





# RF TEST REPORT

**Applicant** Quectel Wireless Solutions Company Limited

FCC ID XMR2023FCU760KN

**Product** Wi-Fi & Bluetooth Module

**Brand** Quectel

Model FCU760K-N

**Report No.** R2308A0881-R1

Issue Date May 28, 2024

Eurofins TA Technology (Shanghai) Co., Ltd. tested the above equipment in accordance with the requirements in **FCC CFR47 Part 15C (2023)**. The test results show that the equipment tested is capable of demonstrating compliance with the requirements as documented in this report.

Prepared by: Zhu Chentao

Approved by: Xu Kai

# Eurofins TA Technology (Shanghai) Co., Ltd.

Building 3, No.145, Jintang Rd, Pudong Shanghai, P.R.China TEL: +86-021-50791141/2/3 FAX: +86-021-50791141/2/3-8000



# **TABLE OF CONTENT**

Report No.: R2308A0881-R1

| 1. Tes | st Laboratory                              |              |
|--------|--|--------------|
| 1.1.   | Notes of the Test Report                   |              |
| 1.2.   | Test Facility                              |              |
| 1.3.   | Testing Location                           |              |
| 2. Ge  | eneral Description of Equipment Under Test | Ę            |
| 2.1.   | Applicant and Manufacturer Information     |              |
| 2.2.   | General Information                        |              |
| 3. Ap  | pplied Standards                           | 6            |
| 4. Te  | st Configuration                           | <del>.</del> |
| 5. Te: | st Case Results                            |              |
| 5.1.   | Maximum output power                       | 8            |
| 5.2.   | 99% Bandwidth and 6dB Bandwidth            |              |
| 5.3.   | Band Edge                                  | 43           |
| 5.4.   | Power Spectral Density                     | 64           |
| 5.5.   | Spurious RF Conducted Emissions            | 83           |
| 5.6.   | Unwanted Emission                          | 115          |
| 5.7.   | Conducted Emission                         | 168          |
| 6. Ma  | ain Test Instruments                       | 173          |
| ANNEX  | 〈 A: The EUT Appearance                    | 174          |
| ANNEX  | K B: Test Setup Photos                     | 175          |



**Summary of Measurement Results** 

Report No.: R2308A0881-R1

| Number | Test Case                       | Clause in FCC rules        | Verdict |
|--------|---------------------------------|----------------------------|---------|
| 1      | Maximum output power            | 15.247(b)(3)               | PASS    |
| 2      | 99% Bandwidth and 6dB Bandwidth | 15.247(a)(2)<br>C63.10 6.9 | PASS    |
| 3      | Power spectral density          | 15.247(e)                  | PASS    |
| 4      | Band Edge                       | 15.247(d)                  | PASS    |
| 5      | Spurious RF Conducted Emissions | 15.247(d)                  | PASS    |
| 6      | Unwanted Emissions              | 15.247(d), 15.205, 15.209  | PASS    |
| 7      | Conducted Emissions             | 15.207                     | PASS    |

Date of Testing: August 30, 2023 ~ May 17, 2024 Date of Sample Received: August 28, 2023

Note: All indications of Pass/Fail in this report are opinions expressed by Eurofins TA Technology (Shanghai) Co., Ltd. based on interpretations and/or observations of test results. Measurement Uncertainties were not taken into account and are published for informational purposes only.

Eurofins TA Technology (Shanghai) Co., Ltd.

TA-MB-04-005R

RF Test Report No.: R2308A0881-R1

# 1. Test Laboratory

# 1.1. Notes of the Test Report

This report shall not be reproduced in full or partial, without the written approval of **Eurofins TA Technology (Shanghai) Co., Ltd.** The results documented in this report apply only to the tested sample, under the conditions and modes of operation as described herein. Measurement Uncertainties were not taken into account and are published for informational purposes only. This report is written to support regulatory compliance of the applicable standards stated above.

# 1.2. Test Facility

FCC (Designation number: CN1179, Test Firm Registration Number: 446626)

Eurofins TA Technology (Shanghai) Co., Ltd. has been listed on the US Federal Communications Commission list of test facilities recognized to perform measurements.

A2LA (Certificate Number: 3857.01)

Eurofins TA Technology (Shanghai) Co., Ltd. has been listed by American Association for Laboratory Accreditation to perform measurement.

# 1.3. Testing Location

Company: Eurofins TA Technology (Shanghai) Co., Ltd.

Address: Building 3, No.145, Jintang Rd, Pudong Shanghai, P.R.China

City: Shanghai

Post code: 201201

Country: P. R. China

Contact: Xu Kai

Telephone: +86-021-50791141/2/3

Fax: +86-021-50791141/2/3-8000

Website: https://www.eurofins.com/electrical-and-electronics

E-mail: Kain.Xu@cpt.eurofinscn.com



**RF Test Report** Report No.: R2308A0881-R1

# 2. General Description of Equipment Under Test

# 2.1. Applicant and Manufacturer Information

| Applicant            | Quectel Wireless Solutions Company Limited                     |  |
|----------------------|--|--|
| Applicant address    | Building 5, Shanghai Business Park Phase III (Area B), No.1016 |  |
| Applicant address    | Tianlin Road, Minhang District, Shanghai, China, 200233        |  |
| Manufacturer         | Quectel Wireless Solutions Company Limited                     |  |
| Manufacturar address | Building 5, Shanghai Business Park Phase III (Area B), No.1016 |  |
| Manufacturer address | Tianlin Road, Minhang District, Shanghai, China, 200233        |  |

# 2.2. General Information

| EUT Description               |  |  |  |  |
|-------------------------------|--|--|--|--|
| Model                         | FCU760K-N  |  |  |  |
| CNI                           | Conducted: E1M23G807000071                                     |  |  |  |
| SN                            | Radiated: E1M23G807000068                                      |  |  |  |
| Hardware Version              | R1.0   |  |  |  |
| Software Version              | NA   |  |  |  |
| Power Supply                  | External power supply  |  |  |  |
| Antenna Type                  | Dipole Antenna   |  |  |  |
| Antonno Commontos             | RP SMA Male (meet with the standard FCC Part 15.203            |  |  |  |
| Antenna Connector             | requirement)   |  |  |  |
| Antenna Gain                  | -0.1 dBi   |  |  |  |
| Additional Beamforming Gain   | NA   |  |  |  |
|                               | 802.11b/g/n(HT20)/ax (HE20): 2412 ~ 2462 MHz                   |  |  |  |
| Operating Frequency Range(s)  | 802.11n(HT40)/ax (HE40): 2422 ~ 2452 MHz                       |  |  |  |
|                               | Bluetooth LE V5.4: 2402 ~2480 MHz                              |  |  |  |
|                               | 802.11b: DSSS  |  |  |  |
| Modulation Type               | 802.11g/n: OFDM  |  |  |  |
| Modulation Type               | 802.11ax: OFDM (Only Support Full Ru)                          |  |  |  |
|                               | Bluetooth LE: GFSK   |  |  |  |
| Max. Output Power             | Wi-Fi 2.4G: 19.93 dBm  |  |  |  |
| Max. Output Fower             | Bluetooth LE: 4.16 dBm   |  |  |  |
| Auxiliary Test Equipment      |  |  |  |  |
| Adapter                       | Manufacturer: HUAWEI   |  |  |  |
| Adaptei                       | Model: HW-050450C01  |  |  |  |
| PC                            | Manufacturer: DELL   |  |  |  |
| FC                            | Model: INSPIRON 5493(12206714403)                              |  |  |  |
| Mother board                  | Manufacturer: Quectel Wireless Solutions Company Limited       |  |  |  |
| Wother board                  | Model: /   |  |  |  |
| Note: 1. The EUT is sent from | the applicant to Eurofins TA and the information of the EUT is |  |  |  |
| declared by the applicant     |  |  |  |  |

declared by the applicant.

RF Test Report Report No.: R2308A0881-R1

# 3. Applied Standards

According to the specifications of the manufacturer, it must comply with the requirements of the following standards:

Test standards:

FCC CFR47 Part 15C (2023) Radio Frequency Devices

ANSI C63.10-2013

Reference standard:

KDB 558074 D01 15.247 Meas Guidance v05r02



# 4. Test Configuration

#### **Test Mode**

The EUT has been associated with peripherals and configuration operated in a manner tended to maximize its emission characteristics in a typical application.

The radiated emission was measured in the following position: EUT stand-up position (Z axis), lie-down position (X, Y axis). The worst emission was found in lie-down position (X axis) and the loop antenna is vertical, the others are vertical and horizontal. and the worst case was recorded.

In order to find the worst case condition, Pre-tests are needed at the presence of different data rate. Preliminary tests have been done on all the configuration for confirming worst case. Data rate below means worst-case rate of each test item.

Worst-case data rates are shown as following table.

| Test Mode                    | Data Rate    |
|------------------------------|--------------|
| Bluetooth (Low Energy)       | 1Mbps; 2Mbps |
| Bluetooth (Low Energy) (S=2) | 500kbps      |
| Bluetooth (Low Energy) (S=8) | 125kbps      |
| 802.11b                      | 1 Mbps       |
| 802.11g                      | 6 Mbps       |
| 802.11n HT20                 | MCS0         |
| 802.11n HT40                 | MCS0         |
| 802.11ax HE20                | MCS0         |
| 802.11ax HE40                | MCS0         |



5. Test Case Results

# 5.1. Maximum output power

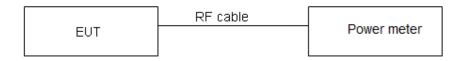
#### **Ambient Condition**

| Temperature | Relative humidity |
|-------------|-------------------|
| 15°C ~ 35°C | 20% ~ 80%         |

#### **Methods of Measurement**

During the process of the testing, The EUT was connected to Power meter with a known loss. The EUT is max power transmission with proper modulation.

# **Test Setup**



#### Limits

Rule Part 15.247 (b) (3) specifies that "For systems using digital modulation in the 902–928 MHz, 2400–2483.5 MHz: 1 Watt."

| Average Output Power ≤ 1W (30dBm) |
|-----------------------------------|
|-----------------------------------|

#### **Measurement Uncertainty**

The assessed measurement uncertainty to ensure 95% confidence level for the normal distribution is with the coverage factor k = 2, U = 0.44 dB.

Report No.: R2308A0881-R1

# **Test Results**

| Power Index |         |         |                 |                  |         |                 |                  |
|-------------|---------|---------|-----------------|------------------|---------|-----------------|------------------|
| Channel     | 802.11b | 802.11g | 802.11n<br>HT20 | 802.11ax<br>HE20 | Channel | 802.11n<br>HT40 | 802.11ax<br>HE40 |
| CH1         | 18      | 17      | 17              | 16               | СНЗ     | 17              | 16               |
| СН6         | 18      | 17      | 17              | 16               | CH6     | 17              | 16               |
| CH11        | 18      | 17      | 17              | 16               | СН9     | 17              | 16               |

Report No.: R2308A0881-R1

| Power Index |                        |  |  |
|-------------|------------------------|--|--|
| Channel     | Bluetooth (Low Energy) |  |  |
| CH0         | Default                |  |  |
| CH19        | Default                |  |  |
| CH39        | Default                |  |  |

| Test Mode Duty cycle Duty cycle correction Factor (dB)                  |  |  |  |  |  |  |
|---|--|--|--|--|--|--|
| 802.11b 0.892 0.50  |  |  |  |  |  |  |
| 802.11g 0.575 2.40  |  |  |  |  |  |  |
| 802.11n HT20 0.833 0.79   |  |  |  |  |  |  |
| 802.11n HT40 0.827 0.82   |  |  |  |  |  |  |
| 802.11ax HE20 0.791 1.02  |  |  |  |  |  |  |
| 802.11ax HE40 0.791 1.02  |  |  |  |  |  |  |
| Bluetooth LE (1M) 0.849 0.71  |  |  |  |  |  |  |
| Bluetooth LE (2M) 0.568 2.45  |  |  |  |  |  |  |
| Bluetooth LE (S=2) 0.909 0.42   |  |  |  |  |  |  |
| Bluetooth LE (S=8) 0.974 0.11   |  |  |  |  |  |  |
| Note: when Duty cycle ≥0.98, Duty cycle correction Factor not required. |  |  |  |  |  |  |

RF Test Report No.: R2308A0881-R1

| Test Mode        | Carrier frequency<br>(MHz) / Channel | Average Power<br>Measured<br>(dBm) | Average Power with duty factor (dBm) | Limit<br>(dBm)    | Conclusion        |
|------------------|--------------------------------------|------------------------------------|--------------------------------------|-------------------|-------------------|
|                  | 2412/CH 1                            | 19.08                              | 19.58                                | 30                | PASS              |
| 802.11b          | 2437/CH 6                            | 19.43                              | 19.93                                | 30                | PASS              |
|                  | 2462/CH11                            | 19.43                              | 19.93                                | 30                | PASS              |
|                  | 2412/CH 1                            | 16.41                              | 18.81                                | 30                | PASS              |
| 802.11g          | 2437/CH 6                            | 15.17                              | 17.57                                | 30                | PASS              |
|                  | 2462/CH11                            | 16.08                              | 18.48                                | 30                | PASS              |
|                  | 2412/CH 1                            | 16.79                              | 17.58                                | 30                | PASS              |
| 802.11n<br>HT20  | 2437/CH 6                            | 14.83                              | 15.62                                | 30                | PASS              |
| 11120            | 2462/CH11                            | 17.96                              | 18.75                                | 30                | PASS              |
|                  | 2422/CH3                             | 16.00                              | 16.82                                | 30                | PASS              |
| 802.11n<br>HT40  | 2437/CH6                             | 17.45                              | 18.27                                | 30                | PASS              |
| 11140            | 2452/CH9                             | 16.75                              | 17.57                                | 30                | PASS              |
|                  | 2412/CH 1                            | 16.20                              | 17.22                                | 30                | PASS              |
| 802.11ax<br>HE20 | 2437/CH 6                            | 16.48                              | 17.50                                | 30                | PASS              |
| TILZU            | 2462/CH11                            | 16.13                              | 17.15                                | 30                | PASS              |
|                  | 2422/CH3                             | 16.43                              | 17.45                                | 30                | PASS              |
| 802.11ax<br>HE40 | 2437/CH6                             | 16.84                              | 17.86                                | 30                | PASS              |
| 11240            | 2452/CH9                             | 16.64                              | 17.66                                | 30                | PASS              |
| Bluetooth        | 2402/CH0                             | 3.36                               | 4.07                                 | 30                | PASS              |
| (Low Energy)     | 2440/CH19                            | 3.45                               | 4.16                                 | 30                | PASS              |
| (1M)             | 2480/CH39                            | 3.03                               | 3.74                                 | 30                | PASS              |
| Bluetooth        | 2402/CH0                             | 1.70                               | 4.15                                 | 30                | PASS              |
| (Low Energy)     | 2440/CH19                            | 1.66                               | 4.11                                 | 30                | PASS              |
| (2M)             | 2480/CH39                            | 1.32                               | 3.77                                 | 30                | PASS              |
| Bluetooth        | 2402/CH0                             | 3.68                               | 4.10                                 | 30                | PASS              |
| (Low Energy)     | 2440/CH19                            | 3.66                               | 4.08                                 | 30                | PASS              |
| (S=2)            | 2480/CH39                            | 3.43                               | 3.85                                 | 30                | PASS              |
| Bluetooth        | 2402/CH0                             | 4.00                               | 4.11                                 | 30                | PASS              |
| (Low Energy)     | 2440/CH19                            | 3.98                               | 4.09                                 | 30                | PASS              |
| (S=8)            | 2480/CH39<br>Power with duty factor  | 3.61<br>= Average Power M          | 3.72                                 | 30<br>le correcti | PASS<br>on factor |



# 5.2. 99% Bandwidth and 6dB Bandwidth

#### **Ambient Condition**

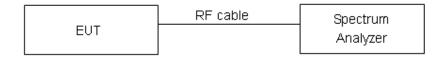
| Temperature | Relative humidity |  |
|-------------|-------------------|--|
| 15°C ~ 35°C | 20% ~ 80%         |  |

# **Method of Measurement**

The EUT was connected to the spectrum analyzer through an external attenuator (20dB) and a known loss cable. RBW is set to 100 kHz; VBW is set to 300 kHz on spectrum analyzer. Dector=Peak, Trace mode=max hold.

The EUT was connected to the spectrum analyzer through a known loss cable. The resolution bandwidth (RBW) shall be in the range of 1% to 5% of the actual occupied / x dB bandwidth and the video bandwidth (VBW) shall not be smaller than three times the RBW value.

#### **Test Setup**



#### Limits

Rule Part 15.247 (a) (2) specifies that "Systems using digital modulation techniques may operate in the 902-928 MHz, 2400-2483.5 MHz bands. The minimum 6 dB bandwidth shall be at least 500 kHz."

| minimum 6 dB bandwidth | ≥ 500 kHz |
|------------------------|-----------|
|------------------------|-----------|

#### **Measurement Uncertainty**

The assessed measurement uncertainty to ensure 95% confidence level for the normal distribution is with the coverage factor k = 2, U = 936 Hz.



# **Test Results:**

| Test Mode                          | Carrier frequency<br>(MHz) | 99%<br>bandwidth<br>(MHz) | Minimum 6 dB<br>bandwidth<br>(MHz) | Limit<br>(kHz) | Conclusion |
|------------------------------------|----------------------------|---------------------------|------------------------------------|----------------|------------|
| 802.11b                            | 2412                       | 12.920                    | 7.551                              | 500            | PASS       |
|                                    | 2437                       | 12.849                    | 7.590                              | 500            | PASS       |
|                                    | 2462                       | 12.914                    | 8.505                              | 500            | PASS       |
| 802.11g                            | 2412                       | 16.441                    | 15.027                             | 500            | PASS       |
|                                    | 2437                       | 16.803                    | 13.990                             | 500            | PASS       |
|                                    | 2462                       | 16.744                    | 16.314                             | 500            | PASS       |
| 802.11n<br>HT20                    | 2412                       | 17.921                    | 16.659                             | 500            | PASS       |
|                                    | 2437                       | 17.935                    | 16.693                             | 500            | PASS       |
|                                    | 2462                       | 17.917                    | 17.285                             | 500            | PASS       |
| 802.11n<br>HT40                    | 2422                       | 36.255                    | 33.506                             | 500            | PASS       |
|                                    | 2437                       | 36.353                    | 33.751                             | 500            | PASS       |
|                                    | 2452                       | 36.316                    | 35.372                             | 500            | PASS       |
| 802.11ax<br>HE20                   | 2412                       | 18.973                    | 18.019                             | 500            | PASS       |
|                                    | 2437                       | 18.961                    | 17.359                             | 500            | PASS       |
|                                    | 2462                       | 18.959                    | 18.411                             | 500            | PASS       |
| 802.11ax<br>HE40                   | 2422                       | 37.752                    | 37.827                             | 500            | PASS       |
|                                    | 2437                       | 37.739                    | 35.814                             | 500            | PASS       |
|                                    | 2452                       | 37.686                    | 35.220                             | 500            | PASS       |
| Bluetooth<br>(Low Energy)<br>(1M)  | 2402                       | 1.031                     | 0.678                              | 500            | PASS       |
|                                    | 2440                       | 1.027                     | 0.657                              | 500            | PASS       |
|                                    | 2480                       | 1.031                     | 0.661                              | 500            | PASS       |
| Bluetooth<br>(Low Energy)<br>(2M)  | 2402                       | 2.061                     | 1.156                              | 500            | PASS       |
|                                    | 2440                       | 2.054                     | 1.144                              | 500            | PASS       |
|                                    | 2480                       | 2.059                     | 1.252                              | 500            | PASS       |
| Bluetooth<br>(Low Energy)<br>(S=2) | 2402                       | 1.014                     | 0.671                              | 500            | PASS       |
|                                    | 2440                       | 1.021                     | 0.654                              | 500            | PASS       |
|                                    | 2480                       | 1.021                     | 0.667                              | 500            | PASS       |
| Bluetooth<br>(Low Energy)<br>(S=8) | 2402                       | 1.050                     | 0.679                              | 500            | PASS       |
|                                    | 2440                       | 1.049                     | 0.683                              | 500            | PASS       |
|                                    | 2480                       | 1.051                     | 0.678                              | 500            | PASS       |

Report No.: R2308A0881-R1



#### 99%bandwidth

#### OBW 802.11ax(HE20) 2412MHz

Report No.: R2308A0881-R1



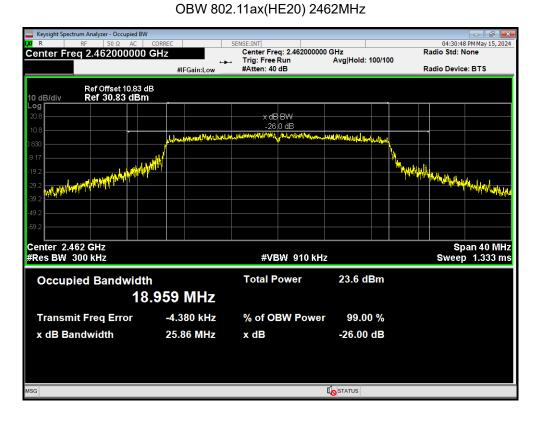
#### OBW 802.11ax(HE20) 2437MHz



Eurofins TA Technology (Shanghai) Co., Ltd.

TA-MB-04-005R

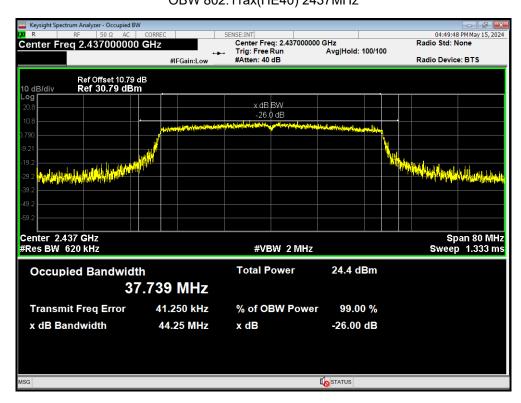
Page 13 of 175



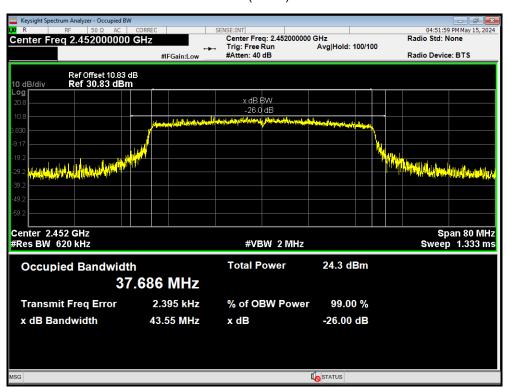
# OBW 802.11ax(HE40) 2422MHz



# Report No.: R2308A0881-R1 OBW 802.11ax(HE40) 2437MHz

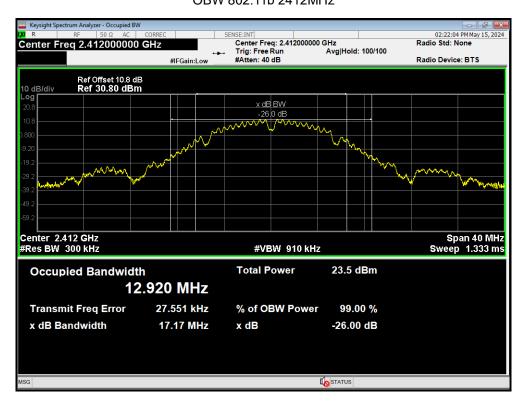


# OBW 802.11ax(HE40) 2452MHz



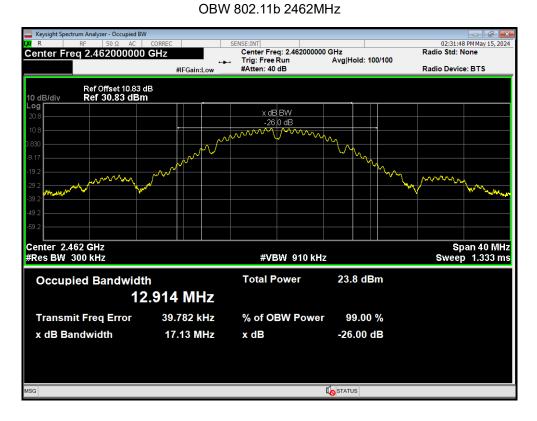
# OBW 802.11b 2412MHz

Report No.: R2308A0881-R1



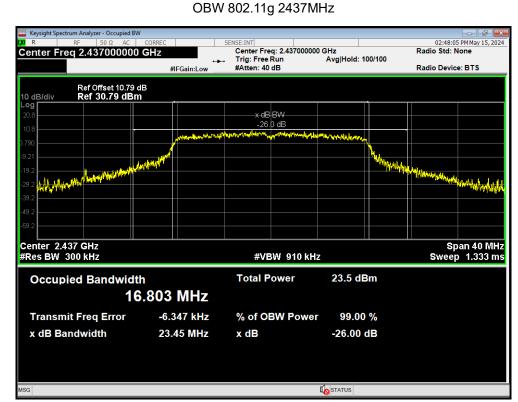
#### OBW 802.11b 2437MHz



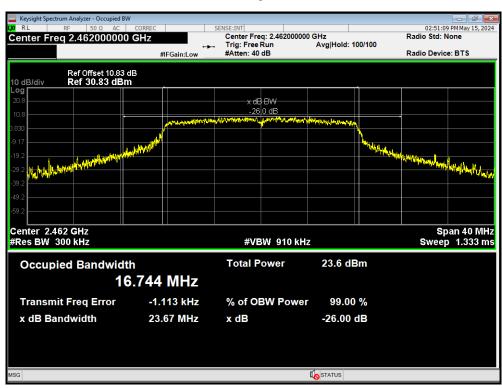


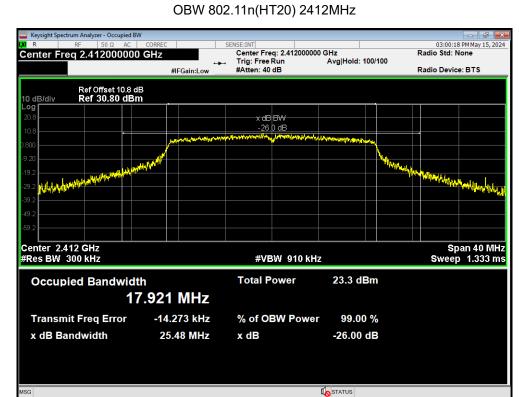
# OBW 802.11g 2412MHz





# OBW 802.11g 2462MHz



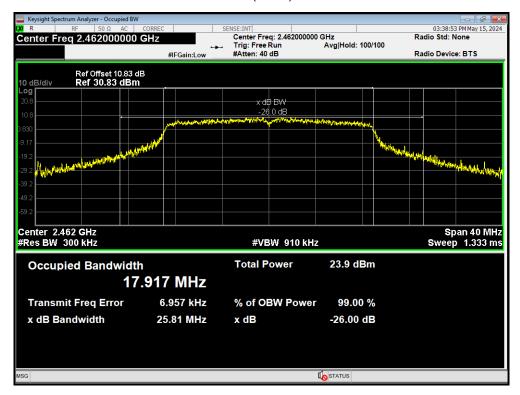


### OBW 802.11n(HT20) 2437MHz



**RF Test Report** Report No.: R2308A0881-R1

# OBW 802.11n(HT20) 2462MHz



### OBW 802.11n(HT40) 2422MHz

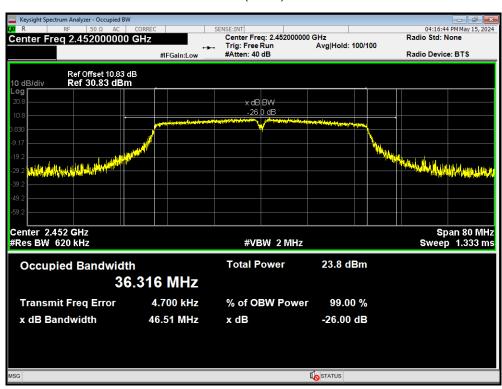


# OBW 802.11n(HT40) 2437MHz

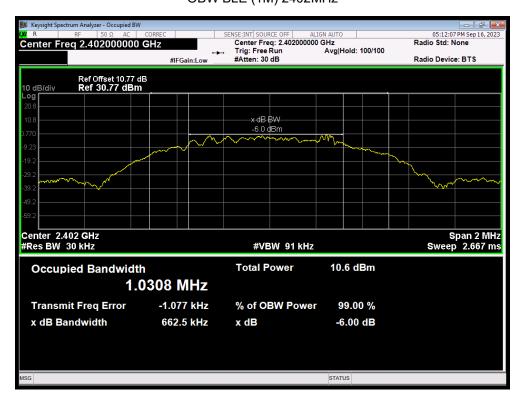
Report No.: R2308A0881-R1



### OBW 802.11n(HT40) 2452MHz



# OBW BLE (1M) 2402MHz



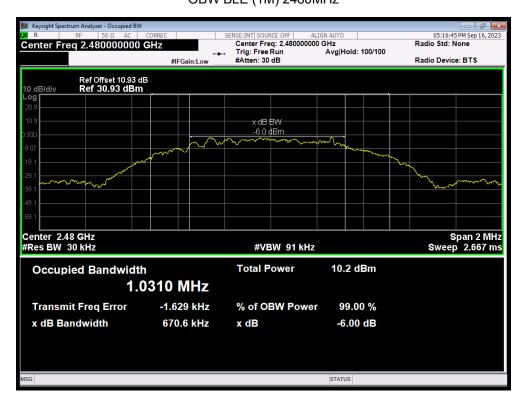
# OBW BLE (1M) 2440MHz



Report No.: R2308A0881-R1

# OBW BLE (1M) 2480MHz

Report No.: R2308A0881-R1

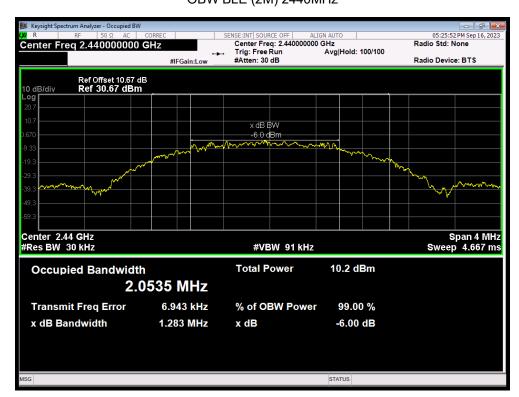


# OBW BLE (2M) 2402MHz



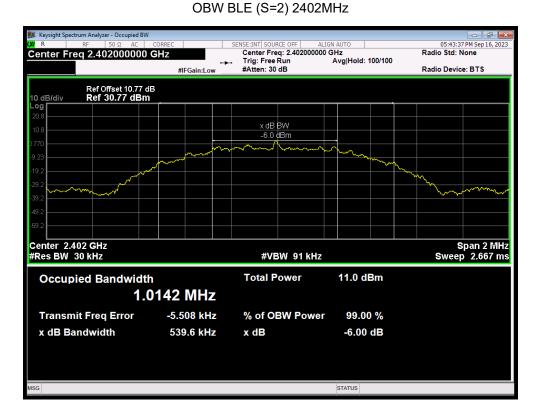
# OBW BLE (2M) 2440MHz

Report No.: R2308A0881-R1



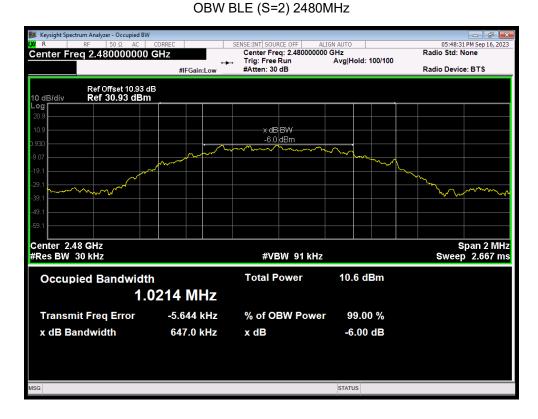
# OBW BLE (2M) 2480MHz





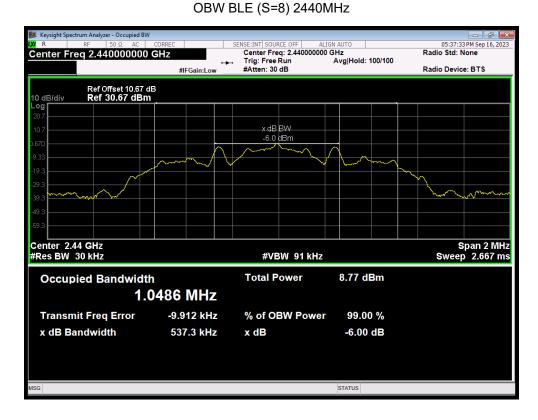
# OBW BLE (S=2) 2440MHz





# OBW BLE (S=8) 2402MHz





# OBW BLE (S=8) 2480MHz



6 dB bandwidth

# Report No.: R2308A0881-R1

# -6dB Bandwidth 802.11ax(HE20) 2412MHz



#### -6dB Bandwidth 802.11ax(HE20) 2437MHz



Eurofins TA Technology (Shanghai) Co., Ltd.

TA-MB-04-005R



# -6dB Bandwidth 802.11ax(HE20) 2462MHz

Report No.: R2308A0881-R1



# -6dB Bandwidth 802.11ax(HE40) 2422MHz





# -6dB Bandwidth 802.11ax(HE40) 2437MHz



# -6dB Bandwidth 802.11ax(HE40) 2452MHz

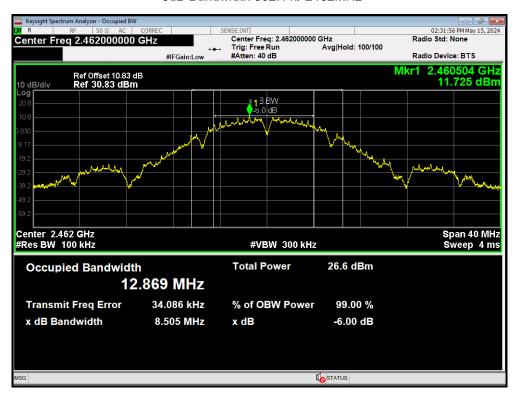




#### -6dB Bandwidth 802.11b 2437MHz

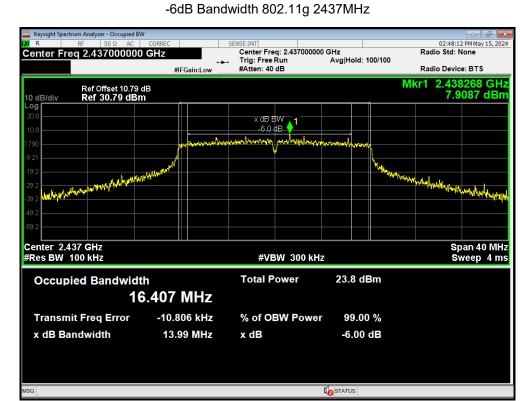


#### -6dB Bandwidth 802.11b 2462MHz

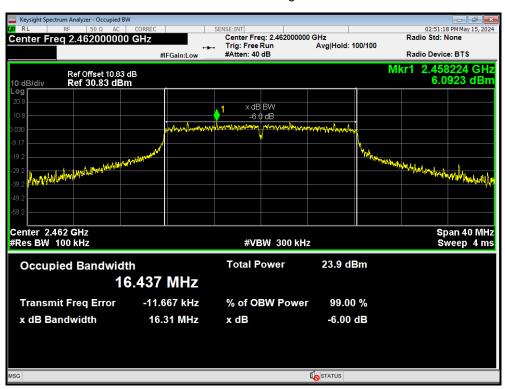


# -6dB Bandwidth 802.11g 2412MHz



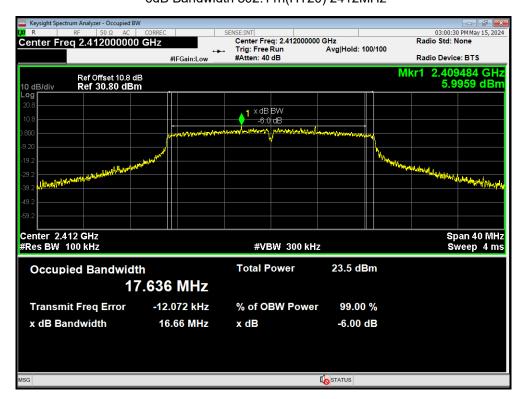


### -6dB Bandwidth 802.11g 2462MHz



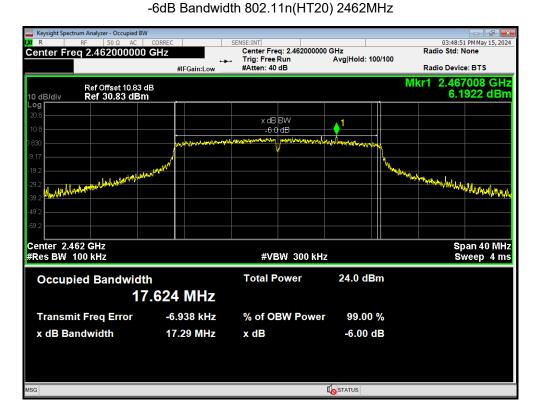
# -6dB Bandwidth 802.11n(HT20) 2412MHz

Report No.: R2308A0881-R1

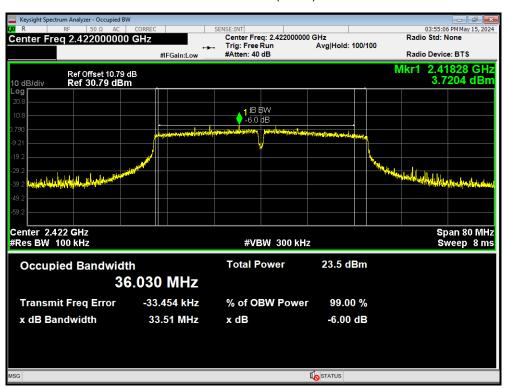


# -6dB Bandwidth 802.11n(HT20) 2437MHz





# -6dB Bandwidth 802.11n(HT40) 2422MHz



**eurofins** 

#### Report No.: R2308A0881-R1

# -6dB Bandwidth 802.11n(HT40) 2437MHz



# -6dB Bandwidth 802.11n(HT40) 2452MHz



**eurofins** 

#### Report No.: R2308A0881-R1



#### -6dB Bandwidth BLE (1M) 2440MHz





### -6dB Bandwidth BLE (2M) 2402MHz

STATUS



**eurofins** 

# Report No.: R2308A0881-R1



#### -6dB Bandwidth BLE (2M) 2480MHz



### -6dB Bandwidth BLE (S=2) 2402MHz



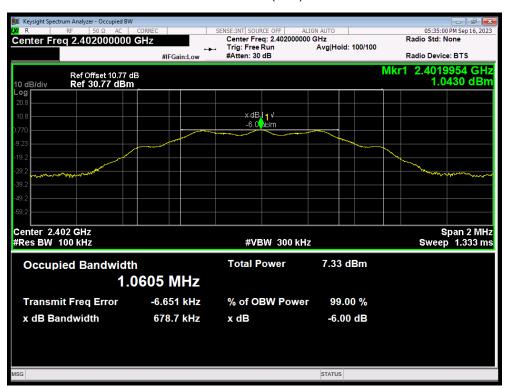
#### -6dB Bandwidth BLE (S=2) 2440MHz



### -6dB Bandwidth BLE (S=2) 2480MHz



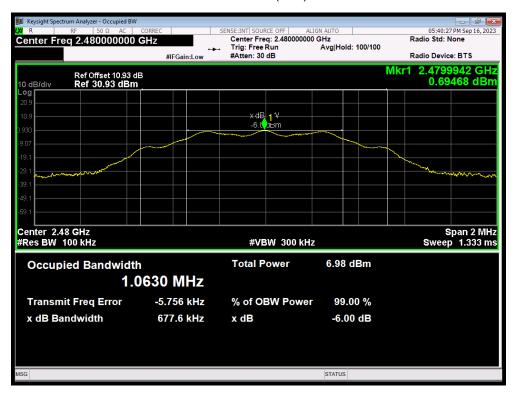
### -6dB Bandwidth BLE (S=8) 2402MHz



### -6dB Bandwidth BLE (S=8) 2440MHz



### -6dB Bandwidth BLE (S=8) 2480MHz



### 5.3. Band Edge

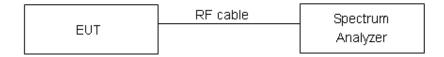
#### **Ambient Condition**

| Temperature | Relative humidity |  |
|-------------|-------------------|--|
| 15°C ~ 35°C | 20% ~ 80%         |  |

#### **Method of Measurement**

The EUT was connected to the spectrum analyzer through an external attenuator (20dB) and a known loss cable the band edge of the lowest and highest channels were measured. The peak detector is used and RBW is set to 100 kHz and VBW is set to 300 kHz on spectrum analyzer. Spectrum analyzer plots are included on the following pages.

#### **Test Setup**



#### Limits

Rule Part 15.247(d) specifies that "In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits." If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB."

#### **Measurement Uncertainty**

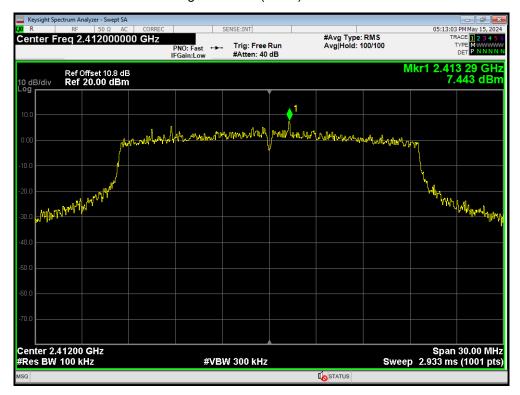
The assessed measurement uncertainty to ensure 95% confidence level for the normal distribution is with the coverage factor k = 1.96.

| Frequency | Uncertainty |  |
|-----------|-------------|--|
| 2GHz-3GHz | 1.407 dB    |  |

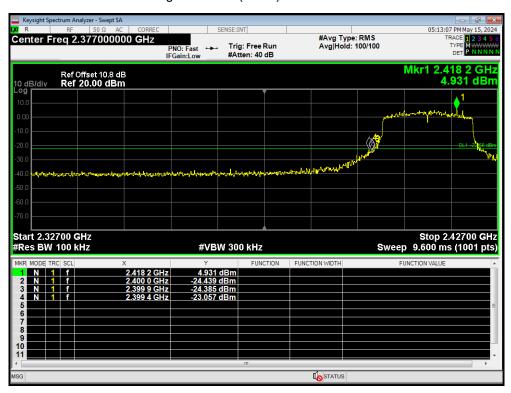
RF Test Report Report No.: R2308A0881-R1

#### **Test Results: PASS**

### Band Edge 802.11ax(HE20) 2412MHz Ref



### Band Edge 802.11ax(HE20) 2412MHz Emission

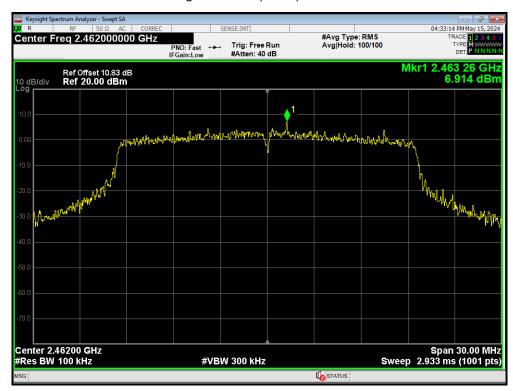


Eurofins TA Technology (Shanghai) Co., Ltd.

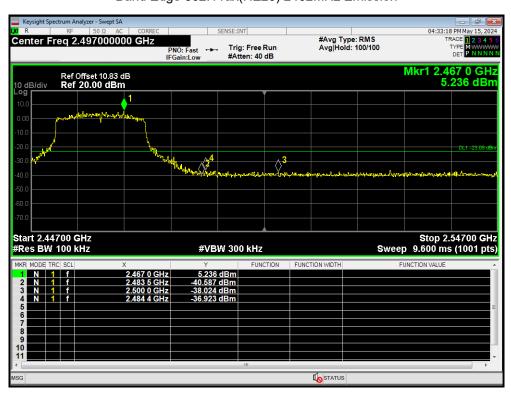
TA-MB-04-005R

Page 44 of 175

### Band Edge 802.11ax(HE20) 2462MHz Ref



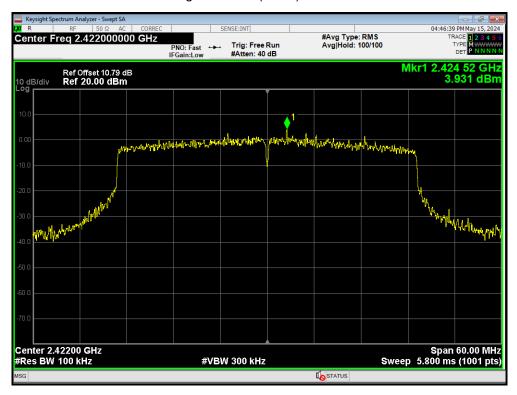
### Band Edge 802.11ax(HE20) 2462MHz Emission



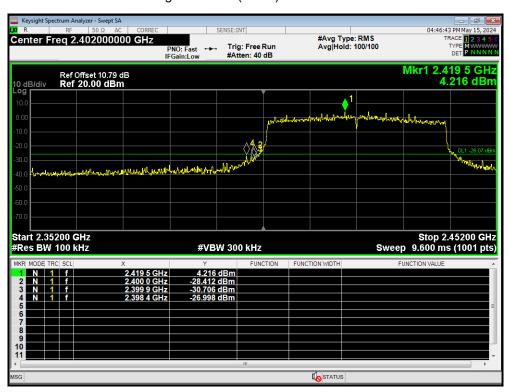
eurofins

#### Report No.: R2308A0881-R1

### Band Edge 802.11ax(HE40) 2422MHz Ref

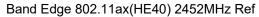


### Band Edge 802.11ax(HE40) 2422MHz Emission



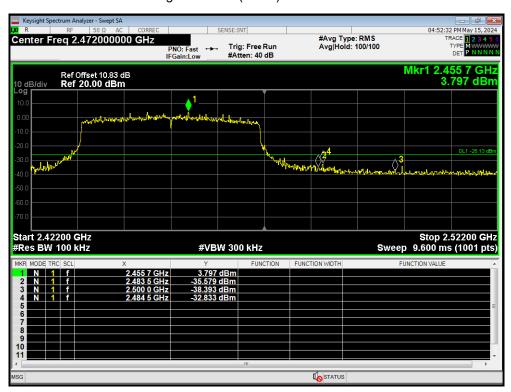
eurofins

#### Report No.: R2308A0881-R1





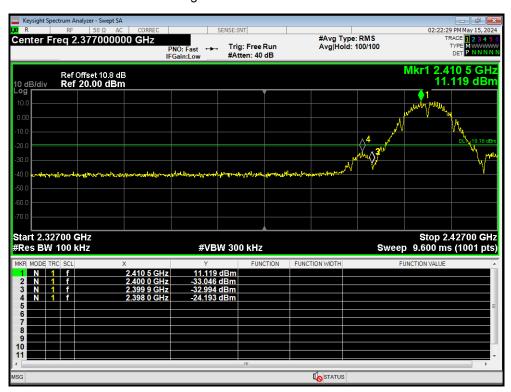
### Band Edge 802.11ax(HE40) 2452MHz Emission



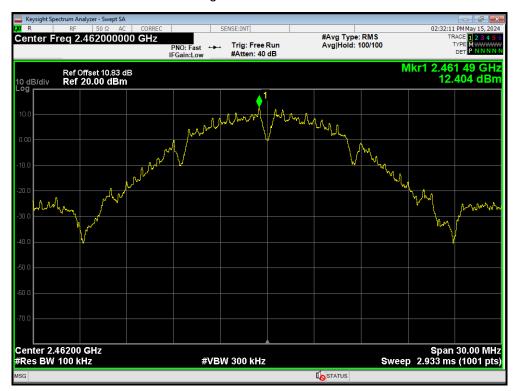
### Band Edge 802.11b 2412MHz Ref



### Band Edge 802.11b 2412MHz Emission



### Band Edge 802.11b 2462MHz Ref



### Band Edge 802.11b 2462MHz Emission





### Band Edge 802.11g 2412MHz Emission





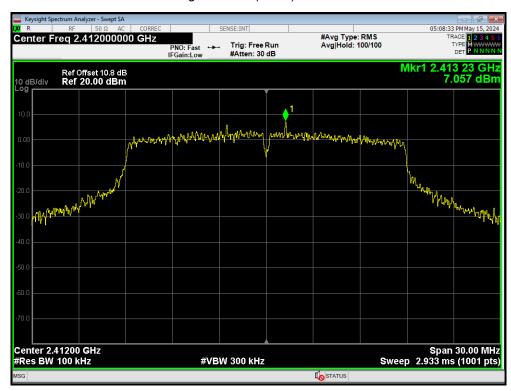
### Band Edge 802.11g 2462MHz Emission



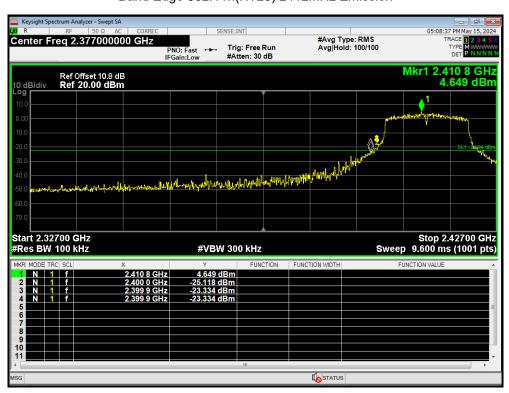
eurofins

Report No.: R2308A0881-R1

### Band Edge 802.11n(HT20) 2412MHz Ref



#### Band Edge 802.11n(HT20) 2412MHz Emission



eurofins

#### Report No.: R2308A0881-R1

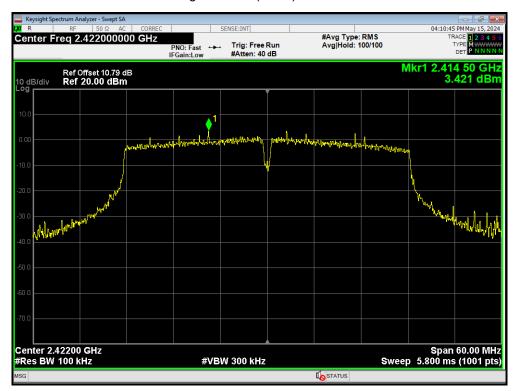
### Band Edge 802.11n(HT20) 2462MHz Ref



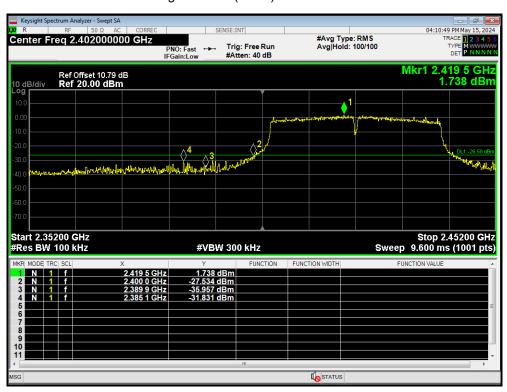
### Band Edge 802.11n(HT20) 2462MHz Emission



### Band Edge 802.11n(HT40) 2422MHz Ref



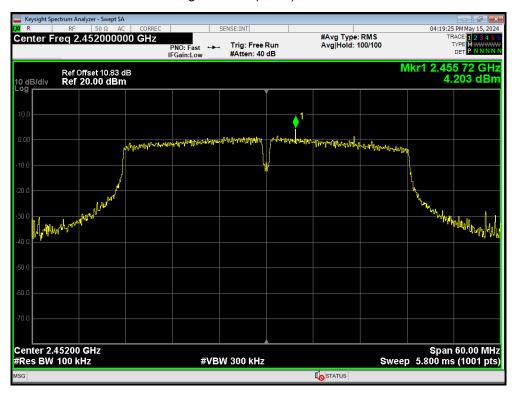
### Band Edge 802.11n(HT40) 2422MHz Emission



eurofins

#### Report No.: R2308A0881-R1

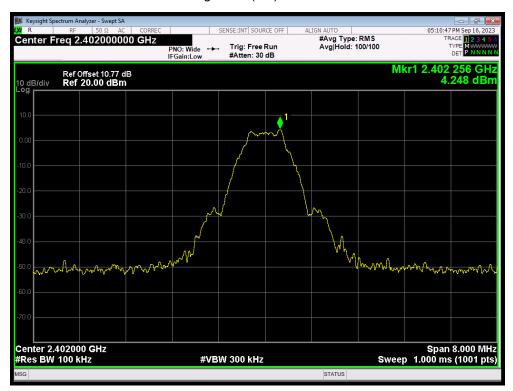
### Band Edge 802.11n(HT40) 2452MHz Ref



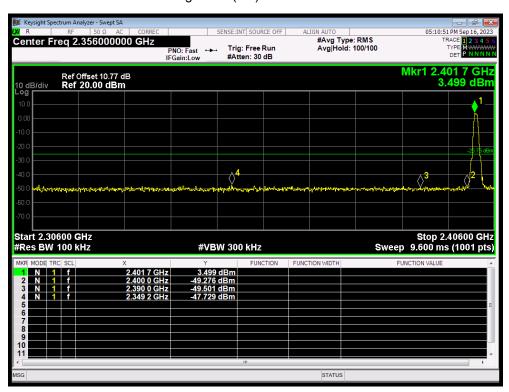
### Band Edge 802.11n(HT40) 2452MHz Emission

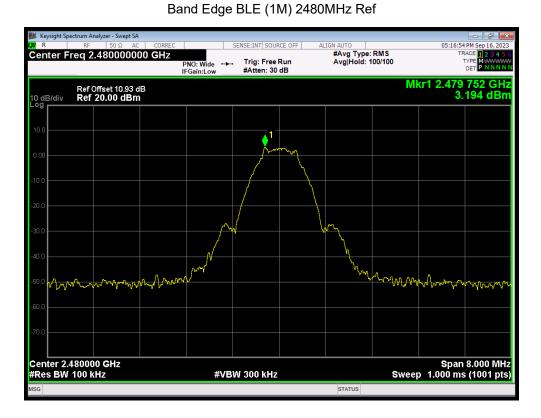


### Band Edge BLE (1M) 2402MHz Ref

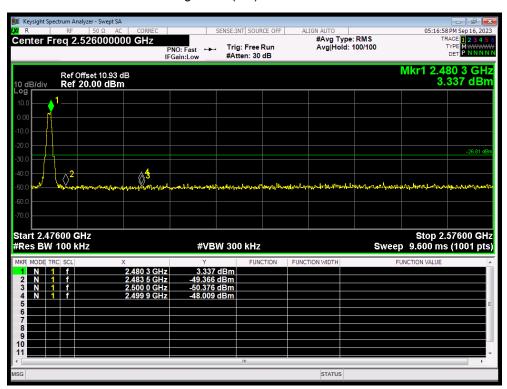


### Band Edge BLE (1M) 2402MHz Emission

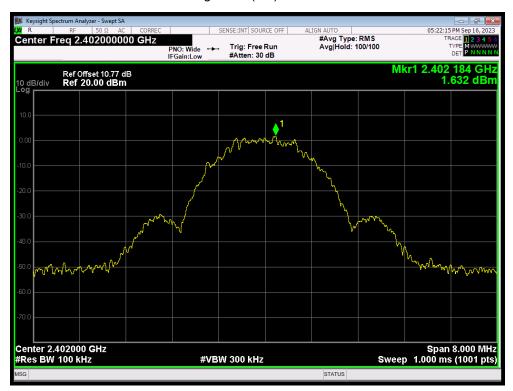




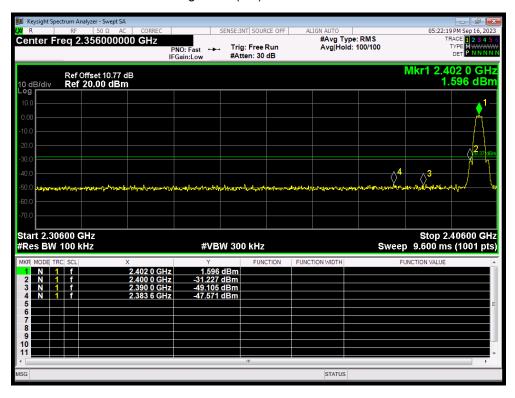
### Band Edge BLE (1M) 2480MHz Emission



### Band Edge BLE (2M) 2402MHz Ref

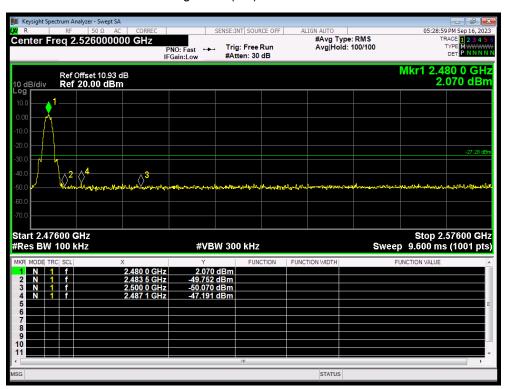


### Band Edge BLE (2M) 2402MHz Emission

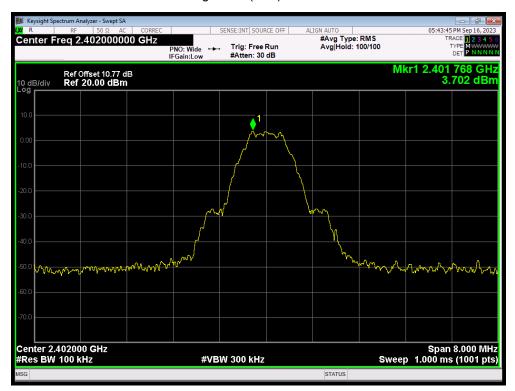




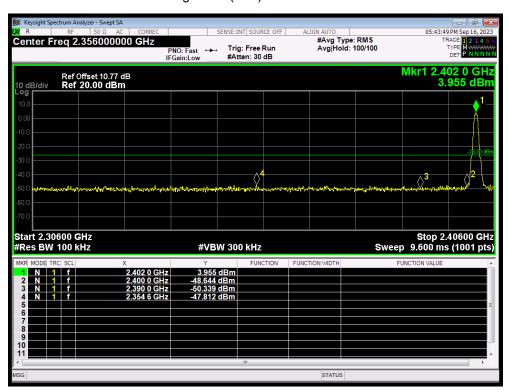
### Band Edge BLE (2M) 2480MHz Emission



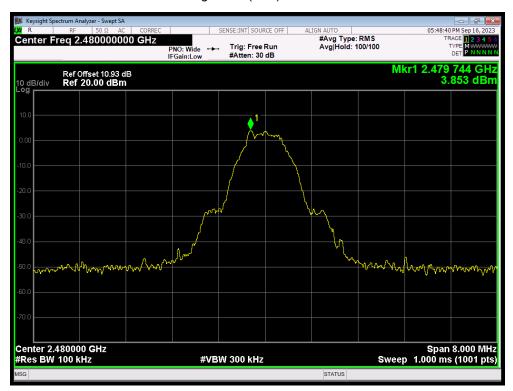
### Band Edge BLE (S=2) 2402MHz Ref



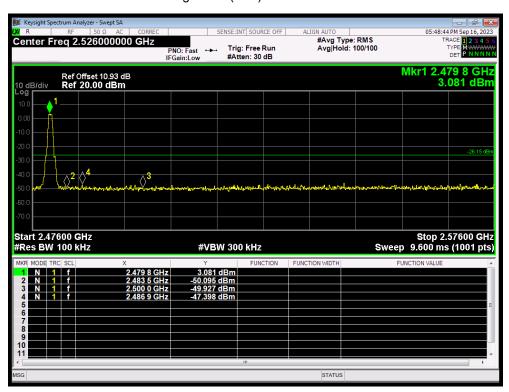
### Band Edge BLE (S=2) 2402MHz Emission



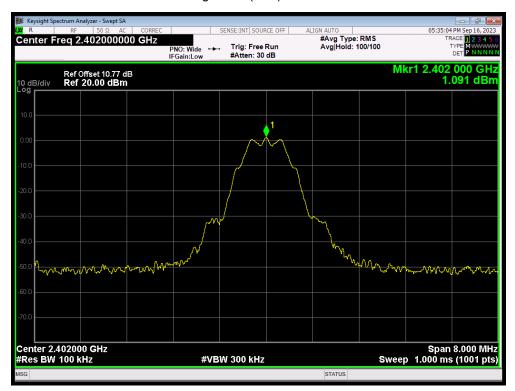
### Band Edge BLE (S=2) 2480MHz Ref



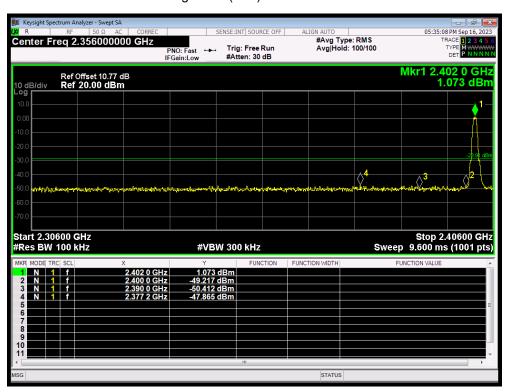
### Band Edge BLE (S=2) 2480MHz Emission



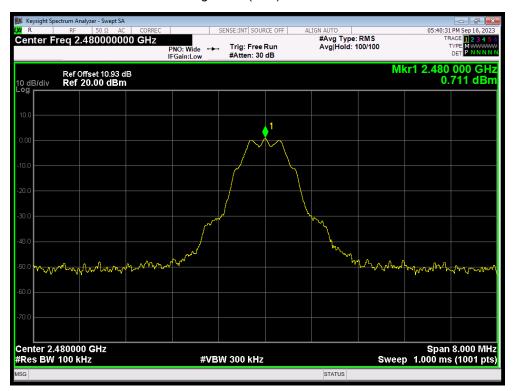
### Band Edge BLE (S=8) 2402MHz Ref



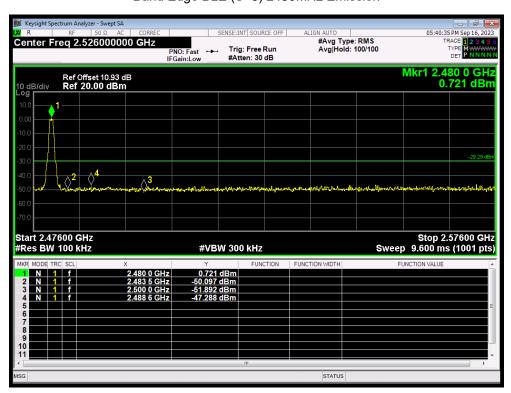
### Band Edge BLE (S=8) 2402MHz Emission



### Band Edge BLE (S=8) 2480MHz Ref



### Band Edge BLE (S=8) 2480MHz Emission





### 5.4. Power Spectral Density

### **Ambient Condition**

| Temperature | Relative humidity |  |
|-------------|-------------------|--|
| 15°C ~ 35°C | 20% ~ 80%         |  |

Report No.: R2308A0881-R1

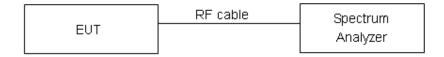
#### **Method of Measurement**

During the process of the testing, The EUT was connected to Spectrum Analyzer with a known loss. The EUT is max power transmission with proper modulation.

Method AVGPSD-2 was used for this test.

- a) Measure the duty cycle (D)of the transmitter output signal as described in 11.6
- b) Set instrument center frequency to DTS channel center frequency
- c) Set span to at least 1.5 times the OBW
- d) Set RBW to:3kHz≤RBW≤100kHz
- e) Set VBW ≥ [3x RBW]
- f) Detector= power averaging (rms) or sample detector (when rms not available)
- g) Ensure that the number of measurement points in the sweep ≥ [2 X span/RBW]
- h) Sweep time =auto couple
- i) Do not use sweep triggering; allow sweep to "free run"
- j) Employ trace averaging (rms) mode over a minimum of 100 traces
- k) Use the peak marker function to determine the maximum amplitude level
- I) Add [10 log(1/ D)], where D is the duty cycle measured in step a), to the measured PSD to compute the average PSD during the actual transmission time
- m) If measured value exceeds requirement specified by regulatory agency then reduce RBW (but no less than 3 kHz) and repeat (note that this may require zooming in on the emission of interest and reducing the span to meet the minimum measurement point requirement as the RBW is reduced)

#### **Test setup**



RF Test Report No.: R2308A0881-R1

#### Limits

Rule Part 15.247(e) specifies that" For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission. "

| Limits | ≤8 dBm / 3kHz |
|--------|---------------|
|--------|---------------|

### **Measurement Uncertainty**

The assessed measurement uncertainty to ensure 95% confidence level for the normal distribution is with the coverage factor k = 2, U = 0.75dB.



**RF Test Report** 

**Test Results:** 

| Test Mode        | Carrier frequency<br>(MHz) )/ Channel | Read Value<br>(dBm / 30kHz) | Power Spectral<br>Density<br>(dBm / 3kHz) | Limit<br>(dBm / 3kHz) | Conclusion |
|------------------|---------------------------------------|-----------------------------|---|-----------------------|------------|
| 802.11b          | 2412/CH 1                             | -1.74                       | -11.24                                    | 8                     | PASS       |
|                  | 2437/CH 6                             | -1.79                       | -11.29                                    | 8                     | PASS       |
|                  | 2462/CH11                             | -1.40                       | -10.90                                    | 8                     | PASS       |
| 802.11g          | 2412/CH 1                             | -6.12                       | -13.72                                    | 8                     | PASS       |
|                  | 2437/CH 6                             | -7.61                       | -15.21                                    | 8                     | PASS       |
|                  | 2462/CH11                             | -7.25                       | -14.85                                    | 8                     | PASS       |
| 802.11n<br>HT20  | 2412/CH 1                             | -6.97                       | -16.18                                    | 8                     | PASS       |
|                  | 2437/CH 6                             | -6.62                       | -15.83                                    | 8                     | PASS       |
|                  | 2462/CH11                             | -5.81                       | -15.02                                    | 8                     | PASS       |
| 802.11n<br>HT40  | 2422/CH3                              | -9.58                       | -18.76                                    | 8                     | PASS       |
|                  | 2437/CH6                              | -9.13                       | -18.31                                    | 8                     | PASS       |
|                  | 2452/CH9                              | -9.81                       | -18.99                                    | 8                     | PASS       |
| 802.11ax<br>HE20 | 2412/CH 1                             | -8.48                       | -17.46                                    | 8                     | PASS       |
|                  | 2437/CH 6                             | -9.76                       | -18.74                                    | 8                     | PASS       |
|                  | 2462/CH11                             | -8.89                       | -17.87                                    | 8                     | PASS       |
| 802.11ax<br>HE40 | 2422/CH3                              | -11.57                      | -20.55                                    | 8                     | PASS       |
|                  | 2437/CH6                              | -10.60                      | -19.58                                    | 8                     | PASS       |
|                  |                                       |                             |   |                       |            |

Note: Power Spectral Density (dBm/3kHz) =Read Value+Duty cycle correction factor + 10\*log10(3/30)

-11.71

2452/CH9

-20.69

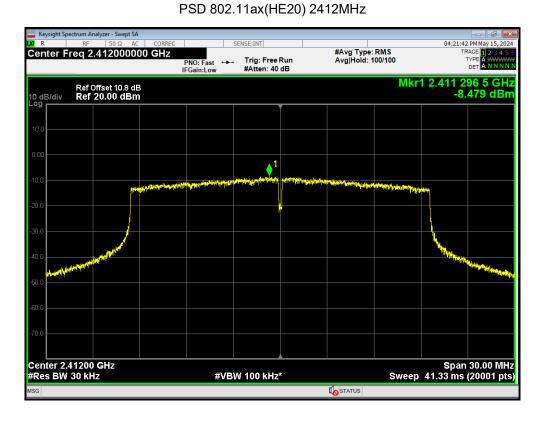
8

**PASS** 

Report No.: R2308A0881-R1

RF Test Report Report No.: R2308A0881-R1

| Test Mode   | Carrier frequency<br>(MHz) )/ Channel | Read Value<br>(dBm / 3kHz) | Power Spectral<br>Density<br>(dBm / 3kHz) | Limit<br>(dBm / 3kHz) | Conclusion |
|---|---------------------------------------|----------------------------|---|-----------------------|------------|
| Bluetooth<br>(Low Energy)<br>(1M)                                     | 2402/CH0                              | -17.69                     | -16.98                                    | 8                     | PASS       |
|   | 2440/CH19                             | -17.58                     | -16.87                                    | 8                     | PASS       |
|   | 2480/CH39                             | -17.61                     | -16.90                                    | 8                     | PASS       |
| Bluetooth<br>(Low Energy)<br>(2M)                                     | 2402/CH0                              | -21.48                     | -19.03                                    | 8                     | PASS       |
|   | 2440/CH19                             | -22.13                     | -19.68                                    | 8                     | PASS       |
|   | 2480/CH39                             | -22.25                     | -19.80                                    | 8                     | PASS       |
| Bluetooth<br>(Low Energy)<br>(S=2)                                    | 2402/CH0                              | -13.65                     | -13.23                                    | 8                     | PASS       |
|   | 2440/CH19                             | -14.56                     | -14.14                                    | 8                     | PASS       |
|   | 2480/CH39                             | -14.81                     | -14.39                                    | 8                     | PASS       |
| Bluetooth<br>(Low Energy)<br>(S=8)                                    | 2402/CH0                              | -2.86                      | -2.75                                     | 8                     | PASS       |
|   | 2440/CH19                             | -2.76                      | -2.65                                     | 8                     | PASS       |
|   | 2480/CH39                             | -3.99                      | -3.88                                     | 8                     | PASS       |
| Note: Power Spectral Density =Read Value+Duty cycle correction factor |                                       |                            |   |                       |            |



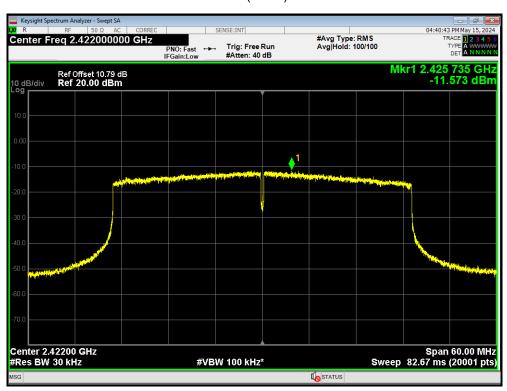
### PSD 802.11ax(HE20) 2437MHz

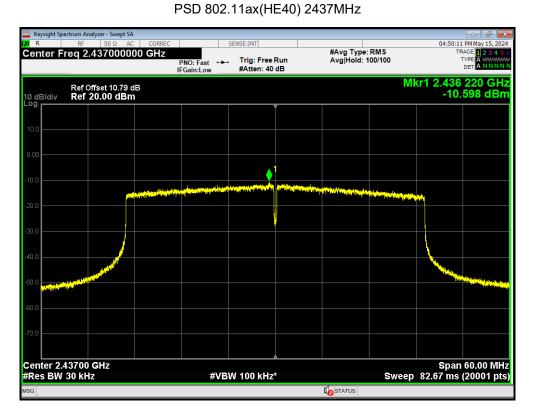


# PSD 802.11ax(HE20) 2462MHz

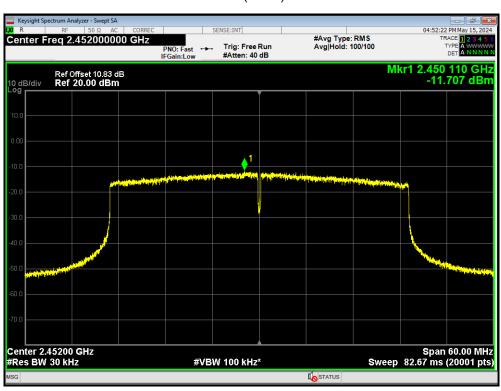


PSD 802.11ax(HE40) 2422MHz





### PSD 802.11ax(HE40) 2452MHz



#### PSD 802.11b 2412MHz



#### PSD 802.11b 2437MHz



#### PSD 802.11b 2462MHz



PSD 802.11g 2412MHz

