Intertek
731 Enterprise Drive
Lexington, KY 40510

Tel 859 226 1000
Fax 859 226 1040

**www.intertek.com**

# OTODATA WIRELESS NETWORK INC.
# TEST REPORT

**SCOPE OF WORK**
EMC TESTING – GEN II

**REPORT NUMBER**
104426030LEX-003.1

| **ISSUE DATE** | **REVISION DATE** |
|---|---|
| 1/12/2020 | 2/14/2021 |

**PAGES**
54

**DOCUMENT CONTROL NUMBER**
Non-Specific EMC Report Shell Rev. December 2017
© 2017 INTERTEK

# EMC TEST REPORT

(FULL COMPLIANCE)

**Report Number:** 104426030LEX-003.1
**Project Number:** G104426030

**Report Issue Date:** 2/14/2021

**Product Name:** GEN II
**Model(s) Tested:** MT4AD16W1

**Standards:** Title 47 CFR Part 15.247
RSS-247 Issue 2
RSS-Gen Issue 5

Tested by:
Intertek Testing Services NA, Inc.
731 Enterprise Dr.
Lexington, KY 40510
USA

Client:
OTODATA WIRELESS NETWORK INC.
9280 Boul. De l'Acadie
Montreal, QC H4N 3C5
Canada

Report prepared by

Bryan Taylor, Team Leader

Report reviewed by

Brian Lackey, Staff Engineer

This report is for the exclusive use of Intertek's Client and is provided pursuant to the agreement between Intertek and its Client. Intertek's responsibility and liability are limited to the terms and conditions of the agreement. Intertek assumes no liability to any party, other than to the Client in accordance with the agreement, for any loss, expense or damage occasioned by the use of this report. Only the Client is authorized to copy or distribute this report and then only in its entirety. Any use of the Intertek name or one of its marks for the sale or advertisement of the tested material, product or service must first be approved in writing by Intertek. The observations and test results in this report are relevant only to the sample tested. This report by itself does not imply that the material, product, or service is or has ever been under an Intertek certification program.

Table of Contents

## 1 Introduction and Conclusion

The tests indicated in section 2.0 were performed on the product constructed as described in section 4.0. The remaining 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.

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. Intertek does not make any claims of compliance for samples or variants which were not tested.

## 2 Test Summary

| Section | Test full name | Result |
|---|---|---|
| 6 | Receiver Spurious Emissions<br>(ANSI C63.4: 2014) | Pass |
| 7 | Transmitter Spurious Emissions<br>(FCC Part 15.247(d), RSS-247 Issue 2 § 5.5) | Pass |
| 8 | Output Power<br>(FCC Part 15.247(b)(3), RSS-247 Issue 2 § 5.4(d)) | Pass |
| 9 | Occupied Bandwidth<br>(FCC Part 15.247, RSS-247 Issue 2 § 5.2(a)) | Pass |
| 10 | Power Spectral Density<br>(FCC Part 15.247(e), RSS-247 Issue 2 § 5.2(b)) | Pass |
| 11 | Conducted Spurious Emissions<br>(FCC Part 15.247(d), RSS-247 Issue 2 § 5.5) | Pass |
| 12 | Antenna Requirement<br>(FCC Part 15.203, RSS-Gen Issue 5 § 6.8) | Pass |
| --- | Conducted Emissions<br>(ANSI C63.4: 2014) | N/A[1] |

1 Not applicable since this device is battery powered and does not connect to the AC mains.

## 3 Client Information

**This product was tested at the request of the following:**

| Client Information | |
|---|---|
| **Client Name:** | OTODATA WIRELESS NETWORK INC. |
| **Address:** | 9280 Boul. De l'Acadie<br>Montreal, QC H4N 3C5<br>Canada |
| **Contact:** | Pascal Turcotte |
| **Email:** | pturcotte@otodata.ca |
| **Manufacturer Information** | |
| **Manufacturer Name:** | OTODATA WIRELESS NETWORK INC. |
| **Manufacturer Address:** | 9280 Boul. De l'Acadie<br>Montreal, QC H4N 3C5<br>Canada |

## 4 Description of Equipment under Test and Variant Models

| Equipment Under Test | |
|---|---|
| **Product Name** | GEN II |
| **Model Number** | MT4AD16W1 |
| **Hardware Version** | C024 |
| **Software Version** | 2009 |
| **Supported Transmit Bands** | Bluetooth Low Energy<br>2402 – 2480MHz |
| **Receive Date** | 10/02/2020 |
| **Test Start Date** | 10/05/2020 |
| **Test End Date** | 10/10/2020 |
| **Device Received Condition** | Good |
| **Test Sample Type** | Production |
| **Rated Voltage** | 3.6VDC Battery |
| **Antenna** | PCB Trace Antenna. 2.14dBi Gain |

**Description of Equipment Under Test (provided by client)**

The MT4AD16W1 is a remote tank level monitoring device. It is intended to be powered by a non-rechargeable lithium battery pack for a predicted average lifetime of 10 years.

The device reads the tank level sensor every few minutes. When a significant level change is detected, the microcontroller activates the cellular module. The latter then attaches to the preferred network and reports the data to a server. If there is no level change after 24 hours, the unit performs a daily report using the same procedure. The microcontroller communicates with the cellular module using AT commands (through a serial port).

The MT4AD16W1 uses low data volume: up to 100KB per month, but usually around 10KB per month.

The unit uses Bluetooth advertising to allow infield testing and diagnostics as well as enabling possible firmware upgrades. The microcontroller has an embedded 2.4GHz transceiver. The manufacturer provides the protocol stack for Bluetooth Low Energy. A PCB antenna over a ground plane is used as Bluetooth antenna.

### 4.1 Variant Models:

There were no variant models covered by this evaluation.

# 5 System Setup and Method

## 5.1 Method:

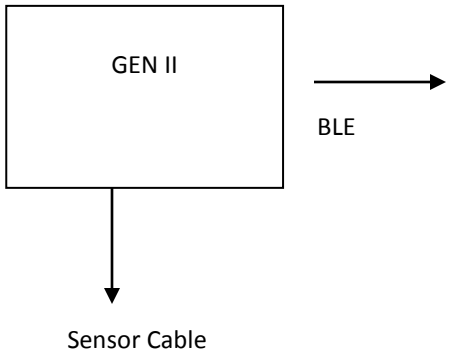
Configuration as required by ANSI C63.4: 2014 and ANSI C63.10:2013

| No. | Descriptions of EUT Exercising |
|---|---|
| 1 | Test commands were used to force the GEN II to transmit a Bluetooth Low Energy (BLE) signal or low, middle, or high channel. |
| 2 | Idle, not transmitting. |

| Cables | | | | | |
|---|---|---|---|---|---|
| ID | Description | Length (m) | Shielding | Ferrites | Termination |
| 1 | Sensor Cable | 1 | None | No | sensor |

| Support Equipment | | | |
|---|---|---|---|
| Description | Manufacturer | Model Number | Serial Number |
| None | | | |

## 5.2 EUT Block Diagram:



# 6 Receiver Spurious Emissions

## 6.1 Test Method

Tests are performed in accordance with ANSI C63.4: 2014

**TEST SITE:** 10m ALSE

**Site Designation:** 10m Chamber

**Measurement Uncertainty**

| Measurement | Frequency Range | Expanded Uncertainty (k=2) | Ucispr |
|---|---|---|---|
| Radiated Emissions, 10m | 30-1000 MHz | 3.9dB | 6.3 dB |
| Radiated Emissions, 3m | 30-1000 MHz | 4.0dB | 6.3 dB |
| Radiated Emissions, 3m | 1-6 GHz | 4.7dB | 5.2 dB |
| Radiated Emissions, 3m | 6-15 GHz | 4.7dB | 5.5 dB |
| Radiated Emissions, 3m | 15-18 GHz | 4.7dB | 5.5 dB |
| Radiated Emissions, 3m | 18-40 GHz | 4.7dB | 5.5 dB |

As shown in the table above our radiated emissions $U_{lab}$ is less than the corresponding $U_{CISPR}$ reference value in CISPR 16-4-2 Table 1, hence the compliance of the product is only based on the measured value, and no measurement uncertainty correction is required.

### 6.2 Sample Calculation

The field strength is calculated by adding the Antenna Factor and Cable Factor, and subtracting the Amplifier Gain (if any) from the measured reading. The basic equation with a sample calculation is as follows:

FS = RA + AF + CF - AG

Where FS = Field Strength in dBμV/m
RA = Receiver Amplitude (including preamplifier) in dBμV
CF = Cable Attenuation Factor in dB
AF = Antenna Factor in dB
AG = Amplifier Gain in dB

In the following table(s), the reading shown on the data table reflects the preamplifier gain. An example for the calculations in the following table is as follows.

Assume a receiver reading of 52.0 dBμV is obtained. The antenna factor of 7.4 dB and cable factor of 1.6 dB is added. The amplifier gain of 29 dB is subtracted, giving a field strength of 32 dBμV/m. This value in dBμV/m was converted to its corresponding level in μV/m.

RA = 52.0 dBμV
AF = 7.4 dB/m
CF = 1.6 dB
AG = 29.0 dB
FS = 32 dBμV/m

To convert from dBμV to μV or mV the following was used:

$UF = 10^{(NF / 20)}$ where UF = Net Reading in μV
NF = Net Reading in dBμV

**Example:**

FS = RA + AF + CF – AG = 52.0 + 7.4 + 1.6 – 29.0 = 32.0
$UF = 10^{(32\ dB\mu V / 20)}$ = 39.8 μV/m

### 6.3 Test Equipment Used

| Description | Asset | Manufacturer | Model | Cal Date | Cal Due |
|---|---|---|---|---|---|
| EMI Test Receiver | 3900 | Rohde & Schwarz | ESU40 | 10/5/2020 | 10/5/2021 |
| Bilog Antenna (30MHz-1GHz) | 7085 | SunAR | JB6 | 9/4/2020 | 9/4/2021 |
| Horn Antenna (18-40GHz) | 3779 | ETS | 3116c | 7/23/2020 | 7/23/2021 |
| Horn Antenna | 4001 | ETS | 3117 | 1/16/2020 | 1/16/2021 |
| System Controller | 4096 | ETS Lindgren | 2090 | Verify at Time of Use | Verify at Time of Use |
| System Controller | 3957 | Sunol Sciences | SC99V | Verify at Time of Use | Verify at Time of Use |
| 3m Cable Antenna→Preamp | 3074 | | | 12/4/2019 | 12/4/2020 |
| 3m Cable Preamplifier | 3918 | Rohde & Schwarz | TS-PR18 | 12/4/2019 | 12/4/2020 |
| 3m Cable Preamp→Chamber | 2588 | | | 12/4/2019 | 12/4/2020 |
| 3m Cable Chamber→Control Room | 2593 | | | 12/4/2019 | 12/4/2020 |
| 3m Cable Control Room→Receiver | 2592 | | | 12/4/2019 | 12/4/2020 |

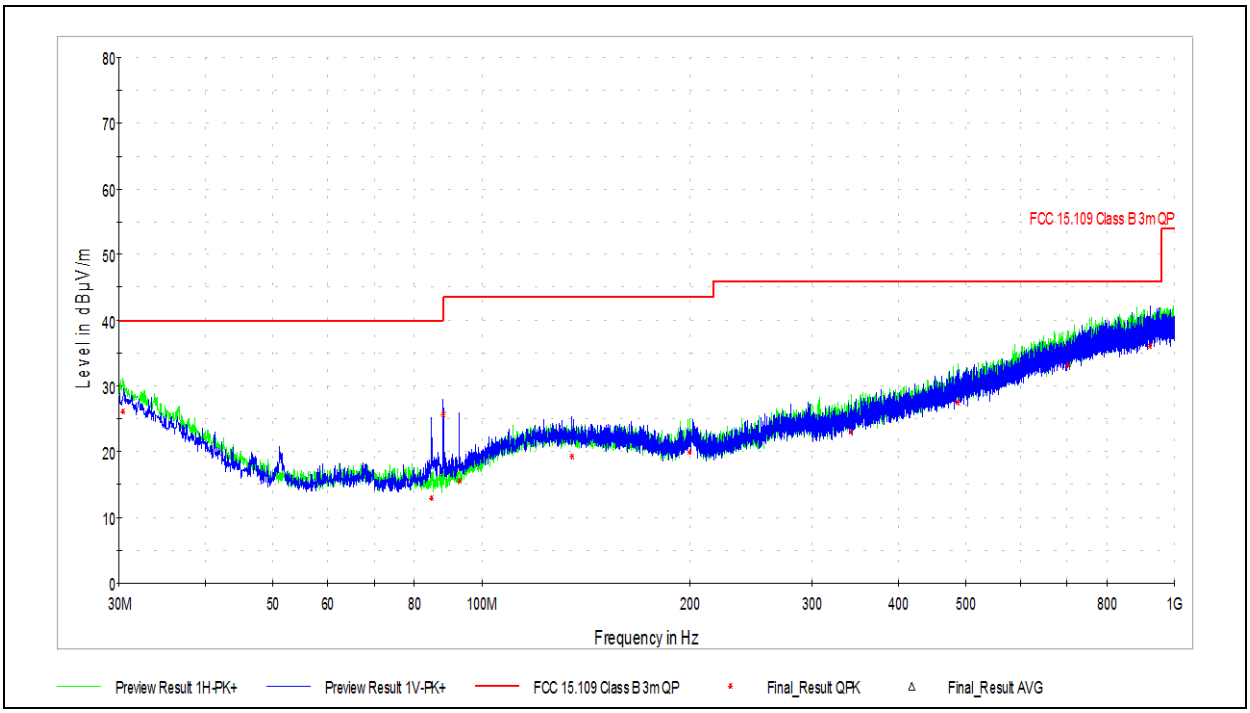
### 6.4 Software Utilized

| Name | Manufacturer | Version |
|---|---|---|
| EMC32 | Rohde & Schwarz | Version 9.15.02 |

### 6.5 Test Results

The sample tested was found to be **compliant**.

### 6.6 Plots/Data: Radiated Emissions, 30MHz – 1GHz (Transmitters Idle)

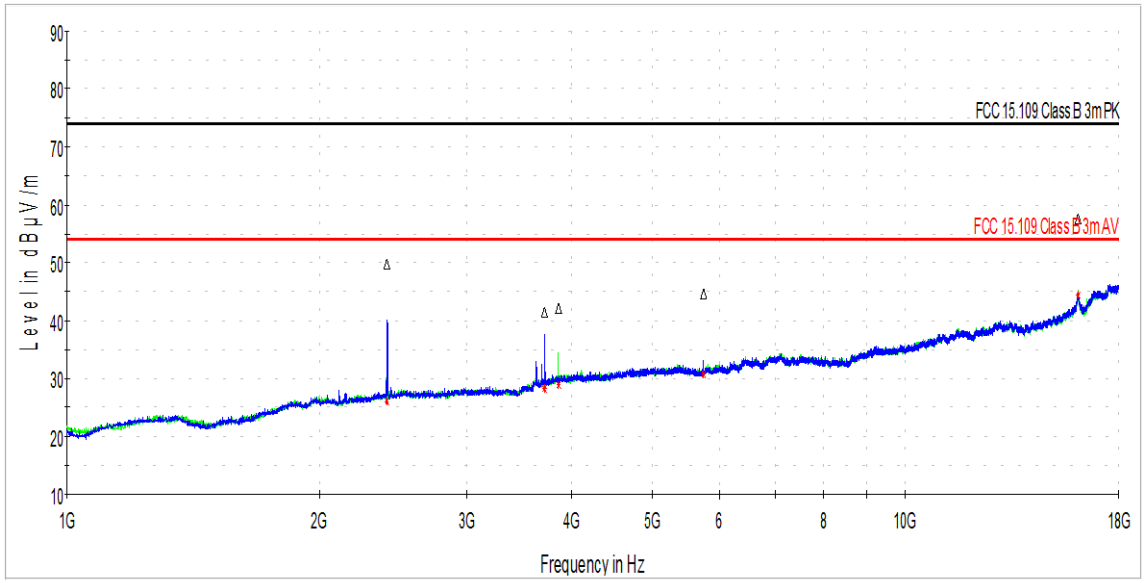



| Frequency (MHz) | QuasiPeak (dBµV/m) | Limit (dBµV/m) | Margin (dB) | Bandwidth (kHz) | Height (cm) | Pol | Azimuth (deg) | Corr. (dB) |
|---|---|---|---|---|---|---|---|---|
| 30.377222 | 26.05 | 40.00 | 13.95 | 120.000 | 333.1 | H | 90.0 | 28.6 |
| 84.751111 | 12.94 | 40.00 | 27.06 | 120.000 | 400.1 | V | 256.0 | 15.9 |
| 88.092222 | 25.66 | 43.52 | 17.86 | 120.000 | 105.4 | V | 218.0 | 16.6 |
| 92.888333 | 15.47 | 43.52 | 28.05 | 120.000 | 129.9 | V | 36.0 | 17.4 |
| 135.029445 | 19.31 | 43.52 | 24.21 | 120.000 | 285.0 | V | 183.0 | 22.2 |
| 199.857778 | 19.81 | 43.52 | 23.71 | 120.000 | 104.9 | H | 340.0 | 22.2 |
| 341.531667 | 23.05 | 46.02 | 22.97 | 120.000 | 273.7 | H | 93.0 | 25.3 |
| 486.007778 | 27.51 | 46.02 | 18.51 | 120.000 | 348.5 | H | 65.0 | 29.4 |
| 701.617222 | 33.12 | 46.02 | 12.90 | 120.000 | 400.0 | H | 210.0 | 34.0 |
| 921.214444 | 36.05 | 46.02 | 9.97 | 120.000 | 154.0 | V | 191.0 | 36.4 |

| | | | |
|---|---|---|---|
| Test Personnel: | Ben Coolbear | Test Date: | 10/07/2020 |
| Supervising/Reviewing Engineer: (Where Applicable) | NA | Limit Applied: | Class B |
| Product Standard: | FCC Part 15B ICES-003 Issue 6 | Ambient Temperature: | 26.3 °C |
| Input Voltage: | 3.9 VDC | Relative Humidity: | 40.5 % |
| Pretest Verification w / Ambient Signals or BB Source: | Yes | Atmospheric Pressure: | 985.3 mbar |

Deviations, Additions, or Exclusions: None

### 6.7 Plots/Data: Radiated Emissions, 1GHz – 18GHz (Transmitters Idle)




| Frequency (MHz) | MaxPeak (dBµV/m) | Limit (dBµV/m) | Margin (dB) | Bandwidth (kHz) | Height (cm) | Pol | Azimuth (deg) | Corr. (dB) |
|---|---|---|---|---|---|---|---|---|
| 2409.500000 | 49.79 | 73.98 | 24.19 | 1000.000 | 140.0 | V | 19.0 | 3.7 |
| 3713.000000 | 41.36 | 73.98 | 32.62 | 1000.000 | 100.0 | V | 0.0 | 6.5 |
| 3861.000000 | 42.05 | 73.98 | 31.93 | 1000.000 | 305.0 | H | 243.0 | 6.9 |
| 5748.500000 | 44.54 | 73.98 | 29.44 | 1000.000 | 100.0 | V | 359.0 | 9.6 |
| 16094.500000 | 57.63 | 73.98 | 16.35 | 1000.000 | 302.0 | H | 297.0 | 25.5 |

| Frequency (MHz) | Average (dBµV/m) | Limit (dBµV/m) | Margin (dB) | Bandwidth (kHz) | Height (cm) | Pol | Azimuth (deg) | Corr. (dB) |
|---|---|---|---|---|---|---|---|---|
| 2409.500000 | 25.85 | 53.98 | 28.13 | 1000.000 | 140.0 | V | 19.0 | 3.7 |
| 3713.000000 | 28.22 | 53.98 | 25.76 | 1000.000 | 100.0 | V | 0.0 | 6.5 |
| 3861.000000 | 28.89 | 53.98 | 25.09 | 1000.000 | 305.0 | H | 243.0 | 6.9 |
| 5748.500000 | 30.65 | 53.98 | 23.33 | 1000.000 | 100.0 | V | 359.0 | 9.6 |
| 16094.500000 | 44.44 | 53.98 | 9.54 | 1000.000 | 302.0 | H | 297.0 | 25.5 |

| | | | |
|---|---|---|---|
| Test Personnel: | Ben Coolbear | Test Date: | 10/09/2020 |
| Supervising/Reviewing Engineer: (Where Applicable) | NA | Limit Applied: | Class B |
| Product Standard: | FCC Part 15B ICES-003 Issue 6 | Ambient Temperature: | 24.7 °C |
| Input Voltage: | 3.9 VDC | Relative Humidity: | 46.6 % |
| Pretest Verification w / Ambient Signals or BB Source: | Yes | Atmospheric Pressure: | 989.1 mbar |

Deviations, Additions, or Exclusions: None

# 7 Transmitter Spurious Emissions

## 7.1 Test Limits

**FCC Part 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. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, 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) (see §15.205(c)).

**RSS-247 Issue 2 § 5.5:**

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating, the RF power that is produced 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 that the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of root-mean-square averaging over a time interval, as permitted under section 5.4(d), the attenuation required shall be 30 dB instead of 20 dB. Attenuation below the general field strength limits specified in RSS-Gen is not required.

## 7.2 Test Method

Tests are performed in accordance with ANSI C63.10:2013 § 11.12.1 Radiated emission measurements.

### 7.3 Test Equipment Used

| Description | Asset | Manufacturer | Model | Cal Date | Cal Due |
|---|---|---|---|---|---|
| EMI Test Receiver | 3900 | Rohde & Schwarz | ESU40 | 10/5/2020 | 10/5/2021 |
| Bilog Antenna (30MHz-1GHz) | 7085 | SunAR | JB6 | 9/4/2020 | 9/4/2021 |
| Magnetic Loop Antenna | 2366 | ETS | 6502 | 7/17/2020 | 7/17/2021 |
| Horn Antenna (18-40GHz) | 3779 | ETS | 3116c | 7/23/2020 | 7/23/2021 |
| Horn Antenna | 4001 | ETS | 3117 | 1/16/2020 | 1/16/2021 |
| System Controller | 4096 | ETS Lindgren | 2090 | Verify at Time of Use | Verify at Time of Use |
| System Controller | 3957 | Sunol Sciences | SC99V | Verify at Time of Use | Verify at Time of Use |
| Preamplifier (18-40GHz) | 3921 | Rohde & Schwarz | TS-PR40 | 12/4/2019 | 12/4/2020 |
| Coaxial Cable (40GHz) | 7020 | | | 12/4/2019 | 12/4/2020 |
| Coaxial Cable (40GHz) | 7021 | | | 12/4/2019 | 12/4/2020 |
| 3m Cable Antenna→Preamp | 3074 | | | 12/4/2019 | 12/4/2020 |
| 3m Cable Preamplifier | 3918 | Rohde & Schwarz | TS-PR18 | 12/4/2019 | 12/4/2020 |
| 3m Cable Preamp→Chamber | 2588 | | | 12/4/2019 | 12/4/2020 |
| 3m Cable Chamber→Control Room | 2593 | | | 12/4/2019 | 12/4/2020 |
| 3m Cable Control Room→Receiver | 2592 | | | 12/4/2019 | 12/4/2020 |

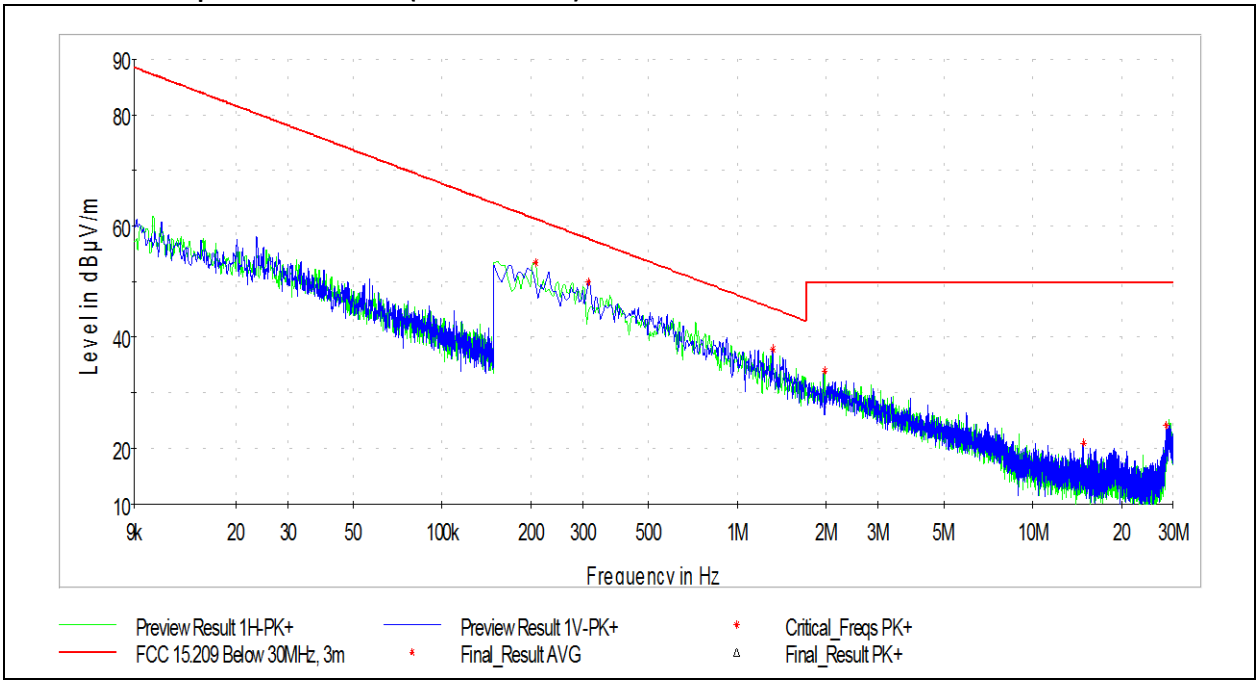
### 7.4 Software Utilized

| Name | Manufacturer | Version |
|---|---|---|
| EMC32 | Rohde & Schwarz | Version 9.15.02 |

### 7.5 Test Results

The sample tested was found to be **compliant**. The data presented represents the worst case emissions with the device positioned in three orthogonal positions. All observed emissions outside of the band of operation were attenuated by at least 20dB.

### 7.6 Radiated Spurious Emissions (9kHz – 30MHz)



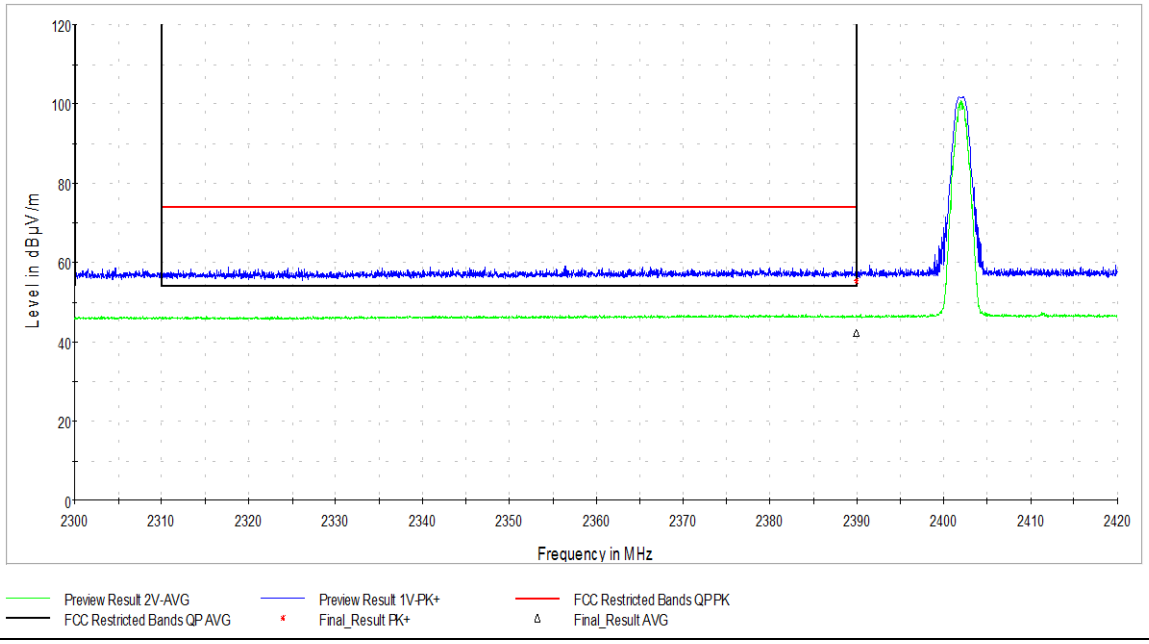

Note: The scan above was performed in a continuous max-hold mode and includes the worst case emissions with the transmitter operating on low, mid, and high channels.

| Frequency (MHz) | MaxPeak (dBµV/m) | Limit (dBµV/m) | Margin (dB) | Bandwidth (kHz) | Azimuth (deg) | Corr. (dB) |
|---|---|---|---|---|---|---|
| 0.207066 | 53.45 | 61.28 | 7.83 | 9kHz | 180.0 | 12.1 |
| 0.312419 | 49.89 | 57.71 | 7.82 | 9kHz | 0.0 | 11.9 |
| 1.317662 | 38.01 | 45.21 | 7.20 | 9kHz | 180.0 | 11.9 |
| 1.971728 | 33.93 | 50.00 | 16.07 | 9kHz | 0.0 | 11.8 |
| 14.859904 | 20.98 | 50.00 | 29.02 | 9kHz | 0.0 | 11.3 |
| 28.454824 | 24.08 | 50.00 | 25.92 | 9kHz | 0.0 | 9.4 |

| | | | |
|---|---|---|---|
| Test Personnel: | Bryan Taylor | Test Date: | 1/30/2021 |
| Supervising/Reviewing Engineer: (Where Applicable) | N/A | Limit Applied: | 15.209 |
| Product Standard: | FCC Part 15C | Ambient Temperature: | 24.3°C |
| Input Voltage: | 3.9 VDC | Relative Humidity: | 52.8% |
| Pretest Verification w / Ambient Signals or BB Source: | Yes | Atmospheric Pressure: | 987.3 mbar |

Deviations, Additions, or Exclusions: This data was measured in a semi-anechoic chamber that has been correlated to measurements performed in an open field.

## 7.7 Radiated Spurious Emissions (BLE, Low Band Edge)




**Final_Result_PK+**

| Frequency (MHz) | MaxPeak (dBµV/m) | Limit (dBµV/m) | Margin (dB) | Bandwidth (kHz) | Height (cm) | Pol | Azimuth (deg) | Corr. (dB) |
|---|---|---|---|---|---|---|---|---|
| 2389.976923 | 55.25 | 73.98 | 18.73 | 1000.000 | 182.0 | V | 200.0 | 38.6 |

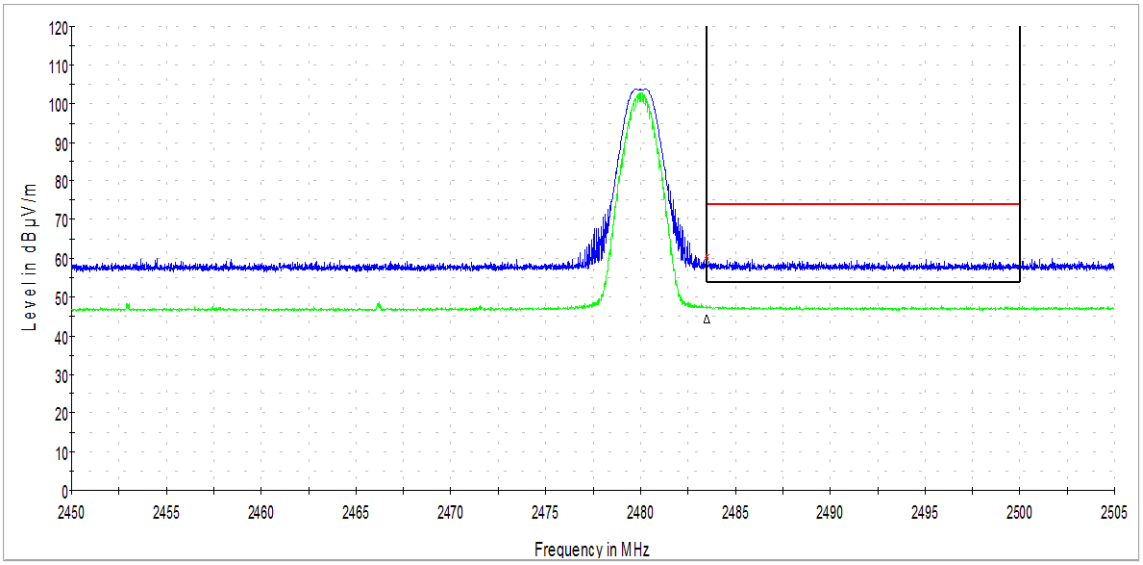
**Final_Result_AVG**

| Frequency (MHz) | Average (dBµV/m) | Limit (dBµV/m) | Margin (dB) | Bandwidth (kHz) | Height (cm) | Pol | Azimuth (deg) | Corr. (dB) |
|---|---|---|---|---|---|---|---|---|
| 2389.976923 | 42.30 | 53.98 | 11.68 | 1000.000 | 182.0 | V | 200.0 | 38.6 |

| | | | |
|---|---|---|---|
| Test Personnel: | Bryan Taylor | Test Date: | 9/18/2020 |
| Supervising/Reviewing Engineer: (Where Applicable) | N/A | Limit Applied: | 15.205 Restricted Bands |
| Product Standard: | FCC Part 15C | Ambient Temperature: | 24.3°C |
| Input Voltage: | 3.9VDC (Battery) | Relative Humidity: | 52.8% |
| Pretest Verification w / Ambient Signals or BB Source: | Yes | Atmospheric Pressure: | 987.3 mbar |

Deviations, Additions, or Exclusions: None

## 7.8 Radiated Spurious Emissions (BLE, High Band Edge)




**Final_Result_PK+**

| Frequency (MHz) | MaxPeak (dBµV/m) | Limit (dBµV/m) | Margin (dB) | Bandwidth (kHz) | Height (cm) | Pol | Azimuth (deg) | Corr. (dB) |
|---|---|---|---|---|---|---|---|---|
| 2483.507692 | 60.39 | 73.98 | 13.59 | 1000.000 | 358.0 | V | 189.0 | 39.0 |

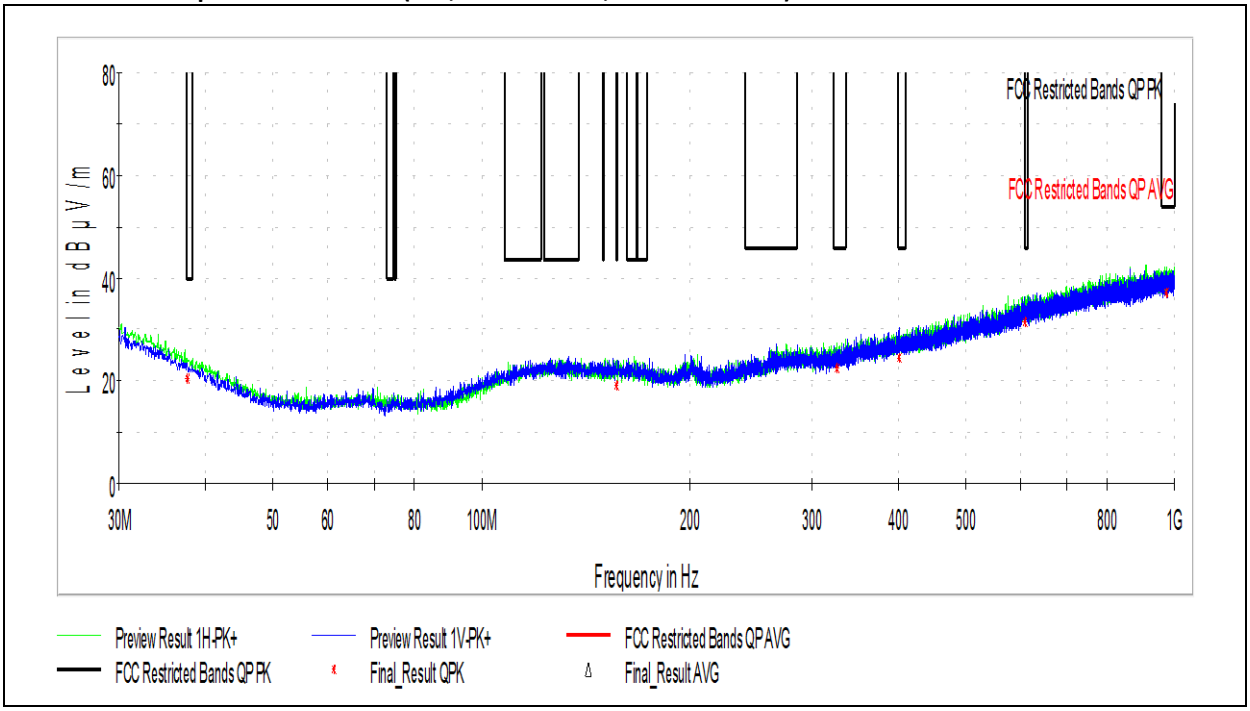
**Final_Result_AVG**

| Frequency (MHz) | Average (dBµV/m) | Limit (dBµV/m) | Margin (dB) | Bandwidth (kHz) | Height (cm) | Pol | Azimuth (deg) | Corr. (dB) |
|---|---|---|---|---|---|---|---|---|
| 2483.507692 | 44.50 | 53.98 | 9.48 | 1000.000 | 358.0 | V | 189.0 | 39.0 |

| | | | |
|---|---|---|---|
| Test Personnel: | Bryan Taylor | Test Date: | 10/10/2020 |
| Supervising/Reviewing Engineer: (Where Applicable) | N/A | Limit Applied: | 15.205 Restricted Bands |
| Product Standard: | FCC Part 15C | Ambient Temperature: | 24.3°C |
| Input Voltage: | 3.9VDC (Battery) | Relative Humidity: | 52.8% |
| Pretest Verification w / Ambient Signals or BB Source: | Yes | Atmospheric Pressure: | 987.3 mbar |

Deviations, Additions, or Exclusions: None

### 7.9 Radiated Spurious Emissions (BLE, Low Channel, 30MHz – 1 GHz)

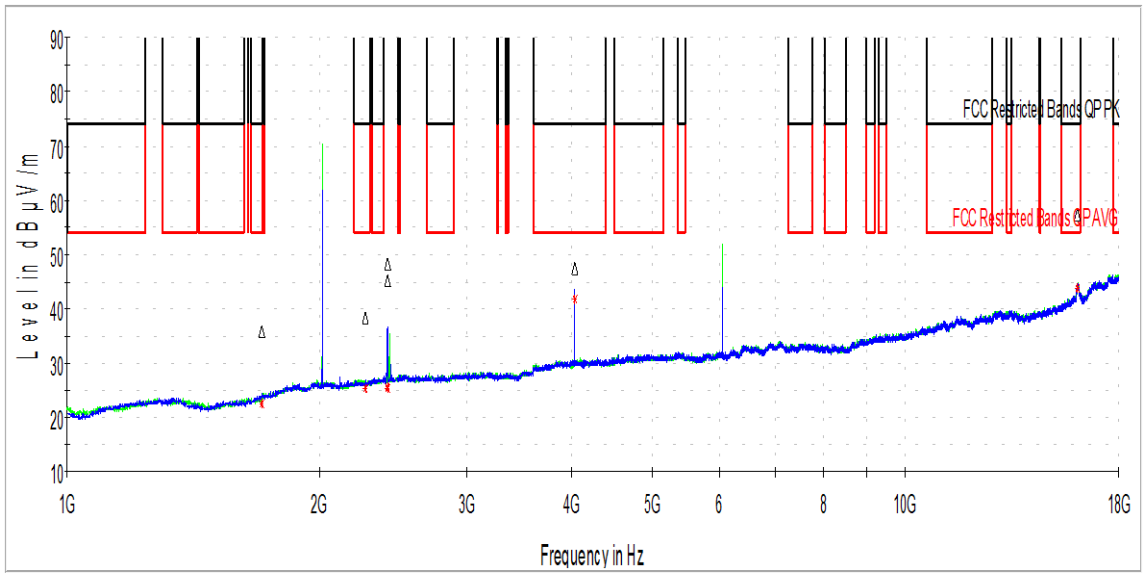



| Frequency (MHz) | QuasiPeak (dBµV/m) | Limit (dBµV/m) | Margin (dB) | Bandwidth (kHz) | Height (cm) | Pol | Azimuth (deg) | Corr. (dB) |
|---|---|---|---|---|---|---|---|---|
| 37.652222 | 20.34 | 40.00 | 19.66 | 120.000 | 399.9 | H | 36.0 | 23.2 |
| 156.746667 | 19.20 | 43.52 | 24.32 | 120.000 | 165.9 | H | 338.0 | 21.6 |
| 326.011667 | 22.46 | 46.02 | 23.56 | 120.000 | 212.8 | H | 7.0 | 24.9 |
| 400.162778 | 24.51 | 46.02 | 21.51 | 120.000 | 264.6 | V | 137.0 | 26.6 |
| 608.120000 | 31.49 | 46.02 | 14.53 | 120.000 | 311.9 | H | 303.0 | 32.2 |
| 973.702222 | 37.09 | 53.98 | 16.89 | 120.000 | 391.1 | H | 272.0 | 37.6 |

| | | | |
|---|---|---|---|
| Test Personnel: | Ben Coolbear | Test Date: | 10/09/2020 |
| Supervising/Reviewing Engineer: (Where Applicable) | NA | Limit Applied: | 15.205 Restricted Bands |
| Product Standard: | FCC Part 15C | Ambient Temperature: | 24.7 °C |
| Input Voltage: | 3.9 VDC | Relative Humidity: | 46.4 % |
| Pretest Verification w / Ambient Signals or BB Source: | Yes | Atmospheric Pressure: | 989.1 mbar |

Deviations, Additions, or Exclusions: None

### 7.10 Radiated Spurious Emissions (BLE, Low Channel, 1GHz – 18GHz)



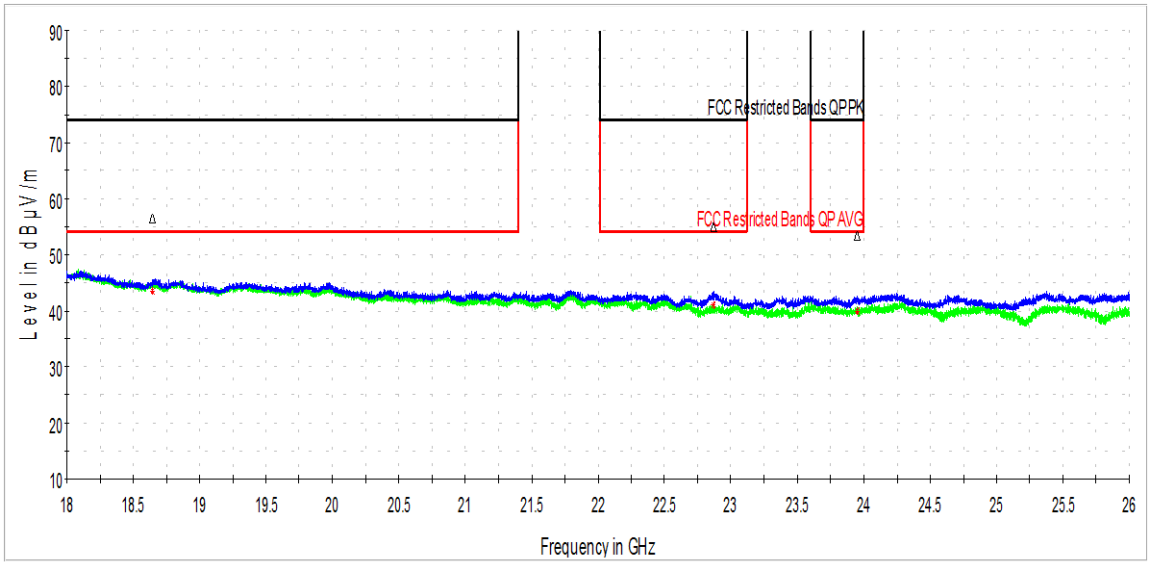

| Frequency (MHz) | MaxPeak (dBµV/m) | Limit (dBµV/m) | Margin (dB) | Bandwidth (kHz) | Height (cm) | Pol | Azimuth (deg) | Corr. (dB) |
|---|---|---|---|---|---|---|---|---|
| 1707.500000 | 35.89 | 73.98 | 38.09 | 1000.000 | 100.0 | V | 125.0 | 0.3 |
| 2271.000000 | 38.29 | 73.98 | 35.69 | 1000.000 | 295.0 | H | 342.0 | 3.4 |
| 4033.500000 | 47.37 | 73.98 | 26.61 | 1000.000 | 183.0 | V | 80.0 | 7.2 |
| 16070.000000 | 57.24 | 73.98 | 16.74 | 1000.000 | 100.0 | H | 113.0 | 25.0 |

| Frequency (MHz) | Average (dBµV/m) | Limit (dBµV/m) | Margin (dB) | Bandwidth (kHz) | Height (cm) | Pol | Azimuth (deg) | Corr. (dB) |
|---|---|---|---|---|---|---|---|---|
| 1707.500000 | 22.36 | 53.98 | 31.62 | 1000.000 | 100.0 | V | 125.0 | 0.3 |
| 2271.000000 | 25.20 | 53.98 | 28.78 | 1000.000 | 295.0 | H | 342.0 | 3.4 |
| 4033.500000 | 41.67 | 53.98 | 12.31 | 1000.000 | 183.0 | V | 80.0 | 7.2 |
| 16070.000000 | 43.81 | 53.98 | 10.17 | 1000.000 | 100.0 | H | 113.0 | 25.0 |

| | | | |
|---|---|---|---|
| Test Personnel: | Ben Coolbear | Test Date: | 10/09/2020 |
| Supervising/Reviewing Engineer: (Where Applicable) | NA | Limit Applied: | 15.205 Restricted Bands |
| Product Standard: | FCC Part 15C | Ambient Temperature: | 24.7 °C |
| Input Voltage: | 3.9 VDC | Relative Humidity: | 46.4 % |
| Pretest Verification w / Ambient Signals or BB Source: | Yes | Atmospheric Pressure: | 989.1 mbar |

Deviations, Additions, or Exclusions: None

### 7.11 Radiated Spurious Emissions (BLE, Low Channel, 18GHz – 26GHz)



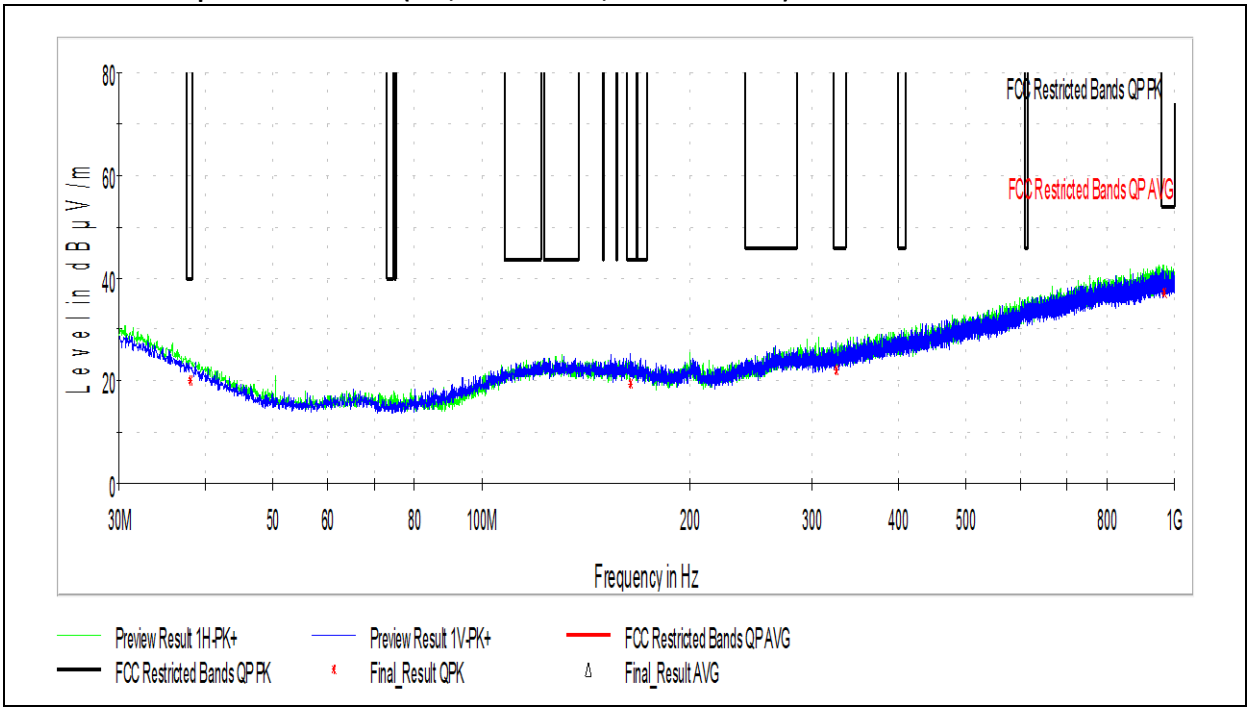

| Frequency (MHz) | MaxPeak (dBµV/m) | Limit (dBµV/m) | Margin (dB) | Bandwidth (kHz) | Height (cm) | Pol | Azimuth (deg) | Corr. (dB) |
|---|---|---|---|---|---|---|---|---|
| 18643.000000 | 56.48 | 73.98 | 17.50 | 1000.000 | 410.0 | V | 124.0 | 18.6 |
| 22868.500000 | 54.88 | 73.98 | 19.10 | 1000.000 | 410.0 | V | 342.0 | 6.5 |
| 23948.500000 | 53.26 | 73.98 | 20.72 | 1000.000 | 109.0 | V | 188.0 | 6.3 |

| Frequency (MHz) | Average (dBµV/m) | Limit (dBµV/m) | Margin (dB) | Bandwidth (kHz) | Height (cm) | Pol | Azimuth (deg) | Corr. (dB) |
|---|---|---|---|---|---|---|---|---|
| 18643.000000 | 43.41 | 53.98 | 10.57 | 1000.000 | 410.0 | V | 124.0 | 18.6 |
| 22868.500000 | 41.12 | 53.98 | 12.86 | 1000.000 | 410.0 | V | 342.0 | 6.5 |
| 23948.500000 | 39.92 | 53.98 | 14.06 | 1000.000 | 109.0 | V | 188.0 | 6.3 |

| | | | |
|---|---|---|---|
| Test Personnel: | Ben Coolbear | Test Date: | 10/09/2020 |
| Supervising/Reviewing Engineer: (Where Applicable) | NA | Limit Applied: | 15.205 Restricted Bands |
| Product Standard: | FCC Part 15C | Ambient Temperature: | 24.7 °C |
| Input Voltage: | 3.9 VDC | Relative Humidity: | 46.4 % |
| Pretest Verification w / Ambient Signals or BB Source: | Yes | Atmospheric Pressure: | 989.1 mbar |

Deviations, Additions, or Exclusions: None

### 7.12 Radiated Spurious Emissions (BLE, Mid Channel, 30MHz – 1 GHz)

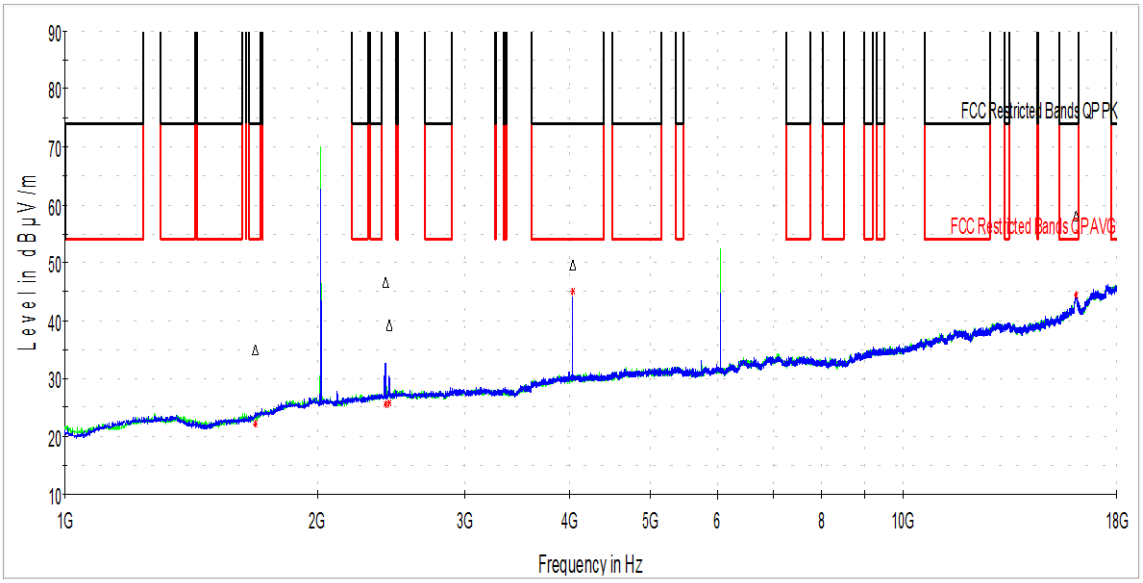



| Frequency (MHz) | QuasiPeak (dBµV/m) | Limit (dBµV/m) | Margin (dB) | Bandwidth (kHz) | Height (cm) | Pol | Azimuth (deg) | Corr. (dB) |
|---|---|---|---|---|---|---|---|---|
| 37.975556 | 20.03 | 40.00 | 19.97 | 120.000 | 105.2 | H | 293.0 | 23.0 |
| 164.183333 | 19.38 | 43.52 | 24.14 | 120.000 | 129.9 | V | 238.0 | 21.8 |
| 324.826111 | 22.01 | 46.02 | 24.01 | 120.000 | 359.3 | V | 126.0 | 24.3 |
| 965.565000 | 37.04 | 53.98 | 16.94 | 120.000 | 106.6 | H | 101.0 | 37.5 |

| | | | |
|---|---|---|---|
| Test Personnel: | Ben Coolbear | Test Date: | 10/09/2020 |
| Supervising/Reviewing Engineer: (Where Applicable) | NA | Limit Applied: | 15.205 Restricted Bands |
| Product Standard: | FCC Part 15C | Ambient Temperature: | 24.7 °C |
| Input Voltage: | 3.9 VDC | Relative Humidity: | 46.4 % |
| Pretest Verification w / Ambient Signals or BB Source: | Yes | Atmospheric Pressure: | 989.1 mbar |

Deviations, Additions, or Exclusions: None

### 7.13 Radiated Spurious Emissions (BLE, Mid Channel, 1GHz – 18GHz)



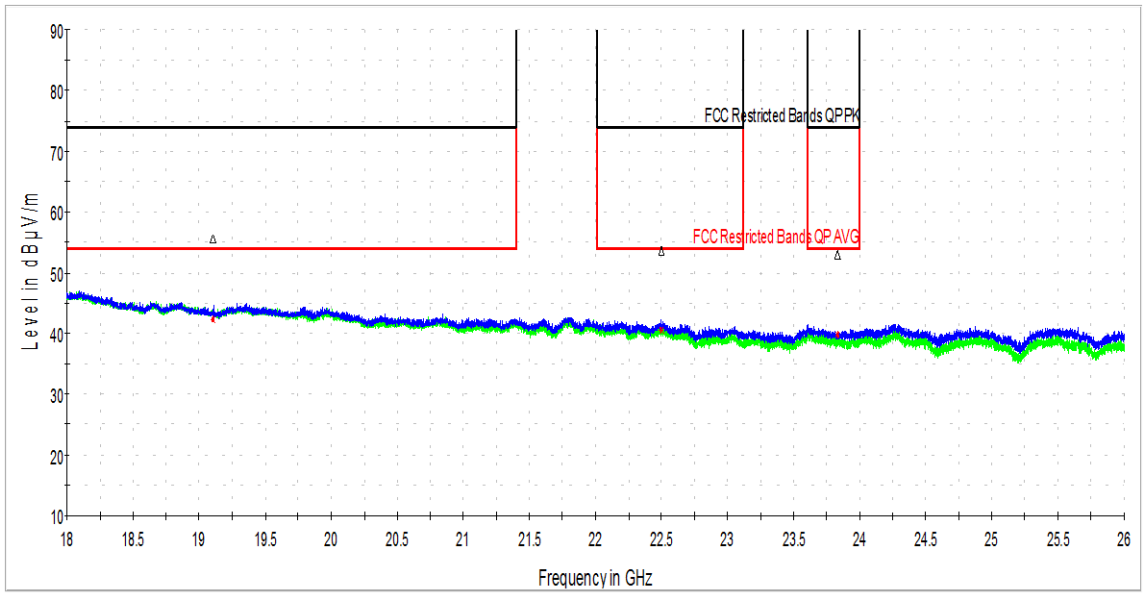

| Frequency (MHz) | MaxPeak (dBµV/m) | Limit (dBµV/m) | Margin (dB) | Bandwidth (kHz) | Height (cm) | Pol | Azimuth (deg) | Corr. (dB) |
|---|---|---|---|---|---|---|---|---|
| 1685.000000 | 35.00 | 73.98 | 38.98 | 1000.000 | 304.0 | V | 316.0 | -0.2 |
| 4034.000000 | 49.57 | 73.98 | 24.41 | 1000.000 | 161.0 | V | 89.0 | 7.2 |
| 16102.500000 | 57.99 | 73.98 | 15.99 | 1000.000 | 100.0 | H | 76.0 | 25.6 |

| Frequency (MHz) | Average (dBµV/m) | Limit (dBµV/m) | Margin (dB) | Bandwidth (kHz) | Height (cm) | Pol | Azimuth (deg) | Corr. (dB) |
|---|---|---|---|---|---|---|---|---|
| 1685.000000 | 22.10 | 53.98 | 31.88 | 1000.000 | 304.0 | V | 316.0 | -0.2 |
| 4034.000000 | 45.03 | 53.98 | 8.95 | 1000.000 | 161.0 | V | 89.0 | 7.2 |
| 16102.500000 | 44.49 | 53.98 | 9.49 | 1000.000 | 100.0 | H | 76.0 | 25.6 |

| | | | |
|---|---|---|---|
| Test Personnel: | Ben Coolbear | Test Date: | 10/09/2020 |
| Supervising/Reviewing Engineer: (Where Applicable) | NA | Limit Applied: | 15.205 Restricted Bands |
| Product Standard: | FCC Part 15C | Ambient Temperature: | 24.7 °C |
| Input Voltage: | 3.9 VDC | Relative Humidity: | 46.4 % |
| Pretest Verification w / Ambient Signals or BB Source: | Yes | Atmospheric Pressure: | 989.1 mbar |

Deviations, Additions, or Exclusions: None

### 7.14 Radiated Spurious Emissions (BLE, Mid Channel, 18GHz – 26GHz)



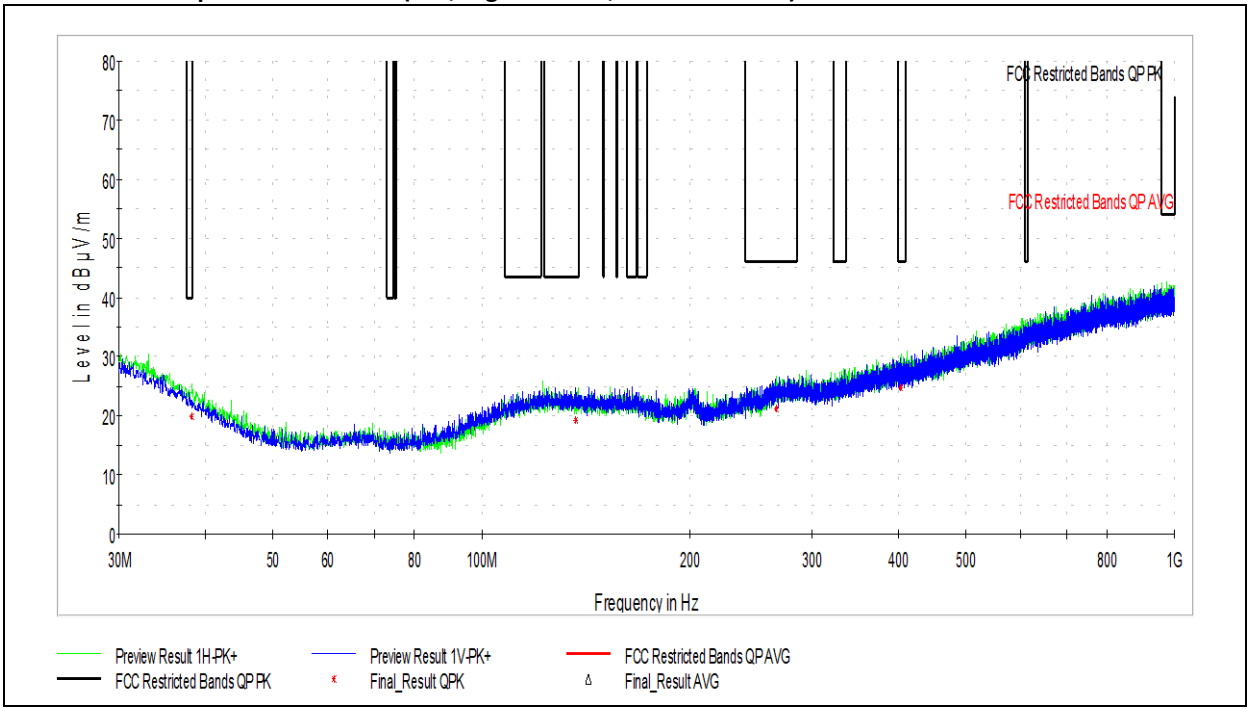

| Frequency (MHz) | MaxPeak (dBµV/m) | Limit (dBµV/m) | Margin (dB) | Bandwidth (kHz) | Height (cm) | Pol | Azimuth (deg) | Corr. (dB) |
|---|---|---|---|---|---|---|---|---|
| 19106.000000 | 55.57 | 73.98 | 18.41 | 1000.000 | 410.0 | H | 174.0 | 17.7 |
| 22500.500000 | 53.58 | 73.98 | 20.40 | 1000.000 | 336.0 | V | 286.0 | 7.4 |
| 23834.000000 | 52.87 | 73.98 | 21.11 | 1000.000 | 410.0 | V | 270.0 | 6.2 |

| Frequency (MHz) | Average (dBµV/m) | Limit (dBµV/m) | Margin (dB) | Bandwidth (kHz) | Height (cm) | Pol | Azimuth (deg) | Corr. (dB) |
|---|---|---|---|---|---|---|---|---|
| 19106.000000 | 42.26 | 53.98 | 11.72 | 1000.000 | 410.0 | H | 174.0 | 17.7 |
| 22500.500000 | 40.55 | 53.98 | 13.43 | 1000.000 | 336.0 | V | 286.0 | 7.4 |
| 23834.000000 | 39.86 | 53.98 | 14.12 | 1000.000 | 410.0 | V | 270.0 | 6.2 |

| | | | |
|---|---|---|---|
| Test Personnel: | Ben Coolbear | Test Date: | 10/09/2020 |
| Supervising/Reviewing Engineer: (Where Applicable) | NA | Limit Applied: | 15.205 Restricted Bands |
| Product Standard: | FCC Part 15C | Ambient Temperature: | 24.7 °C |
| Input Voltage: | 3.9 VDC | Relative Humidity: | 46.4 % |
| Pretest Verification w / Ambient Signals or BB Source: | Yes | Atmospheric Pressure: | 989.1 mbar |

Deviations, Additions, or Exclusions: None

### 7.15 Radiated Spurious Emissions (BLE, High Channel, 30MHz – 1 GHz)

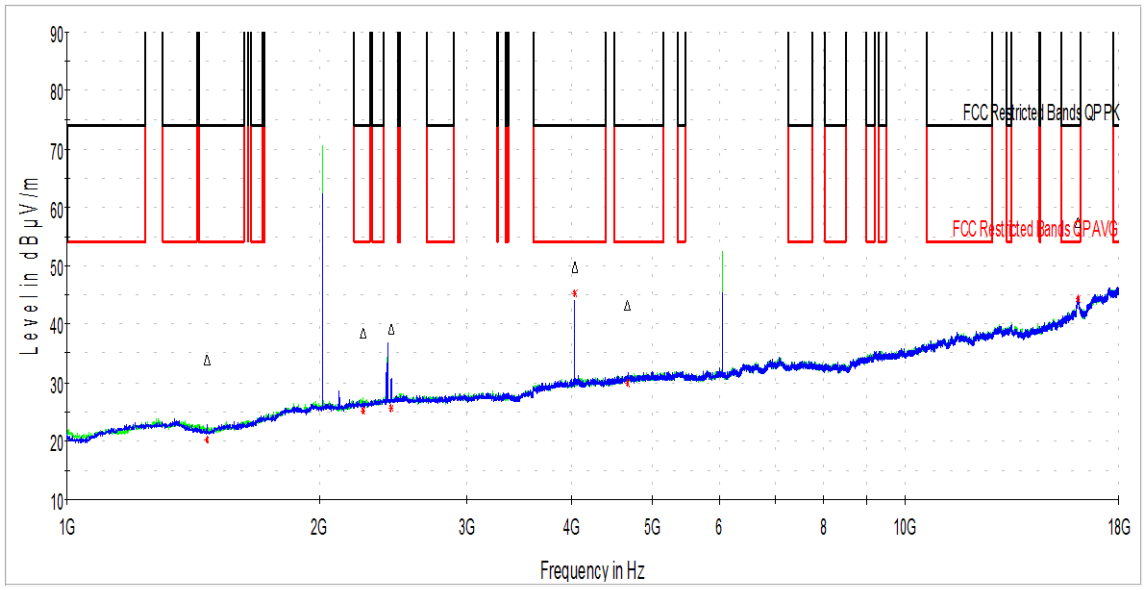



| Frequency (MHz) | QuasiPeak (dBµV/m) | Limit (dBµV/m) | Margin (dB) | Bandwidth (kHz) | Height (cm) | Pol | Azimuth (deg) | Corr. (dB) |
|---|---|---|---|---|---|---|---|---|
| 38.191111 | 19.87 | 40.00 | 20.13 | 120.000 | 165.6 | H | 10.0 | 22.8 |
| 136.915556 | 19.22 | 43.52 | 24.30 | 120.000 | 222.5 | V | 156.0 | 22.1 |
| 266.356667 | 21.11 | 46.02 | 24.91 | 120.000 | 264.6 | H | 292.0 | 23.3 |
| 403.072778 | 24.68 | 46.02 | 21.34 | 120.000 | 379.3 | V | 293.0 | 26.7 |

| | | | |
|---|---|---|---|
| Test Personnel: | Ben Coolbear | Test Date: | 10/09/2020 |
| Supervising/Reviewing Engineer: (Where Applicable) | NA | Limit Applied: | 15.205 Restricted Bands |
| Product Standard: | FCC Part 15C | Ambient Temperature: | 24.7 °C |
| Input Voltage: | 3.9 VDC | Relative Humidity: | 46.4 % |
| Pretest Verification w / Ambient Signals or BB Source: | Yes | Atmospheric Pressure: | 989.1 mbar |

Deviations, Additions, or Exclusions: None

### 7.16 Radiated Spurious Emissions (BLE, High Channel, 1GHz – 18GHz)



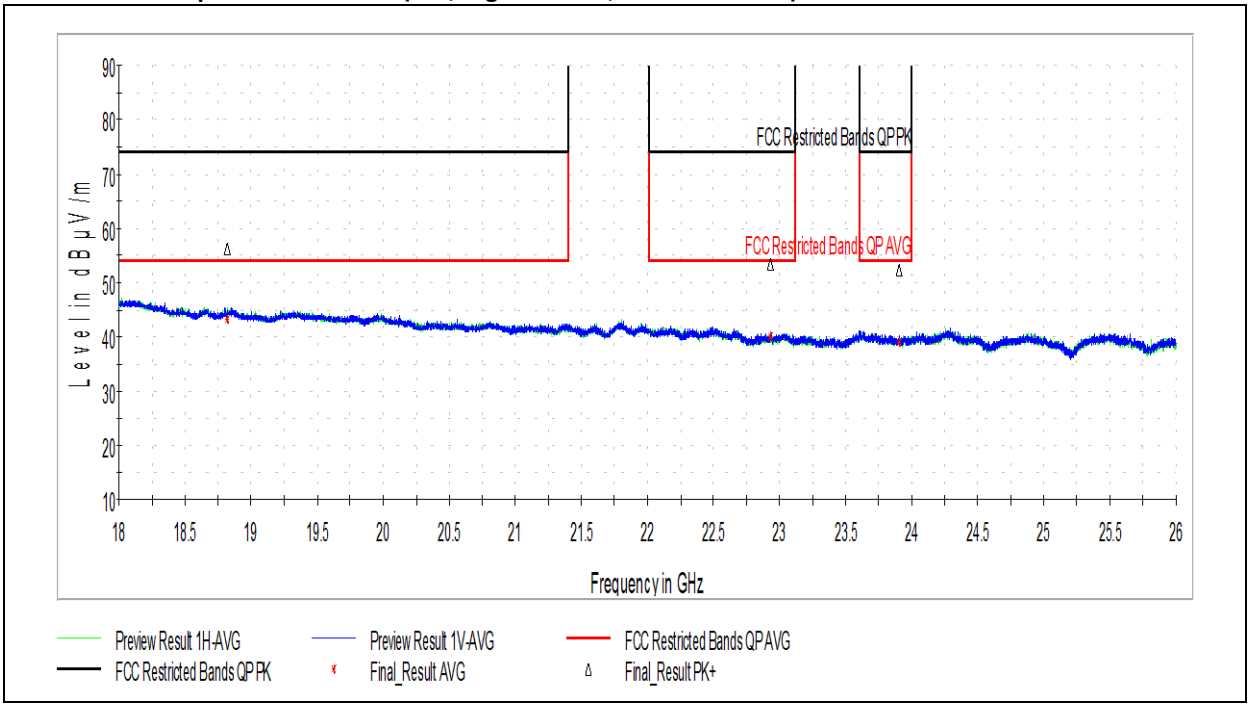

| Frequency (MHz) | MaxPeak (dBµV/m) | Limit (dBµV/m) | Margin (dB) | Bandwidth (kHz) | Height (cm) | Pol | Azimuth (deg) | Corr. (dB) |
|---|---|---|---|---|---|---|---|---|
| 1469.500000 | 33.85 | 73.98 | 40.13 | 1000.000 | 303.0 | V | 194.0 | -1.9 |
| 2257.500000 | 38.43 | 73.98 | 35.55 | 1000.000 | 298.0 | H | 258.0 | 3.3 |
| 4034.500000 | 49.76 | 73.98 | 24.22 | 1000.000 | 184.0 | V | 82.0 | 7.2 |
| 4667.500000 | 43.18 | 73.98 | 30.80 | 1000.000 | 297.0 | H | 235.0 | 8.2 |
| 16108.500000 | 57.54 | 73.98 | 16.44 | 1000.000 | 100.0 | H | 214.0 | 25.4 |

| Frequency (MHz) | Average (dBµV/m) | Limit (dBµV/m) | Margin (dB) | Bandwidth (kHz) | Height (cm) | Pol | Azimuth (deg) | Corr. (dB) |
|---|---|---|---|---|---|---|---|---|
| 1469.500000 | 20.12 | 53.98 | 33.86 | 1000.000 | 303.0 | V | 194.0 | -1.9 |
| 2257.500000 | 25.07 | 53.98 | 28.91 | 1000.000 | 298.0 | H | 258.0 | 3.3 |
| 4034.500000 | 45.33 | 53.98 | 8.65 | 1000.000 | 184.0 | V | 82.0 | 7.2 |
| 4667.500000 | 29.85 | 53.98 | 24.13 | 1000.000 | 297.0 | H | 235.0 | 8.2 |
| 16108.500000 | 44.30 | 53.98 | 9.68 | 1000.000 | 100.0 | H | 214.0 | 25.4 |

| | | | |
|---|---|---|---|
| Test Personnel: | Ben Coolbear | Test Date: | 10/09/2020 |
| Supervising/Reviewing Engineer: (Where Applicable) | NA | Limit Applied: | 15.205 Restricted Bands |
| Product Standard: | FCC Part 15C | Ambient Temperature: | 24.7 °C |
| Input Voltage: | 3.9 VDC | Relative Humidity: | 46.4 % |
| Pretest Verification w / Ambient Signals or BB Source: | Yes | Atmospheric Pressure: | 989.1 mbar |

Deviations, Additions, or Exclusions: None

### 7.17 Radiated Spurious Emissions (BLE, High Channel, 18GHz – 26GHz)




| Frequency (MHz) | MaxPeak (dBµV/m) | Limit (dBµV/m) | Margin (dB) | Bandwidth (kHz) | Height (cm) | Pol | Azimuth (deg) | Corr. (dB) |
|---|---|---|---|---|---|---|---|---|
| 18820.500000 | 56.34 | 73.98 | 17.64 | 1000.000 | 410.0 | H | 153.0 | 18.4 |
| 22932.500000 | 53.28 | 73.98 | 20.70 | 1000.000 | 326.0 | V | 172.0 | 6.6 |
| 23903.000000 | 52.15 | 73.98 | 21.83 | 1000.000 | 126.0 | V | 201.0 | 5.9 |

| Frequency (MHz) | Average (dBµV/m) | Limit (dBµV/m) | Margin (dB) | Bandwidth (kHz) | Height (cm) | Pol | Azimuth (deg) | Corr. (dB) |
|---|---|---|---|---|---|---|---|---|
| 18820.500000 | 43.23 | 53.98 | 10.75 | 1000.000 | 410.0 | H | 153.0 | 18.4 |
| 22932.500000 | 40.06 | 53.98 | 13.92 | 1000.000 | 326.0 | V | 172.0 | 6.6 |
| 23903.000000 | 38.96 | 53.98 | 15.02 | 1000.000 | 126.0 | V | 201.0 | 5.9 |

| | | | |
|---|---|---|---|
| Test Personnel: | Ben Coolbear | Test Date: | 10/09/2020 |
| Supervising/Reviewing Engineer: (Where Applicable) | NA | Limit Applied: | 15.205 Restricted Bands |
| Product Standard: | FCC Part 15C | Ambient Temperature: | 24.7 °C |
| Input Voltage: | 3.9 VDC | Relative Humidity: | 46.4 % |
| Pretest Verification w / Ambient Signals or BB Source: | Yes | Atmospheric Pressure: | 989.1 mbar |

Deviations, Additions, or Exclusions: None

# 8 Output Power

## 8.1 Test Limits

**FCC Part 15.247(b)(3):**

For systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands: 1 Watt. As an alternative to a peak power measurement, compliance with the one Watt limit can be based on a measurement of the maximum conducted output power. Maximum Conducted Output Power is defined as the total transmit power delivered to all antennas and antenna elements averaged across all symbols in the signaling alphabet when the transmitter is operating at its maximum power control level. Power must be summed across all antennas and antenna elements. The average must not include any time intervals during which the transmitter is off or is transmitting at a reduced power level. If multiple modes of operation are possible (e.g., alternative modulation methods), the maximum conducted output power is the highest total transmit power occurring in any mode.

**RSS-247 Issue 2 § 5.4(d):**

For DTSs employing digital modulation techniques operating in the bands 902-928 MHz and 2400-2483.5 MHz, the maximum peak conducted output power shall not exceed 1 W. The e.i.r.p. shall not exceed 4 W, except as provided in section 5.4(e).

As an alternative to a peak power measurement, compliance can be based on a measurement of the maximum conducted output power. The maximum conducted output power is the total transmit power delivered to all antennas and antenna elements, averaged across all symbols in the signalling alphabet when the transmitter is operating at its maximum power control level. Power must be summed across all antennas and antenna elements. The average must not include any time intervals during which the transmitter is off or transmitting at a reduced power level. If multiple modes of operation are implemented, the maximum conducted output power is the highest total transmit power occurring in any mode.

### 8.2 Test Method

Tests are performed in accordance with ANSI C63.10:2013 § 11.9.1.1

### 8.3 Test Equipment Used

| Description | Asset | Manufacturer | Model | Cal Date | Cal Due |
|---|---|---|---|---|---|
| EMI Test Receiver | 3900 | Rohde & Schwarz | ESU40 | 10/5/2020 | 10/5/2021 |
| Coaxial Cable | 6086 | Megaphase | SF26-S1S1-40 | 12/4/2019 | 12/4/2020 |

### 8.4 Test Results

The device was found to be **compliant**. The peak output power was less than 1W.

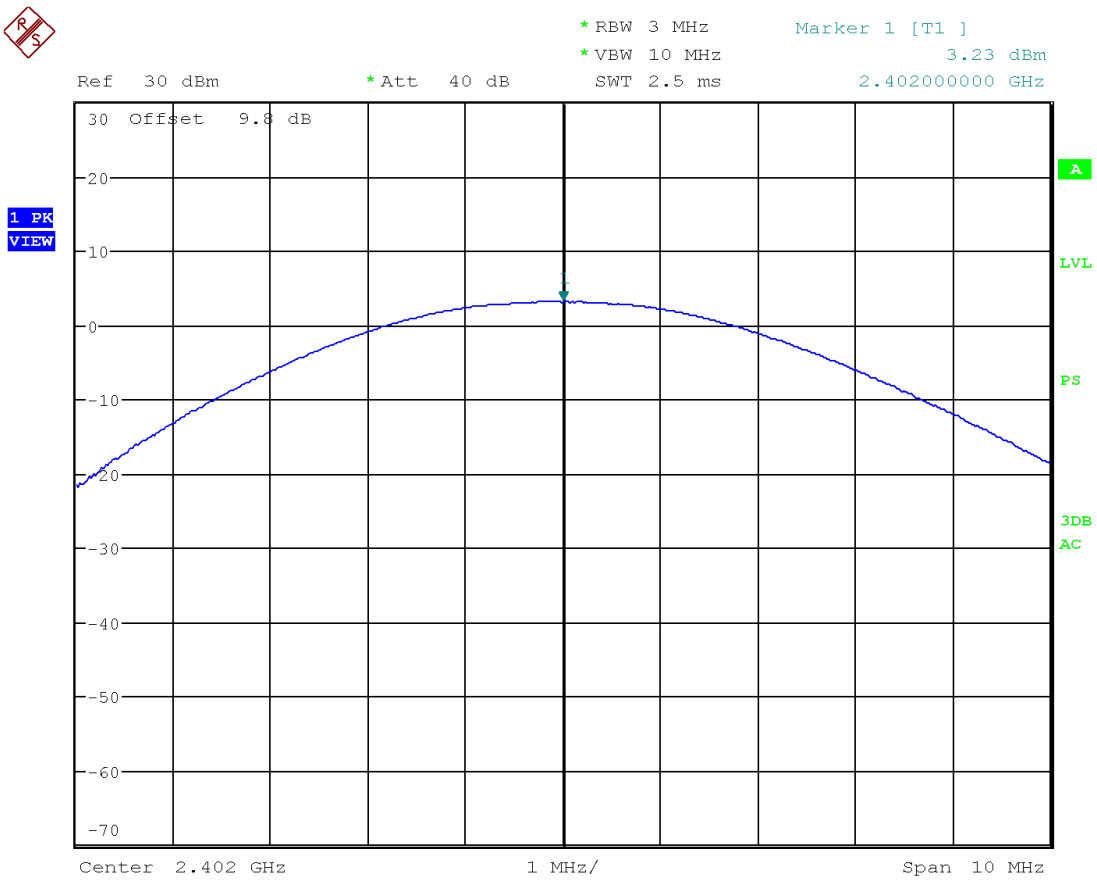
### 8.5 Test Conditions

| | | | |
|---|---|---|---|
| Test Personnel: | Bryan Taylor | Test Date: | 10/25/2020 |
| Supervising/Reviewing Engineer: (Where Applicable) | NA | Limit Applied: | 1 Watt |
| Product Standard: | FCC Part 15.247 RSS-247 Issue 2 | Ambient Temperature: | 22.6C |
| Input Voltage: | 3.9VDC | Relative Humidity: | 41.2% |
| Pretest Verification w / Ambient Signals or BB Source: | Yes | Atmospheric Pressure: | 991.2mbar |

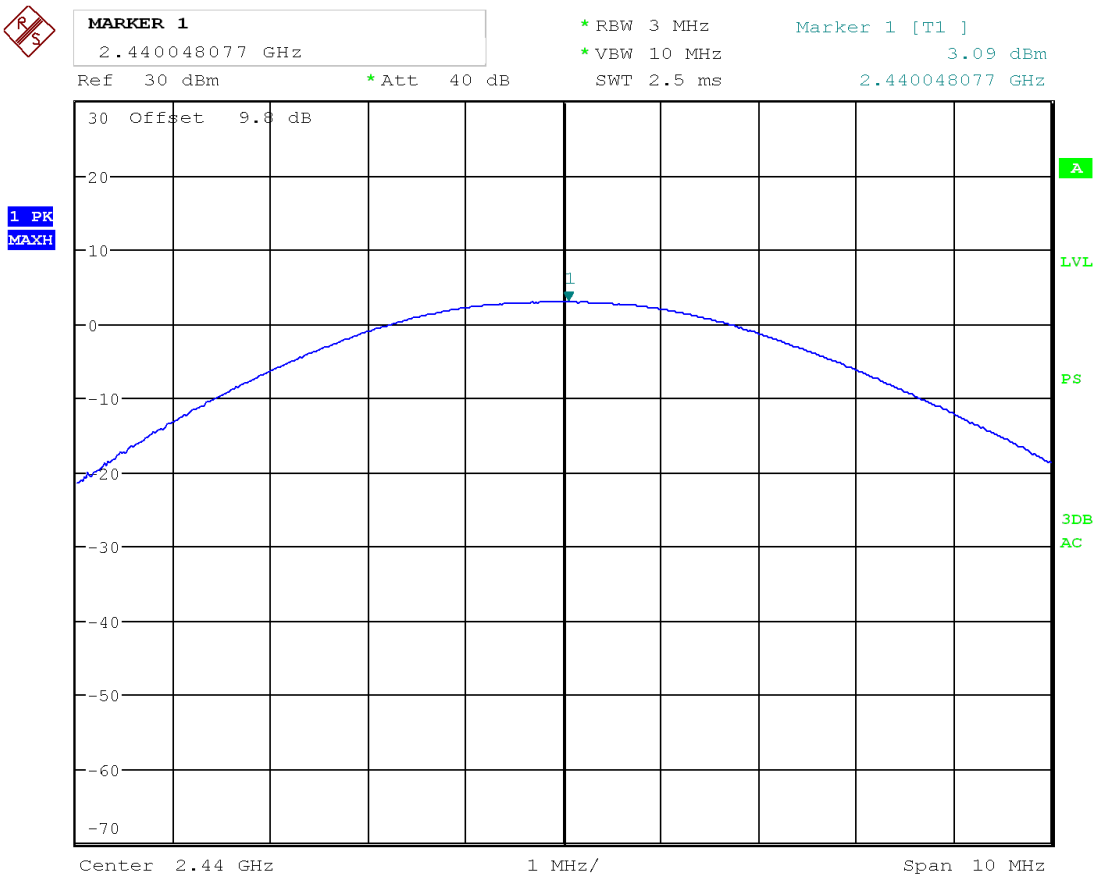
### 8.6 Test Data

| Channel | Frequency (MHz) | Conducted Power (dBm) | Limit (dBm) | Margin (dB) | Result |
|---|---|---|---|---|---|
| 0 | 2402 | 3.23 | 30 | 26.77 | PASS |
| 39 | 2440 | 3.09 | 30 | 26.91 | PASS |
| 79 | 2480 | 3.46 | 30 | 26.54 | PASS |

Deviations, Additions, or Exclusions: None

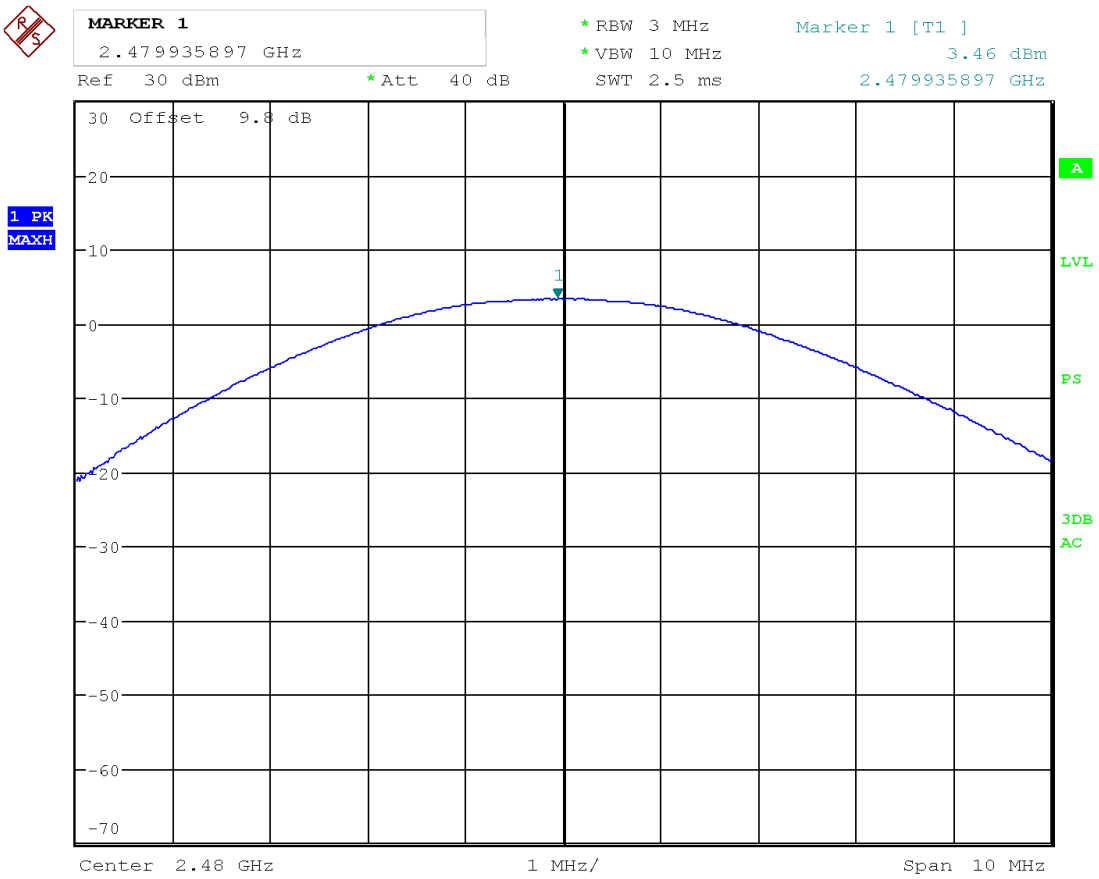



Peak Output Power 2402MHz




Date: 25.OCT.2020 15:54:00

Peak Output Power 2440MHz




Date: 25.OCT.2020 15:54:49

Peak Output Power 2480MHz

# 9 Occupied Bandwidth

## 9.1 Test Limits

**FCC Part 15.247(a)(2):**

Systems using digital modulation techniques may operate in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands. The minimum 6 dB bandwidth shall be at least 500 kHz.

**RSS-247 Issue 2 § 5.2(a):**

The minimum 6 dB bandwidth shall be 500 kHz.

## 9.2 Test Method

Tests are performed in accordance with ANSI C63.10:2013 § 11.8.1.

## 9.3 Test Equipment Used

| Description | Asset | Manufacturer | Model | Cal Date | Cal Due |
|---|---|---|---|---|---|
| EMI Test Receiver | 3900 | Rohde & Schwarz | ESU40 | 10/5/2020 | 10/5/2021 |
| Coaxial Cable | 6086 | Megaphase | SF26-S1S1-40 | 12/4/2019 | 12/4/2020 |

## 9.4 Test Results

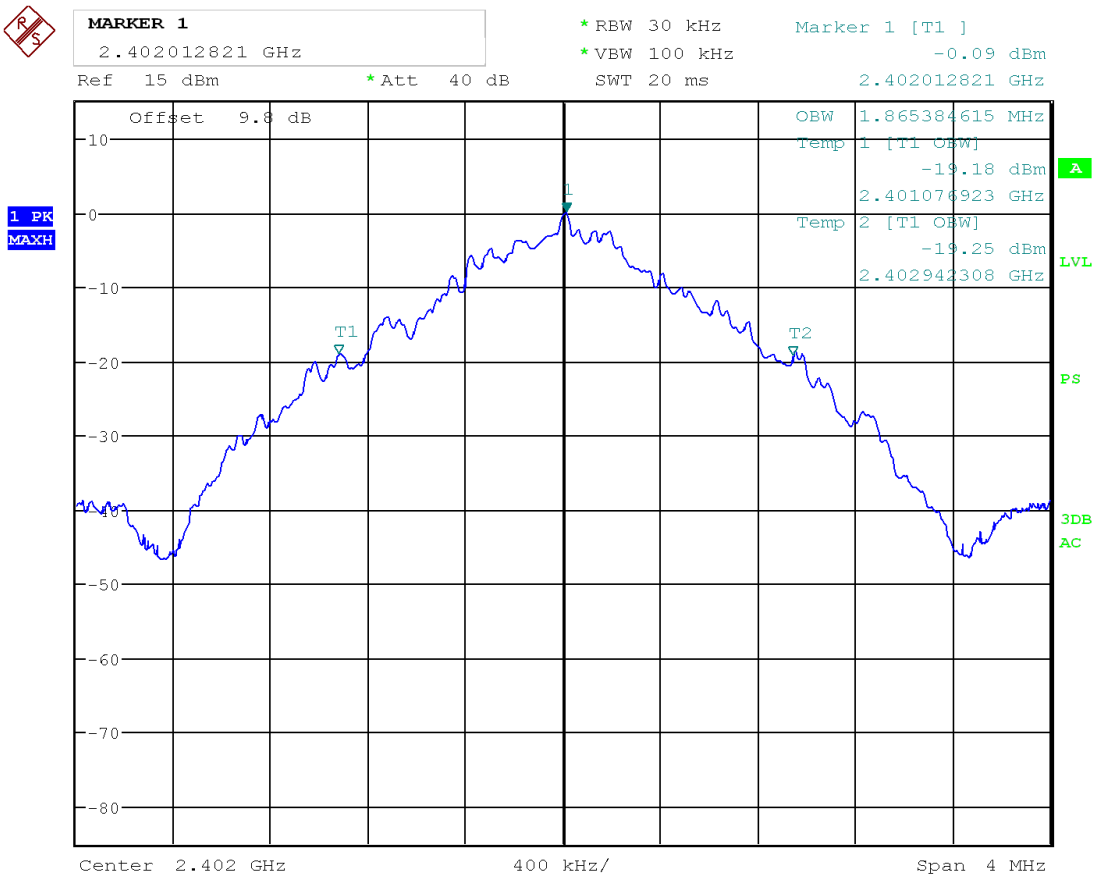
The device was found to be **compliant**. The 6dB bandwidth was at least 500kHz.

## 9.5 Test Conditions

| | | | |
|---|---|---|---|
| Test Personnel: | Bryan Taylor | Test Date: | 10/25/2020 |
| Supervising/Reviewing Engineer: (Where Applicable) | NA | Limit Applied: | 500kHz (for 6dB bandwidth) |
| Product Standard: | FCC Part 15.247 RSS-247 Issue 2 | Ambient Temperature: | 22.1C |
| Input Voltage: | 3.9VDC | Relative Humidity: | 47.7% |
| Pretest Verification w / Ambient Signals or BB Source: | Yes | Atmospheric Pressure: | 992mbar |

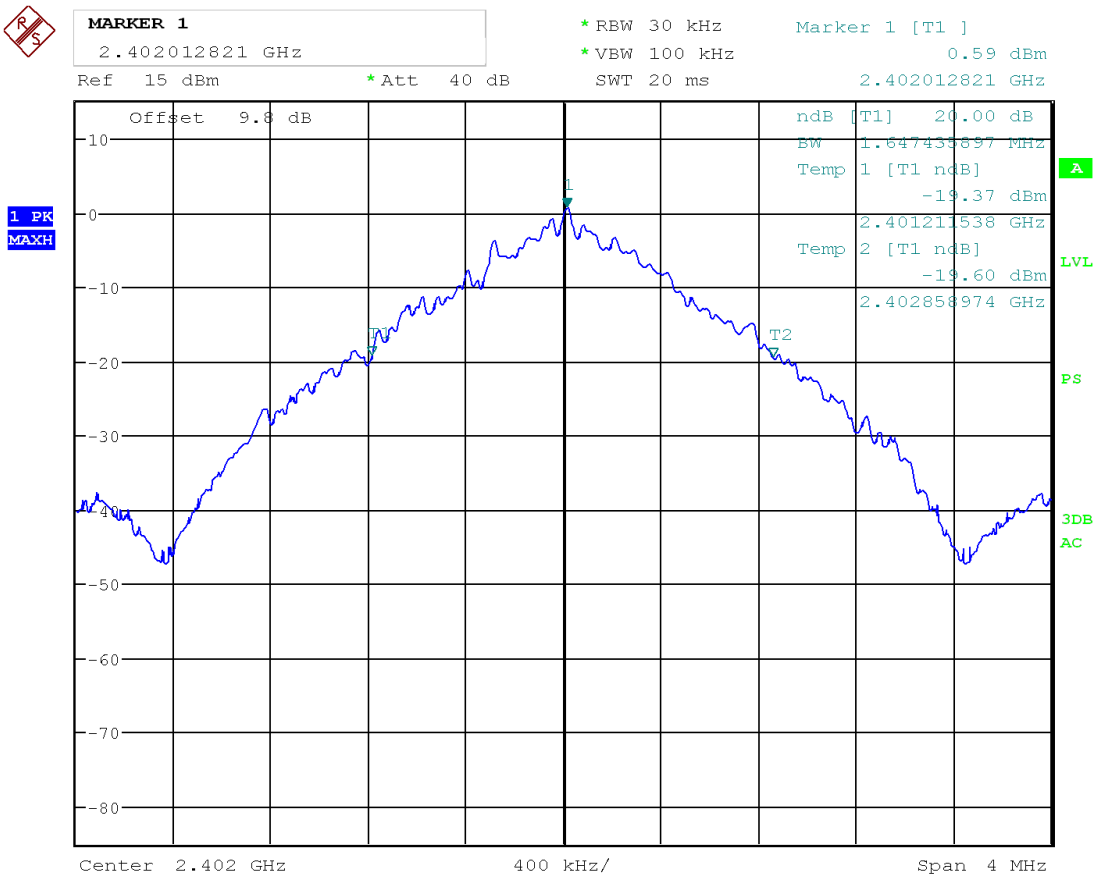
## 9.6 Test Data

| Channel | Frequency (MHz) | DTS BW (kHz) | 6dB BW (kHz) | 99% BW (MHz) |
|---|---|---|---|---|
| 0 | 2402 | 865.3 | 647.4 | 1.86 |
| 39 | 2440 | 826.9 | 551.3 | 1.77 |
| 79 | 2480 | 833.3 | 544.8 | 1.83 |



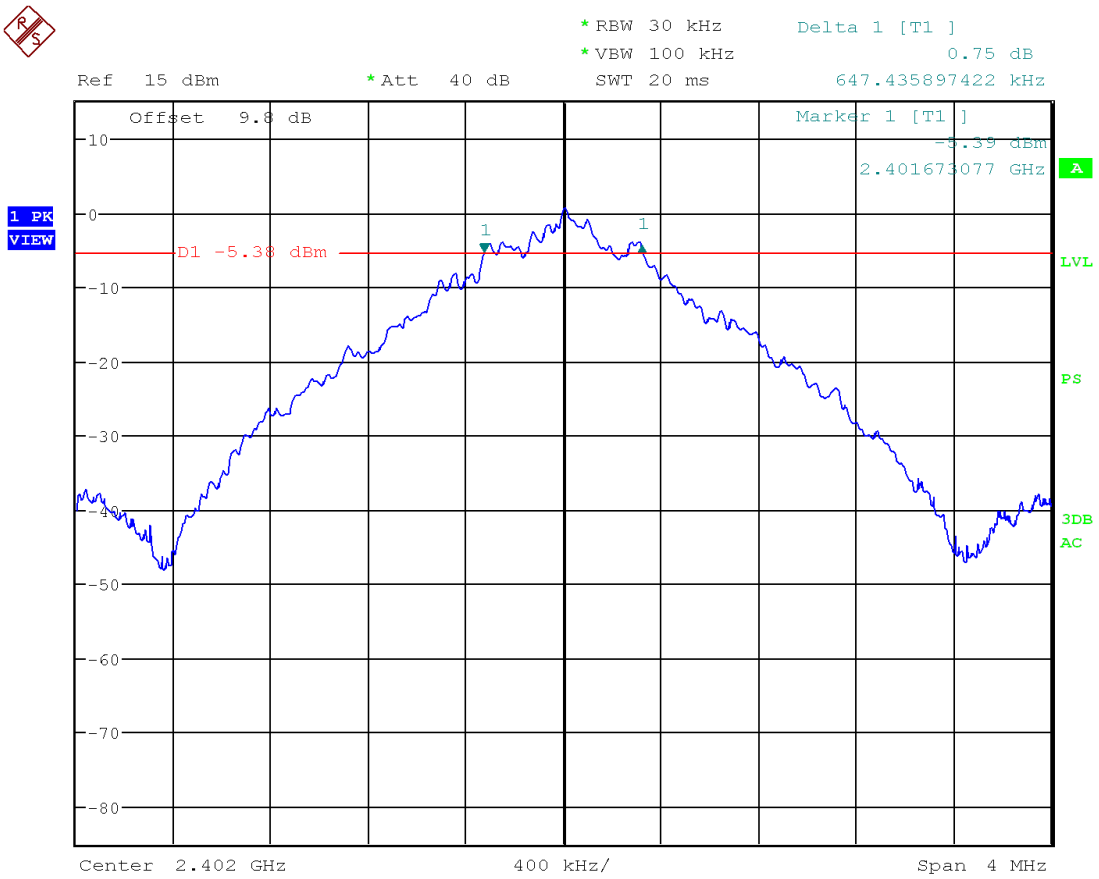

Date: 25.OCT.2020 16:06:36

99% Bandwidth 2402MHz



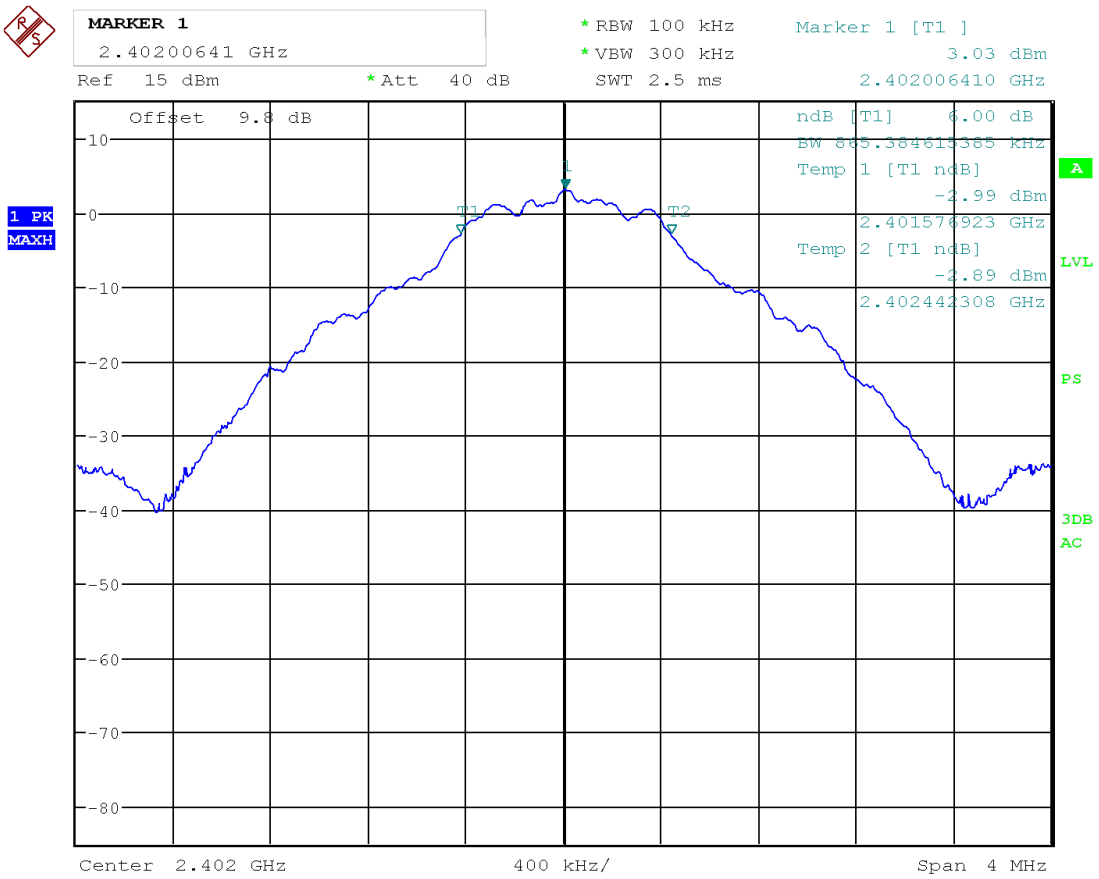

Date: 25.OCT.2020 16:10:58

20dB Down Bandwidth 2402MHz



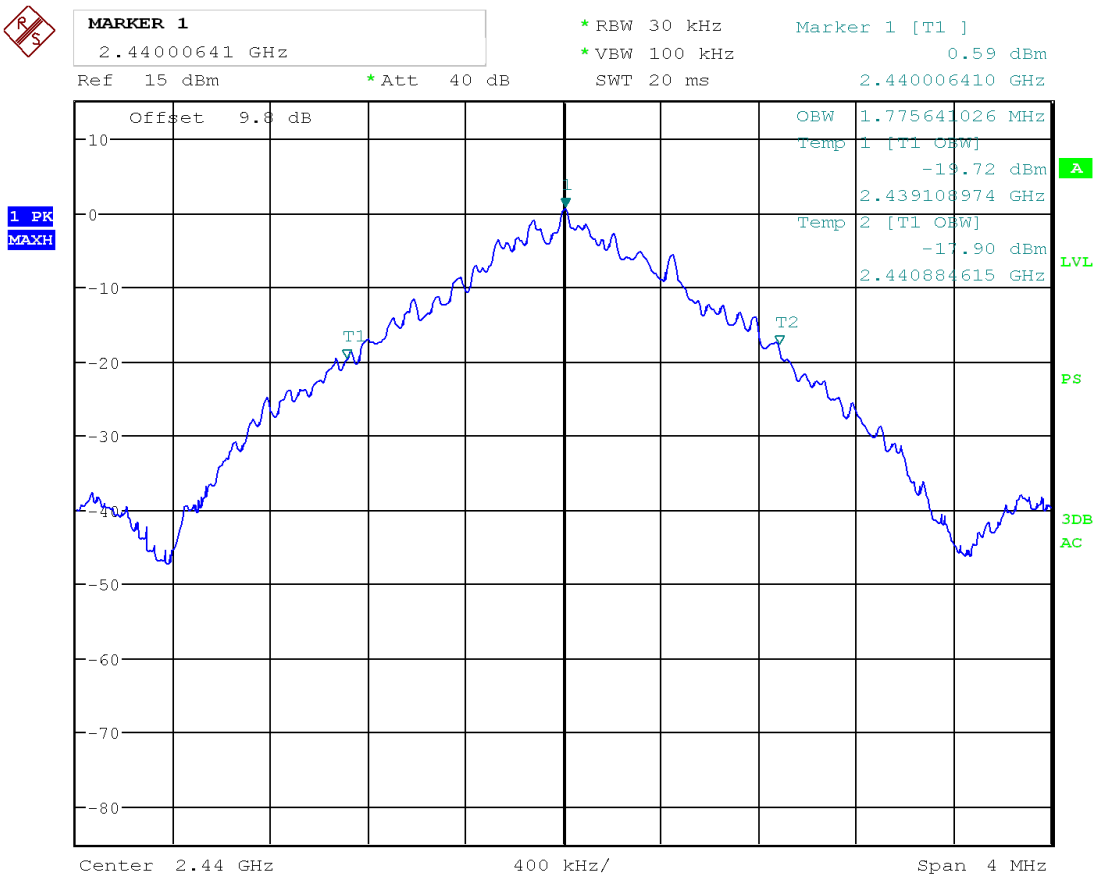

Date: 25.OCT.2020 16:15:52

6dB Down Bandwidth 2402MHz



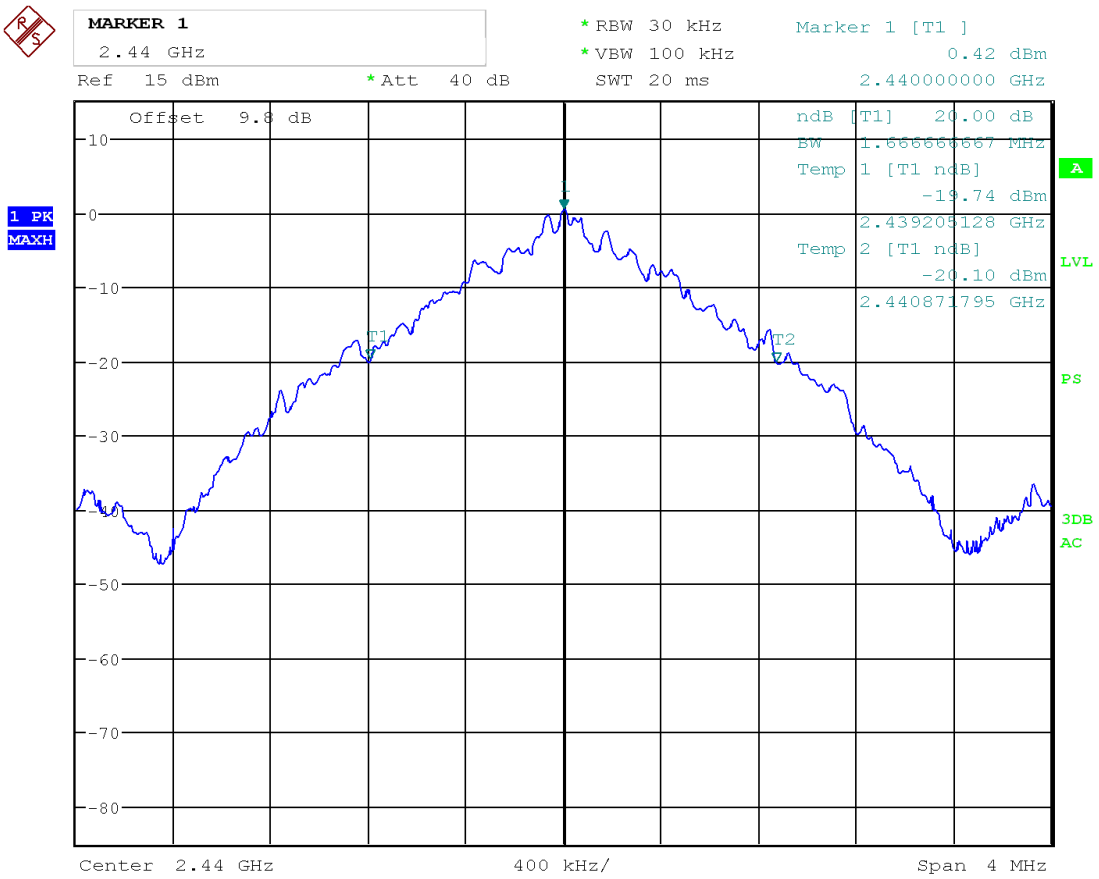

Date: 25.OCT.2020 16:22:51

DTS Bandwidth 2402MHz



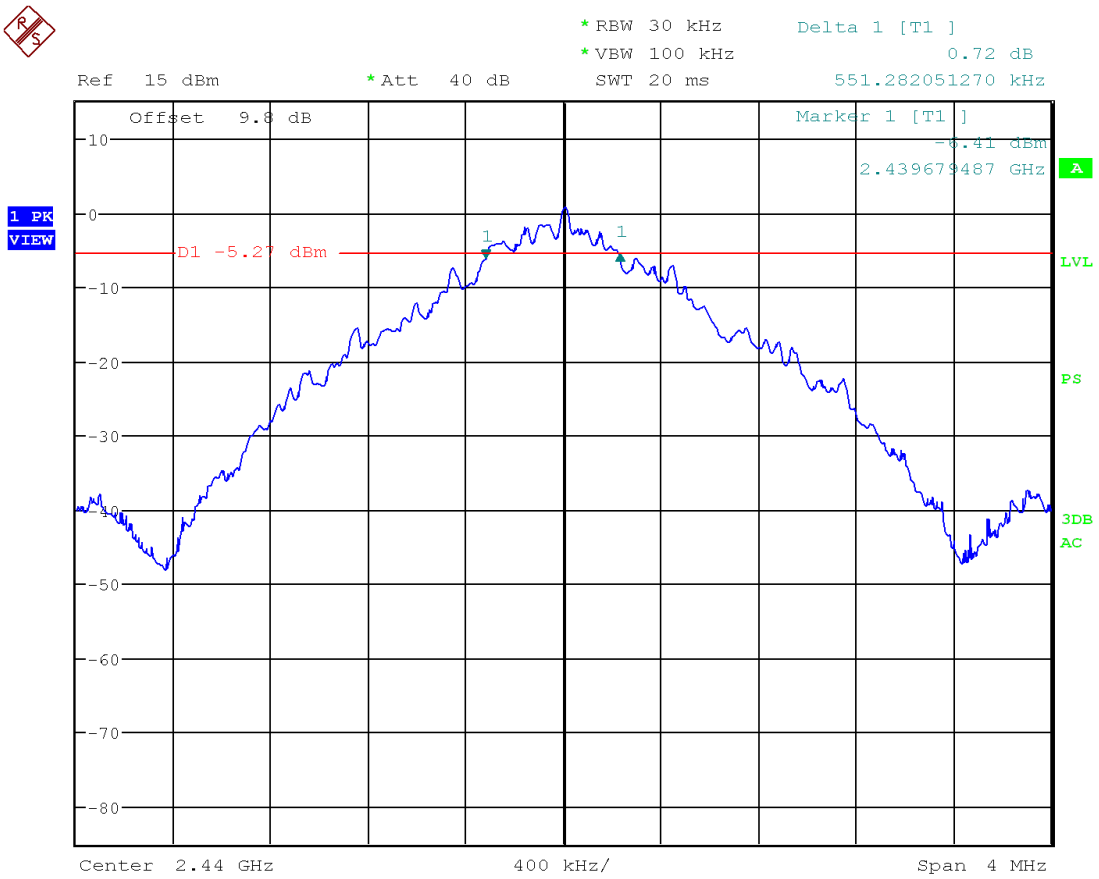

Date: 25.OCT.2020 16:07:28

99% Bandwidth 2440MHz



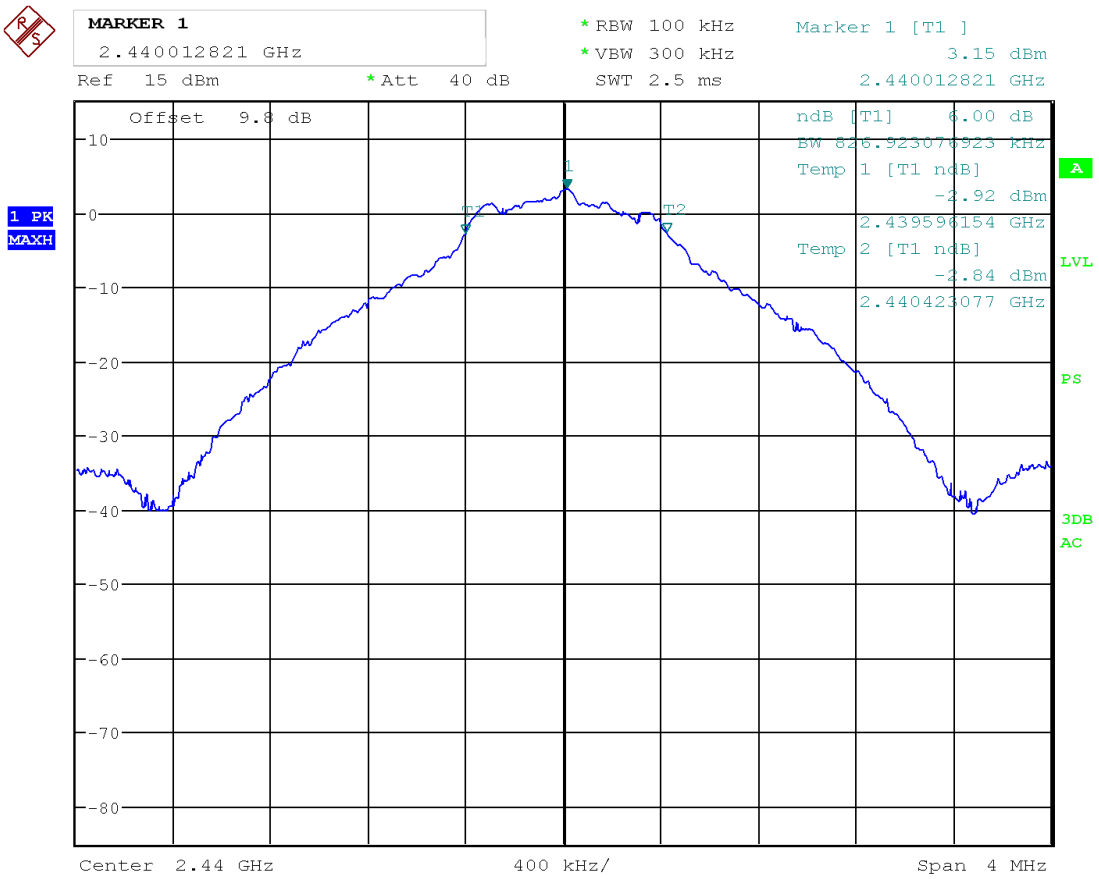

Date: 25.OCT.2020 16:11:41

20dB Down Bandwidth 2440MHz



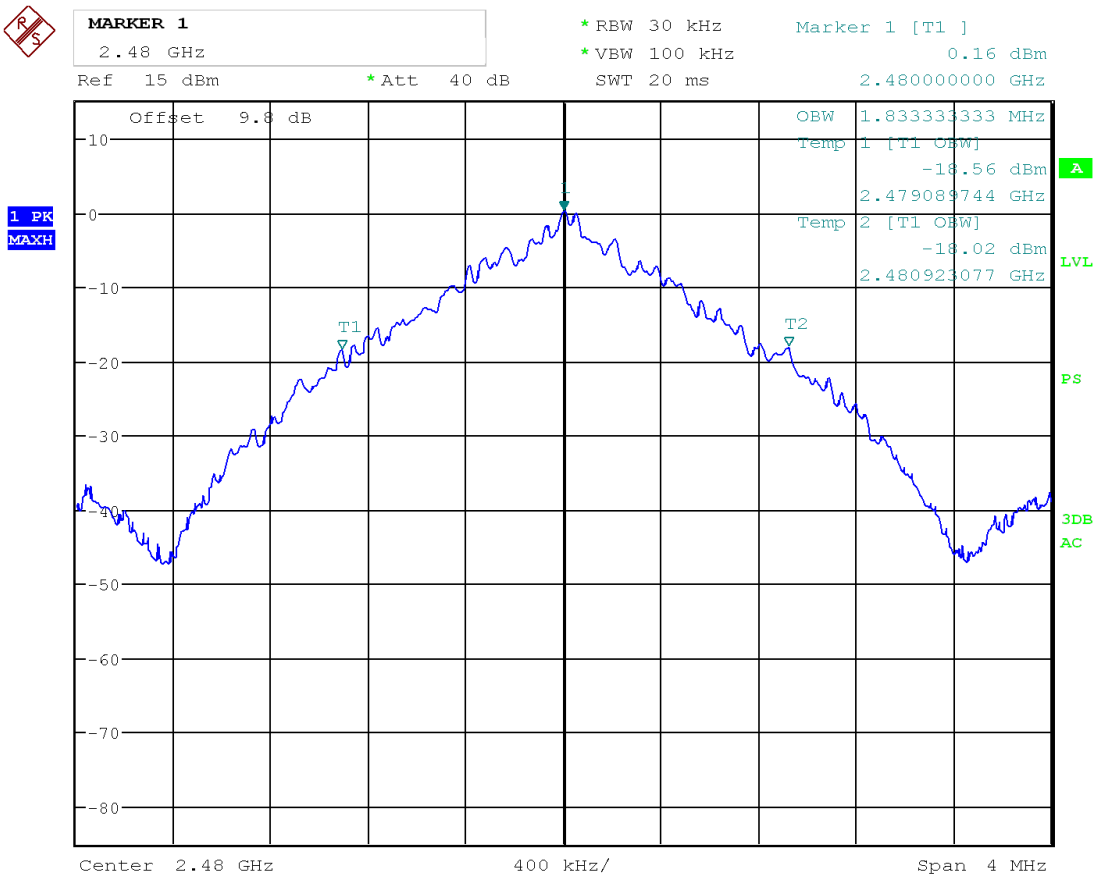

Date: 25.OCT.2020 16:18:07

6dB Down Bandwidth 2440MHz



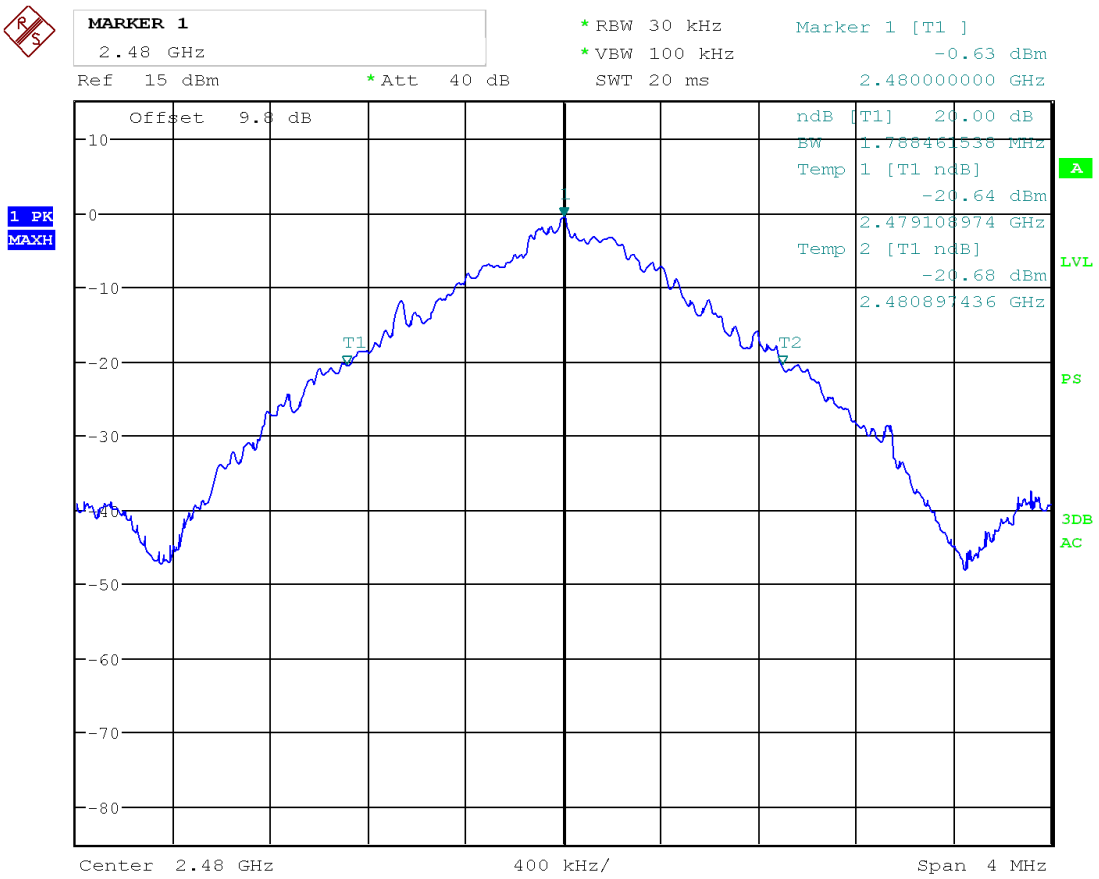

Date: 25.OCT.2020 16:23:38

DTS Bandwidth 2440MHz



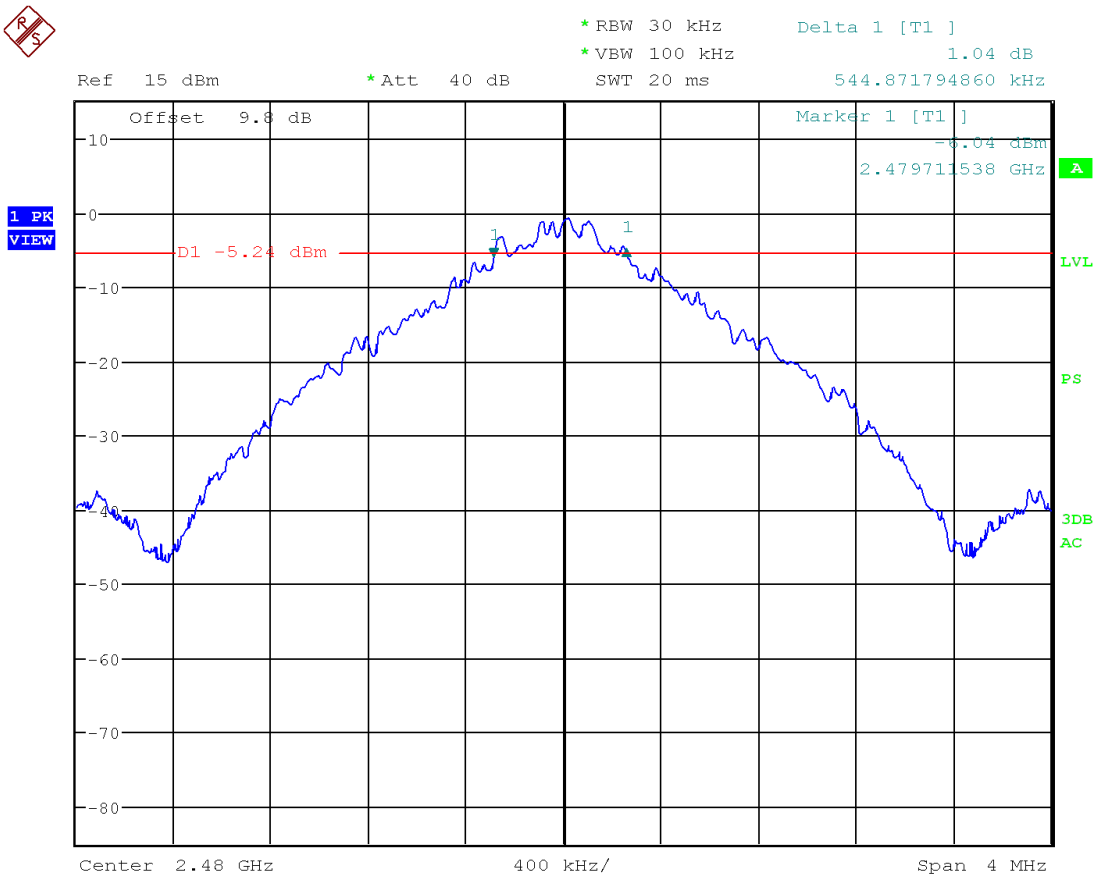

Date: 25.OCT.2020 16:08:35

99% Bandwidth 2480MHz



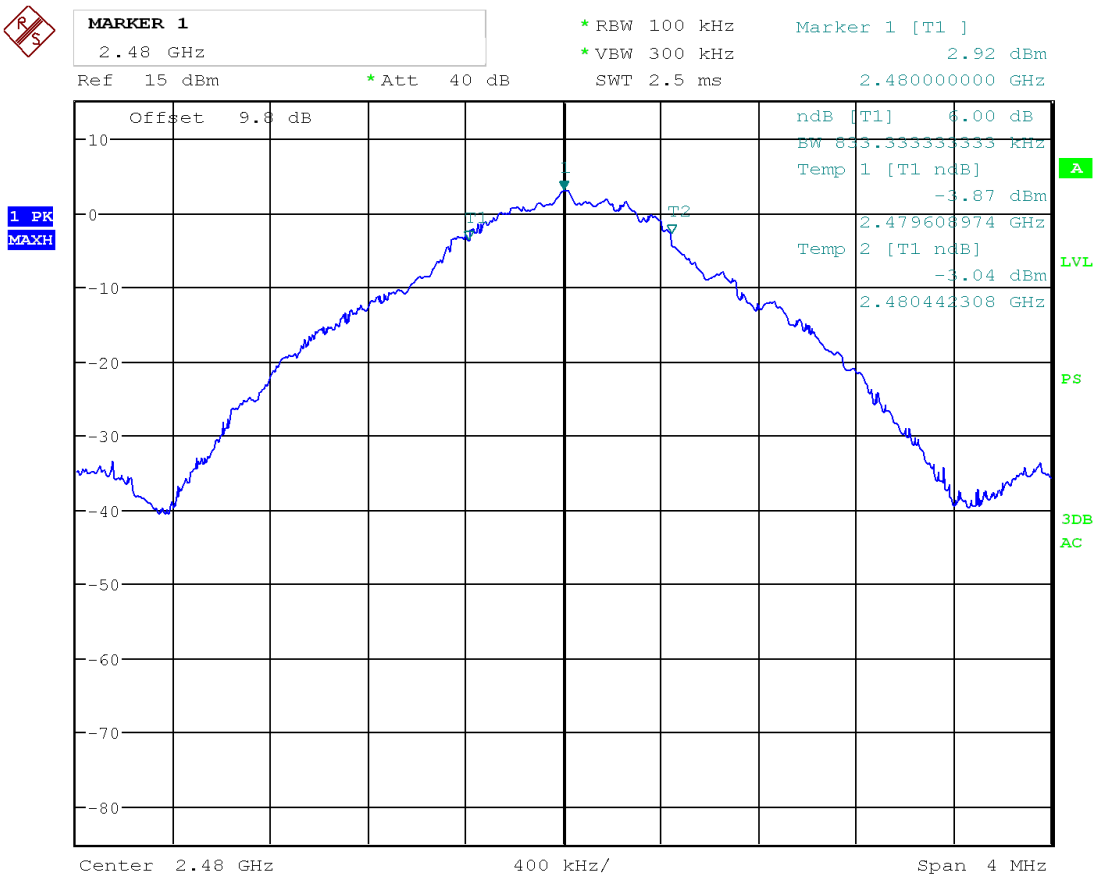

Date: 25.OCT.2020 16:12:29

20dB Down Bandwidth 2480MHz




Date: 25.OCT.2020 16:19:45

6dB Down Bandwidth 2480MHz




Date: 25.OCT.2020 16:24:28

DTS Bandwidth 2480MHz

# 10 Power Spectral Density

## 10.1 Test Limits

**FCC Part 15.247(e):**

> For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission. This power spectral density shall be determined in accordance with the provisions of paragraph (b) of this section. The same method of determining the conducted output power shall be used to determine the power spectral density.

**RSS-247 Issue 2 § 5.2(b):**

> The transmitter power spectral density conducted from the transmitter to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission. This power spectral density shall be determined in accordance with the provisions of section 5.4(d), (i.e. the power spectral density shall be determined using the same method as is used to determine the conducted output power).

## 10.2 Test Method

Tests are performed in accordance with ANSI C63.10:2013 § 11.10.2 Method PKPSD (peak PSD).

## 10.3 Test Equipment Used

| Description | Asset | Manufacturer | Model | Cal Date | Cal Due |
|---|---|---|---|---|---|
| EMI Test Receiver | 3900 | Rohde & Schwarz | ESU40 | 10/5/2020 | 10/5/2021 |
| Coaxial Cable | 6086 | Megaphase | SF26-S1S1-40 | 12/4/2019 | 12/4/2020 |

## 10.4 Test Results

The device was found to be **compliant**. The peak power spectral density was less than 8dBm.

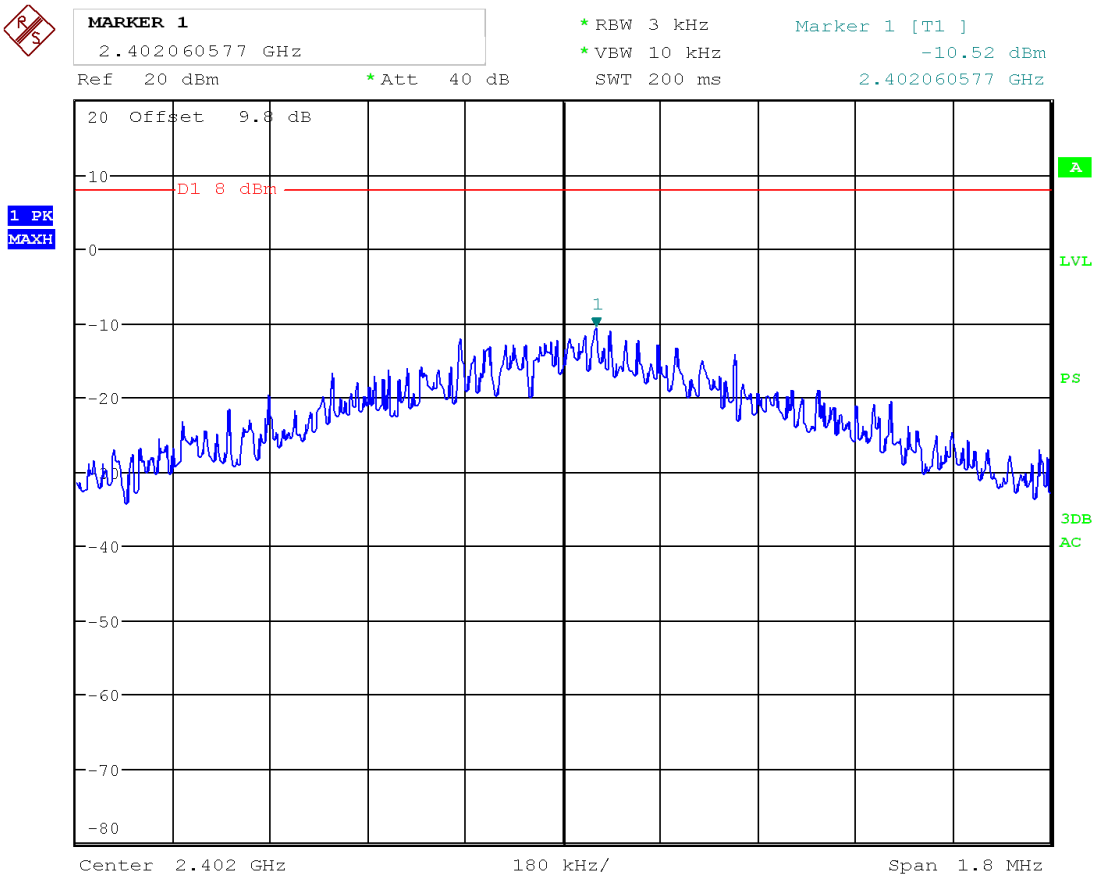
## 10.5 Test Conditions

| | | | |
|---|---|---|---|
| Test Personnel: | Bryan Taylor | Test Date: | 10/25/2020 |
| Supervising/Reviewing Engineer: (Where Applicable) | NA | Limit Applied: | 8dBm / 3kHz |
| Product Standard: | FCC Part 15.247 RSS-247 Issue 2 | Ambient Temperature: | 22.6C |
| Input Voltage: | 3.9VDC | Relative Humidity: | 41.2% |
| Pretest Verification w / Ambient Signals or BB Source: | Yes | Atmospheric Pressure: | 991.2mbar |

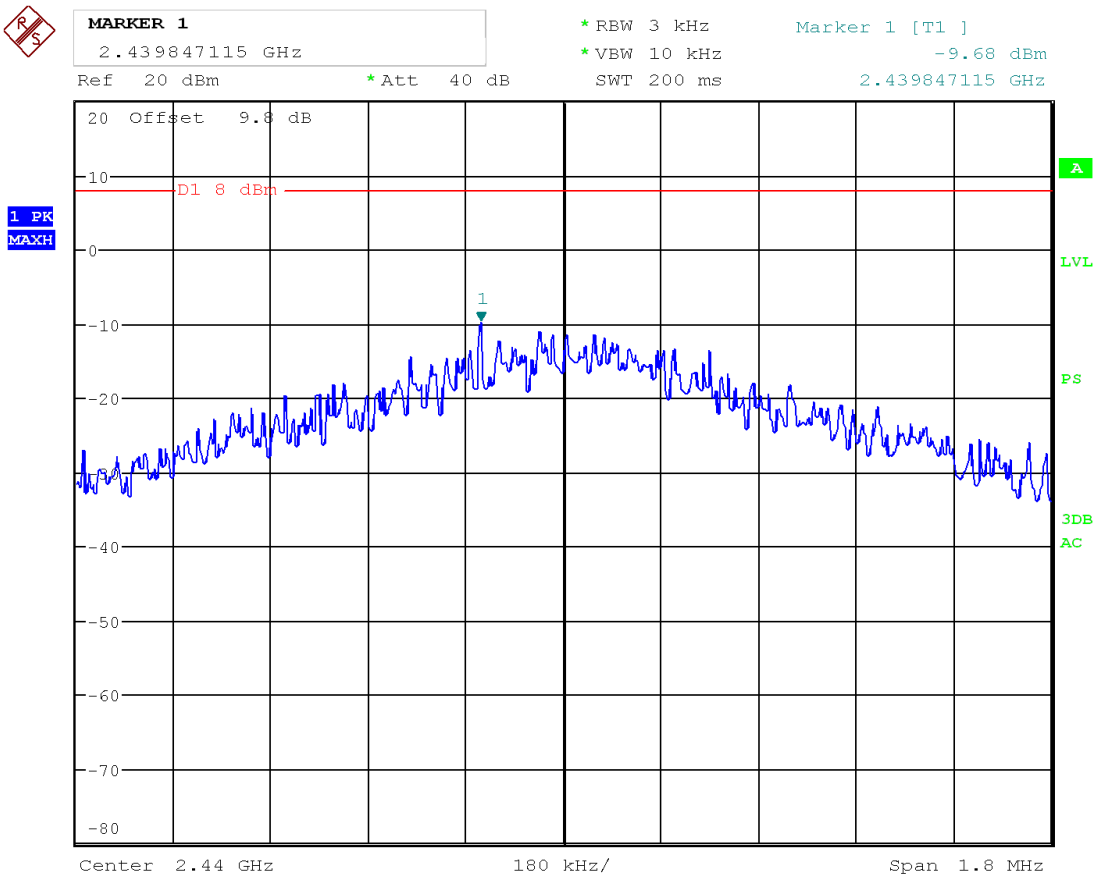
Deviations, Additions, or Exclusions: None.

### 10.6 Test Data

| Channel | Frequency (MHz) | PPSD (dBm/3kHz) | Limit (dBm/3kHz) | Margin (dB) | Result |
|---|---|---|---|---|---|
| 0 | 2402 | -10.52 | 8 | 18.52 | PASS |
| 39 | 2440 | -9.68 | 8 | 17.68 | PASS |
| 79 | 2480 | -10.81 | 8 | 18.81 | PASS |

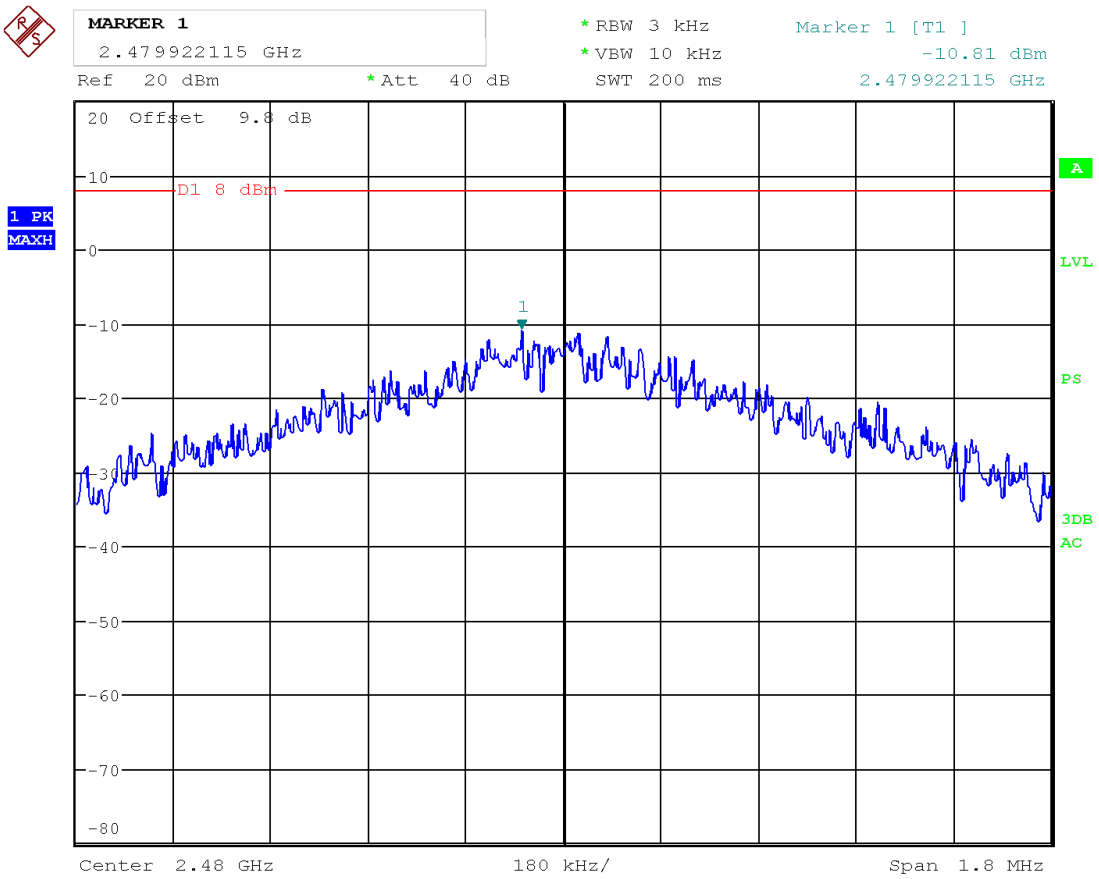



Peak PSD 2402MHz




Date: 25.OCT.2020 16:02:54

Peak PSD 2440MHz




Date: 25.OCT.2020 16:03:41

Peak PSD 2480MHz

# 11 Conducted Spurious Emissions

## 11.1 Test Limits

**FCC Part 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. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, 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) (see §15.205(c)).

**RSS-247 Issue 2 § 5.5:**

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating, the RF power that is produced 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 that the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of root-mean-square averaging over a time interval, as permitted under section 5.4(d), the attenuation required shall be 30 dB instead of 20 dB. Attenuation below the general field strength limits specified in RSS-Gen is not required.

## 11.2 Test Method

Tests are performed in accordance with ANSI C63.10:2013 § 11.11 Emissions in nonrestricted frequency bands.

## 11.3 Test Equipment Used

| Description | Asset | Manufacturer | Model | Cal Date | Cal Due |
|---|---|---|---|---|---|
| EMI Test Receiver | 3900 | Rohde & Schwarz | ESU40 | 10/5/2020 | 10/5/2021 |
| Coaxial Cable | 6086 | Megaphase | SF26-S1S1-40 | 12/4/2019 | 12/4/2020 |

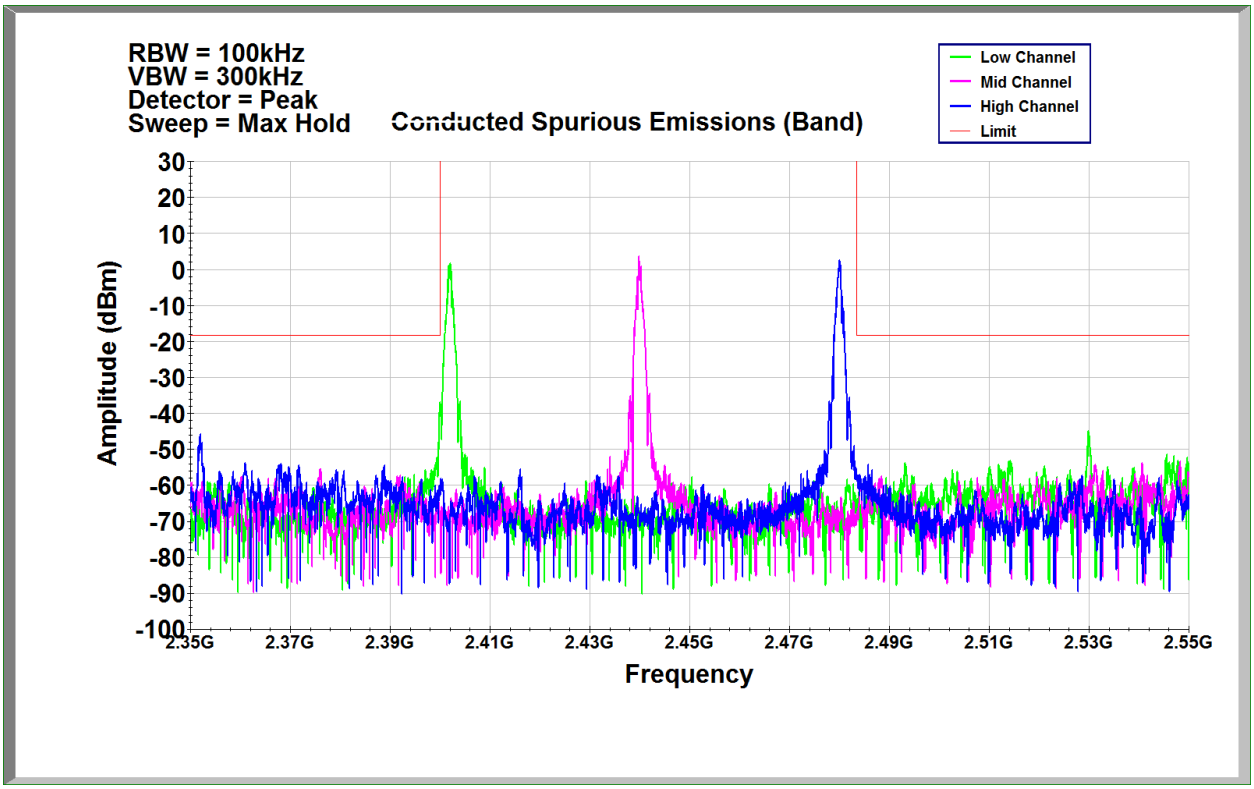
## 11.4 Test Results

The device was found to be **compliant**. All spurious emissions were found to be attenuated more than 20dB below the level of the fundamental.

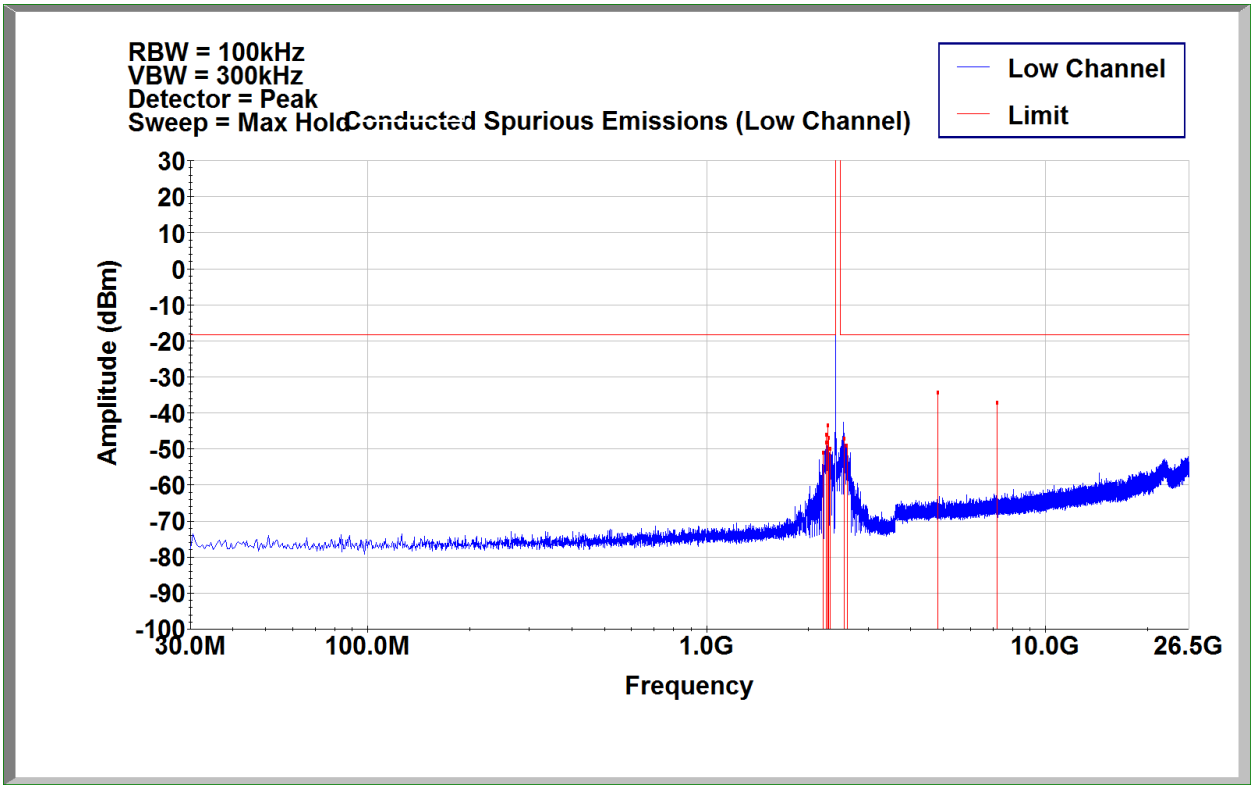
### 11.5 Test Conditions

| | | | |
|---|---|---|---|
| Test Personnel: | Bryan Taylor | Test Date: | 10/25/2020 |
| Supervising/Reviewing Engineer: (Where Applicable) | NA | Limit Applied: | -20dBc |
| Product Standard: | FCC Part 15.247 RSS-247 Issue 2 | Ambient Temperature: | 22.6C |
| Input Voltage: | 3.6VDC | Relative Humidity: | 41.2% |
| Pretest Verification w / Ambient Signals or BB Source: | Yes | Atmospheric Pressure: | 991.2mbar |

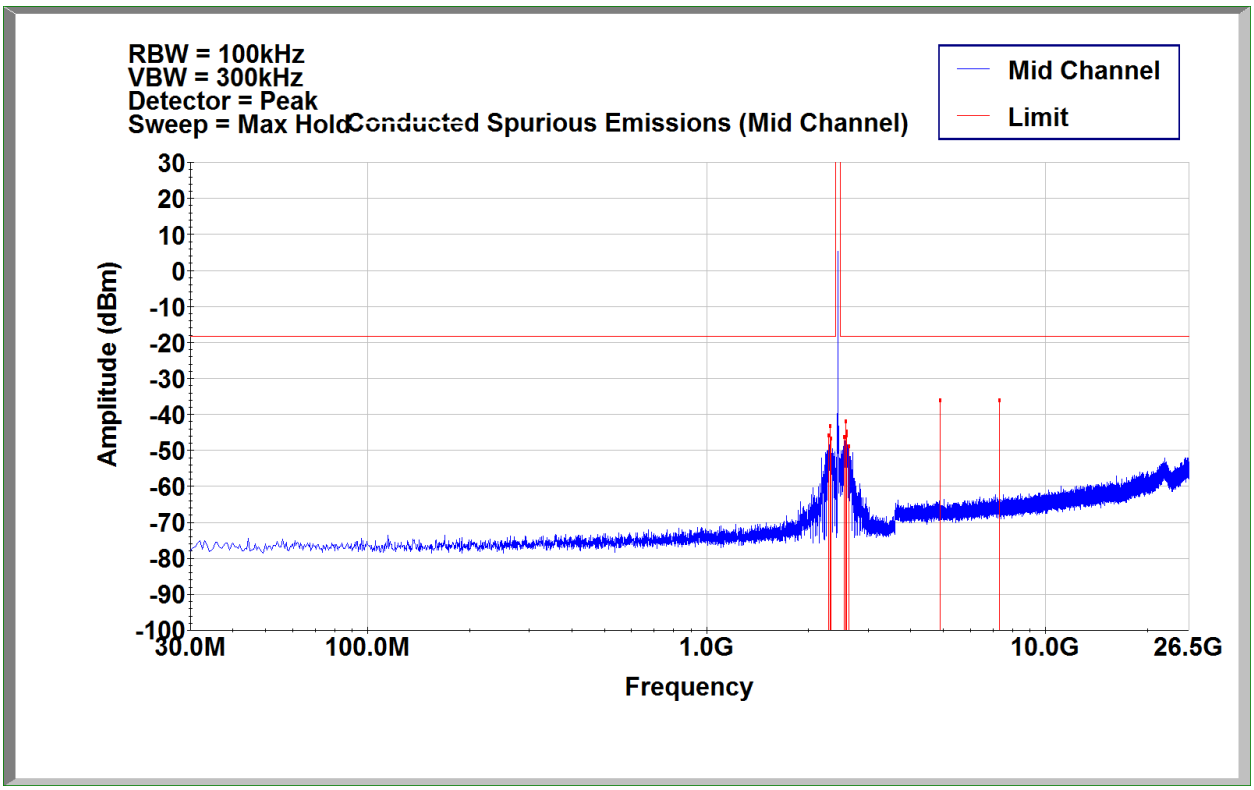
### 11.6 Test Data



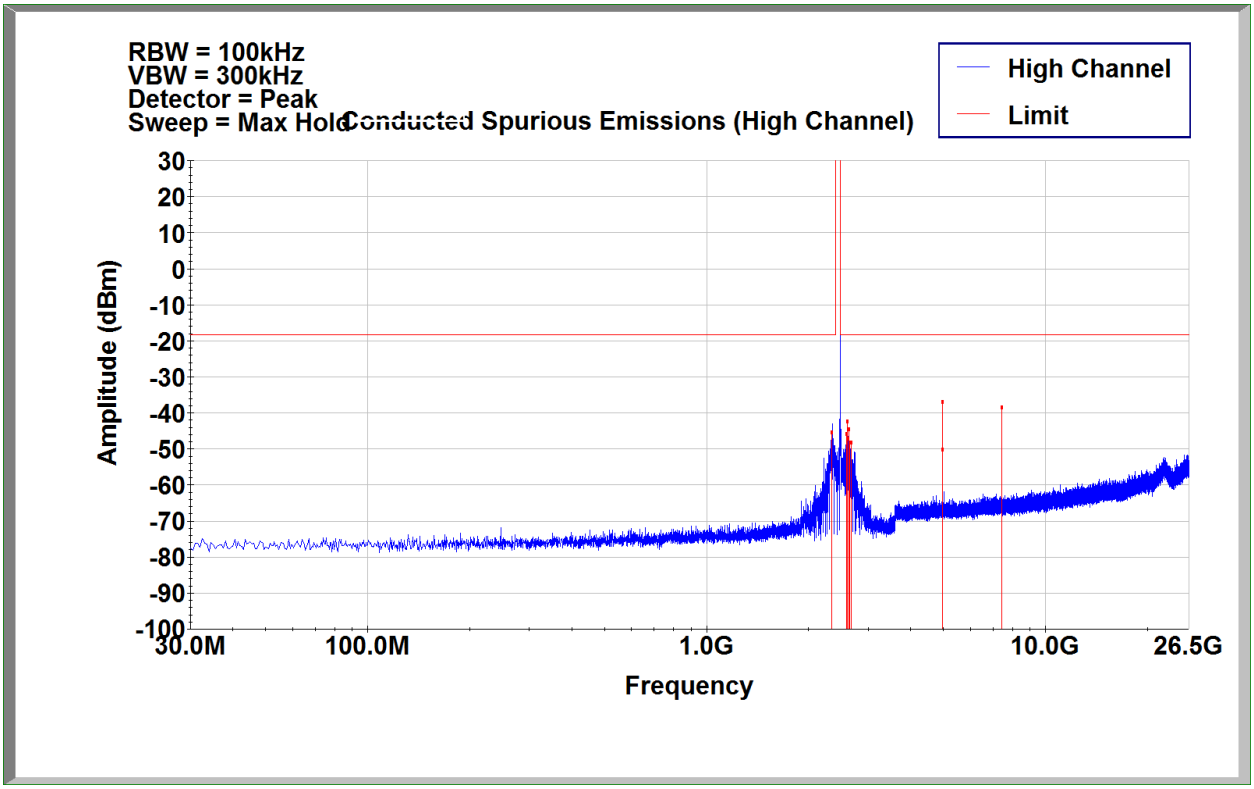

**Conducted Spurious Emissions (Band)**




**2402MHz Conducted Spurious Emissions**




**2440MHz Conducted Spurious Emissions**




**2480MHz Conducted Spurious Emissions**

# 12 Antenna Requirement

## 12.1 Test Limits

**FCC Part 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. 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. This requirement does not apply to carrier current devices or to devices operated under the provisions of §§15.211, 15.213, 15.217, 15.219, 15.221, or §15.236. Further, this requirement does not apply to intentional radiators that must be professionally installed, such as perimeter protection systems and some field disturbance sensors, or to other intentional radiators which, in accordance with §15.31(d), must be measured at the installation site. However, the installer shall be responsible for ensuring that the proper antenna is employed so that the limits in this part are not exceeded.

**RSS-Gen Issue 5 § 6.8:**

The applicant for equipment certification, as per RSP-100, must provide a list of all antenna types that may be used with the licence-exempt transmitter, indicating the maximum permissible antenna gain (in dBi) and the required impedance for each antenna.

Licence-exempt transmitters that have received equipment certification may operate with different types of antennas. However, it is not permissible to exceed the maximum equivalent isotropically radiated power (e.i.r.p.) limits specified in the applicable standard (RSS) for the licence-exempt apparatus.

Testing shall be performed using the highest gain antenna of each combination of licence-exempt transmitter and antenna type, with the transmitter output power set at the maximum level. When a measurement at the antenna connector is used to determine RF output power, the effective gain of the device's antenna shall be stated, based on a measurement or on data from the antenna manufacturer.

User manuals for transmitters equipped with detachable antennas shall also contain the following notice in a conspicuous location:

*This radio transmitter (identify the device by certification number) has been approved by Industry Canada to operate with the antenna types listed below with the maximum permissible gain indicated. Antenna types not included in this list, having a gain greater than the maximum gain indicated for that type, are strictly prohibited for use with this device.*

Immediately following the above notice, the manufacturer shall provide a list of all antenna types approved for use with the transmitter, indicating the maximum permissible antenna gain (in dBi).

## 12.2 Test Results

The device was found to be **compliant**. The device has an internal, permanently affixed antenna.

## 13 Revision History

| Revision Level | Date | Report Number | Prepared By | Reviewed By | Notes |
|---|---|---|---|---|---|
| 0 | 1/12/2020 | 104426030LEX-003 | BCT | BL | Original Issue |
| 1 | 2/14/2021 | 104426030LEX-003.1 | BCT | BL | Included radiated emissions data below 30MHz |
| | | | | | |
| | | | | | |
| | | | | | |