

FCC/IC - TEST REPORT

Report Number : **709502310205-00B** Date of Issue: March 13, 2024

Model : SC155-WQ2, SC155-WQ3, SC155-WQ2A, SC155-WQ2B,
SC155-WQ2C, SC155-WQ3A, SC155-WQ3B, SC155-WQ3C,
SC155-WQ4, SC155-WQ4A, SC155-WQ4B, SC155-WQ4C,
SC155-WQ2D, SC55-WQ3D, SC155-WQ4D

Product Type : Smart Camera

Applicant : Zhejiang Lingzhu Technology Co., Ltd.

Address : Room 302, No 1 Building Huace Center, Xihu District, Hangzhou
City, Zhejiang Province, 31000, China

Manufacturer : Zhejiang Lingzhu Technology Co., Ltd.

Address : Room 302, No 1 Building Huace Center, Xihu District, Hangzhou
City, Zhejiang Province, 31000, China

Test Result : **n Positive** **o Negative**

Total pages including
Appendices : 52

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2 Report Modification Record

Alterations and additions to this report will be issued to the holders of each copy in the form of a complete document.

Issue	Description of Change	Date of Issue
709502310205-00B	First Issue	03/13/2024

3 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,
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Test Firm FCC
Registration
Number: 820234

Designation
number: CN1183

IC Company
Number: 31668

CAB identifier: CN0101

Telephone: +86 21 6141 0123
Fax: +86 21 6140 8600

4 Description of the Equipment under Test

Description of the Equipment Under Test

Product: Smart Camera

PMN / HVIN / Model no.: SC155-WQ2, SC155-WQ3, SC155-WQ2A, SC155-WQ2B, SC155-WQ2C, SC155-WQ3A, SC155-WQ3B, SC155-WQ3C, SC155-WQ4, SC155-WQ4A, SC155-WQ4B, SC155-WQ4C, SC155-WQ2D, SC55-WQ3D, SC155-WQ4D

FCC ID: 2BEWXSC155

IC: 32094-SC155

Rating: 5V DC, 1.5A

RF Transmission Frequency: 802.11b/g/n-HT20: 2412~2462 MHz (Wi-Fi)
802.11n-HT40: 2422~2452 MHz (Wi-Fi)
2402~2480 MHz (BLE5.0)

No. of Operated Channel: 2.4GHz WIFI: 11 for 802.11b/802.11g/802.11(H20)
7 for 802.11n(HT40)

Modulation: For 2.4GHz WIFI:
Direct Sequence Spread Spectrum (DSSS) for 802.11b
Orthogonal Frequency Division Multiplexing (OFDM) for 802.11g/n
For 2.4GHz BLE:
GFSK (1Mbps and 2Mbps)

Channel list:

802.11b/g/n(HT20)				802.11n(HT40)			
Ch	Fre(MHz)	Ch	Fre(MHz)	Ch	Fre(MHz)	Ch	Fre(MHz)
1	2412	7	2442	3	2422	8	2447MHz
2	2417	8	2447	4	2427	9	2452MHz
3	2422	9	2452	5	2432		
4	2427	10	2457	6	2437		
5	2432	11	2462	7	2442		
6	2437						

Bluetooth Low Energy							
Ch	Fre(MHz)	Ch	Fre(MHz)	Ch	Fre(MHz)	Ch	Fre(MHz)
0	2402	10	2422	20	2442	30	2462
1	2404	11	2424	21	2444	31	2464
2	2406	12	2426	22	2446	32	2466
3	2408	13	2428	23	2448	33	2468
4	2410	14	2430	24	2450	34	2470
5	2412	15	2432	25	2452	35	2472
6	2414	16	2434	26	2454	36	2474
7	2416	17	2436	27	2456	37	2476
8	2418	18	2438	28	2458	38	2478
9	2420	19	2440	29	2460	39	2480

Hardware Version: V1.0.1

Software Version: V1

Antenna Type: FPC Antenna

Antenna Gain: 0.48dBi

Description of the EUT: The EUT was a Smart Camera. The Smart Camera has Wi-Fi and BLE function. We tested the Smart Camera and listed the worst data in this report. This report is only for BLE.

Test sample no.: SHA-785720-1 (Conducted sample)
SHA-785720-2 (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.



5 Summary of Test Standards

Test Standards	
FCC Part 15 Subpart C	PART 15 - RADIO FREQUENCY DEVICES Subpart C - Intentional Radiators
RSS-Gen Issue 5 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 Meas Guidance v05r02 and ANSI C63.10 (2013).

6 Summary of Test Results

Technical Requirements						
Test Condition		Pages	Test Site	Test Result		
				Pass	Fail	N/A
§15.207 & RSS-GEN 8.8	Conducted emission AC power port	13-17	Site 1	☒	☐	☐
§15.247 (b) (3) & RSS-247 5.4(d)	Conducted peak output power	18-20	Site 1	☒	☐	☐
§15.247(a)(1) & RSS-247 5.1(b)	20dB 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	---	---	☐	☐	☒
§15.247(a)(2) & RSS-247 5.2(a) & RSS-GEN 6.7	6dB bandwidth and 99% Occupied Bandwidth	21-25	Site 1	☒	☐	☐
§15.247(e) & RSS-247 5.2(b)	Power spectral density	26-28	Site 1	☒	☐	☐
§15.247(d) & RSS-247 5.5	Spurious RF conducted emissions	29-35	Site 1	☒	☐	☐
§15.247(d) & RSS-247 5.5	Band edge	36-40	Site 1	☒	☐	☐
§15.247(d) & §15.209 & RSS-247 5.5 & RSS-Gen 6.13	Spurious radiated emissions for transmitter	41-48	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 PCB antenna, which gain is 0.48dBi. In accordance to §15.203, It is considered sufficiently to comply with the provisions of this section.



7 General Remarks

Remarks

This submittal(s) (test report) is intended for FCC ID: 2BEWXSC155, IC: 32094-SC155 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 2.4G BLE.

According to the client's declaration, all models are identical except for different model name only for differentiate when sold in different regions.

So model SC155-WQ3 was chosen to perform all the tests, another other models are deemed to fulfill all the requirement without further testing.

SUMMARY:

All tests according to the regulations cited on page 5 were

n - Performed

o - **Not** Performed

The Equipment under Test

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

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

Sample Received Date: January 5, 2024

Testing Start Date: January 8, 2024

Testing End Date: January 30, 2024

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

Reviewed by:

Prepared by:

Tested by:

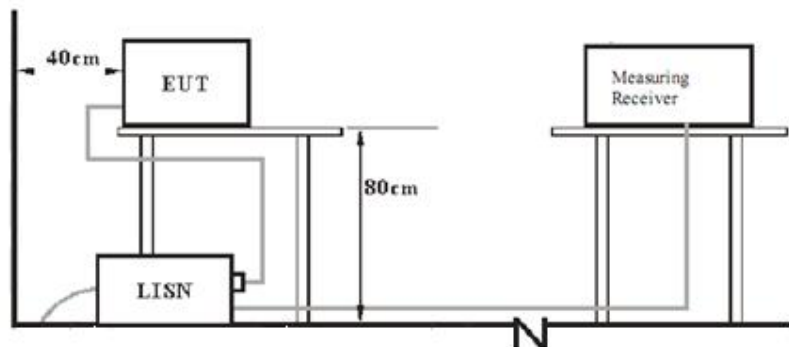
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Jiaxi XU
Project Manager

Chengjie GUO
Test Engineer

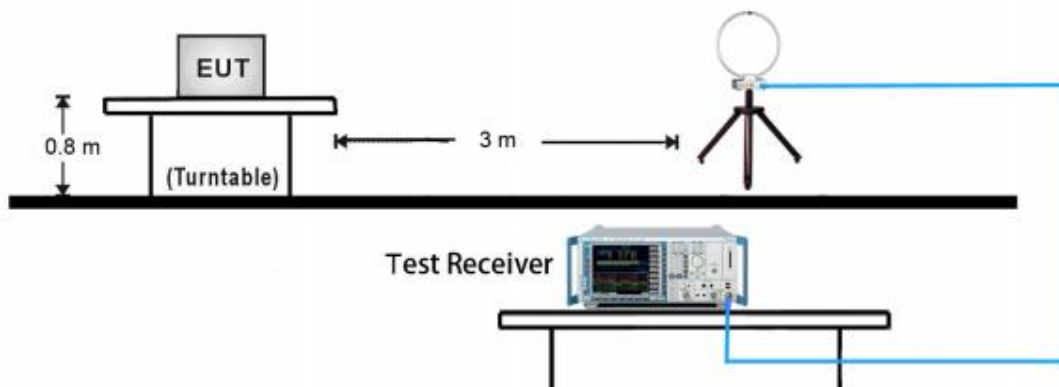
8 Test Setups

7.1 AC Power Line Conducted Emission test setups

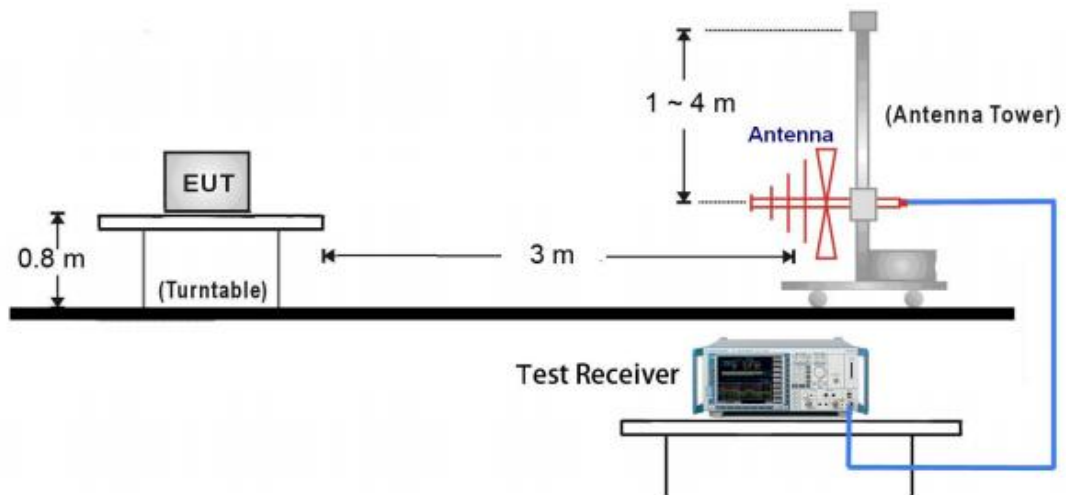


7.2 Radiated test setups

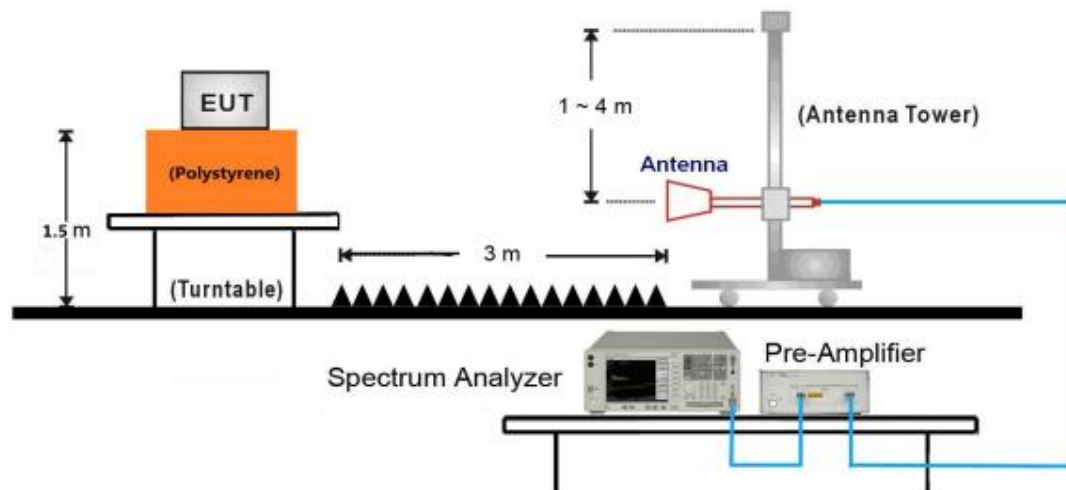
9kHz ~ 30MHz Test Setup:



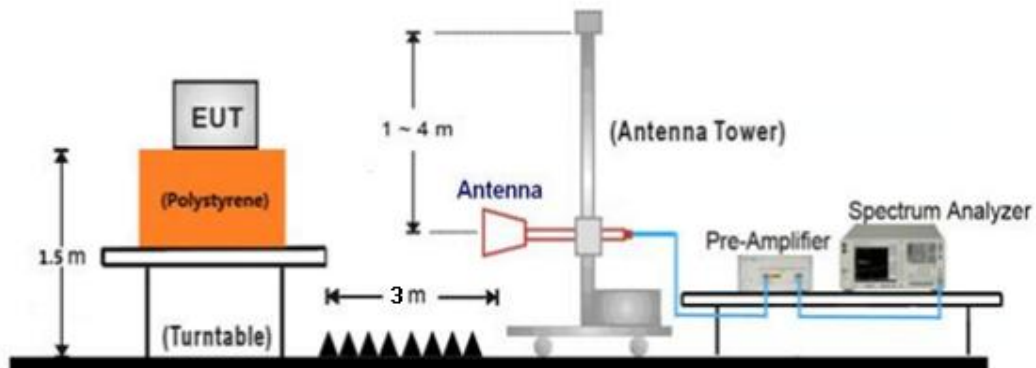
30MHz ~ 1GHz Test Setup:



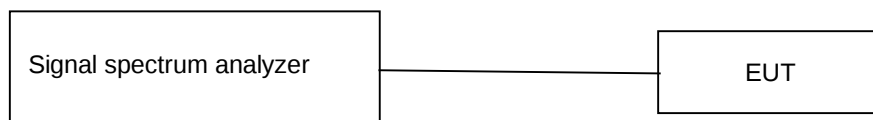
1GHz ~ 18GHz Test Setup:



18GHz ~ 25GHz Test Setup:



7.3 Conducted RF test setups



9 Systems test configuration

Auxiliary Equipment Used during Test:

DESCRIPTION	MANUFACTURER	MODEL NO.(SHIELD)	S/N(LENGTH)
Notebook	Lenovo	E470	PF-OU5TS7 17/09
AC/DC adapter	MLF	MLF-A260502000UU	--
Solar Panel	--	--	--

Test software: RTLBTAPP.exe, which used to control the EUT in continues transmitting mode.

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

Test Mode Applicability and Tested Channel Detail:

Mode	Tested Channel	Data Rate (Mbps)	Modulation	Index Value (Power level setting)
Bluetooth LE	0	1	GFSK	00
	19	1	GFSK	00
	39	1	GFSK	00
Bluetooth LE	0	2	GFSK	00
	19	2	GFSK	00
	39	2	GFSK	00

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.

10 Technical Requirement

10.1 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

According to §15.207 & RSS-GEN 8.8, 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

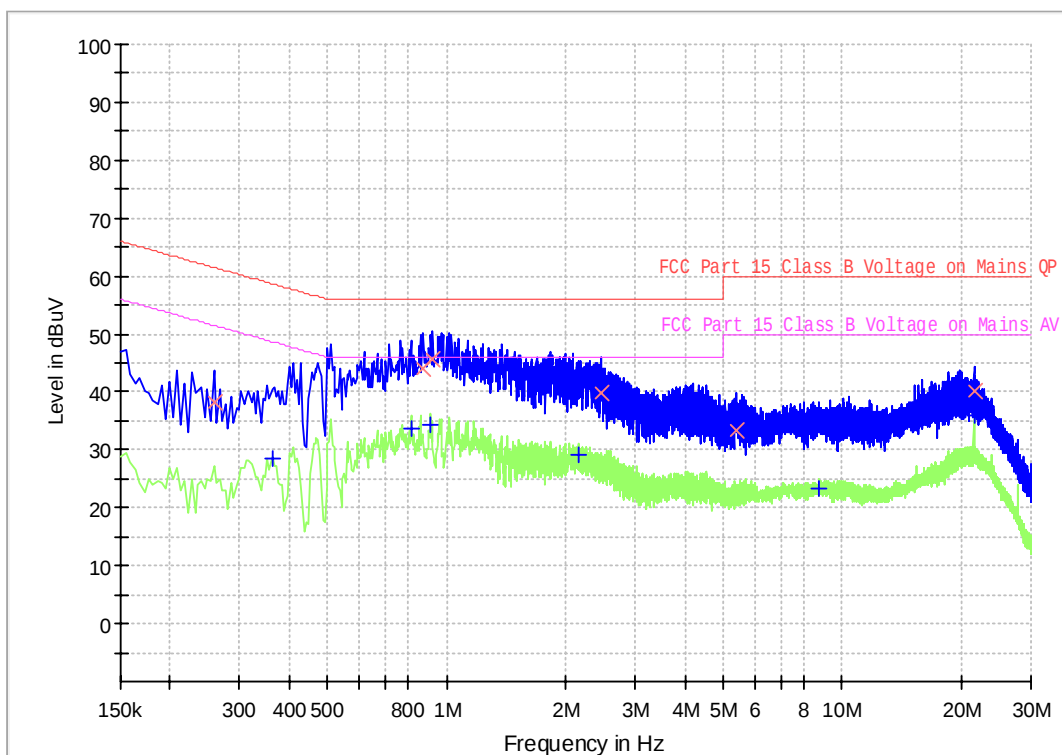
EUT Information

EUT Name: Smart Camera
 Model: SC155-WQ3
 Client: Zhejiang Lingzhu Technology Co., Ltd
 Op Cond: Power on and charging, TX_2402MHz at 2Mbps mode,
 AC 120V/60Hz, T21.5, H43.3%, P103.4kPa
 Operator: Chengjie GUO
 Standard: FCC Part 15.207(a)
 Comment: Phase L
 Sample No.: SHA-785720-2

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)
0.258000	38.19	---	61.50	23.31	1000.0	9.000	L1	19.4
0.361500	---	28.52	48.69	20.17	1000.0	9.000	L1	19.5
0.811500	---	33.59	46.00	12.41	1000.0	9.000	L1	19.5
0.874500	44.02	---	56.00	11.98	1000.0	9.000	L1	19.5
0.910500	---	34.40	46.00	11.60	1000.0	9.000	L1	19.5
0.924000	45.51	---	56.00	10.49	1000.0	9.000	L1	19.5
2.148000	---	29.18	46.00	16.82	1000.0	9.000	L1	19.5
2.454000	39.78	---	56.00	16.22	1000.0	9.000	L1	19.5
5.419500	33.27	---	60.00	26.73	1000.0	9.000	L1	19.6
8.763000	---	23.19	50.00	26.81	1000.0	9.000	L1	19.8
21.502500	---	35.81	50.00	14.19	1000.0	9.000	L1	20.7
21.507000	40.07	---	60.00	19.93	1000.0	9.000	L1	20.7

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

Factor (dB) = Cable Loss (dB) + LISN Factor (dB) + 10dB Attenuator

150k-30MHz Conducted Emission Test

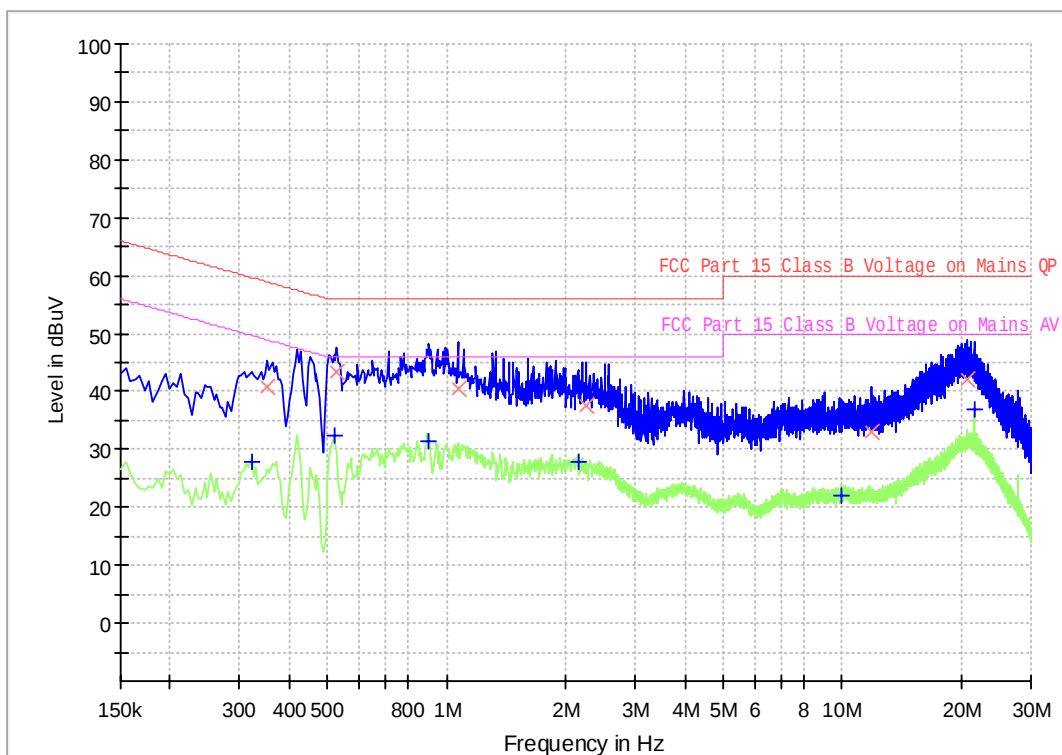
EUT Information

EUT Name: Smart Camera
 Model: SC155-WQ3
 Client: Zhejiang Lingzhu Technology Co., Ltd
 Op Cond: Power on and charging, TX_2402MHz at 2Mbps mode,
 AC 120V/60Hz, T21.5, H43.3%, P103.4kPa
 Operator: Chengjie GUO
 Standard: FCC Part 15.207(a)
 Comment: Phase N
 Sample No.: SHA-785720-2

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	Preamplifier
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)
0.321000	---	27.76	49.68	21.92	1000.0	9.000	N	19.5
0.352500	40.92	---	58.90	17.98	1000.0	9.000	N	19.5
0.519000	---	32.33	46.00	13.67	1000.0	9.000	N	19.5
0.528000	43.29	---	56.00	12.71	1000.0	9.000	N	19.5
0.901500	---	31.29	46.00	14.71	1000.0	9.000	N	19.5
1.068000	40.61	---	56.00	15.39	1000.0	9.000	N	19.5
2.148000	---	27.87	46.00	18.13	1000.0	9.000	N	19.5
2.256000	37.48	---	56.00	18.52	1000.0	9.000	N	19.5
9.928500	---	22.16	50.00	27.84	1000.0	9.000	N	19.7
11.890500	32.93	---	60.00	27.07	1000.0	9.000	N	19.8
20.733000	41.96	---	60.00	18.04	1000.0	9.000	N	20.2
21.502500	---	36.91	50.00	13.09	1000.0	9.000	N	20.4

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

Factor (dB) = Cable Loss (dB) + LISN Factor (dB) + 10dB Attenuator

10.2 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) & RSS-247 5.4(d), conducted peak output power limit as below:

Conducted peak output power

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

e.i.r.p

Frequency Range MHz	Limit W	Limit dBm
2400-2483.5	≤ 4	≤ 36

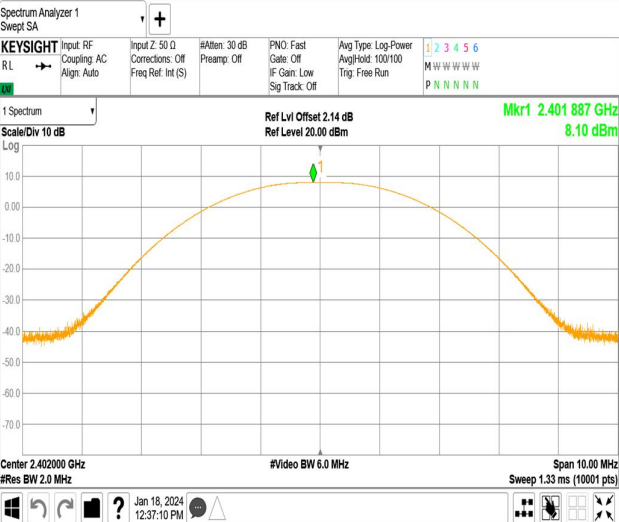
Test result as below table

Antenna gain= 0.48 dBi							
Data transmission Rate	Frequency (MHz)	Conducted Peak Output Power (dBm) §15.247 (b) (3)			e.i.r.p. (dBm) RSS-247 5.4(d)		
		Result	limit	Verdict	Result	limit	Verdict
1Mbps	2402MHz	8.10	≤ 30	Pass	8.58	≤ 36	Pass
	2440MHz	8.05	≤ 30	Pass	8.53	≤ 36	Pass
	2480MHz	7.38	≤ 30	Pass	7.86	≤ 36	Pass
2Mbps	2402MHz	8.22	≤ 30	Pass	8.70	≤ 36	Pass
	2440MHz	8.20	≤ 30	Pass	8.68	≤ 36	Pass
	2480MHz	7.54	≤ 30	Pass	8.02	≤ 36	Pass

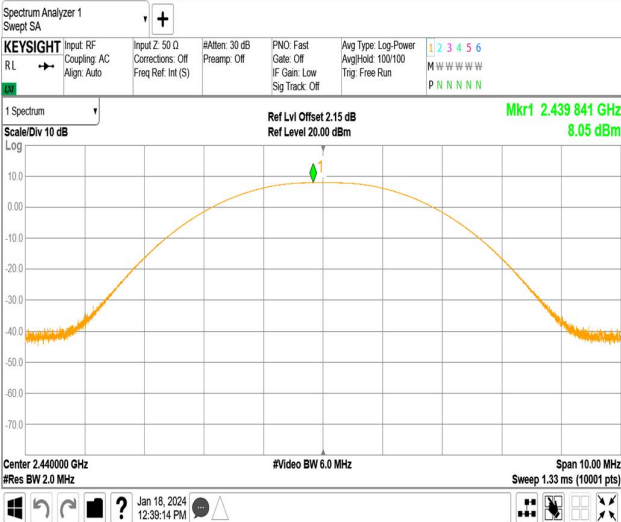


Peak output power (1Mbps)

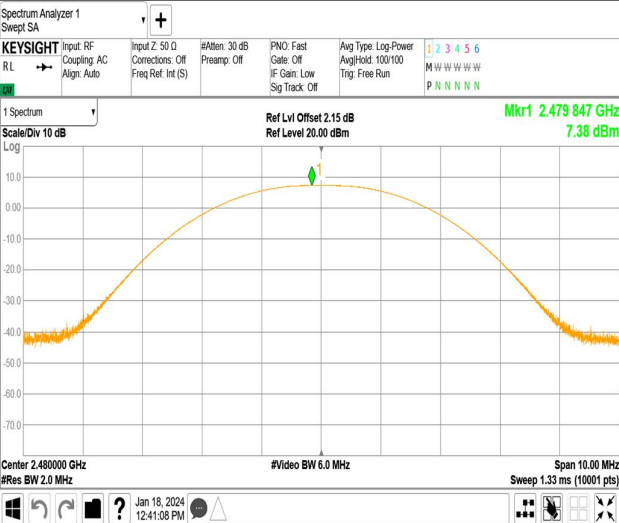
Channel 0 (2402MHz)



Channel 19 (2440MHz)



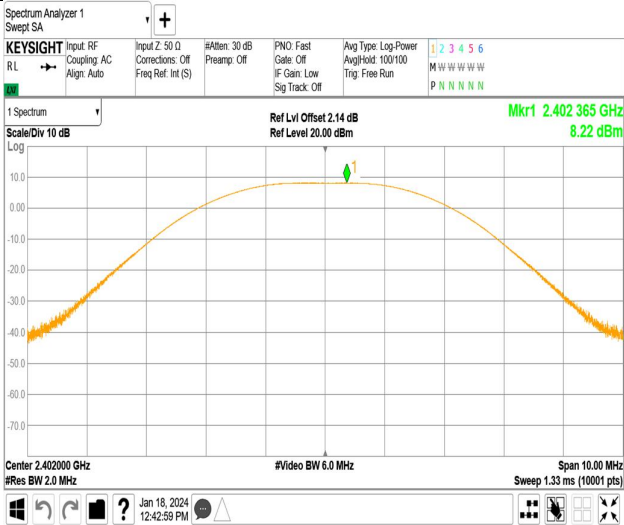
Channel 39 (2480MHz)



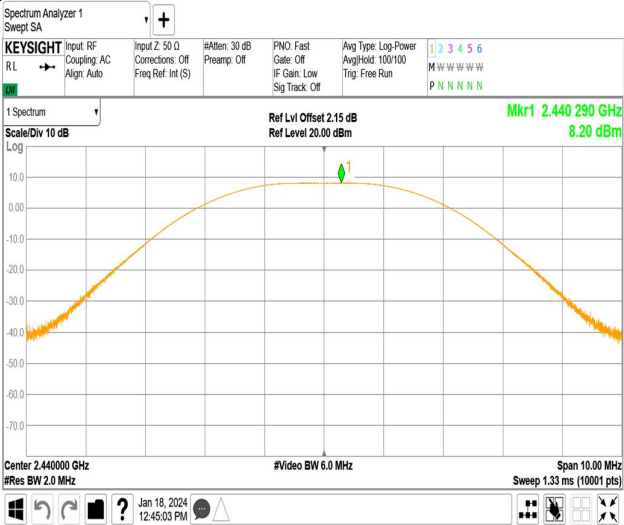


Peak output power (2Mbps)

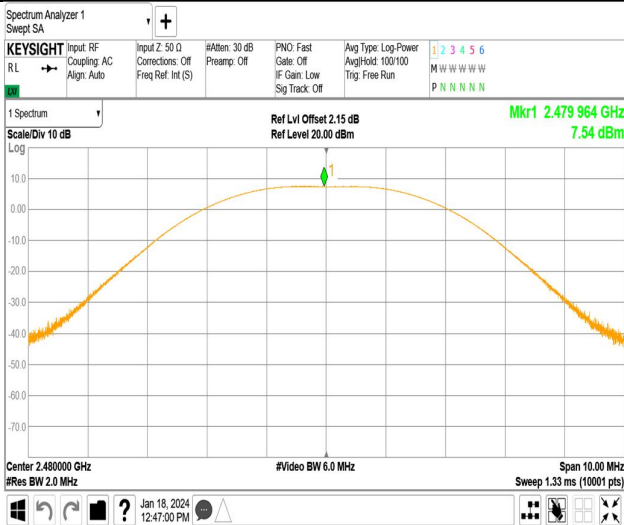
Channel 0 (2402MHz)



Channel 19 (2440MHz)



Channel 39 (2480MHz)



10.36dB bandwidth and 99% Occupied 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 Method for 99 % Bandwidth

1. Use the following spectrum analyzer settings:
RBW=1% to 5% of the actual occupied, VBW $\geq$ 3RBW, Sweep = auto, Detector function = peak, Trace = max hold
2. Use the automatic bandwidth measurement capability of an instrument, 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]

N/A

Test result

Data transmission rate	Frequency MHz	6dB bandwidth (MHz)		Result	99% occupied bandwidth MHz
		result	limit	verdict	
1Mbps	2402	0.655	≥ 0.5	Pass	1.031
	2440	0.665	≥ 0.5	Pass	1.035
	2480	0.646	≥ 0.5	Pass	1.039
2Mbps	2402	1.126	≥ 0.5	Pass	2.043
	2440	1.125	≥ 0.5	Pass	2.048
	2480	1.113	≥ 0.5	Pass	2.046



6dB Bandwidth

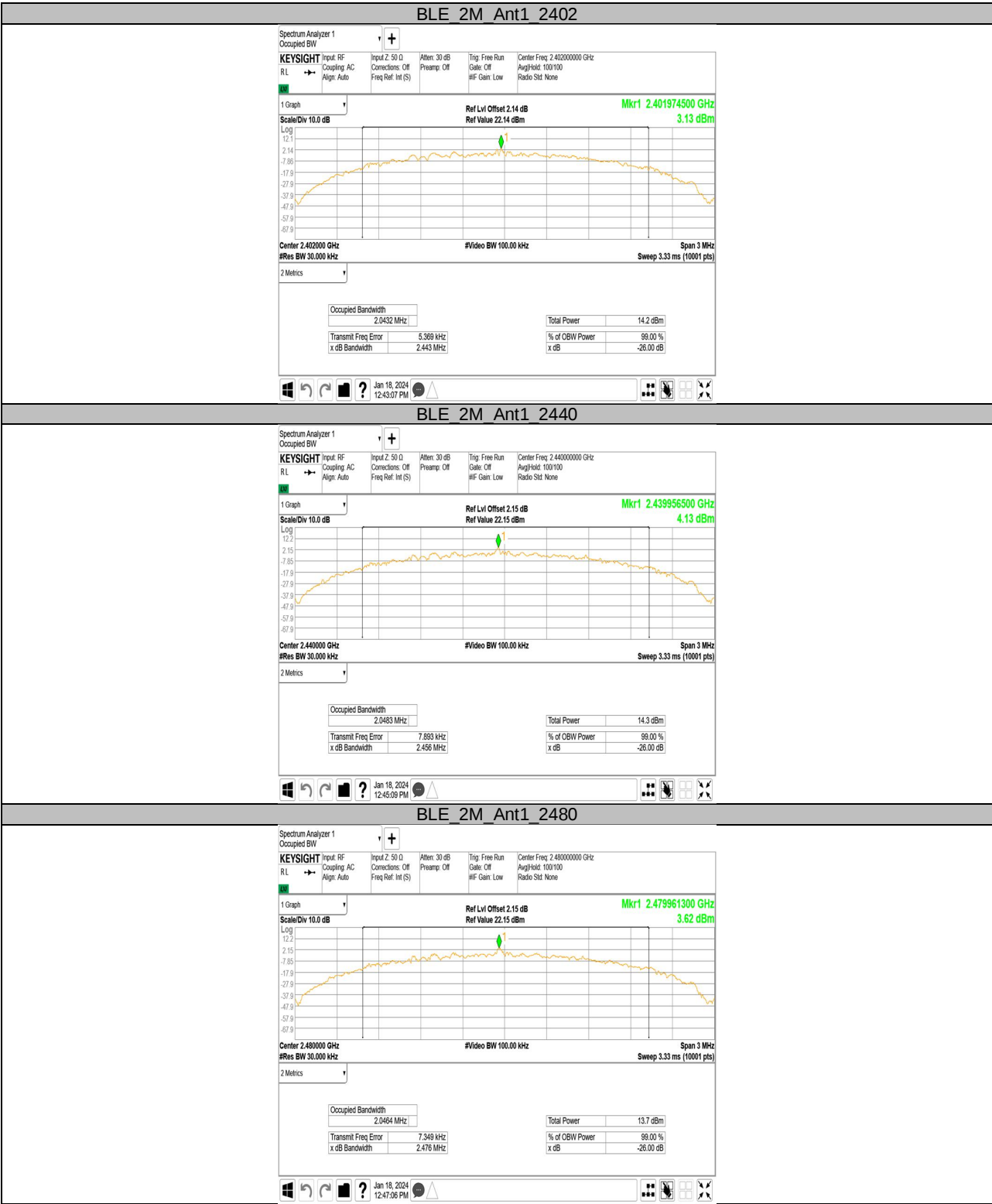






99% Bandwidth





10.4 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.

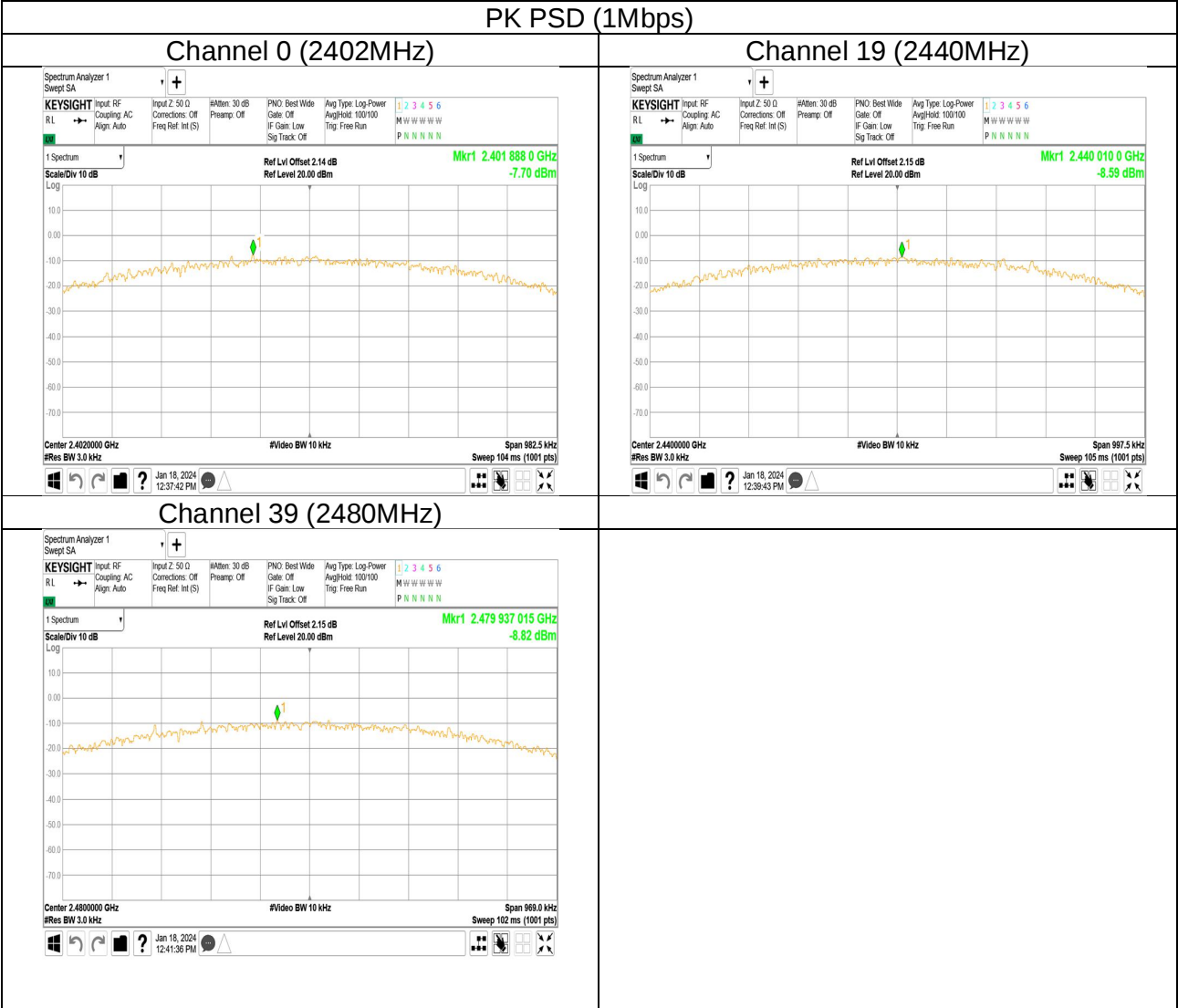
Limit

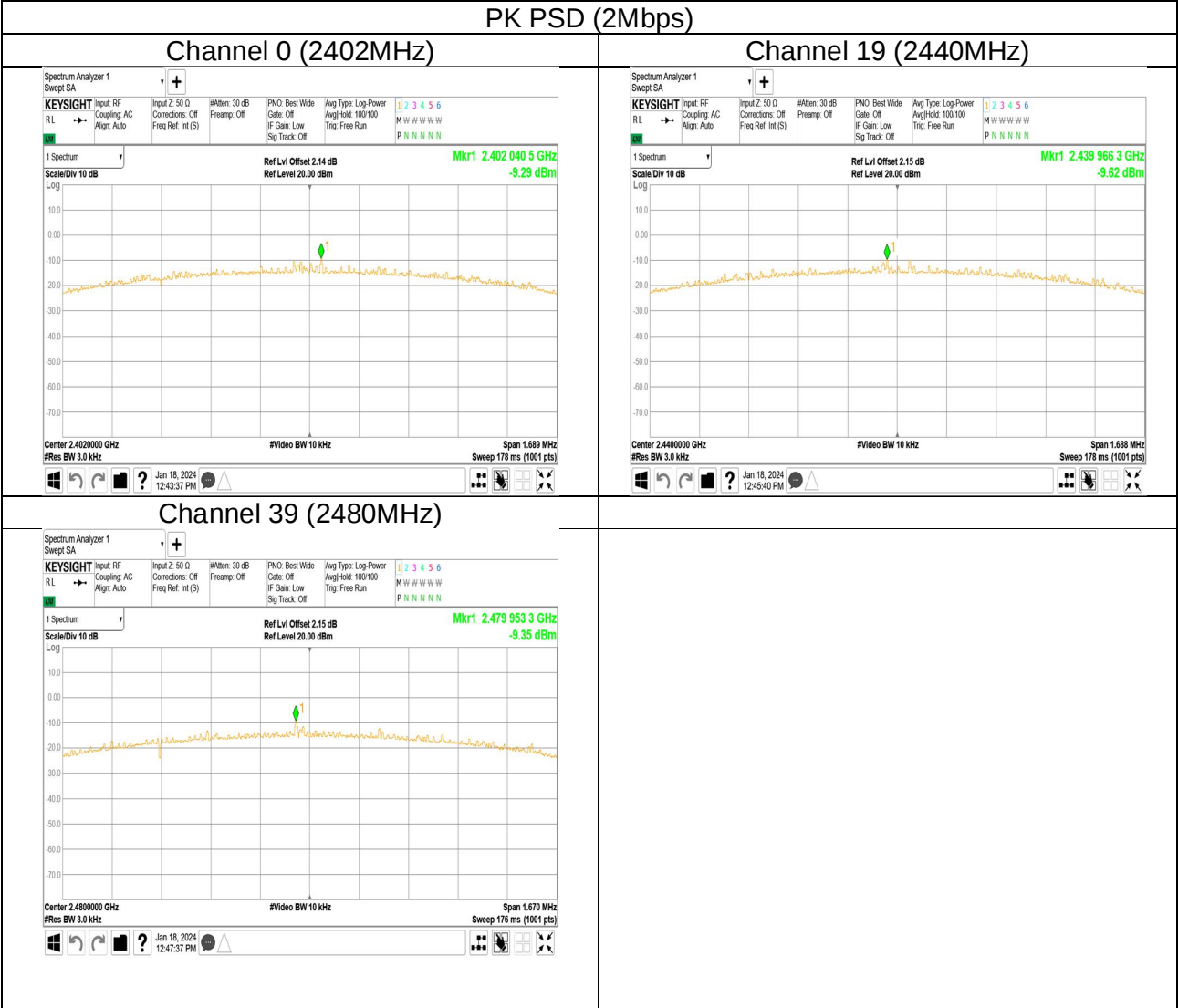
Limit [dBm/3kHz]

≤ 8

Test result

Data transmission rate	Frequency	Power spectral density	Result
1Mbps	MHz	dBm/3kHz	
	Top channel 2402MHz	-7.7	Pass
	Middle channel 2440MHz	-8.6	Pass
	Bottom channel 2480MHz	-8.82	Pass
2Mbps	Top channel 2402MHz	-9.29	Pass
	Middle channel 2440MHz	-9.63	Pass
	Bottom channel 2480MHz	-9.35	Pass





10.5 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

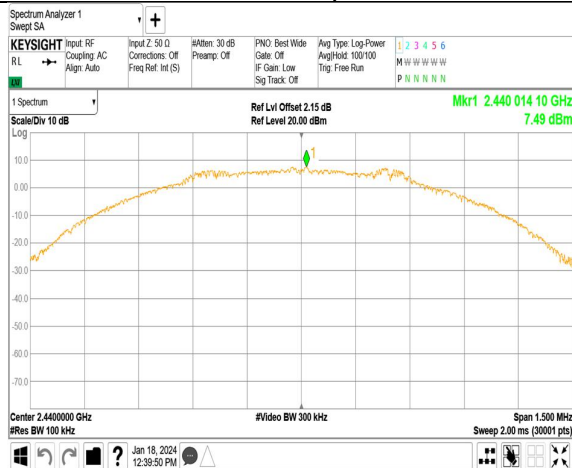
Frequency Range MHz	Limit (dBc)
30-25000	-20

5 Marker Table						
	Mode	Trace	Scale	X	Y	Function
1	N	1	f	2.401 87 GHz	5.964 dBm	Function Width
2	N	1	f	4.804 53 GHz	-50.41 dBm	Function Value
3						
4						
5						
6						

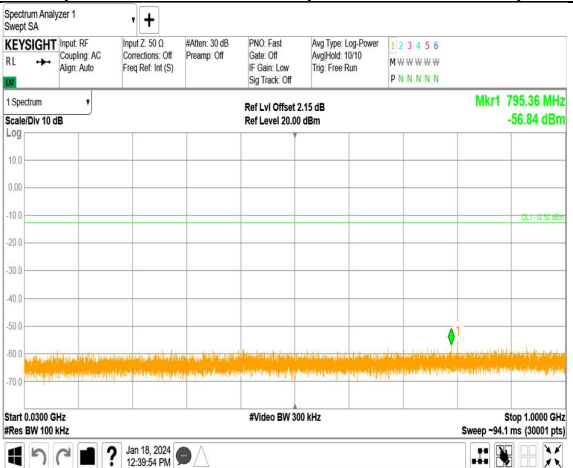


Out-of-Band Emissions (1Mbps)
Channel 19 (2440MHz)

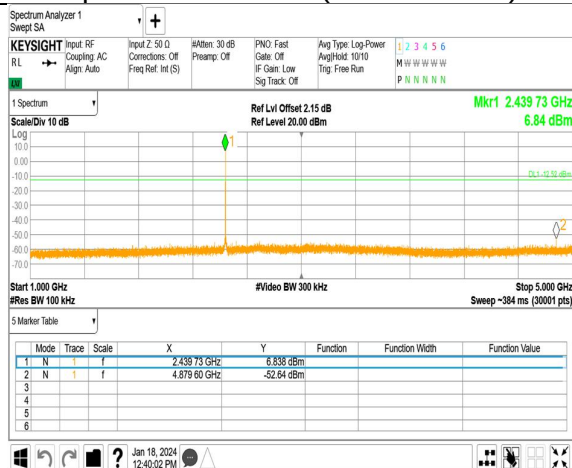
Reference point



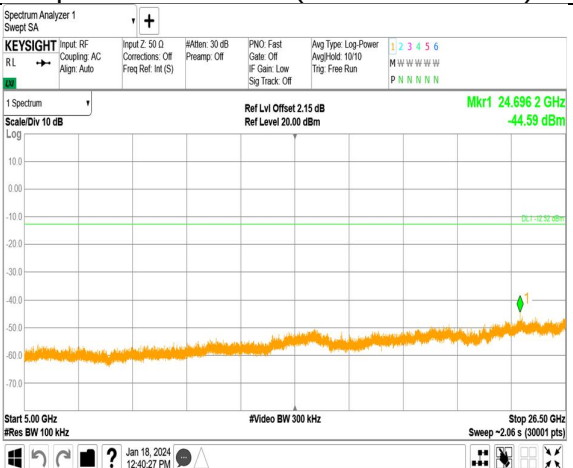
Spurious Emission (30MHz – 1GHz)



Spurious Emission (1GHz – 5GHz)



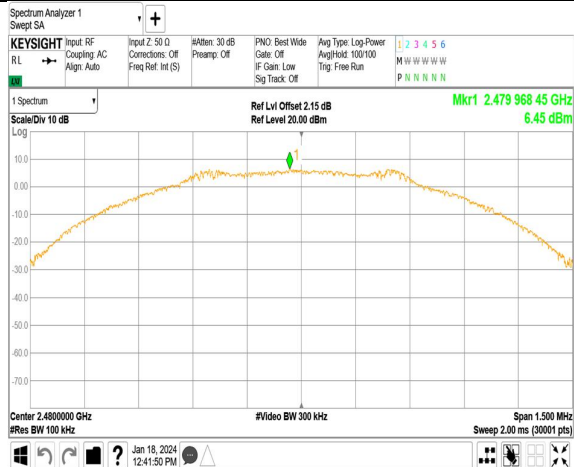
Spurious Emission (5GHz – 26.5GHz)



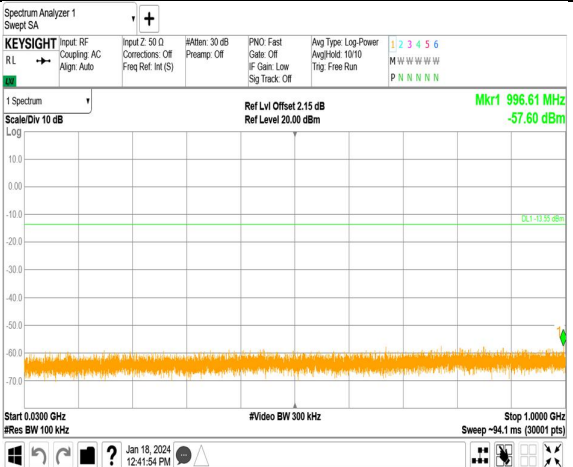


Out-of-Band Emissions (1Mbps)
Channel 39 (2480MHz)

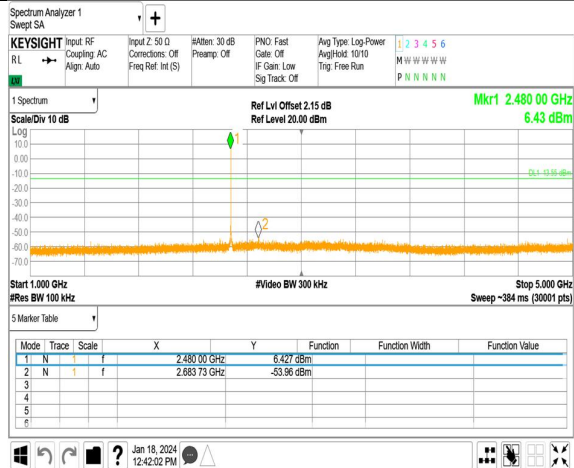
Reference point



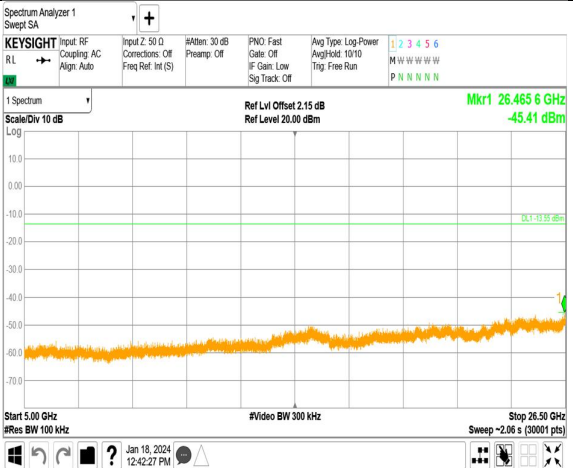
Spurious Emission (30MHz – 1GHz)



Spurious Emission (1GHz –5GHz)



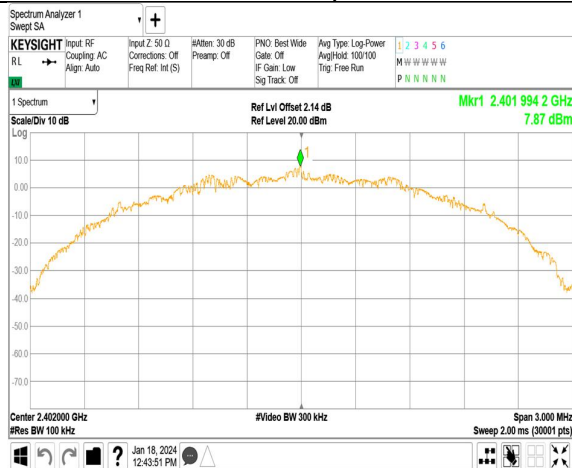
Spurious Emission (5GHz –26.5GHz)



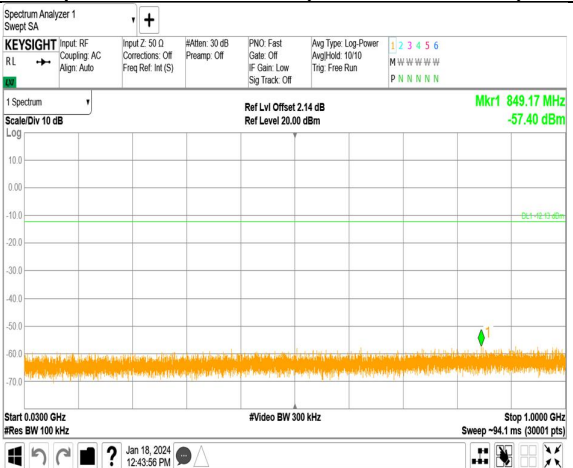


Out-of-Band Emissions (2Mbps)
Channel 0 (2402MHz)

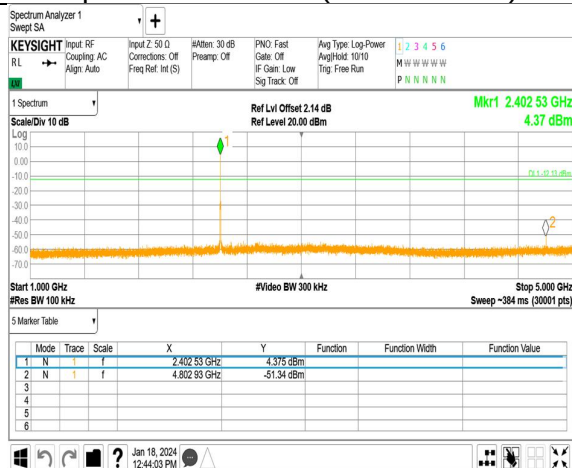
Reference point



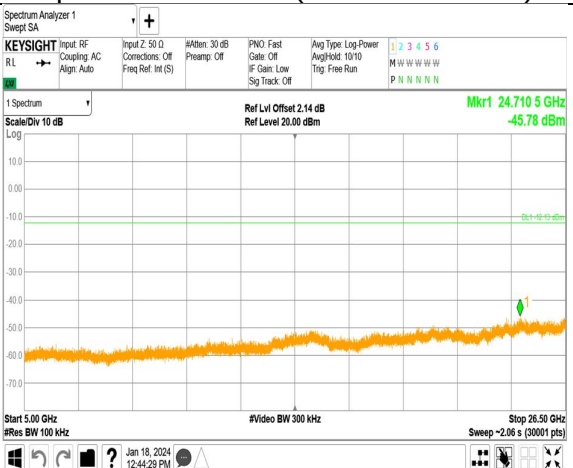
Spurious Emission (30MHz – 1GHz)



Spurious Emission (1GHz –5GHz)



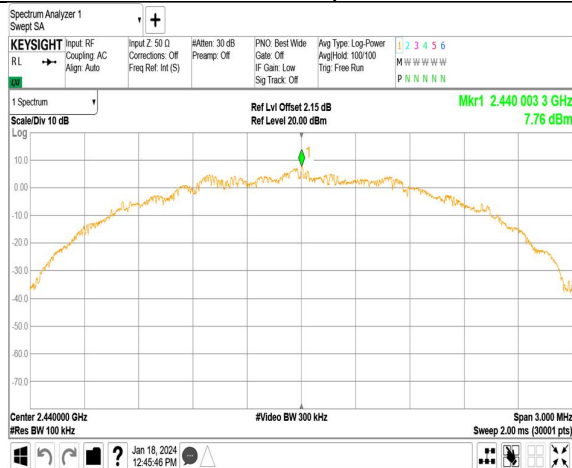
Spurious Emission (5GHz –26.5GHz)



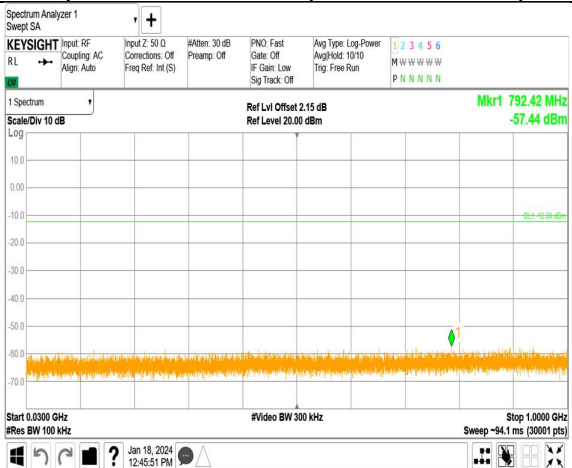


Out-of-Band Emissions (2Mbps)
Channel 19 (2440MHz)

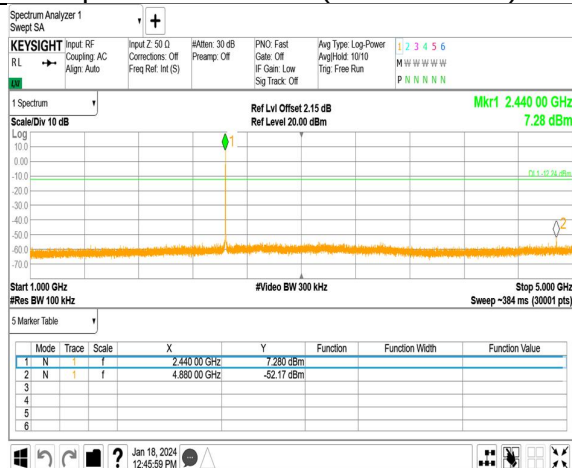
Reference point



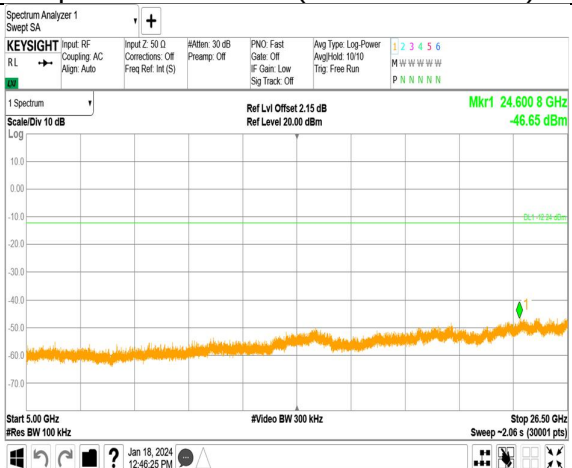
Spurious Emission (30MHz – 1GHz)



Spurious Emission (1GHz –5GHz)



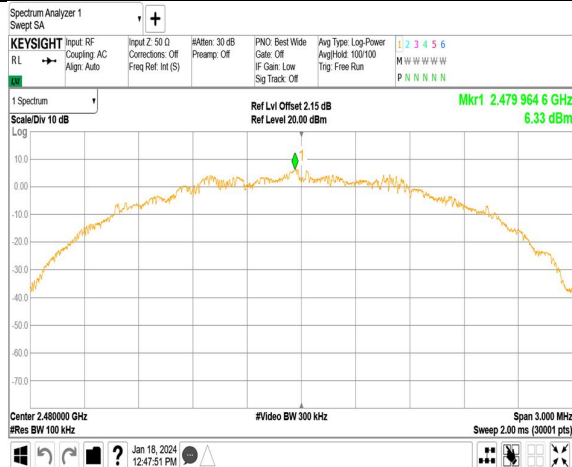
Spurious Emission (5GHz –26.5GHz)



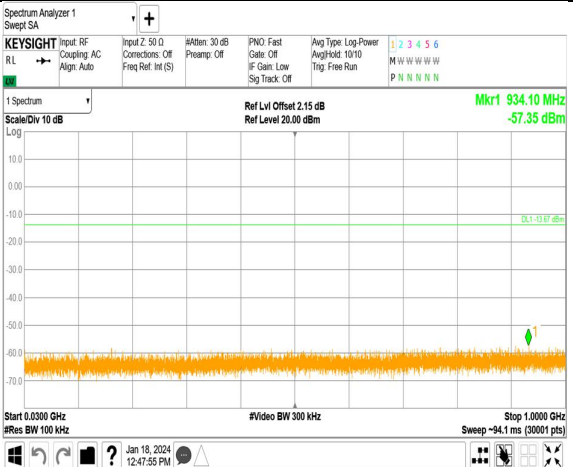


Out-of-Band Emissions (2Mbps)
Channel 39 (2480MHz)

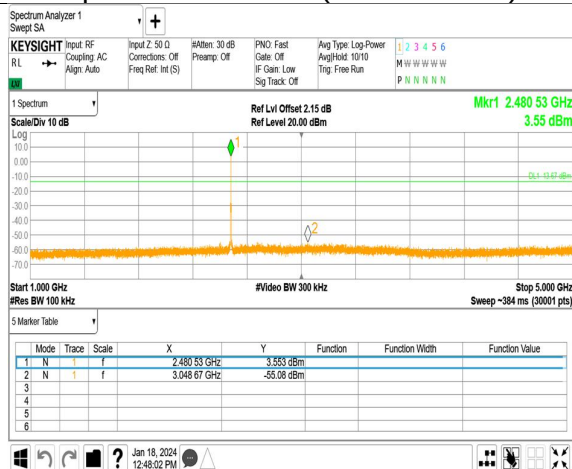
Reference point



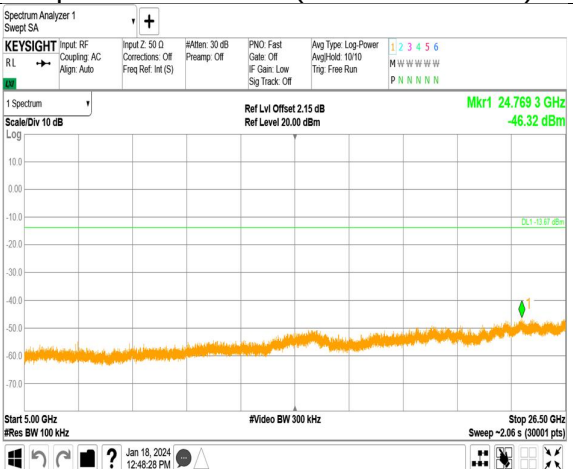
Spurious Emission (30MHz – 1GHz)



Spurious Emission (1GHz –5GHz)



Spurious Emission (5GHz –26.5GHz)



10.6 Band edge

Test Method

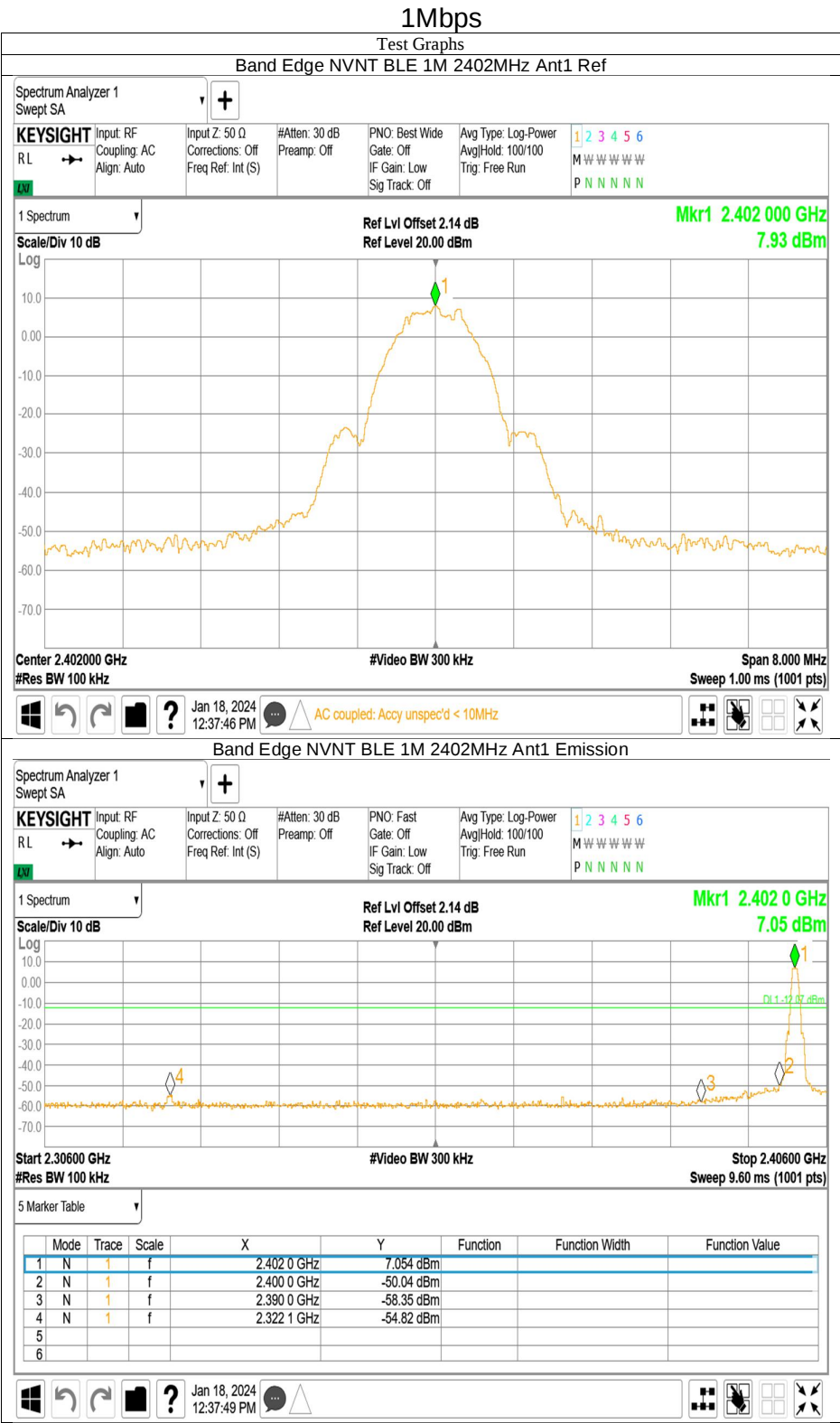
- 1 Use the following spectrum analyzer settings:
Span = wide enough to capture the peak level of the in-band emission and all spurious
RBW = 100 kHz, VBW $\geq$ RBW, Sweep = auto, Detector function = peak, Trace = max hold.
- 2 Allow the trace to stabilize, use the peak and delta measurement to record the result.
- 3 The level displayed must comply with the limit specified in this Section.

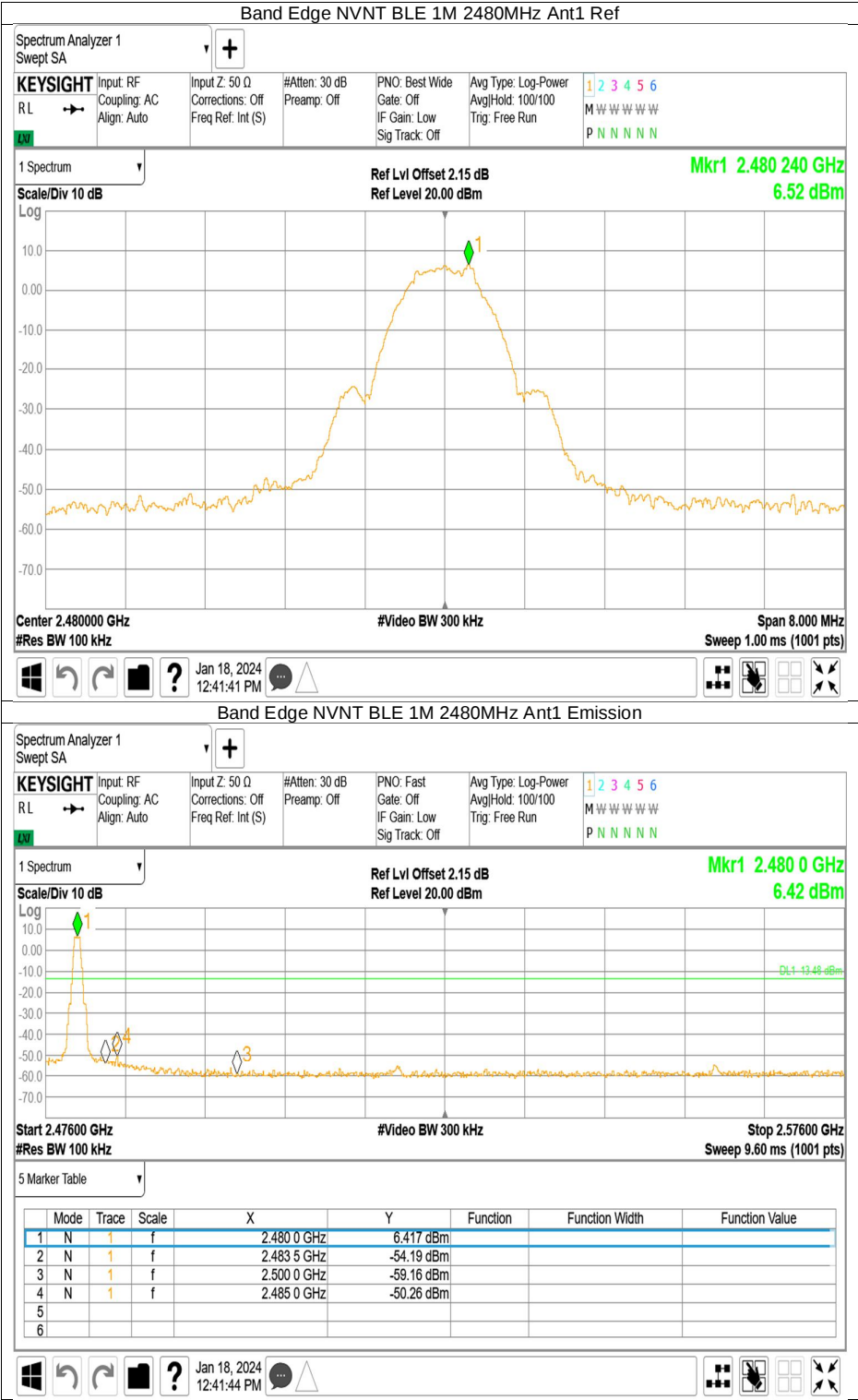
Limit

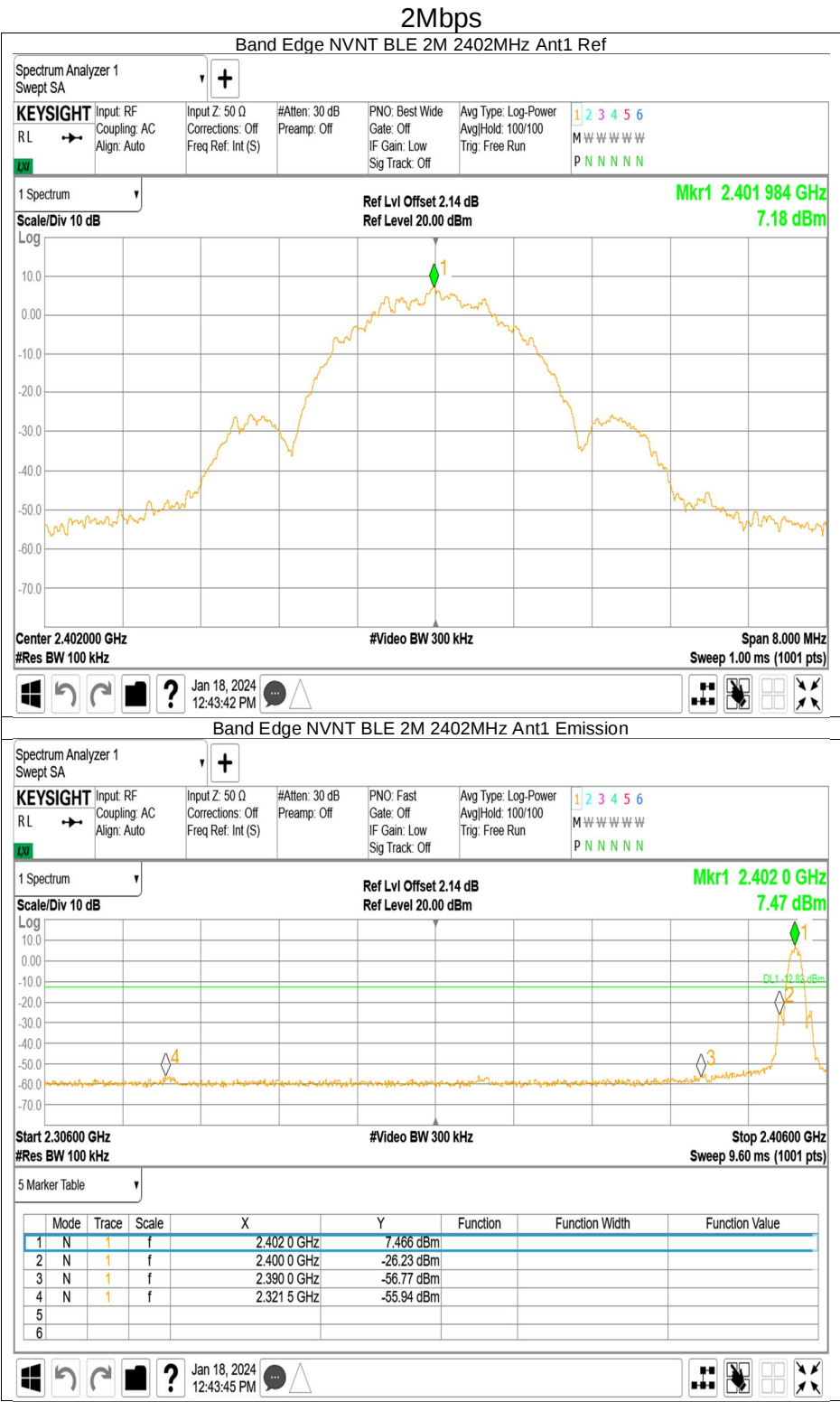
According to §15.247(d) and RSS-247 5.5, in any 100 kHz bandwidth outside the frequency bands in which the spread spectrum intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band 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) and RSS-Gen 8.10, must also comply with the radiated emission limits specified in 15.209(a) (see Section 15.205(c)) and RSS-Gen.



Test result









10.7 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

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 section 8.9, must also comply with the radiated emission limits specified in § 15.209(a) and RSS-Gen section 8.10.

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

Note 2: Limit $3\text{m}(\text{dB}\mu\text{V/m}) = \text{Limit } 30\text{m}(\text{dB}\mu\text{V/m}) + 40\text{Log}(30\text{m}/3\text{m})$ (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. The only worse case test result is listed in the report.

Test result

Test mode:GFSK 1Mbps (2402MHz)					
Frequency MHz	Measure Level (dBuV/m)	Limit (dBuV/M)	Margin (dB)	Detector	Polarization
2384.38	49.06	74.00	24.94	PK	Horiznotal
4804.46	46.49	74.00	27.51	PK	Horiznotal
2383.28	49.98	74.00	24.02	PK	Vertical
4804.47	46.31	74.00	27.69	PK	Vertical

Test mode:GFSK 1Mbps (2440MHz)					
Frequency MHz	Measure Level (dBuV/m)	Limit (dBuV/M)	Margin (dB)	Detector	Polarization
4879.64	45.70	74.00	28.30	PK	Horiznotal
4879.87	45.83	74.00	28.17	PK	Vertical

Test mode:GFSK 1Mbps (2480MHz)					
Frequency MHz	Measure Level (dBuV/m)	Limit (dBuV/M)	Margin (dB)	Detector	Polarization
2483.57	50.41	74.00	23.59	PK	Horiznotal
4960.63	46.69	74.00	27.31	PK	Horiznotal
2483.69	50.39	74.00	23.61	PK	Vertical
4960.15	46.47	74.00	27.53	PK	Vertical

Test mode:GFSK 2Mbps (2402MHz)					
Frequency MHz	Measure Level (dBuV/m)	Limit (dBuV/M)	Margin (dB)	Detector	Polarization
2385.47	49.42	74.00	24.58	PK	Horiznotal
4804.52	47.63	74.00	26.37	PK	Horiznotal
2383.20	48.54	74.00	25.46	PK	Vertical
4804.24	46.73	74.00	27.27	PK	Vertical

Test mode:GFSK 2Mbps (2440MHz)					
Frequency MHz	Measure Level (dBuV/m)	Limit (dBuV/M)	Margin (dB)	Detector	Polarization
4879.85	46.81	74.00	27.19	PK	Horiznotal
4879.96	46.16	74.00	27.84	PK	Vertical

Test mode:GFSK 2Mbps (2480MHz)					
Frequency MHz	Measure Level (dBuV/m)	Limit (dBuV/M)	Margin (dB)	Detector	Polarization
2483.61	50.56	74.00	23.44	PK	Horiznotal
4960.13	46.37	74.00	27.63	PK	Horiznotal
2483.72	50.35	74.00	23.65	PK	Vertical
4960.78	45.71	74.00	28.29	PK	Vertical

Remark:

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

The worst case of Radiated Emission below 1GHz:

30-1000MHz Radiated Emission

EUT Information

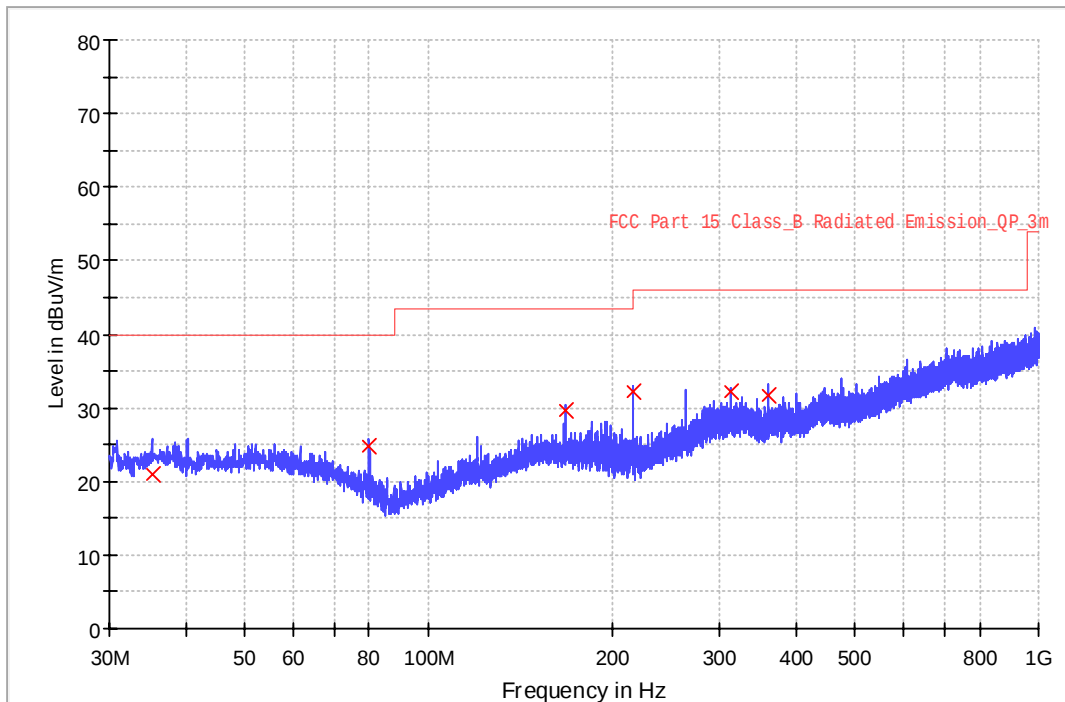
EUT Name:	Smart Camera
Model:	SC155-WQ3
Client:	Zhejiang Lingzhu Technology Co., Ltd
Op Cond:	Power on and charging, TX_2402MHz at 2Mbps mode, AC 120V/60Hz, T20.2, 41.4%, P103.3kPa
Operator:	Chengjie GUO
Test Spec:	FCC Part 15.209(a)
Comment:	Horizontal
Sample No:	SHA-785720-2

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)	Margin - QPK (dB)
35.200000	20.9	1000.0	120.000	124.0	H	132.0	19.5	19.1
79.960000	24.9	1000.0	120.000	187.0	H	116.0	15.8	15.2
168.000000	29.7	1000.0	120.000	124.0	H	325.0	20.4	13.8
215.960000	32.1	1000.0	120.000	152.0	H	175.0	17.5	11.4
312.040000	32.3	1000.0	120.000	175.0	H	215.0	21.9	13.7
360.000000	31.7	1000.0	120.000	122.0	H	175.0	23.0	14.3

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

Frequency (MHz)	Limit - QPK (dBuV/m)	Comment
35.200000	40.0	
79.960000	40.0	
168.000000	43.5	
215.960000	43.5	
312.040000	46.0	
360.000000	46.0	

30-1000MHz Radiated Emission

EUT Information

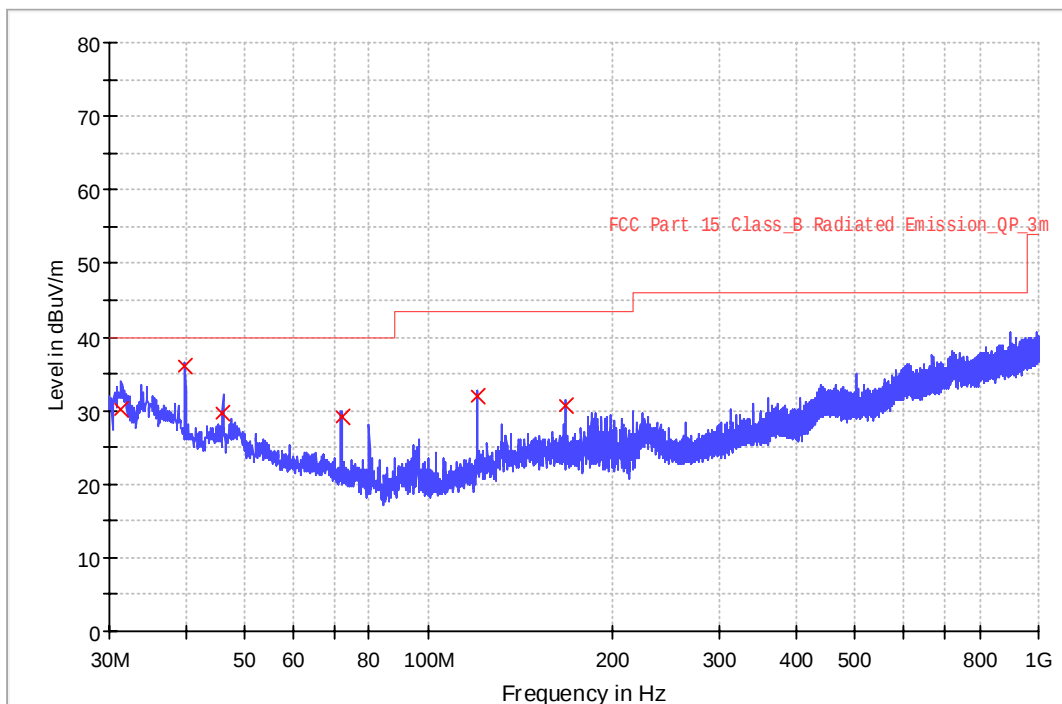
EUT Name: Smart Camera
Model: SC155-WQ3
Client: Zhejiang Lingzhu Technology Co., Ltd
Op Cond: Power on and charging, TX_2402MHz at 2Mbps mode,
AC 120V/60Hz, T20.2, 41.4%, P103.3kPa
Operator: Chengjie GUO
Test Spec: FCC Part 15.209(a)
Comment: Horizontal
Sample No: SHA-785720-2

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)	Margin - QPK (dB)
31.400000	30.2	1000.0	120.000	125.0	V	121.0	19.4	9.8
39.960000	36.0	1000.0	120.000	107.0	V	113.0	20.0	4.0
46.040000	29.7	1000.0	120.000	103.0	V	64.0	20.4	10.3
71.960000	29.1	1000.0	120.000	121.0	V	125.0	18.2	10.9
119.960000	31.9	1000.0	120.000	132.0	V	133.0	18.1	11.6
168.000000	30.8	1000.0	120.000	113.0	V	135.0	20.4	12.7

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

Frequency (MHz)	Limit - QPK (dBuV/m)	Comment
31.400000	40.0	
39.960000	40.0	
46.040000	40.0	
71.960000	40.0	
119.960000	43.5	
168.000000	43.5	

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.

11 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	2023-2-10	2024-2-9
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	2021-9-23	2024-9-22
	Double-ridged waveguide horn antenna	Rohde & Schwarz	HF907	102868	2021-3-15	2024-3-14
	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	00246076	2023-7-7	2026-7-6
CE	3m Semi-anechoic chamber	TDK	9X6X6	----	2021-5-8	2024-5-7
	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

12 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.



13 Photographs of Test Set-ups

Refer to the < Test Setup photos >.



14 Photographs of EUT

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

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