# REPORT

For

## Alpha Technologies Ltd.

7700 Riverfront Gate
Burnaby, BC, V5J 5M4, Canada

Date of Issue: 3 October 2023
Report No.: 20.01.22053-3
Project No.: 22053
Equipment: WiFi/BT radio module for use in Alpha Equipment
Model No.: GL0005322



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| TEST REPORT<br>47 CFR § 15.247, RSS-247 | | |
|---|---|---|
| *RSS-247 — Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices*<br>*47 CFR § 15.247 - Operation within the bands 902–928 MHz, 2400–2483.5 MHz, and 5725–5850 MHz.* | | |
| **Report No.** ..... : | 20.01.22053-3 | |
| **Compiled by** ..... | Zara Vali |  |
| **Approved by** ..... | David Johanson |  |
| **Date of issue** ..... : | 3 October 2023 | |
| **Laboratory information:** | | |
| Testing Laboratory ..... : | LabTest Certification Inc. | |
| Address ..... : | Delta Lab: *Unit 205 – 8291 92ST. Delta, B.C. V4G 0A4, Canada*<br>Richmond Lab: *Unit 3128-20800 Westminster HWY, Richmond, B.C. V6V 2W3 Canada* | |
| FCC Site Registration No.: | CA5970 | |
| IC Site Registration No.: | 5970A-2 | |
| **Applicant's name**..... : | Alpha Technologies Ltd. | |
| Address ..... : | 7700 Riverfront Gate, Burnaby, BC, V5J 5M4, Canada | |
| **Manufacture's Name** ..... : | Same as Applicant | |
| Address ..... : | Same as Applicant | |
| **Test item description :** | | |
| Trade Mark ..... : | NA | |
| Equipment name: ..... | WiFi/BT radio module for use in Alpha Equipment | |
| Model number ..... : | GL0005322 | |
| Serial Number ..... : | Proto-009 | |
| FCC ID ..... : | 2BA9E-GL0005322 | |
| IC ID ..... : | 30668-GL0005322 | |
| **Possible test case verdicts:** | | |
| - test case does not apply to the test object ..... : | NA | |

| | |
|---|---|
| - test object does meet the requirement ..... : | P (Pass) |
| - test object does not meet the requirement ..... : | F (Fail) |
| **Testing:** | |
| Date of receipt of test item ..... : | June 19, 2023 |
| Date (s) of performance of tests..... : | June 19 – August 16, 2023 |

## Revision History

| Revision | Date | Reason For Change | Author |
|---|---|---|---|
| 0 | 21 August 2023 | Initial Data | Zara Vali |
| 1 | 3 October 2023 | Duty Cycle Measurements added | Zara Vali |

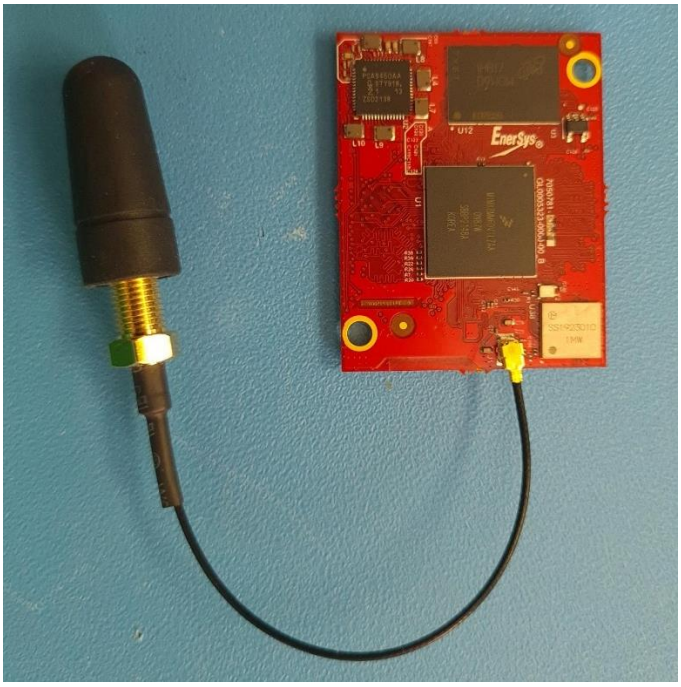
## Result Summary

The tests indicated in result summary were performed on the product constructed as described below. The test sections are the verbatim text from the actual data sheets used during the investigation. These test sections include the test name, the specified test method, a list of the actual test equipment used, documentation photos, results, and raw data. No additions, deviations, or exclusions have been made from the standard(s) unless specifically noted.
The compliance status is a judgment based on the direct measurements and calculated highest emissions to appropriate standard limits. Measurement uncertainty values, provided on calibration certificates, were not be used in the judgment of the final status of compliance.
Based on the results of our investigation, we have concluded the product tested **complies** with the requirements of the standard(s) indicated. The results obtained in this test report pertain only to the item(s) tested. LabTest does not make any claims of compliance for samples or variants which were not tested.

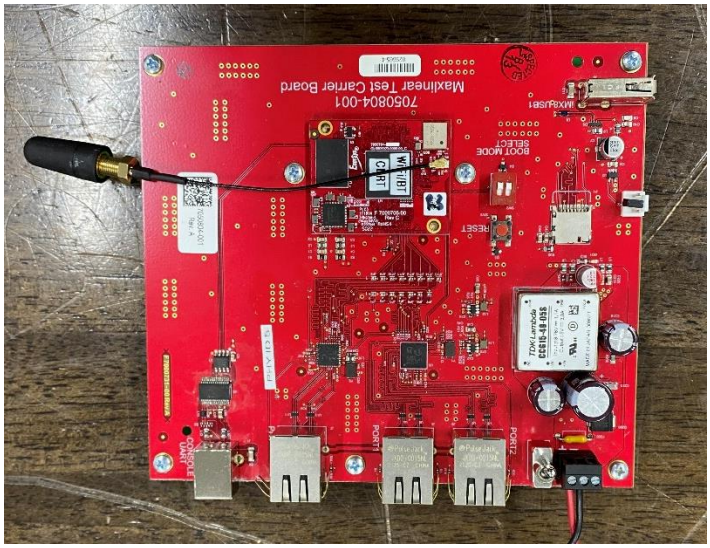
| 47 CFR § 15.247 and RSS-247 | | | |
|---|---|---|---|
| **Test Type** | **Standard** | **Test Method** | **Result** |
| 20 dB Bandwidth Measurement | FCC Part 15.247 (a) (1)<br>RSS-247 5.1<br>FCC 15.215 (c) | KDB 558074 D01 v05r02<br>ANSI C63.10:2013 | Pass |
| Conducted Peak Power Measurement | FCC 15.247 (b)(1)<br>RSS-247 5.4 (b)<br>RSS Gen, Issue 5 | KDB 558074 D01 v05r02<br>ANSI C63.10:2013 | Pass |
| Carrier Frequency Separation Measurement | FCC 15.247(a) (1)<br>RSS-247 5.1 | KDB 558074 D01 v05r02<br>ANSI C63.10: 2013 | Pass |
| Number of Hopping Channels Measurement | FCC 15.247(a) (1) (iii)<br>RSS-247 5.1 | KDB 558074 D01 v05r02<br>ANSI C63.10: 2013 | Pass |
| Time of Occupancy Measurement | FCC 15.247(a) (1) (iii)<br>RSS-247 5.1 | KDB 558074 D01 v05r02<br>ANSI C63.10: 2013 | Pass |
| Band Edge and Out of Band Emissions | FCC Part 15.247 (d)<br>RSS-247 5.5 | KDB 558074 D01 v05r02<br>ANSI C63.10: 2013 | Pass |
| Radiated Spurious Emissions | FCC Part 15.209<br>RSS-Gen Issue 5 | KDB 558074 D01 v05r02<br>ANSI C63.10: 2013 | Pass |
| Radiated Restricted Band Edge Measurement | FCC Part 15. 247 (d)<br>FCC Part 15. 205<br>FCC Part 15. 209<br>RSS-247 5.5 | KDB 558074 D01 v05r02<br>ANSI C63.10: 2013 | Pass |
| **General** | | | |
| Antenna Requirement | 47 CFR Part 15.203<br>RSS-Gen Issue 5 | Inspection | Pass |
| **Non-standard test method** | NA | | |

## Description of Equipment Under Test and Variant Models

**Description:**
WiFi/BT radio module for use in Alpha Equipment
Alpha Communication Module utilizing Murata Type 1MW W-LAN Bluetooth module and Abracon PRO-EX-347 Antenna.



Module shown with antenna Abracon PRO-EX-347 attached with support cable




Module shown installed in Carrier PCB.
Antenna Abracon PRO-EX-347 attached with support cable.

| **Variant Models:**<br>The following variant models were not tested as part of this evaluation, but have been identified by the manufacturer as being electrically identical models, depopulated models, or with reasonable similarity to the model(s) tested. LabTest does not make any claims of compliance for samples or variants which were not tested. |
|---|
| None |

## Radio Device Under Test Description

| | |
|---|---|
| Application for ..... : | WiFi/BT radio module for use in Alpha Equipment |
| Operating Transmit Frequency ..... : | 2402~2480MHz |
| Operating Receive Frequency ..... : | 2402~2480MHz |
| Number of Channels ..... : | 79 |
| Maximum EIRP (dBm) ..... : | 8.929 |
| Modulation Type ..... : | GFSK, Pi/4 DQPSK, 8DPSK |
| Data Rate ..... : | 1Mbps (GFSK), 2Mbps (Pi/4 DQPSK), 3Mbps (8DPSK) |
| Antenna Type/Gain ..... : | 3 dBi |
| Operating condition ..... : | -30 to 85 °C |
| Dimension (W X D X H) | 140 mm X 158 mm X 17 mm |
| Supply Voltage: | 5Vdc @ > 0.5Amps |
| If DC Power: | ☐ Internal Power Supply<br>■ External Power Supply or AC/DC adapter<br>☐ Battery<br>☐ Nickel Cadmium<br>☐ Alkaline, 4 X AA<br>☐ Nickel-Metal Hydride<br>☐ Lithium-Ion<br>☐ Other |

## EUT Internal Operating Frequencies

| # | Frequency | Description |
|---|---|---|
| 1 | 2402~2480MHz | Bluetooth |
| 2 | 24 MHz | Crystal on the SOM PCB |
| 3 | 32.768 kHz | Crystal on the SOM PCB |

## Client Equipment Used During Test

| # | Product Type | Manufacturer | Model | Comments |
|---|---|---|---|---|
| 1 | WiFi/BT module | Alpha Technologies Ltd. | GL0005322 | EUT |
| 2 | Switching mode power supply (AD/DC power adaptor) | Triad | WSX240-1000 | AE |
| 3 | Laptop | Lenovo | ThinkPad | AE |

Abbreviations:
EUT - Equipment Under Test,
AE - Auxiliary/Associated Equipment, or
SIM - Simulator (Not Subjected to Test)

## Software and Firmware

| # | Description | Version |
|---|---|---|
| 1 | Murata RF Test Tool | Version 1.21 |

Abbreviations:
EUT - Equipment Under Test,
AE - Auxiliary/Associated Equipment, or
SIM - Simulator (Not Subjected to Test)

## Input/Output Ports

| Port # | Name | Type* | Cable Max. >3m | Cable Shielded | Comments |
|---|---|---|---|---|---|
| 1 | Enclosure Port | | | | |
| 2 | Antenna Port | | | | |

*Note: AC = AC Power Port DC = DC Power Port N/E = Non-Electrical
I/O = Signal Input or Output Port (Not Involved in Process Control)
TP = Telecommunication Ports

## Power Interface

| Mode # | Voltage (V) | Current (A) | Frequency (DC/AC-Hz) | Phases (#) | Comments |
|---|---|---|---|---|---|
| 1 | 5 VDC | 0.5 Amps | DC | - | Provided by AD/DC power adaptor |

## EUT Operation Modes

| Mode # | Description |
|---|---|
| 1 | Bluetooth mode: EUT is transmitting in the Bluetooth mode. |

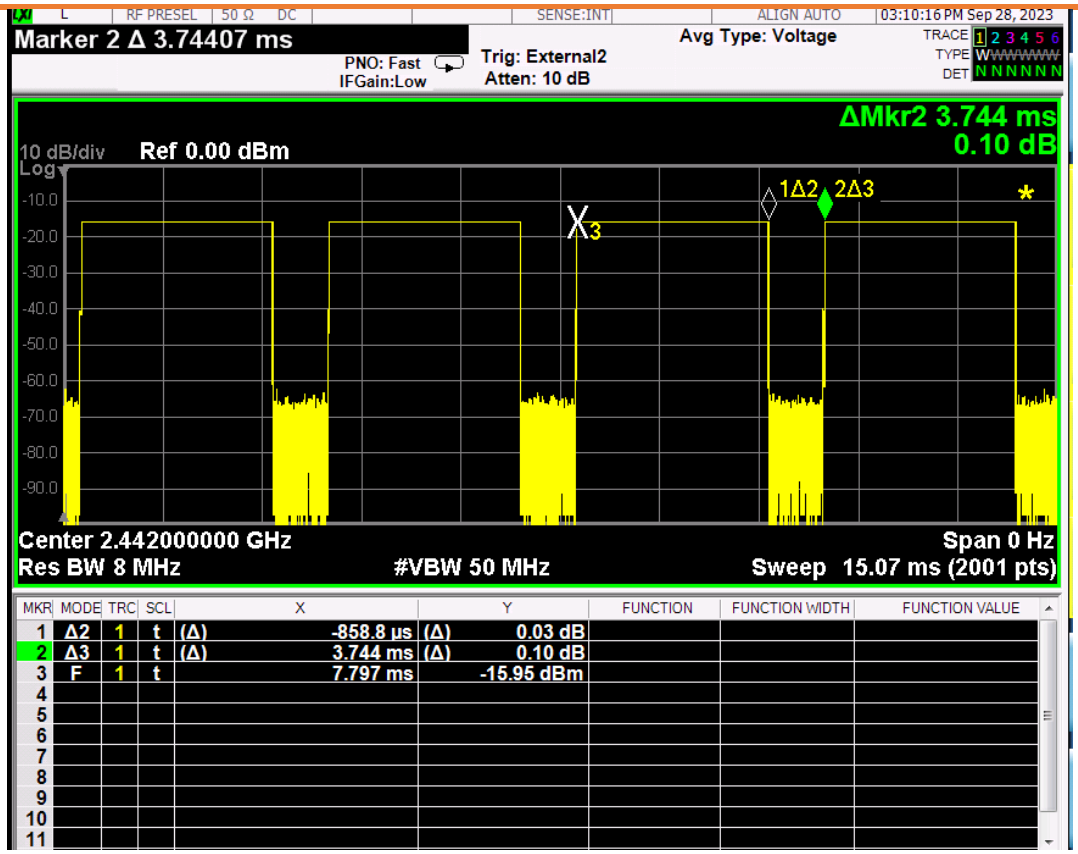
## EUT Configuration Modes

| Mode # | Description |
|---|---|
| 1 | EUT is connected to AC/DC power adaptor. |

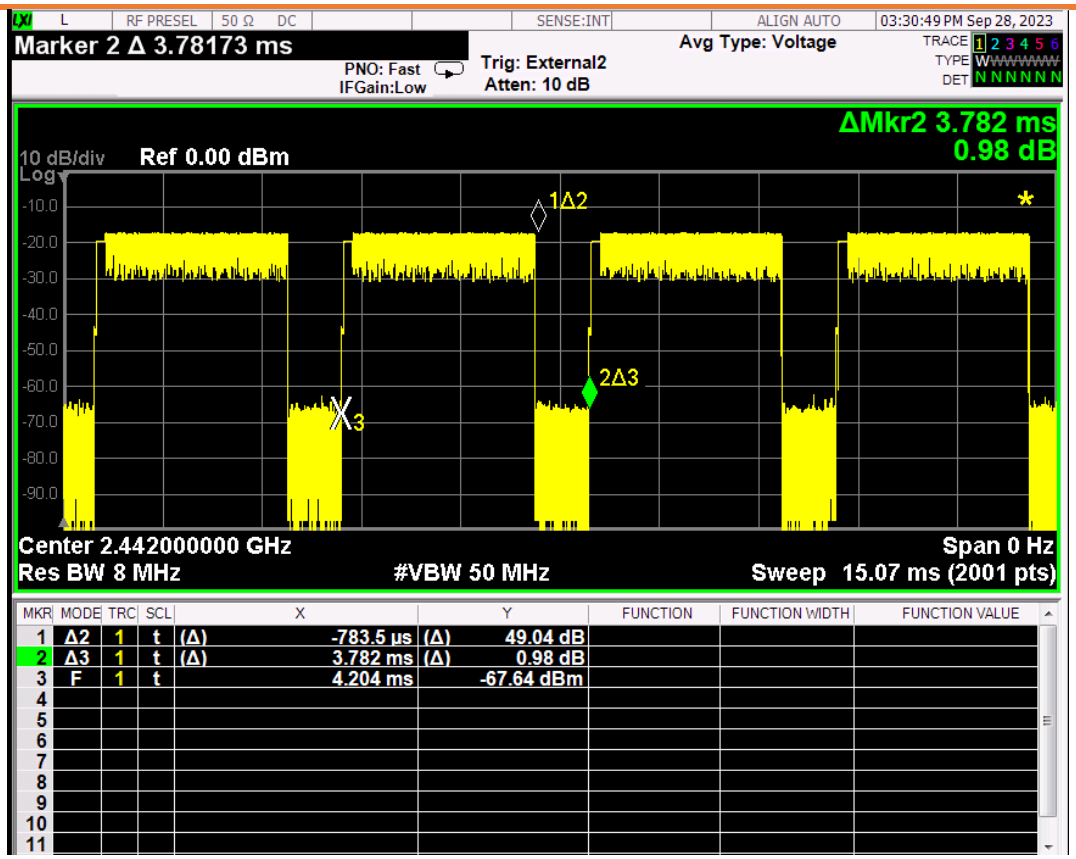
## Duty Cycle Measuement of the EUT

The maximum achievable duty cycle was determined based on measurements performed on a spectrum analyzer in zero-span mode with RBW = 8MHz, VBW = 50MHz, and detector = peak or average per the guidance of Section 6.0 b) of KDB 558074 D01v04. The RBW and VBW were both greater than 50/T, where T is the minimum transmission duration, and the number of sweep points across T was greater than 100. The duty cycles are as follows:

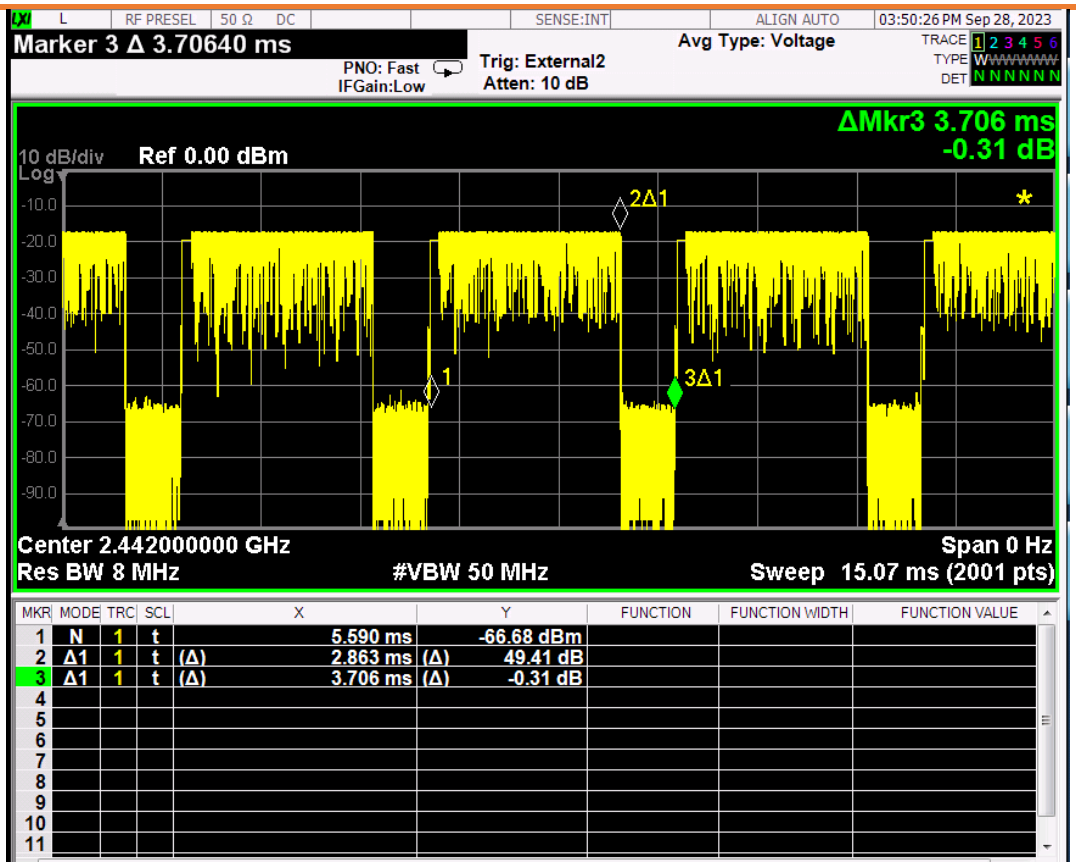
| Mode | Duty Cycle |
|---|---|
| DH5 | 77.06% |
| 2DH5 | 79.28 % |
| 3DH5 | 77.25% |
| Duty cycle (T = Transmission Duration)<br><br>DH5 (T = 2.8852 ms) | |




2DH5 (T = 2.9985 ms)




3DH5 (T = 2.863 ms)



## Test Equipment Verified for Function

| Model # | Description | Checked Function | Results |
|---|---|---|---|
| N9038A | Spectrum Analyzer | Frequency and Amplitude | Connected 50MHz and -20 dBm Ref_siganl and checked OK. |
| JB1 | Antenna, 30 to 2000MHz | Checked structure | Normal – no damage. |
| SAS-571 | Antenna, 1 to 18GHz | Checked structure | Normal – no damage. |
| SAS-572 | Antenna, 18 to 26.5 GHz | Checked structure | Normal – no damage. |
| AL-130 | Antenna, 9kHz to 30MHz | Checked structure | Normal – no damage. |

## Measurement Uncertainty

Where relevant, the following measurement uncertainty levels have been estimated for tests:

| Parameter | Uncertainty |
|---|---|
| Radio Frequency | ± 1 ppm |
| Total RF Power: Conducted | ± 1 dB |
| RF Power Density: Conducted | ± 2.75 dB |
| Spurious Emissions: Conducted | ± 3.0 dB |
| Temperature | ± 1.0 °C |
| Humidity | ± 5.0 % |
| DC and Low Frequency Voltages | ± 3.0 % |
| Radiated Emission, 30 to 6,000MHz | ± 4.93 dB |
| Conducted Measurements, 0.15 to 30MHz | ± 3.52 dB |

Uncertainty figures are valid to a confidence level of 95%.

## 1- Antenna Requirement

| | | | |
|---|---|---|---|
| Standard | 47 CFR Part 15.203<br>RSS-Gen Issue 5 | Room Temperature (°C) | 24.4 |
| Test Method | Inspection | Relative Humidity (%) | 45.9 |
| Test Location | Richmond Lab | Barometric Pressure (hPa) | 1013.5 |
| Test Engineer | Zara Vali | Date of Test | June 19, 2023 |
| Compliant ☒ | Non-Compliant ☐ | Not Applicable ☐ | |

**Test Method**

According to §15.203, an intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section.

**Test Result**

Accordance to the above sections, Abracon PRO-EX-347 is considered sufficient to comply with the provisions of these section. Please see EUT photos for details.

## 2- 20 dB Bandwidth Measurement

| | | | |
|---|---|---|---|
| Standard | FCC Part 15.247 (a) (1)<br>RSS-247 5.1<br>FCC 15.215 (c) | Room Temperature (°C) | 27.6 |
| Test Method | KDB 558074 D01 v05r02<br>ANSI C63.10:2013 | Relative Humidity (RH%) | 44.4 |
| Test Location | Richmond lab | Barometric Pressure (hPa) | 1016.1 |
| Test Engineer | Zara Vali | Date of Test | 15 August 2023 |

| Test Equipment | Manufacturer | Model | Identifier | Calibration | Calibration due |
|---|---|---|---|---|---|
| EMC Analyzer | Keysight | N9038A | 702 | 02 November, 2022 | 02 November, 2023 |
| Attenuator | Mini-Circuit | VAT-20+ | n/a | IHC[1] | IHC[1] |
| RF Cable | MRO | n/a | n/a | IHC[1] | IHC[1] |

Note1) In House Calibration

According to FCC 15.247 (a) (1) and RSS-247 5.1, the bandwidth of a frequency hopping channel is the 20 dB emission bandwidth, measured with the hopping stopped.

Referenced by FCC 15.215 (c), " Intentional radiators must be designed to ensure that the 20 dB bandwidth of the emission, is contained within the frequency band designated in the rule section under which the equipment is operated."

Compliant ☒ Non-Compliant ☐ Not Applicable ☐

**Test Method**

1. Set RBW ≥ 1% to 5% of the 20dB bandwidth
2. VBW = approximately three times RBW
3. Span = approximately 2 to 5 times the 20dB bandwidth, centered on a hopping channel
4. Detector = Peak
5. Trace mode = max hold
6. Sweep = auto couple
7. Allow the trace to stabilize
8. Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower frequencies) that are attenuated by 20 dB relative to the maximum level measured in the fundamental emission.

**Test Setup**

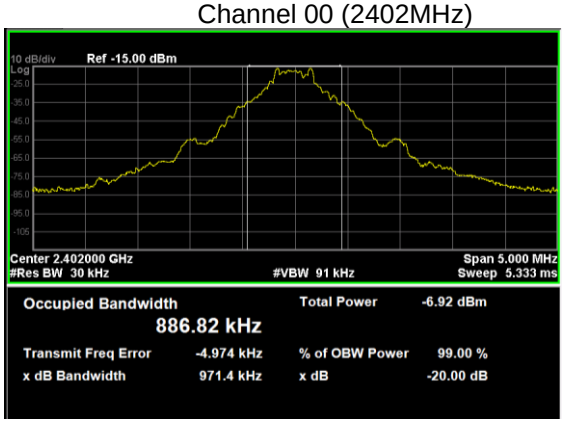

EUT was connected directly to the spectrum analyzer with a 20 dB attenuator.
The EUT was set to **Operation Mode #1 with configuration Mode #1.**

**Test Results**

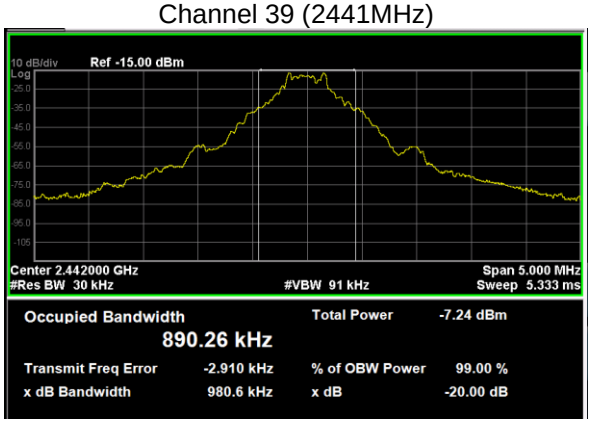
| Test mode | Channel No. | Frequency (MHz) | 20 dB Bandwidth | 99% Bandwidth |
|---|---|---|---|---|
| DH5 | 00 | 2402 | 971.4 kHz | 886.82 KHz |
| DH5 | 39 | 2441 | 980.6 kHz | 890.26 kHz |
| DH5 | 78 | 2480 | 973.1 kHz | 890.70 kHz |
| 2DH5 | 00 | 2402 | 1.348 MHz | 1.2108 MHz |
| 2DH5 | 39 | 2441 | 1.347 MHz | 1.2138 MHz |
| 2DH5 | 78 | 2480 | 1.347MHz | 1.2110 MHz |
| 3DH5 | 00 | 2402 | 1.323 MHz | 1.2145 MHz |
| 3DH5 | 39 | 2441 | 1.323 MHz | 1.2163 MHz |
| 3DH5 | 78 | 2480 | 1.322 MHz | 1.2168 MHz |

***DH5 20dB Bandwidth***

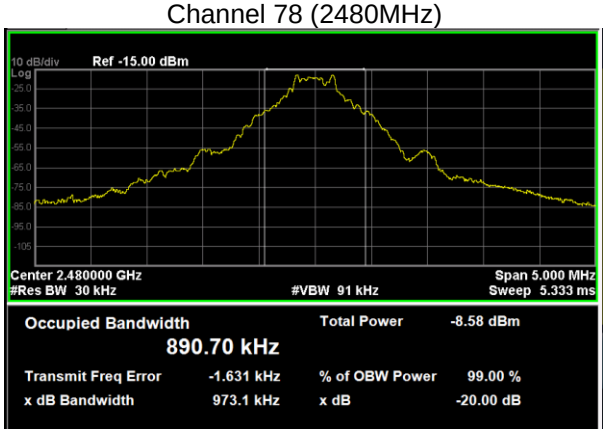
Channel 00 (2402MHz)




Channel 39 (2441MHz)

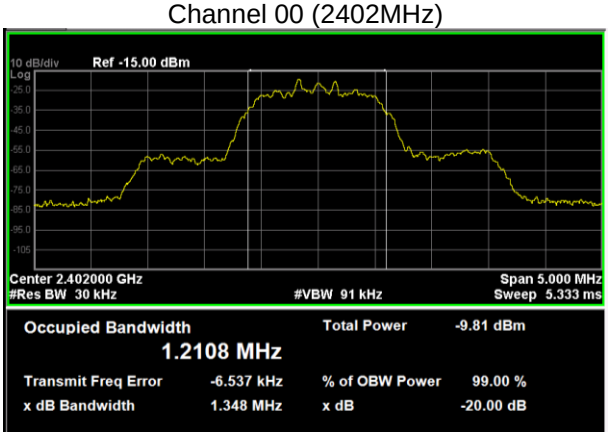


Channel 78 (2480MHz)

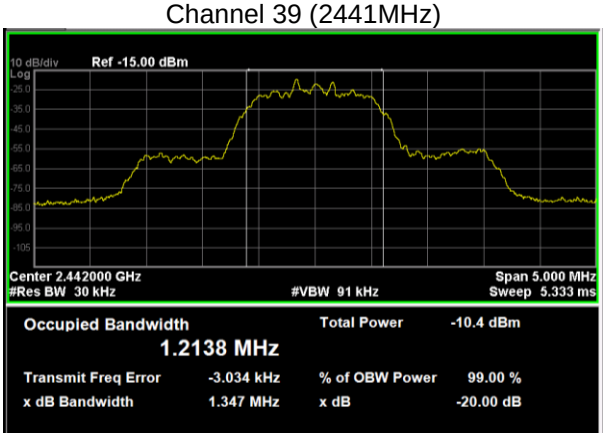



***2DH5 20dB Bandwidth***

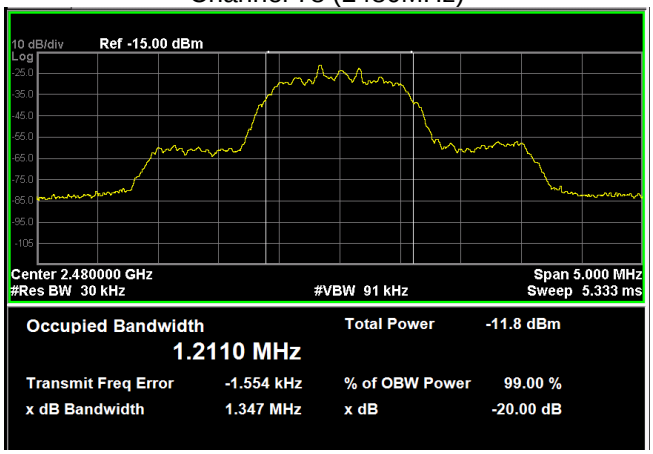
Channel 00 (2402MHz)




Channel 39 (2441MHz)

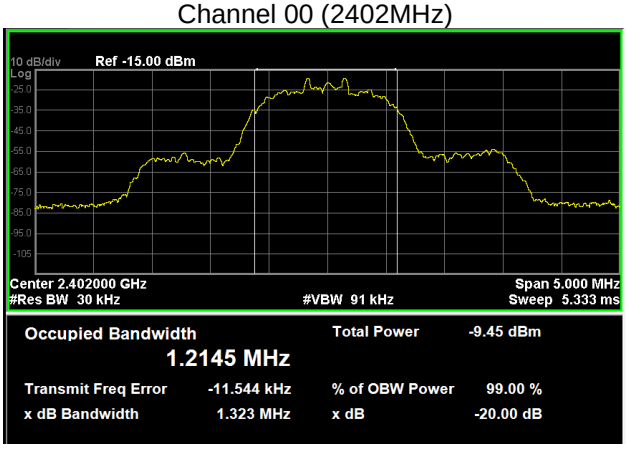



Channel 78 (2480MHz)

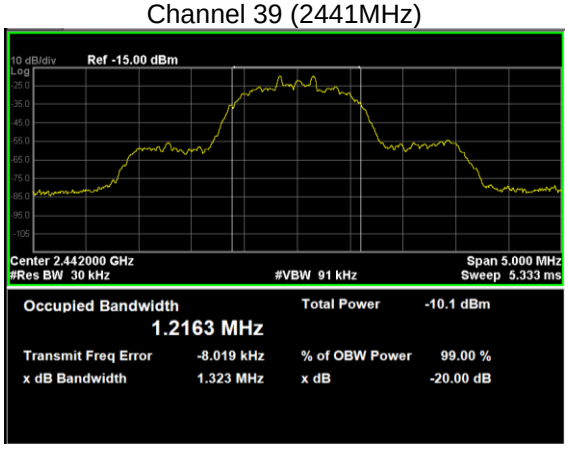


***3DH5 20dB Bandwidth***

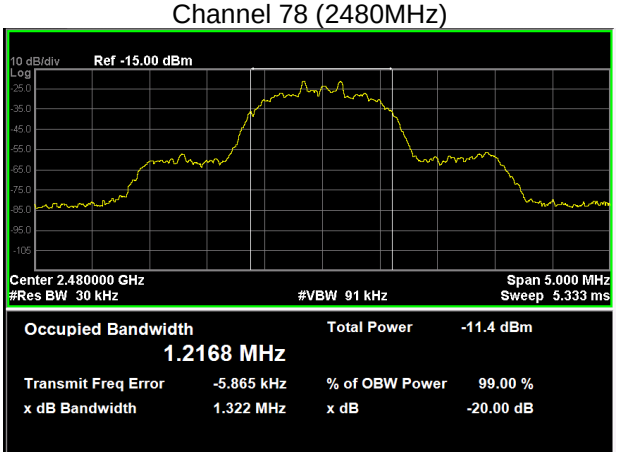
Channel 00 (2402MHz)




Channel 39 (2441MHz)




Channel 78 (2480MHz)



## 3- Conducted Peak Power Measurement

| | | | |
|---|---|---|---|
| Standard | FCC 15.247 (b)(1)<br>RSS-247 5.4 (b)<br>RSS Gen, Issue 5 | Room Temperature (°C) | 27.4 |
| Test Method | KDB 558074 D01 v05r02<br>ANSI C63.10:2013 | Relative Humidity (RH%) | 44.3 |
| Test Location | Richmond Lab | Barometric Pressure (hPa) | 1016.7 |
| Test Engineer | Zara Vali | Date of Test | 15 August 2023 |

| Test Equipment Used | Manufacturer | Model | Identifier | Calibration | Calibration due |
|---|---|---|---|---|---|
| EMC Analyzer | Keysight | N9038A | 702 | 02 November, 2022 | 02 November, 2023 |
| RF Cable | MRO | n/a | n/a | IHC[1] | IHC[1] |
| Attenuator | Mini-Circuit | VAT-20+ | n/a | IHC[1] | IHC[1] |

Note1) In House Calibration

According to FCC. 15.247 (b) and RSS- 247 5.4 (b): The maximum peak conducted output power of the intentional radiator shall not exceed the following: (1) for frequency hopping systems operating in the 2400–2483.5 MHz band employing at least 75 non-overlapping hopping channels, and all frequency hopping systems in the 5725–5850 MHz band: 1 watt. For all other frequency hopping systems in the 2400–2483.5 MHz band: 0.125 watts. The e.i.r.p. shall not exceed 4 W.

Compliant ☒ Non-Compliant ☐ Not Applicable ☐

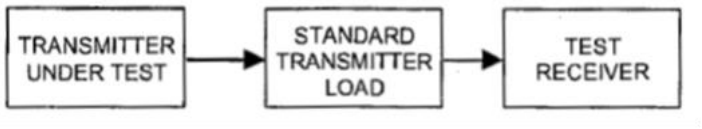
**Test Method**

1. Set RBW ≥ the 20 dB bandwidth of the emission being measured.
2. VBW ≥ RBW
3. Span = approximately five times the 20dB bandwidth, centered on a hopping channel
4. Detector = Peak
5. Trace mode = max hold
6. Sweep = auto couple
7. Allow the trace to stabilize, Use the marker-to-peak function to set the marker to the peak of the emission. The indicated level is the peak output power (don't forget added the external attenuation and cable loss)

Peak Power (dBm) = Peak Power Reading (dBm) + System (dB)
System (dB) = Cable Loss (dB) + Attenuator (dB/m)
Max EIRP (dBm) = Peak Power (dBm) + Antenna Gain (dBi),
Antenna Gain (dBi) = 3

**Test Setup**

Description of test set-up:



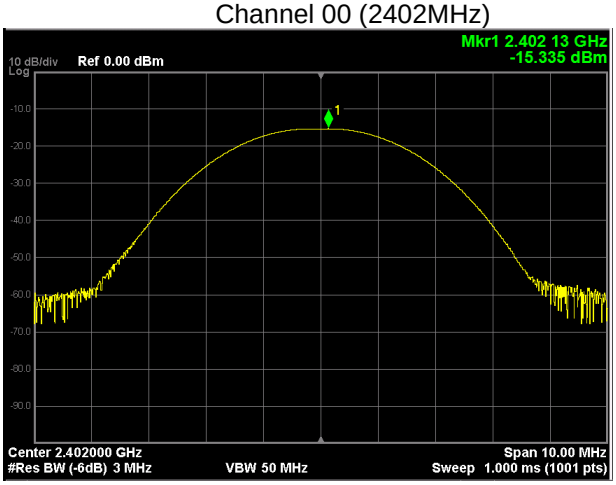

EUT was connected directly to the spectrum analyzer with a 20 dB attenuator and a short cable.
The EUT was set to **Operation Mode #1 with configuration Mode #1.**

**Test Results**

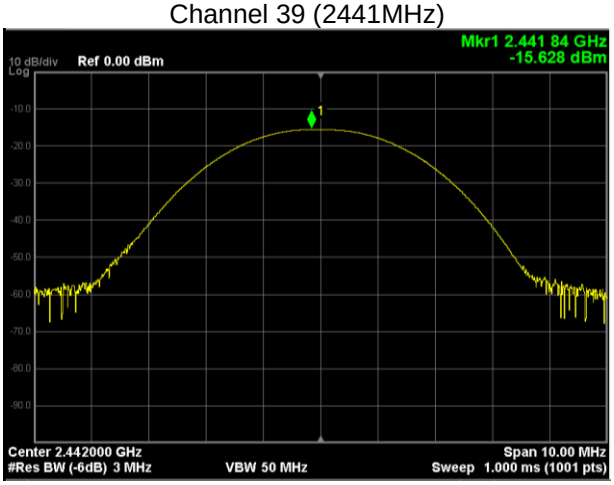
| Test Mode | Channel No. | Frequency (MHz) | Peak Power Reading (dBm) | System (dB) | Peak Power (dBm) | Power Limit (dBm) | Max EIRP (dBm) | EIRP Limit (dBm) |
|---|---|---|---|---|---|---|---|---|
| DH5 | 00 | 2402 | -15.335 | 21.264 | 5.929 | ≤ 30.00 | 8.929 | ≤ 36 |
| DH5 | 39 | 2441 | -15.628 | 21.264 | 5.636 | ≤ 30.00 | 8.636 | ≤ 36 |
| DH5 | 78 | 2480 | -16.900 | 21.264 | 4.364 | ≤ 30.00 | 7.364 | ≤ 36 |
| 2DH5 | 00 | 2402 | -16.502 | 21.264 | 4.762 | ≤ 30.00 | 7.762 | ≤ 36 |
| 2DH5 | 39 | 2442 | -17.131 | 21.264 | 4.133 | ≤ 30.00 | 7.133 | ≤ 36 |
| 2DH5 | 78 | 2480 | -18.517 | 21.264 | 2.747 | ≤ 30.00 | 5.747 | ≤ 36 |
| 3DH5 | 00 | 2402 | -16.198 | 21.264 | 5.066 | ≤ 30.00 | 8.066 | ≤ 36 |
| 3DH5 | 39 | 2441 | -16.839 | 21.264 | 4.425 | ≤ 30.00 | 7.425 | ≤ 36 |
| 3DH5 | 78 | 2480 | -18.231 | 21.264 | 3.033 | ≤ 30.00 | 6.033 | ≤ 36 |

***DH5 Output Power***

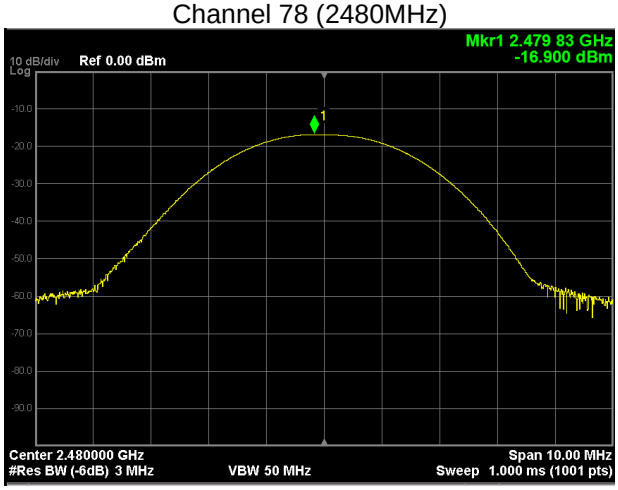
Channel 00 (2402MHz)




Channel 39 (2441MHz)

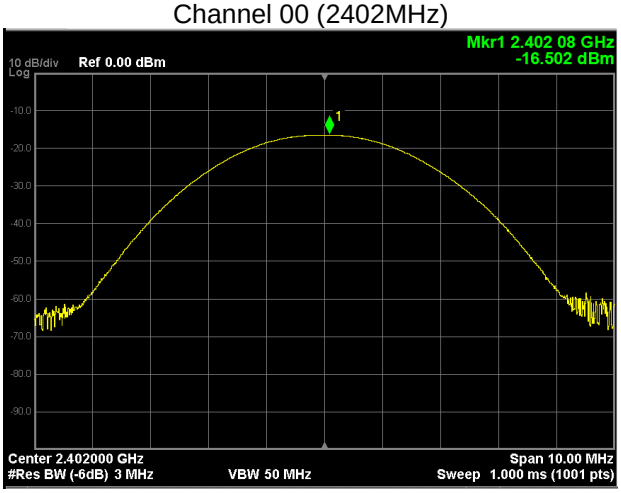



Channel 78 (2480MHz)

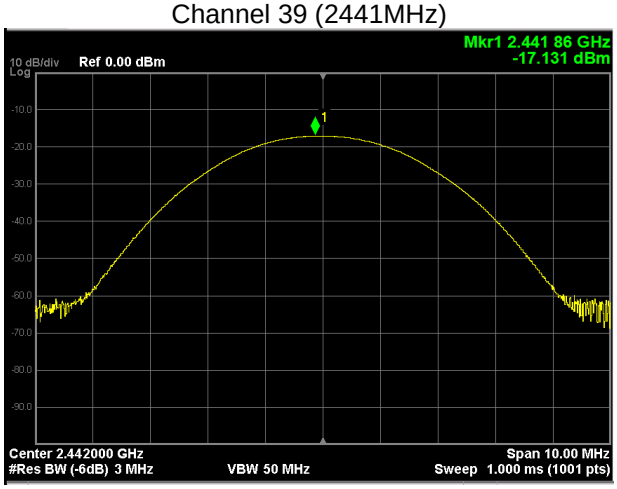



***2DH5 Output Power***

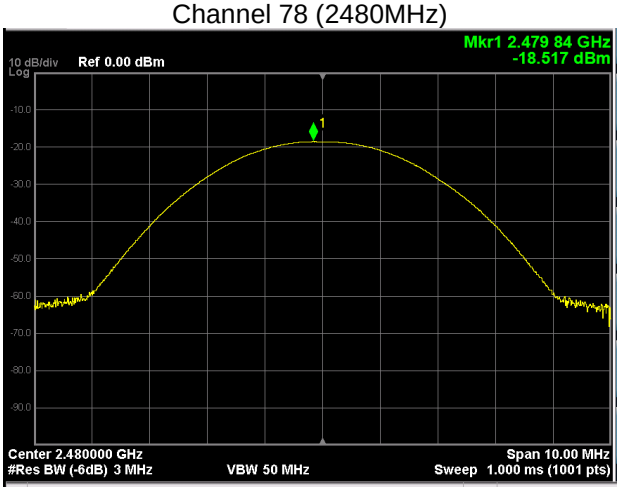
Channel 00 (2402MHz)




Channel 39 (2441MHz)

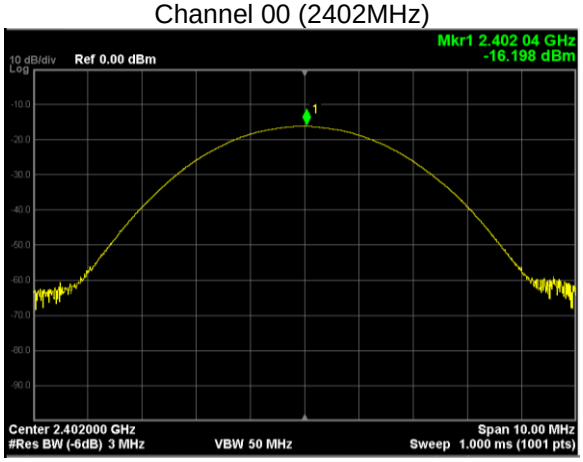


Channel 78 (2480MHz)

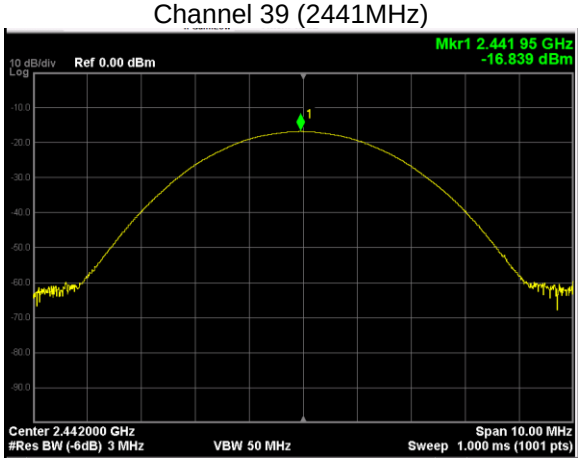



***3DH5 Output Power***

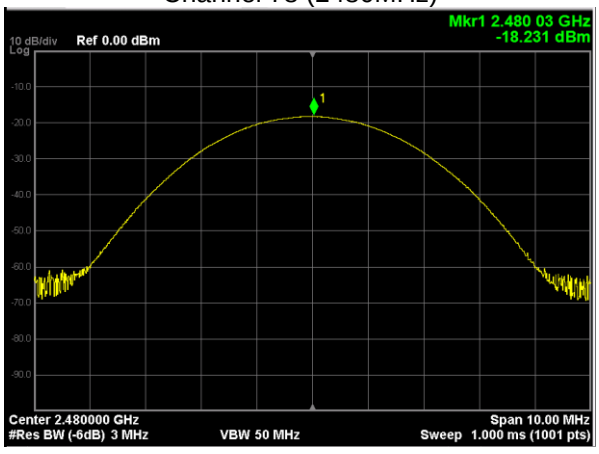
Channel 00 (2402MHz)




Channel 39 (2441MHz)




Channel 78 (2480MHz)



## 4- Carrier Frequency Separation Measurement

| | | | |
|---|---|---|---|
| Standard | FCC 15.247(a) (1)<br>RSS-247 5.1 | Room Temperature (°C) | 27.1 |
| Test Method | ANSI C63.10: 2013 | Relative Humidity (RH%) | 44.8 |
| Test Location | Richmond Lab | Barometric Pressure (hPa) | 1016.6 |
| Test Engineer | Zara Vali | Date of Test | 15 August 2023 |

| Test Equipment Used | Manufacturer | Model | Identifier | Calibration date | Calibration due |
|---|---|---|---|---|---|
| Spectrum Analyzer | Keysight | N9038A | 702 | 02 November, 2022 | 02 November, 2023 |
| Attenuator | Mini-Circuit | VAT-20+ | n/a | IHC[1] | IHC[1] |
| RF Cable | MRO | n/a | n/a | IHC[1] | IHC[1] |

Note1) In House Calibration

According to FCC. 15.247 (a)(1) Frequency hopping systems operating in the 2400–2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW.

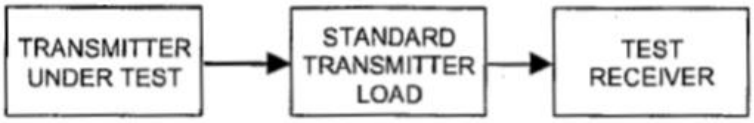
Compliant ☒ Non-Compliant ☐ Not Applicable ☐

**Test Method**

1. Span = wide enough to capture the peaks of two adjacent channels.
2. Start with the RBW set to approximately 30% of the channel spacing; adjust as necessary to best identify the center of each individual channel.
3. VBW ≥ RBW
4. Sweep time = Auto couple
5. Detector = Peak
6. Trace mode = Max hold
7. Allowed the trace to stabilize
8. Use the marker-delta function to determine the separation between the peaks of the adjacent channels.

**Test Setup**

Description of test set-up:



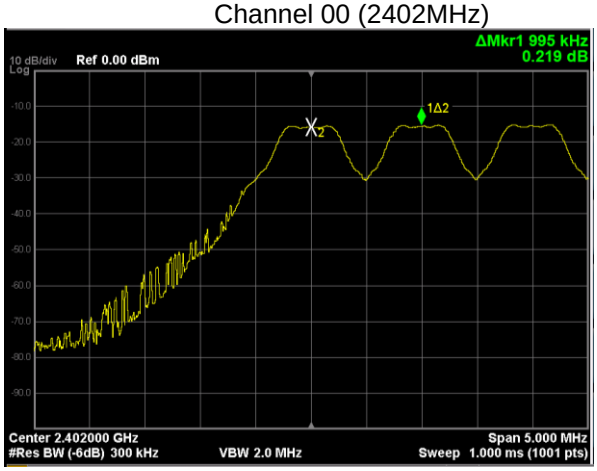

The EUT was connected directly to the spectrum analyzer/receiver with 20 dB attenuation.
The EUT was set to **Operation Mode #1 with configuration Mode #1.**

**Test Results**

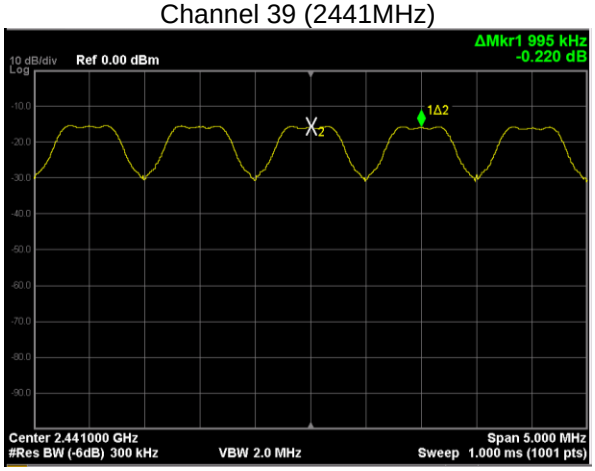
| Test Mode | Channel No. | Frequency (MHz) | Separation | Limit 2/3 20 dB BW |
|---|---|---|---|---|
| DH5 | 00 | 2402 | 995 kHz | >647.6 kHz |
| DH5 | 39 | 2441 | 995 kHz | >653.7 kHz |
| DH5 | 78 | 2480 | 985 kHz | >648.7 kHz |
| 2DH5 | 00 | 2402 | 990 kHz | >898.6 kHz |
| 2DH5 | 39 | 2441 | 1000 kHz | >898 kHz |
| 2DH5 | 78 | 2480 | 995 kHz | >898 kHz |
| 3DH5 | 00 | 2402 | 1000 kHz | >882 kHz |
| 3DH5 | 39 | 2441 | 1005 kHz | >882 kHz |
| 3DH5 | 78 | 2480 | 1000 kHz | >881.3 kHz |

***DH5 Carrier Frequency Separation***

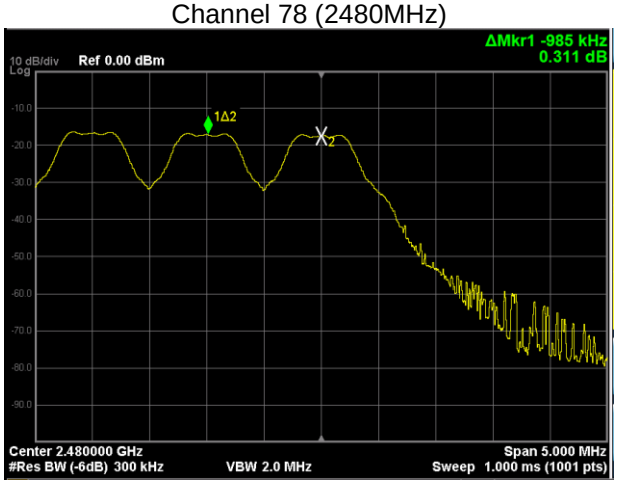
Channel 00 (2402MHz)




Channel 39 (2441MHz)

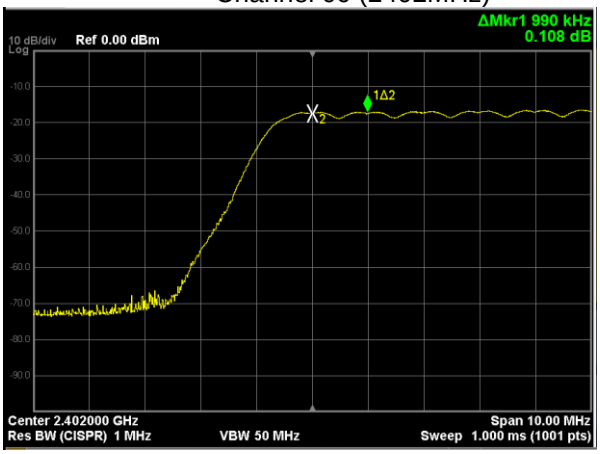


Channel 78 (2480MHz)

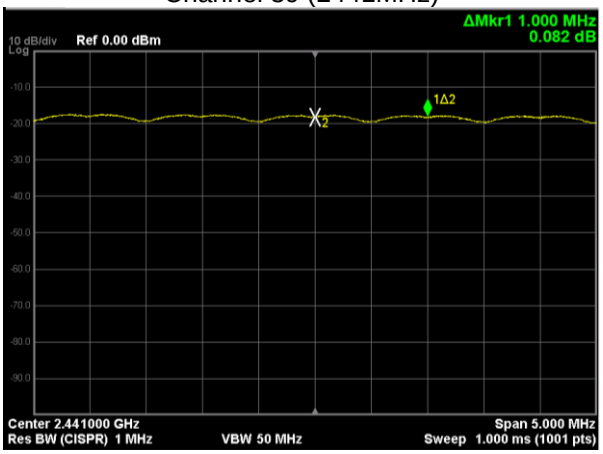



***2DH5 Carrier Frequency Separation***

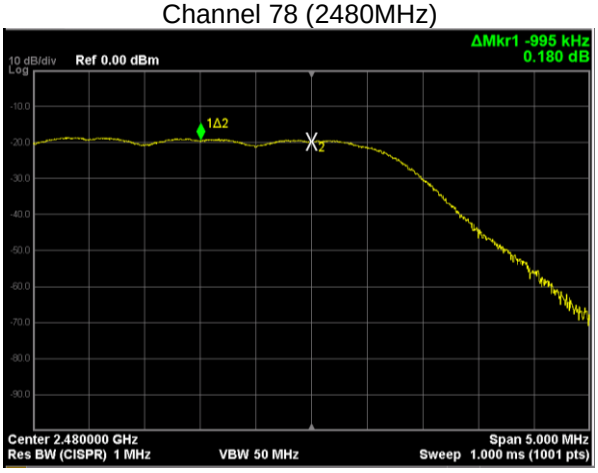
Channel 00 (2402MHz)




Channel 39 (2441MHz)

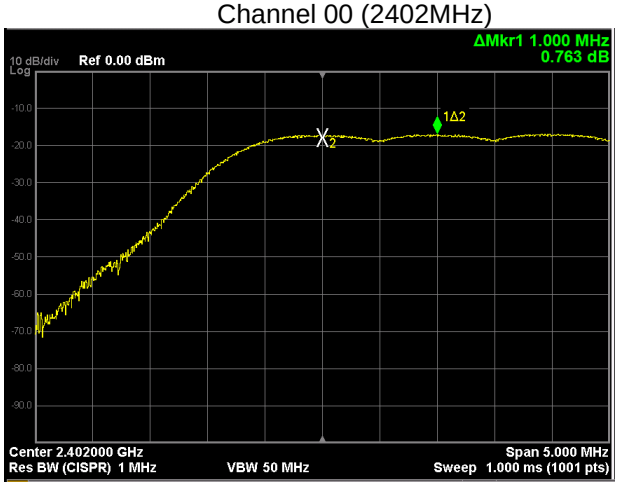



Channel 78 (2480MHz)

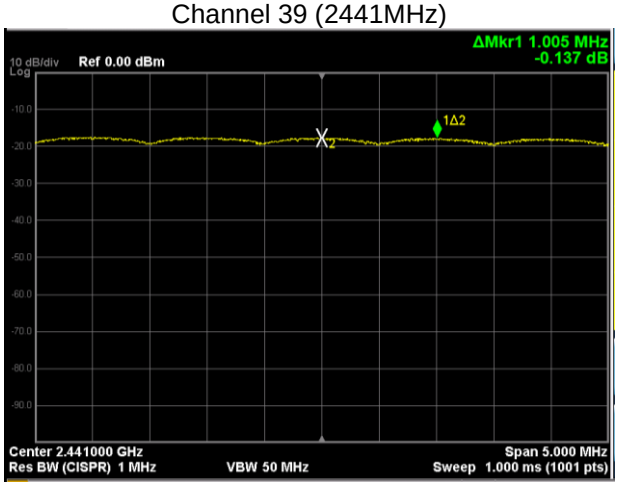


***3DH5 Carrier Frequency Separation***

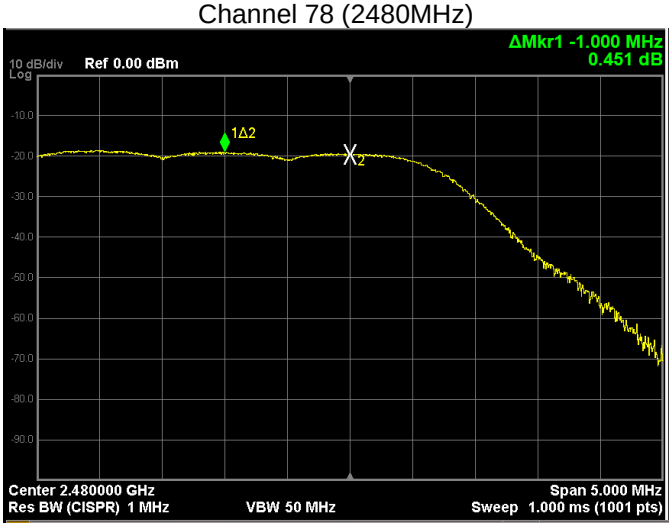
Channel 00 (2402MHz)




Channel 39 (2441MHz)




Channel 78 (2480MHz)



## 5- Number of Hopping Channels Measurement

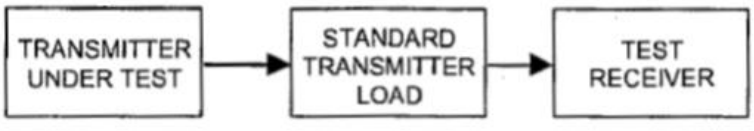
| | | | | | |
|---|---|---|---|---|---|
| Standard | FCC 15.247(a) (1) (iii)<br>RSS-247 5.1 | | Room Temperature (°C) | | 29.1 |
| Test Method | ANSI C63.10: 2013 | | Relative Humidity (RH%) | | 45.8 |
| Test Location | Richmond Lab | | Barometric Pressure (hPa) | | 1016.6 |
| Test Engineer | Zara Vali | | Date of Test | | 15 August 2023 |
| Test Equipment Used | Manufacturer | Model | Identifier | Calibration date | Calibration due |
| Spectrum Analyzer | Keysight | N9038A | 702 | 02 November, 2022 | 02 November, 2023 |
| Attenuator | Mini-Circuit | VAT-20+ | n/a | IHC[1] | IHC[1] |
| RF Cable | MRO | n/a | n/a | IHC[1] | IHC[1] |
| Note1) In House Calibration | | | | | |
| According to FCC. 15.247 (a)(1) (iii), Frequency hopping systems in the 2400–2483.5 MHz band shall use at least 15 channels. | | | | | |
| Compliant ☒ | Non-Compliant ☐ | | Not Applicable ☐ | | |

**Test Method**

1. Span = the frequency band of operation.
2. To identify clearly the individual channels, set the RBW to less than 30% of the channel spacing or the 20 dB bandwidth, whichever is smaller.
3. VBW ≥ RBW
4. Sweep time = Auto couple
5. Detector = Peak
6. Trace mode = Max hold
7. Allow the trace to stabilize

**Test Setup**

Description of test set-up:



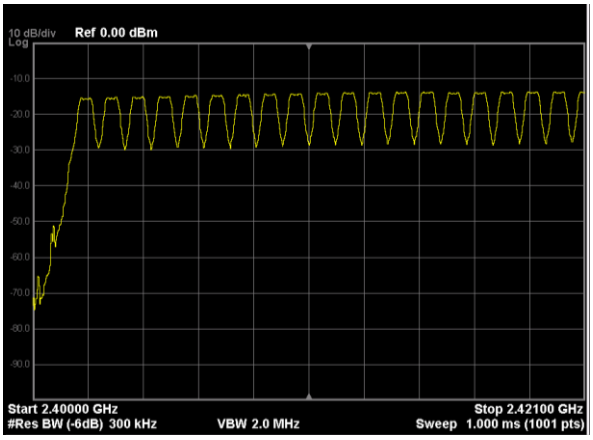

The EUT was connected directly to the spectrum analyzer/receiver with 20 dB attenuation.
The EUT was set to **Operation Mode #1 with configuration Mode #1.**

## Test Results

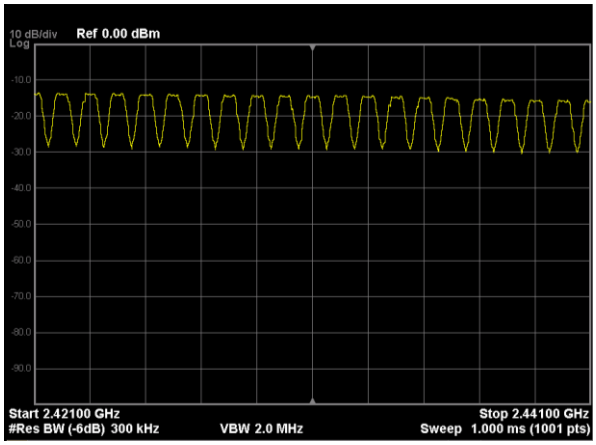
| Test Mode (Hopping) | Channel Numbers | Frequency (MHz) | Limit (Hoppning Channels) |
|---|---|---|---|
| DH5 | 79 | 2402~2480 | >15 |
| 2DH5 | 79 | 2402~2480 | >15 |
| 3DH5 | 79 | 2402~2480 | >15 |

***DH5 Number of Hopping Channels***

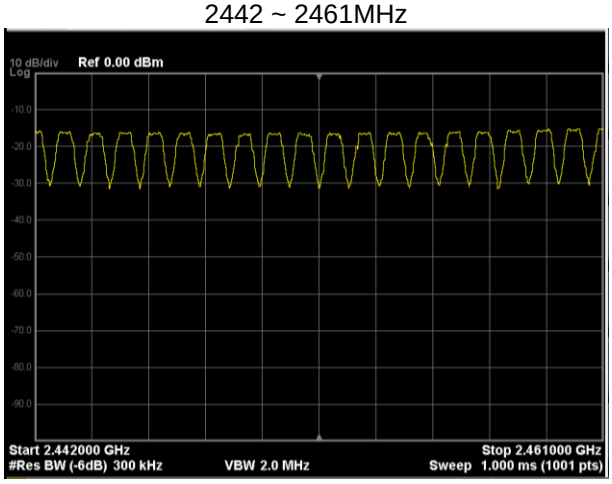
2402 ~ 2421MHz



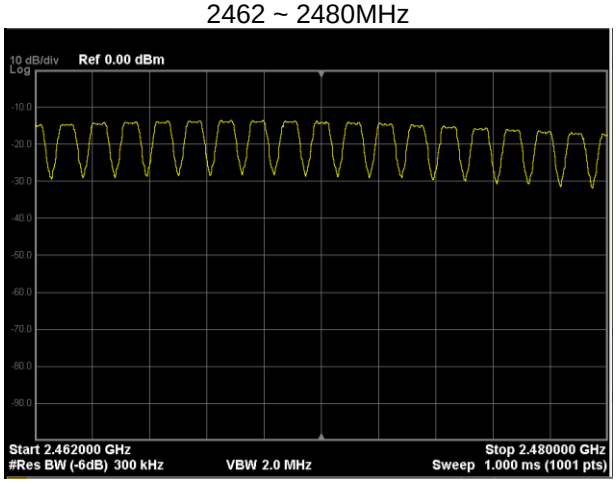

2422 ~ 2441MHz




2442 ~ 2461MHz

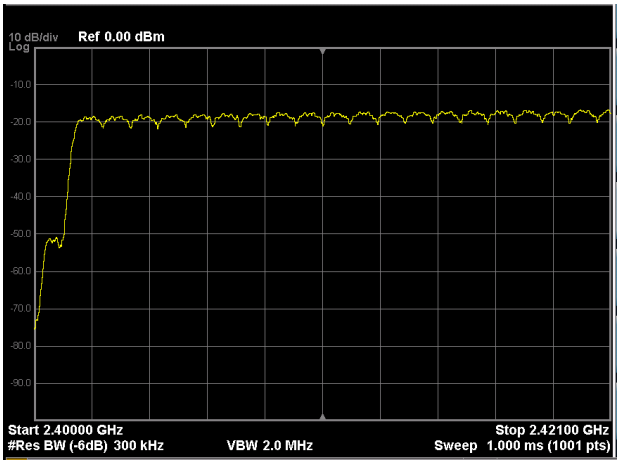



2462 ~ 2480MHz

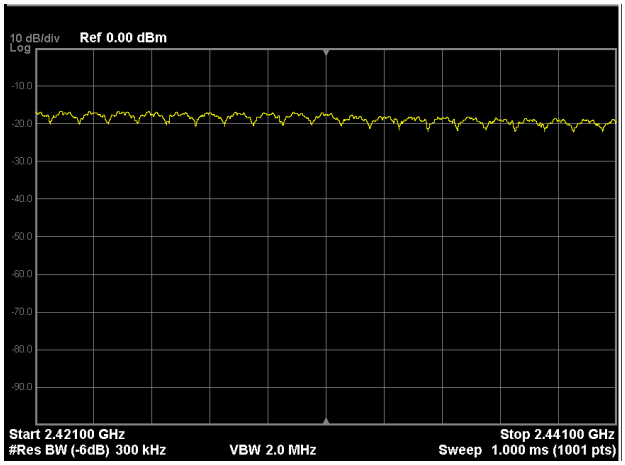


***2DH5 Number of Hopping Channels***

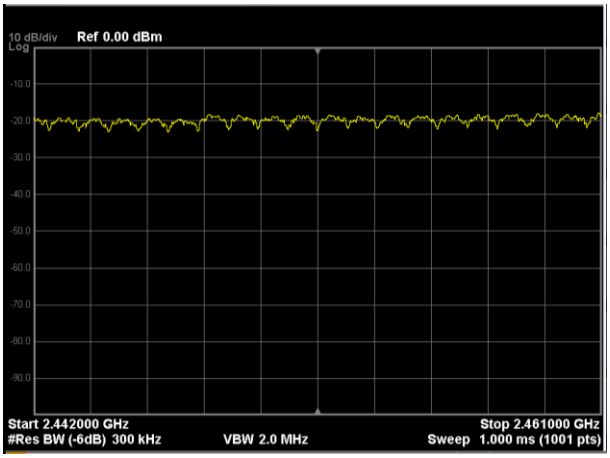
2402 ~ 2421MHz



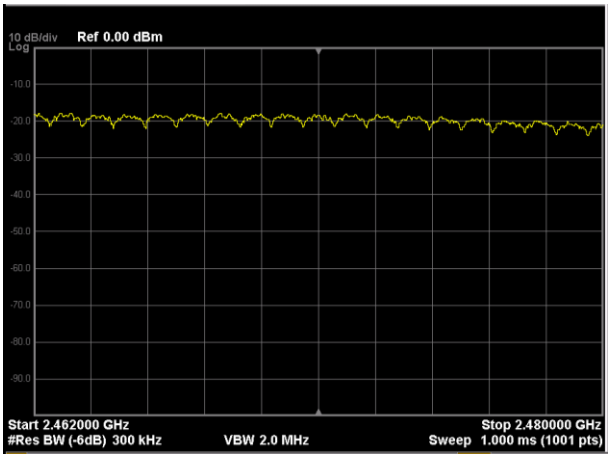

2422 ~ 2441MHz




2442 ~ 2461MHz

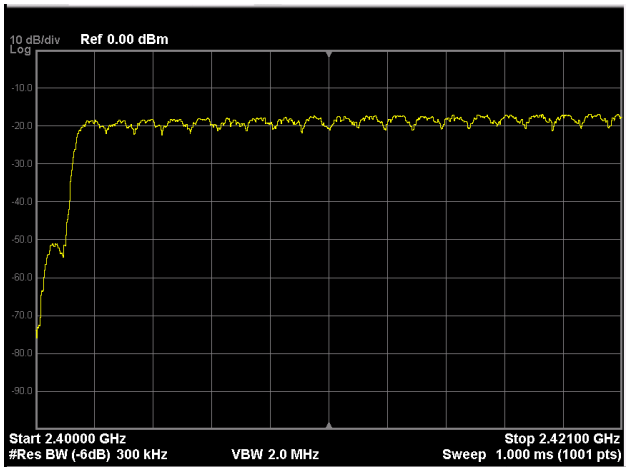



2462 ~ 2480MHz

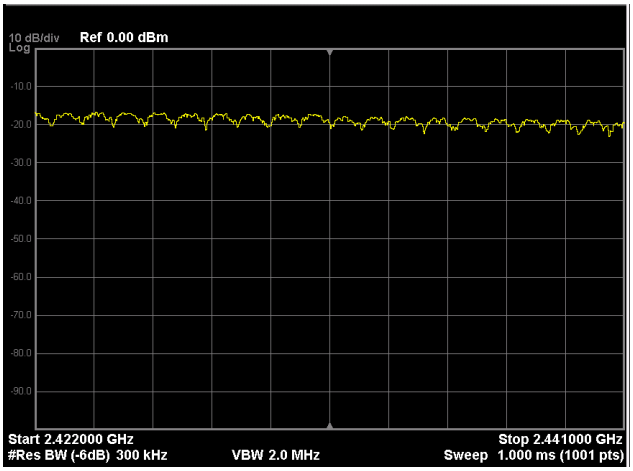


***3DH5 Number of Hopping Channels***

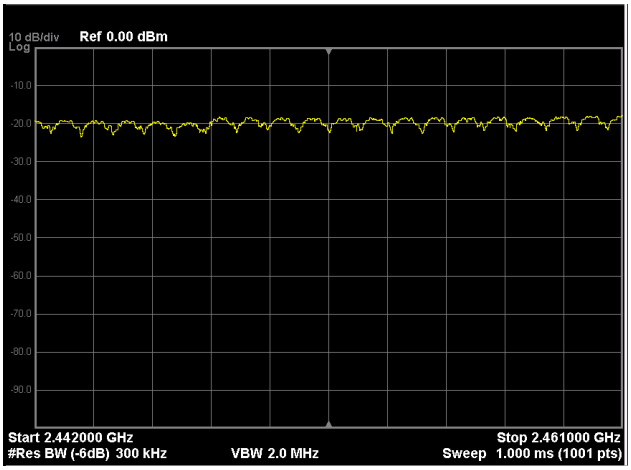
2402 ~ 2421MHz



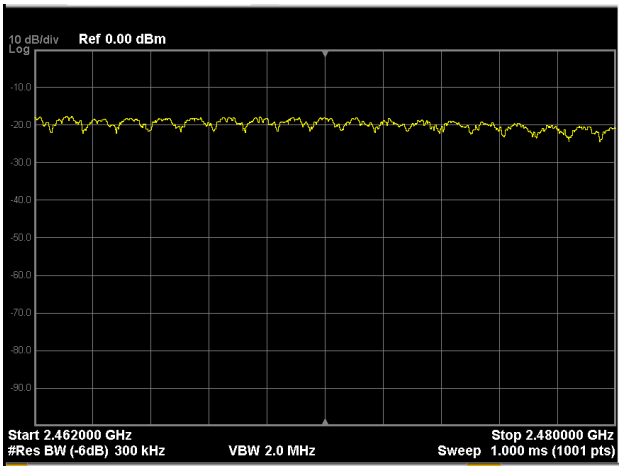

2422 ~ 2441MHz




2442 ~ 2461MHz




2462 ~ 2480MHz



## 6- Time of Occupancy Measurement

| | | | |
|---|---|---|---|
| Standard | FCC 15.247(a) (1) (iii)<br>RSS-247 5.1 | Room Temperature (°C) | 28 |
| Test Method | ANSI C63.10: 2013 | Relative Humidity (RH%) | 45.5 |
| Test Location | Richmond Lab | Barometric Pressure (hPa) | 1017.1 |
| Test Engineer | Zara Vali | Date of Test | 16 August 2023 |

| Test Equipment Used | Manufacturer | Model | Identifier | Calibration date | Calibration due |
|---|---|---|---|---|---|
| Spectrum Analyzer | Keysight | N9038A | 702 | 02 November, 2022 | 02 November, 2023 |
| Attenuator | Mini-Circuit | VAT-20+ | n/a | IHC[1] | IHC[1] |
| RF Cable | MRO | n/a | n/a | IHC[1] | IHC[1] |

Note1) In House Calibration

According to FCC. 15.247 (a)(1) (iii), Frequency hopping systems in the 2400–2483.5 MHz band shall use at least 15 channels. The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed.

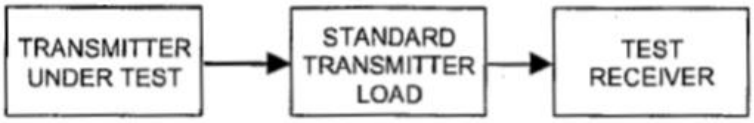
Compliant ☒ Non-Compliant ☐ Not Applicable ☐

**Test Method**

1. Span = zero span, centered on a hopping channel.
2. RBW shall be ≤ channel spacing and where possible RBW should be set >> 1 / T, where T is the expected dwell time per channel.
3. VBW ≥ RBW
4. Sweep time = as necessary to capture the entire dwell time per hopping channel
5. Detector = Peak
6. Trace mode = max hold
7. Use the marker-delta function to determine the transmit time per hop. If this value varies with different modes of operation (data rate, modulation format, number of hopping channels, etc.), then repeat this test for each variation in transmit time. An oscilloscope may be used instead of a spectrum analyzer. The EUT shall show compliance with the appropriate regulatory limit for the number of hopping channels. A plot of the data shall be included in the test report.

**Test Setup**

Description of test set-up:



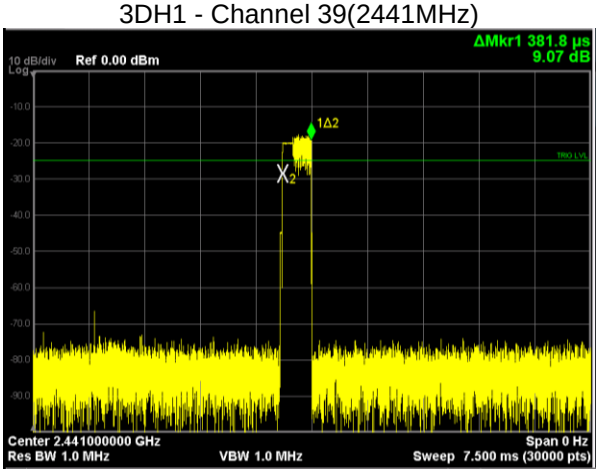

The EUT was connected directly to the spectrum analyzer/receiver with 20 dB attenuation.
The EUT was set to **Operation Mode #1 with configuration Mode #1.**

**Test Results**

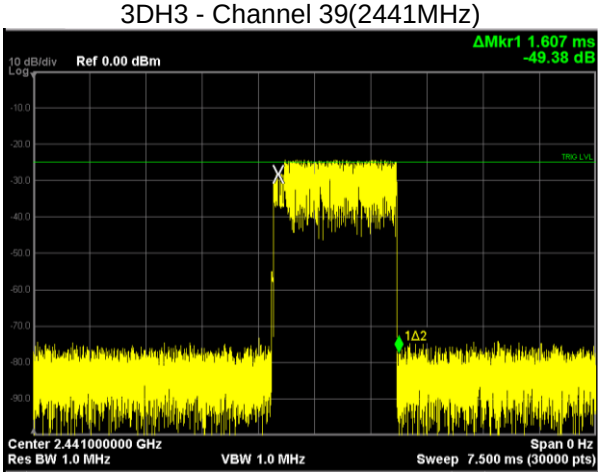
| Test Mode (Hopping) | Channel Numbers | Frequency (MHz) | Hops Over Occupancy Time(Hops) | Packet Transfer Time (ms) | Time of Occupancy (ms) | Limit (ms) |
|---|---|---|---|---|---|---|
| 3DH1 | 39 | 2441 | 320 | 0.381 | 121.92 | <400 |
| 3DH3 | 39 | 2441 | 160 | 1.607 | 257.12 | <400 |
| 3DH5 | 39 | 2441 | 107 | 2.844 | 304.308 | <400 |

***Packet Transfer Time***

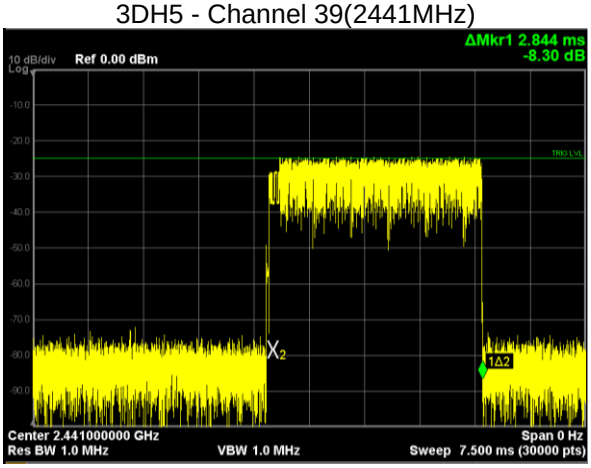
3DH1 - Channel 39(2441MHz)




3DH3 - Channel 39(2441MHz)



3DH5 - Channel 39(2441MHz)




Note 1: According the Bluetooth Standard Specification, the nominal hop rate is 1600 hops/s. All Bluetooth unit participating in the piconet are time and hop synchronized to the channel.
Hops Over Occupancy Time in 31.6s for 3DH1 = 1600 / 2 / 79 * 31.6 = 320.
Hops Over Occupancy Time in 31.6s for 3DH3 = 1600 / 4 / 79 * 31.6 = 160.
Hops Over Occupancy Time in 31.6s for 3DH5 = 1600 / 6 / 79 * 31.6 = 107.
Note 2: Time of Occupancy = Packet Transfer Time * Hops Over Occupancy Time in 31.6s

## 7- Band Edge and Out of Band Emissions

| | | | |
|---|---|---|---|
| Standard | FCC Part 15.247 (d)<br>RSS-247 5.5 | Room Temperature (°C) | 28.4 |
| Test Method | KDB 558074 D01 v05r02<br>ANSI C63.10: 2013 | Relative Humidity (RH%) | 44.6 |
| Test Location | Richmond Lab | Barometric Pressure (hPa) | 1017 |
| Test Engineer | Zara Vali | Date of Test | 16 August 2023 |

| Test Equipment Used | Manufacturer | Model | Identifier | Calibration | Calibration due |
|---|---|---|---|---|---|
| Spectrum Analyzer | Keysight | N9038A | 702 | 02 November, 2022 | 02 November, 2023 |
| Attenuator | Mini-Circuit | VAT-20+ | N/A | IHC[1] | IHC[1] |
| RF Cable | MRO | n/a | n/a | IHC[1] | IHC[1] |

Note1) In House Calibration

According to FCC 15.247 (d): In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits.

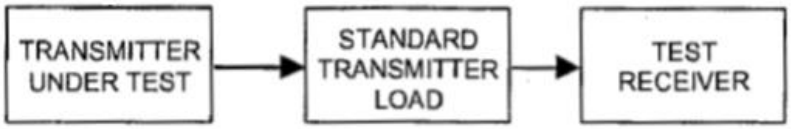
Compliant ☒ Non-Compliant ☐ Not Applicable ☐

**Test Method**

*Reference Level Measurement*
1. Set instrument center frequency to the channel center frequency.
2. Set the span wide enough to capture the peak level of the emission operating on the channel closest to the band edge, as well as any modulation products which fall outside of the authorized band of operation.
3. Set the RBW = 100 kHz.
4. Set the VBW ≥ 3 x RBW.
5. Set the detector to peak mode.
6. Sweep time is set to auto couple
7. Set the trace mode to Max Hold.
8. Allow trace to fully stabilize.

*Emission Level Measurement*
1. Set the center frequency and span to encompass frequency range to be measured.
2. Set the RBW = 100 kHz.
3. Set the VBW ≥ 3 x RBW.
4. Set the detector to peak mode.
5. Set the trace mode to Max Hold.
6. Sweep time is set to auto couple
7. Allow trace to fully stabilize.

**Test Setup**

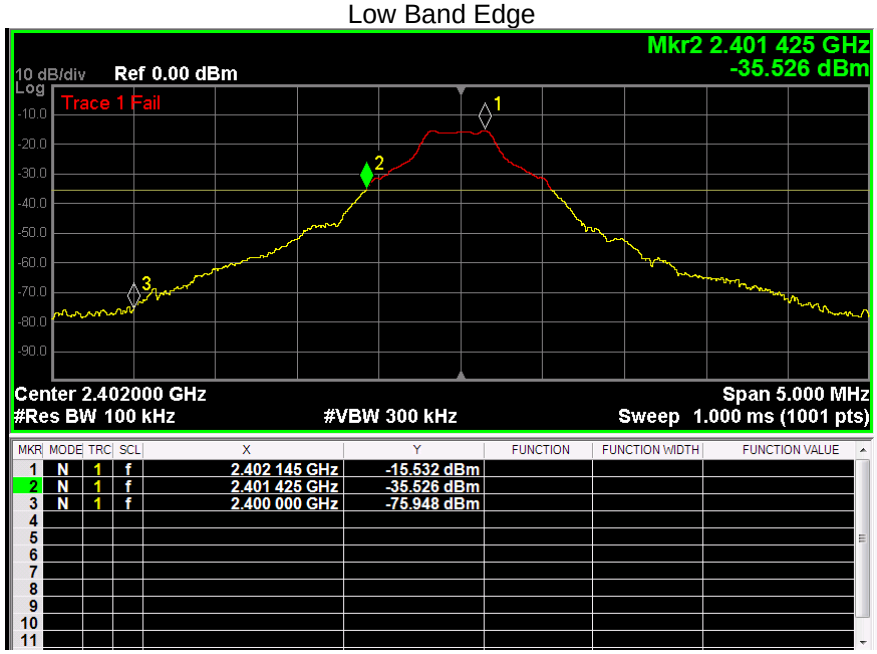



The EUT was connected directly to the spectrum analyser/receiver with appropriate attenuation.
The EUT was set to **Operation Mode #1 with configuration Mode #1.**

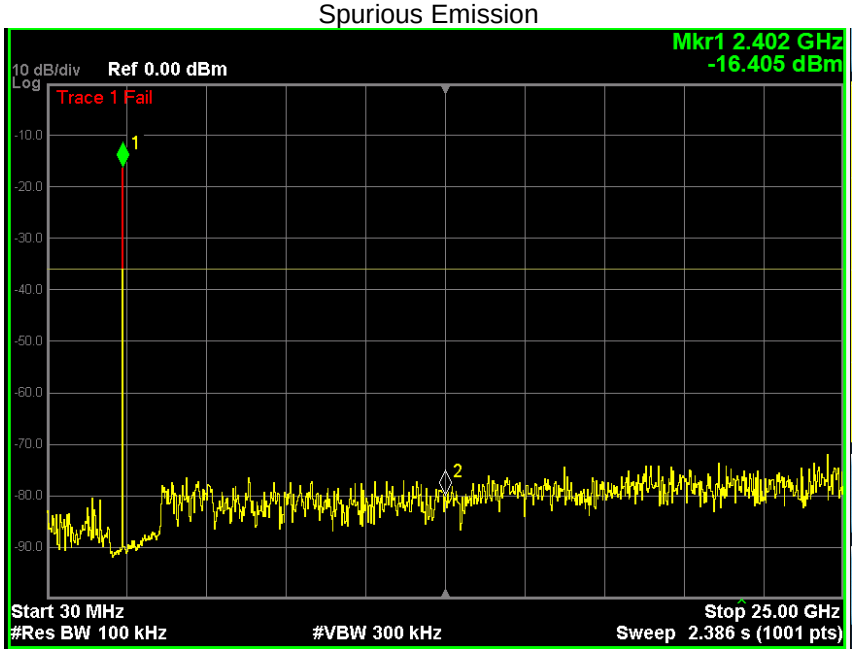
**Test Results**

| Test Mode | Channel No. | Frequency (MHz) | Limit |
|---|---|---|---|
| DH5 | 00 | 2402 | 20 dBc |
| DH5 | 39 | 2441 | 20 dBc |
| DH5 | 78 | 2480 | 20 dBc |
| 2DH5 | 00 | 2402 | 20 dBc |
| 2DH5 | 39 | 2441 | 20 dBc |
| 2DH5 | 78 | 2480 | 20 dBc |
| 3DH5 | 00 | 2402 | 20 dBc |
| 3DH5 | 39 | 2441 | 20 dBc |
| 3DH5 | 78 | 2480 | 20 dBc |

***DH5 - Channel 00 (2402MHz)***
Low Band Edge

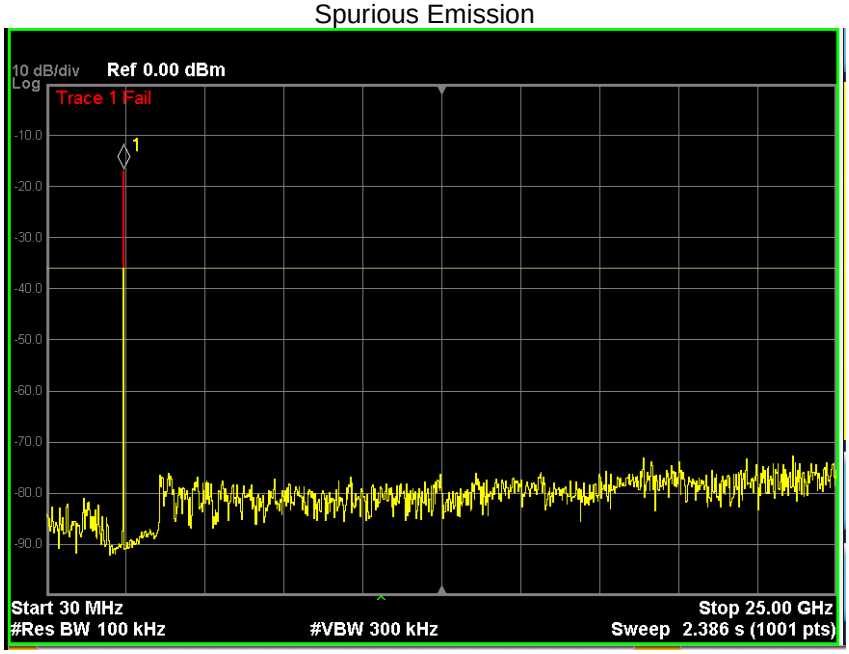


Spurious Emission



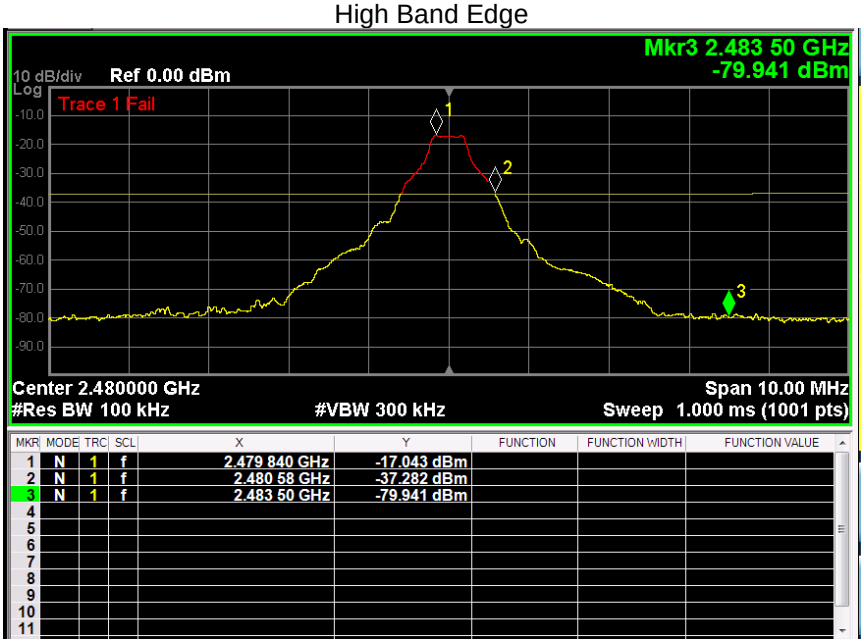

***DH5 - Channel 39 (2441MHz)***

Spurious Emission



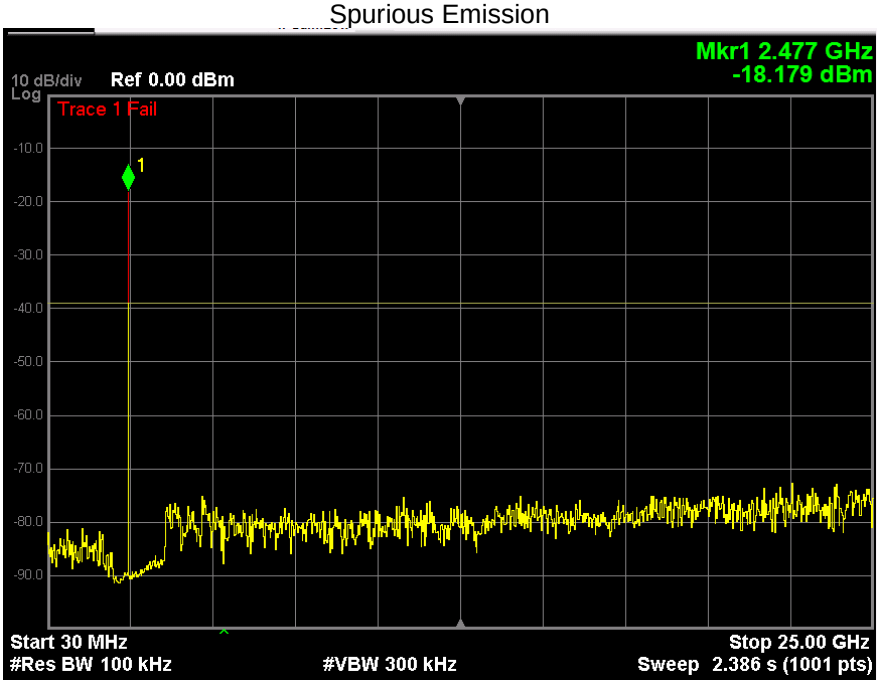
***DH5 - Channel 78 (2480MHz)***

High Band Edge



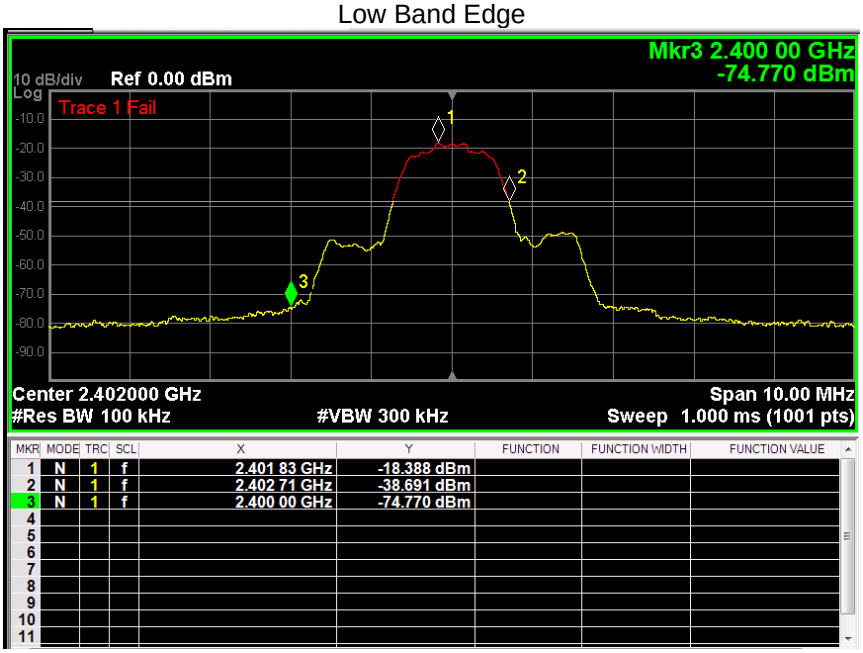

| MKR | MODE | TRC | SCL | X | Y | FUNCTION | FUNCTION WIDTH | FUNCTION VALUE |
|---|---|---|---|---|---|---|---|---|
| 1 | N | 1 | f | 2.479 840 GHz | -17.043 dBm | | | |
| 2 | N | 1 | f | 2.480 58 GHz | -37.282 dBm | | | |
| 3 | N | 1 | f | 2.483 50 GHz | -79.941 dBm | | | |
| 4 | | | | | | | | |
| 5 | | | | | | | | |
| 6 | | | | | | | | |
| 7 | | | | | | | | |
| 8 | | | | | | | | |
| 9 | | | | | | | | |
| 10 | | | | | | | | |
| 11 | | | | | | | | |

Spurious Emission



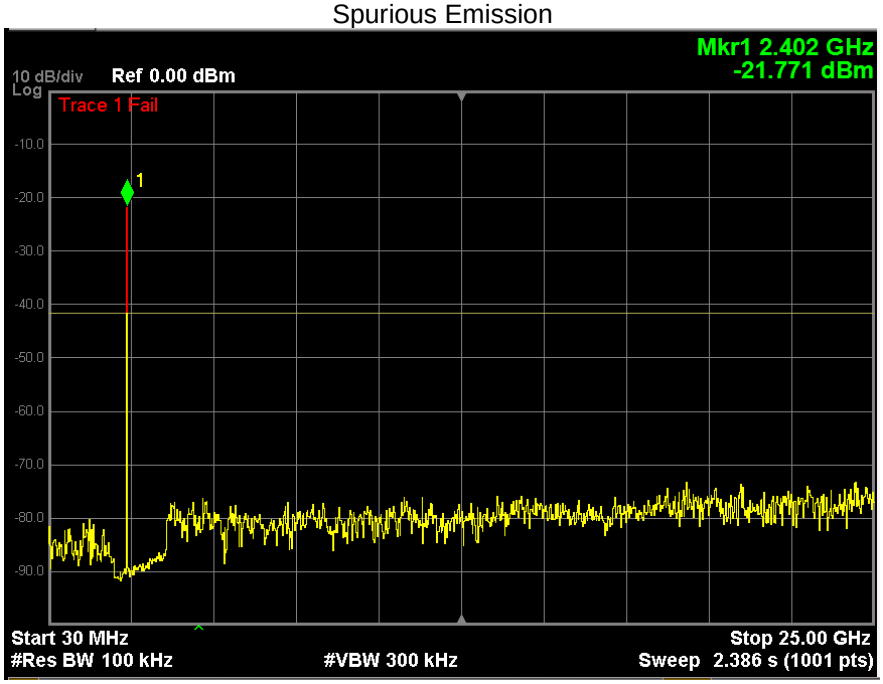
***2DH5 - Channel 00 (2402MHz)***

Low Band Edge



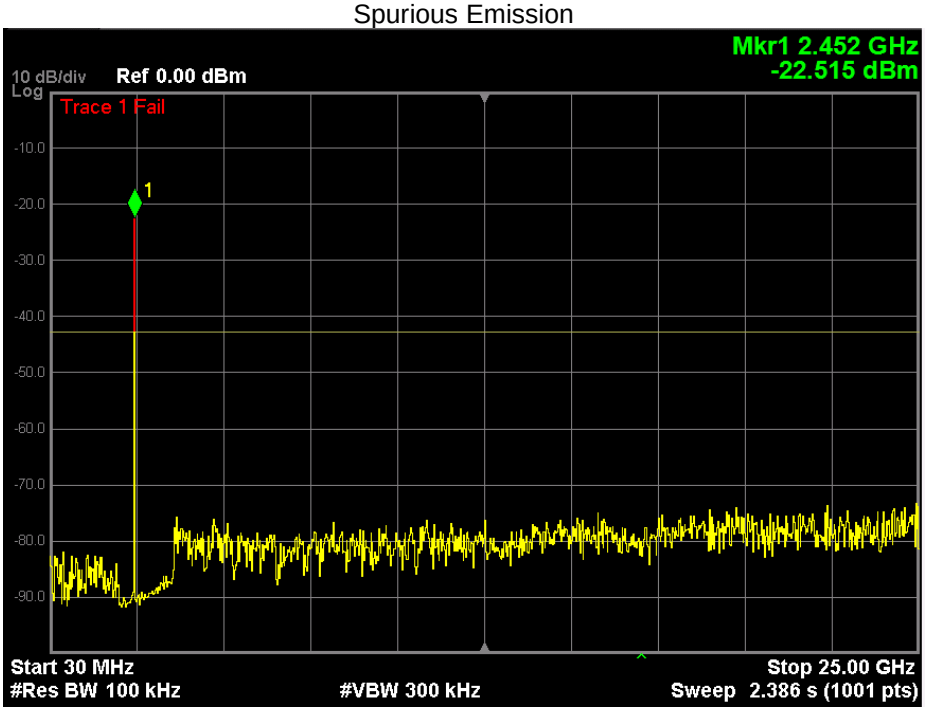

| MKR | MODE | TRC | SCL | X | Y | FUNCTION | FUNCTION WIDTH | FUNCTION VALUE |
|---|---|---|---|---|---|---|---|---|
| 1 | N | 1 | f | 2.401 83 GHz | -18.388 dBm | | | |
| 2 | N | 1 | f | 2.402 71 GHz | -38.691 dBm | | | |
| 3 | N | 1 | f | 2.400 00 GHz | -74.770 dBm | | | |
| 4 | | | | | | | | |
| 5 | | | | | | | | |
| 6 | | | | | | | | |
| 7 | | | | | | | | |
| 8 | | | | | | | | |
| 9 | | | | | | | | |
| 10 | | | | | | | | |
| 11 | | | | | | | | |

Spurious Emission



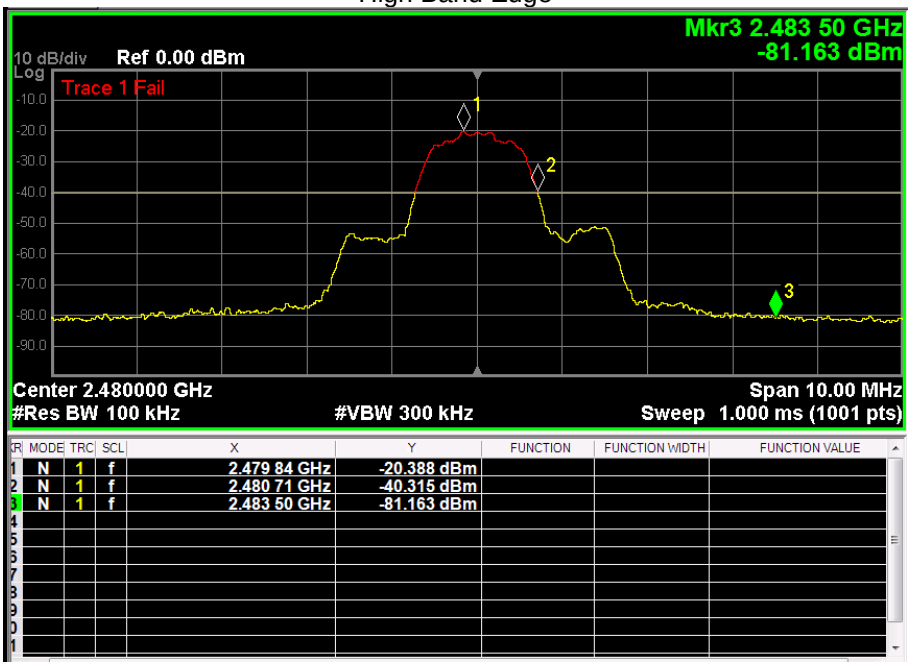
***2DH5 - Channel 39 (2441MHz)***

Spurious Emission



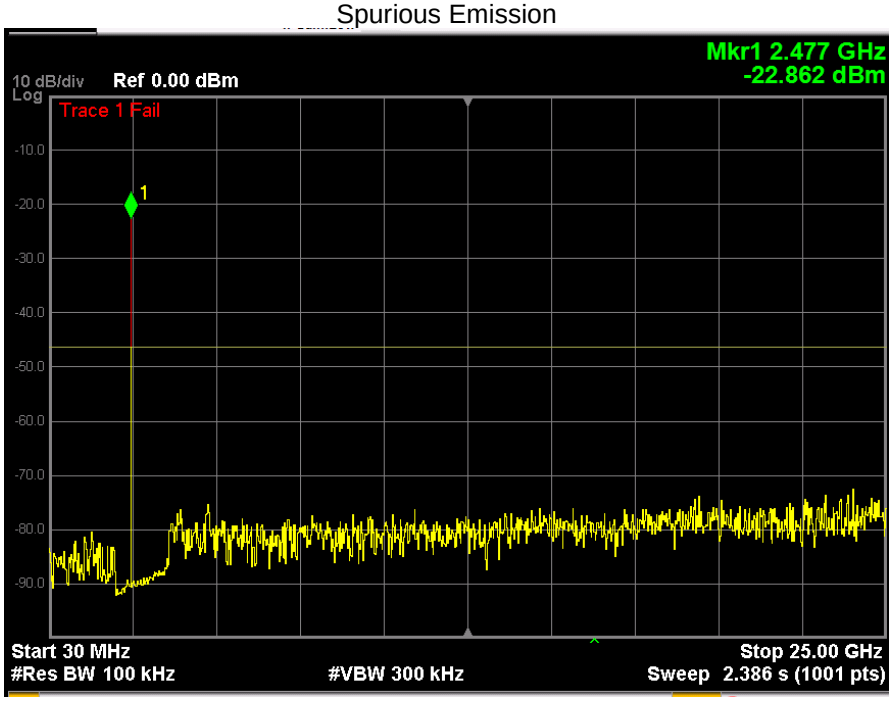

***2DH5 - Channel 78 (2480MHz)***

High Band Edge



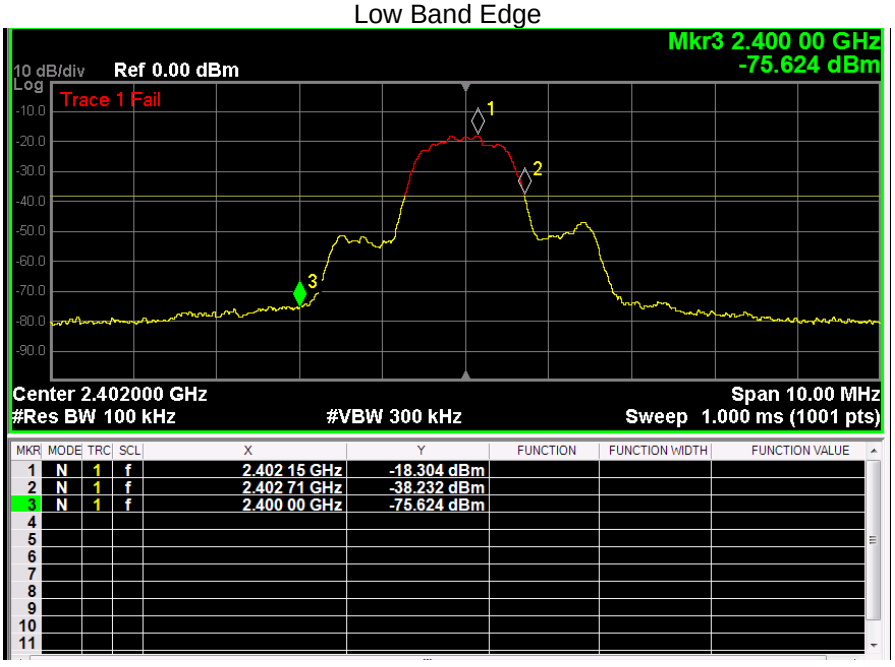

| R | MODE | TRC | SCL | X | Y | FUNCTION | FUNCTION WIDTH | FUNCTION VALUE |
|---|---|---|---|---|---|---|---|---|
| 1 | N | 1 | f | 2.479 84 GHz | -20.388 dBm | | | |
| 2 | N | 1 | f | 2.480 71 GHz | -40.315 dBm | | | |
| 3 | N | 1 | f | 2.483 50 GHz | -81.163 dBm | | | |
| 4 | | | | | | | | |
| 5 | | | | | | | | |
| 6 | | | | | | | | |
| 7 | | | | | | | | |
| 8 | | | | | | | | |
| 9 | | | | | | | | |
| 10 | | | | | | | | |
| 11 | | | | | | | | |

Spurious Emission



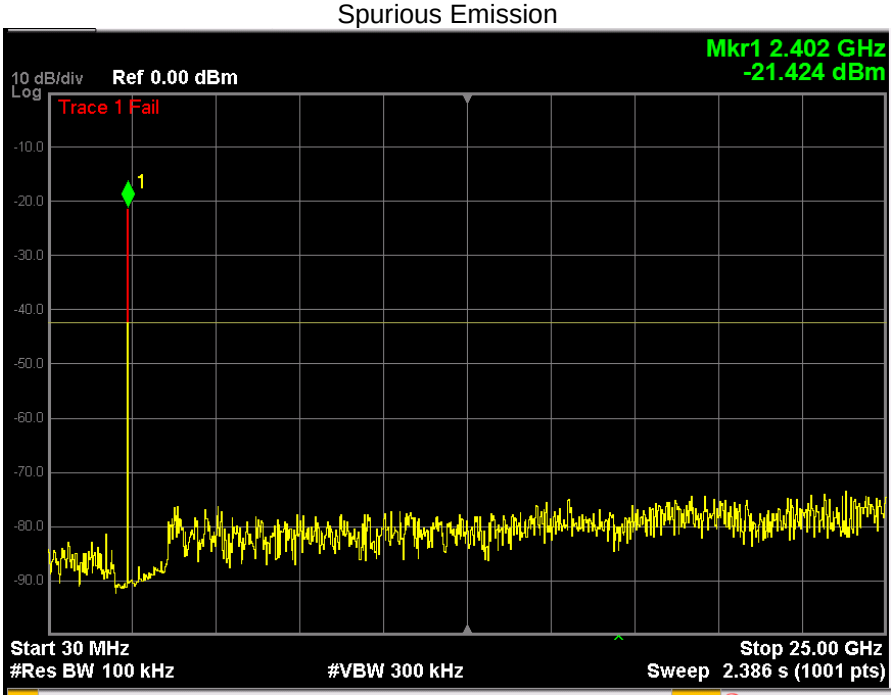

***3DH5 - Channel 00 (2402MHz)***

Low Band Edge



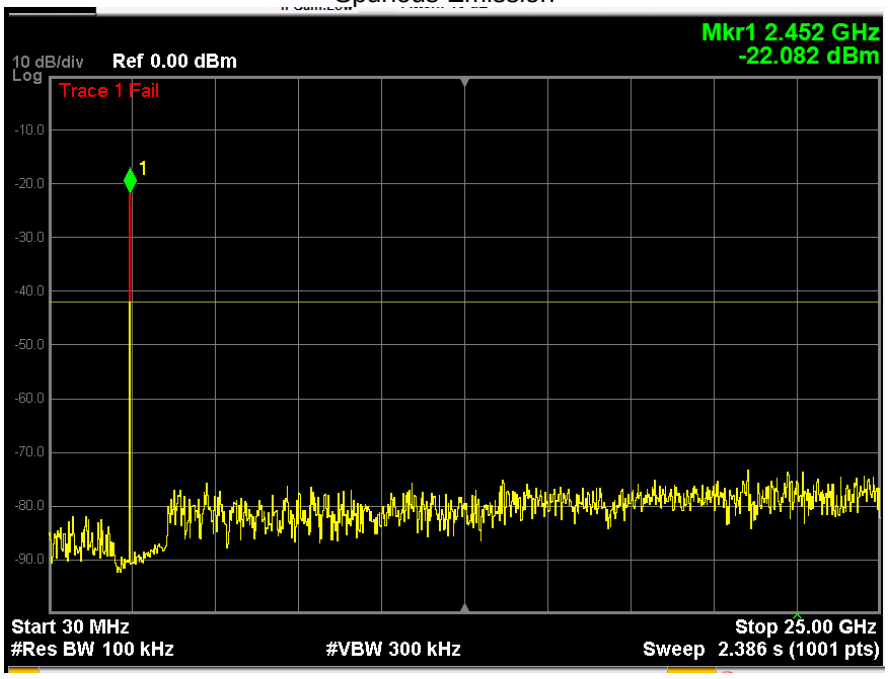

| MKR | MODE | TRC | SCL | X | Y | FUNCTION | FUNCTION WIDTH | FUNCTION VALUE |
|---|---|---|---|---|---|---|---|---|
| 1 | N | 1 | f | 2.402 15 GHz | -18.304 dBm | | | |
| 2 | N | 1 | f | 2.402 71 GHz | -38.232 dBm | | | |
| 3 | N | 1 | f | 2.400 00 GHz | -75.624 dBm | | | |
| 4 | | | | | | | | |
| 5 | | | | | | | | |
| 6 | | | | | | | | |
| 7 | | | | | | | | |
| 8 | | | | | | | | |
| 9 | | | | | | | | |
| 10 | | | | | | | | |
| 11 | | | | | | | | |

Spurious Emission



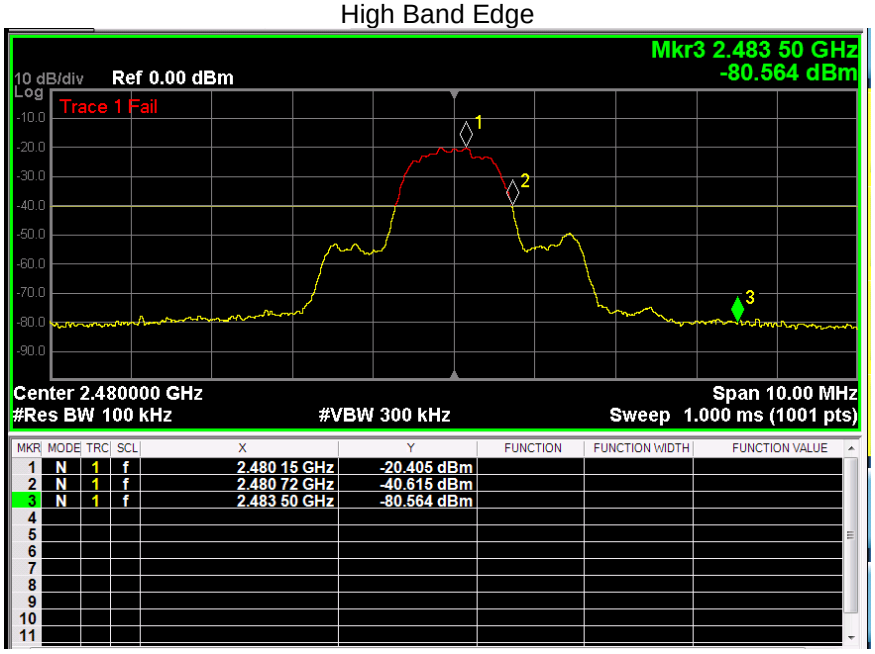

***3DH5 - Channel 39 (2441MHz)***

Spurious Emission



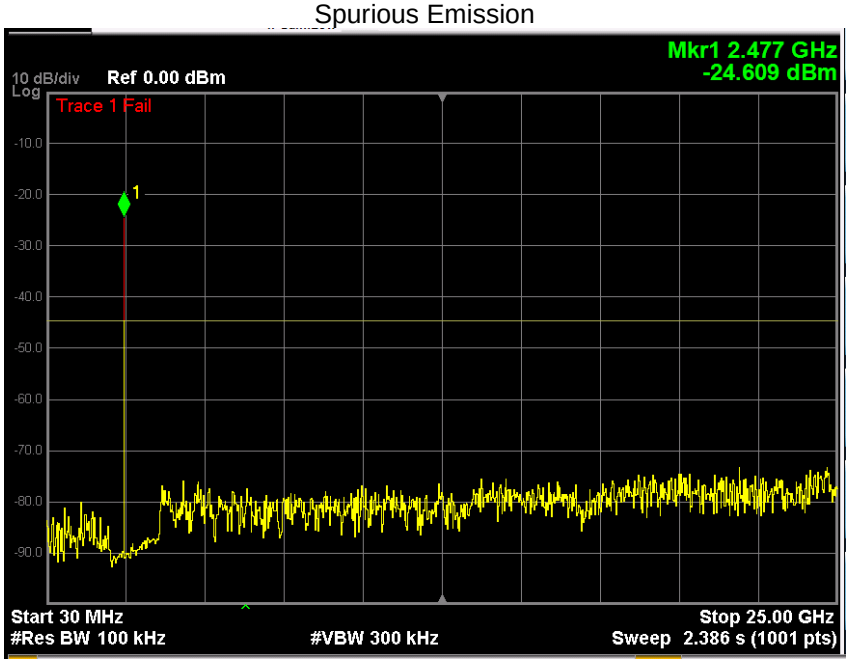
***3DH5 - Channel 78 (2480MHz)***

High Band Edge



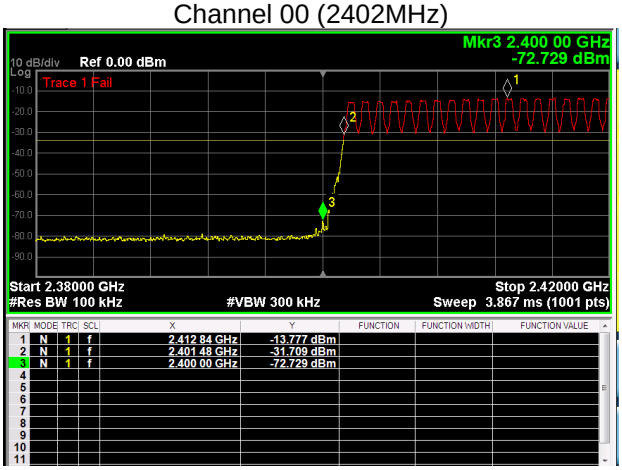

| MKR | MODE | TRC | SCL | X | Y | FUNCTION | FUNCTION WIDTH | FUNCTION VALUE |
|---|---|---|---|---|---|---|---|---|
| 1 | N | 1 | f | 2.480 15 GHz | -20.405 dBm | | | |
| 2 | N | 1 | f | 2.480 72 GHz | -40.615 dBm | | | |
| 3 | N | 1 | f | 2.483 50 GHz | -80.564 dBm | | | |
| 4 | | | | | | | | |
| 5 | | | | | | | | |
| 6 | | | | | | | | |
| 7 | | | | | | | | |
| 8 | | | | | | | | |
| 9 | | | | | | | | |
| 10 | | | | | | | | |
| 11 | | | | | | | | |

Spurious Emission

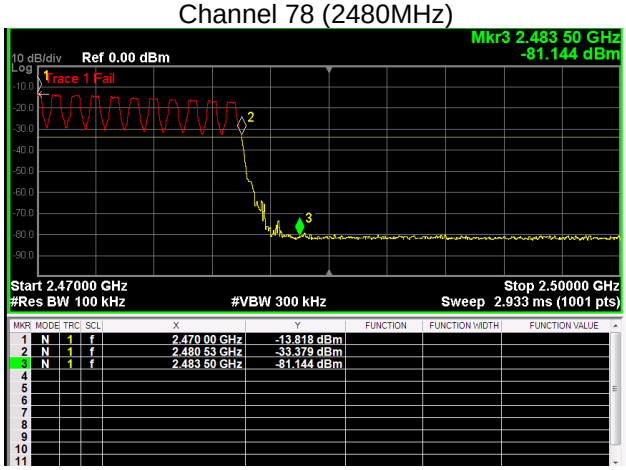


***DH5 Operation Frequency Range of 20dB Bandwidth within Hopping Mode***

Channel 00 (2402MHz)

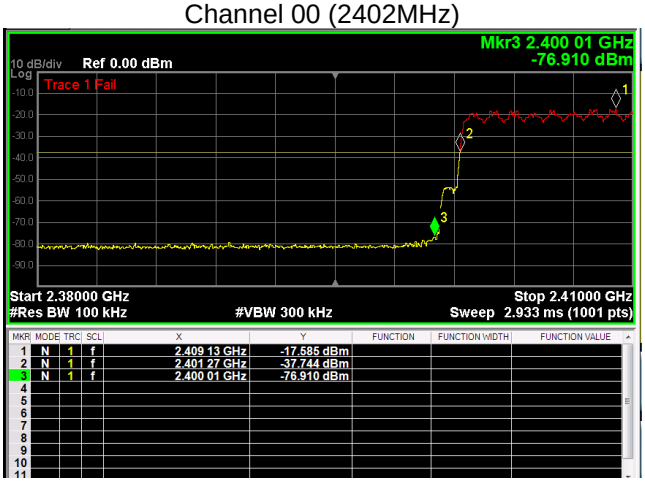



Channel 78 (2480MHz)

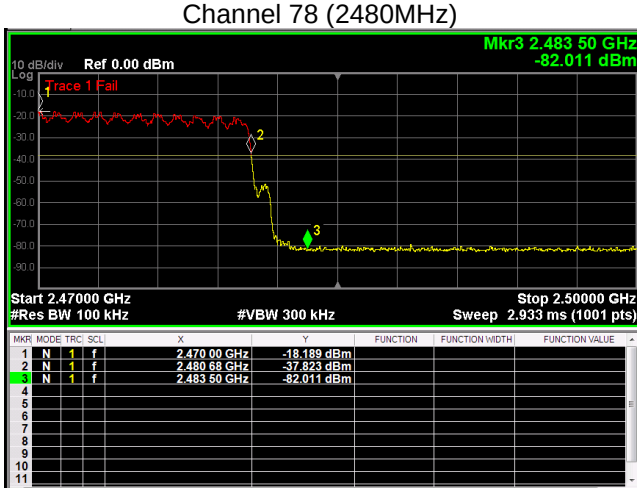



***2DH5 Operation Frequency Range of 20dB Bandwidth within Hopping Mode***

Channel 00 (2402MHz)

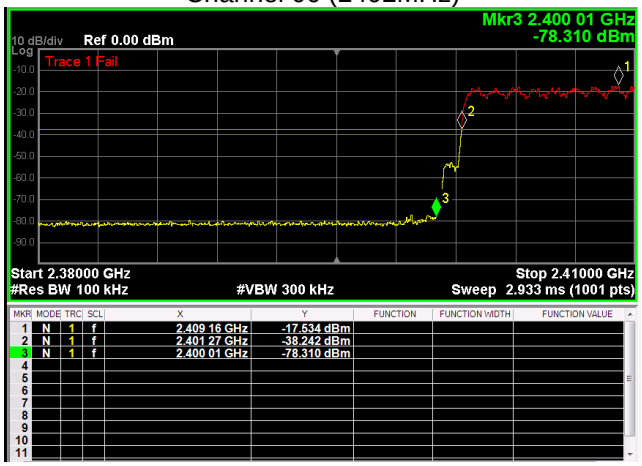



Channel 78 (2480MHz)

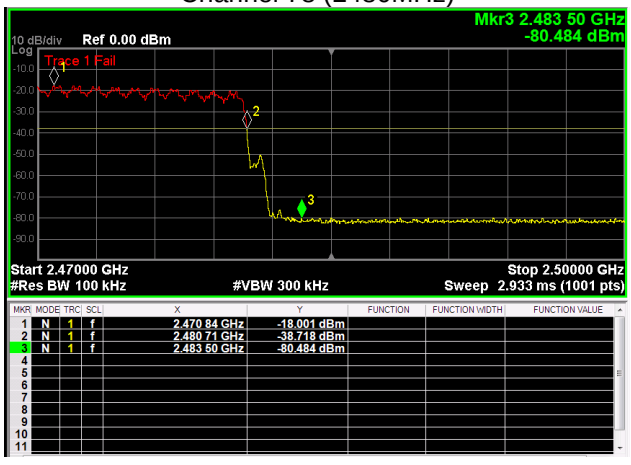



***3DH5 Operation Frequency Range of 20dB Bandwidth within Hopping Mode***

Channel 00 (2402MHz)




Channel 78 (2480MHz)



## 8- Radiated Spurious Emissions

| | | | |
|---|---|---|---|
| Standard | FCC Part 15.209<br>RSS-Gen Issue 5 | Room Temperature (°C) | 24.4 |
| Basic Standard | ANSI C63.10: 2013 | Relative Humidity (%) | 46 |
| Test Location | Richmond Lab | Barometric Pressure (hPa) | 1013 |
| Test Engineer | Zara Vali | Date of Test | 19-29 June 2023 |

| Test Equipment Used | Manufacturer | Model | Identifier | Calibration | Calibration due |
|---|---|---|---|---|---|
| Spectrum Analyzer | Keysight | N9038A | 702 | 02 November, 2022 | 02 November, 2023 |
| Double-ridged Guide Horn Antenna | A.H.Systems | SAS-571 | 227C | 13 September, 2022 | 13 September, 2024 |
| Horn Antenna | A.H.Systems | SAS-572 | 227D | NA | NA |
| Broadband Antenna | Sunol Sciences Co. | JB1 | 371 | 24 October, 2022 | 24 October, 2024 |
| Loop Antenna | ComPower | AL-130 | 241 | 12 Jan 2022 | 12 Jan 2024 |
| RF Cable | MRO | n/a | n/a | IHC[1] | IHC[1] |
| EMC Shielded Enclosure | USC | USC-26 | 374 | IHC[2] | IHC[2] |
| Used Template of Tile 7! | | | | | |

Note1) In House Calibration

| | | | | |
|---|---|---|---|---|
| Detector: | ☒ Peak | ☒ Quasi-Peak/AVG | | |
| Frequency Range: | ☒ 150kHz-30MHz | ☒ 30-1000MHz | ☒ 1-18 GHz | ☒ 18-26.5GHz |
| RBW/VBW: | ☒120/300kHz | ☒ 1/3MHz | | |
| Type of Facility: | ☒ SAC | ☒ FAC | ☐ *in-situ* | |
| Distance: | ☒ 3meter | ☐ 10meter | ☐ 1meter | |
| Arrangement of EUT: | ☒ Table-top only | ☐ Floor-standing only | ☐ Rack Mounted | |
| Compliant ☒ | Non-Compliant ☐ | Not Applicable ☐ | | |

**Test Method**

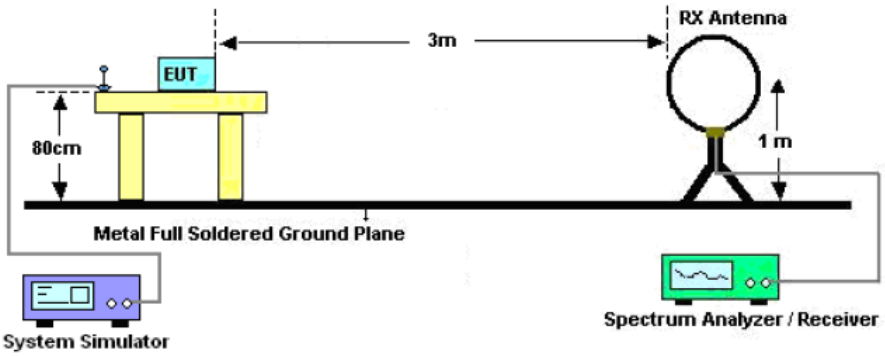
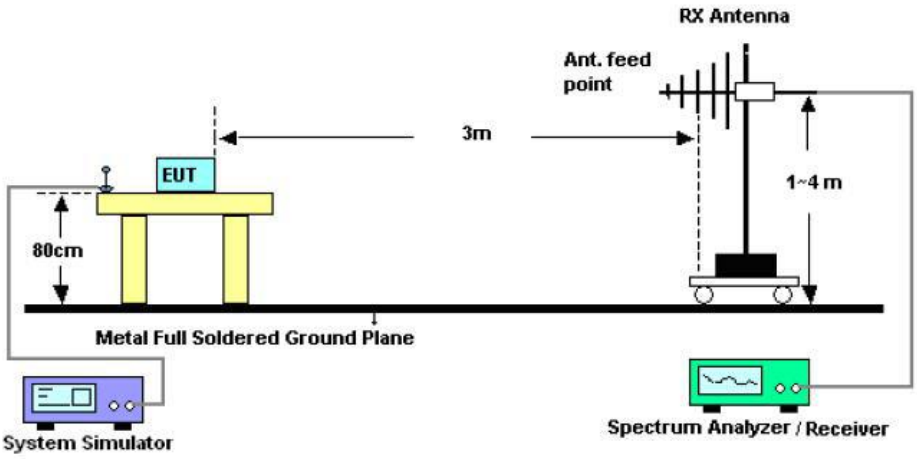
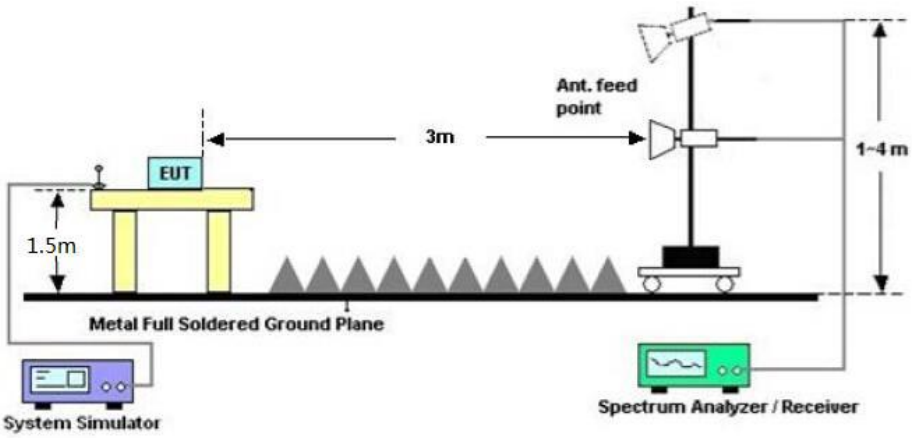
This test measures the radiating levels from the EUT, thus evaluating the potential for the EUT to cause radio frequency interference to other electronic devices. Testing was performed in accordance with the test standard(s) referenced in the test summary section of this report. The Equipment Under Test (EUT) was configured based upon the requirements of the applicable test standard. Initially, the primary emission frequencies are identified by positioning a broadband receive antenna three meter from the EUT.

A test was made with an Spectrum Analyzer, controlled by Test Software, Tile7!, for all Harmonics with the Analyzer in the peak mode. The IF bandwidth was 120 kHz(under 1GHz) and 1MHz(over 1GHz). To ensure that the maximum emission at each discrete frequency of interest is observed, the receive antenna is varied in height from one to four meters and rotated to produce horizontal and vertical polarities while the turntable is rotated to determine the worst emitting configuration. Measurements were then made using CISPR quasi peak (under 1GHz) and Averaging (over 1GHz). The numerical results are included herein to demonstrate compliance. For testing above 1GHz, average measurement is not performed if peak level is lower than average limit.

Test Result
Emission level (dBuV/m) = Detected level (dBuV) +Cable Loss (dB) + Antenna Factor (dB/m)

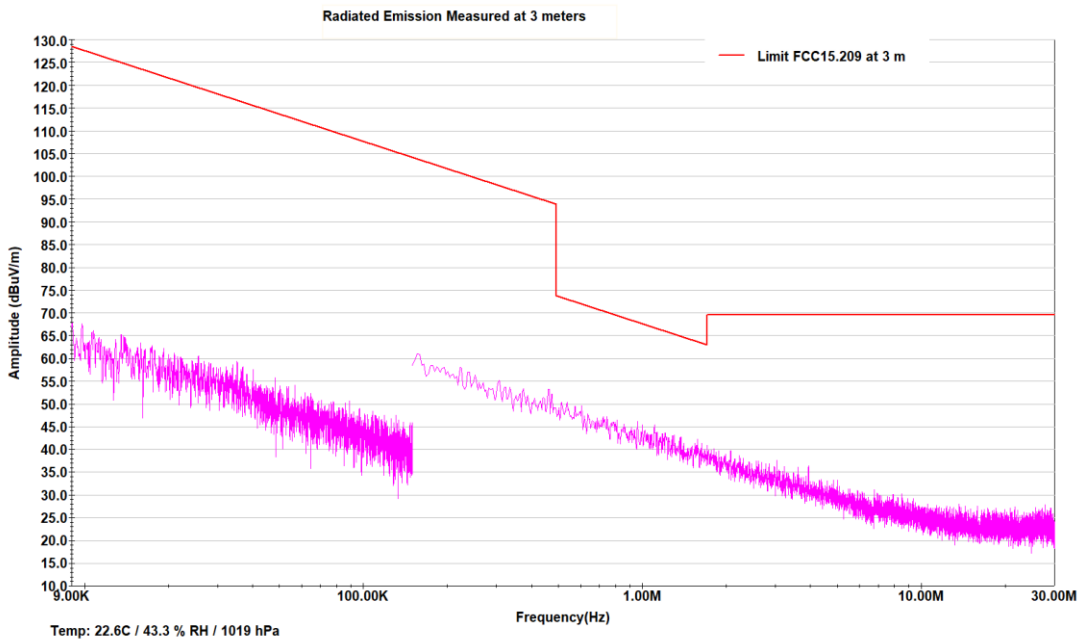
**Test Setup**

| Description of test set-up: |
| --- |
| The EUT was placed on a 0.8 m for under 1GHz and 1.5m for over 1GHz non-conducting table above a Turn table in SAC.<br>The EUT was set to **Operation Mode #1 with configuration Mode #1.** |

| 9kHz- 30MHz test setup with AL-130 |
|---|
|  |
| 30MHz – 1 GHz test setup with JB1 antenna |
|  |
| 1-18 GHz test setup with SAS-571 and 18-26 GHz test setup with SAS-572 |
|  |

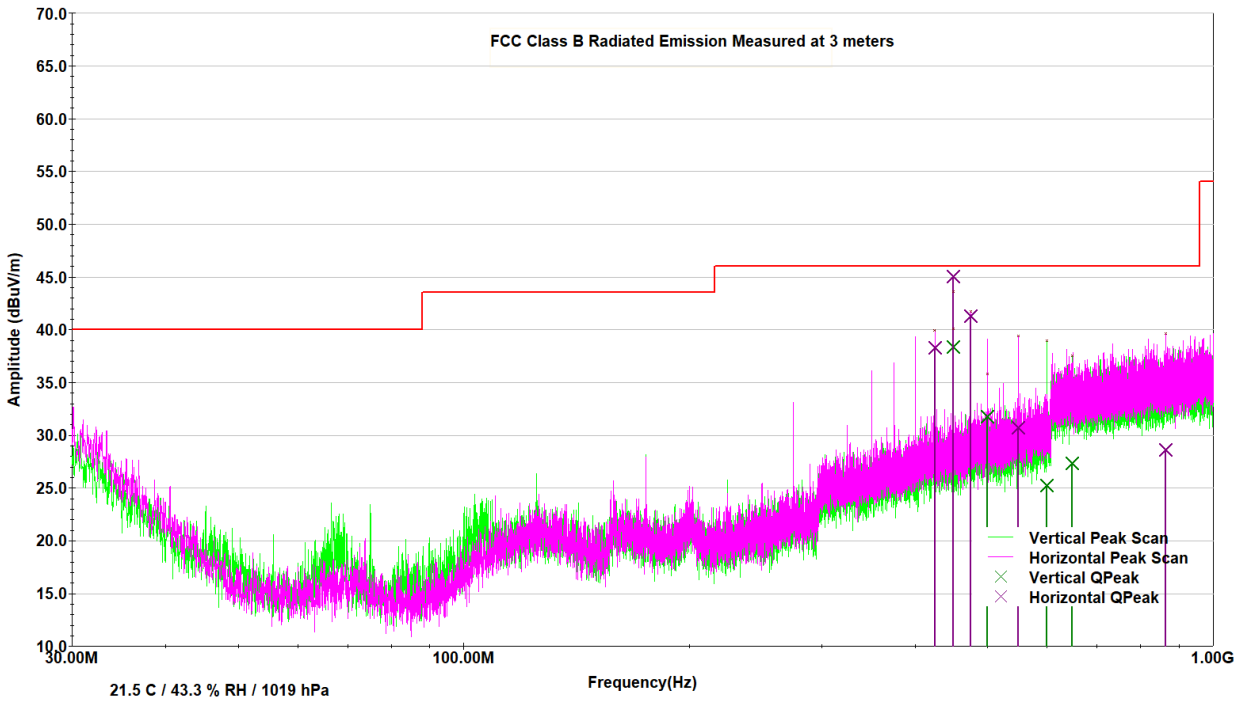
**Test Results**

Graphical Representation for Radiated Emission 9kHz to 30MHz




Note. Where the numerical data is not presented, the radiation is more than 20 dB below the limit line or is indicated as background noise.

Graphical Representation fo Radiated Emission 30 MHz to 1 GHz

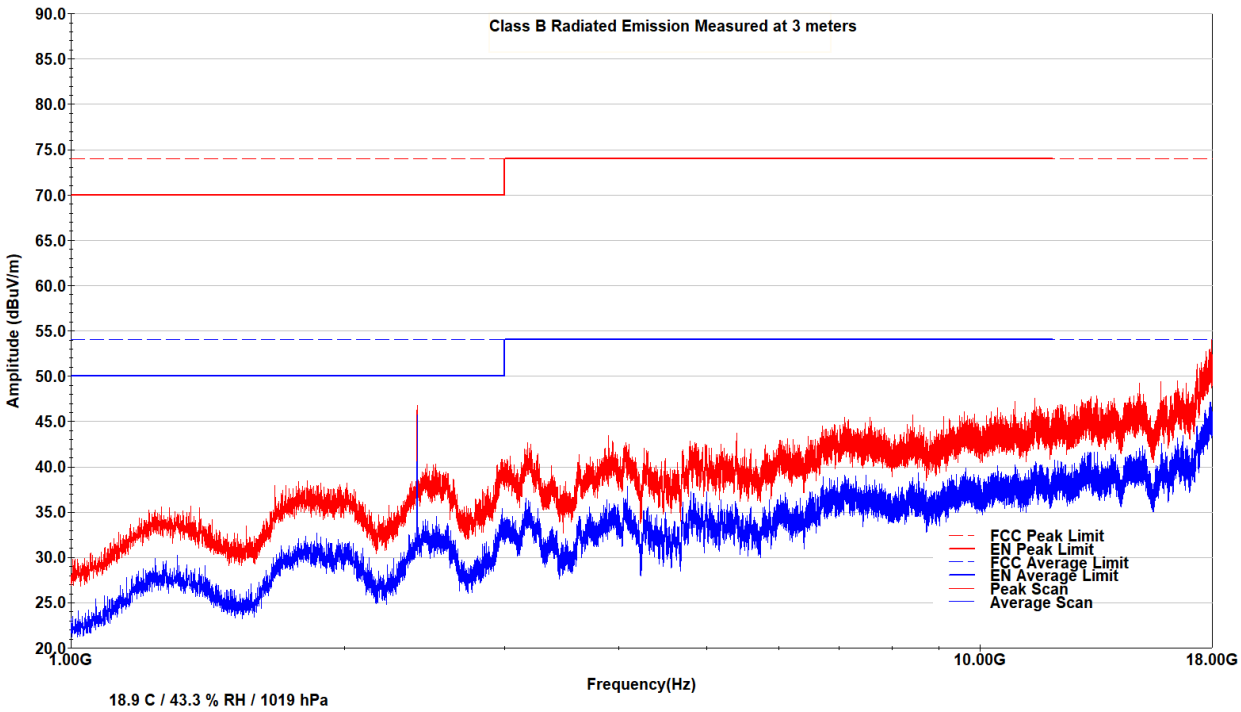



| Frequency | Antenna Polarization | Raw QPeak | Antenna Factor | Correction Factor | QPeak | Margin | Limit |
|---|---|---|---|---|---|---|---|
| MHz | V/H | dBuV | dB/m | dB | dBuV/m | dB | dBuV/m |
| 425.024 | H | 15.5 | 20.8 | 2 | 38.3 | 7.7 | 46 |
| 449.9958 | H | 21.8 | 21.1 | 2.1 | 45 | 1 | 46 |
| 475.0018 | H | 17.2 | 21.9 | 2.2 | 41.3 | 4.7 | 46 |
| 549.9985 | H | 5.5 | 22.9 | 2.3 | 30.7 | 15.3 | 46 |
| 864.1915 | H | -0.9 | 26.6 | 2.9 | 28.6 | 17.4 | 46 |

| Frequency | Antenna Polarization | Raw QPeak | Antenna Factor | Correction Factor | QPeak | Margin | Limit |
|---|---|---|---|---|---|---|---|
| MHz | V/H | dBuV | dB/m | dB | dBuV/m | dB | dBuV/m |
| 450.01 | V | 15.6 | 20.7 | 2.1 | 38.3 | 7.7 | 46 |
| 500.015 | V | 7.7 | 21.9 | 2.2 | 31.8 | 14.2 | 46 |
| 599.9478 | V | 0 | 22.9 | 2.4 | 25.2 | 20.8 | 46 |
| 647.7203 | V | 1 | 23.8 | 2.5 | 27.3 | 18.7 | 46 |

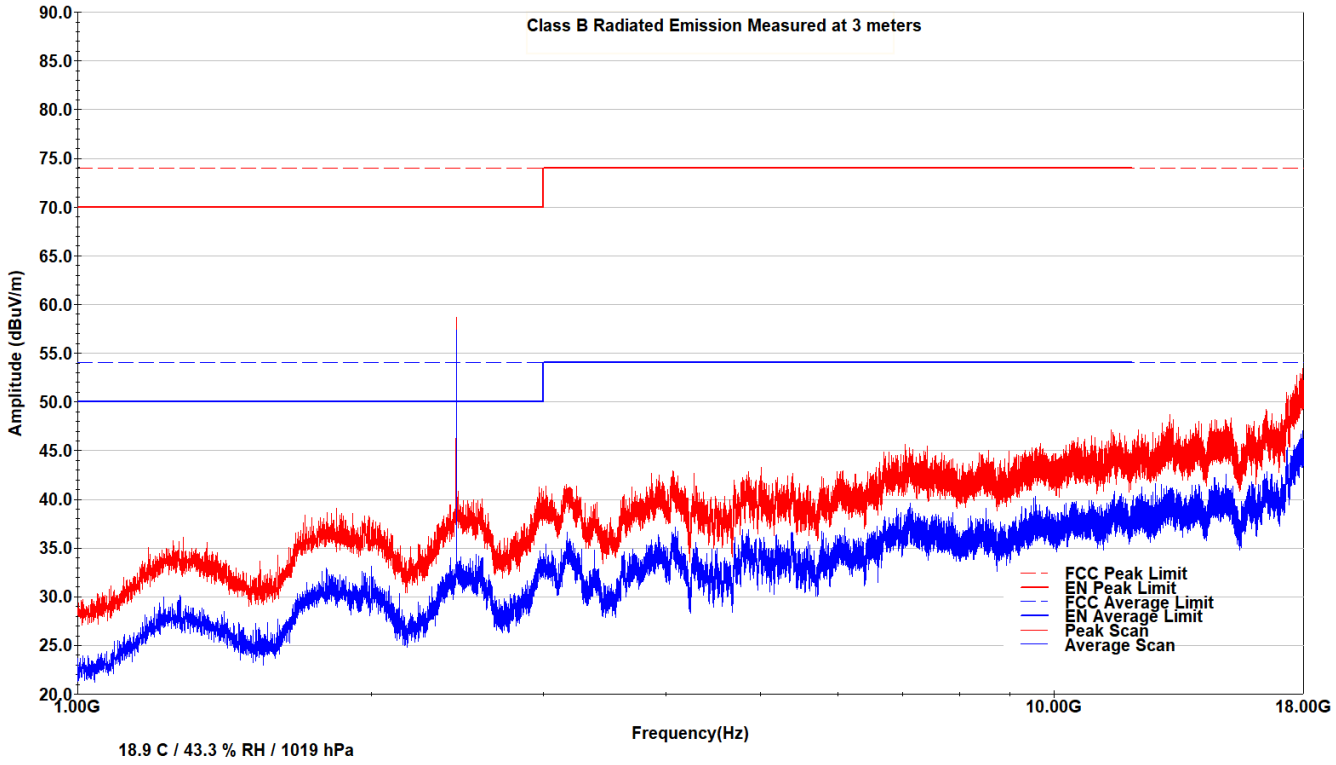
Note. Where the numerical data is not presented, the radiation is more than 20 dB below the limit line or is indicated as background noise.

Graphical Representation for Radiated Emission 1 – 18 GHz, Low Channel



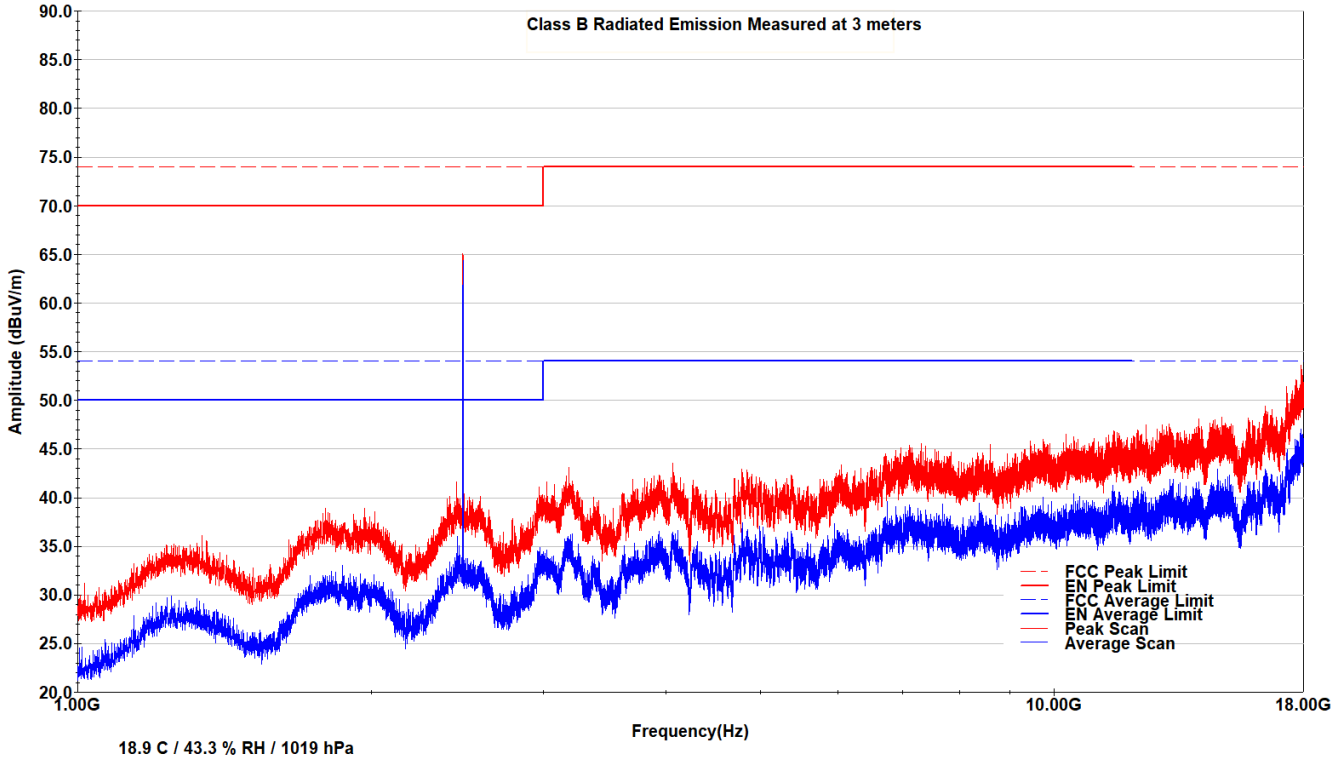

Note. Fundamental signal is shown at 2.4 GHz.
Note. Average measurement is not performed if peak level is lower than average limit.
Note. As other datarates were shown similar results, only one is presented.

Graphical Representation for Radiated Emission 1 – 18 GHz, Mid Channel



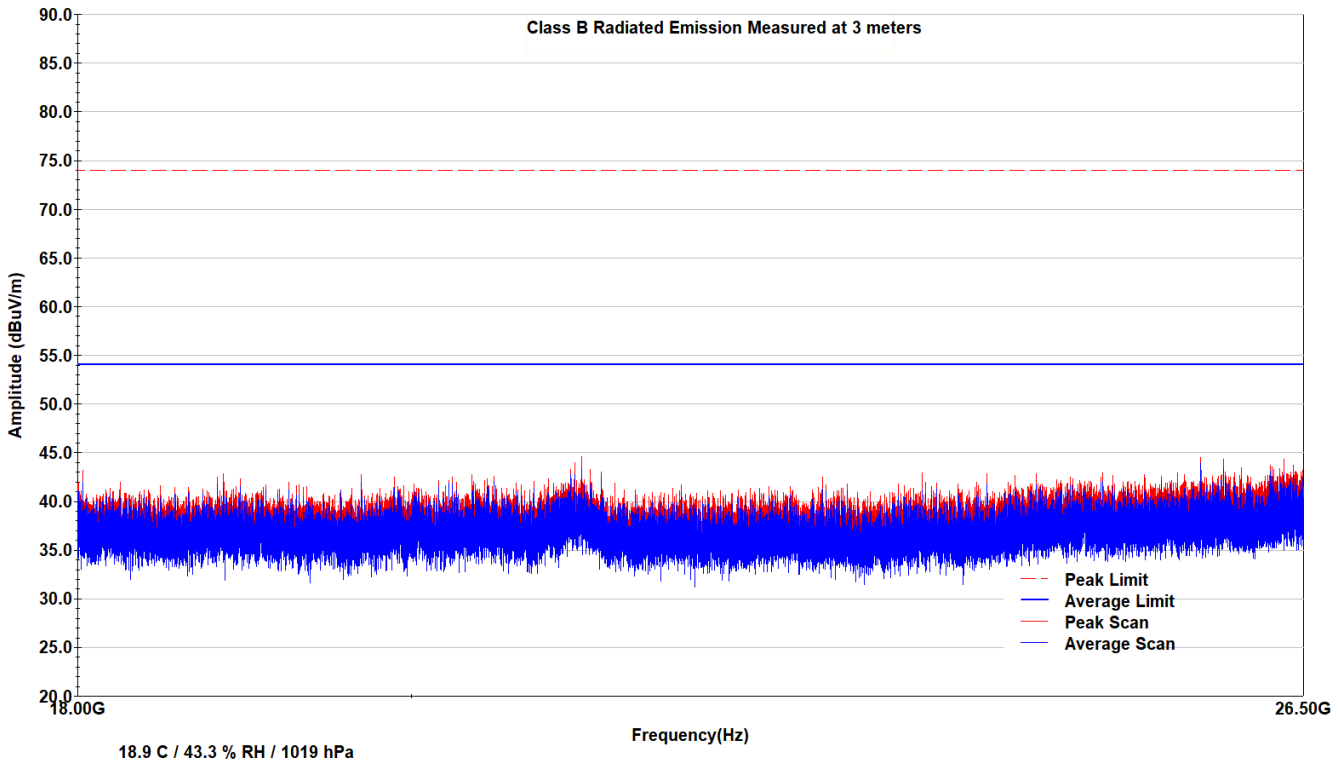

Note. Fundamental signal is shown at 2.4 GHz.
Note. Average measurement is not performed if peak level is lower than average limit.
Note. As other datarates were shown similar results, only one is presented.

Graphical Representation for Radiated Emission 1 – 18 GHz, High Channel




Note. Fundamental signal is shown at 2.4 GHz.
Note. Average measurement is not performed if peak level is lower than average limit.
Note. As other datarates were shown similar results, only one is presented.

Graphical Representation for Radiated Emission 18 – 26.5 GHz




Note. Where the numerical data is not presented, the radiation is more than 20 dB below the limit line or is indicated as background noise.

## 9- Radiated Restricted Band Edge Measurement

| | | | | | |
|---|---|---|---|---|---|
| Standard | FCC Part 15. 247 (d)<br>FCC Part 15. 205<br>FCC Part 15. 209<br>RSS-247 5.5 | | Room Temperature (°C) | | 24.4 |
| Basic Standard | ANSI C63.10: 2013 | | Relative Humidity (%) | | 46 |
| Test Location | Richmond Lab | | Barometric Pressure (hPa) | | 1013 |
| Test Engineer | Zara Vali | | Date of Test | | 22 June 2023 |
| Test Equipment Used | Manufacturer | Model | Identifier | Calibration | Calibration due |
| Spectrum Analyzer | Keysight | N9038A | 702 | 02 November, 2022 | 02 November, 2023 |
| Double-ridged Guide Horn Antenna | A.H.Systems | SAS-571 | 227C | 13 September, 2022 | 13 September, 2024 |
| Preamplifier | Agilent Technologies | 8449B | 273 | IHC[1] | IHC[1] |
| RF Cable | MRO | n/a | n/a | IHC[1] | IHC[1] |
| EMC Shielded Enclosure | USC | USC-26 | 374 | IHC[2] | IHC[2] |
| Used Template of Tile 7! | | | | | |
| Note1) In House Calibration | | | | | |
| Detector: | ☒ Peak | | | | |
| Frequency Range: | ☒ 1-18 GHz | | | | |
| Type of Facility: | ☒ FAC | ☐ *in-situ* | | | |
| Distance: | ☒ 3meter | ☐ 10meter | ☐ 1meter | | |
| Arrangement of EUT: | ☒ Table-top only | ☐ Floor-standing only | ☐ Rack Mounted | | |
| According to §15.247(d), radiated emissions which fall in the restricted bands, as defined in § 15.205(a), must also comply with the radiated emission limits specified in § 15.209(a). | | | | | |
| Compliant ☒ | Non-Compliant ☐ | Not Applicable ☐ | | | |

**Test Method**

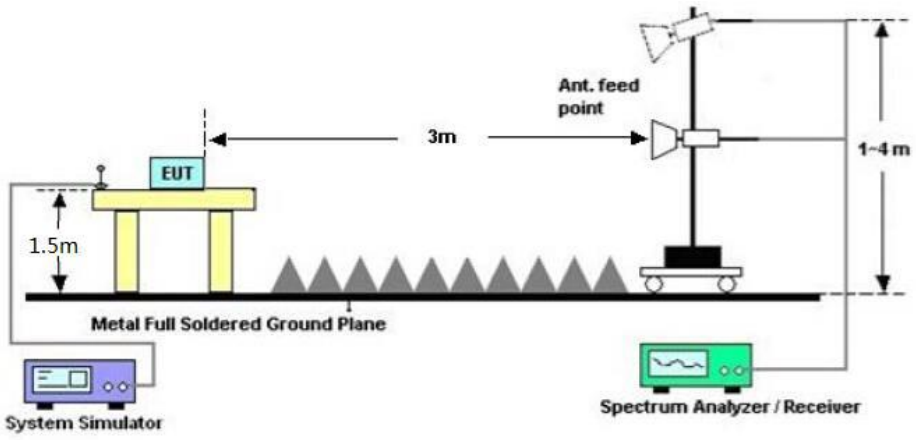
*Field strength measurements*

1. Analyser centre frequency is set to the frequency of the radiated spurious emission of interest.
2. RBW = 1 MHz
3. VBW = Minimum 3 x RBW
4. Detector = Peak
5. Trace mode = Max Hold
6. Sweep time = auto couple
7. Trace is set to be stabilized.

*Test Result*

Corrected Amplitude (dBuV/m) = Reading (dBuV) + Correction Factor (dB/m)
Correction Factor (dB/m) = Cable Loss (dB) + Antenna Factor (dB/m)
Margin (dB)= Limit (dBuV/m) – Corrected Amplitude (dBuV/m)

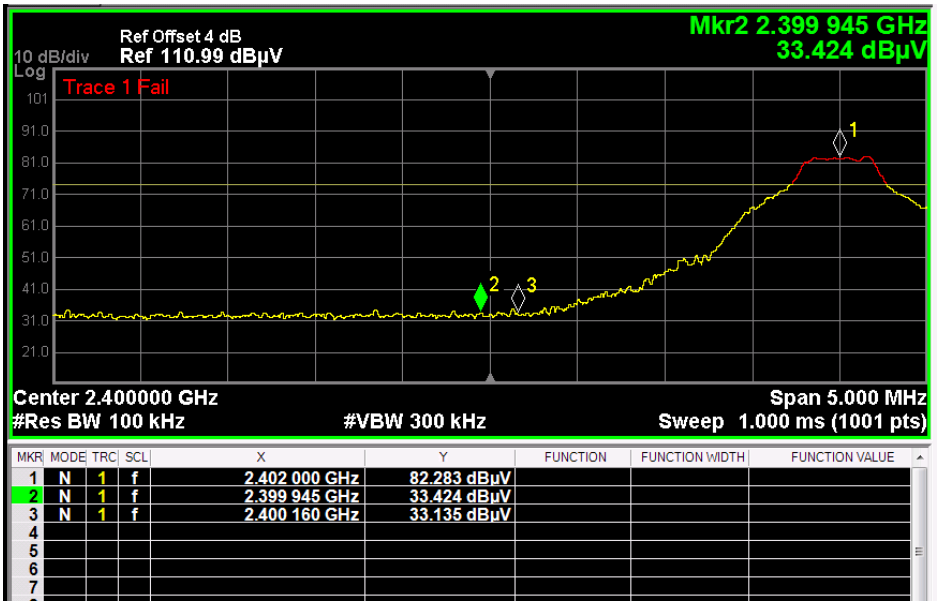
**Test Setup**

| Description of test set-up: |
| --- |
| The EUT is set 3 meter away from the testing antenna and the antenna is moved from 1-4 meter. The EUT is placed on a turntable, which is 1.5 meter above the ground plane, the table is rotated for 360 degrees to find out the highest emission in the restricted band. The reciving antenna should be changed the polarization both of horizontal and vertical.<br>The EUT was set to **Operation Mode #1 with configuration Mode #1.**<br>  <br> |

**Test Results**

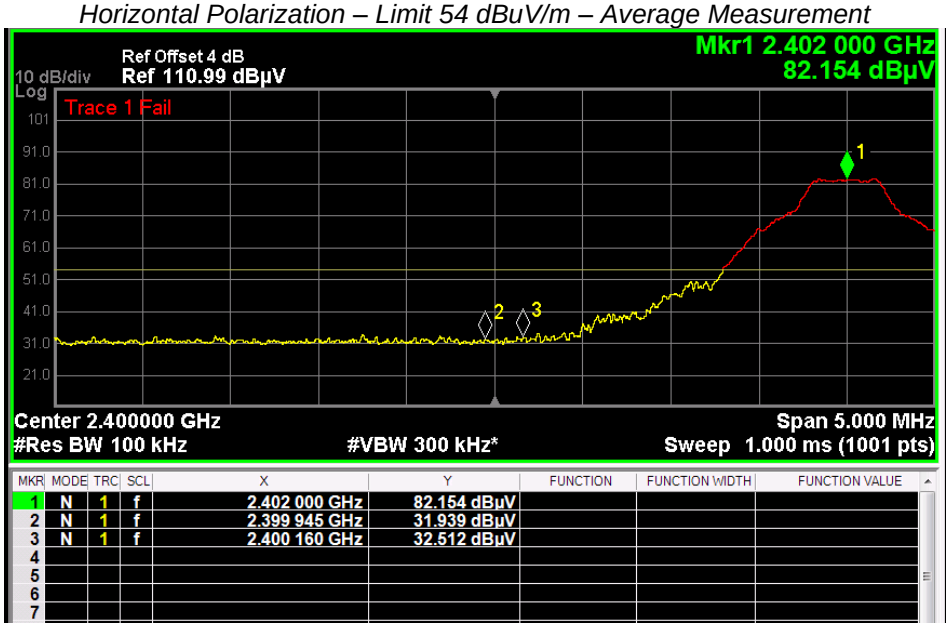
***DH5 at Channel 2402MHz***

*Horizontal Polarization – Limit 74 dBuV/m – Peak Measurement*



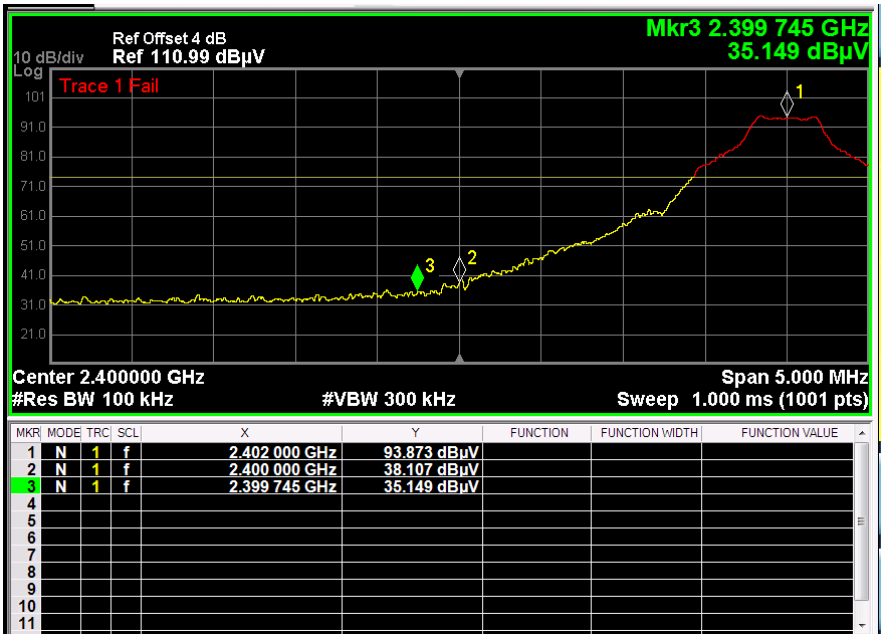

| MKR | MODE | TRC | SCL | X | Y | FUNCTION | FUNCTION WIDTH | FUNCTION VALUE |
|---|---|---|---|---|---|---|---|---|
| 1 | N | 1 | f | 2.402 000 GHz | 82.283 dBµV | | | |
| 2 | N | 1 | f | 2.399 945 GHz | 33.424 dBµV | | | |
| 3 | N | 1 | f | 2.400 160 GHz | 33.135 dBµV | | | |
| 4 | | | | | | | | |
| 5 | | | | | | | | |
| 6 | | | | | | | | |
| 7 | | | | | | | | |

*Horizontal Polarization – Limit 54 dBuV/m – Average Measurement*




| MKR | MODE | TRC | SCL | X | Y | FUNCTION | FUNCTION WIDTH | FUNCTION VALUE |
|---|---|---|---|---|---|---|---|---|
| 1 | N | 1 | f | 2.402 000 GHz | 82.154 dBµV | | | |
| 2 | N | 1 | f | 2.399 945 GHz | 31.939 dBµV | | | |
| 3 | N | 1 | f | 2.400 160 GHz | 32.512 dBµV | | | |
| 4 | | | | | | | | |
| 5 | | | | | | | | |
| 6 | | | | | | | | |
| 7 | | | | | | | | |

*Vertical Polarization – Limit 74 dBuV/m – Peak Measurement*




| MKR | MODE | TRC | SCL | X | Y | FUNCTION | FUNCTION WIDTH | FUNCTION VALUE |
|---|---|---|---|---|---|---|---|---|
| 1 | N | 1 | f | 2.402 000 GHz | 93.873 dBuV | | | |
| 2 | N | 1 | f | 2.400 000 GHz | 38.107 dBuV | | | |
| 3 | N | 1 | f | 2.399 745 GHz | 35.149 dBuV | | | |
| 4 | | | | | | | | |
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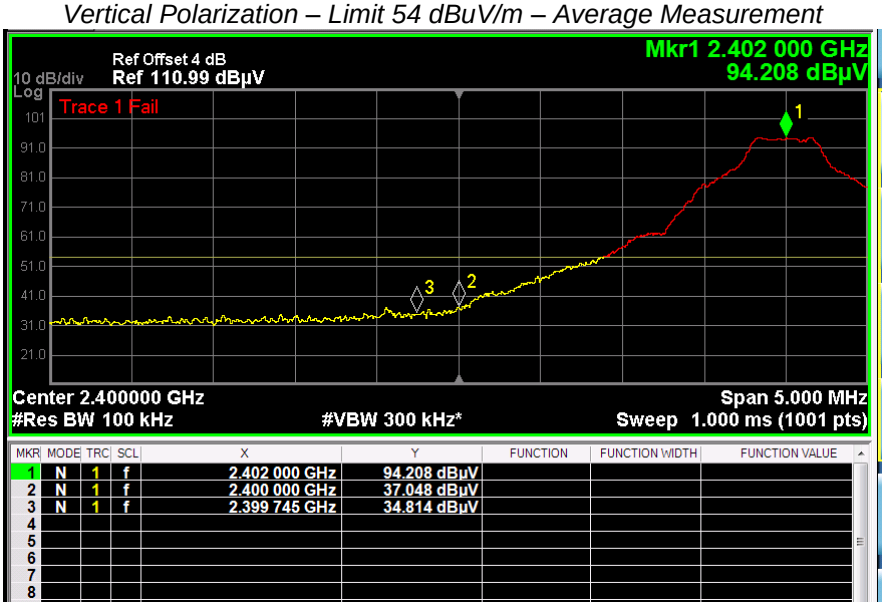
| 9 | | | | | | | | |
| 10 | | | | | | | | |
| 11 | | | | | | | | |

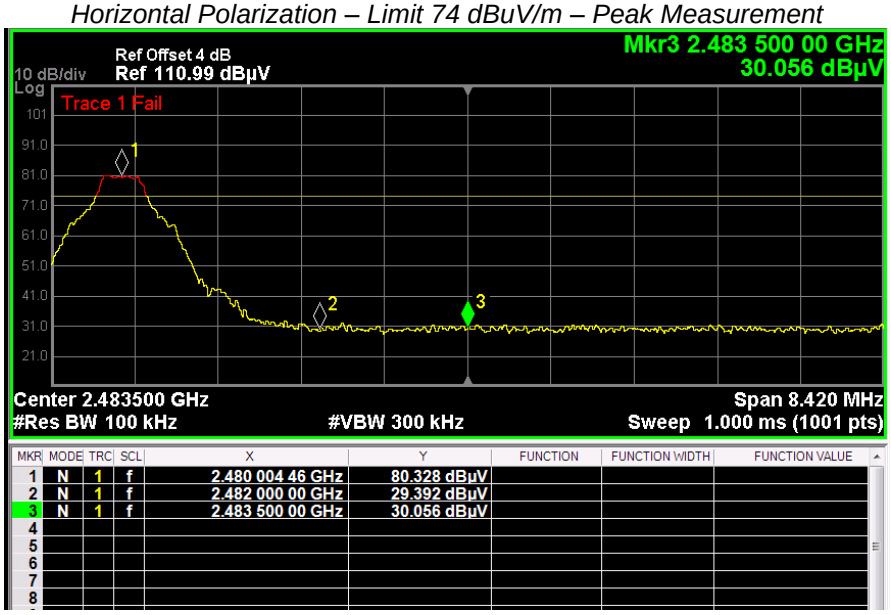
*Vertical Polarization – Limit 54 dBuV/m – Average Measurement*




| MKR | MODE | TRC | SCL | X | Y | FUNCTION | FUNCTION WIDTH | FUNCTION VALUE |
|---|---|---|---|---|---|---|---|---|
| 1 | N | 1 | f | 2.402 000 GHz | 94.208 dBuV | | | |
| 2 | N | 1 | f | 2.400 000 GHz | 37.048 dBuV | | | |
| 3 | N | 1 | f | 2.399 745 GHz | 34.814 dBuV | | | |
| 4 | | | | | | | | |
| 5 | | | | | | | | |
| 6 | | | | | | | | |
| 7 | | | | | | | | |
| 8 | | | | | | | | |

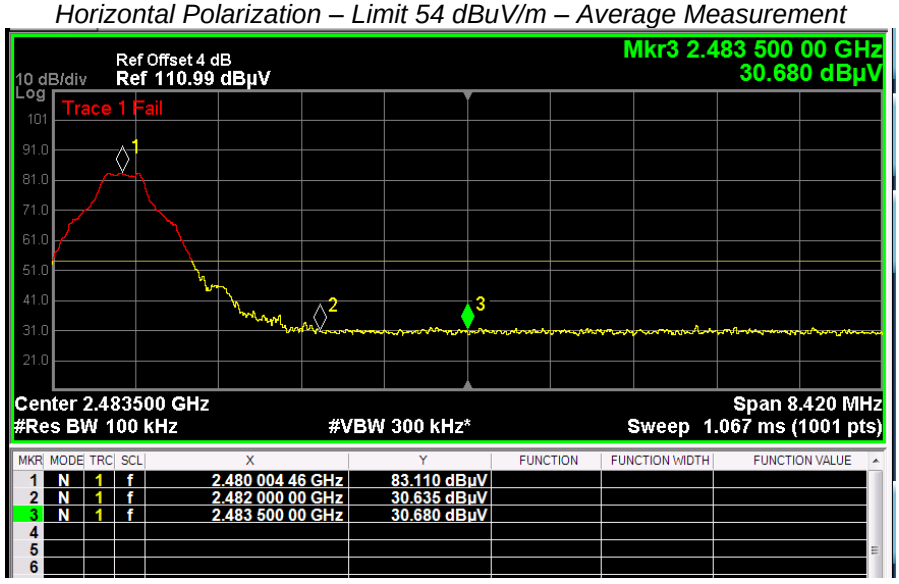
***DH5 at Channel 2480MHz***

*Horizontal Polarization – Limit 74 dBuV/m – Peak Measurement*



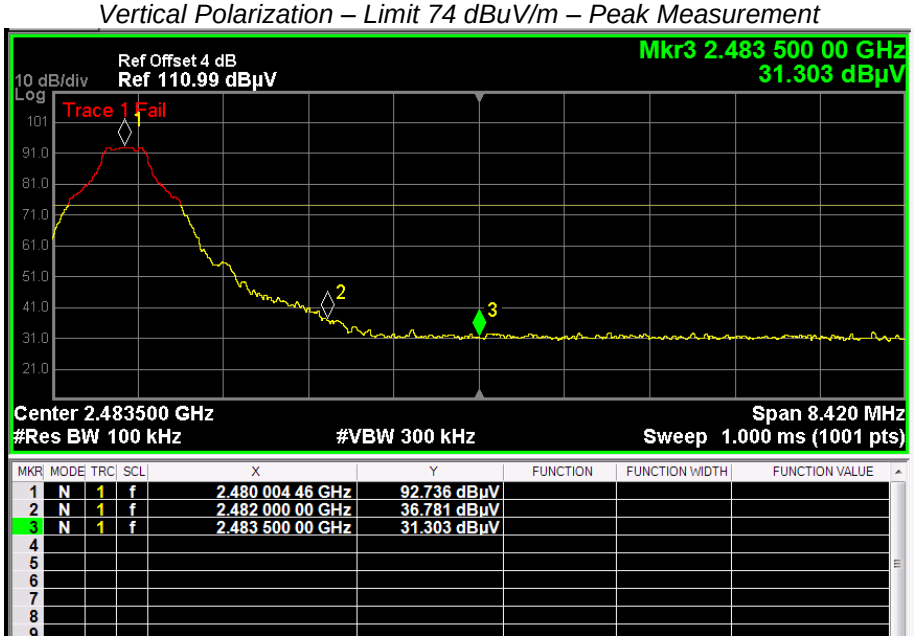

| MKR | MODE | TRC | SCL | X | Y | FUNCTION | FUNCTION WIDTH | FUNCTION VALUE |
|---|---|---|---|---|---|---|---|---|
| 1 | N | 1 | f | 2.480 004 46 GHz | 80.328 dBµV | | | |
| 2 | N | 1 | f | 2.482 000 00 GHz | 29.392 dBµV | | | |
| 3 | N | 1 | f | 2.483 500 00 GHz | 30.056 dBµV | | | |
| 4 | | | | | | | | |
| 5 | | | | | | | | |
| 6 | | | | | | | | |
| 7 | | | | | | | | |
| 8 | | | | | | | | |

*Horizontal Polarization – Limit 54 dBuV/m – Average Measurement*




| MKR | MODE | TRC | SCL | X | Y | FUNCTION | FUNCTION WIDTH | FUNCTION VALUE |
|---|---|---|---|---|---|---|---|---|
| 1 | N | 1 | f | 2.480 004 46 GHz | 83.110 dBµV | | | |
| 2 | N | 1 | f | 2.482 000 00 GHz | 30.635 dBµV | | | |
| 3 | N | 1 | f | 2.483 500 00 GHz | 30.680 dBµV | | | |
| 4 | | | | | | | | |
| 5 | | | | | | | | |
| 6 | | | | | | | | |

*Vertical Polarization – Limit 74 dBuV/m – Peak Measurement*




| MKR | MODE | TRC | SCL | X | Y | FUNCTION | FUNCTION WIDTH | FUNCTION VALUE |
|---|---|---|---|---|---|---|---|---|
| 1 | N | 1 | f | 2.480 004 46 GHz | 92.736 dBµV | | | |
| 2 | N | 1 | f | 2.482 000 00 GHz | 36.781 dBµV | | | |
| 3 | N | 1 | f | 2.483 500 00 GHz | 31.303 dBµV | | | |
| 4 | | | | | | | | |
| 5 | | | | | | | | |
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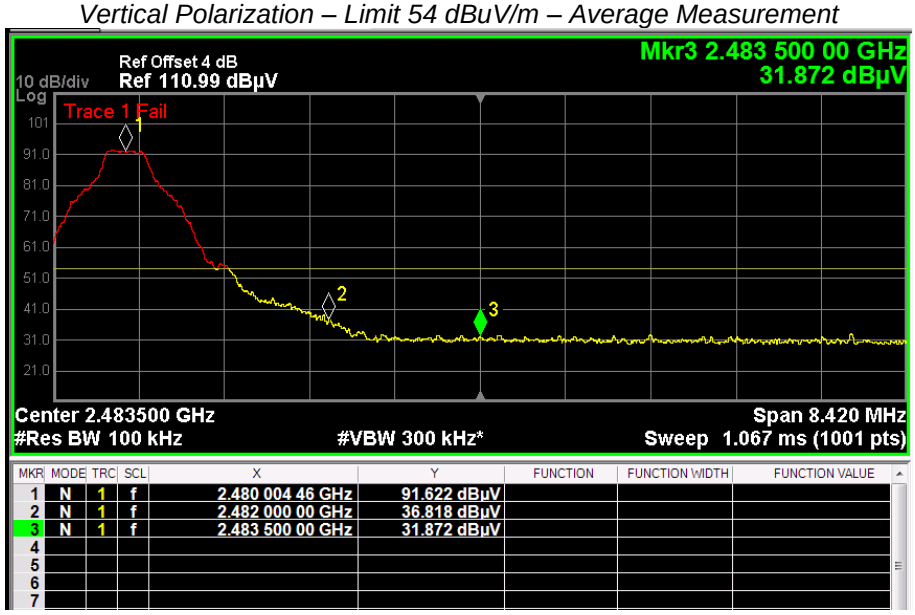
| 7 | | | | | | | | |
| 8 | | | | | | | | |

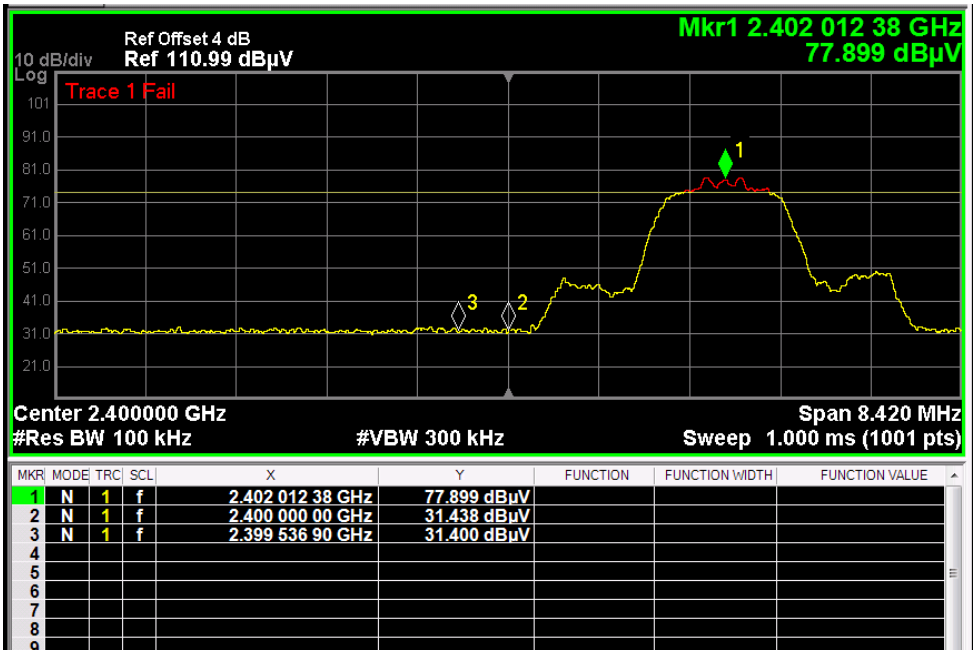
*Vertical Polarization – Limit 54 dBuV/m – Average Measurement*




| MKR | MODE | TRC | SCL | X | Y | FUNCTION | FUNCTION WIDTH | FUNCTION VALUE |
|---|---|---|---|---|---|---|---|---|
| 1 | N | 1 | f | 2.480 004 46 GHz | 91.622 dBµV | | | |
| 2 | N | 1 | f | 2.482 000 00 GHz | 36.818 dBµV | | | |
| 3 | N | 1 | f | 2.483 500 00 GHz | 31.872 dBµV | | | |
| 4 | | | | | | | | |
| 5 | | | | | | | | |
| 6 | | | | | | | | |
| 7 | | | | | | | | |

***2DH5 at Channel 2402MHz***

*Horizontal Polarization – Limit 74 dBuV/m – Peak Measurement*




| MKR | MODE | TRC | SCL | X | Y | FUNCTION | FUNCTION WIDTH | FUNCTION VALUE |
|---|---|---|---|---|---|---|---|---|
| 1 | N | 1 | f | 2.402 012 38 GHz | 77.899 dBµV | | | |
| 2 | N | 1 | f | 2.400 000 00 GHz | 31.438 dBµV | | | |
| 3 | N | 1 | f | 2.399 536 90 GHz | 31.400 dBµV | | | |
| 4 | | | | | | | | |
| 5 | | | | | | | | |
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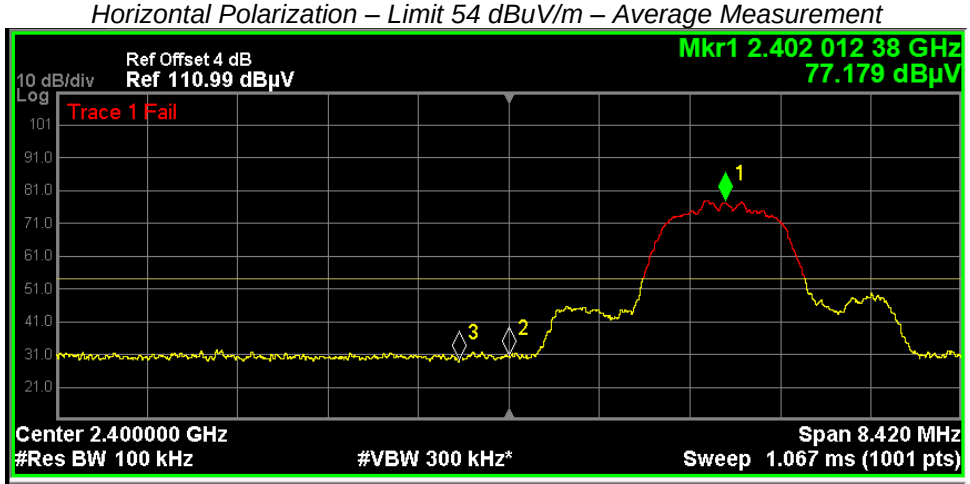
| 7 | | | | | | | | |
| 8 | | | | | | | | |

*Horizontal Polarization – Limit 54 dBuV/m – Average Measurement*




| MKR | MODE | TRC | SCL | X | Y | FUNCTION | FUNCTION WIDTH | FUNCTION VALUE |
|---|---|---|---|---|---|---|---|---|
| 1 | N | 1 | f | 2.402 012 38 GHz | 77.179 dBµV | | | |
| 2 | N | 1 | f | 2.400 000 00 GHz | 30.218 dBµV | | | |
| 3 | N | 1 | f | 2.399 536 90 GHz | 28.701 dBµV | | | |
| 4 | | | | | | | | |
| 5 | | | | | | | | |
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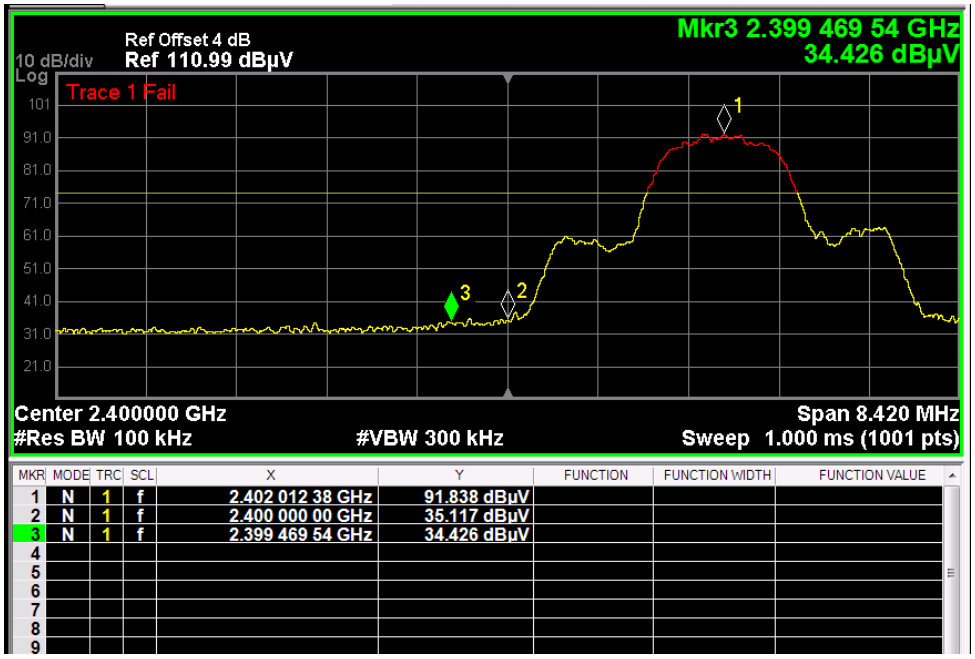
| 7 | | | | | | | | |
| 8 | | | | | | | | |

*Vertical Polarization – Limit 74 dBuV/m – Peak Measurement*




| MKR | MODE | TRC | SCL | X | Y | FUNCTION | FUNCTION WIDTH | FUNCTION VALUE |
|---|---|---|---|---|---|---|---|---|
| 1 | N | 1 | f | 2.402 012 38 GHz | 91.838 dBµV | | | |
| 2 | N | 1 | f | 2.400 000 00 GHz | 35.117 dBµV | | | |
| 3 | N | 1 | f | 2.399 469 54 GHz | 34.426 dBµV | | | |
| 4 | | | | | | | | |
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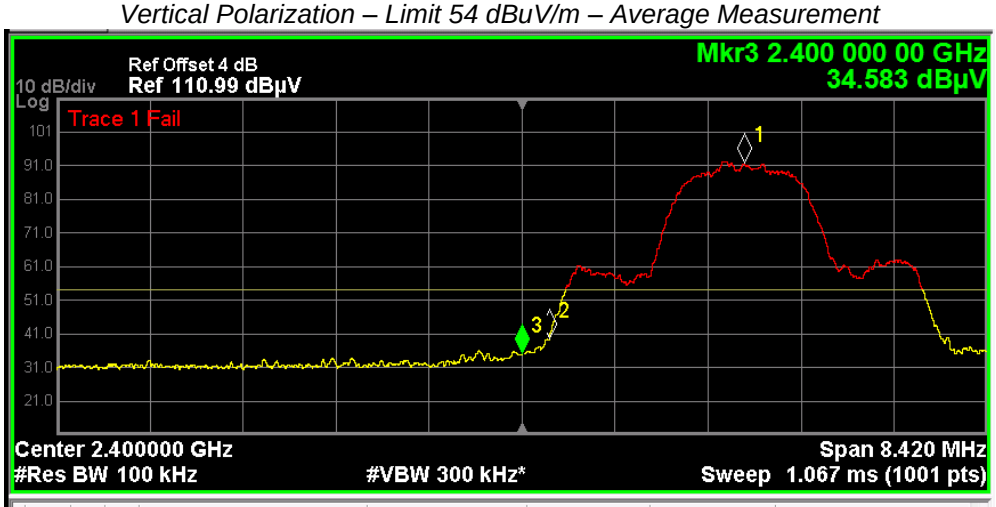
| 7 | | | | | | | | |
| 8 | | | | | | | | |
| 9 | | | | | | | | |

*Vertical Polarization – Limit 54 dBuV/m – Average Measurement*




| R | MODE | TRC | SCL | X | Y | FUNCTION | FUNCTION WIDTH | FUNCTION VALUE |
|---|---|---|---|---|---|---|---|---|
| 1 | N | 1 | f | 2.402 012 38 GHz | 91.240 dBµV | | | |
| 2 | N | 1 | f | 2.400 244 18 GHz | 39.061 dBµV | | | |
| 3 | N | 1 | f | 2.400 000 00 GHz | 34.583 dBµV | | | |
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| 5 | | | | | | | | |
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| 7 | | | | | | | | |
| 8 | | | | | | | | |

***2DH5 at Channel 2480MHz***

*Horizontal Polarization – Limit 74 dBuV/m – Peak Measurement*


| MKR | MODE | TRC | SCL | X | Y | FUNCTION | FUNCTION WIDTH | FUNCTION VALUE |
|---|---|---|---|---|---|---|---|---|
| 1 | N | 1 | f | 2.479 845 72 GHz | 82.348 dBµV | | | |
| 2 | N | 1 | f | 2.482 843 24 GHz | 31.027 dBµV | | | |
| 3 | N | 1 | f | 2.483 500 00 GHz | 31.946 dBµV | | | |
| 4 | | | | | | | | |
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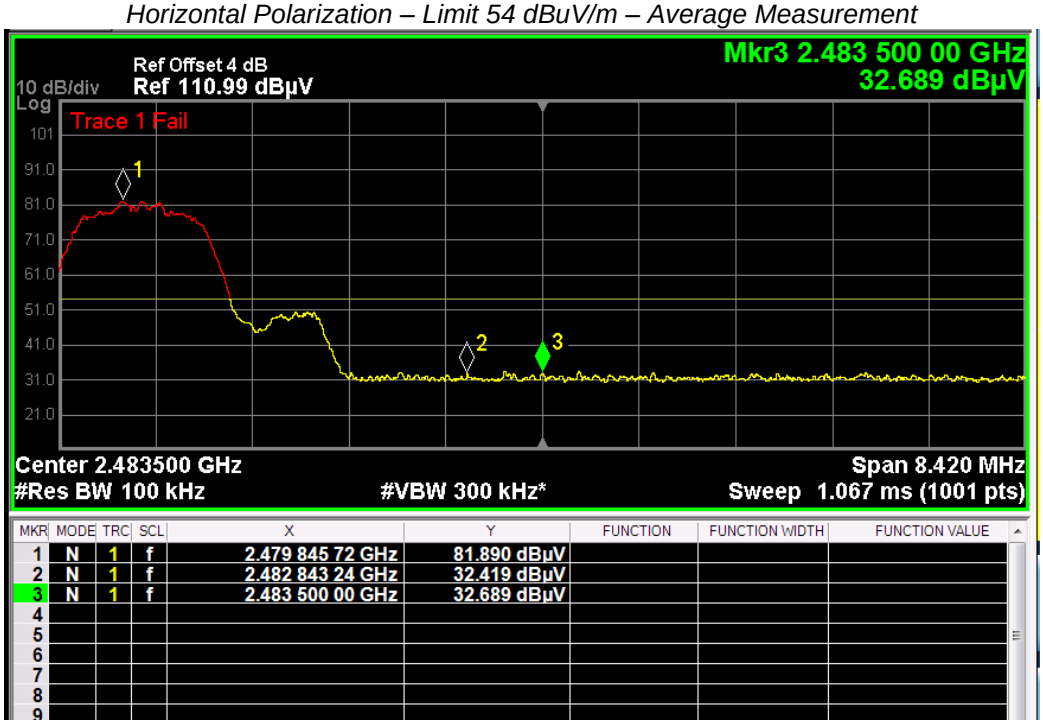
| 7 | | | | | | | | |
| 8 | | | | | | | | |
| 9 | | | | | | | | |

*Horizontal Polarization – Limit 54 dBuV/m – Average Measurement*




| MKR | MODE | TRC | SCL | X | Y | FUNCTION | FUNCTION WIDTH | FUNCTION VALUE |
|---|---|---|---|---|---|---|---|---|
| 1 | N | 1 | f | 2.479 845 72 GHz | 81.890 dBµV | | | |
| 2 | N | 1 | f | 2.482 843 24 GHz | 32.419 dBµV | | | |
| 3 | N | 1 | f | 2.483 500 00 GHz | 32.689 dBµV | | | |
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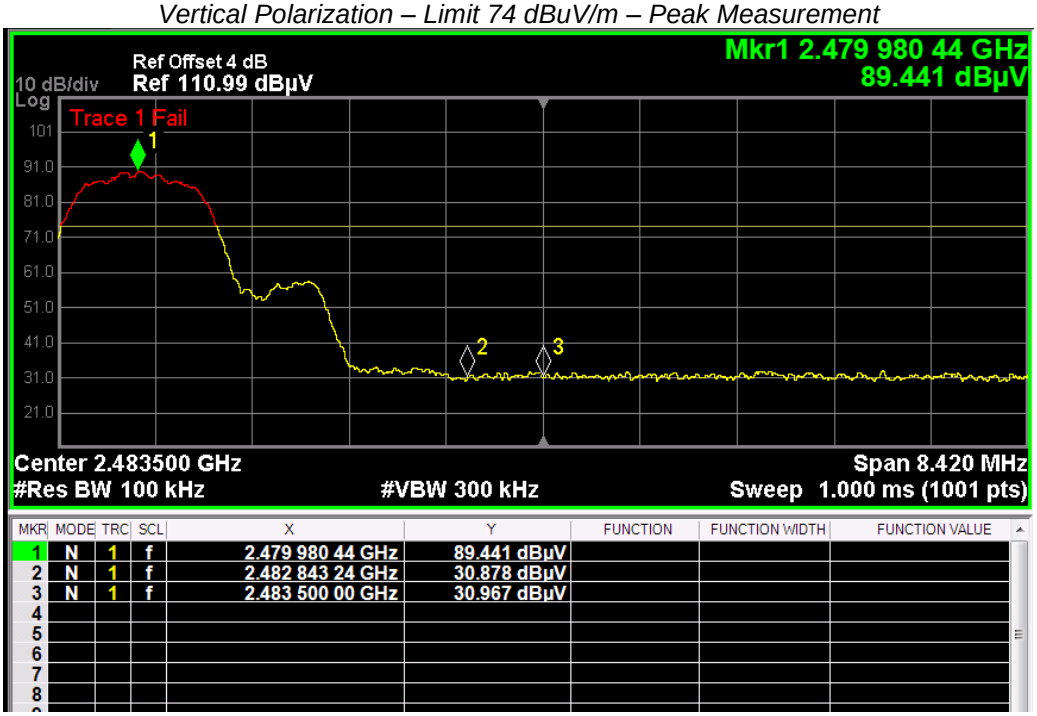
| 8 | | | | | | | | |
| 9 | | | | | | | | |

*Vertical Polarization – Limit 74 dBuV/m – Peak Measurement*




| MKR | MODE | TRC | SCL | X | Y | FUNCTION | FUNCTION WIDTH | FUNCTION VALUE |
|---|---|---|---|---|---|---|---|---|
| 1 | N | 1 | f | 2.479 980 44 GHz | 89.441 dBµV | | | |
| 2 | N | 1 | f | 2.482 843 24 GHz | 30.878 dBµV | | | |
| 3 | N | 1 | f | 2.483 500 00 GHz | 30.967 dBµV | | | |
| 4 | | | | | | | | |
| 5 | | | | | | | | |
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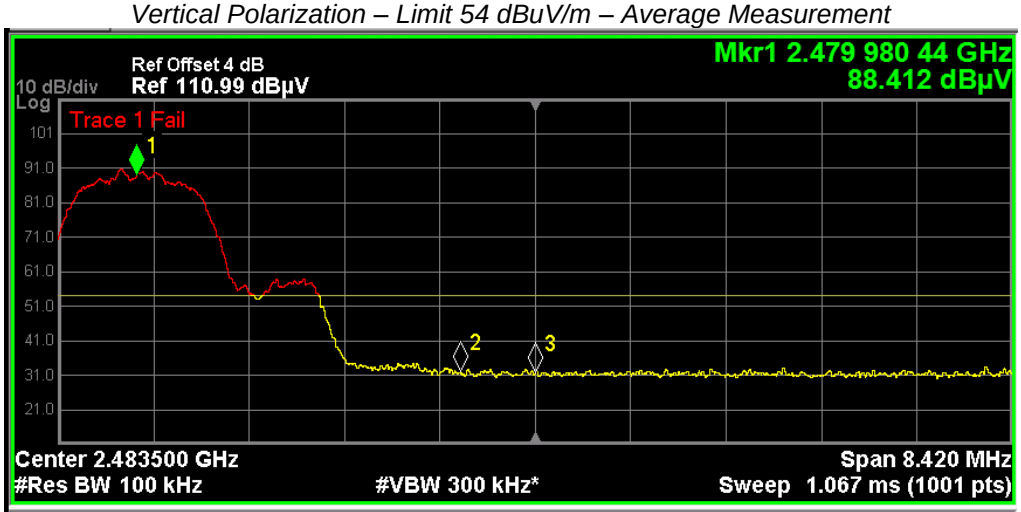
| 7 | | | | | | | | |
| 8 | | | | | | | | |

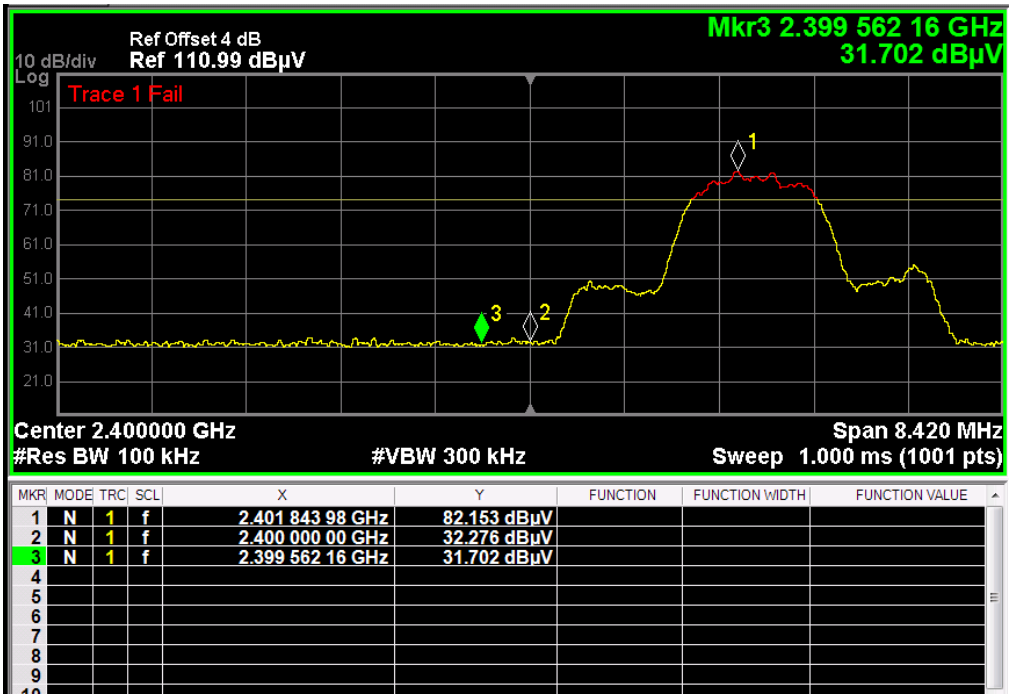
*Vertical Polarization – Limit 54 dBuV/m – Average Measurement*




| MKR | MODE | TRC | SCL | X | Y | FUNCTION | FUNCTION WIDTH | FUNCTION VALUE |
|---|---|---|---|---|---|---|---|---|
| 1 | N | 1 | f | 2.479 980 44 GHz | 88.412 dBµV | | | |
| 2 | N | 1 | f | 2.482 843 24 GHz | 31.460 dBµV | | | |
| 3 | N | 1 | f | 2.483 500 00 GHz | 31.284 dBµV | | | |
| 4 | | | | | | | | |
| 5 | | | | | | | | |
| 6 | | | | | | | | |
| 7 | | | | | | | | |
| 8 | | | | | | | | |

***3DH5 at Channel 2402MHz***

*Horizontal Polarization – Limit 74 dBuV/m – Peak Measurement*




| MKR | MODE | TRC | SCL | X | Y | FUNCTION | FUNCTION WIDTH | FUNCTION VALUE |
|---|---|---|---|---|---|---|---|---|
| 1 | N | 1 | f | 2.401 843 98 GHz | 82.153 dBµV | | | |
| 2 | N | 1 | f | 2.400 000 00 GHz | 32.276 dBµV | | | |
| 3 | N | 1 | f | 2.399 562 16 GHz | 31.702 dBµV | | | |
| 4 | | | | | | | | |
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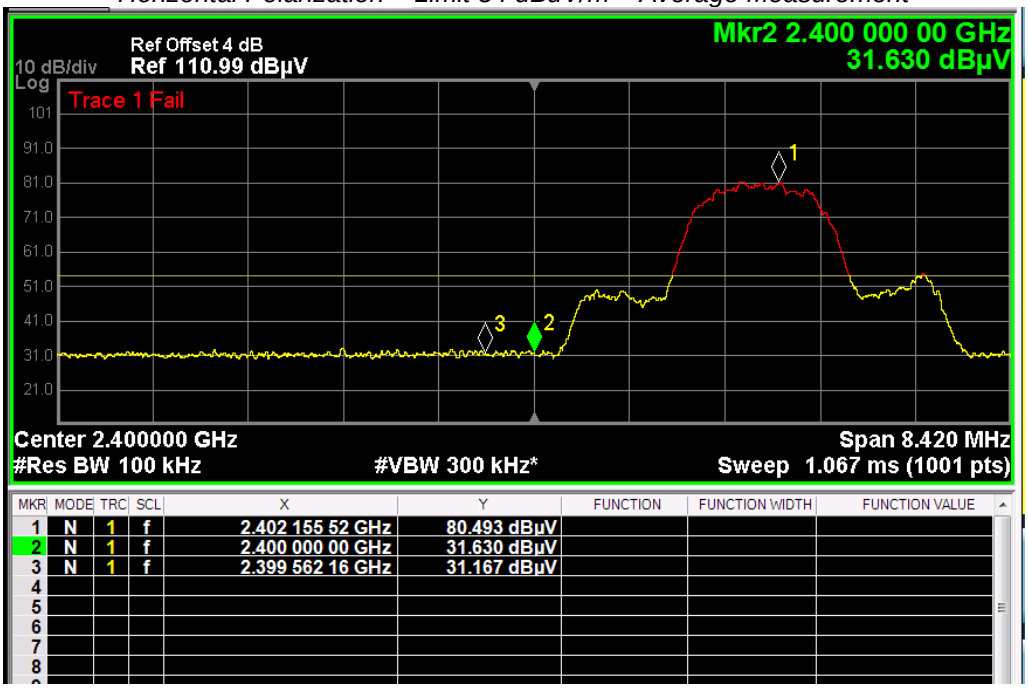
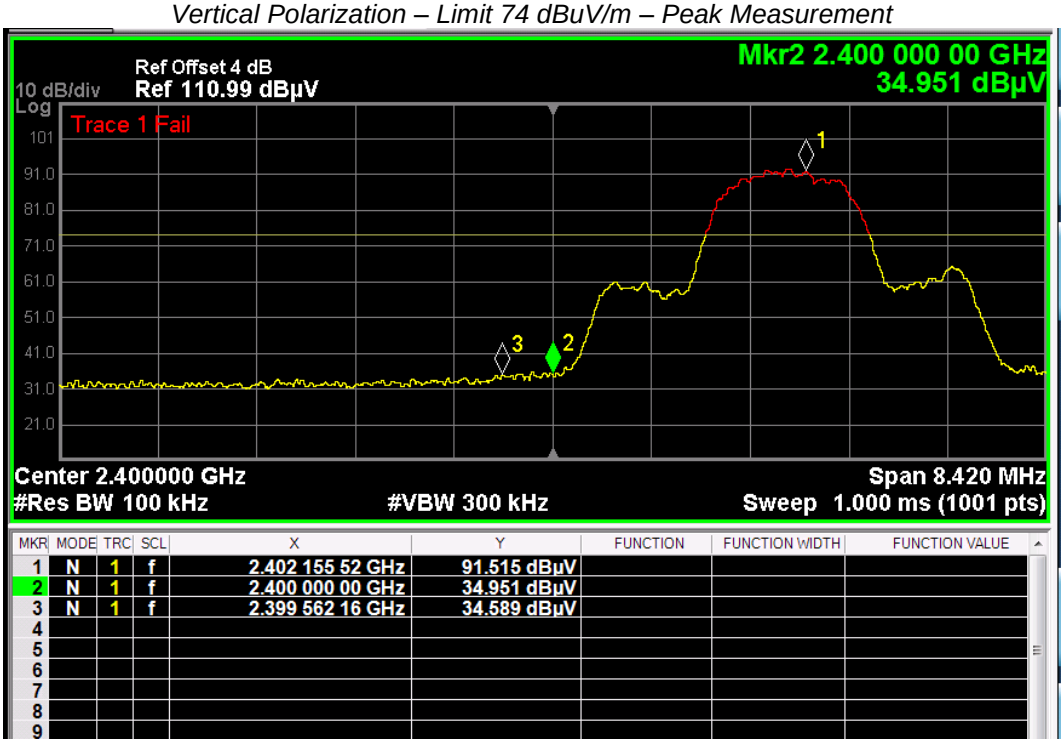
| 7 | | | | | | | | |
| 8 | | | | | | | | |
| 9 | | | | | | | | |

*Horizontal Polarization – Limit 54 dBuV/m – Average Measurement*




| MKR | MODE | TRC | SCL | X | Y | FUNCTION | FUNCTION WIDTH | FUNCTION VALUE |
|---|---|---|---|---|---|---|---|---|
| 1 | N | 1 | f | 2.402 155 52 GHz | 80.493 dBµV | | | |
| 2 | N | 1 | f | 2.400 000 00 GHz | 31.630 dBµV | | | |
| 3 | N | 1 | f | 2.399 562 16 GHz | 31.167 dBµV | | | |
| 4 | | | | | | | | |
| 5 | | | | | | | | |
| 6 | | | | | | | | |
| 7 | | | | | | | | |
| 8 | | | | | | | | |

*Vertical Polarization – Limit 74 dBuV/m – Peak Measurement*




| MKR | MODE | TRC | SCL | X | Y | FUNCTION | FUNCTION WIDTH | FUNCTION VALUE |
|---|---|---|---|---|---|---|---|---|
| 1 | N | 1 | f | 2.402 155 52 GHz | 91.515 dBµV | | | |
| 2 | N | 1 | f | 2.400 000 00 GHz | 34.951 dBµV | | | |
| 3 | N | 1 | f | 2.399 562 16 GHz | 34.589 dBµV | | | |
| 4 | | | | | | | | |
| 5 | | | | | | | | |
| 6 | | | | | | | | |
| 7 | | | | | | | | |
| 8 | | | | | | | | |
| 9 | | | | | | | | |

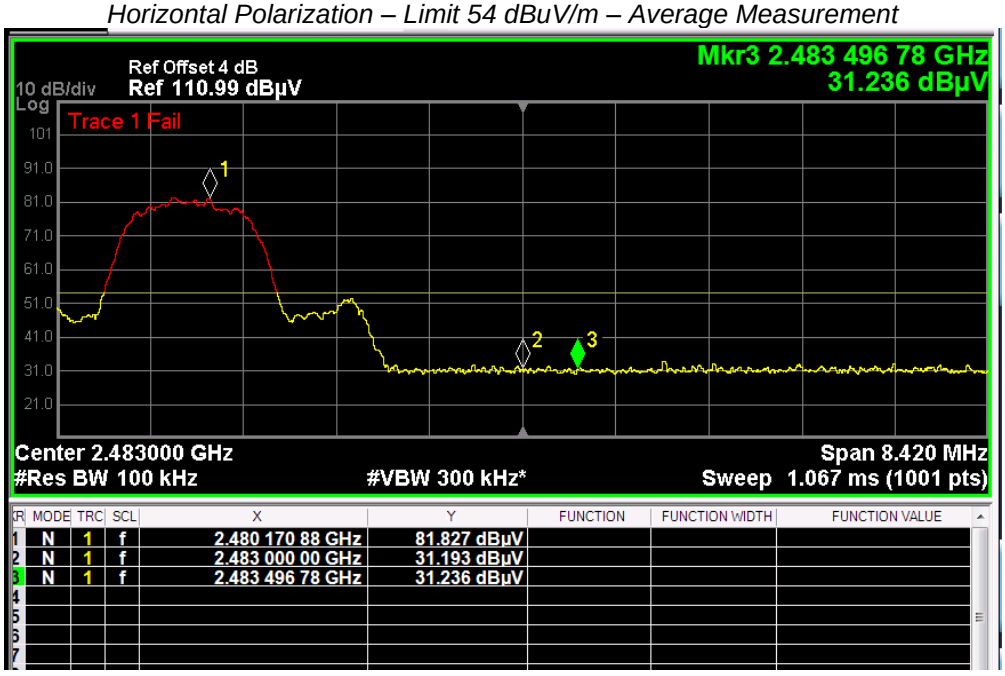
*Vertical Polarization – Limit 54 dBuV/m – Average Measurement*


| MKR | MODE | TRC | SCL | X | Y | FUNCTION | FUNCTION WIDTH | FUNCTION VALUE |
|---|---|---|---|---|---|---|---|---|
| 1 | N | 1 | f | 2.402 155 52 GHz | 91.215 dBµV | | | |
| 2 | N | 1 | f | 2.400 000 00 GHz | 34.975 dBµV | | | |
| 3 | N | 1 | f | 2.399 562 16 GHz | 33.725 dBµV | | | |
| 4 | | | | | | | | |
| 5 | | | | | | | | |
| 6 | | | | | | | | |
| 7 | | | | | | | | |
| 8 | | | | | | | | |
| 9 | | | | | | | | |

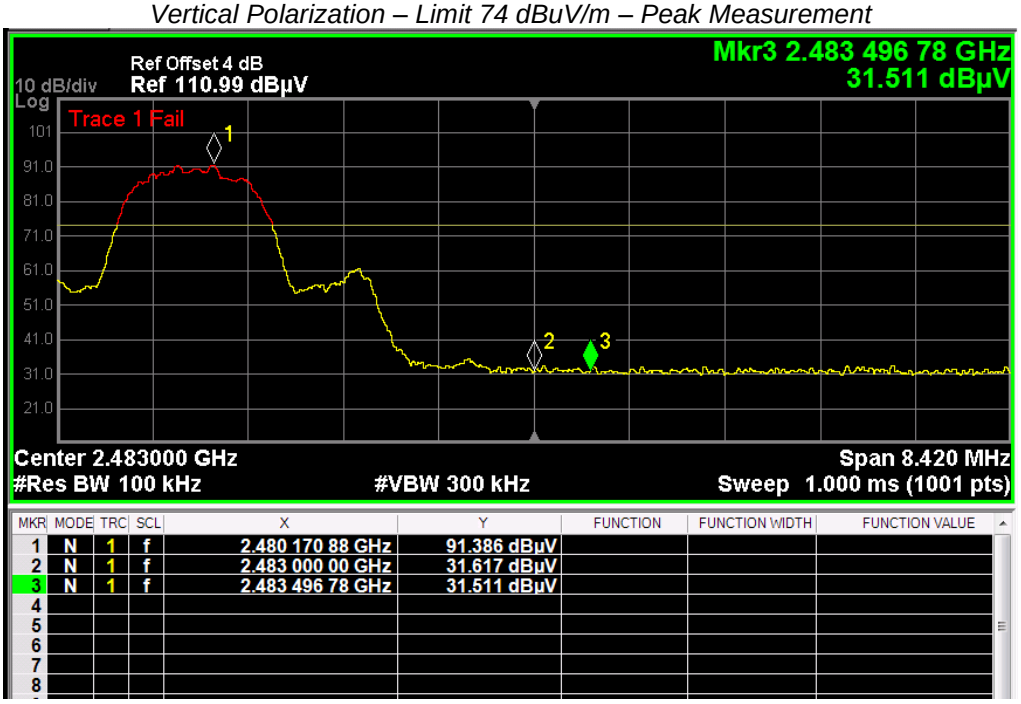
***3DH5 at Channel 2480MHz***

*Horizontal Polarization – Limit 74 dBuV/m – Peak Measurement*


*Horizontal Polarization – Limit 54 dBuV/m – Average Measurement*

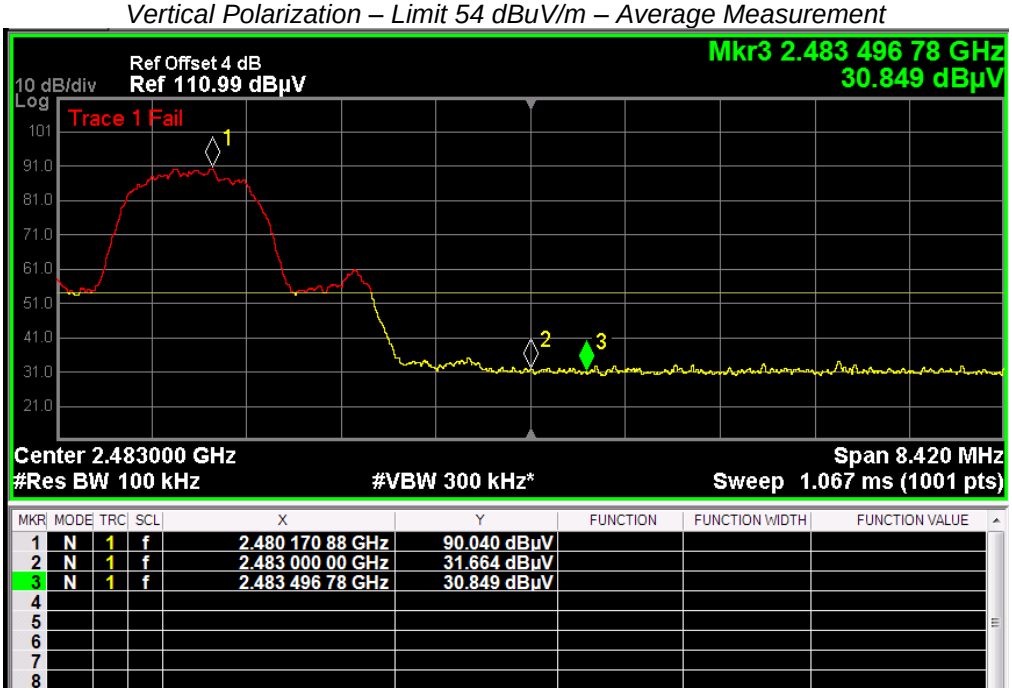


*Vertical Polarization – Limit 74 dBuV/m – Peak Measurement*




| MKR | MODE | TRC | SCL | X | Y | FUNCTION | FUNCTION WIDTH | FUNCTION VALUE |
|---|---|---|---|---|---|---|---|---|
| 1 | N | 1 | f | 2.480 170 88 GHz | 91.386 dBµV | | | |
| 2 | N | 1 | f | 2.483 000 00 GHz | 31.617 dBµV | | | |
| 3 | N | 1 | f | 2.483 496 78 GHz | 31.511 dBµV | | | |
| 4 | | | | | | | | |
| 5 | | | | | | | | |
| 6 | | | | | | | | |
| 7 | | | | | | | | |
| 8 | | | | | | | | |

*Vertical Polarization – Limit 54 dBuV/m – Average Measurement*




| MKR | MODE | TRC | SCL | X | Y | FUNCTION | FUNCTION WIDTH | FUNCTION VALUE |
|---|---|---|---|---|---|---|---|---|
| 1 | N | 1 | f | 2.480 170 88 GHz | 90.040 dBµV | | | |
| 2 | N | 1 | f | 2.483 000 00 GHz | 31.664 dBµV | | | |
| 3 | N | 1 | f | 2.483 496 78 GHz | 30.849 dBµV | | | |
| 4 | | | | | | | | |
| 5 | | | | | | | | |
| 6 | | | | | | | | |
| 7 | | | | | | | | |
| 8 | | | | | | | | |

**END OF REPORT**