

<b>Prüfbericht-Nr.:</b> <i>Test report no.:</i>	<b>CN233T9H 001</b>	<b>Auftrags-Nr.:</b> <i>Order no.:</i>	168418775	<b>Seite 1 von 21</b> <i>Page 1 of 21</i>
<b>Kunden-Referenz-Nr.:</b> <i>Client reference no.:</i>	N/A	<b>Auftragsdatum:</b> <i>Order date:</i>	2023-03-16	
<b>Auftraggeber:</b> <i>Client:</i>	<b>Beijing Roborock Technology Co., Ltd.</b> Room 1001, Floor 10, Building 3, Yard 17, Anju Road, Changping District, Beijing, P.R. China			
<b>Prüfgegenstand:</b> <i>Test item:</i>	Robotic vacuum cleaner			
<b>Bezeichnung / Typ-Nr.:</b> <i>Identification / Type no.:</i>	Q50ULE (Trademark: roborock)			
<b>Auftrags-Inhalt:</b> <i>Order content:</i>	FCC and IC approval			
<b>Prüfgrundlage:</b> <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 2 February 2017 RSS-102 Issue 5, Amendment 1, February 2, 2021 ANSI C63.10: 2013			
<b>Wareneingangsdatum:</b> <i>Date of sample receipt:</i>	2023-03-21	Please refer to photo documents		
<b>Prüfmuster-Nr.:</b> <i>Test sample no.:</i>	A003437355-019~022 A003437355-005~008			
<b>Prüfzeitraum:</b> <i>Testing period:</i>	2023-03-26 - 2023-04-11			
<b>Ort der Prüfung:</b> <i>Place of testing:</i>	TÜV Rheinland (Shenzhen) Co., Ltd.			
<b>Prüflaboratorium:</b> <i>Testing laboratory:</i>	TÜV Rheinland (Shenzhen) Co., Ltd.			
<b>Prüfergebnis*:</b> <i>Test result*:</i>	Pass			
<b>geprüft von:</b> <i>tested by:</i>	<u>X <i>Chris Chen</i></u>	<b>genehmigt von:</b> <i>authorized by:</i>	<u>X <i>Lin Lin</i></u>	
<b>Datum:</b> <i>Date:</i>	2023-05-29 <small>Signed by: Chris Chen</small>	<b>Ausstellungsdatum:</b> <i>Issue date:</i>	2023-05-29 <small>Signed by: Lin Lin</small>	
<b>Stellung / Position</b>	Department Manager	<b>Stellung / Position</b>	Reviewer	
<b>Sonstiges /</b> <i>Other:</i>	FCC ID: 2AN2O-Q50ULE01 IC: 23317-Q50ULE01      HVIN: Q50ULE-BLM8			
<b>Zustand des Prüfgegenstandes bei Anlieferung:</b> <i>Condition of the test item at delivery:</i>	Prüfmuster vollständig und unbeschädigt <i>Test item complete and undamaged</i>			
* Legende: P(ass) = entspricht o.g. Prüfgrundlage(n)    F(ail) = entspricht nicht o.g. Prüfgrundlage(n)    N/A = nicht anwendbar    N/T = nicht getestet * Legend: P(ass) = passed a.m. test specification(s)    F(ail) = failed a.m. test specification(s)    N/A = not applicable    N/T = not tested				
<b>Dieser Prüfbericht bezieht sich nur auf das o.g. Prüfmuster und darf ohne Genehmigung der Prüfstelle nicht auszugsweise vervielfältigt werden. Dieser Bericht berechtigt nicht zur Verwendung eines Prüfzeichens.</b> <i>This test report only relates to the above mentioned test sample. Without permission of the test center this test report is not permitted to be duplicated in extracts. This test report does not entitle to carry any test mark.</i>				

v05

## 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: Photographs of the Test Set-up

Appendix B: Test Results.

## 2 Test Sites

### 2.1 Test Facilities

**TÜV Rheinland (Shenzhen) Co., Ltd.**

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

FCC Registration No.: 694916

IC Registration No.: 25069

### 2.2 List of Test and Measurement Instruments

**Table 1: List of Test and Measurement Equipment**

<b>Radio Spectrum Testing (SRD-Tonscend)</b>				
<b>Equipment</b>	<b>Manufacturer</b>	<b>Model</b>	<b>Serial No.</b>	<b>Cal. until</b>
EXA Signal Analyzer, Multi-touch	Keysight	N9010B	MY60241175	2023-10-10
MXG X-Series RF Vector Signal Generator	Keysight	N5182B	MY61250137	2023-10-10
EXG X-Series Microwave Analog Signal Generator	Keysight	N5173B	MY61250141	2023-10-10
DC power supply	Keysight	E3642A	MY61276100	2023-10-10
Power Control Unit	Tonscend	JS0806-4ADC	N/A	2023-10-10
Automation Control Unit	Tonscend	JS0806-2	21C8060396	2023-10-10
Test Software	Tonscend	JS1120-3	N/A	N/A
Control PC	Lenovo	TianYi510S-071MB	YLX23JMF	N/A
Shielding Room 8#	Albatross	SR8	APC17151-SR8	2024-06-22
<b>Unwanted Emission Testing (TS9975)</b>				
<b>Equipment</b>	<b>Manufacturer</b>	<b>Model</b>	<b>Serial No.</b>	<b>Cal. until</b>
EMI Test Receiver	R&S	ESR 7	102021	2023-08-02
Signal Analyzer	R&S	FSV 40	101439	2023-08-01
System Controller Interface	R&S	SCI-100	S10010038	N/A
Filterbank	R&S	Wlan	100759	2023-08-01
OSP	R&S	OSP 120	102040	N/A
Pre-amplifier	R&S	SCU08F1	08320031	2023-08-02
Amplifier	R&S	SCU-18F	180070	2023-08-02
Amplifier	R&S	SCU40A	100475	2023-08-02
Trilog Broadband Antenna (30 MHz - 7 GHz)	Schwarzbeck	VULB 9162	193	2024-08-06
Double-Ridged Antenna (1 -18 GHz)	ETS-LINDGREN	3117	00218717	2024-08-06

Wideband Ridged Horn Antenna (18-40 GHz)	Steatite	QMS-00880	19067	2024-08-27
Active Loop Antenna	Schwarzbeck	FMZB 1513	302	2023-08-06
Test software	R&S	EMC32 (V10.60.10)	N/A	N/A
Control PC	Dell	OptiPlex 7050	36NV9P2	N/A
3m Semi-Anechoic Chamber	Albatross	SAC-3m	APC17151-SAC	2024-06-22

<b>Conducted Emission</b>				
<b>Equipment</b>	<b>Manufacturer</b>	<b>Model No.</b>	<b>Serial No.</b>	<b>Cal. Until</b>
EMI Test Receiver	R&S	ESR3	102680	2024-02-23
Artificial Mains Network	R&S	ENV216	101445	2024-02-23
EMC32 test software	R&S	EMC32(Ver.10.50.00)	N/A	N/A

## 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.

<b>Parameter</b>	<b>Uncertainty</b>
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
Conducted Emission, (9kHz to 150kHz)/(150kHz to 30MHz)	± 3.70 dB / ± 3.30 dB

## 2.6 Location of Original Data

The original copies of all test data taken during actual testing were at 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.

### 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 BL-M8189FS6.

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

#### 3.2 Ratings and System Details

**Table 2: Technical Specification of EUT**

General Information of EUT	Value
Kind of Equipment:	Robotic Vacuum Cleaner
Type Designation:	Q50ULE
Trademark:	roborock
FCC ID:	2AN2O-Q50ULE01
IC:	23317-Q50ULE01
HVIN:	Q50ULE-BLM8
Operating Voltage:	DC 20V@1.2A input via Charging base DC 14.4V@5200mAh(TYP) input via Lithium-ion battery
Testing Voltage:	AC 120V, 60Hz Fully charged battery
<b>Technical Specification of Wi-Fi 802.11 b/g/n</b>	
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
Max. Antenna Gain:	2.54 dBi



Table 3: 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
- Operation Description
- FCC/IC Label and Location Info

## 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 Q50ULE in this report.

### 4.3 Special Accessories and Auxiliary Equipment

Table 4: List of Accessories and Auxiliary Equipment

Description	Manufacturer	Model	S/N
Laptop	Lenovo	T480	PF-16A6N8

### 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)

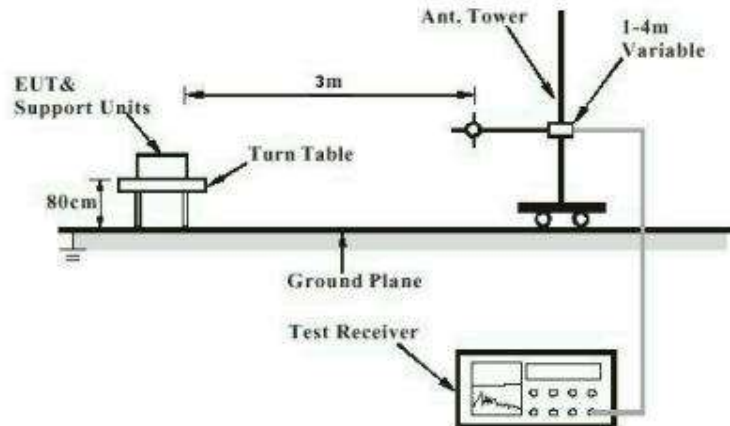


Diagram of Measurement Configuration for Radiation Test (Above 1GHz)

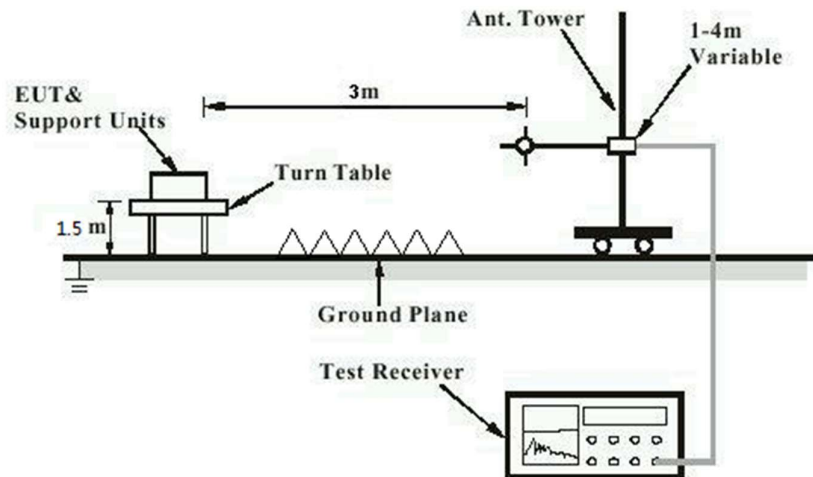


Diagram of Measurement Configuration for Mains Conduction Measurement

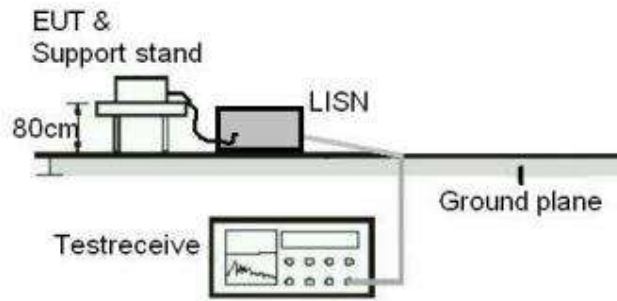
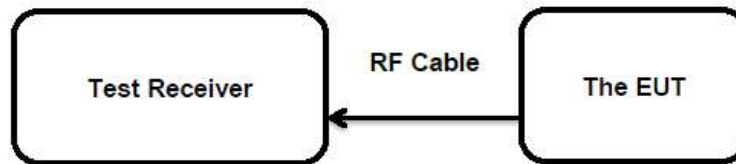


Diagram of Measurement Configuration for Conducted Transmitter Measurement



## 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  
Limit : the use of antennas with directional gains that do not exceed 6 dBi

the EUT has a PCB Antenna , the directional gain of antenna is 2.54 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(2)&(4)  
 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 : 2023-04-04 to 2023-04-06  
 Input voltage : Fully charged battery  
 Operation mode : A  
 Test channel : Low / Middle / High  
 Ambient temperature : 26.4 °C  
 Relative humidity : 58 %  
 Atmospheric pressure : 101 kPa

For details refer to following test result.

**Table 5: Test Result of Maximum Peak Conducted Output Power, Wi-Fi 802.11 b/g/n**

Test Mode	Data Rate	Test Channel (MHz)	Measured Peak Power		Limit (W)
			(dBm)	(W)	
802.11b	1 Mbps	2412	21.52	0.1419	< 1.0
		2437	21.79	0.1510	
		2462	21.77	0.1503	
802.11g	6 Mbps	2412	25.75	0.3758	
		2437	25.25	0.3350	
		2462	25.76	0.3767	
802.11n (HT20)	MCS0	2412	25.82	0.3819	
		2437	25.64	0.3664	
		2462	25.98	0.3963	
802.11n (HT40)	MCS0	2422	25.56	0.3597	
		2437	25.82	0.3819	
		2452	25.88	0.3873	
<b>Maximum Measured Value</b>			25.98	0.3963	
Max. e.i.r.p.=25.98dBm+2.54dBi=28.52dBm, which is less than 36dBm=4W.					

Note:

- 1) The cable loss is taken into account in results.
- 2) Antenna gain(G): 2.54 dBi

### 5.1.3 Conducted Power Spectral Density

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

Test standard	:	FCC Part 15.247(e) RSS-247 Clause 5.2(2)
Basic standard	:	ANSI C63.10: 2013
Limits	:	8 dBm / 3kHz
Kind of test site	:	Shielded Room

**Test Setup**

Date of testing	:	2023-04-04 to 2023-04-06
Input voltage	:	Fully charged battery
Operation mode	:	A
Test channel	:	Low / Middle / High
Ambient temperature	:	26.4 °C
Relative humidity	:	58 %
Atmospheric pressure	:	101 kPa

For the measurement records, refer to the appendix B.

### 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 : 2023-04-04 to 2023-04-06  
Input voltage : Fully charged battery  
Operation mode : A  
Test channel : Low / Middle / High  
Ambient temperature : 26.4 °C  
Relative humidity : 58 %  
Atmospheric pressure : 101 kPa

For the measurement records, refer to the appendix B.



### 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	:	2023-04-04 to 2023-04-06
Input voltage	:	Fully charged battery
Operation mode	:	A
Test channel	:	Low / Middle / High
Ambient temperature	:	26.4 °C
Relative humidity	:	58 %
Atmospheric pressure	:	101 kPa

For the measurement records, refer to the appendix B.

## 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	: 2023-04-04 to 2023-04-06
Input voltage	: Fully charged battery
Operation mode	: A
Test channel	: Low / Middle / High
Ambient temperature	: 26.4 °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 B.

## 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 4 & Table 5
Kind of test site	:	3m Semi-anechoic Chamber

**Test Setup**

Date of testing	:	2023-04-07
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 B.

## 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	:	2023-03-26
Input voltage	:	AC 120V, 60Hz
Operation mode	:	B
Earthing	:	Not connected
Ambient temperature	:	22 °C
Relative humidity	:	55 %
Atmospheric pressure	:	101 kPa

This testing was carried out on all operation modes, but only the worst case was presented in this report.

For the measurement records, refer to the appendix B.

## 6 Photographs of the Test Set-Up

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

---END---