**FCC 47 CFR PART 15 SUBPART C**
**INDUSTRY CANADA RSS-247 ISSUE 1**

# BLUETOOTH LOW ENERGY CERTIFICATION TEST REPORT

**FOR**

**TABLET DEVICE**

**MODEL NUMBER: A1538**

**FCC ID: BCGA1538**
**IC: 579C-A1538**

**REPORT NUMBER: 14U19186-E2, REVISION C**

**ISSUE DATE: JUNE 17, 2015**

*Prepared for*
**APPLE, INC.**
**1 INFINITE LOOP**
**CUPERTINO, CA 95014, U.S.A.**

*Prepared by*
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NVLAP LAB CODE 200065-0

## Revision History

| Rev. | Issue Date | Revisions | Revised By |
|---|---|---|---|
| -- | 04/21/2015 | Initial Issue | M. Mekuria |
| A | 05/04/2015 | Revised report to address TCB's question | T. Chu |
| B | 06/01/2015 | Revised report to RSS-247 standard, updated Section 2 and Section 7.1 | T. Chu |
| C | 06/17/2015 | Updated Section 7.1 KDB version | T. Chu |


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# 1. ATTESTATION OF TEST RESULTS

**COMPANY NAME:** APPLE, INC.
1 INFINITE LOOP
CUPERTINO, CA 95014, U.S.A.

**EUT DESCRIPTION:** TABLET DEVICE

**MODEL:** A1538**Error! Reference source not found.**

**SERIAL NUMBER:** F4KP600FGJJT (CONDUCTED); F4KP606TGJJV (RADIATED);

**DATE TESTED:** FEBRUARY 17, 2015 – MARCH 11, 2015

| APPLICABLE STANDARDS | |
|---|---|
| **STANDARD** | **TEST RESULTS** |
| CFR 47 Part 15 Subpart C | Pass |
| INDUSTRY CANADA RSS-247 Issue 1 | Pass |
| INDUSTRY CANADA RSS-GEN Issue 4 | 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 revisions section. Any alteration of this document not carried out by UL Verification Services Inc. will constitute fraud and shall nullify the document. This report must not be used by the client to claim product certification, approval, or endorsement by NVLAP, NIST, any agency of the Federal Government, or any agency of any government.

Approved & Released For
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Tested By:

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EMC ENGINEER
UL VERIFICATION SERVICES INC.


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# 2. TEST METHODOLOGY

The tests documented in this report were performed in accordance with FCC CFR 47 Part 2, FCC CFR 47 Part 15, RSS-GEN Issue 4, and RSS-247 Issue 1, and ANSI C63.10-2009 for FCC test and ANSI C63.10-2013 with deviation of measurement height of 0.8m rather than 1.5m for IC test.

# 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 |
|---|---|
| ☐ Chamber A | ☒ Chamber D |
| ☐ Chamber B | ☐ Chamber E |
| ☐ Chamber C | ☐ Chamber F |
| | ☐ Chamber G |
| | ☐ Chamber H |

The above test sites and facilities are covered under FCC Test Firm Registration # 208313. Chambers A through H are covered under Industry Canada company address code 2324B with site numbers 2324B -1 through 2324B-8, respectively.

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


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# 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:

Field Strength (dBuV/m) = Measured Voltage (dBuV) + Antenna Factor (dB/m) + Cable Loss (dB) – Preamp Gain (dB)

36.5 dBuV + 18.7 dB/m + 0.6 dB – 26.9 dB = 28.9 dBuV/m

## 4.3. MEASUREMENT UNCERTAINTY

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

| PARAMETER | UNCERTAINTY |
|---|---|
| Conducted Disturbance, 0.15 to 30 MHz | ± 3.52 dB |
| Radiated Disturbance, 30 to 1000 MHz | ± 4.94 dB |
| Radiated Disturbance, 1 to 6 GHz | ± 3.86 dB |
| Radiated Disturbance, 6 to 18 GHz | ± 4.23 dB |
| Radiated Disturbance, 18 to 26 GHz | ± 5.30 dB |
| Radiated Disturbance, 26 to 40 GHz | ± 5.23 dB |

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


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# 5. EQUIPMENT UNDER TEST

## 5.1. DESCRIPTION OF EUT

The EUT is a tablet with multimedia functions (music, application support, and video), IEEE 802.11a/b/g/n/ac radio, and Bluetooth radio. The rechargeable battery is not user accessible

## 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) |
|---|---|---|---|
| 2402 - 2480 | BLE | 7.72 | 5.92 |

## 5.3. DESCRIPTION OF AVAILABLE ANTENNAS

| Frequency Band (GHz) | Antenna Gain |
|---|---|
| | Antenna B |
| 2.4 | 2.00 |

## 5.4. SOFTWARE AND FIRMWARE

The firmware installed in the EUT during testing was 12H33.


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## 5.5. WORST-CASE CONFIGURATION AND MODE

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

The following configurations were investigated and EUT powered by AC/DC adapter was the worst-case scenario. AC power line and below 1G radiated tests were conducted on configuration 1.

| Configuration | Descriptions |
|---|---|
| 1 | EUT powered by AC/DC adapter via USB cable |
| 2 | EUT powered by host PC via USB cable |

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

Worst-case data rates as provided by the client were:

BLE: 1 Mbps.

There are two vendors of the WiFi/Bluetooth radio modules: variant 1 and variant 2. The Wi-Fi/Bluetooth radio modules have the same mechanical outline (e.g., the same package dimension and pin-out layout), use the same on-board antenna matching circuit, have an identical antenna structure, and are built and tested to conform to the same specifications and to operate within the same tolerances.

Baseline testing was performed on the two variants to determine the worst case on all conducted power and radiated emissions.


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## 5.6. DESCRIPTION OF TEST SETUP

**SUPPORT EQUIPMENT**

| Support Equipment List | | | | |
|---|---|---|---|---|
| Description | Manufacturer | Model | Serial Number | FCC ID |
| Laptop AC/DC adapter | Lenovo | 92P1160 | 11S92P1160Z1ZBGH798B12 | NA |
| Laptop | Lenovo | 7659 | L3-AL664 08/03 | NA |
| Earphone | Apple | NA | NA | NA |
| EUT AC/DC adapter | Apple | MD836LL/A | NA | NA |

**I/O CABLES (CONDUCTED TEST)**

| I/O Cable List | | | | | | |
|---|---|---|---|---|---|---|
| Cable No | Port | # of identical ports | Connector Type | Cable Type | Cable Length (m) | Remarks |
| 1 | Antenna | 1 | SMA | Un-Shielded | 0.2 | To spectrum Analyzer |
| 2 | USB | 1 | USB | Shielded | 1 | N/A |

**I/O CABLES (RADIATED ABOVE 1 GHZ)**

| I/O Cable List | | | | | | |
|---|---|---|---|---|---|---|
| Cable No | Port | # of identical ports | Connector Type | Cable Type | Cable Length (m) | Remarks |
| None used | | | | | | |

**I/O CABLES (AC POWER CONDUCTED TEST and below 1 GHZ)**

| I/O Cable List | | | | | | |
|---|---|---|---|---|---|---|
| Cable No | Port | # of identical ports | Connector Type | Cable Type | Cable Length (m) | Remarks |
| 1 | AC | 1 | US115 | Un-Shielded | 0.8 | NA |
| 2 | DC | 1 | lightning | Un-Shielded | 1 | NA |
| 3 | Audio | 1 | Jack | Un-Shielded | 0.5 | NA |


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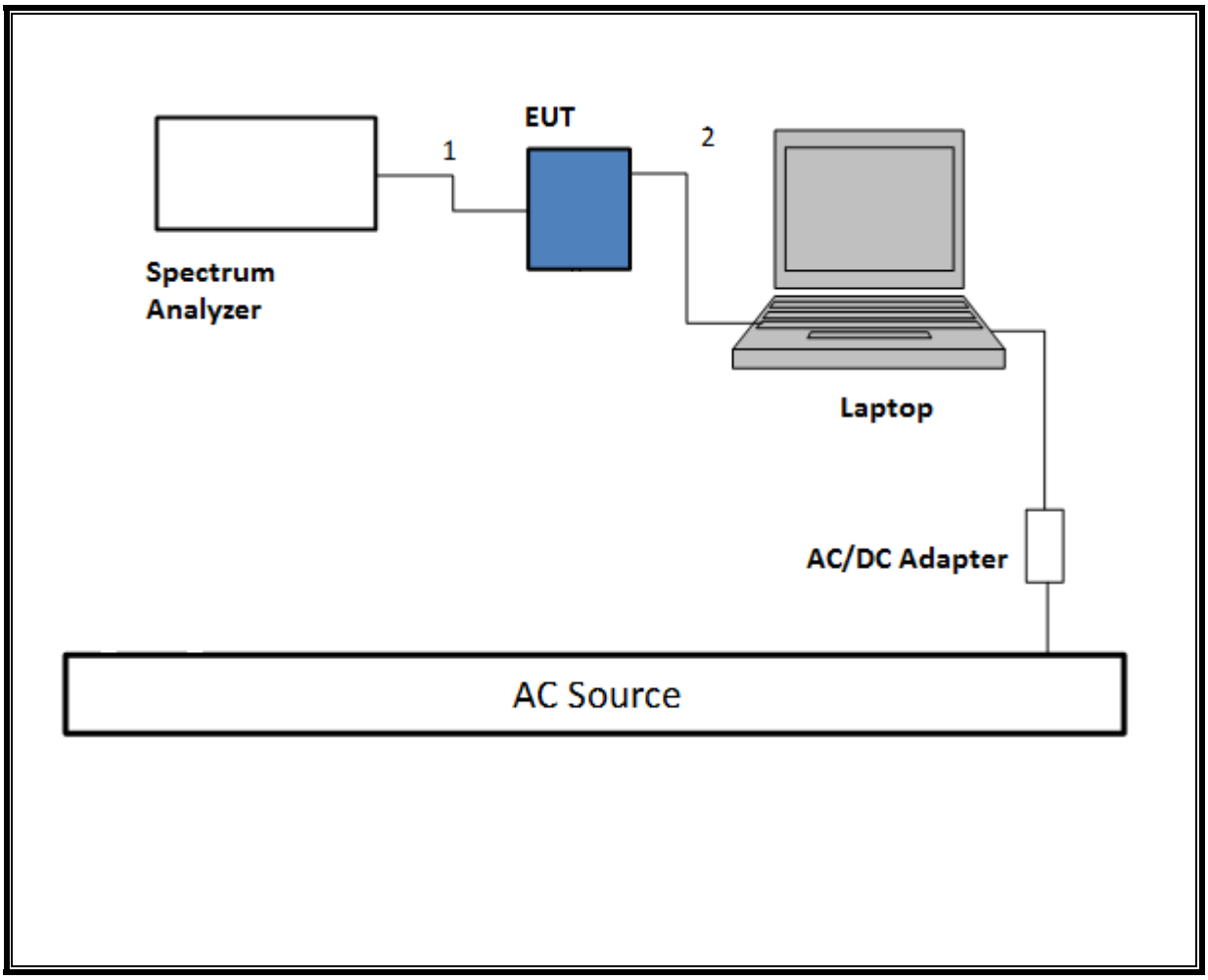
**TEST SETUP- CONDUCTED PORT**

The EUT was tested connected to a host Laptop via USB cable adapter and spectrum analyzer to antenna port. Test software exercised the EUT.

**SETUP DIAGRAM**





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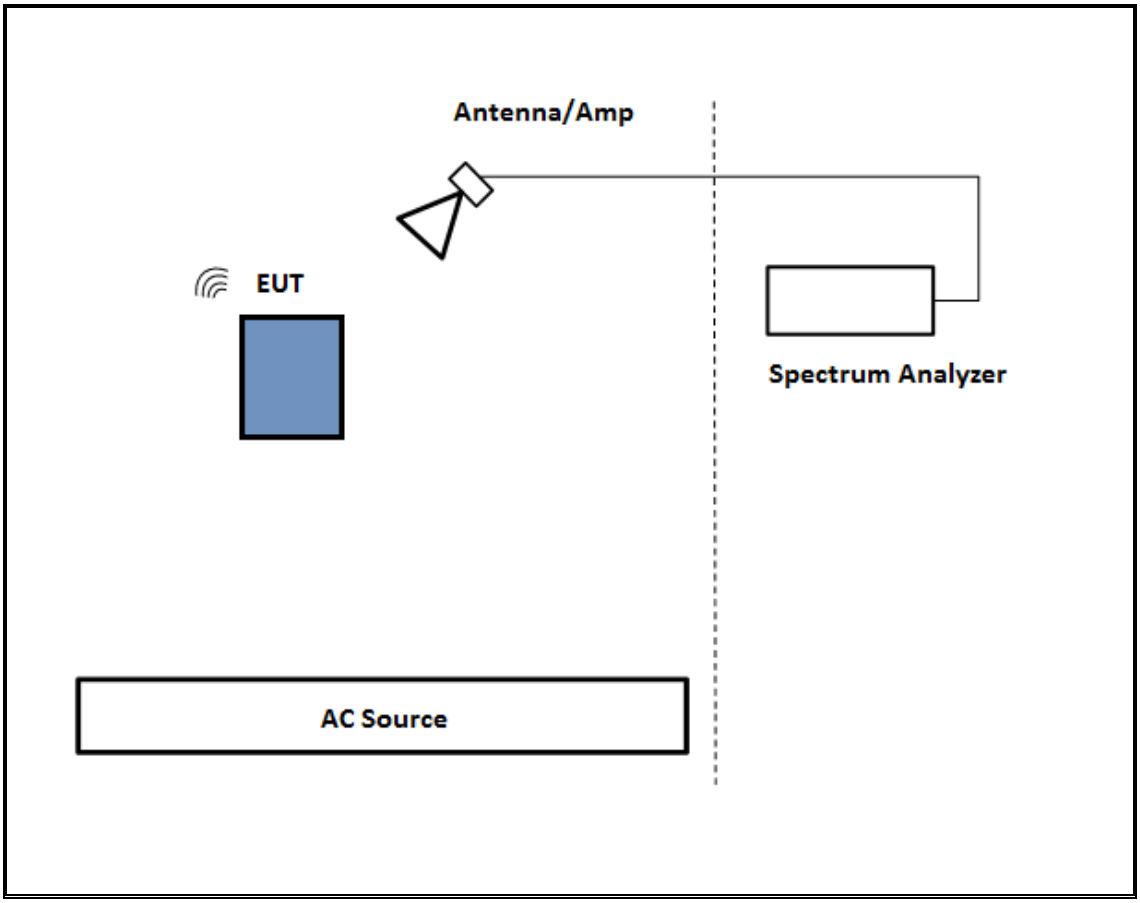
**TEST SETUP- RADIATED-ABOVE 1 GHZ**

The EUT was tested battery powered. Test software exercised the EUT.

**SETUP DIAGRAM**





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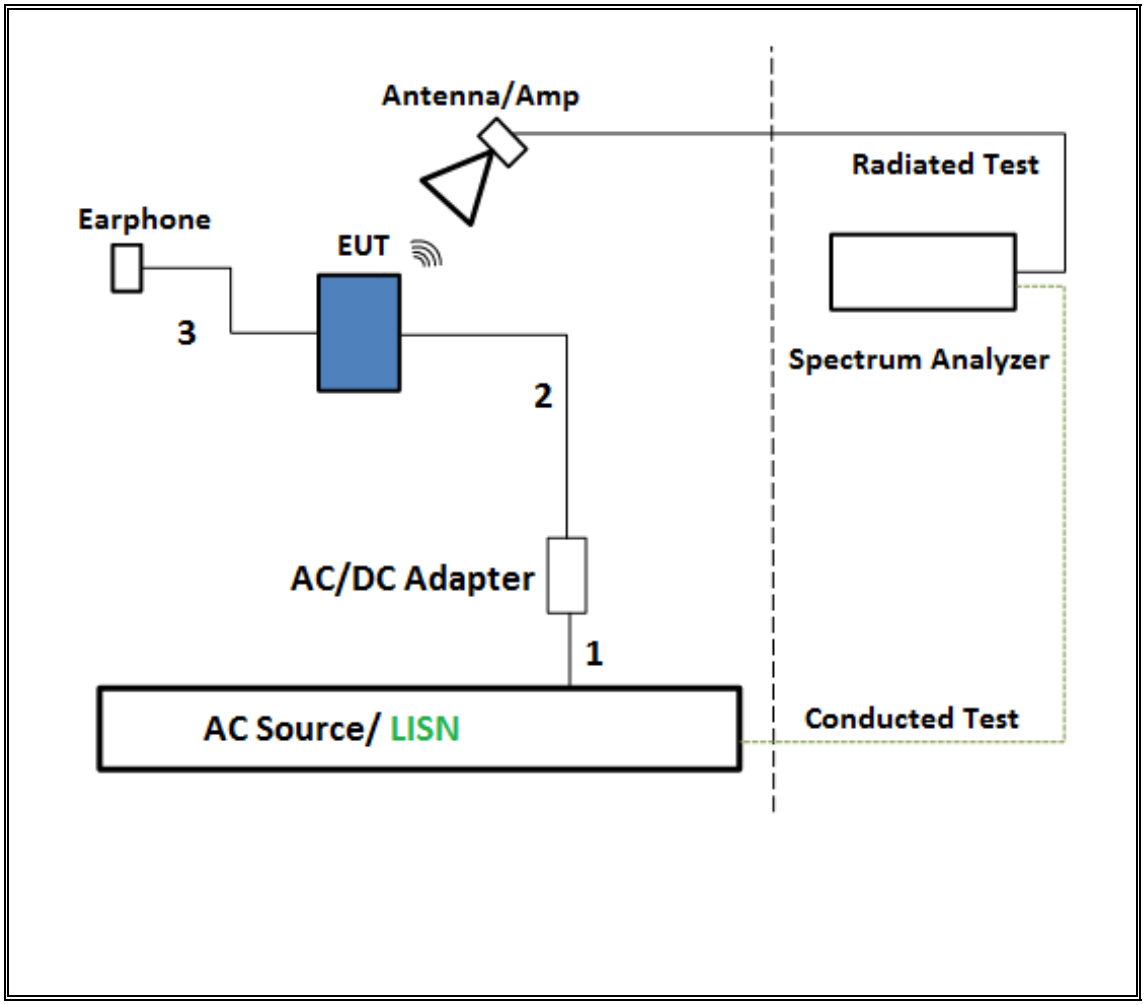
**TEST SETUP- BELOW 1GHZ & AC LINE CONDUCTED TESTS**

The EUT was tested with earphone connected and powered by AC adapter. Test software exercised the EUT.

**SETUP DIAGRAM**





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# 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, Horn 1-18GHz | ETS Lindgren | 3117 | 00143449 | 2/10/2016 |
| Antenna, Broadband Hybrid, 30MHz to 2000MHz | Sunol Sciences | JB3 | A022813-1 | 1/14/2016 |
| Amplifier, 1 - 18GHz | Miteq | AFS42-00101800-25-S-42 | 1782158 | 1/26/2016 |
| Amplifier, 10KHz to 1GHz, 32dB | Sonoma | 310N | 323561 | 5/28/2015 |
| Spectrum Analyzer, PXA, 3Hz to 44GHz | Agilent | N9030A | US51350187 | 5/2/2015 |
| Antenna, Broadband Hybrid, 30MHz to 2000MHz | Sunol Sciences | JB1 | A121003 | 2/13/2016 |
| Amplifier, 10KHz to 1GHz, 32dB | Sonoma | 310N | 185623 | 6/7/2015 |
| Spectrum Analyzer, PXA, 3Hz to 44GHz | Agilent | N9030A | MY51380911 | 2/20/2016 |
| Power Meter, P-series single channel | Agilent | N1911A | GB45100212 | 10/9/2015 |
| Power Sensor, P - series, 50MHz to 18GHz, Wideband | Agilent | N1921A | MY53260010 | 7/12/2015 |
| Antenna, Horn 18 to 26.5GHz | ARA | MWH-1826 | 1049 | 12/17/2015 |
| Spectrum Analyzer, 40 GHz | Agilent | 8564E | 3943A01643 | 8/6/2015 |
| Amplifier, 1 to 26.5GHz, 23.5dB Gain minimum | Agilent | 8449B | 3008A01114 | 10/4/2015 |
| AC Line Conducted | | | | |
| EMI Test Receiver 9Khz-7GHz | Rohde & Schwarz | ESCI7 | 100935 | 9/16/2015 |
| LISN for Conducted Emissions CISPR-16 | FCC | 50/250-25-2 | 114 | 1/16/2016 |
| Power Cable, Line Conducted Emissions ANSI 63.4 | U L | PG1 | N/A | 7/28/2015 |
| **UL SOFTWARE** | | | | |
| Radiated Software | UL | UL EMC | Ver 9.5, July 22, 2014 | |
| Conducted Software | UL | UL EMC | Ver 2.1.2, February 23, 2015 | |
| AC Line Conducted Software | UL | UL EMC | Ver 9.5, February 26, 2015 | |


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# 7. ON TIME, DUTY CYCLE AND MEASUREMENT METHODS

## 7.1. MEASUREMENT METHODS

**MEASUREMENT METHODS**

6 dB BW: KDB 558074 D01 v03r03, Section 8.1.

Output Power: KDB 558074 D01 v03r03, Section 9.1.2.

Power Spectral Density: KDB 558074 D01 v03r03, Section 10.2.

Out-of-band emissions in non-restricted bands: KDB 558074 D01 v03r03, Section 11.0.

Out-of-band emissions in restricted bands: KDB 558074 D01 v03r03, Section 12.1.

Band-edge: KDB 558074 D01 v03r03, Section 12.1


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## ON TIME AND DUTY CYCLE

### LIMITS

None; for reporting purposes only.

### PROCEDURE

KDB 558074 Zero-Span Spectrum Analyzer Method.

### RESULTS

| Mode | ON Time B (msec) | Period (msec) | Duty Cycle x (linear) | Duty Cycle (%) | Duty Cycle Correction Factor (dB) | 1/B Minimum VBW (kHz) |
|---|---|---|---|---|---|---|
| BLE | 100.000 | 100.000 | 1.000 | 100.00% | 0.00 | 0.010 |


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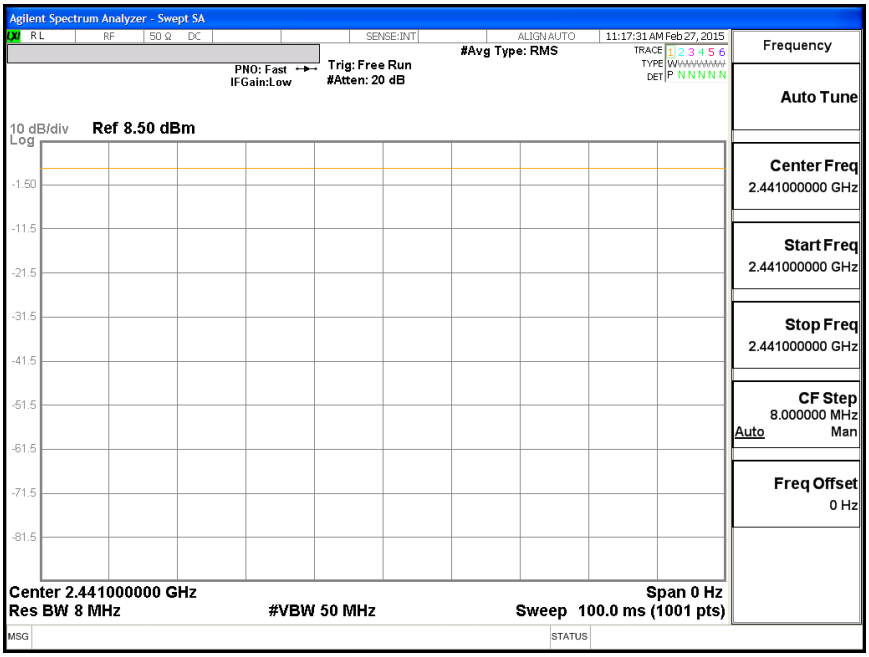
**DUTY CYCLE PLOTS**

DUTY CYCLE BLE MODE





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# 8. ANTENNA PORT TEST RESULTS

## 8.1. 6 dB BANDWIDTH

**LIMITS**

FCC §15.247 (a) (2)

IC RSS-247 (5.2) (1)

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

**RESULTS**

| Channel | Frequency (MHz) | 6 dB Bandwidth (MHz) | Minimum Limit (MHz) |
|---|---|---|---|
| Low | 2402 | 0.825.6 | 0.5 |
| Middle | 2440 | 0.907.2 | 0.5 |
| High | 2480 | 0.725.2 | 0.5 |


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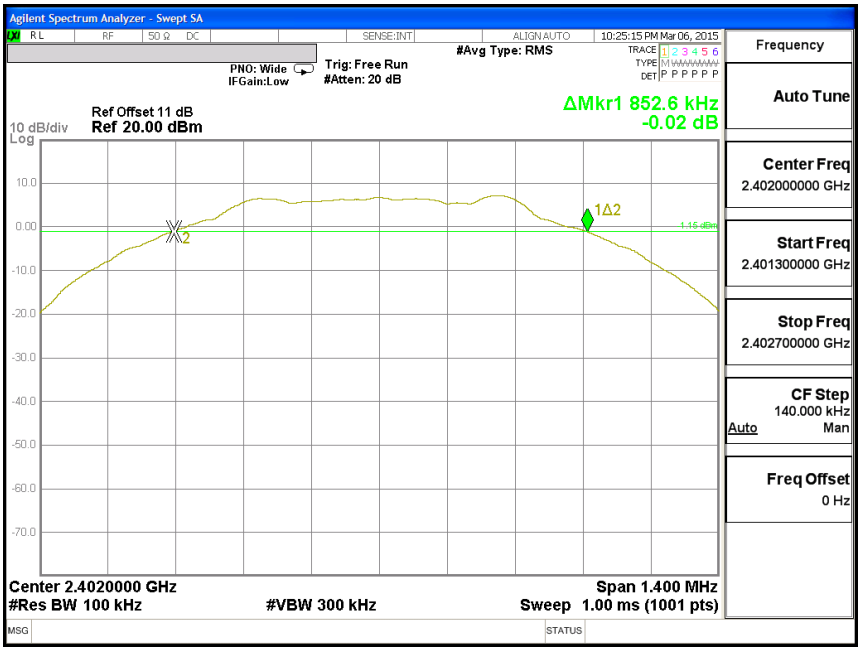
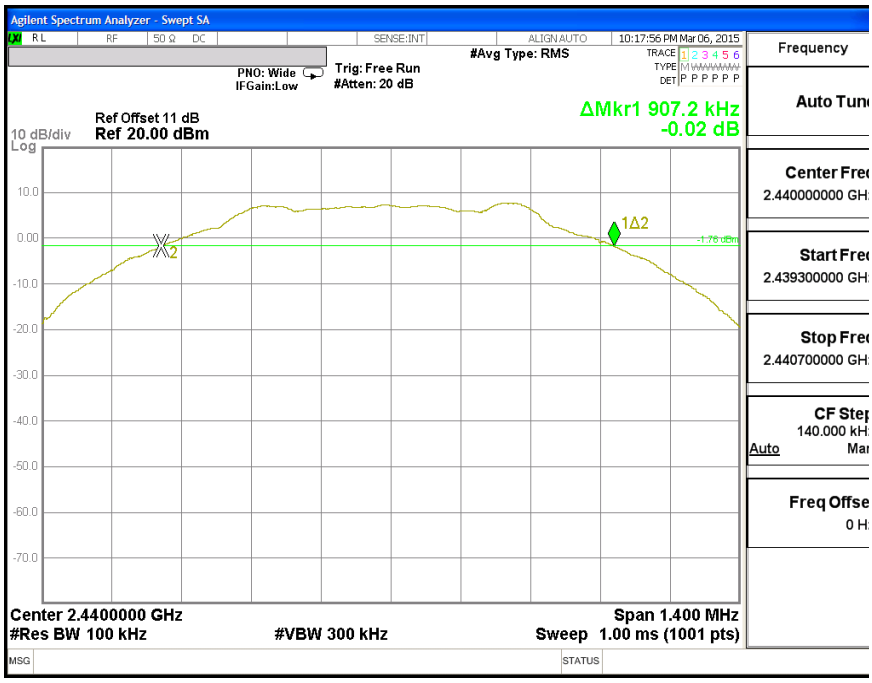
## 6 dB BANDWIDTH

6 dB BANDWIDTH LOW CH




6 dB BANDWIDTH MID CH



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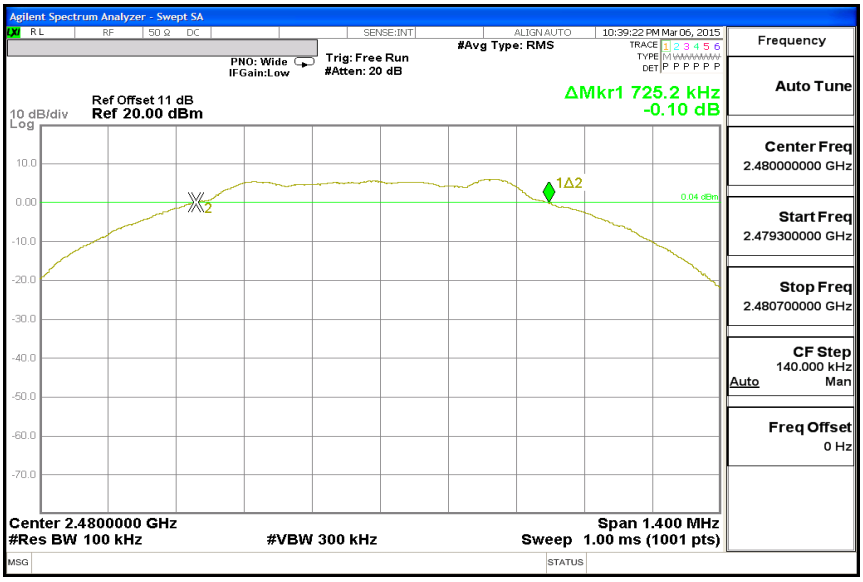
6 dB BANDWIDTH HIGH CH



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## 8.2. 99% BANDWIDTH

**LIMITS**

None; for reporting purposes only.

**TEST PROCEDURE**

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**

| Channel | Frequency (MHz) | 99% Bandwidth (MHz) |
|---|---|---|
| Low | 2402 | 1.0394 |
| Middle | 2440 | 1.0435 |
| High | 2480 | 1.0783 |


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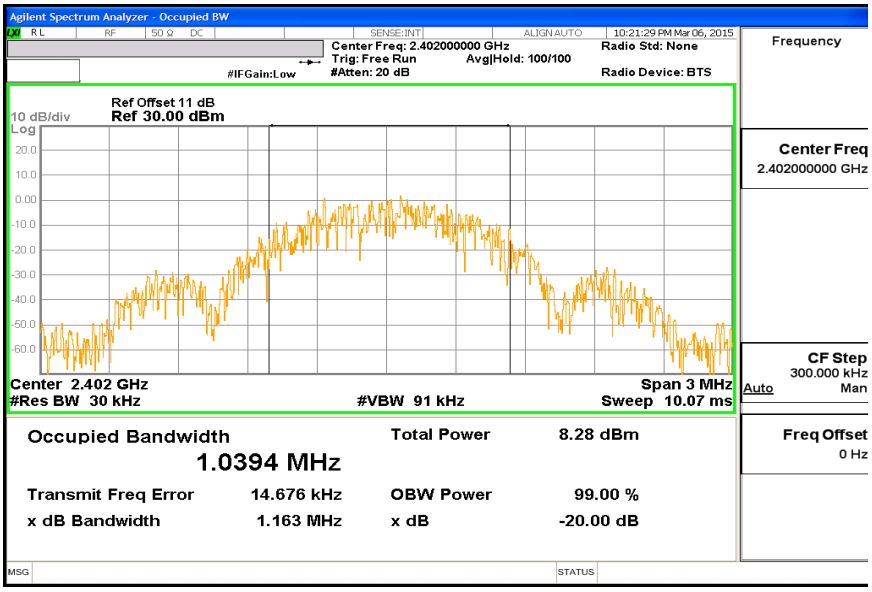
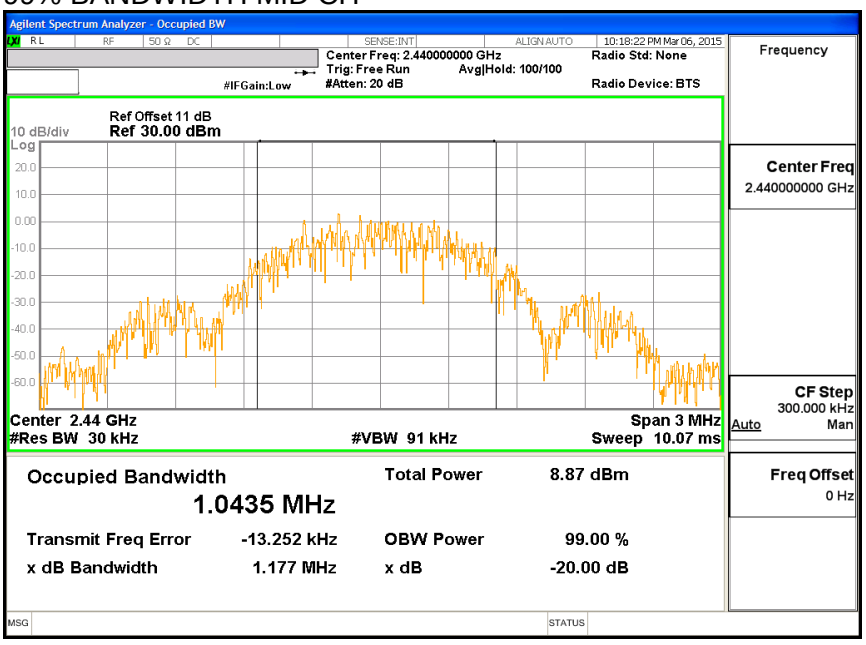
**99% BANDWIDTH**

99% BANDWIDTH LOW CH




99% BANDWIDTH MID CH



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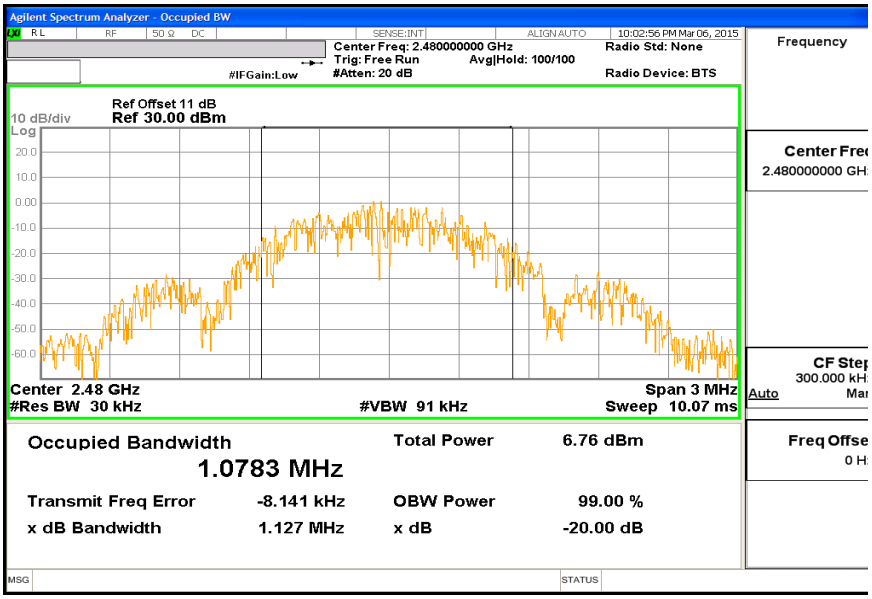
99% BANDWIDTH HIGH CH



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## 8.3. OUTPUT POWER

**LIMITS**

FCC §15.247 (b)

IC RSS-247 (5.4) (4)

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

**RESULTS**

| Channel | Frequency (MHz) | Peak Power Reading (dBm) | Limit (dBm) | Margin (dB) |
|---|---|---|---|---|
| Low | 2402 | 7.67 | 30 | -22.330 |
| Middle | 2440 | 7.72 | 30 | -22.280 |
| High | 2480 | 7.40 | 30 | -22.600 |


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## 8.4. AVERAGE POWER

**LIMITS**

None; for reporting purposes only.

**RESULTS**

The cable assembly insertion loss of 11 dB (including 10 dB pad and 1 dB cable) was entered as an offset in the power meter to allow for direct reading of power.

| Channel | Frequency (MHz) | AV power (dBm) |
|---|---|---|
| Low | 2402 | 7.45 |
| Middle | 2440 | 7.48 |
| High | 2480 | 7.17 |


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## 8.5. POWER SPECTRAL DENSITY

**LIMITS**

FCC §15.247 (e)

IC RSS-247 (5.2) (2)

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

**RESULTS**

| Channel | Frequency (MHz) | PSD (dBm) | Limit (dBm) | Margin (dB) |
|---|---|---|---|---|
| Low | 2402 | -8.65 | 8 | -16.65 |
| Middle | 2440 | -7.98 | 8 | -15.98 |
| High | 2480 | -9.74 | 8 | -17.74 |


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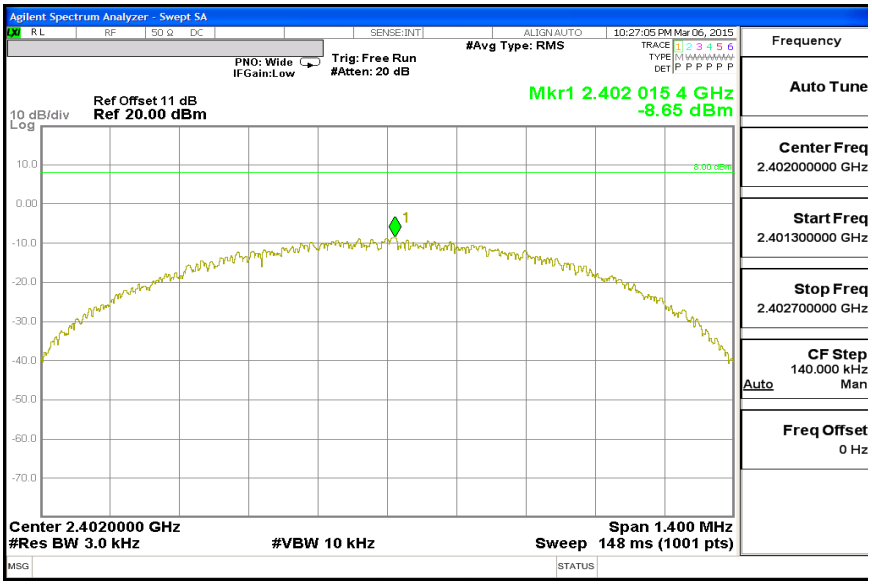
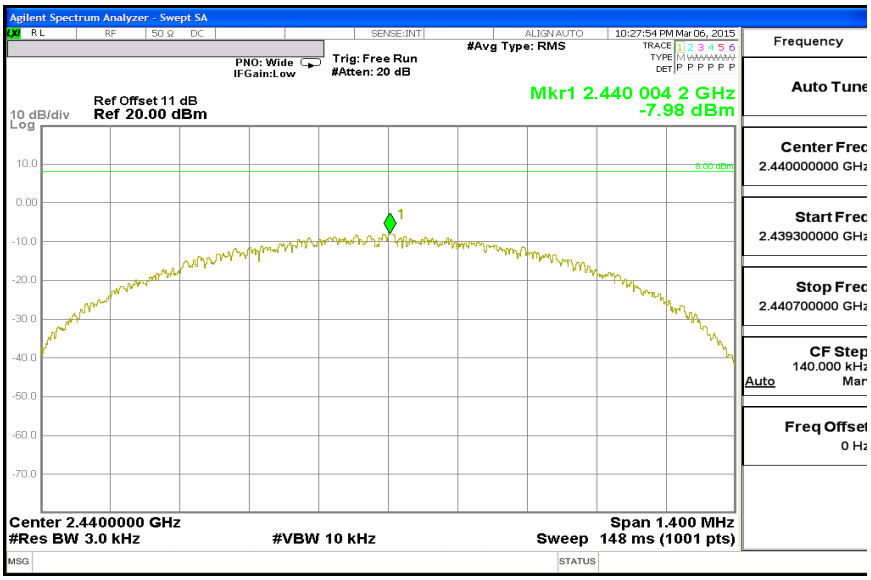
**POWER SPECTRAL DENSITY**

PSD LOW CH




PSD MID CH



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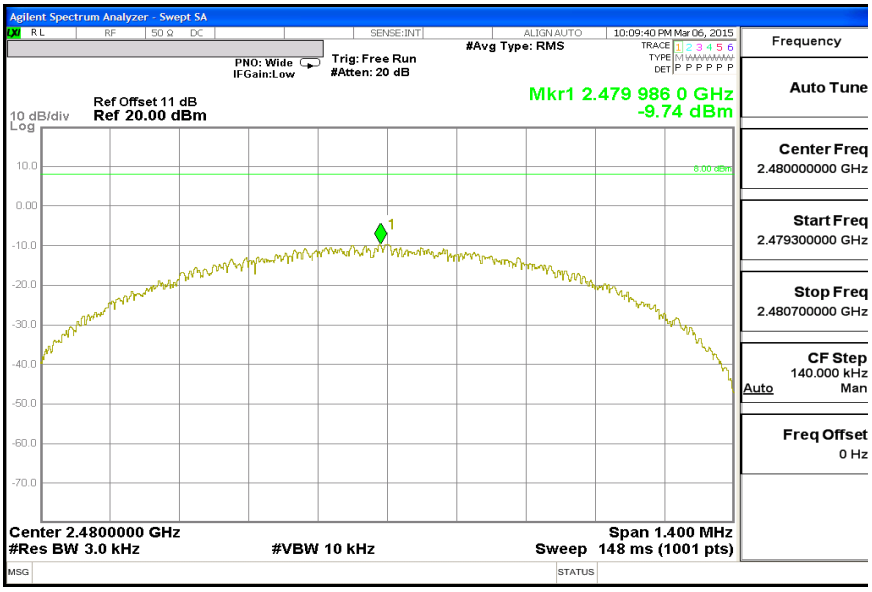
PSD HIGH CH



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## 8.6. CONDUCTED SPURIOUS EMISSIONS

**LIMITS**

FCC §15.247 (d)

IC RSS-247 (5.5)

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


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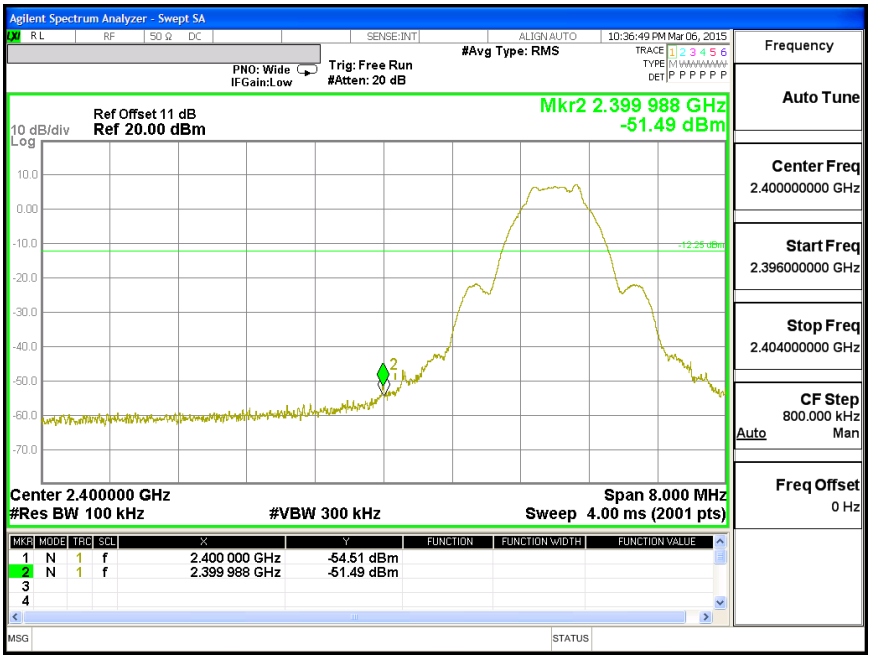
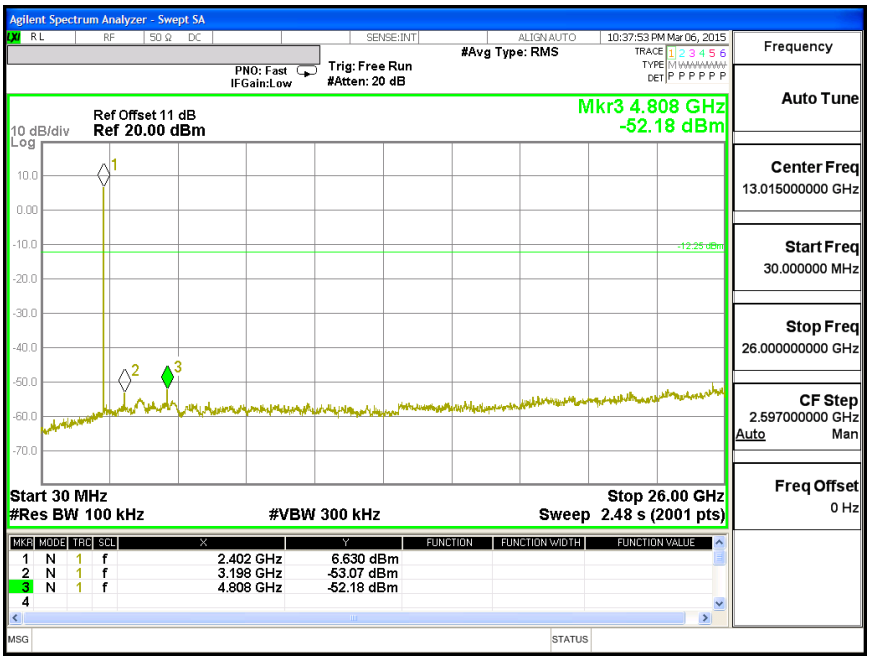
## RESULTS

## SPURIOUS EMISSIONS, LOW CHANNEL

LOW CH BANDEDGE




LOW CH SPURIOUS





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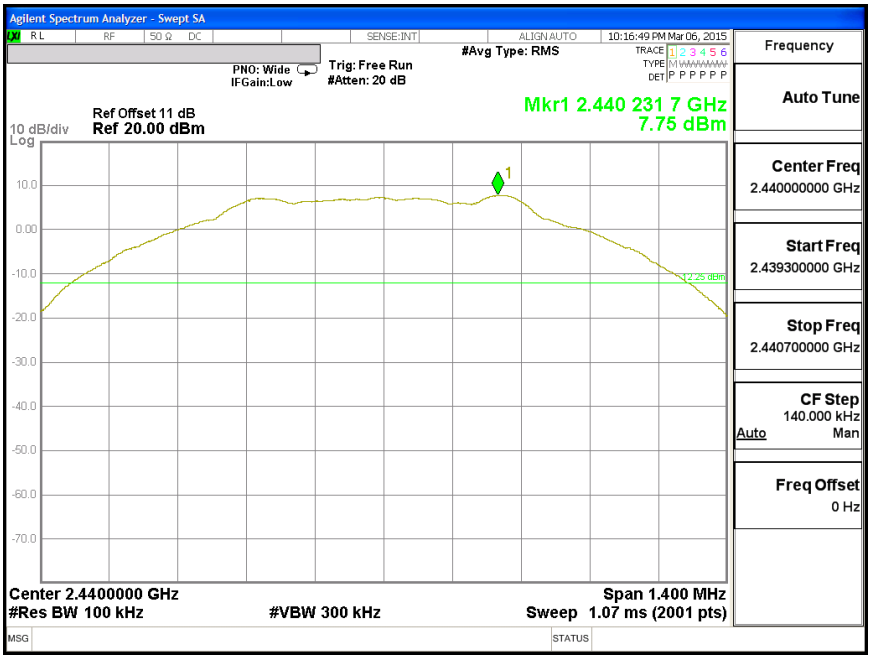
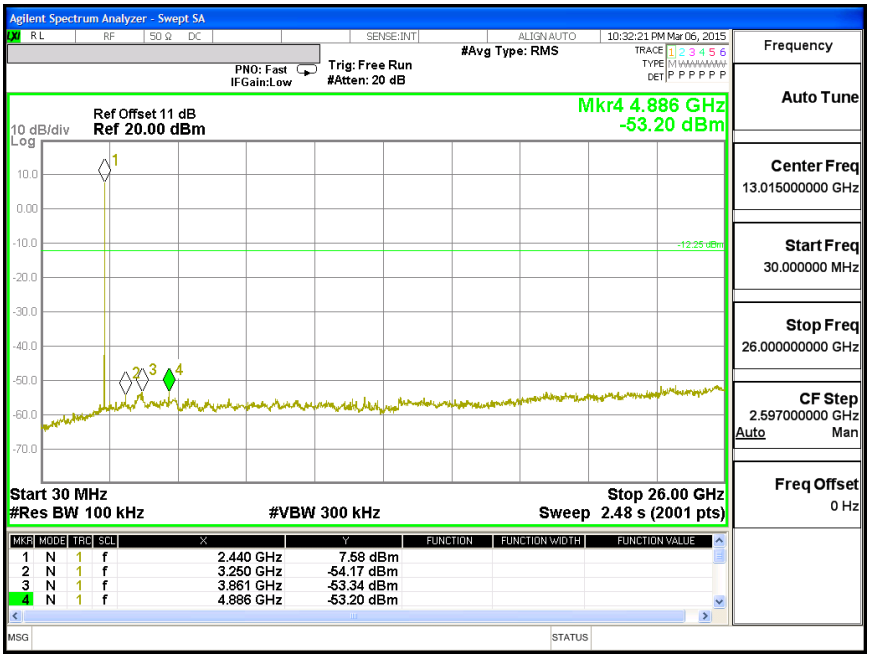
**SPURIOUS EMISSIONS, MID CHANNEL**

MID CH REFERENCE




MID CH SPURIOUS



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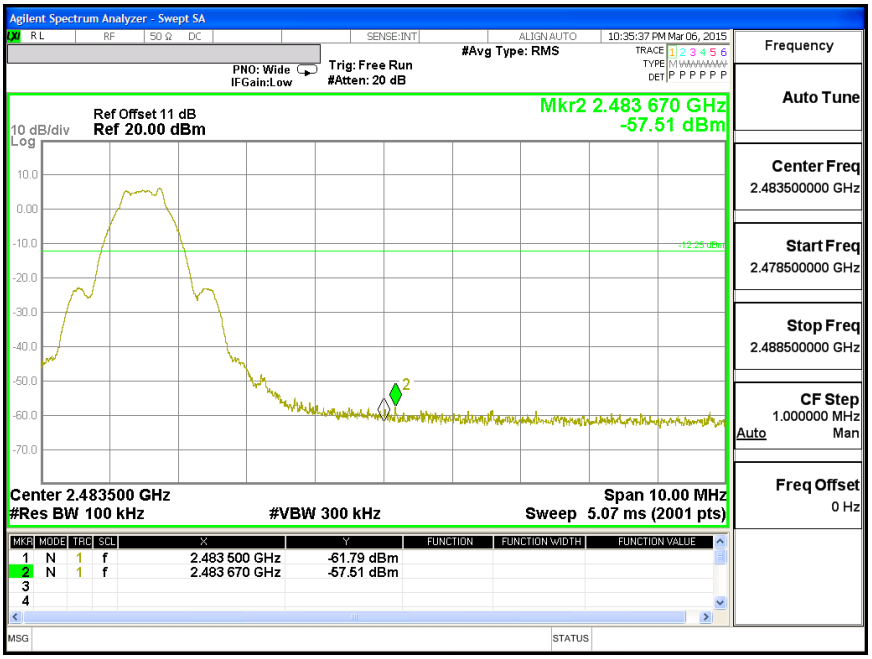
**SPURIOUS EMISSIONS, HIGH CHANNEL**

HIGH CH BANDEDGE




HIGH CH SPURIOUS

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# 9. RADIATED TEST RESULTS

## 9.1. LIMITS AND PROCEDURE

**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 |


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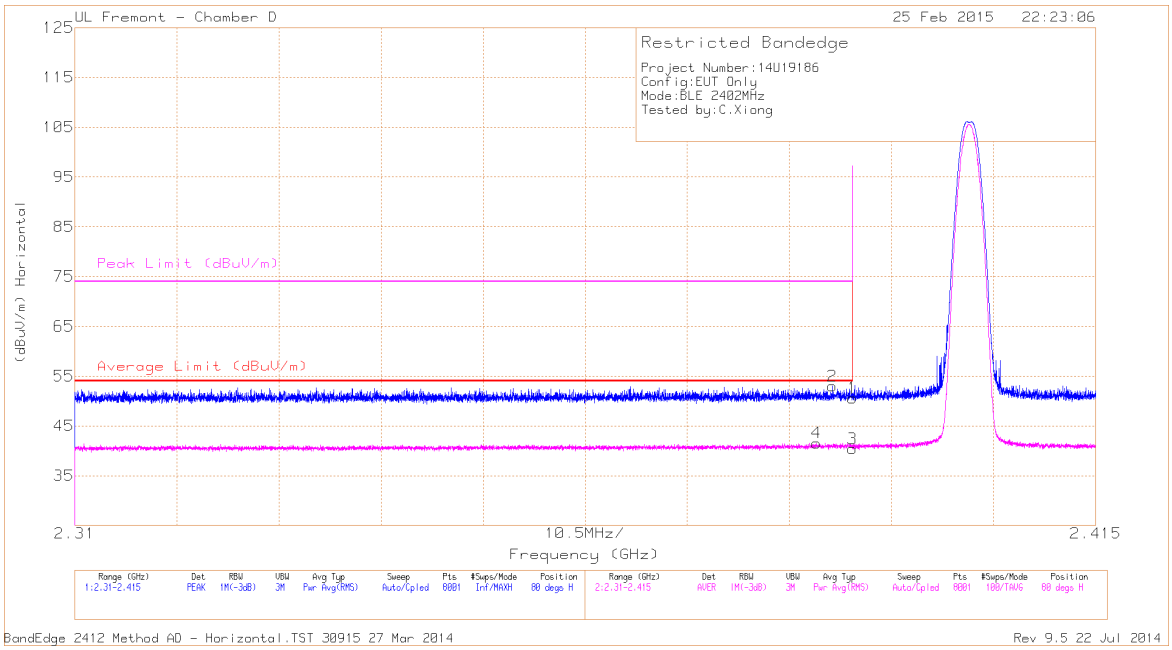
## 9.2. TRANSMITTER ABOVE 1 GHz

**RESTRICTED BANDEDGE (LOW CHANNEL, HORIZONTAL)**

LOW CHANNEL HORIZONTAL PLOT




**DATA**

| Marker | Frequency (GHz) | Meter Reading (dBuV) | Det | AF T344 (dB/m) | Amp/Cbl/Fltr/Pad (dB) | Corrected Reading (dBuV/m) | Average Limit (dBuV/m) | Margin (dB) | Peak Limit (dBuV/m) | PK Margin (dB) | Azimuth (Degs) | Height (cm) | Polarity |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 4 | * 2.386 | 30.29 | RMS | 32.1 | -20.8 | 41.59 | 54 | -12.41 | - | - | 80 | 149 | H |
| 2 | * 2.388 | 41.72 | PK | 32.1 | -20.8 | 53.02 | - | - | 74 | -20.98 | 80 | 149 | H |
| 1 | * 2.39 | 39.21 | PK | 32.1 | -20.7 | 50.61 | - | - | 74 | -23.39 | 80 | 149 | H |
| 3 | * 2.39 | 29.03 | RMS | 32.1 | -20.7 | 40.43 | 54 | -13.57 | - | - | 80 | 149 | H |

* - indicates frequency in CFR 47, Part 15 and Industry Canada RSS-Restricted Band.

PK - Peak detector

RMS - RMS detection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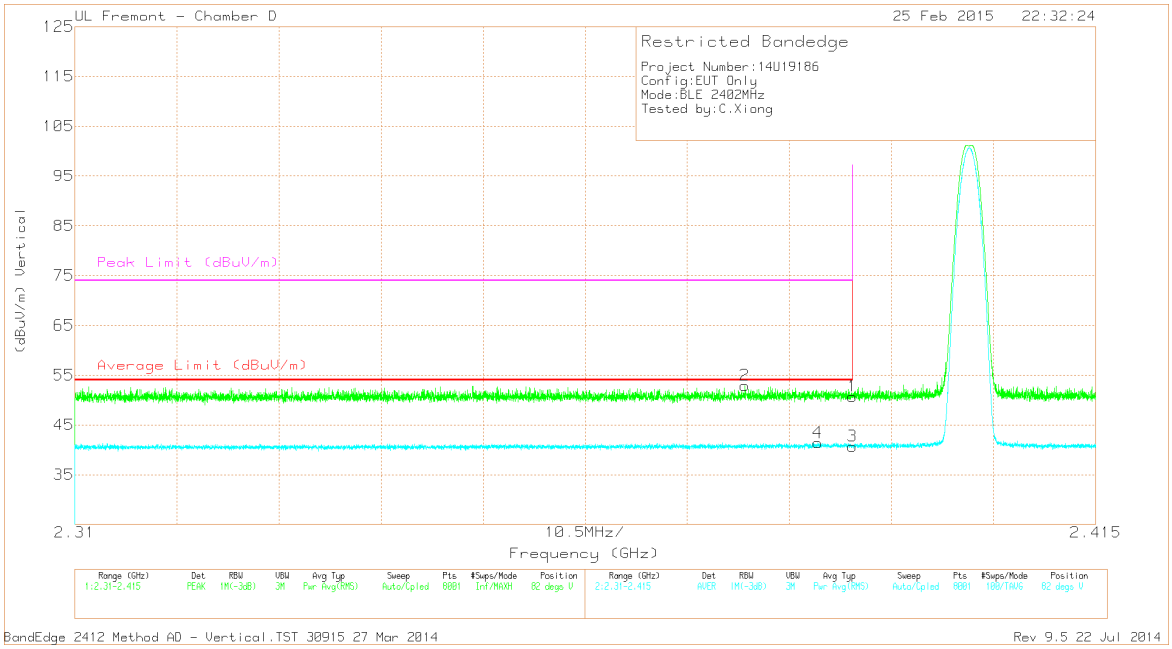
## RESTRICTED BANDEDGE (LOW CHANNEL, VERTICAL)

LOW CHANNEL VERTICAL PLOT




## DATA

| Marker | Frequency (GHz) | Meter Reading (dBuV) | Det | AF T344 (dB/m) | Amp/Cbl/ Fltr/Pad (dB) | Corrected Reading (dBuV/m) | Average Limit (dBuV/m) | Margin (dB) | Peak Limit (dBuV/m) | PK Margin (dB) | Azimuth (Degs) | Height (cm) | Polarity |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2 | * 2.379 | 41.65 | PK | 32.1 | -20.8 | 52.95 | - | - | 74 | -21.05 | 82 | 142 | V |
| 4 | * 2.386 | 30.16 | RMS | 32.1 | -20.8 | 41.46 | 54 | -12.54 | - | - | 82 | 142 | V |
| 1 | * 2.39 | 39.35 | PK | 32.1 | -20.7 | 50.75 | - | - | 74 | -23.25 | 82 | 142 | V |
| 3 | * 2.39 | 29.34 | RMS | 32.1 | -20.7 | 40.74 | 54 | -13.26 | - | - | 82 | 142 | V |

* - indicates frequency in CFR 47, Part 15 and Industry Canada RSS-Restricted Band.

PK - Peak detector

RMS - RMS detection



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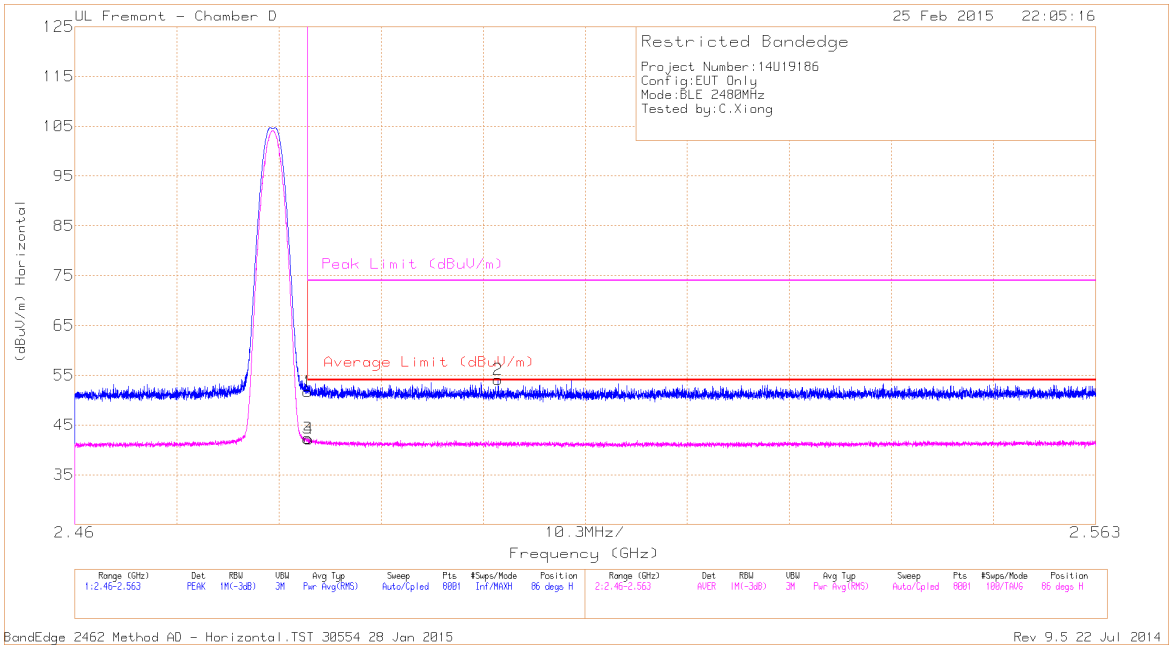
## RESTRICTED BANDEDGE (HIGH CHANNEL, HORIZONTAL)

HIGH CHANNEL HORIZONTAL PLOT




## DATA

| Marker | Frequency (GHz) | Meter Reading (dBuV) | Det | AF T344 (dB/m) | Amp/Cbl/ Fltr/Pad (dB) | Corrected Reading (dBuV/m) | Average Limit (dBuV/m) | Margin (dB) | Peak Limit (dBuV/m) | PK Margin (dB) | Azimuth (Degs) | Height (cm) | Polarity |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | * 2.484 | 40.29 | PK | 32.2 | -20.8 | 51.69 | - | - | 74 | -22.31 | 86 | 139 | H |
| 3 | * 2.484 | 30.93 | RMS | 32.2 | -20.8 | 42.33 | 54 | -11.67 | - | - | 86 | 139 | H |
| 4 | * 2.484 | 30.8 | RMS | 32.2 | -20.8 | 42.2 | 54 | -11.8 | - | - | 86 | 139 | H |
| 2 | 2.503 | 42.63 | PK | 32.2 | -20.7 | 54.13 | - | - | 74 | -19.87 | 86 | 139 | H |

* - indicates frequency in CFR 47, Part 15 and Industry Canada RSS-Restricted Band.

PK - Peak detector

RMS - RMS detection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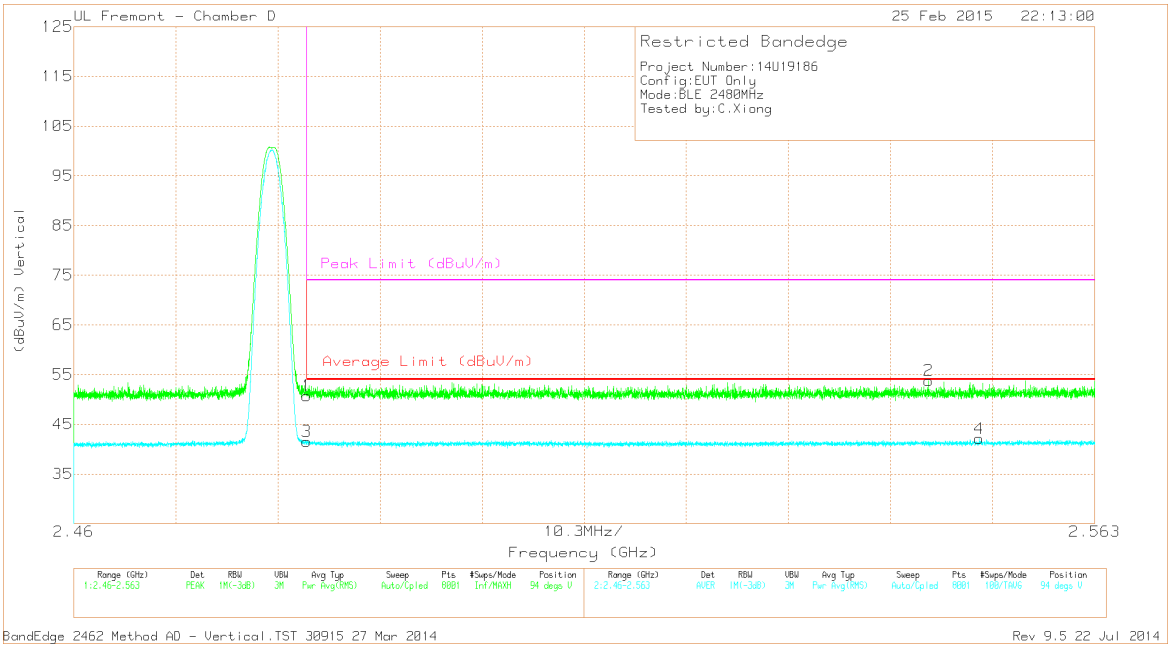
## RESTRICTED BANDEDGE (HIGH CHANNEL, VERTICAL)

HIGH CHANNEL VERTICAL PLOT




## DATA

| Marker | Frequency (GHz) | Meter Reading (dBuV) | Det | AF T344 (dB/m) | Amp/Cbl/ Fltr/Pad (dB) | Corrected Reading (dBuV/m) | Average Limit (dBuV/m) | Margin (dB) | Peak Limit (dBuV/m) | PK Margin (dB) | Azimuth (Degs) | Height (cm) | Polarity |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | * 2.484 | 39.33 | PK | 32.2 | -20.8 | 50.73 | - | - | 74 | -23.27 | 94 | 100 | V |
| 3 | * 2.484 | 30.15 | RMS | 32.2 | -20.8 | 41.55 | 54 | -12.45 | - | - | 94 | 100 | V |
| 2 | 2.546 | 42.2 | PK | 32.3 | -20.7 | 53.8 | - | - | 74 | -20.2 | 94 | 100 | V |
| 4 | 2.551 | 30.51 | RMS | 32.3 | -20.7 | 42.11 | 54 | -11.89 | - | - | 94 | 100 | V |

* - indicates frequency in CFR 47, Part 15 and Industry Canada RSS-Restricted Band.

PK - Peak detector

RMS - RMS detection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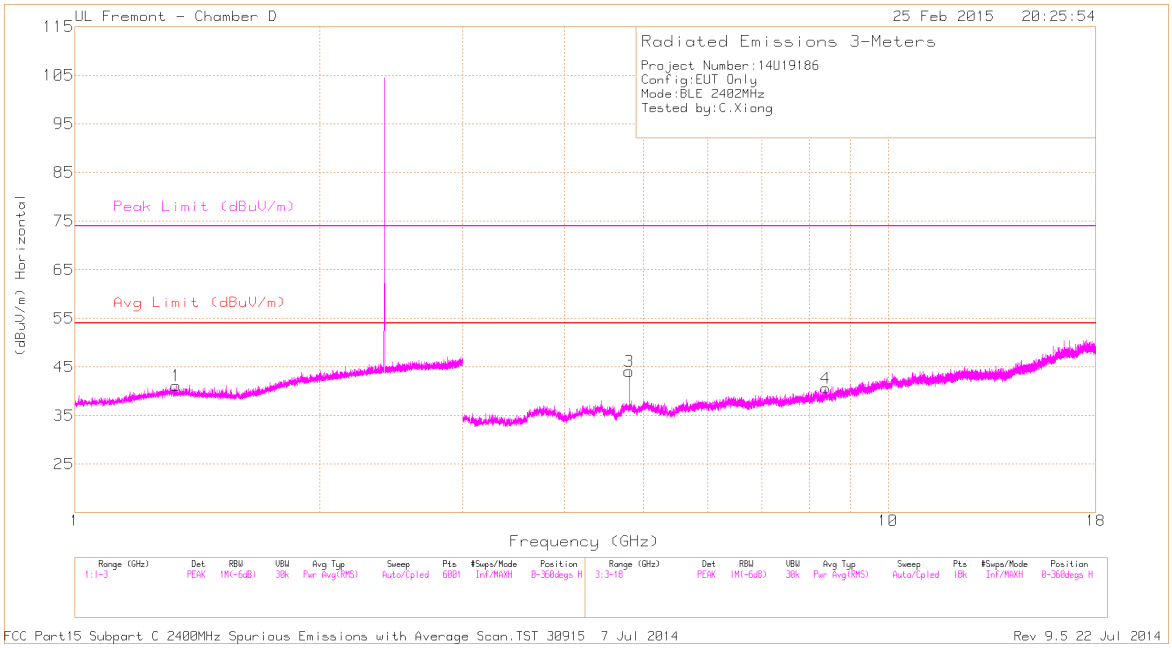
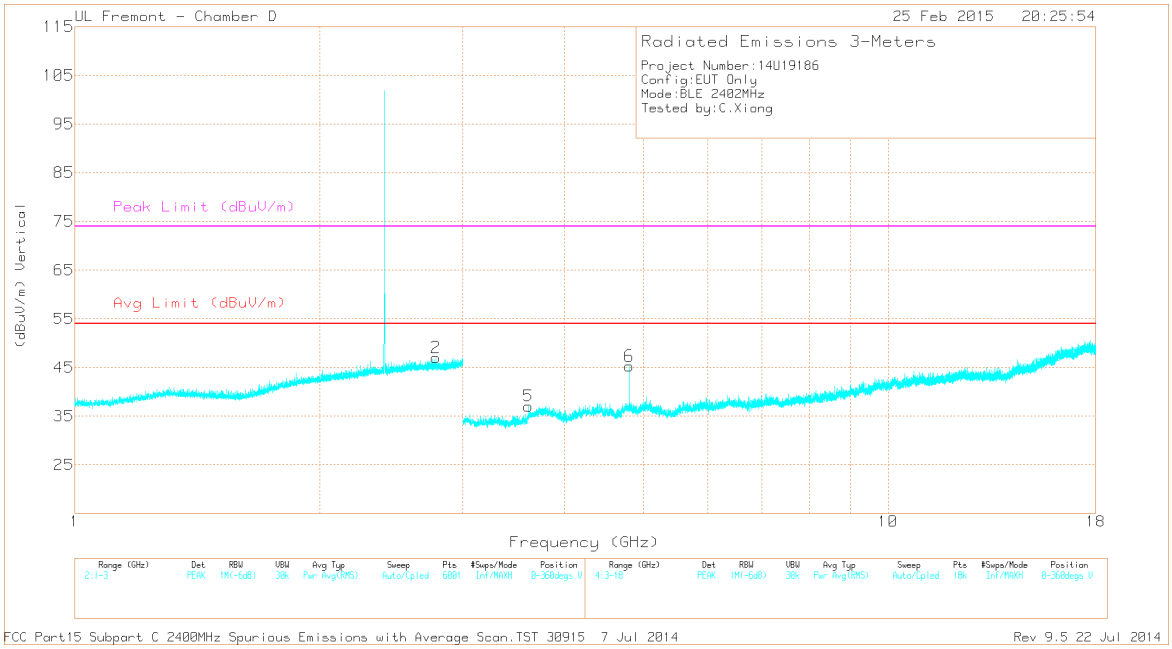
## HARMONICS AND SPURIOUS EMISSIONS

LOW CHANNEL HORIZONTAL PLOT




LOW CHANNEL VERTICAL PLOT



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## DATA

| | Frequency (GHz) | Meter Reading (dBuV) | Det | AF T344 (dB/m) | Amp/Cbl/ Fltr/Pad (dB) | Corrected Reading (dBuV/m) | Avg Limit (dBuV/m) | Margin (dB) | Peak Limit (dBuV/m) | PK Margin (dB) | Azimuth (Degs) | Height (cm) | Polarity |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | * 1.331 | 41.83 | PK2 | 28.9 | -22.2 | 48.53 | - | - | 74 | -25.47 | 60 | 129 | H |
| | * 1.332 | 30.42 | MAv1 | 28.9 | -22.2 | 37.12 | 54 | -16.88 | - | - | 60 | 129 | H |
| 2 | * 2.782 | 41.74 | PK2 | 32.5 | -20.4 | 53.84 | - | - | 74 | -20.16 | 75 | 179 | V |
| | * 2.784 | 30.17 | MAv1 | 32.5 | -20.4 | 42.27 | 54 | -11.73 | - | - | 75 | 179 | V |
| 3 | * 4.804 | 42.07 | PK2 | 34.1 | -27 | 49.17 | - | - | 74 | -24.83 | 6 | 228 | H |
| | * 4.804 | 35.35 | MAv1 | 34.1 | -27 | 42.45 | 54 | -11.55 | - | - | 6 | 228 | H |
| 4 | * 8.38 | 35.29 | PK2 | 35.7 | -23 | 47.99 | - | - | 74 | -26.01 | 15 | 210 | H |
| | * 8.38 | 24.42 | MAv1 | 35.7 | -23 | 37.12 | 54 | -16.88 | - | - | 15 | 210 | H |
| 5 | * 3.612 | 38.43 | PK2 | 33.1 | -28.5 | 43.03 | - | - | 74 | -30.97 | 44 | 166 | V |
| | * 3.61 | 27.33 | MAv1 | 33.1 | -28.5 | 31.93 | 54 | -22.07 | - | - | 44 | 166 | V |
| 6 | * 4.803 | 42.97 | PK2 | 34.1 | -27 | 50.07 | - | - | 74 | -23.93 | 6 | 101 | V |
| | * 4.804 | 35.87 | MAv1 | 34.1 | -27 | 42.97 | 54 | -11.03 | - | - | 6 | 101 | V |

* - indicates frequency in CFR 47, Part 15 and Industry Canada RSS-Restricted Band.

PK2 - KDB558074 Method: Maximum Peak

MAv1 - KDB558074 Option 1 Maximum RMS Average


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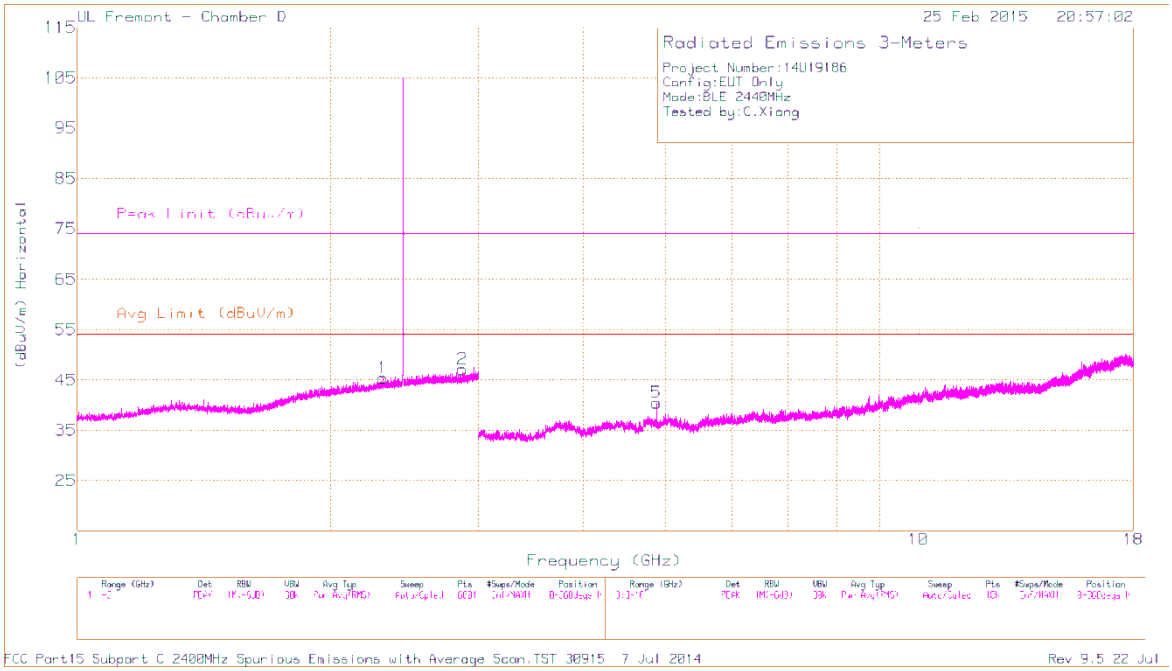
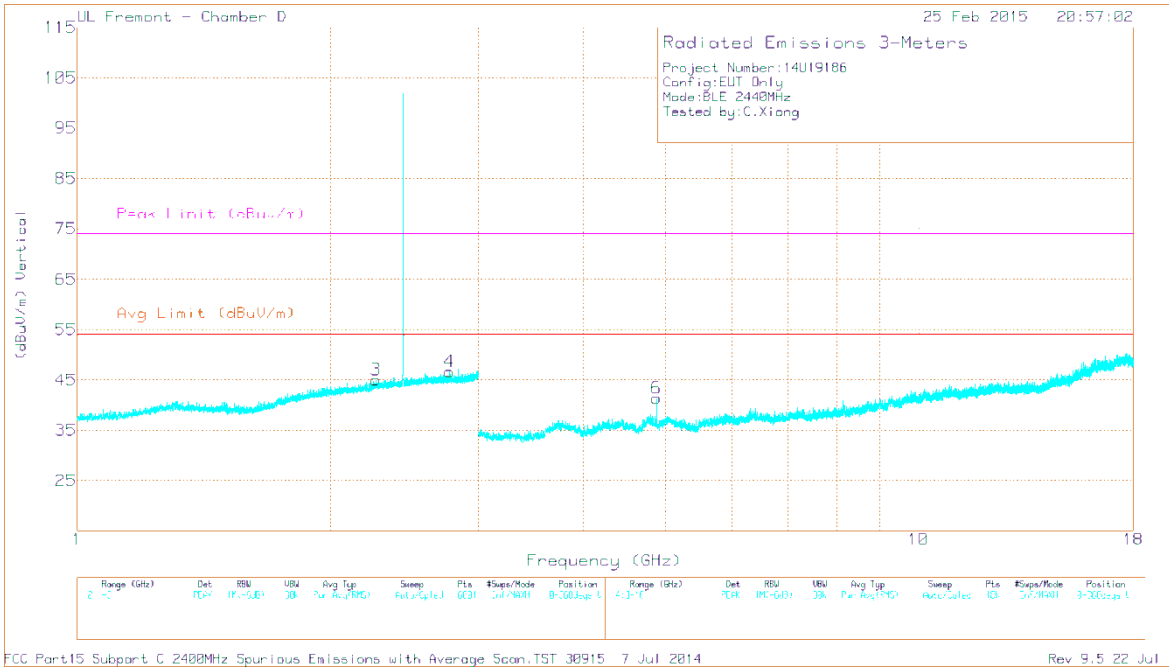
**HARMONICS AND SPURIOUS EMISSIONS**

MID CHANNEL HORIZONTAL PLOT




MID CHANNEL VERTICAL PLOT





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## DATA

| | Frequency (GHz) | Meter Reading (dBuV) | Det | AF T344 (dB/m) | Amp/Cbl/ Fltr/Pad (dB) | Corrected Reading (dBuV/m) | Avg Limit (dBuV/m) | Margin (dB) | Peak Limit (dBuV/m) | PK Margin (dB) | Azimuth (Degs) | Height (cm) | Polarity |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2 | * 2.87 | 41.03 | PK2 | 32.6 | -20.3 | 53.33 | - | - | 74 | -20.67 | 34 | 143 | H |
| | * 2.869 | 29.99 | MAv1 | 32.6 | -20.3 | 42.29 | 54 | -11.71 | - | - | 34 | 143 | H |
| 3 | * 2.266 | 41.23 | PK2 | 31.9 | -20.9 | 52.23 | - | - | 74 | -21.77 | 124 | 183 | V |
| | * 2.267 | 30.21 | MAv1 | 31.9 | -20.9 | 41.21 | 54 | -12.79 | - | - | 124 | 183 | V |
| 4 | * 2.77 | 41.59 | PK2 | 32.5 | -20.4 | 53.69 | - | - | 74 | -20.31 | 109 | 225 | V |
| | * 2.768 | 30.18 | MAv1 | 32.5 | -20.4 | 42.28 | 54 | -11.72 | - | - | 109 | 225 | V |
| 5 | * 4.879 | 41.24 | PK2 | 34.1 | -28.1 | 47.24 | - | - | 74 | -26.76 | 7 | 220 | H |
| | * 4.88 | 32.11 | MAv1 | 34.1 | -28.1 | 38.11 | 54 | -15.89 | - | - | 7 | 220 | H |
| 6 | * 4.879 | 41.43 | PK2 | 34.1 | -28.1 | 47.43 | - | - | 74 | -26.57 | 4 | 100 | V |
| | * 4.88 | 33.34 | MAv1 | 34.1 | -28.1 | 39.34 | 54 | -14.66 | - | - | 4 | 100 | V |
| 1 | 2.31 | 41.3 | PK2 | 32 | -21 | 52.3 | - | - | - | - | 10 | 117 | H |

* - indicates frequency in CFR 47, Part 15 and Industry Canada RSS-Restricted Band.

PK2 - KDB558074 Method: Maximum Peak

MAv1 - KDB558074 Option 1 Maximum RMS Average


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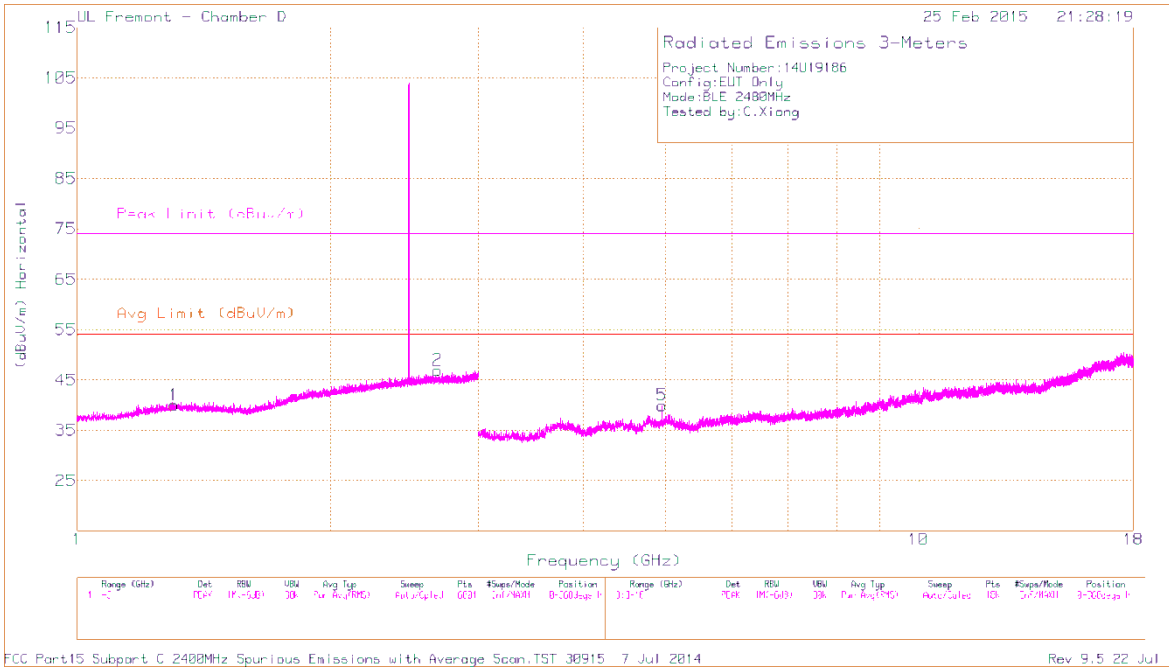
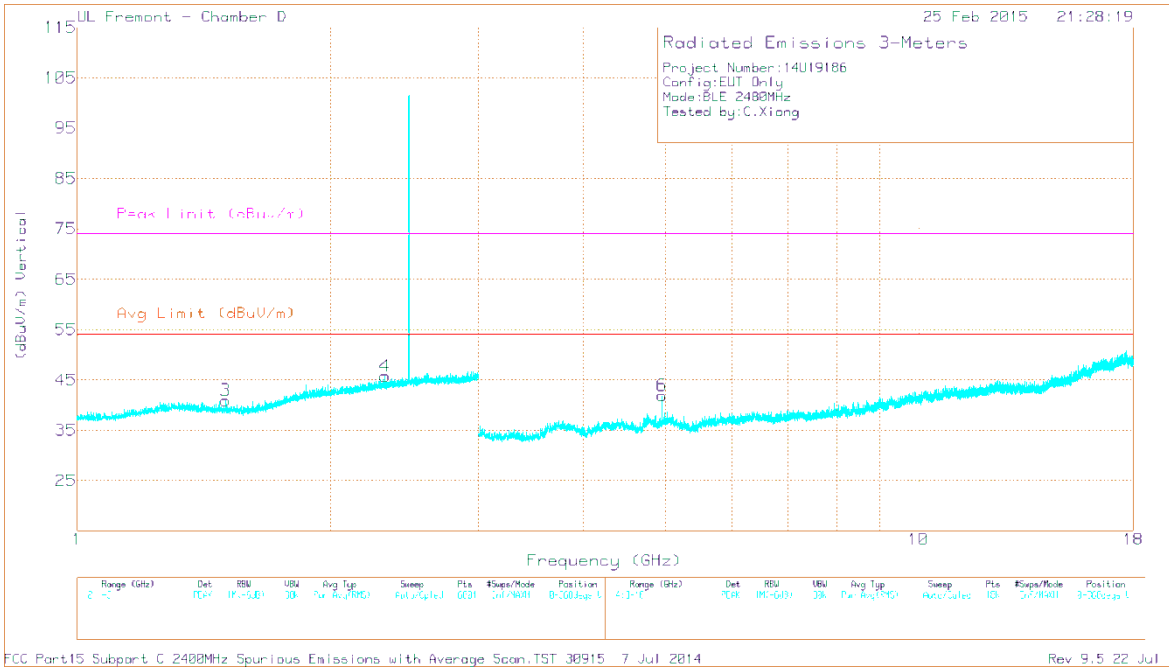
**HARMONICS AND SPURIOUS EMISSIONS**

HIGH CHANNEL HORIZONTAL PLOT




HIGH CHANNEL VERTICAL PLOT





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## DATA

| Frequency (GHz) | Meter Reading (dBuV) | Det | AF T344 (dB/m) | Amp/Cbl/ Fltr/Pad (dB) | Corrected Reading (dBuV/m) | Avg Limit (dBuV/m) | Margin (dB) | Peak Limit (dBuV/m) | PK Margin (dB) | Azimuth (Degs) | Height (cm) | Polarity |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| * 1.302 | 42.14 | PK2 | 29 | -22.3 | 48.84 | - | - | 74 | -25.16 | 28 | 243 | H |
| * 1.304 | 30.39 | MAv1 | 29 | -22.3 | 37.09 | 54 | -16.91 | - | - | 28 | 243 | H |
| * 2.68 | 41.62 | PK2 | 32.4 | -20.6 | 53.42 | - | - | 74 | -20.58 | 48 | 210 | H |
| * 2.68 | 30.29 | MAv1 | 32.4 | -20.6 | 42.09 | 54 | -11.91 | - | - | 48 | 210 | H |
| * 1.502 | 41.47 | PK2 | 28.2 | -21.9 | 47.77 | - | - | 74 | -26.23 | 65 | 157 | V |
| * 1.5 | 30.13 | MAv1 | 28.2 | -21.9 | 36.43 | 54 | -17.57 | - | - | 65 | 157 | V |
| * 2.324 | 41.55 | PK2 | 32 | -21 | 52.55 | - | - | 74 | -21.45 | 28 | 188 | V |
| * 2.323 | 30.16 | MAv1 | 32 | -21 | 41.16 | 54 | -12.84 | - | - | 28 | 188 | V |
| * 4.959 | 39.88 | PK2 | 34.2 | -27.7 | 46.38 | - | - | 74 | -27.62 | 46 | 221 | H |
| * 4.96 | 31.21 | MAv1 | 34.2 | -27.7 | 37.71 | 54 | -16.29 | - | - | 46 | 221 | H |
| * 4.96 | 41.01 | PK2 | 34.2 | -27.7 | 47.51 | - | - | 74 | -26.49 | 5 | 101 | V |
| * 4.96 | 32.46 | MAv1 | 34.2 | -27.7 | 38.96 | 54 | -15.04 | - | - | 5 | 101 | V |

* - indicates frequency in CFR 47, Part 15 and Industry Canada RSS-Restricted Band.

PK2 - KDB558074 Method: Maximum Peak

MAv1 - KDB558074 Option 1 Maximum RMS Average


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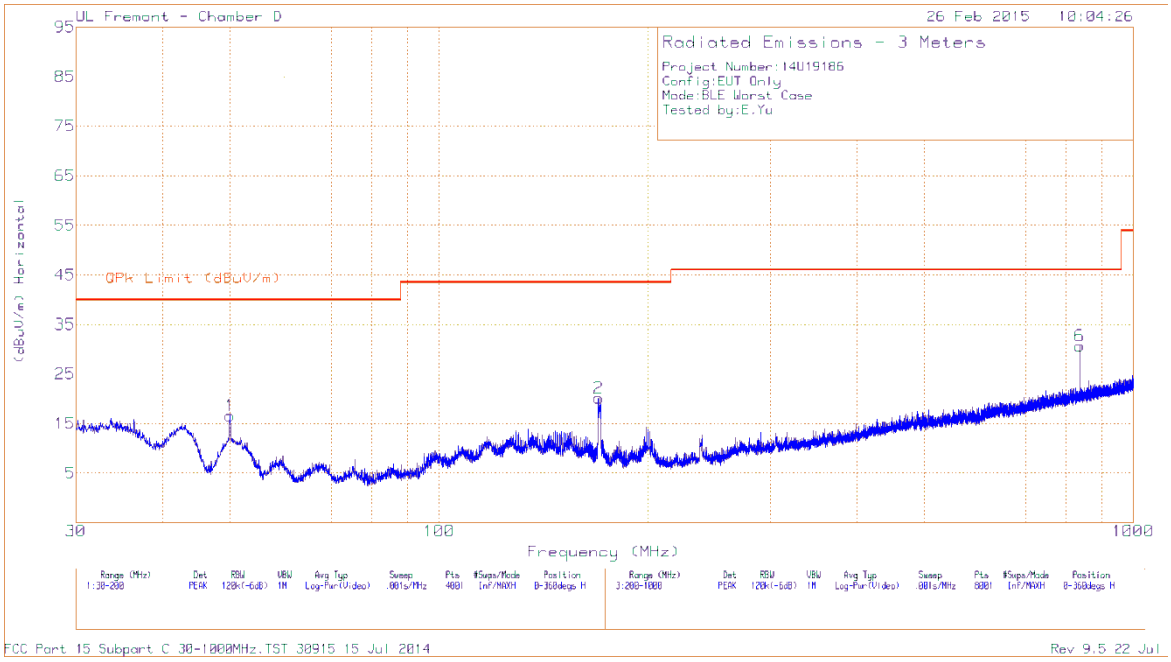
## 9.3. WORST-CASE BELOW 1 GHz

**SPURIOUS EMISSIONS 30 TO 1000 MHz (WORST-CASE CONFIGURATION, HORIZONTAL & VERTICAL)**

HORIZONTAL PLOT





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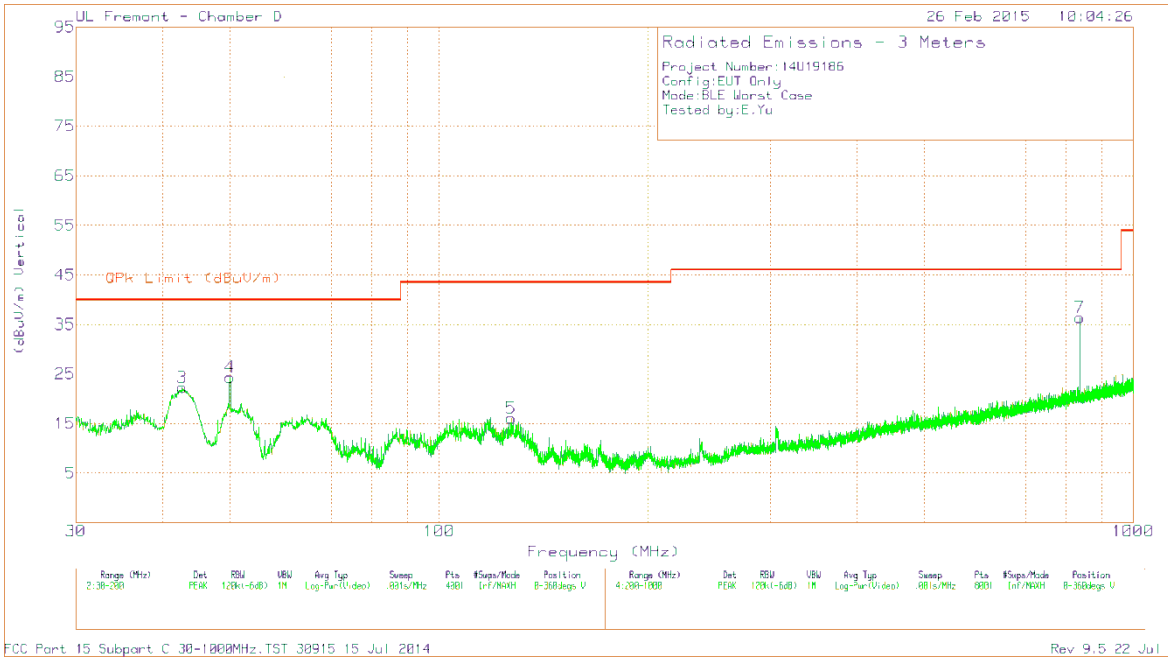
VERTICAL PLOT





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## HORIZONTAL AND VERTICAL DATA

| Marker | Frequency (MHz) | Meter Reading (dBuV) | Det | AF T477 (dB/m) | Amp/Cbl (dB) | Corrected Reading (dBuV/m) | QPk Limit (dBuV/m) | Margin (dB) | Azimuth (Degs) | Height (cm) | Polarity |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 2 | * 169.6125 | 39.34 | PK | 11.8 | -31 | 20.14 | 43.52 | -23.38 | 0-360 | 101 | H |
| 5 | * 126.9425 | 33.73 | PK | 13.6 | -31.2 | 16.13 | 43.52 | -27.39 | 0-360 | 100 | V |
| 3 | 42.7075 | 42.25 | PK | 11.8 | -31.8 | 22.25 | 40 | -17.75 | 0-360 | 100 | V |
| 1 | 49.975 | 40.39 | PK | 7.9 | -31.7 | 16.59 | 40 | -23.41 | 0-360 | 301 | H |
| 4 | 49.9963 | 48.19 | PK | 7.9 | -31.7 | 24.39 | 40 | -15.61 | 0-360 | 100 | V |
| 7 | 836.6 | 43.5 | PK | 21.7 | -28.8 | 36.4 | 46.02 | -9.62 | 0-360 | 99 | V |
| 6 | 836.7 | 37.73 | PK | 21.7 | -28.8 | 30.63 | 46.02 | -15.39 | 0-360 | 100 | H |

* - indicates frequency in CFR 47, Part 15 and Industry Canada RSS-Restricted Band.

PK - Peak detector


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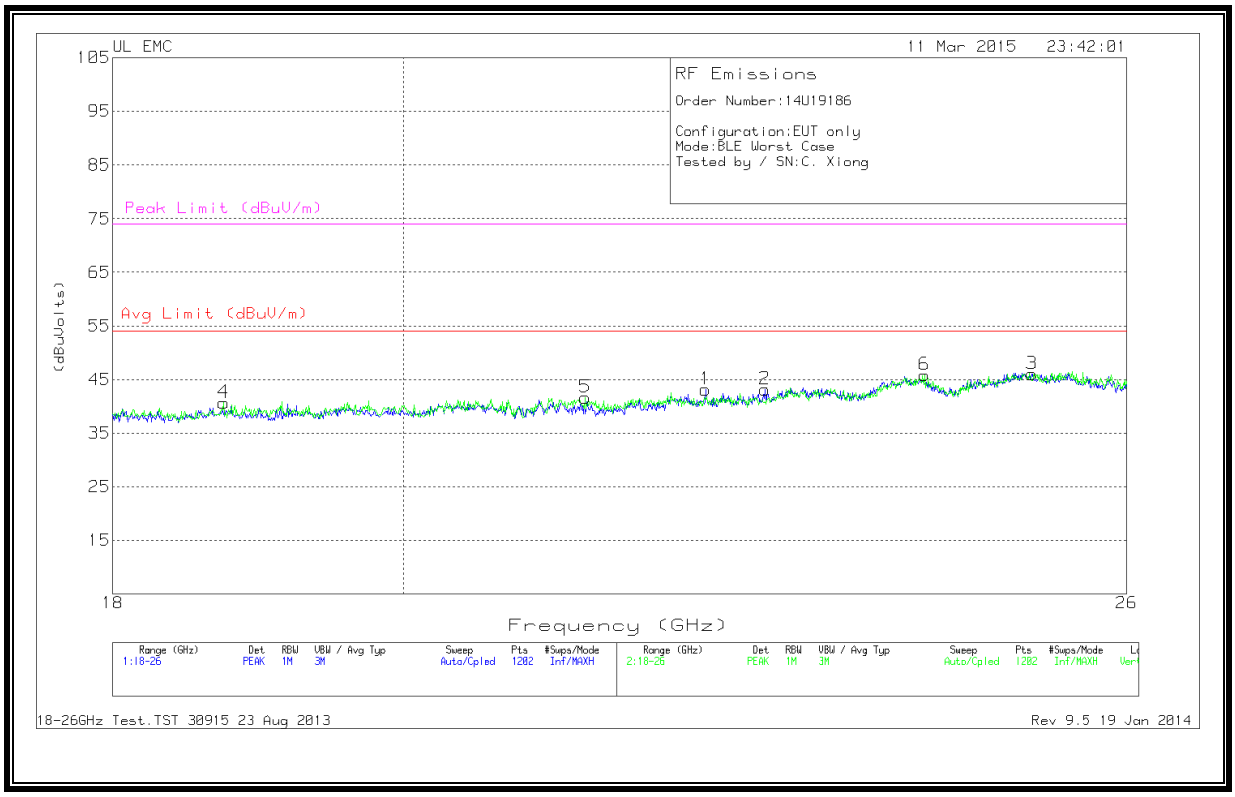
## 9.4. WORST-CASE ABOVE 18 GHz

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





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**Data**

| Marker | Frequency (GHz) | Meter Reading (dBuV) | Det | T89 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 | 22.316 | 42.07 | PK | 33.7 | -23.1 | -9.5 | 43.166 | 54 | -10.833 | 74 | -30.833 |
| 2 | 22.803 | 42.47 | PK | 33.9 | -23.7 | -9.5 | 43.166 | 54 | -10.833 | 74 | -30.833 |
| 3 | 25.121 | 44.1 | PK | 34.5 | -23.1 | -9.5 | 46 | 54 | -8 | 74 | -28 |
| 4 | 18.739 | 41.67 | PK | 32.8 | -24.3 | -9.5 | 40.666 | 54 | -13.333 | 74 | -33.333 |
| 5 | 21.364 | 42.07 | PK | 33.3 | -24.2 | -9.5 | 41.666 | 54 | -12.333 | 74 | -32.333 |
| 6 | 24.162 | 44.03 | PK | 34.2 | -22.9 | -9.5 | 45.833 | 54 | -8.1666 | 74 | -28.166 |

PK - Peak detector


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## 9.5. AC POWER LINE CONDUCTED EMISSIONS

**LIMITS**

FCC §15.207 (a)
RSS-Gen 8.8

| Frequency of emission (MHz) | Conducted limit (dBµV) | |
|---|---|---|
| | 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.

**TEST PROCEDURE**

ANSI C63.10

**RESULTS**

6 WORST EMISSIONS


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## Line-L1 .15 - 30MHz

**Trace Markers**

| Marker | Frequency (MHz) | Meter Reading (dBuV) | Det | T24 IL L1 (dB) | LC Cables 1&3 (dB) | Corrected Reading dBuV | CISPR 22 Class B QP | Margin to Limit (dB) | CISPR 22 Class B Avg | Margin to Limit (dB) |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | .204 | 37.51 | PK | .9 | 0 | 38.41 | 63.4 | -24.99 | - | - |
| 2 | .204 | 30.7 | Av | .9 | 0 | 31.6 | - | - | 53.4 | -21.8 |
| 3 | .591 | 43.71 | PK | .3 | 0 | 44.01 | 56 | -11.99 | - | - |
| 4 | .591 | 29.65 | Av | .3 | 0 | 29.95 | - | - | 46 | -16.05 |
| 5 | 1.68 | 32.9 | PK | .2 | .1 | 33.2 | 56 | -22.8 | - | - |
| 6 | 1.68 | 18.44 | Av | .2 | .1 | 18.74 | - | - | 46 | -27.26 |
| 7 | 9.2085 | 28.47 | PK | .2 | .1 | 28.77 | 60 | -31.23 | - | - |
| 8 | 9.2085 | 18.23 | Av | .2 | .1 | 18.53 | - | - | 50 | -31.47 |

## Line-L2 .15 - 30MHz

**Trace Markers**

| Marker | Frequency (MHz) | Meter Reading (dBuV) | Det | T24 IL L2 (dB) | LC Cables 2&3 (dB) | Corrected Reading dBuV | CISPR 22 Class B QP | Margin to Limit (dB) | CISPR 22 Class B Avg | Margin to Limit (dB) |
|---|---|---|---|---|---|---|---|---|---|---|
| 9 | .2535 | 38.84 | PK | .7 | 0 | 39.54 | 61.6 | -22.06 | - | - |
| 10 | .2535 | 26.75 | Av | .7 | 0 | 27.45 | - | - | 51.6 | -24.15 |
| 11 | .6 | 38.75 | PK | .3 | 0 | 39.05 | 56 | -16.95 | - | - |
| 12 | .6 | 23.45 | Av | .3 | 0 | 23.75 | - | - | 46 | -22.25 |
| 13 | 1.428 | 28.41 | PK | .2 | .1 | 28.71 | 56 | -27.29 | - | - |
| 14 | 1.428 | 11.8 | Av | .2 | .1 | 12.1 | - | - | 46 | -33.9 |
| 15 | 8.979 | 31.07 | PK | .2 | .1 | 31.37 | 60 | -28.63 | - | - |
| 16 | 8.979 | 20.69 | Av | .2 | .1 | 20.99 | - | - | 50 | -29.01 |
| 17 | 9.0015 | 31.18 | PK | .2 | .1 | 31.48 | 60 | -28.52 | - | - |
| 18 | 9.0015 | 20.6 | Av | .2 | .1 | 20.9 | - | - | 50 | -29.1 |

PK - Peak detector

Av - average detection


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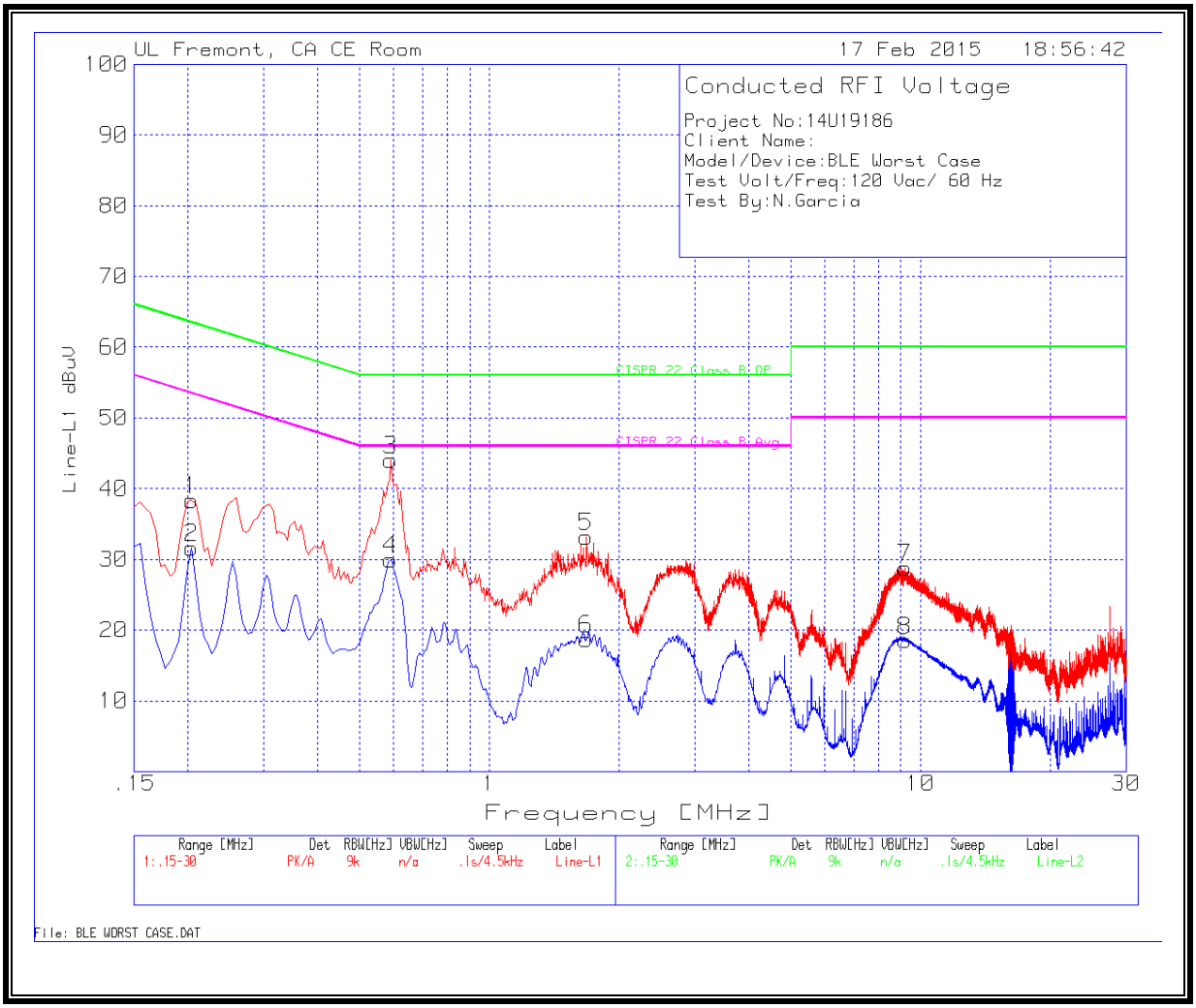
**LINE 1 RESULTS**





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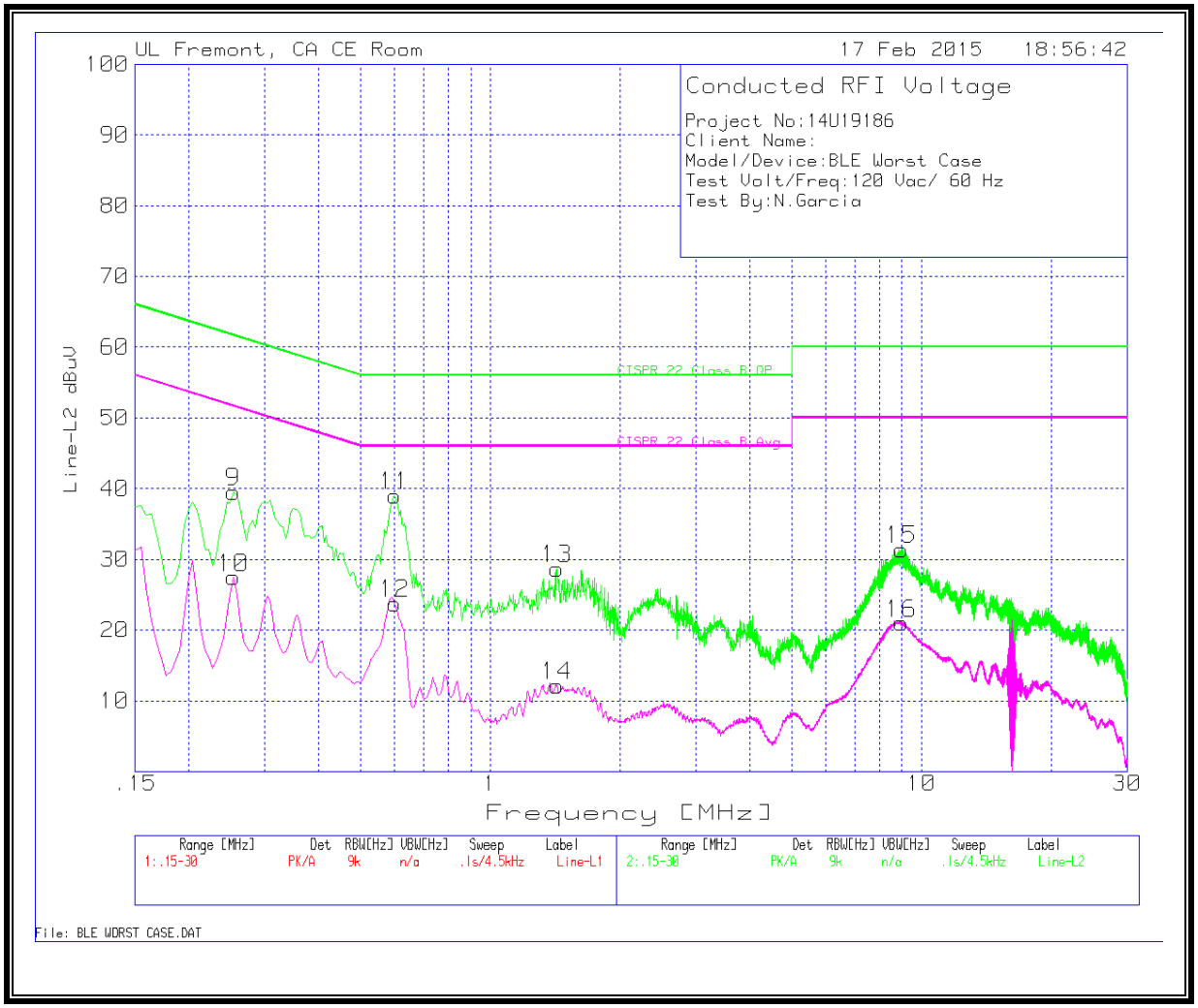
**LINE 2 RESULTS**





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