



CERTIFICATION TEST REPORT

Report Number. : 11949808-E1V2

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

Model : A1639

FCC ID : BCG-A1639

IC : 579C-A1639

EUT Description : WIRELESS SPEAKER

Test Standard(s) : FCC 47 CFR PART 15 SUBPART C
INDUSTRY CANADA RSS - 247 ISSUE 2

Date Of Issue:
October 16, 2017

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NVLAP LAB CODE 200065-0

Revision History

Rev.	Issue Date	Revisions	Revised By
V1	10/9/2017	Initial Review	Tri Pham
V2	10/16/2017	Address TCB's Questions	Chin Pang

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1. ATTESTATION OF TEST RESULTS

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

EUT DESCRIPTION: WIRELESS SPEAKER

MODEL: A1639

SERIAL NUMBER: CC4V2283J5Y3

DATE TESTED: AUGUST 15, 2017 – SEPTEMBER 18, 2017

APPLICABLE STANDARDS	
STANDARD	TEST RESULTS
CFR 47 Part 15 Subpart C	Pass
INDUSTRY CANADA RSS-247 Issue 2	Pass
INDUSTRY CANADA RSS-GEN Issue 4	Pass

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

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

Approved & Released For
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UL VERIFICATION SERVICES INC.

Prepared By:



TRI PHAM
TEST 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, KDB 558074 D01 v04, ANSI C63.10-2013, RSS-GEN Issue 4, and RSS-247 Issue 2.

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 (IC:2324B-1)	☒ Chamber D (IC:22541-1)
☐ Chamber B (IC:2324B-2)	☐ Chamber E (IC:22541-2)
☐ Chamber C (IC:2324B-3)	☒ Chamber F (IC:22541-3)
	☐ Chamber G (IC:22541-4)
	☐ Chamber H (IC:22541-5)

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

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

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

4.3. MEASUREMENT UNCERTAINTY

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

Parameter	Uncertainty
Worst Case Conducted Disturbance, 9KHz to 0.15 MHz	3.84 dB
Worst Case Conducted Disturbance, 0.15 to 30 MHz	3.65 dB
Worst Case Radiated Disturbance, 9KHz to 30 MHz	3.15 dB
Worst Case Radiated Disturbance, 30 to 1000 MHz	5.36 dB
Worst Case Radiated Disturbance, 1000 to 18000 MHz	4.32 dB
Worst Case Radiated Disturbance, 18000 to 26000 MHz	4.45 dB
Worst Case Radiated Disturbance, 26000 to 40000 MHz	5.24 dB
Occupied Channel Bandwidth	±0.39 %
Time	±0.02 %

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

5. EQUIPMENT UNDER TEST

5.1. DESCRIPTION OF EUT

The EUT is a wireless speaker with multimedia function, IEEE 802.11a/b/g/n/ac radio and Bluetooth radio. It has no rechargeable battery. It is powered by 100-240V ~ 50-60Hz, 1A AC Supply Line.

5.2. MAXIMUM OUTPUT POWER

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

Config	Frequency Range (MHz)	Mode	Output Power (dBm)	Output Power (mW)
Pmax	2402 - 2480	Basic GFSK	20.26	106.17
	2402 - 2480	DQPSK	16.81	47.97
	2402 - 2480	Enhanced 8PSK	17.20	52.48
Plow	2402 - 2480	Basic GFSK	12.24	16.75
	2402 - 2480	DQPSK	10.67	11.67
	2402 - 2480	Enhanced 8PSK	10.72	11.80

5.3. DESCRIPTION OF AVAILABLE ANTENNAS

Frequency Band (GHz)	Antenna A Gain (dBi)
2.4	3.80

5.4. SOFTWARE AND FIRMWARE

The firmware installed in the EUT during testing was 15A420.

5.5. WORST-CASE CONFIGURATION AND MODE

Radiated band edge, harmonic, and spurious emissions from 1GHz to 18GHz were performed with the EUT set to transmit at highest power on Low/Middle/High channels.

Radiated emissions below 30MHz, below 1GHz, above 18GHz and power line conducted emissions were performed with the EUT transmits at the channel with the highest output power as worst-case scenario.

EUT was tested at normal operating standup Y axis position.

Worst-case data rates were:

GFSK mode: DH5
8PSK mode: 3-DH5

DQPSK mode has been verified to have the lowest power.

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

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

5.6. DESCRIPTION OF TEST SETUP

SUPPORT EQUIPMENT

Support Equipment List				
Description	Manufacturer	Model	Serial Number	FCC ID
Laptop AC/DC adapter	Liteon Technology	PA-1450-BA1	B123	NA
Laptop	Apple	MackBook Air 4	NA	NA
Dongle	N/A	N/A	HDG1409226823	NA

I/O CABLES (CONDUCTED TEST)

I/O Cable List						
Cable No	Port	# of identical ports	Connector Type	Cable Type	Cable Length (m)	Remarks
1	Antenna	1	SMA	Un-Shielded	0.2	To spectrum Analyzer
2	USB	1	USB	Shielded	1	N/A
3	AC	1	AC	Un-shielded	3	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
1	AC	1	AC	Un-shielded	3	N/A

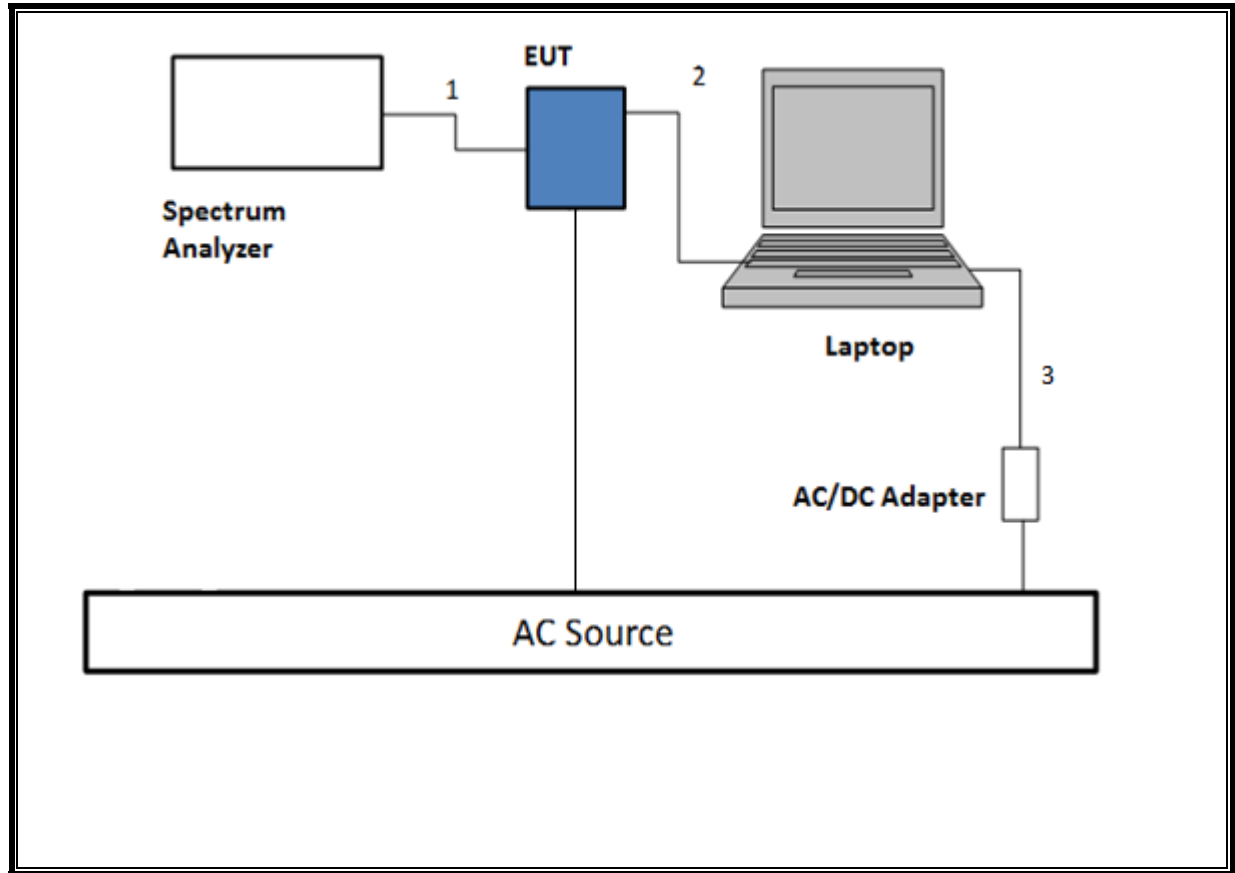
I/O CABLES (AC POWER CONDUCTED TEST AND BELOW 1 GHZ)

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

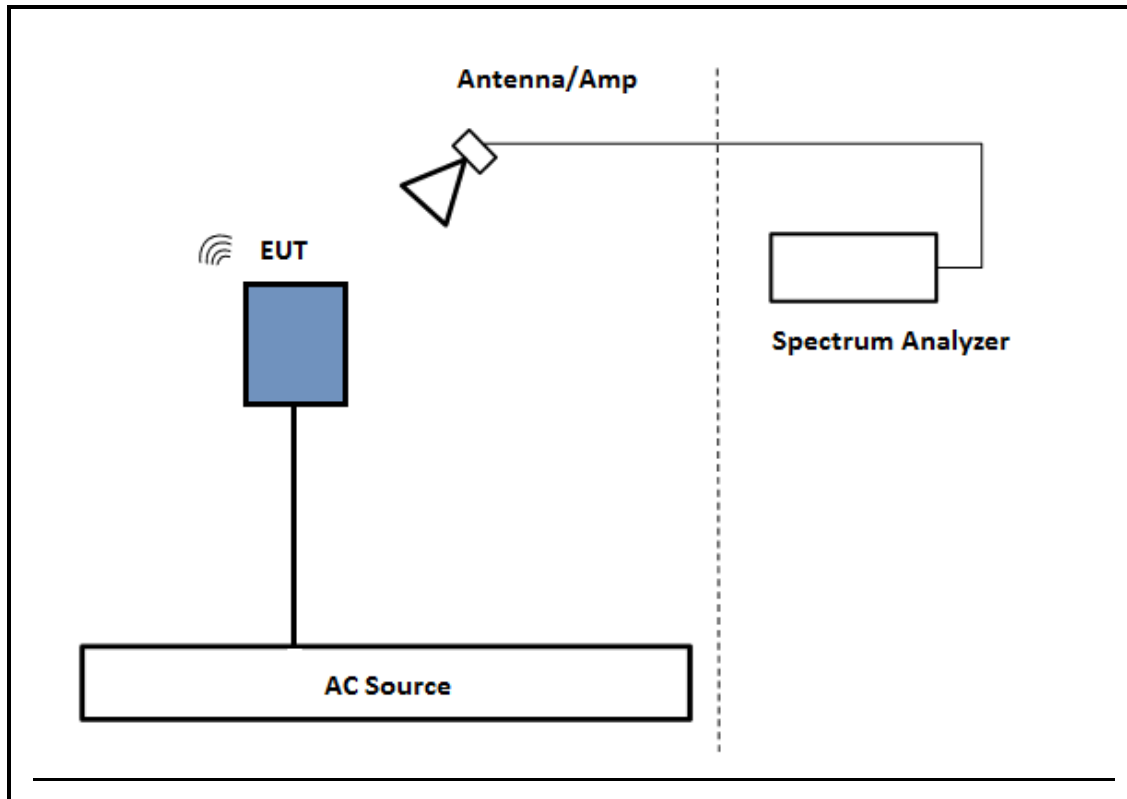
SETUP DIAGRAM



TEST SETUP- RADIATED-ABOVE 1 GHZ

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

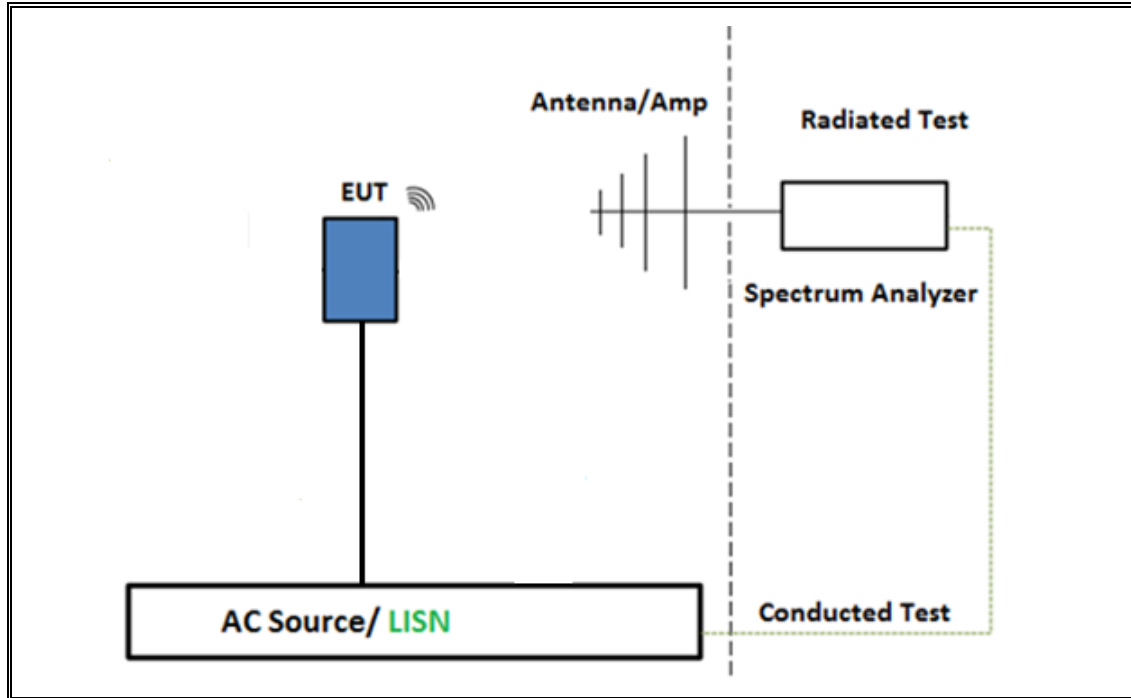
SETUP DIAGRAM



TEST SETUP- BELOW 1GHZ & AC LINE CONDUCTED TESTS

The EUT was powered by AC cord. 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	T711	1/30/2018
Amplifier, 1 to 18GHz	Miteq	AFS42-00101800-25-S-42	T740	11/29/17
Spectrum Analyzer, PXA 3Hz to 44GHz	Keysight	N9030A	T340	12/14/2017
Spectrum Analyzer, PSA, 3Hz to 44GHz	Agilent (Keysight) Technologies	E4446A	T177	03/20/2018
Antenna, Horn 1-18GHz	ETS Lindgren	3117	T119	3/28/2018
Antenna, Broadband Hybrid, 30MHz to 2000MHz	Sunol Sciences	JB1	T122	1/31/2018
Amplifier, 1 to 18GHz	Miteq	AFS42-00101800-25-S-42	T742	11/29/2017
Amplifier, 10KHz to 1GHz, 32dB	Sonoma	310N	T173	6/24/2018
Spectrum Analyzer, PSA, 3Hz to 44GHz	Agilent (Keysight) Technologies	E4446A	T177	03/20/2018
Antenna Horn, 18 to 26GHz	ARA	MWH-1826	T89	1/04/2018
Pre-Amp 18-26GHz	Agilent Technology	8449B	T404	7/23/2018
Power Meter, P-series single channel	Keysight	N1912A	T1244	6/15/2018
Power Sensor	Keysight	N1921A	T1225	3/29/2018
Antenna Horn 18 to 26.5GHz	ARA	MWH-1826/B	T449	6/12/2018
Pre-Amp 18-26GHz	Agilent Technology	8449B	T404	7/23/2018
Spectrum Analyzer, PXA, 3Hz to 44GHz	Agilent (Keysight) Technologies	N9030A	T342	2/23/2018
AC Line Conducted				
EMI Test Receiver 9KHz-7GHz	Rohde & Schwarz	ESCI7	T1436	01/06/2018
LISN for Conducted Emissions CISPR-16	Fischer	50/250-25-2-01	T1310	06/15/2018
UL AUTOMATION SOFTWARE				
Radiated Software	UL	UL EMC	Ver 9.5, April 26, 2016	
Conducted Software	UL	UL EMC	Ver 5.4, October 13, 2016	
AC Line Conducted Software	UL	UL EMC	Ver 9.5, May 26, 2015	

7. ANTENNA PORT TEST RESULTS

ON TIME AND DUTY CYCLE

LIMITS

None; for reporting purposes only.

PROCEDURE

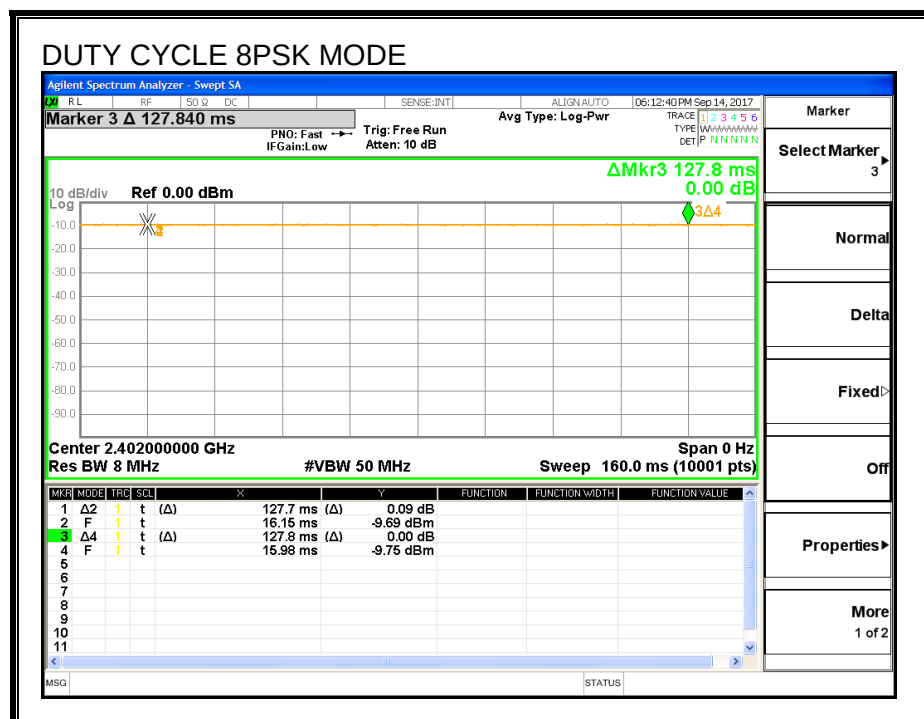
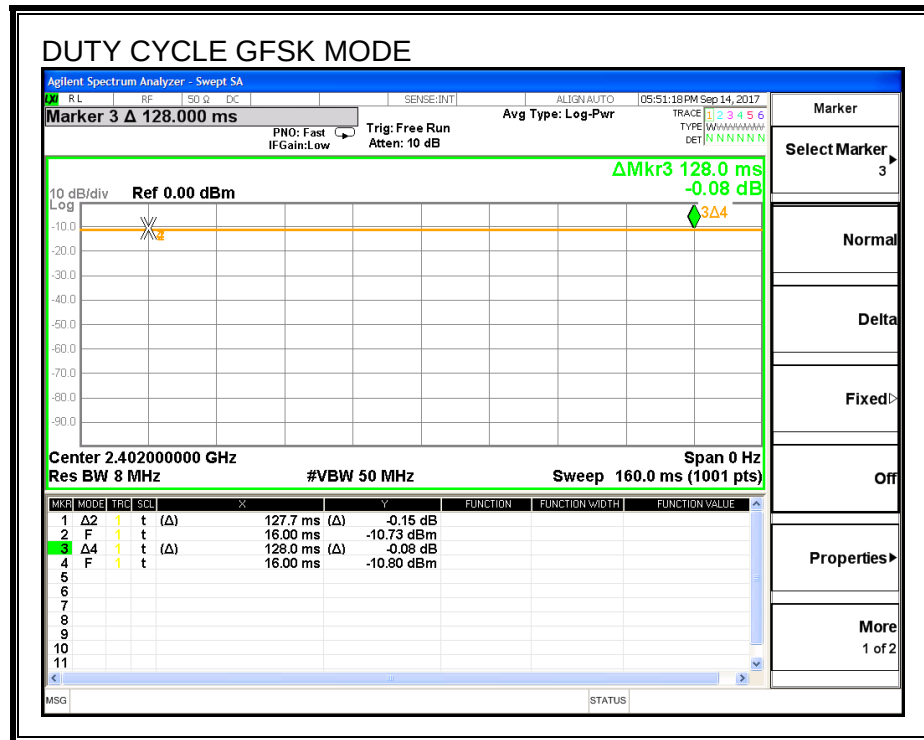
ANSI C63.10, Section 11.6 : Zero-Span Spectrum Analyzer Method.

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)
GFSK High Power	127.7	128.0	0.998	99.77%	0.00	0.010
8PSK High Power	127.7	127.8	0.999	99.92%	0.00	0.010

DUTY CYCLE PLOTS

HOPPING OFF



7.1. Antenna A, Pmax BASIC DATA RATE GFSK MODULATION

7.1.1. 20 dB AND 99% BANDWIDTH

LIMITS

None; for reporting purposes only.

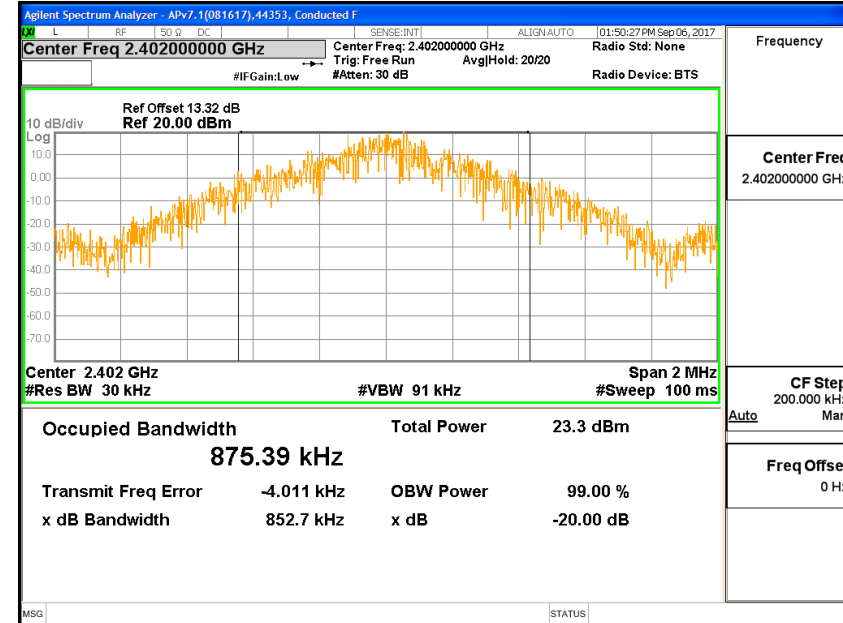
TEST PROCEDURE

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.

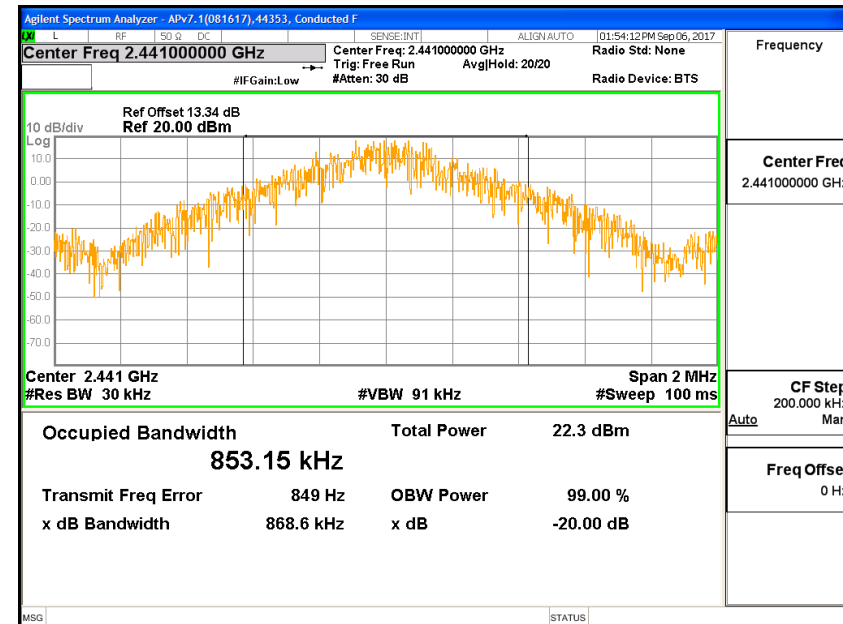
RESULTS

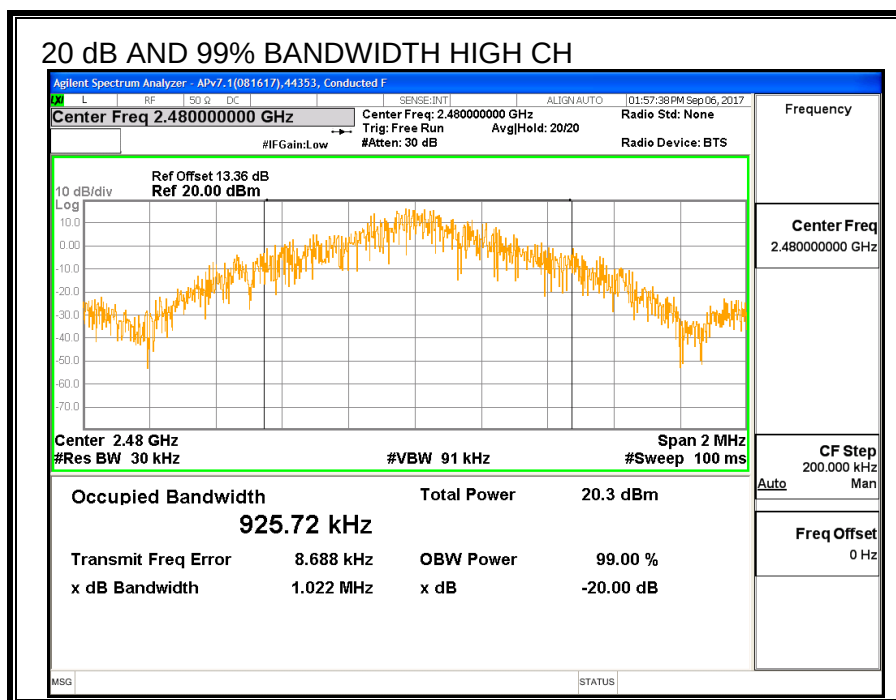
Channel	Frequency (MHz)	20 dB Bandwidth (KHz)	99% Bandwidth (KHz)
Low	2402	852.7	875.39
Middle	2441	868.6	853.15
High	2480	1022	926.72

20 dB AND 99% BANDWIDTH LOW CH



20 dB AND 99% BANDWIDTH MID CH





7.1.2. HOPPING FREQUENCY SEPARATION

LIMITS

FCC §15.247 (a) (1)

IC RSS-247 (5.1) (b)

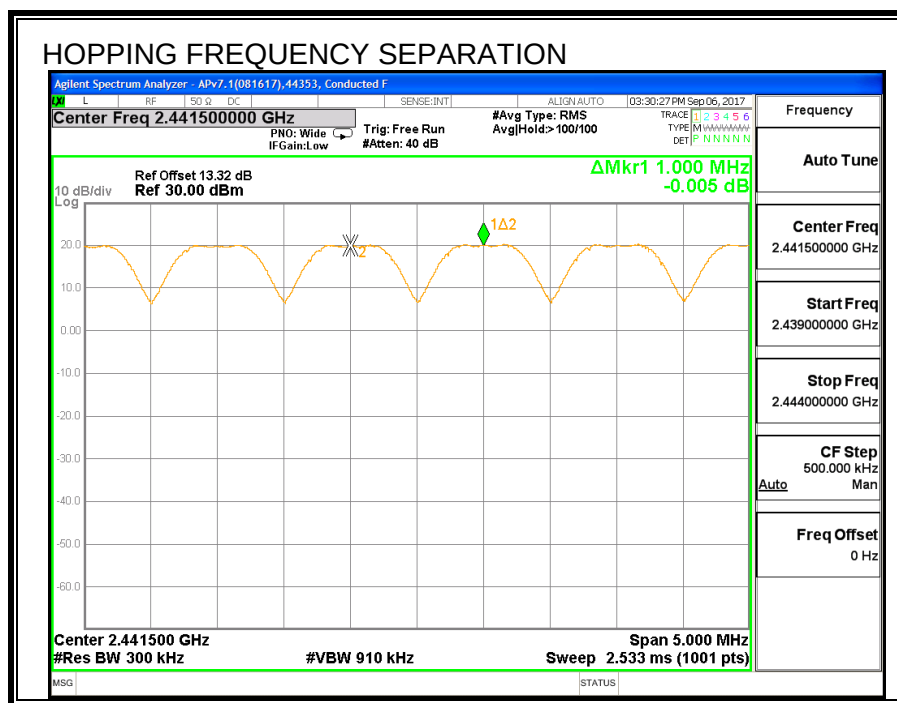
Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater.

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



7.1.3. NUMBER OF HOPPING CHANNELS

LIMITS

FCC §15.247 (a) (1) (iii)

IC RSS-247 (5.1) (d)

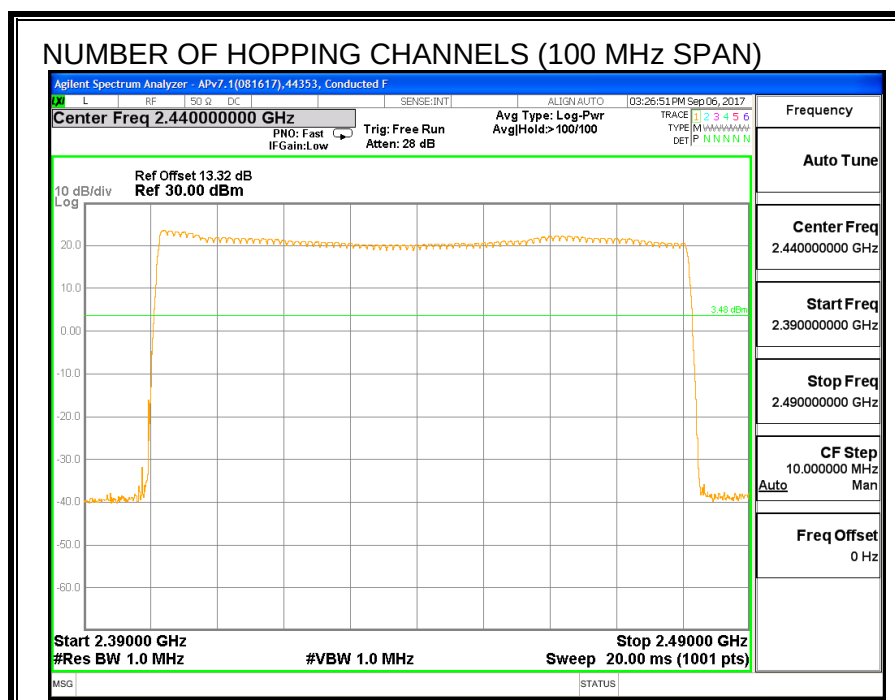
Frequency hopping systems in the 2400 – 2483.5 MHz band shall use at least 15 non-overlapping channels.

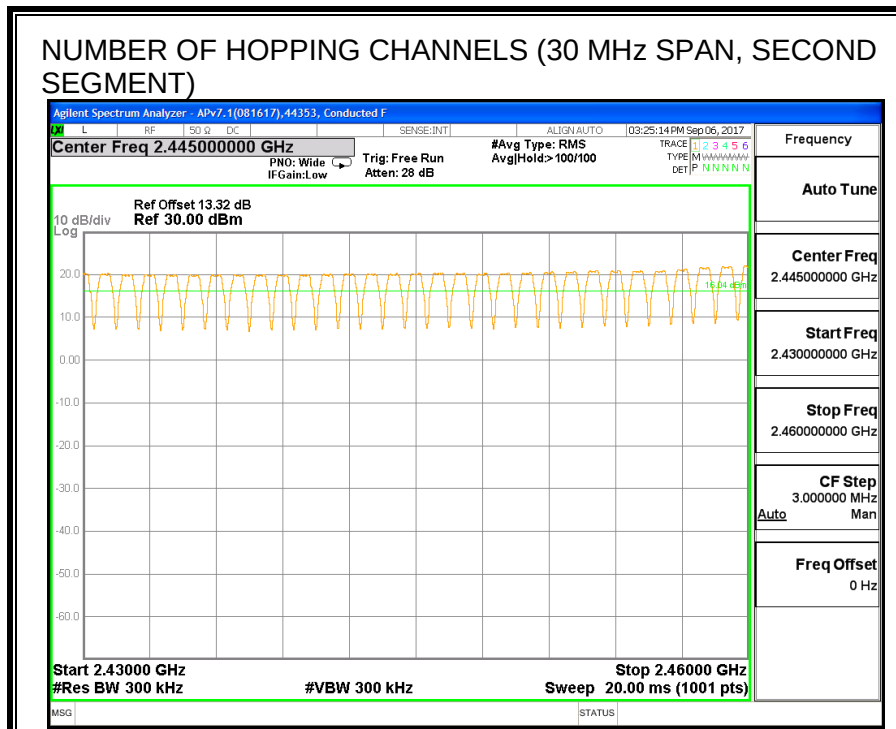
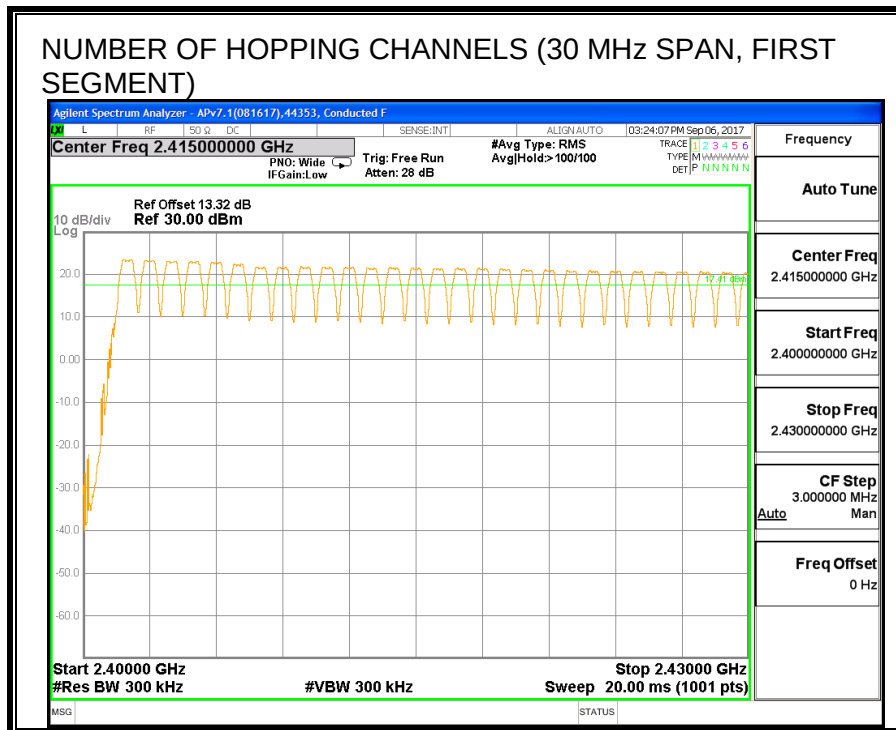
TEST PROCEDURE

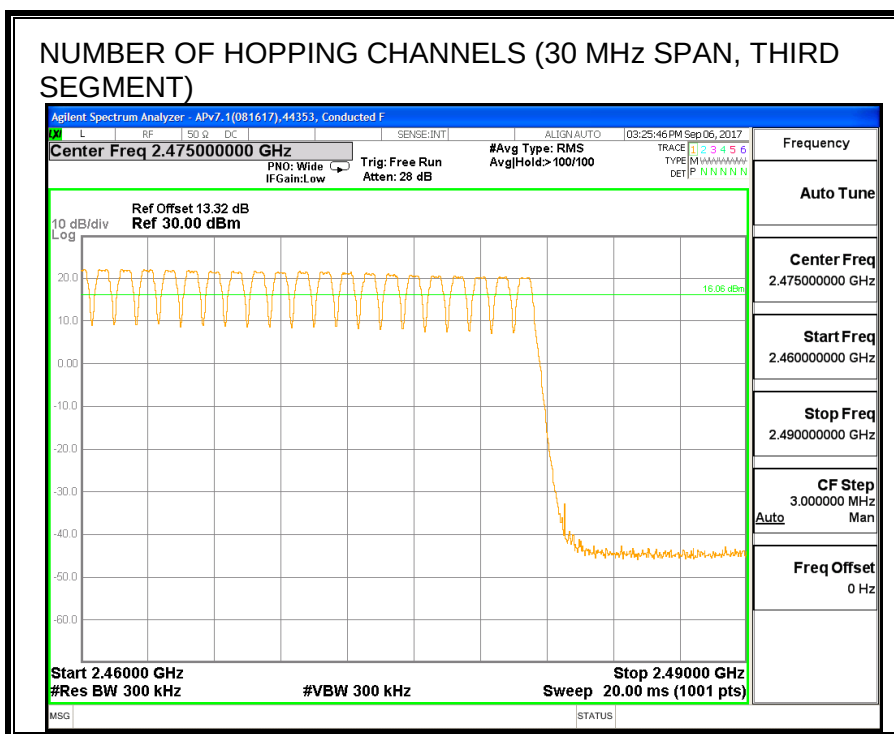
The transmitter output is connected to a spectrum analyzer. The span is set to cover the entire authorized band, in either a single sweep or in multiple contiguous sweeps. The RBW is set to a maximum of 1 % of the span. The analyzer is set to Max Hold.

RESULTS

Normal Mode: 79 Channels observed.







7.1.4. AVERAGE TIME OF OCCUPANCY

LIMITS

FCC §15.247 (a) (1) (iii)

IC RSS-247 (5.1) (d)

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

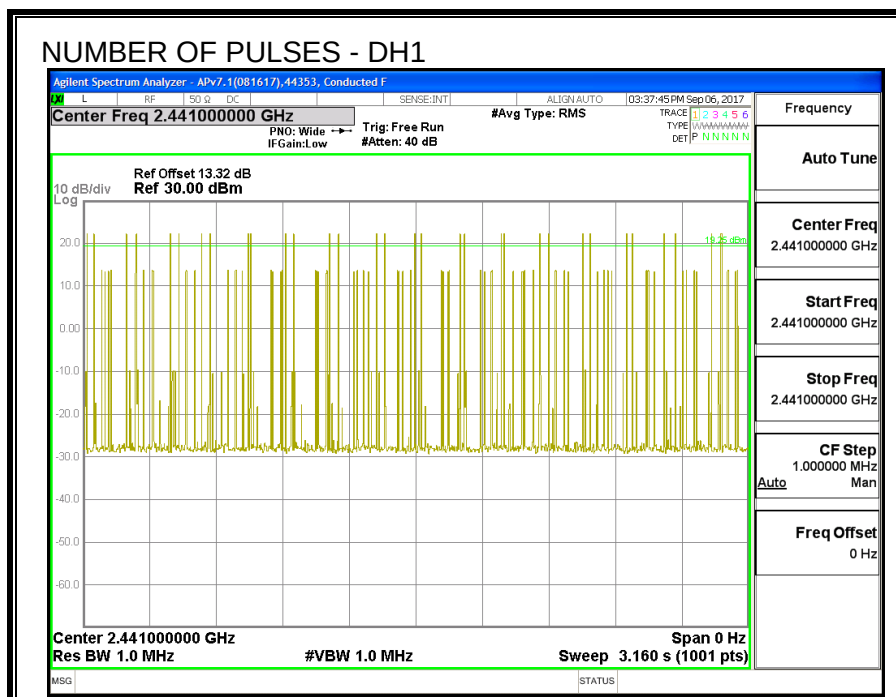
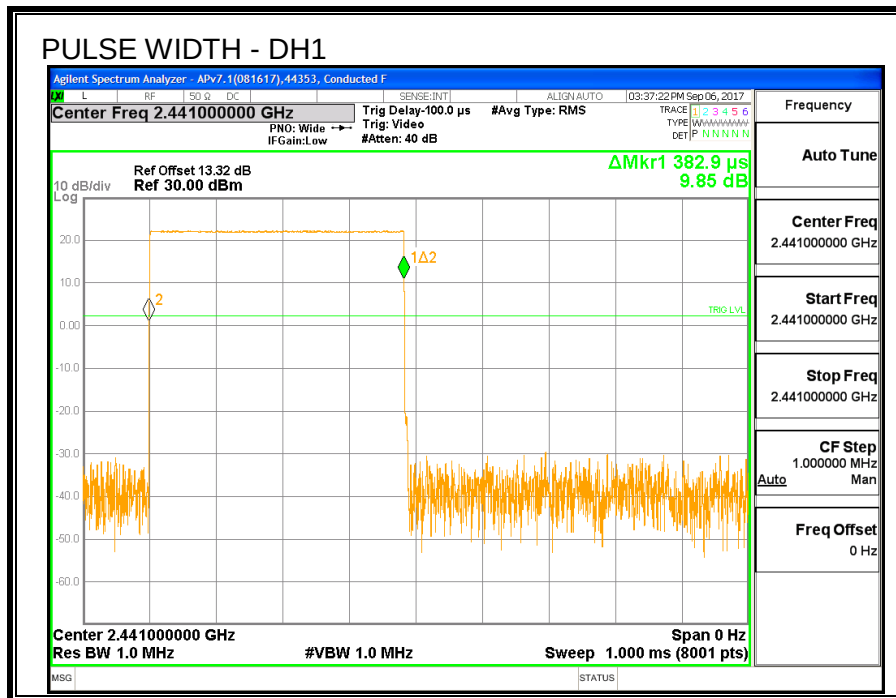
The transmitter output is connected to a spectrum analyzer. The span is set to 0 Hz, centered on a single, selected hopping channel. The width of a single pulse is measured in a fast scan. The number of pulses is measured in a 3.16 second scan, to enable resolution of each occurrence.

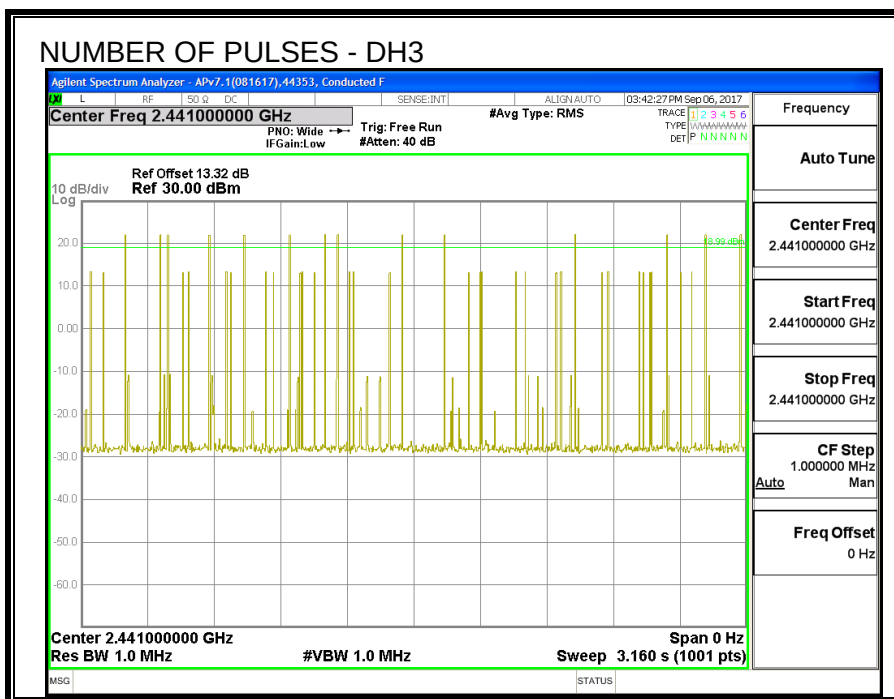
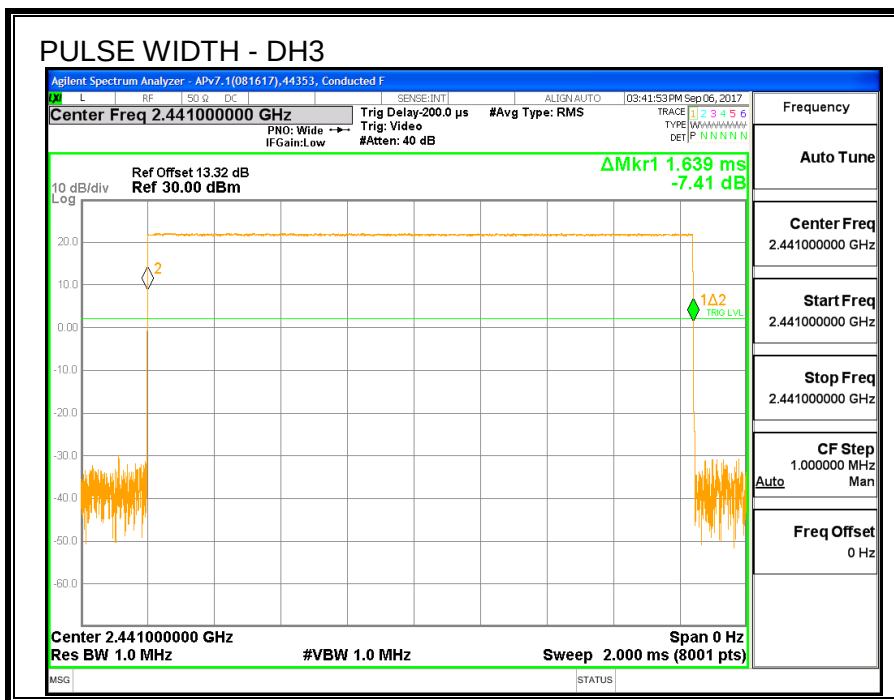
The average time of occupancy in the specified 31.6 second period (79 channels * 0.4 s) is equal to $10 * (\# \text{ of pulses in } 3.16 \text{ s}) * \text{pulse width}$.

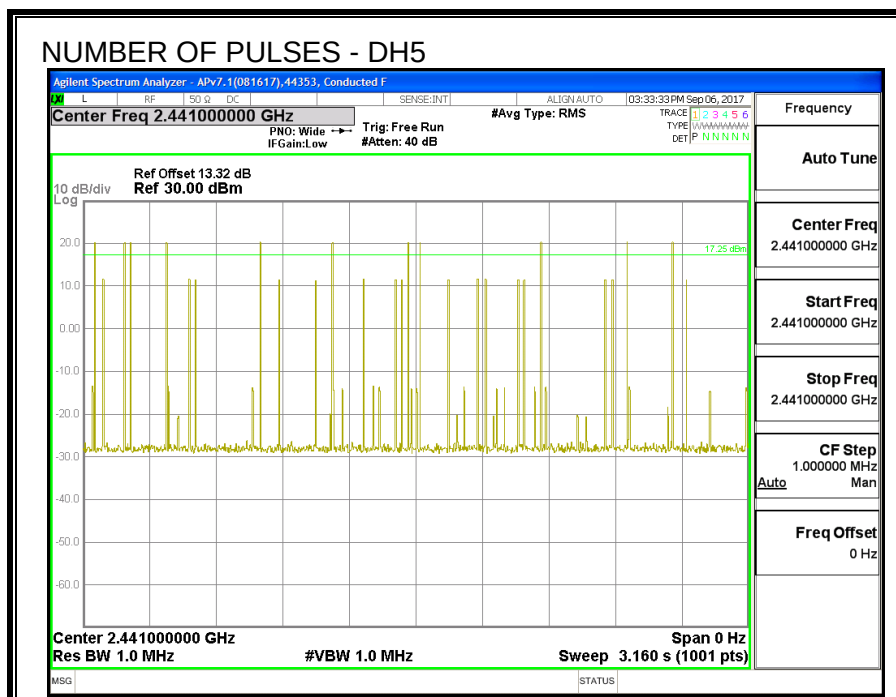
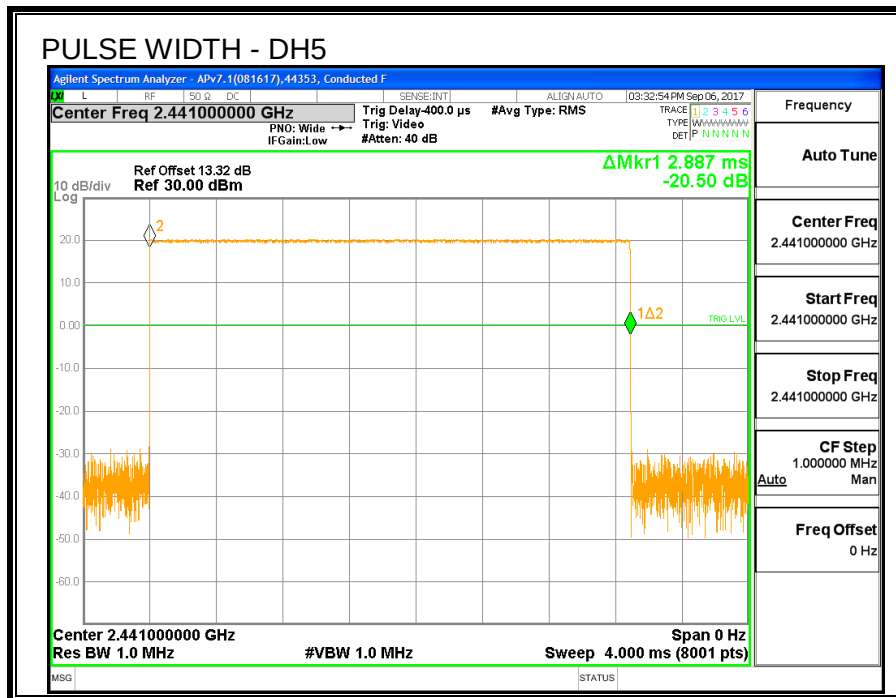
For AFH mode, the average time of occupancy in the specified 8 second period (20 channels * 0.4 seconds) is equal to $10 * (\# \text{ of pulses in } 0.8 \text{ s}) * \text{pulse width}$.

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					
DH1	0.3829	30	0.115	0.4	-0.285
DH3	1.639	14	0.229	0.4	-0.171
DH5	2.887	11	0.318	0.4	-0.082
DH Packet	Pulse Width (msec)	Number of Pulses in 0.8 seconds	Average Time of Occupancy (sec)	Limit (sec)	Margin (sec)
GFSK AFH Mode					
DH1	0.3829	7.5	0.029	0.4	-0.371
DH3	1.639	3.5	0.057	0.4	-0.343
DH5	2.887	2.75	0.079	0.4	-0.321







7.1.5. OUTPUT POWER

ID:	50893	Date:	9/7/2017
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LIMITS

§15.247 (b) (1)

RSS-247 (5.4) (b)

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 and average power meter.

RESULTS

Channel	Frequency (MHz)	Output Power (dBm)	Limit (dBm)	Margin (dB)
Low	2402	20.15	30	-9.85
Middle	2441	20.26	30	-9.74
High	2480	20.09	30	-9.91

7.1.6. AVERAGE POWER

ID:	50893	Date:	9/7/2017
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LIMITS

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.

Channel	Frequency (MHz)	Average Power (dBm)
Low	2402	19.89
Middle	2441	19.97
High	2480	19.81

7.1.7. CONDUCTED SPURIOUS EMISSIONS

LIMITS

FCC §15.247 (d)

IC RSS-247 (5.5)

Limit = -20 dBc

TEST PROCEDURE

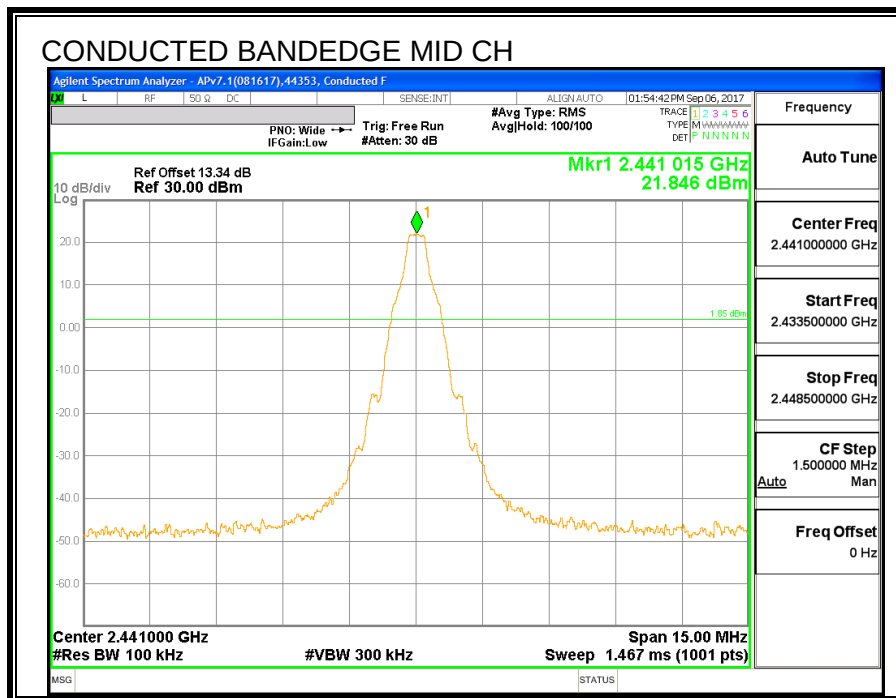
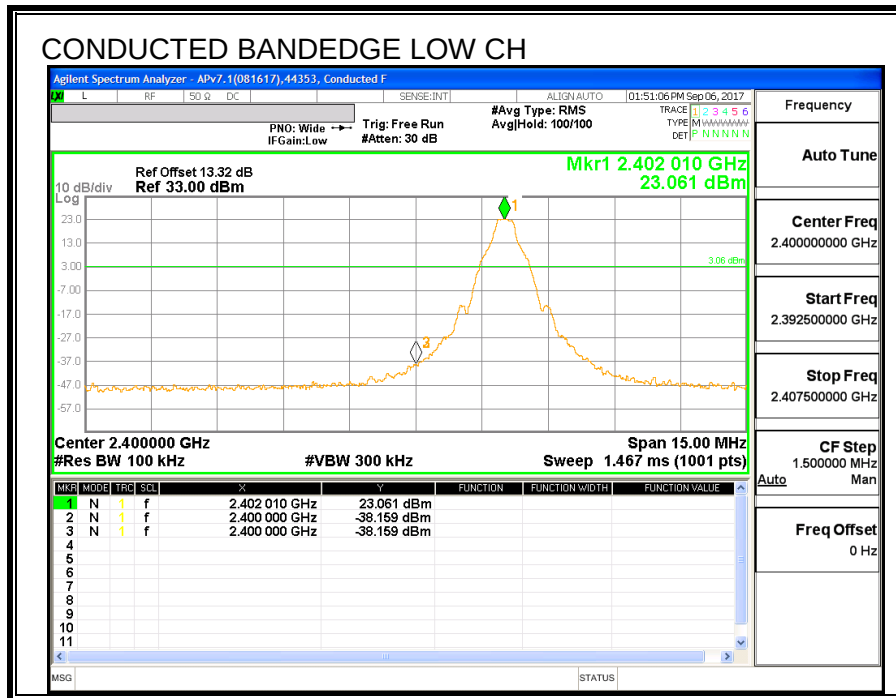
The transmitter output is connected to a spectrum analyzer. The resolution bandwidth is set to 100 kHz. The video bandwidth is set to 300 kHz.

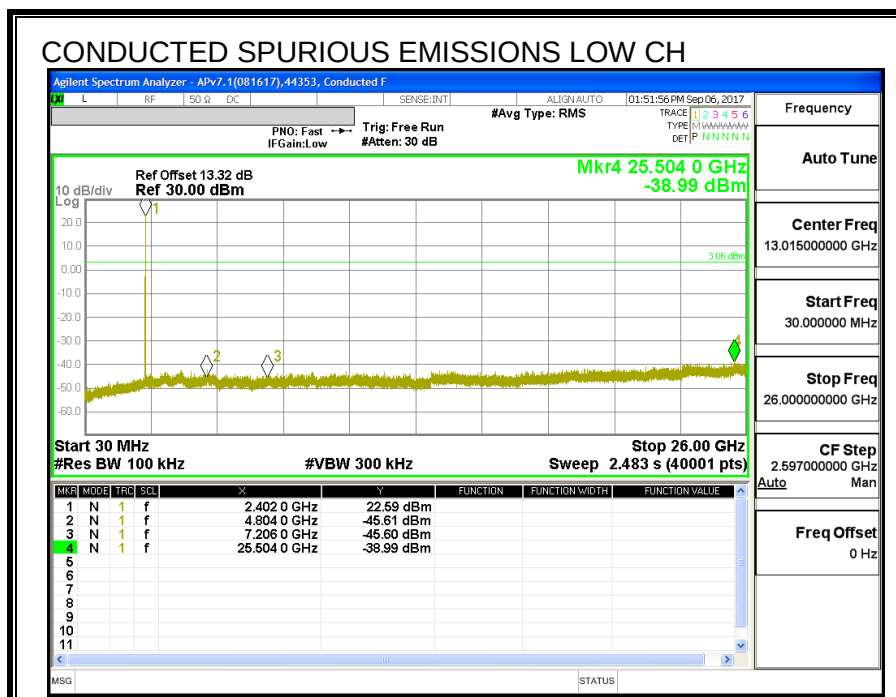
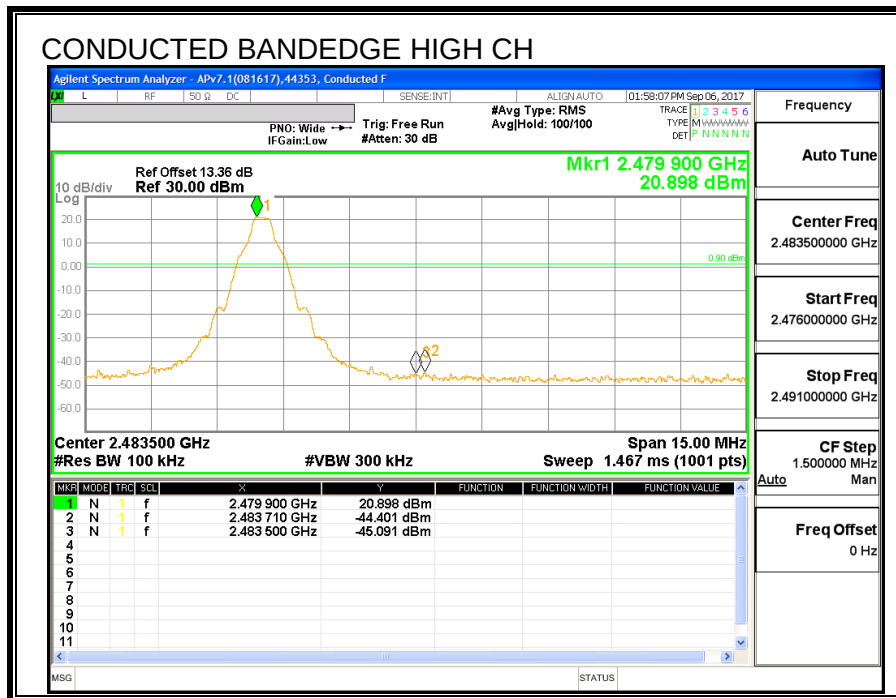
The spectrum from 30 MHz to 26 GHz is investigated with the transmitter set to the lowest, middle, and highest channels.

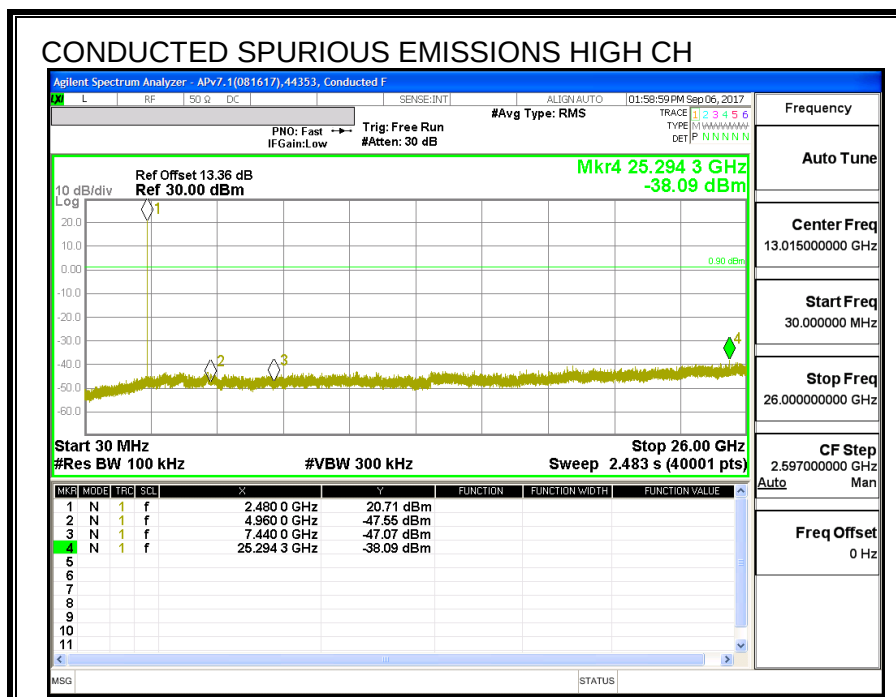
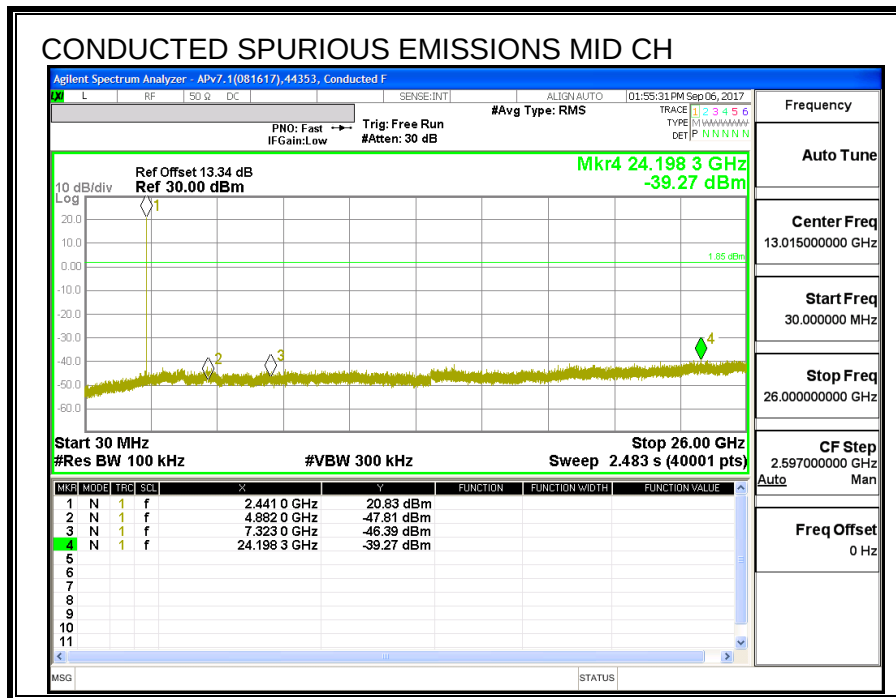
The bandedges at 2.4 and 2.4835 GHz are investigated with the transmitter set to the normal hopping mode.

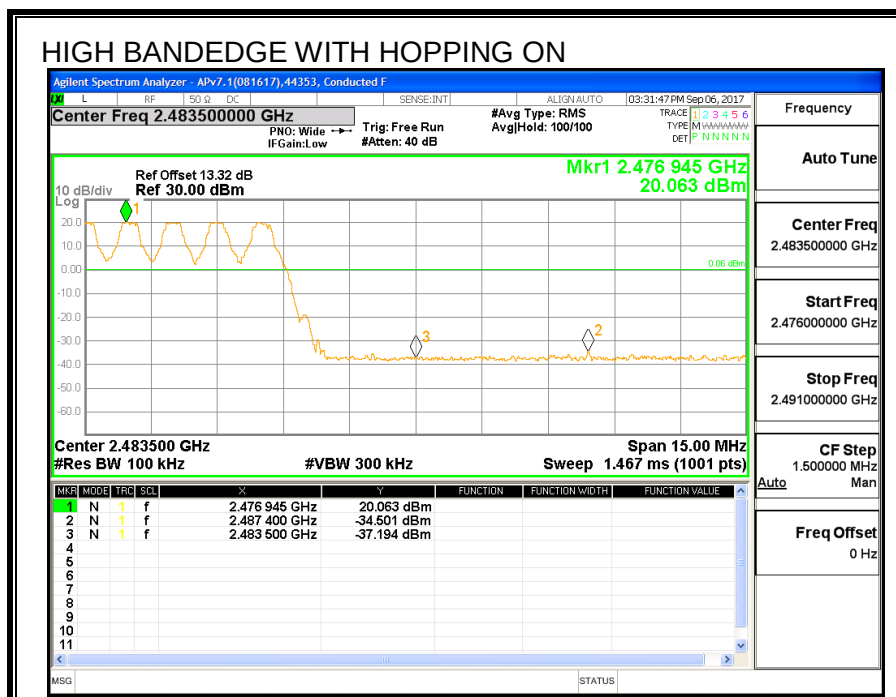
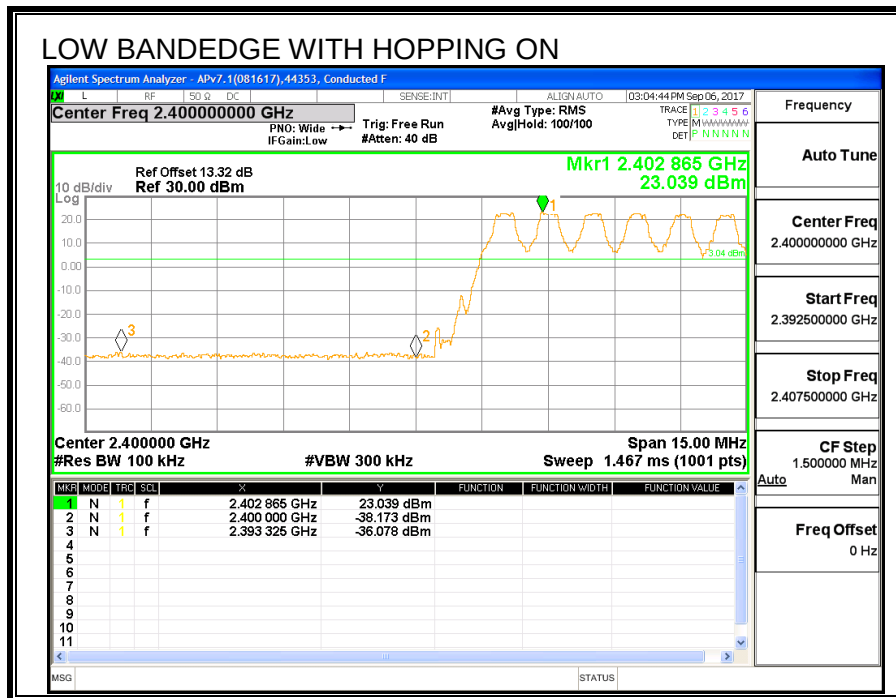
RESULTS

CONDUCTED BANDEDGE AND SPURIOUS EMISSIONS









7.2. Antenna A, Pmax ENHANCED DATA RATE DQPSK MODULATION

7.2.1. OUTPUT POWER

ID:	44353	Date:	9/18/17
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LIMITS

§15.247 (b) (1)

RSS-247 (5.4) (b)

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 and average power meter.

RESULTS

Channel	Frequency (MHz)	Output Power (dBm)	Limit (dBm)	Margin (dB)
Low	2402	16.75	21	-4.25
Middle	2441	16.81	21	-4.19
High	2480	16.69	21	-4.31

7.2.2. AVERAGE POWER

ID:	44353	Date:	9/18/17
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LIMITS

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.

Channel	Frequency (MHz)	Average Power (dBm)
Low	2402	14.44
Middle	2441	14.52
High	2480	14.41

7.3. Antenna A, Pmax ENHANCED DATA RATE 8PSK MODULATION

7.3.1. 20 dB AND 99% BANDWIDTH

LIMITS

None; for reporting purposes only.

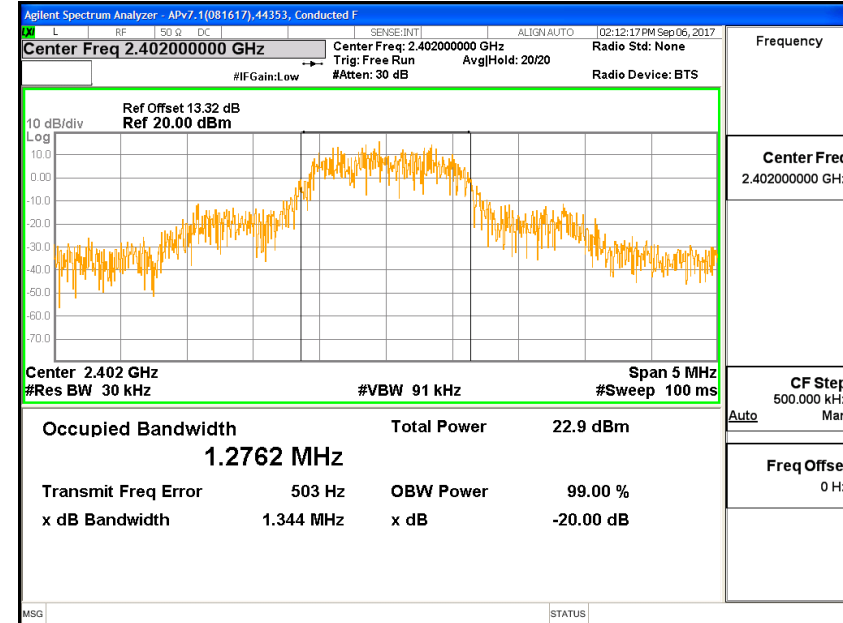
TEST PROCEDURE

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.

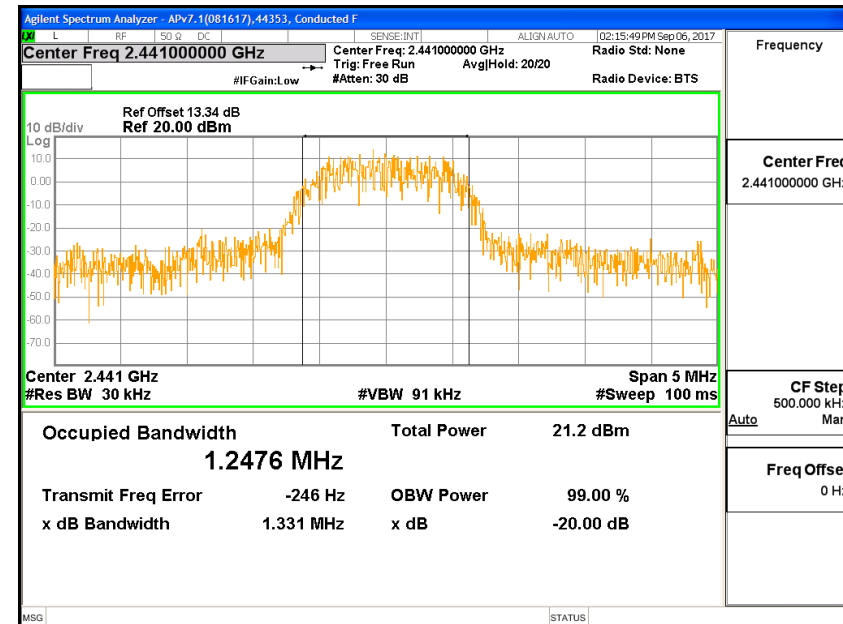
RESULTS

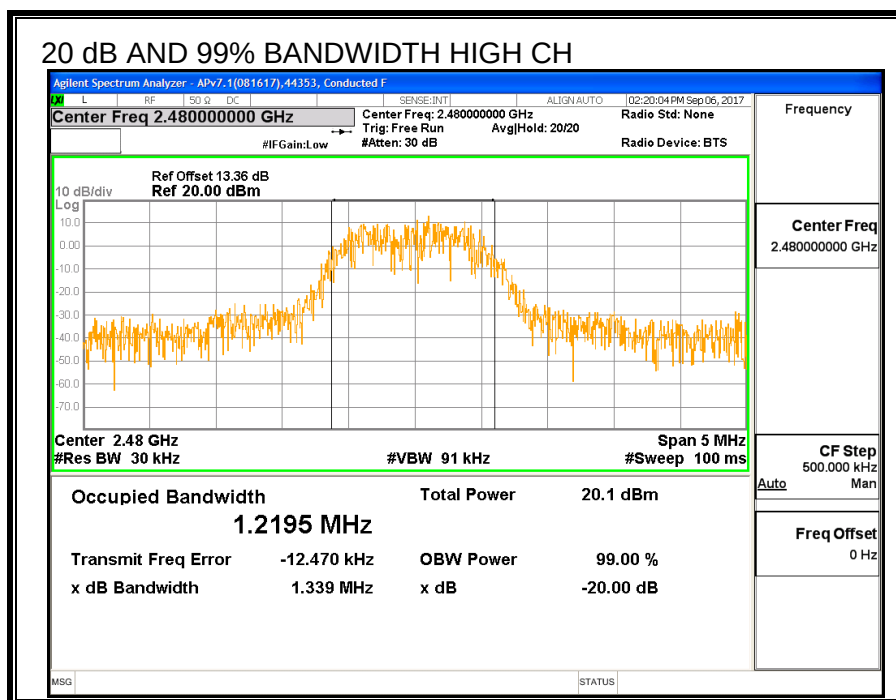
Channel	Frequency (MHz)	20 dB Bandwidth (KHz)	99% Bandwidth (KHz)
Low	2402	1344	1276.2
Middle	2441	1331	1247.6
High	2480	1339	1219.5

20 dB AND 99% BANDWIDTH LOW CH



20 dB AND 99% BANDWIDTH MID CH





7.3.2. HOPPING FREQUENCY SEPARATION

LIMITS

FCC §15.247 (a) (1)

IC RSS-247 (5.1) (b)

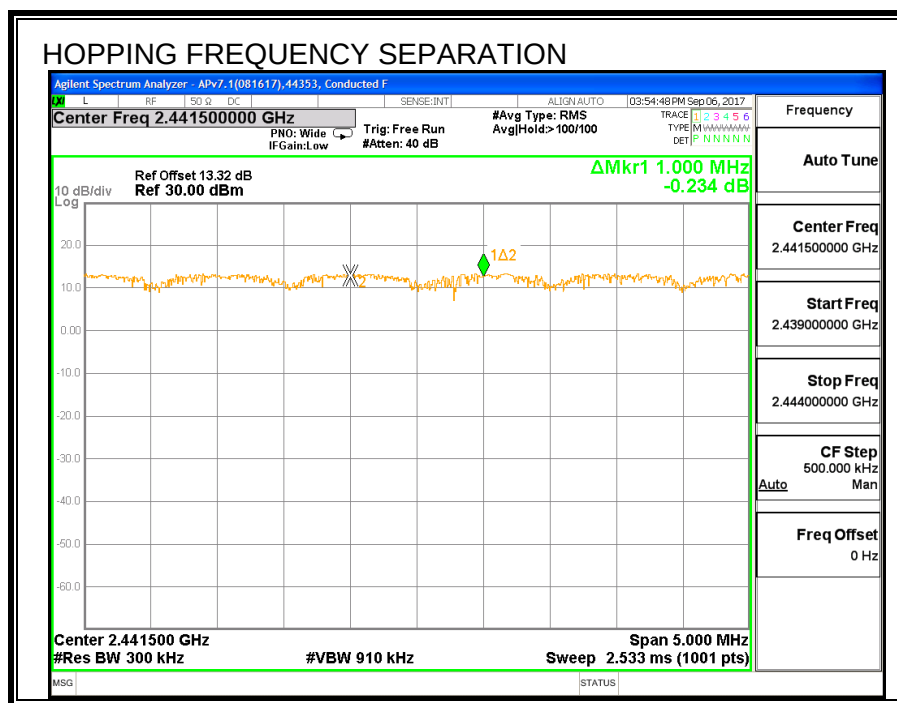
Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater.

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



7.3.3. NUMBER OF HOPPING CHANNELS

LIMITS

FCC §15.247 (a) (1) (iii)

IC RSS-247 (5.1) (d)

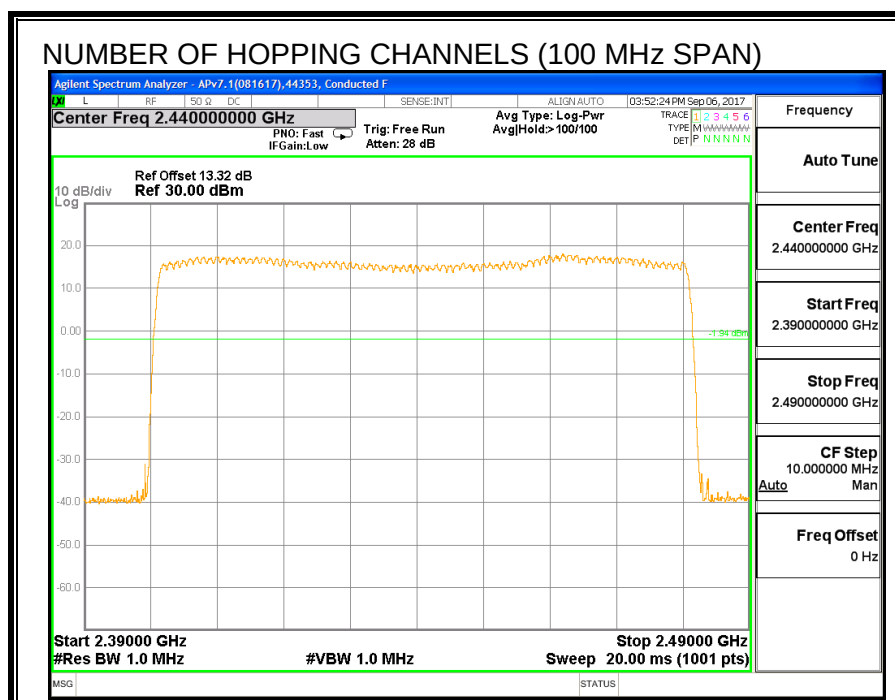
Frequency hopping systems in the 2400 – 2483.5 MHz band shall use at least 15 non-overlapping channels.

TEST PROCEDURE

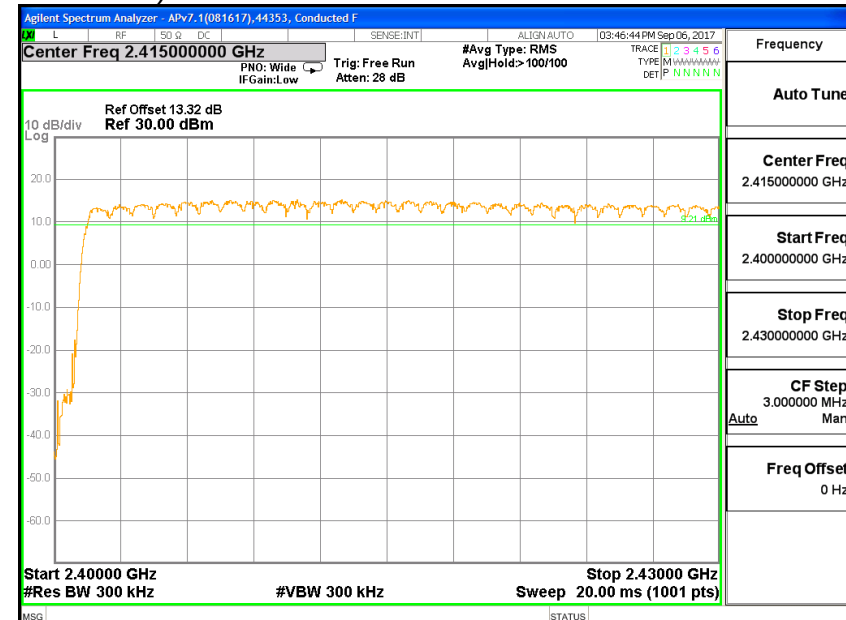
The transmitter output is connected to a spectrum analyzer. The span is set to cover the entire authorized band, in either a single sweep or in multiple contiguous sweeps. The RBW is set to a maximum of 1 % of the span. The analyzer is set to Max Hold.

RESULTS

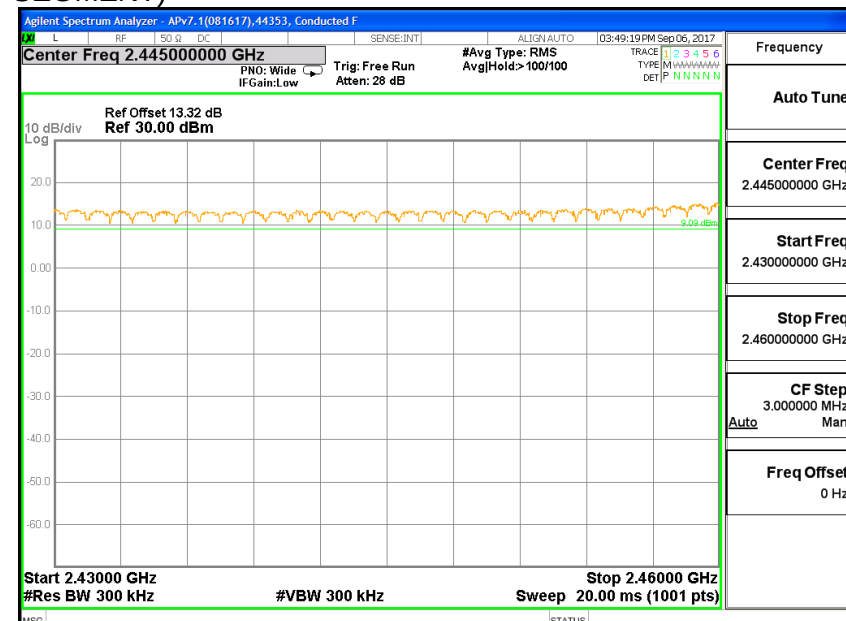
Normal Mode: 79 Channels observed.

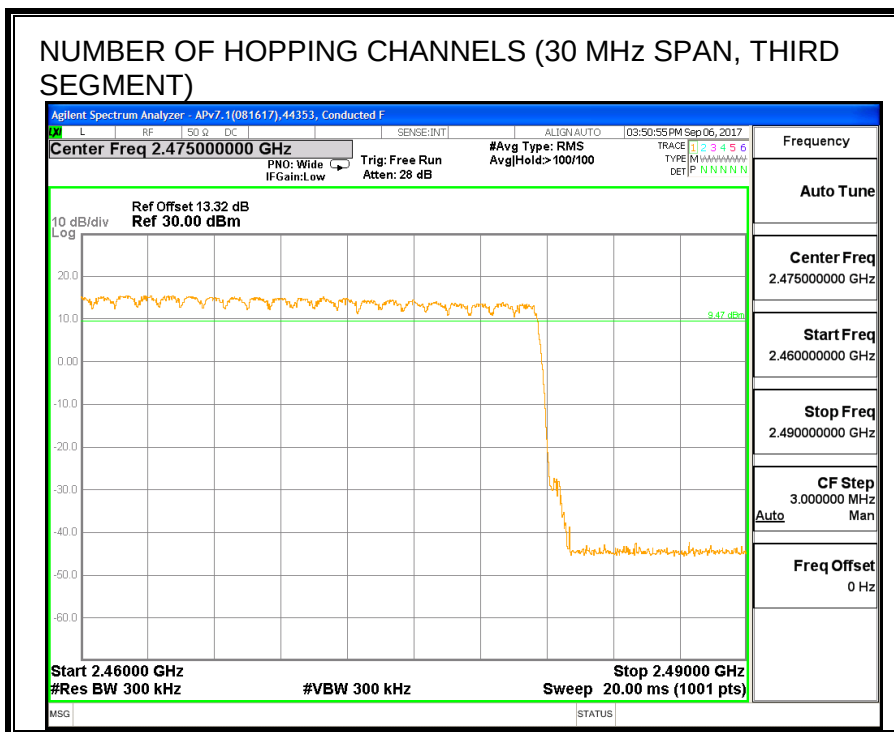


NUMBER OF HOPPING CHANNELS (30 MHz SPAN, FIRST SEGMENT)



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





7.3.4. AVERAGE TIME OF OCCUPANCY

LIMITS

FCC §15.247 (a) (1) (iii)

IC RSS-247 (5.1) (d)

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.

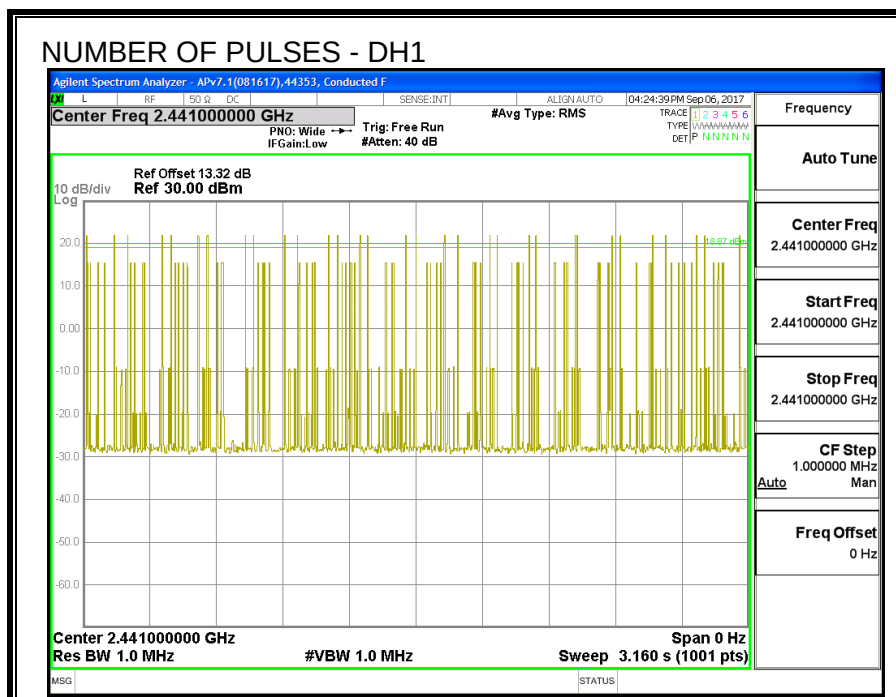
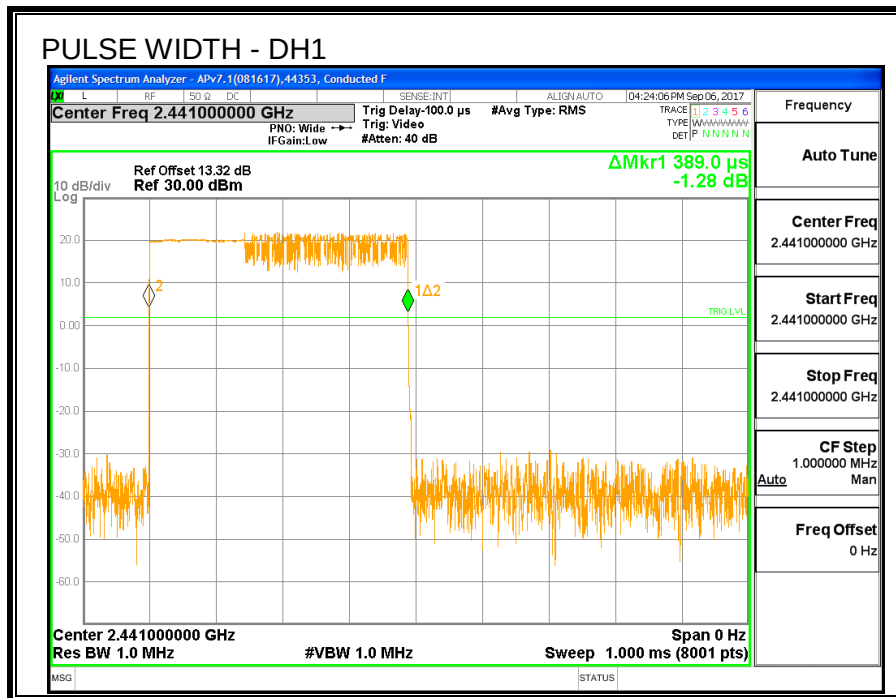
The average time of occupancy in the specified 31.6 second period (79 channels * 0.4 s) is equal to $10 * (\# \text{ of pulses in } 3.16 \text{ s}) * \text{pulse width}$.

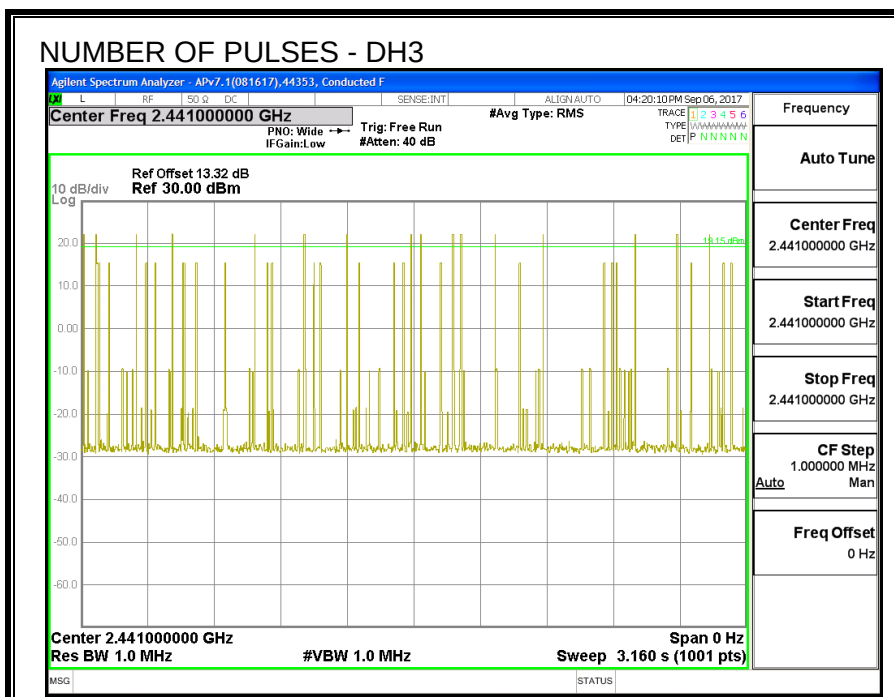
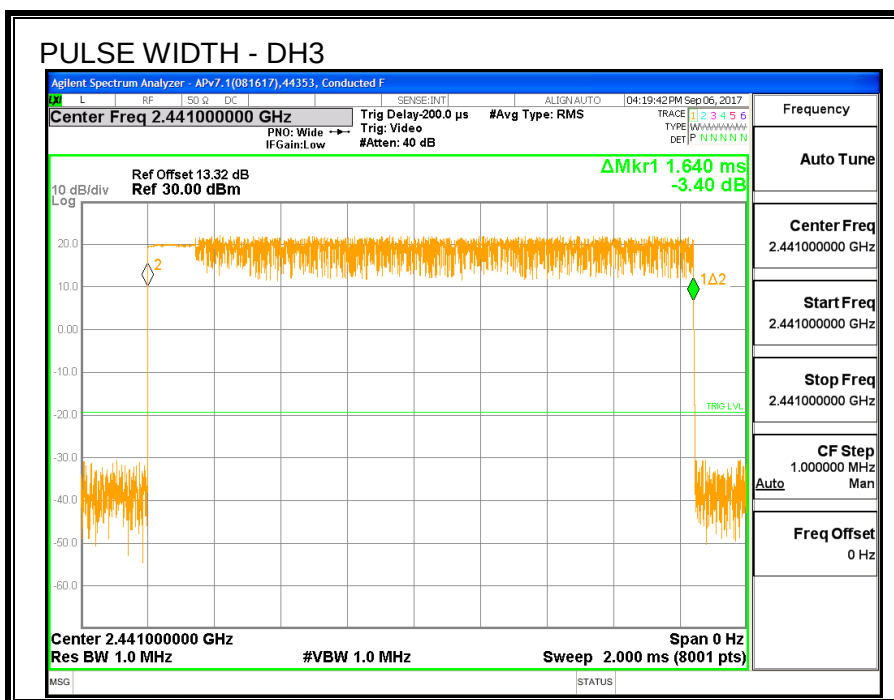
For AFH mode, the average time of occupancy in the specified 8 second period (20 channels * 0.4 seconds) is equal to $10 * (\# \text{ of pulses in } 0.8 \text{ s}) * \text{pulse width}$.

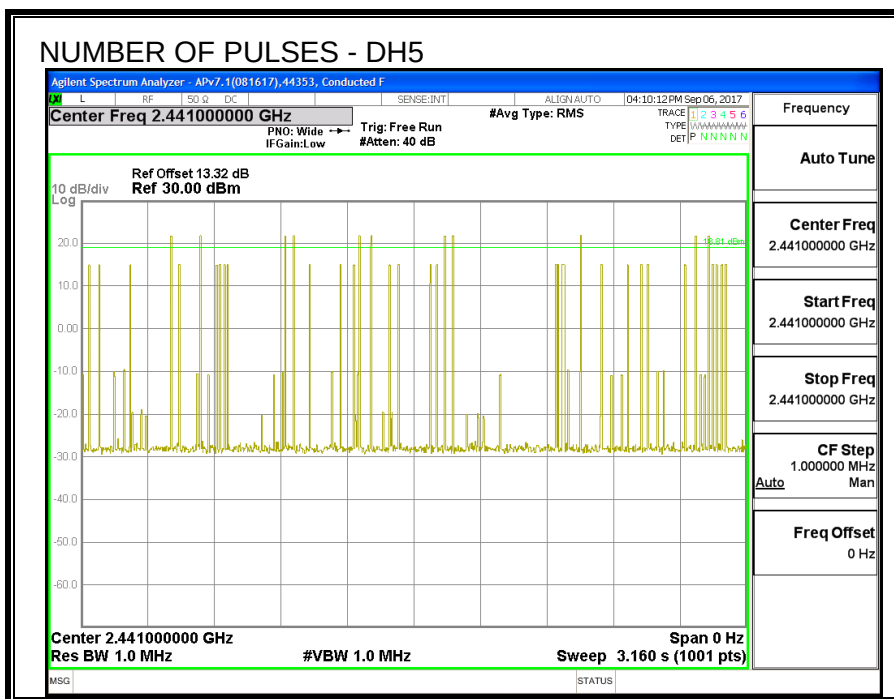
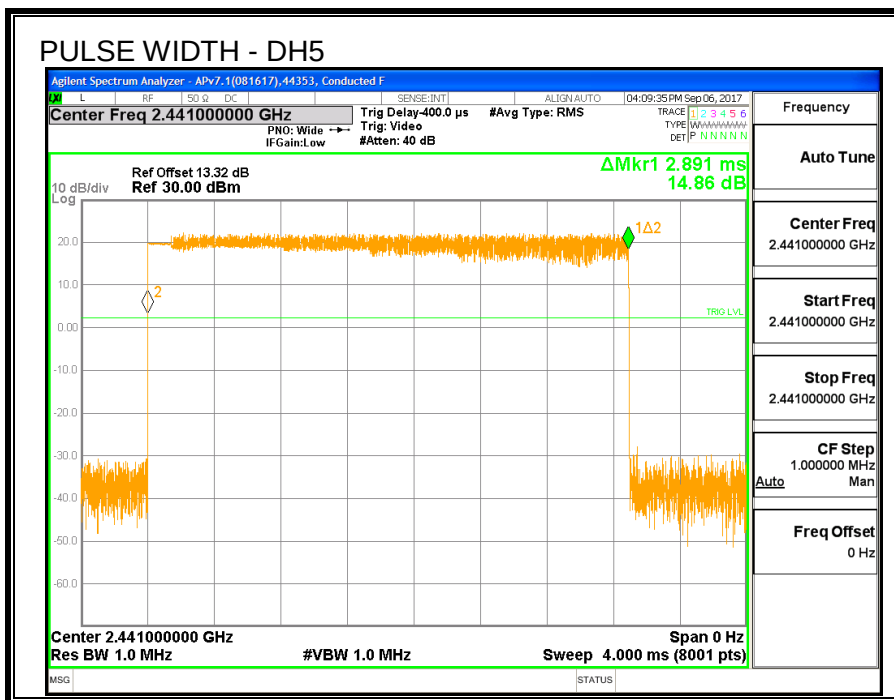
RESULTS

8PSK (EDR) Mode

DH Packet	Pulse Width (msec)	Number of Pulses in 3.16 seconds	Average Time of (sec)	Limit (sec)	Margin (sec)
3DH1	0.389	30	0.117	0.4	-0.283
3DH3	1.64	16	0.262	0.4	-0.138
3DH5	2.891	11	0.318	0.4	-0.082







7.3.5. OUTPUT POWER

ID:	50893	Date:	9/7/2017
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LIMITS

§15.247 (b) (1)

RSS-247 (5.4) (b)

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 and average power meter.

RESULTS

Channel	Frequency (MHz)	Output Power (dBm)	Limit (dBm)	Margin (dB)
Low	2402	17.16	21	-3.84
Middle	2441	17.20	21	-3.80
High	2480	17.11	21	-3.89

7.3.6. AVERAGE POWER

ID:	50893	Date:	9/7/2017
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LIMITS

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.

Channel	Frequency (MHz)	Average Power (dBm)
Low	2402	14.88
Middle	2441	14.93
High	2480	14.82

7.3.7. CONDUCTED SPURIOUS EMISSIONS

LIMITS

FCC §15.247 (d)

IC RSS-247 (5.5)

Limit = -20 dBc

TEST PROCEDURE

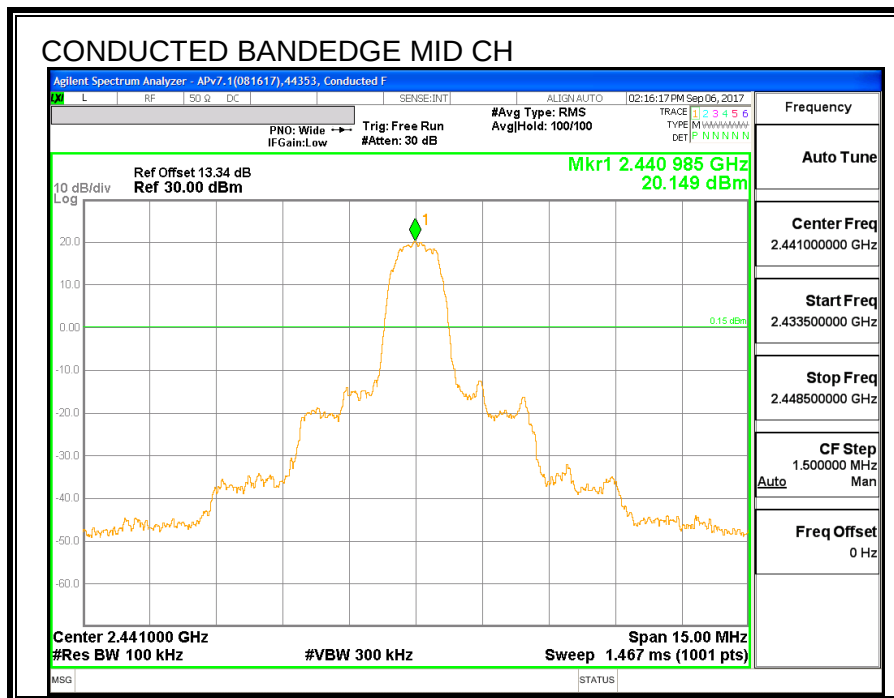
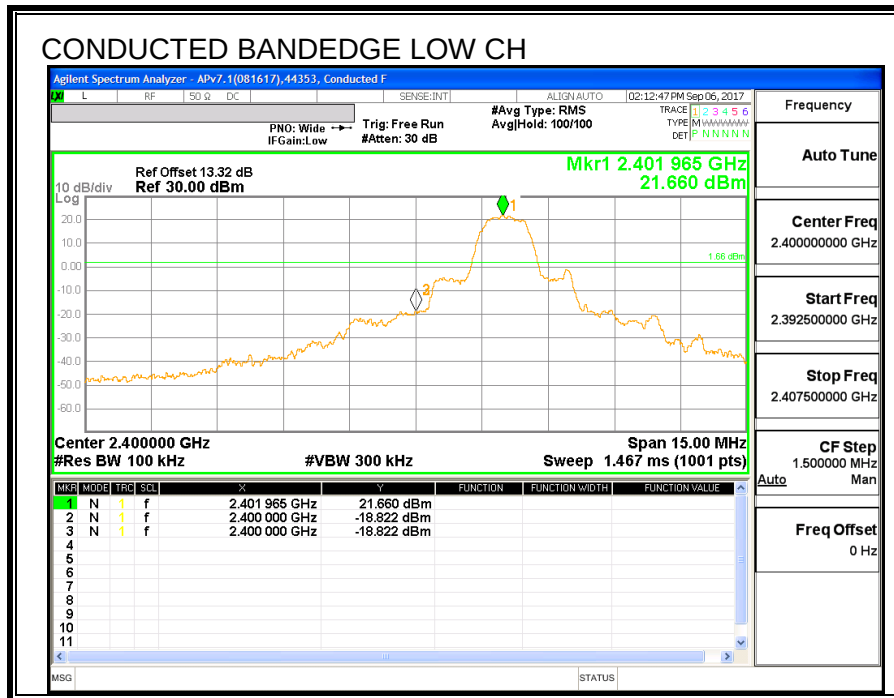
The transmitter output is connected to a spectrum analyzer. The resolution bandwidth is set to 100 kHz. The video bandwidth is set to 300 kHz.

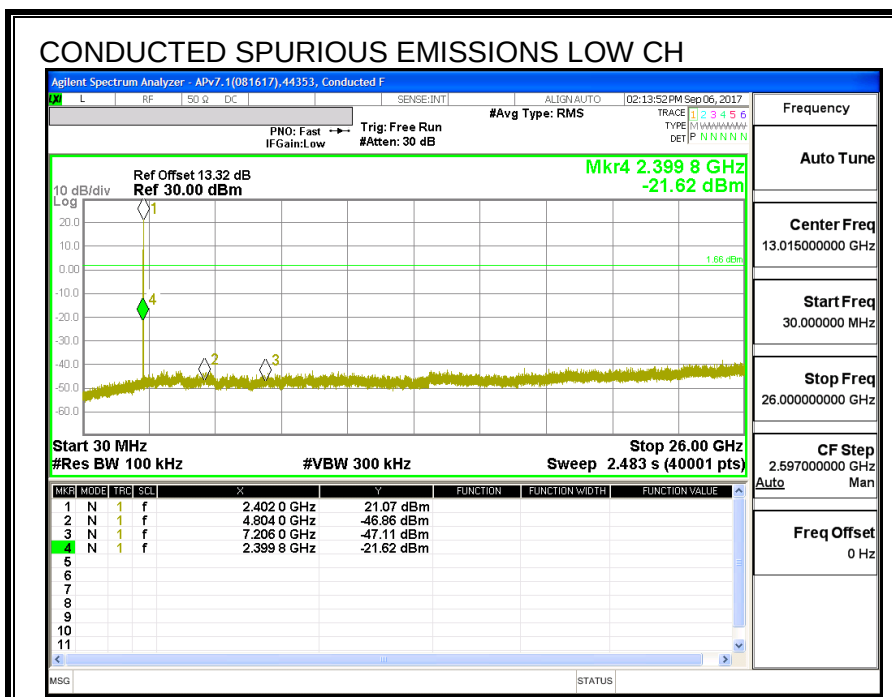
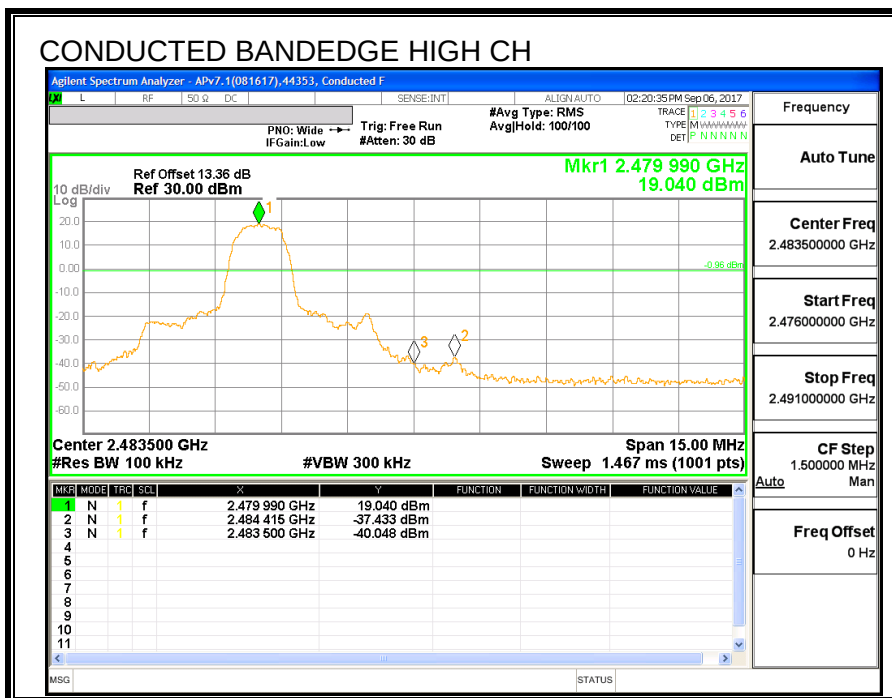
The spectrum from 30 MHz to 26 GHz is investigated with the transmitter set to the lowest, middle, and highest channels.

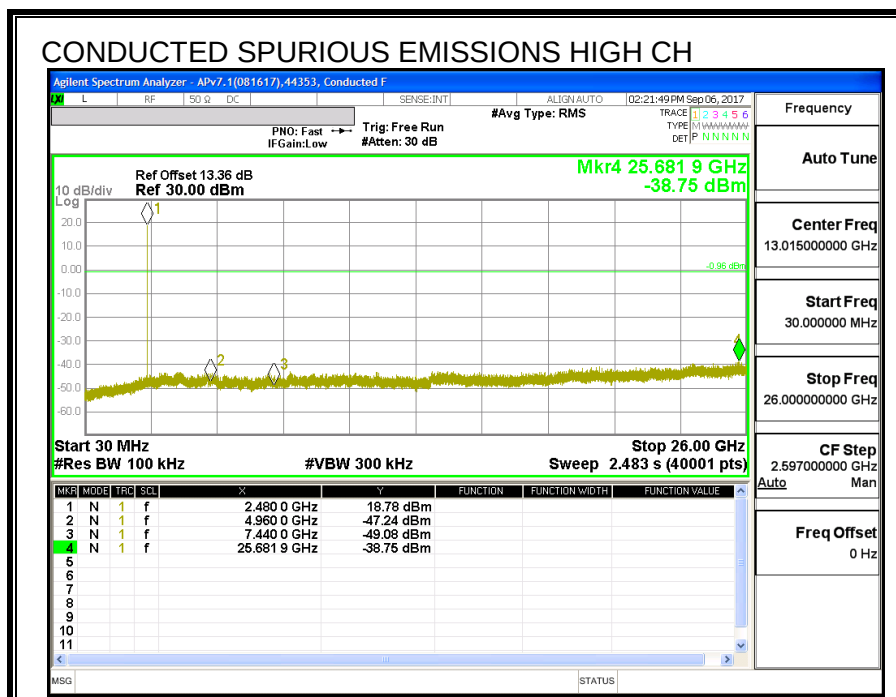
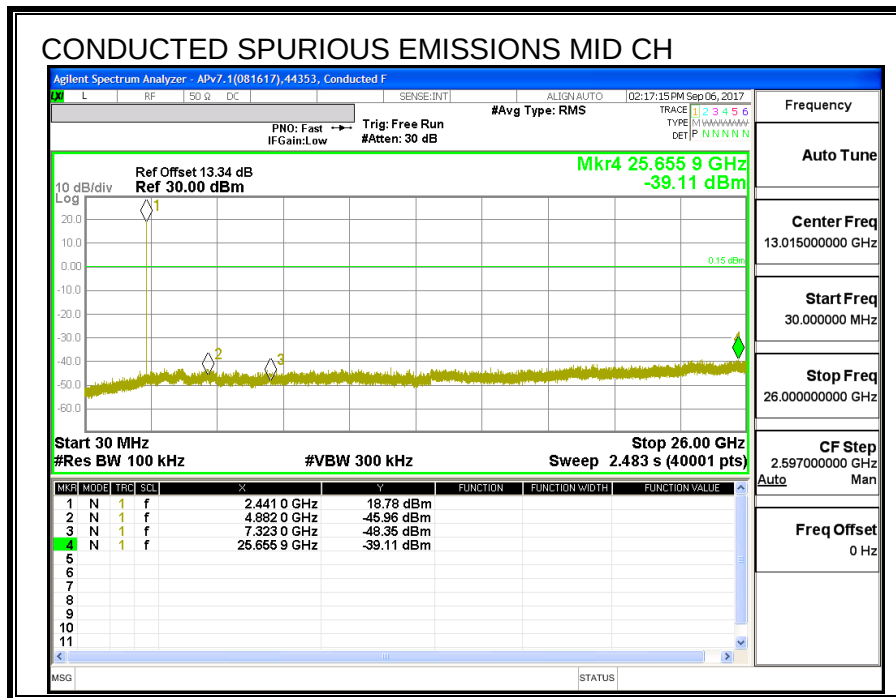
The bandedges at 2.4 and 2.4835 GHz are investigated with the transmitter set to the normal hopping mode.

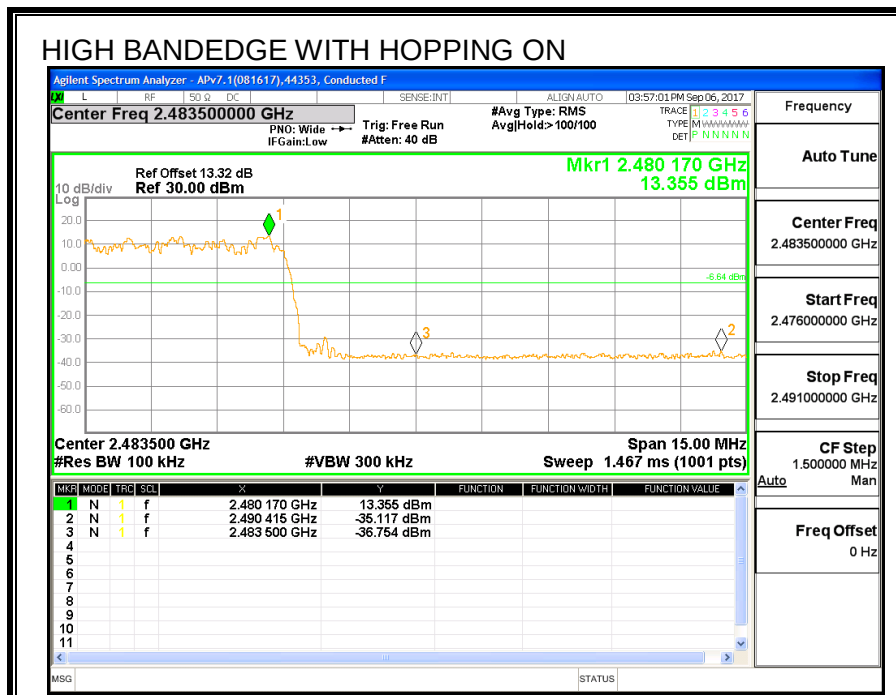
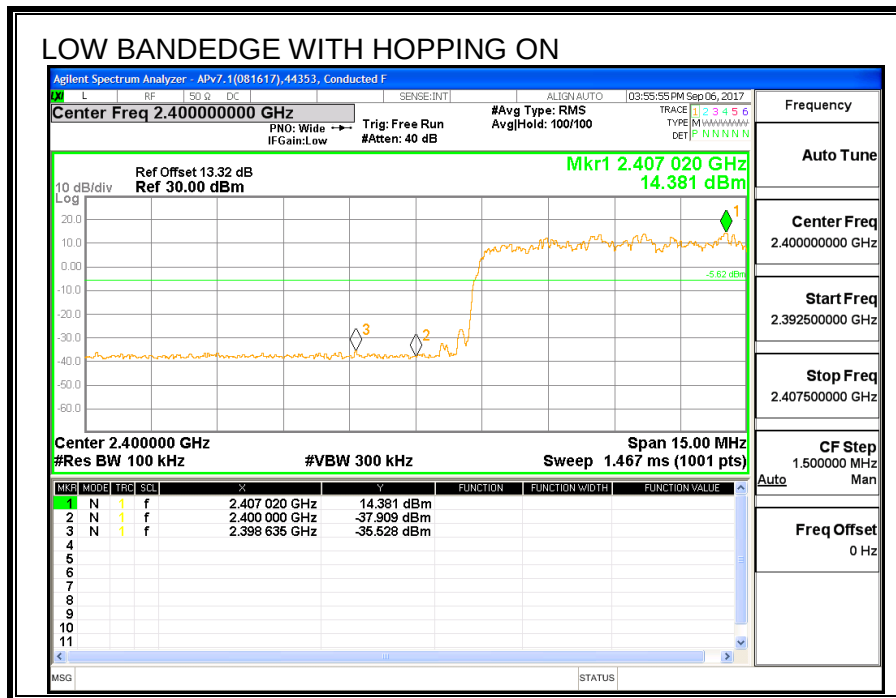
RESULTS

CONDUCTED BANDEDGE AND SPURIOUS EMISSIONS









7.4. Antenna A, Plow BASIC DATA RATE GFSK MODULATION

7.4.1. 20 dB AND 99% BANDWIDTH

LIMITS

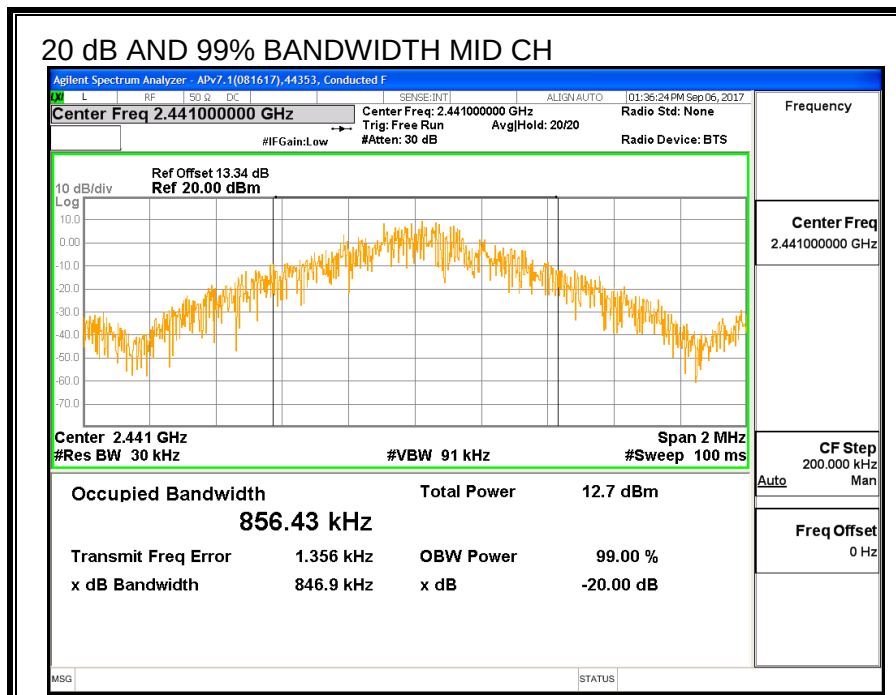
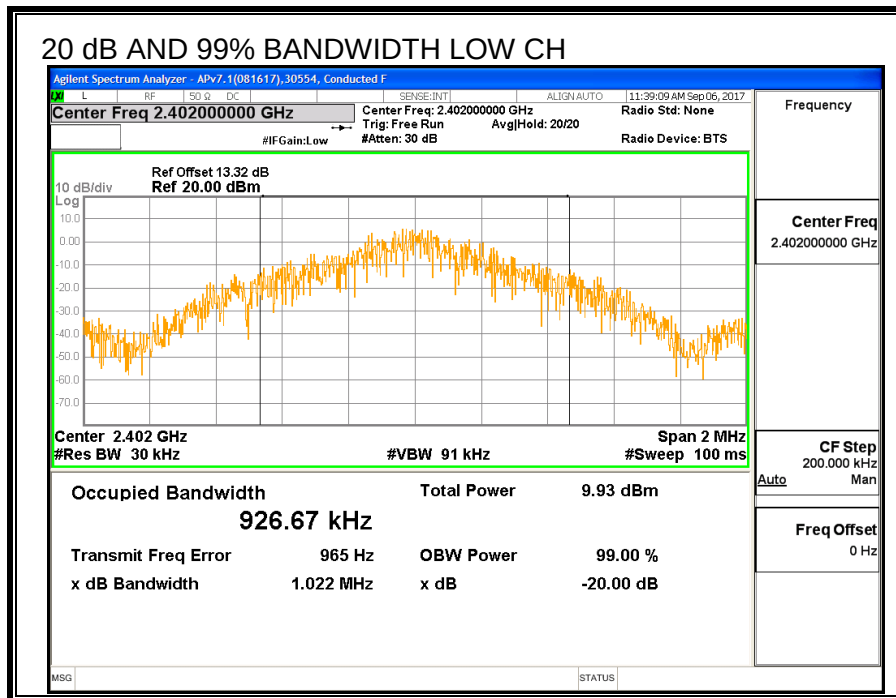
None; for reporting purposes only.

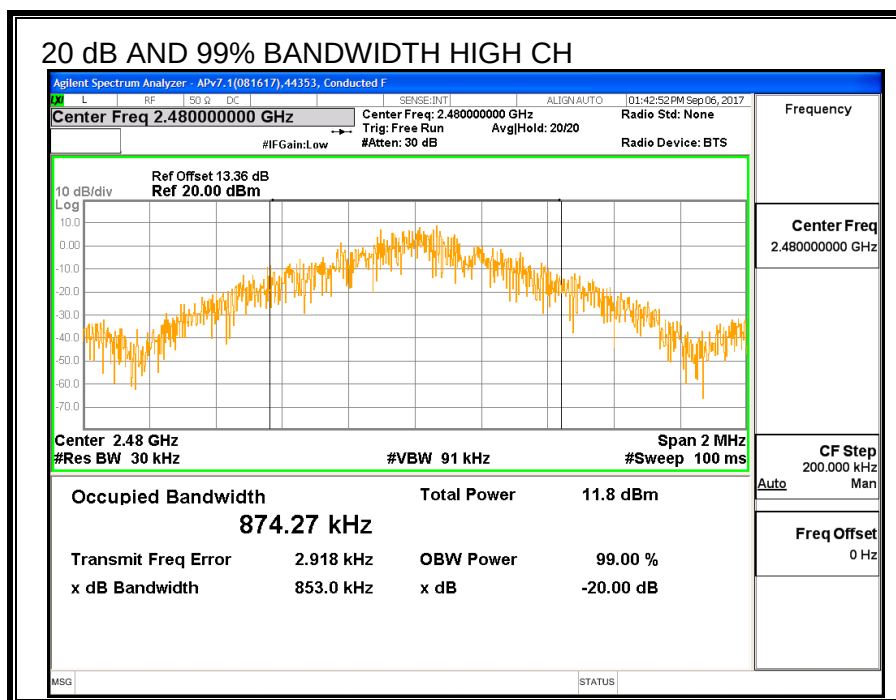
TEST PROCEDURE

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	1022.0	926.67
Middle	2441	846.9	856.43
High	2480	853.0	874.27





7.4.2. HOPPING FREQUENCY SEPARATION

LIMITS

FCC §15.247 (a) (1)

IC RSS-247 (5.1) (b)

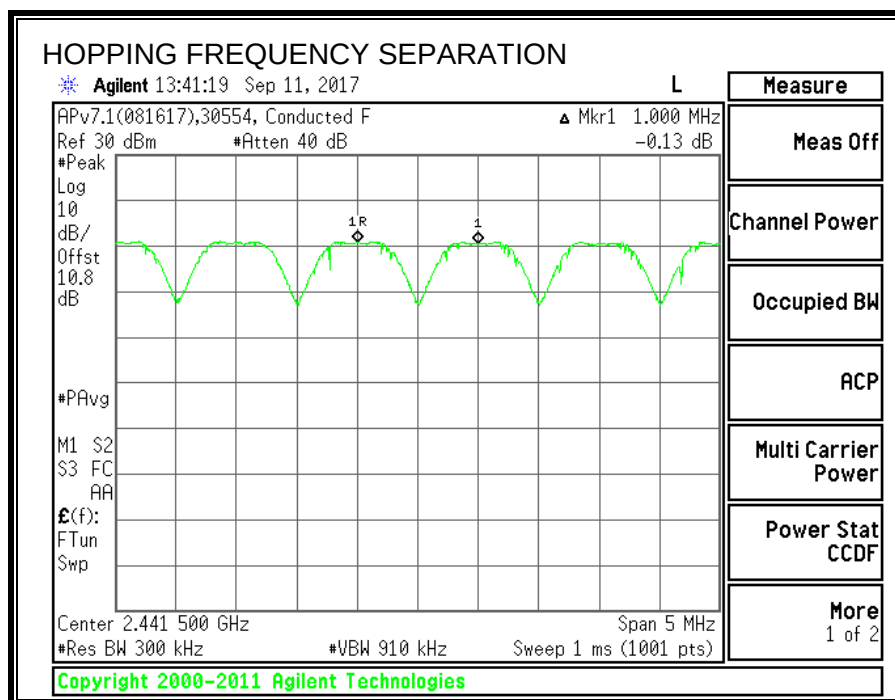
Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater.

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



7.4.3. NUMBER OF HOPPING CHANNELS

LIMITS

FCC §15.247 (a) (1) (iii)

IC RSS-247 (5.1) (d)

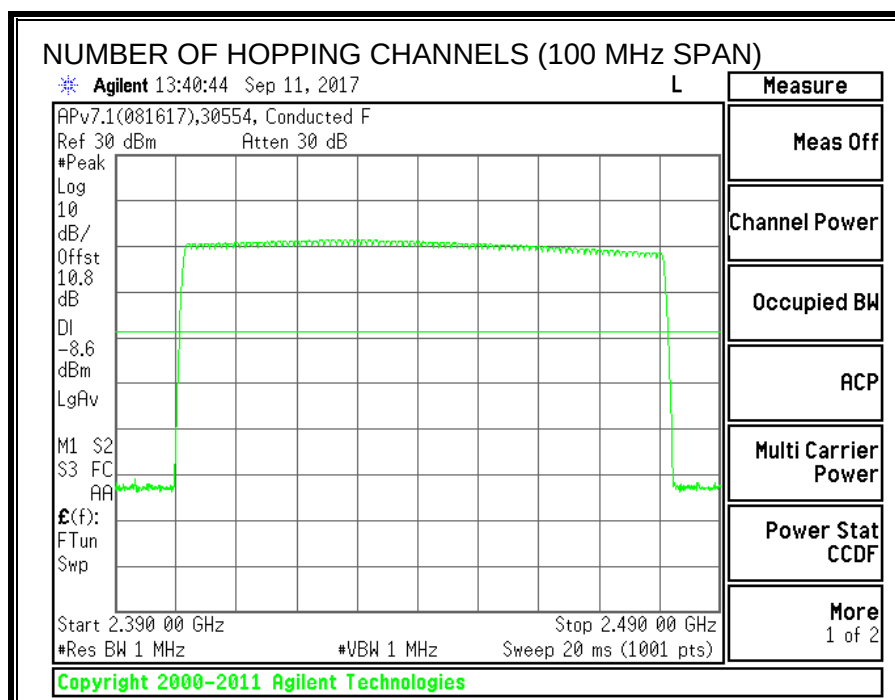
Frequency hopping systems in the 2400 – 2483.5 MHz band shall use at least 15 non-overlapping channels.

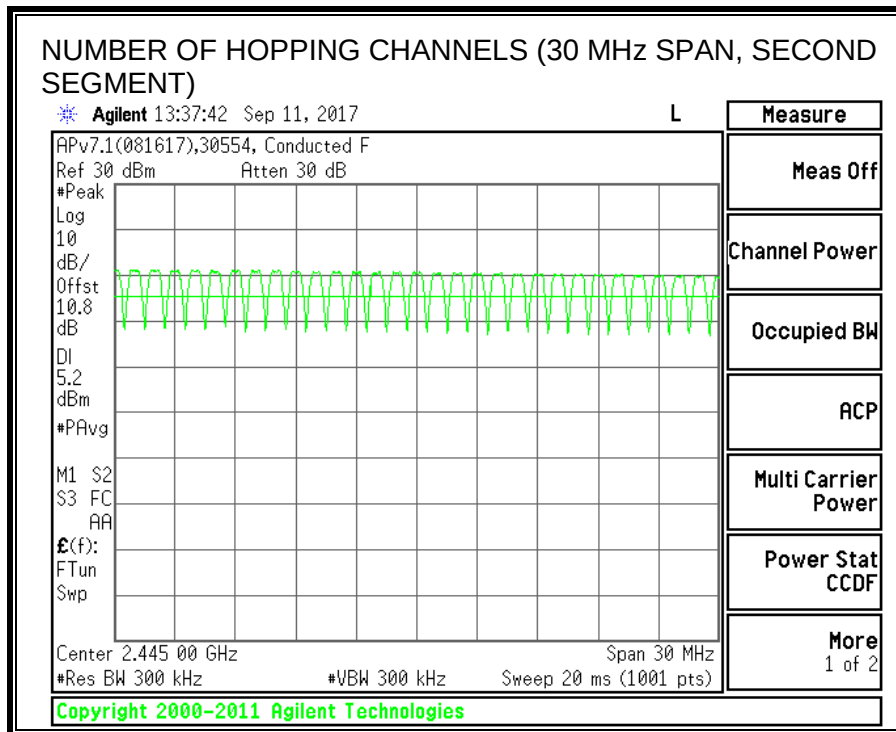
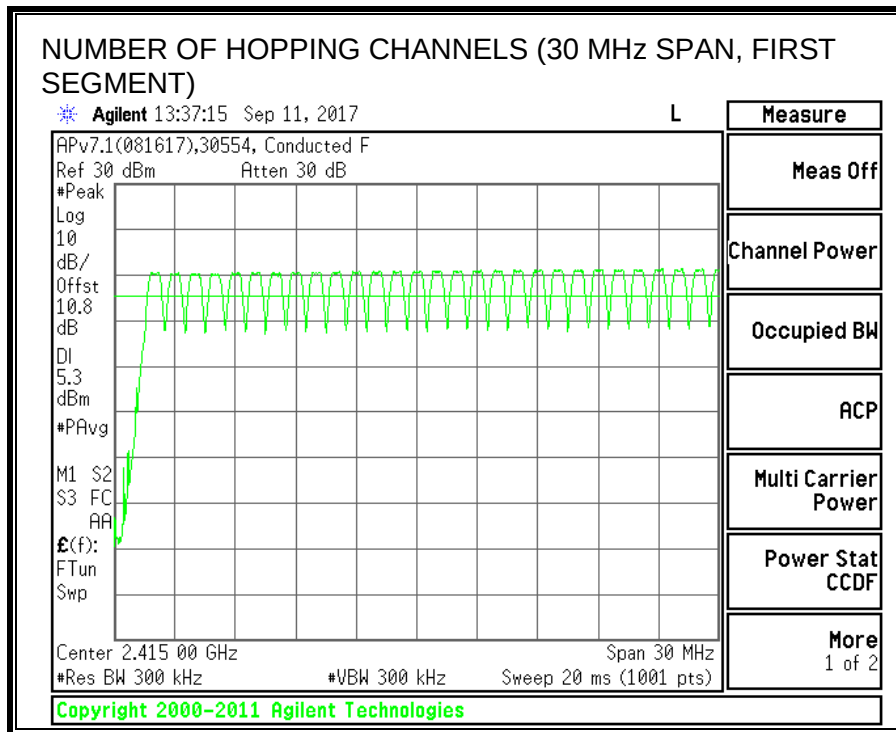
TEST PROCEDURE

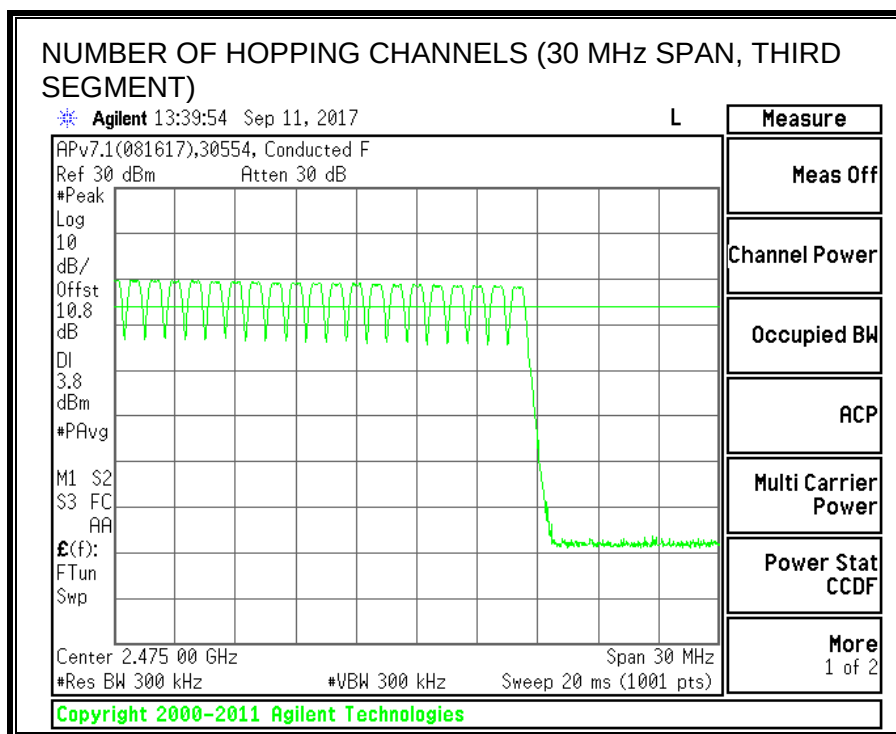
The transmitter output is connected to a spectrum analyzer. The span is set to cover the entire authorized band, in either a single sweep or in multiple contiguous sweeps. The RBW is set to a maximum of 1 % of the span. The analyzer is set to Max Hold.

RESULTS

Normal Mode: 79 Channels observed.







7.4.4. AVERAGE TIME OF OCCUPANCY

LIMITS

FCC §15.247 (a) (1) (iii)

IC RSS-247 (5.1) (d)

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

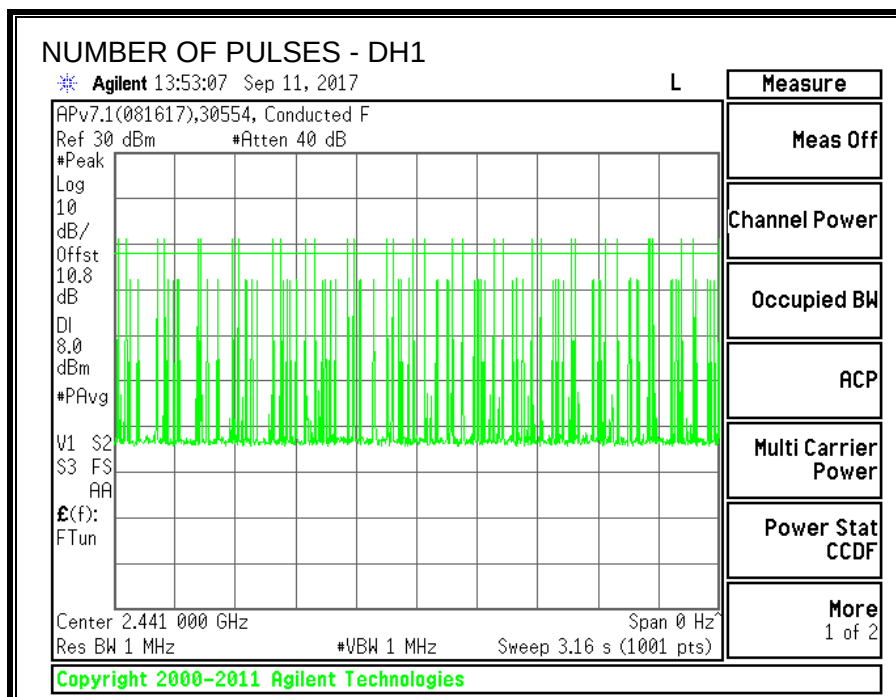
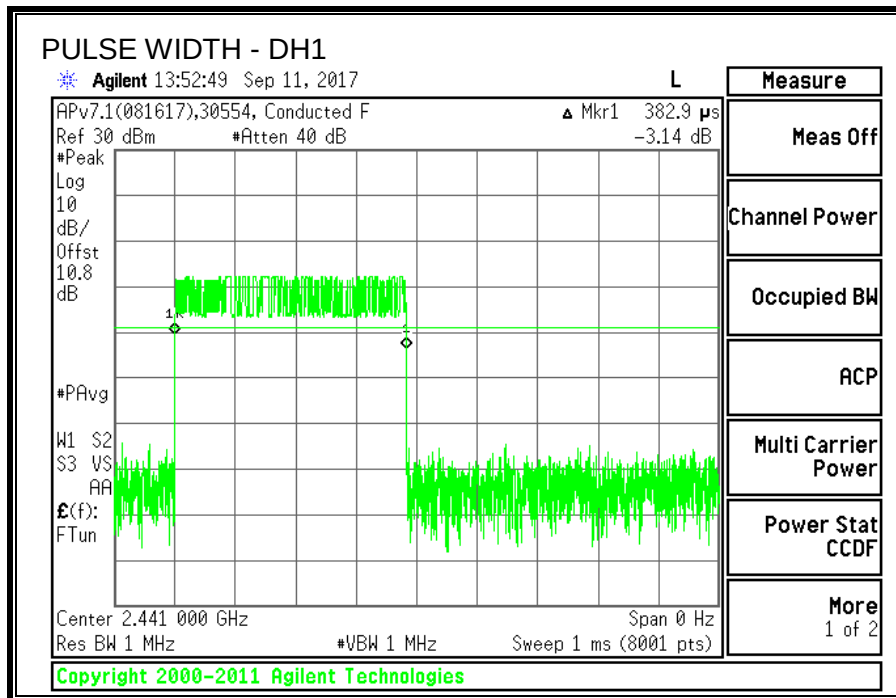
The transmitter output is connected to a spectrum analyzer. The span is set to 0 Hz, centered on a single, selected hopping channel. The width of a single pulse is measured in a fast scan. The number of pulses is measured in a 3.16 second scan, to enable resolution of each occurrence.

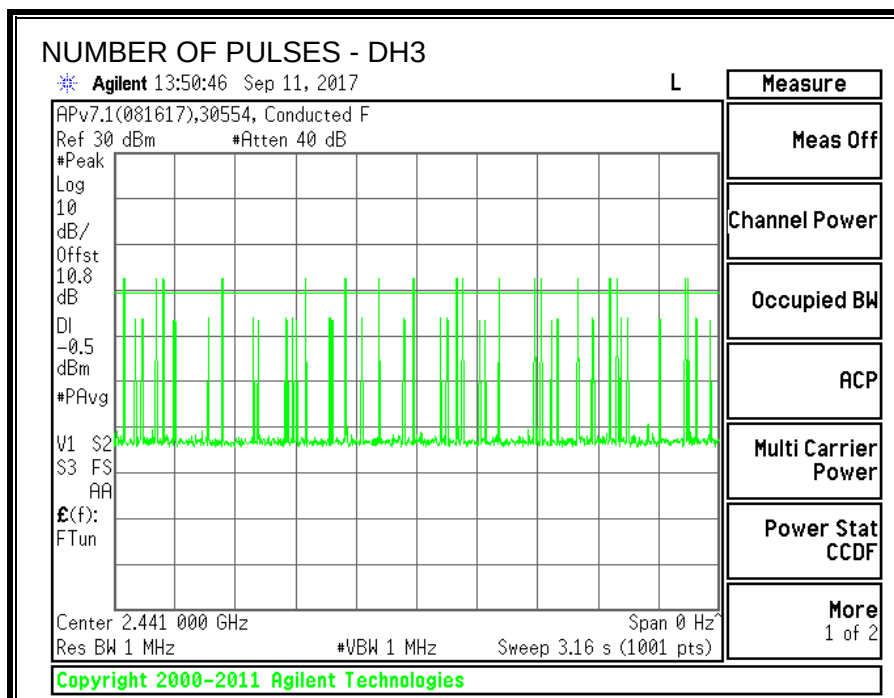
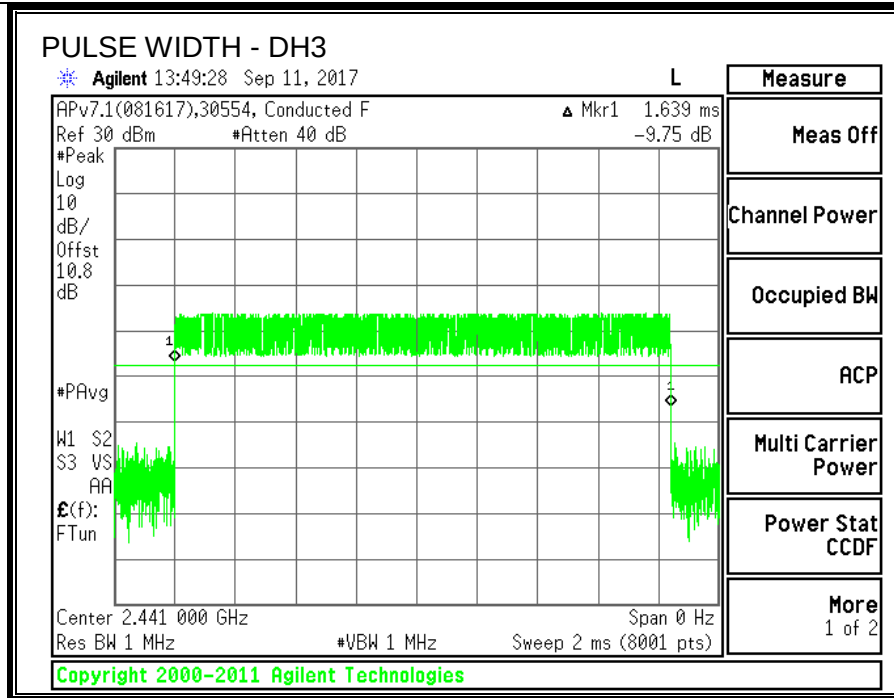
The average time of occupancy in the specified 31.6 second period (79 channels * 0.4 s) is equal to $10 * (\# \text{ of pulses in } 3.16 \text{ s}) * \text{pulse width}$.

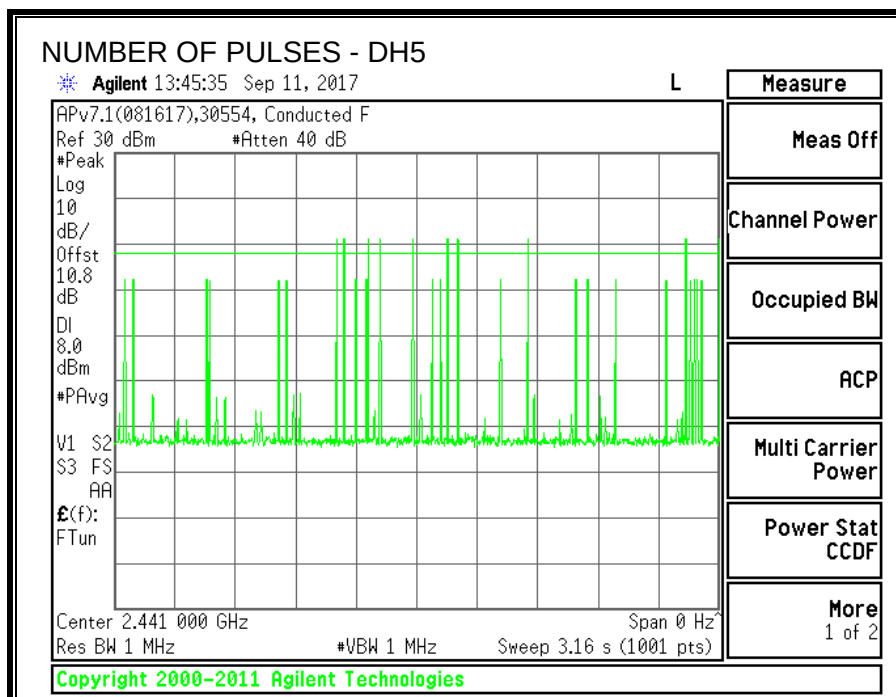
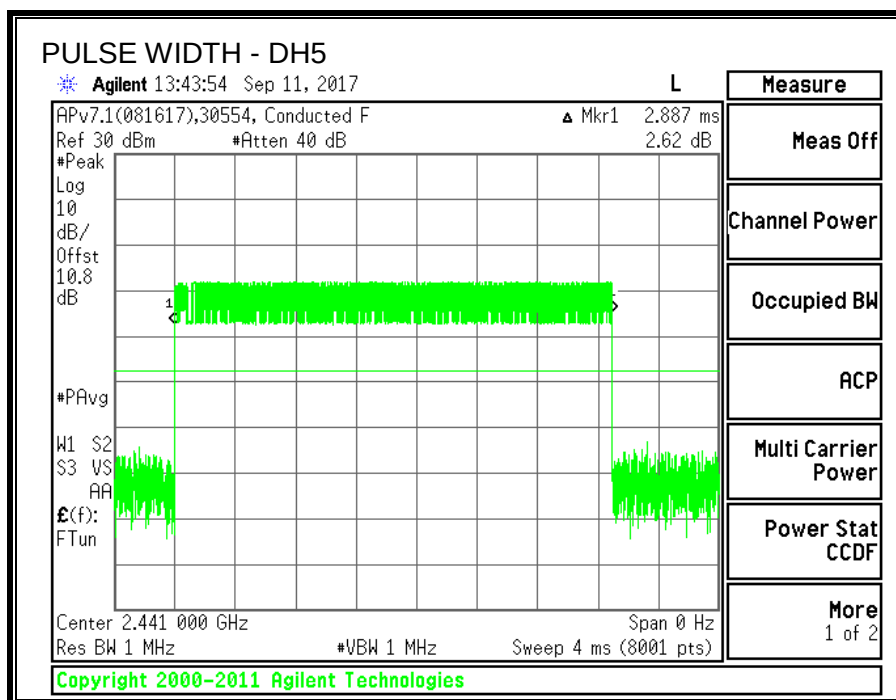
For AFH mode, the average time of occupancy in the specified 8 second period (20 channels * 0.4 seconds) is equal to $10 * (\# \text{ of pulses in } 0.8 \text{ s}) * \text{pulse width}$.

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					
DH1	0.3829	32	0.123	0.4	-0.277
DH3	1.639	17	0.279	0.4	-0.121
DH5	2.887	9	0.260	0.4	-0.140
DH Packet	Pulse Width (msec)	Number of Pulses in 0.8 seconds	Average Time of Occupancy (sec)	Limit (sec)	Margin (sec)
GFSK AFH Mode					
DH1	0.3829	8	0.031	0.4	-0.369
DH3	1.639	4.25	0.070	0.4	-0.330
DH5	2.887	2.25	0.065	0.4	-0.335







7.4.5. OUTPUT POWER

ID:	50893	Date:	9/7/2017
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LIMITS

§15.247 (b) (1)

RSS-247 (5.4) (b)

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 and average power meter.

RESULTS

Channel	Frequency (MHz)	Output Power (dBm)	Limit (dBm)	Margin (dB)
Low	2402	12.11	30	-17.89
Middle	2441	12.24	30	-17.74
High	2480	12.13	30	-17.87

7.4.6. AVERAGE POWER

ID:	50893	Date:	9/7/2017
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LIMITS

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.

Channel	Frequency (MHz)	Average Power (dBm)
Low	2402	11.85
Middle	2441	11.96
High	2480	11.86

7.4.7. CONDUCTED SPURIOUS EMISSIONS

LIMITS

FCC §15.247 (d)

IC RSS-247 (5.5)

Limit = -20 dBc

TEST PROCEDURE

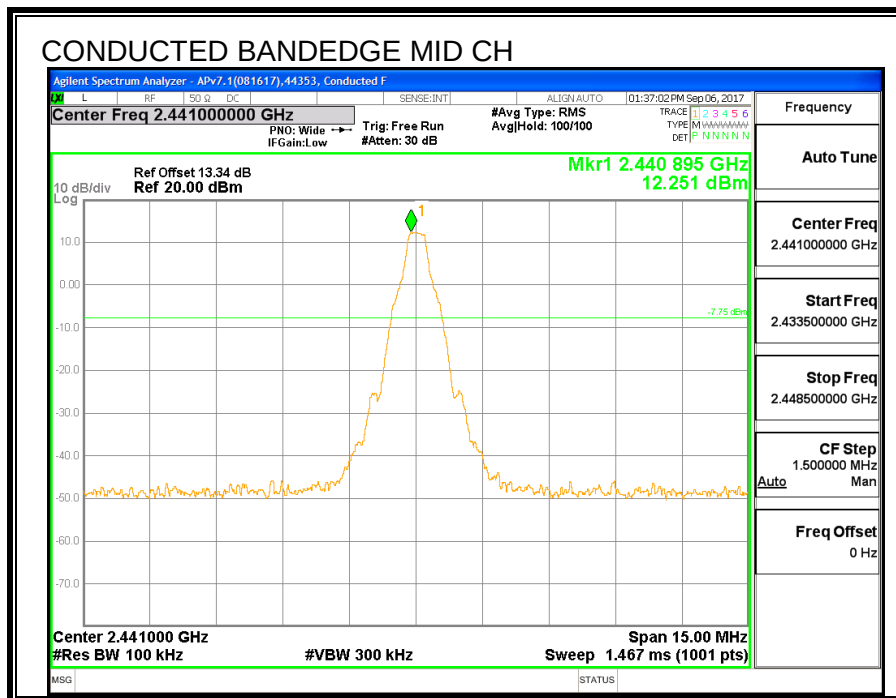
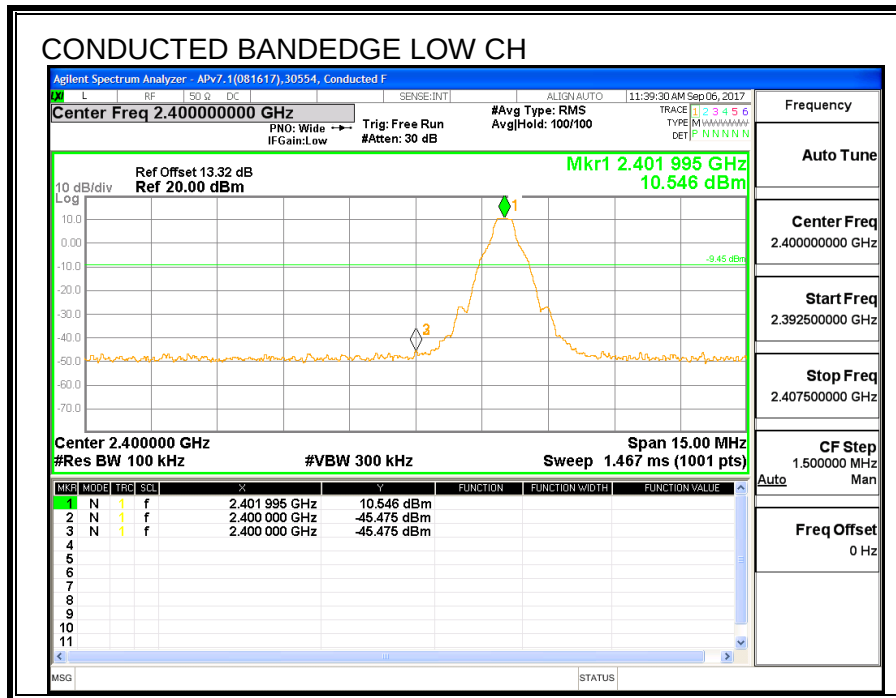
The transmitter output is connected to a spectrum analyzer. The resolution bandwidth is set to 100 kHz. The video bandwidth is set to 300 kHz.

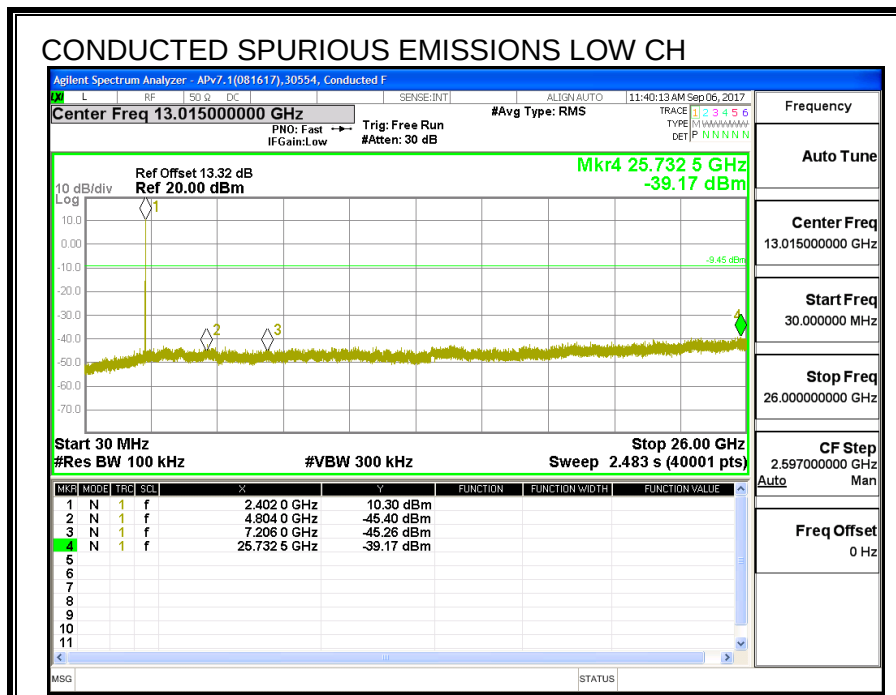
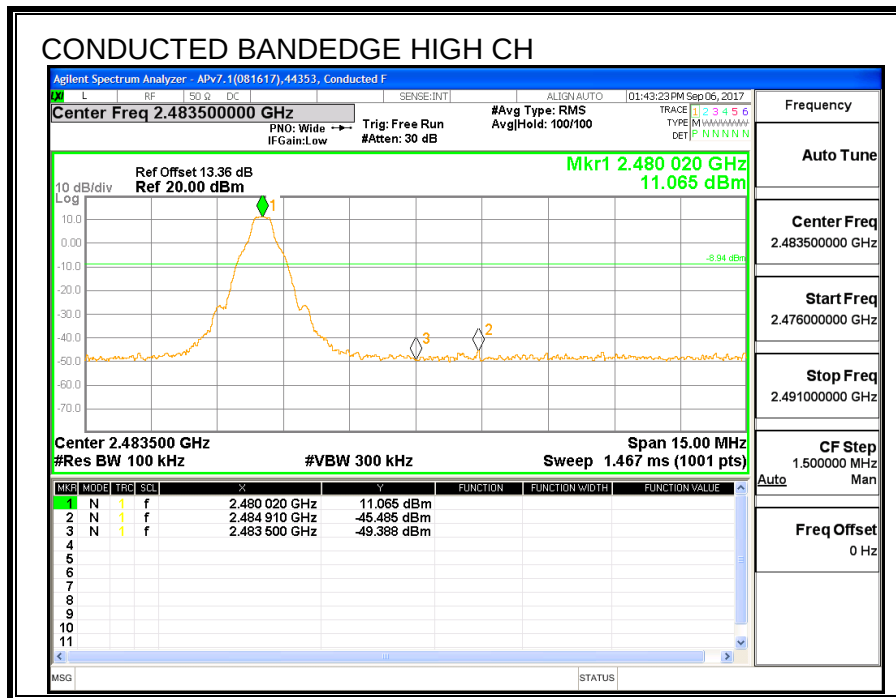
The spectrum from 30 MHz to 26 GHz is investigated with the transmitter set to the lowest, middle, and highest channels.

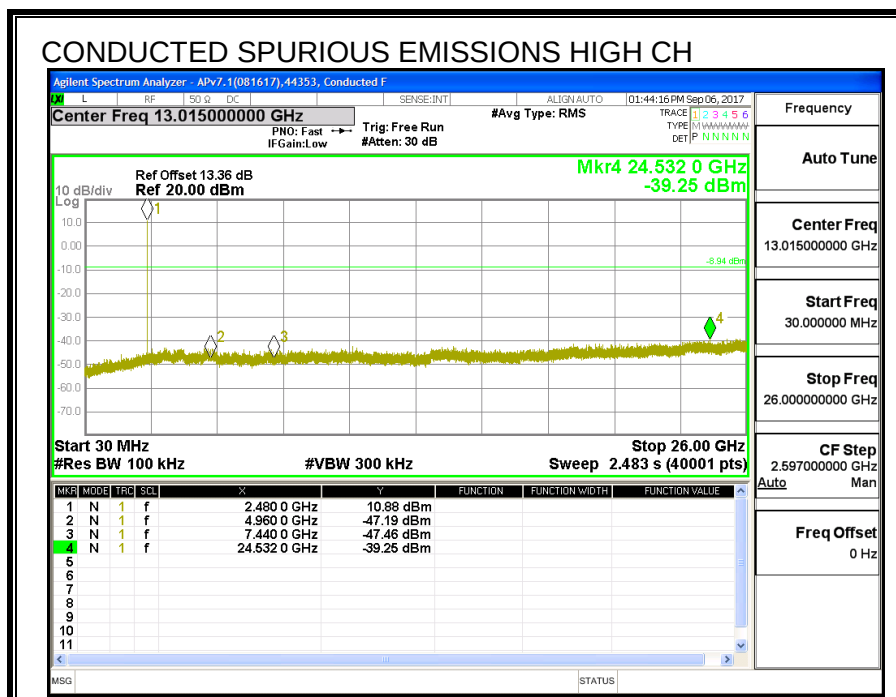
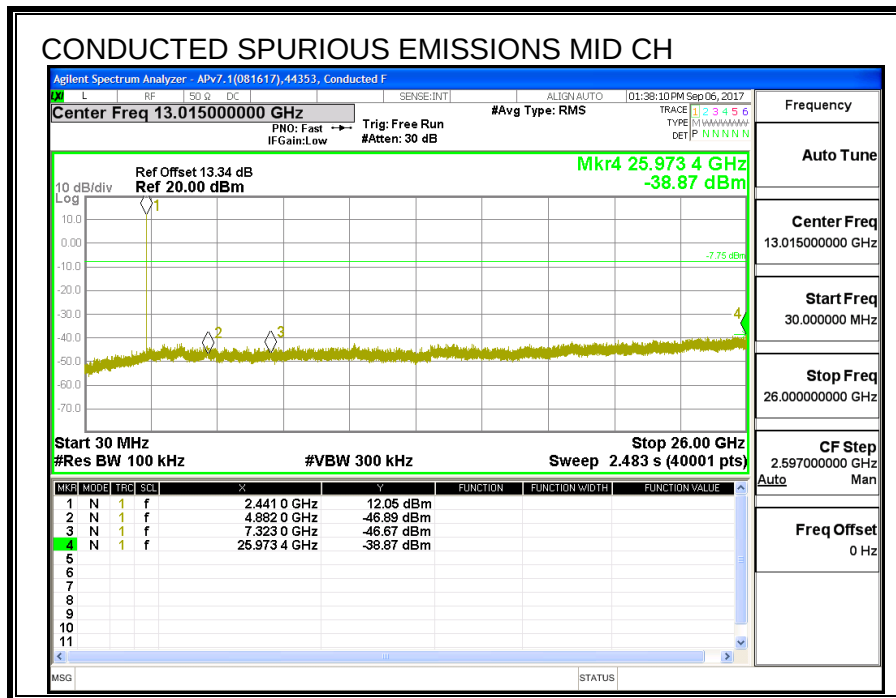
The bandedges at 2.4 and 2.4835 GHz are investigated with the transmitter set to the normal hopping mode.

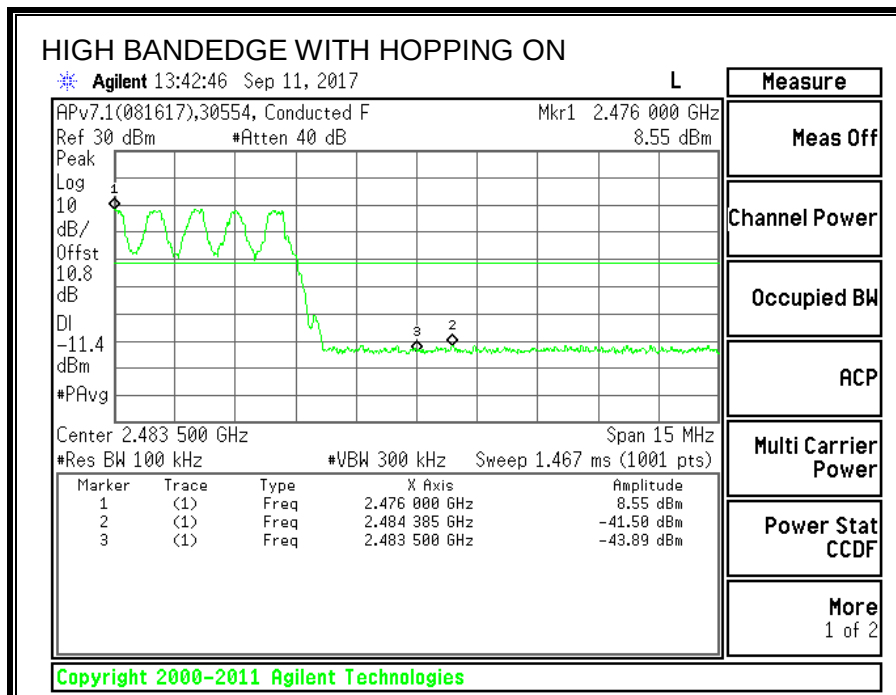
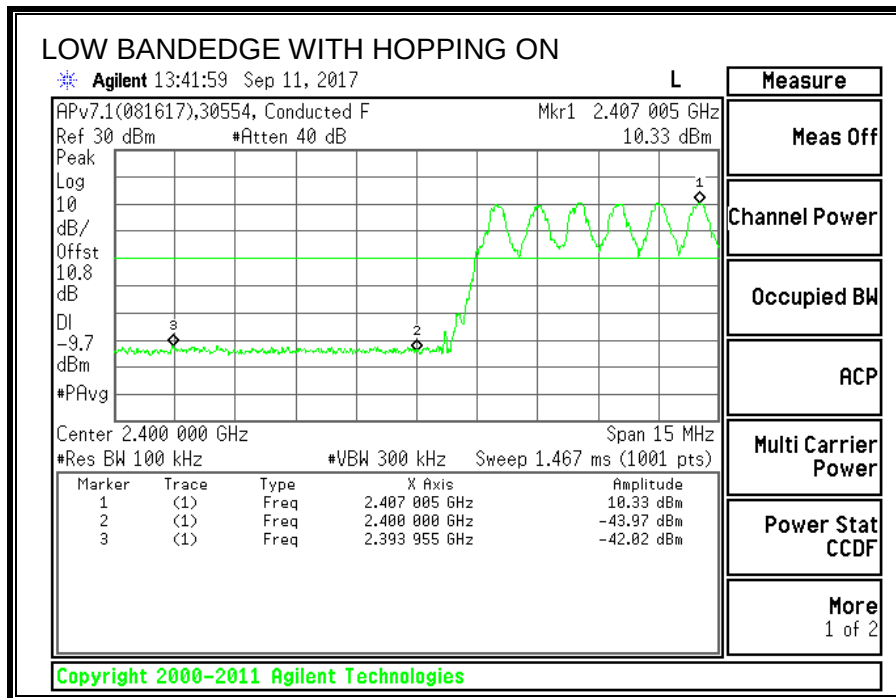
RESULTS

CONDUCTED BANDEDGE AND SPURIOUS EMISSIONS









7.5. Antenna A, Plow ENHANCED DATA RATE DQPSK MODULATION

7.5.1. OUTPUT POWER

ID:	44353	Date:	9/18/17
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LIMITS

§15.247 (b) (1)

RSS-247 (5.4) (b)

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 and average power meter.

RESULTS

Channel	Frequency (MHz)	Output Power (dBm)	Limit (dBm)	Margin (dB)
Low	2402	10.55	21	-10.45
Middle	2441	10.67	21	-10.33
High	2480	10.58	21	-10.42

7.5.2. AVERAGE POWER

ID:	44353	Date:	7/29/17
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LIMITS

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.

Channel	Frequency (MHz)	Average Power (dBm)
Low	2402	8.27
Middle	2441	8.38
High	2480	8.30

7.6. Antenna A, Plow ENHANCED DATA RATE 8PSK MODULATION

7.6.1. 20 dB AND 99% BANDWIDTH

LIMITS

None; for reporting purposes only.

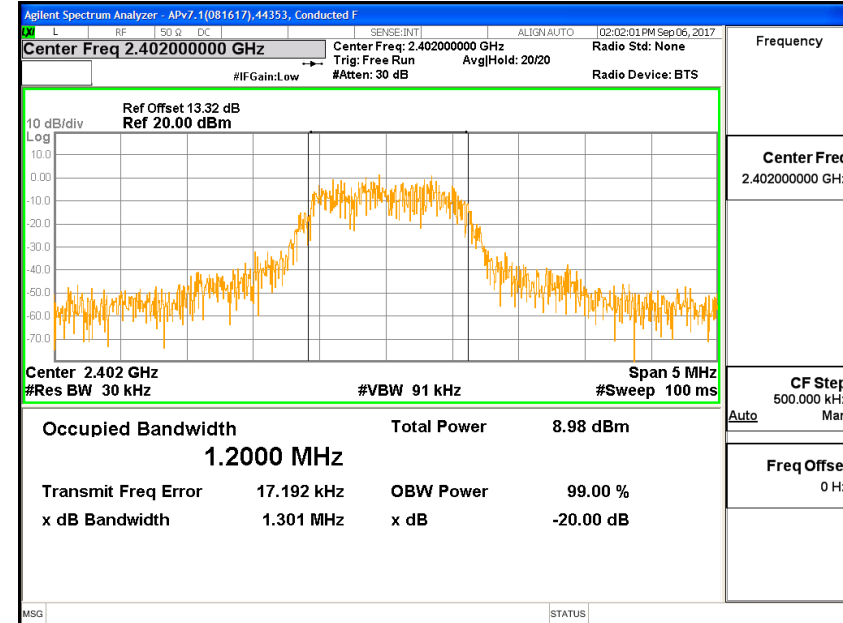
TEST PROCEDURE

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.

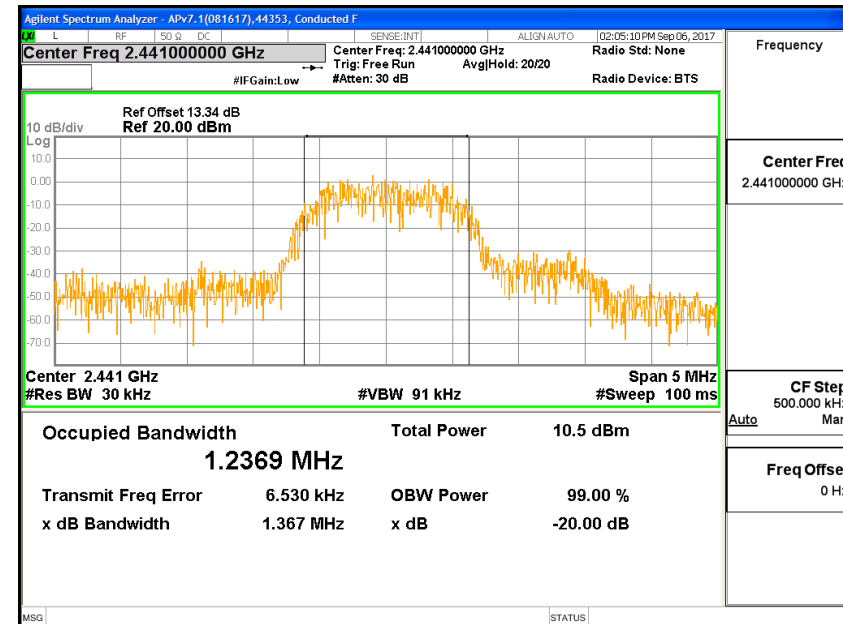
RESULTS

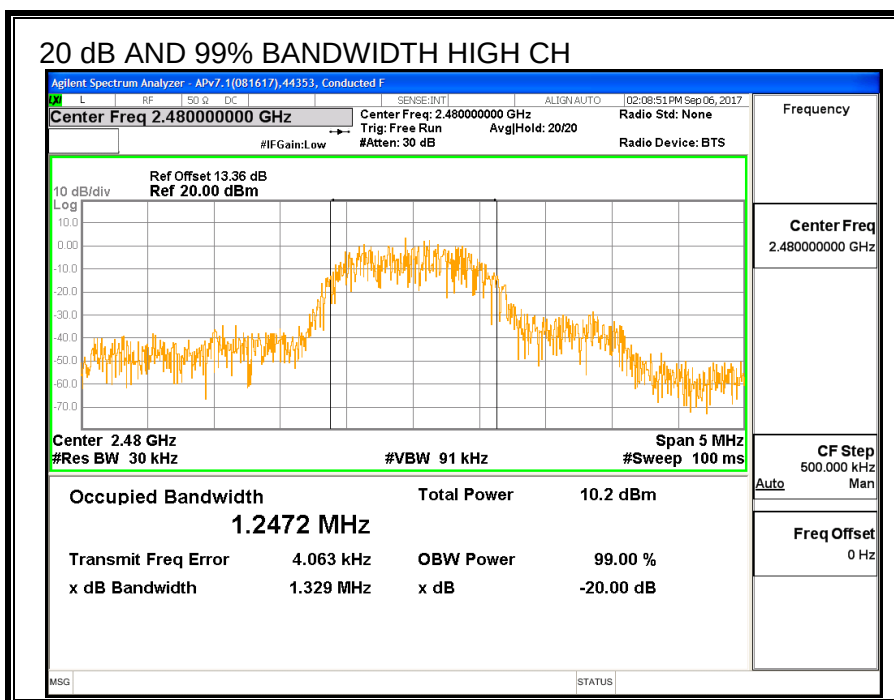
Channel	Frequency (MHz)	20 dB Bandwidth (KHz)	99% Bandwidth (KHz)
Low	2402	1301	1200.0
Middle	2441	1367	1236.7
High	2480	1329	1247.2

20 dB AND 99% BANDWIDTH LOW CH



20 dB AND 99% BANDWIDTH MID CH





7.6.2. HOPPING FREQUENCY SEPARATION

LIMITS

FCC §15.247 (a) (1)

IC RSS-247 (5.1) (b)

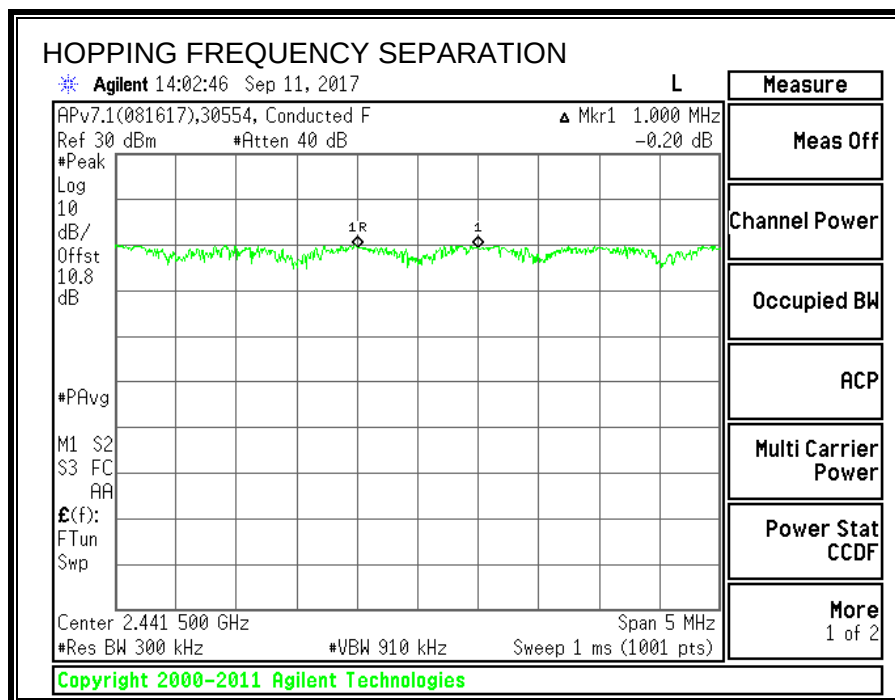
Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater.

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



7.6.3. NUMBER OF HOPPING CHANNELS

LIMITS

FCC §15.247 (a) (1) (iii)

IC RSS-247 (5.1) (d)

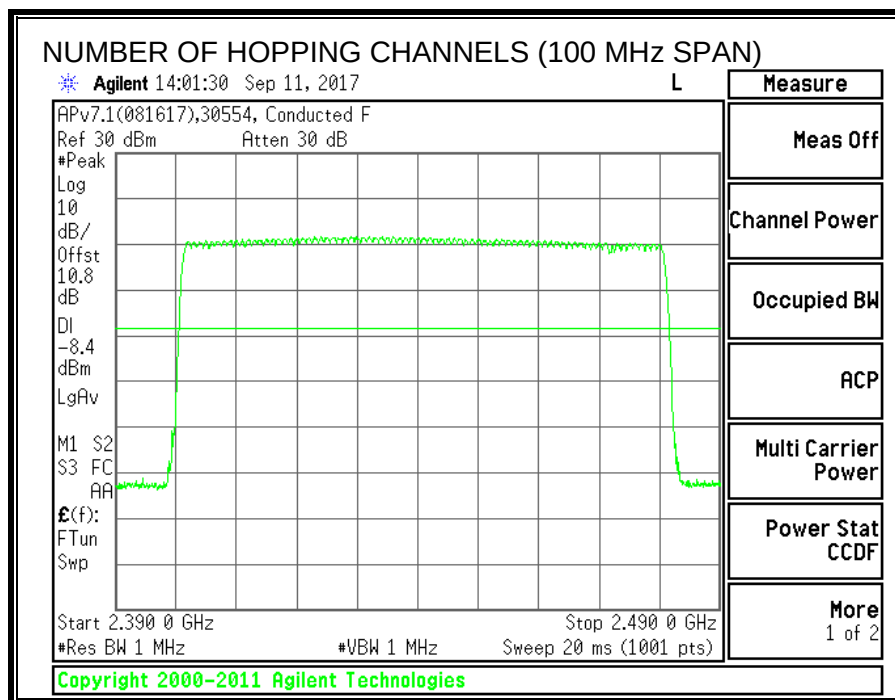
Frequency hopping systems in the 2400 – 2483.5 MHz band shall use at least 15 non-overlapping channels.

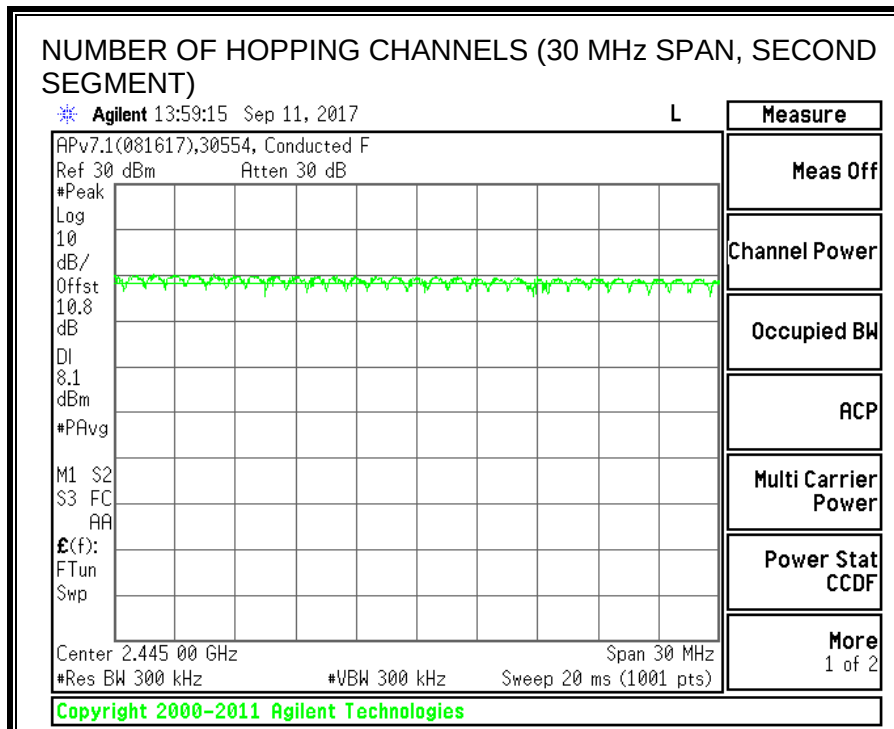
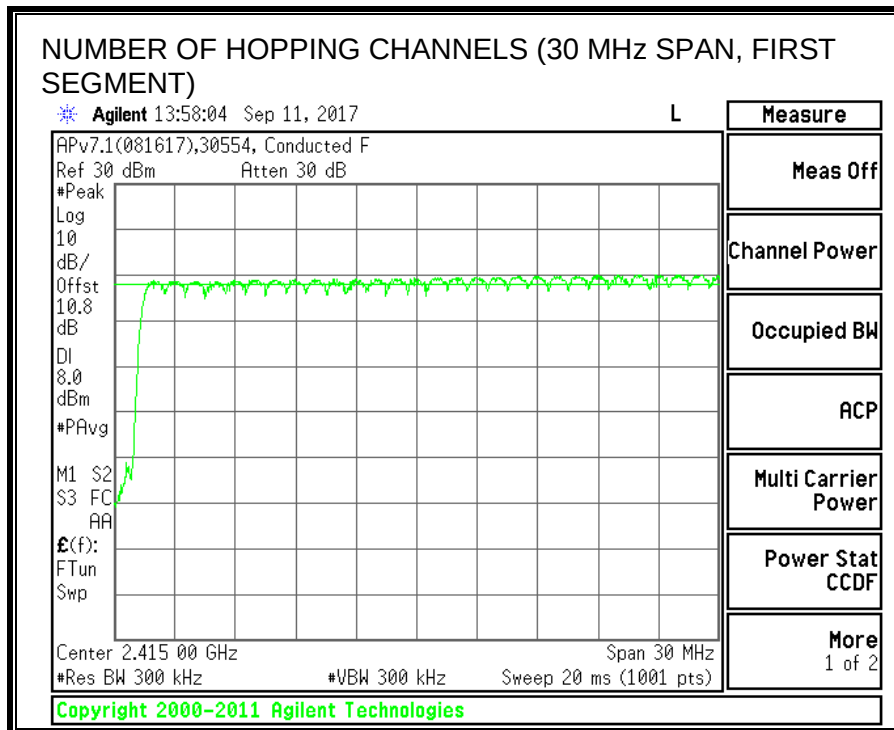
TEST PROCEDURE

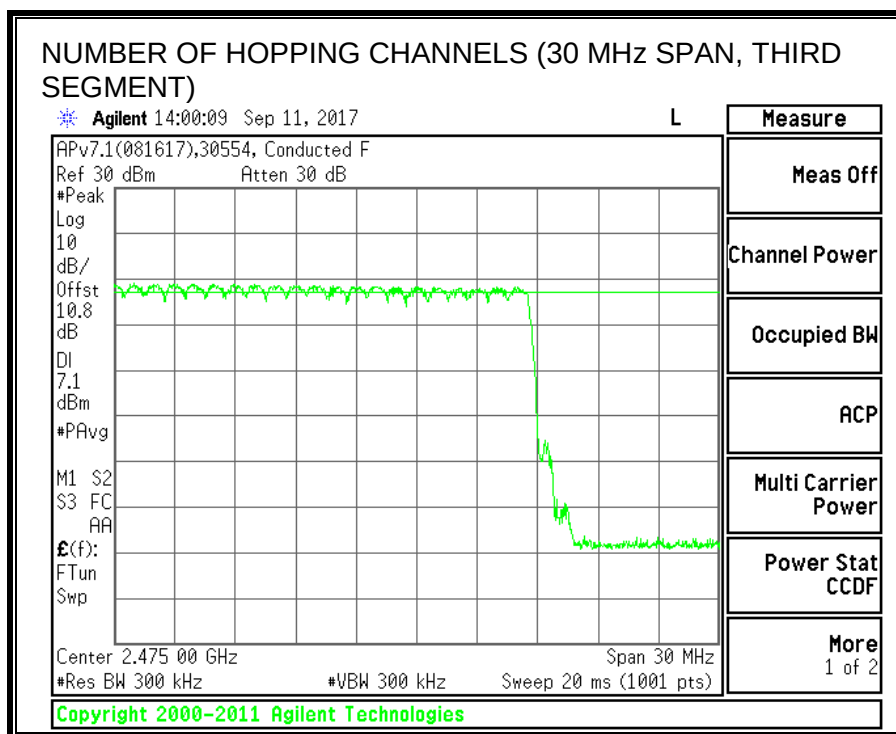
The transmitter output is connected to a spectrum analyzer. The span is set to cover the entire authorized band, in either a single sweep or in multiple contiguous sweeps. The RBW is set to a maximum of 1 % of the span. The analyzer is set to Max Hold.

RESULTS

Normal Mode: 79 Channels observed.







7.6.4. AVERAGE TIME OF OCCUPANCY

LIMITS

FCC §15.247 (a) (1) (iii)

IC RSS-247 (5.1) (d)

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.

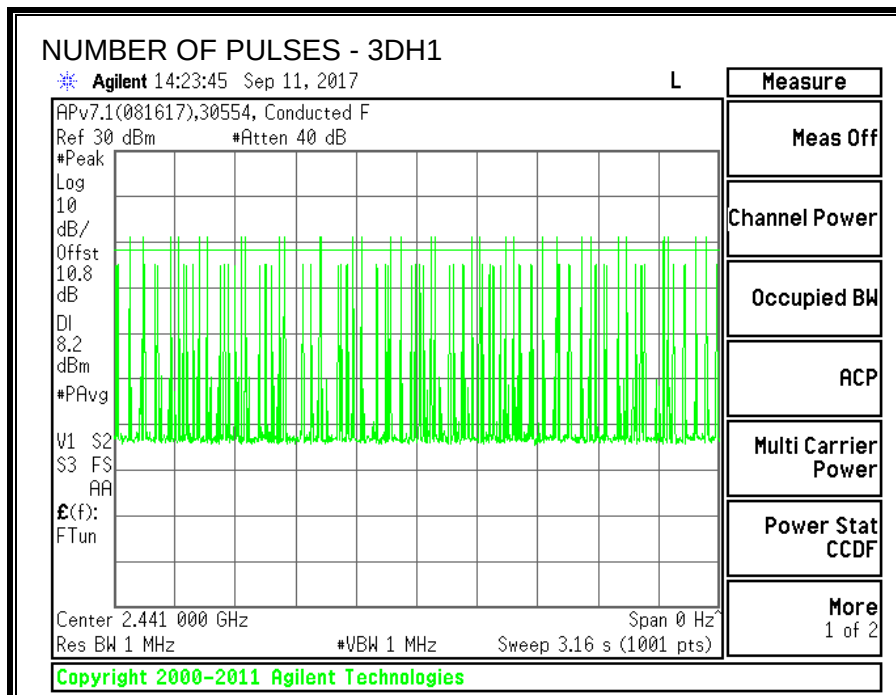
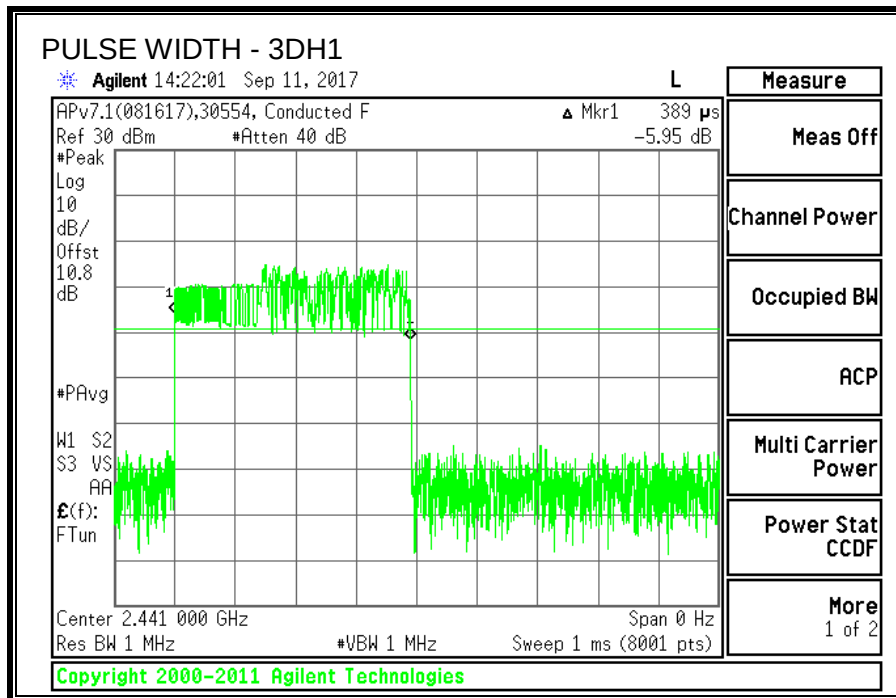
The average time of occupancy in the specified 31.6 second period (79 channels * 0.4 s) is equal to $10 * (\# \text{ of pulses in } 3.16 \text{ s}) * \text{pulse width}$.

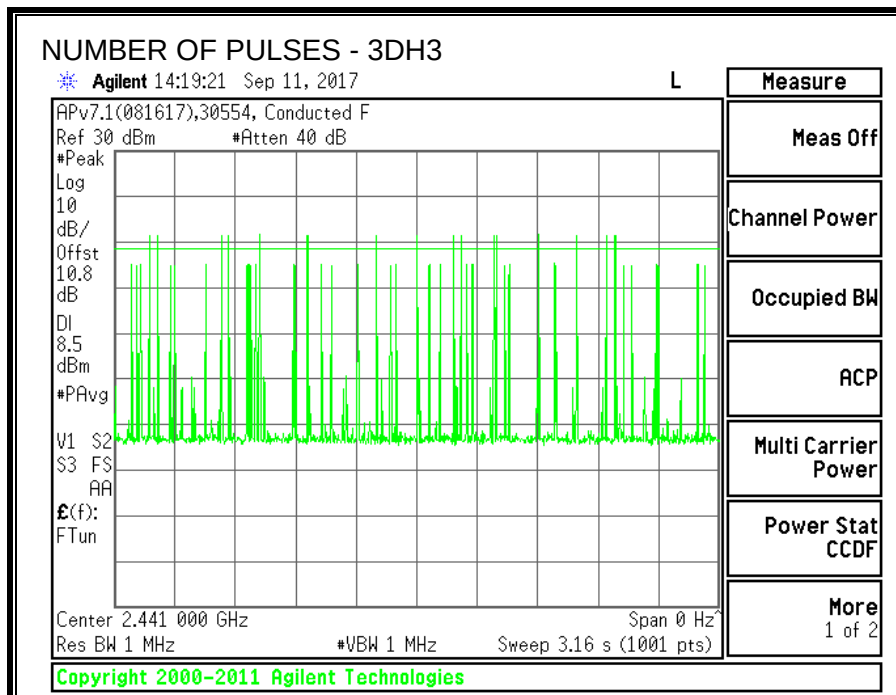
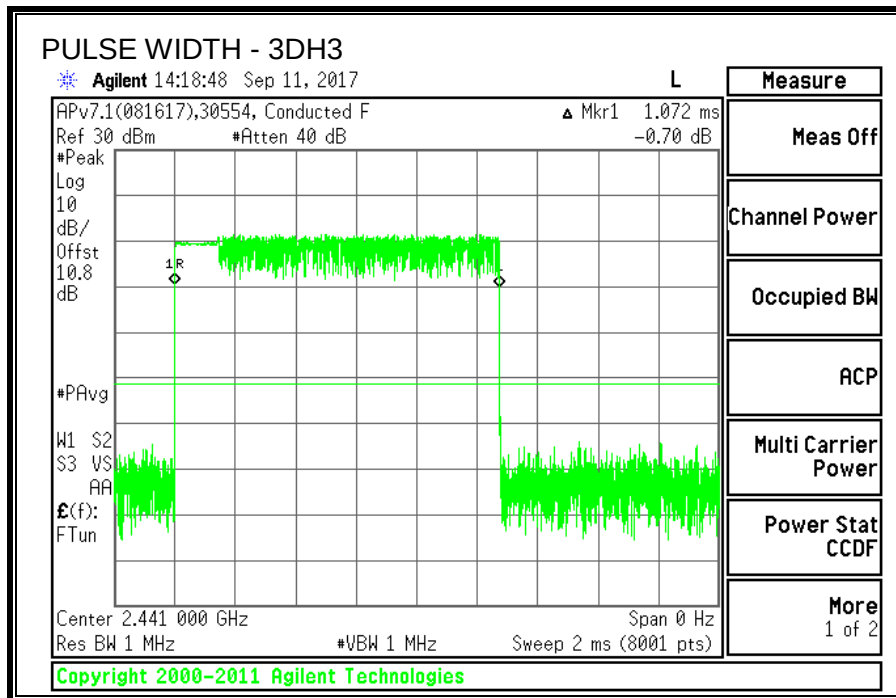
For AFH mode, the average time of occupancy in the specified 8 second period (20 channels * 0.4 seconds) is equal to $10 * (\# \text{ of pulses in } 0.8 \text{ s}) * \text{pulse width}$.

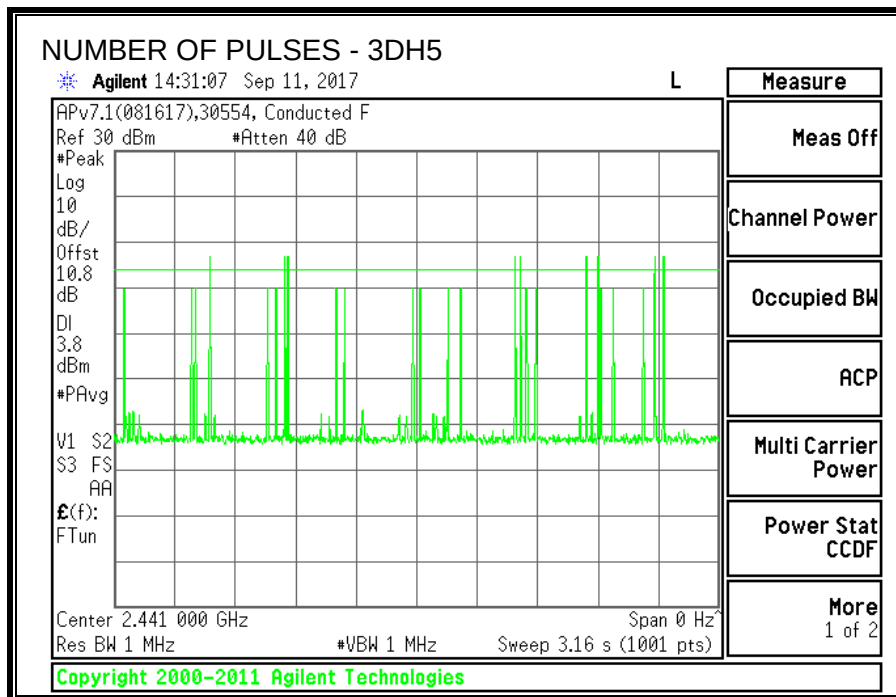
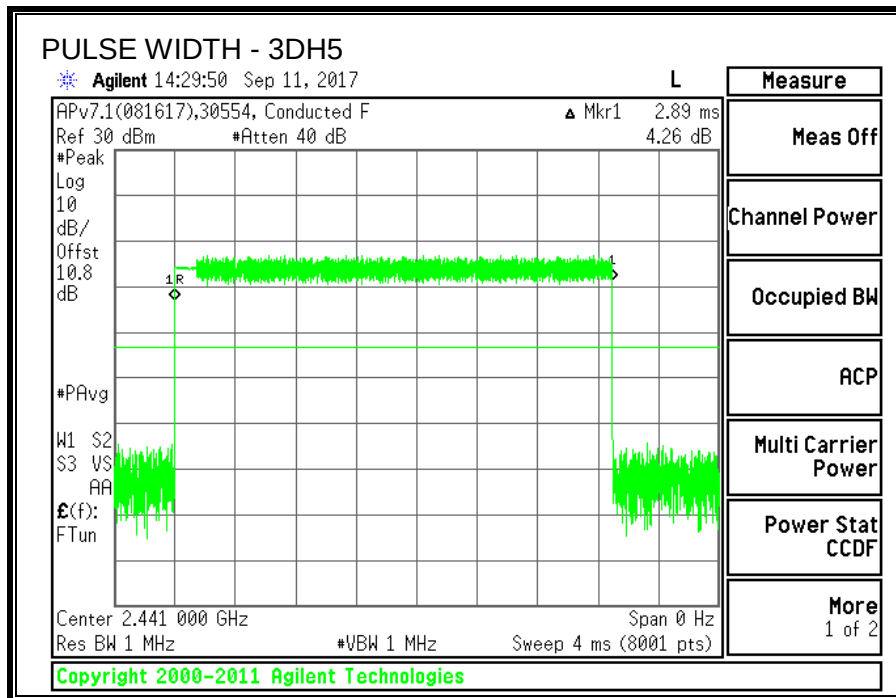
RESULTS

8PSK (EDR) Mode

DH Packet	Pulse Width (msec)	Number of Pulses in 3.16 seconds	Average Time of (sec)	Limit (sec)	Margin (sec)
3DH1	0.389	31	0.121	0.4	-0.279
3DH3	1.072	16	0.172	0.4	-0.228
3DH5	2.89	9	0.260	0.4	-0.140







7.6.5. OUTPUT POWER

ID:	50893	Date:	9/7/2017
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LIMITS

§15.247 (b) (1)

RSS-247 (5.4) (b)

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 and average power meter.

RESULTS

Channel	Frequency (MHz)	Output Power (dBm)	Limit (dBm)	Margin (dB)
Low	2402	10.63	21	-20.37
Middle	2441	10.72	21	-20.28
High	2480	10.62	21	-20.38

7.6.6. AVERAGE POWER

ID:	50893	Date:	9/7/2017
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LIMITS

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.

Channel	Frequency (MHz)	Average Power (dBm)
Low	2402	8.39
Middle	2441	8.47
High	2480	8.36

7.6.7. CONDUCTED SPURIOUS EMISSIONS

LIMITS

FCC §15.247 (d)

IC RSS-247 (5.5)

Limit = -20 dBc

TEST PROCEDURE

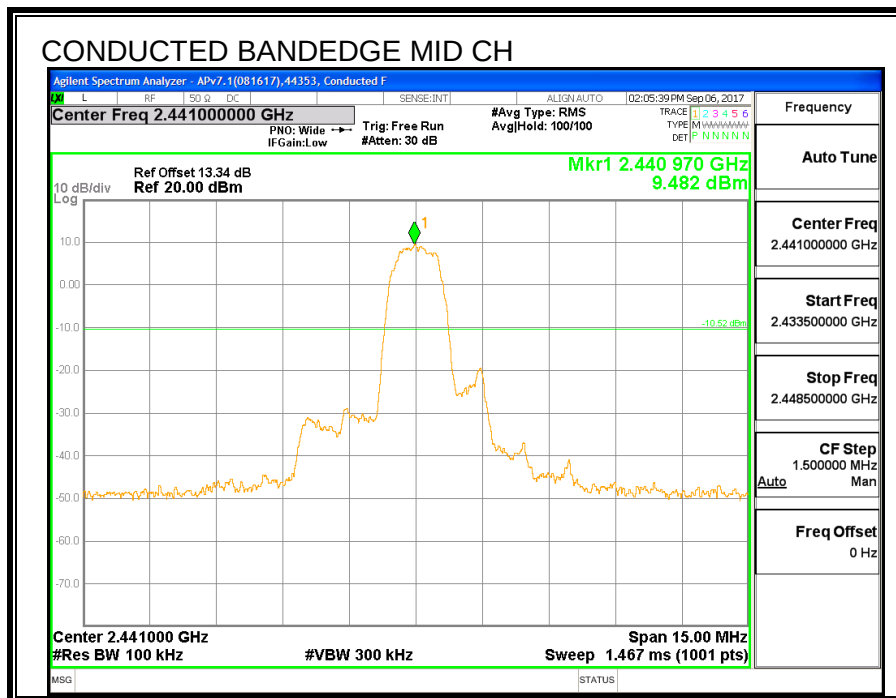
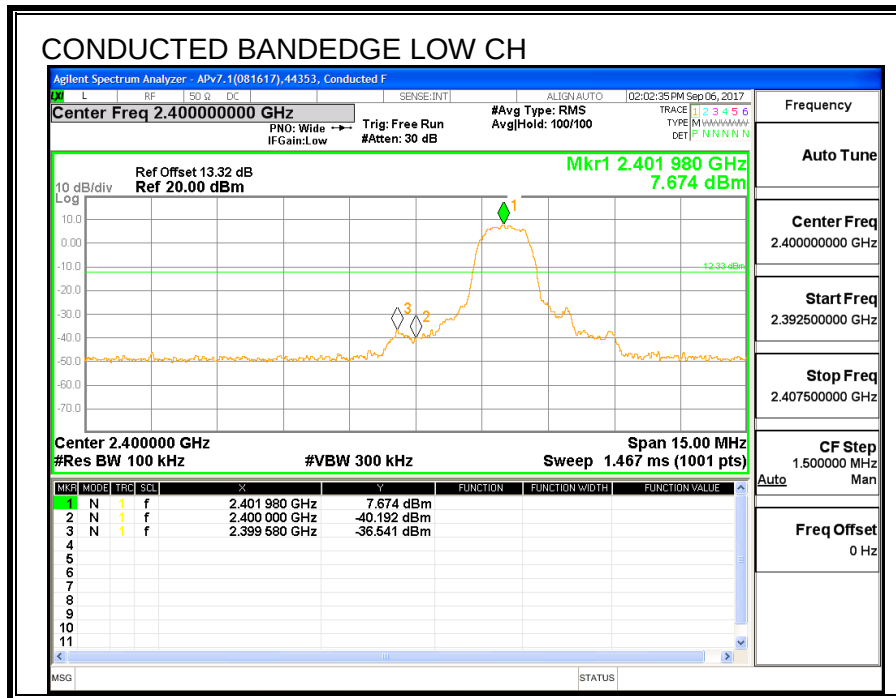
The transmitter output is connected to a spectrum analyzer. The resolution bandwidth is set to 100 kHz. The video bandwidth is set to 300 kHz.

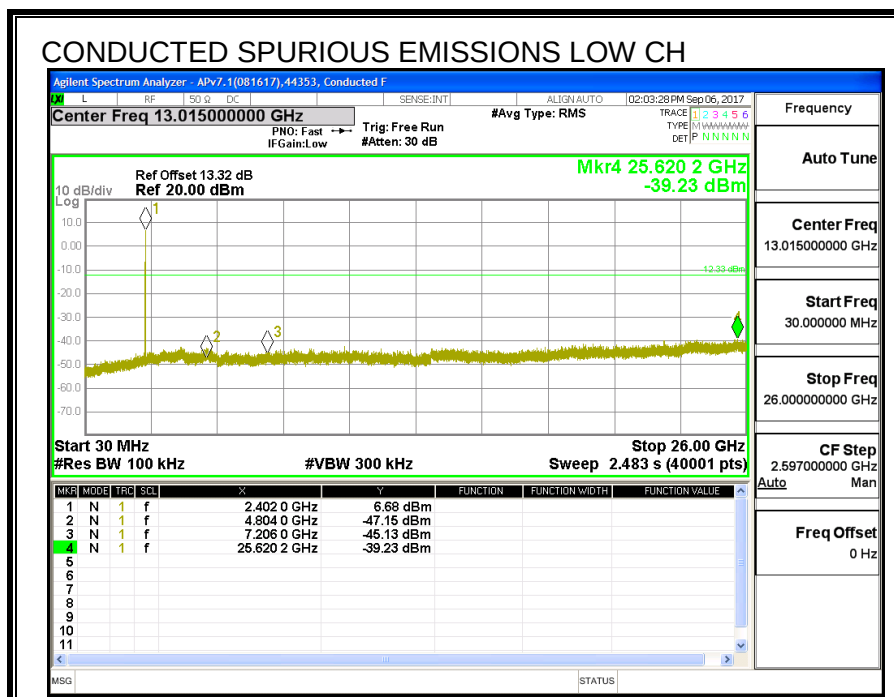
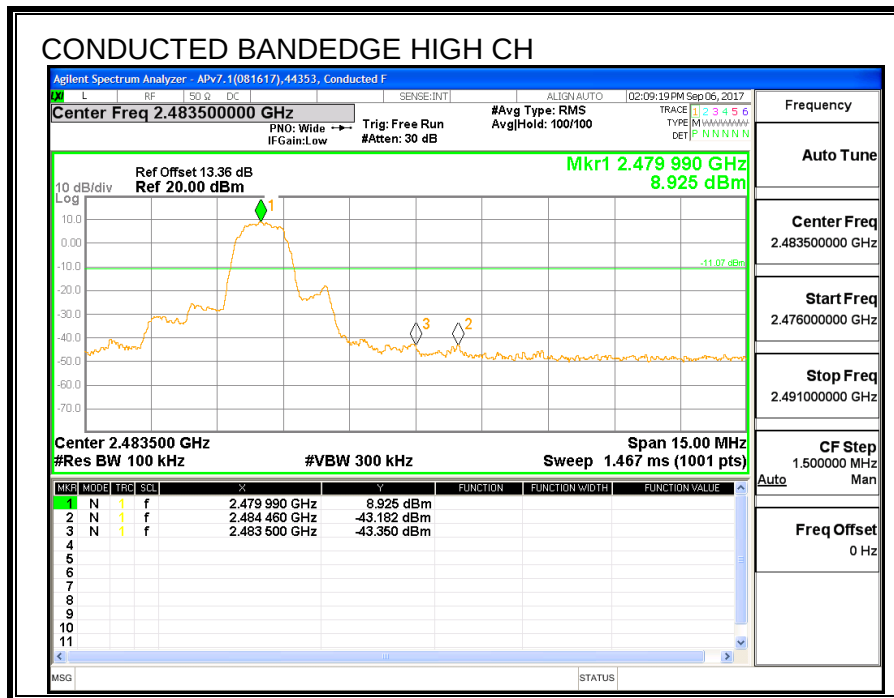
The spectrum from 30 MHz to 26 GHz is investigated with the transmitter set to the lowest, middle, and highest channels.

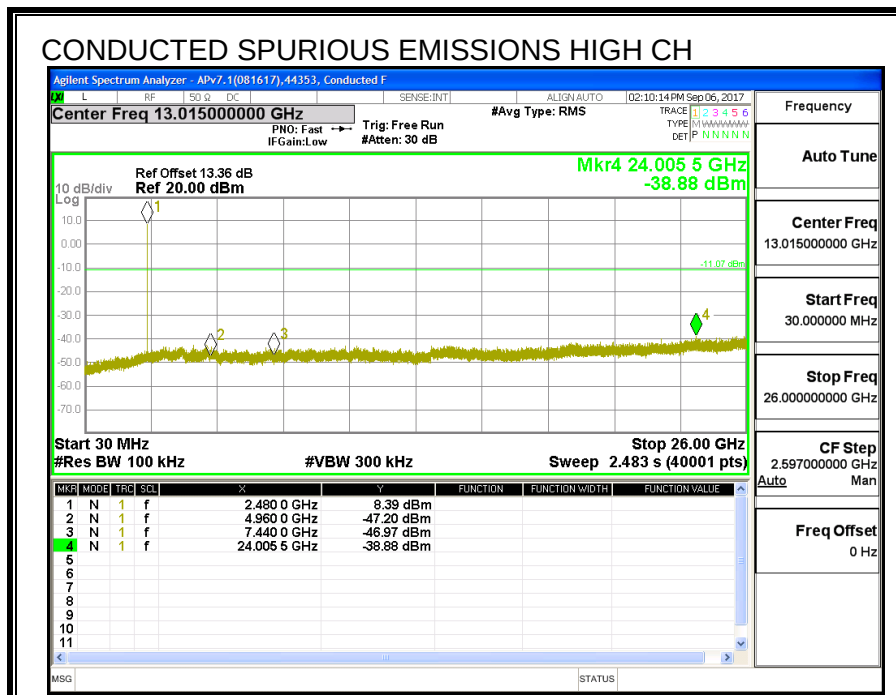
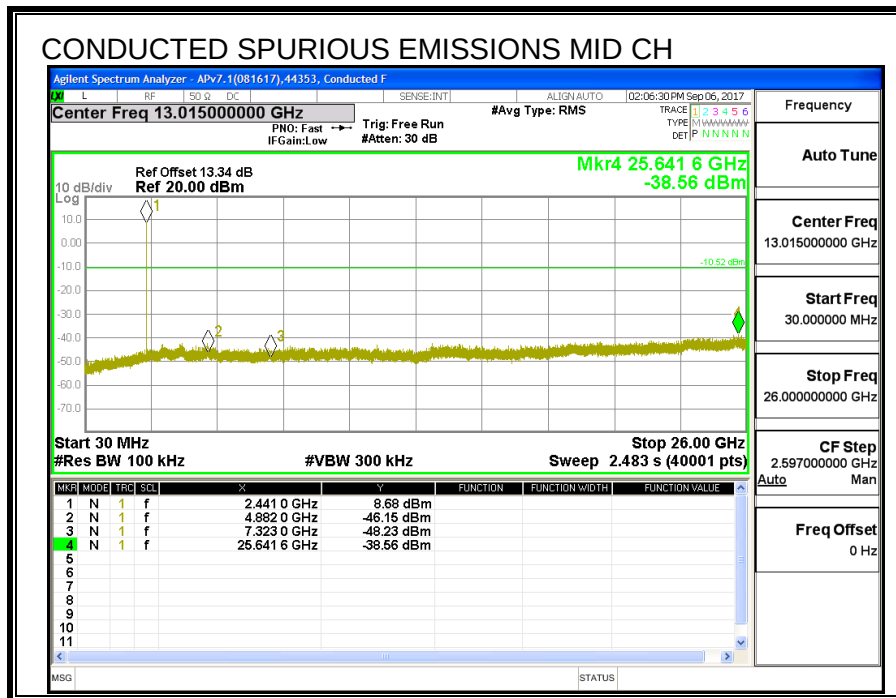
The bandedges at 2.4 and 2.4835 GHz are investigated with the transmitter set to the normal hopping mode.

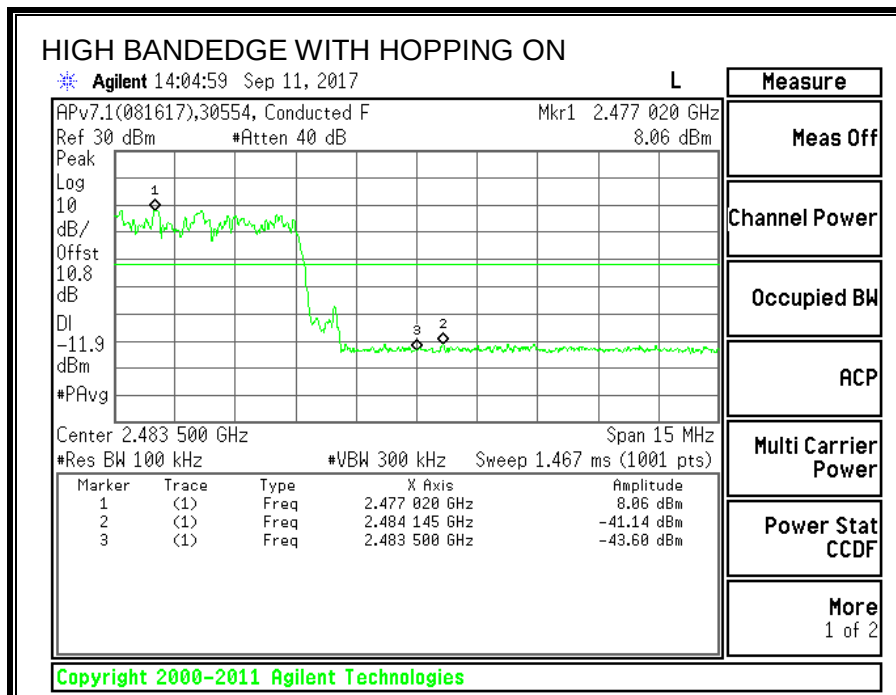
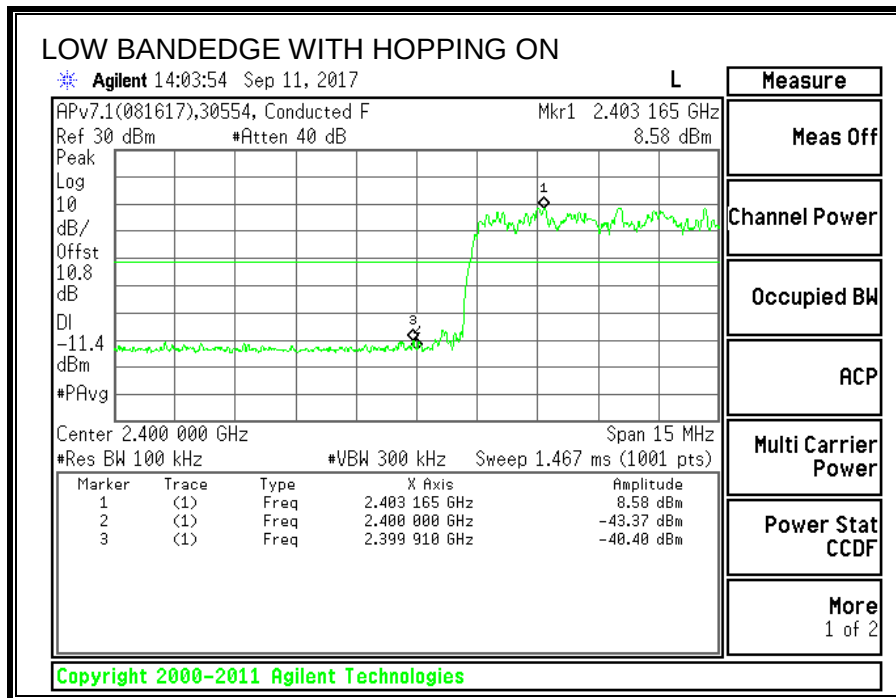
RESULTS

CONDUCTED BANDEDGE AND SPURIOUS EMISSIONS









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.

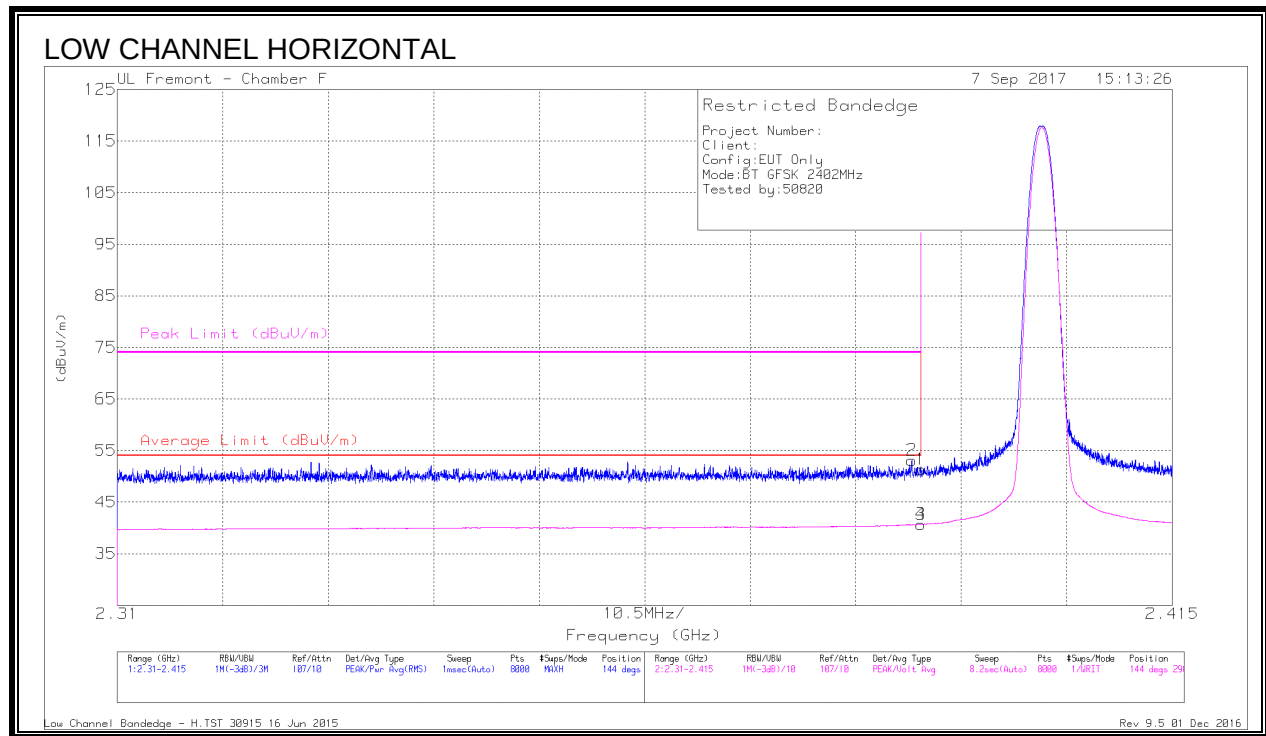
PKFH - FHSS: RB=100k/1MHz VB=3 x RB, Peak→ this is a note from Radiated automation software. When the frequency is below 1G, software is using RB=100kHz; when the frequency is above 1G, software is using RB=1MHz.

The 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. Antenna A, Pmax BASIC DATA RATE GFSK MODULATION

8.2.1. RESTRICTED BANDEDGE (LOW CHANNEL)

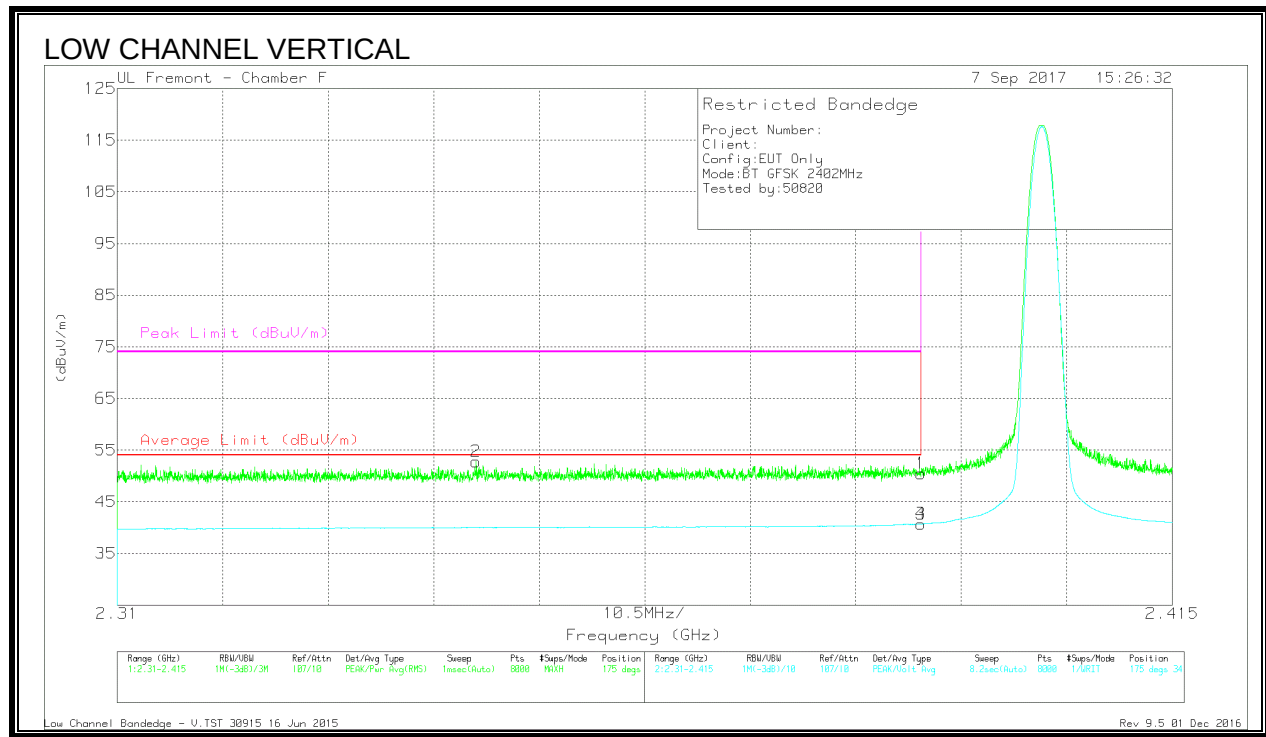


Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AFT119 (dB/m)	Amp/Cbl/ Fitr/Pad (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.39	40.43	Pk	31.9	-21	51.33	-	-	74	-22.67	144	290	H
2	* 2.389	42.1	Pk	31.9	-20.9	53.1	-	-	74	-20.9	144	290	H
3	* 2.39	29.8	VA1T	31.9	-21	40.7	54	-13.3	-	-	144	290	H
4	* 2.39	29.81	VA1T	31.9	-21	40.71	54	-13.29	-	-	144	290	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



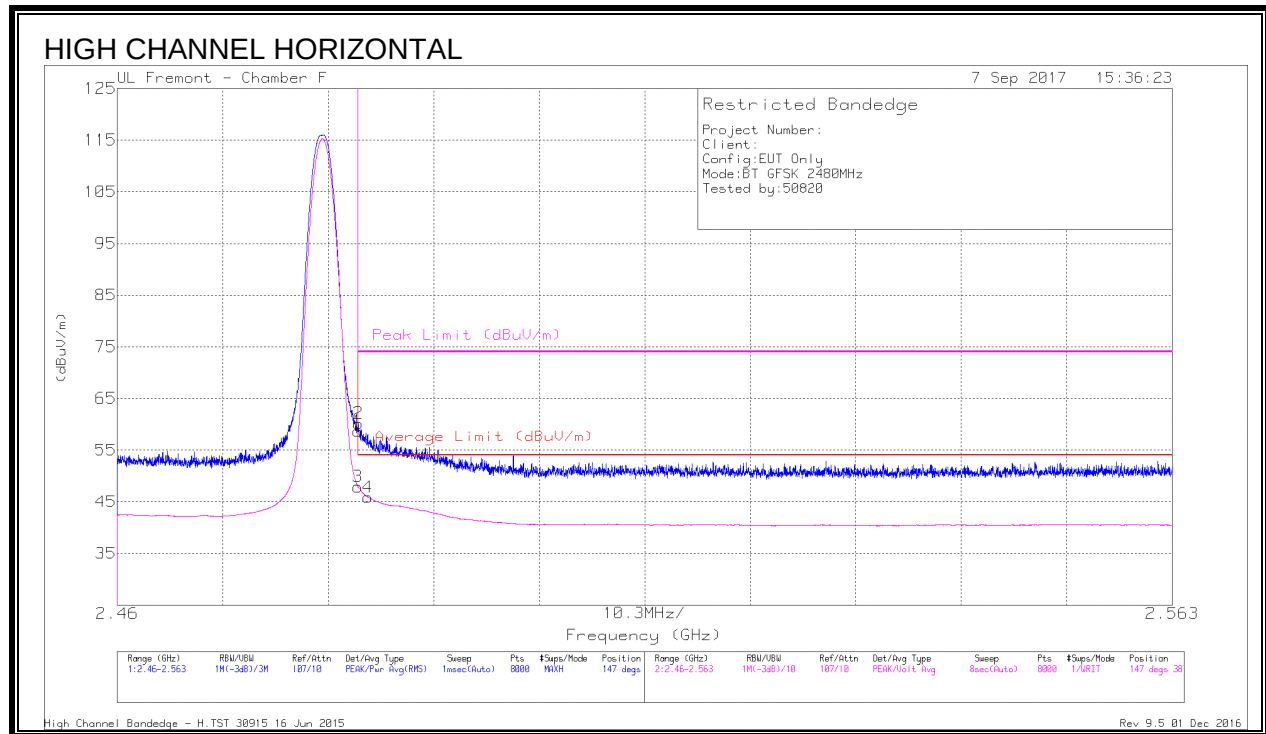
Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T119 (dB/m)	Amp/Cbl/ Fitr/Pad (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.39	39.57	Pk	31.9	-21	50.47	-	-	74	-23.53	175	341	V
2	* 2.346	42.09	Pk	31.7	-21	52.79	-	-	74	-21.21	175	341	V
3	* 2.39	29.81	VA1T	31.9	-21	40.71	54	-13.29	-	-	175	341	V
4	* 2.39	29.82	VA1T	31.9	-21	40.72	54	-13.28	-	-	175	341	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

8.2.2. AUTHORIZED BANDEDGE (HIGH CHANNEL)

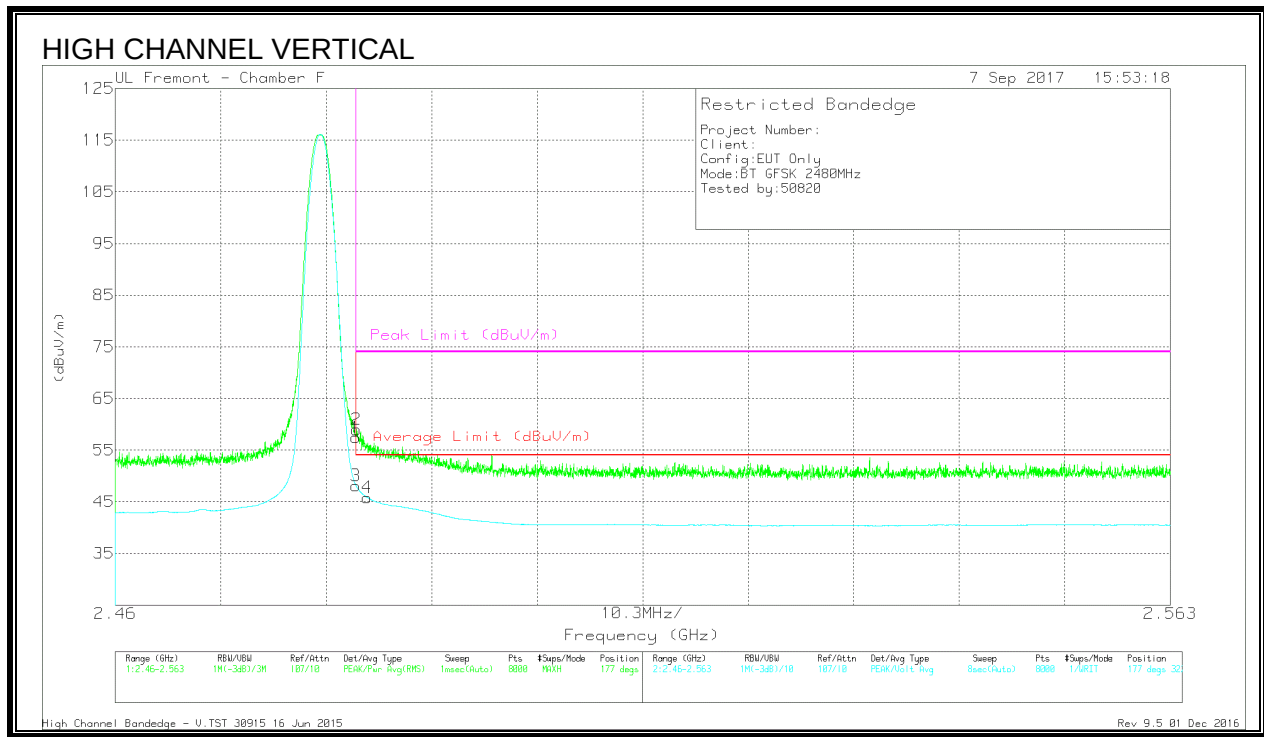


Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T119 (dB/m)	Amp/Cbl/Filtr/ Pad (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.484	47.58	Pk	32.1	-21	58.68	-	-	74	-15.32	147	387	H
2	* 2.484	49.08	Pk	32.1	-21	60.18	-	-	74	-13.82	147	387	H
3	* 2.484	36.81	VA1T	32.1	-21	47.91	54	-6.09	-	-	147	387	H
4	* 2.484	34.69	VA1T	32.2	-21	45.89	54	-8.11	-	-	147	387	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



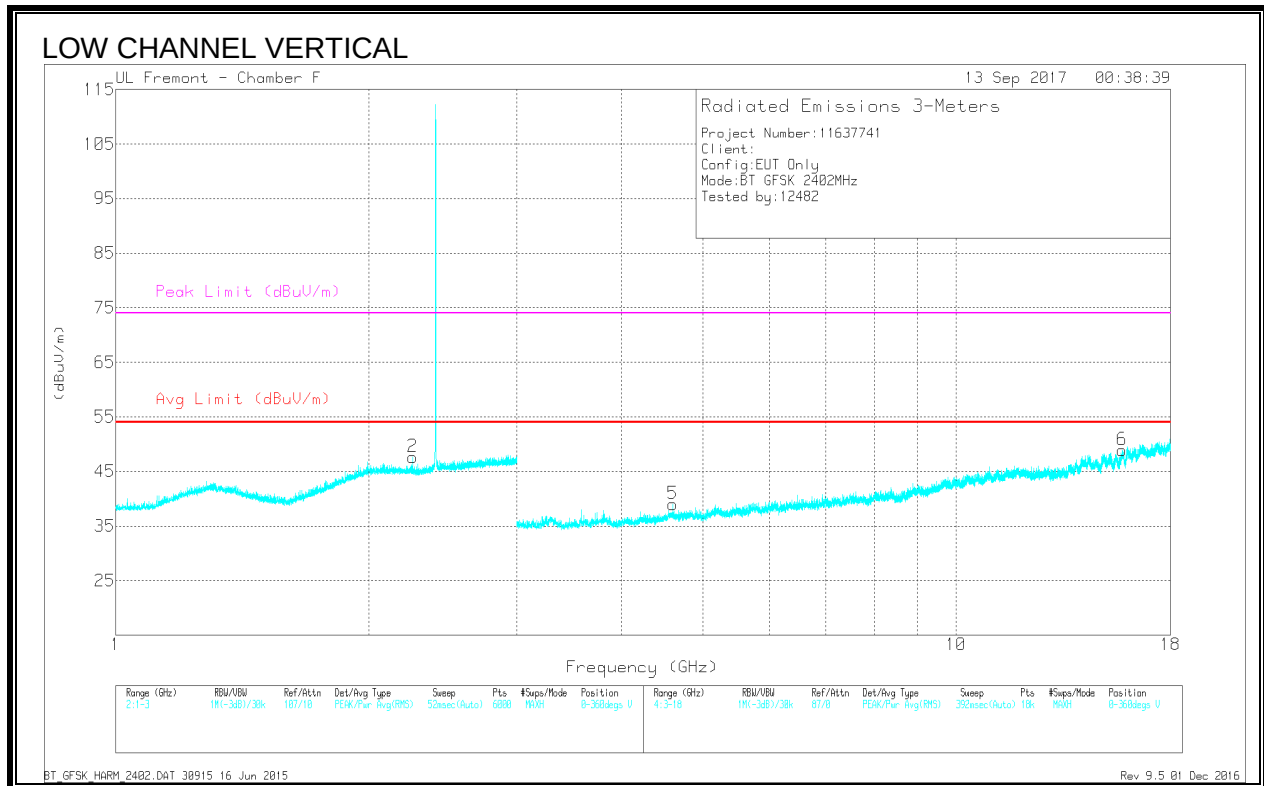
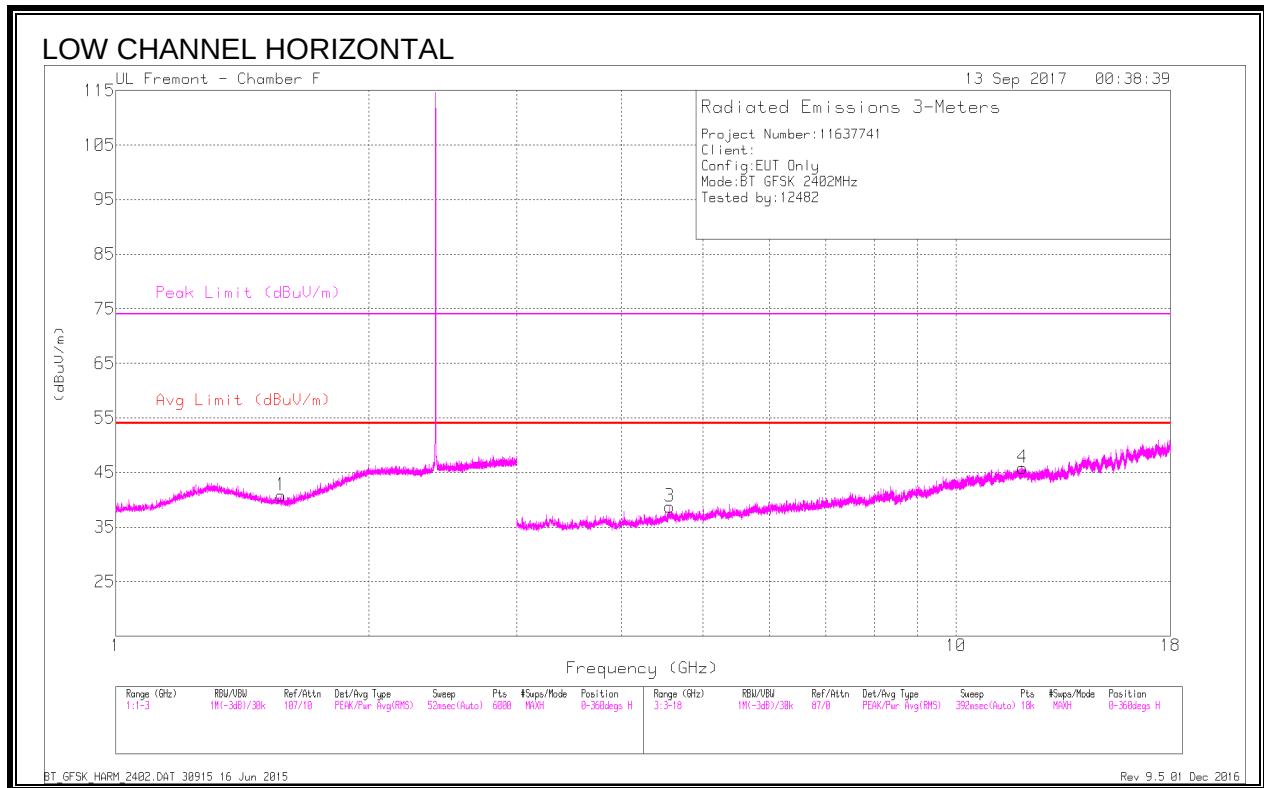
Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T119 (dB/m)	Amp/Cbl/ Fitr/Pad (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.484	46.33	Pk	32.1	-21	57.43	-	-	74	-16.57	177	322	V
2	* 2.484	47.89	Pk	32.1	-21	58.99	-	-	74	-15.01	177	322	V
3	* 2.484	36.99	VA1T	32.1	-21	48.09	54	-5.91	-	-	177	322	V
4	* 2.485	34.61	VA1T	32.2	-21	45.81	54	-8.19	-	-	177	322	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

8.2.3. HARMONICS AND SPURIOUS EMISSIONS

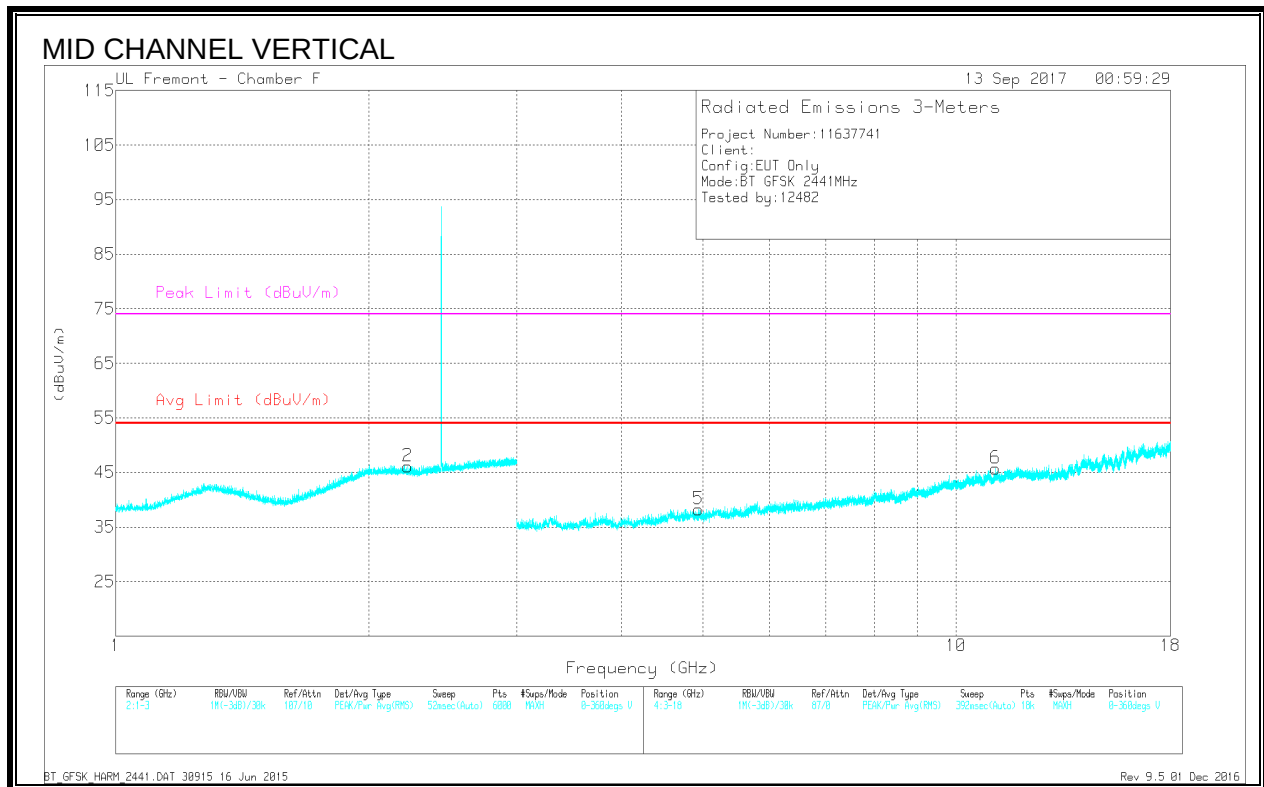
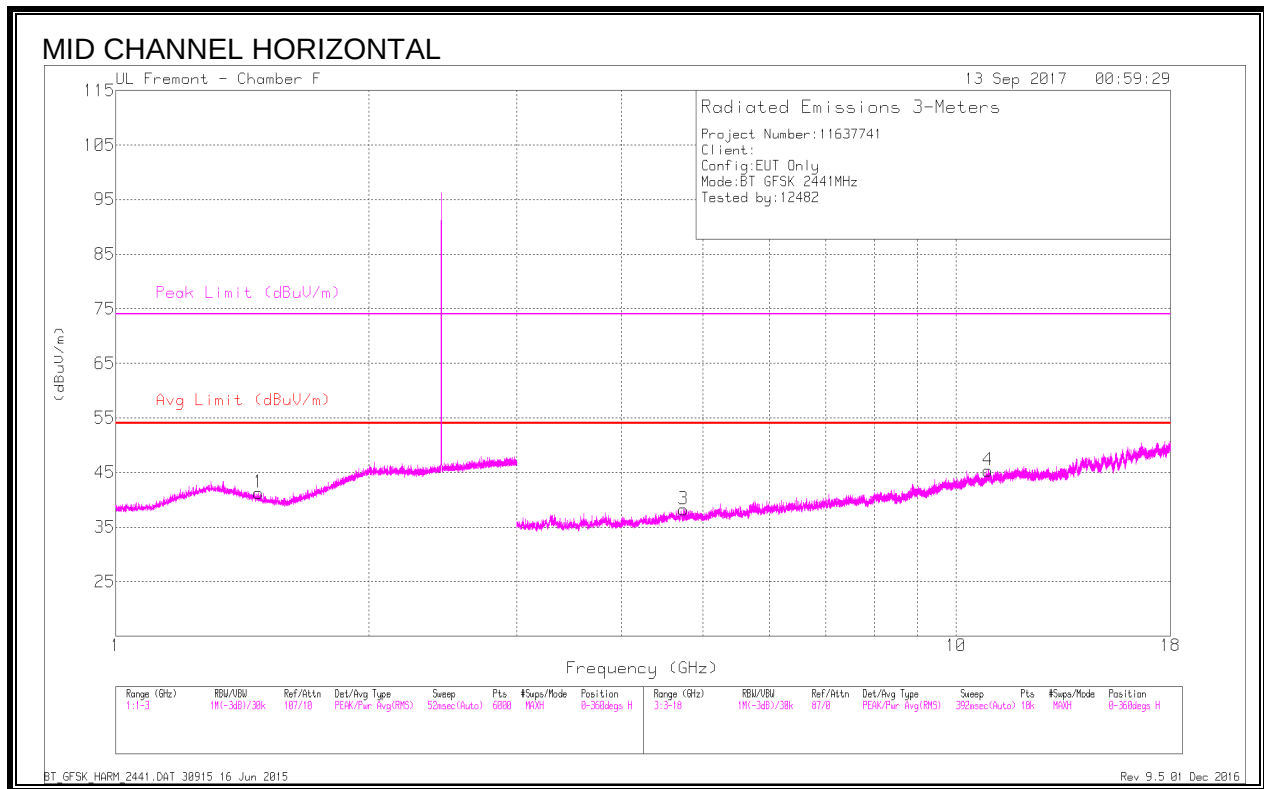


Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T119 (dB/m)	Amp/Cbl/Filtr/ Pad (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 1.573	41.19	PKFH	27.4	-22	46.59	-	-	74	-27.41	110	122	H
	* 1.574	28.78	VA1T	27.4	-22	34.18	54	-19.82	-	-	110	122	H
2	* 2.259	40.68	PKFH	31.8	-21	51.48	-	-	74	-22.52	327	238	V
	* 2.257	28.68	VA1T	31.8	-21	39.48	54	-14.52	-	-	327	238	V
3	* 4.56	38.24	PKFH	34.1	-27.6	44.74	-	-	74	-29.26	59	340	H
	* 4.562	25.67	VA1T	34.1	-27.6	32.17	54	-21.83	-	-	59	340	H
4	* 11.991	34.04	PKFH	39.3	-22.5	50.84	-	-	74	-23.16	75	285	H
	* 11.99	22.89	VA1T	39.3	-22.5	39.69	54	-14.31	-	-	75	285	H
5	* 4.6	37.08	PKFH	34.1	-27.9	43.28	-	-	74	-30.72	247	132	V
	* 4.602	26.02	VA1T	34.1	-27.9	32.22	54	-21.78	-	-	247	132	V
6	* 15.772	35.35	PKFH	41.9	-22.2	55.05	-	-	74	-18.95	238	221	V
	* 15.77	23.42	VA1T	41.8	-22.2	43.02	54	-10.98	-	-	238	221	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

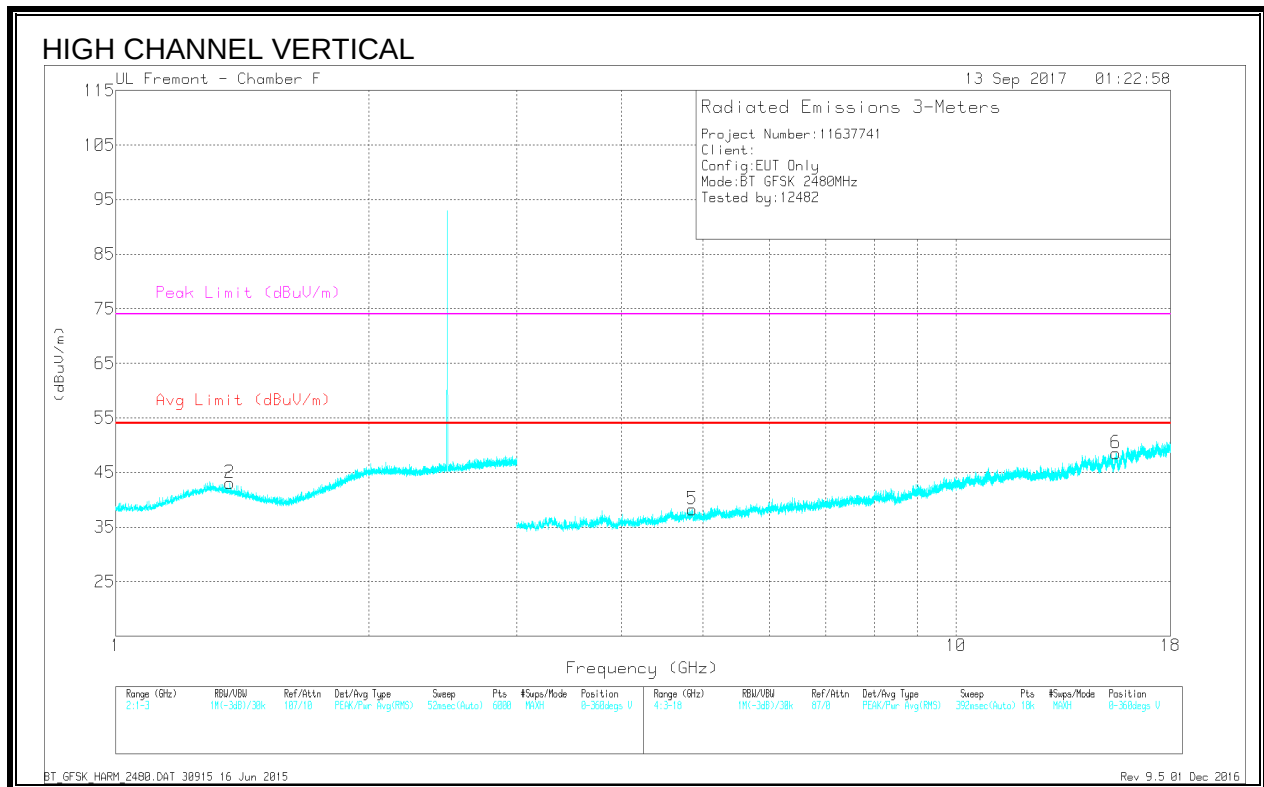
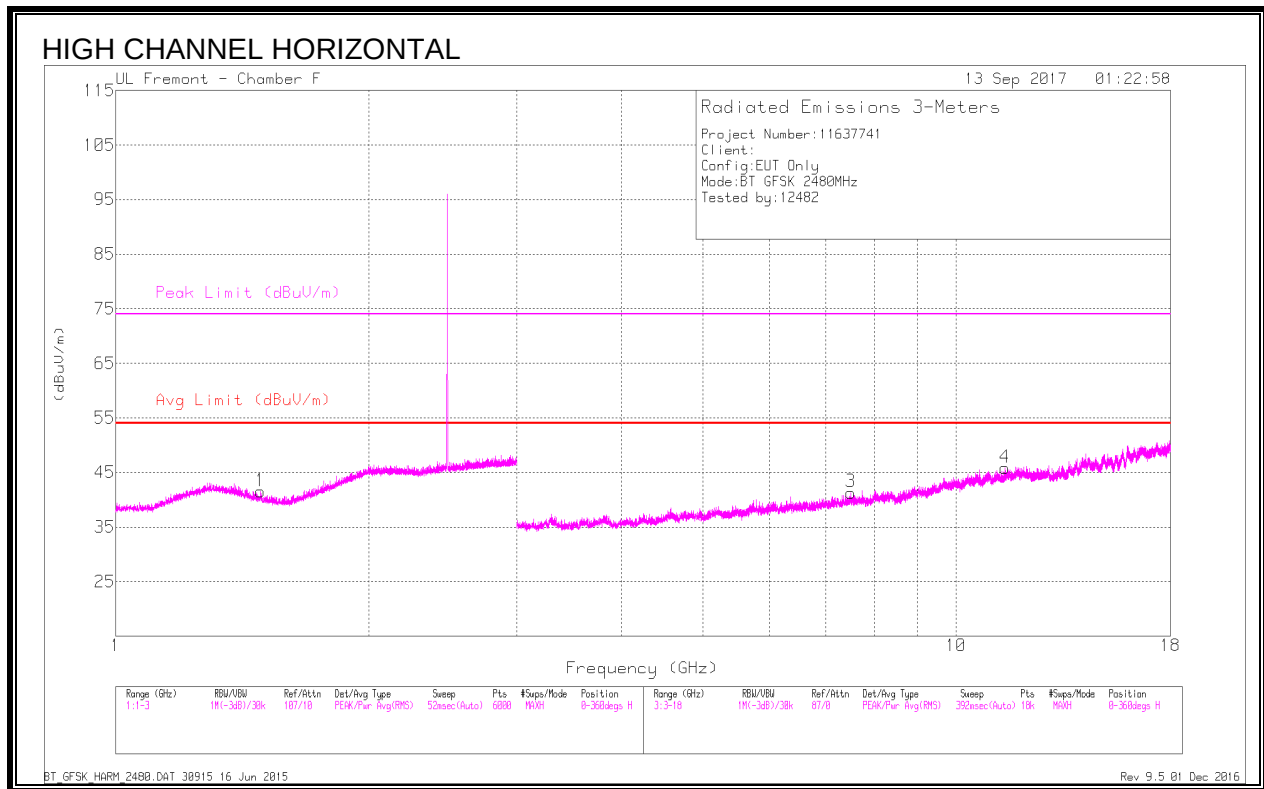


Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T119 (dB/m)	Amp/Cbl/Filtr/ Pad (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 1.481	41.04	PKFH	28	-22	47.04	-	-	74	-26.96	218	159	H
	* 1.481	28.9	VA1T	28	-22	34.9	54	-19.1	-	-	218	159	H
2	* 2.226	40.49	PKFH	31.9	-21.1	51.29	-	-	74	-22.71	60	182	V
	* 2.227	28.71	VA1T	31.9	-21.1	39.51	54	-14.49	-	-	60	182	V
3	* 4.739	38.83	PKFH	34.1	-28.2	44.73	-	-	74	-29.27	307	182	H
	* 4.739	26.34	VA1T	34.1	-28.2	32.24	54	-21.76	-	-	307	182	H
4	* 10.916	34.61	PKFH	37.9	-21.1	51.41	-	-	74	-22.59	72	353	H
	* 10.913	22.41	VA1T	37.9	-21.1	39.21	54	-14.79	-	-	72	353	H
5	* 4.941	37.38	PKFH	34.2	-28.3	43.28	-	-	74	-30.72	102	118	V
	* 4.941	25.93	VA1T	34.2	-28.3	31.83	54	-22.17	-	-	102	118	V
6	* 11.15	34.69	PKFH	38.1	-21.6	51.19	-	-	74	-22.81	142	117	V
	* 11.149	22.62	VA1T	38.1	-21.6	39.12	54	-14.88	-	-	142	117	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



Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T119 (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	* 1.489	40.9	PKFH	27.9	-22	46.8	-	-	74	-27.2	49	112	H
	* 1.487	28.91	VA1T	27.9	-22	34.81	54	-19.19	-	-	49	112	H
2	* 1.365	40.59	PKFH	29.4	-22.1	47.89	-	-	74	-26.11	349	209	V
	* 1.366	28.92	VA1T	29.4	-22.1	36.22	54	-17.78	-	-	349	209	V
3	* 7.497	36.18	PKFH	36.1	-25.2	47.08	-	-	74	-26.92	66	341	H
	* 7.498	23.94	VA1T	36.1	-25.2	34.84	54	-19.16	-	-	66	341	H
4	* 11.448	35.62	PKFH	38.3	-21.8	52.12	-	-	74	-21.88	269	173	H
	* 11.446	22.78	VA1T	38.3	-21.8	39.28	54	-14.72	-	-	269	173	H
5	* 4.856	36.66	PKFH	34.2	-27.6	43.26	-	-	74	-30.74	123	231	V
	* 4.855	25.18	VA1T	34.2	-27.6	31.78	54	-22.22	-	-	123	231	V
6	* 15.49	35.53	PKFH	41.4	-22.3	54.63	-	-	74	-19.37	41	274	V
	* 15.489	23.63	VA1T	41.4	-22.4	42.63	54	-11.37	-	-	41	274	V

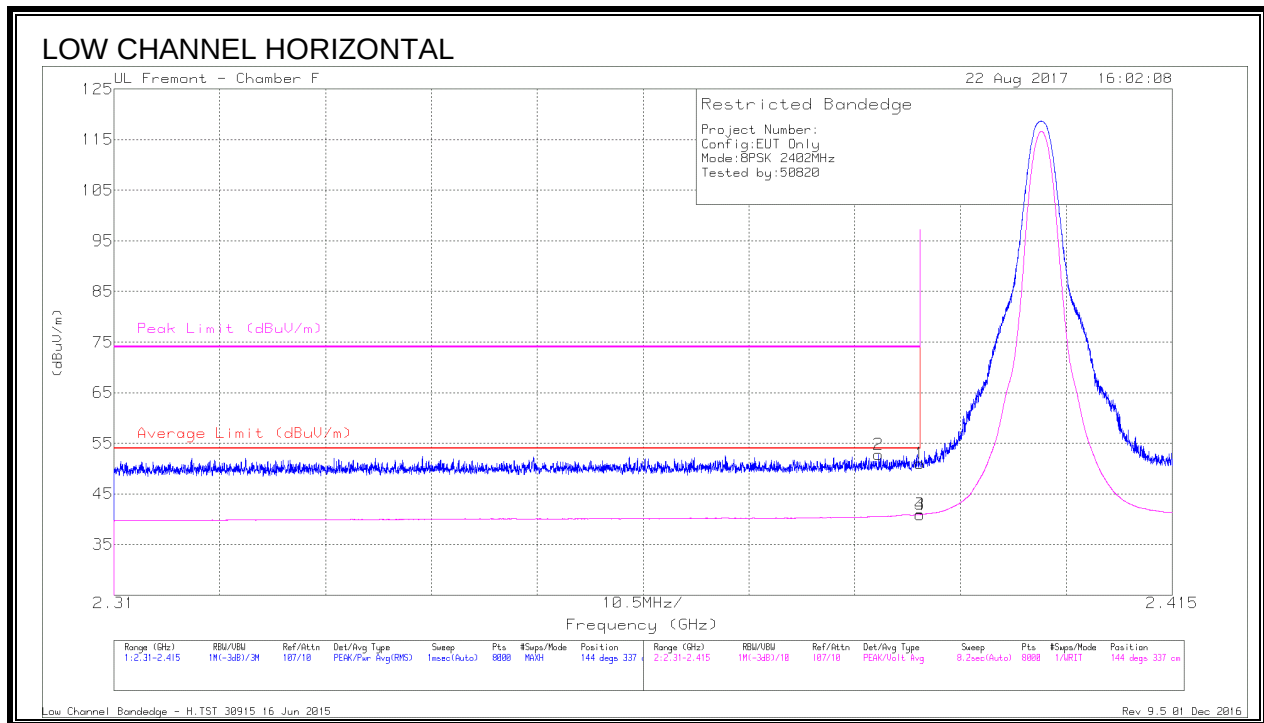
* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band

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. Antenna A, Pmax ENHANCED DATA RATE 8PSK MODULATION

8.3.1. RESTRICTED BANDEDGE (LOW CHANNEL)

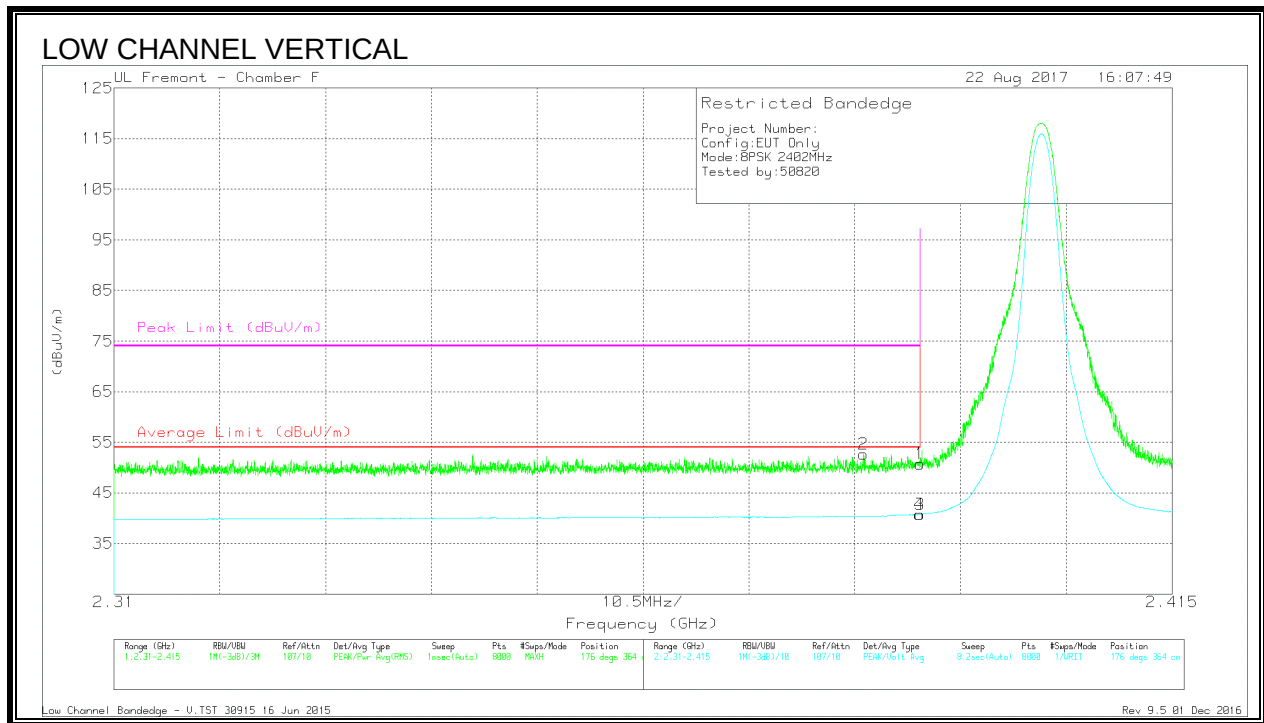


Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T119 (dB/m)	Amp/Cb/ Fitr/Pad (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.39	40.19	Pk	31.9	-21	51.09	-	-	74	-22.91	144	337	H
2	* 2.386	41.84	Pk	31.8	-20.9	52.74	-	-	74	-21.26	144	337	H
3	* 2.39	30.02	VA1T	31.9	-21	40.92	54	-13.08	-	-	144	337	H
4	* 2.39	30.01	VA1T	31.9	-21	40.91	54	-13.09	-	-	144	337	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



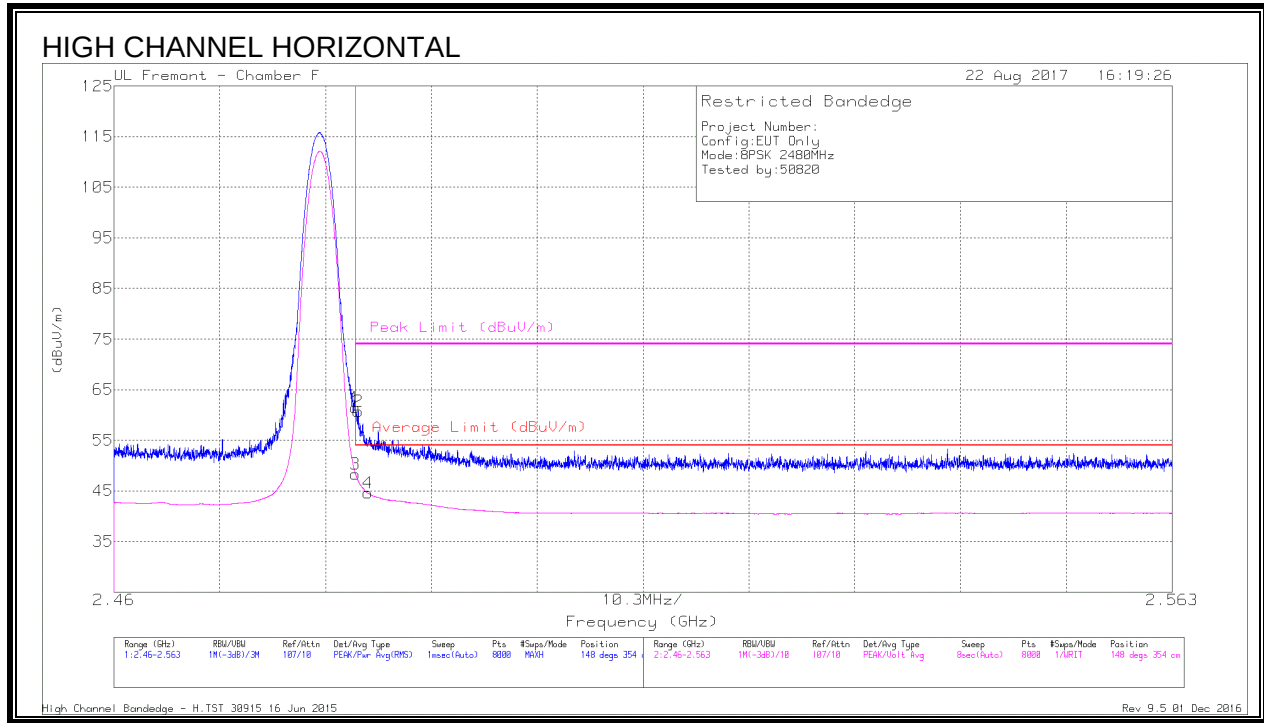
Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T119 (dB/m)	Amp/Cbl/ Ftr/Pad (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.39	39.83	Pk	31.9	-21	50.73	-	-	74	-23.27	176	364	V
2	* 2.384	41.76	Pk	31.8	-20.9	52.66	-	-	74	-21.34	176	364	V
3	* 2.39	29.85	VA1T	31.9	-21	40.75	54	-13.25	-	-	176	364	V
4	* 2.39	29.86	VA1T	31.9	-21	40.76	54	-13.24	-	-	176	364	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

8.3.2. AUTHORIZED BANDEDGE (HIGH CHANNEL)

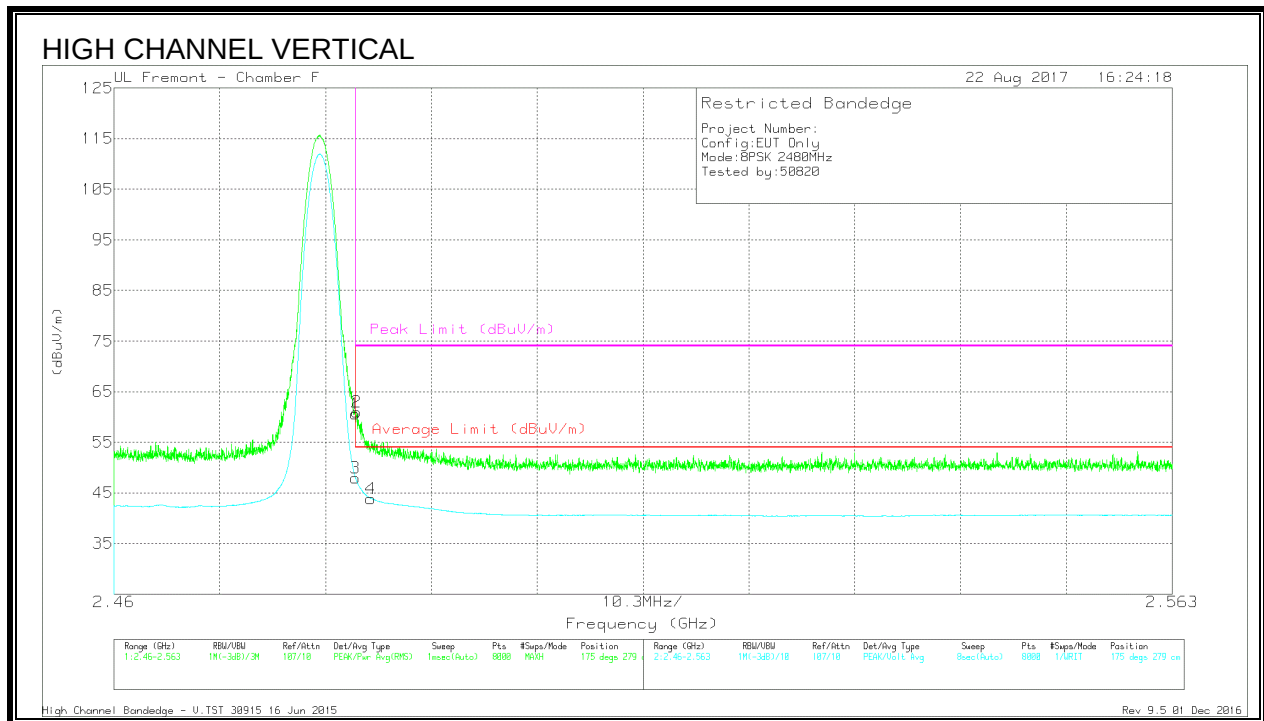


Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T119 (dB/m)	Amp/Cbl/Filtr/ Pad (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.484	50.35	Pk	32.1	-21	61.45	-	-	74	-12.55	148	354	H
2	* 2.484	49.63	Pk	32.1	-21	60.73	-	-	74	-13.27	148	354	H
3	* 2.484	37.2	VA1T	32.1	-21	48.3	54	-5.7	-	-	148	354	H
4	* 2.485	33.33	VA1T	32.2	-21	44.53	54	-9.47	-	-	148	354	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



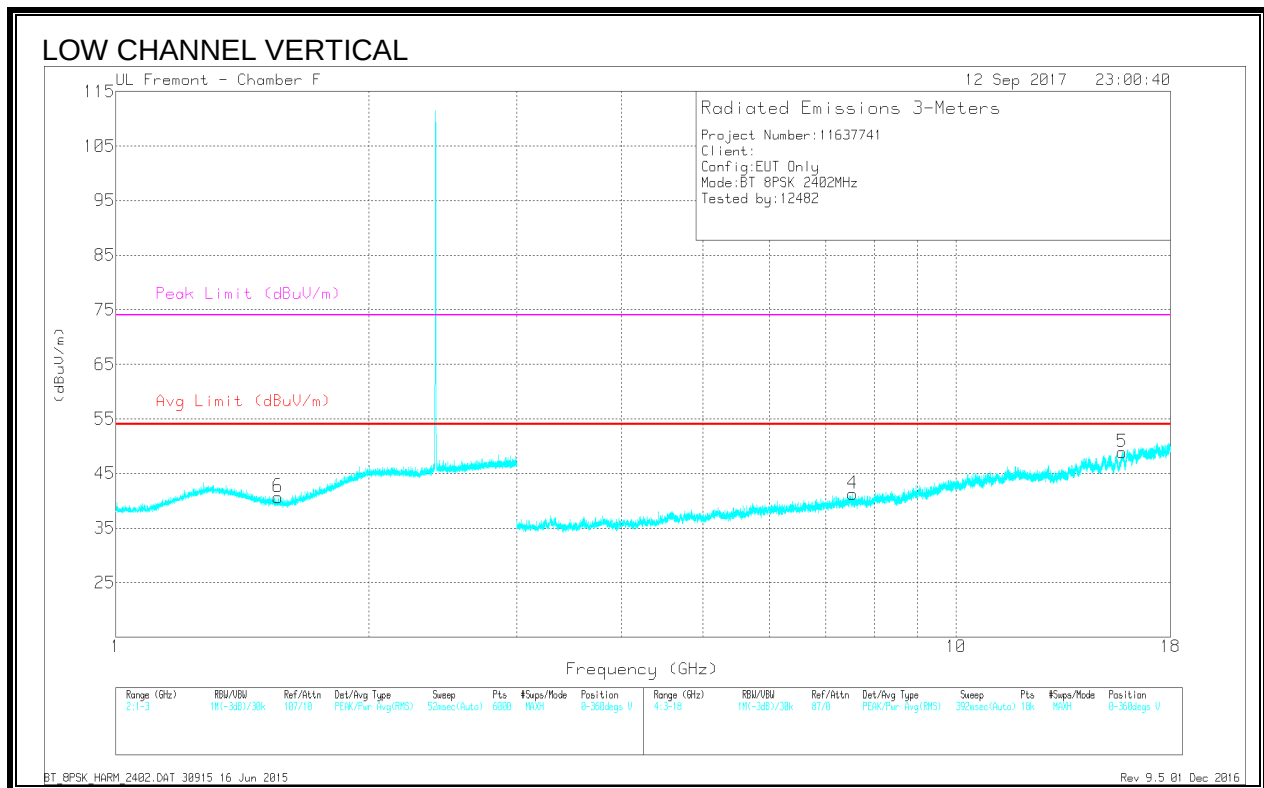
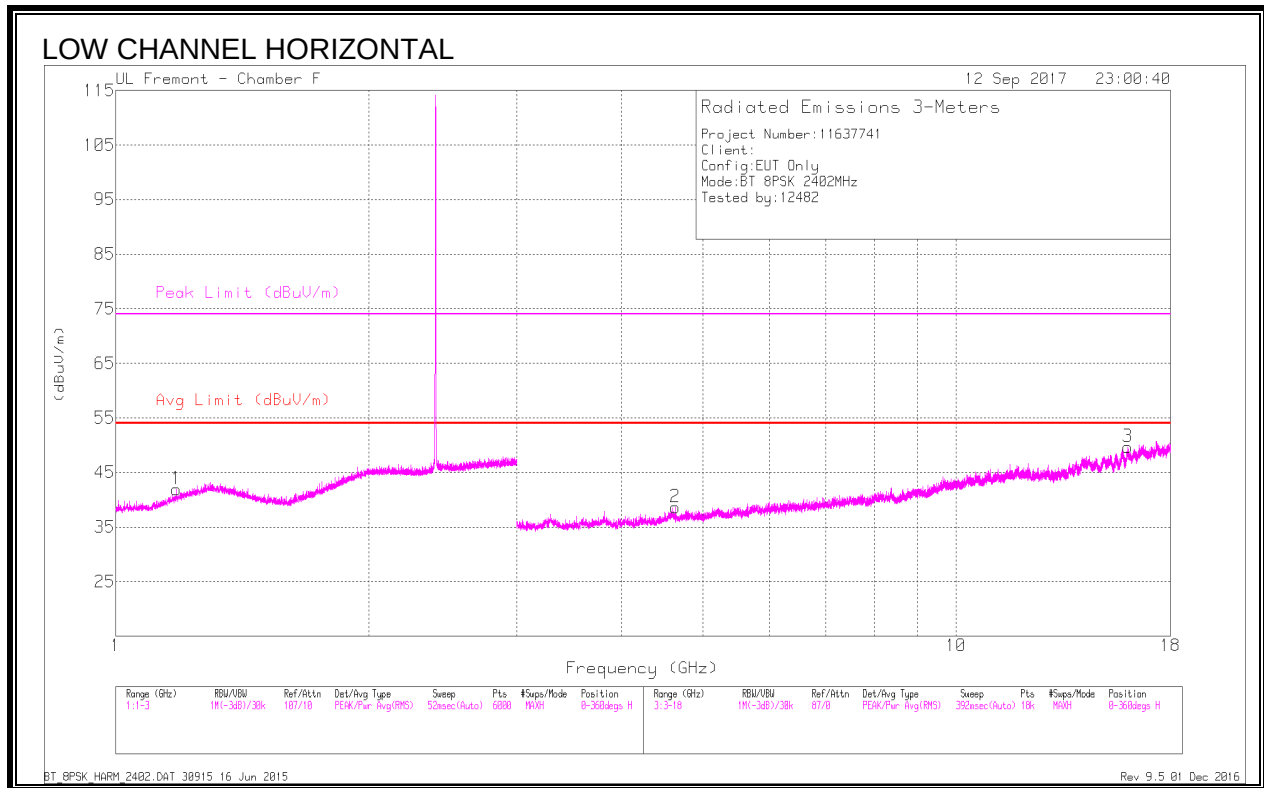
Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T119 (dB/m)	Amp/Cbl/ Ftr/Pad (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.484	49.48	Pk	32.1	-21	60.58	-	-	74	-13.42	175	279	V
2	* 2.484	49.84	Pk	32.1	-21	60.94	-	-	74	-13.06	175	279	V
3	* 2.484	36.85	VA1T	32.1	-21	47.95	54	-6.05	-	-	175	279	V
4	* 2.485	32.68	VA1T	32.2	-21	43.88	54	-10.12	-	-	175	279	V

* - 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

8.3.3. HARMONICS AND SPURIOUS EMISSIONS

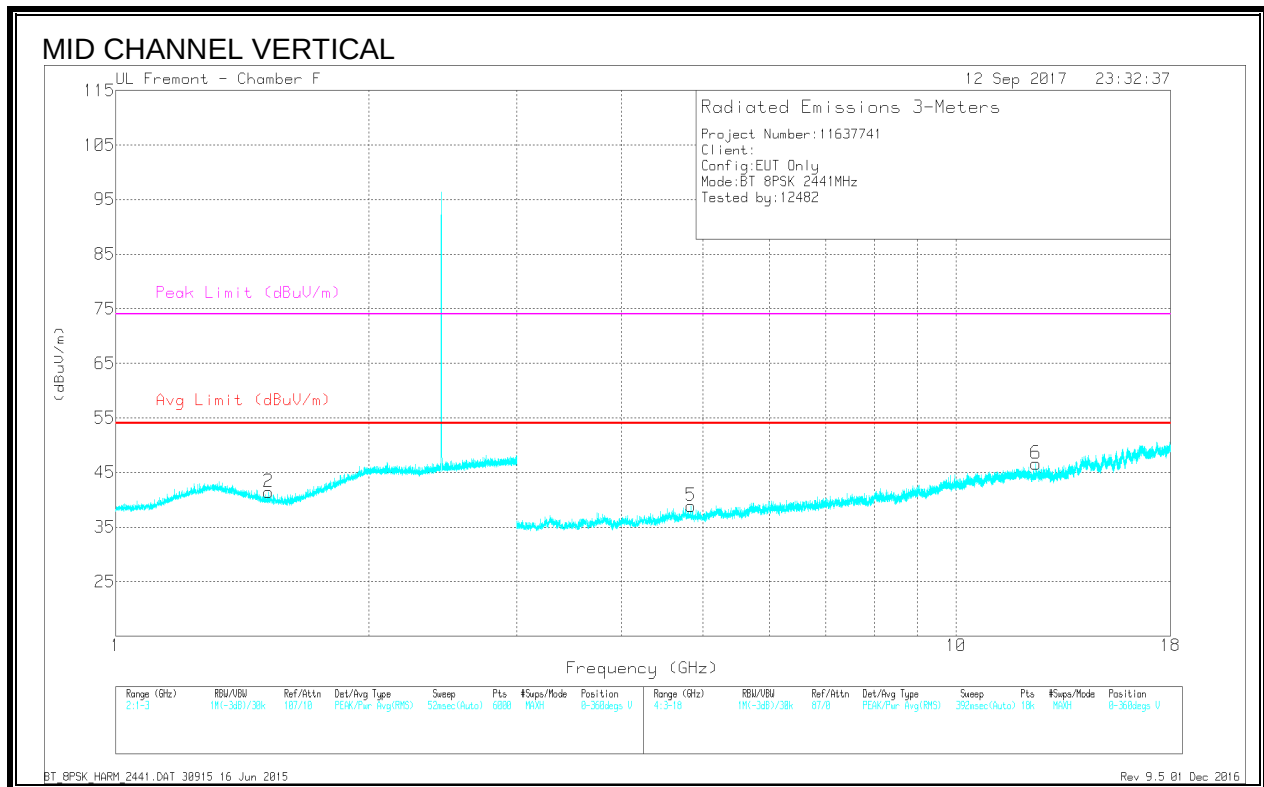
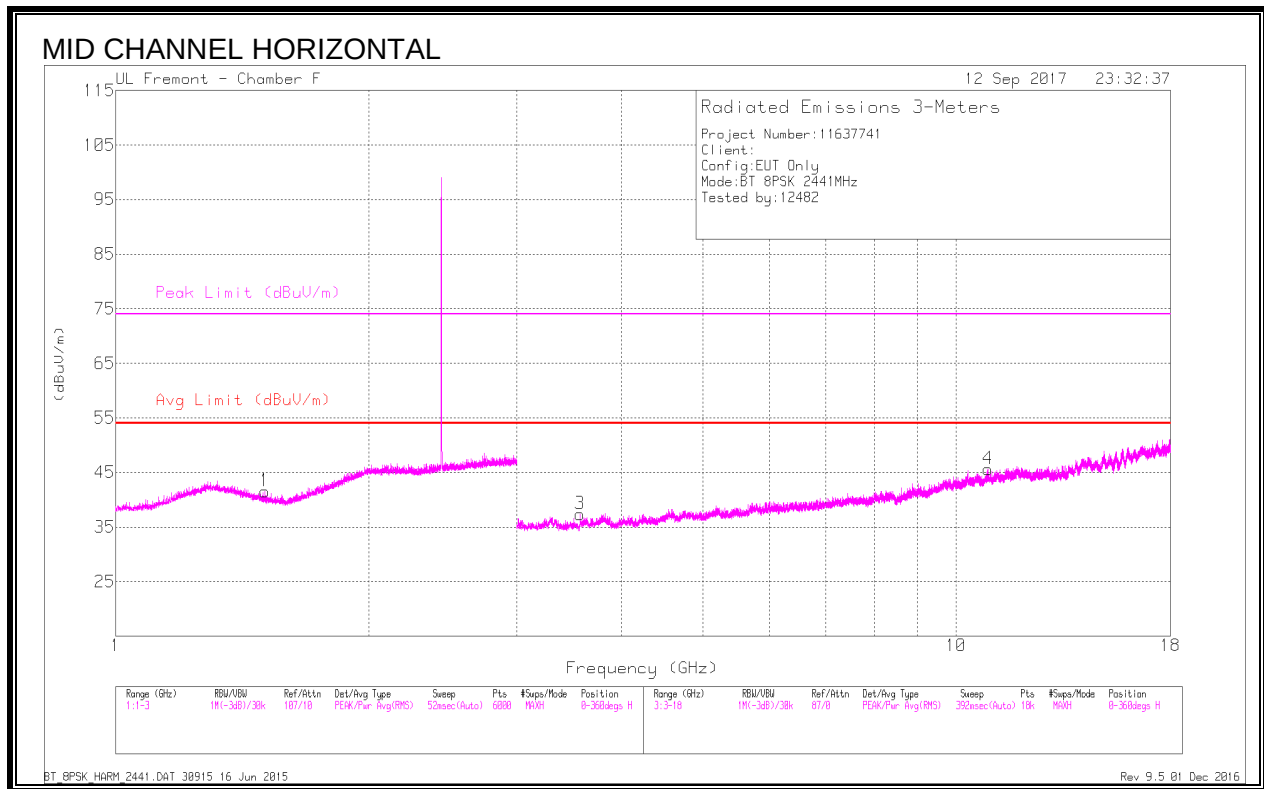


Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T119 (dB/m)	Amp/Cbl/F ltr/Pad (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 1.181	40.54	PKFH	28.5	-22.5	46.54	-	-	74	-27.46	213	289	H
	* 1.181	28.91	VA1T	28.5	-22.5	34.91	54	-19.09	-	-	213	289	H
2	* 4.631	37.31	PKFH	34.1	-28.5	42.91	-	-	74	-31.09	300	371	H
	* 4.632	26.1	VA1T	34.1	-28.5	31.7	54	-22.3	-	-	300	371	H
3	* 16.022	35.52	PKFH	41.8	-21.6	55.72	-	-	74	-18.28	300	101	H
	* 16.018	23.27	VA1T	41.8	-21.5	43.57	54	-10.43	-	-	300	101	H
4	* 7.533	37	PKFH	36.1	-25.1	48	-	-	74	-26	99	117	V
	* 7.533	24.04	VA1T	36.1	-25.1	35.04	54	-18.96	-	-	99	117	V
5	* 15.775	35.04	PKFH	41.9	-22.3	54.64	-	-	74	-19.36	207	116	V
	* 15.775	23.43	VA1T	41.9	-22.3	43.03	54	-10.97	-	-	207	116	V
6	* 1.562	40.33	PKFH	27.4	-22	45.73	-	-	74	-28.27	350	248	V
	* 1.561	28.82	VA1T	27.4	-22	34.22	54	-19.78	-	-	350	248	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

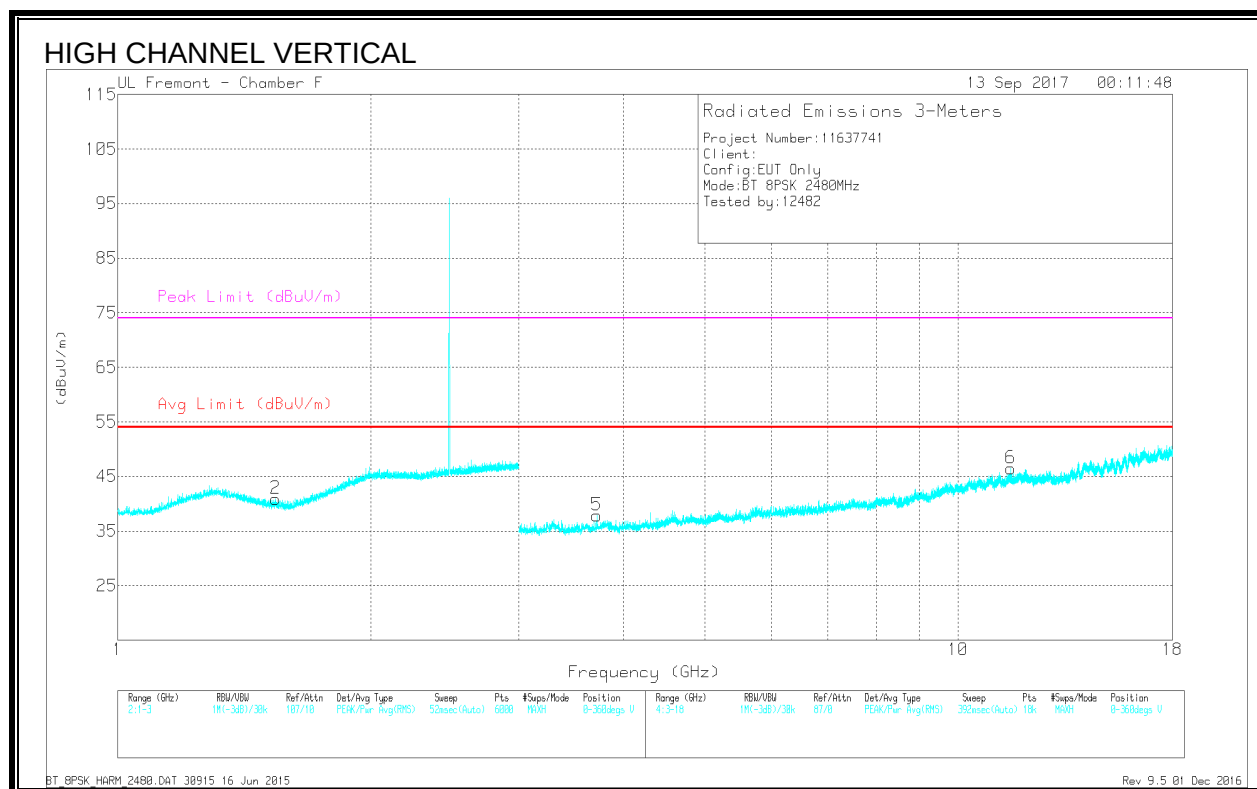
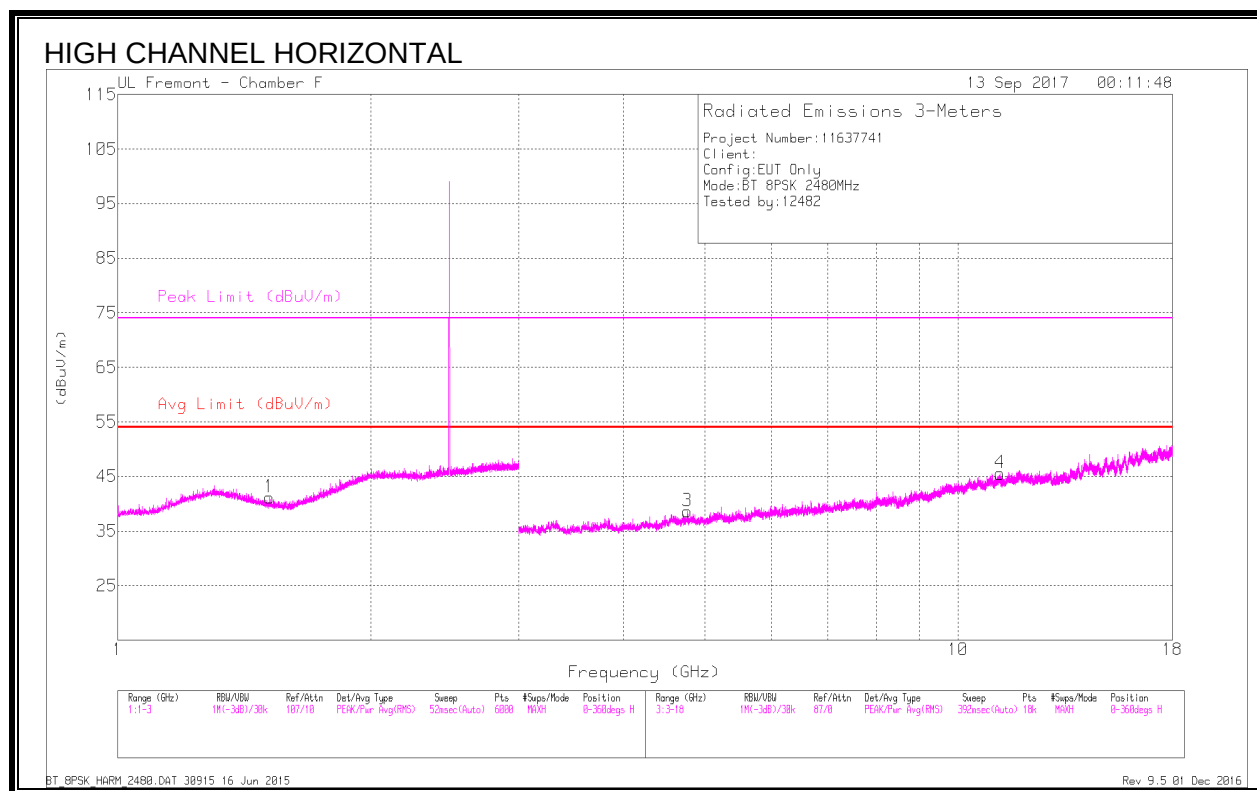


Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T119 (dB/m)	Amp/Cbl/F ltr/Pad (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 1.504	40.83	PKFH	27.7	-22	46.53	-	-	74	-27.47	325	202	H
	* 1.505	28.86	VA1T	27.7	-22	34.56	54	-19.44	-	-	325	202	H
2	* 1.521	41.2	PKFH	27.6	-22	46.8	-	-	74	-27.2	113	127	V
	* 1.519	28.88	VA1T	27.6	-22	34.48	54	-19.52	-	-	113	127	V
3	* 3.568	37.96	PKFH	33.1	-28.9	42.16	-	-	74	-31.84	300	219	H
	* 3.569	26.39	VA1T	33.1	-28.9	30.59	54	-23.41	-	-	300	219	H
4	* 10.926	33.59	PKFH	37.9	-21.1	50.39	-	-	74	-23.61	345	263	H
	* 10.926	22.37	VA1T	37.9	-21.1	39.17	54	-14.83	-	-	345	263	H
5	* 4.84	36.94	PKFH	34.2	-27.3	43.84	-	-	74	-30.16	120	370	V
	* 4.839	25.08	VA1T	34.2	-27.3	31.98	54	-22.02	-	-	120	370	V
6	* 12.454	34.79	PKFH	38.8	-22.1	51.49	-	-	74	-22.51	181	177	V
	* 12.453	22.85	VA1T	38.8	-22.1	39.55	54	-14.45	-	-	181	177	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



Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T119 (dB/m)	Amp/Cbl/ Fitr/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	* 1.517	40.38	PKFH	27.6	-22	45.98	-	-	74	-28.02	312	242	H
	* 1.516	28.81	VA1T	27.6	-22	34.41	54	-19.59	-	-	312	242	H
2	* 1.541	40.62	PKFH	27.5	-22	46.12	-	-	74	-27.88	341	222	V
	* 1.542	28.87	VA1T	27.5	-22	34.37	54	-19.63	-	-	341	222	V
3	* 4.762	38.49	PKFH	34.1	-27.7	44.89	-	-	74	-29.11	129	345	H
	* 4.761	25.92	VA1T	34.1	-27.8	32.22	54	-21.78	-	-	129	345	H
4	* 11.222	34.21	PKFH	38.1	-21.2	51.11	-	-	74	-22.89	250	358	H
	* 11.219	22.48	VA1T	38.1	-21.2	39.38	54	-14.62	-	-	250	358	H
5	* 3.716	38.29	PKFH	33.3	-29.4	42.19	-	-	74	-31.81	59	351	V
	* 3.719	26.49	VA1T	33.3	-29.3	30.49	54	-23.51	-	-	59	351	V
6	* 11.563	34.96	PKFH	38.5	-21.2	52.26	-	-	74	-21.74	15	320	V
	* 11.563	22.16	VA1T	38.5	-21.2	39.46	54	-14.54	-	-	15	320	V

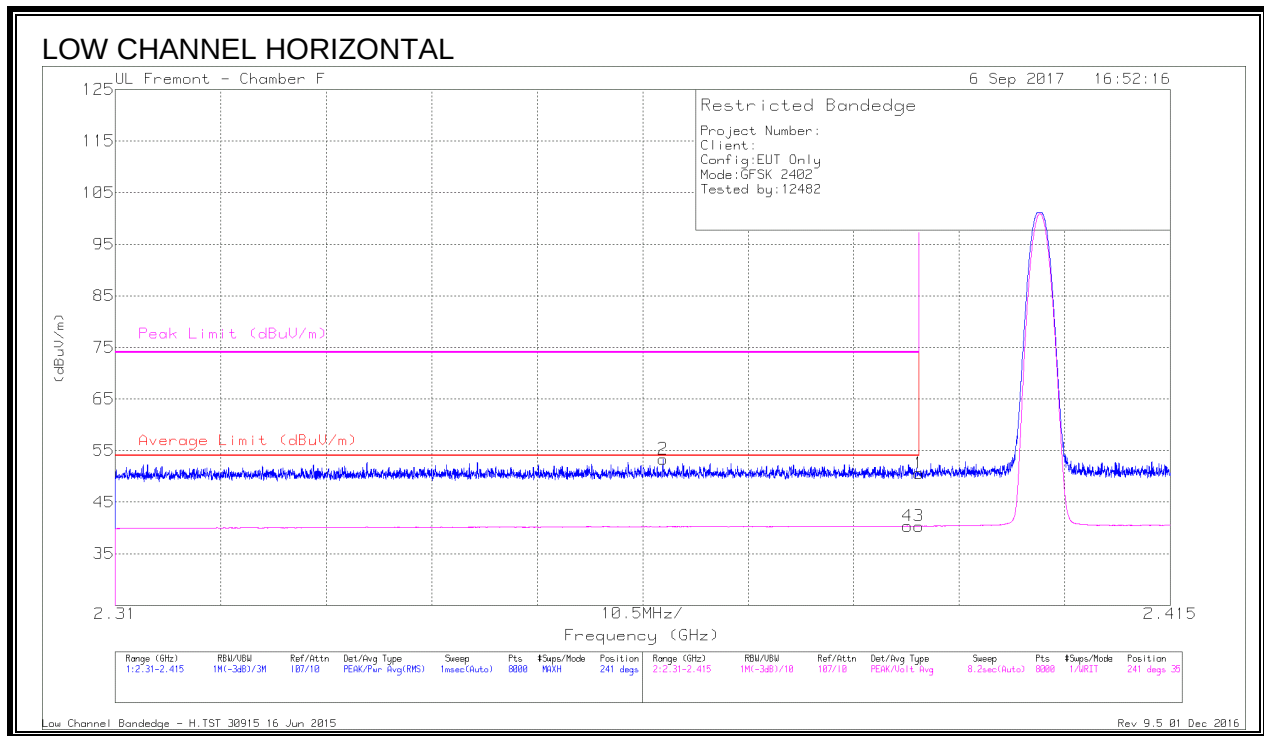
* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band

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

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

8.4. Antenna A, Plow BASIC DATA RATE GFSK MODULATION

8.4.1. RESTRICTED BANDEDGE (LOW CHANNEL)

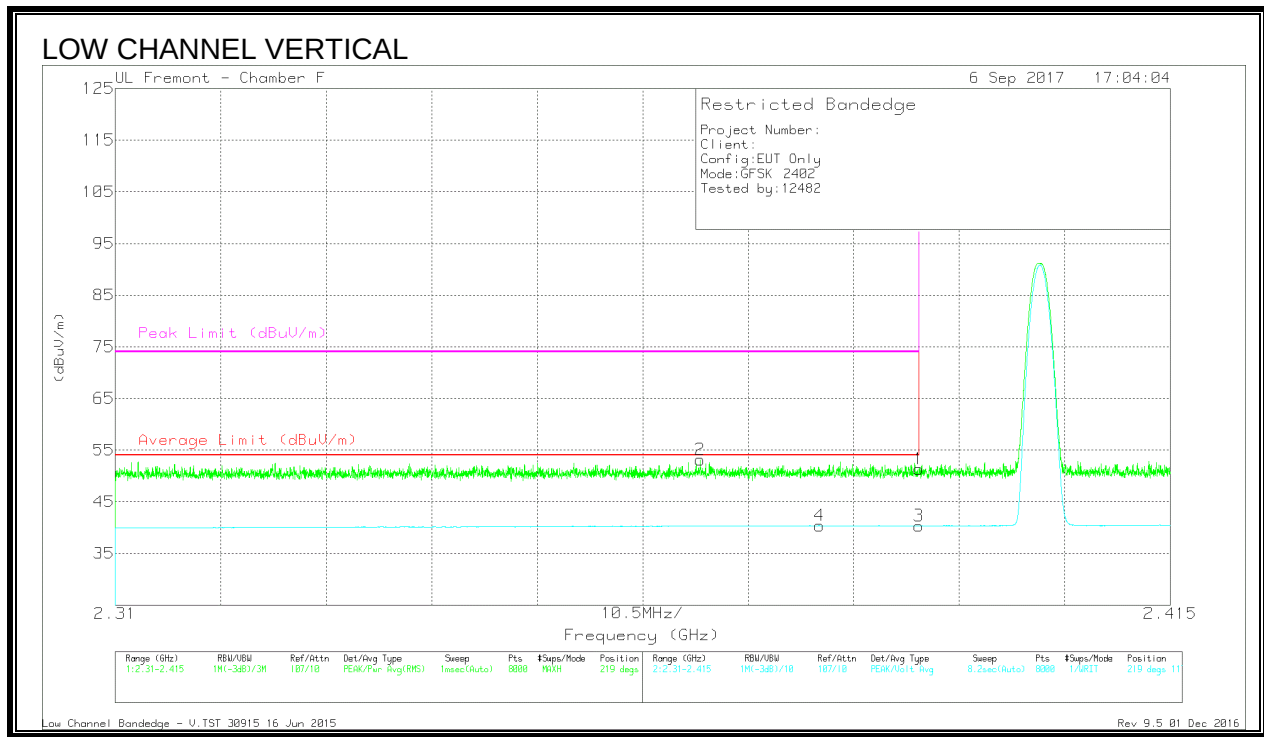


Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T119 (dB/m)	Amp/Cbl/ Ftr/Pad (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.39	39.69	Pk	31.9	-21	50.59	-	-	74	-23.41	241	351	H
2	* 2.365	42.43	Pk	31.8	-20.9	53.33	-	-	74	-20.67	241	351	H
3	* 2.39	29.45	VA1T	31.9	-21	40.35	54	-13.65	-	-	241	351	H
4	* 2.389	29.38	VA1T	31.9	-20.9	40.38	54	-13.62	-	-	241	351	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



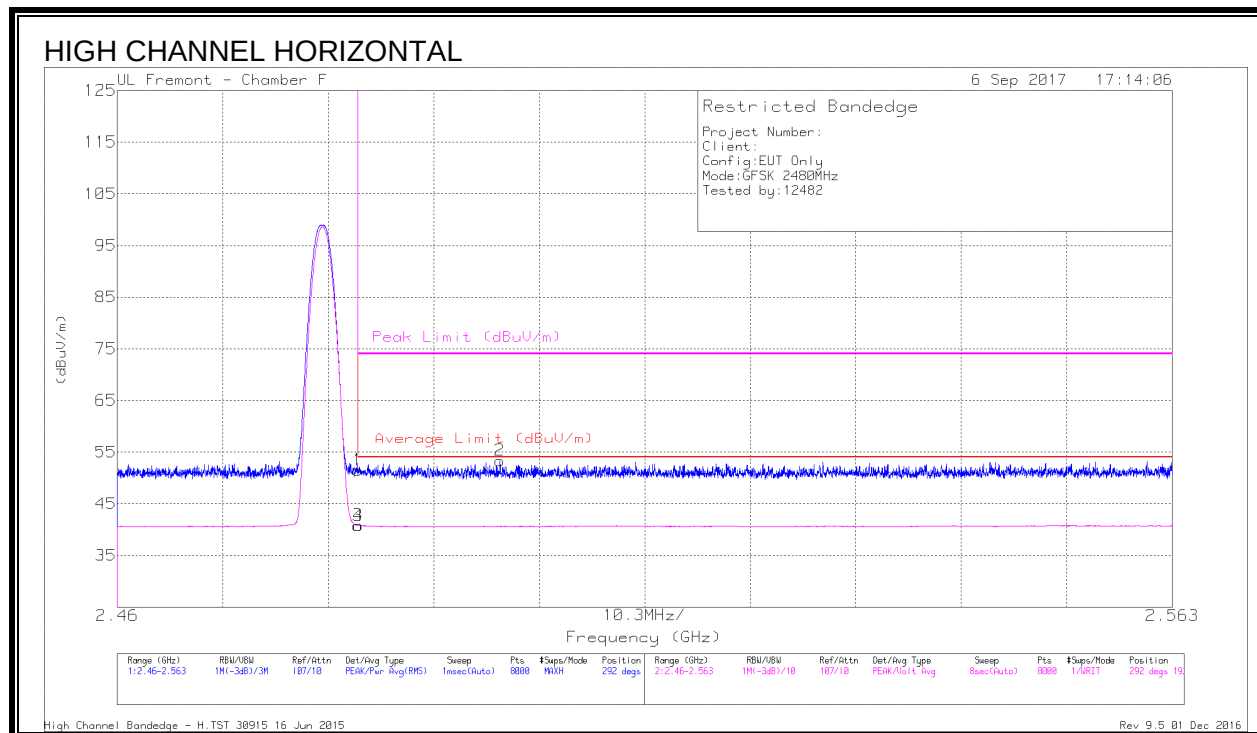
Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T119 (dB/m)	Amp/Cbl/Filtr/ Pad (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.39	40.44	Pk	31.9	-21	51.34	-	-	74	-22.66	219	117	V
2	* 2.368	42.24	Pk	31.8	-20.9	53.14	-	-	74	-20.86	219	117	V
3	* 2.39	29.43	VA1T	31.9	-21	40.33	54	-13.67	-	-	219	117	V
4	* 2.38	29.48	VA1T	31.8	-20.9	40.38	54	-13.62	-	-	219	117	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

8.4.2. AUTHORIZED BANDEDGE (HIGH CHANNEL)

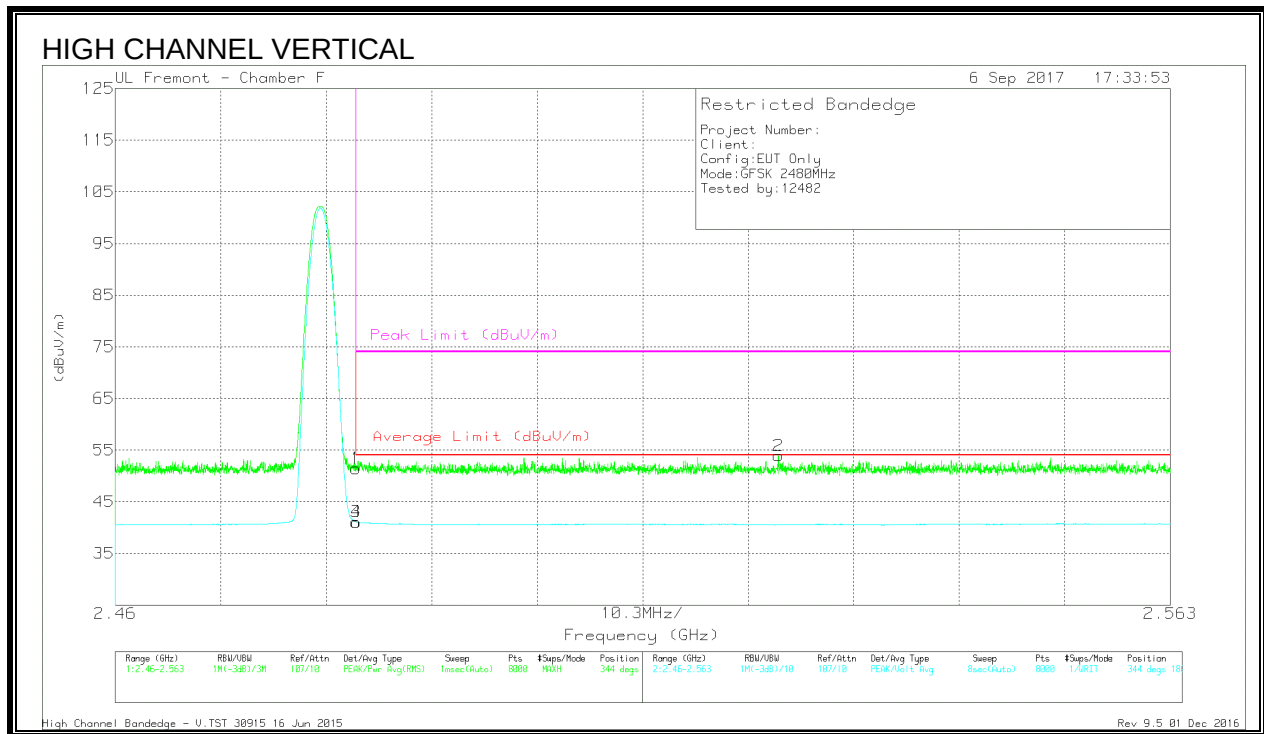


Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T119 (dB/m)	Amp/Cbl/ Filt/Pad (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.484	40.44	Pk	32.1	-21	51.54	-	-	74	-22.46	292	192	H
2	* 2.497	42.27	Pk	32.2	-21.1	53.37	-	-	74	-20.63	292	192	H
3	* 2.484	29.7	VA1T	32.1	-21	40.8	54	-13.20	-	-	292	192	H
4	* 2.484	29.68	VA1T	32.1	-21	40.78	54	-13.22	-	-	292	192	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



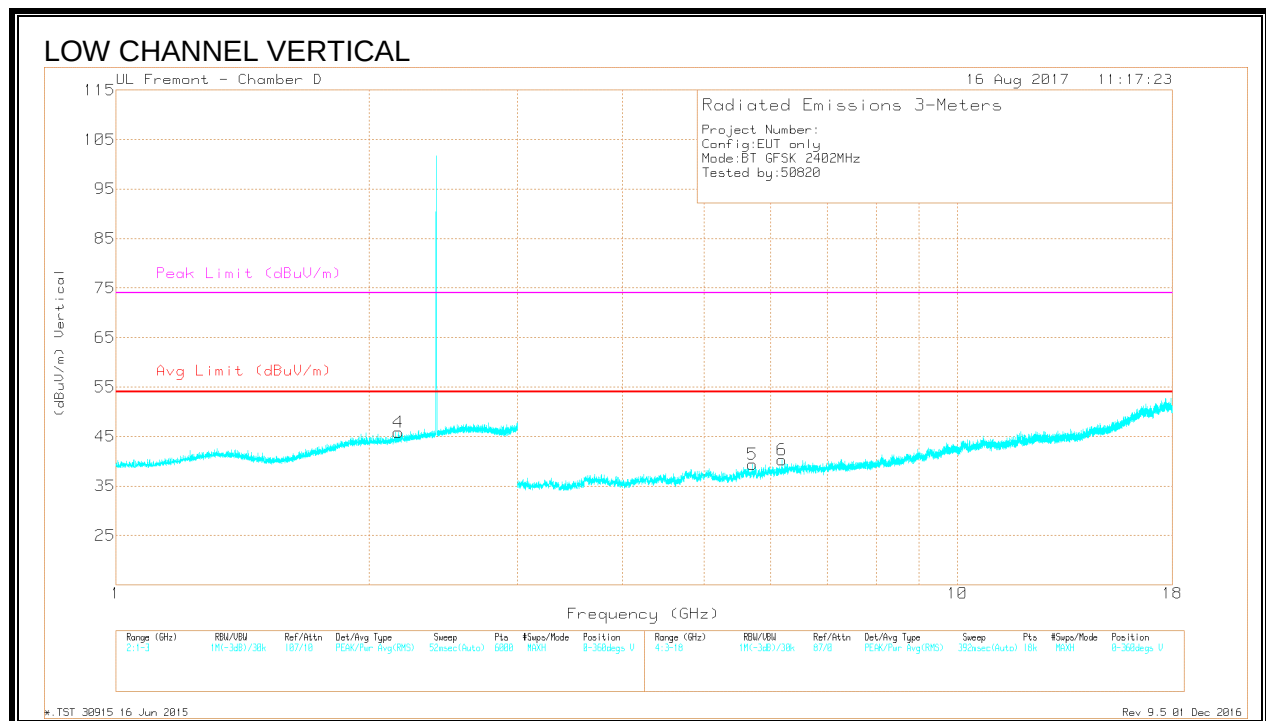
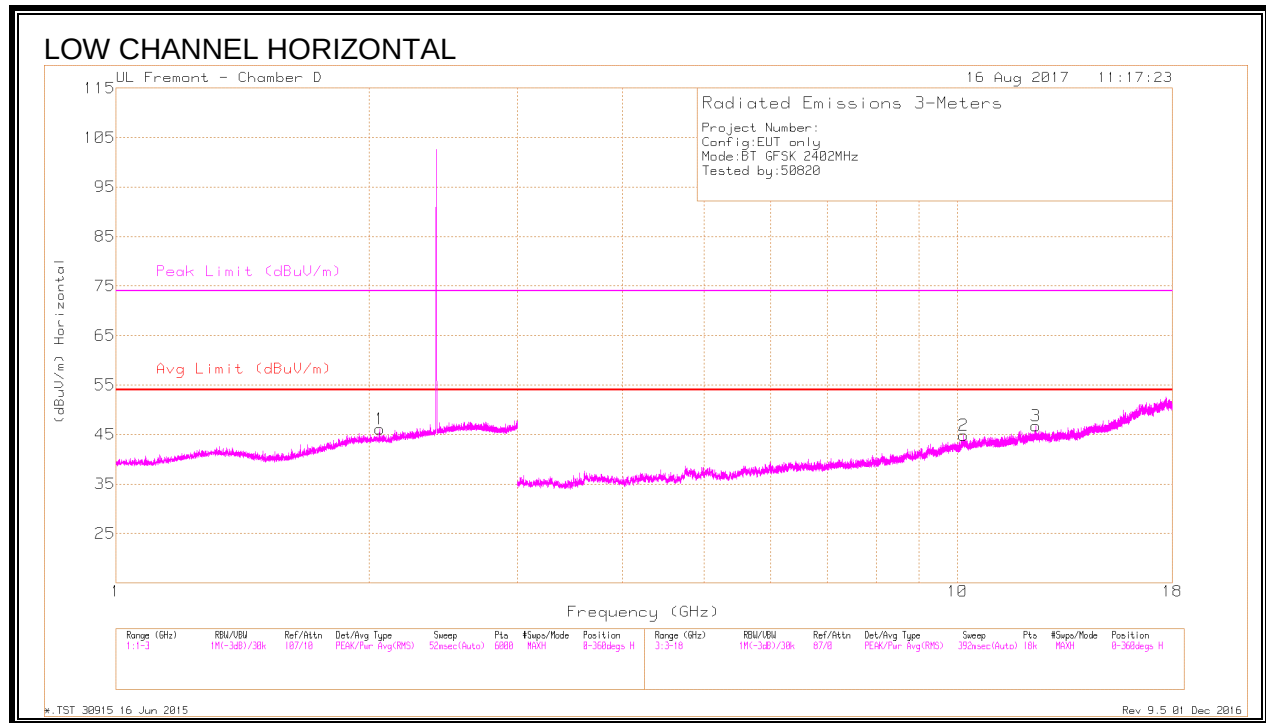
Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T119 (dB/m)	Amp/Cbl/ Ftr/Pad (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.484	40.35	Pk	32.1	-21	51.45	-	-	74	-22.55	344	180	V
2	2.525	42.81	Pk	32.2	-21.1	53.91	-	-	74	-20.09	344	180	V
3	* 2.484	30	VA1T	32.1	-21	41.1	54	-12.90	-	-	344	180	V
4	* 2.484	29.99	VA1T	32.1	-21	41.09	54	-12.91	-	-	344	180	V

* - 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

8.4.3. HARMONICS AND SPURIOUS EMISSIONS

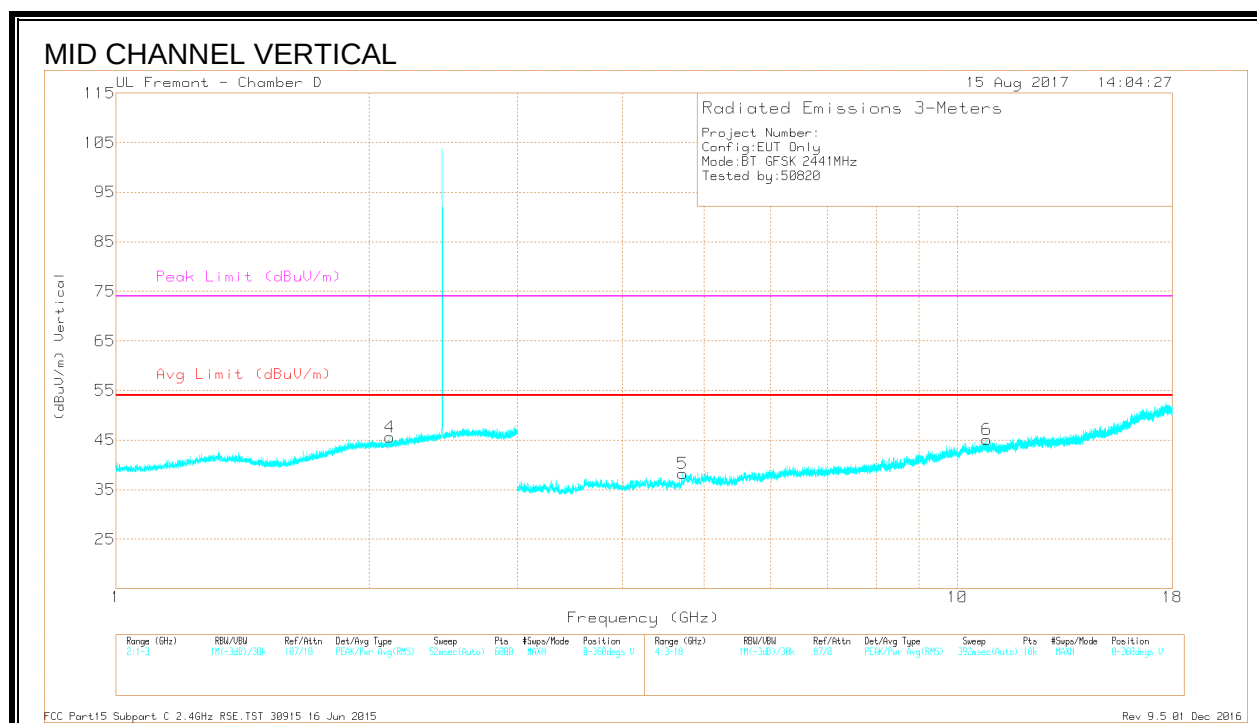
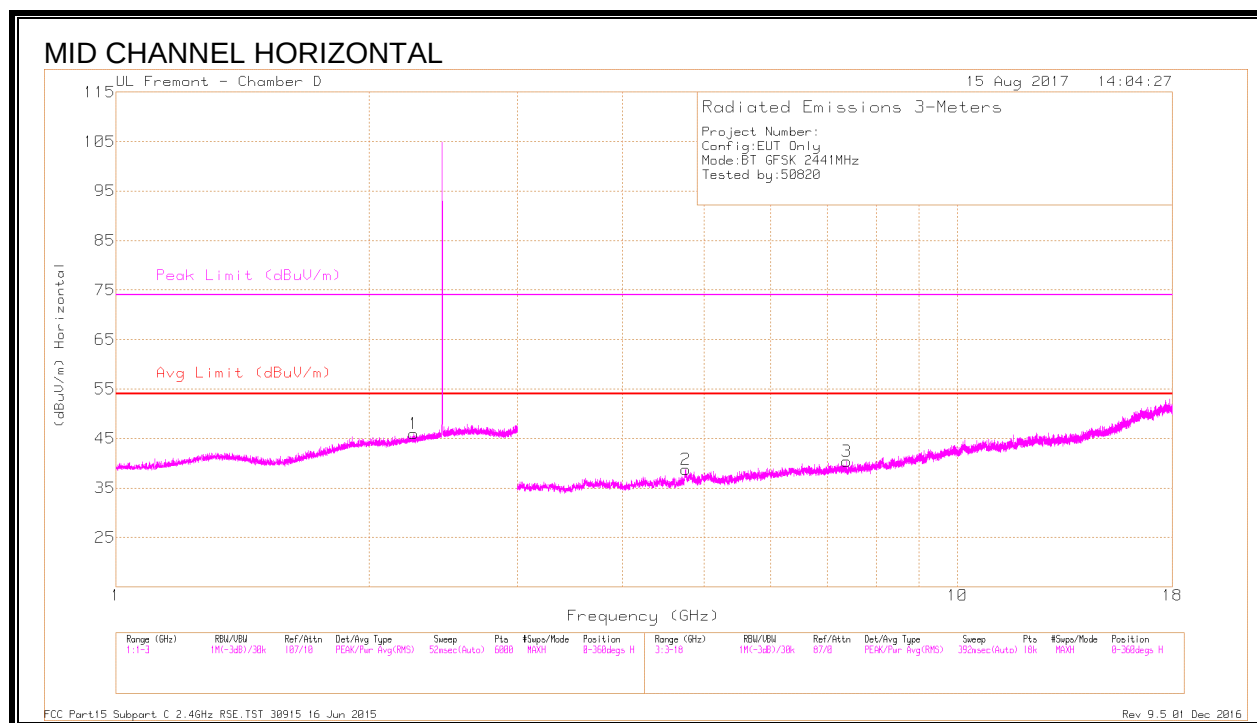


Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T711 (dB/m)	Amp/Cbl/ Fitr/Pad (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	2.058	40.6	PKFH	31.3	-21.2	50.7	-	-	-	-	0	101	H
2	10.168	32.87	PKFH	37	-19.8	50.07	-	-	-	-	0	101	H
3	* 12.4	32.87	PKFH	38.9	-20.6	51.17	-	-	74	-22.83	0	101	H
	* 12.401	21.37	VA1T	38.9	-20.6	39.67	54	-14.33	-	-	0	101	H
4	2.167	40.03	PKFH	31.4	-21	50.43	-	-	-	-	0	101	V
5	5.707	36.14	PKFH	34.8	-27	43.94	-	-	-	-	0	101	V
6	6.188	36.3	PKFH	35.4	-26.7	45	-	-	-	-	0	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

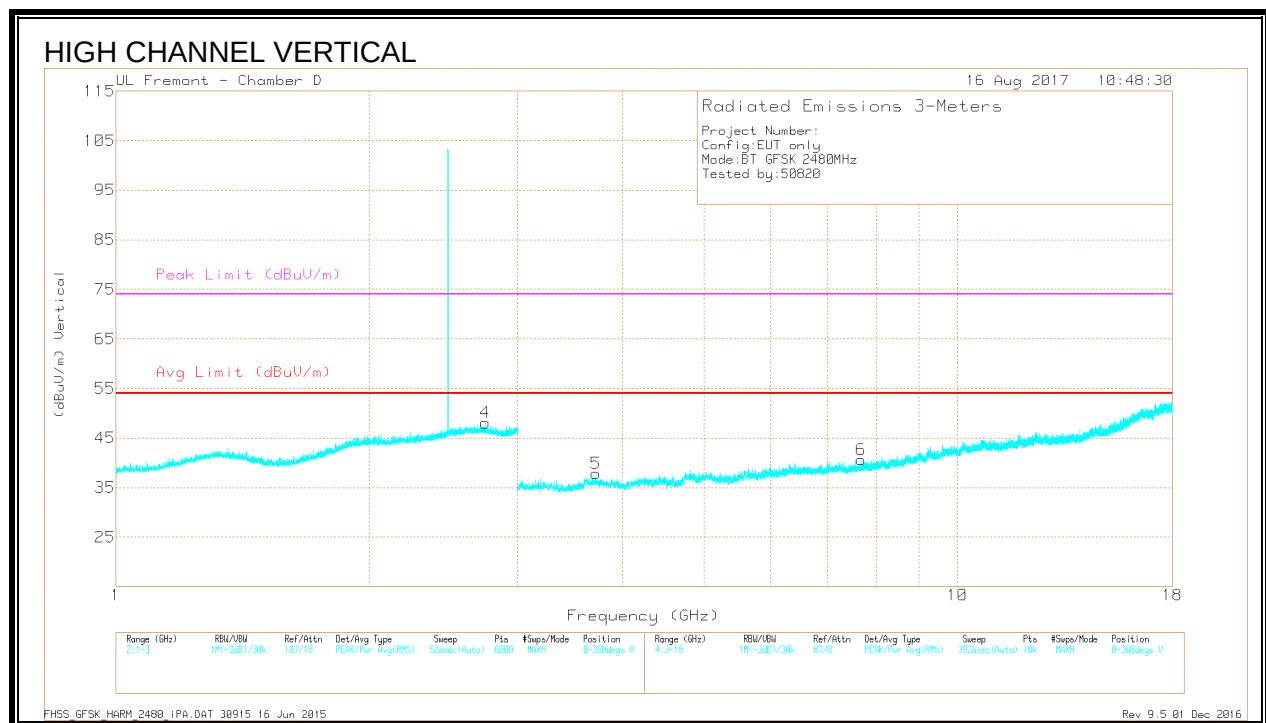
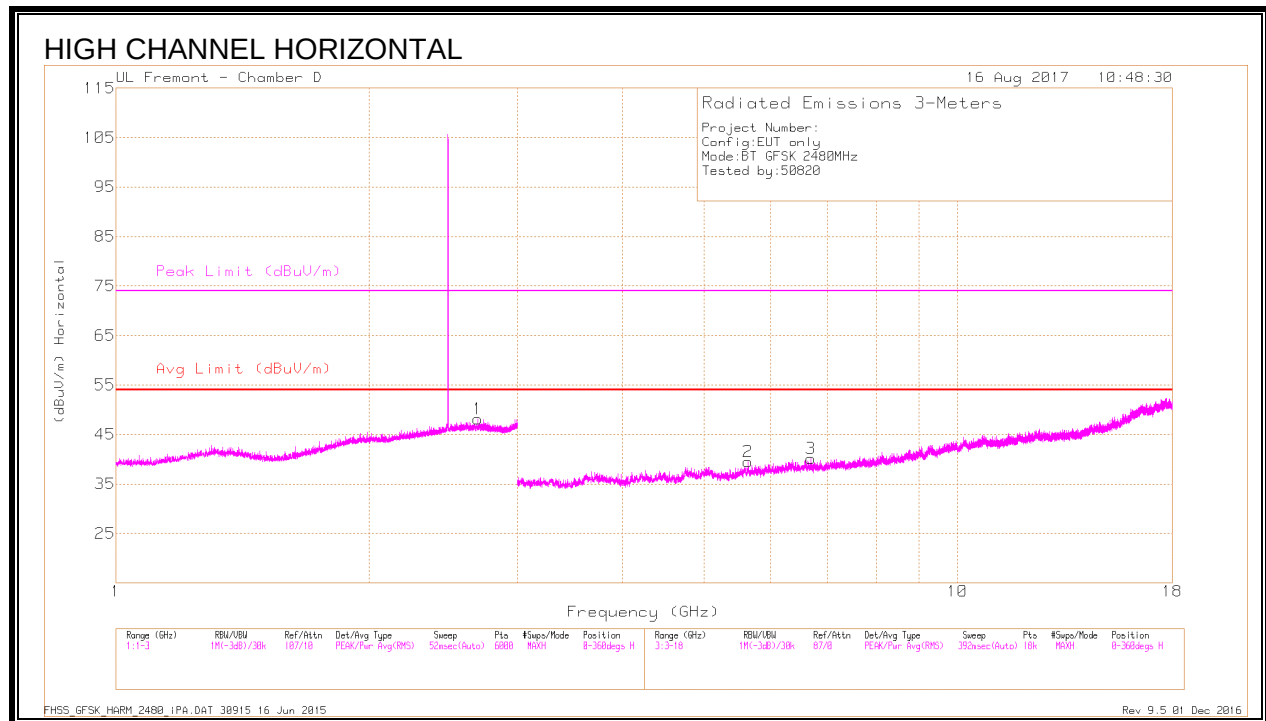


Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T711 (dB/m)	Amp/Cbl/ Fitr/Pad (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.257	40.15	PKFH	31.8	-21.1	50.85	-	-	74	-23.15	0	100	H
	* 2.256	28.57	VA1T	31.8	-21.1	39.27	54	-14.73	-	-	0	100	H
2	* 4.755	37.46	PKFH	33.9	-26.6	44.76	-	-	74	-29.24	0	100	H
	* 4.756	25.44	VA1T	33.9	-26.6	32.74	54	-21.26	-	-	0	100	H
3	* 7.388	35.78	PKFH	35.5	-25.1	46.18	-	-	74	-27.82	0	100	H
	* 7.385	23.15	VA1T	35.5	-25.2	33.45	54	-20.55	-	-	0	100	H
4	* 4.712	37.57	PKFH	33.9	-27.3	44.17	-	-	74	-29.83	0	100	V
	* 4.712	25.21	VA1T	33.9	-27.3	31.81	54	-22.19	-	-	0	100	V
5	* 10.829	32.99	PKFH	37.9	-20.9	49.99	-	-	74	-24.01	0	100	V
	* 10.828	20.98	VA1T	37.9	-20.9	37.98	54	-16.02	-	-	0	100	V
6	2.116	41.58	PKFH	31.2	-21.1	51.68	-	-	-	-	0	100	V
	2.118	28.52	VA1T	31.2	-21.1	38.62	-	-	-	-	0	100	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



Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T711 (dB/m)	Amp/Cbl/ Fitr/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	* 2.694	40.73	PKFH	32.7	-20.6	52.83	-	-	74	-21.17	0	100	H
	* 2.691	28.63	VA1T	32.7	-20.6	40.73	54	-13.27	-	-	0	100	H
2	5.637	35.98	PKFH	34.7	-26.5	44.18	-	-	-	-	0	100	H
3	6.692	36.07	PKFH	35.6	-26.2	45.47	-	-	-	-	0	100	H
4	* 2.748	41	PKFH	32.6	-20.4	53.2	-	-	74	-20.8	0	100	V
	* 2.751	28.58	VA1T	32.6	-20.4	40.78	54	-13.22	-	-	0	100	V
5	* 3.719	38.37	PKFH	33	-28.6	42.77	-	-	74	-31.23	0	100	V
	* 3.718	25.82	VA1T	33	-28.7	30.12	54	-23.88	-	-	0	100	V
6	* 7.683	34.7	PKFH	35.6	-24.7	45.6	-	-	74	-28.4	0	100	V
	* 7.682	22.99	VA1T	35.6	-24.7	33.89	54	-20.11	-	-	0	100	V

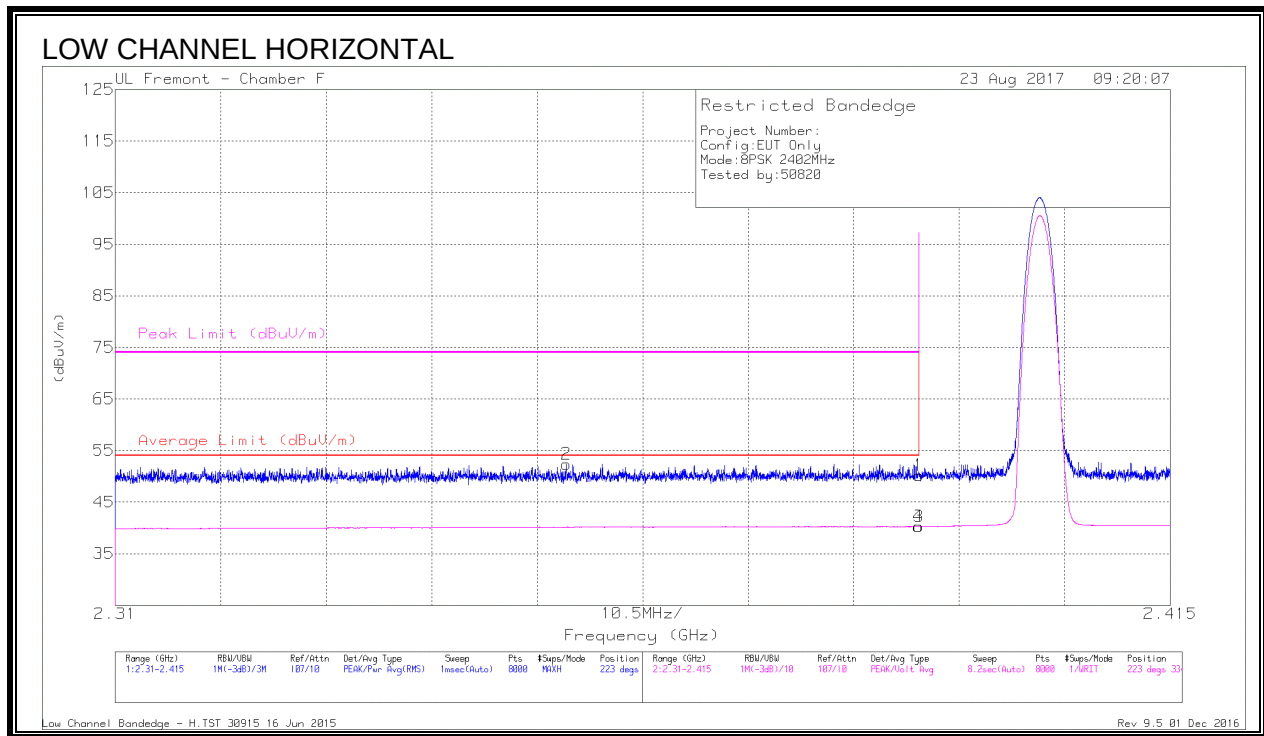
* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band

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

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

8.5. Antenna A, Plow ENHANCED DATA RATE 8PSK MODULATION

8.5.1. RESTRICTED BANDEDGE (LOW CHANNEL)

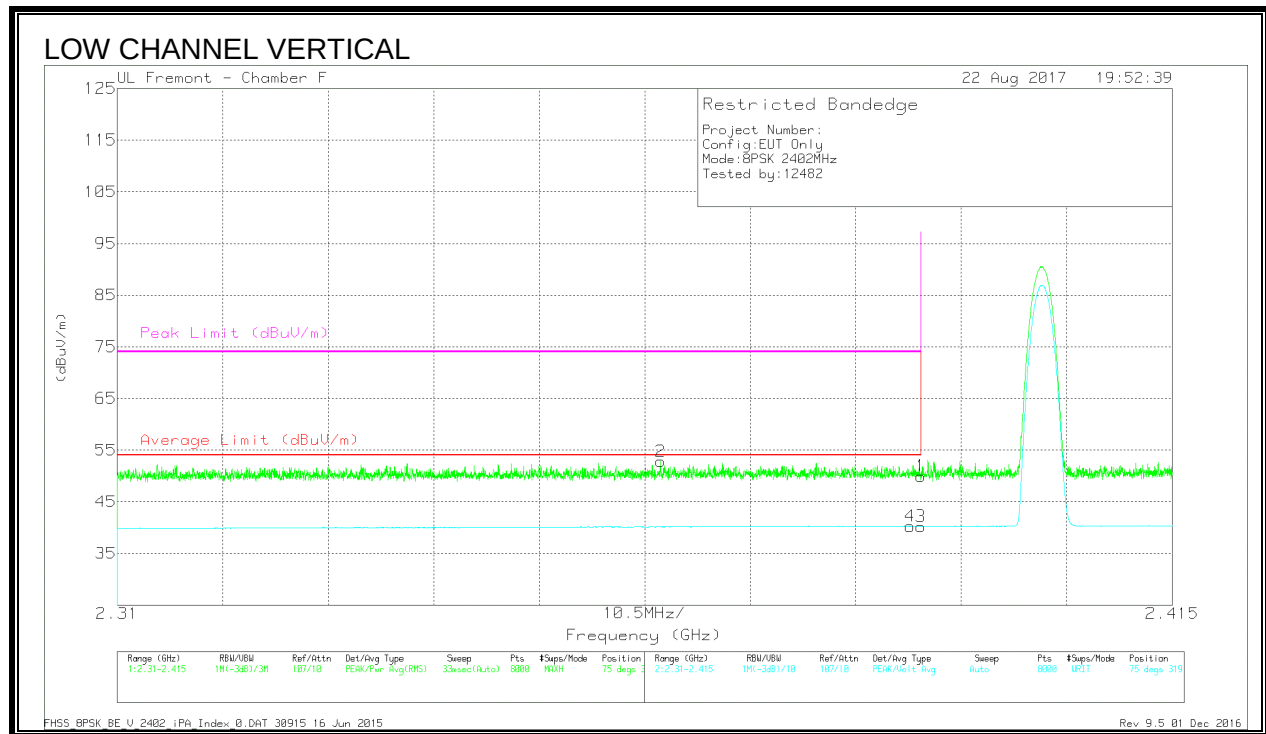


Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T119 (dB/m)	Amp/Cbl/ Ftr/Pad (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.39	39.28	Pk	31.9	-21	50.18	-	-	74	-23.82	223	334	H
2	* 2.355	41.58	Pk	31.8	-21	52.38	-	-	74	-21.62	223	334	H
3	* 2.39	29.37	VA1T	31.9	-21	40.27	54	-13.73	-	-	223	334	H
4	* 2.39	29.39	VA1T	31.9	-21	40.29	54	-13.71	-	-	223	334	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



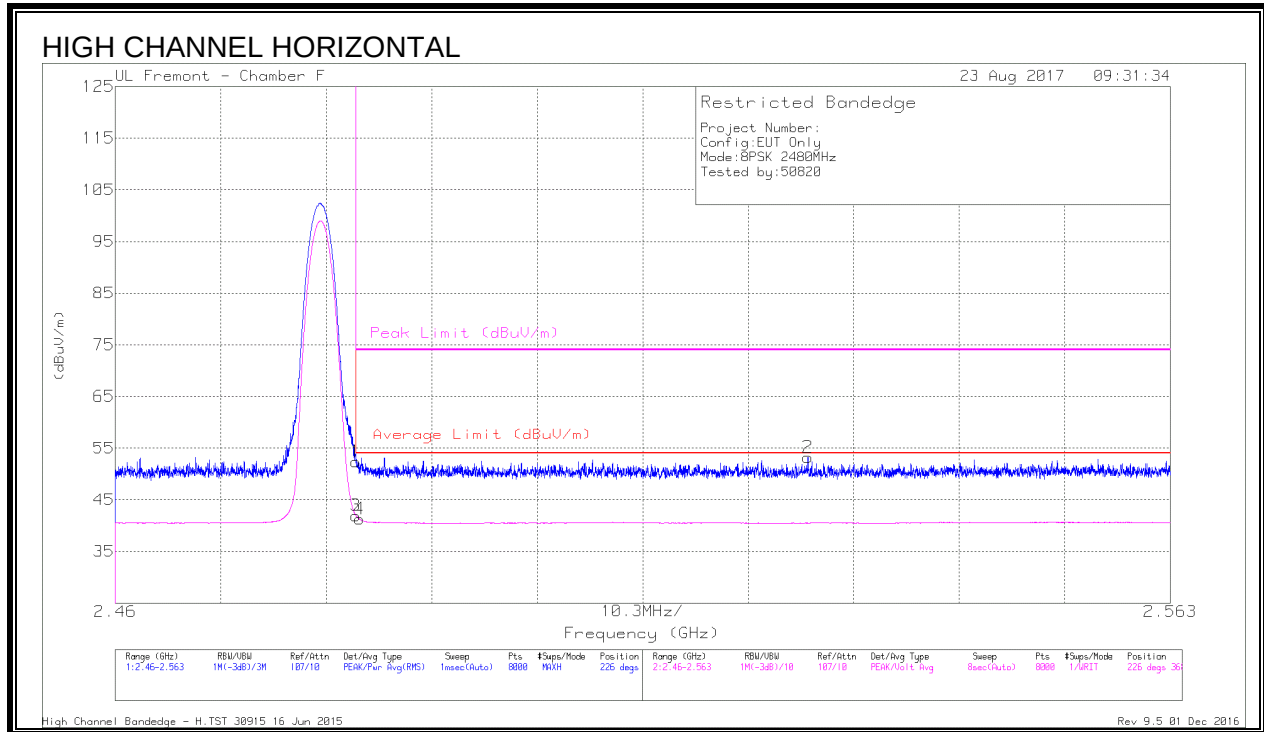
Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T119 (dB/m)	Amp/Cbl/Fitr/ Pad (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.39	39.06	Pk	31.9	-21	49.96	-	-	74	-24.04	75	319	V
2	* 2.364	41.91	Pk	31.8	-20.9	52.81	-	-	74	-21.19	75	319	V
3	* 2.39	29.29	VA1T	31.9	-21	40.19	-	-	-	-	75	319	V
4	* 2.389	29.26	VA1T	31.9	-20.9	40.26	-	-	-	-	75	319	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

8.5.2. AUTHORIZED BANDEDGE (HIGH CHANNEL)

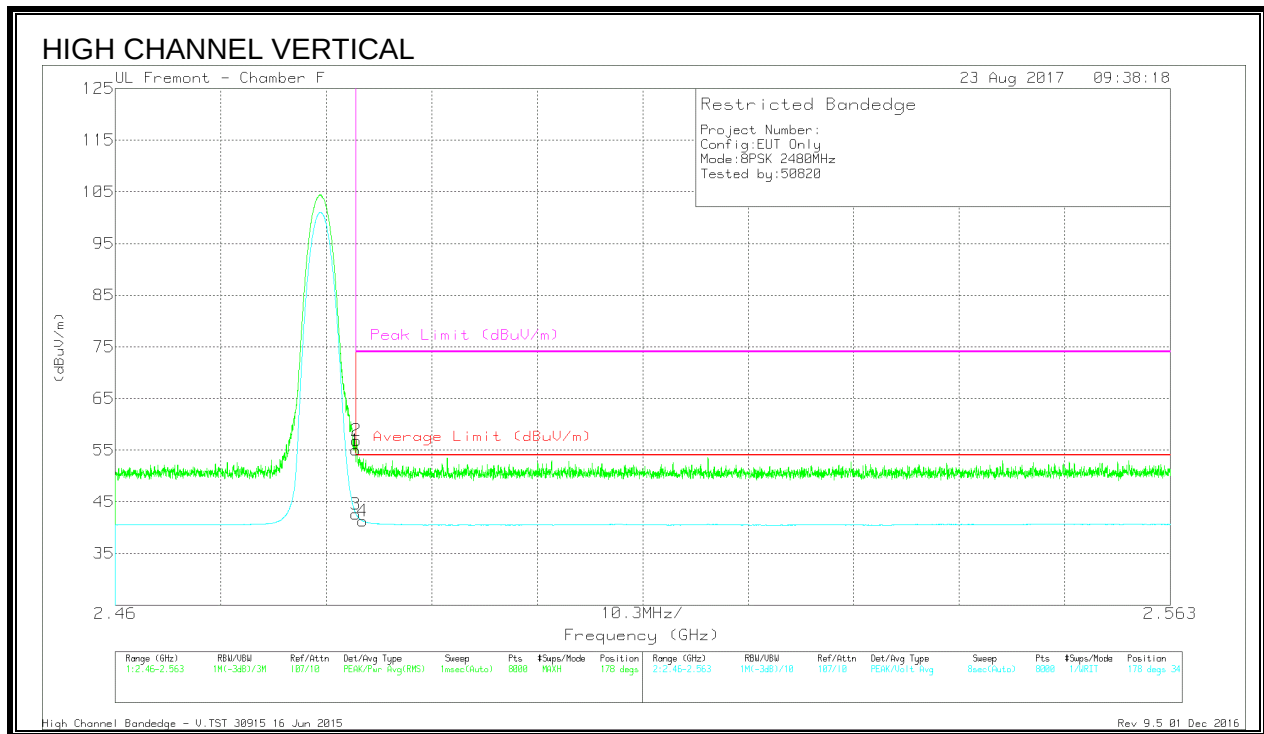


Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T119 (dB/m)	Amp/Cb/Filtr/ Pad (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.484	41.27	Pk	32.1	-21	52.37	-	-	74	-21.63	226	368	H
2	2.528	42.02	Pk	32.2	-21	53.22	-	-	74	-20.78	226	368	H
3	* 2.484	30.84	VA1T	32.1	-21	41.94	54	-12.06	-	-	226	368	H
4	* 2.484	30.18	VA1T	32.1	-21	41.28	54	-12.72	-	-	226	368	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



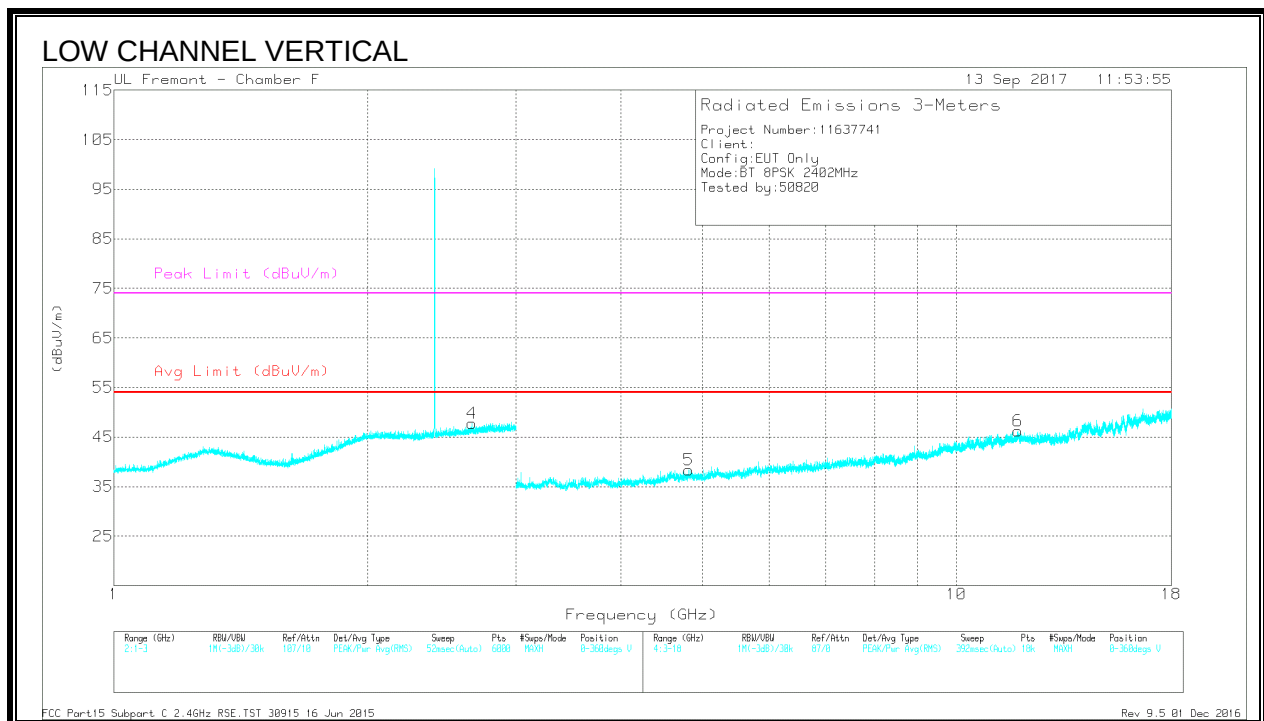
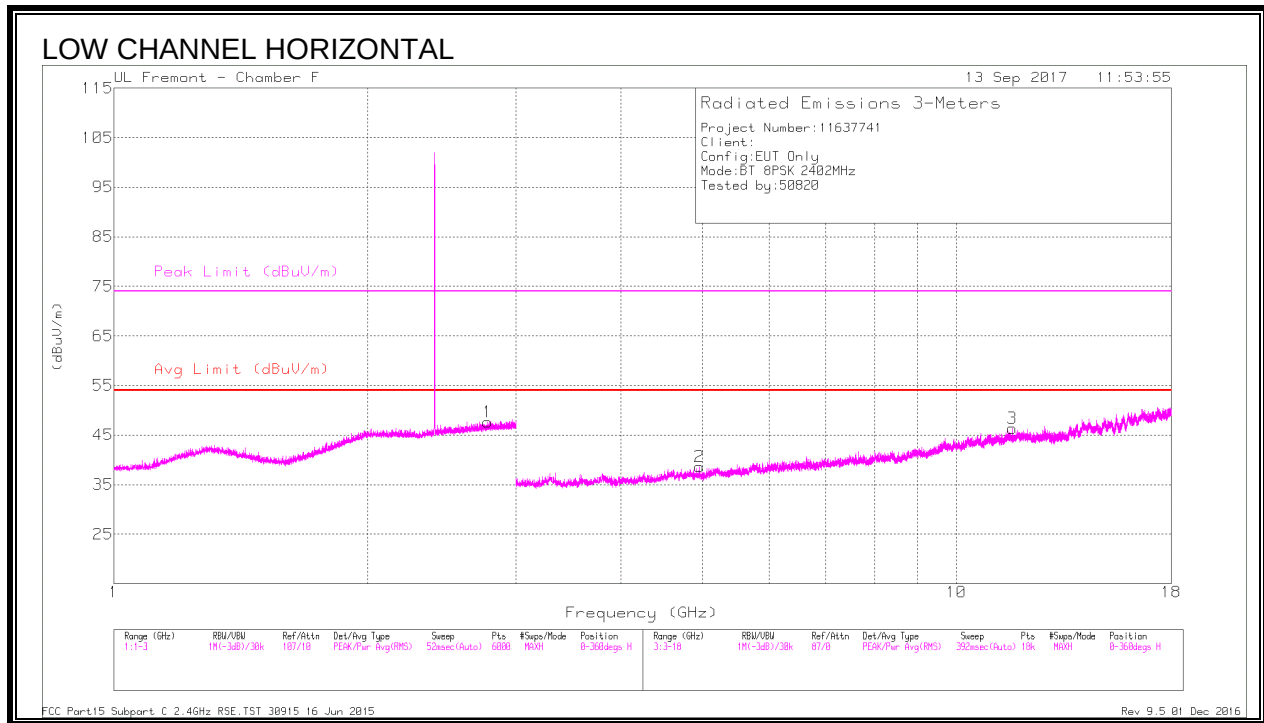
Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T119 (dB/m)	Amp/Cbl/Filtr/Pad (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.484	43.91	Pk	32.1	-21	55.01	-	-	74	-18.99	178	341	V
2	* 2.484	45.79	Pk	32.1	-21	56.89	-	-	74	-17.11	178	341	V
3	* 2.484	31.49	VA1T	32.1	-21	42.59	54	-11.41	-	-	178	341	V
4	* 2.484	30.09	VA1T	32.2	-21	41.29	54	-12.71	-	-	178	341	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

8.5.3. HARMONICS AND SPURIOUS EMISSIONS

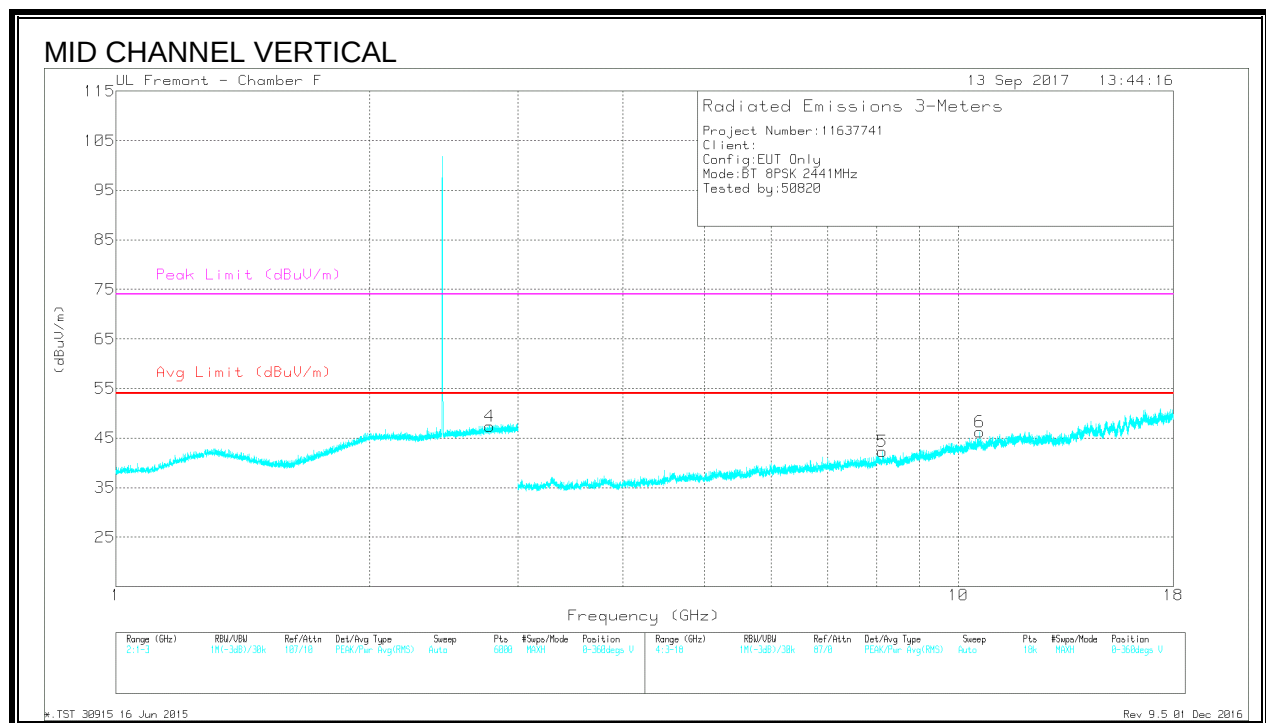
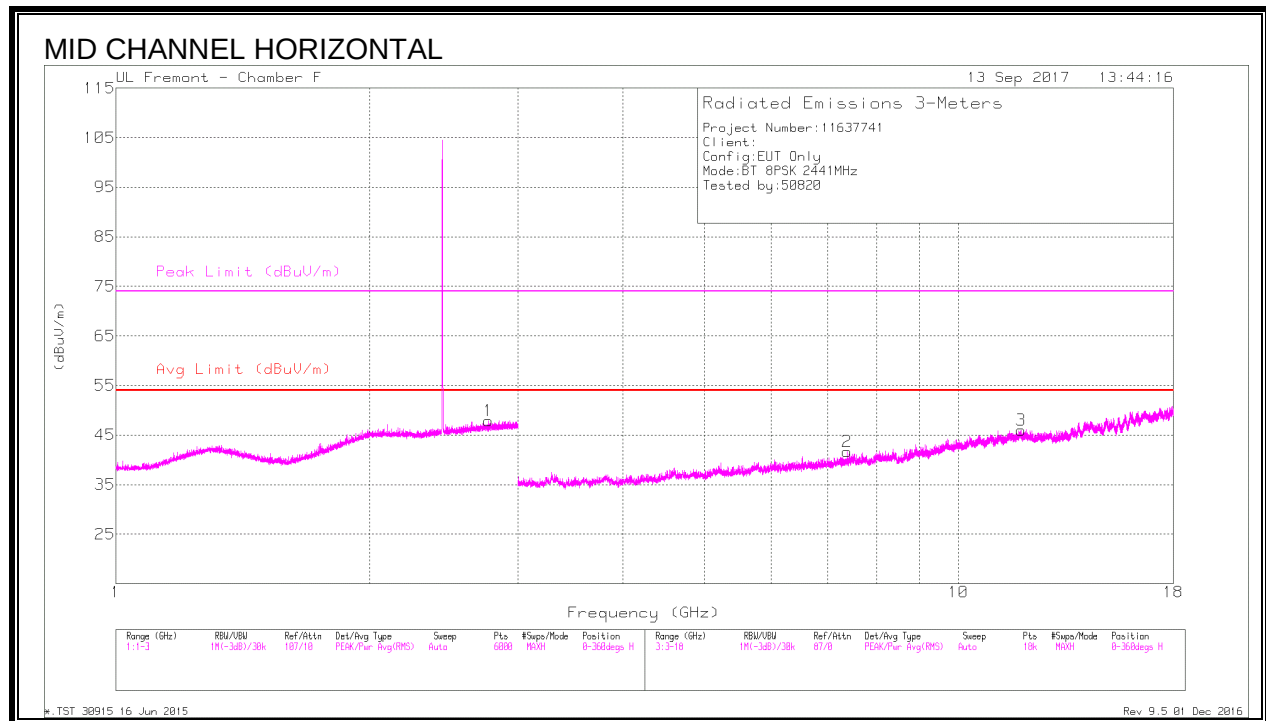


Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T119 (dB/m)	Amp/Cbl/ Fitr/Pad (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.779	42.04	PK2	32.7	-20.6	54.14	-	-	74	-19.86	215	101	H
	* 2.776	30.39	MAv1	32.7	-20.6	42.49	54	-11.51	-	-	215	101	H
2	* 4.954	38.92	PK2	34.2	-28.4	44.72			74	-29.28	109	197	H
	* 4.954	27.98	MAv1	34.2	-28.4	33.78	54	-20.22	-	-	109	197	H
3	* 11.655	36	PK2	38.7	-22.2	52.5			74	-21.5	314	205	H
	* 11.658	24.51	MAv1	38.7	-22.2	41.01	54	-12.99	-	-	214	205	H
4	* 2.66	42.31	PK2	32.4	-20.7	54.01			74	-19.99	156	213	V
	* 2.662	30.53	MAv1	32.4	-20.7	42.23	54	-11.77	-	-	156	213	V
5	* 4.814	37.76	PK2	34.1	-27.3	44.56			74	-29.44	138	89	V
	* 4.814	26.76	MAv1	34.1	-27.3	33.56	54	-20.44	-	-	138	89	V
6	* 11.844	35.36	PK2	39	-21.6	52.76			74	-21.24	247	314	V
	* 11.84	24.39	MAv1	39	-21.6	41.79	54	-12.21	-	-	247	314	V

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

PK2 - KDB558074 Method: Maximum Peak

MAv1 - KDB558074 Option 1 Maximum RMS Average

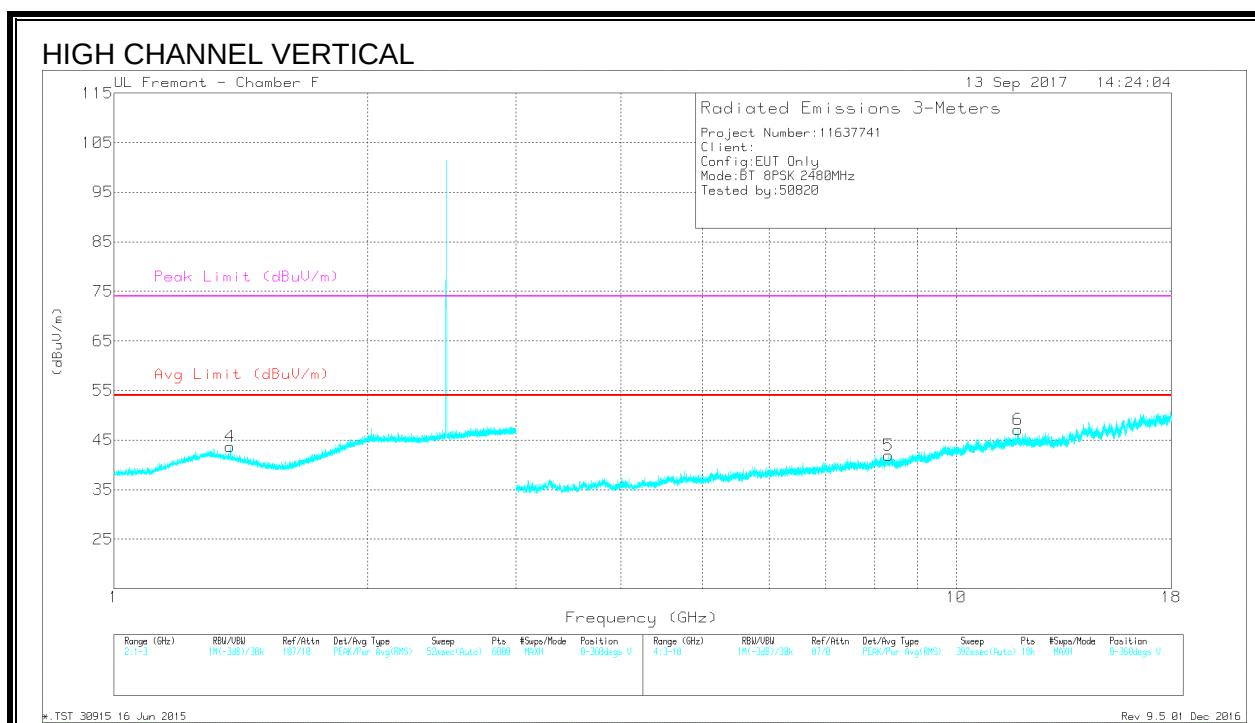
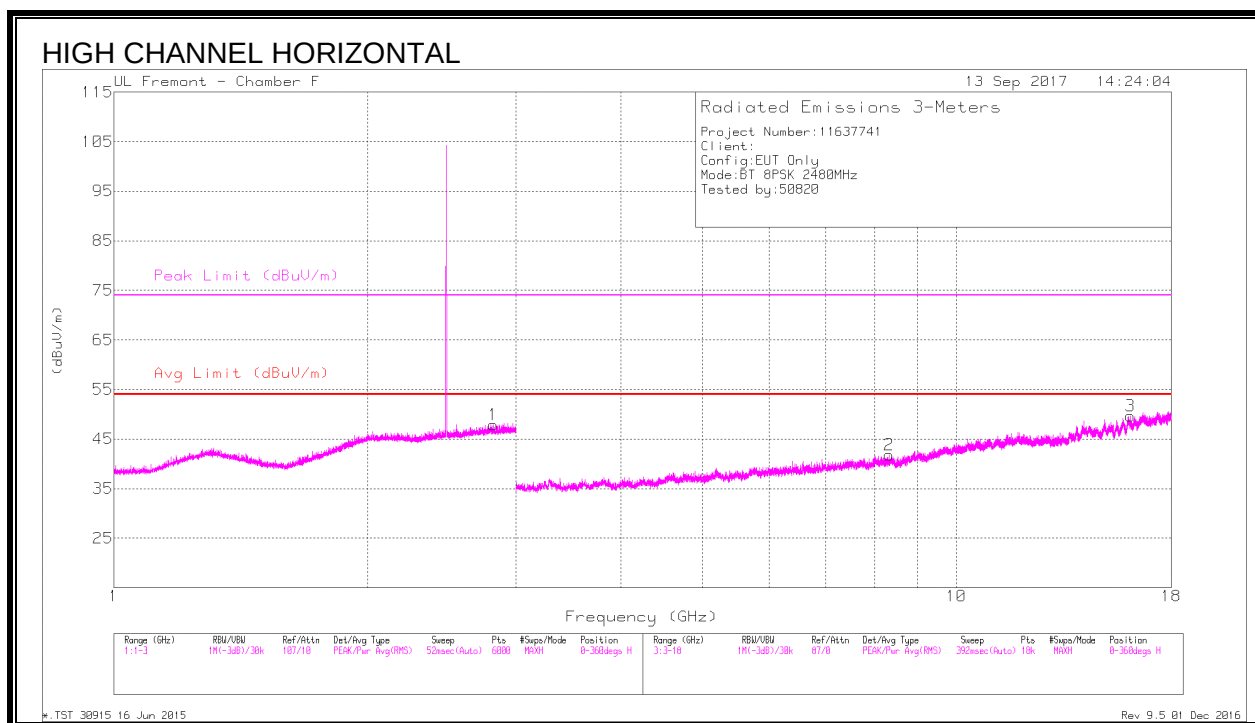


Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T119 (dB/m)	Amp/Cbl/ Fitr/Pad (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.765	41.95	PK2	32.7	-20.6	54.05			74	-19.95	245	111	H
	* 2.765	30.31	MAv1	32.7	-20.6	42.41	54	-11.59	-	-	245	111	H
2	* 7.388	36.55	PK2	36	-25.5	47.05			74	-26.95	132	245	H
	* 7.388	26.04	MAv1	36	-25.5	36.54	54	-17.46	-	-	132	245	H
3	* 11.878	35.53	PK2	38.9	-21.6	52.83			74	-21.17	235	177	H
	* 11.876	24.11	MAv1	38.9	-21.6	41.41	54	-12.59	-	-	235	177	H
4	* 2.774	41.95	PK2	32.7	-20.6	54.05			74	-19.95	159	202	V
	* 2.774	30.42	MAv1	32.7	-20.6	42.52	54	-11.48	-	-	159	202	V
5	* 8.122	36.48	PK2	36.1	-24.1	48.48			74	-25.52	104	275	V
	* 8.122	25.09	MAv1	36.1	-24.1	37.09	54	-16.91	-	-	104	275	V
6	* 10.61	35.85	PK2	37.7	-21.1	52.45			74	-21.55	305	101	V
	* 10.608	24.24	MAv1	37.7	-21.2	40.74	54	-13.26	-	-	305	101	V

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

PK2 - KDB558074 Method: Maximum Peak

MAv1 - KDB558074 Option 1 Maximum RMS Average



Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T119 (dB/m)	Amp/Cbl/ Fitr/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	* 2.82	42.42	PK2	32.8	-20.5	54.72			74	-19.28	156	202	H
	* 2.822	30.25	MAv1	32.8	-20.5	42.55	54	-11.45	-	-	156	202	H
2	* 8.326	36.23	PK2	36	-24.6	47.63			74	-26.37	125	100	H
	* 8.326	25.63	MAv1	36	-24.6	37.03	54	-16.97	-	-	125	100	H
3	* 16.096	36.38	PK2	41.3	-21.6	56.08			74	-17.92	321	247	H
	* 16.096	24.91	MAv1	41.3	-21.6	44.61	54	-9.39	-	-	321	247	H
4	* 1.376	42.26	PK2	29.3	-22.1	49.46			74	-24.54	213	298	V
	* 1.375	30.59	MAv1	29.3	-22.1	37.79	54	-16.21	-	-	213	298	V
5	* 8.311	36.32	PK2	36	-24.5	47.82			74	-26.18	349	174	V
	* 8.312	25.5	MAv1	36	-24.5	37	54	-17	-	-	349	174	V
6	* 11.836	35.7	PK2	39	-21.6	53.1			74	-20.9	78	115	V
	* 11.838	24.42	MAv1	39	-21.6	41.82	54	-12.18	-	-	78	115	V

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

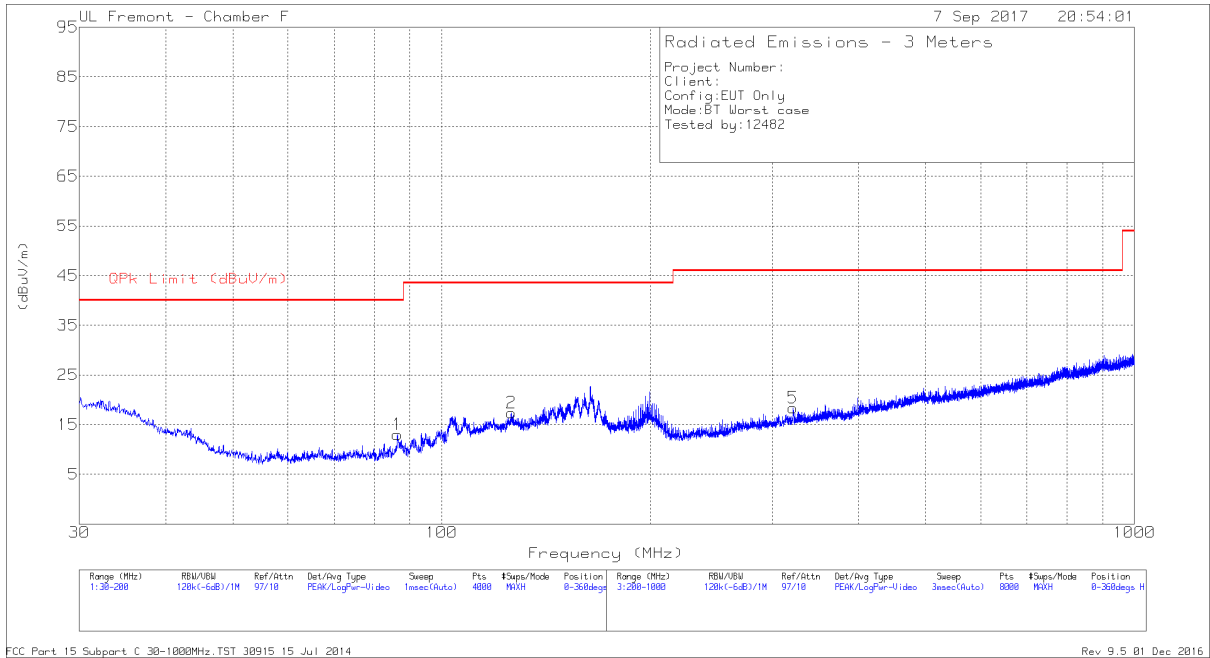
PK2 - KDB558074 Method: Maximum Peak

MAv1 - KDB558074 Option 1 Maximum RMS Average

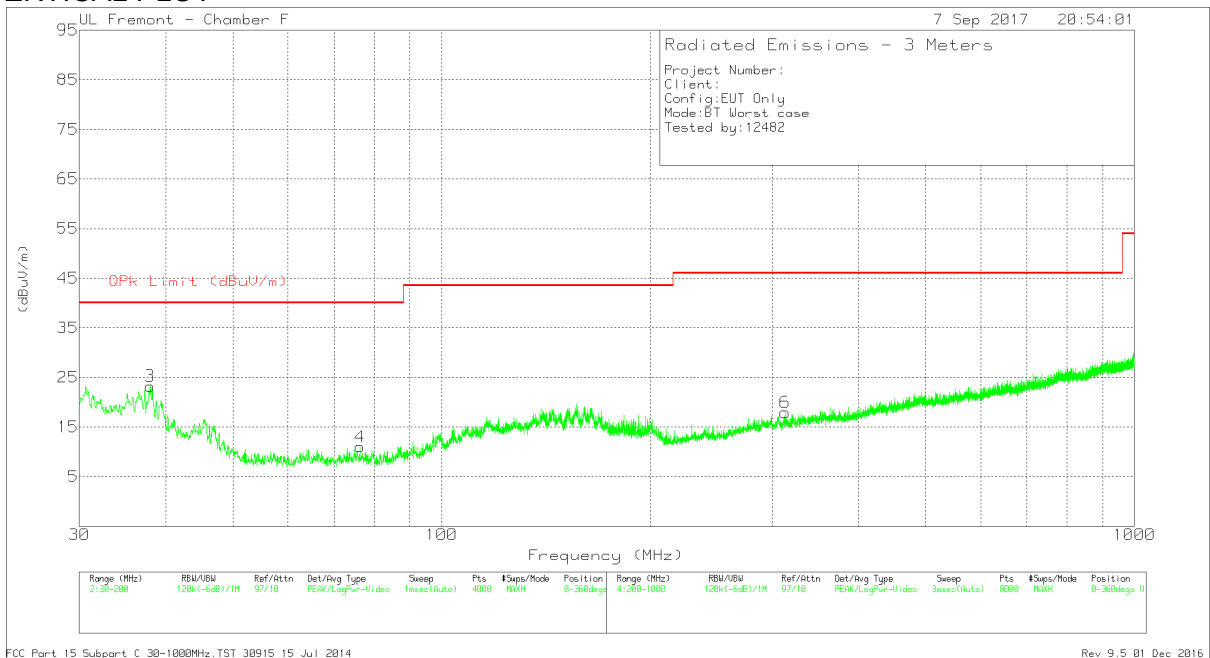
8.6. WORST-CASE BELOW 1 GHz

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

HORIZONTAL PLOT



VERTICAL PLOT



DATA

Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	AF T122 (dB/m)	Amp/Cbl (dB)	Corrected Reading (dBuV/m)	QPk Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	86.3696	32.54	Pk	11.8	-31.3	13.04	40	-26.96	0-360	299	H
2	* 126.1174	30.4	Pk	18	-31	17.4	43.52	-26.12	0-360	299	H
3	* 37.9921	35.84	Pk	19.1	-31.7	23.24	40	-16.76	0-360	100	V
4	76.252	30.6	Pk	11.8	-31.4	11	40	-29	0-360	100	V
5	321.8158	30.18	Pk	18	-29.8	18.38	46.02	-27.64	0-360	101	H
6	313.3147	30.04	Pk	17.8	-29.9	17.94	46.02	-28.08	0-360	199	V

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

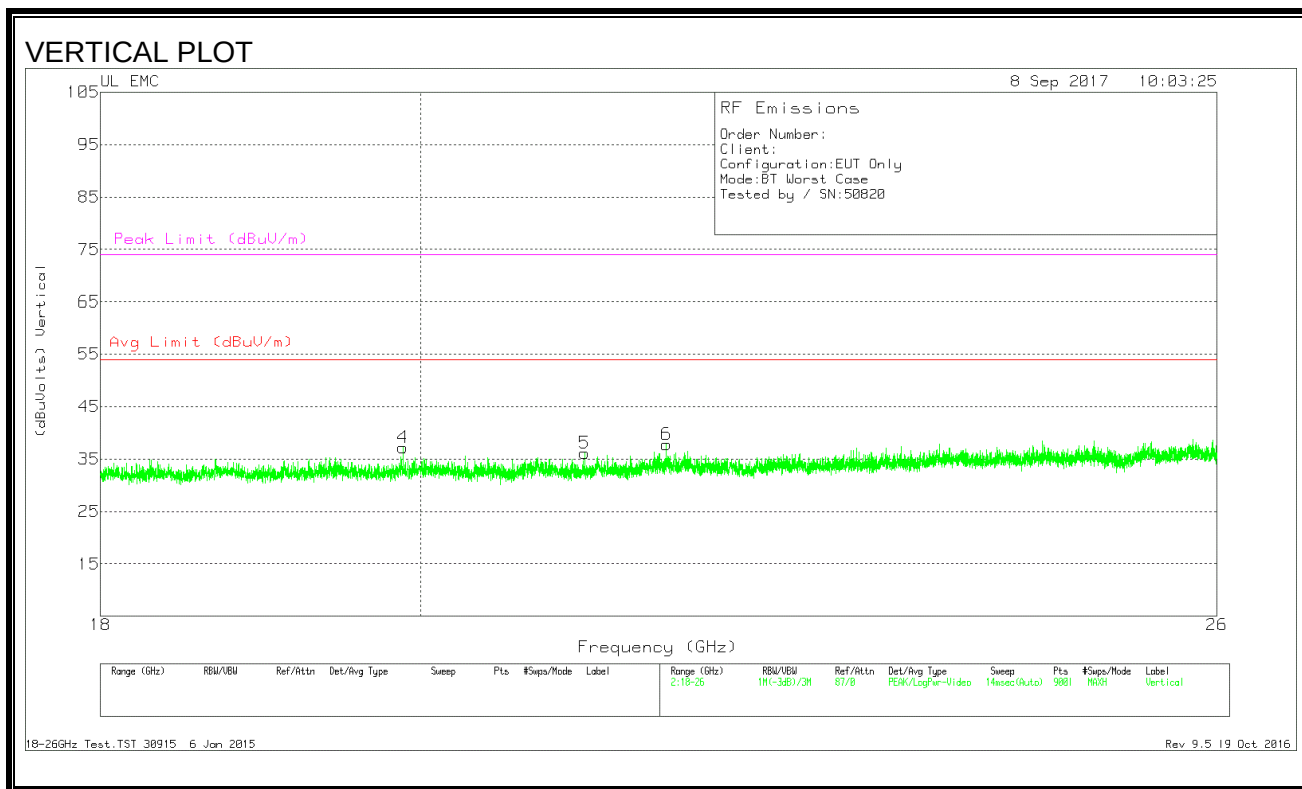
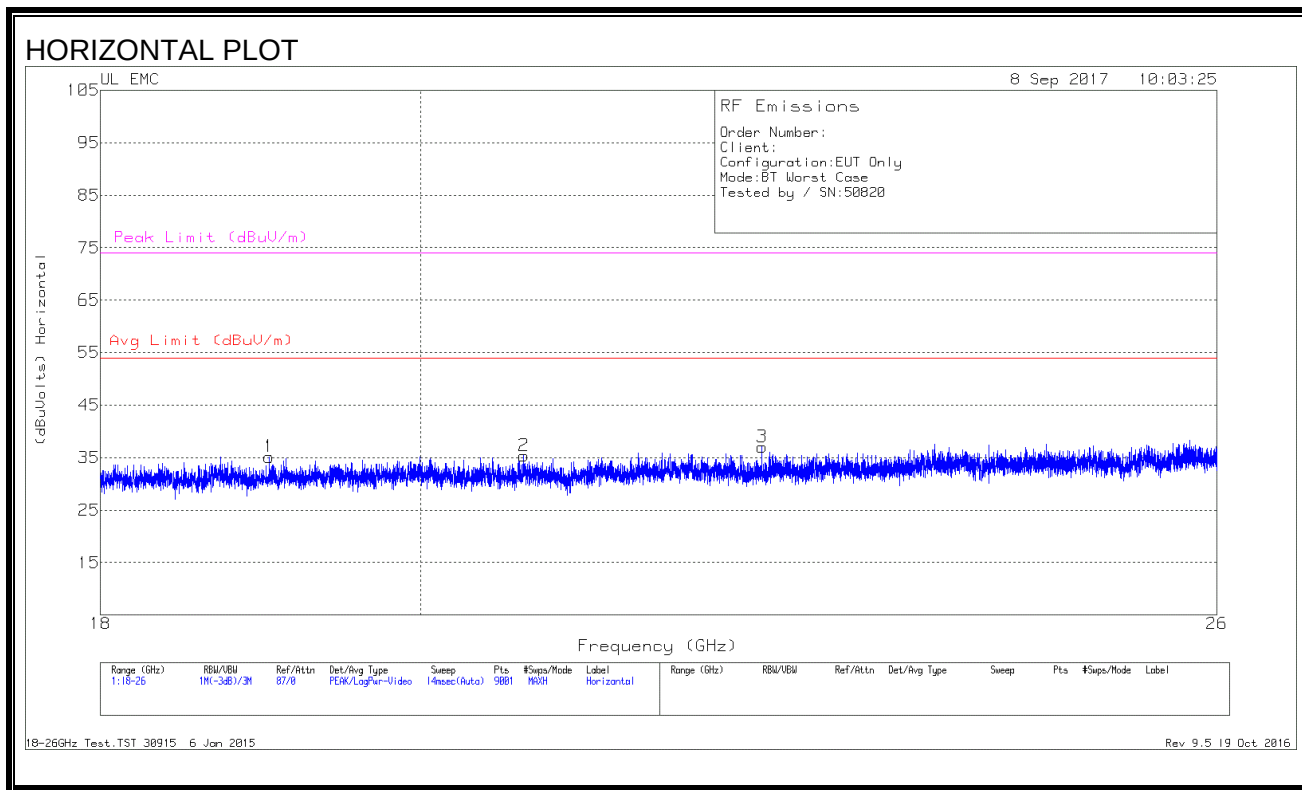
Pk - Peak detector

FCC Part 15 Subpart C 30-1000MHz.TST 30915 15 Jul 2014

Rev 9.5 01 Dec 2016

8.7. WORST-CASE ABOVE 18 GHz

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



Data

Marker	Frequenc y (GHz)	Meter Reading (dBuV)	Det	T89 AF (dB/m)	Amp/Cbl (dB)	Dist Corr (dB)	Correcte d Reading (dBuVOLT s)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)
1	19.028	37.21	Pk	32.2	-24.8	-9.5	35.11	54	-18.89	74	-38.89
2	20.692	37.28	Pk	32.8	-25.2	-9.5	35.38	54	-18.62	74	-38.62
3	22.381	38.25	Pk	33.1	-24.8	-9.5	37.05	54	-16.95	74	-36.95
4	19.886	38.91	Pk	32.8	-25	-9.5	37.21	54	-16.79	74	-36.79
5	21.112	38.1	Pk	32.8	-25.3	-9.5	36.1	54	-17.9	74	-37.9
6	21.687	38.71	Pk	33.3	-24.7	-9.5	37.81	54	-16.19	74	-36.19

Pk - Peak detector

18-26GHz Test.TST 30915 6 Jan 2015

Rev 9.5 19 Oct 2016

9. AC POWER LINE CONDUCTED EMISSIONS

LIMITS

FCC §15.207 (a)

RSS-Gen 8.8

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

*Decreases with the logarithm of the frequency.

TEST PROCEDURE

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

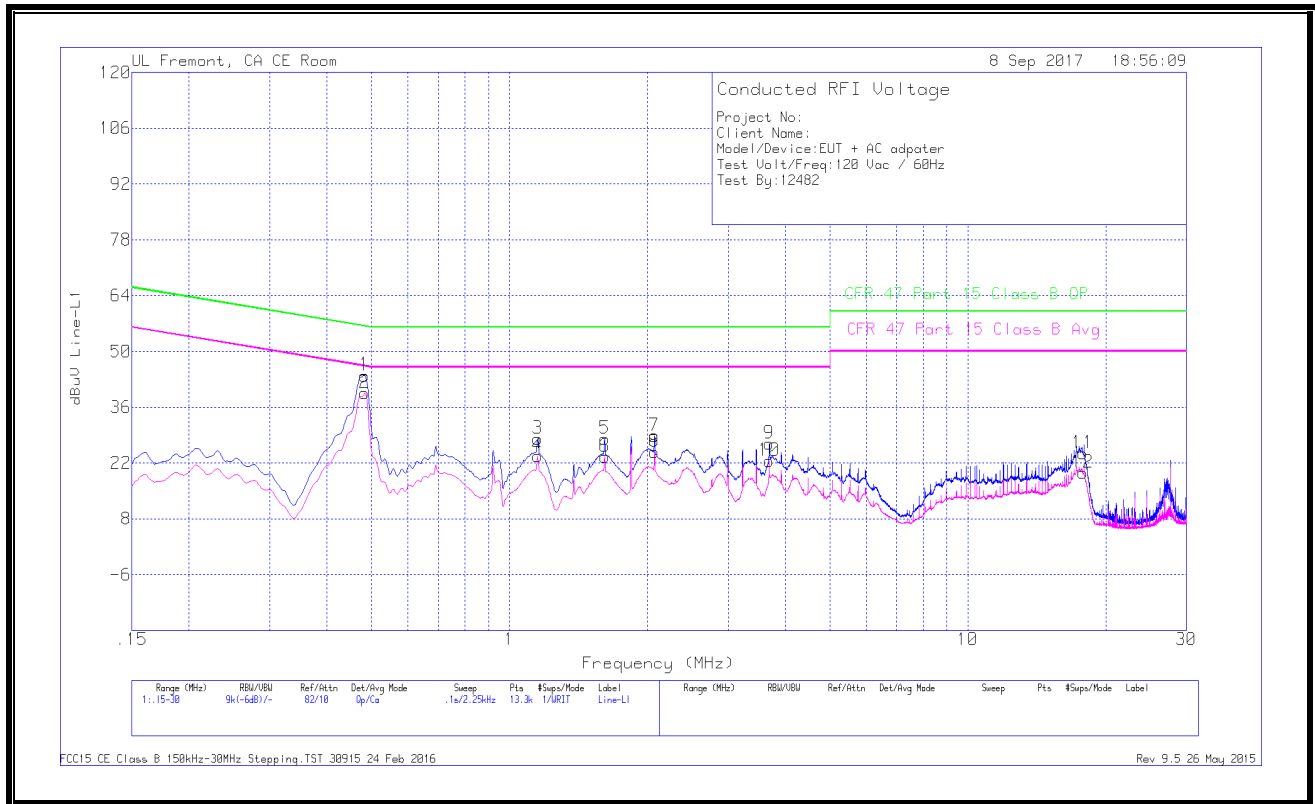
The receiver is set to a resolution bandwidth of 9 kHz. Peak detection is used unless otherwise noted as quasi-peak or average.

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

RESULTS

EUT POWERED BY AC/DC ADAPTER

LINE 1 RESULTS



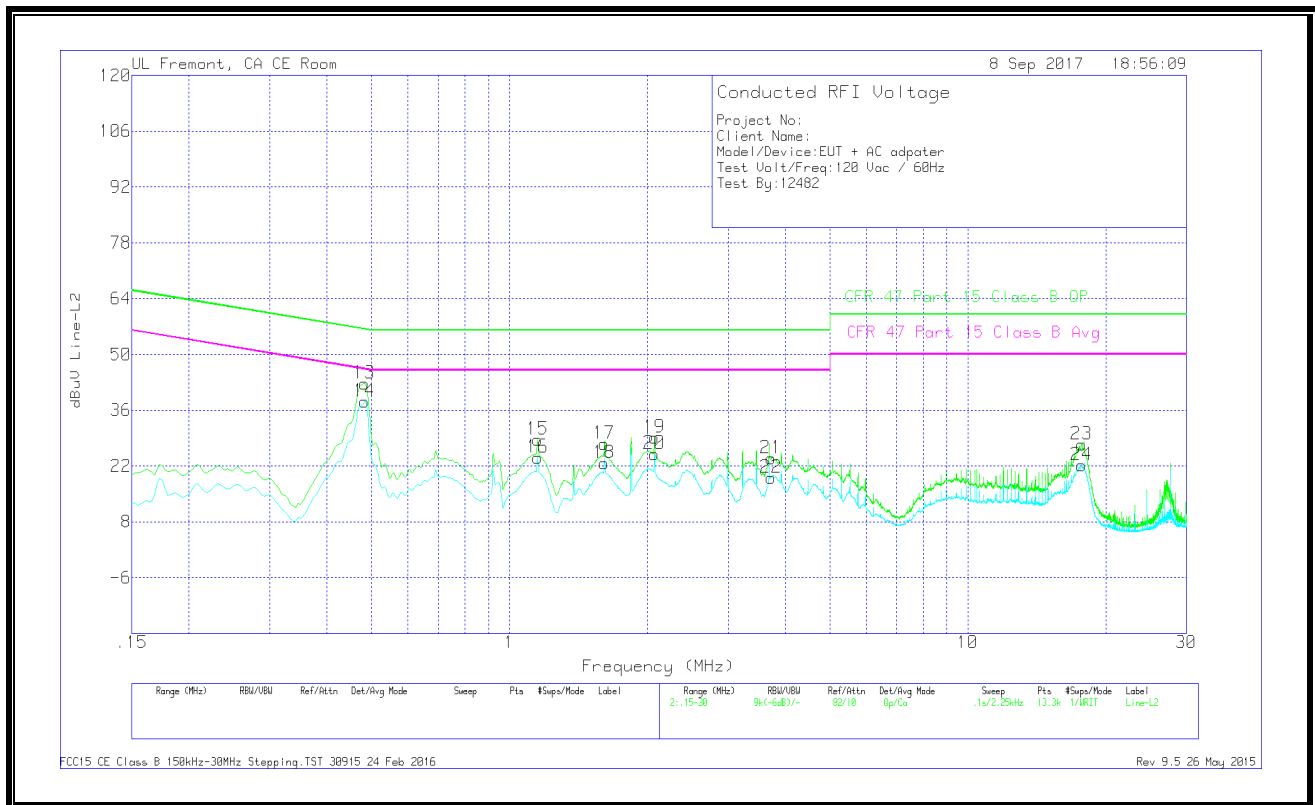
WORST EMISSIONS

Range 1: Line-L1 .15 - 30MHz											
Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	LISN L1	LC Cables C1&C3	Limiter (dB)	Corrected Reading dBuV	CFR 47 Part 15 Class B QP	QP Margin (dB)	CFR 47 Part 15 Class B Avg	Av(CISPR) Margin (dB)
1	.483	33.8	Qp	0	.1	10.1	44	56.29	-12.29	-	-
2	.483	29.29	Ca	0	.1	10.1	39.49	-	-	46.29	-6.8
3	1.15125	17.96	Qp	0	.1	10.1	28.16	56	-27.84	-	-
4	1.15125	13.55	Ca	0	.1	10.1	23.75	-	-	46	-22.25
5	1.6125	17.84	Qp	0	.1	10.1	28.04	56	-27.96	-	-
6	1.6125	13.36	Ca	0	.1	10.1	23.56	-	-	46	-22.44
7	2.07375	18.63	Qp	0	.1	10.1	28.83	56	-27.17	-	-
8	2.07375	14.57	Ca	0	.1	10.1	24.77	-	-	46	-21.23
9	3.687	16.74	Qp	0	.1	10.1	26.94	56	-29.06	-	-
10	3.687	12.38	Ca	0	.1	10.1	22.58	-	-	46	-23.42
11	17.8148	13.9	Qp	0	.3	10.3	24.5	60	-35.5	-	-
12	17.8193	8.96	Ca	0	.3	10.3	19.56	-	-	50	-30.44

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 C2&C3	Limiter (dB)	Corrected Reading dBuV	CFR 47 Part 15 Class B QP	QP Margin (dB)	CFR 47 Part 15 Class B Avg	Av(CISPR) Margin (dB)
13	.483	32.54	Qp	0	.1	10.1	42.74	56.29	-13.55	-	-
14	.483	28.02	Ca	0	.1	10.1	38.22	-	-	46.29	-8.07
15	1.15125	18.34	Qp	0	.1	10.1	28.54	56	-27.46	-	-
16	1.15125	13.98	Ca	0	.1	10.1	24.18	-	-	46	-21.82
17	1.61025	17.39	Qp	0	.1	10.1	27.59	56	-28.41	-	-
18	1.61025	12.55	Ca	0	.1	10.1	22.75	-	-	46	-23.25
19	2.07375	18.9	Qp	0	.1	10.1	29.1	56	-26.9	-	-
20	2.07375	14.85	Ca	0	.1	10.1	25.05	-	-	46	-20.95
21	3.7185	13.79	Qp	0	.1	10.1	23.99	56	-32.01	-	-
22	3.71963	8.93	Ca	0	.1	10.1	19.13	-	-	46	-26.87
23	17.7248	16.96	Qp	0	.2	10.3	27.46	60	-32.54	-	-
24	17.7045	11.73	Ca	0	.2	10.3	22.23	-	-	50	-27.77

Qp - Quasi-Peak detector

Ca - CISPR average detection

END OF REPORT