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

BLUETOOTH LOW ENERGY CERTIFICATION TEST REPORT

FOR

CELLULAR PHONE WITH BLUETOOTH AND WLAN RADIOS

MODEL NUMBER: A1784

FCC ID: BCG-E3092A
IC: 579C-E3092A

REPORT NUMBER: 16U23366-E2V3

ISSUE DATE: AUGUST 26, 2016

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
V1	7/21/2016	Initial Issue	Hung Thai
V2	7/30/2016	Revise report to address TCB questions	Francisco Guarnero
V3	8/26/2016	Updated Power, PSD for high power mode base on client new target power	Joe Vang

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1. ATTESTATION OF TEST RESULTS

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

EUT DESCRIPTION: CELLULAR PHONE WITH BLUETOOTH AND WLAN RADIOS

MODEL: A1784

SERIAL NUMBER: C39RV054HFPQ (CONDUCTED); C39RV064HFPQ (RADIATED)

DATE TESTED: MARCH 01, 2016 – AUGUST 25, 2016

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
UL Verification Services Inc. By:

Prepared By:

MENGISTU MEKURIA
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HUNG THAI
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, KDB 558074 D01 v03r05, ANSI C63.10-2013, RSS-GEN Issue 4, and RSS-247 Issue 1.

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, Model A1784 is a mobile phone with multimedia functions (music, application support, and video), cellular GSM/GPRS/EGPRS/WCDMA/HSPA+/DC-HSDPA/LTE-radio, IEEE 802.11a/b/g/n/ac, NFC 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	16.65	46.24

5.3. DESCRIPTION OF AVAILABLE ANTENNAS

Frequency Band (GHz)	Antenna Gain (dBi)
2.4	-1.85

5.4. SOFTWARE AND FIRMWARE

The firmware Version installed in the EUT during testing was 14.1.39.180

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

Worst-case data rates as provided by the client were:
Based on the baseline scan, the worst-case data rates 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.

For simultaneous transmission of multiple channels from the same antenna in the 2.4GHz and 5GHz bands, tests were conducted for various configurations having the highest power. No noticeable new emission was found.

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5.6. DESCRIPTION OF TEST SETUP

SUPPORT EQUIPMENT

Support Equipment List				
Description	Manufacturer	Model	Serial Number	FCC ID
Laptop	Dell	Latitude 3540	9J6WQZ1	NA
Laptop Power Supply	Dell	LA65NM130	0JNKWD	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	2	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 (BELOW 1 GHZ)

I/O Cable List						
Cable No	Port	# of identical ports	Connector Type	Cable Type	Cable Length (m)	Remarks
1	AC	1	AC	Un-shielded	3	N/A

I/O CABLES (AC LINE CONDUCTED: AC/DC ADAPTER &LAPTOP CONFIGURATION)

I/O Cable List						
Cable No	Port	# of identical	Connector Type	Cable Type	Cable Length (m)	Remarks
1	AC	1	AC	Un-shielded	3	N/A
2	Power Adapter	1	AC	Un-shielded	3	N/A

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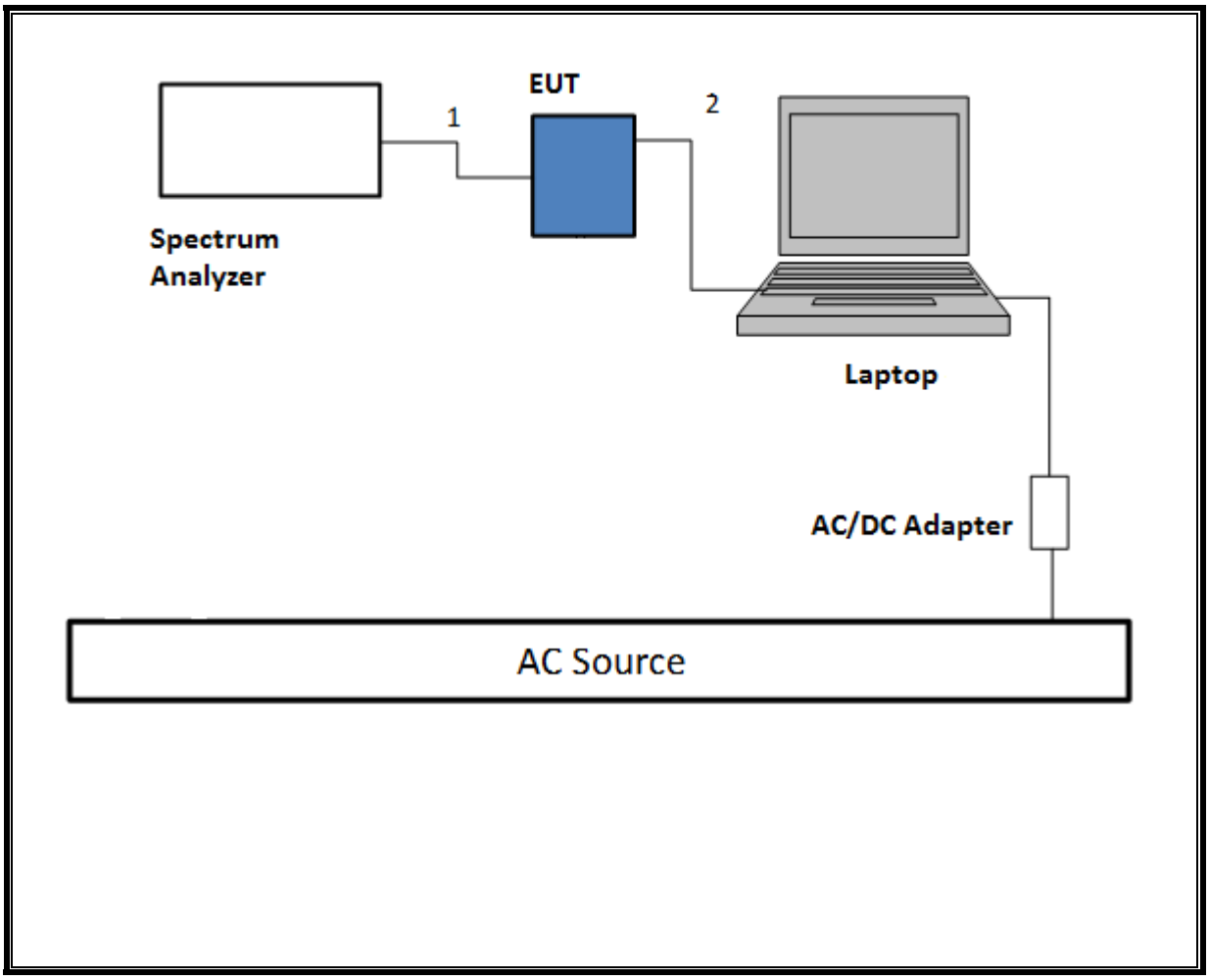
TEST SETUP- CONDUCTED PORT

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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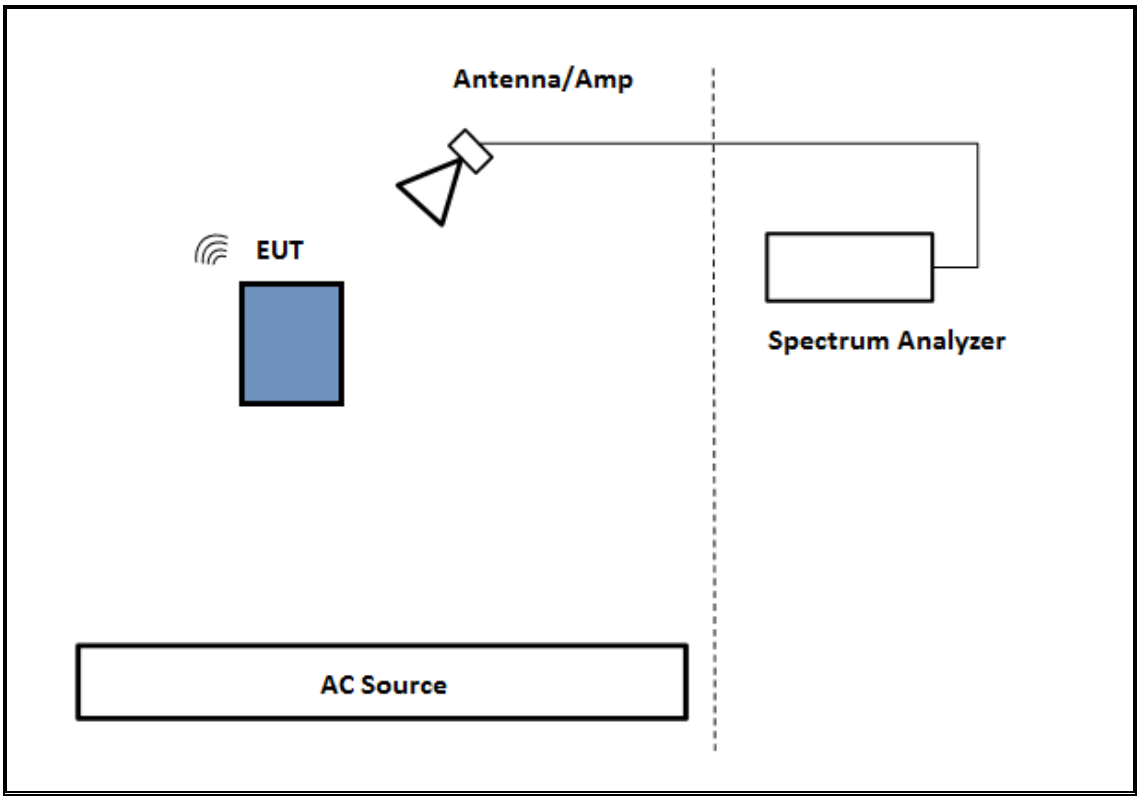
TEST SETUP - RADIATED-ABOVE 1 GHZ

The EUT was powered by AC cord. Test software exercised the EUT.

SETUP DIAGRAM



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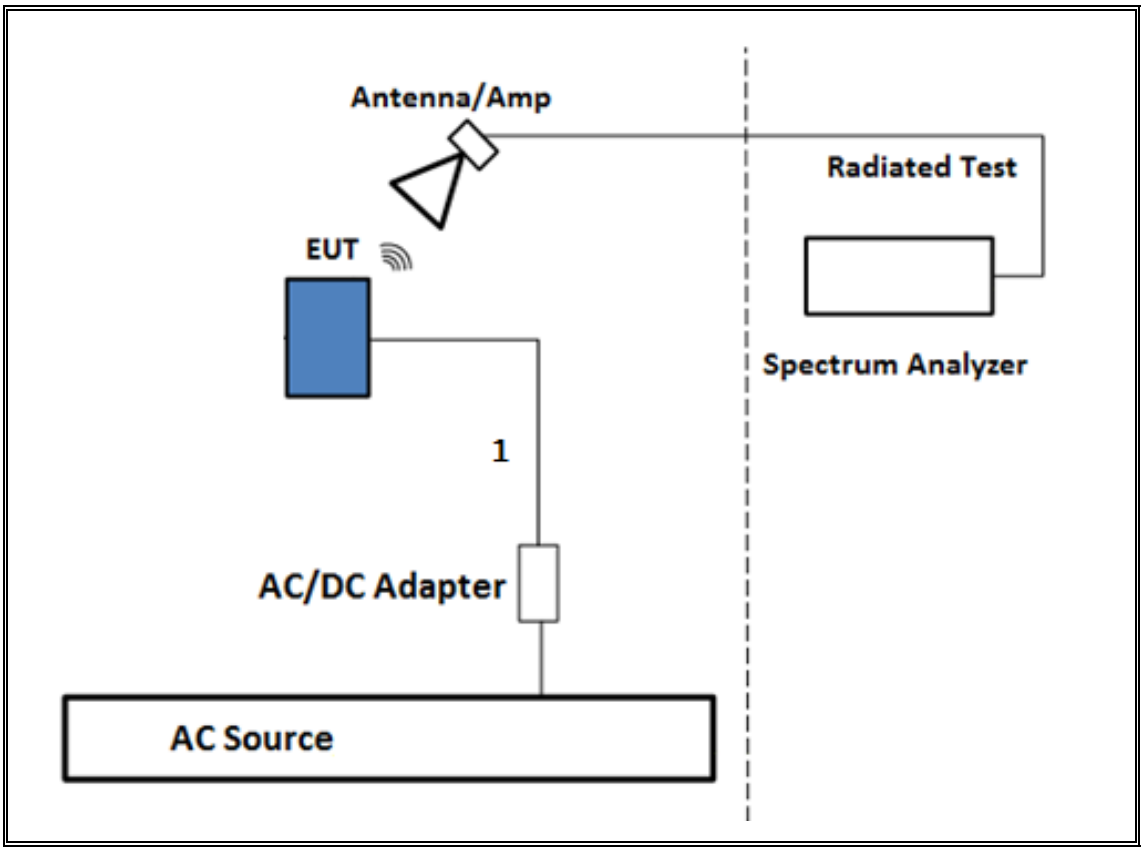
TEST SETUP- BELOW 1GHZ

The EUT was powered by AC cord. Test software exercised the EUT.

SETUP DIAGRAM



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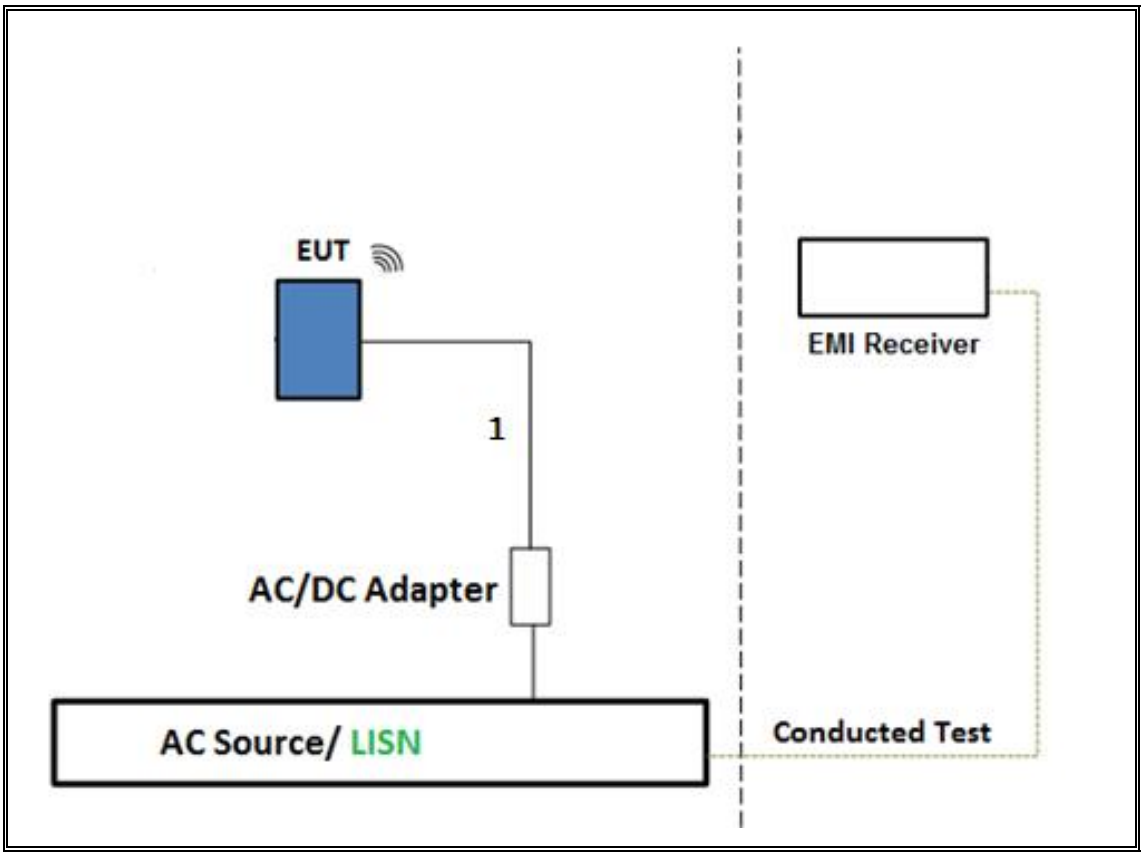
TEST SETUP- AC LINE CONDUCTED: AC/DC ADAPTER

The EUT was tested with powered by AC/DC adapter via USB cable. Test software exercised the EUT.

SETUP DIAGRAM



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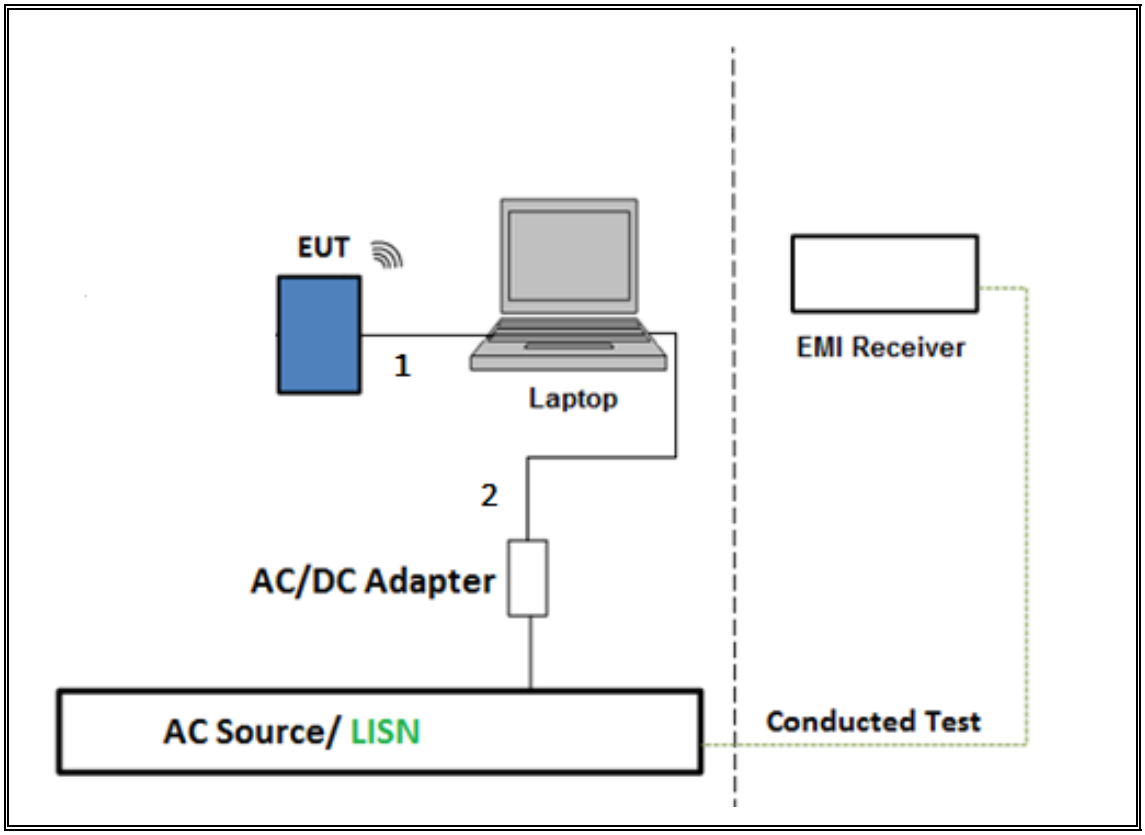
TEST SETUP- AC LINE CONDUCTED: LAPTOP CONFIGURATION

The EUT was tested with powered by host PC via USB cable. 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	00154522	1/12/2017
Antenna, Broadband Hybrid, 30MHz to 2000MHz	Sunol Sciences	JB3	A022813-1	10/28/2016
Amplifier, 1 - 18GHz	Miteq	AFS42-00101800-25-S-42	1782158	1/25/2017
**Amplifier, 10KHz to 1GHz, 32dB	Sonoma	310N	323561	6/8/2016
**Spectrum Analyzer, PXA, 3Hz to 44GHz	Agilent	N9030A	US51350187	6/1/2016
**Amplifier, 10KHz to 1GHz, 32dB	Sonoma	310N	185623	6/9/2016
Spectrum Analyzer, PXA, 3Hz to 44GHz	Agilent	N9030A	MY51380911	10/15/2016
Power Meter, P-series single channel	Agilent	N1911A	GB45100212	9/25/2016
**Power Sensor, P - series, 50MHz to 18GHz, Wideband	Agilent	N1921A	MY53260010	7/8/2016
***Power Sensor, P - series, 50MHz to 18GHz, Wideband	Agilent	N1921A	MY55200004	5/18/2017
**Antenna, Horn 18 to 26.5GHz	ARA	MWH-1826	209336	5/12/2016
**Spectrum Analyzer, 40 GHz	Agilent	8564E	3943A01643	8/14/2016
**Amplifier, 1 to 26.5GHz, 23.5dB Gain minimum	Keysight	8449B	3008A04710	6/29/2016
AC Line Conducted				
EMI Test Receiver 9Khz-7GHz	Rohde & Schwarz	ESCI7	100935	9/10/2016
LISN for Conducted Emissions CISPR-16	Fischer	50/250-25-2	161124	9/16/2016
**Power Cable, Line Conducted Emissions	U L	PG1	N/A	7/28/2016
UL SOFTWARE				
* Radiated Software	UL	UL EMC	Ver 9.5, June 24, 2015	
* Radiated Software	UL	UL EMC	Ver 9.5, June 26, 2016	
* Conducted Software	UL	UL EMC	Ver 4.0, January 11, 2016	
* AC Line Conducted Software	UL	UL EMC	Ver 9.5, May 26, 2015	

Note: * indicates automation software version used in the compliance certification testing
**Testing is completed before equipment expiration date
***Equipment was used after calibration.

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7. ANTENNA PORT TEST RESULTS

7.1. MEASUREMENT METHODS

6 dB BW: KDB 558074 D01 v03r05, Section 8.1.

Output Power: KDB 558074 D01 v03r05, Section 9.1.2.

Power Spectral Density: KDB 558074 D01 v03r05, Section 10.2.

Out-of-band emissions in non-restricted bands: KDB 558074 D01 v03r05, Section 11.0.

Out-of-band emissions in restricted bands: KDB 558074 D01 v03r05, Section 12.1.

Band-edge: KDB 558074 D01 v03r05, Section 12.1.

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7.2. ON TIME, DUTY CYCLE

LIMITS

None; for reporting purposes only.

PROCEDURE

KDB 558074 Zero-Span Spectrum Analyzer Method.

ON TIME AND DUTY CYCLE 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 LOW POWER	1.000	1.000	1.000	100.00%	0.00	0.010
BLE HIGH POWER	1.000	1.000	1.000	100.00%	0.00	0.010

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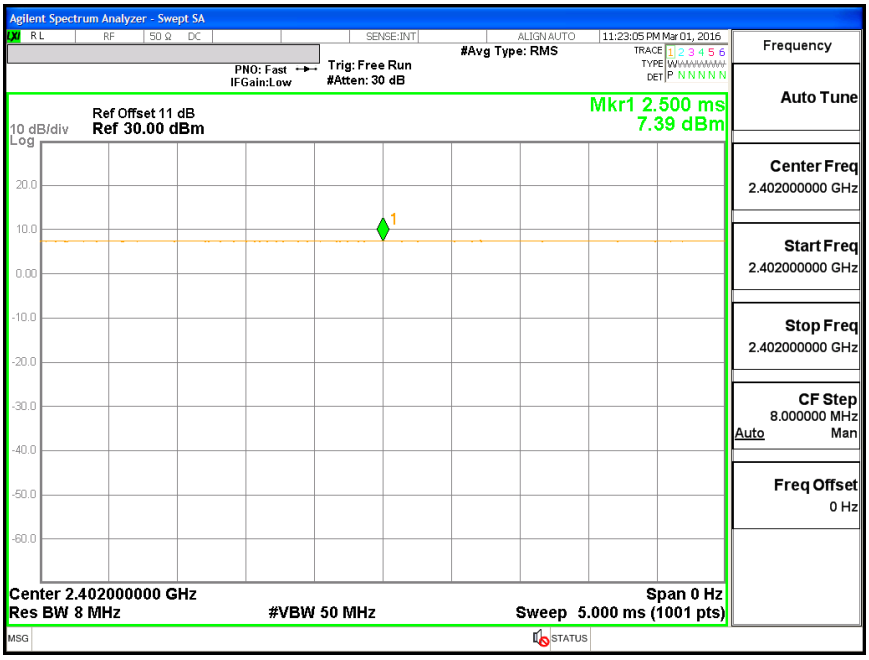
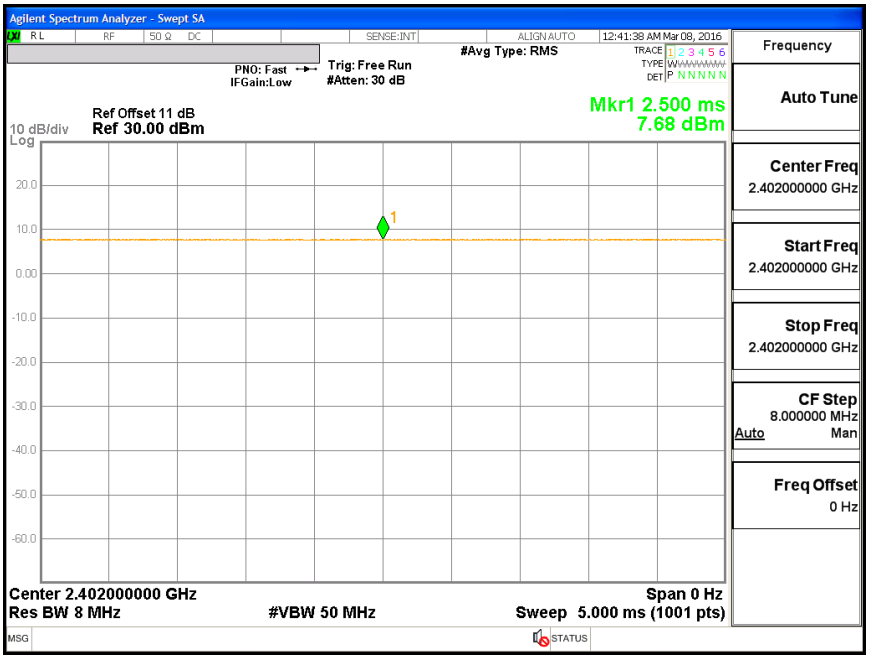
DUTY CYCLE PLOTS

DUTY CYCLE BLE LOW POWER MODE



DUTY CYCLE BLE HIGH POWER MODE



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7.3. 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

Low Power

Channel	Frequency (MHz)	6 dB Bandwidth (MHz)	Minimum Limit (MHz)
Low	2402	0.722	0.5
Middle	2440	0.690	0.5
High	2480	0.694	0.5

High Power

Channel	Frequency (MHz)	6 dB Bandwidth (MHz)	Minimum Limit (MHz)
Low	2402	0.670	0.5
Middle	2440	0.688	0.5
High	2480	0.692	0.5

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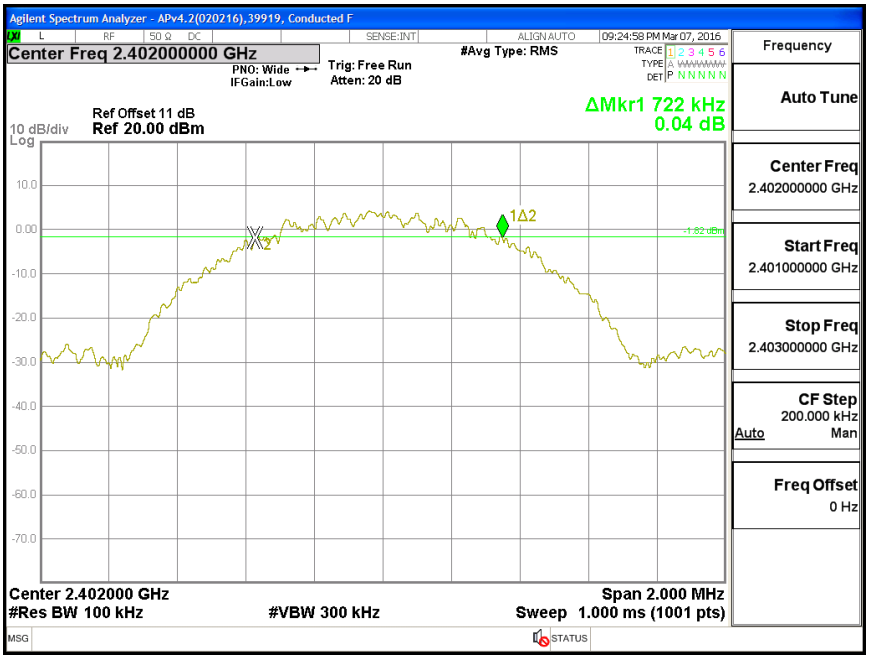
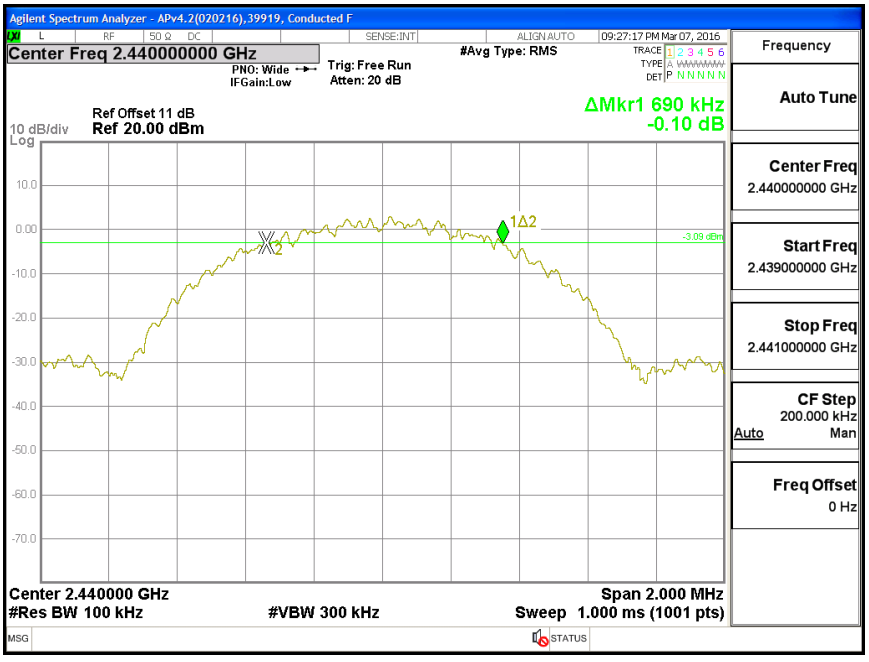
6 dB BANDWIDTH LOW POWER

6 dB BANDWIDTH LOW CH



6 dB BANDWIDTH MID CH



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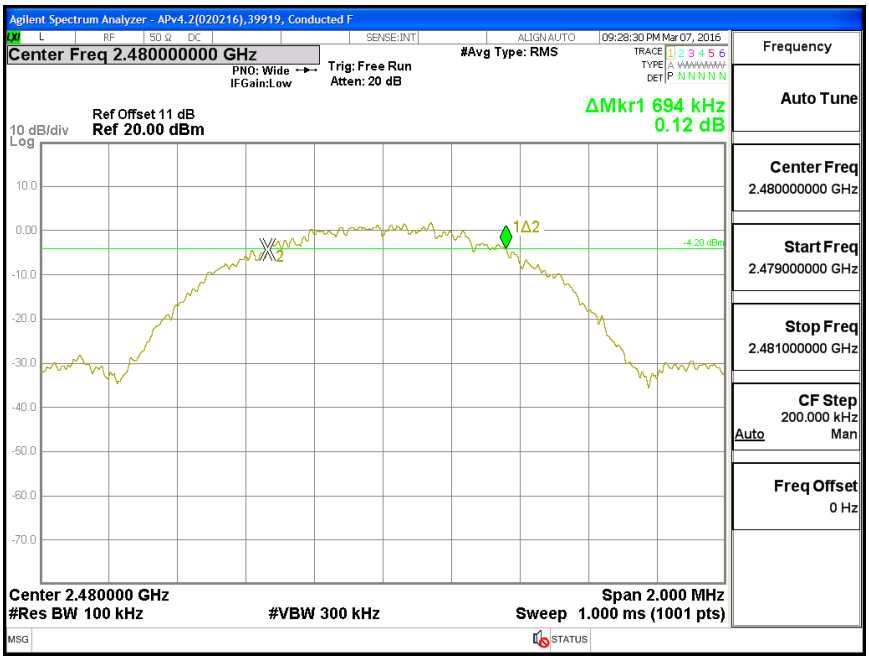
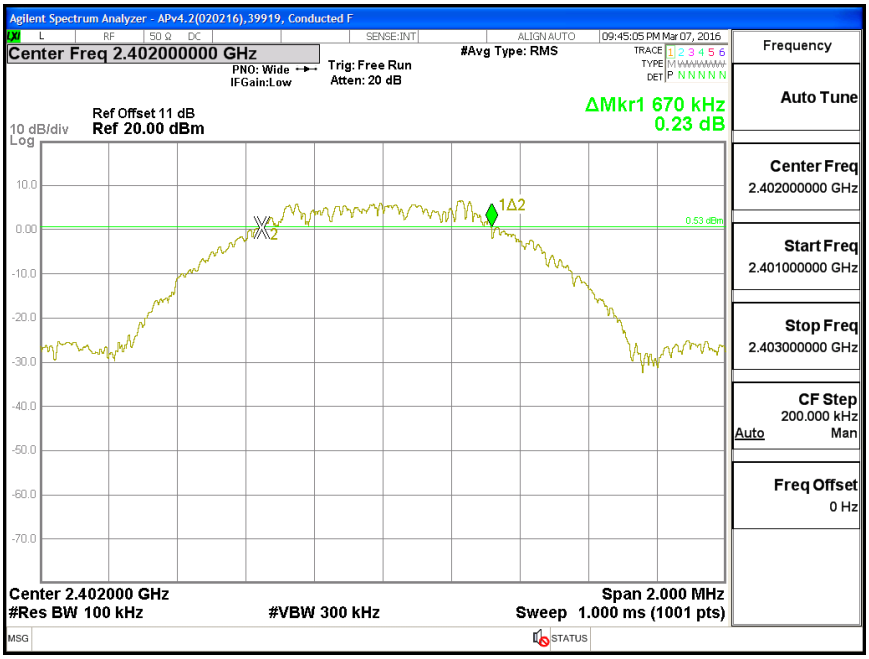
6 dB BANDWIDTH HIGH CH



6 dB BANDWIDTH HIGH POWER

6 dB BANDWIDTH LOW CH



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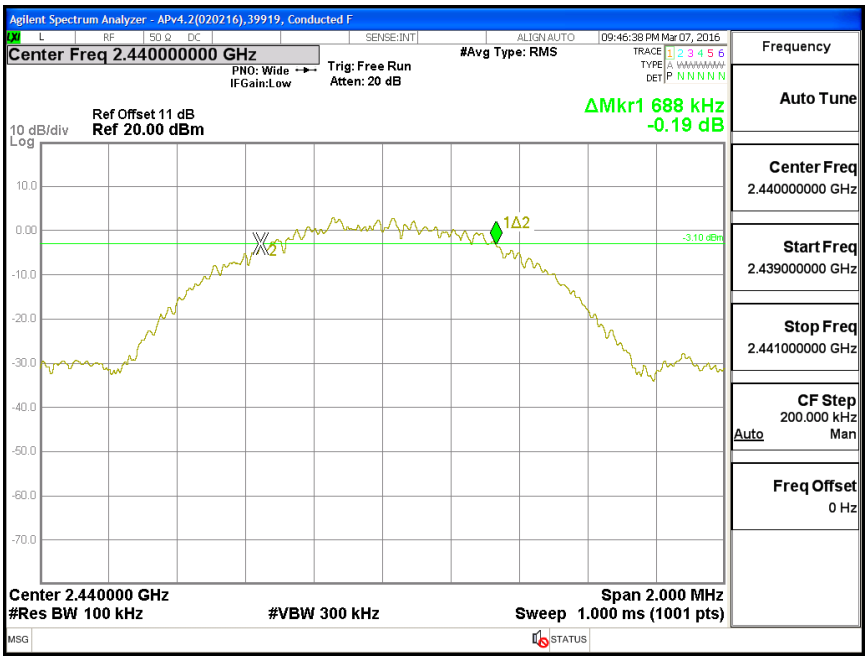
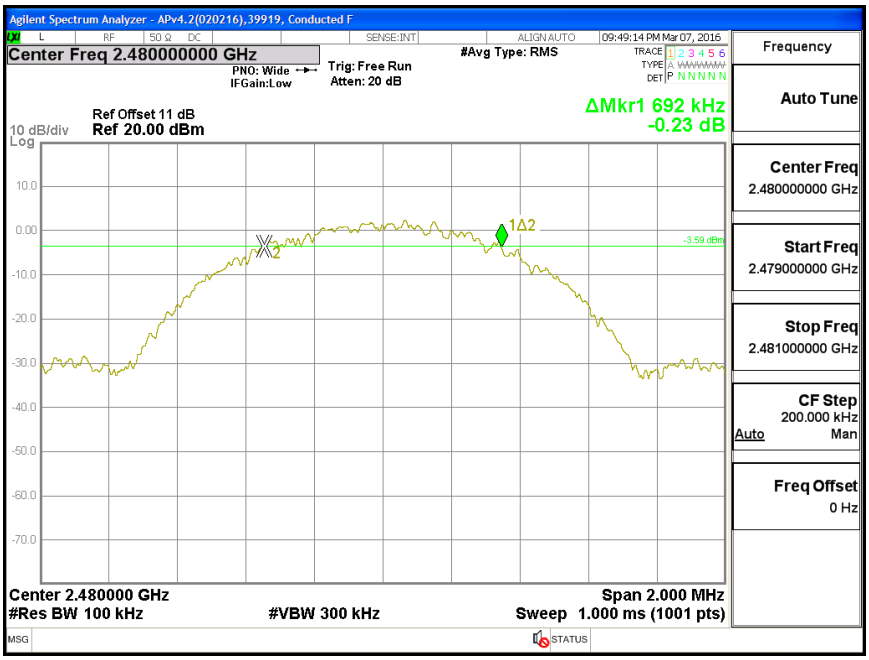
6 dB BANDWIDTH MID CH



6 dB BANDWIDTH HIGH CH



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7.4. 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 or 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

Low Power

Channel	Frequency (MHz)	99% Bandwidth (MHz)
Low	2402	1.0523
Middle	2440	1.0463
High	2480	1.0516

High Power

Channel	Frequency (MHz)	99% Bandwidth (MHz)
Low	2402	1.0499
Middle	2440	1.0504
High	2480	1.0485

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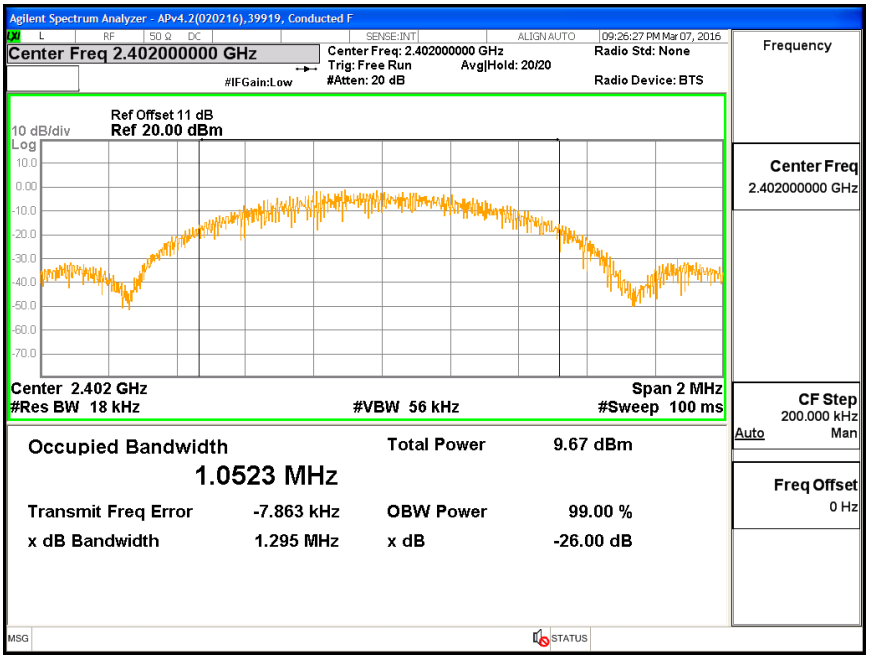
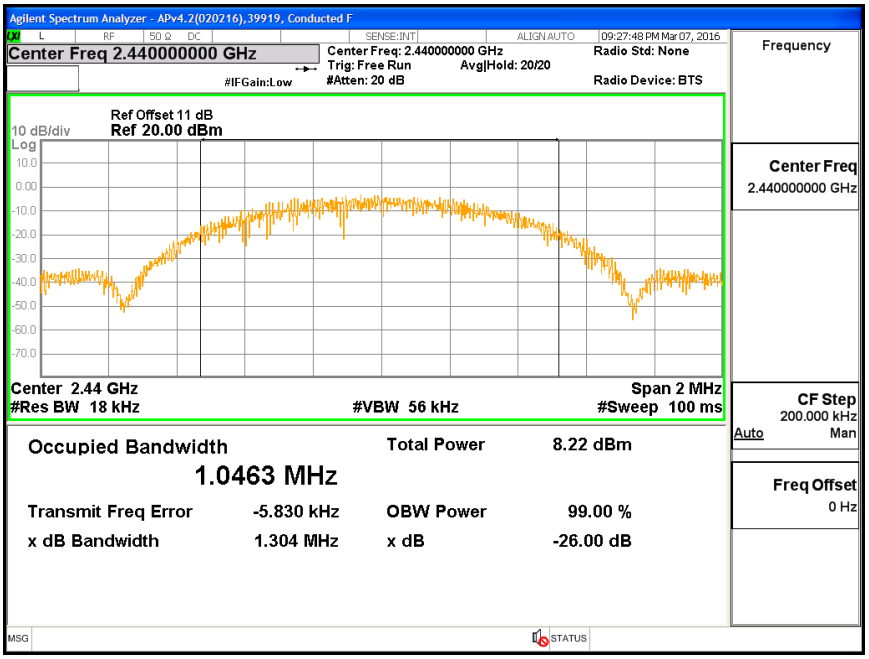
99% BANDWIDTH LOW POWER

99% BANDWIDTH LOW CH



99% BANDWIDTH MID CH



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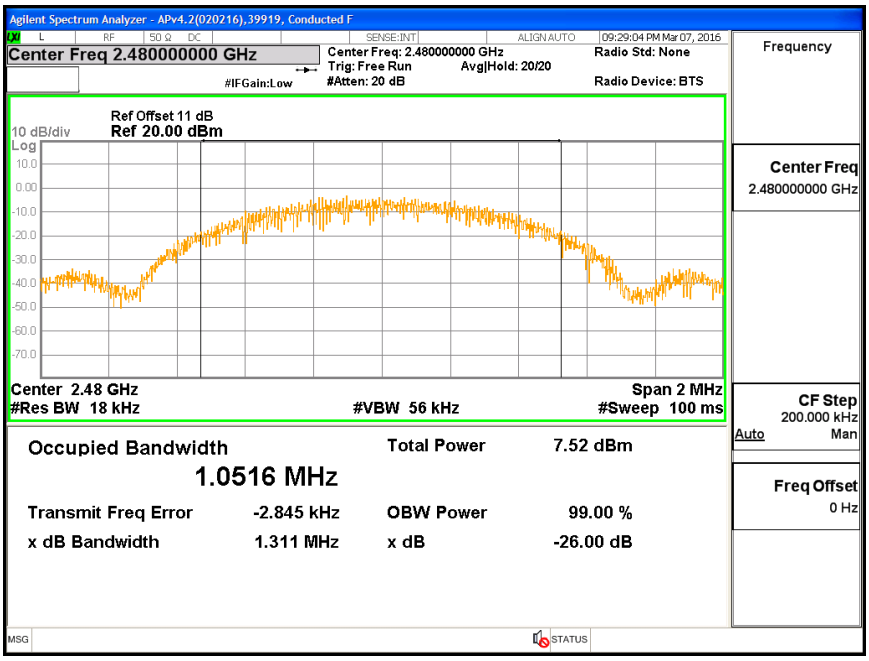
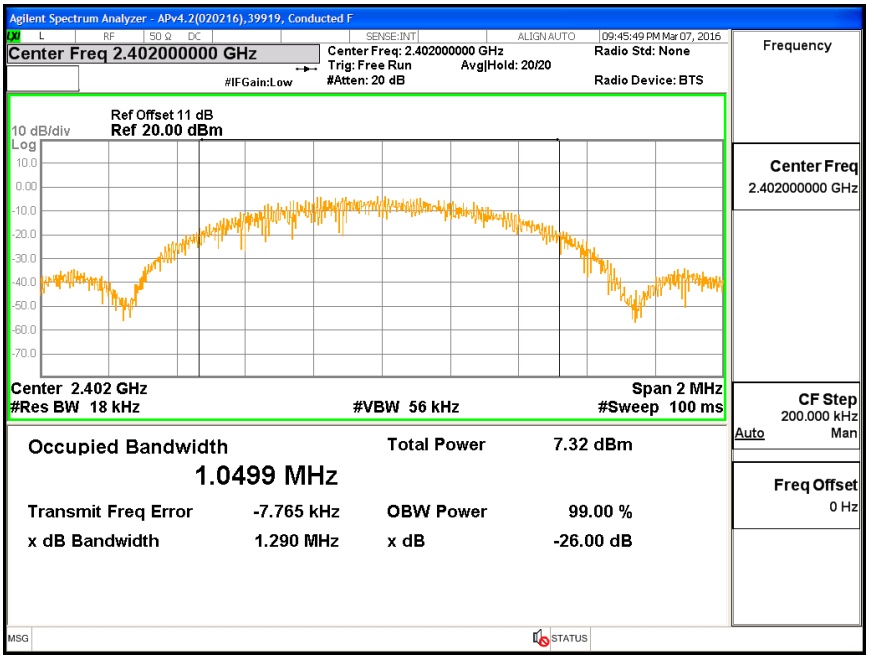
99% BANDWIDTH HIGH CH



99% BANDWIDTH HIGH POWER

99% BANDWIDTH LOW CH



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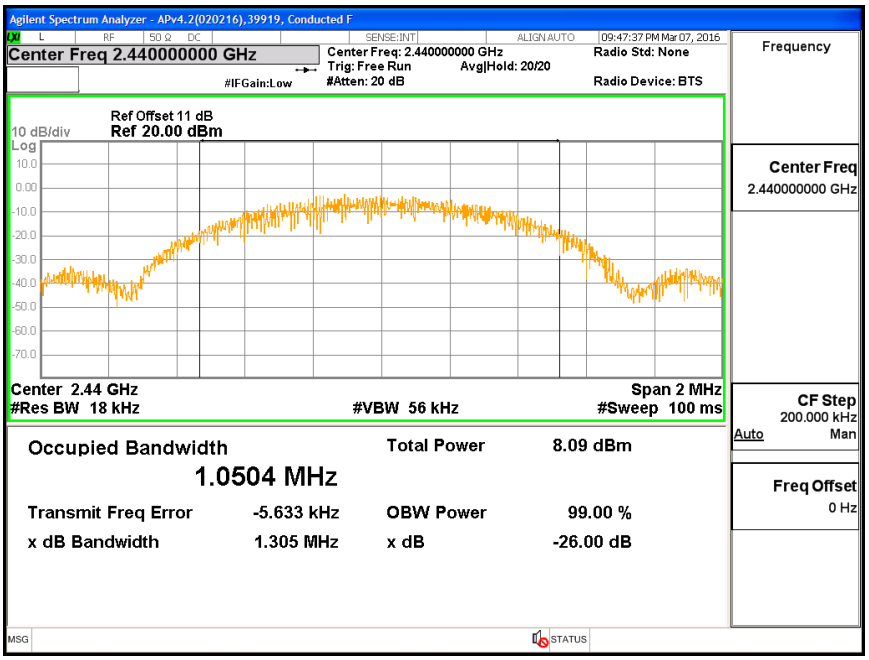
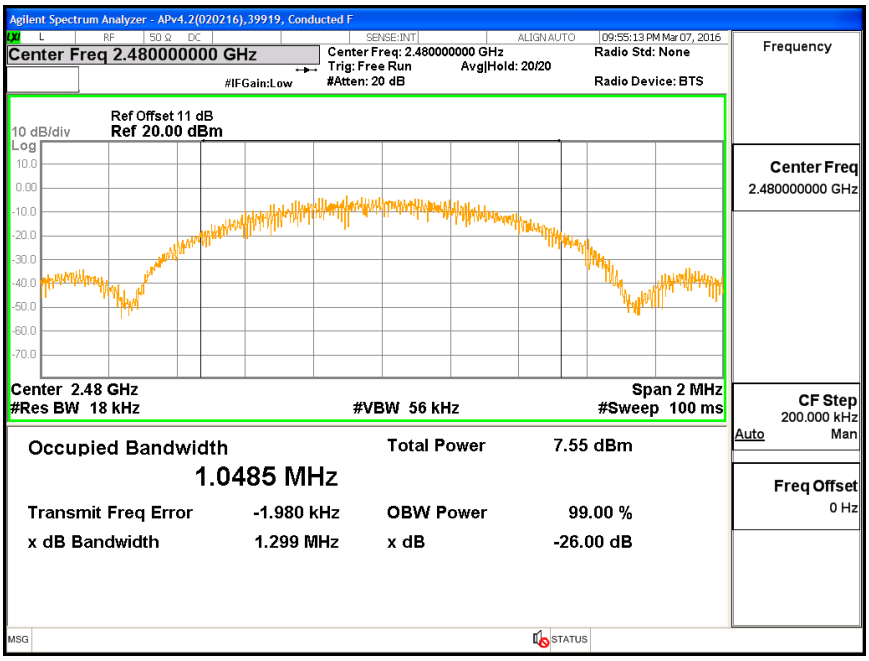
99% BANDWIDTH MID CH



99% BANDWIDTH HIGH CH



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7.5. AVERAGE POWER

LIMITS

None; for reporting purposes only.

RESULTS

ID:	30606	Date:	8/24/16

Low Power

Channel	Frequency (MHz)	AV power (dBm)
Low	2402	9.93
Middle	2440	9.81
High	2480	9.88

High Power

Channel	Frequency (MHz)	AV power (dBm)
Low	2402	16.35
Middle	2440	16.50
High	2480	16.42

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7.6. 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

ID:	30606	Date:	8/24/16

Low Power

Channel	Frequency (MHz)	Peak Power Reading (dBm)	Limit (dBm)	Margin (dB)
Low	2402	10.20	30	-19.800
Middle	2440	10.14	30	-19.860
High	2480	10.18	30	-19.820

High Power

Channel	Frequency (MHz)	Peak Power Reading (dBm)	Limit (dBm)	Margin (dB)
Low	2402	16.44	30	-13.560
Middle	2440	16.65	30	-13.350
High	2480	16.59	30	-13.410

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7.7. 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

Low Power

Channel	Frequency (MHz)	PSD (dBm)	Limit (dBm)	Margin (dB)
Low	2402	-7.78	8	-15.78
Middle	2440	-7.25	8	-15.25
High	2480	-7.46	8	-15.46

High Power

Channel	Frequency (MHz)	PSD (dBm)	Limit (dBm)	Margin (dB)
Low	2402	3.47	8	-4.53
Middle	2440	4.61	8	-3.39
High	2480	4.30	8	-3.70

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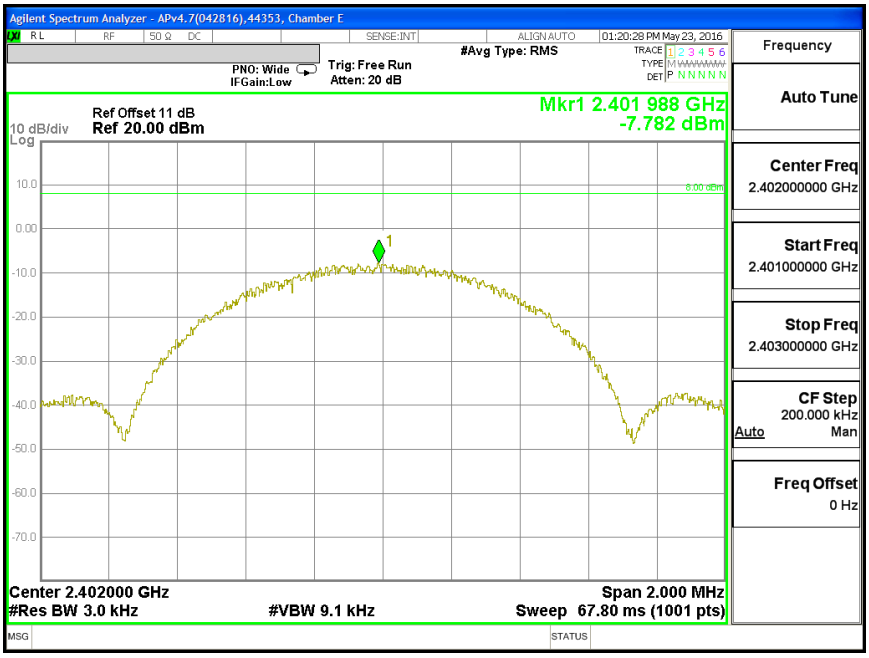
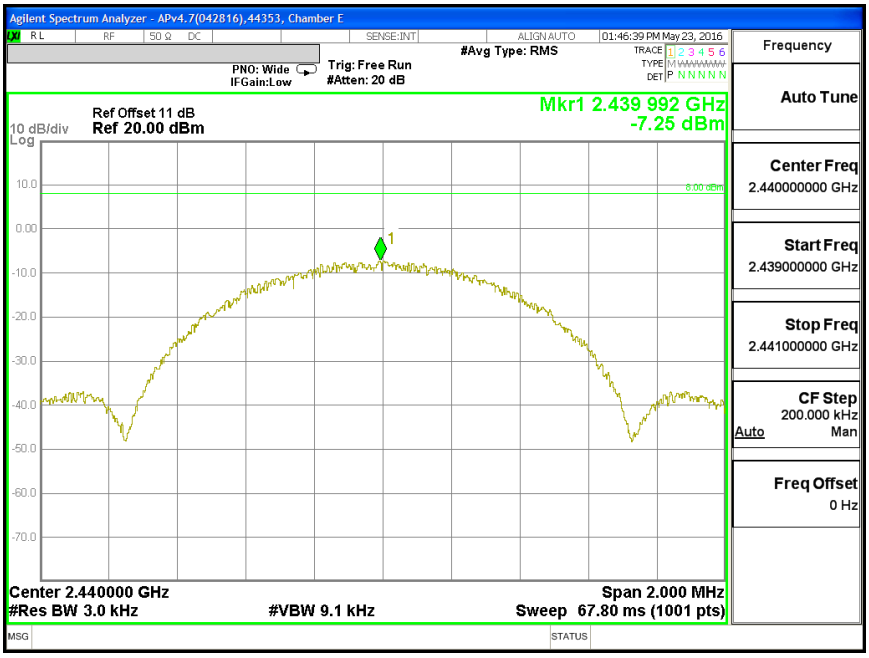
LOW POWER

POWER SPECTRAL DENSITY

PSD LOW CH



PSD MID CH



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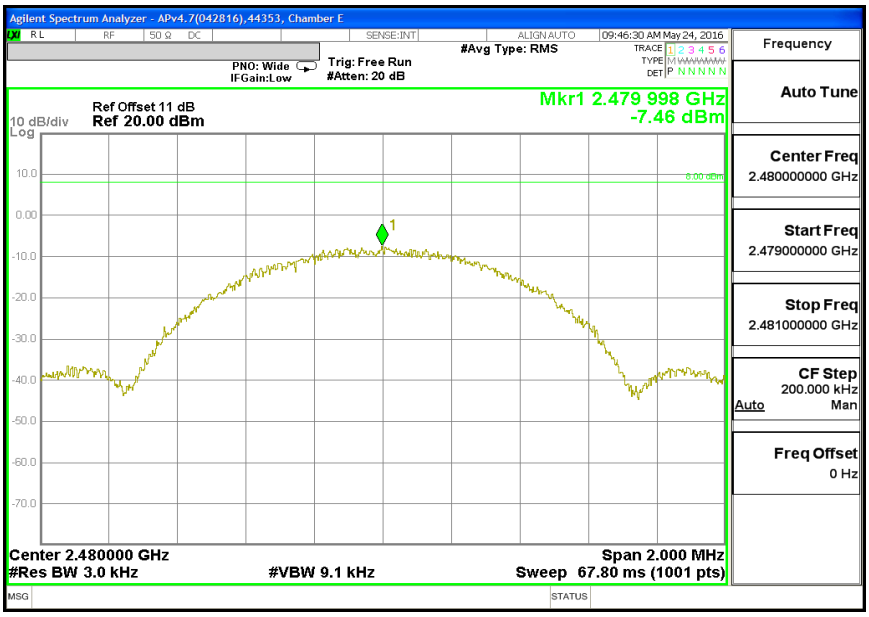
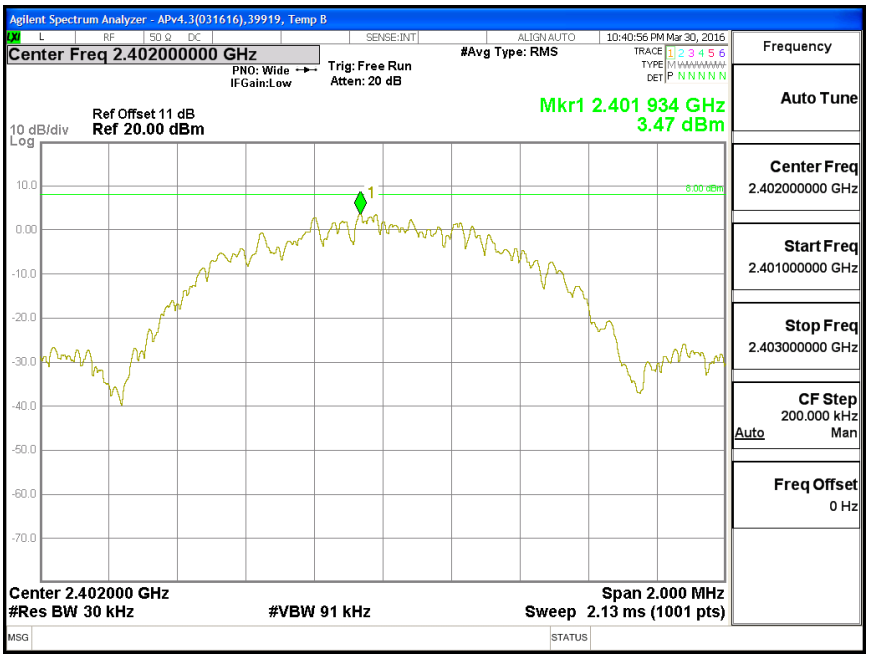
PSD HIGH CH



HIGH POWER

POWER SPECTRAL DENSITY

PSD LOW CH



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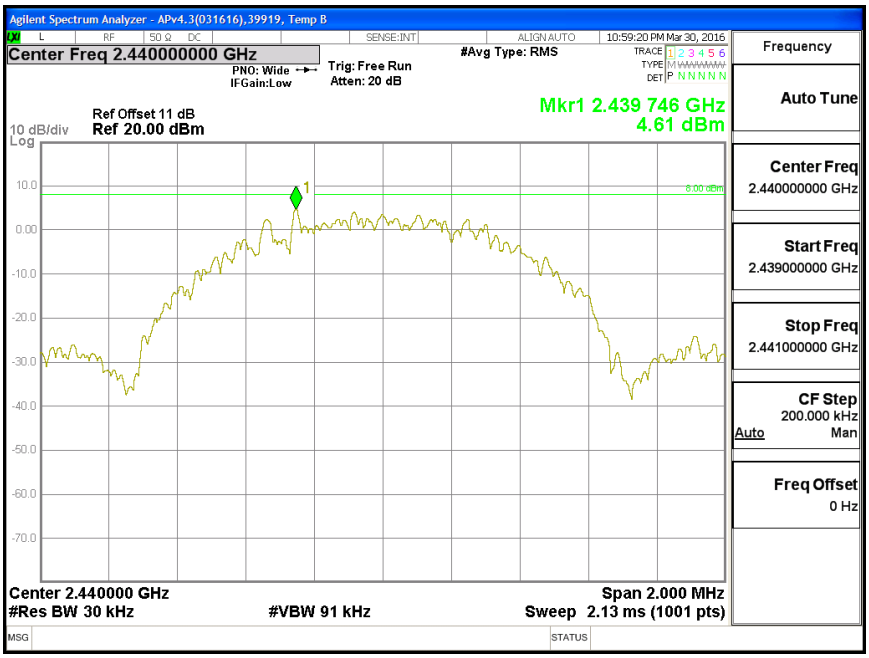
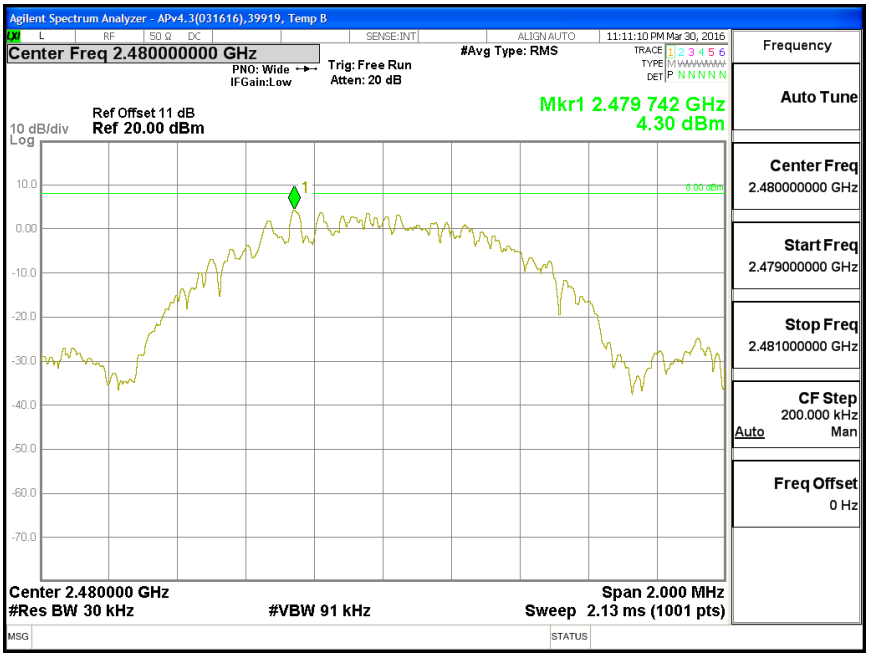
PSD MID CH



PSD HIGH CH



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7.8. 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.

RESULTS

Note: Conducted Spurious Emissions to the high power mode was originally tested with high power than recorded power data of average power table.

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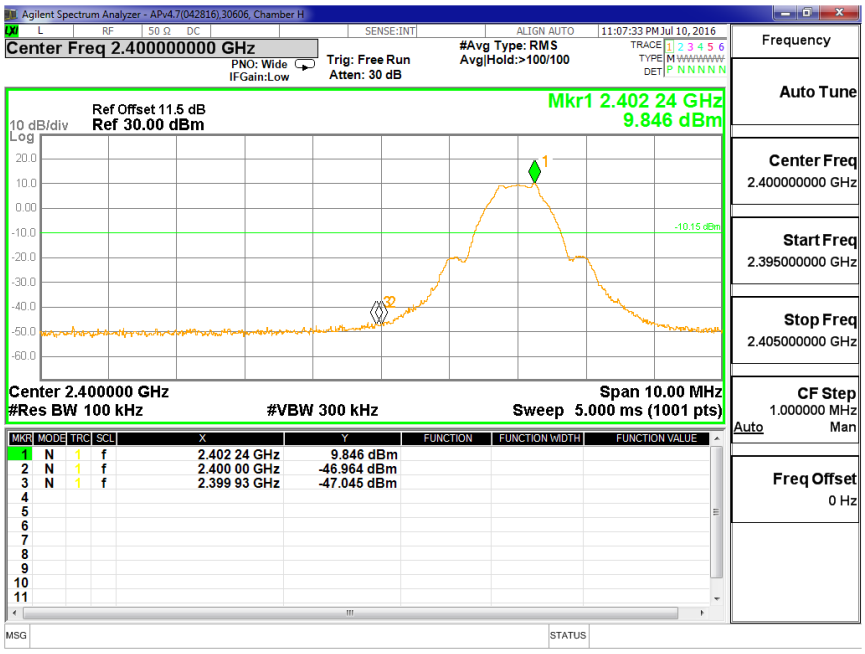
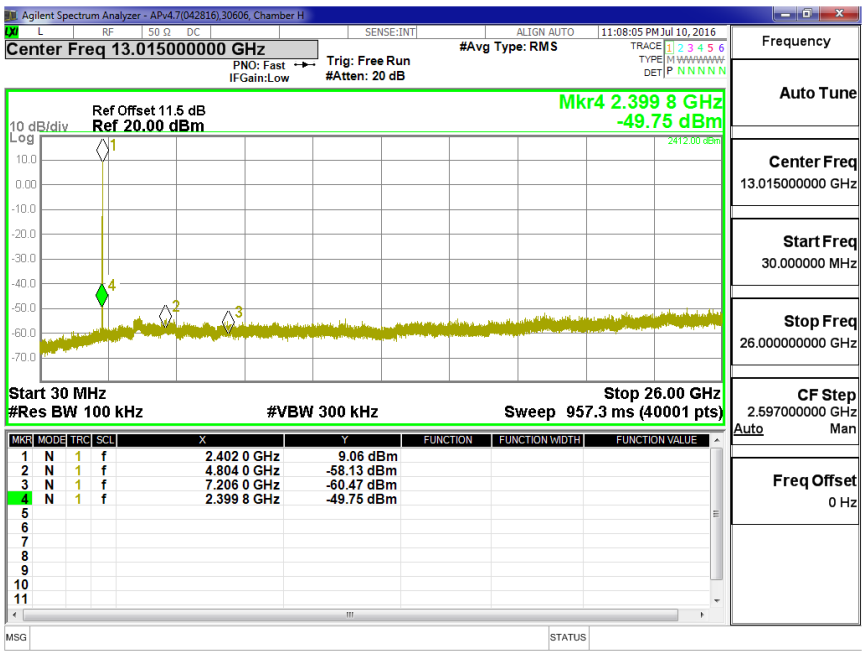
LOW POWER

SPURIOUS EMISSIONS, LOW CHANNEL

LOW CH BANDEDGE



LOW CH SPURIOUS



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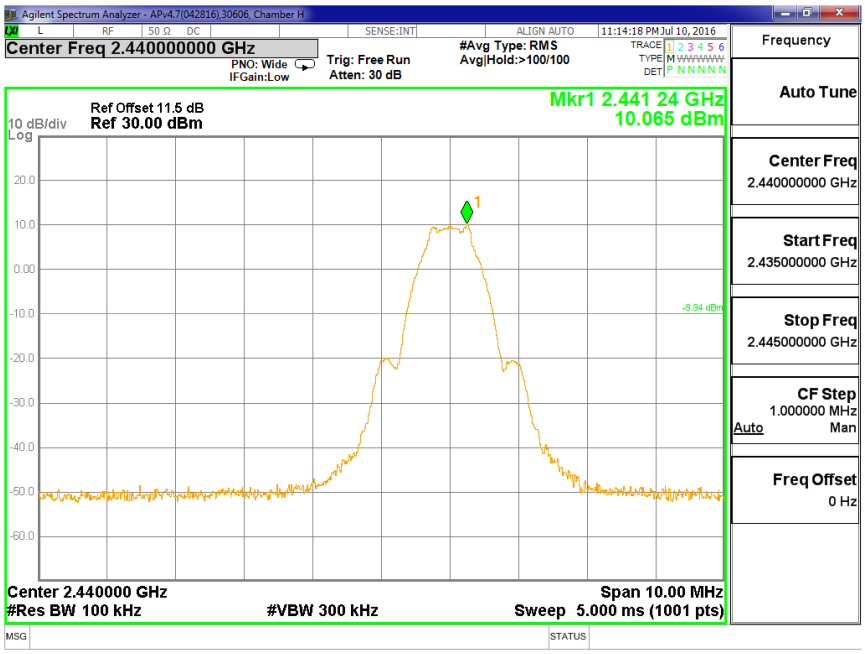
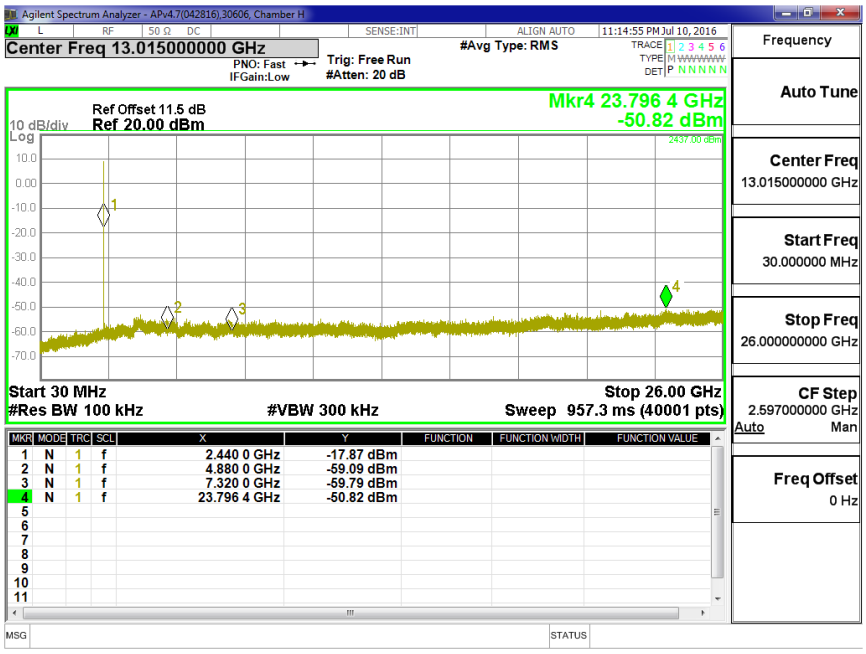
SPURIOUS EMISSIONS, MID CHANNEL

MID CH REFERENCE



MID CH SPURIOUS



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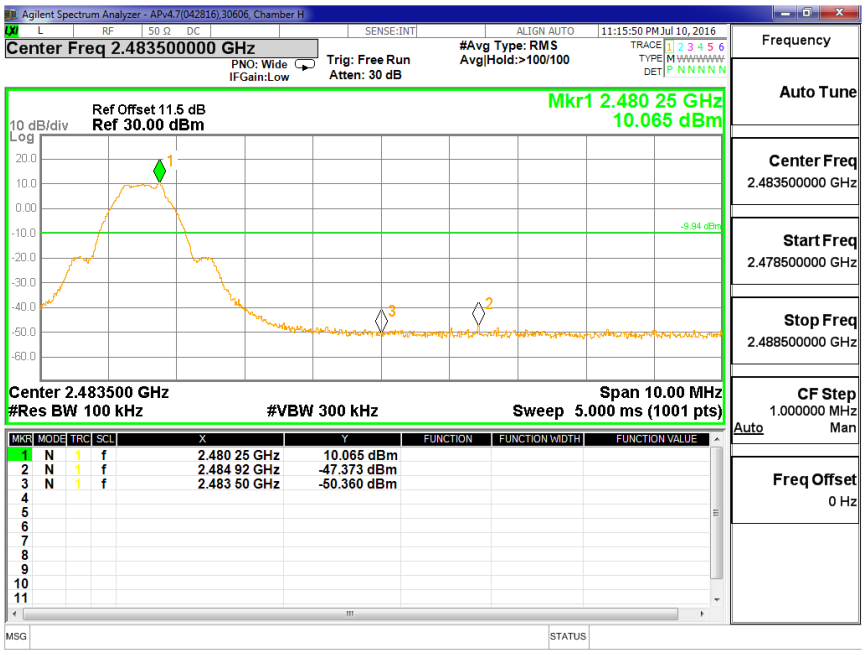
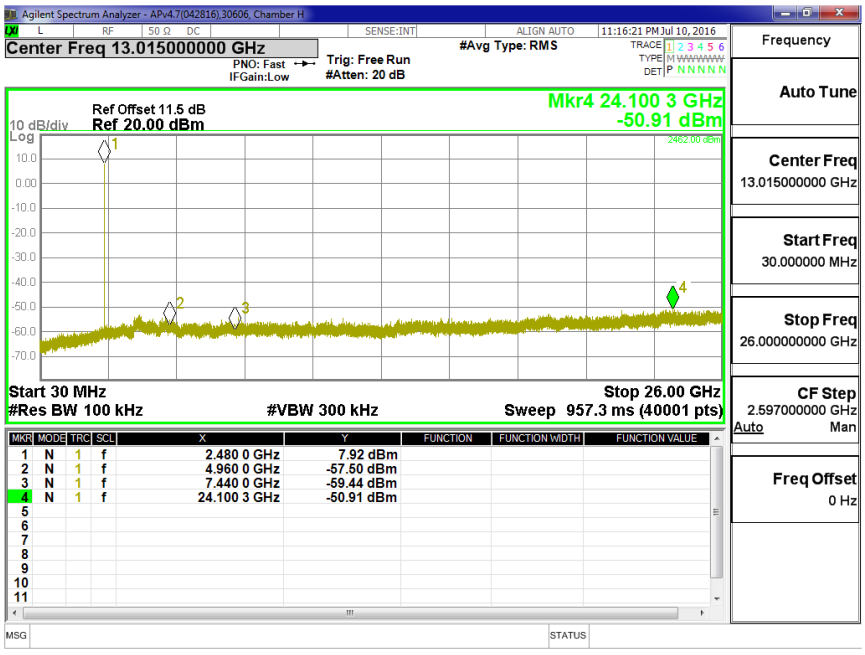
SPURIOUS EMISSIONS, HIGH CHANNEL

HIGH CH BANDEDGE



HIGH CH SPURIOUS



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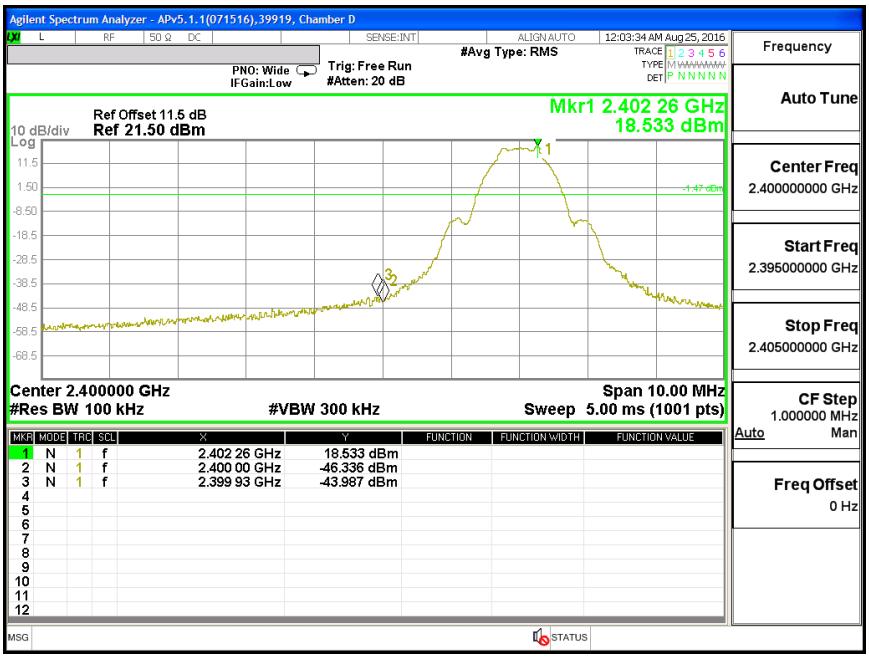
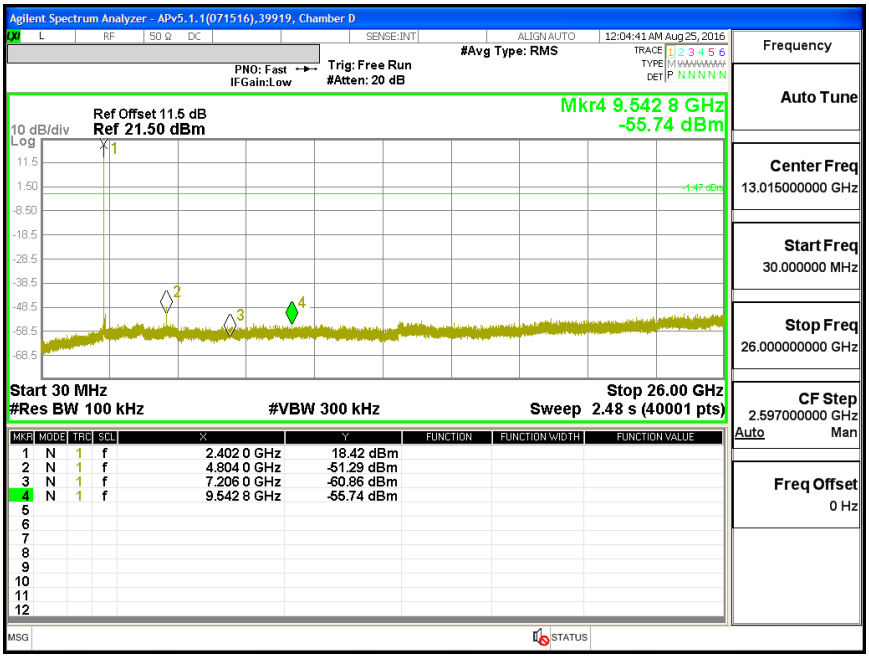
HIGH POWER

SPURIOUS EMISSIONS, LOW CHANNEL

LOW CH BANDEDGE



LOW CH SPURIOUS



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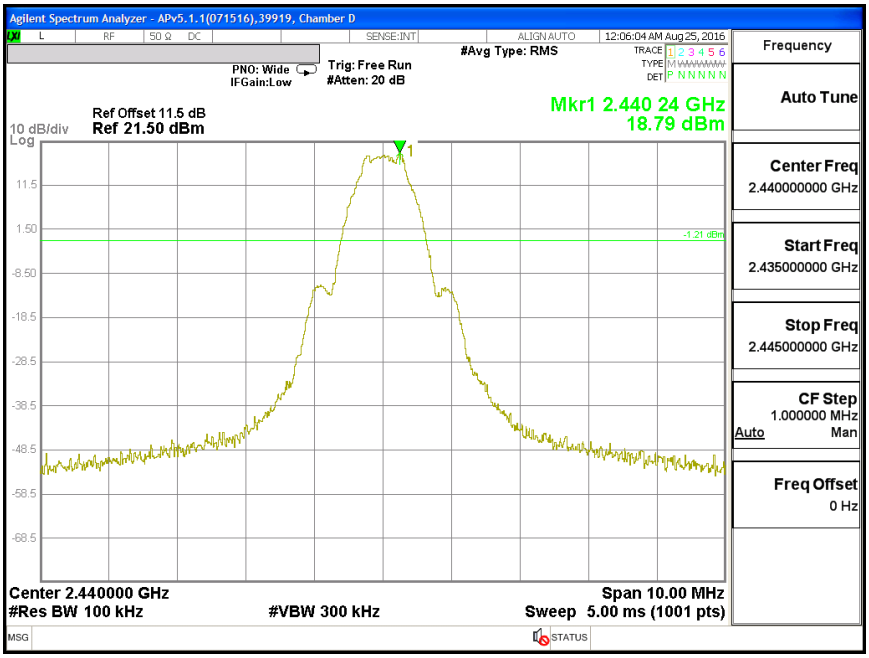
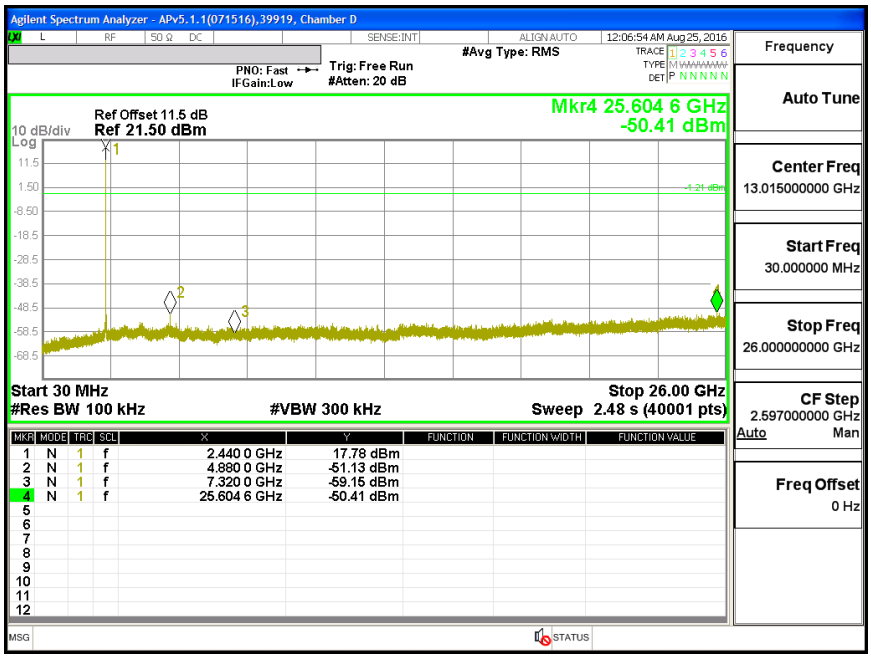
SPURIOUS EMISSIONS, MID CHANNEL

MID CH REFERENCE



MID CH SPURIOUS



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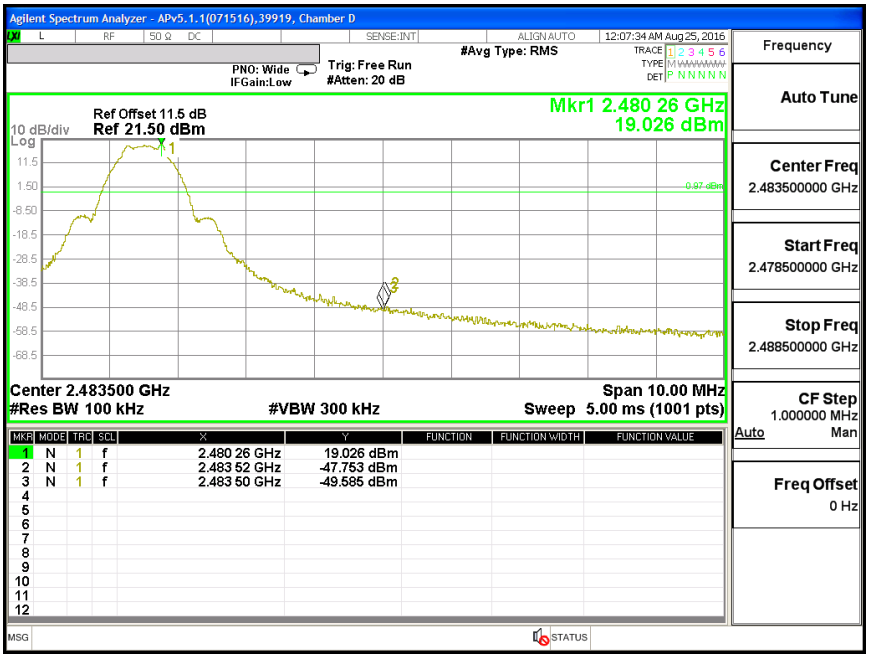
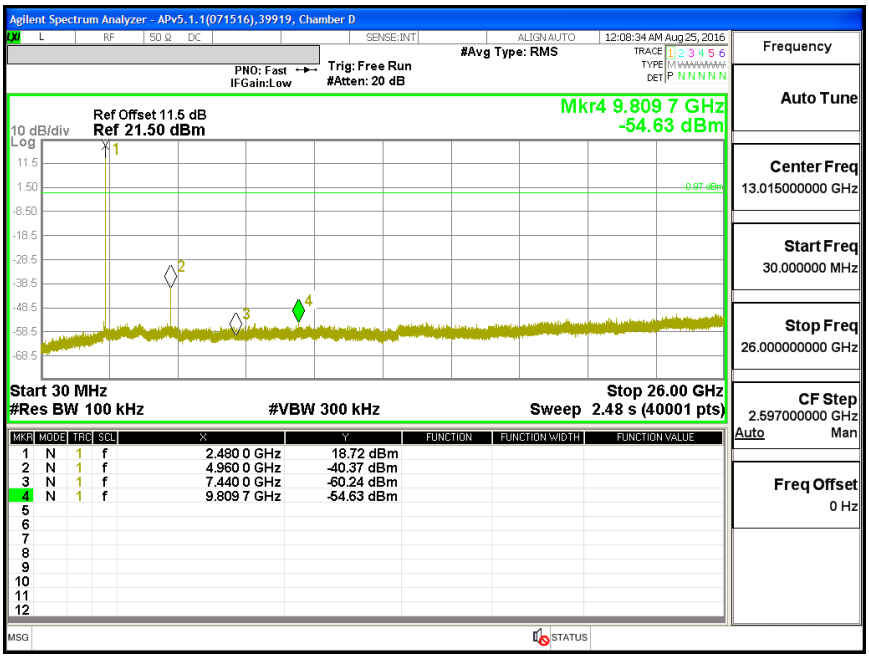
SPURIOUS EMISSIONS, HIGH CHANNEL

HIGH CH BANDEDGE



HIGH CH SPURIOUS



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8. RADIATED TEST RESULTS

8.1. 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

TEST PROCEDURE

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

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

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

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

The spectrum from 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.

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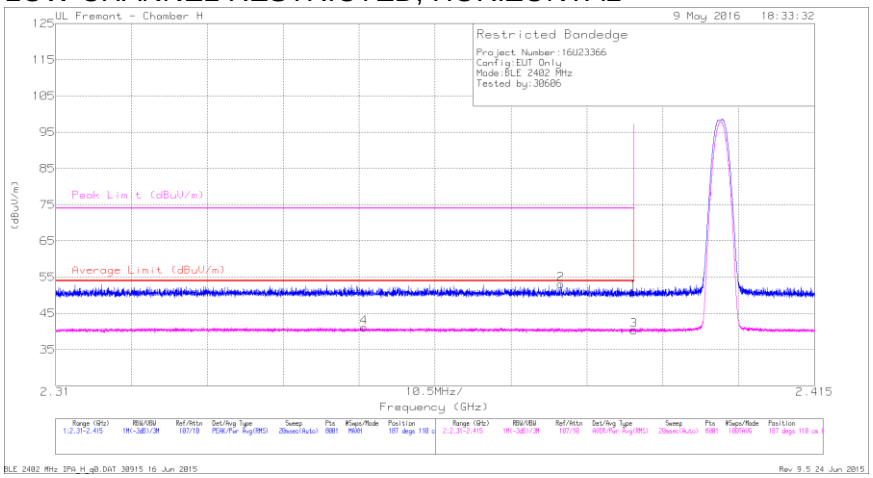
8.2. TRANSMITTER ABOVE 1 GHz

8.2.1. LOW POWER

RESTRICTED BANDEDGE

LOW CHANNEL RESTRICTED, HORIZONTAL



DATA

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T120 (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	* 2.39	40.9	Pk	31.9	-21.9	50.9	-	-	74	-23.1	187	110	H
2	* 2.38	43.06	Pk	31.9	-21.9	53.06	-	-	74	-20.94	187	110	H
3	* 2.39	30.36	RMS	31.9	-21.9	40.36	54	-13.64	-	-	187	110	H
4	* 2.353	31.27	RMS	31.8	-21.9	41.17	54	-12.83	-	-	187	110	H

* - indicates frequency in CFR15.205/IC7.2.2 Restricted Band

Pk - Peak detector

RMS - RMS detection

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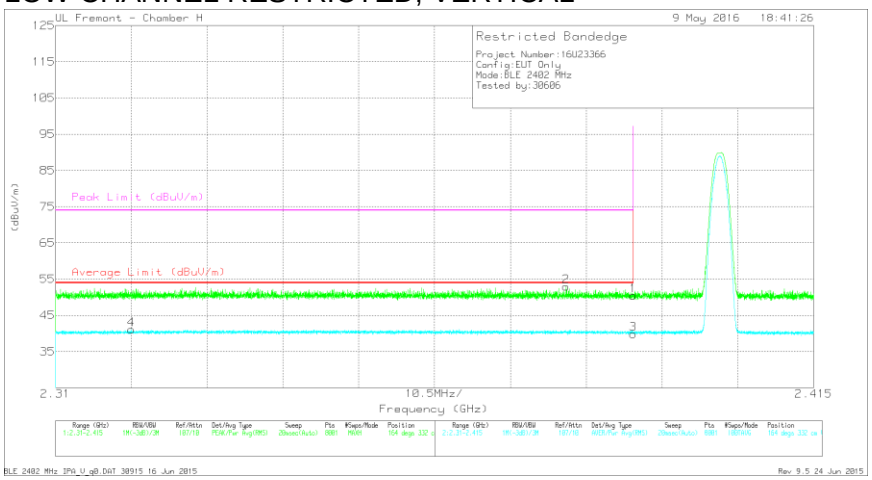
LOW CHANNEL RESTRICTED, VERTICAL



DATA

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T120 (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	* 2.39	40.47	Pk	31.9	-21.9	50.47	-	-	74	-23.53	164	332	V
2	* 2.381	42.92	Pk	31.9	-21.9	52.92	-	-	74	-21.08	164	332	V
3	* 2.39	29.87	RMS	31.9	-21.9	39.87	54	-14.13	-	-	164	332	V
4	* 2.321	31.38	RMS	31.6	-21.9	41.08	54	-12.92	-	-	164	332	V

* - indicates frequency in CFR15.205/IC7.2.2 Restricted Band

Pk - Peak detector

RMS - RMS detection

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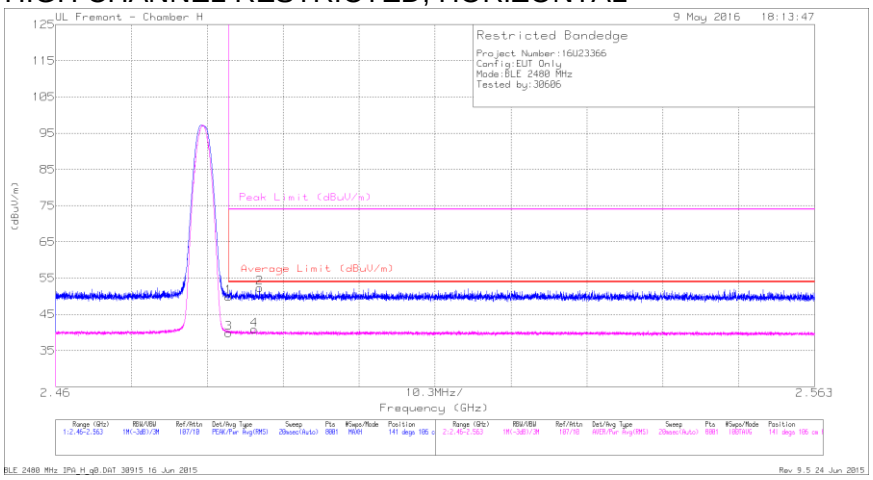
HIGH CHANNEL RESTRICTED, HORIZONTAL



DATA

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T120 (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	39.31	Pk	32.2	-21.7	49.81	-	-	74	-24.19	141	106	H
2	* 2.488	41.86	Pk	32.2	-21.7	52.36	-	-	74	-21.64	141	106	H
3	* 2.484	29.35	RMS	32.2	-21.7	39.85	54	-14.15	-	-	141	106	H
4	* 2.487	30.31	RMS	32.2	-21.7	40.81	54	-13.19	-	-	141	106	H

* - indicates frequency in CFR15.205/IC7.2.2 Restricted Band

Pk - Peak detector

RMS - RMS detection

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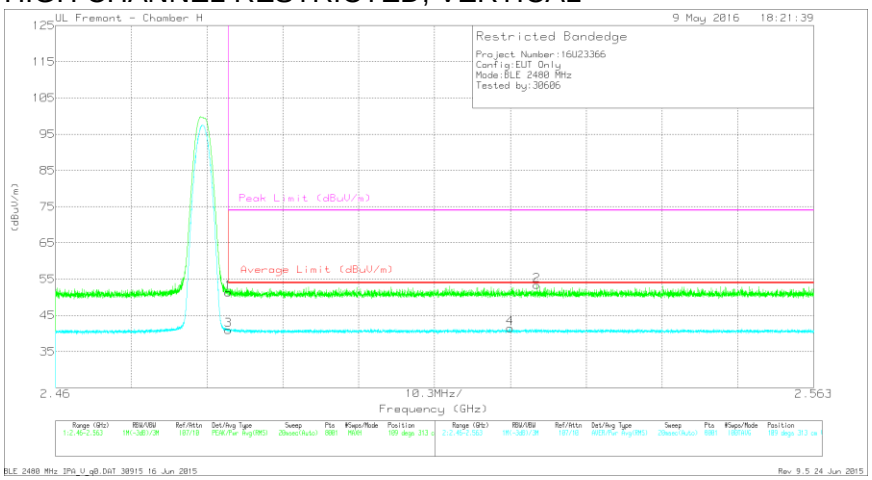
HIGH CHANNEL RESTRICTED, VERTICAL



DATA

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T120 (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	40.86	Pk	32.2	-21.7	51.36	-	-	74	-22.64	109	313	V
3	* 2.484	30.46	RMS	32.2	-21.7	40.96	54	-13.04	-	-	109	313	V
4	2.522	30.78	RMS	32.2	-21.5	41.48	54	-12.52	-	-	109	313	V
2	2.525	42.7	Pk	32.2	-21.5	53.4	-	-	74	-20.6	109	313	V

* - indicates frequency in CFR15.205/IC7.2.2 Restricted Band

Pk - Peak detector

RMS - RMS detection

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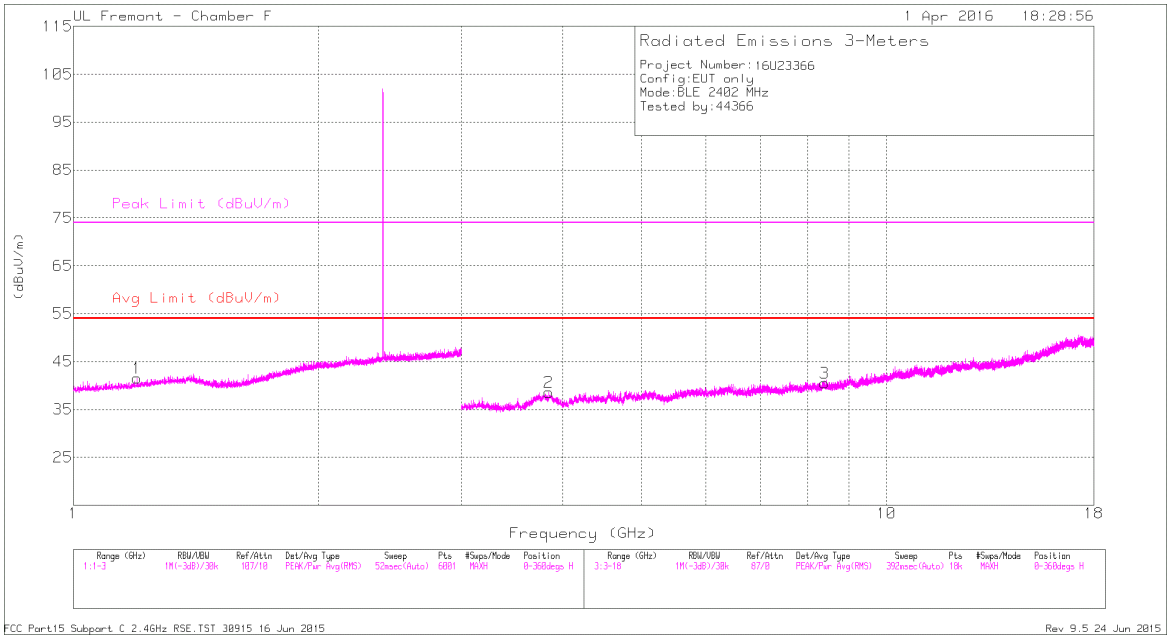
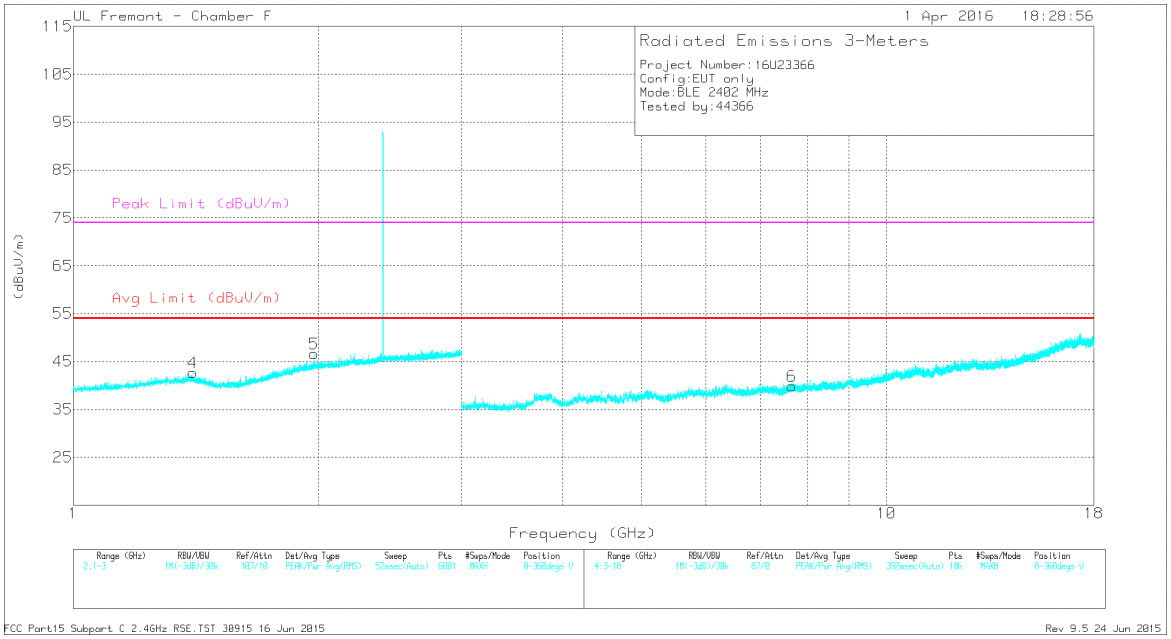
8.2.2. HARMONICS AND SPURIOUS EMISSIONS

LOW CHANNEL HORIZONTAL



LOW CHANNEL VERTICAL



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DATA

Marker	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	* 1.197	42.01	PK2	28.3	-22.5	47.81	-	-	74	-26.19	219	220	H
	* 1.199	30.18	MAv1	28.3	-22.5	35.98	54	-18.02	-	-	219	220	H
4	* 1.403	42.55	PK2	29.3	-22	49.85	-	-	74	-24.15	9	399	V
	* 1.403	29.93	MAv1	29.3	-22	37.23	54	-16.77	-	-	9	399	V
5	1.979	42	PK2	31.4	-21.4	52	-	-	-	-	209	385	V
2	* 3.845	38.48	PK2	33.4	-28.2	43.68	-	-	74	-30.32	308	130	H
	* 3.845	27.02	MAv1	33.4	-28.2	32.22	54	-21.78	-	-	308	130	H
3	* 8.392	35.41	PK2	35.7	-23.8	47.31	-	-	74	-26.69	58	394	H
	* 8.392	23.81	MAv1	35.7	-23.8	35.71	54	-18.29	-	-	58	394	H
6	* 7.653	37.03	PK2	35.7	-25.3	47.43	-	-	74	-26.57	26	293	V
	* 7.656	24.79	MAv1	35.7	-25.3	35.19	54	-18.81	-	-	26	293	V

* - indicates frequency in CFR15.205/IC7.2.2 Restricted Band

PK2 - KDB558074 Method: Maximum Peak

MAv1 - KDB558074 Option 1 Maximum RMS Average

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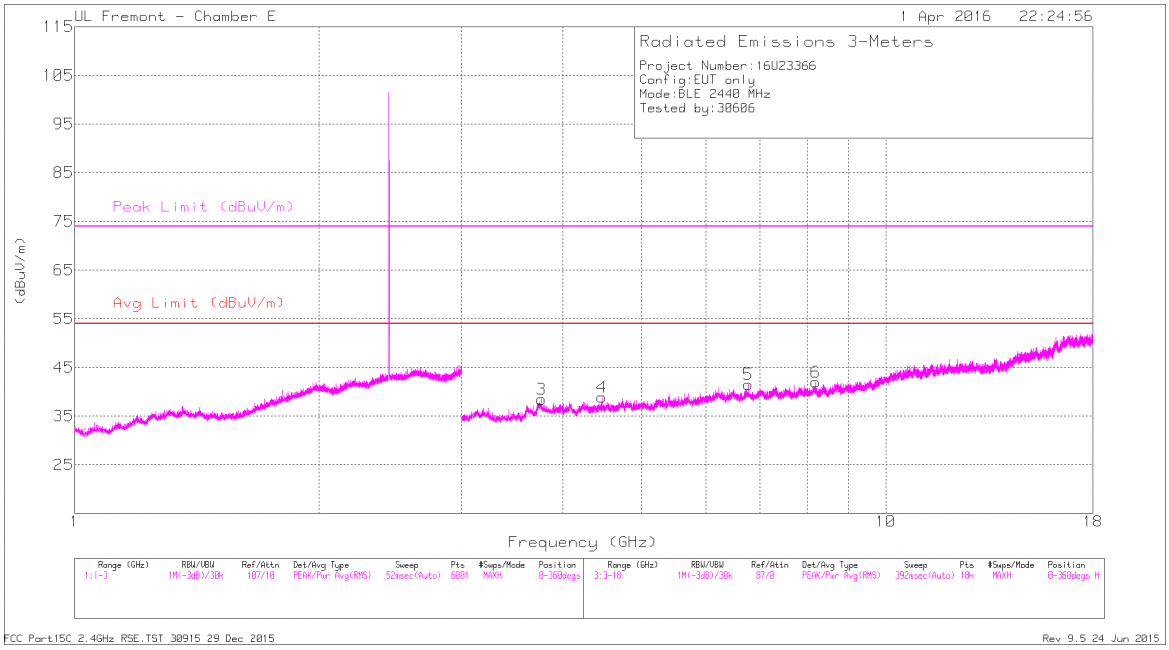
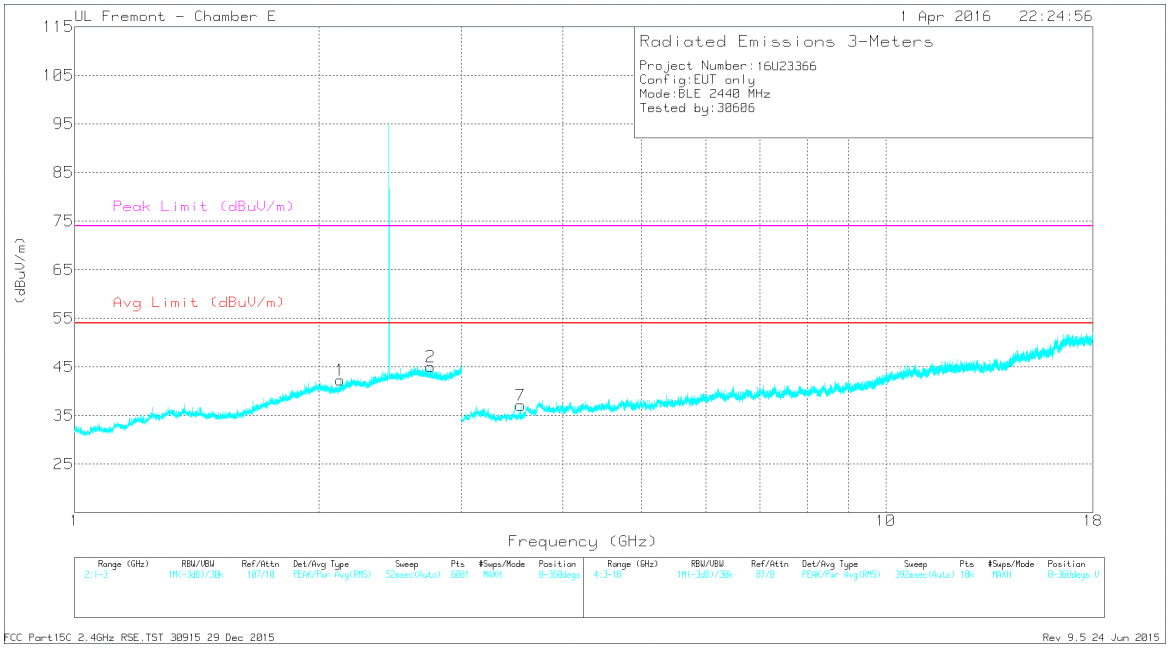
MID CHANNEL HORIZONTAL



LOW CHANNEL VERTICAL



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DATA

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T711 (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	* 2.748	38.24	PK2	32.5	-19.9	50.84	-	-	74	-23.16	296	201	V
	* 2.747	26.07	MAv1	32.5	-19.9	38.67	54	-15.33	-	-	296	201	V
3	* 3.763	40.78	PK2	33.1	-30.2	43.68	-	-	74	-30.32	154	310	H
	* 3.762	29.39	MAv1	33.1	-30.2	32.29	54	-21.71	-	-	154	310	H
6	* 8.2	39.18	PK2	35.8	-26.4	48.58	-	-	74	-25.42	304	376	H
	* 8.198	27.01	MAv1	35.8	-26.3	36.51	54	-17.49	-	-	304	376	H
7	* 3.549	41.55	PK2	32.9	-31.3	43.15	-	-	74	-30.85	351	102	V
	* 3.548	29.21	MAv1	32.9	-31.3	30.81	54	-23.19	-	-	351	102	V
1	2.125	38.03	PK2	31.1	-20.4	48.73	-	-	-	-	0	164	V
4	4.469	40.97	PK2	33.7	-30	44.67	-	-	-	-	248	239	H
5	6.767	38.91	PK2	35.5	-27.1	47.31	-	-	-	-	108	377	H

* - indicates frequency in CFR15.205/IC7.2.2 Restricted Band

PK2 - KDB558074 Method: Maximum Peak

MAv1 - KDB558074 Option 1 Maximum RMS Average

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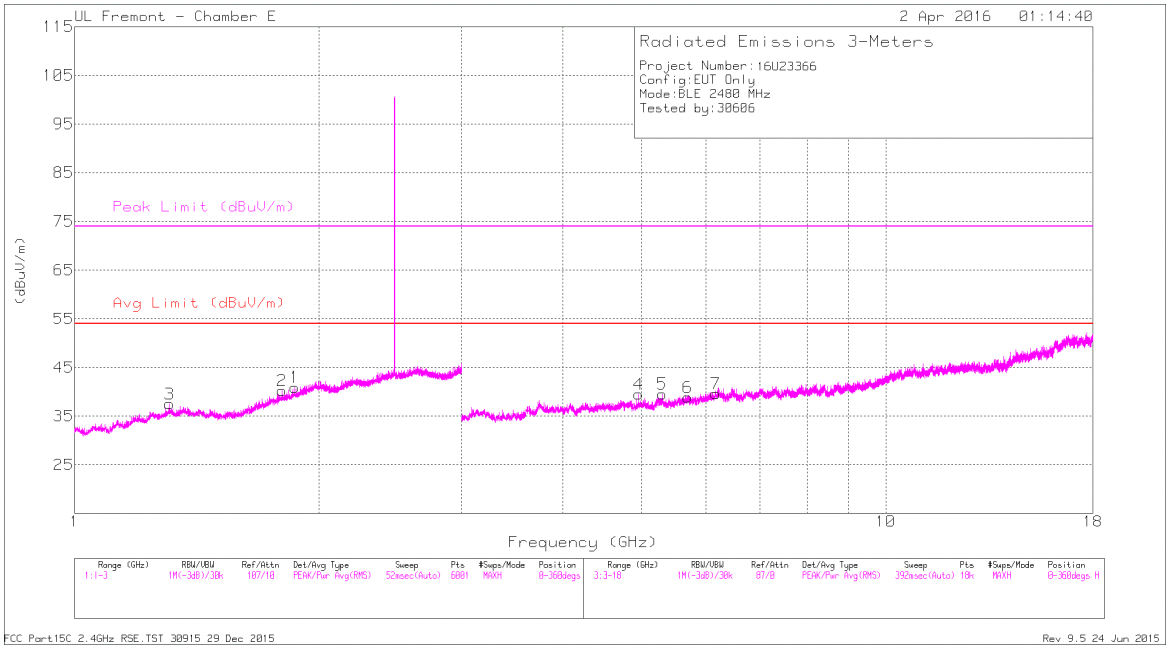
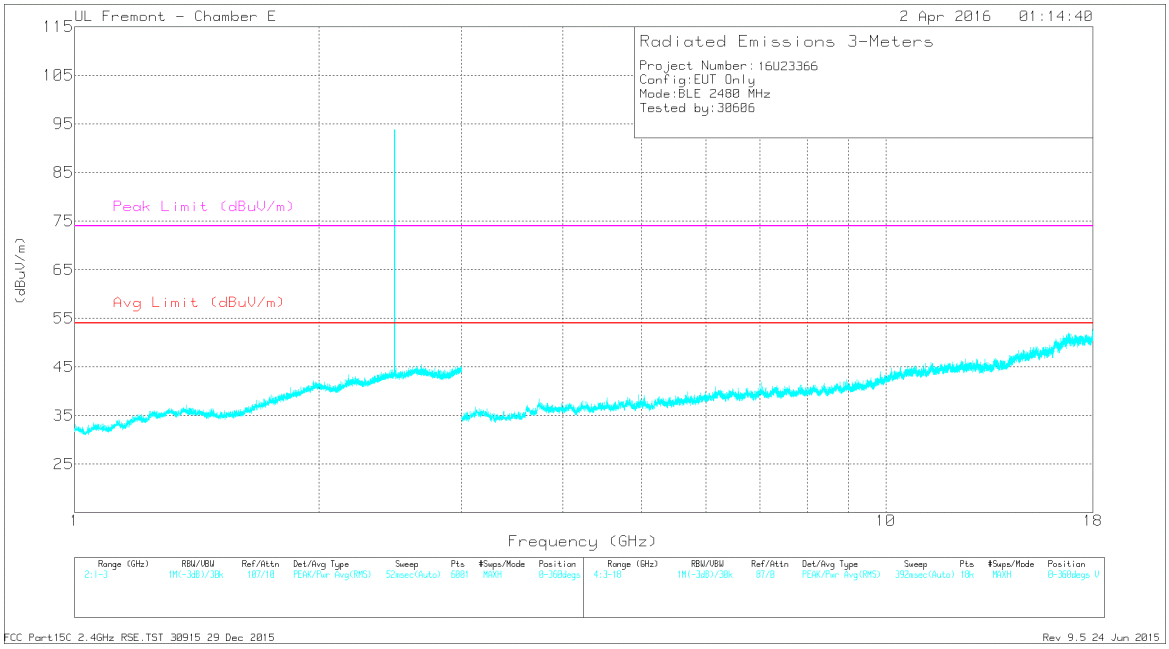
HIGH CHANNEL HORIZONTAL



HIGH CHANNEL VERTICAL



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DATA

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T711 (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
3	* 1.309	37.24	PK2	29.3	-22.4	44.14	-	-	74	-29.86	180	148	H
	* 1.308	24.94	MAv1	29.3	-22.4	31.84	54	-22.16	-	-	180	148	H
4	* 4.96	43.39	PK2	34	-30.5	46.89	-	-	74	-27.11	297	116	H
	* 4.96	33.68	MAv1	34	-30.5	37.18	54	-16.82	-	-	297	116	H
2	1.802	37.37	PK2	30.5	-21	46.87	-	-	-	-	22	347	H
1	1.866	36.83	PK2	31	-20.8	47.03	-	-	-	-	105	219	H
5	5.304	29.97	MAv1	34.3	-29.9	34.37	-	-	-	-	175	169	H
6	5.698	41.08	PK2	35	-29.1	46.98	-	-	-	-	76	164	H
7	6.172	27.74	MAv1	35.5	-27.8	35.44	-	-	-	-	78	262	H

* - indicates frequency in CFR15.205/IC7.2.2 Restricted Band

PK2 - KDB558074 Method: Maximum Peak

MAv1 - KDB558074 Option 1 Maximum RMS Average

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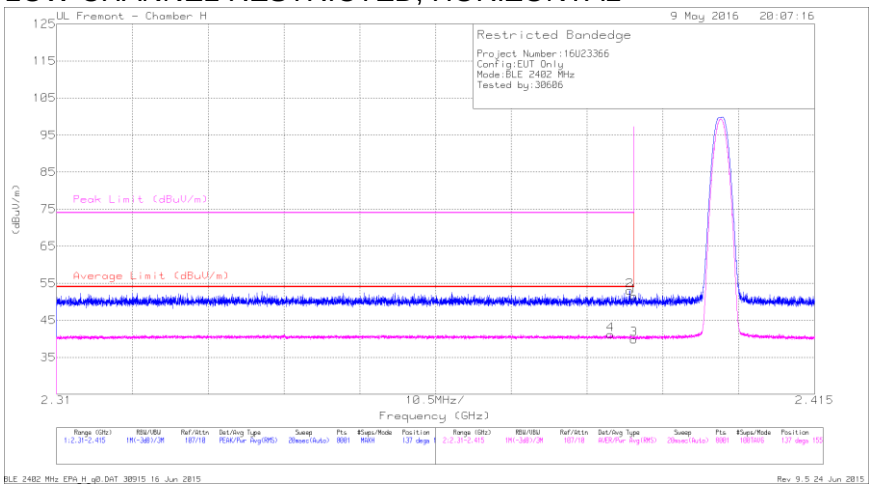
8.2.3. HIGH POWER

RESTRICTED BANDEDGE

LOW CHANNEL RESTRICTED, HORIZONTAL



DATA

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T120 (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	* 2.39	41.52	Pk	31.9	-21.9	51.52	-	-	74	-22.48	137	155	H
2	* 2.389	43	Pk	31.9	-21.9	53	-	-	74	-21	137	155	H
3	* 2.39	29.88	RMS	31.9	-21.9	39.88	54	-14.12	-	-	137	155	H
4	* 2.387	31.16	RMS	31.9	-21.9	41.16	54	-12.84	-	-	137	155	H

* - indicates frequency in CFR15.205/IC7.2.2 Restricted Band

Pk - Peak detector

RMS - RMS detection

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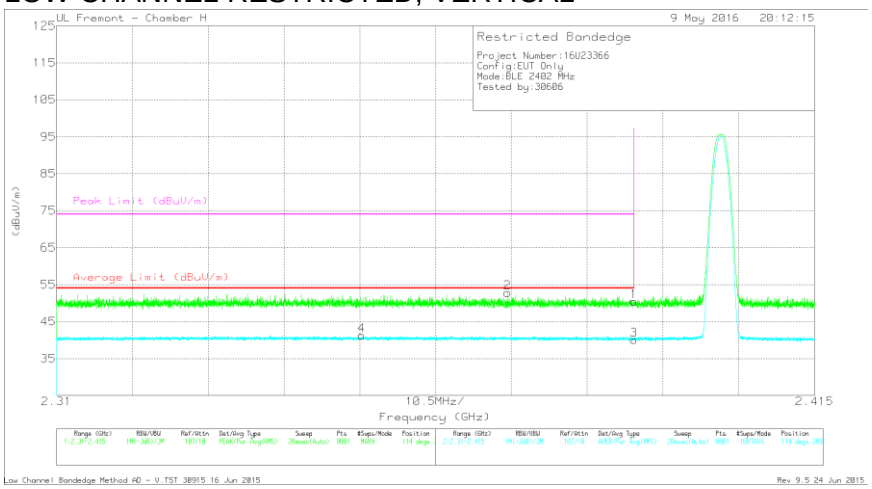
LOW CHANNEL RESTRICTED, VERTICAL



DATA

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T120 (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	* 2.39	40.42	Pk	31.9	-21.9	50.42	-	-	74	-23.58	114	383	V
2	* 2.372	42.95	Pk	31.8	-21.9	52.85	-	-	74	-21.15	114	383	V
3	* 2.39	30.05	RMS	31.9	-21.9	40.05	54	-13.95	-	-	114	383	V
4	* 2.352	31.35	RMS	31.8	-21.9	41.25	54	-12.75	-	-	114	383	V

* - indicates frequency in CFR15.205/IC7.2.2 Restricted Band

Pk - Peak detector

RMS - RMS detection

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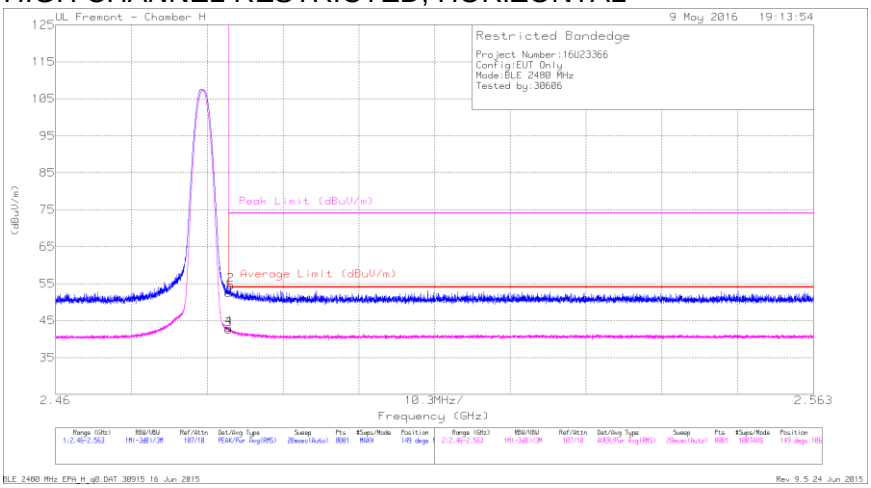
HIGH CHANNEL RESTRICTED, HORIZONTAL



DATA

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T120 (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	42.09	Pk	32.2	-21.7	52.59	-	-	74	-21.41	149	106	H
2	* 2.484	44.06	Pk	32.2	-21.7	54.56	-	-	74	-19.44	149	106	H
3	* 2.484	32.14	RMS	32.2	-21.7	42.64	54	-11.36	-	-	149	106	H
4	* 2.484	32.48	RMS	32.2	-21.7	42.98	54	-11.02	-	-	149	106	H

* - indicates frequency in CFR15.205/IC7.2.2 Restricted Band

Pk - Peak detector

RMS - RMS detection

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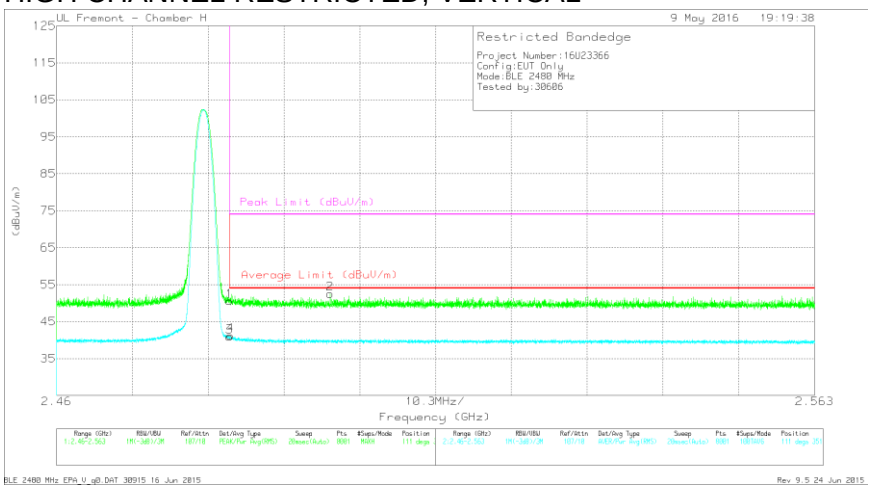
HIGH CHANNEL RESTRICTED, VERTICAL



DATA

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T120 (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	40.05	Pk	32.2	-21.7	50.55	-	-	74	-23.45	111	351	V
2	* 2.497	42.01	Pk	32.2	-21.7	52.51	-	-	74	-21.49	111	351	V
3	* 2.484	30.45	RMS	32.2	-21.7	40.95	54	-13.05	-	-	111	351	V
4	* 2.484	30.71	RMS	32.2	-21.7	41.21	54	-12.79	-	-	111	351	V

* - indicates frequency in CFR15.205/IC7.2.2 Restricted Band

Pk - Peak detector

RMS - RMS detection

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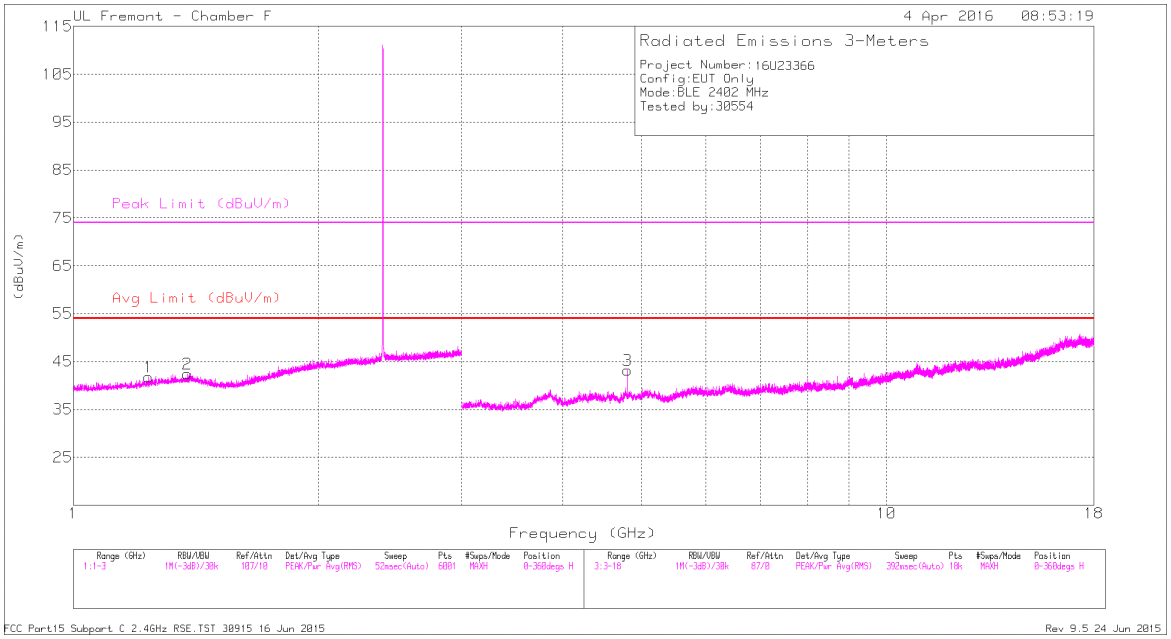
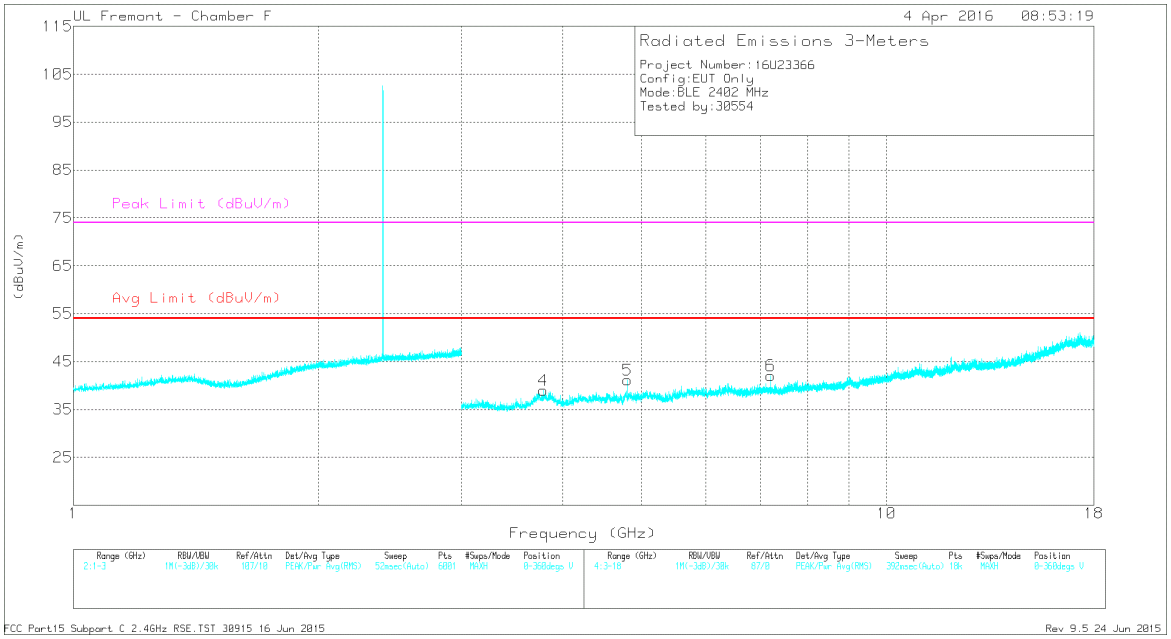
8.2.4. HARMONICS AND SPURIOUS EMISSIONS

LOW CHANNEL HORIZONTAL



LOW CHANNEL VERTICAL



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DATA

Marker	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	* 1.237	42.16	PK-U	28.6	-22.3	48.46	-	-	74	-25.54	296	134	H
	* 1.238	28.96	MAV1	28.6	-22.4	35.16	54	-18.84	-	-	296	134	H
2	* 1.381	42.14	PK-U	29.2	-22.1	49.24	-	-	74	-24.76	236	183	H
	* 1.381	28.78	MAV1	29.2	-22.1	35.88	54	-18.12	-	-	236	183	H
3	* 4.804	39.42	PK-U	34	-27.6	45.82	-	-	74	-28.18	218	205	H
	* 4.804	28.29	MAV1	34	-27.6	34.69	54	-19.31	-	-	218	205	H
4	* 3.783	38.62	PK-U	33.4	-28.9	43.12	-	-	74	-30.88	225	224	V
	* 3.786	25.75	MAV1	33.4	-28.9	30.25	54	-23.75	-	-	225	224	V
5	* 4.804	41.01	PK-U	34	-27.6	47.41	-	-	74	-26.59	66	280	V
	* 4.804	33.68	MAV1	34	-27.6	40.08	54	-13.92	-	-	66	280	V
6	7.206	40.56	PK-U	35.6	-26.4	49.76	-	-	-	-	243	266	V

* - indicates frequency in CFR15.205/IC7.2.2 Restricted Band

PK-U - U-NII: Maximum Peak

MAv1 - KDB558074 Option 1 Maximum RMS Average

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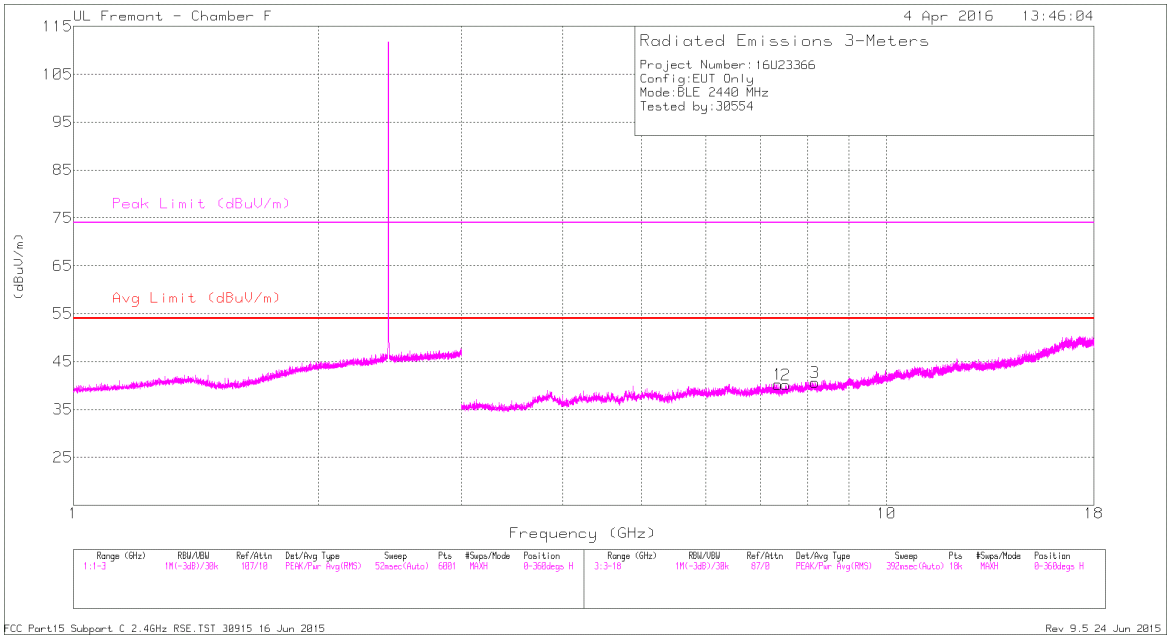
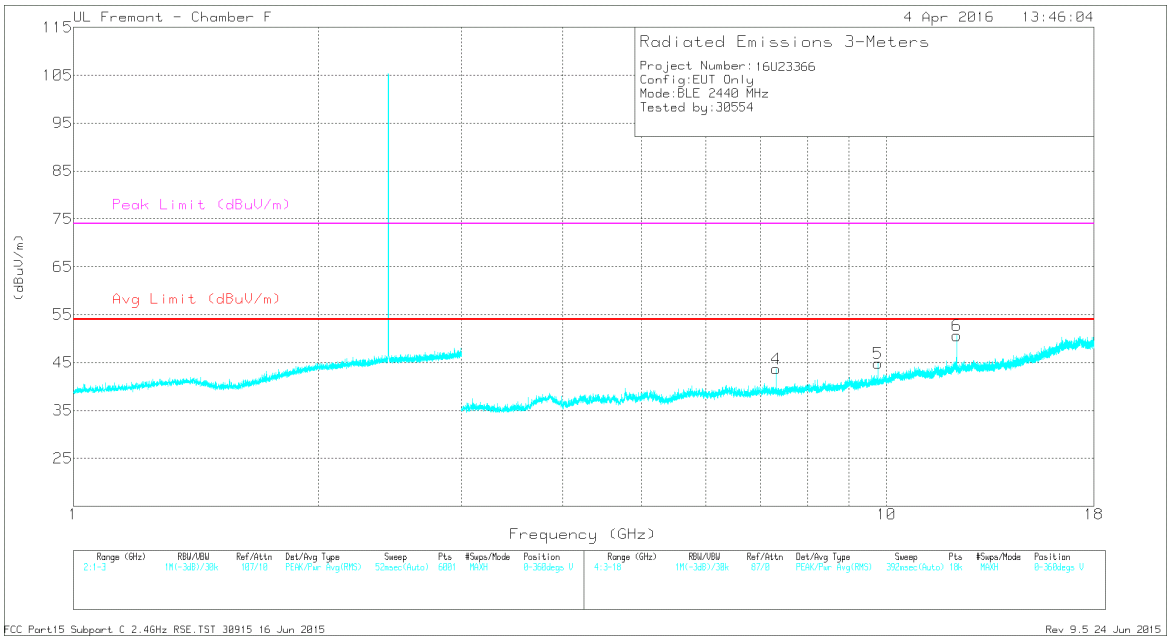
MID CHANNEL HORIZONTAL



LOW CHANNEL VERTICAL



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DATA

Marker	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	* 7.355	37.02	PK2	35.6	-25.8	46.82	-	-	74	-27.18	352	145	H
	* 7.354	25.66	MAv1	35.6	-25.8	35.46	54	-18.54	-	-	352	145	H
2	* 7.525	37.01	PK2	35.6	-25.6	47.01	-	-	74	-26.99	323	164	H
	* 7.524	25.42	MAv1	35.6	-25.6	35.42	54	-18.58	-	-	323	164	H
3	* 8.162	36.4	PK2	35.7	-24.6	47.5	-	-	74	-26.5	283	188	H
	* 8.166	24.9	MAv1	35.7	-24.6	36	54	-18.0	-	-	283	188	H
4	* 7.32	40.2	PK2	35.5	-26.5	49.2	-	-	74	-24.8	135	102	V
	* 7.32	32.38	MAv1	35.5	-26.5	41.38	54	-12.62	-	-	135	102	V
5	9.759	37.79	PK2	36.7	-22.4	52.09	-	-	-	-	316	213	V
6	* 12.199	39.07	PK2	38.9	-21.9	56.07	-	-	74	-17.93	287	200	V
	* 12.201	30.95	MAv1	38.9	-21.9	47.95	54	-6.05	-	-	287	200	V

* - indicates frequency in CFR15.205/IC7.2.2 Restricted Band

PK2 - KDB558074 Method: Maximum Peak

MAv1 - KDB558074 Option 1 Maximum RMS Average

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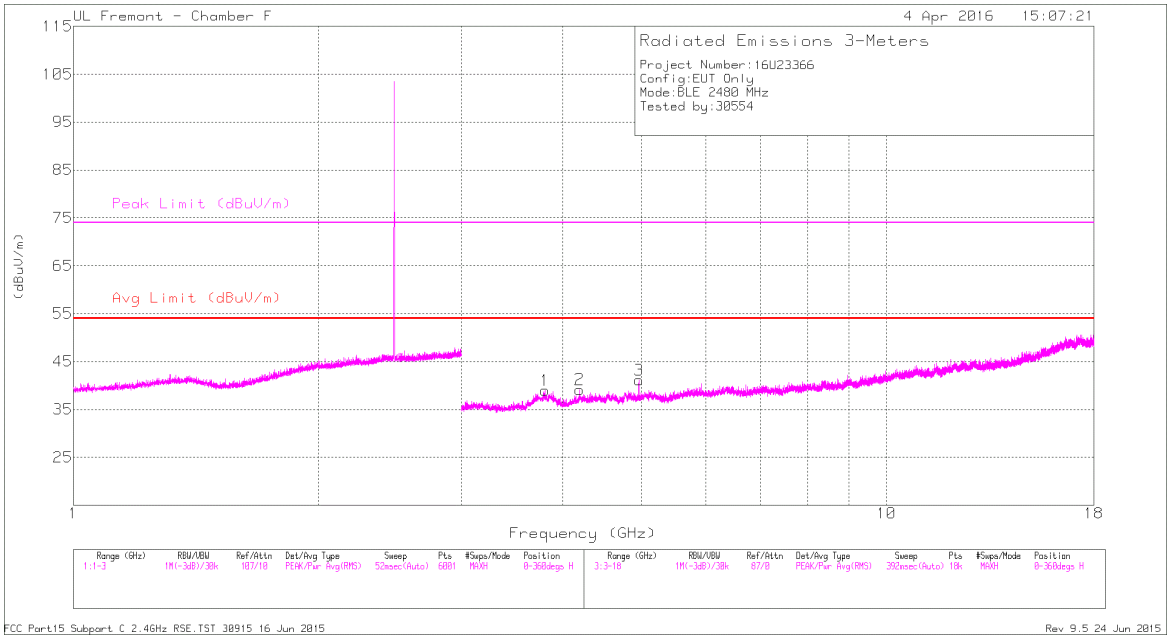
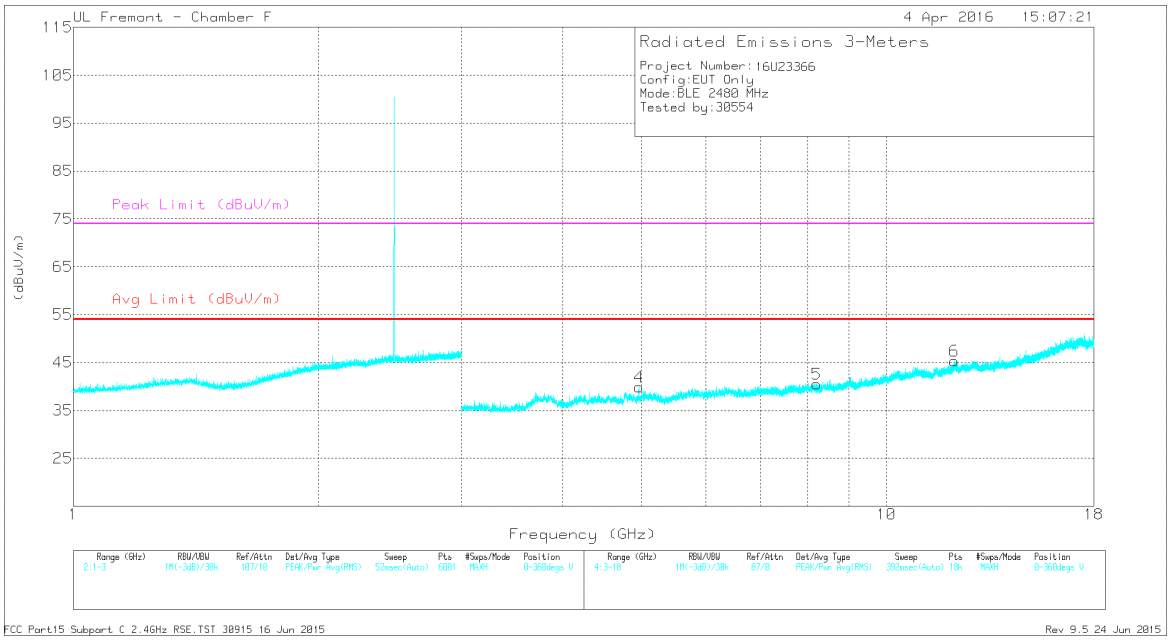
HIGH CHANNEL HORIZONTAL



HIGH CHANNEL VERTICAL



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DATA

Marker	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	* 3.799	38.91	PK2	33.4	-28.7	43.61	-	-	74	-30.39	95	161	H
	* 3.801	27.23	MAv1	33.4	-28.6	32.03	54	-21.97	-	-	95	161	H
2	* 4.194	38.49	PK2	33.7	-28.1	44.09	-	-	74	-29.91	115	171	H
	* 4.194	27.21	MAv1	33.7	-28.1	32.81	54	-21.19	-	-	115	171	H
3	* 4.96	39.91	PK2	34.2	-28.5	45.61	-	-	74	-28.39	138	199	H
	* 4.96	30.33	MAv1	34.2	-28.5	36.03	54	-17.97	-	-	138	199	H
4	* 4.96	41.16	PK2	34.2	-28.5	46.86	-	-	74	-27.14	333	270	V
	* 4.96	32.38	MAv1	34.2	-28.5	38.08	54	-15.97	-	-	333	270	V
5	* 8.207	35.56	PK2	35.8	-25	46.36	-	-	74	-27.64	217	332	V
	* 8.207	24.37	MAv1	35.8	-25	35.17	54	-18.83	-	-	217	332	V
6	* 12.134	34.63	PK2	38.9	-21.6	51.93	-	-	74	-22.07	111	132	V
	* 12.133	22.86	MAv1	38.9	-21.6	40.16	54	-13.84	-	-	111	132	V

* - indicates frequency in CFR15.205/IC7.2.2 Restricted Band

PK2 - KDB558074 Method: Maximum Peak

MAv1 - KDB558074 Option 1 Maximum RMS Average

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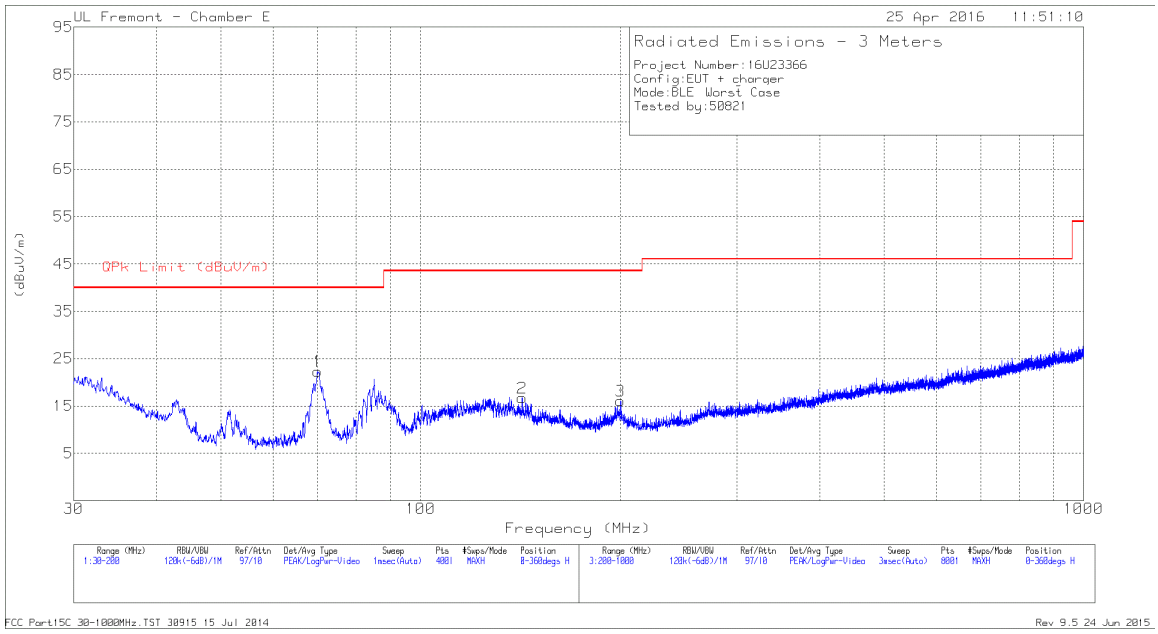
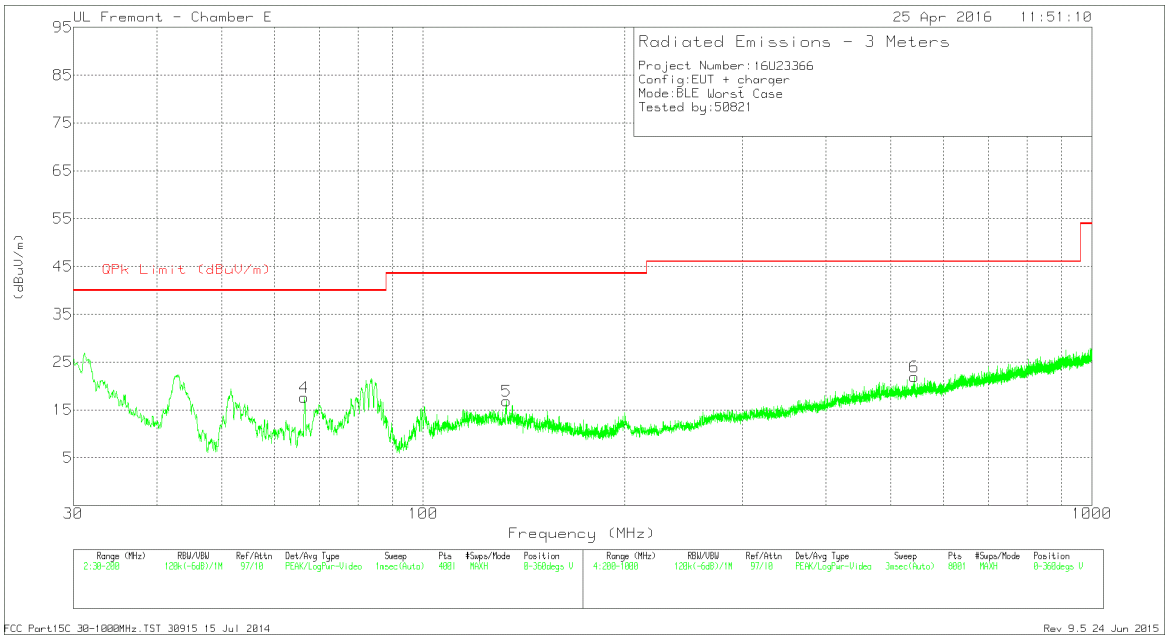
8.3. WORST-CASE BELOW 1 GHz

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

HORIZONTAL PLOT



VERTICAL: PLOT



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DATA

Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	AF T243 (dB/m)	Amp/Cbl (dB)	Corrected Reading (dBuV/m)	QPk Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
5	* 133.2325	30.25	Pk	17.7	-31.1	16.85	43.52	-26.67	0-360	100	V
4	66.4225	37.36	Pk	11.8	-31.5	17.66	40	-22.34	0-360	100	V
1	69.95	41.96	Pk	12	-31.6	22.36	40	-17.64	0-360	201	H
2	142.3275	30.91	Pk	16.9	-31.1	16.71	43.52	-26.81	0-360	301	H
3	200.3	30.14	Pk	16.7	-30.8	16.04	43.52	-27.48	0-360	201	H
6	542.7	29.33	Pk	22.1	-29.5	21.93	46.02	-24.09	0-360	301	V

* - indicates frequency in CFR15.205/IC7.2.2 Restricted Band

Pk - Peak detector

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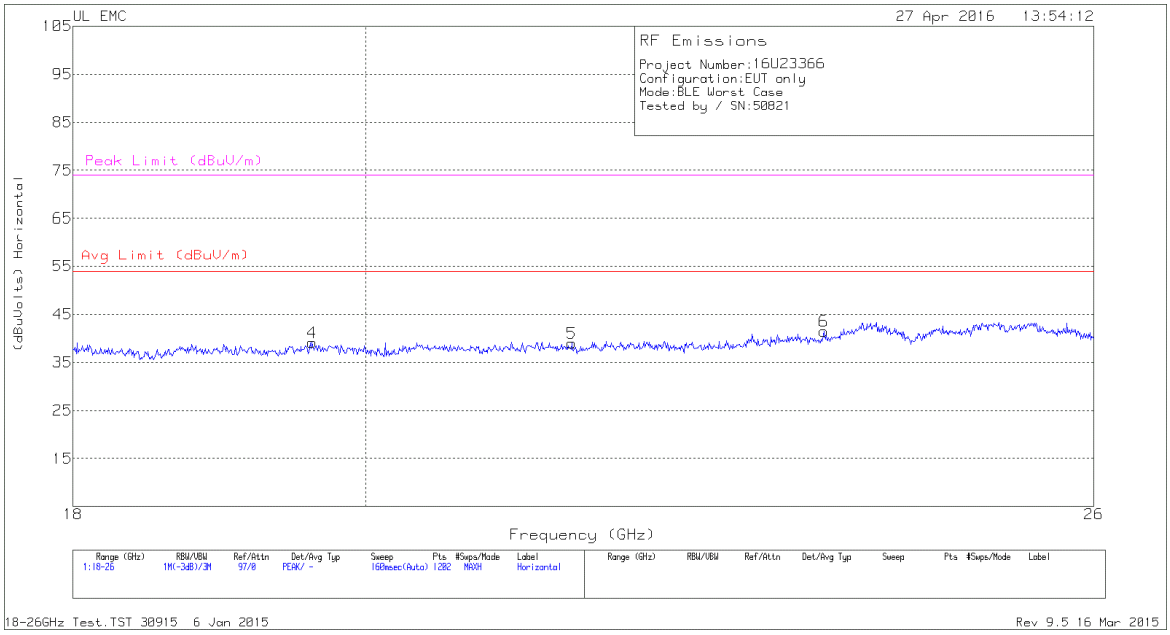
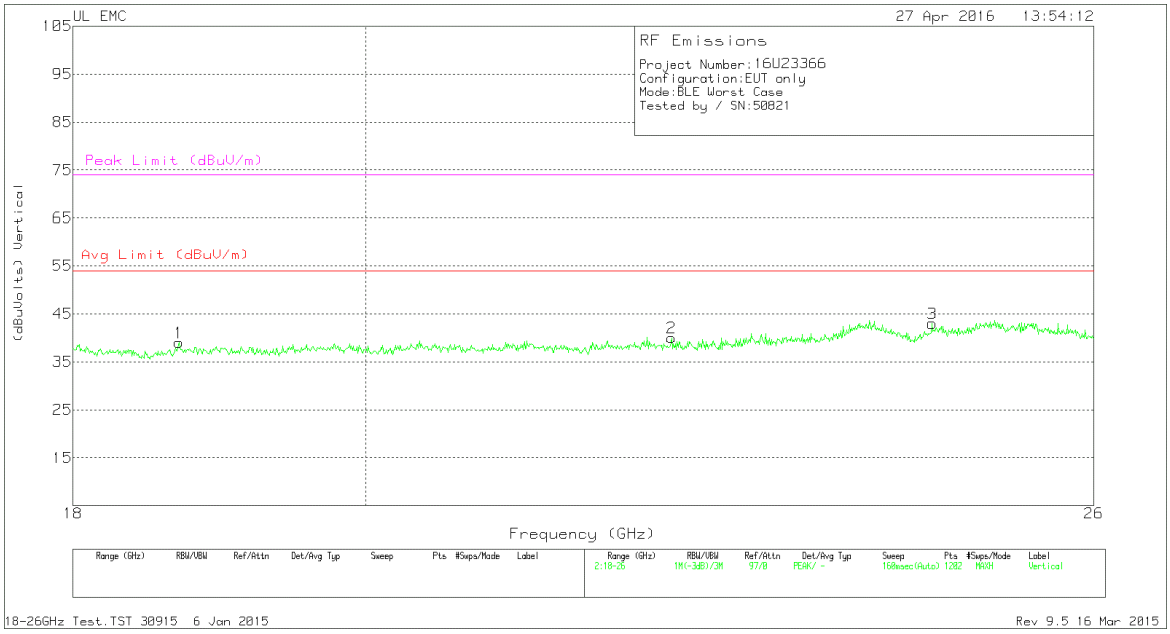
8.4. WORST-CASE 18 to 26 GHz

SPURIOUS EMISSIONS 18 to 26 GHz (WORST-CASE CONFIGURATION)

HORIZONTAL PLOT



VERTICAL PLOT



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DATA

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	T477 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)
4	19.619	40.87	Pk	32.7	-24.9	-9.5	39.17	54	-14.83	74	-34.83
5	21.544	40.7	Pk	33.1	-25.3	-9.5	39	54	-15	74	-35
6	23.589	41.4	Pk	33.9	-24.3	-9.5	41.5	54	-12.5	74	-32.5
1	18.699	40.4	Pk	32.3	-24.2	-9.5	39	54	-15	74	-35
2	22.33	41.1	Pk	33.3	-24.9	-9.5	40	54	-14	74	-34
3	24.528	42.7	Pk	34	-24.2	-9.5	43	54	-11	74	-31

Pk - Peak detector

UL VERIFICATION SERVICES INC. FORM NO: CCSUP4701I
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9. 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

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

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9.1. EUT POWERED BY AC/DC ADAPTER VIA USB CABLE

WORST EMISSIONS

Range 1: Line-L1 .15 - 30MHz											
Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	T24 IL L1	LC Cables 1&3	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	.17025	33.84	Qp	1.2	0	10.1	45.14	64.95	-19.81	-	-
2	.17025	17.25	Ca	1.2	0	10.1	28.55	-	-	54.95	-26.4
3	.19725	32.12	Qp	1	0	10.1	43.22	63.73	-20.51	-	-
4	.20175	15.85	Ca	.9	0	10.1	26.85	-	-	53.54	-26.69
5	.22425	30.81	Qp	.8	0	10.1	41.71	62.66	-20.95	-	-
6	.22425	15.14	Ca	.8	0	10.1	26.04	-	-	52.66	-26.62
7	.2535	30.63	Qp	.7	0	10.1	41.43	61.64	-20.21	-	-
8	.25575	15.92	Ca	.7	0	10.1	26.72	-	-	51.57	-24.85
9	.28725	26.69	Qp	.6	0	10.1	37.39	60.6	-23.21	-	-
10	.28725	12.63	Ca	.6	0	10.1	23.33	-	-	50.6	-27.27
11	.807	32.72	Qp	.3	0	10.1	43.12	56	-12.88	-	-
12	.816	24.62	Ca	.3	0	10.1	35.02	-	-	46	-10.98

Range 2: Line-L2 .15 - 30MHz											
Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	T24 IL L2	LC Cables 2&3	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	.17025	34.51	Qp	1.2	0	10.1	45.81	64.95	-19.14	-	-
14	.17025	16.94	Ca	1.2	0	10.1	28.24	-	-	54.95	-26.71
15	.20175	30.84	Qp	1	0	10.1	41.94	63.54	-21.6	-	-
16	.20175	13.22	Ca	1	0	10.1	24.32	-	-	53.54	-29.22
17	.222	30.22	Qp	.9	0	10.1	41.22	62.74	-21.52	-	-
18	.22425	12.92	Ca	.9	0	10.1	23.92	-	-	52.66	-28.74
19	.2535	31.32	Qp	.7	0	10.1	42.12	61.64	-19.52	-	-
20	.2535	14.49	Ca	.7	0	10.1	25.29	-	-	51.64	-26.35
21	.2895	27.55	Qp	.6	0	10.1	38.25	60.54	-22.29	-	-
22	.28725	10.97	Ca	.6	0	10.1	21.67	-	-	50.6	-28.93
23	.816	33.56	Qp	.3	0	10.1	43.96	56	-12.04	-	-
24	.81487	20.95	Ca	.3	0	10.1	31.35	-	-	46	-14.65

Qp - Quasi-Peak detector

Ca - CISPR average detection

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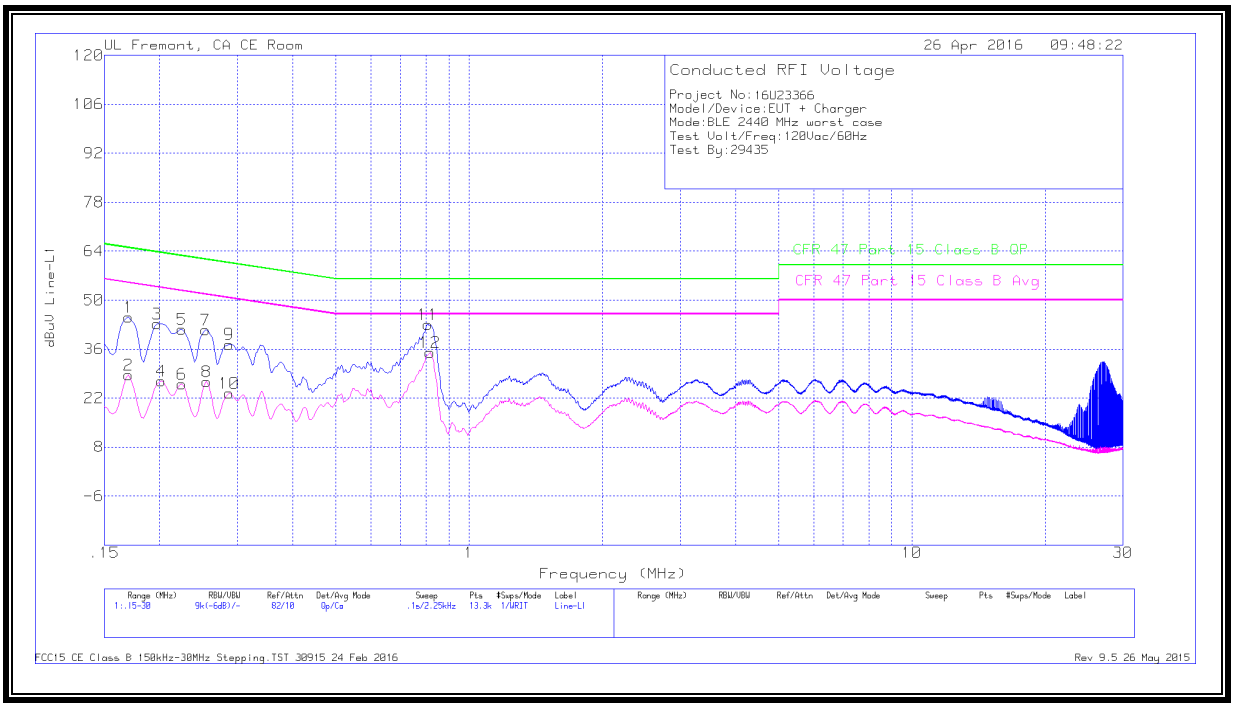
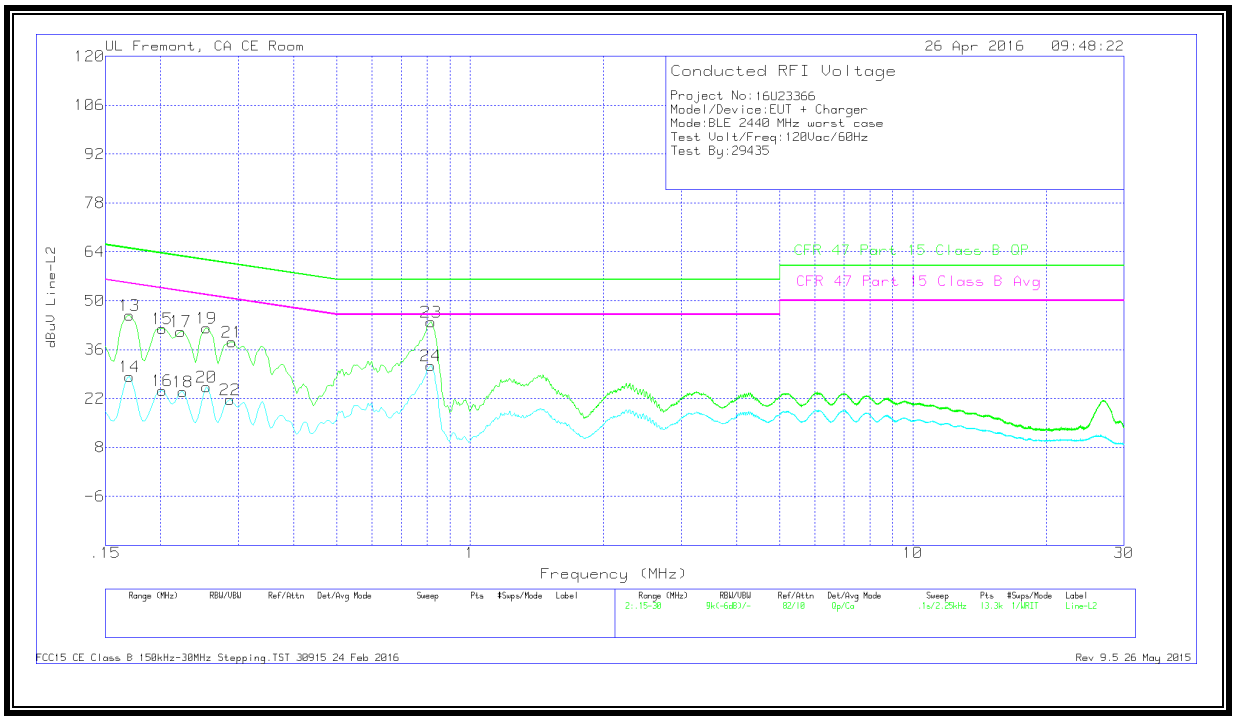
LINE 1 RESULTS



LINE 2 RESULTS



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9.2. EUT POWERED BY HOST PC VIA USB CABLE

WORST EMISSIONS

Range 1: Line-L1 .15 - 30MHz											
Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	T24 IL L1	LC Cables 1&3	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	.168	44.01	Qp	1.2	0	10.1	55.31	65.06	-9.75	-	-
2	.168	31.93	Ca	1.2	0	10.1	43.23	-	-	55.06	-11.83
3	.2085	37.36	Qp	.9	0	10.1	48.36	63.26	-14.9	-	-
4	.2085	25.54	Ca	.9	0	10.1	36.54	-	-	53.26	-16.72
5	.25125	29.02	Qp	.7	0	10.1	39.82	61.72	-21.9	-	-
6	.25125	17.56	Ca	.7	0	10.1	28.36	-	-	51.72	-23.36
7	.29175	24.1	Qp	.6	0	10.1	34.8	60.47	-25.67	-	-
8	.29175	12.9	Ca	.6	0	10.1	23.6	-	-	50.47	-26.87
9	9.6495	13.58	Qp	.2	.2	10.2	24.18	60	-35.82	-	-
10	9.65175	8.03	Ca	.2	.2	10.2	18.63	-	-	50	-31.37
11	13.41713	19.37	Qp	.2	.2	10.2	29.97	60	-30.03	-	-
12	13.41825	13.72	Ca	.2	.2	10.2	24.32	-	-	50	-25.68

Range 2: Line-L2 .15 - 30MHz											
Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	T24 IL L2	LC Cables 2&3	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	.17475	46.06	Qp	1.2	0	10.1	57.36	64.73	-7.37	-	-
14	.177	33.58	Ca	1.2	0	10.1	44.88	-	-	54.63	-9.75
15	.23325	36.31	Qp	.8	0	10.1	47.21	62.33	-15.12	-	-
16	.2355	25.52	Ca	.8	0	10.1	36.42	-	-	52.25	-15.83
17	.2895	29.16	Qp	.6	0	10.1	39.86	60.54	-20.68	-	-
18	.29175	20.27	Ca	.6	0	10.1	30.97	-	-	50.47	-19.5
19	.6405	25.14	Qp	.3	0	10.1	35.54	56	-20.46	-	-
20	.6405	18.35	Ca	.3	0	10.1	28.75	-	-	46	-17.25
21	.78	25.2	Qp	.3	0	10.1	35.6	56	-20.4	-	-
22	.76425	13.34	Ca	.3	0	10.1	23.74	-	-	46	-22.26
23	13.632	25.36	Qp	.2	.2	10.2	35.96	60	-24.04	-	-
24	13.632	18.7	Ca	.2	.2	10.2	29.3	-	-	50	-20.7

Qp - Quasi-Peak detector

Ca - CISPR average detection

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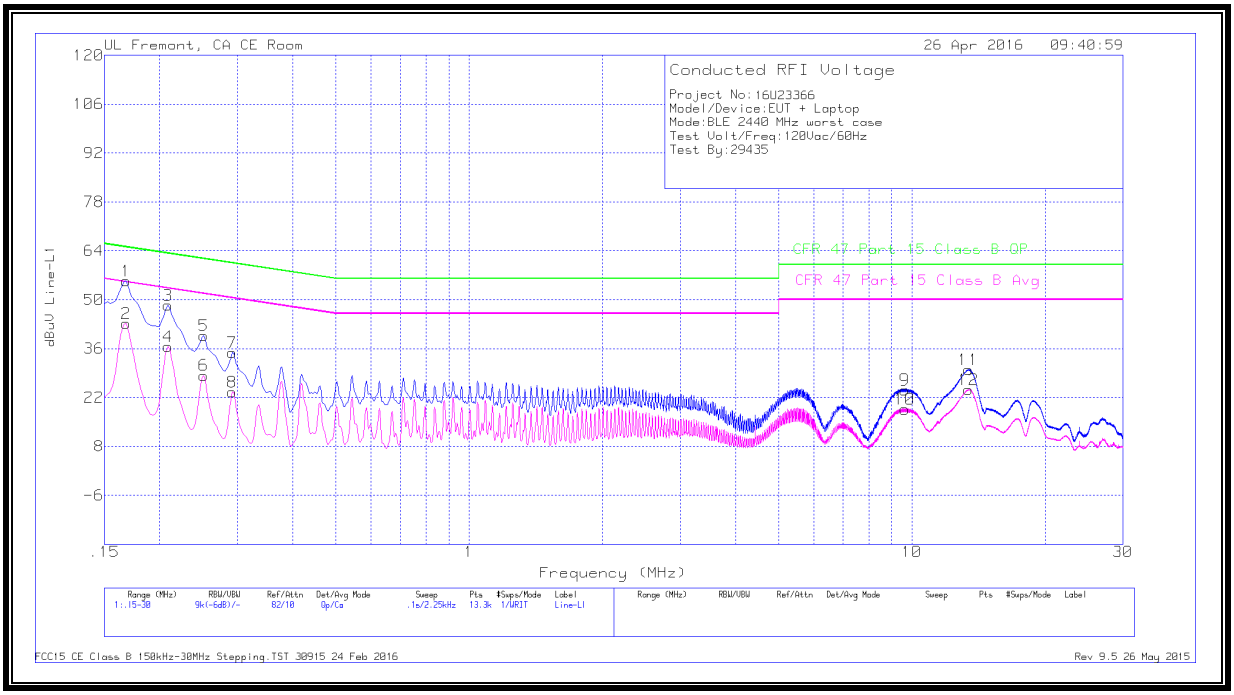
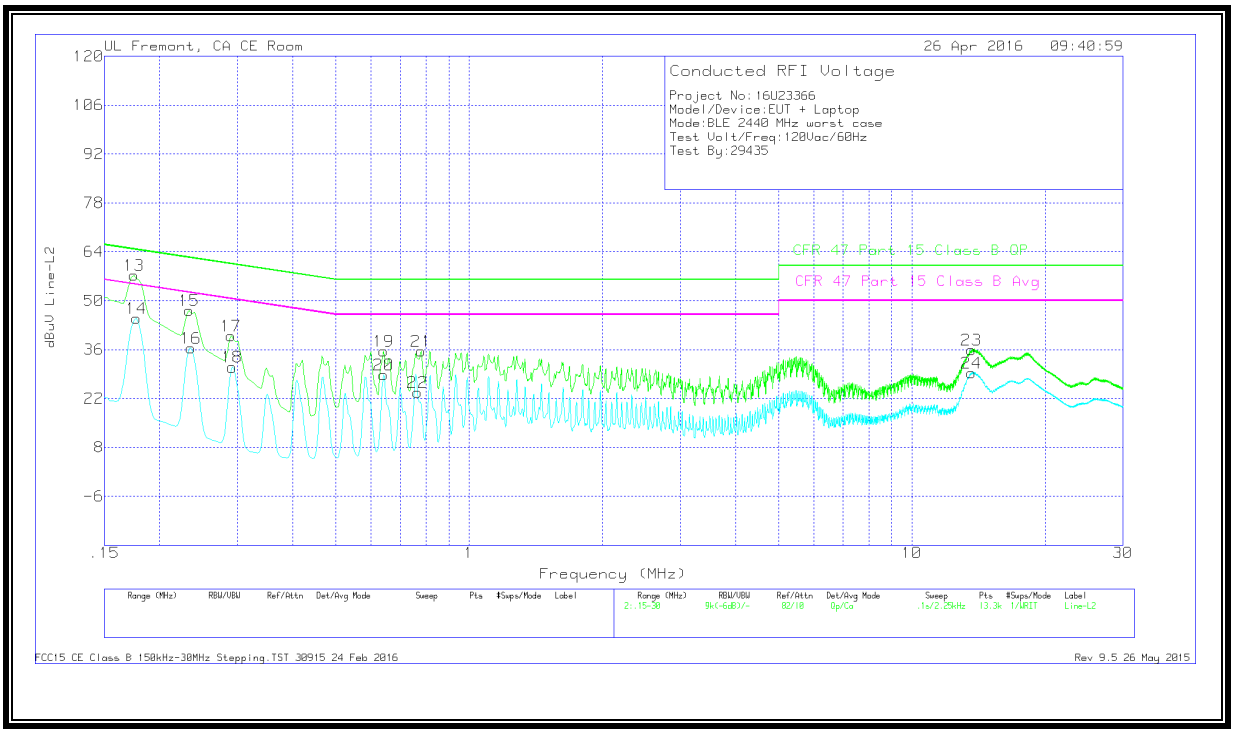
LINE 1 RESULTS



LINE 2 RESULTS



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