# TEST REPORT

FCC/ISED BT LE Test for IET10N
Certification

**APPLICANT**
SJIT Co.,Ltd

**REPORT NO.**
HCT-RF-2406-FI006-R1

**DATE OF ISSUE**
July 15, 2024

**Tested by**
Kyung Jun Woo

**Technical Manager**
Jong Seok Lee

HCT CO., LTD.
BongJai Huh / CEO



**HCT CO., LTD.** 2-6, 73, 74, Seoicheon-ro 578beon-gil, Majang-myeon, Icheon-si, Gyeonggi-do, 17383 KOREA Tel. +82 31 645 6300 Fax. +82 31 645 6401

**HCT CO.,LTD.**
2-6, 73, 74, Seoicheon-ro 578beon-gil, Majang-myeon, Icheon-si, Gyeonggi-do, 17383 KOREA
Tel. +82 31 645 6300 Fax. +82 31 645 6401

# TEST REPORT

REPORT NO.
HCT-RF-2406-FI006-R1

DATE OF ISSUE
July 15, 2024

| | |
|---|---|
| Applicant | **SJIT Co.,Ltd**<br>54-11 Dongtanhana 1-gil, Hwaseong-si, Gyeonggi-do, Republic of Korea |
| Product Name<br>Model Name | Asset Tracker<br>IET10N |
| FCC ID<br>IC | 2BEK7IET10N<br>32019-IET10N |
| Date of Test | February 02, 2024 ~ June 14, 2024<br>July 10, 2024 ~ July 12, 2024 (Simultaneous transfer operations) |
| Max. RF Output Power | 1.900 dBm (1.55 mW) |
| FCC Classification | Digital Transmission System(DTS) |
| Test Standard Used | FCC Rule: Part 15.247<br>ISED Rule: RSS-247 Issue 3 (August 2023),<br>RSS-Gen Issue 5_Amendment 2 (February 2021) |
| Location of Test | ■ Permanent Testing Lab ☐ On Site Testing<br>(Address: 74, Seoicheon-ro 578beon-gil, Majang-myeon, Icheon-si, Gyeonggi-do, Republic of Korea) |
| Test Results | PASS |

## REVISION HISTORY

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

| Revision No. | Date of Issue | Description |
|---|---|---|
| 0 | June 14, 2024 | Initial Release |
| 1 | July 15, 2024 | - Revised Note on page 28, 29<br>- Revised HVIN/HMN on page 5<br>- Added tests for simultaneous transfer operations<br>- Revised Packet on page 43, 44<br>- Added test equipment on page 53, 54 |

## Notice

| Content |
|---|
| Engineering Statement:<br>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 / ISED Rules under normal use and maintenance.<br><br>The results shown in this test report only apply to the sample(s), as received, provided by the applicant, unless otherwise stated.<br>The test results have only been applied with the test methods required by the standard(s).<br><br>The laboratory is not accredited for the test results marked *.<br>Information provided by the applicant is marked **.<br>Test results provided by external providers are marked ***.<br><br>When confirmation of authenticity of this test report is required, please contact www.hct.co.kr<br><br>The test results in this test report are not associated with the ((KS Q) ISO/IEC 17025) accreditation by KOLAS (Korea Laboratory Accreditation Scheme) / A2LA (American Association for Laboratory Accreditation) that are under the ILAC (International Laboratory Accreditation Cooperation) Mutual Recognition Agreement (MRA). |

## CONTENTS

## 1. EUT DESCRIPTION

| | | |
|---|---|---|
| Model | IET10N | |
| Additional Model | - | |
| EUT Type | Asset Tracker | |
| Power Supply | DC 3.6 V | |
| Frequency Range | 1M Bit/s : 2402 - 2480 MHz<br>2M Bit/s : 2404 - 2478 MHz (Except for 2426 MHz) | |
| Max. RF Output Power | Peak | 1M Bit/s : 1.808 dBm (1.52 mW)<br>2M Bit/s : 1.900 dBm (1.55 mW) |
| | Average | 1M Bit/s : 1.39 dBm (1.38 mW)<br>2M Bit/s : 1.38 dBm (1.38 mW) |
| Modulation Type | GFSK | |
| Bluetooth Version | 5.0 | |
| Number of Channels | 1M Bit/s : 40 Channels<br>2M Bit/s : 37 Channels | |
| Antenna Specification | Chip Antenna<br>Peak Gain : 3.01 dBi | |
| Date(s) of Tests | February 02, 2024 ~ June 14, 2024<br>July 10, 2024 ~ July 12, 2024 (Simultaneous transfer operations) | |
| PMN<br>(Product Marketing Number) | IET10N | |
| HVIN<br>(Hardware Version Identification Number) | Ver1.1 | |
| FVIN<br>(Firmware Version Identification Number) | N00_V056 | |
| HMN<br>(Host Marketing Name) | N/A | |
| EUT serial numbers | Radiated : T10BN00G501001<br>Conducted : T10BN00G501002 | |

## ANTENNA CONFIGURATIONS

1. This device supports simultaneous transmission operation, which allows for two channels to operate independent of one another in the 900M and 2.4 GHz Bands simultaneously on each antenna.

| RSDB Scenario | Bluetooth Ant. | SIGFOX Ant. | WiFi Ant. | Test Case |
|---|---|---|---|---|
| BLE + WiFi | on | on | - | Scenario1 |
| BLE + SIGFOX | on | - | on | Scenario2 |

## 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.

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 RSS-Gen issue 5, RSS-247 issue 3.

### 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).
For ISED, test facility was accepted dated March 13, 2024 (CAB identifier: 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

**According to RSS-GEN(Issue 5) Section 6.8:**

The applicant for equipment certification shall provide a list of all antenna types that may be used with the transmitter, where applicable (i.e. for transmitters with detachable antenna), indicating the maximum permissible antenna gain (in dBi) and the required impedance for each antenna. The test report shall demonstrate the compliance of the transmitter with the limit for maximum equivalent isotropically radiated power (e.i.r.p.) specified in the applicable RSS, when the transmitter is equipped with any antenna type, selected from this list.

For expediting the testing, measurements may be performed using only the antenna with highest gain of each combination of transmitter and antenna type, with the transmitter output power set at the maximum level. However, the transmitter shall comply with the applicable requirements under all operational conditions and when in combination with any type of antenna from the list provided in the test report (and in the notice to be included in the user manual, provided below).

When measurements at the antenna port are used to determine the RF output power, the effective gain of the device's antenna shall be stated, based on a measurement or on data from the antenna's manufacturer.

The test report shall state the RF power, output power setting and spurious emission measurements with each antenna type that is used with the transmitter being tested.

## 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.

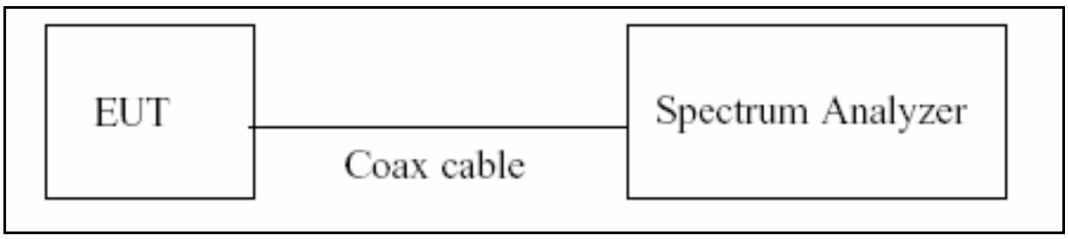
The measurement data shown herein meets or exceeds the $U_{CISPR}$ measurement uncertainty values specified in CISPR 16-4-2 and, thus, can be compared directly to specified limits to determine compliance.

| 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 ≤ 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*.

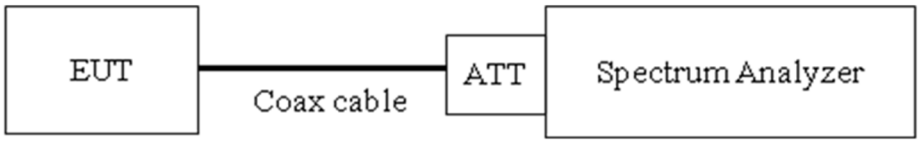
1. RBW = 8 MHz (the largest available value)
2. VBW = 8 MHz (≥ RBW)
3. SPAN = 0 Hz
4. Detector = Peak
5. Number of points in sweep > 100
6. Trace mode = Clear write
7. Measure $T_{total}$ and $T_{on}$
8. Calculate Duty Cycle = $T_{on}$/ $T_{total}$ and Duty Cycle Factor = 10log(1/Duty Cycle)

### 7.2. 6 dB Bandwidth & 99 % 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 ≥ 3 x 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.

**Test Procedure (6dB & 99 % Bandwidth for ISED)**

The transmitter output is connected to the spectrum analyzer.

1) RBW = 1% ~ 5% of the occupied bandwidth
2) VBW ≥ 3 x 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.

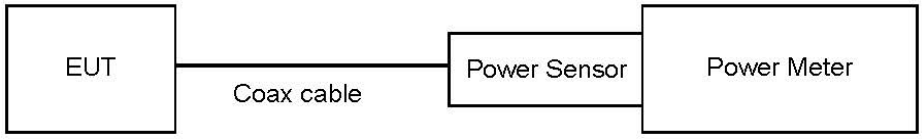
Note : We tested OBW using the automatic bandwidth measurement capability of a spectrum analyzer.

### 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

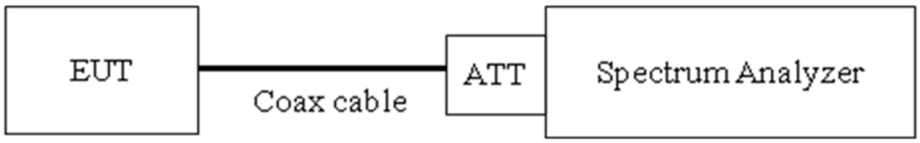
▪ Conducted Output Power(Average) = Measured Value + ATT loss + Cable loss + Duty Cycle Factor

## 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 kHz ≤ RBW ≤ 100 kHz.
4) VBW ≥ 3 x 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

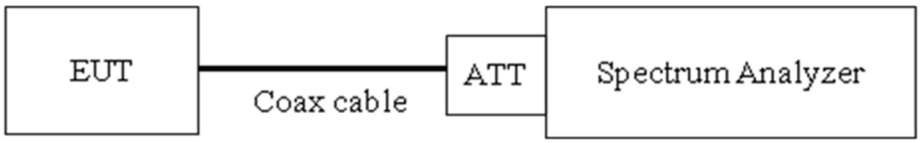
## 7.5. Conducted Band Edge(Out of Band Emissions) & Conducted Spurious Emissions

### 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 ≥ 3 x 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 ≥ 2 x 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 | 10.05 |
| 100 | 10.10 |
| 200 | 10.14 |
| 300 | 10.19 |
| 400 | 10.25 |
| 500 | 10.25 |
| 600 | 10.26 |
| 700 | 10.27 |
| 800 | 10.28 |
| 900 | 10.30 |
| 1 000 | 10.35 |
| 2 000 | 10.50 |
| 2 400 | 10.60 |
| 2 500 | 10.60 |
| 3 000 | 10.64 |
| 4 000 | 10.72 |
| 5 000 | 10.79 |
| 5 700 | 10.80 |
| 5 800 | 10.87 |
| 6 000 | 10.88 |
| 7 000 | 11.01 |
| 8 000 | 11.01 |
| 9 000 | 11.09 |
| 10 000 | 11.19 |
| 11 000 | 11.28 |
| 12 000 | 11.37 |
| 13 000 | 11.38 |
| 14 000 | 11.41 |
| 15 000 | 11.51 |
| 16 000 | 11.59 |
| 17 000 | 11.80 |
| 18 000 | 11.93 |
| 19 000 | 11.85 |
| 20 000 | 11.52 |
| 21 000 | 11.65 |
| 22 000 | 11.64 |
| 23 000 | 11.65 |
| 24 000 | 11.66 |
| 25 000 | 11.76 |

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

## 7.6. Radiated Test

**Limit**

**FCC**

| Frequency (MHz) | Field Strength (μV/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 |

**ISED**

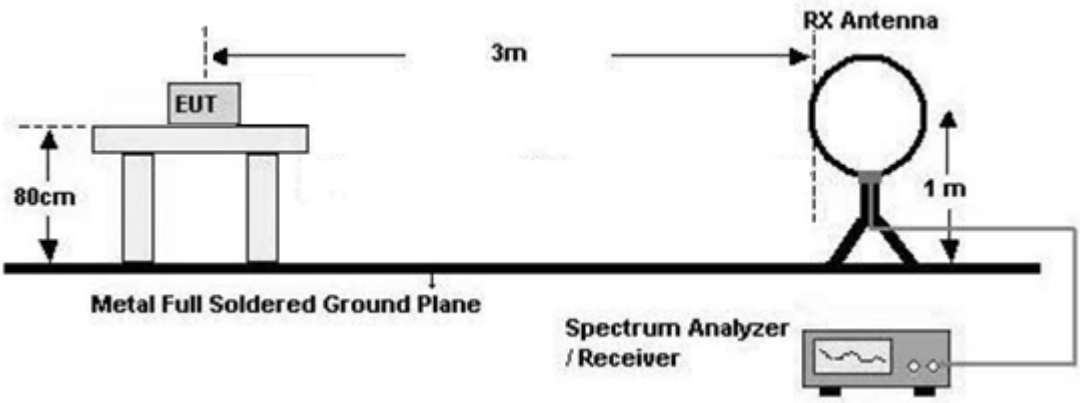
| Frequency (MHz) | Field Strength (μV/m) | Measurement Distance (m) |
|---|---|---|
| 0.009 – 0.490 | 6.37/F(kHz) | 300 |
| 0.490 – 1.705 | 63.7/F(kHz) | 30 |
| 1.705 – 30 | 0.08 | 30 |

**FCC&ISED**

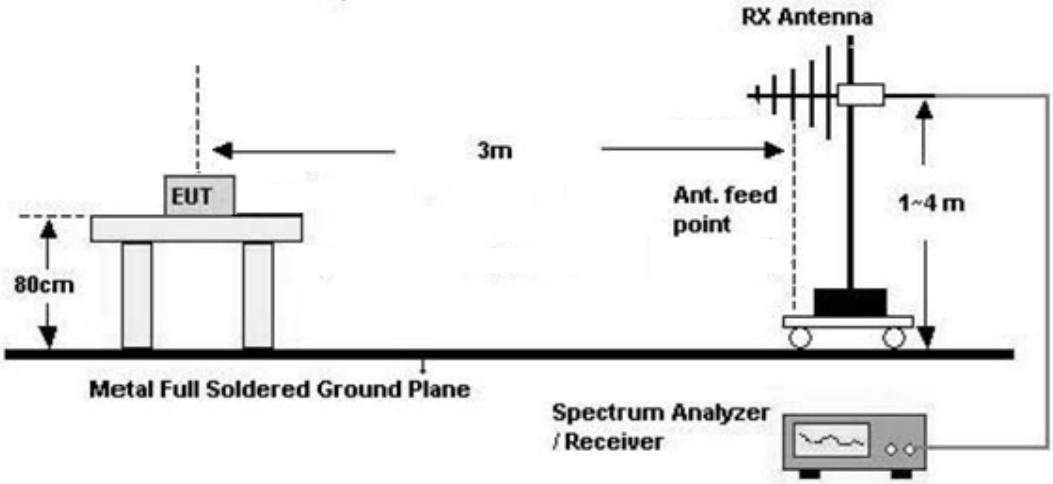
| Frequency (MHz) | Field Strength (μV/m) | Measurement Distance (m) |
|---|---|---|
| 30-88 | 100 | 3 |
| 88-216 | 150 | 3 |
| 216-960 | 200 | 3 |
| Above 960 | 500 | 3 |

## Test Configuration

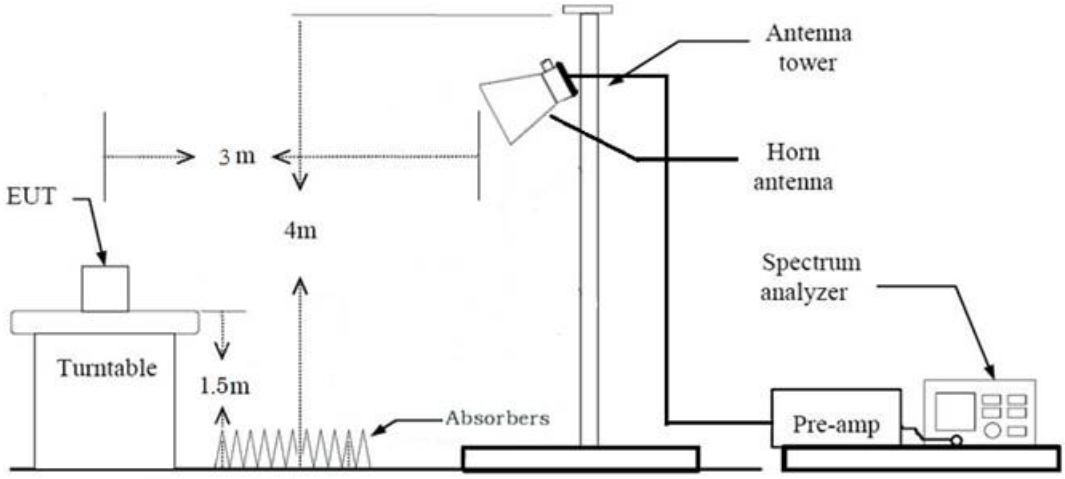
Below 30 MHz




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 pl ane 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) = 40log(3 m/300 m) = - 80 dB
   Measurement Distance : 3 m
7. Distance Correction Factor(0.490 MHz – 30 MHz) = 40log(3 m/30 m) = - 40 dB
   Measurement Distance : 3 m
8. Spectrum Setting
   - Frequency Range = 9 kHz ~ 30 MHz
   - Detector = Peak
   - Trace = Maxhold
   - RBW = 9 kHz
   - VBW ≥ 3 x 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 = Maxhold
      - RBW = 100 kHz
      - VBW ≥ 3 x 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 ≥ 3 x RBW

   (2) Measurement Type(Average):
   - Duty cycle < 98 %, duty cycle variations are less than ±2 %
   - Measured Frequency Range : 1 GHz – 25 GHz
   - Detector = RMS
   - Averaging type = power (*i.e.*, RMS)
   - RBW = 1 MHz
   - VBW ≥ 3 x 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 = 20log (test distance / specific distance) (dB)

11. Total (Measurement Type : Peak)
    = Peak Measured Value + Antenna Factor(A.F) + Cable Loss(C.L) - Amp Gain(A.G) + Distance Factor(D.F)

Total (Measurement Type : Average)

= 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 ≥ 3 x RBW

   (2) Measurement Type(Average):
   - Duty cycle < 98 %, duty cycle variations are less than ±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 ≥ 3 x 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 = 20log (test distance / 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 μH/50 ohms line impedance stabilization network (LISN).

| Frequency Range (MHz) | Limits (dBμV) | |
|---|---|---|
| | Quasi-peak | Average |
| 0.15 to 0.50 | 66 to 56[a] | 56 to 46[a] |
| 0.50 to 5 | 56 | 46 |
| 5 to 30 | 60 | 50 |

[a]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. Receiver Spurious Emissions

Limit

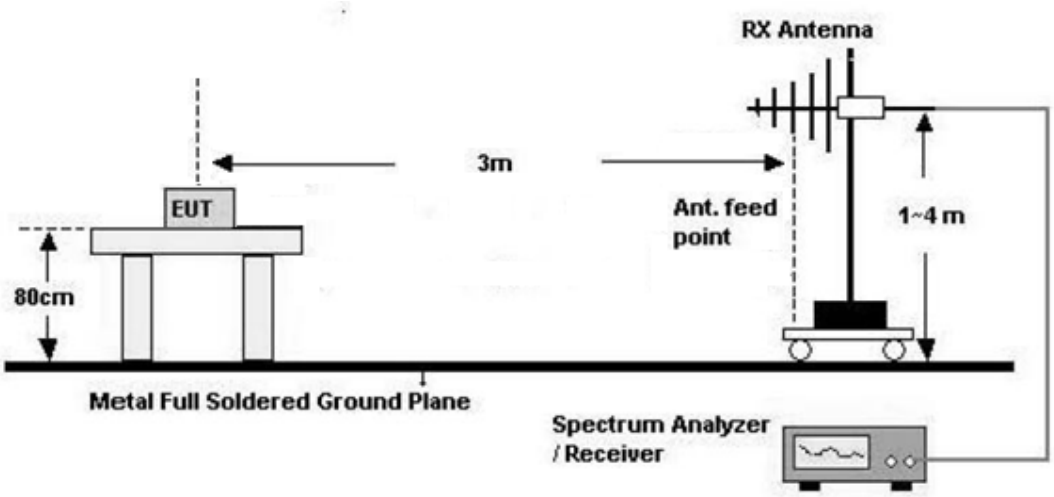
| Frequency (MHz) | Field Strength (μV/m) | Measurement Distance (m) |
|---|---|---|
| 30-88 | 100 | 3 |
| 88-216 | 150 | 3 |
| 216-960 | 200 | 3 |
| Above 960 | 500 | 3 |

Note:

Measurements for compliance with the limits in table may be performed at distances other than 3 meters.

## Test Configuration

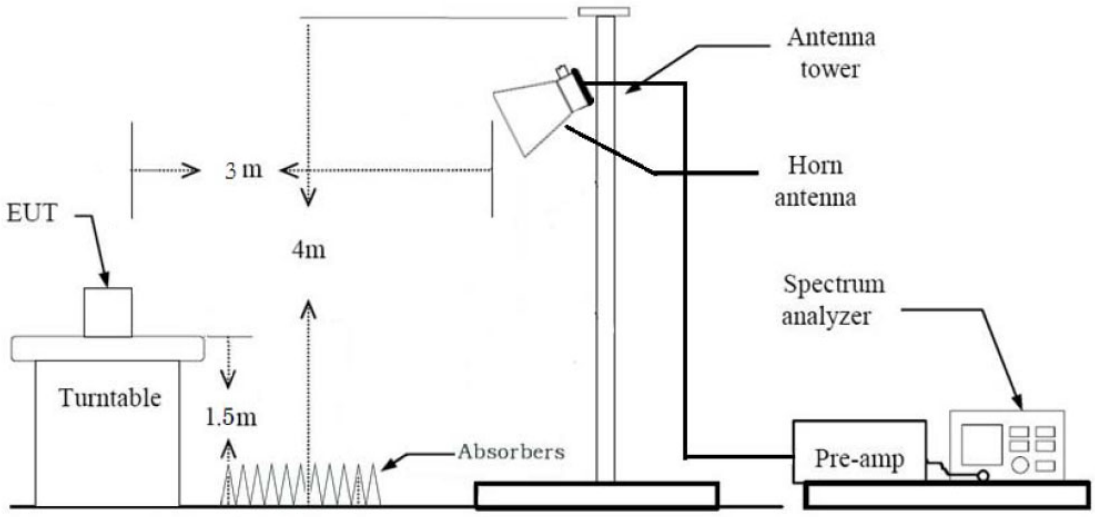
30 MHz - 1 GHz




## Test Procedure of Receiver 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 = Maxhold
      - RBW = 100 kHz
      - VBW ≥ 3 x RBW
7. Total = Measured Value + Antenna Factor(A.F) + Cable Loss(C.L)

Above 1 GHz




**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 1m to 4m 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(Average):
   - RBW = 1 MHz
   - VBW = 3 MHz
   - Detector = Average(RMS)
   - Trace = Average
   - Trace was allowed to stabilize
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. Total = Measured Value + Antenna Factor(A.F) + Cable Loss(C.L) - Amp Gain(A.G) + Distance Factor(D.F)

### 7.9. 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-V
   - Radiated Restricted Band Edge : Z-H
3. All packet length of operation were investigated and the worst case results are reported.
   (Worst case : 1 M, 2 M)
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

Radiated test(DBS)

1. All modes of operation were investigated and the worst case configuration results are reported.
   - Mode : Stand alone
2. EUT Axis
   - RSDB Scenario 1 : X-V
   - RSDB Scenario 2 : Y-H
3. All of RSDB Scenario were investigated and the worst case configuration results are reported.
4. The RSDB mode test investigated both intermodulation and radiated spurious emissions.
   And the worst results were reported.
   - Worst result: Radiated spurious emissions
   - Intermodulation: No signals are generated.
   - Radiated spurious emissions: cf. Section 9.6.

| RSDB Scenario | Bluetooth Ant. | SIGFOX Ant. | WiFi Ant. | Test Case |
|---|---|---|---|---|
| BLE + WiFi | on | on | | Scenario1 |
| BLE + SIGFOX | on | | on | Scenario2 |

5. The following tables show the worst case configurations determined during testing.

(Worst case: The lowest margin condition the channels and modes were selected for test.)

| RSDB Scenario 1 | Description | BLE Emission | SIGFOX Emission |
|---|---|---|---|
| Bluetooth ANT. + SIGFOX Ant. | Antenna | Ant0 | Ant0 |
| | Channel | 39 | Macro 5 / Micro 4 |
| | Data Rate | 1 Mbps | 600 bps |
| | Mode | GFSK | RC2 |

Note : SIGFOX RSDB Data refer to [SIGFOX] Test Report

| RSDB Scenario 2 | Description | BLE Emission | WiFi Emission |
|---|---|---|---|
| Bluetooth ANT. + WiFi Ant. | Antenna | Ant0 | Ant0 |
| | Channel | 39 | 1 |
| | Data Rate | 1 Mbps | 1 Mbps |
| | Mode | GFSK | 802.11b |

Note : DTS RSDB Data refer to [DTS] Test Report

## AC Power line Conducted Emissions

1. Not Tested

## Conducted test

1. The EUT was configured with packet length of highest power.
   - ALL Mode Test
2. All modes of operation were investigated and the worst case configuration results are reported.
   - Mode : Stand alone

## 8. SUMMARY TEST OF RESULTS

FCC Part

| 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.

**ISED Part**

| Test Description | ISED Part Section(s) | Test Limit | Test Condition | Test Result |
|---|---|---|---|---|
| 6 dB Bandwidth | RSS-247, 5.2.(a) | > 500 kHz | Conducted | PASS |
| 99% Bandwidth | RSS-GEN, 6.7 | NA | | PASS |
| Conducted Maximum Peak Output Power And e.i.r.p. | RSS-247, 5.4.(d) | < 1 Watt<br><4 Watt(e.i.r.p.) | | PASS |
| Power Spectral Density | RSS-247, 5.2.(b) | < 8 dBm / 3 kHz Band | | PASS |
| Band Edge (Out of Band Emissions) | RSS-247, 5.5 | Conducted > 20 dBc | | PASS |
| AC Power line Conducted Emissions | RSS-GEN, 8.8 | cf. Section 7.7 | | N/A (Note.1) |
| Radiated Spurious Emissions | RSS-GEN, 8.9 | cf. Section 7.6 | Radiated | PASS |
| Receiver Spurious Emissions | RSS-GEN, 5<br>RSS-GEN, 7.3 | cf. Section 7.8 | | PASS |
| Radiated Restricted Band Edge | RSS-GEN, 8.9<br>RSS-GEN, 8.10 | cf. Section 7.6 | | PASS |

**Note**

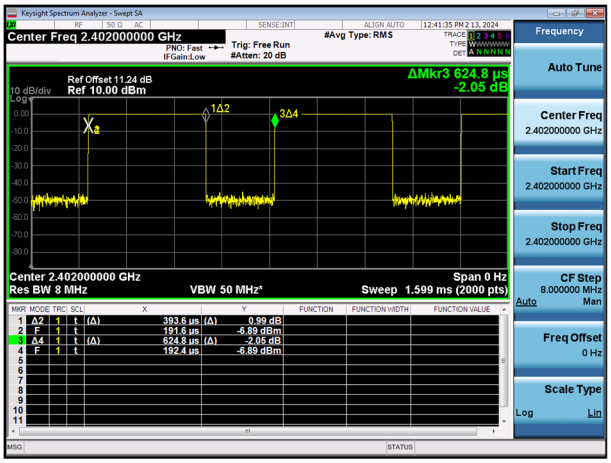
1. The device only employ battery power for operation.

# 9. TEST RESULT

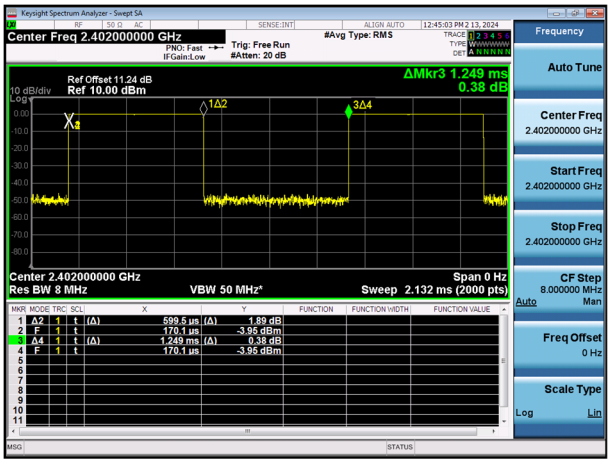
## 9.1 DUTY CYCLE

| Data rate (Bit/s) | Packet length (Byte) | $T_{on}$ (ms) | $T_{total}$ (ms) | Duty Cycle | Duty Cycle Factor (dB) |
|---|---|---|---|---|---|
| 1M | 37 | 0.394 | 0.625 | 0.630 | 2.007 |
| | 255 | 0.600 | 1.249 | 0.480 | 3.188 |
| 2M | 37 | 0.206 | 0.624 | 0.331 | 4.805 |
| | 255 | 0.310 | 0.624 | 0.497 | 3.033 |

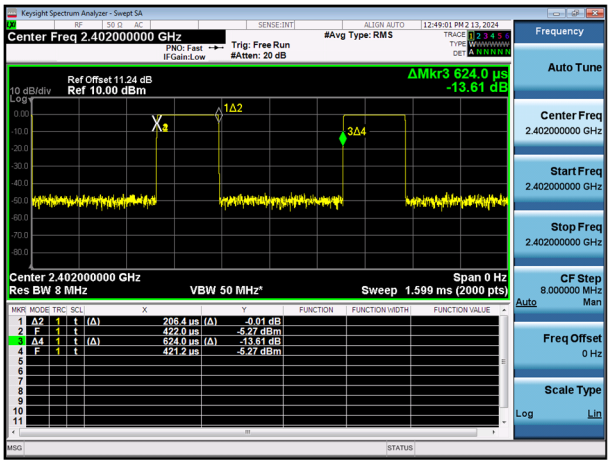
1 M Bit/s (37 Byte)



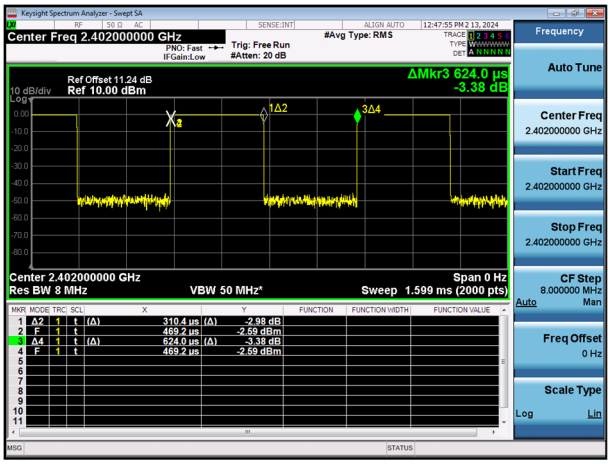

1 M Bit/s (255 Byte)




2 M Bit/s (37 Byte)




2 M Bit/s (255 Byte)



## 9.2 6 dB BANDWIDTH & 99 % BANDWIDTH

FCC

| Mode (Bit/s) | Channel | 6 dB Bandwidth (kHz) | Limit (kHz) |
|---|---|---|---|
| 1M(37) | 37 | 710.2 | > 500 |
| | 17 | 704.7 | |
| | 39 | 709.8 | |
| 1M(255) | 37 | 699.4 | > 500 |
| | 17 | 701.3 | |
| | 39 | 692.3 | |
| 2M(37) | 0 | 1147 | > 500 |
| | 17 | 1142 | |
| | 36 | 1144 | |
| 2M(255) | 0 | 1149 | > 500 |
| | 17 | 1140 | |
| | 36 | 1145 | |

**Note:**

In order to simplify the report, attached plots were only the narrowest 6 dB BW Mode.

1M Bit/s: 255 Byte

2M Bit/s: 255 Byte

ISED

| Mode (Bit/s) | Channel | 6 dB Bandwidth (kHz) | 99 % Bandwidth (MHz) | Limit (kHz) |
|---|---|---|---|---|
| 1M(37) | 37 | 654.4 | 1.0539 | > 500 |
| | 17 | 654.4 | 1.0570 | |
| | 39 | 653.8 | 1.0593 | |
| 1M(255) | 37 | 646.1 | 1.0554 | > 500 |
| | 17 | 646.4 | 1.0596 | |
| | 39 | 644.4 | 1.0595 | |
| 2M(37) | 0 | 578.3 | 2.0747 | > 500 |
| | 17 | 578.5 | 2.0745 | |
| | 36 | 579.2 | 2.0806 | |
| 2M(255) | 0 | 515.6 | 2.0793 | > 500 |
| | 17 | 514.4 | 2.0776 | |
| | 36 | 640.9 | 2.0827 | |

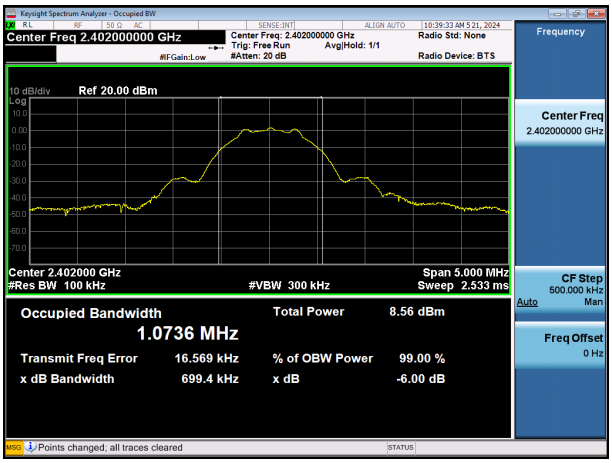
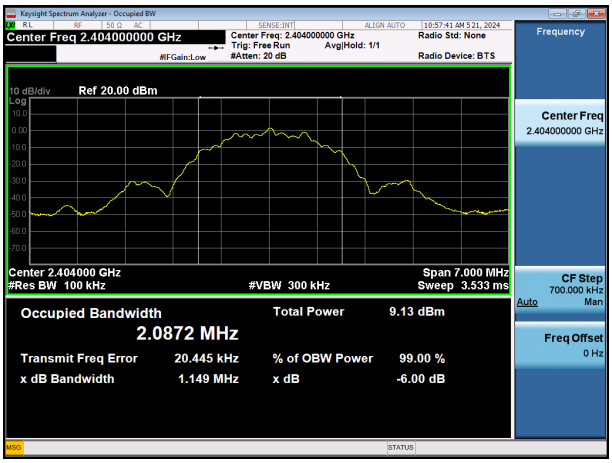
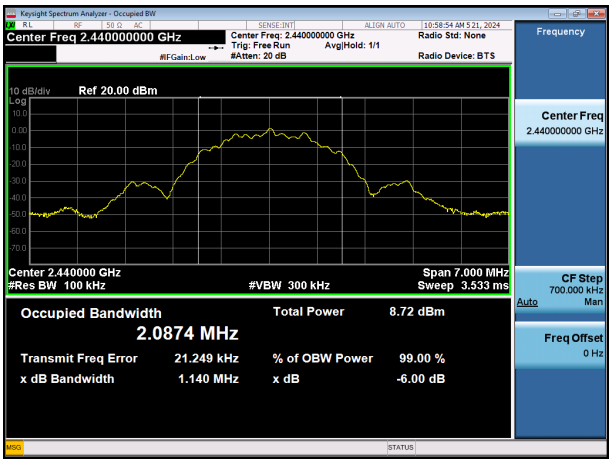
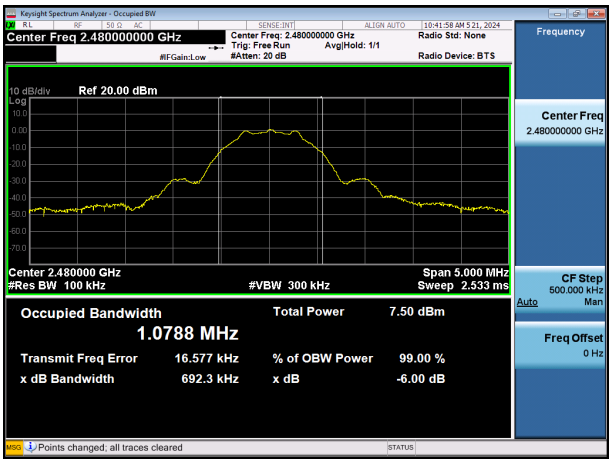
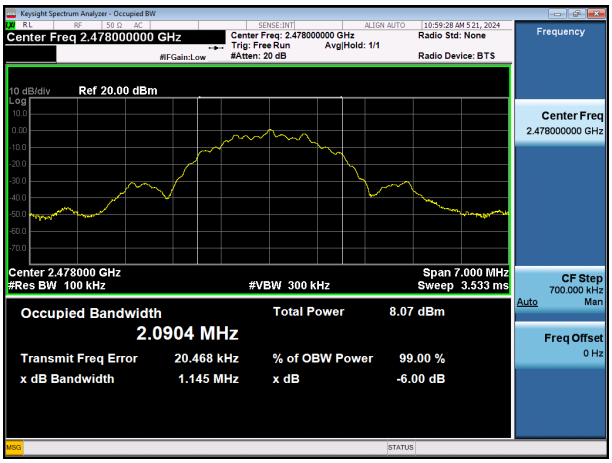
**Note:**

In order to simplify the report, attached plots were only the narrowest 6 dB BW Mode.

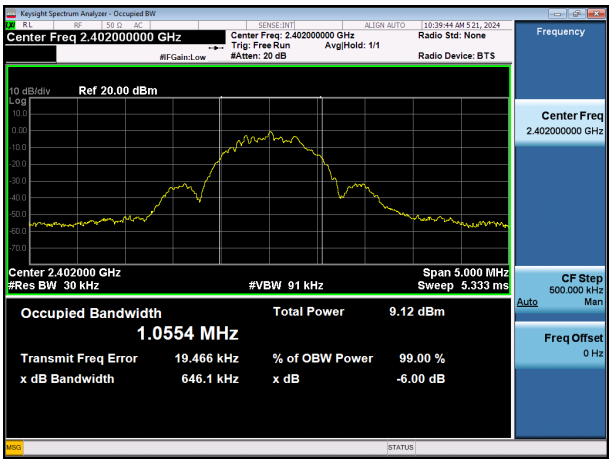
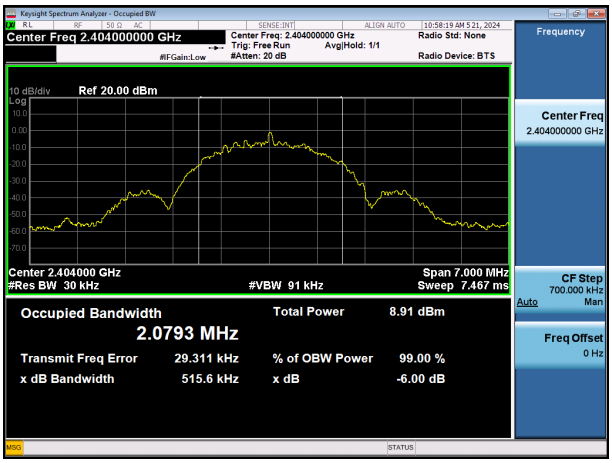
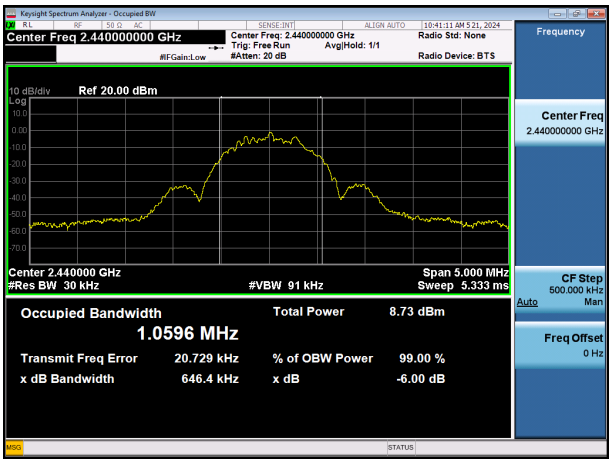
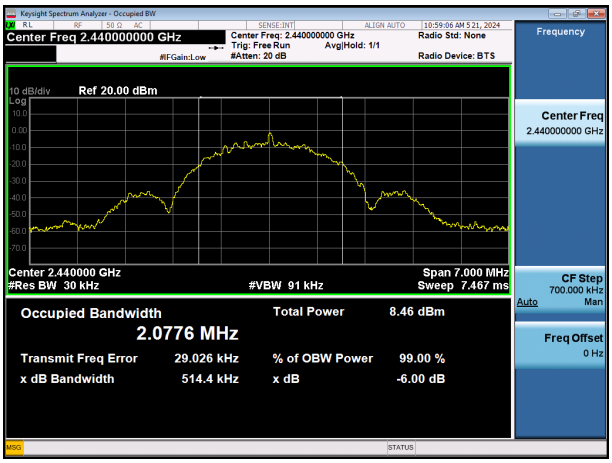
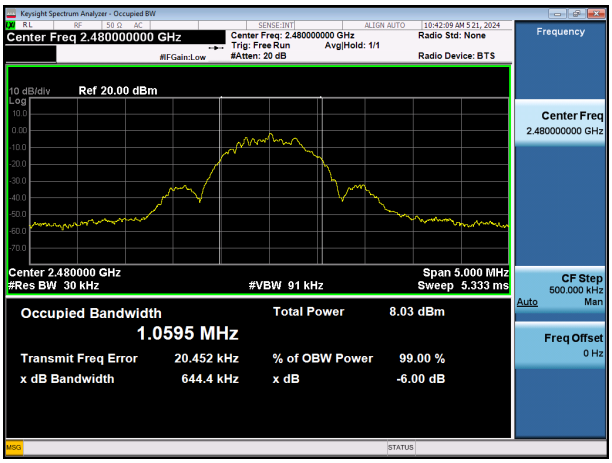
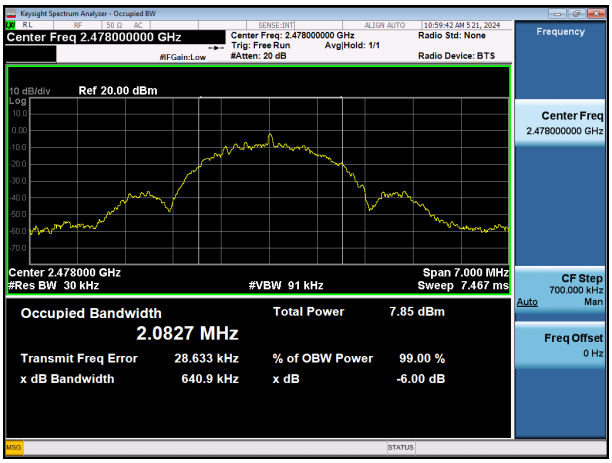
1M Bit/s: 255 Byte

2M Bit/s: 255 Byte

## ▣ Test Plots (FCC)

| 1 MBit/s (255 Byte) | 2 MBit/s (255 Byte) |
|---|---|
| 6 dB Bandwidth plot (Low-CH 37) | 6 dB Bandwidth plot (Low-CH 0) |
|  |  |
| 6 dB Bandwidth plot (Mid-CH 17) | 6 dB Bandwidth plot (Mid-CH 17) |
|  |  |
| 6 dB Bandwidth plot (High-CH 39) | 6 dB Bandwidth plot (High-CH 36) |
|  |  |

## ▣ Test Plots (ISED)

| 1 MBit/s (255 Byte) | 2 MBit/s (255 Byte) |
|---|---|
| 6 dB Bandwidth plot (Low-CH 37) | 6 dB Bandwidth plot (Low-CH 0) |
|  |  |
| 6 dB Bandwidth plot (Mid-CH 17) | 6 dB Bandwidth plot (Mid-CH 17) |
|  |  |
| 6 dB Bandwidth plot (High-CH 39) | 6 dB Bandwidth plot (High-CH 36) |
|  |  |

## 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 | 37 | 1.808 | 30 |
| | | 2440 | 17 | 1.445 | |
| | | 2480 | 39 | 0.770 | |
| | 255 | 2402 | 37 | 1.791 | |
| | | 2440 | 17 | 1.432 | |
| | | 2480 | 39 | 0.739 | |
| 2M | 37 | 2404 | 0 | 1.805 | |
| | | 2440 | 17 | 1.460 | |
| | | 2478 | 36 | 0.829 | |
| | 255 | 2404 | 0 | 1.900 | |
| | | 2440 | 17 | 1.556 | |
| | | 2478 | 36 | 0.941 | |

**Average Power**

| Data rate | Packet length | LE Mode | | Measured Power (dBm) | Duty Cycle Factor (dB) | Result (dBm) | Limit (dBm) |
|---|---|---|---|---|---|---|---|
| (Bit/s) | (Byte) | Frequency (MHz) | Channel | | | | |
| 1M | 37 | 2402 | 37 | -0.62 | 2.01 | 1.39 | 30 |
| | | 2440 | 17 | -0.79 | 2.01 | 1.22 | |
| | | 2480 | 39 | -1.31 | 2.01 | 0.70 | |
| | 255 | 2402 | 37 | -1.85 | 3.19 | 1.34 | |
| | | 2440 | 17 | -1.99 | 3.19 | 1.20 | |
| | | 2480 | 39 | -2.57 | 3.19 | 0.62 | |
| 2M | 37 | 2404 | 0 | -3.42 | 4.80 | 1.38 | |
| | | 2440 | 17 | -3.58 | 4.80 | 1.22 | |
| | | 2478 | 36 | -4.10 | 4.80 | 0.70 | |
| | 255 | 2404 | 0 | -1.67 | 3.03 | 1.36 | |
| | | 2440 | 17 | -1.88 | 3.03 | 1.15 | |
| | | 2478 | 36 | -2.42 | 3.03 | 0.61 | |

## 9.4 POWER SPECTRAL DENSITY

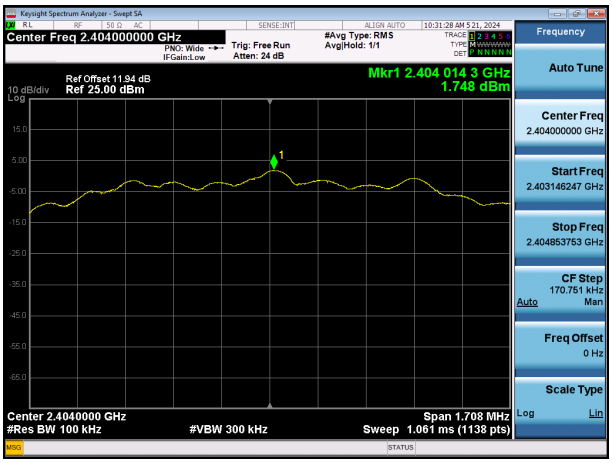
| Frequency (MHz) | Channel No. | Mode | Test Result | |
|---|---|---|---|---|
| | | | Measured PSD (dBm) | Limit |
| 2402 | 37 | 1M Bit/s 37 Byte | 1.731 | 8 dBm / 3 kHz |
| 2440 | 17 | | 1.378 | |
| 2480 | 39 | | 0.691 | |
| 2402 | 37 | 1M Bit/s 255 Byte | 1.717 | |
| 2440 | 17 | | 1.350 | |
| 2480 | 39 | | 0.655 | |
| 2404 | 0 | 2M Bit/s 37 Byte | 1.657 | |
| 2440 | 17 | | 1.300 | |
| 2478 | 36 | | 0.663 | |
| 2404 | 0 | 2M Bit/s 255 Byte | 1.748 | |
| 2440 | 17 | | 1.417 | |
| 2478 | 36 | | 0.774 | |

**Note :**

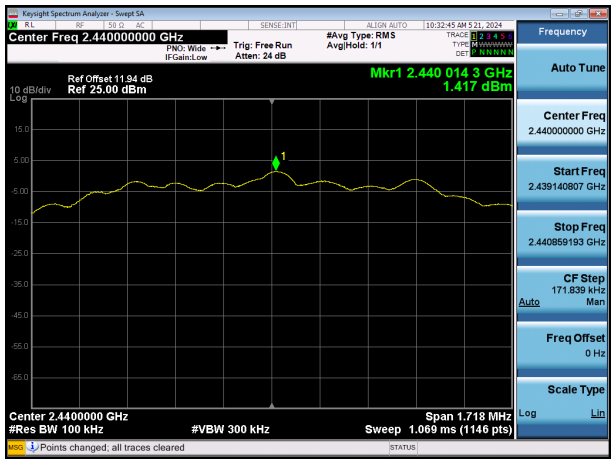
1. The PSD measured results in plot is already including the actual values of loss for the attenuator and cable combination.
2. Worst case test Plot Only : 2 MBit/s (255 Byte)

## ▣ 2 MBit/s (255 Byte) Test Plots

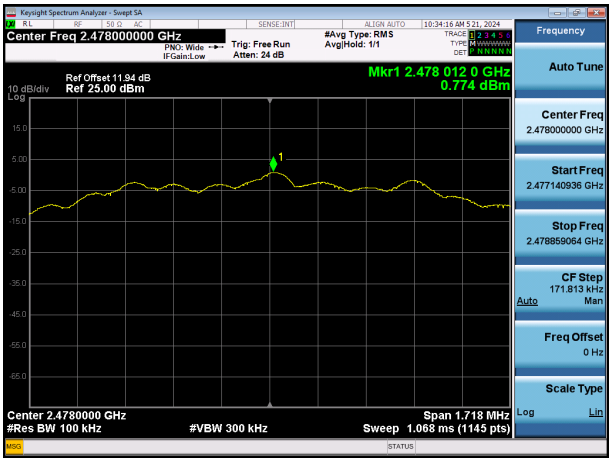
### Power Spectral Density (Low-CH 0)




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




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



## 9.5 BAND EDGE/ CONDUCTED SPURIOUS EMISSIONS

Test Result : please refer to the plot below.
In order to simplify the report, attached plots were only the worst case channel and data rate.

**[BAND EDGE]**

| Frequency (MHz) | Mode | Channel No. | Position | Test Result | |
|---|---|---|---|---|---|
| | | | | Measured Level (dB) | Limit (dBc) |
| 2402 | 1M Bit/s 37 Byte | 37 | Lower | 47.064 | 20 |
| 2480 | | 39 | Upper | 50.437 | 20 |
| 2402 | 1M Bit/s 255 Byte | 37 | Lower | 47.252 | 20 |
| 2480 | | 39 | Upper | 49.271 | 20 |
| 2404 | 2M Bit/s 37 Byte | 0 | Lower | 50.879 | 20 |
| 2478 | | 36 | Upper | 52.357 | 20 |
| 2404 | 2M Bit/s 255 Byte | 0 | Lower | 50.727 | 20 |
| 2478 | | 36 | Upper | 52.363 | 20 |

**Note :**

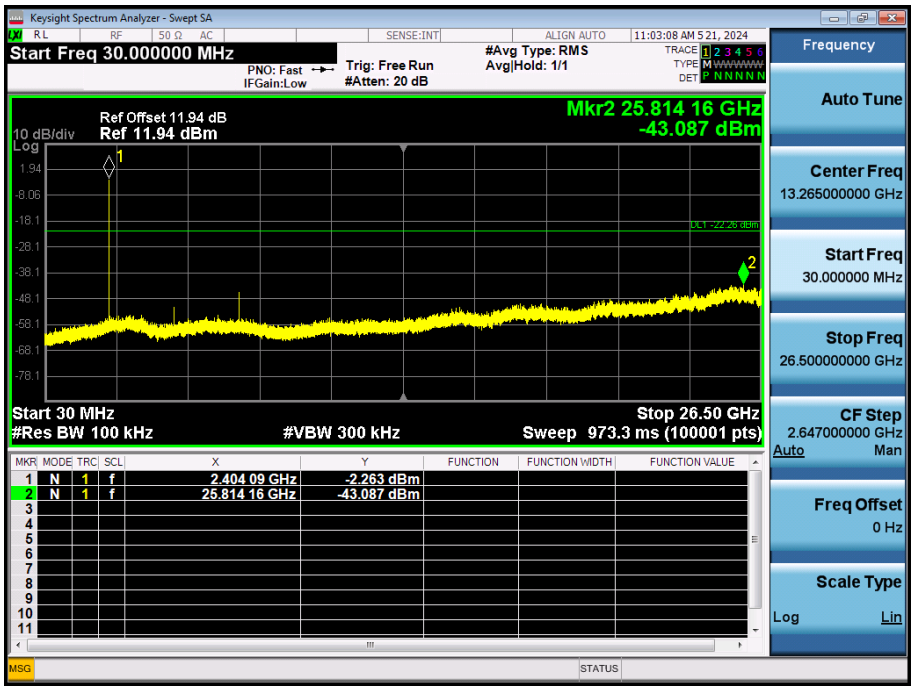
In order to simplify the report, attached plots were only the worst case channel and data rate.
- Lower Band Edge: 1M Bit/s (37 Byte)
- Upper Band Edge: 1M Bit/s (255 Byte)

**▣ Test Plots -BandEdge**

| Lower Band Edge (Low-CH 37) | Upper Band Edge (High-CH 39) |
|---|---|
|  |  |

## ▣ 2M Bit/s (255 Byte) Test Plots -Conducted Spurious Emission

### Spurious Emission (30 MHz – 26 GHz, Low-CH 0)




Limit : -22.26 dBm

## 9.6 RADIATED SPURIOUS EMISSIONS

**Frequency Range : 9 kHz – 30 MHz**

| Frequency | Measured Value | A.F+C.L | POL | Total | Limit | Margin |
|---|---|---|---|---|---|---|
| [MHz] | [dBμV] | [dB/m] | [H/V] | [dBμV/m] | [dBμV/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 = 40log (specific distance / test distance) (dB)
3. Limit line = specific Limits (dBμV) + Distance extrapolation factor

**Frequency Range : Below 1 GHz**

| Frequency | Measured Value | A.F+C.L | POL | Total | Limit | Margin |
|---|---|---|---|---|---|---|
| [MHz] | [dBμV] | [dB/m] | [H/V] | [dBμV/m] | [dBμV/m] | [dB] |
| No Critical peaks found | | | | | | |

**Note:**

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

**Frequency Range : Above 1 GHz**

**Mode : 1 M Bit/s (37 Bytes)**

Operation Mode: CH Low

| Frequency | Measured Value | AF+CL-AG | Pol. | Total | Limit | Margin | Measurement Type |
|---|---|---|---|---|---|---|---|
| [MHz] | [dBµV] | [dB/m] | [H/V] | [dBµV/m] | [dBµV/m] | [dB] | |
| 4804 | 49.84 | 2.94 | V | 52.78 | 73.98 | 21.20 | PK |
| 4804 | 41.97 | 2.94 | V | 44.91 | 53.98 | 9.07 | AV |
| 7206 | 46.69 | 9.79 | V | 56.48 | 73.98 | 17.50 | PK |
| 7206 | 37.36 | 9.79 | V | 47.15 | 53.98 | 6.83 | AV |

Operation Mode: CH Mid

| Frequency | Measured Value | AF+CL-AG | Pol. | Total | Limit | Margin | Measurement Type |
|---|---|---|---|---|---|---|---|
| [MHz] | [dBµV] | [dB/m] | [H/V] | [dBµV/m] | [dBµV/m] | [dB] | |
| 4880 | 49.62 | 3.59 | V | 53.21 | 73.98 | 20.77 | PK |
| 4880 | 42.36 | 3.59 | V | 45.95 | 53.98 | 8.03 | AV |
| 7320 | 46.29 | 10.28 | V | 56.57 | 73.98 | 17.41 | PK |
| 7320 | 36.80 | 10.28 | V | 47.08 | 53.98 | 6.90 | AV |

Operation Mode: CH High

| Frequency | Measured Value | AF+CL-AG | Pol. | Total | Limit | Margin | Measurement Type |
|---|---|---|---|---|---|---|---|
| [MHz] | [dBµV] | [dB/m] | [H/V] | [dBµV/m] | [dBµV/m] | [dB] | |
| 4960 | 51.78 | 2.96 | V | 54.74 | 73.98 | 19.24 | PK |
| 4960 | 45.69 | 2.96 | V | 48.65 | 53.98 | 5.33 | AV |
| 7440 | 48.32 | 10.60 | V | 58.92 | 73.98 | 15.06 | PK |
| 7440 | 39.55 | 10.60 | V | 50.15 | 53.98 | 3.83 | AV |

**Mode : 2 M Bit/s (37 Bytes)**

Operation Mode: CH Low

| Frequency | Measured Value | AF+CL-AG | Pol. | Total | Limit | Margin | Measurement Type |
|---|---|---|---|---|---|---|---|
| [MHz] | [dBµV] | [dB/m] | [H/V] | [dBµV/m] | [dBµV/m] | [dB] | |
| 4808 | 49.45 | 2.94 | V | 52.39 | 73.98 | 21.59 | PK |
| 4808 | 37.97 | 2.94 | V | 40.91 | 53.98 | 13.07 | AV |
| 7212 | 46.65 | 9.73 | V | 56.38 | 73.98 | 17.60 | PK |
| 7212 | 35.46 | 9.73 | V | 45.19 | 53.98 | 8.79 | AV |

Operation Mode: CH Mid

| Frequency | Measured Value | AF+CL-AG | Pol. | Total | Limit | Margin | Measurement Type |
|---|---|---|---|---|---|---|---|
| [MHz] | [dBµV] | [dB/m] | [H/V] | [dBµV/m] | [dBµV/m] | [dB] | |
| 4880 | 49.19 | 3.59 | V | 52.78 | 73.98 | 21.20 | PK |
| 4880 | 38.00 | 3.59 | V | 41.59 | 53.98 | 12.39 | AV |
| 7320 | 46.28 | 10.28 | V | 56.56 | 73.98 | 17.42 | PK |
| 7320 | 33.99 | 10.28 | V | 44.27 | 53.98 | 9.71 | AV |

Operation Mode: CH High

| Frequency | Measured Value | AF+CL-AG | Pol. | Total | Limit | Margin | Measurement Type |
|---|---|---|---|---|---|---|---|
| [MHz] | [dBµV] | [dB/m] | [H/V] | [dBµV/m] | [dBµV/m] | [dB] | |
| 4956 | 51.82 | 2.67 | V | 54.49 | 73.98 | 19.49 | PK |
| 4956 | 41.43 | 2.67 | V | 44.10 | 53.98 | 9.88 | AV |
| 7434 | 48.05 | 10.91 | V | 58.96 | 73.98 | 15.02 | PK |
| 7434 | 36.64 | 10.91 | V | 47.55 | 53.98 | 6.43 | AV |

[DBS]

BT LE 1M + SIGFOX RC2

Operation Mode: BT LE 1M Bit/s 37 Byte CH.39

| Frequency | Measured Value | AF+CL-AG | Pol. | Total | Limit | Margin | Measurement Type |
|---|---|---|---|---|---|---|---|
| [MHz] | [dBµV] | [dB/m] | [H/V] | [dBµV/m] | [dBµV/m] | [dB] | |
| 4960 | 57.69 | -4.82 | V | 52.87 | 73.98 | 21.11 | PK |
| 4960 | 52.74 | -4.82 | V | 47.92 | 53.98 | 6.06 | AV |
| 7440 | 54.50 | 2.13 | V | 56.63 | 73.98 | 17.35 | PK |
| 7440 | 48.00 | 2.13 | V | 50.13 | 53.98 | 3.85 | AV |

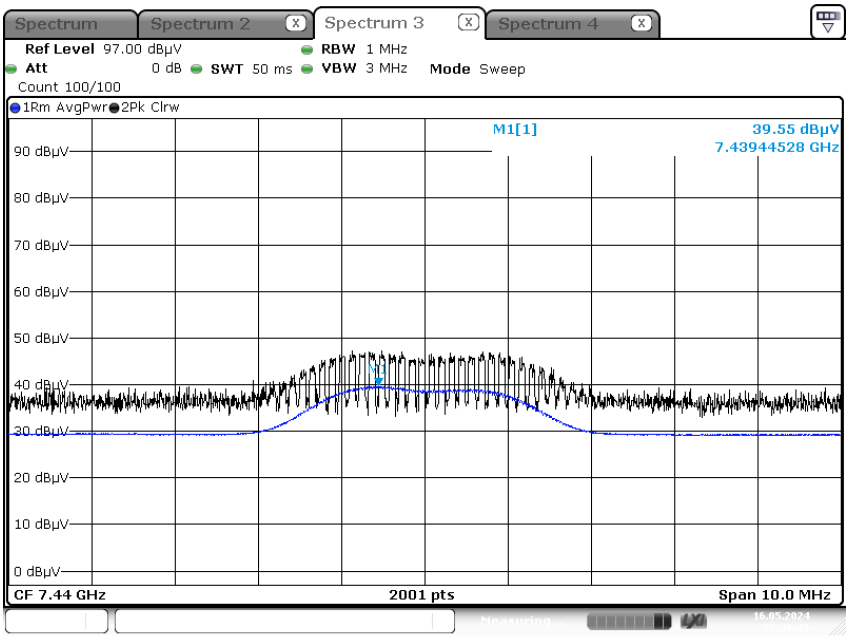
BT LE 1M + WLAN 2.4G

Operation Mode: BT LE 1M Bit/s 37 Byte CH.39

| Frequency | Measured Value | AF+CL-AG | Pol. | Total | Limit | Margin | Measurement Type |
|---|---|---|---|---|---|---|---|
| [MHz] | [dBµV] | [dB/m] | [H/V] | [dBµV/m] | [dBµV/m] | [dB] | |
| 4960 | 57.75 | -4.82 | H | 52.93 | 73.98 | 21.05 | PK |
| 4960 | 51.93 | -4.82 | H | 47.11 | 53.98 | 6.87 | AV |
| 7440 | 54.49 | 2.13 | H | 56.62 | 73.98 | 17.36 | PK |
| 7440 | 48.31 | 2.13 | H | 50.44 | 53.98 | 3.54 | AV |

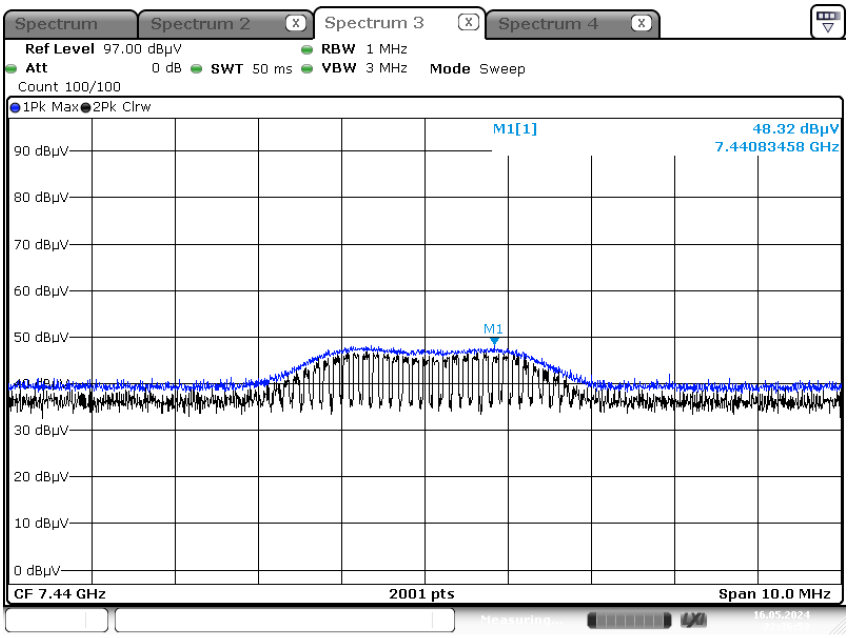
## ▣ 1M Bit/s 37 Byte Test Plots (Worst case : X-V)

Radiated Spurious Emissions plot – Average Result (Ch.39, 3rd Harmonic)




Date: 16.MAY.2024 22:36:38

Radiated Spurious Emissions plot – Peak Result (Ch.39, 3rd Harmonic)




Date: 16.MAY.2024 22:36:54

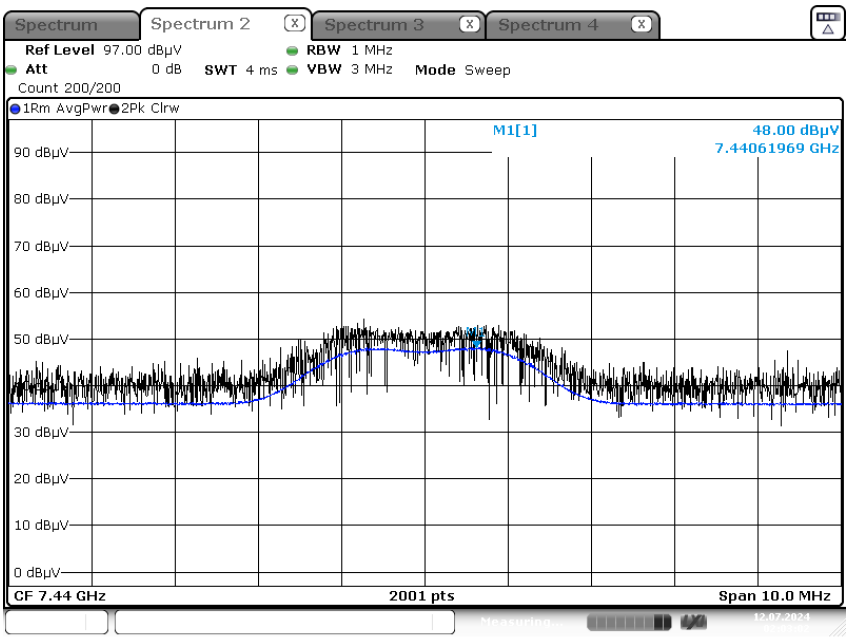
**Note:**

Plot of worst case are only reported.

[DBS]

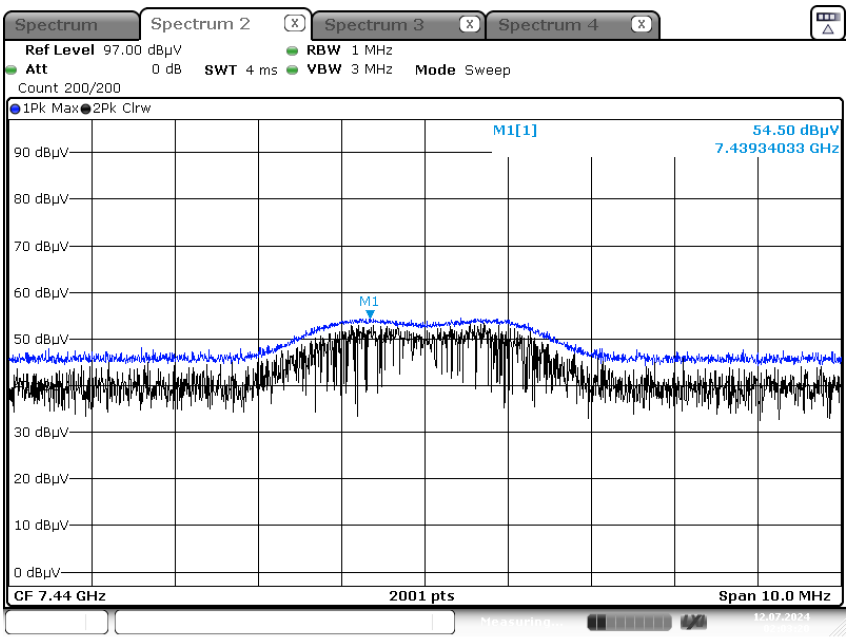
Mode : BT LE 1M + SIGFOX RC2

Radiated Spurious Emissions plot – Average Result (Ch.39, 3rd Harmonic)




Date: 12.JUL.2024 02:03:02

Radiated Spurious Emissions plot – Peak Result (Ch.39, 3rd Harmonic)

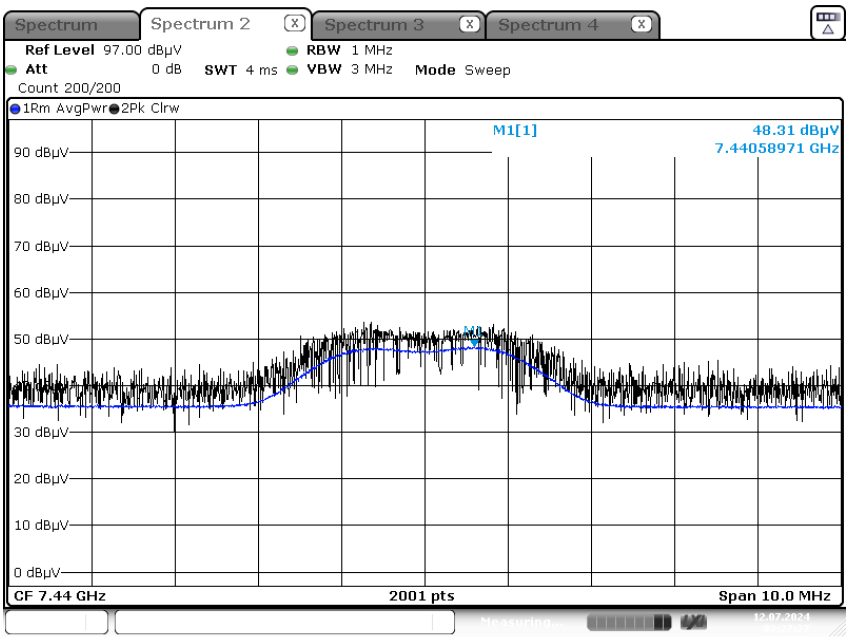



Date: 12.JUL.2024 02:03:20

[DBS]

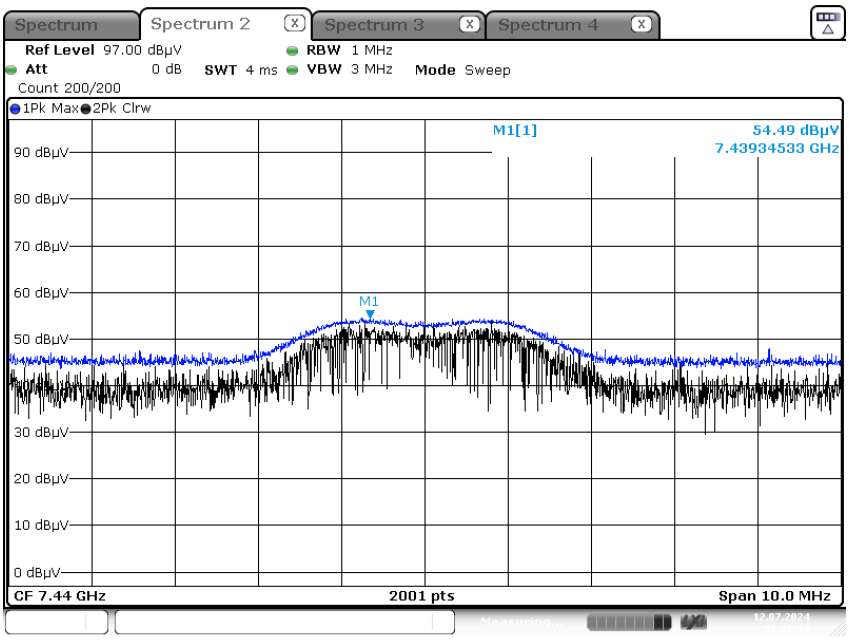
Mode : BT LE 1M + WLAN 2.4G

Radiated Spurious Emissions plot – Average Result (Ch.39, 3rd Harmonic)




Date: 12.JUL.2024 03:27:28

Radiated Spurious Emissions plot – Peak Result (Ch.39, 3rd Harmonic)




Date: 12.JUL.2024 03:27:14

## 9.7 RADIATED RESTRICTED BAND EDGES

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

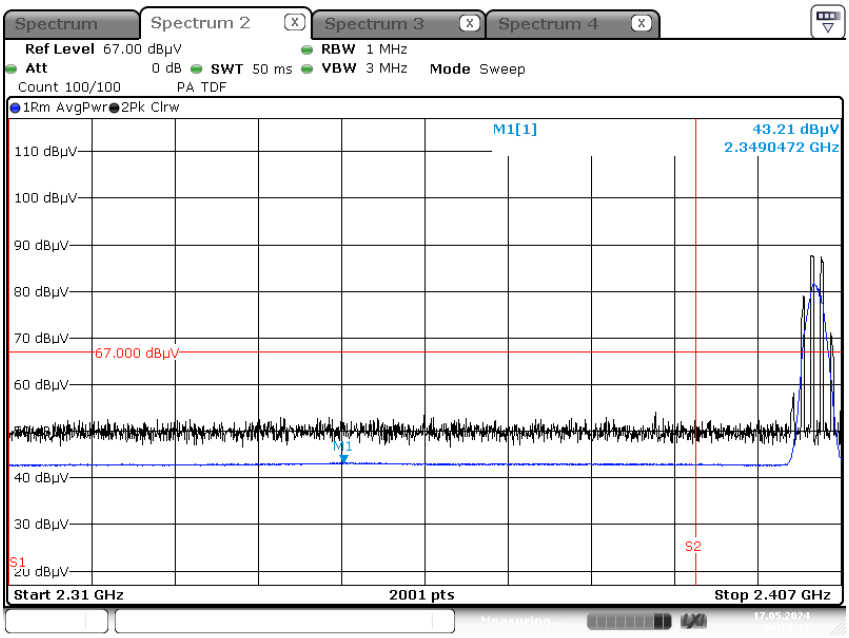
| Frequency | Measured Value | Ant. Pol. | Total | Limit | Margin | Measurement Type |
|---|---|---|---|---|---|---|
| [MHz] | [dBµV] | [H/V] | [dBµV/m] | [dBµV/m] | [dB] | |
| 2390.0 | 55.29 | H | 55.29 | 73.98 | 18.69 | PK |
| 2390.0 | 43.18 | H | 43.18 | 53.98 | 10.80 | AV |
| 2483.5 | 55.05 | H | 55.05 | 73.98 | 18.93 | PK |
| 2483.5 | 42.70 | H | 42.70 | 53.98 | 11.28 | AV |

| | |
|---|---|
| Operation Mode | 2 M Bit/s (37 Bytes) |
| Operating Frequency | 2404 MHz, 2478 MHz |
| Channel No. | 0 CH, 36 CH |

| Frequency | Measured Value | Ant. Pol. | Total | Limit | Margin | Measurement Type |
|---|---|---|---|---|---|---|
| [MHz] | [dBµV] | [H/V] | [dBµV/m] | [dBµV/m] | [dB] | |
| 2390.0 | 54.73 | H | 54.73 | 73.98 | 19.25 | PK |
| 2390.0 | 43.21 | H | 43.21 | 53.98 | 10.77 | AV |
| 2483.5 | 54.69 | H | 54.69 | 73.98 | 19.29 | PK |
| 2483.5 | 42.66 | H | 42.66 | 53.98 | 11.32 | AV |

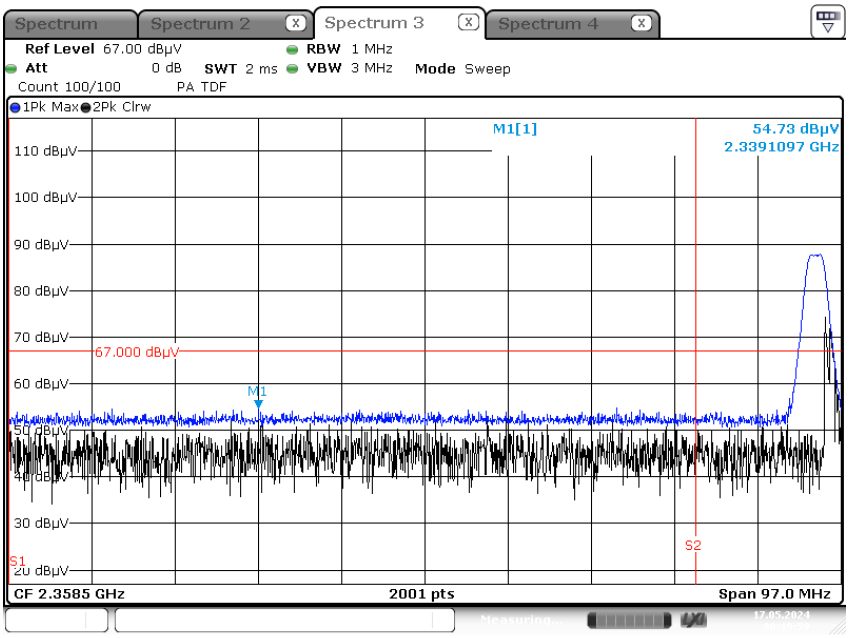
## ▣ 2M Bit/s (37 Byte) Test Plots (Worst case : Z-H)

Radiated Restricted Band Edges plot – Average Result (Ch.0)




Date: 17.MAY.2024 00:19:32

Radiated Restricted Band Edges plot – Peak Result (Ch.0)




Date: 17.MAY.2024 00:19:59

**Note:**

Plot of worst case are only reported.

## 9.8 RECEIVER SPURIOUS EMISSIONS

**Frequency Range : Below 1 GHz**

| Frequency | Measured Value | A.F + C.L | Ant. POL | Total | Limit | Margin |
|---|---|---|---|---|---|---|
| [MHz] | [dBμV] | [dB/m] | [H/V] | [dBμV/m] | [dBμV/m] | [dB] |
| No Critical peaks found | | | | | | |

**Note:**

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

**Frequency Range : Above 1 GHz**

| Frequency | Measured Value | A.F + C.L - A.G + D.F | Ant. POL | Total | Limit | Margin |
|---|---|---|---|---|---|---|
| [MHz] | [dBμV] | [dB/m] | [H/V] | [dBμV/m] | [dBμV/m] | [dB] |
| No Critical peaks found | | | | | | |

## 10. LIST OF TEST EQUIPMENT

Conducted Test

| Equipment | Model | Manufacturer | Serial No. | Due to Calibration | Calibration Interval |
|---|---|---|---|---|---|
| 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:

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.

**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 (Antenna mast & Turn Table) | CO3000 | Innco system | CO3000/ 15421/57580623/G | N/A | N/A |
| Antenna Position Tower | MA4640 | Innco system | 9320422 | 04/05/2025 | Biennial |
| Controller | EM2090 | Emco | 060520 | N/A | N/A |
| Turn Table | N/A | Ets | N/A | N/A | N/A |
| Turn Table | N/A | Innco system | 5930623 | 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 | BBHA 9120D | Schwarzbeck | 9120D-1151 | 07/14/2025 | Biennial |
| Horn Antenna(15 GHz ~ 40 GHz) | BBHA9170 | Schwarzbeck | BBHA9170124 | 03/28/2025 | Biennial |
| Amp & Filter Bank Switch Controller | FBSM-01A | TNM system | 0 | N/A | N/A |
| Amp & Filter Bank Switch Controller | FBSM-01B | T&M system | TM2009001 | N/A | N/A |
| 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 | FMSR-05B (HPF(3~18GHz) + LNA1(1~18GHz)) | T&M system | S5L1 | 03/12/2025 | Annual |
| RF Switching System | FBSR-03A (10dB ATT+LNA) | T&M SYSTEM | S3L2 | 11/17/2024 | Annual |
| RF Switching System | FMSR -05B (LNA1(1~18GHz)) | T&M system | S5L4 | 03/12/2025 | 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 |
| High Pass Filter | F5 | Wainwright Instruments | F5 | 05/16/2024 | Annual |
| Spectrum Analyzer | FSV40 (9 kHz ~ 40 GHz) | Rohde & Schwarz | 100900 | 12/06/2024 | Annual |
| Spectrum Analyzer | FSV40 (9 kHz ~ 40 GHz) | Rohde & Schwarz | 101510 | 03/28/2025 | 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_EUT AND TEST SETUP PHOTO

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

| No. | Description |
|---|---|
| 1 | HCT-RF-2406-FI006-P |