

FCC TEST REPORT

Report No.....: AB26030241FW02
FCC ID.....: **2BVD9-OXBOT-R1**
Applicant.....: Zhuhai Oxbot Technology Co., Ltd.
Address.....: Room 3710, No. 99 Yunqi Street, Xiangzhou District, Zhuhai, China
Manufacturer.....: Zhuhai Oxbot Technology Co., Ltd.
Address.....: Room 3710, No. 99 Yunqi Street, Xiangzhou District, Zhuhai, China
Product Name.....: OXBOT R1
Trade Mark.....: OXBOT
Test Model.....: R1
Additional Model(s).....: R
Standard.....: FCC 47 CFR Part 15 Subpart C (Part 15.247)
Date of Receipt.....: 2026.03.23
Date of Test Date.....: 2026.03.23-2026.04.15
Date of Issue.....: 2026.04.15
Test Result.....: Pass

Compiled by: (Printed Name + Signature)	Huaijie Li	
Supervised by: (Printed Name + Signature)	David Huang	
Approved by: (Printed Name + Signature)	Jay Liu	

Testing Laboratory Name.....: Aibo Standard Technology (Shenzhen) Co., Ltd.
Address.....: 101, Building B, Tuori New Energy Industrial Park, High-tech Park, Tianliao Community, Yutang Street, Guangming District, Shenzhen City, Guangdong Province, China

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FCC TEST REPORT

EUT.....	: OXBOT R1
Test Model.....	: R1
Applicant.....	: Zhuhai Oxbot Technology Co., Ltd.
Address.....	: Room 3710, No. 99 Yunqi Street, Xiangzhou District, Zhuhai, China
Manufacturer.....	: Zhuhai Oxbot Technology Co., Ltd.
Address.....	: Room 3710, No. 99 Yunqi Street, Xiangzhou District, Zhuhai, China

Test Result	Positive
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The test report merely corresponds to the test sample.
It is not permitted to copy extracts of these test result without the written permission of the test laboratory.

REPORT VERSION

Version No.	Issue Date	Description
01	2026.04.15	Initial Issue

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1. GENERAL INFORMATION

1.1. GENERAL DESCRIPTION OF EUT

Product Name:	OXBOT R1	
Trade Mark:	OXBOT	
Test Model:	R1	
Additional Model(s):	R	
Model Difference:	All models are the same circuit and RF module, except the model name	
Hardware Version:	V1.0	
Software Version:	V1.0	
Power Supply:	Input:5V/1A	
Battery:	3.7V/3500mAh*2	
EUT Supports Function: (Provided by the customer)	2.4GHz ISM Bands:	IEEE 802.11b/g/n
Test Sample(s) Number:	AB26030241-01 (Engineer Sample) AB26030241-02 (Normal Sample)	
Radio Specification Subject to this Report		
Radio Specification:	IEEE 802.11b/g/n	
Frequency Range:	2412MHz~2462MHz for IEEE 802.11b/g/n(HT20) 2422MHz~2452MHz for IEEE 802.11n(HT40)	
Modulation Type:	IEEE 802.11b: DSSS (CCK, DQPSK, DBPSK) IEEE 802.11g: OFDM (64-QAM, 16-QAM, QPSK, BPSK) IEEE 802.11n-HT20: OFDM (64-QAM, 16-QAM, QPSK, BPSK) IEEE 802.11n-HT40: OFDM (64-QAM, 16-QAM, QPSK, BPSK)	
Channel Spacing:	5MHz	
Channel Number(s):	11 Channels for IEEE 802.11b/g/n(HT20) 7 Channels for IEEE 802.11n(HT40)	
Antenna Type:	SMD Antenna	
Antenna Gain:	4.3dBi	

Note1: The EUT is built with ESP32S3, ESP32-D0WDQ6-V3, and ESP32-C3 Wi-Fi modules, and each module has been tested separately.

1.2. DESCRIPTION OF SUPPORT EQUIPMENT

Description	Manufacturer	Model	Serial Number	Supplied by
Serial port board	/	/	/	Applicant
Computer	ACER	N22C5	NXEGXCN0022400 3D943400	Applicant
Fast Charger	Shenzhen ACT Industrial Co.,Ltd.	APS-KI015AWE-G	---	Applicant

1.3. DESCRIPTION OF EXTERNAL I/O

I/O Port Description	Quantity	Cable
USB Type-C Interface	1	0.8m, unshielded

1.4. GENERAL DESCRIPTION OF APPLIED STANDARDS

The tests were performed according to following standards:

[FCC Rules Part 15.247](#) - Frequency Hopping, Direct Spread Spectrum and Hybrid Systems that are in operation within the bands of 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz.

[IEEE/ANSI/USEMCSC C63.10-2020](#) - American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices.

[KDB 558074 D01 15.247 Meas Guidance v05r02](#) - Guidance for Compliance Measurements on Digital Transmission System, Frequency Hopping Spread Spectrum System, and Hybrid System Devices operating under Section 15.247 Of the FCC Rules.

1.5. DESCRIPTION OF TEST FACILITY

Test Lab: Aibo Standard Technology (Shenzhen) Co., Ltd.

Address: 101, Building B, Tuori New Energy Industrial Park, High-tech Park, Tianliao Community, Yutang Street, Guangming District, Shenzhen City, Guangdong Province, China

Tel.: +86 755 85250797

E-mail: aibo@aibonorm.com

Website: www.aibonorm.com

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

A2LA-Lab Certificate No.: 7514.01

Aibo Standard Technology (Shenzhen) Co., Ltd. has been accredited by A2LA for technical competence in the field of electrical testing, and proved to be in compliance with ISO/IEC 17025 General Requirements for the Competence of Testing and Calibration Laboratories and any additional program requirements in the identified field of testing.

FCC Accredited Lab.

Designation Number: CN1411

Test Firm Registration Number: 567066

ISED Wireless Device Testing Laboratories

Company Number: 33924

CAB identifier: CN0185

1.6. MEASUREMENT UNCERTAINTY

The measurement data show herein meets or exceeds the CISPR measurement uncertainty values specified in CISPR 16-4-2 and can be compared directly to specified limit to determine compliance.

Items	Measurement Uncertainty
Power Line Conducted Emission (9kHz~150kHz)	±3.62dB
Power Line Conducted Emission (150kHz~30MHz)	±3.38dB
Radiated Emission (9kHz~30MHz)	±3.10dB
Radiated Emission (30MHz~1GHz)	±4.90dB
Radiated Emission (1GHz~18GHz)	±3.88dB
Radiated Emission (8GHz~40GHz)	±5.32dB
RF Conducted Power	±0.57dB
Conducted Spurious Emissions	±1.60dB
RF Frequency	±6.0 x 10 ⁻⁷
Occupied Channel Bandwidth	±28.87KHz
Maximum Power Spectral Density Level	±0.59dB

Note: All measurement uncertainty values are shown with a coverage factor of k = 2 to indicate a 95 % level of confidence.

1.7. ENVIRONMENTAL CONDITIONS

During the measurement the environmental conditions were within the listed ranges:

Normal Temperature:	+15°C ~ +35°C
Lative Humidity	20 % ~ 75 %
Air Pressure	98KPa ~ 101KPa

1.8. DESCRIPTION OF TEST MODES

Operation Frequency List	
Channel Number	Frequency (MHz)
1	2412
2	2417
3	2422
4	2427
5	2432
6	2437
7	2442
8	2447
9	2452
10	2457
11	2462

For portable device, radiated emission was verified over X, Y, Z Axis, and shown the worst case in this report. The following operating modes were applied for the related test items. Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, data packets and antenna ports (if EUT with antenna diversity architecture), only the result of the worst case was recorded in the report.

List of Test Modes	
Test Mode(s)	Description
TM1	Keep the EUT works in continuously transmitting mode (IEEE 802.11b)
TM2	Keep the EUT works in continuously transmitting mode (IEEE 802.11g)
TM3	Keep the EUT works in continuously transmitting mode (IEEE 802.11n(HT20))
TM4	Keep the EUT works in continuously transmitting mode (IEEE 802.11n(H40))

Power setting during the test:

During testing, Channel & Power Controlling Software provided by the customer was used to control the operating channel as well as the output power level. The RF output power selection is for the setting of RF output power expected by the customer and is going to be fixed on the firmware of the final end product.

Frequency	2412MHz	2437MHz	2462MHz
RF Power Parameter(s) for IEEE 802.11b/g/n(HT20)	Default	Default	Default
Frequency	2422MHz	2437MHz	2452MHz
RF Power Parameter(s) for IEEE 802.11n(HT40)	Default	Default	Default

Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations and data rate. Following data rate was (were) selected for the final test as listed below:

Mode	Worst-case data rates
IEEE 802.11b	1Mbps
IEEE 802.11g	6Mbps
IEEE 802.11n(HT20)	MCS7
IEEE 802.11 n(HT40)	MCS7

2. SUMMARY OF TEST RESULT

FCC 47 CFR Part 15 Subpart C Test Cases			
FCC Rule	Description of Test Item(s)	Result	Test Engineer
Part 15.203	Antenna Requirement	Pass	Jacey Fu
Part 15.247(b)(3)	Maximum Peak Conducted Output Power	Pass	Jacey Fu
Part 15.247(a)(2)	6dB Bandwidth	Pass	Jacey Fu
Part 15.247(e)	Power Spectral Density	Pass	Jacey Fu
Part 15.247(d)	Conducted Band Edges Measurement	Pass	Jacey Fu
Part 15.205, 15.209, 15.247(d)	Radiated Emissions and Radiated Band Edges Measurement	Pass	He Chen
Part 15.207	Power Line Conducted Emissions	Pass	He Chen
Part 15.247(i)	RF Exposure (see the RF Exposure Report)	Pass	Jacey Fu

3. MEASUREMENT INSTRUMENTS LIST

Item	Test Equipment	Manufacturer	Model No.	Serial No.	Cal. Date	Cal. Until
1	Loop Antenna	Schwarzbeck	FMZB 1519	1519-025	01/18/2026	01/17/2028
2	ESCI EMI TEST RECEIVER	ROHDE & SCHWARZ	ESPI 7	/	01/20/2026	01/19/2027
3	Power Amplifier	HZEMC	HPA-9K0133	HYP A23029	01/20/2026	01/19/2027
4	Broadband Antenna	Schwarzbeck	VULB 9168	01763	01/29/2026	01/28/2028
5	Attenuator	PRM	ATT50-6-3	ATT50-6-3	01/20/2026	01/19/2027
6	Spectrum Analyzer	R&S	FSV40-N	101365	01/20/2026	01/19/2027
7	Horn Antenna	Schwarzbeck	BBHA 9120 D	02786	02/19/2026	02/18/2028
8	Horn Antenna	Schwarzbeck	ZLB7-18-40G-77	072410839	02/19/2026	02/18/2028
9	Power Amplifier	HZEMC	PA0118-43	HYP A23030	01/20/2026	01/19/2027
10	Power Amplifier	HZEMC	PA01840-45	HYP A23031	01/20/2026	01/19/2027
11	EMI Test Receiver	R&S	ESCI	101196	01/20/2026	01/19/2027
12	LISN	R&S	ENV216	102374	01/20/2026	01/19/2027
13	Pulse Limiter	Schwarzbeck	ESH3-Z2	0357.8810.54	01/20/2026	01/19/2027
14	MXA Signal Analyzer	Keysight	N9020A	MY52091389	01/20/2026	01/19/2027
15	Power Sensor	Agilent	U2021XA	MY54110007	01/20/2026	01/19/2027
16	Power Sensor	Agilent	U2021XA	MY54110009	01/20/2026	01/19/2027
17	MXG Vector Signal Generator	Agilent	N5182A	MY47070153	01/20/2026	01/19/2027
18	Analog Signal Source	Keysight	N5173B	MY60403029	01/20/2026	01/19/2027
19	Vector Signal Generator	R&S	SMCV100B	106103	01/20/2026	01/19/2027
20	WIDEBAND RADIO COMMUNICATION TESTER	R&S	CMW500	118780	01/20/2026	01/19/2027
21	DC POWER SUPPLY	MAISHENG	MT-305DS	2021040016	02/28/2026	02/27/2027
22	Const Temp. & Humidity Chamber	GRT	GR-HWX-150L	GR25010601	01/20/2026	01/19/2027

Test Software		
Software name	Model	Version
Conducted Emission Measurement Software	FASLAB	V4.1
Radiated Emission Measurement Software	FASLAB	V4.1
Bluetooth and WIFI Test System	MTS 8310	V3.0.0.0

4. ANTENNA REQUIREMENT

1) Standard Requirement

15.203 requirement:

An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator, the manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited.

15.247(b) (4) requirement:

The conducted output power limit specified in paragraph (b) of this section is based on the use of antennas with directional gains that do not exceed 6dBi. Except as shown in paragraph (c) of this section, if transmitting antennas of directional gain greater than 6dBi are used, the conducted output power from the intentional radiator shall be reduced below the stated values in paragraphs (b)(1), (b)(2), and (b)(3) of this section, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6dBi.

2) Conclusion

Antenna in the interior of the equipment and no consideration of replacement. The gain of the antenna is 4.3dBi (Max.). It complies with the standard requirement.

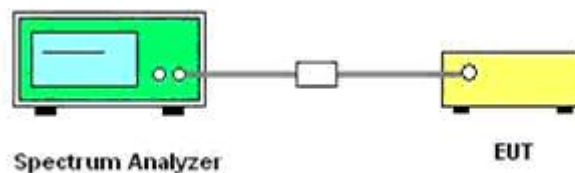
5. CONDUCTED OUTPUT POWER

5.1. LIMIT

According to 15.247(b)(3). For systems using digital modulation in the 902-928MHz, 2400-2483.5MHz, and 5725-5850MHz bands: 1 Watt. As an alternative to a peak power measurement, compliance with the 1 Watt limit can be based on a measurement of the maximum conducted output power. Maximum Conducted Output Power is defined as the total transmit power delivered to all antennas and antenna elements averaged across all symbols in the signaling alphabet when the transmitter is operating at its maximum power control level. Power must be summed across all antennas and antenna elements. The average must not include any time intervals during which the transmitter is off or is transmitting at a reduced power level. If multiple modes of operation are possible (e.g., alternative modulation methods), the maximum conducted output power is the highest total transmit power occurring in any mode.

5.2. TEST SETUP

☒ Using a Spectrum Analyzer for Testing:



☐ Using a Broadband Power Meter for Testing:



5.3. TEST PROCEDURE

☒ Using a Spectrum Analyzer for Testing:

Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.

a) Use the following spectrum analyzer settings:

- 1) Set the RBW $\geq$ DTS bandwidth, centered on the test channel.
 - 2) Set VBW $\geq 3 \times$ RBW.
 - 3) Set Span $\geq 3 \times$ RBW.
 - 4) Sweep: Auto.
 - 5) Detector function: power averaging (rms).
 - 6) Trace: Max hold.
- b) Allow trace to stabilize.
- c) Use the marker-to-peak function to set the marker to the peak of the emission.

d) The indicated level is the peak output power, after any corrections for external attenuators and cables.

e) A plot of the test results and setup description shall be included in the test report.

☐ **Using a Broadband Power Meter for Testing:**

Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the broadband power meter.

5.4. TEST RESULT

Pass.

Please refer to the Appendix E 2.4G WIFI_ESP32S3 RF Conducted Test Data.

Please refer to the Appendix E 2.4G WIFI_ESP32-D0WDQ6-V3 RF Conducted Test Data.

Please refer to the Appendix E 2.4G WIFI_ESP32-C3 RF Conducted Test Data.

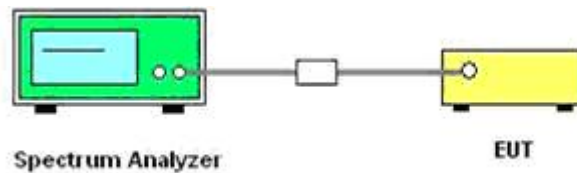
Note: The test results including the cable lose.

6. 6DB BANDWIDTH AND OCCUPIED BANDWIDTH

6.1. LIMIT

According to 15.247(a)(2), Systems using digital modulation techniques may operate in the 902–928 MHz, 2400–2483.5 MHz, and 5725–5850 MHz bands. The minimum 6 dB bandwidth shall be at least 500 kHz.

6.2. TEST SETUP



6.3. TEST PROCEDURE

Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.

Use the following spectrum analyzer settings:

For 6dB Bandwidth Measurement:

- a) Span = approximately 1.5 to 5 times the OBW, centered on the test channel.
- b) RBW = 1% to 5% of the OBW but not less than 100kHz..
- c) VBW $\geq 3 \times$ RBW
- d) Sweep = auto;
- e) Detector function = peak
- f) Trace = max hold
- g) All the trace to stabilize, use the marker-to-peak function to set the marker to the peak of the emission, use the marker-delta function to measure and record the 6dB down bandwidth of the emission.

For 99% Occupied Bandwidth Measurement:

- a) Span = approximately 1.5 to 5 times the OBW, centered on the test channel.
- b) RBW = 1% to 5% of the OBW.
- c) VBW $\geq 3 \times$ RBW
- d) Sweep = auto;
- e) Detector function = peak
- f) Trace = max hold
- g) Use the 99% power bandwidth function of the instrument to measure the Occupied Bandwidth and recoded.

6.4. TEST RESULT

Please refer to the Appendix E 2.4G WIFI_ESP32S3 RF Conducted Test Data.

Please refer to the Appendix E 2.4G WIFI_ESP32-D0WDQ6-V3 RF Conducted Test Data.

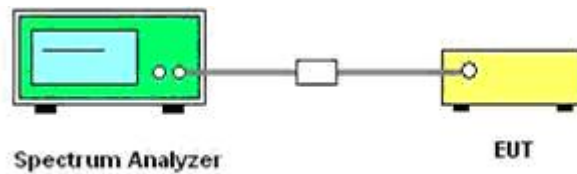
Please refer to the Appendix E 2.4G WIFI_ESP32-C3 RF Conducted Test Data.

7. POWER SPECTRAL DENSITY

7.1. LIMIT

According to 15.247(e), For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8dBm in any 3kHz band during any time interval of continuous transmission.

7.2. TEST SETUP



7.3. TEST PROCEDURE

Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.

Use the following spectrum analyzer settings:

- Set analyzer center frequency to DTS channel center frequency.
- Set the span to 1.5 times the DTS bandwidth.
- Set the RBW to: $3\text{KHz} \leq \text{RBW} \leq 100\text{KHz}$.
- Set the VBW $\geq 3 \times \text{RBW}$.
- Detector function: power averaging (rms).
- Sweep time = auto couple.
- Trace mode = max hold.
- Allow trace to fully stabilize.
- Use the peak marker function to determine the maximum amplitude level within the RBW.
- If measured value exceeds limit, reduce RBW (no less than 3 kHz) and repeat.

7.4. TEST RESULT

Pass.

Please refer to the Appendix E 2.4G WIFI_ESP32S3 RF Conducted Test Data.

Please refer to the Appendix E 2.4G WIFI_ESP32-D0WDQ6-V3 RF Conducted Test Data.

Please refer to the Appendix E 2.4G WIFI_ESP32-C3 RF Conducted Test Data.

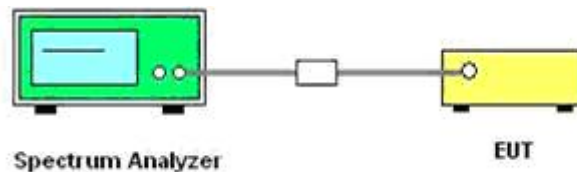
Note: The test results including the cable lose.

8. CONDUCTED BAND EDGES MEASUREMENT

8.1. LIMIT

According to §15.247(d), In any 100kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20dB below that in the 100kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30dB instead of 20dB. Attenuation below the general limits specified in § 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in § 15.205(a), must also comply with the radiated emission limits specified in § 15.209(a) (see § 15.205(c)).

8.2. TEST SETUP



8.3. TEST PROCEDURE

- Remove the antenna from the EUT and connect to the spectrum analyzer via a low loss RF cable.
- Set the spectrum analyzer to any one measured frequency within its operating range.
- Set RBW = 100kHz, VBW = 300kHz, Sweep = Auto, Detector = Peak.
- Measure the highest amplitude appearing on spectral display and set it as a reference level.
- Set a convenient frequency span including 100 kHz bandwidth from band edge. Measure the emission and marking the edge frequency.
- Measure the spurious emissions with frequency range from 9kHz to 26.5GHz.

8.4. TEST RESULT

Pass.

Please refer to the Appendix E 2.4G WIFI_ESP32S3 RF Conducted Test Data.

Please refer to the Appendix E 2.4G WIFI_ESP32-D0WDQ6-V3 RF Conducted Test Data.

Please refer to the Appendix E 2.4G WIFI_ESP32-C3 RF Conducted Test Data.

Note: The test results including the cable lose.

9. RADIATED EMISSIONS AND RADIATED BAND EDGES MEASUREMENT

9.1. LIMIT

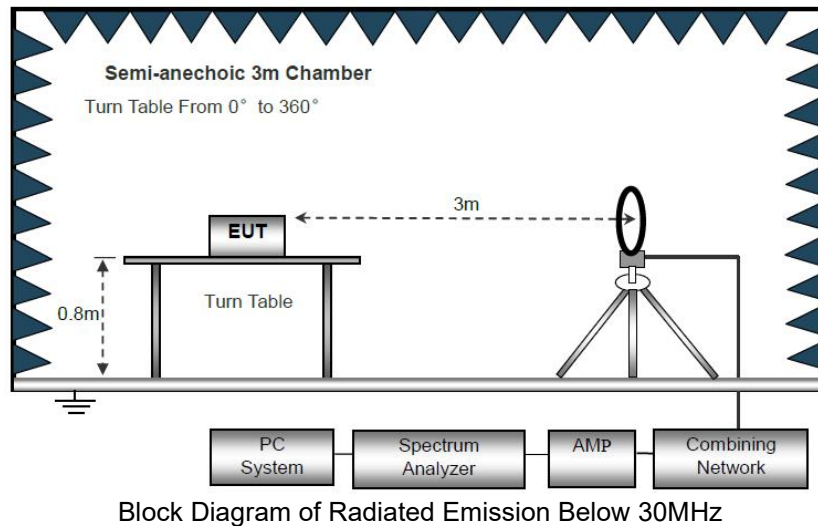
According to §15.247(d), radiated emissions which fall in the restricted bands, as defined in § 15.205(a), must also comply with the radiated emission limits specified in § 15.209(a) (see § 15.205(c)).

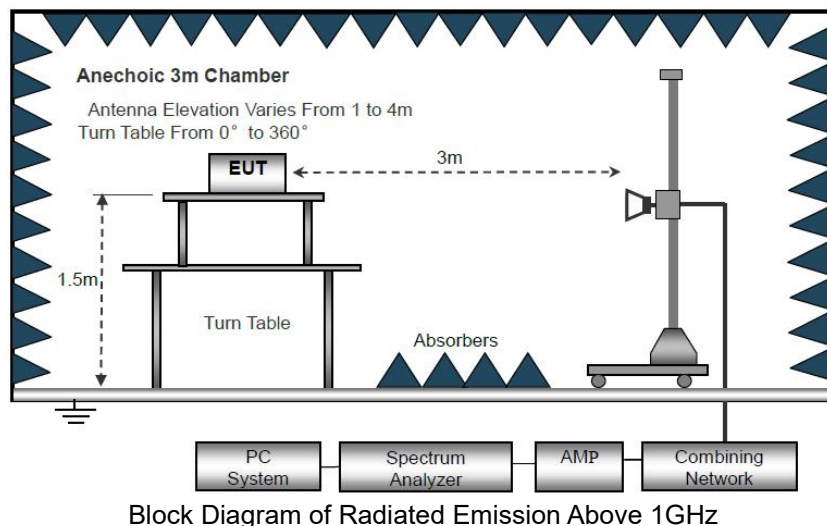
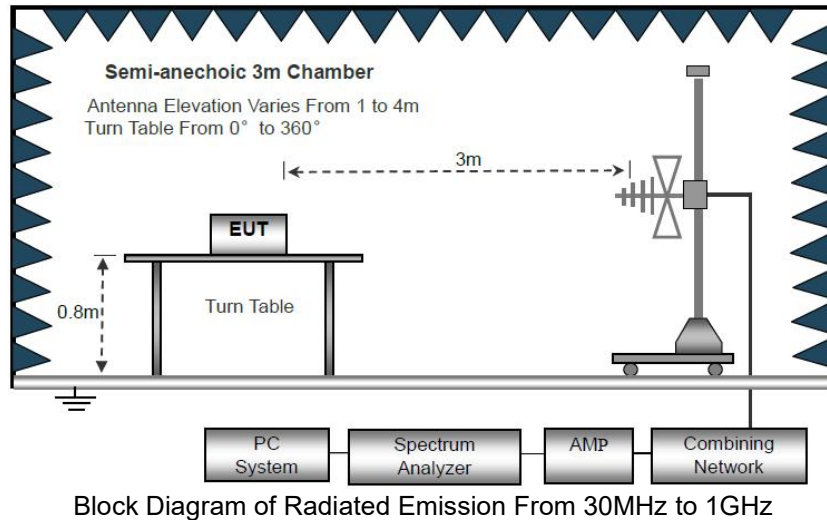
Limits of Spurious Emissions				
Frequency	Field strength (microvolt/meter)	Limit (dB μ V/m)	Remark	Measurement distance (m)
0.009MHz~0.490MHz	2400/F(kHz)	---	---	300
0.490MHz~1.705MHz	24000/F(kHz)	---	---	30
1.705MHz~30MHz	30	---	---	30
30MHz~88MHz	100	40.0	Quasi-peak	3
88MHz~216MHz	150	43.5	Quasi-peak	3
216MHz~960MHz	200	46.0	Quasi-peak	3
960MHz~1GHz	500	54.0	Quasi-peak	3
Above 1GHz	500	54.0	Average	3

Remark:

- The lower limit shall apply at the transition frequencies.
- Emission level (dB μ V/m) = 20*log Emission level (uV/m).
- For frequencies above 1000MHz, the field strength limits are based on average detector, however, the peak field strength of any emission shall not exceed the maximum permitted average limits, specified above by more than 20dB under any condition of modulation.
- Spurious Radiated Emissions measurements starting below or at the lowest crystal frequency.

9.2. TEST SETUP





9.3. TEST PROCEDURE

- Below 1GHz measurement the EUT is placed on a turntable which is 0.8m above ground plane, and above 1GHz measurement EUT was placed on a low permittivity and low loss tangent turn table which is 1.5m above ground plane.
- Maximum procedure was performed by raising the receiving antenna from 1m to 4m and rotating the turn table from 0 degree to 360 degree to acquire the highest emissions from EUT.
- And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.
- Repeat above procedures until all frequency measurements have been completed.
- Radiated emission test frequency band from 9KHz to 25GHz.
- The radiation measurements are performed in X, Y, Z axis positioning for Transmitting mode, and record the worst case in this report.

g) The distance between test antenna and EUT as following table states:

Test Frequency range	Test Antenna Type	Test Distance
9KHz~30MHz	Active Loop Antenna	3
30MHz~1GHz	Bilog Antenna	3
1GHz~18GHz	Horn Antenna	3
18GHz~25GHz	Horn Antenna	1

h) Setting test receiver/spectrum as following table states:

Test Frequency range	Test Receiver/Spectrum Setting	Detector
9KHz~150KHz	RBW=200Hz/VBW=3KHz, Sweep time=Auto	QP
150KHz~30MHz	RBW=9KHz/VBW=100KHz, Sweep time=Auto	QP
30MHz~1GHz	RBW=120KHz/VBW=1000KHz, Sweep time=Auto	QP
1GHz~40GHz	Peak Value: RBW=1MHz/VBW=3MHz, Sweep time=Auto Average Value: RBW=1MHz/ VBW=10Hz, when duty cycle is no less than 98 percent. VBW $\geq 1/T$, when duty cycle is less than 98 percent where T is the minimum transmission duration over which the transmitter is on and is transmitting at its maximum power control level for the tested mode of operation. Sweep time=Auto	Peak

9.4. TEST RESULT

Pass.

Remark:

a) Pre-scan all modes and recorded the worst case in this report.

b) Radiated emission test from 9KHz to 10th harmonic of fundamental was verified, and the emission levels from 9kHz to 30MHz are attenuated 20dB below the limit and not recorded in report.

Note1: ESP32S3 for Radiated Spurious Emissions 9kHz~1GHz, the worst case 802.11n40 mode and highest channel in the Radiated Spurious Emissions above 1GHz was tested.

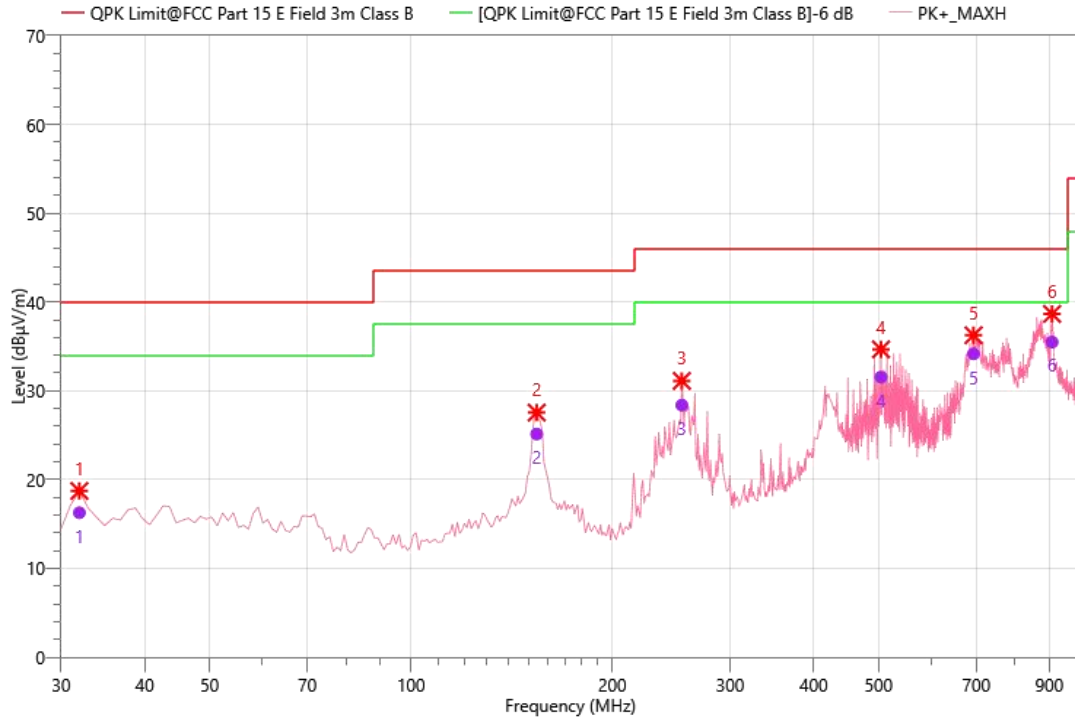
Note2: ESP32-D0WDQ6-V3 for Radiated Spurious Emissions 9kHz~1GHz, the worst case 802.11n20 mode and lowest channel in the Radiated Spurious Emissions above 1GHz was tested.

Note3: ESP32-C3 for Radiated Spurious Emissions 9kHz~1GHz, the worst case 802.11n40 mode and middle channel in the Radiated Spurious Emissions above 1GHz was tested.

ESP32S3

Radiated Emission Test Data (30MHz to 1GHz) Highest Channel

Environmental Conditions	24.6°C, 53.4% RH	Test Engineer	He Chen
Worst Test Mode:	TM4	Polarity:	Horizontal



No.	Freq. (MHz)	Reading (dBμV)	Corr. (dB)	Meas. (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Det.	Height (cm)	Pol.	Azimuth (deg)	Verdict
1	31.940	29.87	-13.59	16.28	40.00	23.72	QPK	100	H	12.5	PASS
2	154.160	36.84	-11.7	25.14	43.50	18.36	QPK	100	H	251.1	PASS
3	254.070	41.73	-13.34	28.39	46.00	17.61	QPK	100	H	181.1	PASS
4	504.330	39.00	-7.45	31.55	46.00	14.45	QPK	100	H	203.2	PASS
5	693.480	37.72	-3.55	34.17	46.00	11.83	QPK	100	H	318.1	PASS
6	908.820	36.34	-0.85	35.49	46.00	10.51	QPK	100	H	236.3	PASS

Remark:

Emission Level = Reading + Factor;

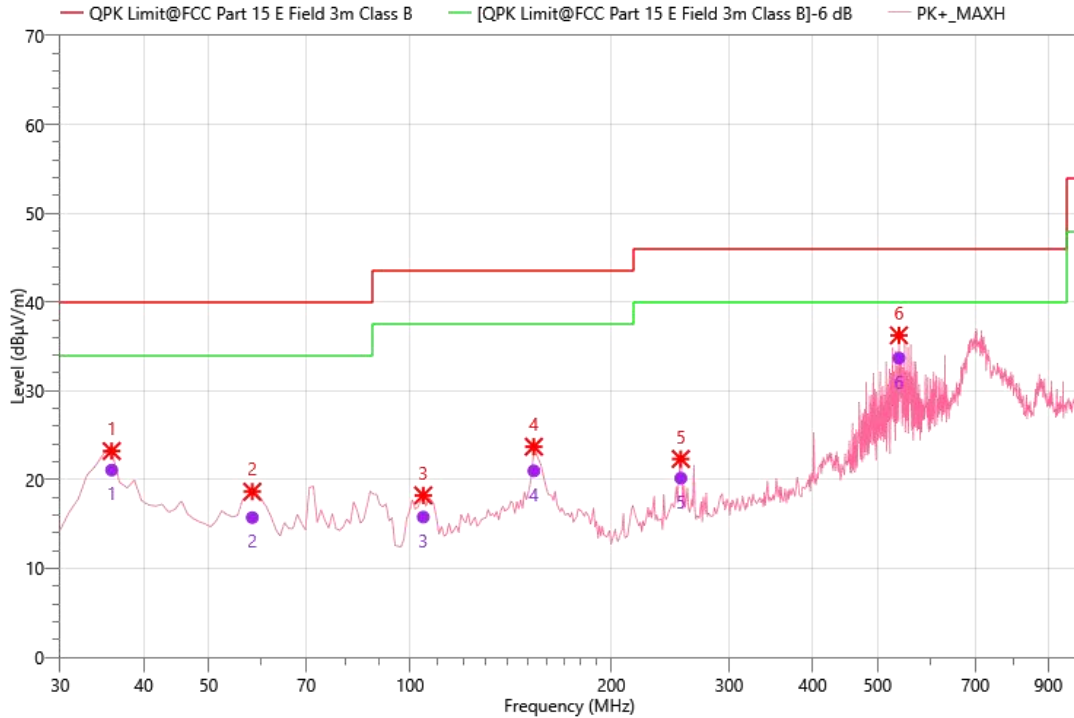
Factor = Antenna Factor + Cable Loss – Pre-amplifier;

Margin=Limit - Emission Level.

ESP32S3

Radiated Emission Test Data (30MHz to 1GHz) Highest Channel

Environmental Conditions	24.6°C, 53.4% RH	Test Engineer	He Chen
Worst Test Mode:	TM4	Polarity:	Vertical



No.	Freq. (MHz)	Reading (dBμV)	Corr. (dB)	Meas. (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Det.	Height (cm)	Pol.	Azimuth (deg)	Verdict
1	35.820	34.34	-13.26	21.08	40.00	18.92	QPK	100	V	108.9	PASS
2	58.130	29.47	-13.74	15.73	40.00	24.27	QPK	100	V	38.4	PASS
3	104.690	31.55	-15.76	15.79	43.50	27.71	QPK	100	V	56.7	PASS
4	153.190	32.69	-11.7	20.99	43.50	22.51	QPK	100	V	208.4	PASS
5	254.070	33.51	-13.34	20.17	46.00	25.83	QPK	100	V	208.4	PASS
6	538.280	40.28	-6.6	33.68	46.00	12.32	QPK	100	V	286.0	PASS

Remark:

Emission Level = Reading + Factor;

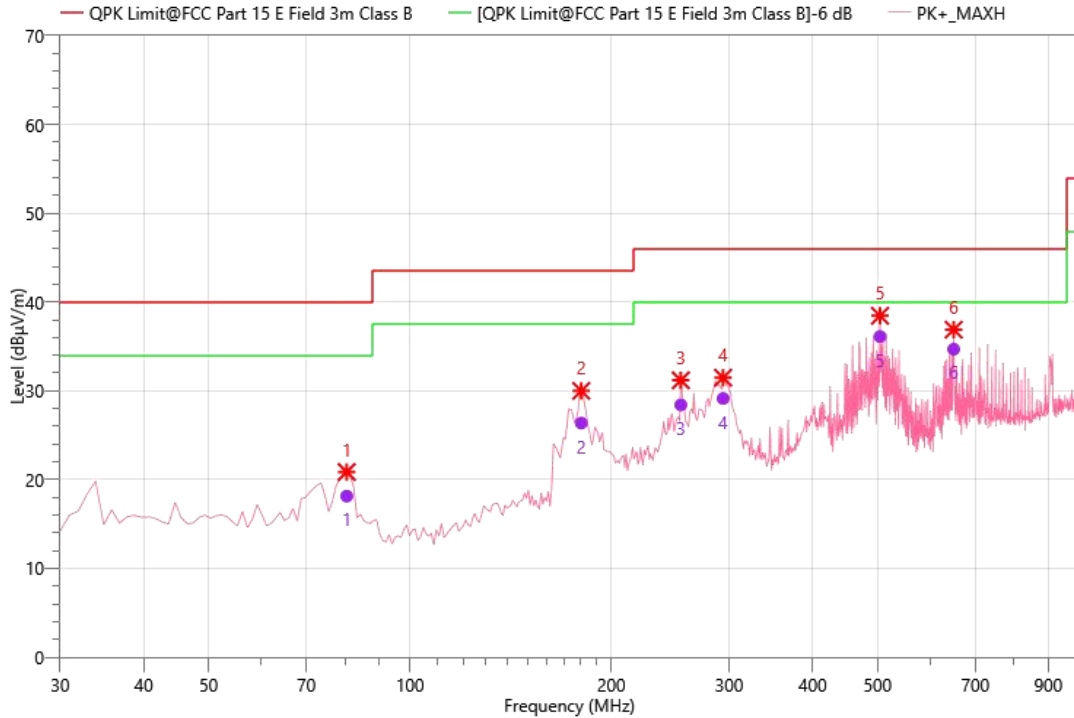
Factor = Antenna Factor + Cable Loss – Pre-amplifier;

Margin=Limit - Emission Level.

ESP32-D0WDQ6-V3

Radiated Emission Test Data (30MHz to 1GHz) Lowest Channel

Environmental Conditions	24.6°C, 53.4% RH	Test Engineer	He Chen
Worst Test Mode:	TM3	Polarity:	Horizontal



No.	Freq. (MHz)	Reading (dBμV)	Corr. (dB)	Meas. (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Det.	Height (cm)	Pol.	Azimuth (deg)	Verdict
1	80.440	35.26	-17.11	18.15	40.00	21.85	QPK	100	H	160.3	PASS
2	180.350	40.61	-14.24	26.37	43.50	17.13	QPK	100	H	104.6	PASS
3	254.070	41.76	-13.34	28.42	46.00	17.58	QPK	100	H	27.1	PASS
4	293.840	41.37	-12.23	29.14	46.00	16.86	QPK	100	H	82.8	PASS
5	504.330	43.56	-7.45	36.11	46.00	9.89	QPK	100	H	197.1	PASS
6	649.830	38.96	-4.27	34.69	46.00	11.31	QPK	100	H	156.1	PASS

Remark:

Emission Level = Reading + Factor;

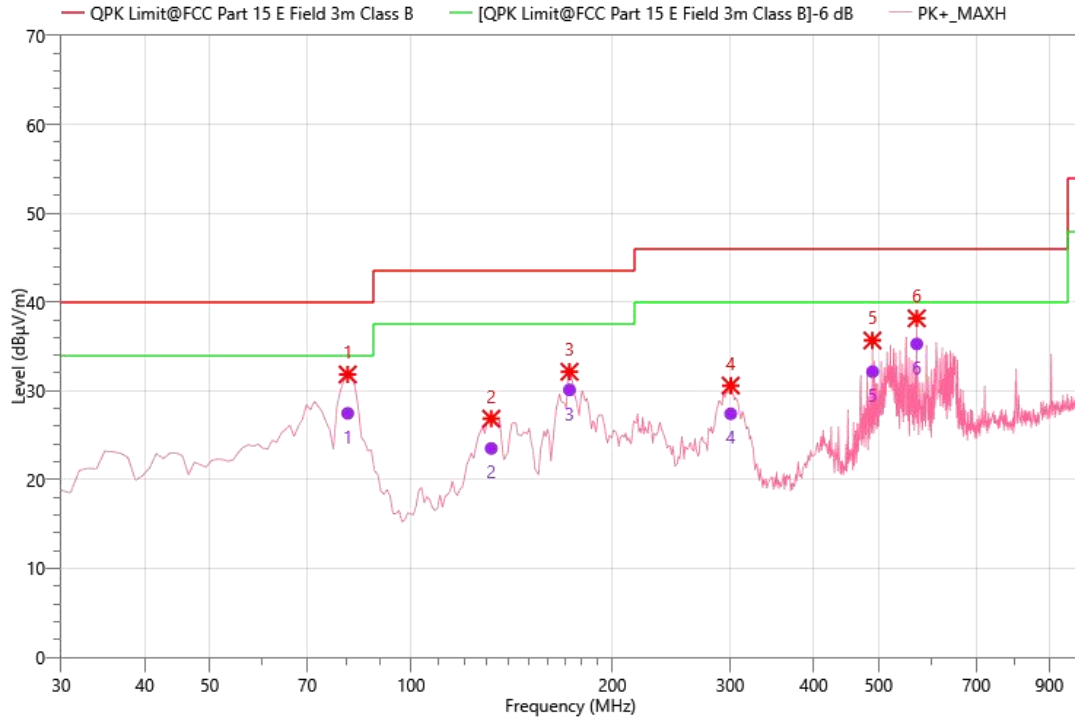
Factor = Antenna Factor + Cable Loss – Pre-amplifier;

Margin=Limit - Emission Level.

ESP32-D0WDQ6-V3

Radiated Emission Test Data (30MHz to 1GHz) Lowest Channel

Environmental Conditions	24.6°C, 53.4% RH	Test Engineer	He Chen
Worst Test Mode:	TM3	Polarity:	Vertical



No.	Freq. (MHz)	Reading (dBμV)	Corr. (dB)	Meas. (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Det.	Height (cm)	Pol.	Azimuth (deg)	Verdict
1	80.440	44.58	-17.11	27.47	40.00	12.53	QPK	100	V	30.5	PASS
2	131.850	36.63	-13.11	23.52	43.50	19.98	QPK	100	V	360.0	PASS
3	172.590	43.16	-13.05	30.11	43.50	13.39	QPK	100	V	170.8	PASS
4	300.630	39.45	-12.03	27.42	46.00	18.58	QPK	100	V	15.9	PASS
5	489.780	39.76	-7.6	32.16	46.00	13.84	QPK	100	V	34.1	PASS
6	570.290	41.25	-5.97	35.28	46.00	10.72	QPK	100	V	0.0	PASS

Remark:

Emission Level = Reading + Factor;

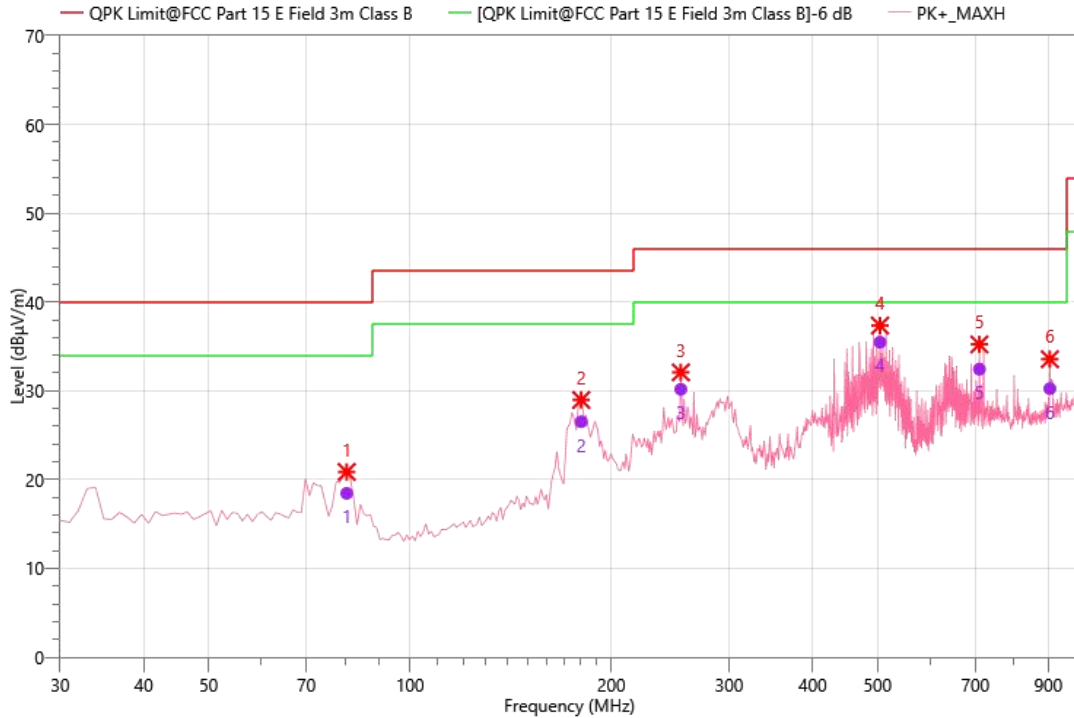
Factor = Antenna Factor + Cable Loss – Pre-amplifier;

Margin=Limit - Emission Level.

ESP32-C3

Radiated Emission Test Data (30MHz to 1GHz) Middle Channel

Environmental Conditions	24.6°C, 53.4% RH	Test Engineer	He Chen
Worst Test Mode:	TM4	Polarity:	Horizontal



No.	Freq. (MHz)	Reading (dBμV)	Corr. (dB)	Meas. (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Det.	Height (cm)	Pol.	Azimuth (deg)	Verdict
1	80.440	35.57	-17.11	18.46	40.00	21.54	QPK	100	H	11.2	PASS
2	180.350	40.76	-14.24	26.52	43.50	16.98	QPK	100	H	137.7	PASS
3	254.070	43.51	-13.34	30.17	46.00	15.83	QPK	100	H	37.6	PASS
4	504.330	42.93	-7.45	35.48	46.00	10.52	QPK	100	H	200.1	PASS
5	709.970	35.80	-3.36	32.44	46.00	13.56	QPK	100	H	7.3	PASS
6	904.940	31.08	-0.83	30.25	46.00	15.75	QPK	100	H	196.2	PASS

Remark:

Emission Level = Reading + Factor;

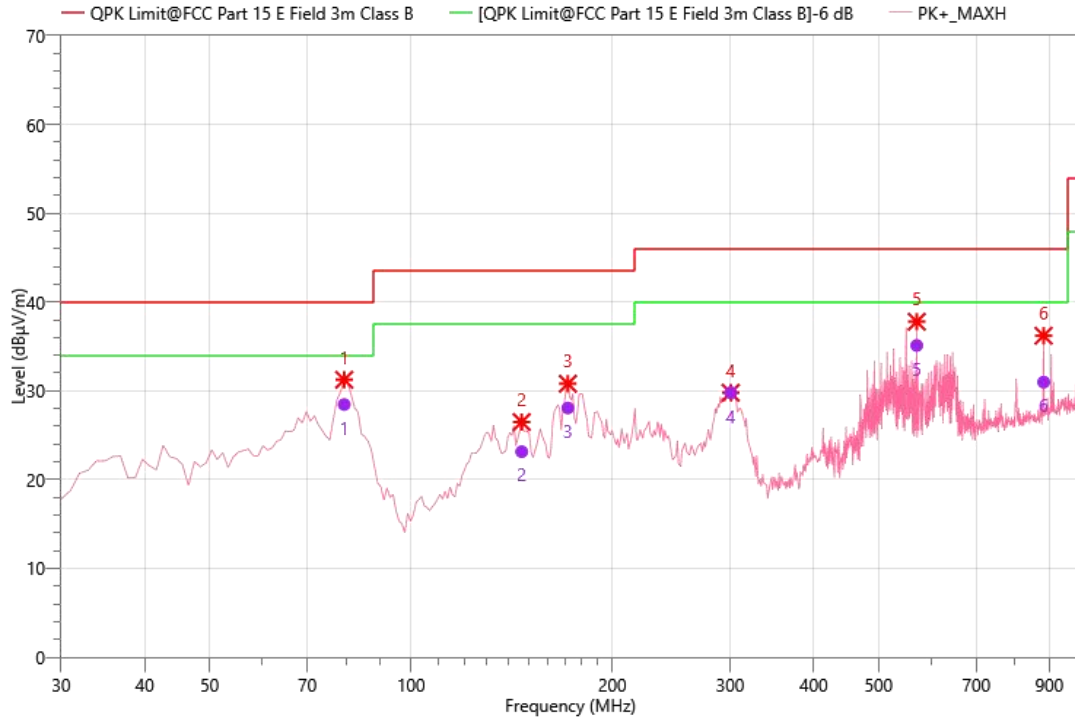
Factor = Antenna Factor + Cable Loss – Pre-amplifier;

Margin=Limit - Emission Level.

ESP32-C3

Radiated Emission Test Data (30MHz to 1GHz) Middle Channel

Environmental Conditions	24.6°C, 53.4% RH	Test Engineer	He Chen
Worst Test Mode:	TM4	Polarity:	Vertical



No.	Freq. (MHz)	Reading (dBμV)	Corr. (dB)	Meas. (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Det.	Height (cm)	Pol.	Azimuth (deg)	Verdict
1	79.470	45.52	-17.06	28.46	40.00	11.54	QPK	100	V	0	PASS
2	146.400	35.17	-12.02	23.15	43.50	20.35	QPK	100	V	120.1	PASS
3	171.620	41.03	-12.96	28.07	43.50	15.43	QPK	100	V	175.1	PASS
4	300.630	41.82	-12.03	29.79	46.00	16.21	QPK	100	V	24.3	PASS
5	570.290	41.08	-5.97	35.11	46.00	10.89	QPK	100	V	351.7	PASS
6	882.630	32.29	-1.31	30.98	46.00	15.02	QPK	100	V	352.8	PASS

Remark:

Emission Level = Reading + Factor;

Factor = Antenna Factor + Cable Loss – Pre-amplifier;

Margin=Limit - Emission Level.

ESP32S3							
Radiated Emission Test Data (Above 1GHz)							
Environmental Conditions		24.6℃, 53.4% RH		Test Engineer		He Chen	
Lowest Channel (Worst Case: Ant1 IEEE 802.11n40_2422MHz)							
Frequency (MHz)	Reading (dBuV)	Correct (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector (PEAK/AVG)	Polar (H/V)
1522.000	48.34	-11.25	37.09	74.00	-36.91	PK+	H
1534.000	44.62	-11.23	33.39	54.00	-20.61	AVG	H
2188.000	46.22	-8.92	37.30	54.00	-16.7	AVG	H
2196.000	50.37	-8.91	41.46	74.00	-32.54	PK+	H
5010.000	49.35	-12.13	37.22	74.00	-36.78	PK+	H
5010.000	38.76	-12.13	26.63	54.00	-27.37	AVG	H
8460.000	46.97	-5.68	41.29	74.00	-32.71	PK+	H
8535.000	35.17	-5.53	29.64	54.00	-24.36	AVG	H
14505.000	32.37	1.34	33.71	54.00	-20.29	AVG	H
14865.000	43.29	1.44	44.73	74.00	-29.27	PK+	H
17985.000	30.40	7.57	37.97	54.00	-16.03	AVG	H
18000.000	41.34	7.7	49.04	74.00	-24.96	PK+	H
1772.000	52.98	-11.01	41.97	74.00	-32.03	PK+	V
1772.000	46.81	-11.01	35.80	54.00	-18.2	AVG	V
2576.000	43.01	-8.62	34.39	54.00	-19.61	AVG	V
2624.000	48.14	-8.5	39.64	74.00	-34.36	PK+	V
5685.000	38.00	-11.01	26.99	54.00	-27.01	AVG	V
5730.000	49.53	-11.13	38.40	74.00	-35.6	PK+	V
10455.000	44.38	-2.33	42.05	74.00	-31.95	PK+	V
10620.000	33.25	-1.96	31.29	54.00	-22.71	AVG	V
14415.000	42.82	1.07	43.89	74.00	-30.11	PK+	V
14520.000	32.71	1.37	34.08	54.00	-19.92	AVG	V
18000.000	41.07	7.7	48.77	74.00	-25.23	PK+	V
18000.000	30.47	7.7	38.17	54.00	-15.83	AVG	V
Middle Channel (Worst Case: Ant1 IEEE 802.11n40_2437MHz)							
Frequency (MHz)	Reading (dBuV)	Correct (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector (PEAK/AVG)	Polar (H/V)
1488.000	48.76	-11.25	37.51	74.00	-36.49	PK+	H
1530.000	44.82	-11.23	33.59	54.00	-20.41	AVG	H
2200.000	46.12	-8.9	37.22	54.00	-16.78	AVG	H
2230.000	50.34	-8.9	41.44	74.00	-32.56	PK+	H
3750.000	51.64	-16.71	34.93	74.00	-39.07	PK+	H
3765.000	40.77	-16.71	24.06	54.00	-29.94	AVG	H
5520.000	48.97	-11.71	37.26	74.00	-36.74	PK+	H
5520.000	38.62	-11.71	26.91	54.00	-27.09	AVG	H
10380.000	44.31	-2.31	42.00	74.00	-32	PK+	H
10590.000	33.49	-2.04	31.45	54.00	-22.55	AVG	H
18000.000	40.35	7.7	48.05	74.00	-25.95	PK+	H
18000.000	30.69	7.7	38.39	54.00	-15.61	AVG	H
1374.000	42.34	-11.05	31.29	54.00	-22.71	AVG	V
1382.000	47.61	-11.06	36.55	74.00	-37.45	PK+	V
2098.000	48.84	-9.11	39.73	74.00	-34.27	PK+	V
2098.000	44.57	-9.11	35.46	54.00	-18.54	AVG	V
5025.000	38.54	-12.11	26.43	54.00	-27.57	AVG	V
5055.000	49.79	-12.07	37.72	74.00	-36.28	PK+	V
8730.000	45.54	-4.94	40.60	74.00	-33.4	PK+	V
8880.000	34.78	-4.94	29.84	54.00	-24.16	AVG	V
13035.000	43.60	-0.19	43.41	74.00	-30.59	PK+	V
13245.000	31.89	0.03	31.92	54.00	-22.08	AVG	V
17850.000	41.01	6.52	47.53	74.00	-26.47	PK+	V
17970.000	30.50	7.43	37.93	54.00	-16.07	AVG	V

Highest Channel (Worst Case: Ant1 IEEE 802.11n40_2452MHz)							
Frequency (MHz)	Reading (dBuV)	Correct (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector (PEAK/AVG)	Polar (H/V)
1520.000	43.80	-11.25	32.55	54.00	-21.45	AVG	H
1522.000	48.09	-11.25	36.84	74.00	-37.16	PK+	H
2190.000	49.95	-8.92	41.03	74.00	-32.97	PK+	H
2194.000	46.91	-8.91	38.00	54.00	-16	AVG	H
4575.000	39.73	-14.12	25.61	54.00	-28.39	AVG	H
4620.000	49.61	-13.95	35.66	74.00	-38.34	PK+	H
7710.000	35.53	-6.38	29.15	54.00	-24.85	AVG	H
7920.000	46.72	-5.96	40.76	74.00	-33.24	PK+	H
11790.000	44.51	-1.35	43.16	74.00	-30.84	PK+	H
11895.000	32.86	-1.44	31.42	54.00	-22.58	AVG	H
17880.000	41.58	6.7	48.28	74.00	-25.72	PK+	H
17985.000	30.01	7.57	37.58	54.00	-16.42	AVG	H
1262.000	55.58	-11.32	44.26	74.00	-29.74	PK+	V
1262.000	50.82	-11.32	39.50	54.00	-14.5	AVG	V
2098.000	49.18	-9.11	40.07	74.00	-33.93	PK+	V
2152.000	44.65	-8.98	35.67	54.00	-18.33	AVG	V
4395.000	50.85	-14.81	36.04	74.00	-37.96	PK+	V
4545.000	39.44	-14.24	25.20	54.00	-28.8	AVG	V
8580.000	46.66	-5.41	41.25	74.00	-32.75	PK+	V
8685.000	34.60	-5.08	29.52	54.00	-24.48	AVG	V
13830.000	42.60	1	43.60	74.00	-30.4	PK+	V
13905.000	32.14	1.27	33.41	54.00	-20.59	AVG	V
17835.000	42.47	6.44	48.91	74.00	-25.09	PK+	V
17985.000	30.05	7.57	37.62	54.00	-16.38	AVG	V

Remark:

Emission Level = Reading + Factor;

Factor = Antenna Factor + Cable Loss – Pre-amplifier;

Margin=Limit - Emission Level.

Testing is carried out with frequency rang 9kHz to the tenth harmonics. The emission levels of other frequencies are attenuated 20dB below the limit and not recorded in report.

ESP32-D0WDQ6-V3							
Radiated Emission Test Data (Above 1GHz)							
Environmental Conditions		24.6℃, 53.4% RH		Test Engineer		He Chen	
Lowest Channel (Worst Case: Ant1 IEEE 802.11n20_2412MHz)							
Frequency (MHz)	Reading (dBuV)	Correct (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector (PEAK/AVG)	Polar (H/V)
1288.000	47.12	-11.18	35.94	74.00	-38.06	PK+	H
1300.000	43.04	-11.12	31.92	54.00	-22.08	AVG	H
1876.000	45.36	-10.5	34.86	54.00	-19.14	AVG	H
1900.000	50.06	-10.4	39.66	74.00	-34.34	PK+	H
4545.000	49.64	-14.24	35.40	74.00	-38.6	PK+	H
4545.000	39.34	-14.24	25.10	54.00	-28.9	AVG	H
7455.000	35.47	-6.28	29.19	54.00	-24.81	AVG	H
7470.000	46.35	-6.31	40.04	74.00	-33.96	PK+	H
11880.000	43.75	-1.42	42.33	74.00	-31.67	PK+	H
12015.000	32.37	-1.34	31.03	54.00	-22.97	AVG	H
18000.000	40.50	7.7	48.20	74.00	-25.8	PK+	H
18000.000	30.12	7.7	37.82	54.00	-16.18	AVG	H
1268.000	50.59	-11.29	39.30	74.00	-34.7	PK+	V
1268.000	46.30	-11.29	35.01	54.00	-18.99	AVG	V
1750.000	45.20	-11.1	34.10	54.00	-19.9	AVG	V
1752.000	50.40	-11.09	39.31	74.00	-34.69	PK+	V
5010.000	38.64	-12.13	26.51	54.00	-27.49	AVG	V
5070.000	48.36	-12.02	36.34	74.00	-37.66	PK+	V
8025.000	46.22	-5.9	40.32	74.00	-33.68	PK+	V
8085.000	35.60	-5.85	29.75	54.00	-24.25	AVG	V
14550.000	42.56	1.44	44.00	74.00	-30	PK+	V
14850.000	32.12	1.39	33.51	54.00	-20.49	AVG	V
17970.000	42.02	7.43	49.45	74.00	-24.55	PK+	V
18000.000	30.26	7.7	37.96	54.00	-16.04	AVG	V
Middle Channel (Worst Case: Ant1 IEEE 802.11n20_2437MHz)							
Frequency (MHz)	Reading (dBuV)	Correct (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector (PEAK/AVG)	Polar (H/V)
1278.000	47.03	-11.24	35.79	74.00	-38.21	PK+	H
1278.000	43.69	-11.24	32.45	54.00	-21.55	AVG	H
1904.000	49.96	-10.38	39.58	74.00	-34.42	PK+	H
1908.000	44.92	-10.35	34.57	54.00	-19.43	AVG	H
4980.000	49.03	-12.24	36.79	74.00	-37.21	PK+	H
5010.000	38.41	-12.13	26.28	54.00	-27.72	AVG	H
10200.000	44.30	-2.13	42.17	74.00	-31.83	PK+	H
10200.000	33.38	-2.13	31.25	54.00	-22.75	AVG	H
14535.000	31.92	1.41	33.33	54.00	-20.67	AVG	H
14565.000	42.42	1.47	43.89	74.00	-30.11	PK+	H
18000.000	41.14	7.7	48.84	74.00	-25.16	PK+	H
18000.000	30.30	7.7	38.00	54.00	-16	AVG	H
1304.000	47.20	-11.11	36.09	74.00	-37.91	PK+	V
1320.000	42.18	-11.08	31.10	54.00	-22.9	AVG	V
1886.000	44.63	-10.46	34.17	54.00	-19.83	AVG	V
1898.000	48.27	-10.41	37.86	74.00	-36.14	PK+	V
5670.000	37.48	-10.96	26.52	54.00	-27.48	AVG	V
5700.000	48.34	-11.07	37.27	74.00	-36.73	PK+	V
9330.000	34.22	-3.7	30.52	54.00	-23.48	AVG	V
9570.000	45.31	-3.48	41.83	74.00	-32.17	PK+	V
14400.000	43.04	1.02	44.06	74.00	-29.94	PK+	V
14535.000	32.09	1.41	33.50	54.00	-20.5	AVG	V
18000.000	41.11	7.7	48.81	74.00	-25.19	PK+	V
18000.000	30.05	7.7	37.75	54.00	-16.25	AVG	V

Highest Channel (Worst Case: Ant1 IEEE 802.11n20_2462MHz)							
Frequency (MHz)	Reading (dBuV)	Correct (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector (PEAK/AVG)	Polar (H/V)
1312.000	44.22	-11.09	33.13	54.00	-20.87	AVG	H
1384.000	48.31	-11.07	37.24	74.00	-36.76	PK+	H
1904.000	46.75	-10.38	36.37	54.00	-17.63	AVG	H
1916.000	50.73	-10.3	40.43	74.00	-33.57	PK+	H
4995.000	51.14	-12.17	38.97	74.00	-35.03	PK+	H
5025.000	39.02	-12.11	26.91	54.00	-27.09	AVG	H
9570.000	46.47	-3.48	42.99	74.00	-31.01	PK+	H
9570.000	34.42	-3.48	30.94	54.00	-23.06	AVG	H
14505.000	32.84	1.34	34.18	54.00	-19.82	AVG	H
14940.000	43.74	1.31	45.05	74.00	-28.95	PK+	H
17820.000	42.98	6.34	49.32	74.00	-24.68	PK+	H
17985.000	30.97	7.57	38.54	54.00	-15.46	AVG	H
1254.000	49.28	-11.36	37.92	74.00	-36.08	PK+	V
1254.000	45.48	-11.36	34.12	54.00	-19.88	AVG	V
1882.000	43.76	-10.47	33.29	54.00	-20.71	AVG	V
1916.000	48.23	-10.3	37.93	74.00	-36.07	PK+	V
5085.000	38.08	-11.97	26.11	54.00	-27.89	AVG	V
5175.000	48.61	-11.99	36.62	74.00	-37.38	PK+	V
8715.000	46.16	-4.98	41.18	74.00	-32.82	PK+	V
8775.000	34.70	-4.9	29.80	54.00	-24.2	AVG	V
12855.000	44.73	-0.49	44.24	74.00	-29.76	PK+	V
13110.000	32.51	-0.14	32.37	54.00	-21.63	AVG	V
17865.000	41.55	6.61	48.16	74.00	-25.84	PK+	V
17985.000	30.55	7.57	38.12	54.00	-15.88	AVG	V

Remark:

Emission Level = Reading + Factor;

Factor = Antenna Factor + Cable Loss – Pre-amplifier;

Margin=Limit - Emission Level.

Testing is carried out with frequency rang 9kHz to the tenth harmonics. The emission levels of other frequencies are attenuated 20dB below the limit and not recorded in report.

ESP32-C3							
Radiated Emission Test Data (Above 1GHz)							
Environmental Conditions		24.6℃, 53.4% RH		Test Engineer		He Chen	
Lowest Channel (Worst Case: Ant1 IEEE 802.11n40_2422MHz)							
Frequency (MHz)	Reading (dBuV)	Correct (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector (PEAK/AVG)	Polar (H/V)
1310.000	47.46	-11.09	36.37	74.00	-37.63	PK+	H
1318.000	43.15	-11.08	32.07	54.00	-21.93	AVG	H
1904.000	49.03	-10.38	38.65	74.00	-35.35	PK+	H
1904.000	44.77	-10.38	34.39	54.00	-19.61	AVG	H
4920.000	49.15	-12.59	36.56	74.00	-37.44	PK+	H
4995.000	38.28	-12.17	26.11	54.00	-27.89	AVG	H
9285.000	45.49	-3.63	41.86	74.00	-32.14	PK+	H
9330.000	34.31	-3.7	30.61	54.00	-23.39	AVG	H
14520.000	32.46	1.37	33.83	54.00	-20.17	AVG	H
14910.000	43.05	1.56	44.61	74.00	-29.39	PK+	H
17970.000	41.07	7.43	48.50	74.00	-25.5	PK+	H
18000.000	30.67	7.7	38.37	54.00	-15.63	AVG	H
1274.000	50.06	-11.26	38.80	74.00	-35.2	PK+	V
1274.000	46.00	-11.26	34.74	54.00	-19.26	AVG	V
1876.000	48.55	-10.5	38.05	74.00	-35.95	PK+	V
1890.000	44.52	-10.44	34.08	54.00	-19.92	AVG	V
5010.000	49.28	-12.13	37.15	74.00	-36.85	PK+	V
5010.000	38.16	-12.13	26.03	54.00	-27.97	AVG	V
8550.000	45.57	-5.5	40.07	74.00	-33.93	PK+	V
8610.000	34.81	-5.32	29.49	54.00	-24.51	AVG	V
14850.000	43.46	1.39	44.85	74.00	-29.15	PK+	V
14850.000	32.14	1.39	33.53	54.00	-20.47	AVG	V
17940.000	40.95	7.17	48.12	74.00	-25.88	PK+	V
17985.000	30.60	7.57	38.17	54.00	-15.83	AVG	V
Middle Channel (Worst Case: Ant1 IEEE 802.11n40_2437MHz)							
Frequency (MHz)	Reading (dBuV)	Correct (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector (PEAK/AVG)	Polar (H/V)
1270.000	48.78	-11.28	37.50	74.00	-36.5	PK+	H
1270.000	43.58	-11.28	32.30	54.00	-21.7	AVG	H
1866.000	49.20	-10.54	38.66	74.00	-35.34	PK+	H
1872.000	44.96	-10.51	34.45	54.00	-19.55	AVG	H
5055.000	49.10	-12.07	37.03	74.00	-36.97	PK+	H
5055.000	38.09	-12.07	26.02	54.00	-27.98	AVG	H
9285.000	33.93	-3.63	30.30	54.00	-23.7	AVG	H
9330.000	44.31	-3.7	40.61	74.00	-33.39	PK+	H
13890.000	42.99	1.32	44.31	74.00	-29.69	PK+	H
14295.000	31.68	1.11	32.79	54.00	-21.21	AVG	H
18000.000	39.97	7.7	47.67	74.00	-26.33	PK+	H
18000.000	30.02	7.7	37.72	54.00	-16.28	AVG	H
1264.000	49.63	-11.31	38.32	54.00	-15.68	AVG	V
1268.000	51.41	-11.29	40.12	74.00	-33.88	PK+	V
2222.000	48.14	-8.9	39.24	74.00	-34.76	PK+	V
2226.000	43.56	-8.9	34.66	54.00	-19.34	AVG	V
5025.000	49.22	-12.11	37.11	74.00	-36.89	PK+	V
5025.000	37.96	-12.11	25.85	54.00	-28.15	AVG	V
8550.000	45.46	-5.5	39.96	74.00	-34.04	PK+	V
8715.000	34.32	-4.98	29.34	54.00	-24.66	AVG	V
14415.000	42.97	1.07	44.04	74.00	-29.96	PK+	V
14535.000	32.12	1.41	33.53	54.00	-20.47	AVG	V
17835.000	42.07	6.44	48.51	74.00	-25.49	PK+	V
18000.000	30.23	7.7	37.93	54.00	-16.07	AVG	V

Highest Channel (Worst Case: Ant1 IEEE 802.11n40_2452MHz)							
Frequency (MHz)	Reading (dBuV)	Correct (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector (PEAK/AVG)	Polar (H/V)
1526.000	47.71	-11.24	36.47	74.00	-37.53	PK+	H
1528.000	43.61	-11.24	32.37	54.00	-21.63	AVG	H
2294.000	48.22	-8.9	39.32	74.00	-34.68	PK+	H
2304.000	43.71	-8.9	34.81	54.00	-19.19	AVG	H
5160.000	37.88	-11.97	25.91	54.00	-28.09	AVG	H
5220.000	48.88	-12.11	36.77	74.00	-37.23	PK+	H
9300.000	44.38	-3.63	40.75	74.00	-33.25	PK+	H
9330.000	34.16	-3.7	30.46	54.00	-23.54	AVG	H
14835.000	32.58	1.34	33.92	54.00	-20.08	AVG	H
14865.000	42.40	1.44	43.84	74.00	-30.16	PK+	H
17790.000	41.13	6.1	47.23	74.00	-26.77	PK+	H
17835.000	31.20	6.44	37.64	54.00	-16.36	AVG	H
1254.000	52.55	-11.36	41.19	74.00	-32.81	PK+	V
1254.000	49.16	-11.36	37.80	54.00	-16.2	AVG	V
2210.000	43.47	-8.9	34.57	54.00	-19.43	AVG	V
2256.000	47.57	-8.9	38.67	74.00	-35.33	PK+	V
4860.000	49.09	-13.05	36.04	74.00	-37.96	PK+	V
4935.000	37.61	-12.49	25.12	54.00	-28.88	AVG	V
8505.000	45.31	-5.59	39.72	74.00	-34.28	PK+	V
8685.000	34.22	-5.08	29.14	54.00	-24.86	AVG	V
14520.000	31.99	1.37	33.36	54.00	-20.64	AVG	V
14850.000	43.20	1.39	44.59	74.00	-29.41	PK+	V
17985.000	30.03	7.57	37.60	54.00	-16.4	AVG	V
18000.000	39.96	7.7	47.66	74.00	-26.34	PK+	V
Remark: Emission Level = Reading + Factor; Factor = Antenna Factor + Cable Loss – Pre-amplifier; Margin=Limit - Emission Level. Testing is carried out with frequency rang 9kHz to the tenth harmonics. The emission levels of other frequencies are attenuated 20dB below the limit and not recorded in report.							

ESP32S3							
Radiated Band Edges Test Data							
Environmental Conditions		24.6℃, 53.4% RH		Test Engineer		He Chen	
Lowest Channel (Worst Case: Ant1 IEEE 802.11n40_2422MHz)							
Frequency (MHz)	Reading (dBuV)	Correct (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector (PEAK/AVG)	Polar (H/V)
2310.000	46.67	-3.62	43.05	74.00	30.95	PK+	H
2310.000	42.57	-3.62	38.95	54.00	15.05	AVG	H
2390.080	48.16	-3.67	44.49	74.00	29.51	PK+	H
2390.080	43.88	-3.67	40.21	54.00	13.79	AVG	H
2399.960	50.86	-3.68	47.18	74.00	26.82	PK+	H
2399.960	46.77	-3.68	43.09	54.00	10.91	AVG	H
2310.000	45.58	-3.62	41.96	74.00	32.04	PK+	V
2310.000	40.88	-3.62	37.26	54.00	16.74	AVG	V
2389.950	46.03	-3.67	42.36	74.00	31.64	PK+	V
2389.950	42.22	-3.67	38.55	54.00	15.45	AVG	V
2400.090	47.50	-3.68	43.82	74.00	30.18	PK+	V
2400.090	43.32	-3.68	39.64	54.00	14.36	AVG	V
Highest Channel (Worst Case: Ant1 IEEE 802.11n40_2452MHz)							
Frequency (MHz)	Reading (dBuV)	Correct (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector (PEAK/AVG)	Polar (H/V)
2483.500	48.47	-3.54	44.93	74.00	29.07	PK+	H
2483.500	43.79	-3.54	40.25	54.00	13.75	AVG	H
2500.000	46.64	-3.5	43.14	74.00	30.86	PK+	H
2500.000	42.50	-3.5	39.00	54.00	15.00	AVG	H
2483.500	47.12	-3.54	43.58	74.00	30.42	PK+	V
2483.500	42.96	-3.54	39.42	54.00	14.58	AVG	V
2500.000	46.95	-3.5	43.45	74.00	30.55	PK+	V
2500.000	42.67	-3.5	39.17	54.00	14.83	AVG	V
Remark:							
Emission Level = Reading + Factor;							
Factor = Antenna Factor + Cable Loss – Pre-amplifier;							
Margin= Emission Level - Limit.							

ESP32-D0WDQ6-V3							
Radiated Band Edges Test Data							
Environmental Conditions		24.6℃, 53.4% RH		Test Engineer		He Chen	
Lowest Channel (Worst Case: Ant1 IEEE 802.11n20_2412MHz)							
Frequency (MHz)	Reading (dBuV)	Correct (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector (PEAK/AVG)	Polar (H/V)
2310.000	46.07	-3.62	42.45	74.00	31.55	PK+	H
2310.000	42.06	-3.62	38.44	54.00	15.56	AVG	H
2390.080	45.74	-3.67	42.07	74.00	31.93	PK+	H
2390.080	41.67	-3.67	38.00	54.00	16.00	AVG	H
2400.090	46.82	-3.68	43.14	74.00	30.86	PK+	H
2400.090	42.94	-3.68	39.26	54.00	14.74	AVG	H
2310.000	46.25	-3.62	42.63	74.00	31.37	PK+	V
2310.000	41.84	-3.62	38.22	54.00	15.78	AVG	V
2390.080	46.18	-3.67	42.51	74.00	31.49	PK+	V
2390.080	42.12	-3.67	38.45	54.00	15.55	AVG	V
2400.090	45.95	-3.68	42.27	74.00	31.73	PK+	V
2400.090	42.10	-3.68	38.42	54.00	15.58	AVG	V
Highest Channel (Worst Case: Ant1 IEEE 802.11n20_2462MHz)							
Frequency (MHz)	Reading (dBuV)	Correct (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector (PEAK/AVG)	Polar (H/V)
2483.500	46.42	-3.54	42.88	74.00	31.12	PK+	H
2483.500	42.08	-3.54	38.54	54.00	15.46	AVG	H
2500.000	46.26	-3.5	42.76	74.00	31.24	PK+	H
2500.000	41.99	-3.5	38.49	54.00	15.51	AVG	H
2483.500	46.09	-3.54	42.55	74.00	31.45	PK+	V
2483.500	41.80	-3.54	38.26	54.00	15.74	AVG	V
2500.000	46.30	-3.5	42.80	74.00	31.20	PK+	V
2500.000	41.94	-3.5	38.44	54.00	15.56	AVG	V
Remark:							
Emission Level = Reading + Factor;							
Factor = Antenna Factor + Cable Loss – Pre-amplifier;							
Margin= Emission Level - Limit.							

ESP32-C3							
Radiated Band Edges Test Data							
Environmental Conditions		24.6℃, 53.4% RH		Test Engineer		He Chen	
Lowest Channel (Worst Case: Ant1 IEEE 802.11n40_2422MHz)							
Frequency (MHz)	Reading (dBuV)	Correct (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector (PEAK/AVG)	Polar (H/V)
2310.000	46.96	-3.62	43.34	74.00	30.66	PK+	H
2310.000	42.88	-3.62	39.26	54.00	14.74	AVG	H
2389.950	46.36	-3.67	42.69	74.00	31.31	PK+	H
2389.950	41.89	-3.67	38.22	54.00	15.78	AVG	H
2400.090	50.16	-3.68	46.48	74.00	27.52	PK+	H
2400.090	45.83	-3.68	42.15	54.00	11.85	AVG	H
2310.000	46.14	-3.62	42.52	74.00	31.48	PK+	V
2310.000	41.87	-3.62	38.25	54.00	15.75	AVG	V
2390.080	46.42	-3.67	42.75	74.00	31.25	PK+	V
2390.080	41.86	-3.67	38.19	54.00	15.81	AVG	V
2400.090	47.30	-3.68	43.62	74.00	30.38	PK+	V
2400.090	43.32	-3.68	39.64	54.00	14.36	AVG	V
Highest Channel (Worst Case: Ant1 IEEE 802.11n40_2452MHz)							
Frequency (MHz)	Reading (dBuV)	Correct (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector (PEAK/AVG)	Polar (H/V)
2483.500	46.91	-3.54	43.37	74.00	30.63	PK+	H
2483.500	42.79	-3.54	39.25	54.00	14.75	AVG	H
2500.000	46.47	-3.5	42.97	74.00	31.03	PK+	H
2500.000	41.79	-3.5	38.29	54.00	15.71	AVG	H
2483.500	46.34	-3.54	42.80	74.00	31.20	PK+	V
2483.500	41.79	-3.54	38.25	54.00	15.75	AVG	V
2500.000	45.87	-3.5	42.37	74.00	31.63	PK+	V
2500.000	41.92	-3.5	38.42	54.00	15.58	AVG	V
Remark:							
Emission Level = Reading + Factor;							
Factor = Antenna Factor + Cable Loss – Pre-amplifier;							
Margin= Emission Level - Limit.							

10. POWER LINE CONDUCTED EMISSIONS

10.1. LIMIT

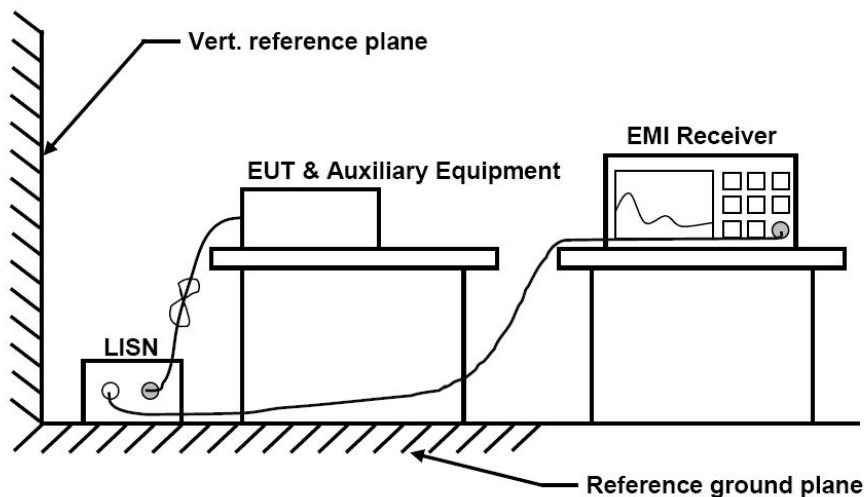
According to the rule FCC Part 15.207, Conducted emissions limit, the limit for a wireless device as below:

Frequency Range (MHz)	Conducted emissions (dBuV)	
	Quasi-peak	Average
0.15~0.5	66 to 56	56 to 46
0.5~5	56	46
5~30	60	50

Remark:

- The lower limit shall apply at the transition frequencies.
- The limit decreases linearly with the logarithm of the frequency in the range 0.15 to 0.50MHz.

10.2. TEST SETUP



10.3. TEST PROCEDURE

Test frequency range :150KHz-30MHz

- The mains terminal disturbance voltage test was conducted in a shielded room.
- The EUT was connected to AC power source through a LISN 1 (Line Impedance Stabilization Network) which provides a $50\Omega/50\mu\text{H} + 5\Omega$ linear impedance. The power cables of all other units of the EUT were connected to a second LISN 2, which was bonded to the ground reference plane in the same way as the LISN 1 for the unit being measured. A multiple socket outlet strip was used to connect multiple power cables to a single LISN provided the rating of the LISN was not exceeded.
- The tabletop EUT was placed upon a non-metallic table 0.8m above the ground reference plane. And for floor-standing arrangement, the EUT was placed on the horizontal ground reference plane,
- The test was performed with a vertical ground reference plane. The rear of the EUT shall be 0.4 m from the vertical ground reference plane. The vertical ground reference plane was bonded to the horizontal ground reference plane. The LISN 1 was placed 0.8 m from the boundary of the unit under test and

bonded to a ground reference plane for LISNs mounted on top of the ground reference plane. This distance was between the closest points of the LISN 1 and the EUT. All other units of the EUT and associated equipment was at least 0.8 m from the LISN 2.

e) In order to find the maximum emission, the relative positions of equipment and all of the interface cables must be changed according to ANSI C63.10 on conducted measurement.

10.4. TEST RESULT

Pass.

Note 1: ESP32S3 for AC line conducted emissions, the maximum peak output power 802.11n40 mode and highest channel was tested.

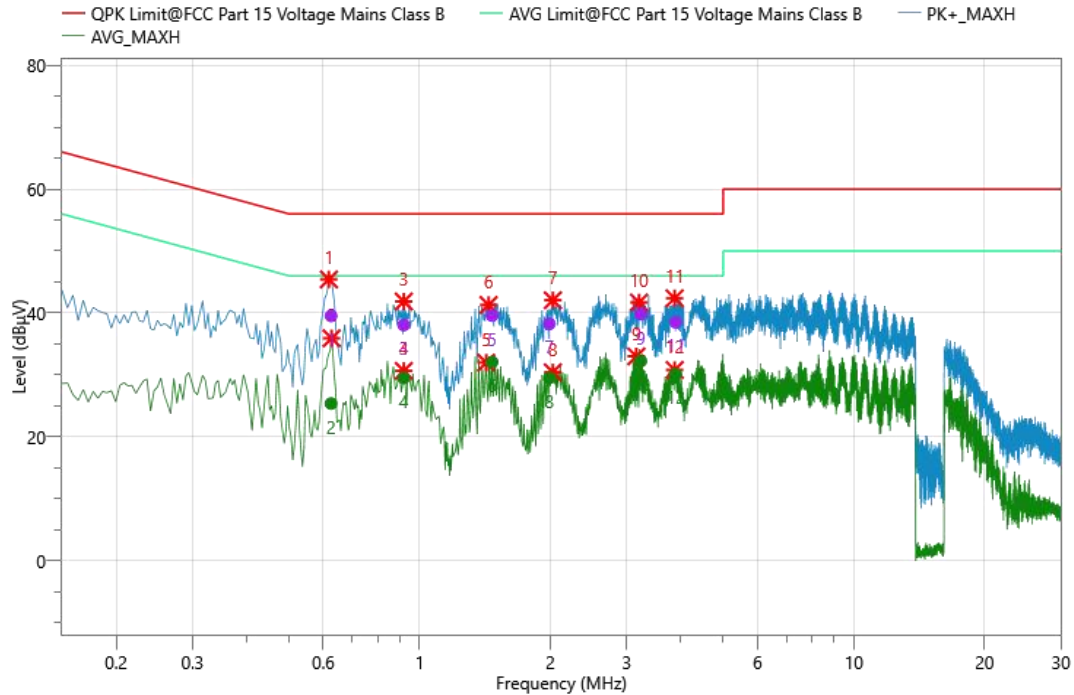
Note 2: ESP32-D0WDQ6-V3 for AC line conducted emissions, the maximum peak output power 802.11g mode and lowest channel was tested.

Note 3: ESP32-C3 for AC line conducted emissions, the maximum peak output power 802.11n20 mode and highest channel was tested.

ESP32S3

Test Plots and Data of Conducted Emissions (IEEE 802.11n40_2452MHz)

Environmental Conditions	24.6°C, 53.4% RH	Test Engineer	He Chen
Test Voltage:	AC 120V/60Hz	Test Power Line:	Line



No.	Freq. (MHz)	Reading (dBμV)	Corr. (dB)	Meas. (dBμV)	Limit (dBμV)	Margin (dB)	Det.	Line	PE
1	0.625	29.38	10.15	39.53	56.00	16.47	QPK	L1	GND
2	0.625	15.22	10.15	25.37	46.00	20.63	AVG	L1	GND
3	0.919	27.81	10.24	38.05	56.00	17.95	QPK	L1	GND
4	0.919	19.27	10.24	29.51	46.00	16.49	AVG	L1	GND
5	1.468	29.30	10.28	39.58	56.00	16.42	QPK	L1	GND
6	1.468	21.79	10.28	32.07	46.00	13.93	AVG	L1	GND
7	1.989	27.91	10.33	38.24	56.00	17.76	QPK	L1	GND
8	1.989	19.19	10.33	29.52	46.00	16.48	AVG	L1	GND
9	3.229	29.34	10.46	39.80	56.00	16.20	QPK	L1	GND
10	3.229	21.78	10.46	32.24	46.00	13.76	AVG	L1	GND
11	3.887	27.97	10.52	38.49	56.00	17.51	QPK	L1	GND
12	3.887	19.59	10.52	30.11	46.00	15.89	AVG	L1	GND

Remark:

Emission Level = Reading + Correct Factor;

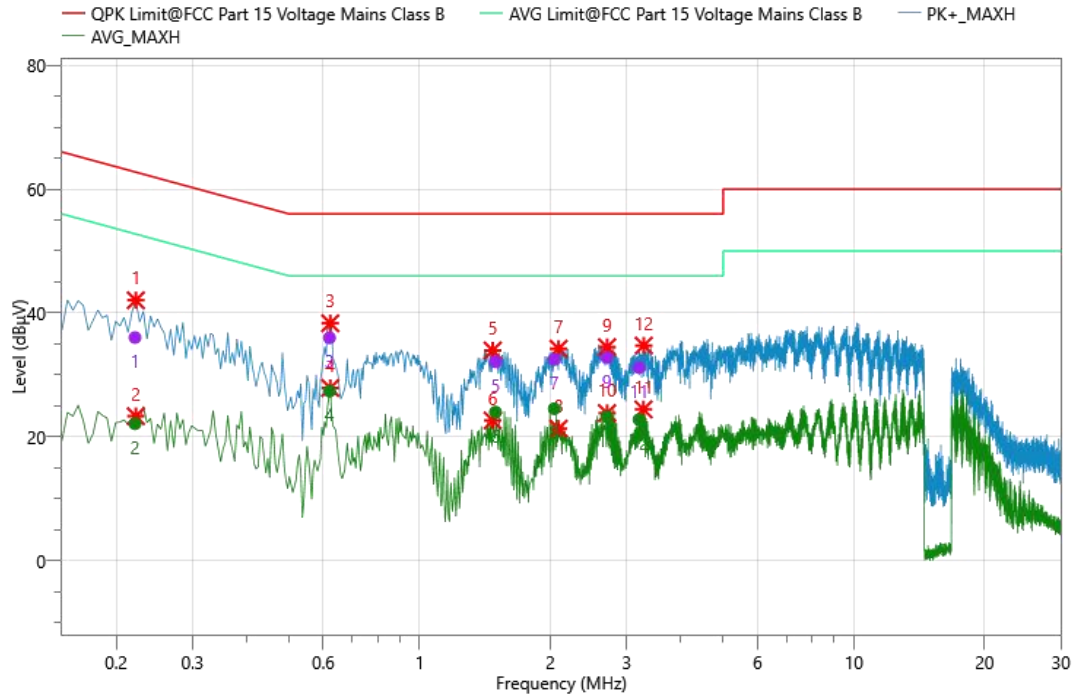
Correct Factor = LISN Factor + Cable Loss + Pulse Limiter Attenuation Factor

Margin= Limit- Emission Level .

ESP32S3

Test Plots and Data of Conducted Emissions (IEEE 802.11n40_2452MHz)

Environmental Conditions	24.6°C, 53.4% RH	Test Engineer	He Chen
Test Voltage:	AC 120V/60Hz	Test Power Line:	Neutral



No.	Freq. (MHz)	Reading (dBμV)	Corr. (dB)	Meas. (dBμV)	Limit (dBμV)	Margin (dB)	Det.	Line	PE
1	0.221	26.01	10.02	36.03	62.78	26.75	QPK	N	GND
2	0.221	12.09	10.02	22.11	52.78	30.67	AVG	N	GND
3	0.620	25.85	10.14	35.99	56.00	20.01	QPK	N	GND
4	0.620	17.24	10.14	27.38	46.00	18.62	AVG	N	GND
5	1.495	21.81	10.29	32.10	56.00	23.90	QPK	N	GND
6	1.495	13.69	10.29	23.98	46.00	22.02	AVG	N	GND
7	2.042	22.14	10.34	32.48	56.00	23.52	QPK	N	GND
8	2.042	14.19	10.34	24.53	46.00	21.47	AVG	N	GND
9	2.697	22.37	10.4	32.77	56.00	23.23	QPK	N	GND
10	2.697	12.86	10.4	23.26	46.00	22.74	AVG	N	GND
11	3.200	20.73	10.45	31.18	56.00	24.82	QPK	N	GND
12	3.200	12.32	10.45	22.77	46.00	23.23	AVG	N	GND

Remark:

Emission Level = Reading + Correct Factor;

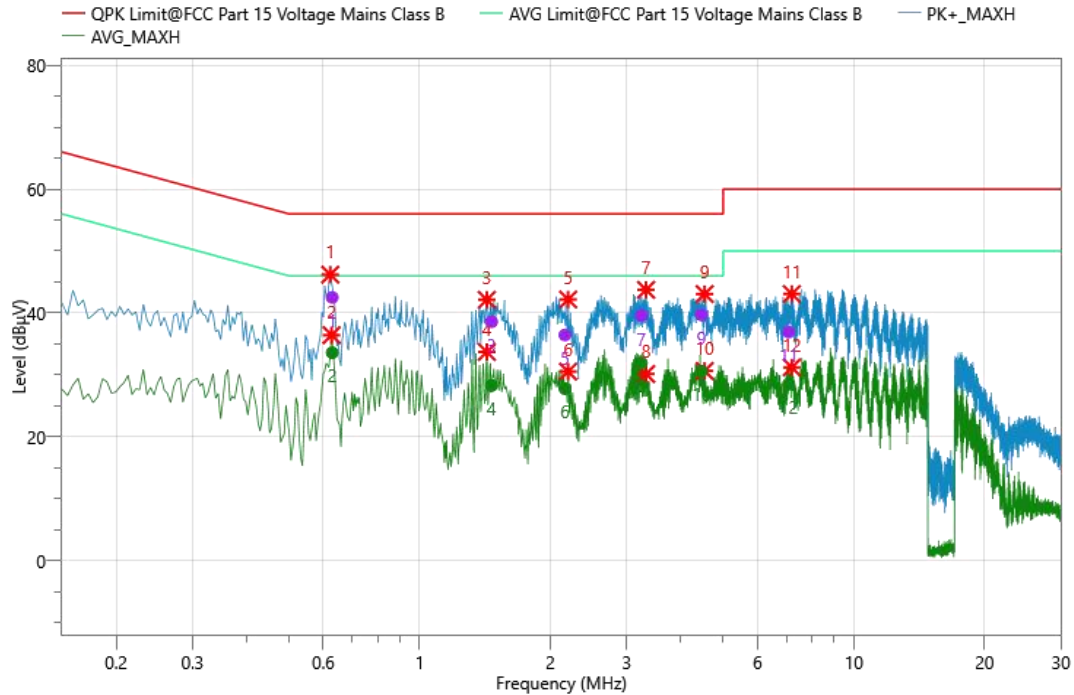
Correct Factor = LISN Factor + Cable Loss + Pulse Limiter Attenuation Factor

Margin= Limit- Emission Level .

ESP32-D0WDQ6-V3

Test Plots and Data of Conducted Emissions (IEEE 802.11g_2422MHz)

Environmental Conditions	24.6°C, 53.4% RH	Test Engineer	He Chen
Test Voltage:	AC 120V/60Hz	Test Power Line:	Line



No.	Freq. (MHz)	Reading (dBμV)	Corr. (dB)	Meas. (dBμV)	Limit (dBμV)	Margin (dB)	Det.	Line	PE
1	0.629	32.36	10.15	42.51	56.00	13.49	QPK	L1	GND
2	0.629	23.42	10.15	33.57	46.00	12.43	AVG	L1	GND
3	1.464	28.30	10.28	38.58	56.00	17.42	QPK	L1	GND
4	1.464	18.00	10.28	28.28	46.00	17.72	AVG	L1	GND
5	2.161	26.09	10.35	36.44	56.00	19.56	QPK	L1	GND
6	2.161	17.43	10.35	27.78	46.00	18.22	AVG	L1	GND
7	3.239	29.14	10.46	39.60	56.00	16.40	QPK	L1	GND
8	3.239	21.47	10.46	31.93	46.00	14.07	AVG	L1	GND
9	4.456	29.03	10.67	39.70	56.00	16.30	QPK	L1	GND
10	4.456	19.90	10.67	30.57	46.00	15.43	AVG	L1	GND
11	7.076	26.03	10.88	36.91	60.00	23.09	QPK	L1	GND
12	7.076	17.65	10.88	28.53	50.00	21.47	AVG	L1	GND

Remark:

Emission Level = Reading + Correct Factor;

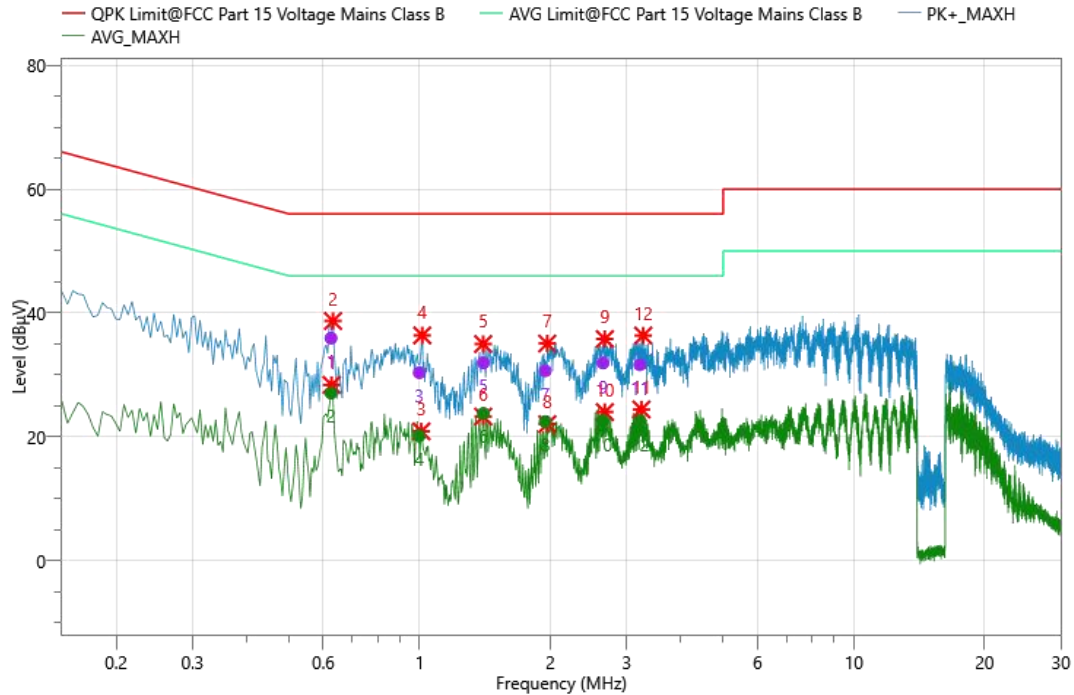
Correct Factor = LISN Factor + Cable Loss + Pulse Limiter Attenuation Factor

Margin= Limit- Emission Level .

ESP32-D0WDQ6-V3

Test Plots and Data of Conducted Emissions (IEEE 802.11g_2422MHz)

Environmental Conditions	24.6°C, 53.4% RH	Test Engineer	He Chen
Test Voltage:	AC 120V/60Hz	Test Power Line:	Neutral



No.	Freq. (MHz)	Reading (dBμV)	Corr. (dB)	Meas. (dBμV)	Limit (dBμV)	Margin (dB)	Det.	Line	PE
1	0.625	25.78	10.15	35.93	56.00	20.07	QPK	N	GND
2	0.625	16.90	10.15	27.05	46.00	18.95	AVG	N	GND
3	0.998	20.11	10.24	30.35	56.00	25.65	QPK	N	GND
4	0.998	9.93	10.24	20.17	46.00	25.83	AVG	N	GND
5	1.402	21.67	10.28	31.95	56.00	24.05	QPK	N	GND
6	1.402	13.50	10.28	23.78	46.00	22.22	AVG	N	GND
7	1.946	20.32	10.33	30.65	56.00	25.35	QPK	N	GND
8	1.946	12.14	10.33	22.47	46.00	23.53	AVG	N	GND
9	2.644	21.51	10.4	31.91	56.00	24.09	QPK	N	GND
10	2.644	12.21	10.4	22.61	46.00	23.39	AVG	N	GND
11	3.214	21.18	10.45	31.63	56.00	24.37	QPK	N	GND
12	3.214	12.06	10.45	22.51	46.00	23.49	AVG	N	GND

Remark:

Emission Level = Reading + Correct Factor;

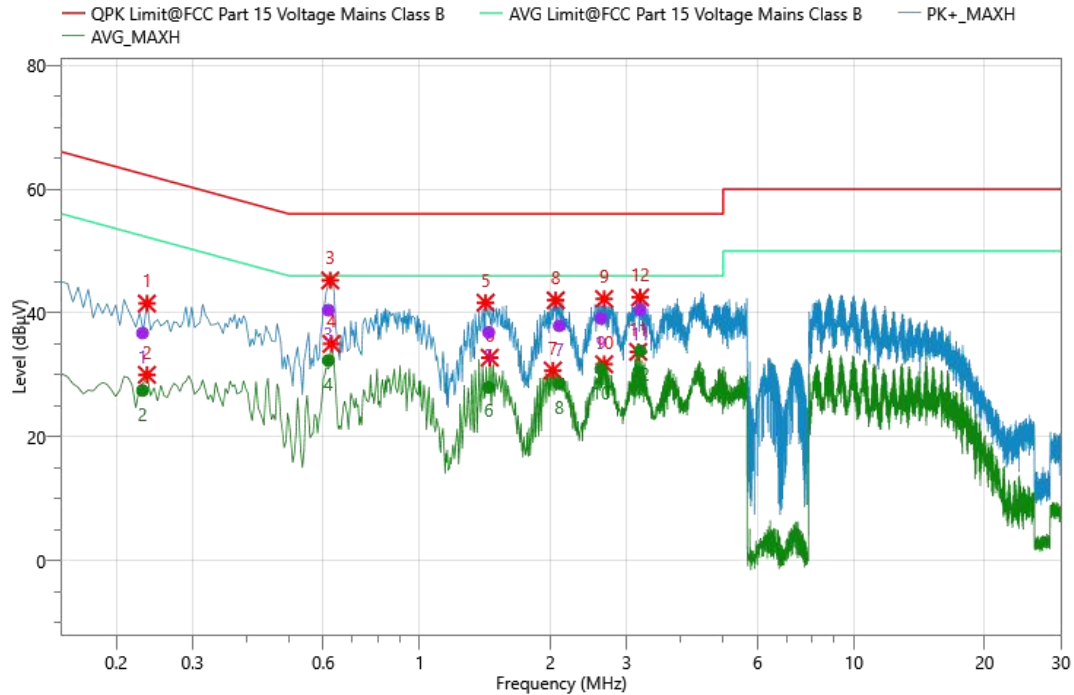
Correct Factor = LISN Factor + Cable Loss + Pulse Limiter Attenuation Factor

Margin= Limit- Emission Level .

ESP32-C3

Test Plots and Data of Conducted Emissions (IEEE 802.11n20_2462MHz)

Environmental Conditions	24.6°C, 53.4% RH	Test Engineer	He Chen
Test Voltage:	AC 120V/60Hz	Test Power Line:	Line



No.	Freq. (MHz)	Reading (dBμV)	Corr. (dB)	Meas. (dBμV)	Limit (dBμV)	Margin (dB)	Det.	Line	PE
1	0.230	26.72	10.03	36.75	62.45	25.70	QPK	L1	GND
2	0.230	17.44	10.03	27.47	52.45	24.98	AVG	L1	GND
3	0.616	30.31	10.14	40.45	56.00	15.55	QPK	L1	GND
4	0.616	22.18	10.14	32.32	46.00	13.68	AVG	L1	GND
5	1.442	26.58	10.28	36.86	56.00	19.14	QPK	L1	GND
6	1.442	17.71	10.28	27.99	46.00	18.01	AVG	L1	GND
7	2.097	27.58	10.34	37.92	56.00	18.08	QPK	L1	GND
8	2.097	18.23	10.34	28.57	46.00	17.43	AVG	L1	GND
9	2.617	28.72	10.39	39.11	56.00	16.89	QPK	L1	GND
10	2.617	20.57	10.39	30.96	46.00	15.04	AVG	L1	GND
11	3.220	30.01	10.45	40.46	56.00	15.54	QPK	L1	GND
12	3.220	23.40	10.45	33.85	46.00	12.15	AVG	L1	GND

Remark:

Emission Level = Reading + Correct Factor;

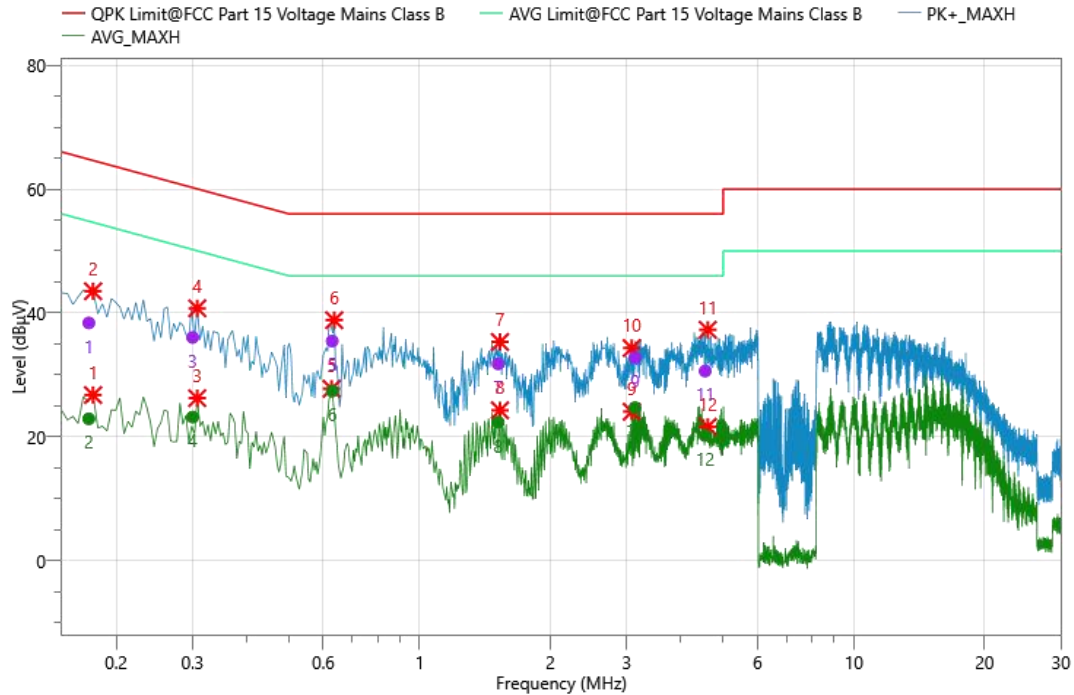
Correct Factor = LISN Factor + Cable Loss + Pulse Limiter Attenuation Factor

Margin= Limit- Emission Level .

ESP32-C3

Test Plots and Data of Conducted Emissions (IEEE 802.11n20_2462MHz)

Environmental Conditions	24.6°C, 53.4% RH	Test Engineer	He Chen
Test Voltage:	AC 120V/60Hz	Test Power Line:	Neutral



No.	Freq. (MHz)	Reading (dBμV)	Corr. (dB)	Meas. (dBμV)	Limit (dBμV)	Margin (dB)	Det.	Line	PE
1	0.173	28.37	10.02	38.39	64.82	26.43	QPK	N	GND
2	0.173	12.88	10.02	22.90	54.82	31.92	AVG	N	GND
3	0.300	25.98	10.06	36.04	60.24	24.20	QPK	N	GND
4	0.300	13.12	10.06	23.18	50.24	27.06	AVG	N	GND
5	0.629	25.31	10.15	35.46	56.00	20.54	QPK	N	GND
6	0.629	17.25	10.15	27.40	46.00	18.60	AVG	N	GND
7	1.516	21.48	10.29	31.77	56.00	24.23	QPK	N	GND
8	1.516	12.06	10.29	22.35	46.00	23.65	AVG	N	GND
9	3.133	22.31	10.45	32.76	56.00	23.24	QPK	N	GND
10	3.133	14.26	10.45	24.71	46.00	21.29	AVG	N	GND
11	4.544	20.02	10.59	30.61	56.00	25.39	QPK	N	GND
12	4.544	9.61	10.59	20.20	46.00	25.80	AVG	N	GND

Remark:

Emission Level = Reading + Correct Factor;

Correct Factor = LISN Factor + Cable Loss + Pulse Limiter Attenuation Factor

Margin= Limit- Emission Level .

11. PHOTOGRAPHS OF TEST SETUP

Please refer to separated files for Test Setup Photos of the EUT.

12. EXTERNAL PHOTOGRAPHS OF THE EUT

Please refer to separated files for External Photos of the EUT.

13. INTERNAL PHOTOGRAPHS OF THE EUT

Please refer to separated files for Internal Photos of the EUT.

*****THE END*****