



Certificate No.: 3745.01



FCC - TEST REPORT

Report Number : **708882102926-01** Date of Issue: April 19, 2024

Model : CB2S

Product Type : Wi-Fi and Bluetooth module

Applicant : Hangzhou Tuya Information Technology Co.,Ltd

Address : Room 301, Building 1, Huace Center, Xihu District,
Hangzhou City, Zhejiang Province, China

Manufacturer : Hangzhou Tuya Information Technology Co.,Ltd

Address : Room 301, Building 1, Huace Center, Xihu District,
Hangzhou City, Zhejiang Province, China

Test Result : ☒ **Positive** ☐ **Negative**

Total pages including
Appendices : 25

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1 Table of Contents

1	Table of Contents	2
2	Details about the Test Laboratory	3
3	Description of the Equipment under Test.....	4
4	Summary of Test Standards	6
5	Summary of Test Results	7
6	General Remarks	8
7	Test Setups	9
8	Systems test configuration	12
9	Technical Requirement.....	13
9.1	Conducted peak output power	13
9.2	Spurious radiated emissions for transmitter.....	15
10	Test Equipment List.....	22
11	System Measurement Uncertainty	23
12	Photographs of Test Set-ups.....	24
13	Photographs of EUT	25



2 Details about the Test Laboratory

Details about the Test Laboratory

Test Site 1

Company name: TÜV SÜD Certification and Testing (China) Co., Ltd. Shanghai Branch
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FCC Registration No.: 820234

FCC Designation Number: CN1183

ISED CAB identifier CN0101

IC Registration No.: 31668

3 Description of the Equipment under Test

Product: Wi-Fi and Bluetooth module

Model no.: CB2S

FCC ID: 2ANDL-CB2S

Options and accessories: NA

Rating: DC 3.0-3.6V

RF Transmission Frequency: For 802.11b/g/n-HT20: 2412~2462 MHz
For 802.11n-HT40: 2422~2452 MHz
For 802.15.1: 2402~2480 MHz

No. of Operated Channel: 2.4GHz WIFI: 11 for 802.11b/802.11g/802.11n(H20)
7 for 802.11n(H40)
2.4GHz BLE: 40

Modulation: For 2.4GHz WIFI:
Direct Sequence Spread Spectrum (DSSS) for 802.11b
Orthogonal Frequency Division Multiplexing (OFDM) for 802.11g/n
For 2.4GHz BLE: GFSK

Channel list:

802.11b/g/n(HT20)			
Ch	Fre(MHz)	Ch	Fre(MHz)
1	2412	7	2442
2	2417	8	2447
3	2422	9	2452
4	2427	10	2457
5	2432	11	2462
6	2437		

802.11n(HT40)			
Ch	Fre(MHz)	Ch	Fre(MHz)
3	2422	7	2442
4	2427	8	2447
5	2432	9	2452
6	2437		

Bluetooth Low Energy							
Ch	Fre(MHz)	Ch	Fre(MHz)	Ch	Fre(MHz)	Ch	Fre(MHz)
0	2402	10	2422	20	2442	30	2462
1	2404	11	2424	21	2444	31	2464
2	2406	12	2426	22	2446	32	2466
3	2408	13	2428	23	2448	33	2468



4	2410	14	2430	24	2450	34	2470
5	2412	15	2432	25	2452	35	2472
6	2414	16	2434	26	2454	36	2474
7	2416	17	2436	27	2456	37	2476
8	2418	18	2438	28	2458	38	2478
9	2420	19	2440	29	2460	39	2480

Antenna Type: PCB Antenna

Antenna Gain: 0 dBi

Description of the EUT: The Equipment Under Test (EUT) is a low-power embedded Wi-Fi and Bluetooth module (5.1). We tested it and listed the worst data in this report.

Test sample no.: SHA-800011-2 (Conducted sample), SHA-800011-1 (Radiated sample)

The sample's mentioned in this report is/are submitted/ supplied/ manufactured by client. The laboratory therefore assumes no responsibility for accuracy of information on the brand name, model number, origin of manufacture, consignment or any information supplied.



4 Summary of Test Standards

Test Standards	
FCC Part 15 Subpart C 10-1-2023 Edition	PART 15 - RADIO FREQUENCY DEVICES Subpart C - Intentional Radiators

All the test methods were according to KDB 558074 D01 15.247 Meas Guidance v05r02 and ANSI C63.10 (2013).



5 Summary of Test Results

Technical Requirements						
FCC Part 15 Subpart C						
Test Condition		Pages	Test Site	Test Result		
				Pass	Fail	N/A
§15.207	Conducted emission AC power port	---	---	☒	☐	☐
§15.247 (b) (3)	Conducted peak output power	13-14	Site 1	☒	☐	☐
§15.247(a)(1)	20dB bandwidth	---	---	☐	☐	☒
§15.247(a)(1)	Carrier frequency separation	---	---	☐	☐	☒
§15.247(a)(1)(iii)	Number of hopping frequencies	---	---	☐	☐	☒
§15.247(a)(1)(iii)	Dwell Time	---	---	☐	☐	☒
§15.247(a)(2)	6dB bandwidth	---	---	☒	☐	☐
§15.247(e)	Power spectral density	---	---	☒	☐	☐
§15.247(d)	Spurious RF conducted emissions	---	---	☒	☐	☐
§15.247(d)	Band edge	---	---	☒	☐	☐
§15.247(d) & §15.209	Spurious radiated emissions for transmitter	15-21	Site 1	☒	☐	☐
§15.203	Antenna requirement	See note 1		☒	☐	☐

Remark 1: N/A – Not Applicable.

Note 1: The EUT uses a PCB Antenna, which gain is 0 dBi. In accordance to §15.203, It is considered sufficiently to comply with the provisions of this section.

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(c) (1)(i) requirement: (i) Systems operating in the 2400-2483.5 MHz band that is used exclusively for fixed. Point-to-point operations may employ transmitting antennas with directional gain greater than 6dBi provided the maximum conducted output power of the intentional radiator is reduced by 1 dB for every 3 dB that the directional gain of the antenna exceeds 6dBi



6 General Remarks

Remarks

NOTICE: This report is a SUPPLEMENT OF PROJECT 708882102926-00. So the report is not valid without the report of 708882102926-00.

This submittal(s) (test report) is intended for FCC ID: 2ANDL-CB2S, complies with Section 15.207, 15.209, 15.247 of the FCC Part 15, Subpart C Rules.

According to the client's declaration, the module optimizes and upgrades the antenna matching circuit. So in this test report only test data of "Conducted peak output power" and "Spurious radiated emissions for transmitter" was new data, other tests were referred from 708882102926-00, and the test data are still effective.

This report is only for the 2.4GHz BLE test report, for the 2.4GHz Wi-Fi test report please refer to 708882102927-01.

According to the client's declaration, the "ILAC – A2LA Accredited" symbol is added to the report.

SUMMARY:

All tests according to the regulations cited on page 5 were

■ - Performed

□ - **Not** Performed

The Equipment under Test

■ - **Fulfills** the general approval requirements.

□ - **Does not** fulfill the general approval requirements.

Sample Received Date: March 27, 2024

Testing Start Date: April 7, 2024

Testing End Date: April 12, 2024

-TÜV SÜD Certification and Testing (China) Co., Ltd. Shanghai Branch

Reviewed by:

Prepared by:

Tested by:

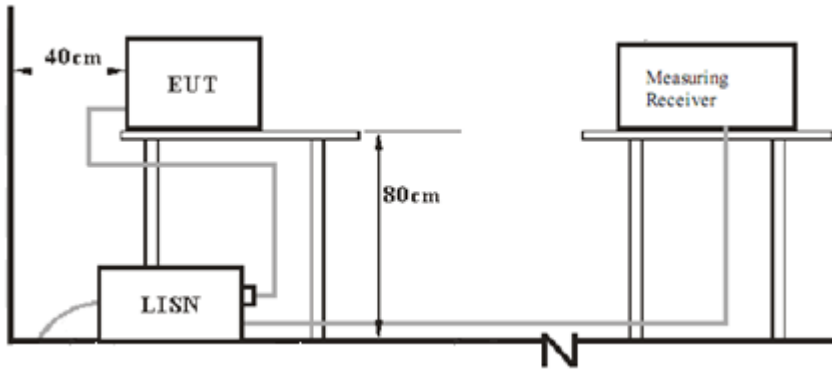
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Review Engineer

Wenqiang LU
Project Engineer

Tianji XU
Test Engineer

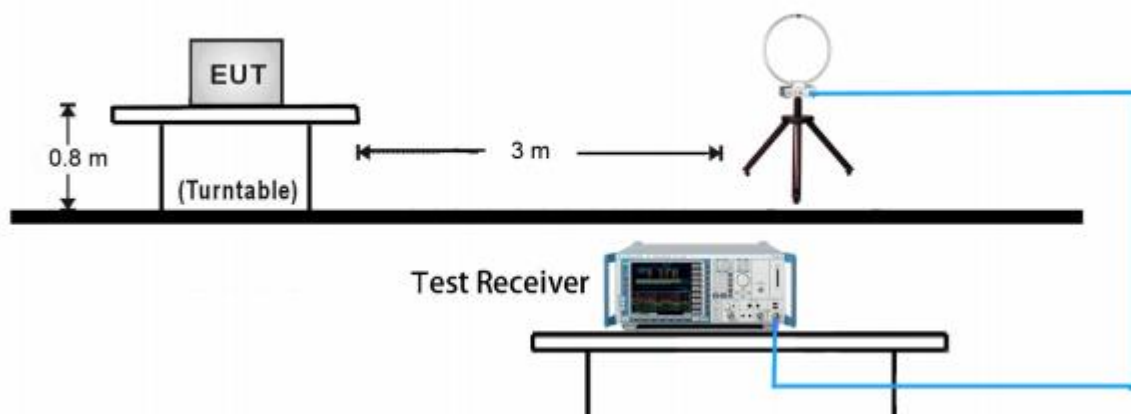
7 Test Setups

7.1 AC Power Line Conducted Emission test setups

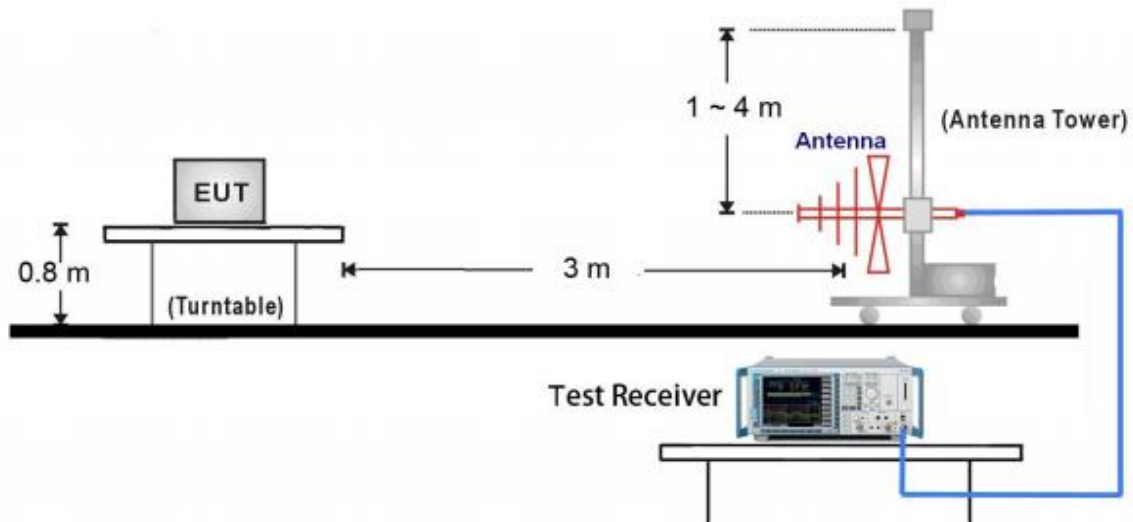


7.2 Radiated test setups

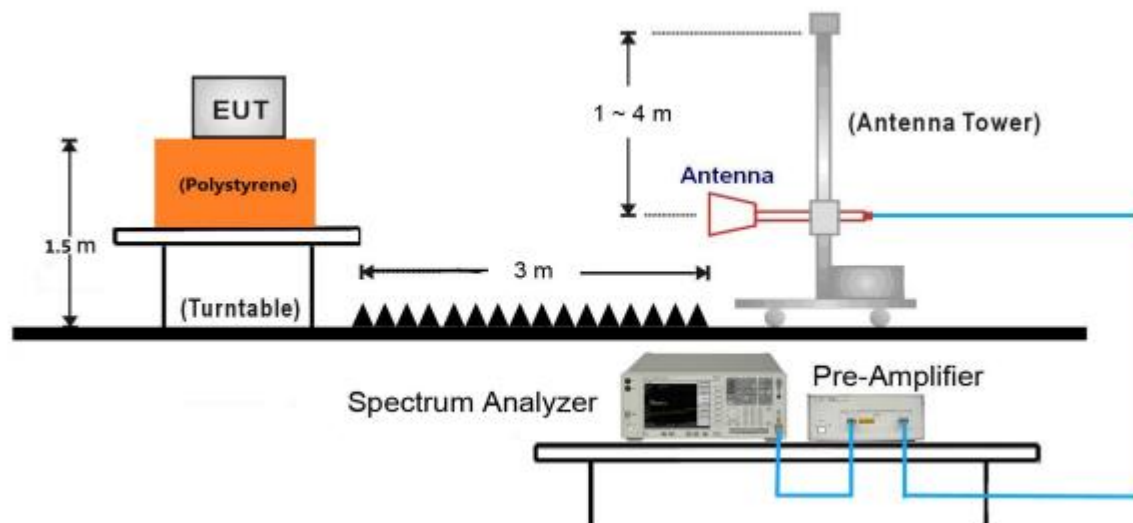
9kHz ~ 30MHz Test Setup:



30MHz ~ 1GHz Test Setup:

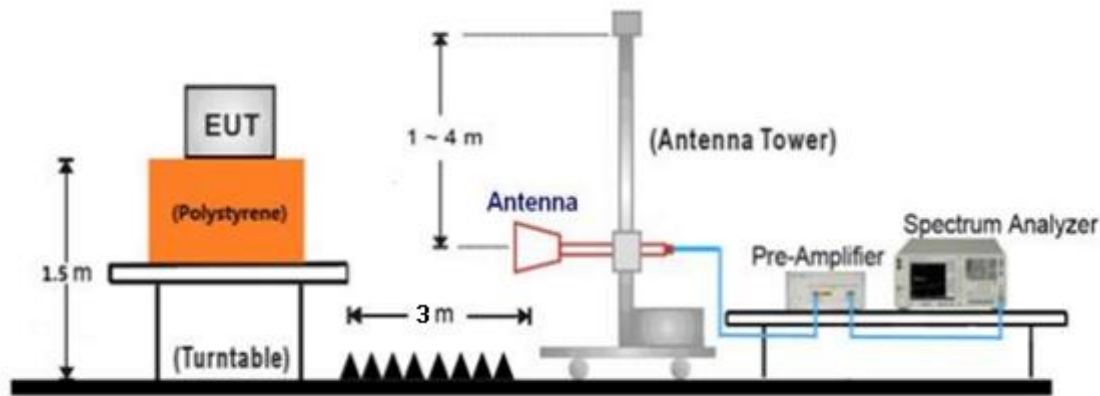


1GHz ~ 18GHz Test Setup:

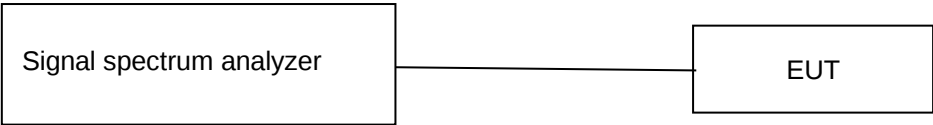




18GHz ~ 25GHz Test Setup:



7.3 Conducted RF test setups



8 Systems test configuration

Auxiliary Equipment Used during Test:

DESCRIPTION	MANUFACTURER	MODEL NO.(SHIELD)	S/N(LENGTH)
Notebook	Lenove	E470	PF-OU5TS7 17/09

Test software: EMI_Test_Tool

The system was configured to channel 0, 19, and 39 for the test.

Non-hopping mode: The system was configured to operate at a signal channel transmitting. The test software allows the configuration and operation at the worst-case duty and the highest transmit power.

Test Mode Applicability and Tested Channel Detail:

Mode	Tested Channel	Data Rate (Mbps)	Modulation	Power level setting
Bluetooth LE	0	1	GFSK	default
	19	1	GFSK	default
	39	1	GFSK	default

9 Technical Requirement

9.1 Conducted peak output power

Test Method

1. Use the following spectrum analyzer settings:
RBW > the 6 dB bandwidth of the emission being measured, VBW $\geq$ 3RBW, Span $\geq$ 3RBW
Sweep = auto, Detector function = peak, Trace = max hold.
2. Add a correction factor to the display.
3. Use a power meter to measure the conducted peak output power.

Limits

Frequency Range MHz	Limit W	Limit dBm
2400-2483.5	≤ 1	≤ 30

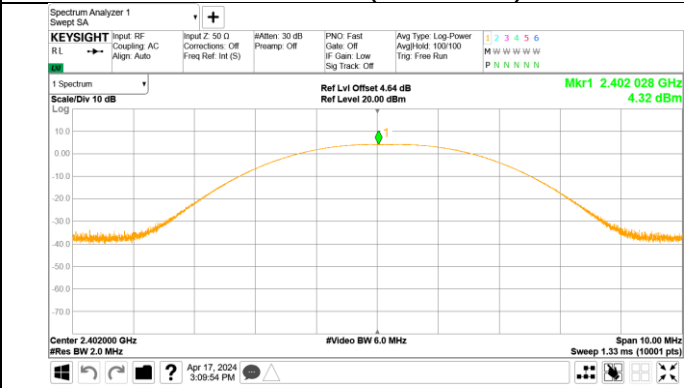
Test result as below table

Data transmission rate:1Mbps		
Frequency	Conducted Peak Output Power	Result
MHz	dBm	
Low channel 2402MHz	4.32	Pass
Middle channel 2440MHz	5.22	Pass
High channel 2480MHz	4.45	Pass

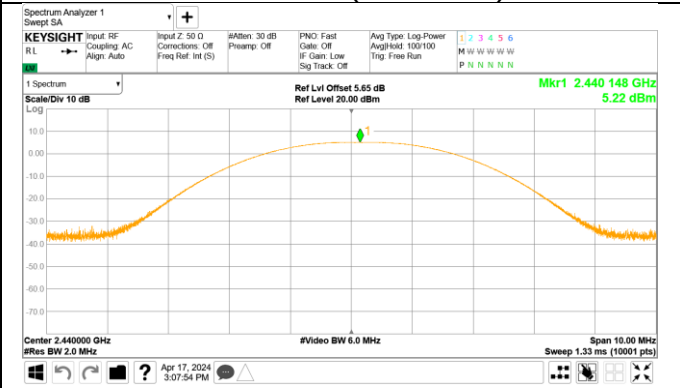


Peak output power (1Mbps)

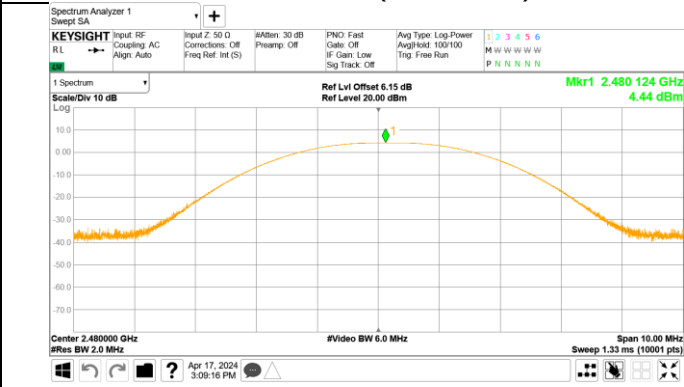
Channel 0 (2402MHz)



Channel 19 (2440MHz)



Channel 39 (2480MHz)



9.2 Spurious radiated emissions for transmitter

Test Method

1. The EUT was placed on a turn table which is 1.5m above ground plane for above 1GHz and 0.8m above ground for below 1GHz at 3 meter chamber room for test. The table was rotated 360 degrees to determine the position of the highest radiation.
2. The EUT was set 3 meters away from the interference – receiving antenna, which was mounted on the top of a variable – height antenna tower.
3. The height of antenna is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.
4. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.
5. Use the following spectrum analyzer settings According to C63.10:

For Below 1GHz

Use the following spectrum analyzer settings:

Span = wide enough to capture the peak level of the in-band emission and all spurious
RBW = 100 kHz to 120 kHz, VBW ≥ RBW for peak measurement, Sweep = auto, Detector function = peak, Trace = max hold.

For Peak unwanted emissions Above 1GHz:

Span = wide enough to capture the peak level of the in-band emission and all spurious
RBW = 1MHz, VBW ≥ RBW for peak measurement, Sweep = auto, Detector function = peak, Trace = max hold.

Procedures for average unwanted emissions measurements above 1000 MHz

- a) RBW = 1MHz.
- b) $VBW \geq [3 \times RBW]$.
- c) Detector = RMS (power averaging), if $[\text{span} / (\# \text{ of points in sweep})] \leq RBW / 2$.
Satisfying this condition can require increasing the number of points in the sweep or reducing the span. If the condition is not satisfied, then the detector mode shall be set to peak.
- d) Averaging type = power (i.e., rms) (As an alternative, the detector and averaging type may be set for linear voltage averaging. Some instruments require linear display mode to use linear voltage averaging. Log or dB averaging shall not be used.)
- e) Sweep time = auto.
- f) Perform a trace average of at least 100 traces if the transmission is continuous. If the transmission is not continuous, then the number of traces shall be increased by a factor of $1 / D$, where D is the duty cycle. For example, with 50% duty cycle, at least 200 traces shall be averaged. (If a specific emission is demonstrated to be continuous—i.e., 100% duty cycle—then rather than turning ON and OFF with the transmit cycle, at least 100 traces shall be averaged.)
- g) If tests are performed with the EUT transmitting at a duty cycle less than 98%, then a correction factor shall be added to the measurement results prior to comparing with the emission limit, to compute the emission level that would have been measured had the test been performed at 100% duty cycle. The correction factor is computed as follows:



- 1) If power averaging (rms) mode was used in the preceding step e), then the correction factor is $[10 \log (1 / D)]$, where D is the duty cycle. For example, if the transmit duty cycle was 50%, then 3 dB shall be added to the measured emission levels.
- 2) If linear voltage averaging mode was used in the preceding step e), then the correction factor is $[20 \log (1 / D)]$, where D is the duty cycle. For example, if the transmit duty cycle was 50%, then 6 dB shall be added to the measured emission levels.
- 3) If a specific emission is demonstrated to be continuous (100% duty cycle) rather than turning ON and OFF with the transmit cycle, then no duty cycle correction is required for that emission.

Limit

The radio emission outside the operating frequency band shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power. Radiated emissions which fall in the restricted bands, as defined in section 15.205 must comply with the radiated emission limits specified in section 15.209.

Frequency MHz	Field Strength uV/m	Measured Distance Meters
0.009~0.490	2400/F (kHz)	300
0.490~1.705	24000/F (kHz)	30
1.705~30	30	30

Frequency MHz	Field Strength uV/m	Field Strength dBuV/m	Detector
30-88	100	40	QP
88-216	150	43.5	QP
216-960	200	46	QP
960-1000	500	54	QP
Above 1000	500	54	AV
Above 1000	5000	74	PK

Spurious radiated emissions for transmitter

According to C63.10, if the peak (or quasi-peak) measured value complies with the average limit, it is unnecessary to perform an average measurement, so AV emission value did not show in below table if the peak value complies with average limit. The only worse case test result is listed in the report.

Test result

Test mode:GFSK 1Mbps (2402MHz)					
Frequency MHz	Measure Level (dBuV/m)	Limit (dBuV/M)	Margin (dB)	Detector	Polarization
2386.36	48.88	74.00	25.12	PK	Horiznotal
4806.93	43.45	74.00	30.55	PK	Horiznotal
2385.54	48.61	74.00	25.39	PK	Vertical
4803.21	43.41	74.00	30.59	PK	Vertical

Test mode:GFSK 1Mbps (2440MHz)					
Frequency MHz	Measure Level (dBuV/m)	Limit (dBuV/M)	Margin (dB)	Detector	Polarization
4879.71	44.51	74.00	29.49	PK	Horiznotal
4882.37	44.04	74.00	29.96	PK	Vertical

Test mode:GFSK 1Mbps (2480MHz)					
Frequency MHz	Measure Level (dBuV/m)	Limit (dBuV/M)	Margin (dB)	Detector	Polarization
2483.71	50.67	74.00	23.33	PK	Horiznotal
4962.59	45.23	74.00	28.77	PK	Horiznotal
2483.60	49.96	74.00	24.04	PK	Vertical
4960.46	43.74	74.00	30.26	PK	Vertical

Remark:

- (1) Emission level= Original Receiver Reading + Correct Factor
- (2) Correct Factor = Antenna Factor + Cable Loss -Amplifier gain
- (3) Margin = limit – Corrected Reading

The worst case of Radiated Emission below 1GHz:

30-1000MHz Radiated Emission

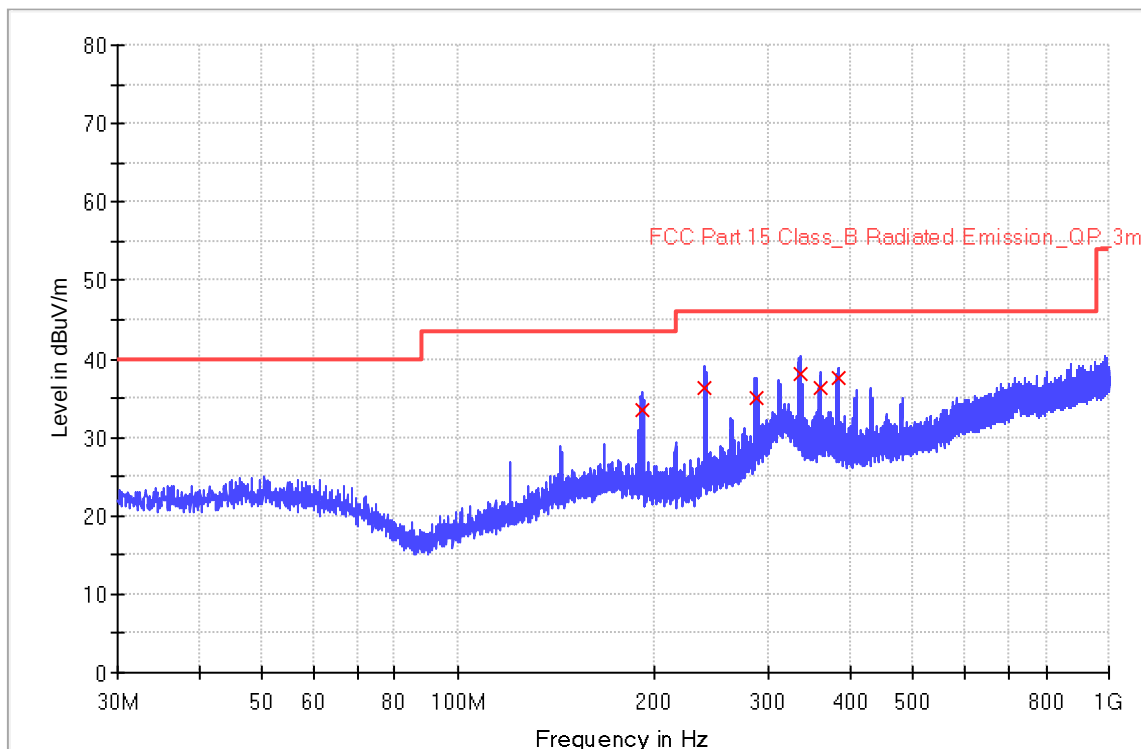
EUT Information

EUT Name:	Wi-Fi and Bluetooth module
Model:	CB2S
Client:	Hangzhou Tuya Information Technology Co., Ltd
Op Cond:	Power on,TX_2440MHz,1Mbps, DC 3.3V, T20.9, H63.4%, P100.1Pa
Operator:	Tianji XU
Test Spec:	FCC Part 15.247
Comment:	Horizontal
Sample No:	SHA-800011-1

Sweep Setup: RE_VULB9168_pre_Cont_30-1000 [EMI radiated]

Hardware Setup:	RE_VULB9168
Receiver:	[ESR 3]
Level Unit:	dBuV/m

Subrange	Step Size	Detectors	Bandwidth	Sweep Time	Preamp
30 MHz - 1 GHz	48.5 kHz	PK+	120 kHz	0.2 s	20 dB
RE_VULB9168_pre_Cont_30-1000					





Limit and Margin

Frequency (MHz)	QuasiPeak (dBuV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)	Margin - QPK (dB)	Limit - QPK (dBuV/m)
192.200000	33.6	1000.0	120.000	100.0	H	133.0	18.3	9.9	43.5
239.040000	36.4	1000.0	120.000	225.0	H	254.0	19.4	9.6	46.0
288.280000	34.9	1000.0	120.000	158.0	H	332.0	21.3	11.1	46.0
336.320000	38.2	1000.0	120.000	302.0	H	19.0	22.6	7.8	46.0
359.560000	36.3	1000.0	120.000	200.0	H	229.0	22.9	9.7	46.0
384.400000	37.6	1000.0	120.000	123.0	H	302.0	23.8	8.4	46.0



30-1000MHz Radiated Emission

EUT Information

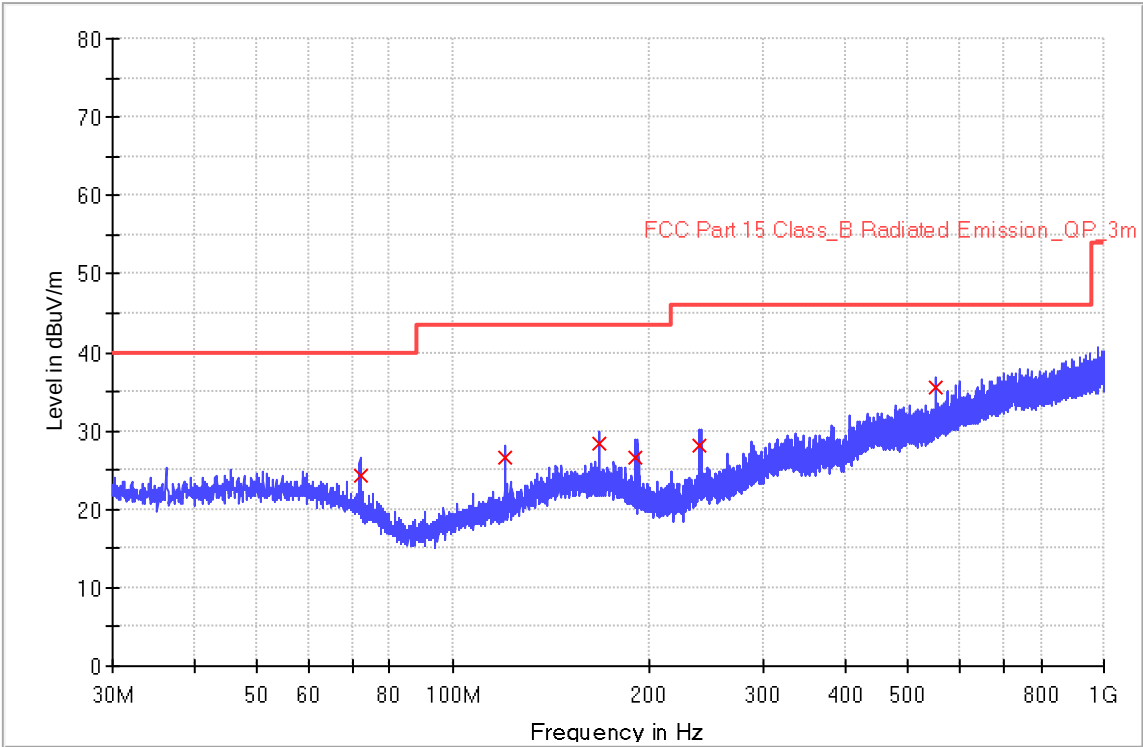
EUT Name:	Wi-Fi and Bluetooth module
Model:	CB2S
Client:	Hangzhou Tuya Information Technology Co., Ltd
Op Cond:	Power on,TX_2440MHz,1Mbps, DC 3.3V, T20.9, H63.4%, P100.1Pa
Operator:	Tianji XU
Test Spec:	FCC Part 15.247
Comment:	Vertical
Sample No:	SHA-800011-1

Sweep Setup: RE_VULB9168_pre_Cont_30-1000 [EMI radiated]

Hardware Setup:	RE_VULB9168
Receiver:	[ESR 3]
Level Unit:	dBuV/m

Subrange	Step Size	Detectors	Bandwidth	Sweep Time	Preamp
30 MHz - 1 GHz	48.5 kHz	PK+	120 kHz	0.2 s	20 dB

RE_VULB9168_pre_Cont_30-1000





Limit and Margin

Frequency (MHz)	QuasiPeak (dBuV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)	Margin - QPK (dB)	Limit - QPK (dBuV/m)
72.000000	24.3	1000.0	120.000	100.0	V	245.0	18.2	15.7	40.0
119.960000	26.6	1000.0	120.000	125.0	V	23.0	18.1	16.9	43.5
168.000000	28.4	1000.0	120.000	200.0	V	118.0	20.4	15.1	43.5
191.160000	26.7	1000.0	120.000	182.0	V	324.0	18.5	16.8	43.5
239.600000	28.1	1000.0	120.000	100.0	V	29.0	19.5	17.9	46.0
551.960000	35.6	1000.0	120.000	201.0	V	337.0	27.5	10.4	46.0

Note 1: Measure Level (dBuV/m) = Reading Level (dBuV) + Factor (dB)

Factor (dB) = Cable Loss (dB) + Antenna Factor (dB/m)

Note 2: The test trace is same as the ambient noise and the amplitude of the emissions are attenuated more than 20dB below the permissible (the test frequency range: 9kHz ~ 30MHz, 18GHz ~ 25GHz), therefore no data appear in the report.

10 Test Equipment List

List of Test Instruments
Test Site1

	DESCRIPTION	MANUFACTURER	MODEL NO.	SERIAL NO.	CAL. DATE	CAL. DUE DATE
C	Signal Analyzer	Rohde & Schwarz	FSV40	101091	2023-8-1	2024-7-31
	RF automatic control unit	MWRFTtest	MW100-RFCB	S2110418b-YQ-EMC	2023-9-28	2024-9-27
RE	EMI Test Receiver	Rohde & Schwarz	ESR3	101906	2023-8-1	2024-7-31
	Signal Analyzer	Rohde & Schwarz	FSV40	101091	2023-8-1	2024-7-31
	Trilog Super Broadband Test Antenna	Schwarzbeck	VULB 9168	961	2019-9-23	2024-9-22
	Double-ridged waveguide horn antenna	Rohde & Schwarz	HF907	102393	2021-4-13	2024-4-12
	Pre-amplifier	Rohde & Schwarz	SCU-18D	19006451	2023-8-1	2024-7-31
	Loop antenna	Rohde & Schwarz	HFH2-Z2	100443	2023-6-15	2024-6-14
	Double Ridged Horn Antenna	ETS-Lindgren	3116C	S2208081-YQ-EMC	2023-7-7	2026-7-6
	3m Semi-anechoic chamber	TDK	9X6X6	----	2021-5-8	2024-5-7

Measurement Software Information			
Test Item	Software	Manufacturer	Version
C	MTS 8310	MWRFTtest	3.0.0.0
RE	EMC 32	Rohde & Schwarz	V10.50.40

C - Conducted RF tests

- Conducted peak output power
- 6dB bandwidth and 99% Occupied Bandwidth
- Power spectral density*
- Spurious RF conducted emissions
- Band edge



11 System Measurement Uncertainty

For a 95% confidence level, the measurement expanded uncertainties for defined systems, in accordance with the recommendations of ISO 17025 were:

Items	Extended Uncertainty
Radiated Disturbance	9kHz to 30MHz, 3.52dB 30MHz to 1GHz, 5.03dB (Horizontal) 5.12dB (Vertical) 1GHz to 18GHz, 5.49dB 18GHz to 40GHz, 5.63dB
RF Conducted Measurement	Power related: 1.16dB Frequency related: 6.00×10^{-8}

Measurement Uncertainty Decision Rule:

Determination of conformity with the specification limits is based on the decision rule according to IEC Guide 115: 2021, clause 4.4.3 and 4.5.1.



12 Photographs of Test Set-ups

Refer to the < Test Setup photos >.



13 Photographs of EUT

Refer to the < External Photos > & < Internal Photos >.

-----End of Test Report-----