

Becton Dickinson and Company

TEST REPORT

SCOPE OF WORK
EMC TESTING – WC

REPORT NUMBER
103511832BOX-012b

ISSUE DATE **[REVISED DATE]**
23-08-2018

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DOCUMENT CONTROL NUMBER
Non-Specific Radio Report Shell Rev. December 2017
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EMISSIONS TEST REPORT

(FULL COMPLIANCE)

Report Number: 103511832BOX-012b

Project Number: G103511832

Report Issue Date: 08/23/2018

Model(s) Tested: WC

Model(s) Partially Tested: None

Model(s) Not Tested but declared equivalent by the client: None

Standards: CFR47 FCC Part 15.247 Subpart C: 06/2018,
CFR47 FCC Part 15 Subpart B: 06/2018,
RSS-247 Issue 2 February 2017,
ICES-003 Issue 6 Published: January 2016 Updated: April 2017,
RSS-Gen Issue 5 April 2018,
RSS-102 Issue 5 March 2015

Tested by:
Intertek Testing Services NA, Inc.
70 Codman Hill Road
Boxborough, MA 01719
USA

Client:
Becton Dickinson and Company
200 Bulfinch Drive
Andover, MA 01810
USA

Report prepared by



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Table of Contents

1 Introduction and Conclusion 4

2 Test Summary 4

3 Client Information 5

4 Description of Equipment Under Test and Variant Models 5

5 System Setup and Method 7

6 Maximum Peak Output Power and Human RF exposure 8

7 6 dB Bandwidth and Occupied Bandwidth 26

8 Maximum Power Spectral Density..... 40

9 Band Edge Compliance..... 52

10 Transmitter spurious emissions..... 64

11 Digital Device and Receiver Radiated Spurious Emissions..... 95

12 Revision History 102

1 Introduction and Conclusion

The tests indicated in section 2.0 were performed on the product constructed as described in section 4.0. The remaining test sections are the verbatim text from the actual data sheets used during the investigation. These test sections include the test name, the specified test Method, a list of the actual Test Equipment Used, documentation Photos, Results and raw Data. No additions, deviations, or exclusions have been made from the standard(s) unless specifically noted.

Based on the results of our investigation, we have concluded the product tested **complies** with the requirements of the standard(s) indicated. The results obtained in this test report pertain only to the item(s) tested. Intertek does not make any claims of compliance for samples or variants which were not tested.

2 Test Summary

| Section | Test full name | Result |
|---------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------|
| 3 | Client Information | -- |
| 4 | Description of Equipment Under Test and Variant Models | -- |
| 5 | System Setup and Method | -- |
| 6 | Maximum Peak Output Power and Human RF exposure CFR47 FCC Part 15 Subpart C:06/2018, Section 15.247 (b)(3) RSS-247 Issue 2 February 2017, RSS-102 Issue 5 March 2015 | Pass |
| 7 | 6 dB Bandwidth and Occupied Bandwidth CFR47 FCC Part 15 Subpart C: 06/2018, Section 15.247 (a)(2) RSS-247 Issue 2 February 2017 | Pass |
| 8 | Maximum Power Spectral Density CFR47 FCC Part 15 Subpart C: 02/2018, Section 15.247 (e) RSS-247 Issue 2 February 2017 | Pass |
| 9 | Band Edge Compliance CFR47 FCC Part 15 Subpart C: 06/2018, Section 15.247 (d) RSS-247 Issue 2: 02/2017) | Pass |
| 10 | Transmitter spurious emissions CFR47 FCC Part 15 Subpart C: 02/2018, Section 15.247 (d) RSS-247 Issue 2 February 2017 | Pass |
| 11 | Digital Device and Receiver Radiated Spurious Emissions (CFR47 FCC Part 15 Subpart B 15.109: 06/2018, ICES-003 Issue 6 Published: January 2016 Updated: April 2017 | Pass |
| -- | AC Mains Conducted Emissions FCC 47CFR Part 15.107: 06/2018 ICES-003 Issue 6 Published: January 2016 Updated: April 2017 | N/A* |
| 12 | Revision History | -- |

Notes: Not applicable as the EUT powers from internal battery with no connection to AC mains.

3 Client Information

This EUT was tested at the request of:

Client: Becton Dickinson and Company
 200 Bulfinch Drive
 Andover, MA 01810
 USA

Contact: Mr. Renold Rodrigues
Telephone: 1.978.901.7294
Fax: None provided
Email: renold.rodrigues@bd.com

4 Description of Equipment Under Test and Variant Models

Manufacturer: Becton Dickinson and Company
 200 Bulfinch Drive
 Andover, MA 01810
 USA


| Equipment Under Test | | | |
|----------------------|------------------------------|--------------|---------------------------------------------------|
| Description | Manufacturer | Model Number | Serial Number |
| Wireless Controller | Becton Dickinson and Company | WC | EWO-01671-LOT 02 (Reprogrammed with P15_11310) |
| Wireless Controller | Becton Dickinson and Company | WC | EWO-01626-Lot 2 Serial # 027(W/RF CABLE) |

| | |
|----------------------------|------------|
| Receive Date: | 07/17/2018 |
| Received Condition: | Good |
| Type: | Production |


Description of Equipment Under Test (provided by client)

The BD Swatch Insulin Delivery System (Swatch) is intended for the continuous subcutaneous delivery of insulin, at set and variable rates, for the management of Type 2 diabetes mellitus in patients requiring insulin. Swatch delivers insulin to the fat under the skin for up to 3 days. Unlike injections, insulin given in this way is similar to how your pancreas delivers insulin normally. A small dose of insulin is delivered throughout the day, while also allowing you to easily and discreetly give yourself more insulin when needed before meals. You will work with your Healthcare Provider (HCP) to adjust the insulin doses to meet your specific needs. Swatch has **2** main components: • The Insulin Delivery Device (IDD), which delivers insulin. • The wireless Remote, which can program the IDD. The IDD can be worn on the body for up to three days. It is designed to be worn during all your activities. The IDD precisely pumps insulin from its internal reservoir once filled.

Insulin Delivery Device (IDD)



wireless Remote



| Equipment Under Test Power Configuration | | | |
|------------------------------------------|---------------|-----------------|------------------|
| Rated Voltage | Rated Current | Rated Frequency | Number of Phases |
| Battery 3V (IDD) | N/A | N/A | N/A |

Operating modes of the EUT:

| No. | Descriptions of EUT Exercising |
|-----|-----------------------------------------------------------|
| 1 | Pre-programmed to transmit at Low, Mid, and High channels |

Software used by the EUT:

| No. | Descriptions of EUT Exercising |
|-----|--------------------------------------------------------------------------|
| 1 | Pre-programmed using Hyper Terminal |
| 2 | Special Software referenced in section equipment under test for EMC test |

| Radio/Receiver Characteristics | |
|----------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------|
| Frequency Band(s) | 2402-2480 MHz |
| Modulation Type(s) | GFSK |
| Maximum Output Power | Low Channel (2402 MHz): -0.1 dBm Mid Channel (2442 MHz): -0.1 dBm High Channel (2480 MHz): +0.4 dBm |
| Test Channels | Low Channel (2402 MHz) Mid Channel (2442 MHz) High Channel (2480 MHz) |
| Occupied Bandwidth | Low Channel (2402 MHz): 1.327 MHz Mid Channel (2442 MHz): 1.485 MHz High Channel (2480 MHz): 1.584 MHz |
| Frequency Hopper: Number of Hopping Channels | N/A |
| Frequency Hopper: Channel Dwell Time | N/A |
| Frequency Hopper: Max interval between two instances of use of the same channel | N/A |
| MIMO Information (# of Transmit and Receive antenna ports) | 1 |
| Equipment Type | Standalone |
| ETSI LBT/Adaptivity | Non-Adaptive |
| ETSI Adaptivity Type | N/A |
| ETSI Temperature Category (I, II, III) | N/A |
| ETSI Receiver Category (1, 2, 3) | 3 |
| Antenna Type and Gain | Integrated, -7.8 dBi |

Variant Models:

The following variant models were not tested as part of this evaluation, but have been identified by the manufacturer as being electrically identical models, depopulated models, or with reasonable similarity to the model(s) tested. Intertek does not make any claims of compliance for samples or variants which were not tested.

None

5 System Setup and Method

| Cables | | | | | |
|--------|-------------|------------|-----------|----------|-------------|
| ID | Description | Length (m) | Shielding | Ferrites | Termination |
| -- | None | -- | -- | -- | -- |

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

5.1 Method:

Configuration as required by Configuration as required by FCC Part 15 Subpart C 15.247: 02/2018, FCC Part 15 Subpart B: 02/2018, RSS 247 Issue 2: 02/2017, ICES 003 Issue 6: 01/2016 updated 06/2016, ANSI C 63.10: 2013 and ANSI C 63.4: 2014.

5.2 EUT Block Diagram:



6 Maximum Peak Output Power and Human RF exposure

6.1 Method

Tests are performed in accordance with CFR47 FCC Part 15.247, RSS-247, RSS-102, and ANSI C63.10.

TEST SITE: EMC Lab

The EMC Lab has one Semi-anechoic Chamber and one Shielded Chamber. AC Mains Power is available at 120, 230, and 277 Single Phase; 208, 400, and 480 3-Phase. Large reference ground-planes are installed in the general lab area to facilitate EMC work not requiring a shielded environment.

6.2 Test Equipment Used:

| Asset | Description | Manufacturer | Model | Serial | Cal Date | Cal Due |
|-----------|------------------------------|--------------------|-----------------------|------------|----------------------|----------------------|
| DAV001' | Weather Station | Davis Instruments | 7400 | PE80519A61 | 12/07/2017 | 12/07/2018 |
| ROS005-1' | Signal and Spectrum Analyzer | Rohde and Shwartz | FSW43 | 100646 | 11/07/2017 | 11/07/2018 |
| DUT 1' | Coaxial Cable | UTIFLEX MICRO-COAX | UFA210A-1-0787-300300 | 101709 | 02/01/2018 | 02/01/2019 |
| -- | 20 dB Attenuator | Pasternack | PE7004-20 | None | Verified Before Used | Verified Before Used |

Software Utilized:

| Name | Manufacturer | Version |
|-----------------------|-----------------|----------|
| R&S EMC32/AMS32/WMS32 | Rohde & Schwarz | 10.30.00 |

6.3 Results:

The sample tested was found to Comply.

§15.247 (b) (3) For systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands: 1 Watt or 30 dBm.

6.4 Setup Photograph:



6.5 Plots/Data:

FCC Part 47 §15.247 2400-2483.5 MHz 2016

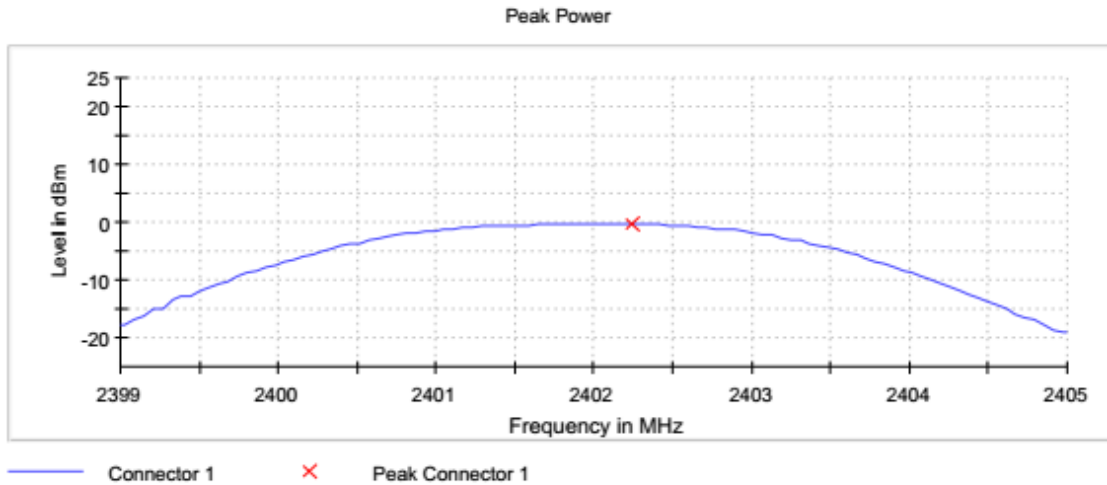
Peak output power (Sweep) (2402 MHz; 30.000 dBm; 1 MHz)

Test according to FCC title 47 part 15 §15.247(b), KDB 558074 D01 DTS Meas Guidance v03r05 and ANSI C63.10

Measurement uncertainty calculated in accordance with ETSI TR 100 028-1.
Expanded Combined Uncertainty of absolute Level Measurement (K=2) < 0.8 dB

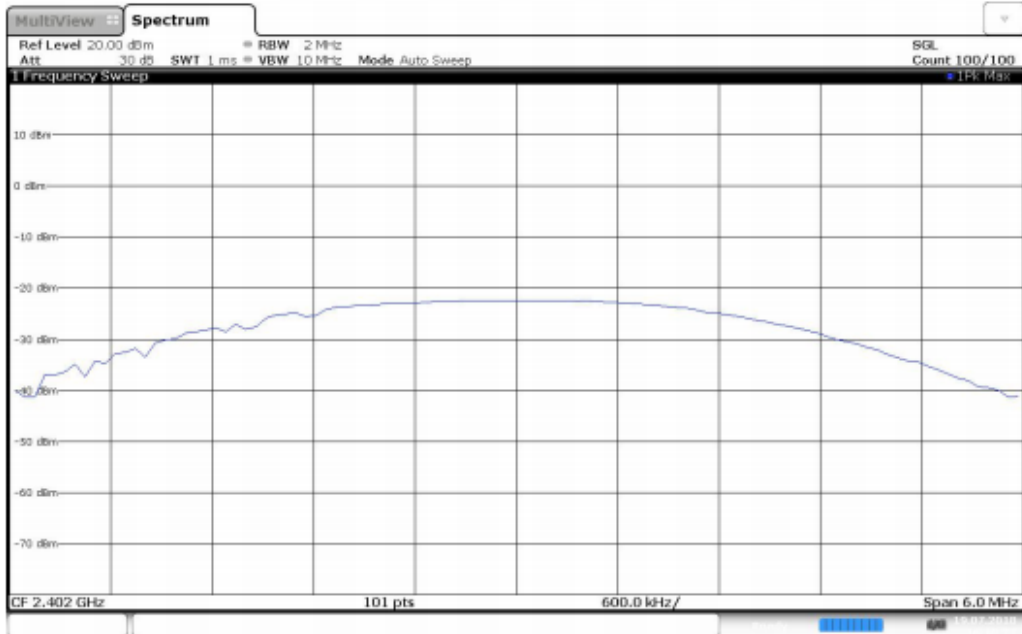
Result

| DUT Frequency (MHz) | Peak Power (dBm) | Limit Max (dBm) | Result |
|---------------------|------------------|-----------------|--------|
| 2402.000000 | -0.3 | 30.0 | PASS |



Peak Power 1

FCC Part 47 §15.247 2400-2483.5 MHz 2016



16:10:28 19.07.2018

FCC Part 47 §15.247 2400-2483.5 MHz 2016

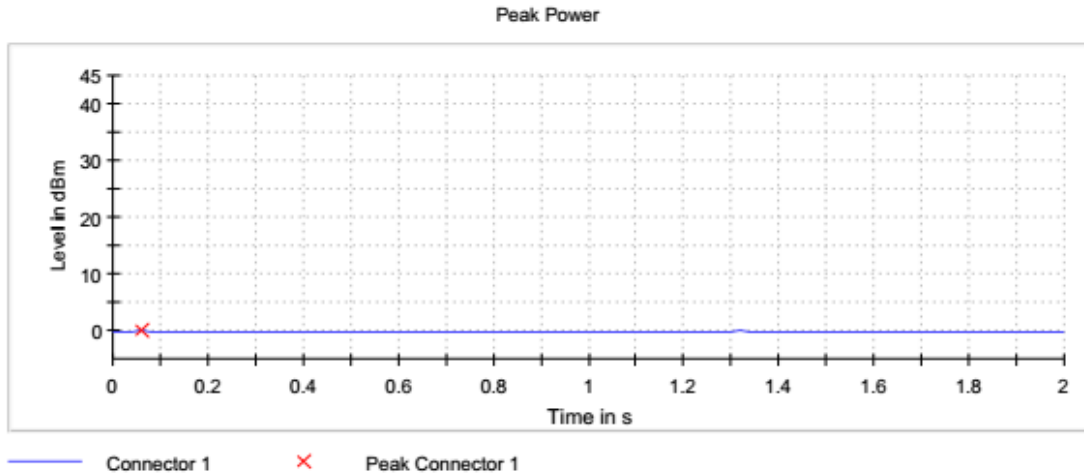
Peak output power (ZeroSpan) (2402 MHz; 30.000 dBm; 1 MHz)

Test according to FCC title 47 part 15 §15.247(b), KDB 558074 D01 DTS Meas Guidance v03r05 and ANSI C63.10

Measurement uncertainty calculated in accordance with ETSI TR 100 028-1.
Expanded Combined Uncertainty of absolute Level Measurement (K=2) < 0.8 dB

Result

| DUT Frequency (MHz) | Peak Power (dBm) | Limit Max (dBm) | Result |
|---------------------|------------------|-----------------|--------|
| 2402.000000 | -0.1 | 30.0 | PASS |



Peak Power 1

FCC Part 47 §15.247 2400-2483.5 MHz 2016



FCC Part 47 §15.247 2400-2483.5 MHz 2016

RF output power (2402 MHz; 30.000 dBm; 1 MHz)

Max level (0.1 dBm) over 20.0 dB lower then nominal power level.

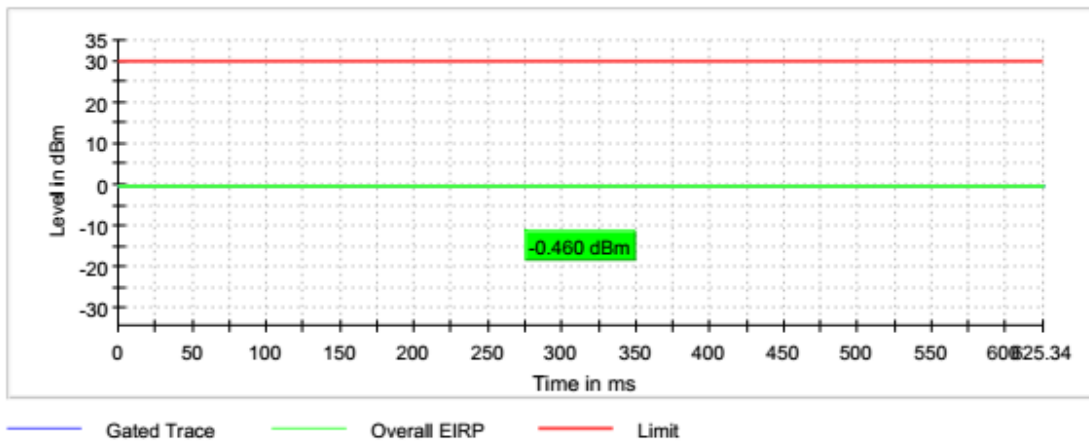
Test according to FCC title 47 part 15 §15.247(b), KDB 558074 D01 DTS Meas Guidance v03r05 and ANSI C63.10

Measurement uncertainty calculated in accordance with ETSI TR 100 028-1.
Expanded Combined Uncertainty of absolute Level Measurement (K=2) < 0.8 dB

Result

| DUT Frequency (MHz) | Gated RMS (dBm) | Limit Max (dBm) | Gated EIRP (dBm) | DutyCycle (%) | Result |
|---------------------|-----------------|-----------------|------------------|---------------|--------|
| 2402.000000 | -0.5 | 30.0 | -0.5 | 62.575 | PASS |

Gated Trace



FCC Part 47 §15.247 2400-2483.5 MHz 2016

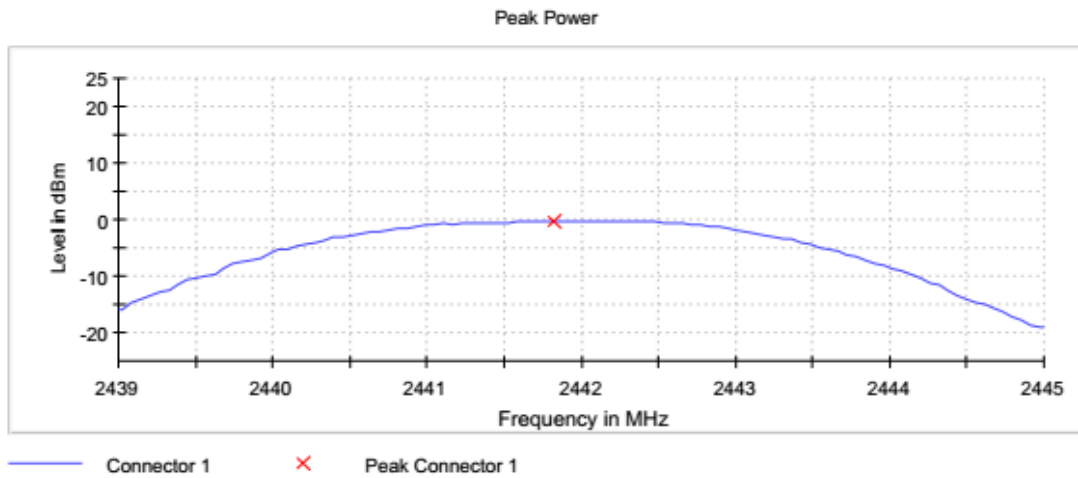
Peak output power (Sweep) (2442 MHz; 30.000 dBm; 1 MHz)

Test according to FCC title 47 part 15 §15.247(b), KDB 558074 D01 DTS Meas Guidance v03r05 and ANSI C63.10

Measurement uncertainty calculated in accordance with ETSI TR 100 028-1.
Expanded Combined Uncertainty of absolute Level Measurement (K=2) < 0.8 dB

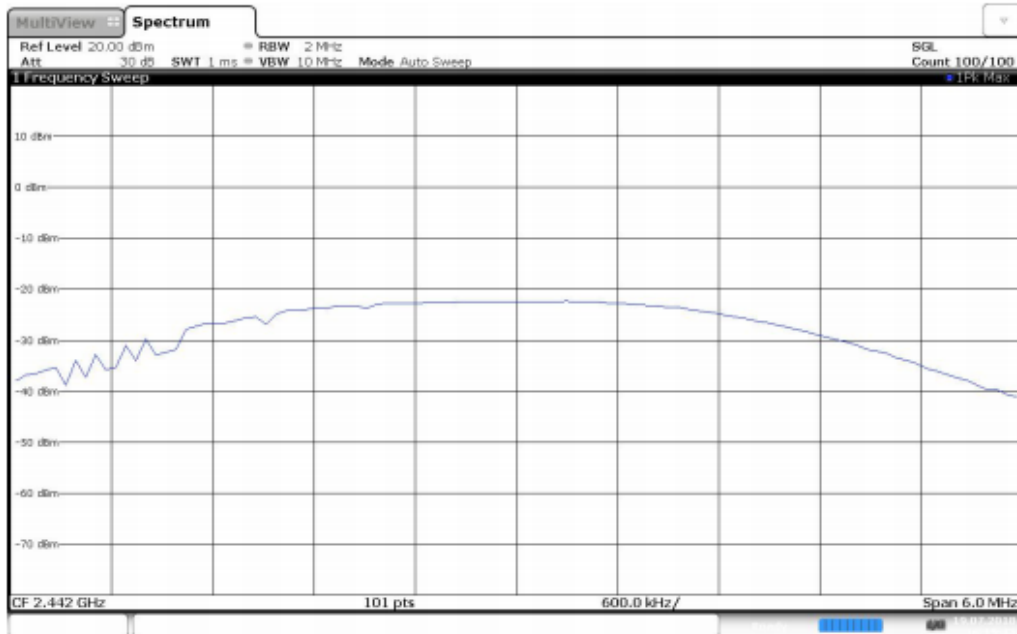
Result

| DUT Frequency (MHz) | Peak Power (dBm) | Limit Max (dBm) | Result |
|---------------------|------------------|-----------------|--------|
| 2442.000000 | -0.2 | 30.0 | PASS |



Peak Power 1

FCC Part 47 §15.247 2400-2483.5 MHz 2016



16:15:43 19.07.2018

FCC Part 47 §15.247 2400-2483.5 MHz 2016

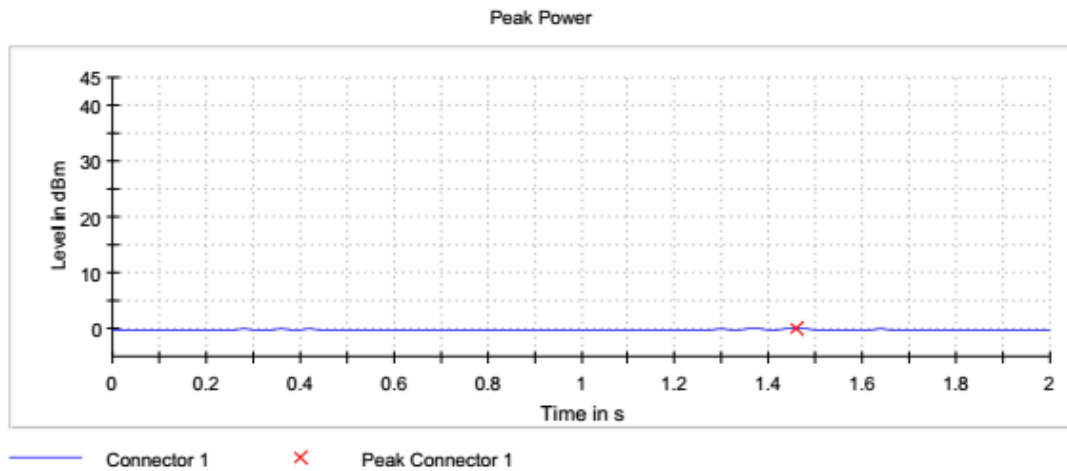
Peak output power (ZeroSpan) (2442 MHz; 30.000 dBm; 1 MHz)

Test according to FCC title 47 part 15 §15.247(b), KDB 558074 D01 DTS Meas Guidance v03r05 and ANSI C63.10

Measurement uncertainty calculated in accordance with ETSI TR 100 028-1.
Expanded Combined Uncertainty of absolute Level Measurement (K=2) < 0.8 dB

Result

| DUT Frequency (MHz) | Peak Power (dBm) | Limit Max (dBm) | Result |
|---------------------|------------------|-----------------|--------|
| 2442.000000 | -0.1 | 30.0 | PASS |



Peak Power 1

FCC Part 47 §15.247 2400-2483.5 MHz 2016



16:16:09 19.07.2018

FCC Part 47 §15.247 2400-2483.5 MHz 2016

RF output power (2442 MHz; 30.000 dBm; 1 MHz)

Max level (0.3 dBm) over 20.0 dB lower then nominal power level.

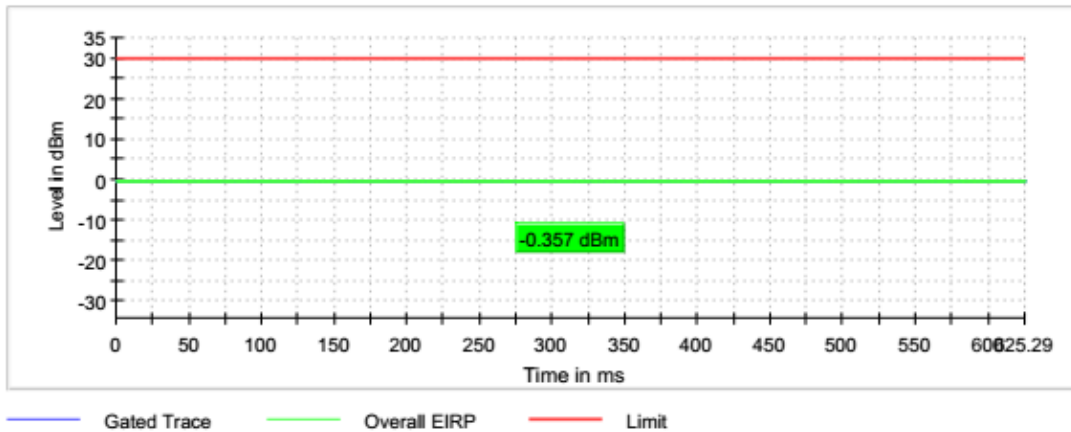
Test according to FCC title 47 part 15 §15.247(b), KDB 558074 D01 DTS Meas Guidance v03r05 and ANSI C63.10

Measurement uncertainty calculated in accordance with ETSI TR 100 028-1.
Expanded Combined Uncertainty of absolute Level Measurement (K=2) < 0.8 dB

Result

| DUT Frequency (MHz) | Gated RMS (dBm) | Limit Max (dBm) | Gated EIRP (dBm) | DutyCycle (%) | Result |
|---------------------|-----------------|-----------------|------------------|---------------|--------|
| 2442.000000 | -0.4 | 30.0 | -0.4 | 62.570 | PASS |

Gated Trace



FCC Part 47 §15.247 2400-2483.5 MHz 2016

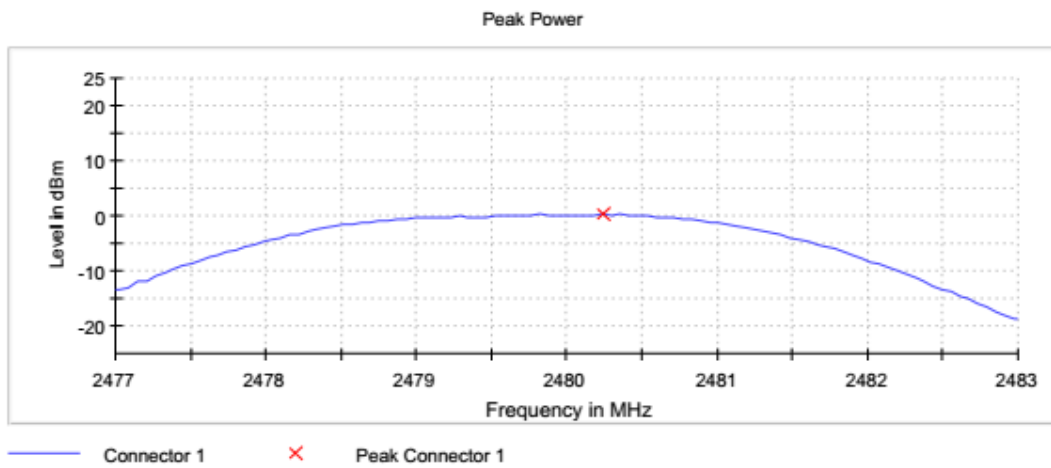
Peak output power (Sweep) (2480 MHz; 30.000 dBm; 1 MHz)

Test according to FCC title 47 part 15 §15.247(b), KDB 558074 D01 DTS Meas Guidance v03r05 and ANSI C63.10

Measurement uncertainty calculated in accordance with ETSI TR 100 028-1.
Expanded Combined Uncertainty of absolute Level Measurement (K=2) < 0.8 dB

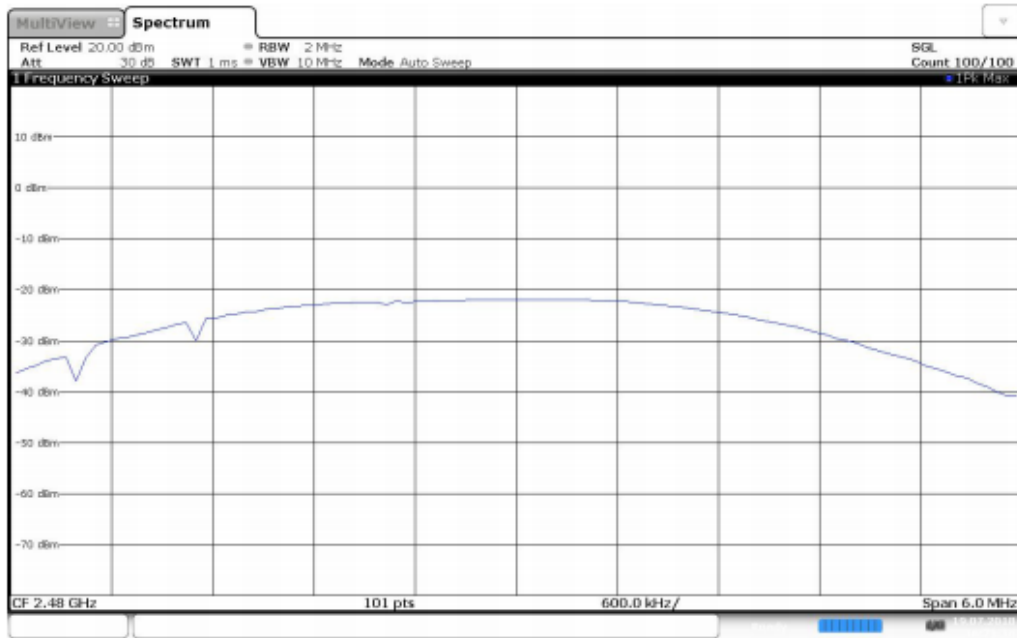
Result

| DUT Frequency (MHz) | Peak Power (dBm) | Limit Max (dBm) | Result |
|---------------------|------------------|-----------------|--------|
| 2480.000000 | 0.2 | 30.0 | PASS |



Peak Power 1

FCC Part 47 §15.247 2400-2483.5 MHz 2016



16:21:18 19.07.2018

FCC Part 47 §15.247 2400-2483.5 MHz 2016

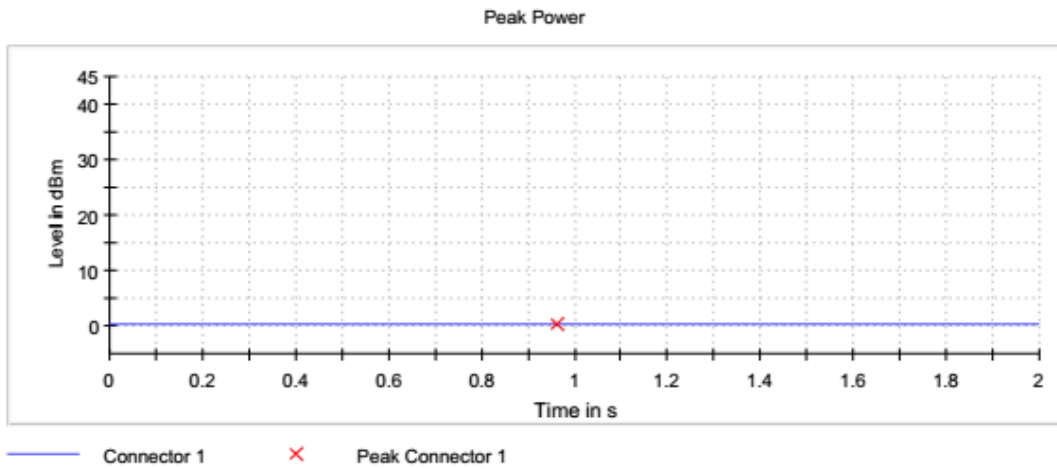
Peak output power (ZeroSpan) (2480 MHz; 30.000 dBm; 1 MHz)

Test according to FCC title 47 part 15 §15.247(b), KDB 558074 D01 DTS Meas Guidance v03r05 and ANSI C63.10

Measurement uncertainty calculated in accordance with ETSI TR 100 028-1.
Expanded Combined Uncertainty of absolute Level Measurement (K=2) < 0.8 dB

Result

| DUT Frequency (MHz) | Peak Power (dBm) | Limit Max (dBm) | Result |
|---------------------|------------------|-----------------|--------|
| 2480.000000 | 0.4 | 30.0 | PASS |



Peak Power 1

FCC Part 47 §15.247 2400-2483.5 MHz 2016



FCC Part 47 §15.247 2400-2483.5 MHz 2016

RF output power (2480 MHz; 30.000 dBm; 1 MHz)

Max level (0.6 dBm) over 20.0 dB lower then nominal power level.

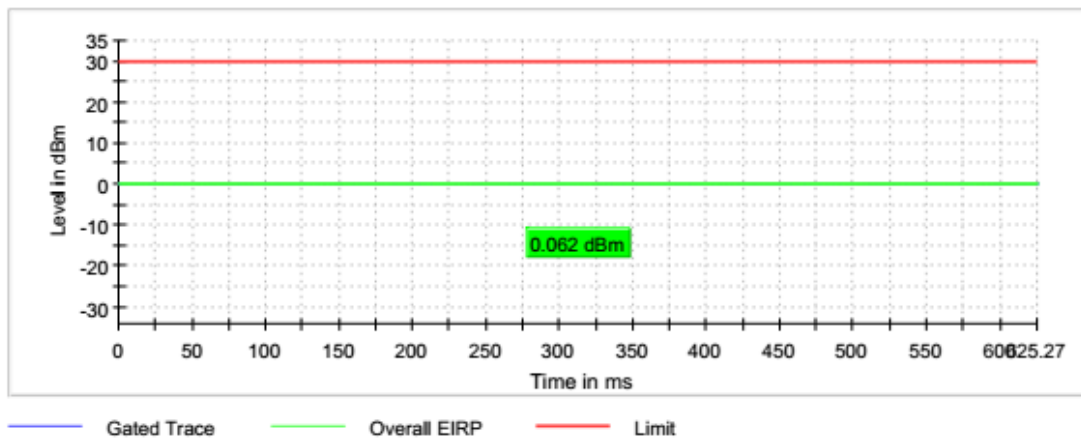
Test according to FCC title 47 part 15 §15.247(b), KDB 558074 D01 DTS Meas Guidance v03r05 and ANSI C63.10

Measurement uncertainty calculated in accordance with ETSI TR 100 028-1.
Expanded Combined Uncertainty of absolute Level Measurement (K=2) < 0.8 dB

Result

| DUT Frequency (MHz) | Gated RMS (dBm) | Limit Max (dBm) | Gated EIRP (dBm) | DutyCycle (%) | Result |
|---------------------|-----------------|-----------------|------------------|---------------|--------|
| 2480.000000 | 0.1 | 30.0 | 0.1 | 62.568 | PASS |

Gated Trace



SAR Exemption Calculation

Maximum Conducted Output Power of Transmitter = 0.4 dBm = 1.096 mW

FCC SAR Exemption per KDB 447498

a) For 100 MHz to 6 GHz and *test separation distances* ≤ 50 mm, the 1-g and 10-g SAR test exclusion thresholds are determined by the following:

$$[(\text{max. power of channel, including tune-up tolerance, mW}) / (\text{min. test separation distance, mm})] \cdot [\sqrt{f_{(\text{GHz})}}] \leq 3.0 \text{ for 1-g SAR, and } \leq 7.5 \text{ for 10-g extremity SAR,}^{30} \text{ where}$$

- $f_{(\text{GHz})}$ is the RF channel transmit frequency in GHz

$$= (1.096/5) \cdot (\text{sqrt}(2.480))$$

$$= 0.345 < 3.0 \text{ (below the limit SAR Exempt per FCC)}$$

RSS 102 SAR Exemption

Table 1: SAR evaluation – Exemption limits for routine evaluation based on frequency and separation distance^{4,5}

| Frequency (MHz) | Exemption Limits (mW) | | | | |
|-----------------|---------------------------------|---------------------------------|---------------------------------|---------------------------------|---------------------------------|
| | At separation distance of ≤5 mm | At separation distance of 10 mm | At separation distance of 15 mm | At separation distance of 20 mm | At separation distance of 25 mm |
| ≤300 | 71 mW | 101 mW | 132 mW | 162 mW | 193 mW |
| 450 | 52 mW | 70 mW | 88 mW | 106 mW | 123 mW |
| 835 | 17 mW | 30 mW | 42 mW | 55 mW | 67 mW |
| 1900 | 7 mW | 10 mW | 18 mW | 34 mW | 60 mW |
| 2450 | 4 mW | 7 mW | 15 mW | 30 mW | 52 mW |
| 3500 | 2 mW | 6 mW | 16 mW | 32 mW | 55 mW |
| 5800 | 1 mW | 6 mW | 15 mW | 27 mW | 41 mW |

The exemption limits in Table 1 are based on measurements and simulations of half-wave dipole antennas at separation distances of 5 mm to 25 mm from a flat phantom, providing a SAR value of approximately 0.4 W/kg for 1 g of tissue. For low frequencies (300 MHz to 835 MHz), the exemption limits are derived from a linear fit. For high frequencies (1900 MHz and above), the exemption limits are derived from a third order polynomial fit.

The conducted output power of the transmitter 1.096 mW @ 2480 MHz is less than 2 mW limit specified at 3500 MHz, device meets SAR exclusion.

| | |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Test Personnel: <u>Kouma Sinn <i>KPS</i></u> Supervising/Reviewing Engineer: <u>Vathana F. Ven <i>VFV</i></u> (Where Applicable) <u>CFR47 FCC Part 15.247</u> Product Standard: <u>RSS-247, RSS-102</u> Input Voltage: <u>Internal Battery Powered</u> | Test Date: <u>07/19/2018</u> Limit Applied: <u>See report section 6.3</u> Ambient Temperature: <u>25 °C</u> Relative Humidity: <u>32 %</u> Atmospheric Pressure: <u>1008 mbars</u> |
| Pretest Verification w/ Ambient Signals or BB Source: <u>N/A</u> | |

Deviations, Additions, or Exclusions: None

7 6 dB Bandwidth and Occupied Bandwidth

7.1 Method

Tests are performed in accordance with CFR47 FCC Part 15.247, RSS-247, RSS-102, and ANSI C63.10.

TEST SITE: EMC Lab

The EMC Lab has one Semi-anechoic Chamber and one Shielded Chamber. AC Mains Power is available at 120, 230, and 277 Single Phase; 208, 400, and 480 3-Phase. Large reference ground-planes are installed in the general lab area to facilitate EMC work not requiring a shielded environment.

7.2 Test Equipment Used:

| Asset | Description | Manufacturer | Model | Serial | Cal Date | Cal Due |
|-----------|------------------------------|--------------------|-----------------------|------------|----------------------|----------------------|
| DAV001' | Weather Station | Davis Instruments | 7400 | PE80519A61 | 12/07/2017 | 12/07/2018 |
| ROS005-1' | Signal and Spectrum Analyzer | Rohde and Shwartz | FSW43 | 100646 | 11/07/2017 | 11/07/2018 |
| DUT 1' | Coaxial Cable | UTIFLEX MICRO-COAX | UFA210A-1-0787-300300 | 101709 | 02/01/2018 | 02/01/2019 |
| -- | 20 dB Attenuator | Pasternack | PE7004-20 | None | Verified Before Used | Verified Before Used |

Software Utilized:

| Name | Manufacturer | Version |
|-----------------------|-----------------|----------|
| R&S EMC32/AMS32/WMS32 | Rohde & Schwarz | 10.30.00 |

7.3 Results:

The sample tested was found to Comply.

§15.247 (a) (2) Systems using digital modulation techniques may operate in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands. The minimum 6 dB bandwidth shall be at least 500 kHz.

7.4 Setup Photograph:

Antenna Port Conducted Test Setup



7.5 Plots/Data:

FCC Part 47 §15.247 2400-2483.5 MHz 2016

Emission Bandwidth 20 dB (2402 MHz; 30.000 dBm; 1 MHz)

Max level (-1.1 dBm) more than 25.0 dB below the nominal power level.

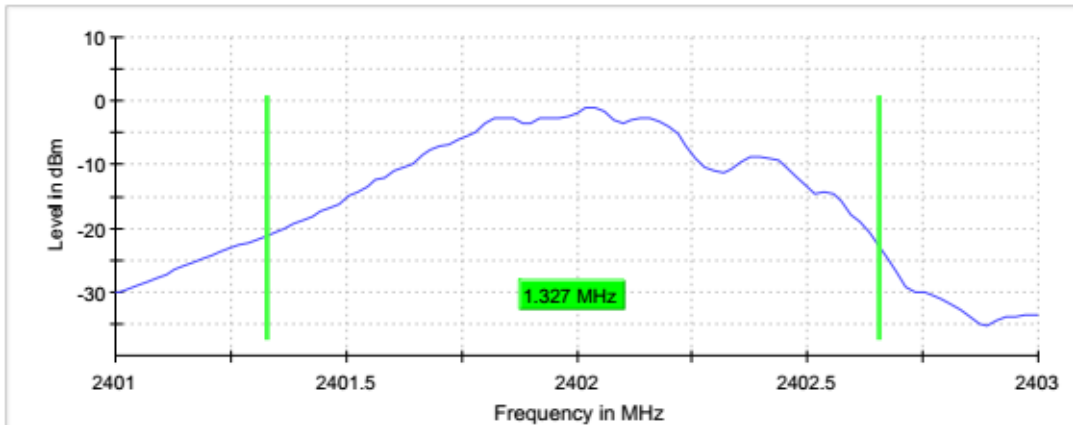
Test according to FCC title 47 part 15 §15.247(a), KDB 558074 D01 DTS Meas Guidance v03r05 and ANSI C63.10

Measurement uncertainty calculated in accordance with ETSI TR 100 028-1.
Expanded Uncertainty (K=2) < 2%

20 dB Bandwidth

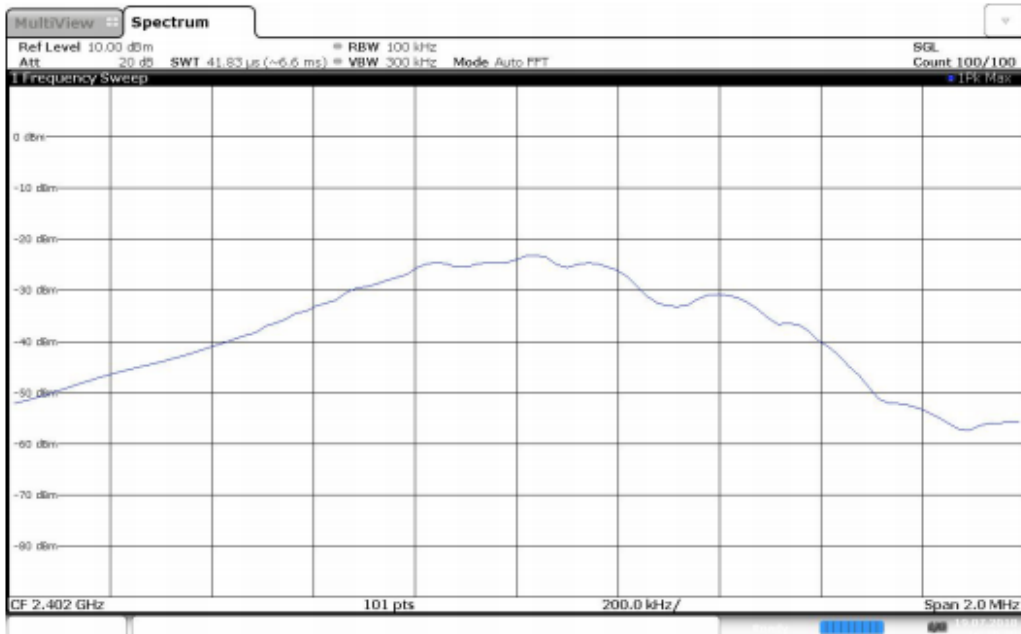
| DUT Frequency (MHz) | Bandwidth (MHz) | Limit Min (MHz) | Limit Max (MHz) | Band Edge Left (MHz) | Band Edge Right (MHz) | Max Level (dBm) | Result |
|---------------------|-----------------|-----------------|-----------------|----------------------|-----------------------|-----------------|--------|
| 2402.000000 | 1.326732 | --- | --- | 2401.326733 | 2402.653465 | -1.1 | PASS |

20 dB Bandwidth



Bandwidth

FCC Part 47 §15.247 2400-2483.5 MHz 2016



16:10:01 19.07.2018

FCC Part 47 §15.247 2400-2483.5 MHz 2016

Emission Bandwidth 20 dB (2442 MHz; 30.000 dBm; 1 MHz)

Max level (-0.8 dBm) more than 25.0 dB below the nominal power level.

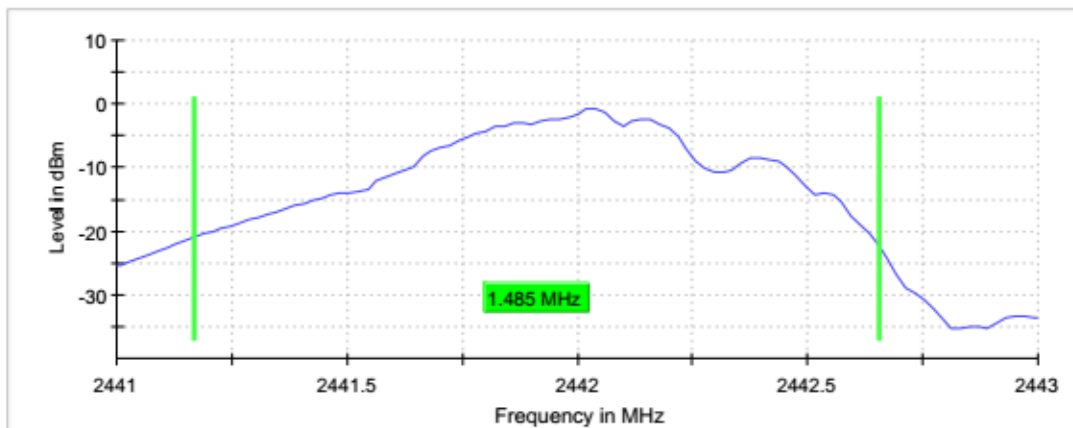
Test according to FCC title 47 part 15 §15.247(a), KDB 558074 D01 DTS Meas Guidance v03r05 and ANSI C63.10

Measurement uncertainty calculated in accordance with ETSI TR 100 028-1.
Expanded Uncertainty (K=2) < 2%

20 dB Bandwidth

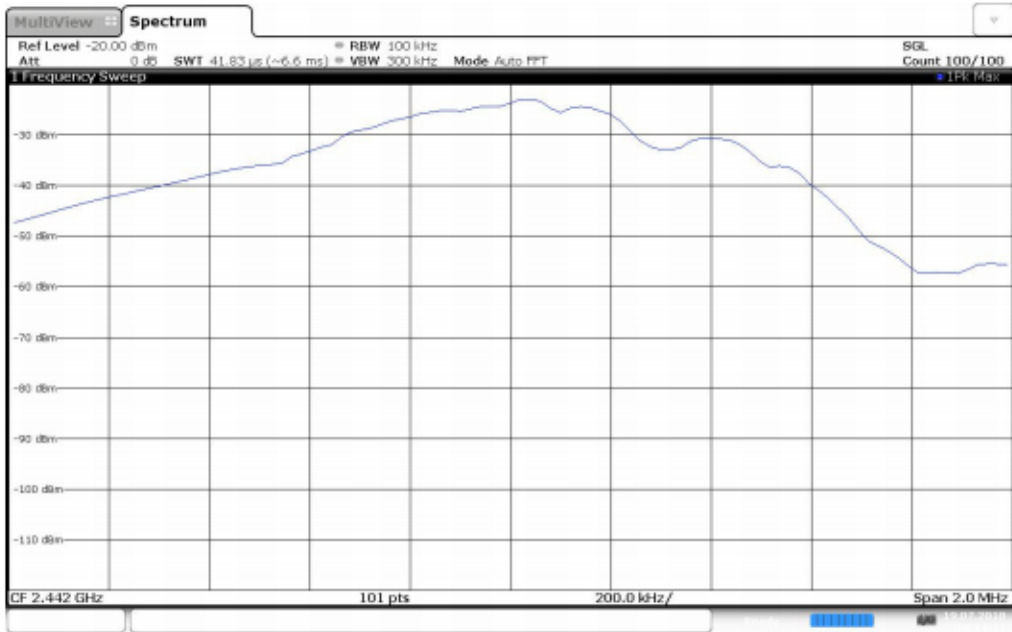
| DUT Frequency (MHz) | Bandwidth (MHz) | Limit Min (MHz) | Limit Max (MHz) | Band Edge Left (MHz) | Band Edge Right (MHz) | Max Level (dBm) | Result |
|---------------------|-----------------|-----------------|-----------------|----------------------|-----------------------|-----------------|--------|
| 2442.000000 | 1.485148 | --- | --- | 2441.168317 | 2442.653465 | -0.8 | PASS |

20 dB Bandwidth



Bandwidth

FCC Part 47 §15.247 2400-2483.5 MHz 2016



16:14:42 19.07.2018

FCC Part 47 §15.247 2400-2483.5 MHz 2016

Emission Bandwidth 20 dB (2480 MHz; 30.000 dBm; 1 MHz)

Max level (-0.6 dBm) more than 25.0 dB below the nominal power level.

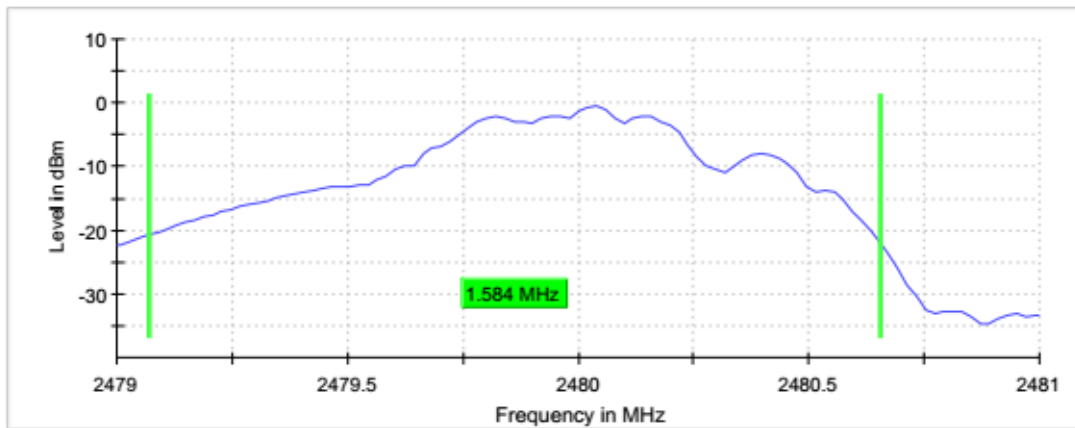
Test according to FCC title 47 part 15 §15.247(a), KDB 558074 D01 DTS Meas Guidance v03r05 and ANSI C63.10

Measurement uncertainty calculated in accordance with ETSI TR 100 028-1.
Expanded Uncertainty (K=2) < 2%

20 dB Bandwidth

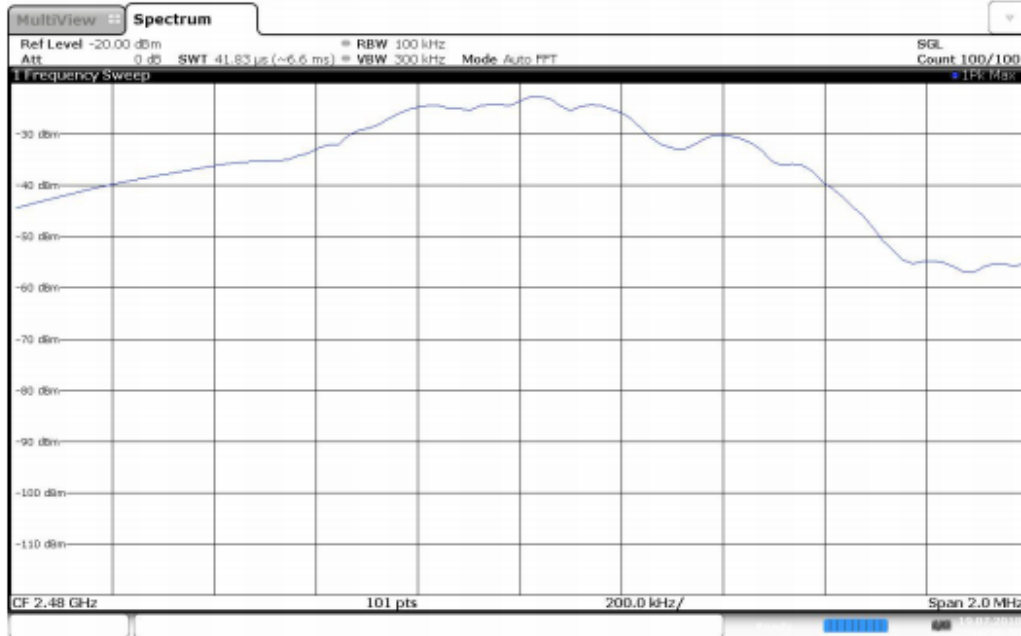
| DUT Frequency (MHz) | Bandwidth (MHz) | Limit Min (MHz) | Limit Max (MHz) | Band Edge Left (MHz) | Band Edge Right (MHz) | Max Level (dBm) | Result |
|---------------------|-----------------|-----------------|-----------------|----------------------|-----------------------|-----------------|--------|
| 2480.000000 | 1.584158 | --- | --- | 2479.069307 | 2480.653465 | -0.6 | PASS |

20 dB Bandwidth



Bandwidth

FCC Part 47 §15.247 2400-2483.5 MHz 2016



16:20:38 19.07.2018

FCC Part 47 §15.247 2400-2483.5 MHz 2016

Minimum Emission Bandwidth 6 dB (2402 MHz; 30.000 dBm; 1 MHz)

Max level (-1.1 dBm) more than 25.0 dB below the nominal power level.

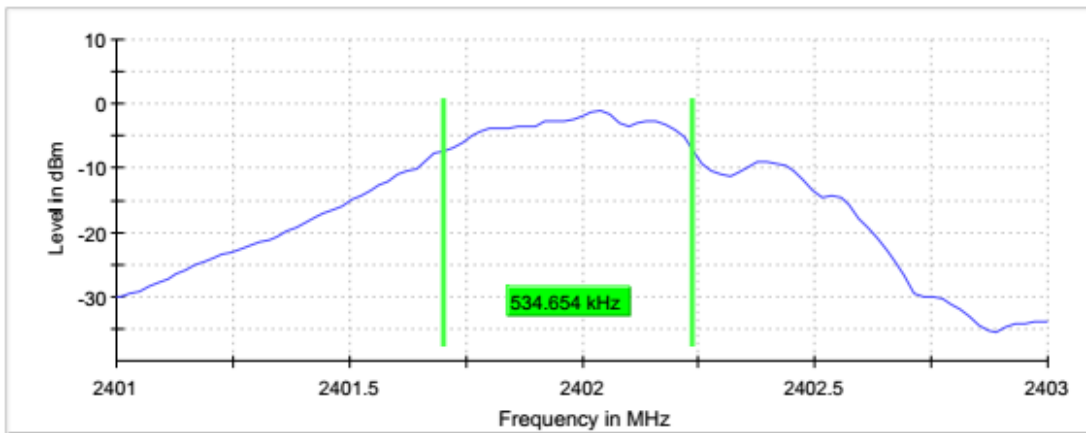
Test according to FCC title 47 part 15 §15.247(a), KDB 558074 D01 DTS Meas Guidance v03r05 and ANSI C63.10

Measurement uncertainty calculated in accordance with ETSI TR 100 028-1.
Expanded Uncertainty (K=2) < 2%

6 dB Bandwidth

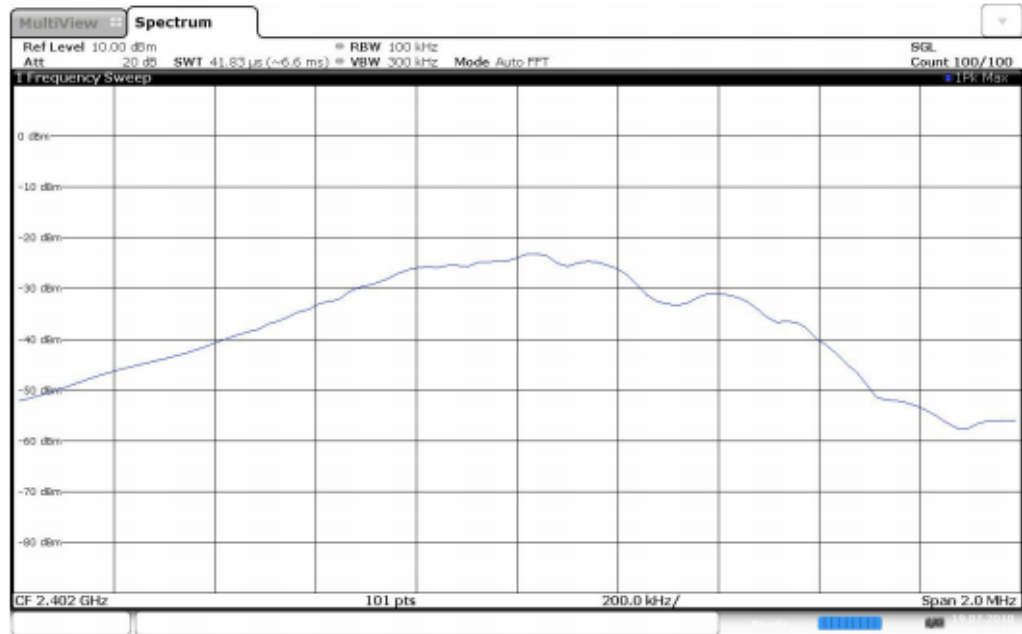
| DUT Frequency (MHz) | Bandwidth (MHz) | Limit Min (MHz) | Limit Max (MHz) | Band Edge Left (MHz) | Band Edge Right (MHz) | Max Level (dBm) | Result |
|---------------------|-----------------|-----------------|-----------------|----------------------|-----------------------|-----------------|--------|
| 2402.000000 | 0.534654 | 0.500000 | --- | 2401.702970 | 2402.237624 | -1.1 | PASS |

6 dB Bandwidth



Bandwidth

FCC Part 47 §15.247 2400-2483.5 MHz 2016



16:10:17 19.07.2018

FCC Part 47 §15.247 2400-2483.5 MHz 2016

Minimum Emission Bandwidth 6 dB (2442 MHz; 30.000 dBm; 1 MHz)

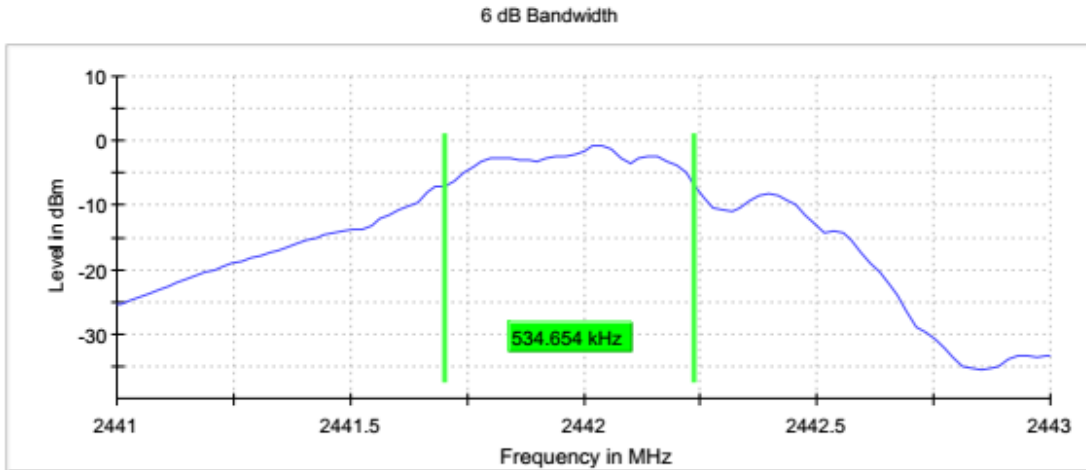
Max level (-0.8 dBm) more than 25.0 dB below the nominal power level.

Test according to FCC title 47 part 15 §15.247(a), KDB 558074 D01 DTS Meas Guidance v03r05 and ANSI C63.10

Measurement uncertainty calculated in accordance with ETSI TR 100 028-1.
Expanded Uncertainty (K=2) < 2%

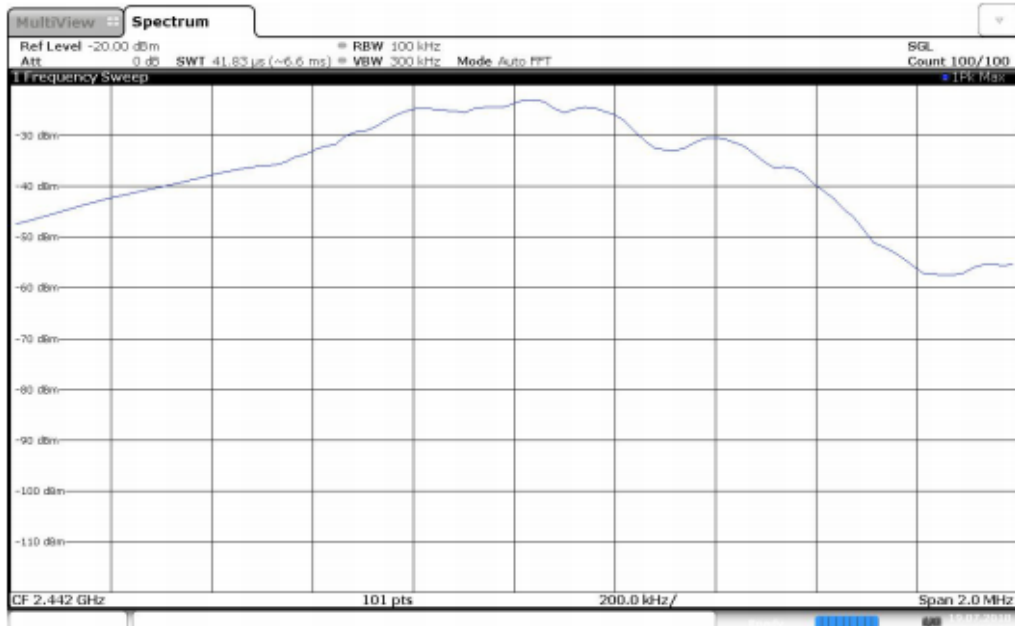
6 dB Bandwidth

| DUT Frequency (MHz) | Bandwidth (MHz) | Limit Min (MHz) | Limit Max (MHz) | Band Edge Left (MHz) | Band Edge Right (MHz) | Max Level (dBm) | Result |
|---------------------|-----------------|-----------------|-----------------|----------------------|-----------------------|-----------------|--------|
| 2442.000000 | 0.534654 | 0.500000 | --- | 2441.702970 | 2442.237624 | -0.8 | PASS |



Bandwidth

FCC Part 47 §15.247 2400-2483.5 MHz 2016



FCC Part 47 §15.247 2400-2483.5 MHz 2016

Minimum Emission Bandwidth 6 dB (2480 MHz; 30.000 dBm; 1 MHz)

Max level (-0.6 dBm) more than 25.0 dB below the nominal power level.

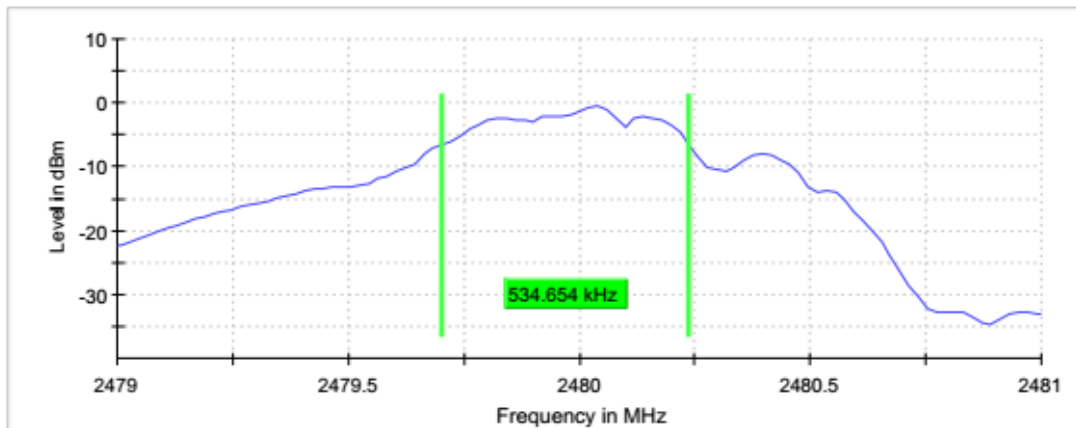
Test according to FCC title 47 part 15 §15.247(a), KDB 558074 D01 DTS Meas Guidance v03r05 and ANSI C63.10

Measurement uncertainty calculated in accordance with ETSI TR 100 028-1.
Expanded Uncertainty (K=2) < 2%

6 dB Bandwidth

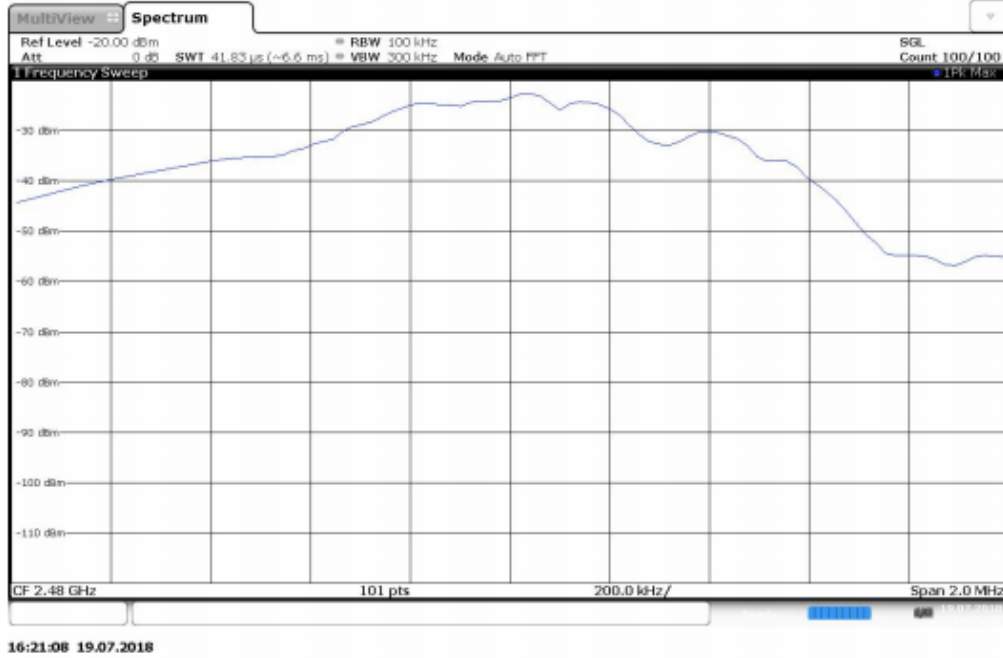
| DUT Frequency (MHz) | Bandwidth (MHz) | Limit Min (MHz) | Limit Max (MHz) | Band Edge Left (MHz) | Band Edge Right (MHz) | Max Level (dBm) | Result |
|---------------------|-----------------|-----------------|-----------------|----------------------|-----------------------|-----------------|--------|
| 2480.000000 | 0.534654 | 0.500000 | --- | 2479.702970 | 2480.237624 | -0.6 | PASS |

6 dB Bandwidth



Bandwidth

FCC Part 47 §15.247 2400-2483.5 MHz 2016



Test Personnel: Kouma Sinn *KPS*
 Supervising/Reviewing Engineer: Vathana F. Ven *VSV*
 (Where Applicable) CFR47 FCC Part 15.247
 Product Standard: RSS-247, RSS-102
 Input Voltage: Internal Battery Powered
 Pretest Verification w/ Ambient Signals or BB Source: N/A

Test Date: 07/19/2018
 Limit Applied: See report section 7.3
 Ambient Temperature: 25 °C
 Relative Humidity: 32 %
 Atmospheric Pressure: 1008 mbars

Deviations, Additions, or Exclusions: None

8 Maximum Power Spectral Density

8.1 Method

Tests are performed in accordance with CFR47 FCC Part 15.247, RSS-247, RSS-102, and ANSI C63.10.

TEST SITE: EMC Lab

The EMC Lab has one Semi-anechoic Chamber and one Shielded Chamber. AC Mains Power is available at 120, 230, and 277 Single Phase; 208, 400, and 480 3-Phase. Large reference ground-planes are installed in the general lab area to facilitate EMC work not requiring a shielded environment.

8.2 Test Equipment Used:

| Asset | Description | Manufacturer | Model | Serial | Cal Date | Cal Due |
|-----------|------------------------------|--------------------|-----------------------|------------|----------------------|----------------------|
| DAV001' | Weather Station | Davis Instruments | 7400 | PE80519A61 | 12/07/2017 | 12/07/2018 |
| ROS005-1' | Signal and Spectrum Analyzer | Rohde and Shwartz | FSW43 | 100646 | 11/07/2017 | 11/07/2018 |
| DUT 1' | Coaxial Cable | UTIFLEX MICRO-COAX | UFA210A-1-0787-300300 | 101709 | 02/01/2018 | 02/01/2019 |
| -- | 20 dB Attenuator | Pasternack | PE7004-20 | None | Verified Before Used | Verified Before Used |

Software Utilized:

| Name | Manufacturer | Version |
|-----------------------|-----------------|----------|
| R&S EMC32/AMS32/WMS32 | Rohde & Schwarz | 10.30.00 |

8.3 Results:

The sample tested was found to Comply.

§15.247 (e) For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

8.4 Setup Photograph:

Antenna Port Conducted Test Setup



8.5 Plots/Data:

FCC Part 47 §15.247 2400-2483.5 MHz 2016

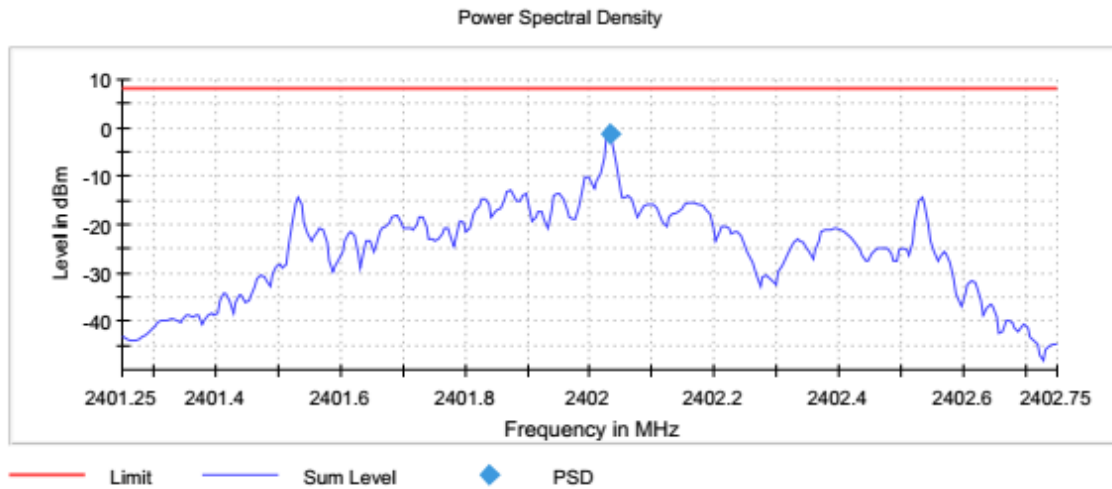
Peak Power Spectral Density (2402 MHz; 30.000 dBm; 1 MHz)

Test according to FCC title 47 part 15 §15.247(a), KDB 558074 D01 DTS Meas Guidance v03r05 and ANSI C63.10

Measurement uncertainty calculated in accordance with ETSI TR 100 028-1.
Expanded Uncertainty (K=2) < 1.1 dB

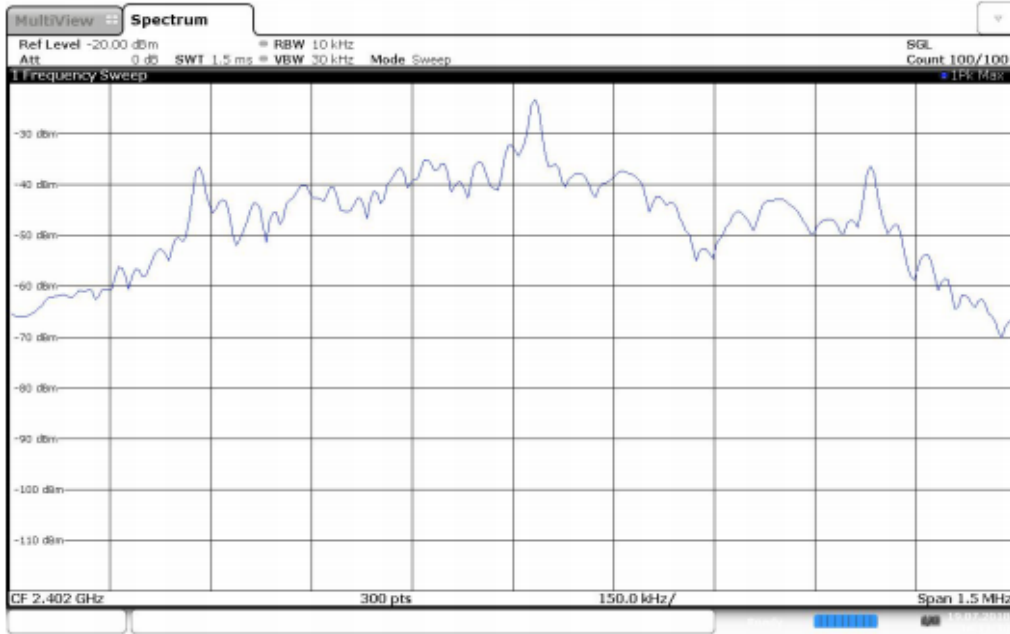
Result

| DUT Frequency (MHz) | Frequency (MHz) | PSD (dBm) | Limit Max (dBm) | Result |
|---------------------|-----------------|-----------|-----------------|--------|
| 2402.000000 | 2402.032500 | -1.200 | 8.0 | PASS |



PSD Connector 1

FCC Part 47 §15.247 2400-2483.5 MHz 2016



FCC Part 47 §15.247 2400-2483.5 MHz 2016

Power Spectral Density (2402 MHz; 30.000 dBm; 1 MHz)

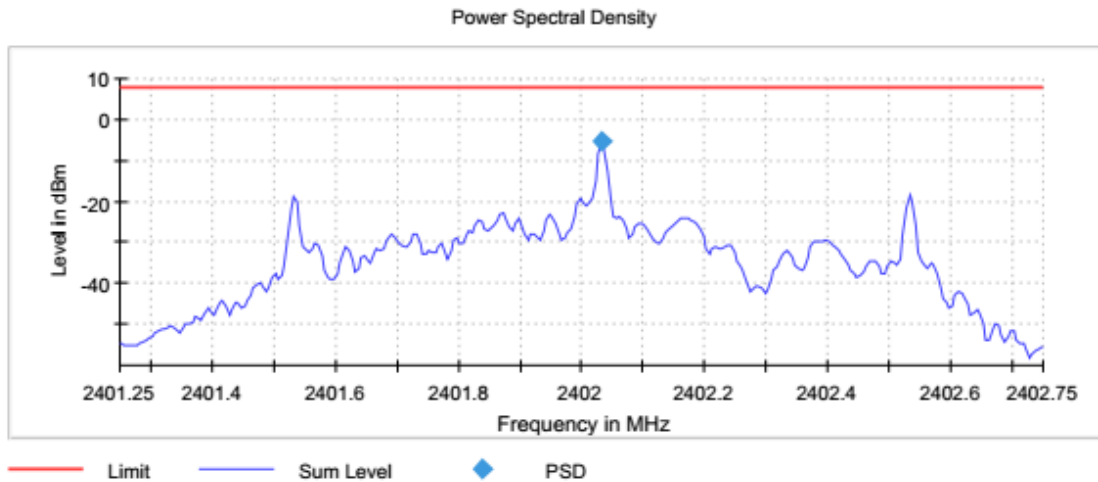
Max level of analyzer (-5.3 dBm) more than 35.0 dB below the nominal power level.

Test according to FCC title 47 part 15 §15.247(a), KDB 558074 D01 DTS Meas Guidance v03r05 and ANSI C63.10

Measurement uncertainty calculated in accordance with ETSI TR 100 028-1.
Expanded Uncertainty (K=2) < 1.1 dB

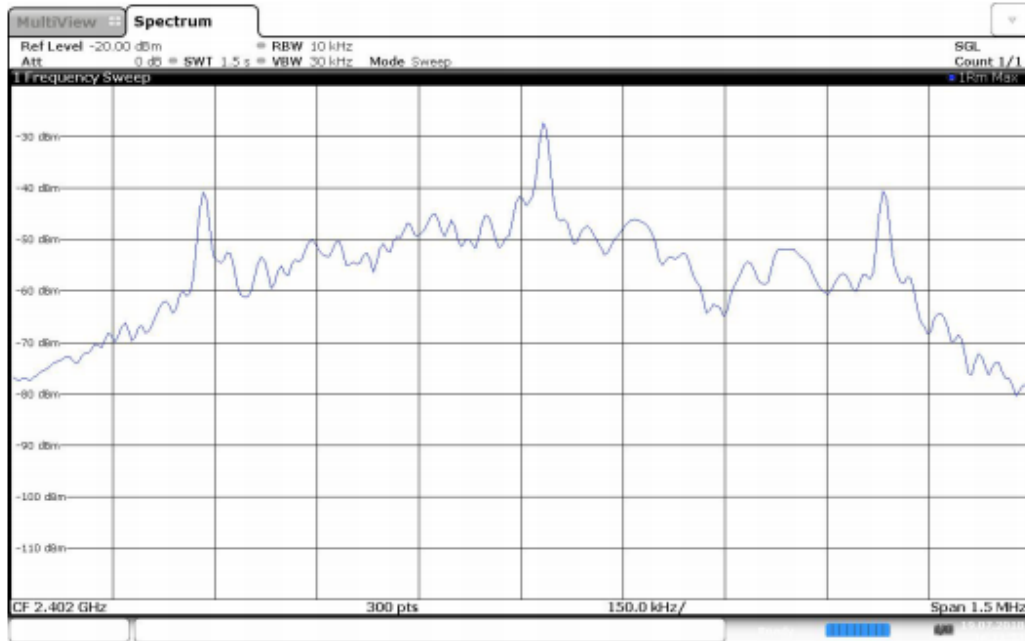
Result

| DUT Frequency (MHz) | Frequency (MHz) | PSD (dBm) | Limit Max (dBm) | Result |
|---------------------|-----------------|-----------|-----------------|--------|
| 2402.000000 | 2402.032500 | -5.255 | 8.0 | PASS |



PSD Connector 1

FCC Part 47 §15.247 2400-2483.5 MHz 2016



16:11:23 19.07.2018

FCC Part 47 §15.247 2400-2483.5 MHz 2016

Power Spectral Density (2442 MHz; 30.000 dBm; 1 MHz)

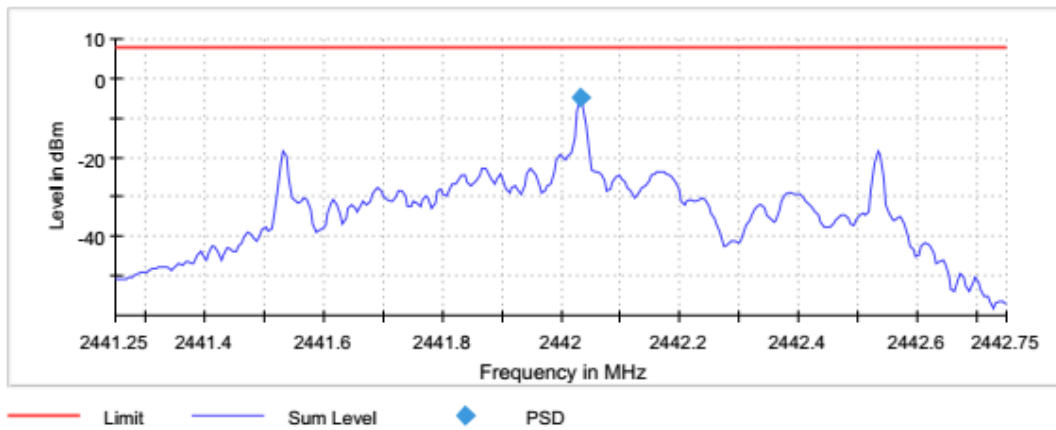
Test according to FCC title 47 part 15 §15.247(a), KDB 558074 D01 DTS Meas Guidance v03r05 and ANSI C63.10

Measurement uncertainty calculated in accordance with ETSI TR 100 028-1.
Expanded Uncertainty (K=2) < 1.1 dB

Result

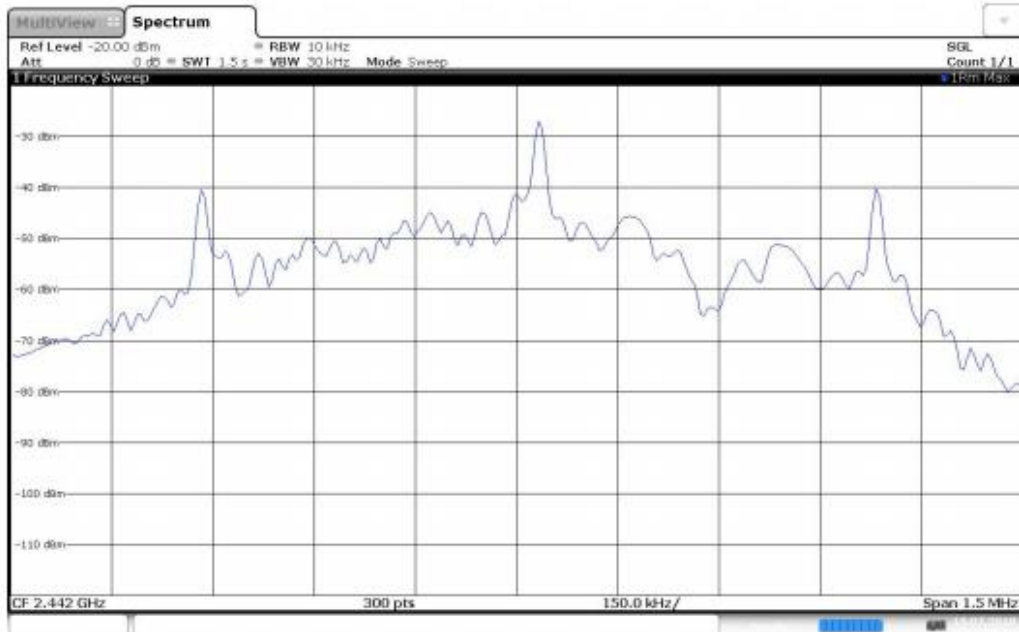
| DUT Frequency (MHz) | Frequency (MHz) | PSD (dBm) | Limit Max (dBm) | Result |
|---------------------|-----------------|-----------|-----------------|--------|
| 2442.000000 | 2442.032500 | -4.916 | 8.0 | PASS |

Power Spectral Density



PSD Connector 1

FCC Part 47 §15.247 2400-2483.5 MHz 2016



16:17:33 19.07.2018

FCC Part 47 §15.247 2400-2483.5 MHz 2016

Peak Power Spectral Density (2480 MHz; 30.000 dBm; 1 MHz)

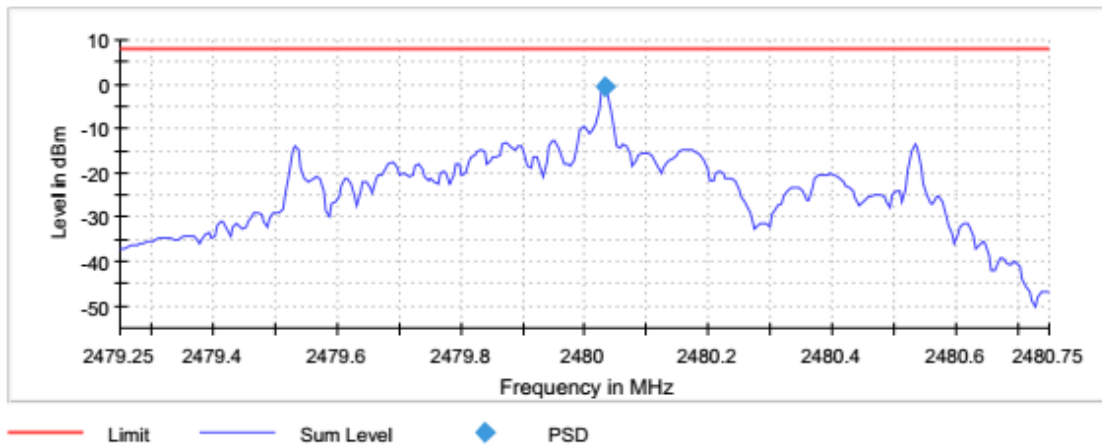
Test according to FCC title 47 part 15 §15.247(a), KDB 558074 D01 DTS Meas Guidance v03r05 and ANSI C63.10

Measurement uncertainty calculated in accordance with ETSI TR 100 028-1.
Expanded Uncertainty (K=2) < 1.1 dB

Result

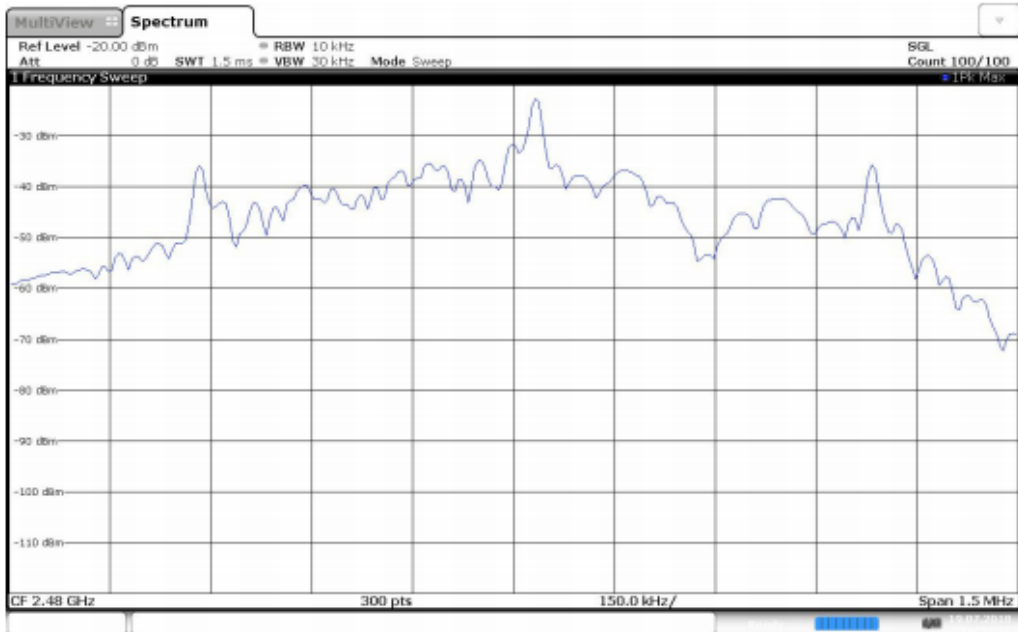
| DUT Frequency (MHz) | Frequency (MHz) | PSD (dBm) | Limit Max (dBm) | Result |
|---------------------|-----------------|-----------|-----------------|--------|
| 2480.000000 | 2480.032500 | -0.599 | 8.0 | PASS |

Power Spectral Density



PSD Connector 1

FCC Part 47 §15.247 2400-2483.5 MHz 2016



FCC Part 47 §15.247 2400-2483.5 MHz 2016

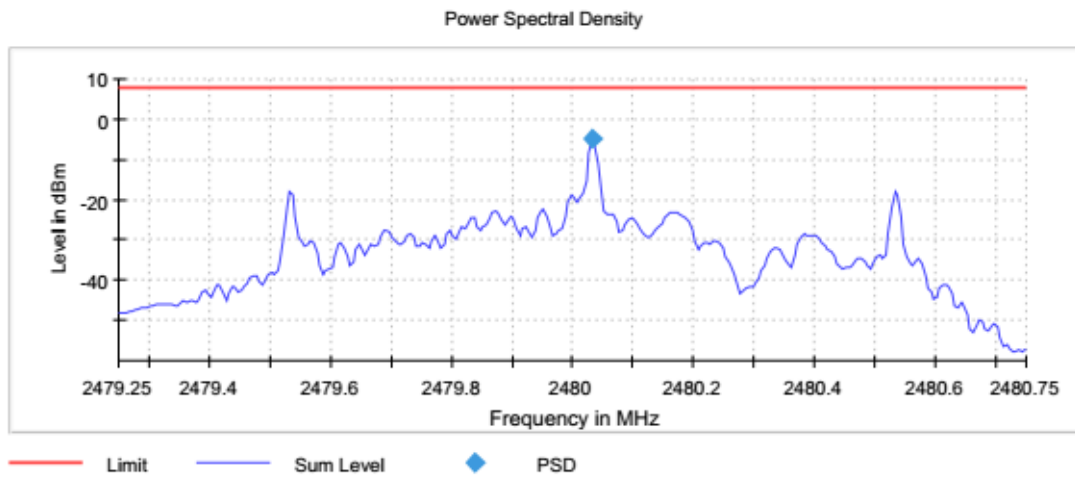
Power Spectral Density (2480 MHz; 30.000 dBm; 1 MHz)

Test according to FCC title 47 part 15 §15.247(a), KDB 558074 D01 DTS Meas Guidance v03r05 and ANSI C63.10

Measurement uncertainty calculated in accordance with ETSI TR 100 028-1.
Expanded Uncertainty (K=2) < 1.1 dB

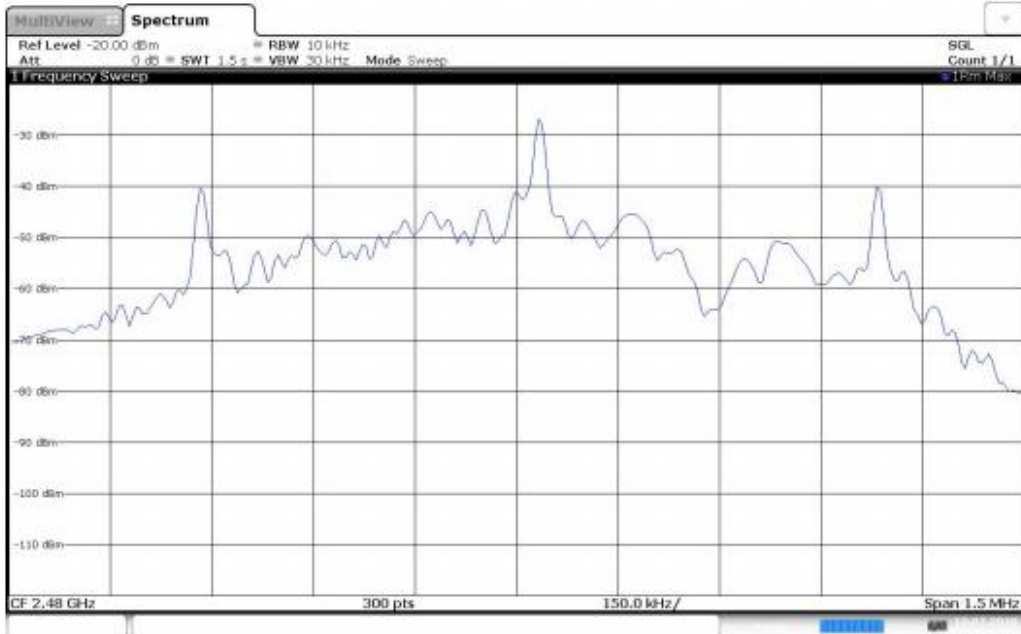
Result

| DUT Frequency (MHz) | Frequency (MHz) | PSD (dBm) | Limit Max (dBm) | Result |
|---------------------|-----------------|-----------|-----------------|--------|
| 2480.000000 | 2480.032500 | -4.803 | 8.0 | PASS |



PSD Connector 1

FCC Part 47 §15.247 2400-2483.5 MHz 2016



16:22:24 19.07.2018

Test Personnel: Kouma Sinn *KPS*
 Supervising/Reviewing Engineer: Vathana F. Ven *VFV*
 (Where Applicable) CFR47 FCC Part 15.247
 Product Standard: RSS-247, RSS-102
 Input Voltage: Internal Battery Powered

Pretest Verification w/
 Ambient Signals or
 BB Source: N/A

Test Date: 07/19/2018

Limit Applied: See report section 8.3

Ambient Temperature: 25 °C

Relative Humidity: 32 %

Atmospheric Pressure: 1008 mbars

Deviations, Additions, or Exclusions: None

9 Band Edge Compliance

9.1 Method

Tests are performed in accordance with FCC Part 15 Subpart C 15.247 RSS 247, ANSI C 63.10, and ANSI C 63.4.

TEST SITE: EMC Lab & 10m ALSE

The EMC Lab has one Semi-anechoic Chamber and one Shielded Chamber. AC Mains Power is available at 120, 230, and 277 Single Phase; 208, 400, and 480 3-Phase. Large reference ground-planes are installed in the general lab area to facilitate EMC work not requiring a shielded environment.

The 10m ALSE is 13m (Length) x 21m (Depth) x 10m (Height) with the effective size in terms of space from the tips of the absorber is 12m (Length) x 20m (Depth) x 8.5m (Height). This chamber achieves broadband performance using a unique arrangement of hybrid and ferrite tile absorber. This chamber has a built in 3m diameter turntable (Embedded type). The metal structure of the table makes electrical connection around the entire circumference of the turntable to the ground plane with a metal brush type connection. The turntable is located on one end of the chamber and the antennas are mounted 3 and 10 meters away at the other end of the chamber on the adjustable an Antenna Mast. The antenna mast is a non-conductive bore sighted type with remote control of antenna height and polarization. The Antenna Mast and the turntable can be remotely controlled through the controller located in the adjacent Control room. A Styrofoam table 80 cm high is used for table-top equipment.

Measurement Uncertainty

| Measurement | Frequency Range | Expanded Uncertainty (k=2) | Ucisp |
|-------------------------|-----------------|----------------------------|--------|
| Radiated Emissions, 10m | 30-1000 MHz | 4.6dB | 6.3 dB |
| Radiated Emissions, 3m | 30-1000 MHz | 5.3 dB | 6.3 dB |
| Radiated Emissions, 3m | 1-6 GHz | 4.5 dB | 5.2 dB |
| Radiated Emissions, 3m | 6-15 GHz | 5.2 dB | 5.5 dB |
| Radiated Emissions, 3m | 15-18 GHz | 5.0 dB | 5.5 dB |
| Radiated Emissions, 3m | 18-40 GHz | 5.0 dB | 5.5 dB |

As shown in the table above our radiated emissions U_{lab} is less than the corresponding U_{CISPR} reference value in CISPR 16-4-2 Table 1, hence the compliance of the product is only based on the measured value, and no measurement uncertainty correction is required, based on CISPR 22 and CISPR 11 (for 2006 and later revisions) Clause 11.

Sample Calculation

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

$$FS = RA + AF + CF - AG$$

Where

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

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

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

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

To convert from dB μ V to μ V or mV the following was used:

$$UF = 10^{(NF / 20)} \text{ where UF = Net Reading in } \mu\text{V}$$

$$NF = \text{Net Reading in dB}\mu\text{V}$$

Example:

$$FS = RA + AF + CF - AG = 52.0 + 7.4 + 1.6 - 29.0 = 32.0$$

$$UF = 10^{(32 \text{ dB}\mu\text{V} / 20)} = 39.8 \mu\text{V/m}$$

9.2 Test Equipment Used:

Conducted measurements

| Asset | Description | Manufacturer | Model | Serial | Cal Date | Cal Due |
|-----------|------------------------------|--------------------|-----------------------|------------|-------------------------|-------------------------|
| DAV001' | Weather Station | Davis Instruments | 7400 | PE80519A61 | 12/07/2017 | 12/07/2018 |
| ROS005-1' | Signal and Spectrum Analyzer | Rohde and Schwartz | FSW43 | 100646 | 11/07/2017 | 11/07/2018 |
| DUT 1' | Coaxial Cable | UTIFLEX MICRO-COAX | UFA210A-1-0787-300300 | 101709 | 02/01/2018 | 02/01/2019 |
| -- | 20 dB Attenuator | Pasternack | PE7004-20 | None | Verified Before Used | Verified Before Used |

Radiated measurements

| Asset | Description | Manufacturer | Model | Serial | Cal Date | Cal Due |
|----------|-------------------------------------------|-----------------|-------------------|------------|------------|------------|
| BAR1' | Digital 4 Line Barometer | Mannix | 0ABA116 | BAR1 | 04/30/2018 | 04/30/2019 |
| 145128' | EMI Receiver (20 Hz - 40 Ghz) | Rohde & Schwarz | ESIB 40 | 839283/001 | 03/22/2018 | 03/22/2019 |
| 145-416' | Cables 145-420 145-423 145-425 145-408 | Huber + Suhner | 3m Track B cables | multiple | 07/25/2018 | 07/25/2019 |
| ETS005' | 1-18GHz horn antenna | ETS-Lindgren | 3117 | 00218279 | 05/14/2018 | 05/14/2019 |

Software Utilized:

| Name | Manufacturer | Version |
|-----------------------|-----------------|----------|
| R&S EMC32/AMS32/WMS32 | Rohde & Schwarz | 10.30.00 |

| Name | Manufacturer | Version |
|--------------------|--------------|------------|
| EMI Boxborough.xls | Intertek | 08/27/2010 |

9.3 Results:

The sample tested was found to Comply.

15.247 (d) In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c))

9.4 Setup Photograph:

Antenna Port Conducted Test Setup



Radiated Test Setup



9.5 Plots/Data:

FCC Part 47 §15.247 2400-2483.5 MHz 2016

Band Edge low (2402 MHz; 30.000 dBm; 1 MHz)

Test according to FCC title 47 part 15 §15.247(d), KDB 558074 D01 DTS Meas Guidance v03r05 and ANSI C63.10

Measurement uncertainty calculated in accordance with ETSI TR 100 028-1.
Expanded Uncertainty (K=2) < 0.6 dB

Result

| DUT Frequency (MHz) | Result |
|---------------------|--------|
| 2402.000000 | PASS |

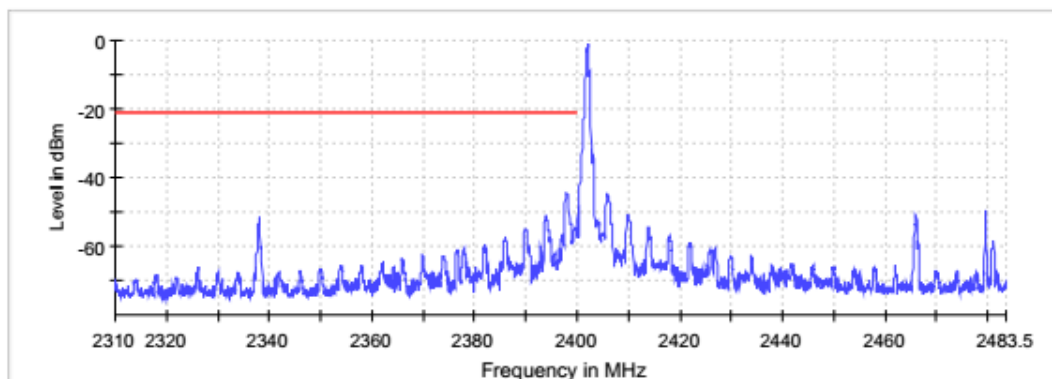
Inband Peak

| Frequency (MHz) | Level (dBm) |
|-----------------|-------------|
| 2402.025000 | -1.2 |

Measurements

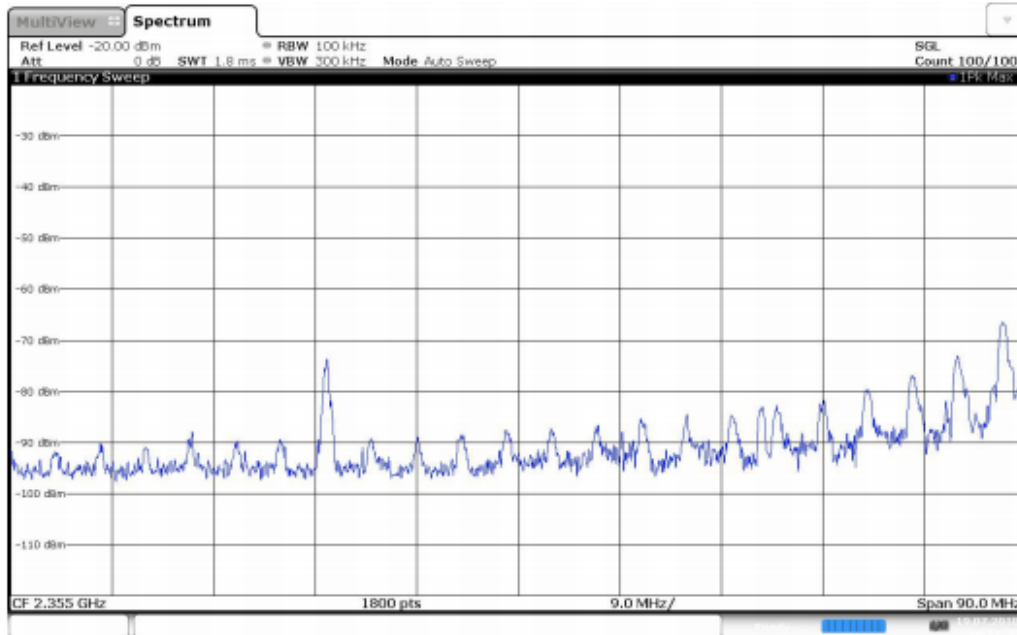
| Frequency (MHz) | Level (dBm) | Margin (dB) | Limit (dBm) | Result |
|-----------------|-------------|-------------|-------------|--------|
| 2397.925000 | -44.3 | 23.1 | -21.2 | PASS |
| 2397.975000 | -44.5 | 23.2 | -21.2 | PASS |
| 2397.875000 | -44.6 | 23.4 | -21.2 | PASS |
| 2398.025000 | -44.8 | 23.6 | -21.2 | PASS |
| 2397.775000 | -44.9 | 23.7 | -21.2 | PASS |
| 2398.125000 | -45.0 | 23.8 | -21.2 | PASS |
| 2397.825000 | -45.0 | 23.8 | -21.2 | PASS |
| 2398.075000 | -45.1 | 23.9 | -21.2 | PASS |
| 2398.175000 | -45.5 | 24.2 | -21.2 | PASS |
| 2397.725000 | -45.6 | 24.4 | -21.2 | PASS |
| 2398.225000 | -46.2 | 24.9 | -21.2 | PASS |
| 2397.675000 | -46.2 | 25.0 | -21.2 | PASS |
| 2398.275000 | -47.3 | 26.1 | -21.2 | PASS |
| 2397.625000 | -47.5 | 26.3 | -21.2 | PASS |
| 2398.325000 | -48.8 | 27.6 | -21.2 | PASS |

Band Edge



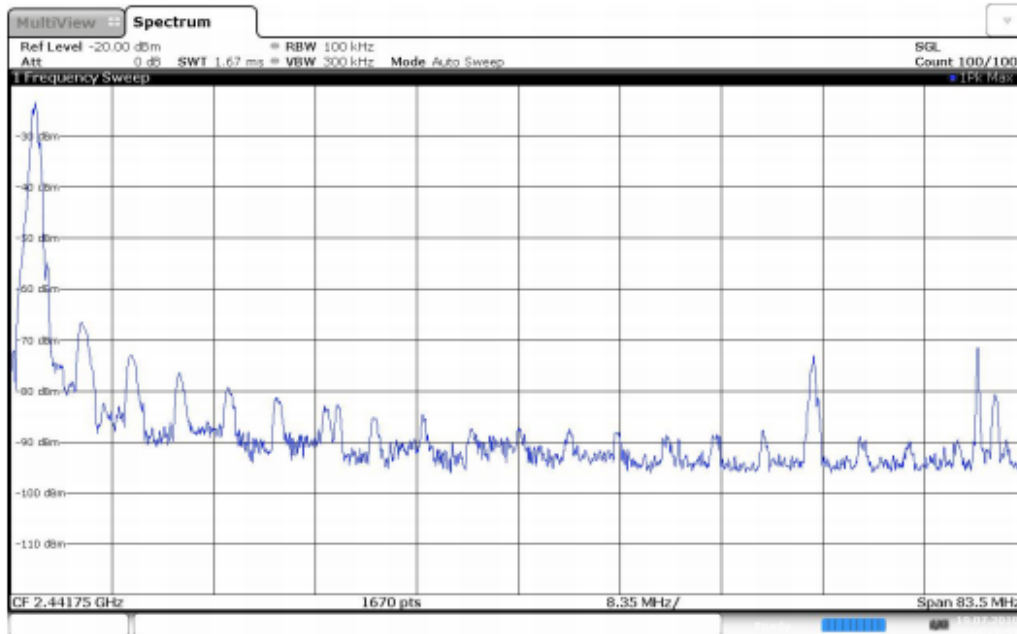
FCC Part 47 §15.247 2400-2483.5 MHz 2016

Band Edge Connector 1_0



16:11:39 19.07.2018

Band Edge Connector 1_1



16:11:52 19.07.2018

FCC Part 47 §15.247 2400-2483.5 MHz 2016

Band Edge high (2480 MHz; 30.000 dBm; 1 MHz)

Test according to FCC title 47 part 15 §15.247(d), KDB 558074 D01 DTS Meas Guidance v03r05 and ANSI C63.10

Measurement uncertainty calculated in accordance with ETSI TR 100 028-1.
Expanded Uncertainty (K=2) < 0.6 dB

Result

| DUT Frequency (MHz) | Result |
|---------------------|--------|
| 2480.000000 | PASS |

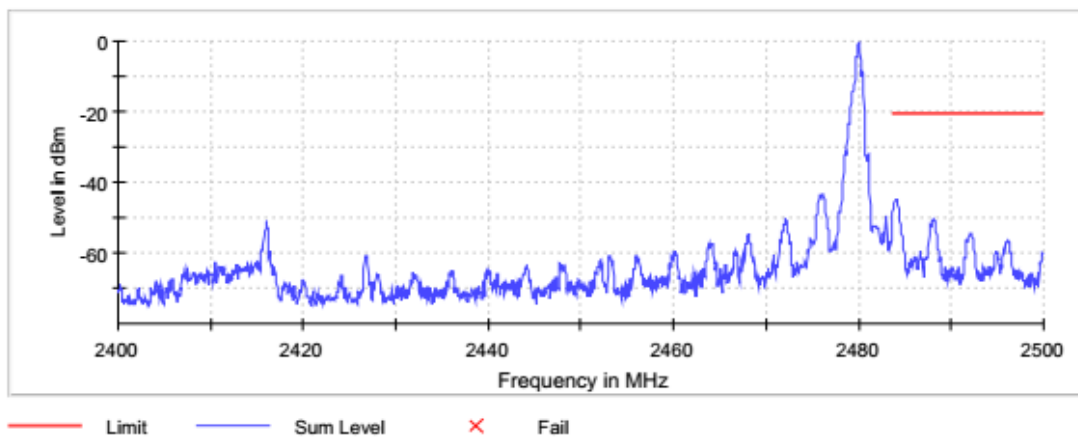
Inband Peak

| Frequency (MHz) | Level (dBm) |
|-----------------|-------------|
| 2480.025000 | -0.6 |

Measurements

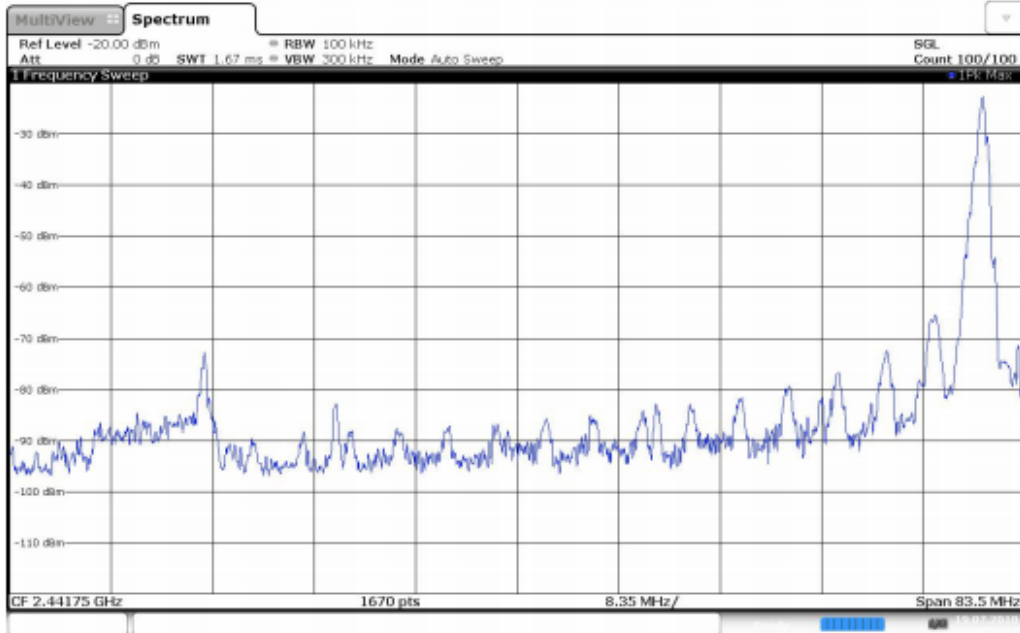
| Frequency (MHz) | Level (dBm) | Margin (dB) | Limit (dBm) | Result |
|-----------------|-------------|-------------|-------------|--------|
| 2483.975000 | -44.8 | 24.3 | -20.6 | PASS |
| 2484.075000 | -44.8 | 24.3 | -20.6 | PASS |
| 2484.025000 | -45.0 | 24.4 | -20.6 | PASS |
| 2483.925000 | -45.1 | 24.5 | -20.6 | PASS |
| 2484.125000 | -45.1 | 24.6 | -20.6 | PASS |
| 2484.175000 | -45.3 | 24.7 | -20.6 | PASS |
| 2484.225000 | -45.5 | 25.0 | -20.6 | PASS |
| 2483.875000 | -46.0 | 25.4 | -20.6 | PASS |
| 2483.825000 | -46.1 | 25.5 | -20.6 | PASS |
| 2484.275000 | -46.5 | 25.9 | -20.6 | PASS |
| 2483.775000 | -46.6 | 26.0 | -20.6 | PASS |
| 2483.725000 | -47.4 | 26.9 | -20.6 | PASS |
| 2484.325000 | -47.5 | 27.0 | -20.6 | PASS |
| 2484.375000 | -48.2 | 27.7 | -20.6 | PASS |
| 2483.675000 | -48.5 | 28.0 | -20.6 | PASS |

Band Edge



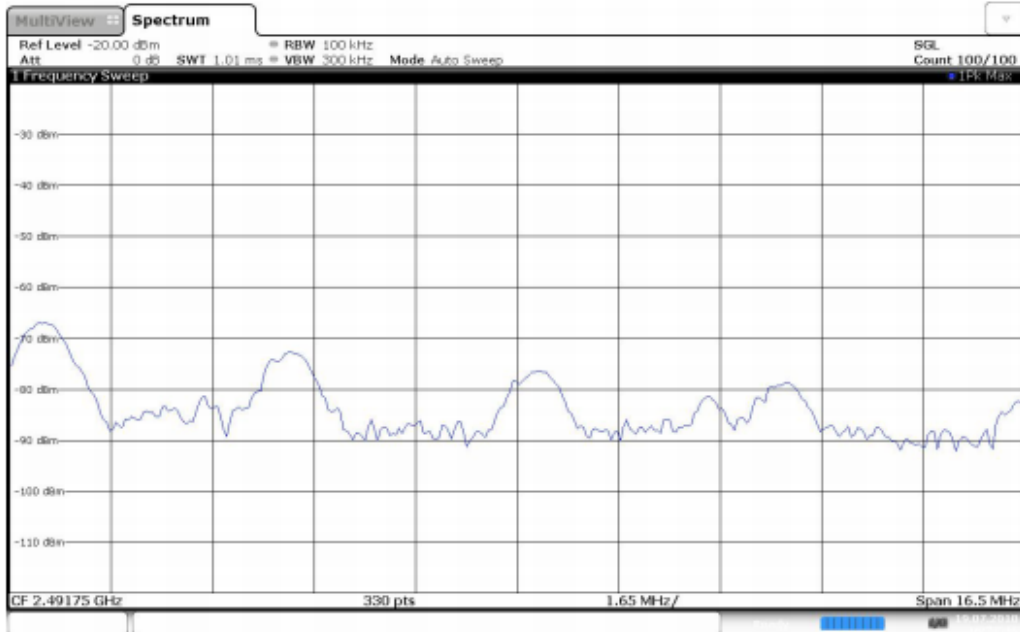
FCC Part 47 §15.247 2400-2483.5 MHz 2016

Band Edge Connector 1_0



16:22:38 19.07.2018

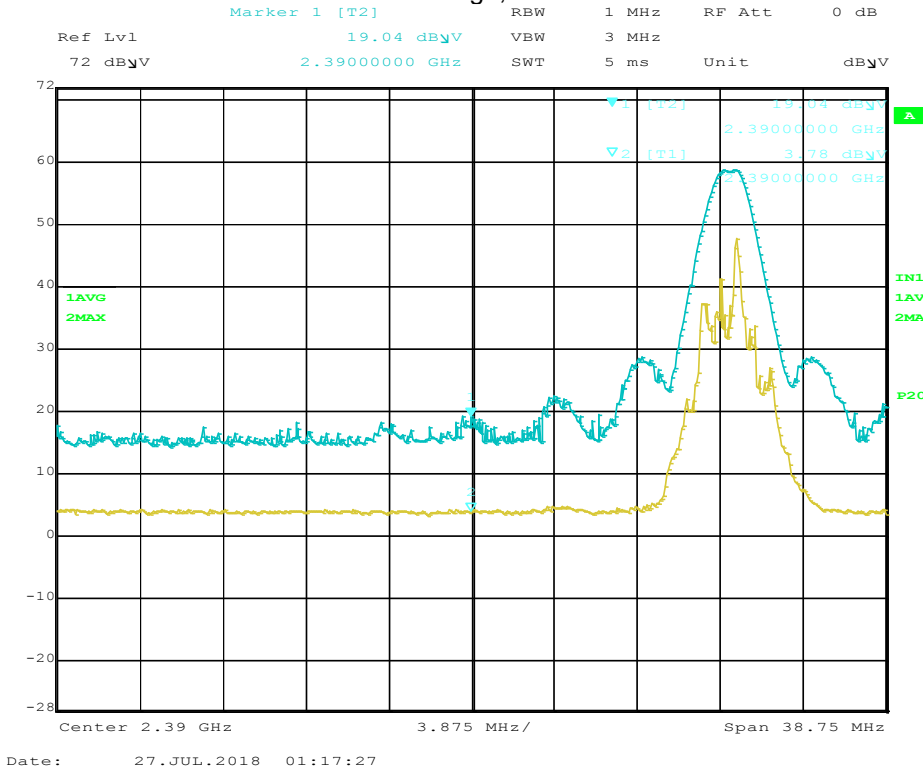
Band Edge Connector 1_1



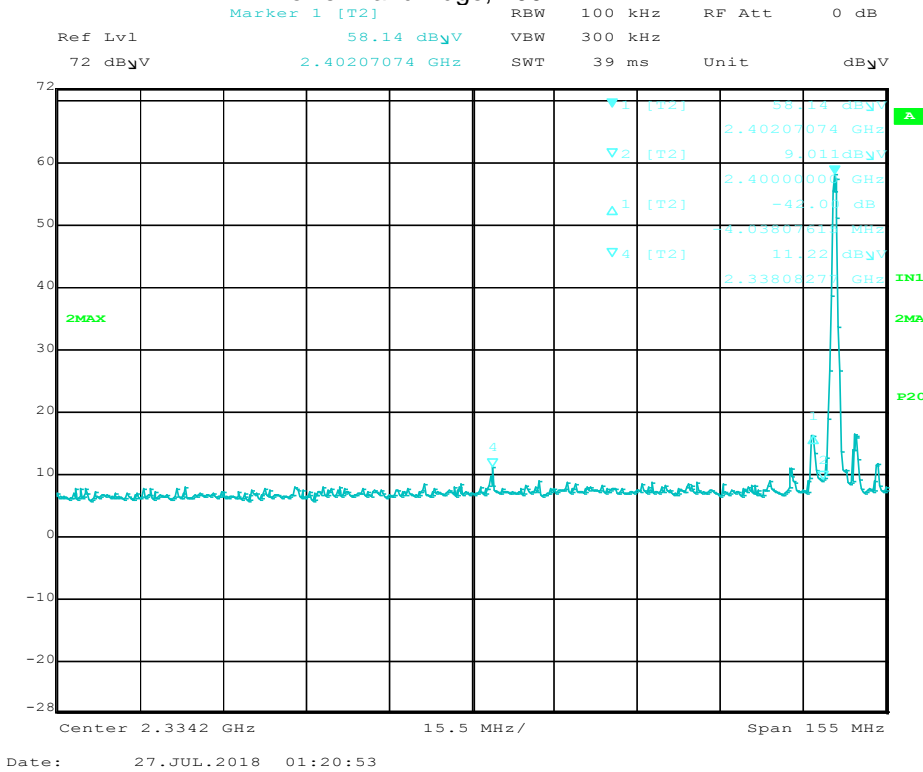
16:22:47 19.07.2018

Radiated measurements

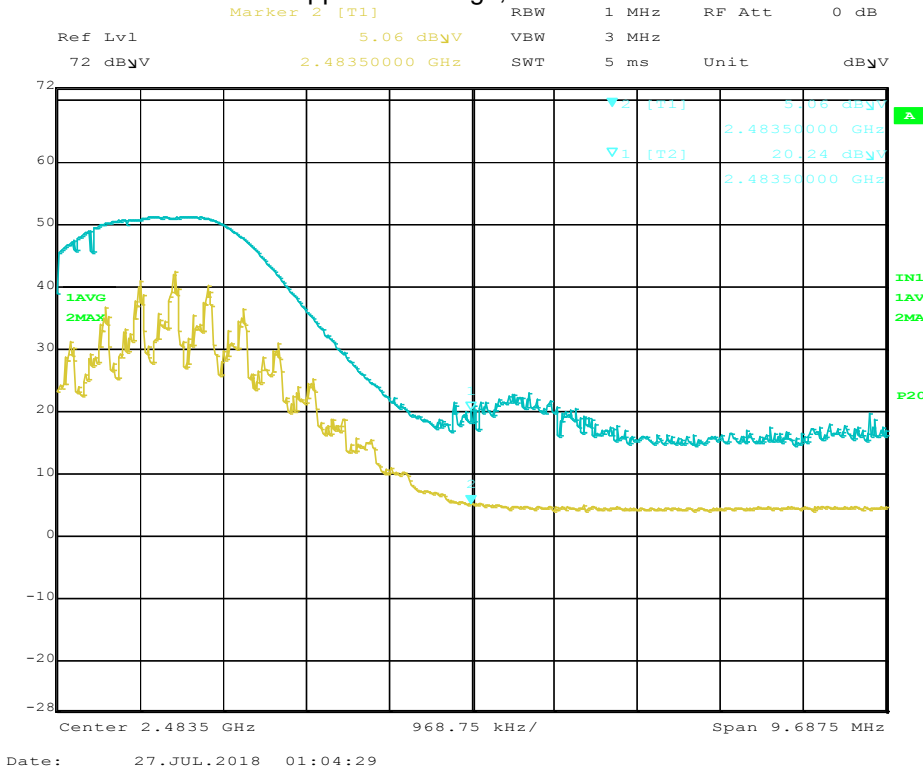
Lower Band Edge, 1MHz RBW



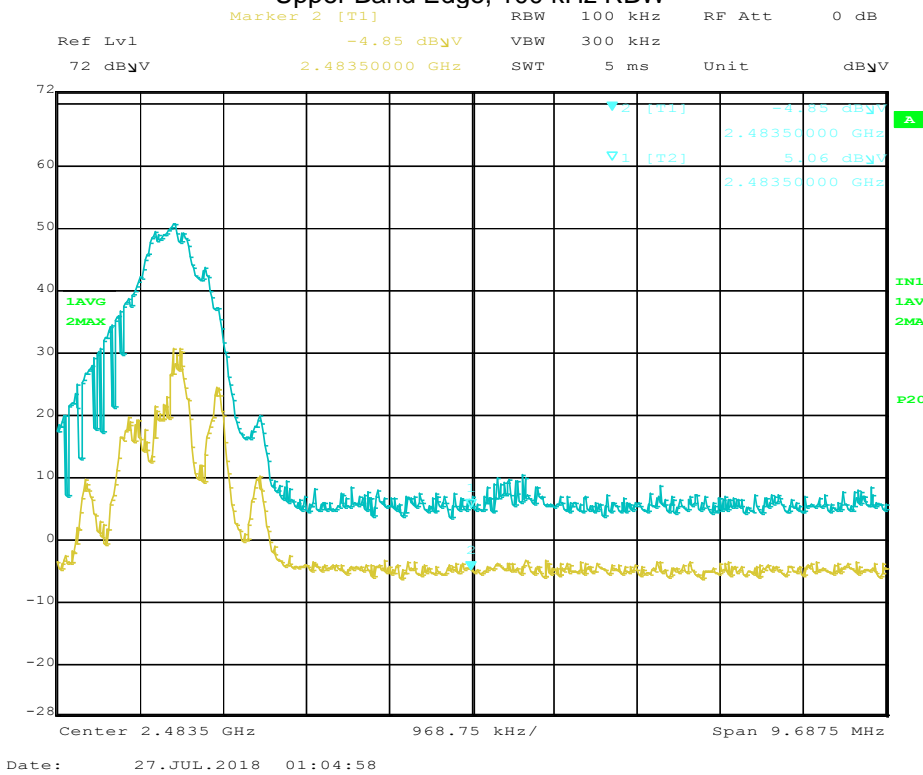
Lower Band Edge, 100 kHz RBW



Upper Band Edge, 1MHz RBW



Upper Band Edge, 100 kHz RBW



Test Personnel: Kouma Sinn *KPS*
Supervising/Reviewing Engineer: Vathana Ven *VSV*
(Where Applicable) Vathana Ven *VSV*
Product Standard: CFR47 FCC Part 15.247
RSS-247, RSS-102
Input Voltage: Internal Battery Powered

Pretest Verification w/
Ambient Signals or
BB Source: N/A

Test Date: 07/19/2018
07/29/2018

Limit Applied: See report section 9.3

Ambient Temperature: 25, 21 °C

Relative Humidity: 32, 50 %

Atmospheric Pressure: 1008, 1001 mbars

Deviations, Additions, or Exclusions: None

10 Transmitter spurious emissions

10.1 Method

Tests are performed in accordance with FCC Part 15 Subpart C 15.247, FCC Part 15 Subpart B, RSS 247 ICES 003, ANSI C 63.10, and ANSI C 63.4.

TEST SITE: EMC Lab & 10m ALSE

The EMC Lab has one Semi-anechoic Chamber and one Shielded Chamber. AC Mains Power is available at 120, 230, and 277 Single Phase; 208, 400, and 480 3-Phase. Large reference ground-planes are installed in the general lab area to facilitate EMC work not requiring a shielded environment.

The 10m ALSE is 13m (Length) x 21m (Depth) x 10m (Height) with the effective size in terms of space from the tips of the absorber is 12m (Length) x 20m (Depth) x 8.5m (Height). This chamber achieves broadband performance using a unique arrangement of hybrid and ferrite tile absorber. This chamber has a built in 3m diameter turntable (Embedded type). The metal structure of the table makes electrical connection around the entire circumference of the turntable to the ground plane with a metal brush type connection. The turntable is located on one end of the chamber and the antennas are mounted 3 and 10 meters away at the other end of the chamber on the adjustable an Antenna Mast. The antenna mast is a non-conductive bore sighted type with remote control of antenna height and polarization. The Antenna Mast and the turntable can be remotely controlled through the controller located in the adjacent Control room. A Styrofoam table 80 cm high is used for table-top equipment.

Measurement Uncertainty

| Measurement | Frequency Range | Expanded Uncertainty (k=2) | U _{CISPR} |
|-------------------------|-----------------|----------------------------|--------------------|
| Radiated Emissions, 10m | 30-1000 MHz | 4.6dB | 6.3 dB |
| Radiated Emissions, 3m | 30-1000 MHz | 5.3 dB | 6.3 dB |
| Radiated Emissions, 3m | 1-6 GHz | 4.5 dB | 5.2 dB |
| Radiated Emissions, 3m | 6-15 GHz | 5.2 dB | 5.5 dB |
| Radiated Emissions, 3m | 15-18 GHz | 5.0 dB | 5.5 dB |
| Radiated Emissions, 3m | 18-40 GHz | 5.0 dB | 5.5 dB |

As shown in the table above our radiated emissions U_{lab} is less than the corresponding U_{CISPR} reference value in CISPR 16-4-2 Table 1, hence the compliance of the product is only based on the measured value, and no measurement uncertainty correction is required, based on CISPR 22 and CISPR 11 (for 2006 and later revisions) Clause 11.

Sample Calculation

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

$$FS = RA + AF + CF - AG$$

Where

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

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

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

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

To convert from dB μ V to μ V or mV the following was used:

$$UF = 10^{(NF / 20)} \text{ where } UF = \text{Net Reading in } \mu\text{V}$$

$$NF = \text{Net Reading in dB}\mu\text{V}$$

Example:

$$FS = RA + AF + CF - AG = 52.0 + 7.4 + 1.6 - 29.0 = 32.0$$

$$UF = 10^{(32 \text{ dB}\mu\text{V} / 20)} = 39.8 \mu\text{V/m}$$

Alternately, when BAT-EMC Emission Software is used, the "Level" includes all losses and gains and is compared directly in the "Margin" column to the "Limit". The "Correction" includes Antenna Factor, Preamp, and Cable Loss. These are already accounted for in the "Level" column.

10.2 Test Equipment Used:

Conducted measurements

| Asset | Description | Manufacturer | Model | Serial | Cal Date | Cal Due |
|-----------|------------------------------|--------------------|-----------------------|------------|----------------------|----------------------|
| DAV001' | Weather Station | Davis Instruments | 7400 | PE80519A61 | 12/07/2017 | 12/07/2018 |
| ROS005-1' | Signal and Spectrum Analyzer | Rohde and Schwartz | FSW43 | 100646 | 11/07/2017 | 11/07/2018 |
| DUT 1' | Coaxial Cable | UTIFLEX MICRO-COAX | UFA210A-1-0787-300300 | 101709 | 02/01/2018 | 02/01/2019 |
| -- | 20 dB Attenuator | Pasternack | PE7004-20 | None | Verified Before Used | Verified Before Used |

Radiated measurements

| Asset | Description | Manufacturer | Model | Serial | Cal Date | Cal Due |
|------------|----------------------------------------------|----------------------|----------------------|-------------|------------|------------|
| BAR1' | Digital 4 Line Barometer | Mannix | 0ABA116 | BAR1 | 04/30/2018 | 04/30/2019 |
| 145128' | EMI Receiver (20 Hz - 40 Ghz) | Rohde & Schwarz | ESIB 40 | 839283/001 | 03/22/2018 | 03/22/2019 |
| ETS005' | 1-18GHz horn antenna | ETS-Lindgren | 3117 | 00218279 | 05/14/2018 | 05/14/2019 |
| EMC04' | ANTENNA, RIDGED GUIDE, 18-40 GHZ | EMCO | 3116 | 2090 | 09/21/2017 | 09/21/2018 |
| 145-410' | Cables 145-420 145-421 145-422 145-406 | Huber + Suhner | 10m Track A Cables | multiple | 07/25/2018 | 07/25/2019 |
| 145-416' | Cables 145-420 145-423 145-425 145-408 | Huber + Suhner | 3m Track B cables | multiple | 07/25/2018 | 07/25/2019 |
| PRE11' | 50dB gain pre-amp | Keith H | PRE11 | PRE11 | 12/02/2017 | 12/02/2018 |
| PRE8' | PREAMPLIFIER 1- 40 GHz | MITEQ | NSP4000-NF | 507145 | 10/02/2017 | 10/02/2018 |
| REA008' | band reject filter 2.4GHz | Reactel, Inc | 12RX7-2441.75-x140 S | 17-01 | 07/13/2018 | 07/13/2019 |
| 145108' | EMI Test Receiver (20Hz - 40GHz) | Rohde & Schwarz | ESIB40 | 100209 | 06/01/2018 | 06/01/2019 |
| MEG002' | Cable,SMA-SMA,9KHz-40GHz, (Cable Kit 6) | Megaphase | TM40-K1K1-197 | 59006401001 | 09/05/2017 | 09/05/2018 |
| CBLSHF204' | Cable, SMA - SMA, 9kHz -40GHz, (Cable Kit 5) | Huber + Suhner | Sucoflex 102EA | 234714001 | 10/30/2017 | 10/30/2018 |
| 145145' | Broadband Hybrid Antenna 30 MHz - 3 GHz | Sunol Sciences Corp. | JB3 | A122313 | 05/16/2018 | 05/16/2019 |

Software Utilized:

| Name | Manufacturer | Version |
|-----------------------|-----------------|----------|
| R&S EMC32/AMS32/WMS32 | Rohde & Schwarz | 10.30.00 |
| BAT-EMC | Nexio | 3.17.0.3 |

10.3 Results:

The sample tested was found to Comply.

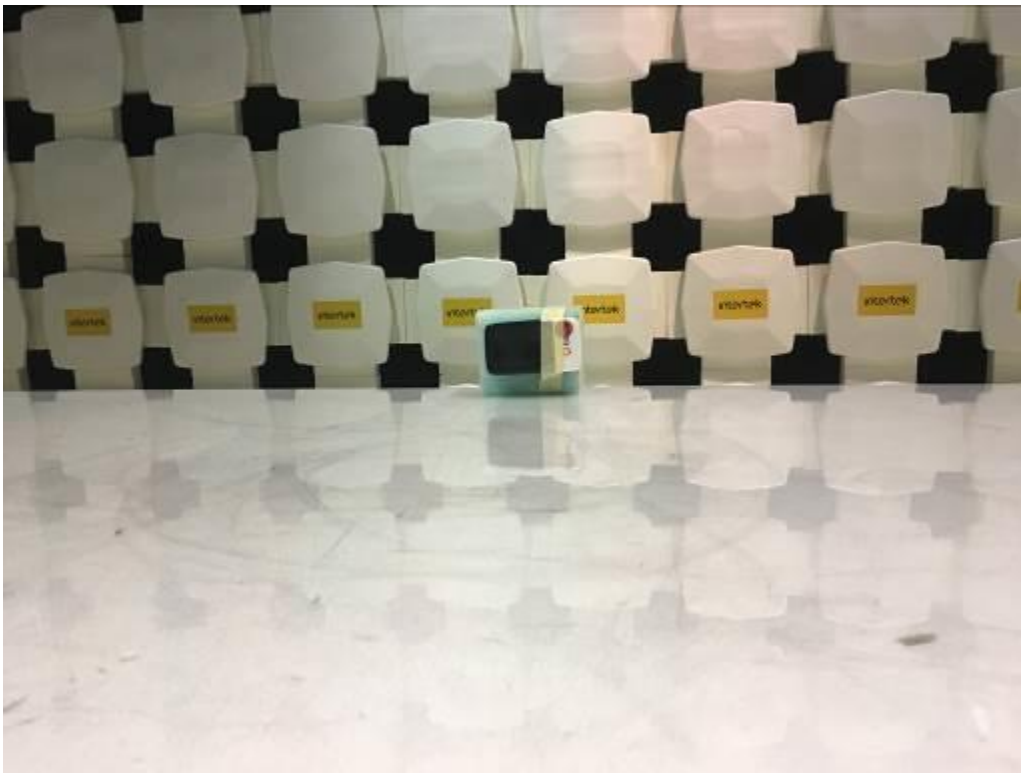
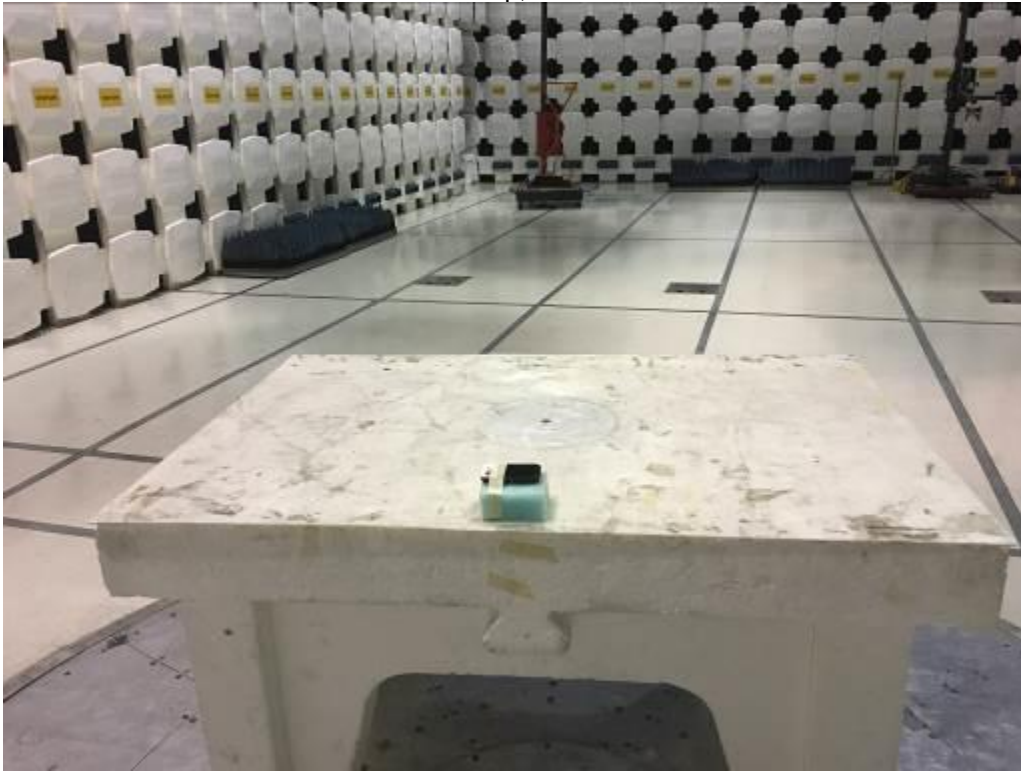
15.247 (d) In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c))

10.4 Setup Photographs:

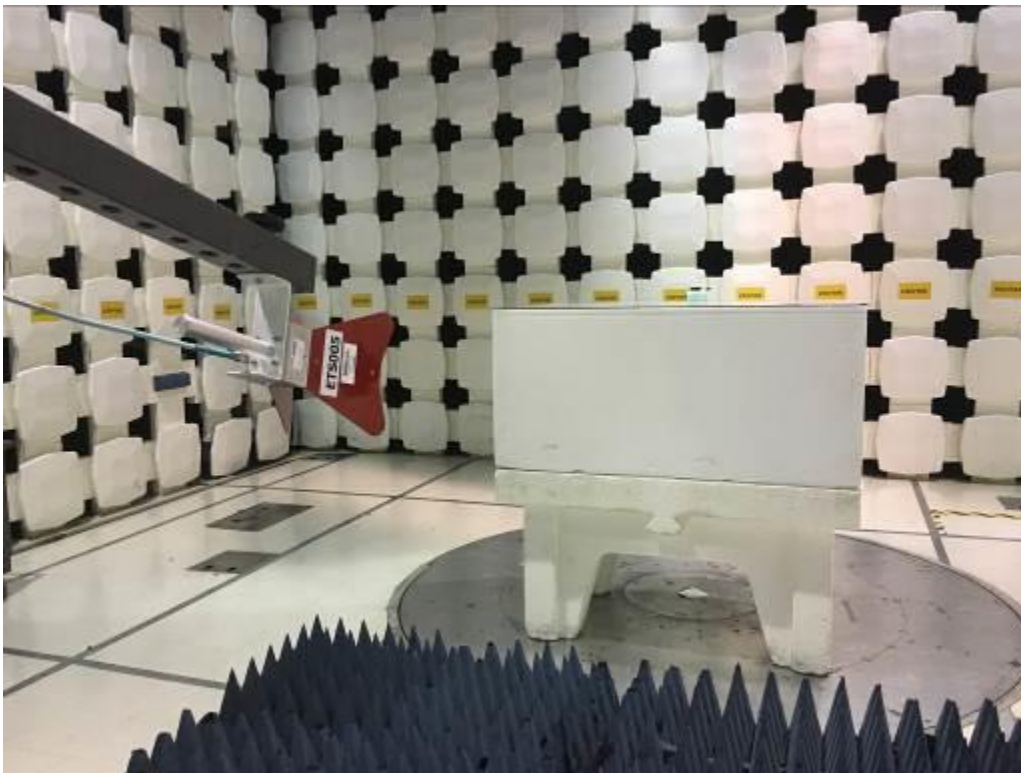
Antenna Port Conducted Test Setup



Radiated Setup, 30-1000 MHz



Radiated Setup, 1-18 GHz

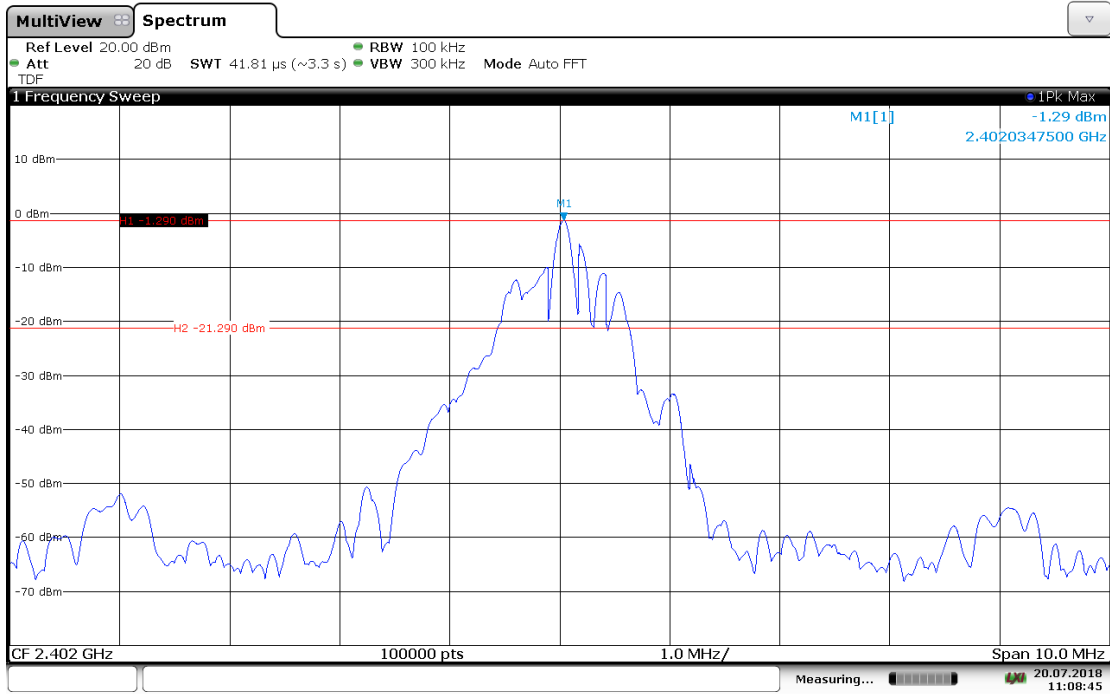


Radiated Setup, 18-25 GHz



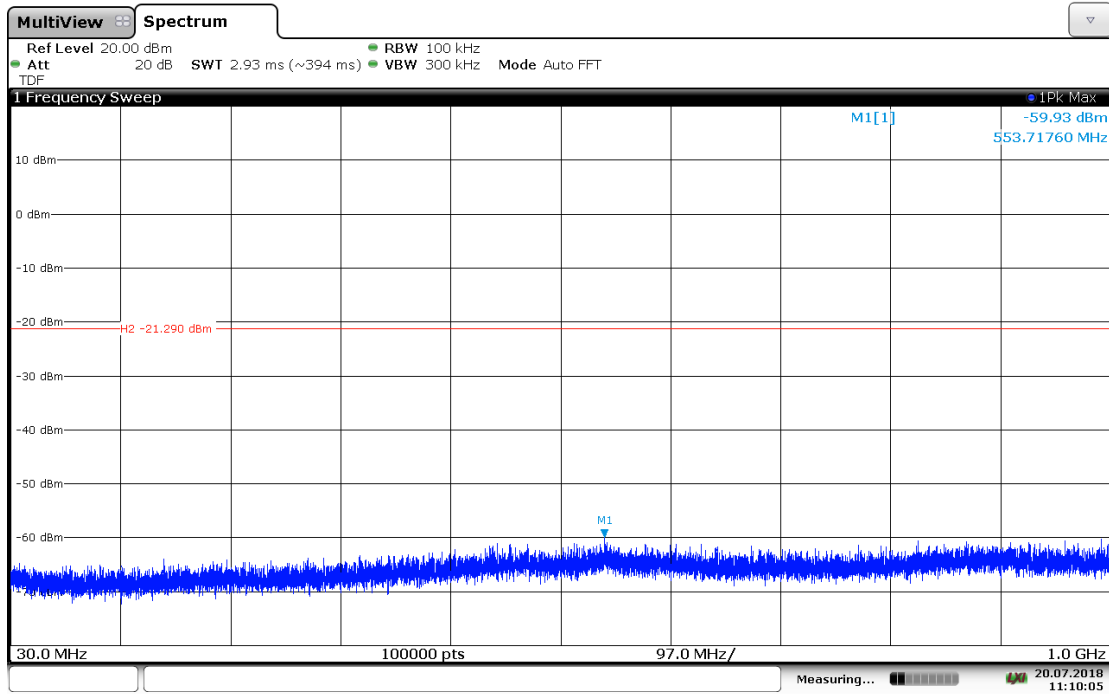
10.5 Plots/Data:

Limit: 20 dB down from the carrier (Low Channel)



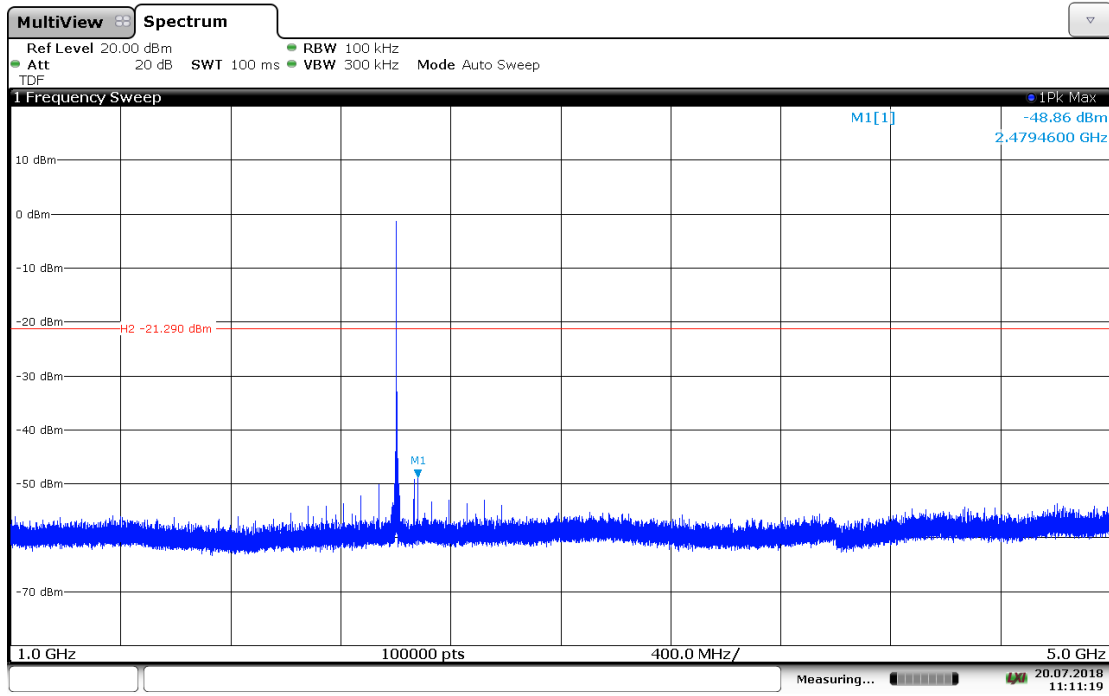
11:08:45 20.07.2018

Low Channel Antenna Port Conducted Spurious Emissions, 30 MHz-1000 MHz



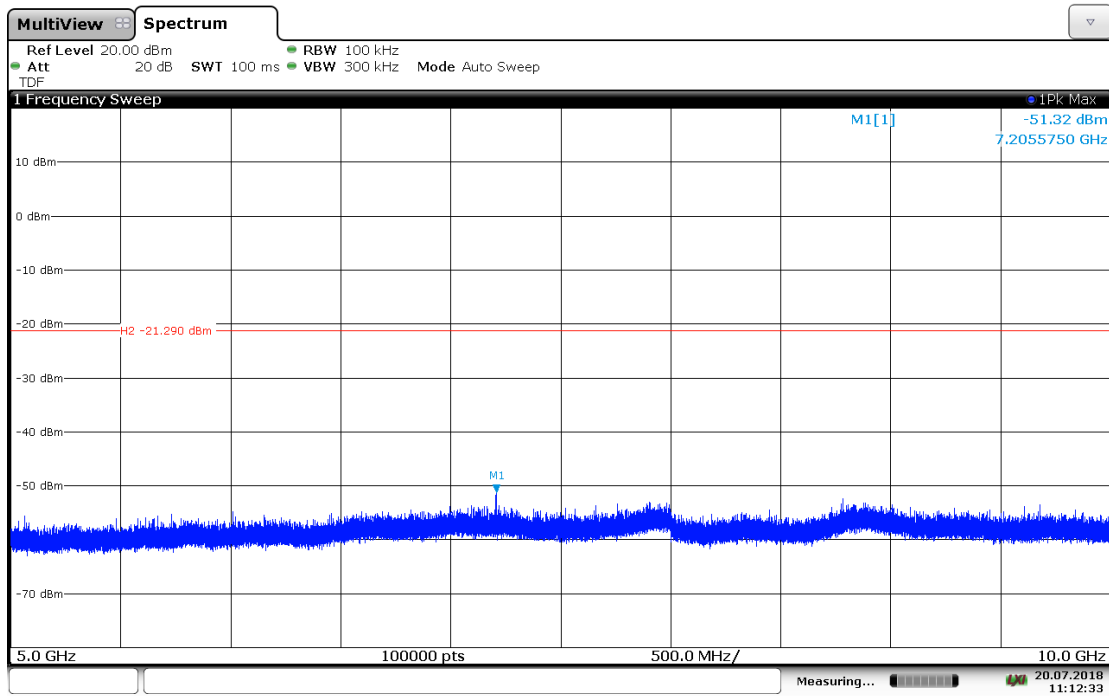
11:10:05 20.07.2018

Low Channel Antenna Port Conducted Spurious Emissions, 1-5 GHz



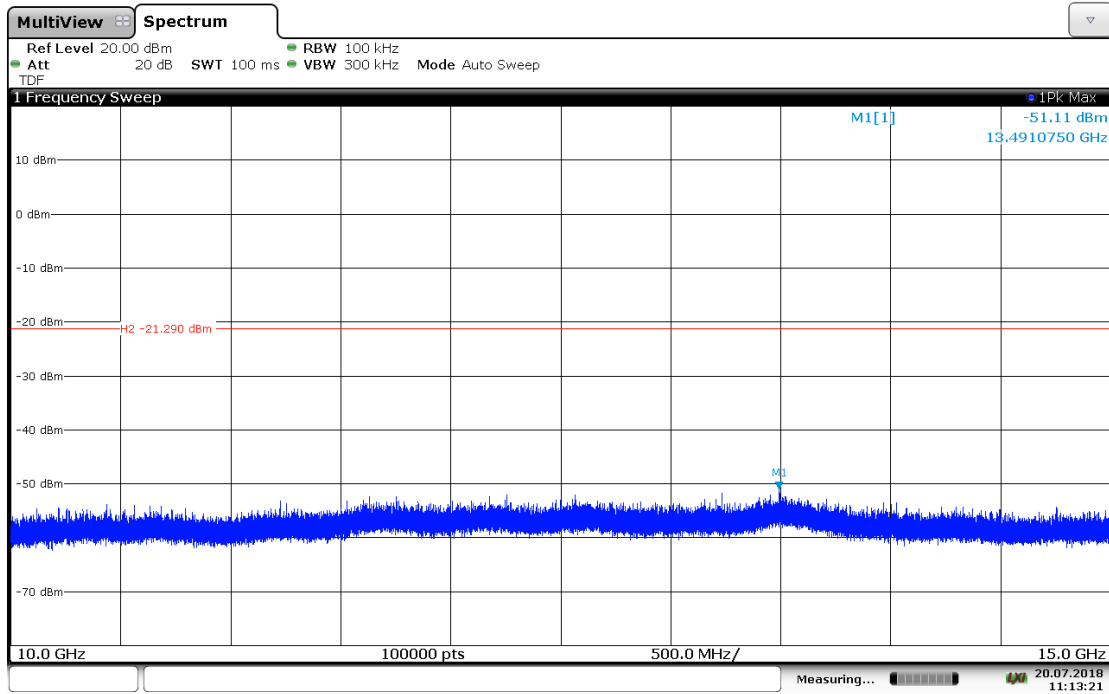
11:11:20 20.07.2018

Low Channel Antenna Port Conducted Spurious Emissions, 5-10 GHz



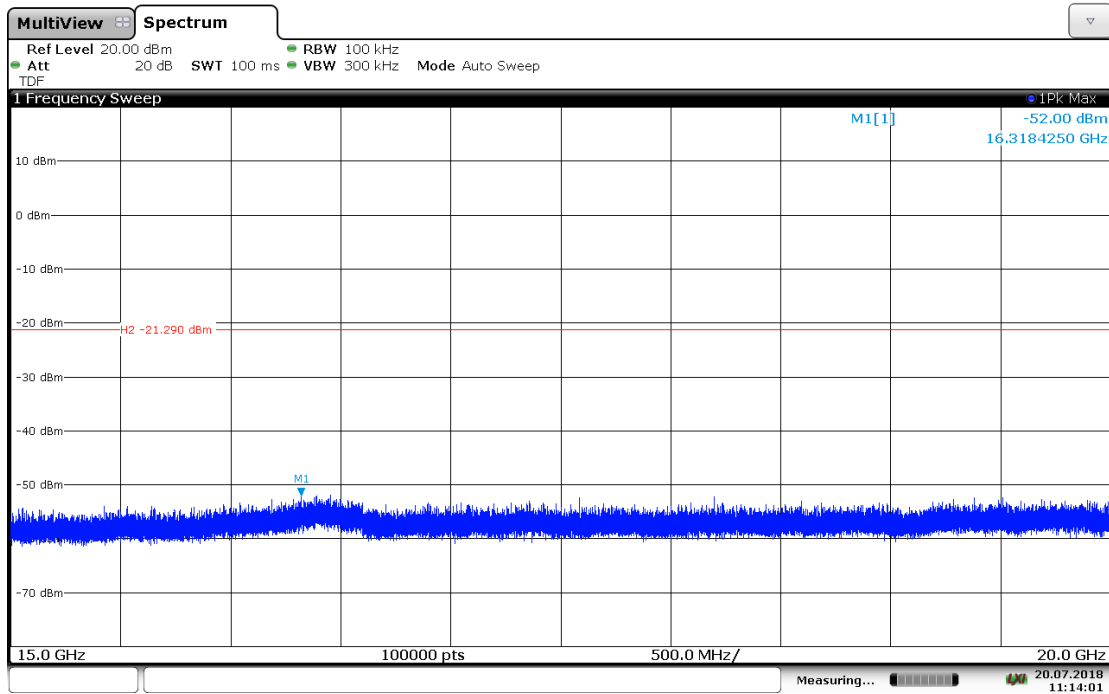
11:12:34 20.07.2018

Low Channel Antenna Port Conducted Spurious Emissions, 10-15 GHz



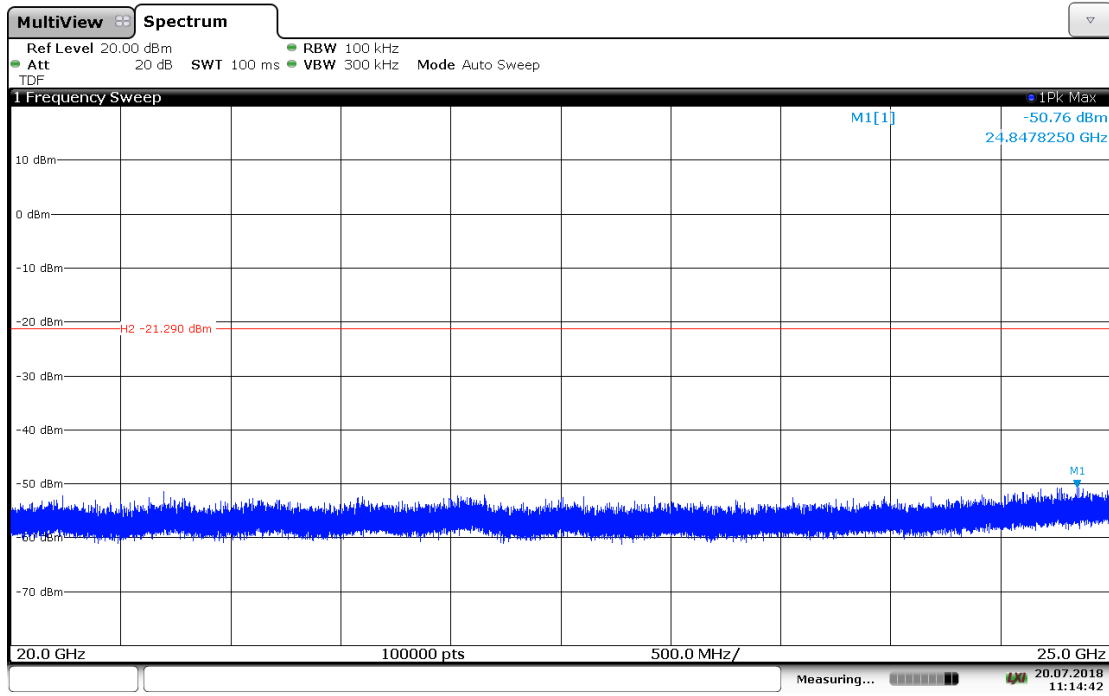
11:13:21 20.07.2018

Low Channel Antenna Port Conducted Spurious Emissions, 15-20 GHz



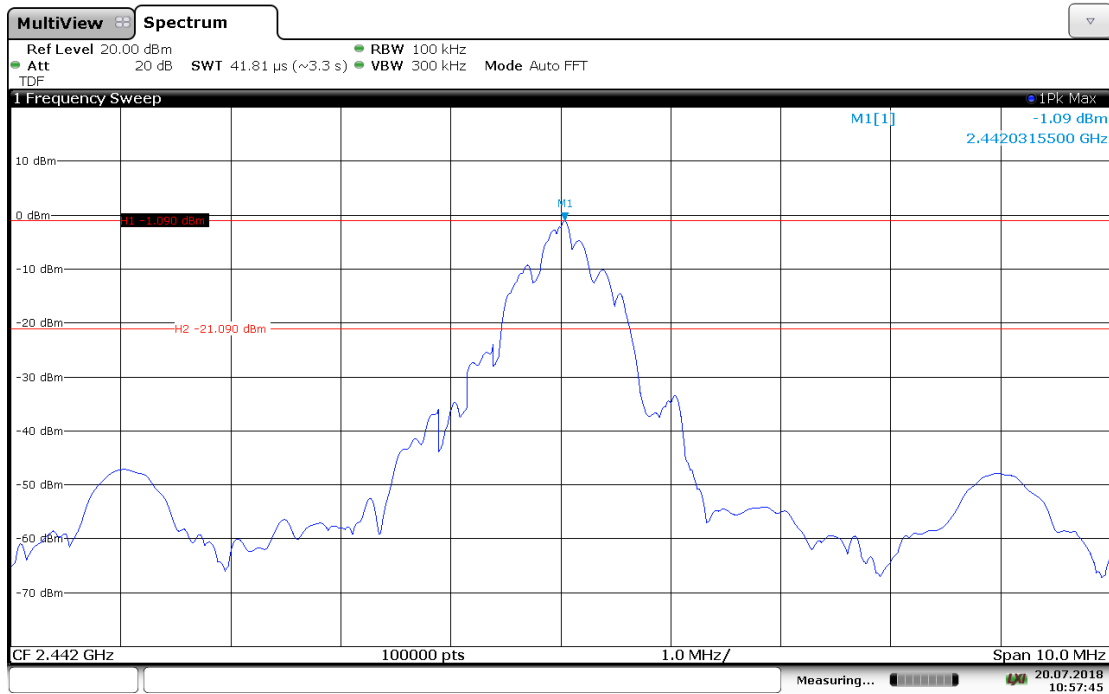
11:14:03 20.07.2018

Low Channel Antenna Port Conducted Spurious Emissions, 20-25 GHz



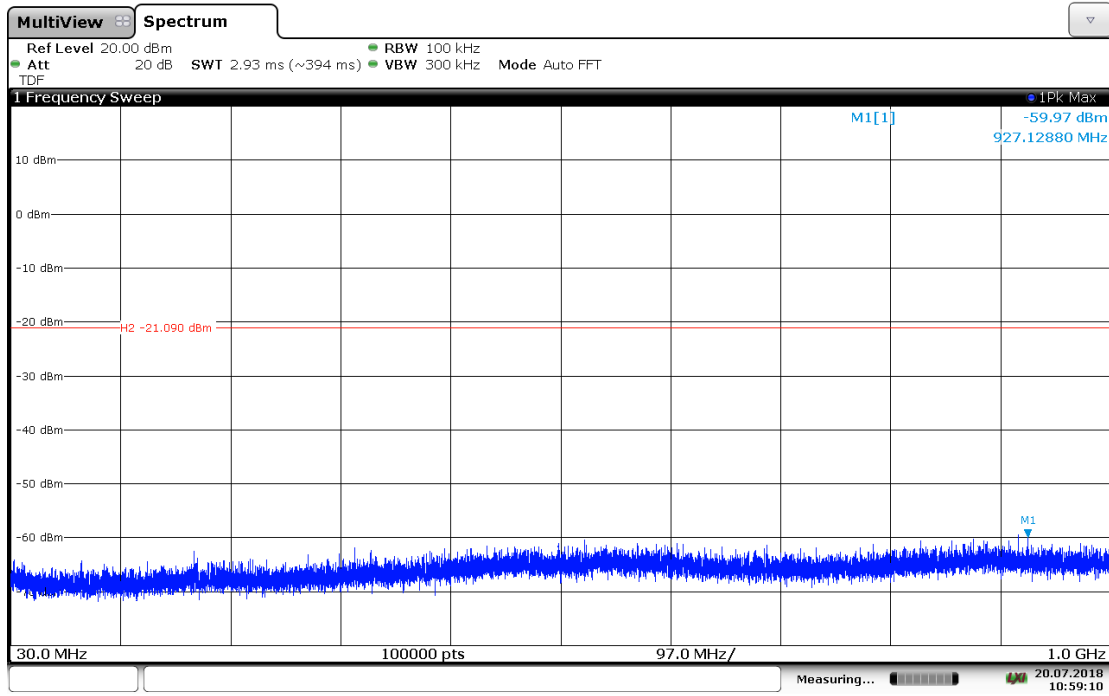
11:14:43 20.07.2018

Limit: 20 dB down from the carrier (Mid Channel)



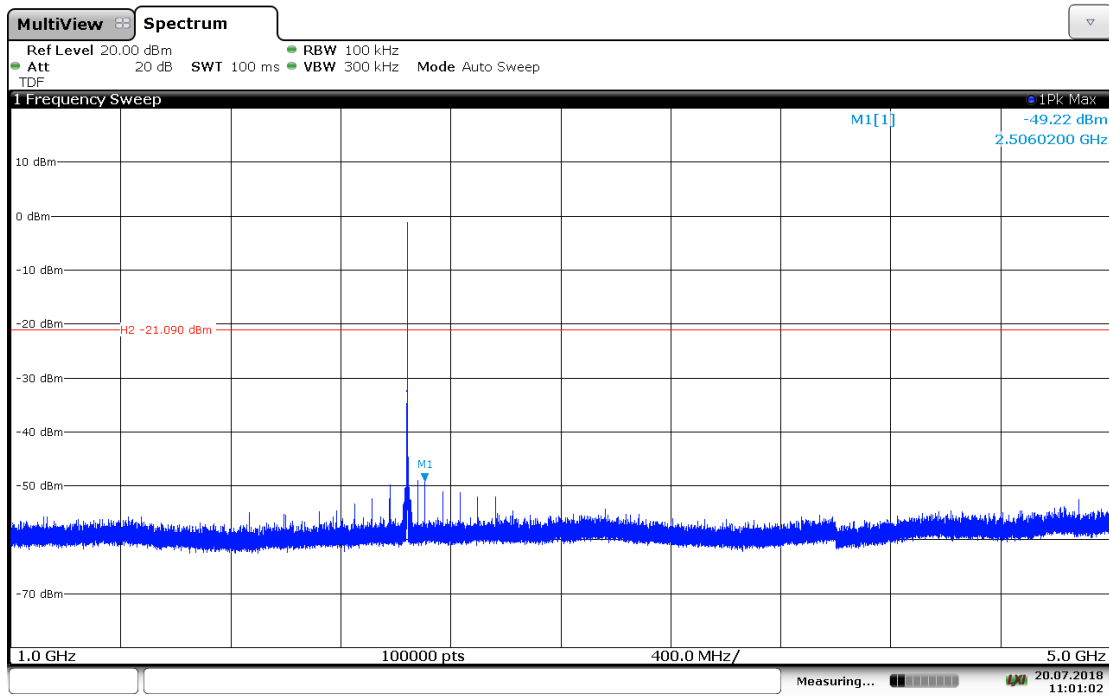
10:57:46 20.07.2018

Mid Channel Antenna Port Conducted Spurious Emissions, 30-1000 MHz



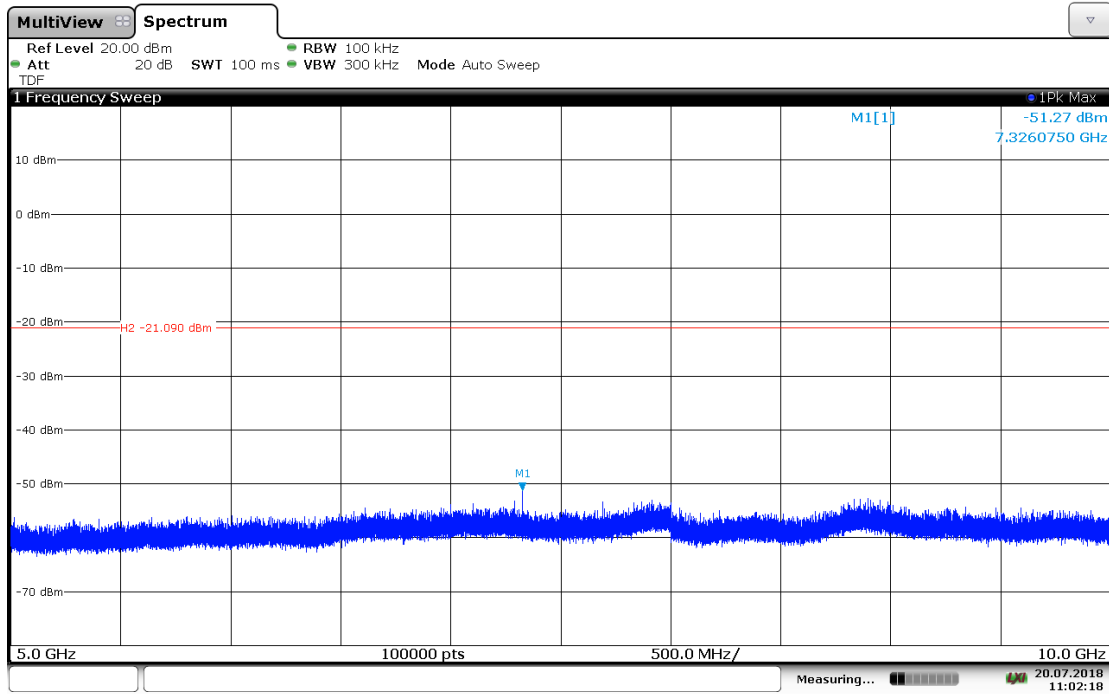
10:59:10 20.07.2018

Mid Channel Antenna Port Conducted Spurious Emissions, 1-5 GHz



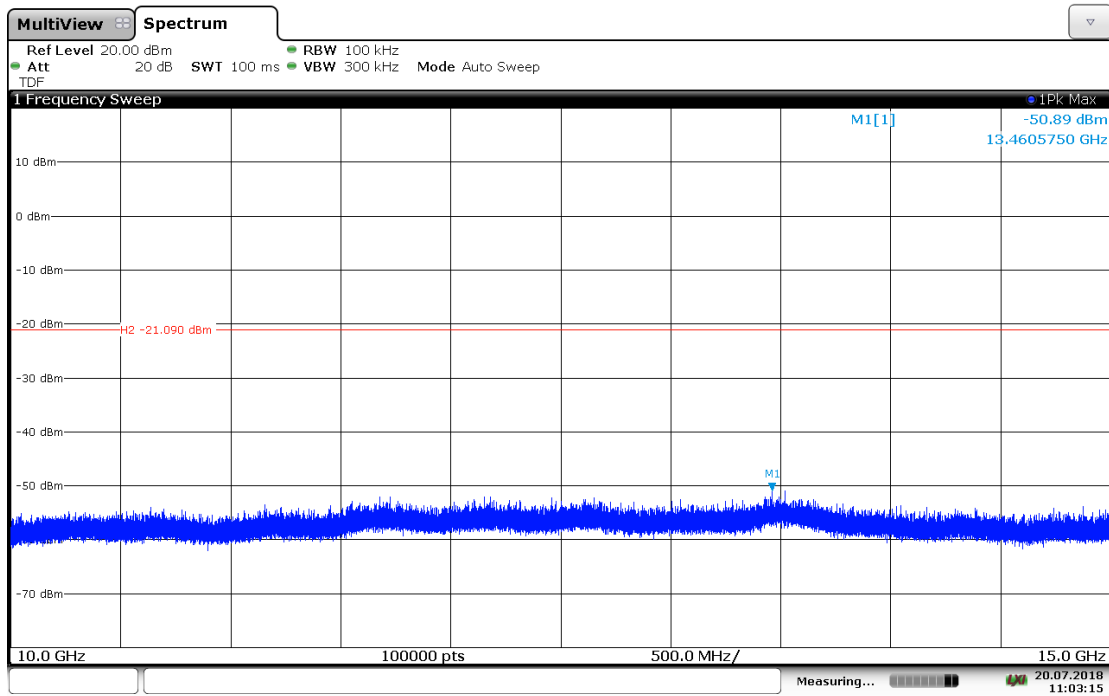
11:01:03 20.07.2018

Mid Channel Antenna Port Conducted Spurious Emissions, 5-10 GHz



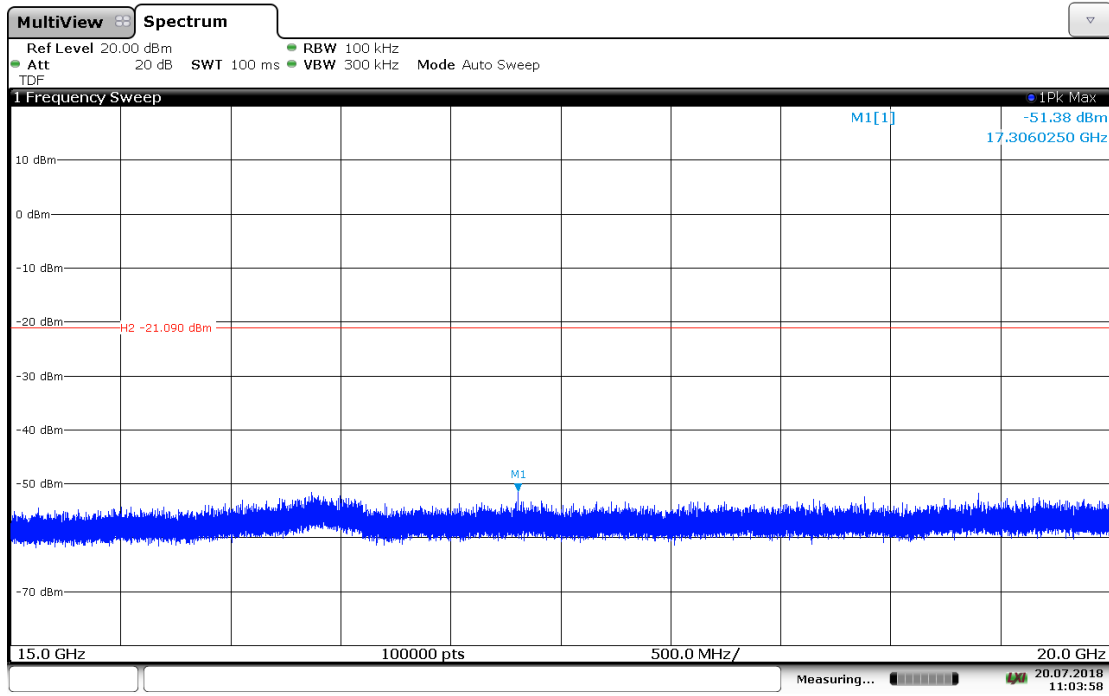
11:02:18 20.07.2018

Mid Channel Antenna Port Conducted Spurious Emissions, 10-15 GHz



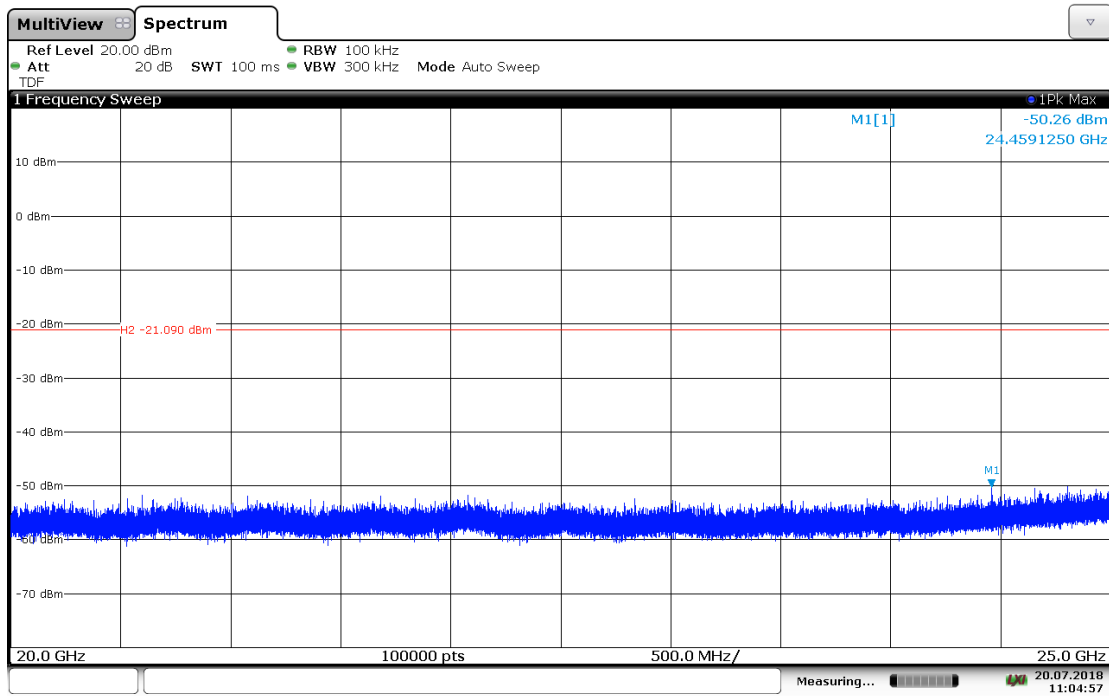
11:03:15 20.07.2018

Mid Channel Antenna Port Conducted Spurious Emissions, 15-20 GHz



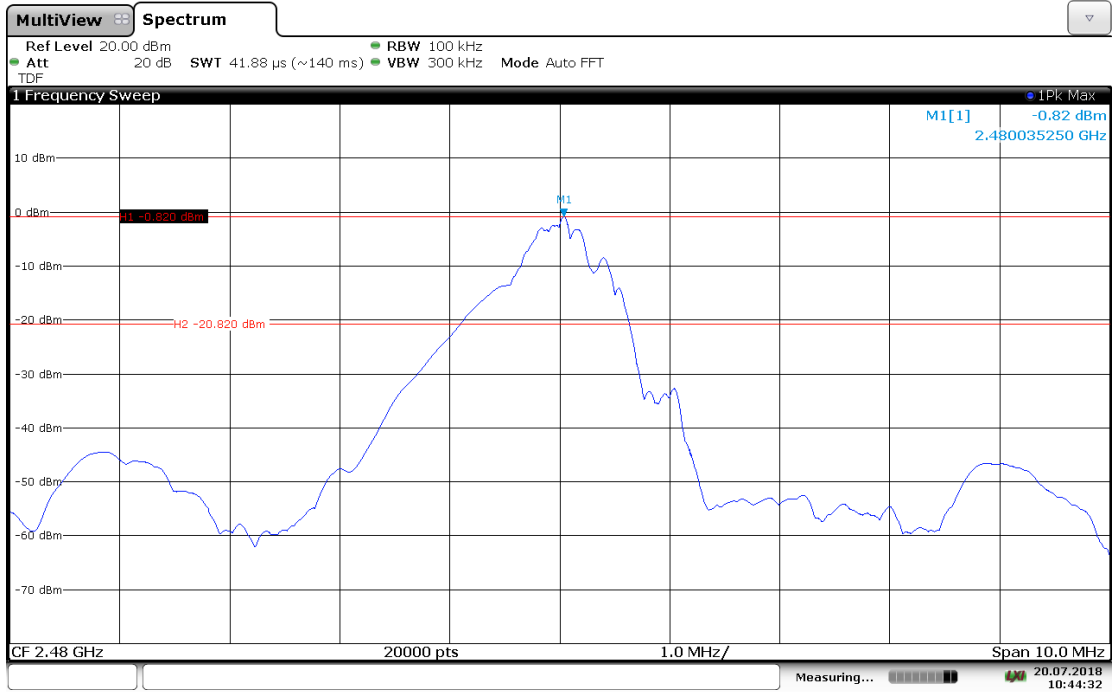
11:03:59 20.07.2018

Mid Channel Antenna Port Conducted Spurious Emissions, 20-25 GHz



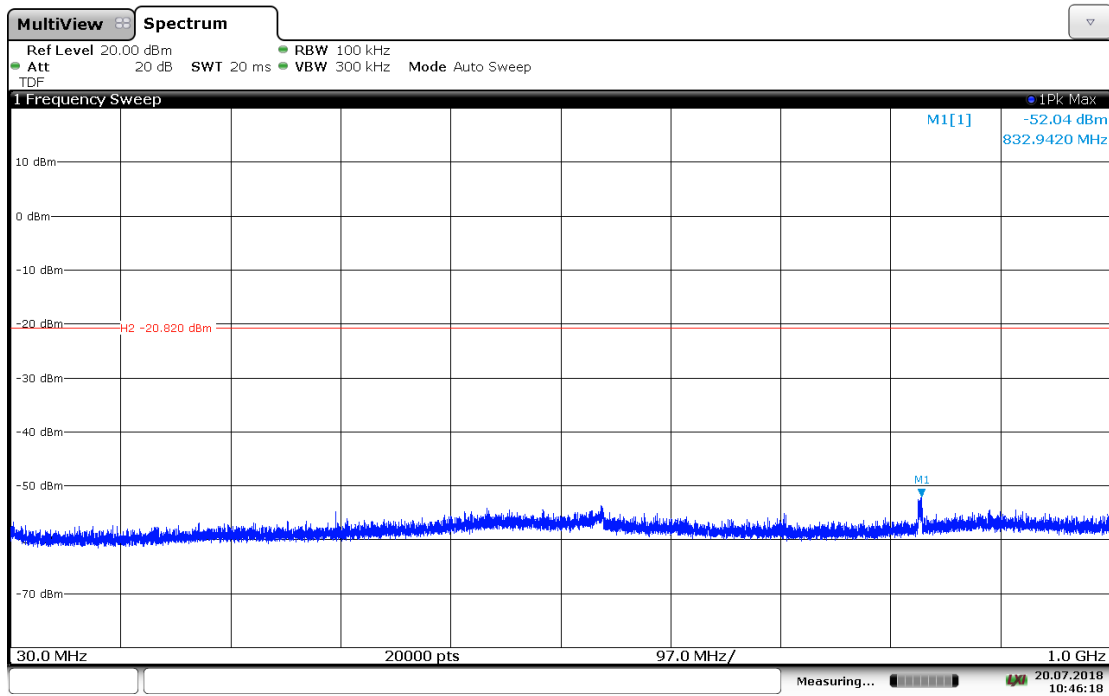
11:04:57 20.07.2018

Limit: 20 dB down from the carrier (High Channel)



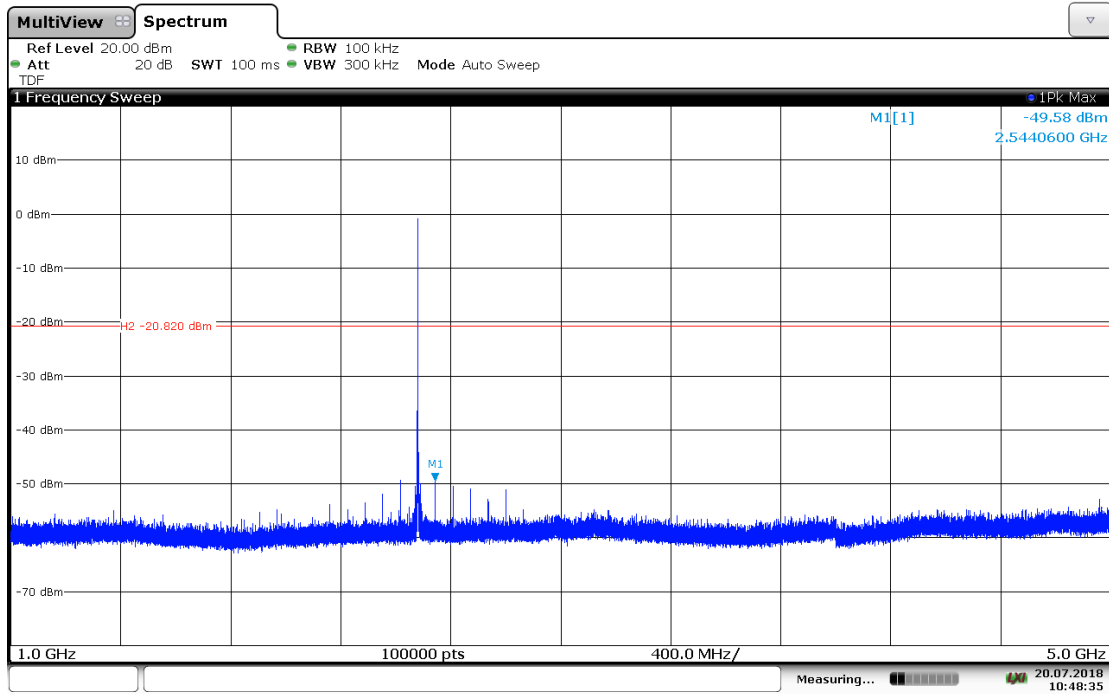
10:44:32 20.07.2018

High Channel Antenna Port Conducted Spurious Emissions, 30-1000 MHz

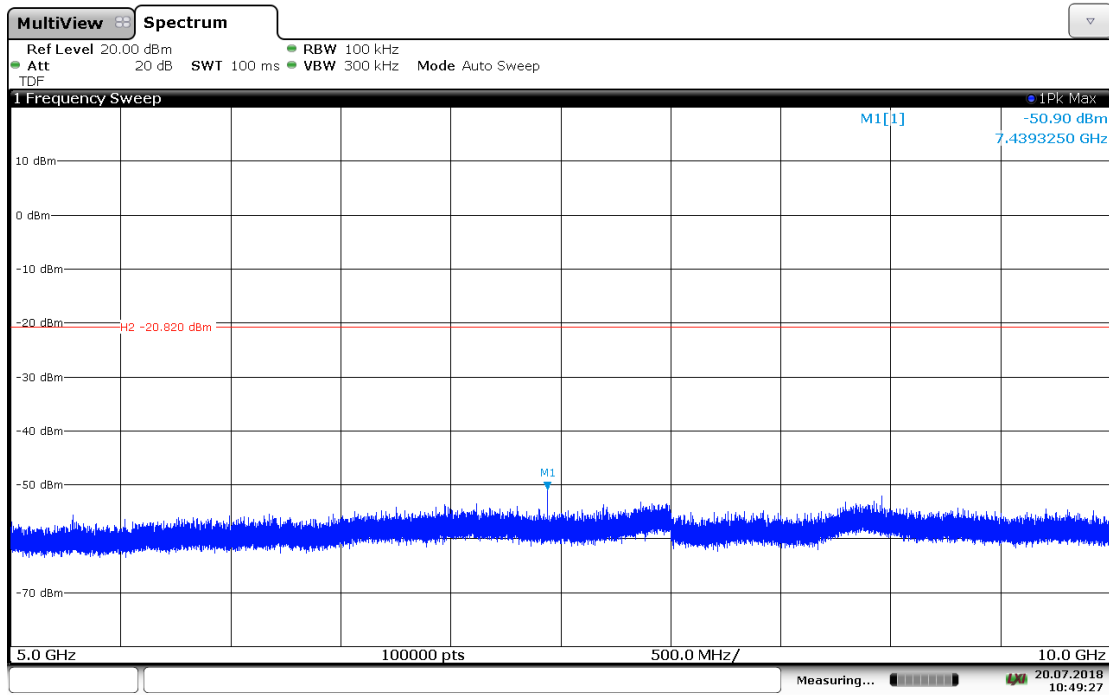


10:46:18 20.07.2018

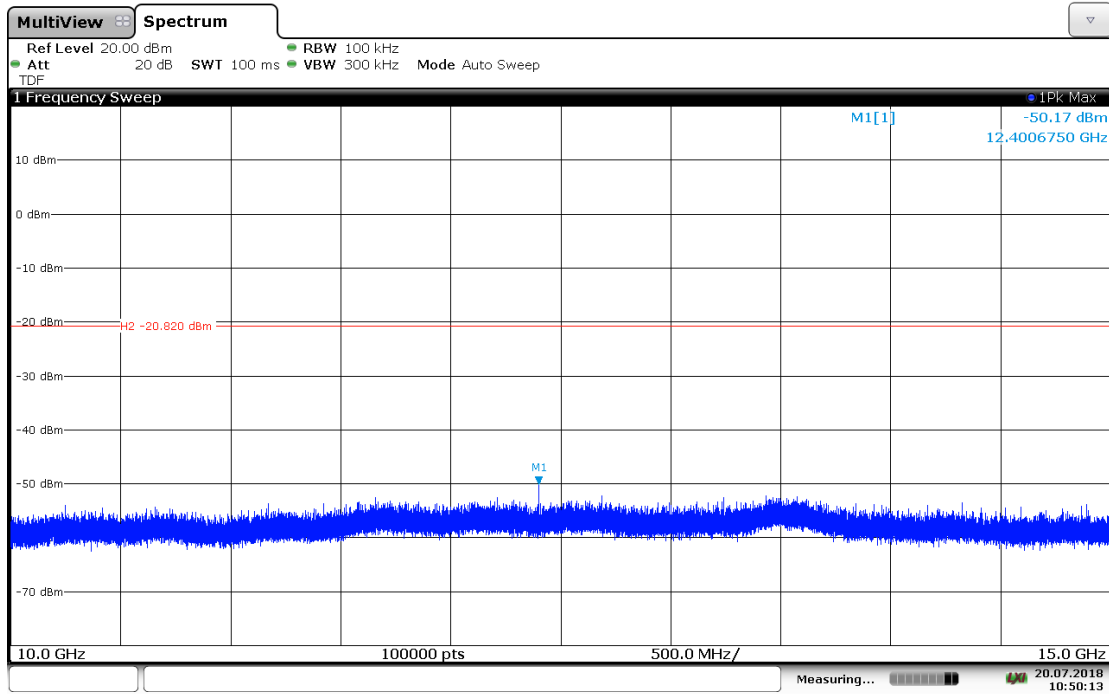
High Channel Antenna Port Conducted Spurious Emissions, 1-5 GHz



High Channel Antenna Port Conducted Spurious Emissions, 5-10 GHz

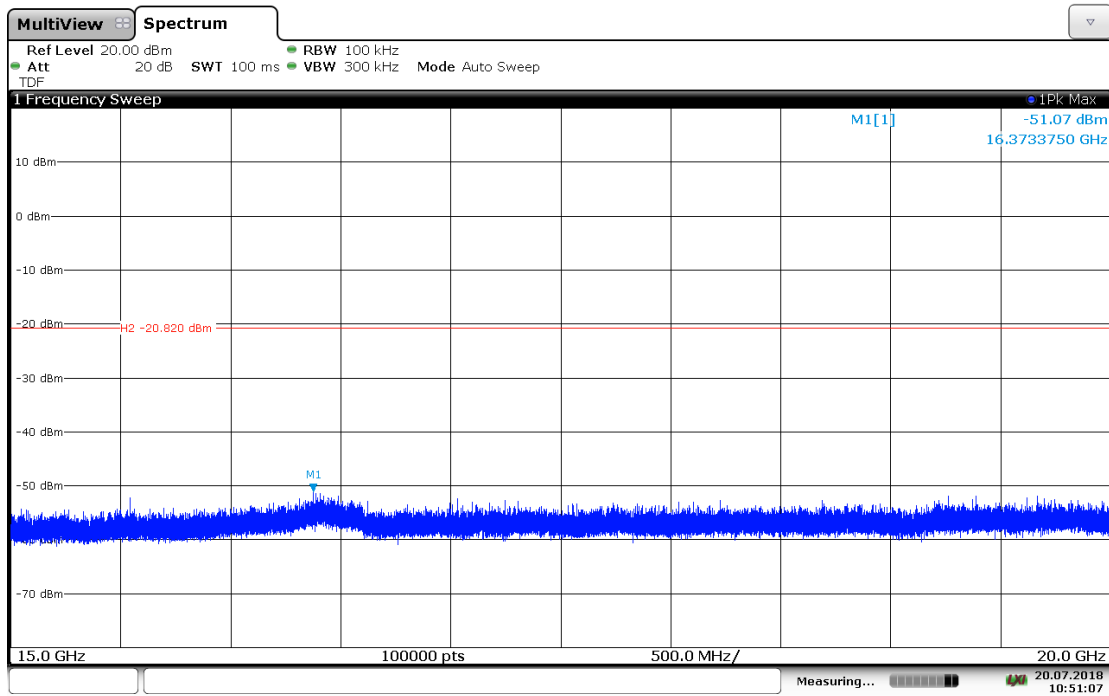


High Channel Antenna Port Conducted Spurious Emissions, 10-15 GHz



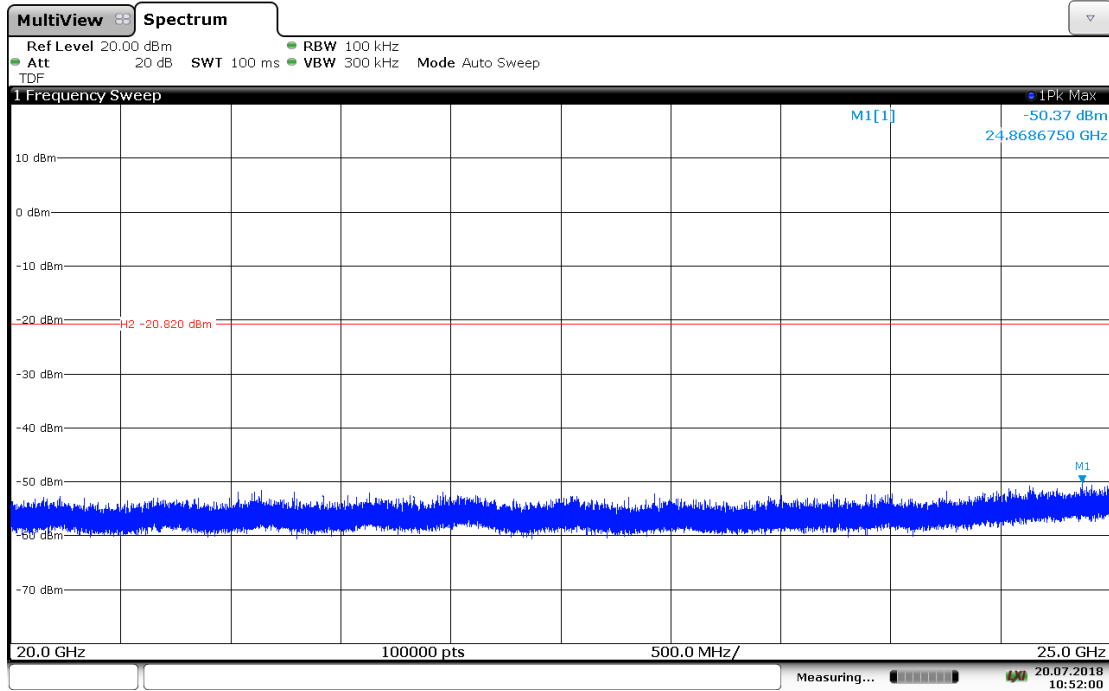
10:50:13 20.07.2018

High Channel Antenna Port Conducted Spurious Emissions, 15-20 GHz



10:51:08 20.07.2018

High Channel Antenna Port Conducted Spurious Emissions, 20-25 GHz



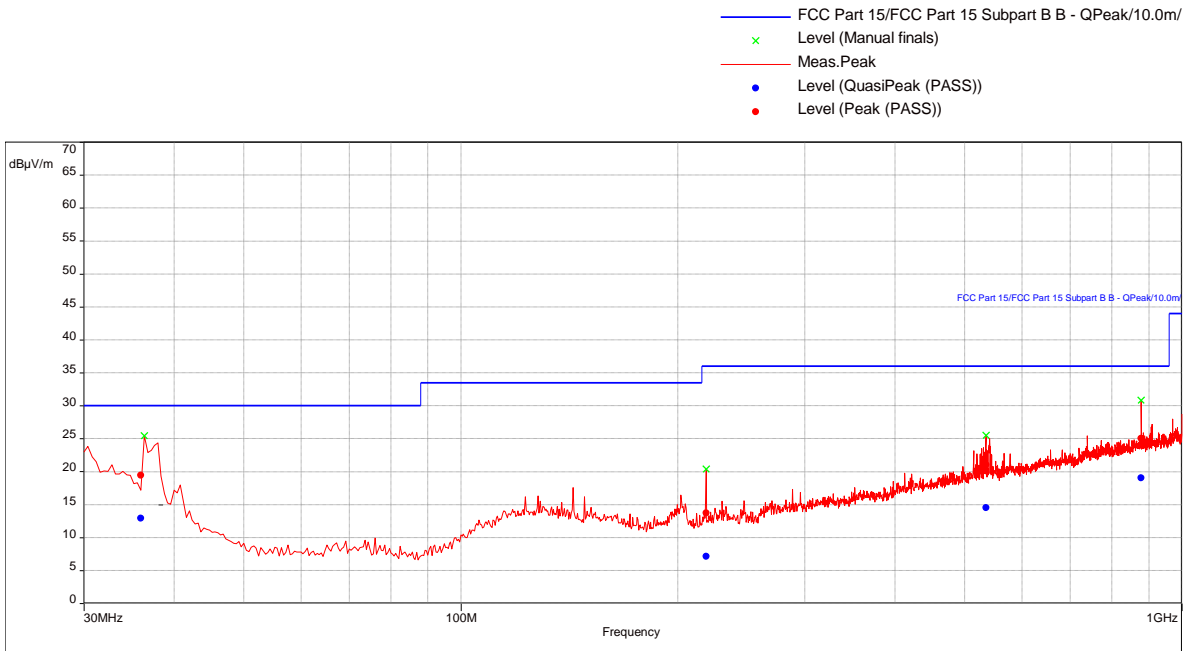
10:52:01 20.07.2018

Low Channel, 2402 MHz, Tx mode, X-Axis, 30 – 1000 MHz

Test Information:

| | |
|---------------------------|-----------------------------------------------------------|
| Date and Time | 7/26/2018 5:03:25 PM |
| Client and Project Number | Becton Dickinson |
| Engineer | Vathana Ven |
| Temperature | 23C |
| Humidity | 54% |
| Atmospheric Pressure | 1009mbar |
| Comments | RE 30-1000MHz_WC_Low channel_Tx mode_X-Axis (on its back) |

Graph:



Results:

QuasiPeak (PASS) (4)

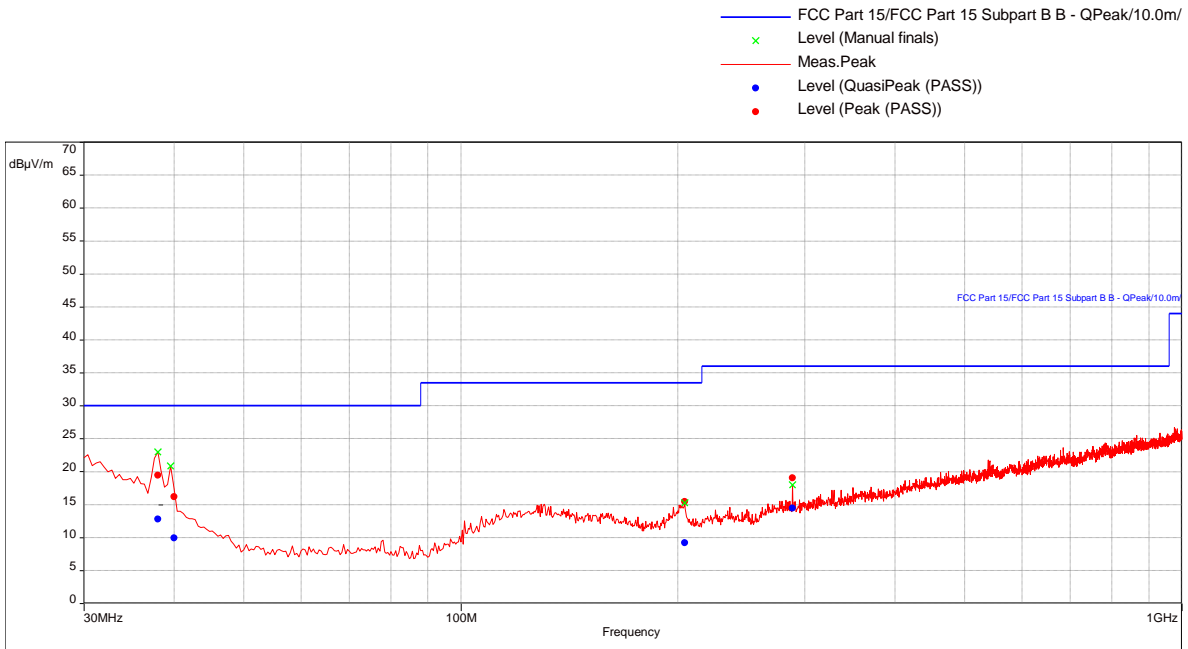
| Frequency (MHz) | Limit (dBµV/m) | Margin (dB) | Azimuth (°) | Height (m) | Pol. | RBW | Correction (dB) |
|-----------------|----------------|-------------|-------------|------------|------------|-----------|-----------------|
| 36.14736842 | 30.00 | -17.10 | 26.00 | 3.59 | Vertical | 120000.00 | -26.47 |
| 218.6736842 | 36.00 | -28.89 | 85.00 | 2.26 | Horizontal | 120000.00 | -30.80 |
| 534.8 | 36.00 | -21.46 | 71.00 | 2.72 | Horizontal | 120000.00 | -21.94 |
| 877.6842105 | 36.00 | -16.97 | 40.00 | 1.84 | Horizontal | 120000.00 | -16.34 |

Low Channel, 2402 MHz, Tx mode, Y-Axis, 30 – 1000 MHz

Test Information:

| | |
|---------------------------|----------------------------------------------------------|
| Date and Time | 7/26/2018 5:32:52 PM |
| Client and Project Number | Becton Dickinson |
| Engineer | Vathana Ven |
| Temperature | 21 deg C |
| Humidity | 50% |
| Atmospheric Pressure | 1001mbar |
| Comments | RE 30-1000MHz_WC_Low channel_Tx mode_Y-Axis (short side) |

Graph:



Results:

QuasiPeak (PASS) (4)

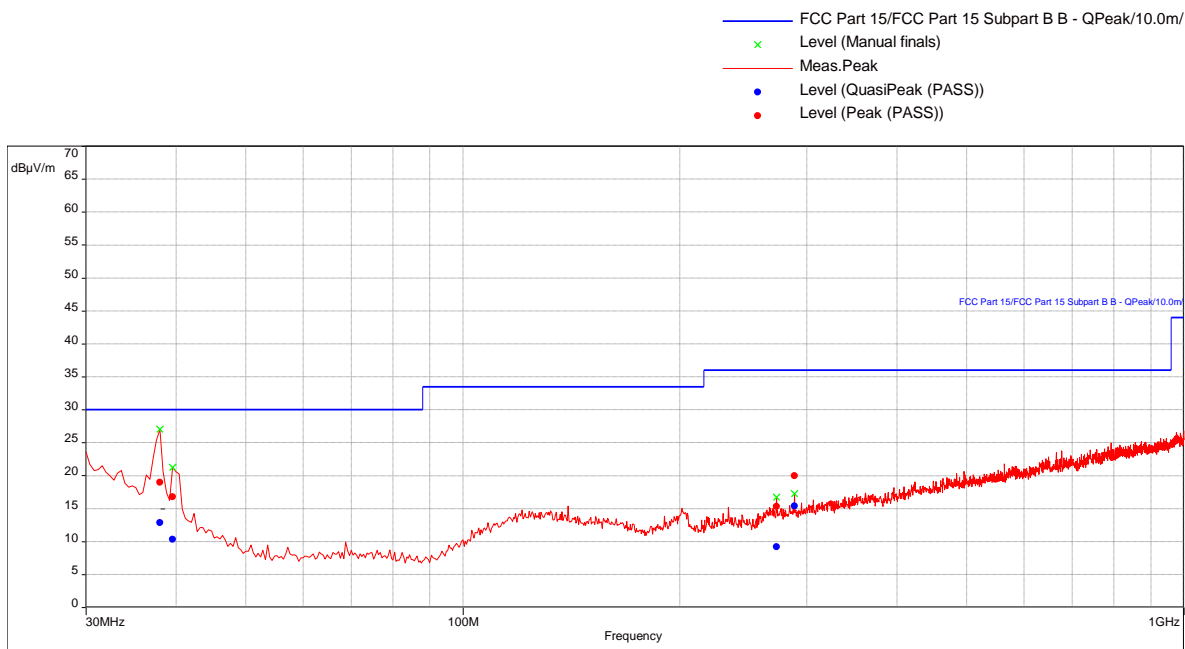
| Frequency (MHz) | Limit (dBµV/m) | Margin (dB) | Azimuth (°) | Height (m) | Pol. | RBW | Correction (dB) |
|-----------------|----------------|-------------|-------------|------------|------------|-----------|-----------------|
| 37.84210526 | 30.00 | -17.24 | 33.00 | 2.56 | Vertical | 120000.00 | -27.72 |
| 39.85263158 | 30.00 | -20.10 | 33.00 | 3.46 | Vertical | 120000.00 | -29.20 |
| 204.2736842 | 33.50 | -24.31 | 144.00 | 2.19 | Vertical | 120000.00 | -29.96 |
| 288.5578947 | 36.00 | -21.55 | 293.00 | 1.60 | Horizontal | 120000.00 | -28.32 |

Low Channel, 2402 MHz, Tx mode, Z-Axis, 30 – 1000 MHz

Test Information:

| | |
|---------------------------|---------------------------------------------------------|
| Date and Time | 7/26/2018 5:57:02 PM |
| Client and Project Number | Becton Dickinson |
| Engineer | Vathana Ven |
| Temperature | 21 deg C |
| Humidity | 50% |
| Atmospheric Pressure | 1001mbar |
| Comments | RE 30-1000MHz_WC_Low channel_Tx mode_Z-Axis (long side) |

Graph:



Results:

QuasiPeak (PASS) (4)

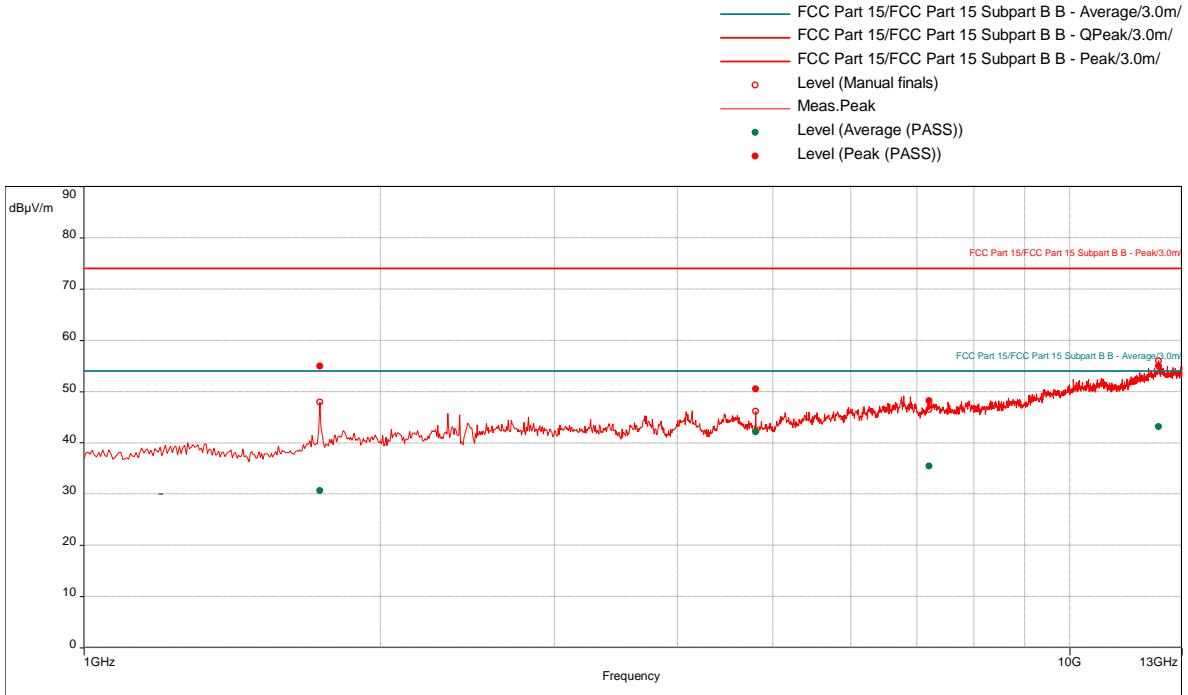
| Frequency (MHz) | Limit (dBµV/m) | Margin (dB) | Azimuth (°) | Height (m) | Pol. | RBW | Correction (dB) |
|-----------------|----------------|-------------|-------------|------------|----------|-----------|-----------------|
| 38.06315789 | 30.00 | -17.16 | 34.00 | 2.27 | Vertical | 120000.00 | -27.88 |
| 39.47368421 | 30.00 | -19.71 | 33.00 | 3.31 | Vertical | 120000.00 | -28.94 |
| 272.3052632 | 36.00 | -26.78 | 138.00 | 1.53 | Vertical | 120000.00 | -28.55 |
| 288.5578947 | 36.00 | -20.65 | 271.00 | 1.00 | Vertical | 120000.00 | -28.32 |

Low Channel, 2402 MHz, Tx mode, X-Axis, 1 – 25 GHz

Test Information:

| | |
|---------------------------|---------------------------------------------------------|
| Date and Time | 7/26/2018 8:43:38 PM |
| Client and Project Number | Becton Dickinson |
| Engineer | Vathana Ven |
| Temperature | 21 deg C |
| Humidity | 50% |
| Atmospheric Pressure | 1001mbar |
| Comments | RE 1 to 13 GHz_WC_Low Channel_Tx mode (X-Axis, on back) |

Graph:



Notes: From 13-25 GHz the scan was performed manually, no emissions were detected above the measuring equipment noise floor.

Results:

Peak (PASS) (4)

| Frequency (MHz) | Level (dBµV/m) | Limit (dBµV/m) | Margin (dB) | Azimuth (°) | Height (m) | Pol. | RBW | Correction (dB) |
|-----------------|----------------|----------------|-------------|-------------|------------|------------|------------|-----------------|
| 1733.947368 | 54.97 | 74.00 | -19.03 | 291.00 | 2.78 | Vertical | 1000000.00 | 1.71 |
| 4803.947368 | 50.47 | 74.00 | -23.53 | 270.00 | 2.46 | Vertical | 1000000.00 | 7.78 |
| 7206.315789 | 48.16 | 74.00 | -25.84 | 226.00 | 2.69 | Horizontal | 1000000.00 | 11.03 |
| 12313.42105 | 54.92 | 74.00 | -19.08 | 204.00 | 2.48 | Horizontal | 1000000.00 | 19.26 |

Average (PASS) (4)

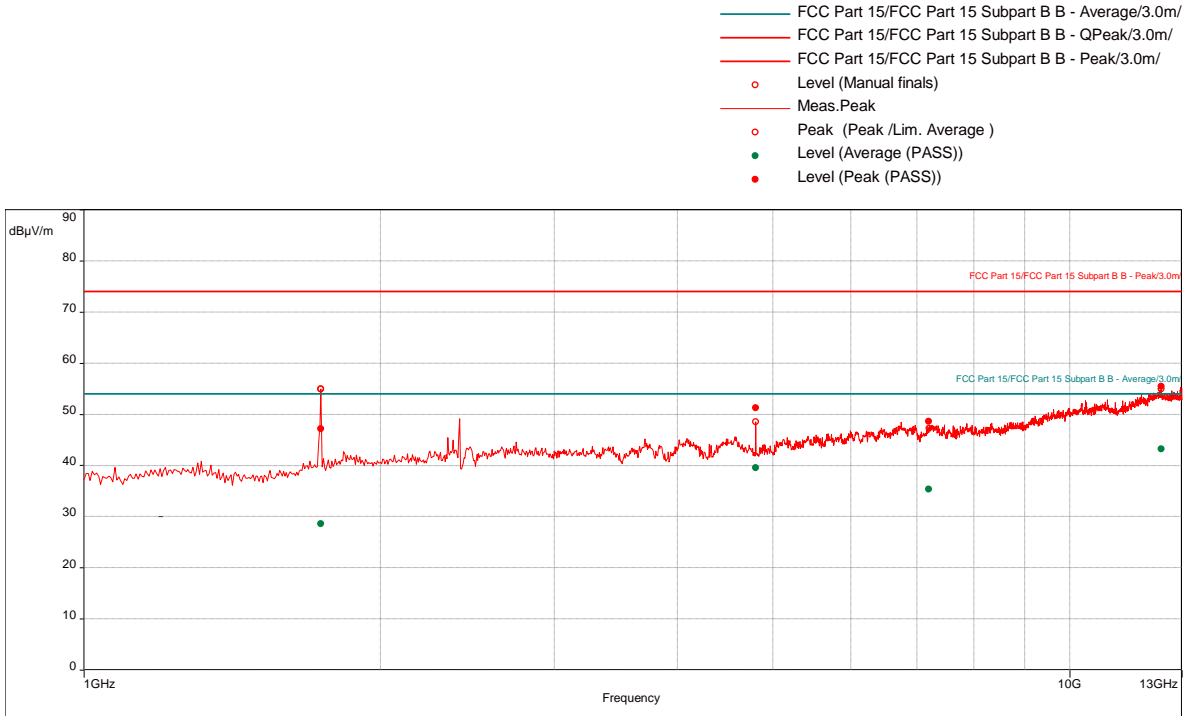
| Frequency (MHz) | Level (dBµV/m) | Limit (dBµV/m) | Margin (dB) | Azimuth (°) | Height (m) | Pol. | RBW | Correction (dB) |
|-----------------|----------------|----------------|-------------|-------------|------------|------------|------------|-----------------|
| 1733.947368 | 30.60 | 54.00 | -23.40 | 291.00 | 2.78 | Vertical | 1000000.00 | 1.71 |
| 4803.947368 | 42.10 | 54.00 | -11.90 | 270.00 | 2.46 | Vertical | 1000000.00 | 7.78 |
| 7206.315789 | 35.47 | 54.00 | -18.53 | 226.00 | 2.69 | Horizontal | 1000000.00 | 11.03 |
| 12313.42105 | 43.16 | 54.00 | -10.84 | 204.00 | 2.48 | Horizontal | 1000000.00 | 19.26 |

Low Channel, 2402 MHz, Tx mode, Y-Axis, 1 – 25 GHz

Test Information:

| | |
|---------------------------|-----------------------------------------------------------|
| Date and Time | 7/26/2018 9:18:19 PM |
| Client and Project Number | Becton Dickinson |
| Engineer | Vathana Ven |
| Temperature | 21 deg C |
| Humidity | 50% |
| Atmospheric Pressure | 1001mbar |
| Comments | RE 1 to 13 GHz_WC_Low Channel_Tx mode (Y-Axis, long side) |

Graph:



Notes: From 13-25 GHz the scan was performed manually, no emissions were detected above the measuring equipment noise floor.

Results:

Peak (PASS) (4)

| Frequency (MHz) | Level (dBµV/m) | Limit (dBµV/m) | Margin (dB) | Azimuth (°) | Height (m) | Pol. | RBW | Correction (dB) |
|-----------------|----------------|----------------|-------------|-------------|------------|------------|------------|-----------------|
| 1737.894737 | 47.10 | 74.00 | -26.90 | 34.00 | 2.85 | Vertical | 1000000.00 | 1.74 |
| 4804.473684 | 51.29 | 74.00 | -22.71 | 270.00 | 1.00 | Vertical | 1000000.00 | 7.78 |
| 7202.105263 | 48.56 | 74.00 | -25.44 | 122.00 | 1.27 | Vertical | 1000000.00 | 11.02 |
| 12391.05263 | 55.45 | 74.00 | -18.55 | 248.00 | 1.50 | Horizontal | 1000000.00 | 19.24 |

Average (PASS) (4)

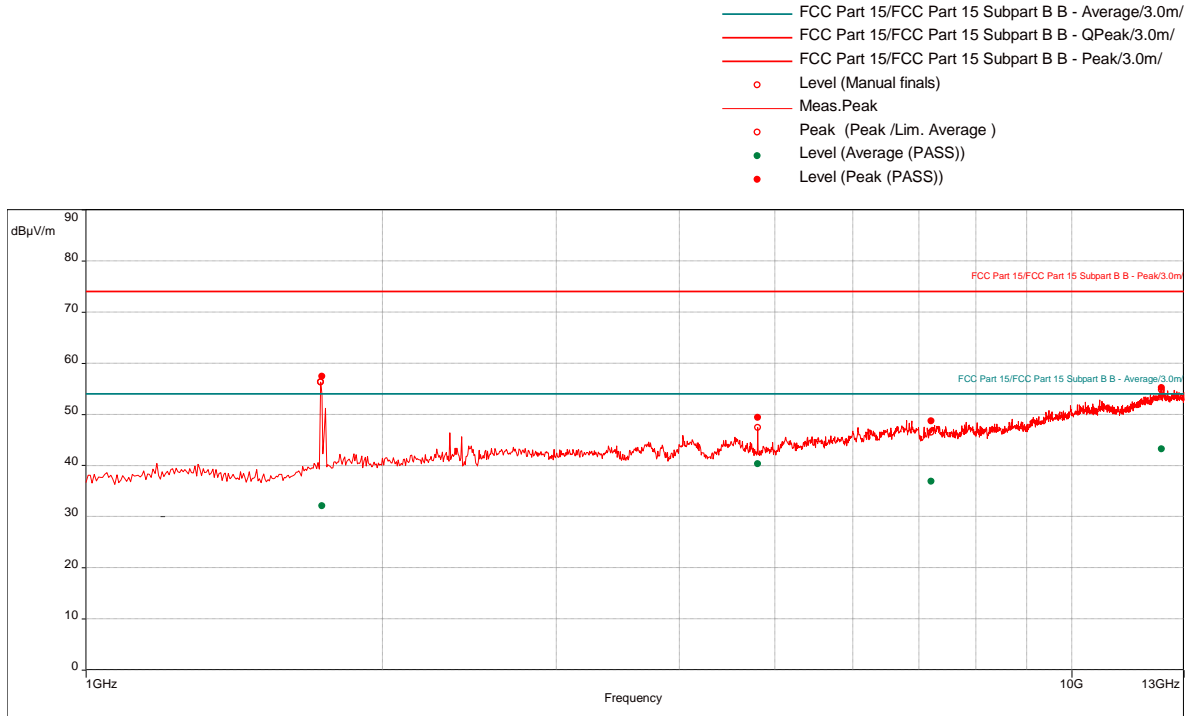
| Frequency (MHz) | Level (dBµV/m) | Limit (dBµV/m) | Margin (dB) | Azimuth (°) | Height (m) | Pol. | RBW | Correction (dB) |
|-----------------|----------------|----------------|-------------|-------------|------------|------------|------------|-----------------|
| 1737.894737 | 28.59 | 54.00 | -25.41 | 34.00 | 2.85 | Vertical | 1000000.00 | 1.74 |
| 4804.473684 | 39.52 | 54.00 | -14.48 | 270.00 | 1.00 | Vertical | 1000000.00 | 7.78 |
| 7202.105263 | 35.37 | 54.00 | -18.63 | 122.00 | 1.27 | Vertical | 1000000.00 | 11.02 |
| 12391.05263 | 43.22 | 54.00 | -10.78 | 248.00 | 1.50 | Horizontal | 1000000.00 | 19.24 |

Low Channel, 2402 MHz, Tx mode, Z-Axis, 1 – 25 GHz

Test Information:

| | |
|---------------------------|-----------------------------------------------------------|
| Date and Time | 7/26/2018 9:41:58 PM |
| Client and Project Number | Becton Dickinson |
| Engineer | Vathana Ven |
| Temperature | 21 deg C |
| Humidity | 50% |
| Atmospheric Pressure | 1001mbar |
| Comments | RE 1 to 13 GHz_WC_Low Channel_Tx mode (Z-Axis, long side) |

Graph:



Notes: From 13-25 GHz the scan was performed manually, no emissions were detected above the measuring equipment noise floor.

Results:

Peak (PASS) (4)

| Frequency (MHz) | Level (dBµV/m) | Limit (dBµV/m) | Margin (dB) | Azimuth (°) | Height (m) | Pol. | RBW | Correction (dB) |
|-----------------|----------------|----------------|-------------|-------------|------------|----------|------------|-----------------|
| 1733.421053 | 57.41 | 74.00 | -16.59 | 166.00 | 1.00 | Vertical | 1000000.00 | 1.70 |
| 4803.947368 | 49.38 | 74.00 | -24.62 | 181.00 | 3.42 | Vertical | 1000000.00 | 7.78 |
| 7203.947368 | 48.70 | 74.00 | -25.30 | 122.00 | 2.36 | Vertical | 1000000.00 | 11.03 |
| 12337.63158 | 55.19 | 74.00 | -18.81 | 160.00 | 2.20 | Vertical | 1000000.00 | 19.25 |

Average (PASS) (4)

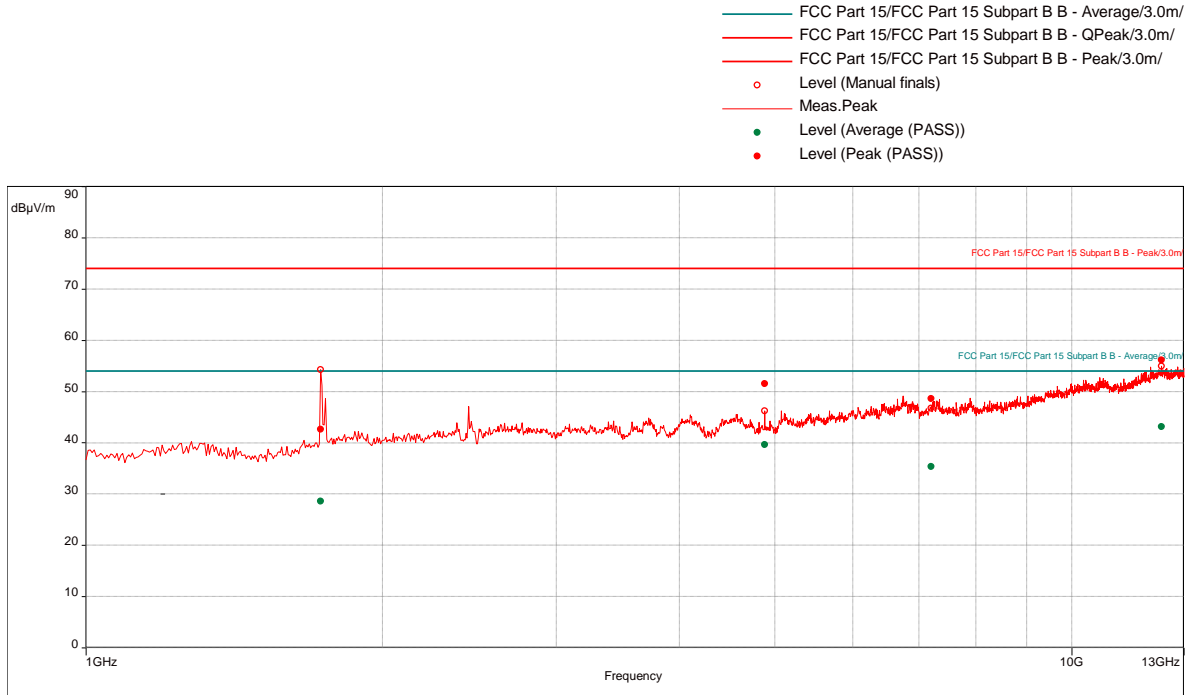
| Frequency (MHz) | Level (dBµV/m) | Limit (dBµV/m) | Margin (dB) | Azimuth (°) | Height (m) | Pol. | RBW | Correction (dB) |
|-----------------|----------------|----------------|-------------|-------------|------------|----------|------------|-----------------|
| 1733.421053 | 32.11 | 54.00 | -21.89 | 166.00 | 1.00 | Vertical | 1000000.00 | 1.70 |
| 4803.947368 | 40.28 | 54.00 | -13.72 | 181.00 | 3.42 | Vertical | 1000000.00 | 7.78 |
| 7203.947368 | 36.90 | 54.00 | -17.10 | 122.00 | 2.36 | Vertical | 1000000.00 | 11.03 |
| 12337.63158 | 43.24 | 54.00 | -10.76 | 160.00 | 2.20 | Vertical | 1000000.00 | 19.25 |

Mid Channel, 2442 MHz, Tx mode, X-Axis, 1 – 25 GHz

Test Information:

| | |
|---------------------------|---------------------------------------------------------|
| Date and Time | 7/26/2018 10:12:46 PM |
| Client and Project Number | Becton Dickinson |
| Engineer | Vathana Ven |
| Temperature | 21 deg C |
| Humidity | 50% |
| Atmospheric Pressure | 1001mbar |
| Comments | RE 1 to 13 GHz_WC_Mid Channel_Tx mode (X-Axis, on back) |

Graph:



Notes: From 13-25 GHz the scan was performed manually, no emissions were detected above the measuring equipment noise floor.

Results:

Peak (PASS) (4)

| Frequency (MHz) | Level (dBµV/m) | Limit (dBµV/m) | Margin (dB) | Azimuth (°) | Height (m) | Pol. | RBW | Correction (dB) |
|-----------------|----------------|----------------|-------------|-------------|------------|------------|------------|-----------------|
| 1731.578947 | 42.63 | 74.00 | -31.37 | 107.00 | 1.66 | Vertical | 1000000.00 | 1.69 |
| 4884.473684 | 51.53 | 74.00 | -22.47 | 197.00 | 2.97 | Horizontal | 1000000.00 | 7.63 |
| 7204.736842 | 48.57 | 74.00 | -25.43 | 12.00 | 2.01 | Horizontal | 1000000.00 | 11.03 |
| 12333.68421 | 56.11 | 74.00 | -17.89 | 188.00 | 2.07 | Vertical | 1000000.00 | 19.25 |

Average (PASS) (4)

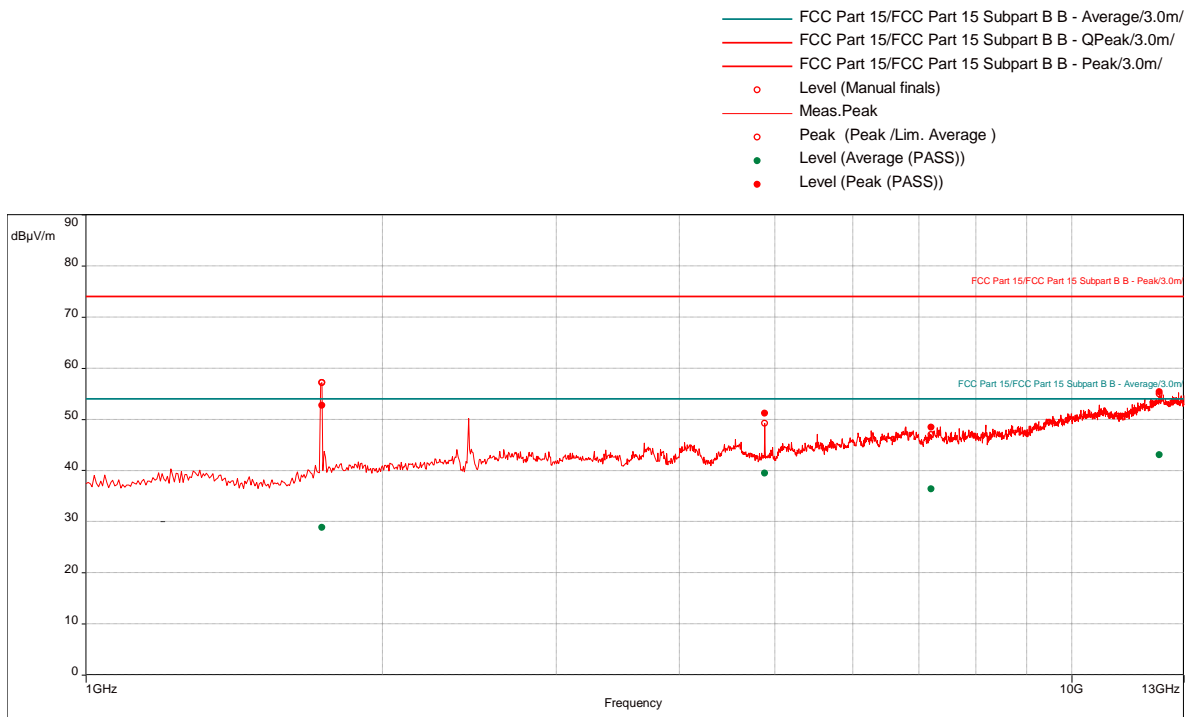
| Frequency (MHz) | Level (dBµV/m) | Limit (dBµV/m) | Margin (dB) | Azimuth (°) | Height (m) | Pol. | RBW | Correction (dB) |
|-----------------|----------------|----------------|-------------|-------------|------------|------------|------------|-----------------|
| 1731.578947 | 28.60 | 54.00 | -25.40 | 107.00 | 1.66 | Vertical | 1000000.00 | 1.69 |
| 4884.473684 | 39.60 | 54.00 | -14.40 | 197.00 | 2.97 | Horizontal | 1000000.00 | 7.63 |
| 7204.736842 | 35.38 | 54.00 | -18.62 | 12.00 | 2.01 | Horizontal | 1000000.00 | 11.03 |
| 12333.68421 | 43.15 | 54.00 | -10.85 | 188.00 | 2.07 | Vertical | 1000000.00 | 19.25 |

Mid Channel, 2442 MHz, Tx mode, Y-Axis, 1 – 25 GHz

Test Information:

| | |
|---------------------------|-----------------------------------------------------------|
| Date and Time | 7/26/2018 10:36:06 PM |
| Client and Project Number | Becton Dickinson |
| Engineer | Vathana Ven |
| Temperature | 21 deg C |
| Humidity | 50% |
| Atmospheric Pressure | 1001mbar |
| Comments | RE 1 to 13 GHz_WC_Mid Channel_Tx mode (Y-Axis, long side) |

Graph:



Notes: From 13-25 GHz the scan was performed manually, no emissions were detected above the measuring equipment noise floor.

Results:

Peak (PASS) (4)

| Frequency (MHz) | Level (dBµV/m) | Limit (dBµV/m) | Margin (dB) | Azimuth (°) | Height (m) | Pol. | RBW | Correction (dB) |
|-----------------|----------------|----------------|-------------|-------------|------------|------------|------------|-----------------|
| 1732.894737 | 52.67 | 74.00 | -21.33 | 79.00 | 3.72 | Vertical | 1000000.00 | 1.70 |
| 4884.473684 | 51.14 | 74.00 | -22.86 | 84.00 | 1.24 | Vertical | 1000000.00 | 7.63 |
| 7205 | 48.43 | 74.00 | -25.57 | 188.00 | 3.07 | Vertical | 1000000.00 | 11.03 |
| 12276.57895 | 55.35 | 74.00 | -18.65 | 33.00 | 1.81 | Horizontal | 1000000.00 | 19.27 |

Average (PASS) (4)

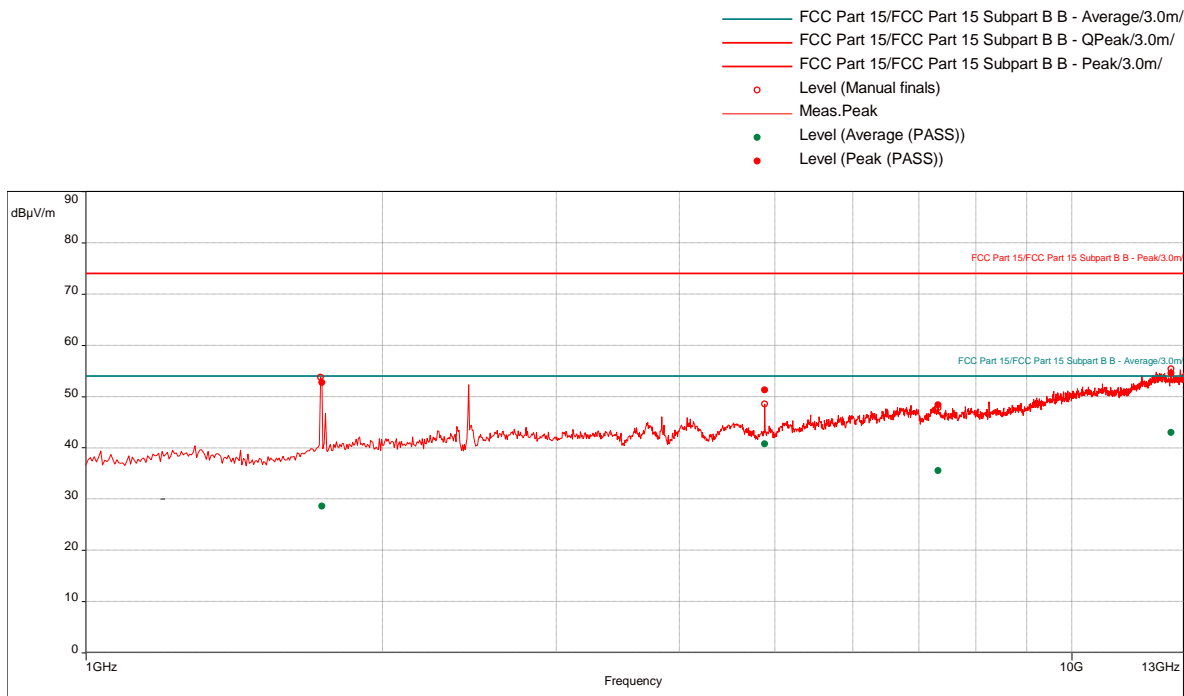
| Frequency (MHz) | Level (dBµV/m) | Limit (dBµV/m) | Margin (dB) | Azimuth (°) | Height (m) | Pol. | RBW | Correction (dB) |
|-----------------|----------------|----------------|-------------|-------------|------------|------------|------------|-----------------|
| 1732.894737 | 28.87 | 54.00 | -25.13 | 79.00 | 3.72 | Vertical | 1000000.00 | 1.70 |
| 4884.473684 | 39.45 | 54.00 | -14.55 | 84.00 | 1.24 | Vertical | 1000000.00 | 7.63 |
| 7205 | 36.37 | 54.00 | -17.63 | 188.00 | 3.07 | Vertical | 1000000.00 | 11.03 |
| 12276.57895 | 43.07 | 54.00 | -10.93 | 33.00 | 1.81 | Horizontal | 1000000.00 | 19.27 |

Mid Channel, 2442 MHz, Tx mode, Z-Axis, 1 – 25 GHz

Test Information:

| | |
|---------------------------|------------------------------------------------------------|
| Date and Time | 7/26/2018 11:03:04 PM |
| Client and Project Number | Becton Dickinson |
| Engineer | Vathana Ven |
| Temperature | 21 deg C |
| Humidity | 50% |
| Atmospheric Pressure | 1001mbar |
| Comments | RE 1 to 13 GHz_WC_Mid Channel_Tx mode (Z-Axis, short side) |

Graph:



Notes: From 13-25 GHz the scan was performed manually, no emissions were detected above the measuring equipment noise floor.

Results:

Peak (PASS) (4)

| Frequency (MHz) | Level (dBµV/m) | Limit (dBµV/m) | Margin (dB) | Azimuth (°) | Height (m) | Pol. | RBW | Correction (dB) |
|-----------------|----------------|----------------|-------------|-------------|------------|------------|------------|-----------------|
| 1732.894737 | 52.67 | 74.00 | -21.33 | 48.00 | 1.50 | Vertical | 1000000.00 | 1.70 |
| 4883.684211 | 51.27 | 74.00 | -22.73 | 150.00 | 3.12 | Vertical | 1000000.00 | 7.63 |
| 7324.736842 | 48.30 | 74.00 | -25.70 | 26.00 | 1.81 | Horizontal | 1000000.00 | 11.04 |
| 12618.15789 | 54.50 | 74.00 | -19.50 | 115.00 | 2.62 | Vertical | 1000000.00 | 19.14 |

Average (PASS) (4)

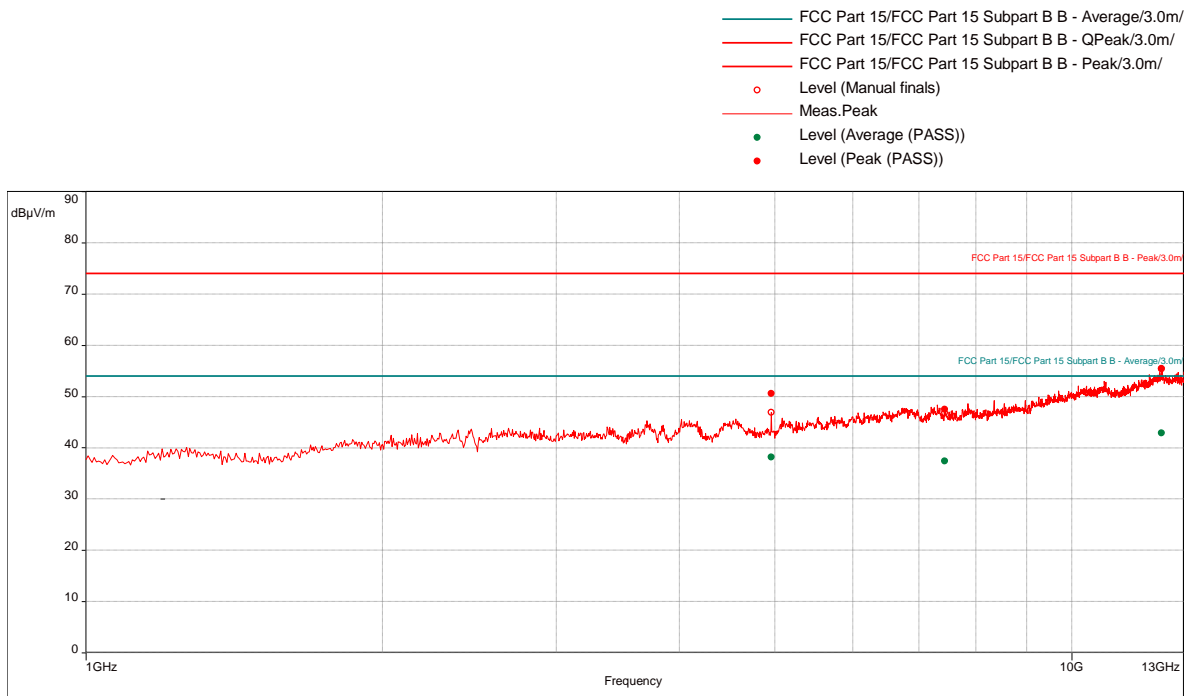
| Frequency (MHz) | Level (dBµV/m) | Limit (dBµV/m) | Margin (dB) | Azimuth (°) | Height (m) | Pol. | RBW | Correction (dB) |
|-----------------|----------------|----------------|-------------|-------------|------------|------------|------------|-----------------|
| 1732.894737 | 28.61 | 54.00 | -25.39 | 48.00 | 1.50 | Vertical | 1000000.00 | 1.70 |
| 4883.684211 | 40.73 | 54.00 | -13.27 | 150.00 | 3.12 | Vertical | 1000000.00 | 7.63 |
| 7324.736842 | 35.47 | 54.00 | -18.53 | 26.00 | 1.81 | Horizontal | 1000000.00 | 11.04 |
| 12618.15789 | 42.94 | 54.00 | -11.06 | 115.00 | 2.62 | Vertical | 1000000.00 | 19.14 |

High Channel, 2480 MHz, Tx mode, X-Axis, 1 – 25 GHz

Test Information:

| | |
|---------------------------|--------------------------------------------------------|
| Date and Time | 7/26/2018 11:33:06 PM |
| Client and Project Number | Becton Dickinson |
| Engineer | Vathana Ven |
| Temperature | 21 deg C |
| Humidity | 50% |
| Atmospheric Pressure | 1001mbar |
| Comments | RE 1 to 13 GHz_WC_Hi Channel_Tx mode (X-Axis, on back) |

Graph:



Notes: From 13-25 GHz the scan was performed manually, no emissions were detected above the measuring equipment noise floor.

Results:

Peak (PASS) (3)

| Frequency (MHz) | Level (dBµV/m) | Limit (dBµV/m) | Margin (dB) | Azimuth (°) | Height (m) | Pol. | RBW | Correction (dB) |
|-----------------|----------------|----------------|-------------|-------------|------------|------------|------------|-----------------|
| 4960.526316 | 50.58 | 74.00 | -23.42 | 85.00 | 2.08 | Vertical | 1000000.00 | 7.60 |
| 7442.368421 | 47.47 | 74.00 | -26.53 | 344.00 | 1.30 | Vertical | 1000000.00 | 10.87 |
| 12332.63158 | 55.47 | 74.00 | -18.53 | 328.00 | 2.24 | Horizontal | 1000000.00 | 19.26 |

Average (PASS) (3)

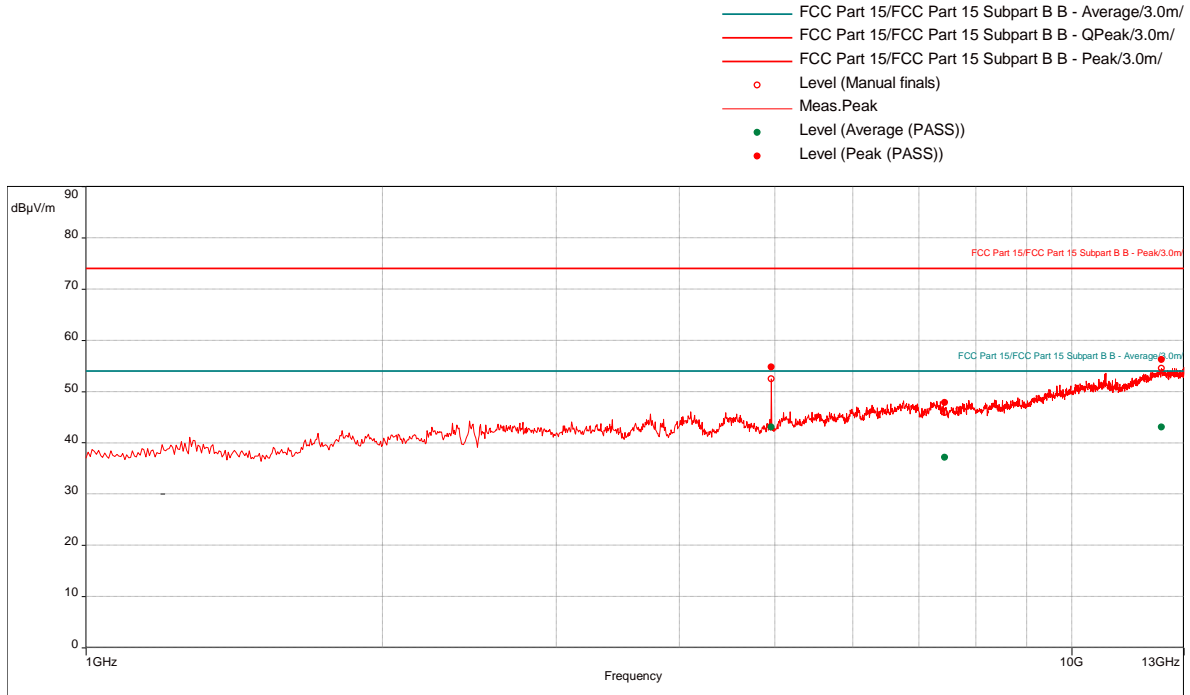
| Frequency (MHz) | Level (dBµV/m) | Limit (dBµV/m) | Margin (dB) | Azimuth (°) | Height (m) | Pol. | RBW | Correction (dB) |
|-----------------|----------------|----------------|-------------|-------------|------------|------------|------------|-----------------|
| 4960.526316 | 38.19 | 54.00 | -15.81 | 85.00 | 2.08 | Vertical | 1000000.00 | 7.60 |
| 7442.368421 | 37.38 | 54.00 | -16.62 | 344.00 | 1.30 | Vertical | 1000000.00 | 10.87 |
| 12332.63158 | 42.87 | 54.00 | -11.13 | 328.00 | 2.24 | Horizontal | 1000000.00 | 19.26 |

High Channel, 2480 MHz, Tx mode, Y-Axis, 1 – 25 GHz

Test Information:

| | |
|---------------------------|----------------------------------------------------------|
| Date and Time | 7/26/2018 11:54:33 PM |
| Client and Project Number | Becton Dickinson |
| Engineer | Vathana Ven |
| Temperature | 21 deg C |
| Humidity | 50% |
| Atmospheric Pressure | 1001mbar |
| Comments | RE 1 to 13 GHz_WC_Hi Channel_Tx mode (Y-Axis, Long side) |

Graph:



Notes: From 13-25 GHz the scan was performed manually, no emissions were detected above the measuring equipment noise floor.

Results:

Peak (PASS) (3)

| Frequency (MHz) | Level (dBµV/m) | Limit (dBµV/m) | Margin (dB) | Azimuth (°) | Height (m) | Pol. | RBW | Correction (dB) |
|-----------------|----------------|----------------|-------------|-------------|------------|------------|------------|-----------------|
| 4960.526316 | 54.77 | 74.00 | -19.23 | 291.00 | 1.00 | Vertical | 1000000.00 | 7.60 |
| 7441.315789 | 47.87 | 74.00 | -26.13 | 307.00 | 2.84 | Horizontal | 1000000.00 | 10.87 |
| 12340.26316 | 56.26 | 74.00 | -17.74 | 270.00 | 3.22 | Vertical | 1000000.00 | 19.25 |

Average (PASS) (3)

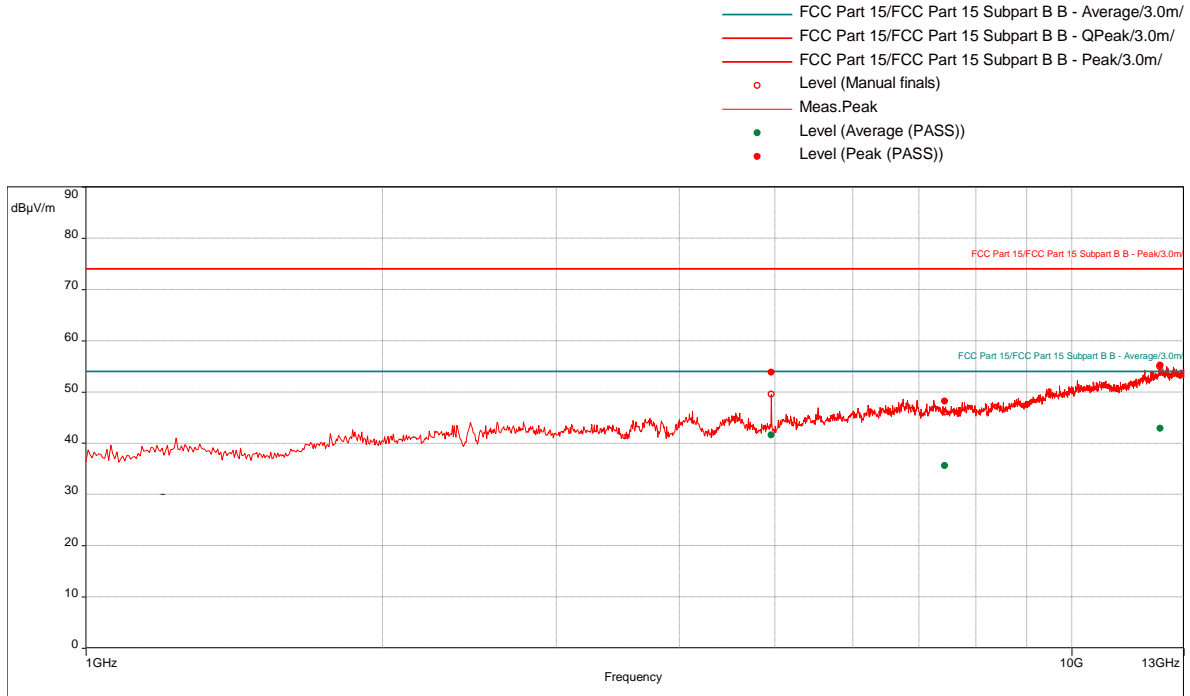
| Frequency (MHz) | Level (dBµV/m) | Limit (dBµV/m) | Margin (dB) | Azimuth (°) | Height (m) | Pol. | RBW | Correction (dB) |
|-----------------|----------------|----------------|-------------|-------------|------------|------------|------------|-----------------|
| 4960.526316 | 43.07 | 54.00 | -10.93 | 291.00 | 1.00 | Vertical | 1000000.00 | 7.60 |
| 7441.315789 | 37.10 | 54.00 | -16.90 | 307.00 | 2.84 | Horizontal | 1000000.00 | 10.87 |
| 12340.26316 | 43.06 | 54.00 | -10.94 | 270.00 | 3.22 | Vertical | 1000000.00 | 19.25 |

High Channel, 2480 MHz, Tx mode, Z-Axis, 1 – 25 GHz

Test Information:

| | |
|---------------------------|-----------------------------------------------------------|
| Date and Time | 7/27/2018 12:15:43 AM |
| Client and Project Number | Becton Dickinson |
| Engineer | Vathana Ven |
| Temperature | 21 deg C |
| Humidity | 50% |
| Atmospheric Pressure | 1001mbar |
| Comments | RE 1 to 13 GHz_WC_Hi Channel_Tx mode (Z-Axis, short side) |

Graph:



Notes: From 13-25 GHz the scan was performed manually, no emissions were detected above the measuring equipment noise floor.

Results:

Peak (PASS) (3)

| Frequency (MHz) | Level (dBµV/m) | Limit (dBµV/m) | Margin (dB) | Azimuth (°) | Height (m) | Pol. | RBW | Correction (dB) |
|-----------------|----------------|----------------|-------------|-------------|------------|------------|------------|-----------------|
| 4959.473684 | 53.86 | 74.00 | -20.14 | 189.00 | 3.07 | Vertical | 1000000.00 | 7.60 |
| 7438.947368 | 48.13 | 74.00 | -25.87 | 63.00 | 3.50 | Vertical | 1000000.00 | 10.87 |
| 12297.89474 | 55.21 | 74.00 | -18.79 | 115.00 | 2.12 | Horizontal | 1000000.00 | 19.27 |

Average (PASS) (3)

| Frequency (MHz) | Level (dBµV/m) | Limit (dBµV/m) | Margin (dB) | Azimuth (°) | Height (m) | Pol. | RBW | Correction (dB) |
|-----------------|----------------|----------------|-------------|-------------|------------|------------|------------|-----------------|
| 4959.473684 | 41.61 | 54.00 | -12.39 | 189.00 | 3.07 | Vertical | 1000000.00 | 7.60 |
| 7438.947368 | 35.56 | 54.00 | -18.44 | 63.00 | 3.50 | Vertical | 1000000.00 | 10.87 |
| 12297.89474 | 42.88 | 54.00 | -11.12 | 115.00 | 2.12 | Horizontal | 1000000.00 | 19.27 |

Test Personnel: Kouma Sinn *KPS*
Vathana Ven *VSV*
Supervising/Reviewing Engineer:
(Where Applicable) Vathana Ven *VSV*
Product Standard: CFR47 FCC Part 15.247
RSS-247, RSS-102
Input Voltage: Internal Battery Powered
Pretest Verification w/
Ambient Signals or
BB Source: N/A

Test Date: 07/20/2018
07/25/2018
Limit Applied: See report section 10.3
Ambient Temperature: 23, 23 °C
Relative Humidity: 47, 54 %
Atmospheric Pressure: 1010, 1009 mbars

Deviations, Additions, or Exclusions: None

11 Digital Device and Receiver Radiated Spurious Emissions

11.1 Method

Tests are performed in accordance with FCC Part 15 Subpart B, ICES 003, and ANSI C 63.4.

TEST SITE: 10m ALSE

The 10m ALSE is 13m (Length) x 21m (Depth) x 10m (Height) with the effective size in terms of space from the tips of the absorber is 12m (Length) x 20m (Depth) x 8.5m (Height). This chamber achieves broadband performance using a unique arrangement of hybrid and ferrite tile absorber. This chamber has a built in 3m diameter turntable (Embedded type). The metal structure of the table makes electrical connection around the entire circumference of the turntable to the ground plane with a metal brush type connection. The turntable is located on one end of the chamber and the antennas are mounted 3 and 10 meters away at the other end of the chamber on the adjustable an Antenna Mast. The antenna mast is a non-conductive bore sighted type with remote control of antenna height and polarization. The Antenna Mast and the turntable can be remotely controlled through the controller located in the adjacent Control room. A Styrofoam table 80 cm high is used for table-top equipment.

Measurement Uncertainty

| Measurement | Frequency Range | Expanded Uncertainty (k=2) | Ucispr |
|-------------------------|-----------------|----------------------------|--------|
| Radiated Emissions, 10m | 30-1000 MHz | 4.6dB | 6.3 dB |
| Radiated Emissions, 3m | 30-1000 MHz | 5.3 dB | 6.3 dB |
| Radiated Emissions, 3m | 1-6 GHz | 4.5 dB | 5.2 dB |
| Radiated Emissions, 3m | 6-15 GHz | 5.2 dB | 5.5 dB |
| Radiated Emissions, 3m | 15-18 GHz | 5.0 dB | 5.5 dB |
| Radiated Emissions, 3m | 18-40 GHz | 5.0 dB | 5.5 dB |

As shown in the table above our radiated emissions U_{lab} is less than the corresponding U_{CISPR} reference value in CISPR 16-4-2 Table 1, hence the compliance of the product is only based on the measured value, and no measurement uncertainty correction is required, based on CISPR 22 and CISPR 11 (for 2006 and later revisions) Clause 11.

Sample Calculation

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

$$FS = RA + AF + CF - AG$$

Where

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

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

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

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

To convert from dB μ V to μ V or mV the following was used:

$$UF = 10^{(NF / 20)} \text{ where } UF = \text{Net Reading in } \mu\text{V}$$

$$NF = \text{Net Reading in dB}\mu\text{V}$$

Example:

$$FS = RA + AF + CF - AG = 52.0 + 7.4 + 1.6 - 29.0 = 32.0$$

$$UF = 10^{(32 \text{ dB}\mu\text{V} / 20)} = 39.8 \mu\text{V/m}$$

Alternately, when BAT-EMC Emission Software is used, the "Level" includes all losses and gains and is compared directly in the "Margin" column to the "Limit". The "Correction" includes Antenna Factor, Preamp, and Cable Loss. These are already accounted for in the "Level" column.

11.2 Test Equipment Used:

| Asset | Description | Manufacturer | Model | Serial | Cal Date | Cal Due |
|----------|-----------------------------------------|----------------------|--------------------|------------|------------|------------|
| BAR1' | Digital 4 Line Barometer | Mannix | 0ABA116 | BAR1 | 04/30/2018 | 04/30/2019 |
| 145128' | EMI Receiver (20 Hz - 40 Ghz) | Rohde & Schwarz | ESIB 40 | 839283/001 | 03/22/2018 | 03/22/2019 |
| ETS005' | 1-18GHz horn antenna | ETS-Lindgren | 3117 | 00218279 | 05/14/2018 | 05/14/2019 |
| 145-410' | Cables 145-420 145-421 145-422 145-406 | Huber + Suhner | 10m Track A Cables | multiple | 07/25/2018 | 07/25/2019 |
| 145-416' | Cables 145-420 145-423 145-425 145-408 | Huber + Suhner | 3m Track B cables | multiple | 07/25/2018 | 07/25/2019 |
| PRE11' | 50dB gain pre-amp | Keith H | PRE11 | PRE11 | 12/02/2017 | 12/02/2018 |
| 145014' | Preamplifier (1 GHz to 26.5 GHz) | Hewlett Packard | 8449B | 3008A00232 | 06/14/2018 | 06/14/2019 |
| 145145' | Broadband Hybrid Antenna 30 MHz - 3 GHz | Sunol Sciences Corp. | JB3 | A122313 | 05/16/2018 | 05/16/2019 |

Software Utilized:

| Name | Manufacturer | Version |
|-------------------|--------------|-----------|
| BAT-EMC Emissions | Nexio | 3.16.0.69 |

11.3 Results:

The sample tested was found to Comply.

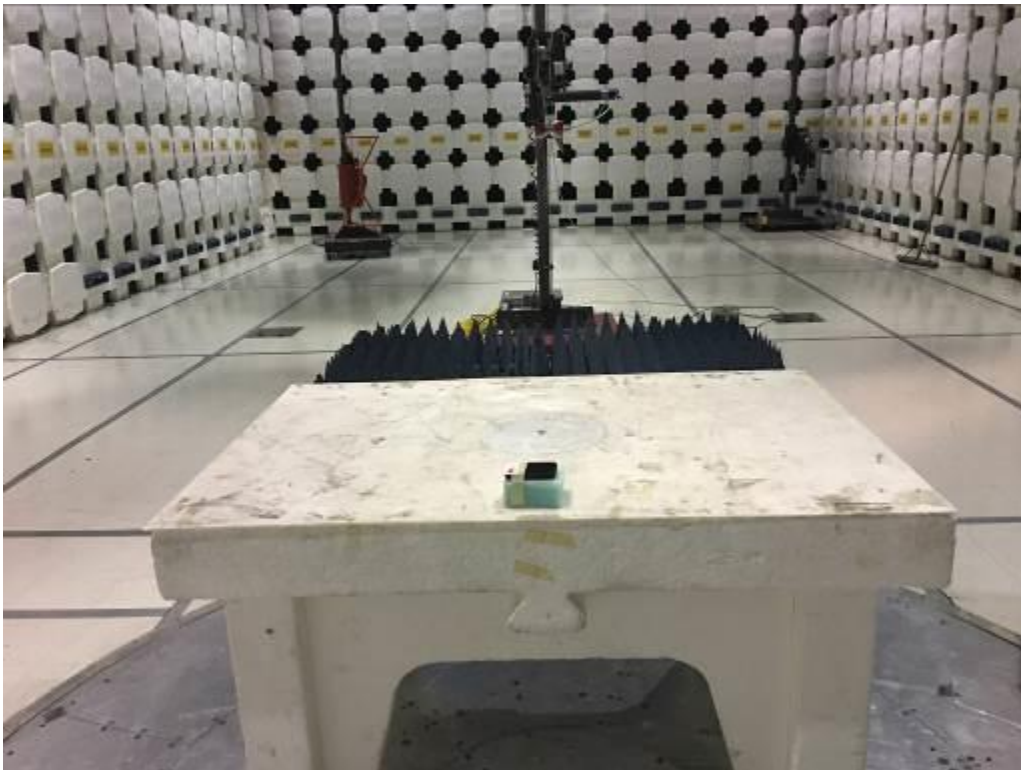
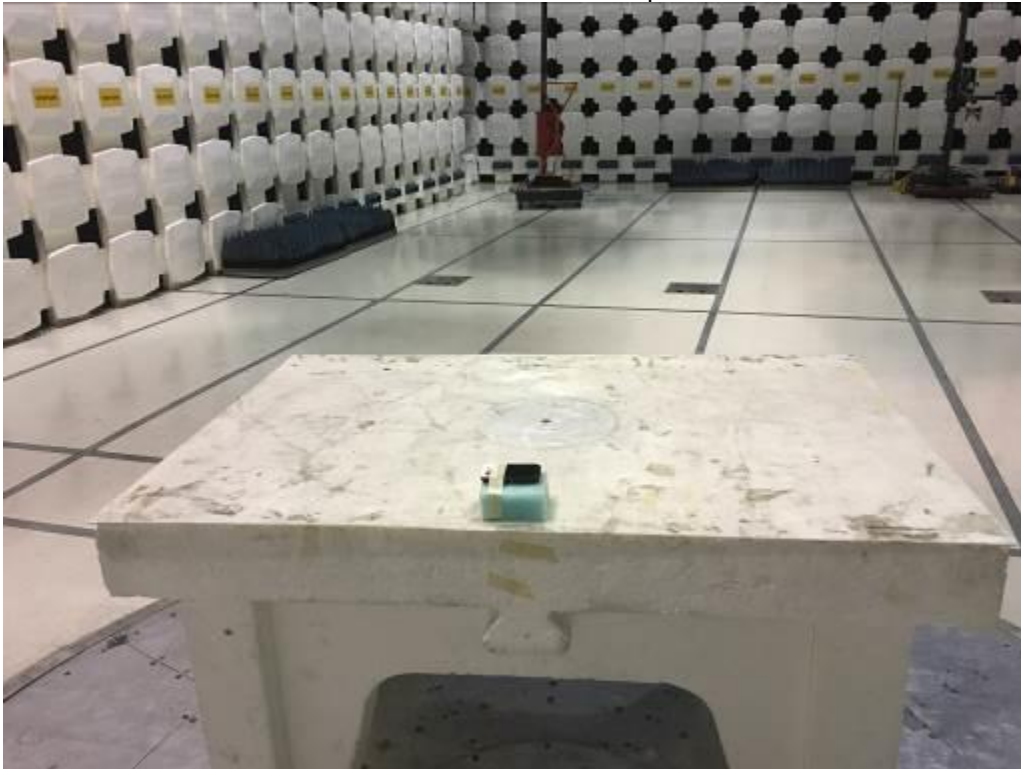
§15.209 Radiated emission limits; general requirements.

(a) Except as provided elsewhere in this subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:

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

11.4 Setup Photographs:

30-1000 MHz Test Setup



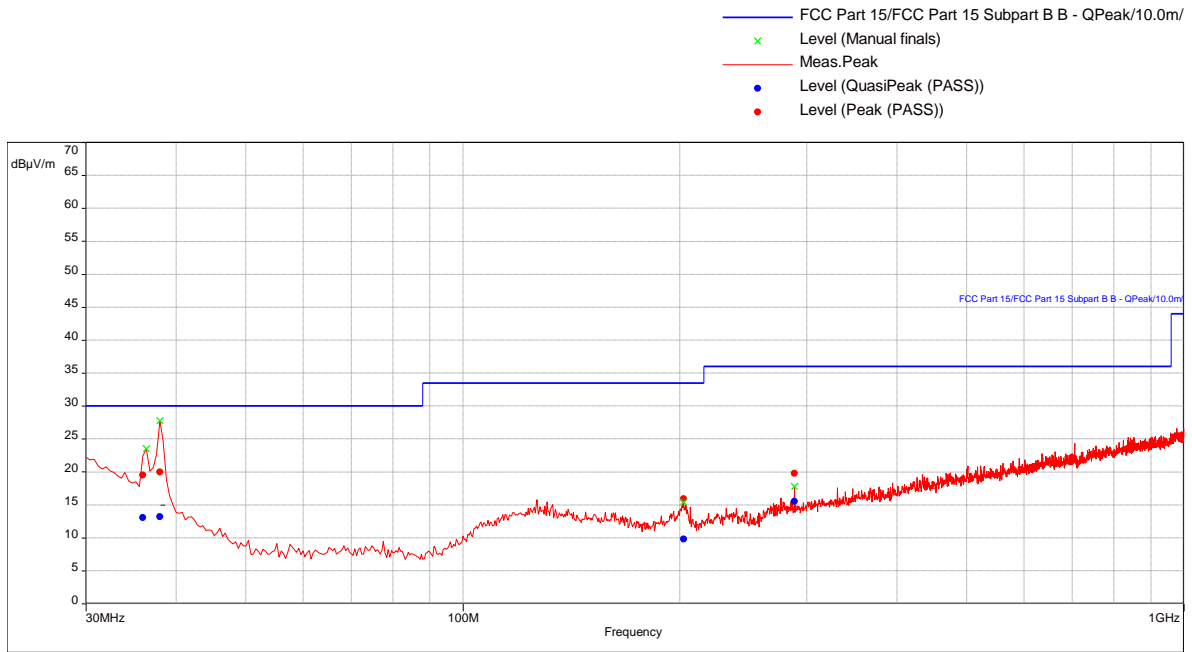
1-13 GHz Test Setup

11.5 Plots/Data:

Test Information:

| | |
|---------------------------|--------------------------------------|
| Date and Time | 7/26/2018 6:51:41 PM |
| Client and Project Number | Becton Dickinson |
| Engineer | Vathana Ven |
| Temperature | 21 deg C |
| Humidity | 50% |
| Atmospheric Pressure | 1001mbar |
| Comments | RE 30-1000MHz_WC_Low channel_Rx mode |

Graph:



Results:

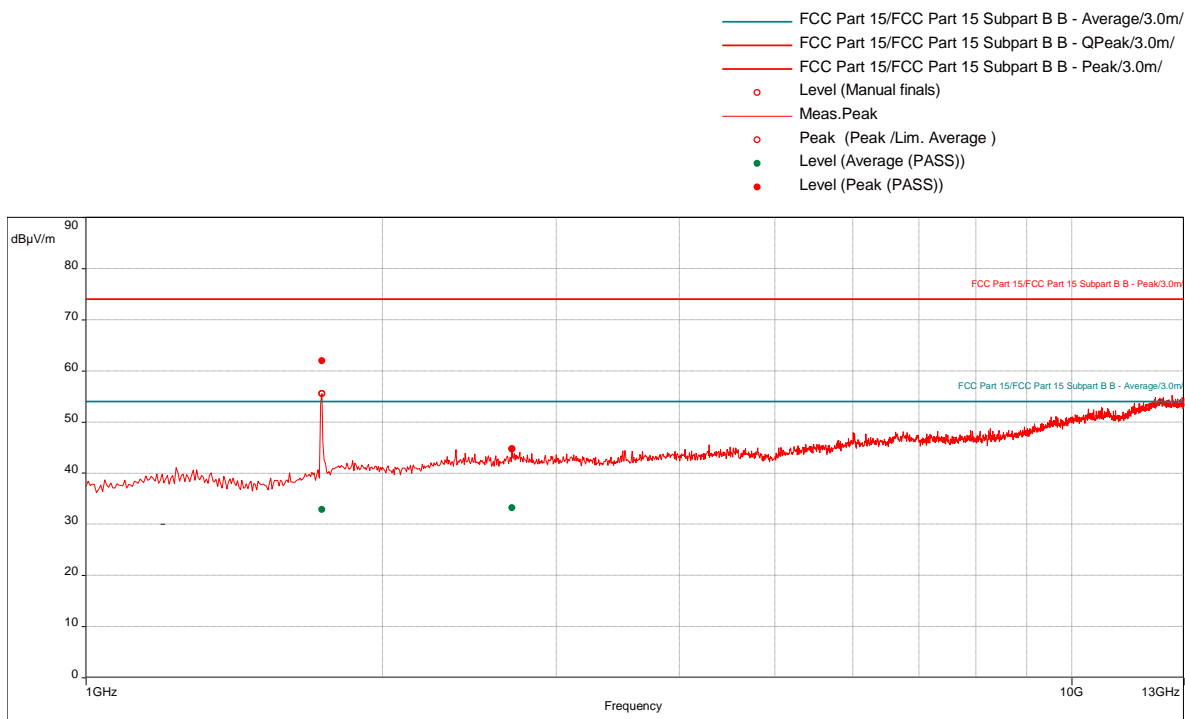
QuasiPeak (PASS) (4)

| Frequency (MHz) | Limit (dBµV/m) | Margin (dB) | Azimuth (°) | Height (m) | Pol. | RBW | Correction (dB) |
|-----------------|----------------|-------------|-------------|------------|----------|-----------|-----------------|
| 35.92631579 | 30.00 | -16.96 | 41.00 | 1.37 | Vertical | 120000.00 | -26.30 |
| 38.09473684 | 30.00 | -16.81 | 33.00 | 1.61 | Vertical | 120000.00 | -27.90 |
| 202.3684211 | 33.50 | -23.70 | 271.00 | 2.20 | Vertical | 120000.00 | -29.31 |
| 288.5578947 | 36.00 | -20.50 | 151.00 | 1.00 | Vertical | 120000.00 | -28.32 |

Test Information:

| | |
|---------------------------|---------------------------------------|
| Date and Time | 7/26/2018 8:13:02 PM |
| Client and Project Number | Becton Dickinson |
| Engineer | Vathana Ven |
| Temperature | 21 deg C |
| Humidity | 50% |
| Atmospheric Pressure | 1001mbar |
| Comments | RE 1 to 13 GHz_WC_Low Channel_Rx mode |

Graph:



Results:

Peak (PASS) (2)

| Frequency (MHz) | Level (dBµV/m) | Limit (dBµV/m) | Margin (dB) | Azimuth (°) | Height (m) | Pol. | RBW | Correction (dB) |
|-----------------|----------------|----------------|-------------|-------------|------------|----------|------------|-----------------|
| 1732.631579 | 61.93 | 74.00 | -12.07 | 78.00 | 1.54 | Vertical | 1000000.00 | 1.70 |
| 2703.684211 | 44.79 | 74.00 | -29.21 | 4.00 | 1.62 | Vertical | 1000000.00 | 5.09 |

Average (PASS) (2)

| Frequency (MHz) | Level (dBµV/m) | Limit (dBµV/m) | Margin (dB) | Azimuth (°) | Height (m) | Pol. | RBW | Correction (dB) |
|-----------------|----------------|----------------|-------------|-------------|------------|----------|------------|-----------------|
| 1732.631579 | 32.90 | 54.00 | -21.10 | 78.00 | 1.54 | Vertical | 1000000.00 | 1.70 |
| 2703.684211 | 33.22 | 54.00 | -20.78 | 4.00 | 1.62 | Vertical | 1000000.00 | 5.09 |

Test Personnel: Vathana Ven *VSV*
Supervising/Reviewing
Engineer:
(Where Applicable) Kouma Sinn *KPS*
Product Standard: FCC Part 15 Subpart B,
Input Voltage: ICES-003
Internal Battery
Pretest Verification w/
Ambient Signals or
BB Source: BB Source

Test Date: 07/26/2018

Limit Applied: See report section 11.3
Ambient Temperature: 21 °C
Relative Humidity: 50 %
Atmospheric Pressure: 1001 mbars

Deviations, Additions, or Exclusions: None

12 Revision History

| Revision Level | Date | Report Number | Prepared By | Reviewed By | Notes |
|----------------|------------|-------------------|----------------|----------------|----------------|
| 0 | 08/23/2018 | 103511832BOX-012a | VFV <i>VFV</i> | KPS <i>KPS</i> | Original Issue |
| | | | | | |
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