Global Product Compliance Laboratory
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**TESTING**
**NVLAP LAB CODE: 100275-0**

# RF Transmitter Certification Test Report
## (FCC ID: 2AD8UFW2RMBOM1)

Regulation

**FCC CFR 47 Part 15 Subpart E, Section 15.407**

Client

**Nokia Solutions and Networks Oy**

Product Evaluated

## Nokia Flexi Zone FW2RMOM1 LAA RF Module Operating in Band 46 UNII-3

**GPCL Report Number**
TR2019-0029 FCC

**GPCL Project Number**
2019-0029

**Date Issued**
February 15, 2019

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**Revisions**

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*The test results documented in this report refer exclusively to the test model/sample specified, under the conditions and modes of operation as described herein.*

Prepared By:

Signed:  2/15/2019

Q. Yu
GPCL Compliance Engineer

Date

Reviewed By:

Signed:  2/15/2019

R.J. Johnson
GPCL Technical Manager
NVLAP Approved Signatory

Date

# 1. ATTESTATION OF TEST RESULTS

| | |
|---|---|
| **Company Name (Manufacturer)** | Nokia Solutions and Networks Oy<br>2000 W. Lucent Lane<br>Naperville, IL 60563 |
| **FCC ID** | 2AD8UFW2MBOM1 |
| **Product Name** | Flexi Zone Multiband Outdoor Micro BTS (MBO)<br>FW2RMBOM1 LAA RF Module |
| **Model Name** | MBO LAA: FW2RMBOM1 |
| **Serial Number(s)** | 1M180528260 (Radiated), 1M180528224 (Conducted) |
| **Test Requirement(s)** | 47 CFR FCC Part 15 Subpart E Section 15.407 |
| **Test Procedures/Methods** | • ANSI C63.10-2013<br>• FCC KDB 789033 D02, v02r01, December 2017<br>• FCC KDB 662911 D01, v02r01, October 2013<br>• FCC KDB 353028 D01, v01, April 2017 |
| **Frequency Band** | E-UTRAN Band 46: 5735-5835 MHz (UNII-3) |
| **Operation Mode** | Master Device |
| **FCC Part 15 Subpart B Sections 15.107 and 15.109 Class B** | Passed |
| **Date Tested** | July 6 – December 14, 2018 |
| **Type of Application** | New Certification |
| **Submission Type** | Original Radio Equipment Certification |
| **Test Laboratory** | Nokia Global Product Compliance Laboratory<br>600-700 Mountain Avenue<br>Murray Hill, New Jersey 07974-0636 USA<br>FCC Registration No/Designation No: 328881/US5302 |
| **Test Engineers** | S. Gordon, M. Soli, O. Okorie and J. Yadav |

The above product has been evaluated and found to be in compliance with the Commission's Rules and Regulations set forth in the above standards.

**FCC Section 2.911(e) Certification of Technical Test Data**

The technical test data presented in this report are accurate.

# 2. SUMMARY OF THE TEST RESULTS

| Applied Standards: 47 CFR FCC Part Subpart E Section 15.407 UNII-3 | | | | |
|---|---|---|---|---|
| **Section** | **FCC Rules** | **Description of Tests** | **Test Condition** | **Results In Compliance** |
| 4.4 | 15.403 (i) & 15.215(c) | Emission Bandwidth (26dB Bandwidth) | Conducted | Yes |
| 4.5 | 15.407 (e) | Minimum Emission Bandwidth (6dB Bandwidth) | | Yes |
| 4.6 | 15.407 (a)(1)(3)(4) | Maximum Power Output and Maximum Outdoor EIRP | | Yes |
| 4.7 | 15.407 (a)(1)(3)(5) | Peak Power Spectrum Density | | Yes |
| 4.8 | 15.407 (b)(1)(4-5)(8) | Unwanted Radiated Out-of-Band Emissions | Radiated | Yes |
| 4.9 | 15.407 (b)(1)(4-8) | Unwanted Radiated Spurious Emissions | | Yes |
| 4.10 | 15.407 (b)(6) & 15.207 | AC Power Line Conducted Emissions | Conducted | Yes |
| | 15.407 (g) | Frequency Stability* | | Yes |

* KDB 789033 D02 Section II.A.3: the grantee is responsible for ensuring that the EUT meets 15.407(g) requirements; however, the applications for equipment certification are not required to include test reports with explicit demonstration of compliance.

## 2.1. Measurement Uncertainties for EMC Conducted and Radiated Emissions

The results of the calculations to estimate uncertainties for the several test methods and standards are shown in the Table below. These are the worst-case values.

**Worst-Case Estimated Measurement Uncertainties**

| **Standard, Method or Procedure** | **Condition** | **Frequency MHz** | **Expanded Uncertainty (k=2)** |
|---|---|---|---|
| a. EMC Emissions, (*e.g.*, ANSI C63.4, CISPR 11, 14, 22, *etc.*, using ESHS 30, EMC-60, LISNs/AMNs and antennas) | Conducted Emissions | 0.009 - 30 | ± 2.0 dB |
| | Radiated Emissions (AR-8 Semi-Anechoic Chambers) | 30 – 200<br>200 – 1000 | ±5.1 ~ ±5.4 dB<br>±4.3 ~ ±4.7 dB |
| | Radiated Emissions (OATS) | 1000 – 18,000 | ±3.3 dB |

## 2.2. Measurement Uncertainties for Antenna Port Conducted Testing

**Worst-Case Estimated Measurement Uncertainties**

| **Standard, Method or Procedure** | **Expanded Uncertainty (k=2)** |
|---|---|
| RF Power | ± 1.4 dB |
| Occupied Bandwidth | ± 2.2 dB |
| Conducted Spurious Emissions | ± 2.8 dB |

# 3. GENERAL INFORMATION

## 3.1 Product Descriptions

**Table 3.1.1 Product Specifications**

| Specification Items | Description | | |
|---|---|---|---|
| Product Type | MBO LAA LTE RF Module | | |
| Radio Type | Intentional Transceiver | | |
| Operation Mode | Master Device, Point to Multipoint | | |
| Modulation | OFDM (QPSK, 16QAM, 64QAM, 256QAM) | | |
| Radio Access Technology | LAA LTE-TDD | | |
| Frequency Range | E-UTRAN Band 46: 5735-5835 MHz (UNII-3) | | |
| Carrier Operating Frequency | 5745 - 5825 MHz | | |
| Channel Bandwidth | 20MHz/40MHz (aggregated) | | |
| Maxi. Number of Carriers per Port | 2 | | |
| Maxi. Spacing between Carriers | Adjacent | | |
| Number of Tx Ports | 2 | | |
| Number of Rx Ports | 2 | | |
| MIMO | Yes | | |
| Transmit Diversity | Yes | | |
| Receive Diversity | Yes | | |
| Max Rated Conducted RF Power | 5735-5835 MHz (UNII-3) | FA2WA Direc Ant with Max Ave Gain ≤ 6 dBi: 30dBm (1W) total<br>FA2RA Omni-Direc Ant with Max Gain = 7.5 dBi: 28.5dBm (0.7W) total<br>FA2RD Omni-Direc Ant with Max Gain = 10 dBi: 26dBm (0.4W) total | |
| Max Rated EIRP Power | 5735-5835 MHz (UNII-3) | 36dBm total | |
| Minimum Condcuted Power | 50mW per path and 100mW per unit | | |
| Deployment Environment | Outdoor | | |
| Environment Temperature Range | -40 ºC to 55 ºC | | |
| Power Source | Voltage Ranges (VAC) | | |
| | Minimum | Nominal | Maximum |
| | 90.0 | 110.0 | 264.0 |
| Software Version (Master) | FLF18 | | |
| Hardware Version (Master) | 474568A.X22 | | |
| Antennas | Refer to Section 3.5 | | |

## 3.2 Accessories

A Nokia system module for MBO, which provides baseband signals, the baseband processing, control and timing to the radio, was used for all required conducted and radiated testing. The EUT is unmodified and is commercially available.

## 3.3 Description of Antenna(s)

Currently, there are three available antennas of two types to be equipped for this MBO LAA RF Module operating in Band 46, no beamforming. The demonstration of meeting the FCC Section 15.203 and KDB 353028 D01 requirements on antennas has been presented in Exhibit 5, where it stated that unique (non-standard) antenna connectors were designed with the product and professional installation was used. There are provisions for special connectors to be used for any external antennas.

**Table 3.3.1 UNII-1/3 Antenna Data from Manufacturers**

| Ant No | Model Name | Antenna Type/ Size (mm) | Freq (MHz) | Tx/Rx Port | Max Avg Antenna Gain Over Two Ports (dBi) |
|---|---|---|---|---|---|
| 1 | FA2RD FZ 474881A | Omni-Directional 316(L) × 29(W) | 5150 ~ 5850 | Tx/Rx 1/2 | 10 |
| 2 | FA2WA FZ 473461A | Directional 380(L) × 290(W) × 190(D) | 5150 ~ 5925 | Tx/Rx 1/2 | 6 |
| 3 | FA2RA 473121A | Omni-Directional , 235(L) × 51(D) | 5150 ~ 5850 | Tx/Rx 1/2 | 7.5 |

**Table 3.3.2 UNII Antennas Tested (with the Highest Gain of Each Type)**

| Antenna No | Model Name | Antenna Type | Frequency (MHz) | Max Avg Ant Gain Over Two Ports (dBi) |
|---|---|---|---|---|
| 1 | FA2RD | Omni-Directional | 5150 ~ 5850 | 10 |
| 2 | FA2WA | Directional | 5150 ~ 5925 | 6 |

The compliance of the EUT with the maximum power setting and the omni-directional antenna #1 and the directional antenna #2, which have the highest antenna gain among the same type, was evaluated, respectively.

The compliance of the EUT with omni-directional anatenna #3 FA2RA has been examined as well.

# 4. REQUIRED MEASUREMENTS AND RESULTS

## 4.1 Regulatory Requirements

The tests in this report were performed for Unlicensed-National Information Infrastructure Devices Operating in the 5735-5835 MHz Band in accordance with the requirements of FCC CFR 47 Part 15 Subpart E. The requirements are provided in the following:

(1) Emission Bandwidth (FCC 15.403 (i), 15.215(c), KDB 789033D02 III.B)

The emission bandwidth shall be determined by the 26dB bandwidth. Determination of the emissions bandwidth is based on the use of measurement instrumentation employing a peak detector function with an instrument resolution bandwidth approximately equal to 1.0 percent of the emission bandwidth of the device under measurement.

In the case of intentional radiators operating under the provisions of Subpart E, the emission bandwidth may span across multiple contiguous frequency bands identified in that subpart. The requirement to contain the designated bandwidth of the emission within the specified frequency band includes the effects from frequency sweeping, frequency hopping and other modulation techniques that may be employed as well as the frequency stability of the transmitter over expected variations in temperature and supply voltage.

(2) Minimum Emission Bandwidth (FCC 15.407(e))

Within the 5.725-5.85 GHz band, the minimum 6 dB bandwidth of U-NII devices shall be at least 500 kHz.

(3) Output Power and Power Spectrum Density Limits (FCC 15.407 (a)(3)(4)(5))

For an access point operating in the band 5.725-5.85 GHz, the maximum conducted output power shall not exceed 1 W. In addition, the maximum power spectral density shall not exceed 30 dBm in any 500kHz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

The maximum conducted output power must be measured with *rms* detector. The maximum power spectral density in the 5.725-5.85 GHz band is measured over a reference bandwidth of 500 kHz or the 26 dB emission bandwidth of the device, whichever is less. A narrower resolution bandwidth can be used, provided that the measured power is integrated over the full reference bandwidth.

(4) Unwanted Emission Limits (FCC 15.407 (b)(4-8)), 15.209 (a) and 15.205 (a, b, c).

The peak emissions outside of the frequency bands of operation shall be attenuated in accordance with the following limits:

i. For transmitters operating in the 5.725-5.85 GHz band: all emissions shall be limited to a level of −27 dBm/MHz at 75 MHz or more above or below the band edge increasing linearly to 10 dBm/MHz at 25 MHz above or below the band edge, and from 25 MHz above or below the band edge increasing

linearly to a level of 15.6 dBm/MHz at 5 MHz above or below the band edge, and from 5 MHz above or below the band edge increasing linearly to a level of 27 dBm/MHz at the band edge.

ii. The emission measurements shall be performed using a minimum resolution bandwidth of 1 MHz. A lower resolution bandwidth may be employed near the band edge, when necessary, provided the measured energy is integrated to show the total power over 1 MHz.

iii. Unwanted emissions below 1 GHz must comply with the general field strength limits set forth in Section 15.209. Further, any U-NII devices using an AC power line are required to comply also with the conducted limits set forth in Section 15.207.

iv. The provisions of Section 15.205 apply to UNII intentional radiators, where the field strength of emissions appearing *within Section 15.205 restricted frequency bands* shall not exceed the limits shown in Section 15.209. At frequencies equal to or less than 1GHz, compliance with the limits in Section 15.209 shall be demonstrated using measurement instrumentation employing a CISPR quasi-peak detector. Above 1GHz, compliance with the emission limits in Section 15.209 shall be demonstrated based on the *average* value of the measured emissions. The provisions in Section 15.35 apply to these measurements.

v. When measuring the emission limits, the nominal carrier frequency shall be adjusted as close to the upper and lower frequency band edges as the design of the equipment permits.

Therefore,

1) the emissions from the UNII transmitter in the frequency spectrum up to the 10$^{th}$ harmonics are subject to the following requirements:
   a. For emissions outside the restricted bands, per 15.407(b)(6-7), KDB789033 D02 II.G.2.a-c,
      (i) f < 1GHz, the limits specified in 15.209 need to be met by QPK or PK;
      (ii) f > 1GHz, the limits specified in 15.407 (b)(1-4) for UNII-1/2/3 need to be met by PK;
   b. For emissions in the restricted bands, per 15.407(b)(6-7), 15.205 (b), KDB 789033 D02 II.G.1.a-c,
      (i) f < 1GHz, the limits specified in 15.209 need to be met by QPK or PK;
      (ii) f > 1GHz, the limits specified in 15.209 need to be met by AVE and the limits specified in 15.407 (b)(1-4) for UNII-1/2/3 need to be met by PK

2) the emissions from the digital circuits of the EUT in the frequency spectrum up to the 5$^{th}$ harmonics are subject to the 15.109 limit.

3) the emissions from AC power lines in the frequency range of 150kHz and 30MHz are subject to the 15.107 and 15.207 limits.

Either radiated measurement with antenna in place or Antenna-port conducted measurement plus cabinet emissions test with antenna terminated can be used.

**Table 4.1.1 FCC Part 15.205 (a) Restricted Bands of Operation**

| MHz | MHz | MHz | GHz |
|---|---|---|---|
| 0.090 - 0.110 | 16.42 - 16.423 | 399.9 - 410 | 4.5 - 5.15 |
| 0.495 - 0.505 | 16.69475 - 16.69525 | 608 - 614 | 5.35 - 5.46 |
| 2.1735 - 2.1905 | 16.80425 - 16.80475 | 960 - 1240 | 7.25 - 7.75 |
| 4.125 - 4.128 | 25.5 - 25.67 | 1300 - 1427 | 8.025 - 8.5 |
| 4.17725 - 4.17775 | 37.5 - 38.25 | 1435 - 1626.5 | 9.0 - 9.2 |
| 4.20725 - 4.20775 | 73 - 74.6 | 1645.5 - 1646.5 | 9.3 - 9.5 |
| 6.215 - 6.218 | 74.8 - 75.2 | 1660 - 1710 | 10.6 - 12.7 |
| 6.26775 - 6.26825 | 108 - 121.94 | 1718.8 - 1722.2 | 13.25 - 13.4 |
| 6.31175 - 6.31225 | 123 - 138 | 2200 - 2300 | 14.47 - 14.5 |
| 8.291 - 8.294 | 149.9 - 150.05 | 2310 - 2390 | 15.35 - 16.2 |
| 8.362 - 8.366 | 156.52475 - 156.52525 | 2483.5 - 2500 | 17.7 - 21.4 |
| 8.37625 - 8.38675 | 156.7 - 156.9 | 2690 - 2900 | 22.01 - 23.12 |
| 8.41425 - 8.41475 | 162.0125 - 167.17 | 3260 - 3267 | 23.6 - 24.0 |
| 12.29 - 12.293 | 167.72 - 173.2 | 3332 - 3339 | 31.2 - 31.8 |
| 12.51975 - 12.52025 | 240 - 285 | 3345.8 - 3358 | 36.43 - 36.5 |
| 12.57675 - 12.57725 | 322 - 335.4 | 3600 - 4400 | Above 38.6 |
| 13.36 - 13.41 | | | |

(5) Frequency Stability (FCC 15.407 (g)).

Manufacturers of UNII devices are responsible for ensuring frequency stability such that an emission is maintained within the band of operation under all conditions of normal operation as specified in the users manual.

KDB 789033 D02 Section II.A.3 stated that the grantee is responsible for ensuring that the EUT meets Section 15.407(g) requirements; however, the applications for equipment certification are *not* required to include test reports with explicit demonstration of compliance.

(6) Antennas to Be Tested (15.203, 15.204, KDB 353028 D01)

Section 15.204(c)(2) requires that compliance testing use the *actual* antennas to be certified with the part 15 intentional radiator. All devices (*e.g.*, radio card, module) must be tested with the antennas connected to the device.

Section 15.204(b) states that an approved "transmission system" must always be marketed as a complete system, *i.e.,* including the antenna.

KDB 353028 D01 Section III.A stated that when submitting test data for part 15 transmitters to be used with multiple antennas, the testing for the highest gain of each type of antenna (*e.g.,* highest gain for each patch, yagi, grid, dish, monopole, etc.) was required. For systems that can operate at different power levels, test data with the highest output power must be submitted.

## 4.2 UNII-3 Band Carrier Frequencies

**Table 4.2.1 5.8GHz UNII-3 (5735 -5835MHz) Frequency Channel Plan**

| Channel No. | Freq (MHz) | Bandwidth |
|---|---|---|
| 149 | 5745 | 20MHz |
| 153 | 5765 | |
| 157 | 5785 | |
| 161 | 5805 | |
| 165 | 5825 | |
| 149, 153 | 5745, 5765 | 40MHz |
| 157, 161 | 5785, 5805 | |
| 161, 165 | 5805, 5825 | |

**Table 4.2.2 5.8GHz UNII-3 (5735 -5835MHz) Channels Used for Testing**

| Channel No. | Freq (MHz) | Bandwidth |
|---|---|---|
| 149 | 5745 | 20MHz |
| 157 | 5785 | |
| 165 | 5825 | |
| 149, 153 | 5745, 5765 | 40MHz |
| 157, 161 | 5785, 5805 | |
| 161, 165 | 5805, 5825 | |

## 4.3 Test Configurations and Setup

All measurements were performed with the EUT transmitting at 100% duty cycle (at least 98% if required by the EUT for amplitude control purposes) at the following power control level.

**Table 4.3.1 Power Levels Tested**

| Band | Per Port Power Setting for Antennas #1 (Max Ave $G^{max}$ = 10 dBi) | Per Port Power Setting for Antennas #2 (Max Ave $G^{max}$ = 6 dBi)* | Per Port Power Setting for Antennas #3 (Max Ave $G^{max}$ = 7.5 dBi) |
|---|---|---|---|
| UNII-3 | 23 dBm | 27 dBm | 25.5 dBm |

Various modulation types (Q/16QAM, 64QAM and 256QAM) and bandwidth modes (20MHz, 40MHz and 60MHz) were evaluated for the conducted and radiated tests, incluing RF power output, peak power spectrum density, emissions bandwidth and unwanted emissions.

The test setup diagrams are given below.

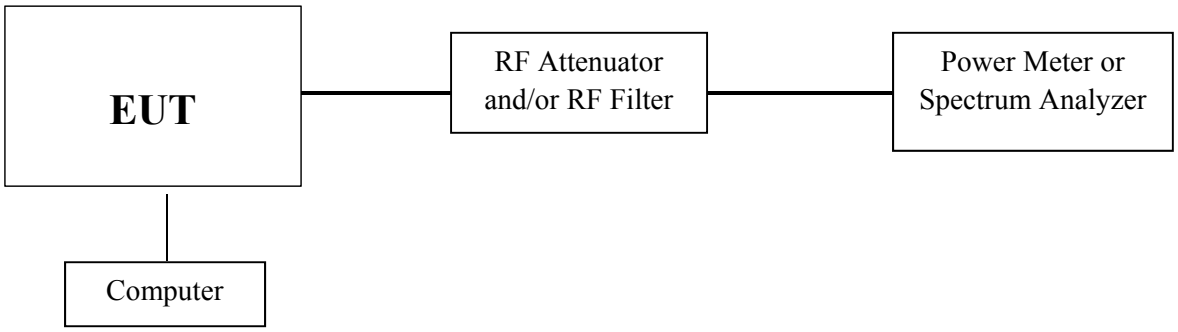



**Figure 4.3.1 Setup Diagram of Conducted Test for RF Output Power, Power Spectrum Density, Modulation Characteristics, Occupied Bandwidth and Unwanted Emissions.**

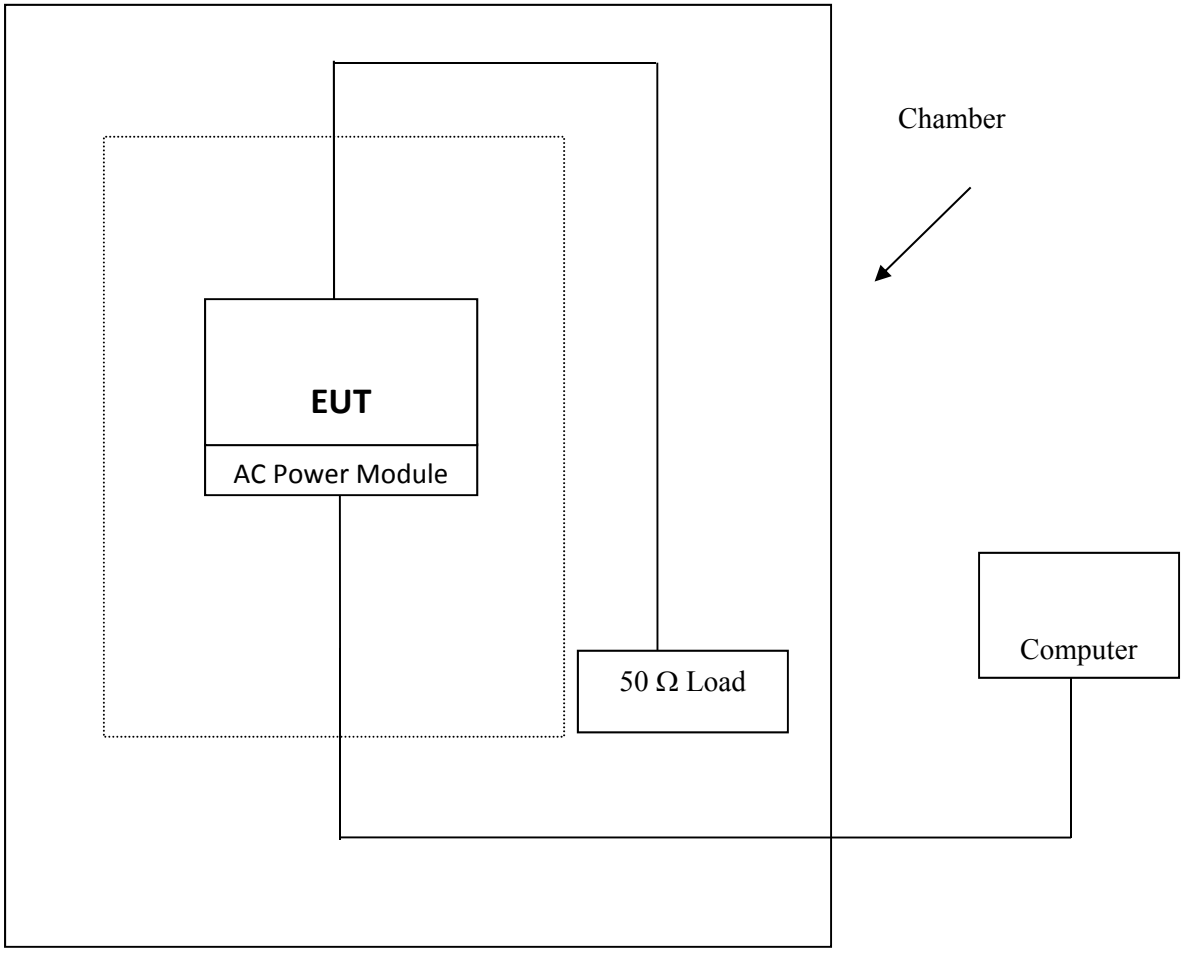



**Figure 4.3.2 Setup Diagram of Radiated Test**

# 4.4 MEASUREMENT REQUIRED: EMISSION BANDWIDTH (26 dB BANDWIDTH) – FCC SECTIONS 15.403 (i) & 15.215(c)

The measurement requirements of the emission bandwidth were provided in Section 4.1

The 26dB emission bandwidth was measured at both antenna ports for all channels listed in Table 4.2.2. The measurement follows the procedures given in ANSI C63.10. The automatic bandwidth measurement function of the spectrum analyzer was utilized where the resolution bandwidth (RBW) is initially set to 1% of the bandwidth and the video bandwidth (VBW), that is 200kHz for 20MHz and 400kHz for 40MHz, the video bandwidth was set to 1MHz, and the peak detector with maximum hold and auto sweep was used. Then the maximum width of the emission that is 26 dB down from the maximum of the emission was measure and compared with the RBW setting of the analyzer. The RBW might be readjusted as needed until the RBW/EBW ration is approximately 1%.

The maximum allowable conducted power levels were used for this measurement. The measured results are tabluated below. Three plots which have the widest emission bandwidth are provided below.

**Table 4.4.1 26dB Emissions Bandwidth for One 20MHz Carrier UNII-3 (27dBm/port)**

| Bands (GHz) | Ch No/ Freq (MHz) | Modulation | Port 1 (MHz) | Port 2 (MHz) |
|---|---|---|---|---|
| UNII-3 (5.735- 5.835) | 149/5745 | Q/16QAM | 20.45 | 20.49 |
| | | 64QAM | 20.13 | 20.26 |
| | | 256QAM | 20.38 | 20.26 |
| | 157/5785 | Q/16QAM | 20.29 | 20.49 |
| | | 64QAM | 20.33 | 20.23 |
| | | 256QAM | 20.37 | 20.37 |
| | 165/5825 | Q/16QAM | 20.17 | 20.11 |
| | | 64QAM | 20.47 | 20.35 |
| | | 256QAM | 20.36 | 20.33 |

**Table 4.4.2 26dB Emissions Bandwidth for Two-20MHz Carriers UNII-3 (27dBm/port)**

| Bands (GHz) | Ch No/ Freq (MHz) | Modulation | Port 1 (MHz) | Port 2 (MHz) |
|---|---|---|---|---|
| UNII-3 (5.74- 5.835) | 157, 161/ 5785, 5805 | Q/16QAM | 40.22 | 40.12 |
| | | 64QAM | 40.23 | 40.19 |
| | | 256QAM | 40.15 | 40.48 |

For UNII-3, the 26dB emission bandwidth measured with 27dBm power setting was in the range of 20.11-20.49 MHz for one-20MHz carriers and 40.12-40.48 MHz for two-20MHz carriers.

The maximum 26dB emissions bandwidths of the EUT measured at its antenna transmitting terminals in the UNII-3 band for various modulations are tabulated below. The results and measurements are in full compliance with the Rules of the Commission.

**Table 4.4.3 Maximum 26dB Emissions Bandwidth (EBW) Measured**

| Bands (GHz) | Bandwidth (MHz) | Max 26dB EBW (MHz) | Test Limit | Test Results |
|---|---|---|---|---|
| UNII-3 (5.74- 5.835) | 1 x 20MHz | 20.49 | NA | Pass |
| | 2 x 20MHz | 40.48 | | Pass |

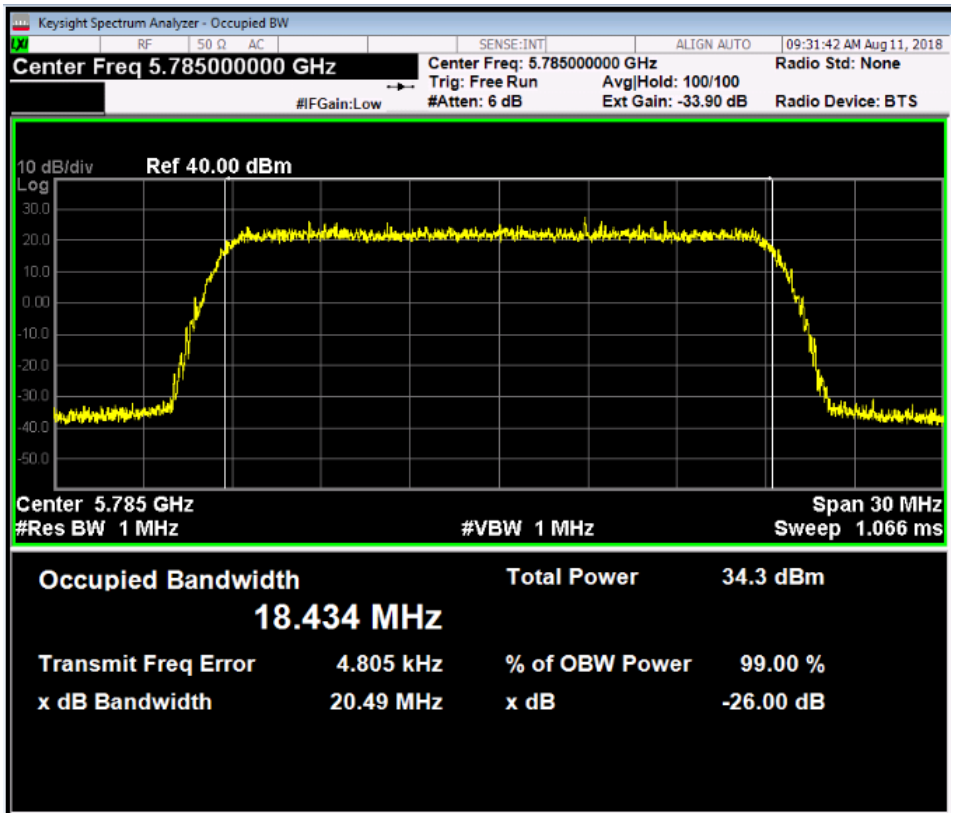



**Figure 4.4.2(a) The Maximum 26dB Emission Bandwidth Measured (20.49MHz) for UNII-3 20 MHz Carrier at 157/5785MHz, 27dBm, Q/16QAM, Port 2.**

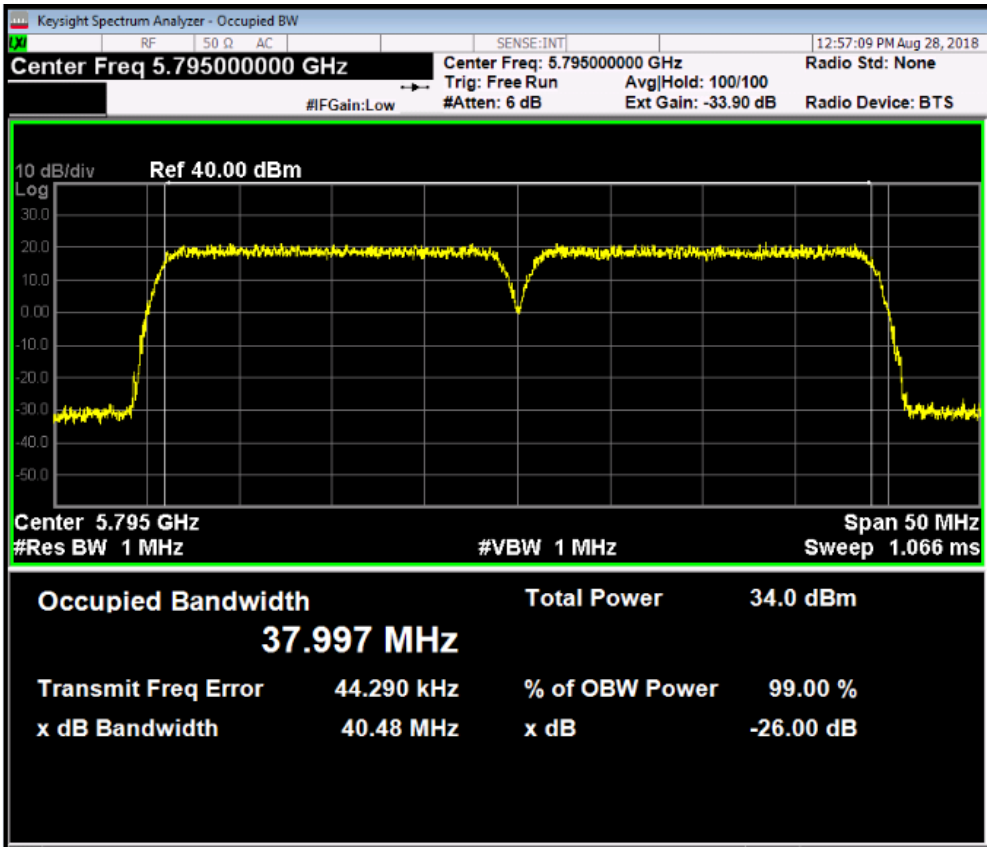



**Figure 4.4.2 The Maximum 26dB Emission Bandwidth Measured (40.48MHz) for UNII-3 Two 20 MHz Carrier at Ch 157, 161/5785, 5805MHz, 27dBm, 256QAM, Port 2.**

# 4.5 MEASUREMENT REQUIRED: MINIMUM EMISSION BANDWIDTH (6 dB BANDWIDTH) – FCC SECTION 15.407 (e)

The 6dB emission bandwidth was measured at both antenna ports for the UNII-3 20MHz channels listed in Table 4.2.2 with all modulations. The measurement follows the procedures given in ANSI C63.10. The RBW and VBW were set to 100kHz and 1MHz, respectively. The peak detector with maximum hold and auto sweep was used. Then the maximum width of the emissions that is 6 dB down from the maximum of the emission was measure.

The lowest power level, 23dBm per port, was used for 6dB emission bandwidth measurement. For UNII-3, the 6dB emission bandwidths measured were in the range of 17.77-18.47 MHz for 1x20MHz carriers with 23dBm per port. The results are well larger than 500kHz requirement. The measured results are tabluated below. The plot which has the smallest emission bandwidth is provided below.

**Table 4.5.1 6dB Emission Bandwidth for 20MHz Carriers (23dBm/Port)**

| Bands (GHz) | Ch No/ Freq (MHz) | Modulation | 6dB Bandwidth Port 1 (MHz) | 6dB Bandwidth Port 2 (MHz) | Test Limit | Test Results |
|---|---|---|---|---|---|---|
| UNII-3 (5.735-5.835) | 149/5745 | Q/16QAM | 17.85 | 18.47 | ≥ 500 kHz | Pass |
| | | 64QAM | 17.96 | 17.97 | | Pass |
| | | 256QAM | 17.78 | 18.18 | | Pass |
| | 157/5785 | Q/16QAM | 17.92 | 17.77 | ≥ 500 kHz | Pass |
| | | 64QAM | 18.36 | 18.27 | | Pass |
| | | 256QAM | 18.15 | 18.18 | | Pass |
| | 165/5825 | Q/16QAM | 18.19 | 18.20 | ≥ 500 kHz | Pass |
| | | 64QAM | 18.15 | 18.28 | | Pass |
| | | 256QAM | 18.20 | 18.15 | | Pass |

The minimum 6dB emission bandwidth of the EUT measured at its antenna transmitting terminals for the UNII-3 band for all operation modes is 17.77 MHz, larger than 500kHz requirement. The results and measurements are in full compliance with the requirement.

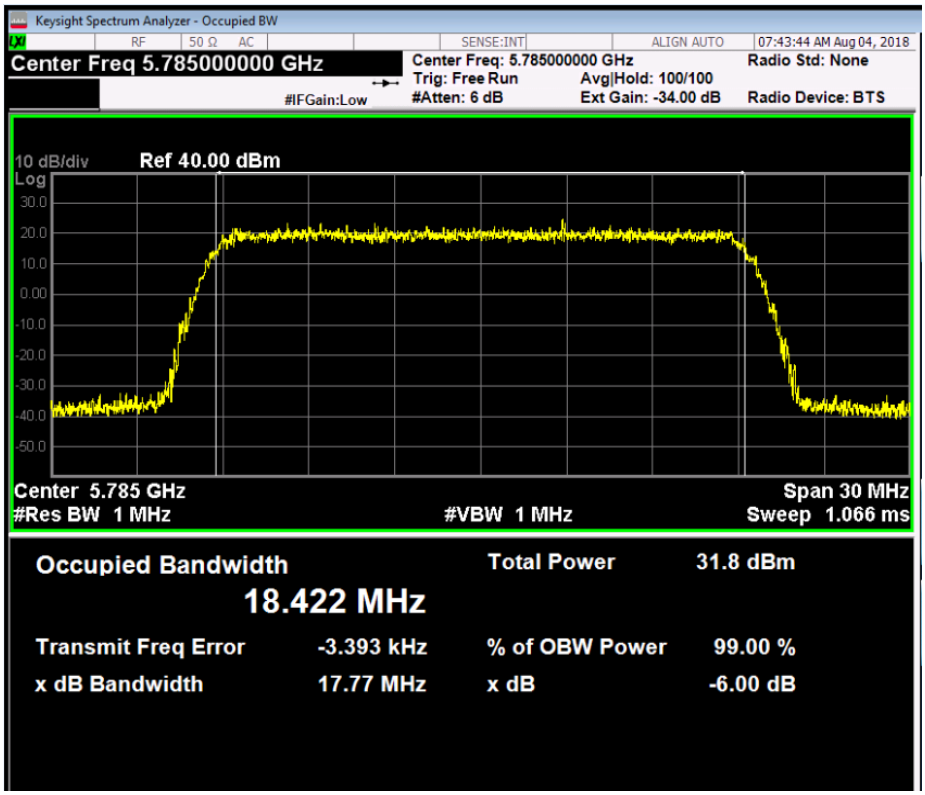



**Figure 4.5.1 The Minimum 6dB Emission Bandwidth Measured (17.77MHz) for a 20MHz Carrier at Ch 157/5785MHz, 23dBm, Q/16QAM, Port 2.**

# 4.6 MEASUREMENT REQUIRED: MAXIMUM POWER OUTPUT AND MAXIMUM OUTDOOR EIRP – FCC SECTION 15.407 (a)(3)(4)

The maximum ouput power was measured at the both antenna ports for all channels listed in Table 4.2.2 and all modulations. The measurement follows the procedures given in ANSI C63.10.

The power limit is 1W (30dBm). The maximum conducted output power shall be reduced by the amount in dB that the antenna gain exceeds 6 dBi.

For multiple antennas with equal transmit power but unequal gains, per KDB 662911 D01, the directional antenna gain of uncorrelated signals is equal to

$$\text{Directional Gain} = 10\log\left[\frac{10^{G_1/10}+10^{G_2/10}+\ldots..+10^{G_N/10}}{N_{ANT}}\right] dBi, \quad \text{and}$$

the directional antenna gain of correlated signals is equal to

$$\text{Directional Gain} = 10\log\left[\frac{\left(10^{G_1/20}+10^{G_2/20}+\ldots..+10^{G_N/20}\right)^2}{N_{ANT}}\right] dBi,$$

where $G_1$, $G_2$ ..., $G_N$ are antenna gains.

For the spatial multiplexing (SM) transmissions, like 802.11n MCS8-15, the EUT operates with two uncorrelated spatial data streams on two transmitting ports. Per KDB 662911 D01 (Section (F)(2)(e)), the directional antenna gain may be calculated by using either of the following methods:

i. Directional Gain = Max{$G_1$, $G_2$ ..., $G_N$} + Array Gain = Max{ $G_1$, $G_2$ ..., $G_N$}, where Array Gain =10 *log* ($N_{ANT}/N_{SS}$) = 0
ii. Calculate the directional gain by using the formula for uncorrelated signals provided above if each antenna is only fed by its own data stream.

For Cyclic Delay Diversity (CDD) transmissions, per KDB 662911 D01 (Section (F)(2)(f)), the directional antenna gain may be calculated by using either of the following methods:

i. Directional Gain = Max{ $G_1$, $G_2$ ..., $G_N$} + Array Gain
    a. For power measurements, Array Gain = 0 if $N_{ANT} \leq 4$;
    b. For power spectrum density (PSD) measurement, Array Gain = 10 *log* ($N_{ANT}/N_{SS}$) dB, where $N_{ss}$ is number of spatial streams and $N_{ss}$ = 1 was suggested by the FCC for calculating the worst directional gain.
ii. Calculate the directional gain by using the formula for correlated signals provided above.

The EUT does not have beamforming function and two signals are not correlated. Hence, for the power and PSD limits, the directional antenna gain was calculated by using the equation above for uncorrelated signals. The limits for the combined maximum transmitting power and PSD are calculated and tabulated below.

**Table 4.6.1. Transmitter Power and PSD Limits at Antenna Ports**

| Band | Antenna | Max Avg Ant Gain* for Spectral Density (dBi) | Max Avg Ant Gain* for Total Power (dBi) | Total PSD Limit (dBm/500kHz) | Total Power Limit (dBm) |
|---|---|---|---|---|---|
| UNII-3 | #1 | 10 | 10 | 26.0 | 26 |
| | #2 | 6 | 6 | 30.0 | 30 |
| | #3 | 7.5 | 7.5 | 28.5 | 28.5 |

*Maximum average antenna gain was based on the uncorrelated directional antenna gain calculated from two antennas.

The output power of the EUT was first verified by a power meter and then measured by a spectrum analyzer. The RBW and VBW were set to 1MHz and 3MHz, respectively. The RMS detector and trace average (≥ 100) were used. The output power was calculated by integrating the spectrum across the EBW of the carrier using the SA's band power measurement function with band limits set equal to the EBW band edges. The total combined output power was calculated by summing the measured output power in mW at the various antenna ports.

For UNII-3 band, the maximum total output power measured for the EUT equipped with the antenna #1 among all operation modes supported was 26.0dBm for both one-20MHz carriers and 26.0 for two-20MHz carriers. They are all below the required limits.

For UNII-3 band, the maximum total output power measured for the EUT equipped the antenna #2 among all operation modes supported was 30.0dBm for one-20MHz carriers and 30.0 for two-20MHz carriers. They are all below the required limits.

The measurement results for the conducted output power at both ports are provided in Tables below and 2 plots which have maximum output power among them are given in Figures below.

Since the EUT equippted with the antenna #3 has a different maximum output power than that of the EUT with #1 and #2 antennas, its output power was verified as well for information. For UNII-3 band, the maximum total output power measured for the EUT equipped the antenna #3 among all operation modes supported was 28.5dBm for one-20MHz carriers and 28.4 for two-20MHz carriers. They are all below the required limits.

**Table 4.6.2(a) Maximum Mean Combined RF Power Output at Antenna Ports for 5GHz 1x20MHz Carrier at 23dBm for UNII-3 for Antenna #1 FA2RD**

| Bands (GHz) | Ch No/ Freq (MHz) | Modulation | Port 1 (dBm) | Port 2 (dBm) | Total Power (dBm) | Power Limit (dBm) | Test Results |
|---|---|---|---|---|---|---|---|
| UNII-3 (5.74-5.835) | 149/5745 | Q/16QAM | 22.95 | 22.90 | 25.94 | 26 | Pass |
| | | 64QAM | 22.95 | 22.95 | 25.96 | 26 | Pass |
| | | 256QAM | 22.79 | 22.86 | 25.84 | 26 | Pass |
| | 157/5785 | Q/16QAM | 22.93 | 22.94 | 25.95 | 26 | Pass |
| | | 64QAM | 22.93 | 22.93 | 25.94 | 26 | Pass |
| | | 256QAM | 22.96 | 22.88 | 25.93 | 26 | Pass |
| | 165/5825 | Q/16QAM | 22.76 | 22.99 | 25.89 | 26 | Pass |
| | | 64QAM | 22.80 | 22.79 | 25.81 | 26 | Pass |
| | | 256QAM | 22.75 | 22.83 | 25.80 | 26 | Pass |

**Table 4.6.2(b) Maximum Mean Combined RF Power Output at Antenna Ports for 5GHz 1x20MHz Carrier at 27dBm for UNII-3 for Antenna #2 FA2WA**

| Bands (GHz) | Ch No/ Freq (MHz) | Modulation | Port 1 (dBm) | Port 2 (dBm) | Total Power (dBm) | Power Limit (dBm) | Test Results |
|---|---|---|---|---|---|---|---|
| UNII-3 (5.74- 5.835) | 149/5745 | Q/16QAM | 27.00 | 26.76 | 29.9 | 30.0 | Pass |
| | | 64QAM | 26.77 | 26.77 | 29.8 | 30.0 | Pass |
| | | 256QAM | 26.75 | 27.02 | 29.9 | 30.0 | Pass |
| | 157/5785 | Q/16QAM | 26.94 | 27.02 | 30.0 | 30.0 | Pass |
| | | 64QAM | 26.99 | 26.99 | 30.0 | 30.0 | Pass |
| | | 256QAM | 26.95 | 26.86 | 29.9 | 30.0 | Pass |
| | 165/5825 | Q/16QAM | 26.93 | 27.06 | 30.0 | 30.0 | Pass |
| | | 64QAM | 26.80 | 26.95 | 29.9 | 30.0 | Pass |
| | | 256QAM | 26.87 | 26.98 | 29.9 | 30.0 | Pass |

**Table 4.6.2(c) Maximum Mean Combined RF Power Output at Antenna Ports for 5GHz 1x20MHz Carrier at 25.5dBm for UNII-3 for Antenna #3 FA2RA**

| Bands (GHz) | Ch No/ Freq (MHz) | Modulation | Port 1 (dBm) | Port 2 (dBm) | Total Power (dBm) | Power Limit (dBm) | Test Results |
|---|---|---|---|---|---|---|---|
| UNII-3 (5.74- 5.835) | 149/5745 | Q/16QAM | 25.23 | 25.27 | 28.26 | 28.5 | Pass |
| | | 64QAM | 25.23 | 25.21 | 28.23 | 28.5 | Pass |
| | | 256QAM | 25.48 | 25.27 | 28.39 | 28.5 | Pass |
| | 157/5785 | Q/16QAM | 25.50 | 25.45 | 28.49 | 28.5 | Pass |
| | | 64QAM | 25.45 | 25.48 | 28.48 | 28.5 | Pass |
| | | 256QAM | 25.48 | 25.48 | 28.49 | 28.5 | Pass |
| | 165/5825 | Q/16QAM | 25.31 | 25.46 | 28.40 | 28.5 | Pass |
| | | 64QAM | 25.44 | 25.47 | 28.47 | 28.5 | Pass |
| | | 256QAM | 25.31 | 25.41 | 28.37 | 28.5 | Pass |

**Table 4.6.3(a) Maximum Mean Combined RF Power Output at Antenna Ports for 5GHz 2x20MHz Carriers at 27dBm for UNII-3 with Antennas #2 FA2WA**

| Bands (GHz) | Ch No/ Freq (MHz) | Modulation | Port 1 (dBm) | Port 2 (dBm) | Total Power (dBm) | Power Limit (dBm) | Test Results |
|---|---|---|---|---|---|---|---|
| UNII-3 (5.74-5.835) | 149, 153/ 5745, 5765 | Q/16QAM | 26.98 | 26.98 | 29.99 | 30 | Pass |
| | | 64QAM | 26.50 | 26.97 | 29.75 | 30 | Pass |
| | | 256QAM | 26.71 | 27.02 | 29.88 | 30 | Pass |
| | 157, 161/ 5785, 5805 | Q/16QAM | 26.97 | 26.94 | 29.97 | 30 | Pass |
| | | 64QAM | 26.97 | 26.98 | 29.99 | 30 | Pass |
| | | 256QAM | 26.89 | 26.84 | 29.88 | 30 | Pass |
| | 161, 165/ 5805, 5825 | Q/16QAM | 26.84 | 26.61 | 29.74 | 30 | Pass |
| | | 64QAM | 26.58 | 26.97 | 29.79 | 30 | Pass |
| | | 256QAM | 26.59 | 26.66 | 29.64 | 30 | Pass |

**Table 4.6.3(b) Maximum Mean Combined RF Power Output at Antenna Ports for 5GHz 2x20MHz Carrier at 23dBm for UNII-3 with Antenna #1 FA2RD**

| Bands (GHz) | Ch No/ Freq (MHz) | Modulation | Port 1 (dBm) | Port 2 (dBm) | Total Power (dBm) | Power Limit (dBm) | Test Results |
|---|---|---|---|---|---|---|---|
| UNII-3 (5.74- 5.835) | 149, 153/ 5745, 5765 | Q/16QAM | 22.73 | 22.95 | 25.85 | 26.0 | Pass |
| | | 64QAM | 22.82 | 22.81 | 25.83 | 26.0 | Pass |
| | | 256QAM | 22.93 | 22.84 | 25.90 | 26.0 | Pass |
| | 157, 161/ 5785, 5805 | Q/16QAM | 22.43 | 22.79 | 25.62 | 26.0 | Pass |
| | | 64QAM | 22.97 | 22.92 | 25.96 | 26.0 | Pass |
| | | 256QAM | 22.90 | 22.93 | 25.93 | 26.0 | Pass |
| | 161, 165/ 5805, 5825 | Q/16QAM | 22.85 | 22.83 | 25.85 | 26.0 | Pass |
| | | 64QAM | 22.68 | 22.99 | 25.85 | 26.0 | Pass |
| | | 256QAM | 22.84 | 22.88 | 25.87 | 26.0 | Pass |

**Table 4.6.3(c) Maximum Mean Combined RF Power Output at Antenna Ports for 5GHz 2x20MHz Carriers at 25.5dBm for UNII-3 with Antennas #3 FA2RA**

| Bands (GHz) | Ch No/ Freq (MHz) | Modulation | Port 1 (dBm) | Port 2 (dBm) | Total Power (dBm) | Power Limit (dBm) | Test Results |
|---|---|---|---|---|---|---|---|
| UNII-3 (5.74-5.835) | 149, 153/ 5745, 5765 | Q/16QAM | 25.48 | 25.11 | 28.31 | 28.5 | Pass |
| | | 64QAM | 25.44 | 25.10 | 28.28 | 28.5 | Pass |
| | | 256QAM | 25.44 | 25.00 | 28.24 | 28.5 | Pass |
| | 157, 161/ 5785, 5805 | Q/16QAM | 25.41 | 25.24 | 28.34 | 28.5 | Pass |
| | | 64QAM | 25.39 | 25.30 | 28.36 | 28.5 | Pass |
| | | 256QAM | 25.31 | 25.23 | 28.28 | 28.5 | Pass |
| | 161, 165/ 5805, 5825 | Q/16QAM | 25.36 | 25.32 | 28.35 | 28.5 | Pass |
| | | 64QAM | 25.25 | 25.33 | 28.30 | 28.5 | Pass |
| | | 256QAM | 25.23 | 25.26 | 28.26 | 28.5 | Pass |

As a result, the maximum total mean output powers at antenna ports measured are:

**Table 4.6.4 Maximum Total Mean Output Power in UNII-3 (5.725-5.835 GHz) at Antenna Ports**

| Antennas Equipped | Power (dBm) One-20MHz | Power (dBm) Two-20MHz |
|---|---|---|
| **#1** | 26.0 | 26.0 |
| **#2** | 30.0 | 30.0 |
| **#3** | 28.5 | 28.4 |

For the antenna #1, the maximum combined mean RF power outputs of the EUT at its antenna transmitting terminals across the UNII-3 bands for all operation modes are 26.0dBm (0.4W) for one-20MHz and two-20MHz carriers. The maximum EIRPs of the EUT equipped with any antenna #1 are all equal or less than 36.0dBm.

For the antenna #2, the maximum combined mean RF power outputs of the EUT at its antenna transmitting terminals across the UNII-3 bands for all operation modes are 30.0dBm (1W), for both one-20MHz and two-20MHz carriers. The maximum EIRPs of the EUT equipped with any antenna #2 are all equal or less than 36.0dBm.

For the antenna #3, the maximum combined mean RF power outputs of the EUT at its antenna transmitting terminals across the UNII-3 bands for all operation modes are 28.5dBm (0.7W), for one-20MHz and two-20MHz carriers. The maximum EIRPs of the EUT equipped with any antenna #2 are all equal or less than 36.0dBm.

They are all below the required limits and are in full compliance with the regulatory requirement.

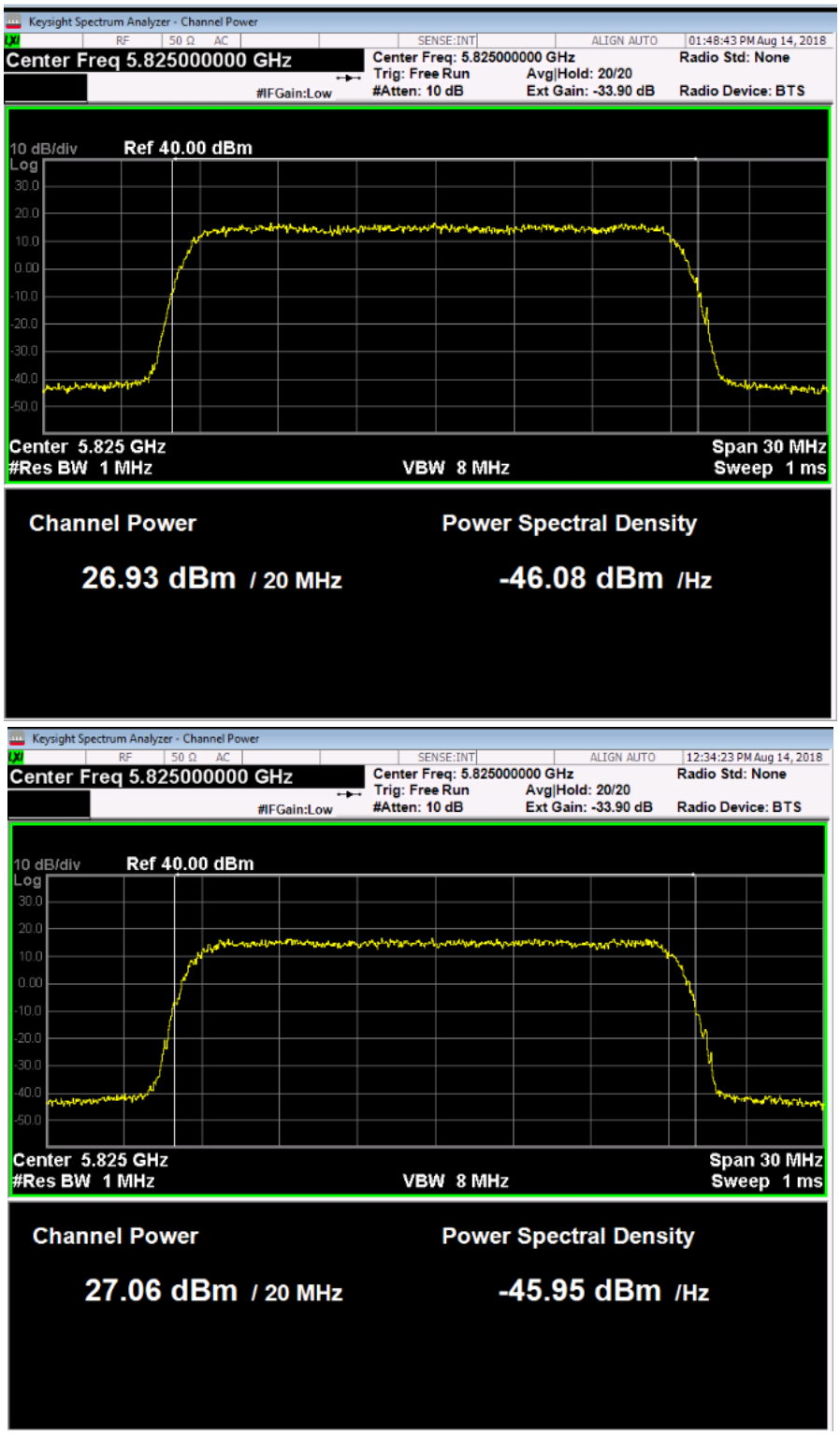



**Figure 4.6.1(a) The Mean Output Power Measured for UNII-3 Q/16Q 1x20MHz Carrier at 5825MHz, 27dBm, Port 1 & Port 2, for EUT with Antenna #2 (Combined Output Power 30.0 dBm).**

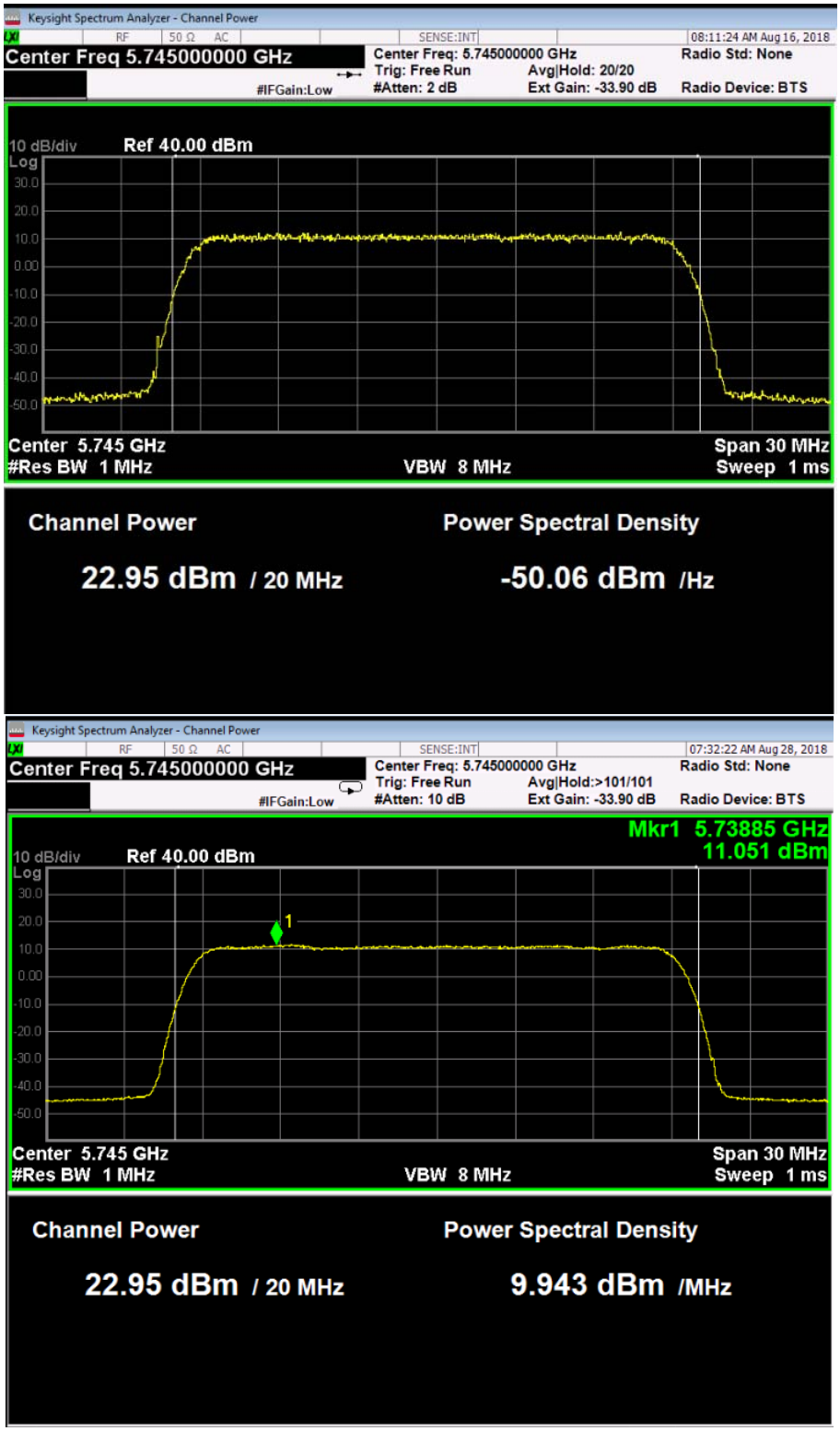



**Figure 4.6.1(b) The Mean Output Power Measured for UNII-3 64QAM 1x20MHz Carrier at 5745MHz, 23dBm, Port 1 & Port 2, for EUT with Antenna #1 (Combined Output Power 26.0 dBm).**

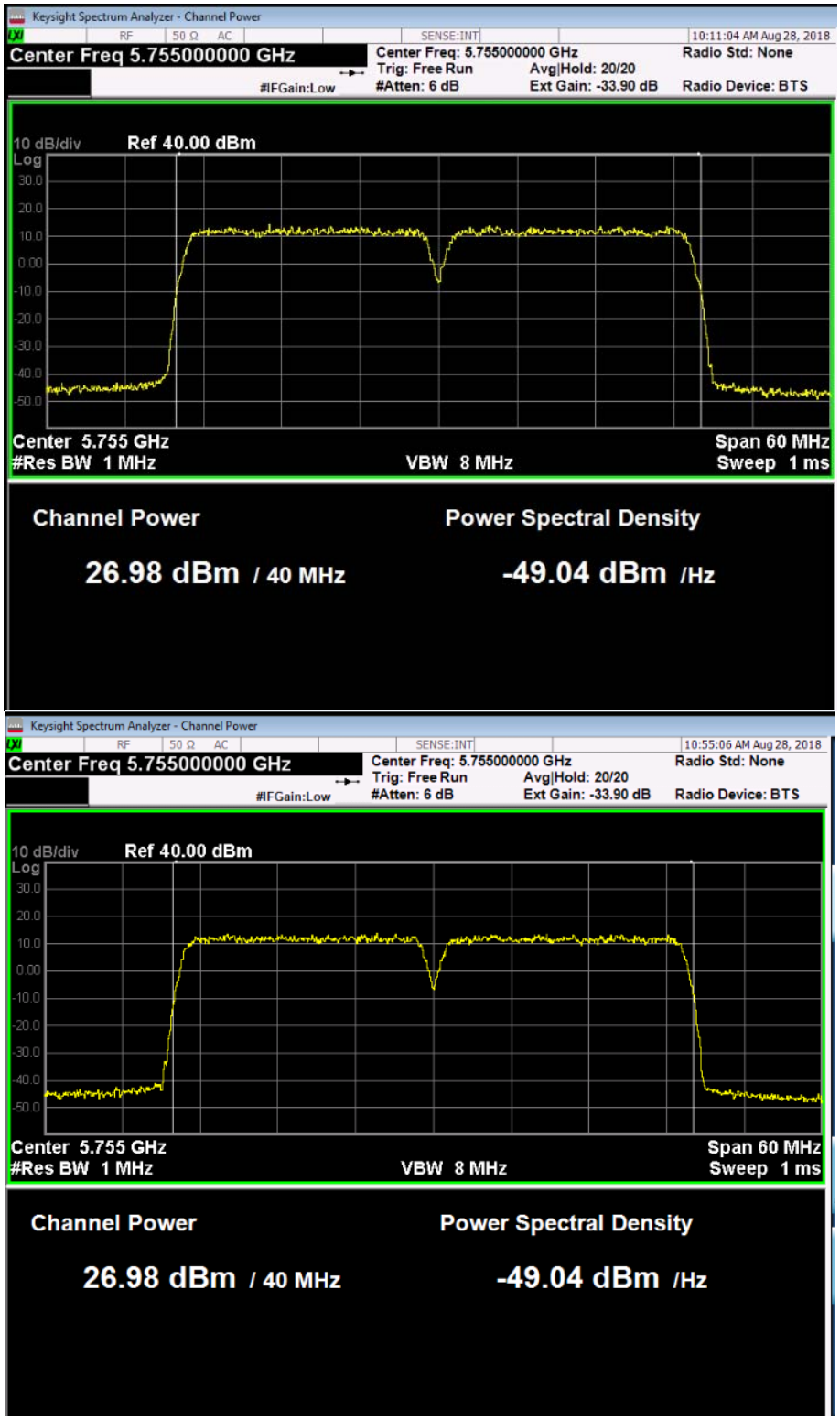



**Figure 4.6.2(a) The Mean Output Power Measured for UNII-3 Q/16Q 2x20MHz Carriers at 5745MHz and 5765MHz, 27dBm, Port 1 & Port 2, for EUT with Antenna #2 (Combined Output Power 30.0 dBm).**

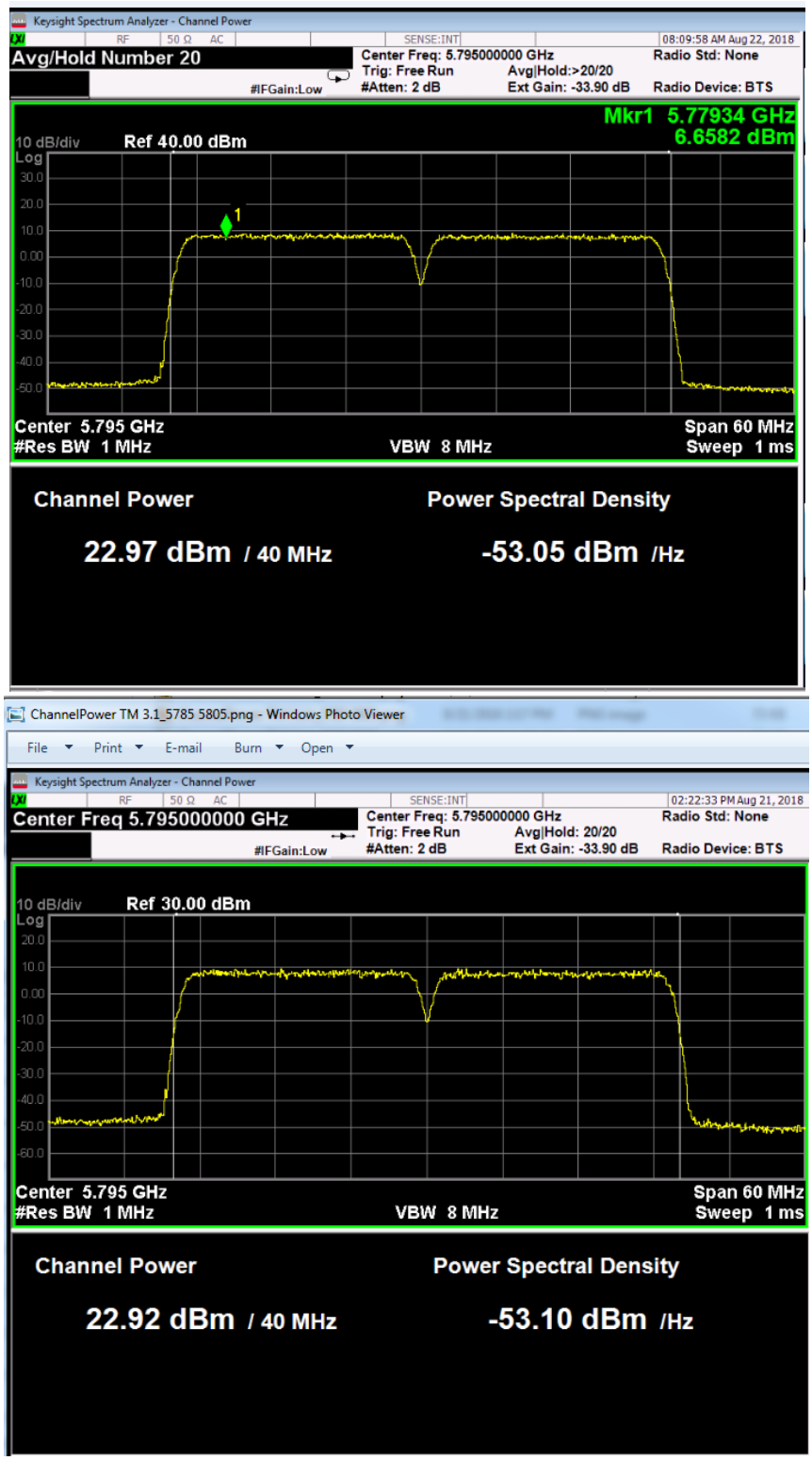



**Figure 4.6.2(b) The Mean Output Power Measured for UNII-3 64QAM 2x20MHz Carriers at 5785MHz and 5805MHz, 23dBm, Port 1 and Port 2, for EUT with Antenna #1 (Combined Output Power 26.0 dBm).**

# 4.7 MEASUREMENT REQUIRED: PEAK POWER SPECTRUM DENSITY – FCC SECTION 15.407 (a)(3)(5)

The peak power spectrum density (PPSD) measures the maximum value of the time average of the PSD measured during a period of continuous transmission.

The PPSD was measured at the both antenna ports for all 20MHz channels listed in Table 4.2.2 for all modulations. The measurement follows the procedures given in KDB 789033 D02.

The FCC limit is **30dBm/500kHz (or 33dBm/MHz**) for UNII-3. The peak conducted PSD shall be reduced by the amount in dB that the antenna gain exceeds 6 dBi. The PPSD limits calculated were provided in Table 4.6.1.

The PSD was measured by a spectrum analyzer. The RBW and VBW were set to 1MHz and 3MHz, respectively. The RMS detector and trace average (≥ 100) were used. The PPSD can be found by using either the peak search function on the instrument to find the peak of the spectrum or the spectrum analyzer's PSD function.

Normally, the total PPSD was calculated by the PPSD measured at the port which usually has higher PPSD based on the measurement for output power plus 3dB for two ports. When the margin is slim, the PPSD measurement was performed at both ports to obtain the combined PPSD value, where the total PPSD was obtained by summing the PPSD measured at both antenna ports.

For UNII-3 band, the minimum margin of total PPSD measured for the EUT equipped with the antenna #1 among all operation modes supported was 14.51dBm/MHz for 20MHz carriers, where the total RF power output setting is at 26.0dBm. The total PPSD measured are all below the required limits.

For UNII-3 band, the minimum margin of total PPSD measured for the EUT equipped with the antennas #2 among all operation modes supported was 18.61dBm/MHz for 20MHz carriers, where the total RF power output setting is at 30dBm. The total PPSD measured are all below the FCC required limits.

The above maximum PPSD at 18.61dBm/MHz for 30dBm total output power is also below the PPSD limit 31.5dBm/MHz for the EUT equipped with antenna #3 FA2RA. Therefore, the EUT equipped with antenna #3 will meet FCC PPSD requirement.

The measurement results are given below. The PPSD plots which have the smallest margin for the output powers of the EUT with #1 and # 2 antennas are provided in Figures 4.8.1 – 4.8.2.

The combined PPSD of the EUT at its antenna transmitting terminals across the UNII-3 band for all operation modes are all below FCC required limits and are in full compliance with the regulatory requirements.

**Table 4.7.1 Maximum Mean Combined PPSD at Antenna Ports for 5GHz 20MHz Carrier at 23dBm for UNII-3 with Antenna #1 FA2RD**

| Bands (GHz) | Ch No/ Freq (MHz) | Modulation | PPSD Port1 (dBm/MHz) | PPSD Port2 (dBm/MHz) | Total PPSD (dBm/MHz) | PPSD Limit (dBm/MHz) | Test Results |
|---|---|---|---|---|---|---|---|
| UNII-3 (5.74-5.835) | 149/5745 | Q/16QAM | 11.152 | 11.301 | 14.24 | 29 | Pass |
| | | 64QAM | 11.051 | 11.064 | 14.07 | 29 | Pass |
| | | 256QAM | 10.812 | 11.163 | 14.00 | 29 | Pass |
| | 157/5785 | Q/16QAM | 11.681 | 11.311 | 14.51 | 29 | Pass |
| | | 64QAM | 10.490 | 11.041 | 13.78 | 29 | Pass |
| | | 256QAM | 11.300 | 11.287 | 14.30 | 29 | Pass |
| | 165/5825 | Q/16QAM | 11.181 | 10.995 | 14.10 | 29 | Pass |
| | | 64QAM | 10.244 | 11.258 | 13.79 | 29 | Pass |
| | | 256QAM | 10.605 | 11.264 | 13.96 | 29 | Pass |

**Table 4.7.2 Maximum Mean Combined PPSD at Antenna Ports for 5GHz 20MHz Carrier at 27dBm for UNII-3 with Antenna #2 FA2WA**

| Bands (GHz) | Ch No/ Freq (MHz) | Modulation | PPSD Port1 (dBm/MHz) | PPSD Port2 (dBm/MHz) | Total PPSD (dBm/MHz) | PPSD Limit (dBm/MHz) | Test Results |
|---|---|---|---|---|---|---|---|
| UNII-3 (5.74-5.835) | 149/5745 | Q/16QAM | 14.479 | 14.723 | 17.61 | 33 | Pass |
| | | 64QAM | 15.490 | 14.639 | 18.10 | 33 | Pass |
| | | 256QAM | 14.876 | 14.784 | 17.84 | 33 | Pass |
| | 157/5785 | Q/16QAM | 15.490 | 15.703 | 18.61 | 33 | Pass |
| | | 64QAM | 14.267 | 14.794 | 17.55 | 33 | Pass |
| | | 256QAM | 14.645 | 14.990 | 17.83 | 33 | Pass |
| | 165/5825 | Q/16QAM | 15.340 | 14.675 | 18.03 | 33 | Pass |
| | | 64QAM | 15.302 | 14.849 | 18.09 | 33 | Pass |
| | | 256QAM | 15.133 | 14.935 | 18.05 | 33 | Pass |

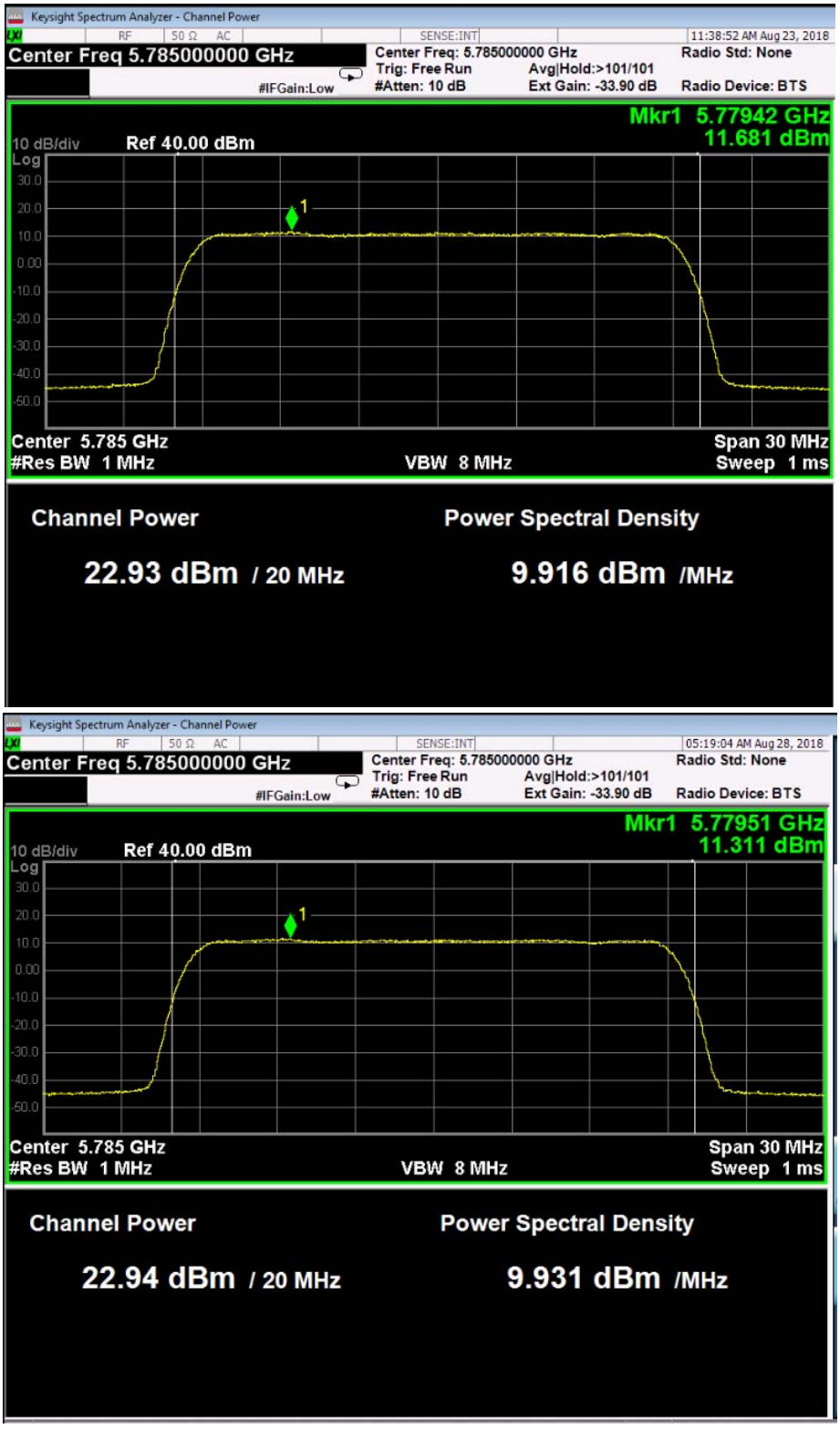



**Figure 4.7.1 The Conducted PPSD Measured (Combined 16.87dBm/MHz) for one 20MHz UNII-3 at Channel 5785MHz, 23dBm, Q/16QAM, Port 1 and Port 2, Antenna #1.**

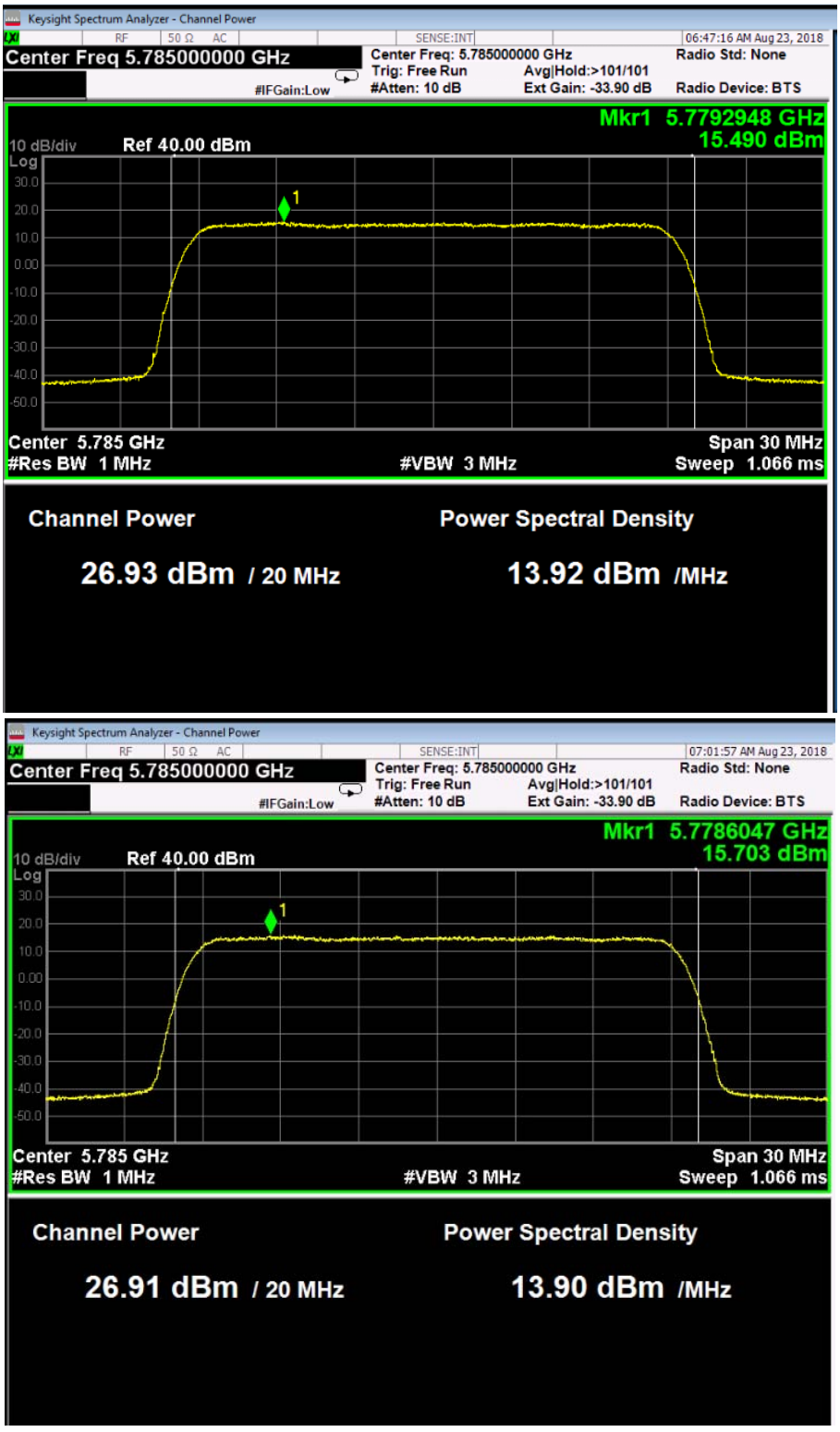



**Figure 4.7.2 The Conducted PPSD Measured (Combined 18.61dBm/MHz) for one 20MHz UNII-3 at Channel 157/5785MHz, 27dBm, Q/16QAM, Port 1 and Port 2, Antenna #2.**

# 4.8 MEASUREMENT REQUIRED: UNWANTED OUT-OF-BAND EMISSIONS – FCC SECTION 15.407 (b)(4-5)(8)

The requirements of the out-of-band emissions are provided in Section 4.1. Per ANSI C63.10 12.7.4.2 or KDB 789033 D02 guidance II.G.3.b, the unwanted emission limits in both the restricted and non-restricted bands are based on radiated measurements; however, as an alternative, antenna-port conducted measurements in conjunction with cabinet emissions tests will be permitted to demonstrate compliance.

The out-of-band emissions provided in this section are the unwanted emissions outside and near the band edges. The unwanted emissions at the frequencies away from the band edges were provided in next section.

The out-of-band emissions were evaluated by conducted measurement first for carriers located at the low, middle (1x20MHz only) and high channels of UNII-3 band given in Table 4.2.2 with QPSK/16QAM, 64QAM and 256QAM modulations and the output power of the EUT equipped with the omni-directional antenna #1 and the directional antenna #2, respectively. The recommendations of ANSI C63.10 were followed for the EUT testing setup. The test setup diagram was given in Section 4.3.

**Table 4.8.1(a) RSS-247/FCC 15.407 UNII-3 Out-of-Band Conducted Power Limits for Omni-Directional Antenna #1 (P=23dBm/port)**

| Band (GHz) | Frequency Investigated (GHz) | P (dBuV/m) | Detector | RBW (MHz) |
|---|---|---|---|---|
| 5.725–5.85 | 5.625-5.950 | **75**[1] **≤ Δf:** -37 | pk | |
| | | **25**[2] **≤ Δf ≤ 75**[1]**:** -37 to 0 | pk | 1 |
| | | **5**[3] **≤ Δf ≤ 25**[2]**:** 0 to 5.6 | pk | |
| | | **0 ≤ Δf ≤ 5**[3]**:** 5.6 to 17 | pk | |

[1]: 5.65GHz and 5.925GHz
[2]: 5.7GHz and 5.875GHz
[3]: 5.720GHz and 5.855GHz
[4]: **Δf:** frequency away from band edges, 5.725 GHz and 5.85GHz, respectively.

**Table 4.8.1(b) RSS-247/FCC 15.407 UNII-3 Out-of-Band Power Limits for Directional Antenna #2 (P=27dBm)**

| Band (GHz) | Frequency Investigated (GHz) | P (dBuV/m) | Detector | RBW (MHz) |
|---|---|---|---|---|
| 5.725–5.85 | 5.625-5.950 | **75**[1] **≤ Δf:** -33 | pk | |
| | | **25**[2] **≤ Δf ≤ 75**[1]**:** -33 to 4 | pk | 1 |
| | | **5**[3] **≤ Δf ≤ 25**[2]**:** 4 to 9.6 | pk | |
| | | **0 ≤ Δf ≤ 5**[3]**:** 9.6 to 21 | pk | |

[1]: 5.65GHz and 5.925GHz
[2]: 5.7GHz and 5.875GHz
[3]: 5.720GHz and 5.855GHz
[4]: **Δf:** frequency away from band edges, 5.725 GHz and 5.85GHz, respectively.

From the measurement results, it was found that for the output power of the EUT equipped with the omni-directional antenna #1 FA2RD (10dBi), the configurations with the minimum margins for conducted out-of-band emissions were ch 165 (5825MHz) with 256QAM for 1x20MHz and ch 149, 153 (5745MHz, 5765MHz) with 256QAM for 2x20MHz. For the output power of the EUT equipped with the omni-directional antenna #2 FA2WA (6dBi), the configurations with the minimum margins for conducted out-of-band emissions were ch 165 (5825MHz) with 256QAM for 1x20MHz and ch 161, 165 (5805MHz, 5825MHz) with 256QAM for 2x20MHz.

Based on the conducted measurement results, the test cases with the worst or near worst out-of-band emissions were evaluated by the radiated measurement as well for the EUT equipped with the omni-directional antenna #1 and the directional antenna #2, respectively.

Per ANSI C63.10 12.7.3, for the radiated measurement, the field strength limit is obtained from the EIRP limit by

$$EIRP = \frac{\sqrt{\mathrm{E \times d}}}{30},$$

where

- E is the field strength in V/m;
- d is the measurement distance in m;
- EIRP is the equivalent isotropically radiated power in W.

Therefore, with E in,

$$E\ (\mathrm{dB\mu V/m}) = EIRP(dBm) - 20 * \log(d) + 104.77.$$

At 3m with EIRP = - 27dBm, E = 68.2 dBμV/m.

**Table 4.8.1 FCC 15.407 UNII-3 Out-of-Band Radiated limits**

| Band (GHz) | Frequency to Be Investigated (GHz) | E (dBuV/m) | Detector | RBW (MHz) |
|---|---|---|---|---|
| 5.725–5.85 | 5.625-5.950 | **75**[1] **≤ Δf: 68.2** | PK | 1 |
| | | **25**[2] **≤ Δf**[4] **≤ 75**[1]**:** 68.2 to 105.2 | PK | |
| | | **5**[3] **≤ Δf ≤ 25**[2]**:** 105.2 to 110.8 | PK | |
| | | **0 ≤ Δf ≤ 5**[3]**:** 110.8 to 122.2 | PK | |

[1]: 5.65GHz and 5.925GHz
[2]: 5.7GHz and 5.875GHz
[3]: 5.720GHz and 5.855GHz
[4]: **Δf:** frequency away from band edges, 5.725 GHz and 5.85GHz, respectively.

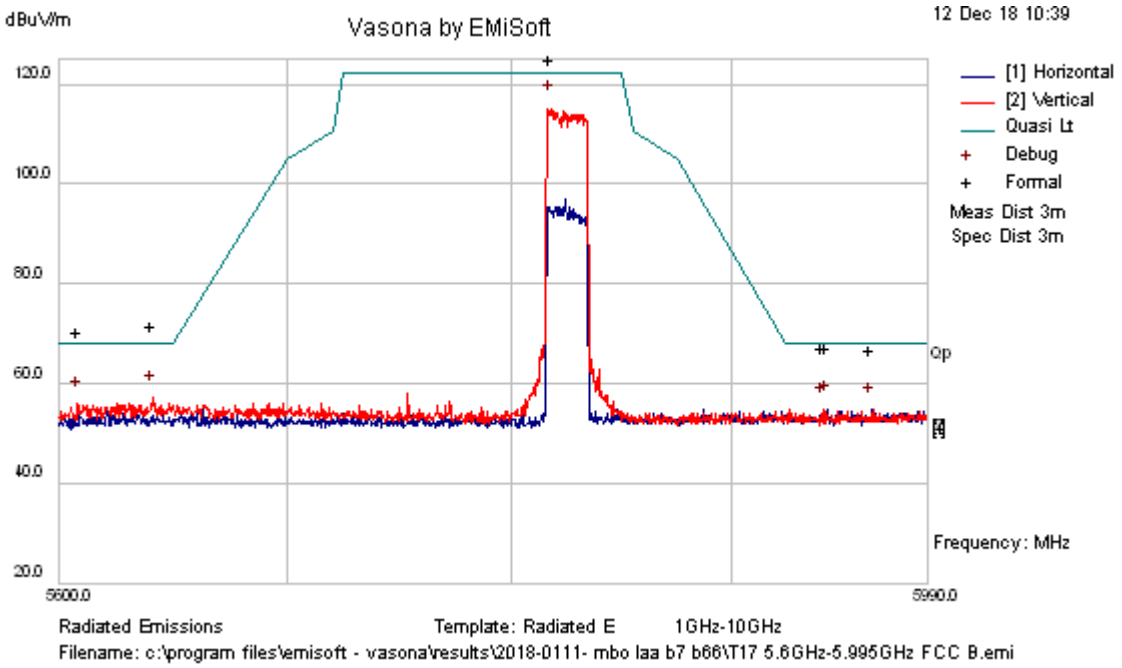
The recommendations of ANSI C63.10 were followed for the EUT testing setup and cabling. The test setup diagram was given in Section 4.3. The emissions were maximized by rotating the turntable 360° and moving the receiving antenna height to scan and capture the emissions from the EUT.

The radiated out-of-band emissions were also examined for the EUT equipped with Antenna #3 FA2RA at three channels with 256QAM modulations and 25.5dBm/port.

The out-of-band radiated emissions measured for the EUT equipped with both omni-directional antenna #1 & #3 and directional antenna #2 are all below the limits required in both the restricted and non-restricted bands (see Table 4.8.3). The restricted bands are provided in Table 4.1.1.

The out-of-band emissions plots which give the minimum emission margin evaluated for the EUT equipped with antennas #1, #2 and #3 were shown below in Figures 4.8.1-3, respectively.

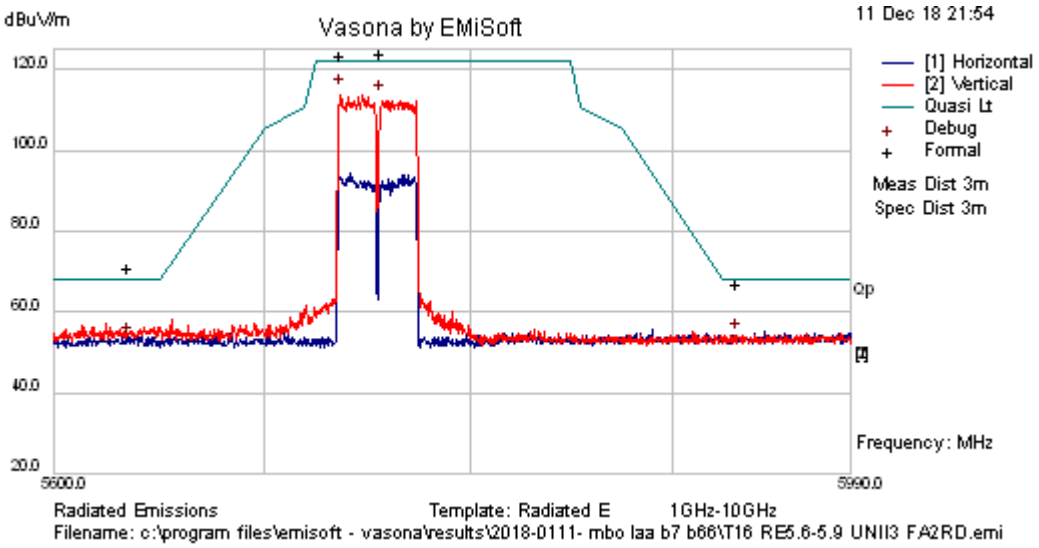
The unwanted out-of-band emissions measured with the EUT transmitting in the UNII-3 band are all below the required regulatory limits for the EUT equipped either omni-directional antenna or directional antenna, respectively, and are in full compliance with the regulatory requirements.




**FORMAL DATA**

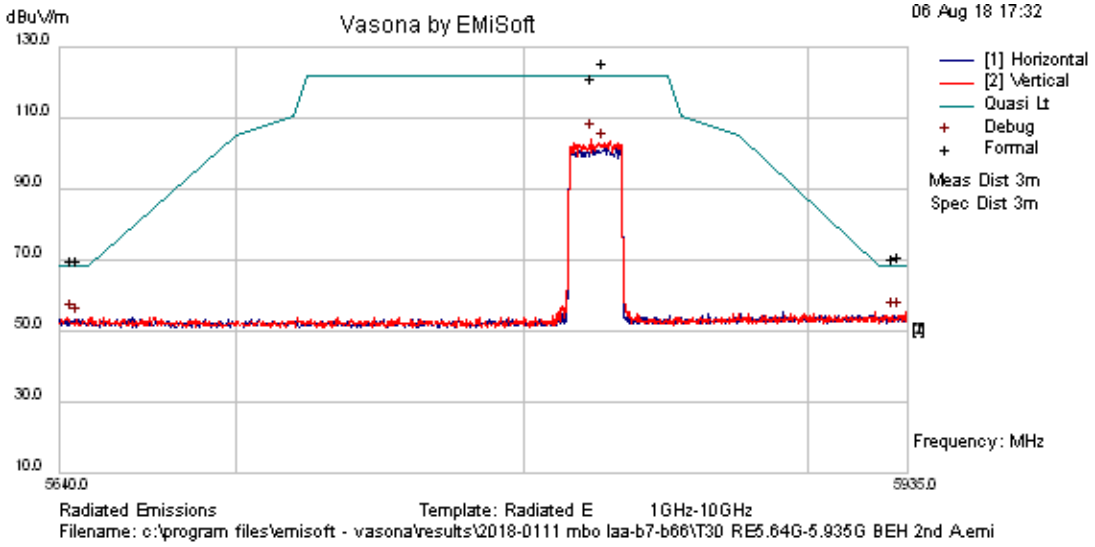
| Freq. (MHz) | Raw (dBuV) | Cable (dB) | Factor (dB) | Level (dBuV/m) | Emission Type | Pol (H/V) | Ht (cm) | Az (deg) | Limit (dBuV/m) | Margin (dB) | Pass /Fail | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 5640.6 | 47.82 | 22.23 | -3.37 | 66.69 | Peak | V | 109 | 146 | 68.2 | -1.51 | Pass | |
| 5817.67 | 101.06 | 22.25 | -3.24 | 120.07 | Peak | V | 134 | 123 | 122.2 | -2.13 | Pass | |
| 5607.84 | 46.91 | 22.23 | -3.4 | 65.75 | Peak | V | 127 | 197 | 68.2 | -2.45 | Pass | |
| 5942.02 | 43.33 | 22.26 | -3.14 | 62.44 | Peak | V | 209 | 171 | 68.2 | -5.76 | Pass | |
| 5944.01 | 43.18 | 22.26 | -3.14 | 62.29 | Peak | H | 244 | 39 | 68.2 | -5.91 | Pass | |
| 5964.18 | 42.83 | 22.26 | -3.13 | 61.96 | Peak | H | 228 | 8 | 68.2 | -6.24 | Pass | |

**Figure 4.8.1 (a) The Radiated Out-of-Band Emissions with the Minimum Margin Evaluated for 1x 20MHz Carrier at UNII-3 Channel 165 (5825MHz), 23dBm per port, 256QAM, Omni-Directional Antenna #1 FA2RD (Formal RBW: 1MHz).**



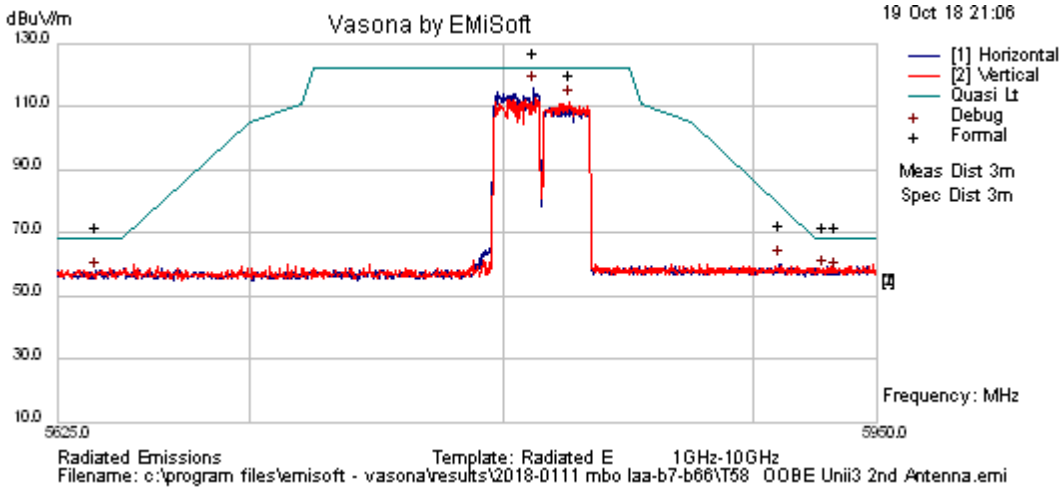

| FORMAL DATA | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Freq. (MHz) | Raw (dBuV) | Cable (dB) | Factor (dB) | Level (dBuV/m) | Emission Type | Pol (H/V) | Ht (cm) | Az (deg) | Limit (dBuV/m) | Margin (dB) | Pass /Fail | Comments |
| 5635.74 | 48.03 | 22.23 | -3.38 | 66.89 | Peak | V | 112 | 162 | 68.2 | -1.31 | Pass | |
| 5757.24 | 100.78 | 22.24 | -3.28 | 119.74 | Peak | V | 127 | 199 | 122.2 | -2.46 | Pass | |
| 5737.46 | 100.05 | 22.24 | -3.3 | 118.99 | Peak | V | 114 | 208 | 122.2 | -3.21 | Pass | |
| 5932.81 | 43.59 | 22.26 | -3.15 | 62.69 | Peak | V | 184 | 55 | 68.2 | -5.51 | Pass | |

**Figure 4.8.1 (b) The Radiated Out-of-Band Emissions with the Minimum Margin Evaluated for 2x 20MHz Carrier at UNII-3 Channel 149, 153 (5745, 5765), 23dBm per port, 256QAM, Omni-Directional Antenna #1 FA2RD (Formal RBW: 1MHz).**




| FORMAL DATA | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Freq. (MHz) | Raw (dBuV) | Cable (dB) | Factor (dB) | Level (dBuV/m) | Emission Type | Pol (H/V) | Ht (cm) | Az (deg) | Limit (dBuV/m) | Margin (dB) | Pass /Fail | Comments |
| 5828.1 | 98.29 | 20.77 | 1.81 | 120.87 | Peak | H | 99 | 352 | 122.2 | -1.33 | Pass | Tx |
| 5932.58 | 43.02 | 20.81 | 1.95 | 65.78 | Peak | V | 250 | 180 | 68.2 | -2.42 | Pass | |
| 5930.46 | 42.76 | 20.81 | 1.95 | 65.52 | Peak | H | 335 | 28 | 68.2 | -2.68 | Pass | |
| 5644.75 | 42.89 | 20.68 | 1.55 | 65.13 | Peak | V | 257 | 347 | 68.2 | -3.07 | Pass | |
| 5646.62 | 42.62 | 20.69 | 1.56 | 64.87 | Peak | H | 275 | 346 | 68.2 | -3.33 | Pass | |
| 5823.61 | 93.47 | 20.77 | 1.8 | 116.03 | Peak | V | 98 | 354 | 122.2 | -6.17 | Pass | Tx |

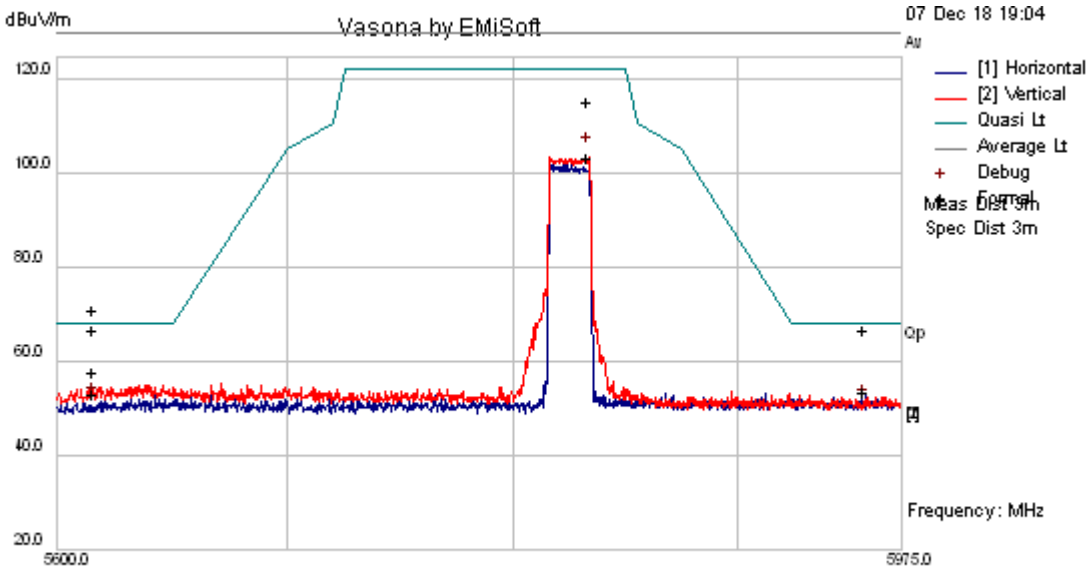
**Figure 4.8.2 (a) The Radiated Out-of-Band Emissions with the Minimum Margin Evaluated for 1x 20MHz Carrier at UNII-3 Channel 165 (5825 MHz), 27dBm per port, 256QAM, Directional Antenna #2 FA2WA (Preview RBW: 100k pk and Formal RBW: 1MHz).**




**FORMAL DATA**

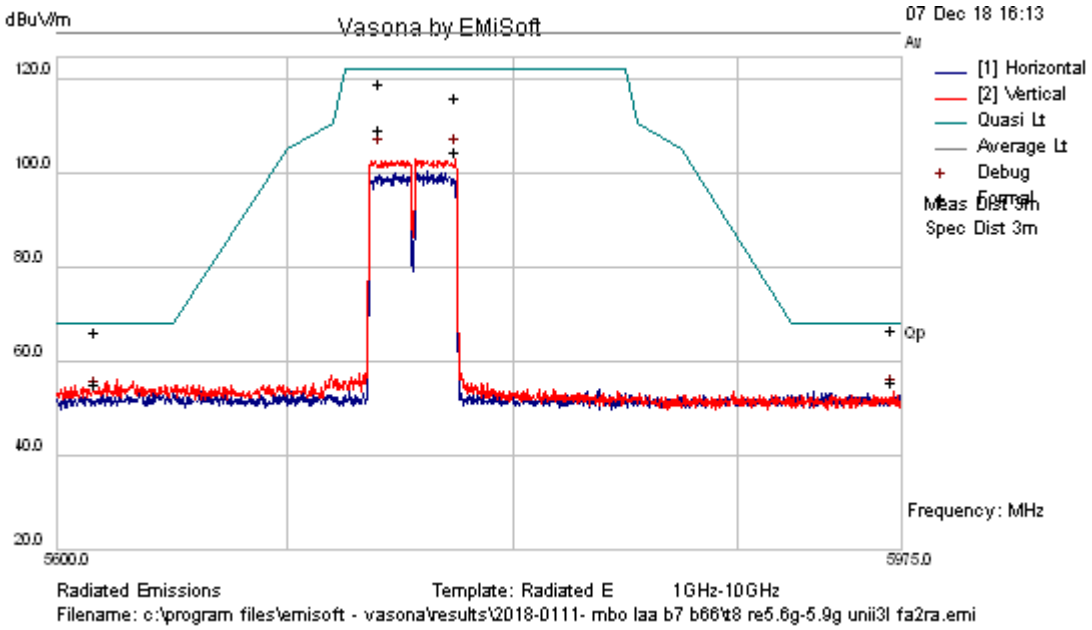
| Freq. (MHz) | Raw (dBuV) | Cable (dB) | Factor (dB) | Level (dBuV/m) | Emission Type | Pol (H/V) | Ht (cm) | Az (deg) | Limit (dBuV/m) | Margin (dB) | Pass /Fail | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 5933.31 | 42.94 | 23.81 | 1.14 | 67.89 | Peak | H | 237 | 175 | 68.2 | -0.31 | Pass | |
| 5928.48 | 42.87 | 23.81 | 1.13 | 67.81 | Peak | V | 153 | 331 | 68.2 | -0.39 | Pass | |
| 5640.66 | 42.96 | 23.68 | 0.84 | 67.49 | Peak | H | 325 | 296 | 68.2 | -0.71 | Pass | |
| 5826.25 | 91.01 | 23.77 | 1.03 | 115.8 | Peak | V | 127 | 331 | 122.2 | -6.4 | Pass | |
| 5910.87 | 43.16 | 23.8 | 1.11 | 68.08 | Peak | H | 151 | 357 | 78.62 | -10.54 | Pass | |

**Figure 4.8.2 (b) The Radiated Out-of-Band Emissions with the Minimum Margin Evaluated for 2x 20MHz Carrier at UNII-3 Channel 161, 165 (5805, 5825), 27dBm per port, 256QAM, Directional Antenna #2 FA2WA (Preview RBW: 100k pk and Formal RBW: 1MHz).**




| FORMAL DATA | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Freq. (MHz) | Raw (dBuV) | Cable (dB) | Factor (dB) | Level (dBuV/m) | Emission Type | Pol (H/V) | Ht (cm) | Az (deg) | Limit (dBuV/m) | Margin (dB) | Pass /Fail | Comments |
| 5615.45 | 47.39 | 22.23 | -3.39 | 66.23 | Peak | V | 148 | 157 | 68.2 | -1.97 | Pass | |
| 5958.37 | 42.87 | 22.26 | -3.13 | 62 | Peak | V | 235 | 296 | 68.2 | -6.2 | Pass | |
| 5615.45 | 43.11 | 22.23 | -3.39 | 61.95 | Peak | H | 157 | 121 | 68.2 | -6.25 | Pass | |
| 5833.63 | 91.47 | 22.25 | -3.22 | 110.49 | Peak | V | 261 | 182 | 122 | -11.51 | Pass | |

**Figure 4.8.3 (a) The Radiated Out-of-Band Emissions with the Minimum Margin Evaluated for 1x 20MHz Carrier at UNII-3 Channel 165 (5825 MHz), 25.5dBm per port, 256QAM, Omni-Directional Antenna #3 FA2RA (Preview RBW: 100k pk and Formal RBW: 1MHz).**




| FORMAL DATA | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Freq. (MHz) | Raw (dBuV) | Cable (dB) | Factor (dB) | Level (dBuV/m) | Emission Type | Pol (H/V) | Ht (cm) | Az (deg) | Limit (dBuV/m) | Margin (dB) | Pass /Fail | Comments |
| 5971.5 | 42.69 | 22.26 | -3.12 | 61.83 | Peak | H | 302 | 19 | 68.2 | -6.37 | Pass | |
| 5616.44 | 42.92 | 22.23 | -3.39 | 61.76 | Peak | H | 152 | 129 | 68.2 | -6.44 | Pass | |
| 5740.53 | 95.69 | 22.24 | -3.29 | 114.63 | Peak | V | 207 | 241 | 122 | -7.37 | Pass | |
| 5773.96 | 92.53 | 22.24 | -3.27 | 111.5 | Peak | V | 176 | 30 | 122 | -10.5 | Pass | |

**Figure 4.8.3 (b) The Radiated Out-of-Band Emissions for 2x 20MHz Carrier at UNII-3 Channel 149, 153 (5745, 5765), 25.5dBm per port, 256QAM, Omni-Directional Antenna #3 FA2RA (Preview RBW: 100k pk and Formal RBW: 1MHz).**

# 4.9 MEASUREMENT REQUIRED: UNWANTED RADIATED SPURIOUS EMISSIONS – FCC SECTION 15.407 (b)(4-8)

The requirements of the unwanted emissions are provided in Section 4.1. Per ANSI C63.10 12.7.4.2, the unwanted emission limits in both the restricted and non-restricted bands are based on radiated measurements; however, as an alternative, antenna-port conducted measurements in conjunction with cabinet emissions tests will be permitted to demonstrate compliance.

The radiated limits of RSS-GEN Table 5, ICES-003/FCC 15.109 Class B and FCC 15.209 were given in Table 4.9.1. The FCC 15.109/ICES-003 Class B limits are identical to the FCC 15.209/RSS-GEN Table 5 limits between 30MHz and 30GHz for the EUT operating in UNII bands.

The combined conducted limits of RSS-GEN Table 5, RSS-247, ICES-003/FCC 15.109 Class B and FCC 15.209 were given in Table 4.9.2, where the conversion between the EIRP and electrical field strength was given in the above section.

**Table 4.9.1. RSS-GEN Table 5, ICES-003, FCC 15.109 Class B and 15.209 Radiated Emissions Limits**

| Frequency (MHz) | Field Stength at 3m (dB uV/m) | | RBW (kHz) | Detector |
|---|---|---|---|---|
| | FCC 15.109/ ICES-003 Class B | FCC 15.209/ RSS-GEN Table 5 | | |
| 10 - 30 | | 49.5 | 9 | QP |
| 30 - 88 | 40 | 40 | 120 | QP |
| 88 - 216 | 43.5 | 43.5 | | |
| 216 - 230 | 46 | 46 | | |
| 230 - 960 | 46 | 46 | | |
| 960 - 1000 | 54 | 54 | | |
| 1000 - 3000 | 54 | 54 | 1000 | Ave. |
| | 74 | 74 | | Peak |
| > 3000 - 5$f_c$ | 54 | 54 | 1000 | Ave. |
| | 74 | 74 | | Peak |
| 5$f_c$ - 10$f_c$ / 40GHz | | 54 | 1000 | Ave. |
| | | 74 | | Peak |

**Table 4.9.2. Combined Worst Conducted Emission Limits per RSS-GEN Table 5, ICES-003 Class B, FCC 15.407 UNII-1/3, 15.209 and 15.109**

| Freq (MHz) | $P^{Lim}$ Ant #1 (G = 6dBi) (dBm) | $P^{Lim}$ for Ant #2 (G = 10dBi) (dBm) | Detector /RBW |
|---|---|---|---|
| 30-88 | -66/-42.2 | -70/-46.2 | qpk/pk 120kHz |
| 88-216 | -62.4/-42.2 | -66.4/-46.2 | |
| 216-960 | -60/-42.2 | -64/-46.2 | |
| 960-1000 | -52/-42.2 | -56/-46.2 | |
| 1G - 40G in Restricted Bands* | -47.2/-33 | -51.2/-37 | ave/pk/1MHz |
| 1G - 40G in Non-Restricted Bands* | -33 | -37 | pk/1MHz |

* The restricted bands of operation specified in RSS-GEN Table 7 were provided in Section 4.1.
** Below 1GHz, a 4.7dB was added for a ground plane when converting between EIRP and E per KDB 789033D02.

The conducted spurious emissions were investigated with peak detector from 30MHz-40GHz first at both antenna ports for 1x20MHz and 2x20MHz carriers located at the low, middle (1x20MHz) and high channels of UNII-3 band given in Table 4.2.2 with various modulations (QPSK/16QAM, 64QAM and 256QAM) and 27dBm/port output power which is the maximum output power of the EUT equipped with the directional antenna #2 FA2WA (6dBi). The recommendations of ANSI C63.10 were followed for EUT testing setup and measurement procedures. The test setup diagram was given in Section 4.3. The conducted emissions of the EUT in the frequency range of below 1GHz and between 6-40GHz have similar performance for various modulations and carrier placement. For the emissions between 1-5.625GHz, the emissions at channel 5825MHz for 1x20MHz and at channel 5805MHz+5825MHz for 2x20MHz have the smallest margin.

The conducted spurious emissions were investigated from 30MHz-40GHz at both antenna ports for 2x20MHz carriers located at the low and high channels of UNII-3 band with various modulations and 23dBm/port output power which corresponds to the maximum output power of the omni-directional antenna #1 FA2RD (10dBi) as well. FA2RD has the highest gain among all omni-directional antennas. For the emissions between 1-5.625GHz, the emissions at channel 5805MHz+5825MHz for 2x20MHz also show the smallest margin.

The conducted spurious emissions measured in the frequency range of 30MHz-40GHz for the EUT, which operated in UNII-3 band with the maximum output power of the EUT equipped with the omni-directional antenna #1 FA2RD and the directional antenna #2 FA2WA, respectively, all met the -27dBm/MHz EIRP requirement.

Based on the conducted measurement, the spurious emissions in the frequency range of 30MHz to 40GHz were evaluated by the radiated measurement for the QPSK/16QAM modulation at the selected channels for the EUT equipped with the omni-directional antenna #1 & #3 and the directional antenna #2 with full power, respectively.

The spurious emissions below 1GHz and above 18GHz were evaluated at one or two carrier configurations given in Table 4.2.2 for each antenna.

The combined radiated limits of RSS-GEN Table 5, RSS-247, ICES-003/FCC 15.109 Class B and FCC 15.209 were given in Table 4.9.3.

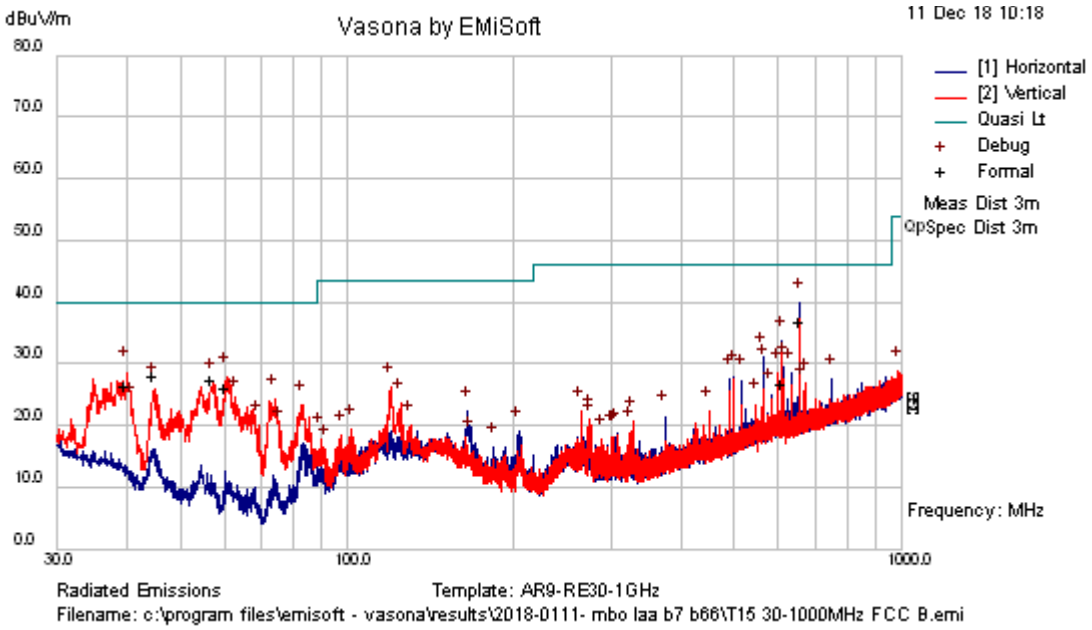
**Table 4.9.3. Combined Worst Radiated Emission Limits Per FCC 15.407 UNII-1/3, 15.209, 15.109/ICES-003 Class B, RSS-GEN Table 5 and RSS-247 at 3m**

| Frequency (MHz) | E (dBuV/m) | RBW (kHz) | Detector |
|---|---|---|---|
| 30 - 88 | 40/63.7* | 120kHz | QP/Peak |
| 88 - 216 | 43.5/63.7 | | |
| 216 - 960 | 46/63.7 | | |
| 960 - 1000 | 54/63.7 | | |
| 1G - 40G in Restricted Bands** | 54/68.2 | 1000 | Ave/Peak |
| 1G - 40G in Non-Restricted Bands** | 68.2 | 1000 | Peak |

*A 4.7dB was added for ground floor per KDB. If no 4.7dB, the limit is 59 dBuV/m.
** For a failing signal, need to check if it is from the transmitter. If not, it needs to meet ICES-003/15.109 Class B.

The recommendations of ANSI C63.10 were followed for EUT testing setup and cabling. The test setup diagram was given in Section 4.3. The emissions were maximized by rotating the turntable 360$^{o}$ and moving the receiving antenna height to scan and capture the emissions from the EUT. The plots with the minimum margin in each frequency range evaluated for each antenna were provided in Figures 4.9.1-3, respectively.

The unwanted radiated spurious emissions measured in the frequency range of 30MHz-40GHz for the EUT, which operated in UNII-3 band and was equipped with the omni-directional antenna #1 FA2RD and #3 FA2RA and the directional antenna #2 FA2WA, respectively, met the regulatory requirements for both intentional radiators specified in RSS-247/FCC 15.407 and unintentional radiators specified in ICES-003/FCC 15.109 Class B.



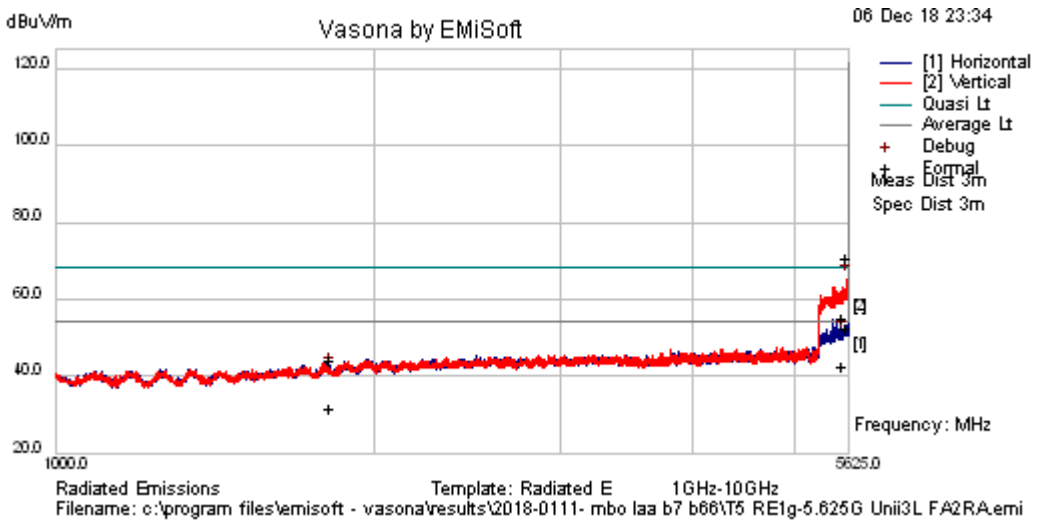

**FORMAL DATA**

| Freq. (MHz) | Raw (dBuV) | Cable (dB) | Factor (dB) | Level (dBuV/m) | Emission Type | Pol (H/V) | Ht (cm) | Az (deg) | Limit (dBuV/m) | Margin (dB) | Pass /Fail | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 656.269 | 39.4 | 1.59 | -7.64 | 33.35 | Quasi Max | H | 99 | 74 | 46 | -12.65 | Pass | |
| 44.737 | 40.85 | 0.39 | -16.9 | 24.4 | Quasi Max | V | 104 | 166 | 40 | -15.6 | Pass | |
| 57.23 | 44.42 | 0.45 | -20.9 | 24.03 | Quasi Max | V | 198 | 276 | 40 | -15.97 | Pass | |
| 39.897 | 37.21 | 0.36 | -14.6 | 22.96 | Quasi Max | V | 149 | 78 | 40 | -17.04 | Pass | |
| 60.461 | 43.75 | 0.47 | -21.5 | 22.73 | Quasi Max | V | 141 | 138 | 40 | -17.27 | Pass | |
| 609.388 | 29.66 | 1.51 | -7.81 | 23.36 | Quasi Max | H | 107 | 75 | 46 | -22.64 | Pass | |

**PREVIEW DATA**

| Freq. (MHz) | Raw (dBuV) | Cable (dB) | Factor (dB) | Level (dBuV/m) | Emission Type | Pol (H/V) | Ht (cm) | Az (deg) | Limit (dBuV/m) | Margin (dB) | Pass /Fail | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 656.231 | 46.03 | 1.59 | -7.64 | 39.98 | Preview | H | 100 | 90 | 46 | -6.02 | Pass | |
| 39.9231 | 42.91 | 0.36 | -14.6 | 28.64 | Preview | V | 100 | 180 | 40 | -11.36 | Pass | |
| 60.4615 | 48.74 | 0.47 | -21.5 | 27.72 | Preview | V | 100 | 270 | 40 | -12.28 | Pass | |
| 609.385 | 39.92 | 1.51 | -7.81 | 33.62 | Preview | H | 100 | 90 | 46 | -12.38 | Pass | |
| 57.2308 | 47.37 | 0.45 | -20.9 | 26.97 | Preview | V | 100 | 135 | 40 | -13.03 | Pass | |
| 44.7692 | 42.47 | 0.39 | -16.9 | 26 | Preview | V | 100 | 180 | 40 | -14 | Pass | |

**Figure 4.9.1(a) The Radiated Unwanted Emissions in 30MHz-1GHz for the EUT with Antenna #3 FA2RA in UNII-3, 2x20MHz Carriers at Channel 149 (5745MHz), 153 (5765MHz), Q/16QAM, 25.5dBm/port, against FCC Part 15.209 and 15.109 Class B Limits at 3m Distance (Preview in PK).**

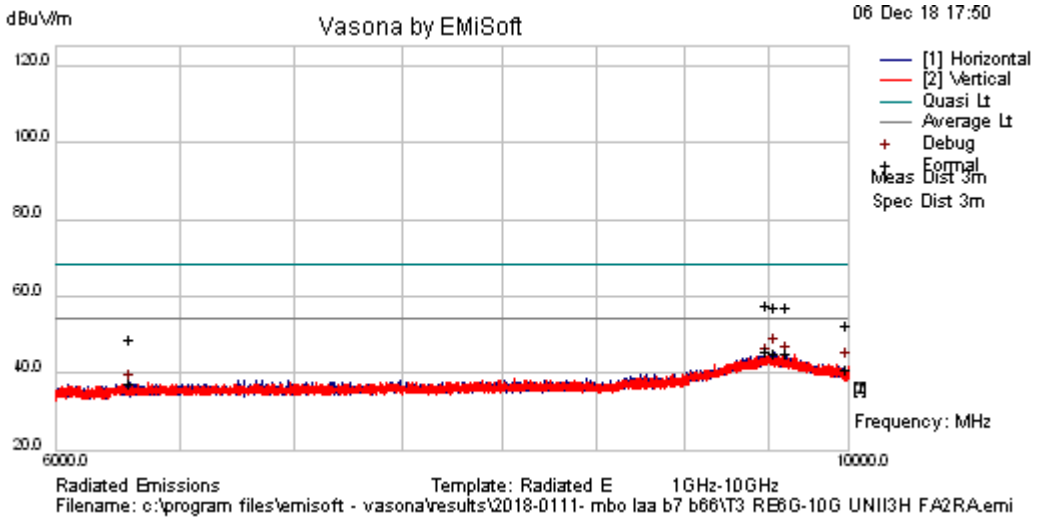



**FORMAL DATA**

| Freq. (MHz) | Raw (dBuV) | Cable (dB) | Factor (dB) | Level (dBuV/m) | Emission Type | Pol (H/V) | Ht (cm) | Az (deg) | Limit (dBuV/m) | Margin (dB) | Pass /Fail | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 5610.31 | 64.95 | 4.92 | -3.4 | 66.48 | Peak | V | 187 | 137 | 68.2 | -1.72 | Pass | |
| 5610.31 | 47.08 | 4.92 | -3.4 | 48.61 | Average | V | 187 | 137 | 54 | -5.39 | Pass | NA |
| 5552.6 | 37.29 | 4.8 | -3.44 | 38.65 | Average | H | 108 | 120 | 54 | -15.35 | Pass | NA |
| 5552.6 | 49.52 | 4.8 | -3.44 | 50.88 | Peak | H | 108 | 120 | 68.2 | -17.32 | Pass | |
| 1819.36 | 33.7 | 2.52 | -8.76 | 27.47 | Average | H | 349 | 201 | 54 | -26.53 | Pass | NA |
| 1819.36 | 46.35 | 2.52 | -8.76 | 40.12 | peak | H | 349 | 201 | 68.2 | -28.08 | Pass | |

Note: NA = Not Applicable.

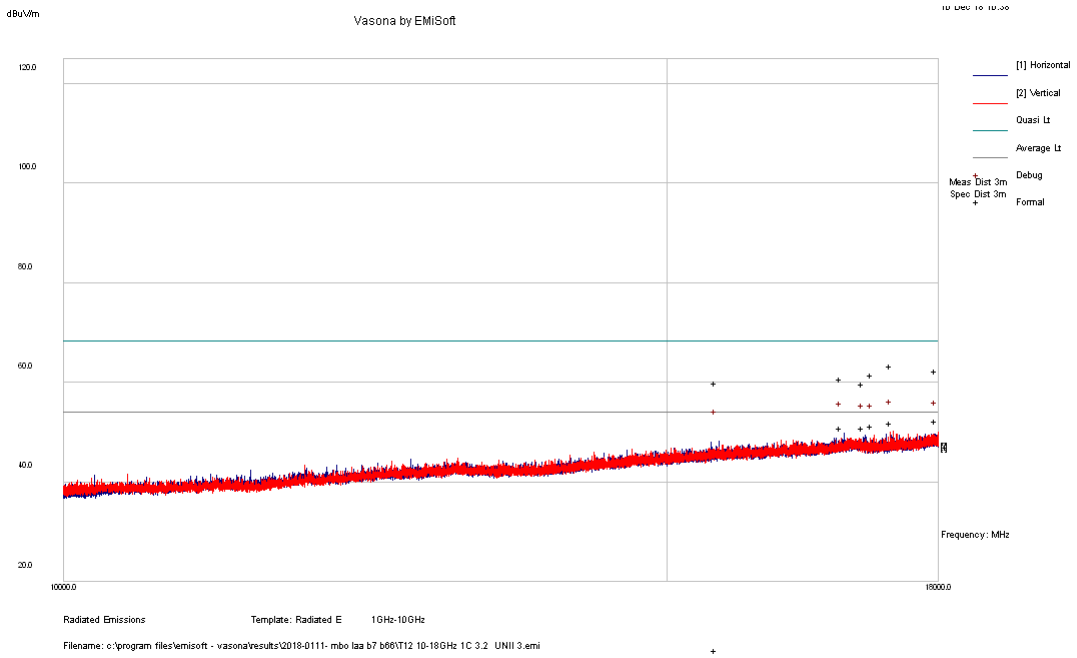
**Figure 4.9.1(b) Radiated Spurious Emissions in 1GHz-5.625GHz for the EUT with Ant #3 FA2RA in UNII-3, 2x20MHz Carriers at Ch 149 (5745MHz), 153 (5765MHz), Q/16QAM, 25.5dBm/pt, against FCC Part 15.407 and 15.209 Limits at 3m Distance (RBW 1MHz, Preview in PK).**




| FORMAL DATA | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Freq. (MHz) | Raw (dBuV) | Cable (dB) | Factor (dB) | Level (dBuV/m) | Emission Type | Pol (H/V) | Ht (cm) | Az (deg) | Limit (dBuV/m) | Margin (dB) | Pass /Fail | Comments |
| 9485.03 | 31.59 | 12.28 | -2.38 | 41.49 | Average | H | 314 | 338 | 54 | -12.51 | Pass | |
| 9536.24 | 31.96 | 11.77 | -2.34 | 41.4 | Average | H | 215 | 23 | 54 | -12.6 | Pass | NA |
| 9619.21 | 32.94 | 10.44 | -2.25 | 41.14 | Average | V | 266 | 291 | 54 | -12.86 | Pass | NA |
| 9485.03 | 43.87 | 12.28 | -2.38 | 53.76 | Peak | H | 314 | 338 | 68.2 | -14.44 | Pass | |
| 9536.24 | 43.78 | 11.77 | -2.34 | 53.22 | Peak | H | 215 | 23 | 68.2 | -14.98 | Pass | |
| 9619.21 | 45.01 | 10.44 | -2.25 | 53.21 | Peak | V | 266 | 291 | 68.2 | -14.99 | Pass | |
| 9994.34 | 31.65 | 7.09 | -1.85 | 36.9 | Average | V | 132 | 309 | 54 | -17.1 | Pass | NA |
| 9994.34 | 43.13 | 7.09 | -1.85 | 48.37 | Peak | V | 132 | 309 | 68.2 | -19.83 | Pass | |
| 6298.35 | 31.98 | 4.41 | -2.85 | 33.54 | Average | V | 297 | 8 | 54 | -20.46 | Pass | NA |
| 6298.35 | 43.47 | 4.41 | -2.85 | 45.03 | Peak | V | 297 | 8 | 68.2 | -23.17 | Pass | |

Note: NA = Not Applicable.

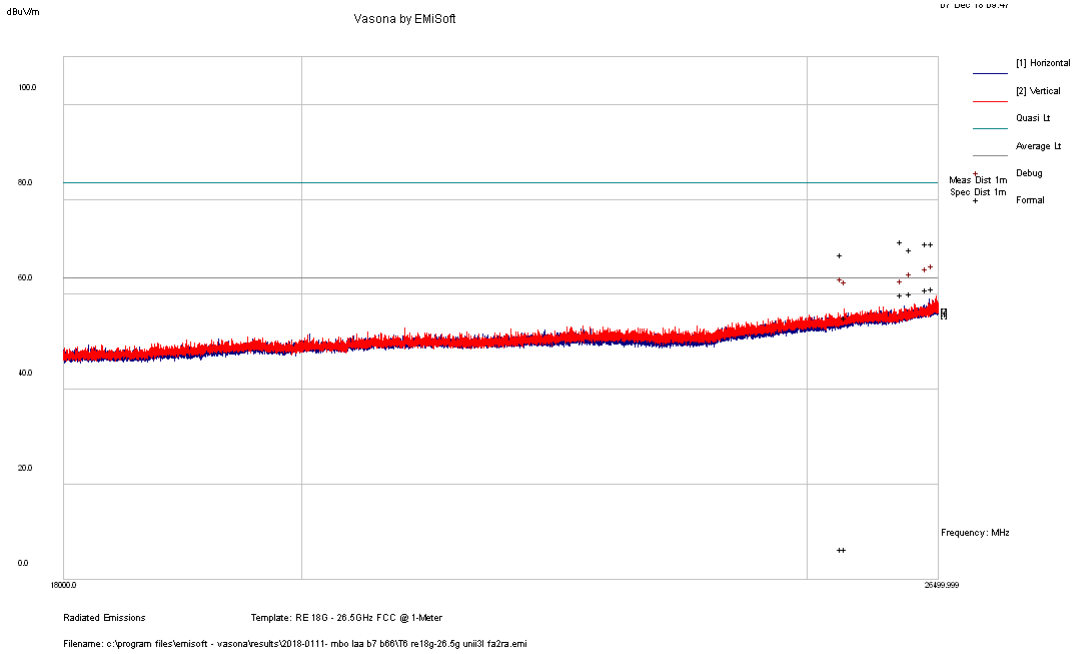
**Figure 4.9.1(c) Radiated Spurious Emissions in 6GHz-10GHz for the EUT with Antenna #3 FA2RA in UNII-3, 2x20MHz Carriers at Ch 161 (5805MHz), 165 (5825MHz), Q/16QAM, 25.5dBm/pt, against FCC Part 15.407 and 15.209 Limits at 3m Distance (RBW 1MHz, Preview in PK).**




| FORMAL DATA | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Freq. (MHz) | Raw (dBuV) | Cable (dB) | Factor (dB) | Level (dBuV/m) | Emission Type | Pol (H/V) | Ht (cm) | Az (deg) | Limit (dBuV/m) | Margin (dB) | Pass /Fail | Comments |
| 17997.5 | 30.36 | 11.13 | 4.66 | 46.15 | AvgMax | V | 99 | 330 | 54 | -7.85 | Pass | |
| 17463.2 | 30.66 | 10.59 | 4.48 | 45.73 | AvgMax | V | 117 | 119 | 54 | -8.27 | Pass | NA |
| 17238.9 | 30.11 | 10.36 | 4.66 | 45.13 | AvgMax | V | 123 | 100 | 54 | -8.87 | Pass | NA |
| 16889.9 | 29.85 | 10.12 | 4.64 | 44.61 | AvgMax | H | 329 | 246 | 54 | -9.39 | Pass | NA |
| 17134.7 | 29.56 | 10.25 | 4.75 | 44.56 | AvgMax | H | 311 | 225 | 54 | -9.44 | Pass | NA |
| 17463.2 | 42.01 | 10.59 | 4.48 | 57.08 | Peak | V | 117 | 119 | 68.2 | -11.12 | Pass | |
| 17997.5 | 40.43 | 11.13 | 4.66 | 56.22 | Peak | V | 99 | 330 | 68.2 | -11.98 | Pass | |
| 17238.9 | 40.37 | 10.36 | 4.66 | 55.39 | Peak | V | 123 | 100 | 68.2 | -12.81 | Pass | |
| 15527.9 | 28.16 | 10.17 | 2.28 | 40.61 | Average | H | 345 | 38 | 54 | -13.39 | Pass | |
| 16889.9 | 39.71 | 10.12 | 4.64 | 54.46 | Peak | H | 329 | 246 | 68.2 | -13.74 | Pass | |
| 15527.9 | 41.29 | 10.17 | 2.28 | 53.74 | Peak | H | 345 | 38 | 68.2 | -14.46 | Pass | |
| 17134.7 | 38.47 | 10.25 | 4.75 | 53.48 | Peak | H | 311 | 225 | 68.2 | -14.72 | Pass | |

Note: NA = Not Applicable.

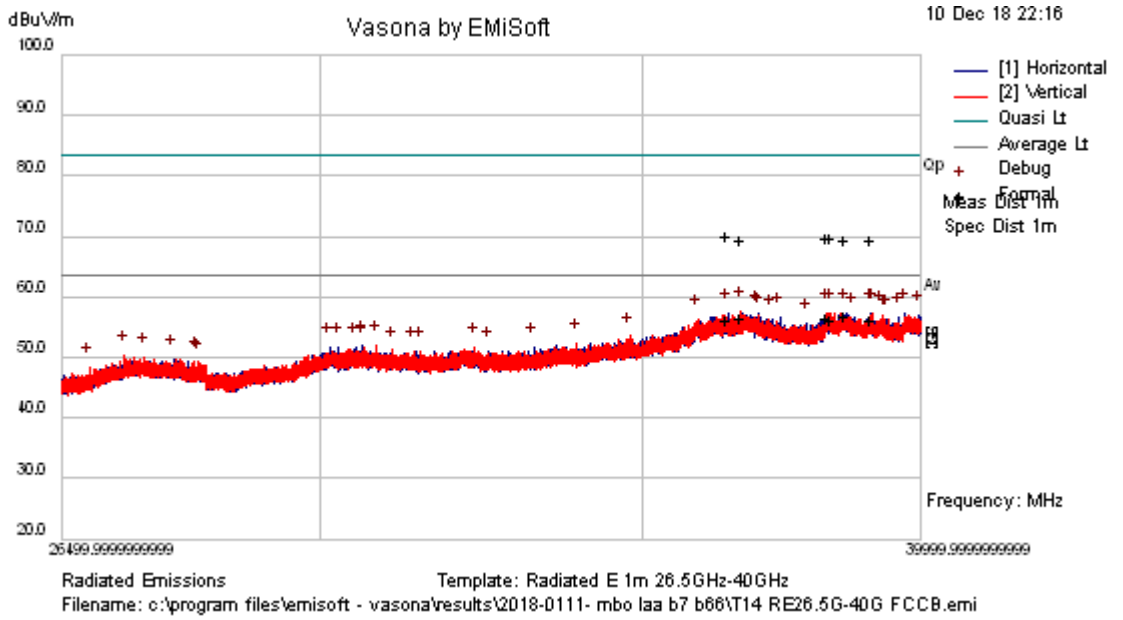
**Figure 4.9.1(d) Radiated Spurious Emissions in 10GHz-18GHz for the EUT with Ant #3 FA2RA in UNII-3, 1x20MHz Carrier at Ch 165 (5825MHz), Q/16QAM, 25.5dBm/pt, against FCC Part 15.407 and 15.209 Limits at 3m Distance (RBW 1MHz, Preview in PK).**




**FORMAL DATA**

| Freq. (MHz) | Raw (dBuV) | Cable (dB) | Factor (dB) | Level (dBuV/m) | Emission Type | Pol (H/V) | Ht (cm) | Az (deg) | Limit (dBuV/m) | Margin (dB) | Pass /Fail | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 26466.6 | 32.15 | 10.28 | 12.26 | 54.69 | AvgMax | V | 134 | 69 | 63.5 | -8.81 | Pass | |
| 26392.3 | 32.25 | 10.19 | 12.05 | 54.49 | AvgMax | H | 100 | 307 | 63.5 | -9.01 | Pass | |
| 26213.6 | 32.07 | 9.96 | 11.56 | 53.59 | AvgMax | V | 120 | 241 | 63.5 | -9.91 | Pass | |
| 26102.8 | 32.33 | 9.83 | 11.25 | 53.4 | AvgMax | H | 190 | 126 | 63.5 | -10.1 | Pass | |
| 25462.9 | 28.54 | 9.54 | 10.47 | 48.55 | AvgMax | H | 189 | 64 | 63.5 | -14.95 | Pass | |
| 25420.5 | 27.79 | 9.54 | 10.42 | 47.75 | Average | V | 181 | 138 | 63.5 | -15.75 | Pass | |
| 26102.8 | 43.51 | 9.83 | 11.25 | 64.59 | Peak | H | 190 | 126 | 77.7 | -13.11 | Pass | |
| 26466.6 | 41.63 | 10.28 | 12.26 | 64.17 | Peak | V | 134 | 69 | 77.7 | -13.53 | Pass | |
| 26392.3 | 41.88 | 10.19 | 12.05 | 64.13 | Peak | H | 100 | 307 | 77.7 | -13.57 | Pass | |
| 26213.6 | 41.48 | 9.96 | 11.56 | 63 | Peak | V | 120 | 241 | 77.7 | -14.7 | Pass | |
| 25462.9 | 42.08 | 9.54 | 10.47 | 62.09 | Peak | H | 189 | 64 | 77.7 | -15.61 | Pass | |
| 25420.5 | 41.86 | 9.54 | 10.42 | 61.81 | Peak | V | 181 | 138 | 77.7 | -15.89 | Pass | |

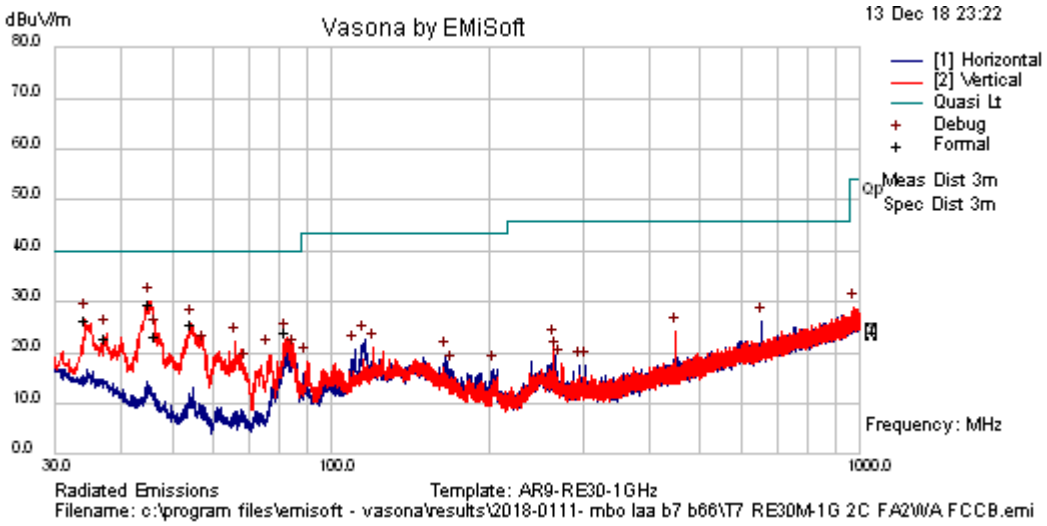
**Figure 4.9.1(e) Radiated Spurious Emissions in 18GHz-26.5GHz for the EUT with Ant #3 FA2RA in UNII-3, 2x20MHz Carriers at Ch 149 (5745MHz), 153 (5765MHz), Q/16QAM, 25.5dBm/pt, against FCC Part 15.407 and 15.209 Limits at 1m Distance (RBW 1MHz, Preview 100kHz RBW in PK).**




| FORMAL DATA | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Freq. (MHz) | Raw (dBuV) | Cable (dB) | Factor (dB) | Level (dBuV/m) | Emission Type | Pol (H/V) | Ht (cm) | Az (deg) | Limit (dBuV/m) | Margin (dB) | Pass /Fail | Comments |
| 38597.1 | 25.99 | 0 | 27.28 | 53.27 | Average | H | 199 | 107 | 63.5 | -10.23 | Pass | NA |
| 38266.7 | 25.57 | 0 | 27.59 | 53.16 | Average | V | 121 | 224 | 63.5 | -10.34 | Pass | NA |
| 36711.3 | 24.55 | 0 | 28.37 | 52.92 | Average | V | 136 | 255 | 63.5 | -10.58 | Pass | NA |
| 38331 | 25.27 | 0 | 27.52 | 52.79 | Average | V | 141 | 119 | 63.5 | -10.71 | Pass | NA |
| 39068.8 | 25.69 | 0 | 27.08 | 52.77 | Average | H | 112 | 267 | 63.5 | -10.73 | Pass | |
| 36472.2 | 24.52 | 0 | 28.12 | 52.64 | Average | H | 196 | 10 | 63.5 | -10.86 | Pass | |
| 36472.2 | 38.48 | 0 | 28.12 | 66.6 | Peak | H | 196 | 10 | 77.7 | -11.1 | Pass | |
| 38266.7 | 38.77 | 0 | 27.59 | 66.36 | Peak | V | 121 | 224 | 77.7 | -11.34 | Pass | |
| 38331 | 38.64 | 0 | 27.52 | 66.16 | Peak | V | 141 | 119 | 77.7 | -11.54 | Pass | |
| 36711.3 | 37.73 | 0 | 28.37 | 66.1 | Peak | V | 136 | 255 | 77.7 | -11.6 | Pass | |
| 39068.8 | 38.92 | 0 | 27.08 | 66 | Peak | H | 112 | 267 | 77.7 | -11.7 | Pass | |

Note: NA = Not Applicable.

**Figure 4.9.1(f) Radiated Spurious Emissions in 26.5GHz-40GHz for the EUT with Ant #3 FA2RA in UNII-3, 2x20MHz Carriers at Ch 149 (5745MHz), 153 (5765MHz), Q/16QAM, 25.5dBm/pt, against FCC Part 15.407 and 15.209 Limits at 1m Distance (RBW 1MHz, Preview 100kHz RBW in PK).**

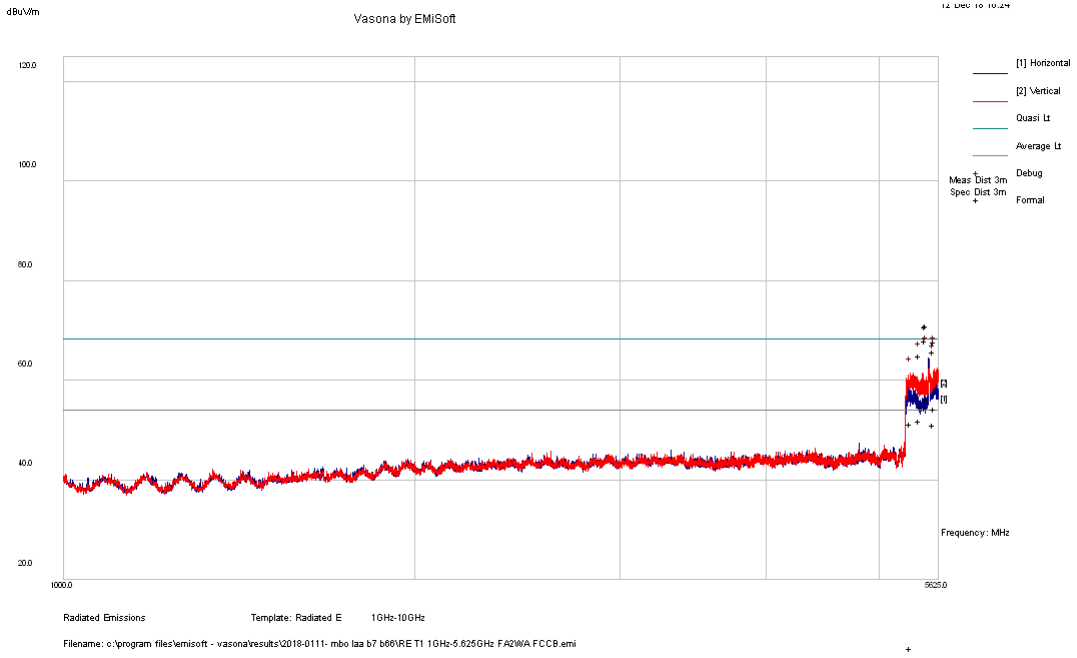



| FORMAL DATA | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Freq. (MHz) | Raw (dBuV) | Cable (dB) | Factor (dB) | Level (dBuV/m) | Emission Type | Pol (H/V) | Ht (cm) | Az (deg) | Limit (dBuV/m) | Margin (dB) | Pass /Fail | Comments |
| 45.4615 | 43.11 | 0.39 | -17.1 | 26.36 | Quasi Max | V | 152 | 190 | 40 | -13.64 | Pass | |
| 34.401 | 34.66 | 0.33 | -11.7 | 23.32 | Quasi Max | V | 137 | 280 | 40 | -16.68 | Pass | |
| 54.276 | 42.19 | 0.44 | -20.1 | 22.5 | Quasi Max | V | 109 | 210 | 40 | -17.5 | Pass | |
| 82.224 | 39.2 | 0.55 | -18.8 | 20.92 | Quasi Max | V | 144 | 120 | 40 | -19.08 | Pass | |
| 46.503 | 37.22 | 0.4 | -17.5 | 20.1 | Quasi Max | V | 175 | 191 | 40 | -19.9 | Pass | |
| 37.5385 | 32.63 | 0.35 | -13.4 | 19.59 | Quasi Max | V | 194 | 137 | 40 | -20.41 | Pass | |

| PREVIEW DATA | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Freq. (MHz) | Raw (dBuV) | Cable (dB) | Factor (dB) | Level (dBuV/m) | Emission Type | Pol (H/V) | Ht (cm) | Az (deg) | Limit (dBuV/m) | Margin (dB) | Pass /Fail | Comments |
| 45.4615 | 46.74 | 0.39 | -17.1 | 29.99 | Preview | V | 100 | 180 | 40 | -10.01 | Pass | |
| 34.3077 | 38.01 | 0.33 | -11.6 | 26.72 | Preview | V | 100 | 270 | 40 | -13.28 | Pass | |
| 54.3846 | 45.39 | 0.44 | -20.2 | 25.66 | Preview | V | 100 | 225 | 40 | -14.34 | Pass | |
| 46.6154 | 40.96 | 0.4 | -17.6 | 23.8 | Preview | V | 100 | 135 | 40 | -16.2 | Pass | |
| 37.5385 | 36.74 | 0.35 | -13.4 | 23.69 | Preview | V | 100 | 180 | 40 | -16.31 | Pass | |
| 82.3846 | 41.32 | 0.55 | -18.8 | 23.07 | Preview | V | 100 | 90 | 40 | -16.93 | Pass | |
| 65.7692 | 43.59 | 0.49 | -21.9 | 22.22 | Preview | V | 200 | 135 | 40 | -17.78 | Pass | |
| 57.5385 | 41.15 | 0.46 | -20.9 | 20.69 | Preview | V | 100 | 180 | 40 | -19.31 | Pass | |
| 656.231 | 32.22 | 1.59 | -7.64 | 26.17 | Preview | H | 100 | 135 | 46 | -19.83 | Pass | |

Note: Preview data was measured using a peak detector to identify frequencies of interest for formal measurement. Formal data consist of all frequencies in the preview list within 6 dB of specification limit or the top six frequencies. Failure in preview data does not necessarily constitute failure in formal data.

**Figure 4.9.2(a) The Radiated Unwanted Emissions in 30MHz-1GHz for the EUT with Antenna #2 FA2WA in UNII-3, 2x20MHz Carriers at Channel 161 (5805MHz), 163 (5825MHz), Q/16QAM, 27dBm/port, against FCC Part 15.209 and 15.109 Class B Limits at 3m Distance (Preview in PK).**

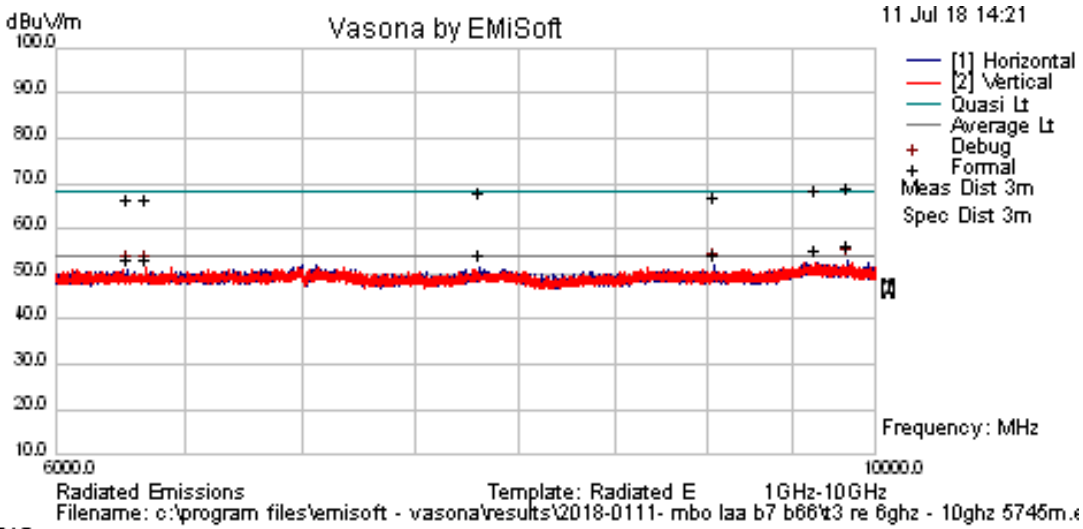



**FORMAL DATA**

| Freq. (MHz) | Raw (dBuV) | Cable (dB) | Factor (dB) | Level (dBuV/m) | Emission Type | Pol (H/V) | Ht (cm) | Az (deg) | Limit (dBuV/m) | Margin (dB) | Pass /Fail | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 5520.78 | 63.59 | 4.73 | -3.47 | 64.86 | Peak | V | 113 | 341 | 68.2 | -3.34 | Pass | |
| 5520.78 | 48.74 | 4.73 | -3.47 | 50.01 | Average | V | 113 | 341 | 54 | -3.99 | Pass | NA |
| 5510.93 | 47.16 | 4.71 | -3.47 | 48.4 | Average | H | 109 | 355 | 54 | -5.6 | Pass | NA |
| 5614.41 | 46.58 | 4.93 | -3.39 | 48.12 | Average | V | 99 | 350 | 54 | -5.88 | Pass | NA |
| 5510.93 | 60.58 | 4.71 | -3.47 | 61.81 | Peak | H | 109 | 355 | 68.2 | -6.39 | Pass | |
| 5614.41 | 60.05 | 4.93 | -3.39 | 61.59 | Peak | V | 99 | 350 | 68.2 | -6.61 | Pass | |
| 5446.98 | 44.42 | 4.71 | -3.52 | 45.62 | Average | V | 99 | 7 | 54 | -8.38 | Pass | |
| 5606.88 | 57.96 | 4.92 | -3.4 | 59.48 | Peak | H | 106 | 26 | 68.2 | -8.72 | Pass | |
| 5350.06 | 43.99 | 4.76 | -3.6 | 45.15 | Average | H | 99 | 332 | 54 | -8.85 | Pass | |
| 5606.88 | 43.39 | 4.92 | -3.4 | 44.91 | Average | H | 106 | 26 | 54 | -9.09 | Pass | NA |
| 5446.98 | 57.55 | 4.71 | -3.52 | 58.74 | Peak | V | 99 | 7 | 68.2 | -9.46 | Pass | |
| 5350.06 | 57.43 | 4.76 | -3.6 | 58.6 | Peak | H | 99 | 332 | 68.2 | -9.6 | Pass | |

Note: NA = Not Applicable.

**Figure 4.9.2(b) Radiated Spurious Emissions in 1GHz-5.625GHz for the EUT with Ant #2 FA2WA in UNII-3, 1x20MHz Carriers at Ch 165 (5825MHz), Q/16QAM, 27dBm/pt, against FCC Part 15.407 and 15.209 Limits at 3m Distance (RBW 1MHz).**

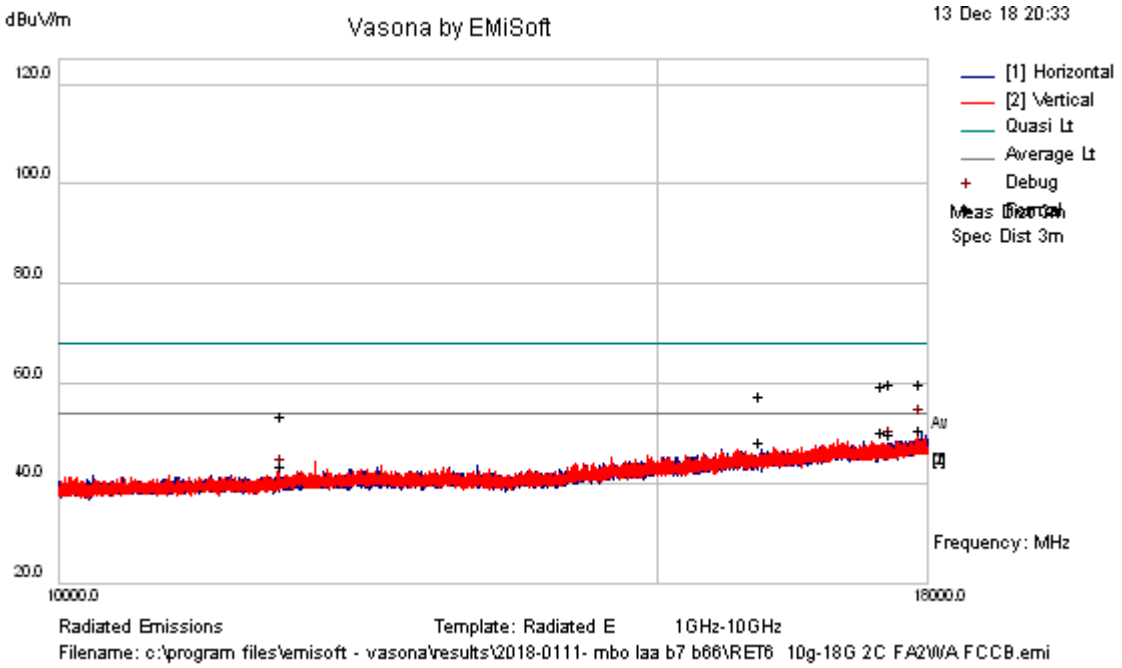



**FORMAL DATA**

| Freq. (MHz) | Raw (dBuV) | Cable (dB) | Factor (dB) | Level (dBuV/m) | Emission Type | Pol (H/V) | Ht (cm) | Az (deg) | Limit (dBuV/m) | Margin (dB) | Pass /Fail | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 9828.73 | 28.94 | 23.88 | 0.27 | 53.1 | Average | H | 194 | 50 | 54 | -0.9 | Pass | NA |
| 9632.31 | 28.41 | 23.79 | 0.02 | 52.22 | Average | V | 373 | 249 | 54 | -1.78 | Pass | NA |
| 9828.73 | 41.85 | 23.88 | 0.27 | 66 | Peak | H | 194 | 50 | 68.2 | -2.2 | Pass | |
| 7807.77 | 28.99 | 22.99 | -0.78 | 51.2 | Average | H | 214 | 243 | 54 | -2.8 | Pass | NA |
| 9632.31 | 41.58 | 23.79 | 0.02 | 65.4 | Peak | V | 373 | 249 | 68.2 | -2.8 | Pass | |
| 9047.16 | 28.07 | 23.53 | -0.43 | 51.17 | Average | H | 240 | 157 | 54 | -2.83 | Pass | |
| 7807.77 | 42.53 | 22.99 | -0.78 | 64.74 | Peak | H | 214 | 243 | 68.2 | -3.46 | Pass | |
| 6345.75 | 28.9 | 22.37 | -0.82 | 50.44 | Average | V | 238 | 130 | 54 | -3.56 | Pass | NA |
| 6270.18 | 28.95 | 22.34 | -0.87 | 50.42 | Average | H | 296 | 297 | 54 | -3.58 | Pass | NA |
| 9047.16 | 40.66 | 23.53 | -0.43 | 63.76 | Peak | H | 240 | 157 | 68.2 | -4.44 | Pass | |
| 6270.18 | 42.12 | 22.34 | -0.87 | 63.6 | Peak | H | 296 | 297 | 68.2 | -4.6 | Pass | |

Note: NA = Not Applicable.

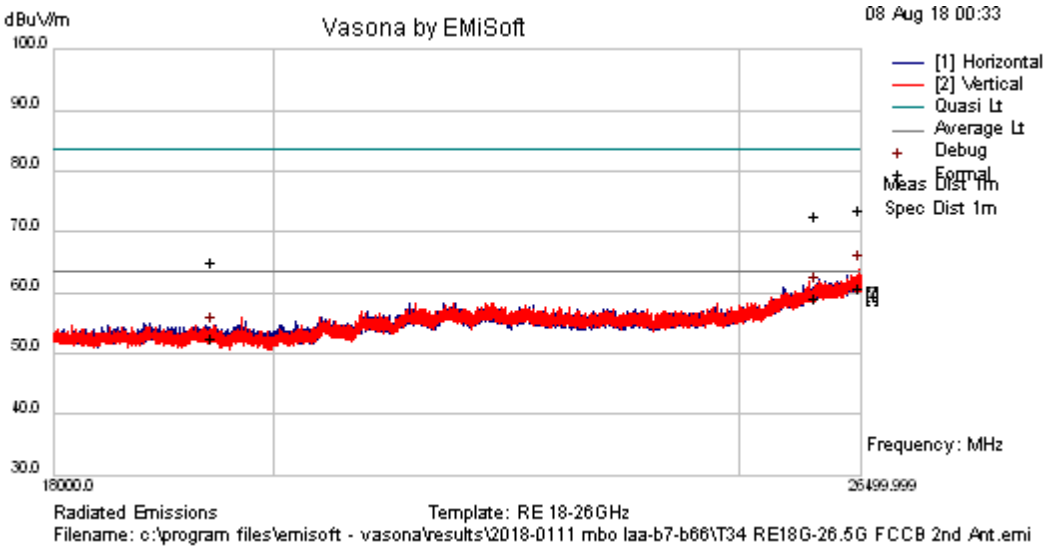
**Figure 4.9.2(c) Radiated Spurious Emissions in 6GHz-10GHz for the EUT with Ant #2 FA2WA in UNII-3, 1x20MHz Carriers at Ch 149 (5745MHz), Q/16QAM, 27dBm/pt, against FCC Part 15.407 and 15.209 Limits at 3m Distance (RBW 1MHz, Preview 30kHz RBW in PK).**




| FORMAL DATA | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Freq. (MHz) | Raw (dBuV) | Cable (dB) | Factor (dB) | Level (dBuV/m) | Emission Type | Pol (H/V) | Ht (cm) | Az (deg) | Limit (dBuV/m) | Margin (dB) | Pass /Fail | Comments |
| 17926.4 | 30.17 | 11.06 | 4.63 | 45.86 | Average | H | 207 | 180 | 54 | -8.14 | Pass | |
| 17478.7 | 30.25 | 10.61 | 4.47 | 45.33 | Average | H | 222 | 322 | 54 | -8.67 | Pass | NA |
| 17576.6 | 30.08 | 10.71 | 4.48 | 45.27 | Average | V | 244 | 309 | 54 | -8.73 | Pass | NA |
| 16093.2 | 30.46 | 10.05 | 2.8 | 43.3 | Average | V | 199 | 257 | 54 | -10.7 | Pass | |
| 17576.6 | 40.07 | 10.71 | 4.48 | 55.26 | Peak | V | 244 | 309 | 68.2 | -12.94 | Pass | |
| 17926.4 | 39.56 | 11.06 | 4.63 | 55.25 | Peak | H | 207 | 180 | 68.2 | -12.95 | Pass | |
| 17478.7 | 39.63 | 10.61 | 4.47 | 54.71 | Peak | H | 222 | 322 | 68.2 | -13.49 | Pass | |
| 11637.5 | 30.64 | 7.97 | -0.1 | 38.51 | Average | H | 339 | 18 | 54 | -15.49 | Pass | |
| 16093.2 | 39.77 | 10.05 | 2.8 | 52.62 | Peak | V | 199 | 257 | 68.2 | -15.58 | Pass | |

Note: NA = Not Applicable.

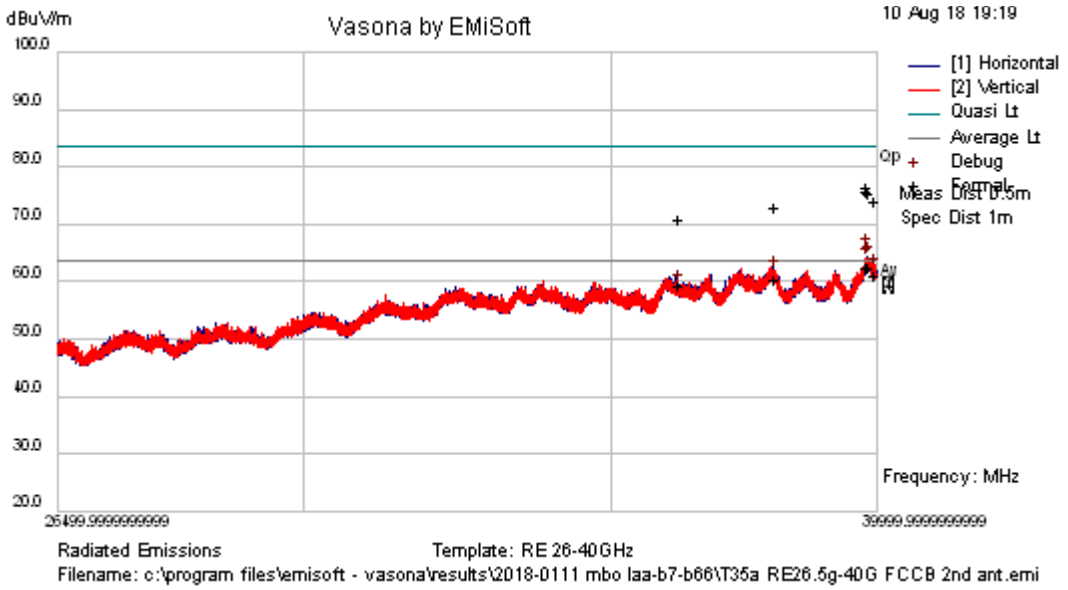
**Figure 4.9.2(d) Radiated Spurious Emissions in 10GHz-18GHz for the EUT with Ant #2 FA2WA in UNII-3, 2x20MHz Carriers at Ch 161 (5805MHz) and 165 (5825MHz), Q/16QAM, 27dBm/pt, against FCC Part 15.407 and 15.209 Limits at 3m Distance (RBW 1MHz, Preview 100kHz RBW in PK).**




| FORMAL DATA | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Freq. (MHz) | Raw (dBuV) | Cable (dB) | Factor (dB) | Level (dBuV/m) | Emission Type | Pol (H/V) | Ht (cm) | Az (deg) | Limit (dBuV/m) | Margin (dB) | Pass /Fail | Comments |
| 26471.7 | 26.51 | 10.29 | 21.3 | 58.1 | Average | V | 133 | 117 | 63.5 | -5.4 | Pass | NA |
| 25937.2 | 26.36 | 9.62 | 20.33 | 56.31 | Average | V | 101 | 33 | 63.5 | -7.19 | Pass | NA |
| 26471.7 | 39.36 | 10.29 | 21.3 | 70.94 | Peak | V | 133 | 117 | 77.8 | -6.86 | Pass | |
| 25937.2 | 39.96 | 9.62 | 20.33 | 69.91 | Peak | V | 101 | 33 | 77.8 | -7.89 | Pass | |
| 19421.3 | 25.87 | 8.22 | 15.49 | 49.58 | Average | V | 135 | 42 | 63.5 | -13.92 | Pass | |
| 19421.3 | 38.67 | 8.22 | 15.49 | 62.38 | Peak | V | 135 | 42 | 77.8 | -15.42 | Pass | |

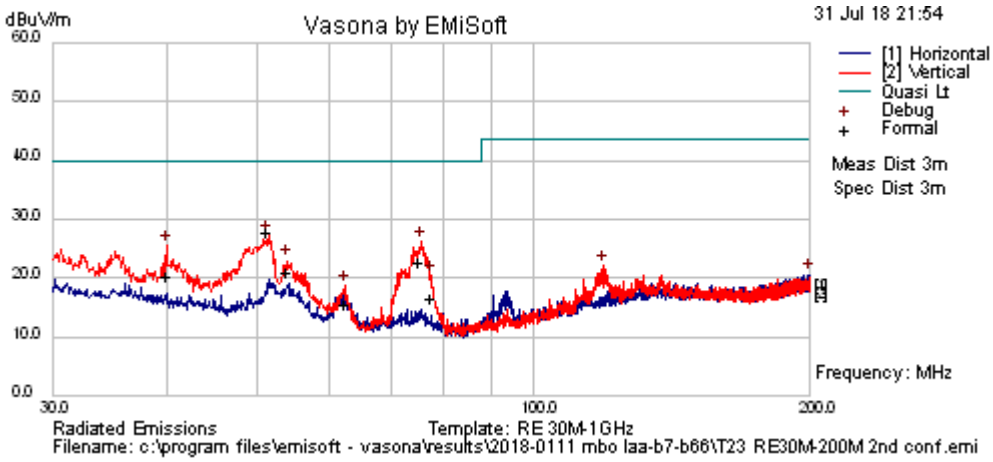
Note: NA = Not Applicable.

**Figure 4.9.2(e) Radiated Spurious Emissions in 18GHz-26.5GHz for the EUT with Ant #2 FA2WA in UNII-3, 1x20MHz Carriers at Ch 165 (5825MHz), Q/16QAM, 27dBm/pt, against FCC Part 15.407 and 15.209 Limits at 1m Distance (RBW 1MHz, Preview 100kHz RBW in PK) (B7 and B66 were transmitting at 2125M and 2627.500MHz at full power).**




| FORMAL DATA | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Freq. (MHz) | Raw (dBuV) | Cable (dB) | Factor (dB) | Level (dBuV/m) | Emission Type | Pol (H/V) | Ht (cm) | Az (deg) | Limit (dBuV/m) | Margin (dB) | Pass /Fail | Comments |
| 39819.2 | 37.06 | 0 | 22.02 | 59.08 | Average | H | 200 | 232 | 63.5 | -4.42 | Pass | |
| 39828.8 | 37.02 | 0 | 22.04 | 59.06 | Average | H | 173 | 240 | 63.5 | -4.44 | Pass | |
| 39860.3 | 36.94 | 0 | 22.11 | 59.05 | Average | V | 168 | 343 | 63.5 | -4.45 | Pass | |
| 39991.8 | 35.09 | 0 | 22.42 | 57.51 | Average | H | 185 | 230 | 63.5 | -5.99 | Pass | |
| 38024.7 | 35.01 | 0 | 22.05 | 57.07 | Average | H | 138 | 205 | 63.5 | -6.43 | Pass | |
| 36243.8 | 34.23 | 0 | 21.74 | 55.97 | Average | V | 188 | 284 | 63.5 | -7.53 | Pass | |
| 39828.8 | 50.98 | 0 | 22.04 | 73.02 | Peak | H | 173 | 240 | 77.7 | -4.68 | Pass | |
| 39819.2 | 50.33 | 0 | 22.02 | 72.35 | Peak | H | 200 | 232 | 77.7 | -5.35 | Pass | |
| 39860.3 | 49.82 | 0 | 22.11 | 71.93 | Peak | V | 168 | 343 | 77.7 | -5.77 | Pass | |
| 39991.8 | 48.28 | 0 | 22.42 | 70.7 | Peak | H | 184 | 231 | 77.7 | -7.00 | Pass | |

**Figure 4.9.2(f) Radiated Spurious Emissions in 26.5GHz-40GHz for the EUT with Ant #2 FA2WA in UNII-3, 1x20MHz Carriers at Ch 165 (5805MHz), Q/16QAM, 27dBm/pt, against FCC Part 15.407 and 15.209 Limits at 1m Distance (RBW 1MHz, Preview 100kHz RBW in PK) (B7 and B66 were transmitting at full power at 2125MHz and 2627.5MHz.**

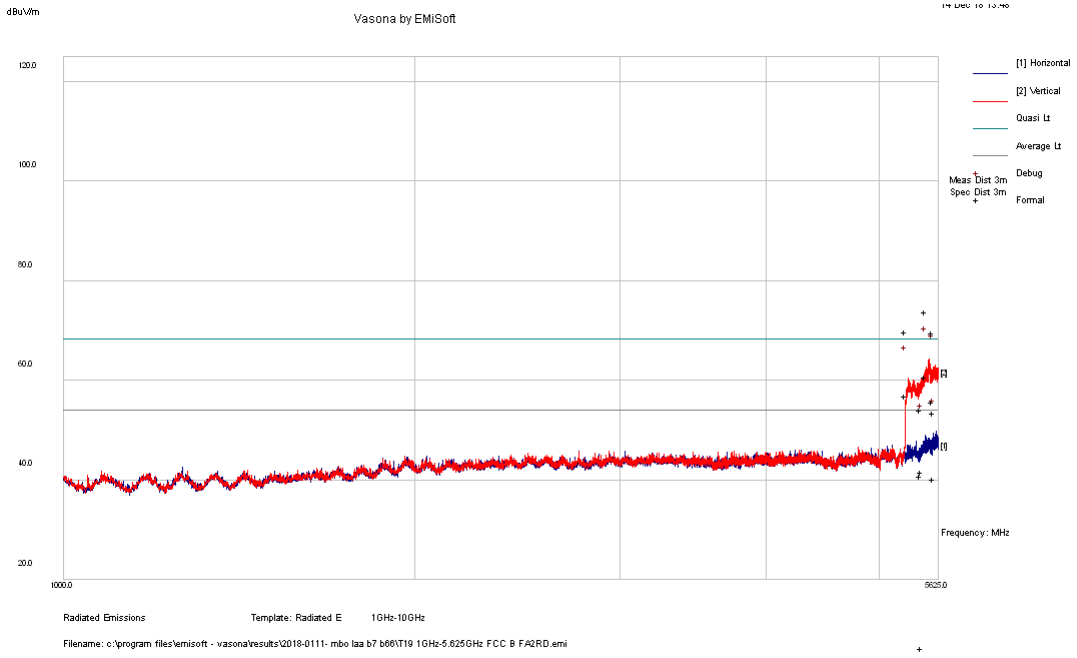



| FORMAL DATA | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Freq. (MHz) | Raw (dBuV) | Cable (dB) | Factor (dB) | Level (dBuV/m) | Emission Type | Pol (H/V) | Ht (cm) | Az (deg) | Limit (dBuV/m) | Margin (dB) | Pass /Fail | Comments |
| 51.499 | 41.27 | 6.47 | -21.9 | 25.86 | Quasi Max | V | 119 | 107 | 40 | -14.14 | Pass | |
| 75.395 | 38.34 | 6.65 | -24.2 | 20.78 | Quasi Max | V | 139 | 269 | 40 | -19.22 | Pass | |
| 54.212 | 34.91 | 6.5 | -22.3 | 19.09 | Quasi Max | V | 118 | 256 | 40 | -20.91 | Pass | |
| 39.95 | 31.86 | 6.4 | -19.9 | 18.32 | Quasi Max | V | 101 | 331 | 40 | -21.68 | Pass | |
| 77.461 | 32.46 | 6.66 | -24.6 | 14.49 | Quasi Max | V | 103 | 85 | 40 | -25.51 | Pass | |
| 62.533 | 30.41 | 6.56 | -23.6 | 13.42 | Quasi Max | V | 107 | 217 | 40 | -26.58 | Pass | |

| PREVIEW DATA | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Freq. (MHz) | Raw (dBuV) | Cable (dB) | Factor (dB) | Level (dBuV/m) | Emission Type | Pol (H/V) | Ht (cm) | Az (deg) | Limit (dBuV/m) | Margin (dB) | Pass /Fail | Comments |
| 51.5471 | 42.69 | 6.47 | -21.9 | 27.27 | Preview | V | 100 | 45 | 40 | -12.73 | Pass | |
| 75.5952 | 43.89 | 6.65 | -24.3 | 26.28 | Preview | V | 100 | 315 | 40 | -13.72 | Pass | |
| 40.004 | 39.01 | 6.4 | -19.9 | 25.47 | Preview | V | 100 | 0 | 40 | -14.53 | Pass | |
| 54.1443 | 38.73 | 6.49 | -22.3 | 22.92 | Preview | V | 100 | 315 | 40 | -17.08 | Pass | |
| 77.519 | 38.47 | 6.66 | -24.7 | 20.49 | Preview | V | 100 | 270 | 40 | -19.51 | Pass | |
| 62.513 | 35.76 | 6.56 | -23.6 | 18.77 | Preview | V | 100 | 180 | 40 | -21.23 | Pass | |
| 119.267 | 35.84 | 6.88 | -20.7 | 22.02 | Preview | V | 100 | 0 | 43.5 | -21.48 | Pass | |
| 199.739 | 31.69 | 7.15 | -18.2 | 20.61 | Preview | H | 290 | 225 | 43.5 | -22.89 | Pass | |

Note: Preview data was measured using a peak detector to identify frequencies of interest for formal measurement. Formal data consist of all frequencies in the preview list within 6 dB of specification limit or the top six frequencies. Failure in preview data does not necessarily constitute failure in formal data.

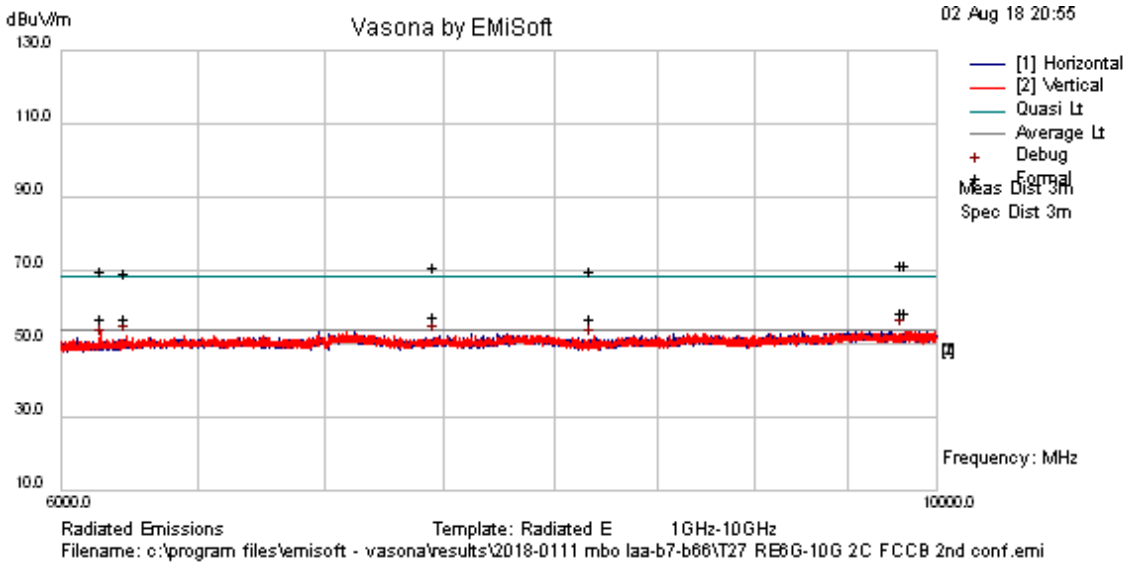
**Figure 4.9.3(a) The Radiated Unwanted Emissions in 30MHz-1GHz for the EUT with Antenna #1 FA2RD in UNII-3, 2x20MHz Carriers at Channel 149 (5745MHz), 153 (5765MHz), Q/16QAM, 23dBm/port, against FCC Part 15.209 and 15.109 Class B Limits at 3m Distance (Preview in PK) (B66 Tx at 2125MH Full Power).**




**FORMAL DATA**

| Freq. (MHz) | Raw (dBuV) | Cable (dB) | Factor (dB) | Level (dBuV/m) | Emission Type | Pol (H/V) | Ht (cm) | Az (deg) | Limit (dBuV/m) | Margin (dB) | Pass /Fail | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 5518.39 | 66.41 | 4.73 | -3.47 | 67.67 | Peak | V | 119 | 209 | 68.2 | -0.53 | Pass | |
| 5300.05 | 62.24 | 5.06 | -3.64 | 63.66 | Peak | V | 167 | 183 | 68.2 | -4.54 | Pass | |
| 5590.21 | 61.85 | 4.88 | -3.41 | 63.32 | Peak | V | 123 | 196 | 68.2 | -4.88 | Pass | |
| 5455.84 | 33.47 | 4.71 | -3.52 | 34.66 | AvgMax | H | 113 | 156 | 54 | -19.34 | Pass | |
| 5474.64 | 47.59 | 4.7 | -3.5 | 48.79 | Peak | H | 119 | 164 | 68.2 | -19.41 | Pass | |
| 5455.84 | 46.74 | 4.71 | -3.52 | 47.93 | Peak | H | 113 | 156 | 68.2 | -20.27 | Pass | |
| 5599.72 | 45.83 | 4.9 | -3.4 | 47.33 | Peak | H | 156 | 195 | 68.2 | -20.87 | Pass | |

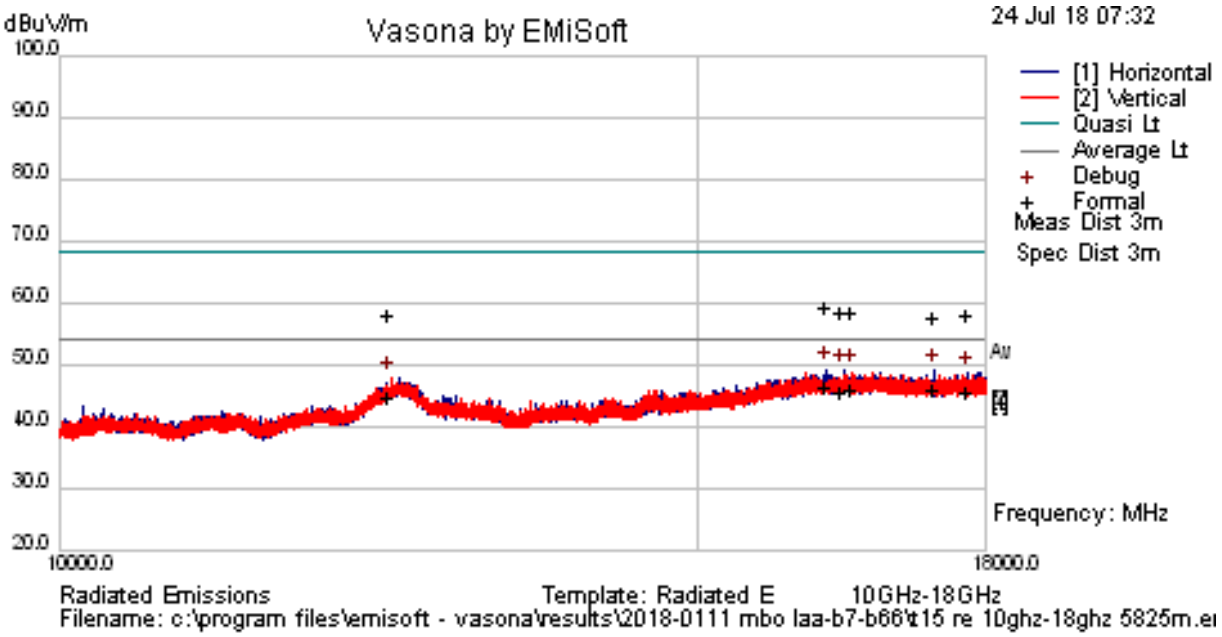
**Figure 4.9.3(b) Radiated Spurious Emissions in 1GHz-5.625GHz for the EUT with Ant #1 FA2RD in UNII-3, 2x20MHz Carriers at Ch 161(5805MHz), 165 (5825MHz), Q/16QAM, 23dBm/pt, against FCC Part 15.407 and 15.209 Limits at 3m Distance (RBW 1MHz) (B66 Tx at 2125MHz Full Power).**




| FORMAL DATA | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Freq. (MHz) | Raw (dBuV) | Cable (dB) | Factor (dB) | Level (dBuV/m) | Emission Type | Pol (H/V) | Ht (cm) | Az (deg) | Limit (dBuV/m) | Margin (dB) | Pass /Fail | Comments |
| 7468.16 | 31.44 | 23.91 | -2.7 | 52.65 | Average | V | 296 | 0 | 54 | -1.35 | Pass | |
| 9830.97 | 44.28 | 24.43 | -2.02 | 66.69 | Peak | H | 391 | 212 | 68.2 | -1.51 | Pass | |
| 9810.26 | 44.28 | 24.43 | -2.04 | 66.67 | Peak | V | 376 | 122 | 68.2 | -1.53 | Pass | |
| 8181.13 | 30.96 | 23.99 | -2.76 | 52.19 | Average | V | 309 | 200 | 54 | -1.81 | Pass | |
| 6234.33 | 31.2 | 23.86 | -2.9 | 52.16 | Average | H | 219 | 236 | 54 | -1.84 | Pass | NA |
| 6148.94 | 30.88 | 23.85 | -2.97 | 51.76 | Average | H | 178 | 64 | 54 | -2.24 | Pass | NA |
| 7468.16 | 44.69 | 23.91 | -2.7 | 65.89 | Peak | V | 296 | 0 | 68.2 | -2.31 | Pass | |
| 6148.94 | 44.28 | 23.85 | -2.97 | 65.17 | Peak | H | 178 | 64 | 68.2 | -3.03 | Pass | |
| 8181.13 | 43.73 | 23.99 | -2.76 | 64.96 | Peak | V | 309 | 200 | 68.2 | -3.24 | Pass | |
| 6234.33 | 43.45 | 23.86 | -2.9 | 64.41 | Peak | H | 219 | 236 | 68.2 | -3.79 | Pass | |

Note: NA = Not Applicable.

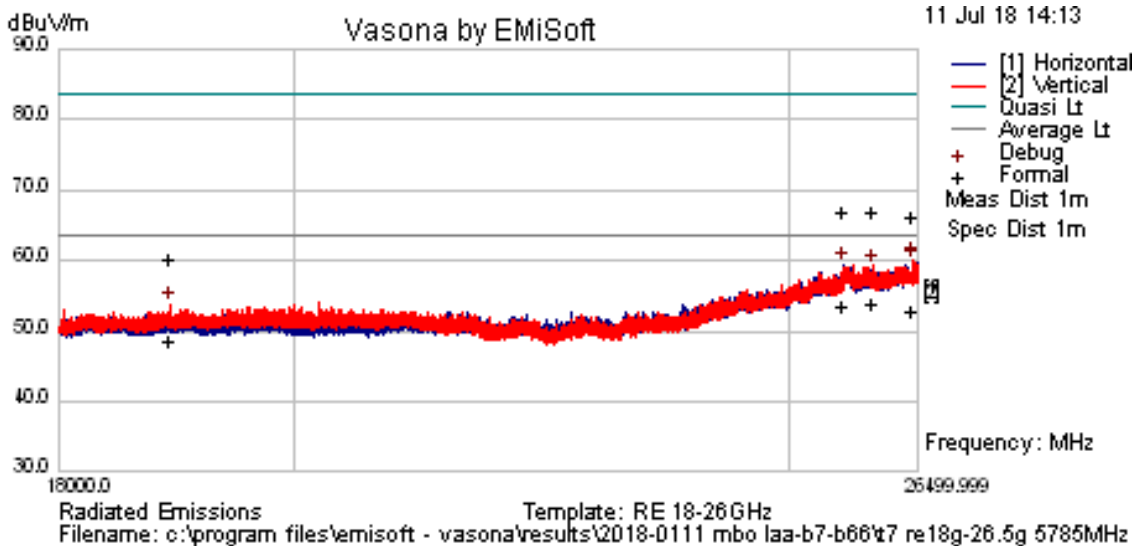
**Figure 4.9.3(c) Radiated Spurious Emissions in 6GHz-10GHz for the EUT with Ant #1 FA2RD in UNII-3, 2x20MHz Carriers at Ch 149(5745MHz), 153 (5765MHz), Q/16QAM, 23dBm/pt, against FCC Part 15.407 and 15.209 Limits at 3m Distance (RBW 1MHz) (B66 Tx at 2125MHz Full Power).**




**FORMAL DATA**

| Freq. (MHz) | Raw (dBuV) | Cable (dB) | Factor (dB) | Level (dBuV/m) | Emission Type | Pol (H/V) | Ht (cm) | Az (deg) | Limit (dBuV/m) | Margin (dB) | Pass /Fail | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 17786.3 | 28.19 | 9.83 | 4.57 | 42.58 | Average | H | 202 | 154 | 54 | -11.42 | Pass | |
| 16276.4 | 42.71 | 10.56 | 3.27 | 56.54 | Peak | H | 348 | 273 | 68.2 | -11.66 | Pass | |
| 12329.7 | 32.63 | 8.19 | 0.78 | 41.61 | Average | V | 265 | 22 | 54 | -12.39 | Pass | |
| 16438.4 | 41.62 | 10.47 | 3.69 | 55.77 | Peak | H | 390 | 30 | 68.2 | -12.43 | Pass | |
| 16536.5 | 41.36 | 10.41 | 3.92 | 55.68 | Peak | V | 214 | 259 | 68.2 | -12.52 | Pass | |
| 12329.7 | 46.15 | 8.19 | 0.78 | 55.13 | Peak | V | 265 | 22 | 68.2 | -13.07 | Pass | |
| 17786.3 | 40.68 | 9.83 | 4.57 | 55.08 | Peak | H | 202 | 154 | 68.2 | -13.12 | Pass | |
| 17412.6 | 40.4 | 9.98 | 4.52 | 54.9 | Peak | H | 304 | 306 | 68.2 | -13.3 | Pass | |

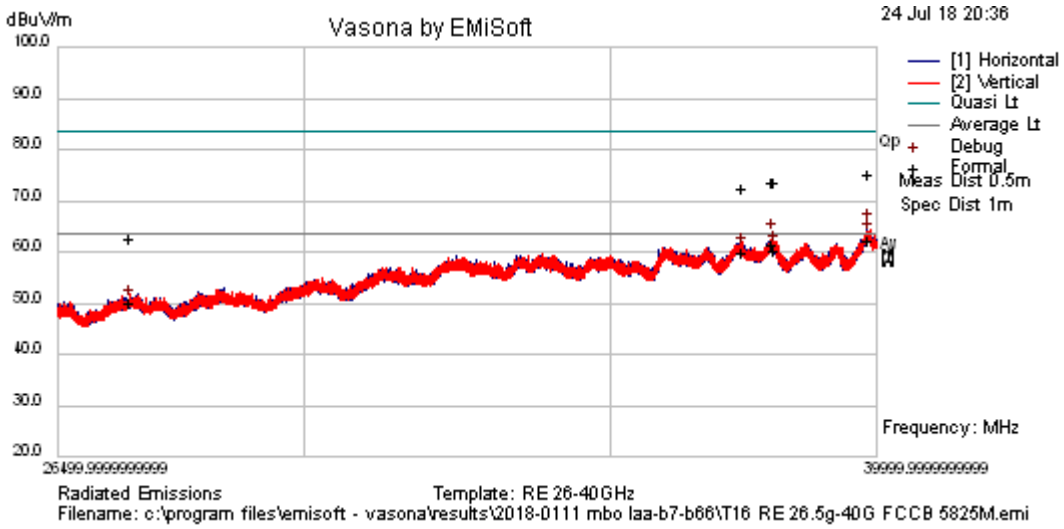
**Figure 4.9.3(d) Radiated Spurious Emissions in 10GHz-18GHz for the EUT with Ant #1 FA2RD in UNII-3, 1x20MHz Carrier at Ch 165(5825MHz), Q/16QAM, 23dBm/pt, against FCC Part 15.407 and 15.209 Limits at 3m Distance (RBW 1MHz, Preview 30kHz) (B7&B66 Tx at 2627.5MHz 2125MHz Full Power).**




**FORMAL DATA**

| Freq. (MHz) | Raw (dBuV) | Cable (dB) | Factor (dB) | Level (dBuV/m) | Emission Type | Pol (H/V) | Ht (cm) | Az (deg) | Limit (dBuV/m) | Margin (dB) | Pass /Fail | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 18925.2 | 28.99 | 9.13 | 8.71 | 46.83 | Average | V | 142 | 133 | 63.5 | -16.67 | Pass | |
| 25964.4 | 42.89 | 11.18 | 10.93 | 65 | Peak | V | 145 | 193 | 77.7 | -12.7 | Pass | |
| 25964.3 | 42.89 | 11.18 | 10.93 | 65 | Peak | V | 113 | 321 | 77.7 | -12.7 | Pass | |
| 25625.2 | 43.3 | 11.06 | 10.62 | 64.98 | Peak | H | 101 | 324 | 77.7 | -12.72 | Pass | |
| 26443.3 | 40.87 | 11.35 | 12.19 | 64.41 | Peak | V | 132 | 82 | 77.7 | -13.29 | Pass | |
| 26433.5 | 40.73 | 11.35 | 12.17 | 64.24 | Peak | V | 200 | 223 | 77.7 | -13.46 | Pass | |
| 18925.2 | 40.32 | 9.13 | 8.71 | 58.16 | Peak | V | 142 | 133 | 77.7 | -19.54 | Pass | |

**Figure 4.9.3(e) Radiated Spurious Emissions in 18GHz-26.5GHz for the EUT with Ant #1 FA2RD in UNII-3, 1x20MHz Carrier at Ch 157(5785MHz), Q/16QAM, 23dBm/pt, against FCC Part 15.407 and 15.209 Limits at 1m Distance (RBW 1MHz, Preview 100kHz) (B7&B66 Tx at 2627.5MHz 2125MHz Full Power).**




**FORMAL DATA**

| Freq. (MHz) | Raw (dBuV) | Cable (dB) | Factor (dB) | Level (dBuV/m) | Emission Type | Pol (H/V) | Ht (cm) | Az (deg) | Limit (dBuV/m) | Margin (dB) | Pass /Fail | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 39874.7 | 36.96 | 0 | 22.15 | 59.11 | Average | V | 137 | 216 | 63.5 | -4.39 | Pass | |
| 39876.7 | 36.92 | 0 | 22.15 | 59.07 | Average | H | 141 | 32 | 63.5 | -4.43 | Pass | |
| 37972.6 | 36.41 | 0 | 22.09 | 58.5 | Average | H | 177 | 143 | 63.5 | -5 | Pass | |
| 38009.1 | 35.12 | 0 | 22.07 | 57.19 | Average | H | 110 | 75 | 63.5 | -6.31 | Pass | |
| 37403.6 | 34.51 | 0 | 22.42 | 56.93 | Average | V | 160 | 119 | 63.5 | -6.57 | Pass | |
| 39874.7 | 50 | 0 | 22.15 | 72.15 | Peak | V | 137 | 216 | 77.7 | -5.55 | Pass | |
| 39876.7 | 49.88 | 0 | 22.15 | 72.03 | Peak | H | 141 | 32 | 77.7 | -5.67 | Pass | |
| 37972.6 | 48.46 | 0 | 22.09 | 70.56 | Peak | H | 177 | 143 | 77.7 | -7.14 | Pass | |
| 38009.1 | 48.46 | 0 | 22.07 | 70.53 | Peak | H | 110 | 75 | 77.7 | -7.17 | Pass | |
| 37403.6 | 47.06 | 0 | 22.42 | 69.48 | Peak | V | 160 | 119 | 77.7 | -8.22 | Pass | |
| 27506.1 | 33.32 | 0 | 13.89 | 47.2 | Average | V | 132 | 53 | 77.7 | -10.5 | Pass | |
| 27506.1 | 45.88 | 0 | 13.89 | 59.76 | Peak | V | 132 | 53 | 77.7 | -17.94 | Pass | |

**Figure 4.9.3(f) Radiated Spurious Emissions in 26.5GHz-40GHz for the EUT with Ant #1 FA2RD in UNII-3, 1x20MHz Carrier at Ch 165(5825MHz), Q/16QAM, 23dBm/pt, against FCC Part 15.407 and 15.209 Limits at 1m Distance (RBW 1MHz) (B7&B66 Tx at 2627.5MHz 2125MHz Full Power).**

# 4.10 MEASUREMENT REQUIRED: AC POWER LINE CONDUCTED EMISSIONS – FCC SECTIONS 15.407(b)(6) & 15.207

The FCC requirements specified in 15.407(b)(6) are provided in Section 4.1, where FCC states that any U-NII devices using an AC power line are required to comply with the conducted limits set forth in 15.207.

FCC 15.207(a) stated that for an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies, within the band 150 kHz to 30 MHz, shall not exceed the limits in the following table, as measured using a 50 μH/50 ohms line impedance stabilization network (LISN). Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower limit applies at the boundary between the frequency ranges.

FCC 15.207(c) states that measurements to demonstrate compliance with the conducted limits are not required for devices which only employ battery power for operation and which do not operate from the AC power lines or contain provisions for operation while connected to the AC power lines. Devices that include, or make provisions for, the use of battery chargers which permit operating while charging, AC adapters or battery eliminators or that connect to the AC power lines indirectly, obtaining their power through another device which is connected to the AC power lines, shall be tested to demonstrate compliance with the conducted limits.

The limits are given in Table 4.10.1.

**Table 4.10.1. FCC 15.107 and 15.207 AC Power Line Conducted Emissions Limits**

| Frequency (MHz) | 15.207 (dBμV) | | 15.107 Class B (dBμV) | | RBW |
|---|---|---|---|---|---|
| | Quasi-Peak | Average | Quasi-Peak | Average | |
| 0.15 – 0.5 | 66 – 56* | 56 – 46* | 66 – 56* | 56 – 46* | 9 kHz |
| 0.5 – 5.0 | 56 | 46 | 56 | 46 | |
| 5.0 – 30.0 | 60 | 50 | 60 | 50 | |

*Decreases with the logarithm of the frequency.

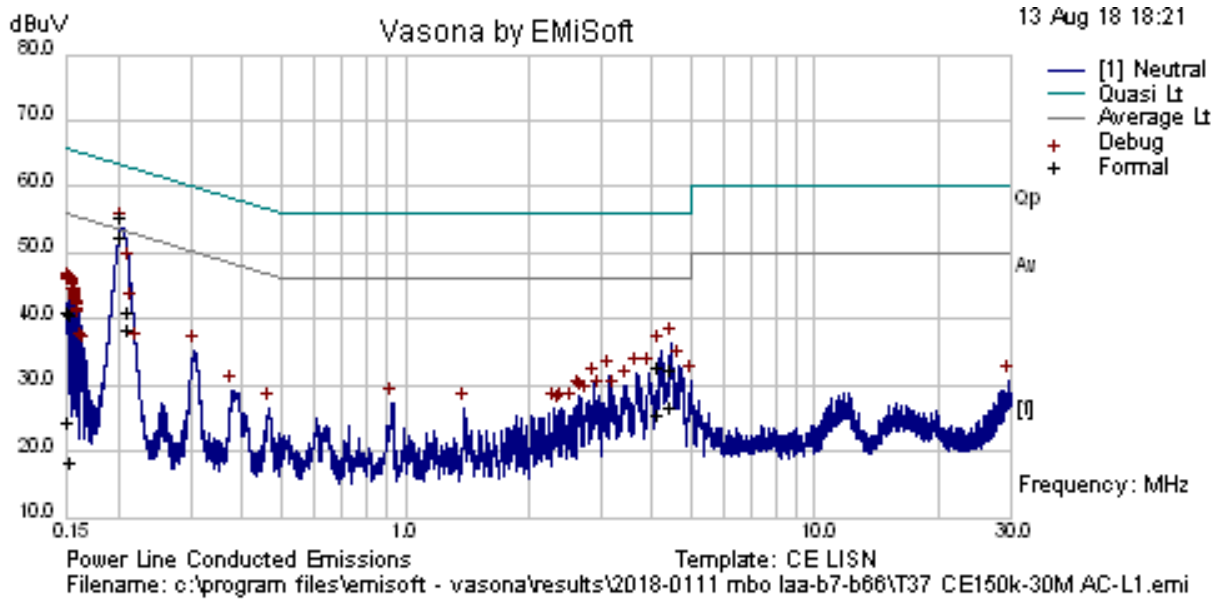
The AC power line conducted emissions of the MBO LAA were evaluated with one UNII-3 20MHz 64QAM carrier transmitting at 5825MHz at the maximum power level, 27dBm, at both ports. The MBO LAA was co-located with MBO B7 FW2HMBOM1 and B66 FW2IMBOM1 RF modules transmitting at 2125MHz (37dBm at each of its two ports) and 2627.5MHz (37dBm at each of its two ports), respectively.

The recommendations of ANSI C63.10 were followed for EUT testing setup and cabling. The test setup photo is given in Section 5.

The conducted emissions were measured at both AC power leads. The AC power line conducted emissions measured in the frequency spectrum 150kHz to 30MHz were all below 15.207 limits with the minimum margin of 4.46dB at 194kHz. The plots are provided in Figures 4.10.1 – 4.10.2.

The FCC 15.107 Class B limits are identical to the 15.207 limits. The AC power line conducted emissions of the EUT are below FCC 15.207 and FCC 15.107 Class B limits and in full compliance with the Rules of the

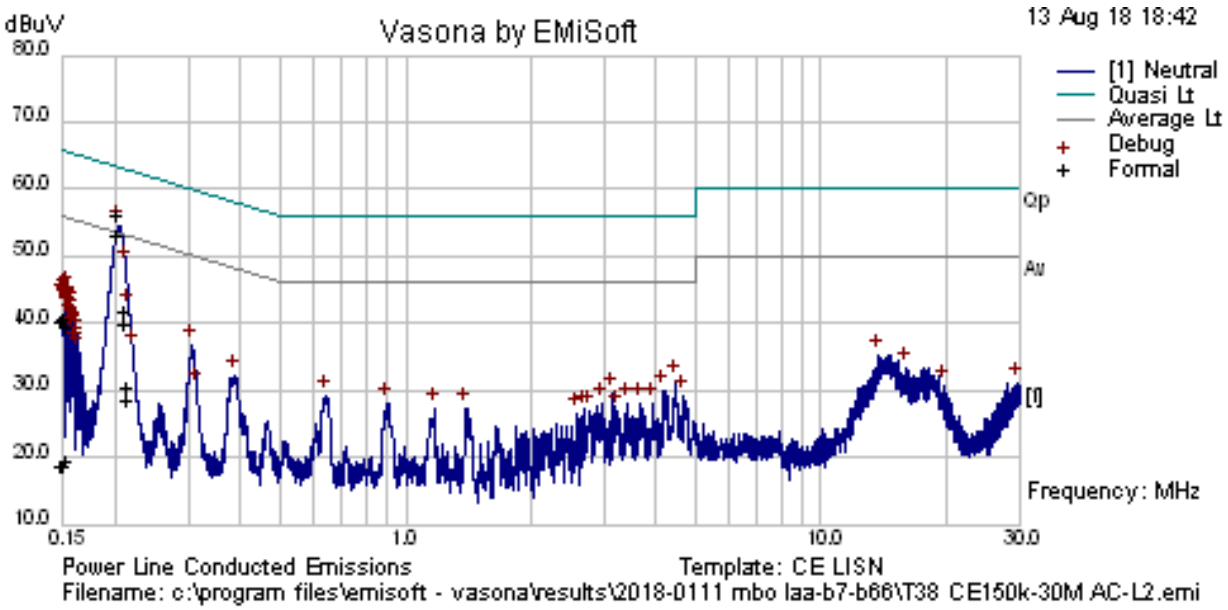
Commission. Therefore, the EUT is in compliance with 15.207 requirements for intentional radiators and the 15.107 Class B requirements for unintentional radiators.




**FORMAL DATA**

| Freq. (MHz) | Raw (dBuV) | Cable (dB) | Factor (dB) | Level (dBuV) | Emission Type | Line | Limit (dBuV) | Margin (dB) | Pass /Fail | Comments |
|---|---|---|---|---|---|---|---|---|---|---|
| 0.205 | 39.81 | 9.93 | 0.05 | 49.79 | Average | L1 | 53.41 | -3.61 | Pass | |
| 0.205 | 42.9 | 9.93 | 0.05 | 52.88 | Quasi Peak | L1 | 63.41 | -10.53 | Pass | |
| 0.21174 | 26.08 | 9.93 | 0.05 | 36.06 | Average | L1 | 53.14 | -17.08 | Pass | |
| 4.475 | 14.17 | 10 | 0.06 | 24.23 | Average | L1 | 46 | -21.77 | Pass | |
| 4.183 | 13.23 | 10 | 0.06 | 23.29 | Average | L1 | 46 | -22.71 | Pass | |
| 0.21174 | 28.62 | 9.93 | 0.05 | 38.61 | Quasi Peak | L1 | 63.14 | -24.53 | Pass | |
| 4.183 | 20.14 | 10 | 0.06 | 30.2 | Quasi Peak | L1 | 56 | -25.8 | Pass | |
| 4.475 | 19.85 | 10 | 0.06 | 29.91 | Quasi Peak | L1 | 56 | -26.09 | Pass | |
| 0.15148 | 28.57 | 9.92 | 0.07 | 38.56 | Quasi Peak | L1 | 65.92 | -27.36 | Pass | |
| 0.15477 | 28.07 | 9.92 | 0.07 | 38.06 | Quasi Peak | L1 | 65.74 | -27.68 | Pass | |
| 0.15148 | 12.16 | 9.92 | 0.07 | 22.15 | Average | L1 | 55.92 | -33.77 | Pass | |
| 0.15477 | 6.03 | 9.92 | 0.07 | 16.02 | Average | L1 | 55.74 | -39.72 | Pass | |

**Figure 4.10.1 Conducted Emissions on AC Main Power Lead L1.**



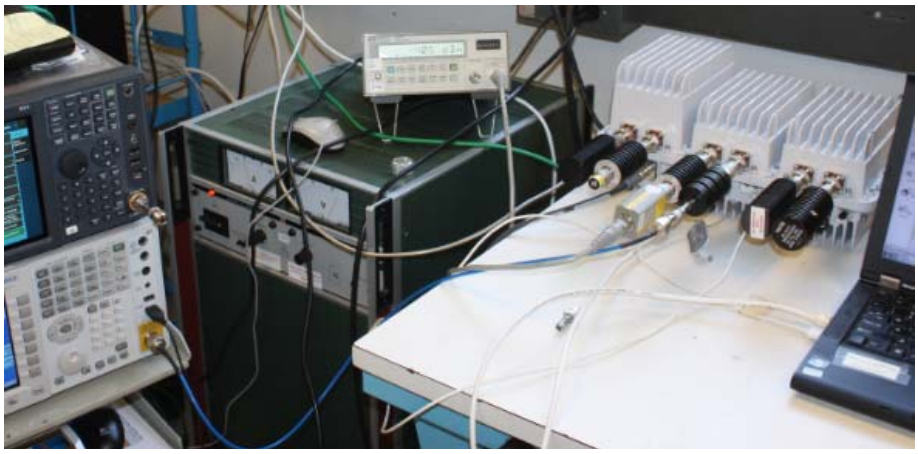

**FORMAL DATA**

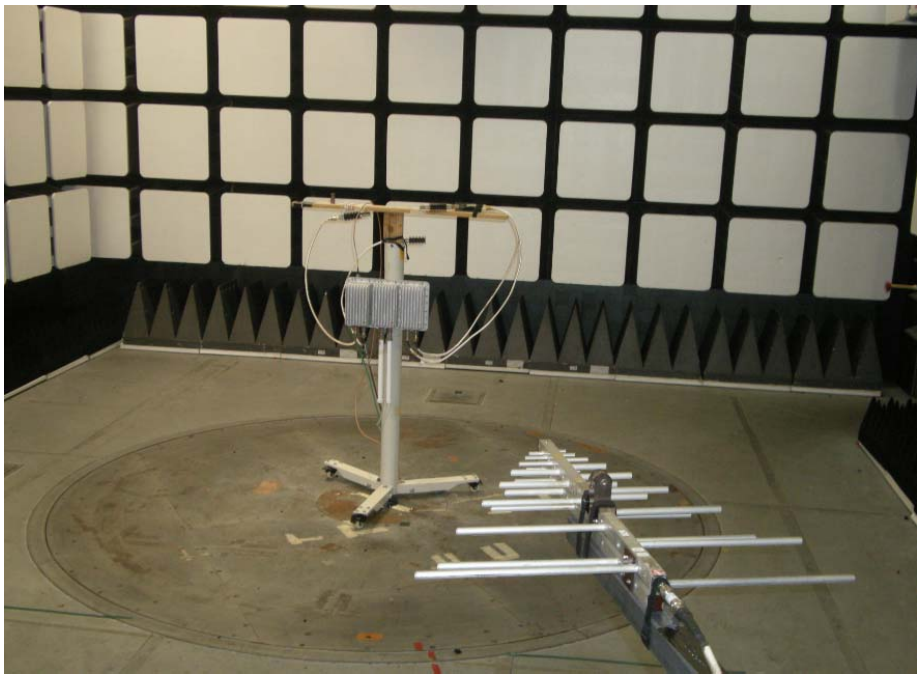
| Freq. (MHz) | Raw (dBuV) | Cable (dB) | Factor (dB) | Level (dBuV) | Emission Type | Line | Limit (dBuV) | Margin (dB) | Pass /Fail | Comments |
|---|---|---|---|---|---|---|---|---|---|---|
| 0.204 | 40.72 | 9.93 | 0.05 | 50.7 | Average | L2 | 53.45 | -2.74 | Pass | |
| 0.204 | 43.72 | 9.93 | 0.05 | 53.7 | Quasi Peak | L2 | 63.45 | -9.75 | Pass | |
| 0.21158 | 27.36 | 9.93 | 0.05 | 37.34 | Average | L2 | 53.14 | -15.8 | Pass | |
| 0.21158 | 29.49 | 9.93 | 0.05 | 39.47 | Quasi Peak | L2 | 63.14 | -23.67 | Pass | |
| 0.21583 | 16.02 | 9.93 | 0.05 | 26 | Average | L2 | 52.98 | -26.98 | Pass | |
| 0.15259 | 28.41 | 9.92 | 0.07 | 38.39 | Quasi Peak | L2 | 65.86 | -27.46 | Pass | |
| 0.15044 | 27.9 | 9.92 | 0.07 | 37.89 | Quasi Peak | L2 | 65.98 | -28.09 | Pass | |
| 0.15325 | 27.17 | 9.92 | 0.07 | 37.16 | Quasi Peak | L2 | 65.82 | -28.67 | Pass | |
| 0.21583 | 18.06 | 9.93 | 0.05 | 28.04 | Quasi Peak | L2 | 62.98 | -34.94 | Pass | |
| 0.15325 | 6.9 | 9.92 | 0.07 | 16.89 | Average | L2 | 55.82 | -38.94 | Pass | |
| 0.15259 | 6.48 | 9.92 | 0.07 | 16.46 | Average | L2 | 55.86 | -39.4 | Pass | |
| 0.15044 | 6.48 | 9.92 | 0.07 | 16.46 | Average | L2 | 55.98 | -39.51 | Pass | |

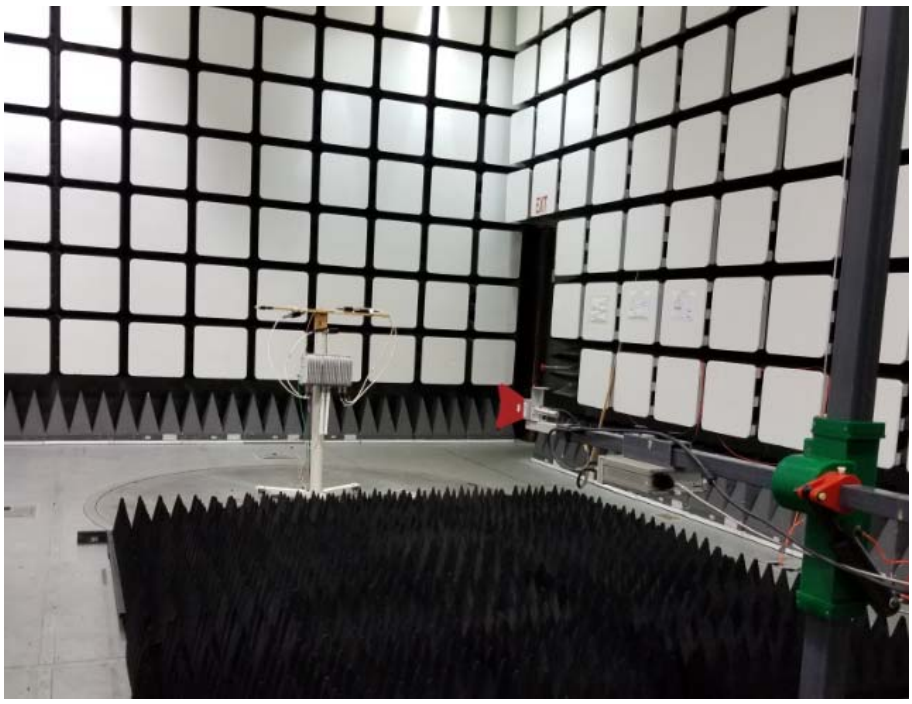
**Figure 4.10.2 Conducted Emissions on AC Main Lead L2**

# 5. PHOTOGRAPHS OF EUT SETUP

The setup photos of the conducted and radiated emissions tests, including AC power line test, were provided below.








NOKIA

# 6. LIST OF TEST EQUIPMENT

**Table 6.1 List of Test Equipment Used**

| Equipment | Manufacturer | Model | Serial # | LastCal Date | Cal Due Date |
|---|---|---|---|---|---|
| MXA Signal Analyzer (20Hz-26.5GHz) | Agilent | N9020A | MY53420147 | 2017-03-13 | 2019-03-13 |
| MXA Signal Analyzer (20Hz-26.5GHz) | Agilent | N9020B | MY57430927 | 2018-04-25 | 2020-04-25 |
| 7dB Attenuator, DC - 2 GHz | JFW | 50F-007 | N/A | N/A | N/A |
| 3 dB Attenuator DC - 4 GHz, 2W | Macom | 2082-6171-03 | N/A | N/A | N/A |
| 20 dB Attenuator DC - 3 GHz, 2 W | Pasternack | PE7001-20 | N/A | N/A | N/A |
| 10 dB Attenuator (DC – 40 GHz, 20W) | Fairview Microwave | SA4023-10 | N/A | N/A | N/A |
| RF Power Meter | Hewlett Packard | 437B | 3125U21137 | 2016-12-15 | 2018-12-15 |
| Power Sensor (0.01-18 GHz) | Hewlett Packard | 8481A | US37294629 | 2017-05-26 | 2019-05-26 |
| EMC Receiver (20Hz to 40 GHz) | Rohde & Schwarz | ESIB-40 | 100119 | 2017-10-30 | 2019-10-30 |
| EMC Receiver (20Hz - 40GHz) | Rohde & Schwarz | ESU40 | 100246 | 2018-09-11 | 2020-09-11 |
| EMC Receiver (20Hz - 40GHz) | Rohde & Schwarz | ESI | 832692/005 | 2018-03-19 | 2020-03-19 |
| LAA Notch Filter (50dB,20W) | Fingu | E1365 | B6171300036 | N/A | N/A |
| 6 dB Attenuator | Weinschel | 2-6 | CD2518 | 2017-05-01 | 2019-05-01 |
| 6 dB Attenuator | Weinschel | 2-6 | CD2534 | 2017-05-23 | 2019-05-23 |
| 6 dB Attenuator | Weinschel | 2-6 | CD2545 | 2017-03-03 | 2019-03-03 |
| Preamplifier (1-26.5 GHz, 30dB) | Hewlett Packard | 8449B | 3008A01384 | 2018-04-10 | 2020-04-10 |
| Amplifier (9kHz-1GHz) | Sonoma Instrument | 310N | 185785 | 2018-01-09 | 2020-01-09 |
| Double-Ridged Horn (1-18 GHz) | ETS Lindgren | 3117 | 00135198 | 2017-06-09 | 2019-06-09 |
| Double-Ridged Horn (18-40 GHz) | EMC Test Systems | 3116 | 2539 | 2017-06-16 | 2019-06-16 |
| Ridged Horn (26.5-40GHz) | A.H. Systems | SAS-200/573 | 137 | 2017-10-04 | 2019-10-04 |
| Log Periodic Antenna (0.2-1GHz) | EMCO | 3146 | 2082 | 2017-05-24 | 2019-05-24 |
| Biconical Antenna | EMCO | 3109 | 2187 | 2016-12-01 | 2019-01-01 |
| High Pass Filter (5-40GHz) | RLC Electronics Inc | F-19414 | 1444001 | N/A | N/A |
| High Pass Filter (5-40GHz) | RLC Electronics | F-19414 | 1444002 | N/A | N/A |

| | | | | | |
|---|---|---|---|---|---|
| Transient Limiter (9KHz-200MHz) | Agilent | 11947A | 3107A02947 | 2018-10-29 | 2020-10-29 |
| EMI Test Receiver (20Hz to 40 GHz) + 30dBm | Rohde & Schwarz | ESIB40 | 100119 | 2017-11-06 | 2019-11-06 |
| Micro-Ohmmeter | Extech | 380460 | H273544 | 2017-05-16 | 2019-05-16 |
| Multi-Meter (True RMS) | Fluke | 16 | 71520011 | 2017-03-07 | 2019-03-07 |
| LISN 50µH 0.25 µF | Solar Electronics | 9348-50-R-24-BNC | 018809 | 2017-05-22 | 2019-05-22 |
| MXA Signal Analyzer (20Hz-26.5GHz) | Agilent | N9020A | MY48011791 | 2017-02-23 | 2019-02-23 |
| Digital Power Meter | Yokogawa | WT210 | 91HA24429 | 2017-02-24 | 2019-02-24 |
| Thermal Logger | Yokogawa | MV200S | S5PB04190 | 2017-02-23 | 2019-02-23 |
| GPS Receiver | Symmetric | OM 58503B | KR93200773 | N/A | N/A |
| Power Supply | Behlman | BL1350 | 04243 | N/A | N/A |
| Multi-Device Controller | ETS Lindgren | 2090 | 0004-1507 | N/A | N/A |
| RF Cable | Micro-Coax Utiflex | 142A 503609-G | 00000387 | N/A | N/A |
| RF Cables (36", 72" & 278" Long) | Megaphase | D230-N1-N1 | 004 | N/A | N/A |
| RF Cables (36", 72" & 278" Long) | Megaphase | D230-N1-N1 | 1003 | N/A | N/A |
| RF Cables (36", 72" & 278" Long) | Megaphase | D230-N1-N1 | 002 | N/A | N/A |

# 7. TEST FACILITIES

All measurement facilities used to collect the measurement data under normal condition are located at 600-700 Mountain Avenue, Murray Hill, New Jersey 07974-0636 USA. The field strength measurements of radiated spurious emissions are made in FCC and IC registered semi-anechoic chambers AR4, AR7 and AR9 (FCC Site Registration Numbers: 439234, 995653 & 896745, IC Filing Numbers: 6933F-4, 6933F-7 & 6933F-9). The sites were constructed and are continuously in conformance with the requirements of ANSI C63.4 and CISPR Publication 32.

Nokia Global Product Compliance Laboratory is accredited with the US Department of Commerce National Institute of Standards and Technology's National Voluntary Laboratory Accreditation Program (NVLAP) for satisfactory compliance with criteria established in Title 15, Part 7 Code of Federal Regulations for offering test services for selected test methods in Electromagnetic Compatibility; Voluntary Control Council for Interference (VCCI), Japan; Australian Communications and Media Authority (ACMA). The laboratory is ISO 9001:2008 Certified.

United States Department of Commerce
National Institute of Standards and Technology

NVLAP®

Certificate of Accreditation to ISO/IEC 17025:2005

NVLAP LAB CODE: 100275-0

Nokia, Global Product Compliance Lab
Murray Hill, NJ

*is accredited by the National Voluntary Laboratory Accreditation Program for specific services, listed on the Scope of Accreditation, for:*

Electromagnetic Compatibility & Telecommunications

*This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2005. This accreditation demonstrates technical competence for a defined scope and the operation of a laboratory quality management system (refer to joint ISO-ILAC-IAF Communique dated January 2009).*

2018-09-05 through 2019-09-30
*Effective Dates*

*For the National Voluntary Laboratory Accreditation Program*

# 8. REFERENCES

[1]. Title 47 Code of Federal Regulations (CFR) Parts 2 and 15.

[2]. ANSI C63.10, American Nation Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices, 2013.

[3]. FCC KDB 789033 D02, Guidelines for Compliance Testing of Unlicensed National Information Infrastructure (U-NII) Devices (Part 15, Subpart E), December 2017, v02r01.

[4]. FCC KDB 662911D01, Emissions Testing of Transmitters with Multiple Outputs in the Same Band, October 2013, v02r01.

[5]. FCC KDB 353028 D01, Basic Equipment Authorization Guidance for Antennas Used with Part 15 Intentional Radiators, April 2017, v01.