



## FCC/IC - TEST REPORT

Report Number : 709502400827-00A Date of Issue: July 31, 2024

Model : YKV24SAED-DB-Z, YKV24SAED-HB-Z

Product Type : Tubular motor

Applicant : Changzhou Yooksmart Innovation Co.,Ltd

Address : 1F, Building 6C, No. 8 Xihu Road Jintong Industrial Park,  
Changzhou, 213000, China

Production Facility : Changzhou Yooksmart Innovation Co.,Ltd

Address : 1F, Building 6C, No. 8 Xihu Road Jintong Industrial Park,  
Changzhou, 213000, ChinaTest Result : ☒ Positive ☐ NegativeTotal pages including  
Appendices : 39

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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 Designation Number: CN1183

ISED CAB identifier CN0101

IC Registration No.: 31668



### 3 Description of the Equipment under Test

#### Description of the Equipment Under Test

Product: Tubular motor

Model no.: YKV24SAED-DB-Z, YKV24SAED-HB-Z

PMN: YKV24SAED-DB-Z, YKV24SAED-HB-Z

HVIN: YKV24SAED-DB-Z, YKV24SAED-HB-Z

FCC ID: 2A9IA-24SAED

IC: 32635-24SAED

Options and accessories: NA

Rating: DC 12V

RF Transmission Frequency: 2405~2480 MHz for Thread

No. of Operated Channel: 16 for Zigbee

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

Channel list for Thread:

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

Antenna Type: Ceramic Antenna

Antenna Gain: 1.3503 dBi

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

Test sample no.: SHA-803389-2 (Conducted sample),  
SHA-803389-3 (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<br>10-1-2023 Edition      | PART 15 - RADIO FREQUENCY DEVICES<br>Subpart C - Intentional Radiators                                                       |
| RSS-Gen Issue 5<br>Amendment 2<br>February 2021 | General Requirements for the Certification of Radio Apparatus                                                                |
| RSS-247 Issue 3<br>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.



## 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            | 14-16      | Site 1    | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>            |
| §15.247 (b) (3)                                         | RSS-247 5.4(d)               | Conducted peak output power                 | 17-18      | Site 1    | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>            |
|                                                         | RSS-247 5.4(d)               | Equivalent Isotropic Radiated Power         | 17-18      | Site 1    | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>            |
| §15.247(a)(1)                                           | RSS-247 5.1(a) & RSS-Gen 6.7 | 20dB bandwidth and 99% Occupied Bandwidth   | ---        | ---       | <input type="checkbox"/>            | <input type="checkbox"/> | <input checked="" type="checkbox"/> |
| §15.247(a)(1)                                           | RSS-247 5.1(b)               | Carrier frequency separation                | ---        | ---       | <input type="checkbox"/>            | <input type="checkbox"/> | <input checked="" type="checkbox"/> |
| §15.247(a)(1)(iii)                                      | RSS-247 5.1(d)               | Number of hopping frequencies               | ---        | ---       | <input type="checkbox"/>            | <input type="checkbox"/> | <input checked="" type="checkbox"/> |
| §15.247(a)(1)(iii)                                      | RSS-247 5.1(d)               | Dwell Time - Average Time of Occupancy      | ---        | ---       | <input type="checkbox"/>            | <input type="checkbox"/> | <input checked="" type="checkbox"/> |
| §15.247(a)(2)                                           | RSS-247 5.2(a) & RSS-GEN 6.7 | 6dB bandwidth and 99% Occupied Bandwidth    | 19-21      | Site 1    | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>            |
| §15.247(e)                                              | RSS-247 5.2(b)               | Power spectral density                      | 22-23      | Site 1    | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>            |
| §15.247(e)                                              | RSS-247 5.5                  | Spurious RF conducted emissions             | 24-27      | Site 1    | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>            |
| §15.247(d)                                              | RSS-247 5.5                  | Band edge                                   | 28-30      | Site 1    | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>            |
| §15.247(d) & §15.209 & §15.205                          | RSS-247 5.5 & RSS-Gen 6.13   | Spurious radiated emissions for transmitter | 31-35      | Site 1    | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>            |
| §15.203                                                 | RSS-Gen 6.8                  | 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 Line Antenna, which gain is 1.3503dBi. In accordance to §15.203 and RSS-Gen 6.8, 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: 2A9IA-24SAED, IC: 32635-24SAED, complies with Section 15.207, 15.209, 15.247 of the FCC Part 15, Subpart C Rules and RSS-247, RSS-GEN.

According to the client's declaration, the wireless components of both models are completely identical, with only slight differences in PCB and structural appearance. The differences mainly include:

- Number of Aluminum Body Apertures: The number of openings or holes in the aluminum body differs between the two models.
- Length of Aluminum Body: The aluminum body exhibits varying lengths across the two models.
- Structure of Driver Unit: The former features a dual motor dual output design, while the latter has a single motor dual output design.

So model YKV24SAED-DB-Z 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 8, 2024

Testing Start Date: July 1, 2024

Testing End Date: July 27, 2024



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

Reviewed by:

Prepared by:

Tested by:

A handwritten signature in blue ink, appearing to read "Hui Tong".

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Hui TONG  
EMC Section Manager

A handwritten signature in blue ink, appearing to read "Tianji Xu".

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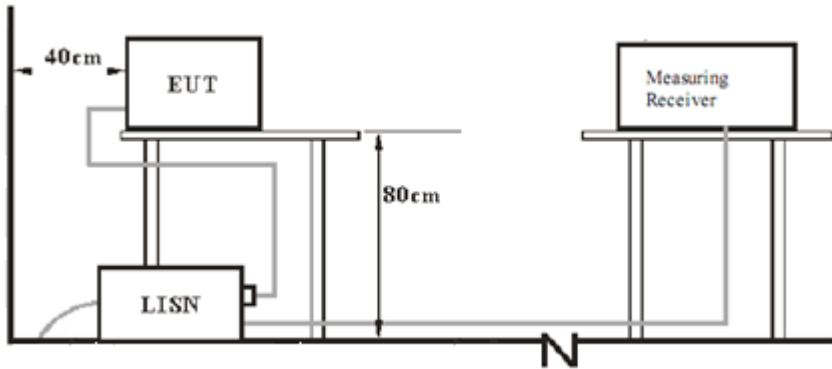
Wenqiang LU  
EMC Project Engineer

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Tianji XU  
EMC Test Engineer

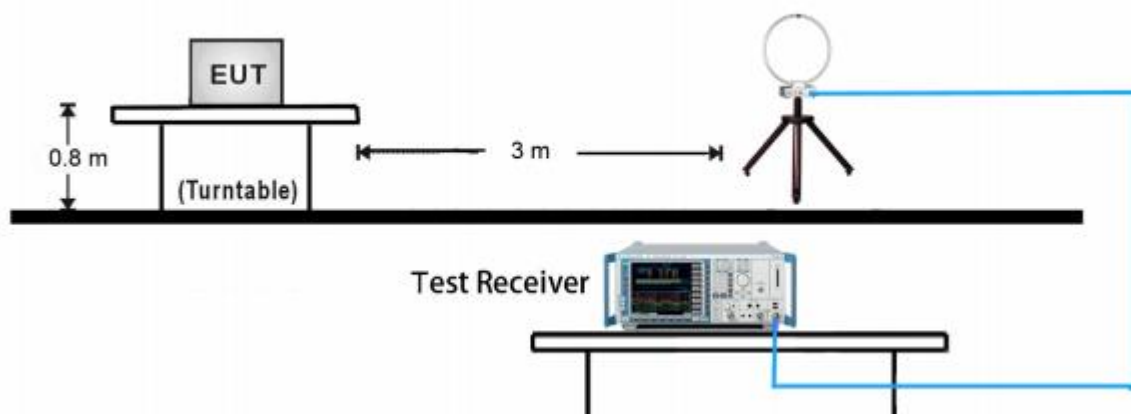
## 7 Test Setups

### 7.1 AC Power Line Conducted Emission test setups

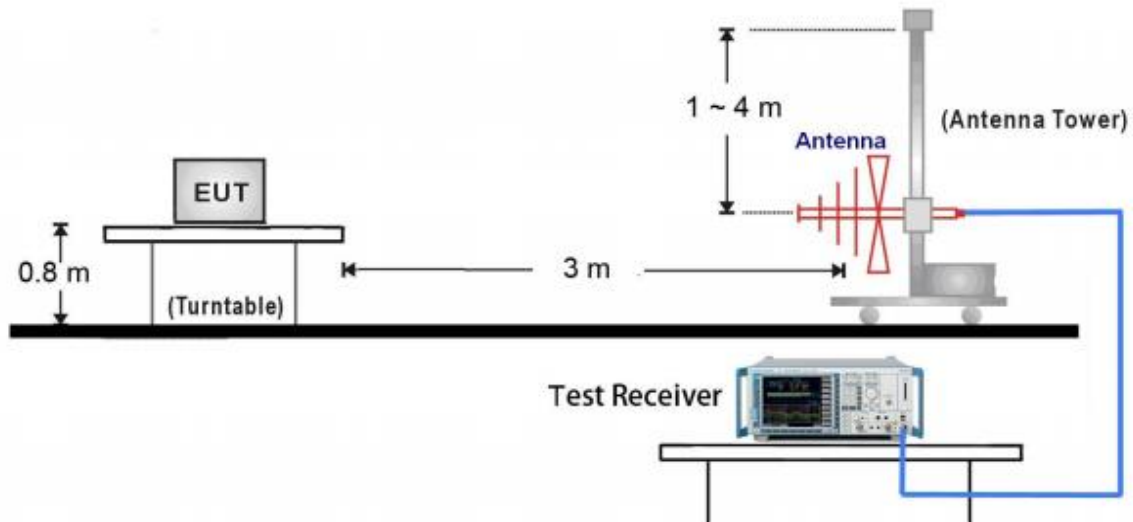


### 7.2 Radiated test setups

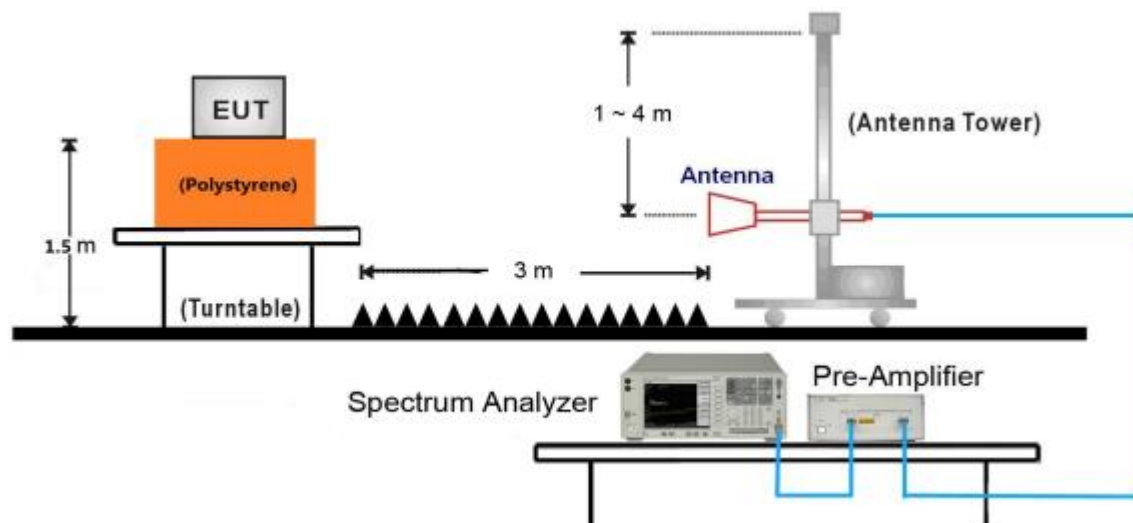
#### 9kHz ~ 30MHz Test Setup:



30MHz ~ 1GHz Test Setup:

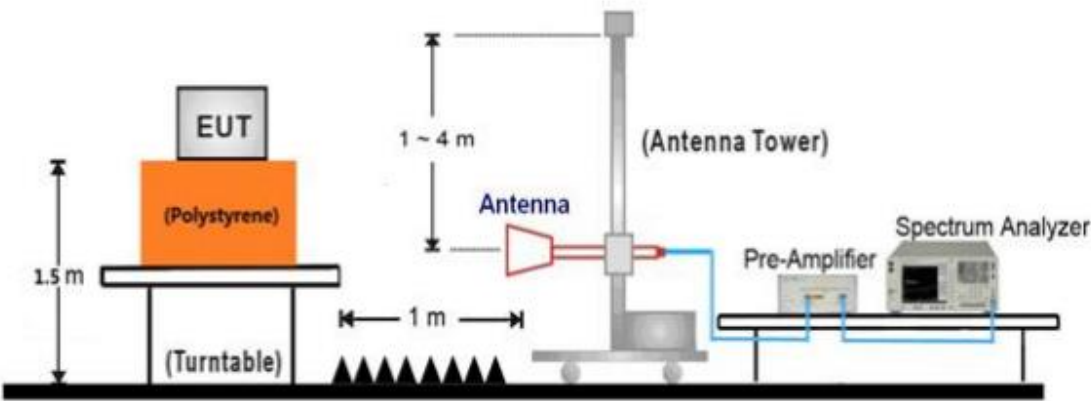


1GHz ~ 18GHz Test Setup:

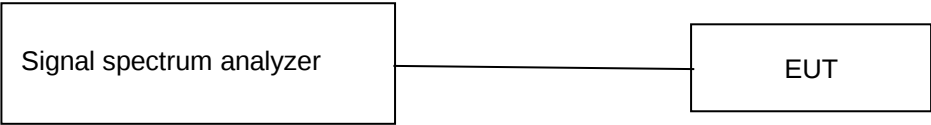




18GHz ~ 25GHz Test Setup:



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       | X240              | Notebook    |

Test software: SSCOM V5.13.1.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 | Data Rate (Mbps) | Modulation                               | Index Value (Power level setting) |
|--------|----------------|------------------|------------------------------------------|-----------------------------------|
| Zigbee | 11             | 1                | 16-ary orthogonal modulation, O-QPSK PHY | 10                                |
|        | 18             | 1                | 16-ary orthogonal modulation, O-QPSK PHY | 10                                |
|        | 26             | 1                | 16-ary orthogonal modulation, O-QPSK PHY | 10                                |



## 9 Technical Requirement

### 9.1 Conducted Emission

#### Test Method

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

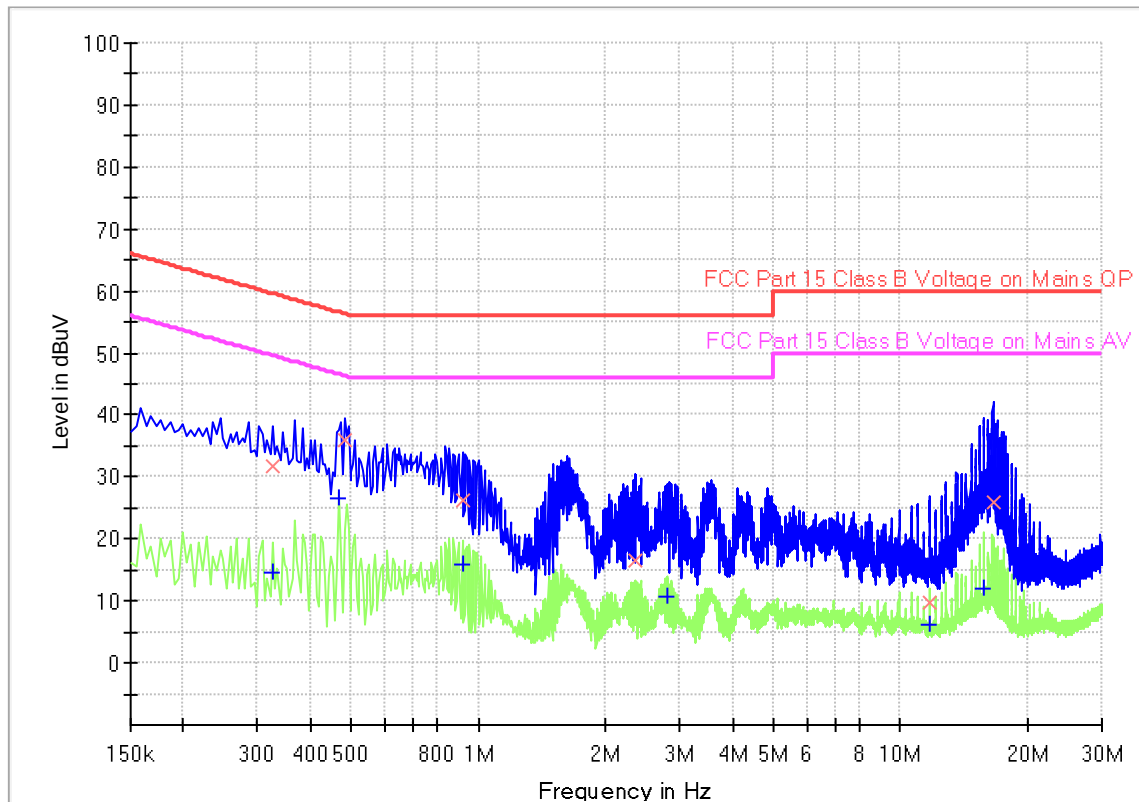
#### Limit

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

| Frequency<br>MHz | QP Limit<br>dB $\mu$ V | AV Limit<br>dB $\mu$ V |
|------------------|------------------------|------------------------|
| 0.150-0.500      | 66-56*                 | 56-46*                 |
| 0.500-5          | 56                     | 46                     |
| 5-30             | 60                     | 50                     |

Decreasing linearly with logarithm of the frequency

Product Type : Tubular motor  
 M/N : YKV24SAED-DB-Z  
 Operating Condition : Mode 1: Tx\_2440MHz (worst case)  
 Test Specification : L-line (charging mode)  
 Comment : AC 120V/60Hz (powered by adaptor)

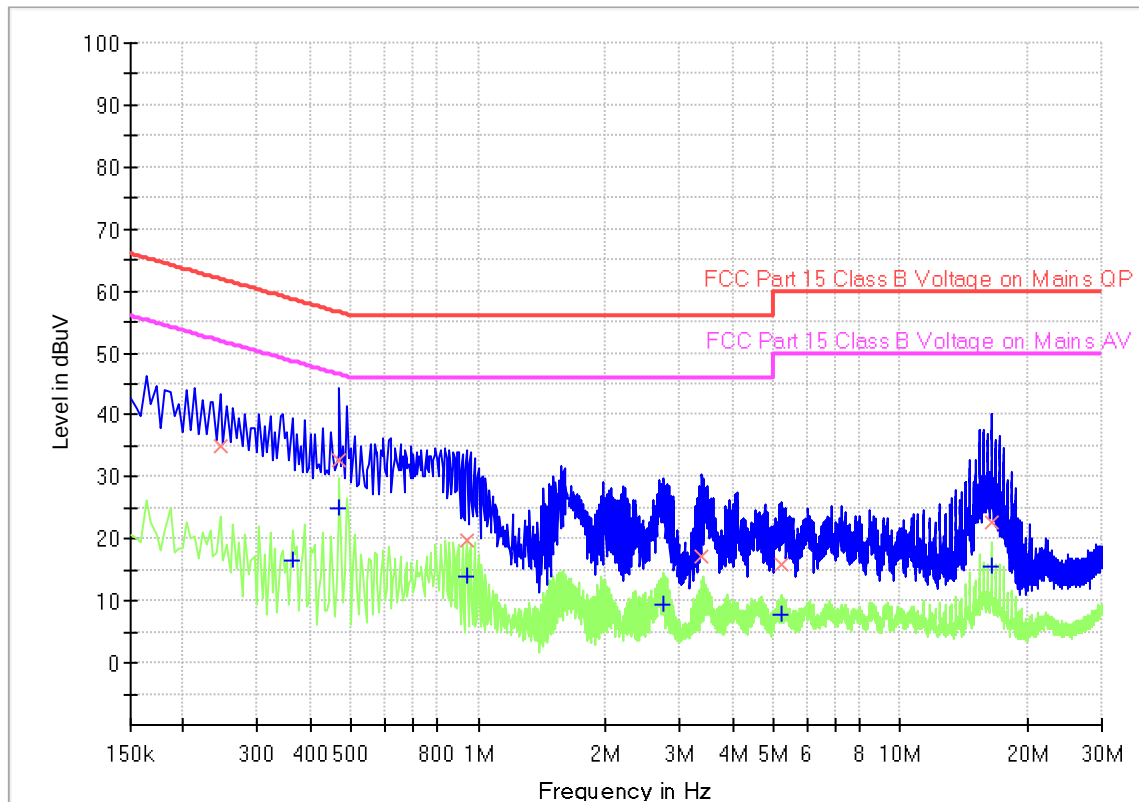


## Final Result

| Frequency (MHz) | Quasi Peak (dBuV) | CAverage (dBuV) | Limit (dBuV) | Margin (dB) | Meas. Time (ms) | Bandwidth (kHz) | Line | Corr. (dB) |
|-----------------|-------------------|-----------------|--------------|-------------|-----------------|-----------------|------|------------|
| 0.325500        | ---               | 14.53           | 49.57        | 35.04       | 1000.0          | 9.000           | L1   | 19.5       |
| 0.325500        | 31.80             | ---             | 59.57        | 27.77       | 1000.0          | 9.000           | L1   | 19.5       |
| 0.469500        | ---               | 26.45           | 46.52        | 20.07       | 1000.0          | 9.000           | L1   | 19.5       |
| 0.483000        | 35.80             | ---             | 56.29        | 20.49       | 1000.0          | 9.000           | L1   | 19.4       |
| 0.915000        | ---               | 15.77           | 46.00        | 30.23       | 1000.0          | 9.000           | L1   | 19.5       |
| 0.915000        | 26.22             | ---             | 56.00        | 29.78       | 1000.0          | 9.000           | L1   | 19.5       |
| 2.346000        | 16.51             | ---             | 56.00        | 39.49       | 1000.0          | 9.000           | L1   | 19.5       |
| 2.809500        | ---               | 10.75           | 46.00        | 35.25       | 1000.0          | 9.000           | L1   | 19.5       |
| 11.742000       | 9.59              | ---             | 60.00        | 50.41       | 1000.0          | 9.000           | L1   | 19.9       |
| 11.746500       | ---               | 6.07            | 50.00        | 43.93       | 1000.0          | 9.000           | L1   | 19.9       |
| 15.801000       | ---               | 11.92           | 50.00        | 38.08       | 1000.0          | 9.000           | L1   | 20.1       |
| 16.548000       | 26.06             | ---             | 60.00        | 33.94       | 1000.0          | 9.000           | L1   | 20.2       |

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

Product Type : Tubular motor  
 M/N : YKV24SAED-DB-Z  
 Operating Condition : Mode 1: Tx\_2440MHz (worst case)  
 Test Specification : N-line (charging mode)  
 Comment : AC 120V/60Hz (powered by adaptor)



## Final Result

| Frequency (MHz) | Quasi Peak (dBuV) | CAverage (dBuV) | Limit (dBuV) | Margin (dB) | Meas. Time (ms) | Bandwidth (kHz) | Line | Corr. (dB) |
|-----------------|-------------------|-----------------|--------------|-------------|-----------------|-----------------|------|------------|
| 0.244500        | 34.86             | ---             | 61.94        | 27.08       | 1000.0          | 9.000           | N    | 19.4       |
| 0.361500        | ---               | 16.66           | 48.69        | 32.03       | 1000.0          | 9.000           | N    | 19.5       |
| 0.469500        | ---               | 24.81           | 46.52        | 21.71       | 1000.0          | 9.000           | N    | 19.5       |
| 0.469500        | 32.71             | ---             | 56.52        | 23.81       | 1000.0          | 9.000           | N    | 19.5       |
| 0.937500        | ---               | 14.09           | 46.00        | 31.91       | 1000.0          | 9.000           | N    | 19.5       |
| 0.937500        | 19.79             | ---             | 56.00        | 36.21       | 1000.0          | 9.000           | N    | 19.5       |
| 2.755500        | ---               | 9.43            | 46.00        | 36.57       | 1000.0          | 9.000           | N    | 19.5       |
| 3.390000        | 17.24             | ---             | 56.00        | 38.76       | 1000.0          | 9.000           | N    | 19.5       |
| 5.226000        | 15.83             | ---             | 60.00        | 44.17       | 1000.0          | 9.000           | N    | 19.6       |
| 5.248500        | ---               | 7.67            | 50.00        | 42.33       | 1000.0          | 9.000           | N    | 19.6       |
| 16.471500       | ---               | 15.65           | 50.00        | 34.35       | 1000.0          | 9.000           | N    | 20.0       |
| 16.485000       | 22.72             | ---             | 60.00        | 37.28       | 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

### Test Method

1. Use the following spectrum analyzer settings:  
RBW > the 6 dB bandwidth of the emission being measured, VBW $\geq$ 3RBW, Span $\geq$ 3RBW  
Sweep = auto, Detector function = peak, Trace = max hold.
2. Add a correction factor to the display.
3. Allow the trace to stabilize. Use the marker-to-peak function to set the marker to the peak of the emission. The indicated level is the peak output power.

### Limits

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     | $\leq 1$ | $\leq 30$ |
| e.i.r.p.                    | 2400-2483.5     | $\leq 4$ | $\leq 36$ |

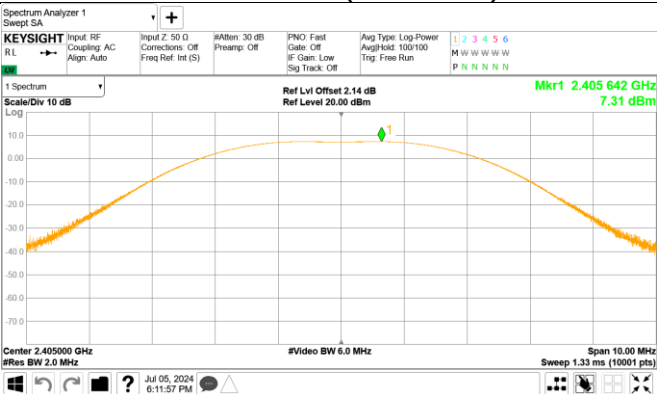
Test result as below table

| Frequency<br>MHz       | Conducted Peak<br>Output Power<br>dBm | E.I.R.P<br>dBm | Result |
|------------------------|---------------------------------------|----------------|--------|
| Low channel 2405MHz    | 7.31                                  | 8.6603         | Pass   |
| Middle channel 2440MHz | 7.08                                  | 8.4303         | Pass   |
| High channel 2480MHz   | 6.13                                  | 7.4803         | Pass   |

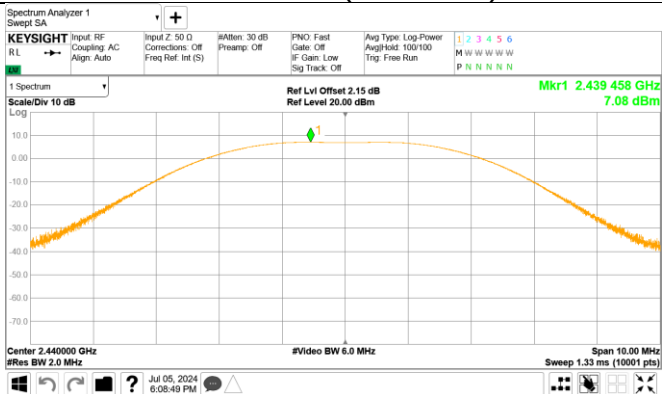


Peak output power

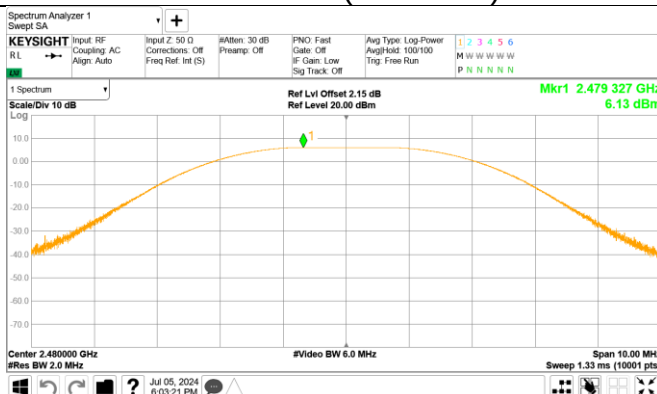
Channel 11 (2405MHz)



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 $\geq$ 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

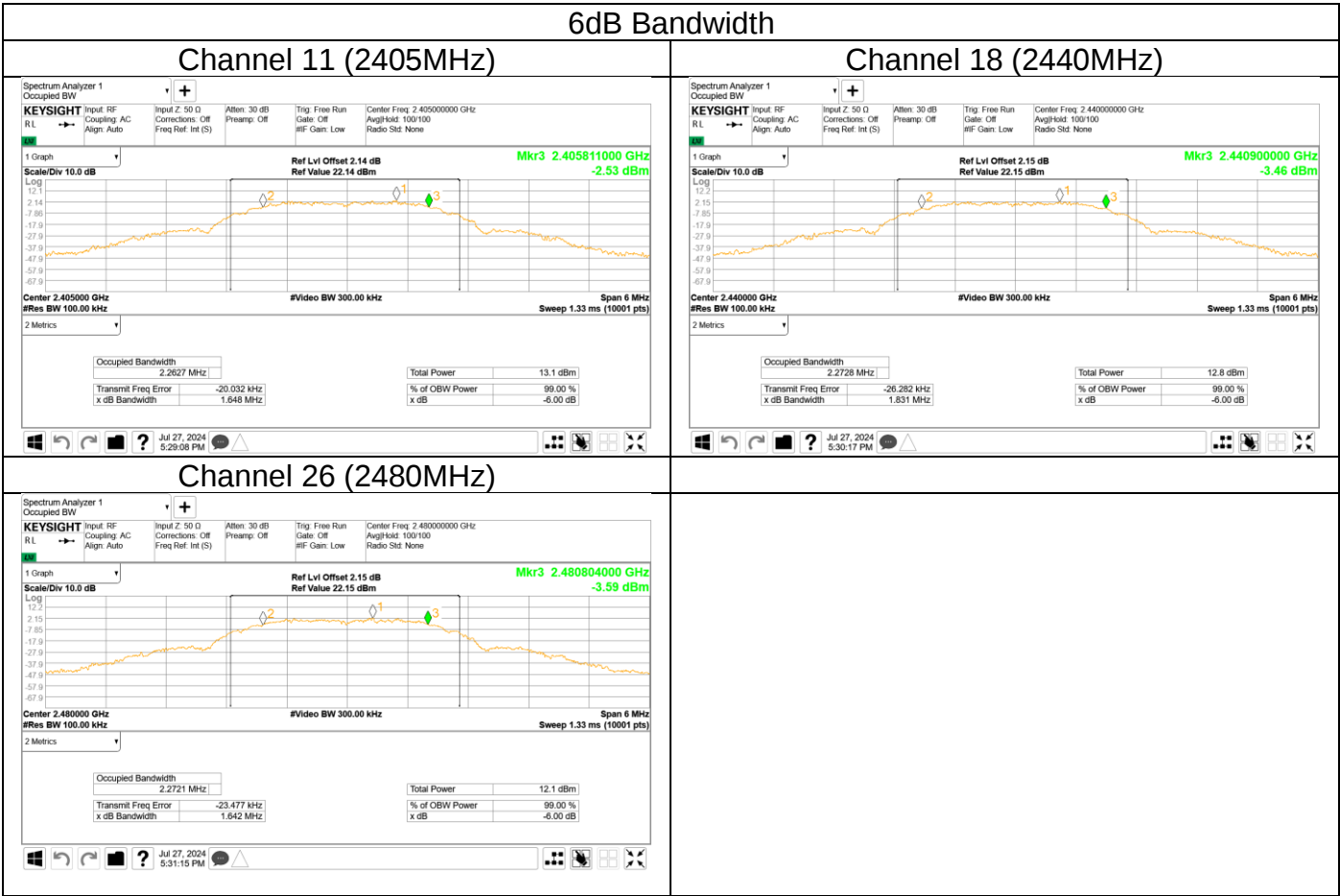
1. Connect EUT test port to spectrum analyzer.  
Use the following spectrum analyzer settings:  
RBW=1% to 5% of the actual occupied, VBW $\geq$ 3RBW, Sweep = auto,  
Detector function = peak, Trace = max hold
2. Use the occupied bandwidth measurement capability of test receiver.
3. Allow the trace to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

#### Limit

| 6dB bandwidth Limit [kHz] | 99% bandwidth Limit [kHz] |
|---------------------------|---------------------------|
| $\geq 500$                | --                        |

#### Test result

| Frequency<br>MHz       | 6dB bandwidth<br>kHz | 99% Bandwidth<br>kHz | Result |
|------------------------|----------------------|----------------------|--------|
| Top channel 2402MHz    | 1648                 | 2272                 | Pass   |
| Middle channel 2440MHz | 1831                 | 2285                 | Pass   |
| Bottom channel 2480MHz | 1642                 | 2258                 | Pass   |







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

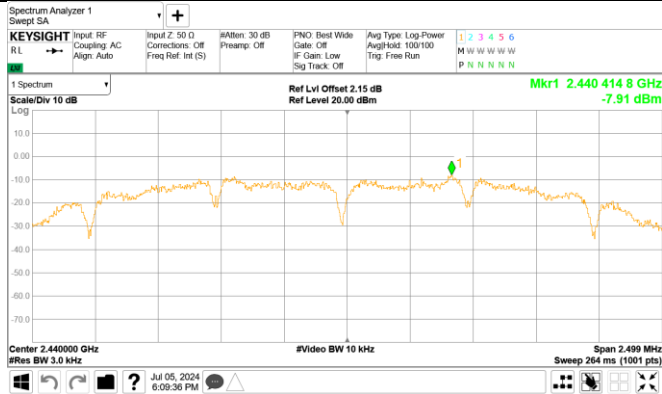
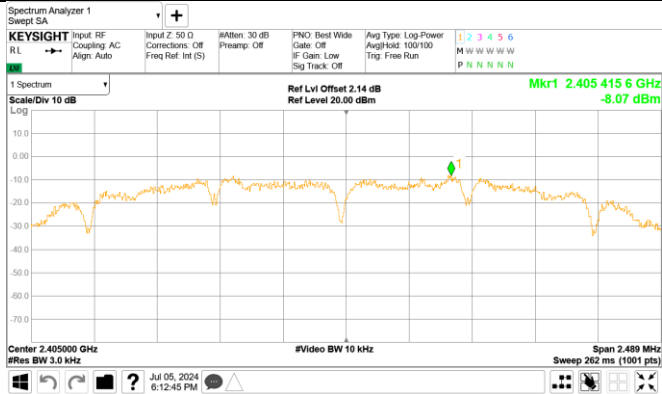
| Frequency<br>MHz       | Power spectral<br>density<br>dBm/3kHz | Result |
|------------------------|---------------------------------------|--------|
| Top channel 2405MHz    | -8.07                                 | Pass   |
| Middle channel 2440MHz | -7.92                                 | Pass   |
| Bottom channel 2480MHz | -8.87                                 | Pass   |



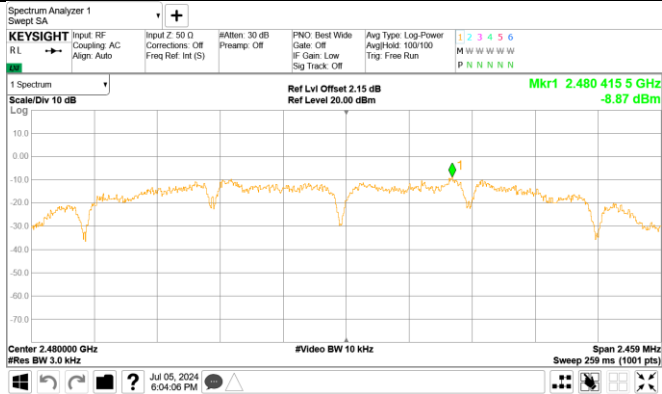
PK PSD

Channel 11 (2405MHz)

Channel 18 (2440MHz)



Channel 26 (2480MHz)





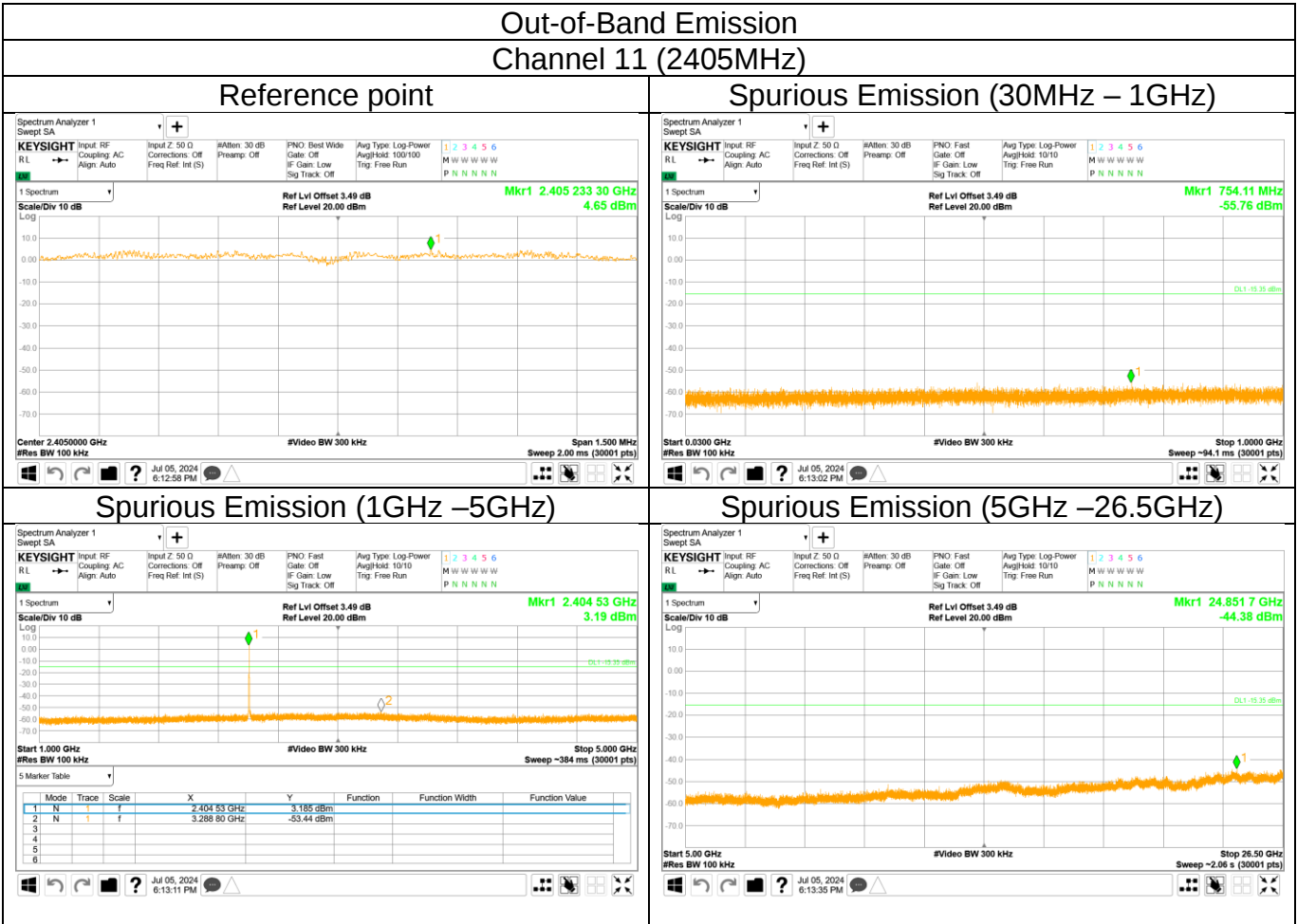
## 9.5 Spurious RF conducted emissions

### Test Method

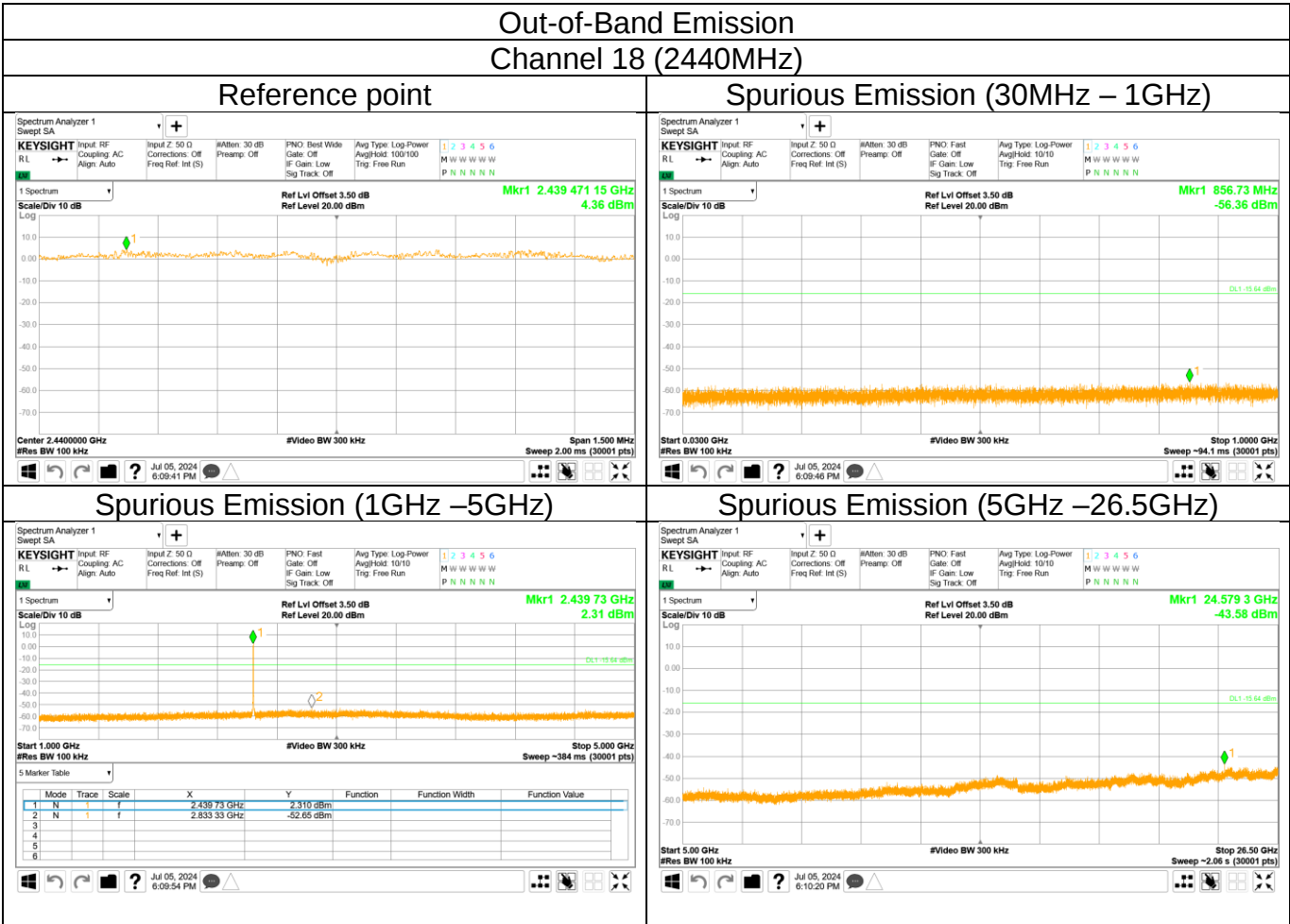
1. The RF output of EUT was connected to the spectrum analyzer by RF cable. The path loss was compensated to the results for each measurement.
2. Set to the maximum power setting, the instrument center frequency is set to the nominal EUT channel center frequency enable the EUT transmit continuously.
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<sup>th</sup> harmonic. Typically, several plots are required to cover this entire span.  
RBW = 100 kHz, VBW $\geq$ 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

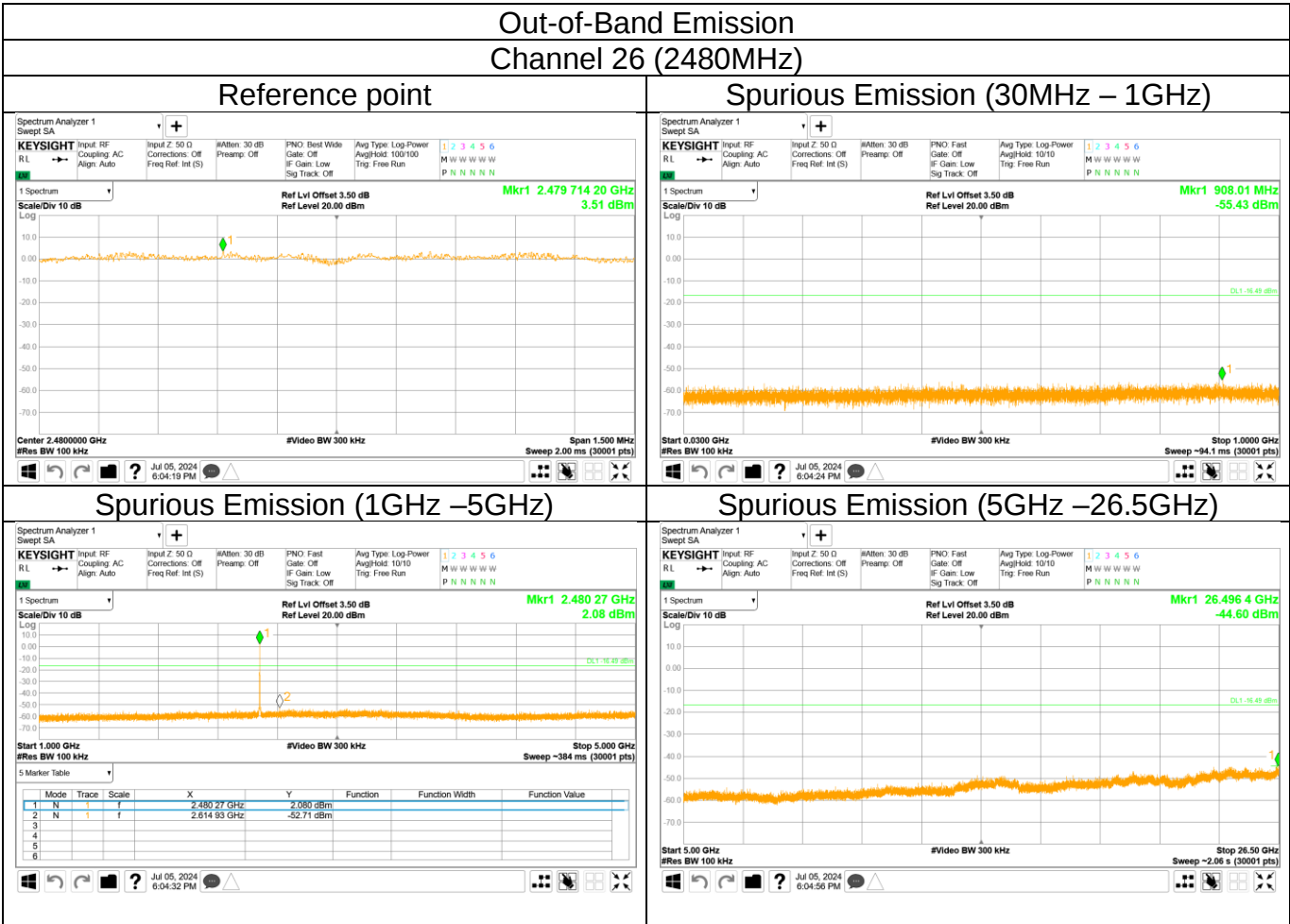
| Frequency Range<br>MHz | Limit (dBc) |
|------------------------|-------------|
| 30-25000               | -20         |



Note: The emission which exceed the limit is the fundamental.



Note: The emission which exceed the limit is the fundamental.



Note: The emission which exceed the limit is the fundamental.



## 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 $\geq$ 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.

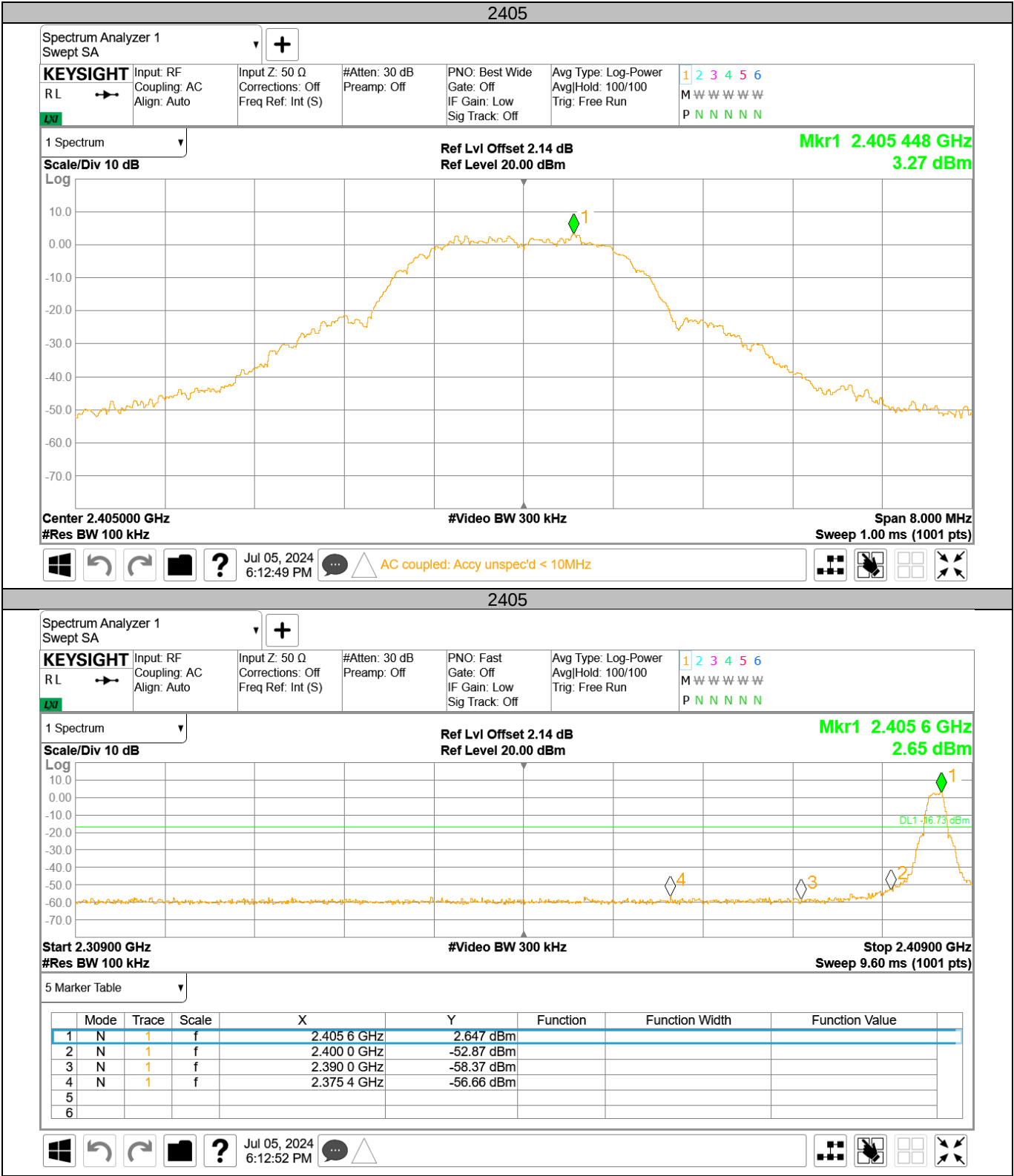
### Limit:

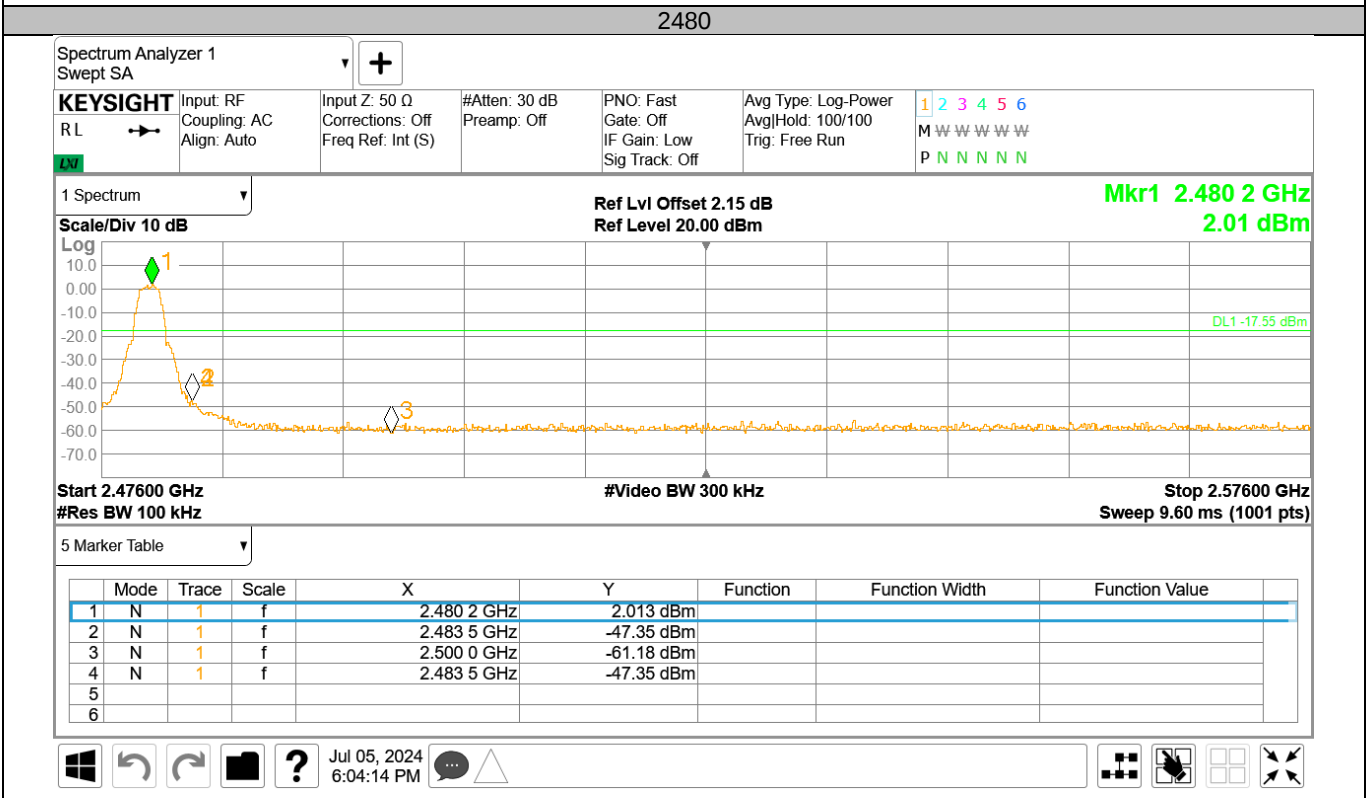
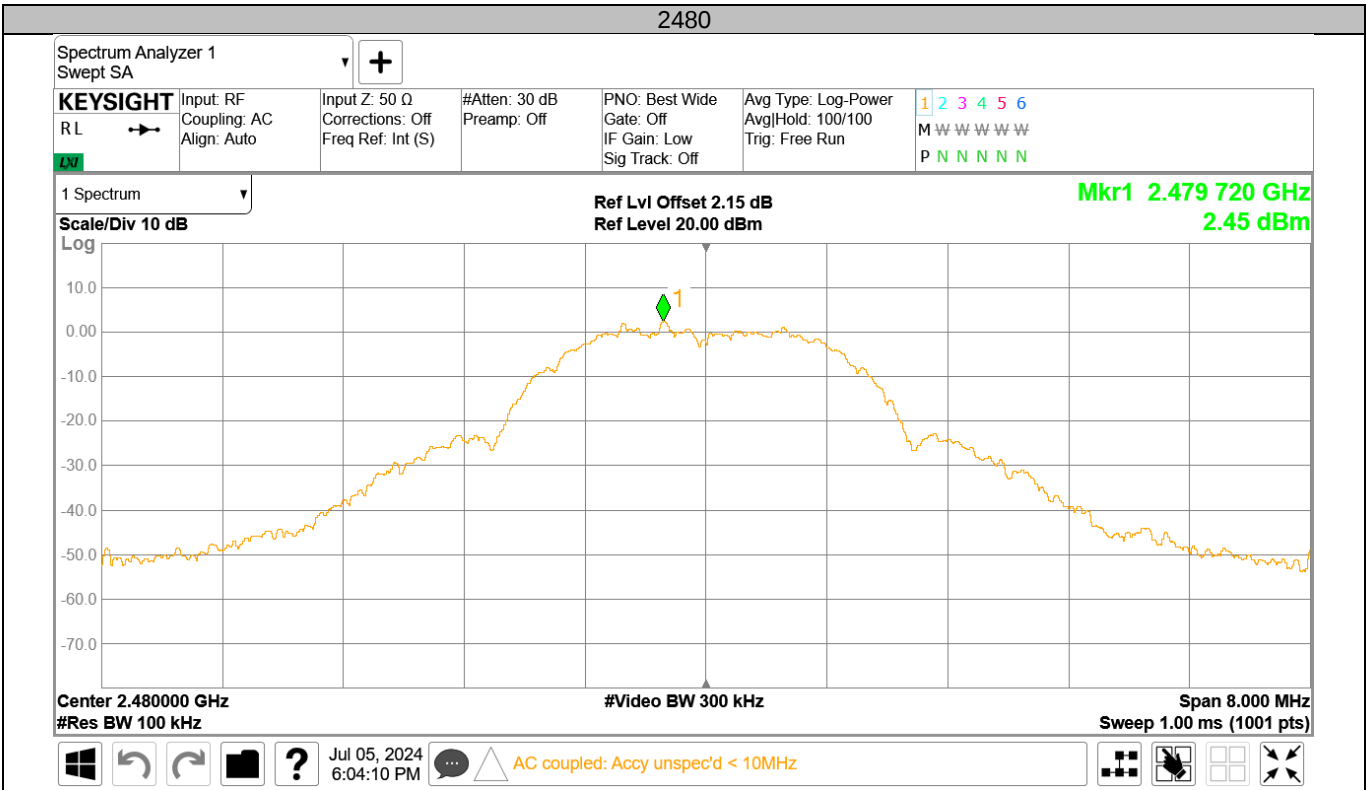
In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating, the RF power that is produced shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either 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.

| Frequency Range<br>MHz | Limit (dBc) |
|------------------------|-------------|
| 30-25000               | -20         |



Test result







## 9.7 Spurious radiated emissions for transmitter

### Test Method

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

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:

#### 2405MHz

| Frequency<br>MHz | Emission<br>Level<br>dBuV/m | Polarization | Limit<br>dBuV/m | Detector | Margin<br>dBuV/m | Result |
|------------------|-----------------------------|--------------|-----------------|----------|------------------|--------|
| 2384.9           | 48.1                        | Horizontal   | 74              | Peak     | 25.9             | pass   |
| 4808.5           | 44.8                        | Horizontal   | 74              | Peak     | 29.2             | pass   |
| 2384.2           | 47.9                        | Vertical     | 74              | Peak     | 26.1             | pass   |
| 4811.1           | 44.3                        | Vertical     | 74              | Peak     | 29.7             | pass   |

#### 2440MHz

| Frequency<br>MHz | Emission<br>Level<br>dBuV/m | Polarization | Limit<br>dBuV/m | Detector | Margin<br>dBuV/m | Result |
|------------------|-----------------------------|--------------|-----------------|----------|------------------|--------|
| 4883.4           | 45.6                        | Horizontal   | 74              | Peak     | 28.4             | pass   |
| 4880.7           | 44.6                        | Vertical     | 74              | Peak     | 29.4             | pass   |

#### 2480MHz

| Frequency<br>MHz | Emission<br>Level<br>dBuV/m | Polarization | Limit<br>dBuV/m | Detector | Margin<br>dBuV/m | Result |
|------------------|-----------------------------|--------------|-----------------|----------|------------------|--------|
| 2484.3           | 50.2                        | Horizontal   | 74              | Peak     | 23.8             | pass   |
| 4965.7           | 46.5                        | Horizontal   | 74              | Peak     | 27.5             | pass   |
| 2484.2           | 50.4                        | Vertical     | 74              | Peak     | 23.6             | pass   |
| 4961.0           | 44.8                        | Vertical     | 74              | Peak     | 29.2             | pass   |

#### Remark:

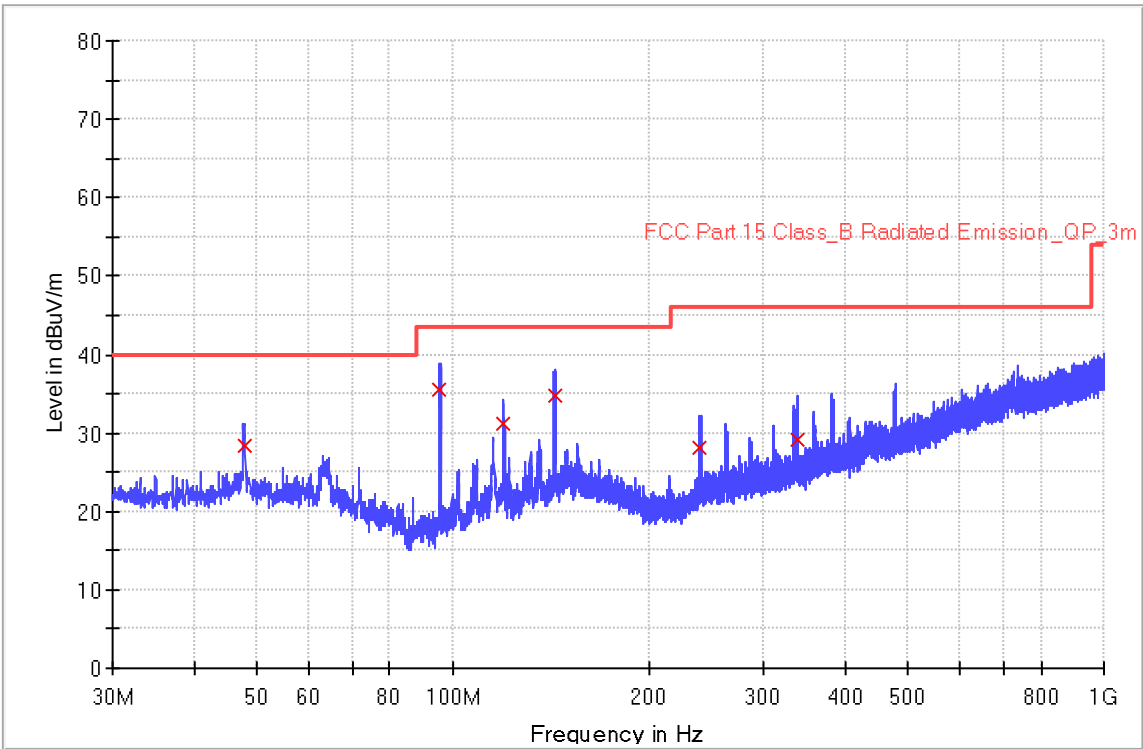
- (1) Emission level= Original Receiver Reading + Correct Factor
- (2) Correct Factor = Antenna Factor + Cable Loss -Amplifier gain
- (3) Margin = limit – Corrected Reading



The worst case of Radiated Emission below 1GHz:

|                                                                     |                                     |
|---------------------------------------------------------------------|-------------------------------------|
| Site: 3 meter chamber                                               | Time: 2024/07/01 - 12:31            |
| Limit: FCC_Part15.209 and RSS-GEN 8.8_RE(3m)                        | Engineer: Wenqiang LU               |
| Probe: VULB9168                                                     | Polarity: Horizontal                |
| UT: Tubular motor, Model no: YKV24SAED-DB-Z                         | Power: 120VAC, 60Hz (Charging mode) |
| Note: Transmit by at channel 2440MHz.                               |                                     |
| Note: Pre-scan with three orthogonal axis and worst case as X axis. |                                     |

RE\_VULB9168\_pre\_Cont\_30-1000



### Limit and Margin

| Frequency (MHz) | QuasiPeak (dBuV/m) | Meas. Time (ms) | Bandwidth (kHz) | Height (cm) | Pol | Azimuth (deg) | Corr. (dB) | Margin - QPK (dB) | Limit - QPK (dBuV/m) |
|-----------------|--------------------|-----------------|-----------------|-------------|-----|---------------|------------|-------------------|----------------------|
| 47.800000       | 28.3               | 1000.0          | 120.000         | 150.0       | H   | 332.0         | 20.5       | 11.7              | 40.0                 |
| 95.320000       | 35.6               | 1000.0          | 120.000         | 150.0       | H   | 152.0         | 15.5       | 7.9               | 43.5                 |
| 119.160000      | 31.2               | 1000.0          | 120.000         | 150.0       | H   | 38.0          | 18.0       | 12.3              | 43.5                 |
| 143.720000      | 34.7               | 1000.0          | 120.000         | 150.0       | H   | 257.0         | 20.6       | 8.8               | 43.5                 |
| 238.400000      | 28.0               | 1000.0          | 120.000         | 150.0       | H   | 118.0         | 19.4       | 18.0              | 46.0                 |
| 337.480000      | 29.2               | 1000.0          | 120.000         | 150.0       | H   | 328.0         | 22.6       | 16.8              | 46.0                 |

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

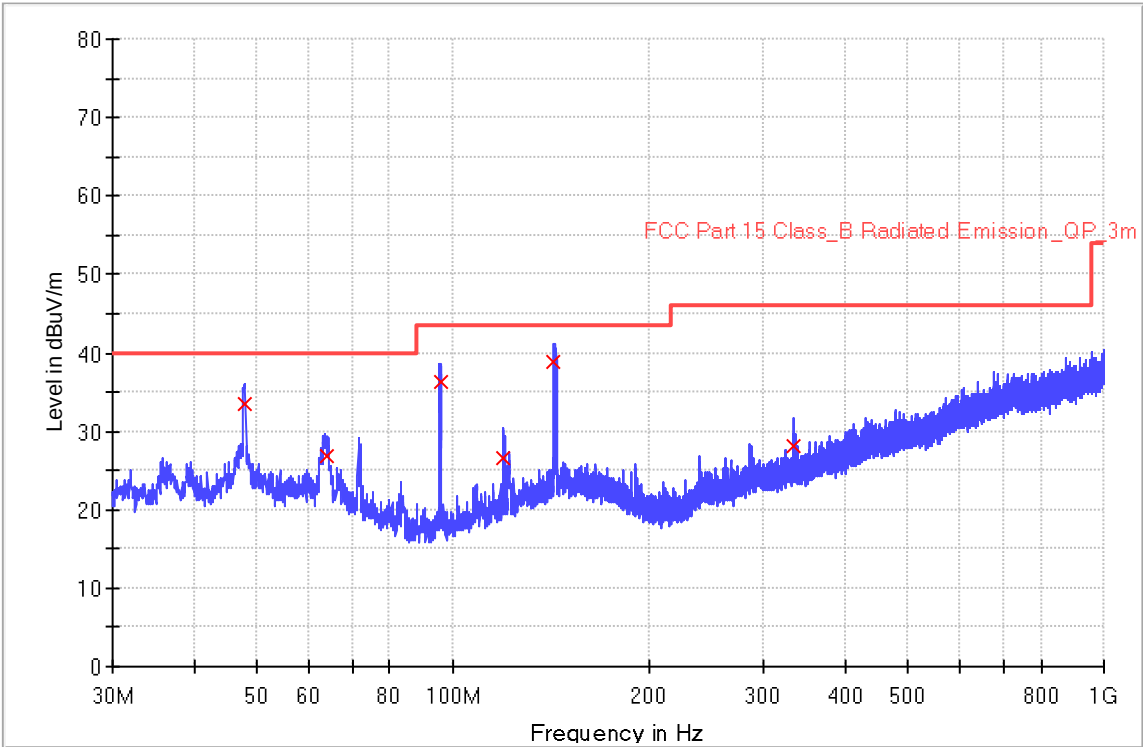
Factor (dB) = Cable Loss (dB) + Antenna Factor (dB/m)

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.



|                                                                     |                                     |
|---------------------------------------------------------------------|-------------------------------------|
| Site: 3 meter chamber                                               | Time: 2024/07/01 - 11:30            |
| Limit: FCC_Part15.209 and RSS-GEN 8.8_RE(3m)                        | Engineer: Wenqiang LU               |
| Probe: VULB9168                                                     | Polarity: Vertical                  |
| UT: Tubular motor, Model no: YKV24SAED-DB-Z                         | Power: 120VAC, 60Hz (Charging mode) |
| Note: Transmit by at channel 2440MHz.                               |                                     |
| Note: Pre-scan with three orthogonal axis and worst case as X axis. |                                     |

RE\_VULB9168\_pre\_Cont\_30-1000



Limit and Margin

| Frequency (MHz) | QuasiPeak (dBuV/m) | Meas. Time (ms) | Bandwidth (kHz) | Height (cm) | Pol | Azimuth (deg) | Corr. (dB) | Margin - QPK (dB) | Limit - QPK (dBuV/m) |
|-----------------|--------------------|-----------------|-----------------|-------------|-----|---------------|------------|-------------------|----------------------|
| 48.000000       | 33.5               | 1000.0          | 120.000         | 150.0       | V   | 250.0         | 20.5       | 6.5               | 40.0                 |
| 64.240000       | 26.8               | 1000.0          | 120.000         | 150.0       | V   | 22.0          | 19.5       | 13.2              | 40.0                 |
| 95.800000       | 36.3               | 1000.0          | 120.000         | 150.0       | V   | 336.0         | 15.6       | 7.2               | 43.5                 |
| 119.200000      | 26.7               | 1000.0          | 120.000         | 150.0       | V   | 315.0         | 18.0       | 16.8              | 43.5                 |
| 143.000000      | 38.8               | 1000.0          | 120.000         | 150.0       | V   | 291.0         | 20.6       | 4.7               | 43.5                 |
| 333.760000      | 28.1               | 1000.0          | 120.000         | 150.0       | V   | 167.0         | 22.6       | 17.9              | 46.0                 |

Note 1: Measure Level (dBuV/m) = Reading Level (dBuV) + Factor (dB)  
Factor (dB) = Cable Loss (dB) + Antenna Factor (dB/m)  
Note 2: The test trace is same as the ambient noise and the amplitude of the emissions are attenuated more than 20dB below the permissible (the test frequency range: 9kHz ~ 30MHz, 18GHz ~ 25GHz), therefore no data appear in the report.



## 10 Test Equipment List

List of Test Instruments  
Test Site1

|    | DESCRIPTION                          | MANUFACTURER    | MODEL NO.  | SERIAL NO. | CAL. DATE | CAL. DUE DATE |
|----|--------------------------------------|-----------------|------------|------------|-----------|---------------|
| C  | Signal 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        | 2021-9-23 | 2024-9-22     |
|    | Double-ridged waveguide horn antenna | Rohde & Schwarz | HF907      | 102393     | 2021-4-13 | 2024-4-12     |
|    | Pre-amplifier                        | Shenzhen HzEMC  | HPA-081843 | HYP A23026 | 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      | ----       | 2021-5-8  | 2024-5-7      |
| 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 | 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<br>30MHz to 1GHz, 5.03dB (Horizontal)<br>5.12dB (Vertical)<br>1GHz to 18GHz, 5.49dB<br>18GHz to 40GHz, 5.63dB |
| RF Conducted Measurement                 | Power related: 1.16dB<br>Frequency related: 6.00×10 <sup>-8</sup>                                                                   |

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 >.

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THE END