



FCC - TEST REPORT

Report Number : **709502402525-00A** Date of Issue: May 14, 2024

Model : Refer to the page 4

Product Type : T8 Tube

Applicant : Zhejiang Lingzhu Technology CO., Ltd

Address : Room 302, No 1 Building Huace Center, Xihu District, Hangzhou
City, Zhejiang Province, China

Manufacturer : Zhejiang Lingzhu Technology CO., Ltd

Address : Room 302, No 1 Building Huace Center, Xihu District, Hangzhou
City, Zhejiang Province, China

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

Total pages including Appendices : 51



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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: T8 Tube

Model no.: U2CL1800-865 G13 1200-2, U2CL1800-860 G13 1200-2, U2CL1800-850 G13 1200-2, U2CL1800-840 G13 1200-2, U2CL1800-830 G13 1200-2, U5CL1800-865 G13 1200-2, U5CL1800-860 G13 1200-2, U5CL1800-850 G13 1200-2, U5CL1800-840 G13 1200-2, U5CL1800-830 G13 1200-2, U2CL2250-865 G13 1200-2, U2CL2250-860 G13 1200-2, U2CL2250-850 G13 1200-2, U2CL2250-840 G13 1200-2, U2CL2250-830 G13 1200-2, U5CL2250-865 G13 1200-2, U5CL2250-860 G13 1200-2, U5CL2250-850 G13 1200-2, U5CL2250-840 G13 1200-2, U5CL2250-830 G13 1200-2, U2CL1500-865 G13 1200-2, U2CL1500-860 G13 1200-2, U2CL1500-850 G13 1200-2, U2CL1500-840 G13 1200-2, U2CL1500-830 G13 1200-2, U5CL1500-865 G13 1200-2, U5CL1500-860 G13 1200-2, U5CL1500-850 G13 1200-2, U5CL1500-840 G13 1200-2, U5CL1500-830 G13 1200-2, U2CL1200-865 G13 1200-2, U2CL1200-860 G13 1200-2, U2CL1200-850 G13 1200-2, U2CL1200-840 G13 1200-2, U2CL1200-830 G13 1200-2, U5CL1200-865 G13 1200-2, U5CL1200-860 G13 1200-2, U5CL1200-850 G13 1200-2, U5CL1200-840 G13 1200-2, U5CL1200-830 G13 1200-2

FCC ID: 2BEWX-UXCLT8

Options and accessories: NA

Rating: AC 100-240V, 50/60Hz

RF Transmission Frequency: BLE: 2402~2480 MHz (LE 5.0)
5.8GHz SRD: 5735-5840MHz

No. of Operated Channel: BLE: 40
5.8GHz SRD: 36

Modulation: BLE: GFSK
5.8GHz SRD: CW

Channel list:

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

5.8GHz SRD							
Ch	Fre(MHz)	Ch	Fre(MHz)	Ch	Fre(MHz)	Ch	Fre(MHz)
1	5735	10	5762	19	5789	28	5816
2	5738	11	5765	20	5792	29	5819
3	5741	12	5768	21	5795	30	5822
4	5744	13	5771	22	5798	31	5825
5	5747	14	5774	23	5801	32	5828
6	5750	15	5777	24	5804	33	5831
7	5753	16	5780	25	5807	34	5834
8	5756	17	5783	26	5810	35	5837
9	5759	18	5786	27	5813	36	5840

Antenna Type: PCB

Antenna Gain: For BLE: -14.62dBi

For 5.8GHz: 1.85dBi

Description of the EUT: The Equipment Under Test (EUT) is a T8 Tube with BLE and 5.8GHz SRD function which support BLE operated 1Mbps and 2Mbps data rate and 5.8GHz SRD operated at 5.8GHz. We tested it and listed the worst data in this report.

Test sample no.: SHA-808518-1 (Conducted sample),
SHA-808518-2 (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 Measurement 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	14-18	Site 1	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
§15.247 (b) (3)	Conducted peak output power	19-21	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	22-24	Site 1	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
§15.247(e)	Power spectral density	25-27	Site 1	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
§15.247(d)	Spurious RF conducted emissions	28-34	Site 1	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
§15.247(d)	Band edge	35-39	Site 1	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
§15.247(d) & §15.209 & §15.205	Spurious radiated emissions for transmitter	40-47	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 PCB Antenna, which gain is for BLE: -14.62dBi, for 5.8GHz: 1.85 dBi. 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: 2BEWX-UXCLT8, complies with Section 15.207, 15.209, 15.247 of the FCC Part 15, Subpart C Rules.

This report is only for the 2.4GHz BLE test report, for the 5.8GHz SRD test report please refer to 709502402525-00B.

According to the client's declaration, all models have the same technical construction including circuit diagram, PCB Layout, components and component layout. The LED tubes have same construction, only difference in power and CCT(color temperatures). Different powers are achieved by adjusting the power output power of the same LED drive. The models, electrical parameters, and structures of lamp beads with different color temperatures are exactly the same. Lamp beads with different color temperatures only use different phosphors and do not affect electromagnetic radiation.

Detail model as follow.

Model NO.	rated power(W)	Lamp Cap	CCT(K)
U2CL1800-865 G13 1200-2	12W	G13	6500
U2CL1800-860 G13 1200-2	12W	G13	6000
U2CL1800-850 G13 1200-2	12W	G13	5000
U2CL1800-840 G13 1200-2	12W	G13	4000
U2CL1800-830 G13 1200-2	12W	G13	3000
U5CL1800-865 G13 1200-2	12W	G13	6500
U5CL1800-860 G13 1200-2	12W	G13	6000
U5CL1800-850 G13 1200-2	12W	G13	5000
U5CL1800-840 G13 1200-2	12W	G13	4000
U5CL1800-830 G13 1200-2	12W	G13	3000
U2CL2250-865 G13 1200-2	15W	G13	6500
U2CL2250-860 G13 1200-2	15W	G13	6000
U2CL2250-850 G13 1200-2	15W	G13	5000
U2CL2250-840 G13 1200-2	15W	G13	4000
U2CL2250-830 G13 1200-2	15W	G13	3000
U5CL2250-865 G13 1200-2	15W	G13	6500
U5CL2250-860 G13 1200-2	15W	G13	6000
U5CL2250-850 G13 1200-2	15W	G13	5000
U5CL2250-840 G13 1200-2	15W	G13	4000
U5CL2250-830 G13 1200-2	15W	G13	3000
U2CL1500-865 G13 1200-2	10W	G13	6500
U2CL1500-860 G13 1200-2	10W	G13	6000
U2CL1500-850 G13 1200-2	10W	G13	5000



U2CL1500-840 G13 1200-2	10W	G13	4000
U2CL1500-830 G13 1200-2	10W	G13	3000
U5CL1500-865 G13 1200-2	10W	G13	6500
U5CL1500-860 G13 1200-2	10W	G13	6000
U5CL1500-850 G13 1200-2	10W	G13	5000
U5CL1500-840 G13 1200-2	10W	G13	4000
U5CL1500-830 G13 1200-2	10W	G13	3000
U2CL1200-865 G13 1200-2	8W	G13	6500
U2CL1200-860 G13 1200-2	8W	G13	6000
U2CL1200-850 G13 1200-2	8W	G13	5000
U2CL1200-840 G13 1200-2	8W	G13	4000
U2CL1200-830 G13 1200-2	8W	G13	3000
U5CL1200-865 G13 1200-2	8W	G13	6500
U5CL1200-860 G13 1200-2	8W	G13	6000
U5CL1200-850 G13 1200-2	8W	G13	5000
U5CL1200-840 G13 1200-2	8W	G13	4000
U5CL1200-830 G13 1200-2	8W	G13	3000

So model U2CL2250-830 G13 1200-2 was chosen to perform all the tests. We listed the worst data in this 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: April 24, 2024

Testing Start Date: April 30, 2024

Testing End Date: May 14, 2024

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

Reviewed by:

Prepared by:

Tested by:

Hui Tong



Wenqiang LU

Cheng Huali

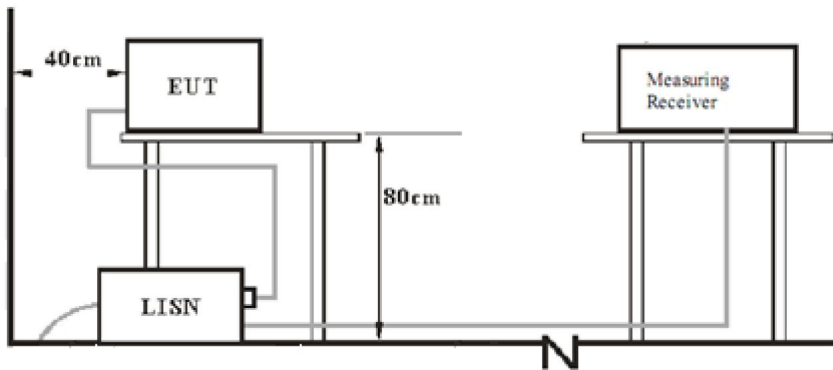
Hui TONG
Review Engineer

Wenqiang LU
Project Engineer

Huali CHENG
Test Engineer

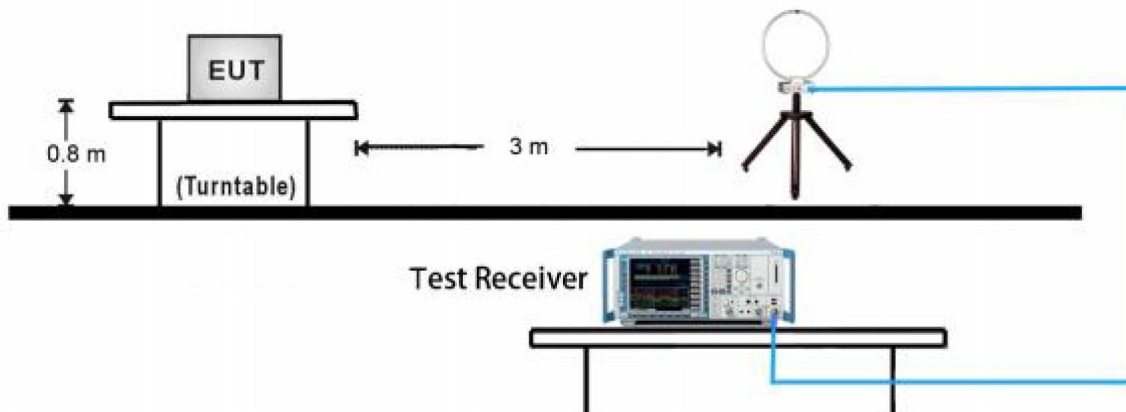
7 Test Setups

7.1 AC Power Line Conducted Emission test setups

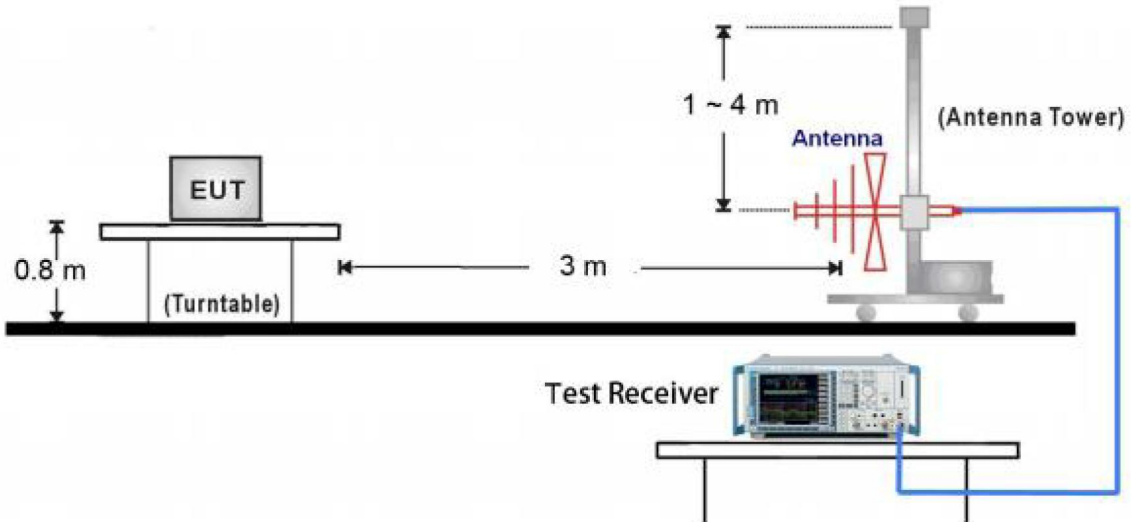


7.2 Radiated test setups

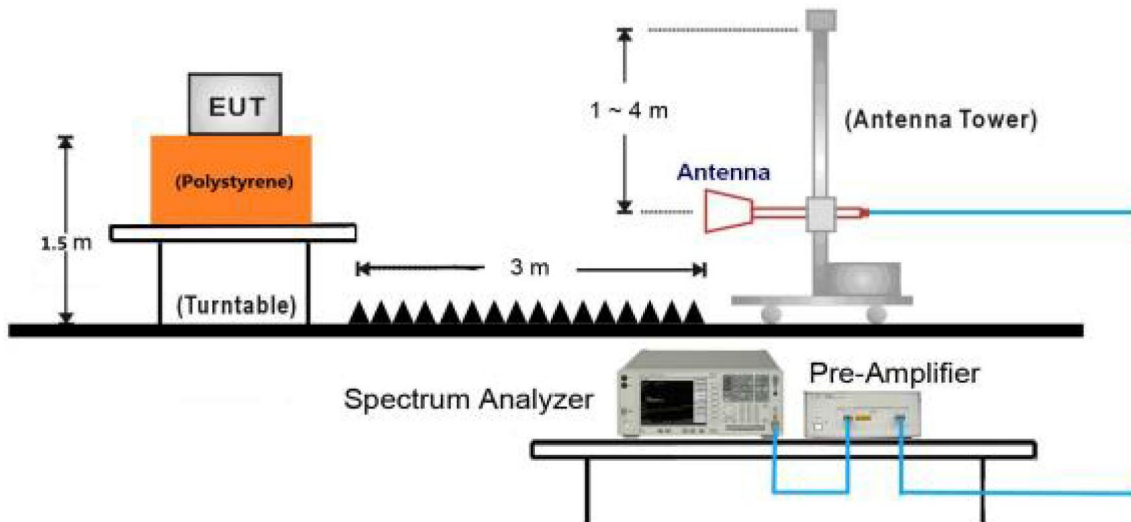
9kHz ~ 30MHz Test Setup:



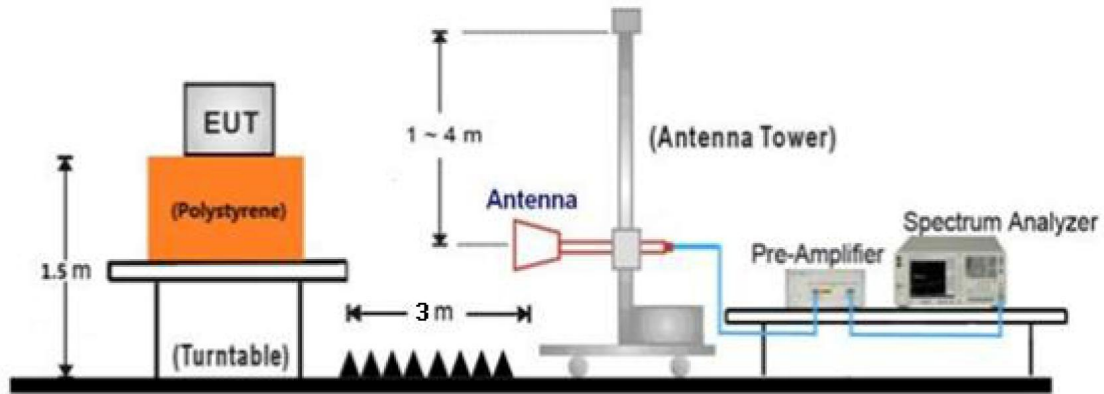
30MHz ~ 1GHz Test Setup:



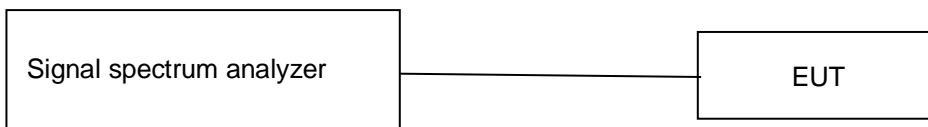
1GHz ~ 18GHz Test Setup:



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_v1.4

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	8.1
	19	1	GFSK	8.1
	39	1	GFSK	8.1

Mode	Tested Channel	Data Rate (Mbps)	Modulation	Power level setting
Bluetooth LE	0	2	GFSK	8.1
	19	2	GFSK	8.1
	39	2	GFSK	8.1

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, conducted emissions limit as below:

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



Conducted Emission

150k-30MHz Conducted Emission Test

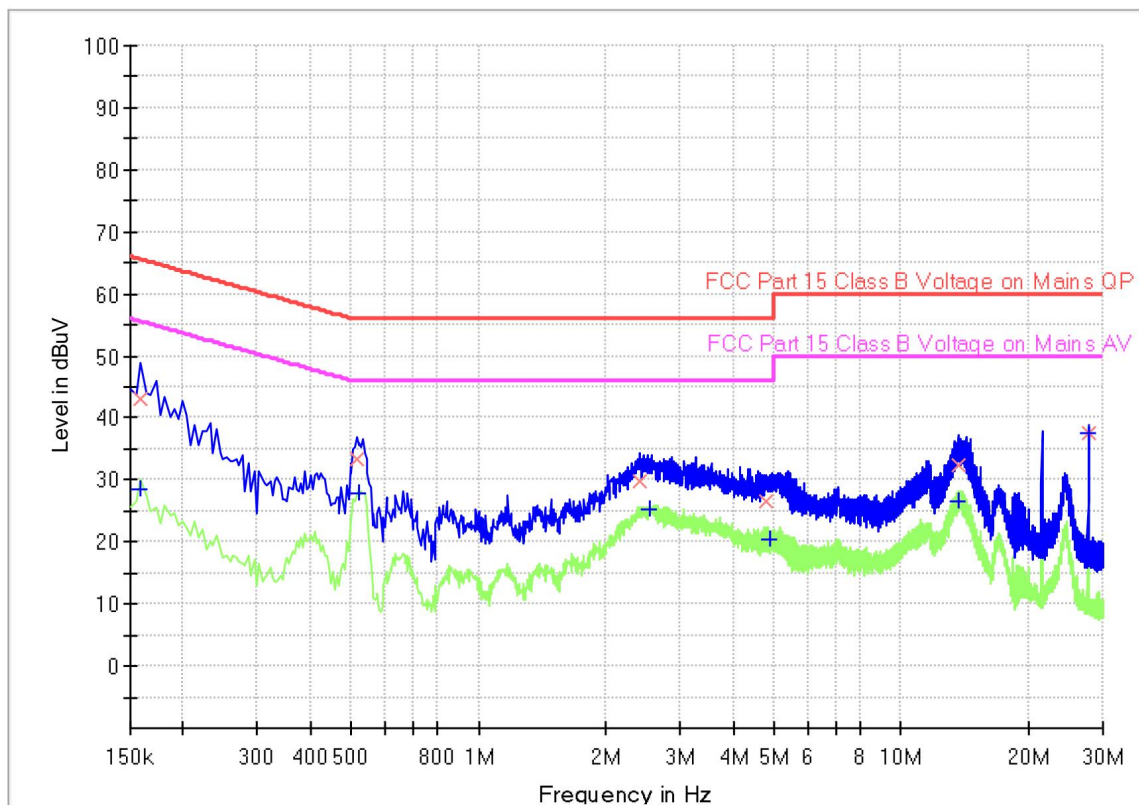
EUT Information

EUT Name: T8 Tube
 Model: U2CL2250-830 G13 1200-2
 Client: Zhejiang Lingzhu Technology CO., Ltd
 Op Cond: Power on, TX_2402,2Mbps, AC 120V/60Hz, T21.5, H52.6%, P103.2kPa
 Operator: Huali CHENG
 Standard: FCC 15.207(a)
 Comment: Phase L
 Sample No.: SHA-808518-2

Scan Setup: Voltage with 2-Line-LISN pre [EMI conducted]

Hardware Setup: Voltage with 2-Line-LISN
 Receiver: [ESR 3]
 Level Unit: dBuV

Subrange	Step Size	Detectors	IF BW	Meas. Time	Preamp
9 kHz - 150 kHz	100 Hz	PK+	200 Hz	0.02 s	0 dB
150 kHz - 30 MHz	4.5 kHz	PK+; AVG	9 kHz	0.01 s	0 dB





Final Result

Frequency (MHz)	QuasiPeak (dBuV)	CAverage (dBuV)	Limit (dBuV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	Corr. (dB)
0.159000	---	28.35	55.52	27.17	1000.0	9.000	L1	19.4
0.159000	42.98	---	65.52	22.54	1000.0	9.000	L1	19.4
0.514500	33.38	---	56.00	22.62	1000.0	9.000	L1	19.4
0.519000	---	27.98	46.00	18.02	1000.0	9.000	L1	19.4
2.400000	29.89	---	56.00	26.11	1000.0	9.000	L1	19.5
2.539500	---	25.12	46.00	20.88	1000.0	9.000	L1	19.5
4.798500	26.51	---	56.00	29.49	1000.0	9.000	L1	19.6
4.879500	---	20.50	46.00	25.50	1000.0	9.000	L1	19.6
13.659000	---	26.71	50.00	23.29	1000.0	9.000	L1	20.0
13.717500	32.45	---	60.00	27.55	1000.0	9.000	L1	20.0
27.649500	---	37.71	50.00	12.29	1000.0	9.000	L1	21.1
27.649500	37.68	---	60.00	22.32	1000.0	9.000	L1	21.1



150k-30MHz Conducted Emission Test

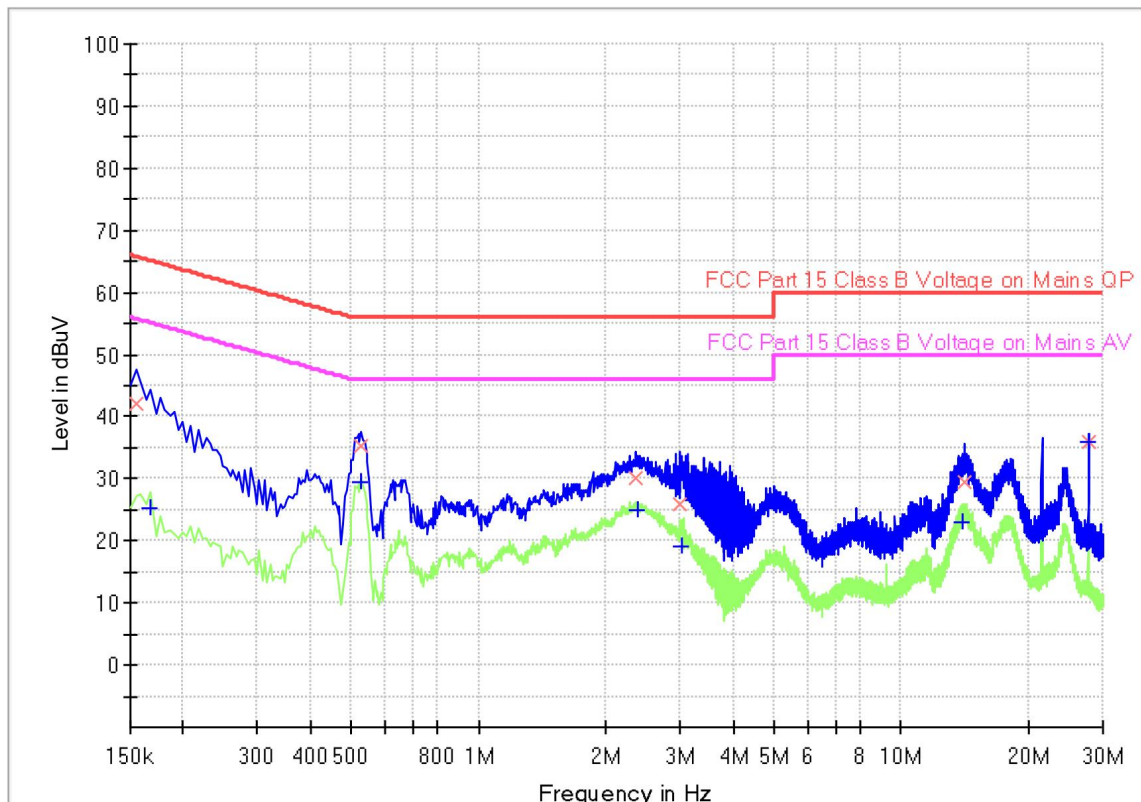
EUT Information

EUT Name: T8 Tube
 Model: U2CL2250-830 G13 1200-2
 Client: Zhejiang Lingzhu Technology CO., Ltd
 Op Cond: Power on, TX_2402,2Mbps, AC 120V/60Hz, T21.5, H52.6%, P103.2kPa
 Operator: Huali CHENG
 Standard: FCC 15.207(a)
 Comment: Phase N
 Sample No.: SHA-808518-2

Scan Setup: Voltage with 2-Line-LISN pre [EMI conducted]

Hardware Setup: Voltage with 2-Line-LISN
 Receiver: [ESR 3]
 Level Unit: dBuV

Subrange	Step Size	Detectors	IF BW	Meas. Time	Preamp
9 kHz - 150 kHz	100 Hz	PK+	200 Hz	0.02 s	0 dB
150 kHz - 30 MHz	4.5 kHz	PK+; AVG	9 kHz	0.01 s	0 dB





Final Result

Frequency (MHz)	QuasiPeak (dBuV)	CAverage (dBuV)	Limit (dBuV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	Corr. (dB)
0.154500	42.23	---	65.75	23.52	1000.0	9.000	N	19.4
0.168000	---	25.13	55.06	29.93	1000.0	9.000	N	19.4
0.528000	---	29.36	46.00	16.64	1000.0	9.000	N	19.5
0.528000	35.28	---	56.00	20.72	1000.0	9.000	N	19.5
2.346000	30.05	---	56.00	25.95	1000.0	9.000	N	19.5
2.382000	---	25.09	46.00	20.91	1000.0	9.000	N	19.5
2.994000	25.96	---	56.00	30.04	1000.0	9.000	N	19.5
3.016500	---	19.10	46.00	26.90	1000.0	9.000	N	19.5
13.983000	---	22.92	50.00	27.08	1000.0	9.000	N	19.9
14.113500	29.36	---	60.00	30.64	1000.0	9.000	N	19.9
27.649500	---	35.90	50.00	14.10	1000.0	9.000	N	20.7
27.649500	36.08	---	60.00	23.92	1000.0	9.000	N	20.7

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. Use a power meter to measure the conducted peak output power.

Limits

According to §15.247 (b) (3), conducted peak output power limit as below:

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

Test result as below table

Data transmission rate:1Mbps		
Frequency MHz	Conducted Peak Output Power dBm	Result
Low channel 2402MHz	8.52	Pass
Middle channel 2440MHz	8.38	Pass
High channel 2480MHz	8.09	Pass

Data transmission rate:2Mbps		
Frequency MHz	Conducted Peak Output Power dBm	Result
Low channel 2402MHz	8.56	Pass
Middle channel 2440MHz	8.34	Pass
High channel 2480MHz	8.05	Pass

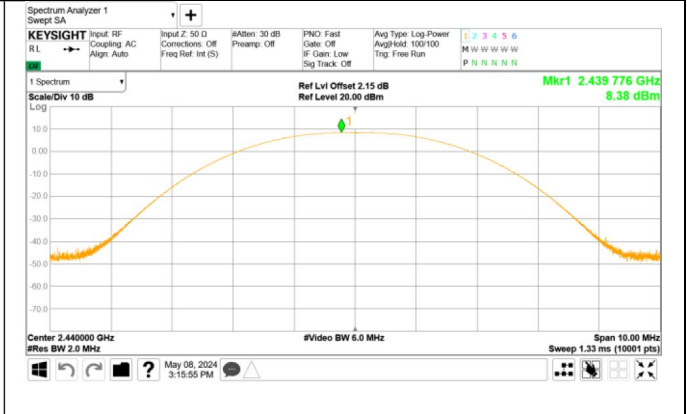


Peak output power (1Mbps)

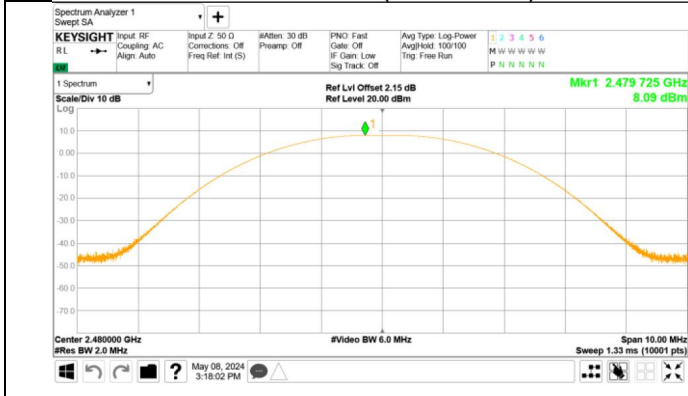
Channel 0 (2402MHz)



Channel 19 (2440MHz)



Channel 39 (2480MHz)



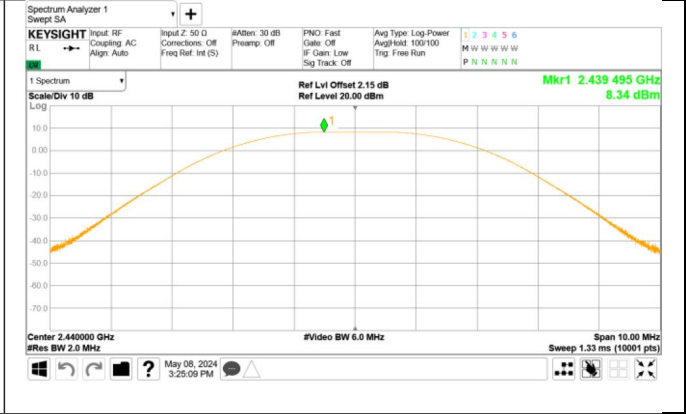


Peak output power (2Mbps)

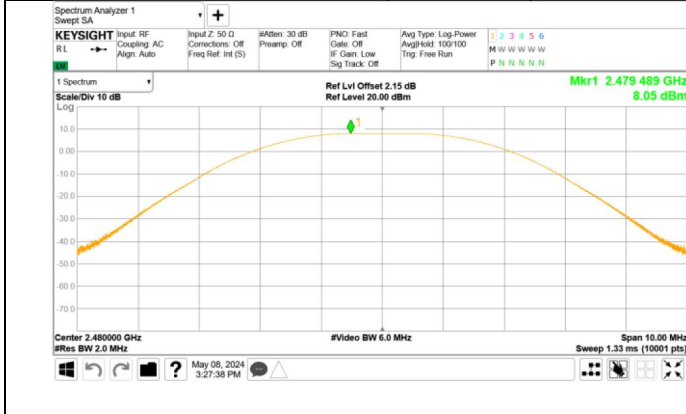
Channel 0 (2402MHz)



Channel 19 (2440MHz)



Channel 39 (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

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

Limit [kHz]

≥ 500

Test result

Data transmission rate	Frequency MHz	6dB bandwidth (MHz)		Result verdict
		result	limit	
1Mbps	2402	0.658	≥ 0.5	Pass
	2440	0.654	≥ 0.5	Pass
	2480	0.683	≥ 0.5	Pass
2Mbps	2402	1.289	≥ 0.5	Pass
	2440	1.332	≥ 0.5	Pass
	2480	1.287	≥ 0.5	Pass



6dB Bandwidth





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

According to §15.247(e), power spectral density limit as below:

Limit [dBm/3kHz]

≤8

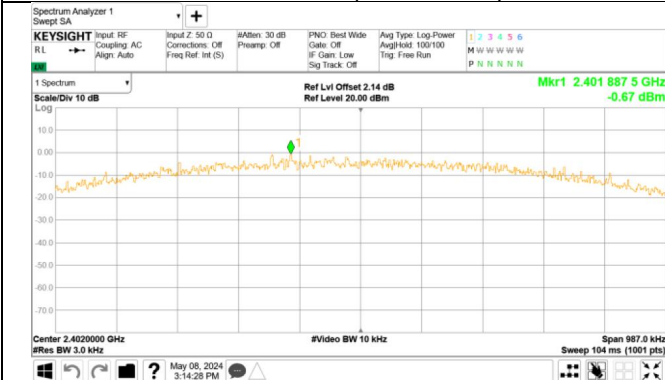
Test result

Data transmission rate	Frequency	Power spectral density	Result
1Mbps	MHz	dBm/3kHz	
	Top channel 2402MHz	-0.67	Pass
	Middle channel 2440MHz	-0.29	Pass
	Bottom channel 2480MHz	-1.7	Pass
2Mbps	Top channel 2402MHz	-3.58	Pass
	Middle channel 2440MHz	-2.96	Pass
	Bottom channel 2480MHz	-4.81	Pass

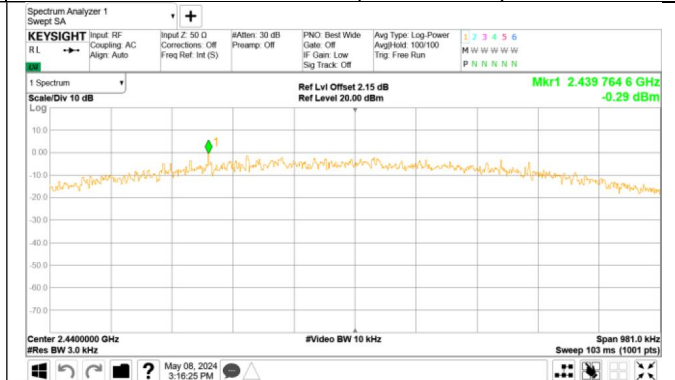


PK PSD (1Mbps)

Channel 0 (2402MHz)



Channel 19 (2440MHz)



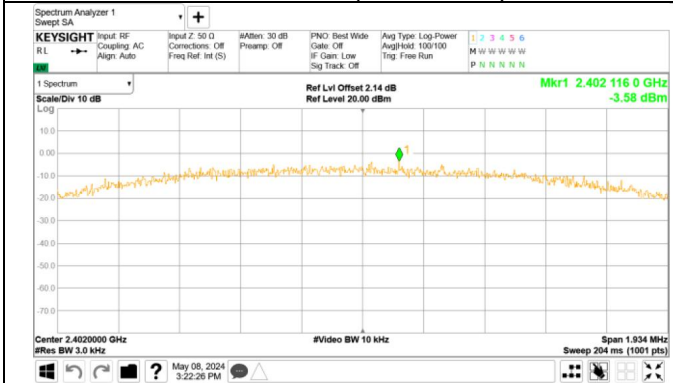
Channel 39 (2480MHz)



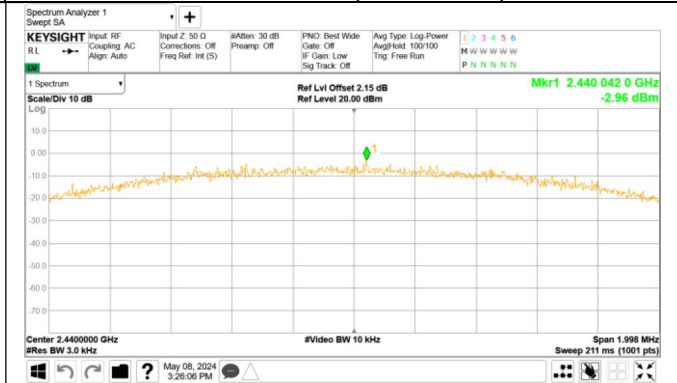


PK PSD (2Mbps)

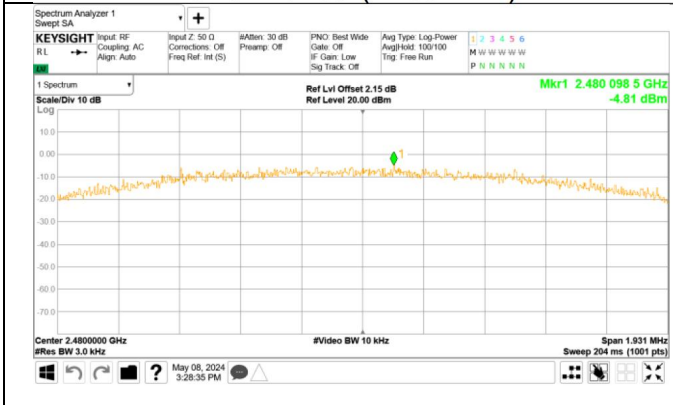
Channel 0 (2402MHz)



Channel 19 (2440MHz)



Channel 39 (2480MHz)





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

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

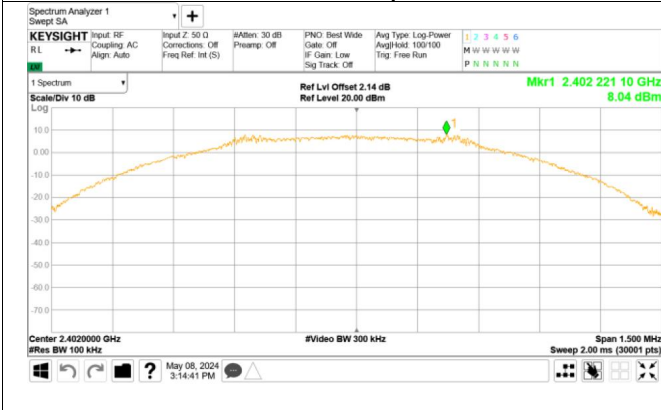
Frequency Range MHz	Limit (dBc)
30-25000	-20



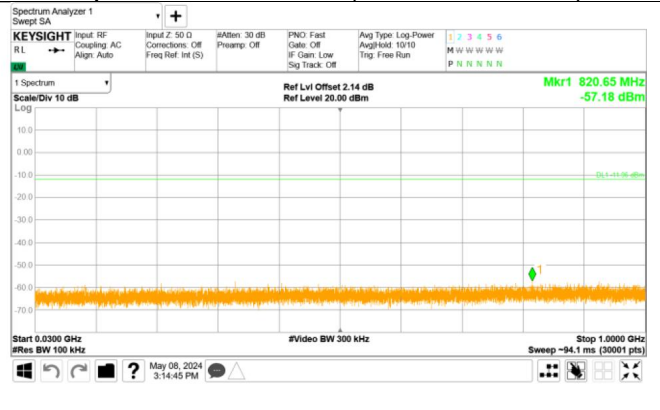
Spurious RF conducted emissions

Out-of-Band Emissions (1Mbps)
Channel 0 (2402MHz)

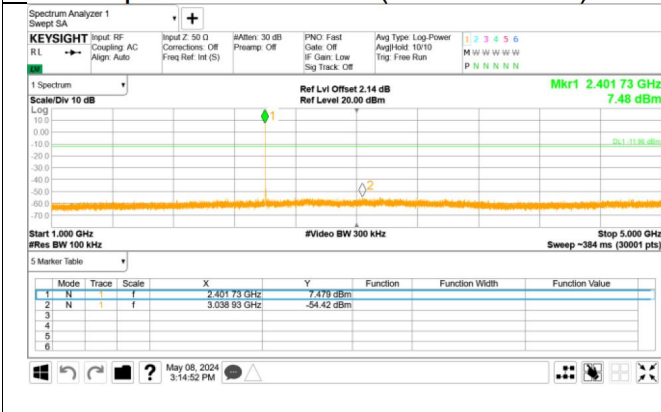
Reference point



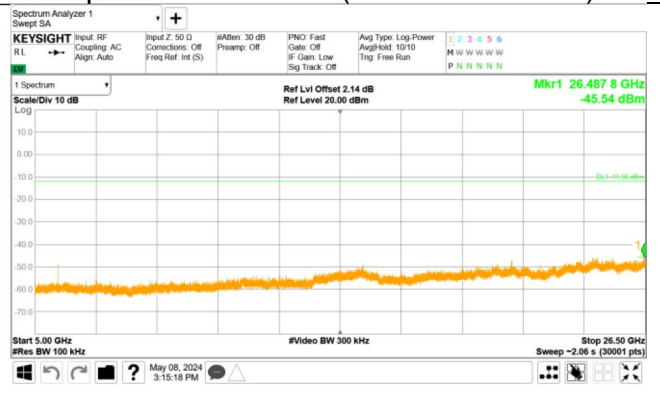
Spurious Emission (30MHz – 1GHz)



Spurious Emission (1GHz – 5GHz)

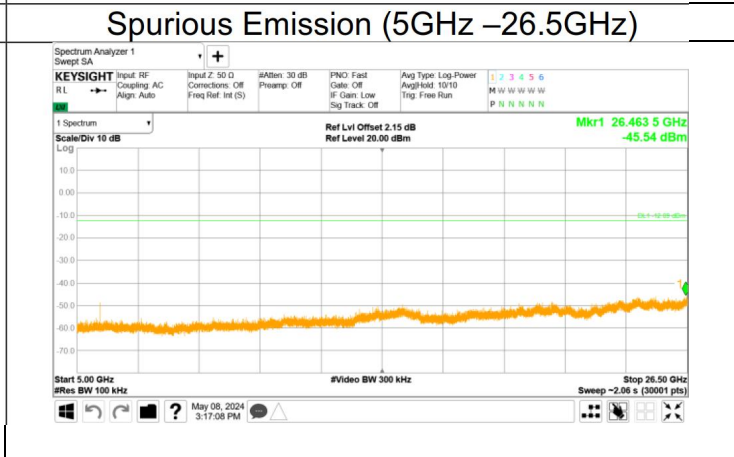
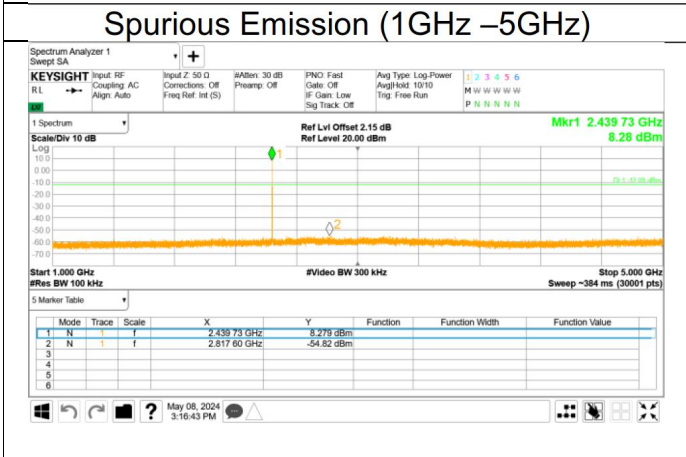
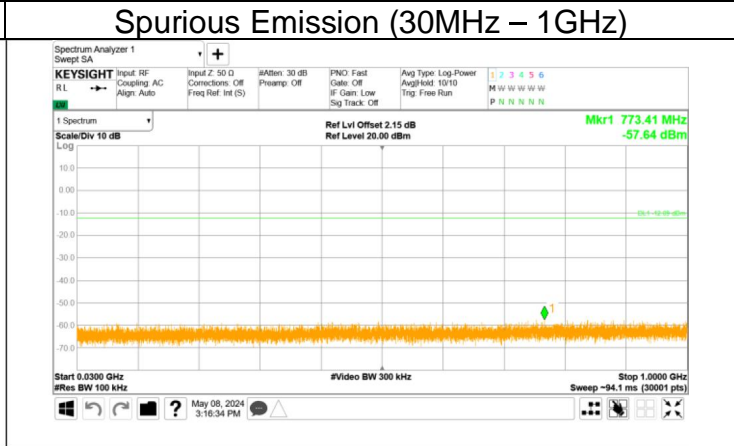
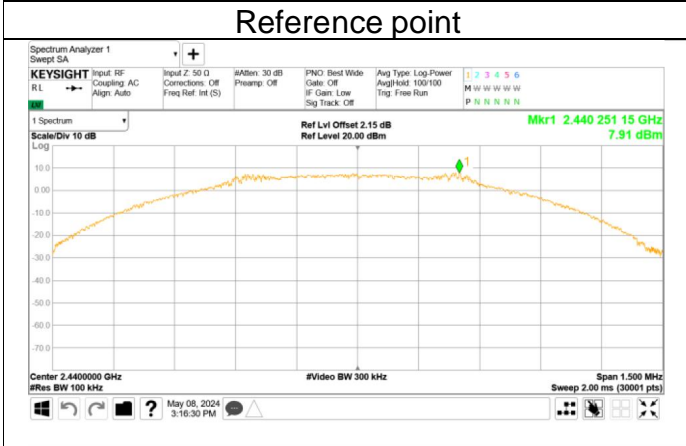


Spurious Emission (5GHz – 26.5GHz)





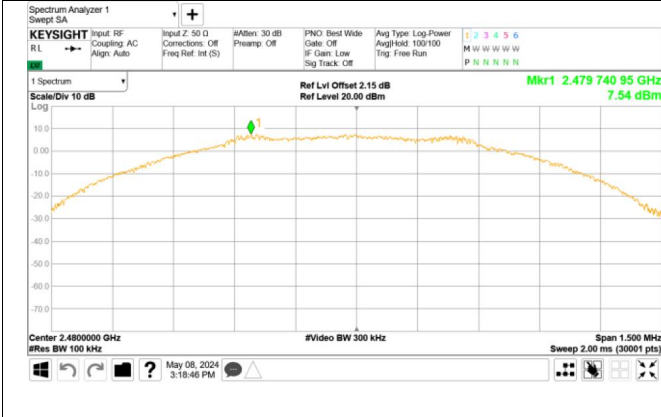
Out-of-Band Emissions (1Mbps)
Channel 19 (2440MHz)



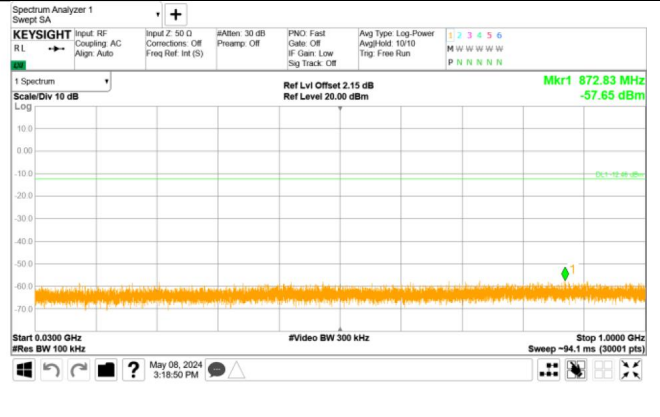


Out-of-Band Emissions (1Mbps)
Channel 39 (2480MHz)

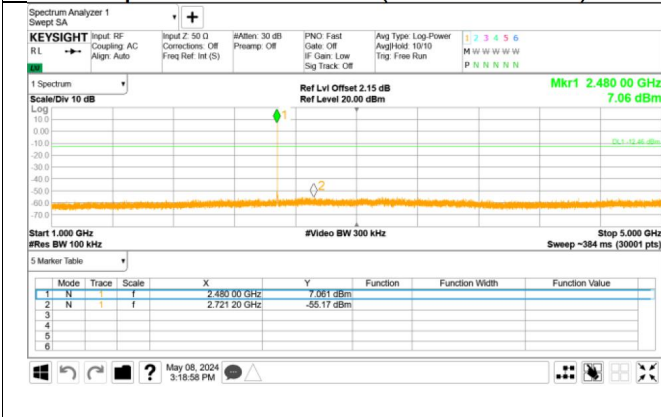
Reference point



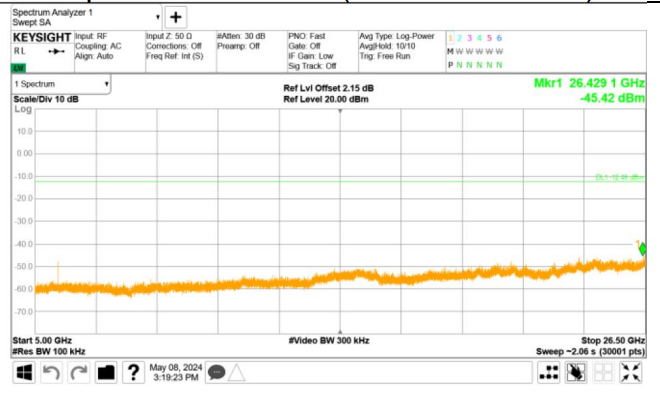
Spurious Emission (30MHz – 1GHz)



Spurious Emission (1GHz – 5GHz)



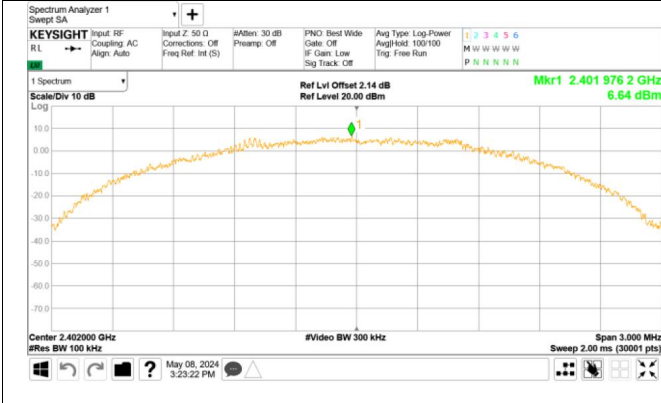
Spurious Emission (5GHz – 26.5GHz)



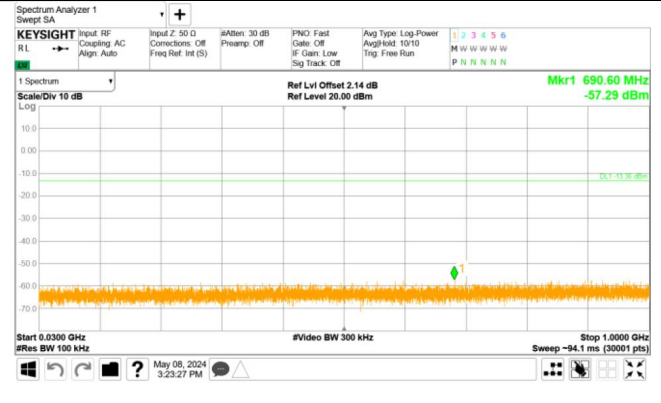


Out-of-Band Emissions (2Mbps)
Channel 0 (2402MHz)

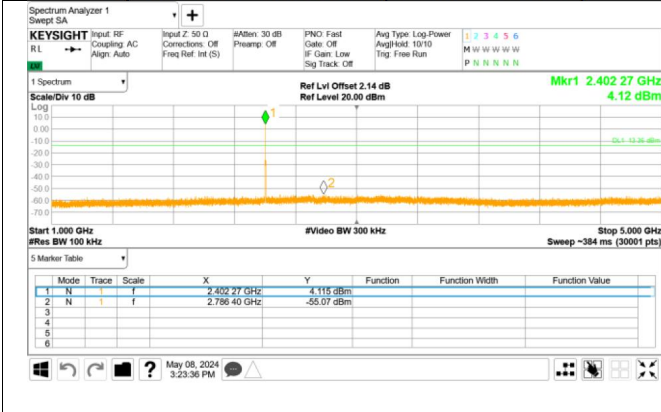
Reference point



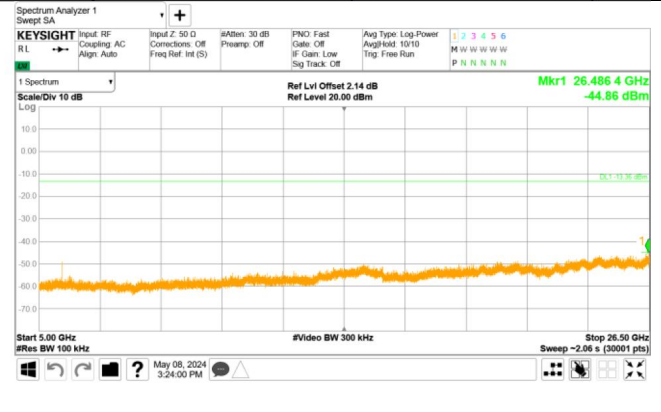
Spurious Emission (30MHz – 1GHz)



Spurious Emission (1GHz –5GHz)



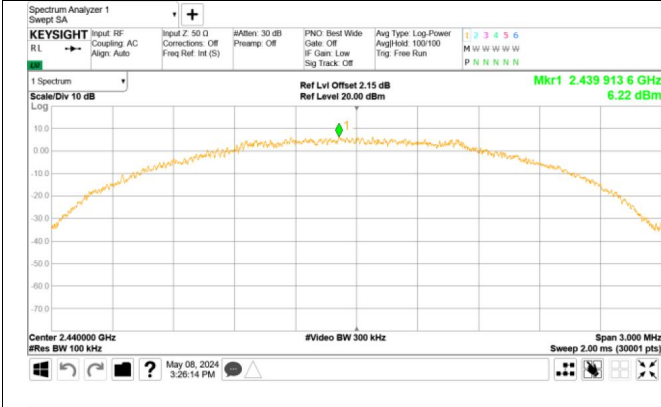
Spurious Emission (5GHz –26.5GHz)



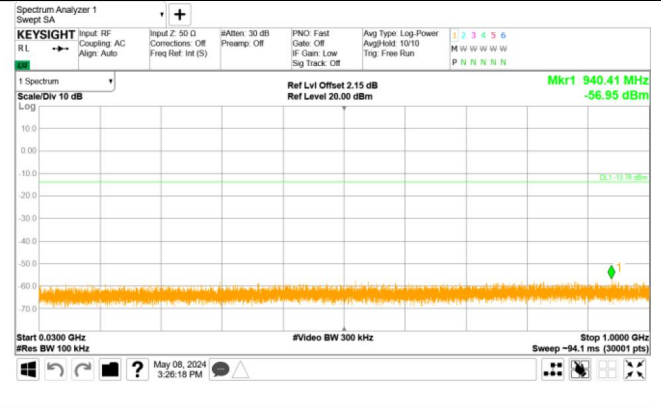


Out-of-Band Emissions (2Mbps)
Channel 19 (2440MHz)

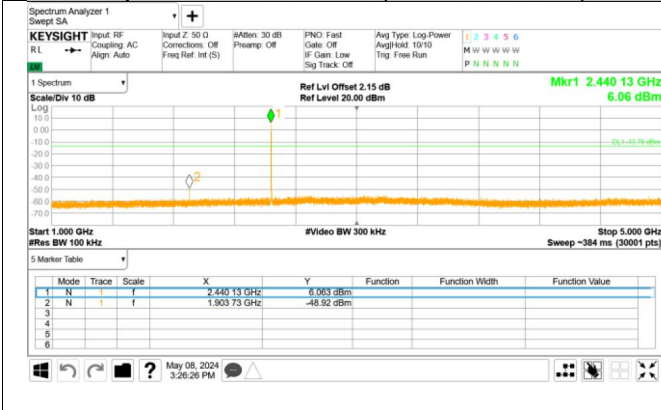
Reference point



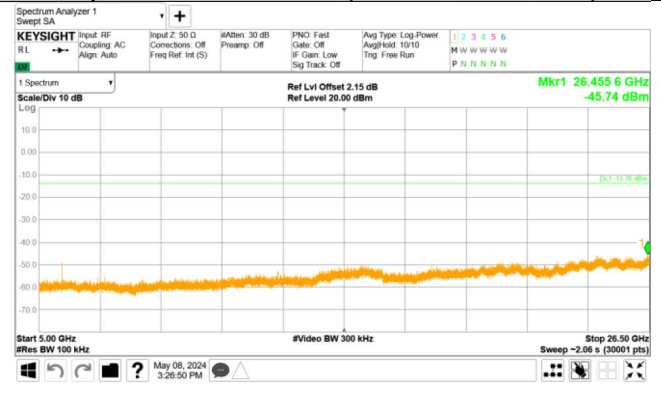
Spurious Emission (30MHz – 1GHz)



Spurious Emission (1GHz –5GHz)



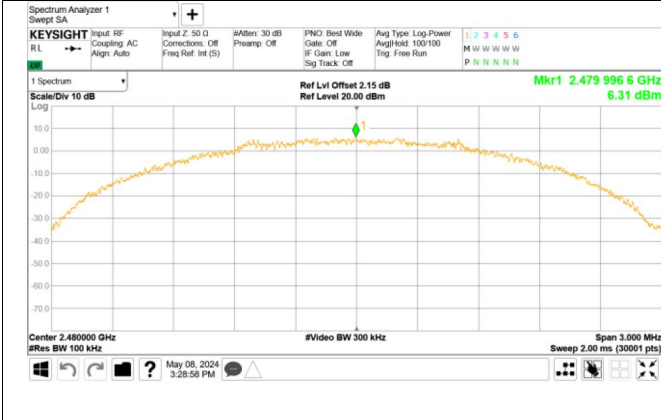
Spurious Emission (5GHz –26.5GHz)



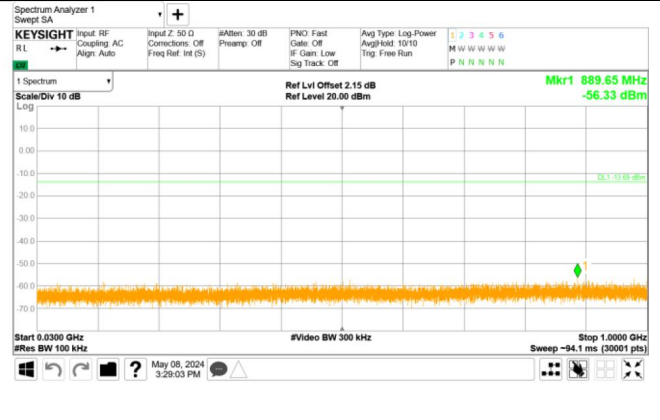


Out-of-Band Emissions (2Mbps) Channel 39 (2480MHz)

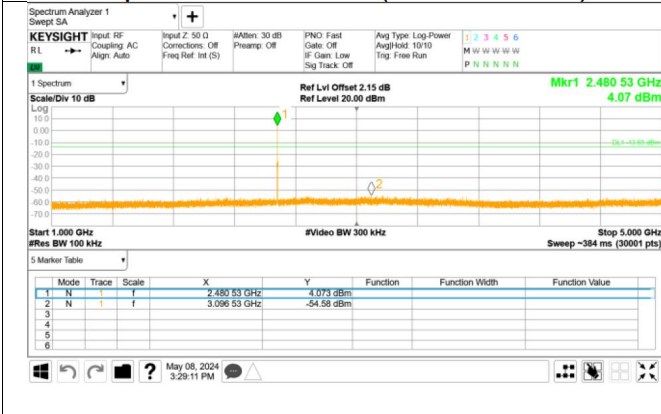
Reference point



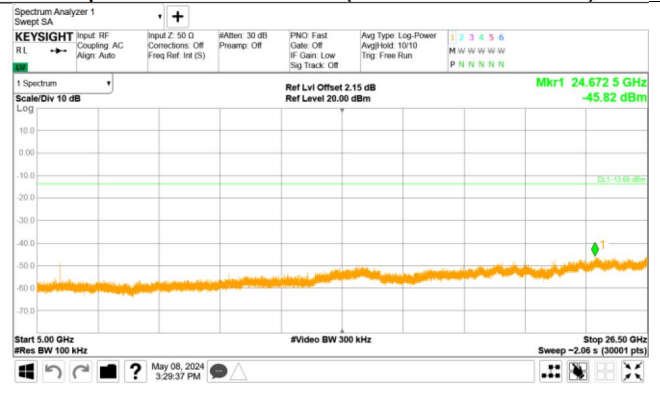
Spurious Emission (30MHz – 1GHz)



Spurious Emission (1GHz – 5GHz)



Spurious Emission (5GHz – 26.5GHz)





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 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), the attenuation required shall be 30 dB instead of 20 dB.

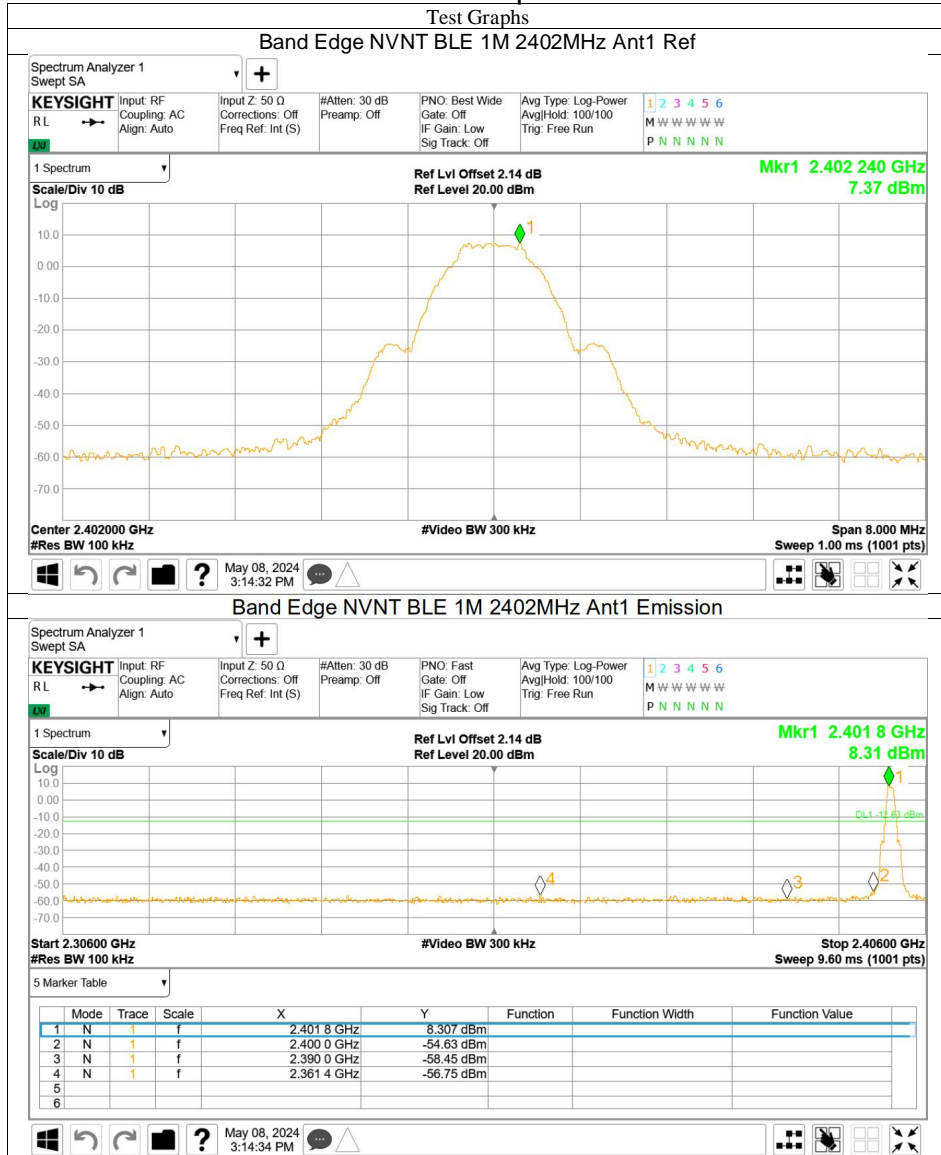
According to §15.247(d), band edge limit as below:

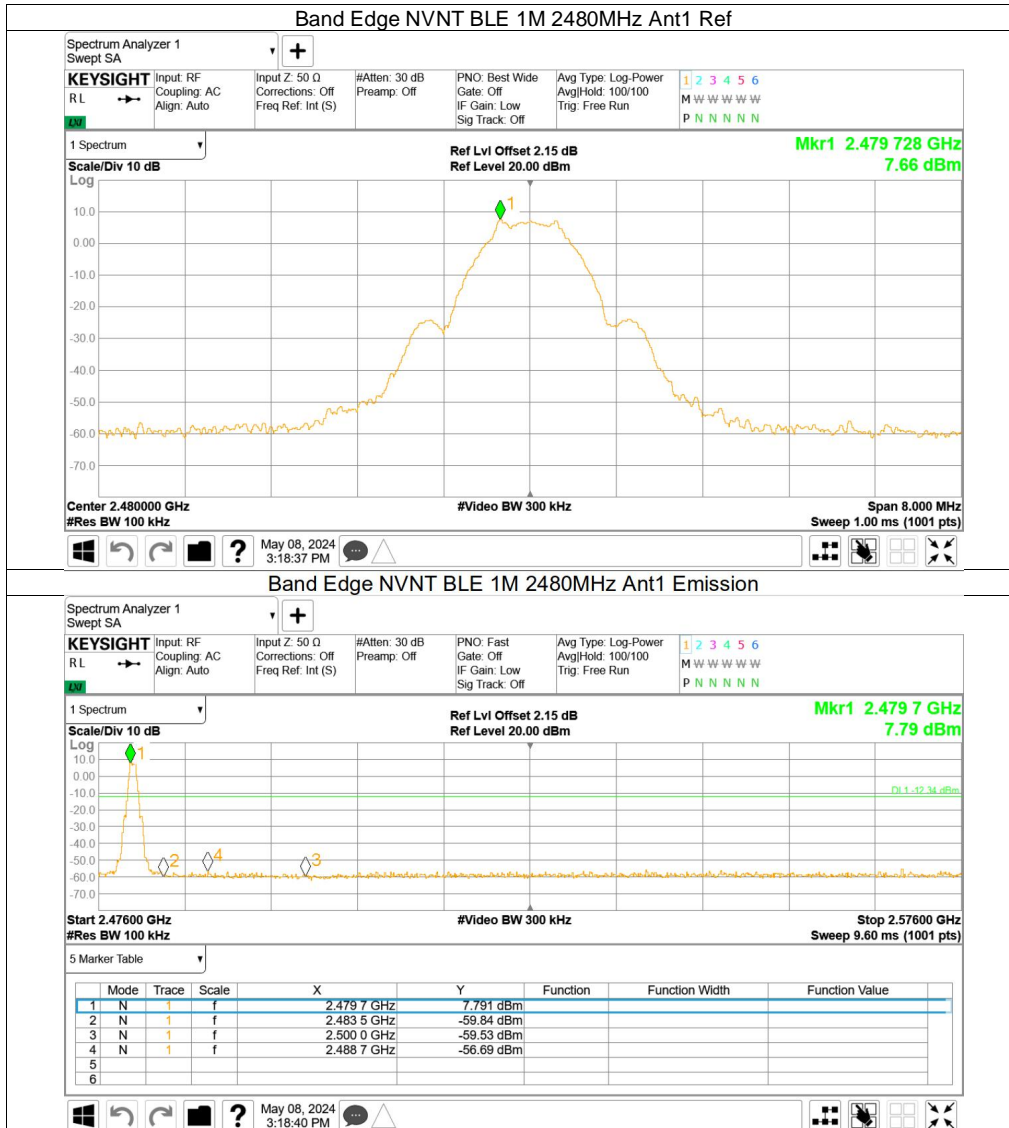
Frequency Range MHz	Limit (dBc)
30-25000	-20



Test result

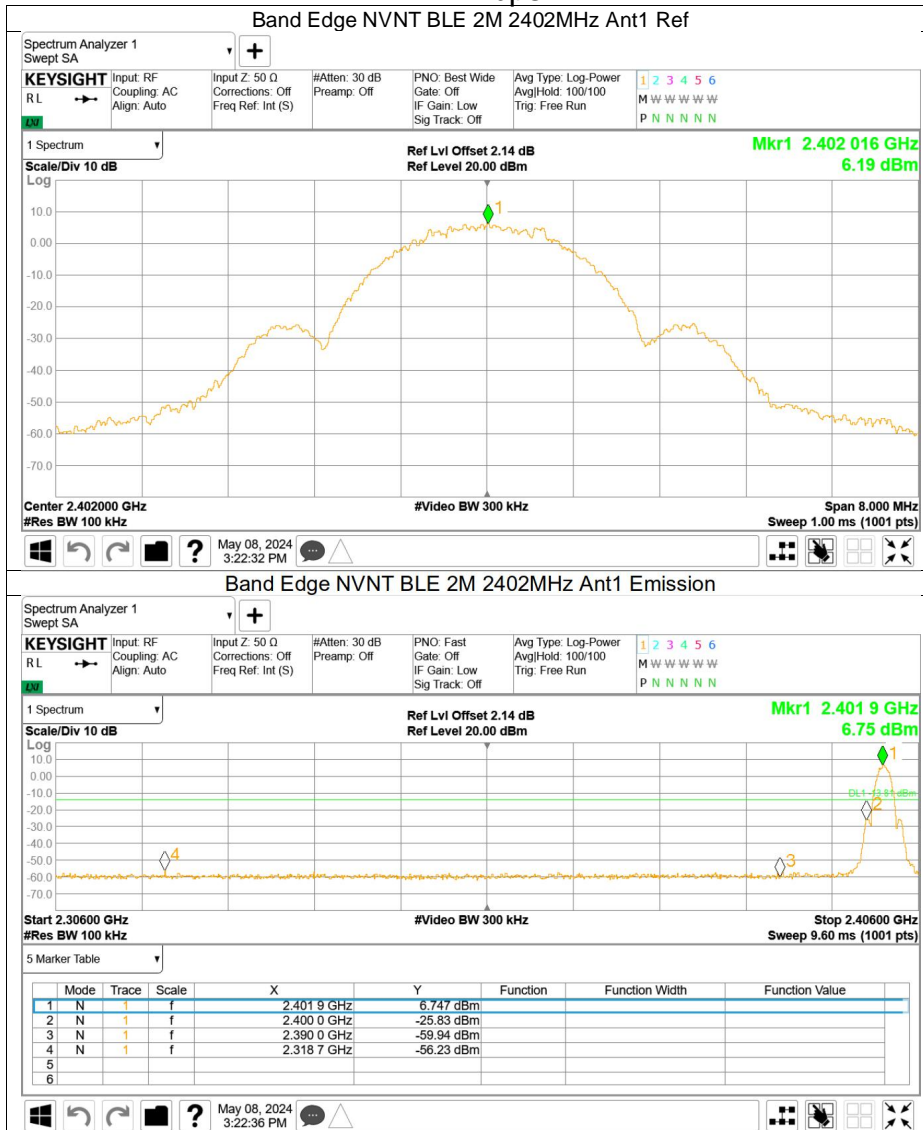
1Mbps

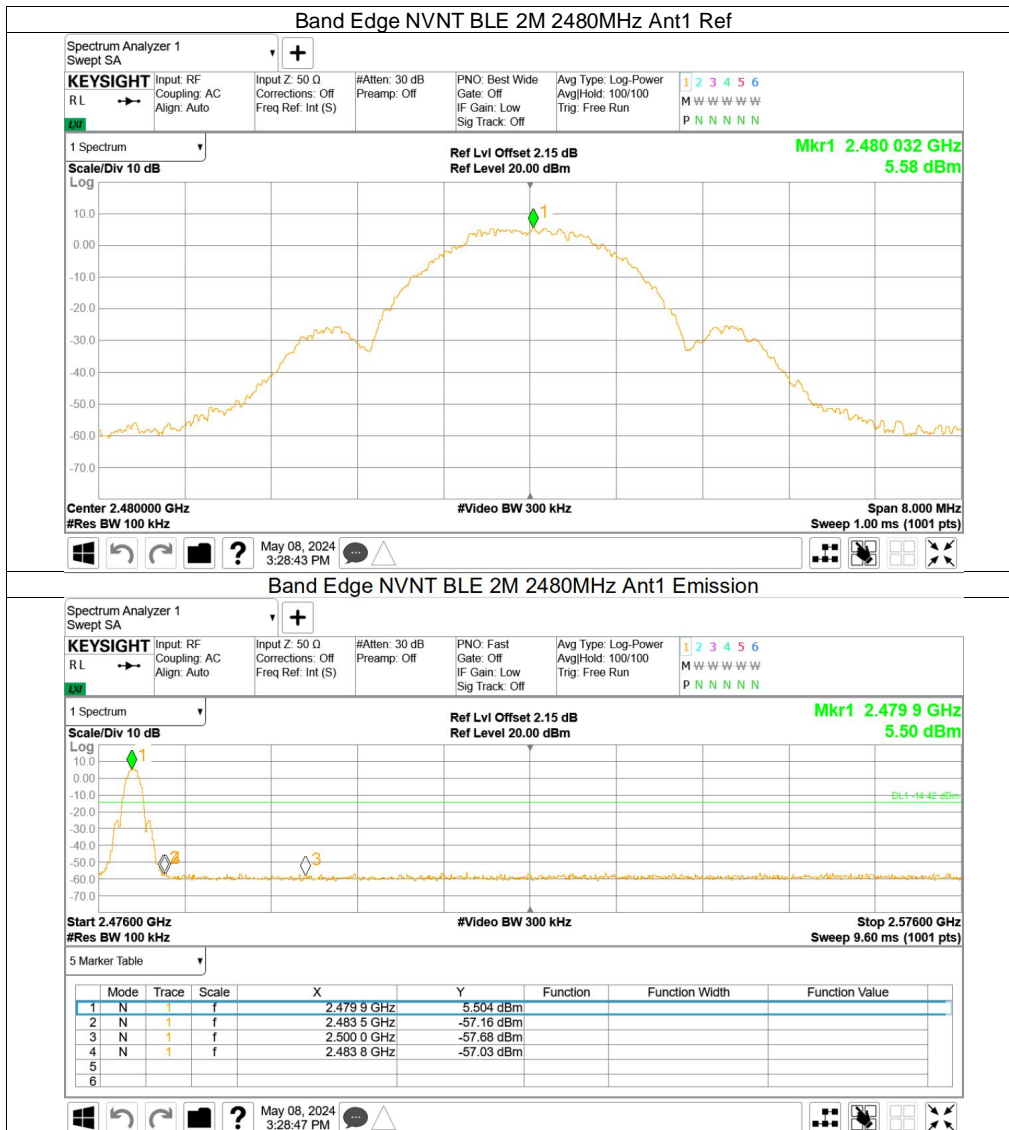






2Mbps





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
 - 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.



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), the attenuation required shall be 30 dB instead of 20 dB. Attenuation below the general field strength limits specified in § 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in § 15.205(a), must also comply with the radiated emission limits specified in § 15.209(a).

Frequency MHz	Field Strength $\mu\text{V/m}$	Field Strength dB $\mu\text{V/m}$	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(dB $\mu\text{V/m}$)=Limit 300m(dB $\mu\text{V/m}$)+40Log(300m/3m) (Below 30MHz)

Note 2: Limit 3m(dB $\mu\text{V/m}$)=Limit 30m(dB $\mu\text{V/m}$)+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.

Above 1GHz Transmitting spurious emission test result as below:

1Mbps

2402MHz

Frequency MHz	Emission Level dBuV/m	Polarization	Limit dBuV/m	Detector	Margin dBuV/m	Result
2379.4	40.15	Horizontal	74	PK	33.85	Pass
4803.2	45.17	Horizontal	74	PK	28.83	Pass
9607.3	47.76	Horizontal	74	PK	26.24	Pass
2383.9	41.17	Veritcal	74	PK	32.83	Pass
4803.7	47.94	Veritcal	74	PK	26.06	Pass
7205.0	47.19	Veritcal	74	PK	26.81	Pass
9608.3	50.09	Veritcal	74	PK	23.91	Pass

2440MHz

Frequency MHz	Emission Level dBuV/m	Polarization	Limit dBuV/m	Detector	Margin dBuV/m	Result
4880.2	44.80	Horizontal	74	PK	29.2	Pass
7320.2	46.94	Horizontal	74	PK	27.06	Pass
9760.8	49.49	Horizontal	74	PK	24.51	Pass
4879.1	49.51	Veritcal	74	PK	24.49	Pass
7319.7	46.75	Veritcal	74	PK	27.25	Pass
9759.2	48.82	Veritcal	74	PK	25.18	Pass

2480MHz

Frequency MHz	Emission Level dBuV/m	Polarization	Limit dBuV/m	Detector	Margin dBuV/m	Result
2483.6	42.98	Horizontal	74	PK	31.02	Pass
4960.4	44.47	Horizontal	74	PK	29.53	Pass
7439.8	48.86	Horizontal	74	PK	25.14	Pass
9919.1	49.05	Horizontal	74	PK	24.95	Pass
2483.6	43.02	Veritcal	74	PK	30.98	Pass
4960.4	48.59	Veritcal	74	PK	25.41	Pass
7439.2	48.10	Veritcal	74	PK	25.9	Pass
9918.6	48.09	Veritcal	74	PK	25.91	Pass



2Mbps
2402MHz

Frequency MHz	Emission Level dBuV/m	Polarization	Limit dBuV/m	Detector	Margin dBuV/m	Result
2379.4	40.07	Horizontal	74	PK	33.93	Pass
4802.6	44.26	Horizontal	74	PK	29.74	Pass
7207.6	48.98	Horizontal	74	PK	25.02	Pass
9607.3	47.59	Horizontal	74	PK	26.41	Pass
2382.7	40.21	Veritcal	74	PK	33.79	Pass
4803.2	43.20	Veritcal	74	PK	30.8	Pass
7204.4	47.80	Veritcal	74	PK	26.2	Pass
9606.2	49.49	Veritcal	74	PK	24.51	Pass

2440MHz

Frequency MHz	Emission Level dBuV/m	Polarization	Limit dBuV/m	Detector	Margin dBuV/m	Result
4880.8	44.30	Horizontal	74	PK	29.7	Pass
7321.3	48.87	Horizontal	74	PK	25.13	Pass
9761.9	50.26	Horizontal	74	PK	23.74	Pass
4880.7	45.70	Veritcal	74	PK	28.3	Pass
7318.1	49.54	Veritcal	74	PK	24.46	Pass
9761.9	50.82	Veritcal	74	PK	23.18	Pass

2480MHz

Frequency MHz	Emission Level dBuV/m	Polarization	Limit dBuV/m	Detector	Margin dBuV/m	Result
2483.5	43.14	Horizontal	74	PK	30.86	Pass
4959.4	44.28	Horizontal	74	PK	29.72	Pass
7441.4	48.83	Horizontal	74	PK	25.17	Pass
9918.1	48.4	Horizontal	74	PK	25.6	Pass
2483.5	43.06	Veritcal	74	PK	30.94	Pass
4958.9	47.97	Veritcal	74	PK	26.03	Pass
7441.4	48.17	Veritcal	74	PK	25.83	Pass
9921.8	47.39	Veritcal	74	PK	26.61	Pass

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

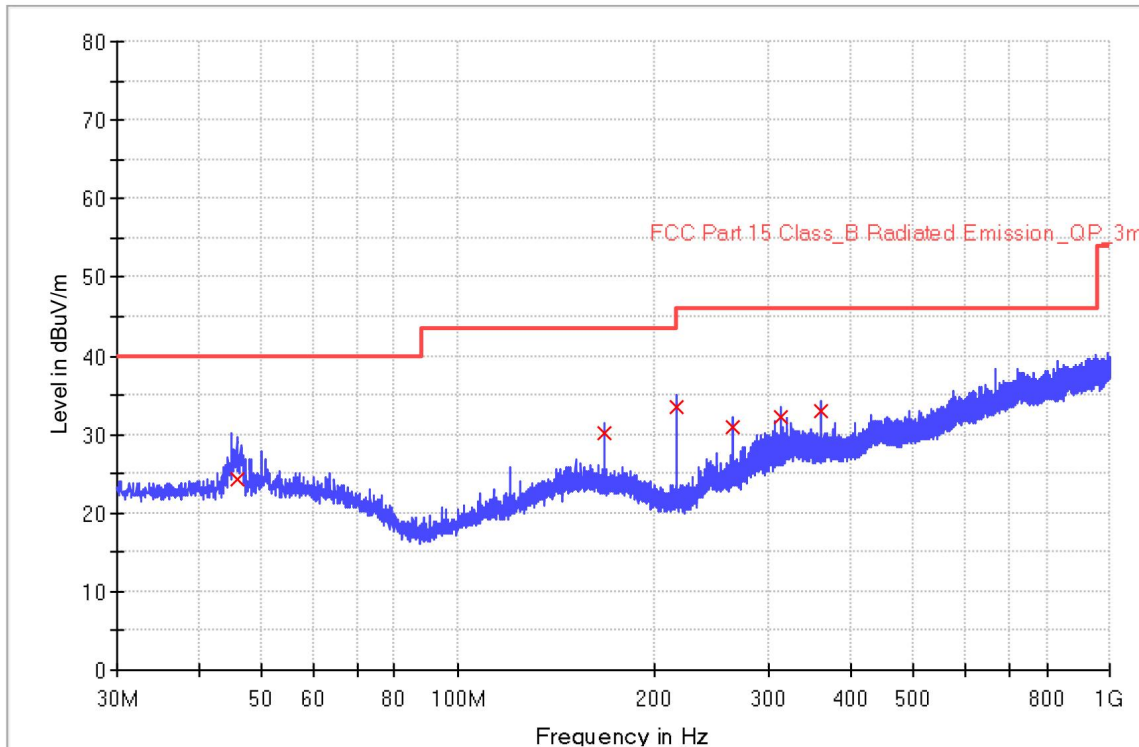
EUT Information

EUT Name: T8 Tube
 Model: U2CL2250-830 G13 1200-2
 Client: Zhejiang Lingzhu Technology CO., Ltd
 Op Cond: Power on, TX_2402MHz, 2Mbps, DC 3.3V, T20.9, H63.4%, P100.1Pa
 Operator: Huali CHENG
 Test Spec: FCC Part 15.247
 Comment: Horizontal
 Sample No: SHA-808518-2

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)
45.800000	24.3	1000.0	120.000	152.0	H	65.0	20.4	15.7	40.0
168.000000	30.2	1000.0	120.000	132.0	H	325.0	20.4	13.3	43.5
216.000000	33.6	1000.0	120.000	169.0	H	120.0	17.5	12.4	46.0
263.960000	31.0	1000.0	120.000	120.0	H	74.0	20.1	15.0	46.0
311.960000	32.3	1000.0	120.000	195.0	H	201.0	21.9	13.7	46.0
359.960000	32.9	1000.0	120.000	115.0	H	98.0	23.0	13.1	46.0



30-1000MHz Radiated Emission

EUT Information

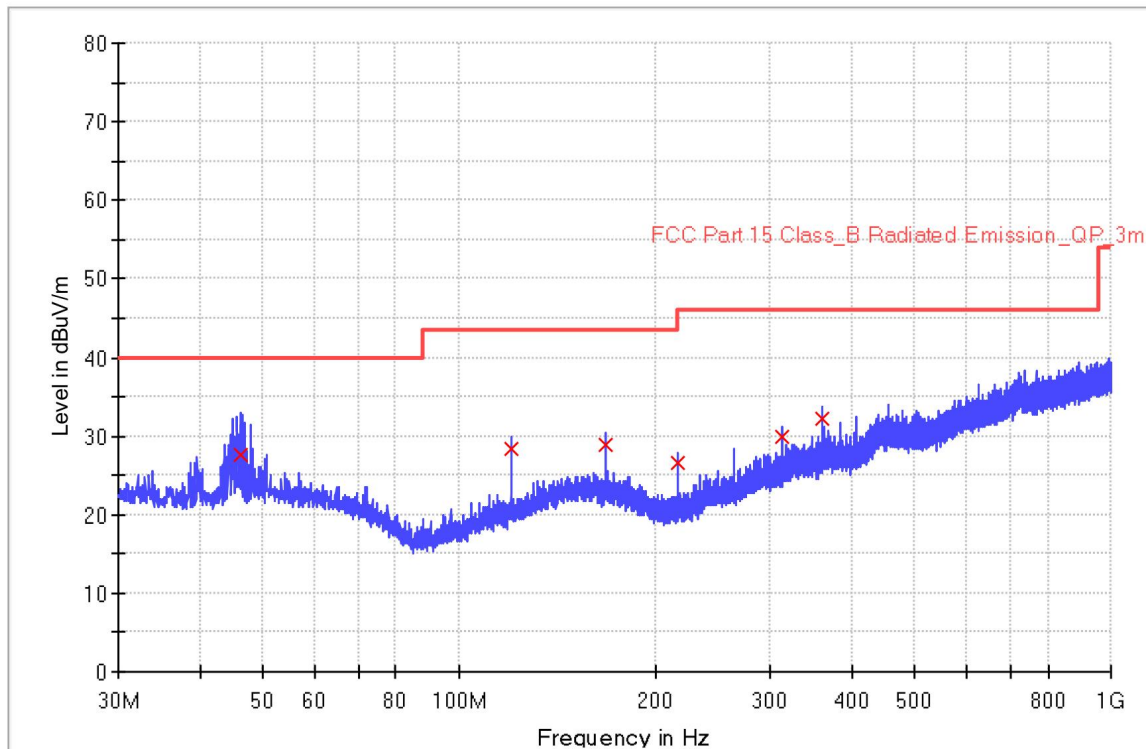
EUT Name: T8 Tube
 Model: U2CL2250-830 G13 1200-2
 Client: Zhejiang Lingzhu Technology CO., Ltd
 Op Cond: Power on, TX_2402MHz,2Mbps, DC 3.3V, T20.9, H63.4%, P100.1Pa
 Operator: Huali CHENG
 Test Spec: FCC Part 15.247
 Comment: Vertical
 Sample No: SHA-808518-2

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)
46.160000	27.6	1000.0	120.000	123.0	V	89.0	20.4	12.4	40.0
119.960000	28.4	1000.0	120.000	126.0	V	152.0	18.1	15.1	43.5
168.000000	29.0	1000.0	120.000	105.0	V	130.0	20.4	14.5	43.5
216.000000	26.6	1000.0	120.000	100.0	V	85.0	17.5	19.4	46.0
311.960000	29.8	1000.0	120.000	109.0	V	119.0	21.9	16.2	46.0
360.000000	32.3	1000.0	120.000	112.0	V	98.0	23.0	13.7	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 spectrum analyzer	Agilent	N9020B	MY59050168	2024-2-19	2025-2-18
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	2024-4-14	2027-4-13
	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
	3m Semi-anechoic chamber	TDK	9X6X6	----	2024-5-8	2027-5-7
CE	EMI Test Receiver	Rohde & Schwarz	ESR3	101907	2023-8-1	2024-7-31
	LISN	Rohde & Schwarz	ENV216	101924	2023-8-1	2024-7-31

Measurement Software Information			
Test Item	Software	Manufacturer	Version
C	MTS 8310	MWRFTtest	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: 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-----