



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

CERTIFICATION TEST REPORT

FOR

WIRELESS HEADPHONES

MODEL NUMBER: A1796

FCC ID: BCG-A1796

IC: 579C-A1796

REPORT NUMBER: 16U23789-E5V3

ISSUE DATE: AUGUST 29, 2016

Prepared for

APPLE, INC.

1 INFINITE LOOP

CUPERTINO, CA 95014, U.S.A.

Prepared by

UL VERIFICATION SERVICES INC.

47173 BENICIA STREET

FREMONT, CA 94538, U.S.A.

TEL: (510) 771-1000

FAX: (510) 661-0888



NVLAP LAB CODE 200065-0

Revision History

Rev.	Issue Date	Revisions	Revised By
V1	08/24/2016	Initial Review	Chin Pang
V2	08/25/2016	Address TCB's Questions	Chin Pang
V3	08/29/2016	Updated Section 5.5	Chin Pang

TABLE OF CONTENTS

1. ATTESTATION OF TEST RESULTS.....	5
2. TEST METHODOLOGY	6
3. FACILITIES AND ACCREDITATION.....	6
4. CALIBRATION AND UNCERTAINTY	7
4.1. MEASURING INSTRUMENT CALIBRATION	7
4.2. SAMPLE CALCULATION.....	7
4.3. MEASUREMENT UNCERTAINTY	7
5. EQUIPMENT UNDER TEST	8
5.1. DESCRIPTION OF EUT.....	8
5.2. MAXIMUM OUTPUT POWER.....	8
5.3. DESCRIPTION OF AVAILABLE ANTENNAS	8
5.4. SOFTWARE AND FIRMWARE	8
5.5. WORST-CASE CONFIGURATION AND MODE.....	9
5.6. DESCRIPTION OF TEST SETUP.....	10
6. TEST AND MEASUREMENT EQUIPMENT	17
7. ANTENNA PORT TEST RESULTS	18
7.1. ON TIME AND DUTY CYCLE	18
7.2. BASIC DATA RATE GFSK MODULATION.....	20
7.2.1. 20 dB AND 99% BANDWIDTH	20
7.2.2. HOPPING FREQUENCY SEPARATION	23
7.2.3. NUMBER OF HOPPING CHANNELS.....	24
7.2.4. AVERAGE TIME OF OCCUPANCY	27
7.2.5. OUTPUT POWER	29
7.2.6. AVERAGE POWER	30
7.2.7. CONDUCTED SPURIOUS EMISSIONS.....	31
7.3. ENHANCED DATA RATE QPSK MODULATION	36
7.3.1. 20 dB AND 99% BANDWIDTH	36
7.3.2. HOPPING FREQUENCY SEPARATION	39
7.3.3. NUMBER OF HOPPING CHANNELS.....	40
7.3.4. AVERAGE TIME OF OCCUPANCY	43
7.3.5. OUTPUT POWER	45
7.3.6. AVERAGE POWER	46
7.3.7. CONDUCTED SPURIOUS EMISSIONS.....	47
8. RADIATED TEST RESULTS	52
8.1. LIMITS AND PROCEDURE	52
8.2. TRANSMITTER ABOVE 1 GHz	53
8.2.1. BASIC DATA RATE GFSK MODULATION.....	53
8.2.2. ENHANCED DATA RATE QPSK MODULATION	63

8.3.	<i>WORST-CASE BELOW 1 GHz</i>	<i>73</i>
8.4.	<i>WORST-CASE ABOVE 18 GHz.....</i>	<i>75</i>
9.	AC POWER LINE CONDUCTED EMISSIONS	77
9.1.	<i>EUT POWERED BY AC/DC ADAPTER VIA USB CABLE</i>	<i>78</i>
9.2.	<i>EUT POWERED BY HOST PC VIA USB CABLE</i>	<i>81</i>
10.	SETUP PHOTOS –	84

1. ATTESTATION OF TEST RESULTS

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

EUT DESCRIPTION: WIRELESS HEADPHONES

MODEL: A1796

SERIAL NUMBER: FL6RX02FH8BD (Conducted) FL6RX02QH8VD (Radiated)

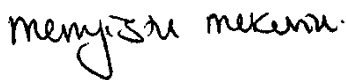
DATE TESTED: AUGUST 01, 2016 - AUGUST 17, 2016

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:



MENGISTU MEKURIA
SENIOR ENGINEER
UL VERIFICATION SERVICES INC.

Prepared By:



TONI LI
EMC ENGINEER
UL VERIFICATION SERVICES INC.

2. TEST METHODOLOGY

The tests documented in this report were performed in accordance with FCC CFR 47 Part 2, FCC CFR 47 Part 15, 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>.

4. CALIBRATION AND UNCERTAINTY

4.1. MEASURING INSTRUMENT CALIBRATION

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

4.2. SAMPLE CALCULATION

Where relevant, the following sample calculation is provided:

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

4.3. MEASUREMENT UNCERTAINTY

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

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

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

5. EQUIPMENT UNDER TEST

5.1. DESCRIPTION OF EUT

The EUT is a wireless headphone. It has an integral battery, microphone and antenna. It can play music from a Bluetooth audio source, or through the 3.5mm stereo audio jack. It has a USB Micro port for charging. It has 4 buttons, power, volume up, volume down, and multi-function.

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	Basic GFSK	5.64	3.66
2402 - 2480	DQPSK	8.32	6.79

5.3. DESCRIPTION OF AVAILABLE ANTENNAS

Frequency Band (GHz)	Antenna Gain (dBi)
2.4	3.14

5.4. SOFTWARE AND FIRMWARE

The software installed in the EUT during testing was 1A341

5.5. WORST-CASE CONFIGURATION AND MODE

The worst-case mode and channel used for 30-1000 MHz radiated was including AC/DC charger, mode and channel with the highest output power. EUT is transmitting while in charging mode.

For AC line conducted emission test, two configuration of powered by AC/DC charger and by host PC via USB cable were investigated with the mode and channel that comes with the highest output power.

Above 1G radiated emission were performed with low, middle and high channels. And above 18GHz radiated emission were performed with the EUT only 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 (Flatbed), Y (Landscape) and Z (Portrait), it was determined that Z orientation was worst-case orientation. Therefore, all final radiated testing was performed with the EUT in Z orientation.

Data Rate tested:

GFSK mode: DH5

DQPSK mode: 3-DH5

5.6. DESCRIPTION OF TEST SETUP

SUPPORT EQUIPMENT

Support Equipment List				
Description	Manufacturer	Model	Serial Number	FCC ID
Laptop AC/DC adapter	Apple	A1424	NSW25679	N/A
Test Jig	Apple	N/A	920-02191-02	N/A
Laptop	Apple	MacBook AIR	C02P41R2G086	N/A
USB	Apple	N/A	N/A	N/A
AC/DC Adapter	Apple	A1385	D292365A20FDHLHCW	N/A

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
3	AC	1	AC	Un-shielded	2	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 (RADIATED 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	2	N/A

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

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

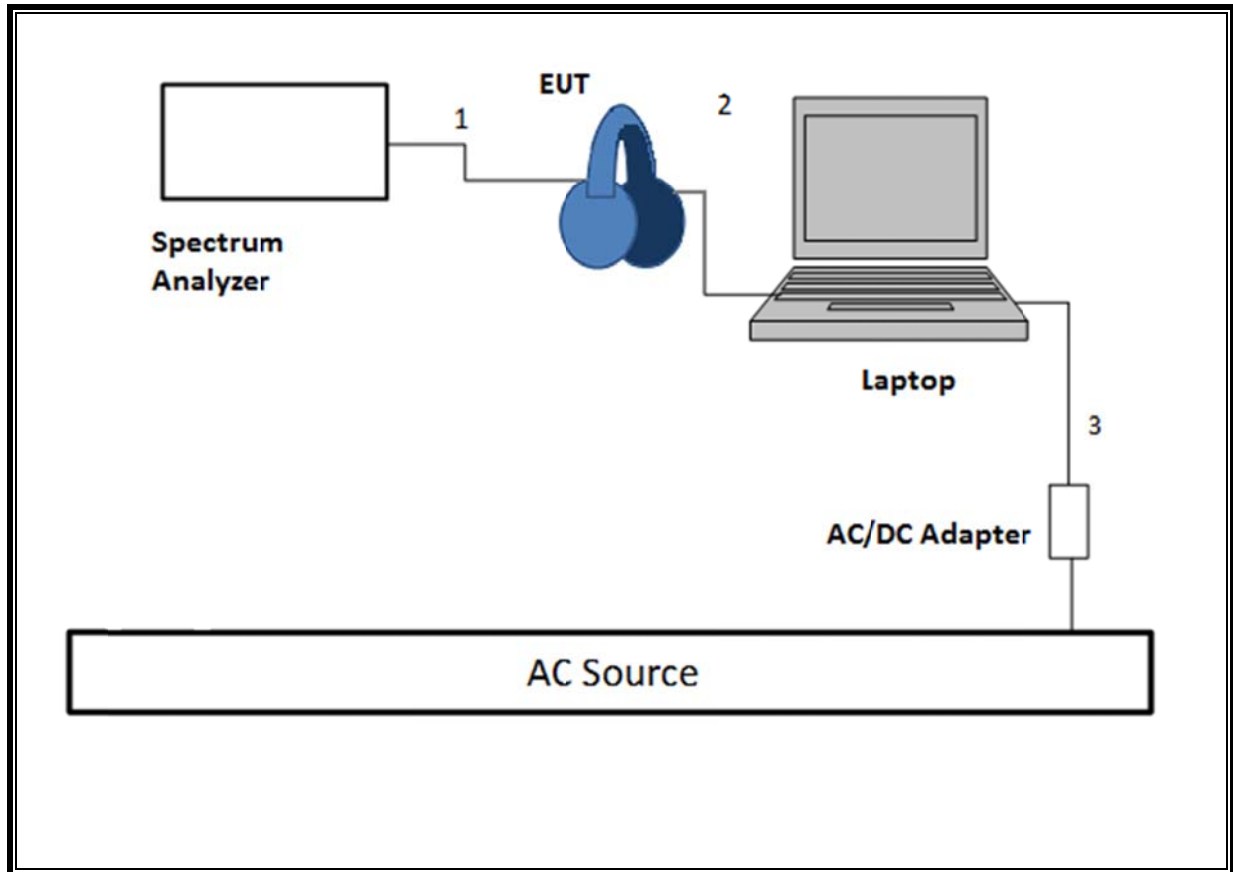
I/O CABLES (AC LINE CONDUCTED: LAPTOP CONFIGUARTION)

I/O Cable List						
Cable No	Port	# of identical ports	Connector Type	Cable Type	Cable Length (m)	Remarks
1	USB	1	AC/DC adapter	Un-shielded	1	
2	USB	1	AC	Un-shielded	2	N/A

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.

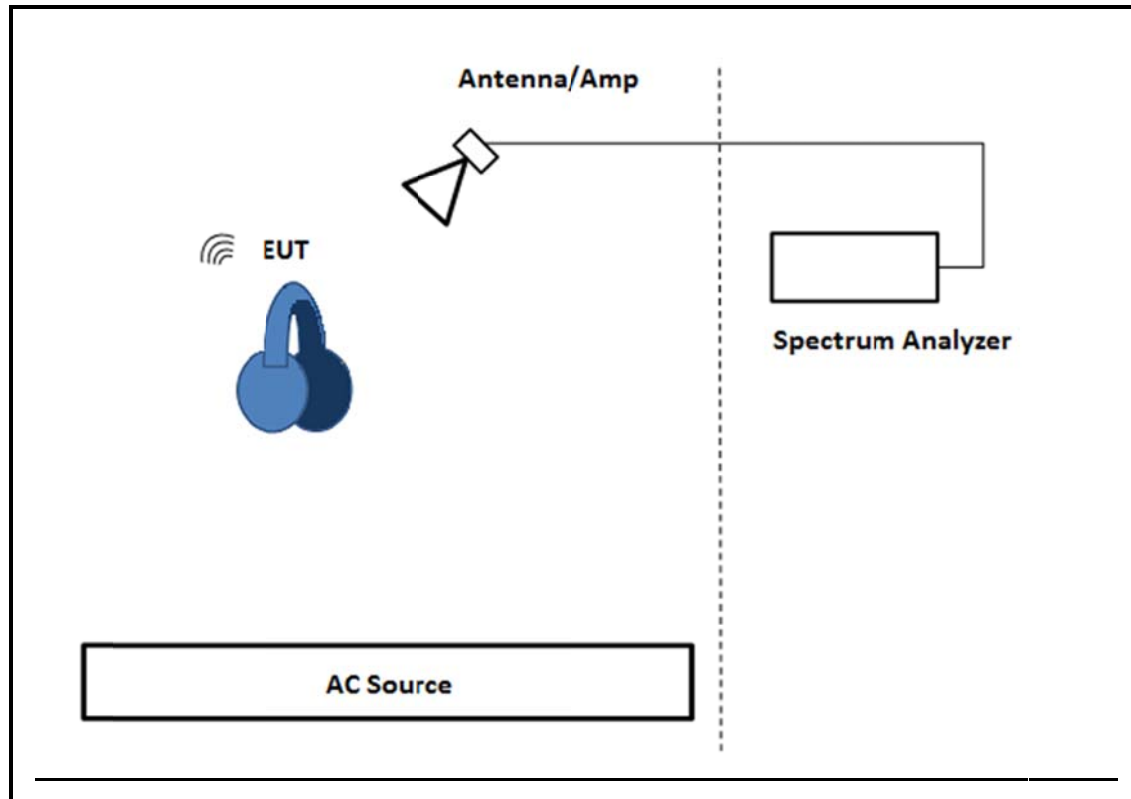
SETUP DIAGRAM



TEST SETUP- RADIATED-ABOVE 1 GHZ

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

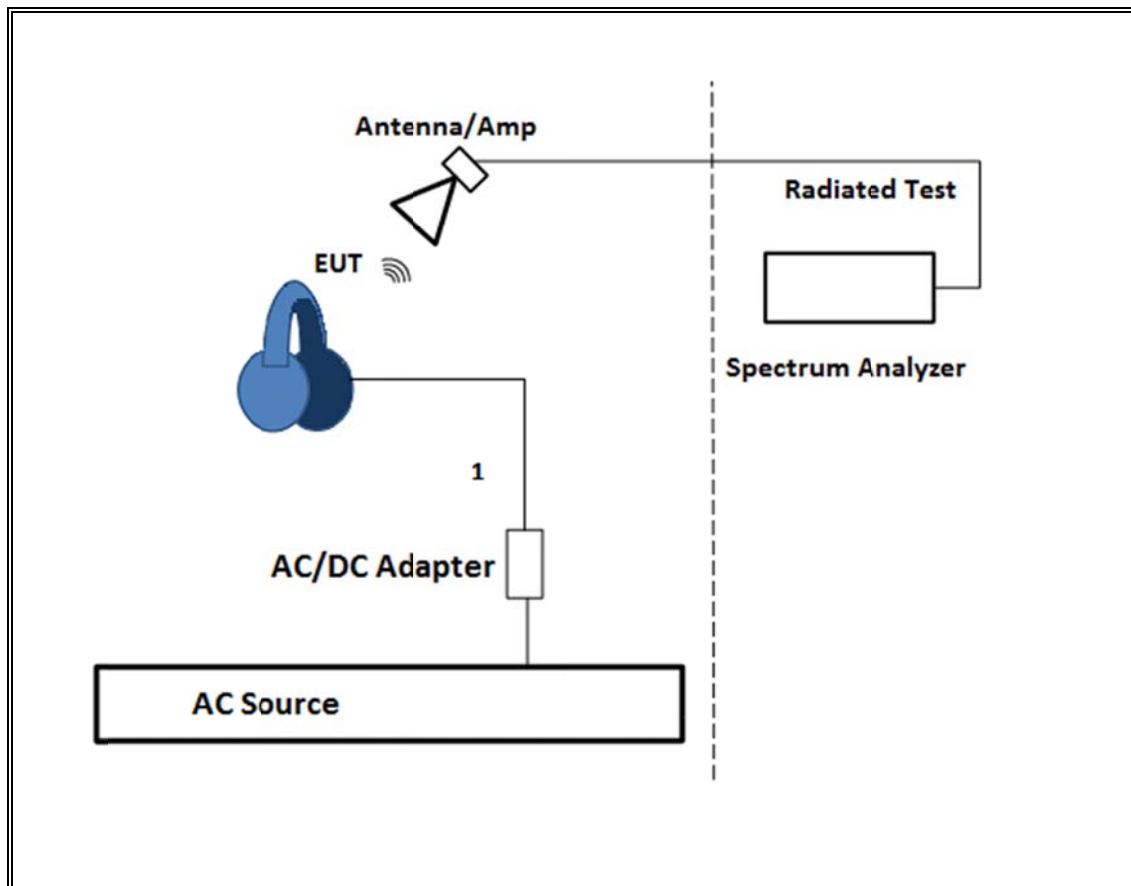
SETUP DIAGRAM



TEST SETUP- BELOW 1GHz

The EUT was tested powered by AC adapter. Test software exercised the EUT.

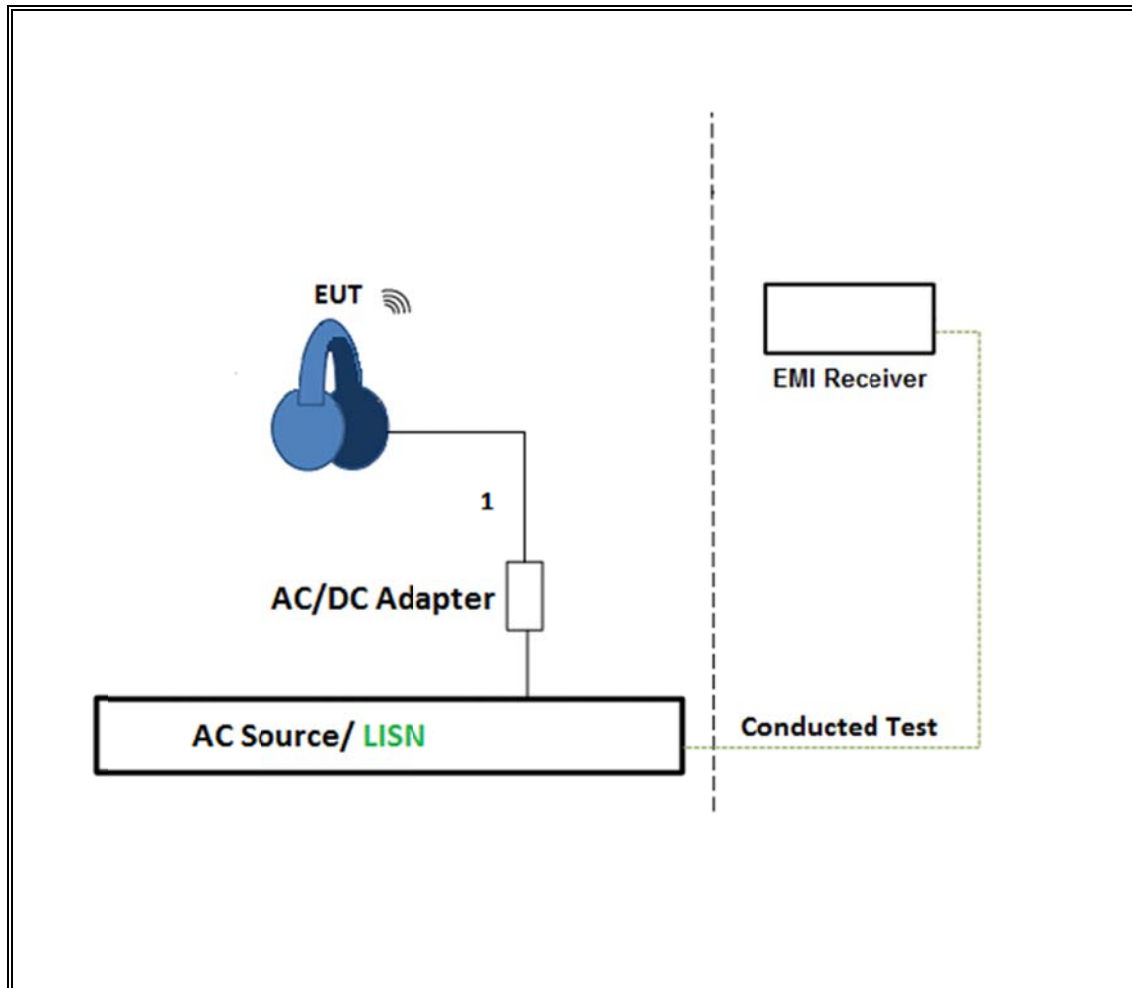
SETUP DIAGRAM



TEST SETUP- AC LINE CONDUCTED: AC/DC ADAPTER

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

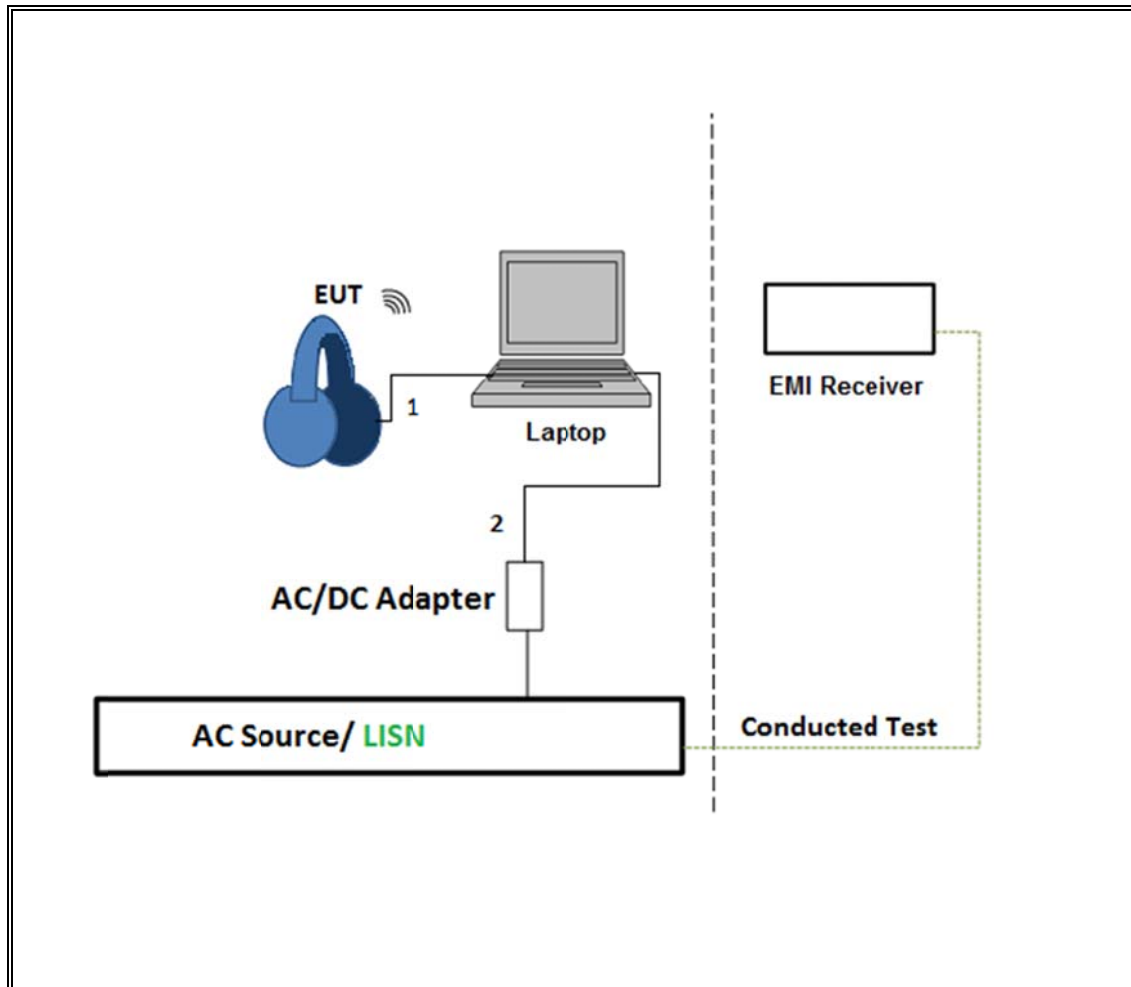
SETUP DIAGRAM



TEST SETUP- AC LINE CONDUCTED: LAPTOP CONFIGURATION

The EUT was tested powered by host PC via USB cable. Test software exercised the EUT.

SETUP DIAGRAM



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	T Number	Cal Due
Antenna, Horn 1-18GHz	ETS Lindgren	3117	T120	4/5/2017
Antenna, Broadband Hybrid, 30MHz to 2000MHz	Sunol Sciences	JB3	T122	1/29/2017
Amplifier, 10KHz to 1GHz, 32dB	Sonoma	310N	T173	6/17/2017
Spectrum Analyzer, PXA, 3Hz to 44GHz	Agilent	N9030A	T341	10/14/2016
Antenna, Horn 1-18GHz	ETS Lindgren	3117	T862	4/18/2017
Antenna, Broadband Hybrid, 30MHz to 2000MHz	Sunol Sciences	JB3	T899	5/26/2017
Amplifier, 1 - 18GHz	Miteq	AFS42-00101800-25-S-42	T491	5/31/2017
Amplifier, 10KHz to 1GHz, 32dB	Sonoma	310N	T834	6/17/2017
Power Meter, P-series single channel	Agilent	N1911A	T1271	7/8/2017
Power Sensor, P - series, 50MHz to 18GHz, Wideband	Agilent	N1921A	T1228	6/20/2017
Antenna, Horn 18 to 26.5GHz	ARA	MWH-1826	T447	6/16/2017
Spectrum Analyzer, 40 GHz	Agilent	8564E	T106	8/13/2016
Amplifier, 1 to 26.5GHz, 23.5dB Gain minimum	Keysight	8449B	T402	7/5/2017
AC Line Conducted				
EMI Test Receiver 9KHz-7GHz	Rohde & Schwarz	ESCI7	100935	9/16/2016
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	
* Conducted Software	UL	UL EMC	Ver 4.0, January 11, 2016	

Note: * indicates automation software version used in the compliance certification testing

7. ANTENNA PORT TEST RESULTS

7.1. ON TIME AND DUTY CYCLE

LIMITS

None; for reporting purposes only.

PROCEDURE

KDB 558074 Zero-Span Spectrum Analyzer Method.

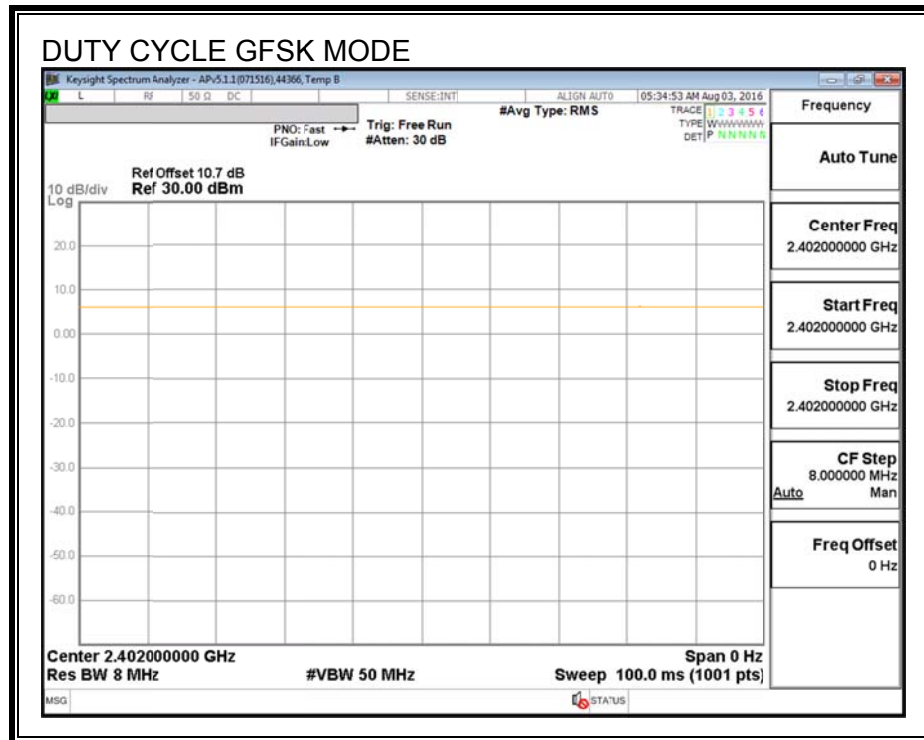
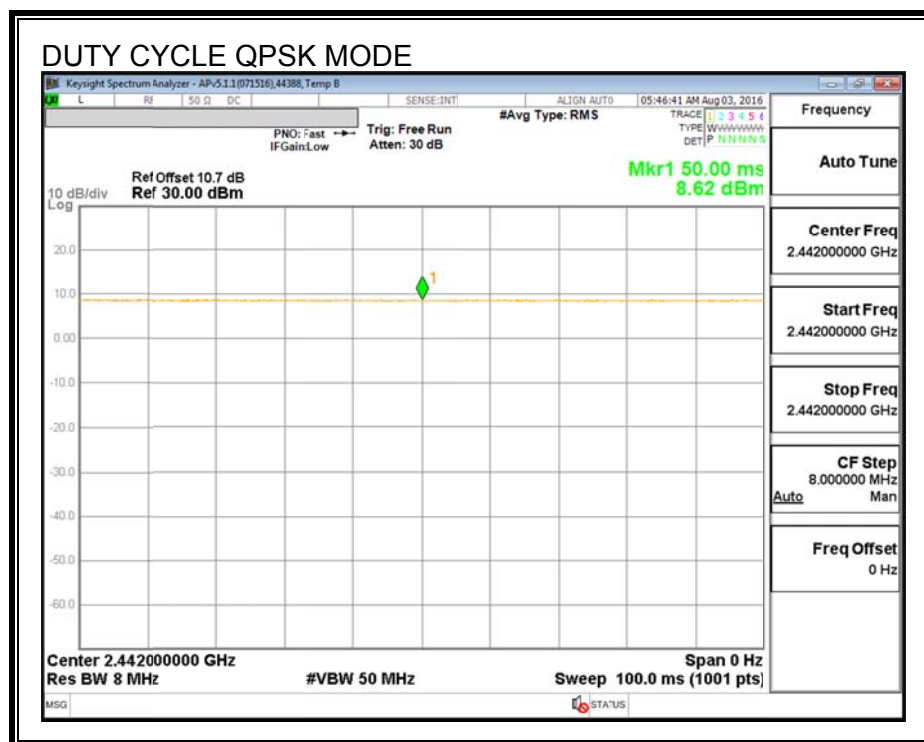
RESULTS

ON TIME AND DUTY CYCLE

Mode	ON Time B (msec)	Period (msec)	Duty Cycle x (linear)	Duty Cycle (%)	Duty Cycle Correction Factor (dB)	1/B Minimum VBW (kHz)
Bluetooth GFSK	1.000	1.000	1.000	100.00%	0.00	0.010
Bluetooth QPSK	1.000	1.000	1.000	100.00%	0.00	0.010

DUTY CYCLE PLOTS

HOPPING OFF



7.2. BASIC DATA RATE GFSK MODULATION

7.2.1. 20 dB AND 99% BANDWIDTH

LIMIT

None; for reporting purposes only.

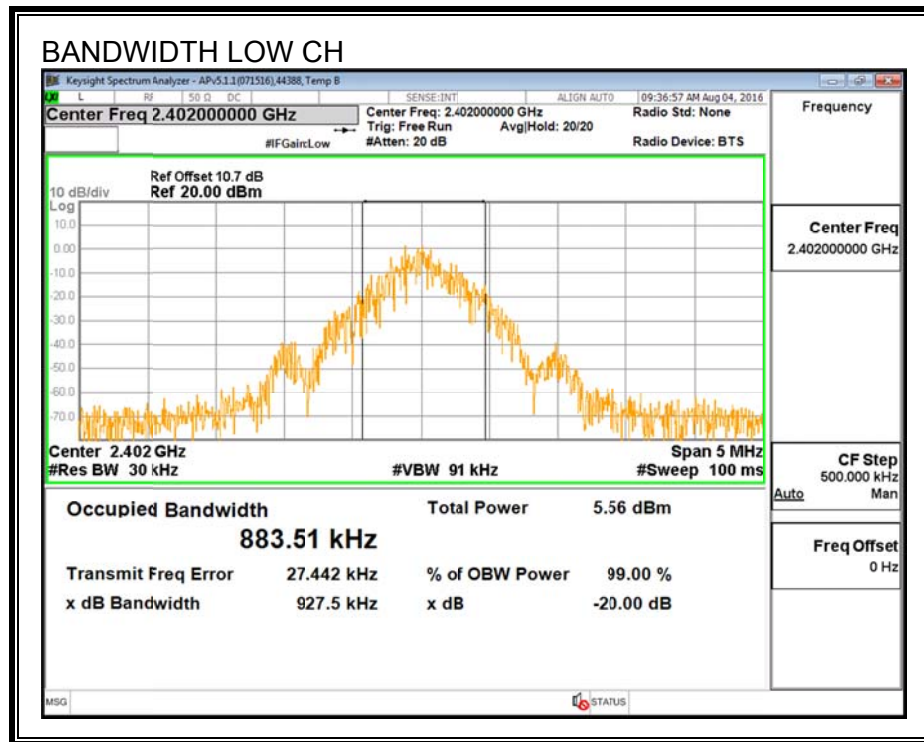
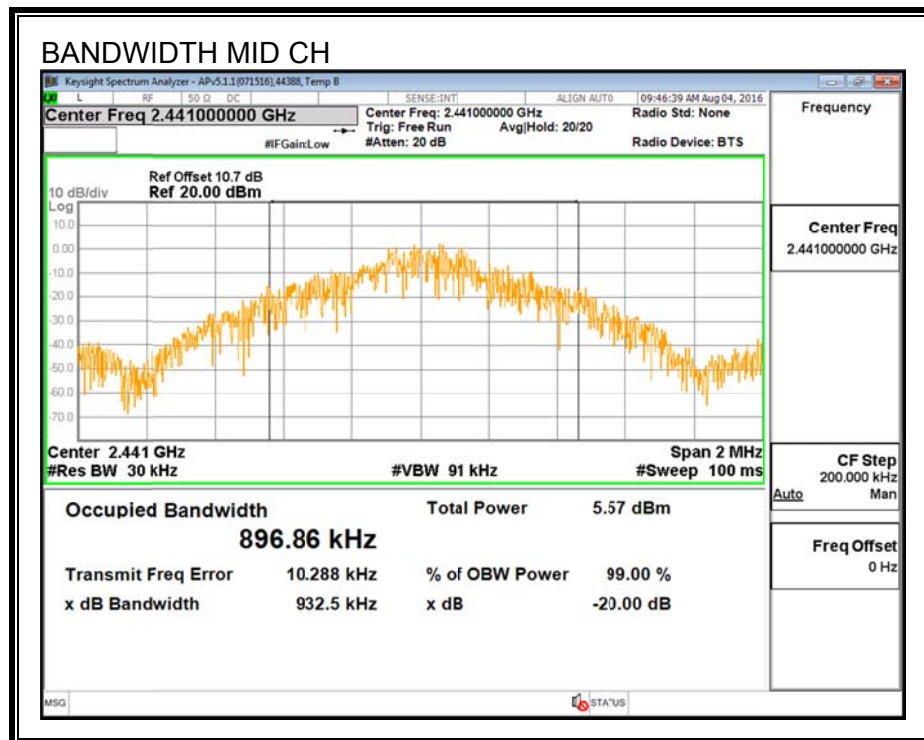
TEST PROCEDURE

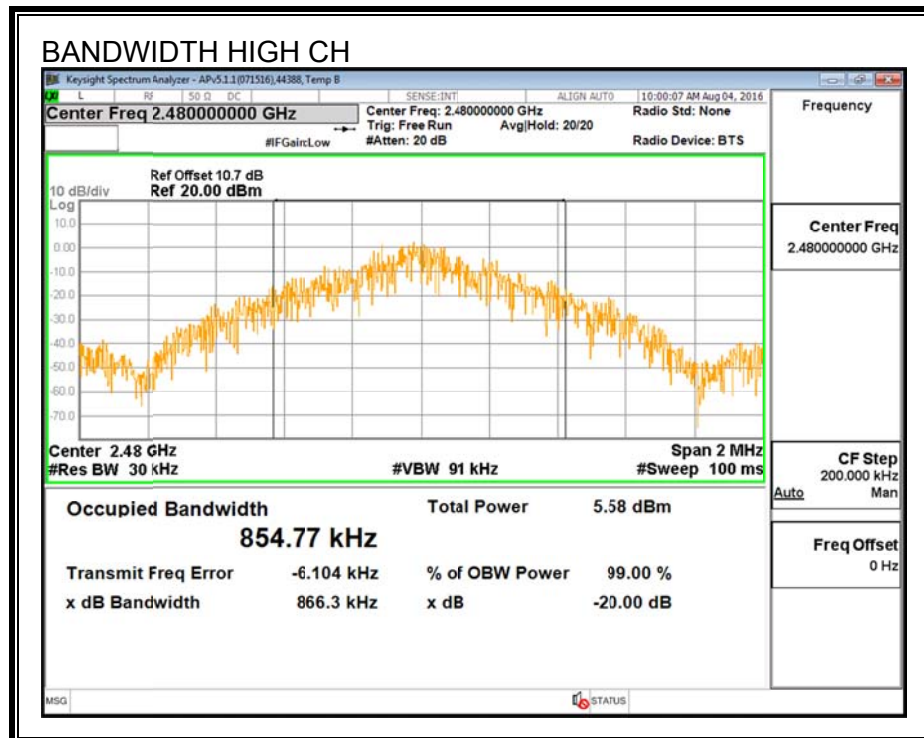
The transmitter output is connected to a spectrum analyzer. The RBW is set to $\geq 1\%$ of the 20 dB bandwidth. The VBW is set to $\geq$ RBW. The sweep time is coupled.

RESULTS

Channel	Frequency (MHz)	20 dB Bandwidth (KHz)	99% Bandwidth (KHz)
Low	2402	927.5	883.5
Middle	2441	932.5	896.9
High	2480	866.3	854.8

20 dB AND 99% BANDWIDTH





7.2.2. HOPPING FREQUENCY SEPARATION

LIMIT

FCC §15.247 (a) (1)

IC RSS-247 (5.1) (2)

Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater.

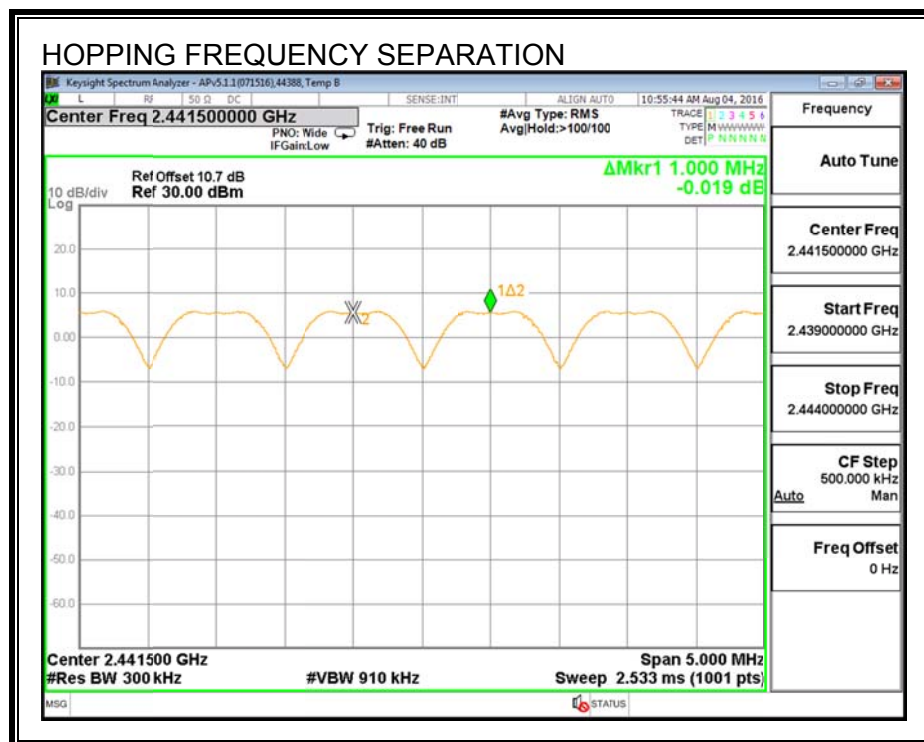
Alternatively, frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW.

TEST PROCEDURE

The transmitter output is connected to a spectrum analyzer. The RBW is set to 300 kHz and the VBW is set to 910 kHz. The sweep time is coupled.

RESULTS

HOPPING FREQUENCY SEPARATION



7.2.3. NUMBER OF HOPPING CHANNELS

LIMIT

FCC §15.247 (a) (1) (iii)

IC RSS-247 (5.1) (4)

Frequency hopping systems in the 2400 – 2483.5 MHz band shall use at least 15 non-overlapping channels.

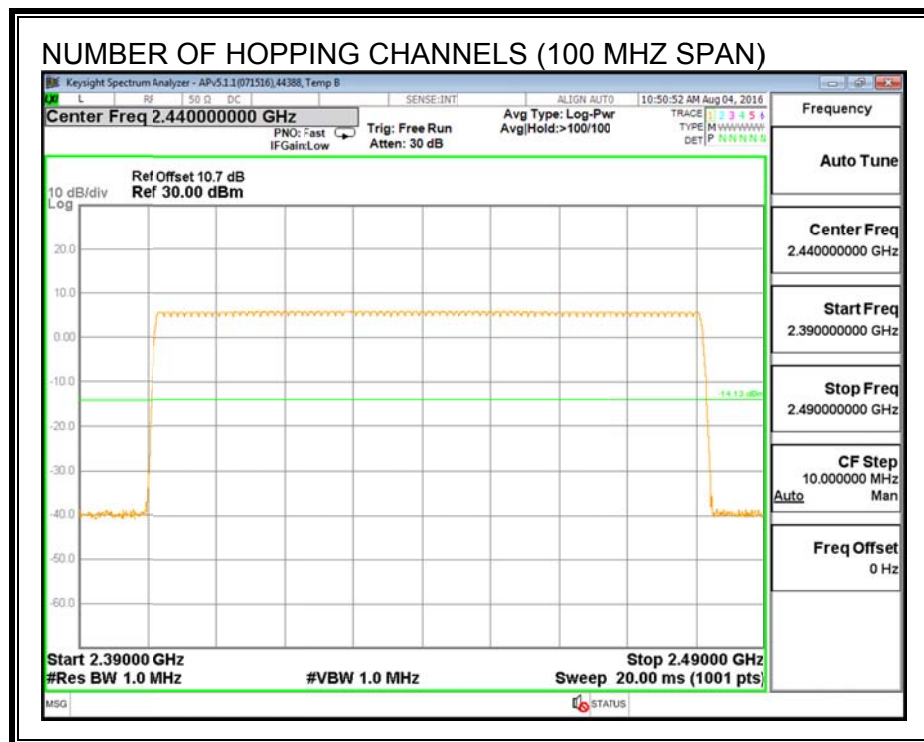
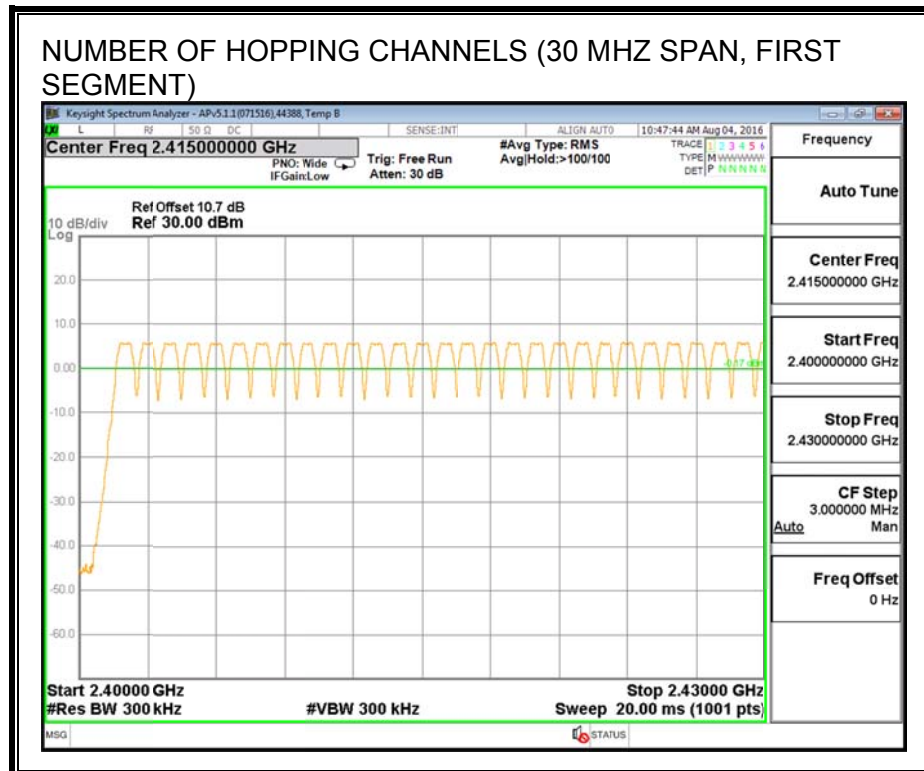
TEST PROCEDURE

The transmitter output is connected to a spectrum analyzer. The span is set to cover the entire authorized band, in either a single sweep or in multiple contiguous sweeps. The RBW is set to a maximum of 1 % of the span. The analyzer is set to Max Hold.

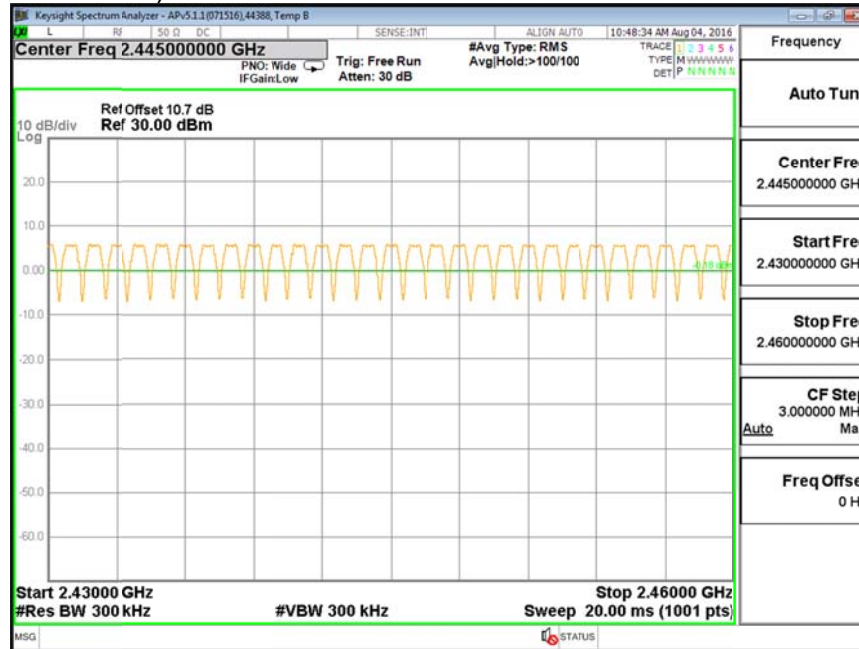
RESULTS

Normal Mode: 79 Channels observed.

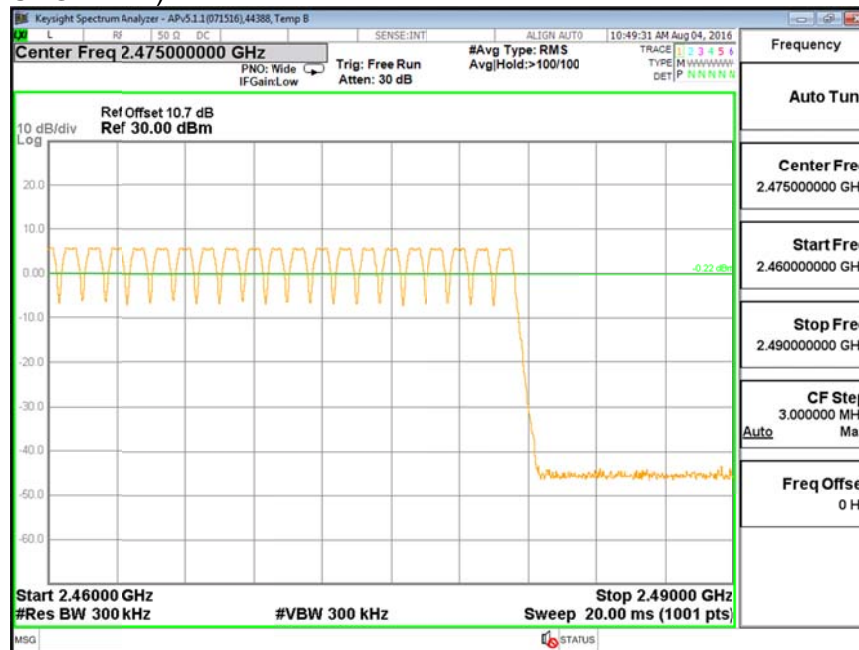
NUMBER OF HOPPING CHANNELS



NUMBER OF HOPPING CHANNELS (30 MHZ SPAN, SECOND SEGMENT)



NUMBER OF HOPPING CHANNELS (30 MHZ SPAN, THIRD SEGMENT)



7.2.4. AVERAGE TIME OF OCCUPANCY

LIMIT

FCC §15.247 (a) (1) (iii)

IC RSS-247 (5.1) (4)

The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed.

TEST PROCEDURE

The transmitter output is connected to a spectrum analyzer. The span is set to 0 Hz, centered on a single, selected hopping channel. The width of a single pulse is measured in a fast scan. The number of pulses is measured in a 3.16 second scan, to enable resolution of each occurrence.

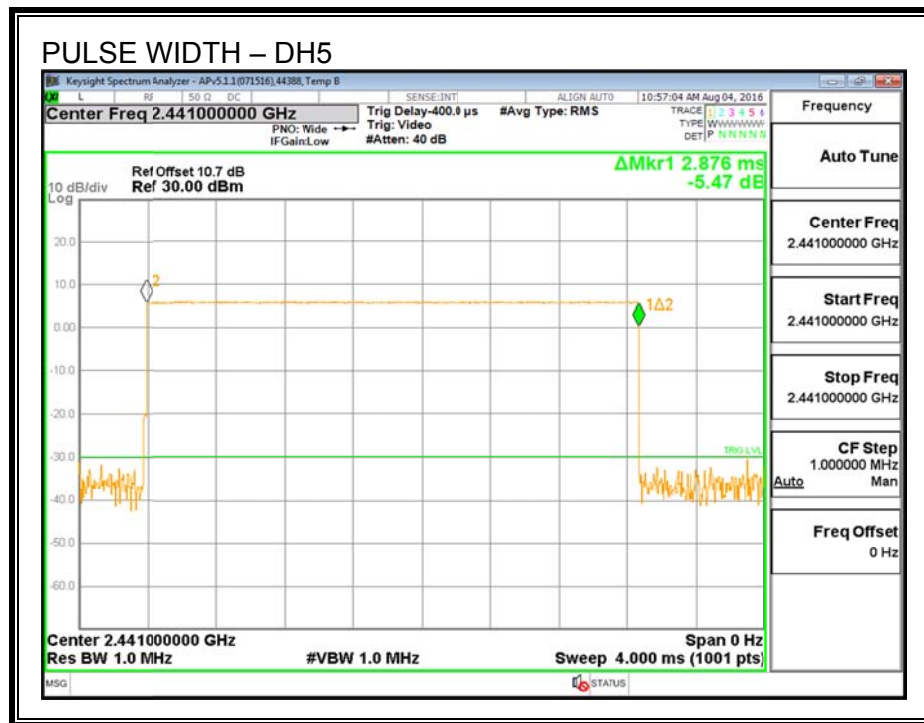
The average time of occupancy in the specified 31.6 second period (79 channels * 0.4 s) is equal to $10 * (\# \text{ of pulses in } 3.16 \text{ s}) * \text{pulse width}$.

For AFH mode, the average time of occupancy in the specified 8 second period (20 channels * 0.4 seconds) is equal to $10 * (\# \text{ of pulses in } 0.8 \text{ s}) * \text{pulse width}$.

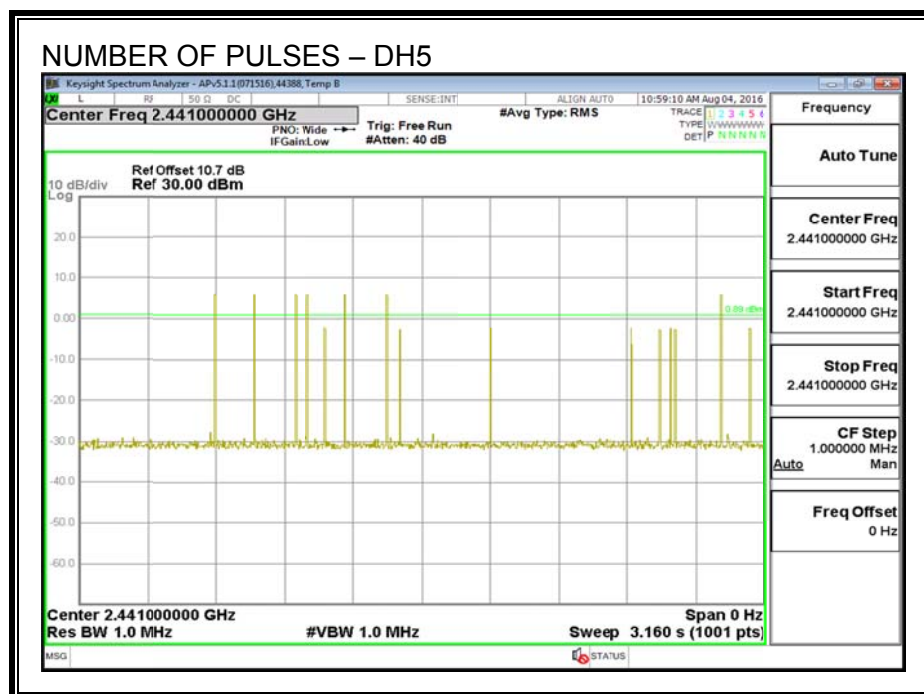
RESULTS

DH Packet	Pulse Width (msec)	Number of Pulses in 3.16 seconds	Average Time of Occupancy (sec)	Limit (sec)	Margin (sec)
GFSK Normal Mode					
DH5	2.876	7	0.201	0.4	-0.199
DH Packet	Pulse Width (msec)	Number of Pulses in 0.8 seconds	Average Time of Occupancy (sec)	Limit (sec)	Margin (sec)
GFSK AFH Mode					
DH5	2.876	1.75	0.050	0.4	-0.350

PULSE WIDTH – DH5



NUMBER OF PULSES IN 3.16 SECOND OBSERVATION PERIOD – DH5



7.2.5. OUTPUT POWER

LIMIT

§15.247 (b) (1)

RSS-247 (5.4) (2)

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

TEST PROCEDURE

The transmitter output is connected to a power meter.

RESULTS

ID:	30606	Date:	8/4/16
------------	-------	--------------	--------

Channel	Frequency (MHz)	Output Power (dBm)	Limit (dBm)	Margin (dB)
Low	2402	5.60	30	-24.40
Middle	2441	5.57	30	-24.43
High	2480	5.64	30	-24.36

7.2.6. AVERAGE POWER

LIMIT

None; for reporting purposes only.

TEST PROCEDURE

The transmitter output is connected to a power meter.

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.

ID:	30606	Date:	8/4/16
------------	-------	--------------	--------

Channel	Frequency (MHz)	Average Power (dBm)
Low	2402	5.47
Middle	2441	5.46
High	2480	5.50

7.2.7. CONDUCTED SPURIOUS EMISSIONS

LIMITS

FCC §15.247 (d)

IC RSS-247 (5.5)

Limit = -20 dBc

TEST PROCEDURE

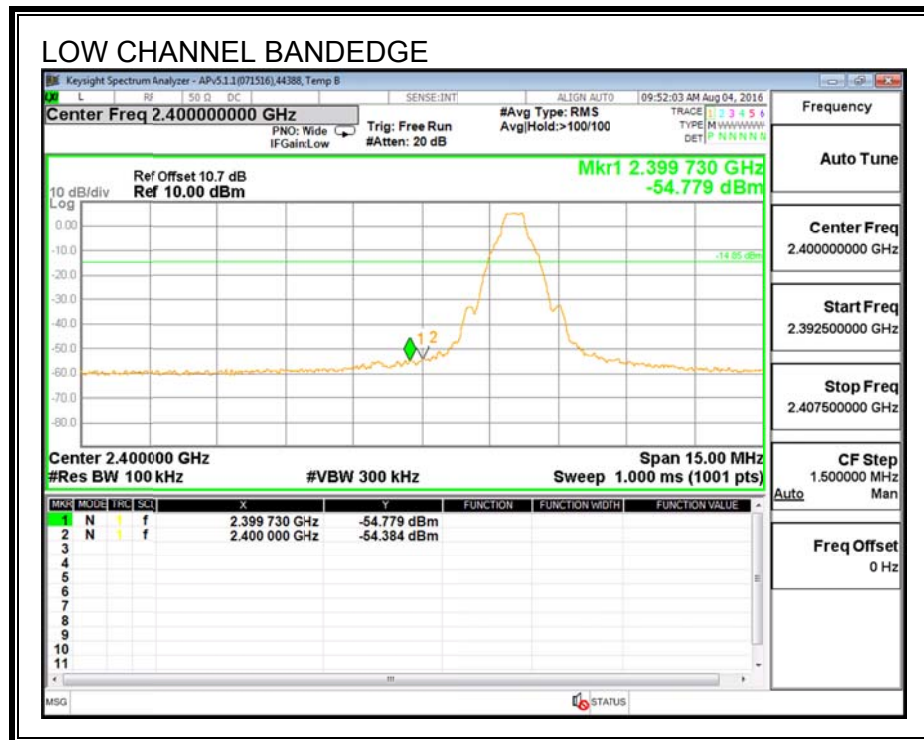
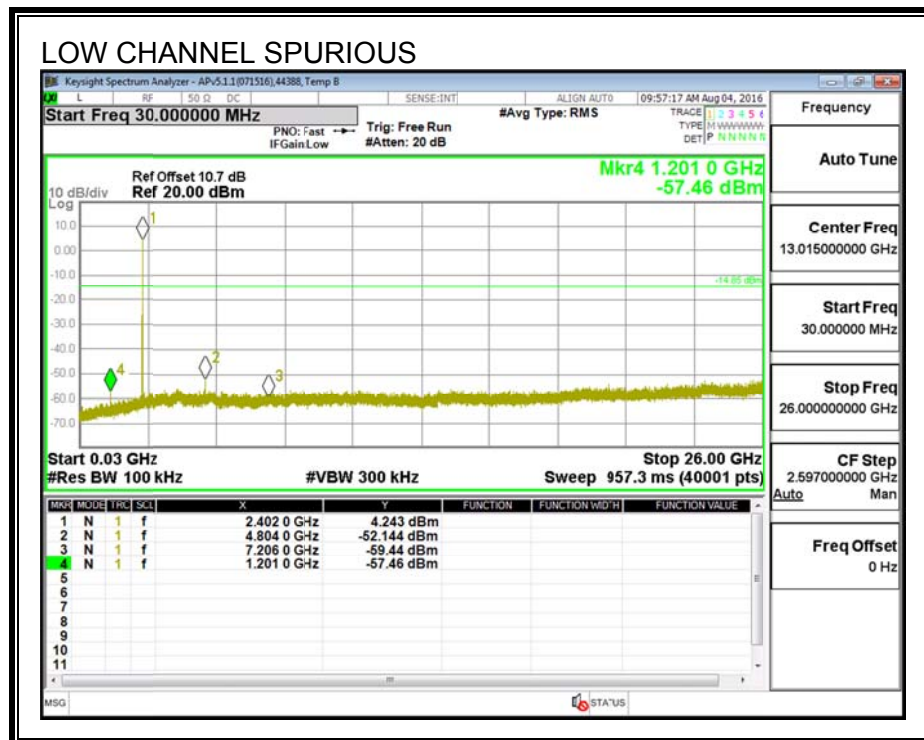
The transmitter output is connected to a spectrum analyzer. The resolution bandwidth is set to 100 kHz. The video bandwidth is set to 300 kHz.

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

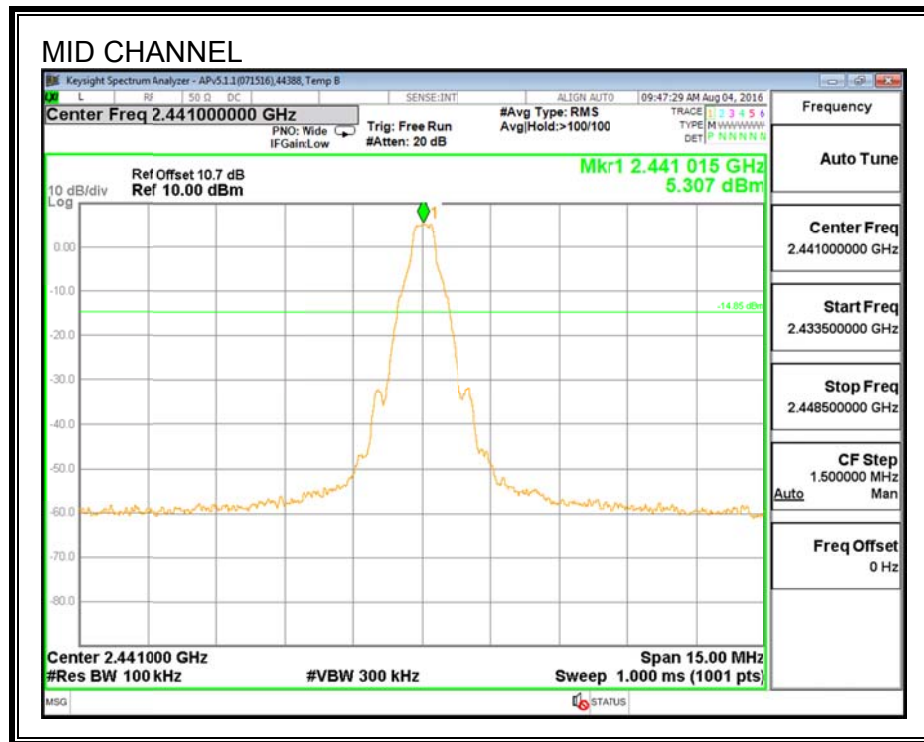
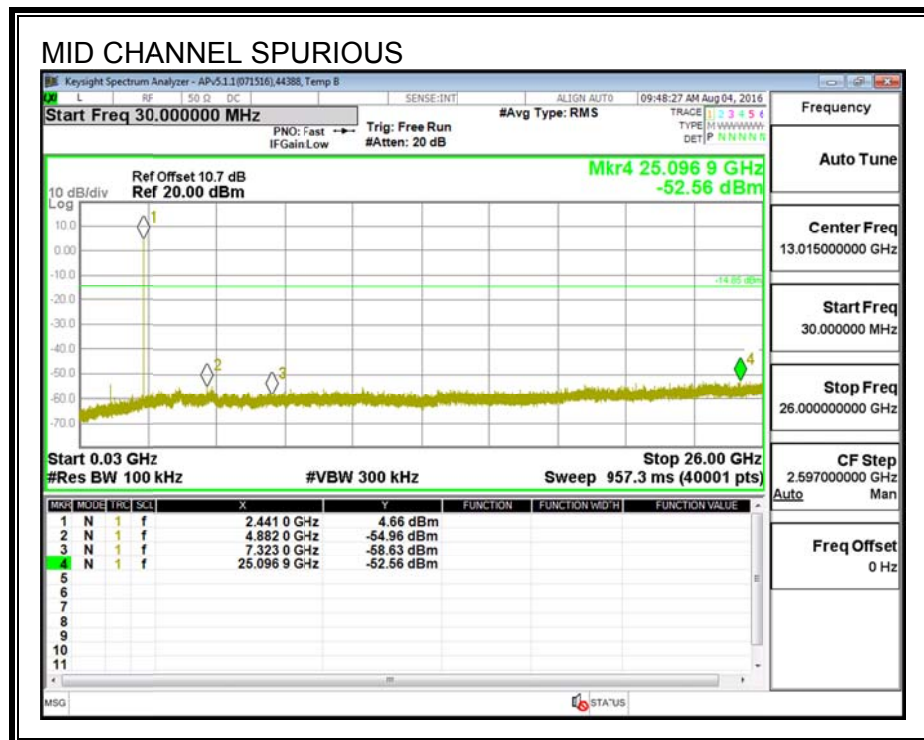
The bandedges at 2.4 and 2.4835 GHz are investigated with the transmitter set to the normal hopping mode.

RESULTS

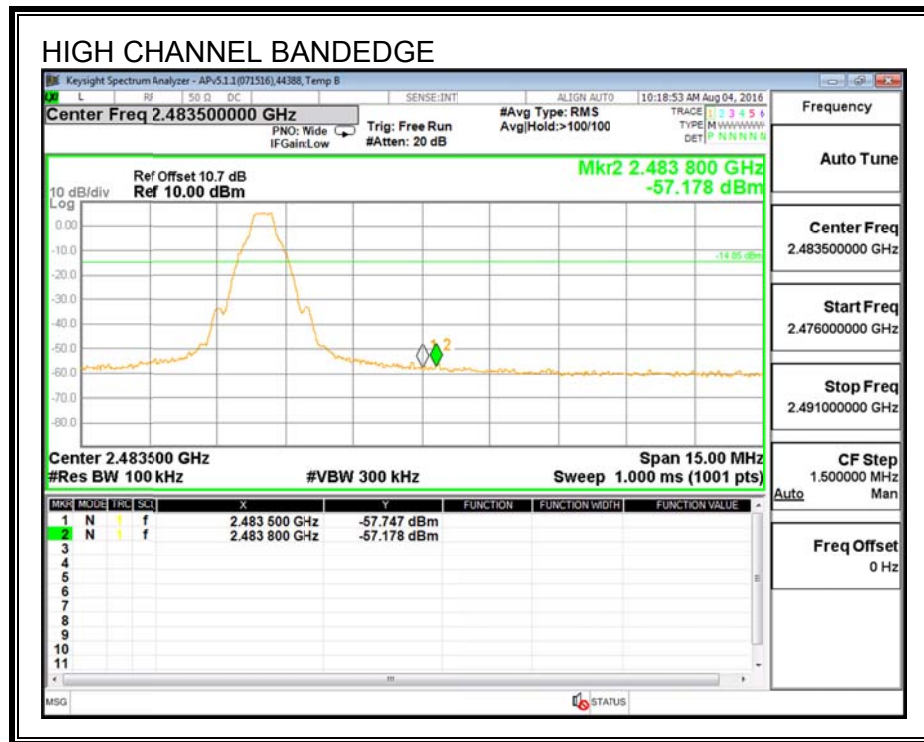
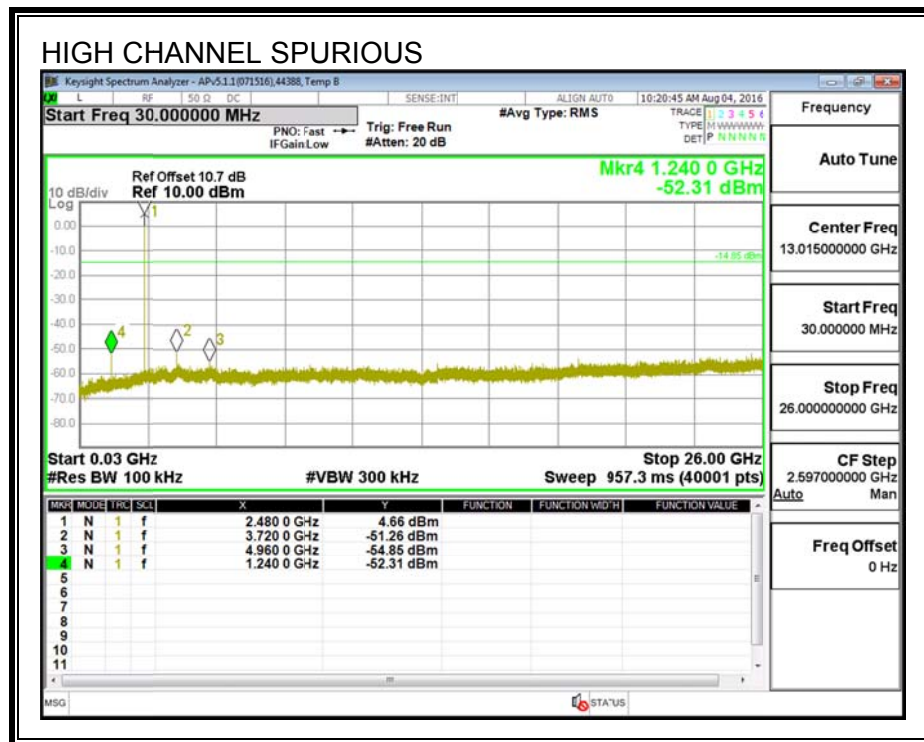
SPURIOUS EMISSIONS, LOW CHANNEL



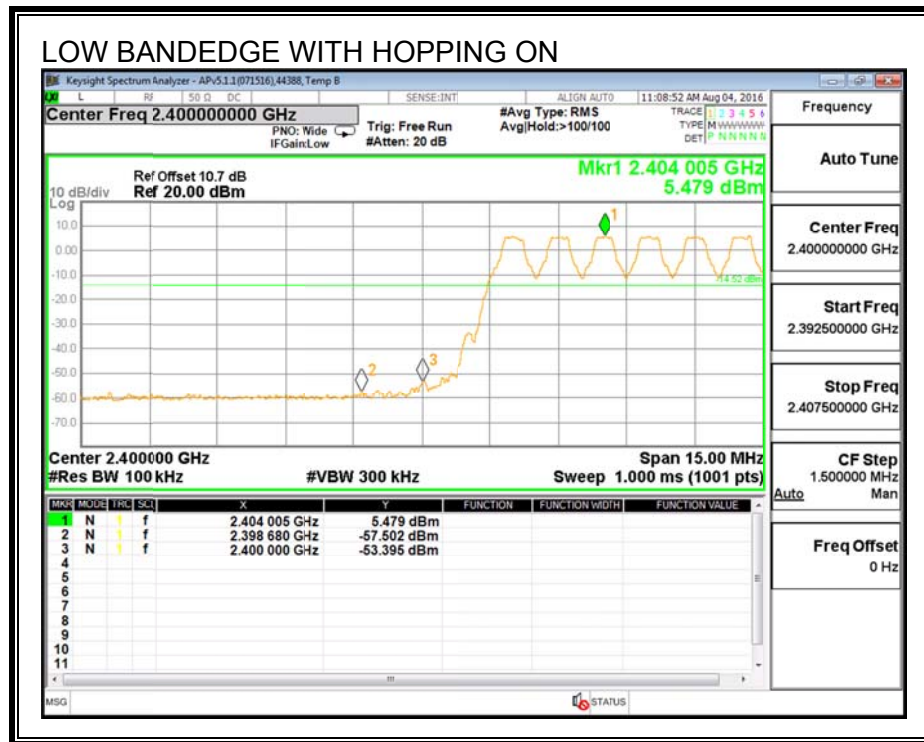
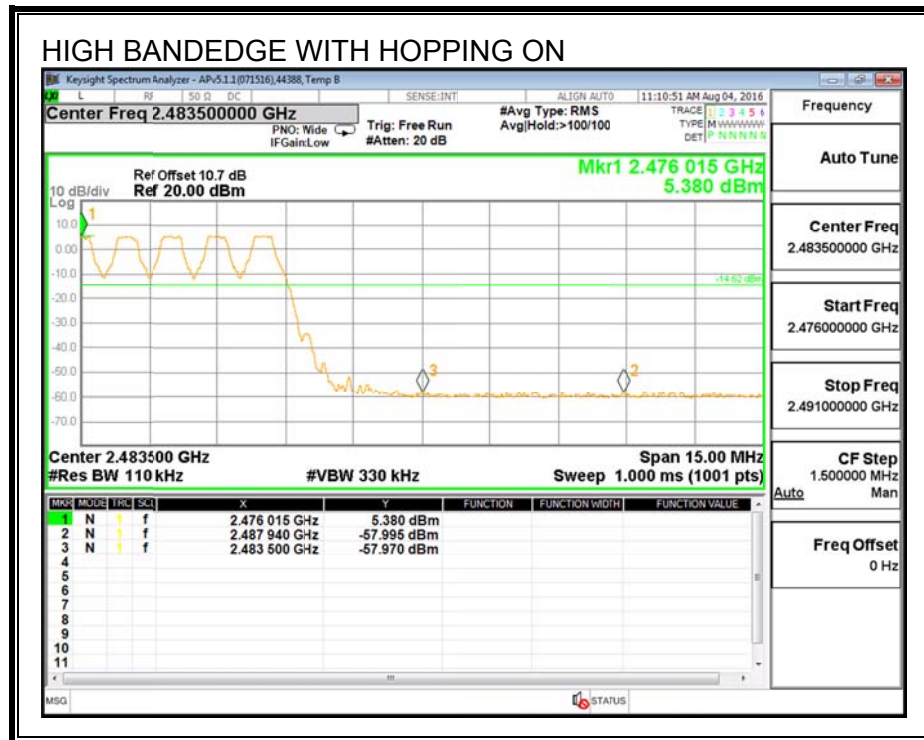
SPURIOUS EMISSIONS, MID CHANNEL



SPURIOUS EMISSIONS, HIGH CHANNEL



SPURIOUS BANDEDGE EMISSIONS WITH HOPPING ON



7.3. ENHANCED DATA RATE QPSK MODULATION

7.3.1. 20 dB AND 99% BANDWIDTH

LIMIT

None; for reporting purposes only.

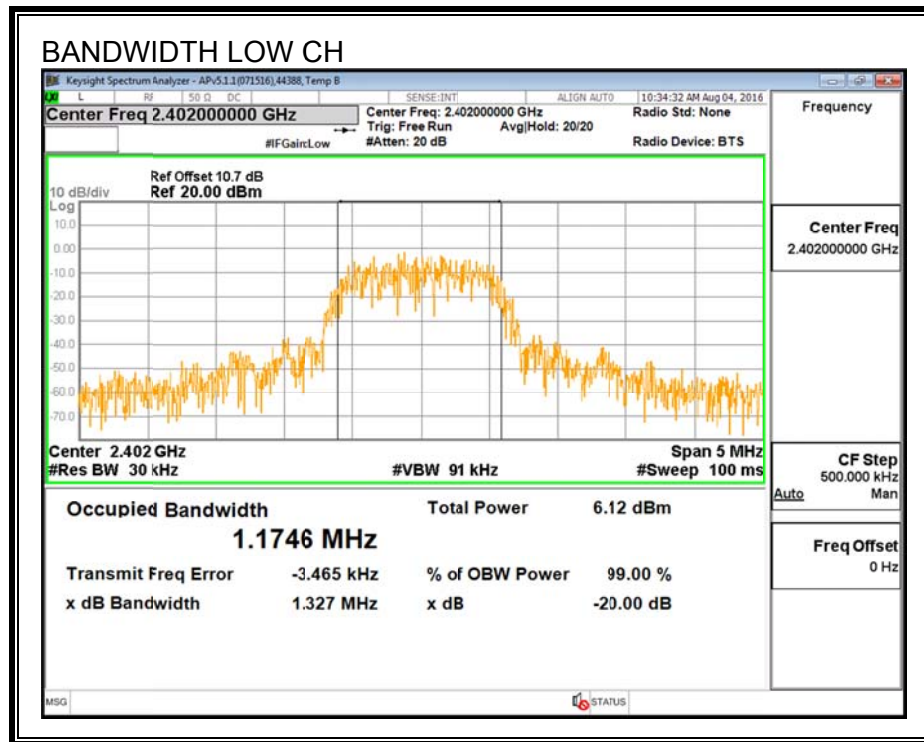
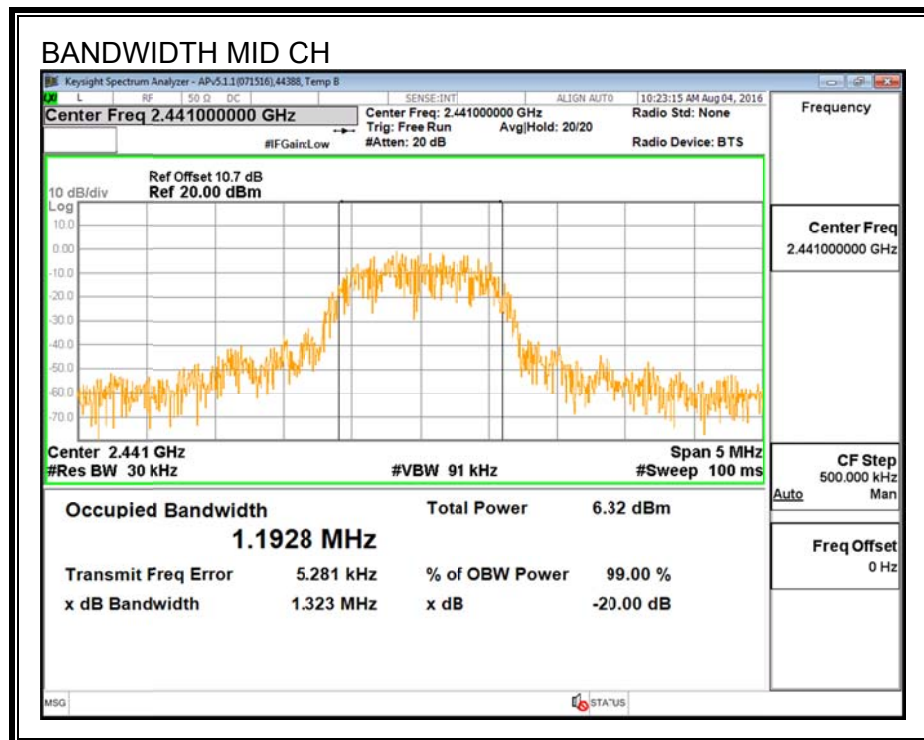
TEST PROCEDURE

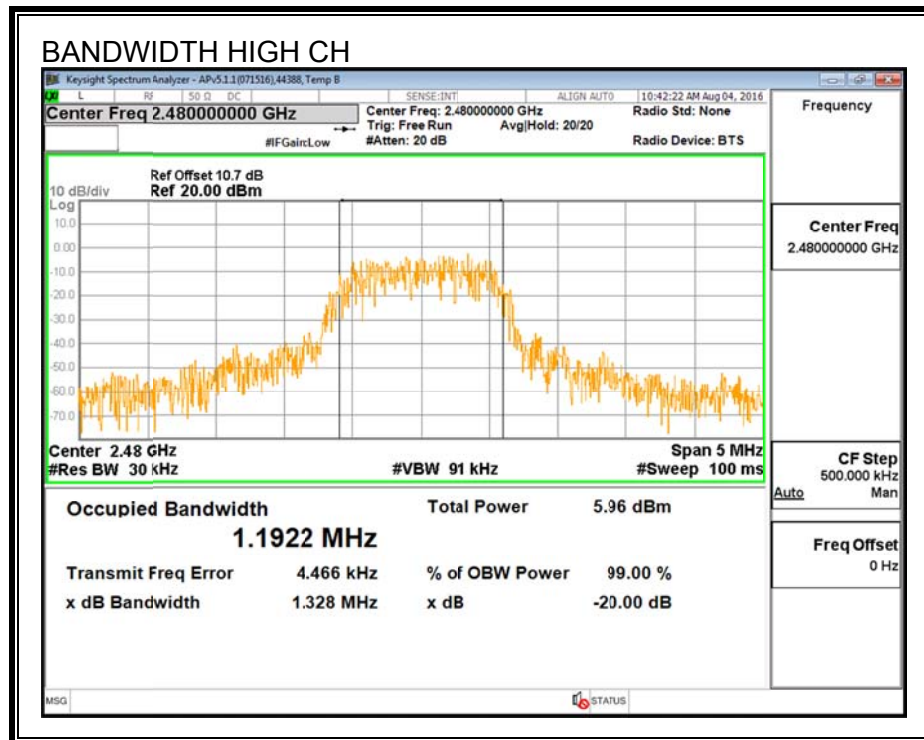
The transmitter output is connected to a spectrum analyzer. The RBW is set to $\geq 1\%$ of the 20 dB bandwidth. The VBW is set to $\geq$ RBW. The sweep time is coupled.

RESULTS

Channel	Frequency (MHz)	20 dB Bandwidth (KHz)	99% Bandwidth (KHz)
Low	2402	1327.00	1174.60
Middle	2441	1323.00	1192.80
High	2480	1328.00	1192.20

20 dB AND 99% BANDWIDTH





7.3.2. HOPPING FREQUENCY SEPARATION

LIMIT

FCC §15.247 (a) (1)

IC RSS-247 (5.1) (2)

Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater.

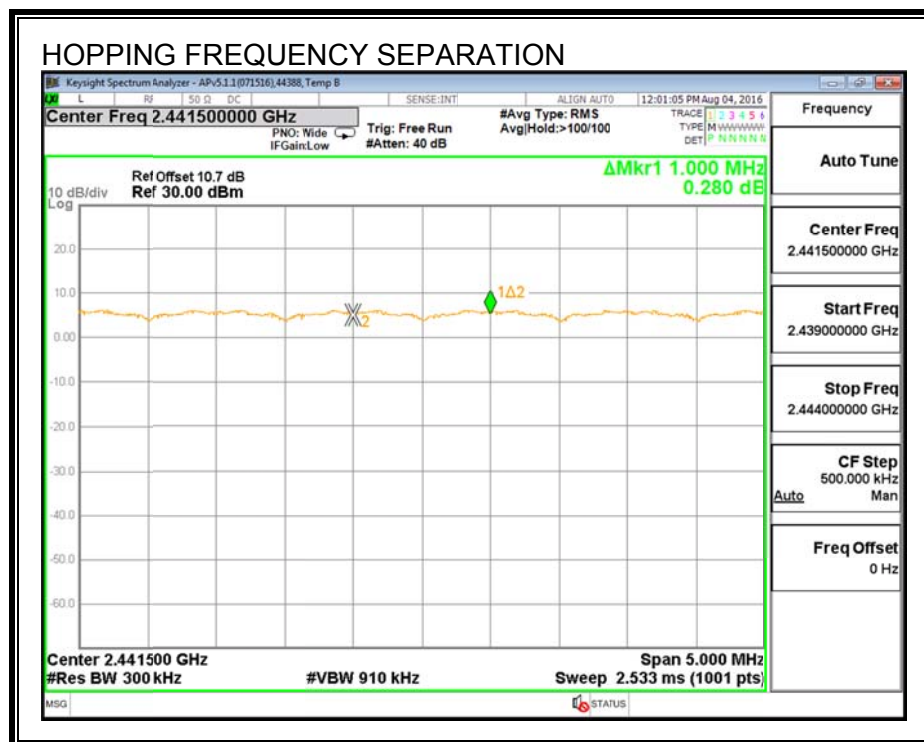
Alternatively, frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW.

TEST PROCEDURE

The transmitter output is connected to a spectrum analyzer. The RBW is set to 300 kHz and the VBW is set to 910 kHz. The sweep time is coupled.

RESULTS

HOPPING FREQUENCY SEPARATION



7.3.3. NUMBER OF HOPPING CHANNELS

LIMIT

FCC §15.247 (a) (1) (iii)

IC RSS-247 (5.1) (4)

Frequency hopping systems in the 2400 – 2483.5 MHz band shall use at least 15 non-overlapping channels.

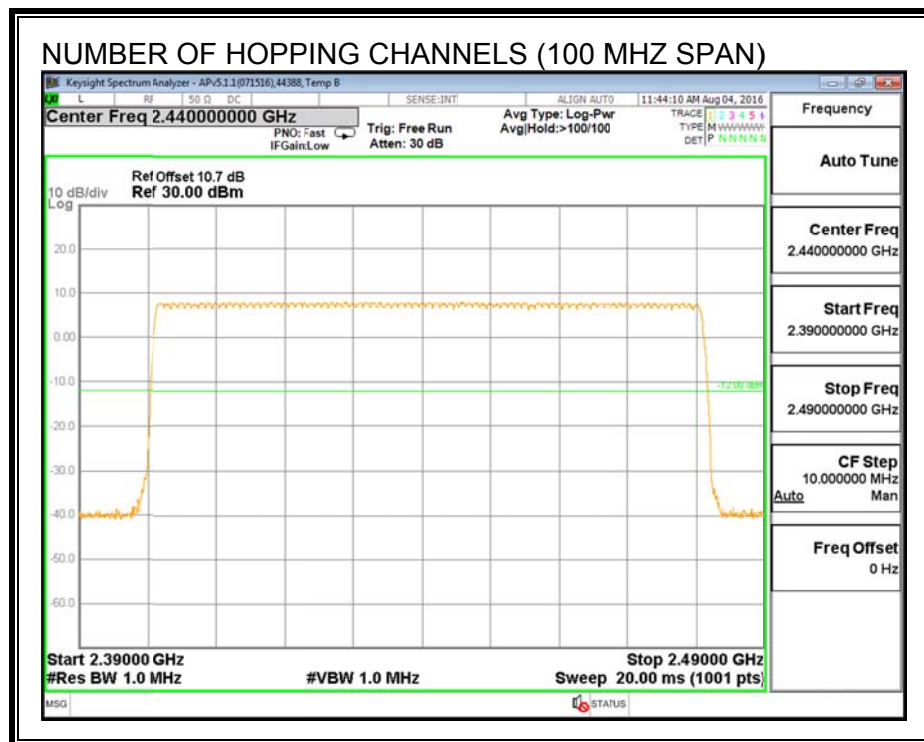
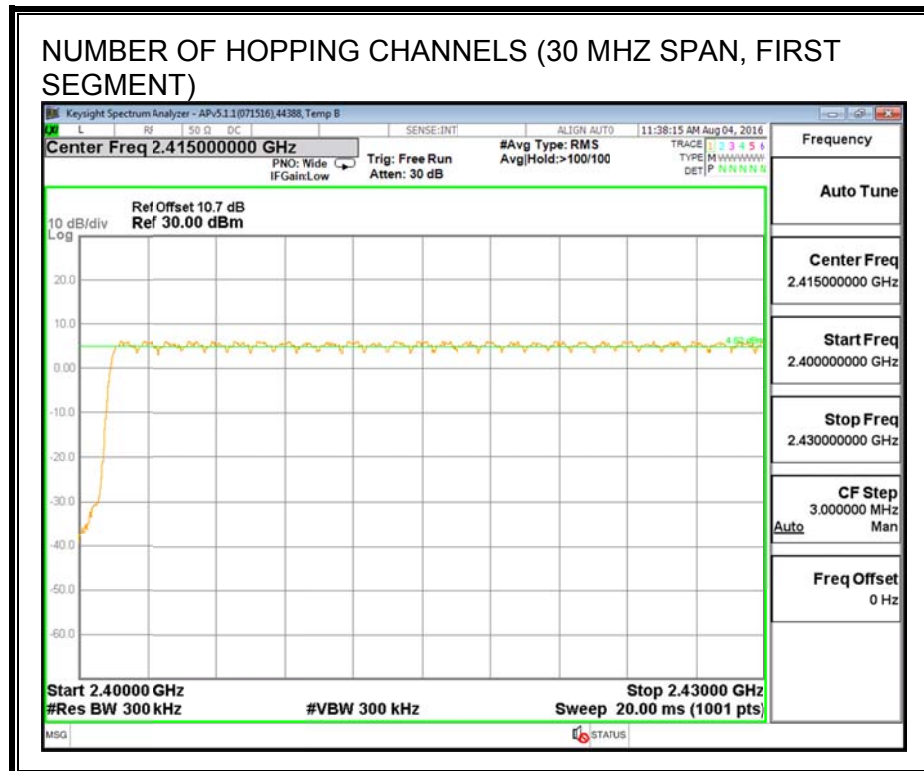
TEST PROCEDURE

The transmitter output is connected to a spectrum analyzer. The span is set to cover the entire authorized band, in either a single sweep or in multiple contiguous sweeps. The RBW is set to a maximum of 1 % of the span. The analyzer is set to Max Hold.

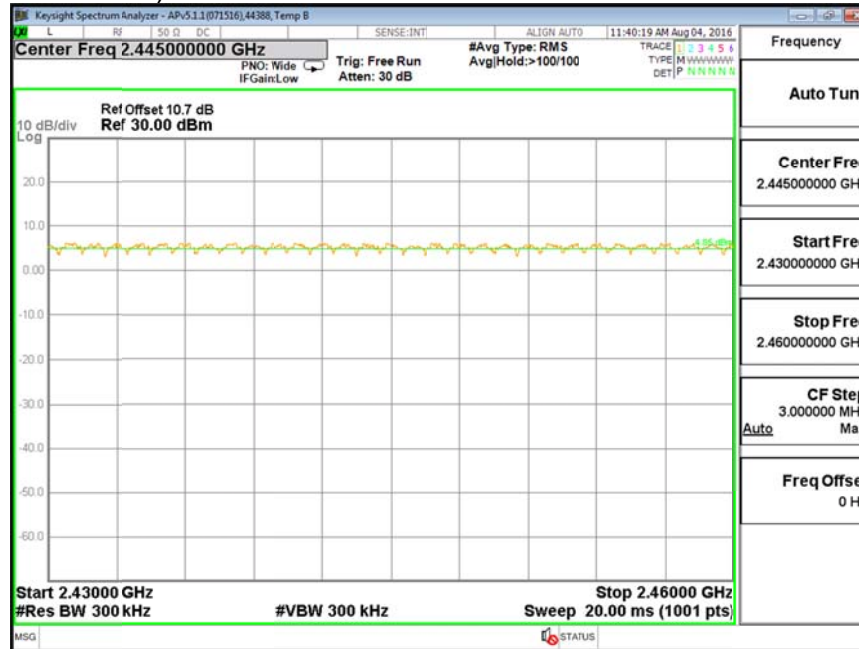
RESULTS

Normal Mode: 79 Channels observed.

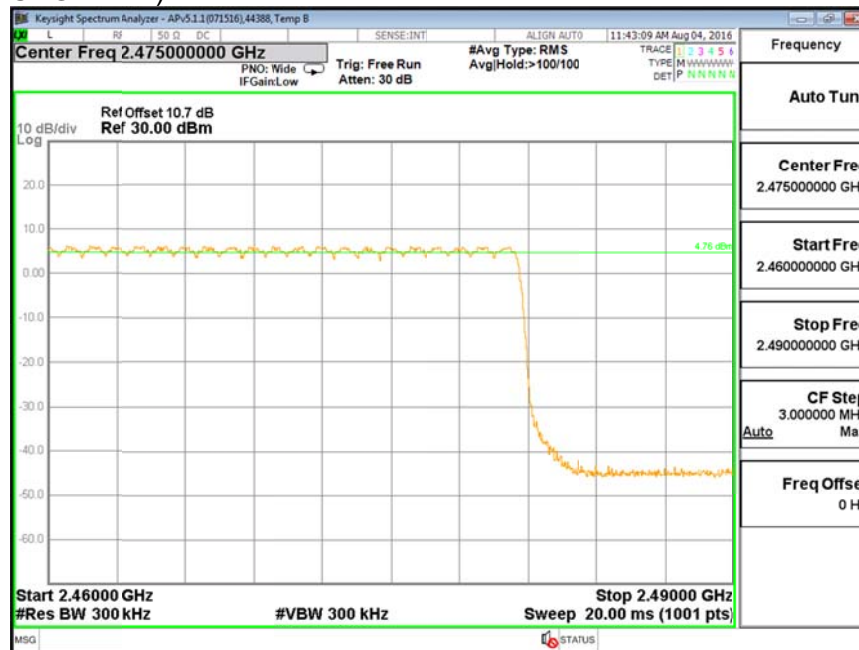
NUMBER OF HOPPING CHANNELS



NUMBER OF HOPPING CHANNELS (30 MHZ SPAN, SECOND SEGMENT)



NUMBER OF HOPPING CHANNELS (30 MHZ SPAN, THIRD SEGMENT)



7.3.4. AVERAGE TIME OF OCCUPANCY

LIMIT

FCC §15.247 (a) (1) (iii)

IC RSS-247 (5.1) (4)

The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed.

TEST PROCEDURE

The transmitter output is connected to a spectrum analyzer. The span is set to 0 Hz, centered on a single, selected hopping channel. The width of a single pulse is measured in a fast scan. The number of pulses is measured in a 3.16 second scan, to enable resolution of each occurrence.

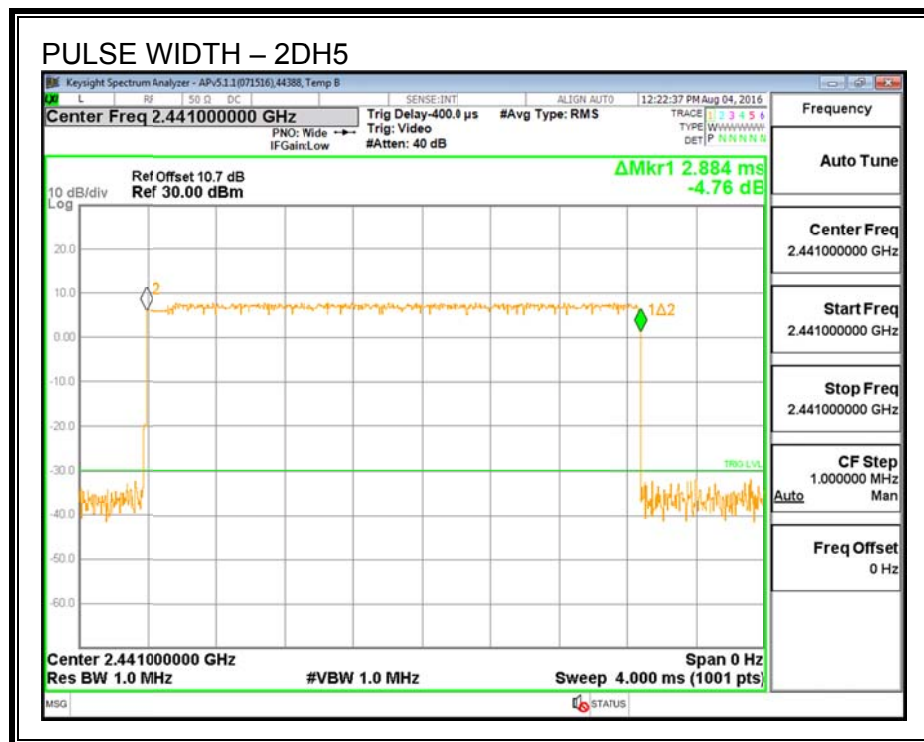
The average time of occupancy in the specified 31.6 second period (79 channels * 0.4 s) is equal to $10 * (\# \text{ of pulses in } 3.16 \text{ s}) * \text{pulse width}$.

RESULTS

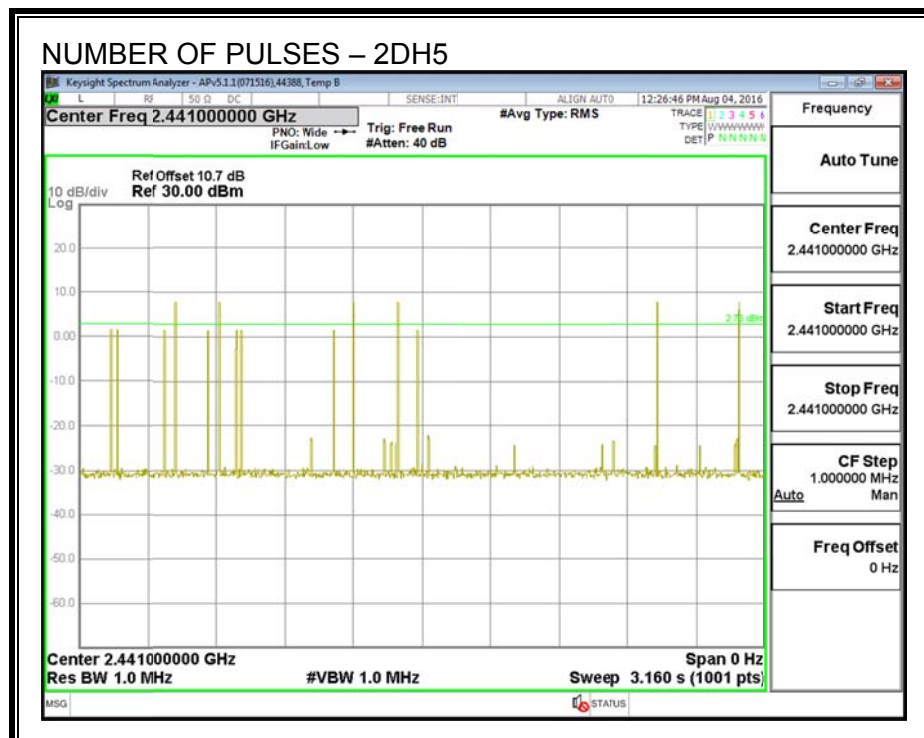
QPSK (EDR) Mode

DH Packet	Pulse Width (msec)	Number of Pulses in 3.16 seconds	Average Time of (sec)	Limit (sec)	Margin (sec)
2DH5	2.884	6	0.173	0.4	-0.227

PULSE WIDTH – 2DH5



NUMBER OF PULSES IN 3.16 SECOND OBSERVATION PERIOD – 2DH5



7.3.5. OUTPUT POWER

LIMIT

§15.247 (b) (1)

RSS-247 (5.4) (2)

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

Alternatively, frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW.

TEST PROCEDURE

The transmitter output is connected to a power meter.

RESULTS

ID:	30606	Date:	8/4/16
------------	-------	--------------	--------

Channel	Frequency (MHz)	Output Power (dBm)	Limit (dBm)	Margin (dB)
Low	2402	8.26	21	-12.71
Middle	2441	8.30	21	-12.67
High	2480	8.32	21	-12.65

7.3.6. AVERAGE POWER

LIMIT

None; for reporting purposes only.

TEST PROCEDURE

The transmitter output is connected to a power meter.

RESULTS

ID:	30606	Date:	8/4/16
------------	-------	--------------	--------

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)	Average Power (dBm)
Low	2402	5.45
Middle	2441	5.49
High	2480	5.50

7.3.7. CONDUCTED SPURIOUS EMISSIONS

LIMITS

FCC §15.247 (d)

IC RSS-247 (5.5)

Limit = -20 dBc

TEST PROCEDURE

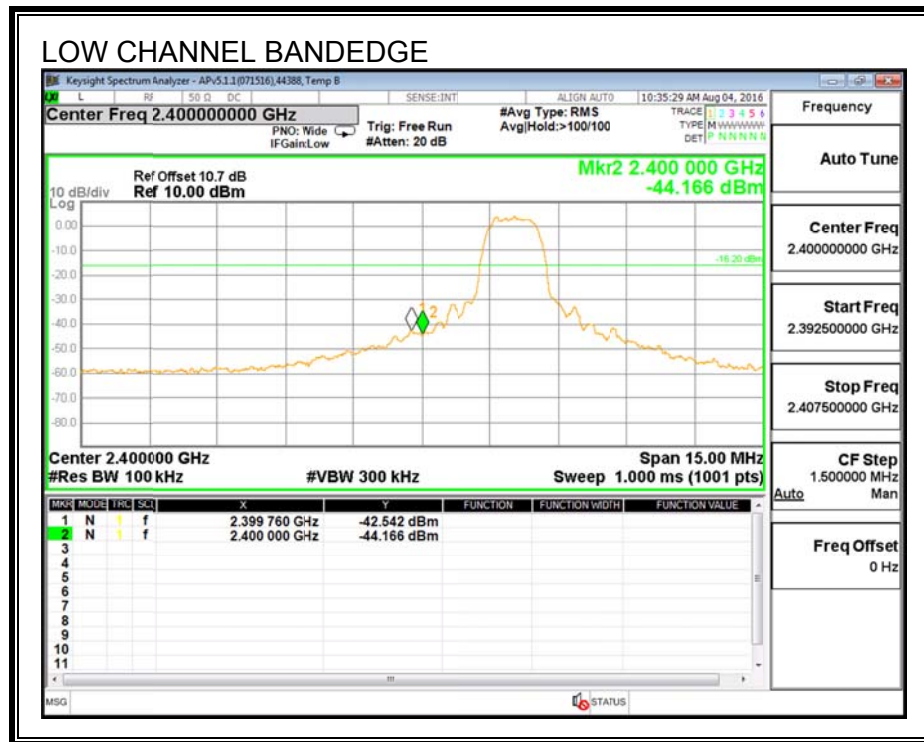
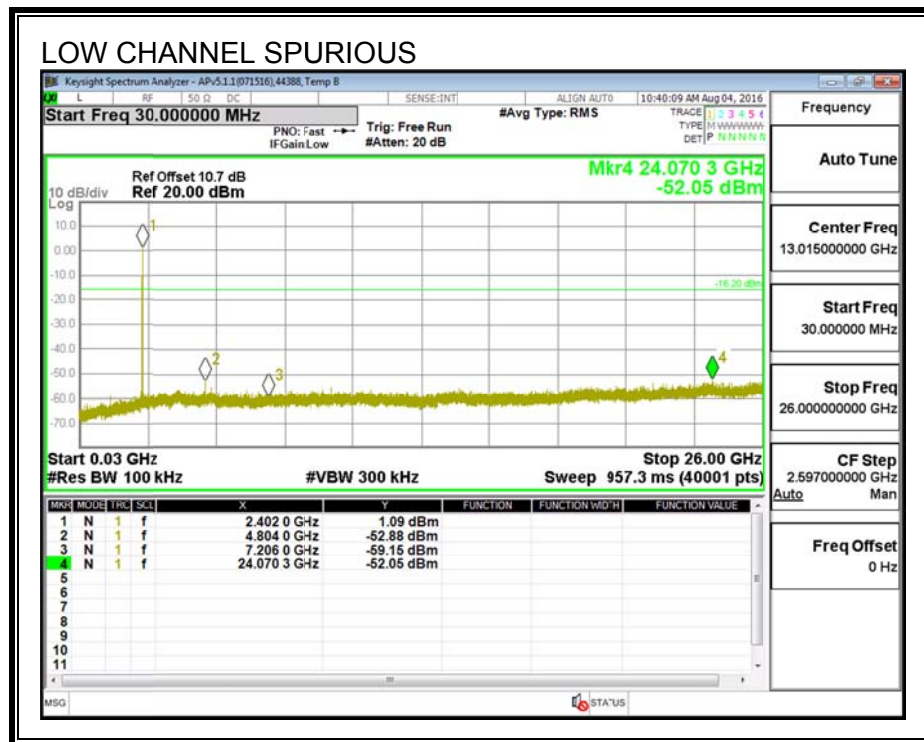
The transmitter output is connected to a spectrum analyzer. The resolution bandwidth is set to 100 kHz. The video bandwidth is set to 300 kHz.

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

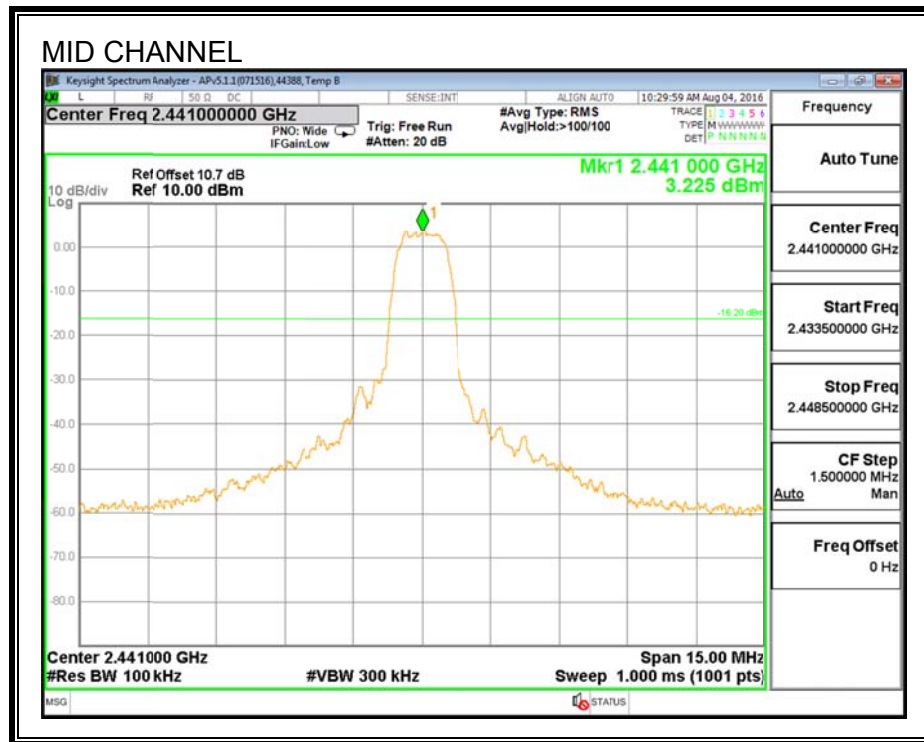
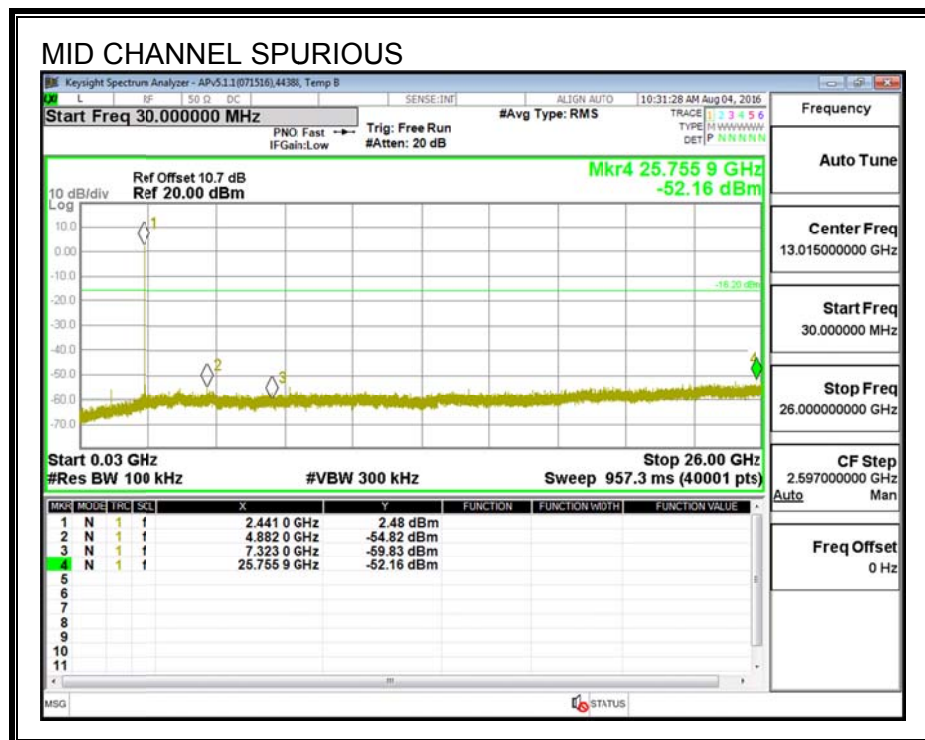
The bandedges at 2.4 and 2.4835 GHz are investigated with the transmitter set to the normal hopping mode.

RESULTS

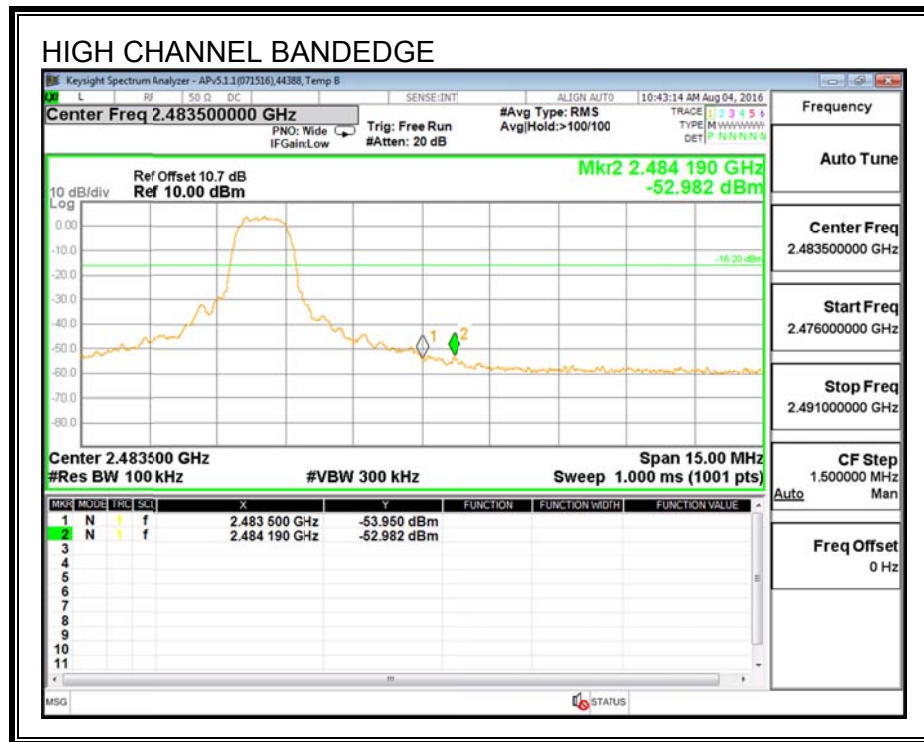
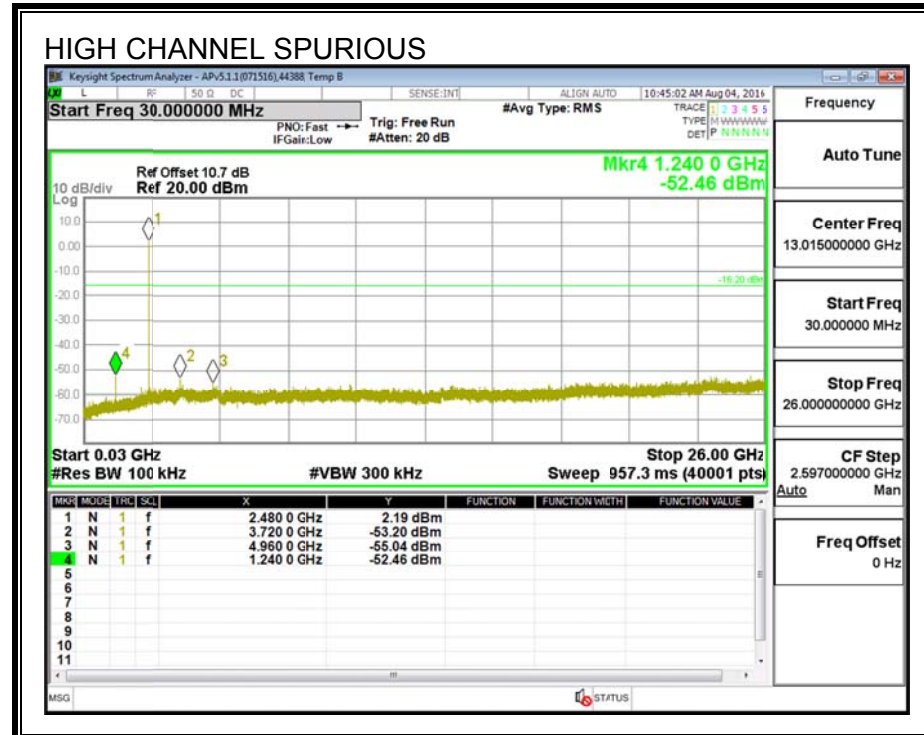
SPURIOUS EMISSIONS, LOW CHANNEL



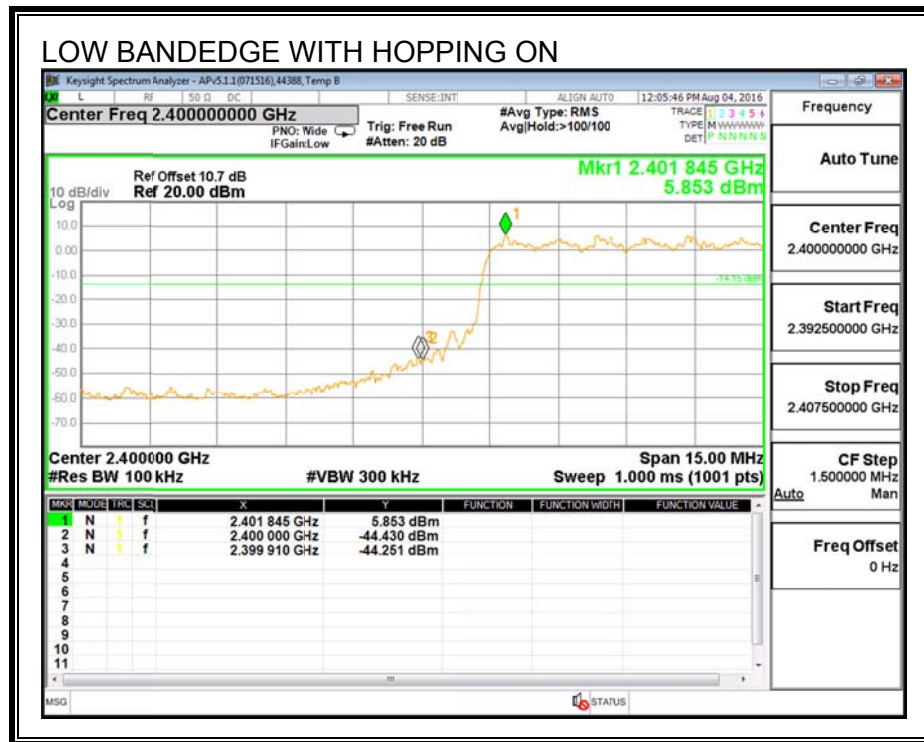
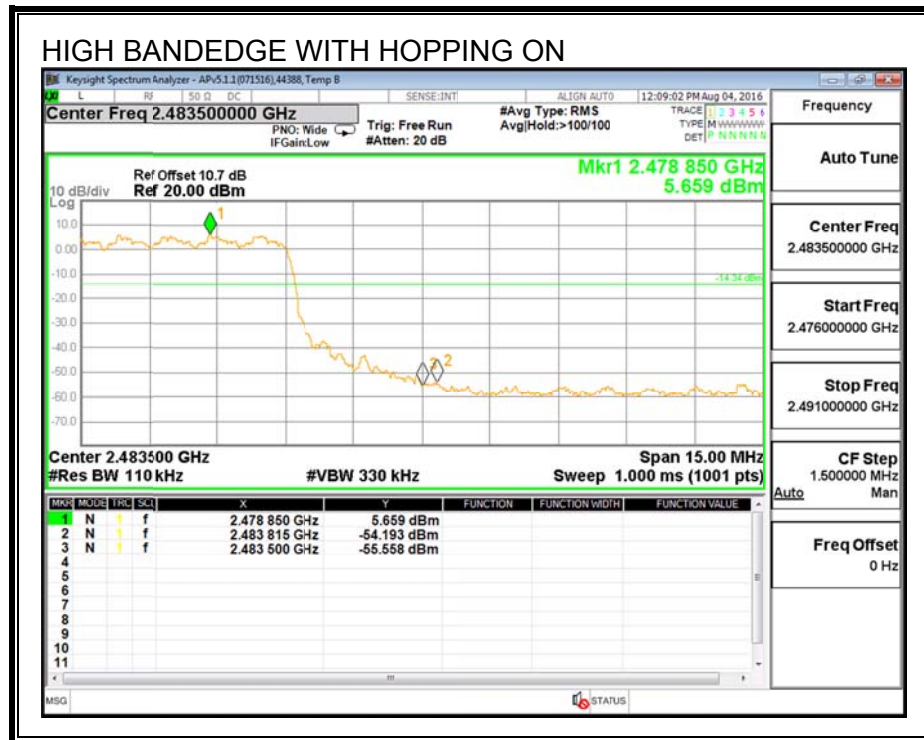
SPURIOUS EMISSIONS, MID CHANNEL



SPURIOUS EMISSIONS, HIGH CHANNEL



SPURIOUS BANDEDGE EMISSIONS WITH HOPPING ON



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 measurements above 1 GHz the resolution bandwidth is set to 1 MHz, then the video bandwidth is set to 3 MHz for peak measurements and 1 MHz resolution bandwidth with 1/T (10 Hz) video bandwidth with peak detector 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.

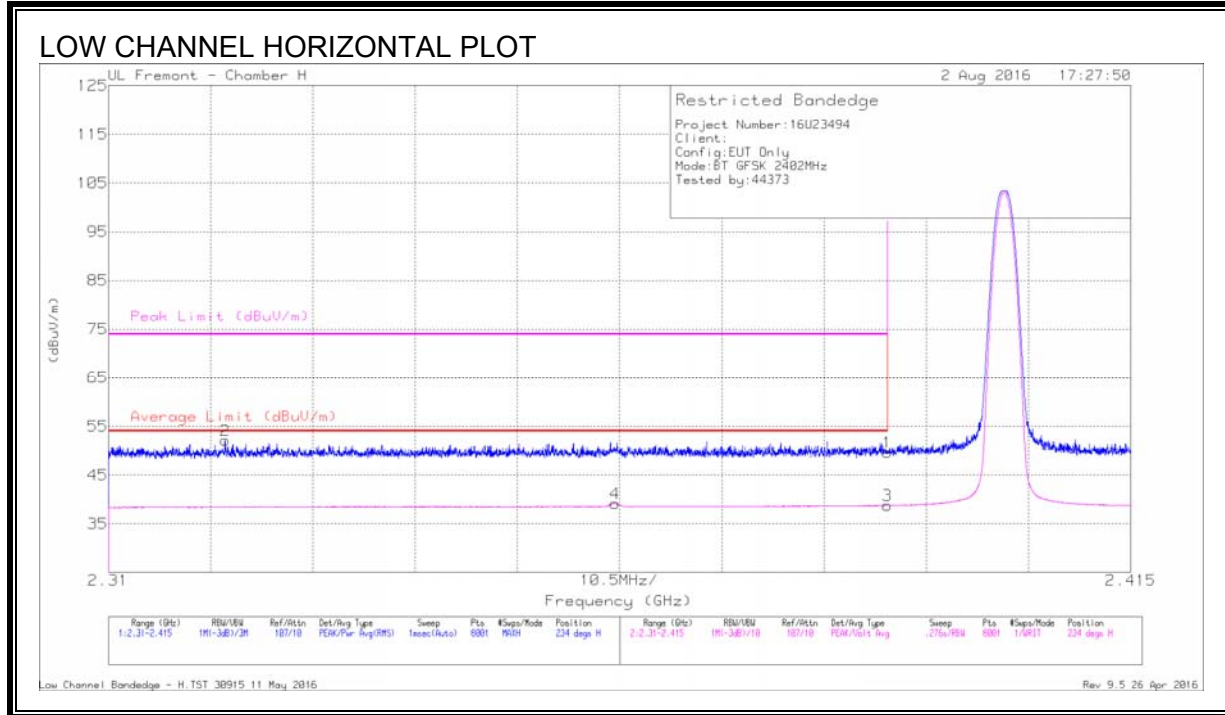
The frequency range of interest is monitored at a fixed antenna height and EUT azimuth. The EUT is rotated through 360 degrees to maximize emissions received. The antenna is scanned from 1 to 4 meters above the ground plane to further maximize the emission. Measurements are made with the antenna polarized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

RESULTS

8.2. TRANSMITTER ABOVE 1 GHz

8.2.1. BASIC DATA RATE GFSK MODULATION

RESTRICTED BANDEDGE (LOW CHANNEL, HORIZONTAL)



DATA

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T120 (dB/m)	Amp/Cbl /Filtr/Pad (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degrees)	Height (cm)	Polarity
1	* 2.39	45.54	Pk	31.9	-27.8	49.64	-	-	74	-24.36	234	100	H
2	* 2.322	48.18	Pk	31.6	-27.7	52.08	-	-	74	-21.92	234	100	H
3	* 2.39	34.66	VA1T	31.9	-27.8	38.76	54	-15.24	-	-	234	100	H
4	* 2.362	35.18	VA1T	31.8	-27.8	39.18	54	-14.82	-	-	234	100	H

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

Pk - Peak detector

VA1T - FHSS: Linear Voltage Average VB=1/Ton where: Ton is transmit duration

LOW CHANNEL VERTICAL PLOT

UL Fremont - Chamber F

2 Aug 2016 18:57:54

Restricted Bandedge

Project Number: 16U23494

Client:

Config: EUT Only

Mode: BT GFSK 2482MHz

Tested by: 44373

Peak Limit (dBuV/m)

Average Limit (dBuV/m)

(dBuV/m)

Frequency (GHz)

Range (GHz)	RBW/VBW	Ref/Alt	Det/Avg Type	Sweep	Pls	#Seps/Mode	Position	Range (GHz)	RBW/VBW	Ref/Alt	Det/Avg Type	Sweep	Pls	#Seps/Mode	Position
1.2 314.400	100-300/10	100/10	Peak/Pre Avg (MS)	Swamp	1000	4000	250 steps 90 s	2.2 314.400	100-300/10	100/10	Peak/Pre Avg	Swamp	1000	4000	250 steps 90 s

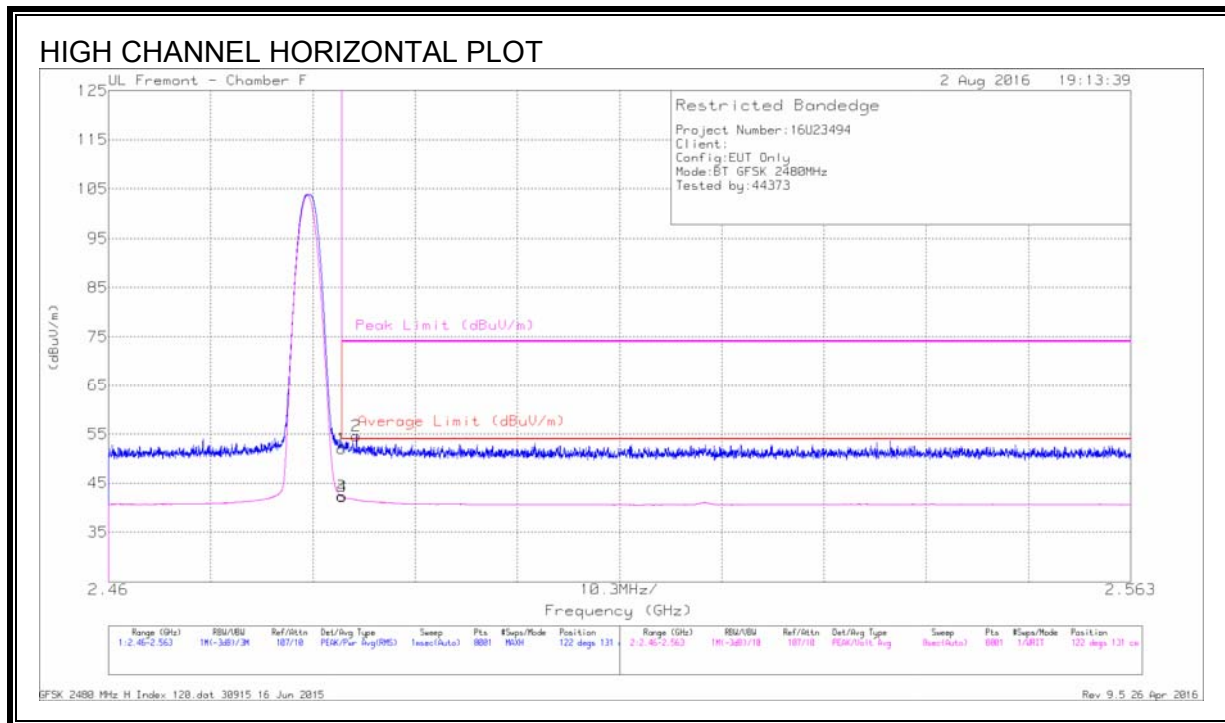
GFSK 2482 MHz U Index 120 dot 30915 16 Jun 2015

Rev 9.5.26 Apr 2016

Mar ker	Freque ncy (GHz)	Meter Readi ng (dBuV)	Det	AF T344 (dB/ m)	Amp/Cbl /Filtr/Pad (dB)	Correct ed Reading (dBuV/ m)	Averag e Limit (dBuV/ m)	Margin (dB)	Peak Limit (dBuV/ m)	PK Margi n (dB)	Azim uth (Deg s)	Heig ht (cm)	Polar ity
1	* 2.39	39.84	Pk	32.1	-20.9	51.04	-	-	74	-22.96	296	98	V
2	* 2.389	42.64	Pk	32.1	-20.9	53.84	-	-	74	-20.16	296	98	V
3	* 2.39	29.24	VA1T	32.1	-20.9	40.44	54	-13.56	-	-	296	99	V
4	* 2.362	29.61	VA1T	32	-20.9	40.71	54	-13.29	-	-	296	99	V

VA1T - FHSS: Linear Voltage Average $V_B = 1/T_{on}$ where: T_{on} is transmit duration

RESTRICTED BANDEDGE (HIGH CHANNEL, HORIZONTAL)



DATA

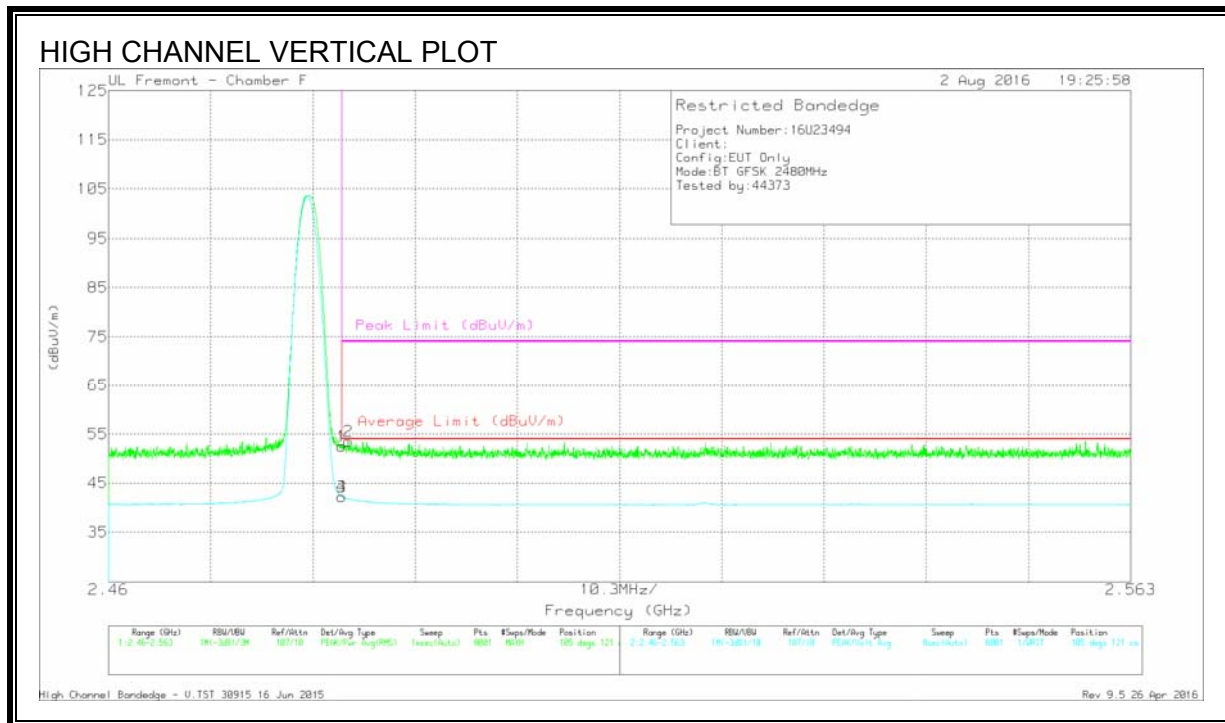
Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T344 (dB/m)	Amp/Cbl /Filtr/Pad (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degrees)	Height (cm)	Polarity
1	* 2.484	40.69	Pk	32.3	-21	51.99	-	-	74	-22.01	122	131	H
2	* 2.485	43.23	Pk	32.3	-20.9	54.63	-	-	74	-19.37	122	131	H
3	* 2.484	31.01	VA1T	32.3	-21	42.31	54	-11.69	-	-	122	131	H
4	* 2.484	30.97	VA1T	32.3	-21	42.27	54	-11.73	-	-	122	131	H

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

Pk - Peak detector

VA1T - FHSS: Linear Voltage Average $V_B = 1/T_{on}$ where: T_{on} is transmit duration

RESTRICTED BANDEDGE (HIGH CHANNEL, VERTICAL)



DATA

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T344 (dB/m)	Amp/Cbl/Ftr/Pad (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degrees)	Height (cm)	Polarity
1	* 2.484	41.17	Pk	32.3	-21	52.47	-	-	74	-21.53	105	121	V
2	* 2.484	42.27	Pk	32.3	-21	53.57	-	-	74	-20.43	105	121	V
3	* 2.484	30.89	VA1T	32.3	-21	42.19	54	-11.81	-	-	105	121	V
4	* 2.484	30.89	VA1T	32.3	-21	42.19	54	-11.81	-	-	105	121	V

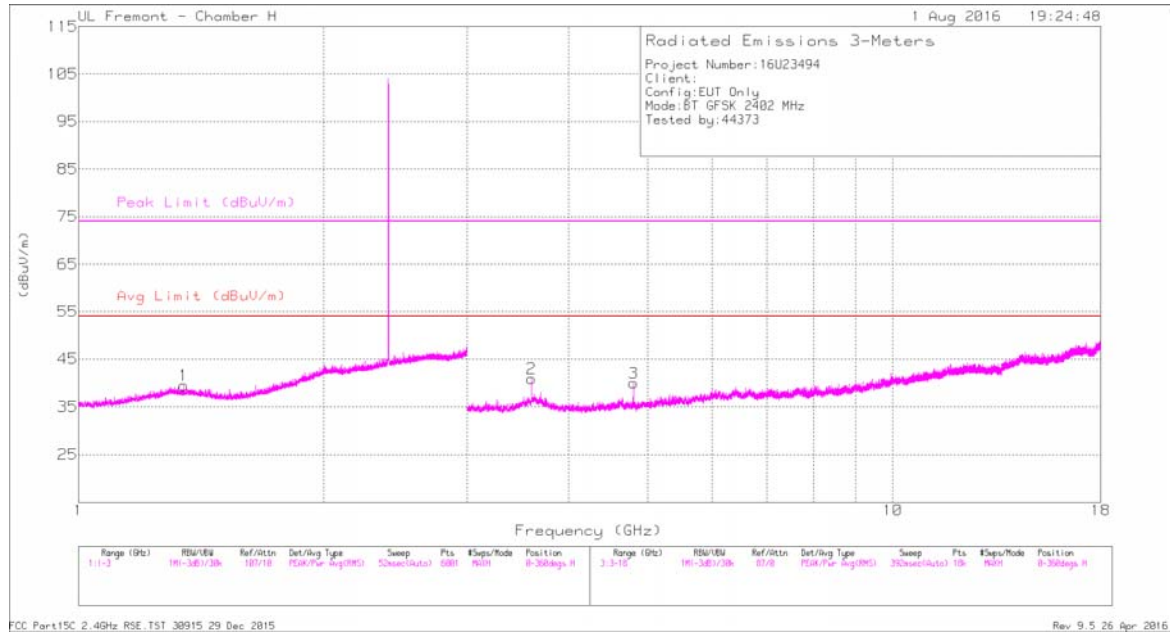
* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band

Pk - Peak detector

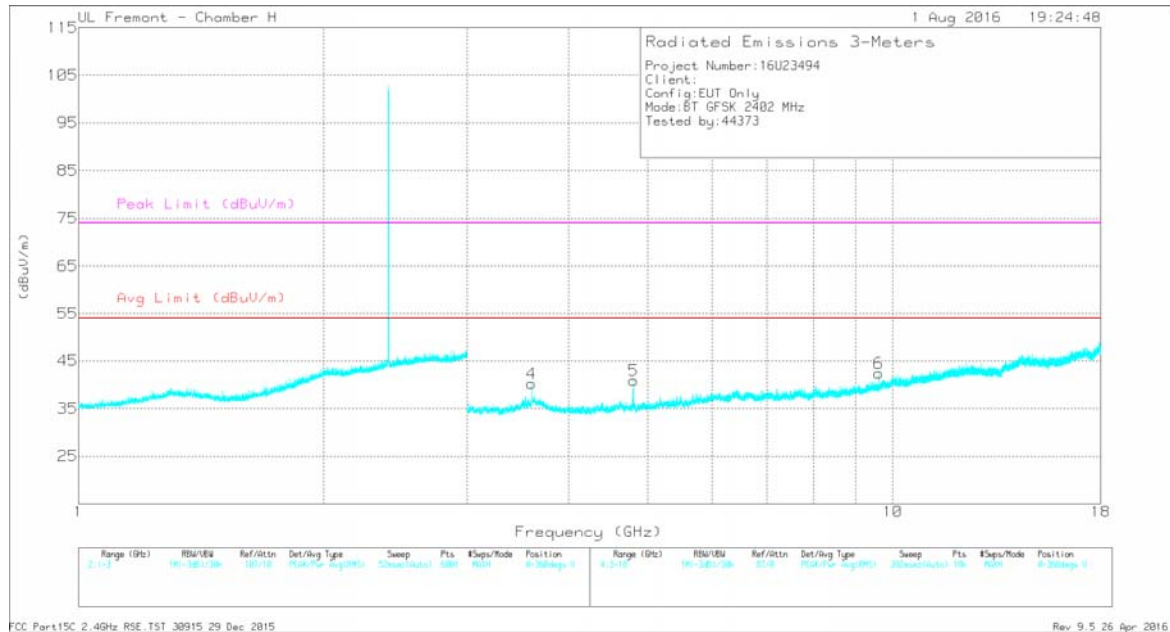
VA1T - FHSS: Linear Voltage Average VB=1/Ton where: Ton is transmit duration

HARMONICS AND SPURIOUS EMISSIONS

LOW CHANNEL HORIZONTAL PLOT



LOW CHANNEL VERTICAL PLOT



DATA

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T120 (dB/m)	Amp/Cbl/Filtr/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	* 1.348	36.8	PKFH	29.6	-22	44.4	-	-	74	-29.6	249	244	H
	* 1.347	25.44	VA1T	29.6	-22	33.04	54	-20.96	-	-	249	244	H
2	* 3.603	45.67	PKFH	34.9	-35.6	44.97	-	-	74	-29.03	233	145	H
	* 3.603	37.85	VA1T	34.9	-35.6	37.15	54	-16.85	-	-	233	145	H
3	* 4.804	46.6	PKFH	34	-35.1	45.5	-	-	74	-28.5	151	122	H
	* 4.804	39.07	VA1T	34	-35.1	37.97	54	-16.03	-	-	151	122	H
4	* 3.603	45.95	PKFH	34.9	-35.6	45.25	-	-	74	-28.75	83	127	V
	* 3.603	37.5	VA1T	34.9	-35.6	36.8	54	-17.2	-	-	83	127	V
5	* 4.804	47.33	PKFH	34	-35.1	46.23	-	-	74	-27.77	212	211	V
	* 4.804	40.35	VA1T	34	-35.1	39.25	54	-14.75	-	-	212	211	V
6	9.608	40.23	PKFH	37	-29.2	48.03	-	-	-	-	193	101	V
	9.608	31.53	VA1T	37	-29.2	39.33	-	-	-	-	193	101	V

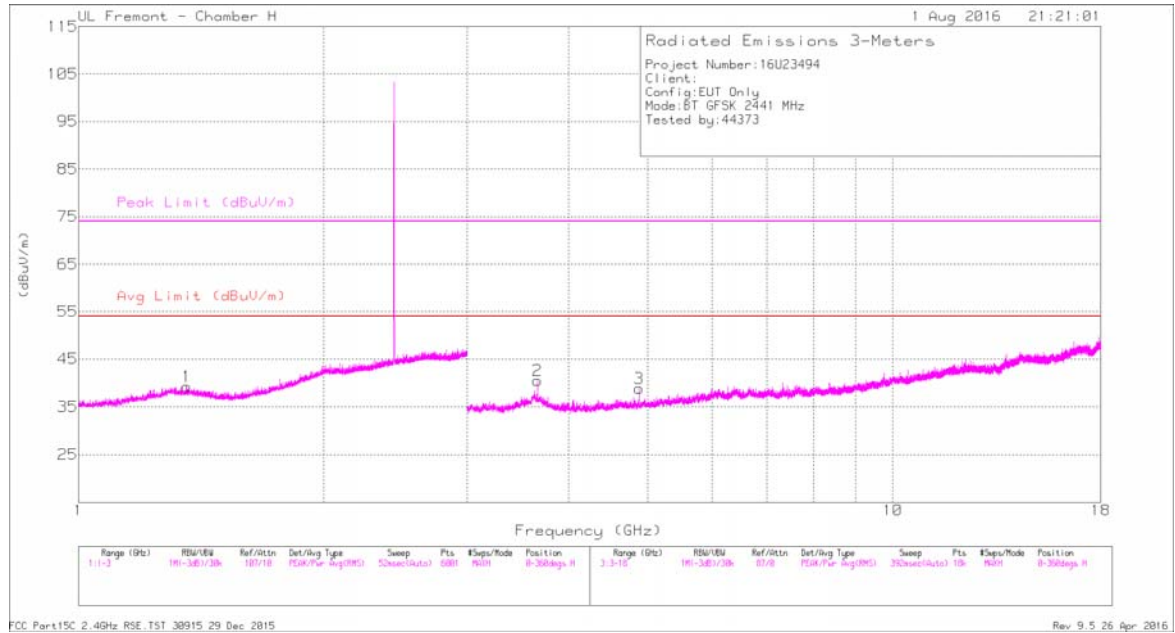
* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band

PKFH - FHSS: RB=100k/1MHz VB=3 x RB, Peak

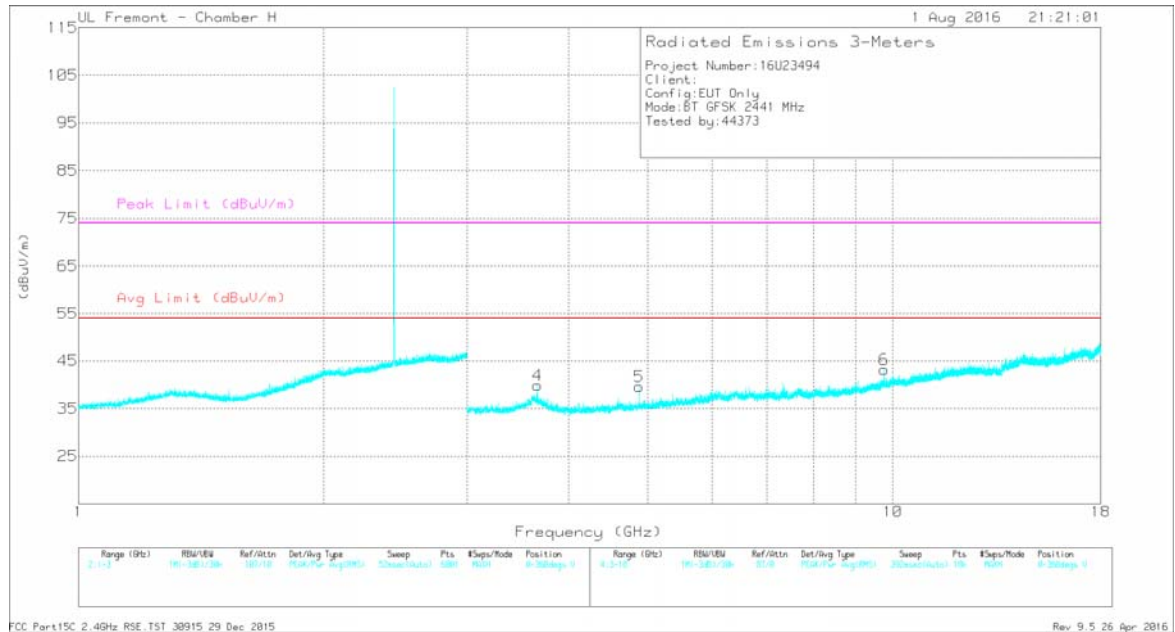
VA1T - FHSS: Linear Voltage Average VB=1/Ton where: Ton is transmit duration

HARMONICS AND SPURIOUS EMISSIONS

MID CHANNEL HORIZONTAL PLOT



MID CHANNEL VERTICAL PLOT



DATA

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T120 (dB/m)	Amp/Cbl/Filtr/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	* 1.359	37.77	PKFH	29.5	-21.9	45.37	-	-	74	-28.63	158	277	H
	* 1.361	25.51	VA1T	29.5	-21.9	33.11	54	-20.89	-	-	158	277	H
2	* 3.661	45.82	PKFH	34.9	-35.9	44.82	-	-	74	-29.18	52	194	H
	* 3.661	38.89	VA1T	34.9	-35.9	37.89	54	-16.11	-	-	52	194	H
3	* 4.882	44.98	PKFH	34	-34.7	44.28	-	-	74	-29.72	150	115	H
	* 4.882	36.92	VA1T	34	-34.7	36.22	54	-17.78	-	-	150	115	H
4	* 3.662	46.09	PKFH	34.9	-35.9	45.09	-	-	74	-28.91	116	118	V
	* 3.662	38.8	VA1T	34.9	-35.9	37.8	54	-16.2	-	-	116	118	V
5	* 4.882	45.89	PKFH	34	-34.7	45.19	-	-	74	-28.81	253	242	V
	* 4.882	37.91	VA1T	34	-34.7	37.21	54	-16.79	-	-	253	242	V
6	9.764	42.04	PKFH	37.3	-29.1	50.24	-	-	-	-	215	149	V
	9.764	31.54	VA1T	37.3	-29.1	39.74	-	-	-	-	215	149	V

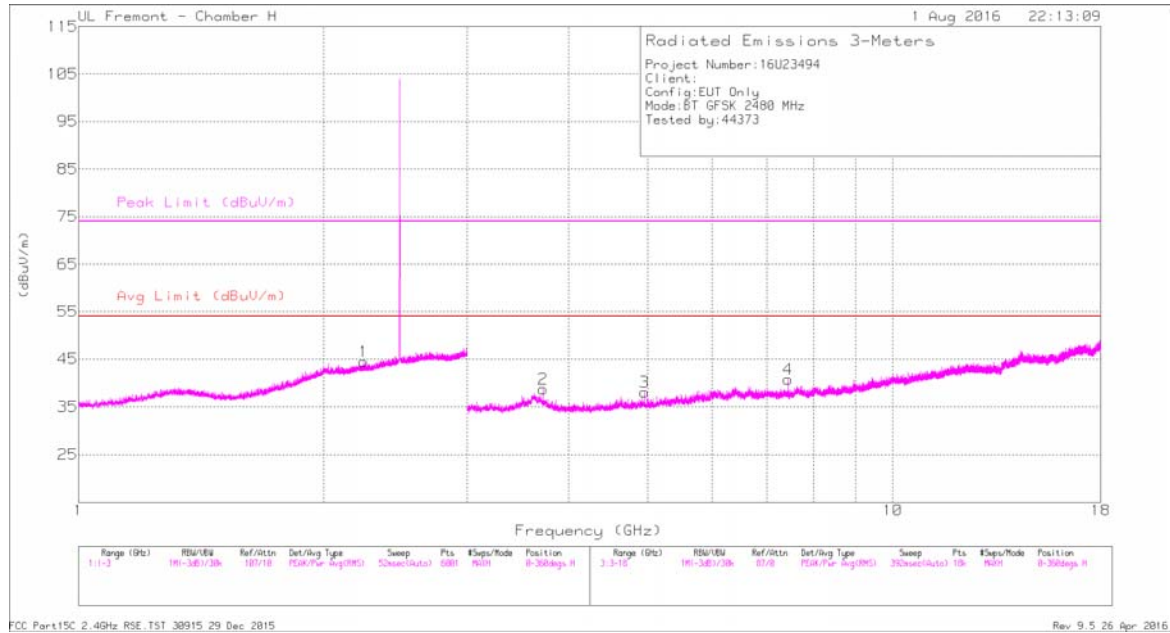
* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band

PKFH - FHSS: RB=100k/1MHz VB=3 x RB, Peak

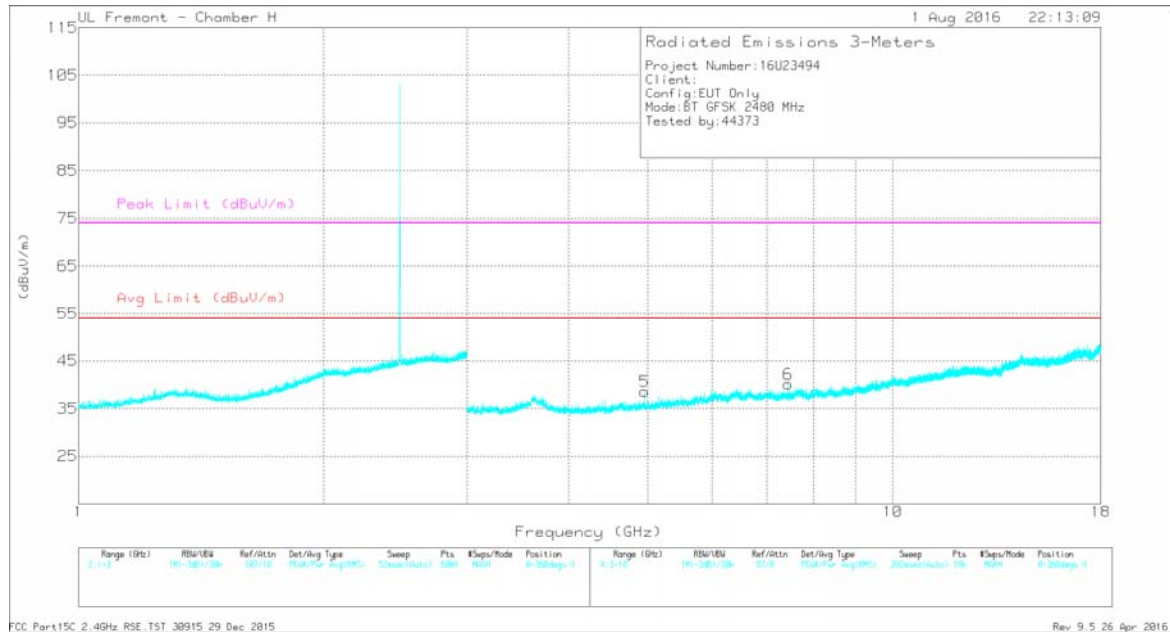
VA1T - FHSS: Linear Voltage Average VB=1/Ton where: Ton is transmi

HARMONICS AND SPURIOUS EMISSIONS

HIGH CHANNEL HORIZONTAL PLOT



HIGH CHANNEL VERTICAL PLOT



DATA

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T120 (dB/m)	Amp/Cbl/Filtr/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	* 2.243	37.77	PKFH	31.6	-19.9	49.47	-	-	74	-24.53	197	330	H
	* 2.244	25.97	VA1T	31.6	-19.9	37.67	54	-16.33	-	-	197	330	H
2	* 3.72	45.41	PKFH	34.7	-35.9	44.21	-	-	74	-29.79	221	156	H
	* 3.72	36.77	VA1T	34.7	-35.9	35.57	54	-18.43	-	-	221	156	H
3	* 4.959	43.67	PKFH	34	-34.3	43.37	-	-	74	-30.63	346	113	H
	* 4.96	35.7	VA1T	34	-34.3	35.4	54	-18.6	-	-	346	113	H
4	* 7.439	41.84	PKFH	35.7	-31.3	46.24	-	-	74	-27.76	360	108	H
	* 7.44	32.77	VA1T	35.7	-31.4	37.07	54	-16.93	-	-	360	108	H
5	* 4.96	44.33	PKFH	34	-34.3	44.03	-	-	74	-29.97	73	158	V
	* 4.96	36.37	VA1T	34	-34.3	36.07	54	-17.93	-	-	73	158	V
6	* 7.44	43.49	PKFH	35.7	-31.3	47.89	-	-	74	-26.11	135	101	V
	* 7.44	36.54	VA1T	35.7	-31.4	40.84	54	-13.16	-	-	135	101	V

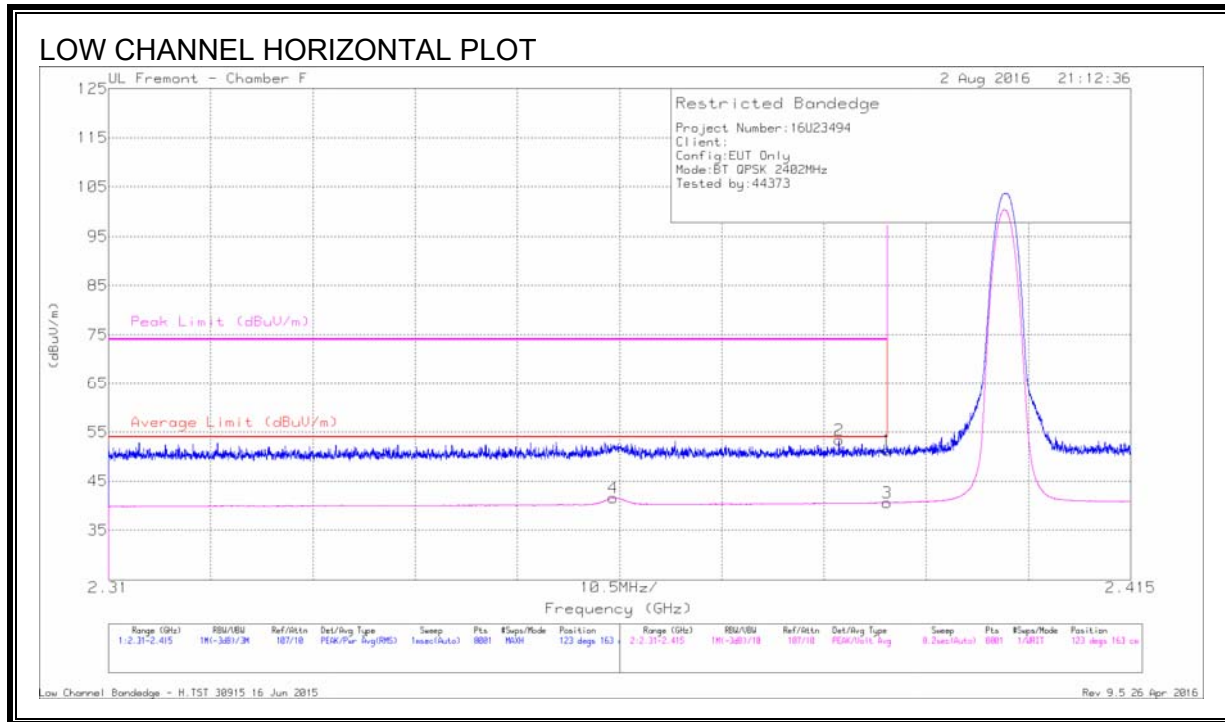
* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band

PKFH - FHSS: RB=100k/1MHz VB=3 x RB, Peak

VA1T - FHSS: Linear Voltage Average VB=1/Ton where: Ton is transmit duration

8.2.2. ENHANCED DATA RATE QPSK MODULATION

RESTRICTED BANDEDGE (LOW CHANNEL, HORIZONTAL)



DATA

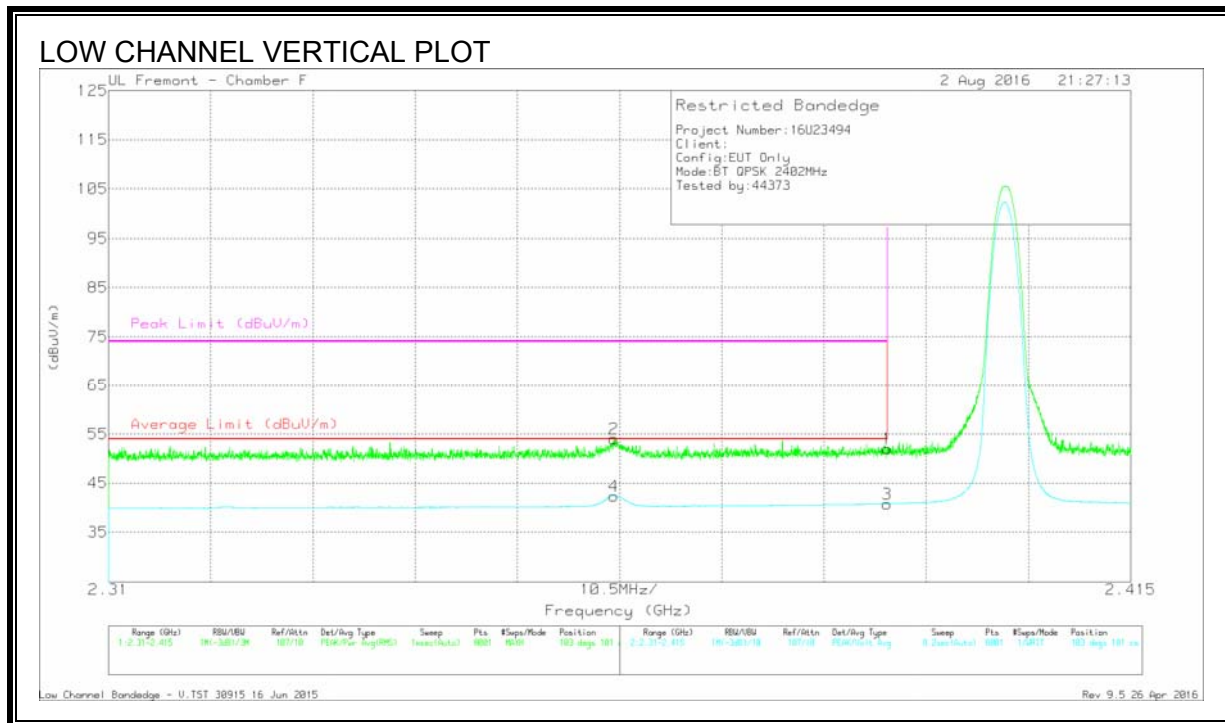
Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T344 (dB/m)	Amp/Cbl/Filtr/Pad (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degrees)	Height (cm)	Polarity
1	* 2.39	40.14	Pk	32.1	-20.9	51.34	-	-	74	-22.66	123	163	H
2	* 2.385	42.21	Pk	32.1	-20.9	53.41	-	-	74	-20.59	123	163	H
3	* 2.39	29.42	VA1T	32.1	-20.9	40.62	54	-13.38	-	-	123	163	H
4	* 2.362	30.45	VA1T	32	-20.9	41.55	54	-12.45	-	-	123	163	H

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

Pk - Peak detector

VA1T - FHSS: Linear Voltage Average $V_B = 1/T_{on}$ where: T_{on} is transmit duration

RESTRICTED BANDEDGE (LOW CHANNEL, VERTICAL)



DATA

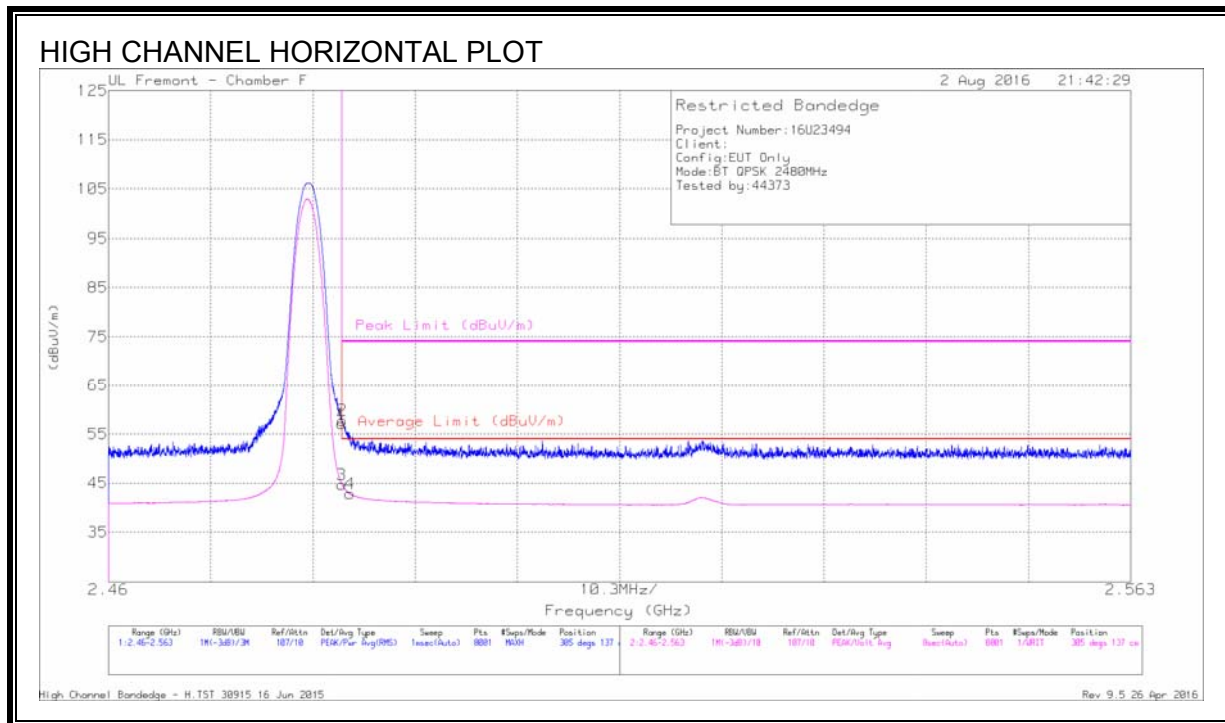
Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T344 (dB/m)	Amp/Cbl/Fitr/Pad (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degrees)	Height (cm)	Polarity
1	* 2.39	40.88	Pk	32.1	-20.9	52.08	-	-	74	-21.92	103	101	V
2	* 2.362	42.96	Pk	32	-20.9	54.06	-	-	74	-19.94	103	101	V
3	* 2.39	29.58	VA1T	32.1	-20.9	40.78	54	-13.22	-	-	103	101	V
4	* 2.362	31.29	VA1T	32	-20.9	42.39	54	-11.61	-	-	103	101	V

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

Pk - Peak detector

VA1T - FHSS: Linear Voltage Average VB=1/Ton where: Ton is transmit duration

RESTRICTED BANDEDGE (HIGH CHANNEL, HORIZONTAL)



DATA

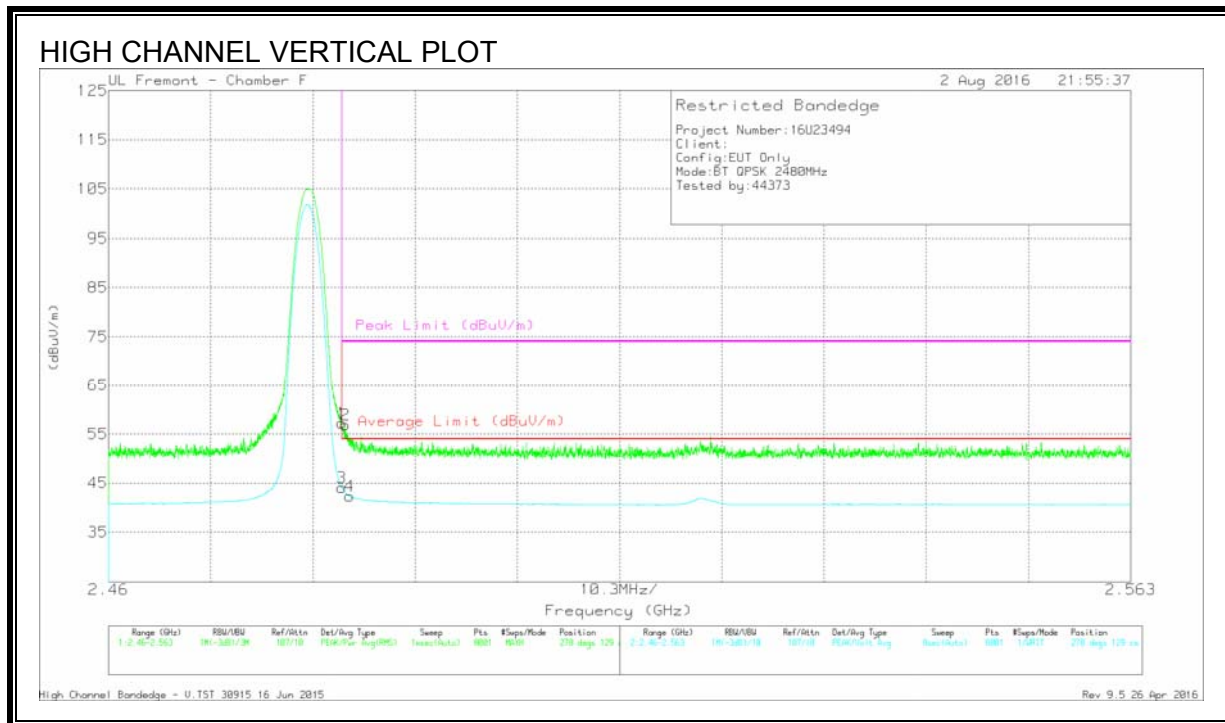
Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T344 (dB/m)	Amp/Cbl/Ftr/Pad (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degrees)	Height (cm)	Polarity
1	* 2.484	45.85	Pk	32.3	-21	57.15	-	-	74	-16.85	305	137	H
2	* 2.484	46.5	Pk	32.3	-21	57.8	-	-	74	-16.2	305	137	H
3	* 2.484	33.45	VA1T	32.3	-21	44.75	54	-9.25	-	-	305	137	H
4	* 2.484	31.51	VA1T	32.3	-21	42.81	54	-11.19	-	-	305	137	H

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

Pk - Peak detector

VA1T - FHSS: Linear Voltage Average VB=1/Ton where: Ton is transmit duration

RESTRICTED BANDEDGE (HIGH CHANNEL, VERTICAL)



DATA

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T344 (dB/m)	Amp/Cbl/Fitr/Pad (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degrees)	Height (cm)	Polarity
1	* 2.484	45.9	Pk	32.3	-21	57.2	-	-	74	-16.8	278	129	V
2	* 2.484	45.52	Pk	32.3	-21	56.82	-	-	74	-17.18	278	129	V
3	* 2.484	32.75	VA1T	32.3	-21	44.05	54	-9.95	-	-	278	129	V
4	* 2.484	31.02	VA1T	32.3	-21	42.32	54	-11.68	-	-	278	129	V

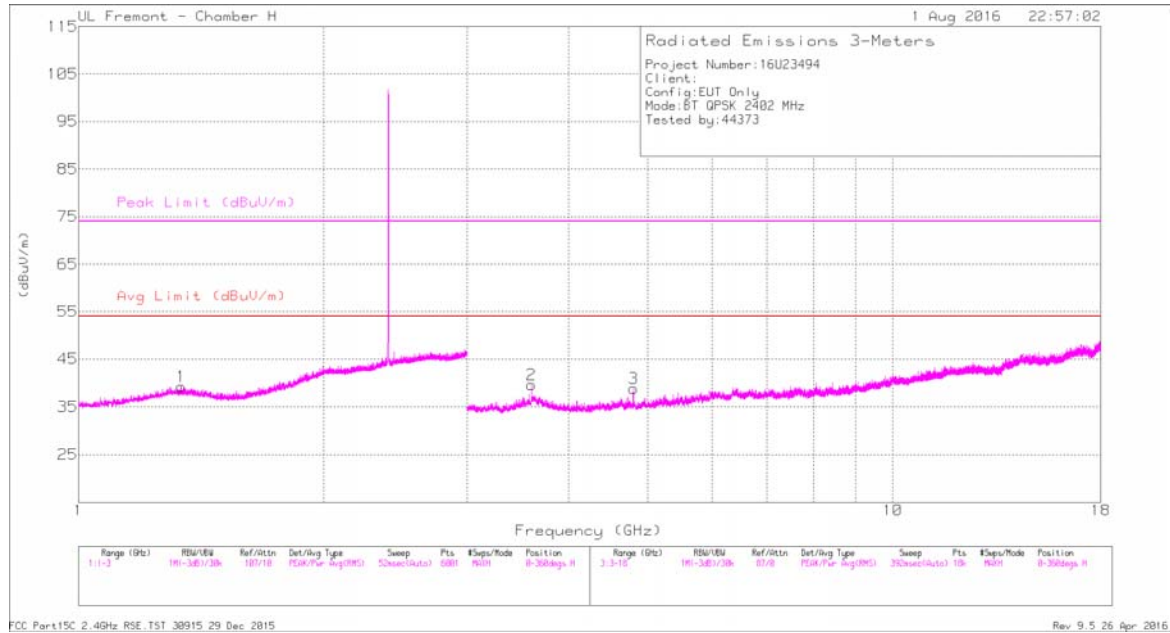
* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band

Pk - Peak detector

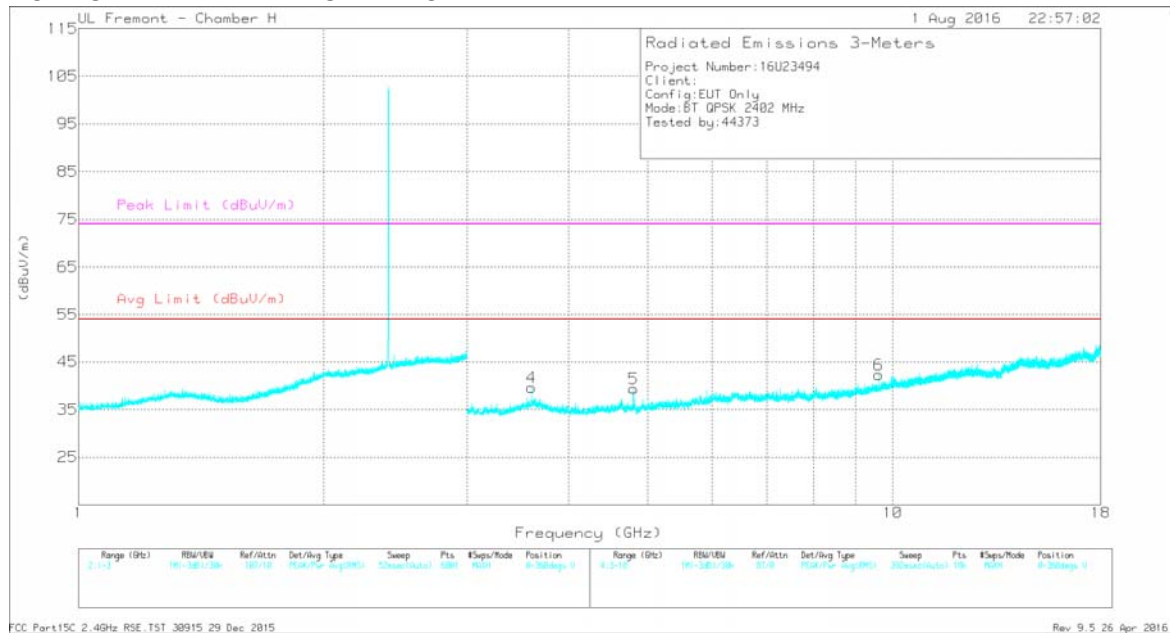
VA1T - FHSS: Linear Voltage Average VB=1/Ton where: Ton is transmit duration

HARMONICS AND SPURIOUS EMISSIONS

LOW CHANNEL HORIZONTAL PLOT



LOW CHANNEL VERTICAL PLOT



DATA

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T120 (dB/m)	Amp/Cbl /Filtr/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	* 1.337	36.76	PKFH	29.6	-22	44.36	-	-	74	-29.64	152	190	H
	* 1.337	25.41	VA1T	29.6	-22	33.01	54	-20.99	-	-	152	190	H
2	* 3.603	45.14	PKFH	34.9	-35.6	44.44	-	-	74	-29.56	264	232	H
	* 3.603	36.7	VA1T	34.9	-35.6	36	54	-18	-	-	264	232	H
3	* 4.804	46.62	PKFH	34	-35.1	45.52	-	-	74	-28.48	176	145	H
	* 4.804	38.05	VA1T	34	-35.1	36.95	54	-17.05	-	-	176	145	H
4	* 3.603	45.72	PKFH	34.9	-35.6	45.02	-	-	74	-28.98	352	118	V
	* 3.603	37.21	VA1T	34.9	-35.6	36.51	54	-17.49	-	-	352	118	V
5	* 4.804	47.78	PKFH	34	-35.1	46.68	-	-	74	-27.32	209	196	V
	* 4.804	38.46	VA1T	34	-35.1	37.36	54	-16.64	-	-	209	196	V
6	9.608	41.49	PKFH	37	-29.2	49.29	-	-	-	-	187	115	V

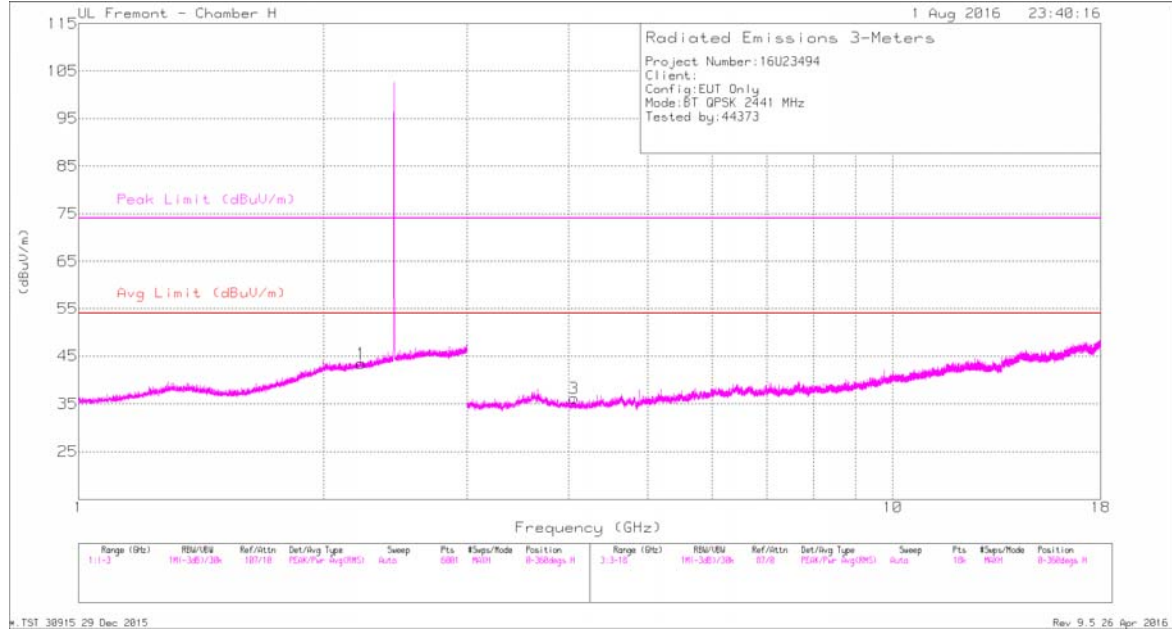
* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band

PKFH - FHSS: RB=100k/1MHz VB=3 x RB, Peak

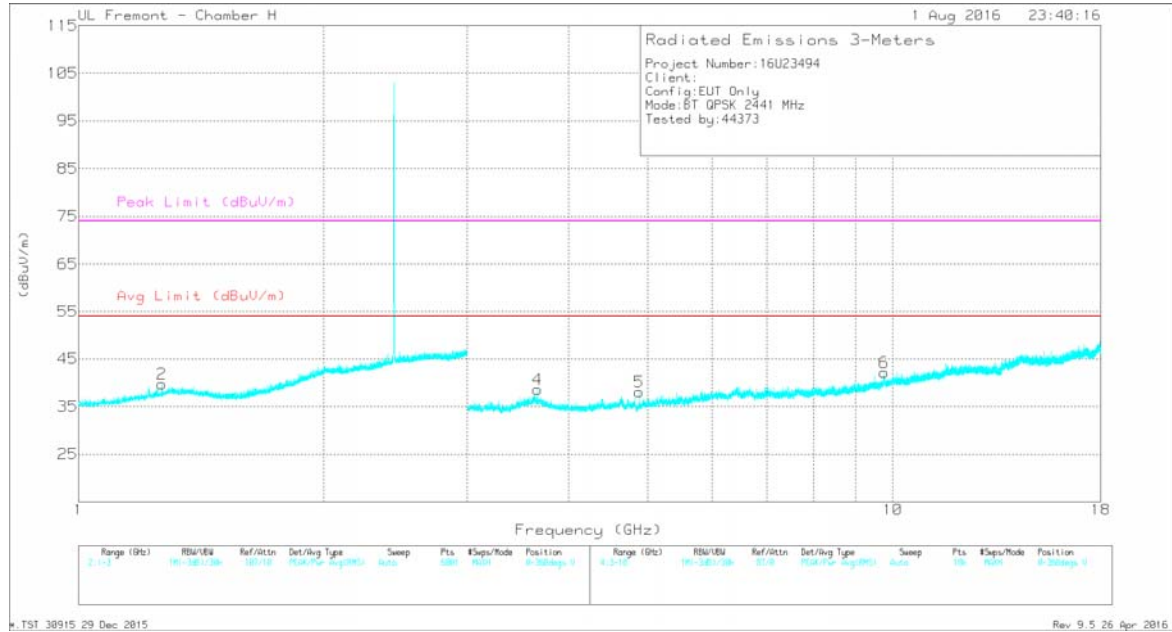
VA1T - FHSS: Linear Voltage Average VB=1/Ton where: Ton is transmit duration

HARMONICS AND SPURIOUS EMISSIONS

MID CHANNEL HORIZONTAL PLOT



MID CHANNEL VERTICAL PLOT



DATA

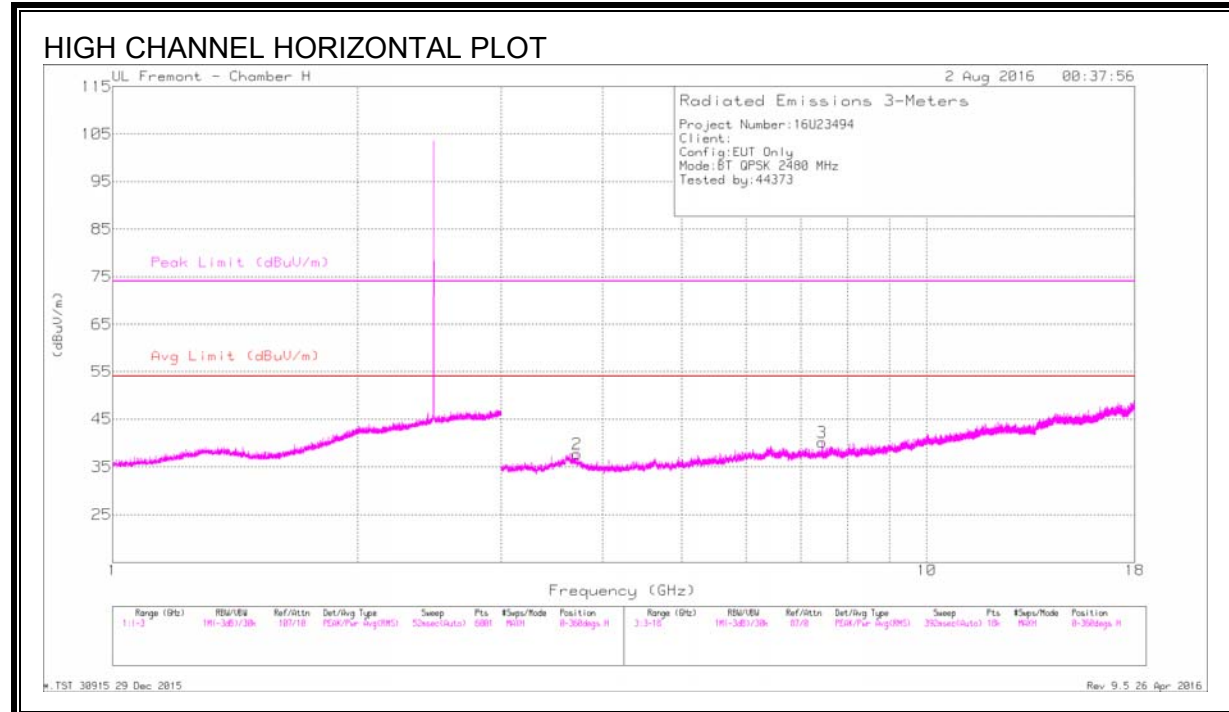
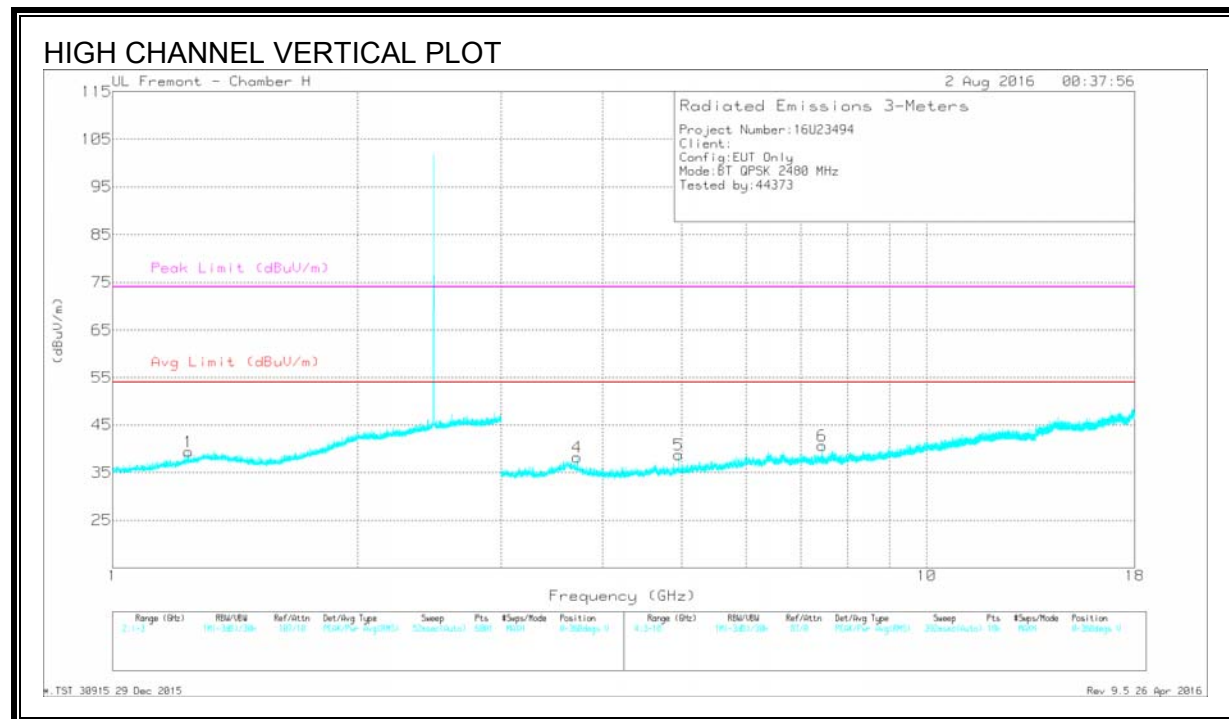
Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T120 (dB/m)	Amp/Cbl/ Ftr/Pad (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.224	37.58	PKFH	31.6	-20	49.18	-	-	74	-24.82	26	165	H
	* 2.227	26.04	VA1T	31.6	-20	37.64	54	-16.36	-	-	26	165	H
2	* 1.268	37.38	PKFH	29.4	-22.1	44.68	-	-	74	-29.32	179	174	V
	* 1.269	25.37	VA1T	29.4	-22.1	32.67	54	-21.33	-	-	179	174	V
3	* 4.063	42.46	PKFH	33.5	-34.9	41.06	-	-	74	-32.94	79	400	H
	* 4.064	31.39	VA1T	33.5	-34.9	29.99	54	-24.01	-	-	79	400	H
4	* 3.662	45.76	PKFH	34.9	-35.9	44.76	-	-	74	-29.24	195	163	V
	* 3.662	37.71	VA1T	34.9	-35.9	36.71	54	-17.29	-	-	195	163	V
5	* 4.882	44.45	PKFH	34	-34.7	43.75	-	-	74	-30.25	347	167	V
	* 4.882	31.68	VA1T	34	-34.7	30.98	54	-23.02	-	-	347	167	V
6	9.762	41.72	PKFH	37.3	-29.1	49.92	-	-	-	-	13	111	V

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

PKFH - FHSS: RB=100k/1MHz VB=3 x RB, Peak

VA1T - FHSS: Linear Voltage Average VB=1/Ton where: Ton is transmit duration

HARMONICS AND SPURIOUS EMISSIONS



DATA

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T120 (dB/m)	Amp/Cbl/Filtr/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	* 1.24	37.58	PKFH	29.1	-22.2	44.48	-	-	74	-29.52	172	158	V
	* 1.24	26.63	VA1T	29.1	-22.2	33.53	54	-20.47	-	-	172	158	V
2	* 3.72	45.47	PKFH	34.7	-35.9	44.27	-	-	74	-29.73	61	172	H
	* 3.72	36.62	VA1T	34.7	-35.9	35.42	54	-18.58	-	-	61	172	H
3	* 7.44	42.83	PKFH	35.7	-31.3	47.23	-	-	74	-26.77	172	103	H
	* 7.44	32.99	VA1T	35.7	-31.4	37.29	54	-16.71	-	-	172	103	H
4	* 3.719	44.73	PKFH	34.7	-35.9	43.53	-	-	74	-30.47	76	182	V
	* 3.72	34.84	VA1T	34.7	-35.9	33.64	54	-20.36	-	-	76	182	V
5	* 4.96	44.4	PKFH	34	-34.3	44.1	-	-	74	-29.9	260	106	V
	* 4.96	34.39	VA1T	34	-34.3	34.09	54	-19.91	-	-	260	106	V
6	* 7.44	42.16	PKFH	35.7	-31.4	46.46	-	-	74	-27.54	220	129	V
	* 7.44	32.98	VA1T	35.7	-31.4	37.28	54	-16.72	-	-	220	129	V

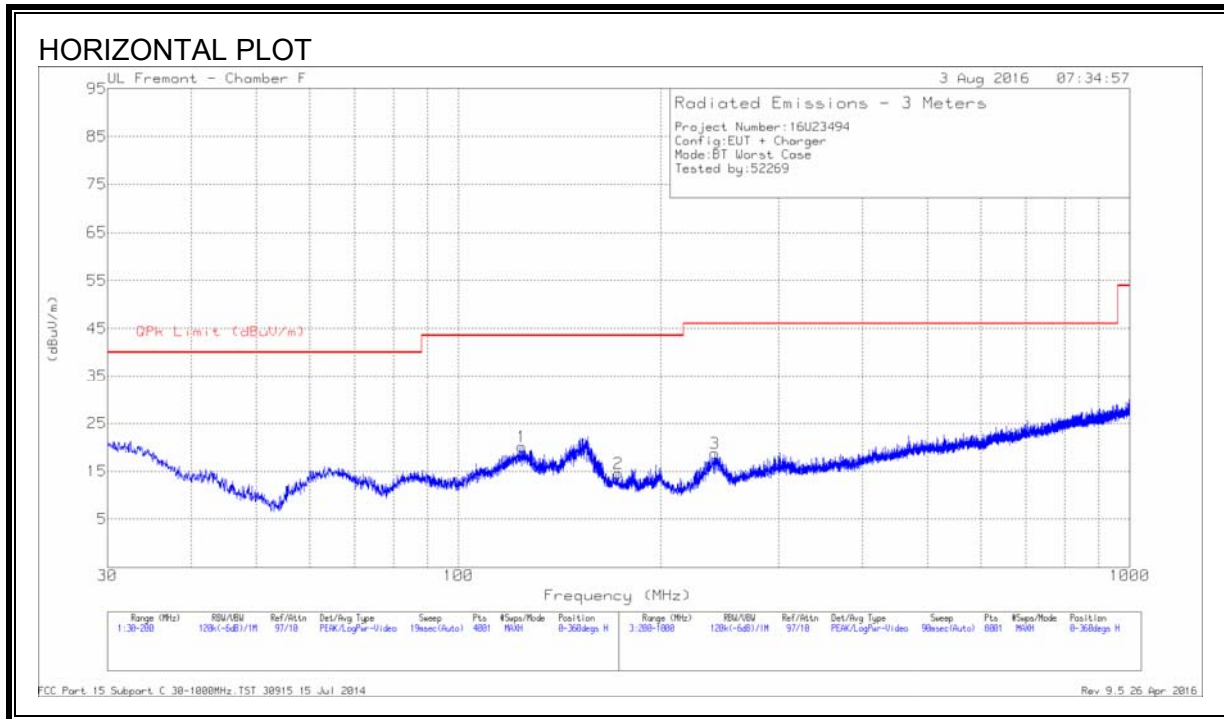
* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band

PKFH - FHSS: RB=100k/1MHz VB=3 x RB, Peak

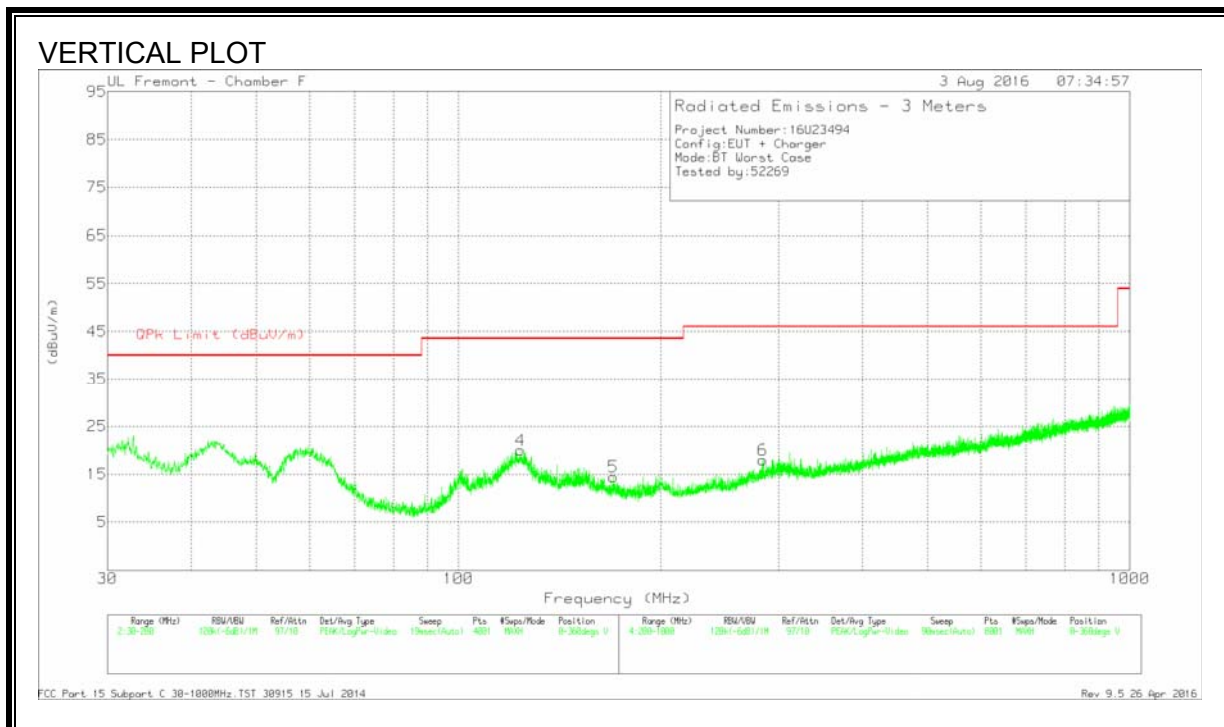
VA1T - FHSS: Linear Voltage Average VB=1/Ton where: Ton is transmit duration

8.3. WORST-CASE BELOW 1 GHz

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



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



DATA

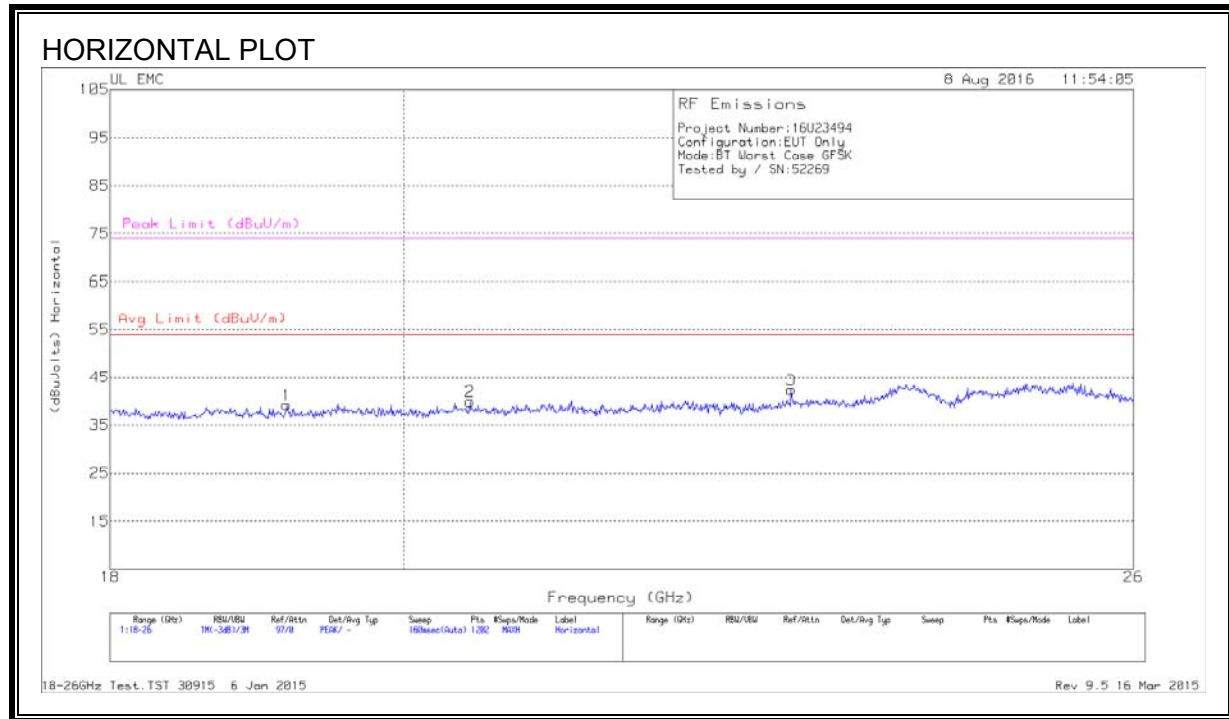
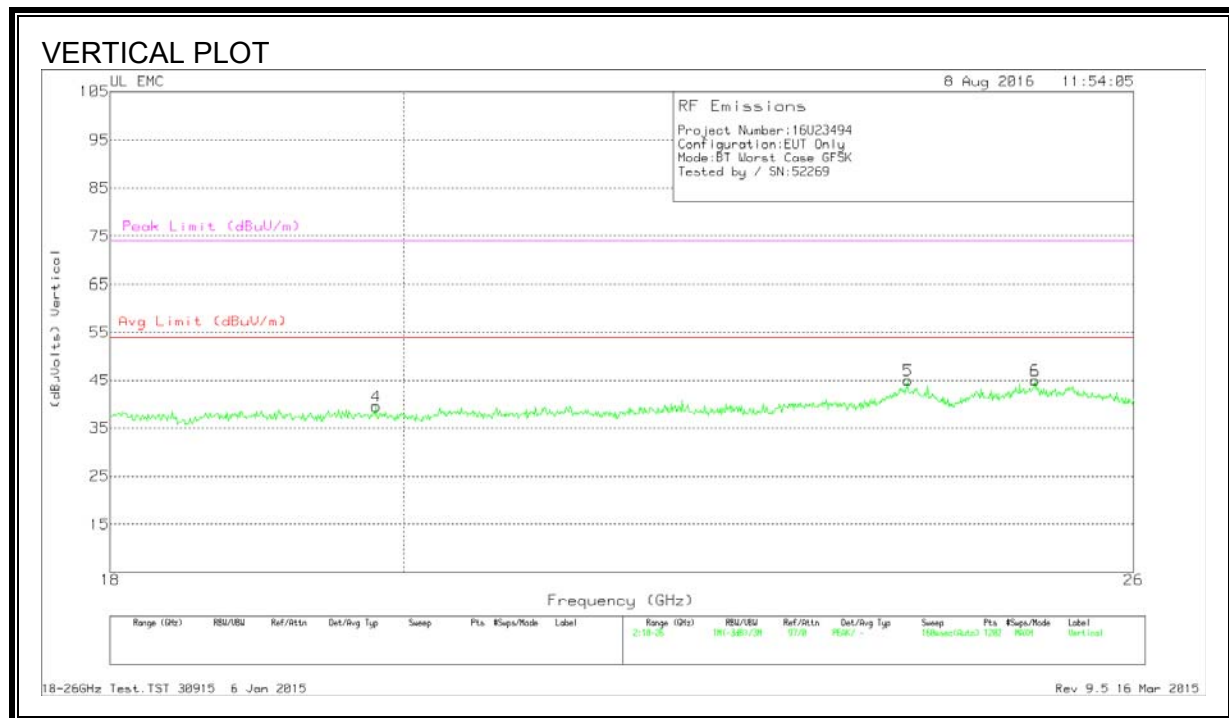
Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	AF T185 (dB/m)	Amp/Cbl (dB)	Corrected Reading (dBuV/m)	QPk Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 124.095	33.07	Pk	18.1	-31	20.17	43.52	-23.35	0-360	199	H
2	* 173.0125	29.91	Pk	15.3	-30.6	14.61	43.52	-28.91	0-360	100	H
4	* 123.67	32.86	Pk	18.1	-31	19.96	43.52	-23.56	0-360	100	V
5	* 170.08	29.59	Pk	15.6	-30.7	14.49	43.52	-29.03	0-360	100	V
3	* 241	33.46	Pk	15.6	-30.3	18.76	46.02	-27.26	0-360	100	H
6	* 284.3	30.61	Pk	17.3	-29.9	18.01	46.02	-28.01	0-360	100	V

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

Pk - Peak detector

8.4. WORST-CASE ABOVE 18 GHz

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



Data

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T449 (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	19.179	40.67	Pk	32.7	-24.7	-9.5	39.17	54	-14.83	74	-34.83
2	20.485	41.73	Pk	32.9	-25.3	-9.5	39.83	54	-14.17	74	-34.17
3	22.989	43.33	Pk	33.4	-24.9	-9.5	42.33	54	-11.67	74	-31.67
4	19.805	41.3	Pk	32.7	-25	-9.5	39.5	54	-14.5	74	-34.5
5	23.975	44.7	Pk	34	-24.2	-9.5	45	54	-9	74	-29
6	25.094	44.7	Pk	34.3	-24.5	-9.5	45	54	-9	74	-29

Pk - Peak detector

9. AC POWER LINE CONDUCTED EMISSIONS

LIMITS

FCC §15.207 (a)

RSS-Gen 8.8

Frequency of Emission (MHz)	Conducted Limit (dB μ V)	
	Quasi-peak	Average
0.15-0.5	66 to 56 *	56 to 46 *
0.5-5	56	46
5-30	60	50

*Decreases with the logarithm of the frequency.

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

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

Line-L1 .15 - 30MHz

Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	LISN 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	46.32	Qp	0	0	10.1	56.42	64.95	-8.53	-	-
2	.1725	30.55	Ca	0	0	10.1	40.65	-	-	54.84	-14.19
3	.25575	41.99	Qp	0	0	10.1	52.09	61.57	-9.48	-	-
4	.258	26.55	Ca	0	0	10.1	36.65	-	-	51.5	-14.85
5	.34125	37.15	Qp	0	0	10.1	47.25	59.17	-11.92	-	-
6	.3435	21.84	Ca	0	0	10.1	31.94	-	-	49.12	-17.18
7	.42675	32.38	Qp	0	0	10.1	42.48	57.32	-14.84	-	-
8	.43125	19.07	Ca	0	0	10.1	29.17	-	-	47.23	-18.06
9	.76875	30.43	Qp	0	0	10.1	40.53	56	-15.47	-	-
10	.76875	20.97	Ca	0	0	10.1	31.07	-	-	46	-14.93
11	18.21525	22.38	Qp	0	.2	10.3	32.88	60	-27.12	-	-
12	18.21863	15.12	Ca	0	.2	10.3	25.62	-	-	50	-24.38

Qp - Quasi-Peak detector

Ca - CISPR average detection

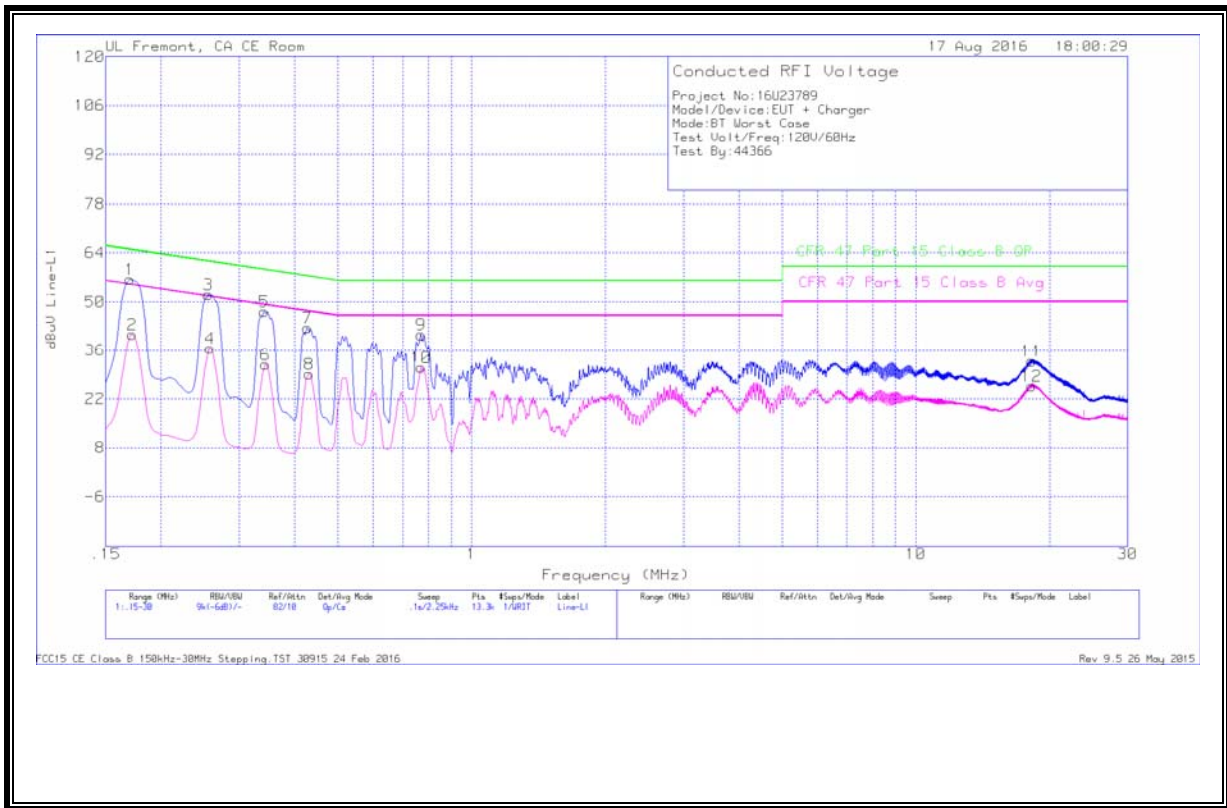
Line-L2 .15 - 30MHz

Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	LISN 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	46.68	Qp	0	0	10.1	56.78	64.95	-8.17	-	-
14	.1725	30.25	Ca	0	0	10.1	40.35	-	-	54.84	-14.49
15	.25575	41.96	Qp	0	0	10.1	52.06	61.57	-9.51	-	-
16	.258	24.94	Ca	0	0	10.1	35.04	-	-	51.5	-16.46
17	.34125	36.13	Qp	0	0	10.1	46.23	59.17	-12.94	-	-
18	.3435	18.72	Ca	0	0	10.1	28.82	-	-	49.12	-20.3
19	.4335	31.35	Qp	0	0	10.1	41.45	57.19	-15.74	-	-
20	.429	14.42	Ca	0	0	10.1	24.52	-	-	47.27	-22.75
21	.7665	30.62	Qp	0	0	10.1	40.72	56	-15.28	-	-
22	.7665	16.05	Ca	0	0	10.1	26.15	-	-	46	-19.85
23	18.11625	18.82	Qp	0	.2	10.3	29.32	60	-30.68	-	-
24	18.12075	7.56	Ca	0	.2	10.3	18.06	-	-	50	-31.94

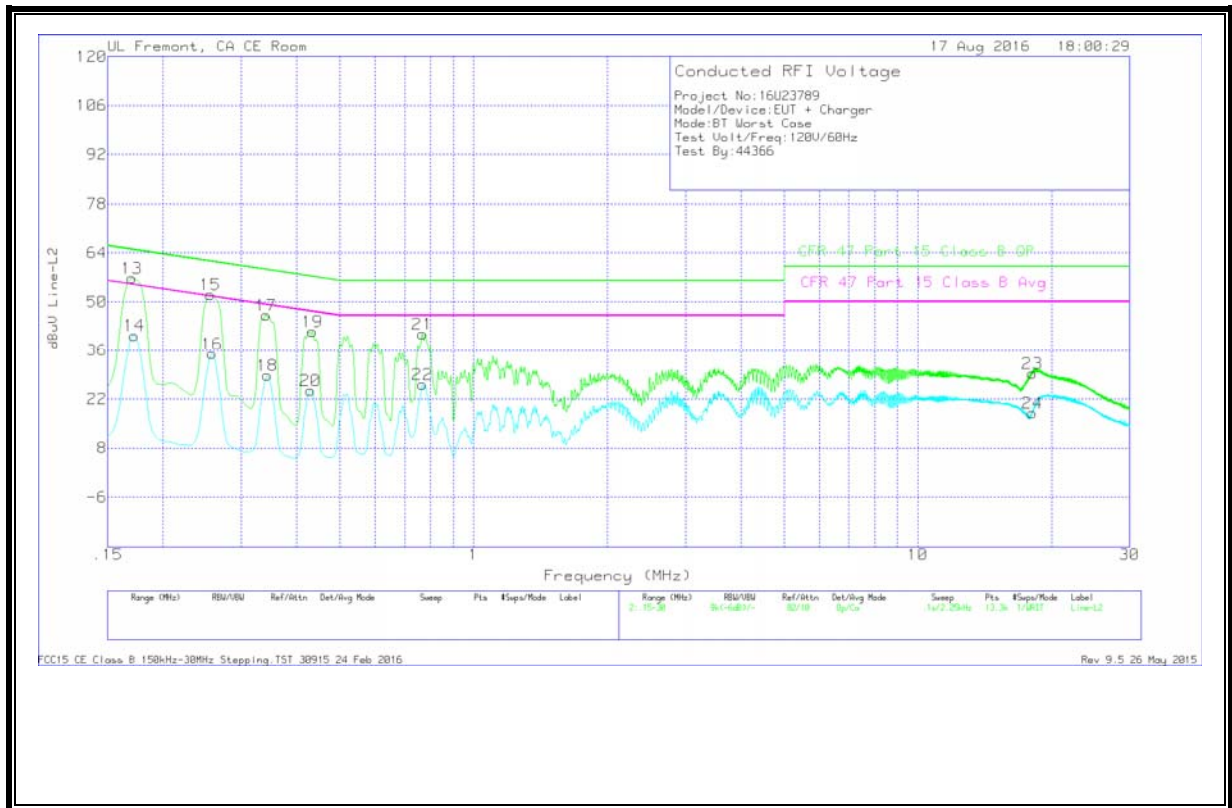
Qp - Quasi-Peak detector

Ca - CISPR average detection

LINE 1 RESULTS



LINE 2 RESULTS



9.2. EUT POWERED BY HOST PC VIA USB CABLE

Line-L1 .15 - 30MHz

Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	LISN 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	.2085	30.16	Qp	0	0	10.1	40.26	63.26	-23	-	-
2	.20625	24.1	Ca	0	0	10.1	34.2	-	-	53.35	-19.15
3	.348	23.91	Qp	0	0	10.1	34.01	59.01	-25	-	-
4	.34575	21.83	Ca	0	0	10.1	31.93	-	-	49.06	-17.13
5	.76425	24.39	Qp	0	0	10.1	34.49	56	-21.51	-	-
6	.762	20.57	Ca	0	0	10.1	30.67	-	-	46	-15.33
7	1.03875	23.75	Qp	0	0	10.1	33.85	56	-22.15	-	-
8	1.03875	18.82	Ca	0	0	10.1	28.92	-	-	46	-17.08
9	5.4555	24.68	Qp	0	.1	10.1	34.88	60	-25.12	-	-
10	5.46	18.01	Ca	0	.1	10.1	28.21	-	-	50	-21.79
11	16.422	20.79	Qp	0	.2	10.3	31.29	60	-28.71	-	-
12	16.422	15.06	Ca	0	.2	10.3	25.56	-	-	50	-24.44

Qp - Quasi-Peak detector

Ca - CISPR average detection

Line-L2 .15 - 30MHz

Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	LISN 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	.2085	28.71	Qp	0	0	10.1	38.81	63.26	-24.45	-	-
14	.20625	26.72	Ca	0	0	10.1	36.82	-	-	53.35	-16.53
15	.348	18.71	Qp	0	0	10.1	28.81	59.01	-30.2	-	-
16	.34575	11.68	Ca	0	0	10.1	21.78	-	-	49.06	-27.28
17	.75975	14.22	Qp	0	.1	10.1	24.42	56	-31.58	-	-
18	.762	7.89	Ca	0	0	10.1	17.99	-	-	46	-28.01
19	1.04325	12.09	Qp	0	0	10.1	22.19	56	-33.81	-	-
20	1.0365	4.05	Ca	0	0	10.1	14.15	-	-	46	-31.85
21	5.4555	22.93	Qp	0	.1	10.1	33.13	60	-26.87	-	-
22	5.45663	16.14	Ca	0	.1	10.1	26.34	-	-	50	-23.66
23	16.43325	15.3	Qp	0	.2	10.3	25.8	60	-34.2	-	-
24	16.431	8.8	Ca	0	.2	10.3	19.3	-	-	50	-30.7

Qp - Quasi-Peak detector

Ca - CISPR average detection

LINE 1 RESULTS

