



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

**CERTIFICATION TEST REPORT**

**FOR**

**PORTABLE COMPUTER**

**MODEL NUMBER: A1708**

**FCC ID: BCGA1708**

**IC: 579C-A1708**

**REPORT NUMBER: 15U23796-E1V2**

**ISSUE DATE: OCTOBER 20, 2016**

*Prepared for*

**APPLE, INC.**

**1 INFINITE LOOP**

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**NVLAP LAB CODE 200065-0**

Revision History

<u>Rev.</u>	<u>Issue Date</u>	<u>Revisions</u>	<u>Revised By</u>
V1	09/22/2016	Initial Review	Chin Pang
V2	10/20/2016	Added measurement method per TCB's request	Tina Chu

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# 1. ATTESTATION OF TEST RESULTS

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

**EUT DESCRIPTION:** PORTABLE COMPUTER

**MODEL:** A1708

**SERIAL NUMBER:** C02RT00FH4RK

**DATE TESTED:** JULY 28 – AUGUST 05, 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:



CHIN PANG  
SENIOR ENGINEER  
UL VERIFICATION SERVICES INC.

Prepared By:



TRI PHAM  
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
<input type="checkbox"/> Chamber A	<input checked="" type="checkbox"/> Chamber D
<input type="checkbox"/> Chamber B	<input checked="" type="checkbox"/> Chamber E
<input type="checkbox"/> Chamber C	<input checked="" type="checkbox"/> Chamber F
	<input type="checkbox"/> Chamber G
	<input type="checkbox"/> 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 laptop device with Bluetooth and WLAN Radios (AC 80 MHZ Beam-Forming)

### 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	12.28	16.90
2402 - 2480	DQPSK	12.25	16.79
2402 - 2480	Enhanced 8PSK	12.47	17.66

### 5.3. DESCRIPTION OF AVAILABLE ANTENNAS

Frequency Band (GHz)	Antenna Gain Chain 0 (dBi)
2.4	4.2

### 5.4. SOFTWARE AND FIRMWARE

The firmware installed in the EUT during testing was v91 c5459



## **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.

Worst-case data rates were:

GFSK mode: DH5  
8PSK mode: 3-DH5

DQPSK mode has been verified to have the lowest power.

The EUT was investigated with and without AC Charger, it was determined that the worst case was with AC Charger. Therefore, all final radiated testing was performed with AC Charger.

## 5.6. DESCRIPTION OF TEST SETUP

### SUPPORT EQUIPMENT

Support Equipment List				
Description	Manufacturer	Model	Serial Number	FCC ID
AC/ DC Adapter	Apple Inc.	A1718	N/A	N/A
Earphone	Apple Inc.	N/A	N/A	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	2	SMA	Un-Shielded	0.2	To Spectrum Analyzer
2	DC	1	Lightning	Un-Shielded	2	N/A

### I/O CABLES (ABOVE 1G RADIATED TEST)

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

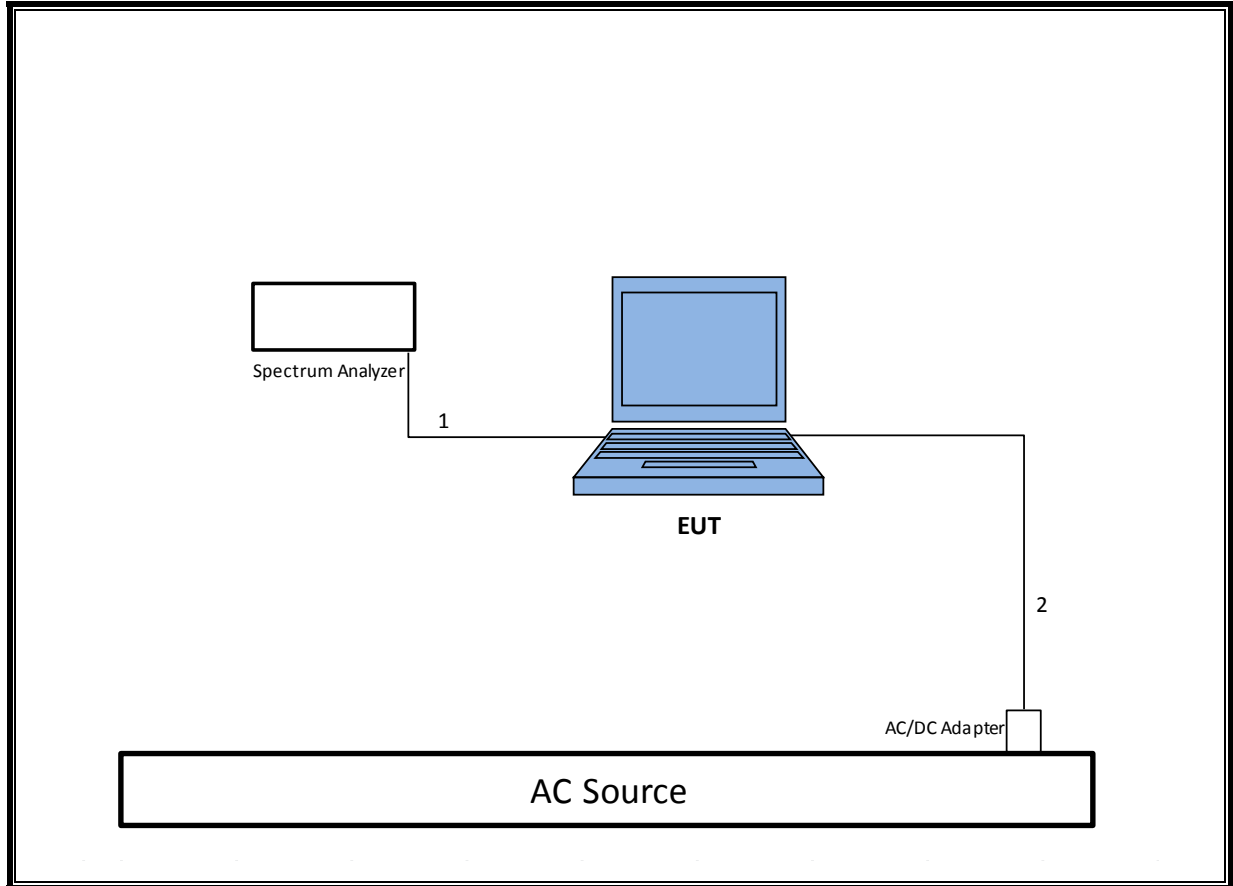
### I/O CABLES (BELOW 1G RADIATED AND AC POWER CONDUCTED TEST)

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

**TEST SETUP- CONDUCTED PORT**

The EUT was tested connected to spectrum analyzer via antenna port. Test software exercised the EUT.

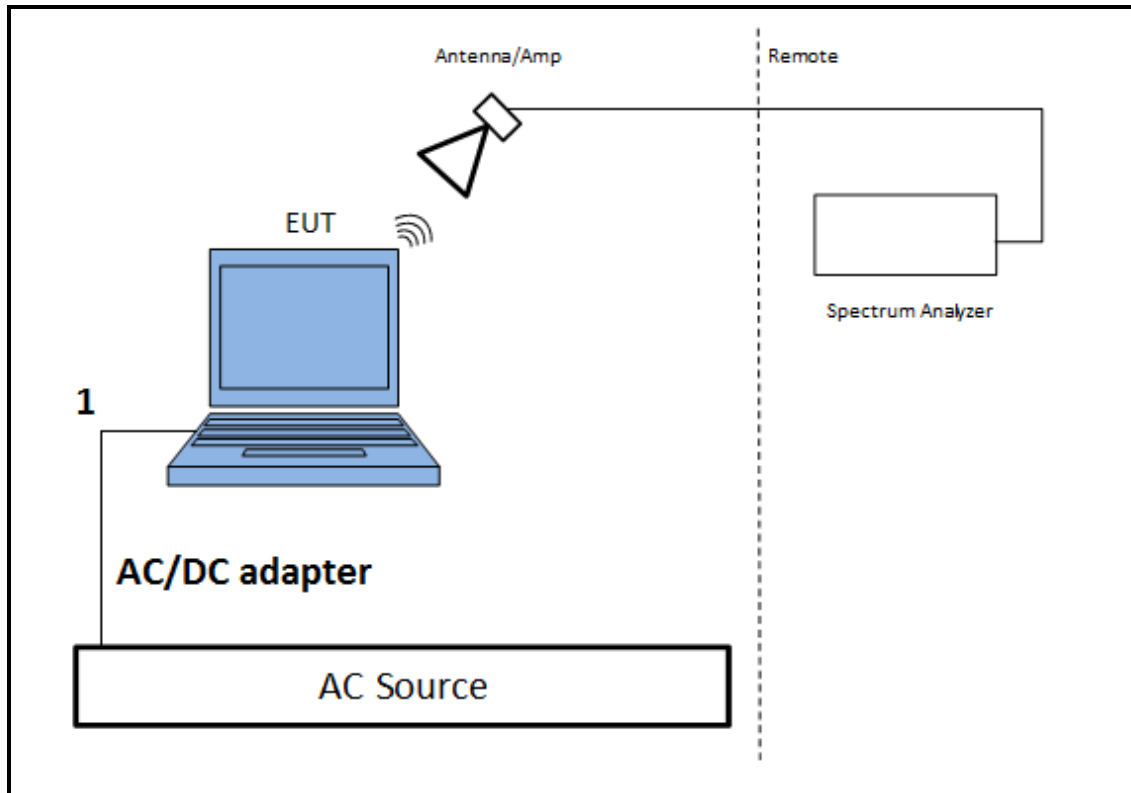
**SETUP DIAGRAM**



**TEST SETUP- RADIATED- ABOVE 1 GHz**

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

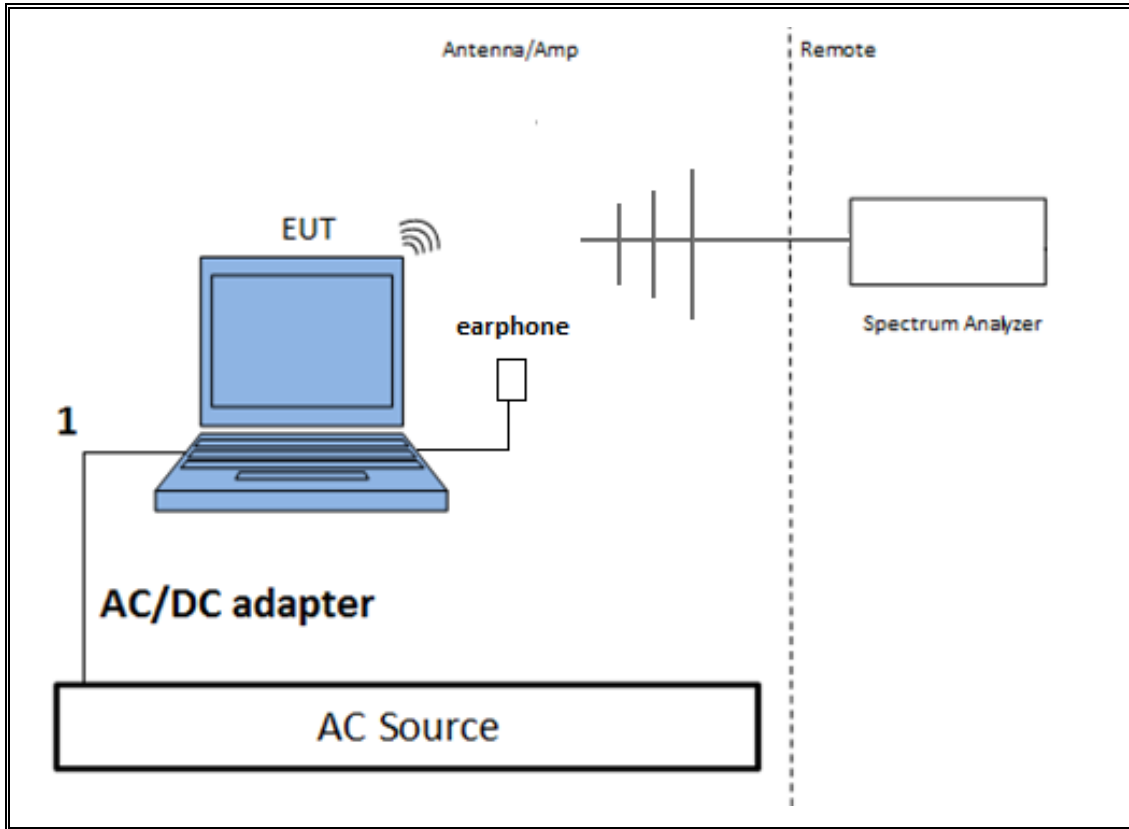
**SETUP DIAGRAM**



**TEST SETUP- RADIATED- BELOW 1 GHz**

The EUT was powered by AC/DC adapter and with earphone plugged in. Test software exercised the EUT.

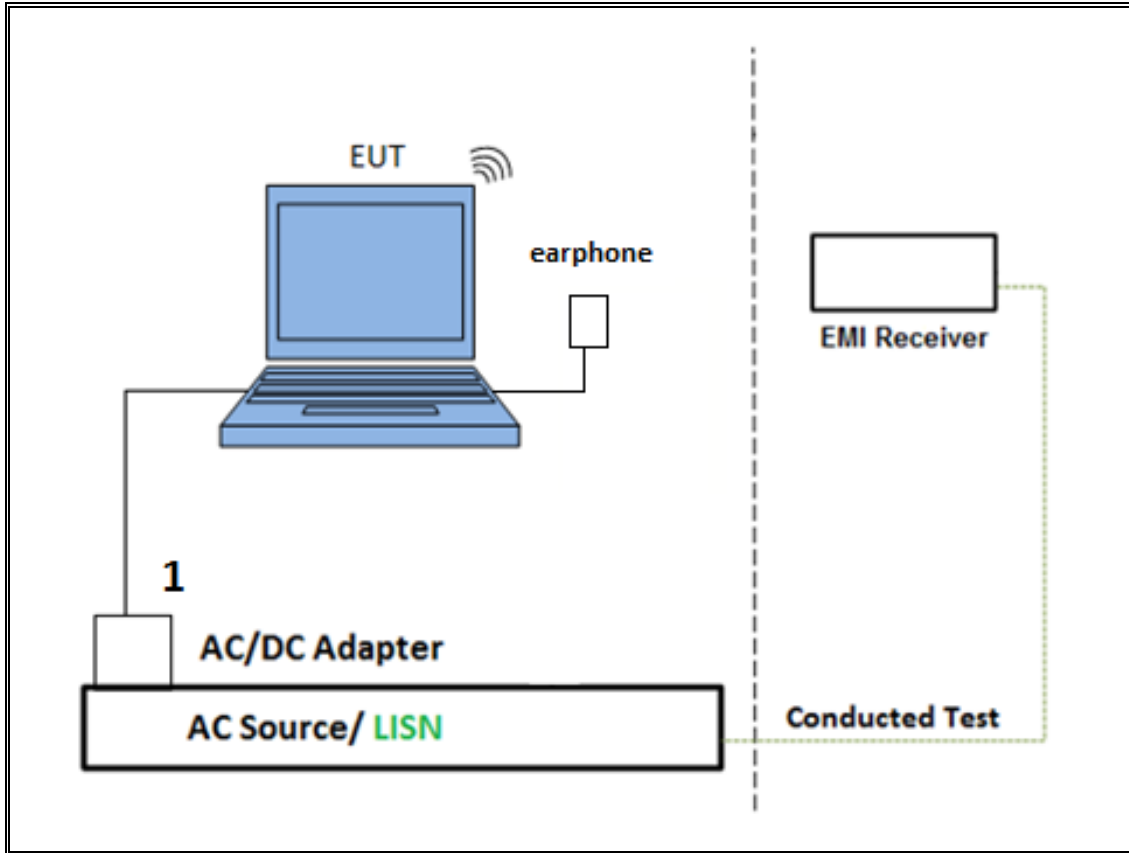
**SETUP DIAGRAM**



**TEST SETUP- AC LINE CONDUCTED TESTS**

The EUT was powered by AC/DC adapter and with earphone plugged in. 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	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	323562	5/4/2017
Spectrum Analyzer, PXA, 3Hz to 44GHz	Agilent	N9030A	MY52350675	11/15/2016
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	7/8/2017
Antenna, Horn 18 to 26.5GHz	ARA	MWH-1826	209336	5/26/2017
Spectrum Analyzer, 40 GHz	Agilent	8564E	3943A01643	8/14/2016
Amplifier, 1 to 26.5GHz, 23.5dB Gain minimum	Keysight	8449B	3008A04710	7/5/2017
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	UL	PG1	N/A	7/28/2017
UL SOFTWARE				
* Radiated Software	UL	UL EMC	Ver 9.5, June 24, 2015	
* Conducted Software	UL	UL EMC	Ver 5.0, June 22, 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

## 7. ANTENNA PORT TEST RESULTS

### 7.1. MEASUREMENT METHODS

20 dB and 99% BW: ANSI C63.10 Section 6.9.3

Hopping Frequency Separation: ANSI C63.10 Section 7.8.2

Number of Hopping Channels: ANSI C63.10 Section 7.8.3

Average Time of Occupancy: ANSI C63.10 Section 7.8.4

Output Power: ANSI C63.10 Section 7.8.5

Conducted Spurious Emissions: ANSI C63.10 Section 6.7

Radiated Spurious Emissions 30-1000MHz: ANSI C63.10 Section 6.3 and 6.5

Radiated Spurious Emissions above 1GHz: ANSI C63.10 Section 6.3 and 6.6

Band-edge: ANSI C63.10 Section 6.10



## 7.2. ON TIME AND DUTY CYCLE

### LIMITS

None; for reporting purposes only.

### PROCEDURE

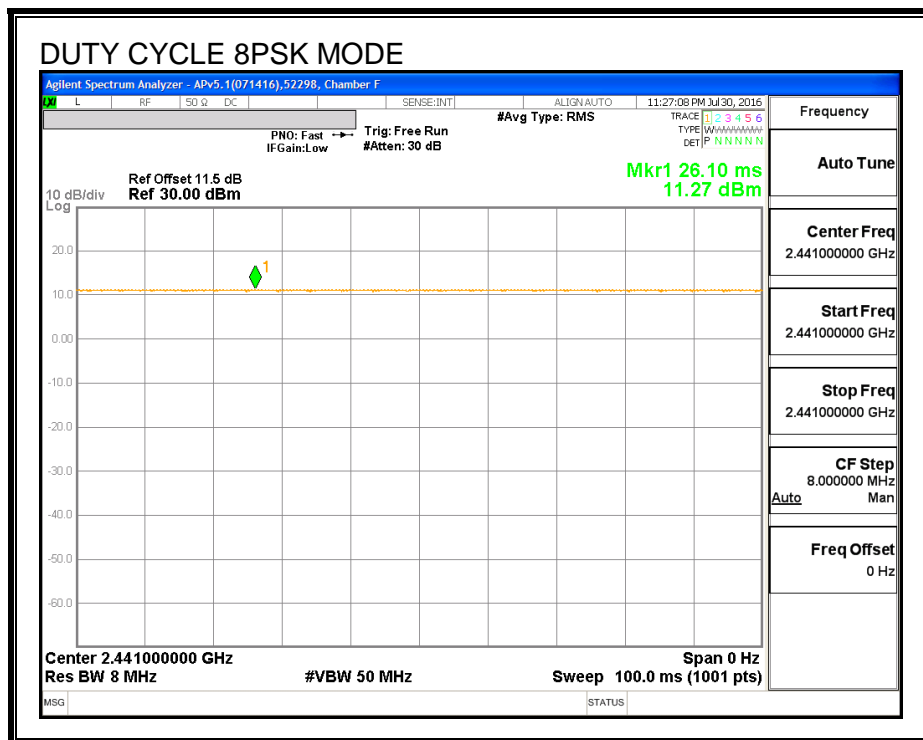
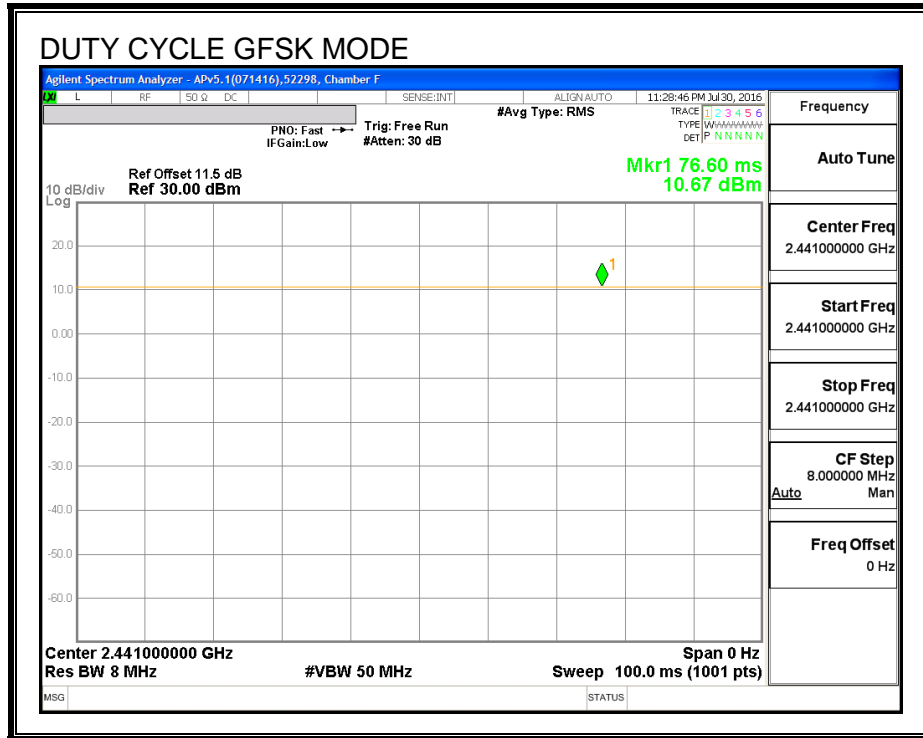
ANSI C63.10, Section 11.6 : Zero-Span Spectrum Analyzer Method.

### 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)
Bluetooth GFSK	100.0	100.0	1.000	100.00%	0.00	0.010
Bluetooth 8PSK	100.0	100.0	1.000	100.00%	0.00	0.010

**DUTY CYCLE PLOTS**

**HOPPING OFF**



### 7.3. BASIC DATA RATE GFSK MODULATION

#### 7.3.1. 20 dB AND 99% BANDWIDTH

##### LIMIT

None; for reporting purposes only.

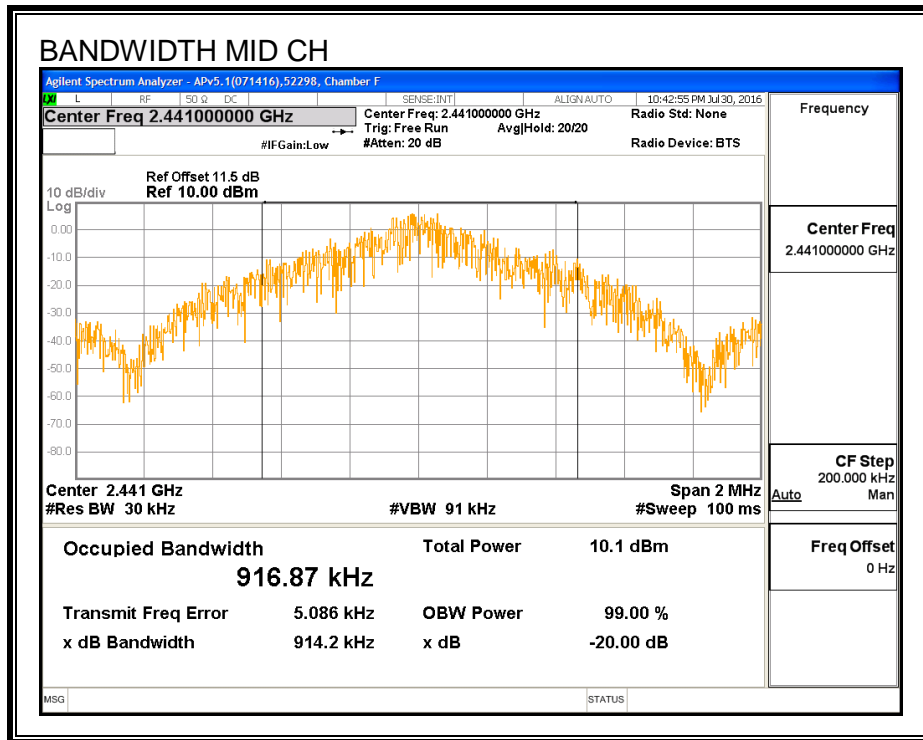
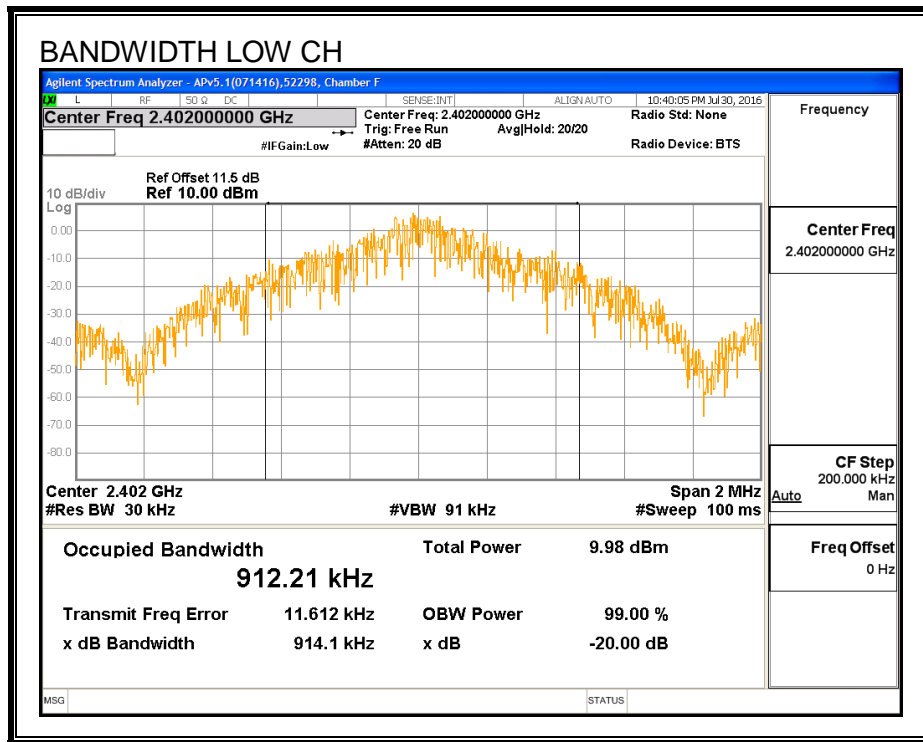
##### TEST PROCEDURE

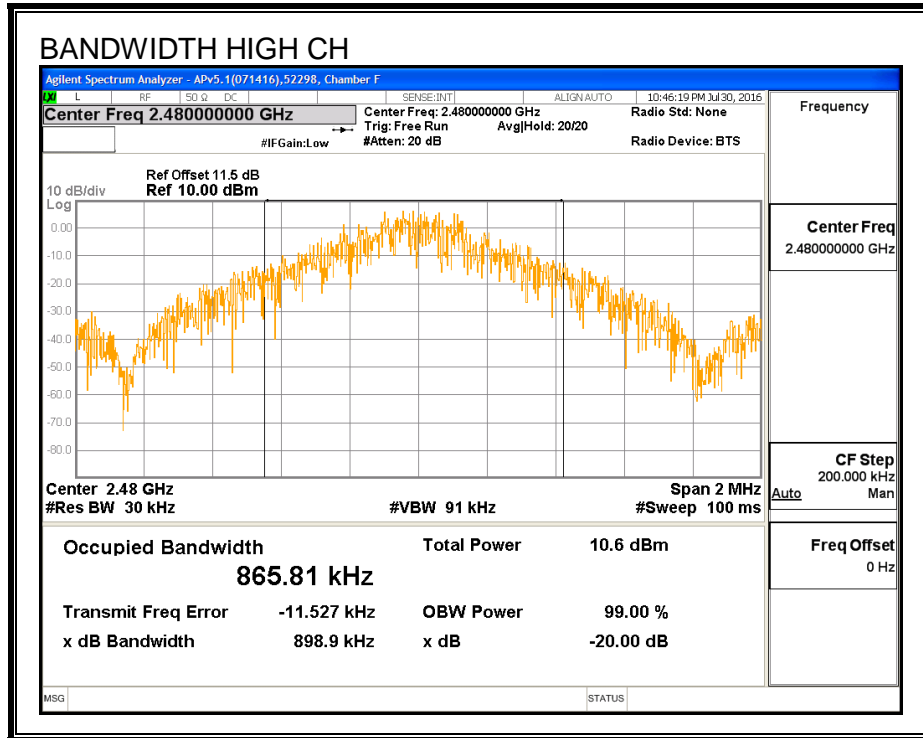
The transmitter output is connected to a spectrum analyzer. The RBW is set to  $\geq 1\%$  of the 20 dB bandwidth. The VBW is set to  $\geq$  RBW. The sweep time is coupled.

##### RESULTS

Channel	Frequency (MHz)	99% Bandwidth (KHz)	20 dB Bandwidth (KHz)
Low	2402	912.21	914.1
Middle	2441	916.87	914.2
High	2480	865.81	898.9

**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.

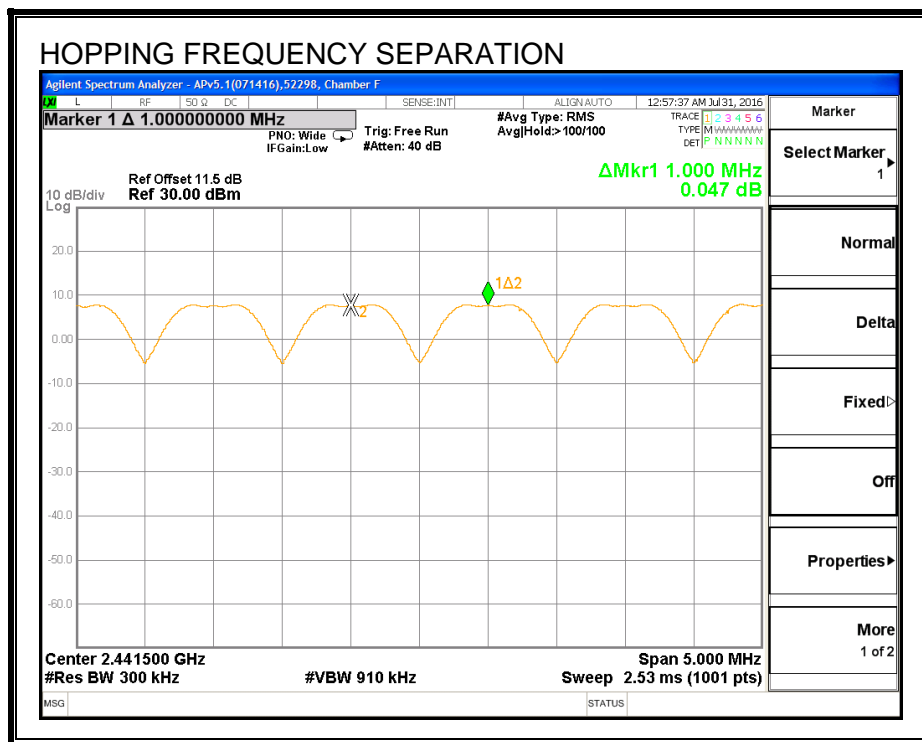
Alternatively, frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than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

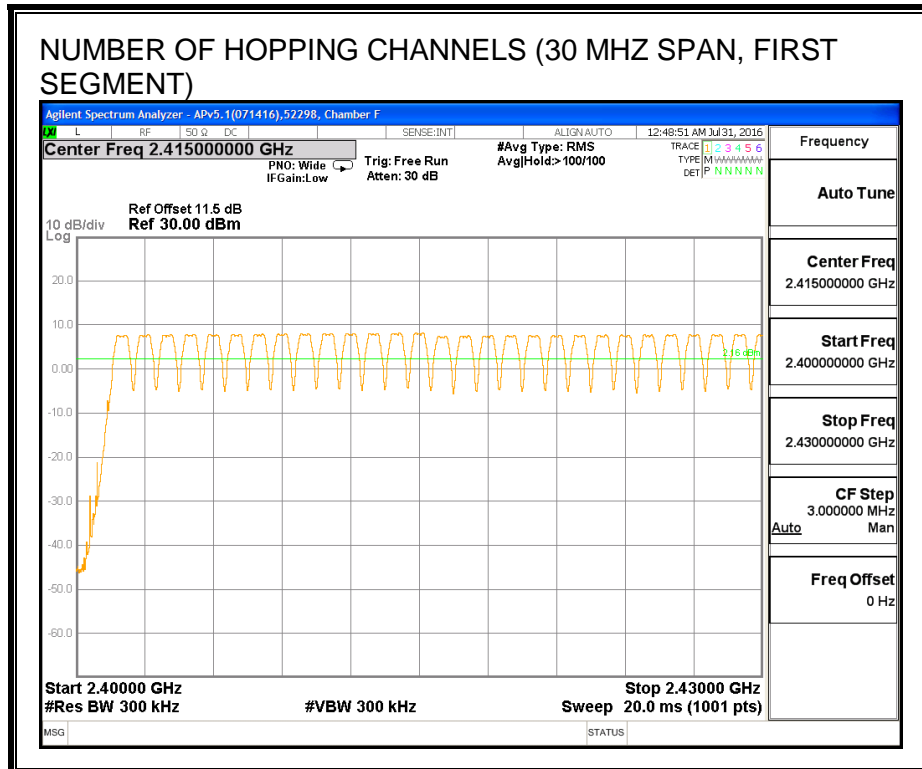
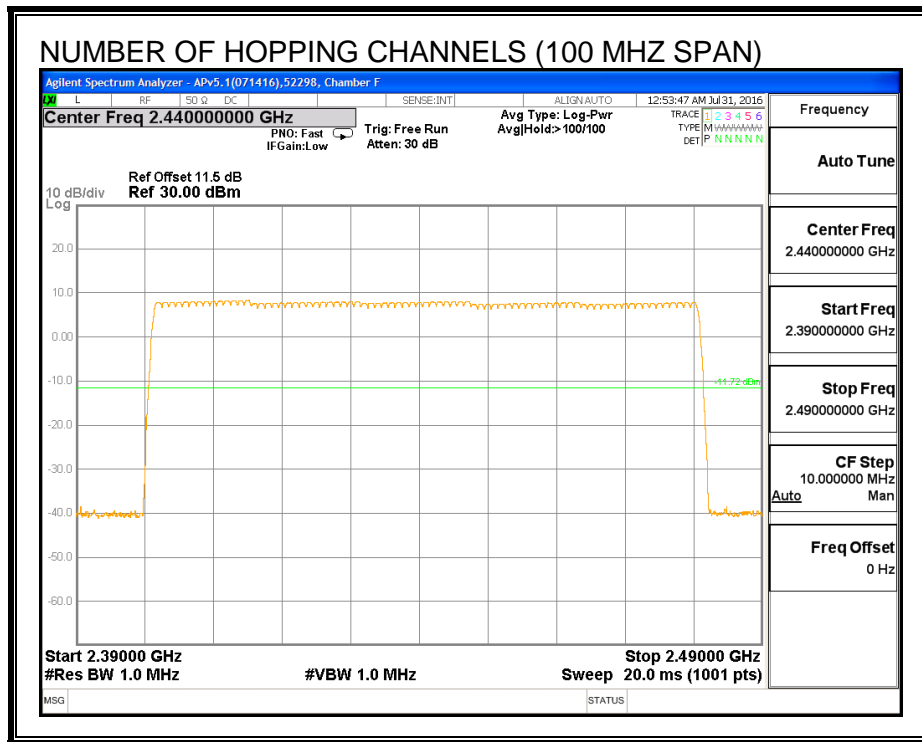
#### **TEST PROCEDURE**

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.

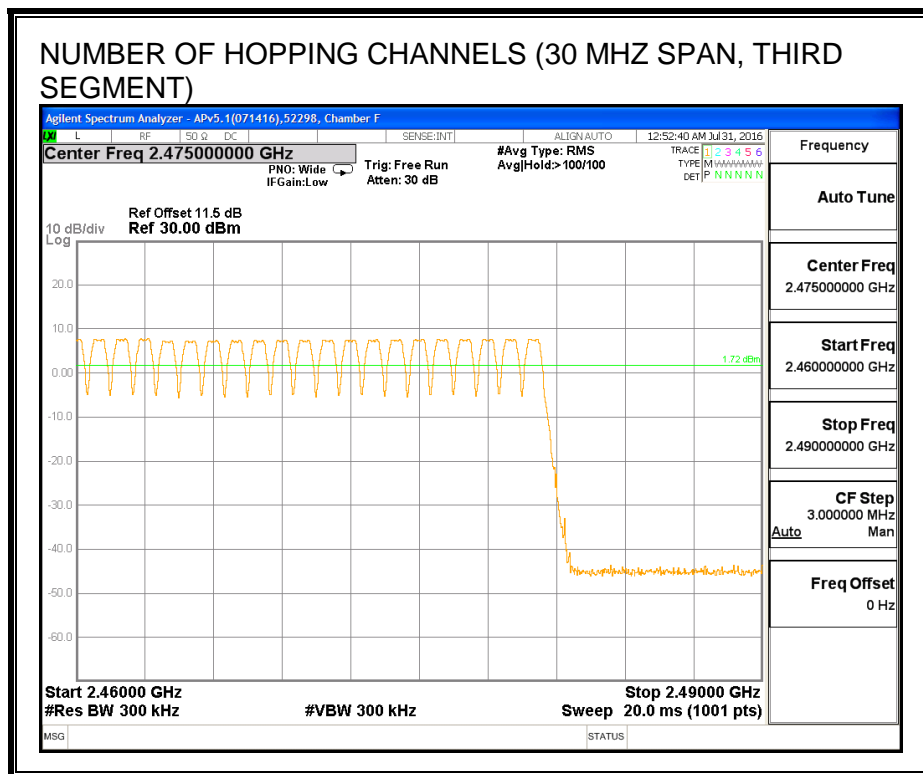
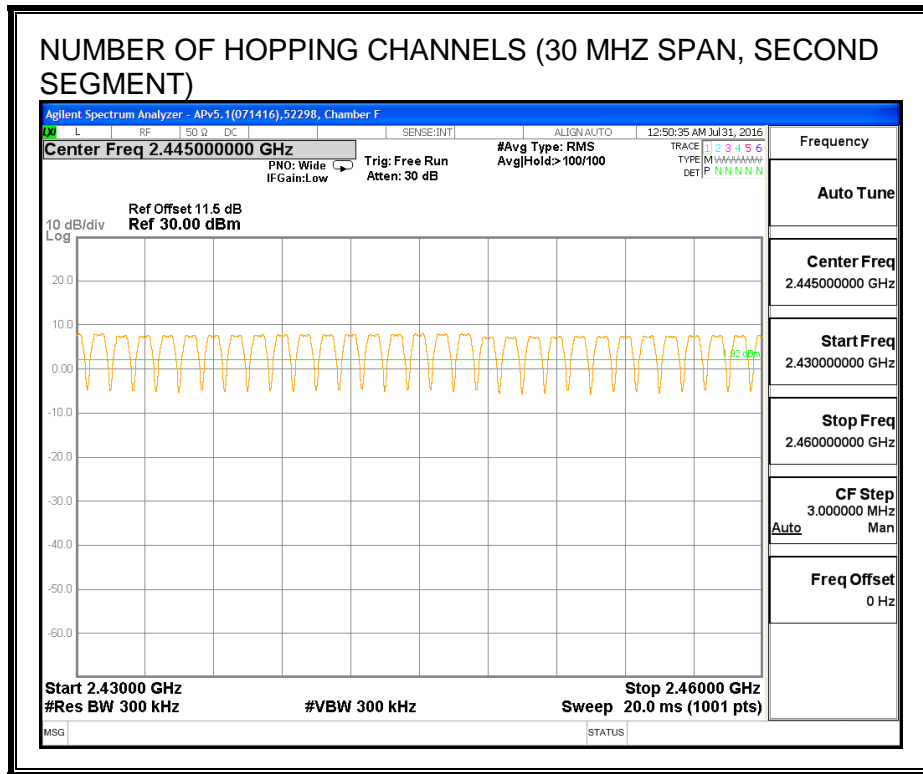
#### **RESULTS**

Normal Mode: 79 Channels observed.

**NUMBER OF HOPPING CHANNELS**







### 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.

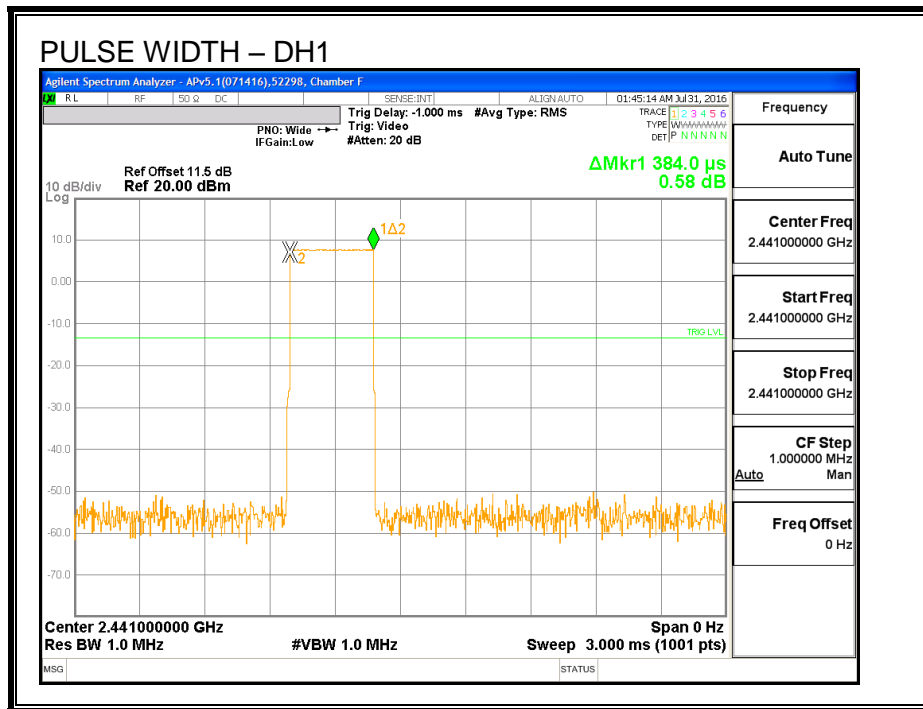
The average time of occupancy in the specified 31.6 second period (79 channels \* 0.4 s) is equal to  $10 * (\# \text{ of pulses in } 3.16 \text{ s}) * \text{ pulse width}$ .

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

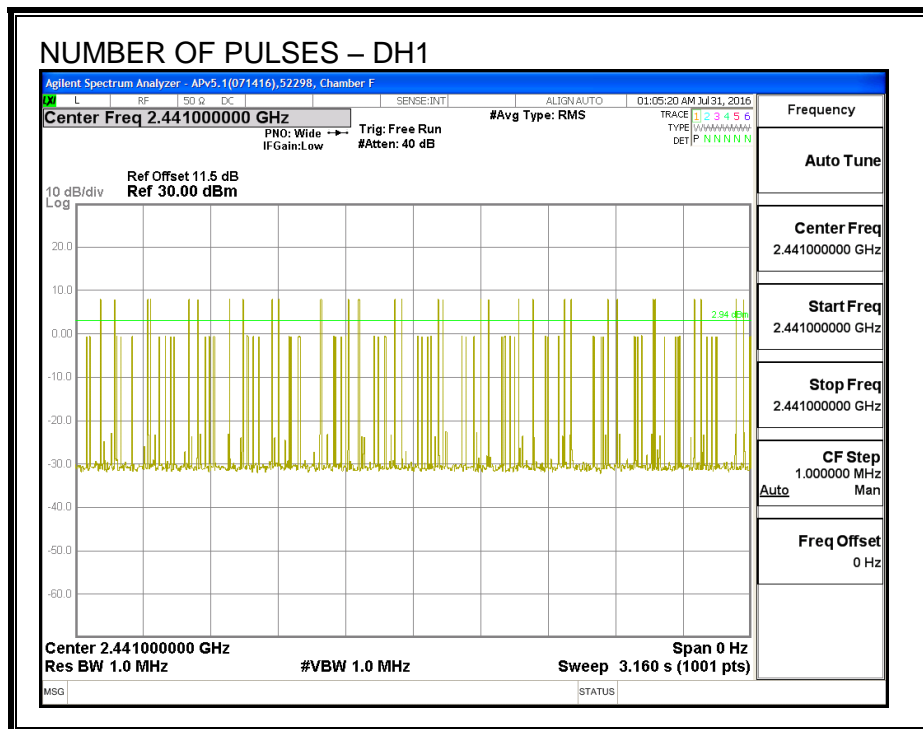
#### RESULTS

DH Packet	Pulse Width (msec)	Number of Pulses in 3.16 seconds	Average Time of Occupancy (sec)	Limit (sec)	Margin (sec)
<b>GFSK Normal Mode</b>					
DH1	0.384	30	0.115	0.4	-0.285
DH3	1.640	18	0.295	0.4	-0.105
DH5	2.215	12	0.266	0.4	-0.134
DH Packet	Pulse Width (msec)	Number of Pulses in 0.8 seconds	Average Time of Occupancy (sec)	Limit (sec)	Margin (sec)
<b>GFSK AFH Mode</b>					
DH1	0.384	7.5	0.029	0.4	-0.371
DH3	1.64	4.5	0.074	0.4	-0.326
DH5	2.215	3	0.066	0.4	-0.334

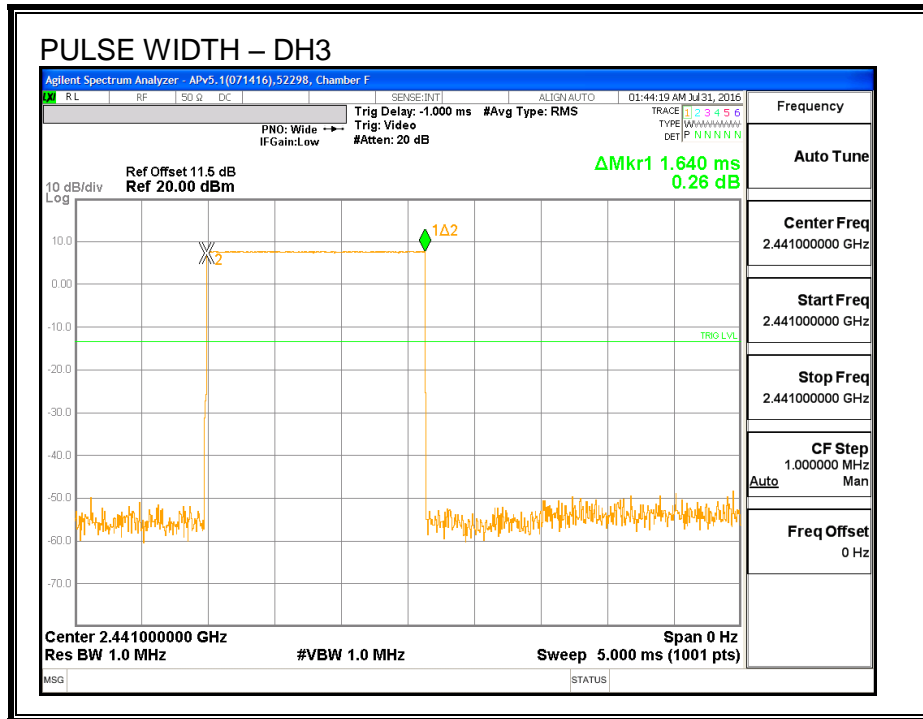
**PULSE WIDTH - DH1**



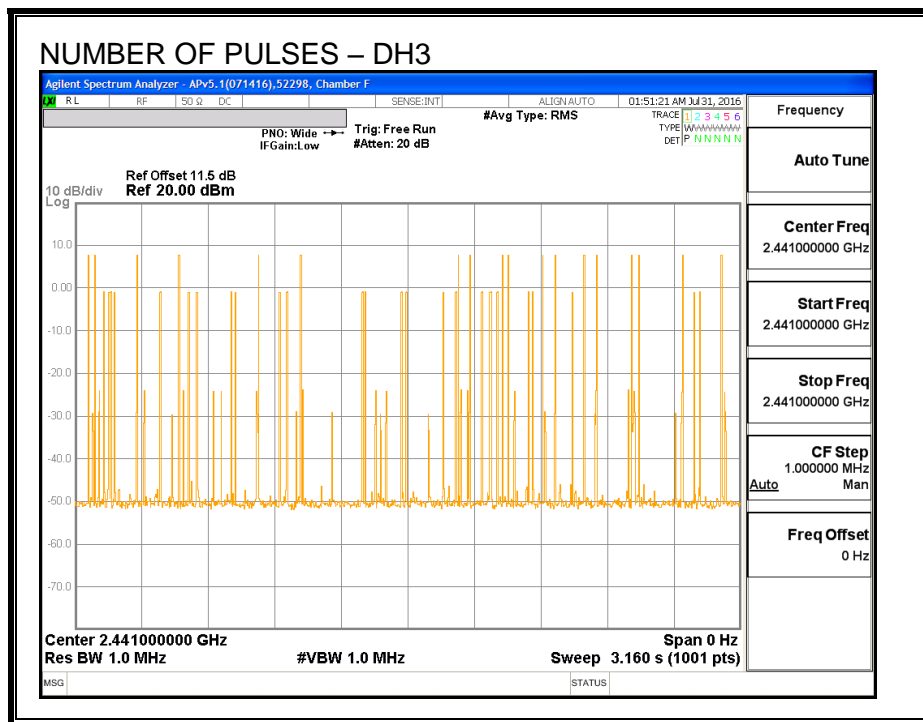
**NUMBER OF PULSES IN 3.16 SECOND OBSERVATION PERIOD - DH1**



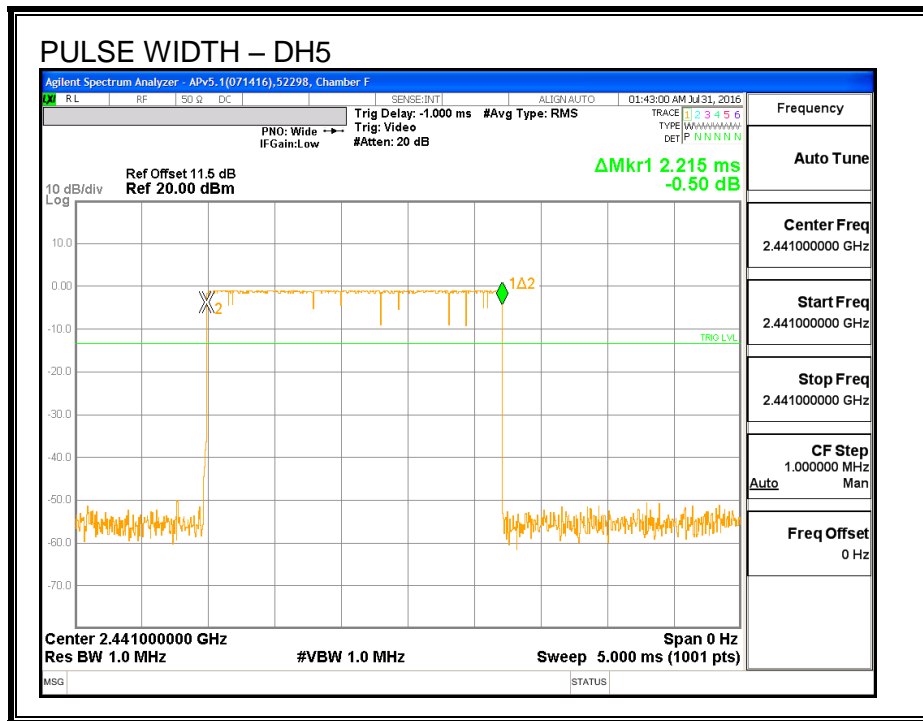
**PULSE WIDTH – DH3**



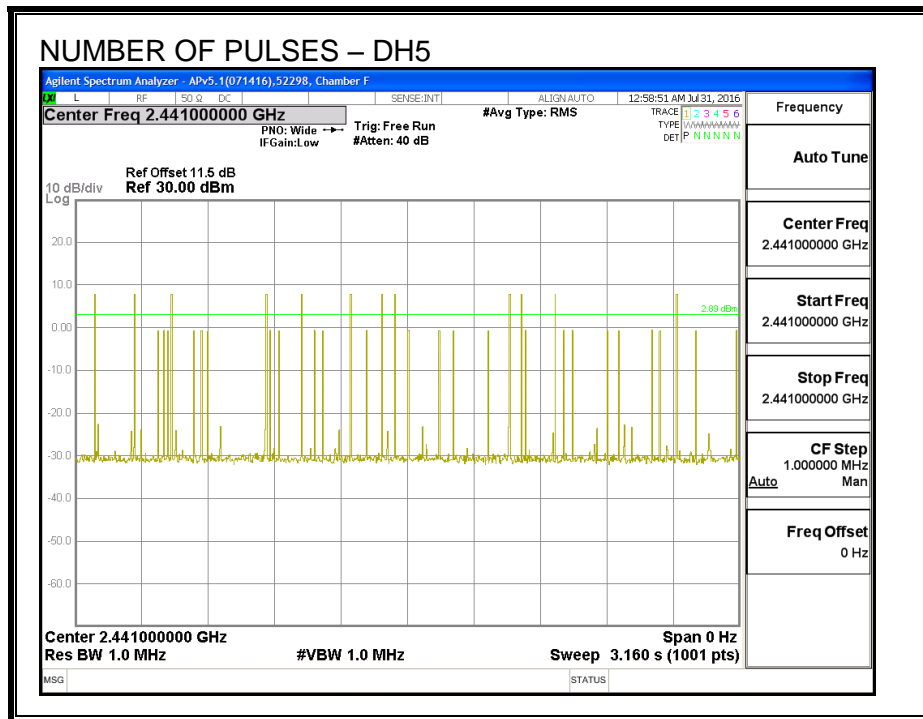
**NUMBER OF PULSES IN 3.16 SECOND OBSERVATION PERIOD – DH3**



**PULSE WIDTH – DH5**



**NUMBER OF PULSES IN 3.16 SECOND OBSERVATION PERIOD – DH5**



### 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.

#### TEST PROCEDURE

The transmitter output is connected to a wideband peak power meter.

#### RESULTS

<b>ID:</b>	45200	<b>Date:</b>	8/1/16
------------	-------	--------------	--------

Channel	Frequency (MHz)	Output Power (dBm)	Limit (dBm)	Margin (dB)
Low	2402	12.18	30	-17.82
Middle	2441	12.22	30	-17.78
High	2480	12.28	30	-17.72

### 7.3.6. 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.

<b>ID:</b>	45200	<b>Date:</b>	8/1/16
------------	-------	--------------	--------

<b>Channel</b>	<b>Frequency (MHz)</b>	<b>Average Power (dBm)</b>
Low	2402	11.94
Middle	2441	11.95
High	2480	12.00

### **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.

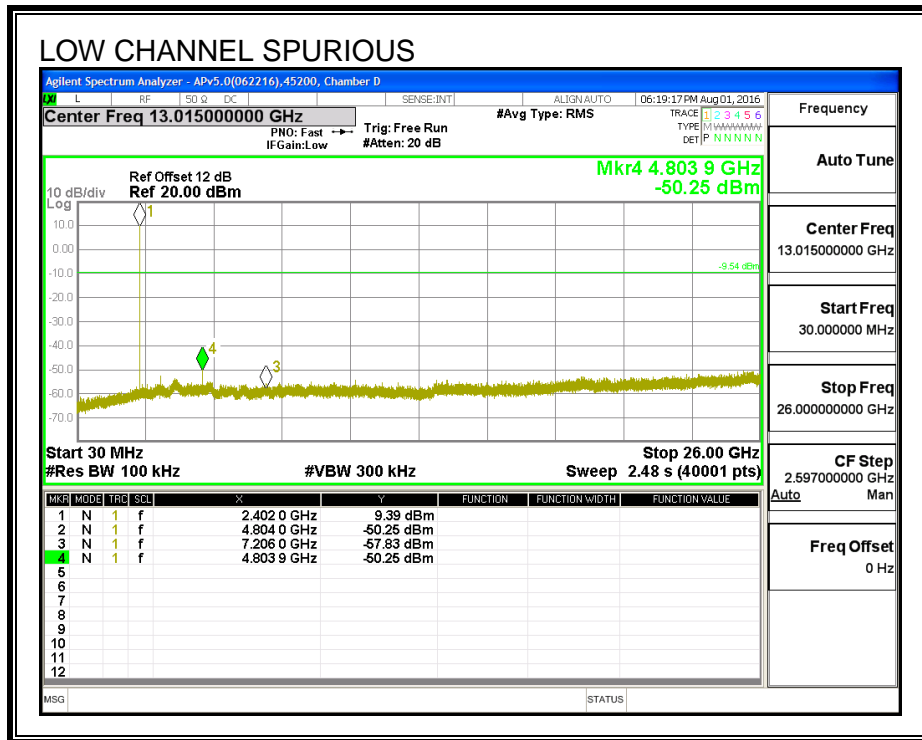
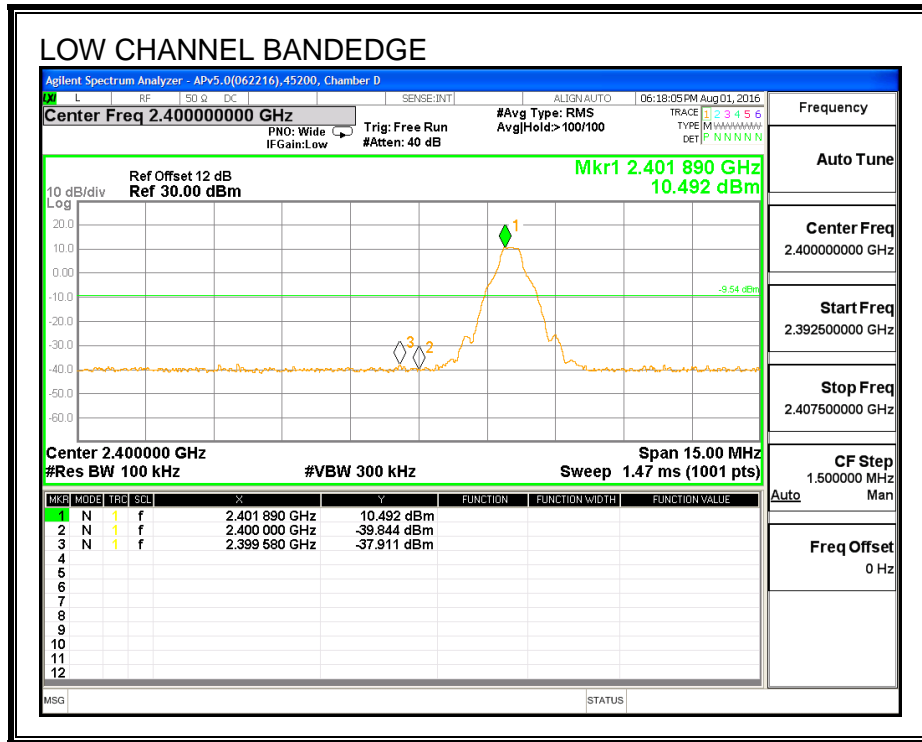
The spectrum from 30 MHz to 26 GHz is investigated with the transmitter set to the lowest, middle, and highest channels.

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

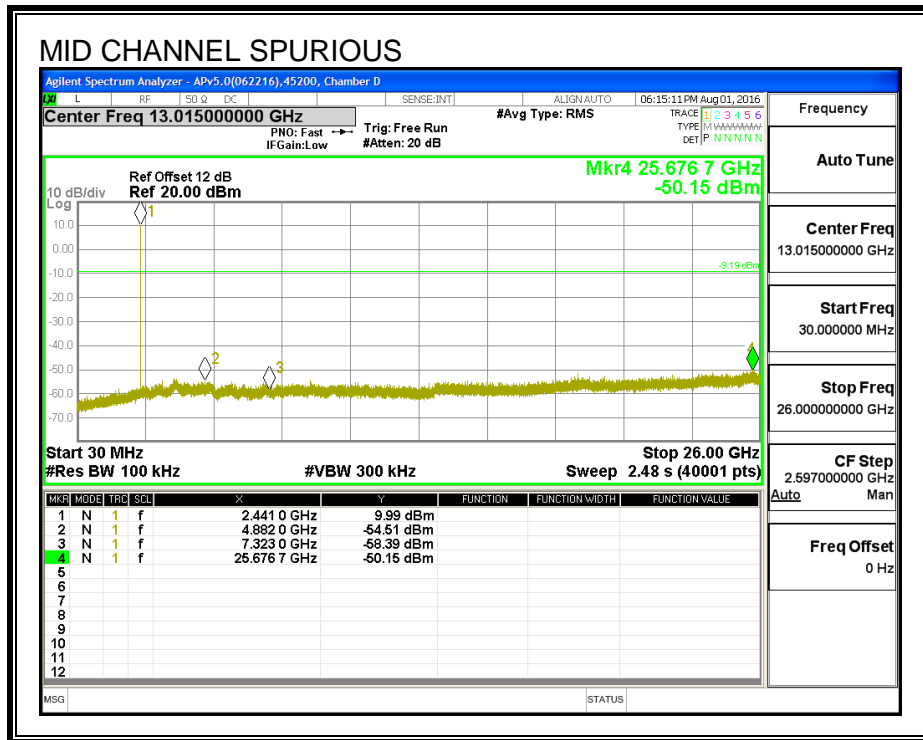
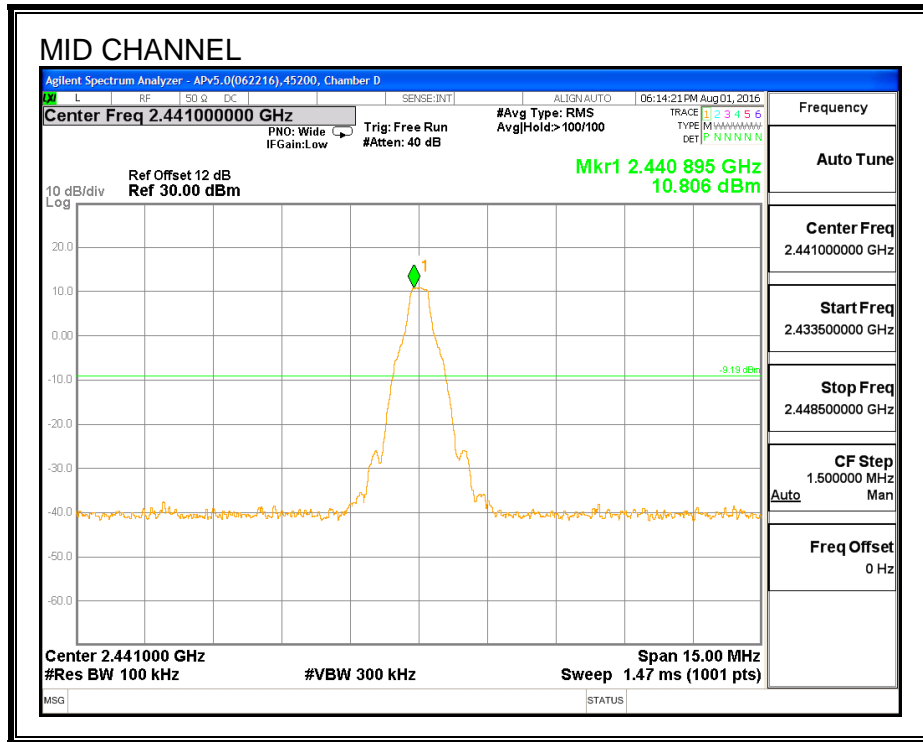
#### **RESULTS**



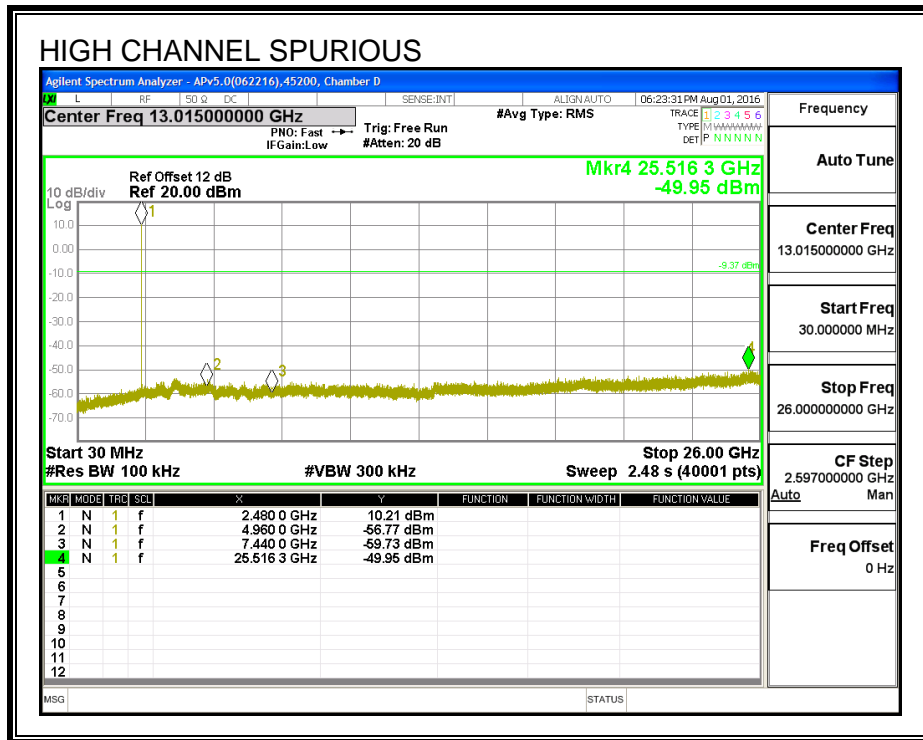
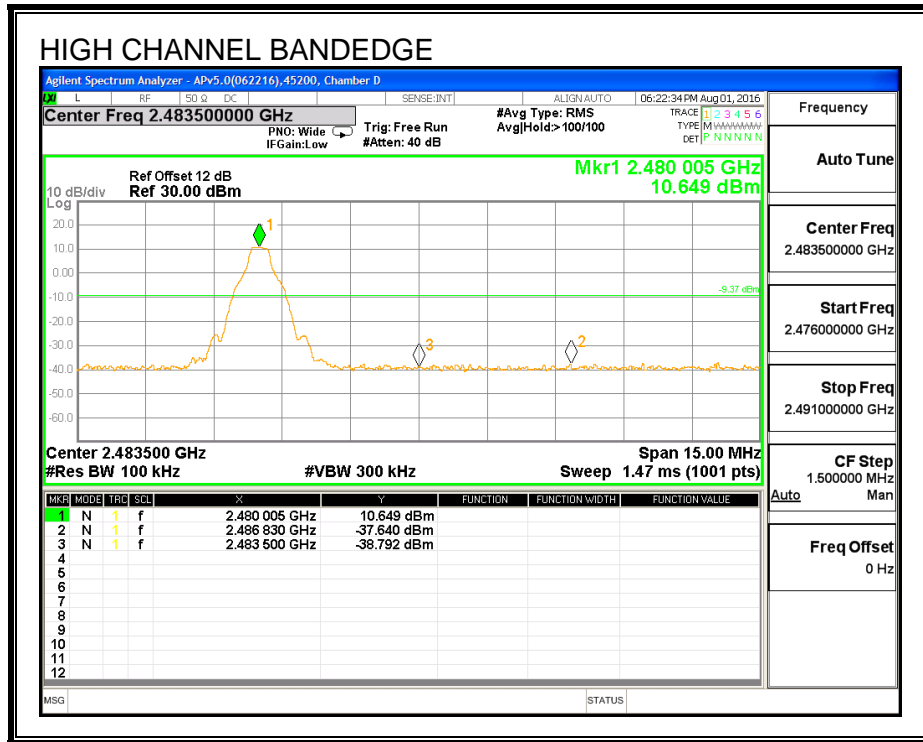
**SPURIOUS EMISSIONS, LOW CHANNEL**



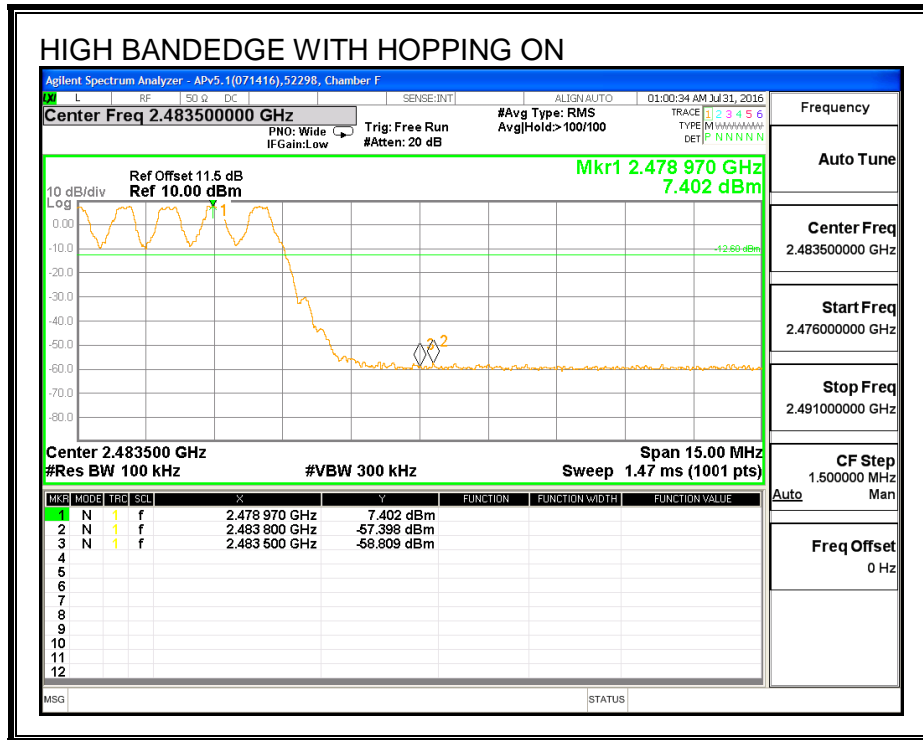
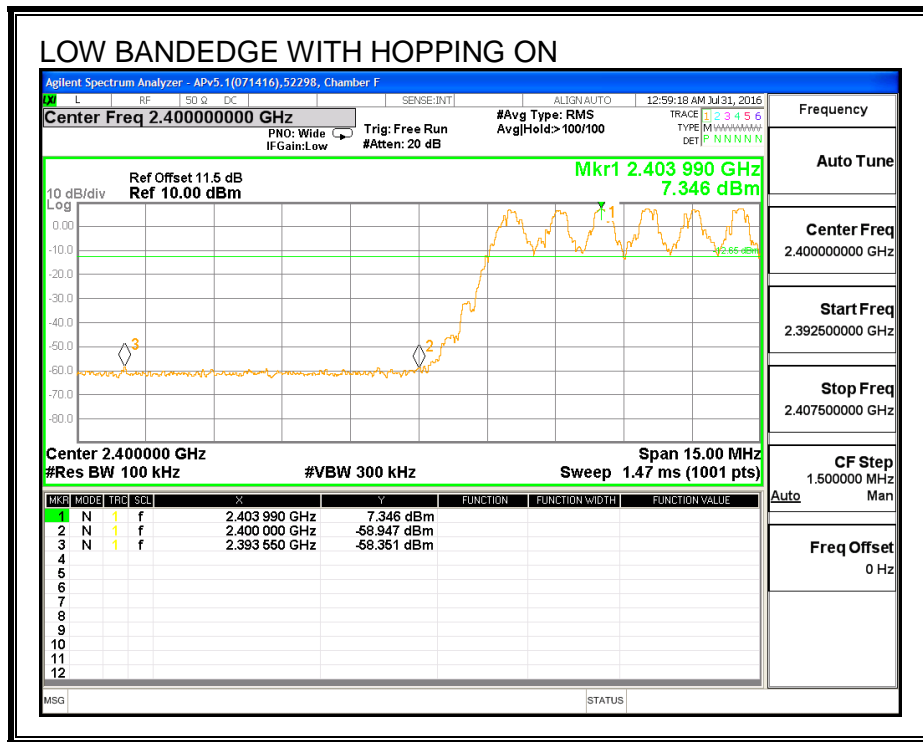
**SPURIOUS EMISSIONS, MID CHANNEL**



**SPURIOUS EMISSIONS, HIGH CHANNEL**



**SPURIOUS BANDEGE EMISSIONS WITH HOPPING ON**



## 7.4. ENHANCED DATA RATE QPSK MODULATION

### 7.4.1. 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 wideband peak power meter.

#### RESULTS

<b>ID:</b>	45200	<b>Date:</b>	8/1/16
------------	-------	--------------	--------

<b>Channel</b>	<b>Frequency (MHz)</b>	<b>Output Power (dBm)</b>	<b>Limit (dBm)</b>	<b>Margin (dB)</b>
Low	2402	12.24	21	-8.73
Middle	2441	12.21	21	-8.76
High	2480	12.25	21	-8.72

## 7.4.2. AVERAGE POWER

### LIMIT

None; for reporting purposes only.

### TEST PROCEDURE

The transmitter output is connected to a power meter.

### RESULTS

<b>ID:</b>	45200	<b>Date:</b>	8/1/16
------------	-------	--------------	--------

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.

<b>Channel</b>	<b>Frequency (MHz)</b>	<b>Average Power (dBm)</b>
Low	2402	9.99
Middle	2441	9.98
High	2480	9.96

## 7.5. ENHANCED DATA RATE 8PSK MODULATION

### 7.5.1. 20 dB AND 99% BANDWIDTH

#### LIMIT

None; for reporting purposes only.

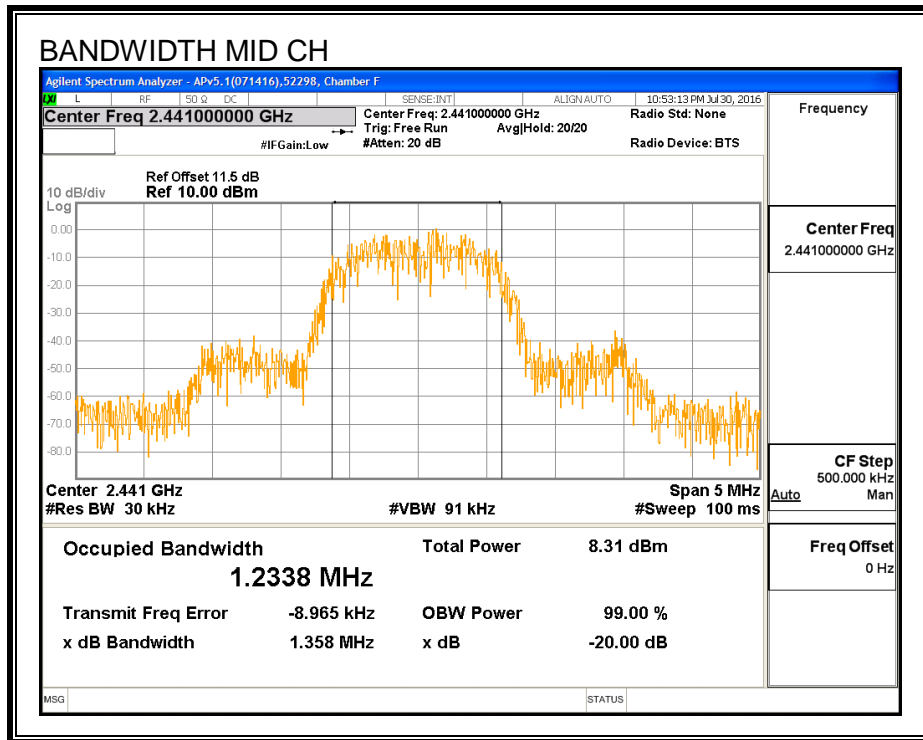
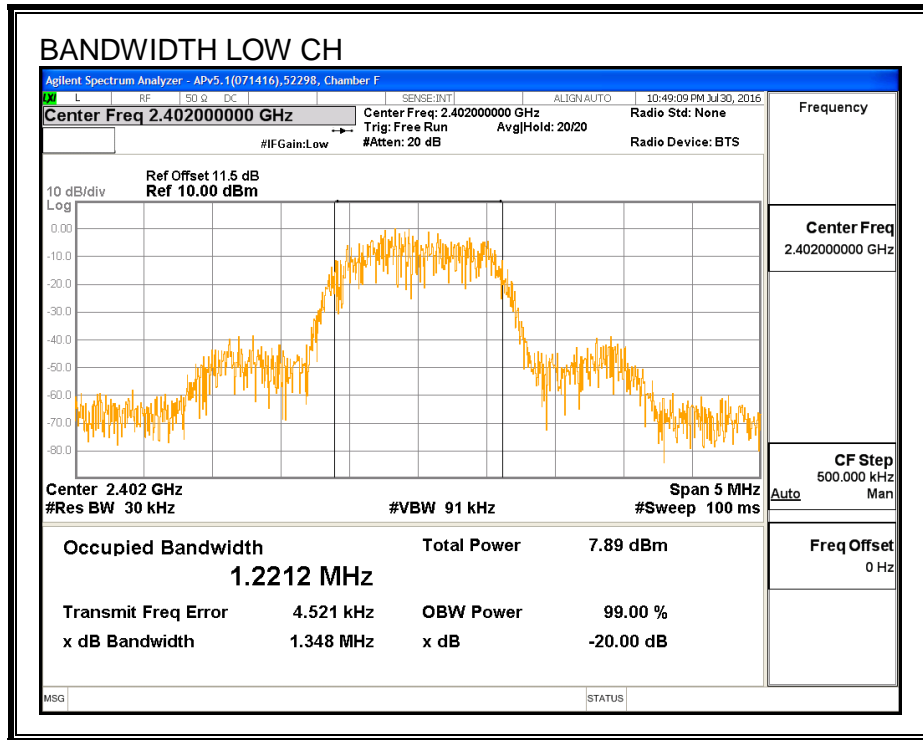
#### TEST PROCEDURE

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.

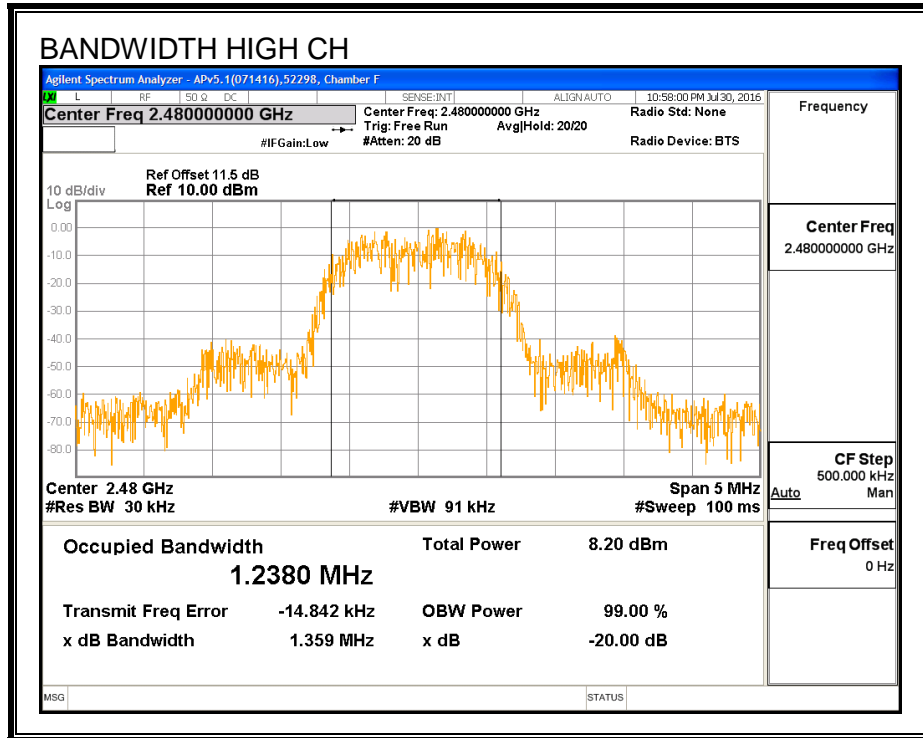
#### RESULTS

Channel	Frequency (MHz)	99% Bandwidth (MHz)	20 dB Bandwidth (MHz)
Low	2402	1.2212	1.348
Middle	2441	1.2338	1.358
High	2480	1.2380	1.359

**20 dB AND 99% BANDWIDTH**







### 7.5.2. 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.

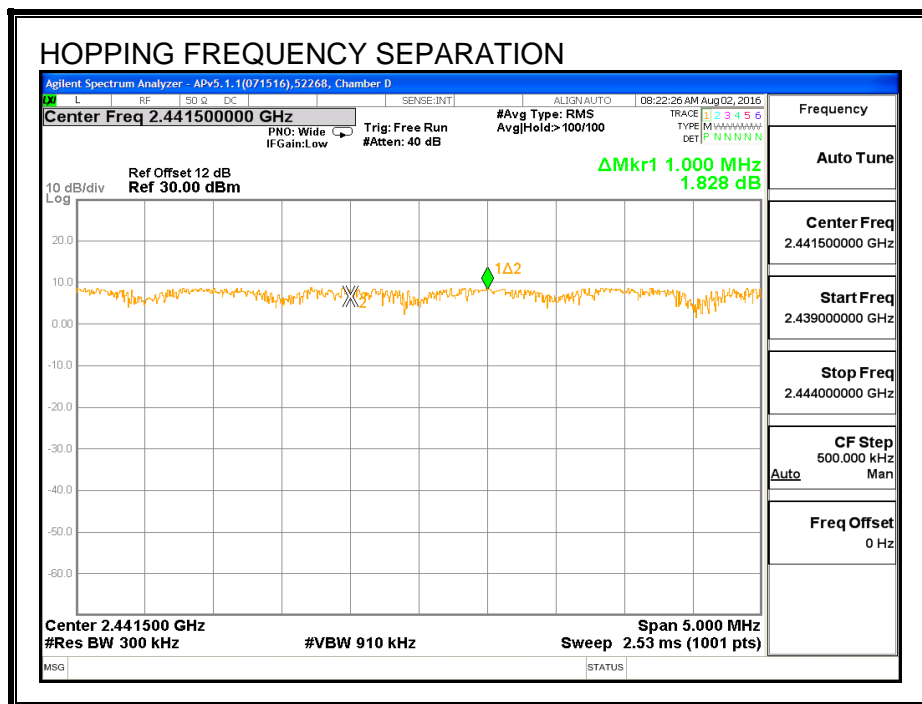
Alternatively, frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than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



### **7.5.3. 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.

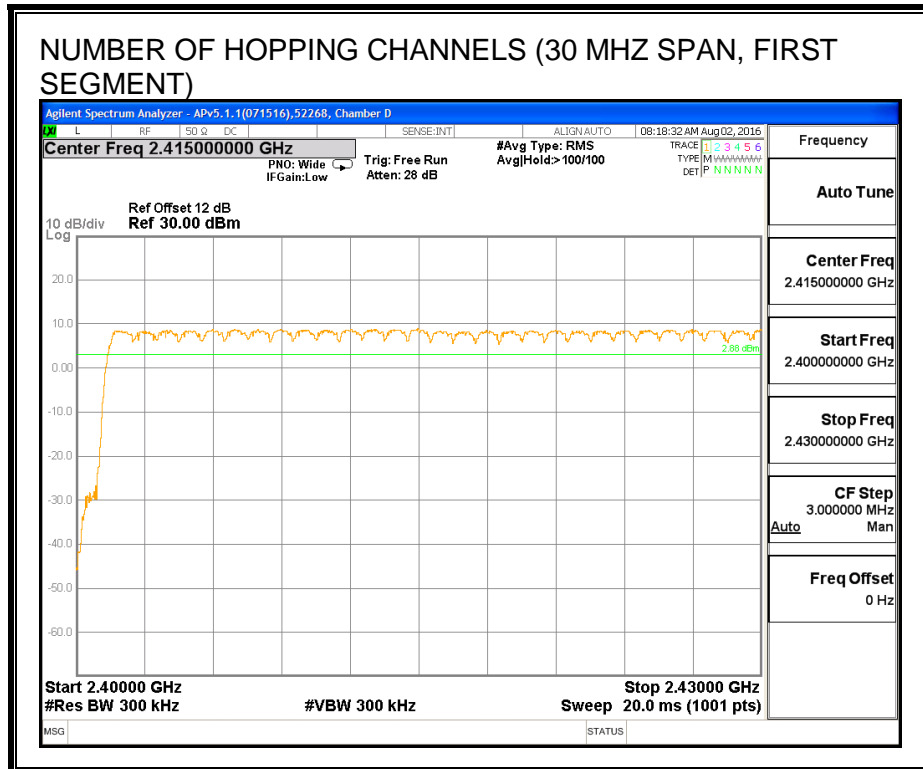
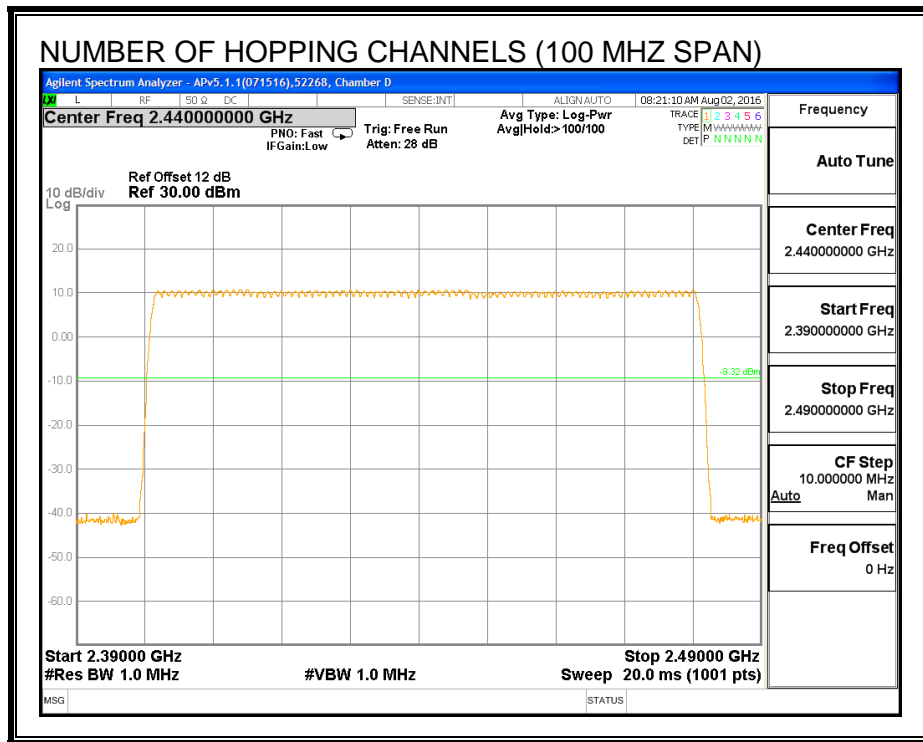
#### **TEST PROCEDURE**

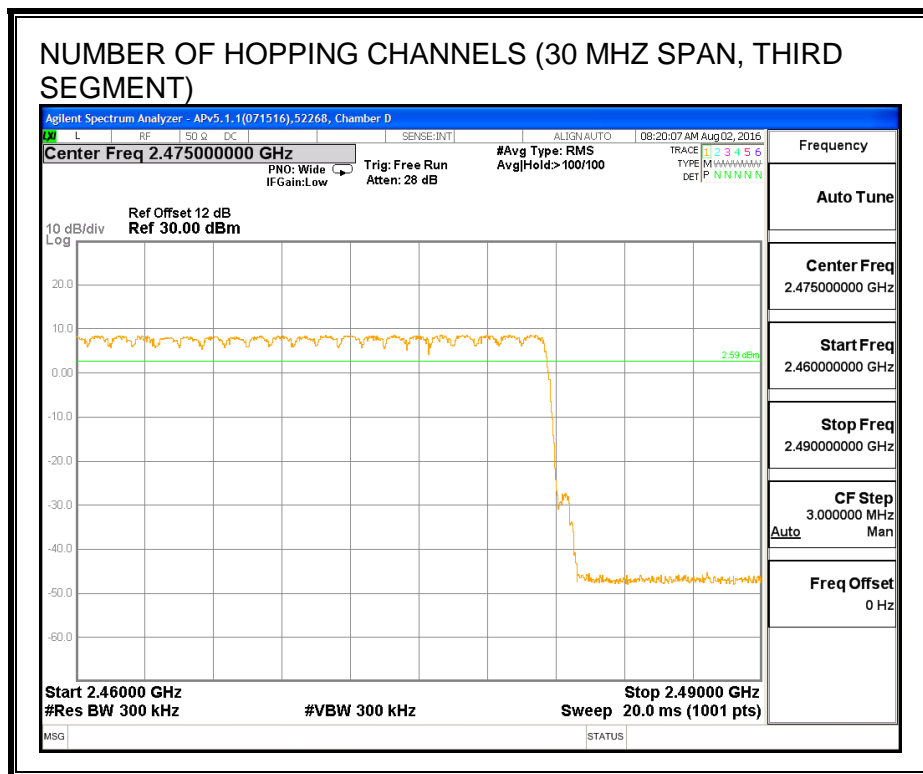
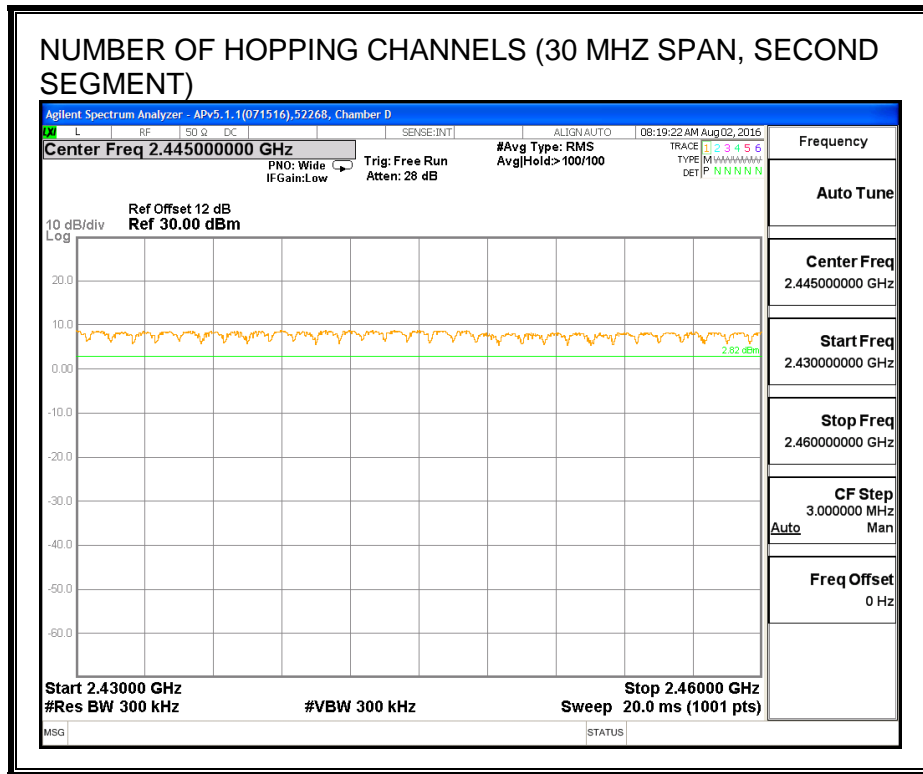
The transmitter output is connected to a spectrum analyzer. The span is set to cover the entire authorized band, in either a single sweep or in multiple contiguous sweeps. The RBW is set to a maximum of 1 % of the span. The analyzer is set to Max Hold.

#### **RESULTS**

Normal Mode: 79 Channels observed.

**NUMBER OF HOPPING CHANNELS**





### 7.5.4. 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.

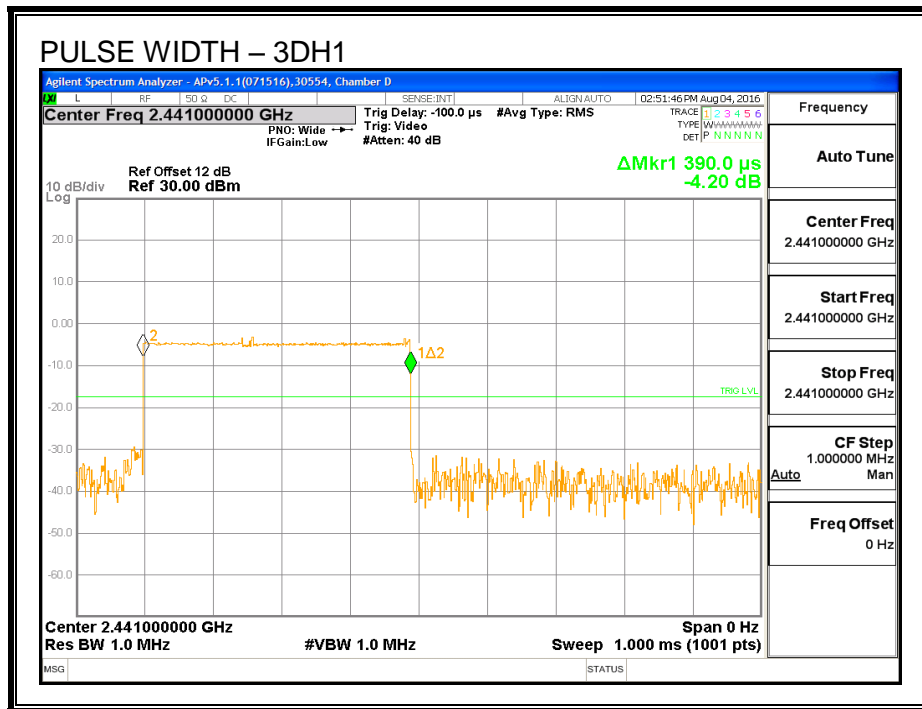
The average time of occupancy in the specified 31.6 second period (79 channels \* 0.4 s) is equal to  $10 * (\# \text{ of pulses in } 3.16 \text{ s}) * \text{ pulse width}$ .

#### RESULTS

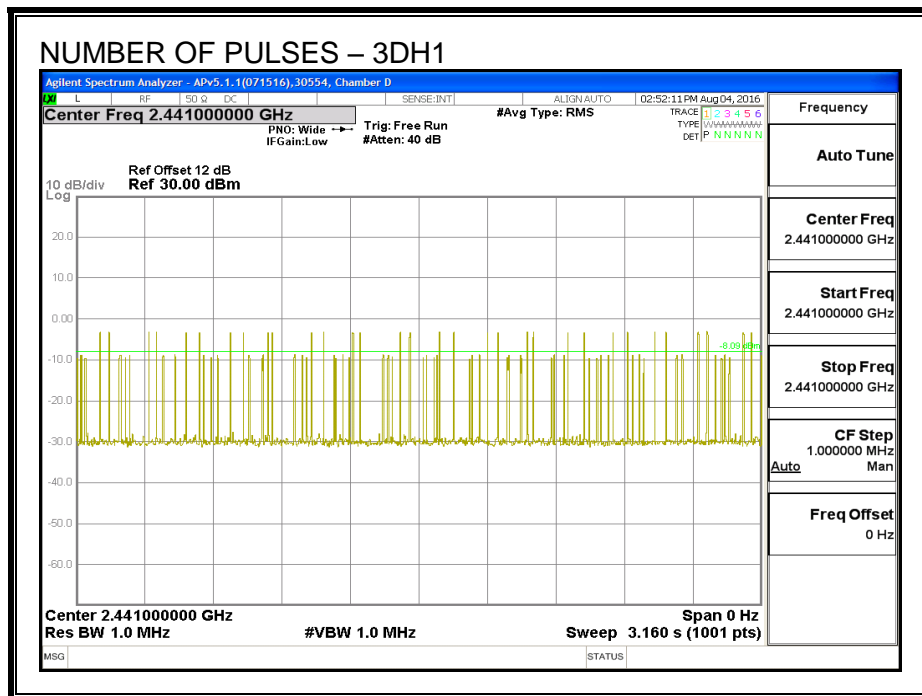
##### 8PSK (EDR) Mode

DH Packet	Pulse Width (msec)	Number of Pulses in 3.16 seconds	Average Time of (sec)	Limit (sec)	Margin (sec)
3DH1	0.390	31	0.121	0.4	-0.279
3DH3	1.640	16	0.262	0.4	-0.138
3DH5	2.868	10	0.287	0.4	-0.113

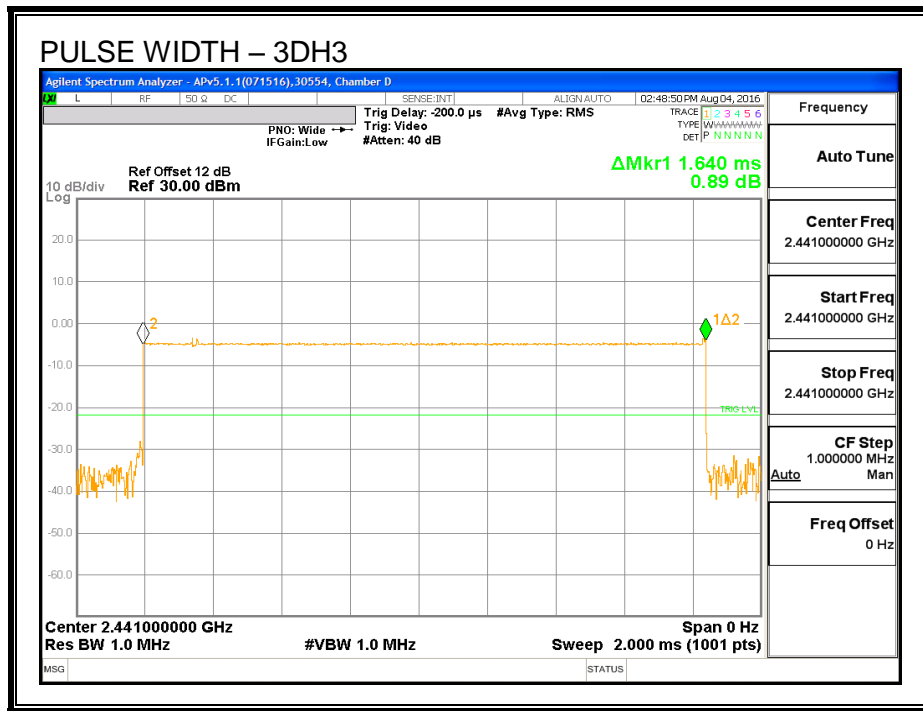
**PULSE WIDTH - 3DH1**



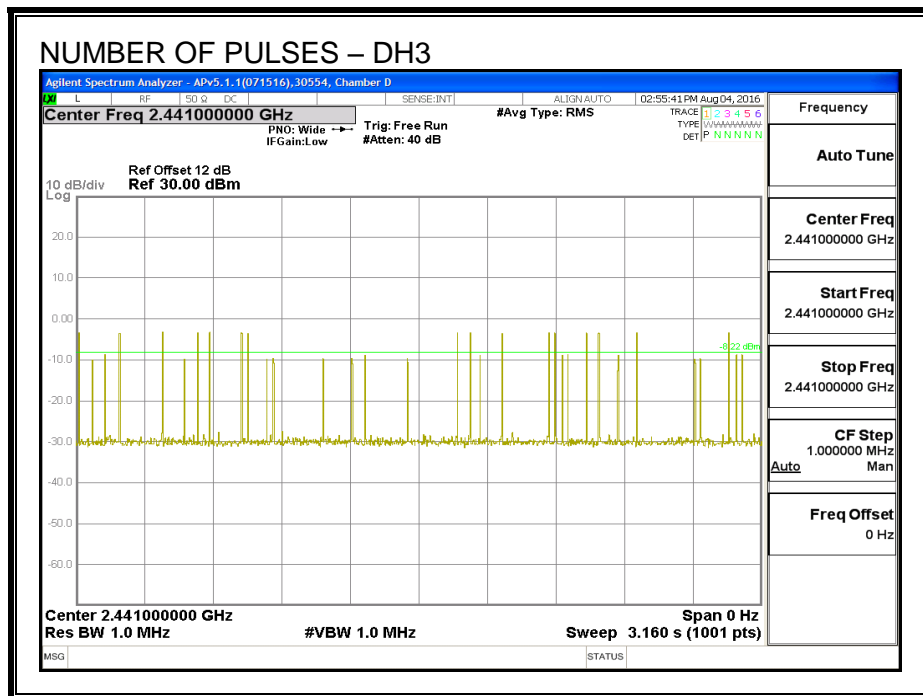
**NUMBER OF PULSES IN 3.16 SECOND OBSERVATION PERIOD - 3DH1**



**PULSE WIDTH – 3DH3**

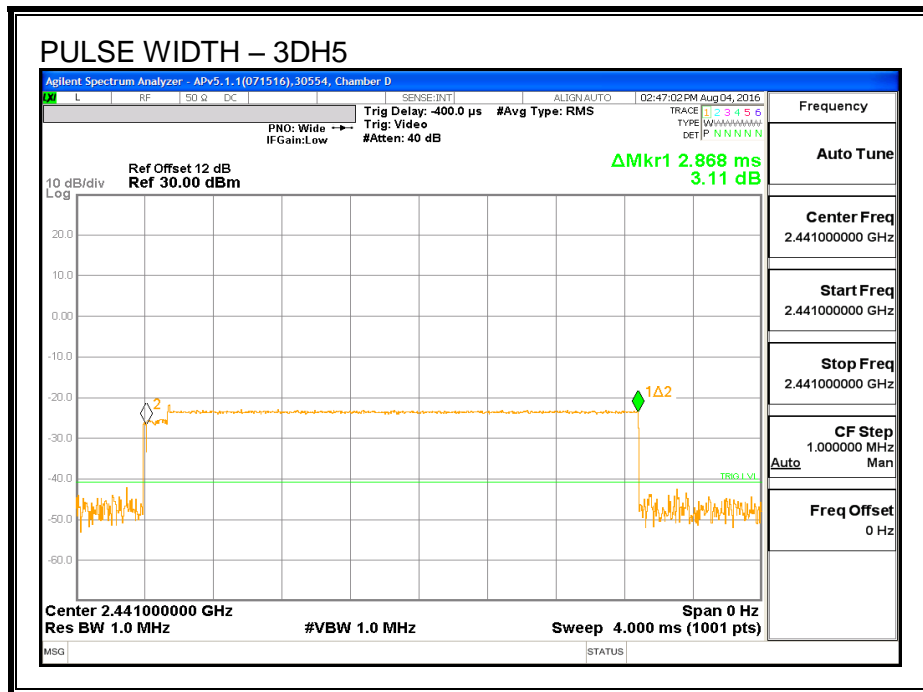


**NUMBER OF PULSES IN 3.16 SECOND OBSERVATION PERIOD – 3DH3**

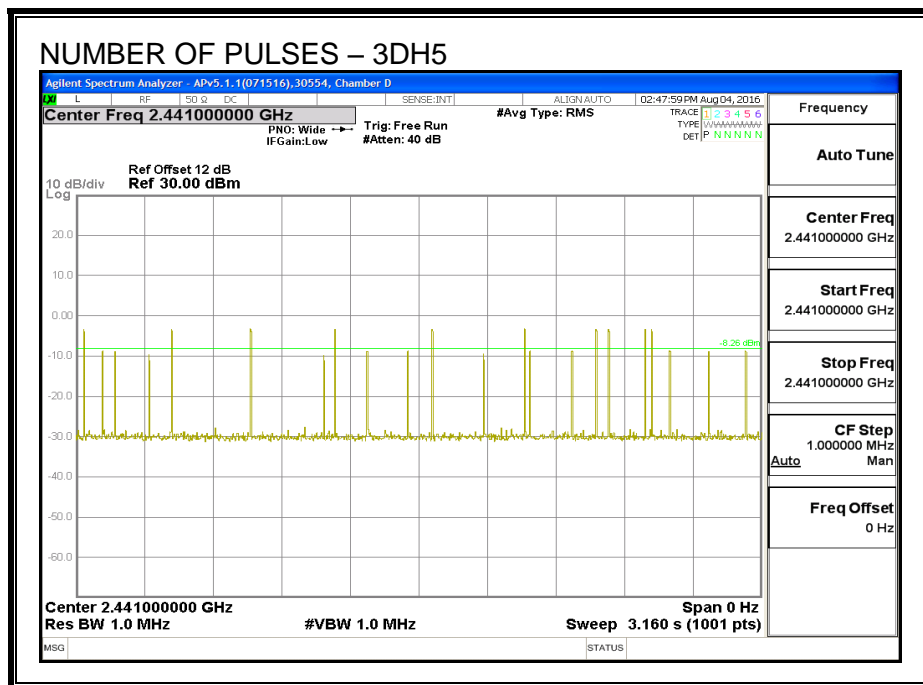




**PULSE WIDTH – 3DH5**



**NUMBER OF PULSES IN 3.16 SECOND OBSERVATION PERIOD – 3DH5**



### 7.5.5. 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 wideband peak power meter.

#### RESULTS

<b>ID:</b>	45200	<b>Date:</b>	8/1/16
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Channel	Frequency (MHz)	Output Power (dBm)	Limit (dBm)	Margin (dB)
Low	2402	12.35	21	-8.62
Middle	2441	12.47	21	-8.50
High	2480	12.45	21	-8.52

### 7.5.6. AVERAGE POWER

#### LIMIT

None; for reporting purposes only.

#### TEST PROCEDURE

The transmitter output is connected to a power meter.

#### RESULTS

<b>ID:</b>	45200	<b>Date:</b>	8/1/16
------------	-------	--------------	--------

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.

<b>Channel</b>	<b>Frequency (MHz)</b>	<b>Average Power (dBm)</b>
Low	2402	9.91
Middle	2441	9.92
High	2480	10.00

## **7.5.7. CONDUCTED SPURIOUS EMISSIONS**

### **LIMITS**

FCC §15.247 (d)

IC RSS-247 (5.5)

Limit = -20 dBc

### **TEST PROCEDURE**

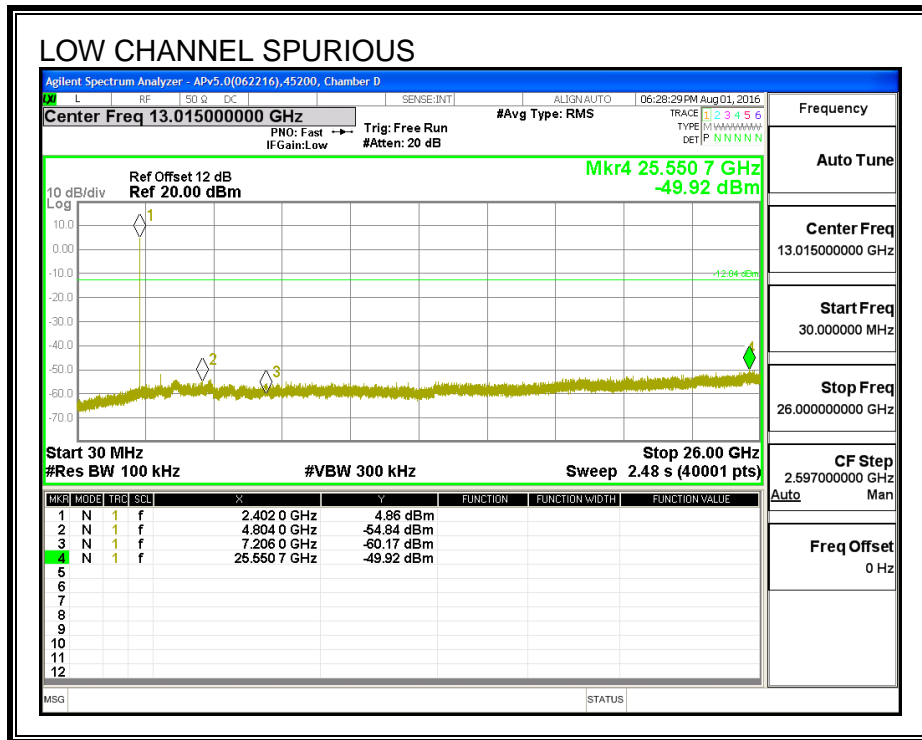
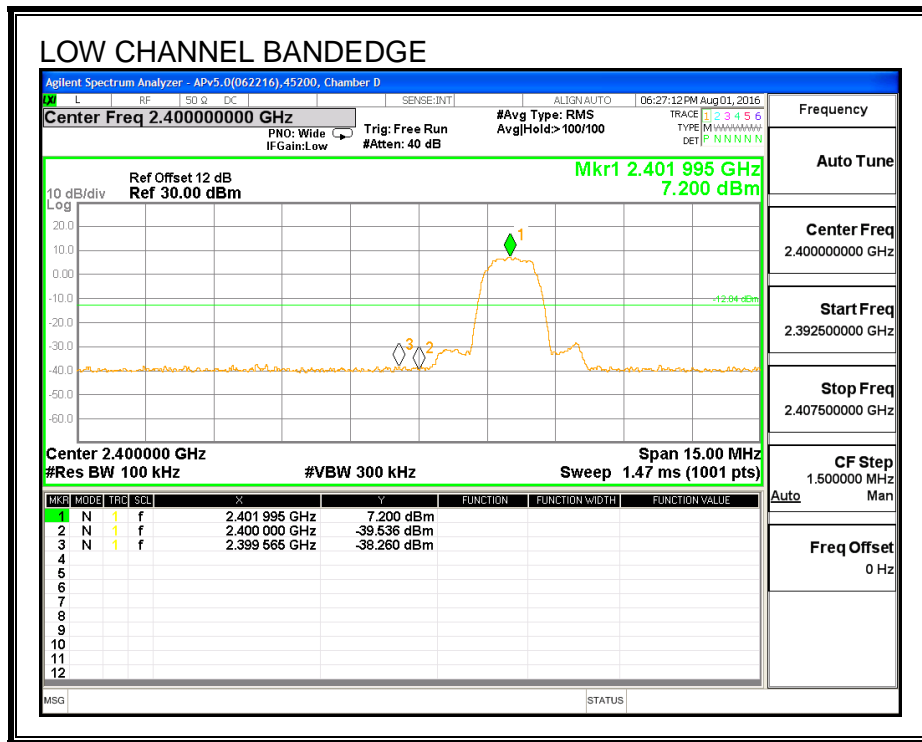
The transmitter output is connected to a spectrum analyzer. The resolution bandwidth is set to 100 kHz. The video bandwidth is set to 300 kHz.

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

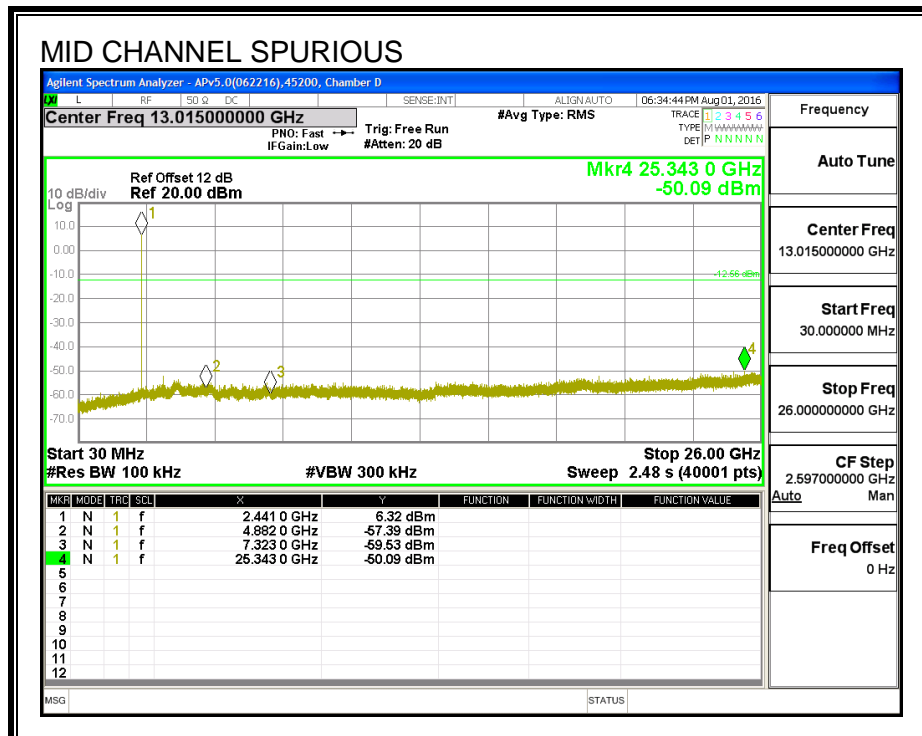
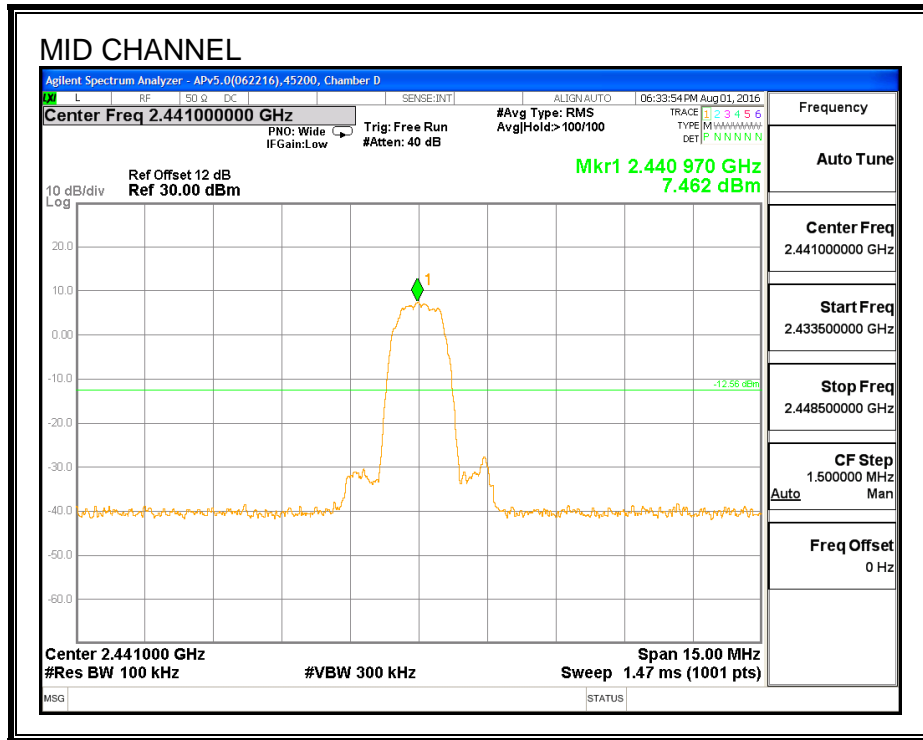
The bandedges at 2.4 and 2.4835 GHz are investigated with the transmitter set to the normal hopping mode.

### **RESULTS**

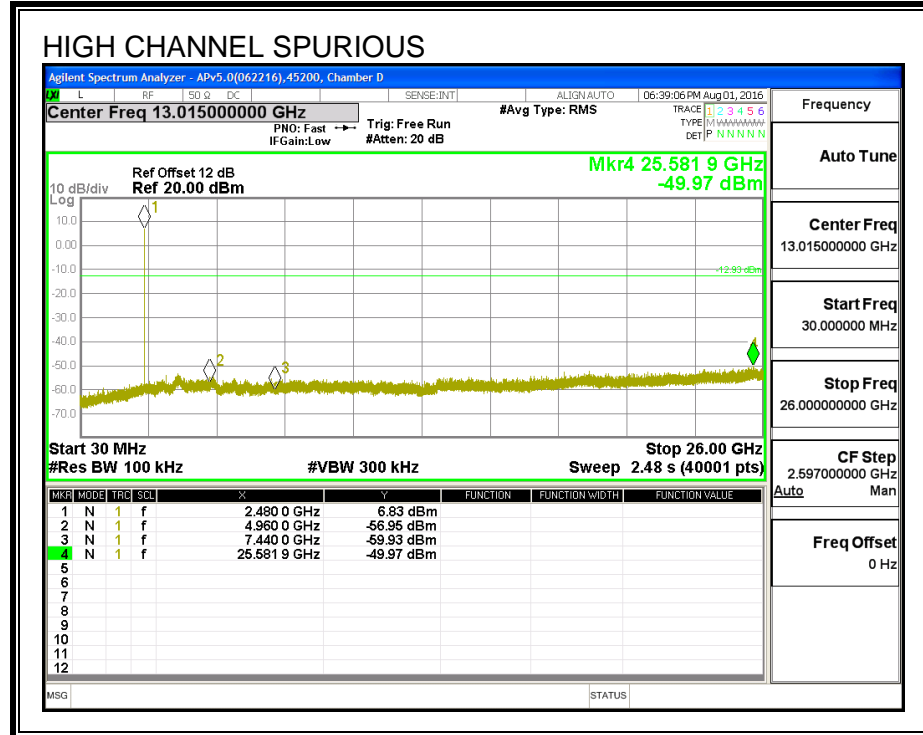
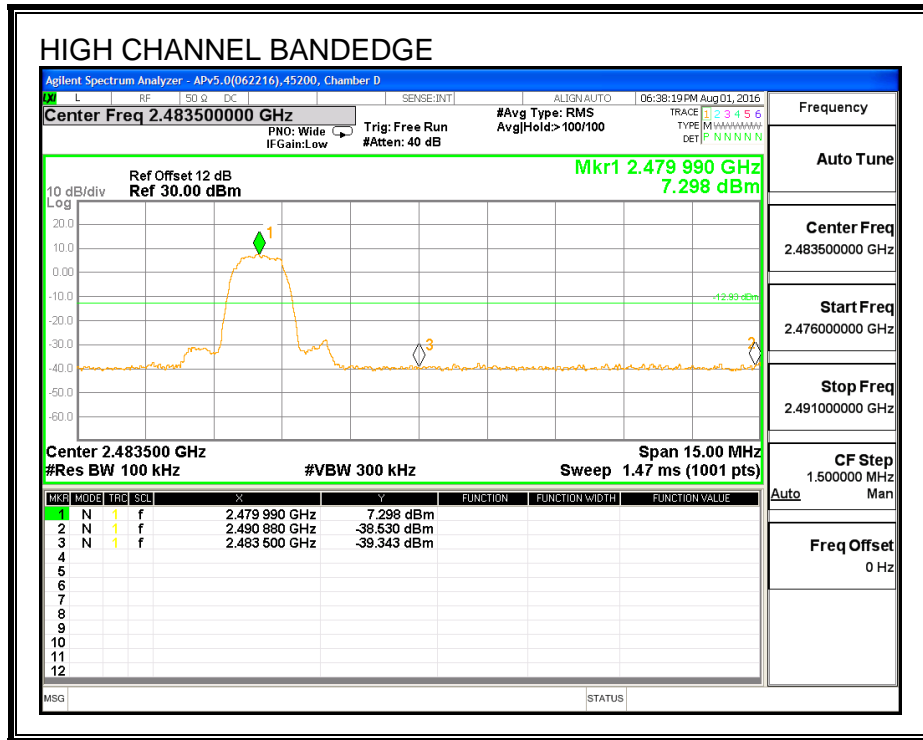
**SPURIOUS EMISSIONS, LOW CHANNEL**



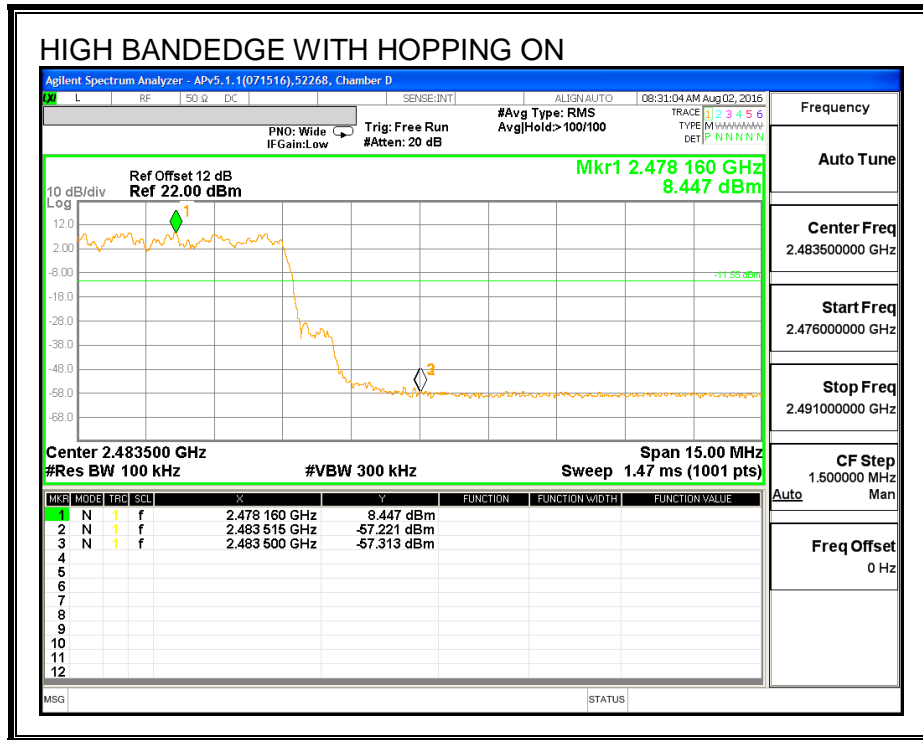
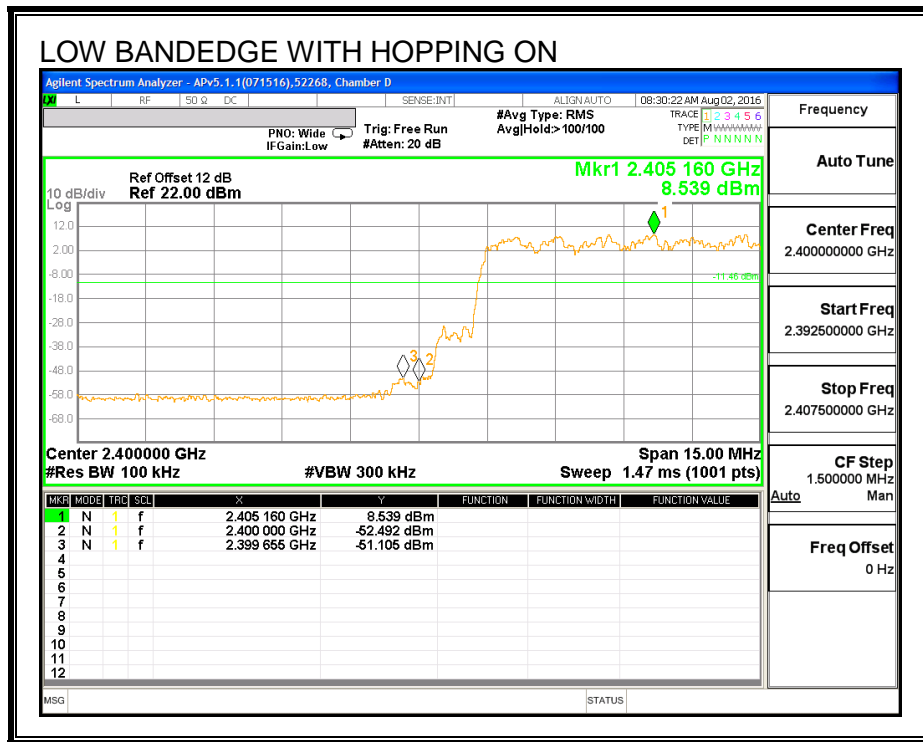
**SPURIOUS EMISSIONS, MID CHANNEL**



**SPURIOUS EMISSIONS, HIGH CHANNEL**



**SPURIOUS BANDEGE 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 final scans 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.

PKFH - FHSS: RB=100k/1MHz VB=3 x RB, Peak→ this is a note from Radiated automation software. When the frequency is below 1G, software is using RB=100kHz; when the frequency is above 1G, software is using RB=1MHz.

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.

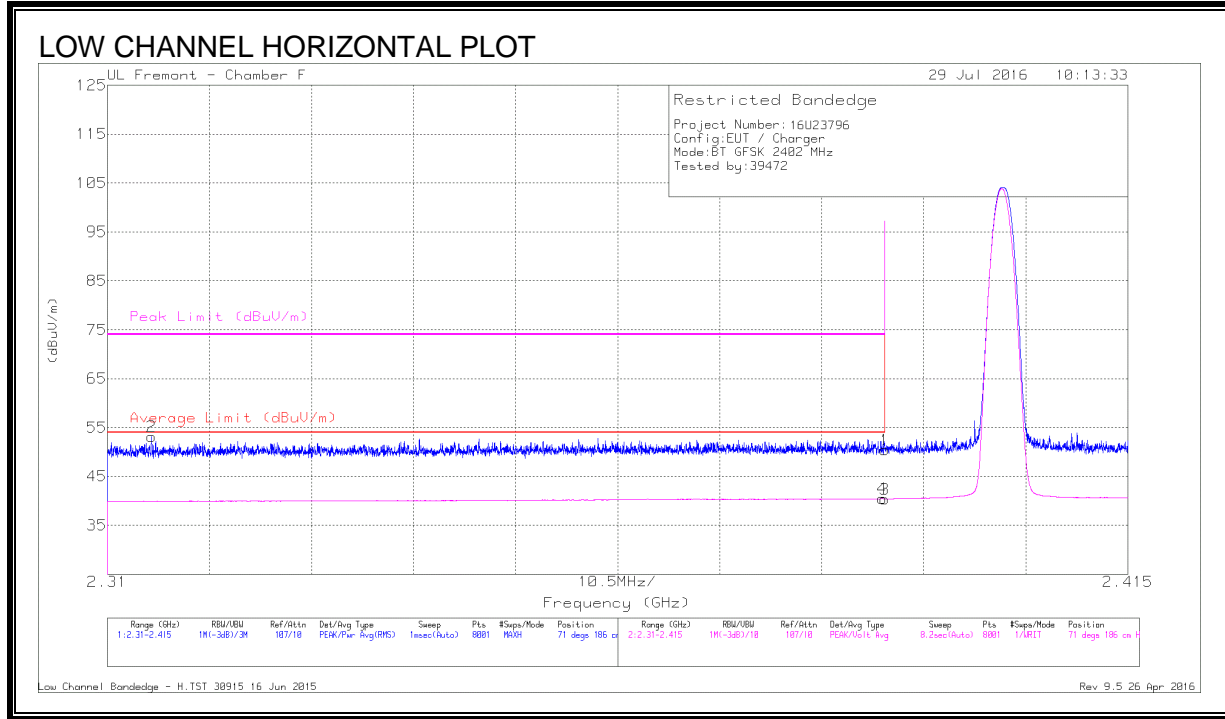
The frequency range of interest is monitored at a fixed antenna height and EUT azimuth. The EUT is rotated through 360 degrees to maximize emissions received. The antenna is scanned from 1 to 4 meters above the ground plane to further maximize the emission. Measurements are made with the antenna polarized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

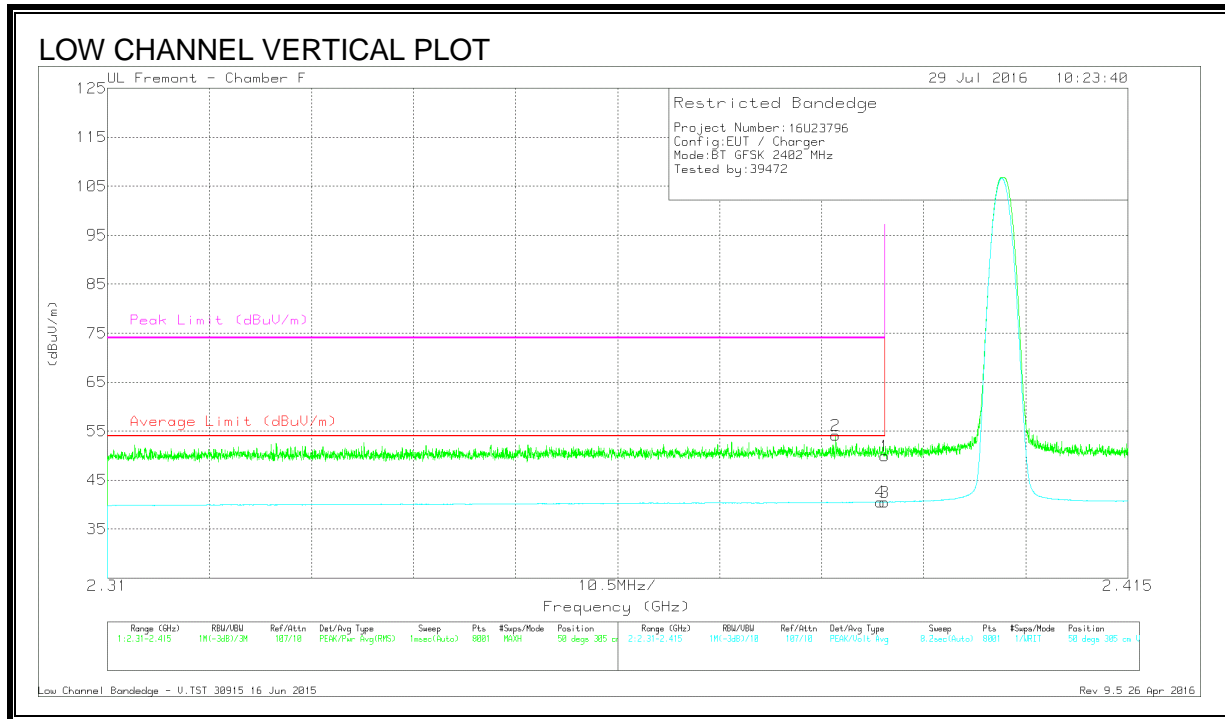
Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T344 (dB/m)	Amp/Cb/FI tr/Pa d (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.39	39.21	Pk	32.1	-20.9	50.41	-	-	74	-23.59	71	186	H
2	* 2.315	42.33	Pk	31.7	-20.9	53.13	-	-	74	-20.87	71	186	H
3	* 2.39	29.21	VA1T	32.1	-20.9	40.41	54	-13.59	-	-	71	186	H
4	* 2.39	29.25	VA1T	32.1	-20.9	40.45	54	-13.55	-	-	71	186	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 (LOW CHANNEL, VERTICAL)**



**DATA**

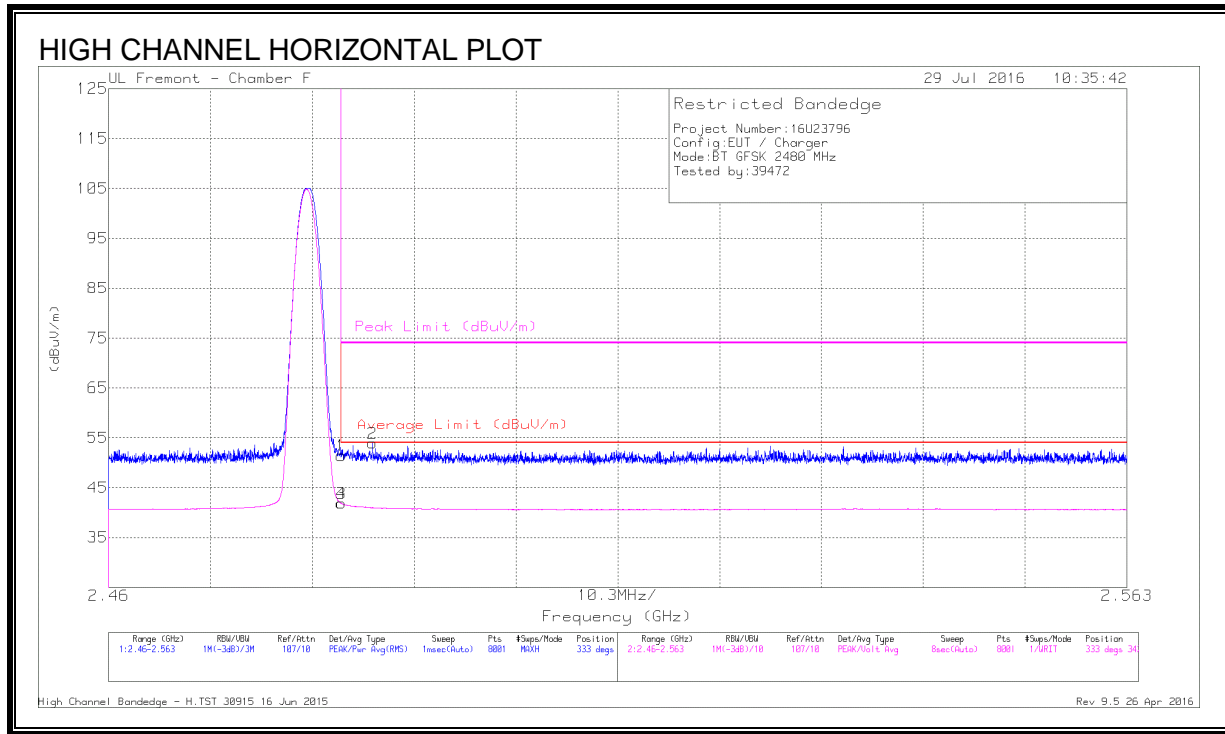
Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T344 (dB/m)	Amp/Cbl/Filtr/Par/d (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degrees)	Height (cm)	Polarity
1	* 2.39	38.77	Pk	32.1	-20.9	49.97	-	-	74	-24.03	50	305	V
2	* 2.385	42.89	Pk	32.1	-20.9	54.09	-	-	74	-19.91	50	305	V
3	* 2.39	29.31	VA1T	32.1	-20.9	40.51	54	-13.49	-	-	50	305	V
4	* 2.39	29.34	VA1T	32.1	-20.9	40.54	54	-13.46	-	-	50	305	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**

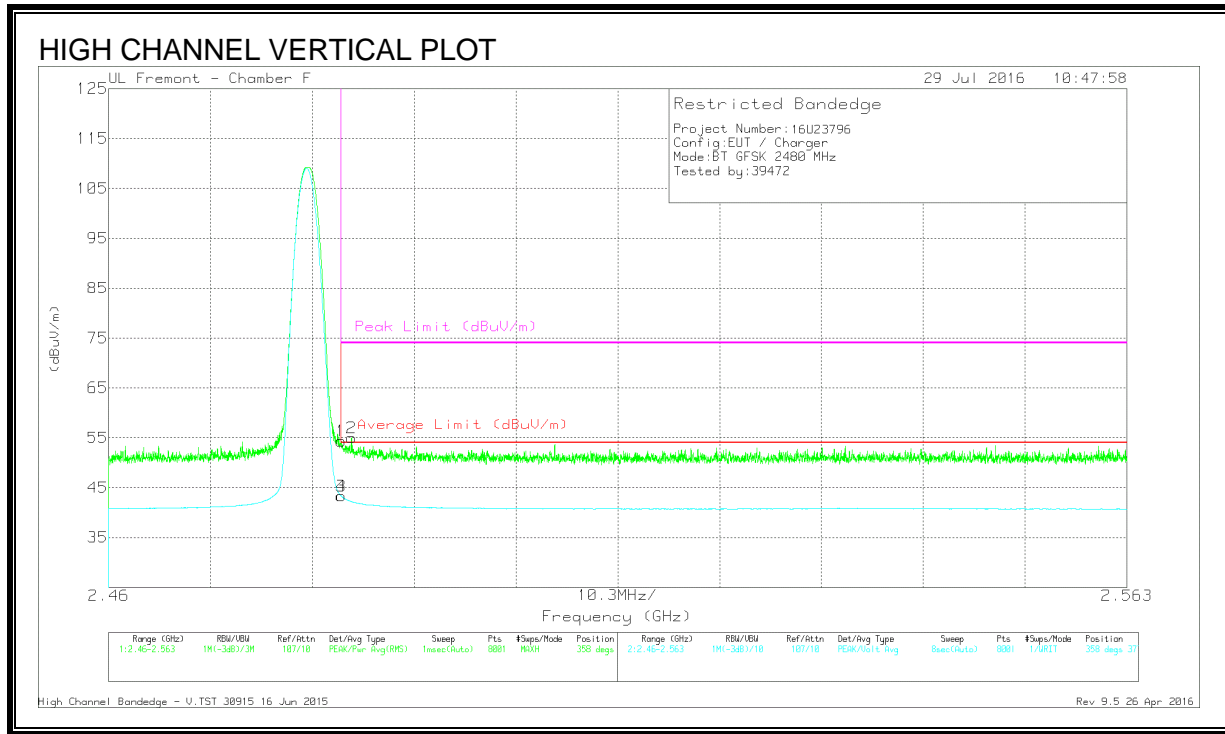
Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T344 (dB/m)	Amp/Cbl/Filtr/Par/d (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degrees)	Height (cm)	Polarity
1	* 2.484	40.14	Pk	32.3	-21	51.44	-	-	74	-22.56	333	342	H
2	* 2.487	42.52	Pk	32.3	-20.9	53.92	-	-	74	-20.08	333	342	H
3	* 2.484	30.55	VA1T	32.3	-21	41.85	54	-12.15	-	-	333	342	H
4	* 2.484	30.55	VA1T	32.3	-21	41.85	54	-12.15	-	-	333	342	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 BANDEGE (HIGH CHANNEL, VERTICAL)**



**DATA**

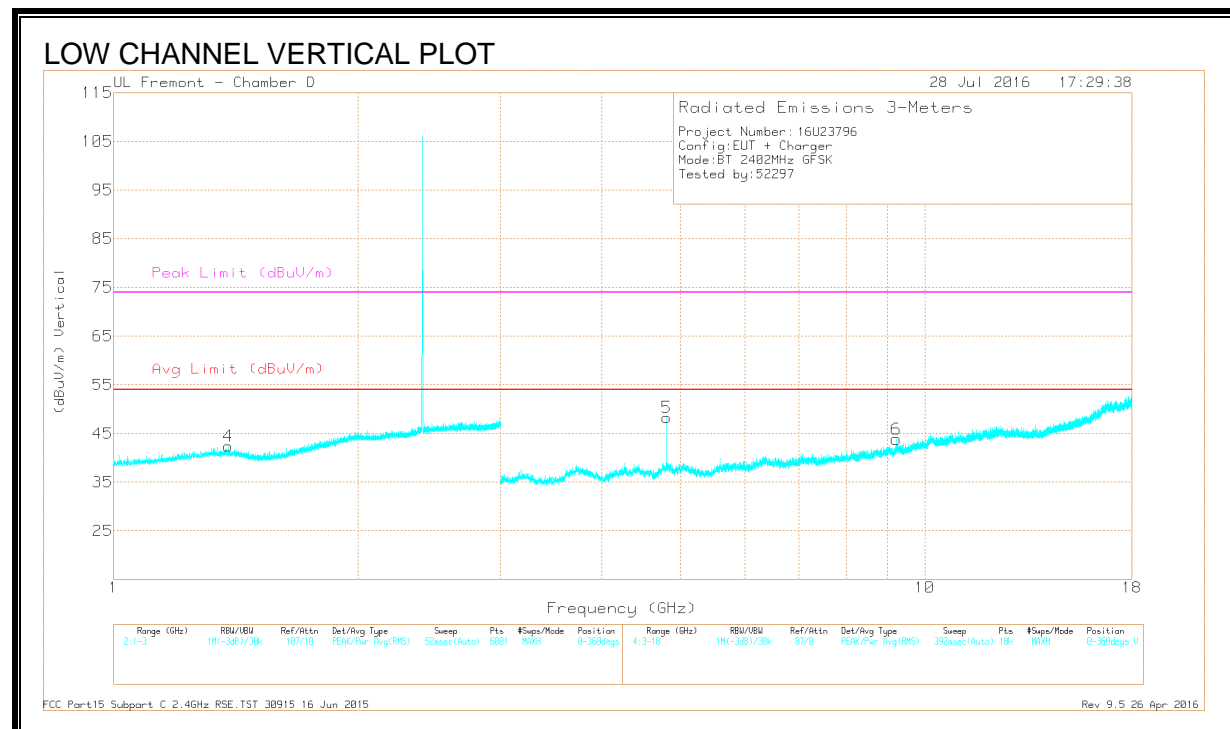
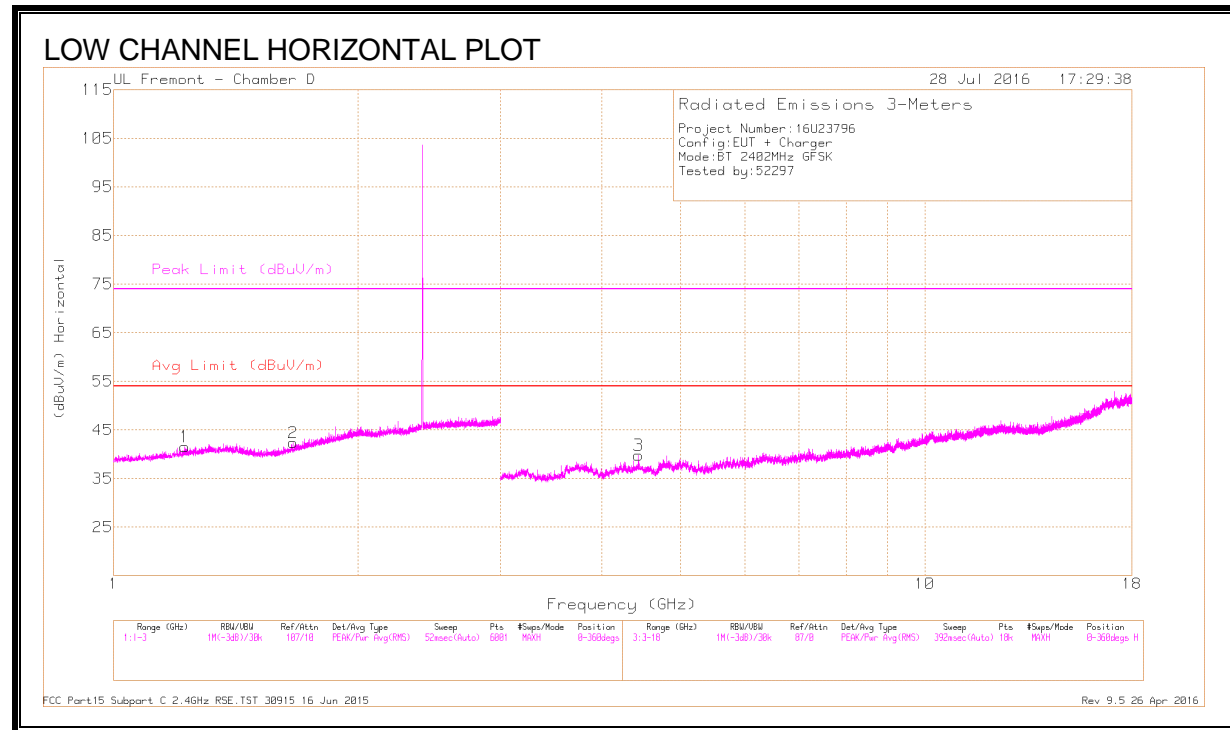
Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T344 (dB/m)	Amp/Cbl/Filtr/Par/d (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.484	43.06	Pk	32.3	-21	54.36	-	-	74	-19.64	358	377	V
2	* 2.485	43.61	Pk	32.3	-20.9	55.01	-	-	74	-18.99	358	377	V
3	* 2.484	32.02	VA1T	32.3	-21	43.32	54	-10.68	-	-	358	377	V
4	* 2.484	32.02	VA1T	32.3	-21	43.32	54	-10.68	-	-	358	377	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**



**DATA**

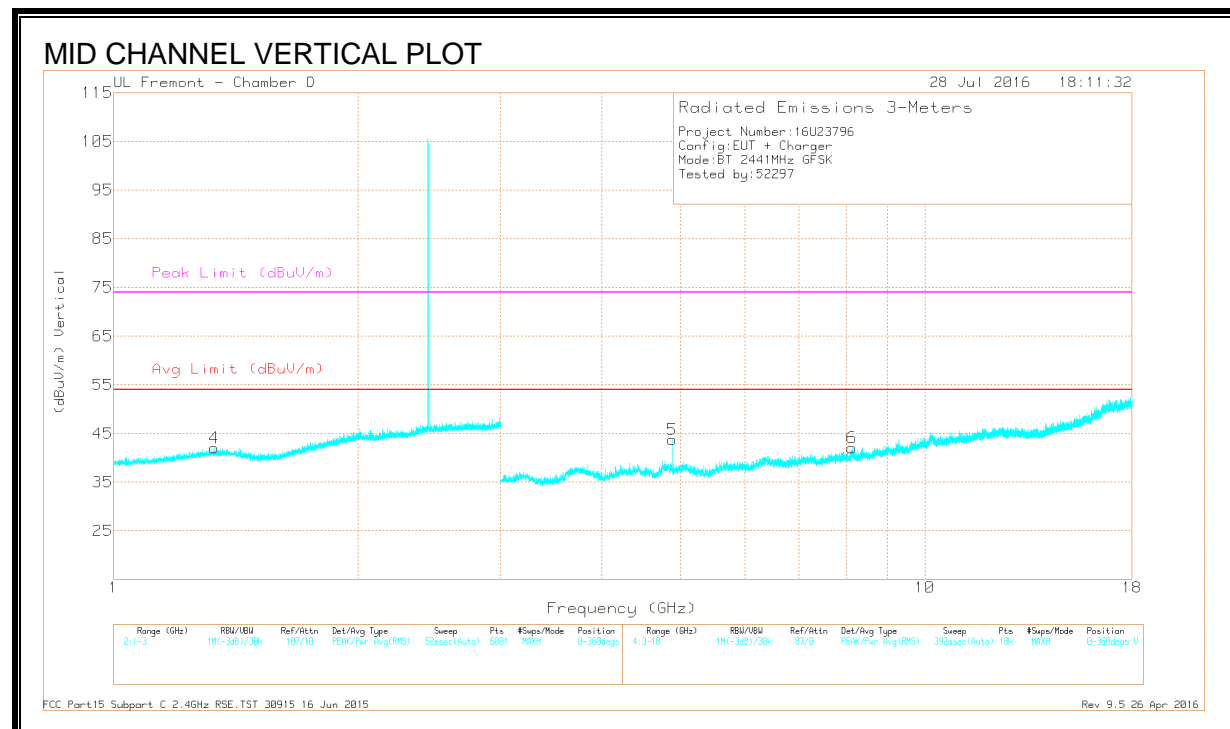
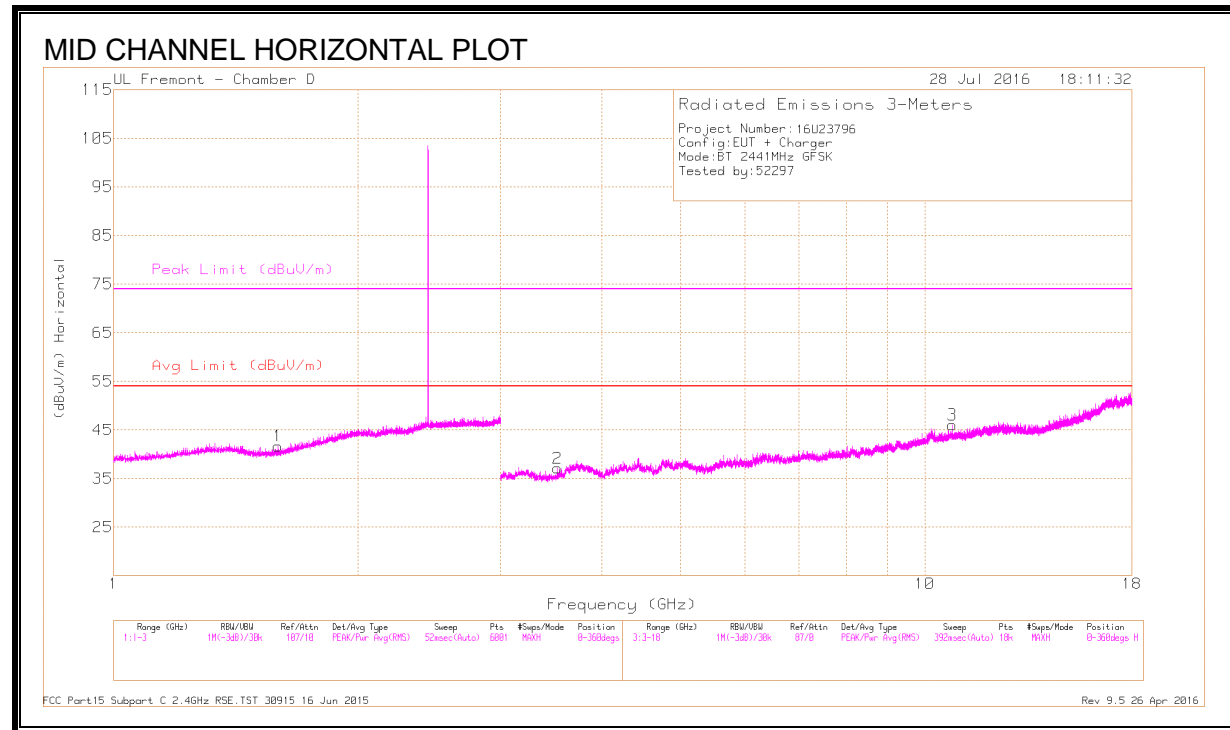
Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T712 (dB/m)	Amp/Cb/Fltr/PA (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 1.224	40.75	PKFH	28.3	-22.2	46.85	-	-	74	-27.15	17	290	H
	* 1.226	29.21	VA1T	28.3	-22.2	35.31	54	-18.69	-	-	17	290	H
2	* 1.665	41.68	PKFH	28.7	-21.5	48.88	-	-	74	-25.12	210	224	H
	* 1.667	29.05	VA1T	28.7	-21.5	36.25	54	-17.75	-	-	210	224	H
3	4.435	36.6	PKFH	33.9	-27.3	43.2	-	-	-	-	126	104	H
4	* 1.383	41.09	PKFH	29	-22	48.09	-	-	74	-25.91	193	135	V
	* 1.385	29.18	VA1T	29	-22	36.18	54	-17.82	-	-	193	135	V
5	* 4.804	44.01	PKFH	34.1	-26.7	51.41	-	-	74	-22.59	278	311	V
	* 4.804	40.27	VA1T	34.1	-26.7	47.67	54	-6.33	-	-	278	311	V
6	9.224	34.38	PKFH	36.3	-21	49.68	-	-	-	-	142	357	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**

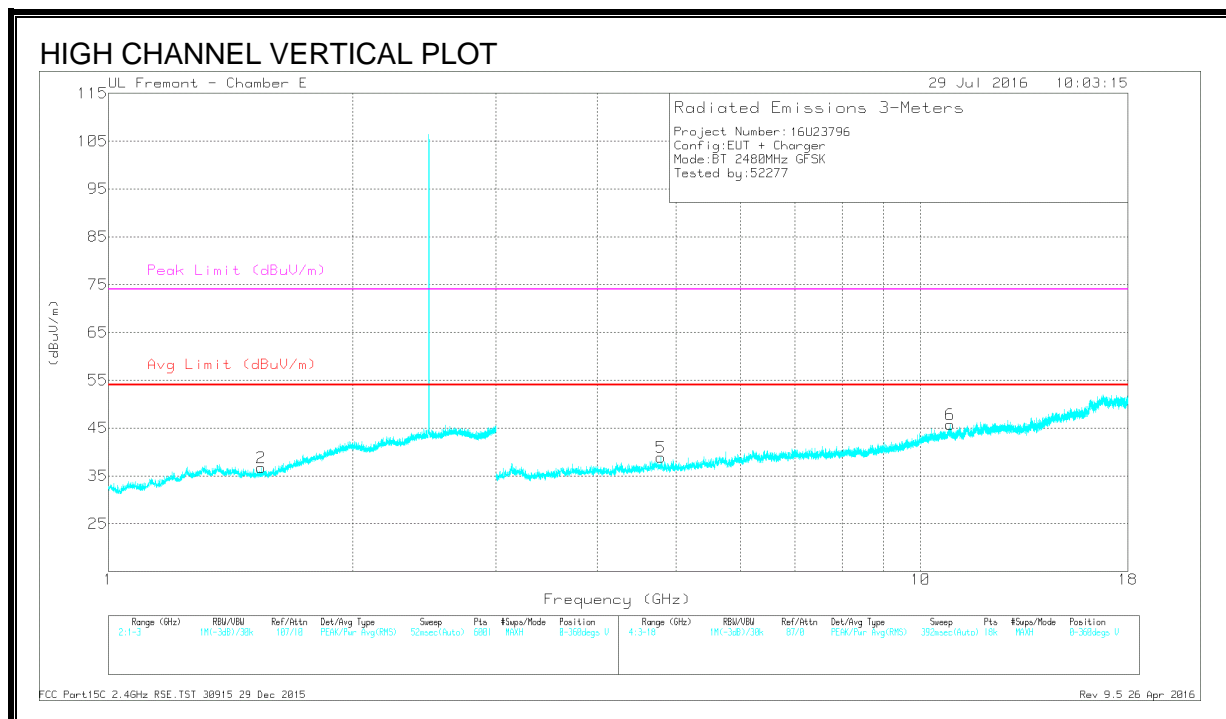
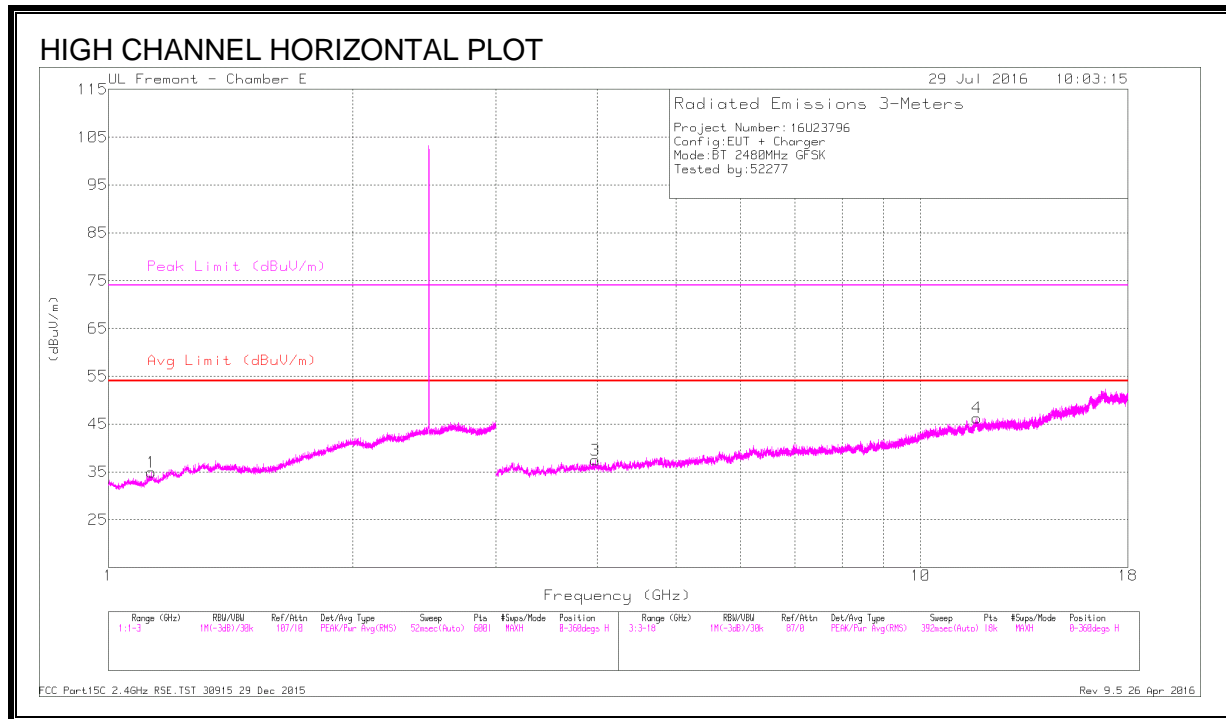
Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T712 (dB/m)	Amp/Cb/FI tr/Par d (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 1.595	41.14	PKFH	28	-21.7	47.44	-	-	74	-26.56	212	116	H
	* 1.595	29.09	VA1T	28	-21.7	35.39	54	-18.61	-	-	212	116	H
2	* 3.525	37.34	PKFH	33.1	-28.3	42.14	-	-	74	-31.86	12	233	H
	* 3.524	26.04	VA1T	33.1	-28.3	30.84	54	-23.16	-	-	12	233	H
3	* 10.816	32.86	PKFH	37.9	-20.3	50.46	-	-	74	-23.54	300	250	H
	* 10.815	21.36	VA1T	37.9	-20.4	38.86	54	-15.14	-	-	300	250	H
4	* 1.329	40.6	PKFH	28.9	-22.1	47.4	-	-	74	-26.6	53	297	V
	* 1.329	29.23	VA1T	28.9	-22.1	36.03	54	-17.97	-	-	53	297	V
5	* 4.882	41.72	PKFH	34.1	-27.9	47.92	-	-	74	-26.08	287	302	V
	* 4.882	35.9	VA1T	34.1	-27.9	42.1	54	-11.9	-	-	287	302	V
6	* 8.134	33.92	PKFH	35.8	-22.6	47.12	-	-	74	-26.88	310	180	V
	* 8.131	22.56	VA1T	35.8	-22.7	35.66	54	-18.34	-	-	310	180	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**

Marke rs	Frequen cy (GHz)	Meter Readi ng (dBuV )	Det	AF T711 (dB/m )	Amp/ Cbl/FI tr/Pa d (dB)	Corre cted Readi ng (dBuV /m)	Avg Limit (dBu V/m)	Margin (dB)	Peak Limit (dBu V/m)	PK Margin (dB)	Azimu th (Degs )	Heig ht (cm)	Polari ty
1	* 1.13	35.4	PKFH	27.9	-23.3	40	-	-	74	-34	252	135	H
	* 1.128	24.21	VA1T	27.9	-23.3	28.81	54	-25.19	-	-	252	135	H
2	* 1.541	35.56	PKFH	27.8	-21.6	41.76	-	-	74	-32.24	217	285	V
	* 1.543	23.97	VA1T	27.8	-21.6	30.17	54	-23.83	-	-	217	285	V
3	* 3.977	39.51	PKFH	33.2	-29.5	43.21	-	-	74	-30.79	53	132	H
	* 3.979	27.9	VA1T	33.2	-29.6	31.5	54	-22.5	-	-	53	132	H
4	* 11.732	36.69	PKFH	38.7	-22.8	52.59	-	-	74	-21.41	220	350	H
	* 11.731	24.68	VA1T	38.7	-22.8	40.58	54	-13.42	-	-	220	350	H
5	* 4.789	39.28	PKFH	34	-29.5	43.78	-	-	74	-30.22	213	218	V
	* 4.787	27.66	VA1T	34	-29.4	32.26	54	-21.74	-	-	213	218	V
6	* 10.883	36.21	PKFH	38	-23	51.21	-	-	74	-22.79	36	383	V
	* 10.884	24.25	VA1T	38	-23	39.25	54	-14.75	-	-	36	383	V

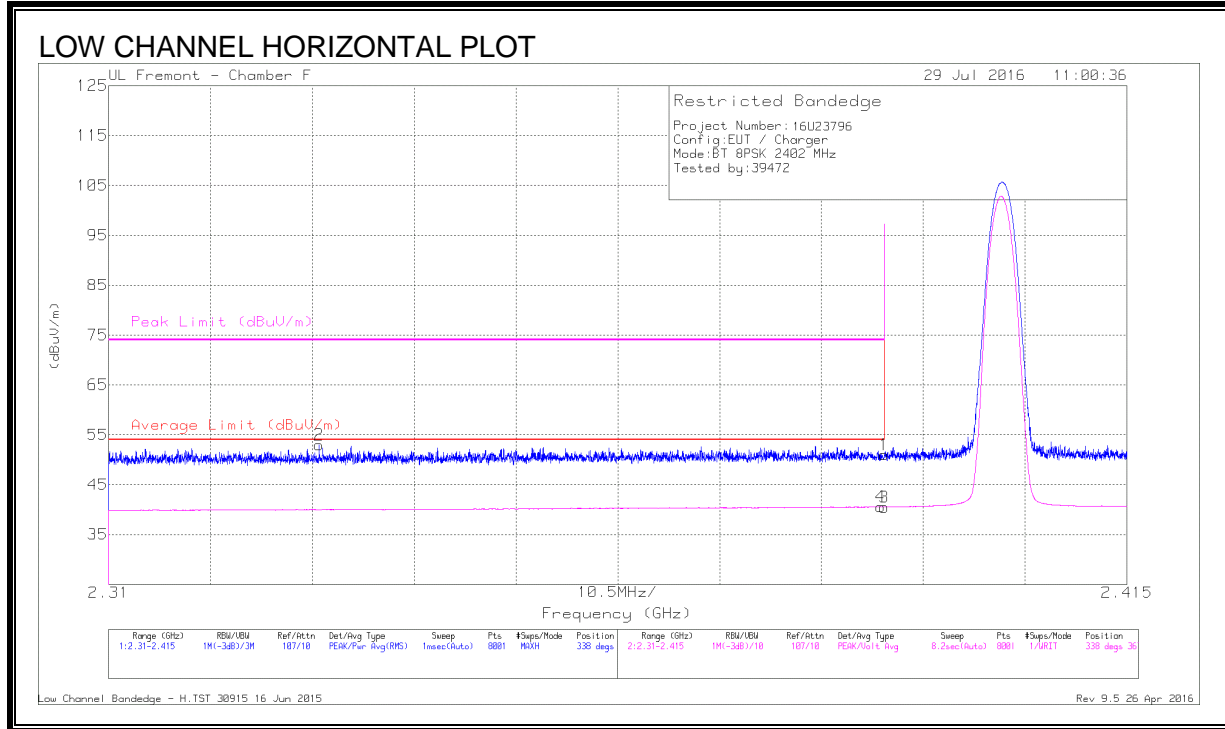
\* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band

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 8PSK MODULATION

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



#### DATA

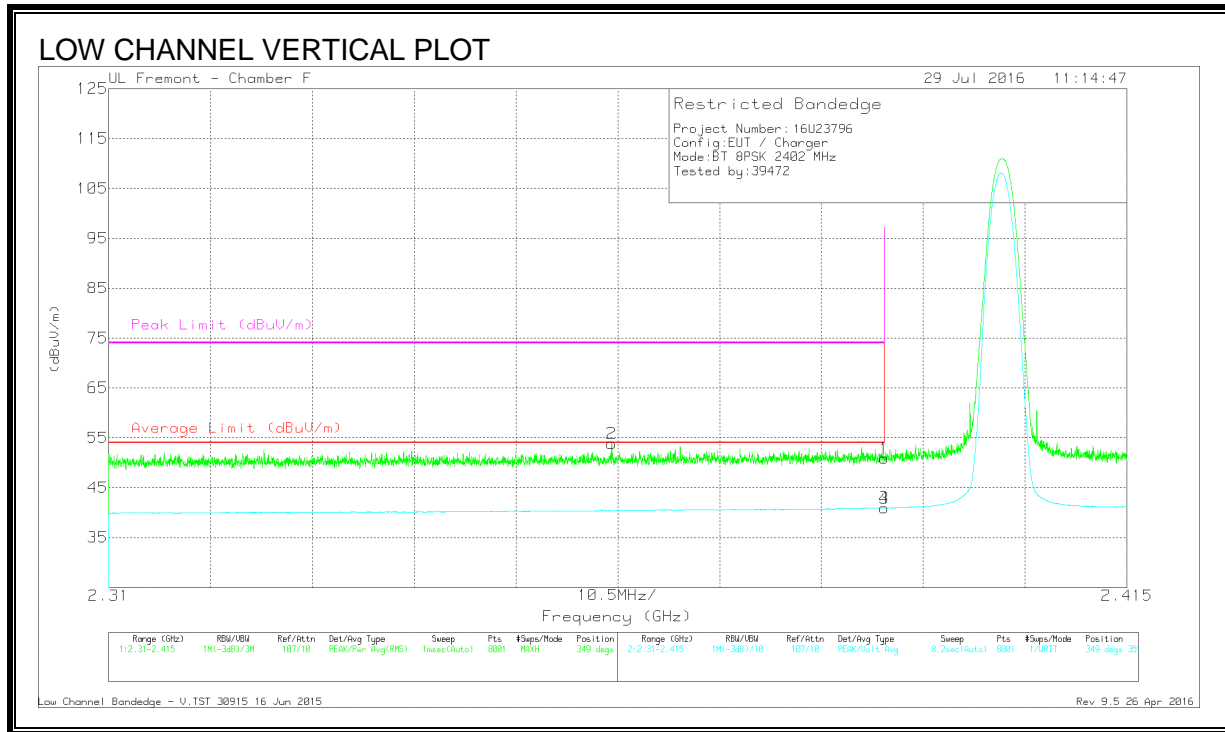
Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T344 (dB/m)	Amp/Cb/Filtr /Pad (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.39	39.84	Pk	32.1	-20.9	51.04	-	-	74	-22.96	338	367	H
2	* 2.332	42.09	Pk	31.8	-20.9	52.99	-	-	74	-21.01	338	367	H
3	* 2.39	29.3	VA1T	32.1	-20.9	40.5	54	-13.5	-	-	338	367	H
4	* 2.39	29.38	VA1T	32.1	-20.9	40.58	54	-13.42	-	-	338	367	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 BANDEGE (LOW CHANNEL, VERTICAL)**



**DATA**

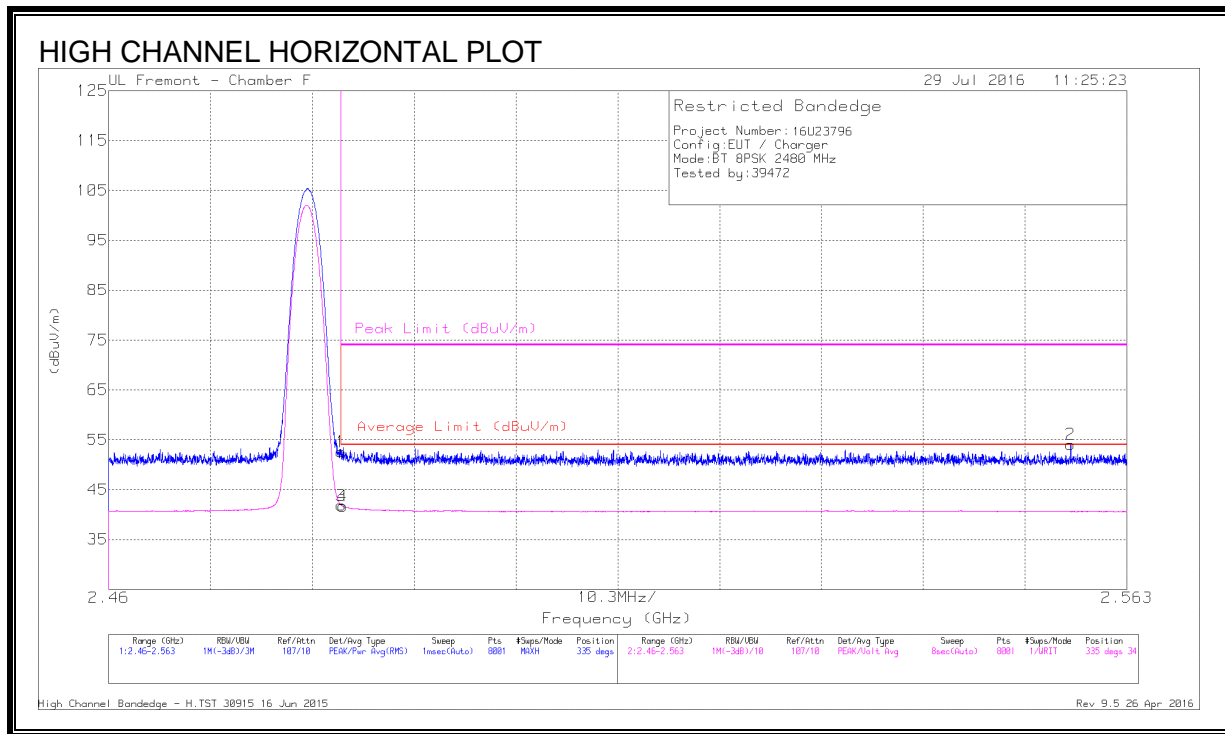
Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T344 (dB/m)	Amp /Cbl/ Fltr/ Pad (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.39	39.68	Pk	32.1	-20.9	50.88	-	-	74	-23.12	349	355	V
2	* 2.362	42.77	Pk	32	-20.9	53.87	-	-	74	-20.13	349	355	V
3	* 2.39	29.72	VA1T	32.1	-20.9	40.92	54	-13.08	-	-	349	355	V
4	* 2.39	29.73	VA1T	32.1	-20.9	40.93	54	-13.07	-	-	349	355	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**

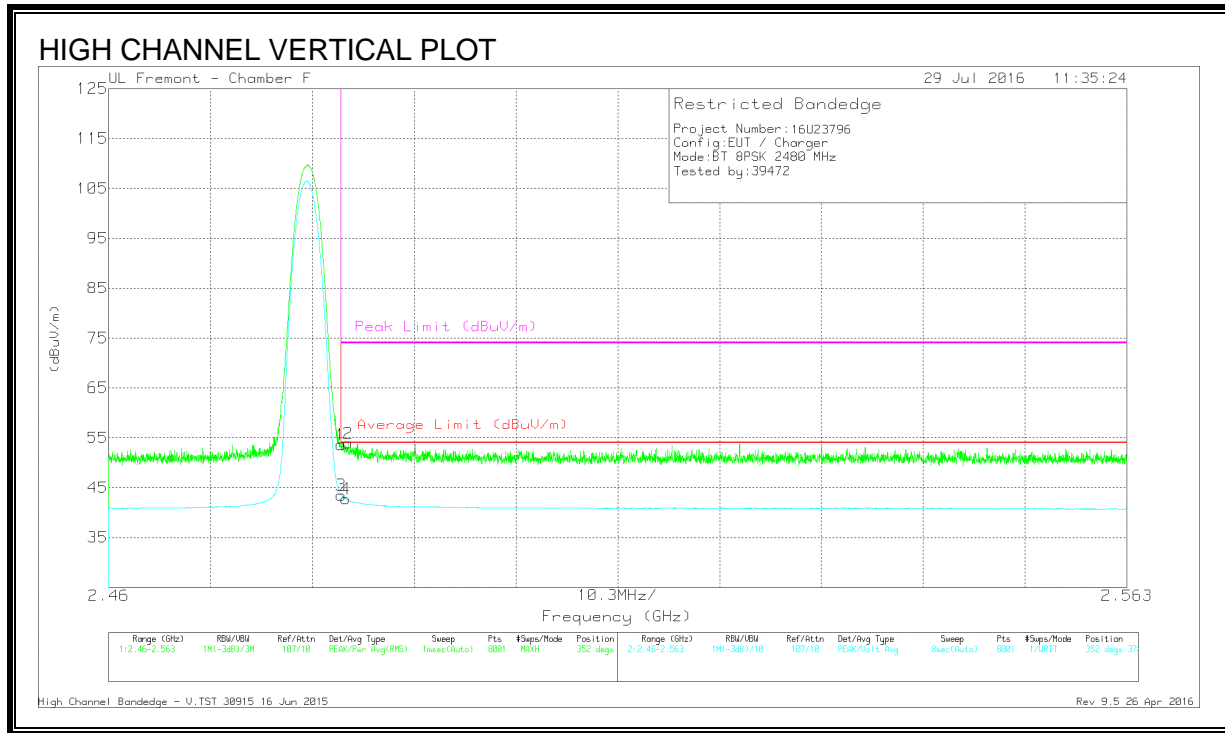
Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T344 (dB/m)	Amp/Cbl/Filtr/PA d (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.484	41.31	Pk	32.3	-21	52.61	-	-	74	-21.39	335	341	H
2	2.557	42.77	Pk	32.2	-20.9	54.07	-	-	74	-19.93	335	341	H
3	* 2.484	30.57	VA1T	32.3	-21	41.87	54	-12.13	-	-	335	341	H
4	* 2.484	30.41	VA1T	32.3	-21	41.71	54	-12.29	-	-	335	341	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**

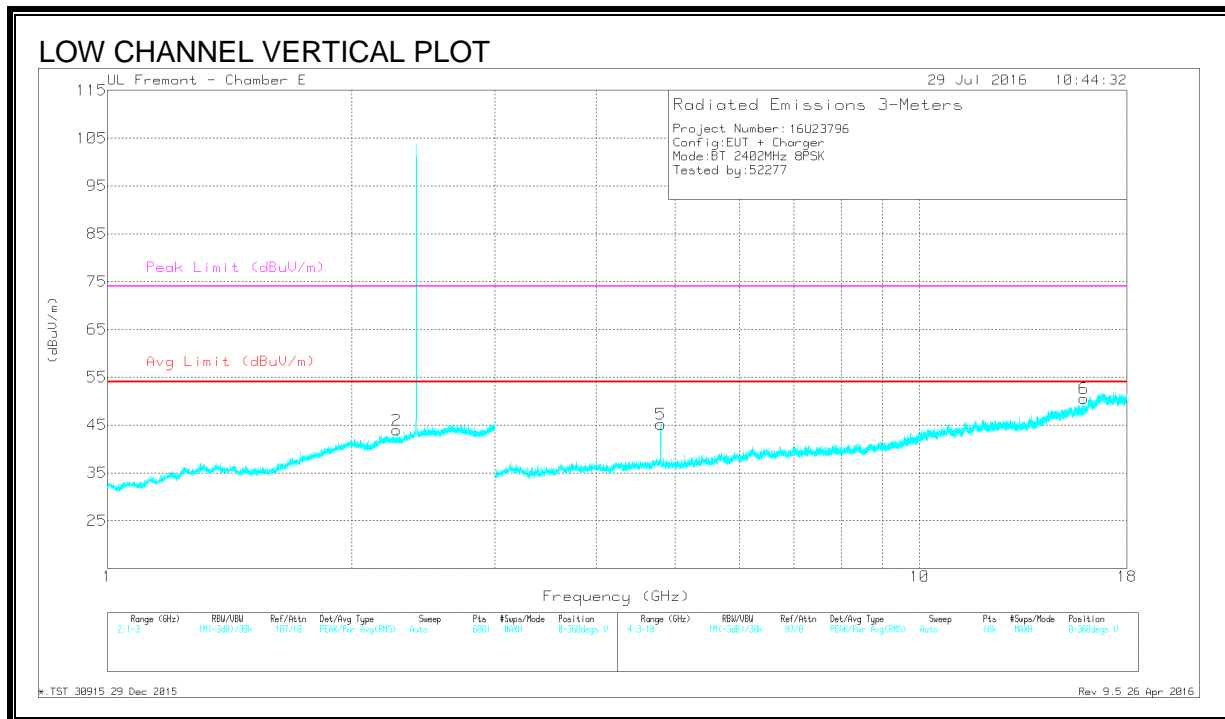
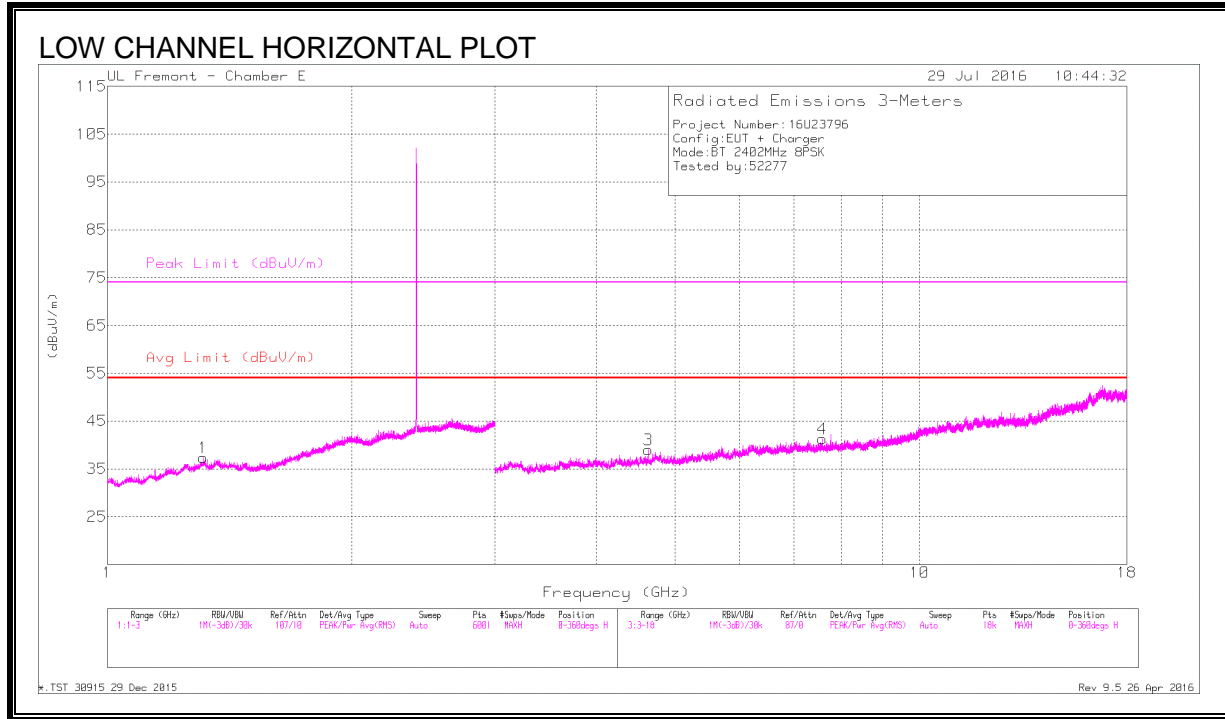
Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T344 (dB/m)	Amp/Cb/Fltr/Pa d (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degrees)	Height (cm)	Polarity
1	* 2.484	42.34	Pk	32.3	-21	53.64	-	-	74	-20.36	352	378	V
2	* 2.484	42.61	Pk	32.3	-21	53.91	-	-	74	-20.09	352	378	V
3	* 2.484	32.2	VA1T	32.3	-21	43.5	54	-10.5	-	-	352	378	V
4	* 2.484	31.44	VA1T	32.3	-21	42.74	54	-11.26	-	-	352	378	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**





**DATA**

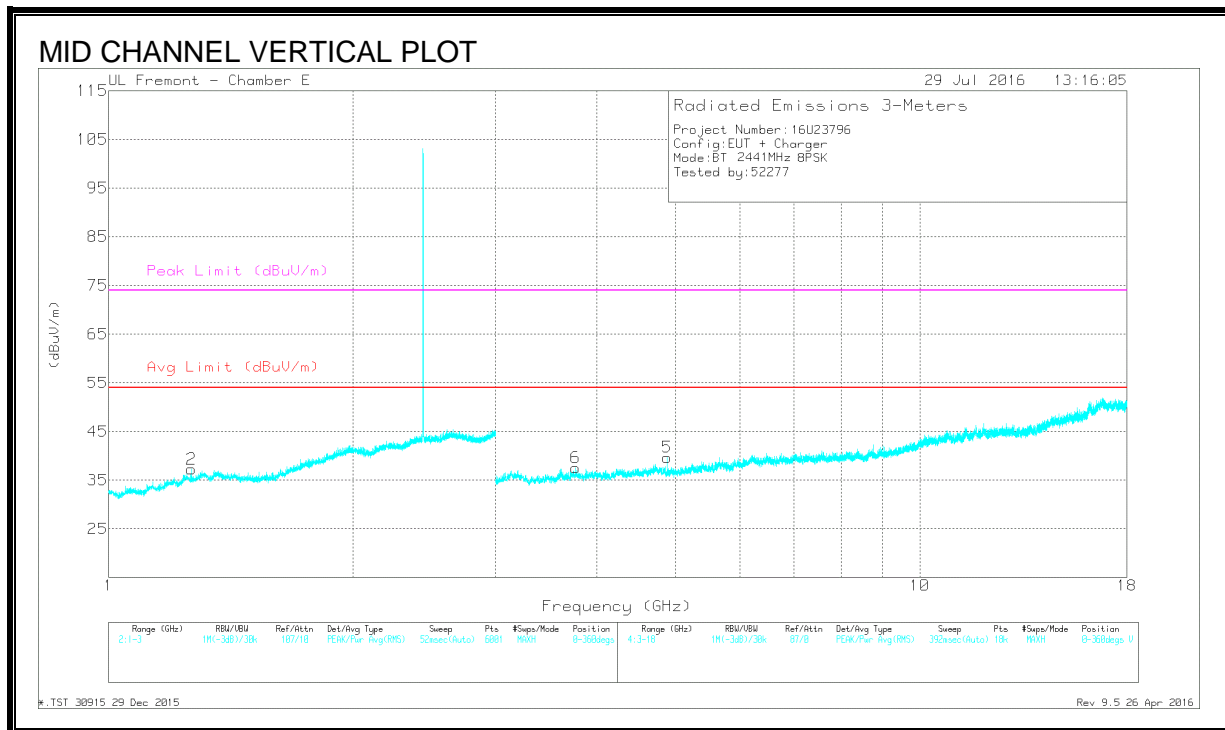
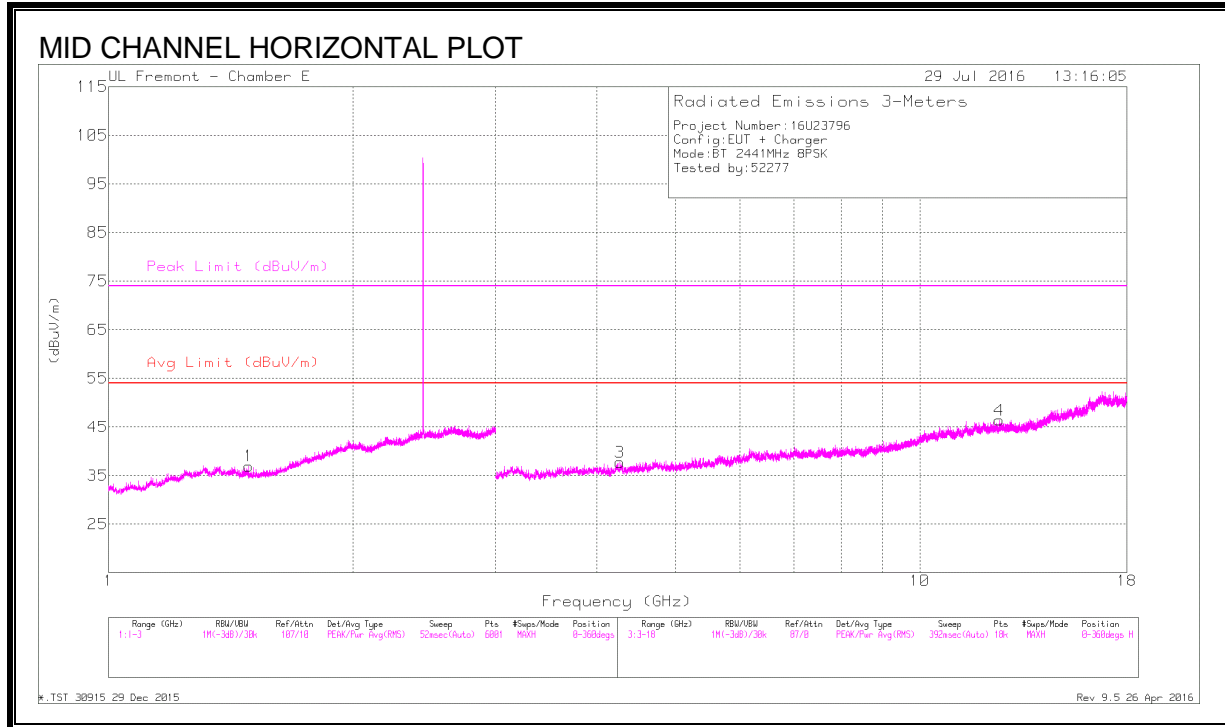
Markers	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T711 (dB/m)	Amp/Cbl/Filtr/Pad (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 1.313	35.22	PKFH	29.3	-22.3	42.22	-	-	74	-31.78	88	100	H
	* 1.312	24.12	VA1T	29.3	-22.4	31.02	54	-22.98	-	-	88	100	H
2	* 2.27	37.32	PKFH	31.6	-20.1	48.82	-	-	74	-25.18	153	134	V
	* 2.27	24.73	VA1T	31.6	-20.1	36.23	54	-17.77	-	-	153	134	V
3	* 4.638	40.2	PKFH	33.9	-30.6	43.5	-	-	74	-30.5	179	109	H
	* 4.637	28.91	VA1T	33.9	-30.6	32.21	54	-21.79	-	-	179	109	H
4	* 7.587	36.49	PKFH	35.7	-26	46.19	-	-	74	-27.81	0	122	H
	* 7.589	25.27	VA1T	35.7	-26	34.97	54	-19.03	-	-	0	122	H
5	* 4.8	46.34	PKFH	34	-29.7	50.64	-	-	74	-23.36	152	302	V
	* 4.8	39.84	VA1T	34	-29.7	44.14	54	-9.86	-	-	152	302	V
6	* 15.932	36.71	PKFH	40.7	-22	55.41	-	-	74	-18.59	62	249	V
	* 15.93	25.41	VA1T	40.7	-22.1	44.01	54	-9.99	-	-	62	249	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**

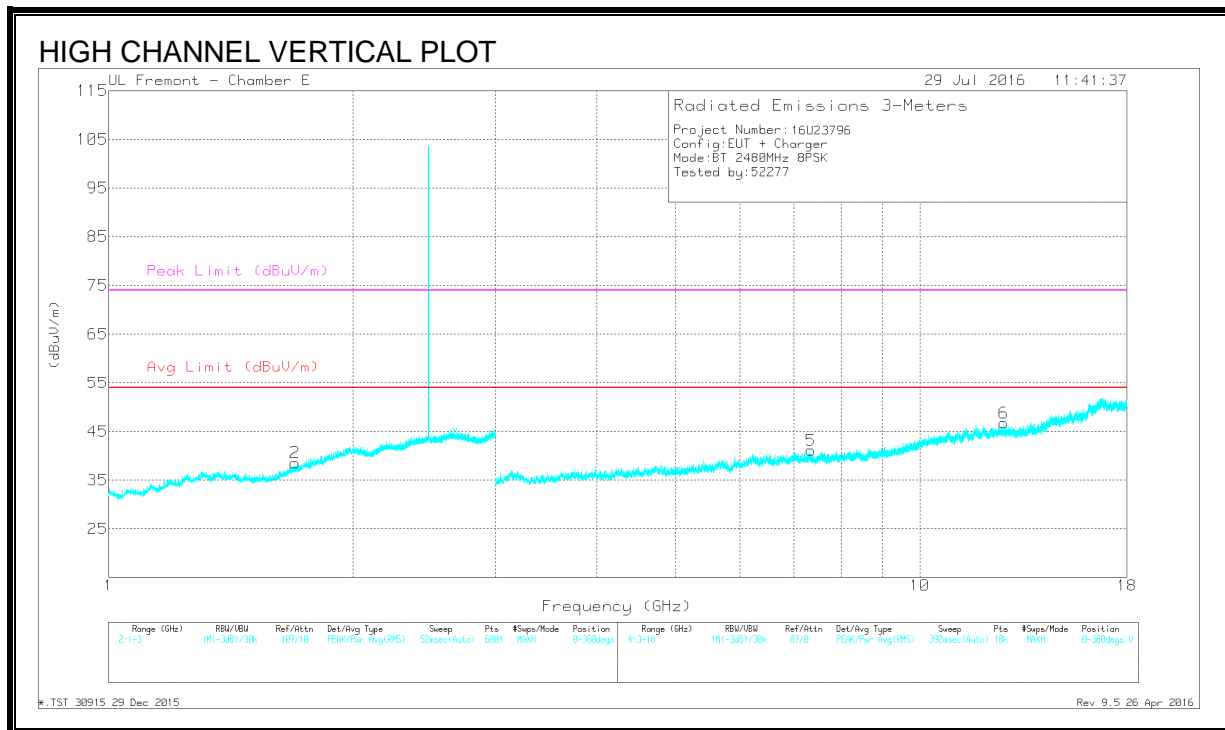
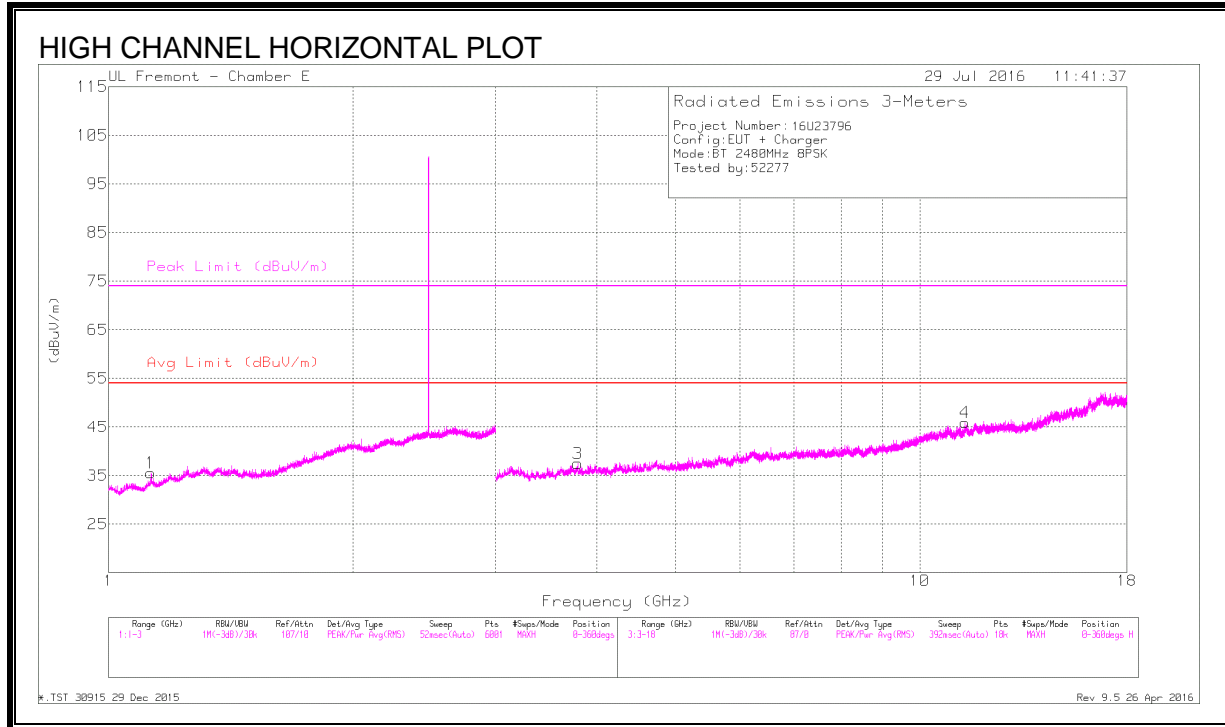
Marker s	Frequen cy (GHz)	Meter Readi ng (dBuV )	Det	AF T711 (dB/ m)	Amp/ Cbl/FI tr/Pa d (dB)	Correct ed Readin g (dBuV/ m)	Avg Limit (dBuV /m)	Margin (dB)	Peak Limit (dBu V/m )	PK Margi n (dB)	Azimu th (Degs )	Heig ht (cm)	Polarit y
1	* 1.489	35.23	PKFH	27.9	-21.6	41.53	-	-	74	-32.47	112	134	H
	* 1.487	23.96	VA1T	27.9	-21.6	30.26	54	-23.74	-	-	112	134	H
2	* 1.265	34.53	PKFH	29.1	-22.7	40.93	-	-	74	-33.07	111	348	V
	* 1.263	23.57	VA1T	29.1	-22.7	29.97	54	-24.03	-	-	111	348	V
3	* 4.266	39.89	PKFH	33.3	-29.1	44.09	-	-	74	-29.91	241	328	H
	* 4.268	27.66	VA1T	33.3	-29.2	31.76	54	-22.24	-	-	241	328	H
4	* 12.53	36.45	PKFH	39.1	-23.9	51.65	-	-	74	-22.35	64	155	H
	* 12.529	24.98	VA1T	39.1	-23.9	40.18	54	-13.82	-	-	64	155	H
5	* 4.882	42.62	PKFH	34	-30.4	46.22	-	-	74	-27.78	145	288	V
	* 4.882	34.22	VA1T	34	-30.4	37.82	54	-16.18	-	-	145	288	V
6	* 3.763	40.15	PKFH	33.1	-30.2	43.05	-	-	74	-30.95	259	118	V
	* 3.761	28.22	VA1T	33.1	-30.1	31.22	54	-22.78	-	-	259	118	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**

Markers	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T711 (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	* 1.128	36.87	PKFH	27.9	-23.3	41.47	-	-	74	-32.53	156	320	H
	* 1.129	24.16	VA1T	27.9	-23.3	28.76	54	-25.24	-	-	156	320	H
2	* 1.696	35.61	PKFH	29.1	-21.1	43.61	-	-	74	-30.39	268	307	V
	* 1.697	23.98	VA1T	29.1	-21	32.08	54	-21.92	-	-	268	307	V
3	* 3.787	39.94	PKFH	33.1	-30.5	42.54	-	-	74	-31.46	143	396	H
	* 3.789	28.55	VA1T	33.1	-30.6	31.05	54	-22.95	-	-	143	396	H
4	* 11.36	35.39	PKFH	38.2	-23	50.59	-	-	74	-23.41	61	327	H
	* 11.361	24.48	VA1T	38.2	-23	39.68	54	-14.32	-	-	61	327	H
5	* 7.341	38.23	PKFH	35.6	-26.9	46.93	-	-	74	-27.07	49	383	V
	* 7.342	25.98	VA1T	35.6	-26.9	34.68	54	-19.32	-	-	49	383	V
6	* 12.693	36.15	PKFH	39.2	-24	51.35	-	-	74	-22.65	339	380	V
	* 12.693	25.37	VA1T	39.2	-24	40.57	54	-13.43	-	-	339	380	V

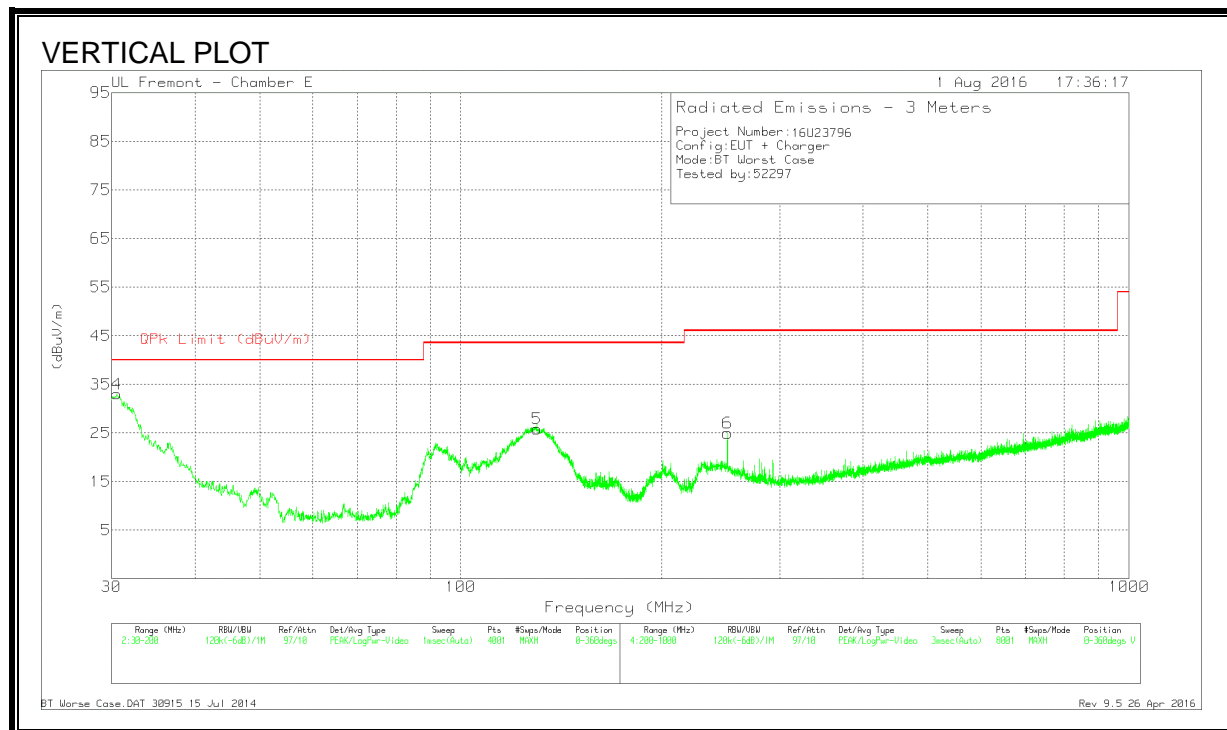
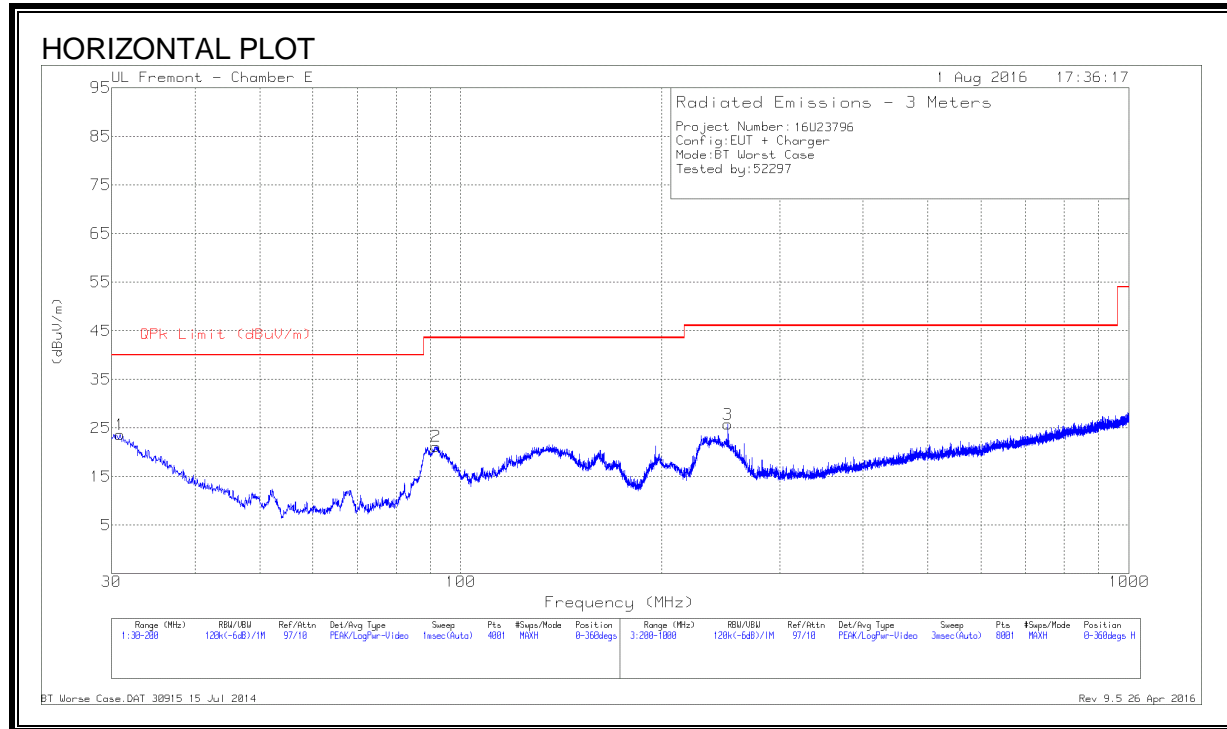
\* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band

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 1GHz

#### SPURIOUS EMISSIONS 30MHz TO 1 GHz (WORST-CASE CONFIGURATION)



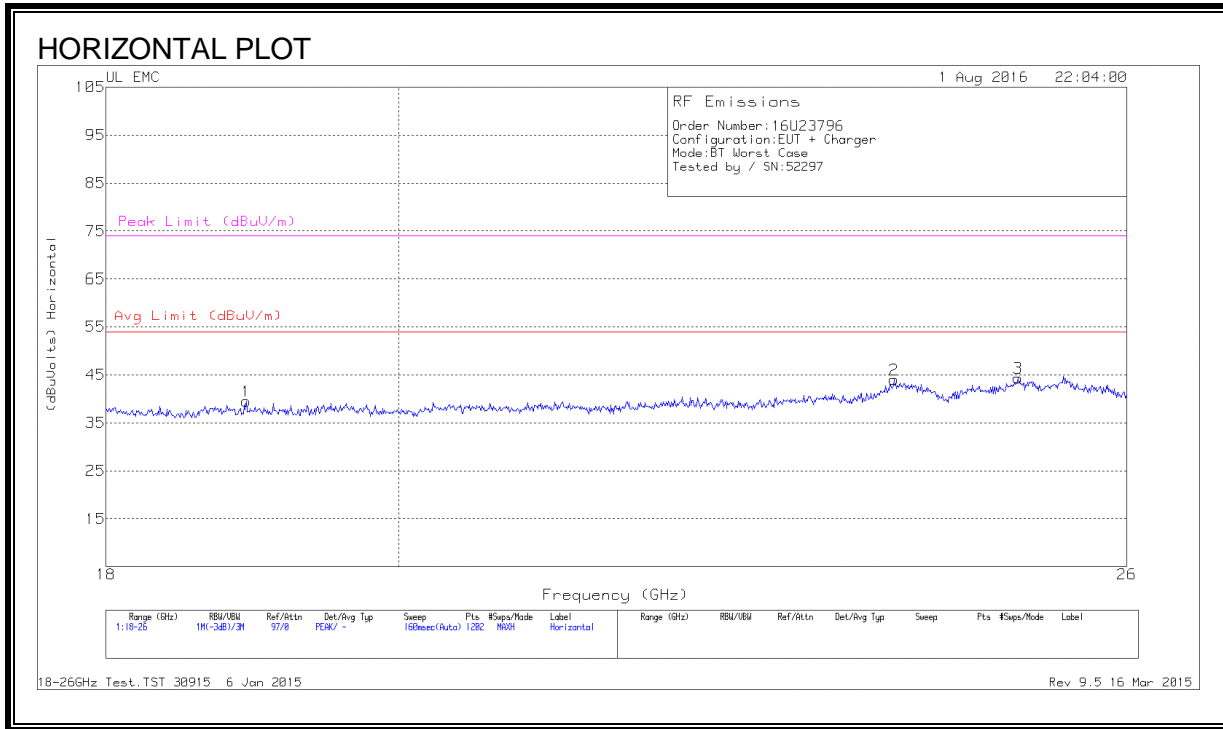
**Data**

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
1	30.8925	30.95	Pk	24.5	-31.8	23.65	40	-16.35	0-360	300	H
2	91.795	40.61	Pk	12	-31.4	21.21	43.52	-22.31	0-360	300	H
3	* 251	40.95	Pk	15.4	-30.6	25.75	46.02	-20.27	0-360	100	H
4	30.5525	40.02	Pk	24.8	-31.8	33.02	40	-6.98	0-360	100	V
5	* 130.045	39.16	Pk	17.9	-31.2	25.86	43.52	-17.66	0-360	100	V
6	* 250.7	40.17	Pk	15.4	-30.6	24.97	46.02	-21.05	0-360	200	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)





**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	18.933	41.8	Pk	32.5	-25.3	-9.5	39.5	54	-14.5	74	-34.5
2	23.908	43.4	Pk	34	-23.9	-9.5	44	54	-10	74	-30
3	25.001	44.23	Pk	34.2	-24.6	-9.5	44.33	54	-9.67	74	-29.67
4	18.36	41.37	Pk	32.4	-25.1	-9.5	39.17	54	-14.83	74	-34.83
5	23.955	43.63	Pk	34	-24.3	-9.5	43.83	54	-10.17	74	-30.17
6	25.447	43.83	Pk	34.4	-24.4	-9.5	44.33	54	-9.67	74	-29.67

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 $\mu$ V)	
	Quasi-peak	Average
0.15-0.5	66 to 56 *	56 to 46 *
0.5-5	56	46
5-30	60	50

\*Decreases with the logarithm of the frequency.

### 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.

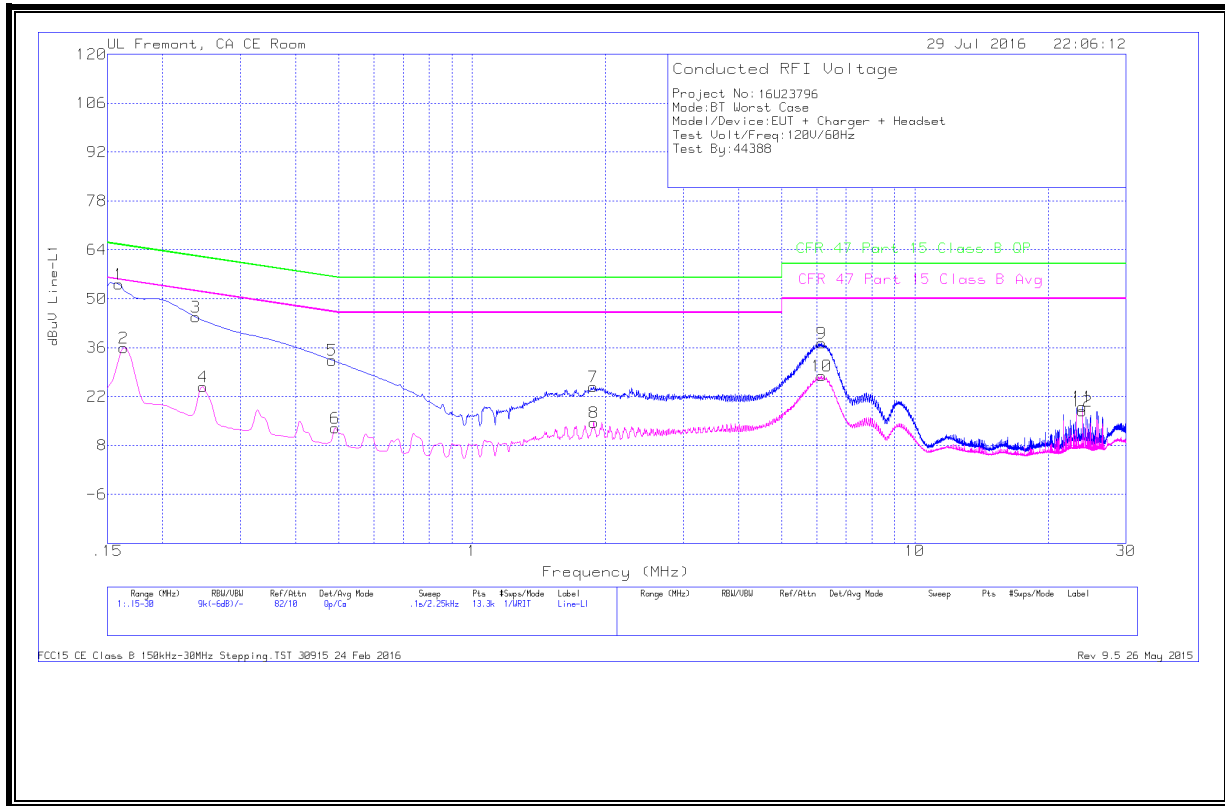
The receiver is set to a resolution bandwidth of 9 kHz. Peak detection is used unless otherwise noted as quasi-peak or average.

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

### RESULTS

**EUT POWERED BY AC/DC ADAPTER VIA USB CABLE**

**LINE 1 RESULTS**

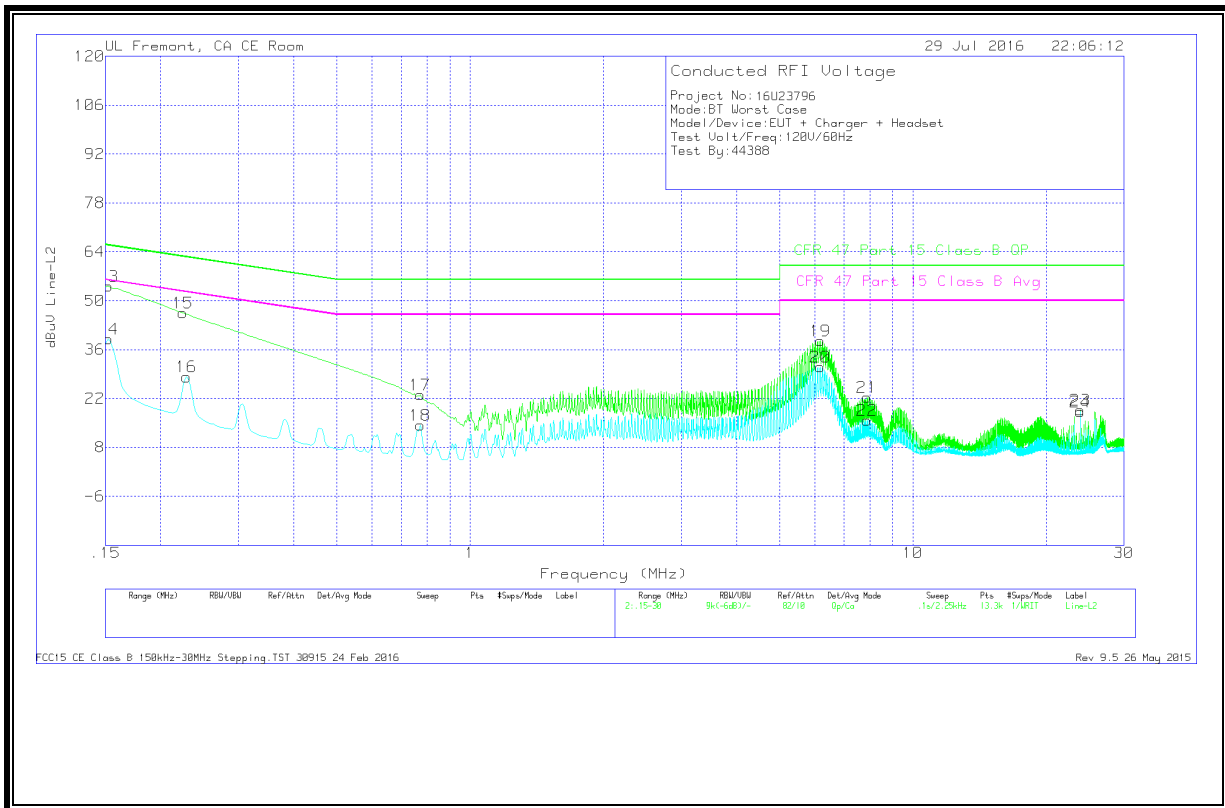


**WORST EMISSIONS**

Range 1: 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	.159	44.1	Qp	0	0	10.1	54.2	65.52	-11.32	-	-
2	.1635	25.83	Ca	0	0	10.1	35.93	-	-	55.28	-19.35
3	.23775	34.63	Qp	0	0	10.1	44.73	62.17	-17.44	-	-
4	.24675	14.64	Ca	0	0	10.1	24.74	-	-	51.87	-27.13
5	.483	22.26	Qp	0	0	10.1	32.36	56.29	-23.93	-	-
6	.48975	2.92	Ca	0	0	10.1	13.02	-	-	46.17	-33.15
7	1.88025	14.58	Qp	0	.1	10.1	24.78	56	-31.22	-	-
8	1.8825	4.27	Ca	0	.1	10.1	14.47	-	-	46	-31.53
9	6.15975	27.02	Qp	0	.1	10.2	37.32	60	-22.68	-	-
10	6.1575	17.55	Ca	0	.1	10.2	27.85	-	-	50	-22.15
11	23.919	8.33	Qp	.1	.2	10.4	19.03	60	-40.97	-	-
12	23.919	7.13	Ca	.1	.2	10.4	17.83	-	-	50	-32.17

Qp - Quasi-Peak detector  
 Ca - CISPR average detection

**LINE 2 RESULTS**



**WORST EMISSIONS**

Range 2: 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	.15225	44.07	Qp	0	0	10.1	54.17	65.88	-11.71	-	-
14	.15225	28.92	Ca	0	0	10.1	39.02	-	-	55.88	-16.86
15	.22425	36.45	Qp	0	0	10.1	46.55	62.66	-16.11	-	-
16	.22875	18.09	Ca	0	0	10.1	28.19	-	-	52.49	-24.3
17	.771	13.03	Qp	0	0	10.1	23.13	56	-32.87	-	-
18	.771	4.34	Ca	0	0	10.1	14.44	-	-	46	-31.56
19	6.17325	28.2	Qp	0	.1	10.2	38.5	60	-21.5	-	-
20	6.17325	20.71	Ca	0	.1	10.2	31.01	-	-	50	-18.99
21	7.872	12.05	Qp	0	.1	10.2	22.35	60	-37.65	-	-
22	7.872	5.5	Ca	0	.1	10.2	15.8	-	-	50	-34.2
23	23.919	8.08	Qp	.1	.2	10.4	18.78	60	-41.22	-	-
24	23.919	7.53	Ca	.1	.2	10.4	18.23	-	-	50	-31.77

Qp - Quasi-Peak detector  
 Ca - CISPR average detection