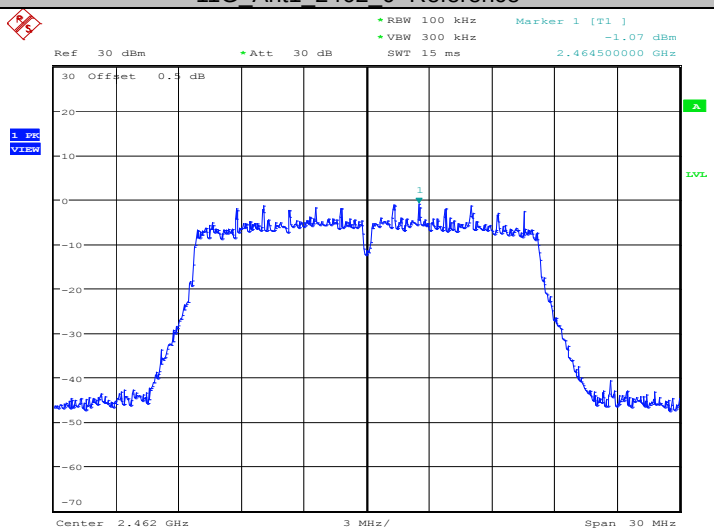
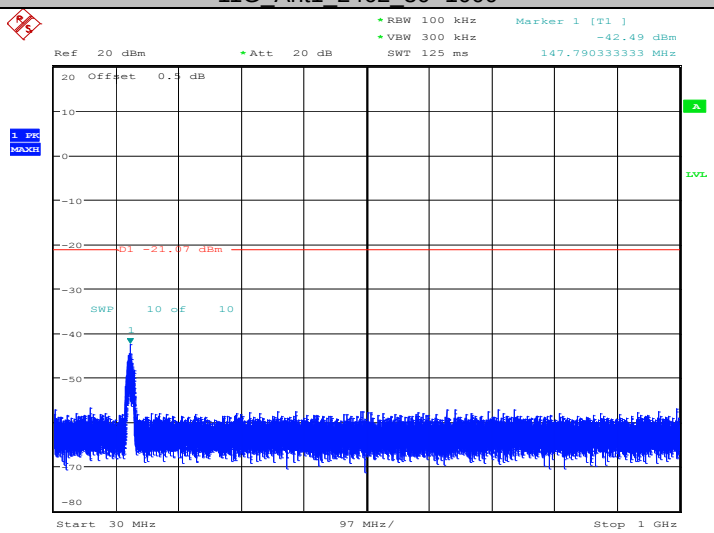
11G_Ant1_2462_0~Reference



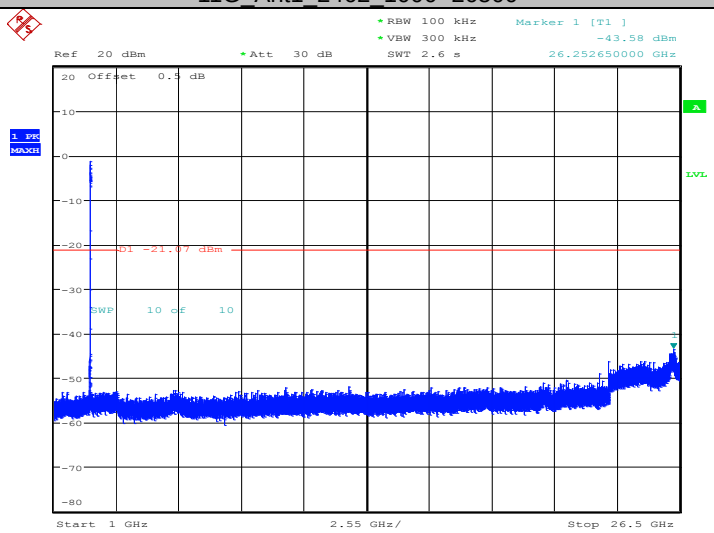

Date: 11.DEC.2020 17:28:24

11G_Ant1_2462_30~1000



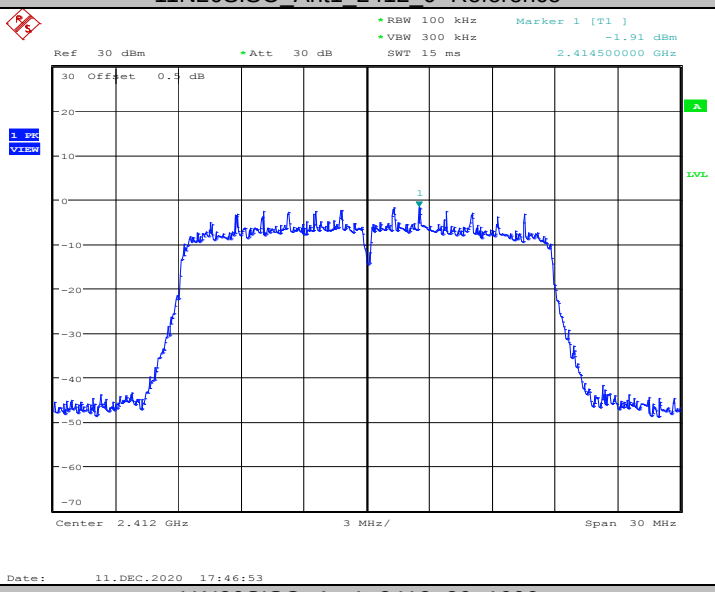

Date: 11.DEC.2020 17:28:35

11G_Ant1_2462_1000~26500

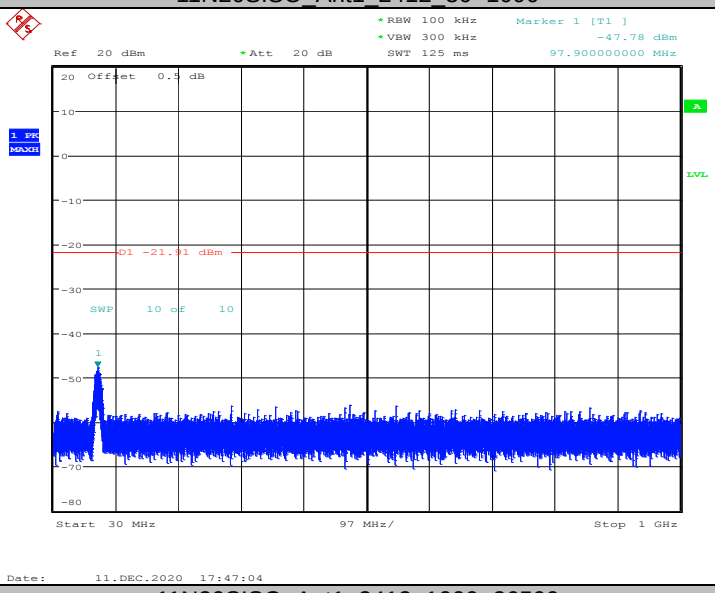



Date: 11.DEC.2020 17:29:26

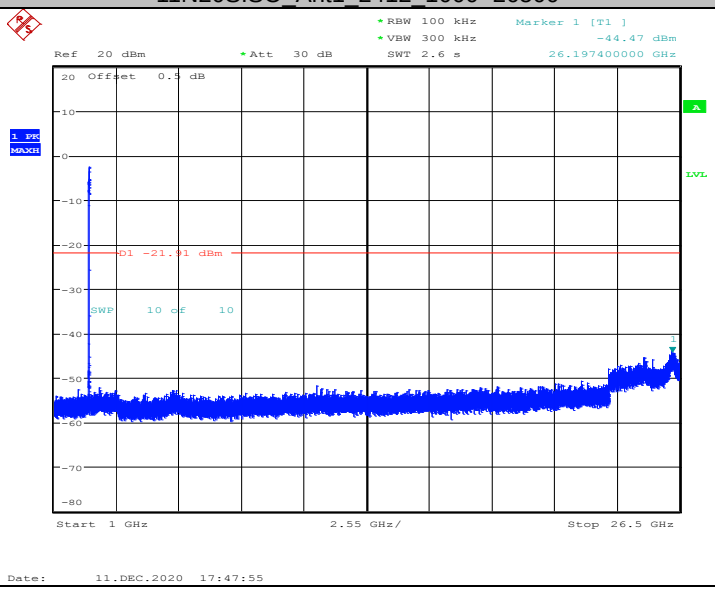
11N20SISO_Ant1_2412_0~Reference



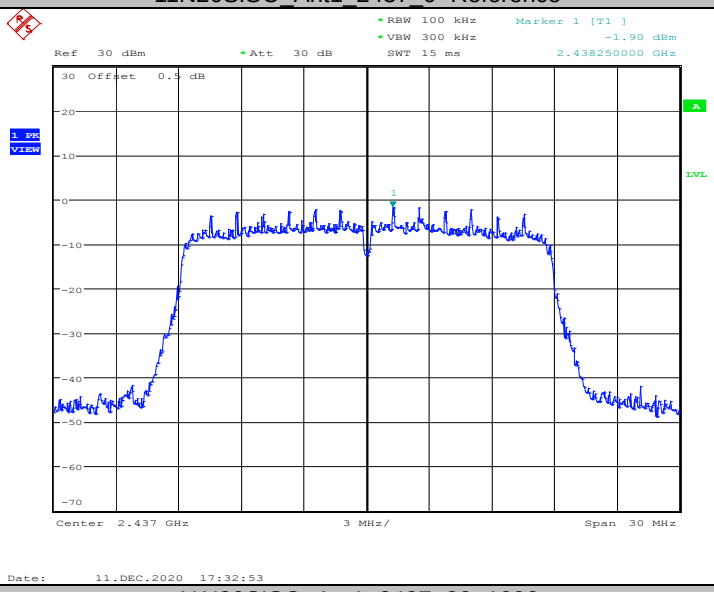

11N20SISO_Ant1_2412_30~1000



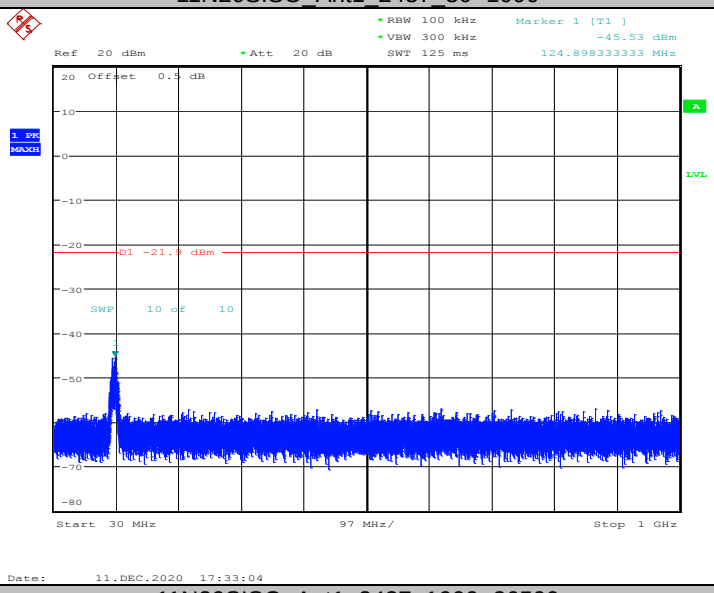

11N20SISO_Ant1_2412_1000~26500



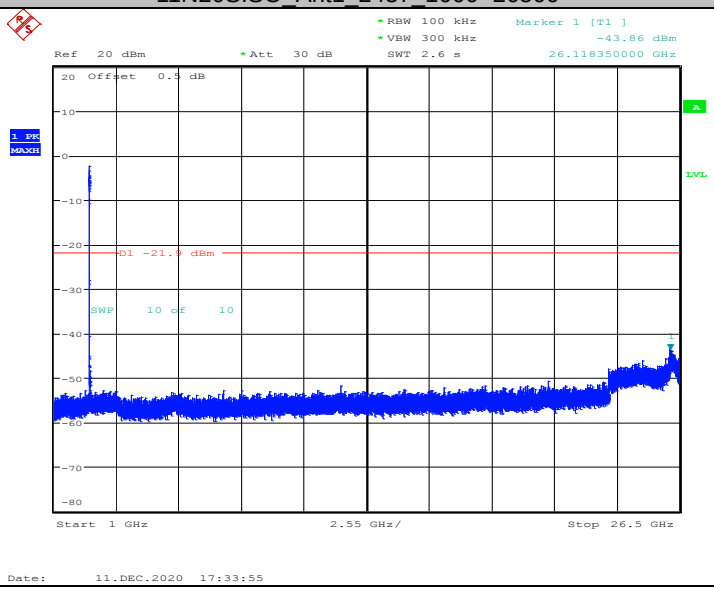
11N20SISO_Ant1_2437_0~Reference



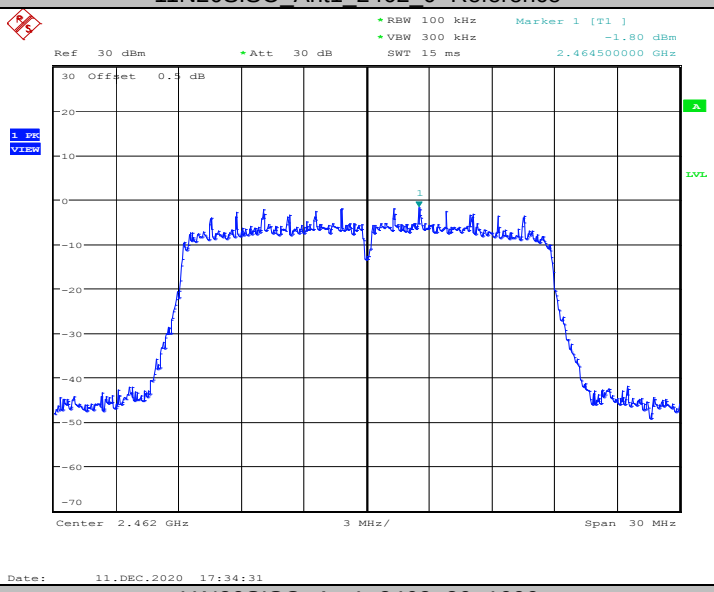

11N20SISO_Ant1_2437_30~1000



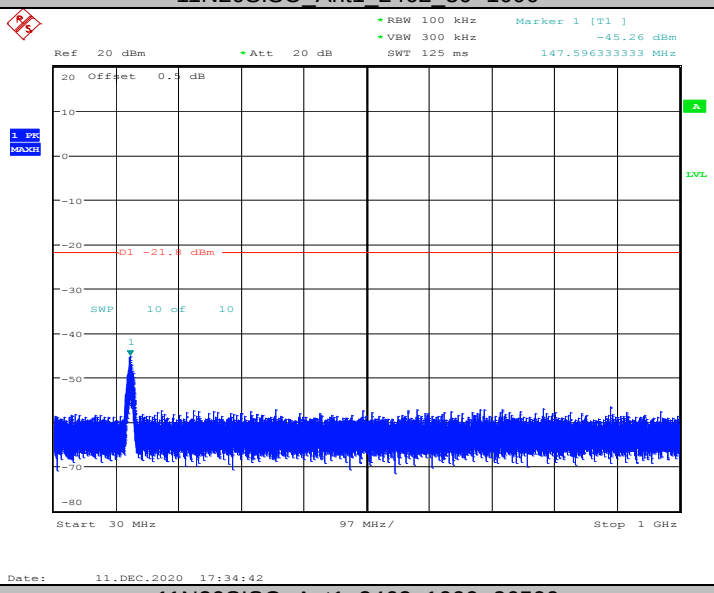

11N20SISO_Ant1_2437_1000~26500



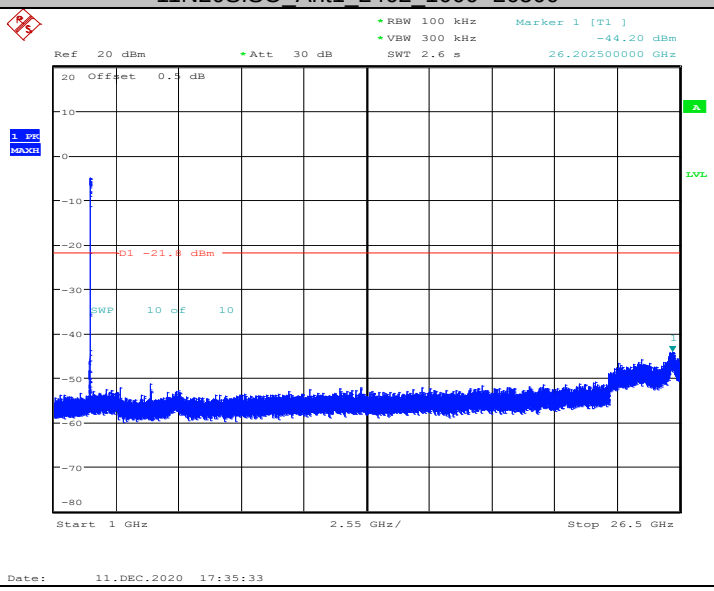
11N20SISO_Ant1_2462_0~Reference



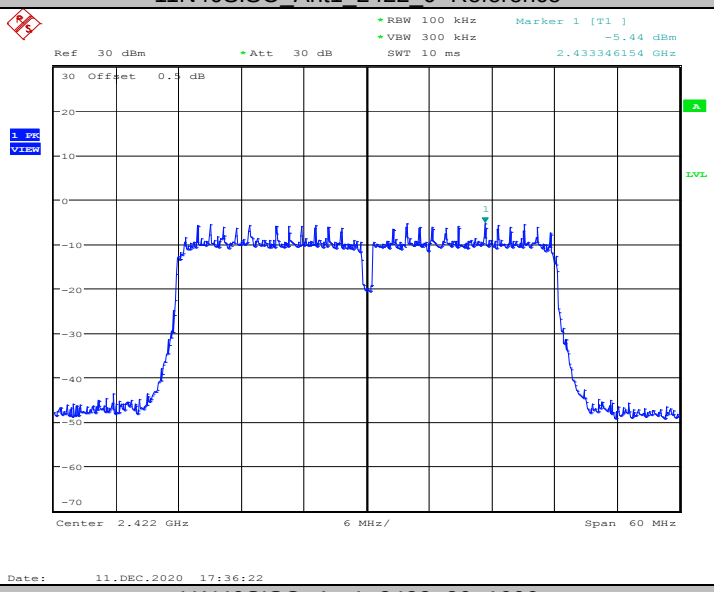

11N20SISO_Ant1_2462_30~1000



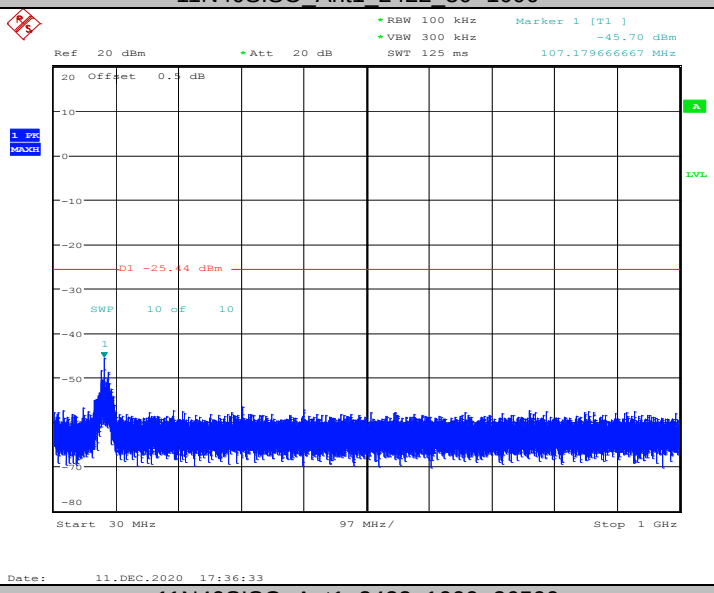

11N20SISO_Ant1_2462_1000~26500



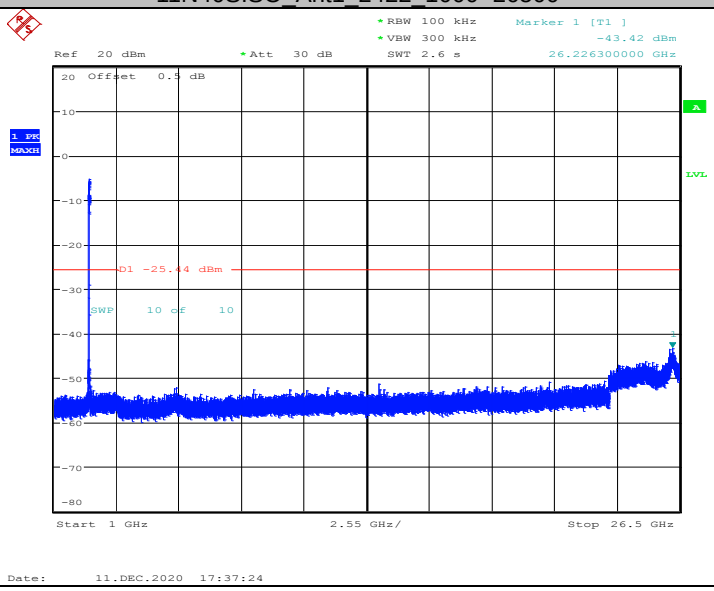
11N40SISO_Ant1_2422_0~Reference



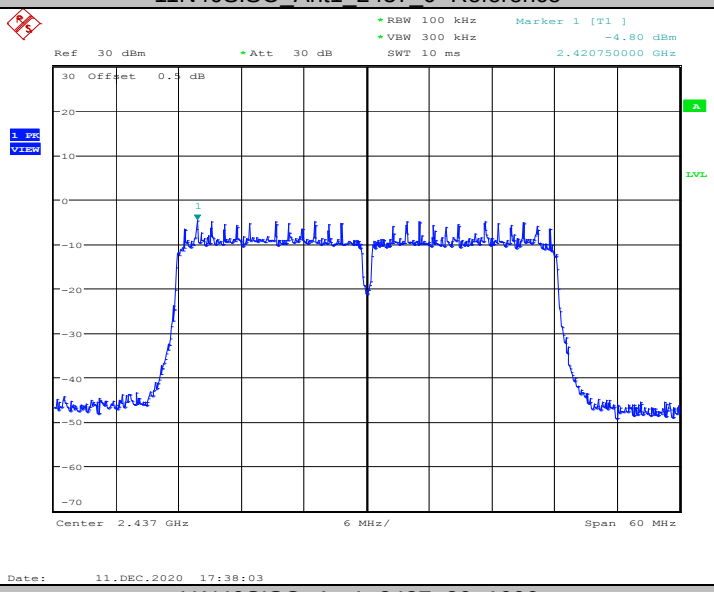

11N40SISO_Ant1_2422_30~1000



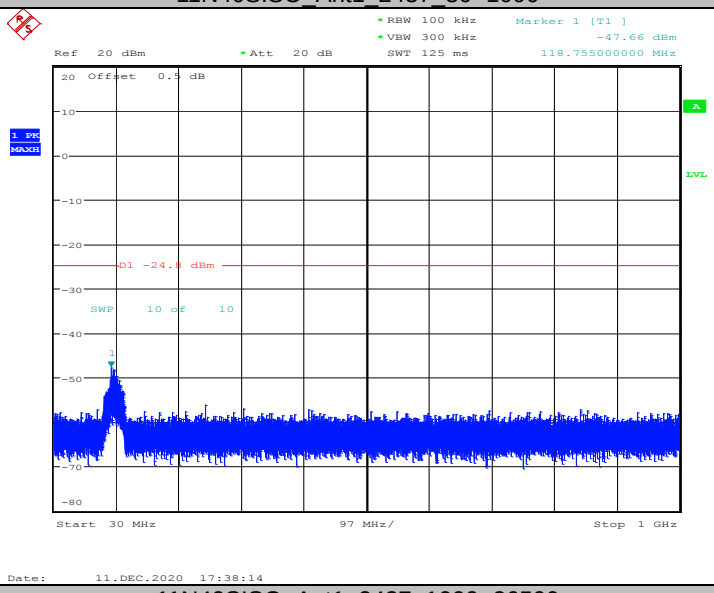

11N40SISO_Ant1_2422_1000~26500



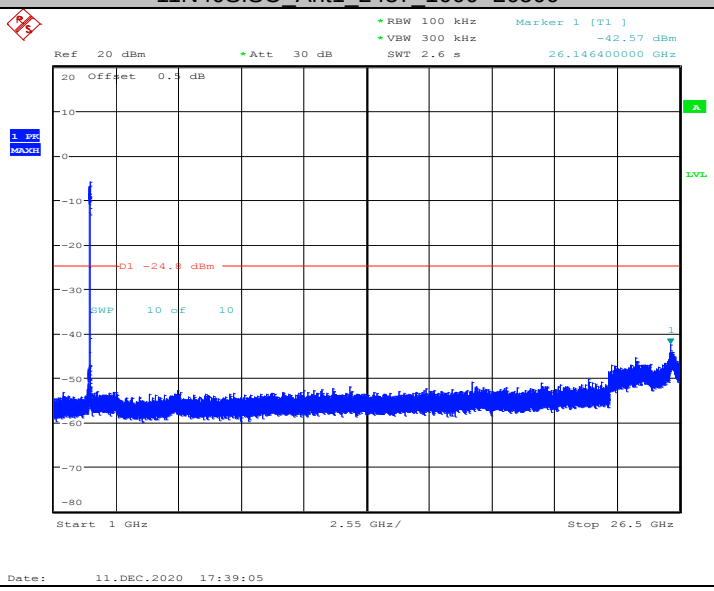
11N40SISO_Ant1_2437_0~Reference



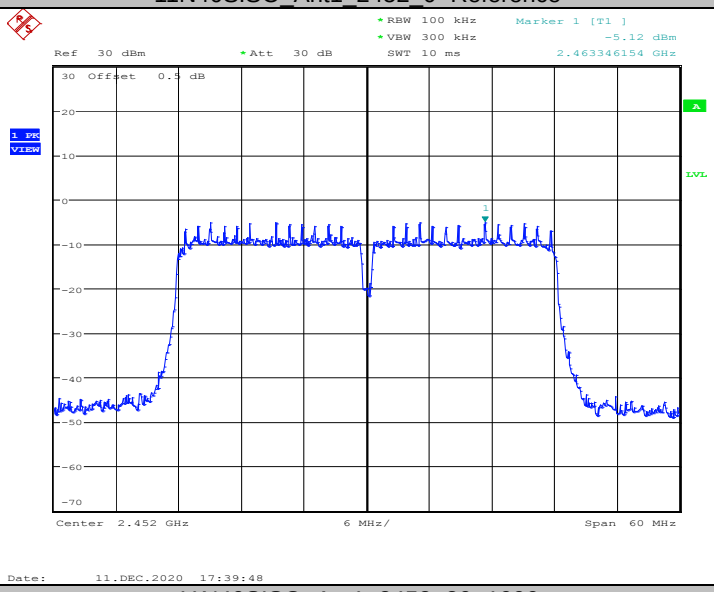

11N40SISO_Ant1_2437_30~1000



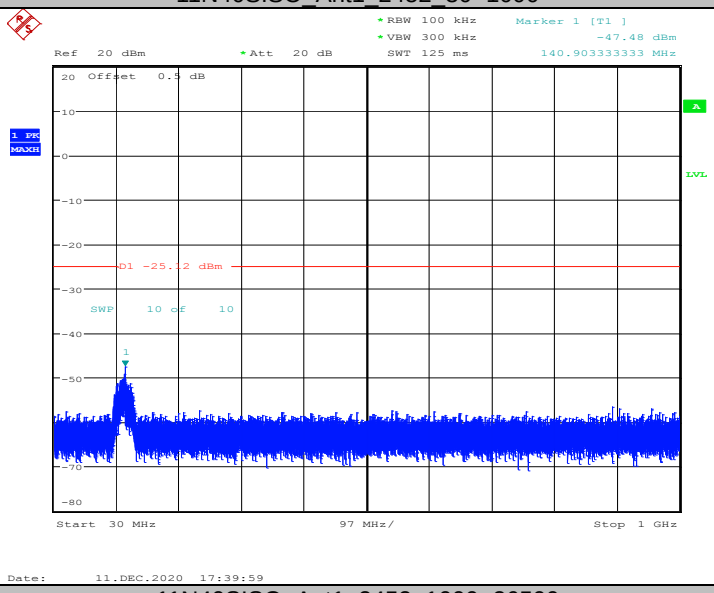

11N40SISO_Ant1_2437_1000~26500



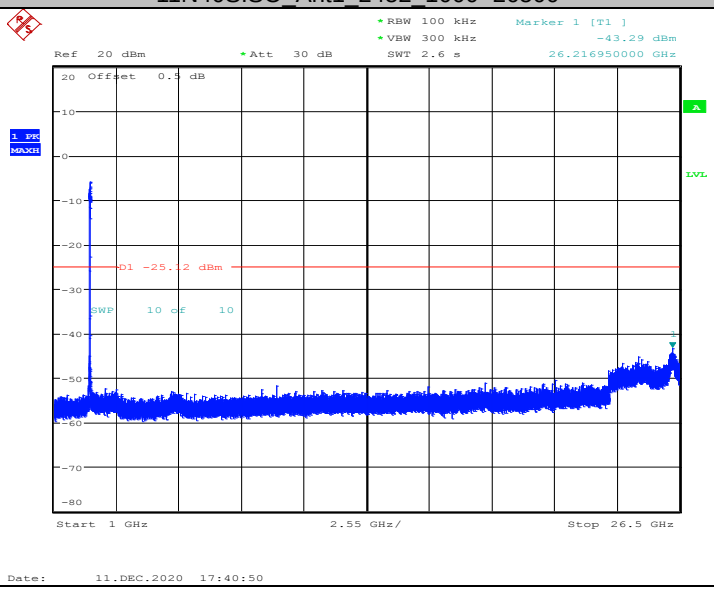
11N40SISO_Ant1_2452_0~Reference




11N40SISO_Ant1_2452_30~1000




11N40SISO_Ant1_2452_1000~26500



## 3.3. Band Edge Emissions

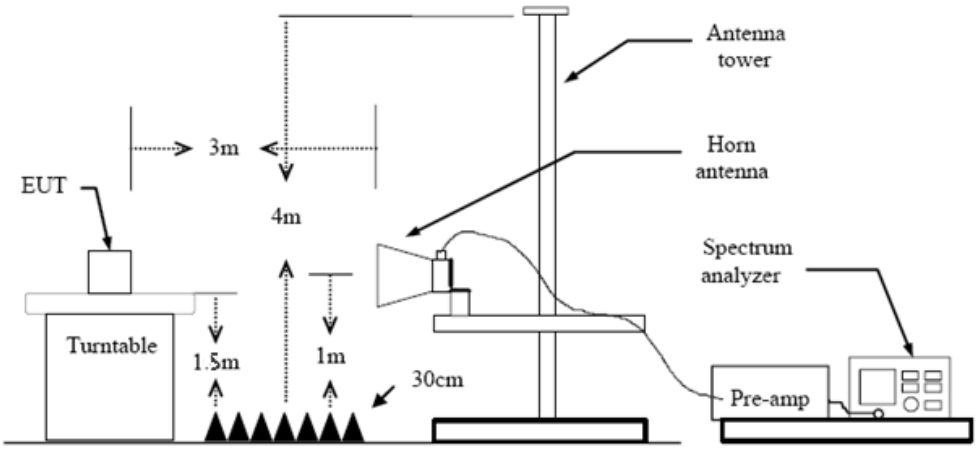
**Limit**

**FCC CFR Title 47 Part 15 Subpart C Section 15.247 (d)**

| Restricted Frequency Band (MHz) | (dBuV/m)(at 3m) | |
|---|---|---|
| | Peak | Average |
| 2310 ~2390 | 74 | 54 |
| 2483.5 ~2500 | 74 | 54 |

**Conducted band edge limit: The highest point of the operating frequency waveform down 20dB**

**Test Configuration**




**Test Procedure**

1. The EUT was setup and tested according to ANSI C63.10:2013 requirements.
2. The EUT is placed on a turn table which is 1.5 meter above ground. The turn table is rotated 360 degrees to determine the position of the maximum emission level.
3. The EUT was positioned such that the distance from antenna to the EUT was 3 meters.
4. The antenna is scanned from 1 meter to 4 meters to find out the maximum emission level. This is repeated for both horizontal and vertical polarization of the antenna. In order to find the maximum emission, all of the interface cables were manipulated according to ANSI C63.10:2013 on radiated measurement.
5. The receiver set as follow:
   RBW=1MHz, VBW=3MHz Peak detector for Peak value.
   RBW=1MHz, VBW see note 1 with Peak Detector for Average Value.

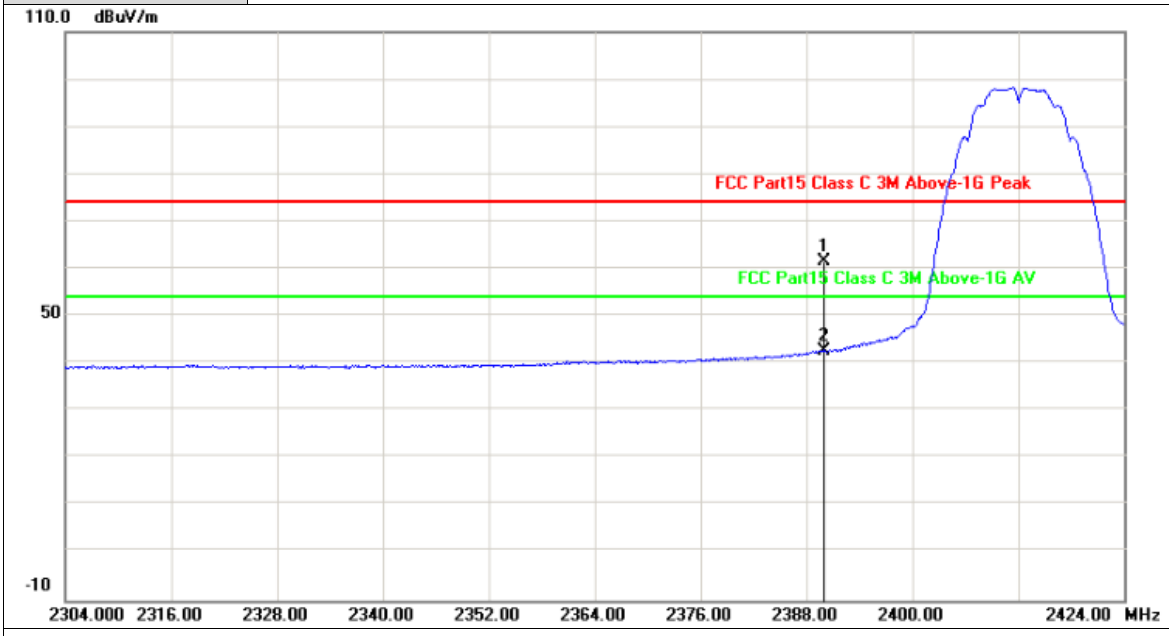
   Note 1: For measurements above 1 GHz the resolution bandwidth is set to 1 MHz, then the video bandwidth is set to 3 MHz for peak measurements and 1 MHz resolution bandwidth with 1/T video bandwidth with peak detector for average measurements. For the Duty Cycle please refer to clause 3.7 Duty Cycle.

**Test Mode**

Please refer to the clause 2.3.

**Test Results**

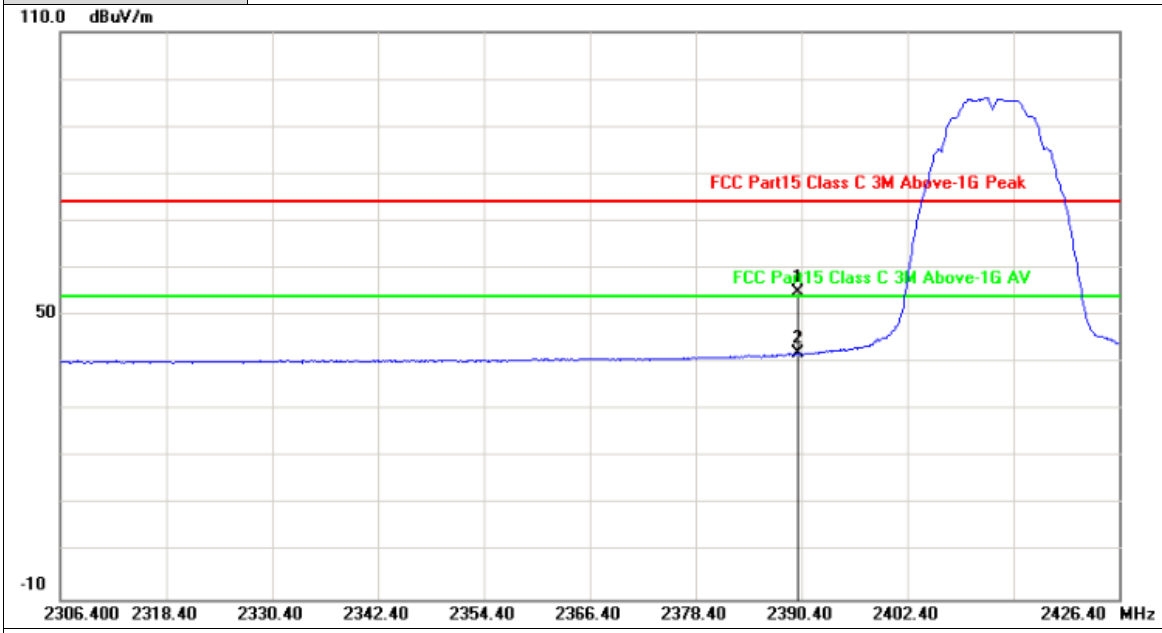
| Ant. Pol. | Horizontal |
|---|---|
| Test Mode: | B Mode 2412MHz |




| No. | Frequency (MHz) | Factor (dB/m) | Reading (dBuV) | Level (dBuV/m) | Limit (dBuV/m) | Margin (dB) | Detector |
|---|---|---|---|---|---|---|---|
| 1 | 2390.000 | 31.10 | 30.31 | 61.41 | 74.00 | -12.59 | peak |
| 2 | 2390.000 | 31.10 | 11.46 | 42.56 | 54.00 | -11.44 | AVG |

Remarks:
1.Factor (dB/m) = Antenna Factor (dB/m)+Cable Factor (dB)-Pre-amplifier Factor
2.Margin value = Level -Limit value

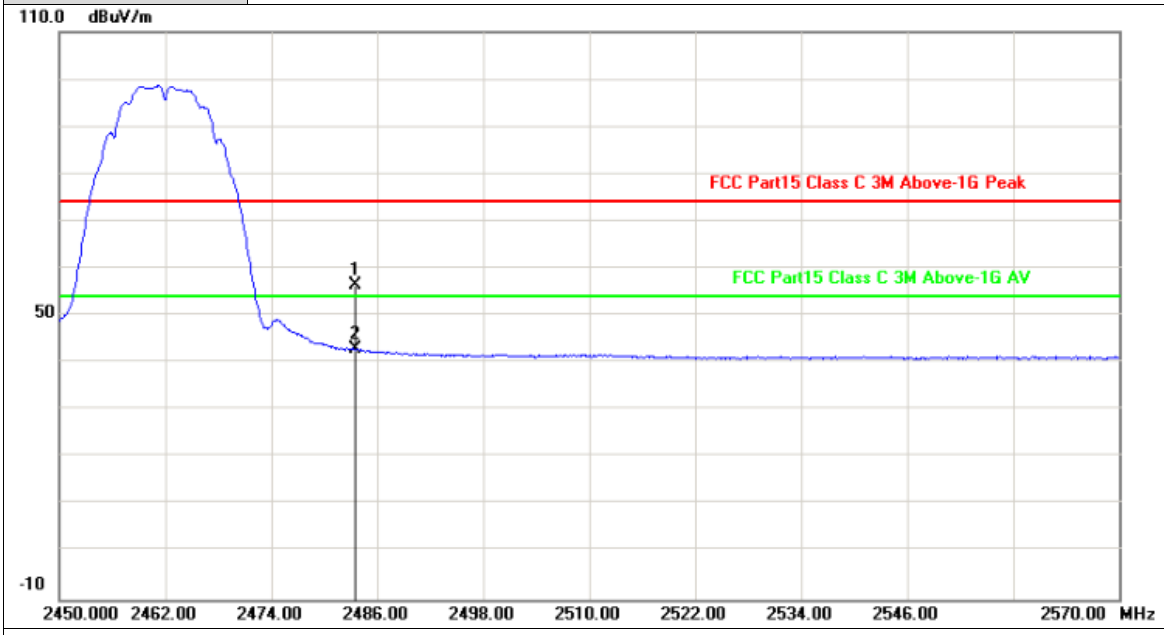
| Ant. Pol. | Vertical |
|---|---|
| Test Mode: | B Mode 2412MHz |




| No. | Frequency (MHz) | Factor (dB/m) | Reading (dBuV) | Level (dBuV/m) | Limit (dBuV/m) | Margin (dB) | Detector |
|---|---|---|---|---|---|---|---|
| 1 | 2390.000 | 31.10 | 23.85 | 54.95 | 74.00 | -19.05 | peak |
| 2 | 2390.000 | 31.10 | 10.85 | 41.95 | 54.00 | -12.05 | AVG |

Remarks:
1.Factor (dB/m) = Antenna Factor (dB/m)+Cable Factor (dB)-Pre-amplifier Factor
2.Margin value = Level -Limit value

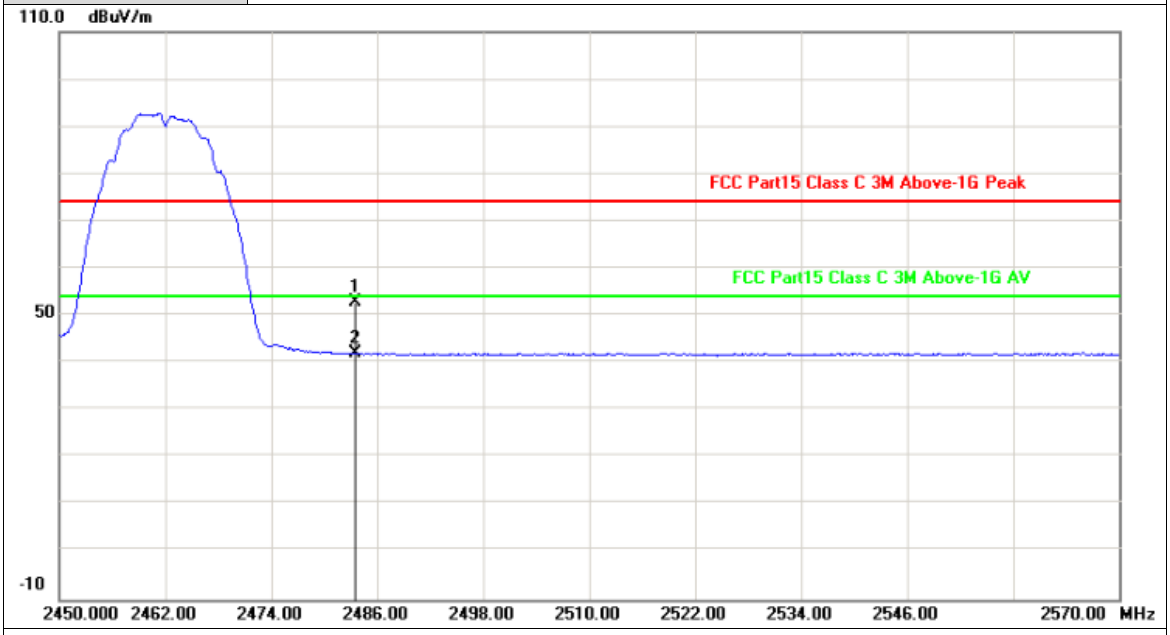
| Ant. Pol. | Horizontal |
|---|---|
| Test Mode: | B Mode 2462 MHz |




| No. | Frequency (MHz) | Factor (dB/m) | Reading (dBuV) | Level (dBuV/m) | Limit (dBuV/m) | Margin (dB) | Detector |
|---|---|---|---|---|---|---|---|
| 1 | 2483.500 | 31.50 | 25.03 | 56.53 | 74.00 | -17.47 | peak |
| 2 | 2483.500 | 31.50 | 11.36 | 42.86 | 54.00 | -11.14 | AVG |

Remarks:
1.Factor (dB/m) = Antenna Factor (dB/m)+Cable Factor (dB)-Pre-amplifier Factor
2.Margin value = Level -Limit value

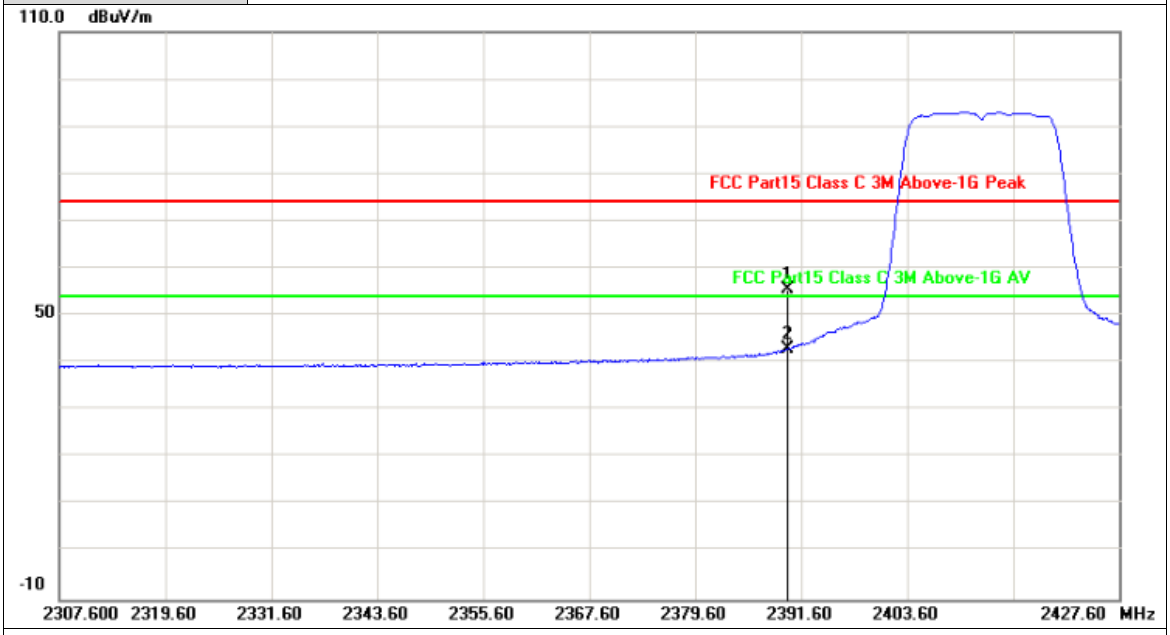
| Ant. Pol. | Vertical |
|---|---|
| Test Mode: | B Mode 2462 MHz |




| No. | Frequency (MHz) | Factor (dB/m) | Reading (dBuV) | Level (dBuV/m) | Limit (dBuV/m) | Margin (dB) | Detector |
|---|---|---|---|---|---|---|---|
| 1 | 2483.500 | 31.50 | 21.43 | 52.93 | 74.00 | -21.07 | peak |
| 2 | 2483.500 | 31.50 | 10.68 | 42.18 | 54.00 | -11.82 | AVG |

Remarks:
1.Factor (dB/m) = Antenna Factor (dB/m)+Cable Factor (dB)-Pre-amplifier Factor
2.Margin value = Level -Limit value

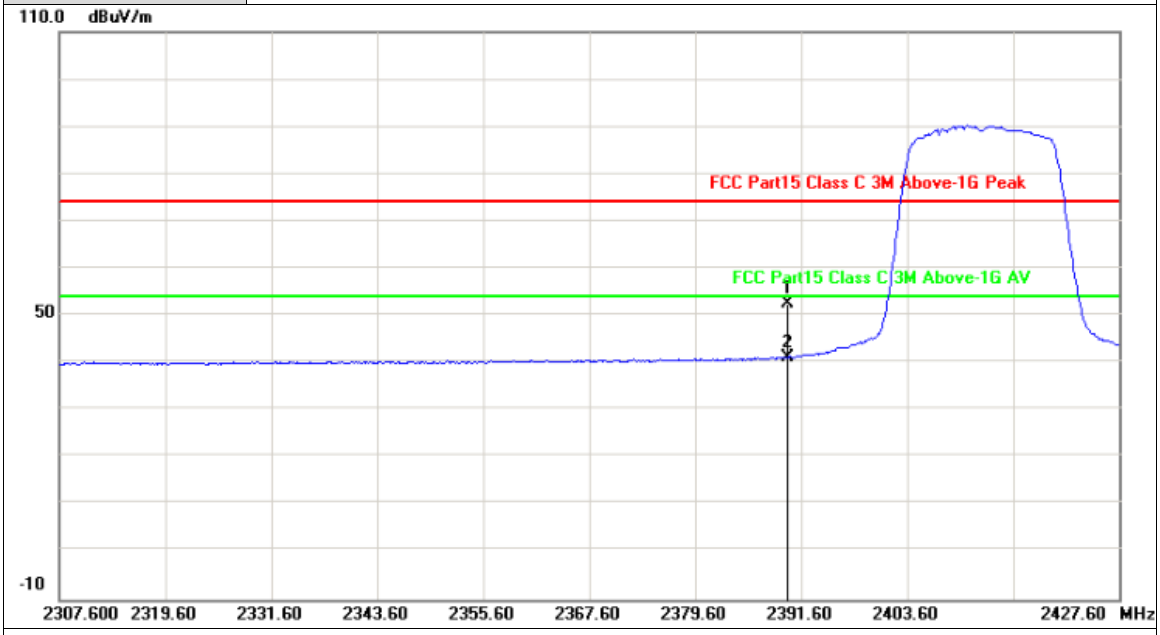
| Ant. Pol. | Horizontal |
|---|---|
| Test Mode: | G Mode 2412MHz |




| No. | Frequency (MHz) | Factor (dB/m) | Reading (dBuV) | Level (dBuV/m) | Limit (dBuV/m) | Margin (dB) | Detector |
|---|---|---|---|---|---|---|---|
| 1 | 2390.000 | 31.10 | 24.53 | 55.63 | 74.00 | -18.37 | peak |
| 2 | 2390.000 | 31.10 | 11.84 | 42.94 | 54.00 | -11.06 | AVG |

Remarks:
1.Factor (dB/m) = Antenna Factor (dB/m)+Cable Factor (dB)-Pre-amplifier Factor
2.Margin value = Level -Limit value

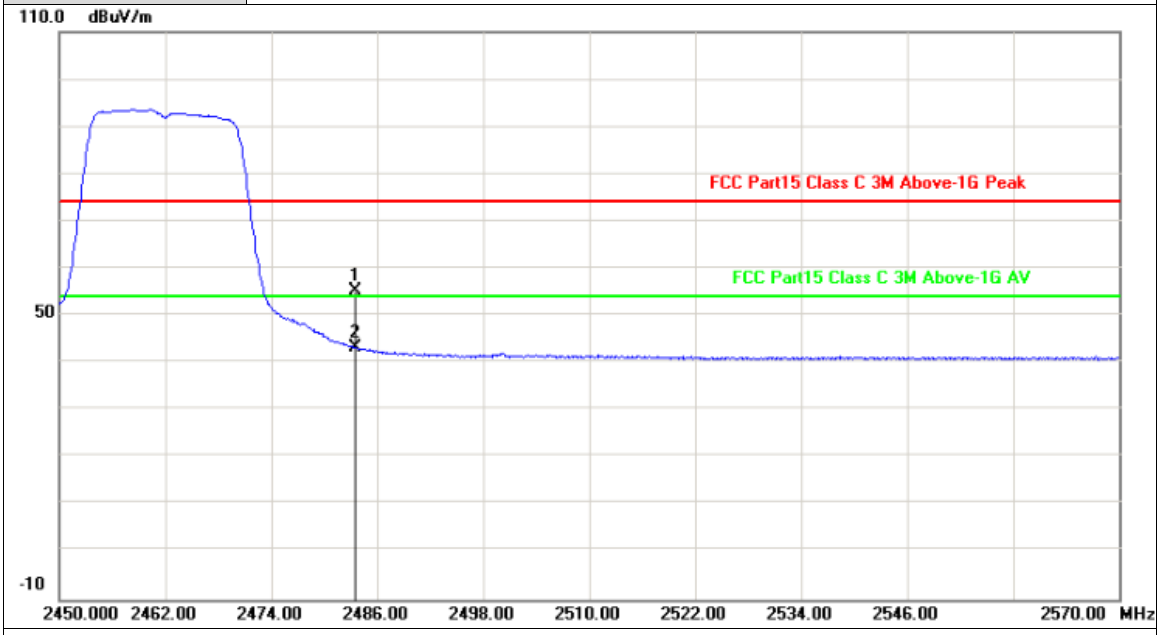
| Ant. Pol. | Vertical |
|---|---|
| Test Mode: | G Mode 2412MHz |




| No. | Frequency (MHz) | Factor (dB/m) | Reading (dBuV) | Level (dBuV/m) | Limit (dBuV/m) | Margin (dB) | Detector |
|---|---|---|---|---|---|---|---|
| 1 | 2390.000 | 31.10 | 21.48 | 52.58 | 74.00 | -21.42 | peak |
| 2 | 2390.000 | 31.10 | 10.09 | 41.19 | 54.00 | -12.81 | AVG |

Remarks:
1.Factor (dB/m) = Antenna Factor (dB/m)+Cable Factor (dB)-Pre-amplifier Factor
2.Margin value = Level -Limit value

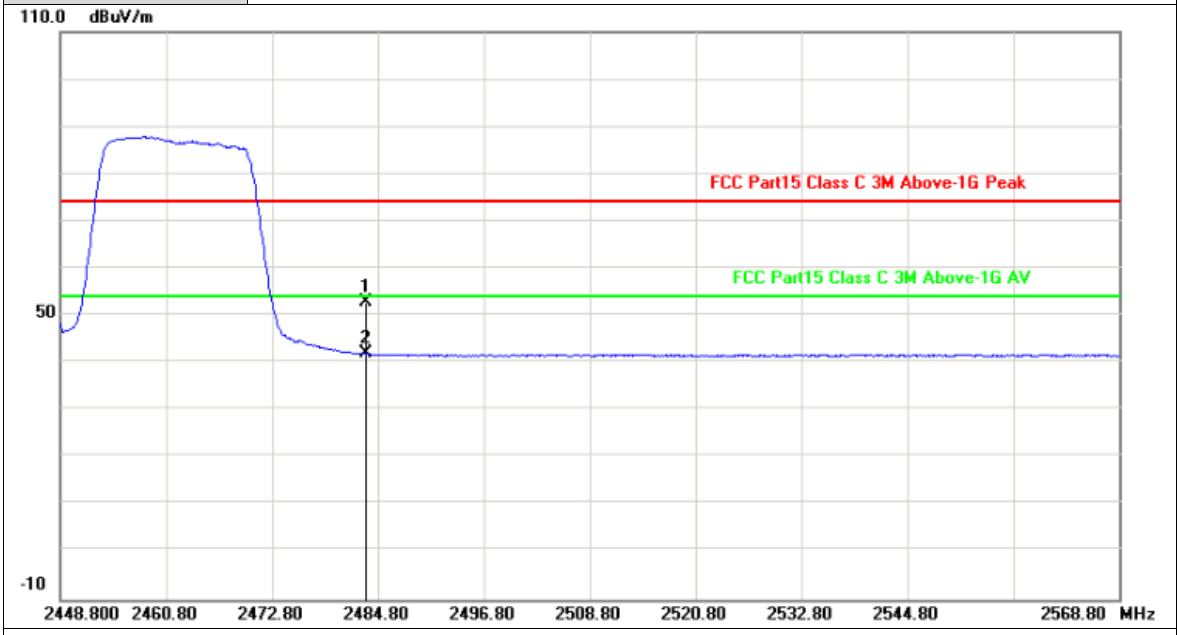
| Ant. Pol. | Horizontal |
|---|---|
| Test Mode: | G Mode 2462MHz |




| No. | Frequency (MHz) | Factor (dB/m) | Reading (dBuV) | Level (dBuV/m) | Limit (dBuV/m) | Margin (dB) | Detector |
|---|---|---|---|---|---|---|---|
| 1 | 2483.500 | 31.50 | 23.78 | 55.28 | 74.00 | -18.72 | peak |
| 2 | 2483.500 | 31.50 | 11.81 | 43.31 | 54.00 | -10.69 | AVG |

Remarks:
1.Factor (dB/m) = Antenna Factor (dB/m)+Cable Factor (dB)-Pre-amplifier Factor
2.Margin value = Level -Limit value

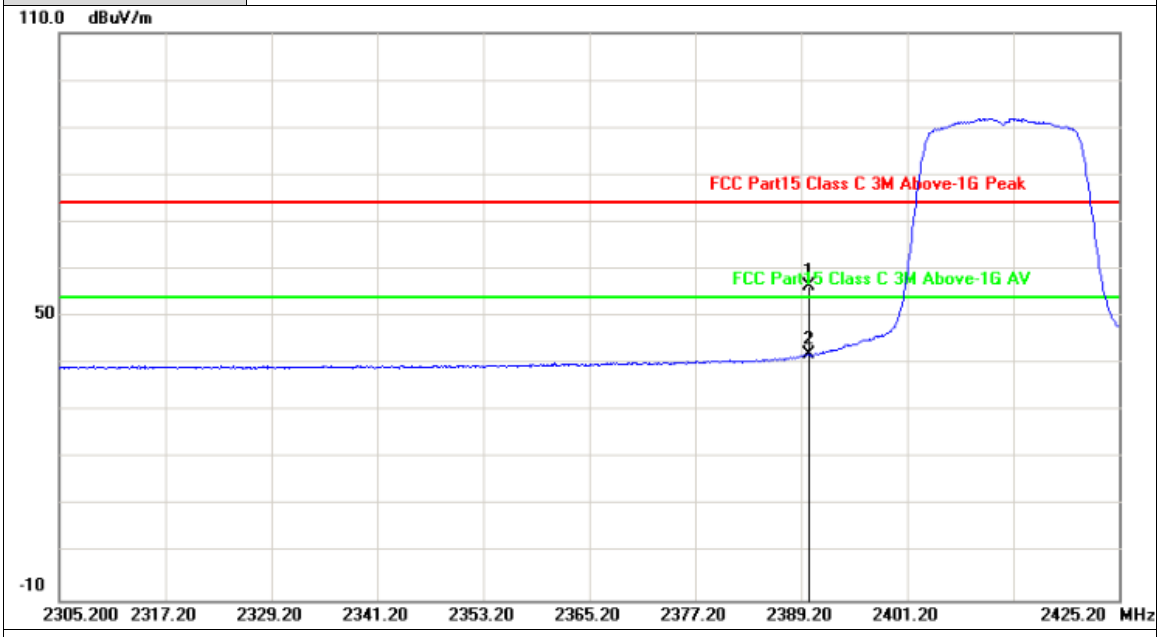
| Ant. Pol. | Vertical |
|---|---|
| Test Mode: | G Mode 2462MHz |




| No. | Frequency (MHz) | Factor (dB/m) | Reading (dBuV) | Level (dBuV/m) | Limit (dBuV/m) | Margin (dB) | Detector |
|---|---|---|---|---|---|---|---|
| 1 | 2483.500 | 31.50 | 21.30 | 52.80 | 74.00 | -21.20 | peak |
| 2 | 2483.500 | 31.50 | 10.51 | 42.01 | 54.00 | -11.99 | AVG |

Remarks:
1.Factor (dB/m) = Antenna Factor (dB/m)+Cable Factor (dB)-Pre-amplifier Factor
2.Margin value = Level -Limit value

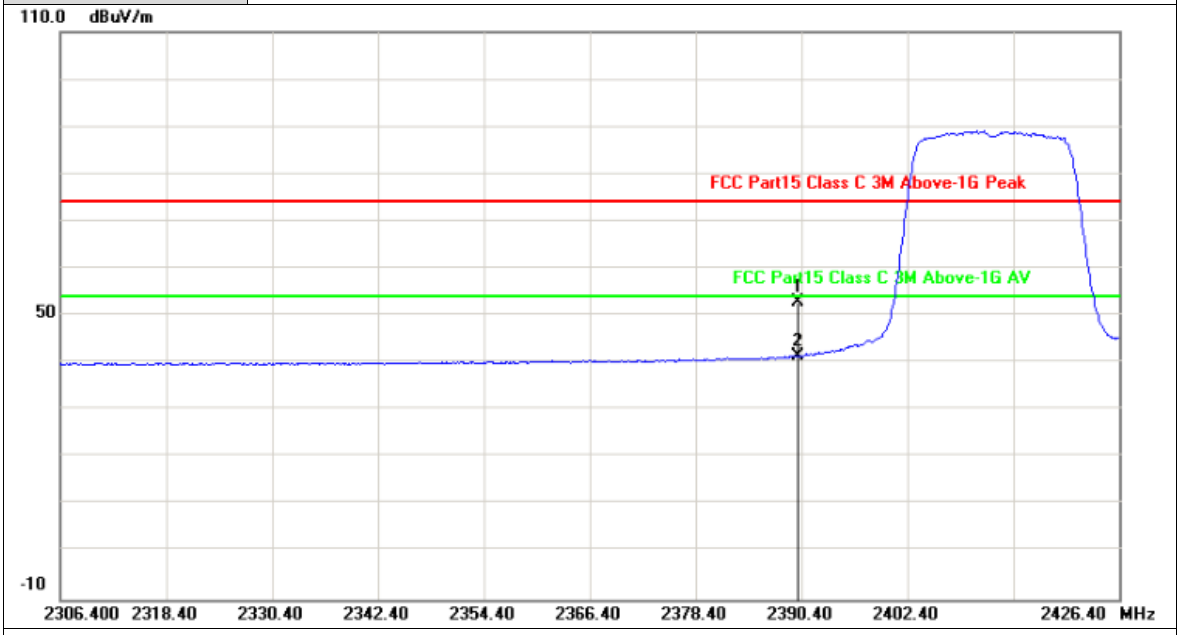
| Ant. Pol. | Horizontal |
|---|---|
| Test Mode: | N(HT20) Mode 2412MHz |




| No. | Frequency (MHz) | Factor (dB/m) | Reading (dBuV) | Level (dBuV/m) | Limit (dBuV/m) | Margin (dB) | Detector |
|---|---|---|---|---|---|---|---|
| 1 | 2390.000 | 31.10 | 25.28 | 56.38 | 74.00 | -17.62 | peak |
| 2 | 2390.000 | 31.10 | 10.87 | 41.97 | 54.00 | -12.03 | AVG |

Remarks:
1.Factor (dB/m) = Antenna Factor (dB/m)+Cable Factor (dB)-Pre-amplifier Factor
2.Margin value = Level -Limit value

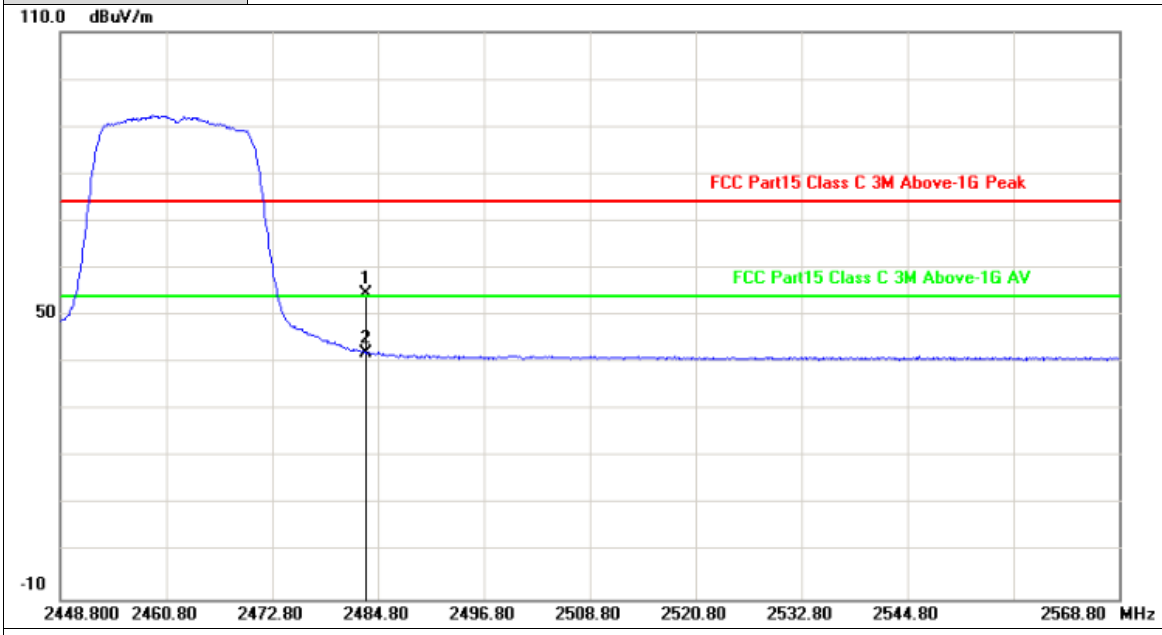
| Ant. Pol. | Vertical |
|---|---|
| Test Mode: | N(HT20) Mode 2412MHz |




| No. | Frequency (MHz) | Factor (dB/m) | Reading (dBuV) | Level (dBuV/m) | Limit (dBuV/m) | Margin (dB) | Detector |
|---|---|---|---|---|---|---|---|
| 1 | 2390.000 | 31.10 | 21.67 | 52.77 | 74.00 | -21.23 | peak |
| 2 | 2390.000 | 31.10 | 10.33 | 41.43 | 54.00 | -12.57 | AVG |

Remarks:
1.Factor (dB/m) = Antenna Factor (dB/m)+Cable Factor (dB)-Pre-amplifier Factor
2.Margin value = Level -Limit value

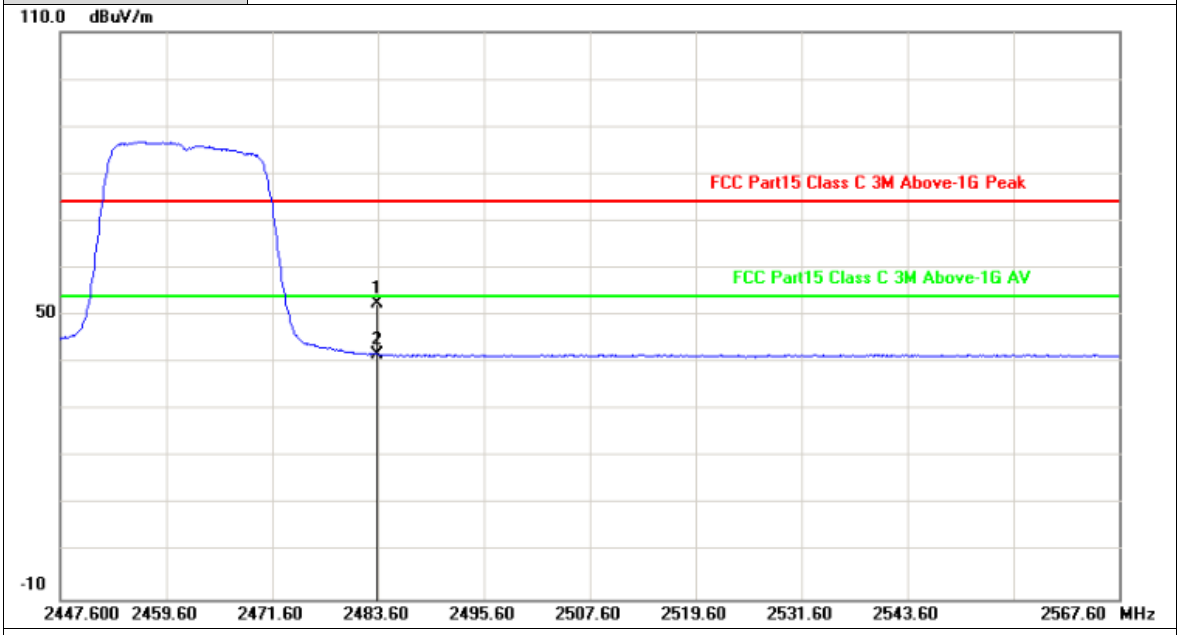
| Ant. Pol. | Horizontal |
|---|---|
| Test Mode: | N(HT20) Mode 2462MHz |




| No. | Frequency (MHz) | Factor (dB/m) | Reading (dBuV) | Level (dBuV/m) | Limit (dBuV/m) | Margin (dB) | Detector |
|---|---|---|---|---|---|---|---|
| 1 | 2483.500 | 31.50 | 23.09 | 54.59 | 74.00 | -19.41 | peak |
| 2 | 2483.500 | 31.50 | 10.66 | 42.16 | 54.00 | -11.84 | AVG |

Remarks:
1.Factor (dB/m) = Antenna Factor (dB/m)+Cable Factor (dB)-Pre-amplifier Factor
2.Margin value = Level -Limit value

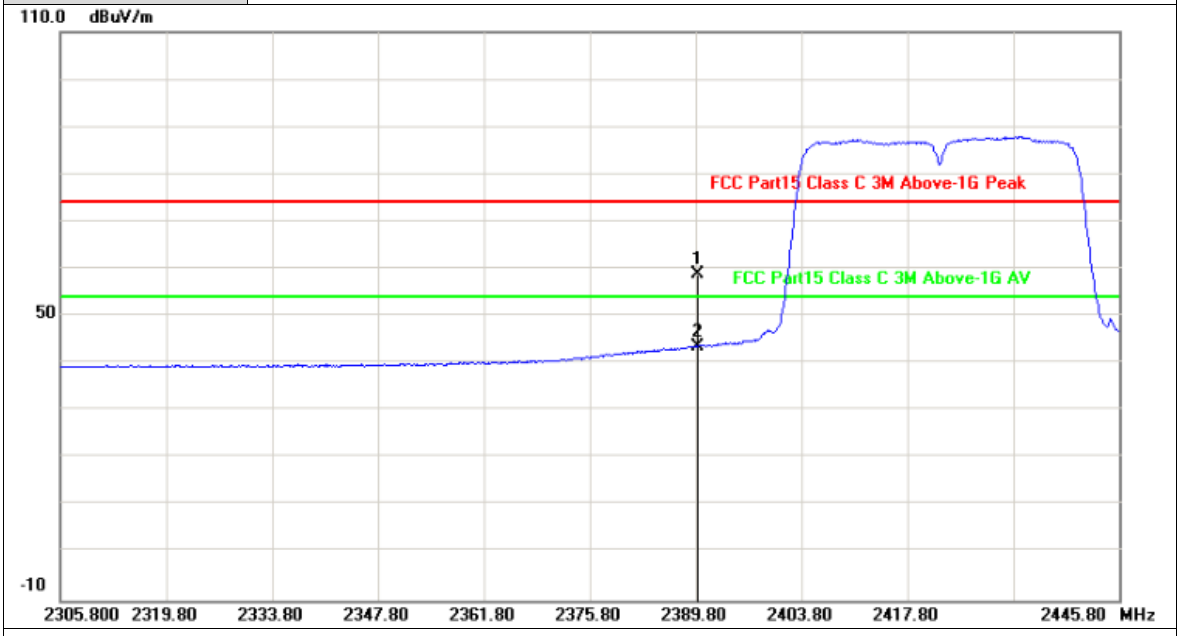
| Ant. Pol. | Vertical |
|---|---|
| Test Mode: | N(HT20) Mode 2462MHz |




| No. | Frequency (MHz) | Factor (dB/m) | Reading (dBuV) | Level (dBuV/m) | Limit (dBuV/m) | Margin (dB) | Detector |
|---|---|---|---|---|---|---|---|
| 1 | 2483.500 | 31.50 | 21.08 | 52.58 | 74.00 | -21.42 | peak |
| 2 | 2483.500 | 31.50 | 10.37 | 41.87 | 54.00 | -12.13 | AVG |

Remarks:
1.Factor (dB/m) = Antenna Factor (dB/m)+Cable Factor (dB)-Pre-amplifier Factor
2.Margin value = Level -Limit value

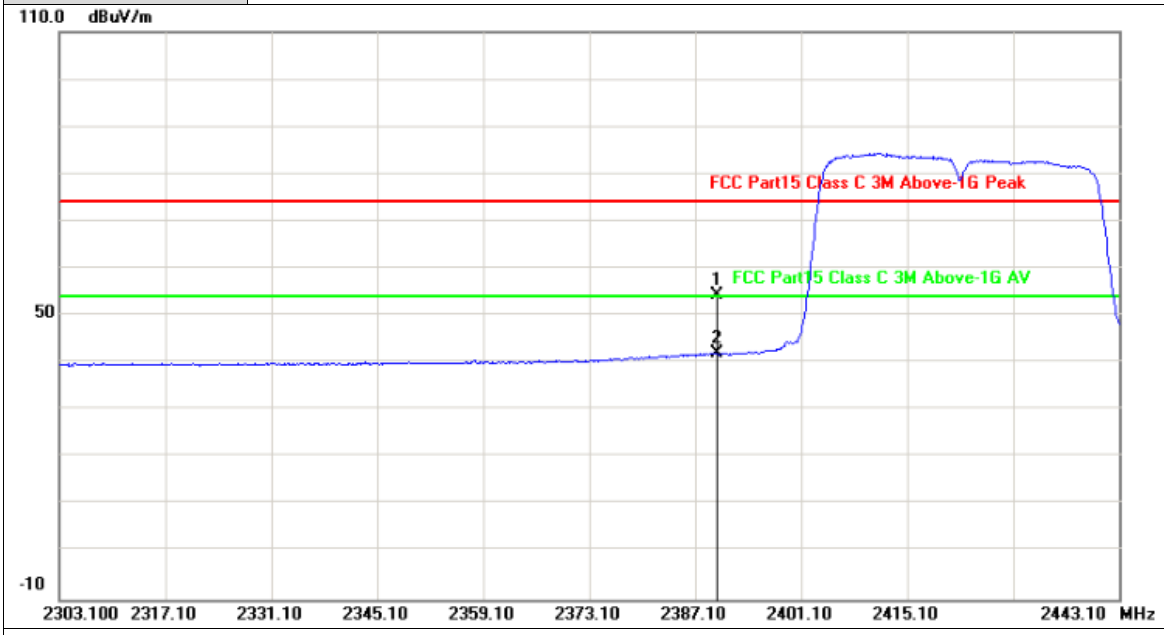
| Ant. Pol. | Horizontal |
|---|---|
| Test Mode: | N(HT40) Mode 2422MHz |




| No. | Frequency (MHz) | Factor (dB/m) | Reading (dBuV) | Level (dBuV/m) | Limit (dBuV/m) | Margin (dB) | Detector |
|---|---|---|---|---|---|---|---|
| 1 | 2390.000 | 31.10 | 27.80 | 58.90 | 74.00 | -15.10 | peak |
| 2 | 2390.000 | 31.10 | 12.59 | 43.69 | 54.00 | -10.31 | AVG |

Remarks:
1.Factor (dB/m) = Antenna Factor (dB/m)+Cable Factor (dB)-Pre-amplifier Factor
2.Margin value = Level -Limit value

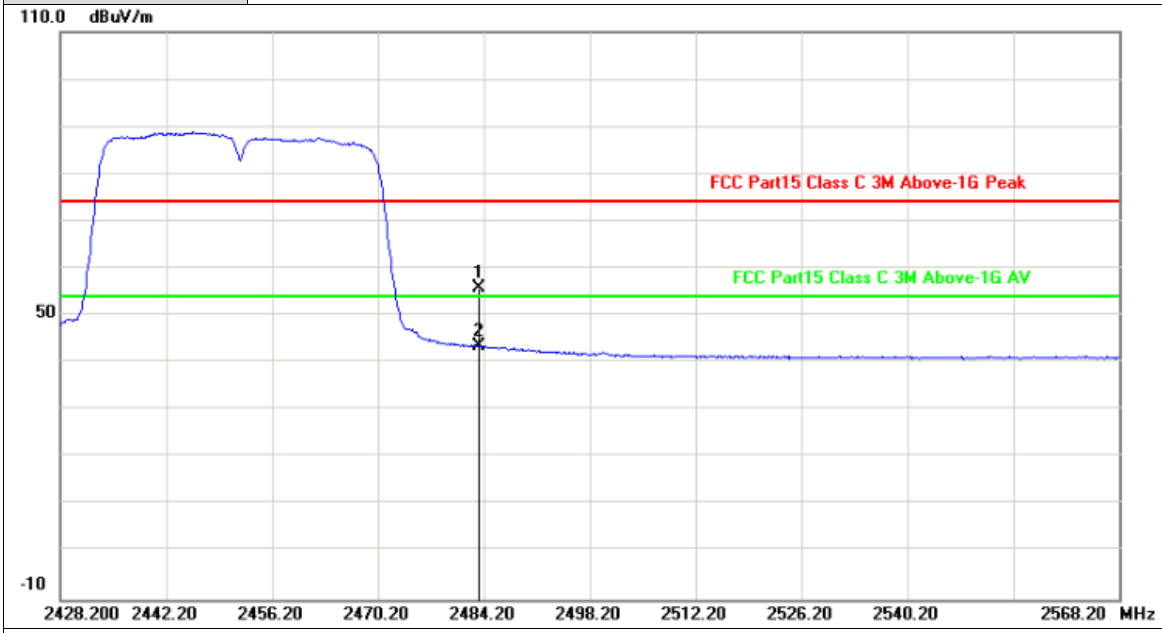
| Ant. Pol. | Vertical |
|---|---|
| Test Mode: | N(HT40) Mode 2422MHz |




| No. | Frequency (MHz) | Factor (dB/m) | Reading (dBuV) | Level (dBuV/m) | Limit (dBuV/m) | Margin (dB) | Detector |
|---|---|---|---|---|---|---|---|
| 1 | 2390.000 | 31.10 | 23.11 | 54.21 | 74.00 | -19.79 | peak |
| 2 | 2390.000 | 31.10 | 10.83 | 41.93 | 54.00 | -12.07 | AVG |

Remarks:
1.Factor (dB/m) = Antenna Factor (dB/m)+Cable Factor (dB)-Pre-amplifier Factor
2.Margin value = Level -Limit value

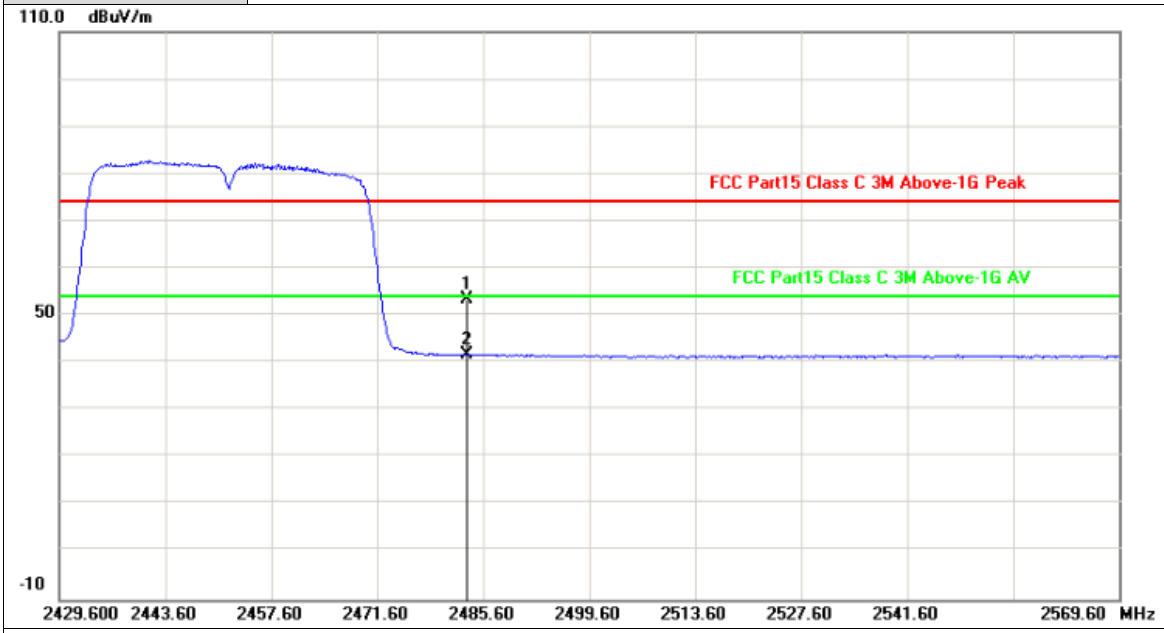
| Ant. Pol. | Horizontal |
|---|---|
| Test Mode: | N(HT40) Mode 2452MHz |




| No. | Frequency (MHz) | Factor (dB/m) | Reading (dBuV) | Level (dBuV/m) | Limit (dBuV/m) | Margin (dB) | Detector |
|---|---|---|---|---|---|---|---|
| 1 | 2483.500 | 31.50 | 24.43 | 55.93 | 74.00 | -18.07 | peak |
| 2 | 2483.500 | 31.50 | 11.99 | 43.49 | 54.00 | -10.51 | AVG |

Remarks:
1.Factor (dB/m) = Antenna Factor (dB/m)+Cable Factor (dB)-Pre-amplifier Factor
2.Margin value = Level -Limit value

| Ant. Pol. | Vertical |
|---|---|
| Test Mode: | N(HT40) Mode 2452MHz |

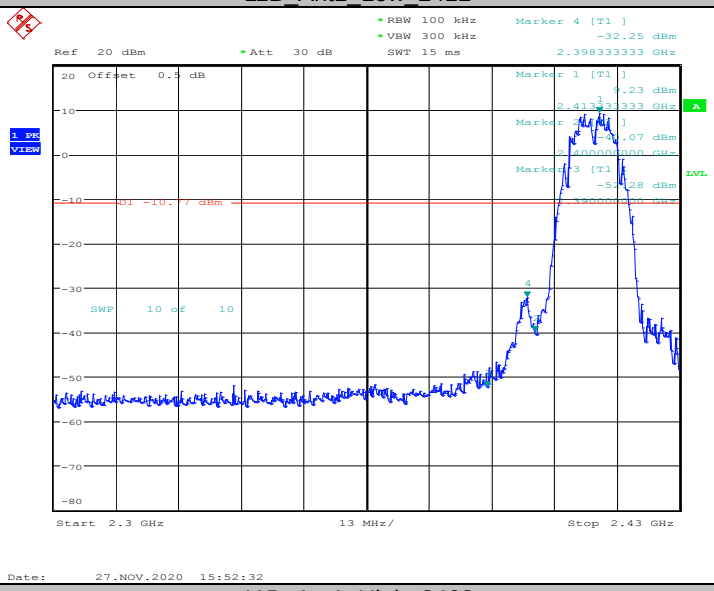



| No. | Frequency (MHz) | Factor (dB/m) | Reading (dBuV) | Level (dBuV/m) | Limit (dBuV/m) | Margin (dB) | Detector |
|---|---|---|---|---|---|---|---|
| 1 | 2483.500 | 31.50 | 22.06 | 53.56 | 74.00 | -20.44 | peak |
| 2 | 2483.500 | 31.50 | 10.30 | 41.80 | 54.00 | -12.20 | AVG |

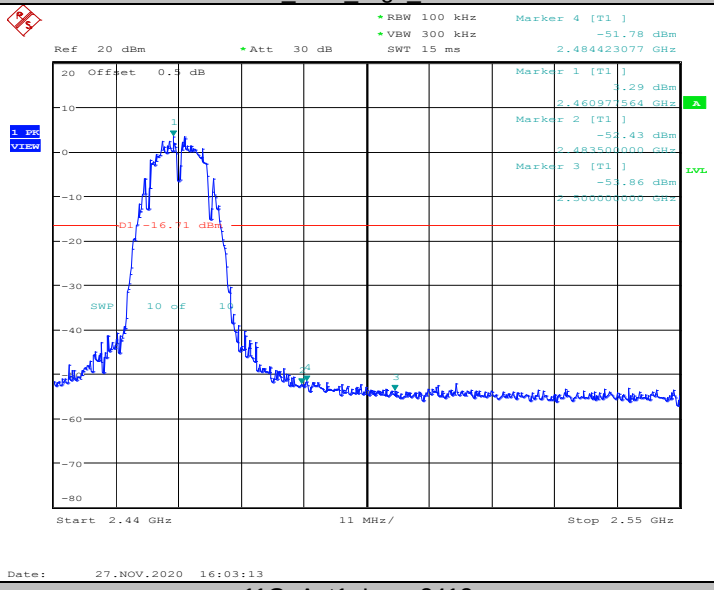
Remarks:
1.Factor (dB/m) = Antenna Factor (dB/m)+Cable Factor (dB)-Pre-amplifier Factor
2.Margin value = Level -Limit value

**Conducted band edge data:**

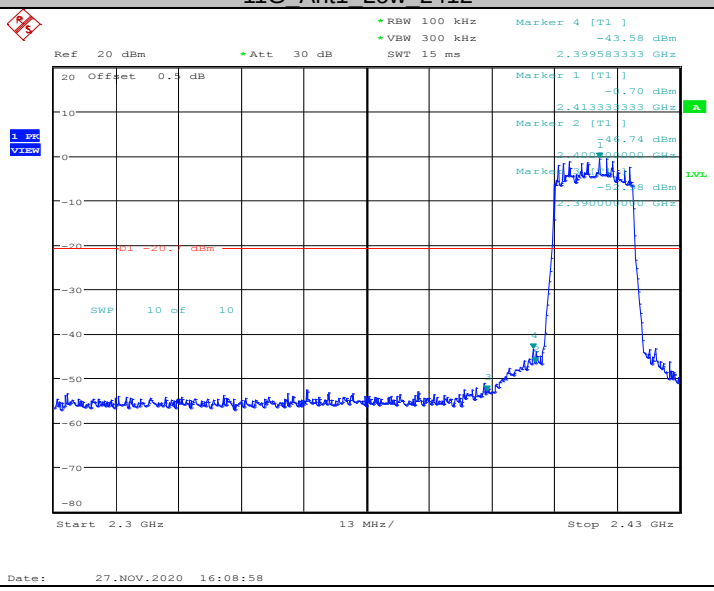
11B_Ant1_Low_2412



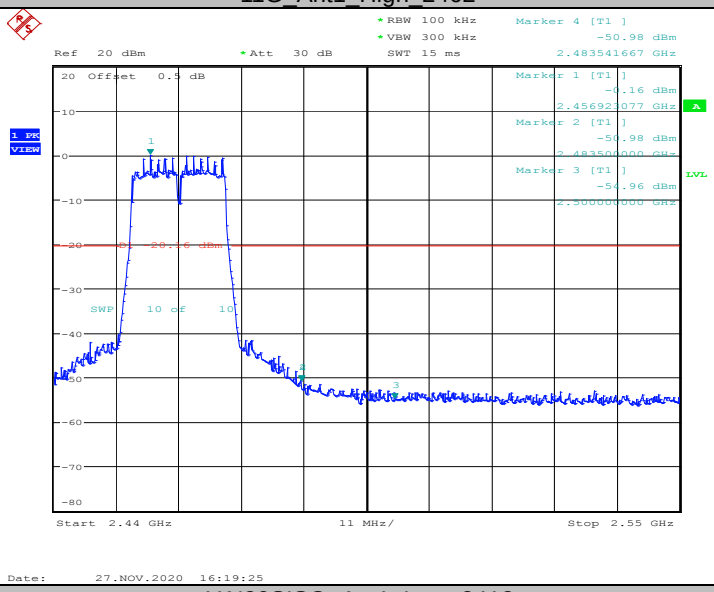

11B_Ant1_High_2462



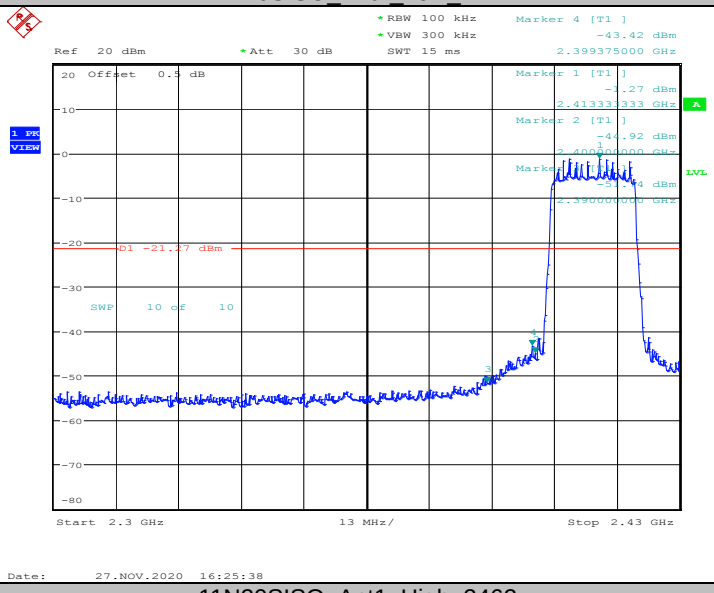

11G_Ant1_Low_2412



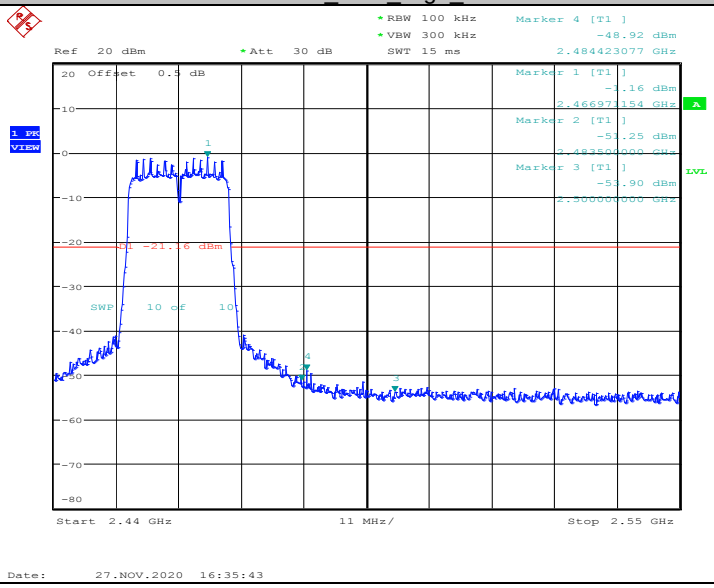
11G_Ant1_High_2462



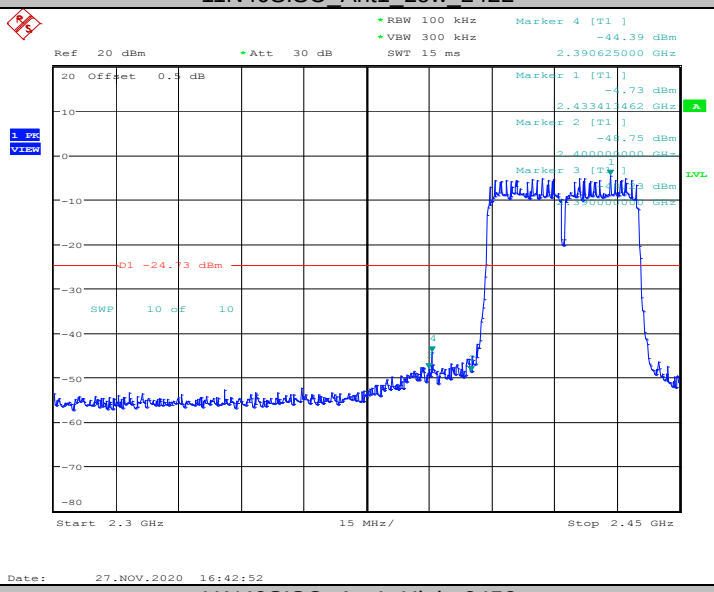

11N20SISO_Ant1_Low_2412



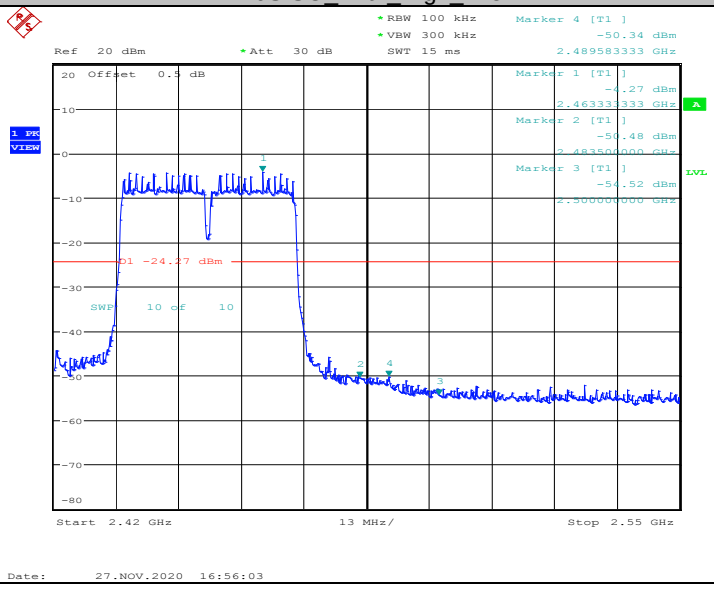

11N20SISO_Ant1_High_2462



11N40SISO_Ant1_Low_2422




11N40SISO_Ant1_High_2452



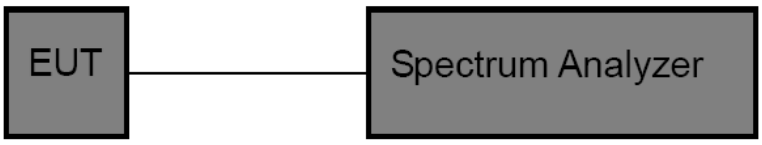
## 3.4. Bandwidth

**Limit**

**FCC CFR Title 47 Part 15 Subpart C Section 15.247 (a)(2)**

| Test Item | Limit | Frequency Range(MHz) |
|---|---|---|
| Bandwidth | >=500 KHz (6dB bandwidth) | 2400~2483.5 |

**Test Configuration**




**Test Procedure**

1. The EUT was directly connected to the spectrum analyzer and antenna output port as show in the block diagram above.
2. DTS Spectrum Setting:
   (1) Set RBW = 100 kHz.
   (2) Set the video bandwidth (VBW) ≥ 3 RBW.
   (3) Detector = Peak.
   (4) Trace mode = Max hold.
   (5) Sweep = Auto couple.
   OCB Spectrum Setting:
   (1) Set RBW = 1% ~ 5% occupied bandwidth.
   (2) Set the video bandwidth (VBW) ≥ 3 RBW.
   (3) Detector = Peak.
   (4) Trace mode = Max hold.
   (5) Sweep = Auto couple.

NOTE: The EUT was set to continuously transmitting in each mode and low, Middle and high channel for the test.

**Test Mode**

Please refer to the clause 2.3.

**Test Results**

Please see the Appendix A1, A2.

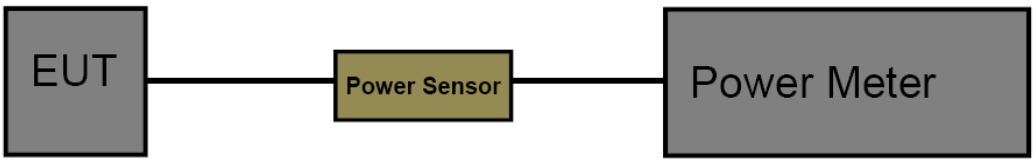
## 3.5. Peak Output Power

**Limit**

**FCC CFR Title 47 Part 15 Subpart C Section 15.247 (b)(3)/ RSS-247 5.4:**

| Section | Test Item | Limit | Frequency Range(MHz) |
|---|---|---|---|
| CFR 47 FCC 15.247(b)(3) | Maximum conducted output power | 1 Watt or 30dBm | 2400~2483.5 |
| ISED RSS-247 5.4 d | EIRP | 4 Watt or 36dBm | 2400~2483.5 |

**Test Configuration**




**Test Procedure**

1. The maximum conducted output power may be measured using a broadband Peak RF power meter.
2. Peak power measurements were performed only when the EUT was transmitting at its maximum power control level using a broadband power meter with a pulse sensor.
3. The power meter implemented triggering and gating capabilities which were set up such that power measurements were recorded only during the ON time of the transmitter.
4. Record the measurement data.

**Test Mode**

Please refer to the clause 2.3

**Test Result**

| TestMode | Antenna | Channel | Result[dBm] | Limit[dBm] | Verdict |
|---|---|---|---|---|---|
| 11B | Ant1 | 2412 | 21.46 | <=30 | PASS |
| | | 2437 | 15.64 | <=30 | PASS |
| | | 2462 | 15.63 | <=30 | PASS |
| 11G | Ant1 | 2412 | 17.28 | <=30 | PASS |
| | | 2437 | 17.60 | <=30 | PASS |
| | | 2462 | 18.17 | <=30 | PASS |
| 11N20SISO | Ant1 | 2412 | 16.97 | <=30 | PASS |
| | | 2437 | 17.20 | <=30 | PASS |
| | | 2462 | 17.23 | <=30 | PASS |
| 11N40SISO | Ant1 | 2422 | 16.39 | <=30 | PASS |
| | | 2437 | 16.72 | <=30 | PASS |
| | | 2452 | 16.64 | <=30 | PASS |

*Note: Test results increased RF cable loss by 0.5dB.*

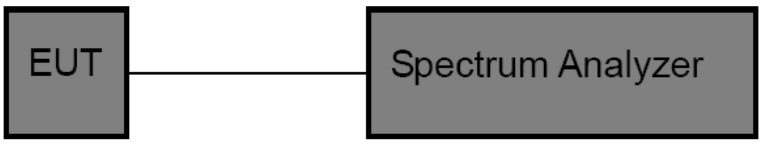
## 3.6. Power Spectral Density

**Limit**

**FCC CFR Title 47 Part 15 Subpart C Section 15.247 (e):**

| Test Item | Limit | Frequency Range(MHz) |
|---|---|---|
| Power Spectral Density | 8dBm(in any 3 kHz) | 2400~2483.5 |

**Test Configuration**




**Test Procedure**

1. The EUT was directly connected to the spectrum analyzer and antenna output port as show in the block diagram above.
2. The EUT was directly connected to the Spectrum Analyzer and antenna output port as show in the block diagram above. The measurement according to section 10.2 of KDB 558074 D01 DTS Meas Guidance v05r02.
3. Spectrum Setting:

Set analyzer center frequency to DTS channel center frequency.
Set the span to 1.5 times the DTS bandwidth.
Set the RBW to: 3 kHz
Set the VBW to: 10 kHz
Detector: peak
Sweep time: auto
Allow trace to fully stabilize. Then use the peak marker function to determine the maximum amplitude level.

**Test Mode**

Please refer to the clause 2.3

**Test Result**

Please see the Appendix B.

*Note：Duty Cycle Correction Factor = 10*log(1/duty cycle)*
*The Duty Cycle Correction Factor is compensated in the graph.*

## 3.7. Antenna requirement

**Requirement**

**FCC CFR Title 47 Part 15 Subpart C Section 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 antenna that uses a unique coupling to the intentional radiator, the manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited.
**FCC CFR Title 47 Part 15 Subpart C Section 15.247(c) (1)(i):**
(i) Systems operating in the 2400~2483.5 MHz band that is used exclusively for fixed. Point-to-point operations may employ transmitting antennas with directional gain greater than 6dBi provided the maximum conducted output power of the intentional radiator is reduced by 1 dB for every 3 dB that the directional gain of the antenna exceeds 6dBi.

**Test Result**
The directional gain of the antenna less than 6dBi, please refer to the EUT internal photographs antenna photo.

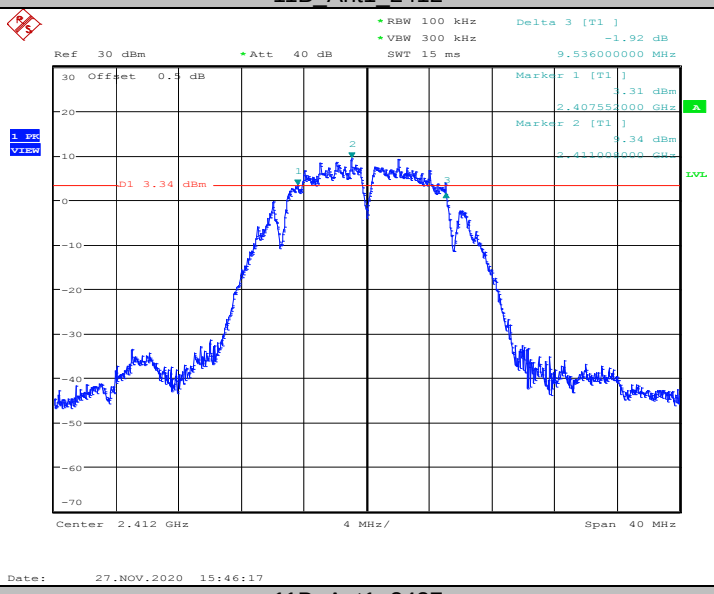
# Appendix A1: DTS Bandwidth

Test Result

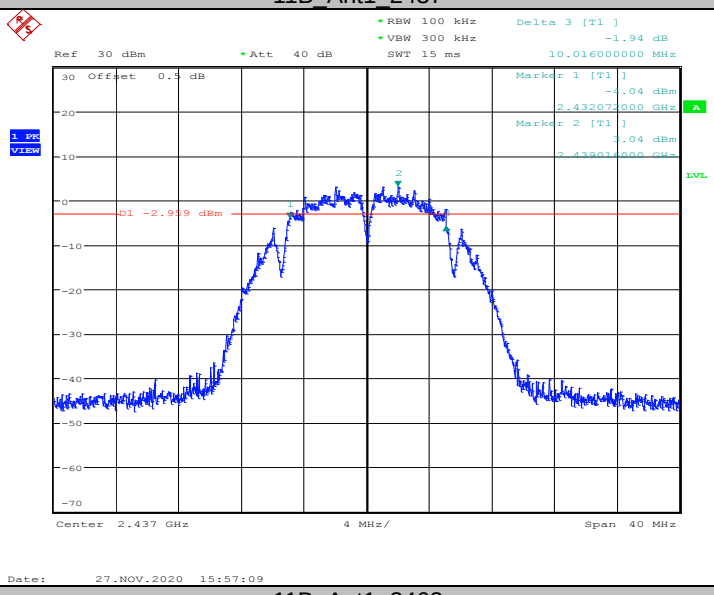
| TestMode | Antenna | Channel | DTS BW [MHz] | FL[MHz] | FH[MHz] | Limit[MHz] | Verdict |
|---|---|---|---|---|---|---|---|
| 11B | Ant1 | 2412 | 9.536 | 2407.552 | 2417.088 | >=0.5 | PASS |
| | | 2437 | 10.016 | 2432.072 | 2442.088 | >=0.5 | PASS |
| | | 2462 | 9.760 | 2457.328 | 2467.088 | >=0.5 | PASS |
| 11G | Ant1 | 2412 | 16.352 | 2403.840 | 2420.192 | >=0.5 | PASS |
| | | 2437 | 16.416 | 2428.808 | 2445.224 | >=0.5 | PASS |
| | | 2462 | 16.416 | 2453.808 | 2470.224 | >=0.5 | PASS |
| 11N20SISO | Ant1 | 2412 | 16.992 | 2403.584 | 2420.576 | >=0.5 | PASS |
| | | 2437 | 17.056 | 2428.488 | 2445.544 | >=0.5 | PASS |
| | | 2462 | 17.120 | 2453.456 | 2470.576 | >=0.5 | PASS |
| 11N40SISO | Ant1 | 2422 | 35.456 | 2404.208 | 2439.664 | >=0.5 | PASS |
| | | 2437 | 35.264 | 2419.400 | 2454.664 | >=0.5 | PASS |
| | | 2452 | 35.520 | 2434.144 | 2469.664 | >=0.5 | PASS |

Test Graphs

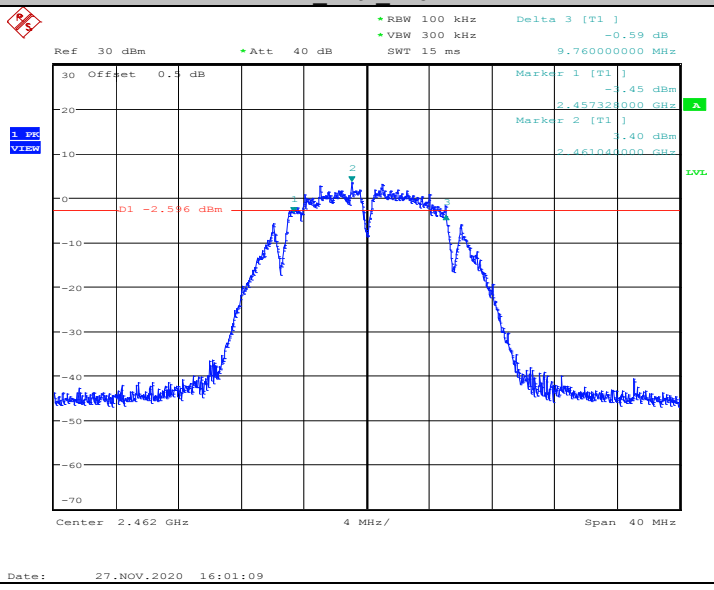
11B_Ant1_2412



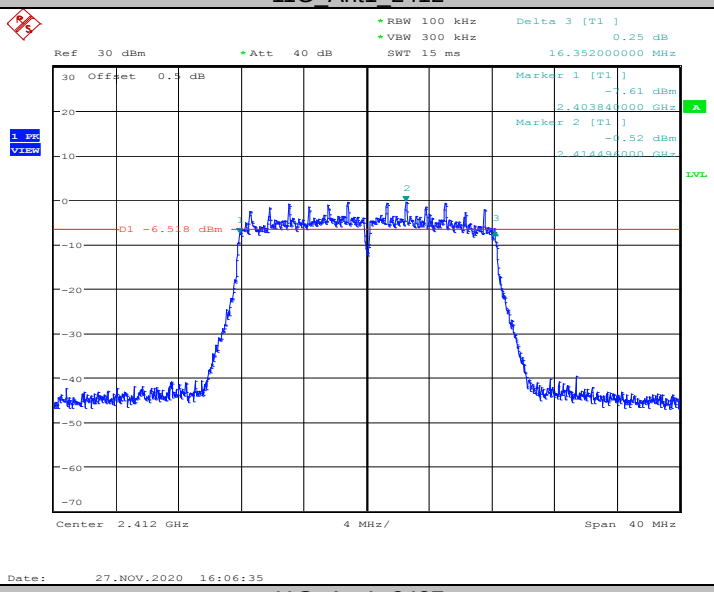

11B_Ant1_2437



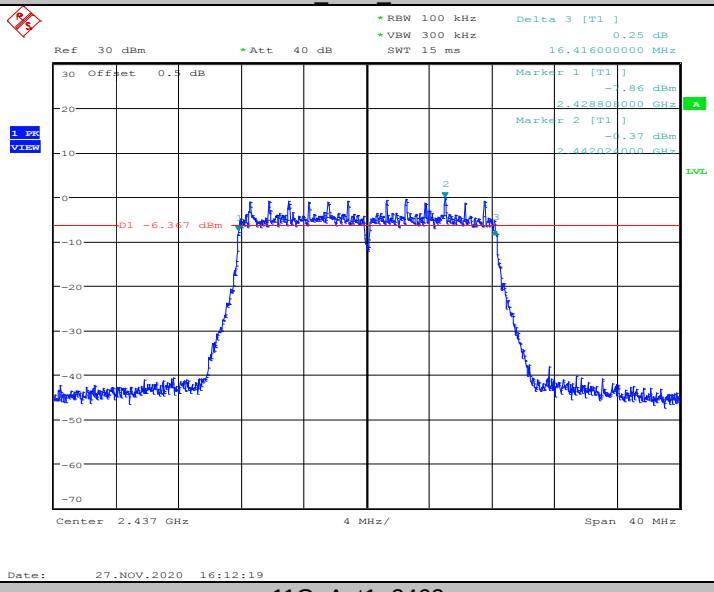

11B_Ant1_2462



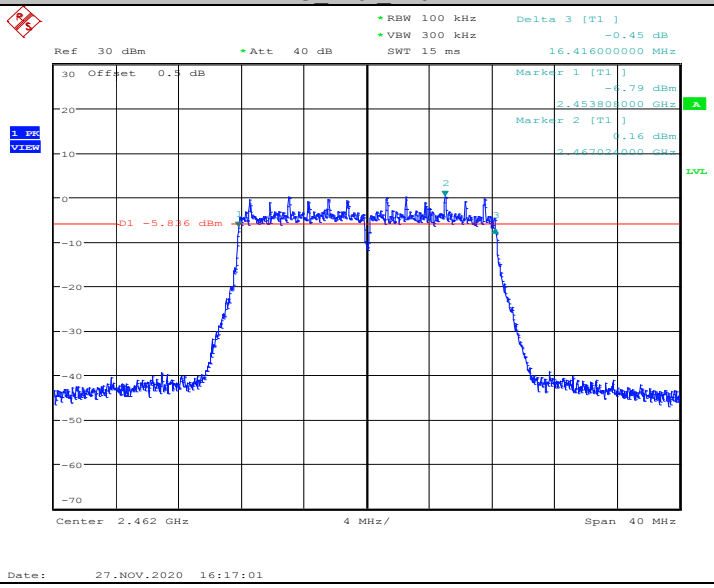
11G_Ant1_2412



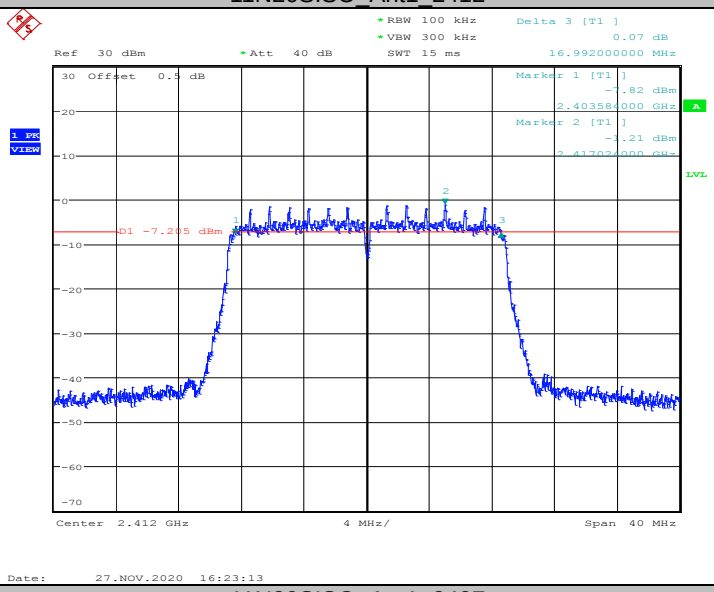

11G_Ant1_2437



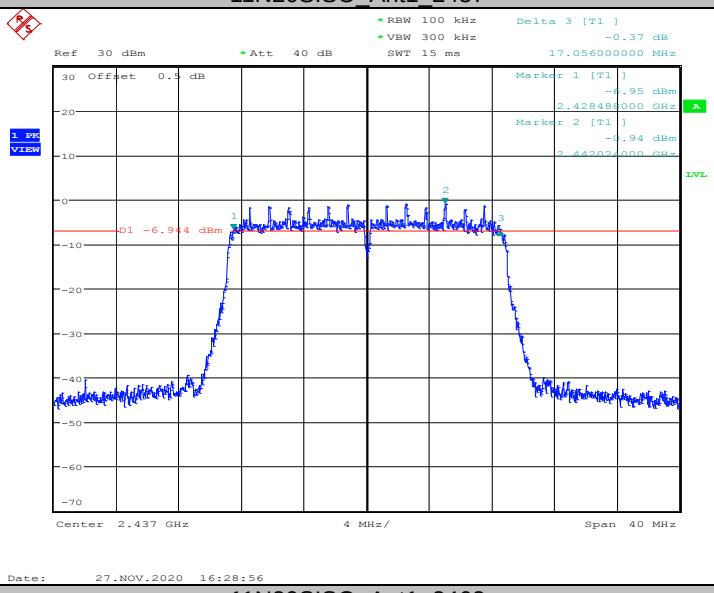

11G_Ant1_2462



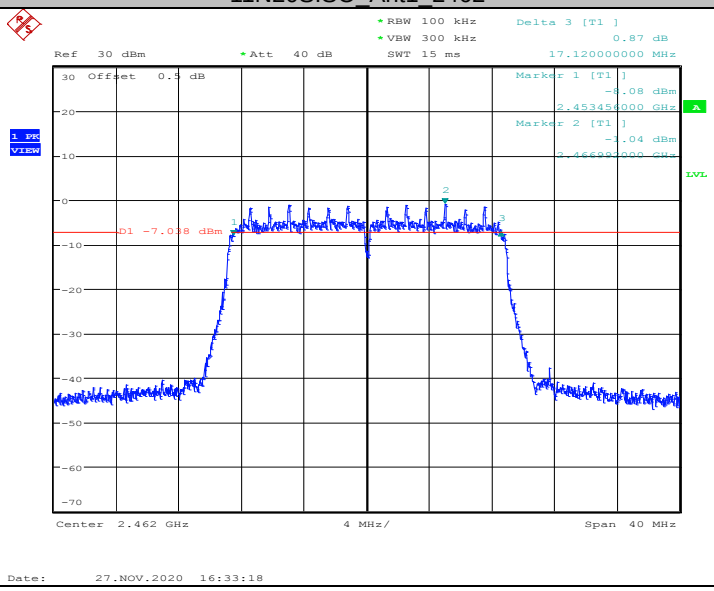
11N20SISO_Ant1_2412



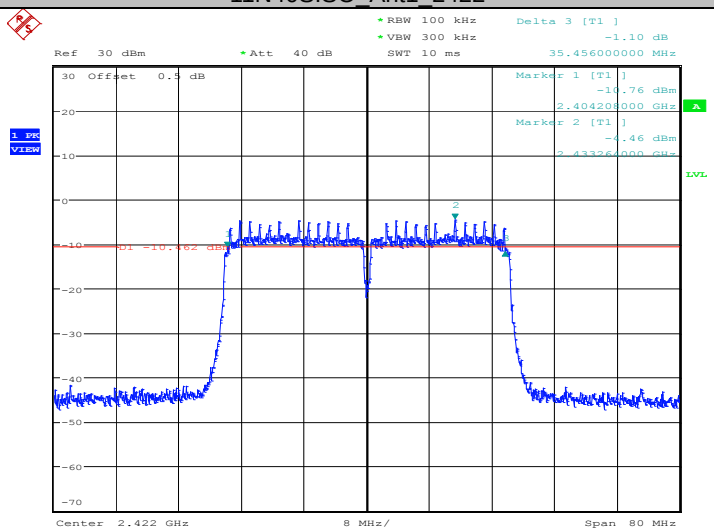

11N20SISO_Ant1_2437




11N20SISO_Ant1_2462

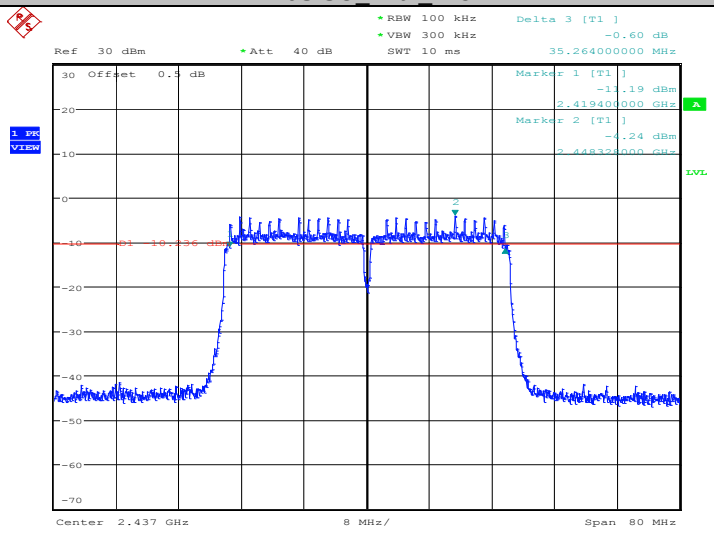


11N40SISO_Ant1_2422



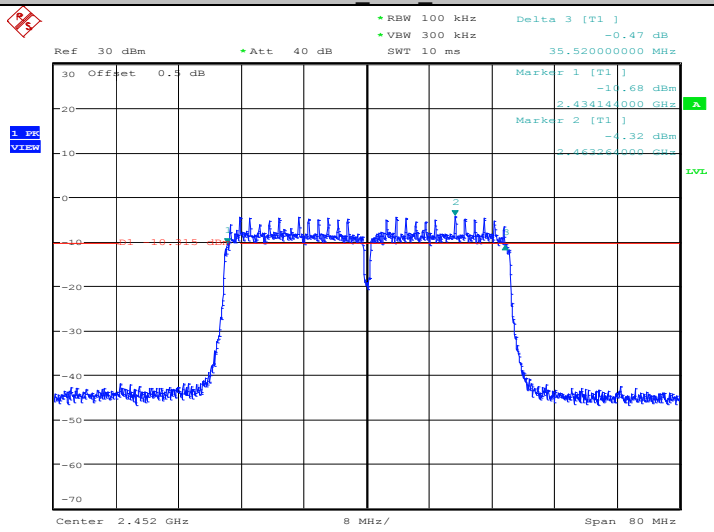

Date: 27.NOV.2020 16:39:34

11N40SISO_Ant1_2437




Date: 27.NOV.2020 16:46:13

11N40SISO_Ant1_2452




Date: 27.NOV.2020 16:52:43

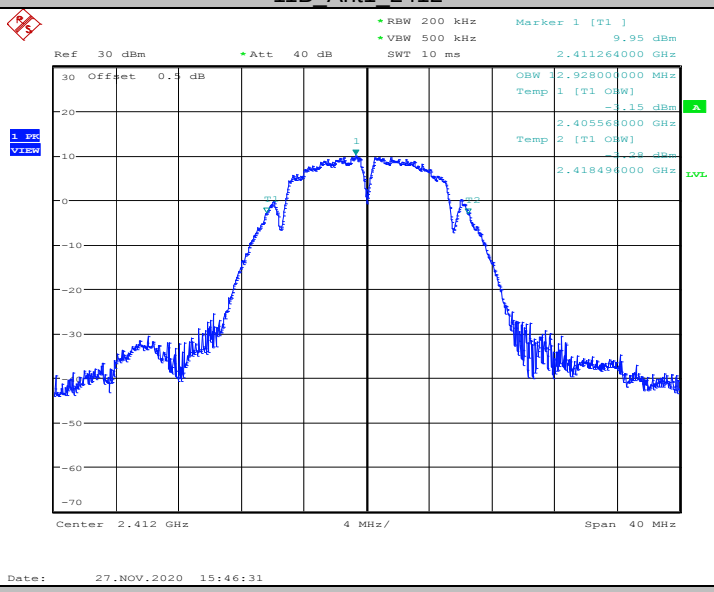
# Appendix A2: Occupied Channel Bandwidth

Test Result

| TestMode | Antenna | Channel | OCB [MHz] | FL[MHz] | FH[MHz] | Verdict |
|---|---|---|---|---|---|---|
| 11B | Ant1 | 2412 | 12.928 | 2405.568 | 2418.496 | PASS |
| | | 2437 | 12.992 | 2430.536 | 2443.528 | PASS |
| | | 2462 | 12.96 | 2455.536 | 2468.496 | PASS |
| 11G | Ant1 | 2412 | 16.768 | 2403.712 | 2420.480 | PASS |
| | | 2437 | 16.96 | 2428.616 | 2445.576 | PASS |
| | | 2462 | 16.96 | 2453.616 | 2470.576 | PASS |
| 11N20SISO | Ant1 | 2412 | 17.792 | 2403.136 | 2420.928 | PASS |
| | | 2437 | 17.792 | 2428.136 | 2445.928 | PASS |
| | | 2462 | 17.792 | 2453.136 | 2470.928 | PASS |
| 11N40SISO | Ant1 | 2422 | 36.096 | 2404.160 | 2440.112 | PASS |
| | | 2437 | 36.096 | 2419.016 | 2455.112 | PASS |
| | | 2452 | 36.16 | 2433.952 | 2470.112 | PASS |

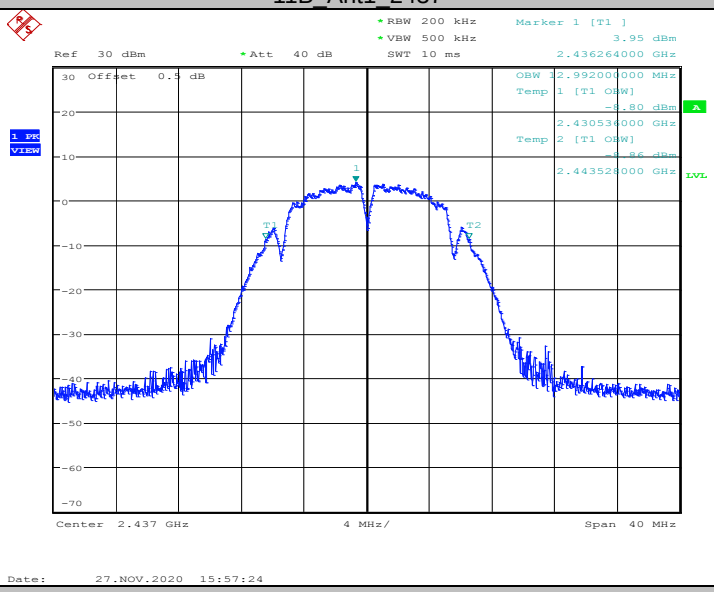
Test Graphs

11B_Ant1_2412



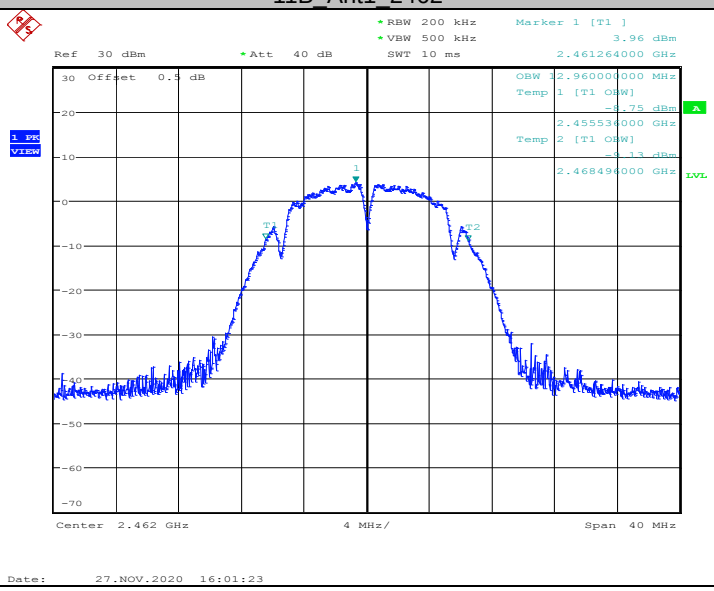

Date: 27.NOV.2020 15:46:31

11B_Ant1_2437



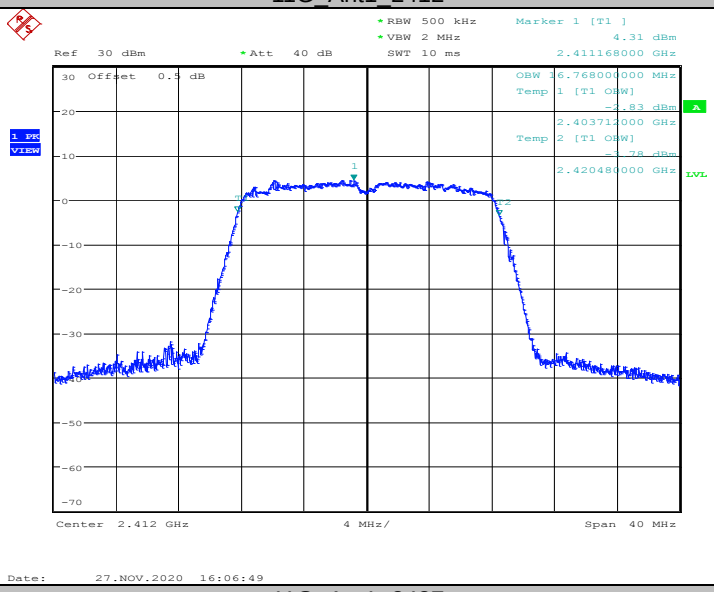

Date: 27.NOV.2020 15:57:24

11B_Ant1_2462

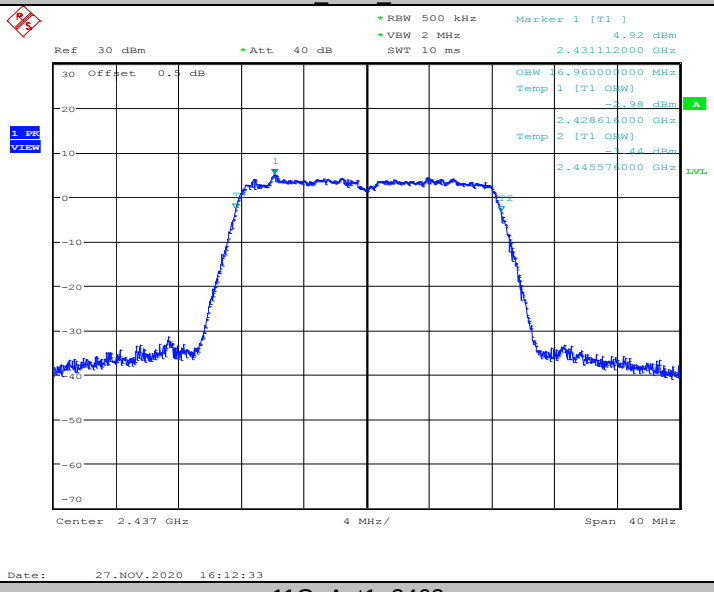



Date: 27.NOV.2020 16:01:23

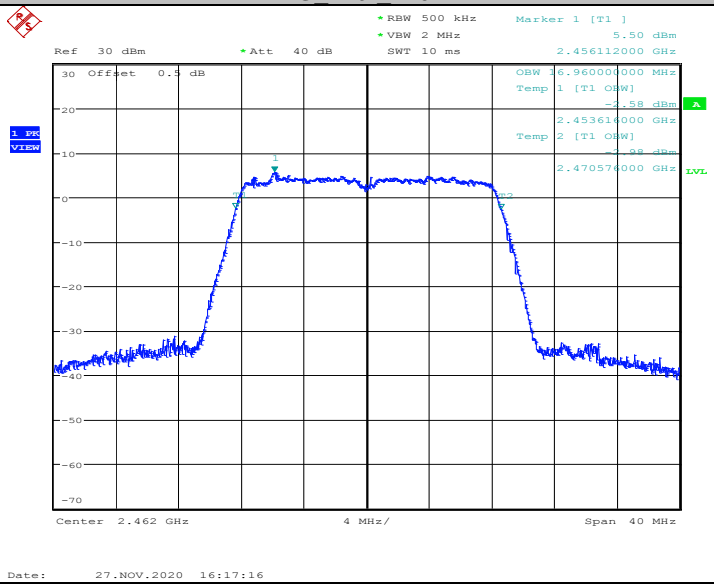
11G_Ant1_2412



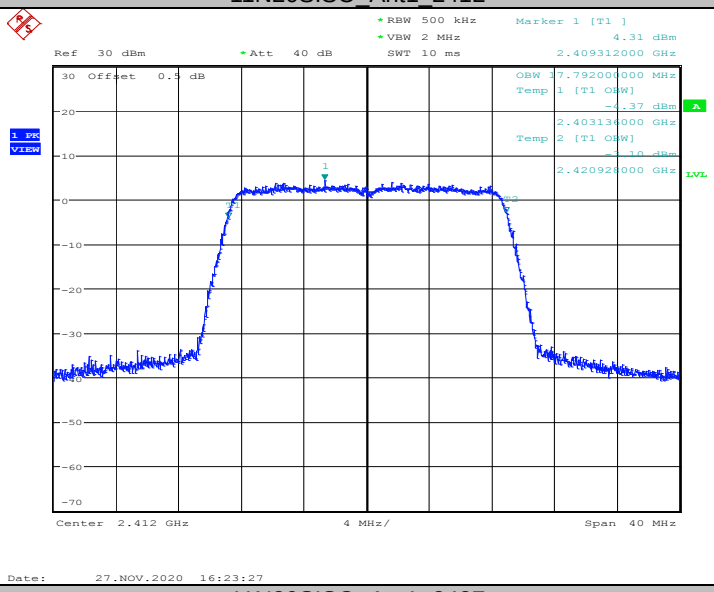

11G_Ant1_2437



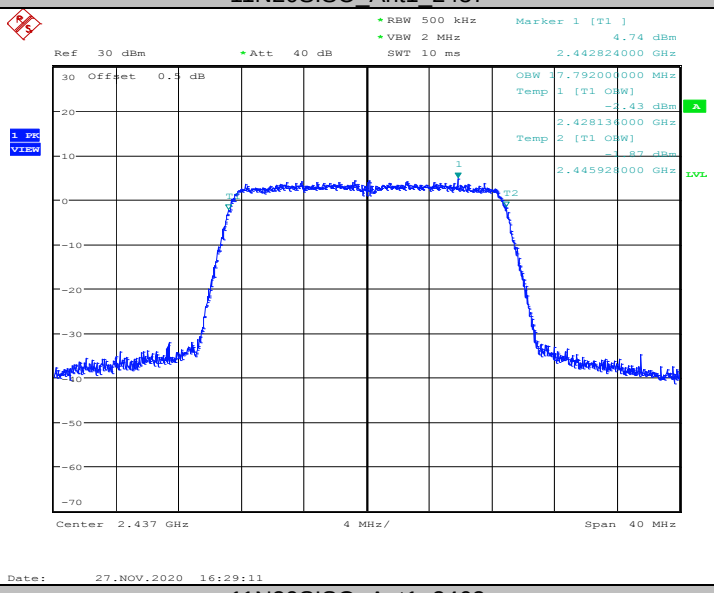

11G_Ant1_2462



11N20SISO_Ant1_2412




11N20SISO_Ant1_2437




11N20SISO_Ant1_2462