

TEST REPORT

Product : Seeed Studio XIAO ESP32C6
Trade mark : Seeed Studio
Model/Type reference : XIAO-ESP32-C6
Serial Number : N/A
Report Number : EED32Q80454002
Date of Issue : Jun. 11, 2024
Product Class : Item 19-2 of Article 2 Paragraph 1
Test result : PASS

Prepared for:

Seeed Technology Co., Ltd
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1 Version

Version No.	Date	Description
00	Jun. 11, 2024	Original

2 Test Summary

Test	Test Requirement	Ordinance regulating radio equipment Limit	Result
Antenna Requirement	item 19-2 of Article 2 Paragraph 1	Ordinance regulating radio equipment Chapter II Section 3	PASS
Test frequency	item 19-2 of Article 2 Paragraph 1	N/A	PASS
Frequency Error	item 19-2 of Article 2 Paragraph 1	±50 PPM or less	PASS
Occupied Bandwidth	item 19-2 of Article 2 Paragraph 1	26MHz or less	PASS
Spread-spectrum Bandwidth	item 19-2 of Article 2 Paragraph 1	500 kHz or more	PASS
Antenna Power	item 19-2 of Article 2 Paragraph 1	10mW/MHz or less Tolerance: +20%,-80%	PASS
Spurious Emission of Tx	item 19-2 of Article 2 Paragraph 1	(1)Below 2458 MHz : 2.5μW (2)2458 to 2471 MHz : 25μW (3)2497 through 2510MHz : 25μW (4)Over 2510 MHz : 2.5μW	PASS
Interference prevention capability	item 19-2 of Article 2 Paragraph 1	Ordinance regulating radio equipment Chapter I Section 5	PASS
Carrier sense capability	item 19-2 of Article 2 Paragraph 1	Notice 88 Appendix 44	N/A
RF accessibility	item 19-2 of Article 2 Paragraph 1	N/A	PASS
Spurious Emission of Rx	item 19-2 of Article 2 Paragraph 1	(1) Below 1 GHz: 4nW (2) 1GHz or higher: 20nW	PASS

Remark:

Company Name and Address shown on Report, the sample(s) and sample Information was/ were provided by the applicant who should be responsible for the authenticity which CTI hasn't verified.

EUT: In this whole report EUT means Equipment Under Test.

Tx: In this whole report Tx (or tx) means the product in transmitting status.

Rx: In this whole report Rx (or rx) means the product in receiving status.

RF: In this whole report RF means Radiated Frequency.

DS: Direct spreading FH: Frequency hopping

OFDM: Orthogonal frequency division multiplexing

NA: No requirements for 20M bandwidth

All antennas have been tested, only the worst data (Antenna1) have been recording in the report.

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4 General Information

4.1 Client Information

Applicant:	Seeed Technology Co., Ltd
Address of Applicant:	9F, G3 Building, TCL International E City, Zhongshanyuan Road, Nanshan District, Shenzhen, Guangdong Province, P.R.C, China
Manufacturer:	Seeed Technology Co., Ltd
Address of Manufacturer:	9F, G3 Building, TCL International E City, Zhongshanyuan Road, Nanshan District, Shenzhen, Guangdong Province, P.R.C, China
Factory:	Seeed Technology Co., Ltd
Address of Factory:	9F, G3 Building, TCL International E City, Zhongshanyuan Road, Nanshan District, Shenzhen, Guangdong Province, P.R.C, China

4.2 General Description of EUT

Product Name:	Seeed Studio XIAO ESP32C6	
Model No.:	XIAO-ESP32-C6	
Test Model No.:	XIAO-ESP32-C6	
Trade Mark:	Seeed Studio	
Operating Frequency:	Wi-Fi: IEEE 802.11b (HT20): 2484MHz	
Conducted rate power	802.11b(channel 14): 1.8mW/MHz	
Type of Modulation:	802.11b: DSSS(CCK/QPSK/BPSK)	
Transmit Data Rate:	802.11b: 1M/2M/5.5M/11M bps	
Channel Separation:	5 MHz	
Antenna Type:	Antenna1: Ceramic chip antenna Antenna2: FPC antenna Antenna3: Rod antenna	
Antenna gain:	Antenna1: 4.97dBi Antenna2: 1.23dBi Antenna3: 2.42dBi	
Test Power Grade:	Default	
Test Software of EUT:	EspRFTTestTool_v3.6_Manual	
Power Supply:	Adapter:	DC 3.3V
Sample Received Date:	DC 3.3V	
Sample tested Date:	Apr. 10, 2024	
Sample tested Date:	Apr. 10, 2024 to Jun. 11, 2024	

4.3 EUT Test Environment Recorded

Temperature:	22°C
Humidity:	53% RH
Atmospheric Pressure:	1010mbar

4.4 Description of Support Units

The EUT has been tested with associated equipment below.

Associated equipment name	Manufacture	model	S/N serial number	Supplied by	Certification
/	/	/	/	/	/

4.5 Test Location

All tests were performed at:

Centre Testing International Group Co., Ltd.

Building C, Hongwei Industrial Park Block 70, Bao'an District, Shenzhen, China

Telephone: +86 (0) 755 3368 3668 Fax: +86 (0) 755 3368 3385

No tests were sub-contracted.

4.6 Measurement Uncertainty (95% confidence levels, k=2)

No.	Item	Measurement Uncertainty
1	Frequency Error	10 Hz
2	Occupied Bandwidth	10 kHz
3	Antenna Power	0.55dB
4	Spurious Emissions	0.46dB(30MHz-1GHz)
		0.55dB(1GHz-18GHz)
5	Carrier sense capability	1.0dB
6	Temperature test	0.64°C
7	Humidity test	3.8%
81	DC and low frequency voltages test	0.026%

5 Equipment List

Equipment	Manufacturer	Model	Serial No.	Cal. Date	Due date	Calibration body	Classification
Spectrum Analyzer	R&S	FSV40	101200	09-02-2020	09-01-2021	LISAI	(c)
Spectrum Analyzer	R&S	FSP40	100416	04-29-2021	04-28-2022	CTI	(c)
Temperature/ Humidity Indicator	biaozhi	GM1360	EJ1611459	02-21-2021	02-20-2022	CTIMT	(c)
Signal Generator	Keysight	E8257D	MY5340110 6	12-28-2020	12-27-2021	CTIMT	(c)
Digital multimeter	FLUKE	111	90240138	05-13-2020	05-12-2021	CTIMT	(c)

Remark:

- (a) Calibration conducted by the National Institute of Information and Communications Technology (NICT) in Japan (hereinafter referred to as "NICT") or a designated calibration agency under Article 102-18 paragraph (1) in JRL.
- (b) Correction conducted pursuant to the provisions of Article 135 or Article 144 of the Measurement Act (Act No. 51 of 1992).
- (c) Calibration conducted in countries except Japan, which shall be equivalent to the calibration conducted by the NICT or a designated calibration agency under Article 102-18 paragraph (1).
- (d) Calibration, etc. conducted by using measuring instruments and other equipment listed in the right column of appended table No. 3, which shall have been given any type of calibration, etc. listed above from (a) to (c).

From JRL Article 24-2, paragraph 4, Item 2

Notice: Calibration duration for above equipment is 1 year.

6 Radio Technical Requirements Specification

Table 1: Radio Technical Requirements Specification for 2.4 GHz band low-power data communication system (Item 19-2 of Article 2 Paragraph 1)

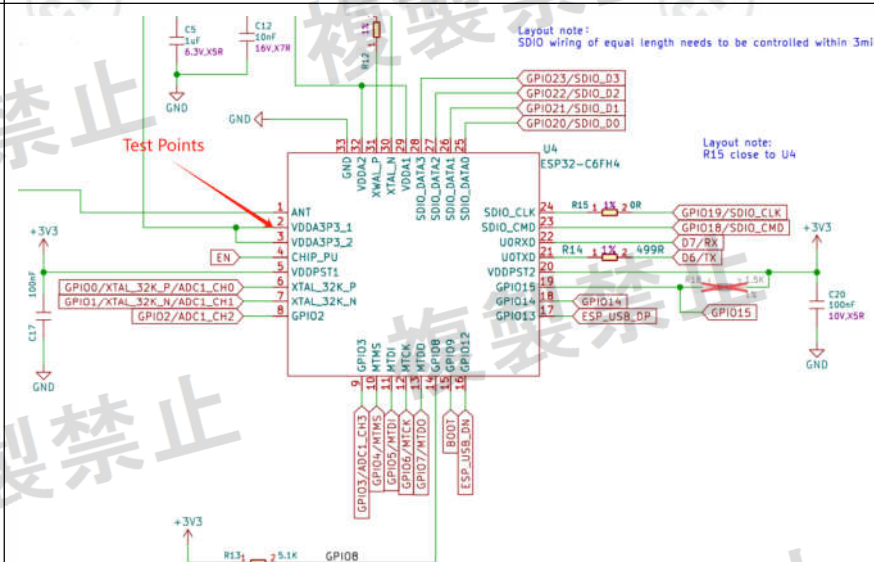
Items	Technical standard
Assigned frequency or designated frequency	2471MHz-2497MHz
Communication method	One-way, Simplex, Duplex, Half-Duplex, Broadcast
Tolerance of frequency ($\times 10^{-6}$)	± 50 PPM
Tolerance of occupied bandwidth	26MHz
Antenna power	10mW/MHz or less Tolerance: +20%,-80%
Antenna gain	2.14dBi or less When an E.R.P. is less than a limit, the shortage shall be compensated for by the gain of the transmitting antenna.
Tolerance of spurious emission intensity	(1) Below 2458 MHz : 2.5 μ W (2) 2458 to 2471 MHz : 25 μ W (3) 2497 through 2510MHz : 25 μ W Over 2510 MHz : 2.5 μ W
Spreading bandwidth	500kHz or more
Spreading rate of spectrum	For DS system;(Spreading bandwidth) / (Frequency corresponding to transmission rate) ≥ 10
Limit of secondary radiated emissions	(1) Below 1 GHz: 4nW (2) 1 GHz or higher: 20nW
Interference prevention function	Shall have the function of automatic transmission and reception of identification sign.
Structure	Shall be of the structure that the RF and modulator sections excluding antenna cannot easily be opened.
Note	DS: Direct spread FH: Frequency hopping

Note: The Technical Standards described here do not cover all of the regulated items.

6.1 Transmitter Requirements

6.1.1 EUT test voltage and Frequency

6.1.1.1 EUT test voltage

Power Supply:	Adapter:	DC 3.3V												
Test voltage require:	Supply the rated voltage and the rated voltage $\pm 10\%$ to power supply. However, If the fluctuation of input voltage to the circuit of RF unit (except power supply) of test equipment is under $\pm 1\%$, when input voltage from external power supply to the test equipment is fluctuated by $\pm 10\%$: Conduct the test with the rated voltage only.													
RF circuit test points:														
Power Supply result:	<p>The measurement result of the voltage fluctuation at RF circuit when DC 3.3V $\pm 10\%$.</p> <table border="1"> <thead> <tr> <th>Remark</th><th>DC Input</th><th>RF circuit</th></tr> </thead> <tbody> <tr> <td>NV</td><td>3.3V</td><td>DC 3.3V</td></tr> <tr> <td>LV</td><td>3.333V</td><td>DC 3.3V</td></tr> <tr> <td>HV</td><td>3.267V</td><td>DC 3.3V</td></tr> </tbody> </table> <p>NT: Normal Temperature NV: Normal Voltage LV: Low Voltage HV: High Voltage</p>		Remark	DC Input	RF circuit	NV	3.3V	DC 3.3V	LV	3.333V	DC 3.3V	HV	3.267V	DC 3.3V
Remark	DC Input	RF circuit												
NV	3.3V	DC 3.3V												
LV	3.333V	DC 3.3V												
HV	3.267V	DC 3.3V												

6.1.1.2 Test frequency

Test frequencies:	If the EUT can be set to 3 or more different (carrier) frequencies in 1 allocated band, testing shall be performed using the Lowest, Middle and the Highest frequency (L,M and H). If there are 2 or fewer frequencies, testing shall be performed with the available frequencies.	
Frequency range over which device operates	Number of frequencies	Location in the range of operation
1 MHz or less	1	Middle
1 to 10 MHz	2	1 near top and 1 near bottom
More than 10 MHz	3	1 near top, 1 near middle and 1 near bottom

EUT channels and frequencies list:

802.11b

Channel	Frequency (MHz)
14	2484

6.1.2 Antenna Requirement

Standard requirement	
Applicable for equipment with an antenna terminal, including testing terminals) If an antenna connector is available, all relevant tests will be carried out conducted. If not, tests will be carried out in an anechoic room or with a suitable test-fixture.	
EUT Antenna	Please see the interior photos
Antenna1: The antenna connector is a ceramic chip antenna and need not be replaced. The optimum gain of the antenna is 4.97dBi. Antenna2: The antenna connector is a FPC antenna and no consideration of replacement. The best case gain of the antenna is 1.23dBi. Antenna3: The antenna connector is a Rod antenna and no consideration of replacement. The best case gain of the antenna is 2.42dBi.	
Result: An antenna connector is available; all relevant tests will be carried out conducted.	

6.1.3 Frequency Error

Test Requirement:	Item 19-2 of Article 2 Paragraph 1
Test Method:	MIC Notice No.88 Appendix No.44
EUT Test Status:	Enter the unmodulation mode for the product. Test in Channel lowest, middle and highest, keep in continuously transmitting status.
Test Configuration:	<div><div>EUT</div><div>→</div><div>Spectrum Analyzer</div></div>
Test Conditions:	Frequency Counter or Spectrum Analyzer is used for measurement.
EUT conditions:	Modulation/Spread/Hopping off, CW Tx If EUT does not accept "Modulation OFF" mode in the measurement, you may use "Modulation ON" mode. In that case you can use the Max power Frequency as the measuring results.
Spectrum Analyzer conditions:	Frequency: Test Frequency Span 1MHz RBW 10kHz (Modulation ON), VBW 10kHz (Modulation ON), Sweep Time Auto Detector mode Positive peak Indication mode Max hold
Technical standard:	Tolerance of frequency: $\pm 50 \times 10^{-6}$
Test result:	Refer to Appendix: 2.4G WIFI of Report No. EED32Q8045403

6.1.4 Occupied Bandwidth (99%)

Test Requirement:	Item 19-2 of Article 2 Paragraph 1
Test Method:	MIC Notice No.88 Appendix No.44
EUT Test Status:	Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, data rates and antenna ports (if EUT with antenna diversity architecture). Following channel(s) was (were) selected for the final test as listed below.
Test Configuration:	<div><div>EUT</div> → <div>Spectrum Analyzer</div></div>
EUT conditions:	Modulation/Spread/Hopping on, PN9 Modulation Tx For equipment using diffusion code, set to the test diffusion code and modulate with standard coding test signal.
Spectrum Analyzer conditions:	Frequency: Test Frequency Span 40MHz RBW 300 kHz VBW 300 kHz Sweep Time Auto Detector mode Positive peak Indication mode Max hold OBW 99%
Technical standard:	26MHz or less
Test result:	Refer to Appendix: 2.4G WIFI of Report No. EED32Q80454003

6.1.5 Spread spectrum Bandwidth (90%)

Test Requirement:	Item 19-2 of Article 2 Paragraph 1
Test Method:	MIC Notice No.88 Appendix No.44
EUT Test Status:	Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, data rates and antenna ports (if EUT with antenna diversity architecture).Following channel(s) was (were) selected for the final test as listed below.
Test Configuration:	<div><div>EUT</div><div>Spectrum Analyzer</div></div>
EUT conditions:	Modulation/Spread/Hopping on, PN9 Modulation Tx For equipment using diffusion code, set to the test diffusion code and modulate with standard coding test signal.
Spectrum Analyzer conditions:	Frequency: Test Frequency Span 40MHz RBW 300kHz VBW 300kHz Sweep Time Auto Detector mode Positive peak Indication mode Max hold OBW 90%
Technical standard:	500kHz or more
Test result:	Refer to Appendix: 2.4G WIFI of Report No. EED32Q80454003

6.1.6 Antenna Power

Test Requirement:	Item 19-2 of Article 2 Paragraph 1
Test Method:	MIC Notice No.88 Appendix No.44
EUT Test Status:	Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, data rates and antenna ports (if EUT with antenna diversity architecture). Following channel(s) was (were) selected for the final test as listed below.
Test Configuration:	<div style="text-align: center;"> <div style="border: 1px solid black; padding: 5px; display: inline-block;">EUT</div> → <div style="border: 1px solid black; padding: 5px; display: inline-block;">Spectrum Analyzer</div> </div>
EUT conditions:	Modulation/Spread/Hopping on, PN9 Modulation Tx For equipment using diffusion code, set to the test diffusion code and modulate with standard coding test signal.
Spectrum Analyzer conditions(FHSS):	1.Search for peak power frequency Frequency: Test Frequency Span 40 MHz RBW 1 MHz VBW 1 MHz Sweep Time Auto detector mode Positive peak Indication mode Max hold 2. Measurement of average antenna power Center frequency: Frequency of peak power found using Span: 0 Hz RBW: 1MHz VBW :3MHz Detector mode: Sample Sweep time: Minimum time required to make an accurate measurement. For burst type (intermittent) transmission, sweep time shall be greater than one burst interval. Sweep data points: 1001 or greater
Technical standard:	Antenna Power (1) 10mW or less (2)Tolerance: +20%, -80%
Test result:	Refer to Appendix: 2.4G WIFI of Report No. EED32Q8045403

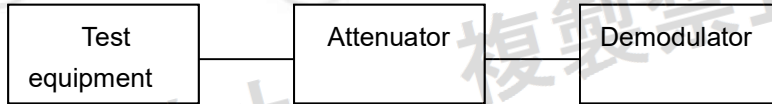
6.1.7 Spurious Emissions of Tx

Test Requirement:	Item 19-2 of Article 2 Paragraph 1
Test Method:	MIC Notice No.88 Appendix No.44
EUT Test Status:	Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, data rates and antenna ports (if EUT with antenna diversity architecture). Following channel(s) was (were) selected for the final test as listed below.
Test Configuration:	<div style="text-align: center;"> <div style="border: 1px solid black; padding: 5px; display: inline-block;">EUT</div> → <div style="border: 1px solid black; padding: 5px; display: inline-block;">Spectrum Analyzer</div> </div>
EUT conditions:	Modulation/Spread/Hopping on, PN9 Modulation Tx For equipment using diffusion code, set to the test diffusion code and modulate with standard coding test signal.
Measurement Procedure:	Step1 All spurious are measured from 30MHz to 12.5GHz by peak mode. Step2 IF the value measured by Step1 is 2dB or less, measure in average mode.
Spectrum Analyzer conditions(Step 1):	Frequency: 30MHz –12.5GHz RBW 100kHz (30 – 1GHz), 1000KHz (over 1GHz) VBW 300kHz (30 – 1GHz), 3000KHz (over 1GHz) Sweep Time Auto Detector mode Positive peak Indication mode Max hold
Spectrum Analyzer conditions(Step 2):	Frequency: Spurious Frequency Span 0Hz RBW 1MHz VBW 1MHz Sweep Time Auto Detector mode Sample Indication mode Max hold
Technical standard:	(1) Below 2458 MHz : 2.5μW (2) 2458 to 2471 MHz : 25μW (3) 2497 through 2510MHz : 25μW (4) Over 2510 MHz : 2.5μW
Test result:	Refer to Appendix: 2.4G WIFI of Report No. EED32Q8045403

6.1.8 Interference prevention function

1) Measurement system diagram

(1) When transmitting identification code



2) Condition of measuring instrument

(1) Demodulator must be able to demodulate the transmitting signal emitted by test equipment and to indicate the identification code.

3) Condition of test equipment The mode of normal use.

4) Measuring operation procedure

(1) When test equipment has the function to transmit identification code automatically:

A) Transmit the predetermined identification code from test equipment.

B) Confirm the transmitted identification code by demodulator.

55:13:06:07:29:77

5) Test result: The unit does meet the requirements (Good).

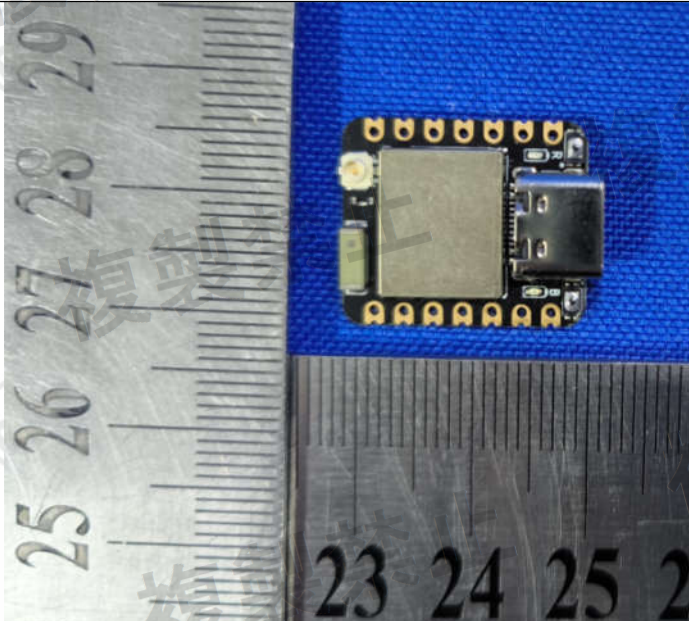
Test result: PASS

6.1.9 RF accessibility

Standard requirement

Article 49-20, paragraph 1 (a)

The EUT shall be constructed in such a way that sensitive RF parts, (like modulation and oscillator parts) cannot be reached easily by the user. These parts shall be covered by soldered metal caps or glue or by other mechanical covers. If the covers are fixed with screws, these shall be not the common type(s) like a Phillips, but special versions like Torx, so that the user cannot open the device with common tools.

<input type="checkbox"/>	Sealed with special screws.
<input type="checkbox"/>	Plastic chassis is being welded using ultrasonic waves.
<input type="checkbox"/>	Chassis is glued using a special adhesive.
<input type="checkbox"/>	Metal covers are spot-fused.
<input type="checkbox"/>	Cover is specially interlocked.
<input checked="" type="checkbox"/>	RF and Modulation components are covered with shielding case and this shielding case is soldered.
<input type="checkbox"/>	Shield case is welded at RF and modulation parts, and ID-ROM is welded using the BGA Method.
<input type="checkbox"/>	Shield case is welded at RF and modulation parts, and ID-ROM is glued at its lead with a special adhesive.
<input type="checkbox"/>	Shield case is welded at RF and modulation parts, and ID-ROM is glued with anon-transparent laminating agent.
<input type="checkbox"/>	Semiconductor circuits of high-frequency parts and modulation parts have more than 10 pins distanced smaller than 1.5mm each other.
	

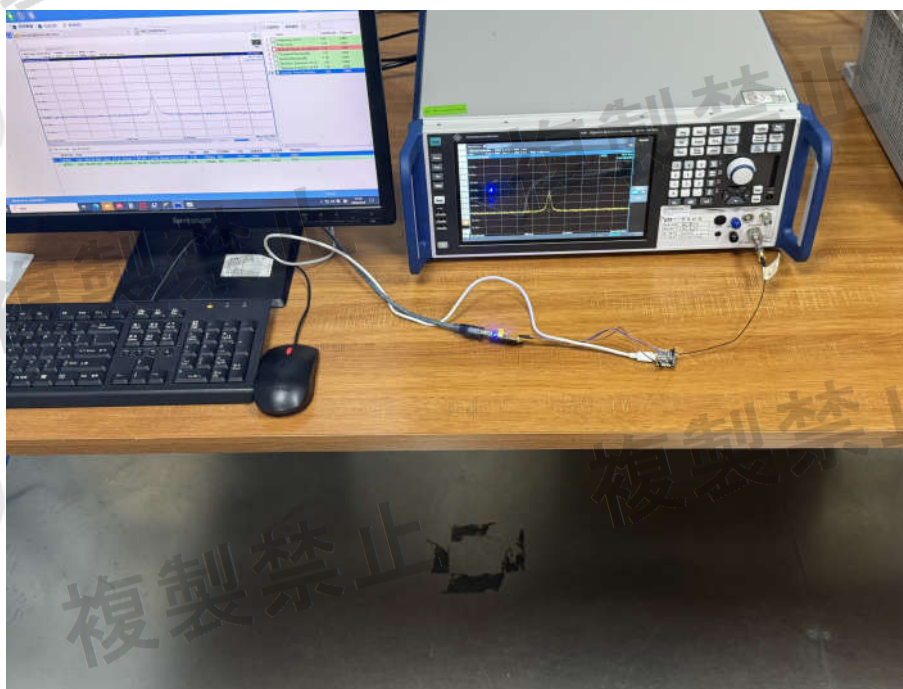
6.2 Receiver Requirements

6.2.1 Spurious Emissions of Rx

Test Requirement:	Item 19-2 of Article 2 Paragraph 1
Test Method:	MIC Notice No.88 Appendix No.44
EUT Test Status:	Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, data rates and antenna ports (if EUT with antenna diversity architecture). Following channel(s) was (were) selected for the final test as listed below.
Test Configuration:	<div style="text-align: center;"> <div style="border: 1px solid black; padding: 5px; display: inline-block;">EUT</div> → <div style="border: 1px solid black; padding: 5px; display: inline-block;">Spectrum Analyzer</div> </div>
EUT conditions:	Rx
Measurement Procedure:	Step 1 All spurious are measured from 30 MHz to 12.5 GHz by peak mode. Step 2 IF the value measured by Step1 is 2 dB or less, measure in average mode.
Spectrum Analyzer conditions(Step 1):	RBW 100 kHz (30 – 1GHz) , 1 MHz (over 1GHz) VBW 100 kHz (30 – 1GHz) , 1 MHz (over 1GHz) Sweep Time Auto Detector mode Positive peak Indication mode Max hold
Spectrum Analyzer Conditions(Step 2):	Frequency: Spurious Frequency Span 0 Hz RBW 100 kHz (30 – 1GHz) , 1 MHz (over 1GHz) VBW 100 kHz (30 – 1GHz) , 1 MHz (over 1GHz) Sweep Time Auto Detector mode Sample Indication mode Max hold
Technical standard:	(1) Below 1 GHz : 4 nW or less (2) 1 GHz and over : 20 nW or less
Test result:	Refer to Appendix: 2.4G WIFI of Report No. EED32Q80454003

7 Photographs

7.1 EUT Test Setup



EUT Test Setup-1

7.2 EUT Constructional Details

Refer to Report No. EED32Q80454001 for EUT external and internal photos

The test report is effective only with both signature and specialized stamp, The result(s) shown in this report refer only to the sample(s) tested. Without written approval of CTI, this report can't be reproduced except in full.

*** End of Report ***