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# Report On

Radio Testing of the  
Trango Systems, Inc.  
StrataPro 24 SP-24 Point-to-Point Wireless Microwave System  
Module

FCC Part 15 Subpart C §15.249  
IC RSS-210 Issue 8 December 2010

Report No. SD72113790-0216A

May 2016



America

TÜV SÜD America Inc., 10040 Mesa Rim Road, San Diego, CA 92121  
Tel: (858) 678-1400. Website: [www.TUVamerica.com](http://www.TUVamerica.com)

|                           |                                                                                                                                                                                          |
|---------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>REPORT ON</b>          | Radio Testing of the<br>Trango Systems, Inc.<br>Point-to-Point Wireless Microwave System Module                                                                                          |
| <b>TEST REPORT NUMBER</b> | SD72113790-0216A                                                                                                                                                                         |
| <b>PREPARED FOR</b>       | Trango Systems, Inc.<br>14118 Stowe Drive, Suite B<br>Poway, CA 92064 USA                                                                                                                |
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| <b>PREPARED BY</b>        | <br>Ferdinand S. Custodio<br><b>Name</b><br>Authorized Signatory<br>Title: EMC/Wireless Test Engineer |
| <b>APPROVED BY</b>        | <br>Chip R. Fleury<br><b>Name</b><br>Authorized Signatory                                             |
| <b>DATED</b>              | May 10, 2016                                                                                                                                                                             |



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## Revision History

| SD72113790-0216A<br>Trango Systems, Inc.<br>StrataPro 24 Point-to-Point Wireless Microwave System Module |                 |              |        |                   |                |
|----------------------------------------------------------------------------------------------------------|-----------------|--------------|--------|-------------------|----------------|
| DATE                                                                                                     | OLD REVISION    | NEW REVISION | REASON | PAGES<br>AFFECTED | APPROVED BY    |
| 05/10/16                                                                                                 | Initial Release |              |        |                   | Chip R. Fleury |
|                                                                                                          |                 |              |        |                   |                |
|                                                                                                          |                 |              |        |                   |                |
|                                                                                                          |                 |              |        |                   |                |
|                                                                                                          |                 |              |        |                   |                |



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## **SECTION 1**

### **REPORT SUMMARY**

Radio Testing of the  
Trango Systems, Inc.  
Point-to-Point Wireless Microwave System Module



## 1.1 INTRODUCTION

The information contained in this report is intended to show verification of the Trango Systems, Inc. Point-to-Point Wireless Microwave System Module to the requirements of FCC Part 15 Subpart C §15.249 and IC RSS-210 Issue 8 December 2010.

|                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|-------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Objective                     | To perform Radio Testing to determine the Equipment Under Test's (EUT's) compliance with the Test Specification, for the series of tests carried out.                                                                                                                                                                                                                                                                                                       |
| Manufacturer                  | Trango Systems, Inc.                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| Model Number(s)               | SP-24                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| FCC ID Number                 | NCY-SP24                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| IC Number                     | 2945A-SP24                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| Serial Number(s)              | N/A                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| Number of Samples Tested      | 1                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| Test Specification/Issue/Date | <ul style="list-style-type: none"><li>• FCC Part 15 Subpart C §15.249 (October 1, 2015).</li><li>• IC RSS-210 Issue 8 December 2010. Licence-exempt Radio Apparatus (All Frequency Bands): Category I Equipment.</li><li>• IC RSS-Gen Issue 4, November 2014 - General Requirements for Compliance of Radio Apparatus.</li><li>• ANSI C63.10-2013. American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices</li></ul> |
| Start of Test                 | February 09, 2016                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| Finish of Test                | February 18, 2016                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| Name of Engineer(s)           | Ferdinand S. Custodio                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| Related Document(s)           | None. Supporting documents for EUT certification are separate exhibits.                                                                                                                                                                                                                                                                                                                                                                                     |



## 1.2 BRIEF SUMMARY OF RESULTS

A brief summary of the tests carried out in accordance with FCC Part 15 Subpart C §15.249 with cross-reference to the corresponding IC RSS standard is shown below.

| Section | Spec Clause   | RSS            | Test Description                                                            | Result    | Comments/Base Standard |
|---------|---------------|----------------|-----------------------------------------------------------------------------|-----------|------------------------|
| 2.1     | §15.207(a)    | RSS-Gen 8.8    | Conducted Emissions                                                         | Compliant |                        |
| 2.2     | §15.215(c)    |                | 20 dB Bandwidth                                                             | Compliant |                        |
| 2.3     |               | RSS-Gen 6.6    | 99% Emission Bandwidth                                                      | Compliant |                        |
| 2.4     | §15.249(b)(1) | RSS-210 A12(a) | Field Strength of Fundamental Emissions for Fixed, Point to Point Operation | Compliant |                        |
| 2.5     | §15.249(b)(2) | RSS-210 A12(b) | Frequency Stability                                                         | Compliant |                        |
| 2.6     | §15.249(d)    | RSS-210 A12(d) | Spurious Radiated Emissions                                                 | Compliant |                        |
| 2.7     | §15.249(e)    | RSS-210 A12(d) | Field Strength of Harmonics for Fixed, Point to Point Operation             | Compliant |                        |

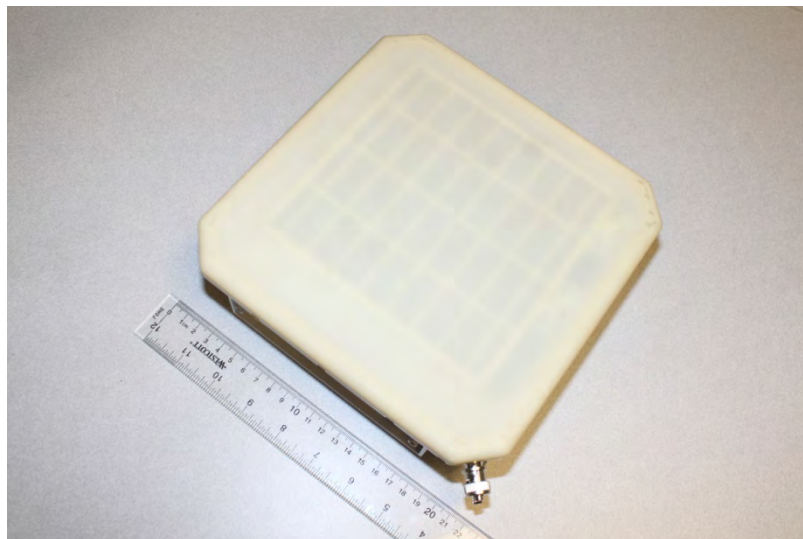
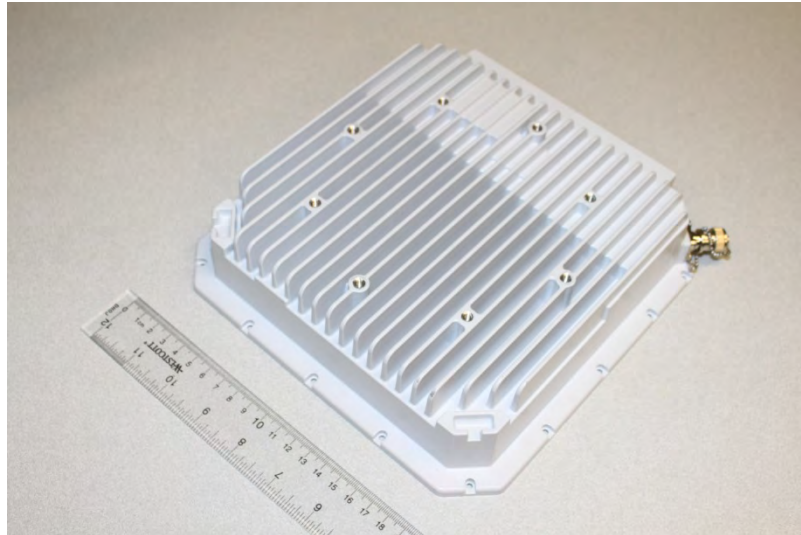
### 1.3 PRODUCT INFORMATION

#### 1.3.1 Technical Description

The Equipment Under Test (EUT) was a Trango Systems, Inc. Point-to-Point Wireless Microwave System Module as shown in the photograph below. The EUT is designed to interface with a custom designed 30 dBi Array Antenna designed by Trango Systems Inc. It operates using the unlicensed 24.05 to 24.25 GHz spectrum.



**Equipment Under Test**



**Equipment Under Test with Custom Antenna**



### 1.3.2 EUT General Description

| EUT Description                       | Point-to-Point Wireless Microwave System Module                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                     |                      |               |                     |                     |                      |        |       |       |       |        |       |       |       |        |       |       |       |        |       |       |       |         |       |       |       |         |       |       |       |
|---------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|----------------------|---------------|---------------------|---------------------|----------------------|--------|-------|-------|-------|--------|-------|-------|-------|--------|-------|-------|-------|--------|-------|-------|-------|---------|-------|-------|-------|---------|-------|-------|-------|
| Model Name                            | StrataPro 24                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                     |                      |               |                     |                     |                      |        |       |       |       |        |       |       |       |        |       |       |       |        |       |       |       |         |       |       |       |         |       |       |       |
| Model Number(s)                       | SP-24                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                     |                      |               |                     |                     |                      |        |       |       |       |        |       |       |       |        |       |       |       |        |       |       |       |         |       |       |       |         |       |       |       |
| Rated Voltage                         | 48VDC                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                     |                      |               |                     |                     |                      |        |       |       |       |        |       |       |       |        |       |       |       |        |       |       |       |         |       |       |       |         |       |       |       |
| Output Power                          | 121.5 dBμV/m @ 3 meters (Peak/Low Channel)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                     |                      |               |                     |                     |                      |        |       |       |       |        |       |       |       |        |       |       |       |        |       |       |       |         |       |       |       |         |       |       |       |
| Frequency Range                       | 24055MHz to 24250 MHz in the 24000 MHz to 24250 MHz Band                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                     |                      |               |                     |                     |                      |        |       |       |       |        |       |       |       |        |       |       |       |        |       |       |       |         |       |       |       |         |       |       |       |
| Channels Verified                     | <table border="1"> <thead> <tr> <th>Channel Width</th><th>Low Frequency (MHz)</th><th>Mid Frequency (MHz)</th><th>High Frequency (MHz)</th></tr> </thead> <tbody> <tr> <td>10 MHz</td><td>24055</td><td>24150</td><td>24245</td></tr> <tr> <td>30 MHz</td><td>24065</td><td>24150</td><td>24235</td></tr> <tr> <td>60 MHz</td><td>24085</td><td>24150</td><td>24215</td></tr> <tr> <td>75 MHz</td><td>24093</td><td>24150</td><td>24208</td></tr> <tr> <td>100 MHz</td><td>24100</td><td>24150</td><td>24200</td></tr> <tr> <td>120 MHz</td><td>24110</td><td>24150</td><td>24110</td></tr> </tbody> </table> |                     |                      | Channel Width | Low Frequency (MHz) | Mid Frequency (MHz) | High Frequency (MHz) | 10 MHz | 24055 | 24150 | 24245 | 30 MHz | 24065 | 24150 | 24235 | 60 MHz | 24085 | 24150 | 24215 | 75 MHz | 24093 | 24150 | 24208 | 100 MHz | 24100 | 24150 | 24200 | 120 MHz | 24110 | 24150 | 24110 |
| Channel Width                         | Low Frequency (MHz)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | Mid Frequency (MHz) | High Frequency (MHz) |               |                     |                     |                      |        |       |       |       |        |       |       |       |        |       |       |       |        |       |       |       |         |       |       |       |         |       |       |       |
| 10 MHz                                | 24055                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | 24150               | 24245                |               |                     |                     |                      |        |       |       |       |        |       |       |       |        |       |       |       |        |       |       |       |         |       |       |       |         |       |       |       |
| 30 MHz                                | 24065                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | 24150               | 24235                |               |                     |                     |                      |        |       |       |       |        |       |       |       |        |       |       |       |        |       |       |       |         |       |       |       |         |       |       |       |
| 60 MHz                                | 24085                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | 24150               | 24215                |               |                     |                     |                      |        |       |       |       |        |       |       |       |        |       |       |       |        |       |       |       |         |       |       |       |         |       |       |       |
| 75 MHz                                | 24093                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | 24150               | 24208                |               |                     |                     |                      |        |       |       |       |        |       |       |       |        |       |       |       |        |       |       |       |         |       |       |       |         |       |       |       |
| 100 MHz                               | 24100                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | 24150               | 24200                |               |                     |                     |                      |        |       |       |       |        |       |       |       |        |       |       |       |        |       |       |       |         |       |       |       |         |       |       |       |
| 120 MHz                               | 24110                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | 24150               | 24110                |               |                     |                     |                      |        |       |       |       |        |       |       |       |        |       |       |       |        |       |       |       |         |       |       |       |         |       |       |       |
| Antenna Type (used during evaluation) | Custom (Complies with Part 15.203 requirements)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                     |                      |               |                     |                     |                      |        |       |       |       |        |       |       |       |        |       |       |       |        |       |       |       |         |       |       |       |         |       |       |       |

### 1.3.3 Antenna Details (used during verifications)

|                     |                                                 |
|---------------------|-------------------------------------------------|
| Model               | N/A                                             |
| Manufacturer        | Trango Systems, Inc.                            |
| Antenna Type        | Array Antenna                                   |
| Antenna Gain        | 30 dBi                                          |
| Operating Frequency | 24.00 to 24.25GHz                               |
| Beamwidth           | <3.5 degrees symmetric in elevation and azimuth |
| Return Loss:        | 10 dB (VSWR < 1.8)                              |

## 1.4 EUT TEST CONFIGURATION

### 1.4.1 Test Configuration Description

| Test Configurations | Description                                                                                                                                                                          |
|---------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Default             | The EUT is on Engineering mode. This mode allows configuration of RF parameters such as Frequency, Modulation and TX transmit power. Default TX transmit power setting used was "6". |

### 1.4.2 EUT Exercise Software

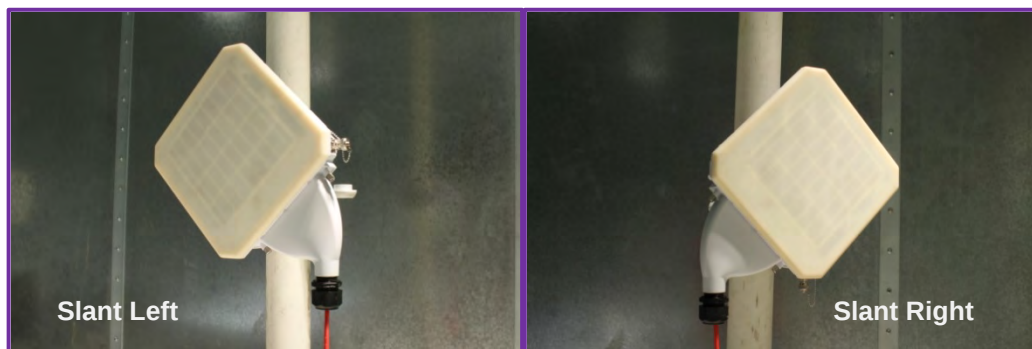
SSH connection to the EUT using its static IP address allows access to Engineering Mode. Once in this mode, RF parameters were configured as per individual test requirement.

### 1.4.3 Support Equipment and I/O cables

| Manufacturer   | Equipment/Cable        | Description                                    |
|----------------|------------------------|------------------------------------------------|
| Microsemi      | 60W PoE Injector       | PD-9501G/SP S/N N15036517007026A03             |
| Trango Systems | 48VDC Power Supply     | Model P-SUPPLY-WM-48-L 1.6A                    |
| Digitus        | CAT 5e Patch Cable     | 3 meters, shielded, gigabit ethernet, 26AWGx4p |
| Lenovo         | Support Laptop (T410S) | P/N 0A31972 S/N R9-92MH0 10/11                 |

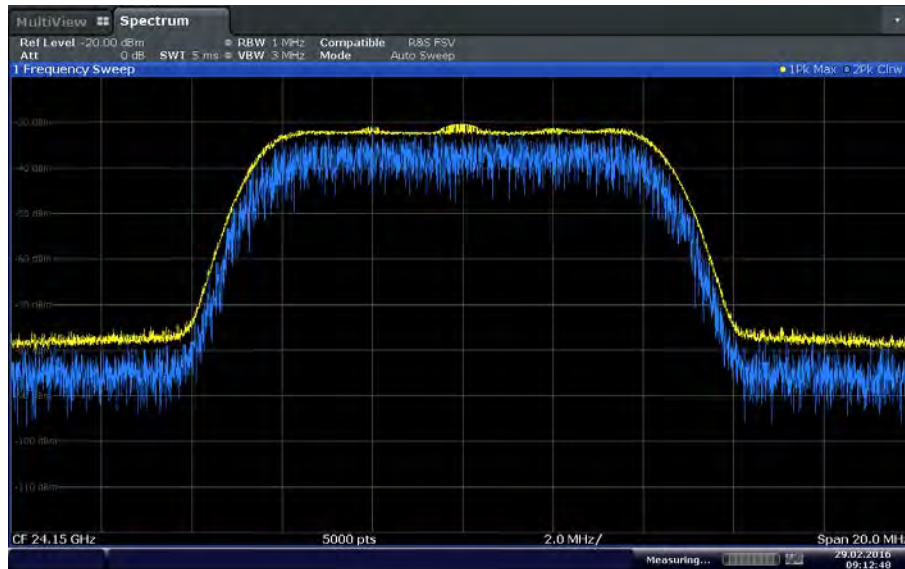
### 1.4.4 Worst Case Configurations

For radiated measurements, both default EUT orientations (Slant Left/Slant Right) were verified but only the worst case presented (Slant Right). The EUT was pre-scanned with a reference Tx profile on both orientations with the measurement receive antenna on both horizontal and vertical polarizations.



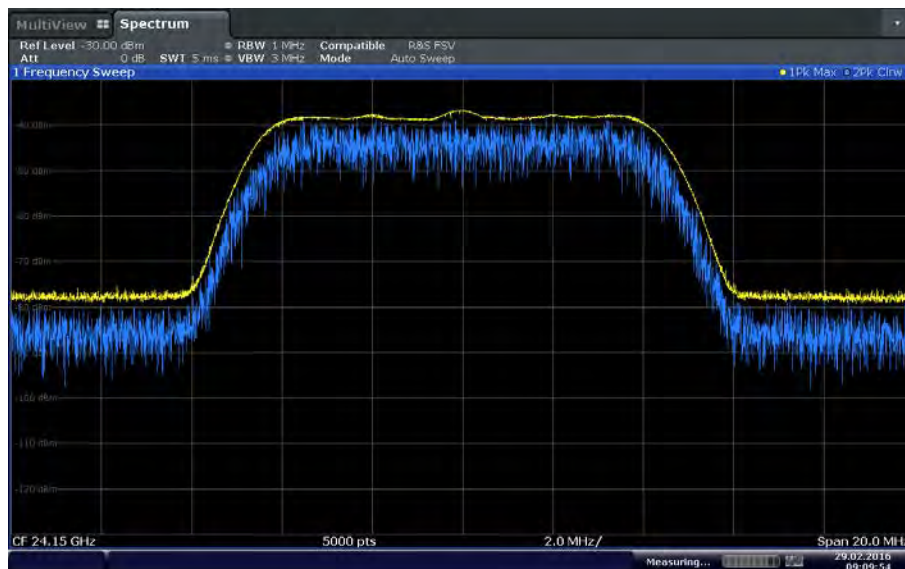
Using data results from OBW measurements, the worst case bandwidth was determined. Since the field strength limits is Peak, the bandwidth with the highest Peak among the available bandwidths was used for radiated measurements. This bandwidth is 10 MHz.

Each available modulation were compared (see attached modulation plots on the following pages). Using the same criteria for determining worst case bandwidth, the worst case modulation was determined. This modulation is QPSK.



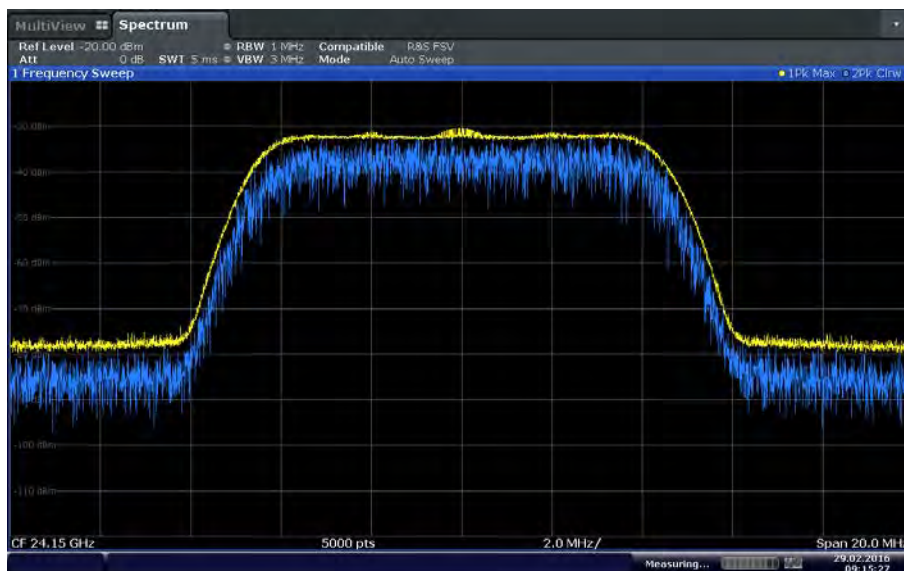
Date: 29.FEB 2016 09:12:48

### QPSK Modulation



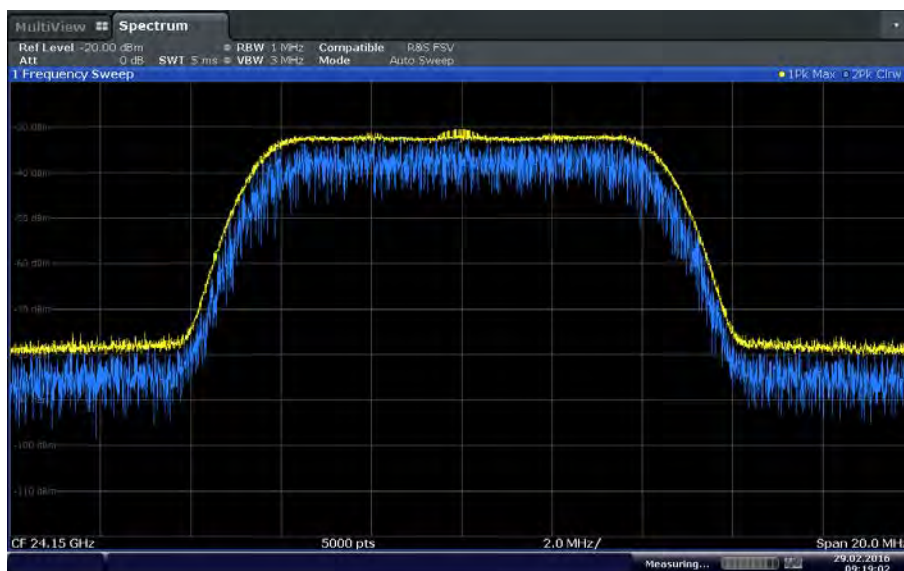
Date: 29.FEB 2016 09:09:54

### QAM16 Modulation



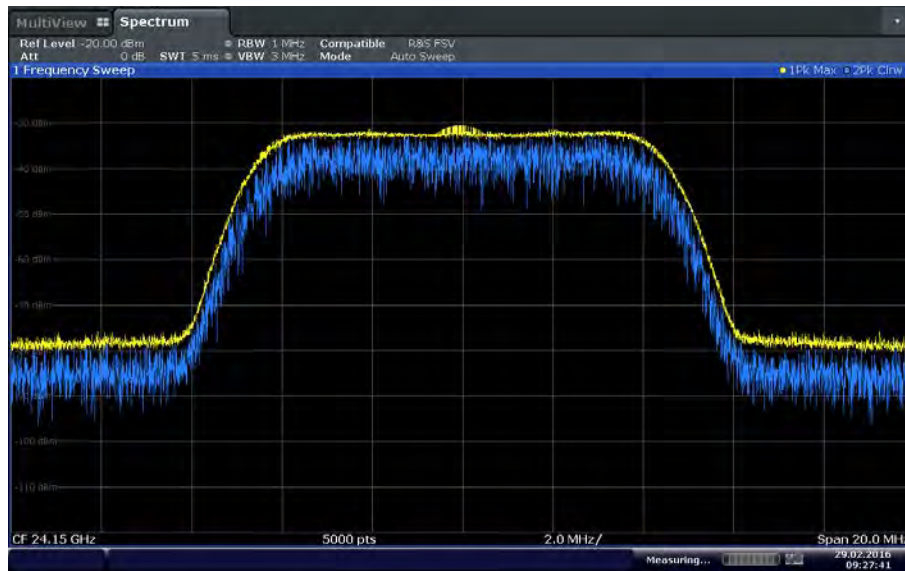
Date: 29.FEB 2016 09:15:27

### QAM32 Modulation



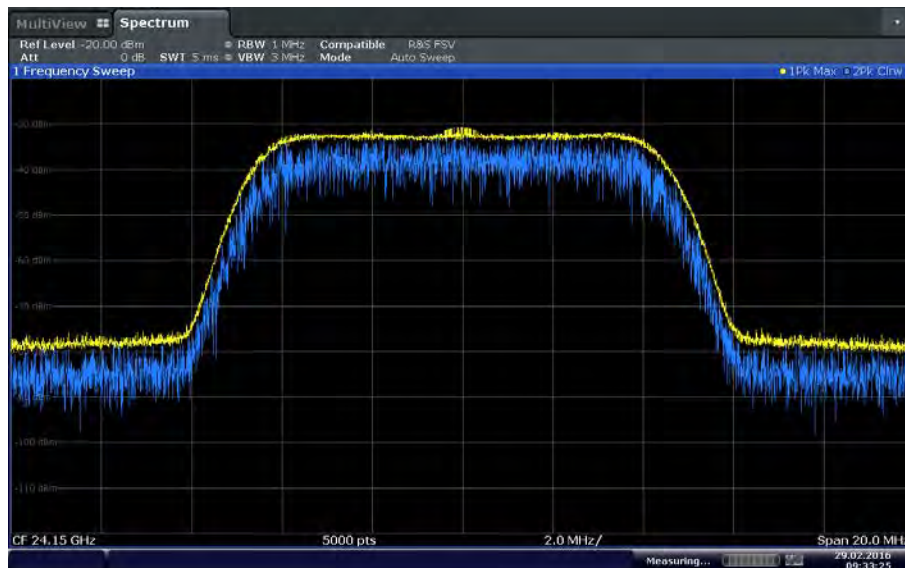
Date: 29.FEB 2016 09:19:02

### QAM64 Modulation



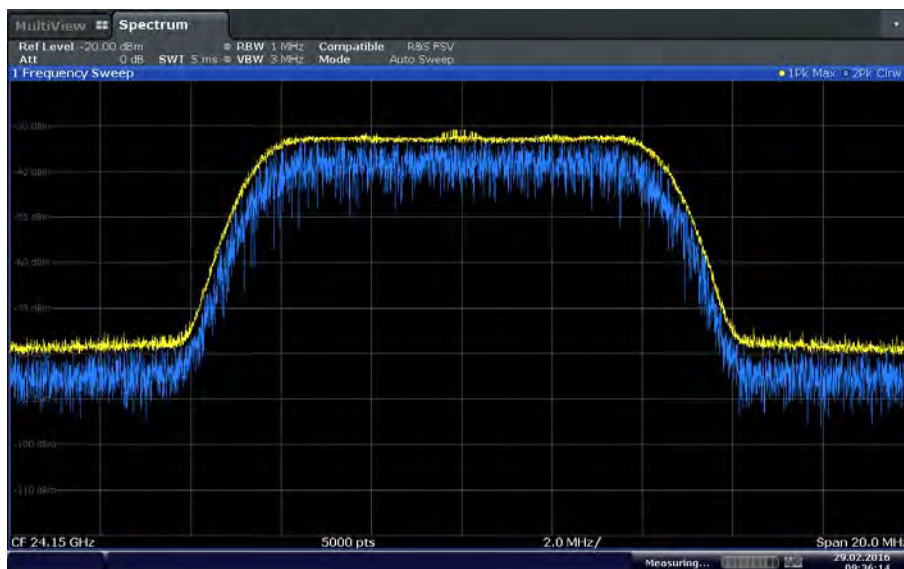
Date: 29.FEB.2016 09:27:41

### QAM128 Modulation



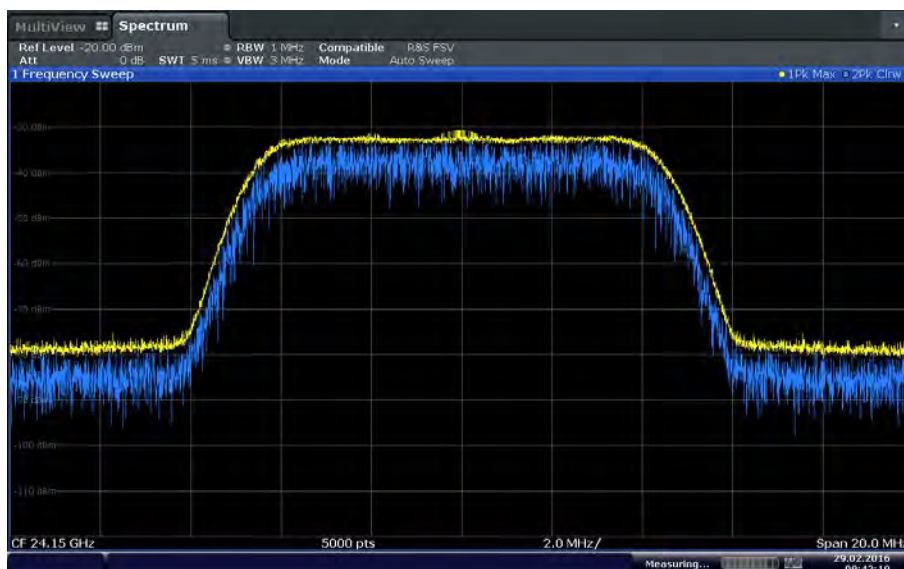
Date: 29.FEB.2016 09:33:25

### QAM256 Modulation



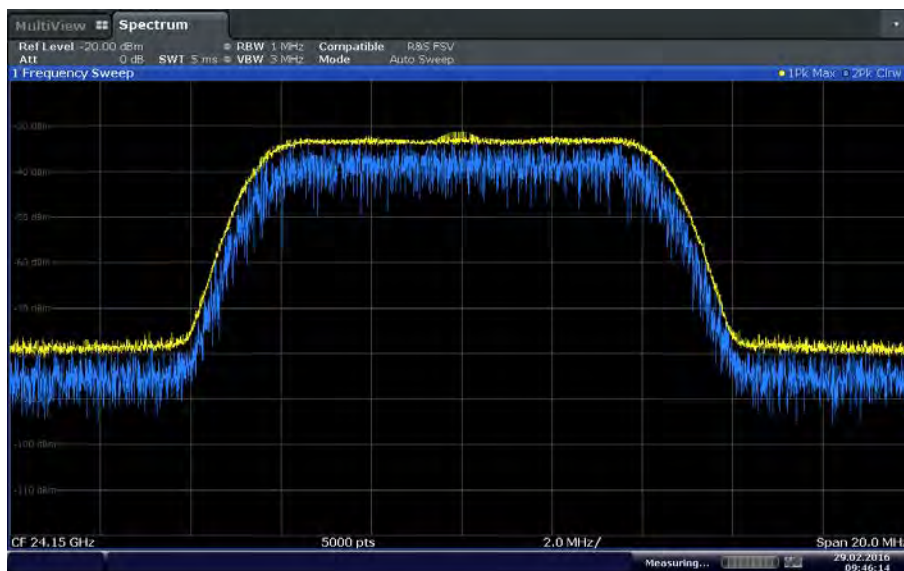
Date: 29.FEB.2016 09:36:14

### QAM512 Modulation

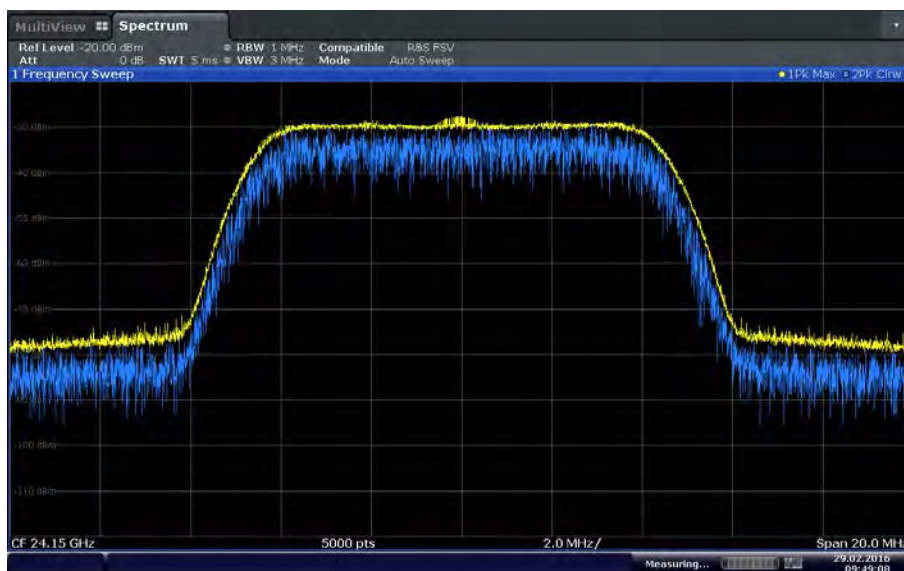


Date: 29.FEB.2016 09:42:20

### QAM1024 Modulation

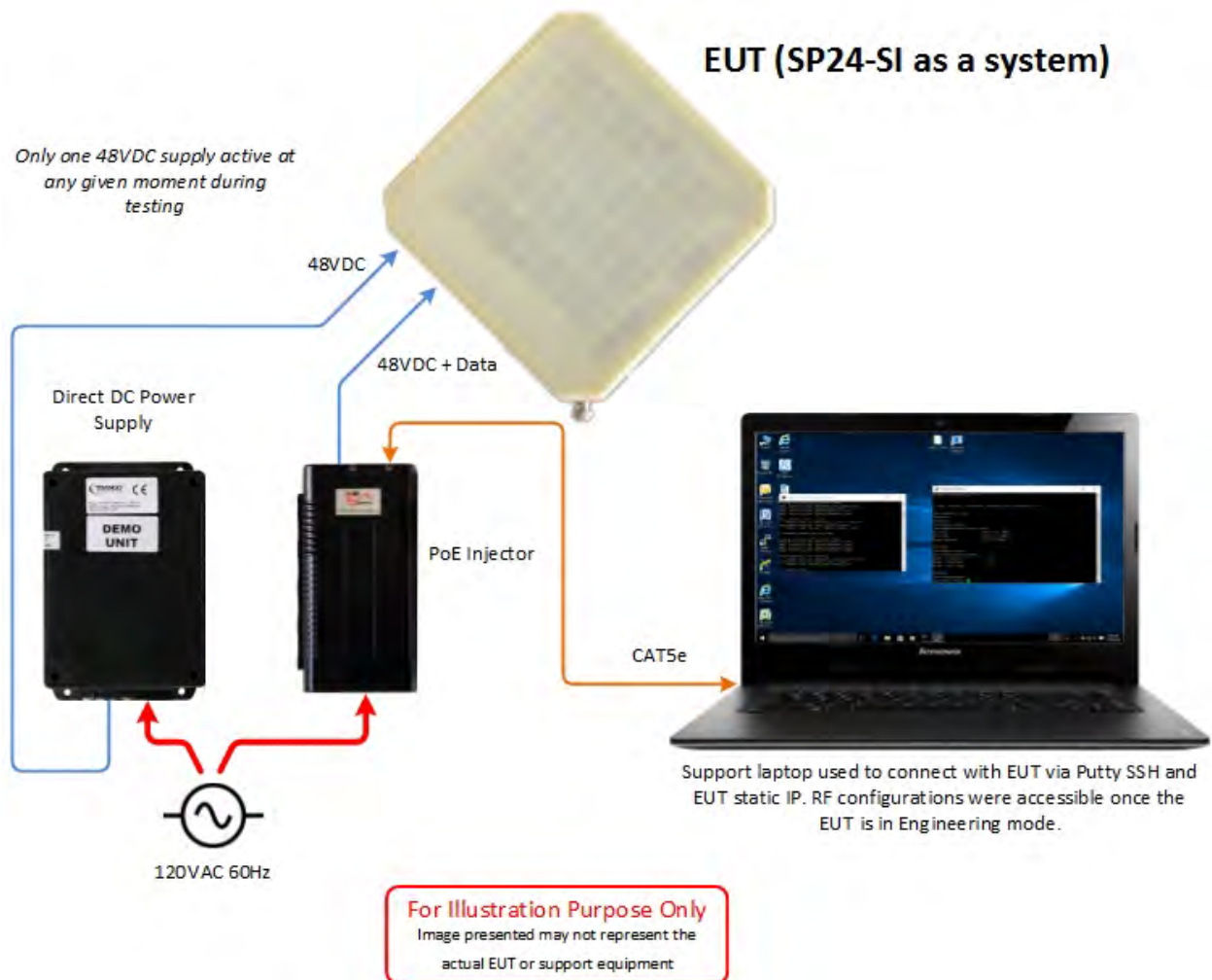


QAM2048 Modulation



QAM4096 Modulation

#### 1.4.5 Simplified Test Configuration Diagram





## 1.5 DEVIATIONS FROM THE STANDARD

No deviations from the applicable test standards or test plan were made during testing.

## 1.6 MODIFICATION RECORD

| Description of Modification | Modification Fitted By | Date Modification Fitted |
|-----------------------------|------------------------|--------------------------|
| Serial Number N/A           |                        |                          |
| N/A                         |                        |                          |

The table above details modifications made to the EUT during the test programme. The modifications incorporated during each test (if relevant) are recorded on the appropriate test pages.

## 1.7 TEST METHODOLOGY

All measurements contained in this report were conducted with ANSI C63.10-2013, American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices.

For conducted and radiated emissions the equipment under test (EUT) was configured to measure its highest possible emission level. This level was based on the maximized cable configuration from exploratory testing per ANSI C63.10-2013. The test modes were adapted according to the Operating Instructions provided by the manufacturer/client.

## 1.8 TEST FACILITY LOCATION

### 1.8.1 TÜV SÜD America Inc. (Mira Mesa)

10040 Mesa Rim Road, San Diego, CA 92121-2912 (32.901268,-117.177681). Phone: 858 678 1400 FAX: 858-546 0364

### 1.8.2 TÜV SÜD America Inc. (Rancho Bernardo)

Building #8 16530 Via Esprillo, San Diego, CA 92127-1708 (33.018644,-117.092409). Phone: 858 942 5542 FAX: 858-546 0364



## **1.9 TEST FACILITY REGISTRATION**

### **1.9.1 FCC – Registration No.: US1146**

TUV SUD America Inc. (San Diego), is an accredited test facility with the site description report on file and has met all the requirements specified in §2.498 of the FCC rules. The acceptance letter from the FCC is maintained in our files and the Registration is US1146.

### **1.9.2 Innovation, Science and Economic Development Canada Registration No.: 3067A**

The 10m Semi-anechoic chamber of TUV SUD America Inc. (San Diego) has been registered by Certification and Engineering Bureau of Innovation, Science and Economic Development Canada for radio equipment testing with Registration No. 3067A.



## **SECTION 2**

### **TEST DETAILS**

Radio Testing of the  
Trango Systems, Inc.  
Point-to-Point Wireless Microwave System Module



## 2.1 CONDUCTED EMISSIONS

### 2.1.1 Specification Reference

Part 15 Subpart C §15.207(a) and RSS-Gen 8.8

### 2.1.2 Standard Applicable

An intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies, within the band 150 kHz to 30 MHz, shall not exceed the limits in the following table, as measured using a 50  $\mu$ H/50 ohms line impedance stabilization network (LISN).

| Frequency of emission (MHz) | Conducted limit (dB $\mu$ V) |           |
|-----------------------------|------------------------------|-----------|
|                             | Quasi-peak                   | Average   |
| 0.15–0.5                    | 66 to 56*                    | 56 to 46* |
| 0.5–5                       | 56                           | 46        |
| 5–30                        | 60                           | 50        |

*\*Decreases with the logarithm of the frequency.*

### 2.1.3 Equipment Under Test and Modification State

Serial No: N/A / Default Test Configuration

### 2.1.4 Date of Test/Initial of test personnel who performed the test

February 29, 2016/FSC

### 2.1.5 Test Equipment Used

The major items of test equipment used for the above tests are identified in Section 3.1.

### 2.1.6 Environmental Conditions/ Test Location

Test performed at TÜV SÜD America Inc. Rancho Bernardo facility

|                     |          |
|---------------------|----------|
| Ambient Temperature | 27.2 °C  |
| Relative Humidity   | 20.3 %   |
| ATM Pressure        | 99.4 kPa |

### 2.1.7 Additional Observations

- Both PoE and direct DC power input verified.
- Verification performed using representative PoE injector and DC power supply (supplied by the manufacturer for testing purposes).
- EUT in Tx mode and max power during verification.



- Measurement was done using EMC32 automated software. Reported level is the actual level with all the correction factors factored in. Correction Factor column is for informational purposes only. See Section 2.1.8 for sample computation.

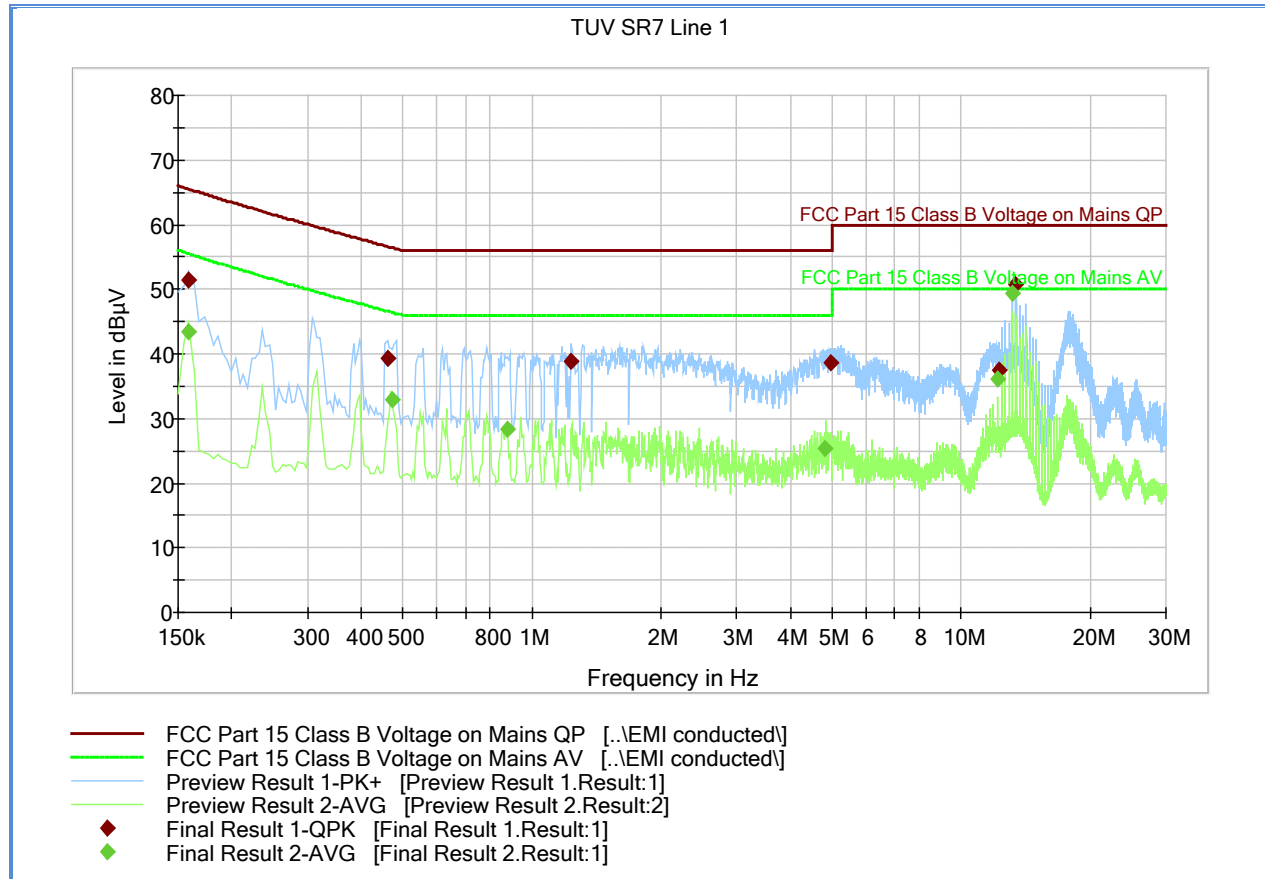
### 2.1.8 Sample Computation (Conducted Emission – Quasi Peak)

|                                                            |                                |      |      |
|------------------------------------------------------------|--------------------------------|------|------|
| Measuring equipment raw measurement (db $\mu$ V) @ 150kHz  |                                |      | 5.5  |
| Correction Factor (dB)                                     | Asset# 8607 (20 dB attenuator) | 19.9 | 20.7 |
|                                                            | Asset# 1177 (cable)            | 0.15 |      |
|                                                            | Asset# 1176 (cable)            | 0.35 |      |
|                                                            | Asset# 7567 (LISN)             | 0.30 |      |
| Reported QuasiPeak Final Measurement (db $\mu$ V) @ 150kHz |                                |      | 26.2 |

### 2.1.9 Test Results

Compliant. See attached plots and tables.

## 2.1.10 FCC Conducted Emissions Line 1 – Hot (PoE Injector)



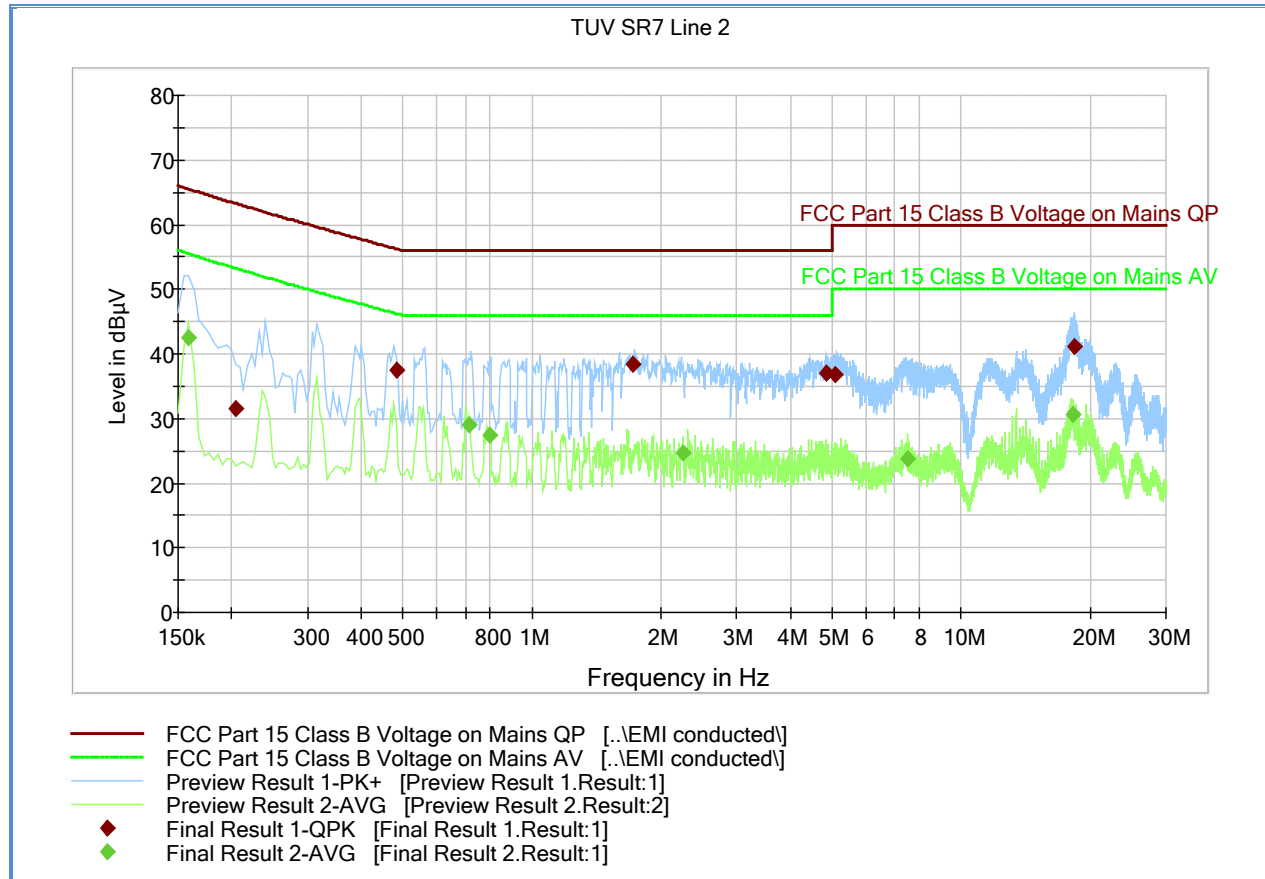
### Quasi Peak

| Frequency (MHz) | QuasiPeak (dBµV) | Meas. Time (ms) | Bandwidth (kHz) | Filter | Line | Corr. (dB) | Margin - QPK (dB) | Limit - QPK (dBµV) |
|-----------------|------------------|-----------------|-----------------|--------|------|------------|-------------------|--------------------|
| 0.159000        | 51.4             | 1000.0          | 9.000           | Off    | L1   | 20.0       | 14.1              | 65.5               |
| 0.460500        | 39.3             | 1000.0          | 9.000           | Off    | L1   | 20.2       | 17.3              | 56.6               |
| 1.234500        | 39.0             | 1000.0          | 9.000           | Off    | L1   | 20.1       | 17.0              | 56.0               |
| 4.974000        | 38.7             | 1000.0          | 9.000           | Off    | L1   | 20.5       | 17.3              | 56.0               |
| 12.232500       | 37.6             | 1000.0          | 9.000           | Off    | L1   | 20.6       | 22.4              | 60.0               |
| 13.425000       | 50.7             | 1000.0          | 9.000           | Off    | L1   | 20.6       | 9.3               | 60.0               |

### Average

| Frequency (MHz) | Average (dBµV) | Meas. Time (ms) | Bandwidth (kHz) | Filter | Line | Corr. (dB) | Margin - Ave (dB) | Limit - Ave (dBµV) |
|-----------------|----------------|-----------------|-----------------|--------|------|------------|-------------------|--------------------|
| 0.159000        | 43.3           | 1000.0          | 9.000           | Off    | L1   | 20.0       | 12.1              | 55.5               |
| 0.474000        | 32.9           | 1000.0          | 9.000           | Off    | L1   | 20.1       | 13.5              | 46.4               |
| 0.874500        | 28.2           | 1000.0          | 9.000           | Off    | L1   | 20.1       | 17.8              | 46.0               |
| 4.821000        | 25.3           | 1000.0          | 9.000           | Off    | L1   | 20.5       | 20.7              | 46.0               |
| 12.160500       | 36.0           | 1000.0          | 9.000           | Off    | L1   | 20.6       | 14.0              | 50.0               |
| 13.173000       | 49.4           | 1000.0          | 9.000           | Off    | L1   | 20.6       | 0.6               | 50.0               |

## 2.1.11 FCC Conducted Emissions Line 2 – Neutral (PoE Injector)



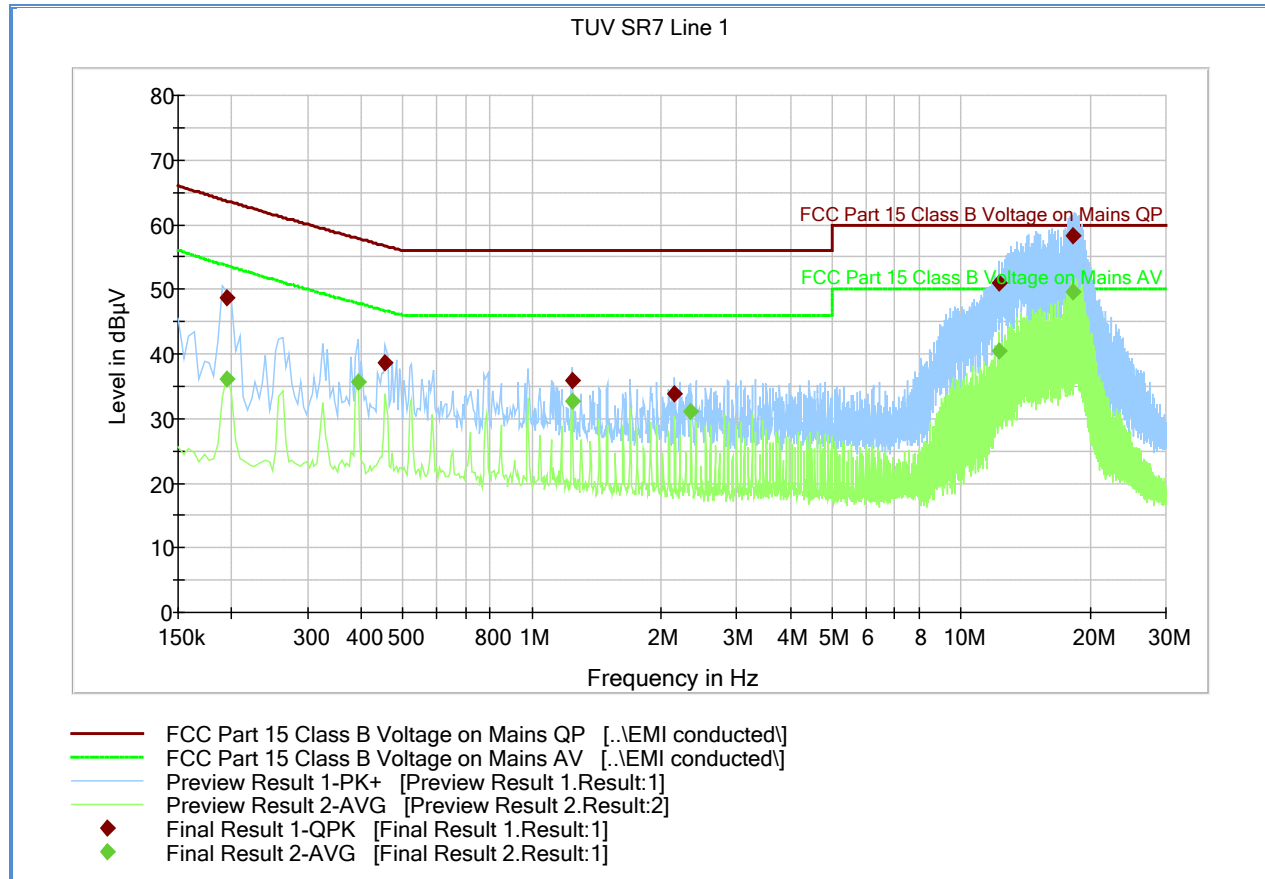
### Quasi Peak

| Frequency (MHz) | QuasiPeak (dBμV) | Meas. Time (ms) | Bandwidth (kHz) | Filter | Line | Corr. (dB) | Margin - QPK (dB) | Limit - QPK (dBμV) |
|-----------------|------------------|-----------------|-----------------|--------|------|------------|-------------------|--------------------|
| 0.204000        | 31.5             | 1000.0          | 9.000           | Off    | N    | 20.1       | 31.8              | 63.3               |
| 0.483000        | 37.5             | 1000.0          | 9.000           | Off    | N    | 20.1       | 18.8              | 56.3               |
| 1.725000        | 38.4             | 1000.0          | 9.000           | Off    | N    | 20.2       | 17.6              | 56.0               |
| 4.861500        | 37.1             | 1000.0          | 9.000           | Off    | N    | 20.5       | 18.9              | 56.0               |
| 5.073000        | 36.9             | 1000.0          | 9.000           | Off    | N    | 20.5       | 23.1              | 60.0               |
| 18.388500       | 41.2             | 1000.0          | 9.000           | Off    | N    | 20.8       | 18.8              | 60.0               |

### Average

| Frequency (MHz) | Average (dBμV) | Meas. Time (ms) | Bandwidth (kHz) | Filter | Line | Corr. (dB) | Margin - Ave (dB) | Limit - Ave (dBμV) |
|-----------------|----------------|-----------------|-----------------|--------|------|------------|-------------------|--------------------|
| 0.159000        | 42.5           | 1000.0          | 9.000           | Off    | N    | 20.0       | 13.0              | 55.5               |
| 0.712500        | 29.0           | 1000.0          | 9.000           | Off    | N    | 20.2       | 17.0              | 46.0               |
| 0.798000        | 27.4           | 1000.0          | 9.000           | Off    | N    | 20.3       | 18.6              | 46.0               |
| 2.247000        | 24.6           | 1000.0          | 9.000           | Off    | N    | 20.4       | 21.4              | 46.0               |
| 7.498500        | 23.9           | 1000.0          | 9.000           | Off    | N    | 20.5       | 26.1              | 50.0               |
| 18.222000       | 30.6           | 1000.0          | 9.000           | Off    | N    | 20.8       | 19.4              | 50.0               |

## 2.1.12 FCC Conducted Emissions Line 1 – Positive (48VDC Direct Inject)



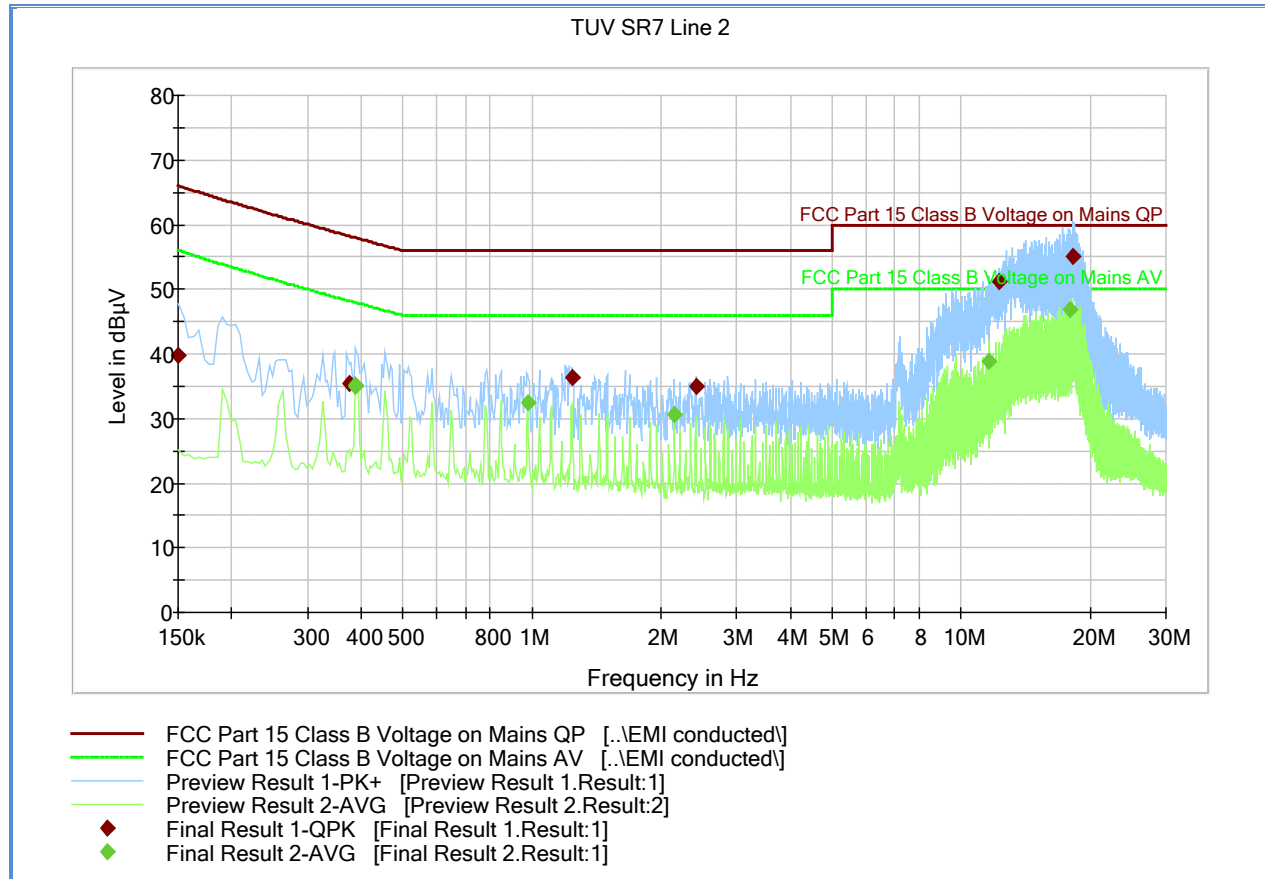
### Quasi Peak

| Frequency (MHz) | QuasiPeak (dBµV) | Meas. Time (ms) | Bandwidth (kHz) | Filter | Line | Corr. (dB) | Margin - QPK (dB) | Limit - QPK (dBµV) |
|-----------------|------------------|-----------------|-----------------|--------|------|------------|-------------------|--------------------|
| 0.195000        | 48.6             | 1000.0          | 9.000           | Off    | L1   | 20.1       | 15.1              | 63.7               |
| 0.456000        | 38.7             | 1000.0          | 9.000           | Off    | L1   | 20.2       | 18.0              | 56.7               |
| 1.239000        | 35.8             | 1000.0          | 9.000           | Off    | L1   | 20.1       | 20.2              | 56.0               |
| 2.148000        | 33.7             | 1000.0          | 9.000           | Off    | L1   | 20.3       | 22.3              | 56.0               |
| 12.255000       | 50.9             | 1000.0          | 9.000           | Off    | L1   | 20.6       | 9.1               | 60.0               |
| 18.249000       | 58.4             | 1000.0          | 9.000           | Off    | L1   | 20.8       | 1.6               | 60.0               |

### Average

| Frequency (MHz) | Average (dBµV) | Meas. Time (ms) | Bandwidth (kHz) | Filter | Line | Corr. (dB) | Margin - Ave (dB) | Limit - Ave (dBµV) |
|-----------------|----------------|-----------------|-----------------|--------|------|------------|-------------------|--------------------|
| 0.195000        | 36.0           | 1000.0          | 9.000           | Off    | L1   | 20.1       | 17.6              | 53.7               |
| 0.393000        | 35.6           | 1000.0          | 9.000           | Off    | L1   | 20.3       | 12.3              | 47.8               |
| 1.239000        | 32.8           | 1000.0          | 9.000           | Off    | L1   | 20.1       | 13.2              | 46.0               |
| 2.346000        | 31.1           | 1000.0          | 9.000           | Off    | L1   | 20.5       | 14.9              | 46.0               |
| 12.255000       | 40.5           | 1000.0          | 9.000           | Off    | L1   | 20.6       | 9.5               | 50.0               |
| 18.249000       | 49.6           | 1000.0          | 9.000           | Off    | L1   | 20.8       | 0.4               | 50.0               |

### 2.1.13 FCC Conducted Emissions Line 2 – Negative (48VDC Direct Inject)



#### Quasi Peak

| Frequency (MHz) | QuasiPeak (dBμV) | Meas. Time (ms) | Bandwidth (kHz) | Filter | Line | Corr. (dB) | Margin - QPK (dB) | Limit - QPK (dBμV) |
|-----------------|------------------|-----------------|-----------------|--------|------|------------|-------------------|--------------------|
| 0.150000        | 39.8             | 1000.0          | 9.000           | Off    | N    | 20.1       | 26.2              | 66.0               |
| 0.375000        | 35.5             | 1000.0          | 9.000           | Off    | N    | 20.2       | 22.7              | 58.2               |
| 1.239000        | 36.2             | 1000.0          | 9.000           | Off    | N    | 20.1       | 19.8              | 56.0               |
| 2.409000        | 34.9             | 1000.0          | 9.000           | Off    | N    | 20.5       | 21.1              | 56.0               |
| 12.304500       | 51.2             | 1000.0          | 9.000           | Off    | N    | 20.7       | 8.8               | 60.0               |
| 18.163500       | 55.1             | 1000.0          | 9.000           | Off    | N    | 20.8       | 4.9               | 60.0               |

#### Average

| Frequency (MHz) | Average (dBμV) | Meas. Time (ms) | Bandwidth (kHz) | Filter | Line | Corr. (dB) | Margin - Ave (dB) | Limit - Ave (dBμV) |
|-----------------|----------------|-----------------|-----------------|--------|------|------------|-------------------|--------------------|
| 0.388500        | 35.0           | 1000.0          | 9.000           | Off    | N    | 20.3       | 12.9              | 47.9               |
| 0.388500        | 35.3           | 1000.0          | 9.000           | Off    | N    | 20.3       | 12.7              | 47.9               |
| 0.978000        | 32.5           | 1000.0          | 9.000           | Off    | N    | 20.1       | 13.5              | 46.0               |
| 2.148000        | 30.7           | 1000.0          | 9.000           | Off    | N    | 20.3       | 15.3              | 46.0               |
| 11.589000       | 39.0           | 1000.0          | 9.000           | Off    | N    | 20.6       | 11.0              | 50.0               |
| 17.902500       | 46.9           | 1000.0          | 9.000           | Off    | N    | 20.8       | 3.1               | 50.0               |



## **2.2 20 dB BANDWIDTH**

### **2.2.1 Specification Reference**

Part 15 Subpart C §15.215(c)

### **2.2.2 Standard Applicable**

(c) Intentional radiators operating under the alternative provisions to the general emission limits, as contained in §§15.217 through 15.257 and in Subpart E of this part, must be designed to ensure that the 20 dB bandwidth of the emission, or whatever bandwidth may otherwise be specified in the specific rule section under which the equipment operates, is contained within the frequency band designated in the rule section under which the equipment is operated. The requirement to contain the designated bandwidth of the emission within the specified frequency band includes the effects from frequency sweeping, frequency hopping and other modulation techniques that may be employed as well as the frequency stability of the transmitter over expected variations in temperature and supply voltage. If a frequency stability is not specified in the regulations, it is recommended that the fundamental emission be kept within at least the central 80% of the permitted band in order to minimize the possibility of out-of-band operation.

### **2.2.3 Equipment Under Test and Modification State**

Serial No: N/A / Default Test Configuration

### **2.2.4 Date of Test/Initial of test personnel who performed the test**

February 11, 2016/FSC

### **2.2.5 Test Equipment Used**

The major items of test equipment used for the above tests are identified in Section 3.1.

### **2.2.6 Environmental Conditions/ Test Location**

Test performed at TÜV SÜD America Inc. Rancho Bernardo facility

|                     |          |
|---------------------|----------|
| Ambient Temperature | 25.8 °C  |
| Relative Humidity   | 19.4 %   |
| ATM Pressure        | 99.5 kPa |

### **2.2.7 Additional Observations**

- This is a radiated test.
- Span is wide enough to capture the channel transmission.
- RBW is between 1% to 5% of the OBW.
- VBW is approx. 3X of the RBW.
- Sweep is auto.
- Detector is positive peak.
- "n dB down" marker function of the Spectrum Analyzer was used for this test.

- All available BW verified using the worst case modulation (See Section 1.4.4 of this test report).
- Worst case BW edges ( $T_1$  and  $T_2$  on the test plots) will determine if the EUT operates within band (24.0 GHz to 24.25 GHz).

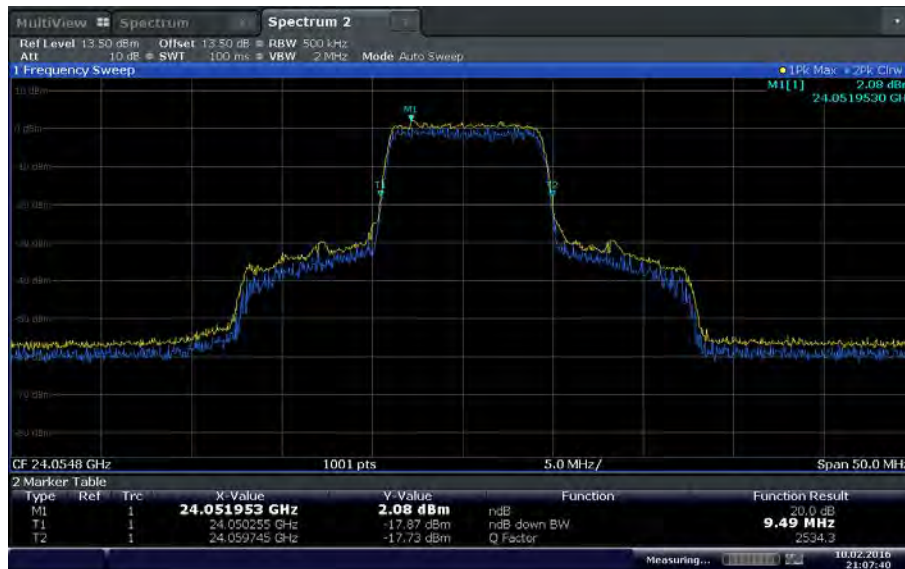
## 2.2.8 Test Results

| Channel BW | Low Channel (MHz) | Mid Channel (MHz) | High Channel (MHz) |
|------------|-------------------|-------------------|--------------------|
| 10 MHz     | 9.490             | 9.440             | 9.490              |
| 30 MHz     | 27.07             | 27.22             | 27.22              |
| 60 MHz     | 57.54             | 57.74             | 57.64              |
| 75 MHz     | 70.53             | 70.23             | 70.03              |
| 100 MHz    | 94.71             | 95.30             | 94.95              |
| 120 MHz    | 113.71            | 113.99            | 113.71             |

Worst case lower 20dB BW edge ( $T_1$  of 10 MHz BW Low Channel) = 24.050255 GHz (within band, **EUT complies**)

Worst case upper 20dB BW edge ( $T_2$  of 10 MHz BW High Channel) = 24.249745 GHz (within band, **EUT complies**)

## 2.2.9 Test Plots



Date: 10.FEB.2016 21:07:41

10 MHz BW (Low Channel)



Date: 10.FEB 2016 21:11:23

### 10 MHz BW (Mid Channel)



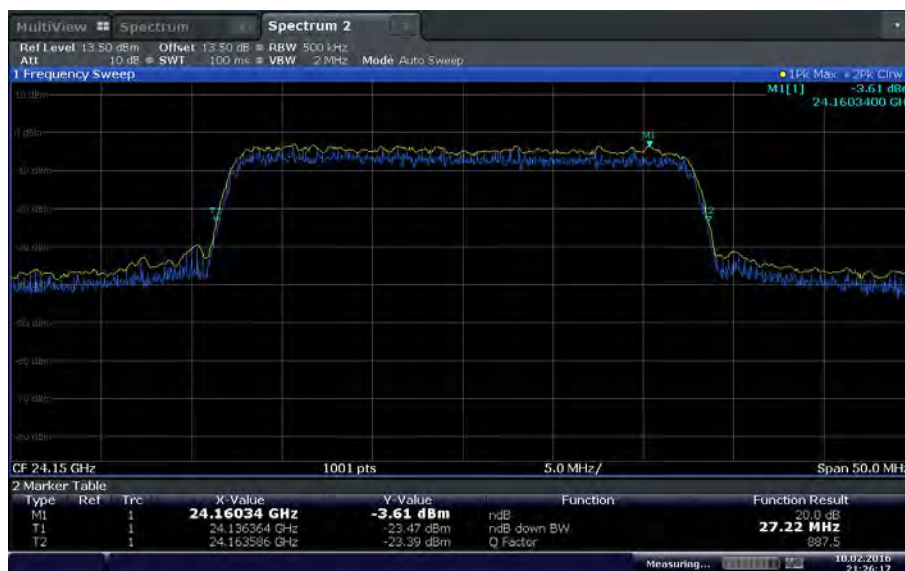
Date: 10.FEB 2016 21:13:19

### 10 MHz BW (High Channel)



Date: 10.FEB 2016 22:34:43

### 30 MHz BW (Low Channel)



Date: 10.FEB 2016 21:26:17

### 30 MHz BW (Mid Channel)



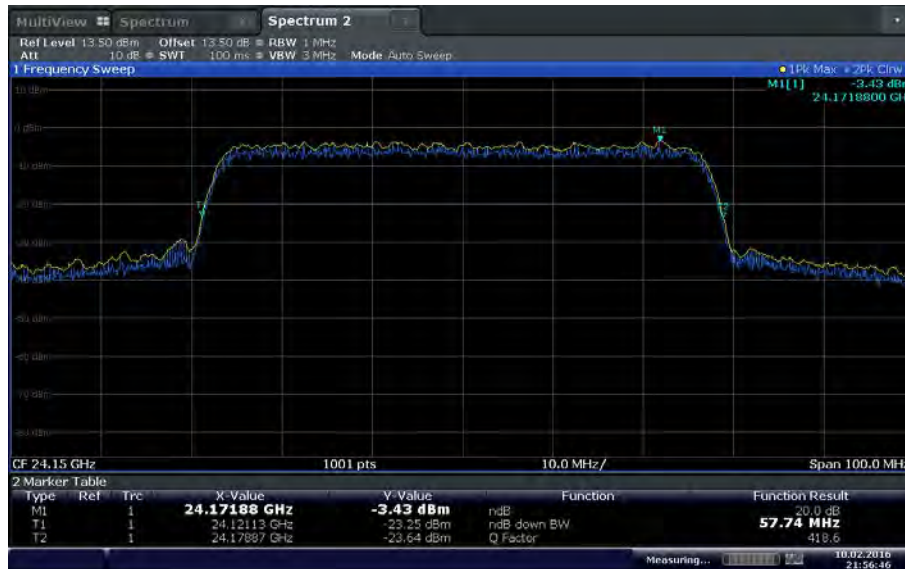
Date: 10.FEB 2016 22:37:07

### 30 MHz BW (High Channel)



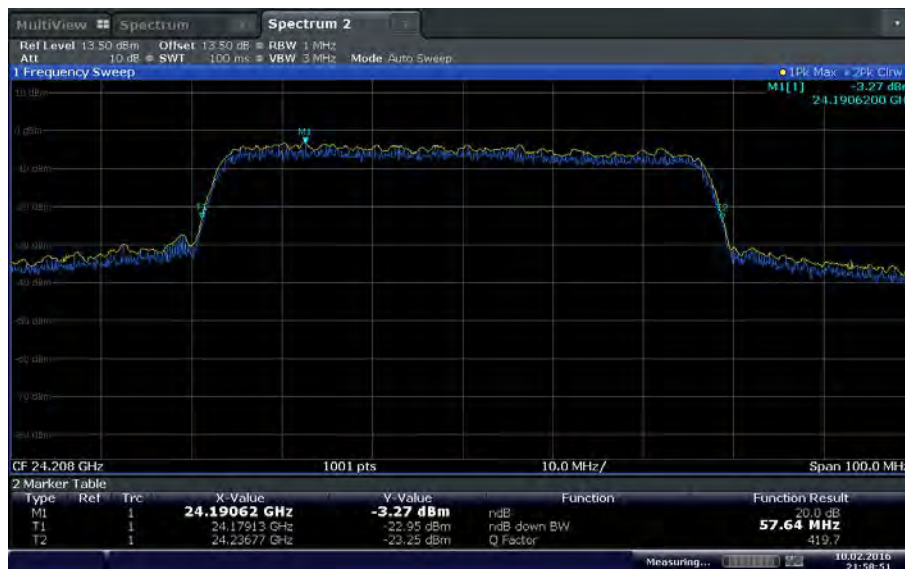
Date: 10.FEB 2016 21:49:37

### 60 MHz BW (Low Channel)



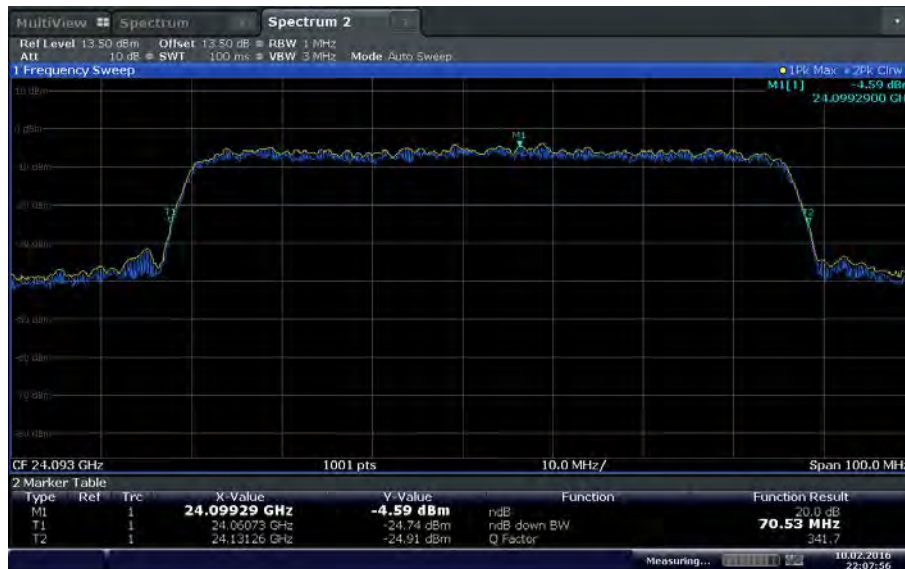
Date: 10.FEB.2016 21:56:47

### 60 MHz BW (Mid Channel)



Date: 10.FEB.2016 21:58:51

### 60 MHz BW (High Channel)



Date: 10.FEB 2016 22:07:57

### 75 MHz BW (Low Channel)



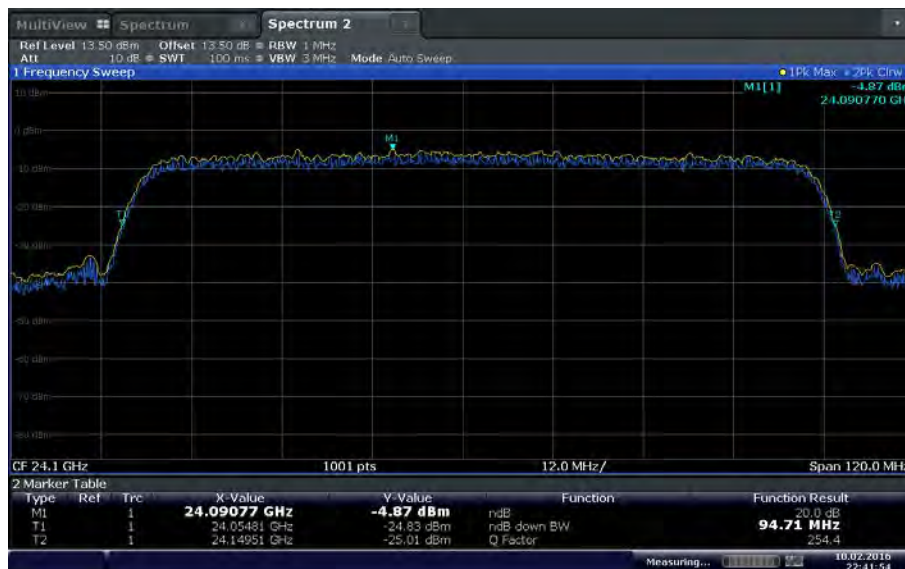
Date: 10.FEB 2016 22:22:36

### 75 MHz BW (Mid Channel)



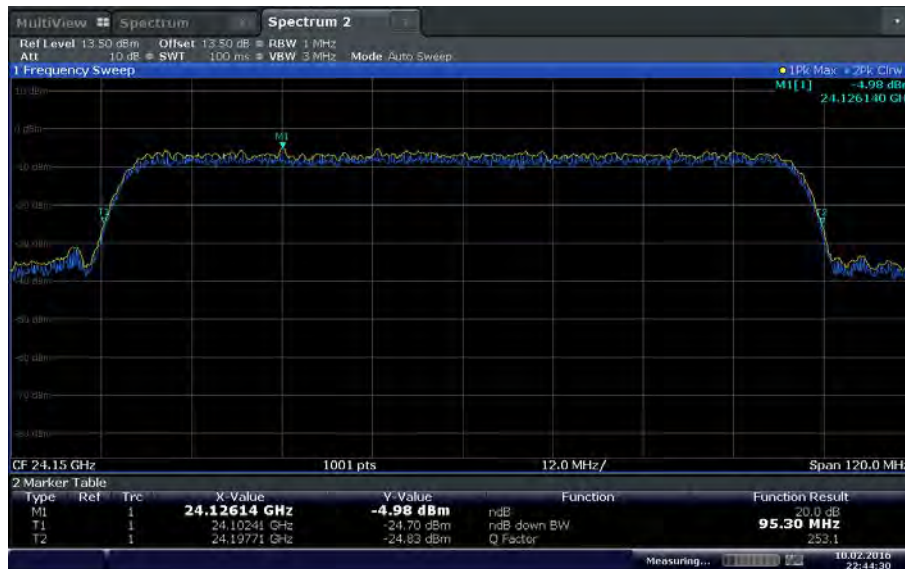
Date: 10.FEB 2016 22:19:16

### 75 MHz BW (High Channel)



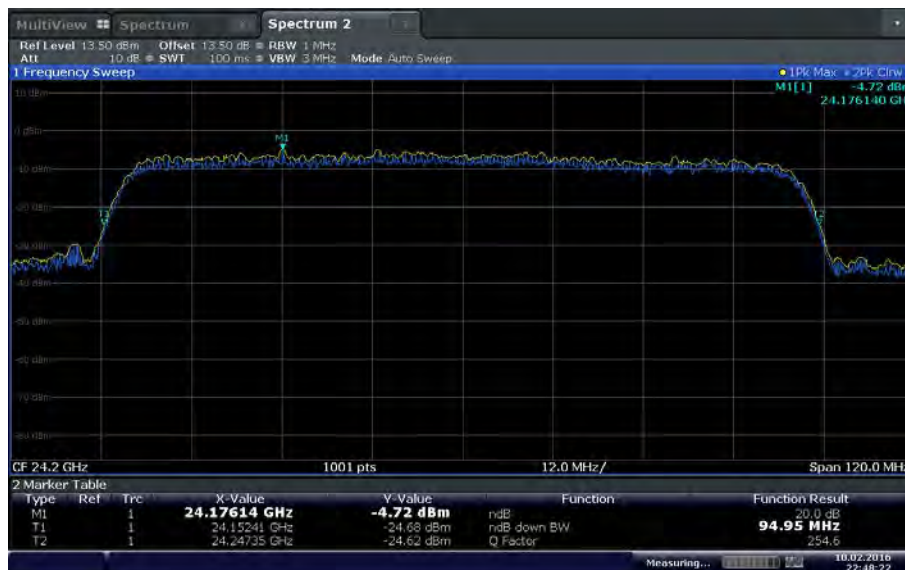
Date: 10.FEB 2016 22:41:54

### 100 MHz BW (Low Channel)



Date: 10.FEB 2016 22:44:30

### 100 MHz BW (Mid Channel)



Date: 10.FEB 2016 22:48:22

### 100 MHz BW (High Channel)



Date: 10.FEB 2016 22:52:46

### 120 MHz BW (Low Channel)



Date: 10.FEB 2016 22:54:31

### 120 MHz BW (Mid Channel)



Date: 10.FEB 2016 22:56:15

### 120 MHz BW (High Channel)



## **2.3 99% EMISSION BANDWIDTH**

### **2.3.1 Specification Reference**

RSS-Gen Clause 6.6

### **2.3.2 Standard Applicable**

The emission bandwidth (x dB) is defined as the frequency range between two points, one above and one below the carrier frequency, at which the spectral density of the emission is attenuated x dB below the maximum in-band spectral density of the modulated signal. Spectral density (power per unit bandwidth) is to be measured with a detector of resolution bandwidth in the range of 1% to 5% of the anticipated emission bandwidth, and a video bandwidth at least 3x the resolution bandwidth.

When the occupied bandwidth limit is not stated in the applicable RSS or reference measurement method, the transmitted signal bandwidth shall be reported as the 99% emission bandwidth, as calculated or measured.

- The transmitter shall be operated at its maximum carrier power measured under normal test conditions.
- The span of the analyzer shall be set to capture all products of the modulation process, including the emission skirts.
- The resolution bandwidth (RBW) shall be in the range of 1% to 5% of the occupied bandwidth (OBW) and video bandwidth (VBW) shall be approximately 3x RBW.

Note: Video averaging is not permitted.

A peak, or peak hold, may be used in place of the sampling detector as this may produce a wider bandwidth than the actual bandwidth (worst-case measurement). Use of a peak hold may be necessary to determine the occupied bandwidth if the device is not transmitting continuously.

The trace data points are recovered and are directly summed in linear power level terms. The recovered amplitude data points, beginning at the lowest frequency, are placed in a running sum until 0.5% of the total is reached and that frequency recorded. The process is repeated for the highest frequency data points (starting at the highest frequency, at the right side of the span, and going down in frequency). This frequency is then recorded.

The difference between the two recorded frequencies is the 99% occupied bandwidth.

### **2.3.3 Equipment Under Test and Modification State**

Serial No: N/A / Default Test Configuration

### **2.3.4 Date of Test/Initial of test personnel who performed the test**

February 11, 2016/FSC

### **2.3.5 Test Equipment Used**

The major items of test equipment used for the above tests are identified in Section 3.1.



### 2.3.6 Environmental Conditions/ Test Location

Test performed at TÜV SÜD America Inc. Rancho Bernardo facility

Ambient Temperature 25.8 °C  
 Relative Humidity 19.4 %  
 ATM Pressure 99.5 kPa

### 2.3.7 Additional Observations

- This is a radiated test.
- Span is wide enough to capture the channel transmission.
- RBW is between 1% to 5% of the OBW.
- VBW is approx. 3X of the RBW.
- Sweep is auto.
- Detector is positive peak.
- All available BW verified using the worst case modulation (See Section 1.4.4 of this test report).
- The % Power Bandwidth setting in the spectrum analyzer was set to 99% (default).
- The Channel Bandwidth measurement function of the spectrum analyzer was used for this test.

### 2.3.8 Test Results

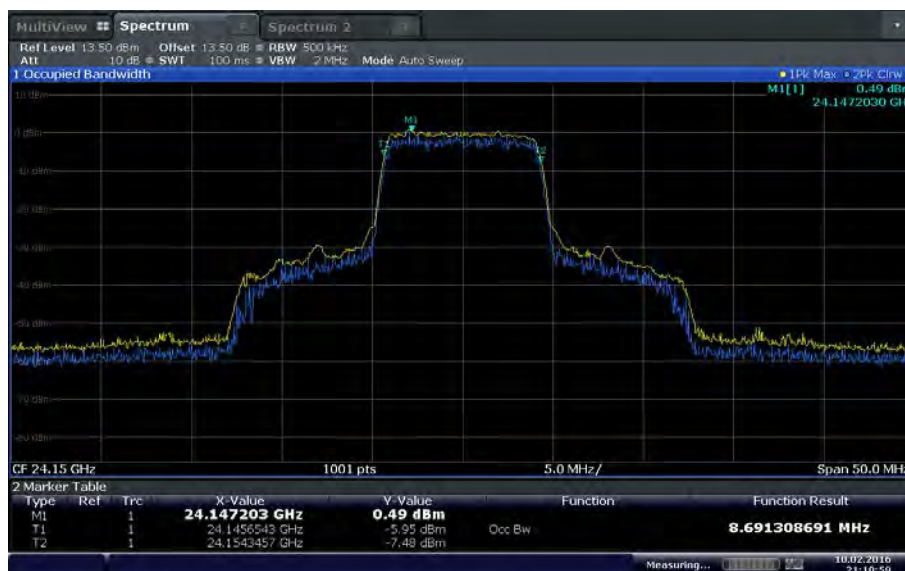
| Channel BW | Low Channel (MHz) | Mid Channel (MHz) | High Channel (MHz) |
|------------|-------------------|-------------------|--------------------|
| 10 MHz     | 8.690             | 8.690             | 8.690              |
| 30 MHz     | 25.32             | 25.37             | 25.42              |
| 60 MHz     | 53.65             | 53.95             | 54.05              |
| 75 MHz     | 65.63             | 65.53             | 65.43              |
| 100 MHz    | 88.47             | 89.31             | 88.71              |
| 120 MHz    | 106.29            | 106.99            | 106.43             |

### 2.3.9 Test Plots



Date: 10.FEB 2016 21:06:11

10 MHz BW (Low Channel)



Date: 10.FEB 2016 21:10:59

10 MHz BW (Mid Channel)



Date: 10.FEB.2016 21:14:15

### 10 MHz BW (High Channel)



Date: 10.FEB.2016 22:35:14

### 30 MHz BW (Low Channel)



Date: 10.FEB 2016 21:27:34

### 30 MHz BW (Mid Channel)



Date: 10.FEB 2016 22:37:32

### 30 MHz BW (High Channel)



Date: 10.FEB 2016 22:28:46

#### 60 MHz BW (Low Channel)



Date: 10.FEB 2016 22:29:57

#### 60 MHz BW (Mid Channel)



Date: 10.FEB 2016 22:30:56

#### 60 MHz BW (High Channel)



Date: 10.FEB 2016 22:08:32

#### 75 MHz BW (Low Channel)



Date: 10.FEB 2016 22:22:05

### 75 MHz BW (Mid Channel)



Date: 10.FEB 2016 22:19:54

### 75 MHz BW (High Channel)



Date: 10.FEB.2016 22:42:28

#### 100 MHz BW (Low Channel)



Date: 10.FEB.2016 22:45:19

#### 100 MHz BW (Mid Channel)



Date: 10.FEB 2016 22:47:04

### 100 MHz BW (High Channel)



Date: 10.FEB 2016 22:52:10

### 120 MHz BW (Low Channel)



Date: 10.FEB.2016 22:54:06

### 120 MHz BW (Mid Channel)



Date: 10.FEB.2016 22:55:48

### 120 MHz BW (High Channel)



## 2.4 FIELD STRENGTH OF FUNDAMENTAL EMISSIONS FOR FIXED, POINT TO POINT OPERATION

### 2.4.1 Specification Reference

47 CFR §15.249(b)(1) and RSS-210 A12(a)

### 2.4.2 Standard Applicable

(1) The field strength of emissions in this band shall not exceed 2500 millivolts/meter.

### 2.4.3 Equipment Under Test and Modification State

Serial No: N/A / Default Test Configuration

### 2.4.4 Date of Test/Initial of test personnel who performed the test

February 15, 2016/FSC

### 2.4.5 Test Equipment Used

The major items of test equipment used for the above tests are identified in Section 3.1.

### 2.4.6 Environmental Conditions/ Test Location

Test performed at TÜV SÜD America Inc. Rancho Bernardo facility

|                     |          |
|---------------------|----------|
| Ambient Temperature | 25.8 °C  |
| Relative Humidity   | 39.3 %   |
| ATM Pressure        | 99.4 kPa |

### 2.4.7 Additional Observations

- Only the worst case modulation and bandwidth verified (Section 1.4.4 of this test report).
- The spectrum was searched from 18GHz up to 40GHz. Band edge measurements were included on the final measurements.
- For Fundamental measurements, the maximization was repeated manually in addition to auto maximization via software.

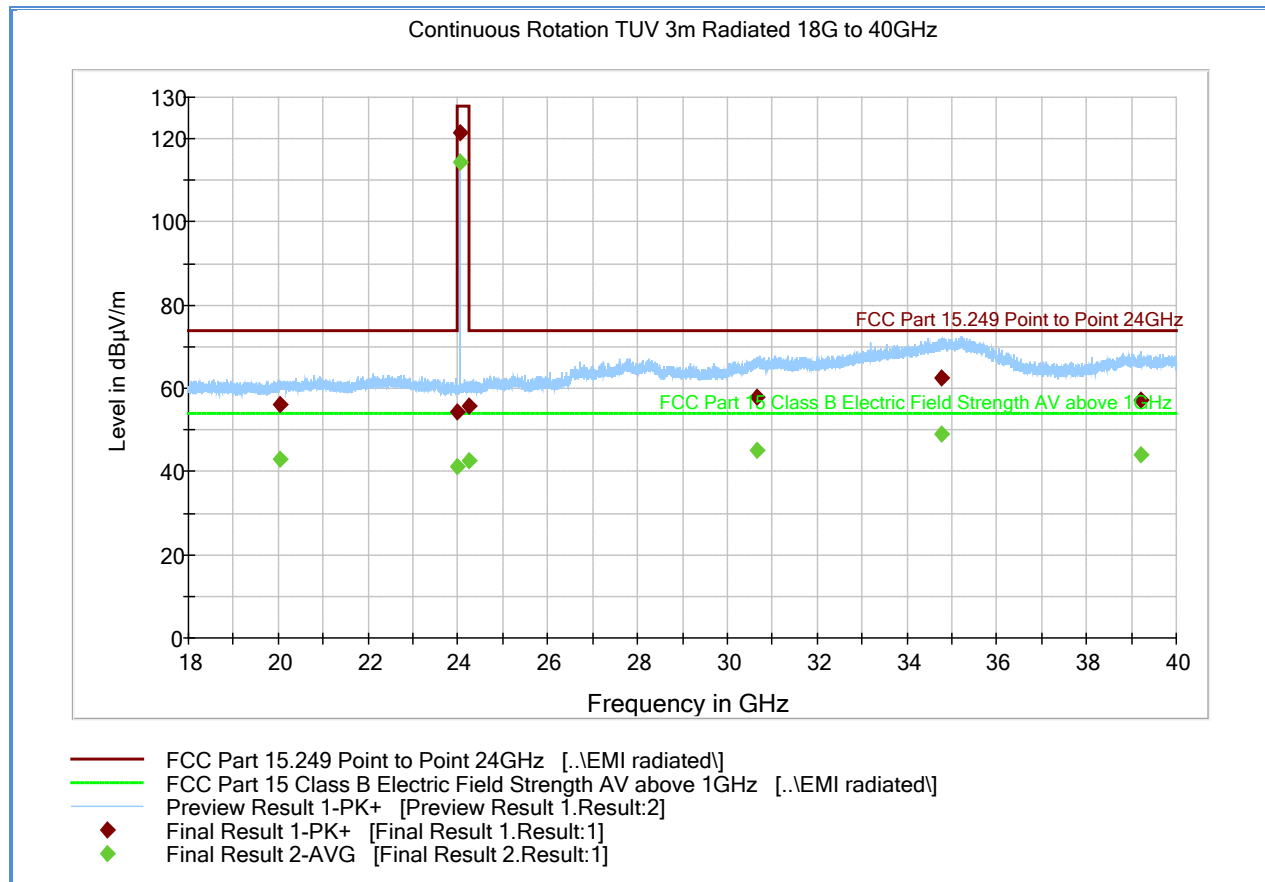
### 2.4.8 Sample Computation (Radiated Emission)

|                                                       |                           |       |       |
|-------------------------------------------------------|---------------------------|-------|-------|
| Measuring equipment raw measurement (dbμV) @ 24055MHz |                           |       | 107   |
| Correction Factor (dB)                                | Asset# 8851 (cable)       | 8.8   | 14.5  |
|                                                       | SLKaa-30-6 (preamplifier) | -39.5 |       |
|                                                       | Asset# 1054 (antenna)     | 45.2  |       |
| Reported Peak Final Measurement (dbμV/m) @ 24055 MHz  |                           |       | 121.5 |

### 2.4.9 Test Results

See attached plots.

## 2.4.10 Test Results for Low Channel (Fundamental, Band-Edges and General Spurious Emissions from 18GHz to 40GHz)



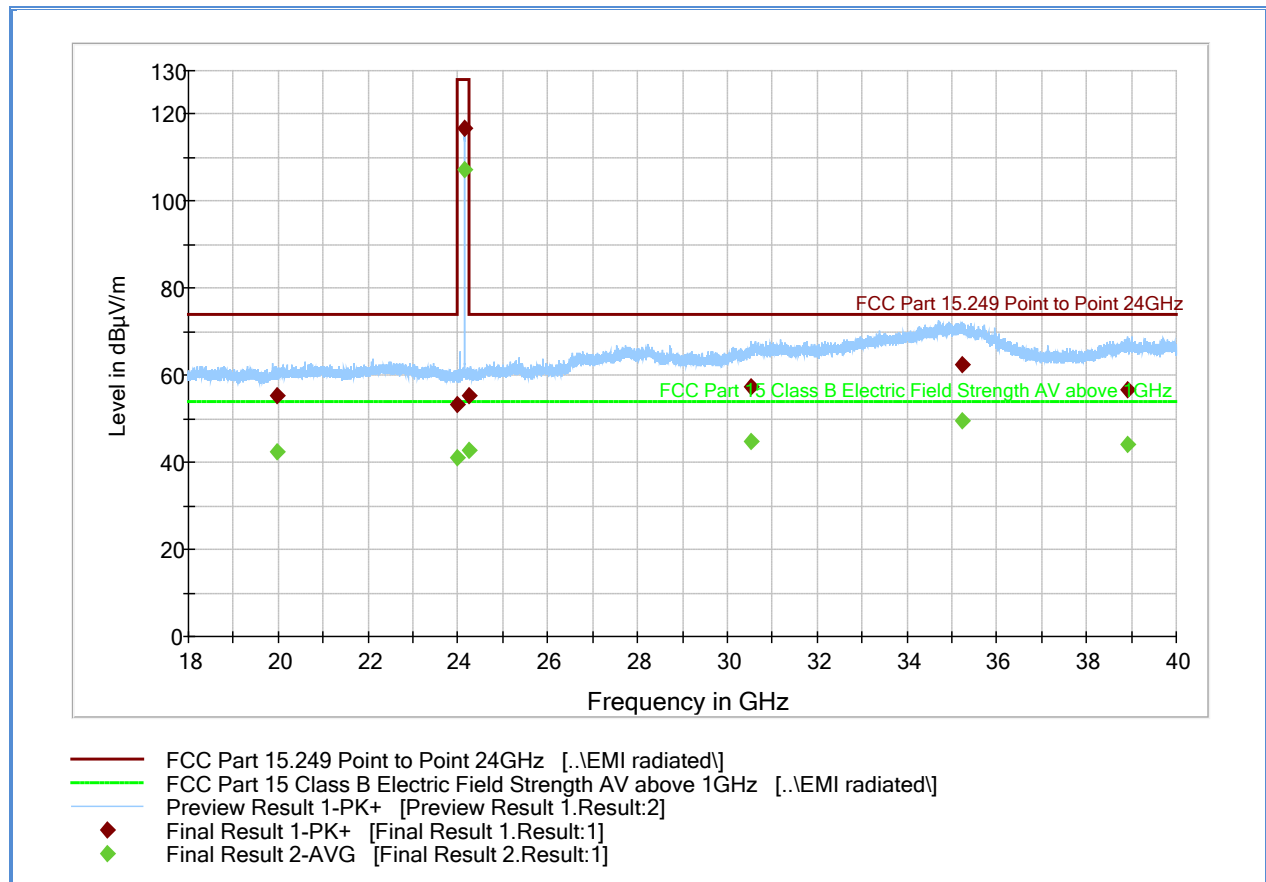
### Peak Data

| Frequency (MHz) | MaxPeak (dBμV/m) | Meas. Time (ms) | Bandwidth (kHz) | Height (cm) | Polarization | Azimuth (deg) | Corr. (dB) | Margin (dB) | Limit (dBμV/m) |
|-----------------|------------------|-----------------|-----------------|-------------|--------------|---------------|------------|-------------|----------------|
| 20033.3333      | 56.0             | 1000.0          | 1000.000        | 140.0       | V            | 14.0          | 14.0       | 17.9        | 73.9           |
| 23999.2000      | 54.3             | 1000.0          | 1000.000        | 140.0       | V            | 1.0           | 14.5       | 19.6        | 73.9           |
| 24051.5333      | 121.5            | 1000.0          | 1000.000        | 150.0       | H            | 1.0           | 14.5       | 6.5         | 128.0          |
| 24250.4666      | 55.9             | 1000.0          | 1000.000        | 150.0       | V            | 169.0         | 14.7       | 18.0        | 73.9           |
| 30650.8000      | 57.9             | 1000.0          | 1000.000        | 154.0       | V            | 253.0         | 18.6       | 16.0        | 73.9           |
| 34766.0000      | 62.4             | 1000.0          | 1000.000        | 120.0       | H            | 8.0           | 22.6       | 11.5        | 73.9           |
| 39208.2666      | 57.0             | 1000.0          | 1000.000        | 120.0       | V            | -15.0         | 18.3       | 16.9        | 73.9           |

### Average Data

| Frequency (MHz) | Average (dBμV/m) | Meas. Time (ms) | Bandwidth (kHz) | Height (cm) | Polarization | Azimuth (deg) | Corr. (dB) | Margin (dB) | Limit (dBμV/m) |
|-----------------|------------------|-----------------|-----------------|-------------|--------------|---------------|------------|-------------|----------------|
| 20033.3333      | 43.1             | 1000.0          | 1000.000        | 140.0       | V            | 14.0          | 14.0       | 10.8        | 53.9           |
| 23999.2000      | 41.4             | 1000.0          | 1000.000        | 140.0       | V            | 1.0           | 14.5       | 12.5        | 53.9           |
| 24051.5333      | 114.2            | 1000.0          | 1000.000        | 150.0       | H            | 1.0           | 14.5       | Fundamental |                |
| 24250.4666      | 42.8             | 1000.0          | 1000.000        | 150.0       | V            | 169.0         | 14.7       | 11.1        | 53.9           |
| 30650.8000      | 45.2             | 1000.0          | 1000.000        | 154.0       | V            | 253.0         | 18.6       | 8.7         | 53.9           |
| 34766.0000      | 48.8             | 1000.0          | 1000.000        | 120.0       | H            | 8.0           | 22.6       | 5.1         | 53.9           |
| 39208.2666      | 44.0             | 1000.0          | 1000.000        | 120.0       | V            | -15.0         | 18.3       | 9.9         | 53.9           |

#### 2.4.11 Test Results for Mid Channel (Fundamental, Band-Edges and General Spurious Emissions from 18GHz to 40GHz)



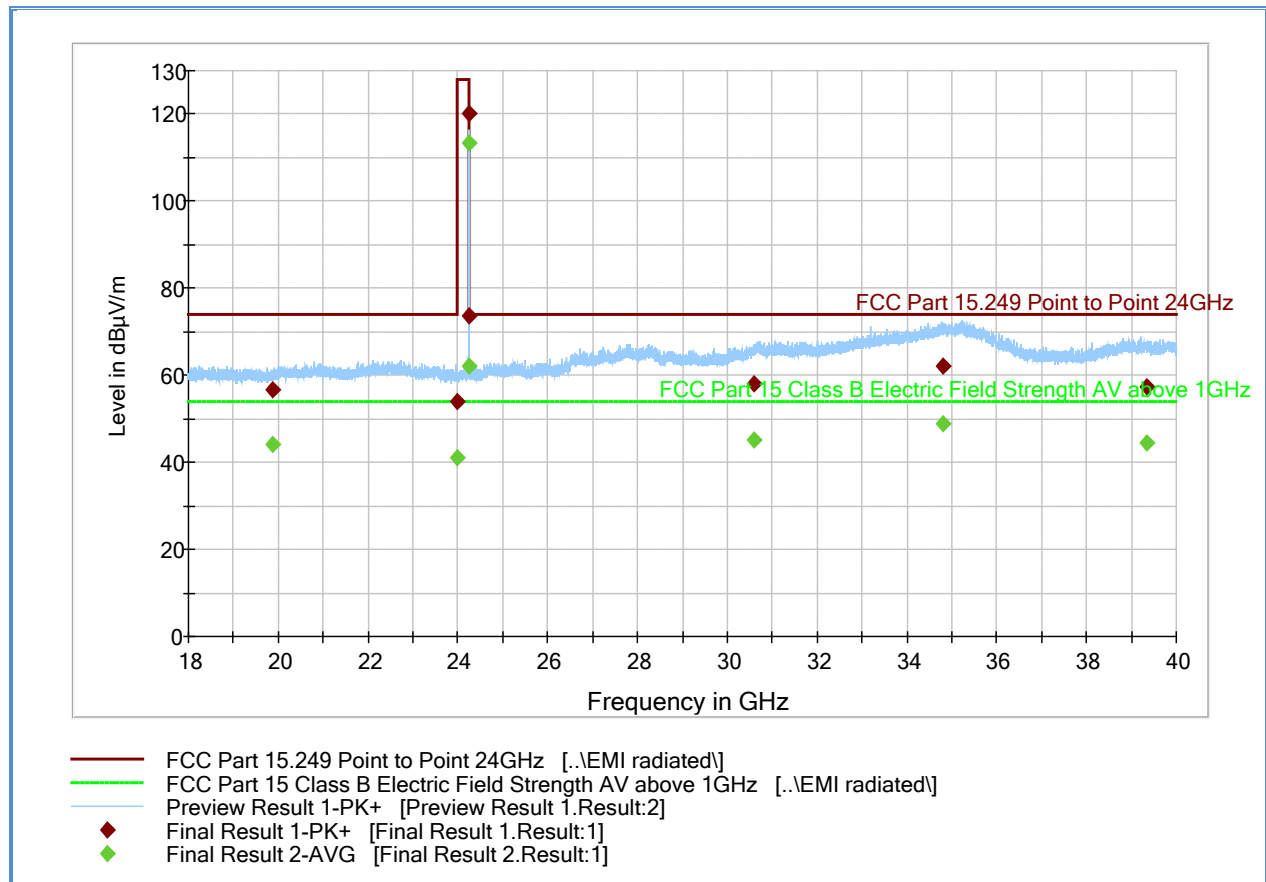
#### Peak Data

| Frequency (MHz) | MaxPeak (dBμV/m) | Meas. Time (ms) | Bandwidth (kHz) | Height (cm) | Polarization | Azimuth (deg) | Corr. (dB) | Margin (dB) | Limit (dBμV/m) |
|-----------------|------------------|-----------------|-----------------|-------------|--------------|---------------|------------|-------------|----------------|
| 19983.8000      | 55.3             | 1000.0          | 1000.000        | 160.0       | H            | 331.0         | 14.1       | 18.6        | 73.9           |
| 23998.9333      | 53.4             | 1000.0          | 1000.000        | 170.0       | V            | 0.0           | 14.5       | 20.5        | 73.9           |
| 24146.6000      | 116.9            | 1000.0          | 1000.000        | 160.0       | V            | 0.0           | 14.6       | 11.0        | 128.0          |
| 24250.3333      | 55.2             | 1000.0          | 1000.000        | 160.0       | H            | 117.0         | 14.7       | 18.7        | 73.9           |
| 30528.7333      | 57.5             | 1000.0          | 1000.000        | 140.0       | V            | 72.0          | 18.3       | 16.4        | 73.9           |
| 35218.8000      | 62.3             | 1000.0          | 1000.000        | 170.0       | H            | 92.0          | 22.6       | 11.6        | 73.9           |
| 38925.4666      | 56.8             | 1000.0          | 1000.000        | 160.0       | H            | -2.0          | 18.5       | 17.1        | 73.9           |

#### Average Data

| Frequency (MHz) | Average (dBμV/m) | Meas. Time (ms) | Bandwidth (kHz) | Height (cm) | Polarization | Azimuth (deg) | Corr. (dB) | Margin (dB) | Limit (dBμV/m) |
|-----------------|------------------|-----------------|-----------------|-------------|--------------|---------------|------------|-------------|----------------|
| 19983.8000      | 42.4             | 1000.0          | 1000.000        | 160.0       | H            | 331.0         | 14.1       | 11.5        | 53.9           |
| 23998.9333      | 40.9             | 1000.0          | 1000.000        | 170.0       | V            | 0.0           | 14.5       | 13.0        | 53.9           |
| 24146.6000      | 107.2            | 1000.0          | 1000.000        | 160.0       | V            | 0.0           | 14.6       | Fundamental |                |
| 24250.3333      | 42.9             | 1000.0          | 1000.000        | 160.0       | H            | 117.0         | 14.7       | 11.0        | 53.9           |
| 30528.7333      | 44.6             | 1000.0          | 1000.000        | 140.0       | V            | 72.0          | 18.3       | 9.3         | 53.9           |
| 35218.8000      | 49.5             | 1000.0          | 1000.000        | 170.0       | H            | 92.0          | 22.6       | 4.4         | 53.9           |
| 38925.4666      | 44.0             | 1000.0          | 1000.000        | 160.0       | H            | -2.0          | 18.5       | 9.9         | 53.9           |

## 2.4.12 Test Results for High Channel (Fundamental, Band-Edges and General Spurious Emissions from 18GHz to 40GHz)



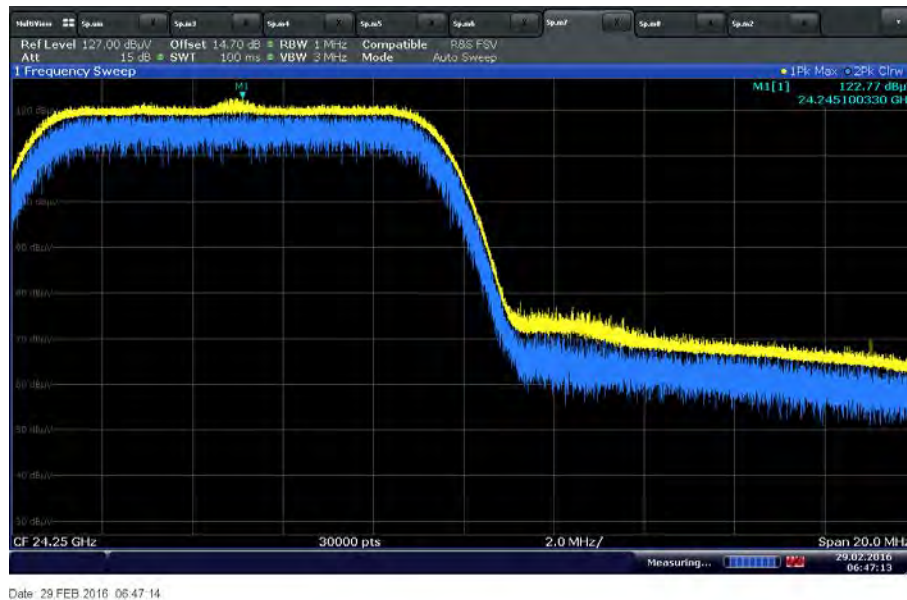
### Peak Data

| Frequency (MHz) | MaxPeak (dBμV/m) | Meas. Time (ms) | Bandwidth (kHz) | Height (cm) | Polarization | Azimuth (deg) | Corr. (dB) | Margin (dB) | Limit (dBμV/m) |
|-----------------|------------------|-----------------|-----------------|-------------|--------------|---------------|------------|-------------|----------------|
| 19888.3333      | 56.8             | 1000.0          | 1000.000        | 122.5       | H            | 69.0          | 14.1       | 17.1        | 73.9           |
| 24000.0333      | 54.1             | 1000.0          | 1000.000        | 130.5       | V            | 18.0          | 14.5       | 73.8        | 128.0          |
| 24248.8000      | 120.1            | 1000.0          | 1000.000        | 130.5       | V            | 6.0           | 14.7       | 7.9         | 128.0          |
| 24250.0000      | 73.7             | 1000.0          | 1000.000        | 130.5       | H            | 7.0           | 14.7       | 15.0        | 128.0          |
| 30609.7333      | 57.9             | 1000.0          | 1000.000        | 170.4       | H            | 172.0         | 18.5       | 16.0        | 73.9           |
| 34813.3333      | 62.0             | 1000.0          | 1000.000        | 132.5       | V            | 20.0          | 22.6       | 11.9        | 73.9           |
| 39340.4000      | 57.2             | 1000.0          | 1000.000        | 135.5       | V            | 159.0         | 18.3       | 16.7        | 73.9           |

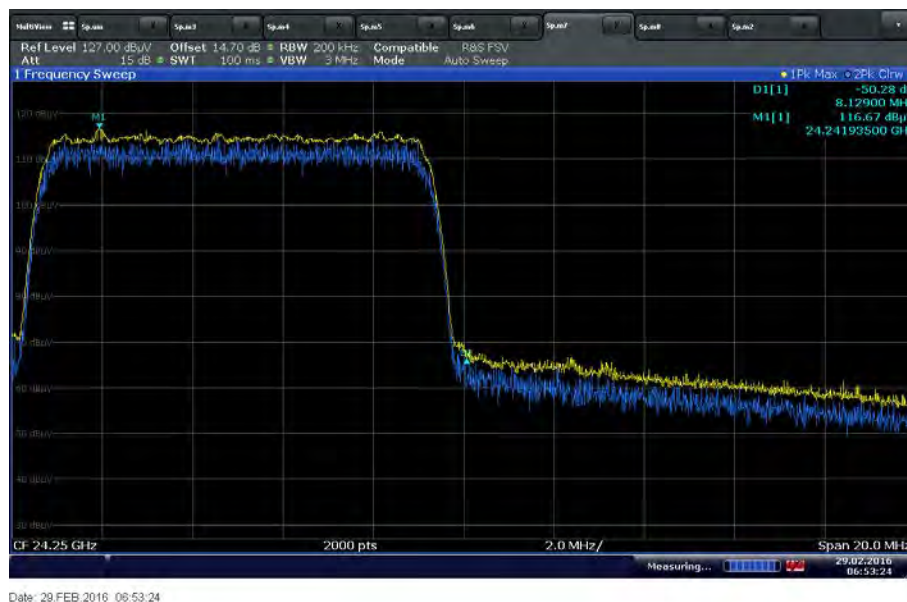
### Average Data

| Frequency (MHz) | Average (dBμV/m) | Meas. Time (ms) | Bandwidth (kHz) | Height (cm) | Polarization | Azimuth (deg) | Corr. (dB) | Margin (dB)         | Limit (dBμV/m) |
|-----------------|------------------|-----------------|-----------------|-------------|--------------|---------------|------------|---------------------|----------------|
| 19888.3333      | 44.1             | 1000.0          | 1000.000        | 122.5       | H            | 69.0          | 14.1       | 9.8                 | 53.9           |
| 24000.0333      | 41.1             | 1000.0          | 1000.000        | 130.5       | V            | 18.0          | 14.5       | 12.8                | 53.9           |
| 24248.8000      | 113.4            | 1000.0          | 1000.000        | 130.5       | V            | 6.0           | 14.7       | Fundamental         |                |
| 24250.0000      | 62.2             | 1000.0          | 1000.000        | 130.5       | H            | 7.0           | 14.7       | Complies with 50dBc |                |
| 30609.7333      | 45.1             | 1000.0          | 1000.000        | 170.4       | H            | 172.0         | 18.5       | 8.8                 | 53.9           |
| 34813.3333      | 48.9             | 1000.0          | 1000.000        | 132.5       | V            | 20.0          | 22.6       | 5.0                 | 53.9           |
| 39340.4000      | 44.4             | 1000.0          | 1000.000        | 135.5       | V            | 159.0         | 18.3       | 9.5                 | 53.9           |

#### 2.4.13 Band Edge Verification at High Channel (Worst Case Configuration) using Delta Marker Method



High Channel Band-Edge using 1MHz RBW/3MHz VBW



High Channel Band-Edge using Delta-Marker Method as per Clause 6.10.6 of ANSI C63.10-2013 showing >50dBc edge measurement



## **2.5 FREQUENCY STABILITY**

### **2.5.1 Specification Reference**

47 CFR §15.249(b)(2) and RSS-210 A12(b)

### **2.5.2 Standard Applicable**

(2) The frequency tolerance of the carrier signal shall be maintained within  $\pm 0.001\%$  of the operating frequency over a temperature variation of  $-20$  degrees to  $+50$  degrees C at normal supply voltage, and for a variation in the primary supply voltage from 85% to 115% of the rated supply voltage at a temperature of 20 degrees C. For battery operated equipment, the equipment tests shall be performed using a new battery.

### **2.5.3 Equipment Under Test and Modification State**

Serial No: N/A / Default Test Configuration

### **2.5.4 Date of Test/Initial of test personnel who performed the test**

February 10 and 11, 2016/FSC

### **2.5.5 Test Equipment Used**

The major items of test equipment used for the above tests are identified in Section 3.1.

### **2.5.6 Environmental Conditions/ Test Location**

Test performed at TÜV SÜD America Inc. Rancho Bernardo facility

|                     |                 |
|---------------------|-----------------|
| Ambient Temperature | 25.4 -27.2 °C   |
| Relative Humidity   | 19.4 - 20.0 %   |
| ATM Pressure        | 99.5 - 99.7 kPa |

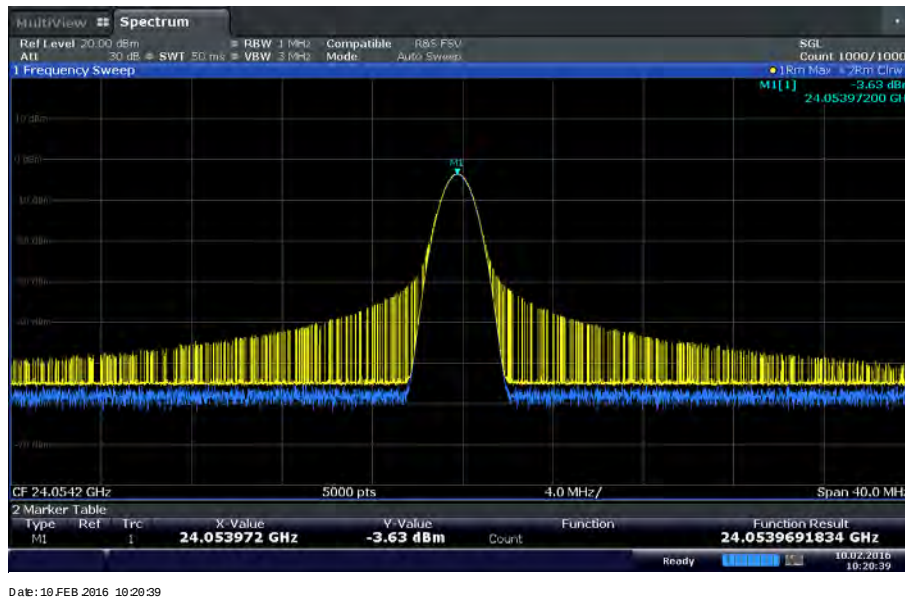
### **2.5.7 Additional Observations**

- This is a radiated test performed with the EUT inside the environmental chamber.
- The Temperature was reduced to  $-20^{\circ}\text{C}$  and allowed to sit for 1 hour to allow the equipment and chamber temperature to stabilize. The measurements were then performed. The temperature was then increased by  $10^{\circ}\text{C}$  steps and allowed to settle before taking the next set of measurements.
- Voltage variation was also performed using 85% and 115% of the nominal voltage at  $20^{\circ}\text{C}$ .
- Verification performed on a representative channel only (min. TX frequency for channel width of 10 MHz).
- EUT was configured in CW mode for this test (opmode off).

## 2.5.8 Test Results Summary

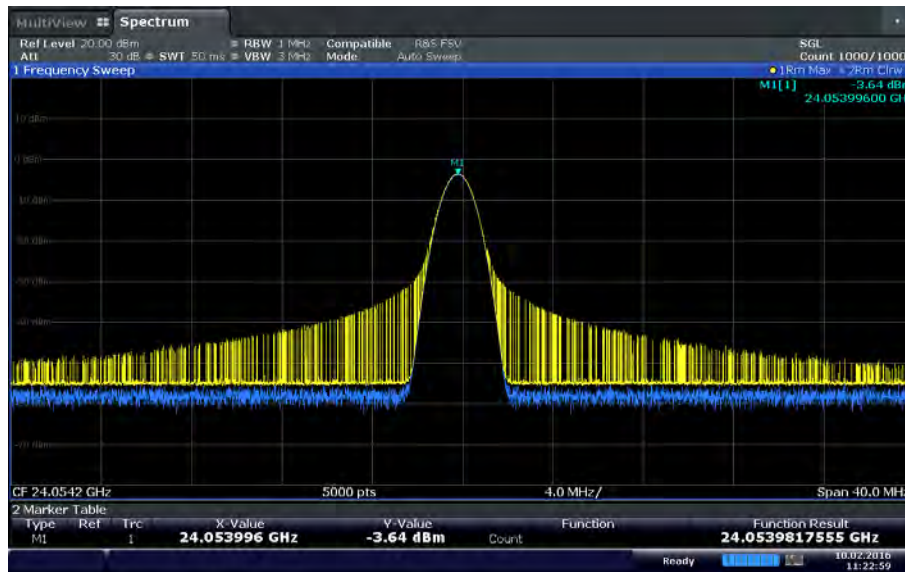
| Low Channel for 10MHz Bandwidth (24.055 GHz) CW Mode                          |             |           |                        |                           |               |
|-------------------------------------------------------------------------------|-------------|-----------|------------------------|---------------------------|---------------|
| Voltage (%)                                                                   | Power (VDC) | Temp (°C) | Center Frequency (GHz) | Frequency Deviation (GHz) | Deviation (%) |
| 100                                                                           | 48.0        | -20       | 24.0539691834          | 0.0000428                 | 0.0002        |
| 100                                                                           |             | -10       | 24.0539817555          | 0.0000303                 | 0.0001        |
| 100                                                                           |             | 0         | 24.0539969059          | 0.0000151                 | 0.0001        |
| 100                                                                           |             | +10       | 24.0540046165          | 0.0000074                 | 0.0000        |
| 100                                                                           |             | +20       | 24.0540120065          | Reference                 | 0             |
| 100                                                                           |             | +30       | 24.0540128702          | -0.0000009                | 0.0000        |
| 100                                                                           |             | +40       | 24.0540049452          | 0.0000071                 | 0.0000        |
| 100                                                                           |             | +50       | 24.0540037898          | 0.0000082                 | 0.0000        |
| 115                                                                           | 55.2        | +20       | 24.0539891467          | 0.0000229                 | 0.0001        |
| 85                                                                            | 40.8        | +20       | 24.0540092413          | 0.0000028                 | 0.0000        |
| Max frequency deviation was 0.0002%, limit is 0.001%, therefore EUT complies. |             |           |                        |                           |               |

## 2.5.9 Test Plots



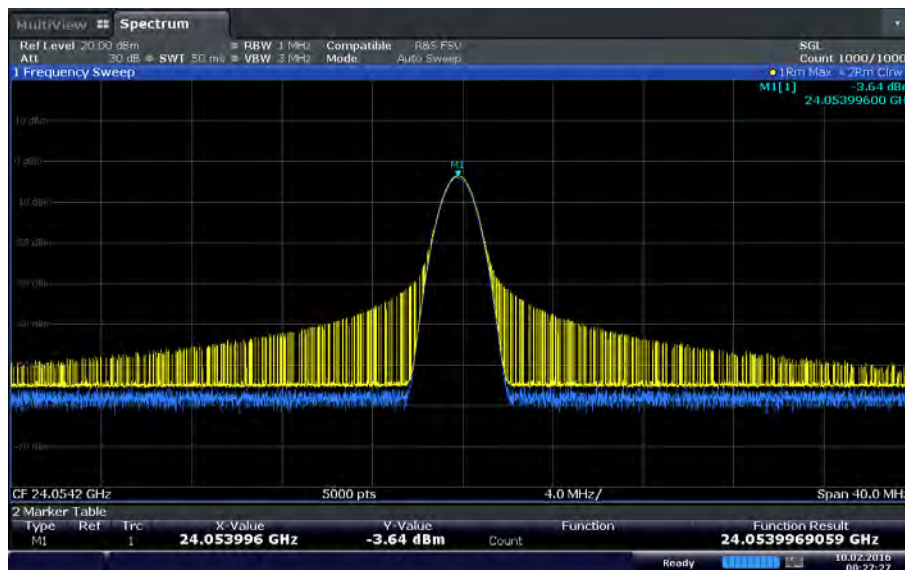
Date: 10.FEB.2016 10:20:39

-20°C @ 48VDC



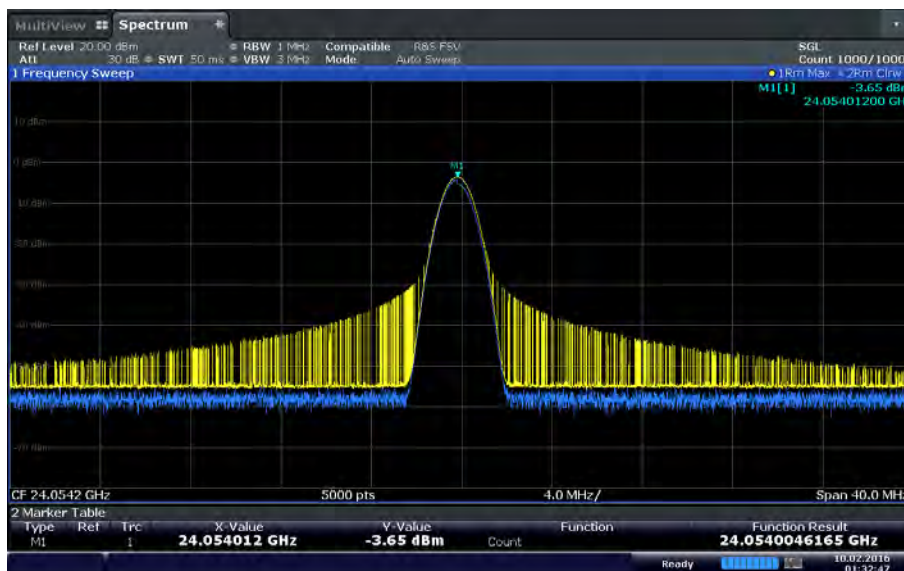
Date: 10.FEB 2016 11:22:58

-10°C @ 48VDC



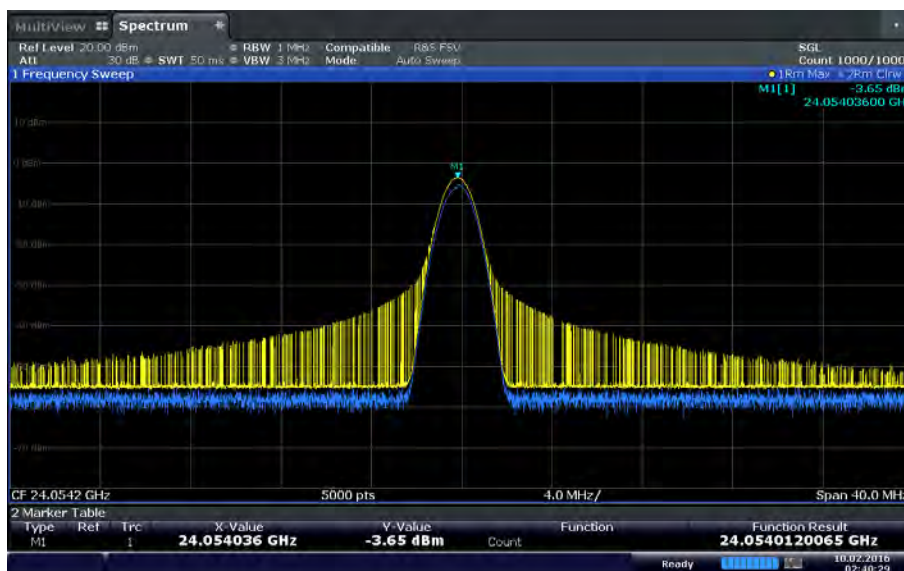
Date: 10.FEB 2016 00:27:27

0°C @ 48VDC



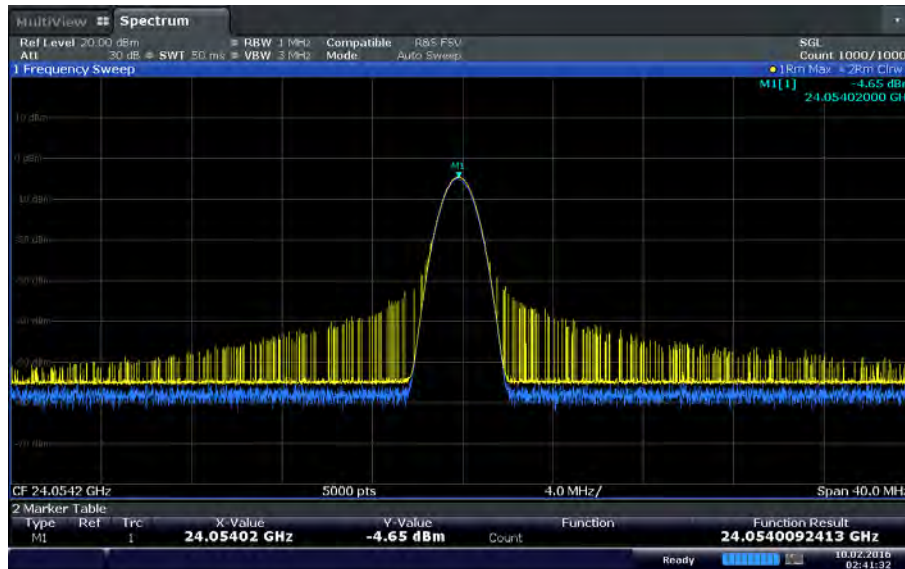
Date: 10.FEB 2016 01:32:47

10°C @ 48VDC



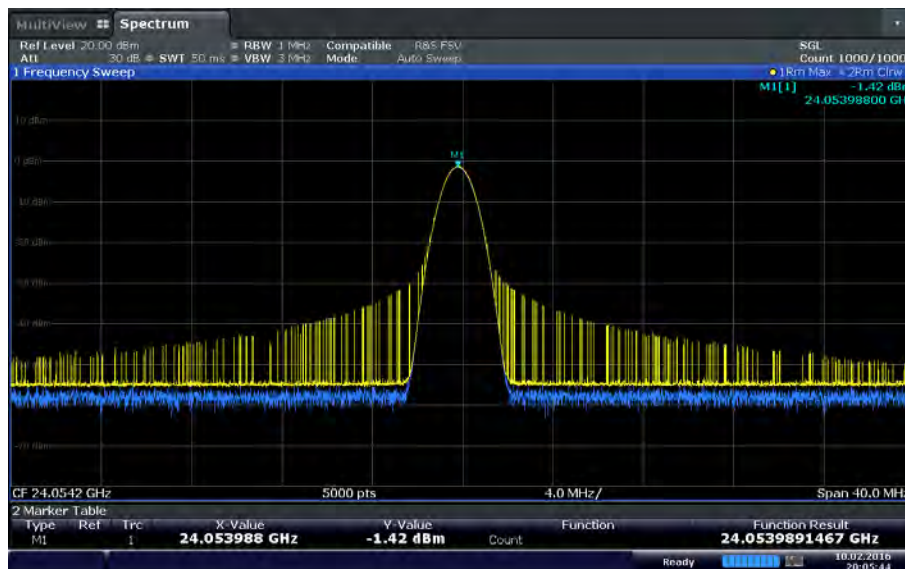
Date: 10.FEB 2016 02:40:29

20°C @ 48VDC



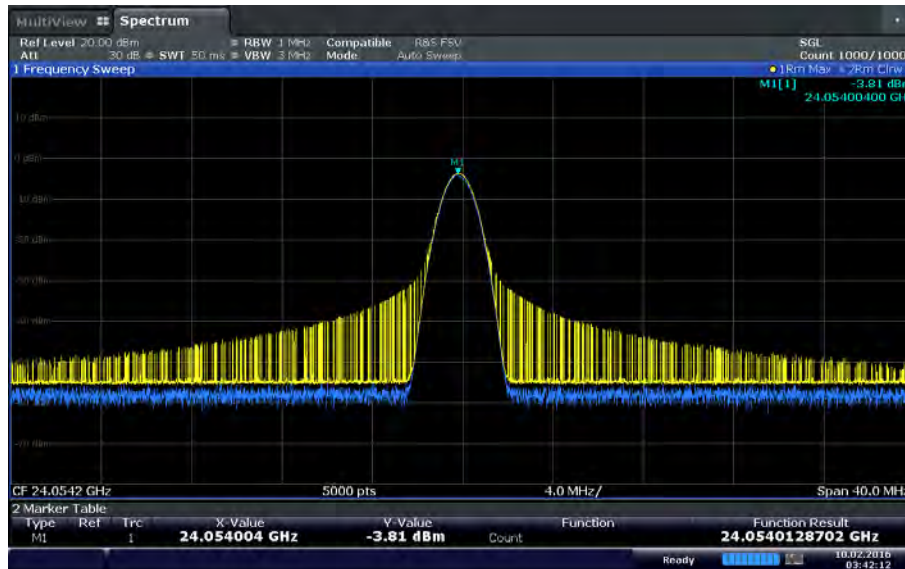
Date: 10.FEB 2016 02:41:33

20°C @ 40VDC



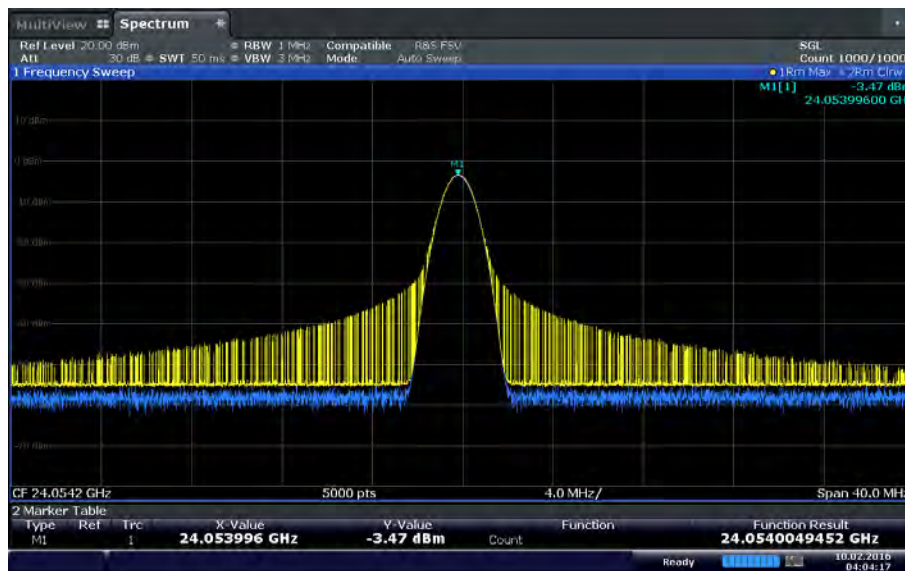
Date: 10.FEB 2016 20:05:45

20°C @ 55VDC



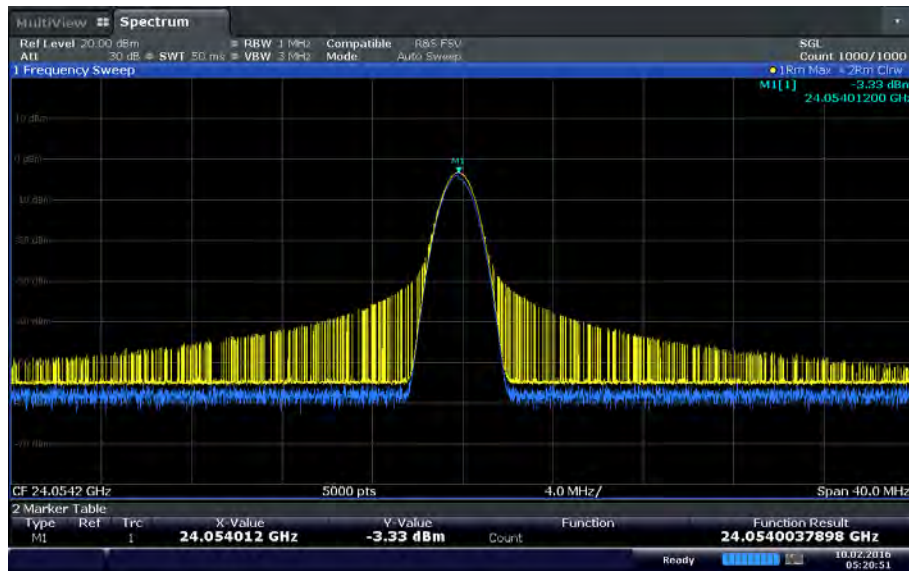
Date: 10.FEB 2016 03:42:12

30°C @ 48VDC



Date: 10.FEB 2016 04:04:17

40°C @ 48VDC



Date: 10 FEB 2016 05:20:51

50°C @ 48VDC



## **2.6 SPURIOUS RADIATED EMISSIONS**

### **2.6.1 Specification Reference**

47 CFR §15.249(d) and RSS-210 A12(d)

### **2.6.2 Standard Applicable**

(d) Emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 50 dB below the level of the fundamental or to the general radiated emission limits in §15.209, whichever is the lesser attenuation

### **2.6.3 Equipment Under Test and Modification State**

Serial No: N/A / Default Test Configuration

### **2.6.4 Date of Test/Initial of test personnel who performed the test**

February 15, 2016/FSC

### **2.6.5 Test Equipment Used**

The major items of test equipment used for the above tests are identified in Section 3.1.

### **2.6.6 Environmental Conditions/ Test Location**

Test performed at TÜV SÜD America Inc. Rancho Bernardo facility

|                     |          |
|---------------------|----------|
| Ambient Temperature | 25.8 °C  |
| Relative Humidity   | 39.3 %   |
| ATM Pressure        | 99.4 kPa |

### **2.6.7 Additional Observations**

- The spectrum was searched from 30 MHz up to 100GHz. Scans from 90GHz up to 100GHz were done manually. No spurious emissions observed on this range.
- Only worst case channel, bandwidth and modulation presented below 18GHz. There were no significant differences between Low, Mid and High channels below 18GHz.
- Results from 18GHz to 40GHz are identical to Section 2.4 of this test report.
- The spurious emissions were assessed to the general radiated emission limits in §15.209 (worst case) or 50 dB below the level of the fundamental (lesser attenuation).
- If using 50 dB below the level of the fundamental, the limits was based from the minimum fundamental measurement (116.9dBµV/m @ 3 meters). This will result with worst case 50dBc limit.
- For measurements performed @ 1 meter, the limits were further adjusted by 9.54dB distance correction factor.



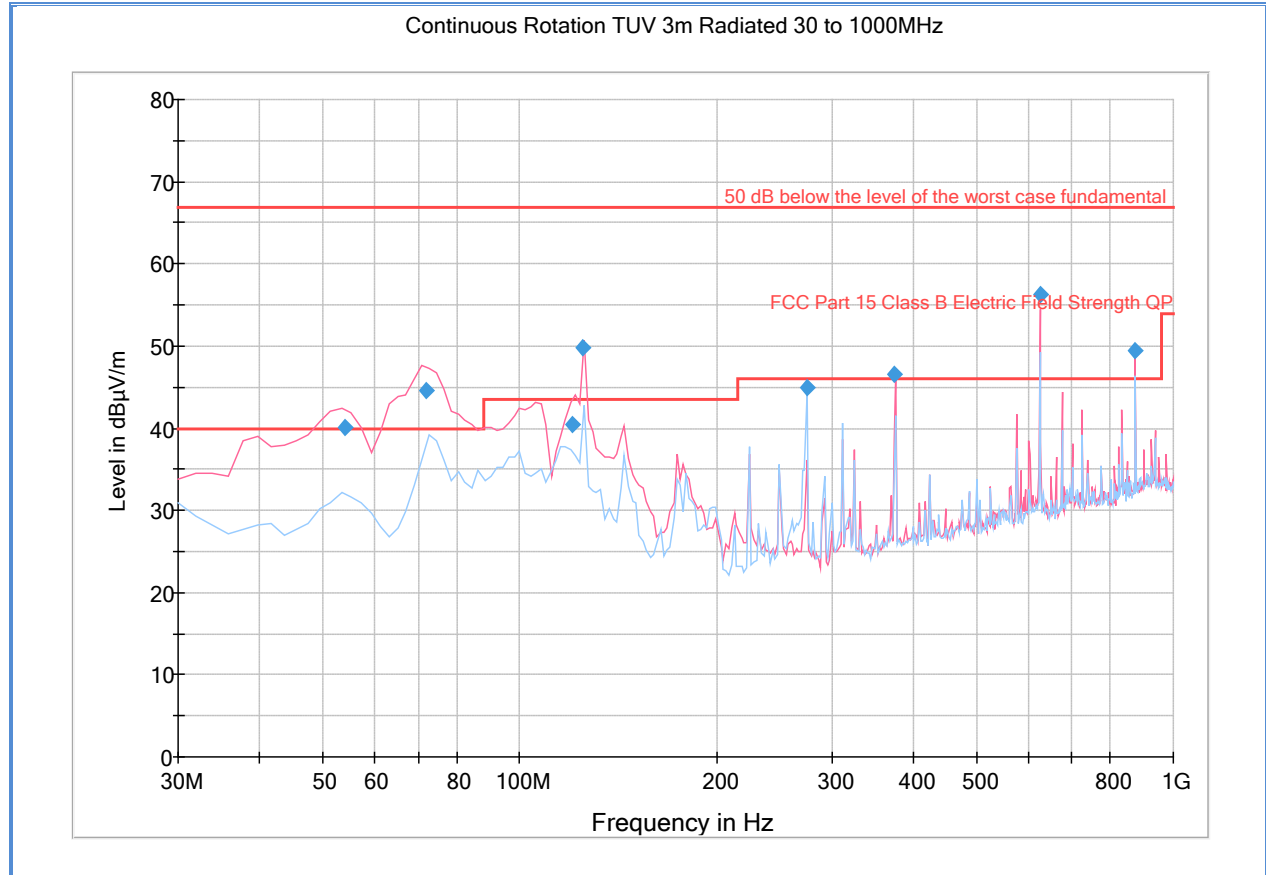
### 2.6.1 Sample Computation (Radiated Emission)

|                                                             |                            |       |       |
|-------------------------------------------------------------|----------------------------|-------|-------|
| Measuring equipment raw measurement (db $\mu$ V) @ 30 MHz   |                            |       | 24.4  |
| Correction Factor (dB)                                      | Asset# 1066 (cable)        | 0.3   | -12.6 |
|                                                             | Asset# 1172 (cable)        | 0.3   |       |
|                                                             | Asset# 1016 (preamplifier) | -30.7 |       |
|                                                             | Asset# 1175(cable)         | 0.3   |       |
|                                                             | Asset# 1002 (antenna)      | 17.2  |       |
| Reported QuasiPeak Final Measurement (db $\mu$ V/m) @ 30MHz |                            |       | 11.8  |

### 2.6.2 Test Results

See attached plots.

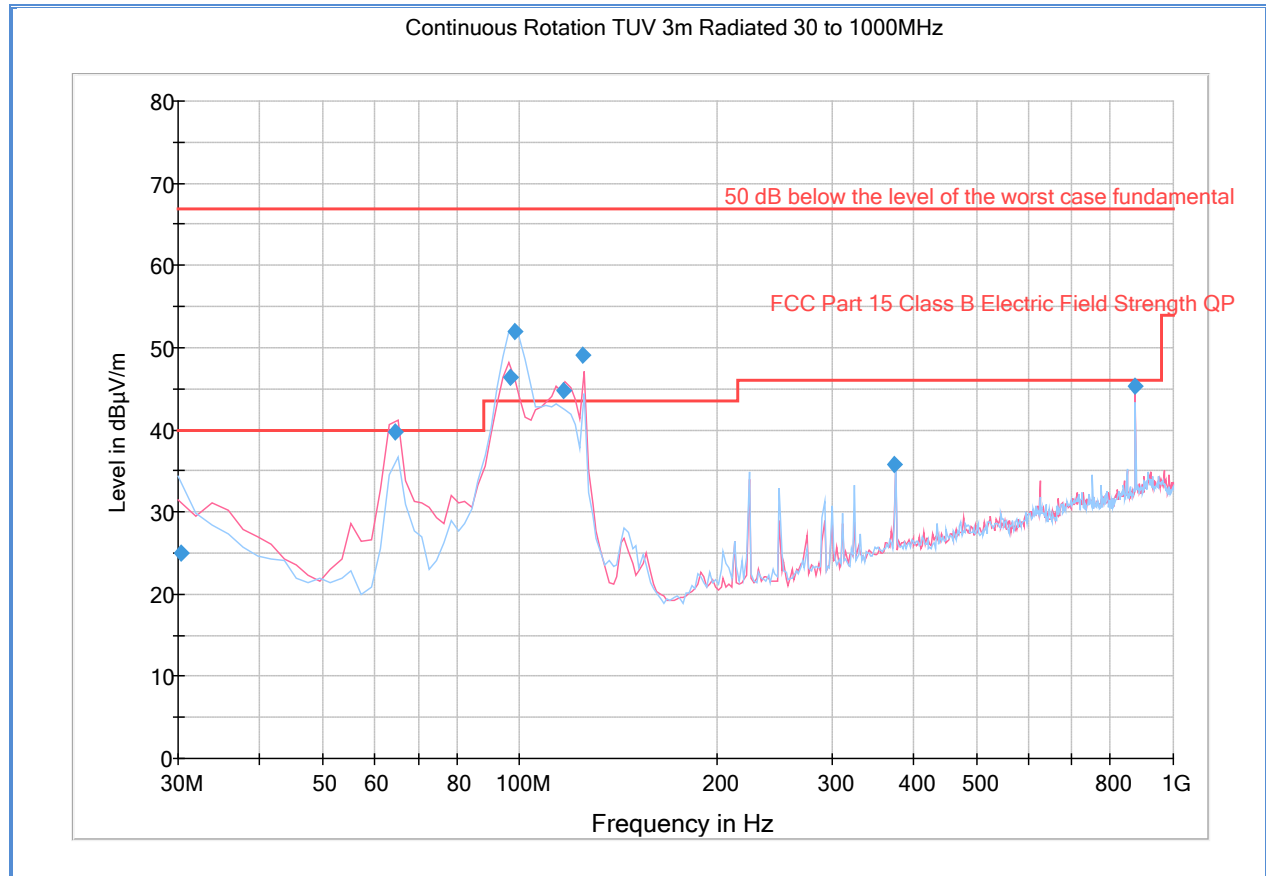
### 2.6.3 Test Results Below 1GHz (Worst Case RF Configuration using direct DC Power)



#### Quasi Peak Data

| Frequency (MHz) | QuasiPeak (dBμV/m) | Meas. Time (ms) | Bandwidth (kHz) | Height (cm) | Polarization | Azimuth (deg) | Corr. (dB) | Margin (dB) | Limit (dBμV/m) |
|-----------------|--------------------|-----------------|-----------------|-------------|--------------|---------------|------------|-------------|----------------|
| 53.926653       | 40.1               | 1000.0          | 120.000         | 100.0       | V            | 49.0          | -15.0      | -0.1        | 40.0           |
| 71.781643       | 44.6               | 1000.0          | 120.000         | 127.0       | V            | 101.0         | -16.7      | -4.6        | 40.0           |
| 120.402725      | 40.4               | 1000.0          | 120.000         | 100.0       | V            | 118.0         | -15.1      | 3.1         | 43.5           |
| 125.010501      | 49.8               | 1000.0          | 120.000         | 100.0       | V            | 102.0         | -15.3      | -6.3        | 43.5           |
| 275.009860      | 45.0               | 1000.0          | 120.000         | 100.0       | H            | 86.0          | -7.7       | 1.0         | 46.0           |
| 375.012024      | 46.6               | 1000.0          | 120.000         | 100.0       | V            | 127.0         | -4.5       | -0.6        | 46.0           |
| 624.989659      | 56.3               | 1000.0          | 120.000         | 100.0       | V            | 257.0         | 1.7        | -10.3       | 46.0           |
| 874.991182      | 49.4               | 1000.0          | 120.000         | 100.0       | V            | 10.0          | 5.3        | -3.4        | 46.0           |

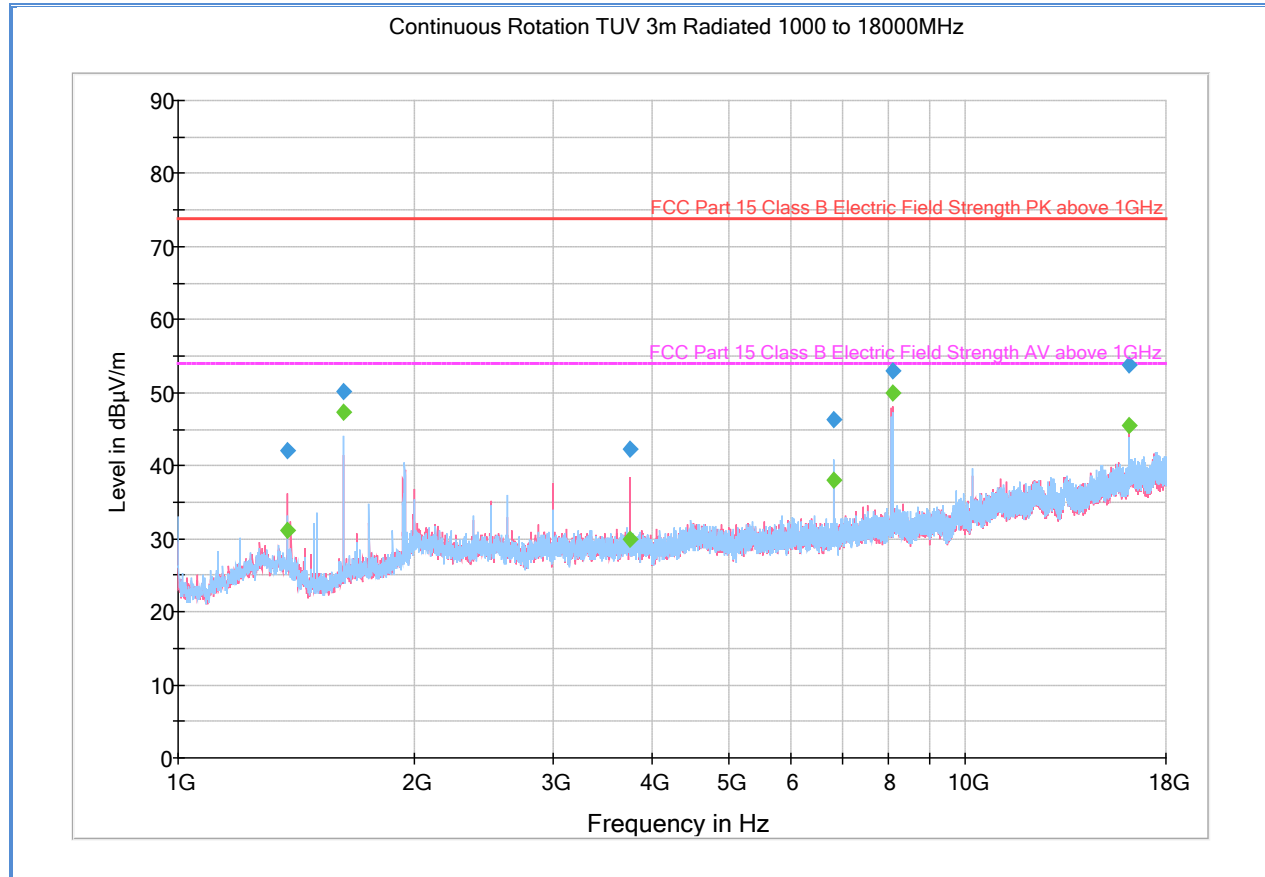
## 2.6.4 Test Results Below 1GHz (Worst Case RF Configuration using PoE)



### Quasi Peak Data

| Frequency (MHz) | QuasiPeak (dBµV/m) | Meas. Time (ms) | Bandwidth (kHz) | Height (cm) | Polarization | Azimuth (deg) | Corr. (dB) | Margin (dB) | Limit (dBµV/m) |
|-----------------|--------------------|-----------------|-----------------|-------------|--------------|---------------|------------|-------------|----------------|
| 30.320000       | 25.0               | 1000.0          | 120.000         | 208.0       | H            | 15.0          | -5.7       | 15.0        | 40.0           |
| 64.589980       | 39.7               | 1000.0          | 120.000         | 100.0       | V            | 242.0         | -16.4      | 0.3         | 40.0           |
| 96.532184       | 46.4               | 1000.0          | 120.000         | 100.0       | V            | 51.0          | -14.2      | -2.9        | 43.5           |
| 98.476072       | 51.9               | 1000.0          | 120.000         | 182.0       | H            | 323.0         | -14.1      | -8.4        | 43.5           |
| 116.627174      | 44.8               | 1000.0          | 120.000         | 105.0       | V            | 285.0         | -14.9      | -1.3        | 43.5           |
| 125.010501      | 49.0               | 1000.0          | 120.000         | 100.0       | V            | 122.0         | -15.3      | -5.5        | 43.5           |
| 375.012024      | 35.8               | 1000.0          | 120.000         | 100.0       | H            | 117.0         | -4.5       | 10.2        | 46.0           |
| 874.991182      | 45.3               | 1000.0          | 120.000         | 100.0       | V            | -8.0          | 5.3        | 0.7         | 46.0           |

## 2.6.5 Test Results Below from 1GHz to 18GHz (Worst Case RF Configuration)



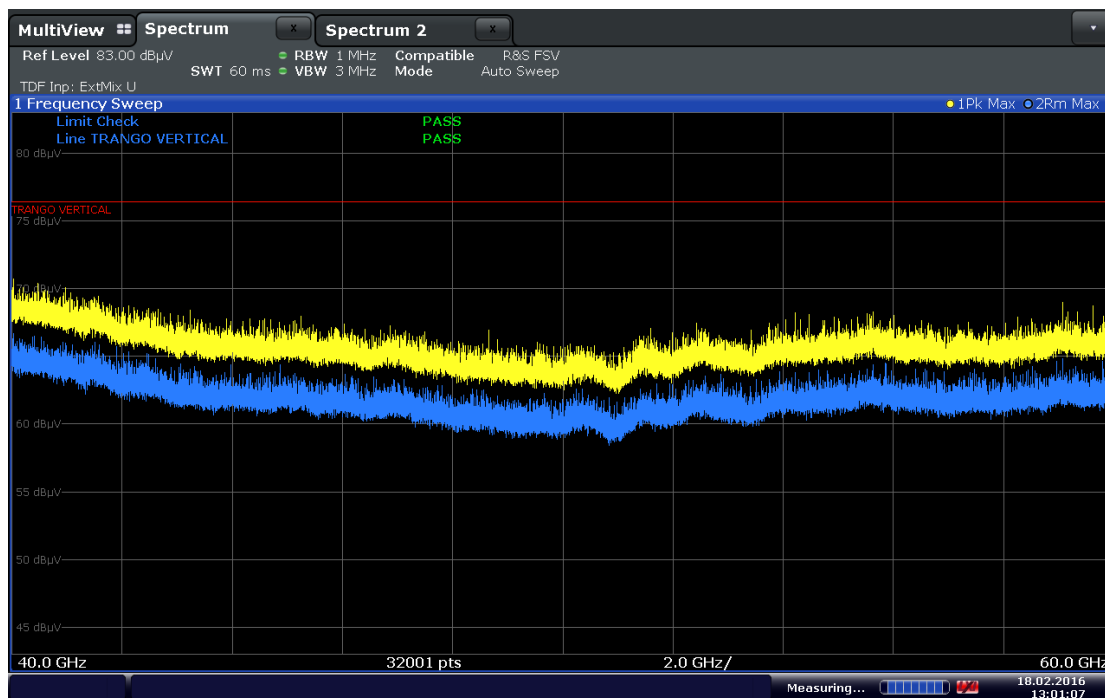
### Peak Data

| Frequency (MHz) | MaxPeak (dB $\mu$ V/m) | Meas. Time (ms) | Bandwidth (kHz) | Height (cm) | Polarization | Azimuth (deg) | Corr. (dB) | Margin (dB) | Limit (dB $\mu$ V/m) |
|-----------------|------------------------|-----------------|-----------------|-------------|--------------|---------------|------------|-------------|----------------------|
| 1374.96666      | 42.0                   | 1000.0          | 1000.000        | 148.7       | V            | 20.0          | -5.6       | 31.9        | 73.9                 |
| 1624.86666      | 50.2                   | 1000.0          | 1000.000        | 131.7       | H            | 311.0         | -5.8       | 23.7        | 73.9                 |
| 3750.03333      | 42.2                   | 1000.0          | 1000.000        | 158.6       | V            | 312.0         | 1.3        | 31.7        | 73.9                 |
| 6800.03333      | 46.3                   | 1000.0          | 1000.000        | 116.7       | H            | 346.0         | 5.8        | 27.6        | 73.9                 |
| 8082.00000      | 53.1                   | 1000.0          | 1000.000        | 116.7       | V            | 30.0          | 7.0        | 20.8        | 73.9                 |
| 16164.2000      | 53.7                   | 1000.0          | 1000.000        | 102.7       | V            | 16.0          | 16.9       | 20.2        | 73.9                 |

### Average Data

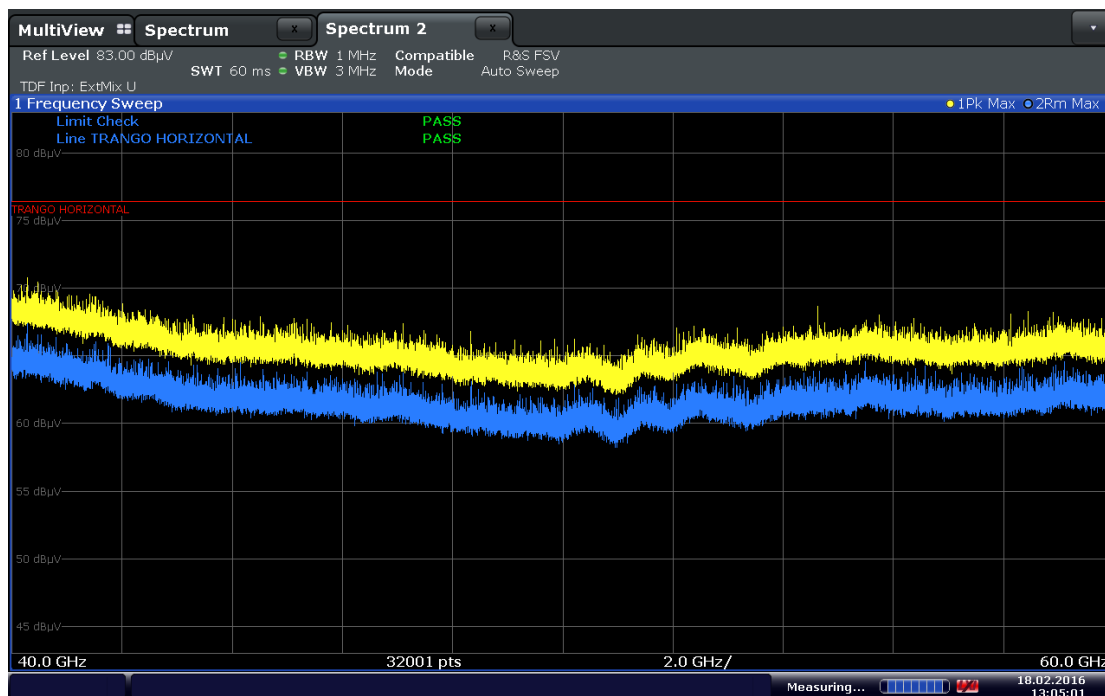
| Frequency (MHz) | Average (dB $\mu$ V/m) | Meas. Time (ms) | Bandwidth (kHz) | Height (cm) | Polarization | Azimuth (deg) | Corr. (dB) | Margin (dB) | Limit (dB $\mu$ V/m) |
|-----------------|------------------------|-----------------|-----------------|-------------|--------------|---------------|------------|-------------|----------------------|
| 1374.96666      | 31.1                   | 1000.0          | 1000.000        | 148.7       | V            | 20.0          | -5.6       | 22.8        | 53.9                 |
| 1624.86666      | 47.3                   | 1000.0          | 1000.000        | 131.7       | H            | 311.0         | -5.8       | 6.6         | 53.9                 |
| 3750.03333      | 30.0                   | 1000.0          | 1000.000        | 158.6       | V            | 312.0         | 1.3        | 23.9        | 53.9                 |
| 6800.03333      | 38.1                   | 1000.0          | 1000.000        | 116.7       | H            | 346.0         | 5.8        | 15.8        | 53.9                 |
| 8082.00000      | 49.9                   | 1000.0          | 1000.000        | 116.7       | V            | 30.0          | 7.0        | 4.0         | 53.9                 |
| 16164.2000      | 45.6                   | 1000.0          | 1000.000        | 102.7       | V            | 16.0          | 16.9       | 8.3         | 53.9                 |

## 2.6.6 Test Plots above 40GHz (1 meter measurement distance)



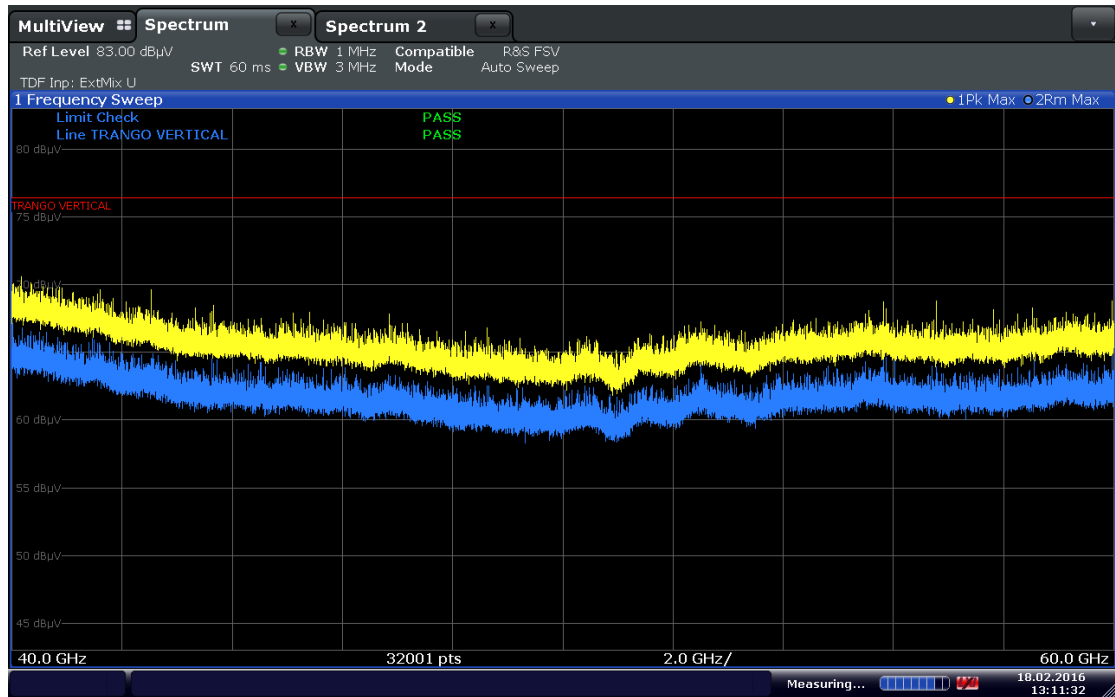
Date: 18.FEB.2016 13:01:08

### Low Channel Vertical (40GHz to 60GHz)



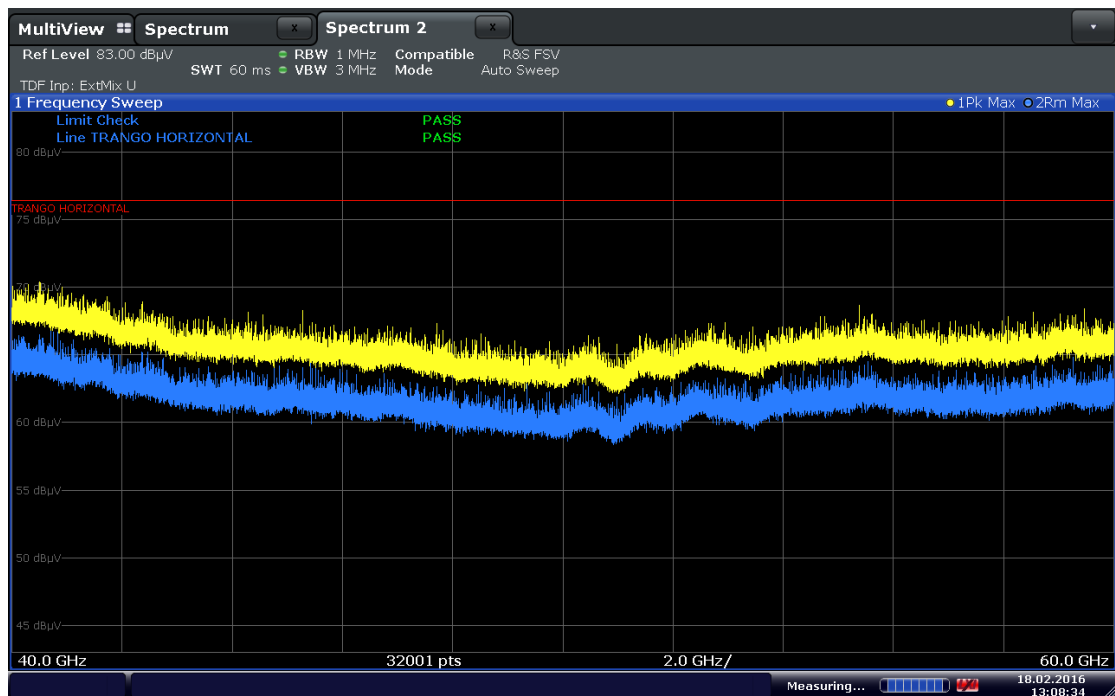
Date: 18.FEB.2016 13:05:01

### Low Channel Horizontal (40GHz to 60GHz)



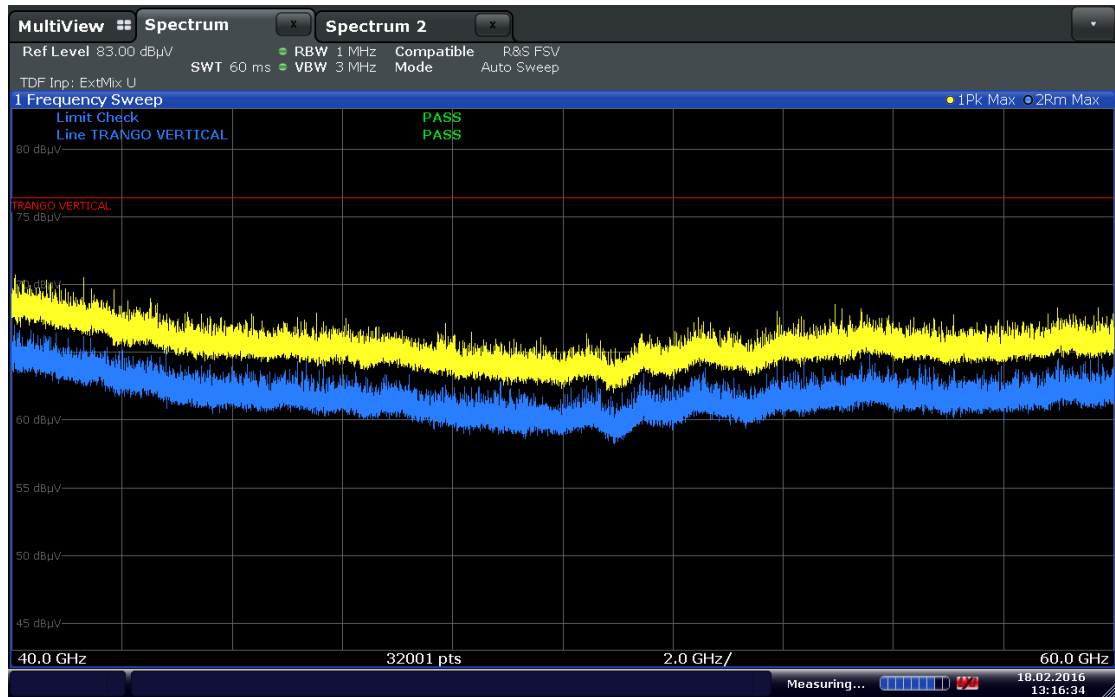
Date: 18.FEB.2016 13:11:32

### Mid Channel Vertical (40GHz to 60GHz)



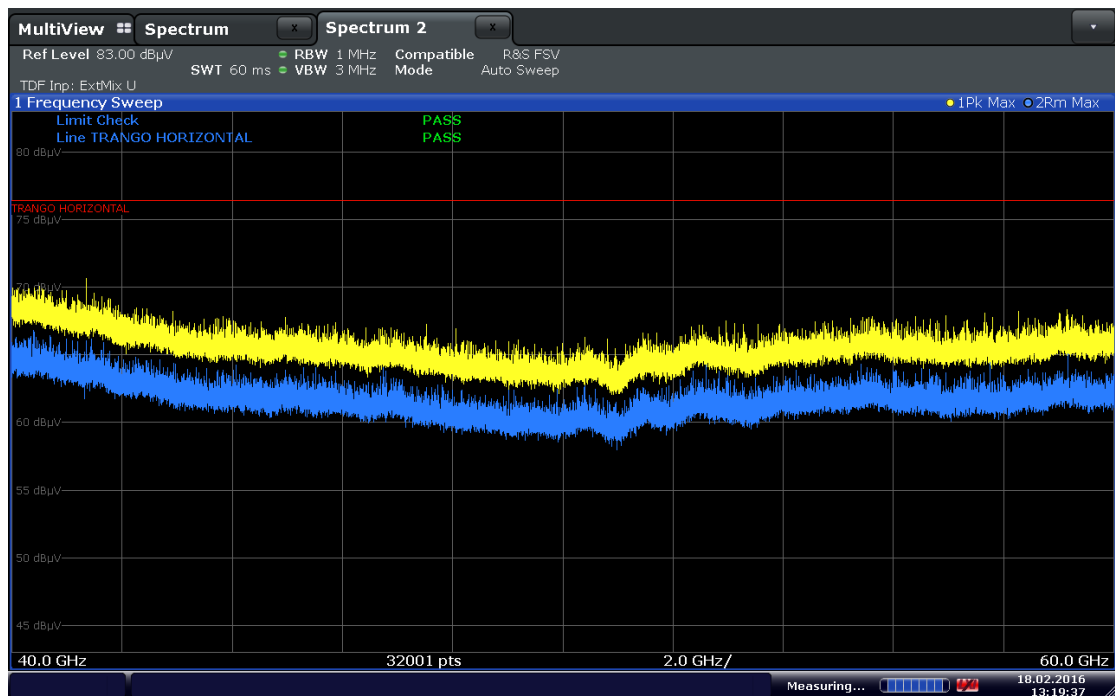
Date: 18.FEB.2016 13:08:34

### Mid Channel Horizontal (40GHz to 60GHz)



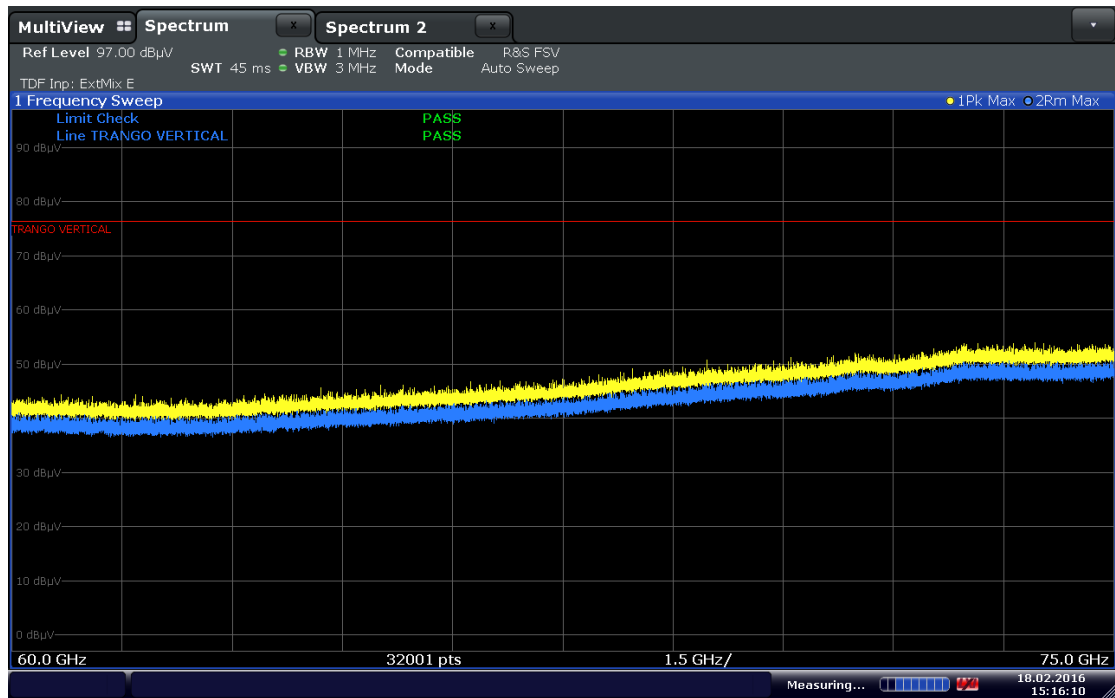
Date: 18.FEB.2016 13:16:35

### High Channel Vertical (40GHz to 60GHz)



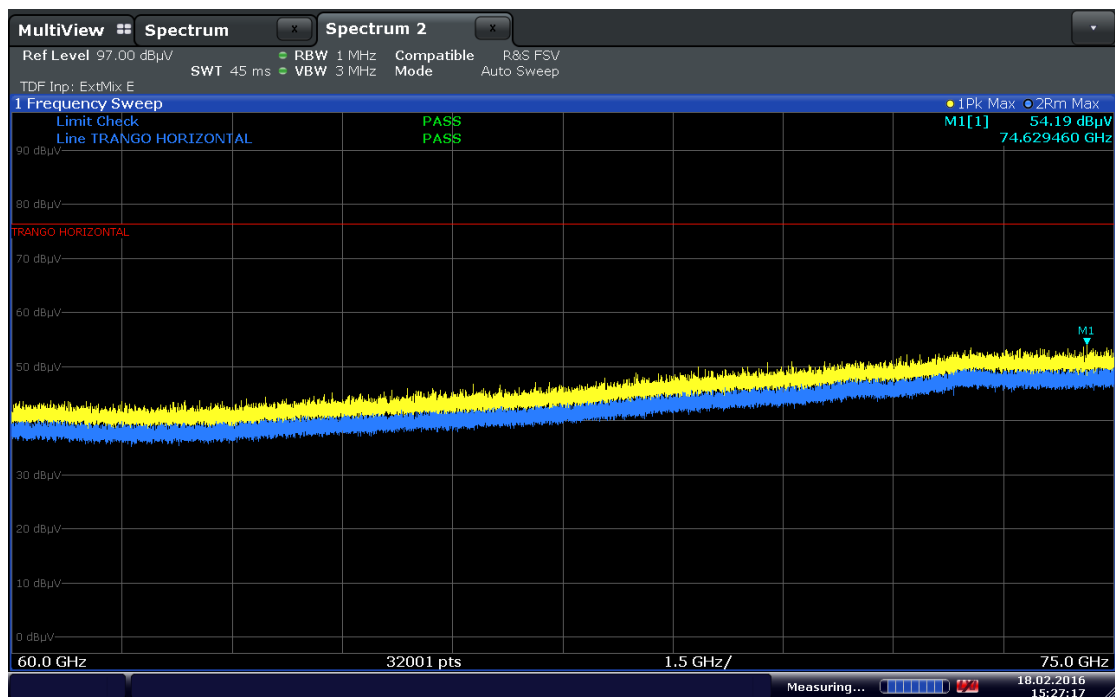
Date: 18.FEB.2016 13:19:37

### High Channel Horizontal (40GHz to 60GHz)



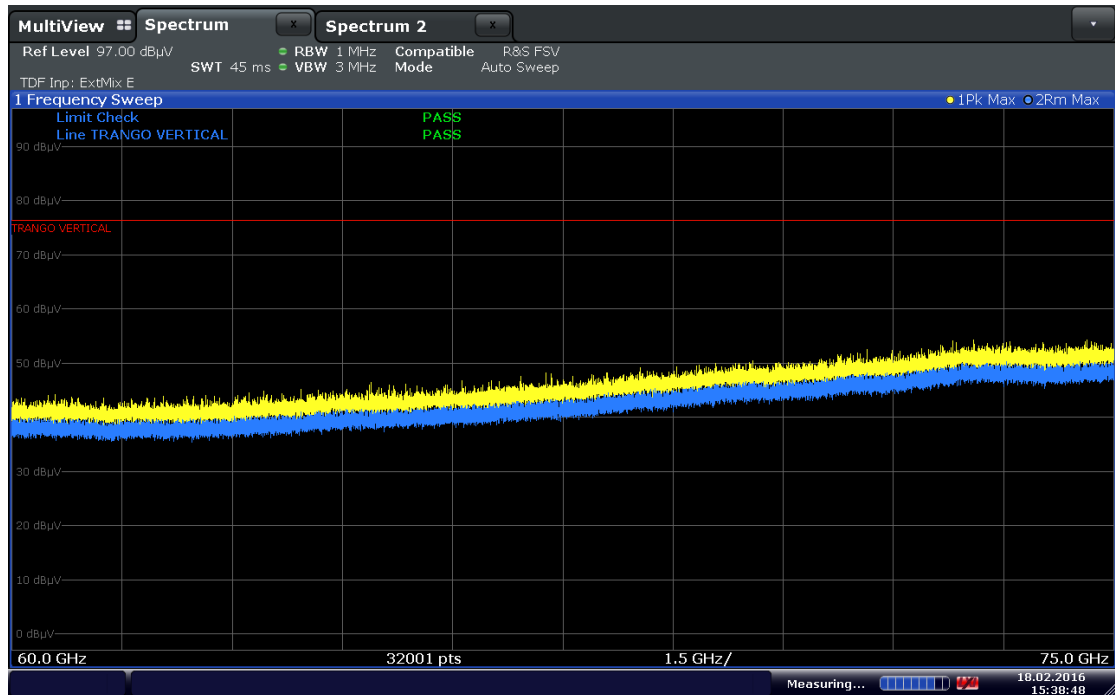
Date: 18.FEB.2016 15:16:10

### Low Channel Vertical (60GHz to 75GHz)



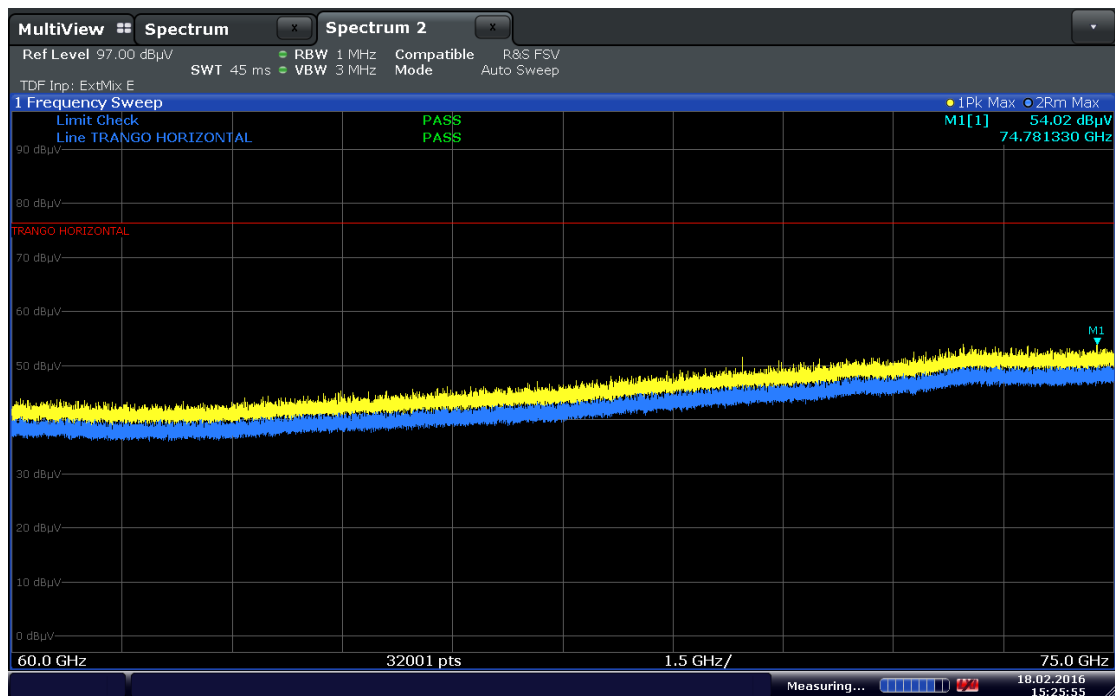
Date: 18.FEB.2016 15:27:17

### Low Channel Horizontal (60GHz to 75GHz)



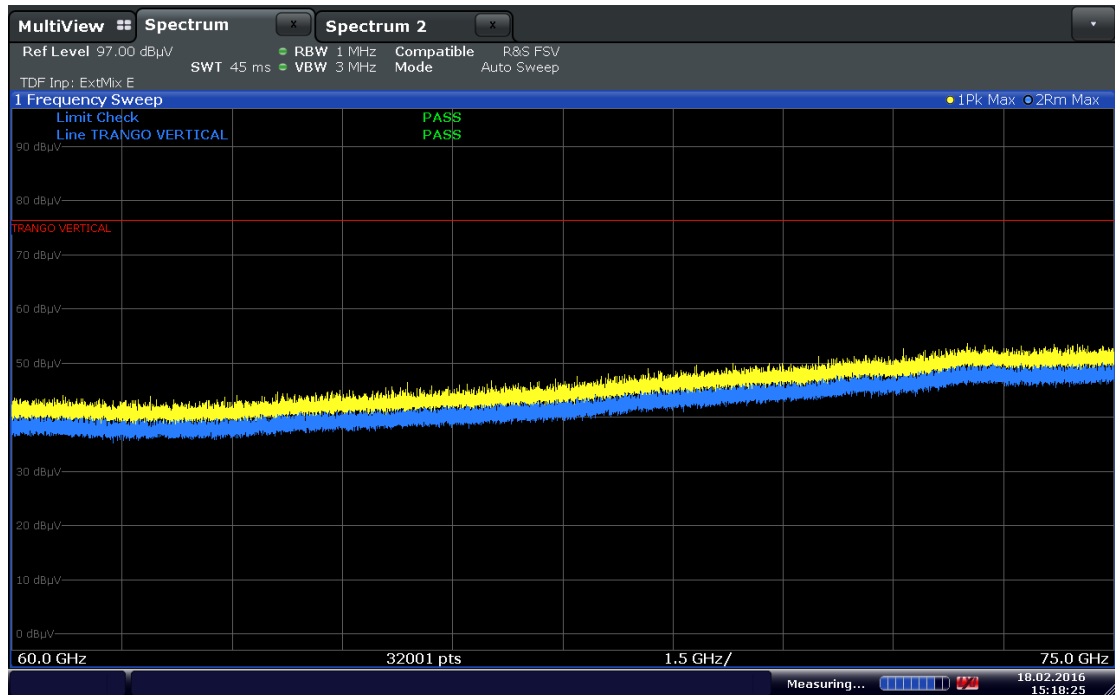
Date: 18.FEB.2016 15:38:48

### Mid Channel Vertical (60GHz to 75GHz)



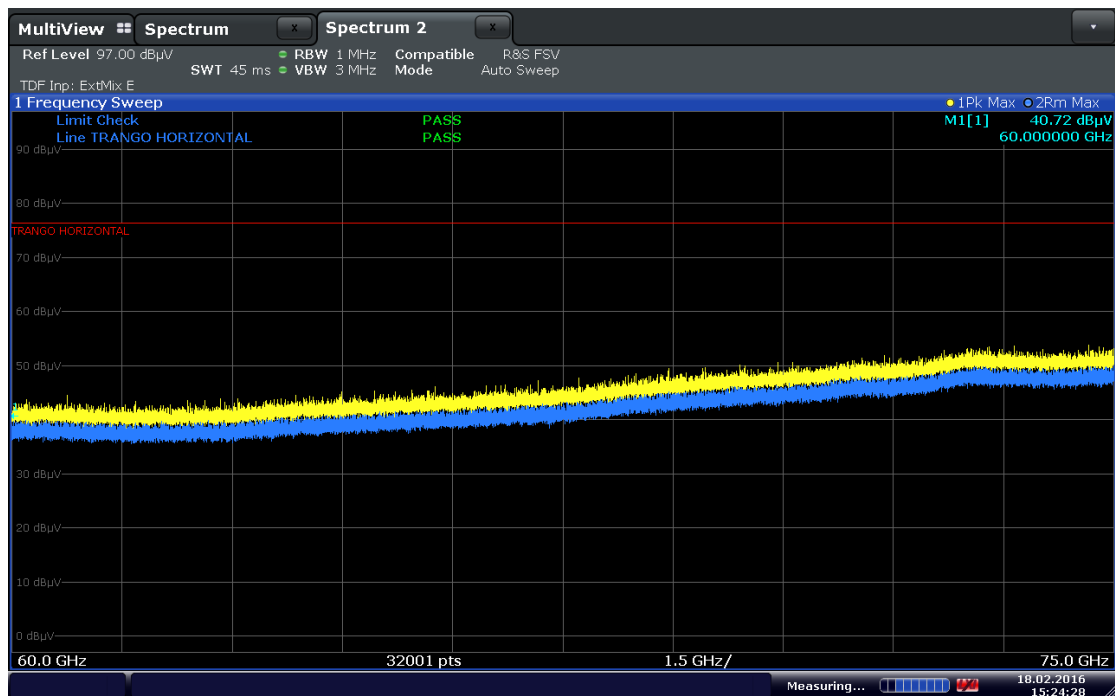
Date: 18.FEB.2016 15:25:55

### Mid Channel Horizontal (60GHz to 75GHz)



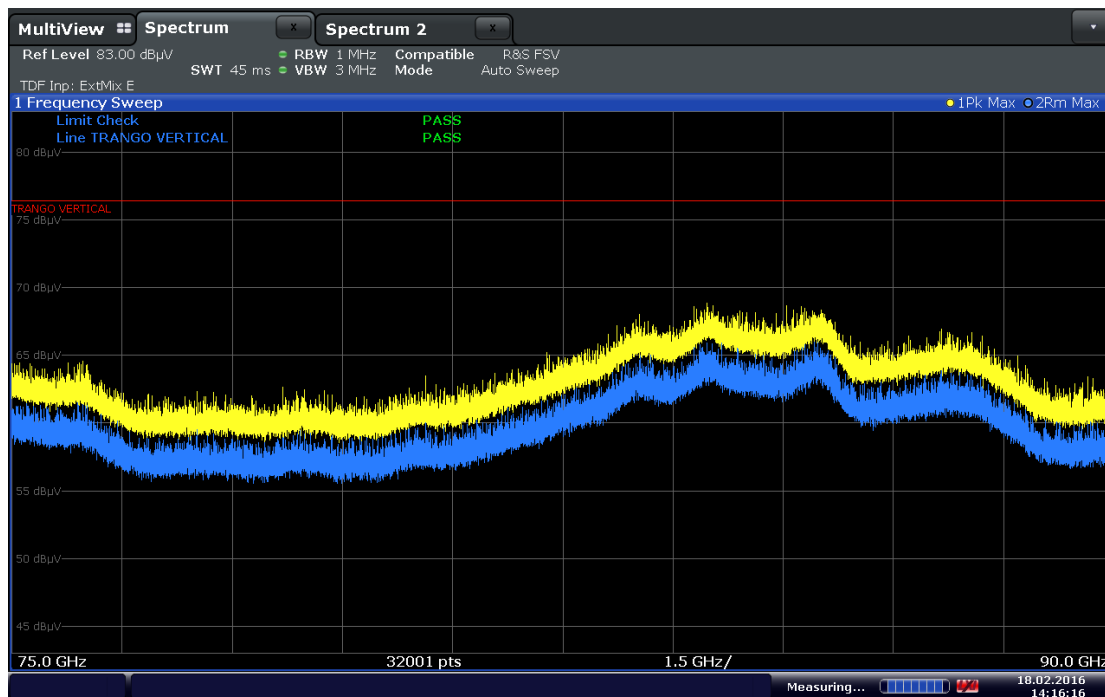
Date: 18.FEB.2016 15:18:26

### High Channel Vertical (60GHz to 75GHz)



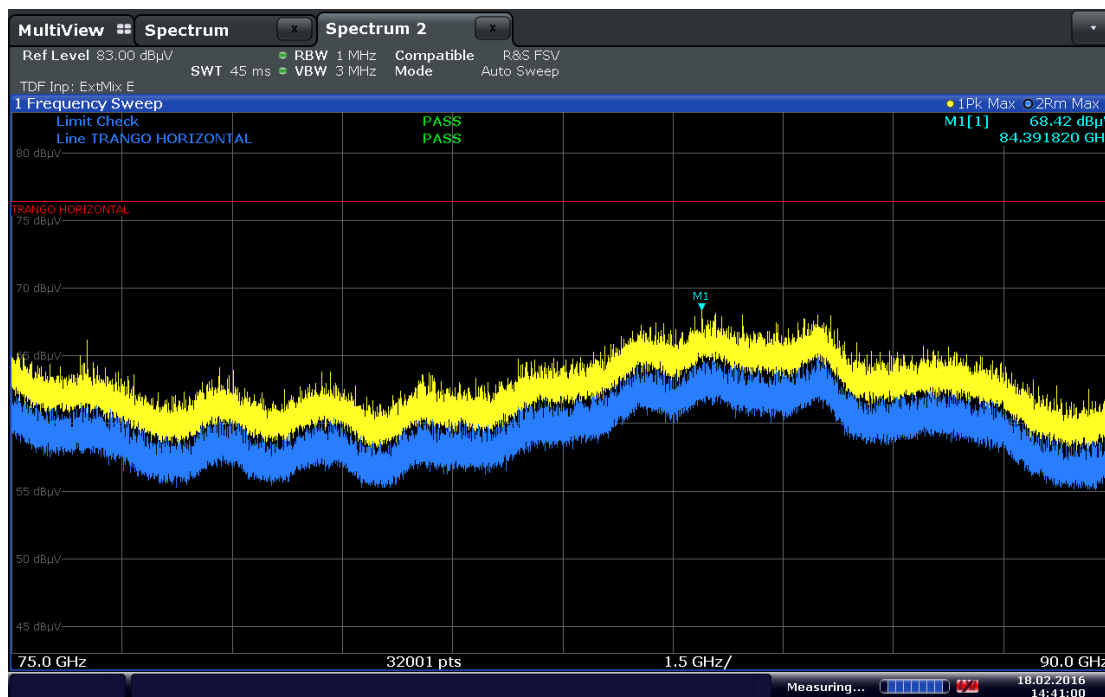
Date: 18.FEB.2016 15:24:28

### High Channel Horizontal (60GHz to 75GHz)



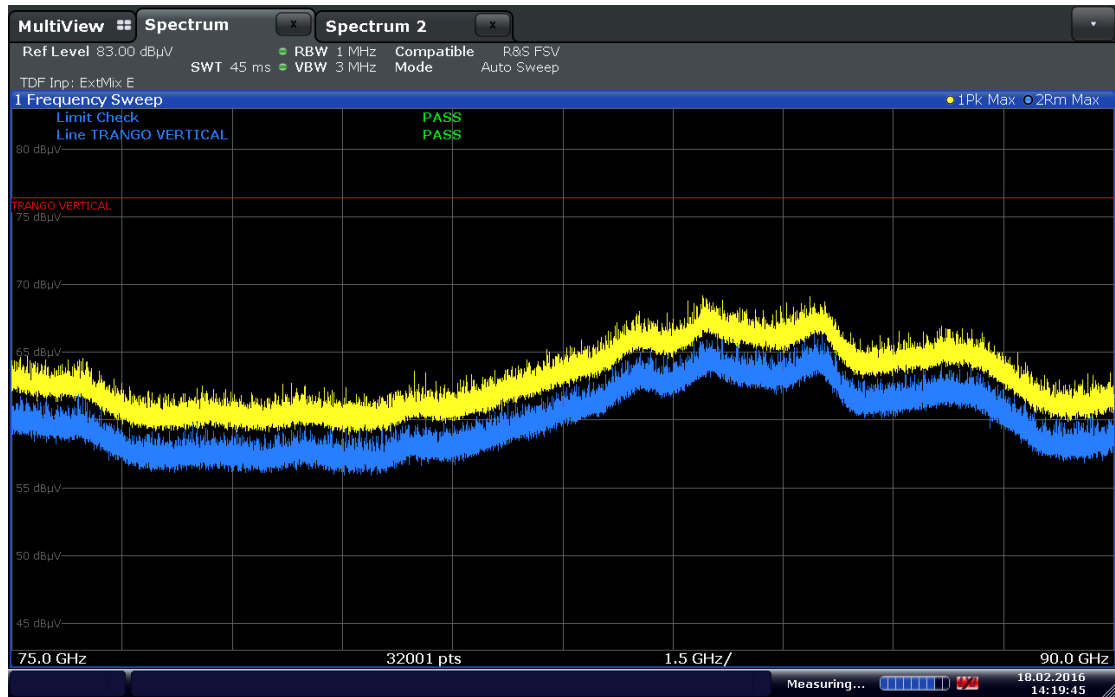
Date: 18.FEB.2016 14:16:16

### Low Channel Vertical (75GHz to 90GHz)



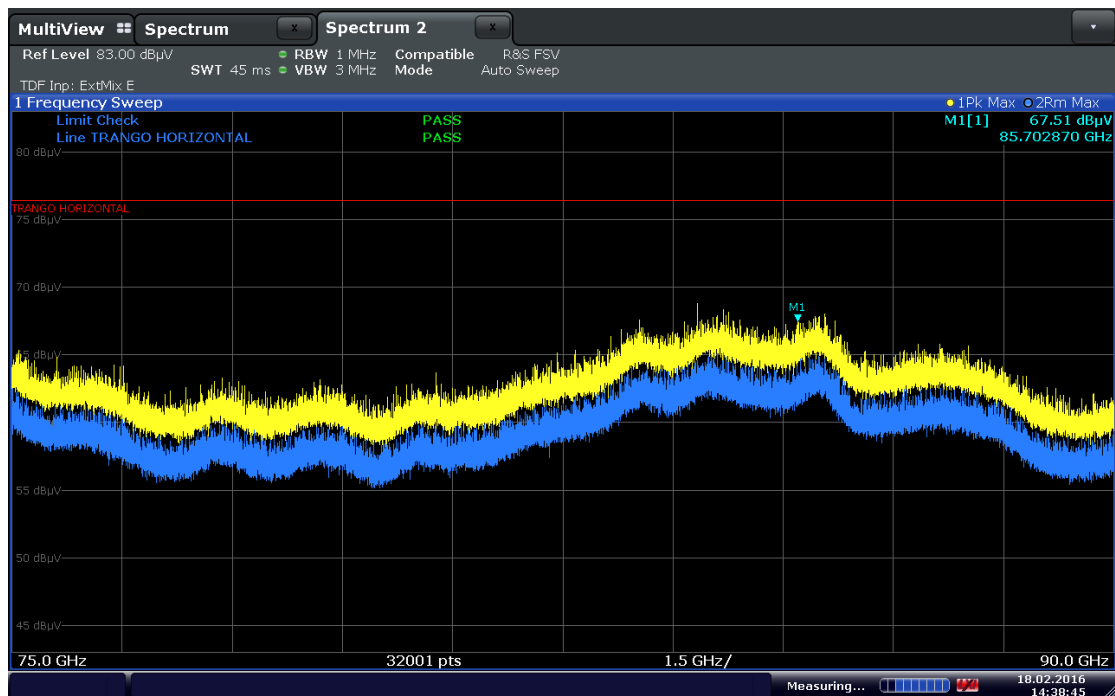
Date: 18.FEB.2016 14:41:00

### Low Channel Horizontal (75GHz to 90GHz)



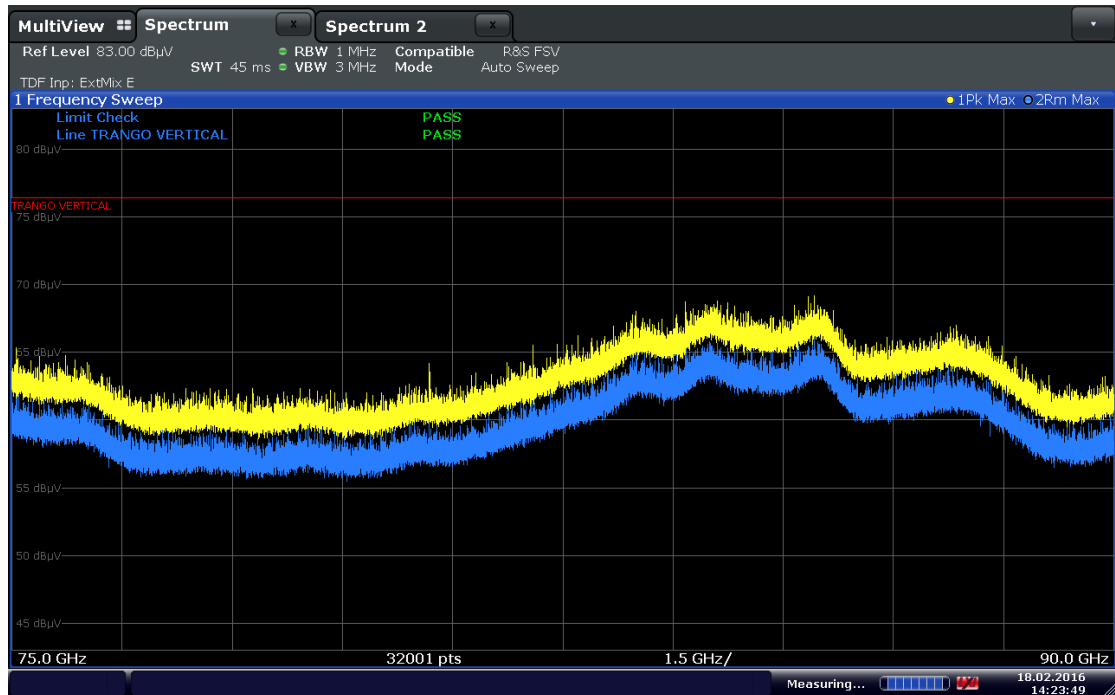
Date: 18.FEB.2016 14:19:45

### Mid Channel Vertical (75GHz to 90GHz)



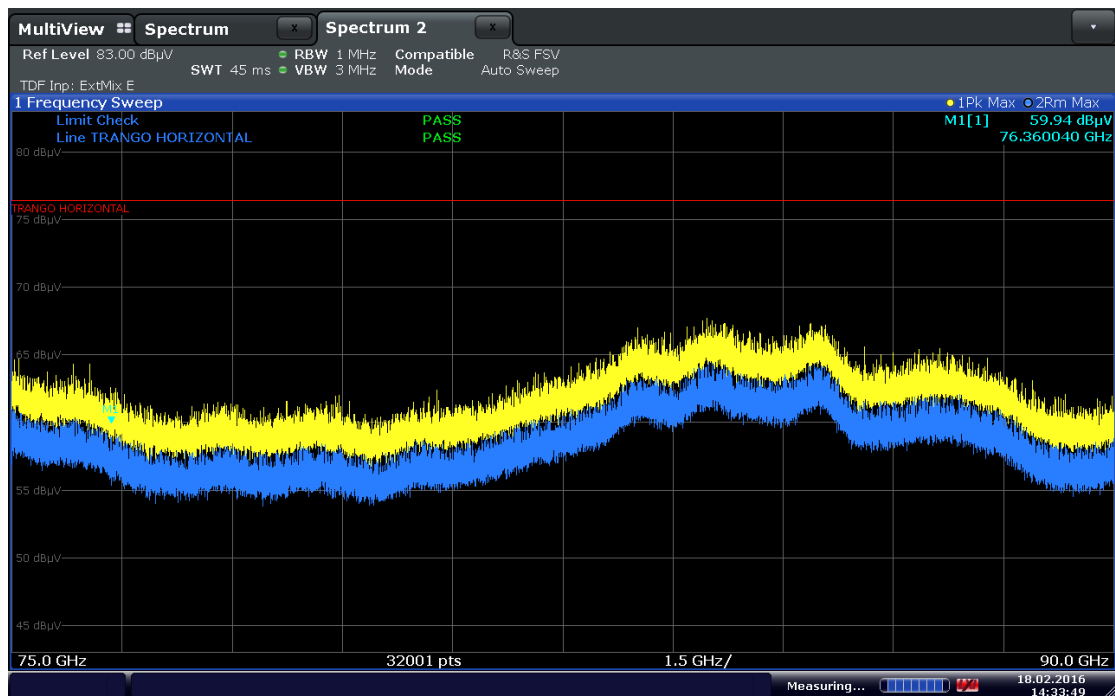
Date: 18.FEB.2016 14:38:45

### Mid Channel Horizontal (75GHz to 90GHz)



Date: 18.FEB.2016 14:23:49

### High Channel Vertical (75GHz to 90GHz)



Date: 18.FEB.2016 14:33:49

### High Channel Horizontal (75GHz to 90GHz)



## **2.7 FIELD STRENGTH OF HARMONICS FOR FIXED, POINT TO POINT OPERATION**

### **2.7.1 Specification Reference**

47 CFR §15.249(e) and RSS-210 A12(d)

### **2.7.2 Standard Applicable**

(e) As shown in §15.35(b), for frequencies above 1000 MHz, the field strength limits in paragraphs (a) and (b) of this section are based on average limits. However, the peak field strength of any emission shall not exceed the maximum permitted average limits specified above by more than 20 dB under any condition of modulation. For point-to-point operation under paragraph (b) of this section, the peak field strength shall not exceed 2500 millivolts/meter at 3 meters along the antenna azimuth.

### **2.7.3 Equipment Under Test and Modification State**

Serial No: N/A / Default Test Configuration

### **2.7.4 Date of Test/Initial of test personnel who performed the test**

February 15, 2016/FSC

### **2.7.5 Test Equipment Used**

The major items of test equipment used for the above tests are identified in Section 3.1.

### **2.7.6 Environmental Conditions/ Test Location**

Test performed at TÜV SÜD America Inc. Rancho Bernardo facility

|                     |          |
|---------------------|----------|
| Ambient Temperature | 25.8 °C  |
| Relative Humidity   | 39.3 %   |
| ATM Pressure        | 99.4 kPa |

### **2.7.7 Test Results**

Test results identical to Section 2.4 and section 2.6 of this test report. No Harmonics observed from the scans performed between 40GHz up to 100GHz.



### **SECTION 3**

#### **TEST EQUIPMENT USED**



### 3.1 TEST EQUIPMENT USED

List of absolute measuring and other principal items of test equipment.

| ID Number (SDGE/SDRB) | Test Equipment                 | Type                   | Serial Number | Manufacturer               | Cal Date                  | Cal Due Date |
|-----------------------|--------------------------------|------------------------|---------------|----------------------------|---------------------------|--------------|
| Radiated Test Setup   |                                |                        |               |                            |                           |              |
| 1151                  | Pre-amplifier                  | TS-PR26                | 100026        | Rhode & Schwarz            | 05/08/15                  | 05/08/16     |
| 7618                  | Horn antenna                   | 3160-09                | 012054-004    | ETS                        | 07/16/15                  | 07/16/17     |
| 7611                  | Signal/Spectrum Analyzer       | FSW26                  | 102017        | Rhode & Schwarz            | 02/01/16                  | 02/01/17     |
| 1151                  | Pre-amplifier                  | TS-PR26                | 100026        | Rhode & Schwarz            | 05/08/15                  | 05/08/16     |
| 1040                  | EMI Test Receiver              | ESIB40                 | 100292        | Rhode & Schwarz            | 09/29/15                  | 09/29/16     |
| 1049                  | EMI Test Receiver              | ESU                    | 100133        | Rhode & Schwarz            | 03/17/16                  | 03/17/17     |
| 1016                  | Pre-amplifier                  | PAM-0202               | 187           | PAM                        | 12/15/15                  | 12/15/16     |
| 1054                  | Horn antenna (18-40 GHz)       | 3116                   | 9407-2233     | EMCO                       | 12/22/2015                | 12/22/2017   |
| 9003                  | Horn antenna (40-60 GHz)       | HO19R                  | 103           | Custom Microwaves          | 04/18/2016                | 04/18/2017   |
| 9004                  | Horn antenna (50-75 GHz)       | HO15R                  | 104           | Custom Microwaves          | 04/18/2016                | 04/18/2017   |
| 9005                  | Horn antenna (75-110 GHz)      | HO10R                  | 105           | Custom Microwaves          | 04/27/2016                | 04/27/2017   |
| 1049                  | EMI Test Receiver              | ESU                    | 100133        | Rhode & Schwarz            | 03/11/15                  | 03/11/16     |
| 8628                  | Pre-amplifier                  | QLJ 01182835-JO        | 8986002       | QuinStar Technologies Inc. | 03/20/15                  | 03/20/16     |
| n/a                   | Pre-amplifier (18-40 GHz)      | SLKka-30-6             | 15G27         | Spacek Labs                | Verified by 1003 and 7611 |              |
| n/a                   | Pre-amplifier (40-60 GHz)      | SBL-4036033080-1919-E1 |               | Sage Millimeter, Inc.      | Verified                  |              |
| n/a                   | Pre-amplifier (50-75 GHz)      | SBL-5037533050-1515-E1 |               | Sage Millimeter, Inc.      | Verified                  |              |
| n/a                   | Pre-amplifier (75-110 GHz)     | FLNA-10-0005           | FTL10839      | Farran Technology Ltd.     | Verified                  |              |
| n/a                   | Harmonics mixer (40-60 GHz)    | FS-Z60                 | 100009        | Rhode & Schwarz            | 01/26/16                  | 01/26/18     |
| n/a                   | Harmonics mixer (60-90 GHz)    | FS-Z90                 | 100092        | Rhode & Schwarz            | 10/26/15                  | 10/26/17     |
| 8872                  | Direct Reading Attenuator      | STA-60-19-D1           | 11875-01      | Sage Millimeter, Inc.      | Verified                  |              |
| 8860                  | Direct Reading Attenuator      | STA-60-15-D1           | 11466-01      | Sage Millimeter, Inc.      | Verified                  |              |
| 8861                  | Direct Reading Attenuator      | STA-60-10-D1           | 11466-01      | Sage Millimeter, Inc.      | Verified                  |              |
| 8873                  | Active Multiplier (40-60 GHz)  | AMC-19-RFH00           | 124           | Millitech, Inc.            | Verified                  |              |
| n/a                   | Active Multiplier (50-75 GHz)  | AMC-15-RFH00           | 283           | Millitech, Inc.            | Verified                  |              |
| n/a                   | Active Multiplier (75-110 GHz) | AMC-10-RFH00           | 606           | Millitech, Inc.            | Verified                  |              |
| 1153                  | High-frequency cable           | SucoFlex 100 SX        | N/A           | Suhner                     | Verified by 1003 and 7611 |              |
| 8543                  | High-frequency cable           | Micropore 19057793     | N/A           | United Microwave Products  | Verified by 1003 and 7611 |              |
| 8849                  | High-frequency cable           | SAC-26G-6.1            | 363           | A.H.Systems                | 01/14/15                  | 01/14/16     |



| Power Line Conducted Emissions |                                             |                     |              |                      |                  |          |
|--------------------------------|---------------------------------------------|---------------------|--------------|----------------------|------------------|----------|
| 7620                           | EMI Test Receiver                           | ESU40               | 100399       | Rhode & Schwarz      | 09/03/15         | 09/03/16 |
| 7568                           | LISN                                        | FCC-LISN-50-25-2-10 | 120305       | Fischer Custom Comm. | 10/28/15         | 10/28/16 |
| 8822                           | 20dB Attenuator                             | 34-20-34            | N/A          | MCE / Weinschel      | 02/20/15         | 02/20/16 |
| 8824                           | 20dB Attenuator                             | 34-20-34            | N/A          | MCE / Weinschel      | 02/20/15         | 02/20/16 |
| Miscellaneous                  |                                             |                     |              |                      |                  |          |
| 1003                           | Signal Generator                            | SMR-40              | 1104.0002.40 | Rhode & Schwarz      | 04/29/15         | 04/29/16 |
| 7579                           | Temperature Chamber                         | 115                 | 151617       | TestQuity            | 08/14/15         | 08/14/16 |
| 6792                           | Multimeter                                  | 3478A               | 2911A70964   | Hewlett Packard      | 08/14/15         | 08/14/16 |
|                                | DC Power Supply                             | 6015A               | 3044A-00106  | Hewlett Packard      | Verified by 6792 |          |
| 7560                           | Barometer/Temperature /Humidity Transmitter | iBTHX-W             | 1240476      | Omega                | 10/19/15         | 10/19/16 |
|                                | Test Software                               | EMC32               | V8.53        | Rhode & Schwarz      | N/A              |          |

### 3.2 MEASUREMENT UNCERTAINTY

For a 95% confidence level, the measurement uncertainties for defined systems are:

#### 3.2.1 AC Conducted Emissions

| Contribution                    |                            | Probability Distribution Type | Probability Distribution $x_i$ | Standard Uncertainty $u(x_i)$ | $[u(x_i)]^2$ |
|---------------------------------|----------------------------|-------------------------------|--------------------------------|-------------------------------|--------------|
| 1                               | Receiver/Spectrum Analyzer | Rectangular                   | 0.36                           | 0.21                          | 0.04         |
| 2                               | Cables                     | Rectangular                   | 0.50                           | 0.29                          | 0.08         |
| 3                               | LISN                       | Rectangular                   | 0.66                           | 0.38                          | 0.15         |
| 4                               | Attenuator                 | Rectangular                   | 0.30                           | 0.17                          | 0.03         |
| 5                               | EUT Setup                  | Rectangular                   | 1.00                           | 0.58                          | 0.33         |
| Combined Uncertainty ( $u_c$ ): |                            |                               |                                |                               | 0.80         |
| Coverage Factor (k):            |                            |                               |                                |                               | 2            |
| Expanded Uncertainty:           |                            |                               |                                |                               | 1.59         |

#### 3.2.2 Radiated Measurements (Below 1GHz)

| Contribution                    |                            | Probability Distribution Type | Probability Distribution $x_i$ | Standard Uncertainty $u(x_i)$ | $[u(x_i)]^2$ |
|---------------------------------|----------------------------|-------------------------------|--------------------------------|-------------------------------|--------------|
| 1                               | Receiver/Spectrum Analyzer | Rectangular                   | 0.45                           | 0.26                          | 0.07         |
| 2                               | Cables                     | Rectangular                   | 0.50                           | 0.29                          | 0.08         |
| 3                               | Preamp                     | Rectangular                   | 0.50                           | 0.29                          | 0.08         |
| 4                               | Antenna                    | Rectangular                   | 0.75                           | 0.43                          | 0.19         |
| 5                               | Site                       | Rectangular                   | 2.70                           | 1.56                          | 2.43         |
| 6                               | EUT Setup                  | Rectangular                   | 1.00                           | 0.58                          | 0.33         |
| Combined Uncertainty ( $u_c$ ): |                            |                               |                                |                               | 1.78         |
| Coverage Factor (k):            |                            |                               |                                |                               | 2            |
| Expanded Uncertainty:           |                            |                               |                                |                               | 3.57         |

#### 3.2.3 Radiated Measurements (Above 1GHz up to 18GHz)

| Contribution                    |                            | Probability Distribution Type | Probability Distribution $x_i$ | Standard Uncertainty $u(x_i)$ | $[u(x_i)]^2$ |
|---------------------------------|----------------------------|-------------------------------|--------------------------------|-------------------------------|--------------|
| 1                               | Receiver/Spectrum Analyzer | Rectangular                   | 0.57                           | 0.33                          | 0.11         |
| 2                               | Cables                     | Rectangular                   | 0.70                           | 0.40                          | 0.16         |
| 3                               | Preamp                     | Rectangular                   | 0.50                           | 0.29                          | 0.08         |
| 4                               | Antenna                    | Rectangular                   | 0.37                           | 0.21                          | 0.05         |
| 5                               | Site                       | Rectangular                   | 2.70                           | 1.56                          | 2.43         |
| 6                               | EUT Setup                  | Rectangular                   | 1.00                           | 0.58                          | 0.33         |
| Combined Uncertainty ( $u_c$ ): |                            |                               |                                |                               | 1.78         |
| Coverage Factor (k):            |                            |                               |                                |                               | 2            |
| Expanded Uncertainty:           |                            |                               |                                |                               | 3.57         |

### 3.2.1 Radiated Measurements (Above 18GHz up to 100GHz)

| Contribution                    |                          | Probability Distribution Type | Probability Distribution $x_i$ | Standard Uncertainty $u(x_i)$ | $[u(x_i)]^2$ |
|---------------------------------|--------------------------|-------------------------------|--------------------------------|-------------------------------|--------------|
| 1                               | Cables                   | Rectangular                   | 0.70                           | 0.40                          | 0.16         |
| 2                               | Preamp                   | Rectangular                   | 0.50                           | 0.29                          | 0.08         |
| 3                               | Spectrum Analyzer/Mixers | Rectangular                   | 3.34                           | 1.93                          | 3.72         |
| 4                               | Antenna                  | Rectangular                   | 2.70                           | 1.56                          | 2.43         |
| 5                               | EUT Setup                | Rectangular                   | 1.50                           | 0.87                          | 0.75         |
| Combined Uncertainty ( $u_c$ ): |                          |                               |                                |                               | 2.67         |
| Coverage Factor (k):            |                          |                               |                                |                               | 2            |
| Expanded Uncertainty:           |                          |                               |                                |                               | 5.35         |

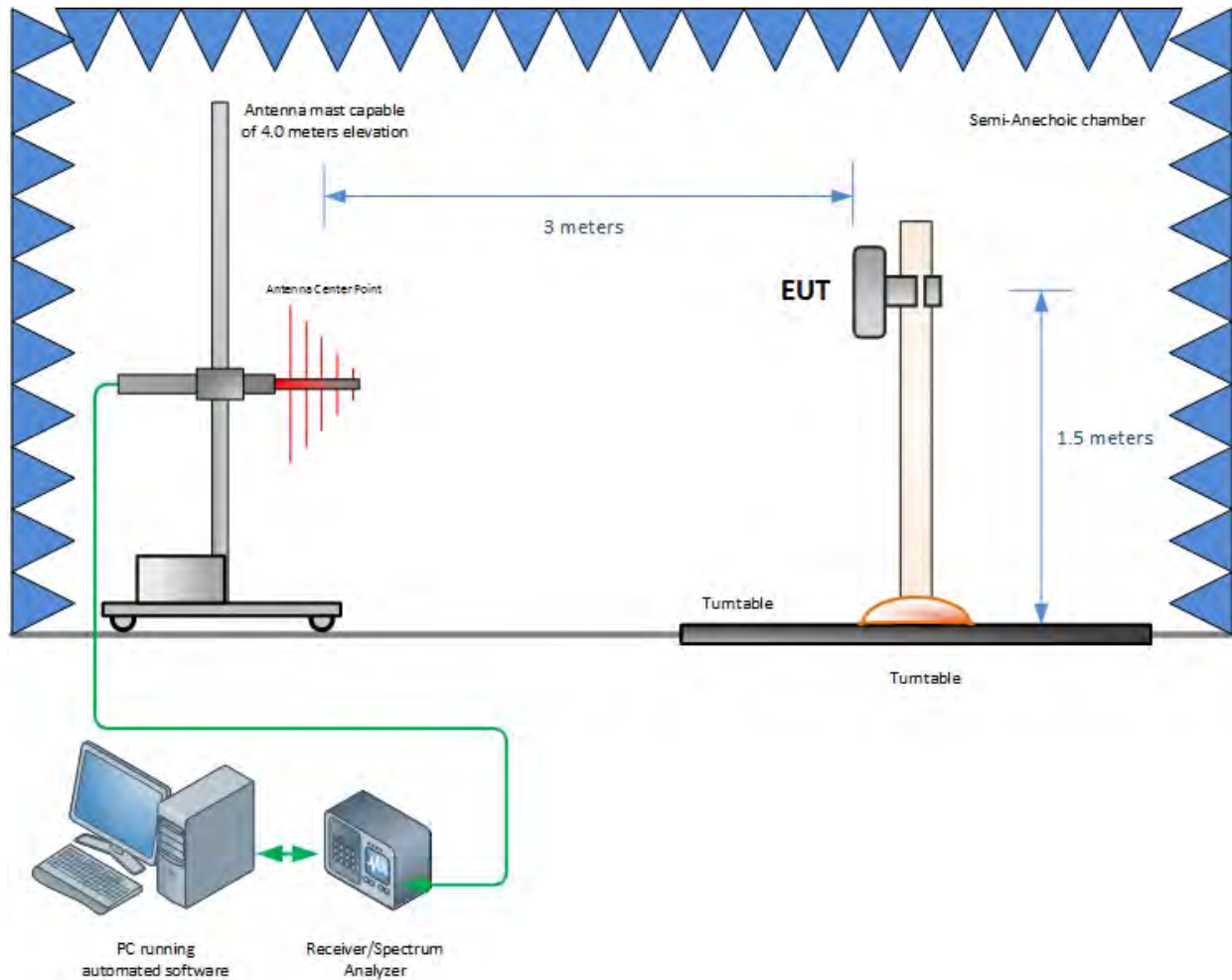
For radiated emissions above 18 GHz alternative interpretation procedure was employed. The measurement uncertainty calculated by the test engineer may be a maximum value for a range of values of measurement, or may be the measurement uncertainty for the specific measurement undertaken.



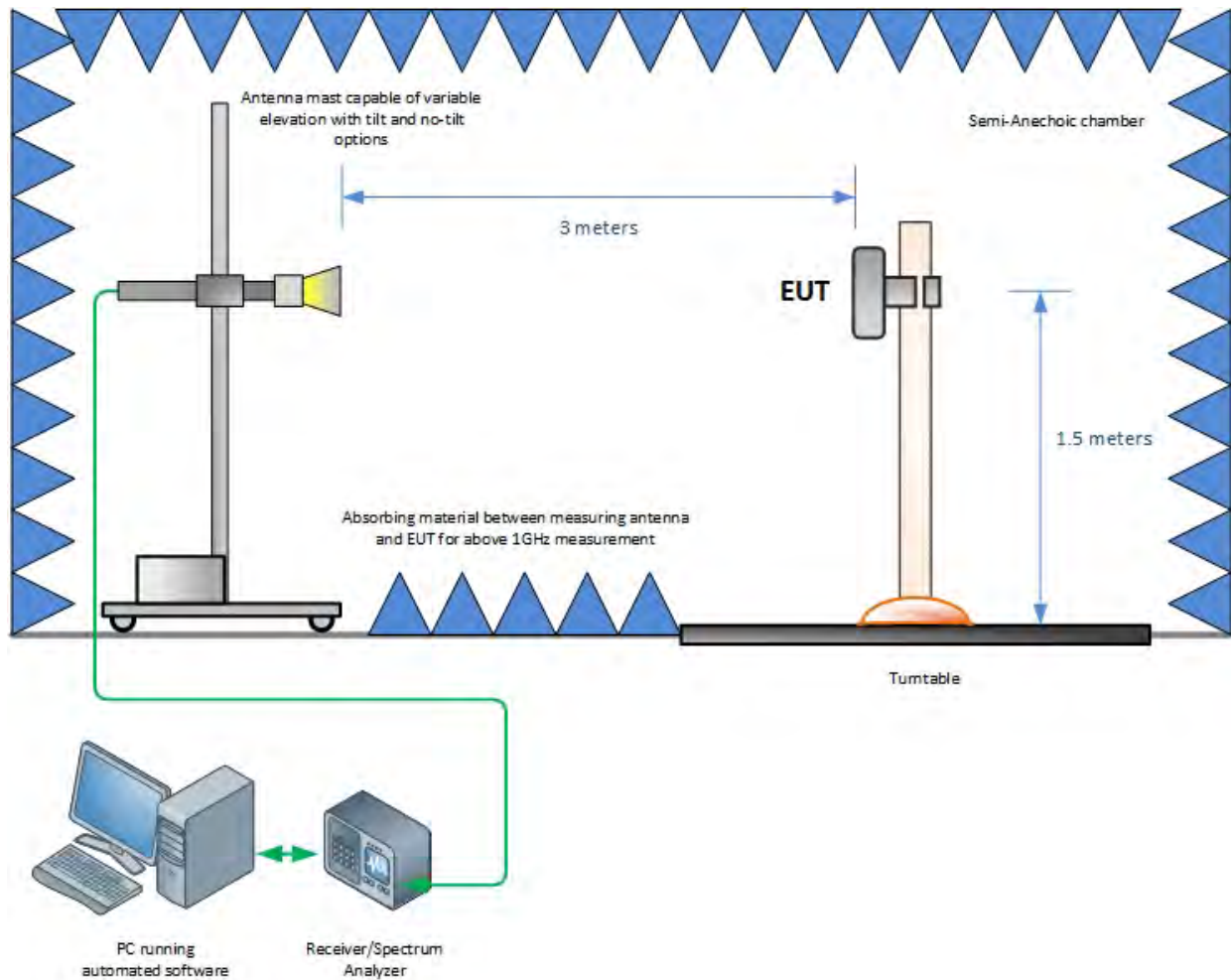
## **SECTION 4**

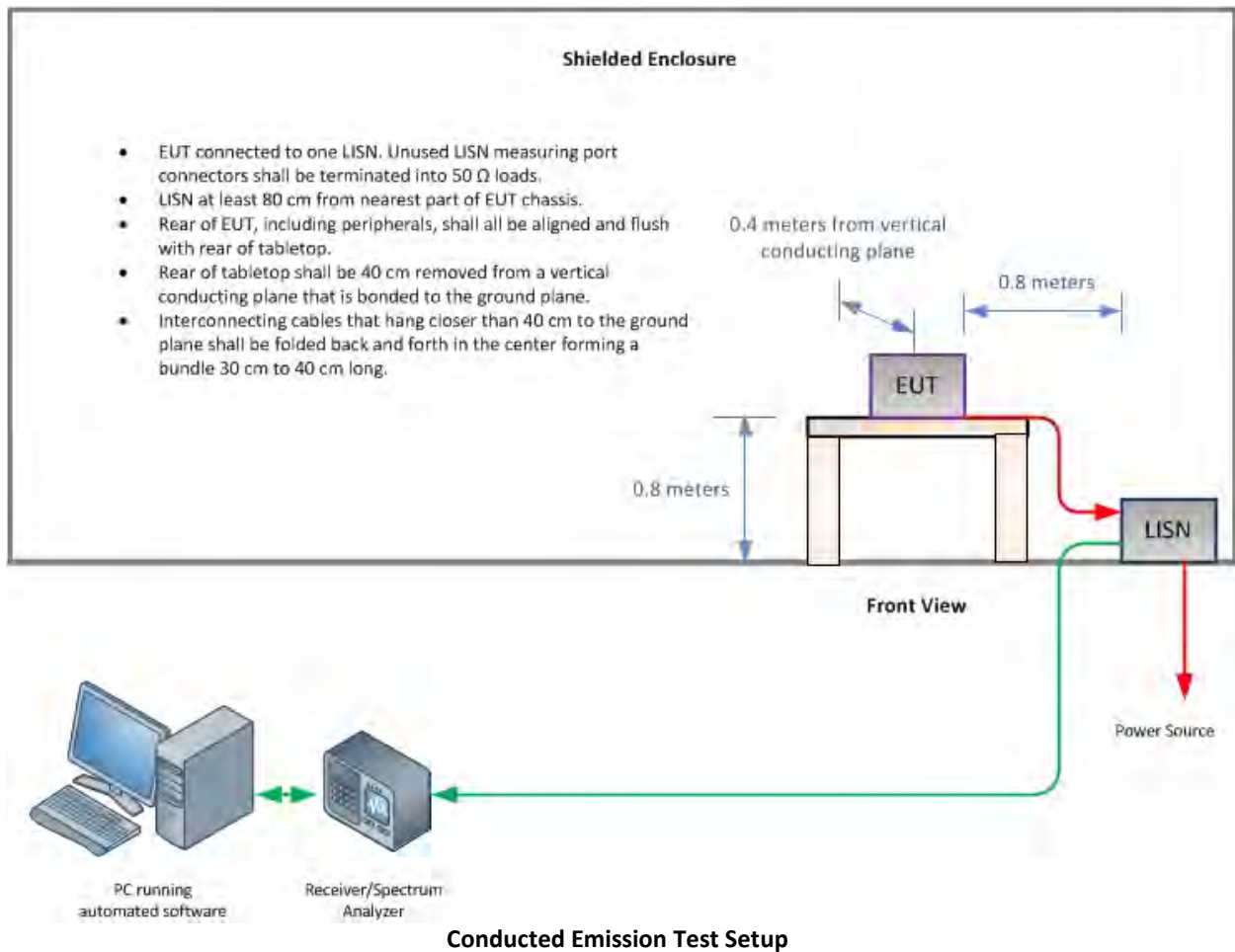
### **DIAGRAM OF TEST SETUP**

#### 4.1 RADIATED EMISSION TEST SETUP (BELOW 1GHZ)



#### 4.2 RADIATED EMISSION TEST SETUP (ABOVE 1GHZ)







## **SECTION 5**

### **ACCREDITATION, DISCLAIMERS AND COPYRIGHT**



## 5.1 ACCREDITATION, DISCLAIMERS AND COPYRIGHT

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