



# **CERTIFICATION TEST REPORT**

**Report Number. :** 12292105-E2V2

**Applicant :** SRAM LLC  
1000 W Fulton Market 4<sup>th</sup> Floor  
Chicago, IL 60607 U.S.A

**Model :** 00010

**FCC ID :** C9O-LSBB1

**IC :** 10161A-LSBB1

**EUT Description :** Left Shifter with AIREA and BLE Radios

**Test Standard(s) :** FCC 47 CFR PART 15 SUBPART C  
ISED RSS-247 ISSUE 2  
ISED RSS-GEN ISSUE 5

**Date Of Issue:**

June 25, 2018

**Prepared by:**

UL Verification Services Inc.  
47173 Benicia Street  
Fremont, CA 94538, U.S.A.  
TEL: (510) 771-1000  
FAX: (510) 661-0888

## REPORT REVISION HISTORY

| Rev. | Issue Date | Revisions           | Revised By  |
|------|------------|---------------------|-------------|
| V1   | 6/15/2018  | Initial Issue       | --          |
| V2   | 6/25/2018  | Updated Section 5.3 | Steven Tran |

## TABLE OF CONTENTS

|                                                |           |
|------------------------------------------------|-----------|
| <b>REPORT REVISION HISTORY .....</b>           | <b>2</b>  |
| <b>TABLE OF CONTENTS .....</b>                 | <b>3</b>  |
| <b>1. ATTESTATION OF TEST RESULTS .....</b>    | <b>5</b>  |
| <b>2. TEST METHODOLOGY .....</b>               | <b>6</b>  |
| <b>3. FACILITIES AND ACCREDITATION .....</b>   | <b>6</b>  |
| <b>4. CALIBRATION AND UNCERTAINTY .....</b>    | <b>7</b>  |
| 4.1. MEASURING INSTRUMENT CALIBRATION .....    | 7         |
| 4.2. SAMPLE CALCULATION .....                  | 7         |
| 4.3. MEASUREMENT UNCERTAINTY.....              | 7         |
| <b>5. EQUIPMENT UNDER TEST .....</b>           | <b>8</b>  |
| 5.1. DESCRIPTION OF EUT .....                  | 8         |
| 5.2. MAXIMUM OUTPUT POWER.....                 | 8         |
| 5.3. DESCRIPTION OF AVAILABLE ANTENNAS .....   | 8         |
| 5.4. SOFTWARE AND FIRMWARE.....                | 8         |
| 5.5. WORST-CASE CONFIGURATION AND MODE .....   | 8         |
| 5.6. DESCRIPTION OF TEST SETUP.....            | 9         |
| <b>6. MEASUREMENT METHOD.....</b>              | <b>12</b> |
| <b>7. TEST AND MEASUREMENT EQUIPMENT .....</b> | <b>13</b> |
| <b>8. ANTENNA PORT TEST RESULTS .....</b>      | <b>14</b> |
| 8.1. ON TIME AND DUTY CYCLE.....               | 14        |
| 8.2. 99% BANDWIDTH.....                        | 15        |
| 8.3. 6 dB BANDWIDTH.....                       | 16        |
| 8.4. OUTPUT POWER.....                         | 17        |
| 8.5. AVERAGE POWER .....                       | 18        |
| 8.6. POWER SPECTRAL DENSITY .....              | 19        |
| 8.7. CONDUCTED SPURIOUS EMISSIONS.....         | 20        |
| <b>9. RADIATED TEST RESULTS.....</b>           | <b>22</b> |
| 9.1. TRANSMITTER ABOVE 1 GHz .....             | 23        |
| 9.2. Worst Case Below 30MHz .....              | 35        |
| 9.3. Worst Case Below 1 GHz .....              | 37        |

---

|                                |           |
|--------------------------------|-----------|
| 9.4. Worst Case 18-26 GHz..... | 39        |
| <b>10. SETUP PHOTOS.....</b>   | <b>41</b> |

## 1. ATTESTATION OF TEST RESULTS

**COMPANY NAME:** SRAM LLC  
1000 W Fulton Market, 4<sup>th</sup> Floor  
Chicago, IL 60607, U.S.A

**EUT DESCRIPTION:** Left Shifter with AIREA and BLE Radios

**MODEL:** 00010

**SERIAL NUMBER:** 1133010252 (Conducted), 1133010216 (Radiated)

**DATE TESTED:** May 16 – 25 , 2018

| APPLICABLE STANDARDS     |              |
|--------------------------|--------------|
| STANDARD                 | TEST RESULTS |
| CFR 47 Part 15 Subpart C | Complies     |
| ISED RSS-247 Issue 2     | Complies     |
| ISED RSS-GEN Issue 5     | Complies     |

UL Verification Services Inc. tested the above equipment in accordance with the requirements set forth in the above standards. All indications of Pass/Fail in this report are opinions expressed by UL Verification Services Inc. based on interpretations and/or observations of test results. Measurement Uncertainties were not taken into account and are published for informational purposes only. The test results show that the equipment tested is capable of demonstrating compliance with the requirements as documented in this report.

**Note:** The results documented in this report apply only to the tested sample, under the conditions and modes of operation as described herein. This document may not be altered or revised in any way unless done so by UL Verification Services Inc. and all revisions are duly noted in the revisions section. Any alteration of this document not carried out by UL Verification Services Inc. will constitute fraud and shall nullify the document. This report must not be used by the client to claim product certification, approval, or endorsement by NVLAP, NIST, any agency of the Federal Government, or any agency of the U.S. government.

Approved & Released For  
UL Verification Services Inc. By:



DAN CORONIA  
CONSUMER TECHNOLOGY DIVISION  
OPERATIONS LEADER  
UL Verification Services Inc.

Prepared By:



GLENN ESCANO  
CONSUMER TECHNOLOGY DIVISION  
TEST ENGINEER  
UL Verification Services Inc.

## 2. TEST METHODOLOGY

The tests documented in this report were performed in accordance with FCC CFR 47 Part 2, FCC CFR 47 Part 15, KDB 558074 D01 v04, ANSI C63.10-2013, RSS-GEN Issue 5, and RSS-247 Issue 2.

## 3. FACILITIES AND ACCREDITATION

The test sites and measurement facilities used to collect data are located at 47173 and 47266 Benicia Street, Fremont, California, USA. Line conducted emissions are measured only at the 47173 address. The following table identifies which facilities were utilized for radiated emission measurements documented in this report. Specific facilities are also identified in the test results sections.

| 47173 Benicia Street                                         | 47266 Benicia Street                                         |
|--------------------------------------------------------------|--------------------------------------------------------------|
| <input checked="" type="checkbox"/> Chamber A (ISED:2324B-1) | <input checked="" type="checkbox"/> Chamber D (ISED:22541-1) |
| <input checked="" type="checkbox"/> Chamber B (ISED:2324B-2) | <input type="checkbox"/> Chamber E (ISED:22541-2)            |
| <input type="checkbox"/> Chamber C (ISED:2324B-3)            | <input type="checkbox"/> Chamber F (ISED:22541-3)            |
|                                                              | <input type="checkbox"/> Chamber G (ISED:22541-4)            |
|                                                              | <input type="checkbox"/> Chamber H (ISED:22541-5)            |

The above test sites and facilities are covered under FCC Test Firm Registration # 208313. Chambers A through C are covered under ISED company address code 2324B with site numbers 2324B -1 through 2324B-3, respectively. Chambers D through H are covered under ISED Canada company address code 22541 with site numbers 22541 -1 through 22541-5, respectively.

UL Verification Services Inc. is accredited by NVLAP, Laboratory Code 200065-0. The full scope of accreditation can be viewed at <http://nist.gov/standards/scopes/2000650.htm>.

## 4. CALIBRATION AND UNCERTAINTY

### 4.1. MEASURING INSTRUMENT CALIBRATION

The measuring equipment utilized to perform the tests documented in this report has been calibrated in accordance with the manufacturer's recommendations, and is traceable to recognized national standards.

### 4.2. SAMPLE CALCULATION

Where relevant, the following sample calculation is provided:

$$\begin{aligned} \text{Field Strength (dBuV/m)} &= \text{Measured Voltage (dBuV)} + \text{Antenna Factor (dB/m)} + \\ &\text{Cable Loss (dB)} - \text{Preamplifier Gain (dB)} \\ 36.5 \text{ dBuV} + 18.7 \text{ dB/m} + 0.6 \text{ dB} - 26.9 \text{ dB} &= 28.9 \text{ dBuV/m} \end{aligned}$$

### 4.3. MEASUREMENT UNCERTAINTY

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the apparatus:

| PARAMETER                                           | UNCERTAINTY |
|-----------------------------------------------------|-------------|
| Worst Case Conducted Disturbance, 9KHz to 0.15 MHz  | 3.84 dB     |
| Worst Case Conducted Disturbance, 0.15 to 30 MHz    | 3.65 dB     |
| Worst Case Radiated Disturbance, 9KHz to 30 MHz     | 3.15 dB     |
| Worst Case Radiated Disturbance, 30 to 1000 MHz     | 5.36 dB     |
| Worst Case Radiated Disturbance, 1000 to 18000 MHz  | 4.32 dB     |
| Worst Case Radiated Disturbance, 18000 to 26000 MHz | 4.45 dB     |
| Worst Case Radiated Disturbance, 26000 to 40000 MHz | 5.24 dB     |

Uncertainty figures are valid to a confidence level of 95%.

## 5. EQUIPMENT UNDER TEST

### 5.1. DESCRIPTION OF EUT

The EUT is a Left Shifter with AIREA and BLE Radios, powered by CR2032, coin cell battery.

### 5.2. MAXIMUM OUTPUT POWER

The transmitter has a maximum conducted output power as follows:

| Frequency Range<br>(MHz) | Mode  | Peak                     |                         | Average                  |                         |
|--------------------------|-------|--------------------------|-------------------------|--------------------------|-------------------------|
|                          |       | Output<br>Power<br>(dBm) | Output<br>Power<br>(mW) | Output<br>Power<br>(dBm) | Output<br>Power<br>(mW) |
| 2405-2480                | AIREA | 2.78                     | 1.90                    | 2.48                     | 1.77                    |

### 5.3. DESCRIPTION OF AVAILABLE ANTENNAS

The radio utilizes a chip antenna type number W3008C, with a maximum gain of 2.2 dBi.

### 5.4. SOFTWARE AND FIRMWARE

The EUT firmware installed during testing was A-1.0.

The test utility software used during testing was Lightblue v2.6.4

### 5.5. WORST-CASE CONFIGURATION AND MODE

Radiated emissions below 1GHz and above 18GHz were performed with the EUT set to transmit at the channel with highest output power as worst-case scenario.

Band edge and radiated emissions between 1GHz and 18GHz were performed with the EUT set to transmit at the highest power on low, middle and high channels.

The fundamental of the EUT was investigated in three orthogonal orientations X,Y,Z, it was determined that X orientation was worst-case orientation; therefore, all final radiated testing was performed with the EUT in X orientation.

## 5.6. DESCRIPTION OF TEST SETUP

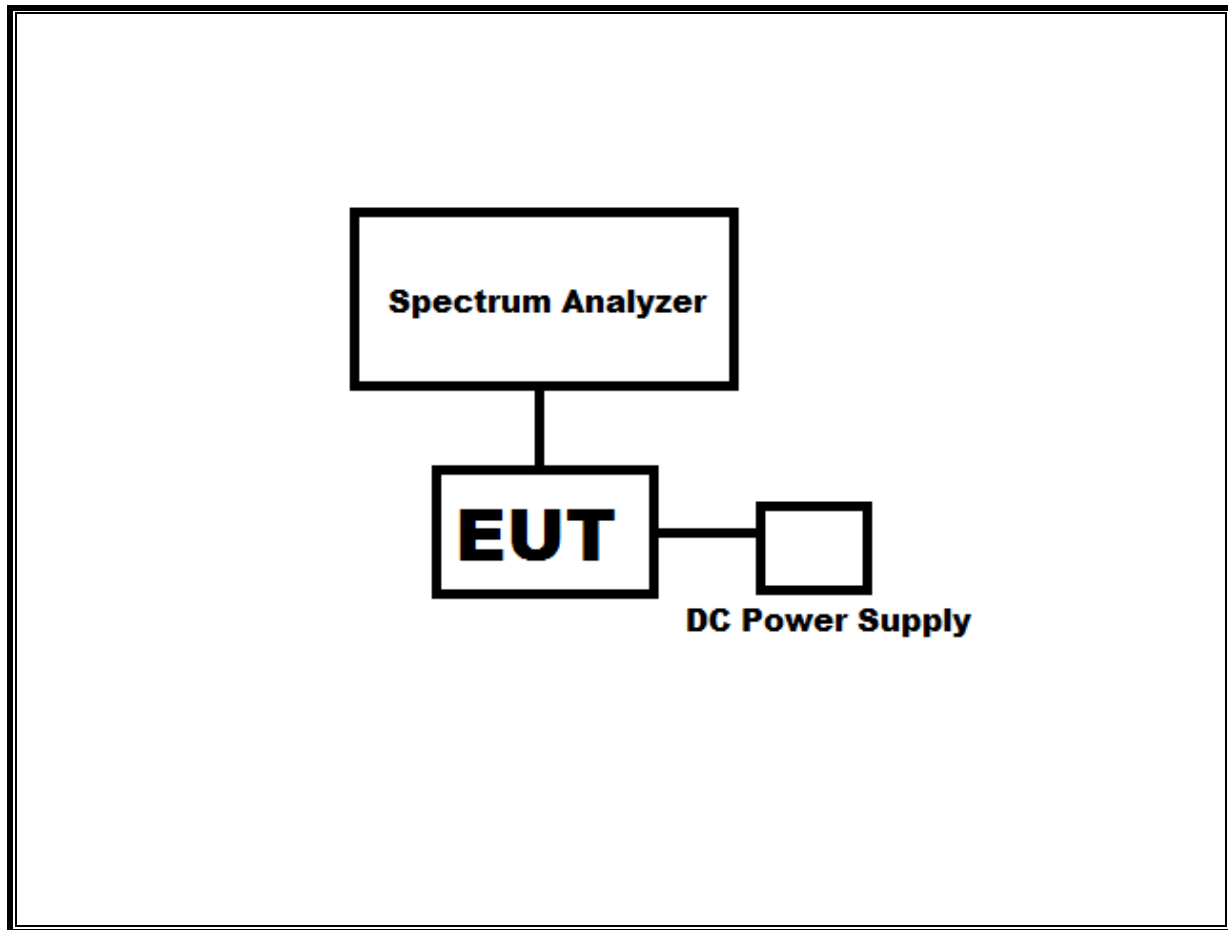
### SUPPORT EQUIPMENT

| Support Equipment List |              |           |               |
|------------------------|--------------|-----------|---------------|
| Description            | Manufacturer | Model     | Serial Number |
| Ipod Touch             | Apple        | MKJ02LL/A | CCQVRHY2GGNL  |

### TEST SETUP

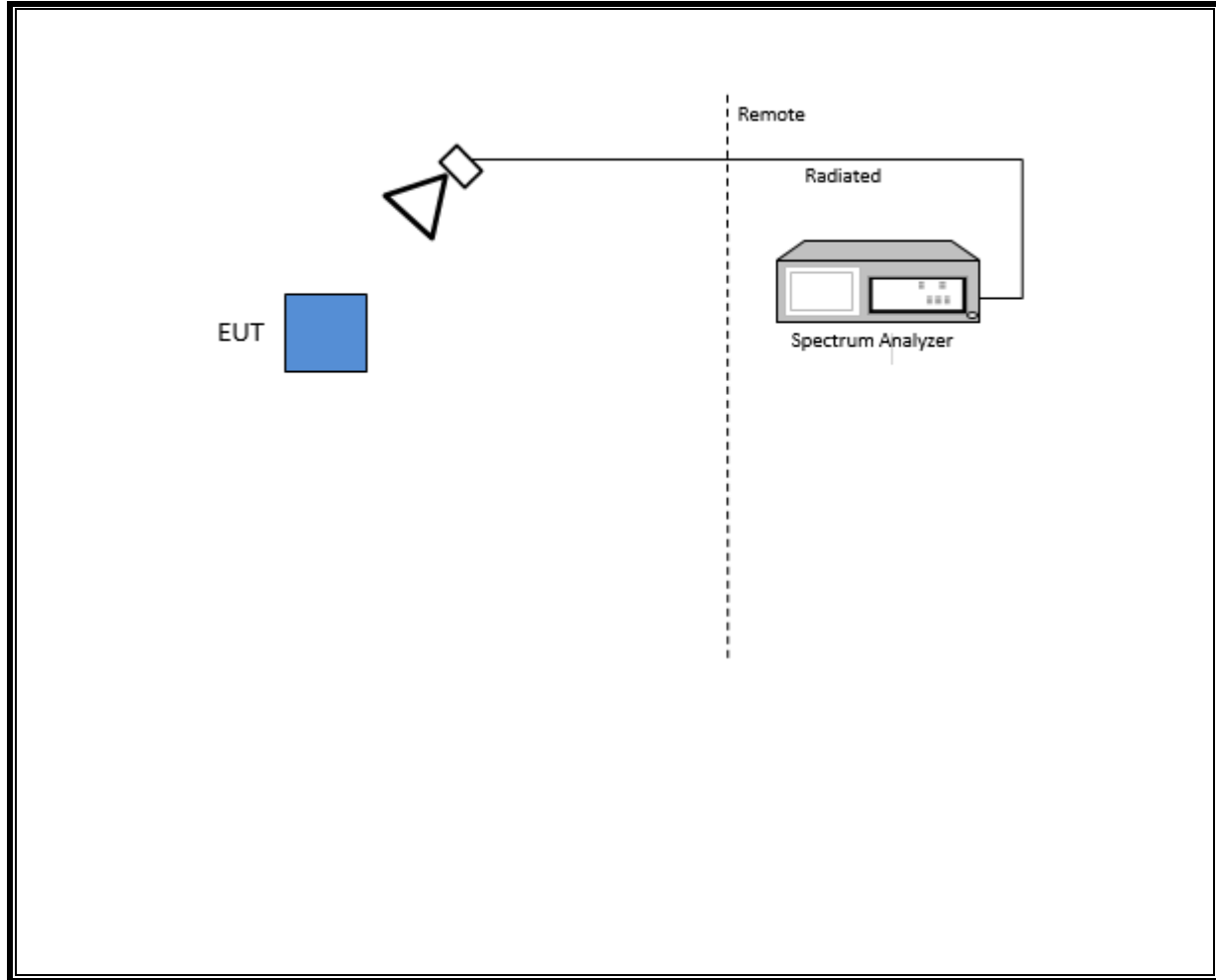
The EUT is powered by a CR2032 coin cell battery. The iPod Touch wirelessly sends commands to the EUT.

**SETUP DIAGRAM FOR CONDUCTED TESTS**



Note – The DC power supply is used only during testing. During normal operation the EUT is powered by a supplied CR2032, coin cell battery.

**SETUP DIAGRAM FOR RADIATED TESTS**



## 6. MEASUREMENT METHOD

On Time and Duty Cycle: KDB 558074 D01 v04, Section 6.

6 dB BW: KDB 558074 D01 v04, Section 8.1.

99% BW: ANSI C63.10-2013, Section 6.9.3.

Output Power: KDB 558074 D01 v04, Section 9.2.3.2.

Power Spectral Density: KDB 558074 D01 v04, Section 10.3.

Out-of-band emissions in non-restricted bands: KDB 558074 D01 v04, Section 11.1 (b).

Out-of-band emissions in restricted bands: KDB 558074 D01 v04, Section 12.1.

Band-edge: KDB 558074 D01 v04, Section 12.1.

## 7. TEST AND MEASUREMENT EQUIPMENT

The following test and measurement equipment was utilized for the tests documented in this

| Test Equipment List               |                |                        |        |          |          |
|-----------------------------------|----------------|------------------------|--------|----------|----------|
| Description                       | Manufacturer   | Model                  | ID No. | Cal Date | Cal Due  |
| Spectrum Analyzer                 | Agilent        | N9030A                 | T1454  | 01/08/18 | 01/08/19 |
| Spectrum Analyzer                 | Agilent        | N9030A                 | T1466  | 04/16/18 | 04/16/19 |
| Antenna, Biconolog, 30MHz-2000MHz | Sunol Sciences | JB1                    | T130   | 10/16/17 | 10/16/18 |
| Antenna, Horn, 1-18GHz            | ETS Lindgren   | 3117                   | T862   | 06/09/17 | 06/09/18 |
| Antenna, Horn, 1-18GHz            | ETS Lindgren   | 3117                   | T863   | 06/09/17 | 06/09/18 |
| RF Preamplifier, 10kHz - 1GHz     | HP             | 8447D                  | T15    | 08/14/17 | 08/14/18 |
| RF Preamplifier, 1 - 18GHz        | Miteq          | AFS42-00101800-25-S-42 | T1165  | 11/25/17 | 11/25/18 |
| RF Preamplifier, 1 - 18GHz        | Miteq          | AFS42-00101800-25-S-42 | T493   | 04/03/18 | 04/03/19 |
| Antenna, Active Loop 9kHz – 30MHz | Com-Power      | AL-130R                | T1866  | 10/10/17 | 10/10/18 |
| Antenna, Horn, 18-26GHz           | ARA            | MWH-1826G              | T89    | 01/18/18 | 01/18/19 |
| Spectrum Analyzer                 | Keysight       | N9030A                 | T1113  | 12/21/17 | 12/21/18 |
| RF Preamplifier, 1-26GHz          | Agilent        | 8449B                  | T404   | 07/23/17 | 07/23/18 |

| Test Software List    |              |        |                       |
|-----------------------|--------------|--------|-----------------------|
| Description           | Manufacturer | Model  | Version               |
| Radiated Software     | UL           | UL EMC | Ver 9.5, Dec 01, 2016 |
| Antenna Port Software | UL           | UL RF  | Ver 8.2, Mar 21, 2018 |

## 8. ANTENNA PORT TEST RESULTS

### 8.1. ON TIME AND DUTY CYCLE

#### LIMITS

None; for reporting purposes only.

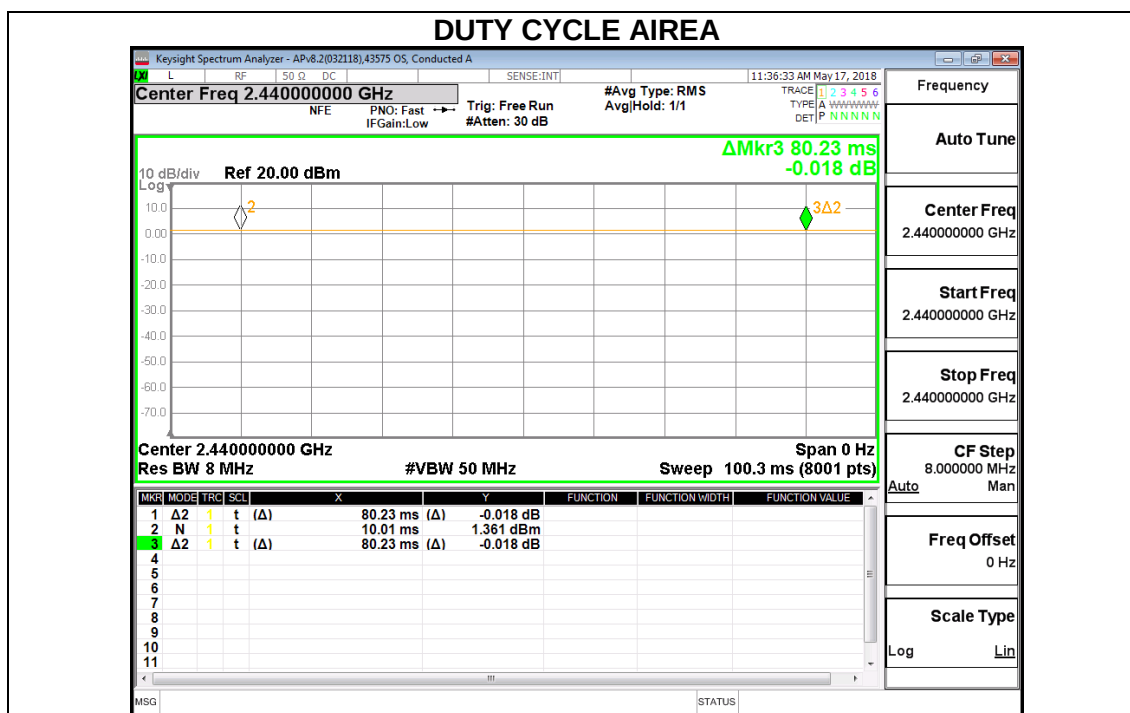
#### PROCEDURE

KDB 789033 Zero-Span Spectrum Analyzer Method.

#### ON TIME AND DUTY CYCLE RESULTS

| Mode  | ON Time<br>B<br>(msec) | Period<br>(msec) | Duty Cycle<br>x<br>(linear) | Duty<br>Cycle<br>(%) | Duty Cycle<br>Correction Factor<br>(dB) | 1/B<br>Minimum VBW<br>(kHz) |
|-------|------------------------|------------------|-----------------------------|----------------------|-----------------------------------------|-----------------------------|
| AIREA | 1.0                    | 1.0              | 1.000                       | 100.00%              | 0.00                                    | 0.010                       |

#### DUTY CYCLE PLOTS



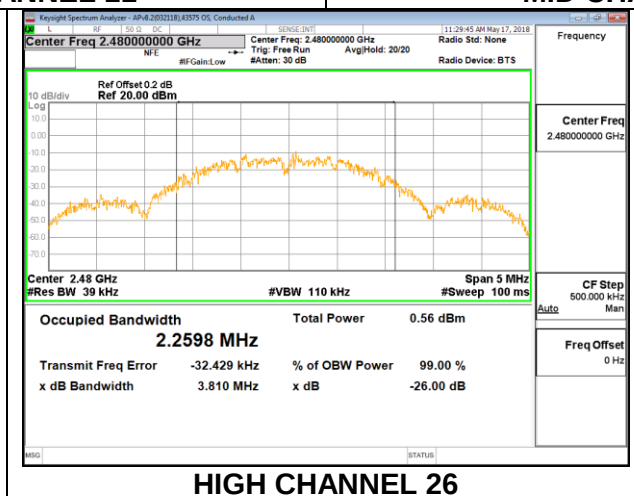
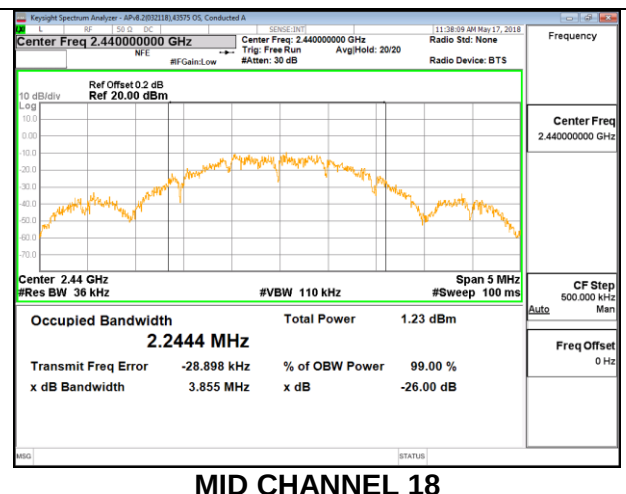
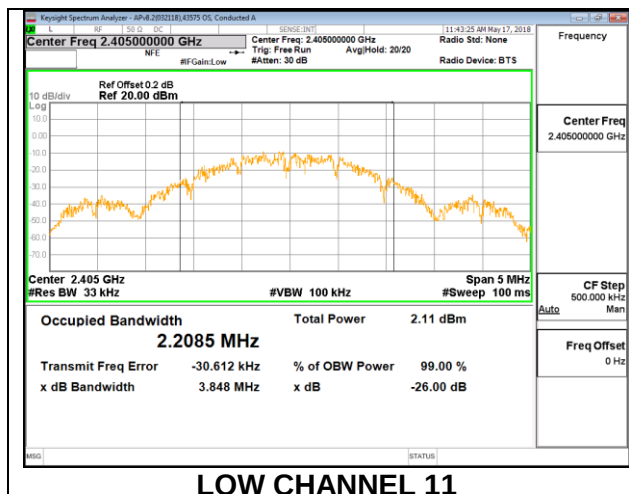
## 8.2. 99% BANDWIDTH

### LIMITS

None; for reporting purposes only.

### RESULTS

| Channel | Frequency | 99% Bandwidth |
|---------|-----------|---------------|
|         | (MHz)     | (MHz)         |
| Low 11  | 2405      | 2.2085        |
| Mid 18  | 2440      | 2.2444        |
| High 26 | 2480      | 2.2598        |



### 8.3. 6 dB BANDWIDTH

#### LIMITS

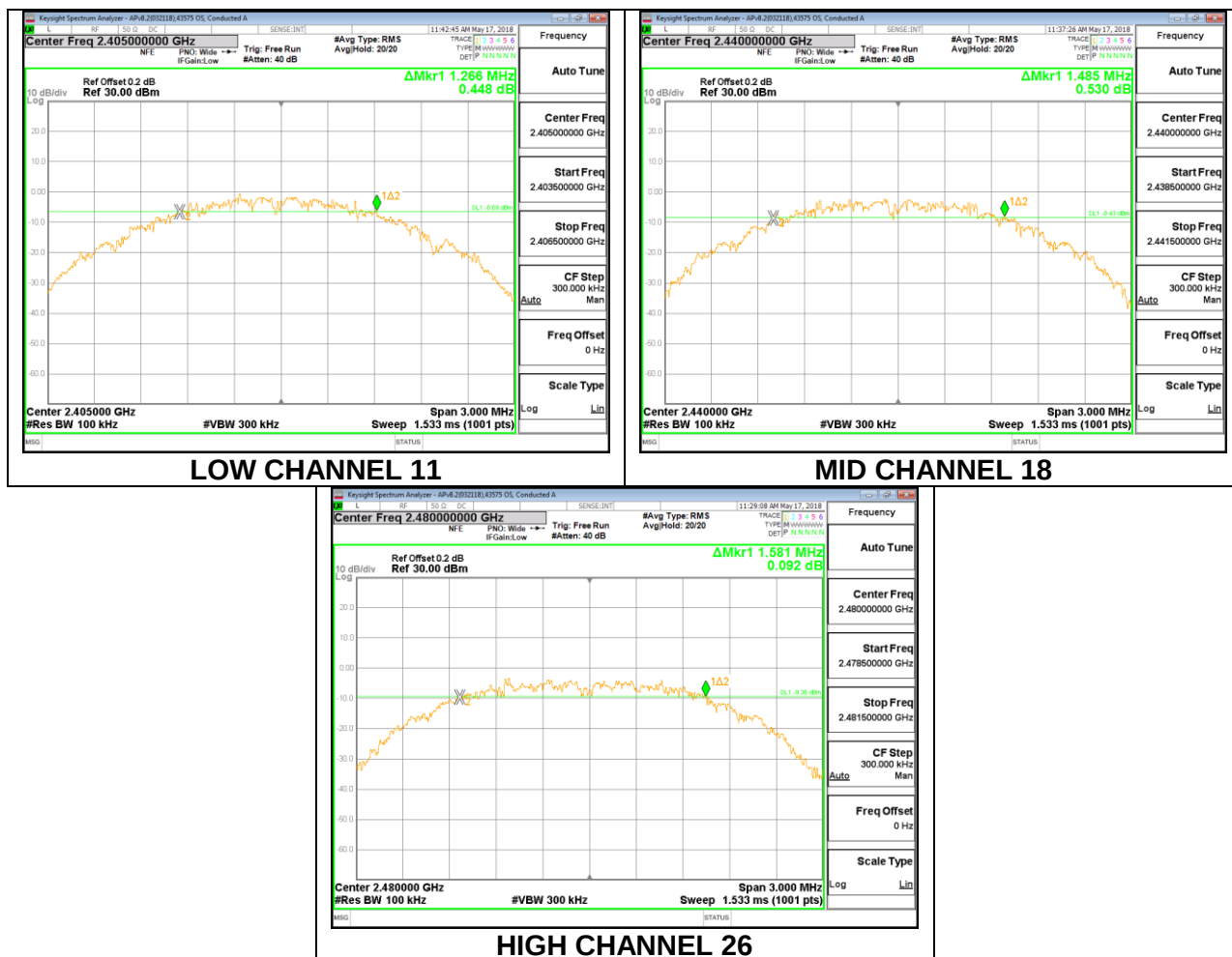
FCC §15.407 (e)

RSS-247 5.2 (a)

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

#### RESULTS

| Channel | Frequency<br>(MHz) | 6 dB Bandwidth<br>(MHz) | Minimum Limit<br>(MHz) |
|---------|--------------------|-------------------------|------------------------|
| Low 11  | 2405               | 1.2660                  | 0.5                    |
| Mid 18  | 2440               | 1.4850                  | 0.5                    |
| High 26 | 2480               | <b>1.5810</b>           | 0.5                    |



## 8.4. OUTPUT POWER

### LIMITS

#### FCC §15.247 (b) (3)

#### RSS-247 5.4 (d)

For systems using digital modulation in the 902–928 MHz, 2400–2483.5 MHz, and 5725–5850 MHz bands: 1 Watt, based on the use of antennas with directional gains that do not exceed 6 dBi. If transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power from the intentional radiator shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

### Test Procedure

The transmitter output is connected to a power meter.

The transmitter output is connected to a power meter. The cable assembly insertion loss was entered as an offset in the power meter to allow for a gated peak reading of power.

### DIRECTIONAL ANTENNA GAIN

There is only one transmitter output therefore the directional gain is equal to the antenna gain.

### RESULTS

|                   |           |
|-------------------|-----------|
| <b>Tested By:</b> | 43575 OS  |
| <b>Date:</b>      | 5/17/2018 |

| Channel   | Frequency<br>(MHz) | Peak Power<br>Reading<br>(dBm) | Limit<br>(dBm) | Margin<br>(dB) |
|-----------|--------------------|--------------------------------|----------------|----------------|
| Low 11    | 2402               | 2.78                           | 30             | -27.22         |
| Middle 18 | 2440               | 2.24                           | 30             | -27.76         |
| High 25   | 2475               | 1.71                           | 30             | -28.29         |
| High 26   | 2480               | -7.04                          | 30             | -37.04         |

## 8.5. AVERAGE POWER

### LIMITS

None; for reporting purposes only

### TEST PROCEDURE

The transmitter output is connected to a power meter.

The transmitter output is connected to a power meter. The cable assembly insertion loss was entered as an offset in the power meter to allow for a gated average reading of power.

### RESULTS

|                   |          |
|-------------------|----------|
| <b>Tested By:</b> | 43575 OS |
| <b>Date:</b>      | 05/17/18 |

| Channel | Frequency<br>(MHz) | Meas<br>Power<br>(dBm) |
|---------|--------------------|------------------------|
| Low 11  | 2405               | 2.48                   |
| Mid 18  | 2440               | 1.83                   |
| High 25 | 2475               | 1.36                   |
| High 26 | 2480               | -8.20                  |

## 8.6. POWER SPECTRAL DENSITY

### LIMITS

FCC §15.247 (e)

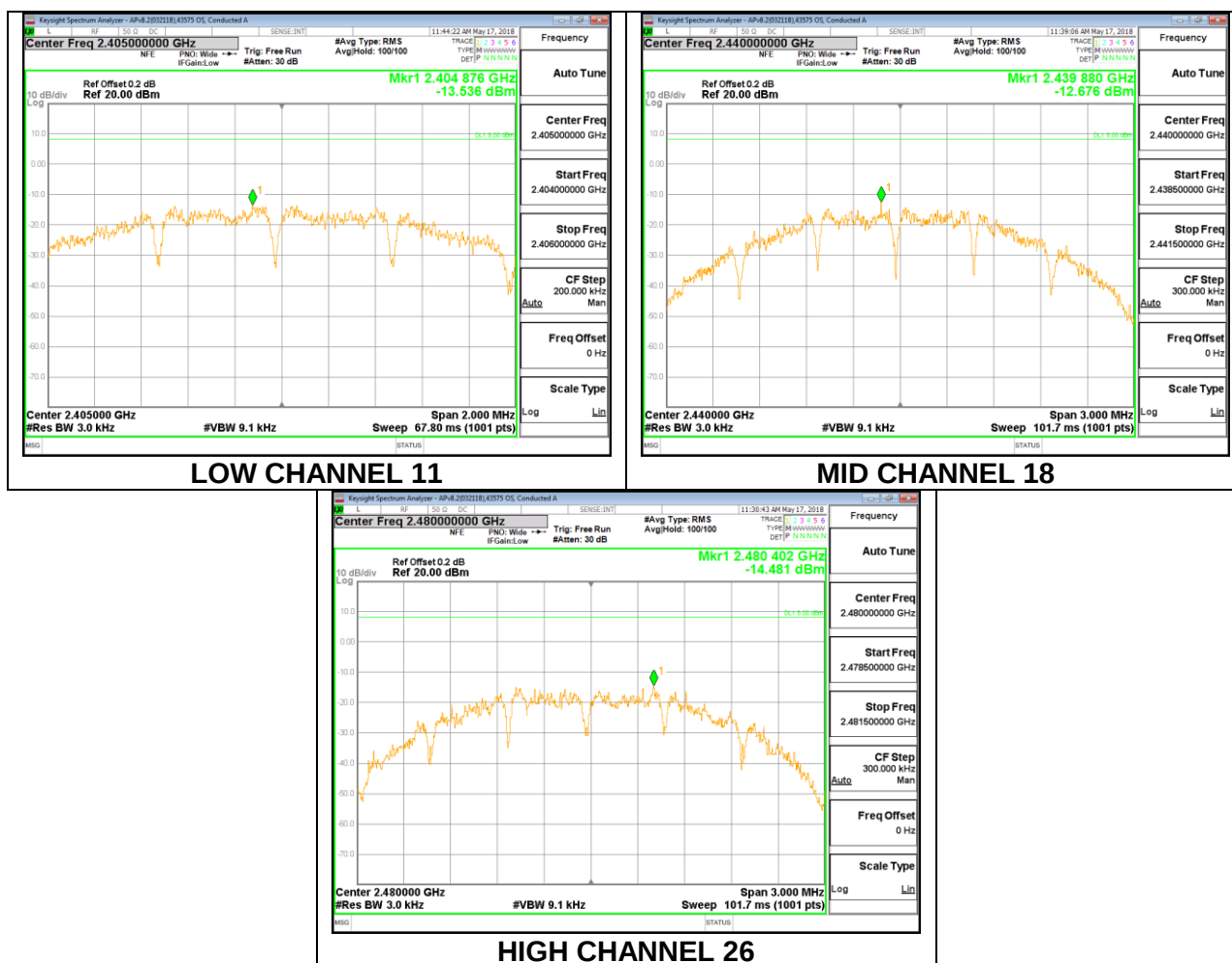
RSS-247 (5.2) (b)

The power spectral density conducted from the transmitter to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

### RESULTS

#### PSD Results

| Channel | Frequency<br>(MHz) | Chain 0<br>Meas<br>(dBm/3kHz) | Total<br>Corr'd<br>PSD<br>(dBm/3kHz) | Limit<br>(dBm/3kHz) | Margin<br>(dB) |
|---------|--------------------|-------------------------------|--------------------------------------|---------------------|----------------|
| Low 11  | 2405               | -13.54                        | -13.54                               | 8.0                 | -21.5          |
| Mid 18  | 2440               | -12.68                        | -12.68                               | 8.0                 | -20.7          |
| High 26 | 2480               | -14.48                        | -14.48                               | 8.0                 | -22.5          |



## **8.7. CONDUCTED SPURIOUS EMISSIONS**

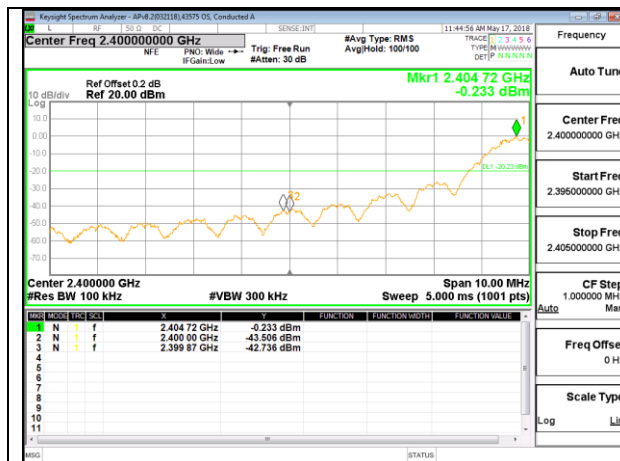
### **LIMITS**

FCC §15.247 (d)

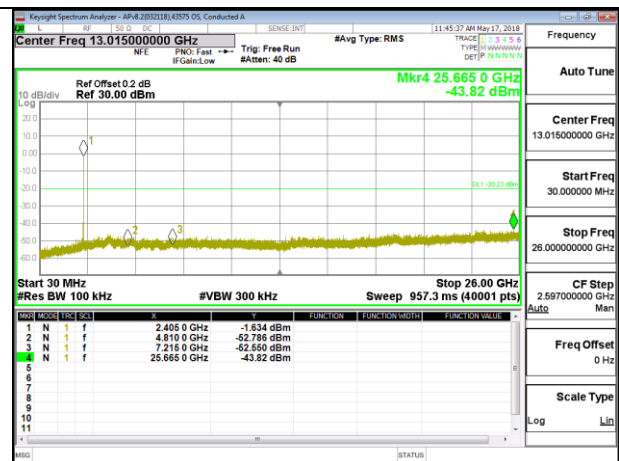
RSS-247 5.5

Output power was measured based on the use of peak measurement, therefore the required attenuation is 20 dB.

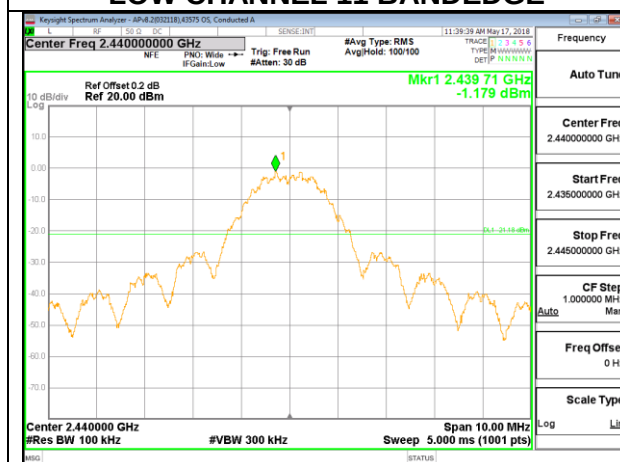
## RESULTS



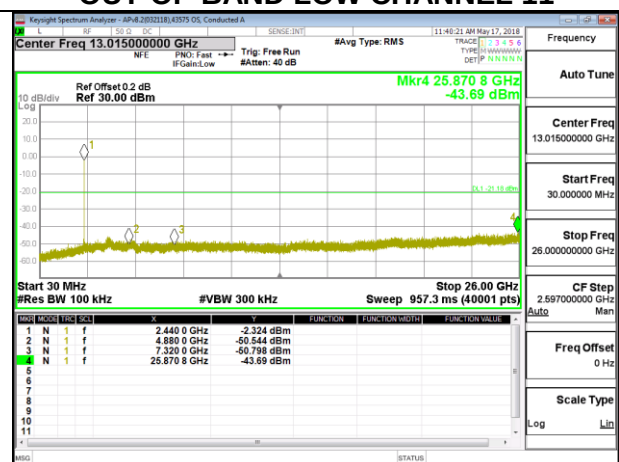
LOW CHANNEL 11 BANDEDGE



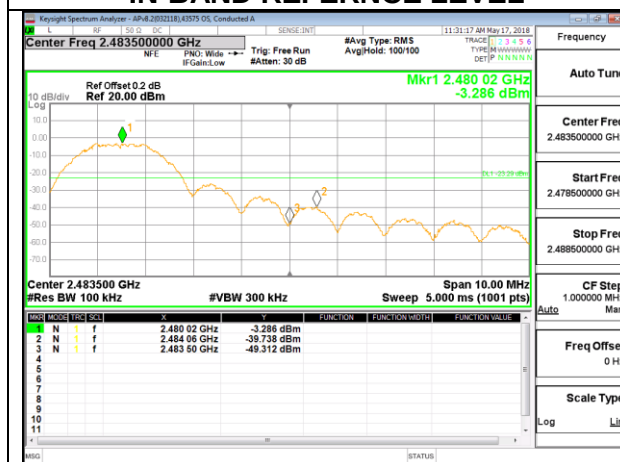
OUT-OF-BAND LOW CHANNEL 11



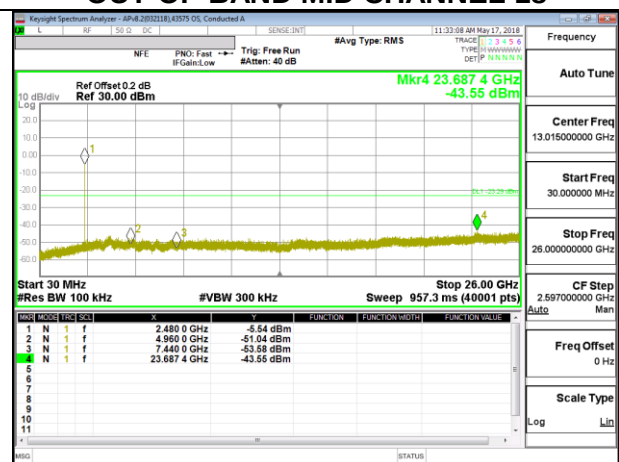
IN-BAND REFERENCE LEVEL



OUT-OF-BAND MID CHANNEL 18



HIGH CHANNEL 26 BANDEDGE



OUT-OF-BAND HIGH CHANNEL 26

## 9. RADIATED TEST RESULTS

### LIMITS

FCC §15.205 and §15.209

RSS-GEN, Section 8.9 and 8.10.

| Frequency Range (MHz) | Field Strength Limit (uV/m) at 3 m | Field Strength Limit (dBuV/m) at 3 m |
|-----------------------|------------------------------------|--------------------------------------|
| 0.009-0.490           | 2400/F(kHz) @ 300 m                | -                                    |
| 0.490-1.705           | 24000/F(kHz) @ 30 m                | -                                    |
| 1.705 - 30            | 30 @ 30m                           | -                                    |
| 30 - 88               | 100                                | 40                                   |
| 88 - 216              | 150                                | 43.5                                 |
| 216 - 960             | 200                                | 46                                   |
| Above 960             | 500                                | 54                                   |

### TEST PROCEDURE

The EUT is placed on a non-conducting table 80 cm above the ground plane for measurement below 1GHz; 1.5 m above the ground plane for measurement above 1GHz. The antenna to EUT distance is 3 meters. The EUT is configured in accordance with ANSI C63.10. The EUT is set to transmit in a continuous mode.

For measurements below 1 GHz the resolution bandwidth is set to 100 kHz for peak detection measurements or 120 kHz for quasi-peak detection measurements. Peak detection is used unless otherwise noted as quasi-peak.

For pre-scans above 1 GHz the resolution bandwidth is set to 1 MHz; the video bandwidth is set to 30 KHz for peak measurements.

For final measurements above 1 GHz the resolution bandwidth is set to 1 MHz; the video bandwidth is set to 3 MHz for peak measurements and as applicable for average measurements.

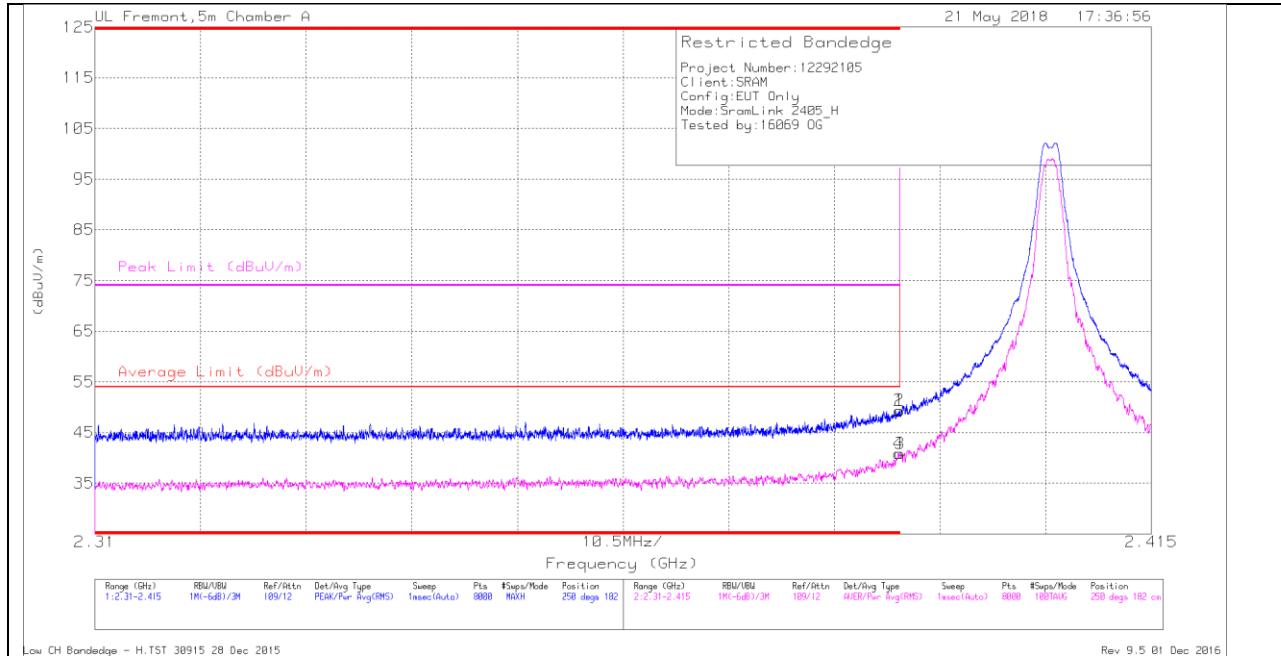
The spectrum from 1 GHz to 18 GHz is investigated with the transmitter set to the lowest, middle, and highest channels in each applicable band. Below 1GHz and above 18GHz emissions, the channel with the highest output power was tested.

The frequency range of interest is monitored at a fixed antenna height and EUT azimuth. The EUT is rotated through 360 degrees to maximize emissions received. The antenna is scanned from 1 to 4 meters above the ground plane to further maximize the emission. Measurements are made with the antenna polarized in both the vertical and the horizontal positions.

## 9.1. TRANSMITTER ABOVE 1 GHz

### BANDEDGE (LOW CHANNEL, CH 11)

#### HORIZONTAL RESULT



#### Trace Markers

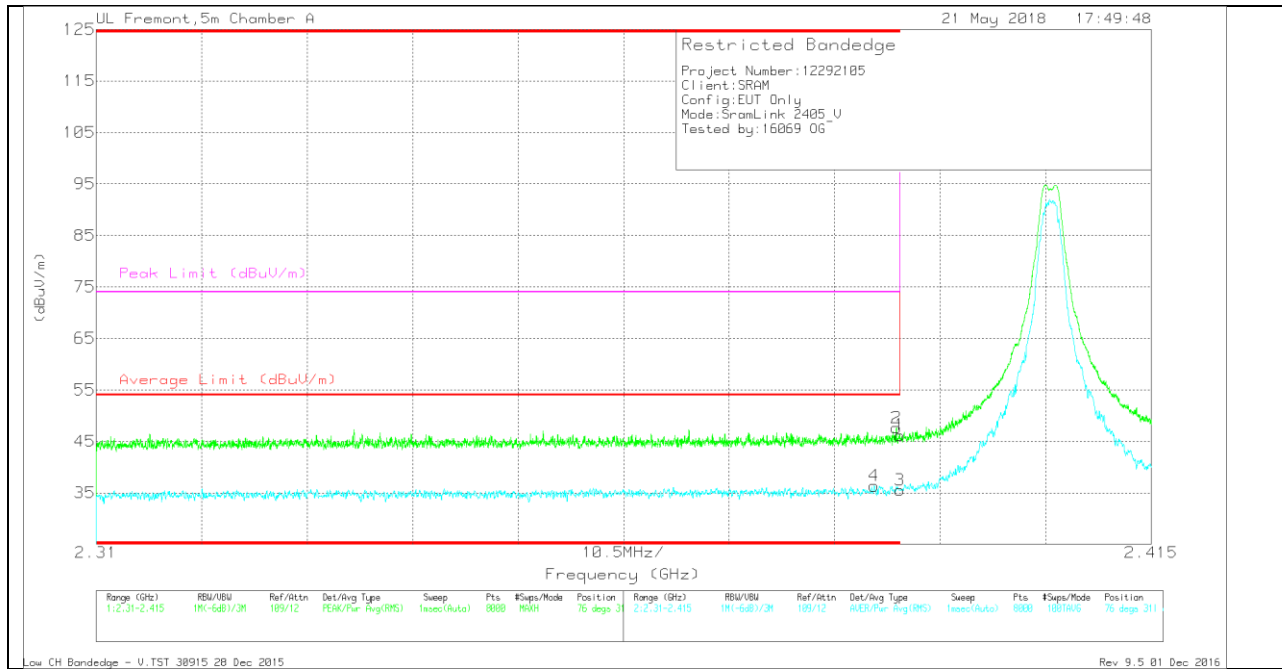
| Marker | Frequency (GHz) | Meter Reading (dBuV) | Det | AF T862 (dB/m) | Amp/Cbl/Filtr/Pad (dB) | DC Corr (dB) | Corrected Reading (dBuV/m) | Average Limit (dBuV/m) | Margin (dB) | Peak Limit (dBuV/m) | PK Margin (dB) | Azimuth (Degs) | Height (cm) | Polarity |
|--------|-----------------|----------------------|-----|----------------|------------------------|--------------|----------------------------|------------------------|-------------|---------------------|----------------|----------------|-------------|----------|
| 1      | * 2.39          | 40.94                | Pk  | 31.8           | -23.4                  | 0            | 49.34                      | -                      | -           | 74                  | -24.66         | 250            | 182         | H        |
| 2      | * 2.39          | 40.96                | Pk  | 31.8           | -23.4                  | 0            | 49.36                      | -                      | -           | 74                  | -24.64         | 250            | 182         | H        |
| 3      | * 2.39          | 32.4                 | RMS | 31.8           | -23.4                  | 0            | 40.8                       | 54                     | -13.2       | -                   | -              | 250            | 182         | H        |
| 4      | * 2.39          | 32.5                 | RMS | 31.8           | -23.4                  | 0            | 40.9                       | 54                     | -13.1       | -                   | -              | 250            | 182         | H        |

\* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band

Pk - Peak detector

RMS - RMS detection

## VERTICAL RESULT



## Trace Markers

| Marker | Frequency (GHz) | Meter Reading (dBuV) | Det | AF T862 (dB/m) | Amp/Cbl/Filtr/Pad (dB) | DC Corr (dB) | Corrected Reading (dBuV/m) | Average Limit (dBuV/m) | Margin (dB) | Peak Limit (dBuV/m) | PK Margin (dB) | Azimuth (Degs) | Height (cm) | Polarity |
|--------|-----------------|----------------------|-----|----------------|------------------------|--------------|----------------------------|------------------------|-------------|---------------------|----------------|----------------|-------------|----------|
| 1      | * 2.39          | 37.83                | Pk  | 31.8           | -23.4                  | 0            | 46.23                      | -                      | -           | 74                  | -27.77         | 76             | 311         | V        |
| 2      | * 2.39          | 39.24                | Pk  | 31.8           | -23.4                  | 0            | 47.64                      | -                      | -           | 74                  | -26.36         | 76             | 311         | V        |
| 3      | * 2.39          | 27.14                | RMS | 31.8           | -23.4                  | 0            | 35.54                      | 54                     | -18.46      | -                   | -              | 76             | 311         | V        |
| 4      | * 2.387         | 27.96                | RMS | 31.8           | -23.4                  | 0            | 36.36                      | 54                     | -17.64      | -                   | -              | 76             | 311         | V        |

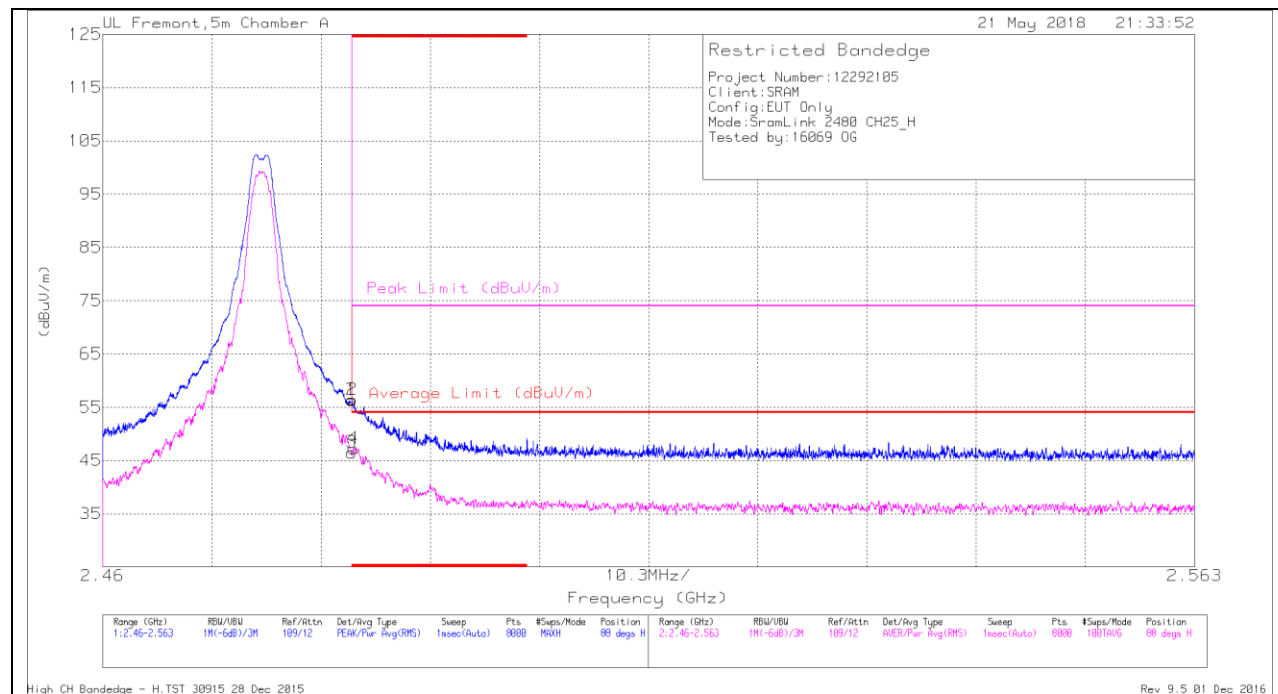
\* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band

Pk - Peak detector

RMS - RMS detection

## BANDEDGE (HIGH CHANNEL, CH 25)

### HORIZONTAL RESULT



### Trace Markers

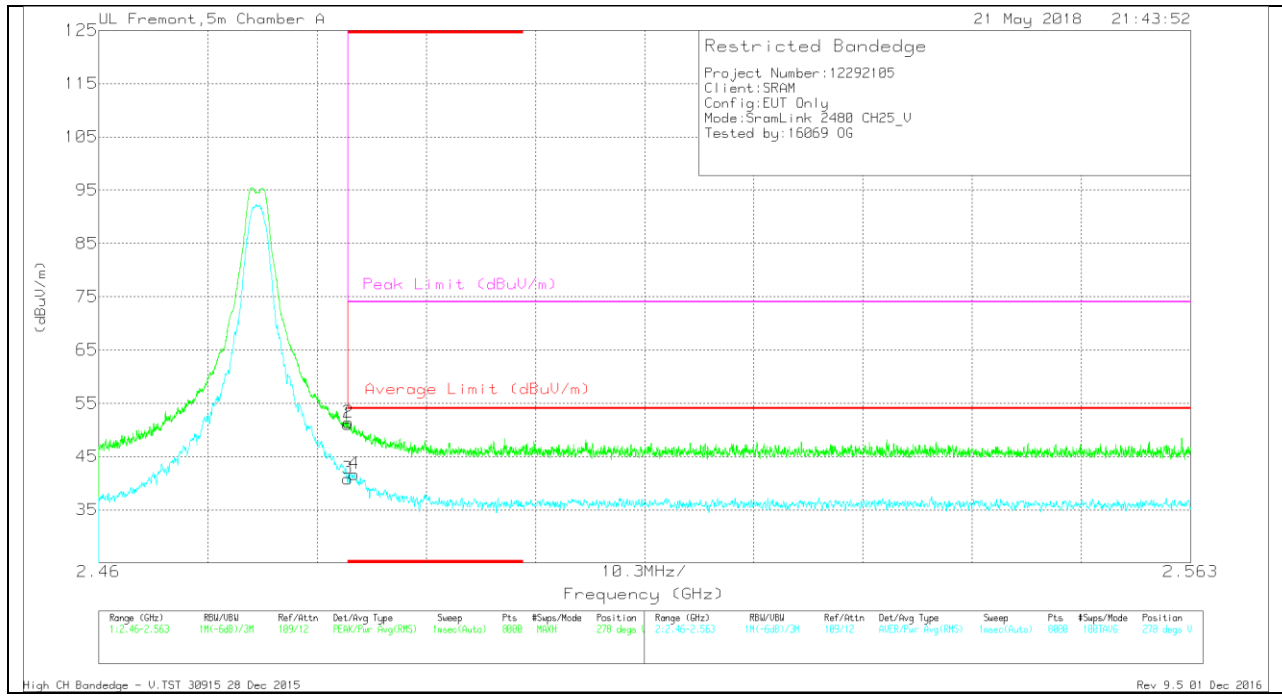
| Marker | Frequency (GHz) | Meter Reading (dBuV) | Det | AF T862 (dB/m) | Amp/Cbl/Filtr/Pad (dB) | DC Corr (dB) | Corrected Reading (dBuV/m) | Average Limit (dBuV/m) | Margin (dB) | Peak Limit (dBuV/m) | PK Margin (dB) | Azimuth (Degs) | Height (cm) | Polarity |
|--------|-----------------|----------------------|-----|----------------|------------------------|--------------|----------------------------|------------------------|-------------|---------------------|----------------|----------------|-------------|----------|
| 1      | * 2.484         | 47.28                | Pk  | 32.3           | -23.3                  | 0            | 56.28                      | -                      | -           | 74                  | -17.72         | 88             | 338         | H        |
| 2      | * 2.484         | 47.41                | Pk  | 32.3           | -23.3                  | 0            | 56.41                      | -                      | -           | 74                  | -17.59         | 88             | 338         | H        |
| 3      | * 2.484         | 37.49                | RMS | 32.3           | -23.3                  | 0            | 46.49                      | 54                     | -7.51       | -                   | -              | 88             | 338         | H        |
| 4      | * 2.484         | 38.24                | RMS | 32.3           | -23.3                  | 0            | 47.24                      | 54                     | -6.76       | -                   | -              | 88             | 338         | H        |

\* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band

Pk - Peak detector

RMS - RMS detection

## VERTICAL RESULT



## Trace Markers

| Marker | Frequency (GHz) | Meter Reading (dBuV) | Det | AF T862 (dB/m) | Amp/Cbl/Filtr/Pad (dB) | DC Corr (dB) | Corrected Reading (dBuV/m) | Average Limit (dBuV/m) | Margin (dB) | Peak Limit (dBuV/m) | PK Margin (dB) | Azimuth (Degs) | Height (cm) | Polarity |
|--------|-----------------|----------------------|-----|----------------|------------------------|--------------|----------------------------|------------------------|-------------|---------------------|----------------|----------------|-------------|----------|
| 1      | * 2.484         | 42.06                | Pk  | 32.3           | -23.3                  | 0            | 51.06                      | -                      | -           | 74                  | -22.94         | 278            | 342         | V        |
| 2      | * 2.484         | 42.42                | Pk  | 32.3           | -23.3                  | 0            | 51.42                      | -                      | -           | 74                  | -22.58         | 278            | 342         | V        |
| 3      | * 2.484         | 31.86                | RMS | 32.3           | -23.3                  | 0            | 40.86                      | 54                     | -13.14      | -                   | -              | 278            | 342         | V        |
| 4      | * 2.484         | 32.61                | RMS | 32.3           | -23.2                  | 0            | 41.71                      | 54                     | -12.29      | -                   | -              | 278            | 342         | V        |

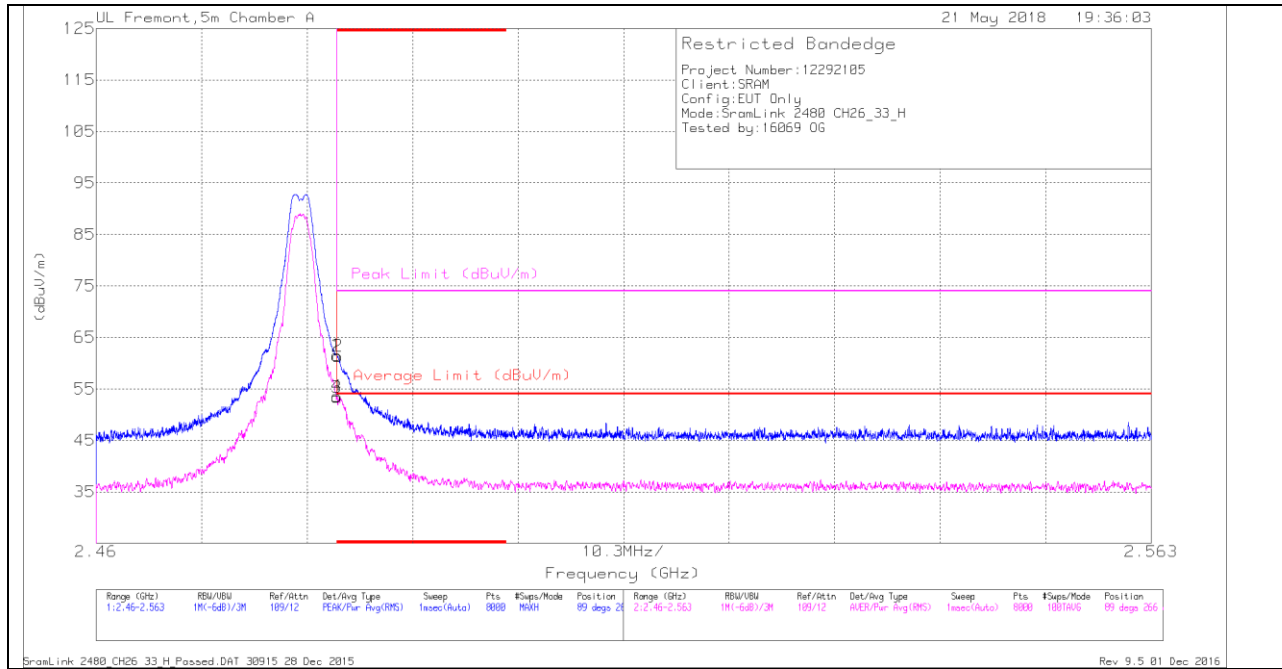
\* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band

Pk - Peak detector

RMS - RMS detection

## BANDEDGE (HIGH CHANNEL, CH 26)

### HORIZONTAL RESULT



### Trace Markers

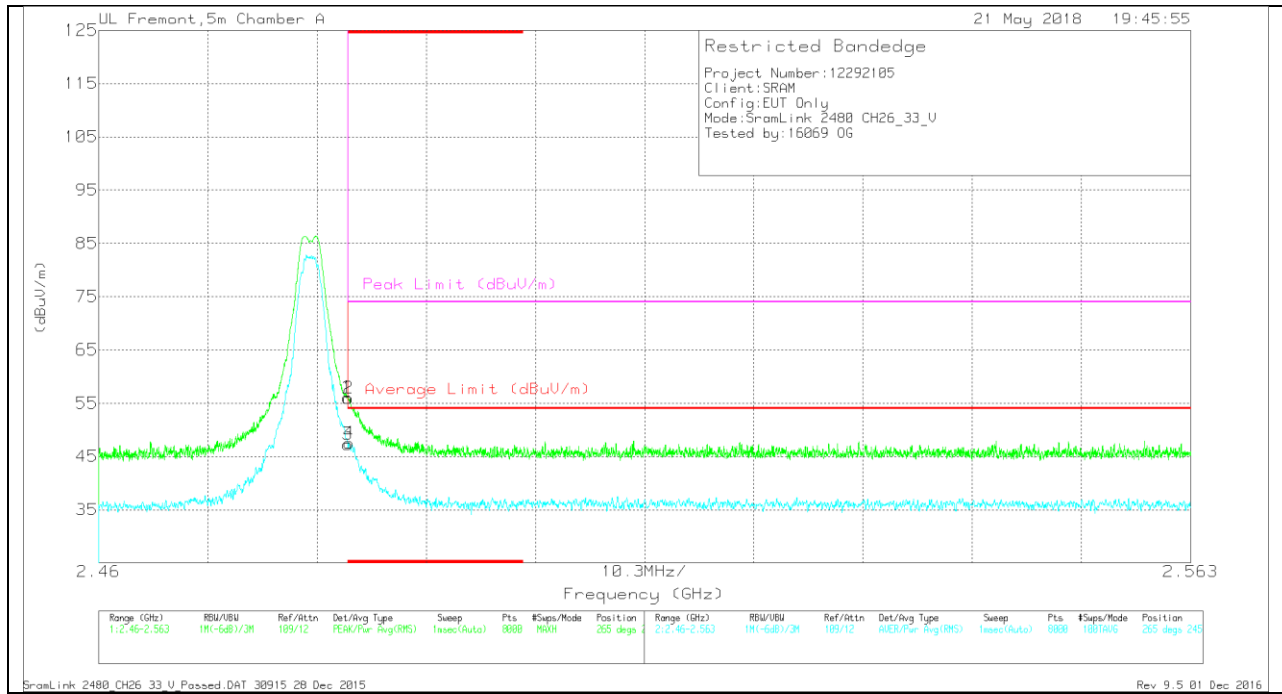
| Marker | Frequency (GHz) | Meter Reading (dBuV) | Det | AF T862 (dB/m) | Amp/Cbl/Filtr/Pad (dB) | DC Corr (dB) | Corrected Reading (dBuV/m) | Average Limit (dBuV/m) | Margin (dB) | Peak Limit (dBuV/m) | PK Margin (dB) | Azimuth (Degs) | Height (cm) | Polarity |
|--------|-----------------|----------------------|-----|----------------|------------------------|--------------|----------------------------|------------------------|-------------|---------------------|----------------|----------------|-------------|----------|
| 1      | * 2.484         | 52.52                | Pk  | 32.3           | -23.3                  | 0            | 61.52                      | -                      | -           | 74                  | -12.48         | 89             | 266         | H        |
| 2      | * 2.484         | 52.36                | Pk  | 32.3           | -23.3                  | 0            | 61.36                      | -                      | -           | 74                  | -12.64         | 89             | 266         | H        |
| 3      | * 2.484         | 44.39                | RMS | 32.3           | -23.3                  | 0            | 53.39                      | 54                     | -61         | -                   | -              | 89             | 266         | H        |
| 4      | * 2.484         | 44.57                | RMS | 32.3           | -23.3                  | 0            | 53.57                      | 54                     | -43         | -                   | -              | 89             | 266         | H        |

\* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band

Pk - Peak detector

RMS - RMS detection

## VERTICAL RESULT



## Trace Markers

| Marker | Frequency (GHz) | Meter Reading (dBuV) | Det | AF T862 (dB/m) | Amp/Cbl/Filtr/Pad (dB) | DC Corr (dB) | Corrected Reading (dBuV/m) | Average Limit (dBuV/m) | Margin (dB) | Peak Limit (dBuV/m) | PK Margin (dB) | Azimuth (Degs) | Height (cm) | Polarity |
|--------|-----------------|----------------------|-----|----------------|------------------------|--------------|----------------------------|------------------------|-------------|---------------------|----------------|----------------|-------------|----------|
| 1      | * 2.484         | 47.03                | Pk  | 32.3           | -23.3                  | 0            | 56.03                      | -                      | -           | 74                  | -17.97         | 265            | 245         | V        |
| 2      | * 2.484         | 46.93                | Pk  | 32.3           | -23.3                  | 0            | 55.93                      | -                      | -           | 74                  | -18.07         | 265            | 245         | V        |
| 3      | * 2.484         | 38.31                | RMS | 32.3           | -23.3                  | 0            | 47.31                      | 54                     | -6.69       | -                   | -              | 265            | 245         | V        |
| 4      | * 2.484         | 38.49                | RMS | 32.3           | -23.3                  | 0            | 47.49                      | 54                     | -6.51       | -                   | -              | 265            | 245         | V        |

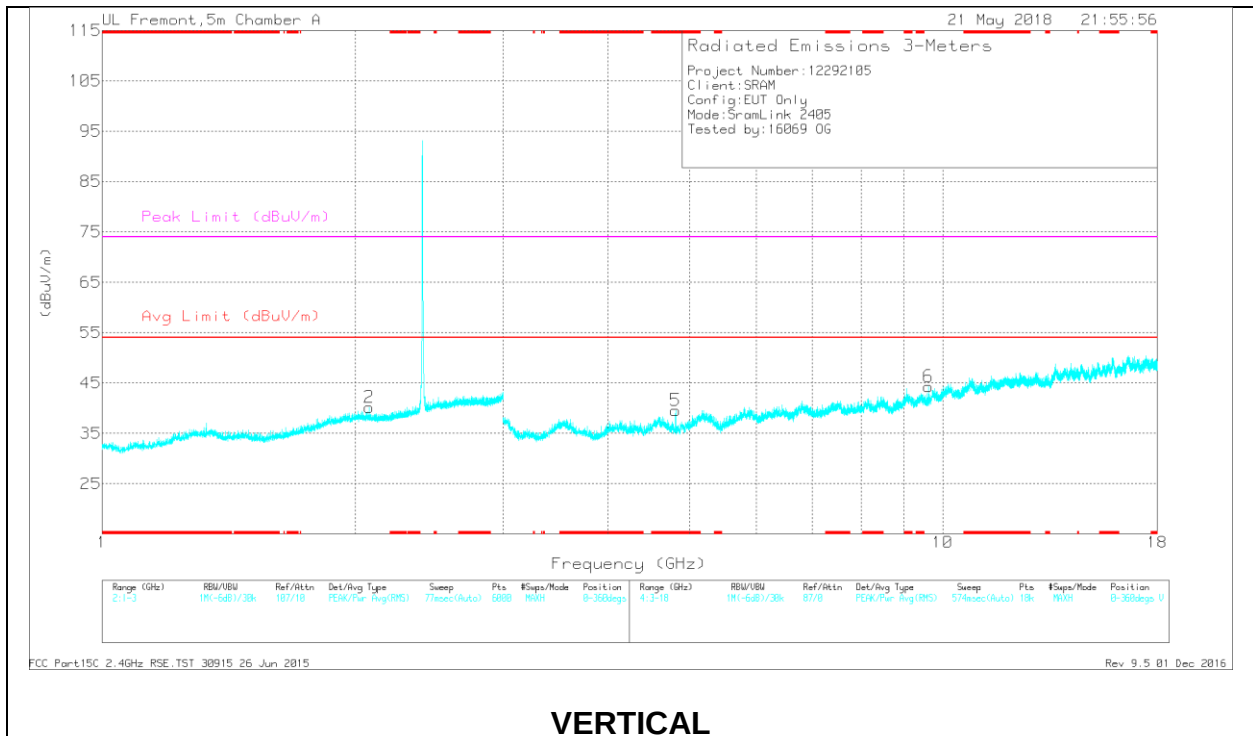
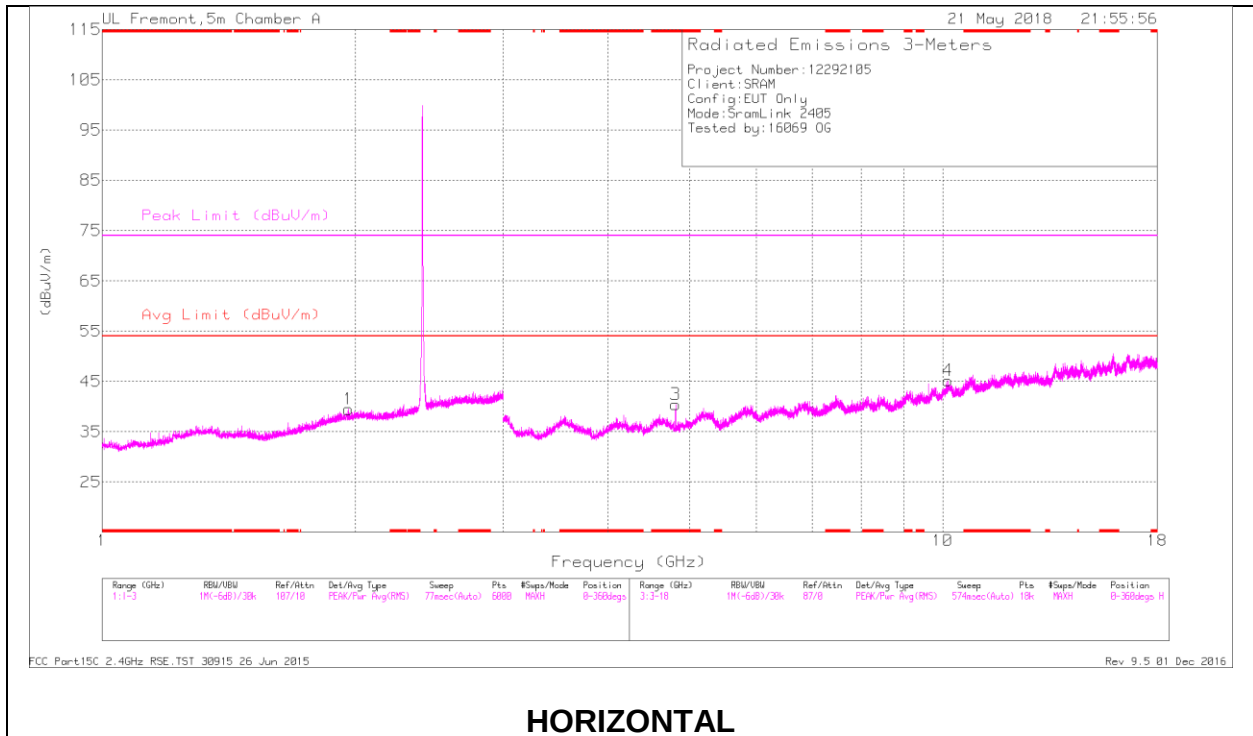
\* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band

Pk - Peak detector

RMS - RMS detection

## HARMONICS AND SPURIOUS EMISSIONS

### LOW CHANNEL, CH 11 RESULTS



## RADIATED EMISSIONS

### Radiated Emissions

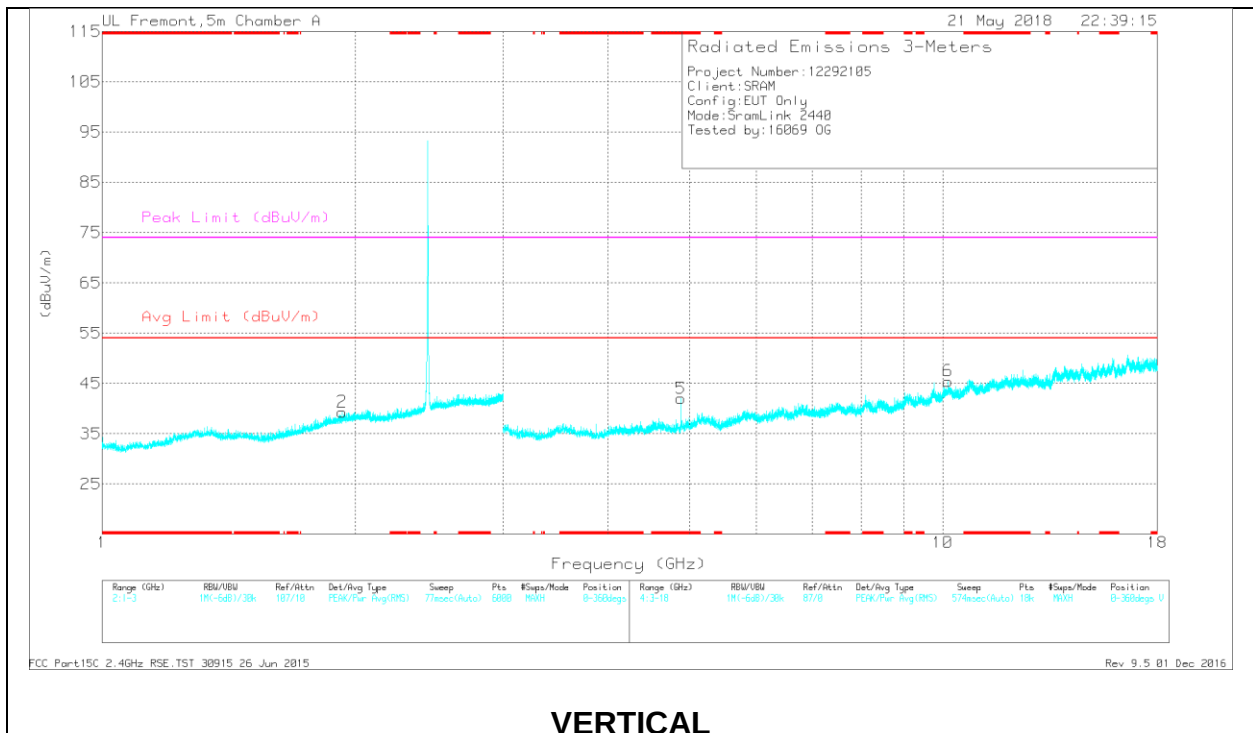
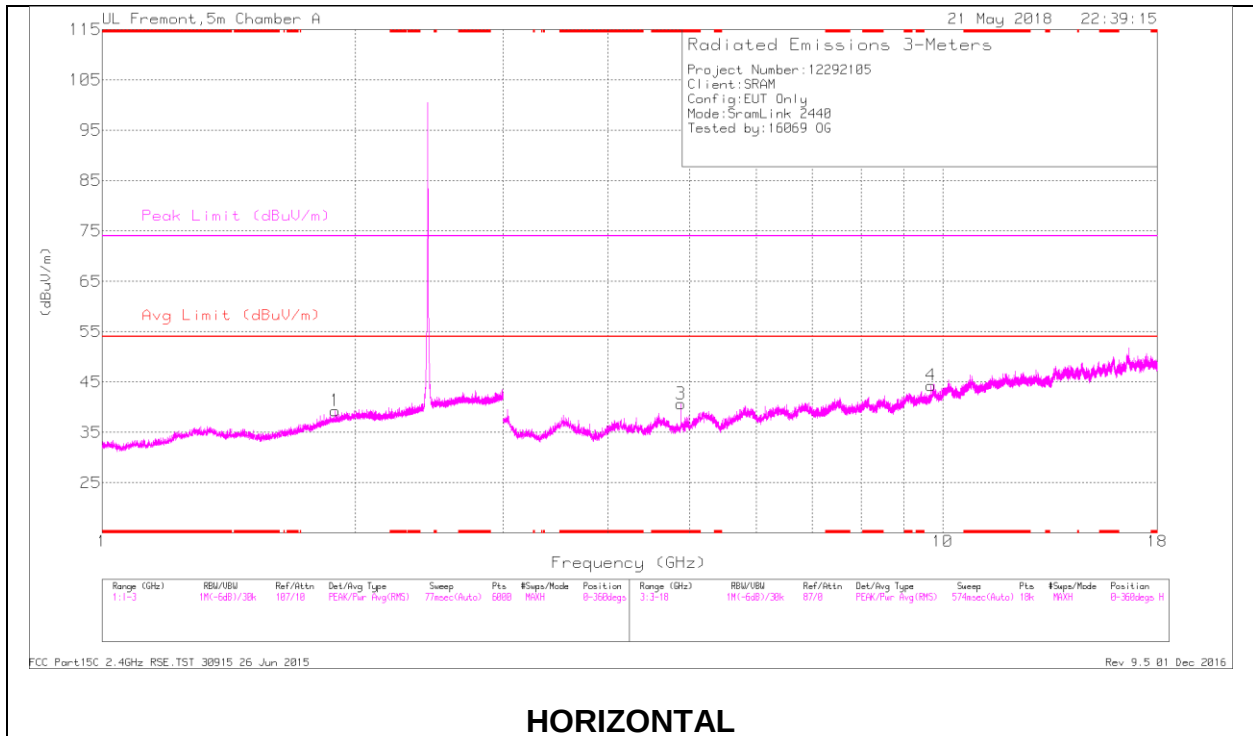
| Marker | Frequency (GHz) | Meter Reading (dBuV) | Det  | AF T862 (dB/m) | Amp/Cbl/Fitr/Pad (dB) | DC Corr (dB) | Corrected Reading (dBuV/m) | Avg Limit (dBuV/m) | Margin (dB) | Peak Limit (dBuV/m) | PK Margin (dB) | Azimuth (Degs) | Height (cm) | Polarity |
|--------|-----------------|----------------------|------|----------------|-----------------------|--------------|----------------------------|--------------------|-------------|---------------------|----------------|----------------|-------------|----------|
| 3      | * 4.809         | 35.36                | PK2  | 34.2           | -27.2                 | 0            | 42.36                      | -                  | -           | 74                  | -31.64         | 6              | 227         | H        |
|        | * 4.812         | 23.99                | MAv1 | 34.2           | -27.2                 | 0            | 30.99                      | 54                 | -23.01      | -                   | -              | 6              | 227         | H        |
| 5      | * 4.81          | 35.3                 | PK2  | 34.2           | -27.2                 | 0            | 42.3                       | -                  | -           | 74                  | -31.7          | 285            | 395         | V        |
|        | * 4.811         | 23.74                | MAv1 | 34.2           | -27.2                 | 0            | 30.74                      | 54                 | -23.26      | -                   | -              | 285            | 395         | V        |
| 1      | 1.963           | 36.95                | PK2  | 31.4           | -23.3                 | 0            | 45.05                      | -                  | -           | -                   | -              | 332            | 227         | H        |
| 2      | 2.076           | 37.69                | PK2  | 31.3           | -23.4                 | 0            | 45.59                      | -                  | -           | -                   | -              | 182            | 253         | V        |
| 6      | 9.618           | 32.68                | PK2  | 36.8           | -21.1                 | 0            | 48.38                      | -                  | -           | -                   | -              | 81             | 296         | V        |
| 4      | 10.146          | 32.39                | PK2  | 37.4           | -19.1                 | 0            | 50.69                      | -                  | -           | -                   | -              | 17             | 180         | H        |

\* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band

PK2 - KDB558074 Method: Maximum Peak

MAv1 - KDB558074 Option 1 Maximum RMS Average

## MID CHANNEL, CH 18 RESULTS



## RADIATED EMISSIONS

### Radiated Emissions

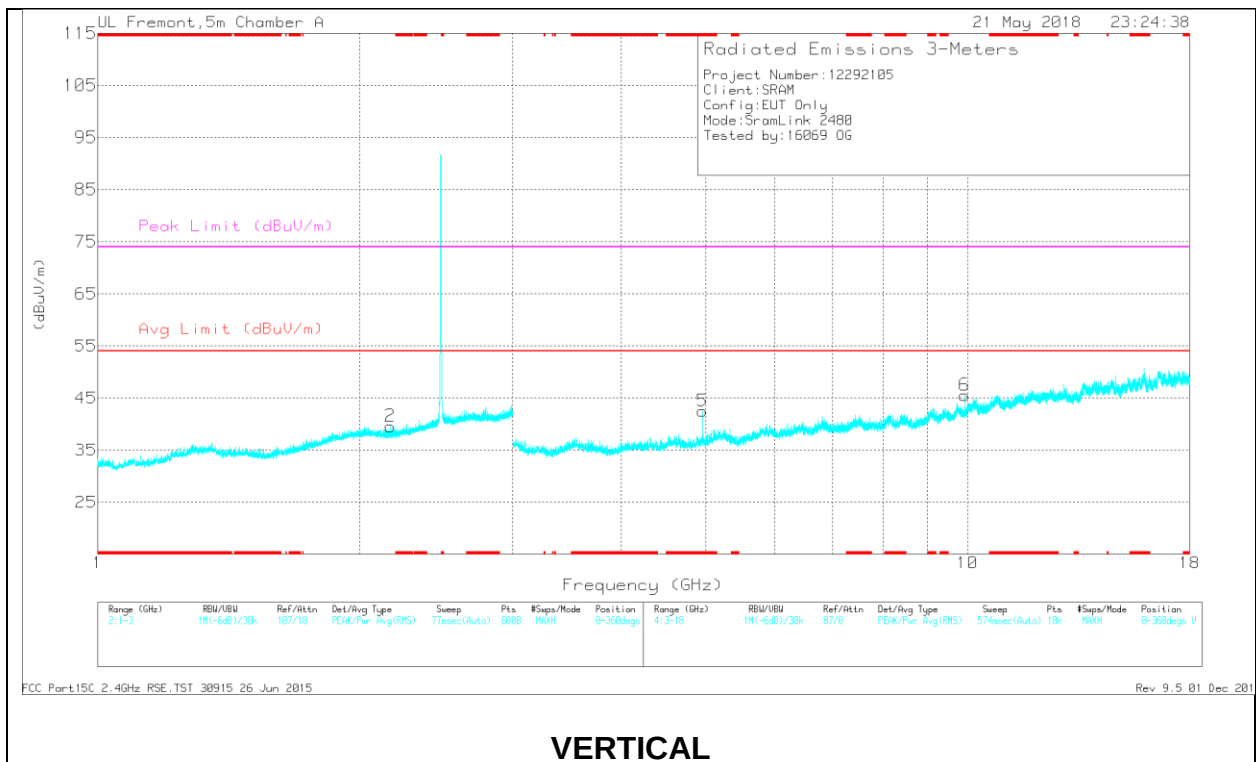
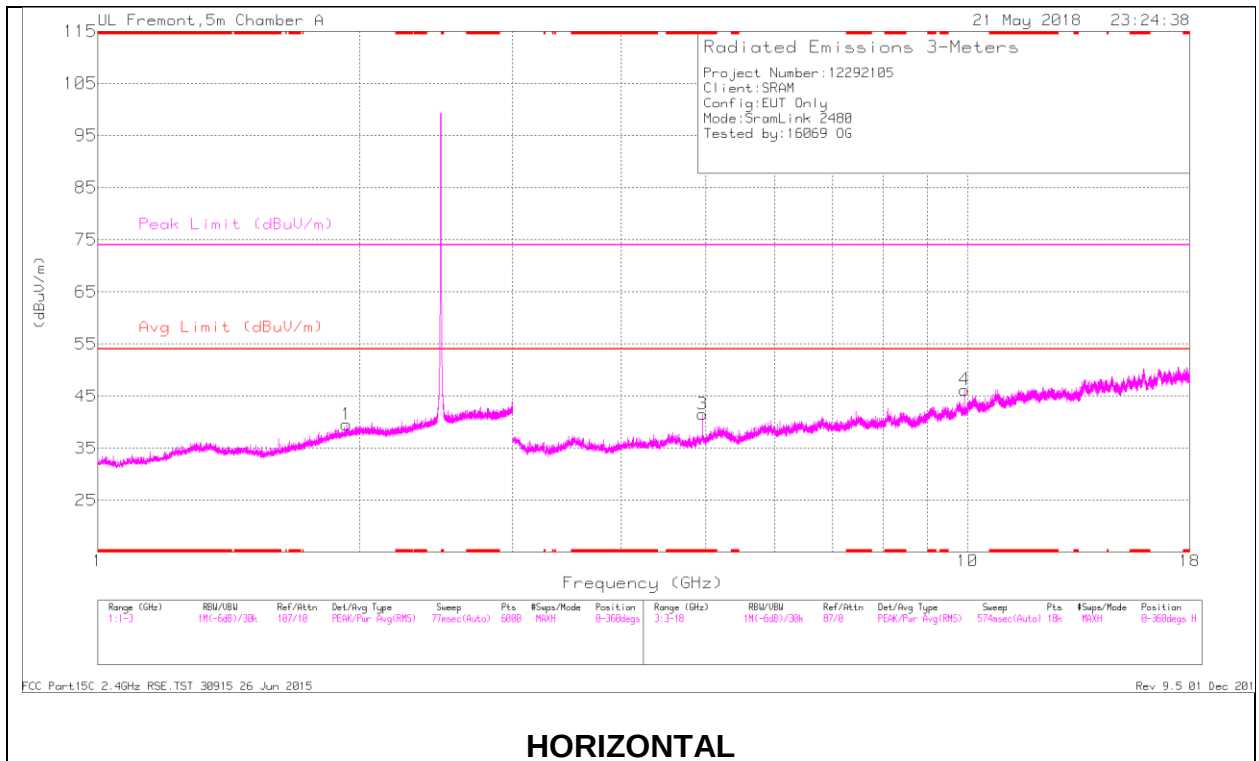
| Marker | Frequency (GHz) | Meter Reading (dBuV) | Det  | AF T862 (dB/m) | Amp/Cbl/Fitr/Pad (dB) | DC Corr (dB) | Corrected Reading (dBuV/m) | Avg Limit (dBuV/m) | Margin (dB) | Peak Limit (dBuV/m) | PK Margin (dB) | Azimuth (Degs) | Height (cm) | Polarity |
|--------|-----------------|----------------------|------|----------------|-----------------------|--------------|----------------------------|--------------------|-------------|---------------------|----------------|----------------|-------------|----------|
| 3      | * 4.88          | 35.88                | PK2  | 34.1           | -26.7                 | 0            | 43.28                      | -                  | -           | 74                  | -30.72         | 251            | 255         | H        |
|        | * 4.883         | 24.62                | MAv1 | 34.1           | -26.7                 | 0            | 32.02                      | 54                 | -21.98      | -                   | -              | 251            | 255         | H        |
| 5      | * 4.883         | 35.96                | PK2  | 34.1           | -26.7                 | 0            | 43.36                      | -                  | -           | 74                  | -30.64         | 93             | 333         | V        |
|        | * 4.881         | 24.66                | MAv1 | 34.1           | -26.7                 | 0            | 32.06                      | 54                 | -21.94      | -                   | -              | 93             | 333         | V        |
| 1      | 1.897           | 36.53                | PK2  | 31             | -23.3                 | 0            | 44.23                      | -                  | -           | -                   | -              | 95             | 278         | H        |
| 2      | 1.93            | 36.28                | PK2  | 31.2           | -23.2                 | 0            | 44.28                      | -                  | -           | -                   | -              | 90             | 166         | V        |
| 4      | 9.688           | 32.48                | PK2  | 36.9           | -20.5                 | 0            | 48.88                      | -                  | -           | -                   | -              | 76             | 178         | H        |
| 6      | 10.148          | 33.17                | PK2  | 37.4           | -19.1                 | 0            | 51.47                      | -                  | -           | -                   | -              | 166            | 173         | V        |

\* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band

PK2 - KDB558074 Method: Maximum Peak

MAv1 - KDB558074 Option 1 Maximum RMS Average

## HIGH CHANNEL, CH 26 RESULTS



## RADIATED EMISSIONS

### Radiated Emissions

| Marker | Frequency (GHz) | Meter Reading (dBuV) | Det  | AF T862 (dB/m) | Amp/Cb/Filtr/Pad (dB) | DC Corr (dB) | Corrected Reading (dBuV/m) | Avg Limit (dBuV/m) | Margin (dB) | Peak Limit (dBuV/m) | PK Margin (dB) | Azimuth (Degs) | Height (cm) | Polarity |
|--------|-----------------|----------------------|------|----------------|-----------------------|--------------|----------------------------|--------------------|-------------|---------------------|----------------|----------------|-------------|----------|
| 3      | * 4.959         | 37.25                | PK2  | 34.2           | -27.4                 | 0            | 44.05                      | -                  | -           | 74                  | -29.95         | 56             | 141         | H        |
|        | * 4.963         | 25.75                | MAv1 | 34.2           | -27.4                 | 0            | 32.55                      | 54                 | -21.45      | -                   | -              | 56             | 141         | H        |
| 5      | * 4.957         | 37.22                | PK2  | 34.2           | -27.3                 | 0            | 44.12                      | -                  | -           | 74                  | -29.88         | 23             | 150         | V        |
|        | * 4.958         | 25.59                | MAv1 | 34.2           | -27.3                 | 0            | 32.49                      | 54                 | -21.51      | -                   | -              | 23             | 150         | V        |
| 1      | 1.933           | 36.97                | PK2  | 31.3           | -23.2                 | 0            | 45.07                      | -                  | -           | -                   | -              | 198            | 330         | H        |
| 2      | 2.171           | 37.02                | PK2  | 31.1           | -23.6                 | 0            | 44.52                      | -                  | -           | -                   | -              | 121            | 292         | V        |
| 4      | 9.918           | 32.04                | PK2  | 37.2           | -20.6                 | 0            | 48.64                      | -                  | -           | -                   | -              | 3              | 153         | H        |
| 6      | 9.917           | 29.05                | PK2  | 37.2           | -20.7                 | 0            | 45.55                      | -                  | -           | -                   | -              | 54             | 198         | V        |

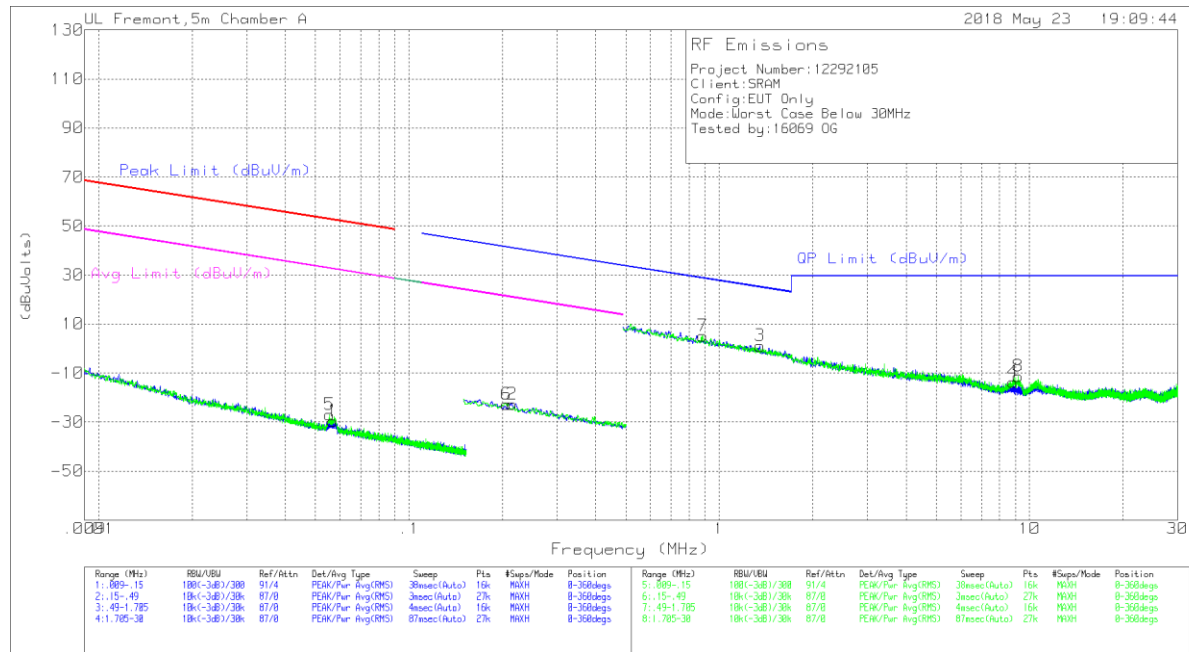
\* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band

PK2 - KDB558074 Method: Maximum Peak

MAv1 - KDB558074 Option 1 Maximum RMS Average

## 9.2. Worst Case Below 30MHz

### FACE ON AND FACE OFF PLOTS



FCC 15.209 Below 30MHz, TST 30915 22 Mar 2017

Rev 9.5 03 May 201

#### NOTE: KDB 414788 OATS and Chamber Correlation Justification

- Based on FCC 15.31 (f) (2): measurements may be performed at a distance closer than that specified in the regulations; however, an attempt should be made to avoid making measurements in the near field.
- OATs and chamber correlation testing had been performed and chamber measured test result is the worst case test result.

### **Below 30MHz DATA**

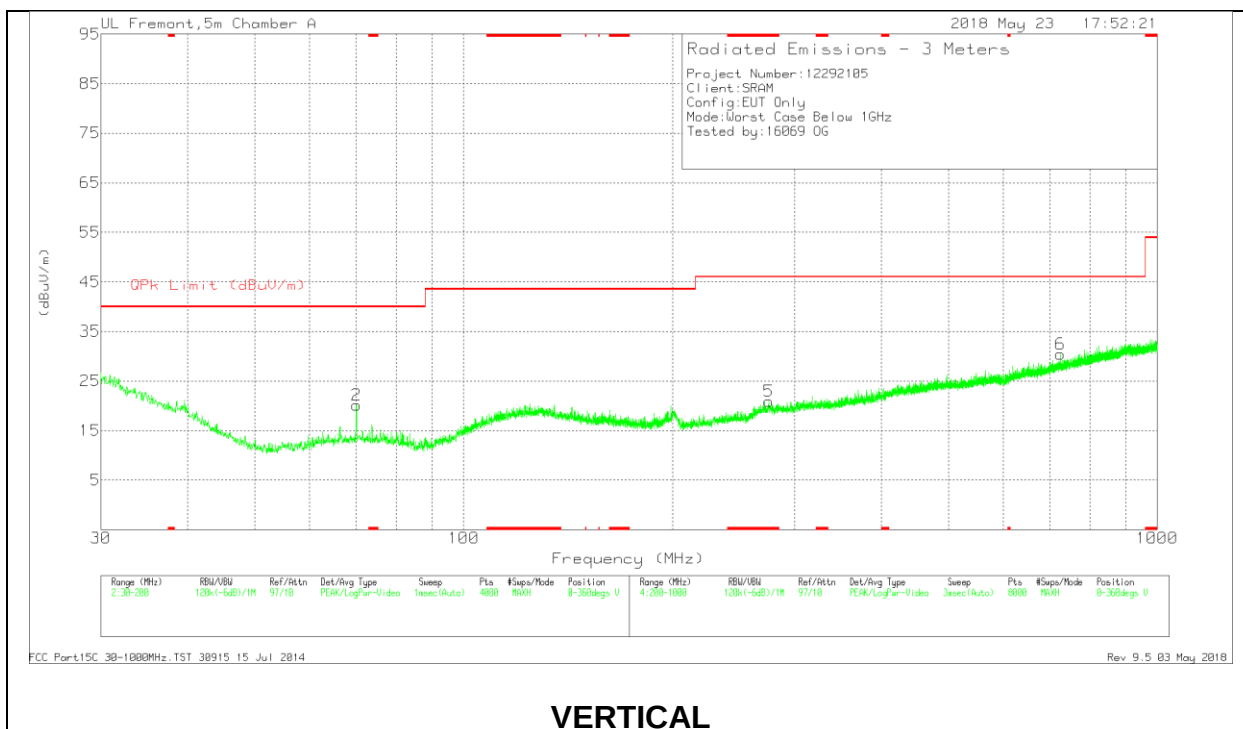
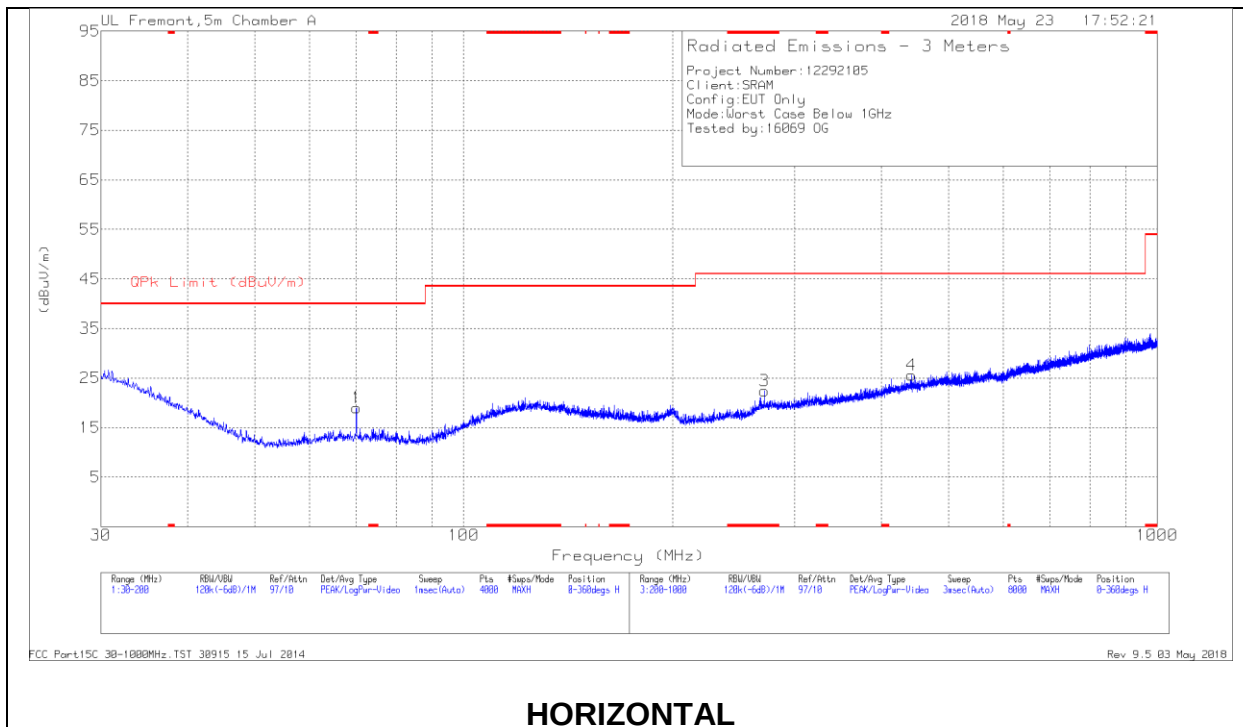
| Marker | Frequency (MHz) | Meter Reading (dBuV) | Det | Loop Antenna (dB/m) | Cbl (dB) | Dist Corr 300m | Corrected Reading (dBuVolts) | Peak Limit (dBuV/m) | Margin (dB) | Avg Limit (dBuV/m) | Margin (dB) | Peak Limit (dBuV/m) | Margin (dB) | Avg Limit (dBuV/m) | Margin (dB) | Azimuth (Degs) |
|--------|-----------------|----------------------|-----|---------------------|----------|----------------|------------------------------|---------------------|-------------|--------------------|-------------|---------------------|-------------|--------------------|-------------|----------------|
| 5      | .05542          | 41.2                 | Pk  | 11.8                | .1       | -80            | -26.9                        | 52.71               | -79.61      | 32.71              | -59.61      | -                   | -           | -                  | -           | 0-360          |
| 1      | .05693          | 38.41                | Pk  | 11.8                | .1       | -80            | -29.69                       | 52.48               | -82.17      | 32.48              | -62.17      | -                   | -           | -                  | -           | 0-360          |
| 6      | .20598          | 46.08                | Pk  | 11                  | .1       | -80            | -22.82                       | -                   | -           | -                  | -           | 41.34               | -64.16      | 21.34              | -44.16      | 0-360          |
| 2      | .21526          | 46.17                | Pk  | 11                  | .1       | -80            | -22.73                       | -                   | -           | -                  | -           | 40.96               | -63.69      | 20.96              | -43.69      | 0-360          |

### **Pk - Peak detector**

| Marker | Frequency (MHz) | Meter Reading (dBuV) | Det | Loop Antenna (dB/m) | Cbl (dB) | Dist Corr 30m | Corrected Reading (dBuVolts) | QP Limit (dBuV/m) | Margin (dB) | Peak Limit (dBuV/m) | Margin (dB) | Avg Limit (dBuV/m) | Margin (dB) | Azimuth (Degs) |
|--------|-----------------|----------------------|-----|---------------------|----------|---------------|------------------------------|-------------------|-------------|---------------------|-------------|--------------------|-------------|----------------|
| 7      | .88326          | 33.83                | Pk  | 11.1                | .2       | -40           | 5.13                         | 28.7              | -23.57      | -                   | -           | -                  | -           | 0-360          |
| 3      | 1.35279         | 29.55                | Pk  | 11.3                | .2       | -40           | 1.05                         | 25                | -23.95      | -                   | -           | -                  | -           | 0-360          |
| 4      | 8.85131         | 14.98                | Pk  | 10.9                | .5       | -40           | -13.62                       | 29.5              | -43.12      | -                   | -           | -                  | -           | 0-360          |
| 8      | 9.19296         | 17.33                | Pk  | 10.9                | .5       | -40           | -11.27                       | 29.5              | -40.77      | -                   | -           | -                  | -           | 0-360          |

### **Pk - Peak detector**

### 9.3. Worst Case Below 1 GHz



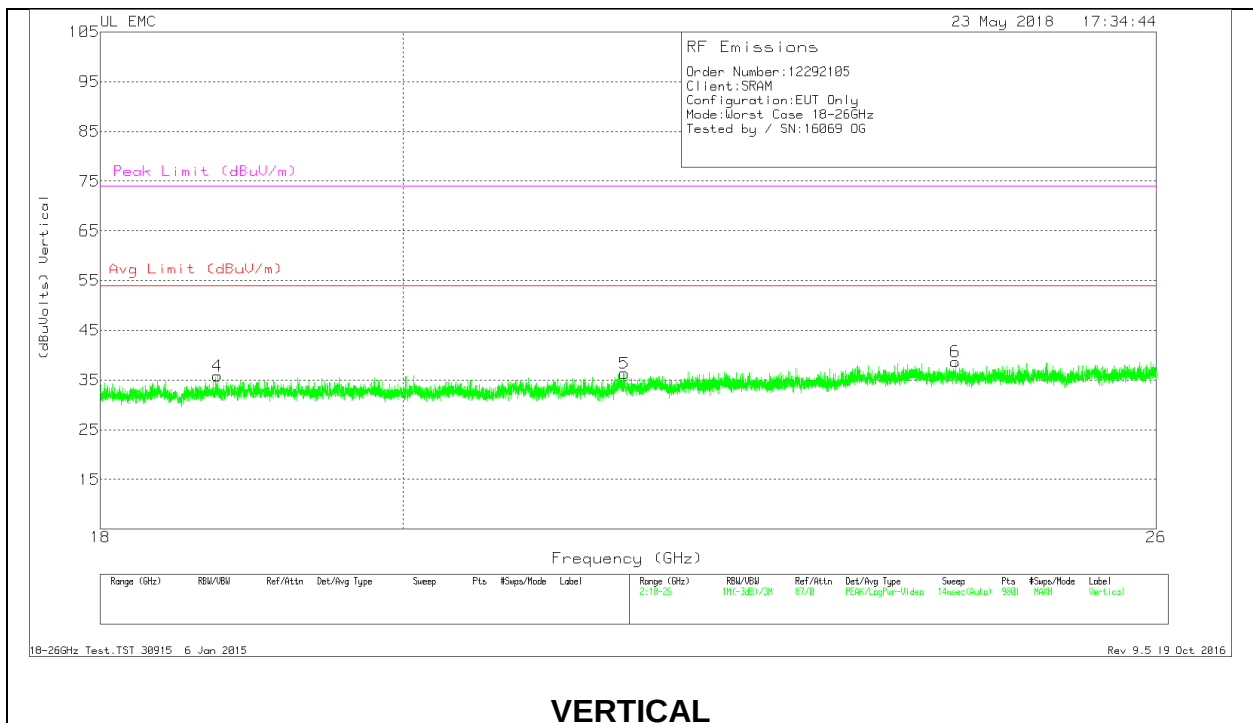
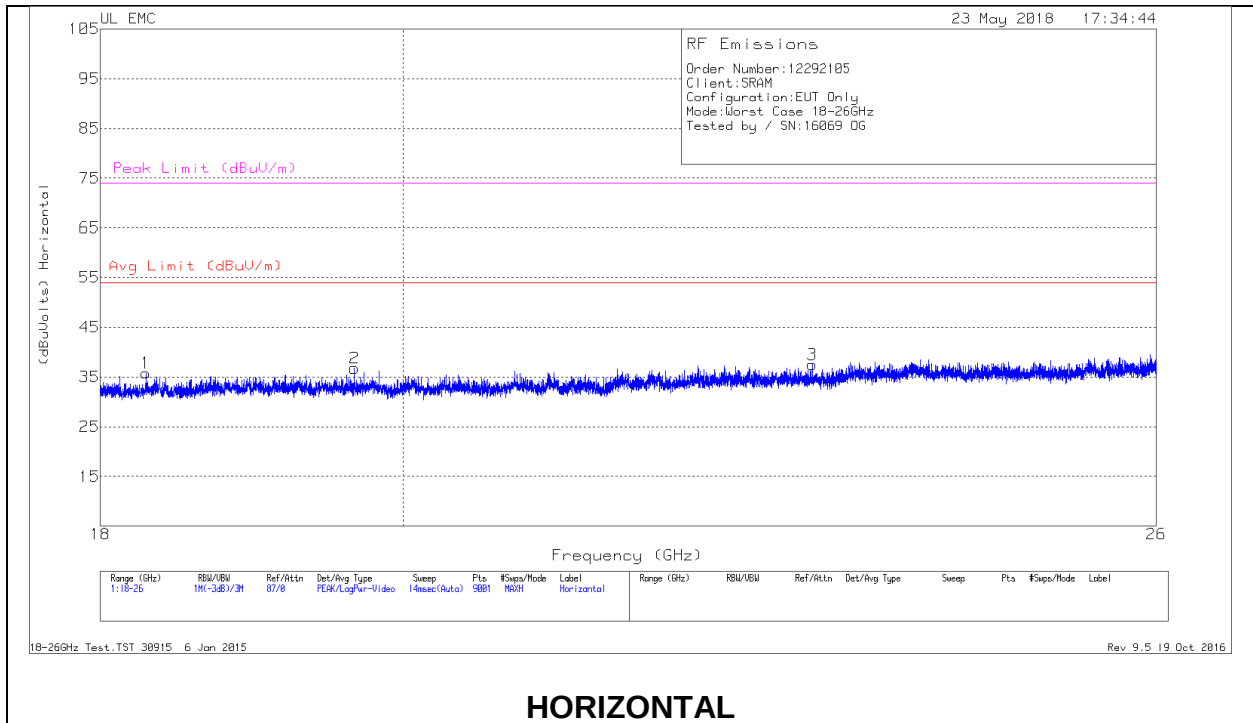
**Below 1GHz DATA**

| Marker | Frequency (MHz) | Meter Reading (dBuV) | Det | AF T130 (dB/m) | Amp/Cbl (dB/m) | Corrected Reading (dBuV/m) | QPk Limit (dBuV/m) | Margin (dB) | Azimuth (Degs) | Height (cm) | Polarity |
|--------|-----------------|----------------------|-----|----------------|----------------|----------------------------|--------------------|-------------|----------------|-------------|----------|
| 3      | * 271.6093      | 29.8                 | Pk  | 17.3           | -24.7          | 22.4                       | 46.02              | -23.62      | 0-360          | 400         | H        |
| 5      | * 275.3098      | 28.26                | Pk  | 17.3           | -24.7          | 20.86                      | 46.02              | -25.16      | 0-360          | 200         | V        |
| 1      | 70.0454         | 33.59                | Pk  | 12.1           | -26.7          | 18.99                      | 40                 | -21.01      | 0-360          | 100         | H        |
| 2      | 70.0454         | 34.8                 | Pk  | 12.1           | -26.7          | 20.2                       | 40                 | -19.8       | 0-360          | 100         | V        |
| 4      | 442.6315        | 30.13                | Pk  | 20.7           | -25.2          | 25.63                      | 46.02              | -20.39      | 0-360          | 100         | H        |
| 6      | 724.5682        | 30.15                | Pk  | 24.5           | -24.2          | 30.45                      | 46.02              | -15.57      | 0-360          | 200         | V        |

\* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band

Pk - Peak detector

## 9.4. Worst Case 18-26 GHz



# **18 – 26GHz DATA**

| Marker | Frequency (GHz) | Meter Reading (dBuV) | Det | T449 AF (dB/m) | Amp/Cbl (dB) | Dist Corr (dB) | Corrected Reading (dBuVolts) | Avg Limit (dBuV/m) | Margin (dB) | Peak Limit (dBuV/m) | PK Margin (dB) |
|--------|-----------------|----------------------|-----|----------------|--------------|----------------|------------------------------|--------------------|-------------|---------------------|----------------|
| 1      | 18.287          | 38.27                | Pk  | 32.2           | -25.2        | -9.5           | 35.77                        | 54                 | -18.23      | 74                  | -38.23         |
| 2      | 19.664          | 38.47                | Pk  | 32.7           | -24.9        | -9.5           | 36.77                        | 54                 | -17.23      | 74                  | -37.23         |
| 3      | 23.064          | 38.59                | Pk  | 33.6           | -25.2        | -9.5           | 37.49                        | 54                 | -16.51      | 74                  | -36.51         |
| 4      | 18.748          | 37.62                | Pk  | 32.3           | -24.6        | -9.5           | 35.82                        | 54                 | -18.18      | 74                  | -38.18         |
| 5      | 21.603          | 37.92                | Pk  | 33.2           | -25.3        | -9.5           | 36.32                        | 54                 | -17.68      | 74                  | -37.68         |
| 6      | 24.243          | 38.66                | Pk  | 33.8           | -24.3        | -9.5           | 38.66                        | 54                 | -15.34      | 74                  | -35.34         |

Pk - Peak detector