



# **CERTIFICATION TEST REPORT**

**Report Number. :** 11747459 - E1V3

**Applicant :** ECHOSTAR TECHNOLOGIES,LLC  
94 INVERNESS TERRACE EAST  
ENGLEWOOD, CO 80112,U.S.A

**FCC ID :** DKNJ2

**IC ID :** 1707A-J2

**EUT Description :** RF4CE ZIGBEE RADIO

**Test Standard(s) :** FCC CFR47 PART 15 SUBPART C

**Date Of Issue:**

July 10, 2017

**Prepared by:**

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NVLAP LAB CODE 200065-0

Revision History

| Rev. | Issue Date | Revisions                                                  | Revised By |
|------|------------|------------------------------------------------------------|------------|
| V1   | 06/23/17   | Initial Issue                                              | D. Corona  |
| V2   | 07/06/17   | Updated Section 5.2, 5.5 9.1, 9.2, 10 & 11                 | D. Corona  |
| V3   | 07/10/17   | Updated Section 5.2 & 8.4 and remove IC standard reference | E.Yu       |

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## 1. ATTESTATION OF TEST RESULTS

**COMPANY NAME:** Echostar Technologies LLC

**EUT DESCRIPTION:** RF4CE ZIGBEE RADIO

**MODEL:** JOEY 3.0 E97

**SERIAL NUMBER:** RBEXSD00303D (Conducted),  
RBEXSD00254D ( Radiated)

**DATE TESTED:** JUNE 14- JULY 10, 2017

| APPLICABLE STANDARDS     |              |
|--------------------------|--------------|
| STANDARD                 | TEST RESULTS |
| CFR 47 Part 15 Subpart C | Pass         |

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

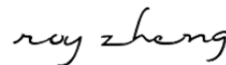
**Note:** The results documented in this report apply only to the tested sample, under the conditions and modes of operation as described herein. This document may not be altered or revised in any way unless done so by UL Verification Services Inc. and all revisions are duly noted in the revision section.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

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## 2. TEST METHODOLOGY

The tests documented in this report were performed in accordance with ANSI C63.10-2013, FCC CFR 47 Part 2, and FCC CFR 47 Part 15.

## 3. FACILITIES AND ACCREDITATION

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

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

The above test sites and facilities are covered under FCC Test Firm Registration # 208313.

UL Verification Services Inc. is accredited by NVLAP, Laboratory Code 200065-0.

Chambers A through C are covered under Industry Canada company address code 2324B with site numbers 2324B -1 through 2324B-3, respectively. Chambers D through H are covered under Industry Canada company address code 22541 with site numbers 22541 -1 through 22541-5, respectively.

## 4. CALIBRATION AND UNCERTAINTY

### 4.1. MEASURING INSTRUMENT CALIBRATION

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

### 4.2. SAMPLE CALCULATION

Where relevant, the following sample calculation is provided:

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

### 4.3. MEASUREMENT UNCERTAINTY

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

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

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

## 5. EQUIPMENT UNDER TEST

### 5.1. DESCRIPTION OF EUT

The EUT is a RF4CE Zigbee Radio.

### 5.2. MAXIMUM OUTPUT POWER

The transmitter has a maximum peak conducted output power as follows:

| Frequency Range (MHz) | Mode   | Output Power (dBm) | Output Power (mW) |
|-----------------------|--------|--------------------|-------------------|
| 2425-2475             | ZIGBEE | 6.46               | 4.43              |

### 5.3. DESCRIPTION OF AVAILABLE ANTENNAS

The radio utilizes an FPCB antenna, with a maximum gain of 0dBi.

### 5.4. WORST-CASE CONFIGURATION AND MODE

Radiated emission and power line conducted emission were performed with the EUT set to transmit on the channel with higher output power as worst-case scenario.

The EUT can only be investigated in orientations X, therefore, all final radiated testing was performed with the EUT in X orientation.

## 5.5. DESCRIPTION OF TEST SETUP

### SUPPORT EQUIPMENT

| Support Equipment List |              |              |                        |        |
|------------------------|--------------|--------------|------------------------|--------|
| Description            | Manufacturer | Model        | Serial Number          | FCC ID |
| AC Adapter             | Liteon       | PB-1180-6ES1 | ETC1620121353          | N/A    |
| Support Host           | Echostar     | JOEY 3.0 E97 | RBEXSD00254D           | N/A    |
| IR remote              | N/A          | N/A          | N/A                    | N/A    |
| Laptop                 | Lenovo       | T460         | PC0C3DUA               | DoC    |
| AC/DC Adapter          | Lenovo       | ADLX65NCC2A  | 11S45N0263Z1ZS9946S904 | DoC    |

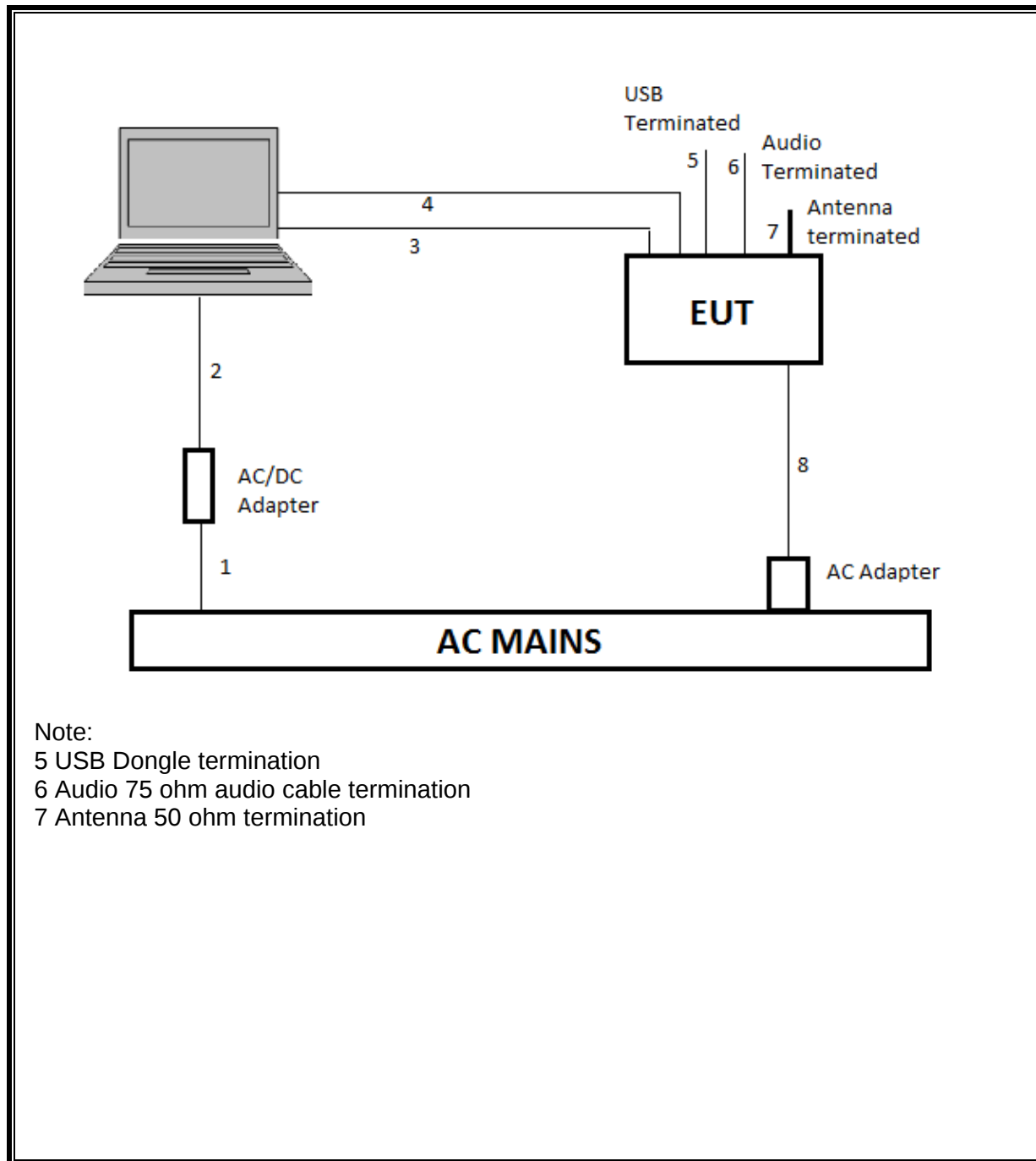
### I/O CABLES

| I/O Cable List |          |                      |                |             |                  |                           |
|----------------|----------|----------------------|----------------|-------------|------------------|---------------------------|
| Cable No       | Port     | # of identical ports | Connector Type | Cable Type  | Cable Length (m) | Remarks                   |
| 1              | AC       | 1                    | AC             | Un-Shielded | 1.2              | AC Mains to AC/DC Adapter |
| 2              | DC       | 1                    | DC             | Un-Shielded | 1.5              | AC/DC Adapter to Laptop   |
| 3              | HDMI     | 1                    | HDMI           | Shielded    | 1.2              | Laptop to EUT             |
| 4              | Ethernet | 1                    | RJ45           | Un-Shielded | 1.5              | Laptop to EUT             |
| 5              | USB      | 1                    | USB            | Un-Shielded | 0.1              | USB Dongle                |
| 6              | Audio    | 1                    | Audio          | Shielded    | 0.5              | Audio cable               |
| 7              | TNC      | 1                    | TNC            | Shielded    | 0.1              | NA                        |
| 8              | AC       | 1                    | AC             | Un-Shielded | 1.2              | AC Mains to EUT           |

### TEST SETUP

EUT was controlled with IR remote to enable ZIGBEE communications.

**SETUP DIAGRAM FOR TESTS**



## 6. TEST AND MEASUREMENT EQUIPMENT

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

| TEST EQUIPMENT LIST                        |                                 |                        |       |          |
|--------------------------------------------|---------------------------------|------------------------|-------|----------|
| Description                                | Manufacturer                    | Model                  | Asset | Cal Due  |
| Antenna, Broadband Hybrid 30MHz to 2000MHz | Sunol Sciences                  | JB3                    | 408   | 11/10/17 |
| Antenna, Active Loop 9kHz-30MHz            | ETS-Lindgren                    | 6502                   | T1683 | 02/17/18 |
| Antenna, Horn 1-18GHz                      | ETS Lindgren                    | 3117                   | 712   | 01/30/18 |
| Amplifier, 1-18GHz                         | Miteq                           | AFS42-00101800-25-S-42 | 931   | 08/26/17 |
| Amplifier, 10kHz-1GHz                      | Agilent (Keysight) Technologies | 8447D                  | T15   | 08/26/17 |
| Amplifier, 1-8 GHz                         | MITEQ                           | AMF-4D-01000800-30-29P | 1156  | 02/15/18 |
| Spectrum Analyzer, PXA, 3Hz to 44GHz       | Keysight                        | N9030A                 | 905   | 01/11/18 |

| Test Software List    |              |        |                         |
|-----------------------|--------------|--------|-------------------------|
| Description           | Manufacturer | Model  | Version                 |
| Radiated Software     | UL           | UL EMC | Ver 9.5, June 24, 2015  |
| Conducted Software    | UL           | UL EMC | Ver 9.5, May 26, 2015   |
| Antenna Port Software | UL           | UL RF  | Ver 3.9.1, Dec 28, 2015 |

## 7. SUMMARY TABLE

| FCC Part Section   | Test Description                        | Test Limit | Test Condition | Test Result |
|--------------------|-----------------------------------------|------------|----------------|-------------|
| 15.247 (a)(2)      | Occupied Bandwidth (6dB)                | >500KHz    | Conducted      | Pass        |
| 2.1051, 15.247 (d) | Band Edge / Conducted Spurious Emission | -20dBc     |                | Pass        |
| 15.247             | TX conducted output power               | <30dBm     |                | Pass        |
| 15.247             | PSD                                     | <8dBm      |                | Pass        |
| 15.207 (a)         | AC Power Line conducted emissions       | Section 10 | Radiated       | Pass        |
| 15.205, 15.209     | Radiated Spurious Emission              | < 54dBuV/m |                | Pass        |

## 8. ANTENNA PORT TEST RESULTS

### 8.1. ON TIME, DUTY CYCLE

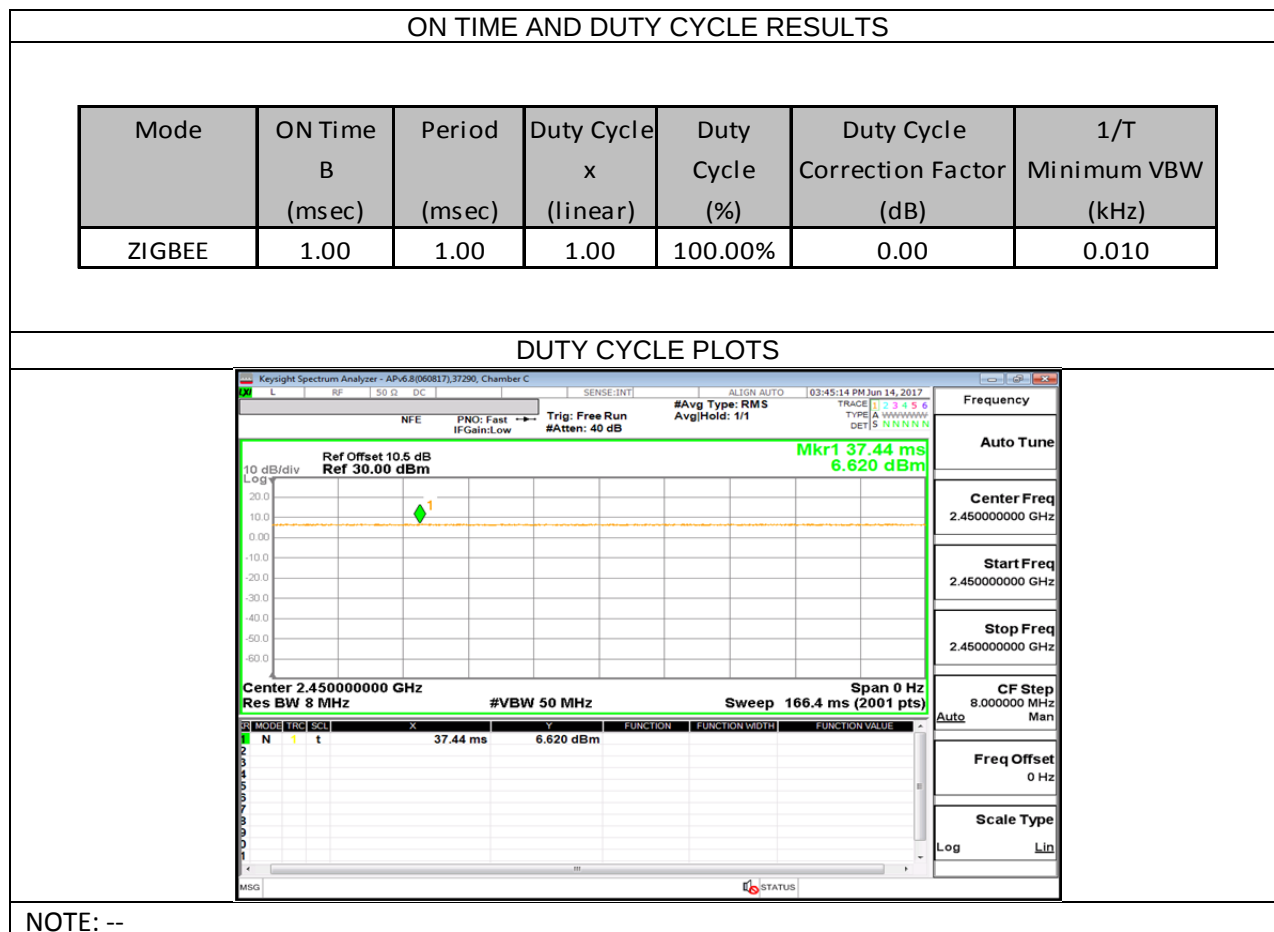
#### LIMITS

None; for reporting purposes only

#### PROCEDURE

KDB 558074 Zero-Span Spectrum Analyzer Method

#### RESULTS



## **8.2. 6 dB BANDWIDTH**

### **LIMITS**

FCC §15.247 (a) (2)

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

### **TEST PROCEDURE**

The transmitter output is connected to a spectrum analyzer. The RBW is set to 100 kHz and the VBW is set to 300 kHz. The sweep time is coupled.

### **RESULTS**

## 8.2.1. 6 dB BANDWIDTH PLOTS AND TABLE



### **8.3. 99% BANDWIDTH**

#### **LIMITS**

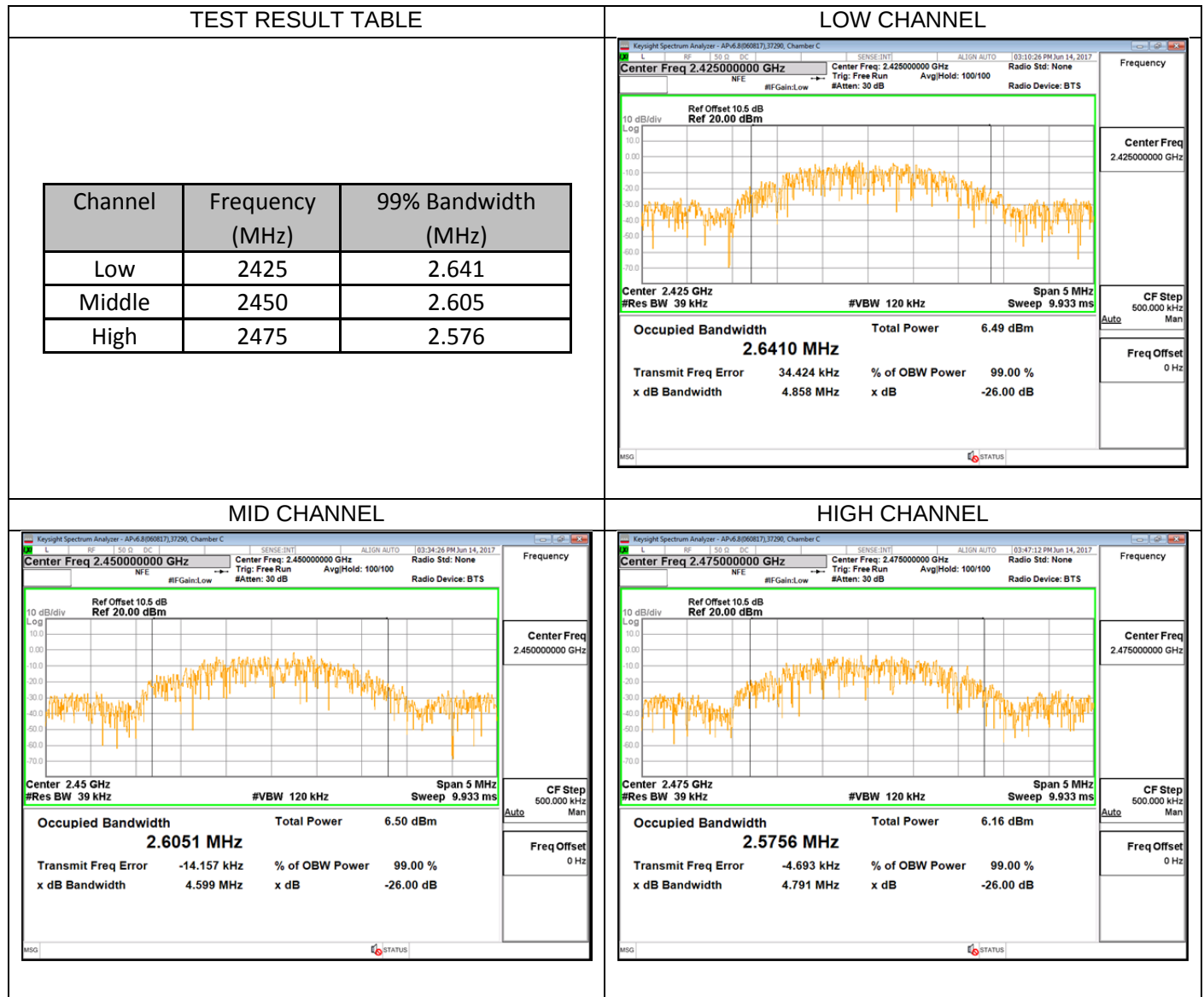
None; for reporting purposes only.

#### **TEST PROCEDURE**

Refer to KDB558074 D01 DTS Meas Guidance v04: The transmitter output is connected to the spectrum analyzer. The RBW is set to 1% to 3% of the 99 % bandwidth and to 1% of the span. The VBW is set to 3 times the RBW. The sweep time is coupled. The spectrum analyzer internal 99% bandwidth function is utilized.

#### **RESULTS**

### 8.3.1. 99% BANDWIDTH PLOTS AND TABLE



## **8.4. OUTPUT POWER**

### **LIMITS**

FCC §15.247

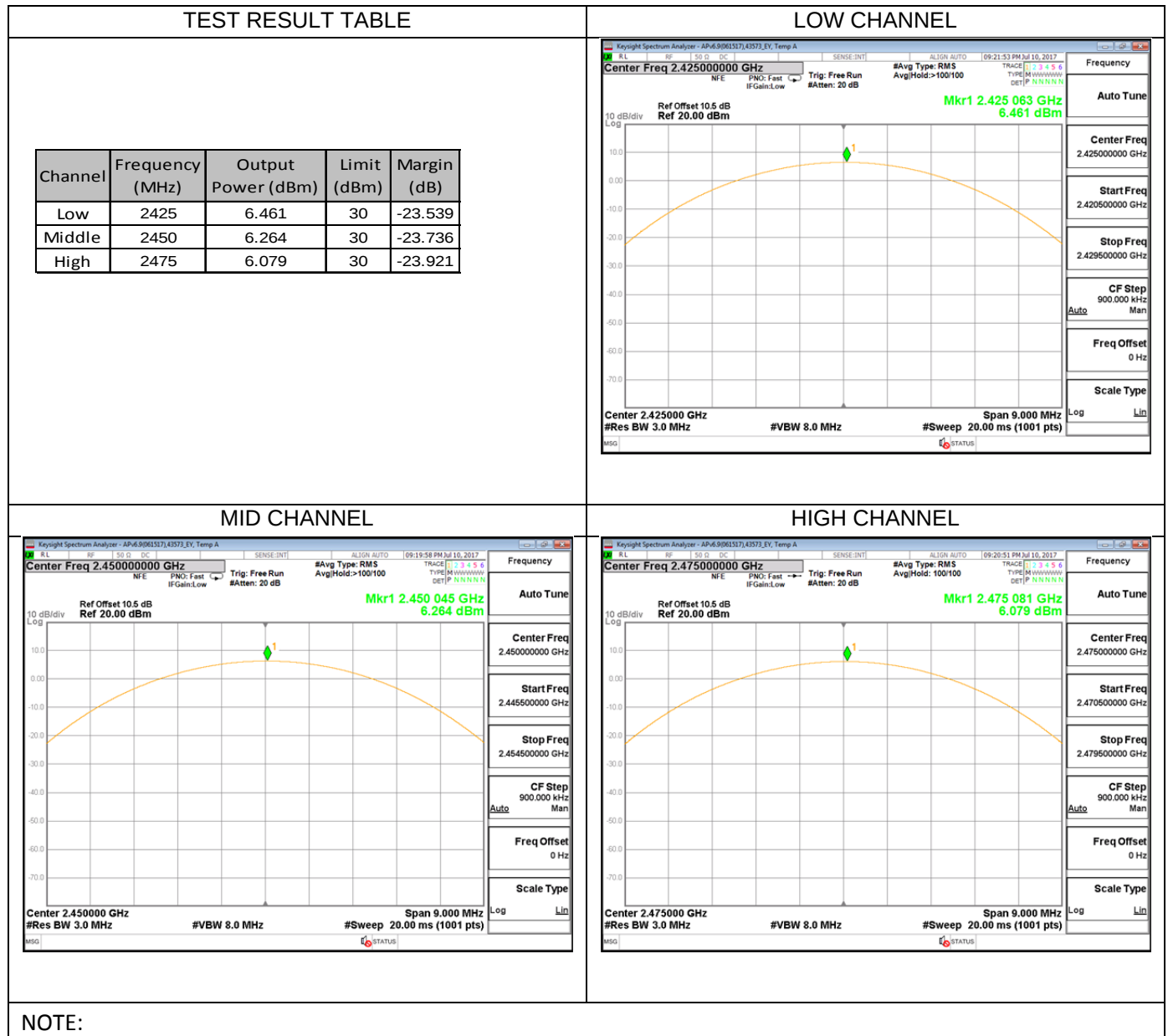
The maximum antenna gain is less than or equal to 6 dBi, therefore the limit is 30 dBm.

### **TEST PROCEDURE**

Peak power is measured using KDB558074 D01 DTS Meas Guidance v04 spectrum analyzer.

### **RESULTS**

## 8.4.1. OUTPUT POWER PLOTS



## 8.5. AVERAGE POWER

### LIMITS

None; for reporting purposes only.

### TEST PROCEDURE

The transmitter output is connected to a power meter.

### RESULTS

The cable assembly insertion loss of 10.5 dB (including 10 dB pad and 0.5 dB cable) was entered as an offset in the power meter to allow for direct reading of power.

| Channel | Frequency<br>(MHz) | Average Power<br>(dBm) |
|---------|--------------------|------------------------|
| Low     | 2425               | 6.100                  |
| Middle  | 2450               | 5.980                  |
| High    | 2475               | 5.840                  |

NOTE: --

## **8.6. POWER SPECTRAL DENSITY**

### **LIMITS**

FCC §15.247

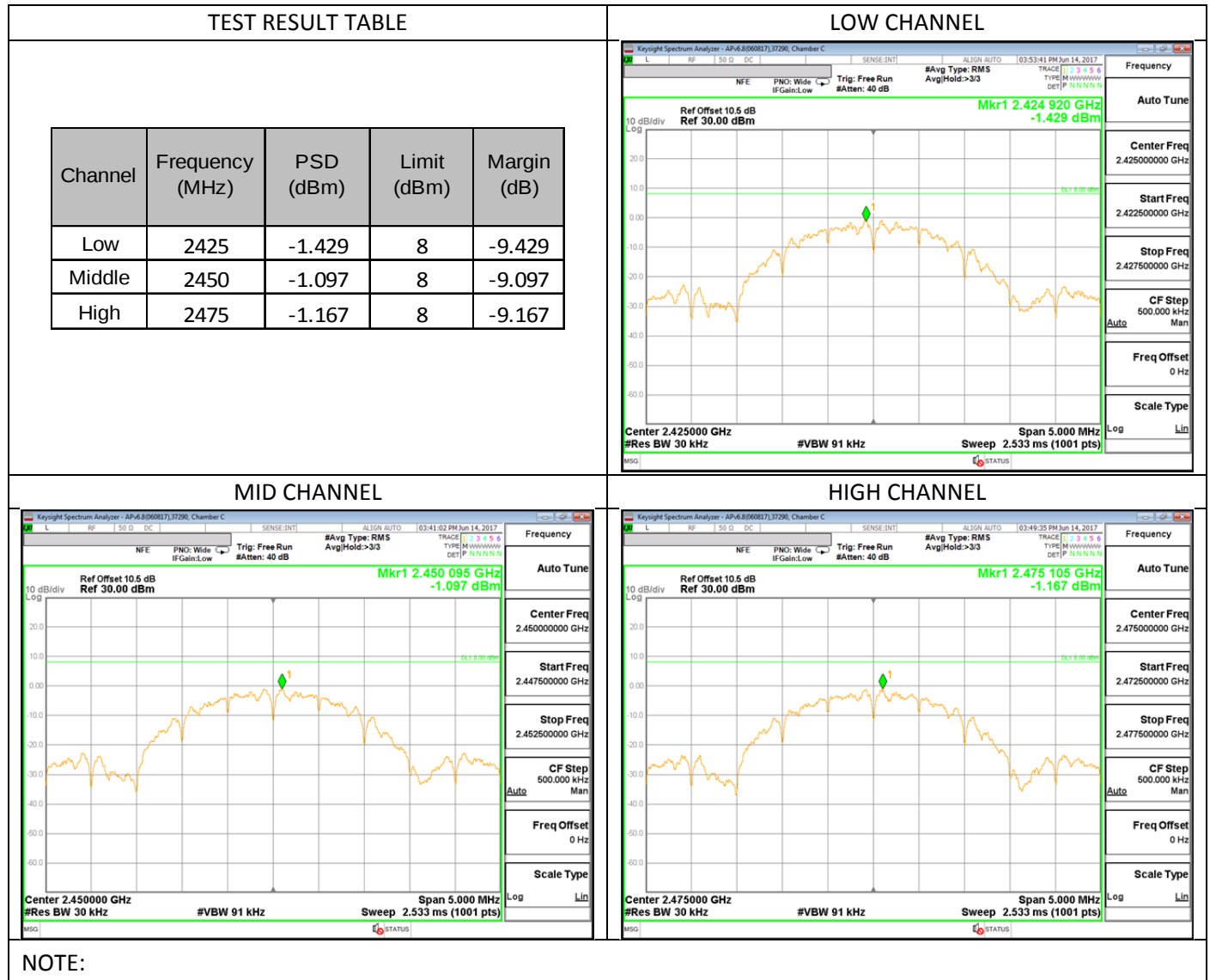
The power spectral density conducted from the transmitter to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

### **TEST PROCEDURE**

Power Spectral Density was performed utilizing the “Method PKPSD (Peak PSD)” under KDB558074 D01 DTS Meas Guidance v04.

### **RESULTS**

## 8.6.1. POWER SPECTRAL DENSITY PLOTS AND TABLE



## **8.7. CONDUCTED SPURIOUS EMISSIONS**

### **LIMITS**

FCC §15.247 (d)

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

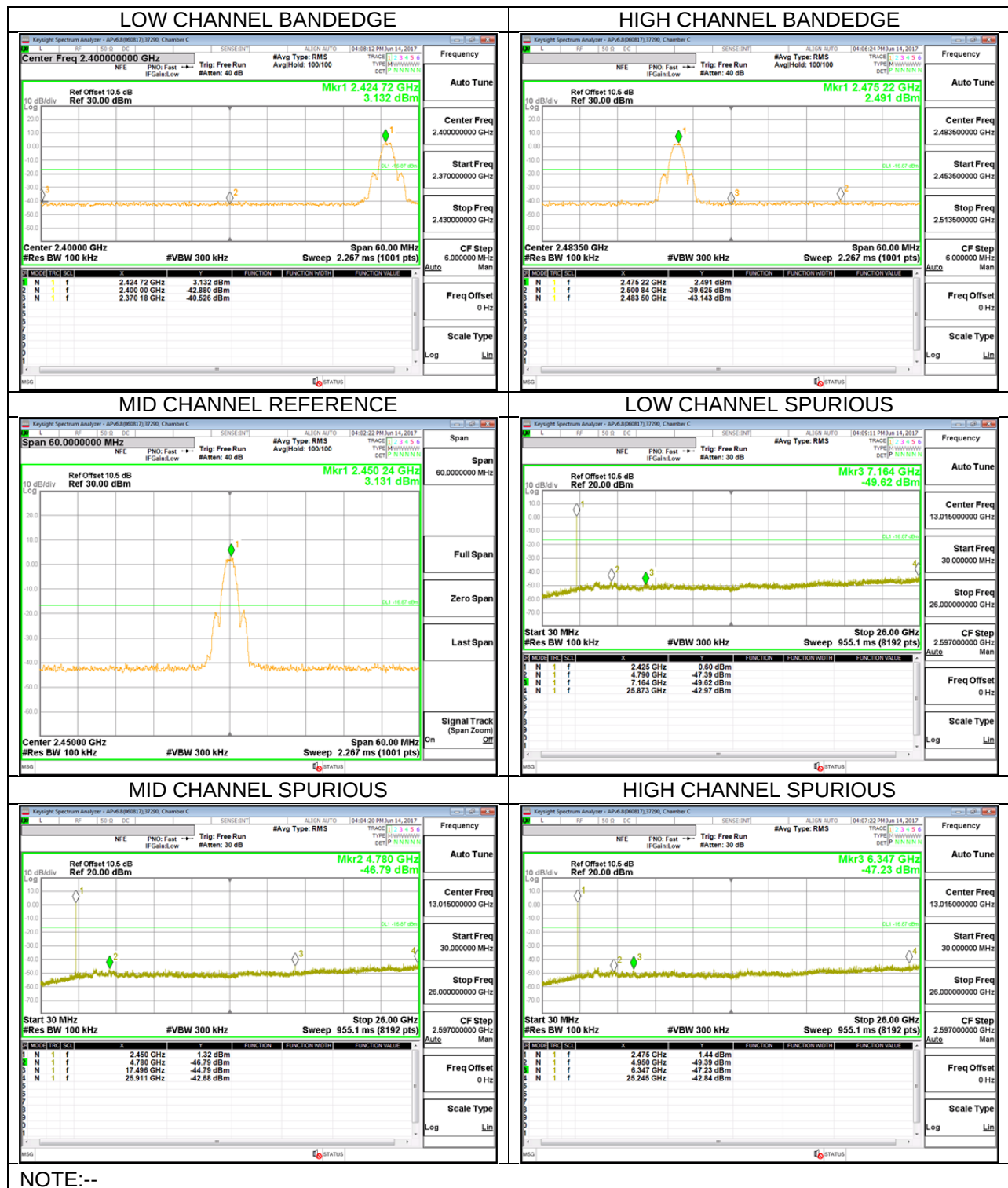
### **TEST PROCEDURE**

The transmitter output is connected to a spectrum analyzer. The resolution bandwidth is set to 100 kHz. The video bandwidth is set to 300 kHz.

The spectrum from 30 MHz to 26 GHz is investigated with the transmitter set to the lowest, middle, and highest channels.

### **RESULTS**

## 8.7.1. BANDEDGE AND SPURIOUS EMISSIONS PLOTS



## 9. RADIATED TEST RESULTS

### LIMITS

FCC §15.205 and §15.209

IC RSS-GEN, Section 8.9 and 8.10.

| Frequency Range (MHz) | Field Strength Limit (uV/m) at 3 m | Field Strength Limit (dBuV/m) at 3 m |
|-----------------------|------------------------------------|--------------------------------------|
| 30 - 88               | 100                                | 40                                   |
| 88 - 216              | 150                                | 43.5                                 |
| 216 - 960             | 200                                | 46                                   |
| Above 960             | 500                                | 54                                   |

### TEST PROCEDURE

The EUT is placed on a non-conducting table 80 cm above the ground plane for below 1GHz and 150cm for above 1GHz. The antenna to EUT distance is 3 meters. The EUT is configured in accordance with ANSI C63.10. The EUT is set to transmit in a continuous mode.

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

For measurements above 1 GHz the resolution bandwidth is set to 1 MHz, then the video bandwidth is set to 1 MHz for peak and average measurements.

The spectrum from 30 MHz to 26 GHz is investigated with the transmitter set to the lowest, middle, and highest channels in the 2.4 GHz band.

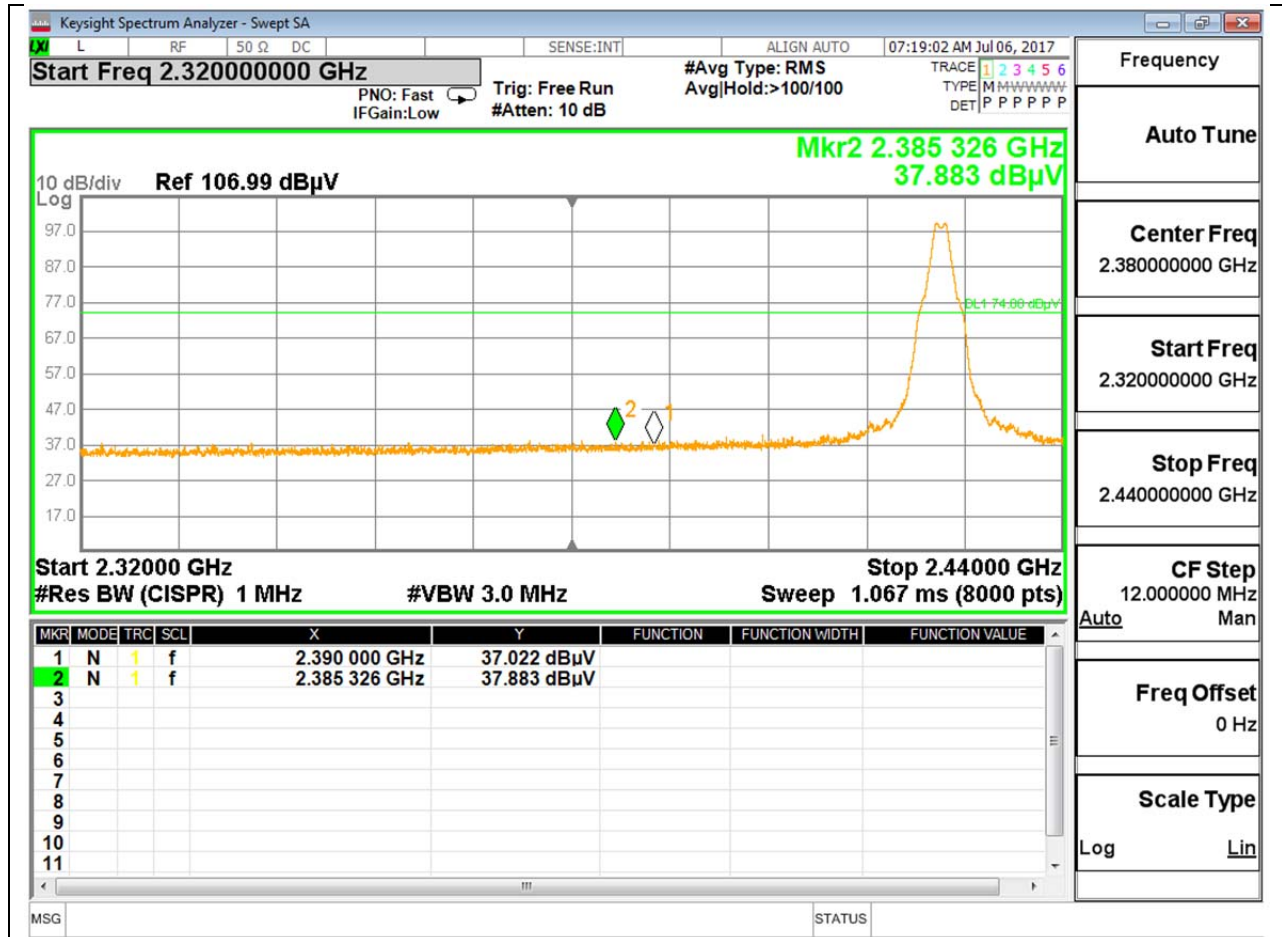
The frequency range of interest is monitored at a fixed antenna height and EUT azimuth. The EUT is rotated through 360 degrees to maximize emissions received. The antenna is scanned from 1 to 4 meters above the ground plane to further maximize the emission. Measurements are made with the antenna polarized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

### RESULTS

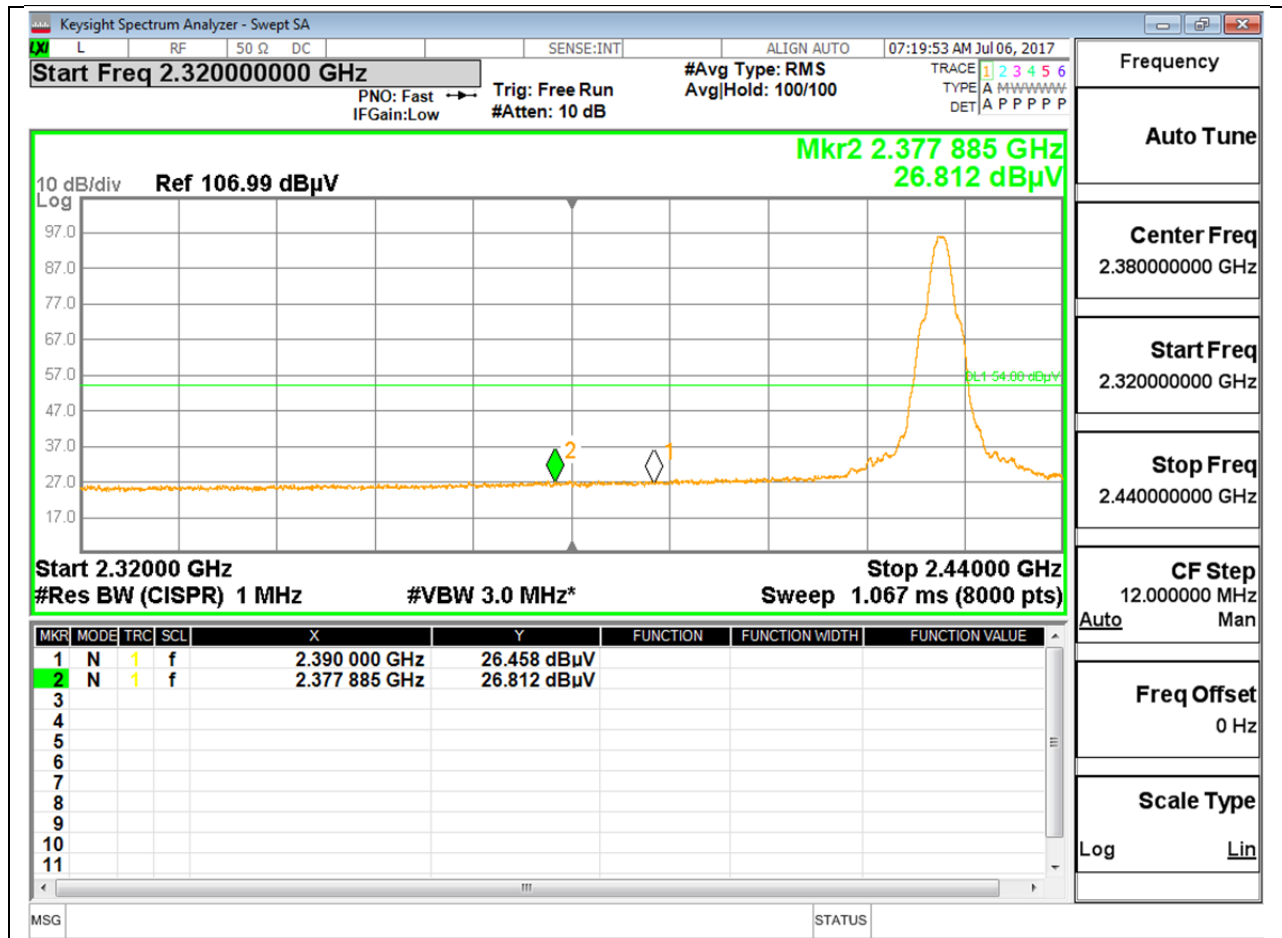
## 9.1. TRANSMITTER ABOVE 1 GHz

### RESTRICTED BANDEDGE (LOW CHANNEL)

#### HORIZONTAL PEAK PLOT



### HORIZONTAL AVERAGE PLOT



### HORIZONTAL DATA

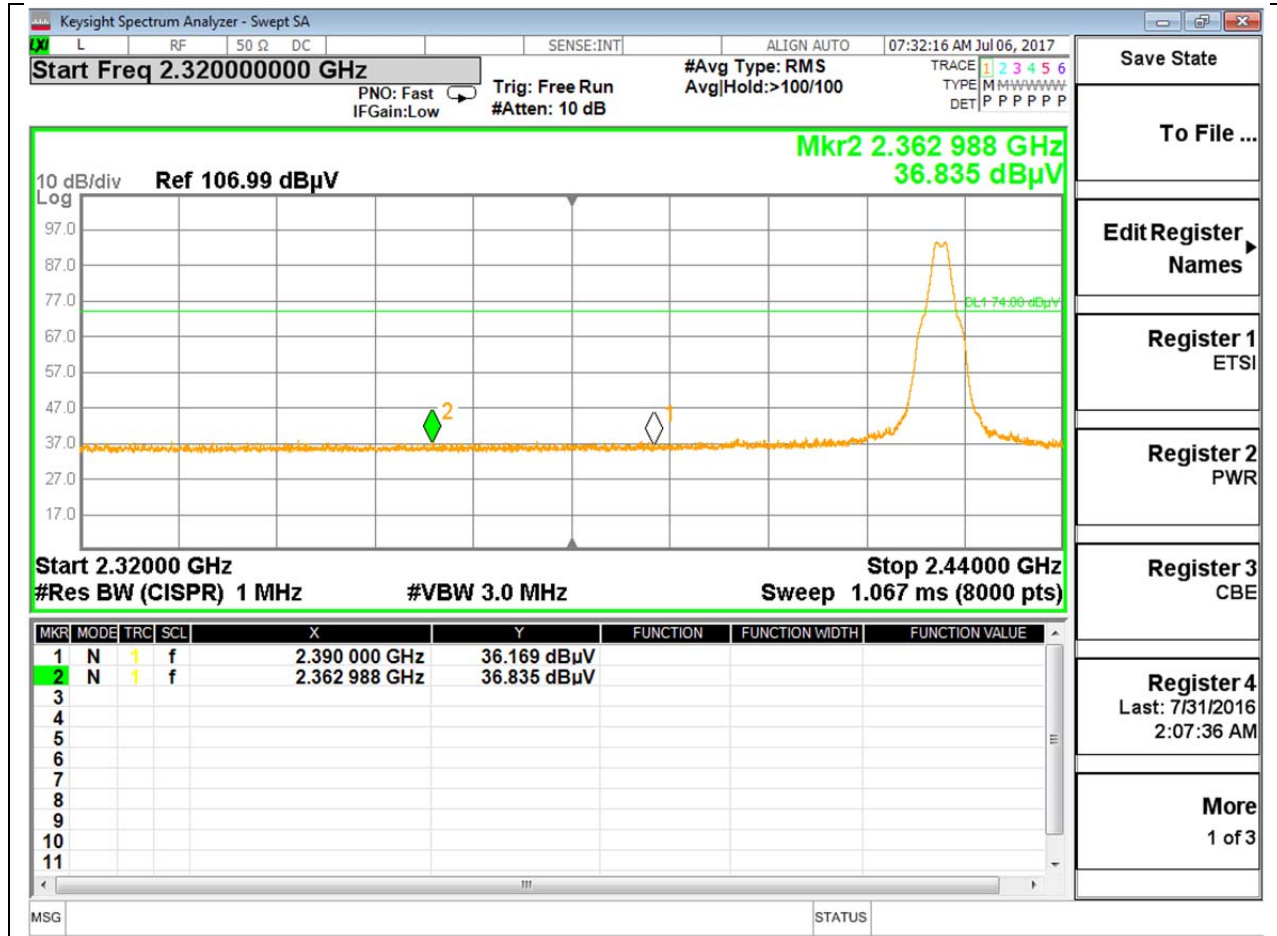
| Frequency (GHz) | Meter Reading (dBμV) | Det | AF T712 (dB/m) | Amp/Cbl/Fitr/Pa d (dB) | Corrected Reading (dBμV/m) | Average Limit (dBμV/m) | Margin (dB) | Peak Limit (dBμV/m) | PK Margin (dB) | Azimuth (Degs) | Height (cm) | Polarity |
|-----------------|----------------------|-----|----------------|------------------------|----------------------------|------------------------|-------------|---------------------|----------------|----------------|-------------|----------|
| * 2.39          | 37.02                | Pk  | 31.9           | -20.8                  | 48.12                      | -                      | -           | 74                  | -25.88         | 356            | 400         | H        |
| * 2.385         | 37.88                | Pk  | 31.8           | -20.9                  | 48.98                      | -                      | -           | 74                  | -25.02         | 356            | 400         | H        |
| * 2.39          | 26.46                | RMS | 31.9           | -20.8                  | 37.56                      | 54                     | -16.44      | -                   | -              | 356            | 400         | H        |
| * 2.378         | 26.81                | RMS | 31.9           | -20.9                  | 37.81                      | 54                     | -16.19      | -                   | -              | 356            | 400         | H        |

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

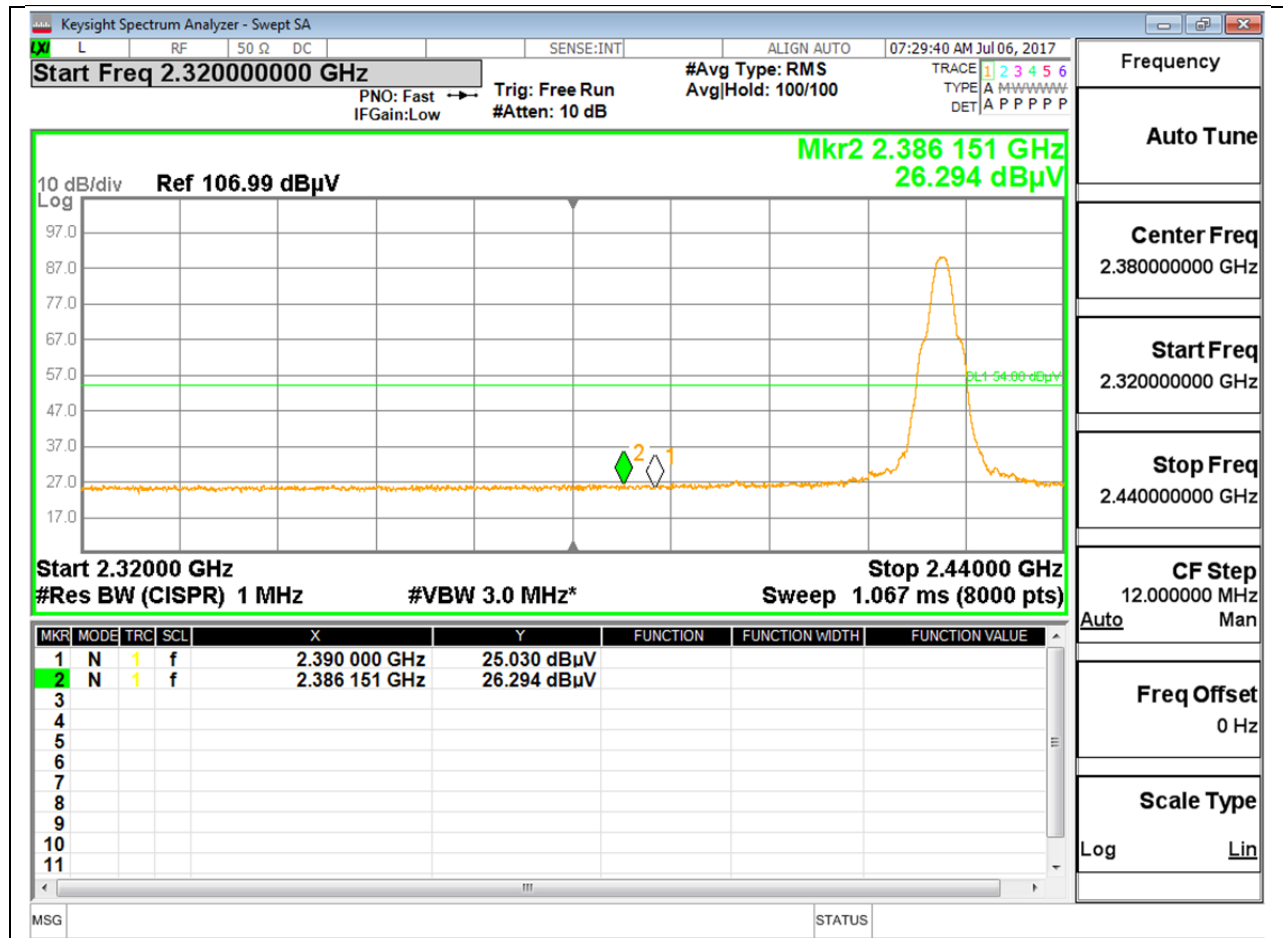
Pk - Peak detector

RMS - RMS detection

# VERTICAL PEAK PLOT



### VERTICAL AVERAGE PLOT



### VERTICAL DATA

| Frequency (GHz) | Meter Reading (dBμV) | Det | AF T712 (dB/m) | Amp/Cbl/Filtr/Pa d (dB) | Corrected Reading (dBμV/m) | Average Limit (dBμV/m) | Margin (dB) | Peak Limit (dBμV/m) | PK Margin (dB) | Azimuth (Degs) | Height (cm) | Polarity |
|-----------------|----------------------|-----|----------------|-------------------------|----------------------------|------------------------|-------------|---------------------|----------------|----------------|-------------|----------|
| * 2.39          | 36.17                | Pk  | 31.9           | -20.8                   | 47.27                      | -                      | -           | 74                  | -26.73         | 262            | 147         | V        |
| * 2.363         | 36.84                | Pk  | 31.9           | -20.7                   | 48.04                      | -                      | -           | 74                  | -25.96         | 262            | 147         | V        |
| * 2.39          | 25.03                | RMS | 31.9           | -20.8                   | 36.13                      | 54                     | -17.87      | -                   | -              | 262            | 147         | V        |
| * 2.386         | 26.29                | RMS | 31.9           | -20.9                   | 37.29                      | 54                     | -16.71      | -                   | -              | 262            | 147         | V        |

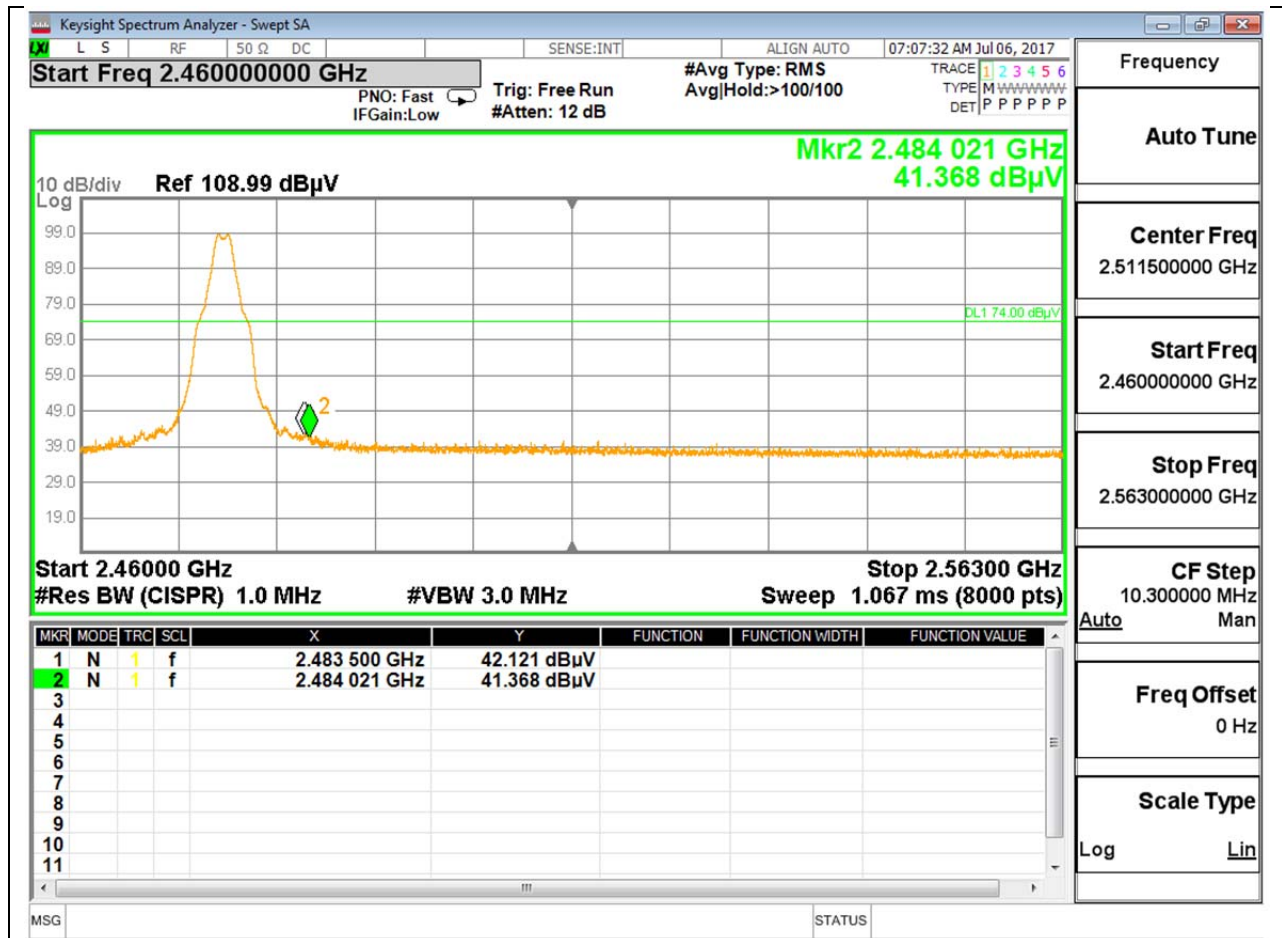
\* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band

Pk - Peak detector

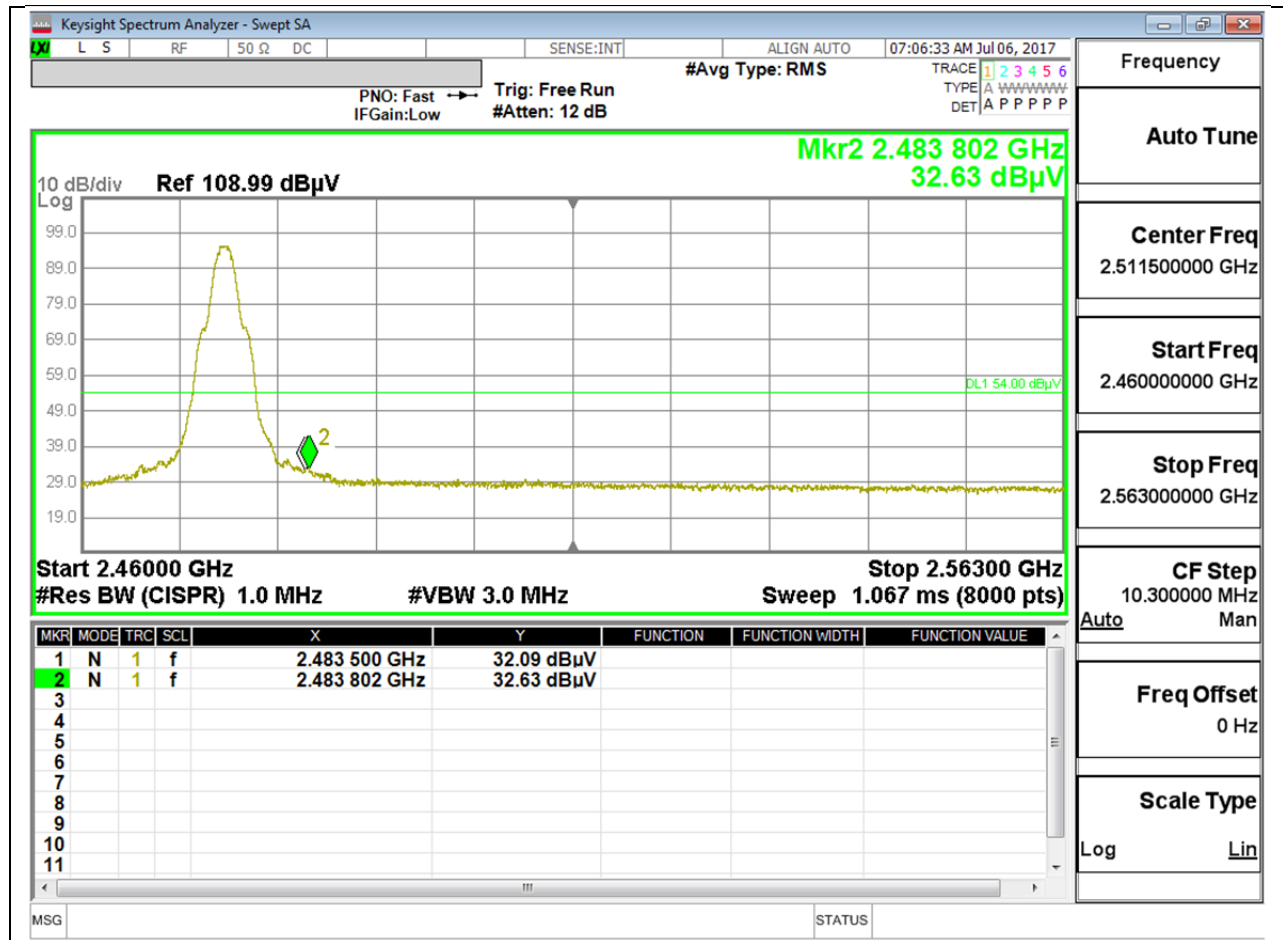
RMS - RMS detection

# AUTHORIZED BANDEDGE (HIGH CHANNEL)

## HORIZONTAL PEAK PLOT



### HORIZONTAL AVERAGE PLOT



### HORIZONTAL DATA

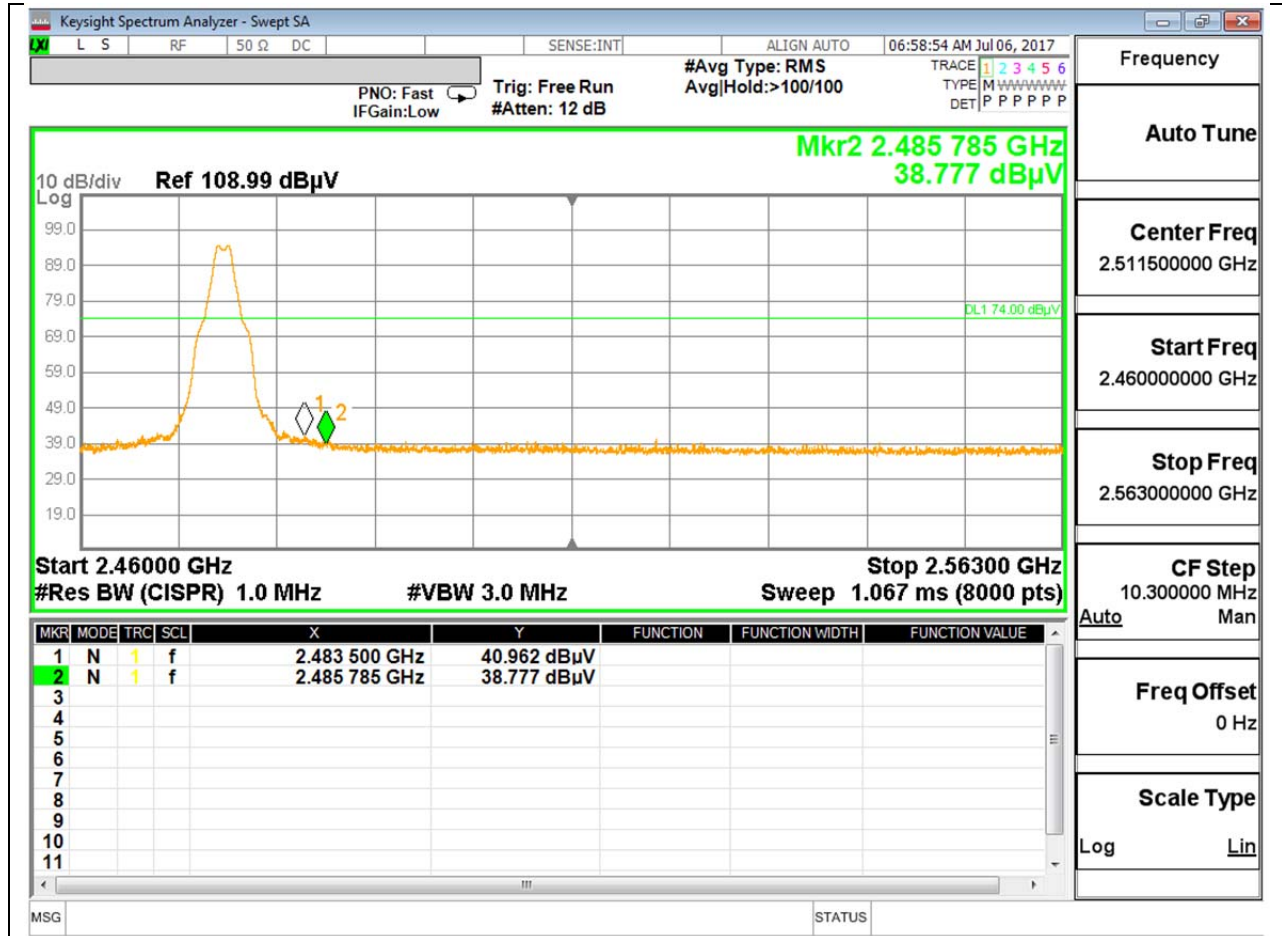
| Frequency (GHz) | Meter Reading (dBμV) | Det | AF T862 (dB/m) | Amp/Cbl/Filtr/Pad (dB) | Corrected Reading (dBμV/m) | Average Limit (dBμV/m) | Margin (dB) | Peak Limit (dBμV/m) | PK Margin (dB) | Azimuth (Degs) | Height (cm) | Polarity |
|-----------------|----------------------|-----|----------------|------------------------|----------------------------|------------------------|-------------|---------------------|----------------|----------------|-------------|----------|
| * 2.484         | 42.12                | Pk  | 32.3           | -23.1                  | 51.32                      | -                      | -           | 74                  | -22.68         | 254            | 126         | H        |
| * 2.484         | 41.37                | Pk  | 32.3           | -23.1                  | 50.57                      | -                      | -           | 74                  | -23.43         | 254            | 126         | H        |
| * 2.484         | 32.09                | RMS | 32.3           | -23.1                  | 41.29                      | 54                     | -12.71      | -                   | -              | 254            | 126         | H        |
| * 2.484         | 32.63                | RMS | 32.3           | -23.1                  | 41.83                      | 54                     | -12.17      | -                   | -              | 254            | 126         | H        |

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

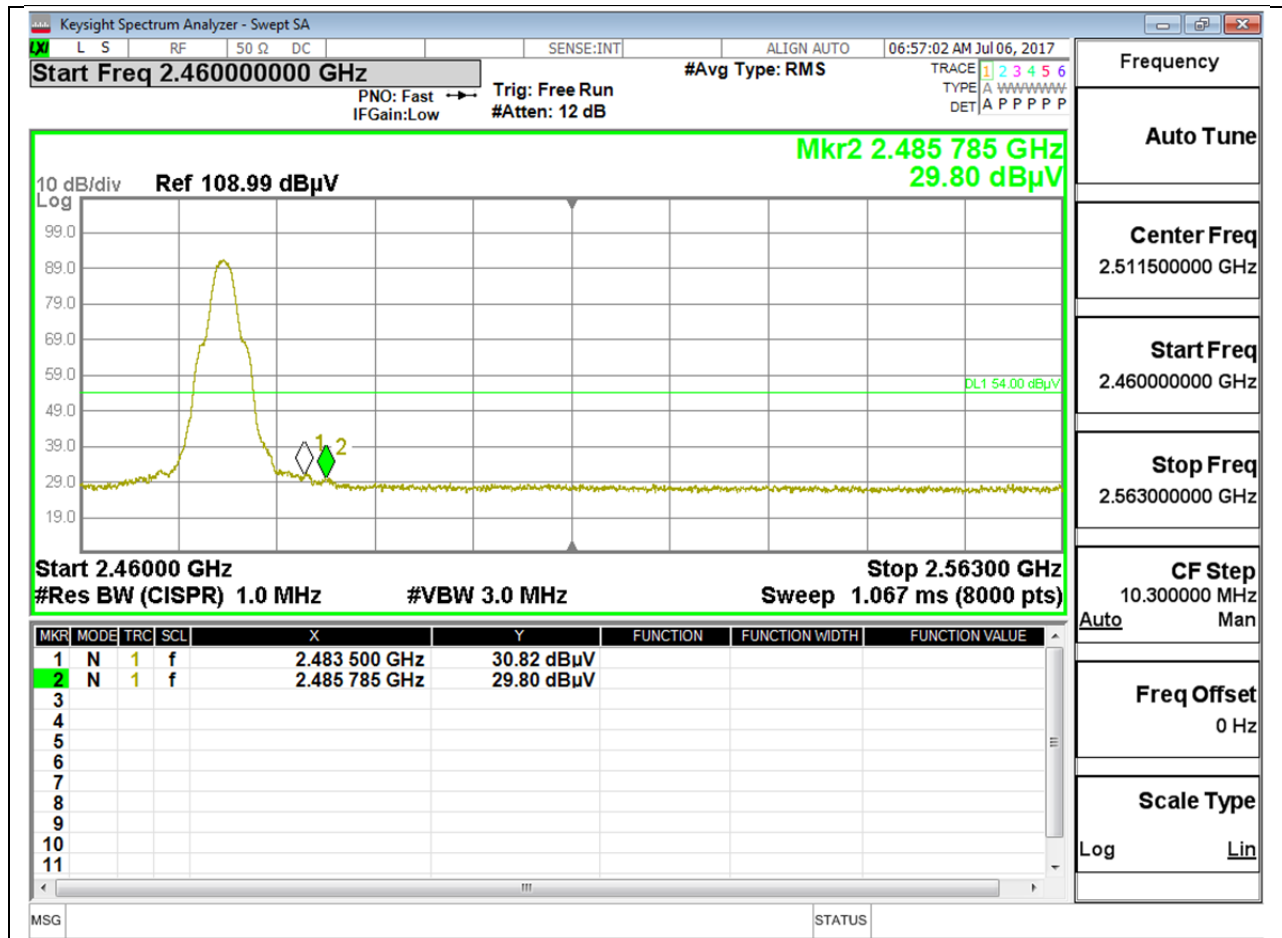
Pk - Peak detector

RMS - RMS detection

# VERTICAL PEAK PLOT



### VERTICAL AVERAGE PLOT



### VERTICAL DATA

| Frequency (GHz) | Meter Reading (dBμV) | Det | AF T862 (dB/m) | Amp/Cbl/Filtr/Pad (dB) | Corrected Reading (dBμV/m) | Average Limit (dBμV/m) | Margin (dB) | Peak Limit (dBμV/m) | PK Margin (dB) | Azimuth (Degs) | Height (cm) | Polarity |
|-----------------|----------------------|-----|----------------|------------------------|----------------------------|------------------------|-------------|---------------------|----------------|----------------|-------------|----------|
| * 2.484         | 40.96                | Pk  | 32.3           | -23.1                  | 50.16                      | -                      | -           | 74                  | -23.84         | 344            | 340         | V        |
| * 2.486         | 38.78                | Pk  | 32.3           | -23.1                  | 47.98                      | -                      | -           | 74                  | -26.02         | 344            | 340         | V        |
| * 2.484         | 30.82                | RMS | 32.3           | -23.1                  | 40.02                      | 54                     | -13.98      | -                   | -              | 344            | 340         | V        |
| * 2.486         | 29.8                 | RMS | 32.3           | -23.1                  | 39                         | 54                     | -15         | -                   | -              | 344            | 340         | V        |

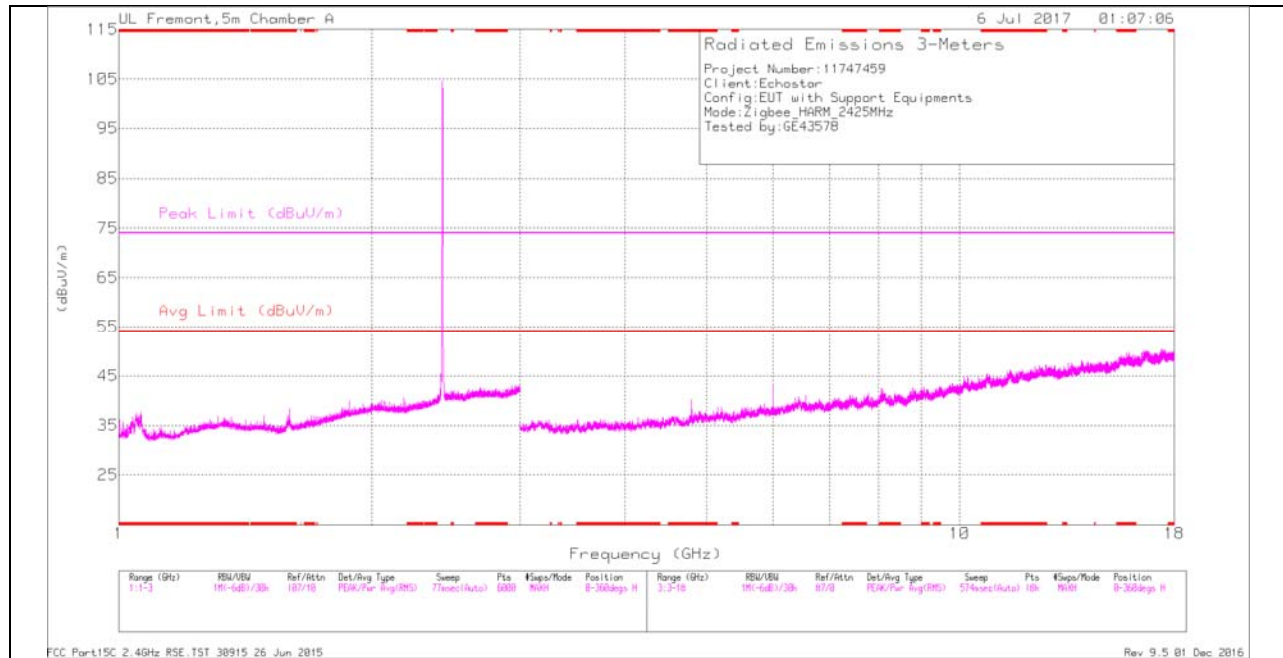
\* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band

Pk - Peak detector

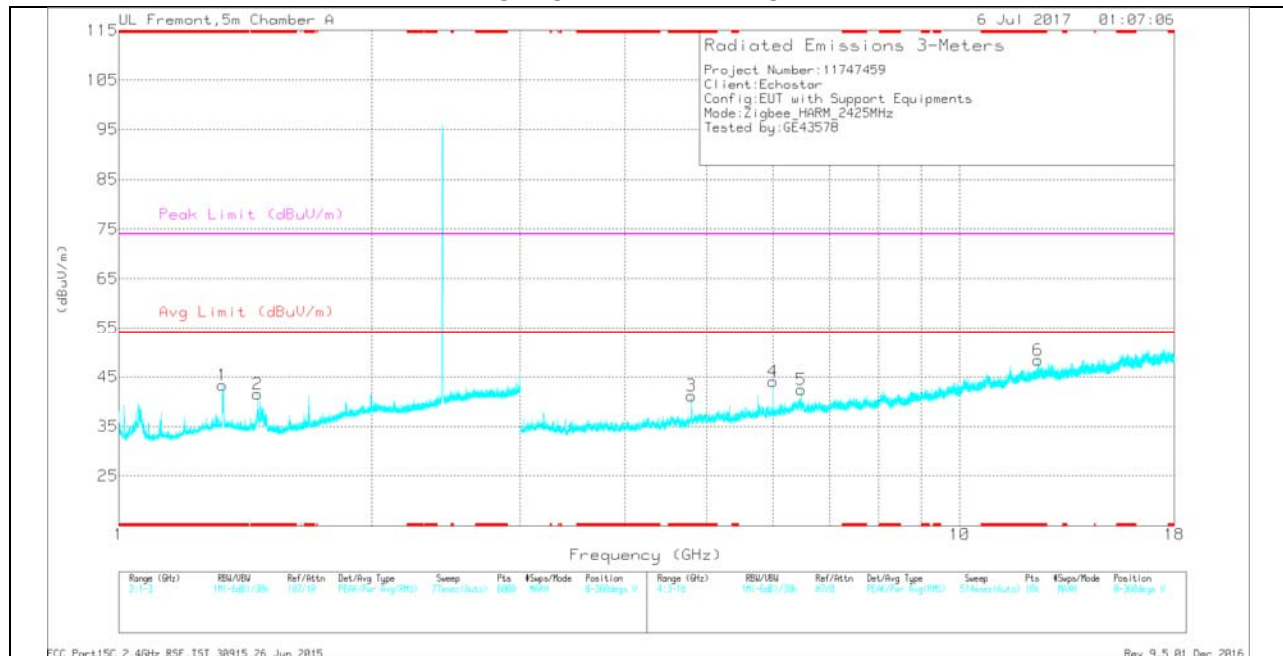
RMS - RMS detection

## HARMONICS AND SPURIOUS EMISSIONS

### LOW CHANNEL HORIZONTAL



### LOW CHANNEL VERTICAL



Note: Emission was scanned up to 26GHz; No emissions were detected above the noise floor which was at least 20dB below the specification limit.

## LOW CHANNEL DATA

### Trace Markers

| Marker | Frequency (GHz) | Meter Reading (dBuV) | Det | AF T862 (dB/m) | Amp/Cb/Filt/Pad (dB) | DC Corr (dB) | Corrected Reading (dBuV/m) | Avg Limit (dBuV/m) | Margin (dB) | Peak Limit (dBuV/m) | PK Margin (dB) | Azimuth (Degs) | Height (cm) | Polarity |
|--------|-----------------|----------------------|-----|----------------|----------------------|--------------|----------------------------|--------------------|-------------|---------------------|----------------|----------------|-------------|----------|
| 1      | * 1.328         | 37.36                | Pk  | 29.5           | -23.5                | 0            | 43.36                      | -                  | -           | 74                  | -30.64         | 0-360          | 200         | V        |
| 2      | * 1.462         | 36.17                | Pk  | 28.7           | -23.3                | 0            | 41.57                      | -                  | -           | 74                  | -32.43         | 0-360          | 101         | V        |
| 3      | * 4.799         | 34.62                | Pk  | 34.2           | -27.6                | 0            | 41.22                      | -                  | -           | 74                  | -32.78         | 0-360          | 200         | V        |
| 6      | * 12.399        | 28.36                | Pk  | 38.9           | -18.9                | 0            | 48.36                      | -                  | -           | 74                  | -25.64         | 0-360          | 200         | V        |
| 4      | 5.999           | 35.29                | Pk  | 35.3           | -26.5                | 0            | 44.09                      | -                  | -           | -                   | -              | 0-360          | 101         | V        |
| 5      | 6.479           | 30.97                | Pk  | 35.7           | -24.2                | 0            | 42.47                      | -                  | -           | -                   | -              | 0-360          | 101         | V        |

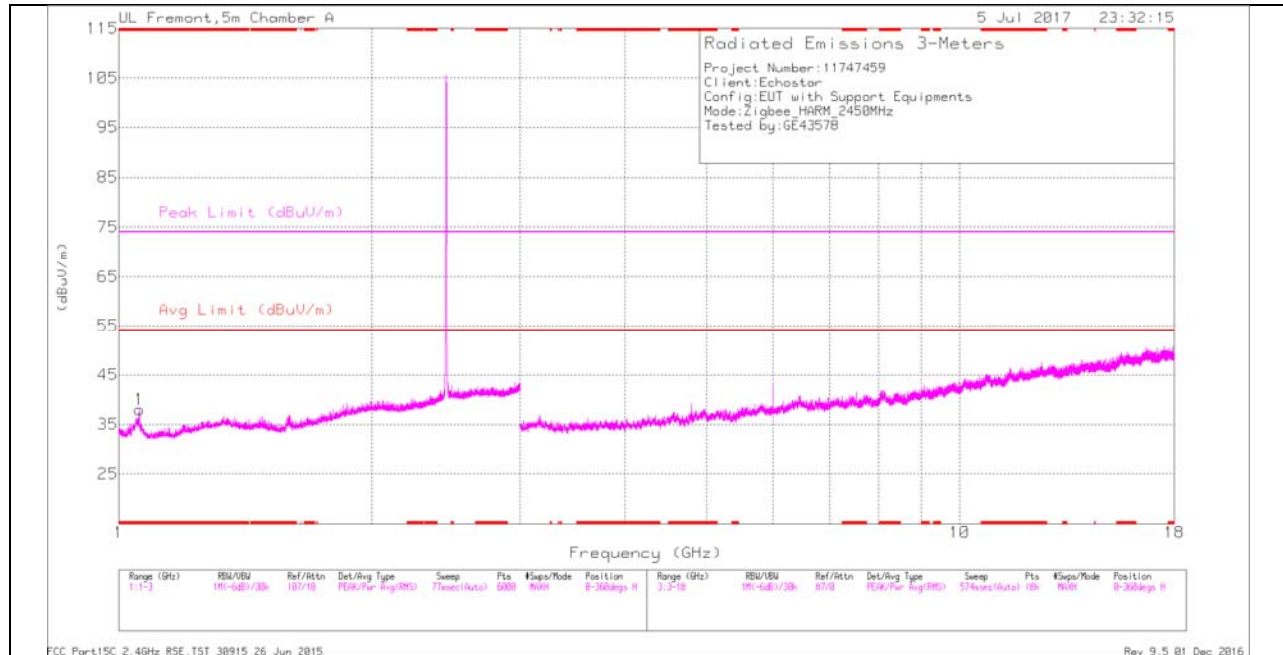
\* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band  
Pk - Peak detector

### Radiated Emissions

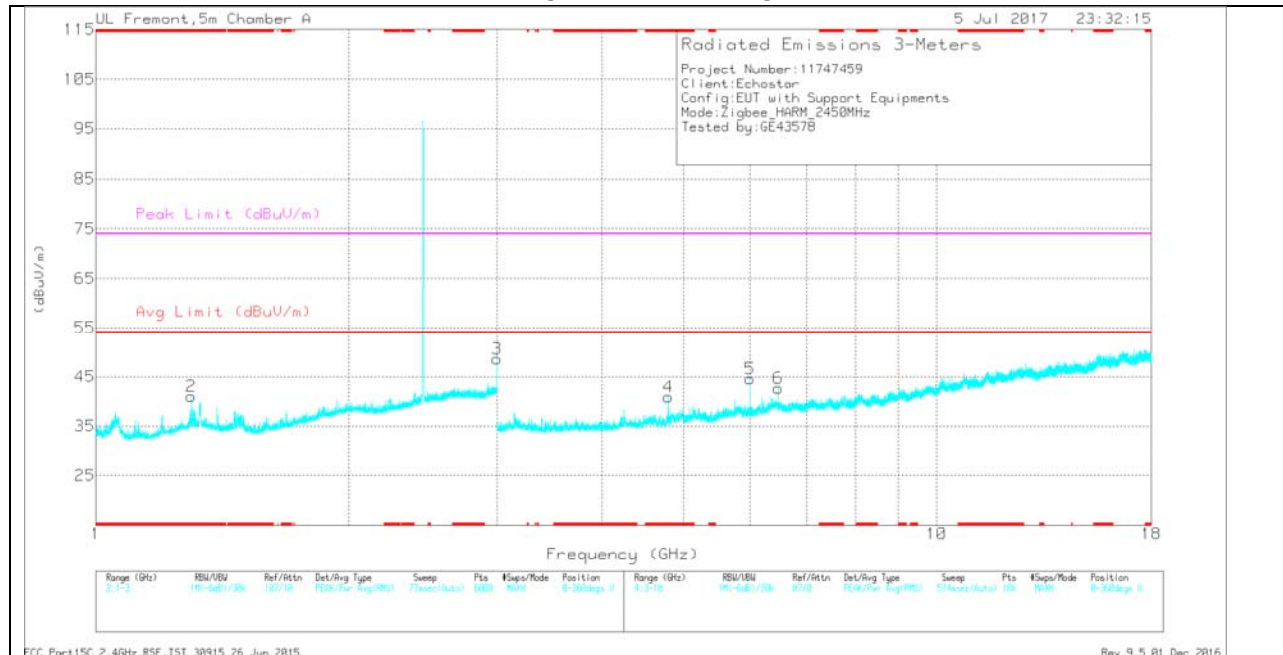
| Frequency (GHz) | Meter Reading (dBuV) | Det  | AF T862 (dB/m) | Amp/Cb/Filt/Pad (dB) | DC Corr (dB) | Corrected Reading (dBuV/m) | Avg Limit (dBuV/m) | Margin (dB) | Peak Limit (dBuV/m) | PK Margin (dB) | Azimuth (Degs) | Height (cm) | Polarity |
|-----------------|----------------------|------|----------------|----------------------|--------------|----------------------------|--------------------|-------------|---------------------|----------------|----------------|-------------|----------|
| * 1.327         | 41.79                | PK2  | 29.5           | -23.5                | 0            | 47.79                      | -                  | -           | 74                  | -26.21         | 98             | 173         | V        |
| * 1.328         | 25.35                | MAV1 | 29.5           | -23.5                | 0            | 31.35                      | 54                 | -22.65      | -                   | -              | 98             | 173         | V        |
| * 1.463         | 43.08                | PK2  | 28.7           | -23.3                | 0            | 48.48                      | -                  | -           | 74                  | -25.52         | 110            | 187         | V        |
| * 1.462         | 25.34                | MAV1 | 28.7           | -23.3                | 0            | 30.74                      | 54                 | -23.26      | -                   | -              | 110            | 187         | V        |
| * 4.8           | 39.47                | PK2  | 34.2           | -27.6                | 0            | 46.07                      | -                  | -           | 74                  | -27.93         | 164            | 201         | V        |
| * 4.8           | 30.37                | MAV1 | 34.2           | -27.6                | 0            | 36.97                      | 54                 | -17.03      | -                   | -              | 164            | 201         | V        |
| * 12.398        | 33.79                | PK2  | 38.9           | -18.9                | 0            | 53.79                      | -                  | -           | 74                  | -20.21         | 234            | 201         | V        |
| * 12.399        | 21.32                | MAV1 | 38.9           | -18.9                | 0            | 41.32                      | 54                 | -12.68      | -                   | -              | 234            | 201         | V        |
| 6               | 38.87                | PK2  | 35.3           | -26.5                | 0            | 47.67                      | -                  | -           | -                   | -              | 252            | 102         | V        |
| 6.48            | 36.26                | PK2  | 35.7           | -24.2                | 0            | 47.76                      | -                  | -           | -                   | -              | 34             | 115         | V        |

\* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band  
PK2 - KDB558074 Method: Maximum Peak  
MAV1 - KDB558074 Option 1 Maximum RMS Average

### MID CHANNEL HORIZONTAL



### MID CHANNEL VERTICAL



Note: Emission was scanned up to 26GHz; No emissions were detected above the noise floor which was at least 20dB below the specification limit.

## MID CHANNEL DATA

### Trace Markers

| Marker | Frequency (GHz) | Meter Reading (dBuV) | Det | AF T862 (dB/m) | Amp/Cbl/Filtr/Pad (dB) | DC Corr (dB) | Corrected Reading (dBuV/m) | Avg Limit (dBuV/m) | Margin (dB) | Peak Limit (dBuV/m) | PK Margin (dB) | Azimuth (Degs) | Height (cm) | Polarity |
|--------|-----------------|----------------------|-----|----------------|------------------------|--------------|----------------------------|--------------------|-------------|---------------------|----------------|----------------|-------------|----------|
| 1      | * 1.057         | 34.74                | Pk  | 27.2           | -24                    | 0            | 37.94                      | -                  | -           | 74                  | -36.06         | 0-360          | 101         | H        |
| 2      | * 1.299         | 35.12                | Pk  | 29.4           | -23.5                  | 0            | 41.02                      | -                  | -           | 74                  | -32.98         | 0-360          | 200         | V        |
| 4      | * 4.8           | 34.31                | Pk  | 34.2           | -27.6                  | 0            | 40.91                      | -                  | -           | 74                  | -33.09         | 0-360          | 200         | V        |
| 3      | 3               | 37.8                 | Pk  | 32.3           | -21.5                  | 0            | 48.6                       | -                  | -           | -                   | -              | 0-360          | 101         | V        |
| 5      | 6               | 35.78                | Pk  | 35.3           | -26.5                  | 0            | 44.58                      | -                  | -           | -                   | -              | 0-360          | 101         | V        |
| 6      | 6.479           | 31.15                | Pk  | 35.7           | -24.2                  | 0            | 42.65                      | -                  | -           | -                   | -              | 0-360          | 200         | V        |

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

Pk - Peak detector

### Radiated Emissions

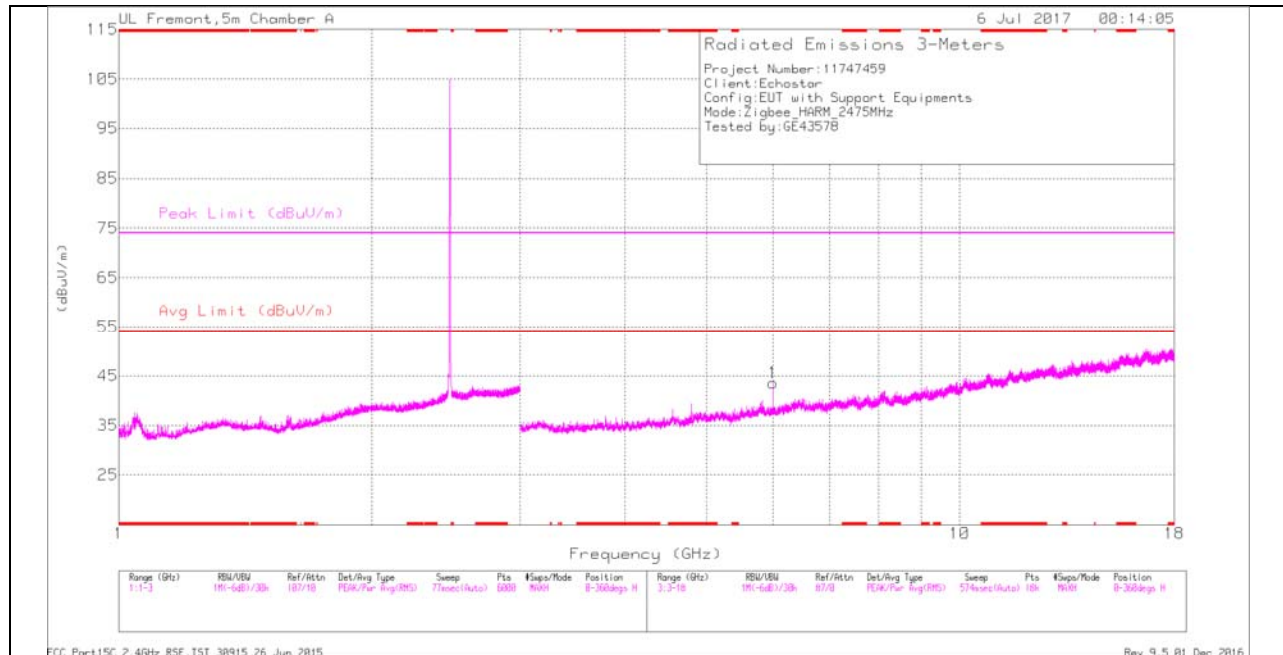
| Frequency (GHz) | Meter Reading (dBuV) | Det  | AF T862 (dB/m) | Amp/Cbl/Filtr/Pad (dB) | DC Corr (dB) | Corrected Reading (dBuV/m) | Avg Limit (dBuV/m) | Margin (dB) | Peak Limit (dBuV/m) | PK Margin (dB) | Azimuth (Degs) | Height (cm) | Polarity |
|-----------------|----------------------|------|----------------|------------------------|--------------|----------------------------|--------------------|-------------|---------------------|----------------|----------------|-------------|----------|
| * 1.057         | 43.57                | PK2  | 27.2           | -24                    | 0            | 46.77                      | -                  | -           | 74                  | -27.23         | 62             | 309         | H        |
| * 1.057         | 27.45                | MAv1 | 27.2           | -24                    | 0            | 30.65                      | 54                 | -23.35      | -                   | -              | 62             | 309         | H        |
| * 1.299         | 48.03                | PK2  | 29.4           | -23.5                  | 0            | 53.93                      | -                  | -           | 74                  | -20.07         | 192            | 192         | V        |
| * 1.299         | 24.07                | MAv1 | 29.4           | -23.5                  | 0            | 29.97                      | 54                 | -24.03      | -                   | -              | 192            | 192         | V        |
| * 4.8           | 40.36                | PK2  | 34.2           | -27.6                  | 0            | 46.96                      | -                  | -           | 74                  | -27.04         | 295            | 235         | V        |
| * 4.8           | 31.42                | MAv1 | 34.2           | -27.6                  | 0            | 38.02                      | 54                 | -15.98      | -                   | -              | 295            | 235         | V        |
| 3               | 37.61                | PK2  | 32.3           | -21.5                  | 0            | 48.41                      | -                  | -           | -                   | -              | 87             | 369         | V        |
| 6               | 38.38                | PK2  | 35.3           | -26.5                  | 0            | 47.18                      | -                  | -           | -                   | -              | 124            | 103         | V        |
| 6.48            | 37.15                | PK2  | 35.7           | -24.2                  | 0            | 48.65                      | -                  | -           | -                   | -              | 107            | 206         | V        |

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

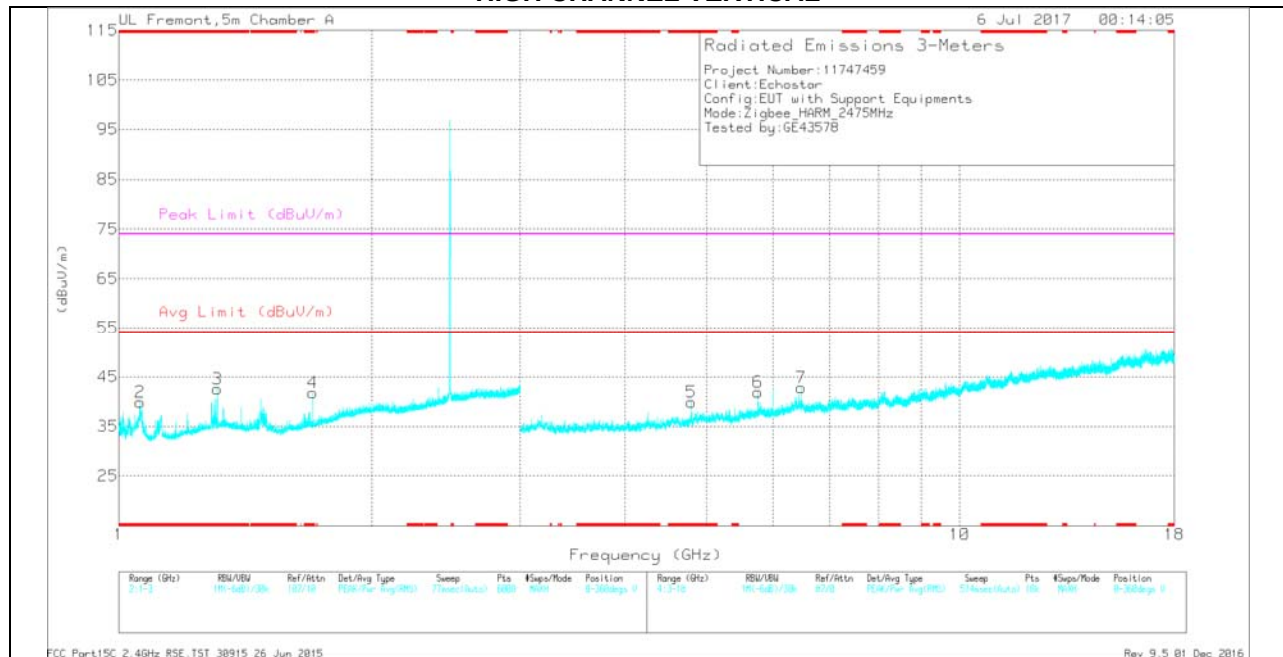
PK2 - KDB558074 Method: Maximum Peak

MAv1 - KDB558074 Option 1 Maximum RMS Average

### HIGH CHANNEL HORIZONTAL



### HIGH CHANNEL VERTICAL



Note: Emission was scanned up to 26GHz; No emissions were detected above the noise floor which was at least 20dB below the specification limit.

## HIGH CHANNEL DATA

### Trace Markers

| Marker | Frequency (GHz) | Meter Reading (dBuV) | Det | AF T862 (dB/m) | Amp/Cbl/Filtr/Pad (dB) | DC Corr (dB) | Corrected Reading (dBuV/m) | Avg Limit (dBuV/m) | Margin (dB) | Peak Limit (dBuV/m) | PK Margin (dB) | Altitude (Degs) | Height (cm) | Polarity |
|--------|-----------------|----------------------|-----|----------------|------------------------|--------------|----------------------------|--------------------|-------------|---------------------|----------------|-----------------|-------------|----------|
| 2      | * 1.059         | 36.64                | Pk  | 27.2           | -24                    | 0            | 39.84                      | -                  | -           | 74                  | -34.16         | 0-360           | 101         | V        |
| 3      | * 1.309         | 36.7                 | Pk  | 29.4           | -23.6                  | 0            | 42.5                       | -                  | -           | 74                  | -31.5          | 0-360           | 200         | V        |
| 4      | * 1.701         | 36.09                | Pk  | 29             | -23.3                  | 0            | 41.79                      | -                  | -           | 74                  | -32.21         | 0-360           | 200         | V        |
| 5      | * 4.799         | 33.27                | Pk  | 34.2           | -27.6                  | 0            | 39.87                      | -                  | -           | 74                  | -34.13         | 0-360           | 200         | V        |
| 6      | 5.76            | 32.96                | Pk  | 35             | -26                    | 0            | 41.96                      | -                  | -           | -                   | -              | 0-360           | 200         | V        |
| 1      | 5.999           | 34.81                | Pk  | 35.3           | -26.5                  | 0            | 43.61                      | -                  | -           | -                   | -              | 0-360           | 199         | H        |
| 7      | 6.48            | 31.35                | Pk  | 35.7           | -24.2                  | 0            | 42.85                      | -                  | -           | -                   | -              | 0-360           | 200         | V        |

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

Pk - Peak detector

### Radiated Emissions

| Frequency (GHz) | Meter Reading (dBuV) | Det  | AF T862 (dB/m) | Amp/Cbl/Filtr/Pad (dB) | DC Corr (dB) | Corrected Reading (dBuV/m) | Avg Limit (dBuV/m) | Margin (dB) | Peak Limit (dBuV/m) | PK Margin (dB) | Altitude (Degs) | Height (cm) | Polarity |
|-----------------|----------------------|------|----------------|------------------------|--------------|----------------------------|--------------------|-------------|---------------------|----------------|-----------------|-------------|----------|
| * 1.06          | 45.08                | PK2  | 27.2           | -24                    | 0            | 48.28                      | -                  | -           | 74                  | -25.72         | 97              | 101         | V        |
| * 1.059         | 26.27                | MAV1 | 27.2           | -24                    | 0            | 29.47                      | 54                 | -24.53      | -                   | -              | 97              | 101         | V        |
| * 1.309         | 36.11                | PK2  | 29.4           | -23.6                  | 0            | 41.91                      | -                  | -           | 74                  | -32.09         | 8               | 239         | V        |
| * 1.309         | 24.12                | MAV1 | 29.4           | -23.6                  | 0            | 29.92                      | 54                 | -24.08      | -                   | -              | 8               | 239         | V        |
| * 1.701         | 37.45                | PK2  | 29             | -23.3                  | 0            | 43.15                      | -                  | -           | 74                  | -30.85         | 223             | 389         | V        |
| * 1.701         | 24.65                | MAV1 | 29             | -23.3                  | 0            | 30.35                      | 54                 | -23.65      | -                   | -              | 223             | 389         | V        |
| * 4.8           | 39.14                | PK2  | 34.2           | -27.6                  | 0            | 45.74                      | -                  | -           | 74                  | -28.26         | 298             | 175         | V        |
| * 4.8           | 29.17                | MAV1 | 34.2           | -27.6                  | 0            | 35.77                      | 54                 | -18.23      | -                   | -              | 298             | 175         | V        |
| 5.759           | 35.59                | PK2  | 35             | -26                    | 0            | 44.59                      | -                  | -           | -                   | -              | 161             | 201         | V        |
| 6               | 40.4                 | PK2  | 35.3           | -26.5                  | 0            | 49.2                       | -                  | -           | -                   | -              | 286             | 245         | H        |
| 6.48            | 36.72                | PK2  | 35.7           | -24.2                  | 0            | 48.22                      | -                  | -           | -                   | -              | 109             | 201         | V        |

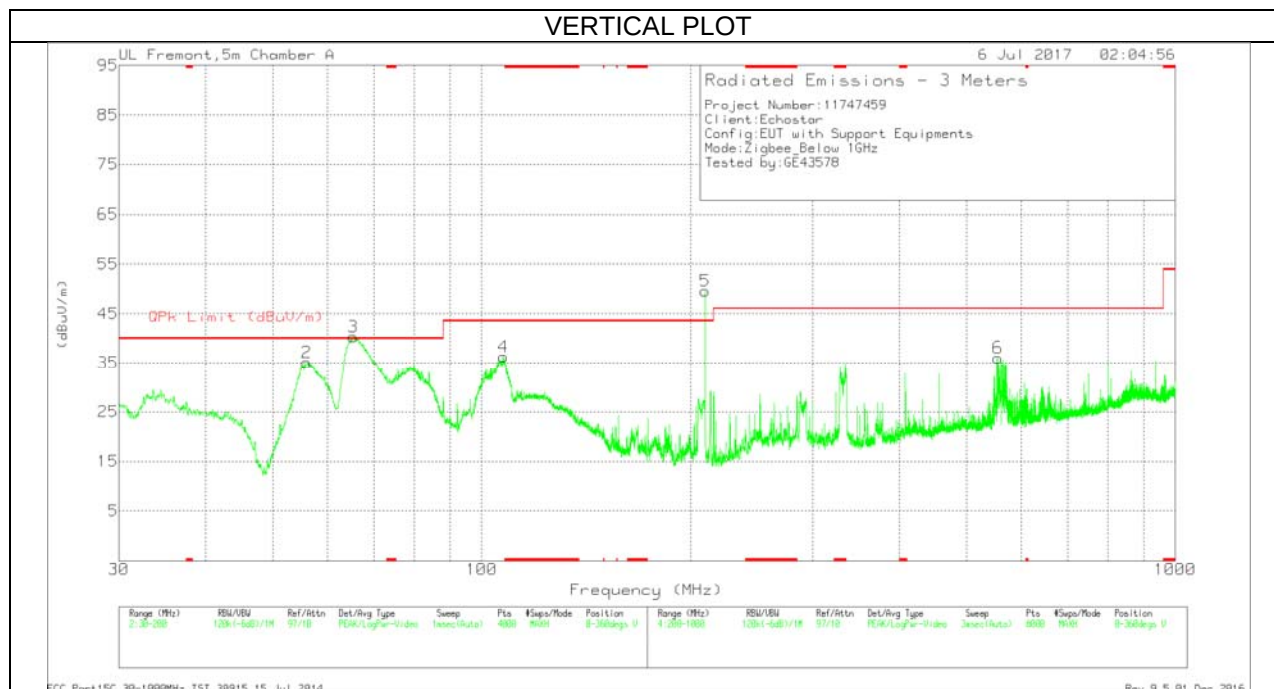
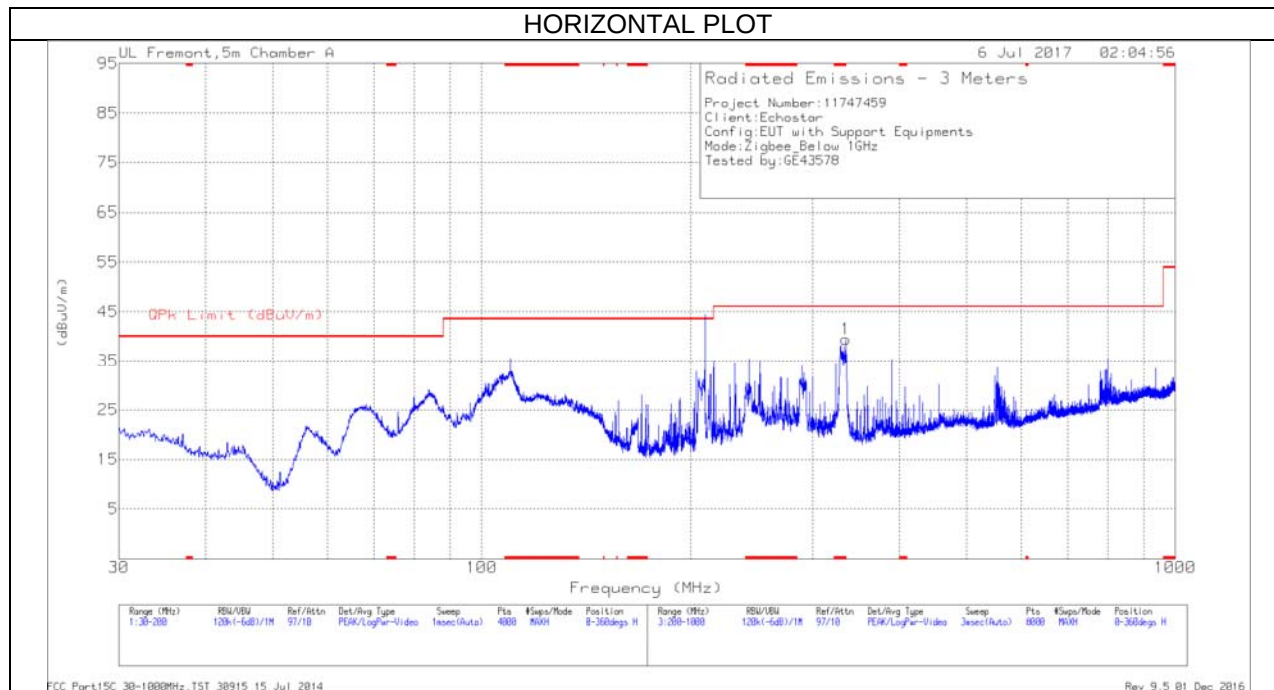
\* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band

PK2 - KDB558074 Method: Maximum Peak

MAV1 - KDB558074 Option 1 Maximum RMS Average

## 9.2. WORST-CASE BELOW 1 GHz

### SPURIOUS EMISSIONS 30 TO 1000 MHz (WORST-CASE CONFIGURATION)



**BELOW 1 GHz TABLE**

**Radiated Emissions**

| Marker | Frequency (MHz) | Meter Reading (dBuV) | Det | AF T130 (dB/m) | Amp/Cbl (dB/m) | Corrected Reading (dBuV/m) | QPk Limit (dBuV/m) | Margin (dB) | Azimuth (Degs) | Height (cm) | Polarity |
|--------|-----------------|----------------------|-----|----------------|----------------|----------------------------|--------------------|-------------|----------------|-------------|----------|
| 1      | * 335.295       | 41                   | Qp  | 18             | -29.2          | 29.8                       | 46.02              | -16.22      | 335            | 102         | H        |
| 2      | 56.1175         | 50.62                | Qp  | 11.2           | -30.9          | 30.92                      | 40                 | -9.08       | 191            | 133         | V        |
| 3      | 65.5097         | 52.49                | Qp  | 12.4           | -30.8          | 34.09                      | 40                 | -5.91       | 222            | 115         | V        |
| 4      | 107.3927        | 45.26                | Qp  | 16.1           | -30.5          | 30.86                      | 43.52              | -12.66      | 181            | 100         | V        |
| 5      | 209.9743        | 50.97                | Qp  | 14.5           | -29.9          | 35.57                      | 43.52              | -7.95       | 31             | 102         | V        |
| 6      | 554.9739        | 36.49                | Qp  | 22.4           | -28.6          | 30.29                      | 46.02              | -15.73      | 29             | 124         | V        |

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

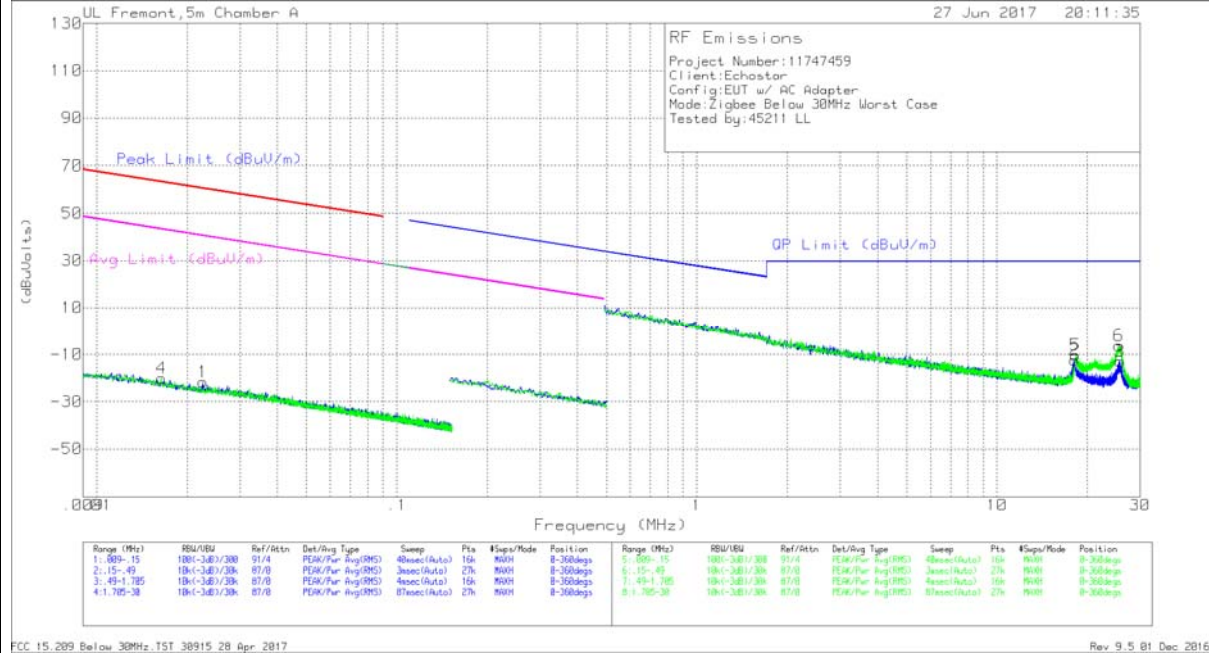
Pk - Peak detector

Qp - Quasi-Peak detector

### 9.3. WORST-CASE BELOW 30 MHz

#### SPURIOUS EMISSIONS BELOW 30 MHz (WORST-CASE CONFIGURATION)

##### HORIZONTAL AND VERTICAL PLOTS



NOTE: KDB 937606 OATS and Chamber Correlation Justification

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

##### Trace Markers

| Marker | Frequency (MHz) | Meter Reading (dBuV) | Det | Loop Antenna (dB/m) | Cbl (dB) | Dist Corr 300m | Corrected Reading (dBuVolts) | Peak Limit (dBuV/m) | Margin (dB) | Avg Limit (dBuV/m) | Margin (dB) | Azimuth (Degs) |
|--------|-----------------|----------------------|-----|---------------------|----------|----------------|------------------------------|---------------------|-------------|--------------------|-------------|----------------|
| 4      | .01643          | 43.03                | Pk  | 16.8                | .1       | -80            | -20.07                       | 63.27               | -83.34      | 43.27              | -63.34      | 0-360          |
| 1      | .02263          | 43.19                | Pk  | 15                  | .1       | -80            | -21.71                       | 60.49               | -82.2       | 40.49              | -62.2       | 0-360          |

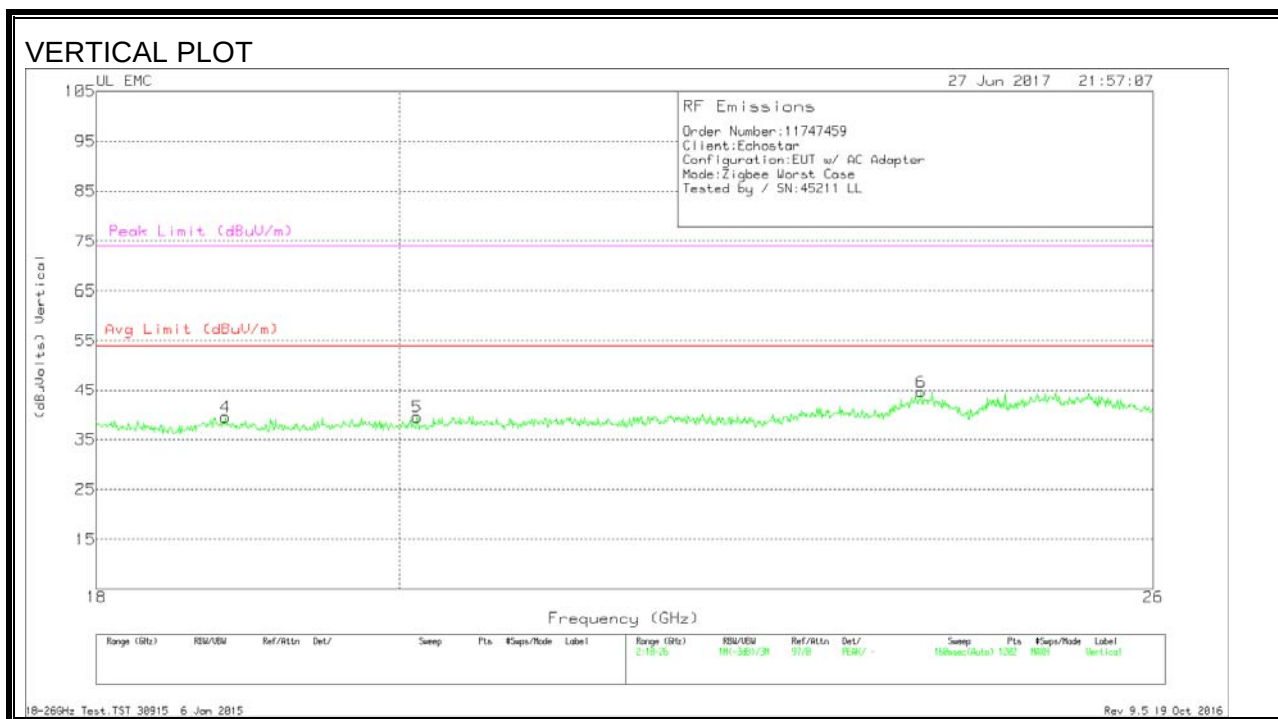
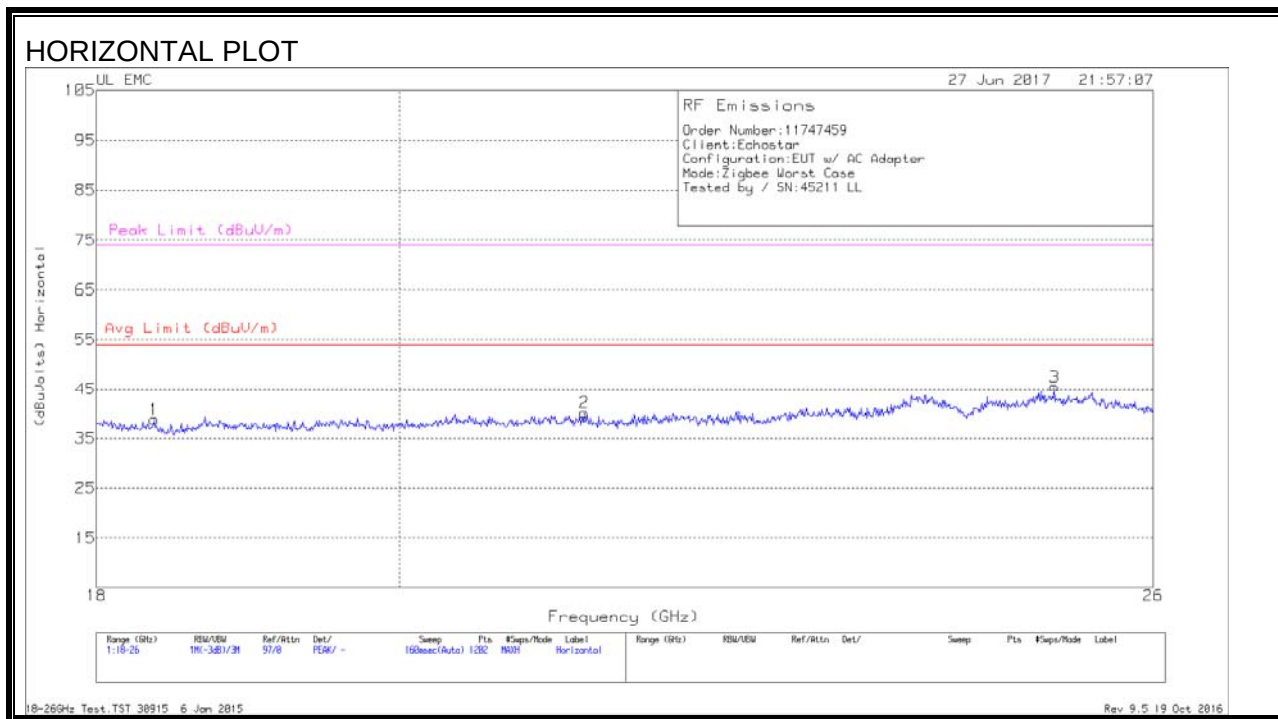
##### Pk - Peak detector

| Marker | Frequency (MHz) | Meter Reading (dBuV) | Det | Loop Antenna (dB/m) | Cbl (dB) | Dist Corr 30m | Corrected Reading (dBuVolts) | QP Limit (dBuV/m) | Margin (dB) | Peak Limit (dBuV/m) | Margin (dB) | Avg Limit (dBuV/m) | Margin (dB) | Azimuth (Degs) |
|--------|-----------------|----------------------|-----|---------------------|----------|---------------|------------------------------|-------------------|-------------|---------------------|-------------|--------------------|-------------|----------------|
| 2      | 18.12349        | 17.09                | Pk  | 9.9                 | .6       | -40           | -12.41                       | 29.5              | -41.91      | -                   | -           | -                  | -           | 0-360          |
| 5      | 18.26026        | 19.26                | Pk  | 9.9                 | .6       | -40           | -10.24                       | 29.5              | -39.74      | -                   | -           | -                  | -           | 0-360          |
| 6      | 25.41862        | 24.25                | Pk  | 8.8                 | .7       | -40           | -6.25                        | 29.5              | -35.75      | -                   | -           | -                  | -           | 0-360          |
| 3      | 25.6759         | 17.63                | Pk  | 8.8                 | .7       | -40           | -12.87                       | 29.5              | -42.37      | -                   | -           | -                  | -           | 0-360          |

##### Pk - Peak detector

## 9.4. WORST-CASE 18 to 26 GHz

### SPURIOUS EMISSIONS 18 TO 26 GHz (WORST-CASE CONFIGURATION, HORIZONTAL & VERTICAL)



## Trace Markers

| Marker | Frequency (GHz) | Meter Reading (dBuV) | Det | T449 AF (dB/m) | Amp/Cbl (dB) | Dist Corr (dB) | Corrected Reading (dBuVolts) | Avg Limit (dBuV/m) | Margin (dB) | Peak Limit (dBuV/m) | PK Margin (dB) |
|--------|-----------------|----------------------|-----|----------------|--------------|----------------|------------------------------|--------------------|-------------|---------------------|----------------|
| 1      | 18.366          | 41.13                | Pk  | 32.3           | -25.1        | -9.5           | 38.83                        | 54                 | -15.17      | 74                  | -35.17         |
| 2      | 21.331          | 41.77                | Pk  | 33.1           | -25.2        | -9.5           | 40.17                        | 54                 | -13.83      | 74                  | -33.83         |
| 3      | 25.121          | 45.3                 | Pk  | 34.3           | -24.6        | -9.5           | 45.5                         | 54                 | -8.5        | 74                  | -28.5          |
| 4      | 18.826          | 41.6                 | Pk  | 32.4           | -25          | -9.5           | 39.5                         | 54                 | -14.5       | 74                  | -34.5          |
| 5      | 20.125          | 41.4                 | Pk  | 32.8           | -25.2        | -9.5           | 39.5                         | 54                 | -14.5       | 74                  | -34.5          |
| 6      | 23.982          | 44.57                | Pk  | 33.9           | -24.3        | -9.5           | 44.67                        | 54                 | -9.33       | 74                  | -29.33         |

Pk - Peak detector

## 10. AC POWER LINE CONDUCTED EMISSIONS

### LIMITS

FCC §15.207 (a)

RSS-Gen 8.8

| Frequency of Emission (MHz) | Conducted Limit (dBuV) |          |
|-----------------------------|------------------------|----------|
|                             | Quasi-peak             | Average  |
| 0.15 – 0.5                  | 66 to 56               | 56 to 46 |
| 0.5 - 5                     | 56                     | 46       |
| 5 - 30                      | 60                     | 50       |

### TEST PROCEDURE

The EUT is placed on a non-conducting table 40 cm from the vertical ground plane and 80 cm above the horizontal ground plane. The EUT is configured in accordance with ANSI C63.10.

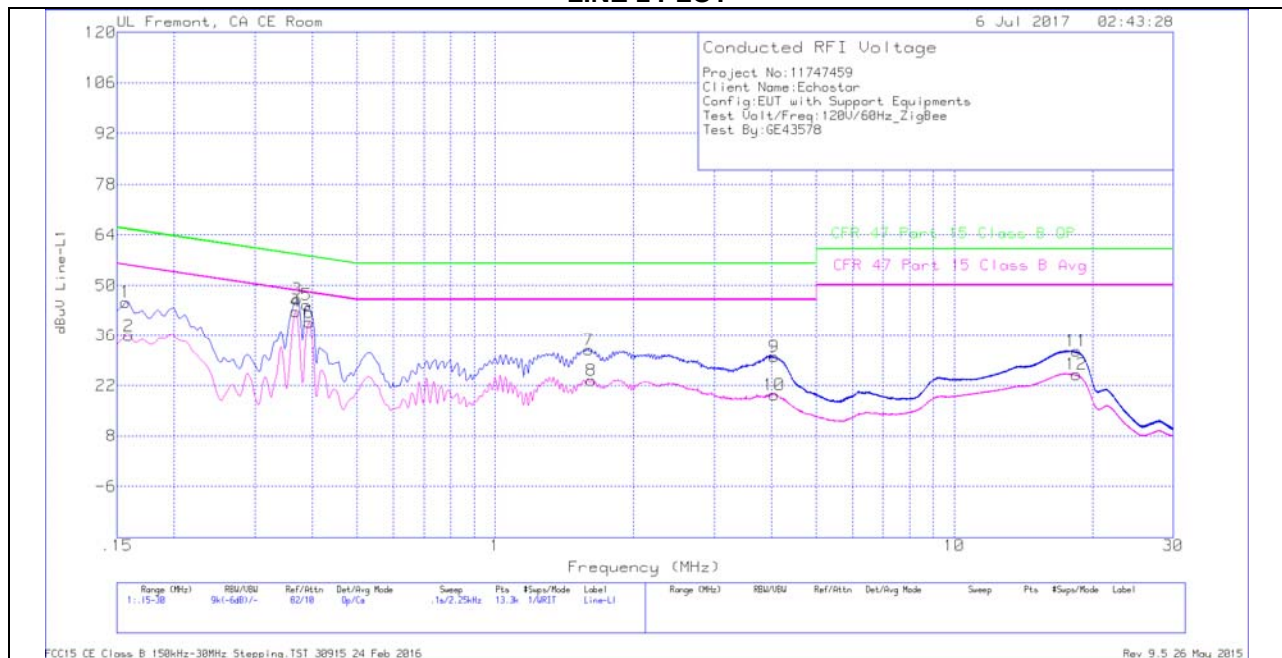
The receiver is set to a resolution bandwidth of 9 kHz. Peak detection is used unless otherwise noted as quasi-peak or average.

Line conducted data is recorded for both NEUTRAL and HOT lines.

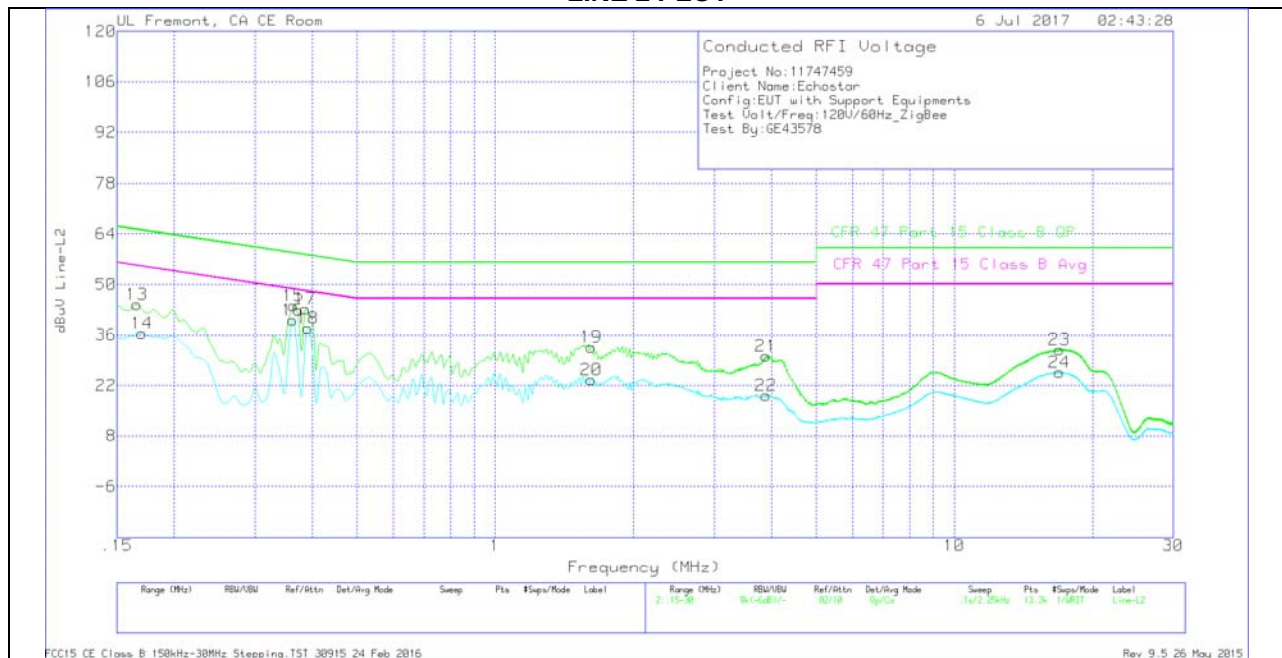
### RESULTS

## 6 WORST EMISSIONS

LINE 1 PLOT



LINE 2 PLOT



## LINE 1 and 2 RESULT

### Trace Markers

| Range 1: Line-L1 .15 - 30MHz |                 |                      |     |         |                 |              |                        |                           |                |                            |                       |
|------------------------------|-----------------|----------------------|-----|---------|-----------------|--------------|------------------------|---------------------------|----------------|----------------------------|-----------------------|
| Marker                       | Frequency (MHz) | Meter Reading (dBuV) | Det | LISN L1 | LC Cables C1&C3 | Limiter (dB) | Corrected Reading dBuV | CFR 47 Part 15 Class B QP | QP Margin (dB) | CFR 47 Part 15 Class B Avg | Av(CISPR) Margin (dB) |
| 1                            | .15675          | 35.09                | Qp  | .1      | .1              | 10.1         | 45.39                  | 65.63                     | -20.24         | -                          | -                     |
| 2                            | .159            | 25.56                | Ca  | .1      | .1              | 10.1         | 35.86                  | -                         | -              | 55.52                      | -19.66                |
| 3                            | .3705           | 35.93                | Qp  | 0       | .1              | 10.1         | 46.13                  | 58.49                     | -12.36         | -                          | -                     |
| 4                            | .36825          | 32.54                | Ca  | 0       | .1              | 10.1         | 42.74                  | -                         | -              | 48.54                      | -5.8                  |
| 5                            | .3885           | 34.4                 | Qp  | 0       | .1              | 10.1         | 44.6                   | 58.1                      | -13.5          | -                          | -                     |
| 6                            | .393            | 29.56                | Ca  | 0       | .1              | 10.1         | 39.76                  | -                         | -              | 48                         | -8.24                 |
| 7                            | 1.599           | 21.66                | Qp  | 0       | .1              | 10.1         | 31.86                  | 56                        | -24.14         | -                          | -                     |
| 8                            | 1.6215          | 13.27                | Ca  | 0       | .1              | 10.1         | 23.47                  | -                         | -              | 46                         | -22.53                |
| 9                            | 4.047           | 19.87                | Qp  | 0       | .1              | 10.1         | 30.07                  | 56                        | -25.93         | -                          | -                     |
| 10                           | 4.056           | 9.24                 | Ca  | 0       | .1              | 10.1         | 19.44                  | -                         | -              | 46                         | -26.56                |
| 11                           | 18.447          | 20.96                | Qp  | 0       | .3              | 10.3         | 31.56                  | 60                        | -28.44         | -                          | -                     |
| 12                           | 18.447          | 14.46                | Ca  | 0       | .3              | 10.3         | 25.06                  | -                         | -              | 50                         | -24.94                |

Qp - Quasi-Peak detector

Ca - CISPR average detection

| Range 2: Line-L2 .15 - 30MHz |                 |                      |     |         |                 |              |                        |                           |                |                            |                       |
|------------------------------|-----------------|----------------------|-----|---------|-----------------|--------------|------------------------|---------------------------|----------------|----------------------------|-----------------------|
| Marker                       | Frequency (MHz) | Meter Reading (dBuV) | Det | LISN L2 | LC Cables C2&C3 | Limiter (dB) | Corrected Reading dBuV | CFR 47 Part 15 Class B QP | QP Margin (dB) | CFR 47 Part 15 Class B Avg | Av(CISPR) Margin (dB) |
| 13                           | .16575          | 34.34                | Qp  | 0       | 0               | 10.1         | 44.44                  | 65.17                     | -20.73         | -                          | -                     |
| 14                           | .17025          | 26.26                | Ca  | 0       | .1              | 10.1         | 36.46                  | -                         | -              | 54.95                      | -18.49                |
| 15                           | .36375          | 33.84                | Qp  | 0       | .1              | 10.1         | 44.04                  | 58.64                     | -14.6          | -                          | -                     |
| 16                           | .36262          | 29.92                | Ca  | 0       | .1              | 10.1         | 40.12                  | -                         | -              | 48.67                      | -8.55                 |
| 17                           | .38625          | 32.96                | Qp  | 0       | .1              | 10.1         | 43.16                  | 58.14                     | -14.98         | -                          | -                     |
| 18                           | .39075          | 27.65                | Ca  | 0       | .1              | 10.1         | 37.85                  | -                         | -              | 48.05                      | -10.2                 |
| 19                           | 1.61925         | 22.41                | Qp  | 0       | .1              | 10.1         | 32.61                  | 56                        | -23.39         | -                          | -                     |
| 20                           | 1.6215          | 13.45                | Ca  | 0       | .1              | 10.1         | 23.65                  | -                         | -              | 46                         | -22.35                |
| 21                           | 3.88725         | 19.96                | Qp  | 0       | .1              | 10.1         | 30.16                  | 56                        | -25.84         | -                          | -                     |
| 22                           | 3.8895          | 9.04                 | Ca  | 0       | .1              | 10.1         | 19.24                  | -                         | -              | 46                         | -26.76                |
| 23                           | 16.953          | 21.43                | Qp  | 0       | .2              | 10.3         | 31.93                  | 60                        | -28.07         | -                          | -                     |
| 24                           | 16.95975        | 15.14                | Ca  | 0       | .2              | 10.3         | 25.64                  | -                         | -              | 50                         | -24.36                |

Qp - Quasi-Peak detector

Ca - CISPR average detection