

# TEST REPORT

FCC BT LE Test for WR24GA  
Certification

**APPLICANT**  
LG Electronics Inc.

**REPORT NO.**  
HCT-RF-2407-FC081

**DATE OF ISSUE**  
July 26, 2024

**Tested by**  
Kyung Jun Woo



**Technical Manager**  
Jong Seok Lee



Accredited by KOLAS, Republic of KOREA

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# TEST REPORT

**REPORT NO.**

HCT-RF-2407-FC081

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July 26, 2024

**Applicant**

**LG Electronics Inc.**

222, LG-ro, Jinwi-myeon, Pyeongtaek-si, Gyeonggi-do 17709, Republic of Korea

**Product Name**

Simple Remote

**Model Name**

WR24GA

**FCC ID**

BEJWR24GA

**Location of Test**

☒ Permanent Testing Lab ☐ On Site Testing Lab

(Address: 74, Seoicheon-ro 578beon-gil, Majang-myeon, Icheon-si, Gyeonggi-do, Republic of Korea)

**Test Results**

PASS

**Date of Test**

July 16, 2024 ~ July 26, 2024

**Max. RF Output Power**

5.029 dBm (3.18 mW)

**Modulation type**

GFSK

**FCC Classification**

Digital Transmission System(DTS)

**Test Standard Used**

FCC Rule: Part 15.247

## REVISION HISTORY

The revision history for this test report is shown in table.

Revision No.	Date of Issue	Description
0	July 26, 2024	Initial Release

## Notice

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### Content

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#### Engineering Statement:

The measurements shown in this report were made in accordance with the procedures indicated, and the emissions from this equipment were found to be within the limits applicable. I assume full responsibility for the accuracy and completeness of these measurements, and for the qualifications of all persons taking them. It is further stated that upon the basis of the measurements made, the equipment tested is capable of operation in accordance with the requirements of the FCC Rules under normal use and maintenance.

The results shown in this test report only apply to the sample(s), as received, provided by the applicant, unless otherwise stated.

The test results have only been applied with the test methods required by the standard(s).

The laboratory is not accredited for the test results marked \*.

Information provided by the applicant is marked \*\*.

Test results provided by external providers are marked \*\*\*.

When confirmation of authenticity of this test report is required, please contact [www.hct.co.kr](http://www.hct.co.kr)

This test report provides test result(s) under the scope accredited by the Korea Laboratory Accreditation Scheme (KOLAS), which signed the ILAC-MRA.  
(KOLAS (KS Q ISO/IEC 17025) Accreditation No. KT197)

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## 1. EUT DESCRIPTION

Model	WR24GA	
Additional Model	-	
EUT Type	Simple Remote	
Power Supply	DC 3.00 V	
Frequency Range	2 402 MHz – 2 480 MHz	
Max. RF Output Power	Peak	1 MBit/s : 5.029 dBm (3.18 mW)
	Average	1 MBit/s : 4.80 dBm (3.02 mW)
Modulation Type	GFSK	
Bluetooth Version	4.2	
Number of Channels	40 Channels	
Antenna Specification	Antenna type: PCB Antenna Peak Gain : 1.94 dBi	
EUT Serial Number	Conduction : WR24GA_C1 Radiation : WR24GA_R1	

## 2. TEST METHODOLOGY

FCC KDB 558074 D01 15.247 Meas Guidance v05r02 dated April 02, 2019 entitled “guidance for compliance measurements on digital transmission system, frequency hopping spread spectrum system, and hybrid system devices and the measurement procedure described in ANSI C63.10 (Version : 2013) ‘the American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices’.

### EUT CONFIGURATION

The EUT configuration for testing is installed on RF field strength measurement to meet the Commissions requirement and operating in a manner that intends to maximize its emission characteristics in a continuous normal application.

### EUT EXERCISE

The EUT was operated in the engineering mode to fix the Tx frequency that was for the purpose of the measurements. According to its specifications, the EUT must comply with the requirements of the Section 15.207, 15.209 and 15.247 under the FCC Rules Part 15 Subpart C.

### GENERAL TEST PROCEDURES

#### Conducted Emissions

The EUT is placed on the turntable, which is 0.8 m above ground plane. According to the requirements in Section 6.2 of ANSI C63.10. (Version :2013) Conducted emissions from the EUT measured in the frequency range between 0.15 MHz and 30 MHz using CISPR Quasi-peak and average detector modes.

#### Radiated Emissions

The EUT is placed on a turn table, which is 0.8 m above ground plane below 1 GHz. Above 1 GHz with 1.5 m using absorbers between the EUT and receive antenna. The turntable shall rotate 360 degrees to determine the position of maximum emission level. EUT is set 3 m away from the receiving antenna, which varied from 1 m to 4 m to find out the highest emission. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical. In order to find out the max. emission, the relative positions of this hand-held transmitter (EUT) was rotated through three orthogonal axes according to the requirements in Section 6.6.5 of ANSI C63.10. (Version: 2013)

## DESCRIPTION OF TEST MODES

The EUT has been tested under operating condition. Test program used to control the EUT for staying in continuous transmitting and receiving mode is programmed.

## 3. INSTRUMENT CALIBRATION

The measuring equipment, which was utilized in performing the tests documented herein, has been calibrated in accordance with the manufacturer's recommendations for utilizing calibration equipment's, which is traceable to recognized national standards.

Especially, all antenna for measurement is calibrated in accordance with the requirements of C63.5 (Version : 2017).

## 4. FACILITIES AND ACCREDITATIONS

### FACILITIES

The SAC(Semi-Anechoic Chamber) and conducted measurement facility used to collect the radiated data are located at the 74, Seoicheon-ro 578beon-gil, Majang-myeon, Icheon-si, Gyeonggi-do, 17383, Rep. of KOREA. The site is constructed in conformance with the requirements of ANSI C63.4. (Version :2014) and CISPR Publication 22.

Detailed description of test facility was submitted to the Commission and accepted dated March 11, 2024 (Registration Number: KR0032).

### EQUIPMENT

Radiated emissions are measured with one or more of the following types of Linearly polarized antennas: tuned dipole, bi-conical, log periodic, bi-log, and/or ridged waveguide, horn. Spectrum analyzers with pre-selectors and quasi-peak detectors are used to perform radiated measurements. Conducted emissions are measured with Line Impedance Stabilization Networks and EMI Test Receivers. Calibrated wideband preamplifiers, coaxial cables, and coaxial attenuators are also used for making measurements.

All receiving equipment conforms to CISPR Publication 16-1, "Radio Interference Measuring Apparatus and Measurement Methods."

## 5. ANTENNA REQUIREMENTS

According to FCC 47 CFR § 15.203:

“An intentional radiator antenna shall be designed to ensure that no antenna other than that furnished by the responsible party can be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section.”

- (1) The antennas of this E.U.T are permanently attached.
- (2) The E.U.T Complies with the requirement of § 15.203

## 6. MEASUREMENT UNCERTAINTY

The measurement uncertainties shown below were calculated in accordance with the requirements of ANSI C63.10-2013.

All measurement uncertainty values are shown with a coverage factor of  $k=2$  to indicate a 95 % level of confidence.

The measurement data shown herein meets or exceeds the  $U_{\text{CISPR}}$  measurement uncertainty values specified in CISPR 16-4-2 and, thus, can be compared directly to specified limits to determine compliance.

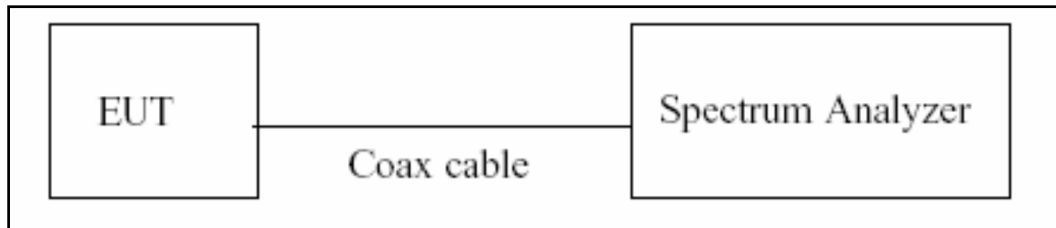
Parameter	Expanded Uncertainty (dB)
Conducted Disturbance (150 kHz ~ 30 MHz)	1.98 ( Confidence level about 95 %, $k=2$ )
Radiated Disturbance (9 kHz ~ 30 MHz)	4.36 ( Confidence level about 95 %, $k=2$ )
Radiated Disturbance (30 MHz ~ 1 GHz)	5.70 ( Confidence level about 95 %, $k=2$ )
Radiated Disturbance (1 GHz ~ 18 GHz)	5.52 ( Confidence level about 95 %, $k=2$ )
Radiated Disturbance (18 GHz ~ 40 GHz)	5.66 ( Confidence level about 95 %, $k=2$ )
Radiated Disturbance (Above 40 GHz)	5.58 ( Confidence level about 95 %, $k=2$ )



## 7. DESCRIPTION OF TESTS

### 7.1. Duty Cycle

#### Test Configuration



#### Test Procedure

The transmitter output is connected to the Spectrum Analyzer.

We tested according to the zero-span measurement method, 6.0)b) in KDB 558074 v05r02.

The largest available value of RBW is 8 MHz and VBW is 8 MHz.

The zero-span method of measuring duty cycle shall not be used if  $T \leq 6.25$  microseconds. ( $50/6.25 = 8$ )

The zero-span method was used because all measured T data are  $> 6.25$  microseconds and both RBW and VBW are  $> 50/T$ .

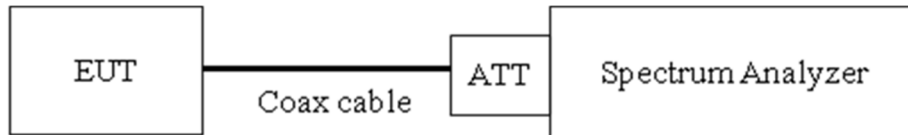
1. RBW = 8 MHz (the largest available value)
2. VBW = 8 MHz ( $\geq$  RBW)
3. SPAN = 0 Hz
4. Detector = Peak
5. Number of points in sweep  $> 100$
6. Trace mode = Clear write
7. Measure  $T_{\text{total}}$  and  $T_{\text{on}}$
8. Calculate Duty Cycle =  $T_{\text{on}}/T_{\text{total}}$  and Duty Cycle Factor =  $10\log(1/\text{Duty Cycle})$

## 7.2. 6 dB Bandwidth

### Limit

The minimum permissible 6 dB bandwidth is 500 kHz.

### Test Configuration



### Test Procedure

The transmitter output is connected to the Spectrum Analyzer.

The Spectrum Analyzer is set to (Procedure 8.2 in KDB 558074 v05r02, Procedure 11.8.1 in ANSI 63.10-2013)

- 1) RBW = 100 kHz
- 2) VBW  $\geq 3 \times$  RBW
- 3) Detector = Peak
- 4) Trace mode = Max hold
- 5) Sweep = auto couple
- 6) Allow the trace to stabilize
- 7) We tested 6 dB bandwidth using the automatic bandwidth measurement capability of a spectrum analyzer. X dB is set 6 dB.

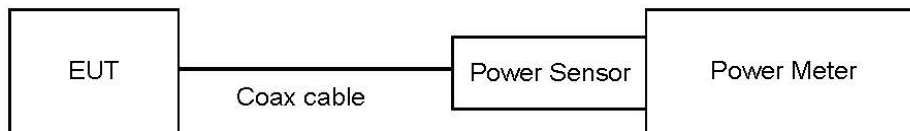
Note : We tested OBW using the automatic bandwidth measurement capability of a spectrum analyzer.

### 7.3. Output Power

#### Limit

The maximum permissible conducted output power is 1 Watt.

#### Test Configuration



#### Test Procedure

The transmitter output is connected to the Power Meter.

- Peak Power (Procedure 11.9.1.3 in ANSI 63.10-2013)  
: Measure the peak power of the transmitter.
- Average Power (Procedure 8.3.2.3 in KDB 558074 v05r02, Procedure 11.9.2.3 in ANSI 63.10-2013)
  - 1) Measure the duty cycle.
  - 2) Measure the average power of the transmitter. This measurement is an average over both the on and off periods of the transmitter.
  - 3) Add  $10 \log (1/x)$ , where  $x$  is the duty cycle, to the measured power in order to compute the average power during the actual transmission times.

#### Sample Calculation

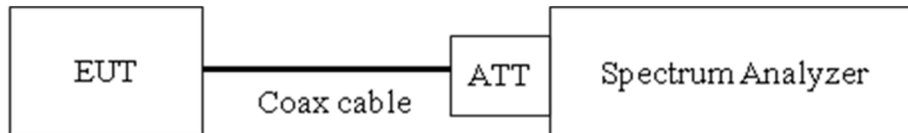
- Conducted Output Power(Peak) = Measured Value + ATT loss + Cable loss
- Conducted Output Power(Average) = Measured Value + ATT loss + Cable loss + Duty Cycle Factor

## 7.4. Power Spectral Density

### Limit

The transmitter power density average over 1-second interval shall not be greater than 8 dBm in any 3 kHz BW.

### Test Configuration



### Test Procedure

The transmitter output is connected to the Spectrum Analyzer.

We tested according to Procedure 8.4 in KDB 558074 v05r02, Procedure 11.10 in ANSI 63.10-2013.

The spectrum analyzer is set to :

- 1) Set analyzer center frequency to DTS channel center frequency.
- 2) Set span to at least 1.5 times the DTS bandwidth.
- 3)  $RBW = 3 \text{ kHz} \leq RBW \leq 100 \text{ kHz}$ .
- 4)  $VBW \geq 3 \times RBW$ .
- 5) Sweep = auto couple.
- 6) Detector = Peak.
- 7) Trace mode = max hold.
- 8) Allow trace to fully stabilize.
- 9) Use the peak marker function to determine the maximum amplitude level within the RBW.
- 10) If measured value exceeds limit, reduce RBW (no less than 3 kHz) and repeat.

### Sample Calculation

- Power Spectral Density = Measured Value + ATT loss + Cable loss + Duty Cycle Factor

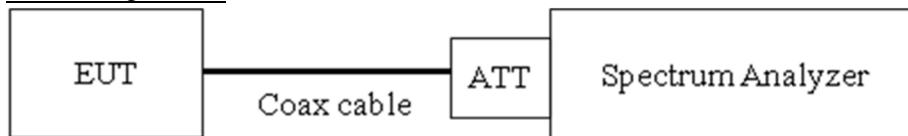
### 7.5. Conducted Band Edge(Out of Band Emissions) & Conducted Spurious Emissions

#### Limit

The maximum conducted (Peak) output power was used to demonstrate compliance, then the peak power in any 100 kHz bandwidth outside of the authorized frequency band shall be attenuated by at least 20 dB relative to the maximum in-band peak PSD level in 100 kHz.

[ Conducted > 20 dBc ]

#### Test Configuration



#### Test Procedure

The transmitter output is connected to the spectrum analyzer.

(Procedure 8.5 in KDB 558074 v05r02, Procedure 11.11 in ANSI 63.10-2013)

- 1) RBW = 100 kHz
- 2) VBW  $\geq 3 \times$  RBW
- 3) Set span to encompass the spectrum to be examined
- 4) Detector = Peak
- 5) Trace Mode = Max hold
- 6) Sweep time = auto couple
- 7) Ensure that the number of measurement points  $\geq 2 \times$  Span/VBW
- 8) Allow trace to fully stabilize.
- 9) Use peak marker function to determine the maximum amplitude level.

Measurements are made over the 30 MHz to 25 GHz range with the transmitter set to the lowest, middle, and highest channels.

### Factors for frequency

Freq(MHz)	Factor(dB)
30	10.94
100	11.12
200	11.18
300	11.12
400	11.13
500	11.31
600	11.34
700	11.48
800	11.50
900	11.60
1 000	11.62
2 000	11.64
2 400	<b>11.74</b>
2 500	<b>11.74</b>
3 000	11.89
4 000	11.88
5 000	11.91
6 000	11.84
7 000	12.23
8 000	12.31
9 000	12.32
10 000	12.42
11 000	12.41
12 000	12.26
13 000	12.46
14 000	12.59
15 000	12.54
16 000	12.60
17 000	12.61
18 000	12.68
19 000	12.74
20 000	12.73
21 000	12.80
22 000	12.84
23 000	12.91
24 000	12.95
25 000	12.96
26 000	13.00

Note : 1. 2400 ~ 2500 MHz is fundamental frequency range.

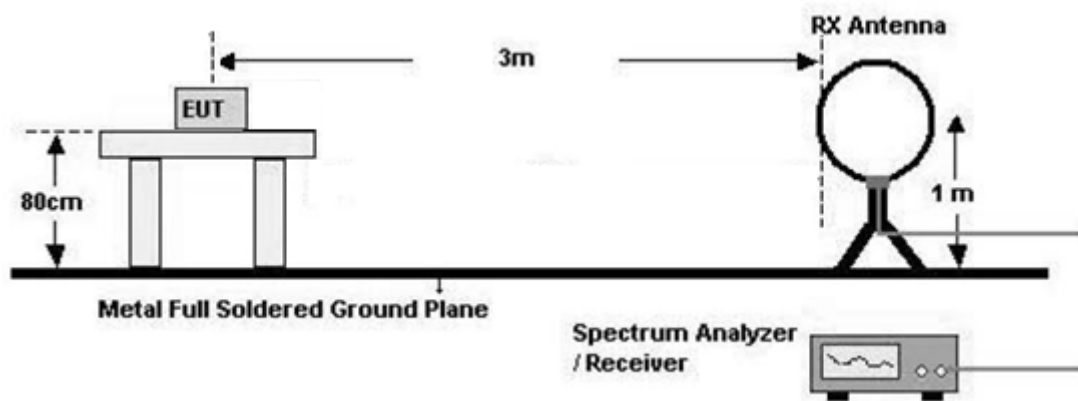
## 7.6. Radiated Test

### Limit

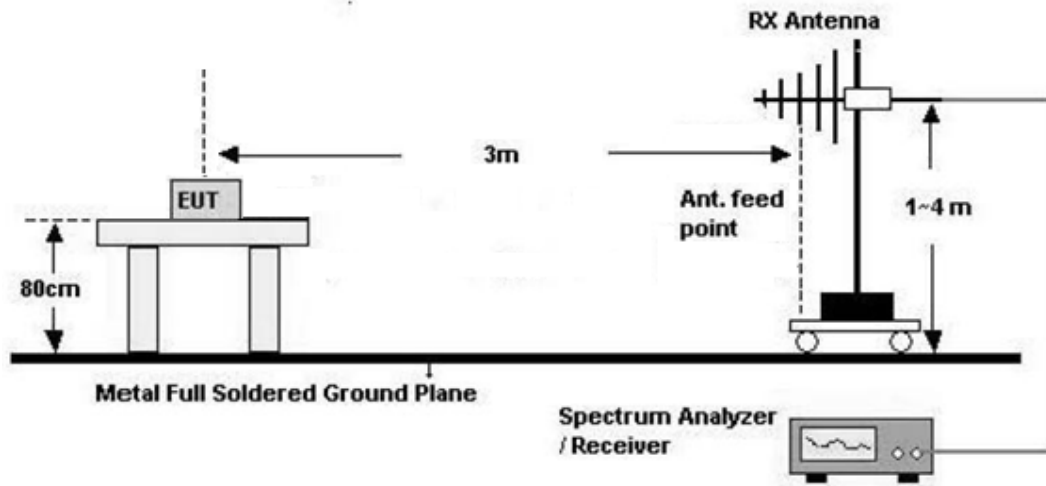
Frequency (MHz)	Field Strength ( $\mu\text{V/m}$ )	Measurement Distance (m)
0.009 – 0.490	2400/F(kHz)	300
0.490 – 1.705	24000/F(kHz)	30
1.705 – 30	30	30
30-88	100	3
88-216	150	3
216-960	200	3
Above 960	500	3

### Test Configuration

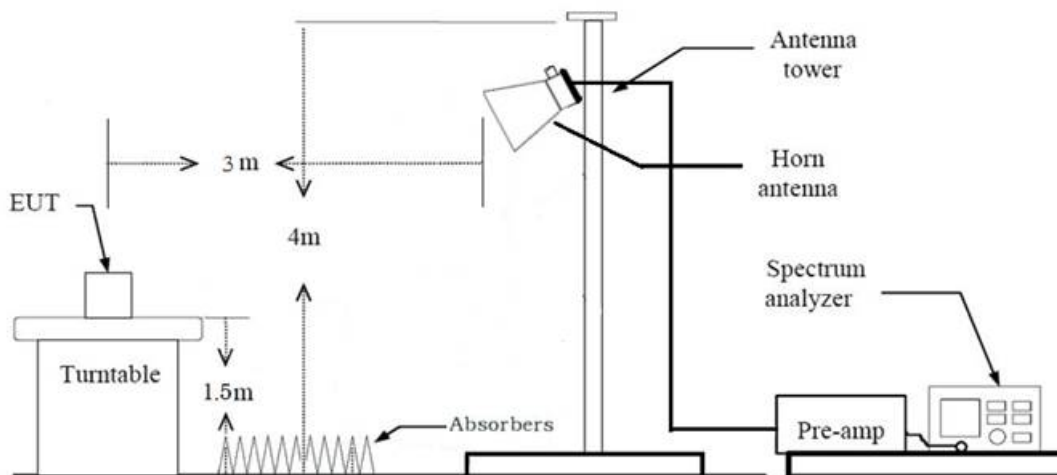
Below 30 MHz



30 MHz - 1 GHz



Above 1 GHz





**Test Procedure of Radiated spurious emissions(Below 30 MHz)**

1. The EUT was placed on a non-conductive table located on semi-anechoic chamber.
2. The loop antenna was placed at a location 3m from the EUT
3. The EUT is placed on a turntable, which is 0.8m above ground plane.
4. We have done x, y, z planes in EUT and horizontal and vertical polarization and Parallel to the ground plane in detecting antenna.
5. The turntable shall be rotated for 360 degrees to determine the position of maximum emission level.
6. Distance Correction Factor(0.009 MHz – 0.490 MHz) =  $40\log(3\text{ m}/300\text{ m}) = -80\text{ dB}$   
Measurement Distance : 3 m
7. Distance Correction Factor(0.490 MHz – 30 MHz) =  $40\log(3\text{ m}/30\text{ m}) = -40\text{ dB}$   
Measurement Distance : 3 m
8. Spectrum Setting
  - Frequency Range = 9 kHz ~ 30 MHz
  - Detector = Peak
  - Trace = Max hold
  - RBW = 9 kHz
  - VBW  $\geq 3 \times$  RBW
9. Total = Measured Level + Antenna Factor(A.F) + Cable Loss(C.L) + Distance Factor(D.F)
10. Measurement value only up to 6 maximum emissions noted, or would be lesser if no specific emissions from the EUT are recorded (ie: margin > 20 dB from the applicable limit) and considered that's already beyond the background noise floor.

**KDB 414788 OFS and Chamber Correlation Justification**

Base on FCC 15.31 (f) (2): measurements may be performed at a distance closer than that specified in the regulations; however, an attempt should be made to avoid making measurements in the near field.

OFS and chamber correlation testing had been performed and chamber measured test result is the worst case test result.

**Test Procedure of Radiated spurious emissions(Below 1GHz)**

1. The EUT was placed on a non-conductive table located on semi-anechoic chamber.
2. The EUT is placed on a turntable, which is 0.8m above ground plane.
3. The Hybrid antenna was placed at a location 3m from the EUT, which is varied from 1m to 4m to find out the highest emissions.
4. We have done x, y, z planes in EUT and horizontal and vertical polarization in detecting antenna.
5. The turntable shall be rotated for 360 degrees to determine the position of maximum emission level.
6. Spectrum Setting
  - (1) Measurement Type(Peak):
    - Measured Frequency Range : 30 MHz – 1 GHz
    - Detector = Peak
    - Trace = Max hold
    - RBW = 100 kHz
    - VBW  $\geq 3 \times$  RBW
  - (2) Measurement Type(Quasi-peak):
    - Measured Frequency Range : 30 MHz – 1 GHz
    - Detector = Quasi-Peak
    - RBW = 120 kHz
- ※In general, (1) is used mainly
7. Total = Measured Value + Antenna Factor(A.F) + Cable Loss(C.L)
8. Measurement value only up to 6 maximum emissions noted, or would be lesser if no specific emissions from the EUT are recorded (ie: margin > 20 dB from the applicable limit) and considered that's already beyond the background noise floor.

**Test Procedure of Radiated spurious emissions (Above 1 GHz)**

1. The EUT is placed on a turntable, which is 1.5 m above ground plane.
2. We have done x, y, z planes in EUT and horizontal and vertical polarization in detecting antenna.
3. The turntable shall be rotated for 360 degrees to determine the position of maximum emission level.
4. EUT is set 3 m away from the receiving antenna, which is varied from 1 m to 4 m to find out the highest emissions.
5. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
6. Each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.
7. The unit was tested with its standard battery.
8. Spectrum Setting (Method 8.6 in KDB 558074 v05r02, Procedure 11.12 in ANSI 63.10-2013)
  - (1) Measurement Type(Peak):
    - Measured Frequency Range : 1 GHz – 25 GHz
    - Detector = Peak
    - Trace = Max hold
    - RBW = 1 MHz
    - VBW  $\geq 3 \times$  RBW
  - (2) Measurement Type(Average):
    - Duty cycle < 98 %, duty cycle variations are less than  $\pm 2$  %
    - Measured Frequency Range : 1 GHz – 25 GHz
    - Detector = RMS
    - Averaging type = power (*i.e.*, RMS)
    - RBW = 1 MHz
    - VBW  $\geq 3 \times$  RBW
    - Sweep time = auto.
    - Trace mode = average (at least 100 traces).
    - Correction factor shall be added to the measurement results prior to comparing to the emission limit in order to compute the emission level that would have been measured had the test been performed at 100 percent duty cycle.
- Duty Cycle Factor (dB) : Please refer to the please refer to section 9.1
9. Measurement value only up to 6 maximum emissions noted, or would be lesser if no specific emissions from the EUT are recorded (ie: margin > 20 dB from the applicable limit) and considered that's already beyond the background noise floor.
10. Distance extrapolation factor =  $20\log(\text{test distance} / \text{specific distance})$  (dB)
11. Total(Measurement Type : Peak)  
= Measured value + Antenna Factor(A.F) + Cable Loss(C.L) - Amp Gain(A.G) + Distance Factor(D.F)

Total(Measurement Type : Average)

= Measured value + Antenna Factor(A.F) + Cable Loss(C.L) - Amp Gain(A.G) + Distance Factor(D.F)

#Note : Used Average measurement method according to KDB 558074 Section11 Q3

### **Test Procedure of Radiated Restricted Band Edge**

1. The EUT is placed on a turntable, which is 1.5 m above ground plane.
2. We have done x, y, z planes in EUT and horizontal and vertical polarization in detecting antenna.
3. The turntable shall be rotated for 360 degrees to determine the position of maximum emission level.
4. EUT is set 3 m away from the receiving antenna, which is varied from 1 m to 4 m to find out the highest emissions.
5. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
6. Each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.
7. The unit was tested with its standard battery.
8. Spectrum Setting
  - (1) Measurement Type(Peak):
    - Measured Frequency Range : 2310 MHz ~ 2390 MHz/ 2483.5 MHz ~ 2500 MHz
    - Detector = Peak
    - Trace = Max hold
    - RBW = 1 MHz
    - VBW  $\geq 3 \times$  RBW
  - (2) Measurement Type(Average):
    - Duty cycle < 98 %, duty cycle variations are less than  $\pm 2$  %
    - Measured Frequency Range : 2310 MHz ~ 2390 MHz/ 2483.5 MHz ~ 2500 MHz
    - Detector = RMS
    - Averaging type = power (*i.e.*, RMS)
    - RBW = 1 MHz
    - VBW  $\geq 3 \times$  RBW
    - Sweep time = auto.
    - Trace mode = average (at least 100 traces).
    - Correction factor shall be added to the measurement results prior to comparing to the emission limit in order to compute the emission level that would have been measured had the test been performed at 100 percent duty cycle.
    - Duty Cycle Factor (dB) : Please refer to the please refer to section 9.1.
9. Measurement value only up to 6 maximum emissions noted, or would be lesser if no specific emissions from the EUT are recorded (ie: margin > 20 dB from the applicable limit) and considered

that's already beyond the background noise floor.

10. Distance extrapolation factor =  $20\log(\text{test distance} / \text{specific distance})$  (dB)

11.Total

(1)Measurement(Peak)

= Measured Value(Peak)

(2)Measurement(Avg)

= Measured Value(Avg)

- We apply to the offset in range 1 GHz - 18 GHz

- The offset = Antenna Factor(A.F) + Cable Loss(C.L) + Distance Factor(D.F)

#Note : Used Average measurement method according to KDB 558074 Section11 Q3

## 7.7. AC Power line Conducted Emissions

### Limit

For an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies, within the band 150 kHz to 30 MHz, shall not exceed the limits in the following table, as measured using a 50  $\mu$ H/50 ohms line impedance stabilization network (LISN).

Frequency Range (MHz)	Limits (dB $\mu$ V)	
	Quasi-peak	Average
0.15 to 0.50	66 to 56 <sup>(a)</sup>	56 to 46 <sup>(a)</sup>
0.50 to 5	56	46
5 to 30	60	50

<sup>(a)</sup>Decreases with the logarithm of the frequency.

Compliance with this provision shall be based on the measurement of the radio frequency voltage between each power line (LINE and NEUTRAL) and ground at the power terminals.

### Test Configuration

See test photographs attached in Annex A for the actual connections between EUT and support equipment.

### Test Procedure

1. The EUT is placed on a wooden table 80 cm above the reference ground plane.
2. The EUT is connected via LISN to a test power supply.
3. The measurement results are obtained as described below:
4. Detectors : Quasi Peak and Average Detector.

### Sample Calculation

Quasi-peak(Final Result) = Measured Value + Correction Factor

## 7.8. Worst case configuration and mode

### Radiated Test

1. All modes of operation were investigated and the worst case configuration results are reported.
  - Mode : Stand alone
2. EUT Axis:
  - Radiated Spurious Emissions : X
  - Radiated Restricted Band Edge : X
3. All packet length of operation were investigated and the worst case results are reported.  
(Worst case : 1M 37 Byte)
4. All position of loop antenna were investigated and the test result is a no critical peak found at all positions.
  - Position : Horizontal, Vertical, Parallel to the ground plane

### AC Power line Conducted Emissions

1. We don't perform powerline conducted emission test. The device only employ battery power for operation.

### Conducted test

1. All packet length of operation were investigated and the worst case results are reported.  
(Worst case : 1M 37 Byte)
2. All modes of operation were investigated and the worst case configuration results are reported.
  - Mode : Stand alone

## 8. SUMMARY TEST OF RESULTS

Test Description	FCC Part Section(s)	Test Limit	Test Condition	Test Result
6 dB Bandwidth	§ 15.247(a)(2)	> 500 kHz	Conducted	PASS
Conducted Maximum Output Power	§ 15.247(b)(3)	< 1 Watt		PASS
Power Spectral Density	§ 15.247(e)	< 8 dBm / 3 kHz Band		PASS
Band Edge (Out of Band Emissions)	§ 15.247(d)	Conducted > 20 dBc		PASS
AC Power line Conducted Emissions	§ 15.207	cf. Section 7.7		N/A (Note.1)
Radiated Spurious Emissions	§ 15.247(d), 15.205, 15.209	cf. Section 7.6	Radiated	PASS
Radiated Restricted Band Edge	§ 15.247(d), 15.205, 15.209	cf. Section 7.6		PASS

### Note

1. The device only employ battery power for operation.



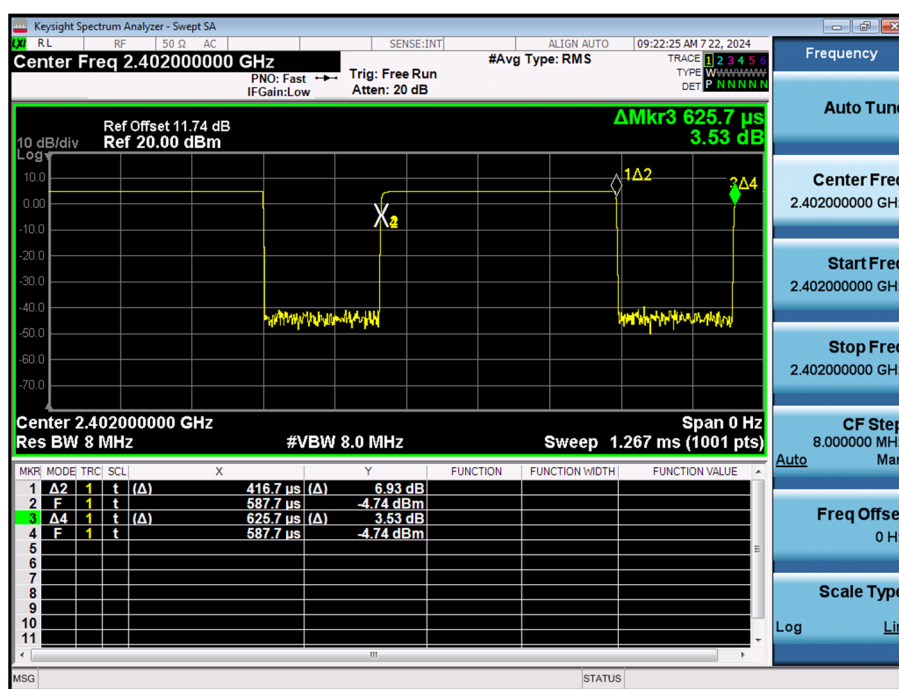
## 9. TEST RESULT

### 9.1 DUTY CYCLE

Data rate (Bit/s)	Packet length (Byte)	T <sub>on</sub> (ms)	T <sub>total</sub> (ms)	Duty Cycle	Duty Cycle Factor (dB)
1M	37	0.417	0.626	0.666	1.765

#### Test Plot

#### 1 M Bit/s (37 Byte) Duty Cycle

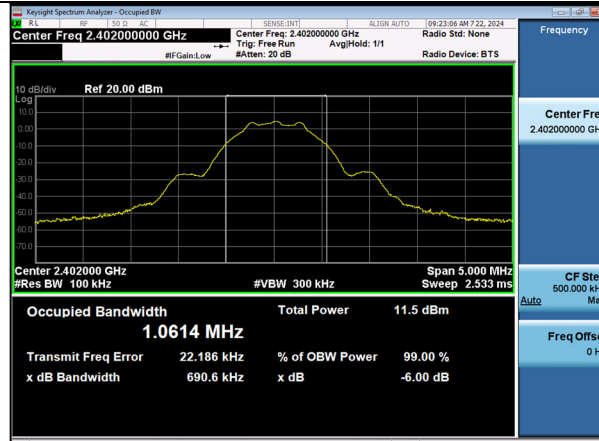


**9.2 6 dB BANDWIDTH & 99 % BANDWIDTH**

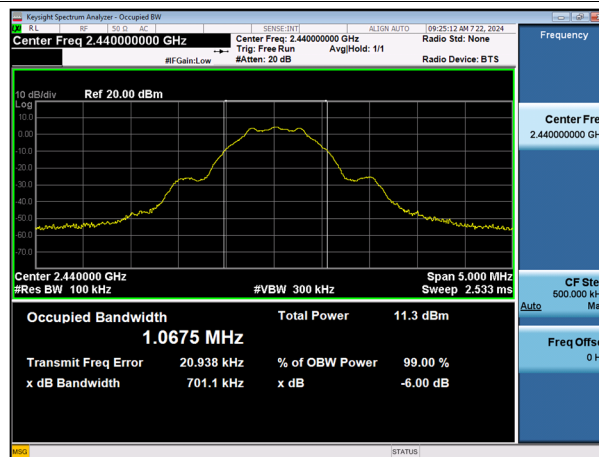
Mode (Bit/s)	Channel	6 dB Bandwidth (kHz)	Limit (kHz)
1M 37 Byte	0	690.6	> 500
	19	701.1	
	39	693.9	

# Test Plots(1M Bit/s(37 Byte))

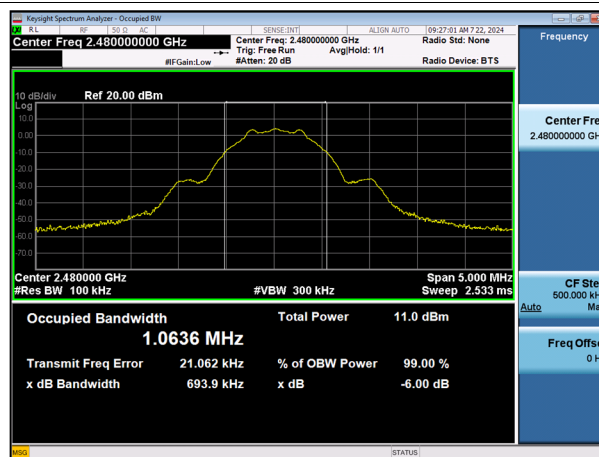
6 dB Bandwidth plot (Low-CH 0)



6 dB Bandwidth plot (Mid-CH 19)



6 dB Bandwidth plot (High-CH 39)



### 9.3 OUTPUT POWER

#### Peak Power

Data rate	Packet length	LE Mode		Peak Power (dBm)	Limit (dBm)
(Bit/s)	(Byte)	Frequency [MHz]	Channel		
1M	37	2402	0	5.029	30
		2440	19	4.858	
		2480	39	4.606	

#### Average Power

Data rate	Packet length	LE Mode		Measured Power (dBm)	Duty Cycle Factor	Result	Limit (dBm)
(Bit/s)	(Byte)	Frequency [MHz]	Channel		(dB)	(dBm)	
1M	37	2402	0	3.03	1.77	4.80	30
		2440	19	2.84	1.77	4.61	
		2480	39	2.67	1.77	4.44	

#### 9.4 POWER SPECTRAL DENSITY

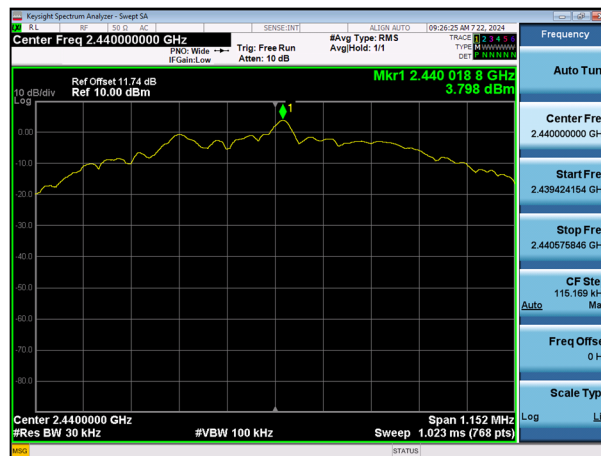
Frequency (MHz)	Channel No.	Mode (Bit/s)	Test Result	
			Power Spectral Density (dBm/kHz)	Limit (dBm/3 kHz)
2402	0	1 MBit/s 37 Byte	3.954	8
2440	19		3.798	
2480	39		3.490	

## 1M Bit/s (37 Byte) Test Plots

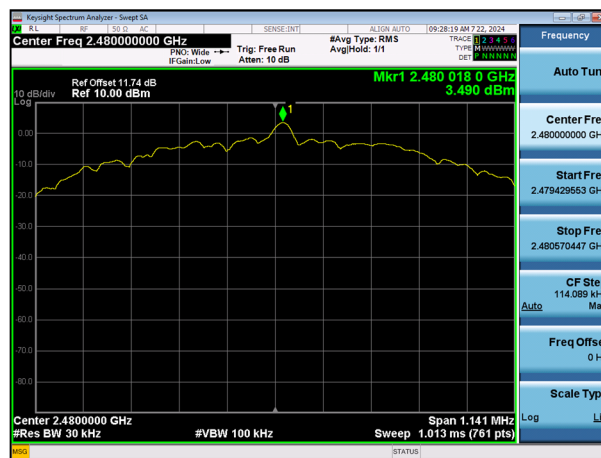
### Power Spectral Density (Low-CH 0)



### Power Spectral Density (Mid-CH 19)



### Power Spectral Density (High-CH 39)



## 9.5 BAND EDGE/ CONDUCTED SPURIOUS EMISSIONS

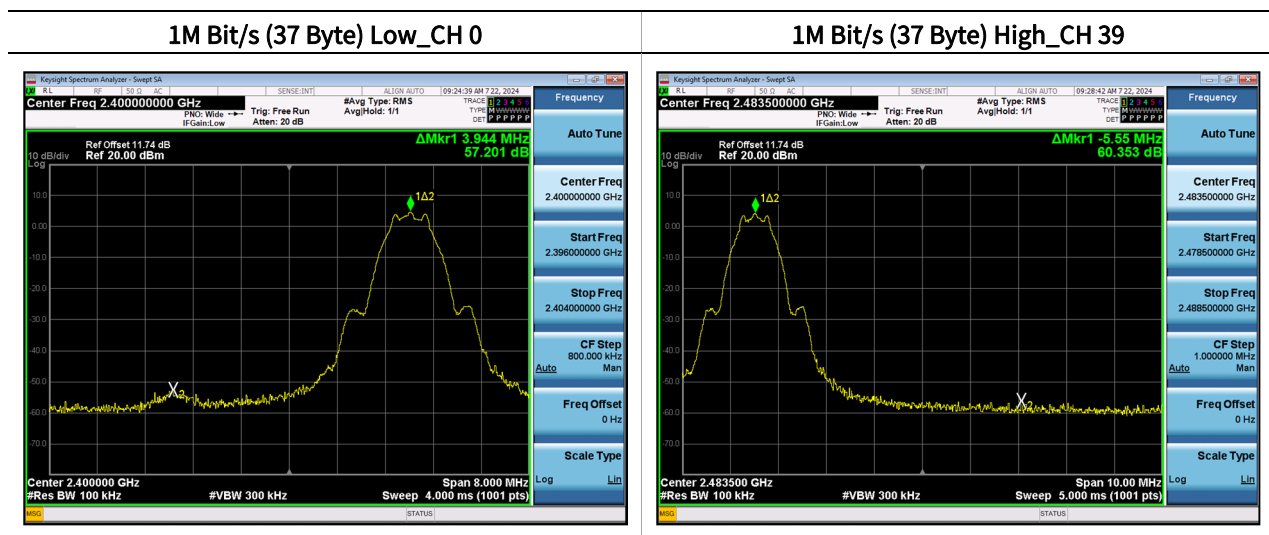
### [BAND EDGE]

Frequency (MHz)	Mode	Channel No.	Position	Test Result	
				Measured Level (dB)	Limit (dBc)
2402	1M Bit/s 37 Byte	0	Lower	57.201	20
2480		39	Upper	60.353	20

### Note:

- In order to simplify the report, attached plots were only the worst case channel and data rate.

### Test Plots



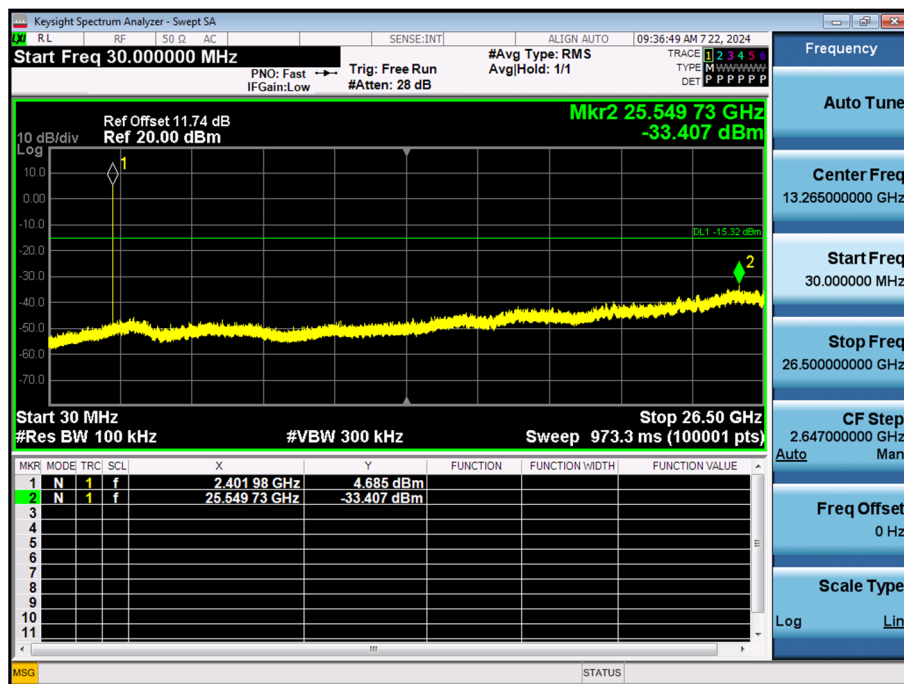
## [Conducted Spurious Emission]

### Note:

1. In order to simplify the report, attached plots were only the worst case channel and data rate.  
Worstcase : 1M Bit/s 37 Byte Ch. 0
2. Limit(dBm) : -15.315

### Test Plots

#### Conducted Spurious Emission (30 MHz – 26.5 GHz)





## 9.6 RADIATED SPURIOUS EMISSIONS

Frequency Range : 9 kHz – 30 MHz

Frequency	Measured Value	A.F+C.L+D.F	POL	Total	Limit	Margin
[MHz]	[dB $\mu$ V]	[dB/m]	[H/V]	[dB $\mu$ V/m]	[dB $\mu$ V/m]	[dB]
No Critical peaks found						

**Note:**

1. The Measured of emissions are attenuated more than 20 dB below the permissible limits or the field strength is too small to be measured.
2. Distance extrapolation factor =  $40\log(\text{specific distance} / \text{test distance})$  (dB)
3. Limit line = specific Limits (dB $\mu$ V) + Distance extrapolation factor

### Frequency Range : Above 1 GHz

Mode		1 M Bit/s (37 Bytes)					
Operating Frequency		2402 MHz					
Channel No.		0 CH					
Frequency	Measured Value	AF+CL-AG	Pol.	Total	Limit	Margin	Measurement Type
[MHz]	[dB $\mu$ V]	[dB/m]	[H/V]	[dB $\mu$ V/m]	[dB $\mu$ V/m]	[dB]	
4804	46.14	2.94	V	49.08	73.98	24.90	PK
4804	36.29	2.94	V	39.23	53.98	14.75	AV
7206	47.23	9.79	V	57.02	73.98	16.96	PK
7206	39.14	9.79	V	48.93	53.98	5.05	AV
12010	38.98	17.37	V	56.35	73.98	17.63	PK
12010	28.26	17.37	V	45.63	53.98	8.35	AV
4804	45.77	2.94	H	48.71	73.98	25.27	PK
4804	35.81	2.94	H	38.75	53.98	15.23	AV
7206	48.99	9.79	H	58.78	73.98	15.20	PK
7206	41.15	9.79	H	50.94	53.98	3.04	AV
12010	40.09	17.37	H	57.46	73.98	16.52	PK
12010	28.93	17.37	H	46.30	53.98	7.68	AV

Mode		1 M Bit/s (37 Bytes)					
Operating Frequency		2440 MHz					
Channel No.		19 CH					
Frequency	Measured Value	AF+CL-AG	Pol.	Total	Limit	Margin	Measurement Type
[MHz]	[dB $\mu$ V]	[dB/m]	[H/V]	[dB $\mu$ V/m]	[dB $\mu$ V/m]	[dB]	
4880	45.02	3.59	V	48.61	73.98	25.37	PK
4880	36.18	3.59	V	39.77	53.98	14.21	AV
7320	45.97	10.28	V	56.25	73.98	17.73	PK
7320	37.11	10.28	V	47.39	53.98	6.59	AV
12200	39.13	17.21	V	56.34	73.98	17.64	PK
12200	27.33	17.21	V	44.54	53.98	9.44	AV
4880	45.39	3.59	H	48.98	73.98	25.00	PK
4880	36.64	3.59	H	40.23	53.98	13.75	AV
7320	46.59	10.28	H	56.87	73.98	17.11	PK
7320	37.49	10.28	H	47.77	53.98	6.21	AV
12200	39.65	17.21	H	56.86	73.98	17.12	PK
12200	27.58	17.21	H	44.79	53.98	9.19	AV

Mode 1 M Bit/s (37 Bytes)

Operating Frequency 2480 MHz

Channel No. 39 CH

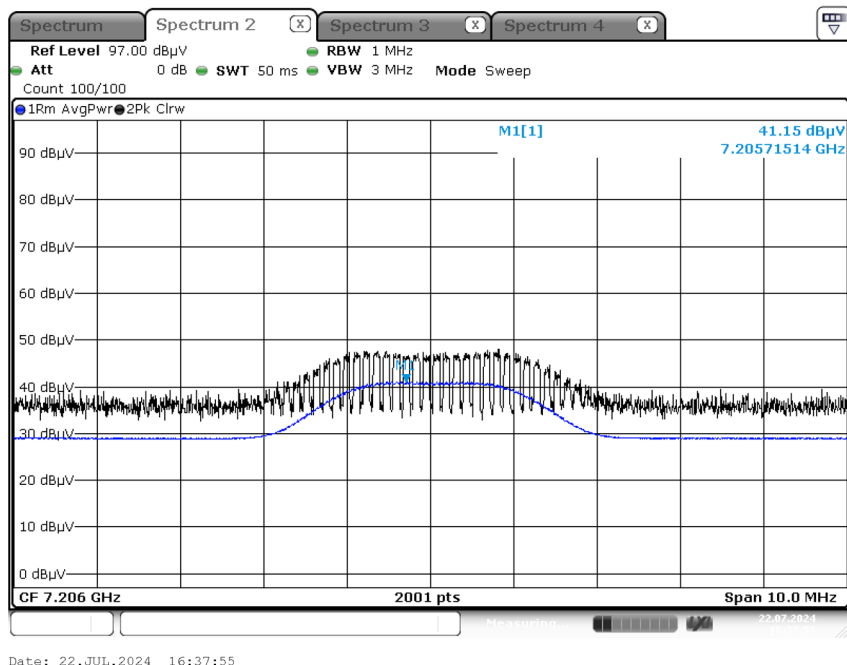
Frequency	Measured Value	AF+CL-AG	Pol.	Total	Limit	Margin	Measurement Type
[MHz]	[dBμV]	[dB/m]	[H/V]	[dBμV/m]	[dBμV/m]	[dB]	
4960	46.34	2.96	V	49.30	73.98	24.68	PK
4960	38.73	2.96	V	41.69	53.98	12.29	AV
7440	45.53	10.60	V	56.13	73.98	17.85	PK
7440	35.76	10.60	V	46.36	53.98	7.62	AV
12400	38.86	16.75	V	55.61	73.98	18.37	PK
12400	26.59	16.75	V	43.34	53.98	10.64	AV
4960	45.56	2.96	H	48.52	73.98	25.46	PK
4960	37.03	2.96	H	39.99	53.98	13.99	AV
7440	45.47	10.60	H	56.07	73.98	17.91	PK
7440	35.91	10.60	H	46.51	53.98	7.47	AV
12400	39.10	16.75	H	55.85	73.98	18.13	PK
12400	26.85	16.75	H	43.60	53.98	10.38	AV

# Note:

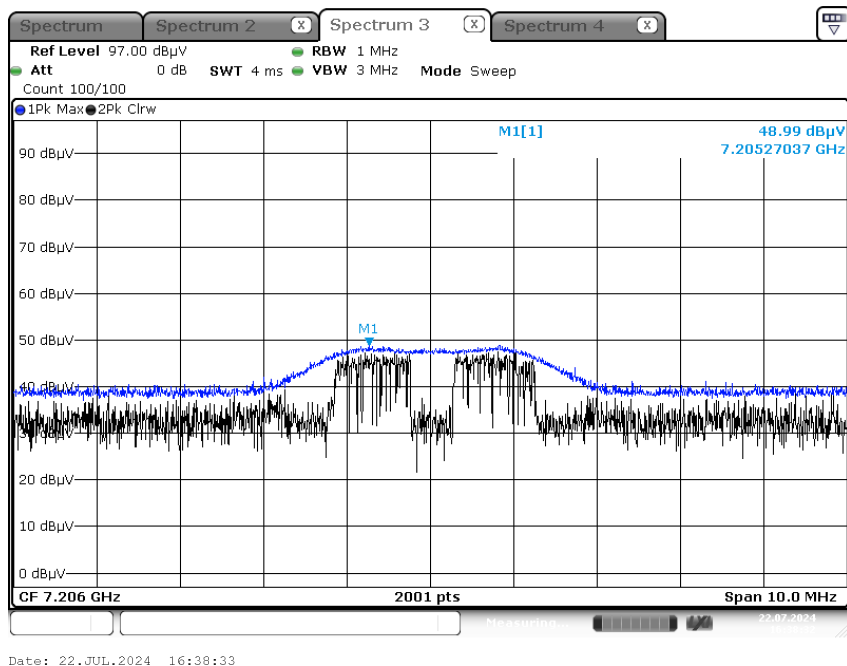
Plots of worst case are only reported.

## 1M Bit/s 37 Bytes Test Plots (Worst case : X-V)

Radiated Spurious Emissions plot – Average Result (Ch.0 3rd Harmonic)



Radiated Spurious Emissions plot – Peak Result (Ch.0 3rd Harmonic)



### Frequency Range : 1G Under

Mode	1 M Bit/s (37 Bytes)						
Operating Frequency	2402MHz						
Channel No.	0 CH						
Frequency	Reading	A.F	C.L	Ant. Pol	Total	Limit	Margin
[MHz]	[dB $\mu$ V]	[dB/m]	[dB]	[H/V]	[dB $\mu$ V/m]	[dB $\mu$ V/m]	[dB]
401.0000	19.68	21.30	1.99	H	42.97	46.02	3.05
401.0000	19.18	21.30	1.99	V	42.47	46.02	3.55

Mode	1 M Bit/s (37 Bytes)						
Operating Frequency	2440 MHz						
Channel No.	19 CH						
Frequency	Reading	A.F	C.L	Ant. Pol	Total	Limit	Margin
[MHz]	[dB $\mu$ V]	[dB/m]	[dB]	[H/V]	[dB $\mu$ V/m]	[dB $\mu$ V/m]	[dB]
401.0000	18.41	21.30	1.99	H	41.70	46.02	4.32
401.0000	18.25	21.30	1.99	V	41.54	46.02	4.48

Mode	1 M Bit/s (37 Bytes)						
Operating Frequency	2402 MHz						
Channel No.	39 CH						
Frequency	Reading	A.F	C.L	Ant. Pol	Total	Limit	Margin
[MHz]	[dB $\mu$ V]	[dB/m]	[dB]	[H/V]	[dB $\mu$ V/m]	[dB $\mu$ V/m]	[dB]
401.0000	18.92	21.30	2.10	H	42.32	46.02	3.70
401.0000	18.32	21.30	2.10	V	41.72	46.02	4.30

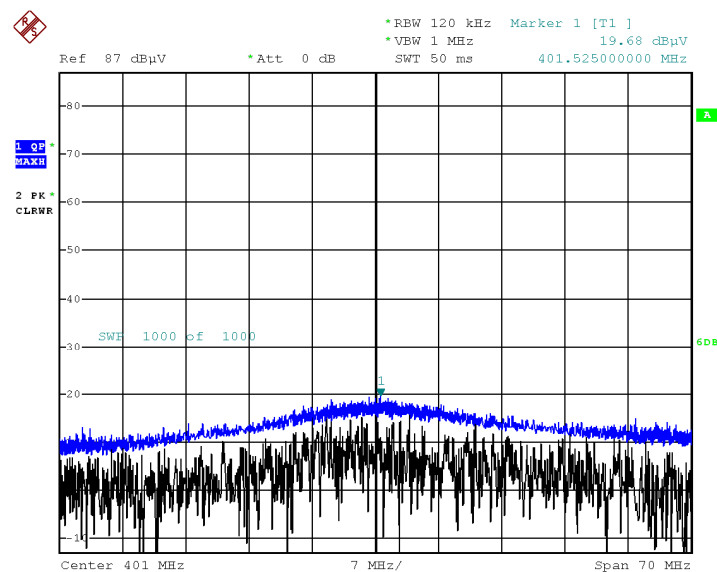
### Note:

1. Radiated emissions measured in frequency range from 30 MHz to 1000 MHz were made with an instrument using Quasi peak detector mode.

**Note:**

Plot of worst case was only reported.

**Radiated Spurious Emissions plot – Result (Ch.0 2 402 MHz, Y-H)**



Date: 1.JAN.2003 01:46:33

## 9.7 RADIATED RESTRICTED BAND EDGES

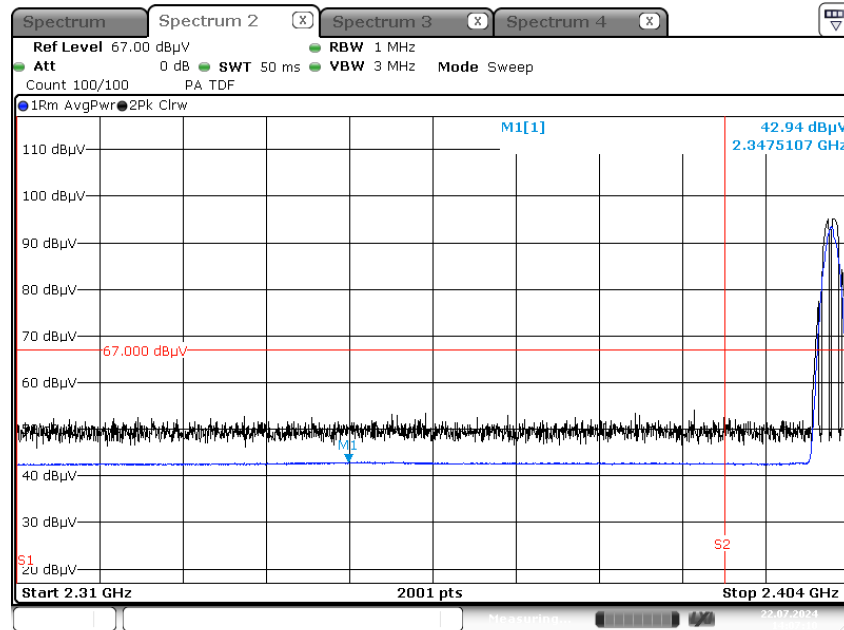
Mode : 1 M Bit/s (37 Bytes)

Mode	1 M Bit/s (37 Bytes)
Operating Frequency	2402 MHz, 2480 MHz
Channel No.	0 CH, 39 CH

Frequency	Measured Value	Ant. Pol.	Total	Limit	Margin	Measurement
[MHz]	[dBμV]	[H/V]	[dBμV/m]	[dBμV/m]	[dB]	Type
2390.0	54.38	H	54.38	73.98	19.60	PK
2390.0	42.94	H	42.94	53.98	11.04	AV
2390.0	54.08	V	54.08	73.98	19.90	PK
2390.0	42.55	V	42.55	53.98	11.43	AV
2483.5	54.39	H	54.39	73.98	19.59	PK
2483.5	42.63	H	42.63	53.98	11.35	AV
2483.5	52.85	V	52.85	73.98	21.13	PK
2483.5	41.94	V	41.94	53.98	12.04	AV

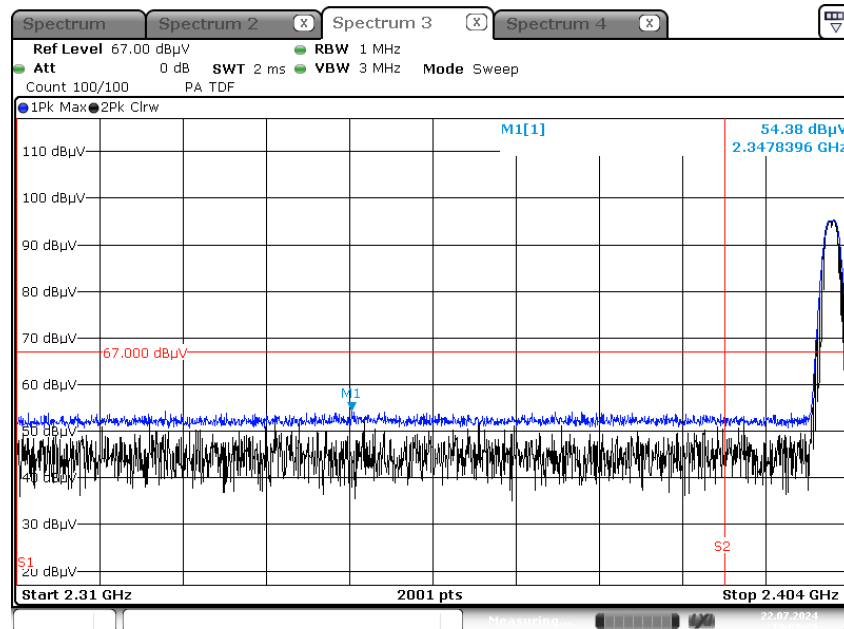
# Mode : 1 M Bit/s (37 Bytes) Test Plots

## Radiated Restricted Band Edges plot – Average Result (Ch. 39, X-H)



Date: 22.JUL.2024 14:07:10

## Radiated Restricted Band Edges plot – Peak Result (Ch. 39, X-H)



Date: 22.JUL.2024 14:07:39

### Note:

Plots of worst case are only reported.



## 10. LIST OF TEST EQUIPMENT

### Conducted Test

Equipment	Model	Manufacturer	Serial No.	Due to Calibration	Calibration Interval
LISN	ENV216	Rohde & Schwarz	102245	08/02/2024	Annual
EMI Test Receiver	ESR	Rohde & Schwarz	101910	05/08/2025	Annual
Temperature Chamber	SU-642	ESPEC	93008124	02/19/2025	Annual
Signal Analyzer	N9030A	Keysight	MY55410508	09/04/2024	Annual
Power Meter	N1911A	Agilent	MY45100523	02/28/2025	Annual
Power Sensor	N1921A	Agilent	MY57820067	02/22/2025	Annual
Directional Coupler	87300B	Agilent	3116A03621	10/30/2024	Annual
Power Splitter	11667B	Hewlett Packard	10545	02/06/2025	Annual
DC Power Supply	E3632A	Agilent	KR75305528	01/02/2025	Annual
Attenuator(10 dB)(DC-26.5 GHz)	8493C-010	Agilent	08285	05/28/2025	Annual
Attenuator(20 dB)	18N-20dB	Rohde & Schwarz	8	02/20/2025	Annual
Software	EMC32	Rohde & Schwarz	N/A	N/A	N/A
FCC WLAN&BT&BLE Conducted Test Software v3.0	N/A	HCT CO., LTD.	N/A	N/A	N/A
Bluetooth Tester	CBT	Rohde & Schwarz	100808	02/15/2025	Annual

### Note:

- Equipment listed above that calibrated during the testing period was set for test after the calibration.
- Equipment listed above that has a calibration due date during the testing period, the testing is completed before equipment expiration date.

### Radiated Test

Equipment	Model	Manufacturer	Serial No.	Due to Calibration	Calibration Interval
Controller(Antenna mast)	CO3000	Innco system	CO3000-4p	N/A	N/A
Antenna Position Tower	MA4640/800-XP-EP	Innco system	S3AM	08/03/2025	Biennial
Controller	EM2090	Emco	060520	N/A	N/A
Turn Table	N/A	Ets	N/A	N/A	N/A
Amp & Filter Bank Switch Controller	FBSM-01A	TNM system	0	N/A	N/A
Loop Antenna	FMZB 1513	Rohde & Schwarz	1513-333	03/07/2026	Biennial
Hybrid Antenna	VULB 9168	Schwarzbeck	9168-0895	08/16/2024	Biennial
Horn Antenna	BBHA 9120D	Schwarzbeck	9120D-1191	11/07/2025	Biennial
Horn Antenna(15 GHz ~ 40 GHz)	BBHA9170	Schwarzbeck	BBHA9170124	03/28/2025	Biennial
Band Reject Filter	WRCJV2400/2483.5-2370/2520-60/12SS	Wainwright Instruments	2	01/02/2025	Annual
Band Reject Filter	WRCJV12-4900-5100-5900-6100-50SS	Wainwright Instruments	5	06/04/2025	Annual
Band Reject Filter	WRCJV12-4900-5100-5900-6100-50SS	Wainwright Instruments	6	06/04/2025	Annual
Band Reject Filter	WRCJV5100/5850-40/50-8EEK	Wainwright Instruments	1	02/14/2025	Annual
RF Switching System	FBSR-03A (3G HPF+LNA)	T&M SYSTEM	S3L1	11/17/2024	Annual
RF Switching System	FBSR-03A (10dB ATT+LNA)	T&M SYSTEM	S3L2	11/17/2024	Annual
RF Switching System	FBSR-03A (7G HPF+LNA)	T&M SYSTEM	S3L3	11/17/2024	Annual
RF Switching System	FBSR-03A (3dB ATT+LNA)	T&M SYSTEM	S3L4	11/17/2024	Annual
Power Amplifier	CBL18265035	CERNEX	22966	11/17/2024	Annual
Power Amplifier	CBL26405040	CERNEX	25956	02/26/2025	Annual
Bluetooth Tester	TC-3000C	TESCOM	3000C000175	03/19/2025	Annual
Spectrum Analyzer	FSV40 (9 kHz ~ 40 GHz)	Rohde & Schwarz	100900	12/06/2024	Annual
Spectrum Analyzer	FSP40 (9 kHz ~ 40 GHz)	Rohde & Schwarz	100843	10/30/2024	Annual

### Note:

1. Equipment listed above that calibrated during the testing period was set for test after the calibration.
2. Equipment listed above that has a calibration due date during the testing period, the testing is completed before equipment expiration date.
3. Especially, all antenna for measurement is calibrated in accordance with the requirements of C63.5(Version : 2017).

**11. ANNEX A\_ TEST SETUP PHOTO**

Please refer to test setup photo file no. as follows;

No.	Description
1	HCT-RF-2407-FC081-P