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# Radio
# Test Report

**EUT Name:** Remote Control

**Model Name:** 1012000409, 1012000410, 1012000411

CFR 47 Part 15.247: 2021 and RSS 247: 2017

*Prepared for:*

Hunter Douglas Window Fashions Division
1 Duette Way
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U.S.A.

*Prepared by:*

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# Revisions

| Revision No. | Date MM/DD/YYYY | Reason for Change | Author |
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Note: Latest revision report will replace all previous reports.

# Statement of Compliance

| | |
|---|---|
| *Manufacturer:* | Hunter Douglas Window Fashions Division<br>1 Duette Way,<br>Broomfield, CO, 80020, USA |
| *Requester / Applicant:* | Hunter Douglas Window Fashions Division |
| *Name of Equipment:* | Remote Control |
| *Model No.* | 1012000409, 1012000410, 1012000411 |
| *Type of Equipment:* | Intentional Radiator |
| *Application of Regulations:* | CFR 47 Part 15.247: 2021 and RSS 247: 2017 |
| *Test Dates:* | June 24, 2021 to June 28, 2021 |

*Guidance Documents:*

Emissions: ANSI C63.10-2013, KDB 558074 D01 DTS Measurement Guidance v05r02

*Test Methods:*

Emissions: ANSI C63.10-2013, KDB 558074 D01 DTS Measurement Guidance v05r02

The electromagnetic compatibility test and documented data described in this report has been performed and recorded by TUV Rheinland, in accordance with the standards and procedures listed herein. As the responsible authorized agent of the EMC laboratory, I hereby declare that the equipment described above has been shown to be compliant with the EMC requirements of the stated regulations and standards based on these results. If any special accessories and/or modifications were required for compliance, they are listed in the Executive Summary of this report.

This report must not be used to claim product endorsement by A2LA or any agency of the U.S. Government. This report shall not be reproduced except in full, without the written authorization of TUV Rheinland of North America.

| | | | |
|---|---|---|---|
| Rachana Khanduri | | Richard Decker | |
| Prepared By | Date July 12, 2021 | Reviewer Signatory | Date July 12, 2021 |

**Testing Cert #3331.02** **US1131** **2932D**

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# 1 Executive Summary

## 1.1 Scope

This report is intended to document the status of conformance with the requirements of the CFR 47 Part 15.247: 2021 and RSS 247: 2017 based on the results of testing performed on June 24, 2021 to June 28, 2021 on the 1012000410 manufactured by Hunter Douglas Window Fashions Division. This report only applies to the specific samples tested under the stated test conditions. It is the responsibility of the manufacturer to assure that additional production units of this model are manufactured with identical or EMI equivalent electrical and mechanical components. This report is further intended to document changes and modifications to the EUT throughout its life cycle. All documentation will be included as a supplement.

## 1.2 Purpose

Testing was performed to evaluate the EMC performance of the EUT in accordance with the applicable requirements, procedures, and criteria defined in the application of regulations and application of standards listed in this report. The 2402 MHz to 2480 MHz frequency band for Bluetooth, Low Energy is covered in this document.

## 1.3 Summary of Test Results

**Table 1:** Summary of Test Results

| Test | Test Method ANSI C 63.10 & C63.4 | Worse Case (Measured) | Result |
|---|---|---|---|
| Maximum Output Power | CFR47 15.247 (b), RSS 247 Sect. 5.4 (d) | 6.93 dBm @ 2402MHz Channel, 1Mbps | **Complied** |
| DTS Bandwidth (6dB) | CFR47 15.247 (a)(2), RSS 247 Sect. 5.2 (a) | 0.716MHz @ 2402MHz Channel, 1Mbps | **Complied** |
| Peak Power Spectral Density | CFR47 15.247 (e), RSS 247 Sect. 5.2 (b) | -6.67 dBm/ kHz @ 2402MHz channel, 1Mbps | **Complied** |
| Out of Band Emissions: Non-Restricted | CFR47 15.247 (d), RSS 247 Sect.5.5 | -26.32 dBc @ 2400 MHz, Lower Band Edge | **Complied** |
| Out of Band Emissions: Restricted | CFR47 15.205, RSS GEN Sect.8.10 | -13.95dB margin @ 2483.5 MHz, Average | **Complied** |
| Transmitter Spurious Emissions | CFR47 15.209, CFR47 15.247 (d), RSS-GEN Sect.8.9 | -1.47dB Margin @ 12010.86MHz, Average | **Complied** |
| AC Power Conducted Emission | CFR47 15.207, RSS-GEN Sect.8.8 | EUT is DC powered | **N/A** |

Note: This test report covers 2400 MHz to 2480 MHz band.
Class B limits were applied where applicable.
N/A = Test not applicable since EUT is DC powered.

## 1.4 Special Accessories

No special accessories were necessary in order to achieve compliance.

## 1.5 Equipment Modifications

None

# 2 Laboratory Information

## *2.1 Accreditations & Endorsements*

### 2.1.1 US Federal Communications Commission

TUV Rheinland of North America EMC test facilities located at 1279 Quarry Lane, Ste. A, Pleasanton, CA, 94566, and 5015 Brandin Ct, Fremont, CA. 94538, are recognized by the Commission for performing testing services for the general public on a fee basis. These laboratory test facilities have been fully described in reports submitted to and accepted by the FCC (Pleasanton Registration No. US1131, Fremont Registration No. US1131). The laboratory Scopes of Accreditation include Title 47 CFR Parts 15, 18 and 90. The accreditations are updated every three years.

### 2.1.2 A2LA

TUV Rheinland of North America EMC test facilities are accredited by the American Association for Laboratory Accreditation (A2LA). The laboratories have been assessed and accredited by A2LA in accordance with ISO Standard 17025:2017 (Testing Certificate #3331.02). The Scope of Laboratory Accreditation includes emission and immunity testing. The accreditations are updated annually.

### 2.1.3 Industry Canada

The Pleasanton 5-meter Semi-Anechoic Chamber, Registration No. 2932M-1, has been accepted by Industry Canada to perform testing to 3 and 5 meters based on the test procedures described in ANSI C63.4-2014. The Fremont 10-meter Semi-Anechoic Chamber, Registration No. 2932D-1, has been accepted by Industry Canada to perform testing to 3 and 10 meters based on the test procedures described in ANSI C63.4-2014.

### 2.1.4 Japan – VCCI

The Voluntary Control Council for Interference by Information Technology Equipment (VCCI) is a group that consists of Information Technology Equipment (ITE) manufacturers and EMC test laboratories. The purpose of the Council is to take voluntary control measures against electromagnetic interference from Information Technology Equipment, and thereby contribute to the development of a socially beneficial and responsible state of affairs in the realm of Information Technology Equipment in Japan. TUV Rheinland of North America EMC test facilities located at 1279 Quarry Lane, Ste. A, Pleasanton, CA, 94566, and 5051 Brandin Ct, Fremont, CA. 94538, have been assessed and approved in accordance with the Regulations for Voluntary Control Measures.

VCCI Registration No. for Pleasanton: A-0326

VCCI Registration No. for Fremont: A-0327

### 2.1.5 Acceptance by Mutual Recognition Arrangement

The United States has an established agreement with specific countries under the Asia Pacific Laboratory Accreditation Corporation (APLAC) Mutual Recognition Arrangement. Under this agreement, all TUV Rheinland at 1279 Quarry Ln, Pleasanton, CA 94566 test results and test reports within the scope of the laboratory NIST / A2LA accreditation will be accepted by each member country.

## *2.2 Test Facilities*

Test facilities are located at 5015 Brandin Ct, Fremont, California, 94538, USA and 1279 Quarry Lane, Pleasanton, California 94566, USA (Fremont is the Pleasanton Annex).

### 2.2.1 Emission Test Facility

The Semi-Anechoic Chambers and AC Line Conducted measurement facilities used to collect radiated and conducted emissions data have been constructed in accordance with ANSI C63.7:1992. The Fremont 10 meter semi-anechoic chamber has been measured in accordance with and verified to comply with the theoretical volumetric normalized site attenuation of ANSI C63.4:2014 and SVSWR requirements of CISPR 16-1-4 Consol. Ed. 3.0 (2010-04), at test distances of 3 and 10 meters. This site has been described in reports dated November 1st, 2006, submitted to the FCC, and accepted by letter dated November 28, 2006. The site is listed with the FCC and accredited by A2LA (Testing Certificate #3331.02). The Pleasanton 5 meter semi-anechoic chamber has been verified to comply with the theoretical volumetric normalized site attenuation of ANSI C63.4:2009 and SVSWR requirements of CISPR 16-1-4 Consol. Ed. 3.0 (2010-04) at a test distance of 3 meters. This site has been described in reports dated November 1st, 2006, submitted to the FCC, and accepted by letter dated November 28, 2006. The site is listed with the FCC and accredited by A2LA (Testing Certificate #3331.02).

## *2.3 Measurement Uncertainty*

Two types of measurement uncertainty are expressed in this report, per *ISO Guide To The Expression Of Uncertainty In Measurement*, 1st Edition, 1995.

*The Combined Standard Uncertainty* is the standard uncertainty of the result of a measurement when that result is obtained from the values of a number of other quantities; it is equal to the positive square root of the sum of the variances or co-variances of these other quantities, weighted according to how the measurement result varies with changes in these quantities. The term *standard uncertainty* is the result of a measurement expressed as a standard deviation.

*The Expanded Uncertainty* defines an interval about the result of a measurement that may be expected to encompass a large fraction of the distribution of values that could reasonably be attributed to the measurement and the fraction may be viewed as the coverage probability or level of confidence of the interval.

### 2.3.1 Sample Calculation – radiated & conducted emissions

The field strength is calculated by subtracting the Amplifier Gain and adding the Cable Loss and Antenna Correction Factor to the measured reading. The basic equation is as follows:

Field Strength (dBμV/m) = RAW - AMP + CBL + ACF

Where: RAW = Measured level before correction (dBμV)

AMP = Amplifier Gain (dB)

CBL = Cable Loss (dB)

ACF = Antenna Correction Factor (dB/m)

$$\mu V/m = 10^{\frac{dB\mu V/m}{20}}$$

**Sample radiated emissions calculation @ 30 MHz**

**Measurement +Antenna Factor–Amplifier Gain+Cable loss=Radiated Emissions (dBuV/m)**

25 dBuV/m + 17.5 dB – 20 dB + 1.0 dB = 23.5 dBuV/m

### 2.3.2 Measurement Uncertainty

| **Per CISPR 16-4-2** | **$U_{lab}$** | **$U_{cispr}$** |
|---|---|---|
| **Radiated Disturbance @ 10 meters** | | |
| 30 – 1,000 MHz | 2.25 dB | 4.51 dB |
| **Radiated Disturbance @ 3 meters** | | |
| 30 – 1,000 MHz | 2.26 dB | 4.52 dB |
| 1 – 6 GHz | 2.12 dB | 4.25 dB |
| 6 – 18 GHz | 2.47 dB | 4.93 dB |
| **Conducted Disturbance @ Mains Terminals** | | |
| 150 kHz – 30 MHz | 1.09 dB | 2.18 dB |
| **Disturbance Power** | | |
| 30 MHz – 300 MHz | 3.92 dB | 4.3 dB |

## 2.4 Calibration Traceability

All measurement instrumentation is traceable to the National Institute of Standards and Technology (NIST). Measurement method complies with ANSI/NCSL Z540-1-1994 and ISO Standard 17025:2017. Equipment calibration records are kept on file at the test facility.

# 3 Product Information

## 3.1 Product Description

The 1012000409, 1012000410, 1012000411 are assembled into various remote assemblies and fabricated into Hunter Douglas window coverings via an easy to use and intuitive push-button handheld remote. This device utilized BLE in the 2400-2483.5MHz band.

Hunter Douglas Remotes which are model numbered differently for marketing purposes but utilize the same hardware and communication software. All devices are identical in componentry and wireless communication aspects. These different model numbers have unique Product Marketing Names and depending on the device utilize different product features which are independent of the device's wireless communication.

Model differences:
1012000409 REMOT; HD; PVG3; WHT; 000
1012000410 REMOT; HD; PVG3; HD; BLK; 000
1012000411 REMOT; NO LOGO; PVG3; WHT; 000

Model 1012000410 is considered worst case and used for testing.

## 3.2 Equipment Configuration

A description of the equipment configuration is given in the Test Plan Section. The EUT was tested as called for in the test standard and was configured and operated in a manner consistent with its intended use. The EUT was connected to rated power and allowed to reach intended operating conditions. The placement of the EUT system components was guided by the test standard and selected to represent typical installation conditions.

In the case of a EUT that can operate in more than one configuration, preliminary testing was performed to determine the configuration that produced maximum radiation.

The final configuration was selected to produce the worst case radiation for emissions testing and to place the EUT in the most susceptible state for immunity testing.

## 3.3 Operating Mode

A description of the operation mode is given in the Test Plan Section. In the case of a EUT that can operate in more than one state, preliminary testing was performed to determine the operating mode that produced maximum radiation.

The final operating mode was selected to produce the worst case radiation for emissions testing.

## *3.4 Unique Antenna Connector*

An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this Section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited. This requirement does not apply to carrier current devices or to devices operated under the provisions of CFR47 Parts 15.211, 15.213, 15.217, 15.219, or 15.221.

### 3.4.1 Results

The Remote Control has 1 dedicated Bluetooth integral, Trace antenna that has maximum gain of 0 dBi. It is not easily accessible to the end user.

It is integrated into the PCB of the device and is not easily accessible to the end user.

## 3.5 Duty Cycle

Model 1012000410 was measured for the duty cycle.

### 3.5.1 Results

| Mode | On Time (ms) | Period (ms) | Duty Cycle (%) | Duty Factor (dB) |
|---|---|---|---|---|
| BLE-1Mbps | 100 | 0 | 100 | 0 |
| BLE-2Mbps | 100 | 0 | 100 | 0 |
| **Notes:** EUT was configured and measured for the duty cycle. All measurements use 100% duty cycle. | | | | |

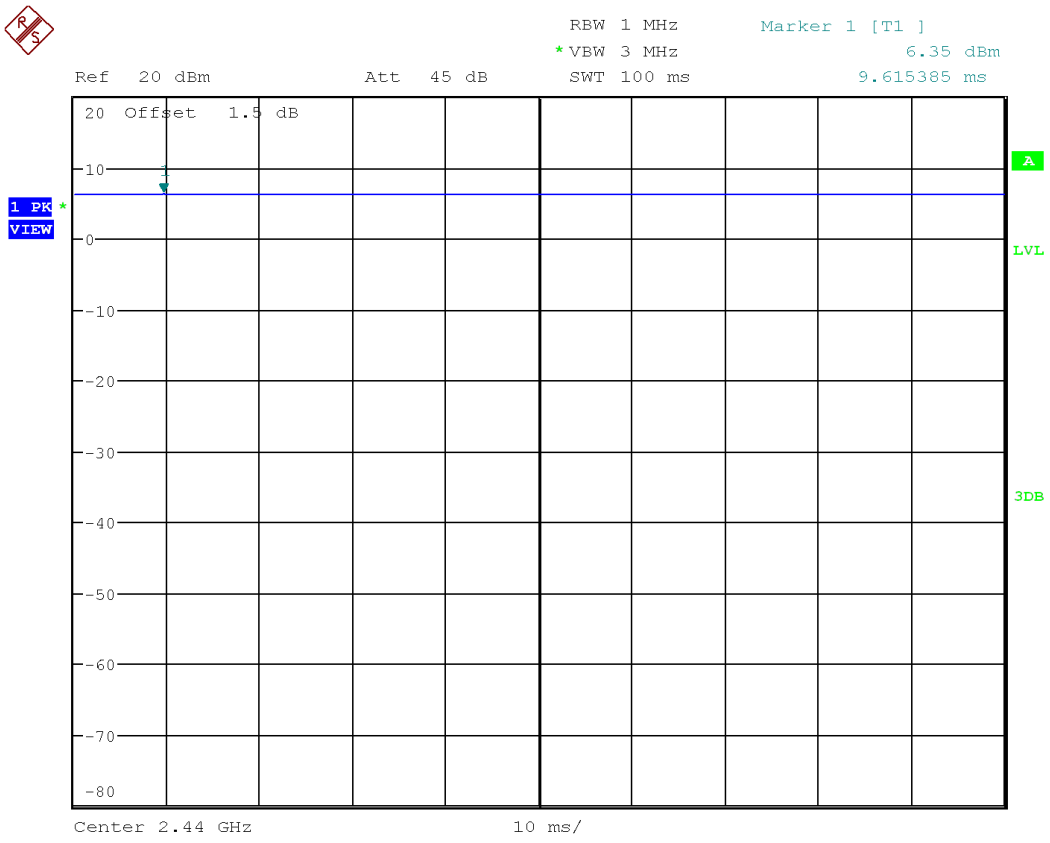



Figure 1: BLE-1Mbps Duty Cycle

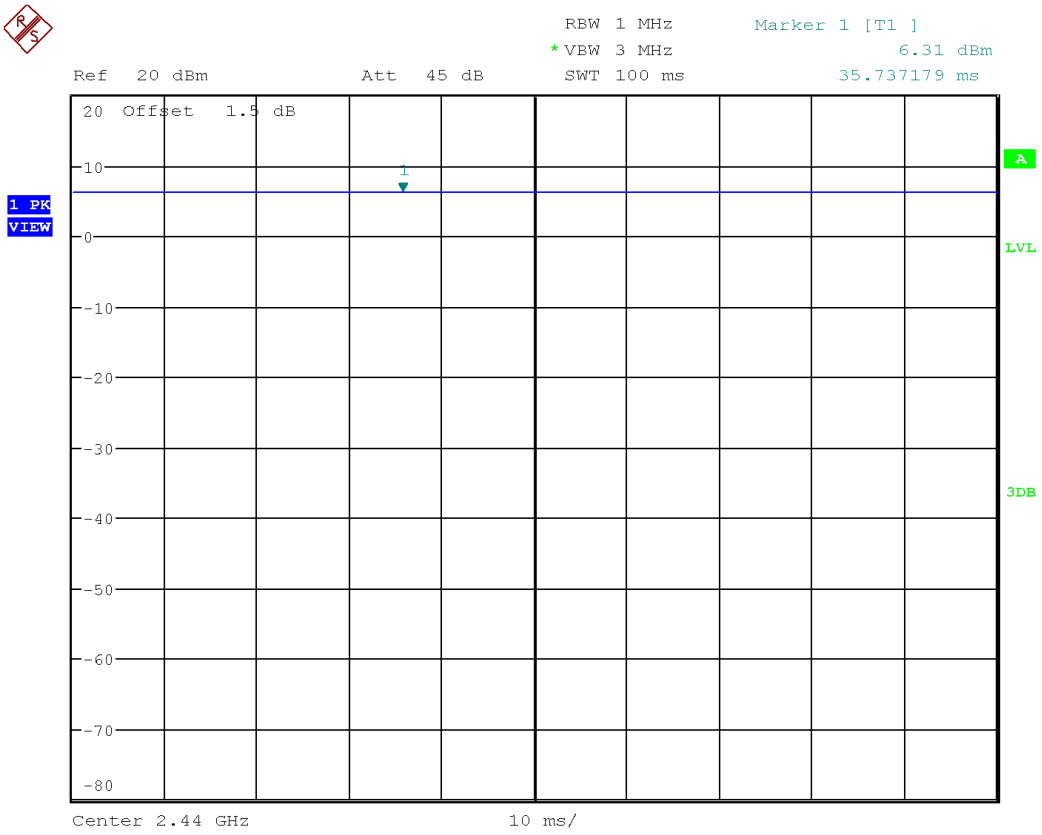



Figure 2: BLE-2Mbps Duty Cycle

# 4 Emissions

Testing was performed in accordance with CFR 47 Part 15.247: 2021 and RSS 247: 2017. These test methods are listed under the laboratory's A2LA Scope of Accreditation. This test measures the levels emanating from the EUT, thus evaluating the potential for the EUT to cause radio frequency interference to other electronic devices. Procedures described in section 8 of the standard were used.

## *4.1 Output Power Requirements*

*The maximum output power requirement is the maximum equivalent isotropic radiated power delivering at the transmitting antenna under specified conditions of measurements in the presence of modulation.*

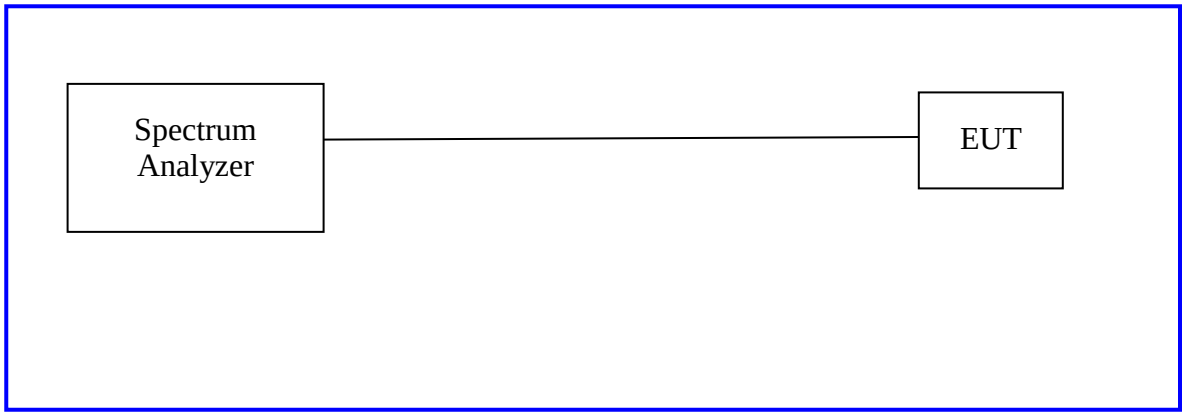
*The maximum output power and harmonics shall not exceed CFR47 Part 15.247 (b) and RSS 247 Sect. 5.4.(d).*

*The maximum transmitted power in the frequency band 2400-2483.5 MHz: 1 W*

### 4.1.1 Test Method

Conducted method was used to measure the channel power output. The worst findings were conducted on 3 channels in each operating range per CFR47 Part 15.247(b) and RSS 247 Sect. 5.4(d); 2400 MHz to 2483.5 MHz The worst mode results indicated below.

### 4.1.2 Test Setup: (Conducted)



### 4.1.3 Results

As originally tested, the EUT was found to be compliant to the requirements of the test standard(s). Worse case data for each mode reported below. Plots of highest power included for low, medium, and high channels.

**Table 2:** RF Output Power at the Antenna Port – Test Results

| | | | | |
|---|---|---|---|---|
| **Test Date:** June 24, 2021 | | **Test By:** Rachana Khanduri | | |
| **Test Method:** Conducted Measurements | | **Power Setting:** +8 dBm | | |
| **Antenna Type:** Integral, Trace | | **Max. Antenna Gain:** 0 dBi | | |
| **Ambient Temp.:** 21 °C | | **Relative Humidity:** 37% | | |
| **Bluetooth LE – RF Output Power** | | | | |
| **Data Rate** | **Operating Channel (MHz)** | **Measured Peak Output [dBm]** | **Limit [dBm]** | **Margin [dB]** |
| 1Mbps | 2402 | 6.93 | +30.00 | -23.07 |
| | 2440 | 6.71 | +30.00 | -23.29 |
| | 2480 | 6.83 | +30.00 | -23.17 |
| 2Mbps | 2402 | 6.80 | +30.00 | -23.20 |
| | 2440 | 6.64 | +30.00 | -23.36 |
| | 2480 | 6.79 | +30.00 | -23.21 |
| **Note:** The EUT transmitted at 100% duty cycle. The highest power output observed was at 1 Mbps | | | | |

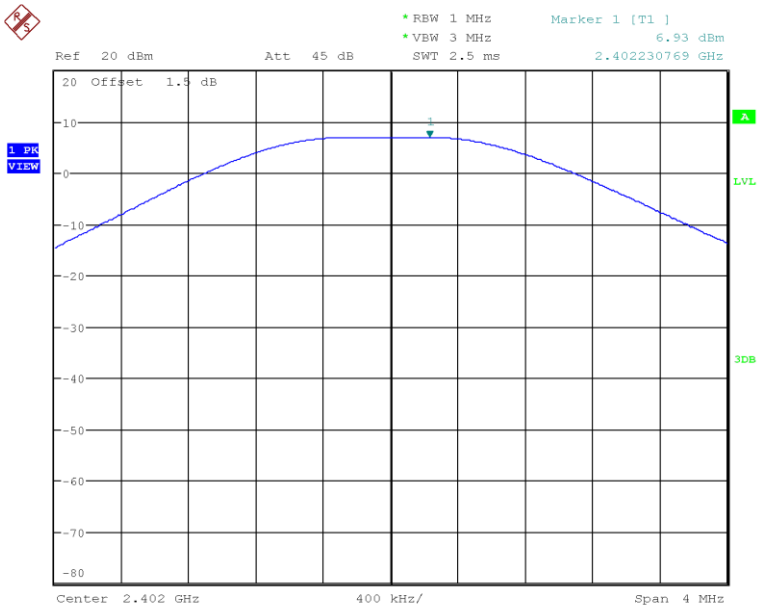



Figure 3: Maximum Conducted Power, 2402 MHz, 1Mbps

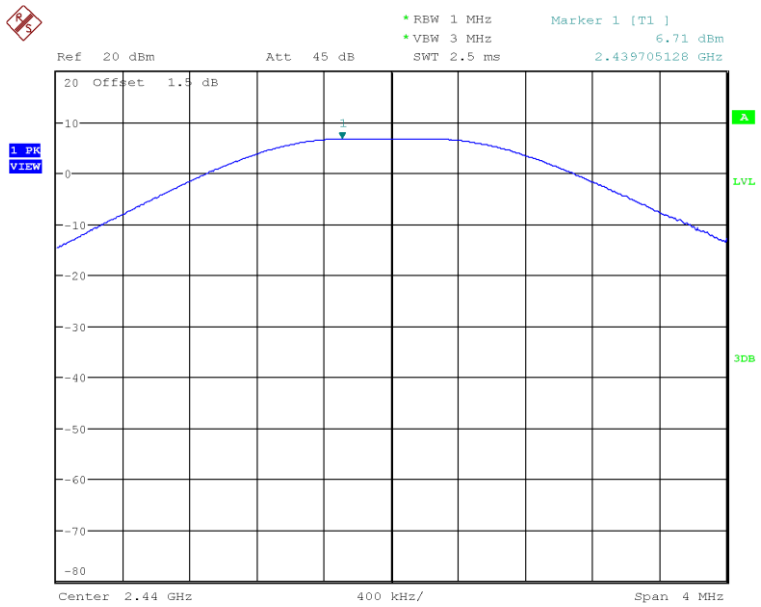



Figure 4: Maximum Conducted Power, 2440MHz, 1Mbps

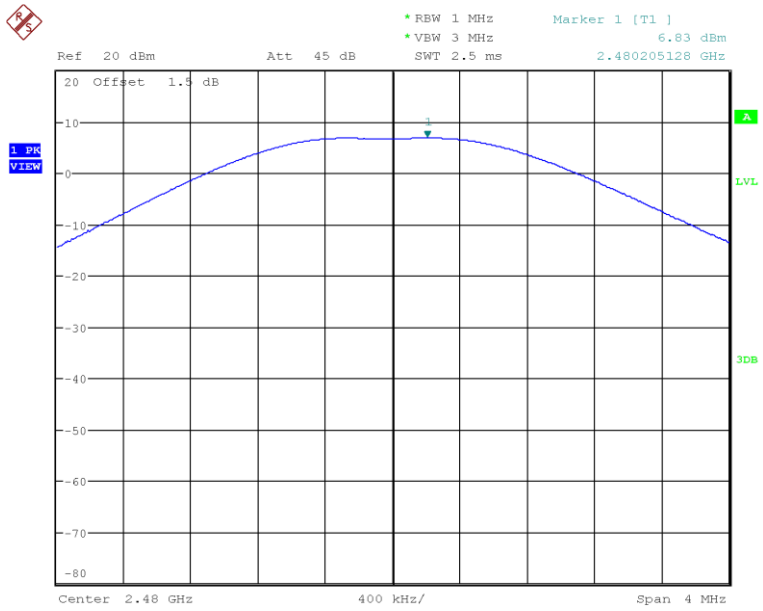



Figure 5: Maximum Conducted Power, 2480MHz, 1Mbps

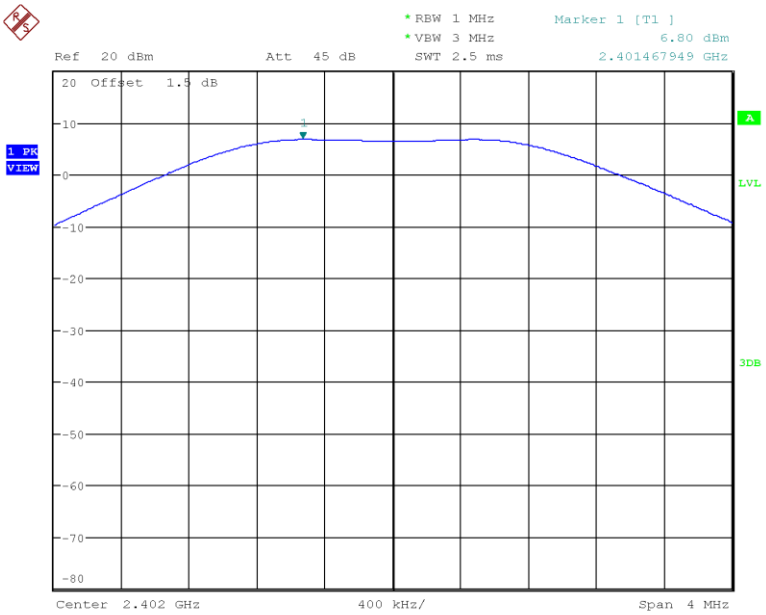



Figure 6: Maximum Conducted Power, 2402 MHz, 2Mbps

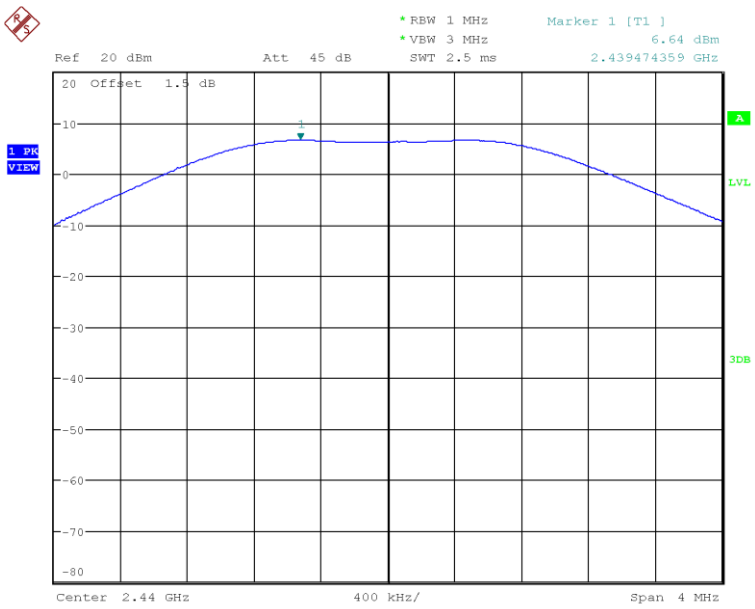



Figure 7: Maximum Conducted Power, 2440MHz, 2Mbps

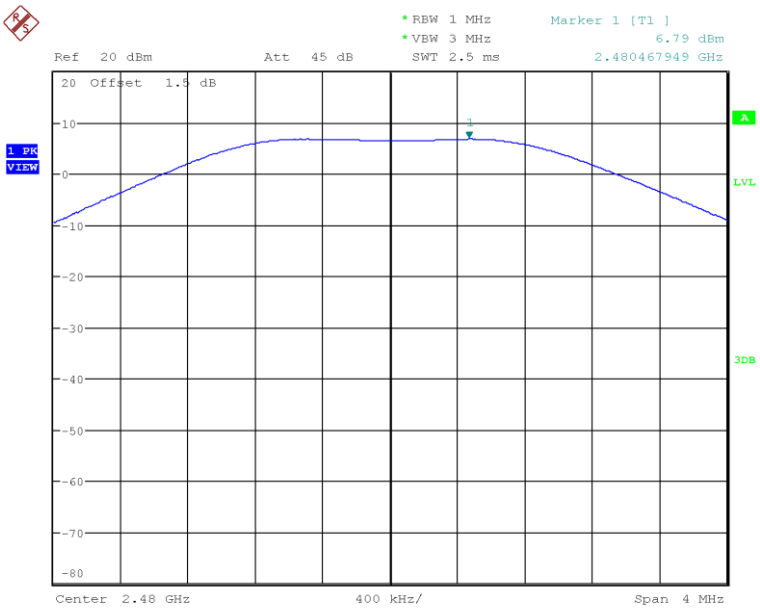



Figure 8: Maximum Conducted Power, 2480MHz, 2Mbps

## *4.2 DTS Bandwidth (6dB) and Occupied Bandwidth*

*The occupied bandwidth is measured at an amplitude level reduced from the reference level by a specified ratio. The reference level is the level of the highest amplitude signal observed from the transmitter at the fundamental frequency.*

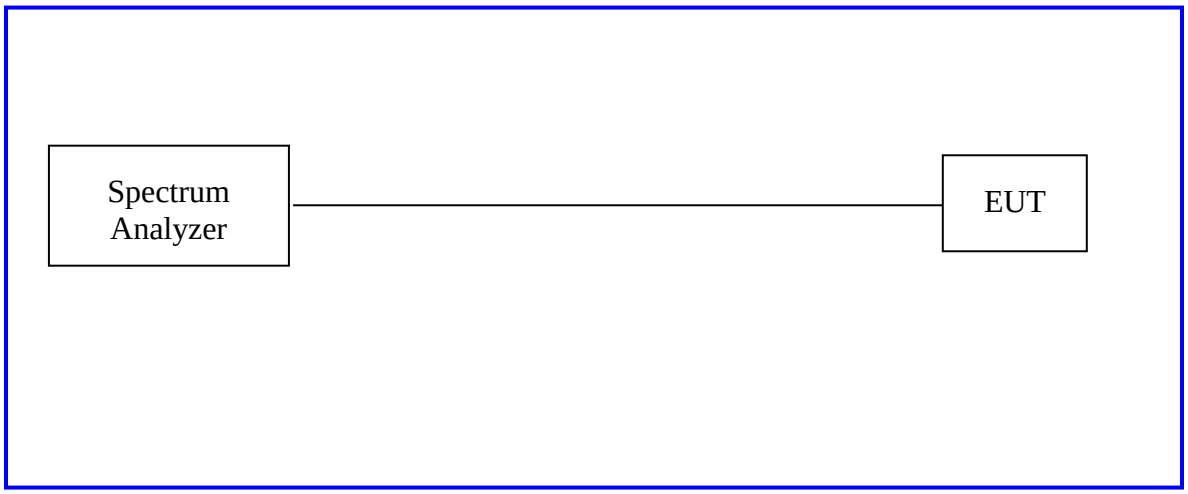
*The 99% bandwidth is the bandwidth in which 99% of the transmitted power occupied.*

*The minimum 6 dB bandwidth shall be at least 500 kHz.*

### 4.2.1 Test Method

The conducted method was used to measure the occupied bandwidth according to ANSI C63.10:2013 Section 11.8. The measurement was performed with modulation per CFR47 15.247 (a) (2) and RSS Gen Sect. 6.6. Measurements were performed on the low, middle and high channels of the operating frequency range; 2400 MHz to 2483.5 MHz.

### 4.2.2 Test Setup: (Conducted)




### 4.2.3 Results

As originally tested, the EUT was found to be compliant to the requirements of the test standard(s).

**Table 3:** Occupied Bandwidth – Test Results

| | |
|---|---|
| **Test Date:** June 24, 2021 | **Test By:** Rachana Khanduri |
| **Test Method:** Conducted Measurements | **Power Setting:** +8 dBm |
| **Antenna Type:** Integral, Trace | **Max. Antenna Gain:** 0 dBi |
| **Ambient Temp.:** 21 °C | **Relative Humidity:** 37% |

**Bluetooth LE – Occupied Bandwidth**

| Data Rate | Operating Channel (MHz) | 99% Bandwidth (MHz) | 6dB (DTS) Bandwidth (MHz) |
|---|---|---|---|
| 1Mbps | 2402 | 1.063 | 0.716 |
| | 2440 | 1.063 | 0.731 |
| | 2480 | 1.082 | 0.716 |
| 2Mbps | 2402 | 2.083 | 1.314 |
| | 2440 | 2.091 | 1.274 |
| | 2480 | 2.083 | 1.410 |

**Note:** The narrower bandwidth was measured at 1 Mbps and 100% duty cycle.

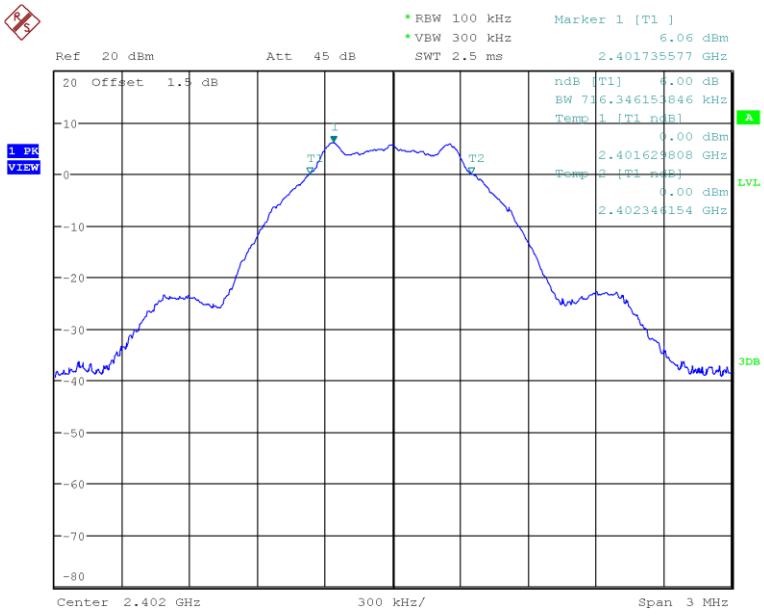



Figure 9: 2402MHz, 1Mbps, 6dB Bandwidth

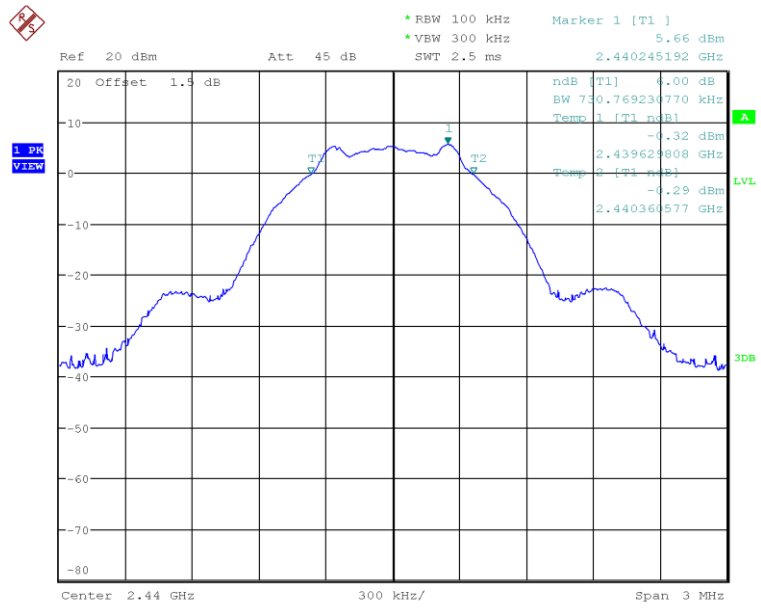



Figure 10: 2440MHz, 1Mbps, 6dB Bandwidth

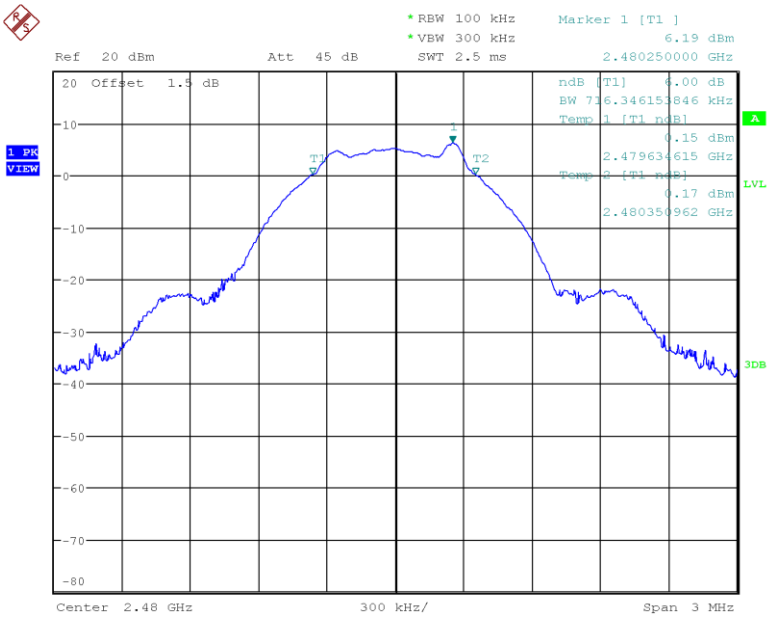



Figure 11: 2480MHz, 1Mbps, 6dB Bandwidth

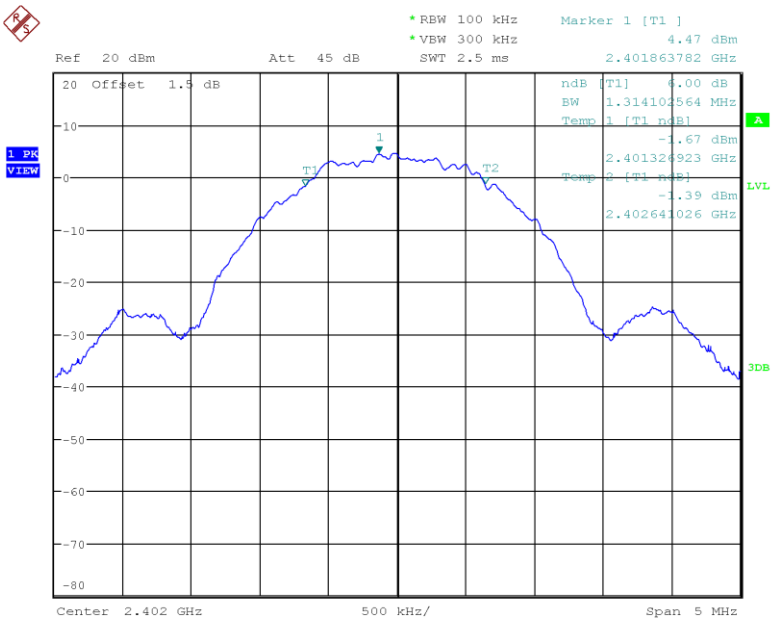



Figure 12: 2402MHz, 2Mbps, 6dB Bandwidth

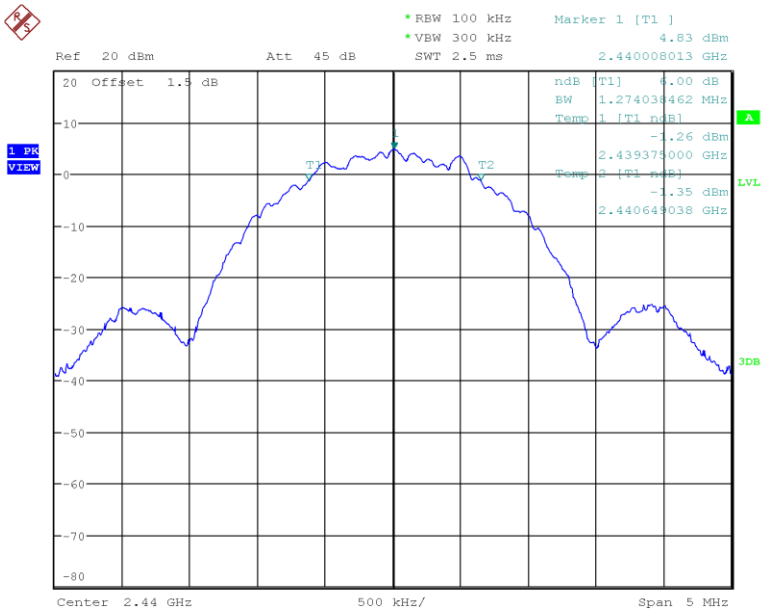



Figure 13: 2440MHz, 2Mbps, 6dB Bandwidth

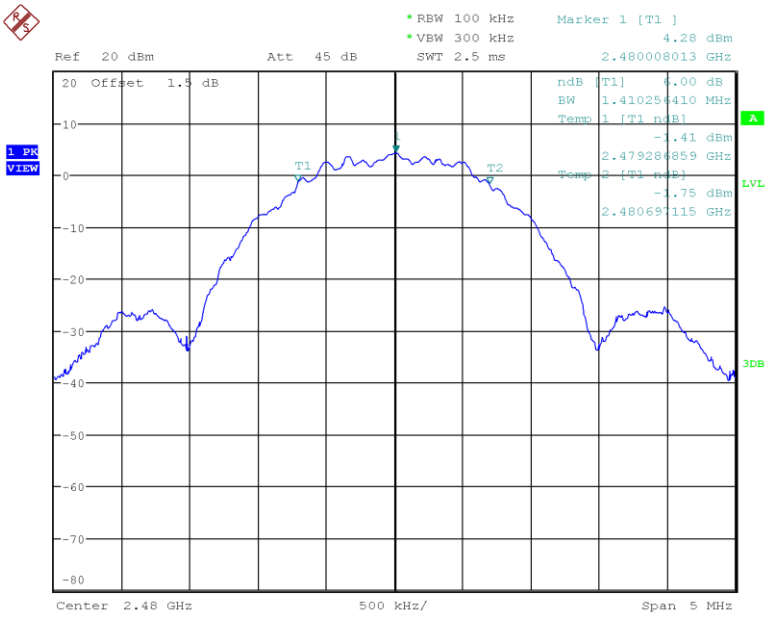



Figure 14: 2480MHz, 2Mbps, 6dB Bandwidth

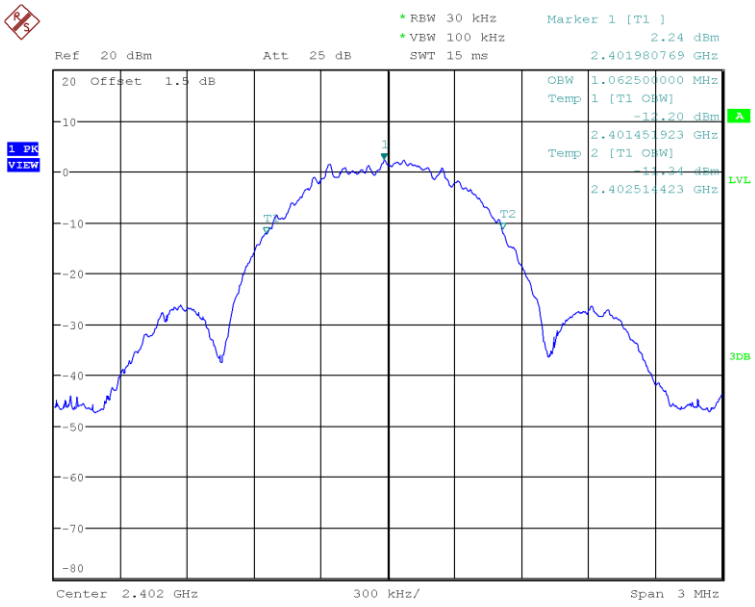



Figure 15: 2402MHz, 1Mbps, 99% Bandwidth

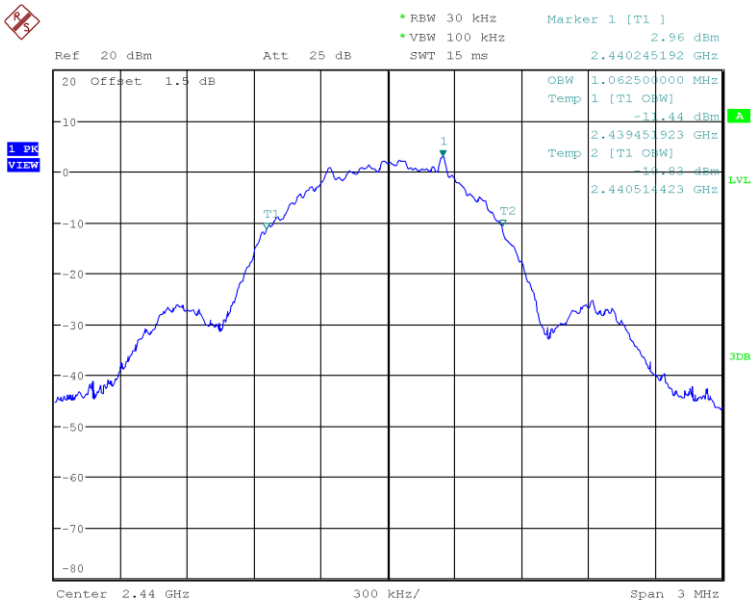



Figure 16: 2440MHz, 1Mbps, 99% Bandwidth

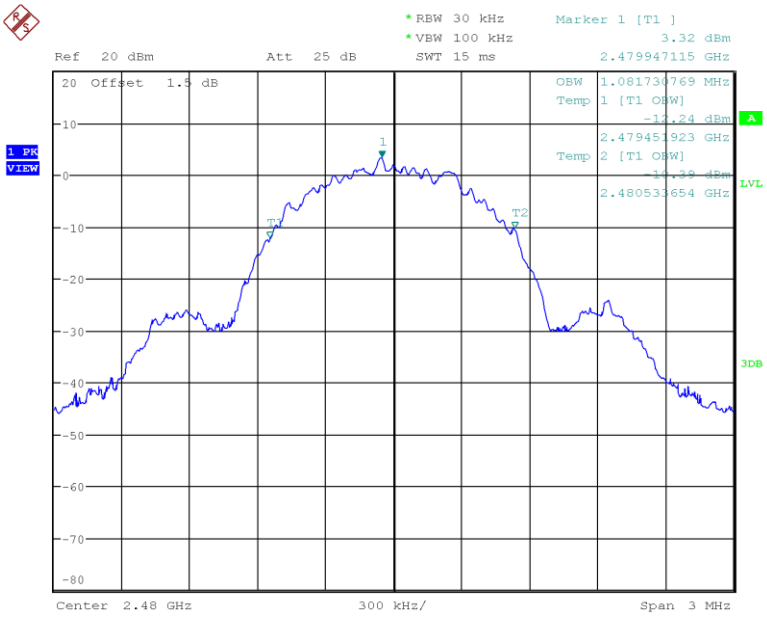



Figure 17: 2480MHz, 1Mbps, 99% Bandwidth

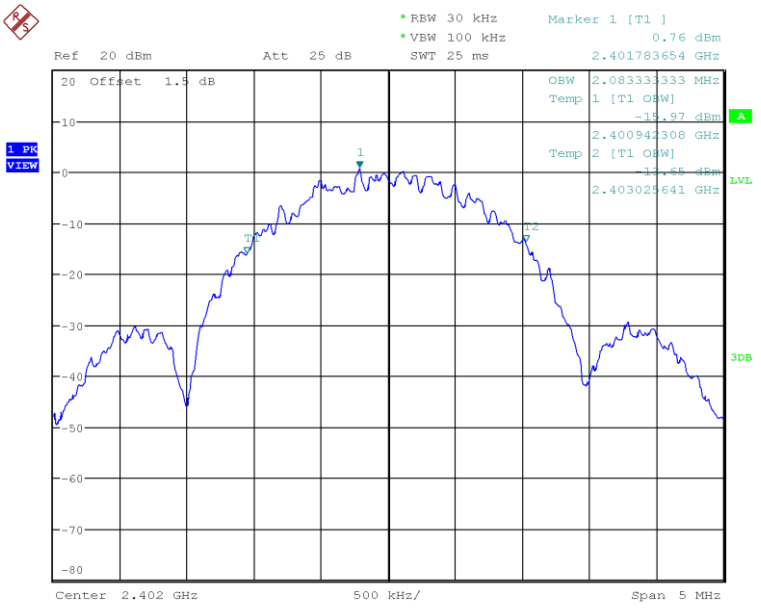



Figure 18: 2402MHz, 2Mbps, 99% Bandwidth

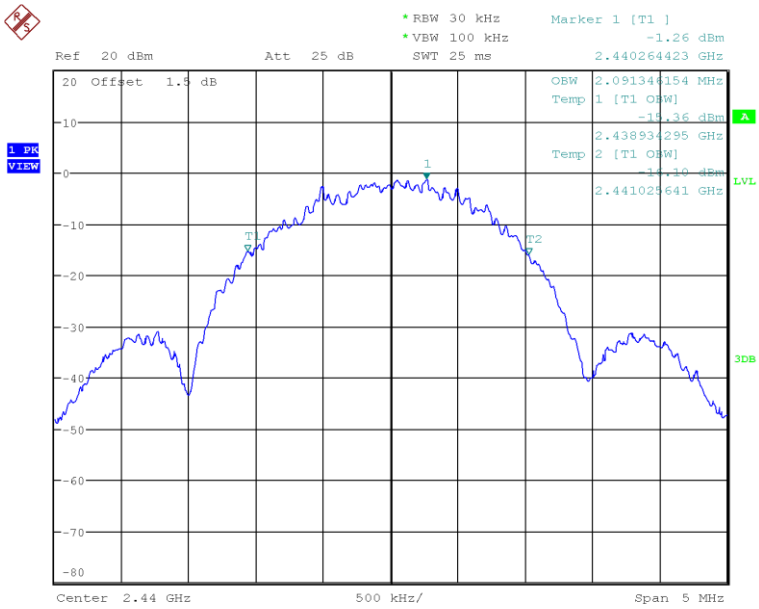



Figure 19: 2440MHz, 2Mbps, 99% Bandwidth

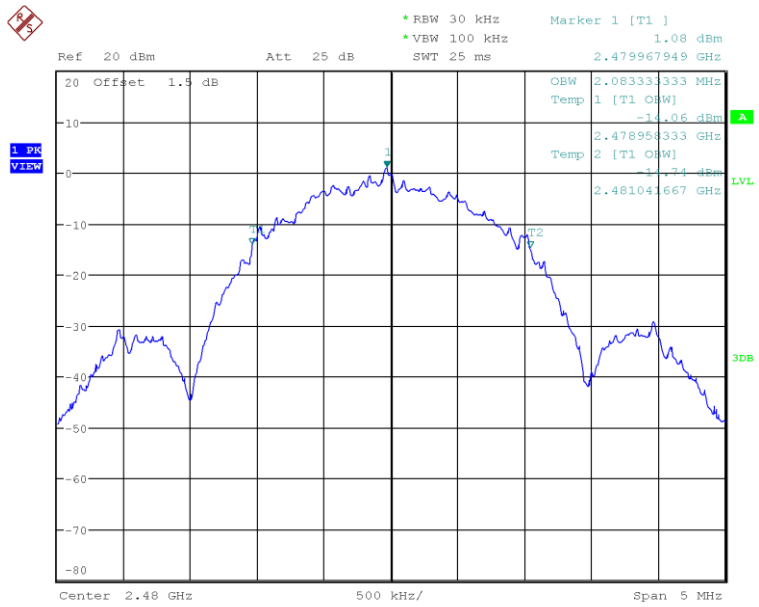



Figure 20: 2480MHz, 2Mbps, 99% Bandwidth

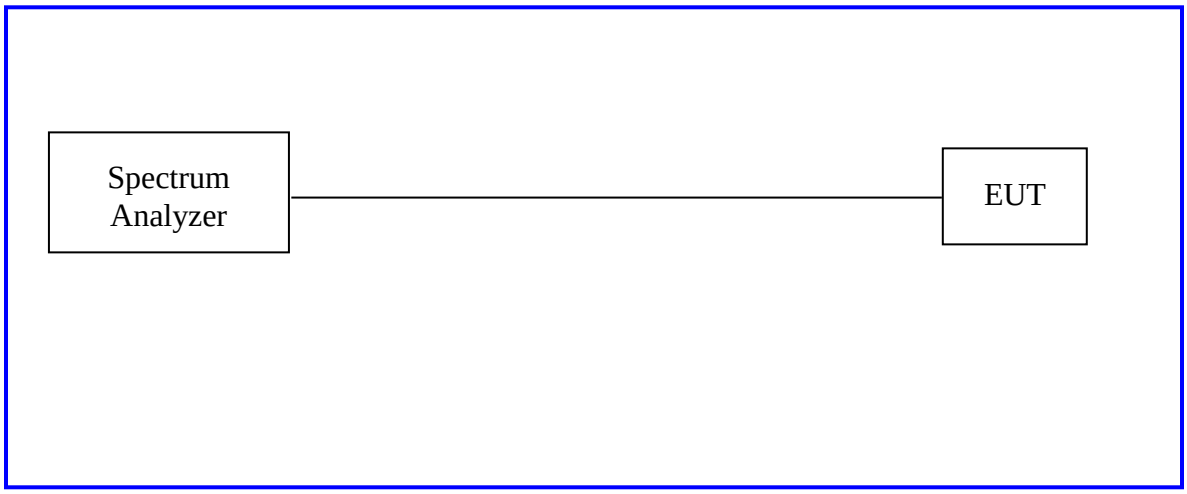
## *4.3 Peak Power Spectral Density*

*According to the CFR47 Part 15.247 (e) and RSS 247 Sect.5.2 (b), the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.*

### 4.3.1 Test Method

The conducted method was used to measure the channel power output per ANSI C63.10-2013 Section 11.10.2. The measurement was performed with modulation per CFR47 Part 15.247 (e) and RSS 247 Sect.5.2 (b). The worst findings were conducted on 3 channels in each operating frequency range of 2400 MHz to 2483.5 MHz.

### 4.3.2 Test Setup: (Conducted)




*Method PKPSD of "KDB 558074 – DTS Measurement Guidance v04" was used.*

### 4.3.3 Results

As originally tested, the EUT was found to be compliant to the requirements of the test standard(s).

**Table 4:** Peak Power Spectral Density – Test Results

| | |
|---|---|
| **Test Date:** June 25, 2021 | **Test By:** Rachana Khanduri |
| **Test Method:** Conducted Measurements | **Power Setting:** +8 dBm |
| **Antenna Type:** Integral, Trace | **Max. Antenna Gain:** 0 dBi |
| **Ambient Temp.:** 21 °C | **Relative Humidity:** 37% |

**Bluetooth LE – Peak Power Spectral Density**

| Data Rate | Operating Channel (MHz) | Total PSD [dBm/kHz] | Limit [dBm/3kHz] | Margin [dB] |
|---|---|---|---|---|
| 1Mbps | 2402 | -6.67 | 8.0dBm /3kHz | -14.67 |
| | 2440 | -6.93 | 8.0dBm /3kHz | -14.93 |
| | 2480 | -7.01 | 8.0dBm /3kHz | -15.01 |
| 2Mbps | 2402 | -10.14 | 8.0dBm /3kHz | -18.14 |
| | 2440 | -9.48 | 8.0dBm /3kHz | -17.48 |
| | 2480 | -10.03 | 8.0dBm /3kHz | -18.03 |

**Note:** The EUT transmitted at 100% duty cycle.

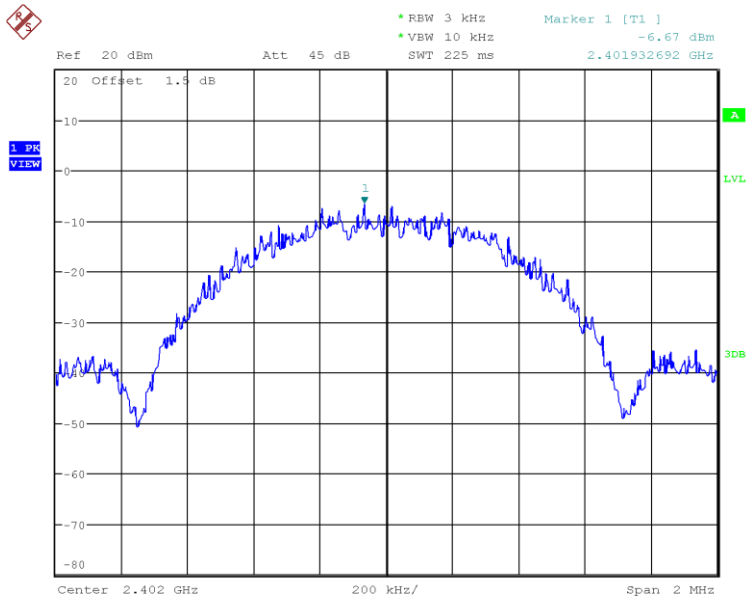



Figure 21: 2402 MHz, 1Mbps, PSD

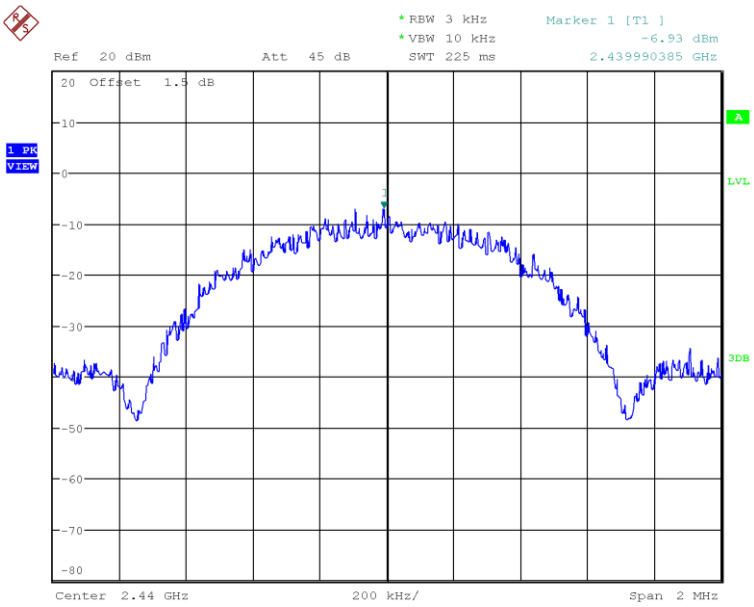



Figure 22: 2440 MHz, 1Mbps, PSD

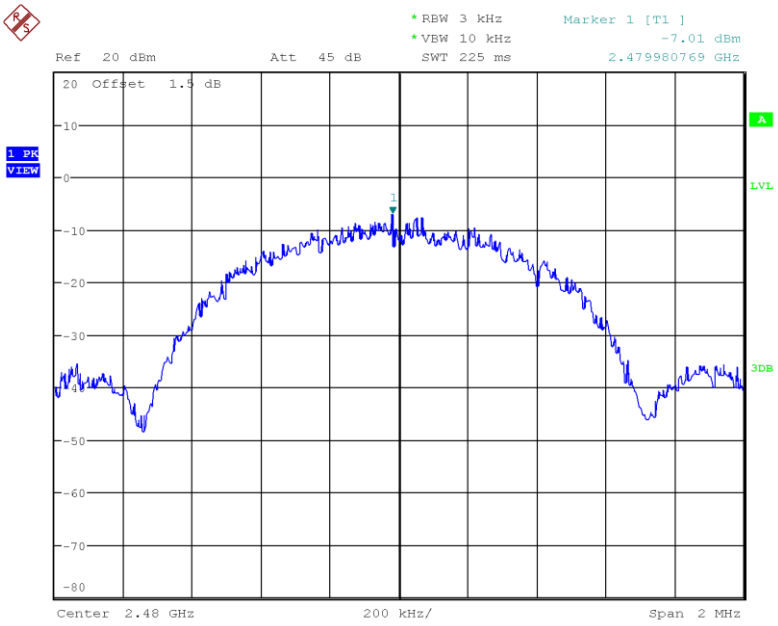



Figure 23: 2480MHz, 1Mbps, PSD

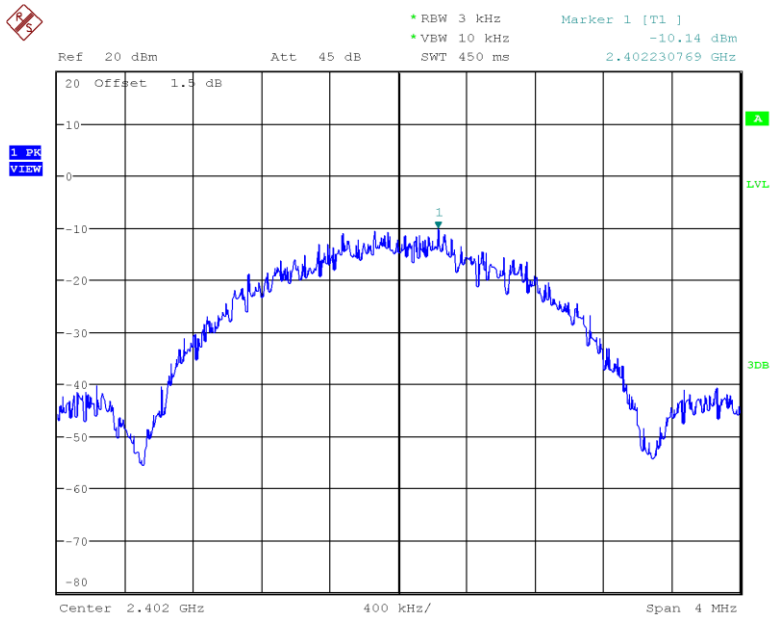



Figure 24: 2402 MHz, 2Mbps, PSD

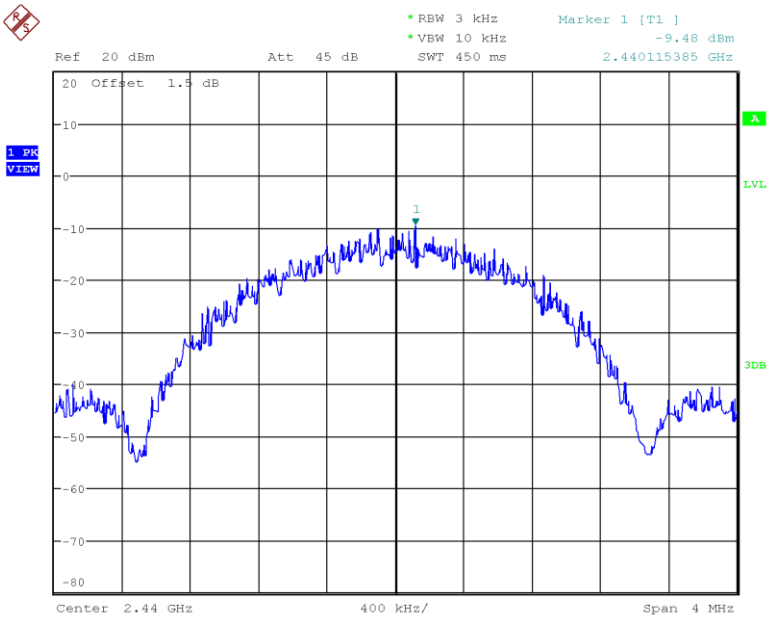



Figure 25: 2440 MHz, 2Mbps, PSD

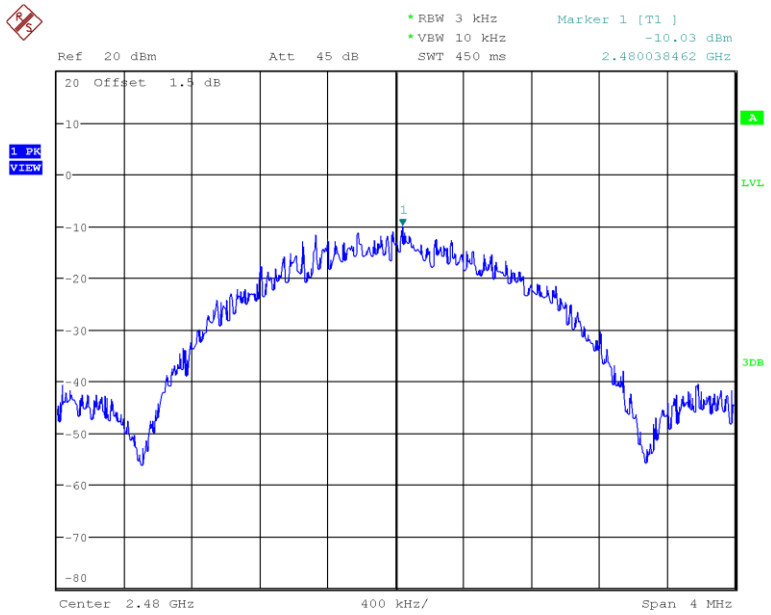



Figure 26: 2480MHz, 2Mbps, PSD

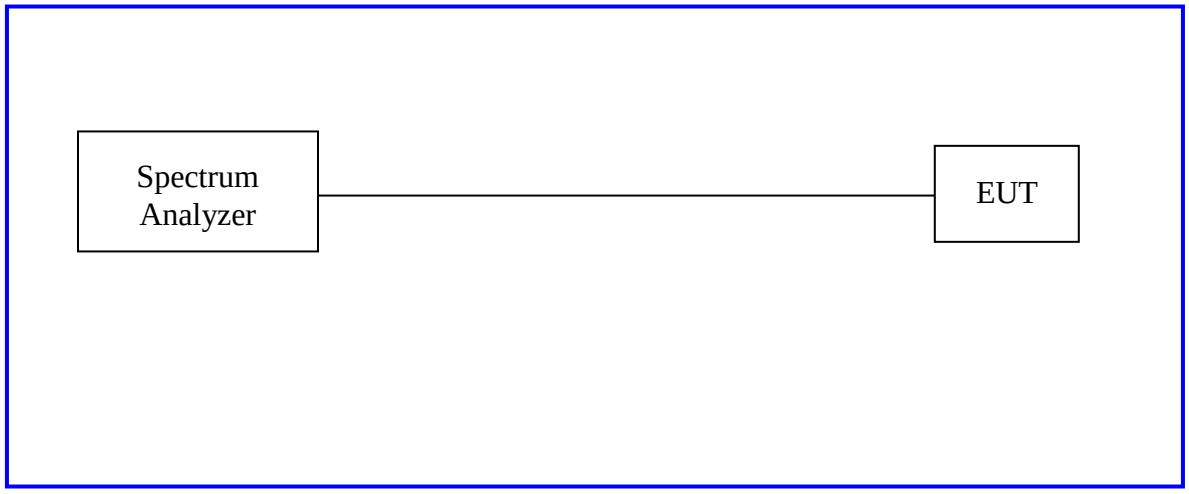
## 4.4 Out of Band Emissions: Non-Restricted Bands

*Transmitter spurious emissions are emissions outside the frequency range of the equipment when the equipment is in transmitting mode; per requirement of CFR47 15.205, 15.209, 15.247(d), RSS-247 Sect. 5.5, RSS-GEN Sect. 8.9 and 8.10.*

### 4.4.1 Test Method

Conducted measurements per ANSI C63.10-2013 Sections 6.10, 11.11, 14.3.3 were used to measure the undesirable emission requirement in non-restricted bands. The measurement was performed with modulation. The measurement was conducted from 30MHz to 26.5GHz on 3 channels in each mode on the EUT. Band edge tests were conducted on the low and high channel of each mode. The worst case measurement of each mode is recorded in this report.

### 4.4.2 Test Setup: (Conducted)



### 4.4.3 Results

As originally tested, the EUT was found to be compliant to the requirements of the test standard(s).

**Table 5:** Emissions at the Band-Edge – Test Results

| | |
|---|---|
| **Test Date:** June 25, 2021 | **Test By:** Rachana Khanduri |
| **Test Method:** Conducted Measurements | **Power Setting:** +8 dBm |
| **Antenna Type:** Integral, Trace | **Max. Antenna Gain:** 0 dBi |
| **Ambient Temp.:** 21 °C | **Relative Humidity:** 37% |

**Bluetooth LE – Emissions at the Band-Edge**

| Data Rate | Band Edge | Center Freq (MHz) | Out of Band Level (dBm) | 20dBc Level (dBm) | Measured Freq (MHz) | Results |
|---|---|---|---|---|---|---|
| 1Mbps | Low | 2402 | -37.80 | -14.60 | 2400.0 | Pass |
| | High | 2480 | -40.37 | -14.64 | 2483.5 | Pass |
| 2Mbps | Low | 2402 | -26.32 | -14.99 | 2400.0 | Pass |
| | High | 2480 | -40.67 | -15.15 | 2483.5 | Pass |

**Note:** dBc is defined as the level below the main carrier.
The band-edge level must be lower than the 20dBc level.

### *4.4.3.1 Band Edge - conducted*

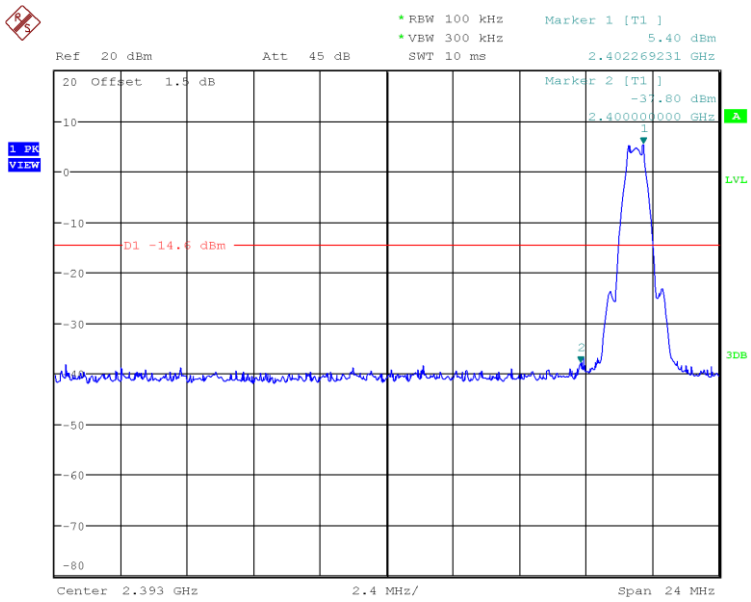



Figure 27: 2402MHz, 1Mbps, Lower Band Edge

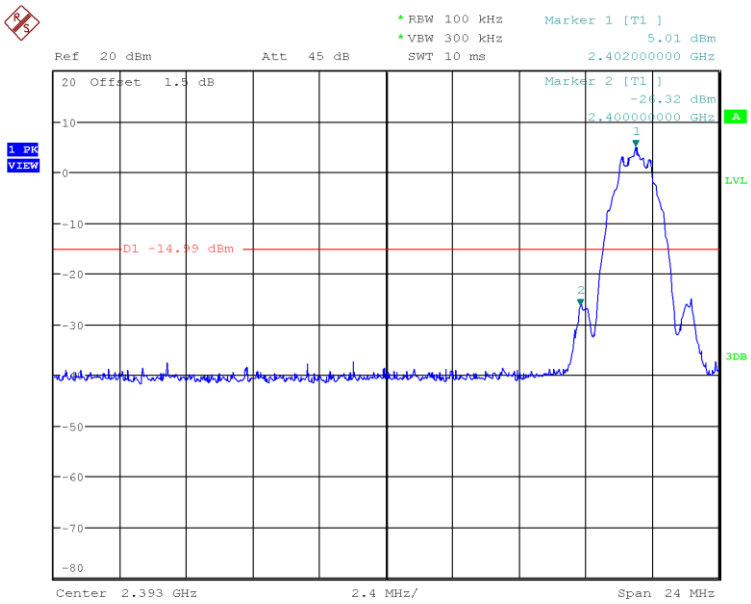



Figure 28: 2402MHz, 2Mbps, Lower Band Edge

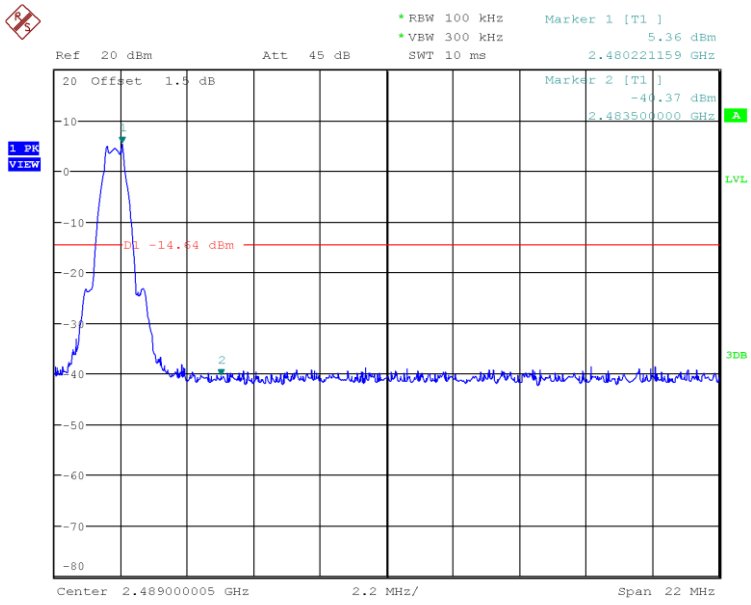



Figure 29: 2480MHz, 1Mbps Upper Band Edge

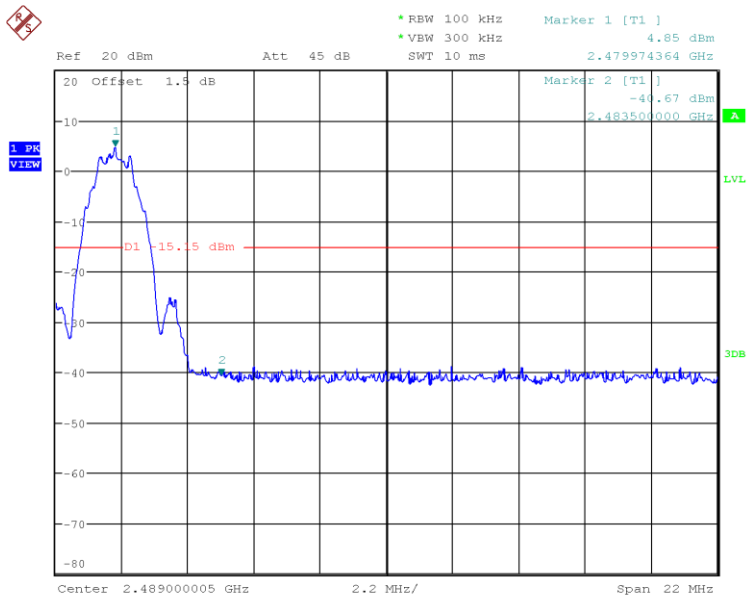



Figure 30: 2480MHz, 2Mbps Upper Band Edge

### *4.4.3.2 Conducted Spurious*

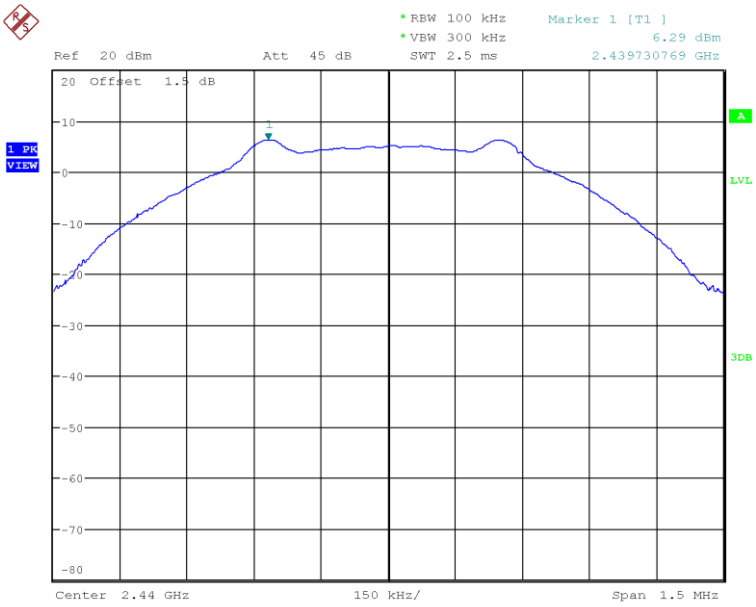



Figure 31: 1Mbps Ref Measurement

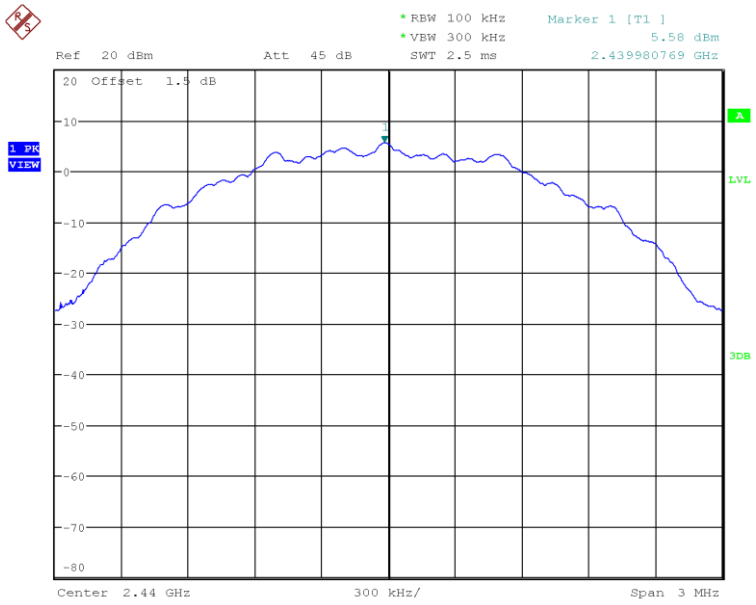



Figure 32: 2Mbps Ref Measurement

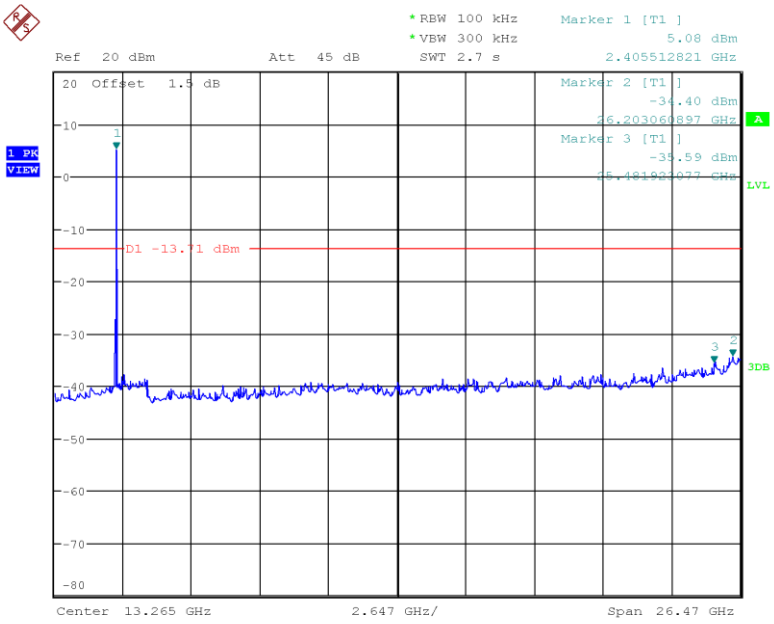



Figure 33: Conducted Emissions, 2402 MHz, 1Mbps

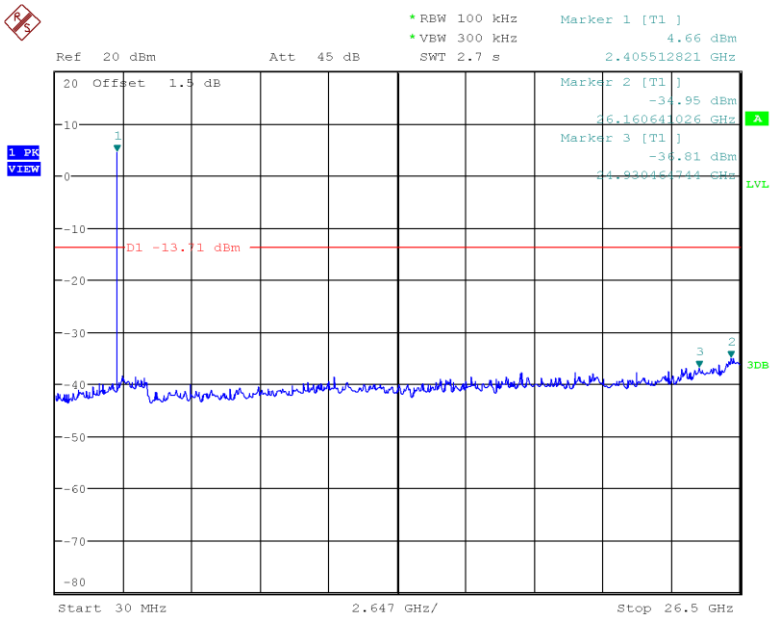



Figure 34: Conducted Emissions, 2440 MHz, 1Mbps

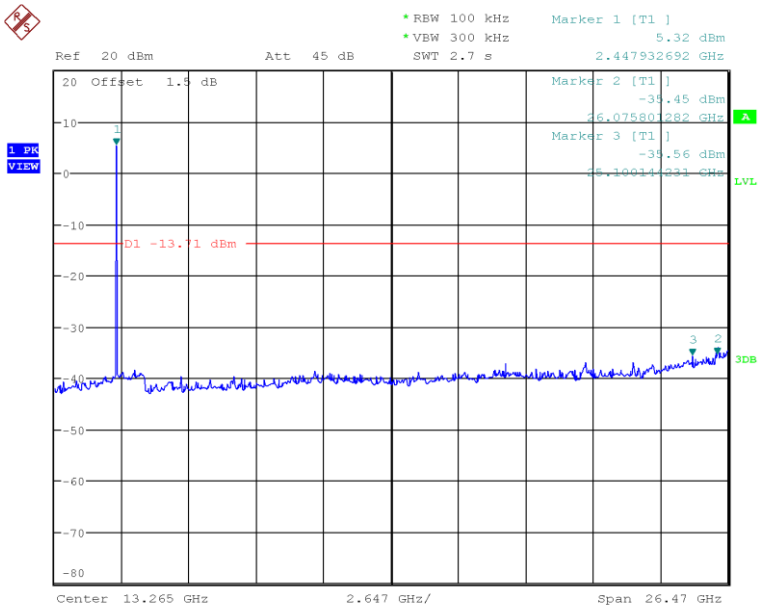



Figure 35: Conducted Emissions, 2480 MHz, 1Mbps

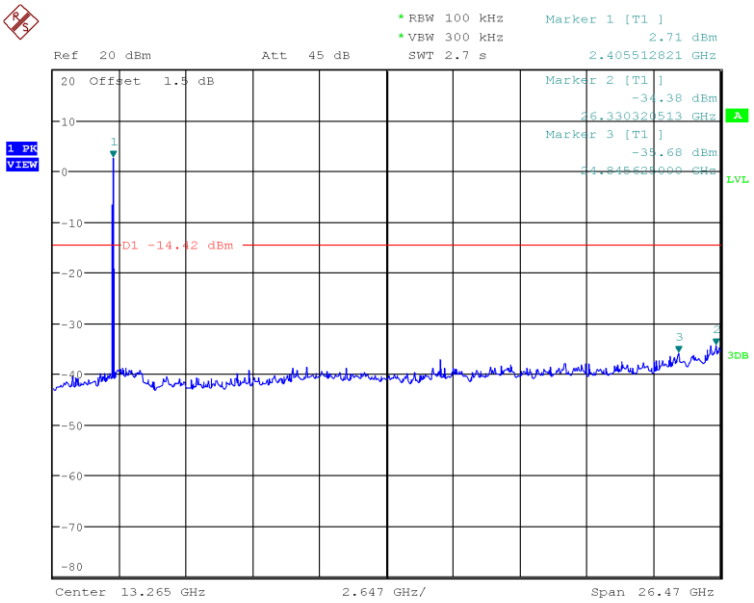



Figure 36: Conducted Emissions, 2402 MHz, 2Mbps

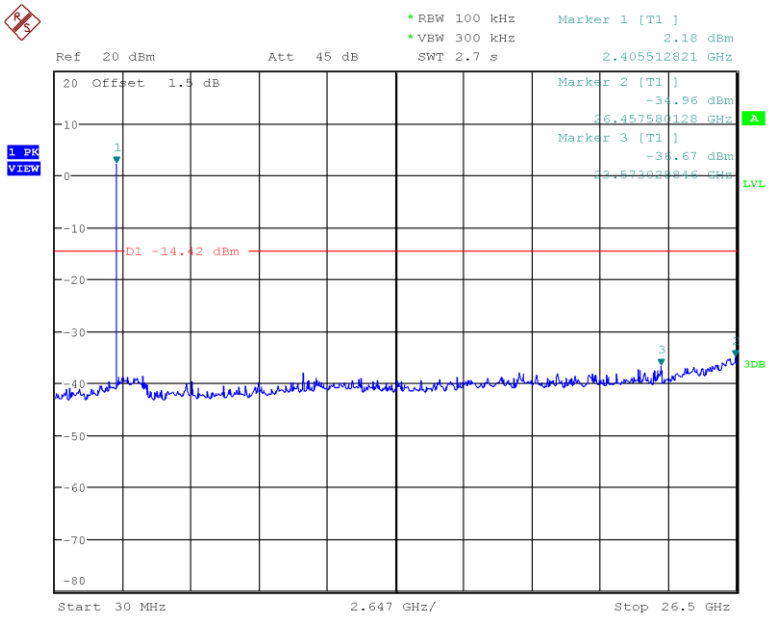



Figure 37: Conducted Emissions, 2440 MHz, 2Mbps

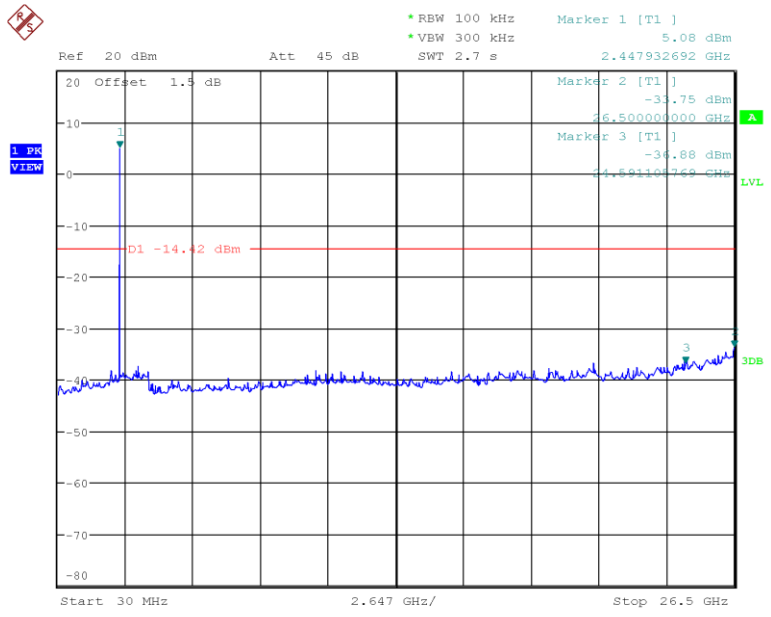



Figure 38: Conducted Emissions, 2480 MHz, 2Mbps

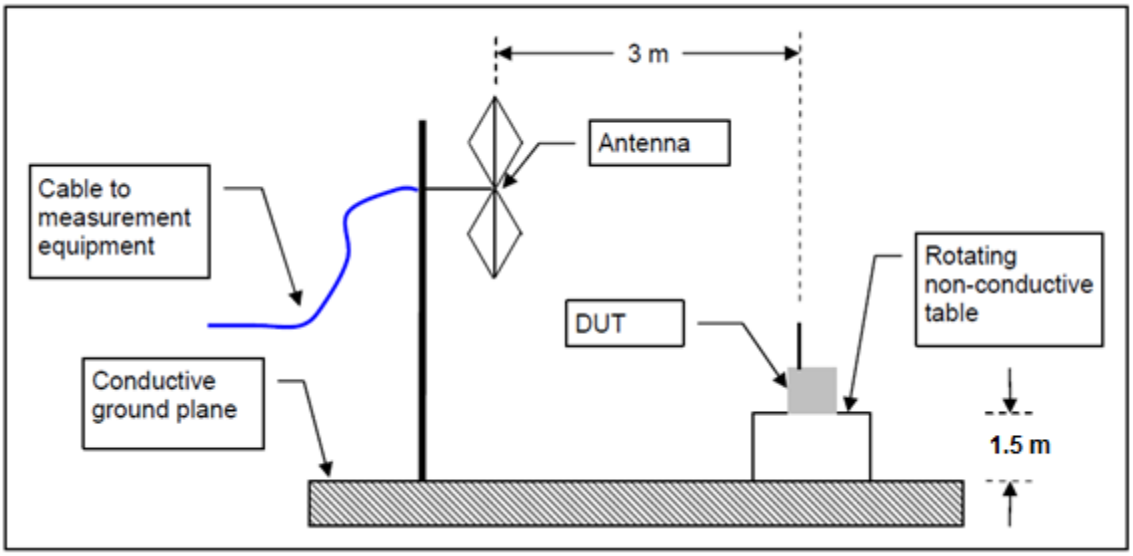
## *4.5 Out of Band Emissions: Restricted Band Edge*

*Transmitter spurious emissions are emissions outside the frequency range of the equipment when the equipment is in transmitting mode; per requirement of CFR47 15.205, 15.209, 15.247(d), RSS-247 Sect. 5.5, RSS-GEN Sect. 8.9 and 8.10.*

### 4.5.1 Test Method

Radiated measurements per ANSI C63.10-2013 Section 6.10.5 were used to measure the undesirable emission requirement in restricted bands. Peak points were found and RMS Average was taken for each point found. The measurement was performed with modulation. This test was conducted on 3 channels in each mode on the EUT. The worst case measurement of each channel is recorded in this report. All channels were tested at highest power settings.

### Test Setup




The DUT was stimulated by manufacturer provided test software that is not available to the end user.

### 4.5.2 Test Results

| |
|---|
| **Test Conditions:** Radiated Measurement, Normal Temperature and Voltage |
| **Antenna Type:** Integral, Trace |
| **Power Setting:** +8dBm |
| **Max. Antenna Gain:** 0dBi |
| **Test Performed by:** Rachana Khanduri |

## Final Result

| Frequency (MHz) | MaxPeak (dBµV/m) | Average (dBµV/m) | Limit (dBµV/m) | Margin (dB) | Bandwidth (kHz) | Height (cm) | Pol | Azimuth (deg) | Corr. (dB/m) |
|---|---|---|---|---|---|---|---|---|---|
| 2338.248000 | 36.92 | --- | 74.00 | 37.08 | 1000.000 | 234.0 | V | 345.0 | -2.3 |
| 2338.248000 | --- | 23.95 | 54.00 | 30.05 | 1000.000 | 234.0 | V | 345.0 | -2.3 |
| 2377.414400 | 36.85 | --- | 74.00 | 37.15 | 1000.000 | 150.0 | V | 312.0 | -2.2 |
| 2377.414400 | --- | 24.16 | 54.00 | 29.84 | 1000.000 | 150.0 | V | 312.0 | -2.2 |

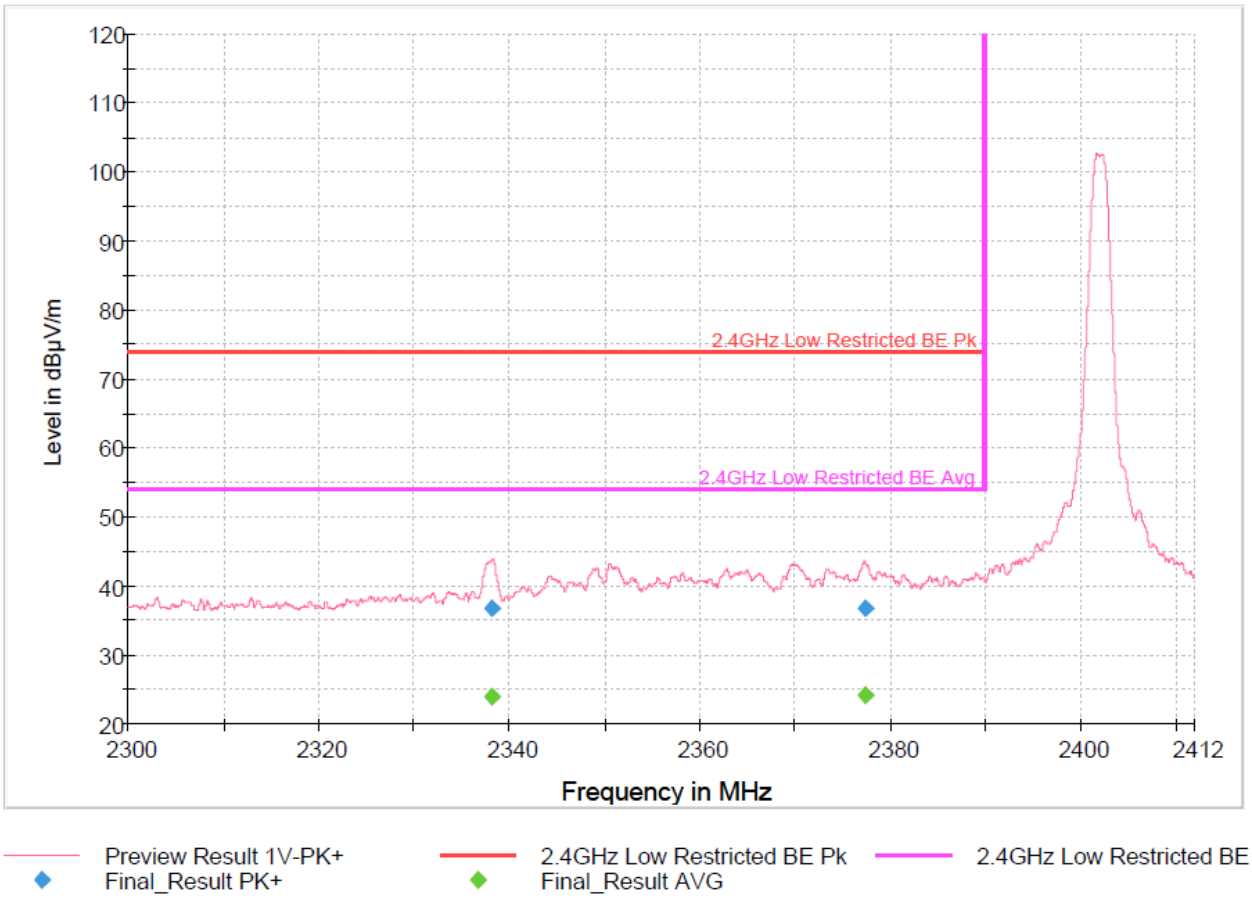



Figure 39: Restricted Band Edge, Low, 2402MHz, 1 Mbps

## Final Result

| Frequency (MHz) | MaxPeak (dBµV/m) | Average (dBµV/m) | Limit (dBµV/m) | Margin (dB) | Bandwidth (kHz) | Height (cm) | Pol | Azimuth (deg) | Corr. (dB/m) |
|---|---|---|---|---|---|---|---|---|---|
| 2388.390400 | --- | 24.18 | 54.00 | 29.82 | 1000.000 | 100.0 | V | 229.0 | -2.2 |
| 2388.390400 | 38.05 | --- | 74.00 | 35.95 | 1000.000 | 100.0 | V | 229.0 | -2.2 |
| 2389.969600 | --- | 24.17 | 54.00 | 29.83 | 1000.000 | 118.0 | V | 239.0 | -2.2 |
| 2389.969600 | 37.54 | --- | 74.00 | 36.46 | 1000.000 | 118.0 | V | 239.0 | -2.2 |

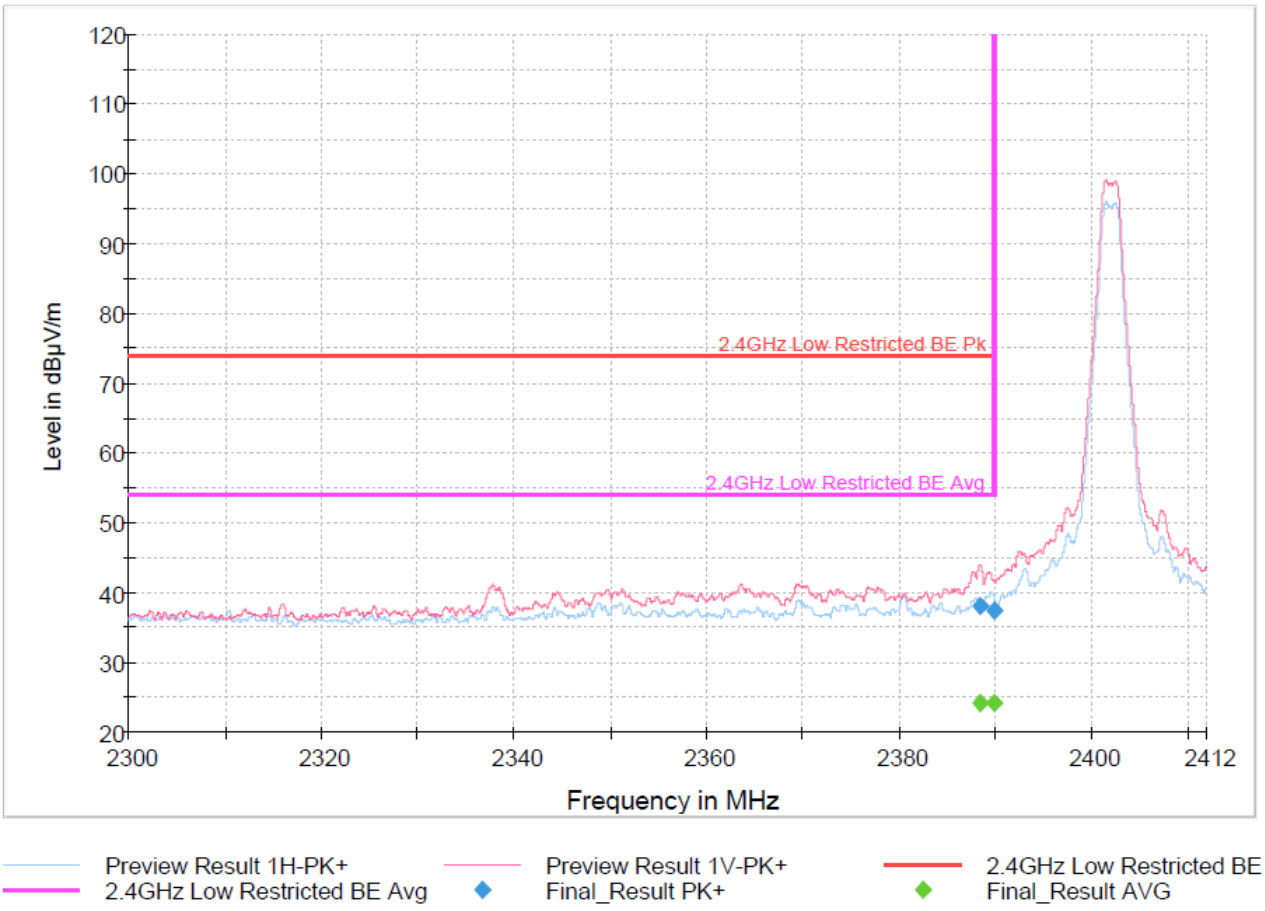



Figure 40: Restricted Band Edge, Low, 2402MHz, 2 Mbps

## Final Result

| Frequency (MHz) | MaxPeak (dBµV/m) | Average (dBµV/m) | Limit (dBµV/m) | Margin (dB) | Bandwidth (kHz) | Height (cm) | Pol | Azimuth (deg) | Corr. (dB/m) |
|---|---|---|---|---|---|---|---|---|---|
| 2483.541800 | 53.47 | --- | 74.00 | 20.53 | 1000.000 | 105.0 | V | 258.0 | -1.6 |
| 2483.541800 | --- | 40.05 | 54.00 | 13.95 | 1000.000 | 105.0 | V | 258.0 | -1.6 |
| 2483.859200 | 52.23 | --- | 74.00 | 21.77 | 1000.000 | 119.0 | V | 217.0 | -1.6 |
| 2483.859200 | --- | 38.99 | 54.00 | 15.01 | 1000.000 | 119.0 | V | 217.0 | -1.6 |
| 2515.599200 | --- | 31.16 | 54.00 | 22.84 | 1000.000 | 100.0 | V | 289.0 | -1.2 |
| 2515.599200 | 43.29 | --- | 74.00 | 30.71 | 1000.000 | 100.0 | V | 289.0 | -1.2 |

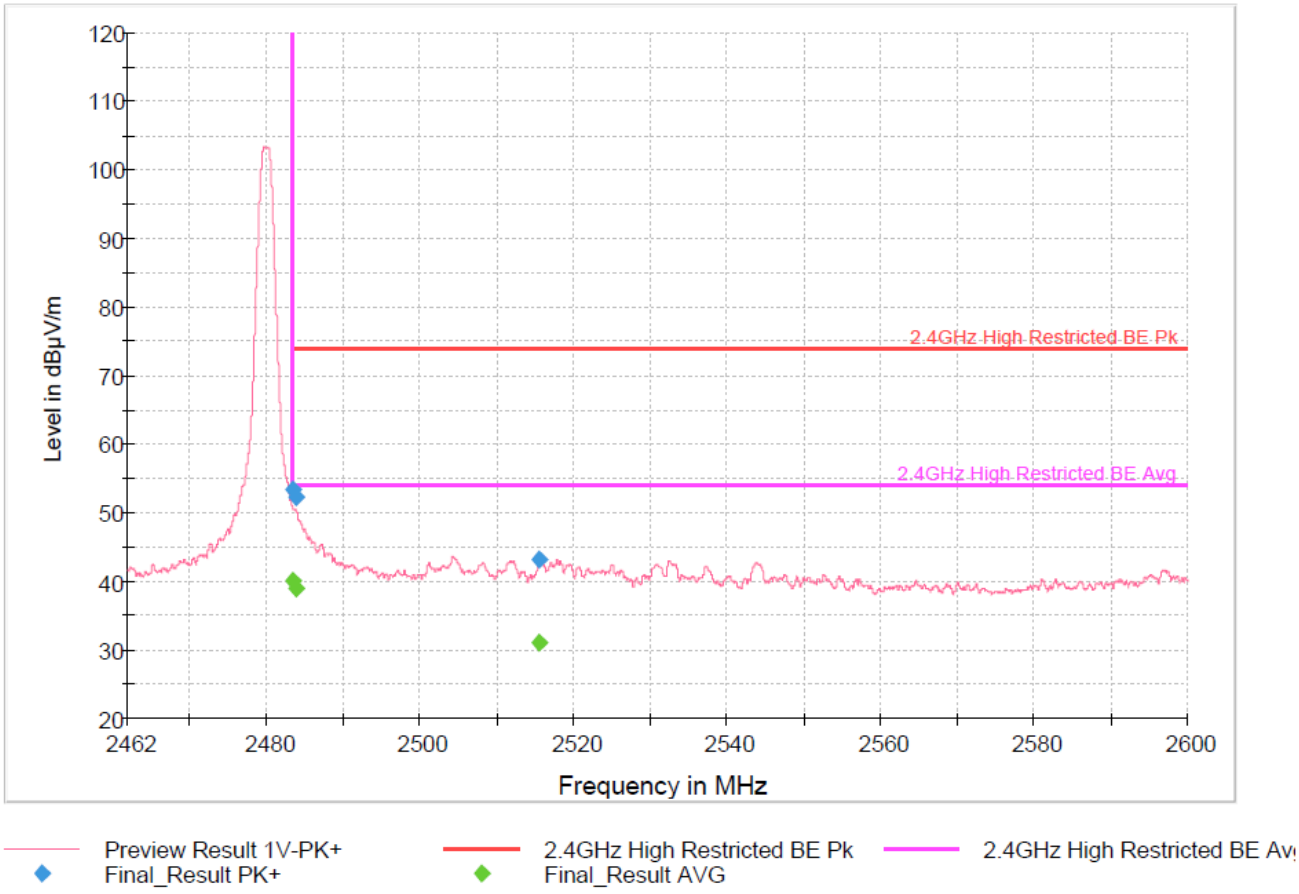



Figure 41: Restricted Band Edge, High, 2480MHz, 1 Mbps

## Final Result

| Frequency (MHz) | MaxPeak (dBµV/m) | Average (dBµV/m) | Limit (dBµV/m) | Margin (dB) | Bandwidth (kHz) | Height (cm) | Pol | Azimuth (deg) | Corr. (dB/m) |
|---|---|---|---|---|---|---|---|---|---|
| 2483.528000 | --- | 24.03 | 54.00 | 29.97 | 1000.000 | 144.0 | V | 222.0 | -1.6 |
| 2483.528000 | 36.53 | --- | 74.00 | 37.47 | 1000.000 | 144.0 | V | 222.0 | -1.6 |
| 2483.900600 | --- | 24.03 | 54.00 | 29.97 | 1000.000 | 150.0 | V | 212.0 | -1.6 |
| 2483.900600 | 36.81 | --- | 74.00 | 37.19 | 1000.000 | 150.0 | V | 212.0 | -1.6 |

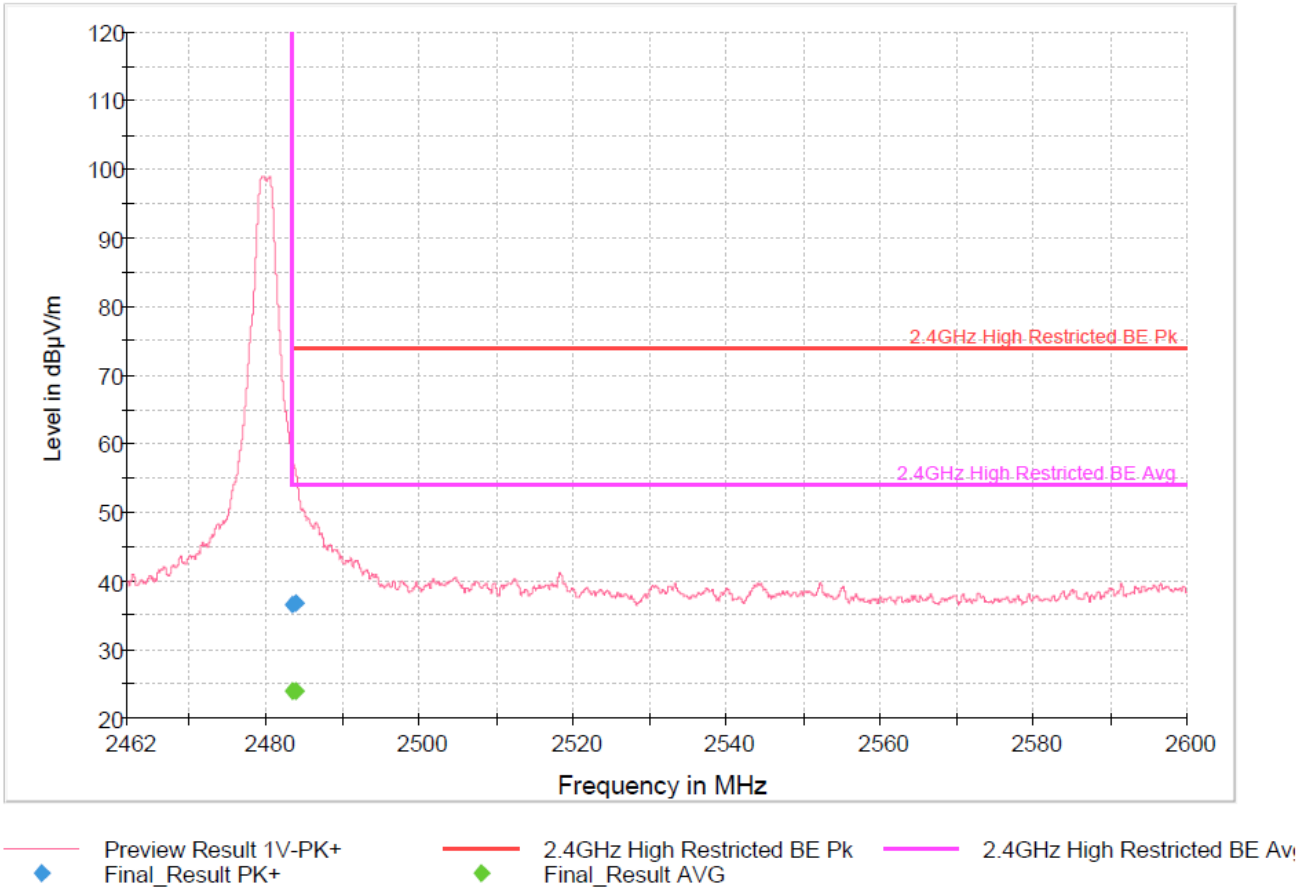



Figure 42: Restricted Band Edge, High, 2480MHz, 2 Mbps

## 4.6 Transmitter Spurious Emissions

*Transmitter spurious emissions are emissions outside the frequency range of the equipment when the equipment is in transmit mode; per requirement of CFR47 15.205, 15.209, 15.247(d), RSS 247 Sect.5.5, RSS-GEN Sect. 8.9 and 8.10.*

### 4.6.1 Test Methodology

#### *4.6.1.1 Preliminary Test*

A test program that controls instrumentation and data logging was used to automate the preliminary RF emission test procedure. The frequency range of interest was divided into sub-ranges to yield a frequency resolution of approximately 120 kHz and provide a reading at each frequency for no more than 12° of turntable rotation. For each frequency sub-range the turntable was rotated 360° while peak emission data was recorded and Figure 2: ted over the frequency range of interest in horizontal and vertical antenna polarization's.

Preliminary emission profile testing was performed inside the anechoic chamber. The EUT was placed on a 1.0m x 1.5m non-conductive table 80cm (<1 GHz) and 150cm (>1 GHz) above the floor. The EUT was positioned as shown in the setup photographs. The receiving antenna was placed at a distance of 3m at a fixed height of 1m. Measurement equipment was located outside of the chamber. A video camera was placed inside the chamber to view the EUT.

Pre-scans were performed to determine the worst data rate / chains.

#### *4.6.1.2 Final Test*

For each frequency measured, the peak emission was maximized by manipulating the receiving antenna from 1 to 4 meters above the ground plane and placing it at the position that produced the maximum signal strength reading. The turntable was then rotated through 360° while observing the peak signal and placing the EUT at the position that produced maximum radiation. The six highest emissions relative to the limit were measured unless such emissions were more than 20 dB below the limit. If less than six emissions are within 20 dB of the limit, than the noise level of the receiver is measured at frequencies where emissions are expected. Multiples of all oscillator and microprocessor frequencies were also checked.

Final testing was performed on an NSA compliant test site. The EUT was placed on a 1.0m x 1.5m non-conductive table 80cm (<1 GHz) and 150cm (>1 GHz) above the ground plane. The placement of EUT and cables were the same as for preliminary testing and is shown in the setup photographs.

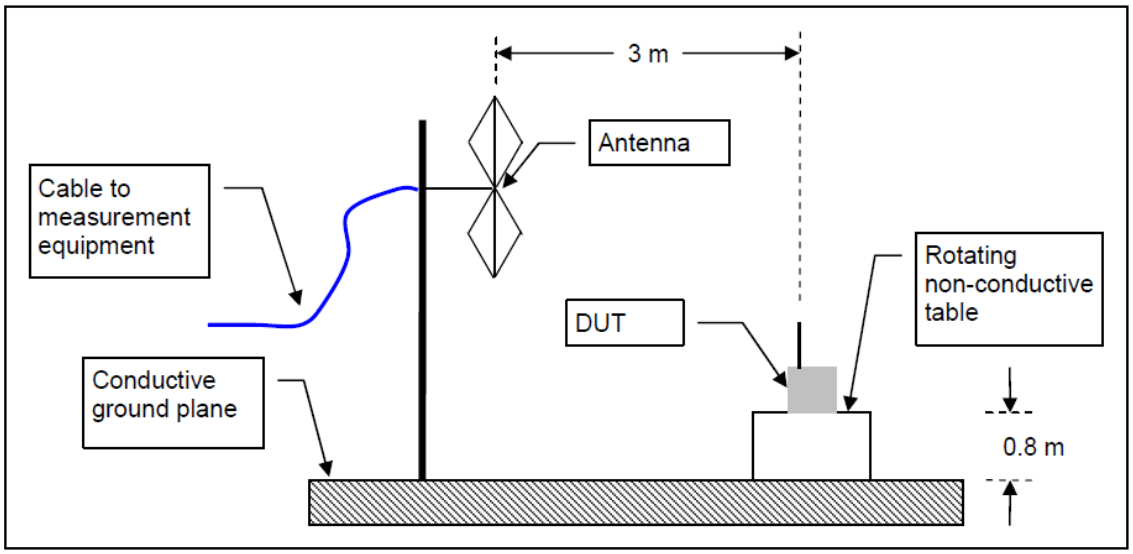
#### *4.6.1.3 Deviations*

None.

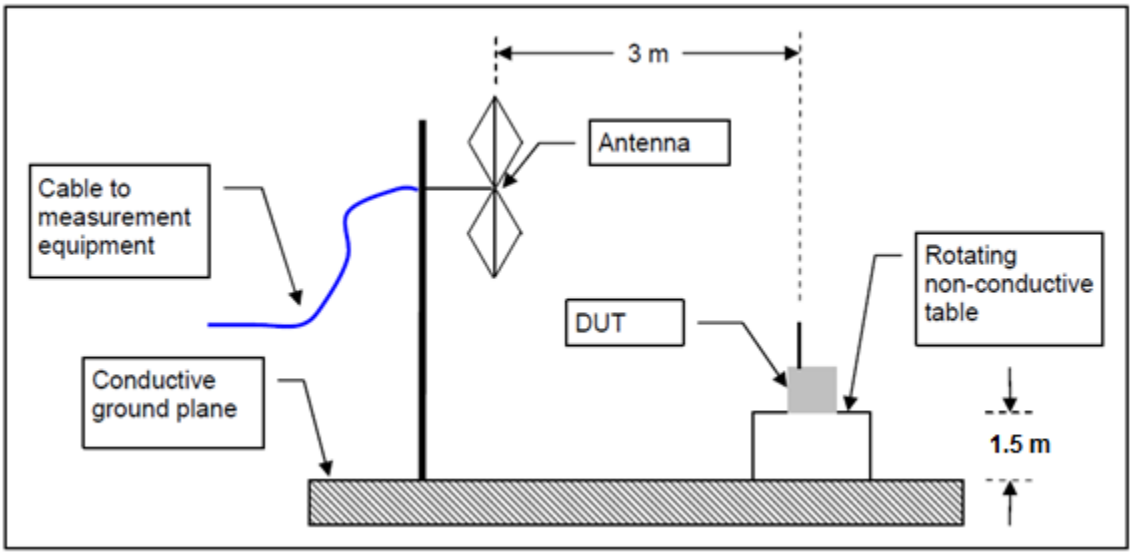
### 4.6.2 Test Setup:

All tests were conducted at full power on low, middle, and high channels. The DUT was stimulated by manufacturer provided test software that is not available to the end user.

***30MHz-1GHz***




***1-26GHz***



### 4.6.3 Transmitter Spurious Emission Limit

The spurious emissions of the transmitter shall not exceed the values in CFR47 Part 15.205, 15.209: 2015 and RSS Gen Sect. 8.9 and 8.10: 2014.

| Frequency (MHz) | Field strength (microvolts/meter) | Measurement distance (meters) |
|---|---|---|
| 0.009-0.490..... | 2400/F(kHz) | 300 |
| 0.490-1.705..... | 24000/F(kHz) | 30 |
| 1.705-30.0..... | 30 | 30 |
| 30-88..... | 100 ** | 3 |
| 88-216..... | 150 ** | 3 |
| 216-960..... | 200 ** | 3 |
| Above 960..... | 500 | 3 |

### 4.6.4 Test Results

The final measurement data was taken under the worst case operating modes, configurations, and/or cable positions. It also reflects the results including any modifications and/or special accessories listed in Sections 1.4 and test plan.

Frequencies below 30MHz and above 18GHz were investigated and no emissions were found above the noise floor. Both horizontal and vertical polarities were investigated. The results show only the worst case.

As originally tested, the EUT was found to be compliant to the requirements of the test standard(s).

Note: The 2.4 GHz notch filter was used to protect the front end of the pre-amp.

### *4.6.4.1 Measurement Results:*

**Final Result**

| Frequency (MHz) | QuasiPeak (dBµV/m) | MaxPeak (dBµV/m) | Limit (dBµV/m) | Margin (dB) | Meas. Time (ms) | Bandwidth (kHz) | Height (cm) | Pol | Azimuth (deg) | Corr. (dB/m) |
|---|---|---|---|---|---|---|---|---|---|---|
| 39.599680 | 13.79 | --- | 40.00 | 26.21 | 10000.0 | 120.000 | 153.0 | V | 243.0 | -11.7 |
| 39.599680 | --- | 21.52 | --- | --- | 10000.0 | 120.000 | 153.0 | V | 243.0 | -11.7 |
| 55.993000 | 12.66 | --- | 40.00 | 27.34 | 10000.0 | 120.000 | 100.0 | V | 116.0 | -11.1 |
| 55.993000 | --- | 20.38 | --- | --- | 10000.0 | 120.000 | 100.0 | V | 116.0 | -11.1 |
| 199.982960 | --- | 21.60 | --- | --- | 10000.0 | 120.000 | 100.0 | V | 101.0 | -13.0 |
| 199.982960 | 17.33 | --- | 43.52 | 26.19 | 10000.0 | 120.000 | 100.0 | V | 101.0 | -13.0 |
| 479.792000 | --- | 22.76 | --- | --- | 10000.0 | 120.000 | 105.0 | H | 42.0 | -7.2 |
| 479.792000 | 14.71 | --- | 46.02 | 31.31 | 10000.0 | 120.000 | 105.0 | H | 42.0 | -7.2 |
| 599.199000 | 15.80 | --- | 46.02 | 30.22 | 10000.0 | 120.000 | 154.0 | V | 243.0 | -4.9 |
| 599.199000 | --- | 24.20 | --- | --- | 10000.0 | 120.000 | 154.0 | V | 243.0 | -4.9 |
| 937.631920 | 20.48 | --- | 46.02 | 25.54 | 10000.0 | 120.000 | 100.0 | V | 40.0 | -0.3 |
| 937.631920 | --- | 28.40 | --- | --- | 10000.0 | 120.000 | 100.0 | V | 40.0 | -0.3 |

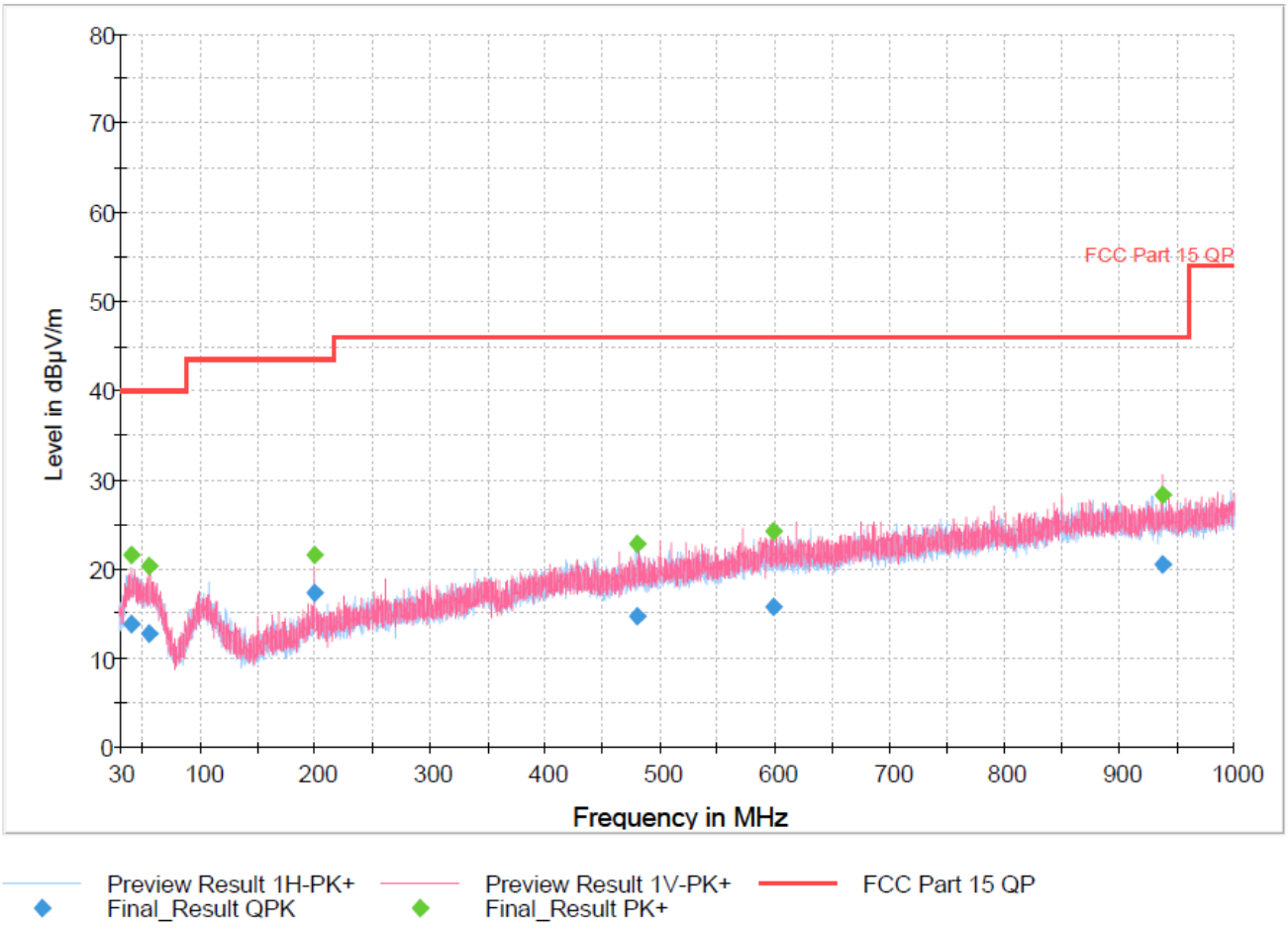



Figure 43: Radiated Spurious Emissions 30MHz – 1GHz, 2440MHz, 1Mbps

## Final Result

| Frequency (MHz) | QuasiPeak (dBµV/m) | MaxPeak (dBµV/m) | Limit (dBµV/m) | Margin (dB) | Meas. Time (ms) | Bandwidth (kHz) | Height (cm) | Pol | Azimuth (deg) | Corr. (dB/m) |
|---|---|---|---|---|---|---|---|---|---|---|
| 53.374000 | 12.21 | --- | 40.00 | 27.79 | 10000.0 | 120.000 | 155.0 | V | 229.0 | -10.8 |
| 53.374000 | --- | 19.84 | --- | --- | 10000.0 | 120.000 | 155.0 | V | 229.0 | -10.8 |
| 103.191140 | 10.68 | --- | 43.52 | 32.84 | 10000.0 | 120.000 | 100.0 | H | 145.0 | -12.8 |
| 103.191140 | --- | 18.47 | --- | --- | 10000.0 | 120.000 | 100.0 | H | 145.0 | -12.8 |
| 200.007080 | 16.99 | --- | 43.52 | 26.53 | 10000.0 | 120.000 | 100.0 | V | 339.0 | -13.0 |
| 200.007080 | --- | 21.29 | --- | --- | 10000.0 | 120.000 | 100.0 | V | 339.0 | -13.0 |
| 428.943140 | --- | 21.54 | --- | --- | 10000.0 | 120.000 | 150.0 | V | 68.0 | -8.1 |
| 428.943140 | 13.23 | --- | 46.02 | 32.79 | 10000.0 | 120.000 | 150.0 | V | 68.0 | -8.1 |
| 640.886600 | --- | 24.12 | --- | --- | 10000.0 | 120.000 | 150.0 | V | 2.0 | -4.7 |
| 640.886600 | 15.76 | --- | 46.02 | 30.26 | 10000.0 | 120.000 | 150.0 | V | 2.0 | -4.7 |
| 857.412920 | 18.90 | --- | 46.02 | 27.12 | 10000.0 | 120.000 | 155.0 | V | 76.0 | -1.1 |
| 857.412920 | --- | 27.14 | --- | --- | 10000.0 | 120.000 | 155.0 | V | 76.0 | -1.1 |

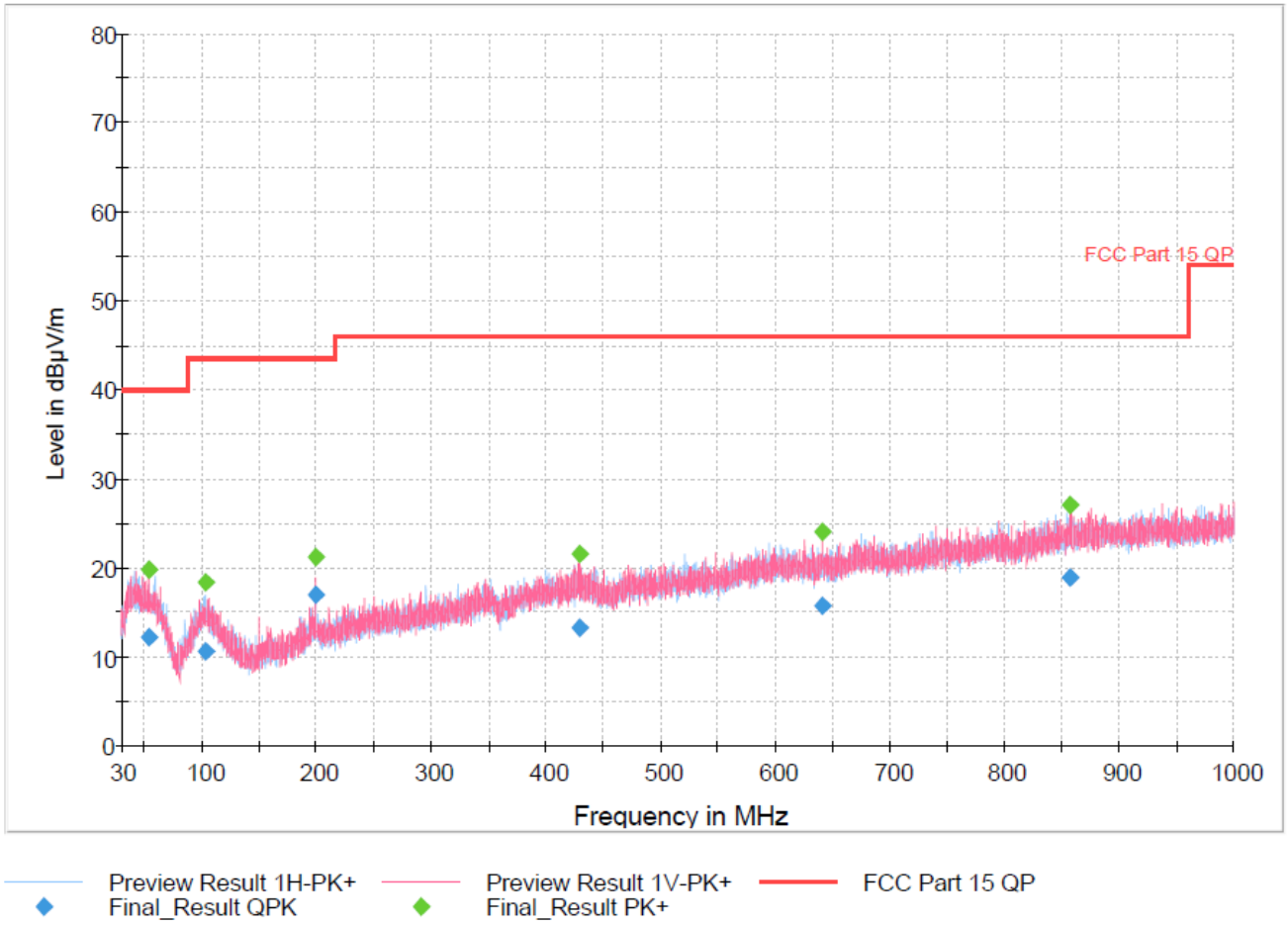



Figure 44: Radiated Spurious Emissions 30MHz – 1GHz, 2440MHz, 2Mbps

## Final Result

| Frequency (MHz) | MaxPeak (dBµV/m) | Average (dBµV/m) | Limit (dBµV/m) | Margin (dB) | Bandwidth (kHz) | Height (cm) | Pol | Azimuth (deg) | Corr. (dB/m) |
|---|---|---|---|---|---|---|---|---|---|
| 4803.499029 | --- | 45.93 | 54.00 | 8.07 | 1000.000 | 100.0 | H | 170.0 | 5.7 |
| 4803.499029 | 53.42 | --- | 74.00 | 20.58 | 1000.000 | 100.0 | H | 170.0 | 5.7 |
| 7206.000000 | 53.62 | --- | 74.00 | 20.38 | 1000.000 | 104.0 | V | 192.0 | 8.4 |
| 7206.000000 | --- | 45.88 | 54.00 | 8.12 | 1000.000 | 104.0 | V | 192.0 | 8.4 |
| 12010.860971 | 60.68 | --- | 74.00 | 13.32 | 1000.000 | 194.0 | H | 133.0 | 12.9 |
| 12010.860971 | --- | 52.53 | 54.00 | 1.47 | 1000.000 | 194.0 | H | 133.0 | 12.9 |
| 14346.716971 | --- | 38.90 | 54.00 | 15.10 | 1000.000 | 118.0 | V | 174.0 | 16.3 |
| 14346.716971 | 53.73 | --- | 74.00 | 20.27 | 1000.000 | 118.0 | V | 174.0 | 16.3 |
| 17489.000000 | 55.33 | --- | 74.00 | 18.67 | 1000.000 | 150.0 | V | 328.0 | 20.1 |
| 17489.000000 | --- | 42.52 | 54.00 | 11.48 | 1000.000 | 150.0 | V | 328.0 | 20.1 |
| 17839.880971 | --- | 42.62 | 54.00 | 11.38 | 1000.000 | 150.0 | H | 107.0 | 20.7 |
| 17839.880971 | 55.50 | --- | 74.00 | 18.50 | 1000.000 | 150.0 | H | 107.0 | 20.7 |

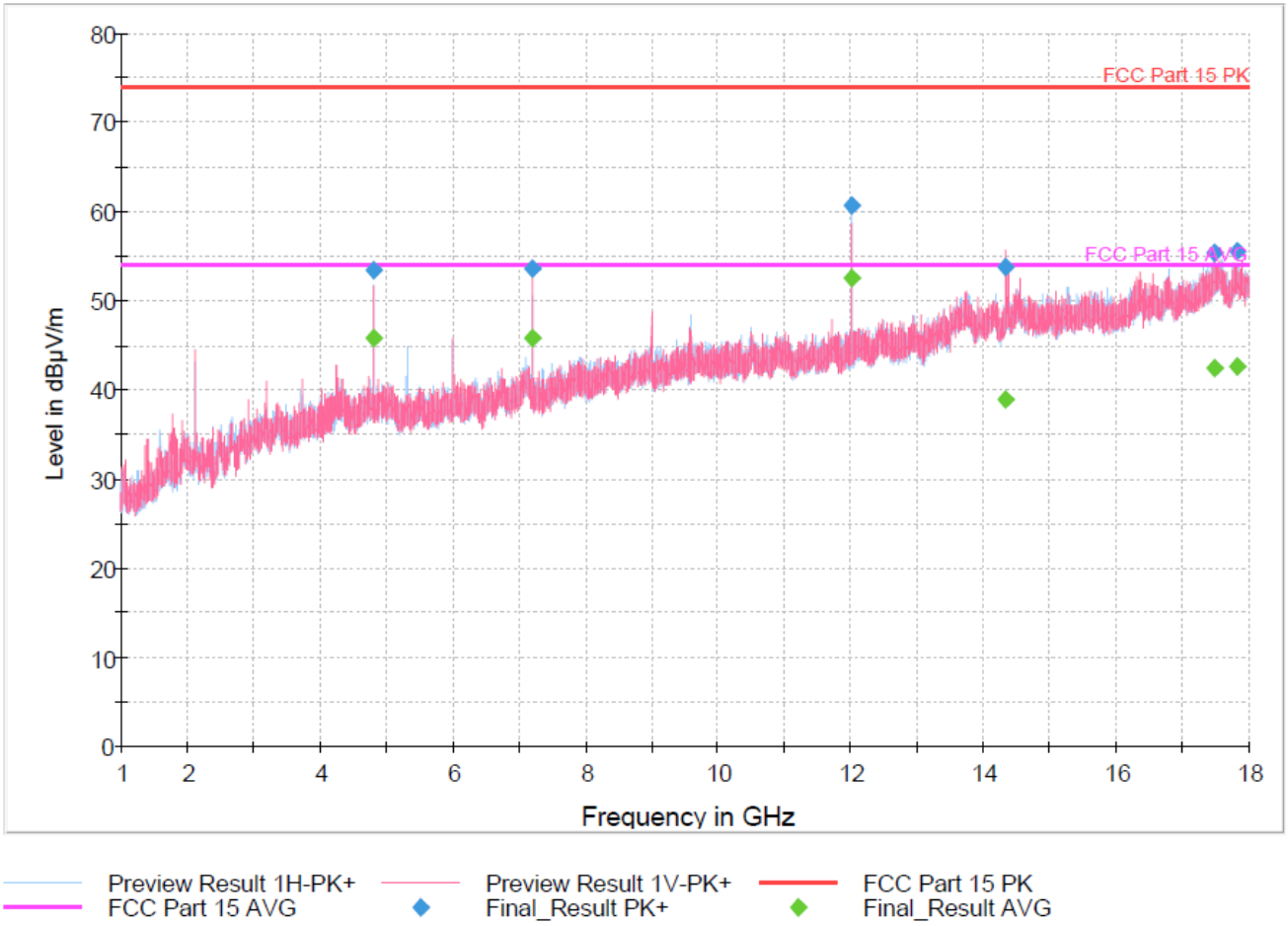



Figure 45: Radiated Spurious Emissions 1GHz - 18GHz, 2402MHz, 1Mbps

## Final Result

| Frequency (MHz) | MaxPeak (dBµV/m) | Average (dBµV/m) | Limit (dBµV/m) | Margin (dB) | Bandwidth (kHz) | Height (cm) | Pol | Azimuth (deg) | Corr. (dB/m) |
|---|---|---|---|---|---|---|---|---|---|
| 4879.500000 | --- | 37.24 | 54.00 | 16.76 | 1000.000 | 131.0 | H | 171.0 | 5.8 |
| 4879.500000 | 47.38 | --- | 74.00 | 26.62 | 1000.000 | 131.0 | H | 171.0 | 5.8 |
| 7319.274971 | 54.18 | --- | 74.00 | 19.82 | 1000.000 | 104.0 | V | 148.0 | 8.0 |
| 7319.274971 | --- | 46.12 | 54.00 | 7.88 | 1000.000 | 104.0 | V | 148.0 | 8.0 |
| 9556.499029 | --- | 33.00 | 54.00 | 21.00 | 1000.000 | 150.0 | V | 234.0 | 11.1 |
| 9556.499029 | 45.94 | --- | 74.00 | 28.06 | 1000.000 | 150.0 | V | 234.0 | 11.1 |
| 9760.500000 | 54.75 | --- | 74.00 | 19.25 | 1000.000 | 100.0 | H | 168.0 | 11.7 |
| 9760.500000 | --- | 45.77 | 54.00 | 8.23 | 1000.000 | 100.0 | H | 168.0 | 11.7 |
| 12199.499029 | 57.37 | --- | 74.00 | 16.63 | 1000.000 | 100.0 | H | 130.0 | 13.2 |
| 12199.499029 | --- | 47.01 | 54.00 | 6.99 | 1000.000 | 100.0 | H | 130.0 | 13.2 |
| 14391.000000 | 58.20 | --- | 74.00 | 15.80 | 1000.000 | 144.0 | H | 87.0 | 16.8 |
| 14391.000000 | --- | 38.97 | 54.00 | 15.03 | 1000.000 | 144.0 | H | 87.0 | 16.8 |

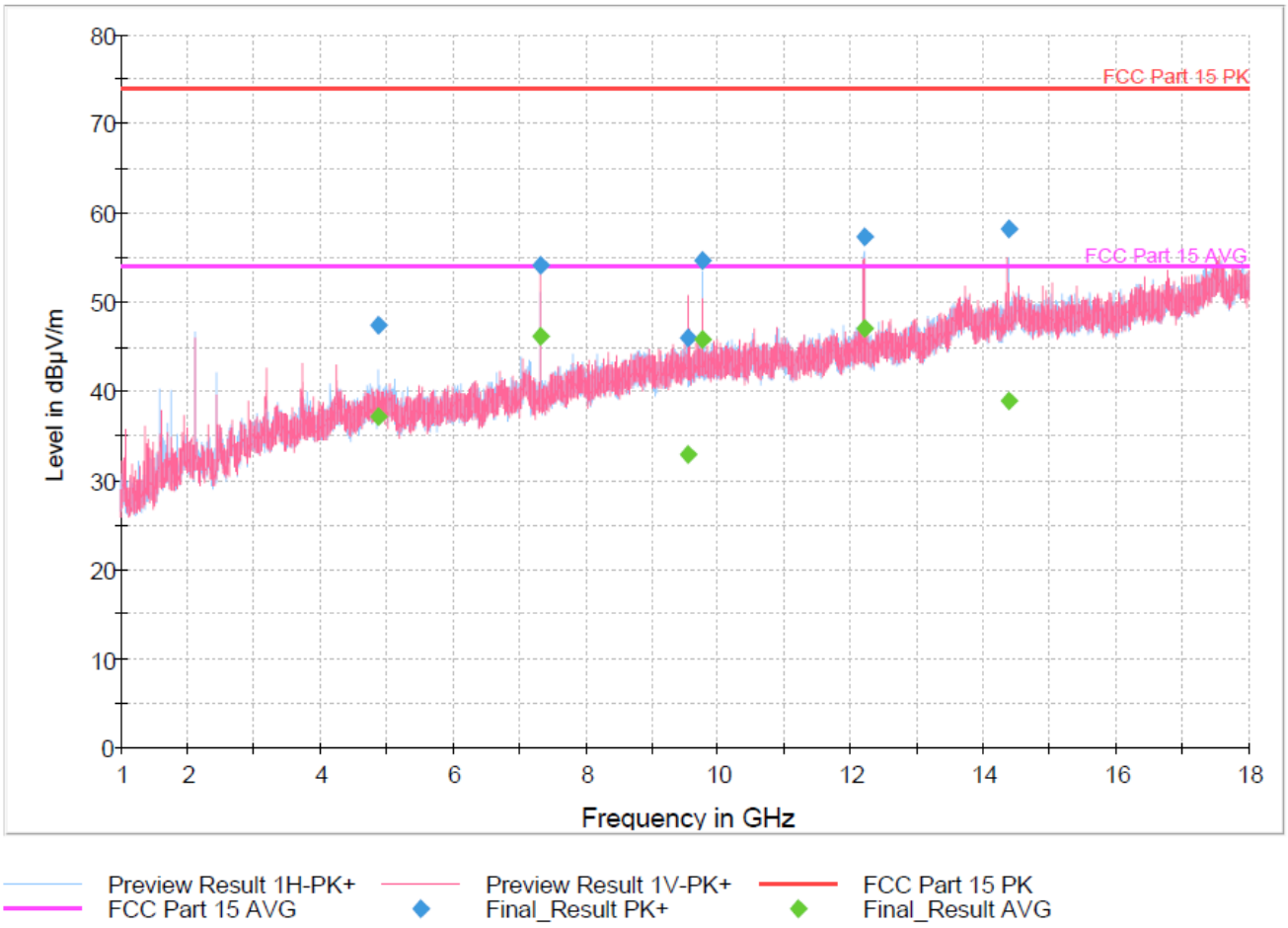



Figure 46: Radiated Spurious Emissions 1GHz - 18GHz, 2440MHz, 1Mbps

## Final Result

| Frequency (MHz) | MaxPeak (dBµV/m) | Average (dBµV/m) | Limit (dBµV/m) | Margin (dB) | Bandwidth (kHz) | Height (cm) | Pol | Azimuth (deg) | Corr. (dB/m) |
|---|---|---|---|---|---|---|---|---|---|
| 1592.617971 | 52.36 | --- | 74.00 | 21.64 | 1000.000 | 250.0 | V | 185.0 | -4.1 |
| 1592.617971 | --- | 23.67 | 54.00 | 30.33 | 1000.000 | 250.0 | V | 185.0 | -4.1 |
| 7439.270000 | 54.82 | --- | 74.00 | 19.18 | 1000.000 | 103.0 | V | 144.0 | 8.5 |
| 7439.270000 | --- | 47.29 | 54.00 | 6.71 | 1000.000 | 103.0 | V | 144.0 | 8.5 |
| 9919.500000 | 57.20 | --- | 74.00 | 16.80 | 1000.000 | 100.0 | H | 162.0 | 11.6 |
| 9919.500000 | --- | 49.16 | 54.00 | 4.84 | 1000.000 | 100.0 | H | 162.0 | 11.6 |
| 12399.000000 | --- | 44.55 | 54.00 | 9.45 | 1000.000 | 100.0 | V | 5.0 | 13.2 |
| 12399.000000 | 53.80 | --- | 74.00 | 20.20 | 1000.000 | 100.0 | V | 5.0 | 13.2 |
| 14379.892000 | --- | 39.81 | 54.00 | 14.19 | 1000.000 | 169.0 | V | 90.0 | 16.7 |
| 14379.892000 | 56.51 | --- | 74.00 | 17.49 | 1000.000 | 169.0 | V | 90.0 | 16.7 |
| 17508.539971 | --- | 42.73 | 54.00 | 11.27 | 1000.000 | 196.0 | V | 330.0 | 20.2 |
| 17508.539971 | 55.02 | --- | 74.00 | 18.98 | 1000.000 | 196.0 | V | 330.0 | 20.2 |
| 17804.000971 | 55.60 | --- | 74.00 | 18.40 | 1000.000 | 250.0 | V | 13.0 | 20.5 |
| 17804.000971 | --- | 42.60 | 54.00 | 11.40 | 1000.000 | 250.0 | V | 13.0 | 20.5 |

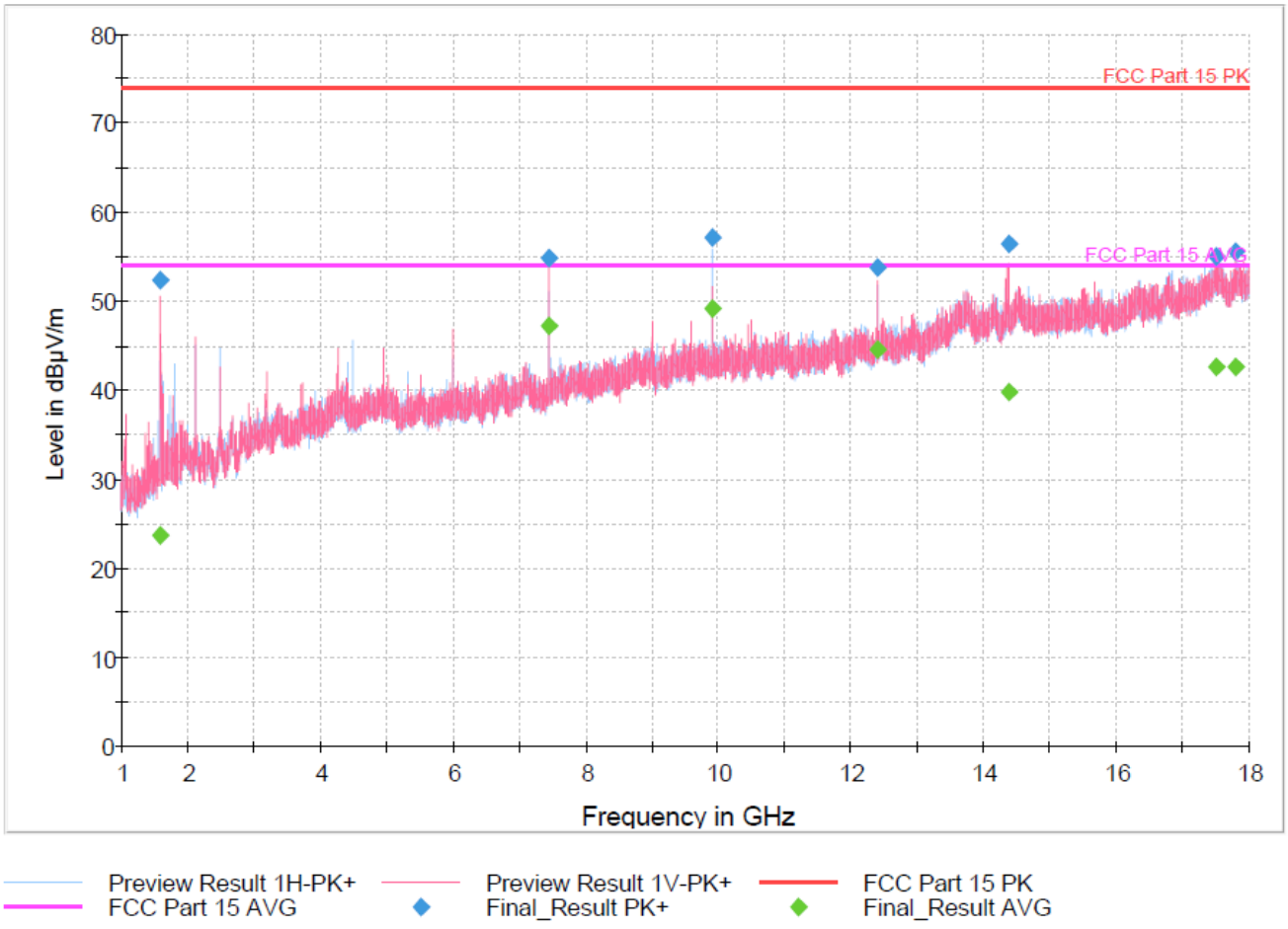



Figure 47: Radiated Spurious Emissions 1GHz - 18GHz, 2480MHz, 1Mbps

## Final Result

| Frequency (MHz) | MaxPeak (dBµV/m) | Average (dBµV/m) | Limit (dBµV/m) | Margin (dB) | Bandwidth (kHz) | Height (cm) | Pol | Azimuth (deg) | Corr. (dB/m) |
|---|---|---|---|---|---|---|---|---|---|
| 2132.000971 | 49.38 | --- | 74.00 | 24.62 | 1000.000 | 180.0 | V | 143.0 | -2.3 |
| 2132.000971 | --- | 31.62 | 54.00 | 22.38 | 1000.000 | 180.0 | V | 143.0 | -2.3 |
| 7204.810029 | --- | 44.97 | 54.00 | 9.03 | 1000.000 | 104.0 | V | 185.0 | 8.4 |
| 7204.810029 | 52.80 | --- | 74.00 | 21.20 | 1000.000 | 104.0 | V | 185.0 | 8.4 |
| 12012.909971 | 47.78 | --- | 74.00 | 26.22 | 1000.000 | 105.0 | V | 201.0 | 12.9 |
| 12012.909971 | --- | 35.11 | 54.00 | 18.89 | 1000.000 | 105.0 | V | 201.0 | 12.9 |
| 14337.500000 | --- | 39.83 | 54.00 | 14.17 | 1000.000 | 181.0 | V | 176.0 | 16.3 |
| 14337.500000 | 57.42 | --- | 74.00 | 16.58 | 1000.000 | 181.0 | V | 176.0 | 16.3 |
| 17605.000000 | 55.08 | --- | 74.00 | 18.92 | 1000.000 | 250.0 | V | 140.0 | 20.0 |
| 17605.000000 | --- | 42.41 | 54.00 | 11.59 | 1000.000 | 250.0 | V | 140.0 | 20.0 |
| 17788.500971 | --- | 42.33 | 54.00 | 11.67 | 1000.000 | 100.0 | H | 179.0 | 20.3 |
| 17788.500971 | 55.47 | --- | 74.00 | 18.53 | 1000.000 | 100.0 | H | 179.0 | 20.3 |

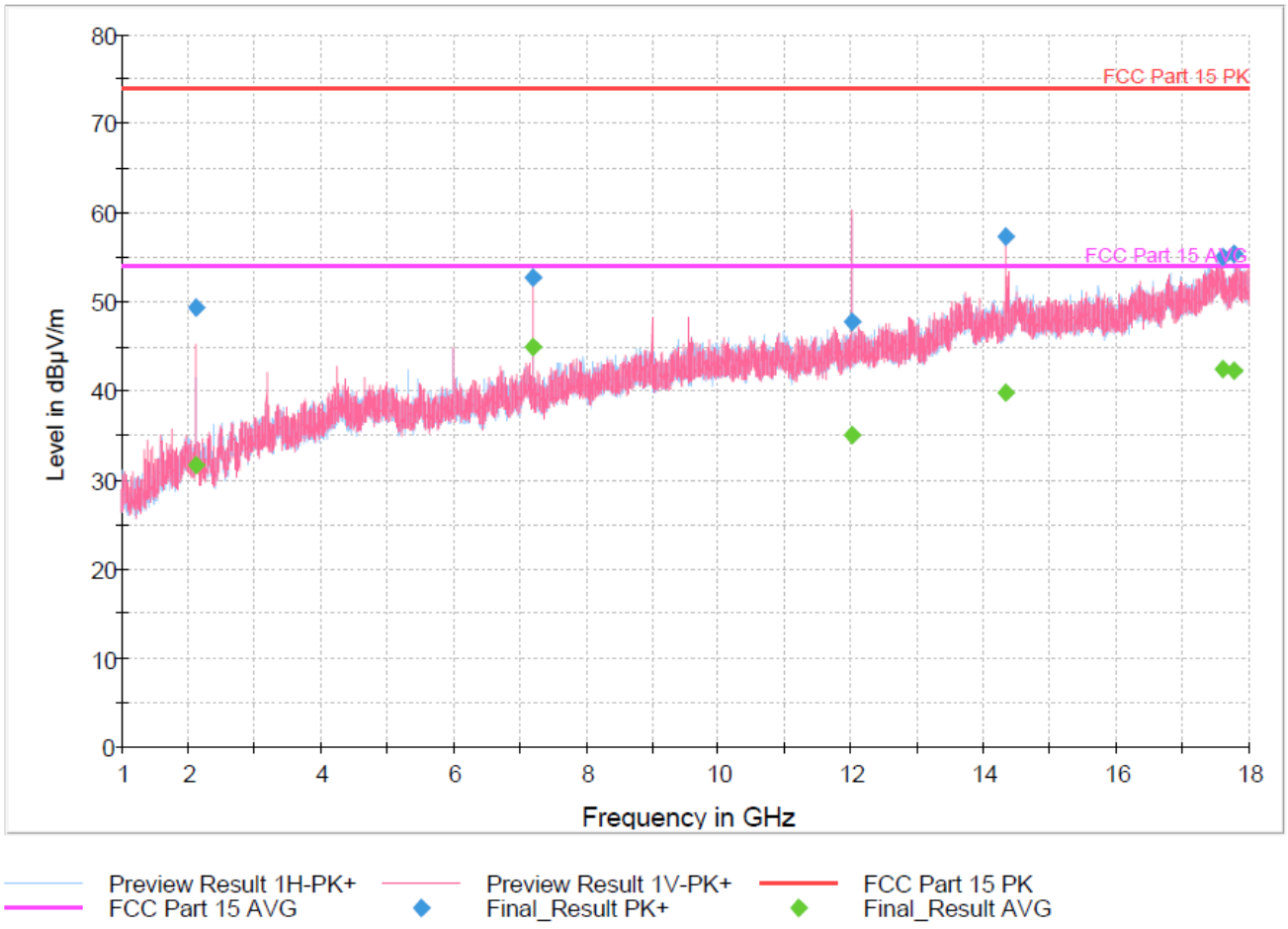



Figure 48: Radiated Spurious Emissions 1GHz - 18GHz, 2402MHz, 2Mbps

## Final Result

| Frequency (MHz) | MaxPeak (dBµV/m) | Average (dBµV/m) | Limit (dBµV/m) | Margin (dB) | Bandwidth (kHz) | Height (cm) | Pol | Azimuth (deg) | Corr. (dB/m) |
|---|---|---|---|---|---|---|---|---|---|
| 7320.500971 | 53.93 | --- | 74.00 | 20.07 | 1000.000 | 106.0 | V | 188.0 | 8.0 |
| 7320.500971 | --- | 44.55 | 54.00 | 9.45 | 1000.000 | 106.0 | V | 188.0 | 8.0 |
| 9761.500000 | 54.99 | --- | 74.00 | 19.01 | 1000.000 | 197.0 | H | 206.0 | 11.7 |
| 9761.500000 | --- | 46.39 | 54.00 | 7.61 | 1000.000 | 197.0 | H | 206.0 | 11.7 |
| 12197.845029 | 60.11 | --- | 74.00 | 13.89 | 1000.000 | 233.0 | H | 178.0 | 13.2 |
| 12197.845029 | --- | 51.55 | 54.00 | 2.45 | 1000.000 | 233.0 | H | 178.0 | 13.2 |
| 14343.000000 | --- | 39.74 | 54.00 | 14.26 | 1000.000 | 150.0 | V | 123.0 | 16.3 |
| 14343.000000 | 57.30 | --- | 74.00 | 16.70 | 1000.000 | 150.0 | V | 123.0 | 16.3 |
| 17030.339971 | 54.65 | --- | 74.00 | 19.35 | 1000.000 | 195.0 | V | 57.0 | 19.2 |
| 17030.339971 | --- | 40.92 | 54.00 | 13.08 | 1000.000 | 195.0 | V | 57.0 | 19.2 |
| 17523.387000 | --- | 42.83 | 54.00 | 11.17 | 1000.000 | 117.0 | H | 138.0 | 20.3 |
| 17523.387000 | 55.49 | --- | 74.00 | 18.51 | 1000.000 | 117.0 | H | 138.0 | 20.3 |
| 17818.788971 | --- | 42.65 | 54.00 | 11.35 | 1000.000 | 150.0 | V | 100.0 | 20.6 |
| 17818.788971 | 56.02 | --- | 74.00 | 17.98 | 1000.000 | 150.0 | V | 100.0 | 20.6 |

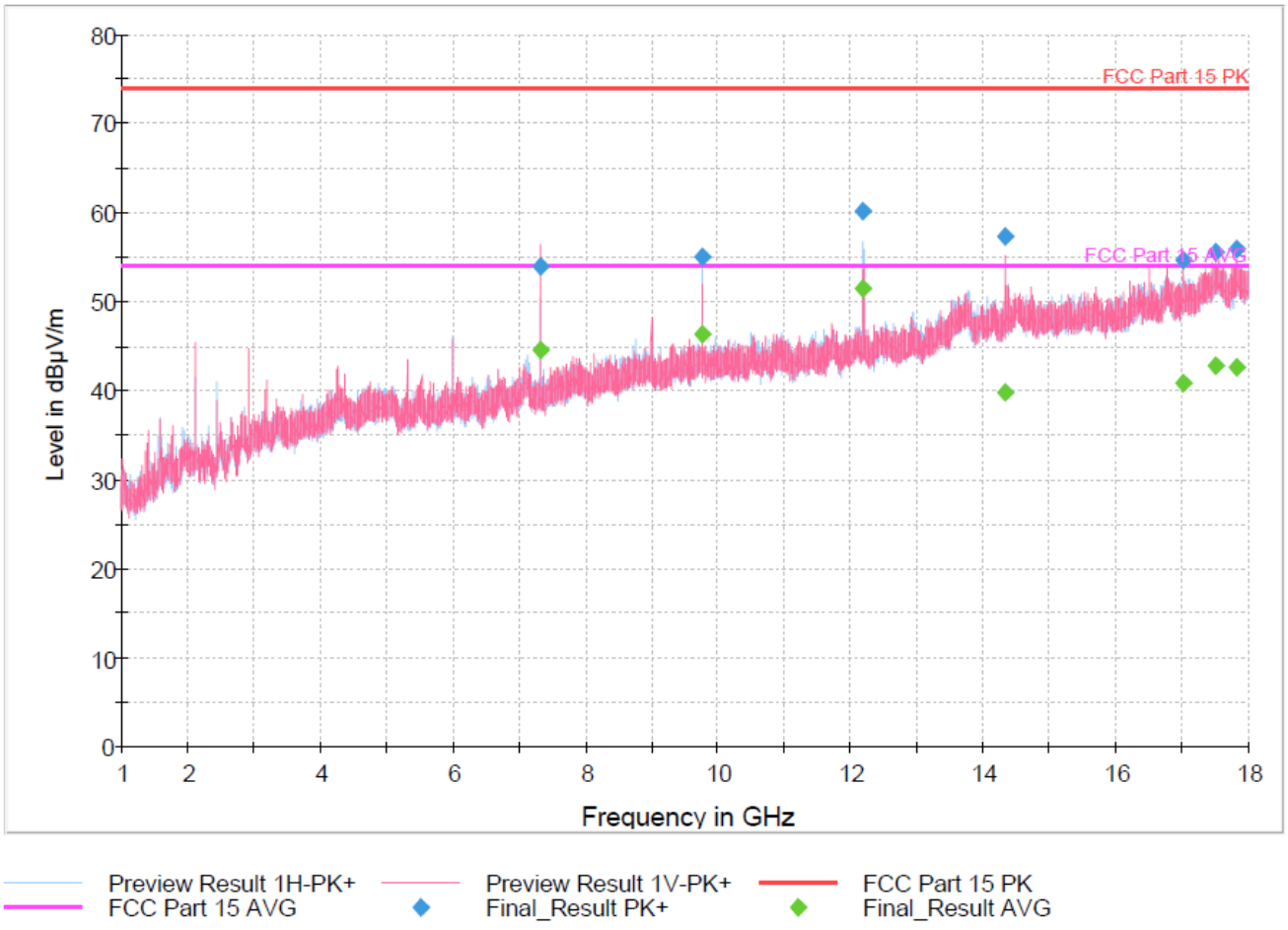



Figure 49: Radiated Spurious Emissions 1GHz - 18GHz, 2440MHz, 2Mbps

## Final Result

| Frequency (MHz) | MaxPeak (dBµV/m) | Average (dBµV/m) | Limit (dBµV/m) | Margin (dB) | Bandwidth (kHz) | Height (cm) | Pol | Azimuth (deg) | Corr. (dB/m) |
|---|---|---|---|---|---|---|---|---|---|
| 7439.000000 | 56.77 | --- | 74.00 | 17.23 | 1000.000 | 100.0 | V | 190.0 | 8.5 |
| 7439.000000 | --- | 49.43 | 54.00 | 4.57 | 1000.000 | 100.0 | V | 190.0 | 8.5 |
| 9921.697971 | 56.88 | --- | 74.00 | 17.12 | 1000.000 | 183.0 | H | 192.0 | 11.6 |
| 9921.697971 | --- | 48.05 | 54.00 | 5.95 | 1000.000 | 183.0 | H | 192.0 | 11.6 |
| 12397.516000 | 55.47 | --- | 74.00 | 18.53 | 1000.000 | 194.0 | H | 136.0 | 13.2 |
| 12397.516000 | --- | 44.43 | 54.00 | 9.57 | 1000.000 | 194.0 | H | 136.0 | 13.2 |
| 14373.498971 | 52.41 | --- | 74.00 | 21.59 | 1000.000 | 146.0 | V | -2.0 | 16.6 |
| 14373.498971 | --- | 38.83 | 54.00 | 15.17 | 1000.000 | 146.0 | V | -2.0 | 16.6 |
| 16378.791029 | 53.28 | --- | 74.00 | 20.72 | 1000.000 | 195.0 | H | 222.0 | 18.1 |
| 16378.791029 | --- | 40.46 | 54.00 | 13.54 | 1000.000 | 195.0 | H | 222.0 | 18.1 |
| 17500.891971 | --- | 42.62 | 54.00 | 11.38 | 1000.000 | 150.0 | H | 185.0 | 20.2 |
| 17500.891971 | 55.25 | --- | 74.00 | 18.75 | 1000.000 | 150.0 | H | 185.0 | 20.2 |
| 17813.842000 | 56.12 | --- | 74.00 | 17.88 | 1000.000 | 150.0 | V | 146.0 | 20.5 |
| 17813.842000 | --- | 42.59 | 54.00 | 11.41 | 1000.000 | 150.0 | V | 146.0 | 20.5 |

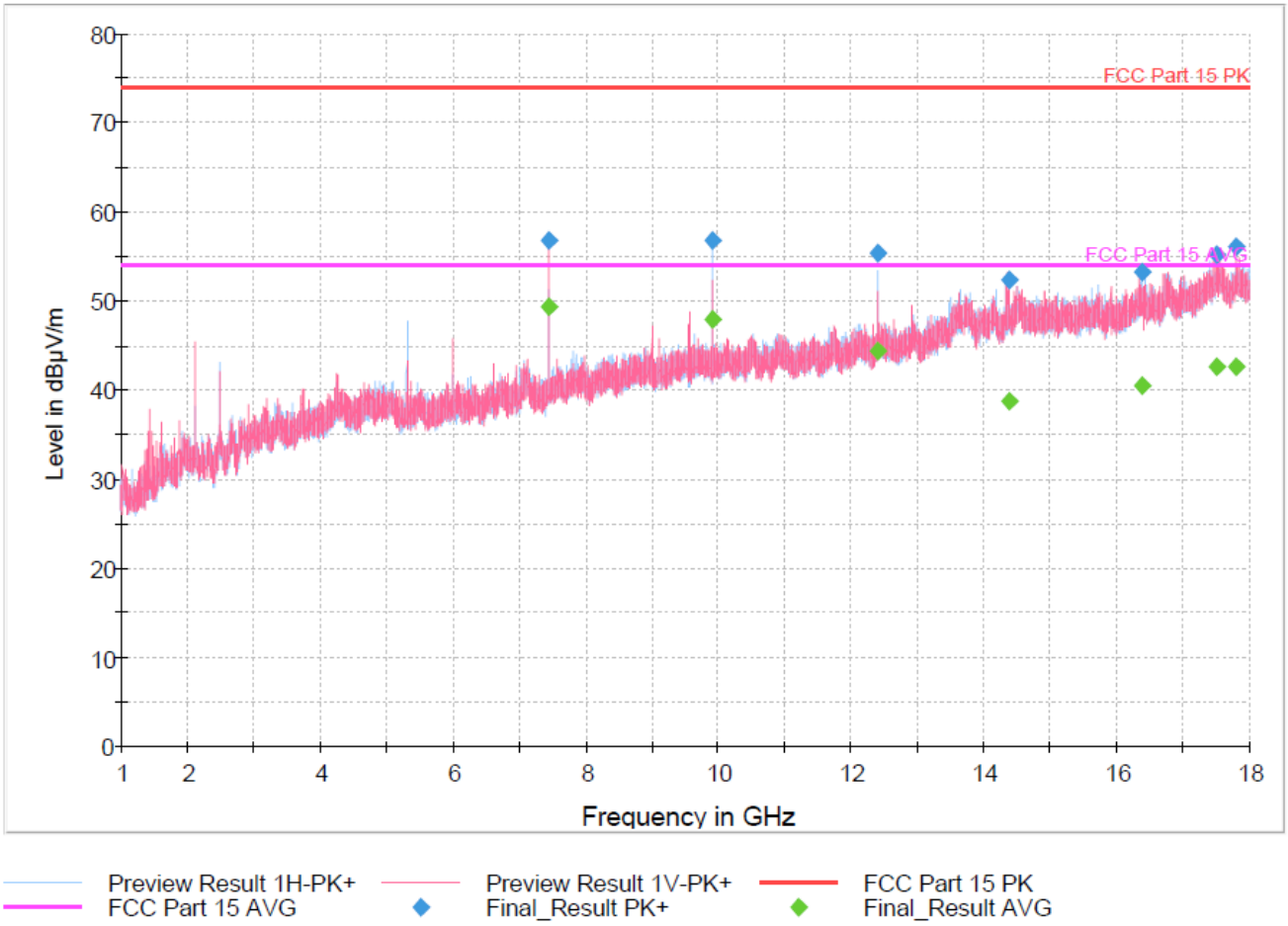



Figure 50: Radiated Spurious Emissions 1GHz - 18GHz, 2480MHz, 2Mbps

## *4.7 AC Conducted Emissions*

Testing was performed in accordance with ANSI C63.10: 2013. These test methods are listed under the laboratory's A2LA Scope of Accreditation.

This test measures the levels emanating from the EUT's AC input port, thus evaluating the potential for the EUT to cause radio frequency interference to other electronic devices.

The AC conducted emissions of equipment under test shall not exceed the values in CFR47 Part 15.207: 2021 and RSS Gen: 2019 Sect. 8.8.

### 4.7.1 Test Methodology

A test program that controls instrumentation and data logging was used to automate the AC Power Line Conducted emission test procedure. The frequency range of interest was divided into sub-ranges such as to yield a frequency resolution of 9 kHz. Each phase and neutral of the AC power line were measured with respect to ground. Measurements were performed using a set of 50μH / 50Ω LISNs.

The setup photographs clearly identify which site was used. The vertical ground plane used in the semi-anechoic chamber is a 2m x 2m solid aluminum frame and panel, and it is bonded to the horizontal ground plane.

In the case of tabletop equipment, the EUT is placed on a 1.0m x 1.5m non-conductive table 80cm above the ground plane and 40cm from a vertical ground reference plane. The rear of the EUT was positioned flush with the backside of the table and directly over the LISNs. The power and I/O cables were routed over the edge of the table and bundled approximately 40cm from the ground plane. Support equipment was powered from a separate LISN.

#### *4.7.1.1 Deviations*

There were no deviations from this test methodology.

### 4.7.2 Test Results

Test is not applicable since the EUT is DC powered by a battery.

# 5 Test Equipment List

## *5.1 Equipment List*

| Equipment | Manufacturer | Model # | Serial/Inst # | Last Cal mm/dd/yyyy | Next Cal mm/dd/yyyy |
|---|---|---|---|---|---|
| Spectrum Analyzer | Rohde & Schwarz | FSU26.5 | 1166.1660.26 | 02/24/2021 | 02/24/2022 |
| EMI Receiver | Rohde & Schwarz | ESW44 | 838399 | 02/12/2021 | 02/12/2022 |
| Preamplifier, 9 kHz – 1 GHz | Sonoma | 310N | 213221 | 08/06/2020 | 08/06/2022 |
| Bilog Antenna | Sunol Sciences | JB3 | A061907 | 02/12/2021 | 02/12/2022 |
| Preamplifier – 1-18GHz | Miteq | AMF-70-01001800-30-10P-L | 2074297 | 02/12/2021 | 02/12/2022 |
| Horn Antenna | Sunol Sciences | DRH-118 | A040806 | 06/17/2020 | 06/172022 |
| Preamplifier – 1-10GHz | HP | 8449B | 3008A01013 | 06/08/2020 | 06/08/2022 |
| Horn Antenna | EMCO | RA42-K-F-B-C | 100011 | 03/04/2019 | 03/04/2022 |
| Amplifier | Rohde & Schwarz | TS-PR26 | 100011 | 06/13/2020 | 06/13/2022 |
| 2.4GHZ Band Filter | Microtronics | BRM50702 | 009 | N/A (See Note) | |

Note: Equipment is characterized before use.

# 6 EMC Test Plan

## 6.1 Introduction

This section provides a description of the Equipment Under Test (EUT), configurations, operating conditions, and performance acceptance criteria. It is an overview of information provided by the manufacturer (information supplied by the customer and can affect the validity of results) so that the test laboratory may perform the requested testing.

## 6.2 Customer

The information in the following tables is required, as it should appear in the final test report.

**Table 6:** Customer Information

| | |
|---|---|
| **Company Name** | Hunter Douglas Window Fashions Division Division |
| **Address** | 1 Duette Way |
| **City, State, Zip** | Broomfield, CO, 80020 |
| **Country** | USA |

**Table 7:** Technical Contact Information

| | |
|---|---|
| **Name** | Mike Rockwood |
| **E-mail** | mike.rockwood@hunterdouglas.com |
| **Phone** | 651-528-1165 |

## 6.3 Equipment Under Test (EUT)

The information provided in the following table should be listed as it should appear in the final report. For those products that have only a model name, list the model number as *non-applicable* and vice-versa.

**Table 8**: EUT Designation

| | |
|---|---|
| Product Name | Remote Control |
| Model Number | 1012000409, 1012000410, 1012000411 |
| Product Description | The 1012000409, 1012000410, 1012000411 are assembled into various remote assemblies and fabricated into Hunter Douglas window coverings via an easy to use and intuitive push-button handheld remote. This device utilized BLE in the 2400-2483.5MHz band.<br>Hunter Douglas Remotes which are model numbered differently for marketing purposes but utilize the same hardware and communication software. All devices are identical in componentry and wireless communication aspects. These different model numbers have unique Product Marketing Names and depending on the device utilize different product features which are independent of the device's wireless communication. |

## 6.4 Product Specifications

The information provided in the following table should be listed as it should appear in the final report.

**Table 9:** EUT Specifications*

| EUT Specifications | |
|---|---|
| DC Power Input | 3 VDC (powered by battery) |
| Multiple Feeds: | ☐ Yes and how many<br>☒ No |
| Product Marketing Name (PMN) | Remote Control |
| Test Sample Number | 1012000325 |
| Hardware Version Identification Number (HVIN) | 1012000409, 1012000410, 1012000411 |
| Firmware Version Identification Number (FVIN) | N/A |
| Operating Modes | Bluetooth Low Energy |
| Transmitter Frequency Band | 2400 MHz to 2483.5 MHz |
| Power Setting @ Operating Channel | +8dBm |
| Antenna Type | Integral, Trace |
| Antenna Gain | 0 dBi |
| Modulation Type | ☐ AM ☐ FM ☐ DSSS ☒ OFDM<br>☒ Other describe: GFSK |
| Data Rate | 1 Mbps, 2Mbps |
| TX/RX Chain (s) | 1 |
| Type of Equipment | ☒ Table Top ☐ Wall-mount ☐ Floor standing cabinet<br>☐ Other: |
| **Note:** *All EUT specifications are provided by the manufacturer or the TUV direct customer. Information supplied by the customer and can affect the validity of results. | |

**Table 10:** Antenna Information

| Number | Antenna Type | Description | Max Gain (dBi) |
|---|---|---|---|
| 1 | Integral, Trace | Internal | 0 |

**Table 11:** Interface Specifications

| Interface Type | Cabled with what type of cable? | Is the cable shielded? | Maximum potential length of the cable? | Metallic (M), Coax (C), Fiber (F), or Not Applicable? |
|---|---|---|---|---|
| USB Cable | Serial to USB | ☐ Yes | ☒ Metric: <3.0m | ☒ M |
| Note: Cable required for EUT configuration for regulatory test mode. 3pin to USB cable not utilized within final product. EUT powered via DC power supply during testing. | | | | |

**Table 12:** Accessory Equipment

| Equipment | Manufacturer | Model | Serial | Comment |
|---|---|---|---|---|
| USB to Serial Connector cable | N/A (generic) | N/A (generic) | N/A | Used between test cases to configure EUT operational test mode. |
| **Note:** None. | | | | |

**Table 13**: Ancillary Equipment (used for test purposes only)

| Equipment | Manufacturer | Model | Serial | Used for |
|---|---|---|---|---|
| Laptop | Lenovo | X201 | N/A | Setup EUT operating channels via serial connection to EUT |
| **Note:** None. | | | | |

**Table 14:** Description of Sample used for Testing

| Device | Sample Number | Configuration | Used For |
|---|---|---|---|
| Remote Control | 1012000325 | Integrated Antenna | Radiated Emissions, Radiated Band Edge |
| | | Direct via temporary SMA connector | Transmit Power, Occupied Bandwidth, Out of Band Emission, PSD, Duty Cycle |

**Table 15:** Description of Test Configuration used for Radiated Measurement.

| Device | Antenna | Mode | Setup Description |
|---|---|---|---|
| Remote Control | Integral, Trace | Transmit | EUT Flat |
| **Note:** EUT was tested on its X-Axis as this was worse case | | | |

## *6.5 Test Specifications*

**Table 16:** Test Specifications

| Emissions and Immunity | |
|---|---|
| **Standard** | **Requirement** |
| CFR 47 Part 15.247: 2021 | All |
| RSS 247 Issue 2, 2017 | All |

# END OF REPORT