

## TEST REPORT

**Report Number: 104988398MPK-008**

**Project Number: G104988398**

**Issue Date: September 9, 2022**

**Testing performed on the  
SmartValve™  
Model Number: SmartValve SmartValve 10-1800 v1.04**

**FCC ID: QPS01010  
IC: 22326-01010**

**To  
FCC Part 15 Subpart C (15.247)  
ISED RSS-247 Issue 2**


**For  
  
Smart Wires, Inc.**

Test Performed by:  
Intertek  
1365 Adams Court  
Menlo Park, CA 94025 USA

Test Authorized by:  
Smart Wires, Inc.  
1035 Swabia Court, Suite 130  
Durham, NC 27703 USA

Prepared by:   
Kenneth Roque

**Date:** September 9, 2022

Reviewed by:   
Anderson Soungpanya

**Date:** September 9, 2022

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| Report No. 104988398MPK-008 |   |
|-----------------------------|---|
| Equipment Under Test:       | SmartValve™   |
| Trade Name:                 | Smart Wires, Inc.   |
| Model Number(s):            | SmartValve SmartValve 10-1800 v1.04                                   |
| Applicant:                  | Smart Wires, Inc.   |
| Contact:                    | Karamjit Singh  |
| Address:                    | Smart Wires, Inc.<br>1035 Swabia Court, Suite 130<br>Durham, NC 27703 |
| Country:                    | USA   |
| Tel. Number:                | (919) 294-3998  |
| Email:                      | karamjit.singh@smartwires.com   |
| Applicable Regulation:      | FCC Part 15 Subpart C (15.247)<br>ISED RSS-247 Issue 2                |
| Date of Test:               | March 14 – 17, 2022 & April 11 – May 6, 2022                          |

*We attest to the accuracy of this report:*



Kenneth Roque  
EMC Project Engineer



Anderson Soungpanya  
EMC Team Lead

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## 1.0 Introduction

This report is designed to show compliance of the EUT's 2.4GHz transceiver with the requirements of FCC Part 15 Subpart C (15.247) and RSS-247. This test report covers only the FHSS radio.

### 1.1 Summary of Tests

| TEST                                   | Reference<br>FCC          | Reference<br>ISED | RESULTS                                 |
|--|---------------------------|-------------------|---|
| RF Output Power                        | 15.247(b)                 | RSS-247, 5.4.2    | Complies                                |
| 20-dB Bandwidth                        | 15.247(a)(1)              | RSS-247, 5.1.1    | Complies                                |
| Channel Separation                     | 15.247(a)(1)              | RSS-247, 5.1.2    | Complies                                |
| Number of Hopping Channels             | 15.247(a)(1)              | RSS-247, 5.14     | Complies                                |
| Average Channel Occupancy Time         | 15.247(a)(1)              | RSS-247, 5.14     | Complies                                |
| Out-of-Band Antenna Conducted Emission | 15.247(d)                 | RSS-247, 5.5      | Complies                                |
| Transmitter Radiated Emissions         | 15.247(d), 15.209, 15.205 | RSS-GEN           | Complies                                |
| RF Exposure                            | 15.247(i)                 | RSS-102           | Complies                                |
| AC Conducted Emission                  | 15.207                    | RSS-GEN           | Not Applicable <sup>1, 2</sup>          |
| Antenna Requirement                    | 15.203                    | RSS-GEN           | Complies<br>(Professional Installation) |

<sup>1</sup> The EUT does not have AC or DC power ports.

<sup>2</sup> DC Power Supply is not present in actual use and installation of EUT. It is used to simulate EUT connected to powerline, therefore it is not tested. The device harvests power from the line using internal Power Harvesting Transformers that generate this 400V output during operation of the device.

## 2.0 General Description

### 2.1 Product Description

Smart Wires, Inc. supplied the following description of the EUT:

The SmartValve™ builds upon the success of its predecessors. By using revolutionary power electronics, the SmartValve effectively increases or decreases the reactance of a given circuit, enabling real-time control of power flow. A modular, Static Synchronous Series Compensator (SSSC), the SmartValve injects a leading or lagging voltage in quadrature with the line current, providing the functionality of a series capacitor or series reactor respectively. However, unlike conventional series capacitors or reactors, the SmartValve can inject the voltage independently of the line current, thus increasing the ohmic injection when operated below the rated value. Also, the SmartValve does not have the negative characteristics of these passive devices, such as the risk of sub-synchronous resonance (SSR) with series capacitors and the constant VAR consumption of series reactors. As a modular device that can be deployed and re-deployed, the solution size of an installation can be scaled up or down to support the dynamic needs of the transmission grid. Given the fast response of the unit's power electronics, the unit can provide dynamic services and its set-point can be changed frequently to actively manage power flows with no degradation in unit life.

For more information, see user's manual provided by the manufacturer.

Information about the 2.4 GHz radio is presented below:

|                                     |  |
|-------------------------------------|--|
| <b>Applicant</b>                    | Smart Wires, Inc.  |
| <b>Model No.</b>                    | SmartValve SmartValve 10-1800 v1.04  |
| <b>FCC Identifier</b>               | QPS01010   |
| <b>IC Identifier</b>                | 22326-01010  |
| <b>Type of Transmission</b>         | Frequency Hopping Spread Spectrum  |
| <b>Rated RF Output</b>              | 11.56 dBm or 14.321 mW   |
| <b>Antenna(s) &amp; Gain</b>        | Internal Antenna, Gain: 5.0 dBi  |
| <b>Frequency Range</b>              | 2436.000000 – 2463.921747 MHz  |
| <b>Number of Channel(s)</b>         | 24   |
| <b>Modulation Type</b>              | 2-FSK  |
| <b>Applicant Name &amp; Address</b> | Smart Wires, Inc.<br>1035 Swabia Court, Suite 130<br>Durham, NC 27703<br>USA |

**EUT receive date:** March 14, 2022, April 11, 2022

**EUT receive condition:** The pre-production version of the EUT was received in good condition with no apparent damage. As declared by the Applicant, it is identical to the production units.

**Test start date:** March 14, 2022, April 11, 2022

**Test completion date:** March 17, 2022, May 6, 2022

The test results in this report pertain only to the item tested.

## 2.2 Related Submittal(s) Grants

None.

## 2.3 Test Methodology

Antenna conducted measurements were performed according to the FCC documents "Guidance for Performing Compliance Measurement on Digital Transmission Systems, Frequency Hopping Spread Spectrum System, and Hybrid System devices Operating under §15.247" (KDB 558074 D01 15.247 Meas Guidance v05r02), RSS-247 Issue 2, ANSI C63.10: 2013 and RSS-GEN Issue 5.

Radiated emissions and AC mains conducted emissions measurements were performed according to the procedures in ANSI C63.10: 2013 & ANSI C63.4-2014. Radiated tests were performed at an antenna to EUT distance of 3 meters, unless stated otherwise in the "Data Sheet" of this report.

All other measurements were made in accordance with the procedures in part 2 of CFR 47.

Following is the channel test plan:

| Channels in 2.4 GHz band |      |                           |        |
|--------------------------|------|---------------------------|--------|
| Test Channel             |      | Frequency, MHz            | Tested |
| Low                      | 0    | 2436.000000               | √      |
| Middle                   | 12   | 2450.567868               | √      |
| High                     | 23   | 2463.921747               | √      |
| Hopping Mode             | 0-23 | 2436.000000 - 2463.921747 | √      |

## 2.4 Test Facility

The test site used to collect antenna port testing is located at 1365 Adams Court, Menlo Park, California, 94025. This test facility and site measurement data have been fully placed on file with the FCC, IC and A2LA accredited.

The test site for radiated emission measurements was tested in-situ: Smart Wires, Inc. 3292 Whipple Rd Union City, CA 9458

### 3.0 System Test Configuration

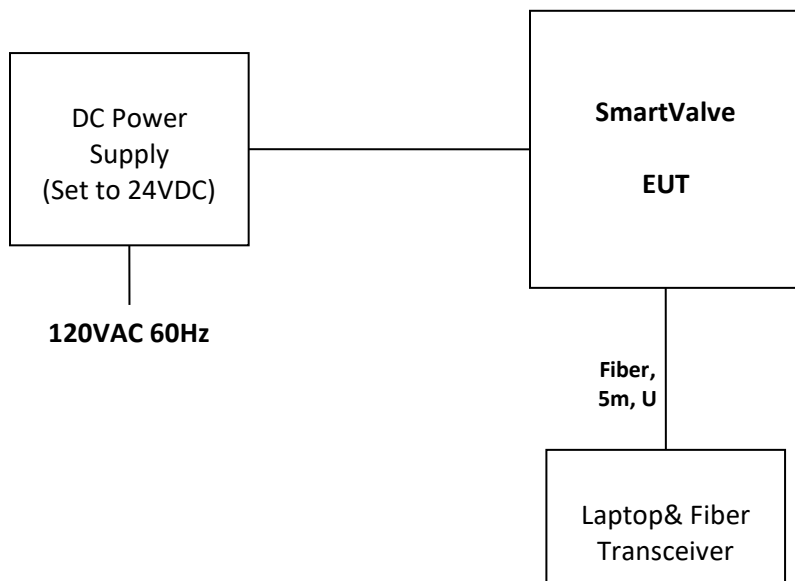
#### 3.1 Support Equipment

| Description       | Manufacturer | Model Number     |
|-------------------|--------------|------------------|
| Laptop            | Dell         | P137G            |
| DC Power Supply   | Agilent      | E3620A           |
| Fiber Transceiver | EZWELL       | 10/100/1000M SFP |

#### 3.2 Block Diagram of Test Setup

| Equipment Under Test |                   |                                     |               |
|----------------------|-------------------|-------------------------------------|---------------|
| Description          | Manufacturer      | Model Number                        | Serial Number |
| Communication Device | Smart Wires, Inc. | SmartValve SmartValve 10-1800 v1.04 | EMCProto1     |

Antenna was removed and co-axial connector with a cable was installed for Conducted Measurements.



|                       |                             |
|-----------------------|-----------------------------|
| <b>S</b> = Shielded   | <b>F</b> = With Ferrite     |
| <b>U</b> = Unshielded | <b>m</b> = Length in Meters |

### 3.3 Justification

The SmartValve' size and weight were excessive (>16,000 pounds) to safely lift onto an 80cm or 1.5m table for testing or to move into a semi-anechoic chamber. Due to the practical considerations dictated by the size and installation, requirements of the Equipment Under Test (EUT), testing was performed *in situ* at the applicant's location. Arrangements were made to perform *in situ* testing at the client's premise with the approval from FCC.

For radiated emission measurements the EUT is attached to peripherals and they are connected and operational (as typical as possible). The EUT is wired to transmit full power. During testing, all cables are manipulated to produce worst-case emissions.

### 3.4 Mode of Operation During Test

During transmitter testing, the transmitter was setup to transmit continuously at maximum RF power on the low channel, middle channel, high channel and with hopping channels enabled.

The Maximum power allowed by the manufacturer's provided GUI is RF Power = 11

Radiated Spurious testing on 2.4GHz Radio was performed with simultaneous transmission of 900MHz Radio.

### 3.5 Modifications Required for Compliance

Intertek installed no modifications during compliance testing in order to bring the product into compliance.

### 3.6 Additions, Deviations and Exclusions from Standards

No additions, deviations or exclusions from the standard were made.



#### 4.0 Emissions Measurement Results

##### 4.1 20dB Bandwidth, and 99% Occupied Bandwidth FCC Rule 15.247(a)(1)

###### 4.1.1 Procedure

The Procedure described in the FCC Publication 558074 D01 Meas Guidance v05r02 & Section 7.8.7 of ANSI C63.10:2013 for Frequency Hopping Spread Spectrum Systems was used to determine the 20dB bandwidth.

- Span = Approximately 2 to 3 times the 20 dB bandwidth, centered on a hopping channel
- RBW = 1% of the 20 dB bandwidth
- VBW = 3 x RBW
- Sweep = Auto
- Detector function = Peak
- Trace = Max hold

The EUT should be transmitting at its maximum data rate. Allow the trace to stabilize. Use the marker-to-peak function to set the marker to the peak of the emission. Use the marker delta function to measure 20 dB down one side of the emission. Reset the marker-delta function, and move the marker to the other side of the emission, until it is (as close as possible to) even with the reference marker level. The marker-delta reading at this point is the 20 dB bandwidth of the emission. If this value varies with different modes of operation (e.g., data rate, modulation format, etc.), repeat this test for each variation. The limit is specified in one of the subparagraphs of this Section. Submit this plot(s).

For 99% power bandwidth measurement, the bandwidth was determined by using the built-in 99% occupied bandwidth function of the spectrum analyzer.

The antenna port of the EUT was connected to the input of a spectrum analyzer (SA). For each RF output channel investigated, the spectrum analyzer center frequency was set to the channel carrier. A Peak output reading was taken, a Display line was drawn for 20dB lower than Peak level. The 20dB bandwidth was determined from where the channel output spectrum intersected the display line.

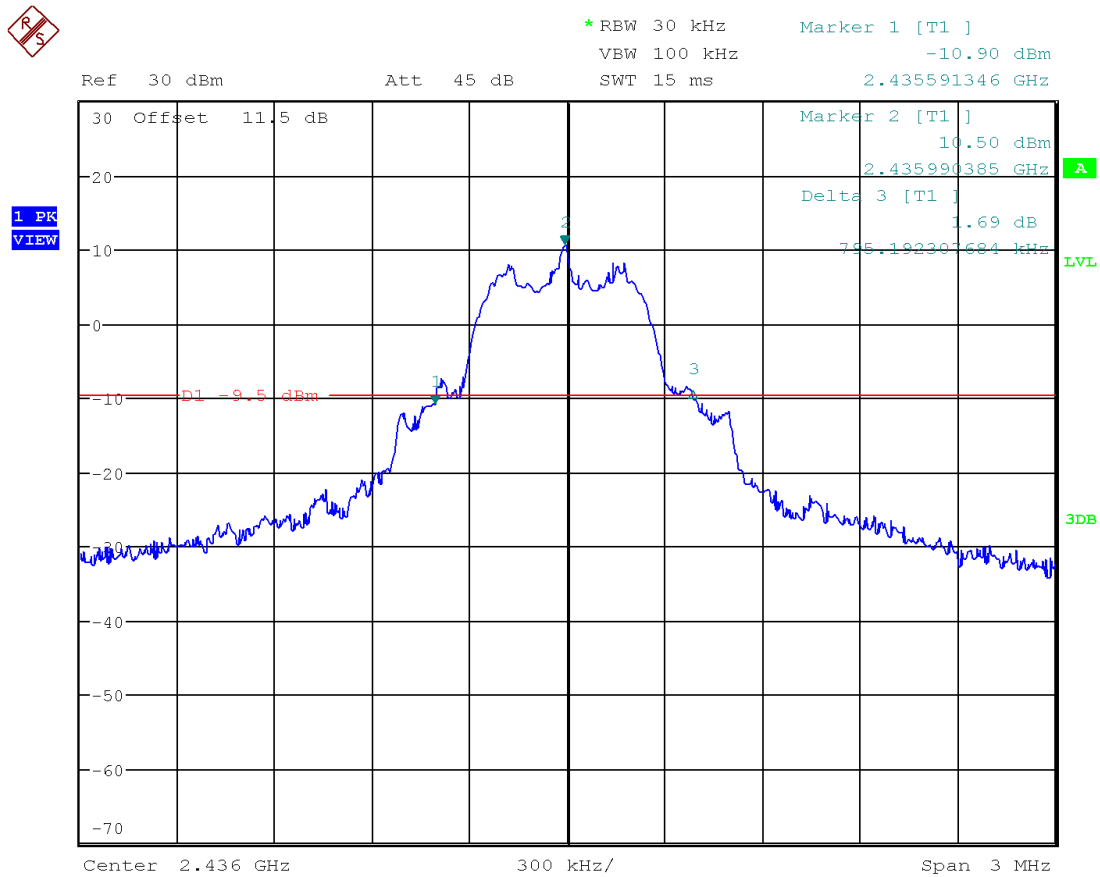
| Tested By     | Test Date      |
|---------------|----------------|
| Kenneth Roque | April 21, 2022 |

#### 4.1.2 Test Result

| Frequency<br>MHz | 20 dB FCC Bandwidth,<br>kHz | 99% Bandwidth,<br>kHz | Plot # |
|------------------|-----------------------------|-----------------------|--------|
| 2436.000000      | 795.192                     | -                     | 1.1    |
|                  | -                           | 778.846               | 1.2    |
| 2450.567868      | 817.308                     |                       | 1.3    |
|                  | -                           | 817.308               | 1.4    |
| 2463.921747      | 782.692                     |                       | 1.5    |
|                  | -                           | 788.462               | 1.6    |

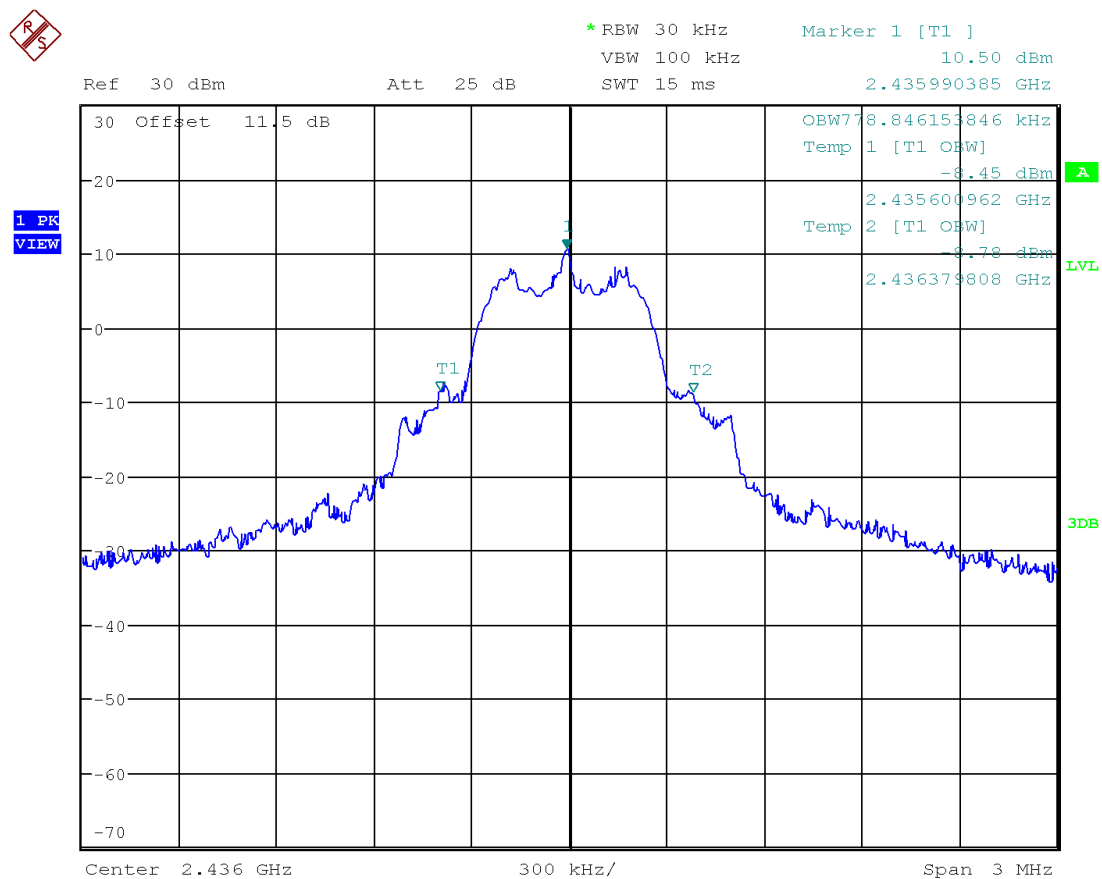
|                |          |
|----------------|----------|
| <b>Results</b> | Complies |
|----------------|----------|

Plot 1. 1 – 20dB Bandwidth Low Channel



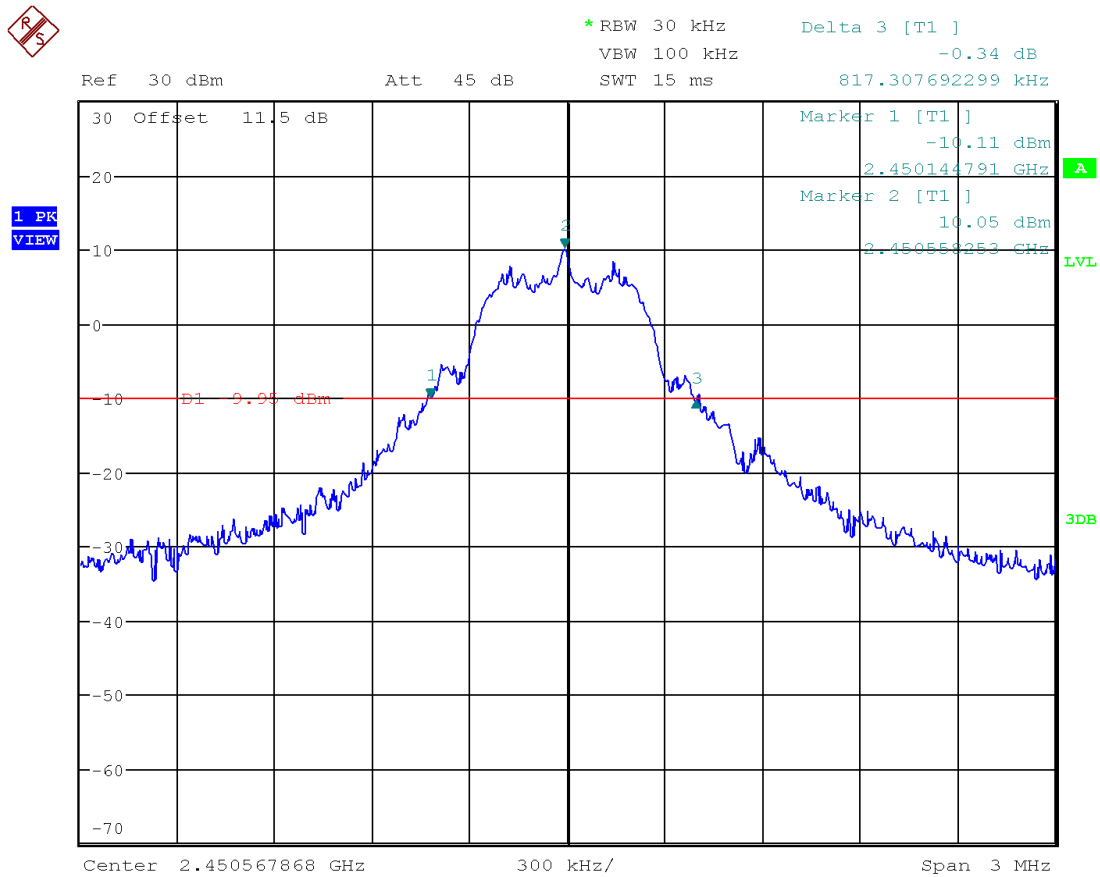
Date: 21.APR.2022 14:26:46

Plot 1. 2–99% Bandwidth Low Channel



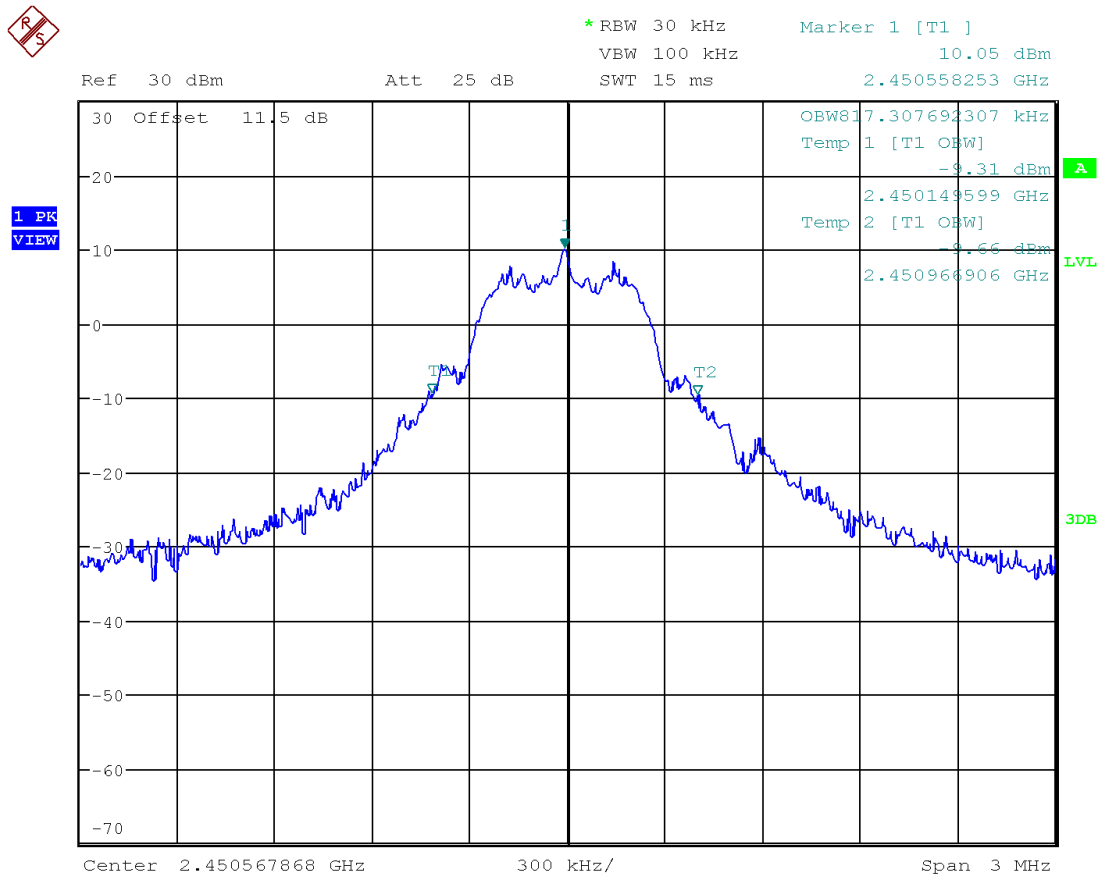
Date: 21.APR.2022 14:28:02

*Plot 1. 3 – 20dB Bandwidth Middle Channel*



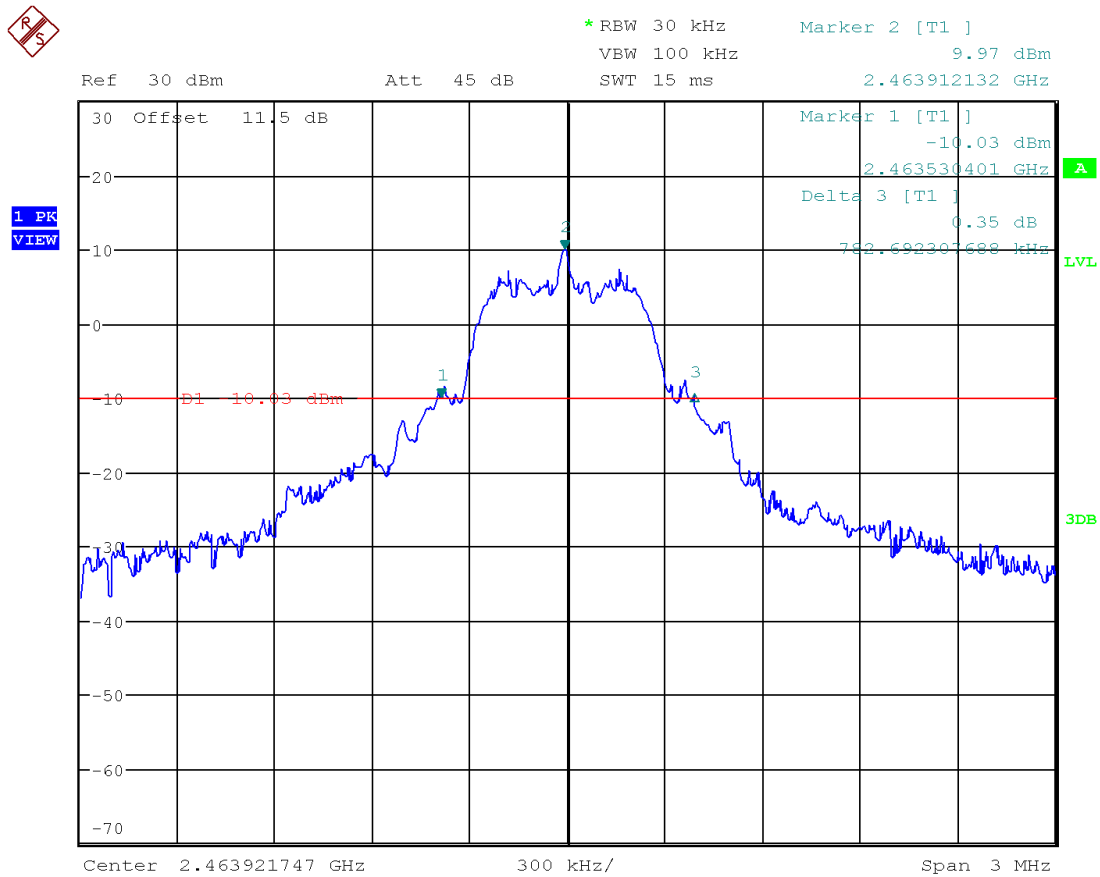
Date: 21.APR.2022 14:31:14

Plot 1. 4 -99% Bandwidth Middle Channel



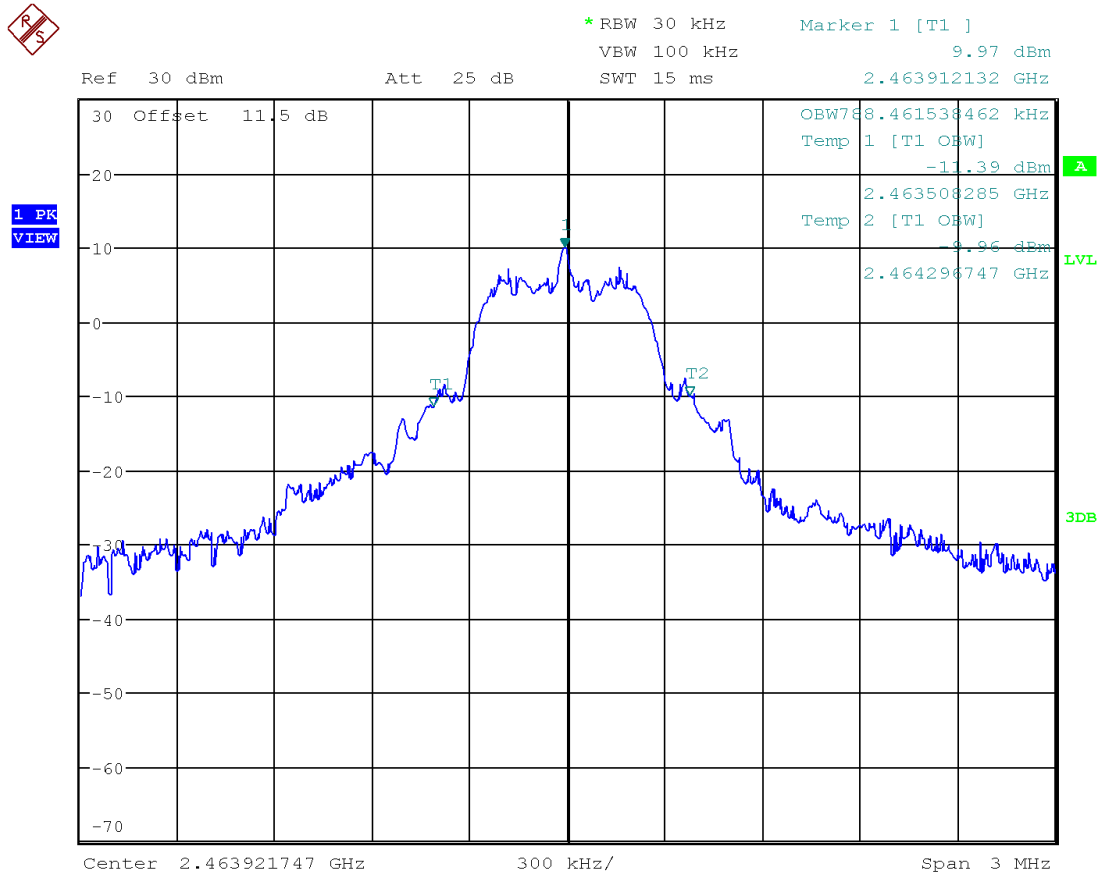
Date: 21.APR.2022 14:31:55

Plot 1. 5 – 20dB Bandwidth High Channel



Date: 21.APR.2022 14:34:50

Plot 1. 6-99% Bandwidth High Channel



Date: 21.APR.2022 14:35:21



#### 4.2 Conducted Output Power at Antenna Terminals FCC Rule 15.247(b)(1)

##### 4.2.1 Requirement

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.

##### 4.2.2 Procedure

The procedure described in FCC Publication 558074 D01 Meas Guidance v05r02 was used. Specifically, Section 7.8.5 of ANSI C63.10:2013 for Frequency Hopping Spread Spectrum Systems was used to determine the RF Output Power.

- Span = approximately 5 times the 20 dB bandwidth, centered on a hopping channel
- RBW > the 20 dB bandwidth of the emission being measured
- VBW = 3 x RBW
- Sweep = auto
- Detector function = peak
- Trace = max hold

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 (see the NOTE above regarding external attenuation and cable loss). The limit is specified in one of the subparagraphs of this Section. Submit this plot.

The antenna port of the EUT was connected to the input of a spectrum analyzer. Power was read directly from the spectrum analyzer and cable loss correction was added to the reading to obtain the power at the antenna terminals.

| Tested By     | Test Date      |
|---------------|----------------|
| Kenneth Roque | April 19, 2022 |

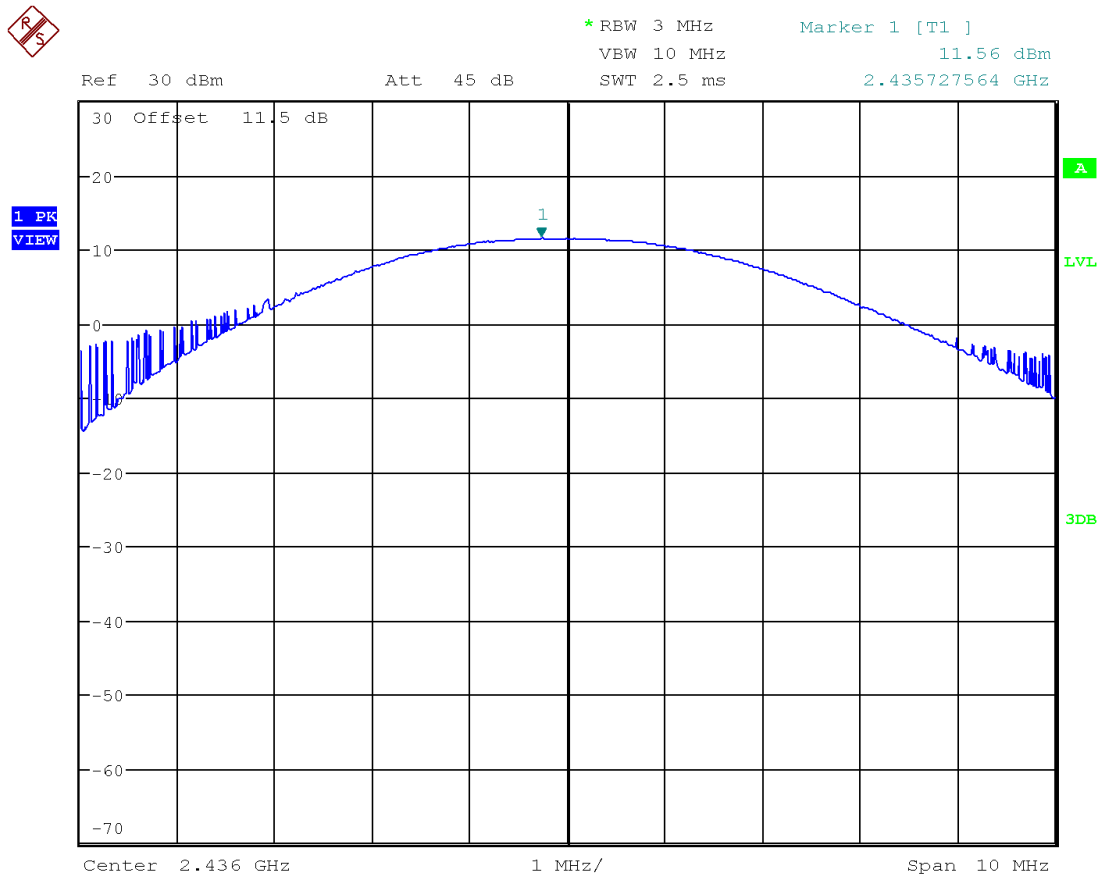
#### 4.2.3 Test Result

Refer to the following plots for the test result:

| Frequency<br>MHz | Conducted Peak Power<br>dBm | Conducted Peak Power<br>mW | Plot<br># |
|------------------|-----------------------------|----------------------------|-----------|
| 2436.000000      | 11.56                       | 14.322                     | 2.1       |
| 2450.567868      | 11.38                       | 13.740                     | 2.2       |
| 2463.921747      | 11.14                       | 13.002                     | 2.3       |

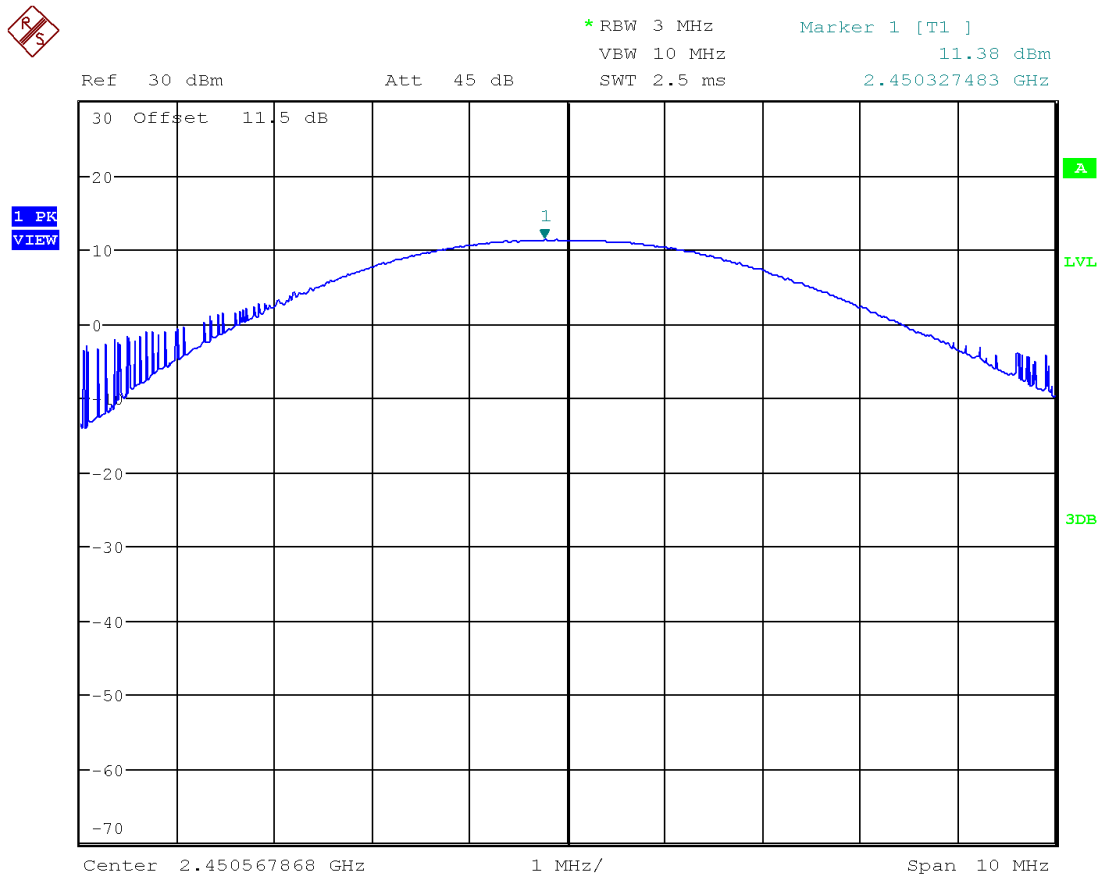
|                |                            |
|----------------|----------------------------|
| <b>Results</b> | 64 Channels used; Complies |
|----------------|----------------------------|

*Plot 2. 2 – Output Power Low Channel*



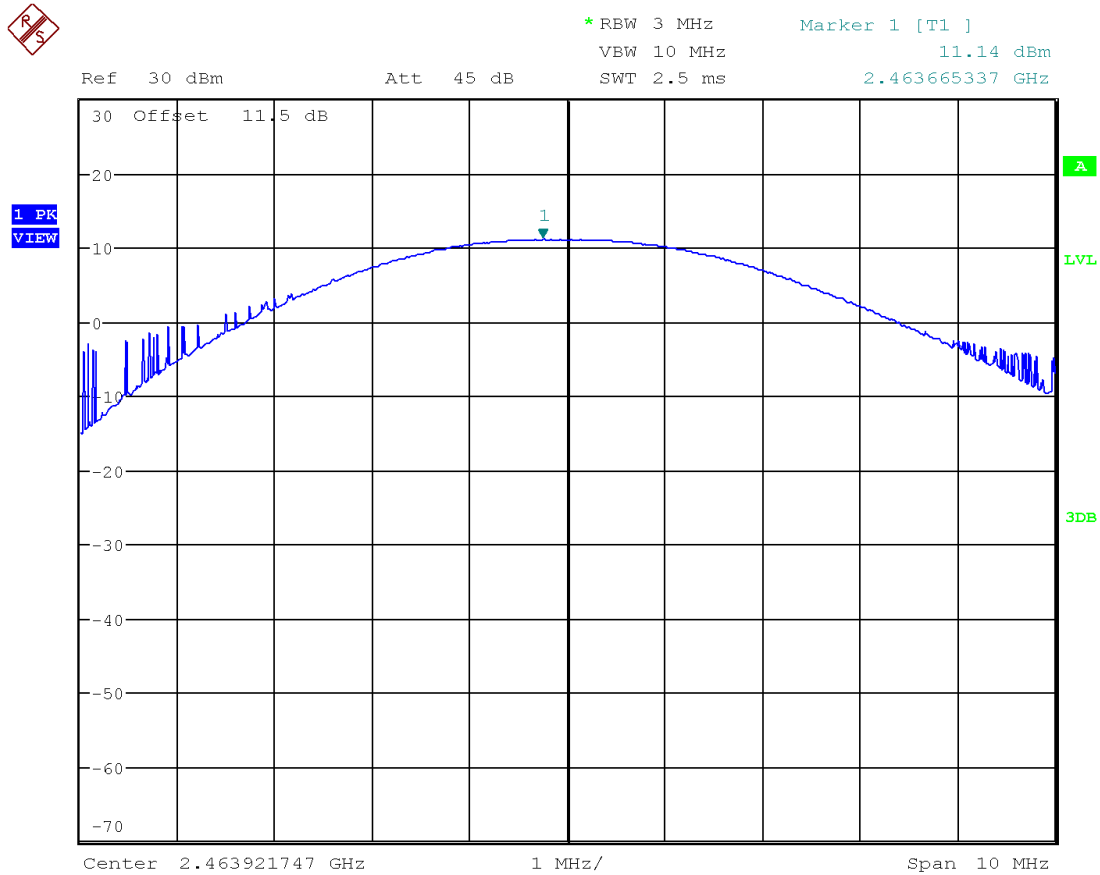
Date: 19.APR.2022 19:06:10

*Plot 2. 2 – Output Power Middle Channel*



Date: 19.APR.2022 19:08:46

*Plot 2. 3 – Output Power High Channel*



Date: 19.APR.2022 19:09:59

#### 4.3 Carrier Frequency Separation FCC 15.247 (a)(1)

##### 4.3.1 Requirement

Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater. Alternatively, 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.

##### 4.3.2 Procedure

The procedure described in FCC Publication 558074 D01 Meas Guidance v05r02 was used. Specifically, Section 7.8.2 of ANSI C63.10:2013 for Frequency Hopping Spread Spectrum Systems was used to determine the Carrier Frequency Separation.

- The EUT must have its hopping function enabled
- Span = wide enough to capture the peaks of two adjacent channels
- Resolution (or IF) Bandwidth (RBW) = 1% of the span
- Video (or Average) Bandwidth (VBW) = 3 x RBW
- Sweep = auto
- Detector function = peak
- Trace = max hold

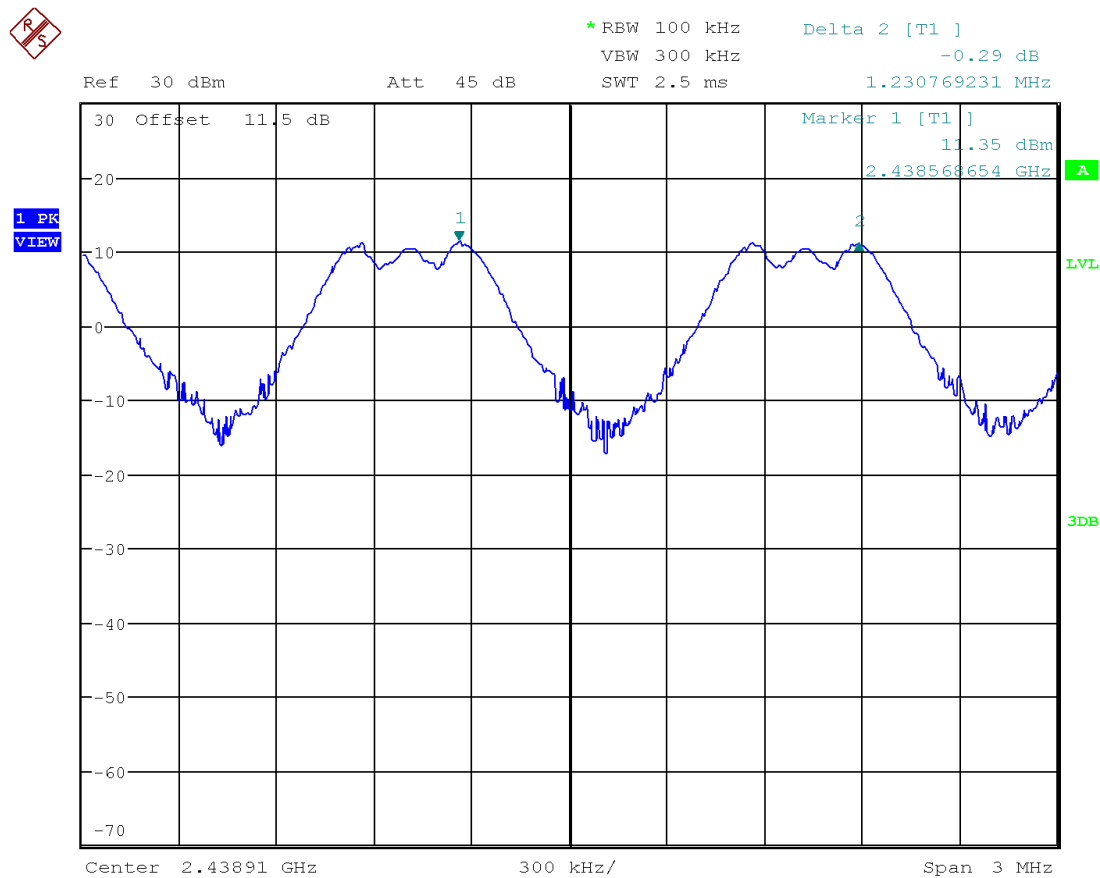
Allow the trace to stabilize. Use the marker-delta function to determine the separation between the peaks of the adjacent channels.

| Tested By     | Test Date      |
|---------------|----------------|
| Kenneth Roque | April 21, 2022 |

### 4.3.3 Test Result

The worst case 20dB Bandwidth is 817.308 kHz, therefore the minimum Carrier Frequency Separation shall be greater than two thirds of 817.308 kHz (544.872 kHz). The measured channel separation is 1.231 MHz. Carrier Frequency Separation meets the minimum requirement. Please refer to spectrum analyzer Plot 3.1 below for the test result.

*Plot 3.1– Channel Separation*



Date: 21.APR.2022 15:06:48

**Results**

**Complies**

4.4 Number of Channels  
FCC 15.247 (a)(1)(iii)

4.4.1 Requirement

For frequency hopping systems operating in the 902-928 MHz band: if the 20 dB bandwidth of the hopping channel is less than 250 kHz, the system shall use at least 50 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 20 second period; if the 20 dB bandwidth of the hopping channel is 250 kHz or greater, the system shall use at least 25 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 10 second period. The maximum allowed 20 dB bandwidth of the hopping channel is 500 kHz.

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. Frequency hopping systems may avoid or suppress transmissions on a particular hopping frequency provided that a minimum of 15 channels are used.

4.4.2 Procedure

The procedure described in FCC Publication 558074 D01 Meas Guidance v05r02 was used. Specifically, Section 7.8.3 of ANSI C63.10:2013 for Frequency Hopping Spread Spectrum Systems was used to determine the Number of Channels.

- The EUT must have its hopping function enabled.
- Span = the frequency band of operation
- RBW = 1% of the span
- VBW = 3 x RBW
- Sweep = auto
- Detector function = peak
- Trace = max hold

Allow the trace to stabilize. It may prove necessary to break the span up to sections, in order to clearly show all of the hopping frequencies.

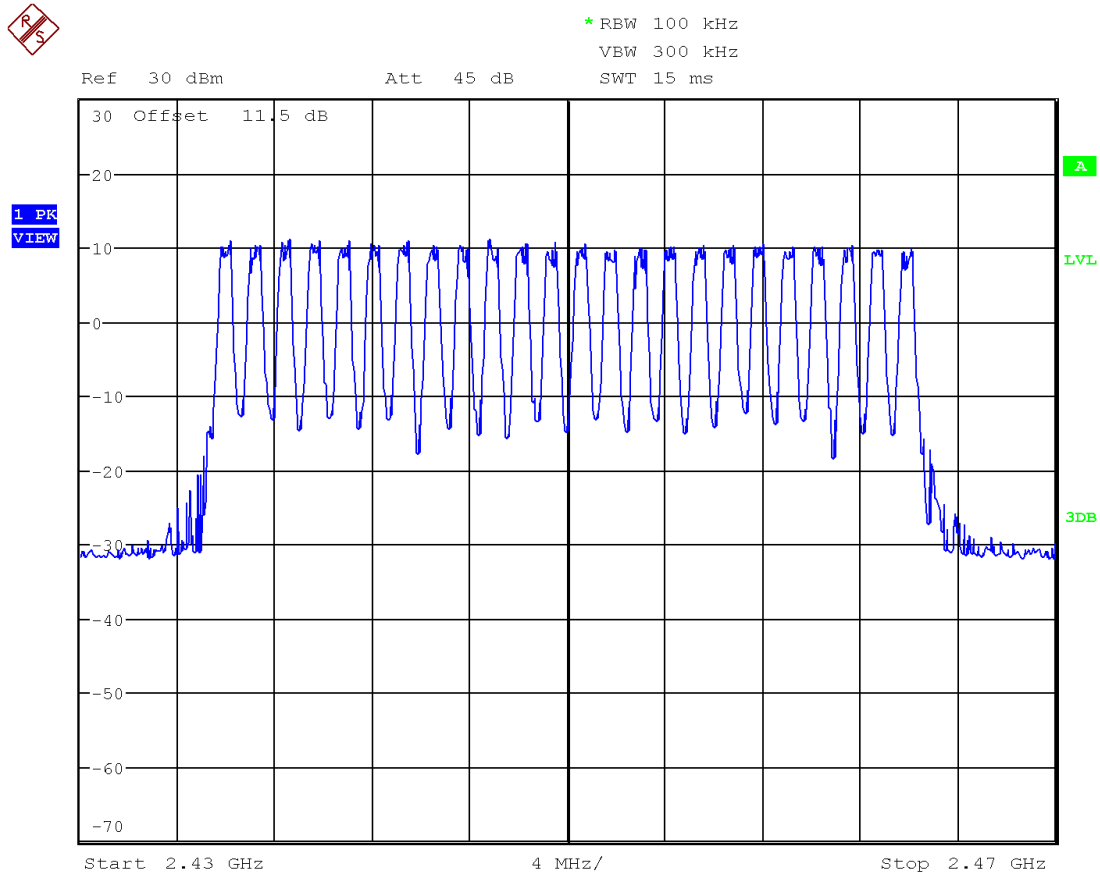
With the analyzer set to MAX HOLD, readings were taken once channels were filled in. The channel peaks were recorded and compared to the minimum number of channels required in the regulation.

| Tested By     | Test Date      |
|---------------|----------------|
| Kenneth Roque | April 21, 2022 |



#### 4.4.3 Test Result

*Plot 4.1 - Number of hopping channels, 2435 – 2449 MHz*



Date: 21.APR.2022 15:15:02

**Results**

**Complies, 24 Channels**

#### 4.5 Average Channel Occupancy Time FCC 15.247(a)(1)

##### 4.5.1 Requirement

For frequency hopping systems operating in the 902-928 MHz band: if the 20 dB bandwidth of the hopping channel is less than 250 kHz, the system shall use at least 50 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 20 second period; if the 20 dB bandwidth of the hopping channel is 250 kHz or greater, the system shall use at least 25 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 10 second period. The maximum allowed 20 dB bandwidth of the hopping channel is 500 kHz.

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. Frequency hopping systems may avoid or suppress transmissions on a particular hopping frequency provided that a minimum of 15 channels are used.

##### 4.5.2 Procedure

The procedure described in FCC Publication 558074 D01 Meas Guidance v05r02 was used. Specifically, Section 7.8.4 of ANSI C63.10:2013 for Frequency Hopping Spread Spectrum Systems was used to determine the Average Channel Occupancy Time.

- The EUT must have its hopping function enabled.
- Span = zero span, centered on a hopping channel
- RBW = 1 MHz
- VBW = 3 x RBW
- Sweep = as necessary to capture the entire dwell time per hopping channel
- Detector function = peak
- Trace = max hold

If possible, use the marker-delta function to determine the dwell time. If this value varies with different modes of operation (e.g., data rate, modulation format, etc.), repeat this test for each variation. The limit is specified in one of the subparagraphs of this Section. An oscilloscope may be used instead of a spectrum analyzer.

The spectrum analyzer center frequency was set to one of the known hopping channels, the SPAN was set to ZERO SPANS, and the TRIGGER was set to VIDEO. The time duration of the transmission so captured was measured with the MARKER DELTA function.

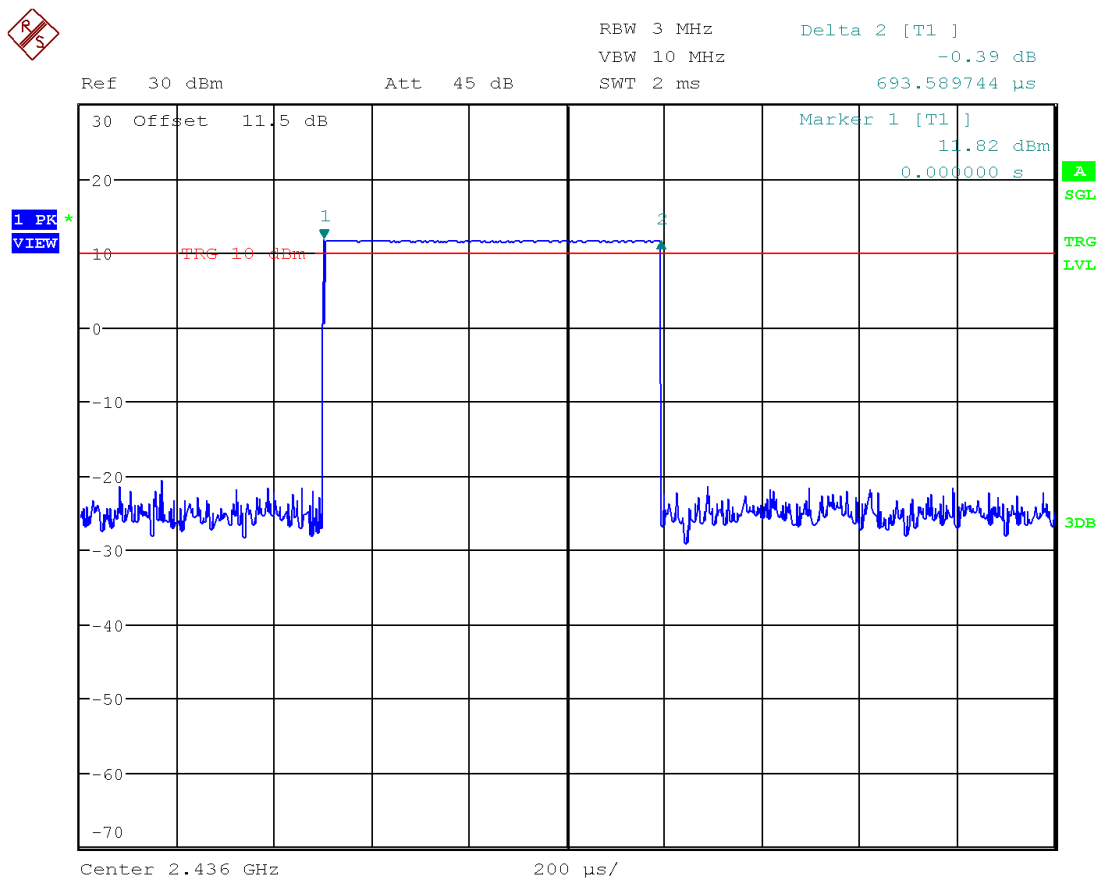
| Tested By     | Test Date      |
|---------------|----------------|
| Kenneth Roque | April 21, 2022 |

#### 4.5.3 Test Results

| No. of Burst in 960 ms | Burst On Time (ms) | Dwell Time (ms)<br>(Burst Time * No. of Burst * 10) | Dwell Time limit (ms) |
|------------------------|--------------------|---|-----------------------|
| 8                      | 0.694              | 55.52   | 400                   |

The 20-dB bandwidth of the hopping channel is greater than 250 kHz, the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a period of the number of channels (24) multiplied by 0.4 second (9.6 seconds).

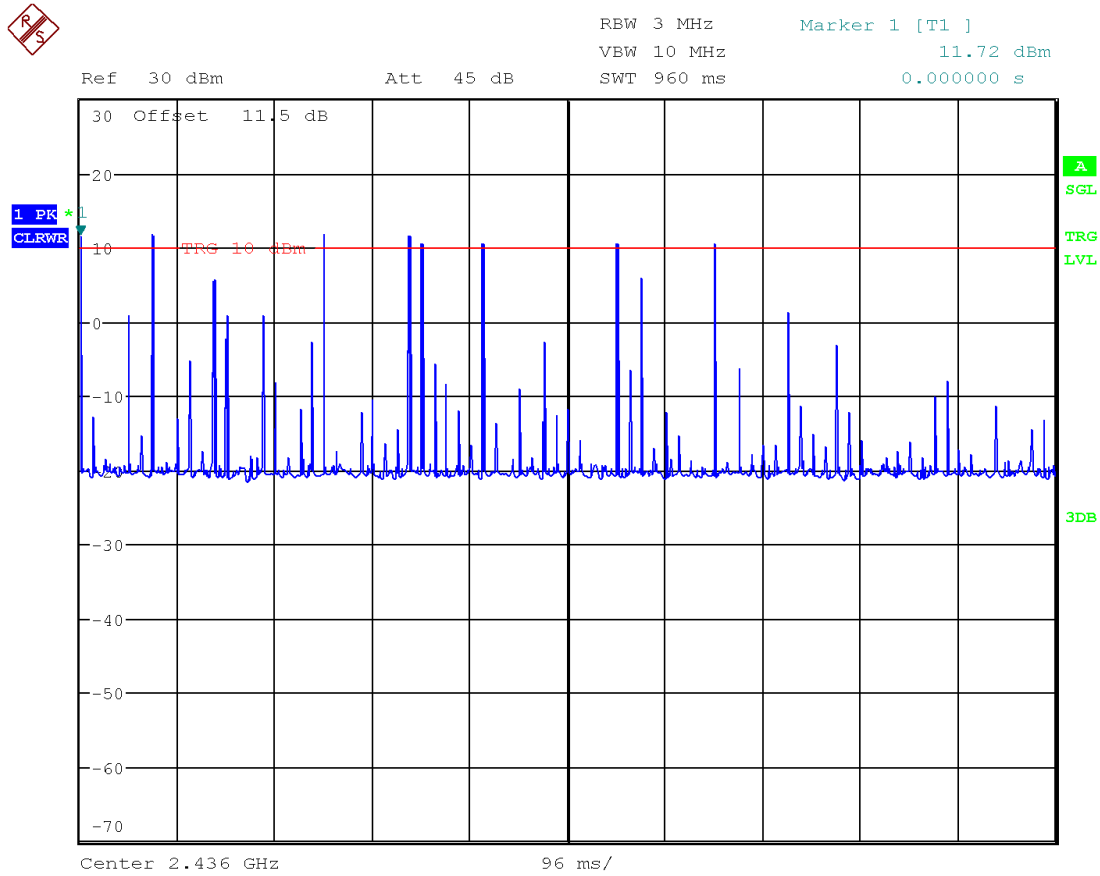
#### Burst Time



Date: 21.APR.2022 15:20:18

#### 4.5.3 Test Results (Continued)

##### *Number of Burst in 960 ms*



Date: 21.APR.2022 15:18:32

**Results**

**Complies**

#### 4.6 Out-of-Band Conducted Emissions FCC 15.247(d)

##### 4.6.1 Requirement

In any 100 kHz bandwidths outside the EUT pass-band, the RF power shall be at least 20dB (peak) or 30 dB (average) below that of the maximum in-band 100 kHz emissions.

##### 4.6.2 Procedure

The procedure described in FCC Publication 558074 D01 Meas Guidance v05r02 was used. Specifically, Section 7.8.8 of ANSI C63.10:2013 for Frequency Hopping Spread Spectrum Systems was used to determine the Out-of-Band Conducted Emissions.

- Span = wide enough to capture the peak level of the in-band emission and all spurious emissions (e.g., harmonics) from the lowest frequency generated in the EUT up through the 10th harmonic.
- RBW = 100 kHz
- VBW = 3 x RBW
- Sweep = auto
- Detector function = peak
- Trace = max hold

Allow the trace to stabilize. Set the marker on the peak of any spurious emission recorded. The level displayed must comply with the limit specified in this section.

A spectrum analyzer was connected to the antenna port of the transmitter. Analyzer Resolution Bandwidth was set to 100 kHz. For each channel investigated, the in-band and out-of-band emission measurements were performed. The out-of-band emissions were measured from 30 MHz to 26 GHz.

| Tested By     | Test Date      |
|---------------|----------------|
| Kenneth Roque | April 21, 2022 |

#### 4.6.3 Test Result

Refer to the following plots and out-of-band conducted spurious emissions at the Band-Edge, Table 4.1 & 4.2 for the test results:

Table 4.1

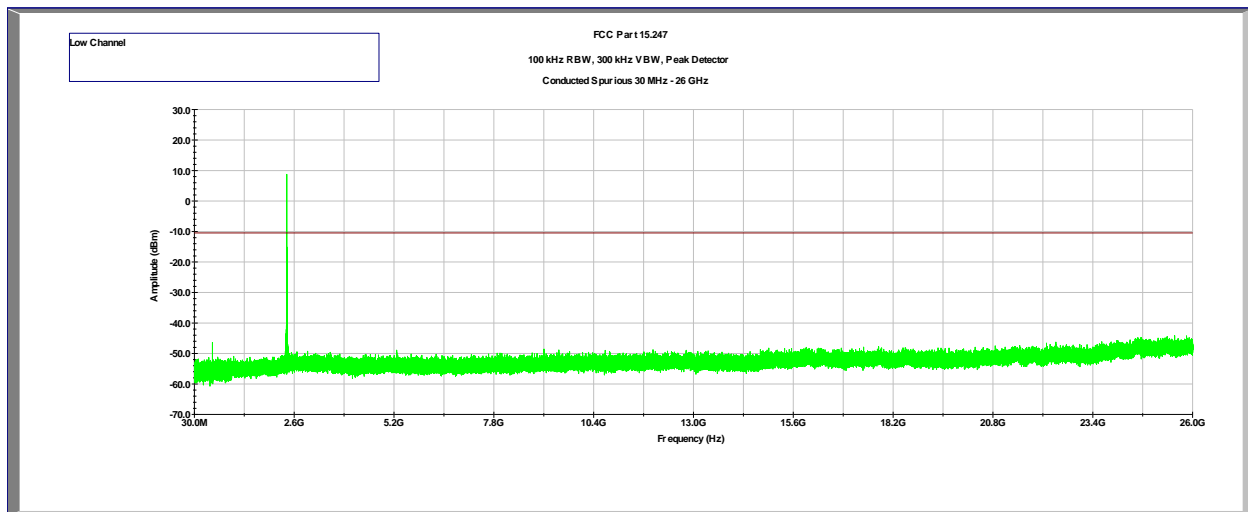
| Frequency MHz | Description          | Plot # |
|---------------|----------------------|--------|
| 2436.000000   | Scan 30 MHz – 26 GHz | 4.1    |
| 2450.567868   | Scan 30 MHz – 26 GHz | 4.2    |
| 2463.921747   | Scan 30 MHz – 26 GHz | 4.3    |

#### Out-of-Band Conducted Spurious Emissions at the Band-Edge:

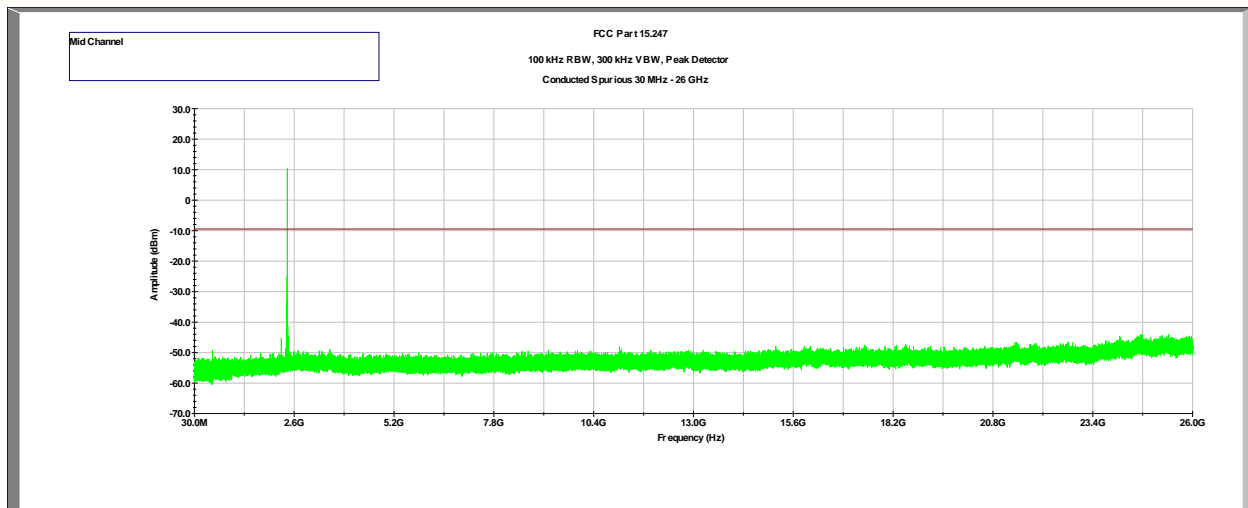
Table 4.2

| Channel | Frequency MHz  | Out-band emissions margin to In-band emissions | Plot # |
|---------|----------------|--|--------|
| 0       | 2436.000000    | Complies, Greater than 20dB                    | 4.4    |
| Hopping | Low Band Edge  | Complies, Greater than 20dB                    | 4.5    |
| 23      | 2463.921747    | Complies, Greater than 20dB                    | 4.6    |
| Hopping | High Band Edge | Complies, Greater than 20dB                    | 4.7    |

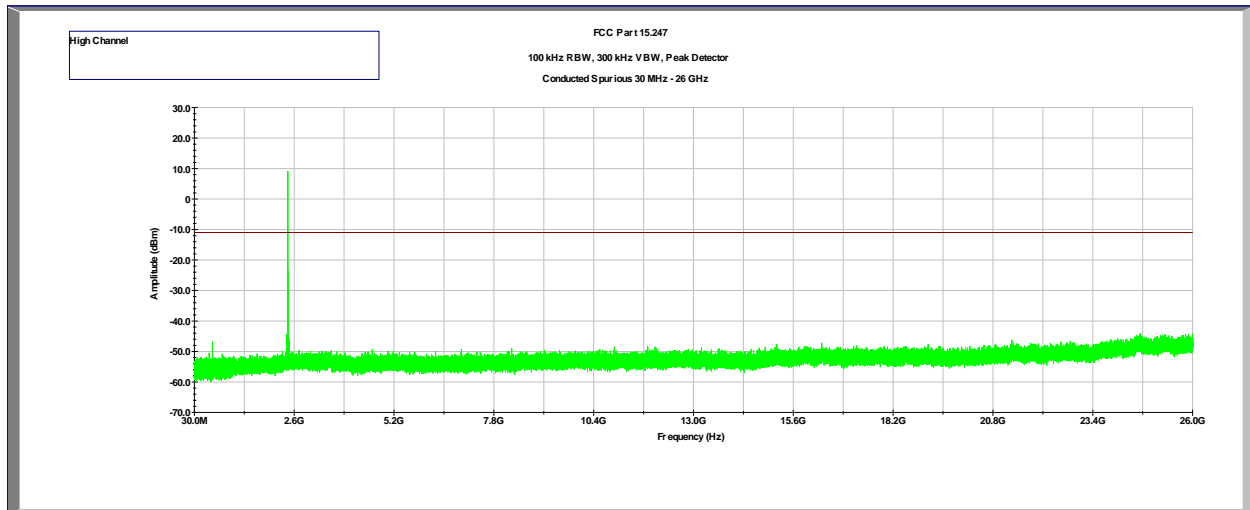
Plot 4.1  
*Transmitter Spurious, Low Channel*



Plot 4.2  
*Transmitter Spurious, Middle Channel*

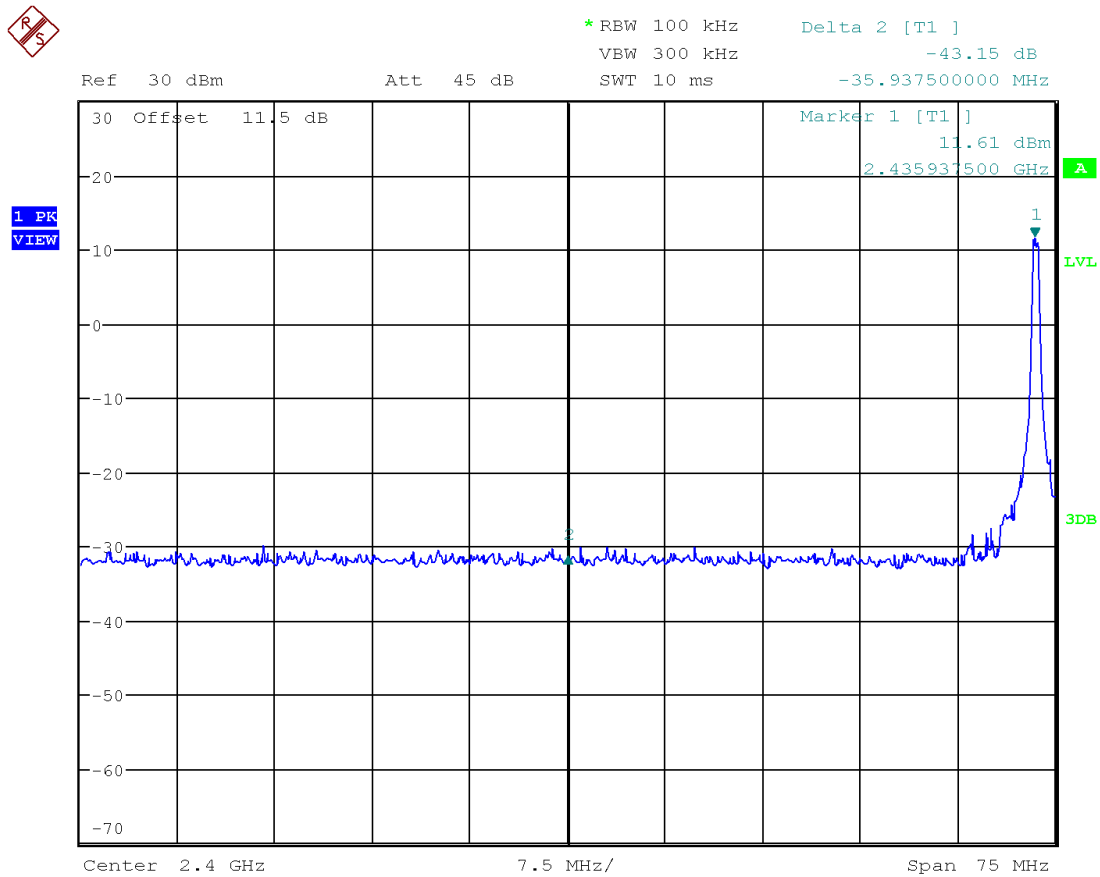


Plot 4.3  
*Transmitter Spurious, High Channel*



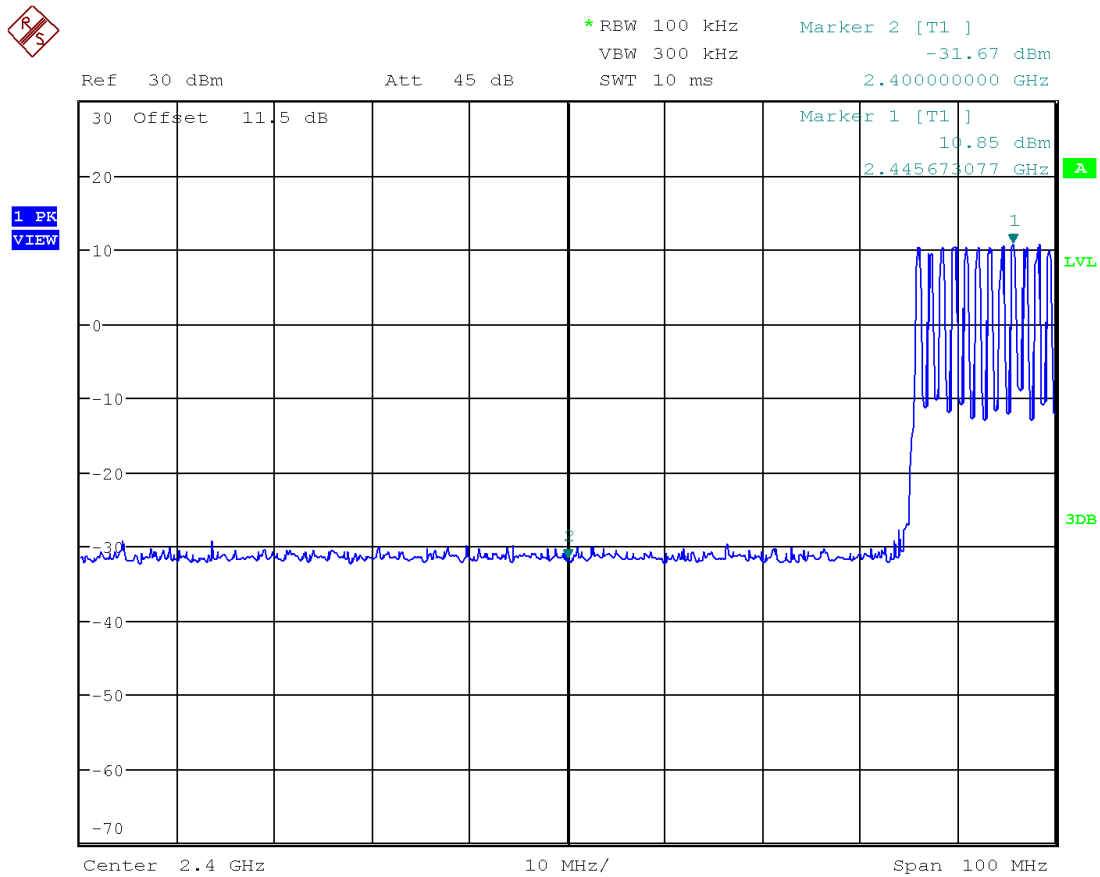


**Plot 4.4**  
*Conducted Band Edge, Low Channel*



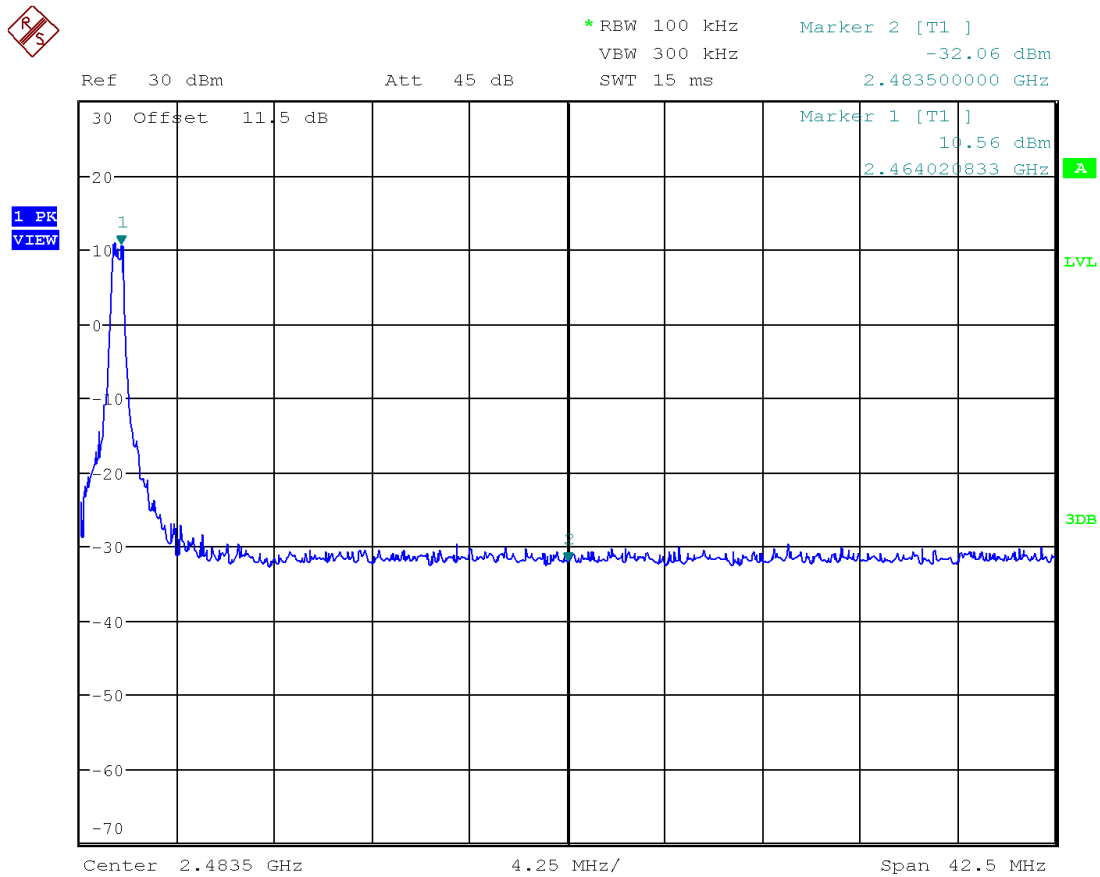
Date: 21.APR.2022 15:37:11

Plot 4.11  
Conducted Band Edge (Hopping)



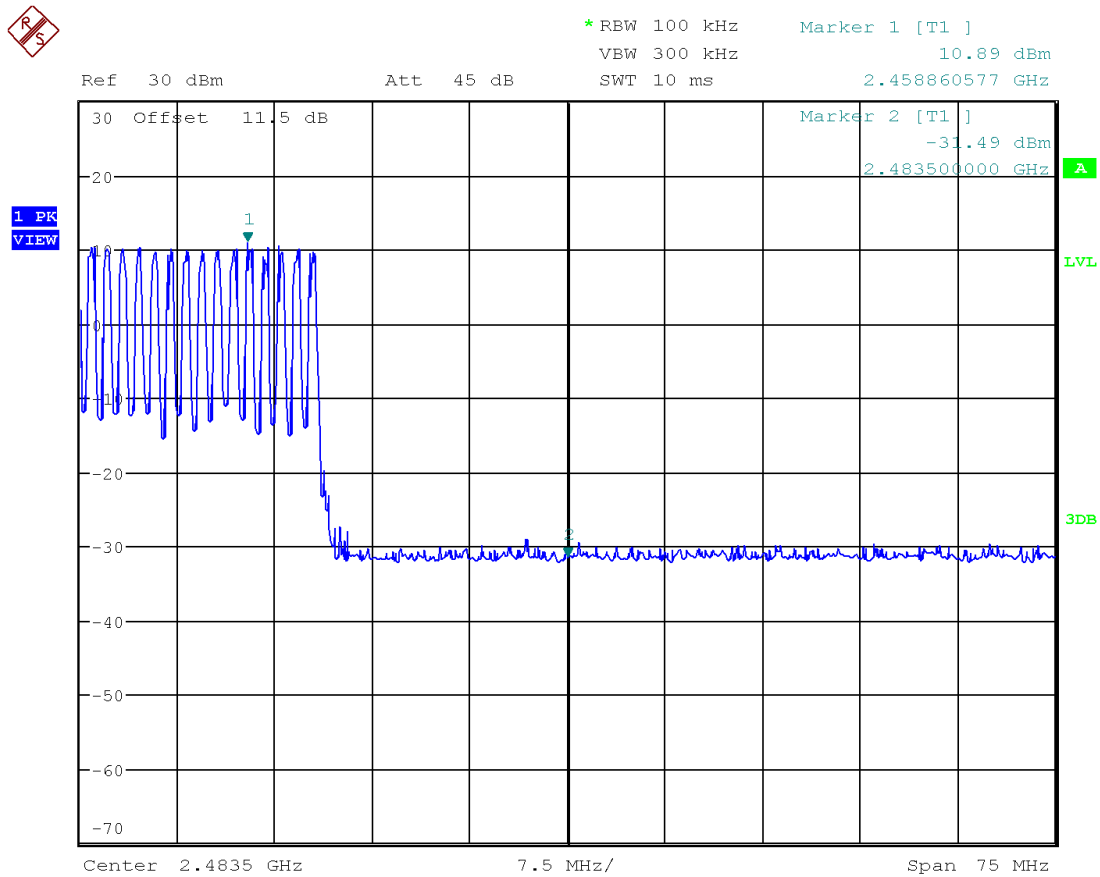
Date: 21.APR.2022 15:28:46

**Plot 4.12**  
*Conducted Band Edge, High Channel*



Date: 21.APR.2022 15:41:43

Plot 4.13  
*Conducted Band Edge (Hopping)*



Date: 21.APR.2022 15:33:13

**Results**

**Complies**

#### 4.7 Transmitter Radiated Emissions FCC Rule 15.247(d), 15.209, 15.205

##### 4.7.1 Requirement

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)).

For out of band radiated emissions (except for frequencies in restricted bands), in any 100 kHz bandwidths outside the EUT pass-band, the RF power shall be at least 20dB (peak) or 30 dB (average) below that of the maximum in-band 100 kHz emissions.

##### 4.7.2 Procedure

Radiated emission measurements were performed from 9kHz to 25GHz. Spectrum Analyzer Resolution Bandwidth is 100 kHz or greater for frequencies 30 MHz to 1000 MHz, 1 MHz for frequencies above 1000 MHz.

If the EUT attaches to peripherals, they are connected and operational (as typical as possible). During testing, all cables were manipulated to produce worst-case emissions. The signal is maximized through rotation. The antenna height and polarization are varied during the search for maximum signal level. The antenna height is varied from 1 to 4 meters.

Radiated emissions are taken at 3 meters for frequencies above 1 GHz & below 1 GHz.

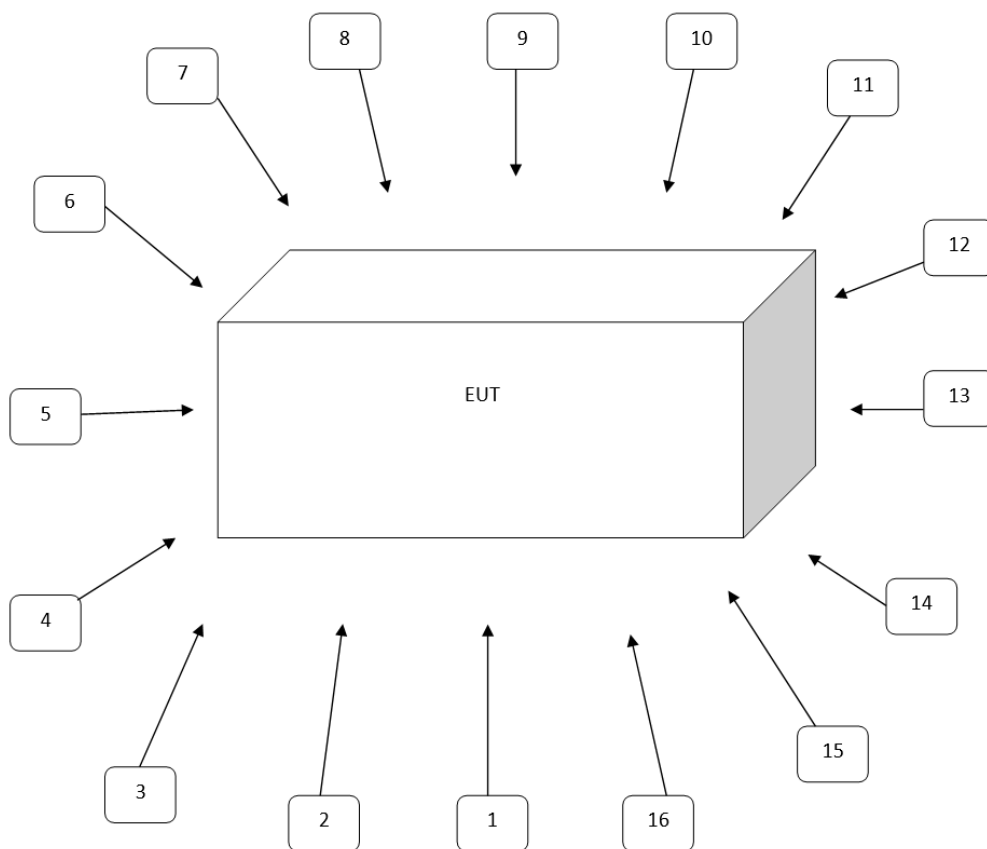
Spurious measurements are made with a preamp from 9kHz MHz to 25 GHz.

Measurements may be made with a Peak Detector and compared to QP limits for 9kHz – 1 GHz and Average limits for 1 GHz – 25 GHz.

Radiated Spurious measurements were performed at the customer's site, specifically in their parking lot. EUT was too large and heavy to transport to Intertek's facilities. Procedure and approval were made with the FCC to proceed with these measurements. Measuring Antenna was placed evenly at 16 positions around the EUT. Measuring antennas were 3m from the EUT during measurements. See Figure 1 and test photos for further details.

Radiated Band Edge in the Restricted band were measured inside a semi anechoic chamber. The Radio Board and Antenna were removed from its host and placed on a 1.5m table for measurement.

**Out-of-Band Radiated Spurious Emissions**



**Figure 1. Measuring Antenna Positions; Separated by 22.5°**

Note: Measuring Antenna Positioned 3m from the EUT.

#### 4.7.3 Field Strength Calculation

##### Field Strength 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:

$FS = RA + AF + CF - AG$ ; if measurement is performed at a distance other than specified in the rule, a Distance Correction Factor (DCF) shall be added.

Where FS = Field Strength in dB( $\mu$ V/m)

RA = Receiver Amplitude (including preamplifier) in dB( $\mu$ V); AF = Antenna Factor in dB(1/m)

CF = Cable Attenuation Factor in dB; AG = Amplifier Gain in dB

Assume a receiver reading of 52.0 dB( $\mu$ V) is obtained. The antennas factor of 7.4 dB(1/m) and cable factor of 1.6 dB is added. The amplifier gain of 29 dB is subtracted, giving field strength of 32 dB( $\mu$ V/m). This value in dB( $\mu$ V/m) was converted to its corresponding level in  $\mu$ V/m.

RA = 52.0 dB( $\mu$ V)

AF = 7.4 dB(1/m)

CF = 1.6 dB

AG = 29.0 dB

$FS = 52.0 + 7.4 + 1.6 - 29.0 = 32 \text{ dB}(\mu\text{V/m})$ .

Level in  $\mu$ V/m = Common Antilogarithm  $[(32 \text{ dB}\mu\text{V/m})/20] = 39.8 \mu\text{V/m}$ .

#### 4.7.4 Antenna-port conducted measurements

Antenna-port conducted measurements may also be used as an alternative to radiated measurements for demonstrating compliance in the restricted frequency bands. If conducted measurements are performed, then proper impedance matching must be ensured and an additional radiated test for cabinet/case spurious emissions is required.

#### 4.7.5 General Procedure for conducted measurements in restricted bands

- a) Measure the conducted output power (in dBm) using the detector specified for determining quasi-peak, peak, and average conducted output power, respectively.
- b) Add the maximum transmit antenna gain (in dBi) to the measured output power level to determine the EIRP level (see 12.2.5 for guidance on determining the applicable antenna gain)
- c) Add the appropriate maximum ground reflection factor to the EIRP level (6 dB for frequencies  $\leq 30$  MHz, 4.7 dB for frequencies between 30 MHz and 1000 MHz, inclusive and 0 dB for frequencies  $> 1000$  MHz).
- d) For devices with multiple antenna-ports, measure the power of each individual chain and sum the EIRP of all chains in linear terms (*e.g.*, Watts, mW).
- e) Convert the resultant EIRP level to an equivalent electric field strength using the following relationship:  

$$E = \text{EIRP} - 20\log D + 104.8 + \text{DCF (DCF for Average measurements)}$$
 where:  
 E = electric field strength in dB $\mu$ V/m,  
 EIRP = equivalent isotropic radiated power in dBm  
 D = specified measurement distance in meters.  
 DCF = Duty Cycle Correction Factor
- f) Compare the resultant electric field strength level to the applicable limit.
- g) Perform radiated spurious emission test

#### 4.7.6 Test Results

| Tested By     | Test Date                            |
|---------------|--------------------------------------|
| Kenneth Roque | March 14 – 17, 2022 & April 15, 2022 |

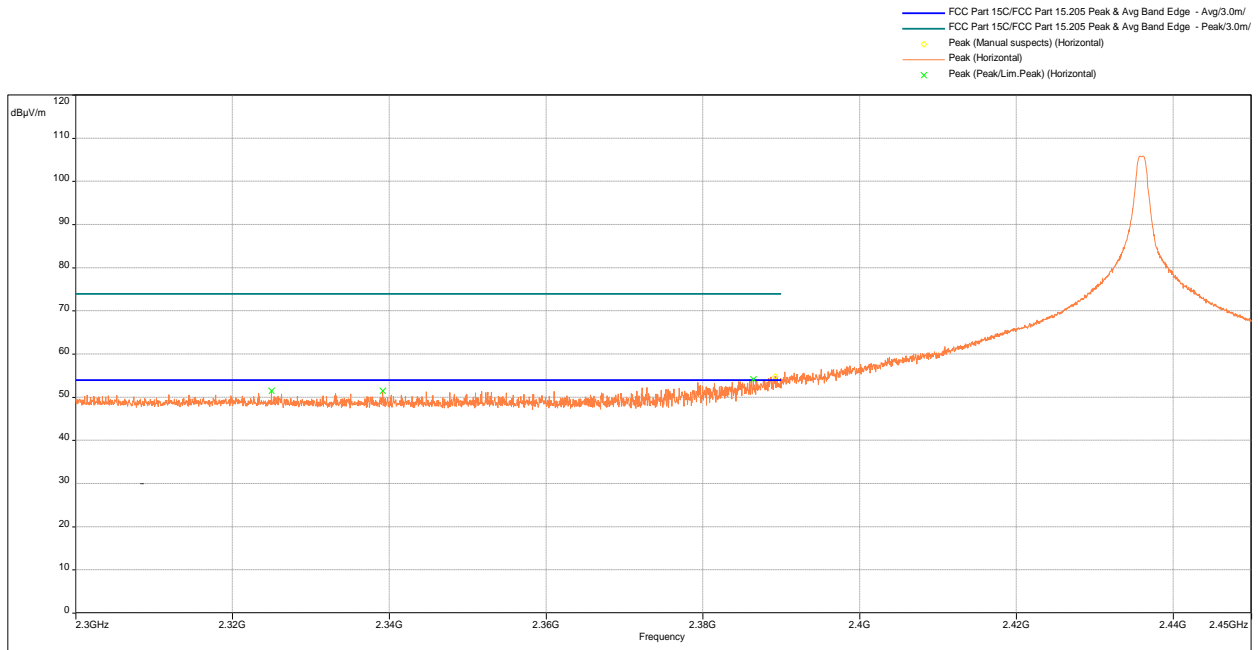
These measurements were performed with Antenna in place.



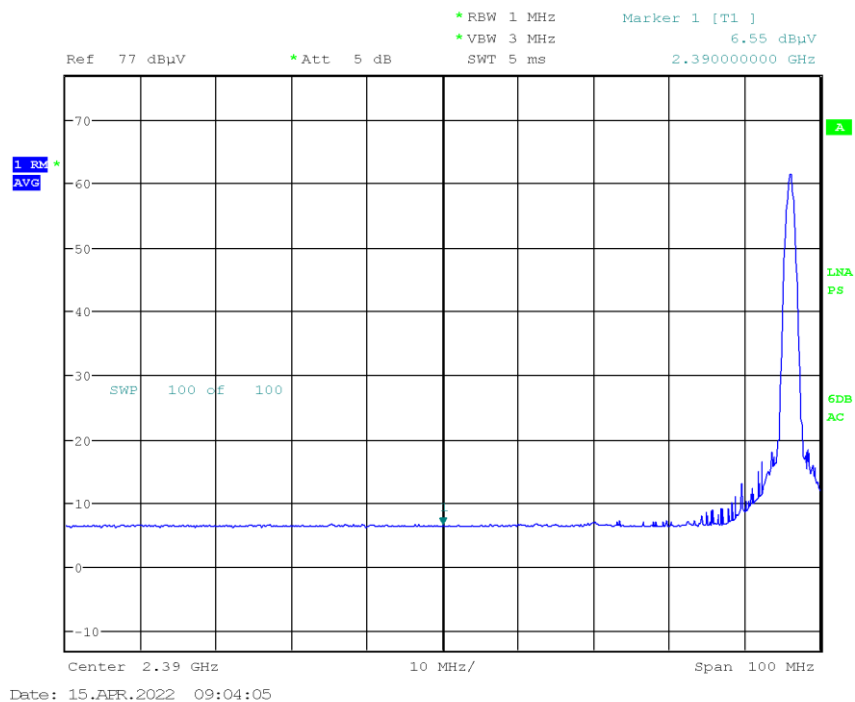
#### 4.7.6 Test Results (Continued)

#### Test Results: 15.209/15.205 Radiated Restricted Band Emissions

#### Radiated Band Edge at the Restricted Band – Tx @ Low Channel, Peak vs Peak and Avg Limits



Radiated Band Edge at the Restricted Band – Tx @ Low Channel, Avg

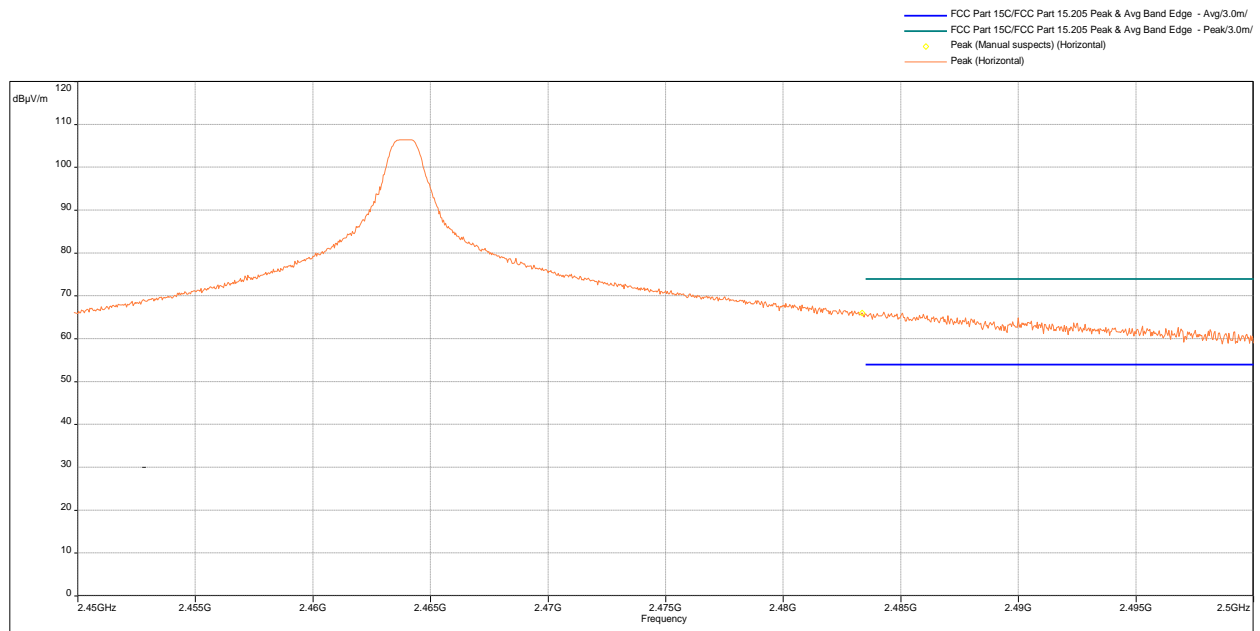


| Frequency (MHz) | Raw  | Avg (dBμV/m) | Lim. Average (dBμV/m) | Margin (dB) | Height (m) | Angle (°) | Comment    | Correction (dB) | Duty Cycle CF* |
|-----------------|------|--------------|-----------------------|-------------|------------|-----------|------------|-----------------|----------------|
| 2390            | 6.55 | 50.27        | 54                    | -3.73       | 3.44       | 272.5     | Horizontal | 31.26           | 12.46          |

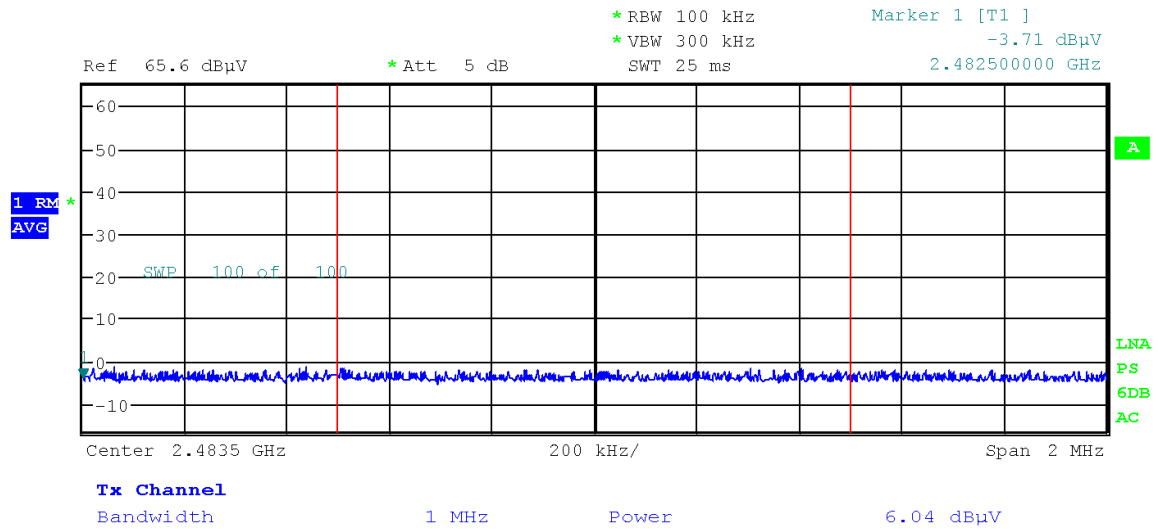
\*Duty Cycle Measured: 5.67%

Note: Worst case polarity shown.

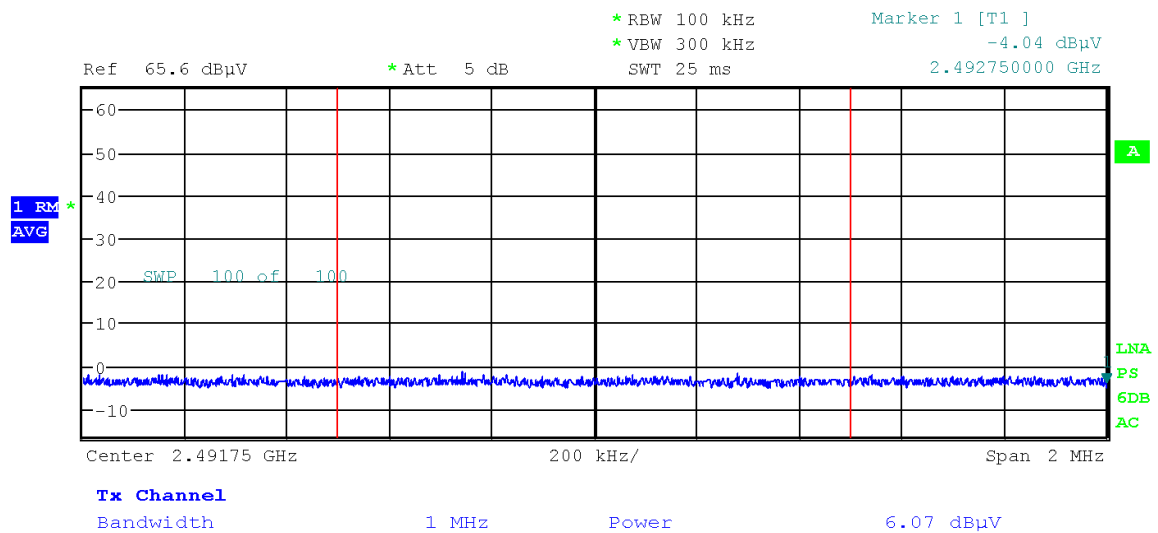
Radiated Band Edge at the Restricted Band – Tx @ High Channel, Peak vs Peak and Avg Limit



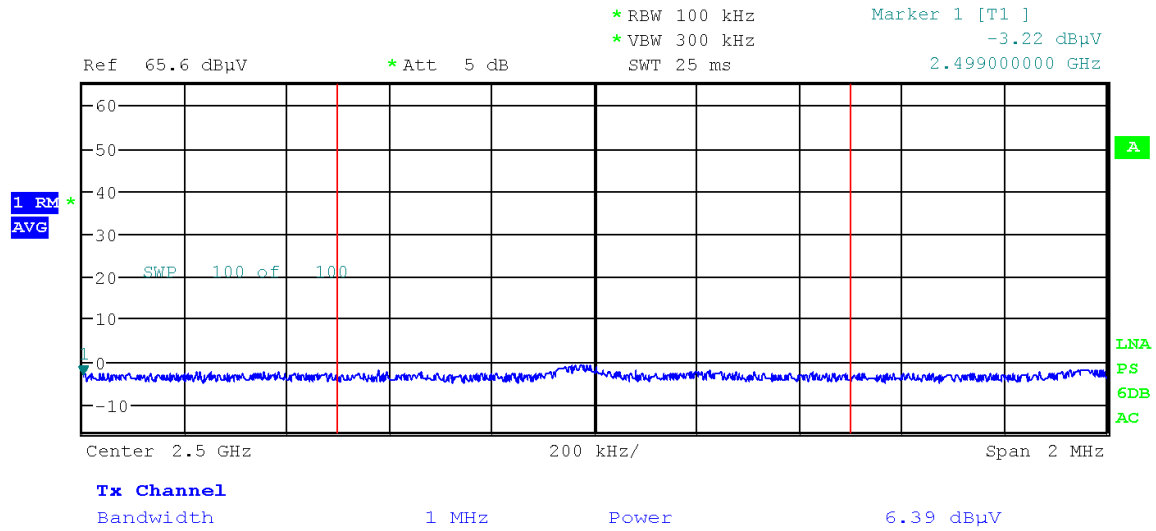
**Radiated Band Edge at the Restricted Band – Tx @ High Channel, Avg**



Date: 15.APR.2022 09:55:59



Date: 15.APR.2022 09:59:48

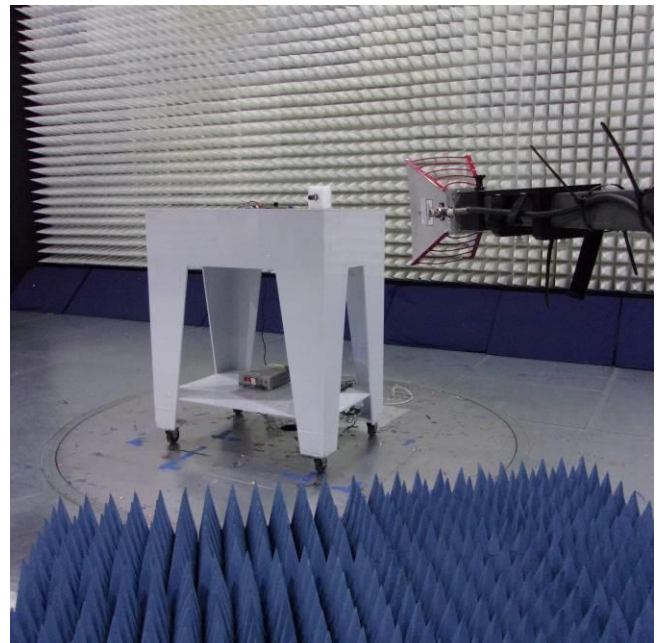
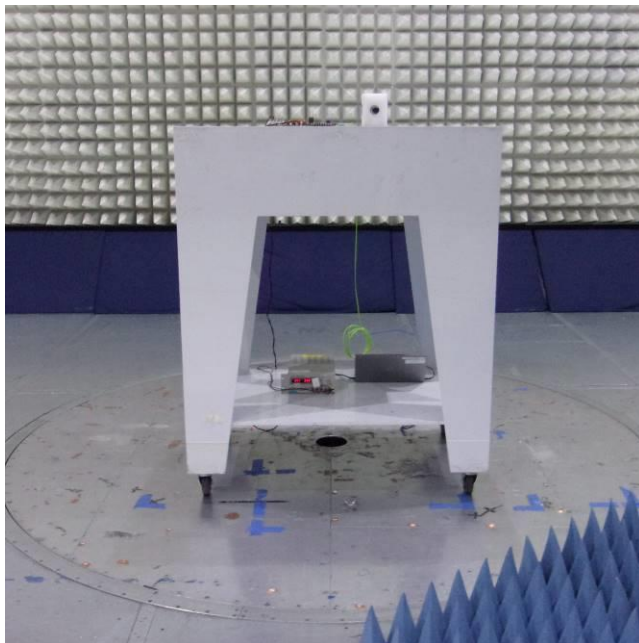
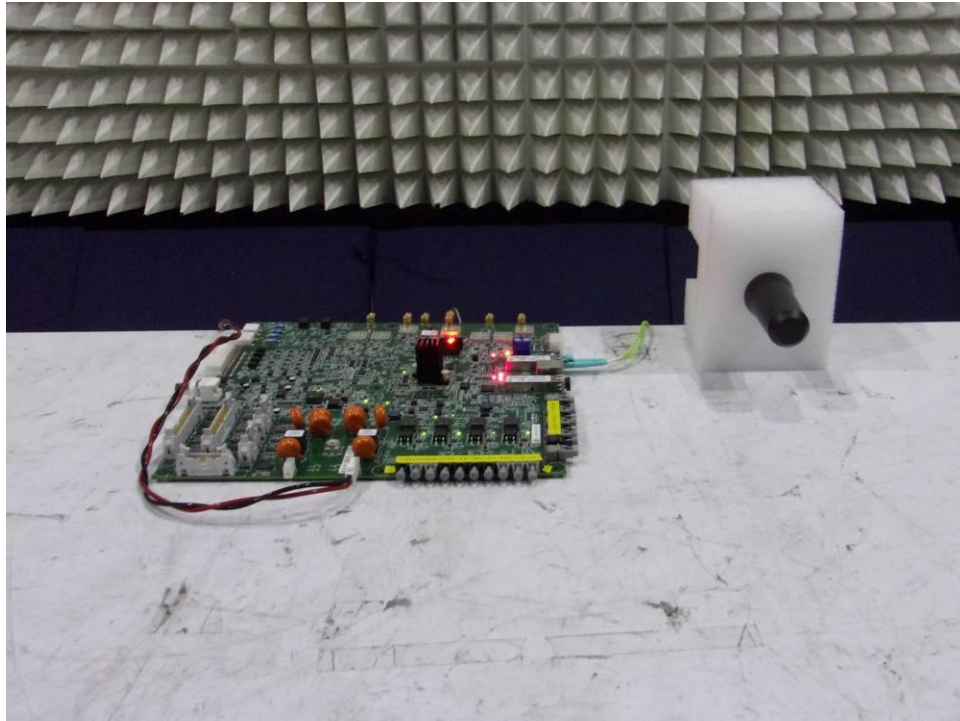


Date: 15.APR.2022 09:57:29

| Frequency (MHz) | Raw  | Peak (dBμV/m) | Lim. Average (dBμV/m) | Peak-Lim (dB) | Height (m) | Angle (°) | Comment    | Correction (dB) | Duty Cycle CF* |
|-----------------|------|---------------|-----------------------|---------------|------------|-----------|------------|-----------------|----------------|
| 2.4835          | 6.04 | 50.09         | 54                    | -3.91         | 3.44       | 272.5     | Horizontal | 31.59           | 12.46          |
| 2.49175         | 6.07 | 50.12         | 54                    | -3.86         | 3.44       | 272.5     | Horizontal | 31.59           | 12.46          |
| 2.5             | 6.39 | 50.44         | 54                    | -3.56         | 3.44       | 272.5     | Horizontal | 31.59           | 12.46          |

\*Duty Cycle Measured: 5.67%  
 Note: Worst case polarity shown.

## Radiated Band Edge Setup Pictures



### Out-of-Band Radiated Spurious Emissions

Test Results: Worst Case Spurious from Antenna Positions 1 – 4.  
15.209 Radiated Spurious Emissions Low Channel, Tx at 2436 MHz

| Freq.<br>(MHz) | Ant.<br>Polarity | Raw<br>Amp.<br>@ 3m<br>dBuV/m | Preamp<br>dB | Ant.<br>Factor<br>dB/m | Cable<br>Loss<br>dB | Field<br>Strength<br>Final<br>Amp<br>@ 3m<br>dBuV/m | Ant.<br>Position | Ant<br>Height<br>m | Detector | Limit<br>@3 m<br>dBuV/m | Margin<br>dB |
|----------------|------------------|-------------------------------|--------------|------------------------|---------------------|---|------------------|--------------------|----------|-------------------------|--------------|
| 14.476         | Par              | 52.87                         | 32.53        | 34.02                  | 0.37                | 54.73   | 1                | 1.00               | Peak     | 69.50                   | -14.77       |
| 15.195         | Par              | 51.23                         | 32.54        | 33.96                  | 0.38                | 53.03   | 1                | 1.00               | Peak     | 69.50                   | -16.47       |
| 14.460         | Perp             | 50.13                         | 32.53        | 34.02                  | 0.37                | 51.99   | 1                | 1.00               | Peak     | 69.50                   | -17.51       |
| 26.910         | Perp             | 41.28                         | 32.55        | 32.96                  | 0.48                | 42.17   | 3                | 1.00               | Peak     | 69.50                   | -27.33       |
| 62.980         | H                | 43.57                         | 32.53        | 10.31                  | 0.75                | 22.10   | 4                | 1.70               | Peak     | 40.00                   | -17.90       |
| 299.900        | H                | 39.71                         | 32.50        | 17.16                  | 1.44                | 25.81   | 1                | 1.70               | Peak     | 46.00                   | -20.19       |
| 375.770        | V                | 45.57                         | 32.56        | 18.71                  | 1.59                | 33.32   | 2                | 1.70               | Peak     | 46.00                   | -12.68       |
| 1117.036       | V                | 50.32                         | 46.66        | 23.92                  | 2.60                | 30.18   | 3                | 3.50               | Peak     | 54.00                   | -23.82       |
| 1815.539       | V                | 59.23                         | 45.55        | 26.04                  | 3.26                | 42.99   | 2                | 3.50               | Peak     | 54.00                   | -11.01       |
| 4060.953       | V                | 53.45                         | 44.27        | 32.00                  | 4.82                | 46.00   | 2                | 3.50               | Peak     | 54.00                   | -8.00        |
| 4872.000       | V                | 47.72                         | 43.84        | 33.14                  | 5.29                | 42.31   | 1                | 2.20               | Peak     | 74.00                   | -31.69       |
| 4872.000       | V                | 33.56                         | 43.84        | 33.14                  | 5.29                | 28.15   | 1                | 2.20               | Avg      | 54.00                   | -25.85       |
| 7308.000       | V                | 47.68                         | 43.91        | 37.45                  | 6.47                | 47.68   | 2                | 2.20               | Peak     | 74.00                   | -26.32       |
| 7308.000       | V                | 33.70                         | 43.91        | 37.45                  | 6.47                | 33.70   | 2                | 2.20               | Avg      | 54.00                   | -20.30       |
| 9744.000       | V                | 47.83                         | 44.10        | 38.11                  | 7.53                | 49.38   | 1                | 2.20               | Peak     | 74.00                   | -24.62       |
| 9744.000       | V                | 33.24                         | 44.10        | 38.11                  | 7.53                | 34.79   | 1                | 2.20               | Avg      | 54.00                   | -19.21       |
| 12180.000      | V                | 45.37                         | 43.84        | 38.41                  | 8.39                | 48.33   | 2                | 2.20               | Peak     | 74.00                   | -25.67       |
| 12180.000      | V                | 30.74                         | 43.84        | 38.41                  | 8.39                | 33.70   | 2                | 2.20               | Avg      | 54.00                   | -20.30       |
| 14616.000      | V                | 51.11                         | 45.39        | 40.76                  | 9.24                | 55.72   | 1                | 2.20               | Peak     | 74.00                   | -18.28       |
| 14616.000      | V                | 37.19                         | 45.39        | 40.76                  | 9.24                | 41.80   | 1                | 2.20               | Avg      | 54.00                   | -12.20       |
| 17052.000      | V                | 51.77                         | 43.86        | 41.14                  | 10.15               | 59.19   | 1                | 2.20               | Peak     | 74.00                   | -14.81       |
| 17052.000      | V                | 37.82                         | 43.86        | 41.14                  | 10.15               | 45.24   | 1                | 2.20               | Avg      | 54.00                   | -8.76        |
| 19488.000      | V                | 52.35                         | 53.43        | 45.50                  | 11.00               | 55.42   | 1                | 2.60               | Peak     | 74.00                   | -18.58       |
| 19488.000      | V                | 37.13                         | 53.43        | 45.50                  | 11.00               | 40.20   | 1                | 2.60               | Avg      | 54.00                   | -13.80       |

Note: FS = Raw – Preamp Factor + Antenna Factor + Cable Factor

Test Results: Worst Case Spurious from Antenna Positions 5 – 8.  
15.209 Radiated Spurious Emissions Low Channel, Tx at 2436 MHz

| Freq.<br>(MHz) | Ant.<br>Polarity | Raw<br>Amp.<br>@ 3m<br>dBuV/m | Preamp<br>dB | Ant.<br>Factor<br>dB/m | Cable<br>Loss<br>dB | Field<br>Strength<br>Final<br>Amp<br>@ 3m<br>dBuV/m | Ant.<br>Position | Ant<br>Height<br>m | Detector | Limit<br>@3 m<br>dBuV/m | Margin<br>dB |
|----------------|------------------|-------------------------------|--------------|------------------------|---------------------|---|------------------|--------------------|----------|-------------------------|--------------|
| 14.467         | Par              | 51.19                         | 32.53        | 34.02                  | 0.37                | 53.05   | 8                | 1.00               | Peak     | 69.50                   | -16.45       |
| 15.176         | Par              | 49.92                         | 32.54        | 33.96                  | 0.38                | 51.72   | 8                | 1.00               | Peak     | 69.50                   | -17.78       |
| 14.472         | Perp             | 45.54                         | 32.53        | 34.02                  | 0.37                | 47.40   | 5                | 1.00               | Peak     | 69.50                   | -22.10       |
| 26.896         | Perp             | 45.05                         | 32.55        | 32.96                  | 0.48                | 45.94   | 8                | 1.00               | Peak     | 69.50                   | -23.56       |
| 62.980         | H                | 44.90                         | 32.53        | 10.31                  | 0.75                | 23.43   | 7                | 2.20               | Peak     | 40.00                   | -16.57       |
| 299.900        | H                | 40.52                         | 32.50        | 17.16                  | 1.44                | 26.62   | 7                | 2.20               | Peak     | 46.00                   | -19.38       |
| 375.770        | V                | 46.14                         | 32.56        | 18.71                  | 1.59                | 33.89   | 7                | 2.20               | Peak     | 46.00                   | -12.11       |
| 1117.036       | V                | 50.92                         | 46.66        | 23.92                  | 2.60                | 30.78   | 5                | 3.50               | Peak     | 54.00                   | -23.22       |
| 1815.539       | V                | 58.90                         | 45.55        | 26.04                  | 3.26                | 42.66   | 5                | 3.50               | Peak     | 54.00                   | -11.34       |
| 4060.953       | V                | 53.64                         | 44.27        | 32.00                  | 4.82                | 46.19   | 7                | 3.50               | Peak     | 54.00                   | -7.81        |
| 4872.000       | V                | 47.51                         | 43.84        | 33.14                  | 5.29                | 42.11   | 7                | 3.80               | Peak     | 74.00                   | -31.89       |
| 4872.000       | V                | 37.29                         | 43.84        | 33.14                  | 5.29                | 31.88   | 7                | 3.80               | Avg      | 54.00                   | -22.12       |
| 7308.000       | V                | 47.11                         | 43.91        | 37.45                  | 6.47                | 47.11   | 8                | 3.80               | Peak     | 74.00                   | -26.89       |
| 7308.000       | V                | 35.79                         | 43.91        | 37.45                  | 6.47                | 35.79   | 8                | 3.80               | Avg      | 54.00                   | -18.21       |
| 9744.000       | V                | 46.61                         | 44.10        | 38.11                  | 7.53                | 48.16   | 5                | 3.80               | Peak     | 74.00                   | -25.84       |
| 9744.000       | V                | 36.94                         | 44.10        | 38.11                  | 7.53                | 38.49   | 5                | 3.80               | Avg      | 54.00                   | -15.51       |
| 12180.000      | V                | 47.07                         | 43.84        | 38.41                  | 8.39                | 50.03   | 8                | 3.80               | Peak     | 74.00                   | -23.97       |
| 12180.000      | V                | 37.58                         | 43.84        | 38.41                  | 8.39                | 40.54   | 8                | 3.80               | Avg      | 54.00                   | -13.46       |
| 14616.000      | V                | 46.56                         | 45.39        | 40.76                  | 9.24                | 51.17   | 6                | 3.80               | Peak     | 74.00                   | -22.83       |
| 14616.000      | V                | 37.13                         | 45.39        | 40.76                  | 9.24                | 41.74   | 6                | 3.80               | Avg      | 54.00                   | -12.26       |
| 17052.000      | V                | 46.57                         | 43.86        | 41.14                  | 10.15               | 53.99   | 8                | 3.80               | Peak     | 74.00                   | -20.01       |
| 17052.000      | V                | 35.12                         | 43.86        | 41.14                  | 10.15               | 42.54   | 8                | 3.80               | Avg      | 54.00                   | -11.46       |
| 19488.000      | V                | 52.23                         | 53.43        | 45.50                  | 11.00               | 55.30   | 8                | 2.40               | Peak     | 74.00                   | -18.70       |
| 19488.000      | V                | 38.03                         | 53.43        | 45.50                  | 11.00               | 41.10   | 8                | 2.40               | Avg      | 54.00                   | -12.90       |

Note: FS = Raw – Preamp Factor + Antenna Factor + Cable Factor



Test Results: Worst Case Spurious from Antenna Positions 9 – 12.  
15.209 Radiated Spurious Emissions Low Channel, Tx at 2436 MHz

| Freq.<br>(MHz) | Ant.<br>Polarity | Raw<br>Amp.<br>@ 3m<br>dBuV/m | Preamp<br>dB | Ant.<br>Factor<br>dB/m | Cable<br>Loss<br>dB | Field<br>Strength<br>Final<br>Amp<br>@ 3m<br>dBuV/m | Ant.<br>Position | Ant<br>Height<br>m | Detector | Limit<br>@3 m<br>dBuV/m | Margin<br>dB |
|----------------|------------------|-------------------------------|--------------|------------------------|---------------------|---|------------------|--------------------|----------|-------------------------|--------------|
| 14.577         | Par              | 51.80                         | 32.53        | 34.02                  | 0.37                | 53.66   | 10               | 1.00               | Peak     | 69.50                   | -15.84       |
| 15.083         | Par              | 51.27                         | 32.54        | 33.96                  | 0.38                | 53.07   | 9                | 1.00               | Peak     | 69.50                   | -16.43       |
| 14.475         | Perp             | 50.95                         | 32.53        | 34.02                  | 0.37                | 52.81   | 11               | 1.00               | Peak     | 69.50                   | -16.69       |
| 26.863         | Perp             | 51.29                         | 32.55        | 32.96                  | 0.48                | 52.18   | 11               | 1.00               | Peak     | 69.50                   | -17.32       |
| 62.980         | H                | 47.32                         | 32.53        | 10.31                  | 0.75                | 25.85   | 12               | 2.00               | Peak     | 40.00                   | -14.15       |
| 299.900        | H                | 43.72                         | 32.50        | 17.16                  | 1.44                | 29.82   | 12               | 2.00               | Peak     | 46.00                   | -16.18       |
| 375.770        | V                | 47.55                         | 32.56        | 18.71                  | 1.59                | 35.30   | 10               | 2.00               | Peak     | 46.00                   | -10.70       |
| 1117.036       | V                | 50.89                         | 46.66        | 23.92                  | 2.60                | 30.75   | 12               | 3.50               | Peak     | 54.00                   | -23.25       |
| 1815.539       | V                | 59.23                         | 45.55        | 26.04                  | 3.26                | 42.99   | 12               | 3.50               | Peak     | 54.00                   | -11.01       |
| 4060.953       | V                | 54.02                         | 44.27        | 32.00                  | 4.82                | 46.57   | 10               | 3.50               | Peak     | 54.00                   | -7.43        |
| 4872.000       | V                | 47.57                         | 43.84        | 33.14                  | 5.29                | 42.17   | 12               | 3.40               | Peak     | 74.00                   | -31.83       |
| 4872.000       | V                | 37.96                         | 43.84        | 33.14                  | 5.29                | 32.56   | 12               | 3.40               | Avg      | 54.00                   | -21.44       |
| 7308.000       | V                | 46.35                         | 43.91        | 37.45                  | 6.47                | 46.35   | 11               | 3.40               | Peak     | 74.00                   | -27.65       |
| 7308.000       | V                | 37.96                         | 43.91        | 37.45                  | 6.47                | 37.96   | 11               | 3.40               | Avg      | 54.00                   | -16.04       |
| 9744.000       | V                | 46.72                         | 44.10        | 38.11                  | 7.53                | 48.26   | 12               | 3.40               | Peak     | 74.00                   | -25.74       |
| 9744.000       | V                | 35.31                         | 44.10        | 38.11                  | 7.53                | 36.85   | 12               | 3.40               | Avg      | 54.00                   | -17.15       |
| 12180.000      | V                | 47.95                         | 43.84        | 38.41                  | 8.39                | 50.91   | 12               | 3.40               | Peak     | 74.00                   | -23.09       |
| 12180.000      | V                | 35.93                         | 43.84        | 38.41                  | 8.39                | 38.90   | 12               | 3.40               | Avg      | 54.00                   | -15.10       |
| 14616.000      | V                | 47.20                         | 45.39        | 40.76                  | 9.24                | 51.81   | 11               | 3.40               | Peak     | 74.00                   | -22.19       |
| 14616.000      | V                | 37.74                         | 45.39        | 40.76                  | 9.24                | 42.36   | 11               | 3.40               | Avg      | 54.00                   | -11.64       |
| 17052.000      | V                | 47.04                         | 43.86        | 41.14                  | 10.15               | 54.46   | 11               | 3.40               | Peak     | 74.00                   | -19.54       |
| 17052.000      | V                | 37.22                         | 43.86        | 41.14                  | 10.15               | 44.65   | 11               | 3.40               | Avg      | 54.00                   | -9.35        |
| 19488.000      | V                | 53.15                         | 53.43        | 45.50                  | 11.00               | 56.22   | 12               | 3.20               | Peak     | 74.00                   | -17.78       |
| 19488.000      | V                | 38.45                         | 53.43        | 45.50                  | 11.00               | 41.52   | 12               | 3.20               | Avg      | 54.00                   | -12.48       |

Note: FS = Raw – Preamp Factor + Antenna Factor + Cable Factor

Test Results: Worst Case Spurious from Antenna Positions 13 – 16.  
15.209 Radiated Spurious Emissions Low Channel, Tx at 2436 MHz

| Freq. (MHz) | Ant. Polarity | Raw Amp. @ 3m dBuV/m | Preamp dB | Ant. Factor dB/m | Cable Loss dB | Field Strength Final Amp @ 3m dBuV/m | Ant. Position | Ant Height m | Detector | Limit @3 m dBuV/m | Margin dB |
|-------------|---------------|----------------------|-----------|------------------|---------------|--------------------------------------|---------------|--------------|----------|-------------------|-----------|
| 14.505      | Par           | 50.44                | 32.53     | 34.02            | 0.37          | 52.30                                | 16            | 1.00         | Peak     | 69.50             | -17.20    |
| 15.210      | Par           | 47.87                | 32.54     | 33.96            | 0.38          | 49.67                                | 16            | 1.00         | Peak     | 69.50             | -19.83    |
| 14.460      | Perp          | 51.68                | 32.53     | 34.02            | 0.37          | 53.54                                | 14            | 1.00         | Peak     | 69.50             | -15.96    |
| 26.910      | Perp          | 51.04                | 32.55     | 32.96            | 0.48          | 51.93                                | 14            | 1.00         | Peak     | 69.50             | -17.57    |
| 62.980      | H             | 44.62                | 32.53     | 10.31            | 0.75          | 23.15                                | 14            | 2.40         | Peak     | 40.00             | -16.85    |
| 299.900     | H             | 47.01                | 32.50     | 17.16            | 1.44          | 33.11                                | 16            | 2.40         | Peak     | 46.00             | -12.89    |
| 375.770     | V             | 51.64                | 32.56     | 18.71            | 1.59          | 39.39                                | 14            | 2.40         | Peak     | 46.00             | -6.61     |
| 1117.036    | V             | 51.22                | 46.66     | 23.92            | 2.60          | 31.08                                | 14            | 3.50         | Peak     | 54.00             | -22.92    |
| 1815.539    | V             | 59.86                | 45.55     | 26.04            | 3.26          | 43.62                                | 13            | 3.50         | Peak     | 54.00             | -10.38    |
| 4060.953    | V             | 54.64                | 44.27     | 32.00            | 4.82          | 47.19                                | 13            | 3.50         | Peak     | 54.00             | -6.81     |
| 4872.000    | V             | 47.21                | 43.84     | 33.14            | 5.29          | 41.81                                | 16            | 3.50         | Peak     | 74.00             | -32.19    |
| 4872.000    | V             | 35.43                | 43.84     | 33.14            | 5.29          | 30.02                                | 16            | 3.50         | Avg      | 54.00             | -23.98    |
| 7308.000    | V             | 47.26                | 43.91     | 37.45            | 6.47          | 47.27                                | 14            | 3.50         | Peak     | 74.00             | -26.73    |
| 7308.000    | V             | 36.32                | 43.91     | 37.45            | 6.47          | 36.33                                | 14            | 3.50         | Avg      | 54.00             | -17.67    |
| 9744.000    | V             | 47.19                | 44.10     | 38.11            | 7.53          | 48.74                                | 13            | 3.50         | Peak     | 74.00             | -25.26    |
| 9744.000    | V             | 36.99                | 44.10     | 38.11            | 7.53          | 38.54                                | 13            | 3.50         | Avg      | 54.00             | -15.46    |
| 12180.000   | V             | 46.05                | 43.84     | 38.41            | 8.39          | 49.02                                | 13            | 3.50         | Peak     | 74.00             | -24.98    |
| 12180.000   | V             | 36.55                | 43.84     | 38.41            | 8.39          | 39.51                                | 13            | 3.50         | Avg      | 54.00             | -14.49    |
| 14616.000   | V             | 47.75                | 45.39     | 40.76            | 9.24          | 52.36                                | 14            | 3.50         | Peak     | 74.00             | -21.64    |
| 14616.000   | V             | 36.45                | 45.39     | 40.76            | 9.24          | 41.07                                | 14            | 3.50         | Avg      | 54.00             | -12.93    |
| 17052.000   | V             | 47.65                | 43.86     | 41.14            | 10.15         | 55.08                                | 13            | 3.50         | Peak     | 74.00             | -18.92    |
| 17052.000   | V             | 37.13                | 43.86     | 41.14            | 10.15         | 44.55                                | 13            | 3.50         | Avg      | 54.00             | -9.45     |
| 19488.000   | V             | 50.16                | 53.43     | 45.50            | 11.00         | 53.23                                | 13            | 3.20         | Peak     | 74.00             | -20.77    |
| 19488.000   | V             | 37.86                | 53.43     | 45.50            | 11.00         | 40.93                                | 13            | 3.20         | Avg      | 54.00             | -13.07    |

Note: FS = Raw – Preamp Factor + Antenna Factor + Cable Factor

Test Results: Worst Case Spurious from Antenna Positions 1 – 4.  
15.209 Radiated Spurious Emissions Middle Channel, Tx at 2450.567868 MHz

| Freq. (MHz) | Ant. Polarity | Raw Amp. @ 3m dBuV/m | Preamp dB | Ant. Factor dB/m | Cable Loss dB | Field Strength Final Amp @ 3m dBuV/m | Ant. Position | Ant Height m | Detector | Limit @3 m dBuV/m | Margin dB |
|-------------|---------------|----------------------|-----------|------------------|---------------|--------------------------------------|---------------|--------------|----------|-------------------|-----------|
| 14.476      | Par           | 53.03                | 32.53     | 34.02            | 0.37          | 54.89                                | 1             | 1.00         | Peak     | 69.50             | -14.61    |
| 15.195      | Par           | 51.14                | 32.54     | 33.96            | 0.38          | 52.94                                | 1             | 1.00         | Peak     | 69.50             | -16.56    |
| 14.460      | Perp          | 49.33                | 32.53     | 34.02            | 0.37          | 51.19                                | 1             | 1.00         | Peak     | 69.50             | -18.31    |
| 26.910      | Perp          | 39.40                | 32.55     | 32.96            | 0.48          | 40.29                                | 2             | 1.00         | Peak     | 69.50             | -29.21    |
| 62.980      | H             | 42.83                | 32.53     | 10.31            | 0.75          | 21.36                                | 4             | 1.70         | Peak     | 40.00             | -18.64    |
| 299.900     | H             | 38.44                | 32.50     | 17.16            | 1.44          | 24.54                                | 1             | 1.70         | Peak     | 46.00             | -21.46    |
| 375.770     | V             | 45.09                | 32.56     | 18.71            | 1.59          | 32.84                                | 3             | 1.70         | Peak     | 46.00             | -13.16    |
| 1117.036    | V             | 50.19                | 46.66     | 23.92            | 2.60          | 30.05                                | 3             | 3.50         | Peak     | 54.00             | -23.95    |
| 1815.539    | V             | 59.10                | 45.55     | 26.04            | 3.26          | 42.86                                | 2             | 3.50         | Peak     | 54.00             | -11.14    |
| 4060.953    | V             | 53.32                | 44.27     | 32.00            | 4.82          | 45.87                                | 2             | 3.50         | Peak     | 54.00             | -8.13     |
| 4901.136    | V             | 47.27                | 43.86     | 32.98            | 5.30          | 41.69                                | 1             | 2.20         | Peak     | 74.00             | -32.31    |
| 4901.136    | V             | 33.53                | 43.86     | 32.98            | 5.30          | 27.95                                | 1             | 2.20         | Avg      | 54.00             | -26.05    |
| 7351.704    | V             | 47.08                | 43.96     | 37.69            | 6.48          | 47.29                                | 2             | 2.20         | Peak     | 74.00             | -26.71    |
| 7351.704    | V             | 33.40                | 43.96     | 37.69            | 6.48          | 33.61                                | 2             | 2.20         | Avg      | 54.00             | -20.39    |
| 9802.271    | V             | 47.54                | 44.18     | 38.21            | 7.56          | 49.12                                | 2             | 2.20         | Peak     | 74.00             | -24.88    |
| 9802.271    | V             | 33.09                | 44.18     | 38.21            | 7.56          | 34.67                                | 2             | 2.20         | Avg      | 54.00             | -19.33    |
| 12252.839   | V             | 44.94                | 43.80     | 38.59            | 8.45          | 48.18                                | 4             | 2.20         | Peak     | 74.00             | -25.82    |
| 12252.839   | V             | 31.09                | 43.80     | 38.59            | 8.45          | 34.33                                | 4             | 2.20         | Avg      | 54.00             | -19.67    |
| 14703.407   | V             | 51.27                | 45.29     | 40.68            | 9.27          | 55.93                                | 3             | 2.20         | Peak     | 74.00             | -18.07    |
| 14703.407   | V             | 37.21                | 45.29     | 40.68            | 9.27          | 41.87                                | 3             | 2.20         | Avg      | 54.00             | -12.13    |
| 17153.975   | V             | 50.82                | 43.68     | 41.13            | 10.18         | 58.46                                | 1             | 2.20         | Peak     | 74.00             | -15.54    |
| 17153.975   | V             | 36.91                | 43.68     | 41.13            | 10.18         | 44.55                                | 1             | 2.20         | Avg      | 54.00             | -9.45     |
| 19604.543   | V             | 53.02                | 53.22     | 45.53            | 11.03         | 56.35                                | 1             | 2.60         | Peak     | 74.00             | -17.65    |
| 19604.543   | V             | 36.72                | 53.22     | 45.53            | 11.03         | 40.05                                | 1             | 2.60         | Avg      | 54.00             | -13.95    |

Note: FS = Raw – Preamp Factor + Antenna Factor + Cable Factor

Test Results: Worst Case Spurious from Antenna Positions 5 – 8.  
15.209 Radiated Spurious Emissions Middle Channel, Tx at 2450.567868 MHz

| Freq. (MHz) | Ant. Polarity | Raw Amp. @ 3m dBuV/m | Preamp dB | Ant. Factor dB/m | Cable Loss dB | Field Strength Final Amp @ 3m dBuV/m | Ant. Position | Ant Height m | Detector | Limit @3 m dBuV/m | Margin dB |
|-------------|---------------|----------------------|-----------|------------------|---------------|--------------------------------------|---------------|--------------|----------|-------------------|-----------|
| 14.467      | Par           | 50.73                | 32.53     | 34.02            | 0.37          | 52.59                                | 8             | 1.00         | Peak     | 69.50             | -16.91    |
| 15.176      | Par           | 49.01                | 32.54     | 33.96            | 0.38          | 50.81                                | 8             | 1.00         | Peak     | 69.50             | -18.69    |
| 14.472      | Perp          | 46.35                | 32.53     | 34.02            | 0.37          | 48.21                                | 5             | 1.00         | Peak     | 69.50             | -21.29    |
| 26.896      | Perp          | 45.26                | 32.55     | 32.96            | 0.48          | 46.15                                | 8             | 1.00         | Peak     | 69.50             | -23.35    |
| 62.980      | H             | 45.12                | 32.53     | 10.31            | 0.75          | 23.65                                | 7             | 2.20         | Peak     | 40.00             | -16.35    |
| 299.900     | H             | 41.61                | 32.50     | 17.16            | 1.44          | 27.71                                | 7             | 2.20         | Peak     | 46.00             | -18.29    |
| 375.770     | V             | 45.40                | 32.56     | 18.71            | 1.59          | 33.15                                | 8             | 2.20         | Peak     | 46.00             | -12.85    |
| 1117.036    | V             | 50.80                | 46.66     | 23.92            | 2.60          | 30.66                                | 5             | 3.50         | Peak     | 54.00             | -23.34    |
| 1815.539    | V             | 58.78                | 45.55     | 26.04            | 3.26          | 42.54                                | 5             | 3.50         | Peak     | 54.00             | -11.46    |
| 4060.953    | V             | 53.52                | 44.27     | 32.00            | 4.82          | 46.07                                | 7             | 3.50         | Peak     | 54.00             | -7.93     |
| 4901.136    | V             | 47.84                | 43.86     | 32.98            | 5.30          | 42.26                                | 8             | 3.80         | Peak     | 74.00             | -31.74    |
| 4901.136    | V             | 35.42                | 43.86     | 32.98            | 5.30          | 29.84                                | 8             | 3.80         | Avg      | 54.00             | -24.16    |
| 7351.704    | V             | 47.40                | 43.96     | 37.69            | 6.48          | 47.60                                | 8             | 3.80         | Peak     | 74.00             | -26.40    |
| 7351.704    | V             | 36.65                | 43.96     | 37.69            | 6.48          | 36.86                                | 8             | 3.80         | Avg      | 54.00             | -17.14    |
| 9802.271    | V             | 47.79                | 44.18     | 38.21            | 7.56          | 49.37                                | 5             | 3.80         | Peak     | 74.00             | -24.63    |
| 9802.271    | V             | 35.17                | 44.18     | 38.21            | 7.56          | 36.75                                | 5             | 3.80         | Avg      | 54.00             | -17.25    |
| 12252.839   | V             | 46.81                | 43.80     | 38.59            | 8.45          | 50.05                                | 7             | 3.80         | Peak     | 74.00             | -23.95    |
| 12252.839   | V             | 35.24                | 43.80     | 38.59            | 8.45          | 38.48                                | 7             | 3.80         | Avg      | 54.00             | -15.52    |
| 14703.407   | V             | 47.62                | 45.29     | 40.68            | 9.27          | 52.28                                | 8             | 3.80         | Peak     | 74.00             | -21.72    |
| 14703.407   | V             | 36.89                | 45.29     | 40.68            | 9.27          | 41.55                                | 8             | 3.80         | Avg      | 54.00             | -12.45    |
| 17153.975   | V             | 47.08                | 43.68     | 41.13            | 10.18         | 54.72                                | 8             | 3.80         | Peak     | 74.00             | -19.28    |
| 17153.975   | V             | 37.76                | 43.68     | 41.13            | 10.18         | 45.39                                | 8             | 3.80         | Avg      | 54.00             | -8.61     |
| 19604.543   | V             | 52.23                | 53.22     | 45.53            | 11.03         | 55.56                                | 6             | 2.40         | Peak     | 74.00             | -18.44    |
| 19604.543   | V             | 36.25                | 53.22     | 45.53            | 11.03         | 39.59                                | 6             | 2.40         | Avg      | 54.00             | -14.41    |

Note: FS = Raw – Preamp Factor + Antenna Factor + Cable Factor

Test Results: Worst Case Spurious from Antenna Positions 9 – 12.  
15.209 Radiated Spurious Emissions Middle Channel, Tx at 2450.567868 MHz

| Freq. (MHz) | Ant. Polarity | Raw Amp. @ 3m dBuV/m | Preamp dB | Ant. Factor dB/m | Cable Loss dB | Field Strength Final Amp @ 3m dBuV/m | Ant. Position | Ant Height m | Detector | Limit @3 m dBuV/m | Margin dB |
|-------------|---------------|----------------------|-----------|------------------|---------------|--------------------------------------|---------------|--------------|----------|-------------------|-----------|
| 14.577      | Par           | 52.06                | 32.53     | 34.02            | 0.37          | 53.92                                | 9             | 1.00         | Peak     | 69.50             | -15.58    |
| 15.083      | Par           | 51.68                | 32.54     | 33.96            | 0.38          | 53.48                                | 9             | 1.00         | Peak     | 69.50             | -16.02    |
| 14.475      | Perp          | 50.63                | 32.53     | 34.02            | 0.37          | 52.49                                | 11            | 1.00         | Peak     | 69.50             | -17.01    |
| 26.863      | Perp          | 50.15                | 32.55     | 32.96            | 0.48          | 51.04                                | 11            | 1.00         | Peak     | 69.50             | -18.46    |
| 62.980      | H             | 47.75                | 32.53     | 10.31            | 0.75          | 26.28                                | 12            | 2.00         | Peak     | 40.00             | -13.72    |
| 299.900     | H             | 42.91                | 32.50     | 17.16            | 1.44          | 29.01                                | 12            | 2.00         | Peak     | 46.00             | -16.99    |
| 375.770     | V             | 48.78                | 32.56     | 18.71            | 1.59          | 36.53                                | 11            | 2.00         | Peak     | 46.00             | -9.47     |
| 1117.036    | V             | 50.57                | 46.66     | 23.92            | 2.60          | 30.43                                | 12            | 3.50         | Peak     | 54.00             | -23.57    |
| 1815.539    | V             | 58.91                | 45.55     | 26.04            | 3.26          | 42.67                                | 12            | 3.50         | Peak     | 54.00             | -11.33    |
| 4060.953    | V             | 53.70                | 44.27     | 32.00            | 4.82          | 46.25                                | 10            | 3.50         | Peak     | 54.00             | -7.75     |
| 4901.136    | V             | 47.89                | 43.86     | 32.98            | 5.30          | 42.31                                | 11            | 3.40         | Peak     | 74.00             | -31.69    |
| 4901.136    | V             | 36.51                | 43.86     | 32.98            | 5.30          | 30.93                                | 11            | 3.40         | Avg      | 54.00             | -23.07    |
| 7351.704    | V             | 46.39                | 43.96     | 37.69            | 6.48          | 46.60                                | 12            | 3.40         | Peak     | 74.00             | -27.40    |
| 7351.704    | V             | 35.72                | 43.96     | 37.69            | 6.48          | 35.93                                | 12            | 3.40         | Avg      | 54.00             | -18.07    |
| 9802.271    | V             | 46.55                | 44.18     | 38.21            | 7.56          | 48.13                                | 12            | 3.40         | Peak     | 74.00             | -25.87    |
| 9802.271    | V             | 36.98                | 44.18     | 38.21            | 7.56          | 38.56                                | 12            | 3.40         | Avg      | 54.00             | -15.44    |
| 12252.839   | V             | 47.14                | 43.80     | 38.59            | 8.45          | 50.38                                | 11            | 3.40         | Peak     | 74.00             | -23.62    |
| 12252.839   | V             | 37.02                | 43.80     | 38.59            | 8.45          | 40.26                                | 11            | 3.40         | Avg      | 54.00             | -13.74    |
| 14703.407   | V             | 46.90                | 45.29     | 40.68            | 9.27          | 51.57                                | 11            | 3.40         | Peak     | 74.00             | -22.43    |
| 14703.407   | V             | 36.62                | 45.29     | 40.68            | 9.27          | 41.28                                | 11            | 3.40         | Avg      | 54.00             | -12.72    |
| 17153.975   | V             | 46.72                | 43.68     | 41.13            | 10.18         | 54.35                                | 12            | 3.40         | Peak     | 74.00             | -19.65    |
| 17153.975   | V             | 36.94                | 43.68     | 41.13            | 10.18         | 44.58                                | 12            | 3.40         | Avg      | 54.00             | -9.42     |
| 19604.543   | V             | 53.15                | 53.22     | 45.53            | 11.03         | 56.48                                | 12            | 3.20         | Peak     | 74.00             | -17.52    |
| 19604.543   | V             | 38.41                | 53.22     | 45.53            | 11.03         | 41.74                                | 12            | 3.20         | Avg      | 54.00             | -12.26    |

Note: FS = Raw – Preamp Factor + Antenna Factor + Cable Factor

Test Results: Worst Case Spurious from Antenna Positions 13 – 16.  
15.209 Radiated Spurious Emissions Middle Channel, Tx at 2450.567868 MHz

| Freq. (MHz) | Ant. Polarity | Raw Amp. @ 3m dBuV/m | Preamp dB | Ant. Factor dB/m | Cable Loss dB | Field Strength Final Amp @ 3m dBuV/m | Ant. Position | Ant Height m | Detector | Limit @3 m dBuV/m | Margin dB |
|-------------|---------------|----------------------|-----------|------------------|---------------|--------------------------------------|---------------|--------------|----------|-------------------|-----------|
| 14.505      | Par           | 50.12                | 32.53     | 34.02            | 0.37          | 51.98                                | 16            | 1.00         | Peak     | 69.50             | -17.52    |
| 15.210      | Par           | 47.60                | 32.54     | 33.96            | 0.38          | 49.40                                | 16            | 1.00         | Peak     | 69.50             | -20.10    |
| 14.460      | Perp          | 53.27                | 32.53     | 34.02            | 0.37          | 55.13                                | 14            | 1.00         | Peak     | 69.50             | -14.37    |
| 26.910      | Perp          | 50.91                | 32.55     | 32.96            | 0.48          | 51.80                                | 14            | 1.00         | Peak     | 69.50             | -17.70    |
| 62.980      | H             | 45.98                | 32.53     | 10.31            | 0.75          | 24.51                                | 16            | 2.40         | Peak     | 40.00             | -15.49    |
| 299.900     | H             | 46.39                | 32.50     | 17.16            | 1.44          | 32.49                                | 14            | 2.40         | Peak     | 46.00             | -13.51    |
| 375.770     | V             | 46.91                | 32.56     | 18.71            | 1.59          | 34.66                                | 16            | 2.40         | Peak     | 46.00             | -11.34    |
| 1117.036    | V             | 51.73                | 46.66     | 23.92            | 2.60          | 31.59                                | 14            | 3.50         | Peak     | 54.00             | -22.41    |
| 1815.539    | V             | 58.26                | 45.55     | 26.04            | 3.26          | 42.02                                | 15            | 3.50         | Peak     | 54.00             | -11.98    |
| 4060.953    | V             | 54.72                | 44.27     | 32.00            | 4.82          | 47.27                                | 15            | 3.50         | Peak     | 54.00             | -6.73     |
| 4901.136    | V             | 47.86                | 43.86     | 32.98            | 5.30          | 42.28                                | 16            | 3.50         | Peak     | 74.00             | -31.72    |
| 4901.136    | V             | 37.68                | 43.86     | 32.98            | 5.30          | 32.10                                | 16            | 3.50         | Avg      | 54.00             | -21.90    |
| 7351.704    | V             | 47.88                | 43.96     | 37.69            | 6.48          | 48.08                                | 14            | 3.50         | Peak     | 74.00             | -25.92    |
| 7351.704    | V             | 37.15                | 43.96     | 37.69            | 6.48          | 37.36                                | 14            | 3.50         | Avg      | 54.00             | -16.64    |
| 9802.271    | V             | 47.81                | 44.18     | 38.21            | 7.56          | 49.39                                | 13            | 3.50         | Peak     | 74.00             | -24.61    |
| 9802.271    | V             | 35.93                | 44.18     | 38.21            | 7.56          | 37.51                                | 13            | 3.50         | Avg      | 54.00             | -16.49    |
| 12252.839   | V             | 47.91                | 43.80     | 38.59            | 8.45          | 51.15                                | 13            | 3.50         | Peak     | 74.00             | -22.85    |
| 12252.839   | V             | 36.36                | 43.80     | 38.59            | 8.45          | 39.60                                | 13            | 3.50         | Avg      | 54.00             | -14.40    |
| 14703.407   | V             | 46.24                | 45.29     | 40.68            | 9.27          | 50.91                                | 13            | 3.50         | Peak     | 74.00             | -23.09    |
| 14703.407   | V             | 35.91                | 45.29     | 40.68            | 9.27          | 40.57                                | 13            | 3.50         | Avg      | 54.00             | -13.43    |
| 17153.975   | V             | 46.15                | 43.68     | 41.13            | 10.18         | 53.78                                | 14            | 3.50         | Peak     | 74.00             | -20.22    |
| 17153.975   | V             | 36.37                | 43.68     | 41.13            | 10.18         | 44.00                                | 14            | 3.50         | Avg      | 54.00             | -10.00    |
| 19604.543   | V             | 51.47                | 53.22     | 45.53            | 11.03         | 54.80                                | 14            | 3.20         | Peak     | 74.00             | -19.20    |
| 19604.543   | V             | 36.32                | 53.22     | 45.53            | 11.03         | 39.65                                | 14            | 3.20         | Avg      | 54.00             | -14.35    |

Note: FS = Raw – Preamp Factor + Antenna Factor + Cable Factor

Test Results: Worst Case Spurious from Antenna Positions 1 – 4.  
15.209 Radiated Spurious Emissions High Channel, Tx at 2463.921747 MHz

| Freq. (MHz) | Ant. Polarity | Raw Amp. @ 3m dBuV/m | Preamp dB | Ant. Factor dB/m | Cable Loss dB | Field Strength Final Amp @ 3m dBuV/m | Ant. Position | Ant Height m | Detector | Limit @3 m dBuV/m | Margin dB |
|-------------|---------------|----------------------|-----------|------------------|---------------|--------------------------------------|---------------|--------------|----------|-------------------|-----------|
| 14.476      | Par           | 53.09                | 32.53     | 34.02            | 0.37          | 54.95                                | 1             | 1.00         | Peak     | 69.50             | -14.55    |
| 15.195      | Par           | 51.81                | 32.54     | 33.96            | 0.38          | 53.61                                | 1             | 1.00         | Peak     | 69.50             | -15.89    |
| 14.460      | Perp          | 49.76                | 32.53     | 34.02            | 0.37          | 51.62                                | 1             | 1.00         | Peak     | 69.50             | -17.88    |
| 26.910      | Perp          | 39.60                | 32.55     | 32.96            | 0.48          | 40.49                                | 1             | 1.00         | Peak     | 69.50             | -29.01    |
| 62.980      | H             | 42.65                | 32.53     | 10.31            | 0.75          | 21.18                                | 4             | 1.70         | Peak     | 40.00             | -18.82    |
| 299.900     | H             | 38.89                | 32.50     | 17.16            | 1.44          | 24.99                                | 1             | 1.70         | Peak     | 46.00             | -21.01    |
| 375.770     | V             | 45.61                | 32.56     | 18.71            | 1.59          | 33.36                                | 1             | 1.70         | Peak     | 46.00             | -12.64    |
| 1117.036    | V             | 50.23                | 46.66     | 23.92            | 2.60          | 30.09                                | 3             | 3.50         | Peak     | 54.00             | -23.91    |
| 1815.539    | V             | 59.14                | 45.55     | 26.04            | 3.26          | 42.90                                | 2             | 3.50         | Peak     | 54.00             | -11.10    |
| 4060.953    | V             | 53.36                | 44.27     | 32.00            | 4.82          | 45.91                                | 2             | 3.50         | Peak     | 54.00             | -8.09     |
| 4927.843    | V             | 47.22                | 43.88     | 32.98            | 5.32          | 41.64                                | 1             | 2.20         | Peak     | 74.00             | -32.36    |
| 4927.843    | V             | 33.54                | 43.88     | 32.98            | 5.32          | 27.96                                | 1             | 2.20         | Avg      | 54.00             | -26.04    |
| 7391.765    | V             | 47.77                | 44.02     | 37.79            | 6.48          | 48.03                                | 3             | 2.20         | Peak     | 74.00             | -25.97    |
| 7391.765    | V             | 33.51                | 44.02     | 37.79            | 6.48          | 33.77                                | 3             | 2.20         | Avg      | 54.00             | -20.23    |
| 9855.687    | V             | 32.54                | 44.27     | 38.48            | 7.60          | 34.35                                | 4             | 2.20         | Peak     | 74.00             | -39.65    |
| 9855.687    | V             | 32.48                | 44.27     | 38.48            | 7.60          | 34.29                                | 4             | 2.20         | Avg      | 54.00             | -19.71    |
| 12319.609   | V             | 44.90                | 43.82     | 38.72            | 8.49          | 48.29                                | 3             | 2.20         | Peak     | 74.00             | -25.71    |
| 12319.609   | V             | 30.96                | 43.82     | 38.72            | 8.49          | 34.35                                | 3             | 2.20         | Avg      | 54.00             | -19.65    |
| 14783.530   | V             | 51.65                | 45.06     | 40.35            | 9.31          | 56.24                                | 1             | 2.20         | Peak     | 74.00             | -17.76    |
| 14783.530   | V             | 36.92                | 45.06     | 40.35            | 9.31          | 41.51                                | 1             | 2.20         | Avg      | 54.00             | -12.49    |
| 17247.452   | V             | 50.23                | 43.56     | 41.69            | 10.22         | 58.57                                | 2             | 2.20         | Peak     | 74.00             | -15.43    |
| 17247.452   | V             | 37.11                | 43.56     | 41.69            | 10.22         | 45.45                                | 2             | 2.20         | Avg      | 54.00             | -8.55     |
| 19711.374   | V             | 52.93                | 53.62     | 45.64            | 11.05         | 56.00                                | 2             | 2.60         | Peak     | 74.00             | -18.00    |
| 19711.374   | V             | 37.11                | 53.62     | 45.64            | 11.05         | 40.18                                | 2             | 2.60         | Avg      | 54.00             | -13.82    |

Note: FS = Raw – Preamp Factor + Antenna Factor + Cable Factor

Test Results: Worst Case Spurious from Antenna Positions 5 – 8.  
15.209 Radiated Spurious Emissions High Channel, Tx at 2463.921747 MHz

| Freq. (MHz) | Ant. Polarity | Raw Amp. @ 3m dBuV/m | Preamp dB | Ant. Factor dB/m | Cable Loss dB | Field Strength Final Amp @ 3m dBuV/m | Ant. Position | Ant Height m | Detector | Limit @3 m dBuV/m | Margin dB |
|-------------|---------------|----------------------|-----------|------------------|---------------|--------------------------------------|---------------|--------------|----------|-------------------|-----------|
| 14.467      | Par           | 51.16                | 32.53     | 34.02            | 0.37          | 53.02                                | 8             | 1.00         | Peak     | 69.50             | -16.48    |
| 15.176      | Par           | 49.23                | 32.54     | 33.96            | 0.38          | 51.03                                | 8             | 1.00         | Peak     | 69.50             | -18.47    |
| 14.472      | Perp          | 44.48                | 32.53     | 34.02            | 0.37          | 46.34                                | 8             | 1.00         | Peak     | 69.50             | -23.16    |
| 26.896      | Perp          | 45.79                | 32.55     | 32.96            | 0.48          | 46.68                                | 8             | 1.00         | Peak     | 69.50             | -22.82    |
| 62.980      | H             | 45.98                | 32.53     | 10.31            | 0.75          | 24.51                                | 7             | 2.20         | Peak     | 40.00             | -15.49    |
| 299.900     | H             | 41.79                | 32.50     | 17.16            | 1.44          | 27.89                                | 8             | 2.20         | Peak     | 46.00             | -18.11    |
| 375.770     | V             | 46.04                | 32.56     | 18.71            | 1.59          | 33.79                                | 7             | 2.20         | Peak     | 46.00             | -12.21    |
| 1117.036    | V             | 50.47                | 46.66     | 23.92            | 2.60          | 30.33                                | 5             | 3.50         | Peak     | 54.00             | -23.67    |
| 1815.539    | V             | 58.45                | 45.55     | 26.04            | 3.26          | 42.21                                | 5             | 3.50         | Peak     | 54.00             | -11.79    |
| 4060.953    | V             | 53.19                | 44.27     | 32.00            | 4.82          | 45.74                                | 7             | 3.50         | Peak     | 54.00             | -8.26     |
| 4927.843    | V             | 46.52                | 43.88     | 32.98            | 5.32          | 40.94                                | 7             | 3.80         | Peak     | 74.00             | -33.06    |
| 4927.843    | V             | 35.10                | 43.88     | 32.98            | 5.32          | 29.52                                | 7             | 3.80         | Avg      | 54.00             | -24.48    |
| 7391.765    | V             | 47.13                | 44.02     | 37.79            | 6.48          | 47.39                                | 6             | 3.80         | Peak     | 74.00             | -26.61    |
| 7391.765    | V             | 37.42                | 44.02     | 37.79            | 6.48          | 37.68                                | 6             | 3.80         | Avg      | 54.00             | -16.32    |
| 9855.687    | V             | 47.80                | 44.27     | 38.48            | 7.60          | 49.62                                | 5             | 3.80         | Peak     | 74.00             | -24.38    |
| 9855.687    | V             | 35.42                | 44.27     | 38.48            | 7.60          | 37.23                                | 5             | 3.80         | Avg      | 54.00             | -16.77    |
| 12319.609   | V             | 47.24                | 43.82     | 38.72            | 8.49          | 50.63                                | 7             | 3.80         | Peak     | 74.00             | -23.37    |
| 12319.609   | V             | 37.38                | 43.82     | 38.72            | 8.49          | 40.77                                | 7             | 3.80         | Avg      | 54.00             | -13.23    |
| 14783.530   | V             | 46.95                | 45.06     | 40.35            | 9.31          | 51.55                                | 7             | 3.80         | Peak     | 74.00             | -22.45    |
| 14783.530   | V             | 37.67                | 45.06     | 40.35            | 9.31          | 42.26                                | 7             | 3.80         | Avg      | 54.00             | -11.74    |
| 17247.452   | V             | 46.26                | 43.56     | 41.69            | 10.22         | 54.60                                | 6             | 3.80         | Peak     | 74.00             | -19.40    |
| 17247.452   | V             | 35.91                | 43.56     | 41.69            | 10.22         | 44.25                                | 6             | 3.80         | Avg      | 54.00             | -9.75     |
| 19711.374   | V             | 51.59                | 53.62     | 45.64            | 11.05         | 54.66                                | 8             | 2.40         | Peak     | 74.00             | -19.34    |
| 19711.374   | V             | 37.78                | 53.62     | 45.64            | 11.05         | 40.84                                | 8             | 2.40         | Avg      | 54.00             | -13.16    |

Note: FS = Raw – Preamp Factor + Antenna Factor + Cable Factor



Test Results: Worst Case Spurious from Antenna Positions 9 – 12.  
15.209 Radiated Spurious Emissions High Channel, Tx at 2463.921747 MHz

| Freq. (MHz) | Ant. Polarity | Raw Amp. @ 3m dBuV/m | Preamp dB | Ant. Factor dB/m | Cable Loss dB | Field Strength Final Amp @ 3m dBuV/m | Ant. Position | Ant Height m | Detector | Limit @3 m dBuV/m | Margin dB |
|-------------|---------------|----------------------|-----------|------------------|---------------|--------------------------------------|---------------|--------------|----------|-------------------|-----------|
| 14.577      | Par           | 51.52                | 32.53     | 34.02            | 0.37          | 53.38                                | 9             | 1.00         | Peak     | 69.50             | -16.12    |
| 15.083      | Par           | 51.66                | 32.54     | 33.96            | 0.38          | 53.46                                | 9             | 1.00         | Peak     | 69.50             | -16.04    |
| 14.475      | Perp          | 57.89                | 32.53     | 34.02            | 0.37          | 59.75                                | 9             | 1.00         | Peak     | 69.50             | -9.75     |
| 26.863      | Perp          | 50.94                | 32.55     | 32.96            | 0.48          | 51.83                                | 11            | 1.00         | Peak     | 69.50             | -17.67    |
| 62.980      | H             | 47.43                | 32.53     | 10.31            | 0.75          | 25.96                                | 12            | 2.00         | Peak     | 40.00             | -14.04    |
| 299.900     | H             | 43.81                | 32.50     | 17.16            | 1.44          | 29.91                                | 12            | 2.00         | Peak     | 46.00             | -16.09    |
| 375.770     | V             | 49.09                | 32.56     | 18.71            | 1.59          | 36.84                                | 10            | 2.00         | Peak     | 46.00             | -9.16     |
| 1117.036    | V             | 50.66                | 46.66     | 23.92            | 2.60          | 30.52                                | 12            | 3.50         | Peak     | 54.00             | -23.48    |
| 1815.539    | V             | 59.00                | 45.55     | 26.04            | 3.26          | 42.76                                | 12            | 3.50         | Peak     | 54.00             | -11.24    |
| 4060.953    | V             | 53.79                | 44.27     | 32.00            | 4.82          | 46.34                                | 10            | 3.50         | Peak     | 54.00             | -7.66     |
| 4927.843    | V             | 46.90                | 43.88     | 32.98            | 5.32          | 41.32                                | 11            | 3.40         | Peak     | 74.00             | -32.68    |
| 4927.843    | V             | 36.92                | 43.88     | 32.98            | 5.32          | 31.34                                | 11            | 3.40         | Avg      | 54.00             | -22.66    |
| 7391.765    | V             | 47.54                | 44.02     | 37.79            | 6.48          | 47.80                                | 11            | 3.40         | Peak     | 74.00             | -26.20    |
| 7391.765    | V             | 37.02                | 44.02     | 37.79            | 6.48          | 37.28                                | 11            | 3.40         | Avg      | 54.00             | -16.72    |
| 9855.687    | V             | 46.12                | 44.27     | 38.48            | 7.60          | 47.93                                | 12            | 3.40         | Peak     | 74.00             | -26.07    |
| 9855.687    | V             | 35.67                | 44.27     | 38.48            | 7.60          | 37.49                                | 12            | 3.40         | Avg      | 54.00             | -16.51    |
| 12319.609   | V             | 47.26                | 43.82     | 38.72            | 8.49          | 50.66                                | 12            | 3.40         | Peak     | 74.00             | -23.34    |
| 12319.609   | V             | 36.68                | 43.82     | 38.72            | 8.49          | 40.07                                | 12            | 3.40         | Avg      | 54.00             | -13.93    |
| 14783.530   | V             | 46.31                | 45.06     | 40.35            | 9.31          | 50.90                                | 11            | 3.40         | Peak     | 74.00             | -23.10    |
| 14783.530   | V             | 35.11                | 45.06     | 40.35            | 9.31          | 39.70                                | 11            | 3.40         | Avg      | 54.00             | -14.30    |
| 17247.452   | V             | 47.95                | 43.56     | 41.69            | 10.22         | 56.29                                | 12            | 3.40         | Peak     | 74.00             | -17.71    |
| 17247.452   | V             | 35.15                | 43.56     | 41.69            | 10.22         | 43.49                                | 12            | 3.40         | Avg      | 54.00             | -10.51    |
| 19711.374   | V             | 53.15                | 53.62     | 45.64            | 11.05         | 56.22                                | 10            | 3.20         | Peak     | 74.00             | -17.78    |
| 19711.374   | V             | 36.90                | 53.62     | 45.64            | 11.05         | 39.97                                | 10            | 3.20         | Avg      | 54.00             | -14.03    |

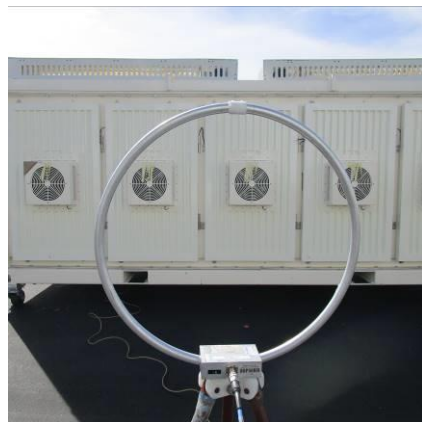
Note: FS = Raw – Preamp Factor + Antenna Factor + Cable Factor

Test Results: Worst Case Spurious from Antenna Positions 13 – 16.  
15.209 Radiated Spurious Emissions High Channel, Tx at 2463.921747 MHz

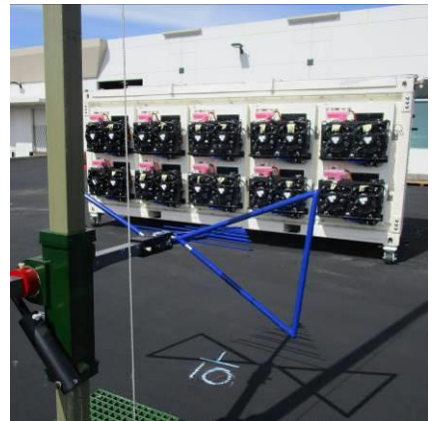
| Freq. (MHz) | Ant. Polarity | Raw Amp. @ 3m dBuV/m | Preamp dB | Ant. Factor dB/m | Cable Loss dB | Field Strength Final Amp @ 3m dBuV/m | Ant. Position | Ant Height m | Detector | Limit @3 m dBuV/m | Margin dB |
|-------------|---------------|----------------------|-----------|------------------|---------------|--------------------------------------|---------------|--------------|----------|-------------------|-----------|
| 14.505      | Par           | 50.40                | 32.53     | 34.02            | 0.37          | 52.26                                | 16            | 1.00         | Peak     | 69.50             | -17.24    |
| 15.210      | Par           | 47.89                | 32.54     | 33.96            | 0.38          | 49.69                                | 14            | 1.00         | Peak     | 69.50             | -19.81    |
| 14.460      | Perp          | 52.99                | 32.53     | 34.02            | 0.37          | 54.85                                | 15            | 1.00         | Peak     | 69.50             | -14.65    |
| 26.910      | Perp          | 49.27                | 32.55     | 32.96            | 0.48          | 50.16                                | 14            | 1.00         | Peak     | 69.50             | -19.34    |
| 62.980      | H             | 45.71                | 32.53     | 10.31            | 0.75          | 24.24                                | 16            | 2.40         | Peak     | 40.00             | -15.76    |
| 299.900     | H             | 42.65                | 32.50     | 17.16            | 1.44          | 28.75                                | 16            | 2.40         | Peak     | 46.00             | -17.25    |
| 375.770     | V             | 49.03                | 32.56     | 18.71            | 1.59          | 36.78                                | 14            | 2.40         | Peak     | 46.00             | -9.22     |
| 1117.036    | V             | 52.43                | 46.66     | 23.92            | 2.60          | 32.29                                | 13            | 3.50         | Peak     | 54.00             | -21.71    |
| 1815.539    | V             | 58.09                | 45.55     | 26.04            | 3.26          | 41.85                                | 13            | 3.50         | Peak     | 54.00             | -12.15    |
| 4060.953    | V             | 54.41                | 44.27     | 32.00            | 4.82          | 46.96                                | 13            | 3.50         | Peak     | 54.00             | -7.04     |
| 4927.843    | V             | 47.87                | 43.88     | 32.98            | 5.32          | 42.29                                | 14            | 3.50         | Peak     | 74.00             | -31.71    |
| 4927.843    | V             | 35.08                | 43.88     | 32.98            | 5.32          | 29.50                                | 14            | 3.50         | Avg      | 54.00             | -24.50    |
| 7391.765    | V             | 46.98                | 44.02     | 37.79            | 6.48          | 47.23                                | 14            | 3.50         | Peak     | 74.00             | -26.77    |
| 7391.765    | V             | 37.44                | 44.02     | 37.79            | 6.48          | 37.70                                | 14            | 3.50         | Avg      | 54.00             | -16.30    |
| 9855.687    | V             | 46.51                | 44.27     | 38.48            | 7.60          | 48.32                                | 14            | 3.50         | Peak     | 74.00             | -25.68    |
| 9855.687    | V             | 36.55                | 44.27     | 38.48            | 7.60          | 38.36                                | 14            | 3.50         | Avg      | 54.00             | -15.64    |
| 12319.609   | V             | 46.42                | 43.82     | 38.72            | 8.49          | 49.81                                | 14            | 3.50         | Peak     | 74.00             | -24.19    |
| 12319.609   | V             | 35.76                | 43.82     | 38.72            | 8.49          | 39.15                                | 14            | 3.50         | Avg      | 54.00             | -14.85    |
| 14783.530   | V             | 47.10                | 45.06     | 40.35            | 9.31          | 51.70                                | 14            | 3.50         | Peak     | 74.00             | -22.30    |
| 14783.530   | V             | 35.15                | 45.06     | 40.35            | 9.31          | 39.74                                | 14            | 3.50         | Avg      | 54.00             | -14.26    |
| 17247.452   | V             | 46.90                | 43.56     | 41.69            | 10.22         | 55.24                                | 13            | 3.50         | Peak     | 74.00             | -18.76    |
| 17247.452   | V             | 36.86                | 43.56     | 41.69            | 10.22         | 45.20                                | 13            | 3.50         | Avg      | 54.00             | -8.80     |
| 19711.374   | V             | 51.02                | 53.62     | 45.64            | 11.05         | 54.09                                | 13            | 3.20         | Peak     | 74.00             | -19.91    |
| 19711.374   | V             | 37.68                | 53.62     | 45.64            | 11.05         | 40.75                                | 13            | 3.20         | Avg      | 54.00             | -13.25    |

Note: FS = Raw – Preamp Factor + Antenna Factor + Cable Factor

#### 4.7.7 Test Setup Photographs



#### 4.7.5 Test Setup Photographs (Continued)





#### 4.7.5 Test Setup Photographs (Continued)



#### 4.7.5 Test Setup Photographs (Continued)



4.8 AC Line Conducted Emission  
FCC: 15.207

4.8.1 Requirement

| Frequency Band<br>MHz | Class B Limit dB( $\mu$ V) |            | Class A Limit dB( $\mu$ V) |         |
|-----------------------|----------------------------|------------|----------------------------|---------|
|                       | Quasi-Peak                 | Average    | Quasi-Peak                 | Average |
| 0.15-0.50             | 66 to 56 *                 | 56 to 46 * | 79                         | 66      |
| 0.50-5.00             | 56                         | 46         | 73                         | 60      |
| 5.00-30.00            | 60                         | 50         | 73                         | 60      |

*Note: \*Decreases linearly with the logarithm of the frequency  
At the transition frequency the lower limit applies.*

#### 4.8.2 Procedure

Measurements are carried out using quasi-peak and average detector receivers in accordance with CISPR 16. An AMN is required to provide a defined impedance at high frequencies across the power feed at the point of measurement of terminal voltage and also to provide isolation of the circuit under test from the ambient noise on the power lines. An AMN as defined in CISPR 16 shall be used.

The EUT is located so that the distance between the boundary of the EUT and the closest surface of the AMN is 0.8m.

Where a flexible mains cord is provided by the manufacturer, this shall be 1m long or if in excess of 1m, the excess cable is folded back and forth as far as possible so as to form a bundle not exceeding 0.4m in length.

The EUT is arranged and connected with cables terminated in accordance with the product specification.

Conducted disturbance is measured between the phase lead and the reference ground, and between the neutral lead and the reference ground. Both measured values are reported.

The EUT, where intended for tabletop use, is placed on a table whose top is 0.8m above the ground plane. A vertical, metal reference plane is placed 0.4m from the EUT. The vertical metal reference-plane is at least 2m by 2m. The EUT shall be kept at least 0.8m from any other metal surface or other ground plane not being part of the EUT. The table is constructed of non-conductive materials. Its dimensions are 1m by 1.5m, but may be extended for larger EUT.

Floor standing EUT are placed on a horizontal metal ground plane and isolated from the ground plane by resting on an insulating material. The metal ground plane extends at least 0.5m beyond the boundaries of the EUT and has minimum dimensions of 2m by 2m.

Equipment setup for conducted disturbance tests followed the guidelines of ANSI C63.4:2014 and ANSI C63.10:2013.

#### 4.8.3 Test Results

Not Applicable. EUT does not have AC or DC power ports.



## 5.0 List of Test Equipment and Software

Measurement equipment used for emission compliance testing utilized the equipment on the following list:

Test Dates: March 14 – 17, 2022

| Equipment Description            | Manufacturer      | Model/ Type                | Asset No. | Cal Interval | Cal Due  |
|----------------------------------|-------------------|----------------------------|-----------|--------------|----------|
| Spectrum Analyzer                | Rohde and Schwarz | FSP-40                     | ITS 01200 | 12           | 01/11/23 |
| Passive Loop                     | EMCO              | 6512                       | ITS 01598 | 12           | 06/21/22 |
| Horn Antenna                     | ETS-Lindgren      | 3115                       | ITS 00982 | 12           | 05/13/22 |
| Horn Antenna                     | EMCO              | 3160-09                    | ITS 00571 | #            | #        |
| Bi-Log Antenna                   | Teseq             | CBL 6111D                  | ITS 01058 | 12           | 11/16/22 |
| Pre-Amplifier<br>(30 – 1000 MHz) | Sonoma Instrument | 310N                       | ITS 01714 | 12           | 11/19/22 |
| Pre-Amplifier<br>(1 – 18 GHz)    | uComp Nordic      | MCN-40-<br>00101800-25-10P | ITS 01817 | 12           | 01/11/23 |
| RF Cable                         | TRU Corporation   | TRU Core 300               | ITS 01460 | 12           | 06/29/22 |
| RF Cable                         | TRU Corporation   | TRU Core 300               | ITS 01333 | 12           | 04/28/22 |
| RF Cable                         | TRU Corporation   | TRU Core 300               | ITS 01342 | 12           | 09/10/22 |
| RF Cable                         | TRU Corporation   | TRU CORE 300               | ITS 0333  | 12           | 04/28/22 |
| RF Cable                         | Mega Phase        | EMC1-K1K1-236              | ITS 01781 | 12           | 02/25/23 |
| Notch Filter                     | Microtronics      | BRM50702                   | ITS 01166 | 12           | 06/29/22 |
| High Pass Filter                 | Microtronics      | HPM50114-02                | ITS 01722 | 12           | 11/24/22 |

# = No Calibration Required

Test Dates: April 11 – May 6, 2022

| Equipment Description | Manufacturer      | Model/ Type   | Asset No. | Cal Interval | Cal Due  |
|-----------------------|-------------------|---------------|-----------|--------------|----------|
| EMI Receiver          | Rohde and Schwarz | ESU40         | ITS 00961 | 12           | 03/10/23 |
| Spectrum Analyzer     | Rohde and Schwarz | FSU           | ITS 00913 | 12           | 05/24/22 |
| Horn Antenna          | ETS Lindgren      | 3115          | ITS 00982 | 12           | 05/13/22 |
| RF Cable              | Mega Phase        | EMC1-K1K1-236 | ITS 01408 | 12           | 09/10/22 |
| RF Cable              | Mega Phase        | TM40-K1K1-59  | ITS 01156 | 12           | 07/07/22 |
| Attenuator            | Narda             | FSCM99899     | ITS 01583 | 12           | 10/25/22 |

Software used for emission compliance testing utilized the following:

| Name | Manufacturer   | Version  | Template/Profile                                    |
|------|----------------|----------|---|
| Tile | Quantum Change | 3.4.K.22 | Conducted Spurious_30M-26GHz<br>Conducted Emissions |

## 6.0 Document History

| Revision/<br>Job Number | Writer<br>Initials | Reviewers<br>Initials | Date              | Change                        |
|-------------------------|--------------------|-----------------------|-------------------|-------------------------------|
| 1.0 / G104988398        | KR                 | AS                    | May 25, 2022      | Original Document             |
| 1.1 / G104988398        | KR                 | AS                    | September 9, 2022 | Corrected antenna gain value. |

***END OF REPORT***