



FCC- TEST REPORT

Report Number : **7088820032104-00** Date of Issue: November 30, 2020

Model : ZTU

Product Type : Zigbee Module

Applicant : Hangzhou Tuya Information Technology Co.,Ltd

Address : Room701,Building3,More Center,No.87 GuDun
Road,Hangzhou,Zhejiang China

Production Facility : Newtronics Hangzhou Co.,Ltd

Address : No.15,Jiu zhou Road,Jiang Gan Science&Technology
Economic Park Hangzhou

Test Result : **Positive** **Negative**

Total pages including Appendices : 35

TÜV SÜD Certification and Testing (China) Co., Ltd. Shanghai Branch is a subcontractor to TÜV SÜD Product Service GmbH according to the principles outlined in ISO 17025.

TÜV SÜD Certification and Testing (China) Co., Ltd. Shanghai Branch reports apply only to the specific samples tested under stated test conditions. Construction of the actual test samples has been documented. It is the manufacturer's responsibility to assure that additional production units of this model are manufactured with identical electrical and mechanical components. The manufacturer/importer is responsible to the Competent Authorities in Europe for any modifications made to the production units which result in non-compliance to the relevant regulations. TÜV SÜD Certification and Testing (China) Co., Ltd. Shanghai Branch shall have no liability for any deductions, inferences or generalizations drawn by the client or others from TÜV SÜD Certification and Testing (China) Co., Ltd. Shanghai Branch issued reports.

This report is the confidential property of the client. As a mutual protection to our clients, the public and ourselves, extracts from the test report shall not be reproduced except in full without our written approval.



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.....	5
5	Summary of Test Results	6
6	General Remarks.....	7
7	Test Setups.....	8
8	Systems test configuration	11
9	Technical Requirement	12
9.1	Conducted Emission	12
9.2	Conducted peak output power	15
9.3	6dB bandwidth	17
9.4	Power spectral density.....	19
9.5	Spurious RF conducted emissions.....	21
9.6	Band edge	25
9.7	Spurious radiated emissions for transmitter	27
10	Test Equipment List.....	32
11	System Measurement Uncertainty.....	33
12	Photographs of Test Set-ups	34
13	Photographs of EUT	35



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
No.16 Lane, 1951 Du Hui Road,
Shanghai 201108,
P.R. China

Test Firm Registration
Number: 820234
Telephone: +86 21 6141 0123
Fax: +86 21 6140 8600

3 Description of the Equipment under Test

Description of the Equipment Under Test

Product: Zigbee Module

Model no.: ZTU

FCC ID: 2ANDL-ZTU

Options and accessories: NA

Rating: DC 1.8V-3.6V

RF Transmission Frequency: 2405~2480MHz

No. of Operated Channel: 16

Modulation: 16-ary orthogonal modulation, O-QPSK PHY

Channel list:

Operation Frequency each of channel			
Channel	Frequency	Channel	Frequency
11	2405 MHz	19	2445 MHz
12	2410 MHz	20	2450 MHz
13	2415 MHz	21	2455 MHz
14	2420 MHz	22	2460 MHz
15	2425 MHz	23	2465 MHz
16	2430 MHz	24	2470 MHz
17	2435 MHz	25	2475 MHz
18	2440 MHz	26	2480 MHz

Antenna Type: On board PCB antenna

Antenna Gain: 1.08dBi

Description of the EUT: The Equipment Under Test (EUT) is a Zigbee Module. We tested it and listed the worst data in this report.

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



4 Summary of Test Standards

Test Standards	
FCC Part 15 Subpart C	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	12-14	Site 1	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
§15.247 (b) (1)	Conducted peak output power	15-16	Site 1	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
§15.247(a)(1)	20dB bandwidth	---	---	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
§15.247(a)(1)	Carrier frequency separation	---	---	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
§15.247(a)(1)(iii)	Number of hopping frequencies	---	---	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
§15.247(a)(1)(iii)	Dwell Time	---	---	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
§15.247(a)(2)	6dB bandwidth	17-18	Site 1	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
§15.247(e)	Power spectral density	19-20	Site 1	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
§15.247(d)	Spurious RF conducted emissions	21-24	Site 1	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
§15.247(d)	Band edge	25-26	Site 1	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
§15.247(d) & §15.209	Spurious radiated emissions for transmitter	27-31	Site 1	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
§15.203	Antenna requirement	See note 1		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Remark 1: N/A – Not Applicable.

Note 1: The EUT uses a patch antenna, which gain is 1.08dBi. In accordance to §15.203, It is considered sufficiently to comply with the provisions of this section.



6 General Remarks

Remarks

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

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: November 17, 2020

Testing Start Date: November 19, 2020

Testing End Date: November 24, 2020

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

Reviewed by:

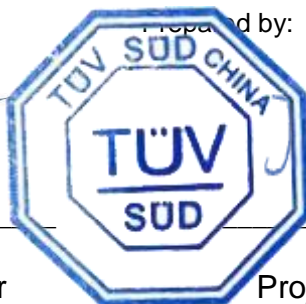
Hui TONG
Review Engineer

Prepared by:

Jiaxi XU
Project Engineer

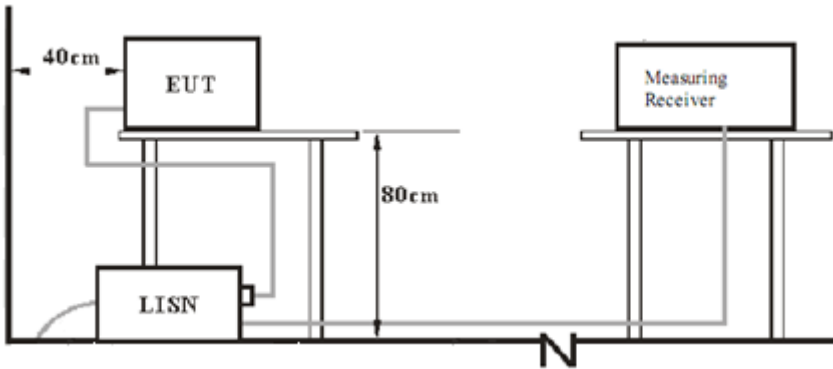
Tested by:

Wenqiang LU
Test Engineer



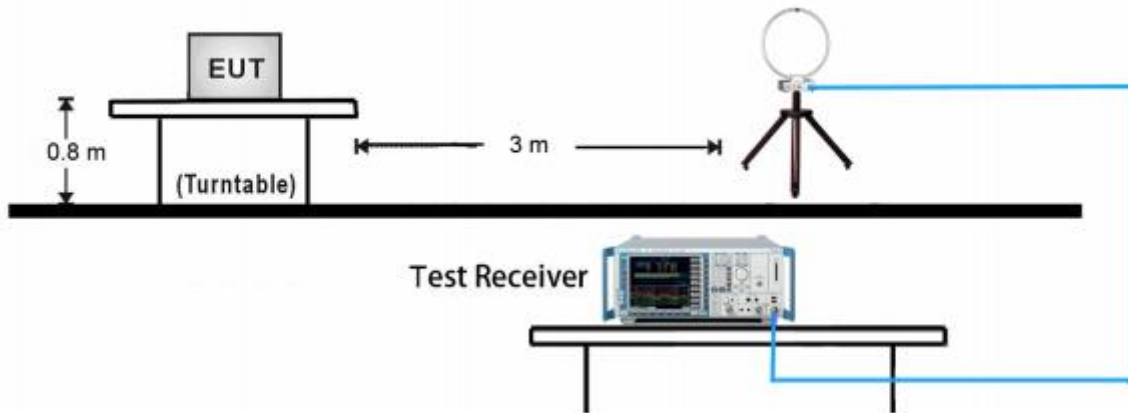
7 Test Setups

7.1 AC Power Line Conducted Emission test setups

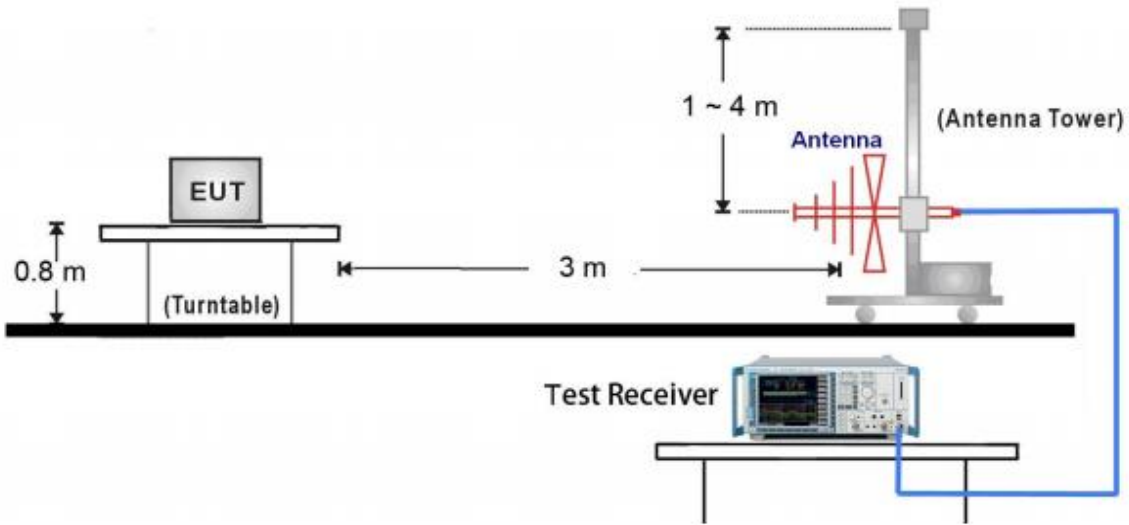


7.2 Radiated test setups

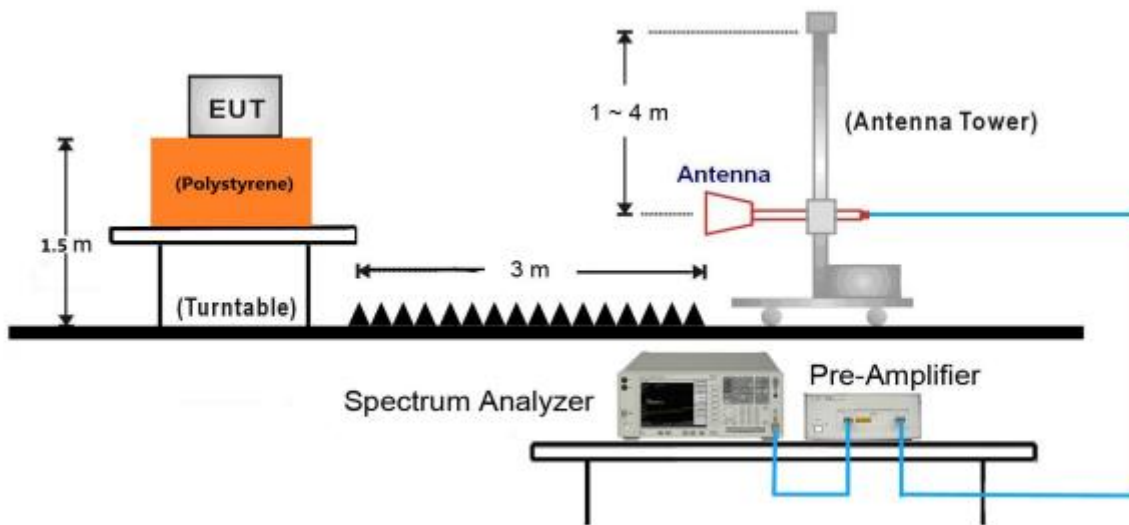
9kHz ~ 30MHz Test Setup:



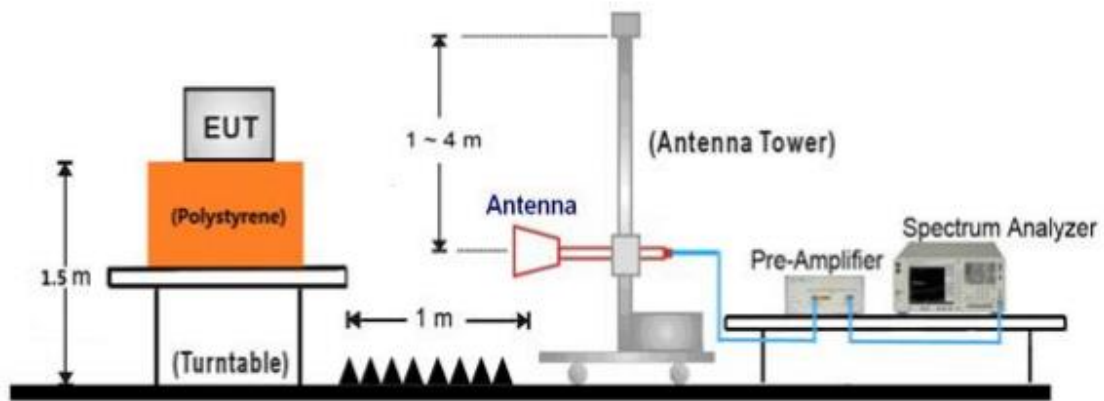
30MHz ~ 1GHz Test Setup:



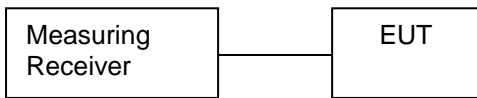
1GHz ~ 18GHz Test Setup:



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	Notebook

Test software: EMI Tool

The system was configured to channel 11, 18, and 26 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.

9 Technical Requirement

9.1 Conducted Emission

Test Method

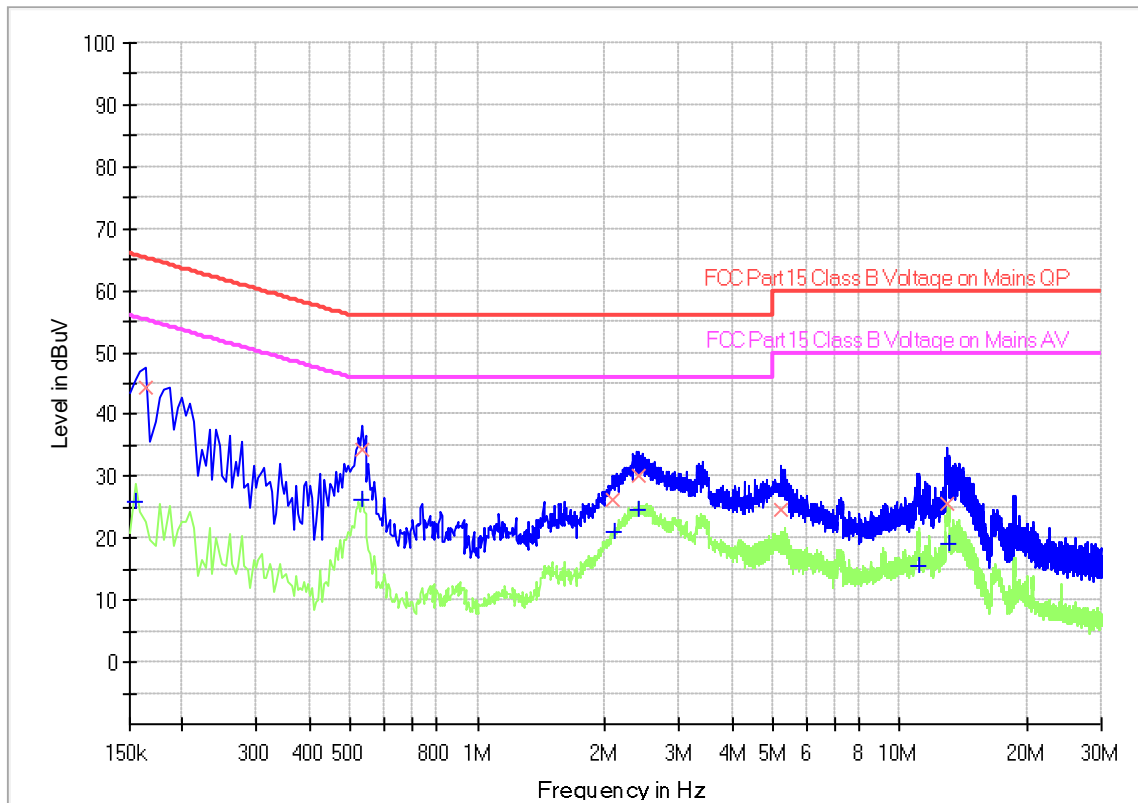
1. The EUT was placed on a table, which is 0.8m above ground plane
2. The power line of the EUT is connected to the AC mains through a Artificial Mains Network (A.M.N.).
3. Maximum procedure was performed to ensure EUT compliance
4. A EMI test receiver is used to test the emissions from both sides of AC line

Limit

Frequency MHz	QP Limit dB μ V	AV Limit dB μ V
0.150-0.500	66-56*	56-46*
0.500-5	56	46
5-30	60	50

Decreasing linearly with logarithm of the frequency

Product Type : Zigbee Module
 M/N : ZTU
 Operating Condition : Mode 1: Tx_2405MHz
 Test Specification : L-line
 Comment : AC 120V/60Hz (powered by notebook)

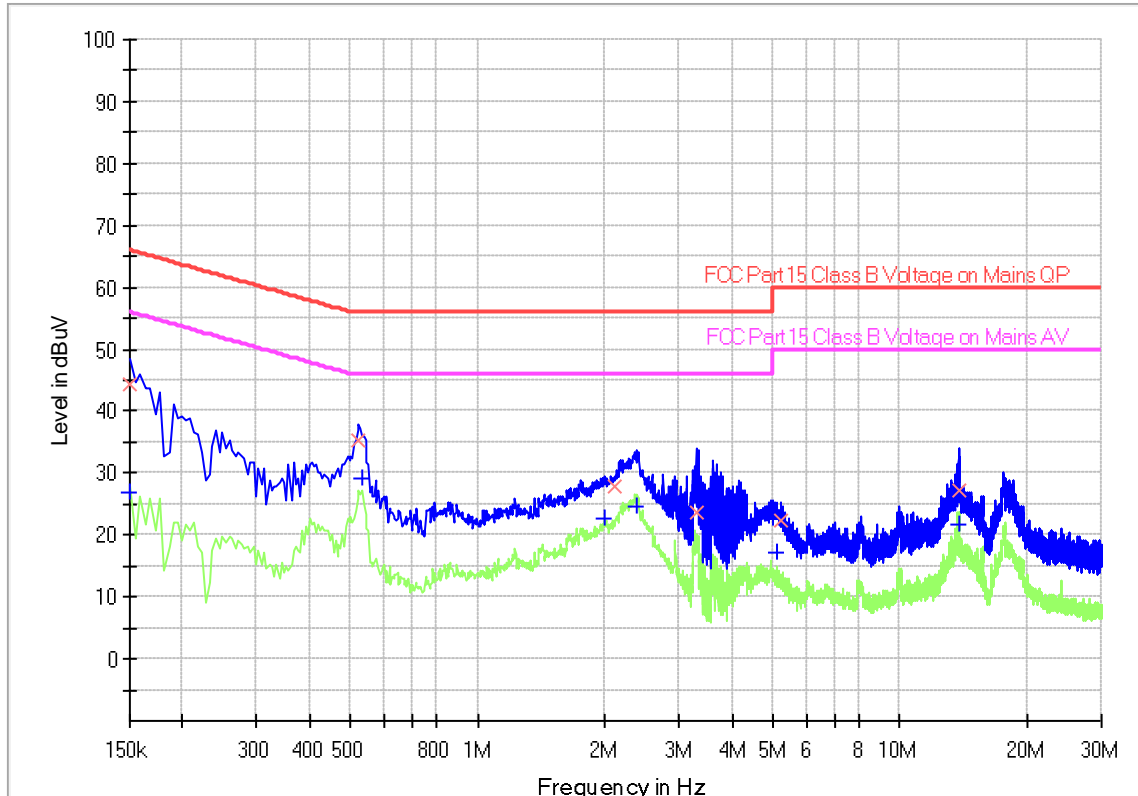


Final Result

Frequency (MHz)	QuasiPeak (dBuV)	CAverage (dBuV)	Limit (dBuV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	Corr. (dB)
0.154500	---	25.99	55.75	29.76	1000.0	9.000	L1	19.5
0.163500	44.48	---	65.28	20.80	1000.0	9.000	L1	19.5
0.532500	---	26.36	46.00	19.64	1000.0	9.000	L1	19.5
0.532500	34.41	---	56.00	21.59	1000.0	9.000	L1	19.5
2.085000	26.08	---	56.00	29.92	1000.0	9.000	L1	19.5
2.121000	---	21.22	46.00	24.78	1000.0	9.000	L1	19.5
2.395500	30.06	---	56.00	25.94	1000.0	9.000	L1	19.5
2.404500	---	24.63	46.00	21.37	1000.0	9.000	L1	19.5
5.244000	24.57	---	60.00	35.43	1000.0	9.000	L1	19.5
11.062500	---	15.53	50.00	34.47	1000.0	9.000	L1	19.7
12.925500	25.46	---	60.00	34.54	1000.0	9.000	L1	19.7
13.051500	---	19.05	50.00	30.95	1000.0	9.000	L1	19.7

Note 1: Measure Level (dBuV/m) = Reading Level (dBuV) + Factor (dB)
 Factor (dB) = Cable Loss (dB) + LISN Factor (dB) + 10dB Attenuator

Product Type : Zigbee Module
 M/N : ZTU
 Operating Condition : Mode 1: Tx_2405MHz
 Test Specification : N-line
 Comment : AC 120V/60Hz (powered by notebook)



Final Result

Frequency (MHz)	QuasiPeak (dBuV)	CAverage (dBuV)	Limit (dBuV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	Corr. (dB)
0.150000	---	26.81	56.00	29.19	1000.0	9.000	N	19.5
0.150000	44.21	---	66.00	21.79	1000.0	9.000	N	19.5
0.523500	35.15	---	56.00	20.85	1000.0	9.000	N	19.5
0.532500	---	28.99	46.00	17.01	1000.0	9.000	N	19.5
1.999500	---	22.58	46.00	23.42	1000.0	9.000	N	19.5
2.121000	27.92	---	56.00	28.08	1000.0	9.000	N	19.5
2.391000	---	24.54	46.00	21.46	1000.0	9.000	N	19.6
3.286500	23.67	---	56.00	32.33	1000.0	9.000	N	19.6
5.131500	---	17.09	50.00	32.91	1000.0	9.000	N	19.6
5.212500	22.33	---	60.00	37.67	1000.0	9.000	N	19.6
13.821000	---	21.78	50.00	28.22	1000.0	9.000	N	19.8
13.821000	27.22	---	60.00	32.78	1000.0	9.000	N	19.8

Note 1: Measure Level (dBuV/m) = Reading Level (dBuV) + Factor (dB)
 Factor (dB) = Cable Loss (dB) + LISN Factor (dB) + 10dB Attenuator

9.2 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. Allow the trace to stabilize. Use the marker-to-peak function to set the marker to the peak of the emission. The indicated level is the peak output power.

Limits

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

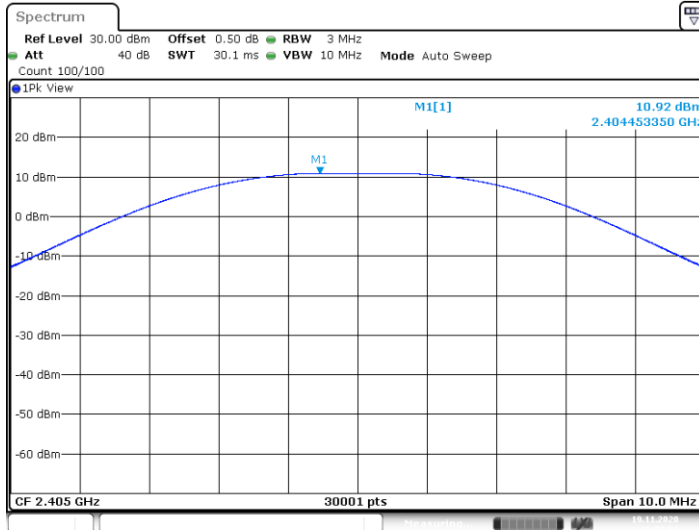
Test result as below table

Frequency MHz	Conducted Peak Output Power dBm	Result
Low channel 2405MHz	10.92	Pass
Middle channel 2440MHz	10.74	Pass
High channel 2480MHz	10.56	Pass

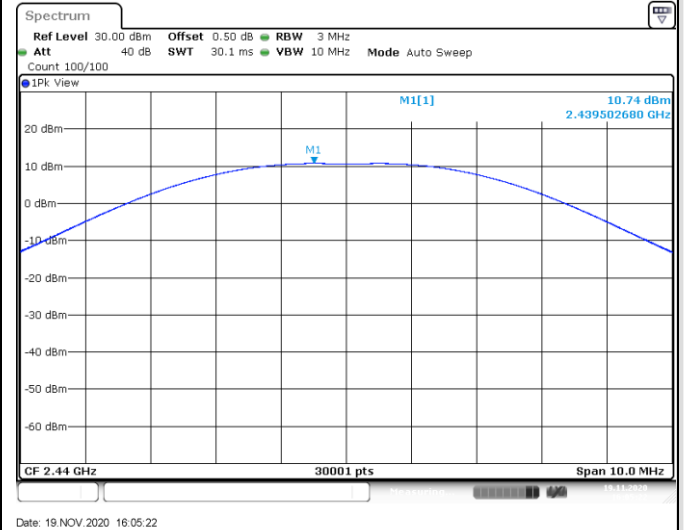


Peak output power

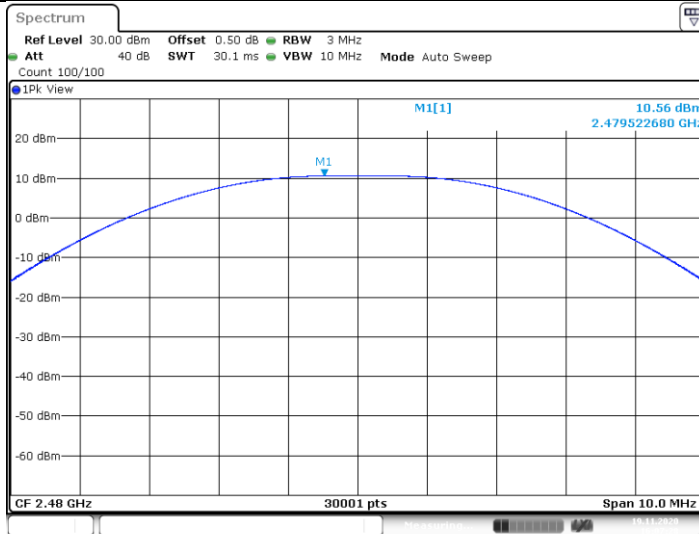
Channel 11 (2405MHz)



Channel 18 (2440MHz)



Channel 26 (2480MHz)



9.3 6dB bandwidth

Test Method

1. Use the following spectrum analyzer settings:
RBW=100K, VBW \geq 3RBW, Sweep = auto, Detector function = peak, Trace = max hold
2. Use the automatic bandwidth measurement capability of an instrument, may be employed using the X dB bandwidth mode with X set to 6 dB, care shall be taken so that the bandwidth measurement is not influenced by any intermediate power nulls in the fundamental emission that might be \geq 6 dB.
3. Allow the trace to stabilize, record the X dB Bandwidth value.

Limit

Limit [kHz]

≥ 500

Test result

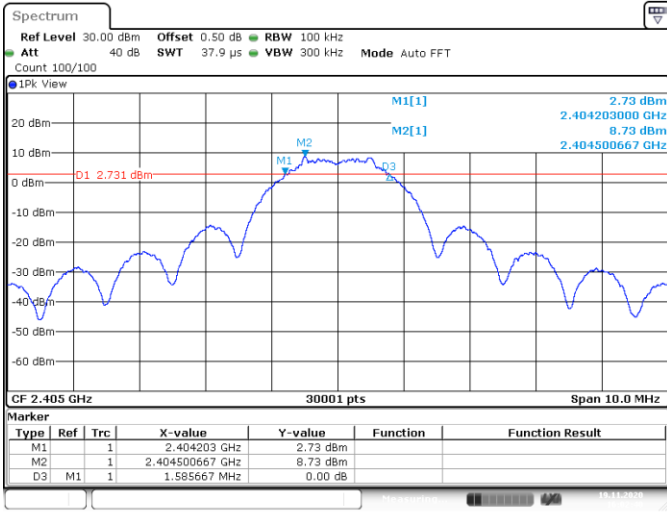
Frequency MHz	6dB bandwidth kHz	Result
Top channel 2405MHz	1586	Pass
Middle channel 2440MHz	1575	Pass
Bottom channel 2480MHz	1341	Pass



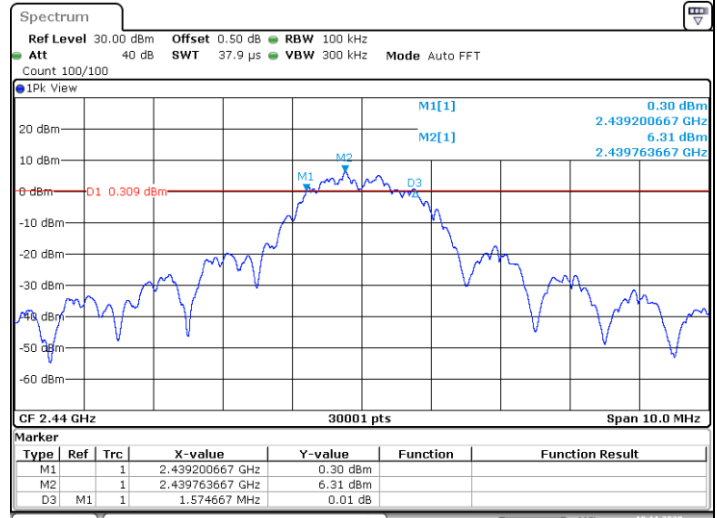
6dB Bandwidth

Channel 11 (2405MHz)

Channel 18 (2440MHz)

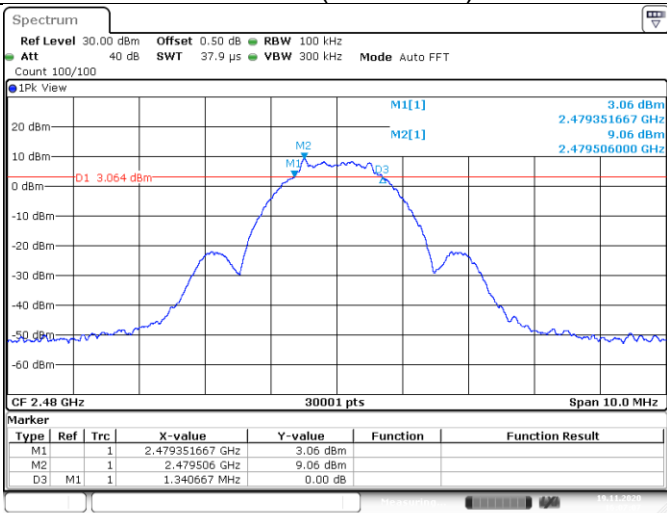


Date: 19 NOV 2020 16:02:40



Date: 19 NOV 2020 16:05:01

Channel 26 (2480MHz)



Date: 19 NOV 2020 16:07:07

9.4 Power spectral density

Test Method

This procedure shall be used if maximum peak conducted output power was used to demonstrate compliance:

1. Set analyzer center frequency to DTS channel center frequency.
RBW=3kHz,VBW \geq 3RBW,Span=1.5 times DTS bandwidth, Detector=Peak, Sweep=auto, Trace= max hold.
2. Allow trace to fully stabilize, use the peak marker function to determine the maximum amplitude level within the RBW.
3. Repeat above procedures until other frequencies measured were completed.

Limit

Limit [dBm/3KHz]

≤8

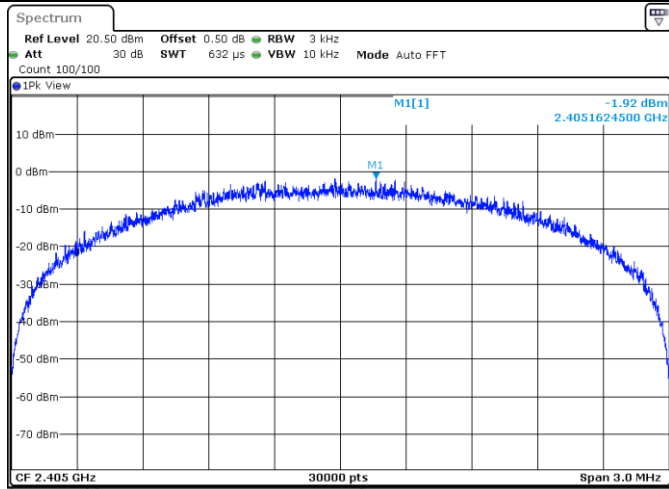
Test result

Frequency MHz	Power spectral density dBm/3KHz	Result
Top channel 2405MHz	-1.92	Pass
Middle channel 2440MHz	-2.42	Pass
Bottom channel 2480MHz	-1.69	Pass



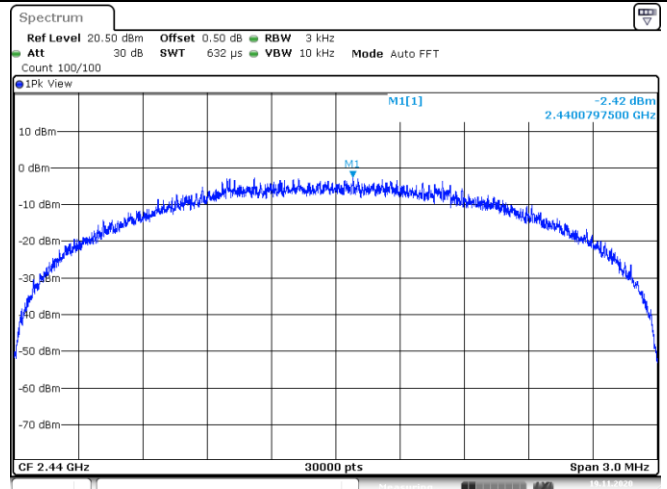
PK PSD

Channel 11 (2405MHz)



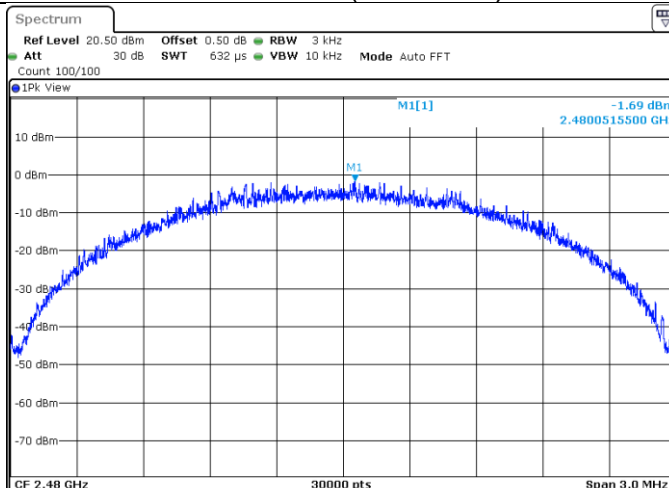
Date: 19 NOV 2020 16:03:08

Channel 18 (2440MHz)



Date: 19 NOV 2020 16:05:29

Channel 26 (2480MHz)



Date: 19 NOV 2020 16:07:35

9.5 Spurious RF conducted emissions

Test Method

1. Establish a reference level by using the following procedure:
 - a. Set RBW=100 kHz. VBW \geq 3RBW. Detector =peak, Sweep time = auto couple, Trace mode = max hold.
 - b. Allow trace to fully stabilize, use the peak marker function to determine the maximum PSD level.
2. Use the maximum PSD level to establish the reference level.
 - a. Set the center frequency and span to encompass frequency range to be measured.
 - b. Use the peak marker function to determine the maximum amplitude level. Ensure that the amplitude of all unwanted emissions outside of the authorized frequency band (excluding restricted frequency bands) are attenuated by at least the minimum requirements, report the three highest emissions relative to the limit.
3. Repeat above procedures until other frequencies measured were completed.

Limit

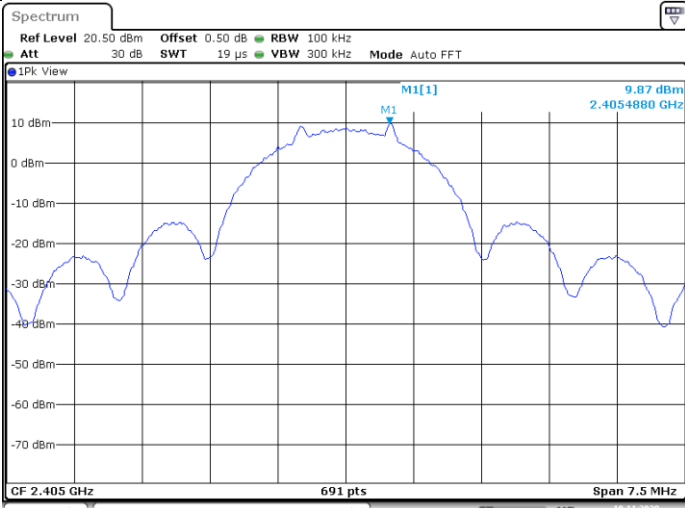
Frequency Range MHz	Limit (dBc)
30-25000	-20

Spurious RF conducted emissions

Out-of-Band Emissions

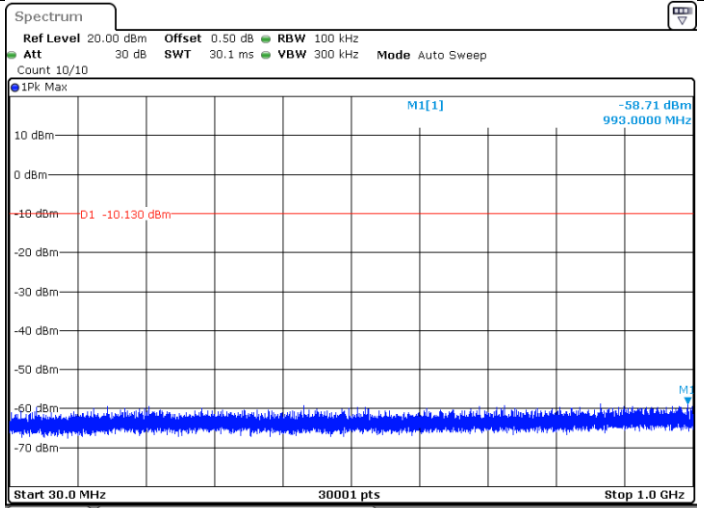
Channel 11 (2405MHz)

Reference point



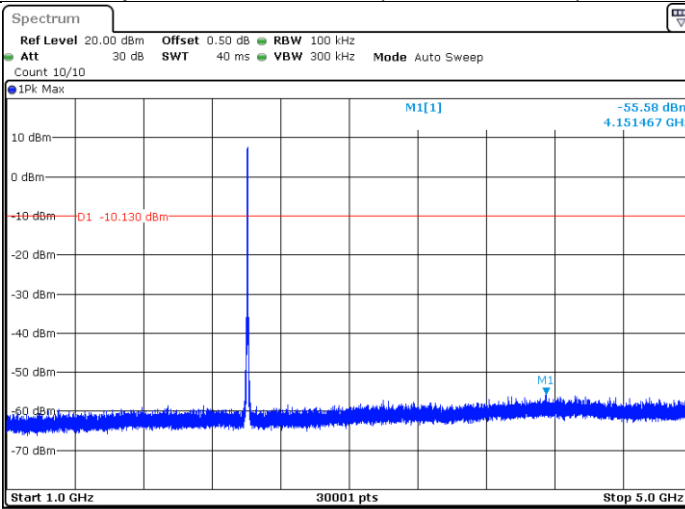
Date: 19.NOV.2020 16:03:25

Spurious Emission (30MHz – 1GHz)



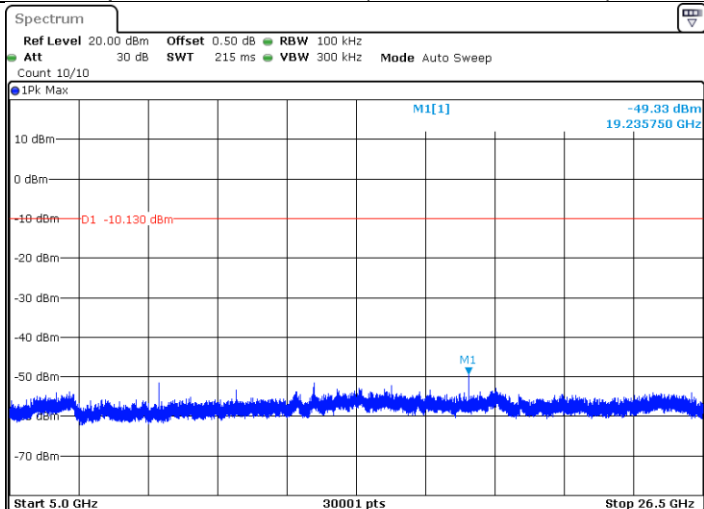
Date: 19.NOV.2020 16:03:30

Spurious Emission (1GHz –5GHz)



Date: 19.NOV.2020 16:03:43

Spurious Emission (5GHz –26.5GHz)



Date: 19.NOV.2020 16:04:16

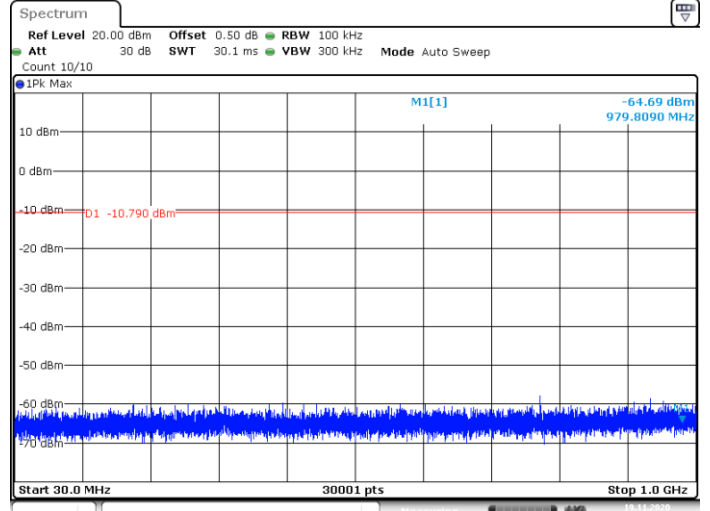
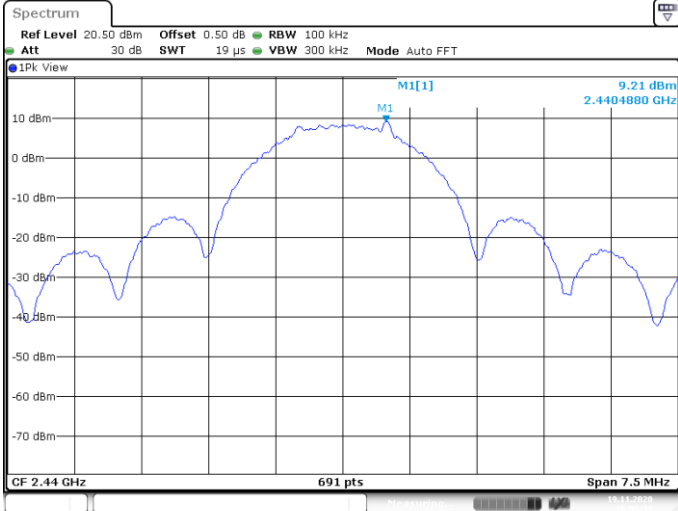
Remark: The emissions exceed the limit, it is fundamental signal.



Out-of-Band Emissions
Channel 18 (2440MHz)

Reference point

Spurious Emission (30MHz – 1GHz)

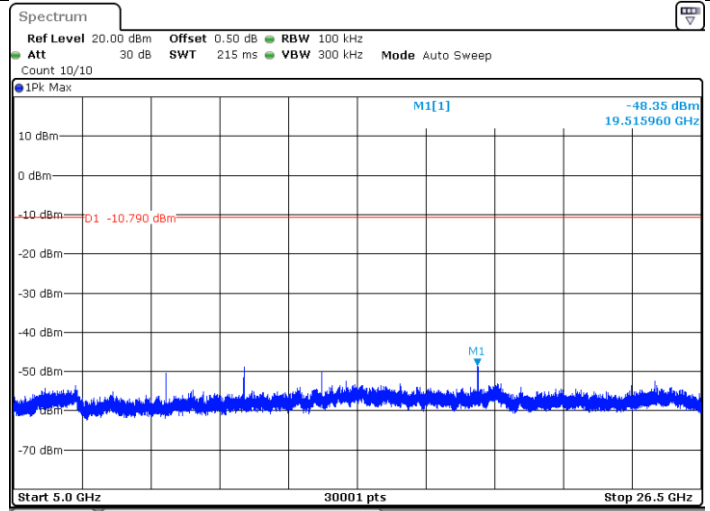
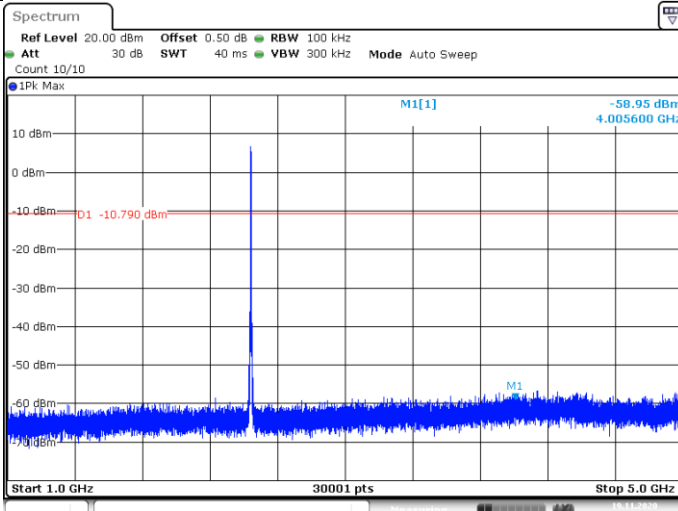


Date: 19.NOV.2020 16:05:35

Date: 19.NOV.2020 16:05:40

Spurious Emission (1GHz –5GHz)

Spurious Emission (5GHz –26.5GHz)



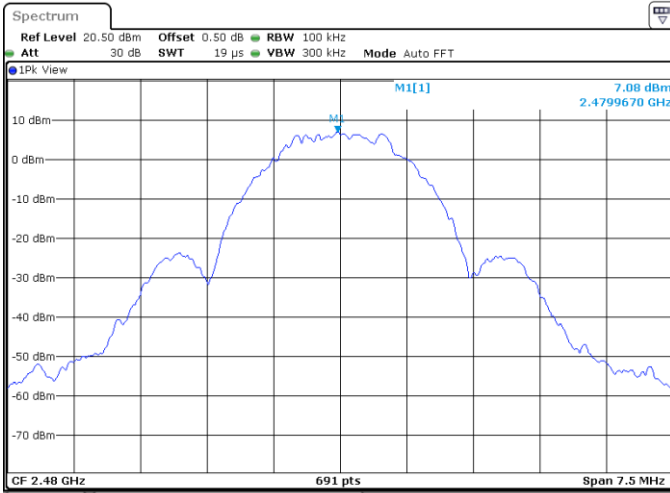
Date: 19.NOV.2020 16:05:53

Date: 19.NOV.2020 16:06:26

Remark: The emissions exceed the limit, it is fundamental signal.

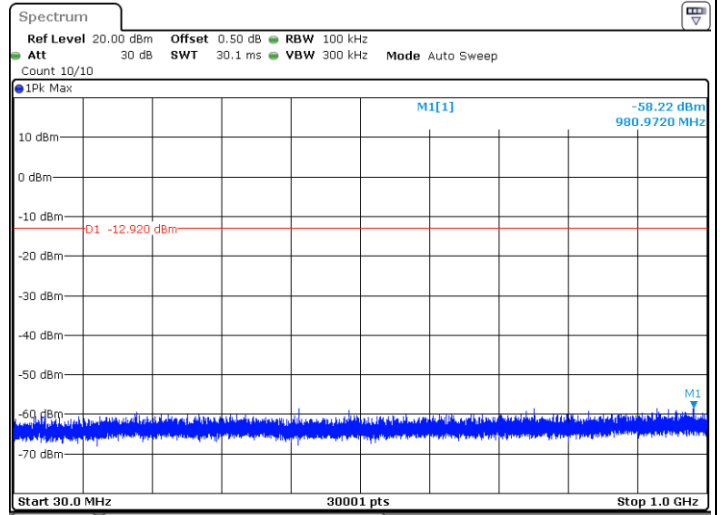
Out-of-Band Emissions Channel 26 (2480MHz)

Reference point



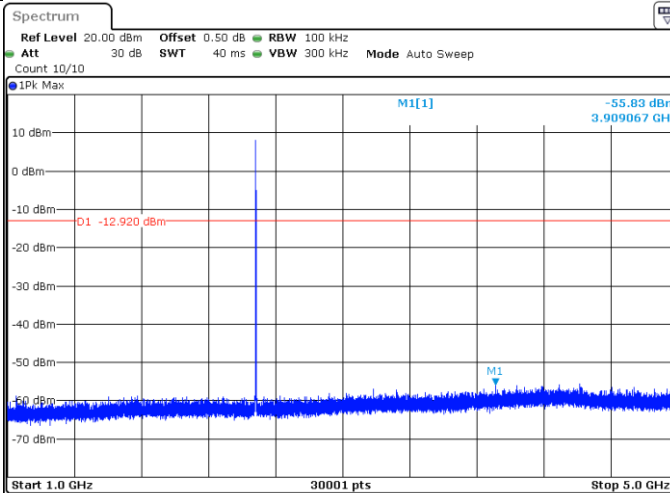
Date: 19.NOV.2020 16:07:51

Spurious Emission (30MHz – 1GHz)



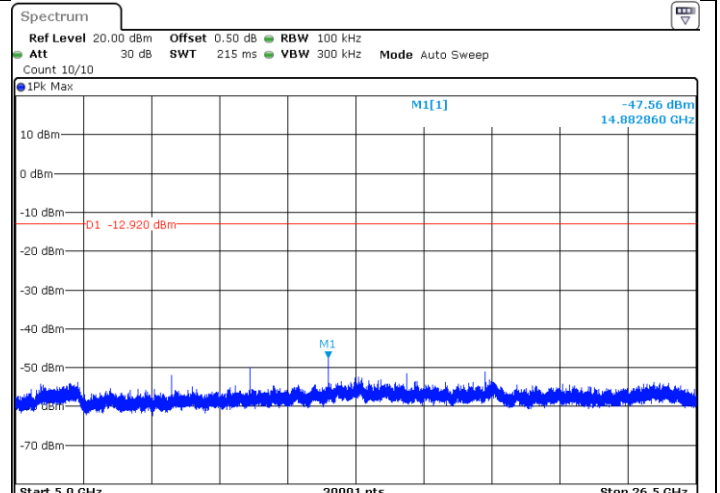
Date: 19.NOV.2020 16:07:57

Spurious Emission (1GHz –5GHz)



Date: 19.NOV.2020 16:08:10

Spurious Emission (5GHz –26.5GHz)



Date: 19.NOV.2020 16:08:42

Remark: The emissions exceed the limit, it is fundamental signal.



9.6 Band edge

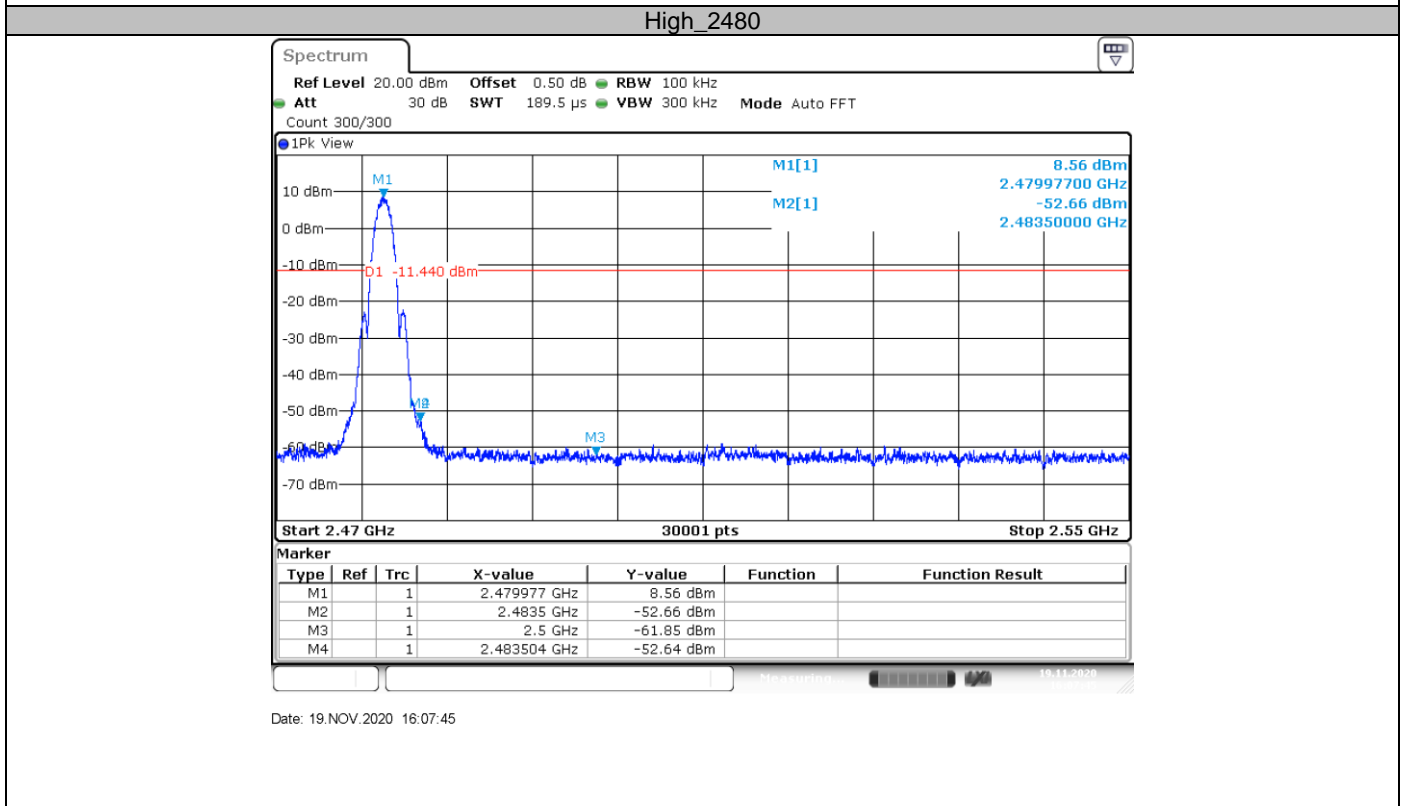
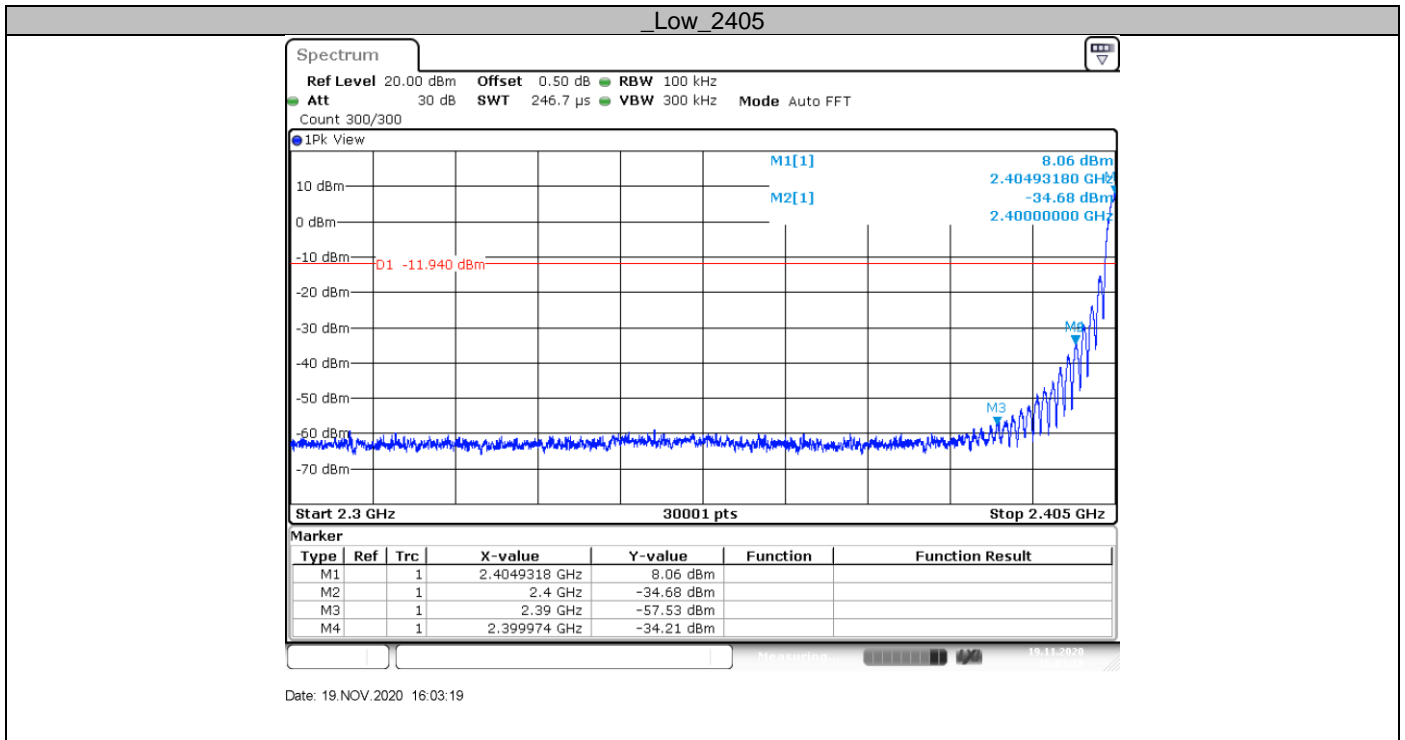
Test Method

- 1 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, VBW \geq RBW, Sweep = auto, Detector function = peak, Trace = max hold.
- 2 Allow the trace to stabilize, use the peak and delta measurement to record the result.
- 3 The level displayed must comply with the limit specified in this Section.

Limit

In any 100 kHz bandwidth outside the frequency bands in which the spread spectrum intentional radiator is operating, the radio frequency power that is produced by the intentional radiator 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, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. 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 Section 15.205(c)).

Test result



9.7 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 ≥ [3 × RBW].
- c) Detector = RMS (power averaging), if $[\text{span} / (\# \text{ of points in sweep})] \leq \text{RBW} / 2$. 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 dBµV/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.

Transmitting spurious emission test result as below:

Pre-scan with three orthogonal axis and worst case as X axis listed below table

Test mode: O-QPSK					
Channel 11 (2405MHz)					
Frequency (MHz)	Measure Level (dBuV/m)	Limit (dBuV/M)	Margin (dB)	Detector	Polarization
2374.0	45.28	74.0	28.72	Peak	Horizontal
2390.0	41.36	74.0	32.64	Peak	Horizontal
4810.0	49.87	74.0	24.13	Peak	Horizontal
7213.5	49.45	74.0	24.55	Peak	Horizontal
2331.7	45.11	74.0	28.89	Peak	Vertical
4809.0	45.09	74.0	28.91	Peak	Vertical
7216.3	49.65	74.0	24.35	Peak	Vertical
Test mode: O-QPSK					
Channel 18 (2440MHz)					
Frequency (MHz)	Measure Level (dBuV/m)	Limit (dBuV/M)	Margin (dB)	Detector	Polarization
4880.6	47.72	74.0	42.85	Peak	Horizontal
7320.4	50.34	74.0	40.34	Peak	Horizontal
4880.6	50.47	74.0	40.23	Peak	Vertical
7320.2	49.71	74.0	41.71	Peak	Vertical
Test mode: O-QPSK					
Channel 26 (2480MHz)					
Frequency (MHz)	Measure Level (dBuV/m)	Limit (dBuV/M)	Margin (dB)	Detector	Polarization
2483.5	46.38	74.0	27.62	Peak	Horizontal
4960.6	51.87	74.0	22.13	Peak	Horizontal
7442.8	50.93	74.0	23.07	Peak	Horizontal
2483.5	48.46	74.0	25.54	Peak	Vertical
4960.6	41.22	74.0	32.78	Peak	Vertical
7438.4	51.93	74.0	22.07	Peak	Vertical

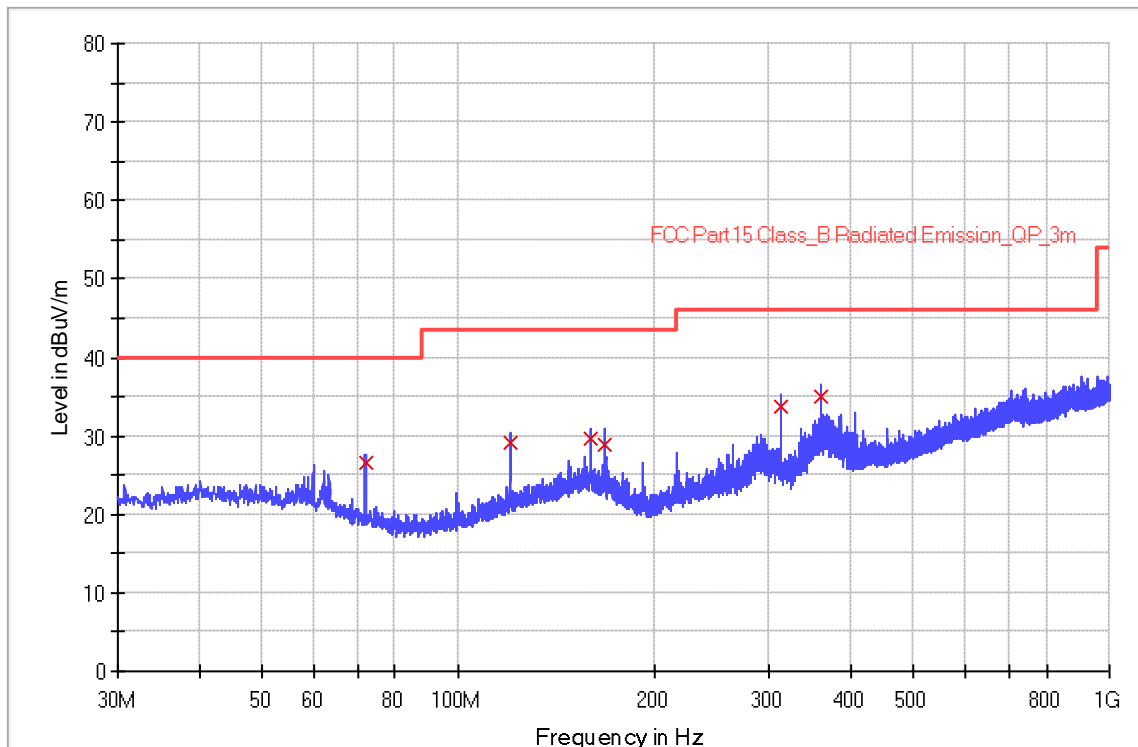
Remark:

- (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:

Site: 3 meter chamber	Time: 2020/11/24 - 10:34
Limit: FCC_Part15.209_RE(3m)_ClassB	Engineer: Jiaxi XU
Probe: VULB9168	Polarity: Horizontal
EUT: BT Module, Model no: ZTU	Power: 120VAC, 60Hz
Note: Transmit by at channel 2405MHz.	
Note: There is the worst case within frequency range 30MHz~1GHz.	

RE_VULB9168_pre_Cbnt_30-1000



Limit and Margin

Frequency (MHz)	QuasiPeak (dBuV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)	Margin - QPK (dB)	Limit - QPK (dBuV/m)
71.960000	26.6	1000.0	120.000	100.1	H	190.0	11.5	13.4	40.0
120.000000	29.0	1000.0	120.000	100.1	H	135.0	13.5	14.5	43.5
160.040000	29.6	1000.0	120.000	100.1	H	259.0	15.7	13.9	43.5
167.920000	29.0	1000.0	120.000	100.1	H	318.0	14.9	14.5	43.5
311.960000	33.8	1000.0	120.000	100.1	H	82.0	15.3	12.2	46.0
359.960000	35.0	1000.0	120.000	100.1	H	80.0	16.5	11.0	46.0

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

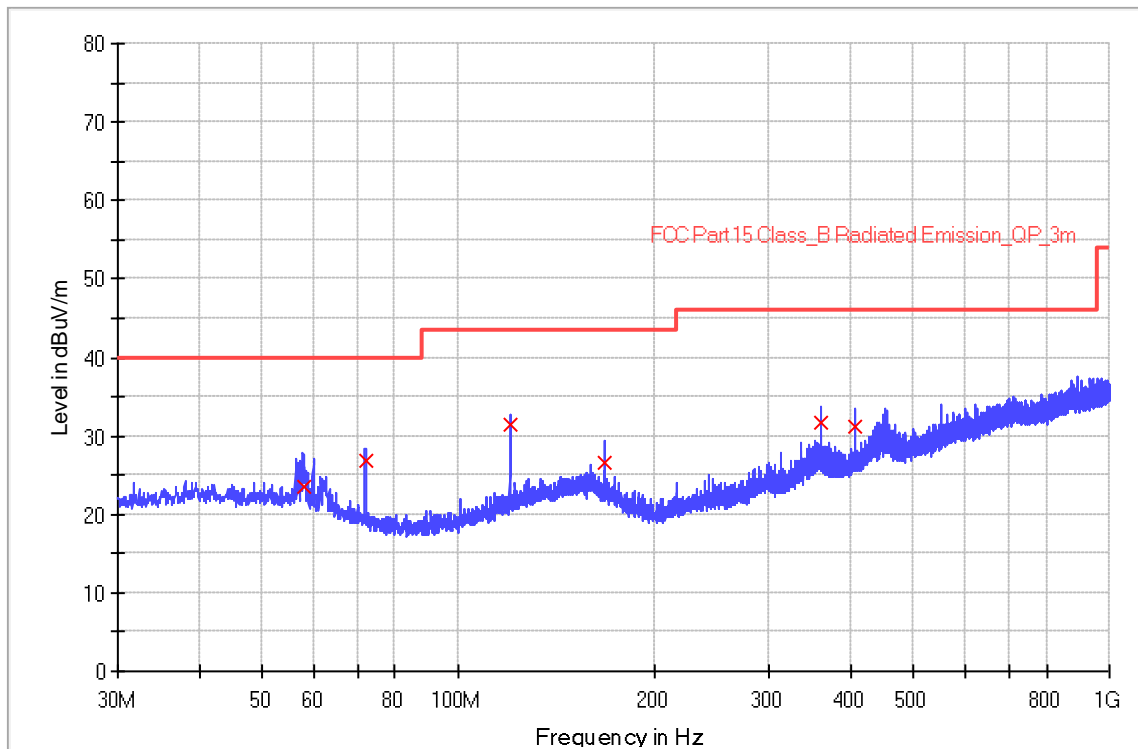
Factor (dB) = Cable Loss (dB) + Antenna Factor (dB/m)

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.

The worst case of Radiated Emission below 1GHz:

Site: 3 meter chamber	Time: 2020/11/24 - 12:31
Limit: FCC_Part15.209_RE(3m)_ClassB	Engineer: Jiaxi XU
Probe: VULB9168	Polarity: Vertical
EUT: BT Module, Model no: ZTU	Power: 120VAC, 60Hz
Note: Transmit by at channel 2405MHz.	
Note: There is the worst case within frequency range 30MHz~1GHz.	

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)	Margin - QPK (dB)	Limit - QPK (dBuV/m)
57.800000	23.6	1000.0	120.000	100.3	V	283.0	13.8	16.4	40.0
72.000000	26.9	1000.0	120.000	100.3	V	59.0	11.5	13.1	40.0
120.000000	31.5	1000.0	120.000	100.3	V	89.0	13.5	12.0	43.5
167.920000	26.7	1000.0	120.000	100.3	V	176.0	14.9	16.8	43.5
360.000000	31.6	1000.0	120.000	100.3	V	123.0	16.5	14.4	46.0
407.960000	31.1	1000.0	120.000	100.3	V	233.0	17.5	14.9	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	2020-8-4	2021-8-3
RE	EMI Test Receiver	Rohde & Schwarz	ESR3	101906	2020-8-4	2021-8-3
	Signal Analyzer	Rohde & Schwarz	FSV40	101091	2020-8-4	2021-8-3
	Trilog Super Broadband Test Antenna	Schwarzbeck	VULB 9168	961	2019-3-16	2022-3-15
	Horn Antenna	Rohde & Schwarz	HF907	102393	2018-6-11	2021-4-1
	Pre-amplifier	Rohde & Schwarz	SCU-18D	19006451	2020-8-4	2021-8-3
	Loop antenna	Rohde & Schwarz	HFH2-Z2	100443	2020-3-13	2023-3-14
	DOUBLE-RIDGED WAVEGUIDE HORN WITH PRE-AMPLIFIER (18 GHZ - 40 GHZ)	ETS-Lindgren	3116C-PA	002222727	2018-1-29	2021-1-28
	3m Semi-anechoic chamber	TDK	9X6X6	----	2018-5-11	2021-5-10
CE	EMI Test Receiver	Rohde & Schwarz	ESR3	101907	2020-8-4	2021-8-3
	LISN	Rohde & Schwarz	ENV216	101924	2020-8-4	2021-8-3

Measurement Software Information

Test Item	Software	Manufacturer	Version
C	Bluetooth and WiFi Test System	Shenzhen JS tonskend co.,ltd	2.6.77.0518
RE	EMC 32	Rohde & Schwarz	V9.15.00
CE	EMC 32	Rohde & Schwarz	V9.15.03

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
Conducted Disturbance at Mains Terminals	150kHz to 30MHz, LISN, ± 3.16 dB
Radiated Disturbance	30MHz to 1GHz, ± 5.03 dB (Horizontal) ± 5.12 dB (Vertical) 1GHz to 18GHz, ± 5.49 dB 18GHz to 40GHz, ± 5.63 dB
Carrier power conducted measurement	50MHz~18GHz, ± 1.238 dB
Spurious Emission Conducted Measurement	9kHz ~40GHz, ± 1.224 dB



12 Photographs of Test Set-ups

Refer to the < Test Setup photos >.



13 Photographs of EUT

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

THE END