ACCREDITED Certificate #5162.01

TÜVRheinland®

Prüfbericht-Nr.: *Test report no.:*	**CN222GQB 002**	**Auftrags-Nr.:** *Order no.:*	**168350093**	**Seite 1 von 19** *Page 1 of 19*
Kunden-Referenz-Nr.: *Client reference no.:*	**N/A**	**Auftragsdatum:** *Order date:*	2022-01-04	
Auftraggeber: *Client:*	**Sichuan AI-Link Technology Co.,Ltd.** Anzhou Industrial Park, Mianyang, Sichuan,P.R.C			
Prüfgegenstand: *Test item:*	Wi-Fi Module			
Bezeichnung / Typ-Nr.: *Identification / Type no.:*	WF-M63B-USD1			
Auftrags-Inhalt: *Order content:*	Test Report			
Prüfgrundlage: *Test specification:*	CFR47 FCC Part 15: Subpart C Section 15.247			

Wareneingangsdatum: *Date of sample receipt:*	2022-01-04	Please refer to Photo Document
Prüfmuster-Nr.: *Test sample no:*	A003194326-001~002	
Prüfzeitraum: *Testing period:*	2022-01-05 - 2022-01-18	
Ort der Prüfung: *Place of testing:*	TÜV Rheinland (Shenzhen) Co., Ltd.	
Prüflaboratorium: *Testing laboratory:*	TÜV Rheinland (Shenzhen) Co., Ltd.	
Prüfergebnis*: *Test result*:*	Pass	

geprüft von: *tested by:*	X Bell Hu Signed by: Bell Hu	**genehmigt von:** *authorized by:*	X Lin Lin Signed by: Lin Lin
Datum: *Date:* 2022-01-26		**Ausstellungsdatum:** *Issue date:* 2022-01-26	
Stellung */ Position:*	Project Manager	**Stellung** */ Position:*	Reviewer

Sonstiges */ Other:* FCC ID: 2AOKI-WFM63BUSD1

Zustand des Prüfgegenstandes bei Anlieferung: Prüfmuster vollständig und unbeschädigt
Condition of the test item at delivery: *Test item complete and undamaged*

* Legende:	1 = sehr gut	2 = gut	3 = befriedigend	4 = ausreichend	5 = mangelhaft
	P(ass) = entspricht o.g. Prüfgrundlage(n)		F(ail) = entspricht nicht o.g. Prüfgrundlage(n)	N/A = nicht anwendbar	N/T = nicht getestet
** Legend:*	*1 = very good*	*2 = good*	*3 = satisfactory*	*4 = sufficient*	*5 = poor*
	P(ass) = passed a.m. test specification(s)		*F(ail) = failed a.m. test specification(s)*	*N/A = not applicable*	*N/T = not tested*

Test Summary

5.1.1 ANTENNA REQUIREMENT
RESULT: Pass

5.1.2 MAXIMUM CONDUCTED OUTPUT POWER
RESULT: Pass

5.1.3 CONDUCTED POWER SPECTRAL DENSITY
RESULT: Pass

5.1.4 6DB BANDWIDTH
RESULT: Pass

5.1.5 99% 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 AC CONDUCTED EMISSION
RESULT: Pass

Contents

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 Test Set-up

Appendix B: Test Results of Wi-Fi 802.11 b/g/n

2 Test Sites

2.1 Test Facilities

TÜV Rheinland (Shenzhen) Co., Ltd.
362 Huanguan Road Middle Longhua District, Shenzhen 518110 People's Republic of China

FCC Registration No.: 694916
ISED wireless device testing laboratory: 25069

2.2 List of Test and Measurement Instruments

Table 1: List of Test and Measurement Equipment

Radio Spectrum Testing (TS8997)				
Equipment	**Manufacturer**	**Model**	**Serial No.**	**Cal. until**
Signal Analyzer	R&S	FSV 40	101441	09.08.2022
OSP	R&S	OSP 150	101017	02.12.2022
Control PC	DELL	OptiPlex 7050	FTJZ9P2	N/A
Test Software	R&S	WMS32 (V11.00.00)	N/A	N/A
Power Meter	R&S	NRP2	107105	02.12.2022
Wideband Power Sensor	R&S	NRP-Z81	105677	09.08.2022
Shielding Room 8#	Albatross	SR8	APC17151-SR8	22.06.2024
Unwanted Emission Testing (TS9975)				
Equipment	**Manufacturer**	**Model**	**Serial No.**	**Cal. until**
EMI Test Receiver	R&S	ESR 7	102021	10.08.2022
Signal Analyzer	R&S	FSV 40	101439	09.08.2022
System Controller Interface	R&S	SCI-100	S10010038	N/A
Filterbank	R&S	Wlan	100759	09.08.2022
OSP	R&S	OSP 120	102040	N/A
Pre-amplifier	R&S	SCU08F1	08320031	09.08.2022
Amplifier	R&S	SCU-18F	180070	09.08.2022
Amplifier	R&S	SCU40A	100475	09.08.2022
Trilog Broadband Antenna (30 MHz - 7 GHz)	Schwarzbeck	VULB 9162	193	08.08.2022
Double-Ridged Antenna (1 -18 GHz)	ETS-LINDGREN	3117	00218717	08.08.2022
Wideband Ridged Horn Antenna (18-40 GHz)	Steatite	QMS-00880	19067	08.08.2022
Active Loop Antenna	Schwarzbeck	FMZB 1513	302	13.09.2022
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	22.06.2024

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 basics 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.

Parameter	Uncertainty
Radio Frequency	±1 x 10-7
RF Power (conducted)	±2.5 dB
Radiated Emission of Transmitter, valid up to 26.5 GHz	±6 dB
Radiated Emission of Receiver, valid up to 26.5 GHz	±6 dB
Temperature	±1 °C
Humidity	±5 %
Voltage (DC)	±1 %
Voltage (AC, <10kHz)	±2 %

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) Co., Ltd. file for certification follow-up purposes.

2.7 Status of Facility Used for Testing

The TÜV Rheinland (Shenzhen) Co., Ltd. Test facility located at 362 Huanguan Road Middle Longhua District, Shenzhen 518110 People's Republic of 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 a Wi-Fi Module, which supports Bluetooth, 2.4GHz Wi-Fi 802.11 b/g/n and 5GHz Wi-Fi 802.11a/n/ac wireless technology.

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:	Wi-Fi Module
Type Designation:	WF-M63B-USD1
FCC ID:	2AOKI-WFM63BUSD1
Operating Voltage:	DC 3.3V
Antenna Type:	Antennas with IPEX connector (non-standard connector)
Antenna Gain:	**Wi-Fi Antenna 1#:** Max gain 1.89dBi for 2.4GHz Wi-Fi Max gain 1.84dBi for 5GHz Wi-Fi **Wi-Fi Antenna 2#:** Max gain 1.85dBi for 2.4GHz Wi-Fi Max gain 1.96dBi for 5GHz Wi-Fi **BT Antenna 3#:** Max gain 1.92dBi for Bluetooth As for MIMO mode for Antenna 1# and Antenna 2#, Cyclic Delay Diversity mode Employed. No beamforming.
Technical Specification of Bluetooth (Dual Mode)	
Operating Frequency:	2402 MHz to 2480 MHz
Type of Modulation:	GFSK, π/4-DQPSK, 8DPSK
Channel Number:	79 channels, BDR & EDR 40 channels, BLE
Channel Separation:	1MHz (for EDR & BDR), 2MHz (for BLE)
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
MIMO and SISO mode:	SISO for 802.11b/g, MIMO and SISO for 802.11n.

Technical Specification of Wi-Fi 802.11 a/n/ac	
Operating Frequency:	5180-5320MHz, 5500-5720MHz, 5745-5825MHz
Type of Modulation:	OFDM(BPSK/QPSK/16QAM/64QAM/256QAM)
Channels:	5180-5320MHz, 802.11 a/n20/n40/ac20/ac40/ac80 5500-5720MHz, 802.11 a/n20/n40/ac20/ac40/ac80 5745-5825MHz, 802.11 a/n20/n40/ac20/ac40/ac80
Channel Separation	5 MHz
MIMO and SISO mode:	SISO for 802.11a, MIMO and SISO for 802.11n/ac.
DFS:	Client device without DFS detection

3.3 Independent Operation Modes

The basic operation modes are:

A. On, Wi-Fi 802.11 b/g/n wireless transmitting mode
   1) Low Channel
   2) Middle Channel
   3) High Channel

B. On, Wi-Fi 802.11 b/g/n connecting mode

C. Off

3.4 Noise Generating and Noise Suppressing Parts

Refer to Circuit Diagram for further details.

3.5 Submitted Documents

- Application Form
- Block Diagram
- User Manual
- 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 tests were performed according to the procedures in ANSI C63.10: 2013.

According to clause 3.1, all tests were performed on model WF-M63B-USD1 in this report.

Table 3: Test environments

Environment Parameter	Selected Values During Tests		
	Temperature	Voltage (adapter)	Relative Humidity
NTNV	24.6°C	DC 3.3V	Ambient

Table 4: Test channel and frequency

Mode	Test Channels
802.11b/g/n(HT20)	L: CH01, 2412MHz; M: CH06, 2437MHz; H: CH11, 2462MHz
802.11b/g/n(HT40)	L: CH03, 2422MHz; M: CH06, 2437MHz; H: CH09, 2452MHz

4.3 Special Accessories and Auxiliary Equipment

Table 5: Auxiliary Equipment Used during Test

Description	Manufacturer	Model	S/N	Rating
Laptop	Lenovo	T480	PF-16A6N8	N/A
Test jig	Sichuan AI-Link Technology Co.,Ltd.	WF-M63B-USD1	N/A	DC 5V

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)

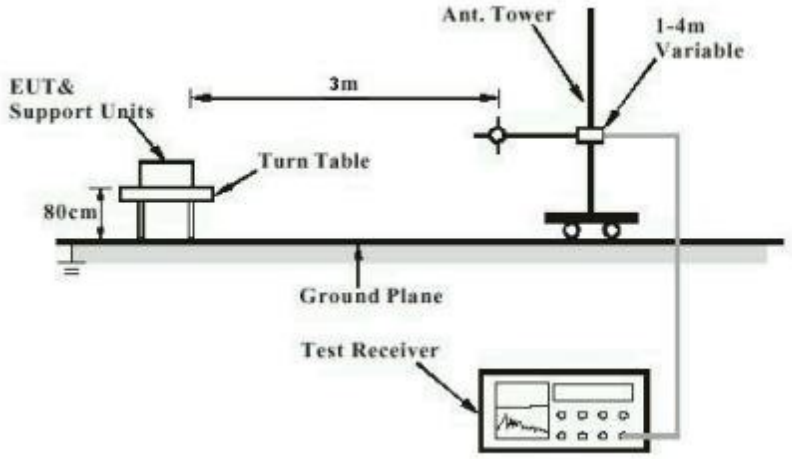


Diagram of Measurement Configuration for Radiation Test (Above 1GHz)

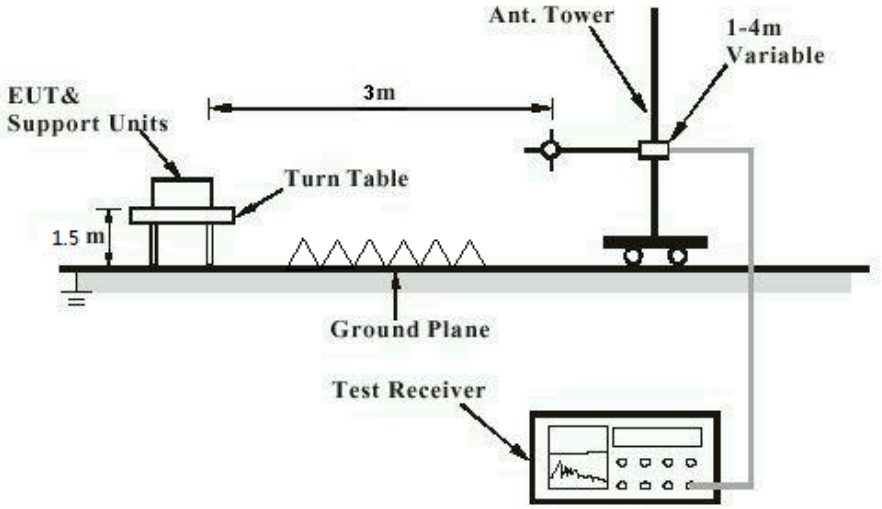
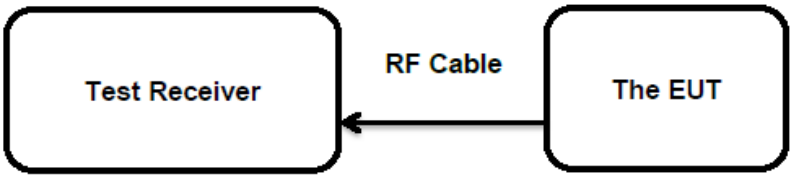


Diagram of Measurement Configuration for Conducted Transmitter Measurement



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

According to the manufacturer declared, the EUT has integral antennas with a unique connector, which is designed with permanent attachment and no consideration of replacement. The maximum antenna gain is 1.89 dBi.

Therefore the EUT is considered sufficient to comply with the provision.

Refer to EUT Photo for further details.

5.1.2 Maximum Conducted Output Power

RESULT: **Pass**

Test Specification

Test standard	:	FCC Part 15.247(b)(3)
Basic standard	:	ANSI C63.10: 2013
Limits	:	1.0 Watts
Kind of test site	:	Shielded Room

Test Setup

Date of testing	:	2022-01-07
Input voltage	:	DC 3.3V
Operation mode	:	A
Test channel	:	Low / Middle / High
Ambient temperature	:	24.6 ℃
Relative humidity	:	55 %
Atmospheric pressure	:	101 kPa

Table 6: Test Result of Maximum Conducted Output Power, Wi-Fi 802.11 b/g/n

Test Mode	Data Rate	Test Channel (MHz)	Maximum conducted output power				Limit (W)
			SISO Ant 1# (dBm)	SISO Ant 2# (dBm)	MIMO Sum (Ant1#+ Ant 2#) (dBm)	MIMO Sum (Ant1#+ Ant 2#) (W)	
802.11b	1 Mbps	2412	15.59	15.56	/	/	< 1.0
		2437	16.23	16.00	/	/	
		2462	16.19	16.13	/	/	
802.11g	6 Mbps	2412	15.96	15.95	/	/	
		2437	16.02	15.79	/	/	
		2462	16.23	15.98	/	/	
802.11n (HT20)	MCS0	2412	15.82	16.06	18.95	0.0785	
		2437	16.10	15.68	18.91	0.0778	
		2462	16.13	15.77	18.96	0.0787	
802.11n (HT40)	MCS0	2422	15.98	15.55	18.78	0.0755	
		2437	16.25	15.87	19.07	0.0807	
		2452	16.23	15.91	19.08	0.0809	
Maximum Measured Value			0.0809 W				

Note:

1) The cable loss is taken into account in results.
2) e.i.r.p.=$P_{(Peak\ power)}$+ G, which is far below the 4 W
3) The maximum Duty cycle is 99.6% for 802.11b, 97.2% for 802.11b and 94.2% for 802.11n. The duty cycle factor has been considered in results listed above.

5.1.3 Conducted Power Spectral Density

RESULT: **Pass**

Test Specification

Test standard	:	FCC Part 15.247(e)
Basic standard	:	ANSI C63.10: 2013
Limits	:	< 8 dBm / 3kHz
Kind of test site	:	Shielded Room

Test Setup

Date of testing	:	2022-01-08
Input voltage	:	DC 3.3V
Operation mode	:	A
Test channel	:	Low / Middle / High
Ambient temperature	:	24.6 ℃
Relative humidity	:	55 %
Atmospheric pressure	:	101 kPa

For the measurement records, refer to the appendix B.

5.1.4 6dB Bandwidth

RESULT: **Pass**

Test Specification

Test standard	:	FCC Part 15.247(a)(2)
Basic standard	:	ANSI C63.10: 2013
Limits	:	> 500 KHz
Kind of test site	:	Shielded Room

Test Setup

Date of testing	:	2022-01-05
Input voltage	:	DC 3.3V
Operation mode	:	A
Test channel	:	Low / Middle / High
Ambient temperature	:	24.6 ℃
Relative humidity	:	55 %
Atmospheric pressure	:	101 kPa

For the measurement records, refer to the appendix B.

5.1.5 99% Bandwidth

RESULT: **Pass**

Test Specification

Test standard	:	FCC Part 15.247(a)
Basic standard	:	ANSI C63.10: 2013
Kind of test site	:	Shielded Room

Test Setup

Date of testing	:	2022-01-05
Input voltage	:	DC 3.3V
Operation mode	:	A
Test channel	:	Low / Middle / High
Ambient temperature	:	24.6 ℃
Relative humidity	:	55 %
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)
Basic standard	:	ANSI C63.10: 2013
Limits	:	If the tested output power based on peak test: At least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power. If the tested output power based on RMS averaging over a time interval: At least 30 dB below that in the 100 kHz 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	:	2022-01-05
Input voltage	:	DC 3.3V
Operation mode	:	A
Test channel	:	Low / Middle / High
Ambient temperature	:	24.6 ℃
Relative humidity	:	55 %
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.
Considering that the conducted power is based on RMS average over a time interval, the attenuation required under this paragraph shall be 30 dB instead of 20 dB.
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
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	:	2022-01-08 ~ 2022-01-12
Input voltage	:	DC 3.3V
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.
As for Co-location with Bluetooth, it verified that there was no additional emission found and no need to report it.
For the measurement records, refer to the appendix B.

5.1.8 AC Conducted Emission

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)
Kind of test site	:	Shielded Room

Test Setup

Date of testing	:	2022-01-12
Input voltage	:	**Error! Reference source not found.**
Operation mode	:	on
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 B .
All modes tested, only the worst-case reported.

6 Photographs of the Test Set-Up

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

7 List of Tables