

# Test Report

|                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Product</b>                                                                                                                                                                                                                                                                                                                                                                                                         | Telematics unit for mounting on forklifts                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| <b>Name and address of the applicant</b>                                                                                                                                                                                                                                                                                                                                                                               | Toyota Material Handling Manufacturing Sweden AB<br>Svarvargatan 8<br>SE-59581 Mjölby, Sweden                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| <b>Name and address of the manufacturer</b>                                                                                                                                                                                                                                                                                                                                                                            | Toyota Material Handling Manufacturing Sweden AB<br>Svarvargatan 8<br>SE-59581 Mjölby, Sweden                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| <b>Model</b>                                                                                                                                                                                                                                                                                                                                                                                                           | DHU4                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| <b>Rating</b>                                                                                                                                                                                                                                                                                                                                                                                                          | External DC supply (12-48 V <sub>DC</sub> )                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| <b>Trademark</b>                                                                                                                                                                                                                                                                                                                                                                                                       | TOYOTA                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| <b>Serial number</b>                                                                                                                                                                                                                                                                                                                                                                                                   | 202205REVBZ02404                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| <b>Additional information</b>                                                                                                                                                                                                                                                                                                                                                                                          | WiFi, BT Classic, BLE                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| <b>Tested according to</b>                                                                                                                                                                                                                                                                                                                                                                                             | <b>Parts of FCC Part 15.247</b><br>Digital Transmission Systems<br><b>Parts of ISED Canada RSS-247, Issue 2</b><br>Digital Transmission Systems (DTSS), Frequency Hopping Systems (FHSs) and<br>Licence-Exempt Local Area Network (LE-LAN) Devices                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| <b>Order number</b>                                                                                                                                                                                                                                                                                                                                                                                                    | 433049                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| <b>Tested in period</b>                                                                                                                                                                                                                                                                                                                                                                                                | 2022-05-23 to 2022-05-24                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| <b>Issue date</b>                                                                                                                                                                                                                                                                                                                                                                                                      | 2022-06-08                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| <b>Name and address of the testing laboratory</b>                                                                                                                                                                                                                                                                                                                                                                      | <div style="display: flex; justify-content: space-between; align-items: center;"> <div style="text-align: center;"> <br/> Instituttveien 6<br/>Kjeller, Norway<br/>www.nemko.com </div> <div style="text-align: center;"> CAB Number:<br/>FCC: NO0001<br/>ISED: NO0470 </div> <div style="text-align: center;"> <br/>  </div> </div> <p style="text-align: center; color: red;">An accredited technical test executed under the Norwegian accreditation scheme</p> |
| <div style="display: flex; justify-content: space-around; align-items: center;"> <div style="text-align: center;"> <br/> Prepared by [Frode Sveisen] </div> <div style="text-align: center;"> <br/> Approved by [G.Suhanthakumar] </div> </div> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
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## Revision history

| Revision | Date       | Comment       | Sign |
|----------|------------|---------------|------|
| 00       | 2022-06-08 | First edition | FS   |
|          |            |               |      |



### 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                             | Toyota                                                                                                                                                                                                                                                                                                                       |
| Model/version                    | DHU4                                                                                                                                                                                                                                                                                                                         |
| FCC ID                           | 2A24D-DHU4                                                                                                                                                                                                                                                                                                                   |
| ISED ID                          | 27803-DHU4                                                                                                                                                                                                                                                                                                                   |
| Serial number                    | 202205REVBZ02404                                                                                                                                                                                                                                                                                                             |
| Hardware identity and/or version | BZ1                                                                                                                                                                                                                                                                                                                          |
| Software identity and/or version | dv_b1_2021-05-05                                                                                                                                                                                                                                                                                                             |
| Frequency Range                  | 2412 – 2462 MHz                                                                                                                                                                                                                                                                                                              |
| Number of Channels               | 11 (7 channels for HT40)                                                                                                                                                                                                                                                                                                     |
| Operating Modes                  | 802.11 b/g/n (only 20 MHz Mode)                                                                                                                                                                                                                                                                                              |
| Type of Modulation               | DSSS / OFDM                                                                                                                                                                                                                                                                                                                  |
| Conducted Output Power           | 802.11b: 0.0383 W<br>802.11g: 0.0246 W<br>802.11n HT20: 0.0249 W<br>802.11n HT40: 0.0191 W                                                                                                                                                                                                                                   |
| Antenna Connector                | Quad MiniFakra                                                                                                                                                                                                                                                                                                               |
| Antenna Type                     | Smarteq SmartDisc Combi (4-in-1 antenna, 2xLTE, GNSS, WiFi/BT/BLE)<br>P/N: 550237 (tested with 200mm cable, longer cables may also be used)<br><br>Antenna element LTE1: Rx/Tx<br>Antenna element LTE2: Rx Only<br>Antenna element WiFi/BT: Rx/Tx 2.4GHz WiFi/BT/BLE and 5GHz WiFi<br>Antenna element GNSS: Rx Only GNSS/GPS |
| Antenna Diversity Supported      | Not for WiFi                                                                                                                                                                                                                                                                                                                 |
| Smart Antennas Supported         | No                                                                                                                                                                                                                                                                                                                           |
| Power Source                     | External DC Supply (12-48V <sub>DC</sub> , supplied through MX23 connector)                                                                                                                                                                                                                                                  |
| Interfaces                       | MX23 Connector<br>HSD Connector (100TX Ethernet)                                                                                                                                                                                                                                                                             |

### Description of Test Item

The EUT is a telematics unit with radio modules for BT/BLE/WiFi and Mobile (GSM/WCDMA/LTE). Both radio modules are certified radio modules. The EUT also contains a GPS receiver.

This test report covers verification tests after change of WiFi Module from FC20-Q73 to FC20-Q93.

## 1.2 Normal test conditions

|                      |                                                    |
|----------------------|----------------------------------------------------|
| Temperature:         | 20 - 24 °C                                         |
| Relative humidity:   | 20 - 50 %                                          |
| Normal test voltage: | 24V DC (2x 12V lead acid batteries, Fiamm FG20451) |

The EUT was powered from two fully charged batteries during all tests.

The values are the limit registered during the test period.

## 1.3 Test Engineer(s)

Frode Sveinsen

## 1.4 Antenna Requirement

|                                                          |                                         |                             |
|----------------------------------------------------------|-----------------------------------------|-----------------------------|
| Does the EUT have detachable antenna(s)?                 | <input checked="" type="checkbox"/> YES | <input type="checkbox"/> NO |
| If detachable, is the antenna connector(s) non-standard? | <input checked="" type="checkbox"/> YES | <input type="checkbox"/> NO |
| Antenna Connector: Quad MiniFakra                        |                                         |                             |

Requirement: FCC 15.203, 15.204

## 1.5 EUT Operating Modes

|                                |                                                                                                                                                                        |
|--------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Description of operating modes | Radiated Emissions and Power Line Conducted Emissions were performed with the EUT set to transmit at the channel with the highest output power as worst-case scenario. |
|--------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

## 1.6 Radio Modules

| Data for radio modules |          |                                                                           |                                                          |
|------------------------|----------|---------------------------------------------------------------------------|----------------------------------------------------------|
| Manufacturer           | Model No | Identification                                                            | Technology                                               |
| Quectel                | FC20     | FCC ID: XMR201703FC20<br>IC: 10224A-201703FC20<br>P/N: FC20-Q93           | BT Classic<br>BT Low Energy<br>WiFi 2.4 GHz<br>WiFi 5GHz |
| Quectel                | EG25     | FCC ID: XMR201903EG25G<br>IC: 10224A-201903EG25G<br>P/N: EG25GGB-256-SGNS | GSM<br>WCDMA<br>LTE                                      |

## 1.7 Power Levels

| Operating Mode | Bitrate | Channels | Power Setting |
|----------------|---------|----------|---------------|
| 802.11b        | 1M      | 1 to 11  | 18            |
|                | 11M     | 1 to 11  | 18            |
| 802.11g        | 6M      | 1 to 10  | 17            |
|                | 6M      | 11       | 16*           |
|                | 54M     | 1 to 9   | 15            |
|                | 54M     | 10       | 11*           |
|                | 54M     | 11       | 10*           |
| 802.11n HT20   | MCS0    | 1 to 11  | 16            |
|                | MCS7    | 1 to 9   | 15            |
|                | MCS7    | 10       | 12*           |
|                | MCS7    | 11       | 10*           |
| 802.11n HT40   | MCS0    | 3 to 8   | 15            |
|                | MCS0    | 9        | 15*           |
|                | MCS7    | 3 to 8   | 14            |
|                | MCS7    | 9        | 10*           |

Power levels were as shown above.

Levels with red text are reduced from module certification, all other levels are the default values.

## 1.8 Comments

All ports were populated during spurious emission measurements.

This test report covers only selected tests, all other tests are covered by the original Test Reports.

## 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 ISSED 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 performed in a semi-anechoic chamber at measuring distances of 3m.

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

|                                                                |                                                     |
|----------------------------------------------------------------|-----------------------------------------------------|
| <input type="checkbox"/> New Submission                        | <input checked="" type="checkbox"/> Production Unit |
| <input checked="" type="checkbox"/> Class II Permissive Change | <input type="checkbox"/> Pre-production Unit        |
| DTS      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   |
|-------------------------------|-------------------------------------|-------------------------------------------------|-------------------------------------------|----------|
| Antenna Requirement           | 15.203                              | 6.8 (RSS-GEN)                                   | 5.8                                       | Complies |
| Peak Power Output             | 15.247(b)                           | 5.4 (RSS-247)                                   | 11.9.1.1                                  | 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 |

## 3 TEST RESULTS

### 3.1 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 | Field Strength, dBμV/m @3m |         |            |         |           |           |           |           |
|-------------------|----------------------------|---------|------------|---------|-----------|-----------|-----------|-----------|
|                   | 802.11b 1M                 | 802.11b | 802.11g 6M | 802.11g | 802.11n   | 802.11n   | 802.11n   | 802.11n   |
|                   | 1M                         | 11M     | 6M         | 54M     | HT20 MCS0 | HT20 MCS7 | HT40 MCS0 | HT40 MCS7 |
| 2412 MHz          |                            | 110.1   | 108.4      | 105.1   | 107.1     | 104.5     |           |           |
| 2422 MHz          |                            |         |            |         |           |           | 105.6     | 101.9     |
| 2447 MHz          |                            |         |            |         |           |           | 105.5     | 100.8     |
| 2452 MHz          |                            |         |            | 108.6   |           | 107.7     | 103.8     | 97.6      |
| 2457 MHz          |                            |         |            | 105.3   |           | 103.6     |           |           |
| 2462 MHz          |                            | 110.1   | 110.1      | 102.4   | 109.6     | 101.5     |           |           |
| Carrier Frequency | Peak EIRP, dBm             |         |            |         |           |           |           |           |
|                   | 802.11b 1M                 | 802.11b | 802.11g 6M | 802.11g | 802.11n   | 802.11n   | 802.11n   | 802.11n   |
|                   | 1M                         | 11M     | 6M         | 54M     | HT20 MCS0 | HT20 MCS7 | HT40 MCS0 | HT40 MCS7 |
| 2412 MHz          |                            | 14.9    | 13.1       | 9.9     | 11.9      | 9.3       |           |           |
| 2422 MHz          |                            |         |            |         |           |           | 10.4      | 6.7       |
| 2447 MHz          |                            |         |            |         |           |           | 10.3      | 5.6       |
| 2452 MHz          |                            |         |            | 13.3    |           | 12.5      | 8.6       | 2.4       |
| 2457 MHz          |                            |         |            | 10.1    |           | 8.4       |           |           |
| 2462 MHz          |                            | 14.8    | 14.8       | 7.2     | 14.4      | 6.3       |           |           |

Output Power reported is Maximum Average Power measured radiated.

The Integrated Band Power Method with RMS detector and Trace Averaging (SA1) was used, Ref ANSI C63.10-2013.

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

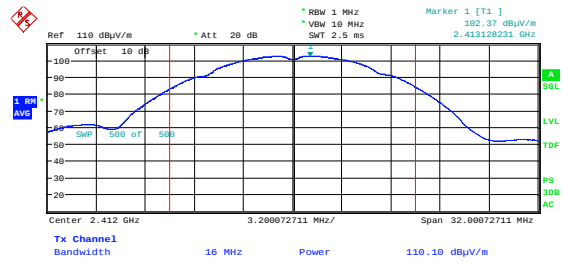
See attached plots.

#### Requirements:

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

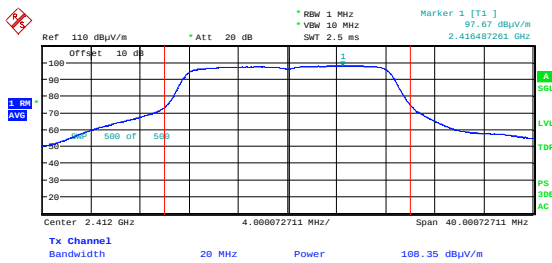
For Digital Transmission Systems in the 2400 - 2483.5 MHz band: 1 Watt (30 dBm)

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.



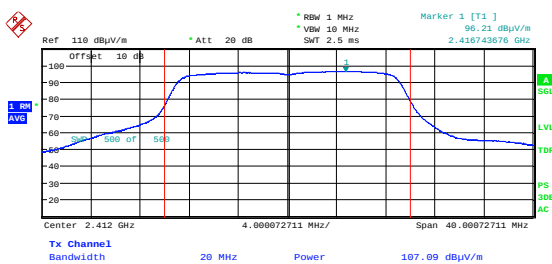
Date: 23.MAY.2022 15:17:28

#### Maximum Field Strength, 2412 MHz, 802.11b 11M



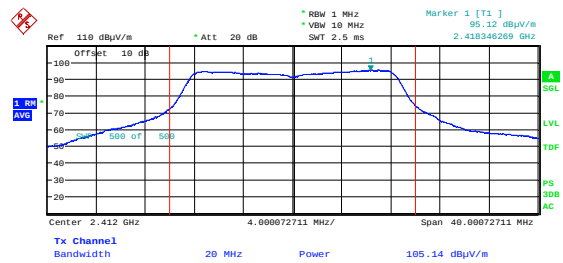
Date: 23.MAY.2022 15:02:29

#### Maximum Field Strength, 2412 MHz, 802.11g 6M



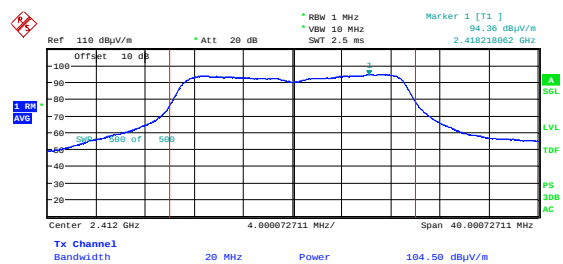
Date: 23.MAY.2022 15:13:00

#### Maximum Field Strength, 2412 MHz, 802.11n HT20 MCS0



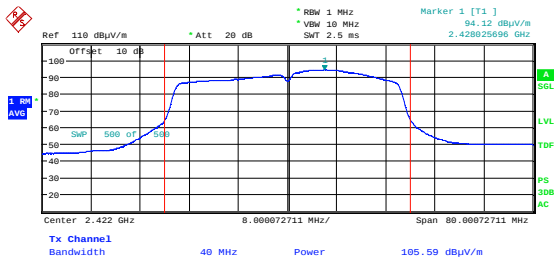
Date: 23.MAY.2022 14:59:05

#### Maximum Field Strength, 2412 MHz, 802.11g 54M



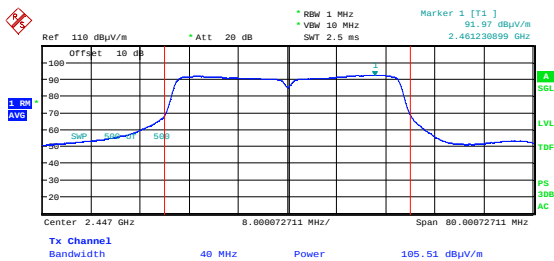
Date: 23.MAY.2022 15:09:44

#### Maximum Field Strength, 2412 MHz, 802.11n HT20 MCS7



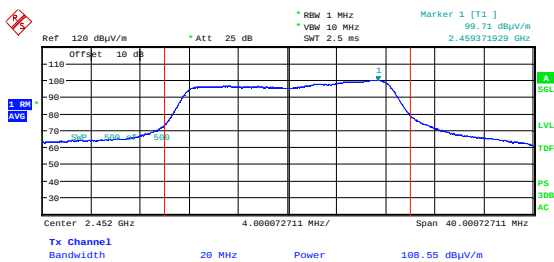
Date: 23.MAY.2022 14:55:04

### Maximum Field Strength, 2422 MHz, 802.11n HT40 MCS0



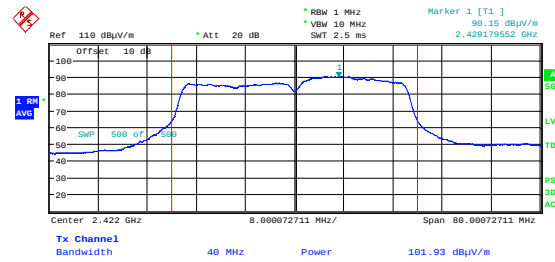
Date: 23.MAY.2022 14:46:47

### Maximum Field Strength, 2447 MHz, 802.11n HT40 MCS0



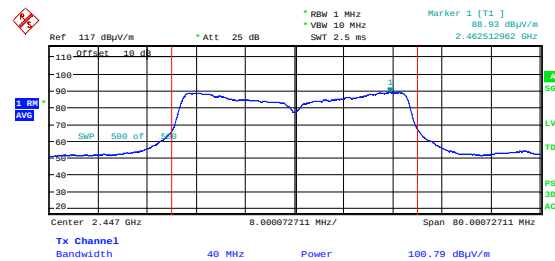
Date: 23.MAY.2022 13:43:14

### Maximum Field Strength, 2452 MHz, 802.11g 54M



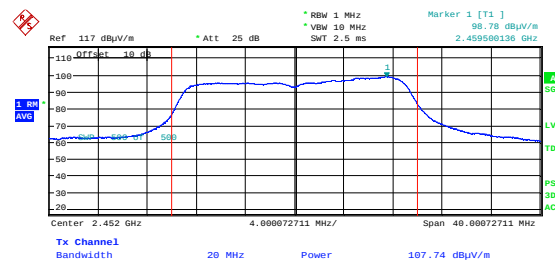
Date: 23.MAY.2022 14:50:32

### Maximum Field Strength, 2422 MHz, 802.11n HT40 MCS7



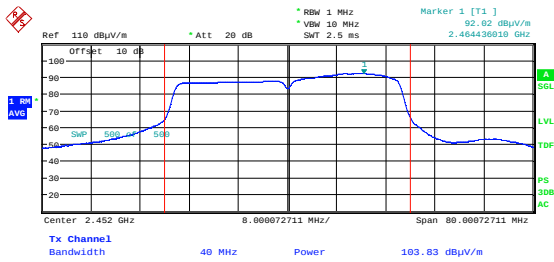
Date: 23.MAY.2022 14:31:04

### Maximum Field Strength, 2447 MHz, 802.11n HT40 MCS7



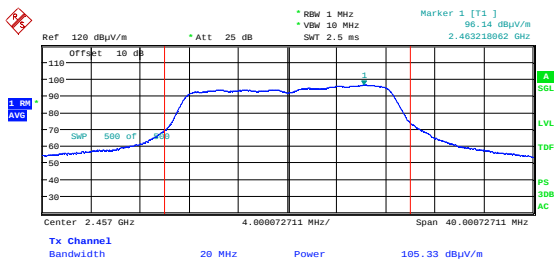
Date: 23.MAY.2022 14:15:41

### Maximum Field Strength, 2452 MHz, 802.11n HT20 MCS7



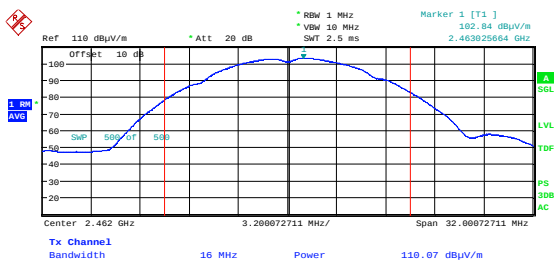
Date: 23.MAY.2022 14:39:07

### Maximum Field Strength, 2452 MHz, 802.11n HT40 MCS0



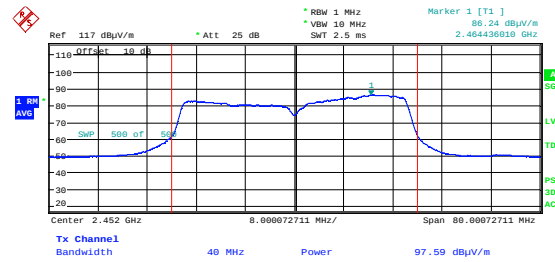
Date: 23.MAY.2022 12:19:54

### Maximum Field Strength, 2457 MHz, 802.11g 54M



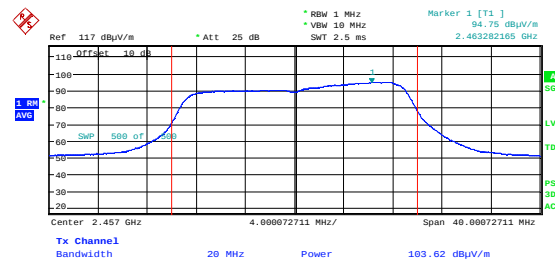
Date: 23.MAY.2022 15:21:19

### Maximum Field Strength, 2462 MHz, 802.11b 11M



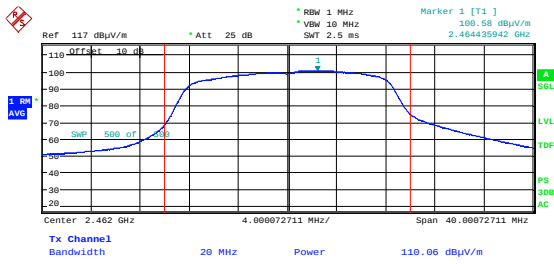
Date: 23.MAY.2022 14:28:14

### Maximum Field Strength, 2452 MHz, 802.11n HT40 MCS7



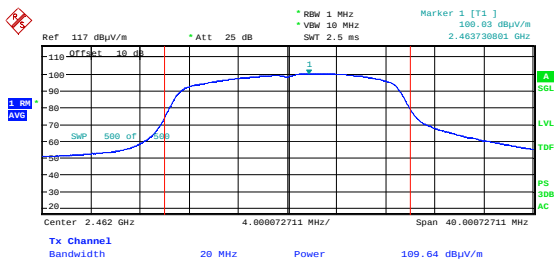
Date: 23.MAY.2022 14:12:21

### Maximum Field Strength, 2457 MHz, 802.11n HT20 MCS7



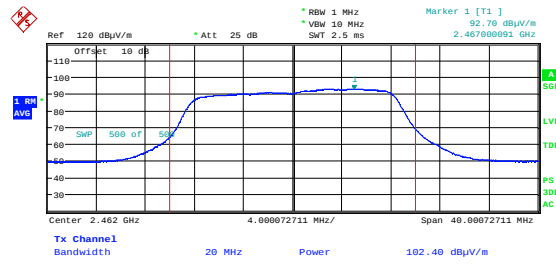
Date: 23.MAY.2022 13:53:20

### Maximum Field Strength, 2462 MHz, 802.11g 6M



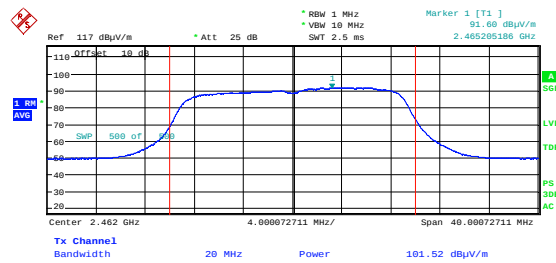
Date: 23.MAY.2022 14:26:59

### Maximum Field Strength, 2462 MHz, 802.11n HT20 MCS0



Date: 23.MAY.2022 13:33:47

### Maximum Field Strength, 2462 MHz, 802.11g 54M



Date: 23.MAY.2022 14:07:00

### Maximum Field Strength, 2462 MHz, 802.11n HT20 MCS7

### 3.2 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

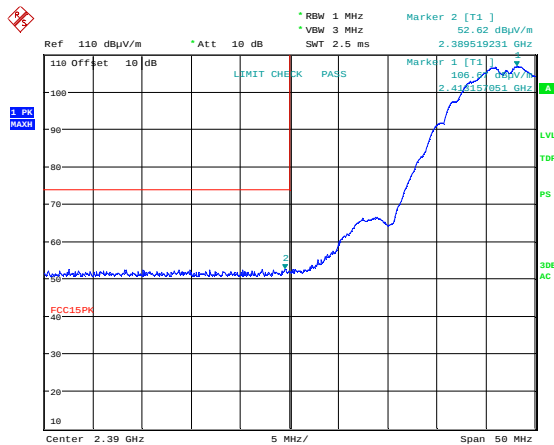
Measurement Data:

| Carrier Freq.<br>(MHz) | Modulation and<br>Bitrate | Measured field strength (dBμV/m) |         | Limit (dB) |    | Margin (dB) |      |
|------------------------|---------------------------|----------------------------------|---------|------------|----|-------------|------|
|                        |                           | Peak                             | Average | Pk         | Av | Pk          | Av   |
| 2412                   | 11b 11M                   | 52.6                             | 41.1    | 74         | 54 | 21.4        | 12.9 |
|                        | 11g 6M                    | 60.2                             | 45.7    | 74         | 54 | 13.8        | 8.3  |
|                        | 11g 54M                   | 66.6                             | 45.4    | 74         | 54 | 7.5         | 8.6  |
|                        | 11n HT20 MCS0             | 58.0                             | 44.8    | 74         | 54 | 16.0        | 9.2  |
|                        | 11n HT20 MCS7             | 66.3                             | 45.4    | 74         | 54 | 7.7         | 8.6  |
| 2422                   | 11n HT40 MCS0             | 56.9                             | 43.0    | 74         | 54 | 17.1        | 11.1 |
|                        | 11n HT40 MCS7             | 61.6                             | 43.0    | 74         | 54 | 12.4        | 11.0 |
| 2447                   | 11n HT40 MCS0             | 68.4                             | 52.5    | 74         | 54 | 5.6         | 1.5  |
|                        | 11n HT40 MCS7             | 73.5                             | 53.0    | 74         | 54 | 0.5         | 1.0  |
| 2452                   | 11g 54M                   | 73.3                             | 51.6    | 74         | 54 | 0.7         | 2.4  |
|                        | 11n HT20 MCS7             | 73.2                             | 50.3    | 74         | 54 | 0.8         | 3.7  |
|                        | 11n HT40 MCS0             | 66.0                             | 52.4    | 74         | 54 | 8.0         | 1.6  |
|                        | 11n HT40 MCS7             | 66.0                             | 47.9    | 74         | 54 | 8.0         | 6.1  |
| 2457                   | 11g 6M                    | 62.7                             | 49.1    | 74         | 54 | 11.3        | 4.9  |
|                        | 11g 54M                   | 66.3                             | 47.3    | 74         | 54 | 7.7         | 6.7  |
|                        | 11n HT20 MCS7             | 65.8                             | 47.3    | 74         | 54 | 8.2         | 6.7  |
| 2462                   | 11b 11M                   | 57.7                             | 44.3    | 74         | 54 | 16.3        | 9.7  |
|                        | 11g 6M                    | 64.4                             | 51.6    | 74         | 54 | 9.6         | 2.5  |
|                        | 11g 54M                   | 70.2                             | 46.5    | 74         | 54 | 3.8         | 7.5  |
|                        | 11n HT20 MCS0             | 64.8                             | 51.6    | 74         | 54 | 9.2         | 2.4  |
|                        | 11n HT20 MCS7             | 54.4                             | 46.5    | 74         | 54 | 19.6        | 7.5  |

Average values were measured using trace averaging as described in ANSI C63.10-2013 clause 11.12.2.5.1 (Duty Cycle ≈100%).

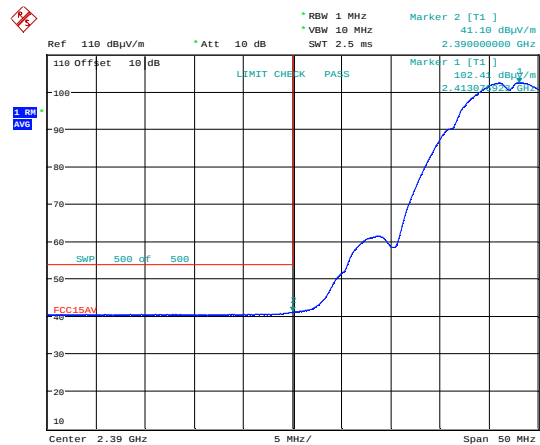
Measuring distance was 3m.

See attached plots.



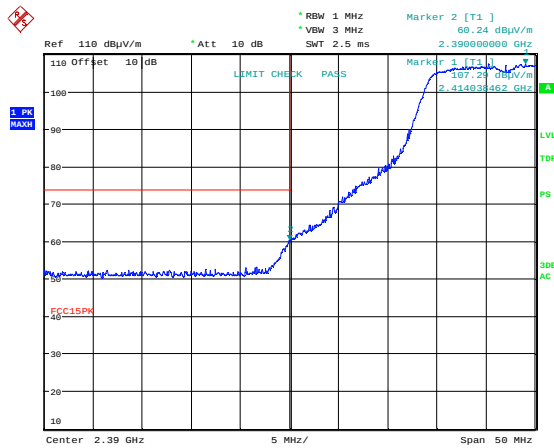
Date: 23.MAY.2022 15:16:24

Lower Band Edge, 2412 MHz, 802.11b 11M, Peak



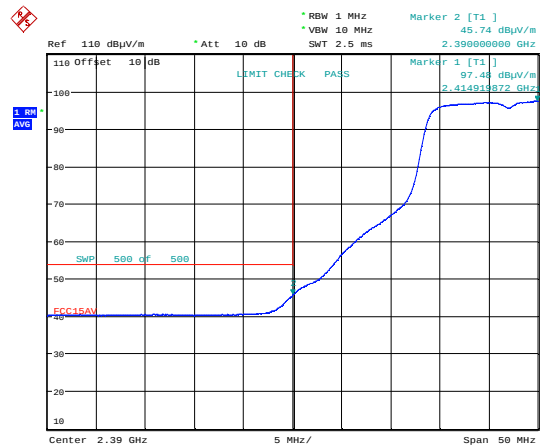
Date: 23.MAY.2022 15:17:03

Lower Band Edge, 2412 MHz, 802.11b 11M, Average



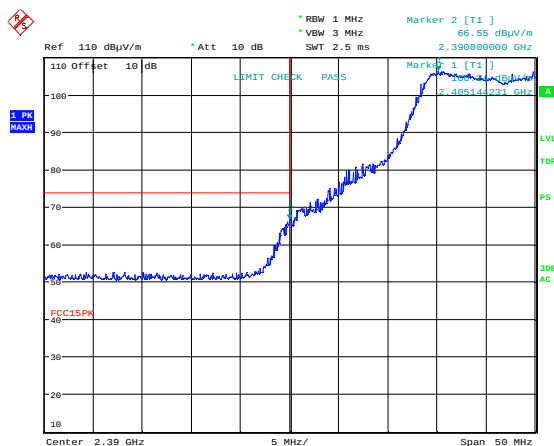
Date: 23.MAY.2022 15:01:32

Lower Band Edge, 2412 MHz, 802.11g 6M, Peak



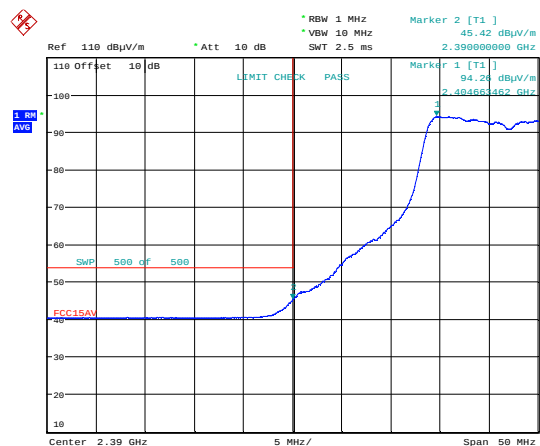
Date: 23.MAY.2022 15:02:03

Lower Band Edge, 2412 MHz, 802.11g 6M, Average



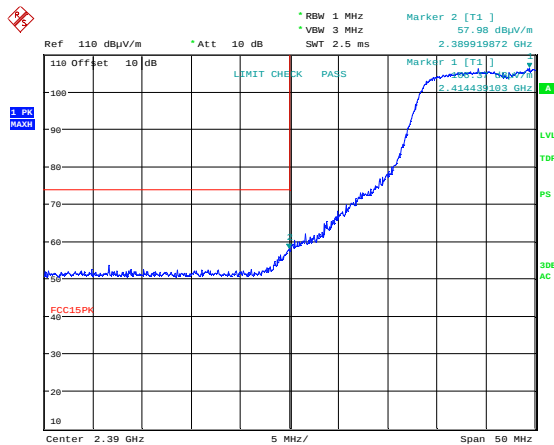
Date: 23.MAY.2022 14:58:06

Lower Band Edge, 2412 MHz, 802.11g 54M, Peak



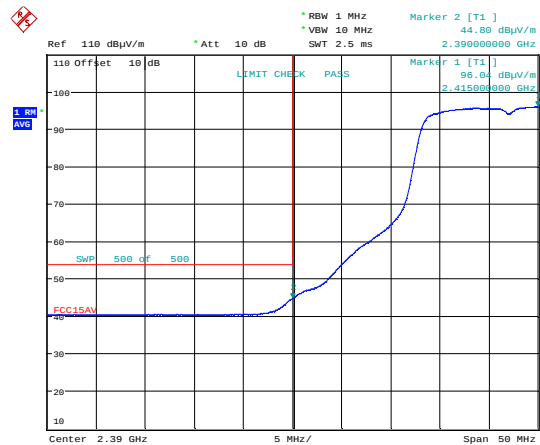
Date: 23.MAY.2022 14:58:35

Lower Band Edge, 2412 MHz, 802.11g 54M, Average



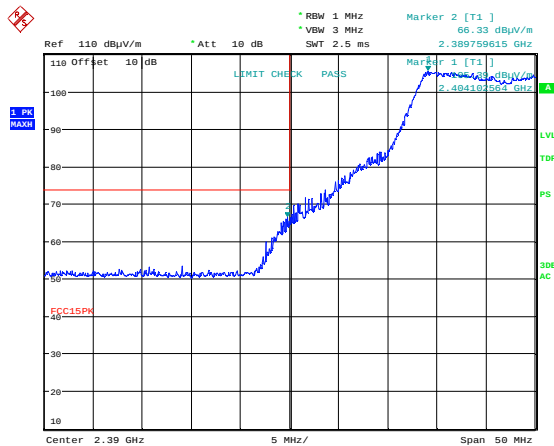
Date: 23.MAY.2022 15:12:33

Lower Band Edge, 2412 MHz, 802.11n HT20 MCS0, Peak



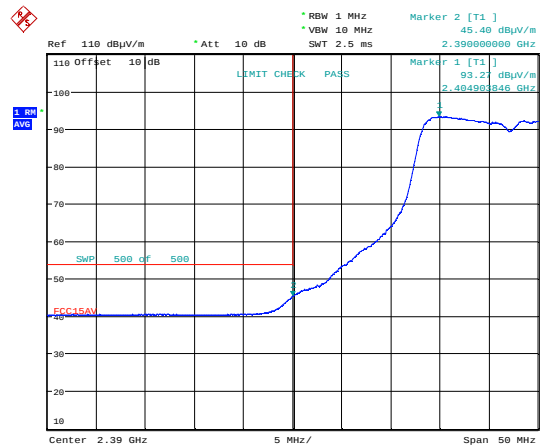
Date: 23.MAY.2022 15:13:30

Lower Band Edge, 2412 MHz, 802.11n HT20 MCS0, Average



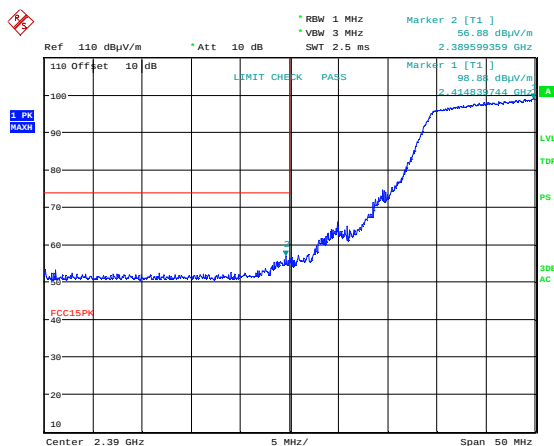
Date: 23.MAY.2022 15:07:29

Lower Band Edge, 2412 MHz, 802.11n HT20 MCS7, Peak



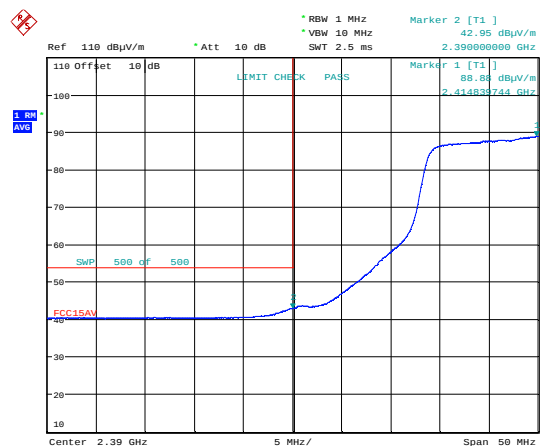
Date: 23.MAY.2022 15:09:19

Lower Band Edge, 2412 MHz, 802.11n HT20 MCS7, Average



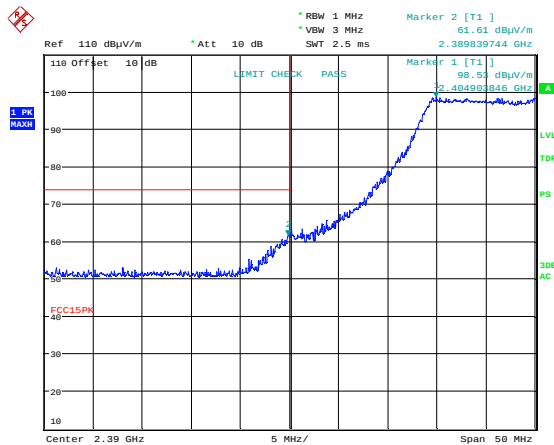
Date: 23.MAY.2022 14:52:53

Lower Band Edge, 2422 MHz, 802.11n HT40 MCS0, Peak



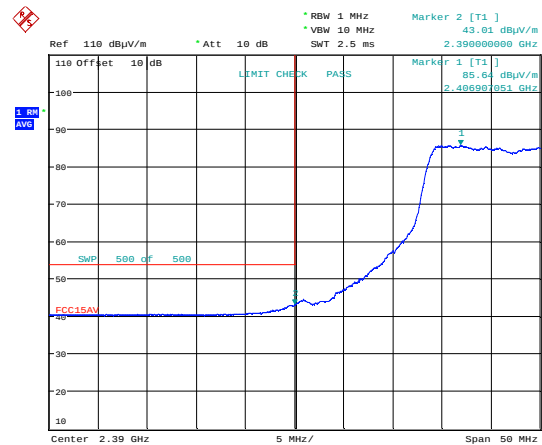
Date: 23.MAY.2022 14:53:56

Lower Band Edge, 2422 MHz, 802.11n HT40 MCS0, Average



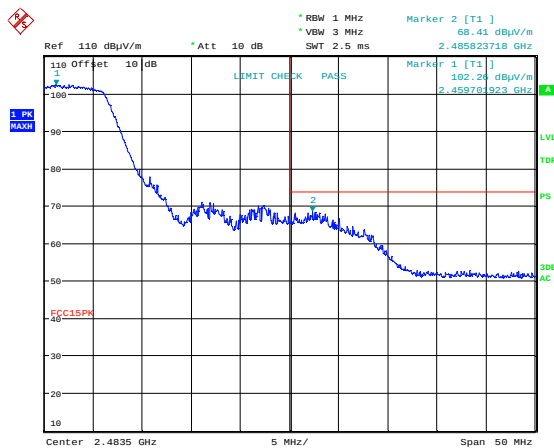
Date: 23.MAY.2022 14:50:06

Lower Band Edge, 2422 MHz, 802.11n HT40 MCS7, Peak



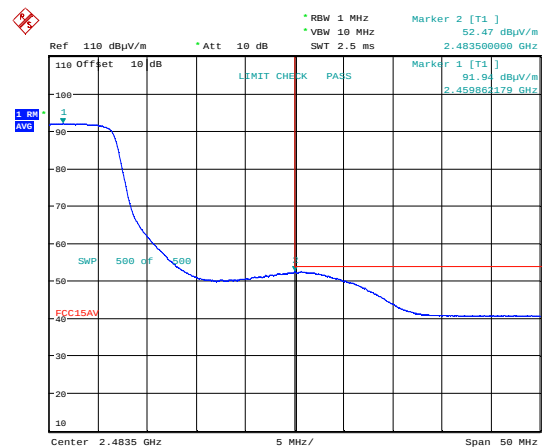
Date: 23.MAY.2022 14:48:58

Lower Band Edge, 2422 MHz, 802.11n HT40 MCS7, Average



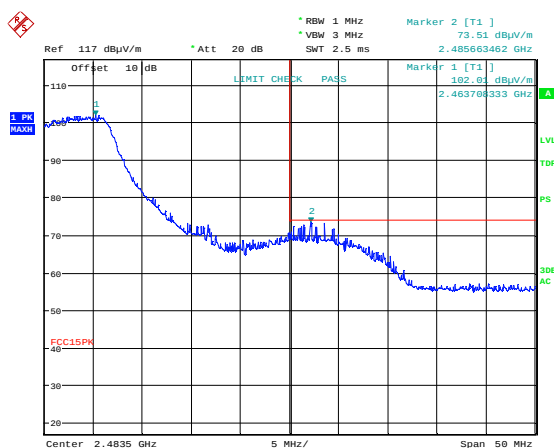
Date: 23.MAY.2022 14:46:20

Lower Band Edge, 2422 MHz, 802.11n HT40 MCS7, Peak



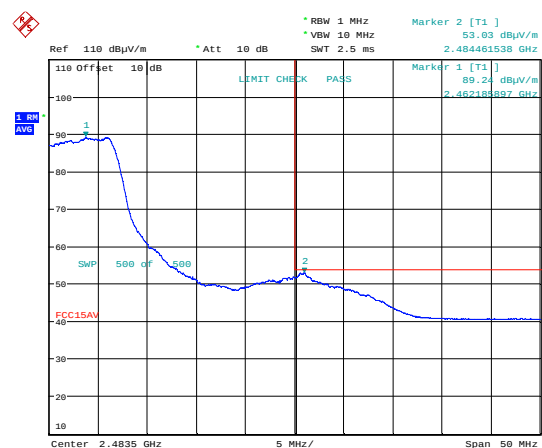
Date: 23.MAY.2022 14:45:14

Lower Band Edge, 2422 MHz, 802.11n HT40 MCS7, Average



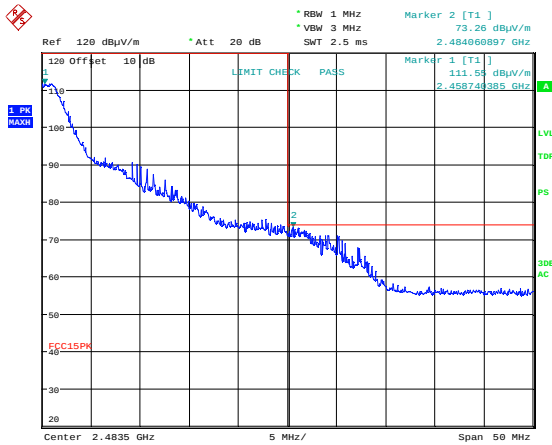
Date: 23.MAY.2022 14:29:58

Upper Band Edge, 2447 MHz, 802.11n HT40 MCS0, Peak



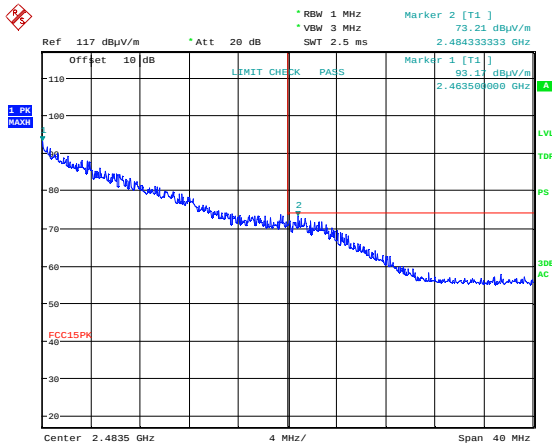
Date: 23.MAY.2022 14:32:24

Upper Band Edge, 2447 MHz, 802.11n HT40 MCS0, Average



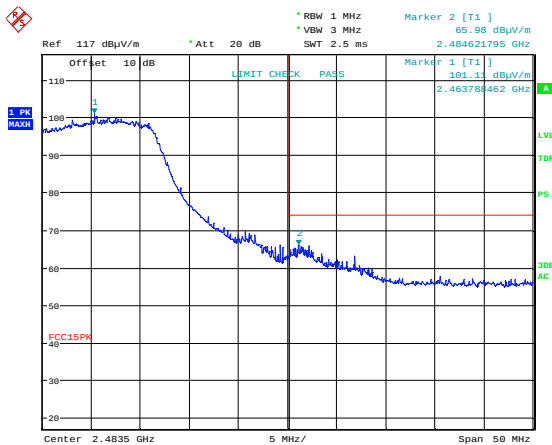
Date: 23.MAY.2022 13:42:18

### Upper Band Edge, 2452 MHz, 802.11g 54M, Peak



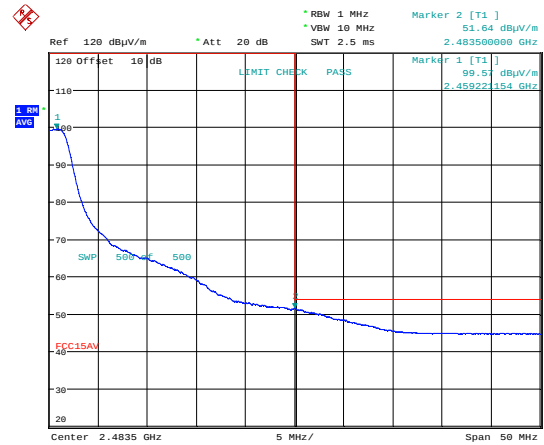
Date: 23.MAY.2022 14:14:50

### Upper Band Edge, 2452 MHz, 802.11n HT20 MCS7, Peak



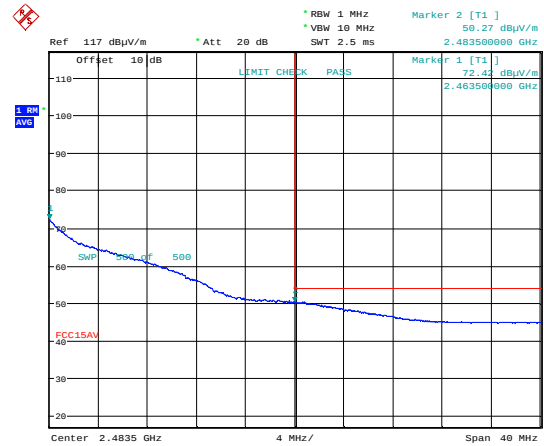
Date: 23.MAY.2022 14:27:22

### Upper Band Edge, 2452 MHz, 802.11n HT40 MCS0, Peak



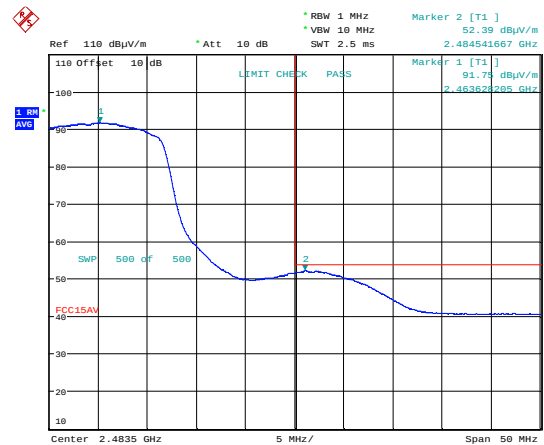
Date: 23.MAY.2022 13:42:46

### Upper Band Edge, 2452 MHz, 802.11g 54M, Average



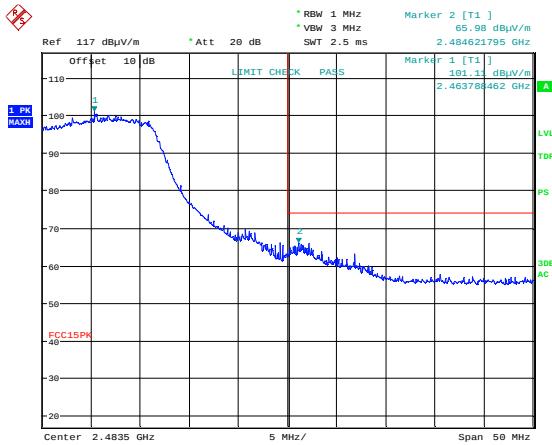
Date: 23.MAY.2022 14:15:17

### Upper Band Edge, 2452 MHz, 802.11n HT20 MCS7, Average



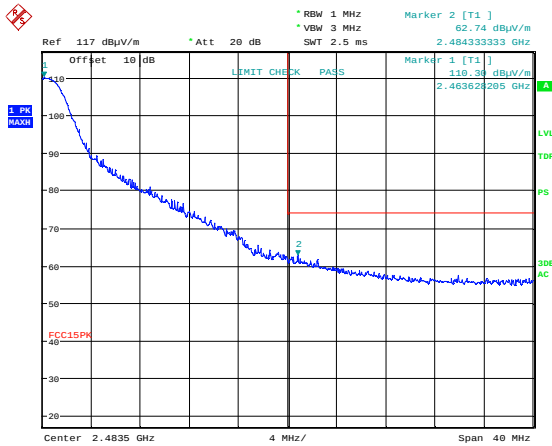
Date: 23.MAY.2022 14:36:54

### Upper Band Edge, 2452 MHz, 802.11n HT40 MCS0, Average



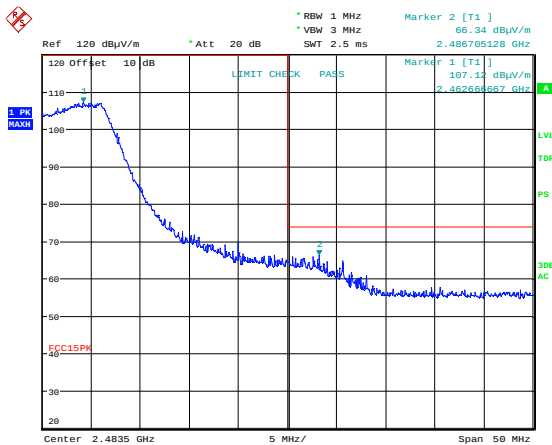
Date: 23.MAY.2022 14:27:22

#### Upper Band Edge, 2452 MHz, 802.11n HT40 MCS7, Peak



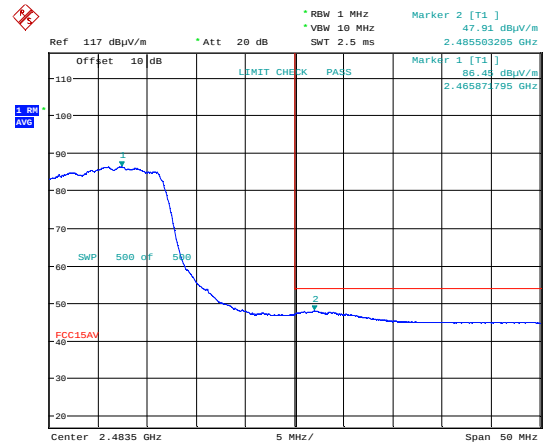
Date: 23.MAY.2022 13:55:28

#### Upper Band Edge, 2457 MHz, 802.11g 6M, Peak



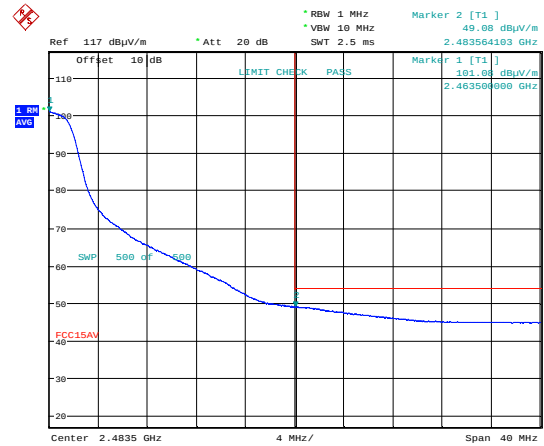
Date: 23.MAY.2022 13:39:42

#### Upper Band Edge, 2457 MHz, 802.11g 54M, Peak



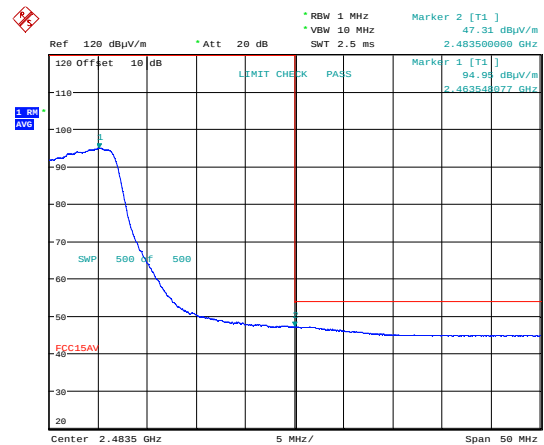
Date: 23.MAY.2022 14:27:49

#### Upper Band Edge, 2452 MHz, 802.11n HT40 MCS7, Average



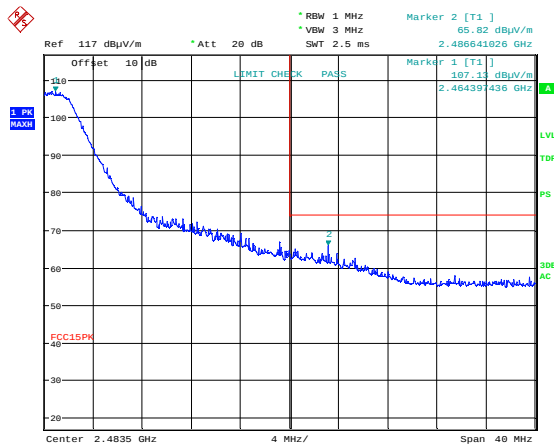
Date: 23.MAY.2022 13:56:47

#### Upper Band Edge, 2457 MHz, 802.11g 6M, Average



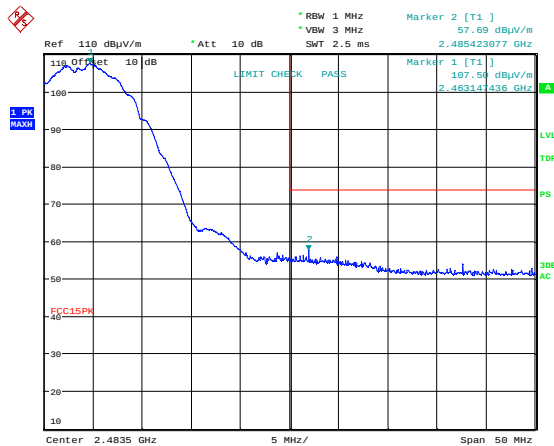
Date: 23.MAY.2022 13:40:08

#### Upper Band Edge, 2457 MHz, 802.11g 54M, Average



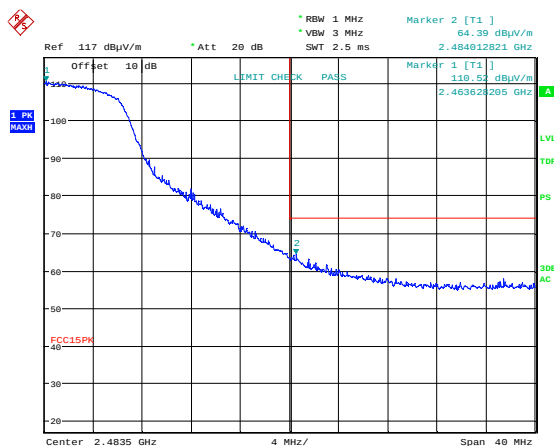
Date: 23.MAY.2022 14:10:57

### Upper Band Edge, 2457 MHz, 802.11n HT20 MCS7, Peak



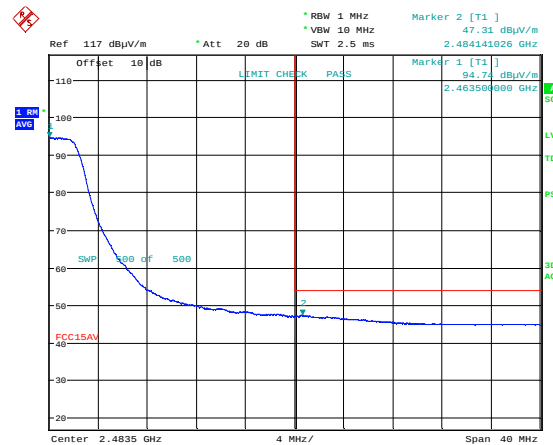
Date: 23.MAY.2022 15:19:47

### Upper Band Edge, 2462 MHz, 802.11b 11M, Peak



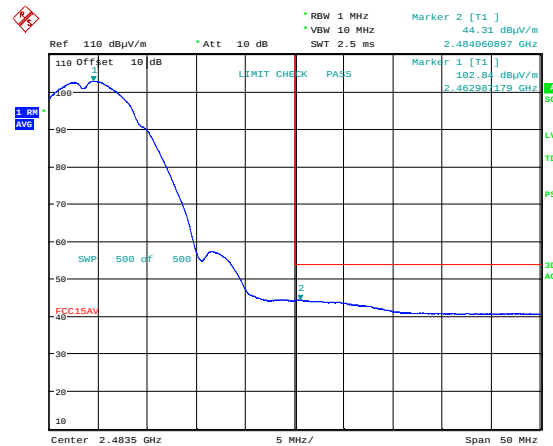
Date: 23.MAY.2022 13:52:30

### Upper Band Edge, 2462 MHz, 802.11g 6M, Peak



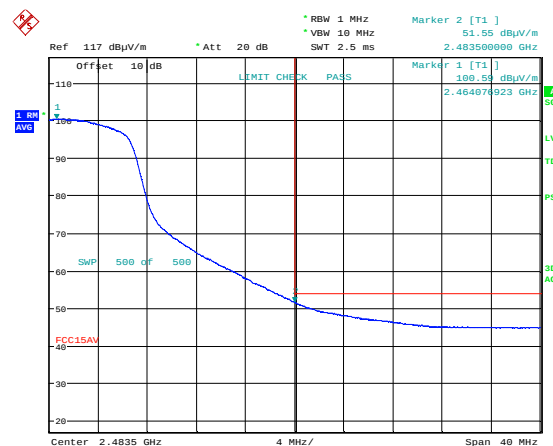
Date: 23.MAY.2022 14:11:57

### Upper Band Edge, 2457 MHz, 802.11n HT20 MCS7, Average



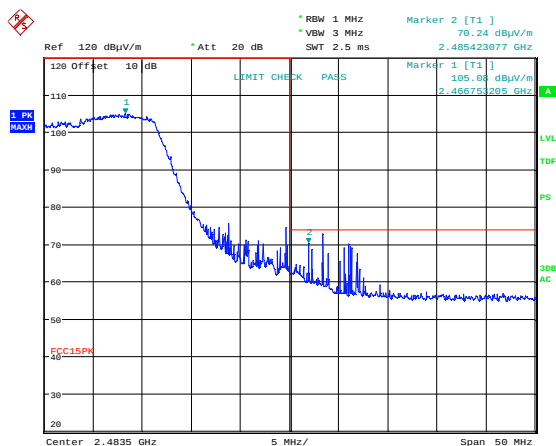
Date: 23.MAY.2022 15:20:55

### Upper Band Edge, 2462 MHz, 802.11b 11M, Average



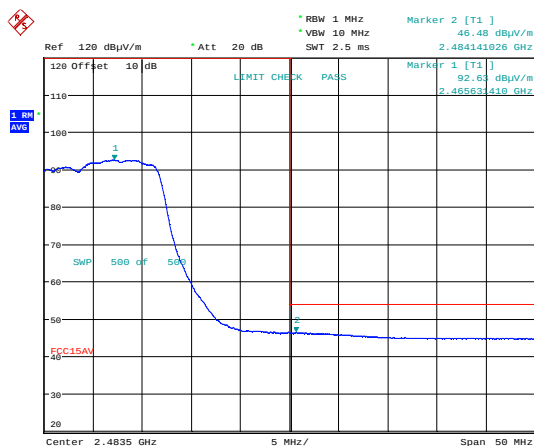
Date: 23.MAY.2022 13:52:56

### Upper Band Edge, 2462 MHz, 802.11g 6M, Average



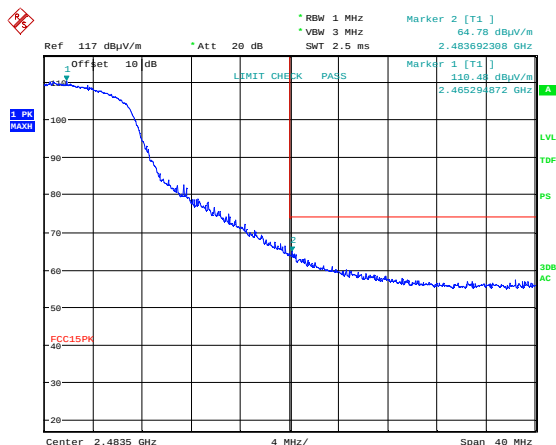
Date: 23.MAY.2022 13:34:53

### Upper Band Edge, 2462 MHz, 802.11g 54M, Peak



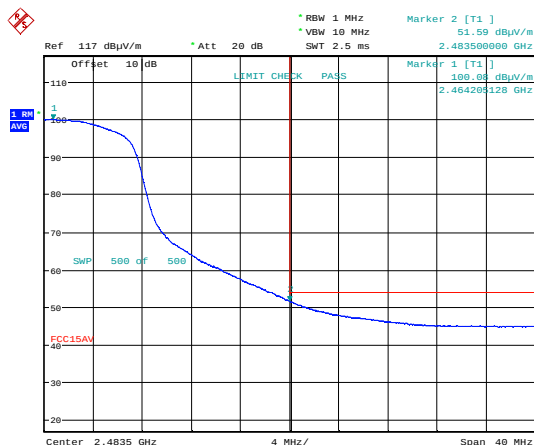
Date: 23.MAY.2022 13:33:18

### Upper Band Edge, 2462 MHz, 802.11g 54M, Average



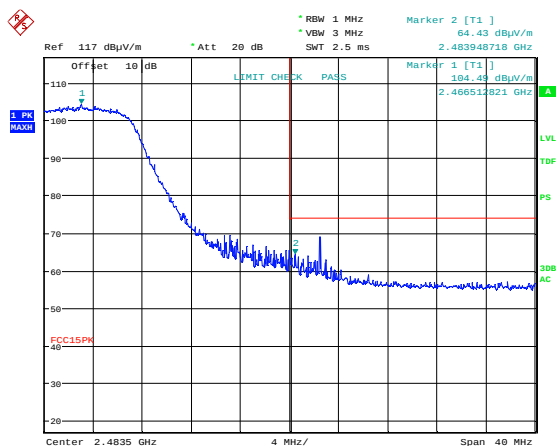
Date: 23.MAY.2022 14:19:45

### Upper Band Edge, 2462 MHz, 802.11n HT20 MCS0, Peak



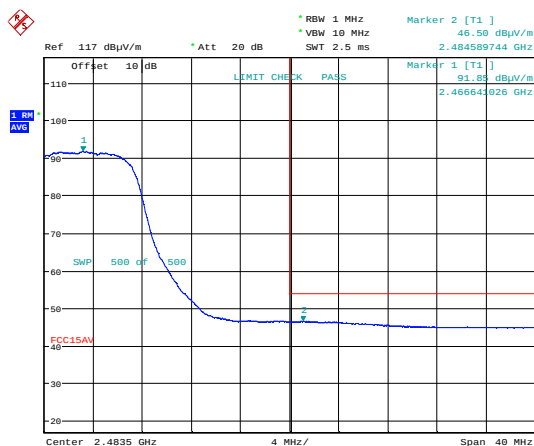
Date: 23.MAY.2022 14:20:23

### Upper Band Edge, 2462 MHz, 802.11n HT20 MCS0, Average



Date: 23.MAY.2022 14:05:30

### Upper Band Edge, 2462 MHz, 802.11n HT20 MCS7, Peak



Date: 23.MAY.2022 14:06:16

### Upper Band Edge, 2462 MHz, 802.11n HT20 MCS7, Average

### 3.3 Radiated Emissions, 1-18 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:

RBW/VBW = 1MHz/3MHz

| Carrier Frequency (MHz) | Measured Frequency (GHz) | Modulation and Bitrate | Measured Emissions (dBμV/m) |         | Limit (dBμV/m) |         | Margin (dB) |         |
|-------------------------|--------------------------|------------------------|-----------------------------|---------|----------------|---------|-------------|---------|
|                         |                          |                        | Peak                        | Average | Peak           | Average | Peak        | Average |
| 2437                    | 1-18                     | 802.11g 6M             | <58                         | <46     | 74             | 54      | >18         | >8      |

A Band Reject Filter (2.4GHz) was used for measurements from 1 GHz to 18 GHz.

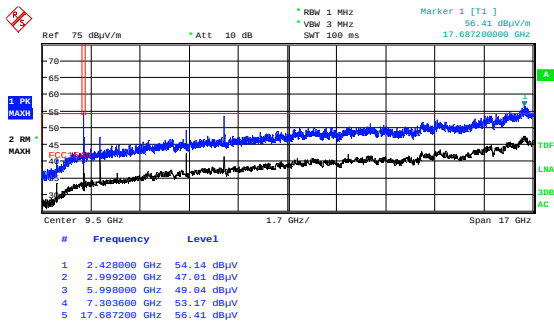
Antenna factor, PreAmp Gain and Cable Loss are included in spectrum analyzer "Transducer factor".

Measuring distance was 3m for this measurement.

See plots.

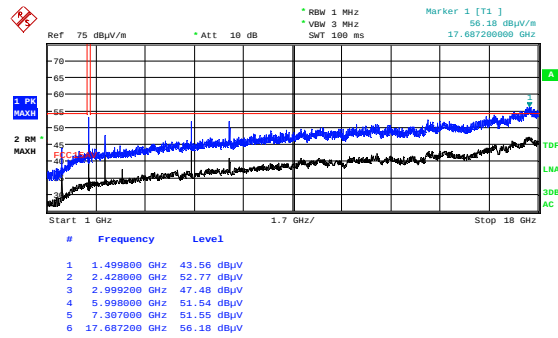
#### Requirements/Limit

|             |                                                                  |               |
|-------------|------------------------------------------------------------------|---------------|
| 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 |
| Above 1 GHz | 54.0 dBμV/m                                                      | 74.0 dBμV/m   |



Date: 24.MAY.2022 09:07:07

Radiated Emissions 1 - 18 GHz, 2437 MHz, 802.11g 54M, HP



Date: 24.MAY.2022 09:01:08

Radiated Emissions 1 - 18 GHz, 2437 MHz, 802.11g 54M, VP

### 3.4 Radiated Emissions, Interoperability

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 Detector

Measuring distance: 3m

| Band 02 + WiFi            |                   |                       |                  |                             |         |                |         |             |         |
|---------------------------|-------------------|-----------------------|------------------|-----------------------------|---------|----------------|---------|-------------|---------|
| WiFi ch06 + GSM1900 ch680 |                   |                       |                  |                             |         |                |         |             |         |
| Measured Frequency        | Carrier Freq WiFi | WiFi Mode and Bitrate | Carrier Freq GSM | Measured Emissions (dBμV/m) |         | Limit (dBμV/m) |         | Margin (dB) |         |
|                           |                   |                       |                  | Peak                        | Average | Peak           | Average | Peak        | Average |
| 1 – 5 GHz                 | 2437 MHz          | 11g 6M                | 1883.8           | < 56                        | < 50    | 74             | 54      | >18         | >4      |
| 1331 MHz                  | 2437 MHz          | 11g 6M                | 1883.8           | 55.4                        | 49.2    | 74             | 54      | 18.6        | 4.8     |
| 1331 MHz                  | 2437 MHz          | 11g 54M               | 1883.8           | 55.6                        | 49.4    | 74             | 54      | 18.4        | 4.6     |
| 1331 MHz                  | 2437 MHz          | 11n MCS0              | 1883.8           | 54.2                        | 48.3    | 74             | 54      | 19.8        | 5.7     |
| 1331 MHz                  | 2437 MHz          | 11n MCS7              | 1883.8           | 54.6                        | 48.4    | 74             | 54      | 19.4        | 5.6     |

Band Reject Filters for both 2.4GHz and GSM1900 band were used for all measurements.

The cellular module was controlled by the CMW500 and set to transmit with maximum output power.

The limit for Part 15.209 was used for all tests since this is the strictest limit.

The limit for most of the tested licensed bands are -13 dBm average, which is equivalent to 82 dBμV/m @3m.

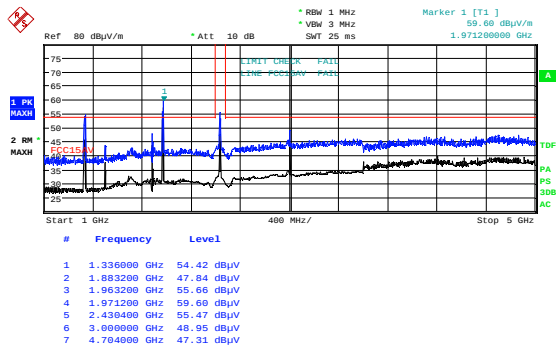
Antenna factor, PreAmp Gain and Cable Loss are included in spectrum analyzer "Transducer factor".

Results are shown below. No other emissions related to intermodulation were detected.

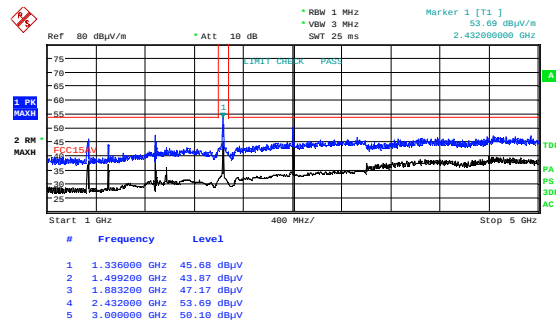
#### Requirements/Limit

|            |                                                                  |               |
|------------|------------------------------------------------------------------|---------------|
| 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                                |               |
|            | Average Detector                                                 | Peak Detector |
| 1 – 26 GHz | 54.0 dBμV/m                                                      | 74.0 dBμV/m   |

## B02: GSM1900

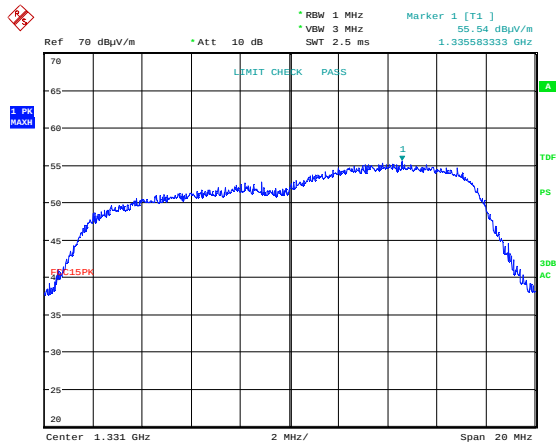


Date: 24.MAY.2022 10:56:22



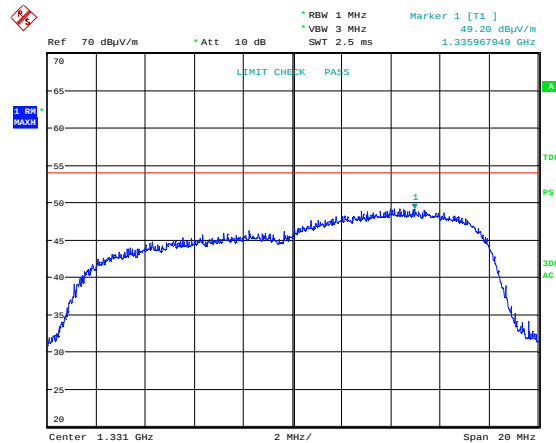
Date: 24.MAY.2022 10:58:12

## 1000-5000MHz, WiFi ch06 11g 6M + GSM1900 ch680, VP



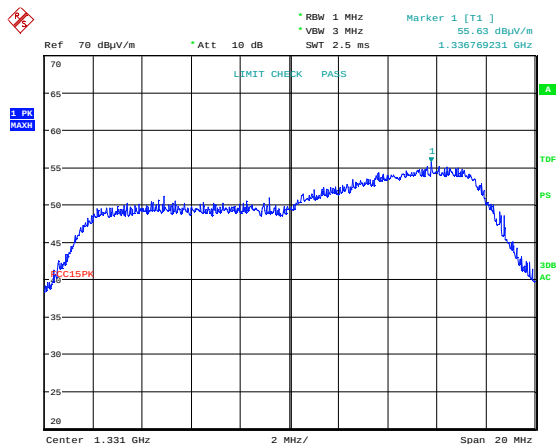
Date: 24.MAY.2022 11:20:32

## HP



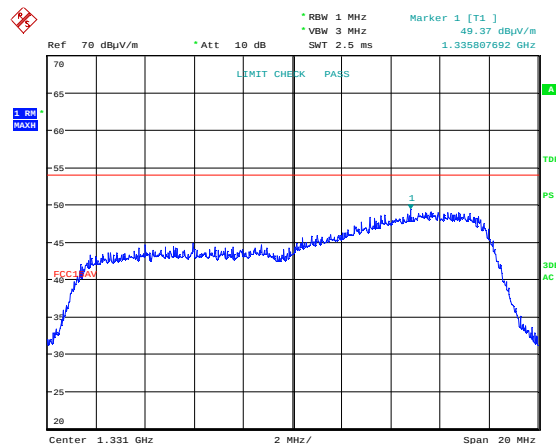
Date: 24.MAY.2022 11:21:24

## 1331MHz, WiFi ch06 11g 6M + GSM1900 ch680, Peak



Date: 24.MAY.2022 11:54:57

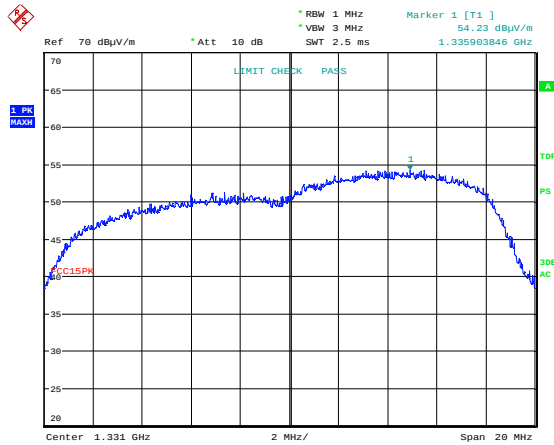
## 1331MHz, WiFi ch06 11g 6M + GSM1900 ch680, Average (SA-3)



Date: 24.MAY.2022 11:55:45

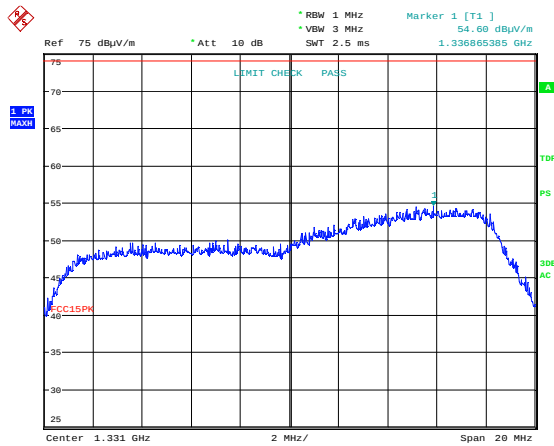
## 1331MHz, WiFi ch06 11g 54M + GSM1900 ch680, Peak

## 1331MHz, WiFi ch06 11g 54M + GSM1900 ch680, Average (SA-3)



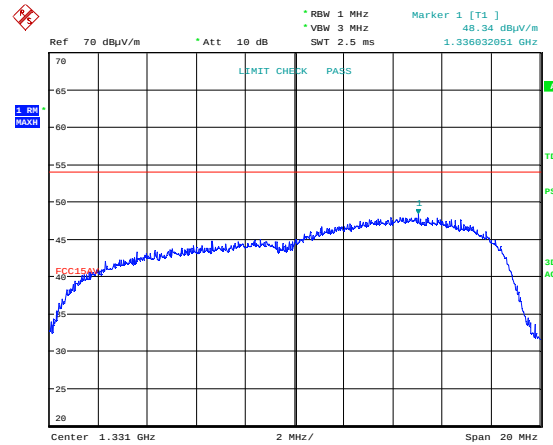
Date: 24.MAY.2022 11:59:33

1331MHz, WiFi ch06 11n MCS0 + GSM1900 ch680, Peak



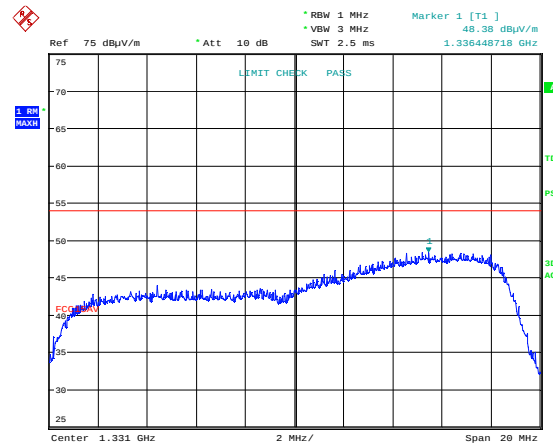
Date: 24.MAY.2022 12:00:55

1331MHz, WiFi ch06 11n MCS7 + GSM1900 ch680, Peak



Date: 24.MAY.2022 11:58:25

1331MHz, WiFi ch06 11n MCS0 + GSM1900 ch680, Average (SA-3)



Date: 24.MAY.2022 12:03:23

1331MHz, WiFi ch06 11n MCS7 + GSM1900 ch680, Average (SA-3)

## 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   | ESU40        | Measuring Receiver        | Rohde & Schwarz    | LR 1639  | 2022-01   | 2023-01  |
| 2   | 6810-17B     | Attenuator                | Suhner             | LR 1669  | 2021-08   | 2022-08  |
| 3   | N0324415     | BandStop Filter (2.4 GHz) | Microwave Circuits | LR 1760  | COU       |          |
| 4   | 8449A        | Pre-amplifier             | Hewlett Packard    | LR 1322  | 2021-08   | 2022-08  |
| 5   | 3115         | Horn Antenna              | EMCO               | LR 1330  | N/A       |          |
| 6   | 3117-PA      | Horn Antenna +PreAmp      | EMCO               | LR 1717  | 2021-08   | 2022-08  |
| 7   | CMW500       | Radiocom Tester           | Rohde & Schwarz    | LR 1791  | 2022-02   | 2023-02  |

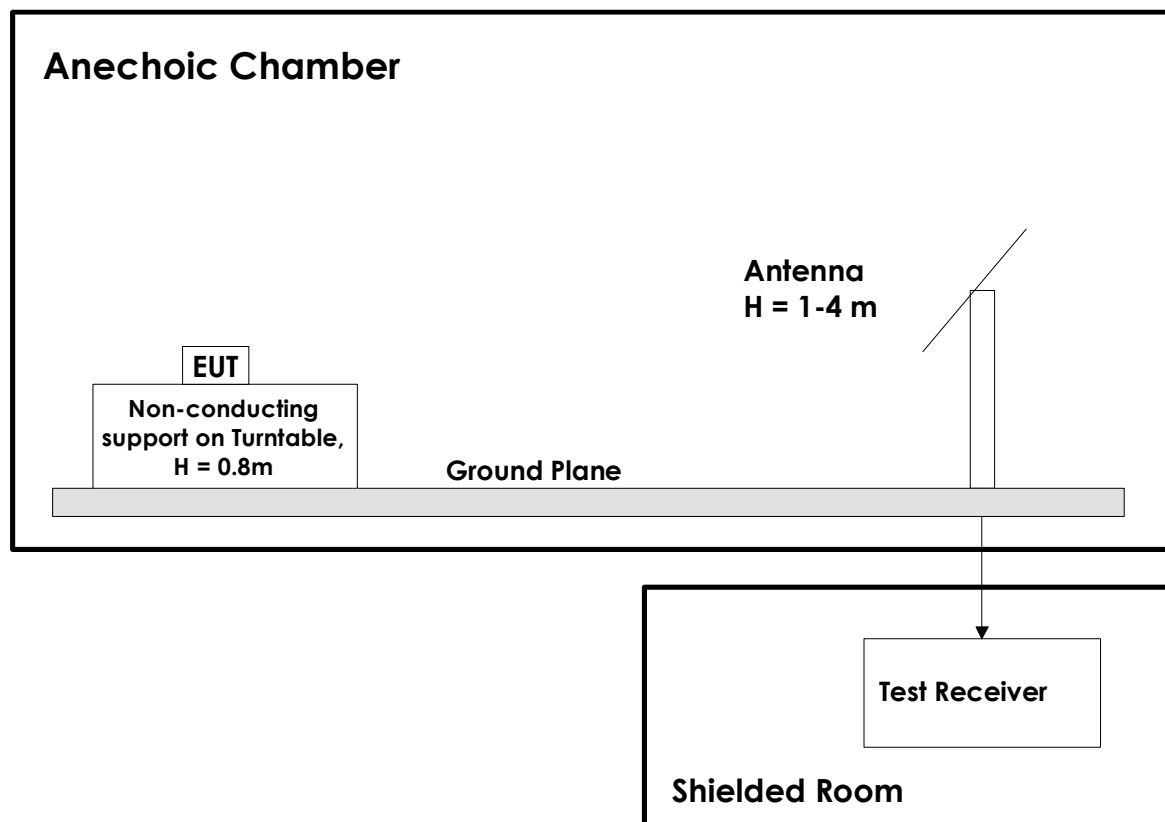
Note: COU – calibrate on use; N/A – Not Applicable

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

| No. | Manufacturer | Name   | Version | Comment                                 |
|-----|--------------|--------|---------|-----------------------------------------|
| 1   | Nemko AS     | RSPlot | 1.0.8.0 | Screenshots from R&S Spectrum Analyzers |
|     |              |        |         |                                         |

## 6 BLOCK DIAGRAM

### 6.1 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.