

# Test Report

|                                                                                                                                                                                                                                                                                                                   |                                                                                                                                                                                                                                                                                                                                            |                                                                                      |  |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|--|
| <b>Product</b>                                                                                                                                                                                                                                                                                                    | Reader and Communication Controller                                                                                                                                                                                                                                                                                                        |                                                                                      |  |
| <b>Name and address of the applicant</b>                                                                                                                                                                                                                                                                          | ASSA ABLOY Global Solutions Norway AS<br>Postboks 340, Anolitveien 1-3,<br>1402 Ski, Norway                                                                                                                                                                                                                                                |                                                                                      |  |
| <b>Name and address of the manufacturer</b>                                                                                                                                                                                                                                                                       | ASSA ABLOY Global Solutions Norway AS<br>Postboks 340, Anolitveien 1-3,<br>1402 Ski, Norway                                                                                                                                                                                                                                                |                                                                                      |  |
| <b>Model</b>                                                                                                                                                                                                                                                                                                      | RCC1601                                                                                                                                                                                                                                                                                                                                    |                                                                                      |  |
| <b>Rating</b>                                                                                                                                                                                                                                                                                                     | 4.5 VDC, (3x1.5 VDC AA secondary Batteries)                                                                                                                                                                                                                                                                                                |                                                                                      |  |
| <b>Trademark</b>                                                                                                                                                                                                                                                                                                  | ASSA ABLOY                                                                                                                                                                                                                                                                                                                                 |                                                                                      |  |
| <b>Serial number</b>                                                                                                                                                                                                                                                                                              | See page 3                                                                                                                                                                                                                                                                                                                                 |                                                                                      |  |
| <b>Additional information</b>                                                                                                                                                                                                                                                                                     | 2.4 GHz Zigbee based on IEEE 802.15.4                                                                                                                                                                                                                                                                                                      |                                                                                      |  |
| <b>Tested according to</b>                                                                                                                                                                                                                                                                                        | <b>FCC Part 15.247</b><br>Frequency Hopping Transmitters / Digital Transmission Systems<br><b>Industry Canada RSS-247, Issue 2</b><br>Digital Transmission Systems (DTSS), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices                                                                         |                                                                                      |  |
| <b>Order number</b>                                                                                                                                                                                                                                                                                               | 480298                                                                                                                                                                                                                                                                                                                                     |                                                                                      |  |
| <b>Tested in period</b>                                                                                                                                                                                                                                                                                           | 2022-11-15 - 2022-11-25                                                                                                                                                                                                                                                                                                                    |                                                                                      |  |
| <b>Issue date</b>                                                                                                                                                                                                                                                                                                 | 2023-06-29                                                                                                                                                                                                                                                                                                                                 |                                                                                      |  |
| <b>Name and address of the testing laboratory</b>                                                                                                                                                                                                                                                                 | <div> Nemko Scandinavia AS<br/> Instituttveien 6<br/> 2007 Kjeller<br/> Norway </div> <div> CAB Number:<br/> FCC: NO0001<br/> ISED: NO0470 </div> <div>   </div> |                                                                                      |  |
| An accredited technical test executed under the Norwegian accreditation scheme                                                                                                                                                                                                                                    |                                                                                                                                                                                                                                                                                                                                            |                                                                                      |  |
|                                                                                                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                            |  |  |
| Prepared by [G.Suwanthakumar]                                                                                                                                                                                                                                                                                     |                                                                                                                                                                                                                                                                                                                                            | Approved by [Frode Sveinsen]                                                         |  |
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## Revision history

| Revision | Date       | Comment     | Sign |
|----------|------------|-------------|------|
| A        | 2023-06-29 | First Issue | gns  |
|          |            |             |      |



### THIS TEST REPORT APPLIES ONLY TO THE ITEM(S) AND CONFIGURATIONS TESTED.

Deviations from, additions to, or exclusions from the test specifications are described in "Summary of Test Data".

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# 1 INFORMATION

## 1.1 Test Item

|                                  |                                                               |
|----------------------------------|---------------------------------------------------------------|
| Name                             | ASSA ABLOY                                                    |
| Model/version                    | RCC1601                                                       |
| FCC ID                           | Y7V-RCC1601C1                                                 |
| ISED ID                          | 9514A-RCC1601C1                                               |
| Serial number                    | 2241 FLEX 00762<br>Marked as (Radiated: 1Z and Conducted: 3Z) |
| Hardware identity and/or version | RCC1601C1                                                     |
| Software identity and/or version | Ver.1.0                                                       |
| Frequency Range                  | 2405–2480 MHz                                                 |
| Number of Channels               | 16                                                            |
| Operating Modes                  | Transceiver                                                   |
| Type of Modulation               | Offset-QPSK                                                   |
| Conducted Output Power           | 3.90 mW (Peak)                                                |
| Antenna Connector                | integral antenna type: PCB                                    |
| Number of Antennas               | 1                                                             |
| Diversity or Smart Antennas      | NA                                                            |
| Power Supply                     | 4.5V DC Secondary batteries (3x 1.5V DC AA batteries)         |
| Desktop Charger                  | NA                                                            |

### Description of Test Item

The Reader and Communication Controller is an electronic module located inside the external door handle of the electro-mechanic lock. The device is designed to implement several functions: user interface by the RGB LED, Touch sensor and proximity detector; setup and emergency power function by the USB-C service connector; communication function by BLE (for mobile phone access and interaction) and ZigBee technologies (for a local system monitoring) realized in a single chip solution and finally the function of reading the RFID card through the RFID reader. The device is powered by the Lock Case Controller (the device that control the mechanical part) by two of the six wires, the remaining wires are used for signaling. The 3 mentioned radio technologies: RFID, BLE and ZigBee cannot operate simultaneously, and his test report covers only the Zigbee operation.

## 1.2 Normal test condition

|                      |            |
|----------------------|------------|
| Temperature:         | 20 - 24 °C |
| Relative humidity:   | 20 - 50 %  |
| Normal test voltage: | 4.5 VDC    |

The values are the limit registered during the test period.

## 1.3 Test Engineer(s)

G.Suwanthakumar

## 1.4 Antenna Requirement

|                                                                                                                     |                              |                                        |
|---------------------------------------------------------------------------------------------------------------------|------------------------------|----------------------------------------|
| Does the EUT have detachable antenna(s)?                                                                            | <input type="checkbox"/> YES | <input checked="" type="checkbox"/> NO |
| If detachable, is the antenna connector(s) non-standard?                                                            | <input type="checkbox"/> YES | <input type="checkbox"/> NO            |
| The tested equipment has only integral antennas. Conducted tests were performed with a temporary antenna connector. |                              |                                        |

Requirement: FCC 15.203, 15.204

## 1.5 EUT Operating Modes

|                                |                                                                                                |
|--------------------------------|------------------------------------------------------------------------------------------------|
| Description of operating modes | Continuous TX                                                                                  |
| Additional information         | The following settings were used for all tests:<br>Power Setting: 4 dBm<br>Data Rate: 250 kbps |

## 1.6 Comments

The EUT uses the Zigbee protocol based on IEEE 802.15.4.

All measurements were done with the EUT powered by a fully charged battery.

All ports were populated during spurious emission measurements.

## 2 TEST REPORT SUMMARY

### 2.1 General

All measurements are traceable to national standards.

The tests were conducted for demonstrating compliance with FCC CFR 47 Part 15, paragraph 15.247 and Industry Canada RSS-247 Issue 2 and RSS-GEN Issue 5.

Tests were performed in accordance with ANSI C63.4-2014 and ANSI C63.10-2013.

Radiated tests were made in a semi-anechoic chamber at measuring distances of 1m, 3m and 10m.

A description of the test facility is on file with FCC and ISED.

|                                                     |                                                         |
|-----------------------------------------------------|---------------------------------------------------------|
| <input checked="" type="checkbox"/> New Submission  | <input type="checkbox"/> Production Unit                |
| <input type="checkbox"/> Class II Permissive Change | <input checked="" type="checkbox"/> Pre-production Unit |
| <b>DTS</b> Equipment Code                           | <input type="checkbox"/> Family Listing                 |

### 2.2 Test Summary

| Name of test                           | FCC Part 15 reference               | RSS-247 Issue 2, RSS-GEN Issue 5 reference      | ANSI C63.10-2013 Reference                | Result                |
|----------------------------------------|-------------------------------------|-------------------------------------------------|-------------------------------------------|-----------------------|
| Supply Voltage Variations              | 15.31(e)                            | 6.11 (RSS-GEN)                                  | 5.13                                      | N/A <sup>1</sup>      |
| Antenna Requirement                    | 15.203                              | 6.8 (RSS-GEN)                                   | 5.8                                       | Complies <sup>2</sup> |
| Power Line Conducted Emission          | 15.107(a)<br>15.207(a)              | 7.2 / 8.8 (RSS-GEN)                             | 6.2                                       | N/A <sup>1</sup>      |
| Occupied Bandwidth (99% BW)            | N/A                                 | 6.7 (RSS-GEN)                                   | 6.9.3                                     | -                     |
| DTS Bandwidth                          | 15.247(a)(2)                        | 5.2 (1) (RSS-247)                               | 11.8 Option 2                             | Complies              |
| Peak Power Output                      | 15.247(b)                           | 5.4 (RSS-247)                                   | 11.9.1.1                                  | Complies              |
| Power Spectral Density                 | 15.247(d)                           | 5.2 (2) (RSS-247)                               | 11.10.2 PKPSD (DTS)                       | Complies              |
| Spurious Emissions (Antenna Conducted) | 15.247(c)                           | 5.5 (RSS-247)                                   | 6.7<br>11.11 (DTS)                        | Complies              |
| Spurious Emissions (Radiated)          | 15.247(c)<br>15.109(a)<br>15.209(a) | 5.5 (RSS-247)<br>7.3 (RSS-GEN)<br>8.9 (RSS-GEN) | 6.3, 6.5, 6.6, 6.10<br>11.12, 11.13 (DTS) | Complies              |

<sup>1</sup> The EUT is battery operated

<sup>2</sup> Integral antenna.

- for information only

### 3 TEST RESULTS

#### 3.1 Occupied Bandwidth (99% BW)

FCC Part 15.247 (a)(1)(iii)

ISED Canada RSS-247 Issue 2, Clause 5.1

ISED Canada RSS-GEN Issue 5, Clause 6.7

Measurement procedure: ANSI C63.10-2013 Clause 6.9.3 / 7.8.3

Test Results: Complies

**Measurement Data:**

| Carrier Frequency | Occupied Bandwidth (99% BW) |
|-------------------|-----------------------------|
| 2405 MHz          | 2.25 MHz                    |
| 2440 MHz          | 2.25 MHz                    |
| 2480 MHz          | 2.26 MHz                    |

Occupied Bandwidth is the same for all channels

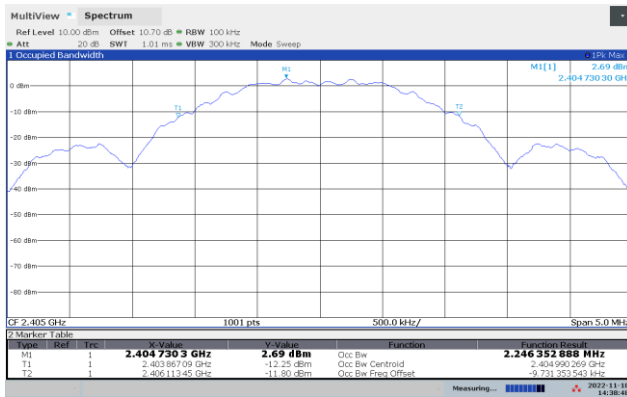
See attached plots.

**Requirements:**

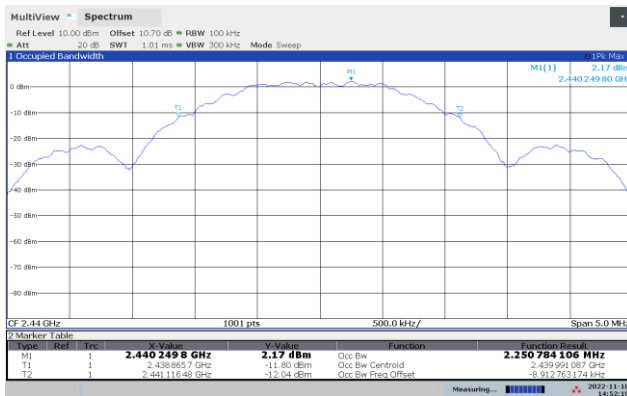
Frequency hopping systems in the 2400 - 2483.5 MHz band shall use at least 15 non-overlapping channels. No requirements for bandwidth for this frequency band.

No requirements for Digital Transmission Systems.

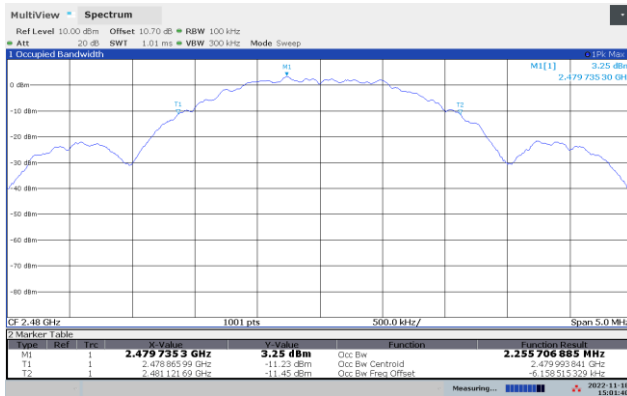
No requirement for 99% BW, reported for information only.



99 % Occupied BW, Ch2405 MHz



99 % Occupied BW, Ch2440 MHz



99 % Occupied BW, ch2480 MHz



### 3.2 DTS Bandwidth

FCC Part 15.247 (a)(2)

ISED Canada RSS-247 Issue 2, Clause 5.2 (a)

Measurement procedure: ANSI C63.10-2013 Clause 11.8

Test Results: Complies

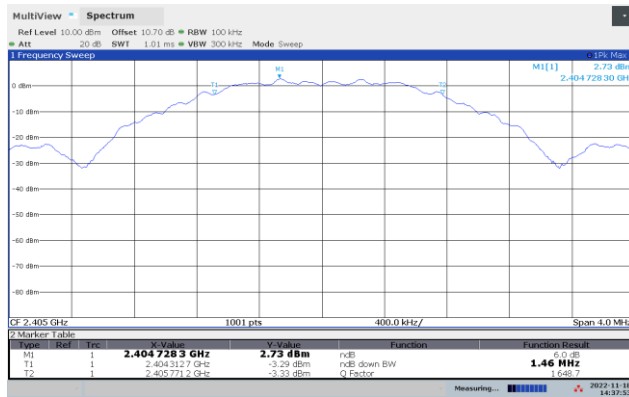
#### Measurement Data:

| Operating Mode | DTS Bandwidth (6 dB BW) |          |          |
|----------------|-------------------------|----------|----------|
|                | 2405 MHz                | 2440 MHz | 2480 MHz |
| Zigbee         | 1.46 MHz                | 1.53 MHz | 1.50 MHz |

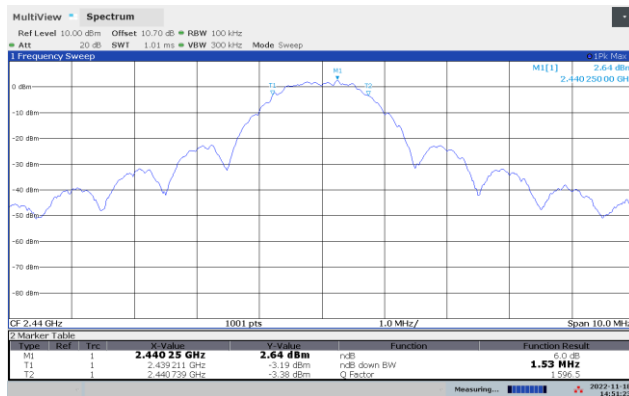
#### Requirements:

For Digital Transmission Systems in the 2400-2483.5 MHz band the minimum 6 dB bandwidth shall be at least 500 KHz.

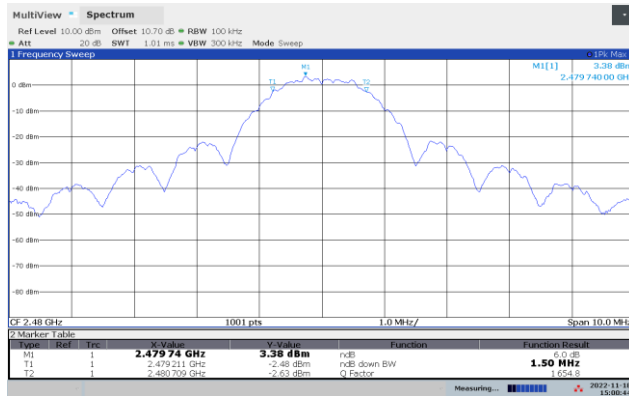
No requirements for Frequency Hopping Systems.



DTS BW, 2405 MHz



DTS BW, 2440 MHz



DTS BW, 2480 MHz

### 3.3 Peak Power Output

FCC Part 15.247 (b)

ISED Canada RSS-247 Issue 2, Clause 5.4

Measurement procedure: ANSI C63.10-2013 Clause 11.9.1.2

Test Results: Complies

Measurement Data:

| Carrier Frequency (MHz) | Modulation Type | Conducted Power (dBm) | Conducted Power (mW) | Field Strength (dBμV/m) | EIRP (mW) | Antenna gain (dBi) |
|-------------------------|-----------------|-----------------------|----------------------|-------------------------|-----------|--------------------|
| 2405                    | O-QPSK          | 5.4                   | 3.43                 | 102.5                   | 5.38      | 2.0                |
| 2440                    | O-QPSK          | 5.2                   | 3.29                 | 101.7                   | 4.41      | 1.3                |
| 2480                    | O-QPSK          | 5.9                   | 3.90                 | 102.7                   | 5.55      | 1.5                |

Output Power reported is Maximum Peak Power.

Radiated Power was calculated from measured Field Strength using the method described in FCC KDB 412172 D01.

Antenna Gain is less than 6 dBi.

See attached plots.

#### Requirements:

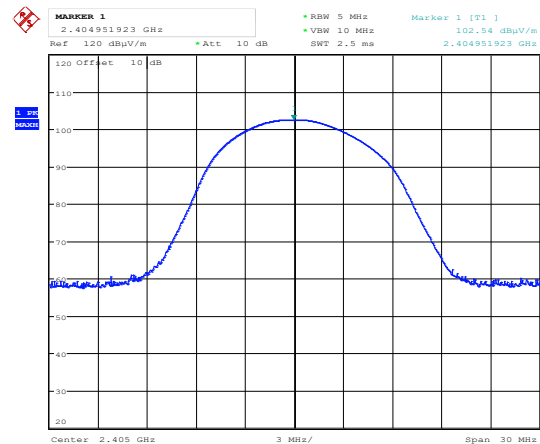
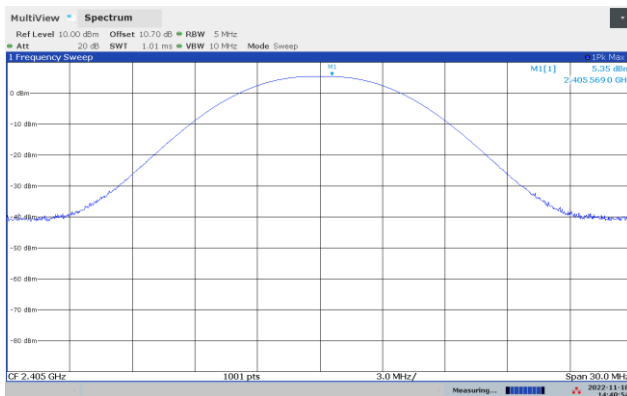
The maximum peak output power shall not exceed the following limits:

For frequency hopping systems employing at least 75 hopping channels: 1 Watt

For all other frequency hopping systems in the 2400 - 2483.5 MHz band: 0.125 Watts

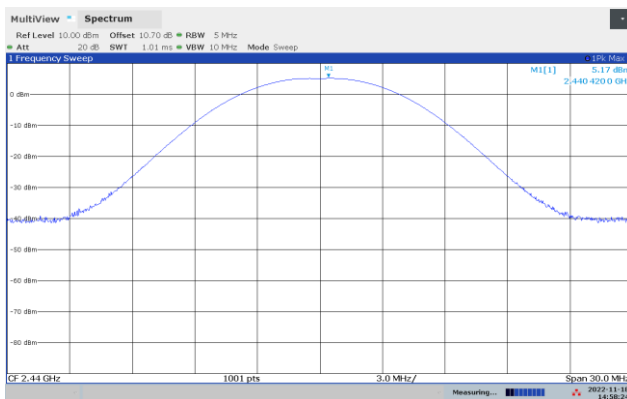
For Digital Transmission Systems in the 2400 - 2483.5 MHz band: 1 Watt

If transmitting antennas of directional gain greater than 6 dBi are used, the peak output power from the intentional radiator shall be reduced below the stated value above by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

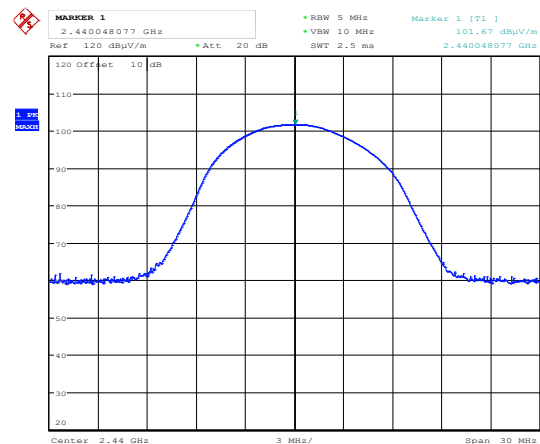


Date: 18.NOV.2022 09:08:10

### Peak Power, 2405 MHz, O-QPSK

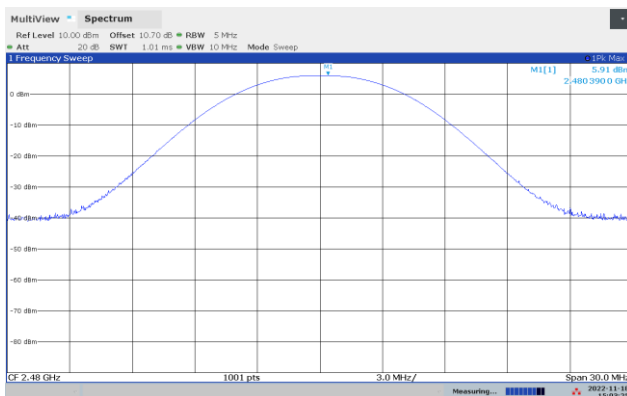


### Maximum Field Strength, 2405 MHz, O-QPSK, XZ plane, HP

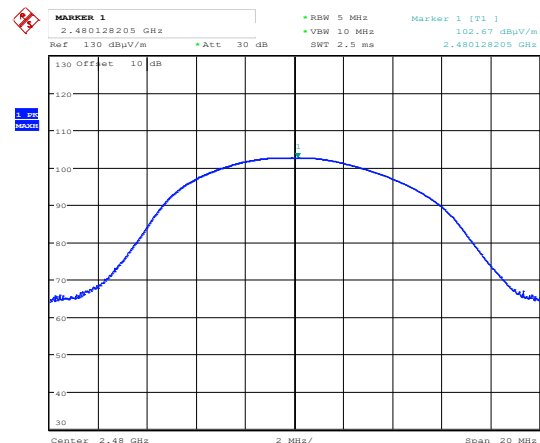


Date: 18.NOV.2022 09:15:00

### Peak Power, 2440 MHz, O-QPSK



### Maximum Field Strength, 2440 MHz, O-QPSK, XZ plane, HP



Date: 18.NOV.2022 09:18:22

### Peak Power, 2480 MHz, O-QPSK

### Maximum Field Strength, 2480 MHz, O-QPSK, XZ plane, HP

### 3.4 Conducted Emissions at Antenna Connector

FCC Part 15.247 (d)

ISED Canada RSS-247 Issue 2, Clause 5.5

Measurement procedure: ANSI C63.10-2013 Clause 11.11

Test Results: Complies

#### Measurement Data:

| Carrier Frequency | Highest Value (dBc) | Margin (dB) | Verdict |
|-------------------|---------------------|-------------|---------|
| 2405 MHz          | >40                 | > 20        | Pass    |
| 2440 MHz          | >40                 | > 20        | Pass    |
| 2480 MHz          | >40                 | > 20        | Pass    |

Measured with Peak Detector

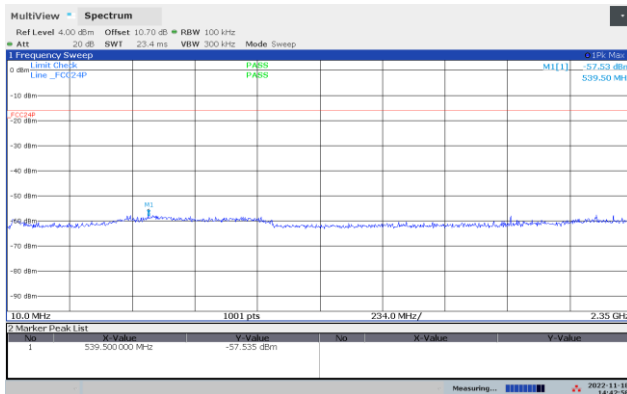
RF conducted power to 25 GHz: see attached plots.

#### Limit

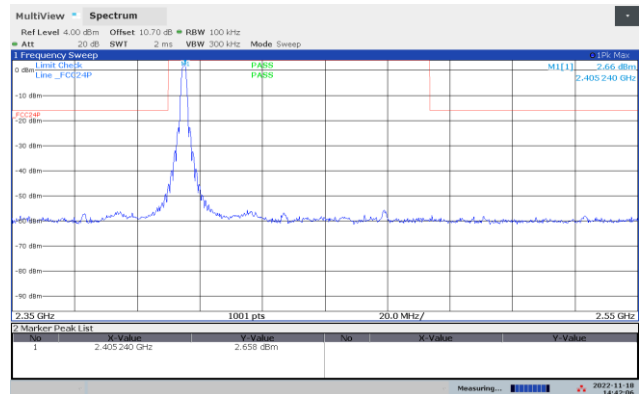
| Peak measurement                    | RMS averaging                       |
|-------------------------------------|-------------------------------------|
| 20 dBc or more in 100 kHz bandwidth | 30 dBc or more in 100 kHz bandwidth |

Detector type shall be the same as used for measuring Output Power.

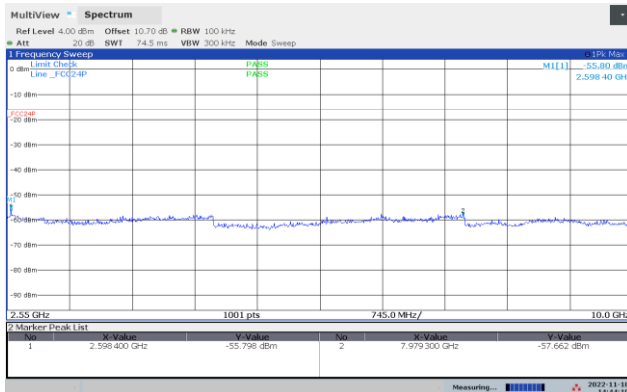
Attenuation below the general limits specified in part 15.209(a) is not required.



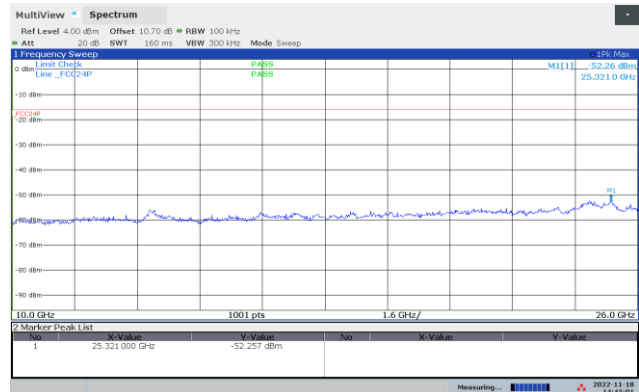
Conducted Emissions 10-2350MHz, 2405 MHz, O-QPSK



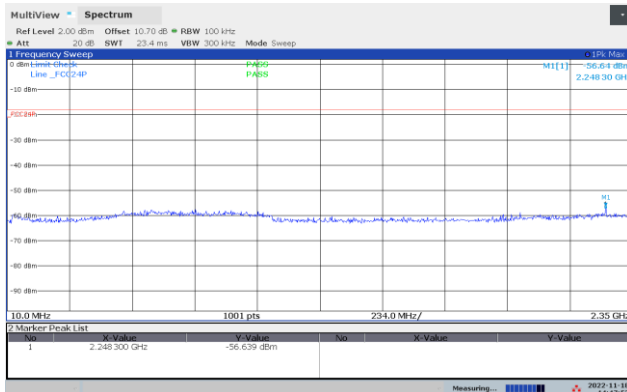
Conducted Emissions 2350-2550 MHz, 2405 MHz, O-QPSK



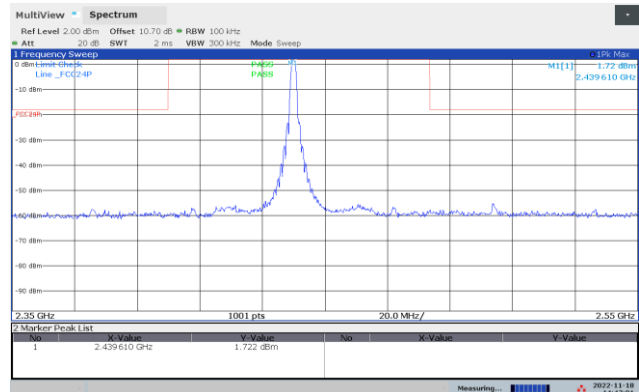
Conducted Emissions 2550-10000 MHz, 2405 MHz, O-QPSK



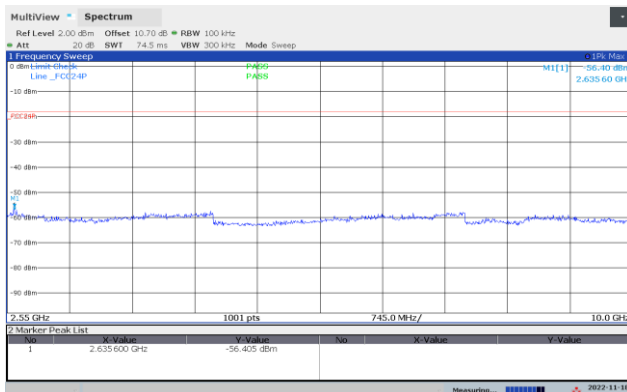
Conducted Emissions 10000-26000 MHz, 2405 MHz, O-QPSK



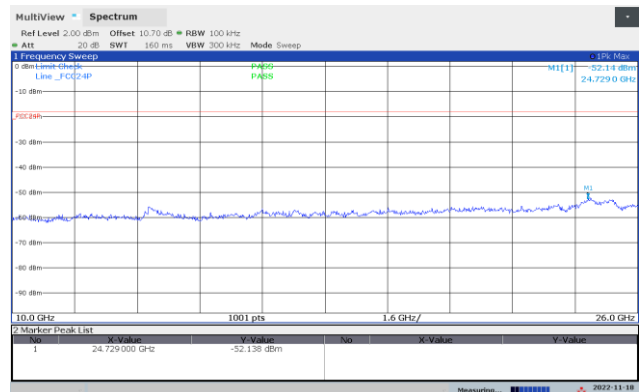
Conducted Emissions 10-2350MHz, 2440 MHz, O-QPSK



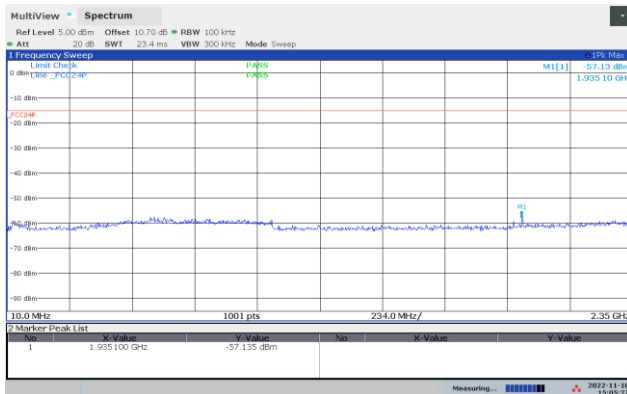
Conducted Emissions 2350-2550 MHz, 2440 MHz, O-QPSK



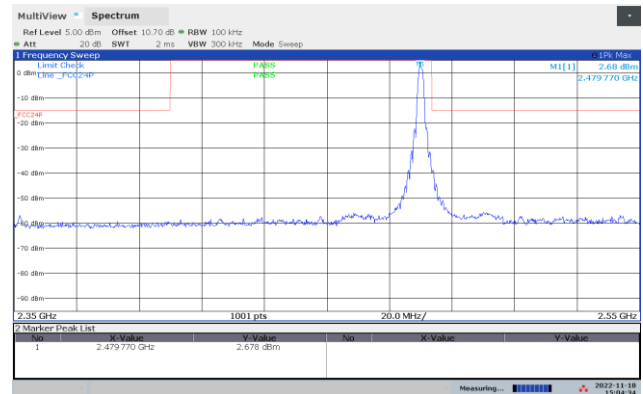
Conducted Emissions 2550-10000 MHz, 2440 MHz, O-QPSK



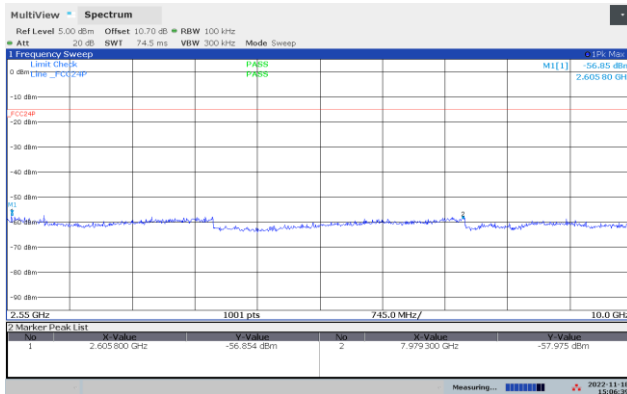
Conducted Emissions 10000-26000 MHz, 2440 MHz, O-QPSK



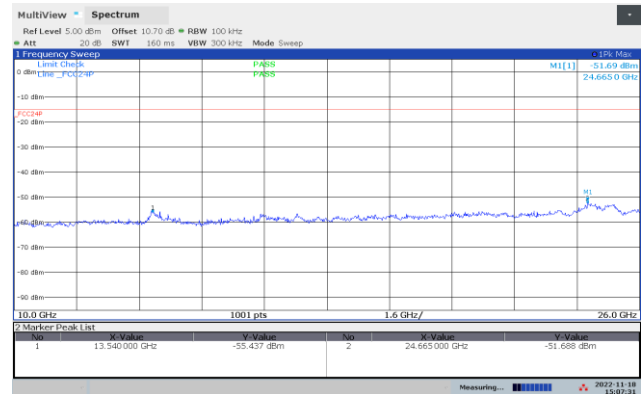
Conducted Emissions 10-2350MHz, 2480 MHz, O-QPSK



Conducted Emissions 2350-2550 MHz, 2480 MHz, O-QPSK



Conducted Emissions 2550-10000 MHz, 2480 MHz, O-QPSK



Conducted Emissions 10000-26000 MHz, 2480 MHz, O-QPSK

### 3.5 Restricted Bands of operation

Restricted Bands of operation for FCC and ISED are defined in FCC Part 15.205 and ISED RSS-GEN, Issue 5 clause 8.10.

Generally, no fundamentals are allowed in the restricted bands and all emissions must comply with the limits in FCC 15.209 or RSS-GEN, Issue 5, clause 8.9.

| FCC (MHz)                           | ISED Canada (MHz)  | FCC (GHz)                            | ISED Canada (GHz) |
|-------------------------------------|--------------------|--------------------------------------|-------------------|
| 0.090-0.110                         |                    | <b>0.96-1.24</b><br><b>1.3-1.427</b> | <b>0.96-1.427</b> |
| 0.495-0.505                         |                    | 1.435-1.6265                         |                   |
| 2.1735-2.1905                       |                    | 1.6455-1.6465                        |                   |
|                                     | <b>3.020-3.026</b> | 1.660-1.710                          |                   |
| 4.125-4.128                         |                    | 1.7188-1.7222                        |                   |
| 4.17725-4.17775                     |                    | 2.2-2.3                              |                   |
| 4.20725-4.20775                     |                    | 2.31-2.39                            |                   |
|                                     | <b>5.677-5.683</b> | 2.4835-2.5                           |                   |
| 6.215-6.218                         |                    | <b>2.69-2.9</b>                      | <b>2.655-2.9</b>  |
| 6.26775-6.26825                     |                    | 3.26-3.267                           |                   |
| 6.31175-6.31225                     |                    | 3.332-3.339                          |                   |
| 8.291-8.294                         |                    | 3.3458-3.358                         |                   |
| 8.362-8.366                         |                    | <b>3.6-4.4</b>                       | <b>3.5-4.4</b>    |
| 8.37625-8.38675                     |                    | 4.5-5.15                             |                   |
| 8.41425-8.41475                     |                    | 5.35-5.46                            |                   |
| 12.29-12.293                        |                    | 7.25-7.75                            |                   |
| 12.51975-12.52025                   |                    | 8.025-8.5                            |                   |
| 12.57675-12.57725                   |                    | 9.0-9.2                              |                   |
| 13.36-13.41                         |                    | 9.3-9.5                              |                   |
| 16.42-16.423                        |                    | 10.6-12.7                            |                   |
| 16.69475-16.69525                   |                    | 13.25-13.4                           |                   |
| 16.80425-16.80475                   |                    | 14.47-14.5                           |                   |
| 25.5-25.67                          |                    | 15.35-16.2                           |                   |
| 37.5-38.25                          |                    | 17.7-21.4                            |                   |
| 73-74.6                             |                    | 22.01-23.12                          |                   |
| 74.8-75.2                           |                    | 23.6-24.0                            |                   |
| <b>108-121.94</b><br><b>123-138</b> | <b>108-138</b>     | 31.2-31.8                            |                   |
| 149.9-150.05                        |                    | 36.43-36.5                           |                   |
| 156.52475-156.52525                 |                    | Above 38.6                           |                   |
| 156.7-156.9                         |                    |                                      |                   |
| 162.0125-167.17                     |                    |                                      |                   |
| 167.72-173.2                        |                    |                                      |                   |
| 240-285                             |                    |                                      |                   |
| 322-335.4                           |                    |                                      |                   |
| 399.9-410                           |                    |                                      |                   |
| 608-614                             |                    |                                      |                   |

Frequencies in **Bold** text are specific for FCC or ISED, all other frequencies are common.



### 3.6 Radiated Emissions, Band Edge

FCC Part 15.209 (a)

ISED Canada RSS-GEN Issue 5, Clause 7.3 / 8.9

Measurement procedure: ANSI C63.10-2013 Clause 11.12

Test Results: Complies

#### Measurement Data:

| Carrier Frequency and Data Rate | Band Edge Frequency | Measured Field Strength (dBμV/m) |                  | Limit (dBμV/m) |             | Margin (dB) |             |
|---------------------------------|---------------------|----------------------------------|------------------|----------------|-------------|-------------|-------------|
|                                 |                     | Peak Detector                    | Average Detector | Peak Det       | Average Det | Peak Det    | Average Det |
| 2405 MHz, O-QPSK                | 2390 MHz            | 55.36                            | 35.36            | 74             | 54          | 18.64       | 18.64       |
| 2480 MHz, O-QPSK                | 2483.5 MHz          | 71.05                            | 51.05            |                |             | 2.95        | 2.95        |

Average Detector values are measured with Peak Detector and corrected for Duty Cycle.

See attached plots.

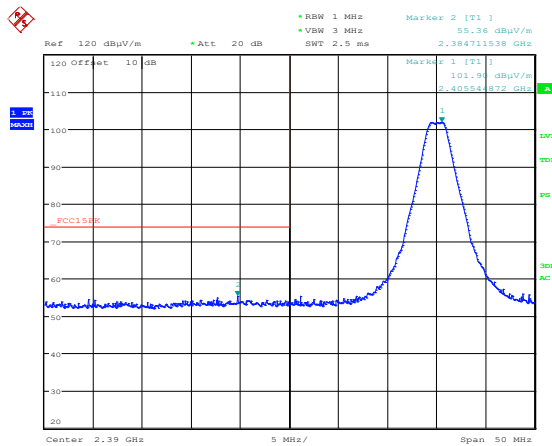
#### Duty Cycle Correction Factor Calculation:

Manufacturer data:

Duty Cycle = 6.624 %

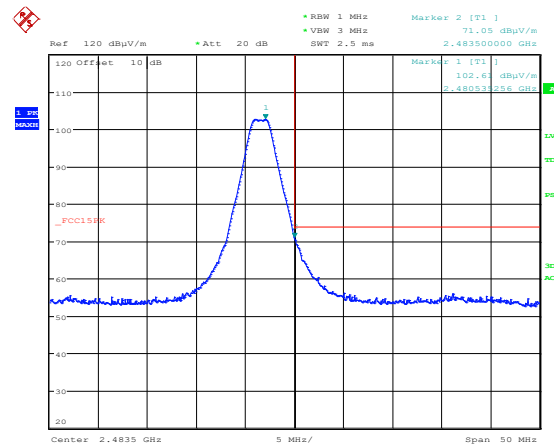
Duty Cycle Correction factor =  $-20 \times \log(0.06624) = 23.6$  dB

**Maximum Duty Cycle Correction Factor according to Para 15.35 (b): 20 dB**



Date: 18.NOV.2022 09:10:15

Lower Band Edge 2405 MHz, O-QPSK, Peak



Date: 18.NOV.2022 09:20:21

Upper Band Edge 2480 MHz, O-QPSK, Peak

### 3.8 Radiated Emission, 30 – 1000 MHz.

FCC Part 15.209 (a)

ISED Canada RSS-GEN Issue 5, Clause 7.3/8.9

Measurement procedure: ANSI C63.10-2013 Clause 11.12

Test Results: Complies

#### Measurement Data:

Detector: Peak (found frequencies were measured with Quasi-Peak Detector)

Measuring distance 3 m

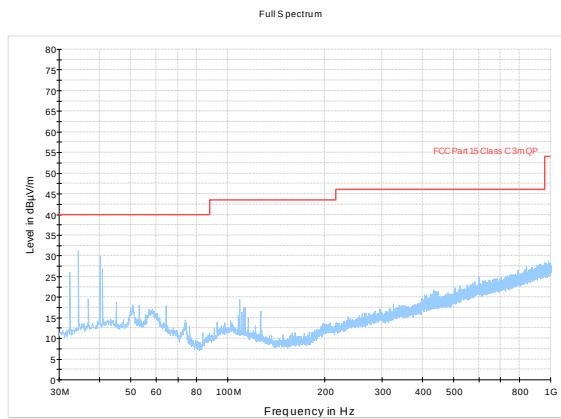
Measured in Zigbee test mode

| Measured Frequency (MHz) | Carrier Frequency (MHz) | Modulation | Measured Emission (dBµV/m) | Limit (dBµV/m) | Margin (dB) |
|--------------------------|-------------------------|------------|----------------------------|----------------|-------------|
| 30 – 88                  | 2440                    | O-QPSK     | /                          | 40.0           | /           |
| 88 – 216                 | 2440                    | O-QPSK     | /                          | 43.5           | /           |
| 216 – 960                | 2440                    | O-QPSK     | /                          | 46.0           | /           |
| 960 – 1000               | 2440                    | O-QPSK     | /                          | 54.0           | /           |

See attached plots

#### Requirements/Limit

| FCC            | Part 15.209 @ frequencies defined in §15.205                     |             |
|----------------|------------------------------------------------------------------|-------------|
| ISED           | RSS-GEN Issue 5, Clause 8.9 @ frequencies defined in clause 8.10 |             |
| Frequency      | Radiated emission limit @3 meters                                |             |
| 30 – 88 MHz    | 100 µV/m                                                         | 40.0 dBµV/m |
| 88 – 216 MHz   | 150 µV/m                                                         | 43.5 dBµV/m |
| 216 – 960 MHz  | 200 µV/m                                                         | 46.0 dBµV/m |
| 960 – 1000 MHz | 500 µV/m                                                         | 54.0 dBµV/m |
|                | Limits above are with Quasi Peak Detector                        |             |



Radiated Emissions 30 - 1000 MHz,

### 3.9 Radiated Emissions, 1-25 GHz

FCC Part 15.209 (a)

ISED Canada RSS-GEN Issue 5, Clause 7.3/8.9

Measurement procedure: ANSI C63.10-2013 Clause 11.12

Test Results: Complies

Measurement Data:

Measuring distance: 3m (1 – 18 GHz)

A pre-scan was performed above 18 GHz and no spurious emissions were detected.

Peak Detector, RBW=1 MHz

| Carrier freq. (MHz) | Measured Frequency (GHz) | Modulation | Measured Emission (dBμV/m) | Limit (dBμV/m) | Margin (dB) |
|---------------------|--------------------------|------------|----------------------------|----------------|-------------|
| 2405                | 7.215                    | O-QPSK     | 57.50                      | 74             | 16.50       |
| 2440                | 7.320                    | O-QPSK     | 58.42                      | 74             | 15.58       |
| 2480                | 7.440                    | O-QPSK     | 62.44                      | 74             | 11.56       |

Average Detector, RBW=1 MHz

| Carrier freq. (MHz) | Measured Frequency (GHz) | Modulation | Measured Emission (dBμV/m) | Limit (dBμV/m) | Margin (dB) |
|---------------------|--------------------------|------------|----------------------------|----------------|-------------|
| 2405                | 7.215                    | O-QPSK     | 37.50                      | 54             | 16.50       |
| 2440                | 7.320                    | O-QPSK     | 38.42                      | 54             | 15.58       |
| 2480                | 7.440                    | O-QPSK     | 42.44                      | 54             | 11.56       |

Maximum radiated spurious emissions are obtained in Horizontal polarization.

Duty Cycle Correction Factor Calculation:

Manufacturer data:

Duty Cycle = 6.624 %

Duty Cycle Correction factor =  $-20 \times \log(0.06624) = 23.6$  dB

Average Detector values are calculated from Peak values by Duty Cycle Correction Factor

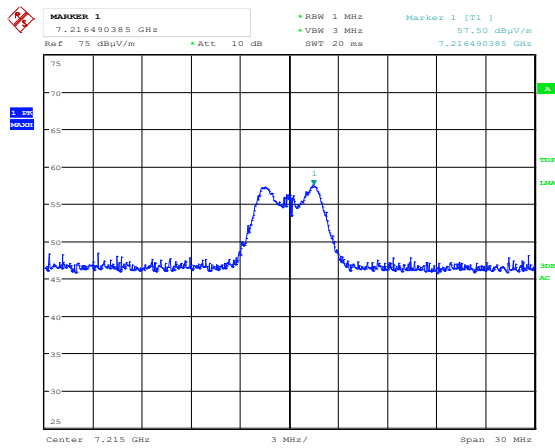
A Band Reject Filter was used for measurements from 1 GHz to 18 GHz

Antenna factor, amplifier gain and cable loss are included in spectrum analyzer "Transducer factor"

See plots

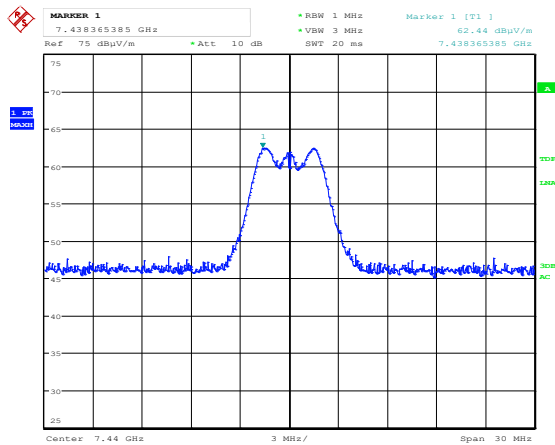
Requirements/Limit

| FCC        | Part 15.209 @ frequencies defined in §15.205                     |               |
|------------|------------------------------------------------------------------|---------------|
| ISED       | RSS-GEN Issue 5, clause 8.9 @ frequencies defined in clause 8.10 |               |
|            | Radiated emission limit @3 meters                                |               |
| Frequency  | Average Detector                                                 | Peak Detector |
| 1 – 26 GHz | 54.0 dBµV/m                                                      | 74.0 dBµV/m   |



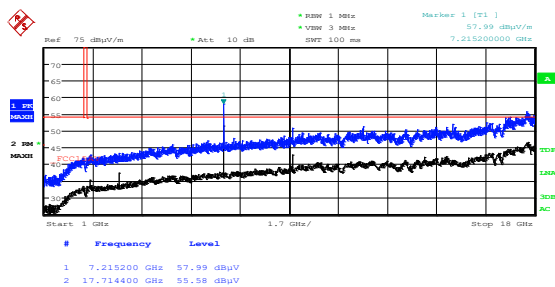
Date: 18.NOV.2022 10:02:27

### 3<sup>rd</sup> harmonic, ch2405 MHz, HP, PK



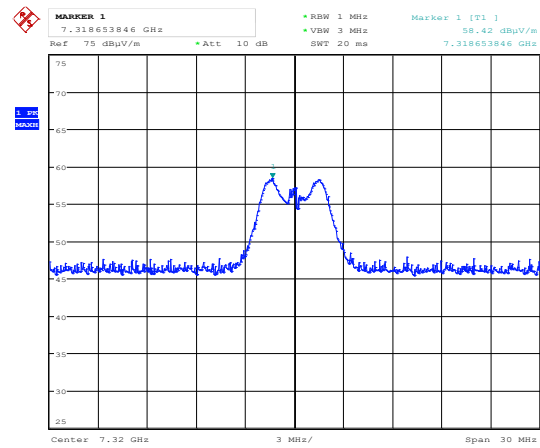
Date: 18.NOV.2022 09:40:26

### 3<sup>rd</sup> harmonic, ch2480 MHz, HP, PK



Date: 18.NOV.2022 09:58:54

### Radiated Emissions 1 - 18 GHz, 2405 MHz, HP



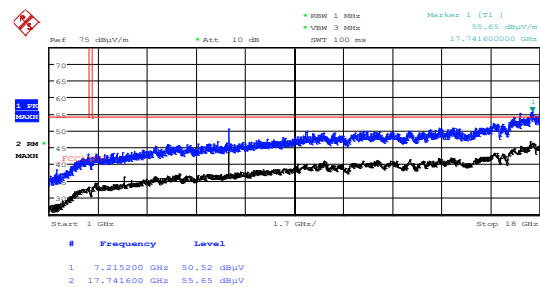
Date: 18.NOV.2022 09:51:39

### 3<sup>rd</sup> harmonic, ch2440 MHz, HP, PK



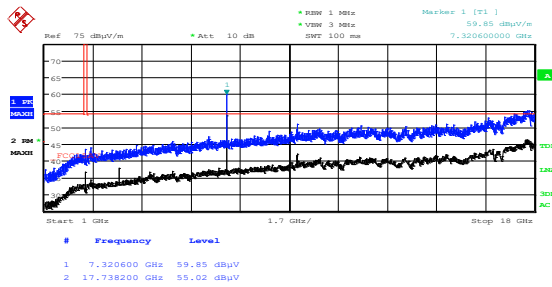
Date: 18.NOV.2022 09:40:26

### 3<sup>rd</sup> harmonic, ch2480 MHz, HP, PK



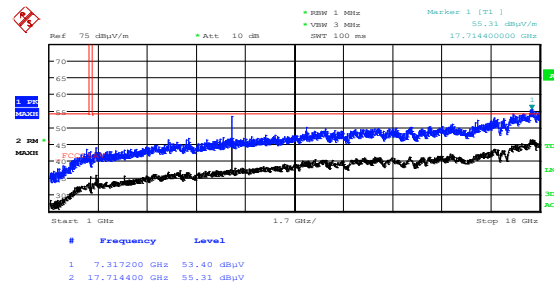
Date: 18.NOV.2022 09:56:42

### Radiated Emissions 1 - 18 GHz, 2405 MHz, VP



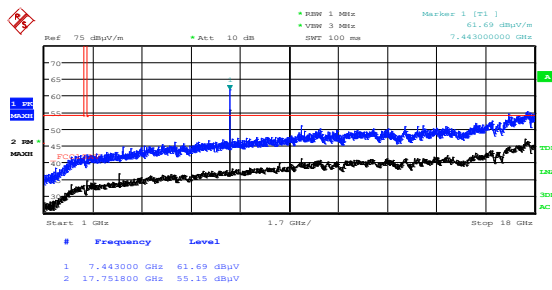
Date: 18.NOV.2022 09:48:40

### Radiated Emissions 1 - 18 GHz, 2440 MHz, HP



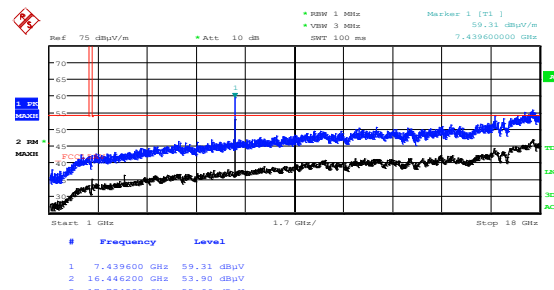
Date: 18.NOV.2022 09:46:29

### Radiated Emissions 1 - 18 GHz, 2440 MHz, VP



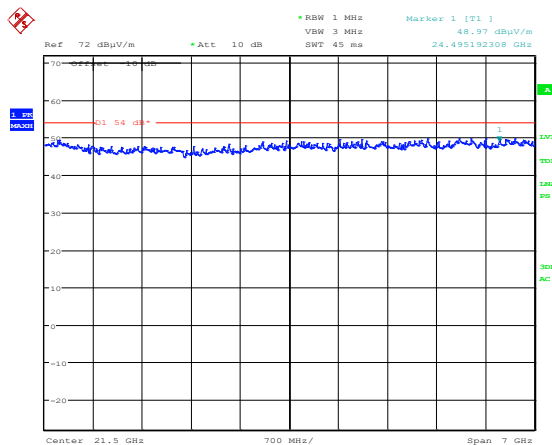
Date: 18.NOV.2022 09:33:25

### Radiated Emissions 1 - 18 GHz, 2480 MHz,, HP



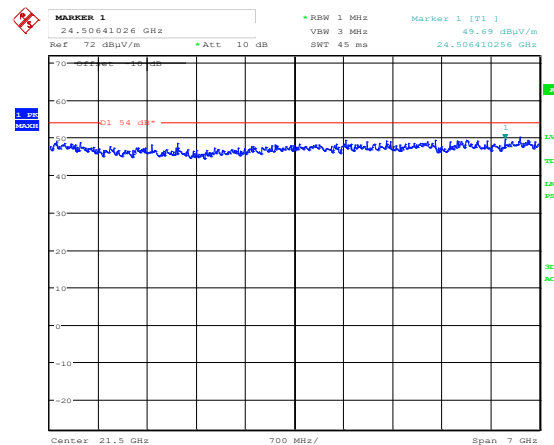
Date: 18.NOV.2022 09:31:36

### Radiated Emissions 1 - 18 GHz, 2480 MHz, , VP



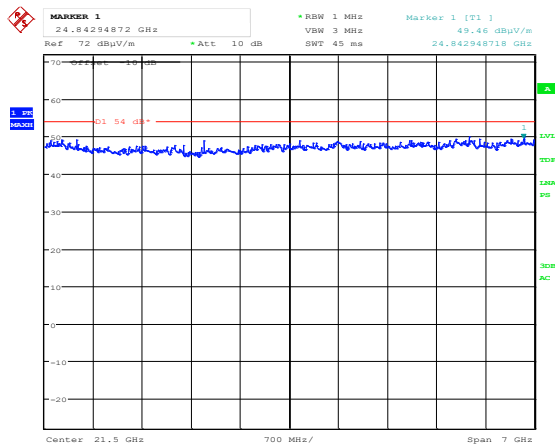
Date: 18.NOV.2022 10:38:11

### Radiated Emissions 18 - 25 GHz, 2405 MHz, O-QPSK, HP, pk @1m



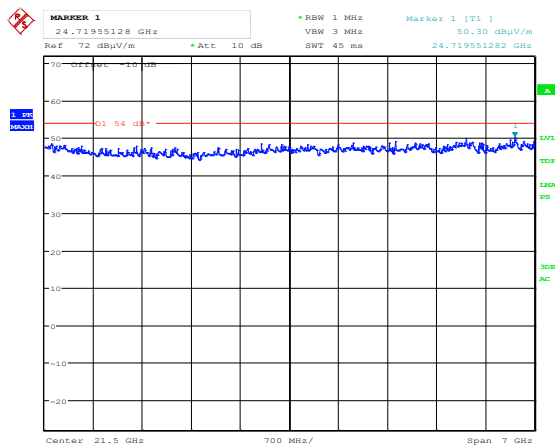
Date: 18.NOV.2022 10:38:28

### Radiated Emissions 18 - 25 GHz, 2405 MHz, O-QPSK, VP, pk @1m



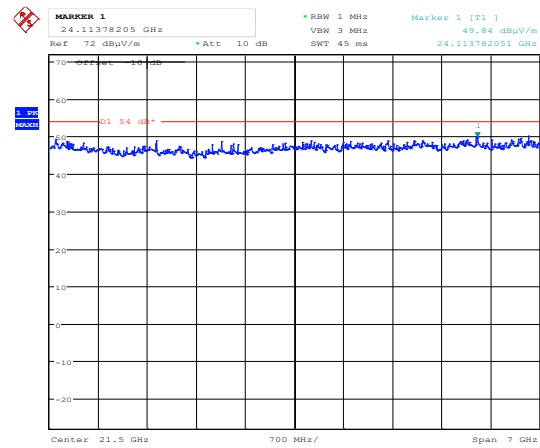
Date: 18.NOV.2022 10:40:34

### Radiated Emissions 18 - 25 GHz, 2440 MHz, O-QPSK, HP, pk @1m



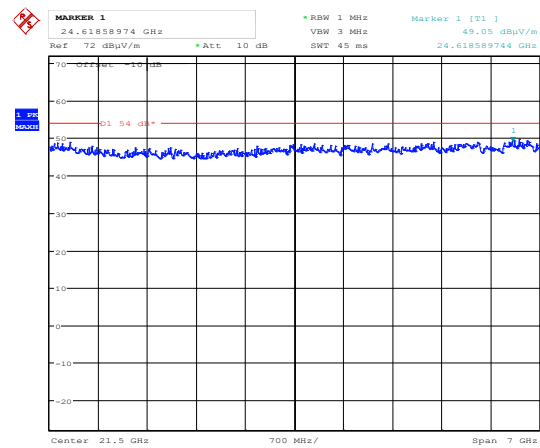
Date: 18.NOV.2022 10:41:33

### Radiated Emissions 18 - 25 GHz, 2480 MHz, O-QPSK, HP, pk @1m



Date: 18.NOV.2022 10:40:53

### Radiated Emissions 18 - 25 GHz, 2440 MHz, O-QPSK, VP, pk @1m



Date: 18.NOV.2022 10:41:45

### Radiated Emissions 18 - 25 GHz, 2480 MHz, O-QPSK, VP, pk @1m



### 3.10 Power Spectral Density (PSD)

FCC part 15.247(d)

ISED Canada RSS-247 Issue 2, Clause 5.2 (2)

Measurement procedure: ANSI C63.10-2013 Clause 11.10

Test Results: Complies

#### Measurement Data:

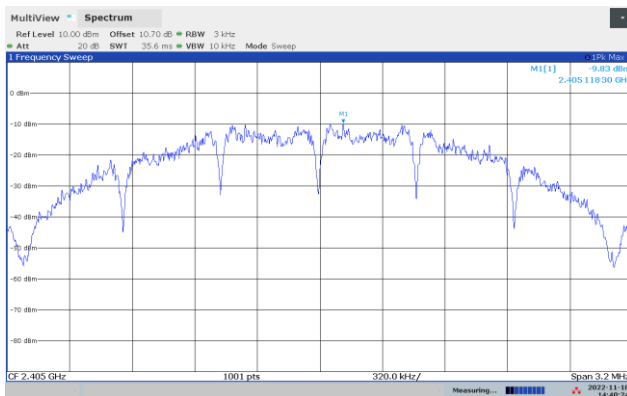
The measurement procedure PKPSD described in ANSI C63.10-2013 was used.

| Modulation Type | Measured Power Spectral Density (dBm/3kHz) |          |          |
|-----------------|--------------------------------------------|----------|----------|
|                 | 2405 MHz                                   | 2440 MHz | 2480 MHz |
| O-QPSK          | -9.83                                      | -8.39    | -8.85    |

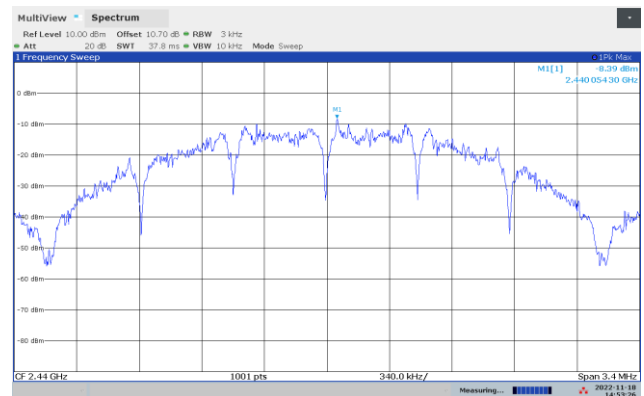
#### Requirements:

The Power Spectral Density of a Digital Transmission System shall be no greater than +8 dBm in any 3 kHz band

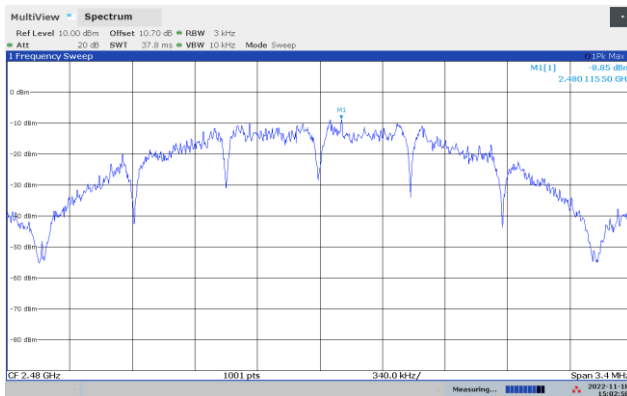
No requirements for Frequency Hopping Systems.



PSD, 2405 MHz, O-QPSK



PSD, 2440 MHz, O-QPSK



PSD, 2480 MHz, O-QPSK

## 4 Measurement Uncertainty

| Measurement Uncertainty Values   |           |                |
|----------------------------------|-----------|----------------|
| Test Item                        |           | Uncertainty    |
| Output Power                     |           | ±0.5 dB        |
| Power Spectral Density           |           | ±0.5 dB        |
| Out of Band Emissions, Conducted | < 3.6 GHz | ±0.6 dB        |
|                                  | > 3.6 GHz | ±0.9 dB        |
| Spurious Emissions, Radiated     | < 1 GHz   | ±2.5 dB        |
|                                  | > 1 GHz   | ±2.2 dB        |
| Emission Bandwidth               |           | ±4 %           |
| Power Line Conducted Emissions   |           | +2.9 / -4.1 dB |
| Spectrum Mask Measurements       | Frequency | ±5 %           |
|                                  | Amplitude | ±1.0 dB        |
| Frequency Error                  |           | ±0.6 ppm       |
| Temperature Uncertainty          |           | ±1 °C          |

All uncertainty values are expanded standard uncertainty to give a confidence level of 95%, based on coverage factor k=2

## 5 LIST OF TEST EQUIPMENT

To facilitate inclusion on each page of the test equipment used for related tests, each item of test equipment and ancillaries are identified (numbered) by the Test Laboratory.

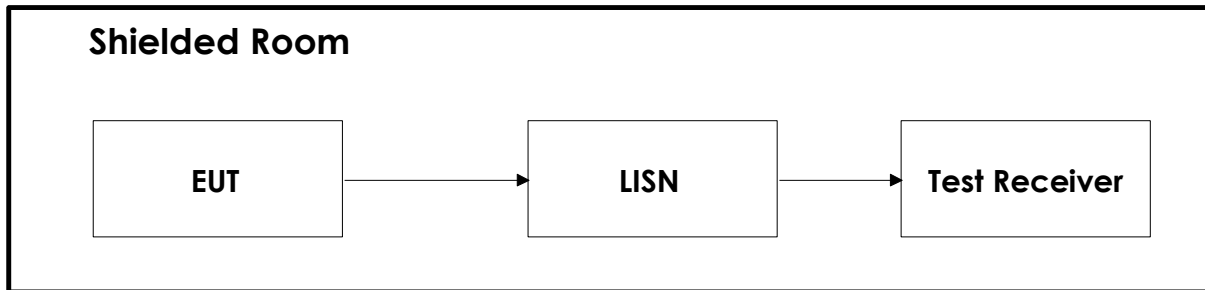
| No. | Model number  | Description                 | Manufacturer       | Ref. no. | Cal. date | Cal. Due |
|-----|---------------|-----------------------------|--------------------|----------|-----------|----------|
| 1.  | ESU 40        | EMI Receiver                | Rohde & Schwarz    | LR 1639  | 2022-01   | 2023-01  |
| 2.  | FSU26         | Spectrum Analyzer           | Rohde & Schwarz    | LR 1504  | 2022-01   | 2023-01  |
| 3.  | 6810.17B      | Attenuator                  | Suhner             | LR 1668  | COU       |          |
| 4.  | NO324415      | Band Reject Filter          | Microwave Circuits | LR 1760  | COU       |          |
| 5.  | VULB9163      | Bilog                       | Schwarzbeck        | LR 1616  | 2020-05   | 2023-05  |
| 6.  | 316           | Preamplifier                | Sonoma Inst.       | LR 1686  | 2022-08   | 2023-08  |
| 7.  | 3117-PA       | Horn Antenna +PreAmp        | EMCO               | LR 1717  | 2017-08   | 2023-08  |
| 8.  | 8449A         | Pre-amplifier               | Hewlett Packard    | LR 1322  | 2022-08   | 2023-08  |
| 9.  | 3115          | Double Ridged, Horn antenna | EMCO               | LR 1226  | N/A       |          |
| 10  | 638           | Antenna Horn                | Narda              | LR 1480  | N/A       |          |
| 11  | 4768-10       | Attenuator                  | Narda              | LR 1670  | COU       |          |
| 12  | Model 87V     | Multimeter                  | Fluke              | LR 1599  | 2021-01   | 2023-01  |
| 13  | ST18/SMA/N/36 | RF Cable                    | Suhner             | LR 1627  | COU       |          |

The software listed below has been used for one or more tests.

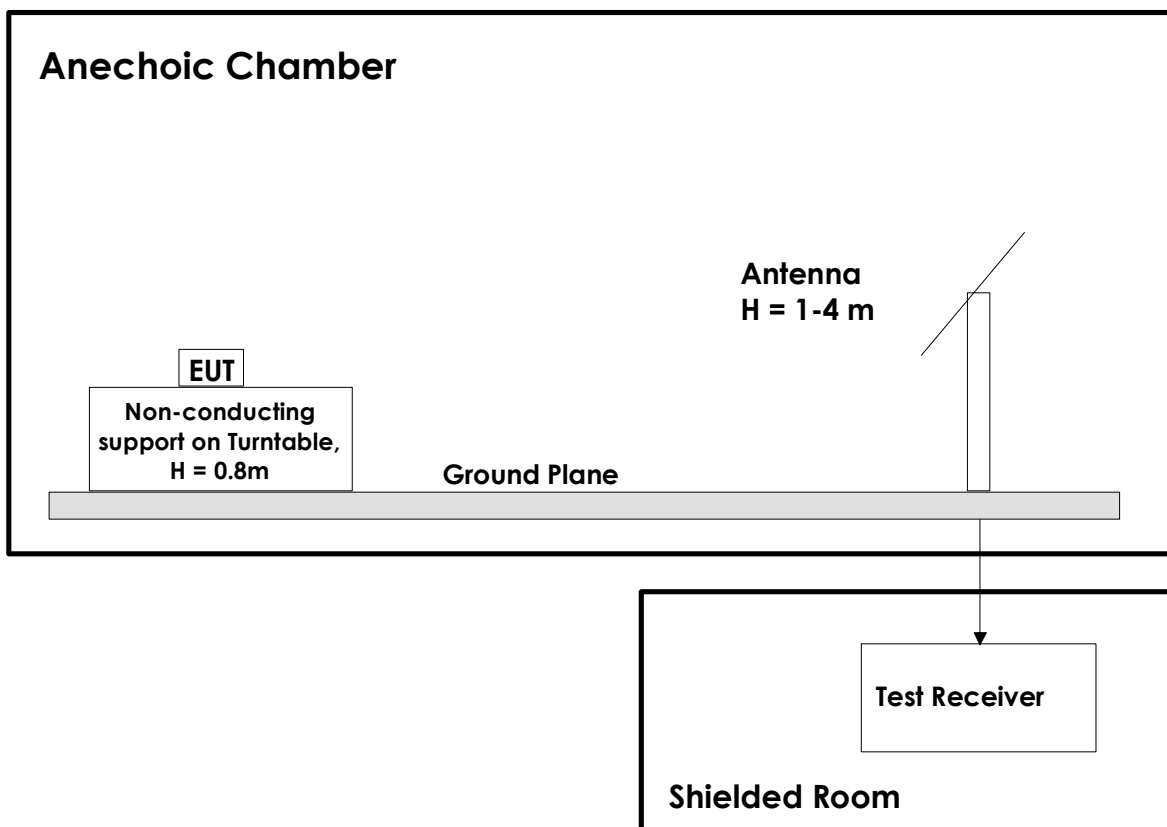
| No. | Manufacturer    | Name   | Version  | Comment                                    |
|-----|-----------------|--------|----------|--------------------------------------------|
| 1   | Rohde & Schwarz | EMC32  | 10.30.10 | Power Line Conducted test software         |
| 2   | Rohde & Schwarz | EMC32  | 10.30.10 | Radiated Emission test software            |
| 3   | Nemko AS        | RSPlot | 1.0.8.0  | Screen capture from R&S Spectrum Analyzers |
|     |                 |        |          |                                            |

## 6 BLOCK DIAGRAM

### 6.1 Power Line Conducted Emission



### 6.2 Test Site Radiated Emission



This test setup is used for all radiated emissions tests. For frequencies below 30 MHz the measuring distance is 10m, for all other frequencies it is 3m or 1m. Emissions above 1 GHz are measured with a Spectrum Analyzer and Horn Antenna. For measurements above 18 GHz the test receiver is moved inside the anechoic chamber and located next to the antenna to minimize the cable loss. All measurements at 1GHz and above were performed with turntable height 1.5m and with the ground plane covered by absorbers. A pre-amplifier is used for all measurements above 30 MHz, and High-Pass or Band-Pass filter is used for all harmonics.