FCC/ISED - TEST REPORT

Report Number	:	709502408755-00C	Date of Issue:	November 18, 2024

Model	:	CM-08-E
Product Type	:	HONEYCOMB MOTOR
Applicant	:	Coulisse B.V.
Address	:	Vonderweg 48, 7468 DC Enter, THE NETHERLANDS
Production Facility	:	Ningbo Dooya Mechanical & Electronic Technology Co., Ltd.
Address	:	No.168 Shengguang Road, Luotuo, Zhenhai 315202 Ningbo, Zhejiang province, People's republic of China

Test Result	:	■ **Positive**	☐ **Negative**
Total pages including Appendices	:	46	

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.

1 Table of Contents

TÜV SÜD Certification and Testing (China) Co., Ltd. Shanghai Branch
3-13, No.151, Heng Tong Road, Shanghai, 200070, P.R. China
Phone: +86 21 61410123, Fax:+86 21 61408600

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
Telephone:	+86 21 6141 0123
Fax:	+86 21 6140 8600
FCC Registration No.:	820234
FCC Designation Number:	CN1183
ISED CAB identifier	CN0101
IC Registration No.:	31668

TÜV SÜD Certification and Testing (China) Co., Ltd. Shanghai Branch
3-13, No.151, Heng Tong Road, Shanghai, 200070, P.R. China
Phone: +86 21 61410123, Fax:+86 21 61408600

3 Description of the Equipment under Test

Description of the Equipment Under Test

Product:	HONEYCOMB MOTOR
Model no.:	CM-08-E
Hardware Version Identification No. (HVIN)	CM-08-EV2
Product Marketing Name (PMN)	CM-08-E
FCC ID:	ZY4CM08E1
IC:	28177-CM08E1
Options and accessories:	NA
Rating:	USB input: DC5V, 7W (12V for battery)
RF Transmission Frequency:	SRD transceiver: 433.92MHz; 2.4GHz BLE: 2402~2480 MHz 2.4GHz Thread: 2405~2480MHz
No. of Operated Channel:	SRD transceiver: 1; 2.4GHz BLE: 40 2.4GHz Thread: 16
Modulation:	SRD transceiver: FSK; 2.4GHz BLE: GFSK 2.4GHz Thread: OQPSK
Channel list:	SRD transceiver: 433.92MHz; 2.4GHz BLE:

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

TÜV SÜD Certification and Testing (China) Co., Ltd. Shanghai Branch
3-13, No.151, Heng Tong Road, Shanghai, 200070, P.R. China
Phone: +86 21 61410123, Fax:+86 21 61408600

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

2.4GHz Thread:

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

Antenna Type: SRD transceiver: Line Antenna;
2.4GHz BLE: Line Antenna
2.4GHz Thread: Line Antenna

Antenna Gain: SRD transceiver: -4dBi;
2.4GHz BLE: 2.2dBi
2.4GHz Thread: 2.2dBi

Description of the EUT: The Equipment Under Test (EUT) is a HONEYCOMB MOTOR with BLE function and Thread function and SRD function (transceiver). We tested it and listed the worst data in this report.

Test sample no.: SHA-831821-9 (Conducted sample),
SHA-831821-10 (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, antenna gain 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
RSS-Gen Issue 5 April 2018 + Amendment 1 March 2019 + Amendment 2 February 2021	General Requirements for Compliance of Radio Apparatus
RSS-247 Issue 3 August 2023	Digital Transmission Systems (DTSS), Frequency Hopping Systems (FHSS) and License-Exempt Local Area Network (LE-LAN) Devices

All the test methods were according to KDB 558074 D01 15.247 Measurement Guidance v05r02 and ANSI C63.10-2013.

TÜV SÜD Certification and Testing (China) Co., Ltd. Shanghai Branch
3-13, No.151, Heng Tong Road, Shanghai, 200070, P.R. China
Phone: +86 21 61410123, Fax:+86 21 61408600

5 Summary of Test Results

Technical Requirements							
FCC Part 15 Subpart C & RSS-247 Issue 3/RSS-Gen Issue 5							
Test Condition			Pages	Test Site	Test Result		
					Pass	Fail	N/A
§15.207	RSS-GEN 8.8	Conducted emission AC power port	13-15	Site 1	☒	☐	☐
§15.247 (b) (3)	RSS-247 5.4(d)	Conducted peak output power	16-17	Site 1	☒	☐	☐
	RSS-247 5.4(d)	Equivalent Isotropic Radiated Power	16-17	Site 1	☒	☐	☐
§15.247(a)(1)	RSS-247 5.1(a) & RSS-Gen 6.7	20dB bandwidth and 99% Occupied Bandwidth	---	---	☐	☐	☒
§15.247(a)(1)	RSS-247 5.1(b)	Carrier frequency separation	---	---	☐	☐	☒
§15.247(a)(1)(iii)	RSS-247 5.1(d)	Number of hopping frequencies	---	---	☐	☐	☒
§15.247(a)(1)(iii)	RSS-247 5.1(d)	Dwell Time - Average Time of Occupancy	---	---	☐	☐	☒
§15.247(a)(2)	RSS-247 5.2(a) & RSS-GEN 6.7	6dB bandwidth and 99% Occupied Bandwidth	18-20	---	☒	☐	☐
§15.247(e)	RSS-247 5.2(b)	Power spectral density	21-22	---	☒	☐	☐
§15.247(d)	RSS-247 5.5	Spurious RF conducted emissions	23-26	---	☒	☐	☐
§15.247(d)	RSS-247 5.5	Band edge	27-29	---	☒	☐	☐
§15.247(d) & §15.209 & §15.205	RSS-247 5.5 & RSS-Gen 6.13	Spurious radiated emissions for transmitter	30-42	Site 1	☒	☐	☐
§15.203	RSS-Gen 6.8	Antenna requirement	See note 1		☒	☐	☐

Remark 1: N/A – Not Applicable.
Note 1: The EUT uses a Line Antenna, which gain is -4dBi for SRD transceiver and 2.2dBi for 2.4GHz BLE and Thread. 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: ZY4CM08E1, IC: 28177-CM08E1, complies with Section 15.207, 15.209, 15.247 of the FCC Part 15, Subpart C Rules and RSS-247, RSS-GEN.

This report is only for the 2.4GHz Thread test report, for the 2.4GHz BLE test report please refer to 709502408755-00B, for the 433.92MHz test report please refer to 709502408755-00A.

SUMMARY:

All tests according to the regulations cited on page 7 were

■ - Performed

☐ - **Not** Performed

The Equipment under Test

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

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

Sample Received Date:	July 15, 2024
Testing Start Date:	August 8, 2024
Testing End Date:	September 29, 2024

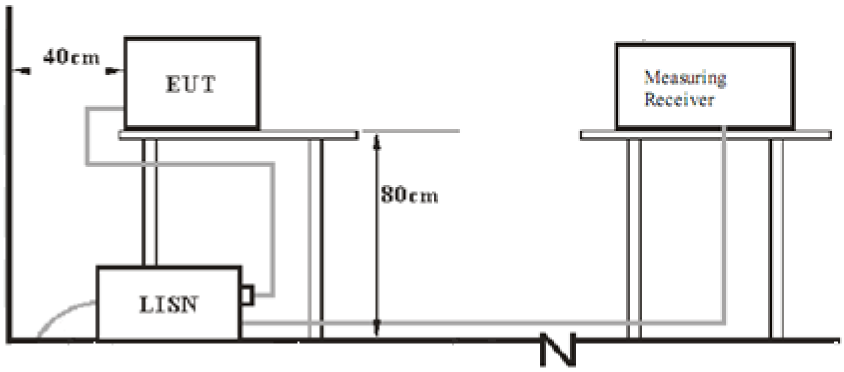
-TÜV SÜD Certification and Testing (China) Co., Ltd. Shanghai Branch

Reviewed by:	Prepared by:	Tested by:
Hui Tong	Wenqiang LU	Guochengjie
Hui TONG EMC Section Manager	Wenqiang LU EMC Project Engineer	Chengjie GUO EMC Test Engineer

TÜV SÜD Certification and Testing (China) Co., Ltd. Shanghai Branch
3-13, No.151, Heng Tong Road, Shanghai, 200070, P.R. China
Phone: +86 21 61410123, Fax:+86 21 61408600

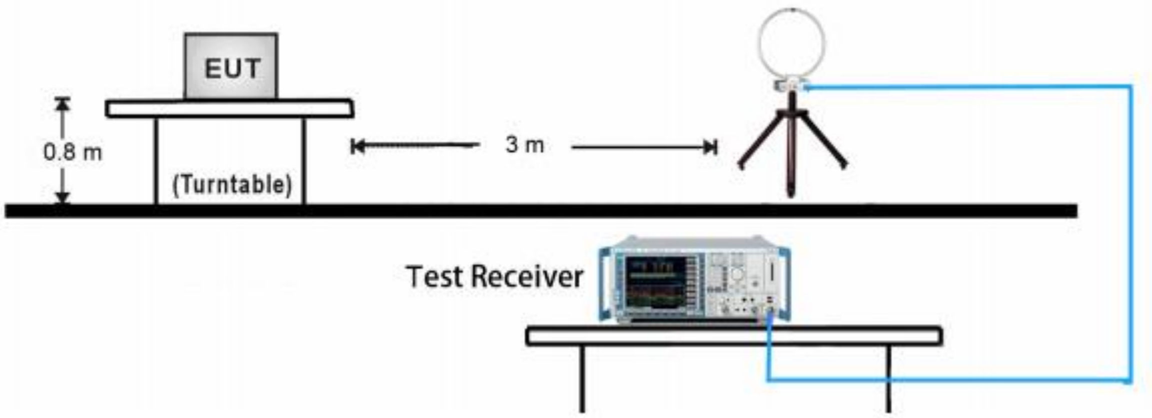
7 Test Setups

7.1 AC Power Line Conducted Emission test setups



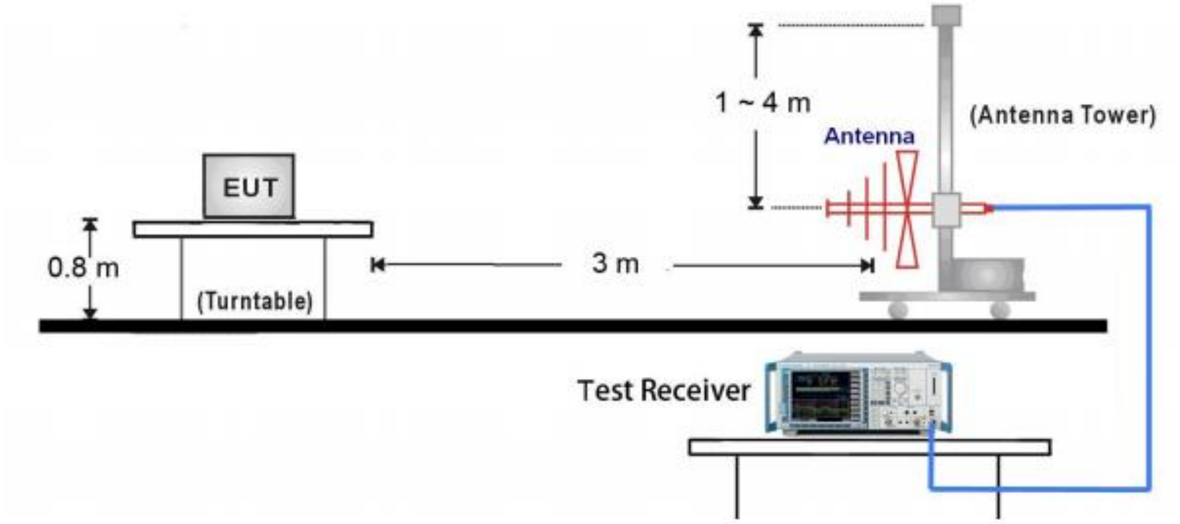
7.2 Radiated test setups

9kHz ~ 30MHz Test Setup:

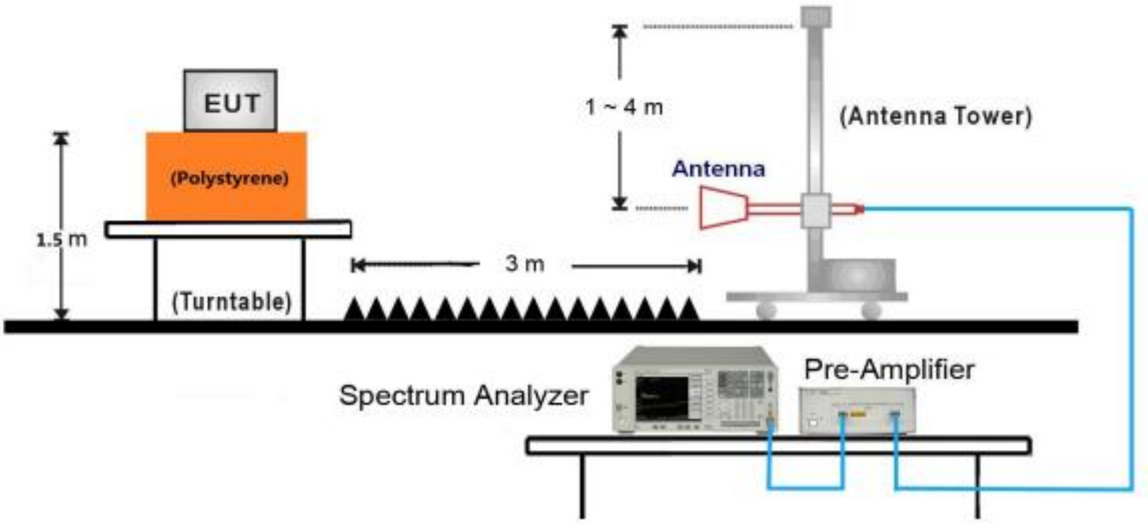


TÜV SÜD Certification and Testing (China) Co., Ltd. Shanghai Branch
3-13, No.151, Heng Tong Road, Shanghai, 200070, P.R. China
Phone: +86 21 61410123, Fax:+86 21 61408600

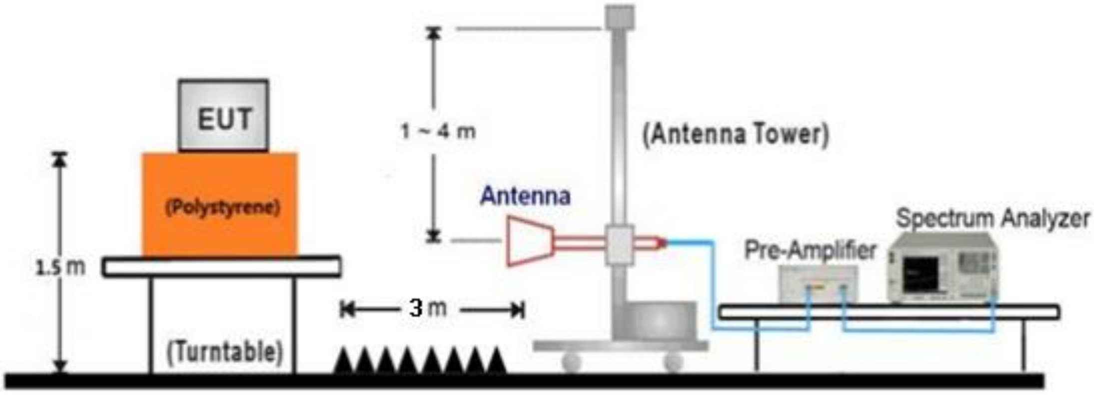
30MHz ~ 1GHz Test Setup:



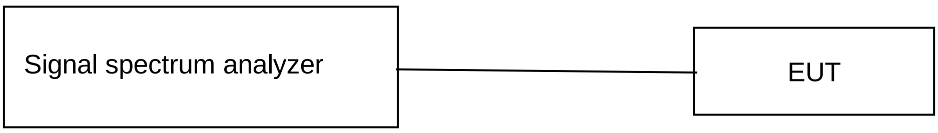
1GHz ~ 18GHz Test Setup:



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	X240	Notebook

Test software: PUTTY.exe

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.

Test Mode Applicability and Tested Channel Detail:

Mode	Tested Channel	Modulation	Index Value (Power level setting)
Thread	11	OQPSK	8
	18	OQPSK	8
	26	OQPSK	8

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. An EMI test receiver is used to test the emissions from both sides of AC line

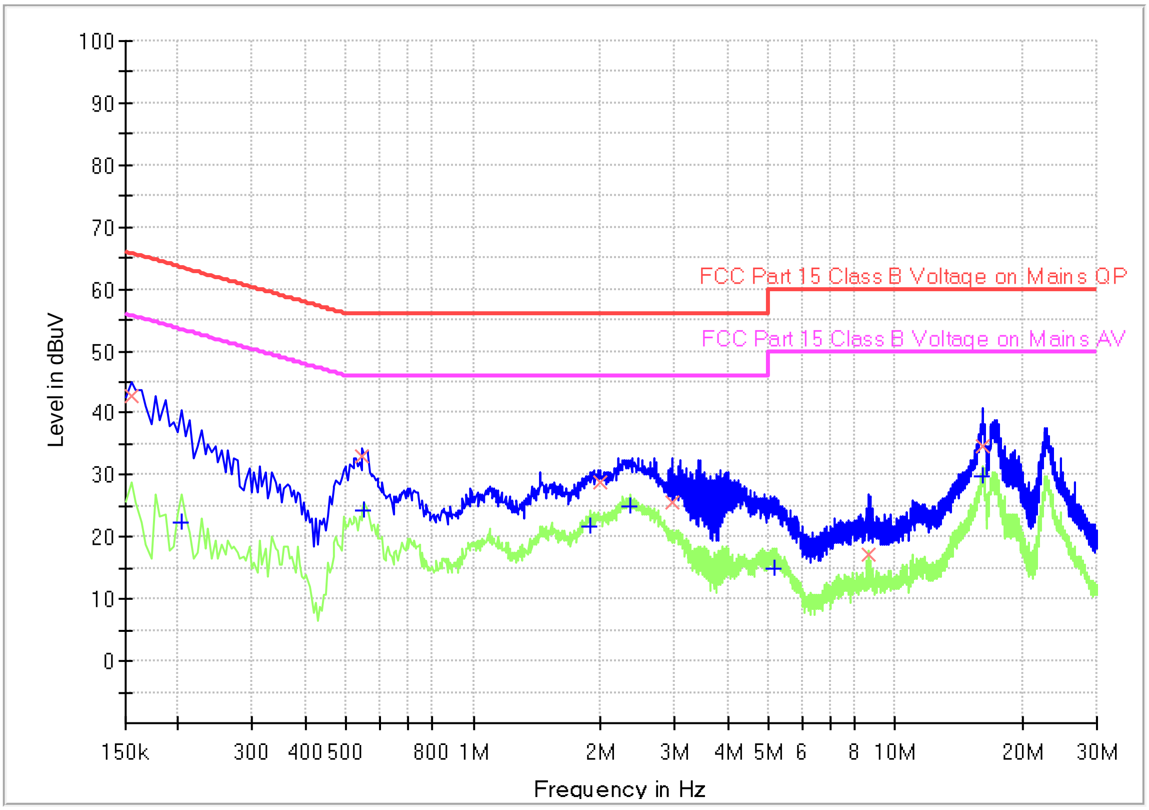
Limit

According to §15.207 & RSS-GEN 8.8, conducted emissions limit as below:

Frequency MHz	QP Limit dBμV	AV Limit dBμV
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	:	HONEYCOMB MOTOR
M/N	:	CM-08-E
Operating Condition	:	Mode 1: Tx_2405MHz (worst case)
Test Specification	:	L-line
Comment	:	5VDC (powered by notebook whose input is 120V~, 60Hz)



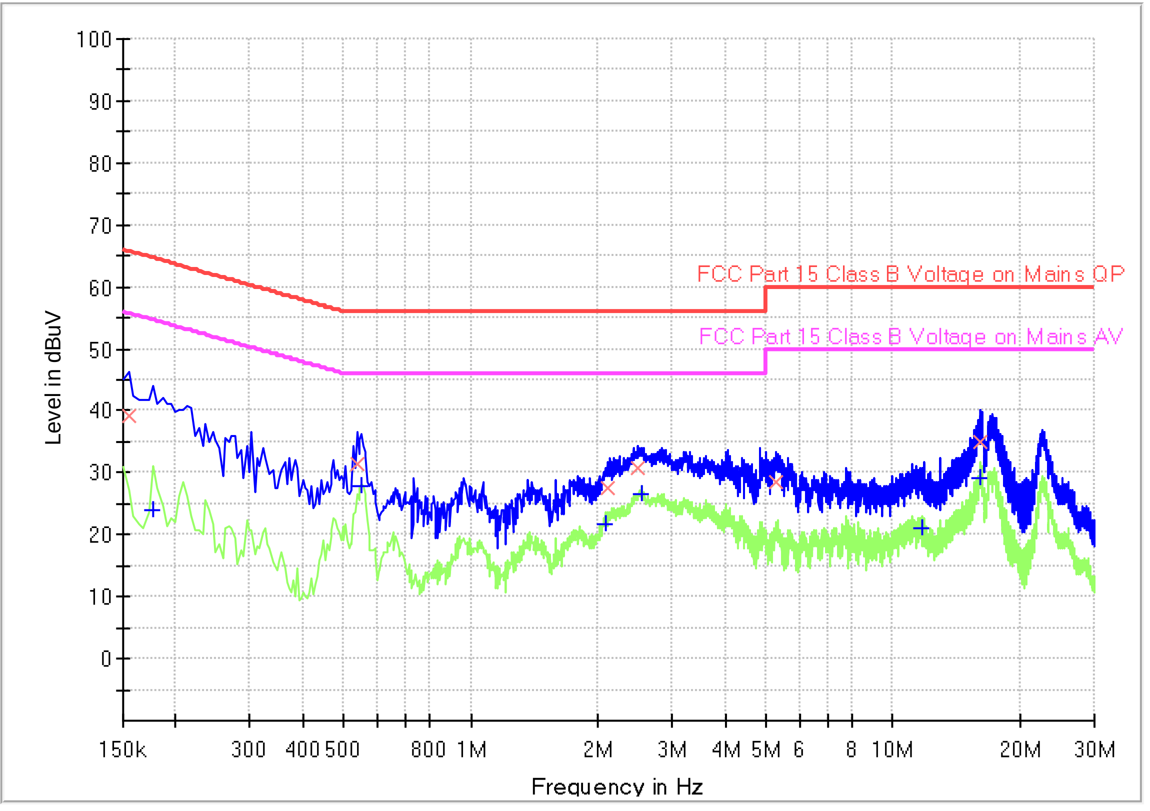
Final_Result

Frequency (MHz)	Quasi Peak (dBuV)	CAverage (dBuV)	Limit (dBuV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	Corr. (dB)
0.154500	42.65	---	65.75	23.10	1000.0	9.000	L1	19.4
0.204000	---	22.42	53.45	31.03	1000.0	9.000	L1	19.4
0.546000	33.09	---	56.00	22.91	1000.0	9.000	L1	19.4
0.550500	---	24.31	46.00	21.69	1000.0	9.000	L1	19.4
1.896000	---	21.84	46.00	24.16	1000.0	9.000	L1	19.5
1.999500	28.67	---	56.00	27.33	1000.0	9.000	L1	19.5
2.364000	---	25.09	46.00	20.91	1000.0	9.000	L1	19.5
2.962500	25.66	---	56.00	30.34	1000.0	9.000	L1	19.5
5.181000	---	15.03	50.00	34.97	1000.0	9.000	L1	19.6
8.632500	17.13	---	60.00	42.87	1000.0	9.000	L1	19.7
16.012500	---	29.73	50.00	20.27	1000.0	9.000	L1	20.1
16.012500	34.66	---	60.00	25.34	1000.0	9.000	L1	20.1

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

TÜV SÜD Certification and Testing (China) Co., Ltd. Shanghai Branch
3-13, No.151, Heng Tong Road, Shanghai, 200070, P.R. China
Phone: +86 21 61410123, Fax:+86 21 61408600

Product Type	:	HONEYCOMB MOTOR
M/N	:	CM-08-E
Operating Condition	:	Mode 1: Tx_2405MHz (worst case)
Test Specification	:	N-line
Comment	:	5VDC (powered by notebook whose input is 120V~, 60Hz)



Final_Result

Frequency (MHz)	Quasi Peak (dBuV)	CAverage (dBuV)	Limit (dBuV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	Corr. (dB)
0.154500	39.25	---	65.75	26.50	1000.0	9.000	N	19.4
0.177000	---	23.86	54.63	30.77	1000.0	9.000	N	19.4
0.537000	31.38	---	56.00	24.62	1000.0	9.000	N	19.5
0.550500	---	27.84	46.00	18.16	1000.0	9.000	N	19.5
2.076000	---	21.86	46.00	24.14	1000.0	9.000	N	19.5
2.112000	27.55	---	56.00	28.45	1000.0	9.000	N	19.5
2.494500	30.86	---	56.00	25.14	1000.0	9.000	N	19.5
2.539500	---	26.41	46.00	19.59	1000.0	9.000	N	19.5
5.284500	28.47	---	60.00	31.53	1000.0	9.000	N	19.6
11.692500	---	20.97	50.00	29.03	1000.0	9.000	N	19.8
16.120500	---	29.13	50.00	20.87	1000.0	9.000	N	20.0
16.152000	35.06	---	60.00	24.94	1000.0	9.000	N	20.0

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 and E.I.R.P

Test Method

1. Use the following spectrum analyzer settings:
   RBW > the 6 dB bandwidth of the emission being measured, VBW≥3RBW, Span≥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

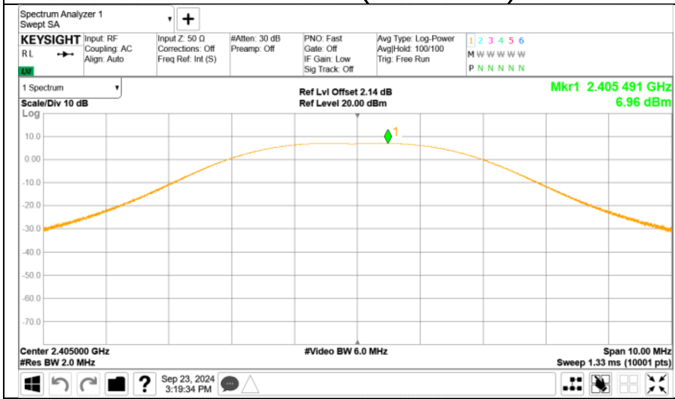
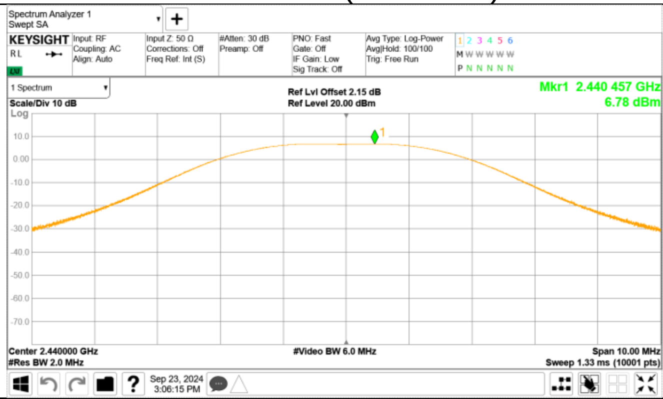
According to §15.247 (b) (3) & RSS-247 5.4(d), conducted peak output power limit as below:

	Frequency Range	Limit	Limit
	MHz	W	dBm
Conducted peak output power	2400-2483.5	≤1	≤30
e.i.r.p.	2400-2483.5	≤4	≤36

Test result as below table

Frequency **MHz**	Conducted Peak Output Power **dBm**	E.I.R.P **dBm**	Result
Low channel 2405MHz	**6.96**	**9.16**	Pass
Middle channel 2440MHz	6.78	8.98	Pass
High channel 2480MHz	6.41	8.61	Pass

TÜV SÜD Certification and Testing (China) Co., Ltd. Shanghai Branch
3-13, No.151, Heng Tong Road, Shanghai, 200070, P.R. China
Phone: +86 21 61410123, Fax:+86 21 61408600

Peak output power (1Mbps)	
Channel 11 (2405MHz)	Channel 18 (2440MHz)
	
Channel 26 (2480MHz)	
	

9.3 6dB bandwidth and 99% Occupied Bandwidth

Test Method for 6 dB Bandwidth

1. The RF output of EUT was connected to the spectrum analyzer. The path loss was compensated to the results for each measurement.
2. Set to the maximum power setting, the instrument center frequency is set to the nominal EUT channel center frequency enable the EUT transmit continuously.
3. Use the following spectrum analyzer settings:
   RBW=100KHz, VBW≥3RBW, Sweep = auto, Detector function = peak, Trace = max hold
4. Use the automatic bandwidth measurement capability of an instrument, use the X dB bandwidth mode with X set to 6 dB.
5. Allow the trace to stabilize, record the 6 dB Bandwidth value.

Test Method for 99 % Bandwidth

1. Connect EUT test port to spectrum analyzer.
   Use the following spectrum analyzer settings:
   RBW=1% to 5% of the actual occupied, VBW≥3RBW, Sweep = auto,
   Detector function = peak, Trace = max hold
2. Use the occupied bandwidth measurement capability of test receiver.
3. Allow the trace to stabilize, record the occupied bandwidth value.

Limit

According to §15.247(a)(2), 6dB bandwidth limit as below:

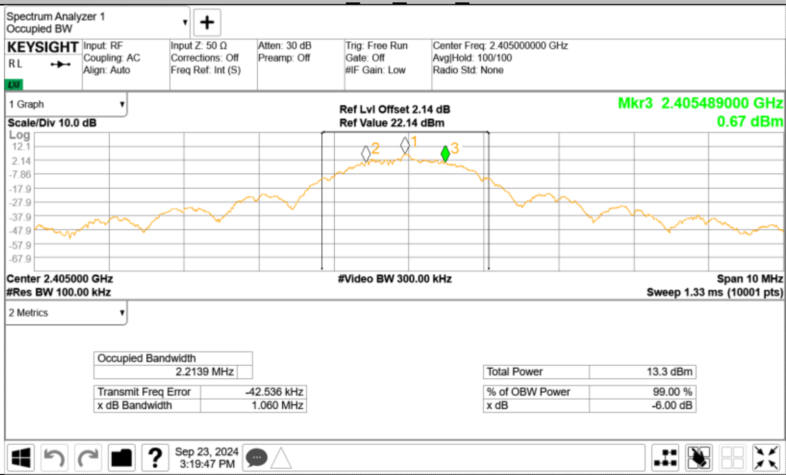
6dB bandwidth Limit [kHz]	99% bandwidth Limit [kHz]
≥500	--

Test result

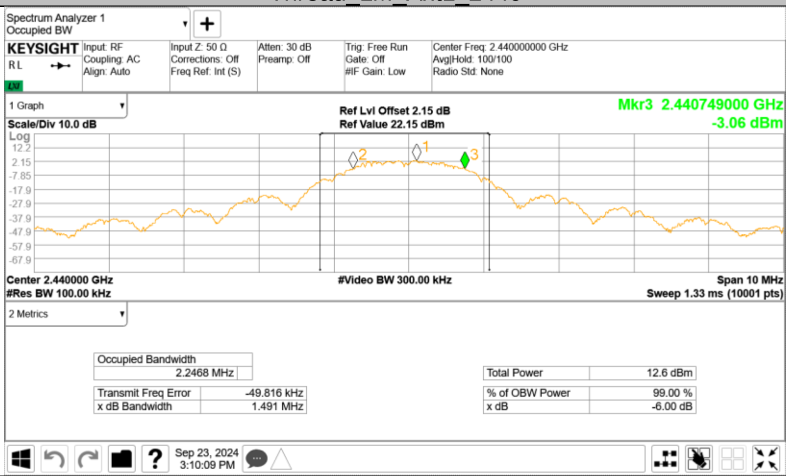
Frequency MHz	6dB bandwidth kHz	99% Bandwidth kHz	Result
Top channel 2405MHz	1060	2233	Pass
Middle channel 2440MHz	1491	2238	Pass
Bottom channel 2480MHz	1094	2238	Pass

6dB Bandwidth

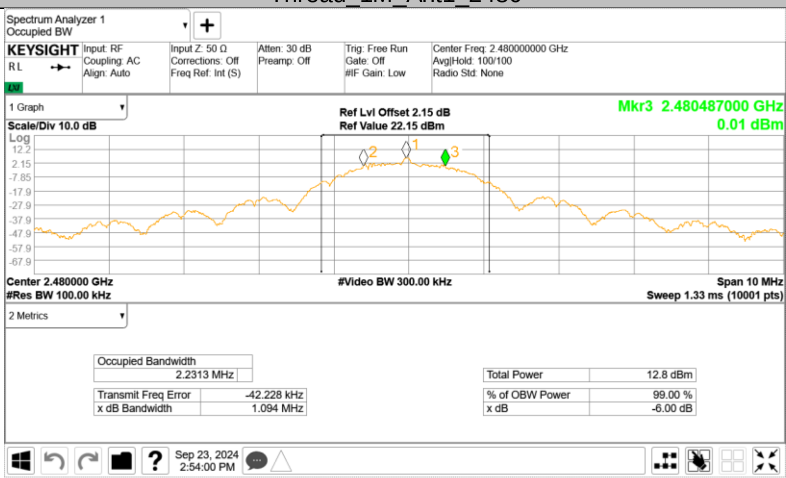
Thread_1M_Ant1_2405



Thread_1M_Ant1_2440

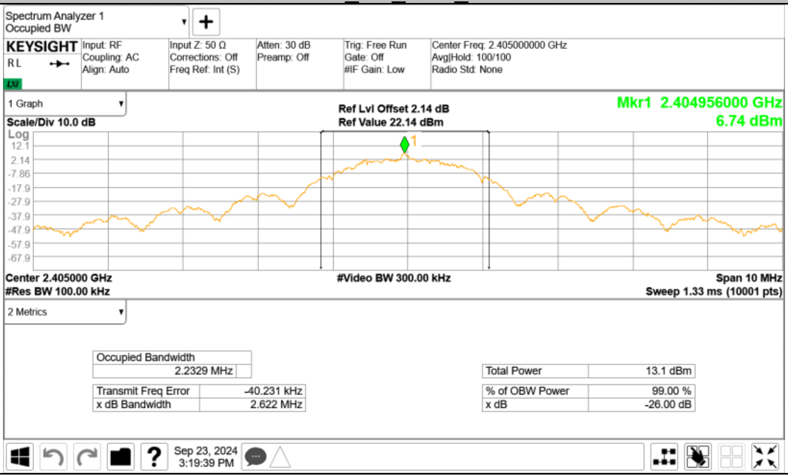


Thread_1M_Ant1_2480

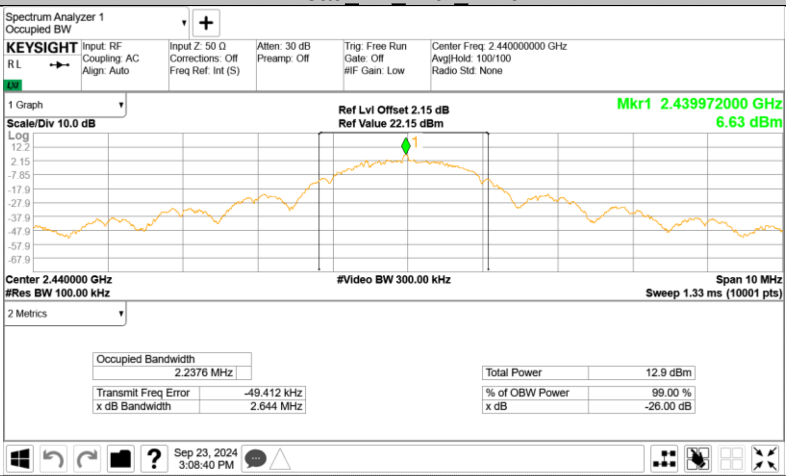


99% Occupied Bandwidth

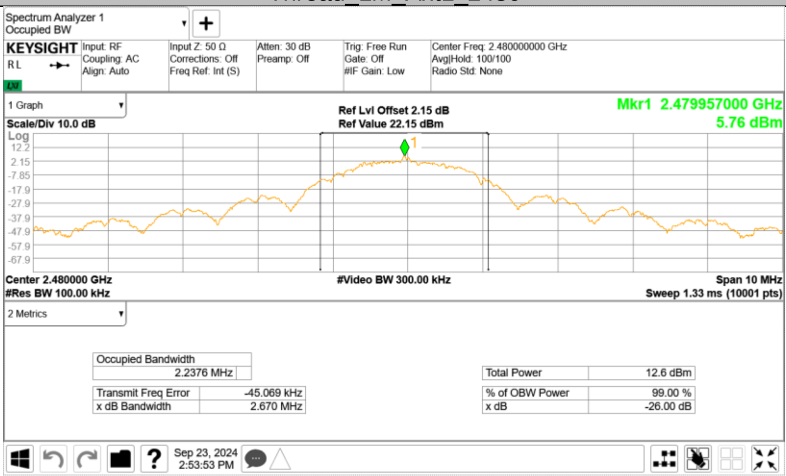
Thread_1M_Ant1_2405



Thread_1M_Ant1_2440



Thread_1M_Ant1_2480



9.4 Power spectral density

Test Method

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

1. The RF output of EUT was connected to the spectrum analyzer. The path loss was compensated to the results for each measurement.
2. Set to the maximum power setting, the instrument center frequency is set to the nominal EUT channel center frequency enable the EUT transmit continuously.
3. Use the following spectrum analyzer settings:
4. Set analyzer center frequency to DTS channel center frequency. RBW=3kHz, VBW≥3RBW, Span=1.5 times DTS bandwidth, Detector=Peak, Sweep=auto, Trace= max hold.
5. Allow trace to fully stabilize, use the peak marker function to determine the maximum amplitude level within the RBW.
6. Repeat above procedures until other frequencies measured were completed.

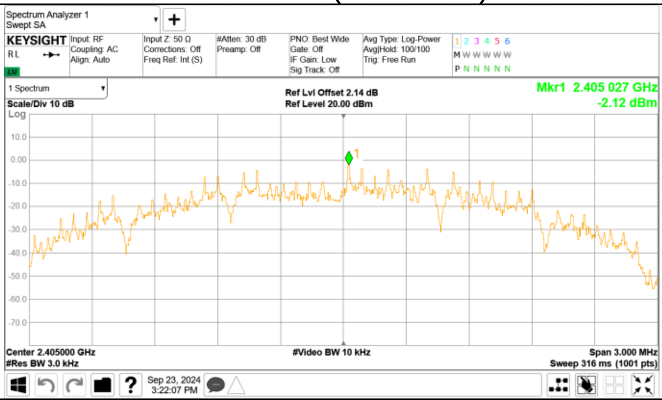
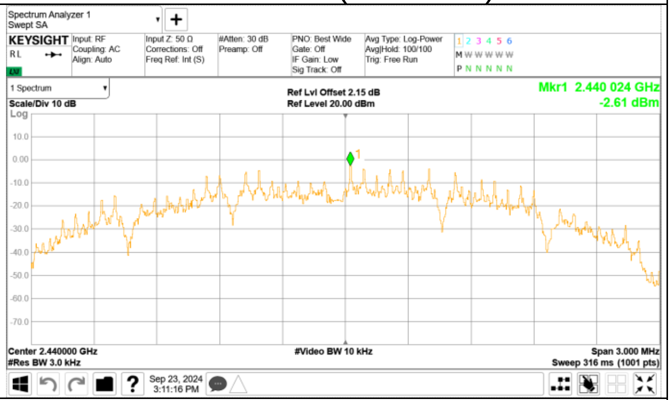
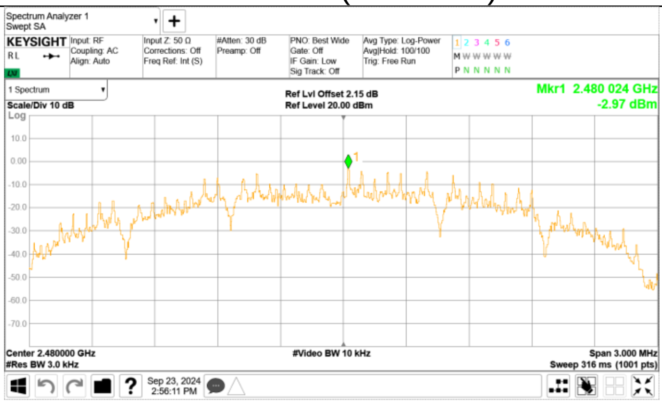
Limit

Limit [dBm/3KHz]
≤8

Test result

Frequency MHz	Power spectral density dBm/3kHz	Result
Top channel 2405MHz	-2.12	Pass
Middle channel 2440MHz	-2.61	Pass
Bottom channel 2480MHz	-2.97	Pass

TÜV SÜD Certification and Testing (China) Co., Ltd. Shanghai Branch
3-13, No.151, Heng Tong Road, Shanghai, 200070, P.R. China
Phone: +86 21 61410123, Fax:+86 21 61408600

<table>
<tr><td colspan="2">PK PSD (1Mbps)</td></tr>
<tr><td>Channel 0 (2405MHz)</td><td>Channel 19 (2440MHz)</td></tr>
<tr><td>
</td><td>
</td></tr>
<tr><td>Channel 39 (2480MHz)</td><td></td></tr>
<tr><td>
</td><td></td></tr>
</table>

9.5 Spurious RF conducted emissions

Test Method

1. The RF output of EUT was connected to the spectrum analyzer by RF cable. The path loss was compensated to the results for each measurement.
2. Set to the maximum power setting, the instrument center frequency is set to the nominal EUT channel center frequency enable the EUT transmit continuously.
3. Use the following spectrum analyzer settings:
   Span = wide enough to capture the peak level of the in-band emission and all spurious emissions (e.g., harmonics) from the lowest frequency generated in the EUT up through the 10^{th} harmonic. Typically, several plots are required to cover this entire span.
   RBW = 100 kHz, VBW≥3RBW, Sweep = auto, Detector function = peak, Trace = max hold
4. Allow the trace to stabilize. Set the marker on the peak of any spurious emission recorded.
5. The level displayed must comply with the limit specified in this Section. Submit these plots.
6. Repeat above procedures until all frequencies measured were complete.

Limit

According to §15.247(d), spurious RF conducted emissions limit as below:

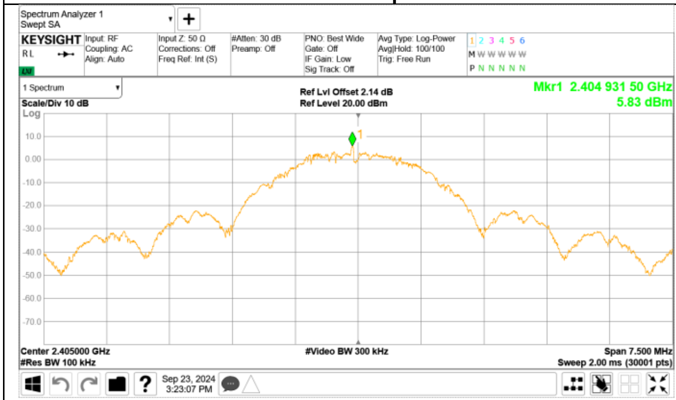
Frequency Range MHz	Limit (dBc)
30-25000	-20

Spurious RF conducted emissions

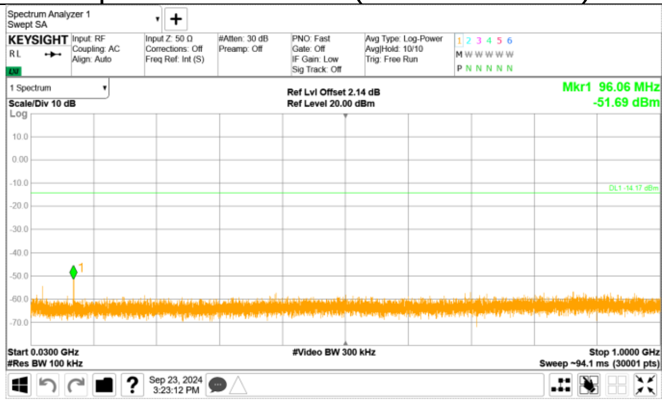
Out-of-Band Emissions (1Mbps)

Channel 0 (2405MHz)

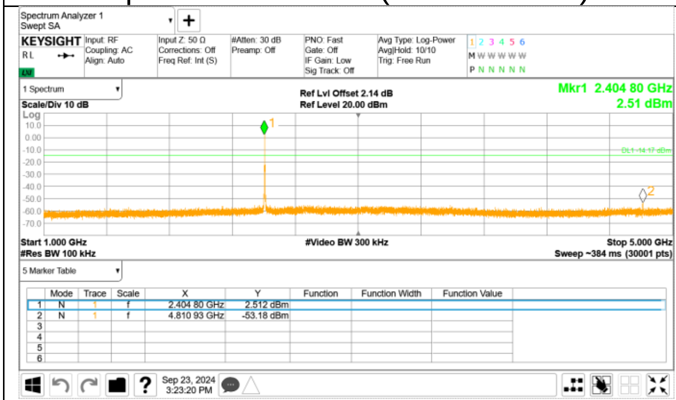
Reference point



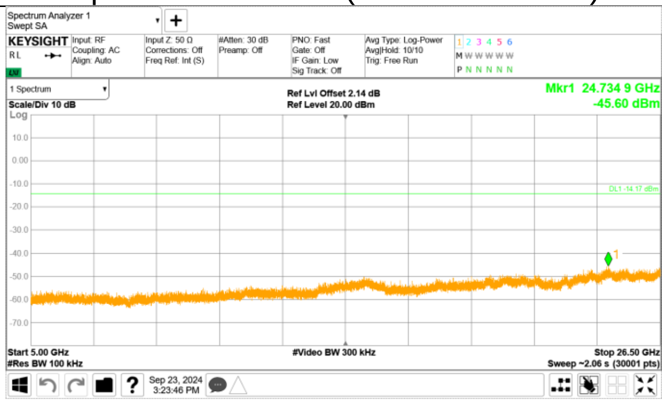
Spurious Emission (30MHz – 1GHz)

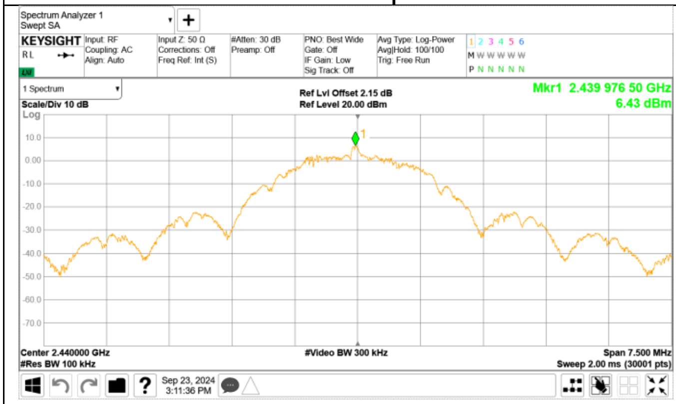
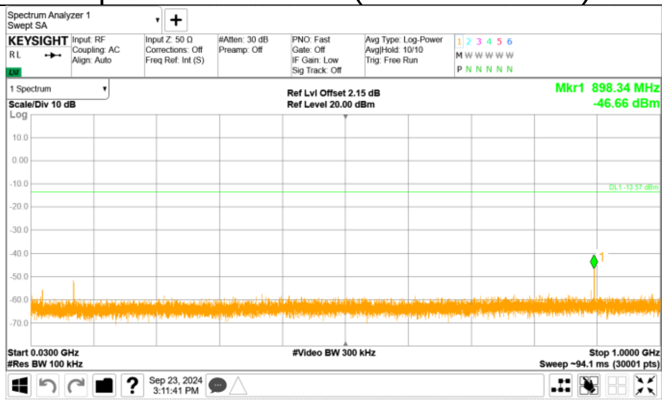
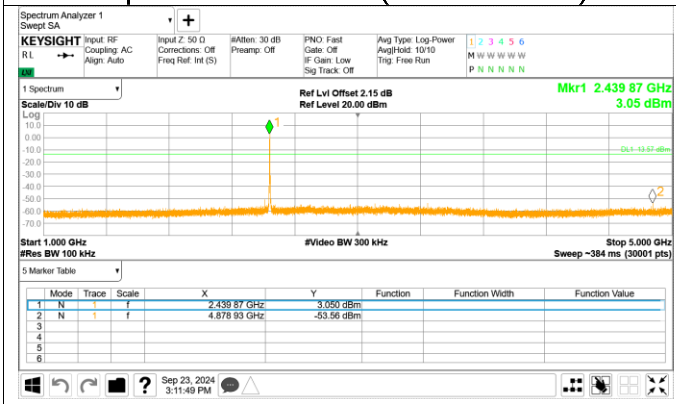
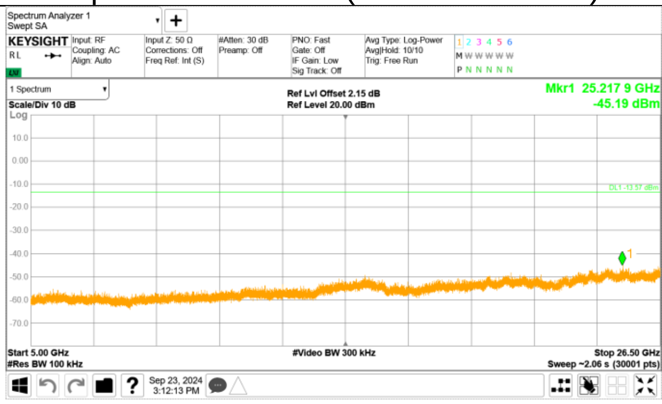


Spurious Emission (1GHz –5GHz)



Spurious Emission (5GHz –26.5GHz)

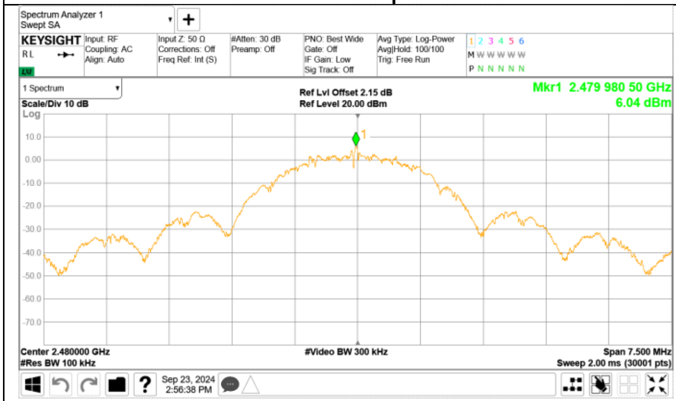


<table>
<tr><th colspan="2">Out-of-Band Emissions (1Mbps)</th></tr>
<tr><th colspan="2">Channel 19 (2440MHz)</th></tr>
<tr><th>Reference point</th><th>Spurious Emission (30MHz – 1GHz)</th></tr>
<tr><td>
</td><td>
</td></tr>
<tr><th>Spurious Emission (1GHz –5GHz)</th><th>Spurious Emission (5GHz –26.5GHz)</th></tr>
<tr><td>
</td><td>
</td></tr>
</table>

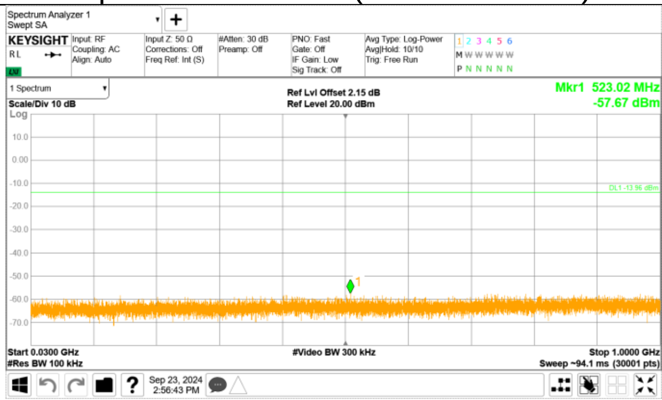
Out-of-Band Emissions (1Mbps)

Channel 39 (2480MHz)

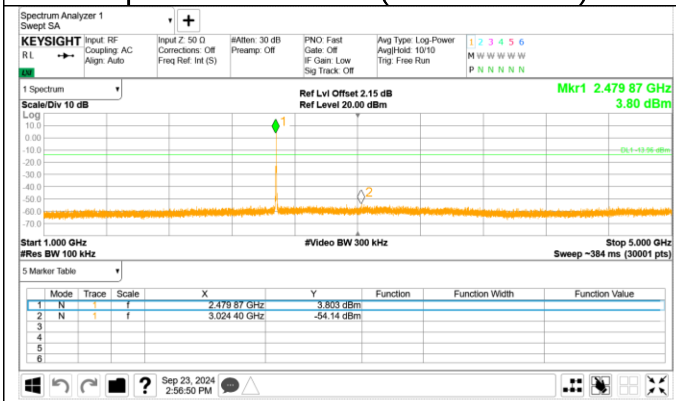
Reference point



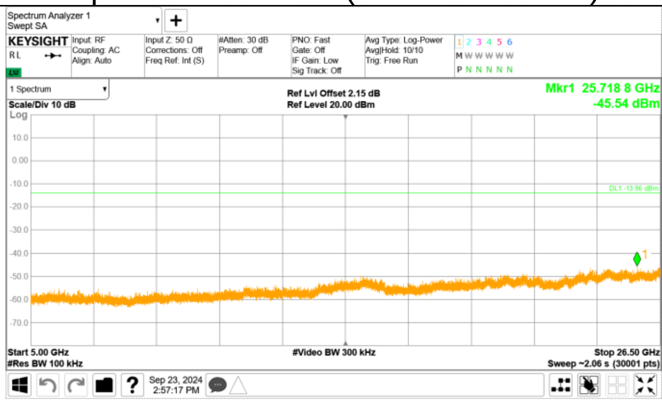
Spurious Emission (30MHz – 1GHz)



Spurious Emission (1GHz –5GHz)



Spurious Emission (5GHz –26.5GHz)



TÜV SÜD Certification and Testing (China) Co., Ltd. Shanghai Branch
3-13, No.151, Heng Tong Road, Shanghai, 200070, P.R. China
Phone: +86 21 61410123, Fax:+86 21 61408600

9.6 Band edge

Test Method

1. The RF output of EUT was connected to the spectrum analyzer by RF cable. The path loss was compensated to the results for each measurement.
2. Set to the maximum power setting, the instrument center frequency is set to the nominal EUT channel center frequency enable the EUT transmit continuously.
3. 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≥3RBW, Sweep = auto, Detector function = peak, Trace = max hold
4. Allow the trace to stabilize, use the peak and delta measurement to record the result.
5. The level displayed must comply with the limit specified in this Section.
6. Repeat above procedures until all frequencies measured were complete and submit all the plots.

Limit:

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating, the RF power that is produced 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 that 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 § 15.247(b)(3) and RSS-247 section 5.4(d), the attenuation required shall be 30 dB instead of 20 dB.

According to §15.247(d), band edge limit as below:

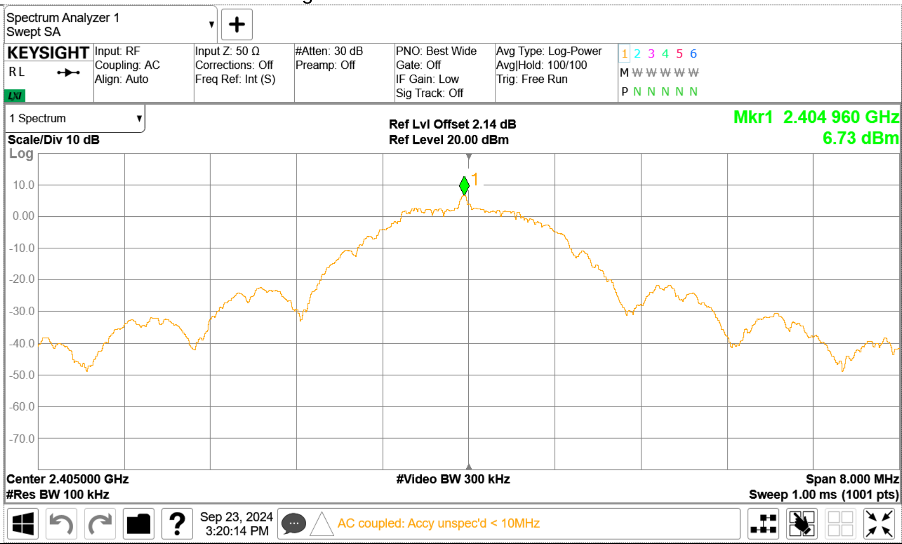
Frequency Range MHz	**Limit (dBc)**
30-25000	-20

Test result

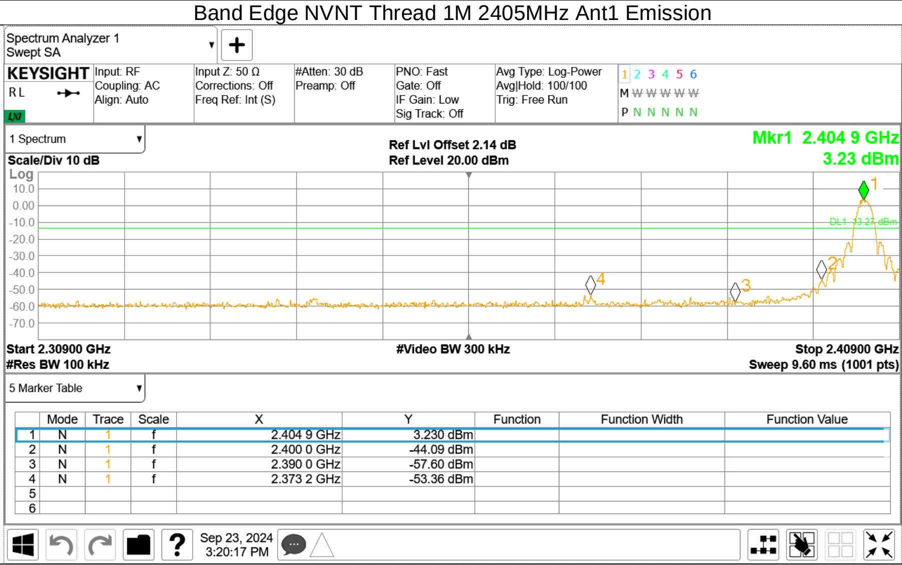
1Mbps

Test Graphs

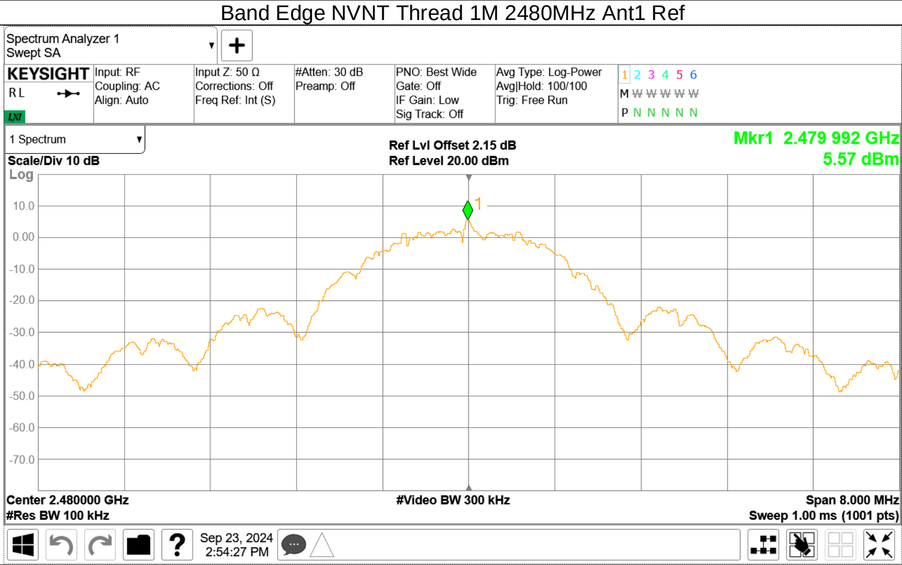
Band Edge NVNT Thread 1M 2405MHz Ant1 Ref



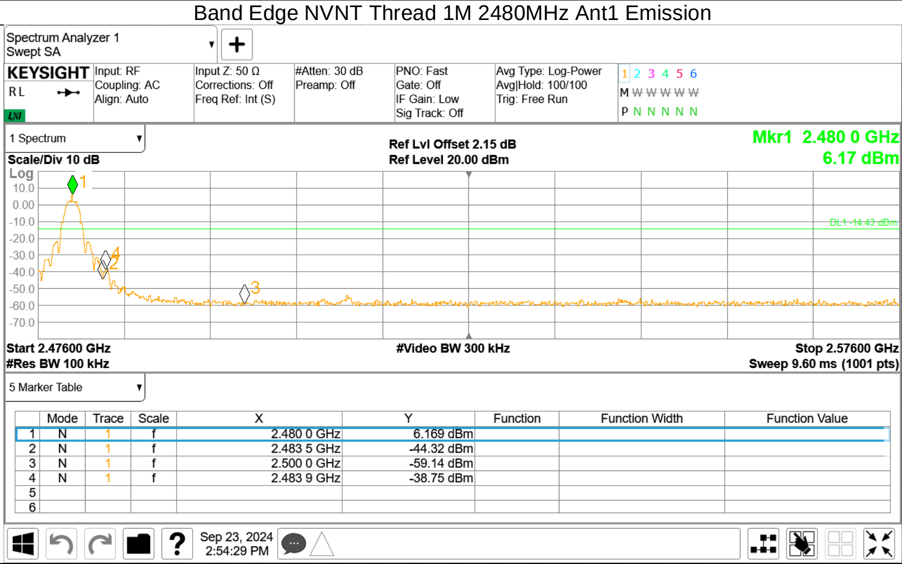
Band Edge NVNT Thread 1M 2405MHz Ant1 Emission



Band Edge NVNT Thread 1M 2480MHz Ant1 Ref



Band Edge NVNT Thread 1M 2480MHz Ant1 Emission



9.7 Spurious radiated emissions for transmitter

Test Method

1. The EUT was place 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

   1) Procedure for Unwanted Emissions Measurements Below 1000 MHz
   Span = wide enough to capture the peak level of the in-band emission and all spurious RBW = 100 kHz to 120kHz, VBW≥RBW for peak measurement, Sweep = auto, Detector function = peak, Trace = max hold.

   2) 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 1GHz
   a) RBW = 1MHz.
   b) VBW \ [3 × RBW].
   c) Detector = RMS (power averaging), if [span / (# of points in sweep)] \ 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.

TÜV SÜD Certification and Testing (China) Co., Ltd. Shanghai Branch
3-13, No.151, Heng Tong Road, Shanghai, 200070, P.R. China
Phone: +86 21 61410123, Fax:+86 21 61408600

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 (AV) at frequency above 1GHz.

Limit

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating, the RF power that is produced 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 that 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 § 15.247(b)(3) and RSS 247 section 5.4(d), the attenuation required shall be 30 dB instead of 20 dB. Attenuation below the general field strength limits specified in § 15.209(a) and RSS-Gen is not required. In addition, radiated emissions which fall in the restricted bands, as defined in§ 15.205(a) and RSS-Gen scetion8.9, must also comply with the radiated emission limits specified in § 15.209(a) and RSS-Gen section 8.10.

Frequency MHz	Field Strength μV/m	Field Strength dBμV/m	Detector	Measurement distance meters
0.009-0.490	2400/F(kHz)	48.5-13.8	AV	300
0.490-1.705	24000/F(kHz)	33.8-23.0	QP	30
1.705-30	30	29.5	QP	30
30-88	100	40	QP	3
88-216	150	43.5	QP	3
216-960	200	46	QP	3
960-1000	500	54	QP	3
Above 1000	500	54	AV	3
Above 1000	5000	74	PK	3

Note 1: Limit 3m(dBμV/m)=Limit 300m(dBμV/m)+40Log(300m/3m) (Below 30MHz)
Note 2: Limit 3m(dBμV/m)=Limit 30m(dBμV/m)+40Log(30m/3m) (Below 30MHz)

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.
Data of measurement within frequency range 9kHz-30MHz is the noise floor or attenuated more than 20dB below the permissible limits or the field strength is too small to be measured, so test data does not present in this report.

Test result

The worst case of Radiated Emission below 1GHz: Only the worst case listed as below.

30-1000MHz Radiated Emission

EUT Information

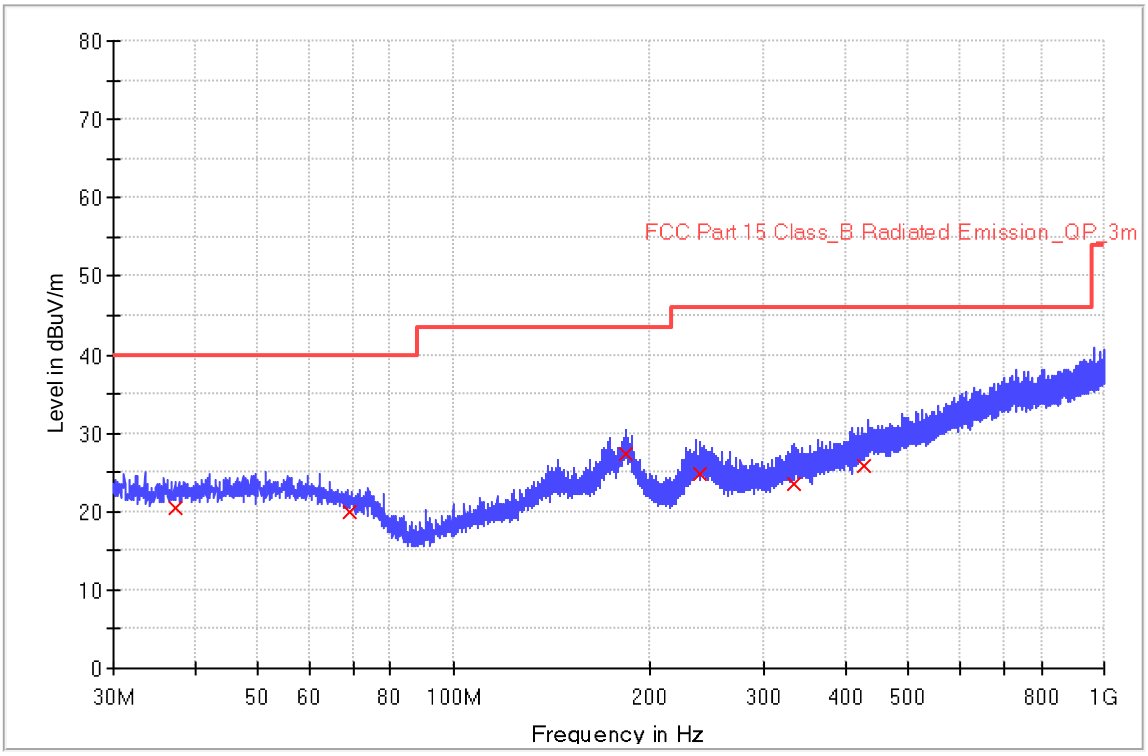
EUT Name:	Tubular motor
Model:	CM-08-E
Client:	Coulisse B.V.
Op Cond:	Power on and TX at 2405MHz, 1Mbps
Operator:	Chengjie GUO
Test Spec:	FCC Part 15.209(a)
Sample No:	SHA-831821-10

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)
37.280000	20.5	1000.0	120.000	165.0	H	132.0	19.7	19.5
69.280000	19.8	1000.0	120.000	175.0	H	122.0	18.7	20.2
183.440000	27.2	1000.0	120.000	211.0	H	164.0	19.0	16.3
239.600000	24.9	1000.0	120.000	186.0	H	231.0	19.5	21.1
332.880000	23.6	1000.0	120.000	197.0	H	175.0	22.6	22.4
428.880000	25.9	1000.0	120.000	165.0	H	216.0	25.2	20.1

(continuation of the "Limit and Margin" table from column 16 ...)

Frequency (MHz)	Limit - QPK (dBuV/m)
37.280000	40.0
69.280000	40.0
183.440000	43.5
239.600000	46.0
332.880000	46.0
428.880000	46.0

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

30-1000MHz Radiated Emission

EUT Information

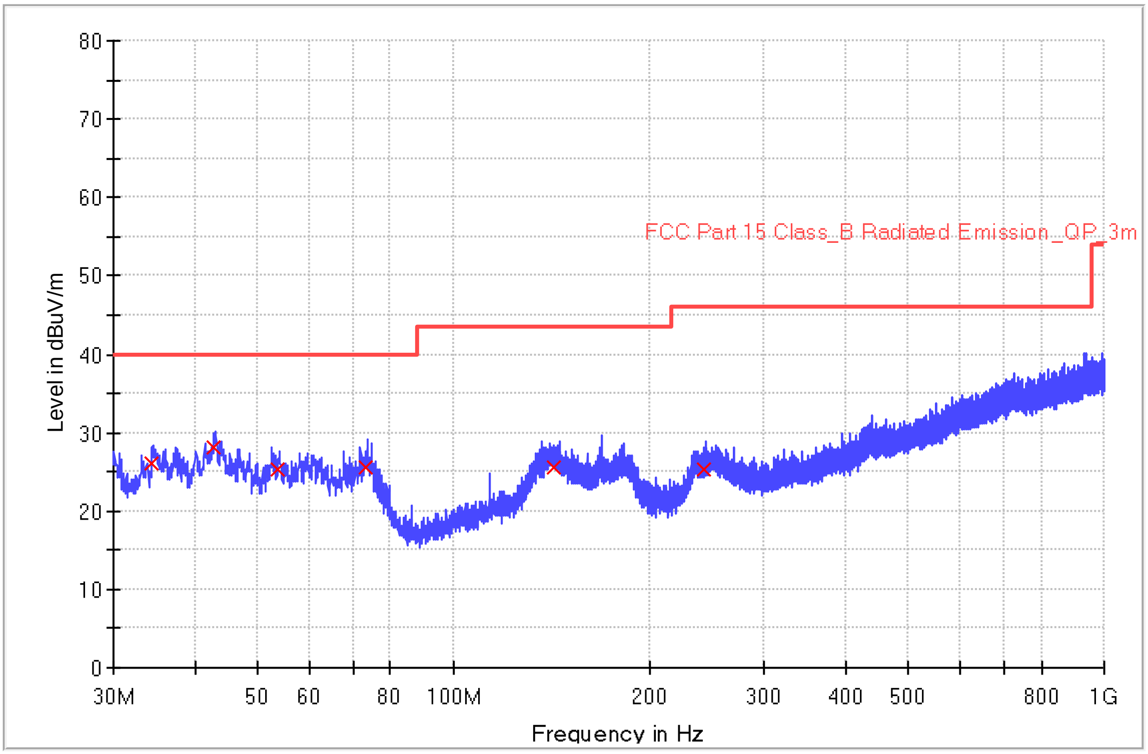
EUT Name:	Tubular motor
Model:	CM-08-E
Client:	Coulisse B.V.
Op Cond:	Power on and TX at 2405MHz, 1Mbps
Operator:	Chengjie GUO
Test Spec:	FCC Part 15.209(a)
Sample No:	SHA-831821-10

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)
34.360000	26.2	1000.0	120.000	122.0	V	213.0	19.4	13.8
42.800000	28.1	1000.0	120.000	114.0	V	221.0	20.2	11.9
53.600000	25.3	1000.0	120.000	132.0	V	175.0	20.4	14.7
73.200000	25.5	1000.0	120.000	142.0	V	216.0	17.9	14.6
142.480000	25.7	1000.0	120.000	175.0	V	216.0	20.6	17.8
242.400000	25.2	1000.0	120.000	117.0	V	121.0	19.7	20.8

(continuation of the "Limit and Margin" table from column 16 ...)

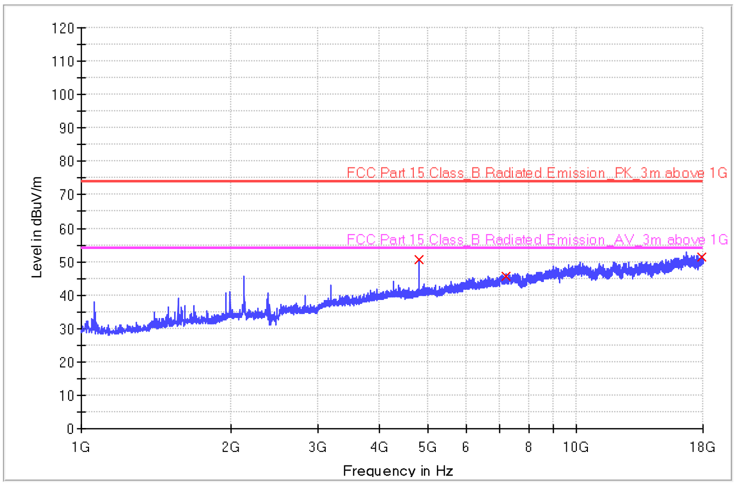
Frequency (MHz)	Limit - QPK (dBuV/m)
34.360000	40.0
42.800000	40.0
53.600000	40.0
73.200000	40.0
142.480000	43.5
242.400000	46.0

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

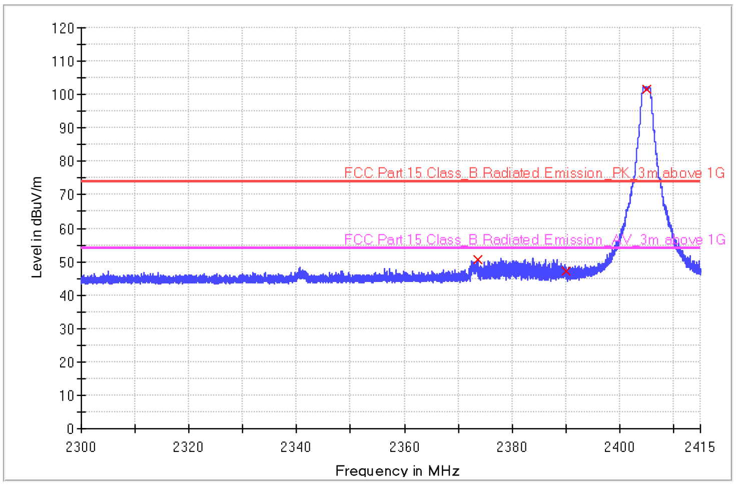
TÜV SÜD Certification and Testing (China) Co., Ltd. Shanghai Branch
3-13, No.151, Heng Tong Road, Shanghai, 200070, P.R. China
Phone: +86 21 61410123, Fax:+86 21 61408600

Radiated Emission 1-18GHz

Frequency: 2405MHz, 1Mbps

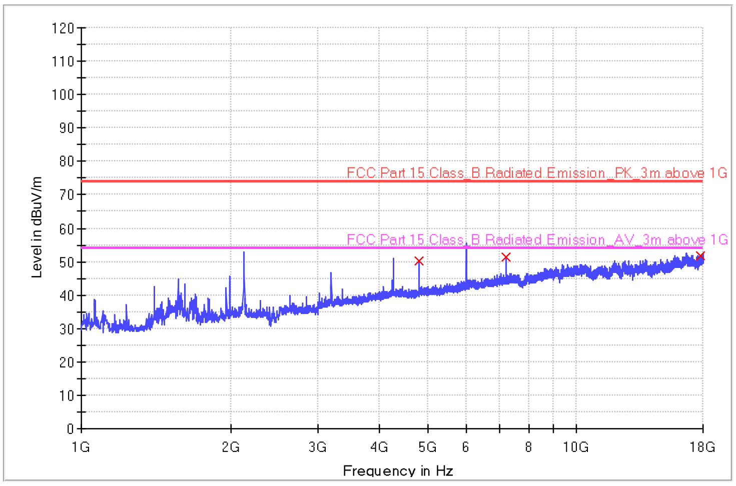


Frequency (MHz)	MaxPeak (dBuV/m)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)	Margin - PK+ (dB)	Limit - PK+ (dBuV/m)
4809.400000	50.4	188.0	H	138.0	-2.7	23.6	74.0
7214.800000	45.5	108.0	H	195.0	0.8	28.5	74.0
17899.300000	51.3	216.0	H	113.0	7.8	22.7	74.0



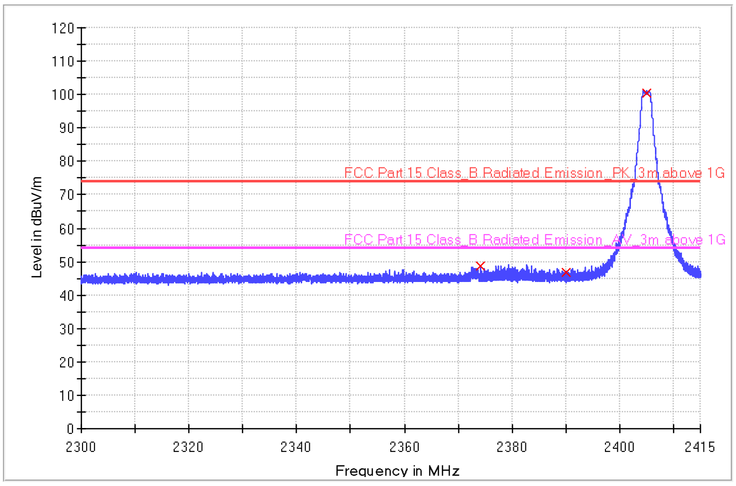
Frequency (MHz)	MaxPeak (dBuV/m)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)	Margin - PK+ (dB)	Limit - PK+ (dBuV/m)
2373.619167	50.5	115.0	H	1.0	-0.8	23.5	74.0
2390.000000	47.2	186.0	H	1.0	-0.8	26.8	74.0
2405.000000	101.7	153.0	H	1.0	-0.8	/	/

RE_HF907_BRF_Pre



Frequency (MHz)	MaxPeak (dBuV/m)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)	Margin - PK+ (dB)	Limit - PK+ (dBuV/m)
4808.000000	50.4	196.0	V	138.0	-2.7	23.6	74.0
7213.600000	51.4	111.0	V	69.0	0.8	22.6	74.0
17752.083330	51.7	215.0	V	167.0	7.5	22.3	74.0

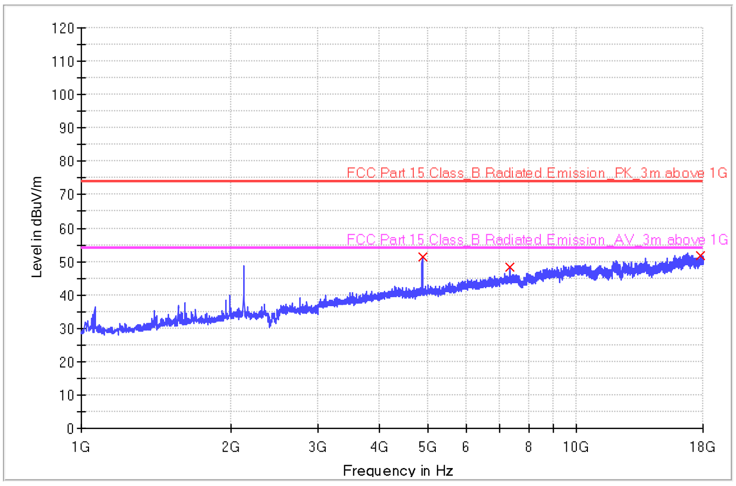
RE_HF907_BRF_Pre



Frequency (MHz)	MaxPeak (dBuV/m)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)	Margin - PK+ (dB)	Limit - PK+ (dBuV/m)
2374.155833	48.8	108.0	V	139.0	-0.8	25.2	74.0
2390.000000	46.6	143.0	V	165.0	-0.8	27.4	74.0
2405.000000	100.4	117.0	V	155.0	-0.8	/	/

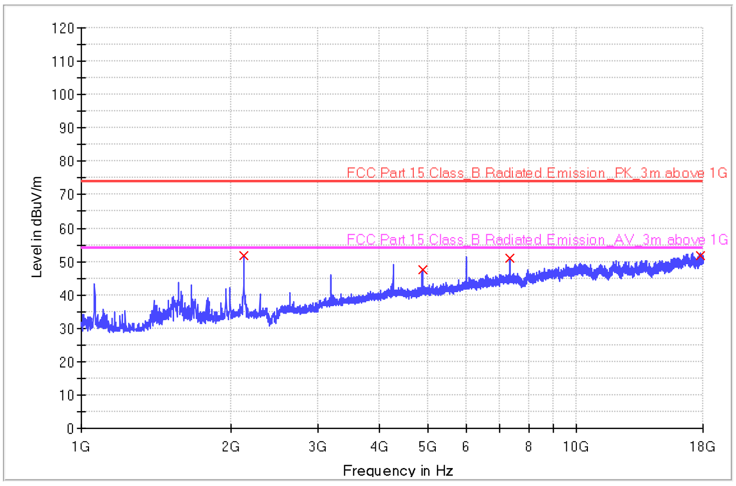
Frequency:2440MHz

RE_HF907_BRF_Pre



Frequency (MHz)	MaxPeak (dBuV/m)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)	Margin - PK+ (dB)	Limit - PK+ (dBuV/m)
4880.200000	51.5	205.0	H	168.0	-2.4	22.5	74.0
7318.300000	48.2	194.0	H	135.0	0.8	25.8	74.0
17838.400000	51.8	161.0	H	218.0	7.7	22.2	74.0

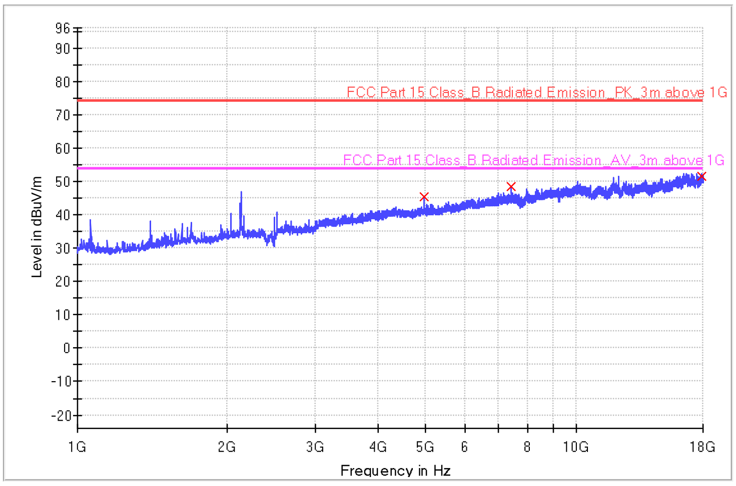
RE_HF907_BRF_Pre



Frequency (MHz)	MaxPeak (dBuV/m)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)	Margin - PK+ (dB)	Limit - PK+ (dBuV/m)
2123.500000	51.9	202.0	V	168.0	-11.4	22.1	74.0
4880.200000	47.4	204.0	V	351.0	-2.4	26.6	74.0
7318.300000	50.9	189.0	V	254.0	0.8	23.1	74.0
17837.200000	51.9	121.0	V	190.0	7.7	22.1	74.0

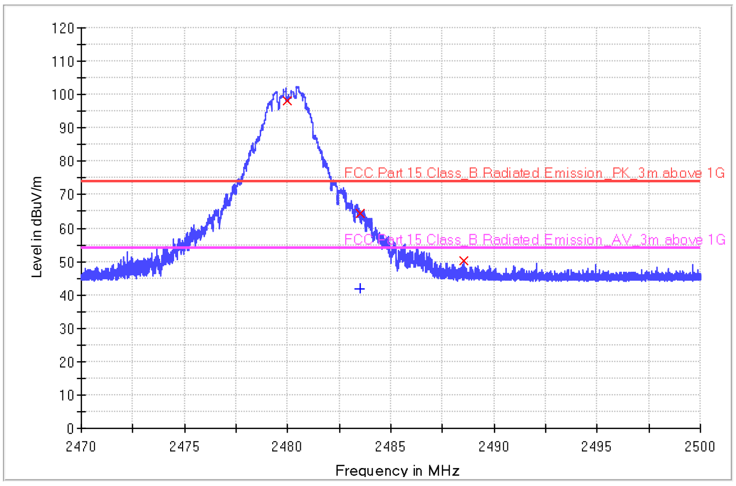
Frequency:2480MHz

RE_HF907_BRF_Pre



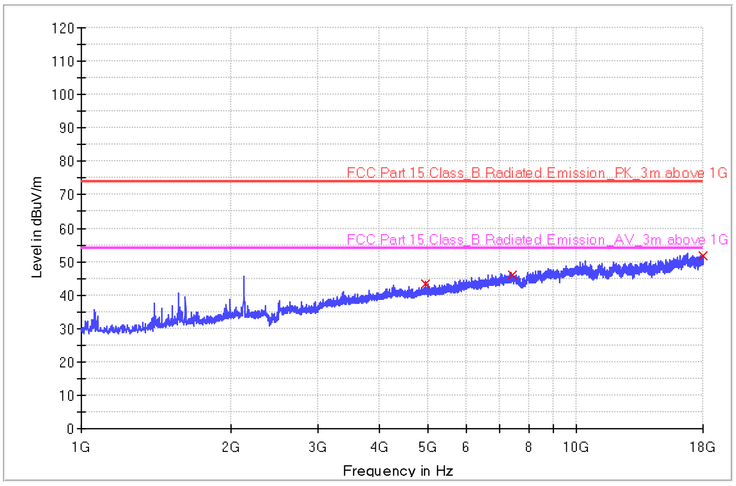
Frequency (MHz)	MaxPeak (dBuV/m)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)	Margin - PK+ (dB)	Limit - PK+ (dBuV/m)
4959.700000	45.5	193.0	H	241.0	-2.3	28.5	74.0
7437.400000	48.3	181.0	H	44.0	0.8	25.7	74.0
17898.100000	51.4	204.0	H	134.0	7.8	22.6	74.0

RE_HF907_BRF_Pre



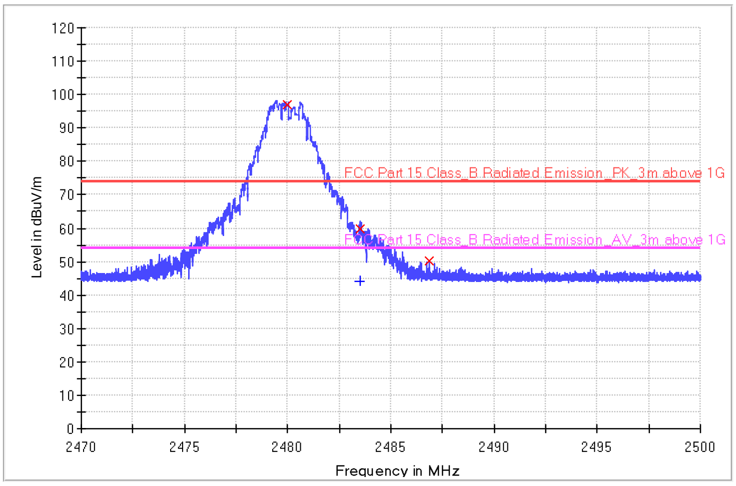
Frequency (MHz)	MaxPeak (dBuV/m)	RMS (dBuV/m)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)	Margin - PK+ (dB)	Limit - PK+ (dBuV/	Margin - RMS (dB)	Limit - RMS (dBuV/m)
2480.000000	98.2	---	203.0	H	135.0	-0.3	/	/	/	/
2483.500000	64.5	---	166.0	H	124.0	-0.3	9.5	74.0	---	---
2483.500000	---	41.8	189.0	H	124.0	-0.3	---	---	12.2	54.0
2488.510000	50.3	---	165.0	H	192.0	-0.3	23.7	74.0	---	---

RE_HF907_BRF_Pre



Frequency (MHz)	MaxPeak (dBuV/m)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)	Margin - PK+ (dB)	Limit - PK+ (dBuV/m)
4960.900000	43.4	149.0	H	116.0	-2.3	30.6	74.0
7441.600000	45.9	167.0	H	162.0	0.8	28.1	74.0
17968.900000	51.7	203.0	H	135.0	7.9	22.3	74.0

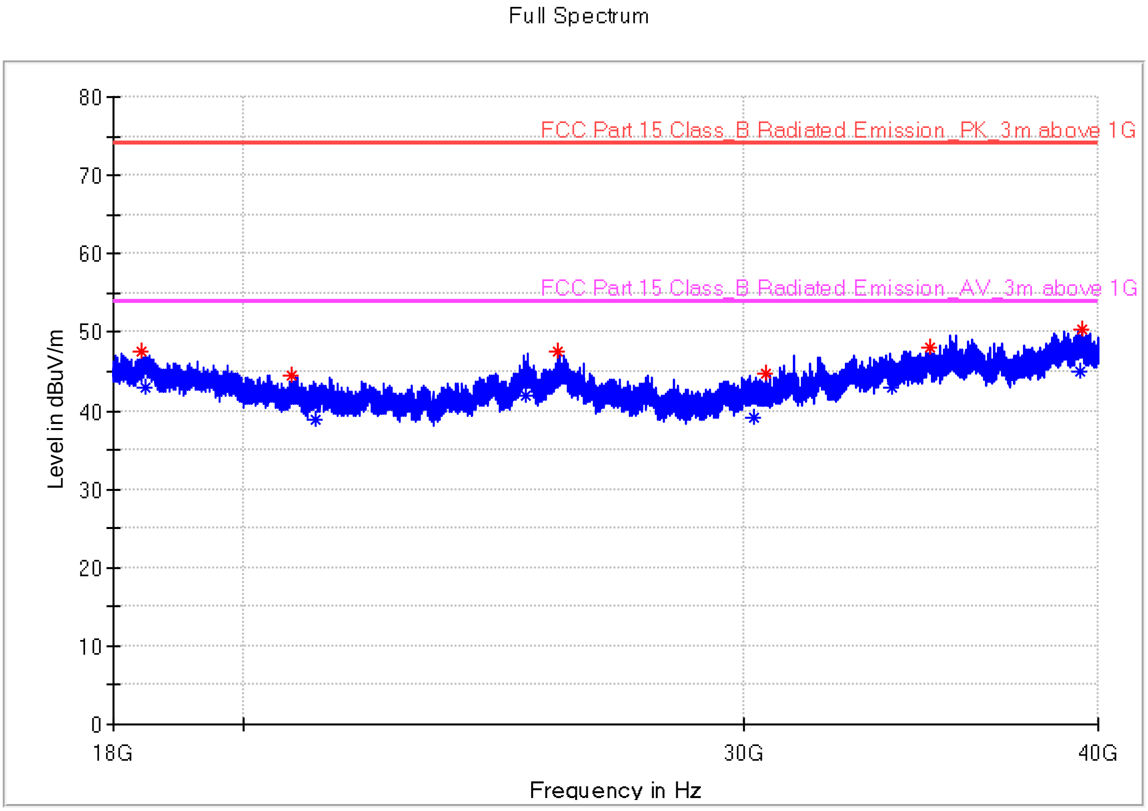
RE_HF907_BRF_Pre



Frequency (MHz)	MaxPeak (dBuV/m)	RMS (dBuV/m)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)	Margin - PK+ (dB)	Limit - PK+ (dBuV/	Margin - RMS (dB)	Limit - RMS (dBuV/m)
2480.000000	96.9	---	136.0	V	168.0	-0.3	/	/	/	/
2483.500000	59.9	---	149.0	V	135.0	-0.3	14.1	74.0	---	---
2483.500000	---	44.3	172.0	V	135.0	-0.3	---	---	9.7	54.0
2486.847500	50.3	---	143.0	V	94.0	-0.3	23.7	74.0	---	---

The worst case of Radiated Emission Above 18GHz

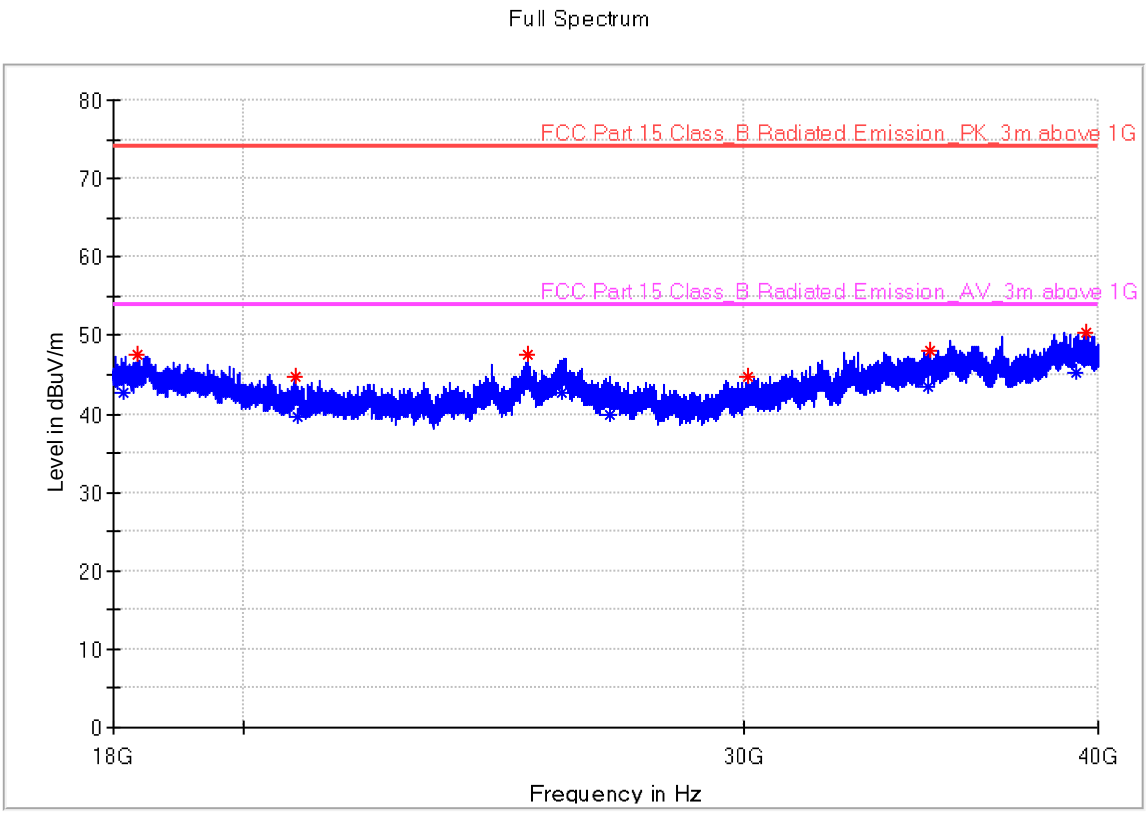
Frequency:2405MHz



Limit and Margin

Frequency (MHz)	MaxPeak (dBuV/m)	Average (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
18412.500000	47.60	---	74.00	26.40	100.0	H	0.0	8.1
18470.937500	---	42.94	54.00	11.06	100.0	H	151.0	8.1
20798.125000	44.41	---	74.00	29.59	100.0	H	0.0	8.5
21195.500000	---	38.96	54.00	15.04	100.0	H	158.0	8.6
25165.125000	---	41.89	54.00	12.11	100.0	H	65.0	9.1
25807.937500	47.48	---	74.00	26.52	100.0	H	58.0	9.6
30238.187500	---	39.22	54.00	14.78	100.0	H	165.0	10.2
30571.625000	44.62	---	74.00	29.38	100.0	H	115.0	10.3
33859.250000	---	42.98	54.00	11.02	100.0	H	34.0	11.1
34891.187500	48.16	---	74.00	25.84	100.0	H	65.0	12.2
39392.250000	---	45.04	54.00	8.96	100.0	H	223.0	13.6
39471.312500	50.27	---	74.00	23.73	100.0	H	158.0	13.7

TÜV SÜD Certification and Testing (China) Co., Ltd. Shanghai Branch
3-13, No.151, Heng Tong Road, Shanghai, 200070, P.R. China
Phone: +86 21 61410123, Fax:+86 21 61408600



Limit and Margin

Frequency (MHz)	MaxPeak (dBuV/m)	Average (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
39269.187500	---	45.30	54.00	8.70	100.0	V	2.0	13.6
18158.125000	---	42.68	54.00	11.32	100.0	V	100.0	8.1
39599.187500	50.43	---	74.00	23.57	100.0	V	130.0	13.8
25202.250000	47.44	---	74.00	26.56	100.0	V	145.0	9.2
25893.187500	---	42.65	54.00	11.35	100.0	V	167.0	9.6
30107.562500	44.80	---	74.00	29.20	100.0	V	182.0	10.1
34830.687500	---	43.34	54.00	10.66	100.0	V	232.0	12.2
26904.500000	---	39.78	54.00	14.22	100.0	V	292.0	9.2
20910.187500	---	39.55	54.00	14.45	100.0	V	327.0	8.5
34878.812500	47.98	---	74.00	26.02	100.0	V	327.0	12.2
20848.312500	44.64	---	74.00	29.36	100.0	V	342.0	8.5
18348.562500	47.48	---	74.00	26.52	100.0	V	349.0	8.1

Remark:

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

10 Test Equipment List

List of Test Instruments
Test Site1

	DESCRIPTION	MANUFACTURER	MODEL NO.	SERIAL NO.	CAL. DATE	CAL. DUE DATE
C	Signal spectrum analyzer	Agilent	N9020B	MY59050168	2024-2-19	2025-2-18
RE	EMI Test Receiver	Rohde & Schwarz	ESR3	101906	2024-8-1	2025-7-31
	Signal Analyzer	Rohde & Schwarz	FSV40	101091	2024-8-1	2025-7-31
	Trilog Super Broadband Test Antenna	Schwarzbeck	VULB 9168	961	2021-9-23	2024-9-22
	Trilog Super Broadband Test Antenna	Schwarzbeck	VULB 9168	961	2024-8-30	2025-8-29
	Double-ridged waveguide horn antenna	Rohde & Schwarz	HF907	102393	2024-4-14	2027-4-13
	Pre-amplifier	Shenzhen HzEMC	HPA-081843	HYPA23026	2024-4-16	2025-4-15
	Loop antenna	Rohde & Schwarz	HFH2-Z2	100443	2024-6-26	2025-6-25
	Double Ridged Horn Antenna	ETS-Lindgren	3116C	00246076	2023-7-7	2026-7-6
	3m Semi-anechoic chamber	TDK	9X6X6	----	2024-5-8	2027-5-7
CE	EMI Test Receiver	Rohde & Schwarz	ESR3	101907	2024-8-1	2025-7-31
	LISN	Rohde & Schwarz	ENV216	101924	2024-8-1	2025-7-31

Measurement Software Information			
Test Item	Software	Manufacturer	Version
C	MTS 8310	MWRFtest	3.0.0.0
RE	EMC 32	Rohde & Schwarz	V10.50.40
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, 3.16dB
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: 2023, clause 4.3.3.

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

TÜV SÜD Certification and Testing (China) Co., Ltd. Shanghai Branch
3-13, No.151, Heng Tong Road, Shanghai, 200070, P.R. China
Phone: +86 21 61410123, Fax:+86 21 61408600