilog Broadband Antenna (30 MHz - 7 GHz)	Schwarzbeck	VULB 9162	193	2022-08-07	2024-08-06

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Double-Ridged Antenna (1 -18 GHz)	ETS-LINDGREN	3117	00218717	2022-08-07	2024-08-06
Wideband Ridged Horn Antenna (18-40 GHz)	Steatite	QMS-00880	19067	2022-08-28	2024-08-27
Active Loop Antenna	Schwarzbeck	FMZB 1513	302	2022-08-07	2024-08-06
Test software	R&S	EMC32 (V10.60.10)	N/A	N/A	N/A
Control PC	Dell	OptiPlex 7050	36NV9P2	N/A	N/A
3m Semi-Anechoic Chamber	Albatross	SAC-3m	APC17151-SAC	2024-06-21	2025-06-20

TÜV Rheinland (Suzhou) Co., Ltd.

Conducted Emissions					
Equip.	Description	Model No.	Manufacturer	Last Date DD.MM.YYYY	Due Date DD.MM.YYYY
9061503	Shielded enclosure	10.055x3.605x3.000	Frankonia	08.11.2023	08.11.2028
9023229	EMI test receiver	ESR3	Rohde&Schwarz	23.08.2023	23.08.2024
G1830003	Artificial mains network	ENV432	Rohde&Schwarz	16.10.2023	16.10.2024
G1824248	Dual display multimeter	F45	Fluke	12.06.2024	12.06.2026
9062744	EMI measurement software	EMC32-E+(10.60.20)	Rohde&Schwarz	NA*	NA*

2.3 Traceability

All measurement equipment calibrations are traceable to NIM (National Institute of Metrology) or where calibration is performed in other countries, to equivalent nationally recognized standards organizations.

2.4 Calibration

Equipment requiring calibration is calibrated periodically by the manufacturer or according to manufacturer's specifications. Additionally all equipment is verified for proper performance on a regular basis using in house standards or comparisons.

2.5 Measurement Uncertainty

The estimated combined standard uncertainty for radiated emissions and conducted emissions measurements as below table.

Table 2: Measurement Uncertainty

TÜV Rheinland (Shenzhen) Co., Ltd.

Parameter	Uncertainty (k=2)
RF output power, conducted	± 0.99 dB
Occupied Channel Bandwidth	± 2.08 %
RF power density, conducted	± 0.99 dB
Unwanted Emissions, conducted	± 0.89 dB
All emissions, radiated	±4.17 dB

TÜV Rheinland (Shanghai) Co., Ltd.

Parameter	Uncertainty
Conducted Emission, (9kHz to 150kHz)/(150kHz to 30MHz)	2.33

2.6 Location of Original Data

The original copies of all test data taken during actual testing were attached at Appendix A & B of this report and delivered to the applicant. A copy has been retained in the TÜV Rheinland (Shenzhen) file for certification follow-up purposes.

2.7 Status of Facility Used for Testing

The TÜV Rheinland (Shenzhen) Co., Ltd. Test facility located at No.362, Huanguan Middle Road, Songyuansha Community, Guanhu Subdistrict, Longhua District, Shenzhen 518110, Guangdong, China is listed on the US Federal Communications Commission list of facilities approved to perform measurements.

The TÜV Rheinland (Suzhou) Co., Ltd. Test facility located at No.14 building and north half of No.10 workshop building, No.525, Yuewang Lingang South Road, Pingqian (Taicang) Modern Industrial Park, Shaxi Town, Taicang City, Jiangsu Province, China is listed on the US Federal Communications Commission list of facilities approved to perform measurements.

3 General Product Information

3.1 Product Function and Intended Use

The EUT is **Robotic Vacuum Cleaner**, which supports Wi-Fi 802.11 b/g/n wireless technology.
The EUT contains wireless module F89FTSM13.

For details refer to the User Manual, Technical Description and Circuit Diagram.

3.2 Ratings and System Details

Table 3: Technical Specification of EUT

General Information of EUT	Value
Kind of Equipment:	Robotic Vacuum Cleaner
Type Designation:	QC0CRL
Trademark:	roborock
FCC:	2AN20-QC0CRL01
IC:	23317-QC0CRL01
HVIN:	QC0CRL-FNF8
Operating Voltage:	DC 20V input via docking station, DC 14.4V@5200mAh input via Lithium-ion battery
Testing Voltage:	AC 120V, 60Hz or Fully charged battery
Technical Specification of Wi-Fi 802.11 b/g/n	
Operating Frequency:	2412 - 2462 MHz for 802.11b/g/n(HT20) 2422 - 2452 MHz for 802.11n(HT40)
Type of Modulation:	DSSS(DBPSK/DQPSK/CCK) OFDM(BPSK/QPSK/16QAM/64QAM)
Data Rate:	1/2/5.5/11 Mbps for 802.11b 6/9/12/18/24/36/48/54 Mbps for 802.11g MCS0 ~ MCS7 for 802.11n
Channel Number:	11 channels for 802.11b/g/n(HT20) 7 channels for 802.11n(HT40)
Channel Separation:	5 MHz
Antenna Type:	PCB Antenna
Antenna Gain:	2.23 dBi (Provided by the Client)

Table 4: RF Channel and Frequency of Wi-Fi 802.11 b/g/n

RF Channel	802.11 b/g/n(HT20)	802.11 n(HT40)
	Frequency (MHz)	Frequency (MHz)
01	2412	/
02	2417	/
03	2422	2422
04	2427	2427
05	2432	2432
06	2437	2437
07	2442	2442
08	2447	2447
09	2452	2452
10	2457	/
11	2462	/

Test frequencies are lowest channel: 2412 MHz, middle channel: 2437 MHz and highest channel: 2462 MHz for 802.11b/g/n(HT20)

Test frequencies are lowest channel: 2422 MHz, middle channel: 2437 MHz and highest channel: 2452 MHz for 802.11n(HT40)

3.3 Independent Operation Modes

The basic operation modes are:

- A. On, Wi-Fi transmitting mode
 - 1) Low Channel
 - 2) Middle Channel
 - 3) High Channel
- B. On, Charging and Wi-Fi Link
- C. Off

3.4 Noise Generating and Noise Suppressing Parts

Refer to Circuit Diagram for further details.

3.5 Submitted Documents

- Application Form
- User Manual
- ID Label and Location Info
- Operation Description

4 Test Set-up and Operation Modes

4.1 Principle of Configuration Selection

Radio Spectrum: The equipment under test (EUT) was configured at its highest power output in order to measure its highest possible radiation and conducted level. The test modes were adapted accordingly in reference to the instructions for use.

Emission: The equipment under test (EUT) was configured to measure its highest possible radiation level. The test modes were adapted accordingly in reference to the instructions for use.

4.2 Test Operation and Test Software

Test operation refers to test setup in chapter 5. All testing were performed according to the procedures in ANSI C63.10: 2013.

According to clause 3.1, all tests were performed on model QC0CRL in this report.

4.3 Special Accessories and Auxiliary Equipment

Table 5: List of Accessories and Auxiliary Equipment

Description	Manufacturer	Model	S/N	Rating
DC power Supply	Topward	3303D	809332	0-30 Volts, 0-3 Amps
Laptop	Lenovo	T480	PF-16A6N8	N/A
Empty Wash Fill Dock Auto	Roborock	EWFD14LRR	N/A	Input: AC 120V 60Hz, Output: DC 20V 1.5A

4.4 Countermeasures to Achieve EMC Compliance

The test sample which has been tested contained the noise suppression parts as described in the Technical Construction File (TCF).

No additional measures were employed to achieve compliance.

4.5 Test Setup Diagram

Diagram of Measurement Configuration for Radiation Test (Below 1GHz)

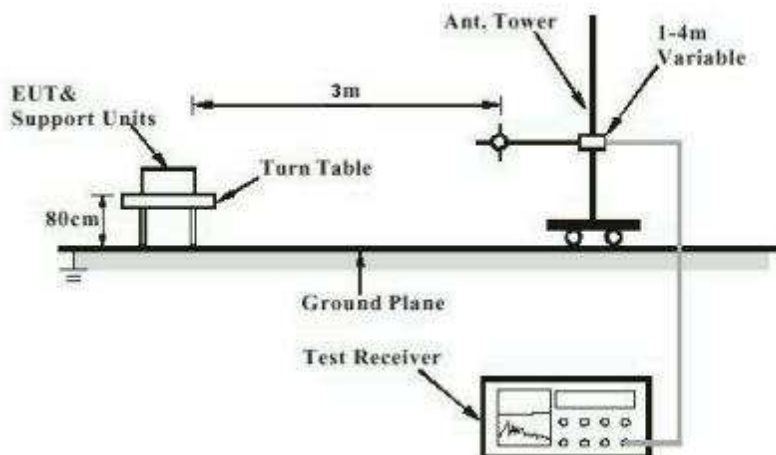


Diagram of Measurement Configuration for Radiation Test (Above 1GHz)

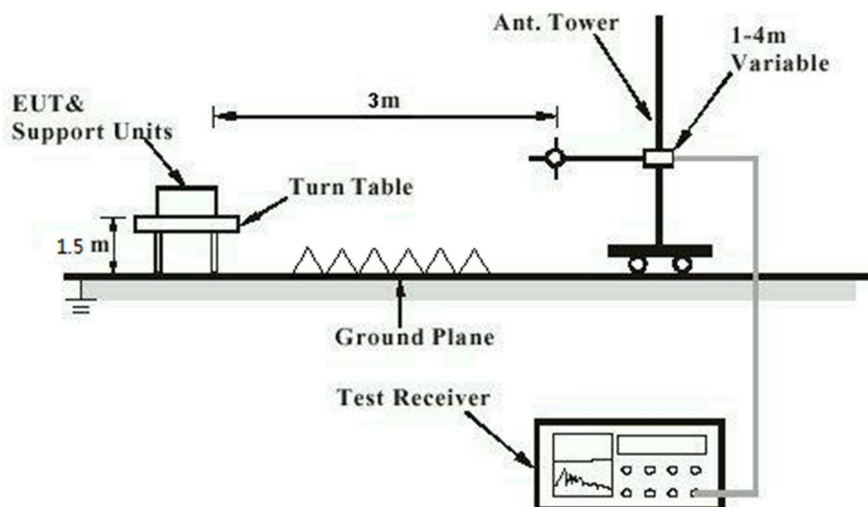


Diagram of Measurement Configuration for Mains Conduction Measurement

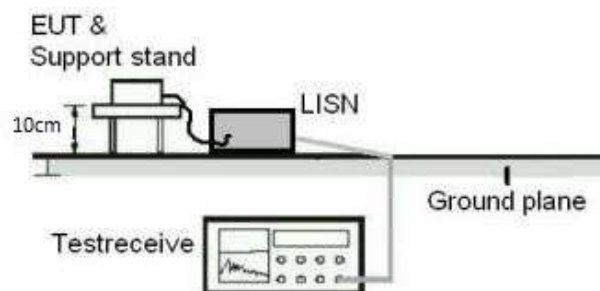
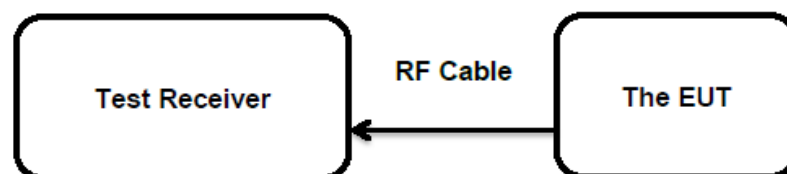


Diagram of Measurement Configuration for Conducted Transmitter Measurement



5 Test Results

5.1 Transmitter Requirement & Test Suites

5.1.1 Antenna Requirement

RESULT:**Pass****Test Specification**

Test standard	:	FCC Part 15.247(b)(4) and Part 15.203 RSS-Gen Clause 6.8
Limit	:	the use of antennas with directional gains that do not exceed 6 dBi

According to the manufacturer declared, the EUT has a PCB Antenna, the directional gain of antenna is 2.23 dBi, and the antenna connector is designed with permanent attachment and no consideration of replacement. Therefore the EUT is considered sufficient to comply with the provision.

Refer to EUT Photo for further details.

5.1.2 Maximum Peak Conducted Output Power

RESULT:
Pass
Test Specification

Test standard	:	FCC Part 15.247(b)(3) RSS-247 Clause 5.4(d)
Basic standard	:	ANSI C63.10: 2013
Limits	:	< 1 W (Maximum Conducted Peak Power) e.i.r.p. <4W
Kind of test site	:	Shielded Room

Test Setup

Date of testing	:	2024-07-04
Input voltage	:	Fully charged battery
Operation mode	:	A
Test channel	:	Low / Middle / High
Ambient temperature	:	24.3 °C
Relative humidity	:	58 %
Atmospheric pressure	:	101 kPa

For details refer to following test result.

Table 6: Test Result of Maximum Peak Conducted Output Power

Test Mode	Data Rate	Test Channel (MHz)	Measured Peak Power		Limit (W)	
			(dBm)	(W)		
802.11b	1 Mbps	2412	20.7	0.1175	< 1.0	
		2437	19.8	0.0955		
		2462	17.2	0.0525		
802.11g	6 Mbps	2412	22.5	0.1778		
		2437	21.7	0.1479		
		2462	19.5	0.0891		
802.11n (HT20)	MCS0	2412	22.2	0.1660		
		2437	21.6	0.1445		
		2462	18.5	0.0708		
802.11n (HT40)	MCS0	2422	17.9	0.0617		
		2437	17.1	0.0513		
		2452	16.0	0.0398		
Maximum Measured Value			22.5	0.1778		
Max. e.i.r.p.=22.5dBm+2.23dBi=24.73dBm, which is less than 36dBm=4W.						

Note:

- 1) The cable loss is taken into account in results.
- 2) Antenna gain(G): 2.23 dBi

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5.1.3 Conducted Power Spectral Density

RESULT:

Pass

Test Specification

Test standard	: FCC Part 15.247(e) RSS-247 Clause 5.2(b)
Basic standard	: ANSI C63.10: 2013
Limits	: 8 dBm / 3kHz
Kind of test site	: Shielded Room

Test Setup

Date of testing	: 2024-07-04
Input voltage	: Fully charged battery
Operation mode	: A
Test channel	: Low / Middle / High
Ambient temperature	: 24.3 °C
Relative humidity	: 58 %
Atmospheric pressure	: 101 kPa

For the measurement records, refer to the appendix A.

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5.1.4 99%dB Bandwidth

RESULT:

Pass

Test Specification

Test standard	: RSS-Gen clause 6.7
Basic standard	: ANSI C63.10: 2013
Kind of test site	: Shielded Room

Test Setup

Date of testing	: 2024-07-04
Input voltage	: Fully charged battery
Operation mode	: A
Test channel	: Low / Middle / High
Ambient temperature	: 24.3 °C
Relative humidity	: 58 %
Atmospheric pressure	: 101 kPa

For the measurement records, refer to the appendix A.

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5.1.5 6dB Bandwidth

RESULT:**Pass****Test Specification**

Test standard : FCC Part 15.247(a)(2)
RSS-247 Clause 5.2(a)

Basic standard : ANSI C63.10: 2013

Limits : > 500 KHz

Kind of test site : Shielded Room

Test Setup

Date of testing : 2024-07-04

Input voltage : Fully charged battery

Operation mode : A

Test channel : Low / Middle / High

Ambient temperature : 24.3 °C

Relative humidity : 58 %

Atmospheric pressure : 101 kPa

For the measurement records, refer to the appendix A.

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5.1.6 Conducted Spurious Emissions Measured in 100 kHz Bandwidth

RESULT:

Pass

Test Specification

Test standard	: FCC Part 15.247(d) RSS-247 Clause 5.5
Basic standard	: ANSI C63.10: 2013
Limits	: 20dB (below that in the 100kHz bandwidth within the band that contains the highest level of the desired power); In addition, radiated emissions which fall in the restricted bands, must also comply with the radiated emission limits specified in 15.209(a)
Kind of test site	: Shielded Room

Test Setup

Date of testing	: 2024-07-04
Input voltage	: Fully charged battery
Operation mode	: A
Test channel	: Low / Middle / High
Ambient temperature	: 24.3 °C
Relative humidity	: 58 %
Atmospheric pressure	: 101 kPa

Test results of 100kHz Bandwidth of Frequency Band Edge by Conducted method refer to test plots, and compliance is achieved as well.

For the measurement records, refer to the appendix A.

5.1.7 Radiated Spurious Emission

RESULT:**Pass****Test Specification**

Test standard	: FCC Part 15.247(d) & FCC Part 15.205 RSS-247 Clause 3.3 & 5.5
Basic standard	: ANSI C63.10: 2013
Limits	: Refer to 15.209(a) of FCC part 15.247(d) RSS-Gen Table 5
Kind of test site	: 3m Semi-anechoic Chamber

Test Setup

Date of testing	: 2024-07-04 to 2024-07-05
Input voltage	: Fully charged battery
Operation mode	: A
Test channel	: Low / Middle / High
Ambient temperature	: Refer to test result
Relative humidity	: Refer to test result
Atmospheric pressure	: 101 kPa

Remark:

Testing was carried out within frequency range 9kHz to the tenth harmonics. Only the worst case spurious emissions configuration of the each mode were reported.

For the measurement records, refer to the appendix A.

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5.1.8 Conducted Emission on AC Mains

RESULT:**Pass****Test Specification**

Test standard	: FCC Part 15.207(a) RSS-Gen Clause 8.8
Basic standard	: ANSI C63.10: 2013
Frequency range	: 0.15 – 30MHz
Limits	: FCC Part 15.207(a) RSS-Gen Table 4
Kind of test site	: Shielded Room

Test Setup

Date of testing	: 2024-7-04
Input voltage	: AC 120V, 60Hz
Operation mode	: B
Earthing	: Not connected
Ambient temperature	: Refer to test result
Relative humidity	: Refer to test result
Atmospheric pressure	: 101 kPa

For the measurement records, refer to the appendix A.

6 Photographs of the Test Set-Up

For photographs of the test set-up, refer to the appendix B.

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