FCC 47 CFR PART 15 SUBPART C
ISED CANADA RSS-247 ISSUE 2

CERTIFICATION TEST REPORT

FOR

WIRELESS HEADSET

MODEL NUMBER: AP2

FCC ID: A94AP2
IC: 3232A-AP2

REPORT NUMBER: R11777487-E1

ISSUE DATE: 2017-08-15

Prepared for
BOSE CORPORATION
100 THE MOUNTAIN
FRAMINGHAM, MA 01701 USA

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NVLAP TESTING

NVLAP LAB CODE 200246-0

Revision History

Ver.	Issue Date	Revisions	Revised By
1	2017-08-04	Initial Issue	Brian Kiewra
2	2017-08-15	Revised Description in Sections 5.1 and 8.1 Corrected limit in Section 8.2.5 Revised title in plot on p.93	Brian Kiewra

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1. ATTESTATION OF TEST RESULTS

COMPANY NAME: Bose Corporation
100 The Mountain
Framingham, MA 01701 USA

EUT DESCRIPTION: Wireless Headset

MODEL: AP2

SERIAL NUMBER: Non-Serialized

DATE TESTED: 2017-06-28 to 2017-07-11

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

UL LLC 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 LLC 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 LLC and all revisions are duly noted in the revisions section. Any alteration of this document not carried out by UL LLC 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, or any agency of the U.S. Government.

Approved & Released
For UL LLC By:

Jeffrey Moser
Operations Leader
UL – Consumer Technology Division

Prepared By:

Brian Kiewra
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UL – Consumer Technology Division

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, RSS-247 Issue 2.

3. FACILITIES AND ACCREDITATION

The test sites and measurement facilities used to collect data are located at 12 Laboratory Dr., Research Triangle Park, NC 27709, USA and 2800 Perimeter Park Dr., Suite B, Morrisville, NC 27560, USA.

12 Laboratory Dr., RTP, NC 27709
☐ Chamber A
☐ Chamber C

2800 Suite B Perimeter Park Dr., Morrisville, NC 27560
☒ Chamber NORTH
☒ Chamber SOUTH

The onsite chambers are covered under Industry Canada company address code 2180C with site numbers 2180C -1 through 2180C-4, respectively.

UL LLC (RTP) is accredited by NVLAP, Laboratory Code 200246-0. The full scope of accreditation can be viewed at http://www.nist.gov/nvlap/.

4. CALIBRATION AND UNCERTAINTY

4.1. MEASURING INSTRUMENT CALIBRATION

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

4.2. SAMPLE CALCULATION

Where relevant, the following sample calculation is provided:

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

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

4.3. MEASUREMENT UNCERTAINTY

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

PARAMETER	UNCERTAINTY	Required by standard
Occupied Channel Bandwidth	2.00%	±5 %
RF output power, conducted	1.3 dB	±1,5 dB
Power Spectral Density, conducted	2.47 dB	±3 dB
Unwanted Emissions, conducted	2.94 dB	±3 dB
All emissions, radiated	5.36 dB	±6 dB
Temperature	2.26 °C	±3 °C
Supply voltages	2.40%	±3 %
Time	3.39%	±5 %

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

5. EQUIPMENT UNDER TEST

5.1. ESCRIPTION OF EUT

The EUT is a wireless headset.

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	9.96	9.91
2402 - 2480	DQPSK	8.49	7.06
2402 - 2480	Enhanced 8PSK	8.79	7.57

5.3. DESCRIPTION OF AVAILABLE ANTENNAS

The radio utilizes an antenna with a maximum gain of +2.9 dBi.

5.4. SOFTWARE AND FIRMWARE

The firmware installed in the EUT during testing was ver 1.1.9.424.
The EUT driver software installed in the host support equipment during testing was 2.4.0.0
The test utility software used during testing was CSR BlueSuite, rev. 2.6.4.

5.5. WORST-CASE CONFIGURATION AND MODE

Radiated emissions 1-18GHz were performed with the EUT set to transmit on low, mid, and high channels. Radiated emissions 9kHz – 1000MHz and 18-26GHz were performed with the EUT set to transmit at the channel with highest output power as worst-case scenario.

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

For Enhanced Data rate modes, 8DPSK is considered worst-case and only select tests were performed for the DQPSK mode. Additionally, unless noted in the test report, all tests were performed with the DH5 packet size as this was considered worst-case.

5.6. DESCRIPTION OF TEST SETUP

SUPPORT EQUIPMENT

Support Equipment List				
Description	**Manufacturer**	**Model**	**Serial Number**	**FCC ID**
Laptop	Lenovo	T450s	PC-0A2UQS 16/01	NA
Power Supply	Lenovo	ADLX65NLC2A	11S45N0259Z1Z9743D21T	NA

I/O CABLES

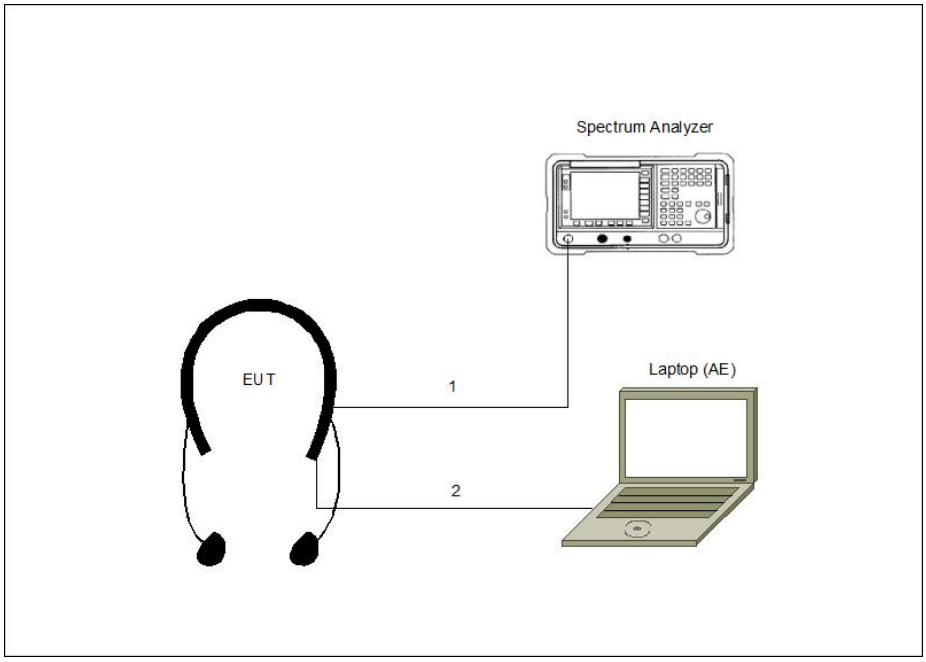
I/O Cable List						
Cable No.	**Port**	**# of Identical Ports**	**Connector Type**	**Cable Type**	**Cable Length (m)**	**Remarks**
1	Antenna	1	SMA	RF	<3m	None
2	USB	1	µUSB	USB	<3m	Used to configure EUT

TEST SETUP

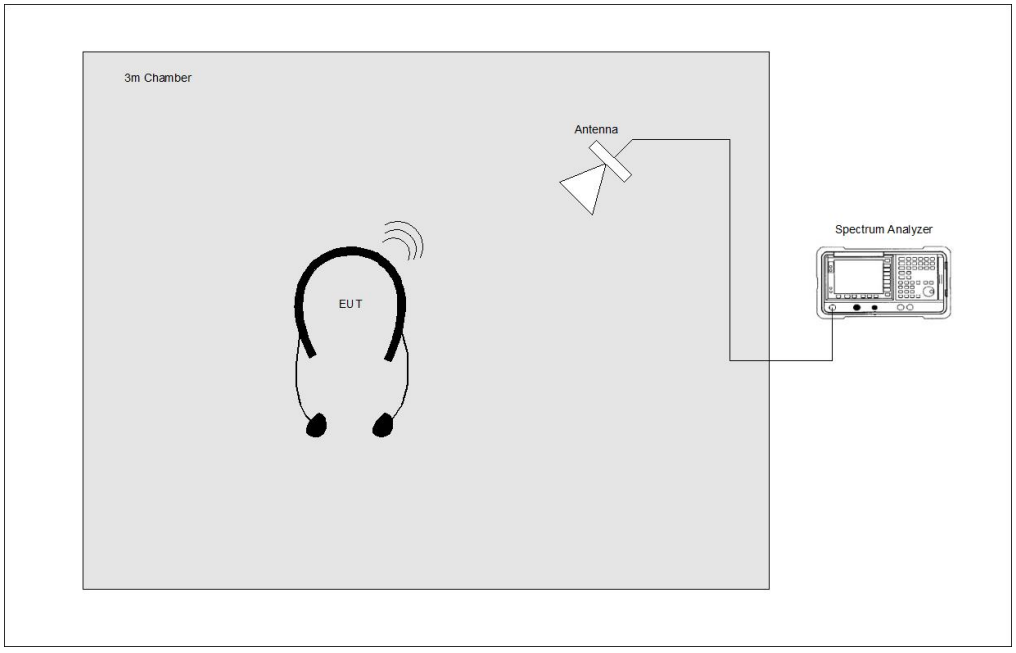
The EUT is setup as a standalone device

SETUP DIAGRAM FOR TESTS

Conducted Setup



Radiated Setup



6. TEST AND MEASUREMENT EQUIPMENT

The following test and measurement equipment was utilized for the tests documented in this report:

Test Equipment Used - Radiated Disturbance Emissions Test Equipment (Morrisville - North Chamber)

Equip. ID	Description	Manufacturer	Model Number	Last Cal.	Next Cal.
	0.009-30MHz	**(Loop Ant.)**			
AT0079	Active Loop Antenna	ETS-Lindgren	6502	2016-12-28	2017-12-31
	1-18 GHz				
AT0072	Double-Ridged Waveguide Horn Antenna, 1 to 18 GHz	ETS Lindgren	3117	2017-04-05	2018-04-05
	Gain-Loss Chains				
N-SAC01	Gain-loss string: 0.009-30MHz	Various	Various	2016-10-04	2017-10-04
N-SAC03	Gain-loss string: 1-18GHz	Various	Various	2016-08-28	2017-08-28
	Receiver & Software				
SA0027	Spectrum Analyzer	Agilent	N9030A	2017-03-16	2018-03-16
SOFTEMI	EMI Software	UL	Version 9.5	NA	NA
	Additional Equipment used				
s/n 161024690	Environmental Meter	Fisher Scientific	15-077-963	2016-12-21	2018-12-21

Test Equipment Used - Wireless Conducted Measurement Equipment

Equipment ID	Description	Manufacturer	Model Number	Last Cal.	Next Cal.
	Conducted Room 2				
SA0020	Spectrum Analyzer	Agilent Technologies	E4446A	2017-04-25	2018-04-25
PWM005	RF Power Meter	Keysight Technologies	N1911A	2017-05-18	2018-05-18
PWS005	Peak and Avg Power Sensor, 50MHz to 6GHz	Keysight Technologies	E9323A	2017-05-18	2018-05-18
15557603	Temp/Humidity Sensor	Fisher Scientific	14-650-118	2016-11-02	2018-11-02

Test Equipment Used - Radiated Disturbance Emissions Test Equipment (Morrisville - South Chamber)

Equip. ID	Description	Manufacturer	Model Number	Last Cal.	Next Cal.
	30-1000 MHz				
AT0074	Hybrid Broadband Antenna	Sunol Sciences Corp.	JB3	2017-06-15	2018-06-15
	1-18 GHz				
AT0069	Double-Ridged Waveguide Horn Antenna, 1 to 18 GHz	ETS Lindgren	3117	2017-04-05	2018-04-05
	18-40 GHz				
AT0076	Horn Antenna, 18-26.5GHz	ARA	MWH-1826/B	2016-09-06	2017-09-06
AT0077	Horn Antenna, 26-40GHz	ARA	MWH-2640/B	2016-09-06	2017-09-06
	Gain-Loss Chains				
S-SAC02	Gain-loss string: 30-1000MHz	Various	Various	2017-06-11	2018-06-11
S-SAC03	Gain-loss string: 1-18GHz	Various	Various	2016-08-28	2017-08-28
S-SAC04	Gain-loss string: 18-40GHz	Various	Various	2017-03-03	2018-03-03
	Receiver & Software				
SA0025	Spectrum Analyzer	Agilent	N9030A	2017-04-10	2018-04-10
SA0026 (18-40GHz RSE)	Spectrum Analyzer	Agilent	N9030A	2017-02-17	2018-02-28
SOFTEMI	EMI Software	UL	Version 9.5	NA	NA
	Additional Equipment used				
s/n 161024887	Environmental Meter	Fisher Scientific	15-077-963	2016-12-23	2018-12-23

7. MEASUREMENT METHODS

Duty Cycle: KDB 558074 Zero-Span Spectrum Analyzer Method

20 dB BW: ANSI C63.10 Section 6.9.2.

99% Occupied Bandwidth: ANSI C63.10-2013, 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

Out-of-band emissions in non-restricted bands: ANSI C63.10 Section 7.8.6 & 7.8.8

Out-of-band emissions in restricted bands: ANSI C63.10:2013 Sections 6.3-6.6

8. ANTENNA PORT TEST RESULTS

8.1. ON TIME AND DUTY CYCLE

LIMITS

None; for reporting purposes only.

PROCEDURE

KDB 558074 Zero-Span Spectrum Analyzer Method.

ON TIME AND DUTY CYCLE RESULTS

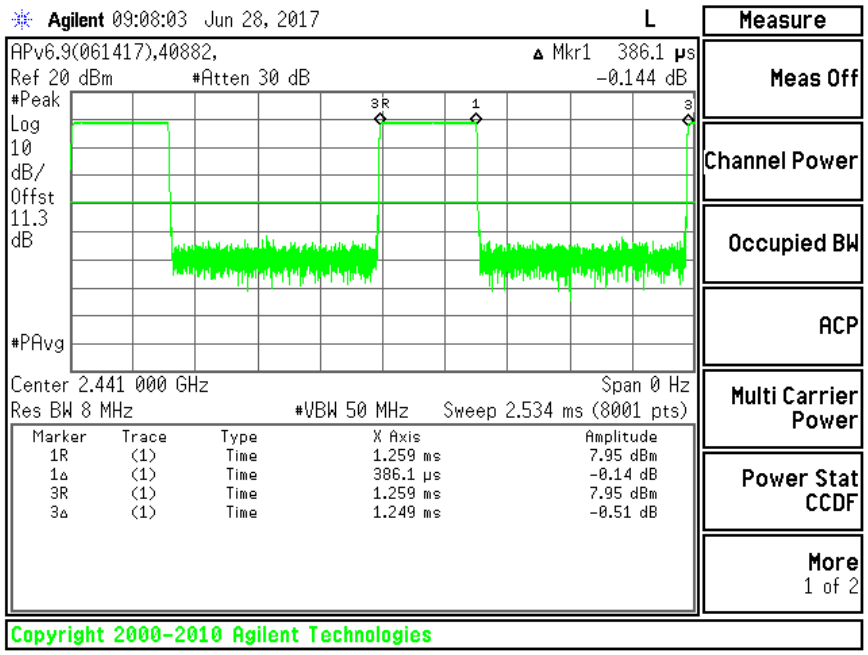
Mode	ON Time B (msec)	Period (msec)	Duty Cycle x (linear)	Duty Cycle (%)	Duty Cycle Correction Factor (dB)	1/B Minimum VBW (kHz)
2.4 GHz band (Hopping OFF)						
GFSK	0.386	1.249	0.309	30.91%	5.10	2.590
8PSK	0.401	1.249	0.321	32.13%	4.93	2.492

TEST INFORMATION

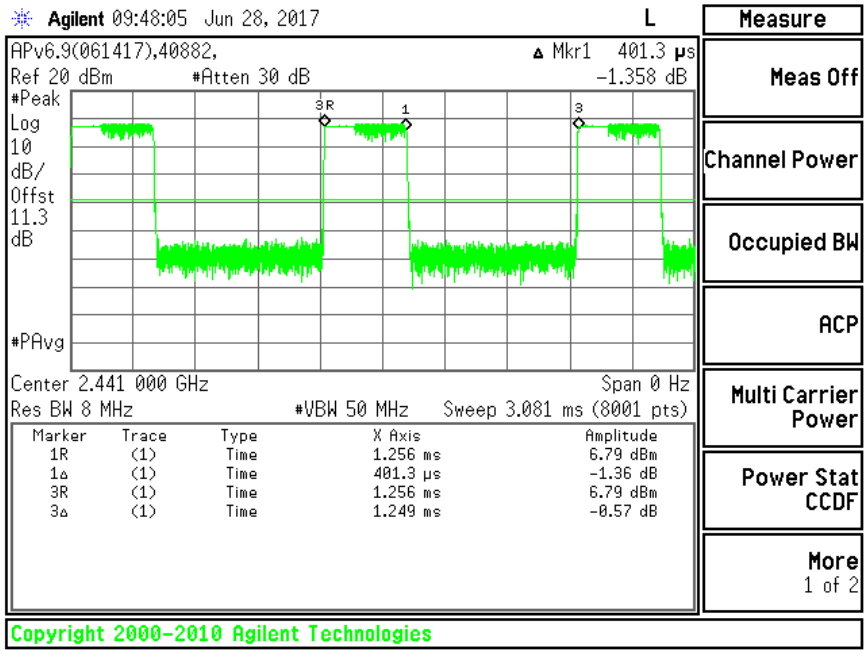
Date: 2017-06-28
Tester: Jeffrey Cabrera

DUTY CYCLE PLOTS

DUTY CYCLE GFSK MODE



DUTY CYCLE 8PSK MODE



8.2. BASIC DATA RATE GFSK MODULATION

8.2.1. 20 dB AND 99% BANDWIDTH

LIMIT

None; for reporting purposes only. Test per FCC §15.247(a)(1); IC RSS-247 5.1 (1), RSS-Gen 6.6.

TEST PROCEDURE

The transmitter output is connected to a spectrum analyzer. The RBW is set to 1%-5% of the 20 dB bandwidth and 99% Occupied Bandwidth. The VBW is set to ≥ RBW. The sweep time is coupled.

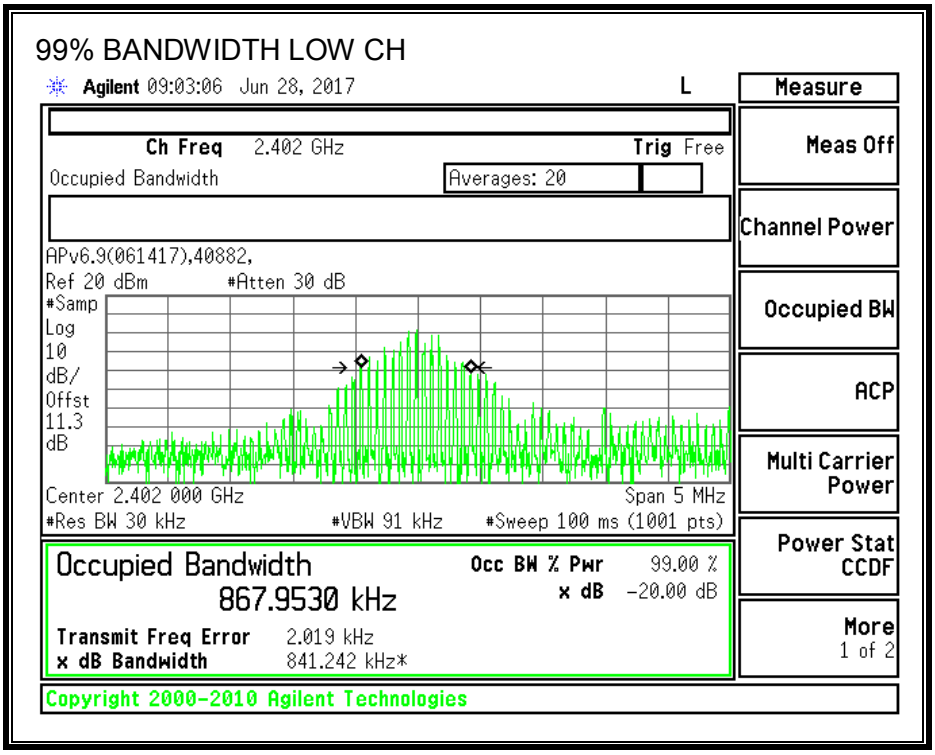
RESULTS

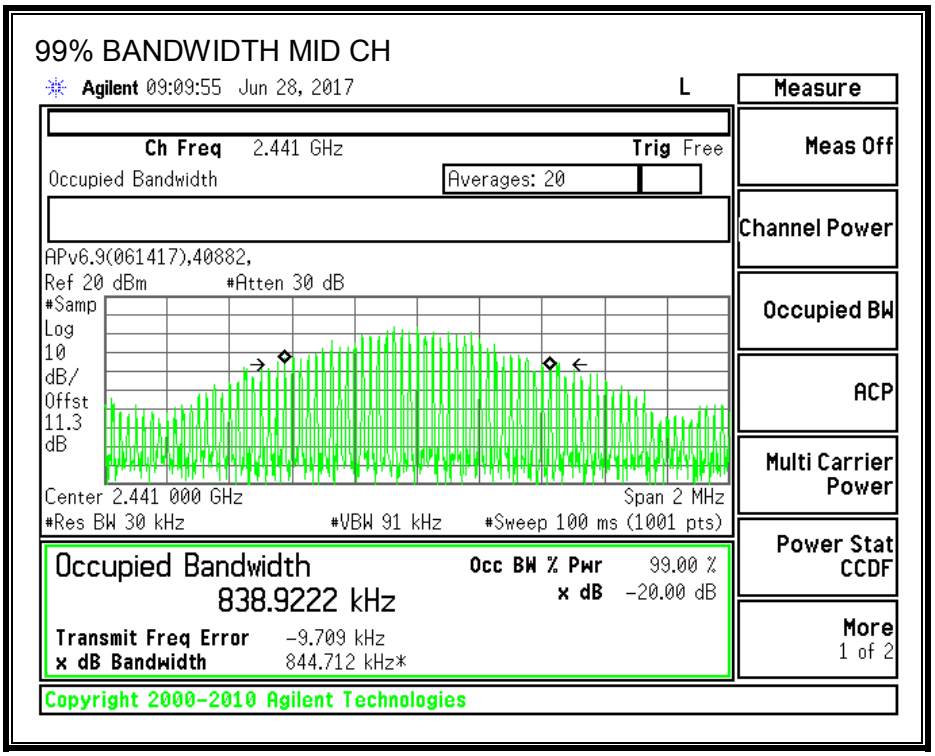
Channel	Frequency (MHz)	20 dB Bandwidth (kHz)	99% Bandwidth (kHz)
Low	2402	920.000	867.953
Middle	2441	852.000	838.9222
High	2480	892.000	849.0463

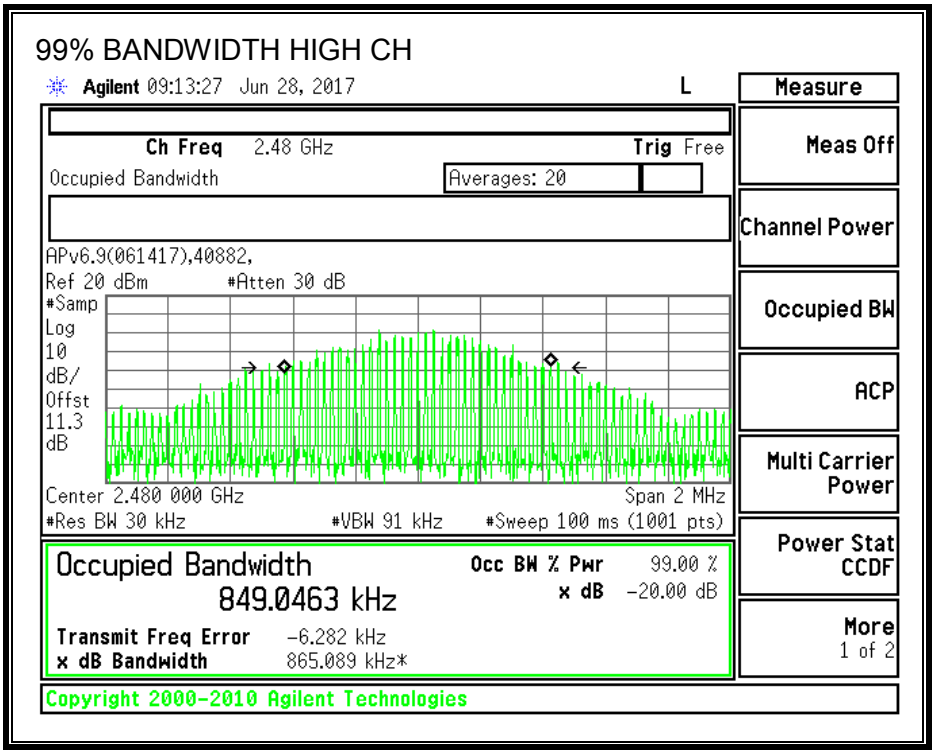
TEST INFORMATION

Date: 2017-06-28
Tester: Jeffrey Cabrera

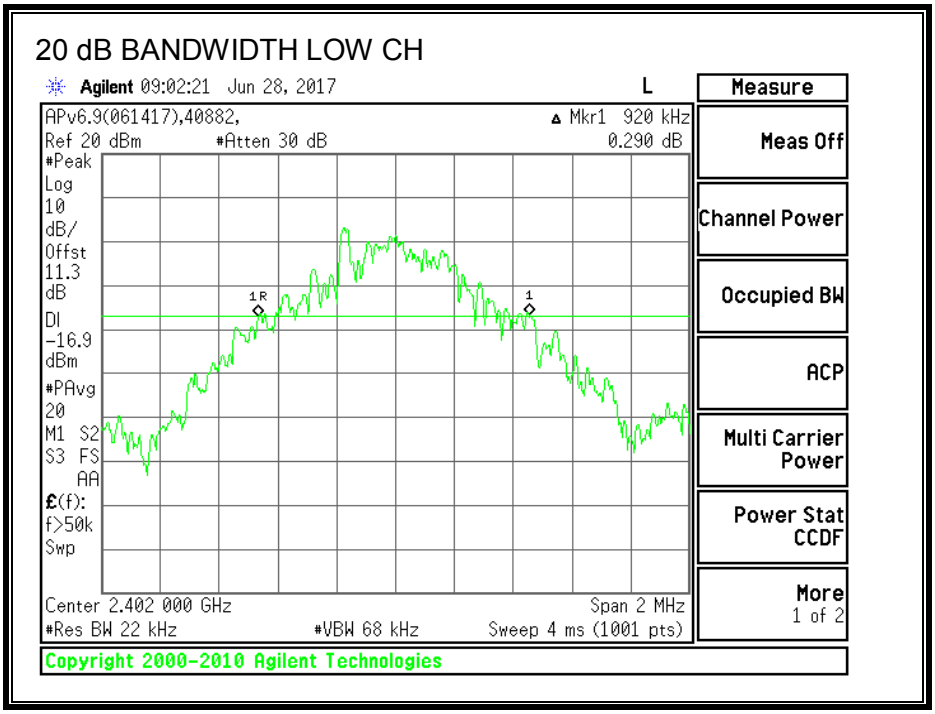
99% BANDWIDTH



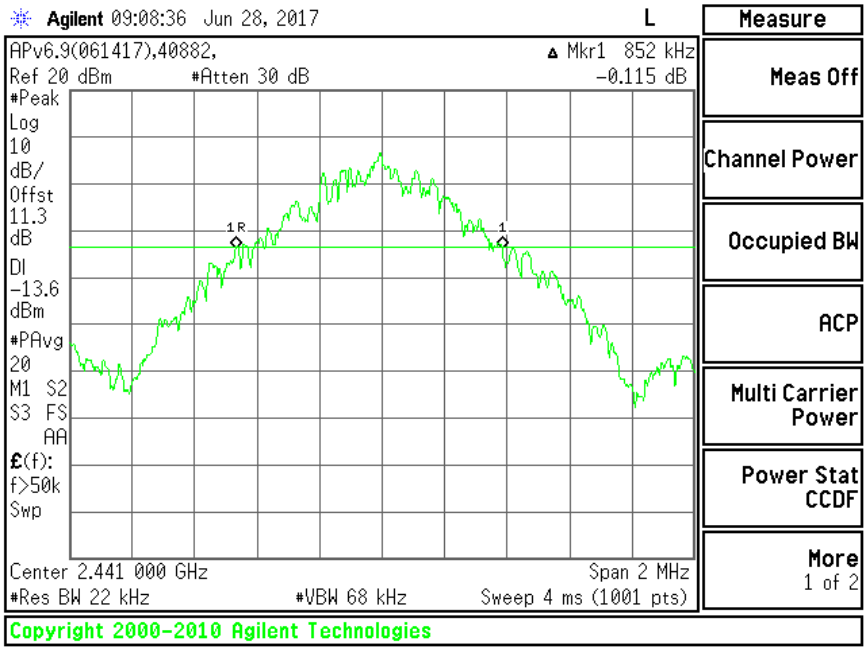




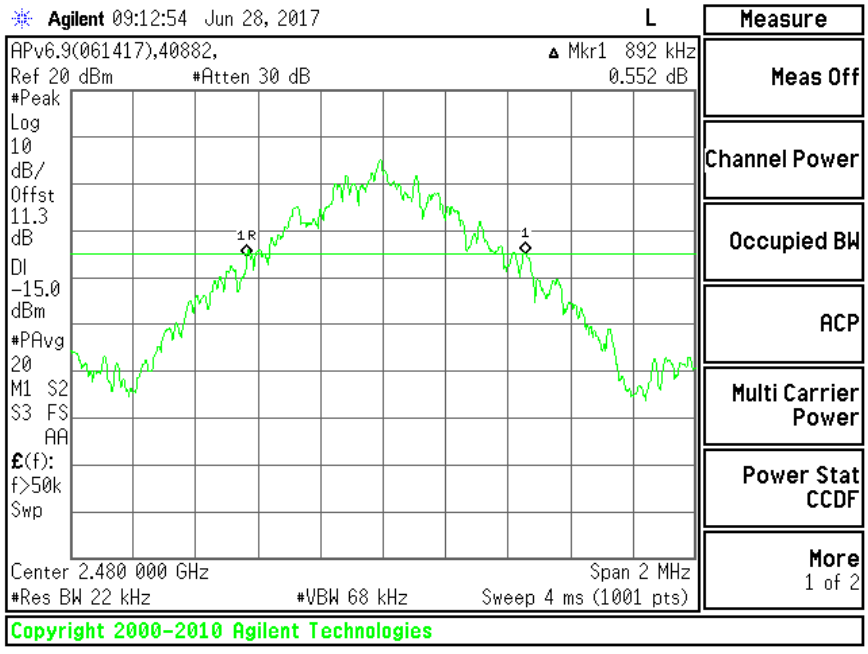
20 dB BANDWIDTH



20 dB BANDWIDTH MID CH



20 dB BANDWIDTH HIGH CH



8.2.2. HOPPING FREQUENCY SEPARATION

LIMIT

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 hoping channel, whichever is greater.

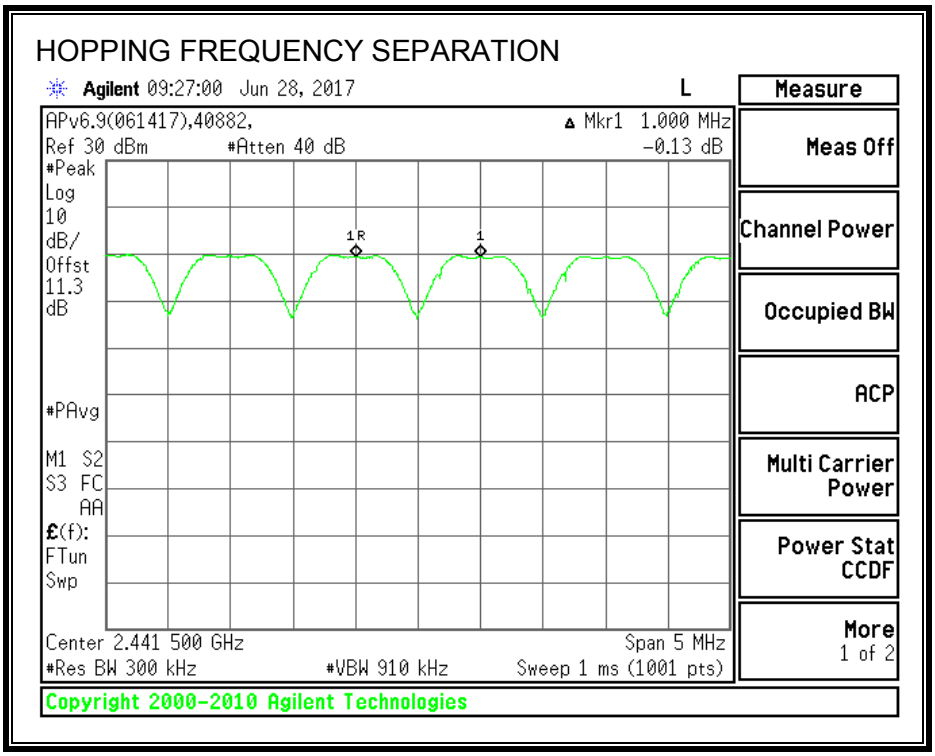
Alternatively, frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than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

RESULTS

HOPPING FREQUENCY SEPARATION



Ch. A (MHz)	Ch. B (MHz)	Ch. 1 to Ch. 2 Sep. (MHz)	Max. 20 dB BW (MHz)	Margin (MHz)
2441	2442	1.000	0.920	-0.080

TEST INFORMATION

Date: 2017-06-28

Tester: Jeffrey Cabrera

8.2.3. NUMBER OF HOPPING CHANNELS

LIMIT

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 for visibility of the entire span. Then, smaller spans are set to more clearly identify the channels.The RBW is set to 30% of the channel spacing (approx. 300kHz). The analyzer is set to Max Hold.

RESULTS

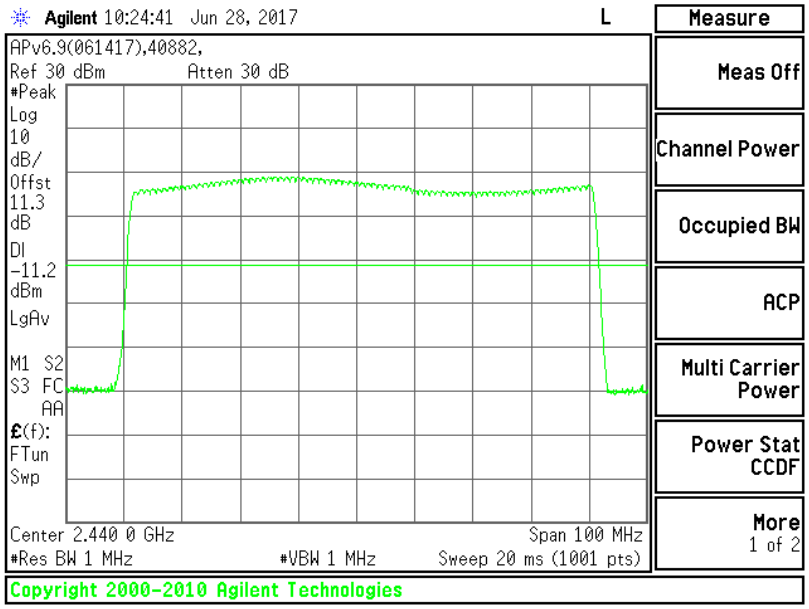
Normal Mode: 79 Channels observed.
AFH Mode: 20 Channels minimum declared.

TEST INFORMATION

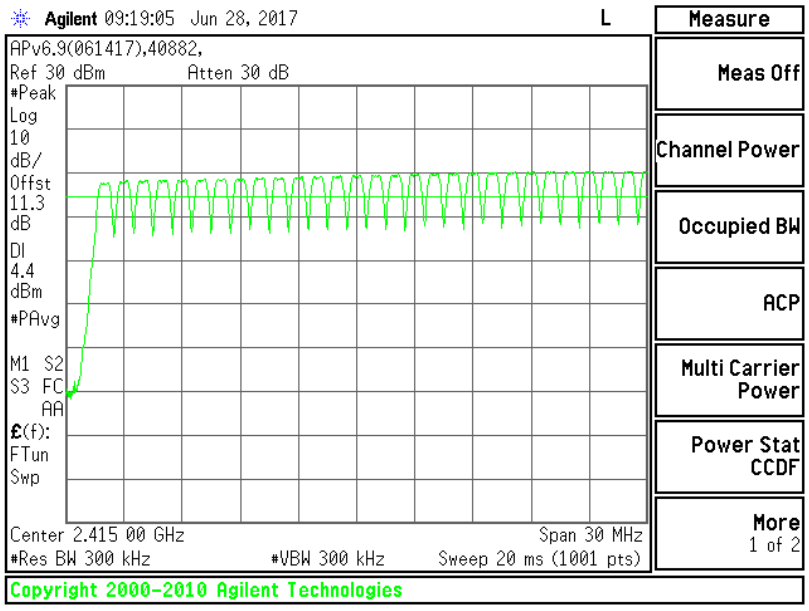
Date: 2017-06-28
Tester: Jeffrey Cabrera

NUMBER OF HOPPING CHANNELS

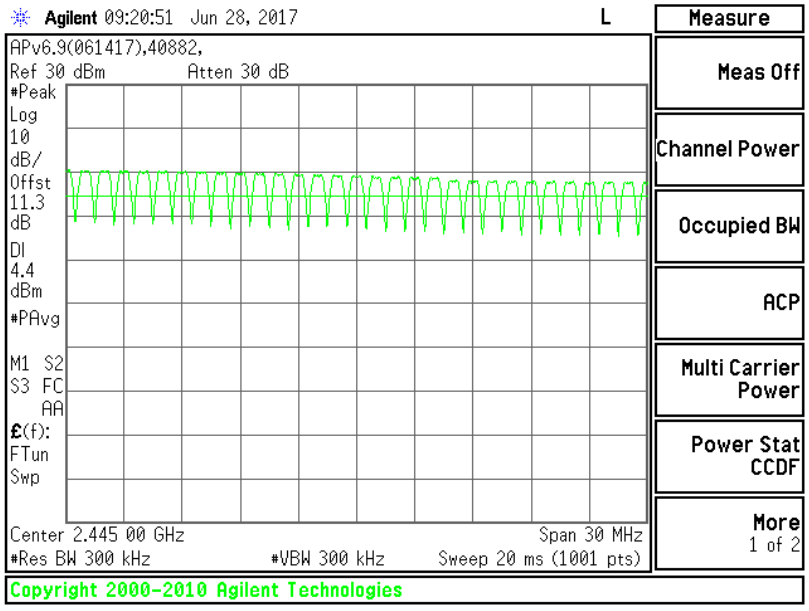
NUMBER OF HOPPING CHANNELS (100 MHZ SPAN)



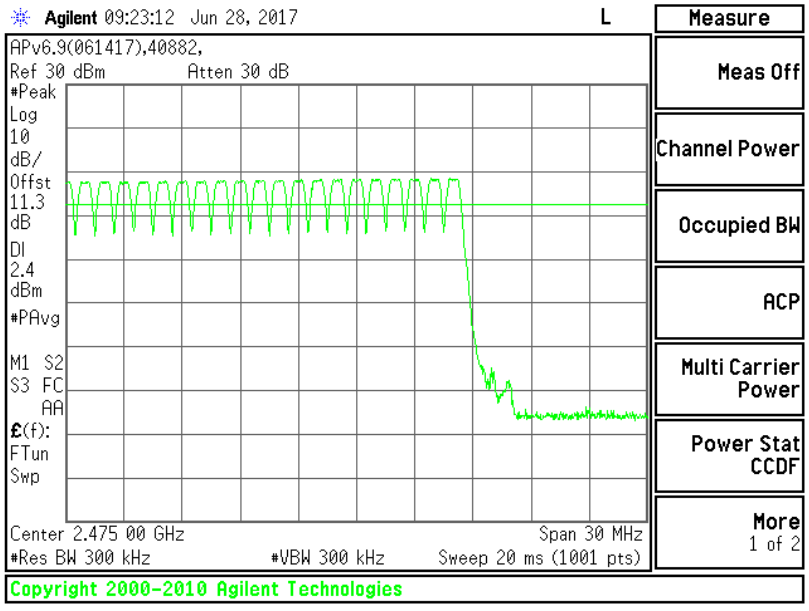
NUMBER OF HOPPING CHANNELS (30 MHZ SPAN, FIRST SEGMENT)



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



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



8.2.4. AVERAGE TIME OF OCCUPANCY

LIMIT

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 * (# of pulses in 3.16 s) * 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 * (# of pulses in 0.8 s) * pulse width.

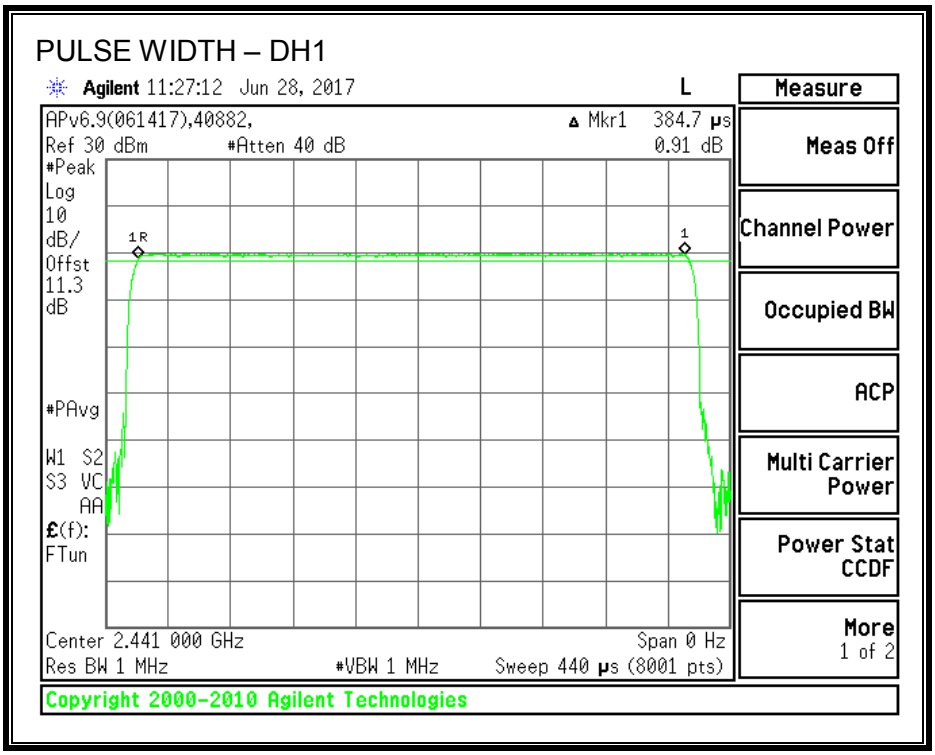
RESULTS

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	0.3847	32	0.123	0.4	-0.277
DH3	1.636	16	0.262	0.4	-0.138
DH5	2.881	11	0.317	0.4	-0.083
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	0.3847	8	0.031	0.4	-0.369
DH3	1.636	4	0.065	0.4	-0.335
DH5	2.881	2.75	0.079	0.4	-0.321

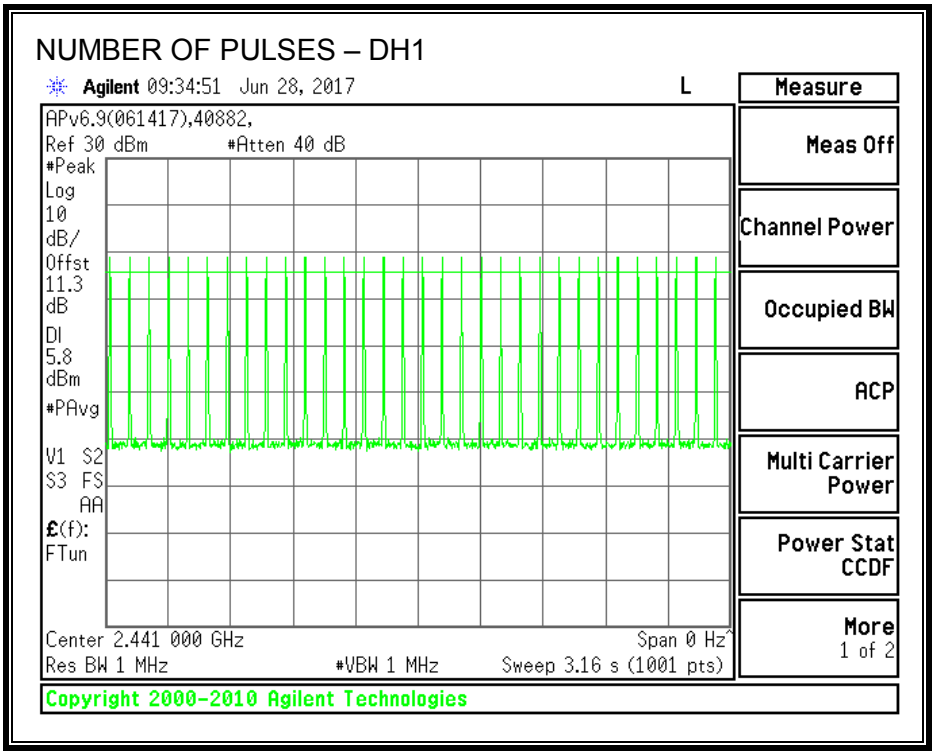
TEST INFORMATION

Date: 2017-06-28
Tester: Jeffrey Cabrera

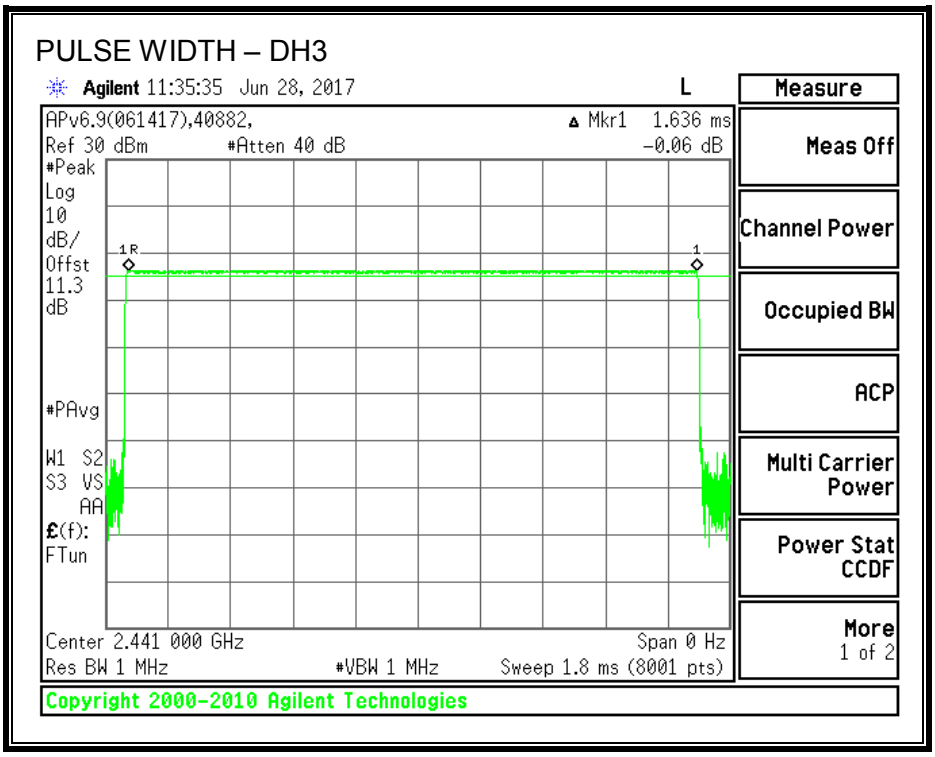
PULSE WIDTH - DH1



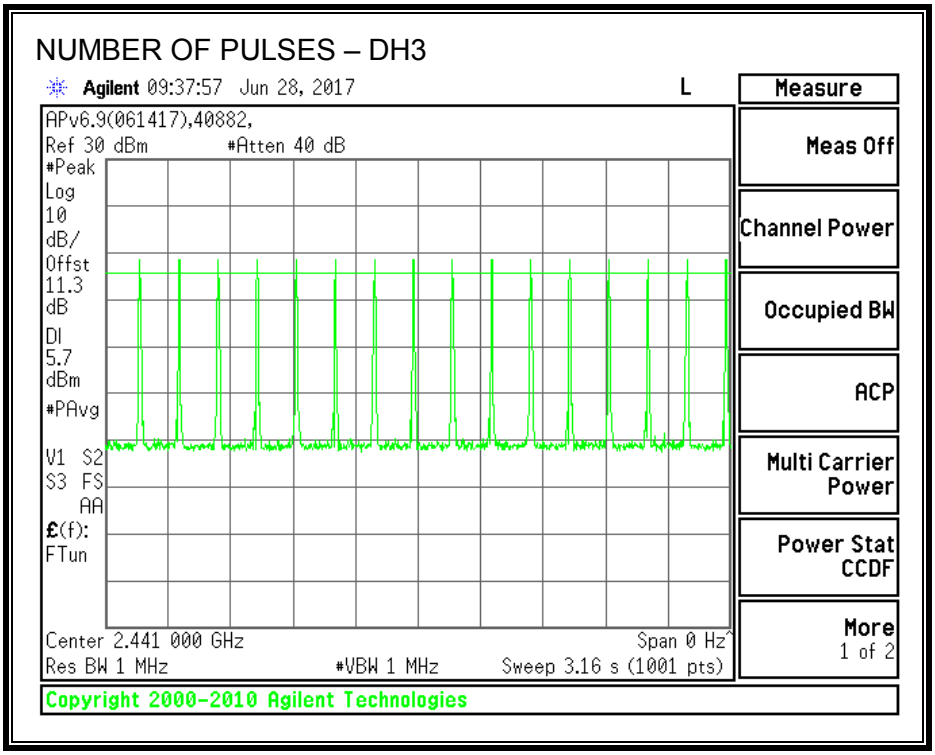
NUMBER OF PULSES IN 3.16 SECOND OBSERVATION PERIOD – DH1



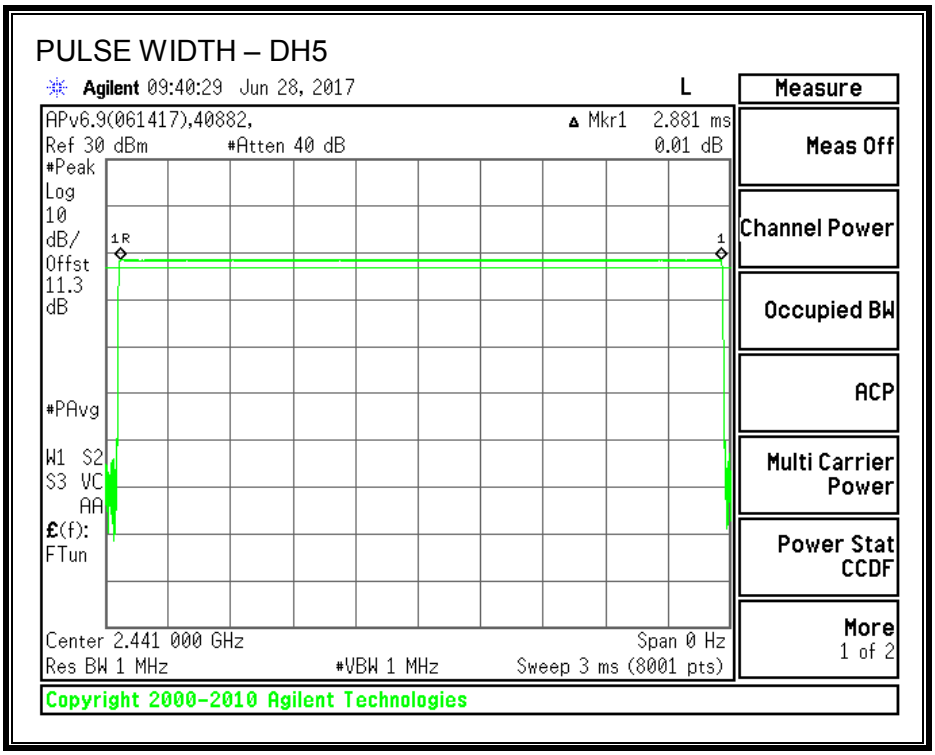
PULSE WIDTH – DH3



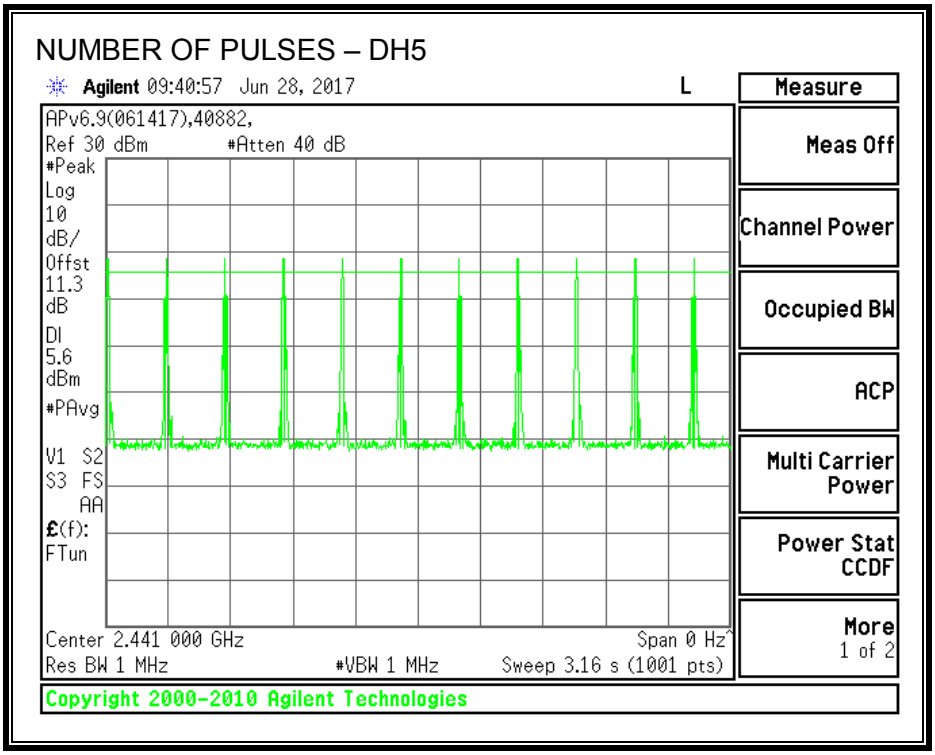
NUMBER OF PULSES IN 3.16 SECOND OBSERVATION PERIOD – DH3



PULSE WIDTH – DH5



NUMBER OF PULSES IN 3.16 SECOND OBSERVATION PERIOD – DH5



8.2.5. OUTPUT POWER

LIMIT

§15.247 (b) (1)

For frequency hopping systems operating in the 2400-2483.5 MHz band employing at least 75 non-overlapping hopping channels, and all frequency hopping systems in the 5725-5850 MHz band: 1 watt. For all other frequency hopping systems in the 2400-2483.5 MHz band: 0.125 watts.

RSS-247 5.4 (b)

For frequency hopping systems operating in the band 2400-2483.5 MHz and employing at least 75 hopping channels, the maximum peak conducted output power shall not exceed 1 W; for all other frequency hopping systems in the band, the maximum peak conducted output power shall not exceed 0.125 W.

TEST PROCEDURE

The transmitter output is connected to a spectrum analyzer the analyzer bandwidth is set to a value greater than the 20 dB bandwidth of the EUT.

RESULTS

Channel	Frequency (MHz)	Output Power (dBm)	Directional Gain (dBi)	Limit (dBm)	Margin (dB)
Low	2402	8.02	2.90	30	-21.98
Middle	2441	9.96	2.90	30	-20.04
High	2480	8.64	2.90	30	-21.36

TEST INFORMATION

Date: 2017-07-05
Tester: Jeffrey Cabrera

8.2.6. AVERAGE POWER

LIMIT

None; for reporting purposes only.

TEST PROCEDURE

The transmitter output is connected to a power meter.

RESULTS

The cable assembly insertion loss of 11.31 dB (including 10 dB pad and 1.31 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	7.68
Middle	2441	9.73
High	2480	9.36

TEST INFORMATION

Date: 2017-07-05
Tester: Jeffrey Cabrera

8.2.7. CONDUCTED SPURIOUS EMISSIONS

LIMITS

FCC §15.247 (d)

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

IC RSS-247 5.5
In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating, the RF power that is produced shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided that the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of root-mean-square averaging over a time interval, as permitted under Section A8.4 (4), the attenuation required shall be 30 dB instead of 20 dB. Attenuation below the general field strength limits specified in RSS-Gen is not required.

TEST PROCEDURE

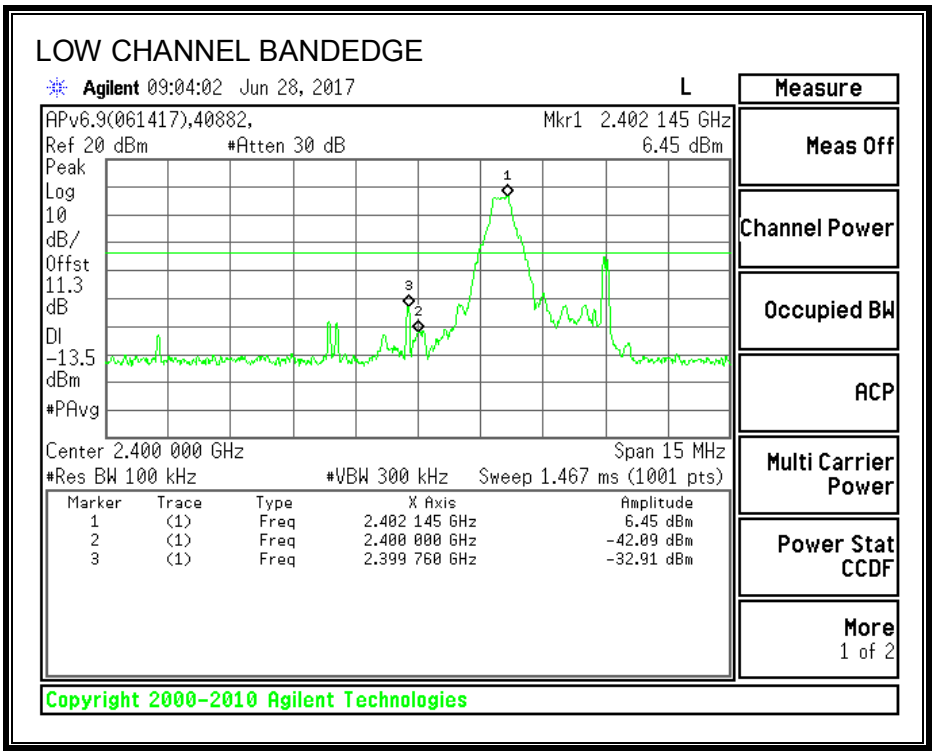
The transmitter output is connected to a spectrum analyzer. The resolution bandwidth is set to 100 kHz. The video bandwidth is set to 300 kHz.

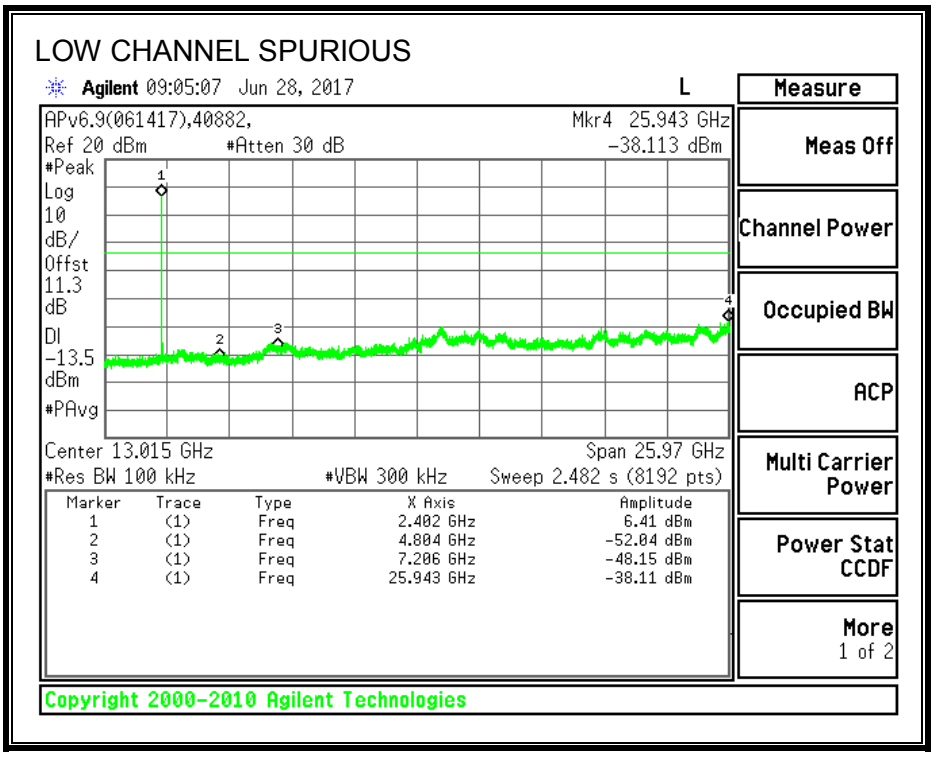
The spectrum from 30 MHz to 26 GHz is investigated with the transmitter set to the lowest, middle, and highest channels.

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

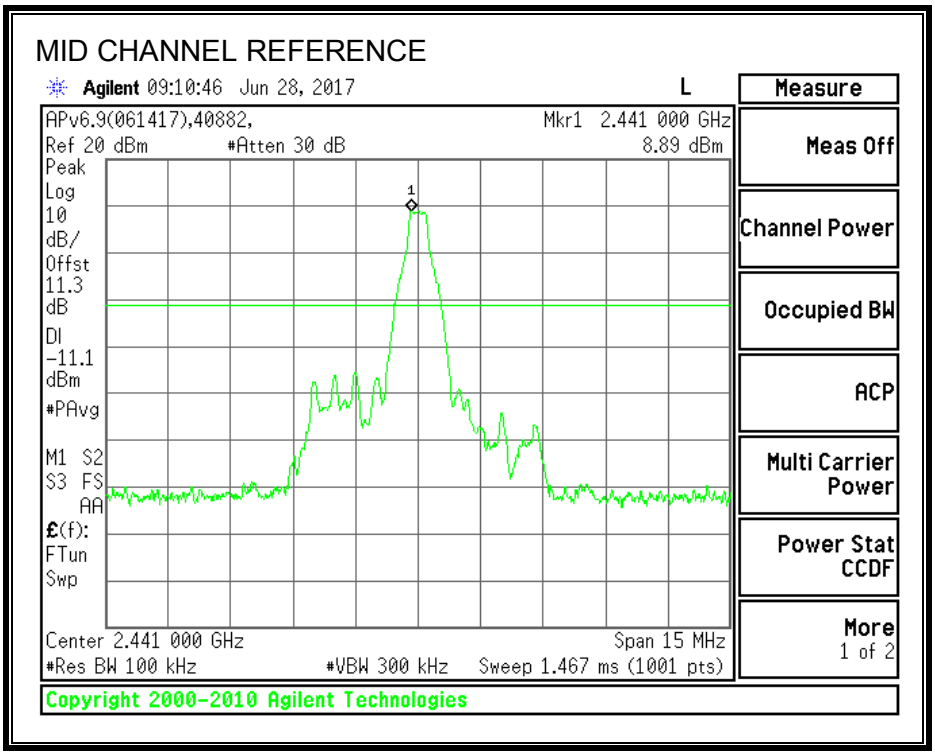
TEST INFORMATION
Date: 2017-06-28
Tester: Jeffrey Cabrera

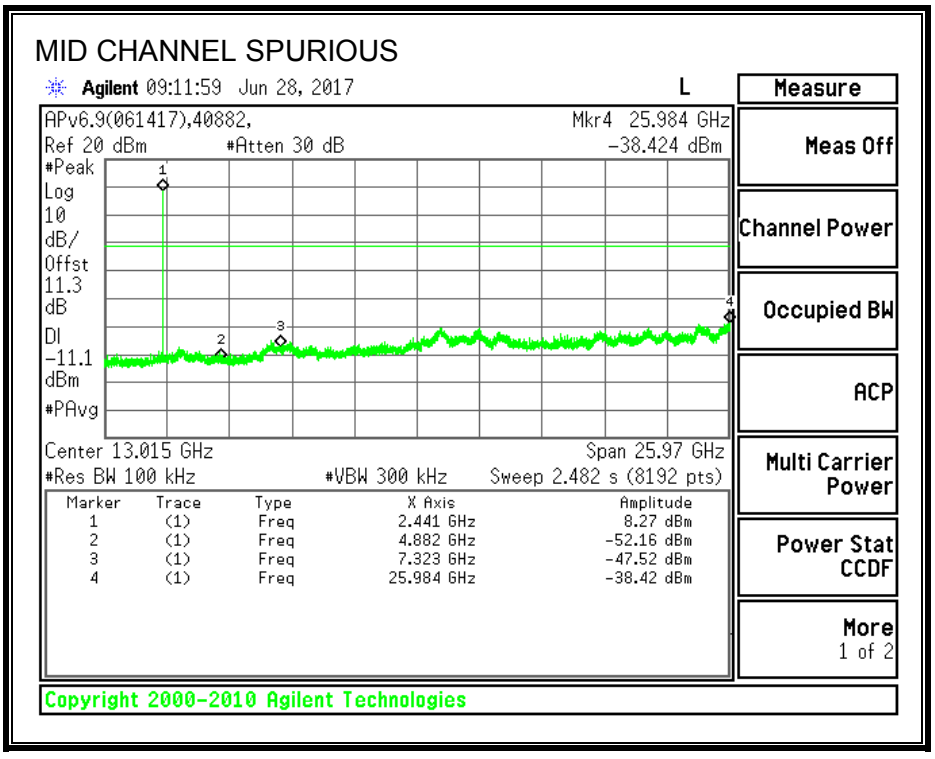
SPURIOUS EMISSIONS, LOW CHANNEL



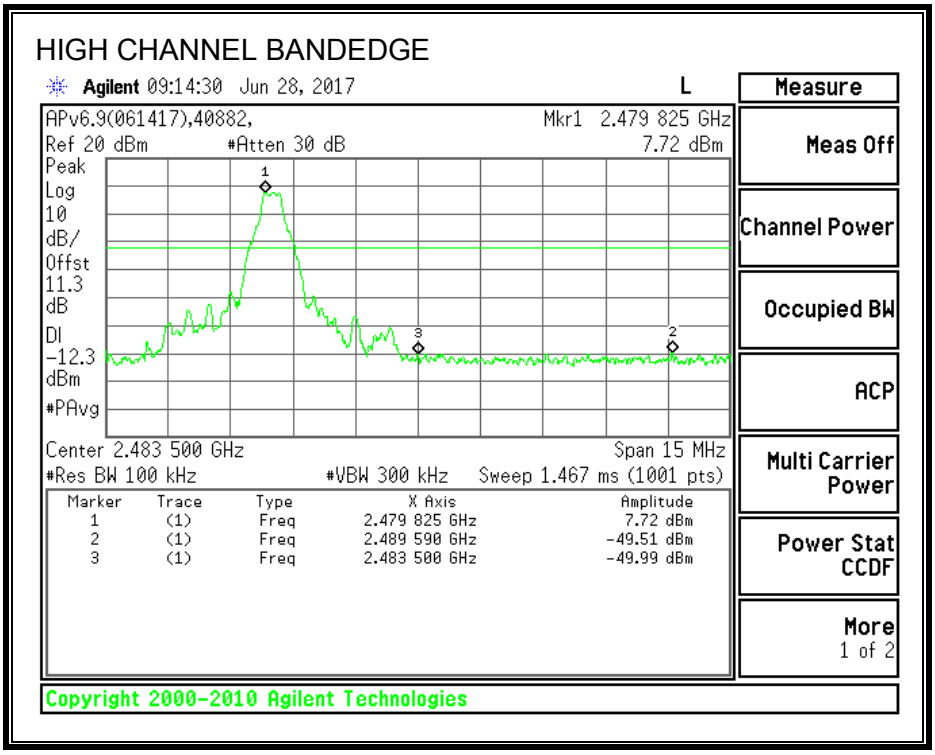


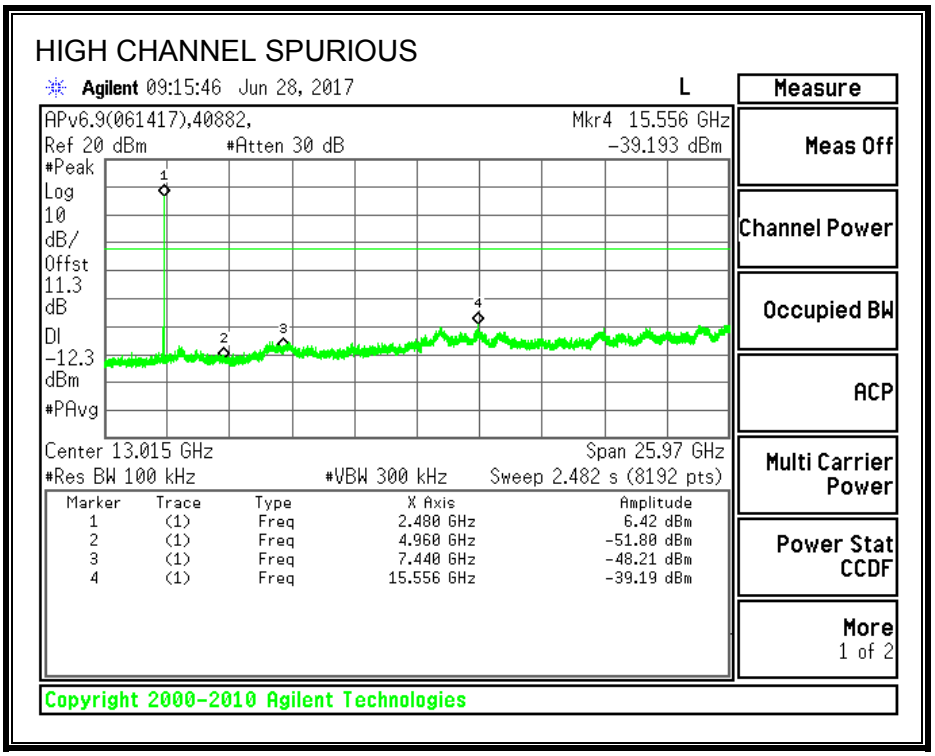
SPURIOUS EMISSIONS, MID CHANNEL





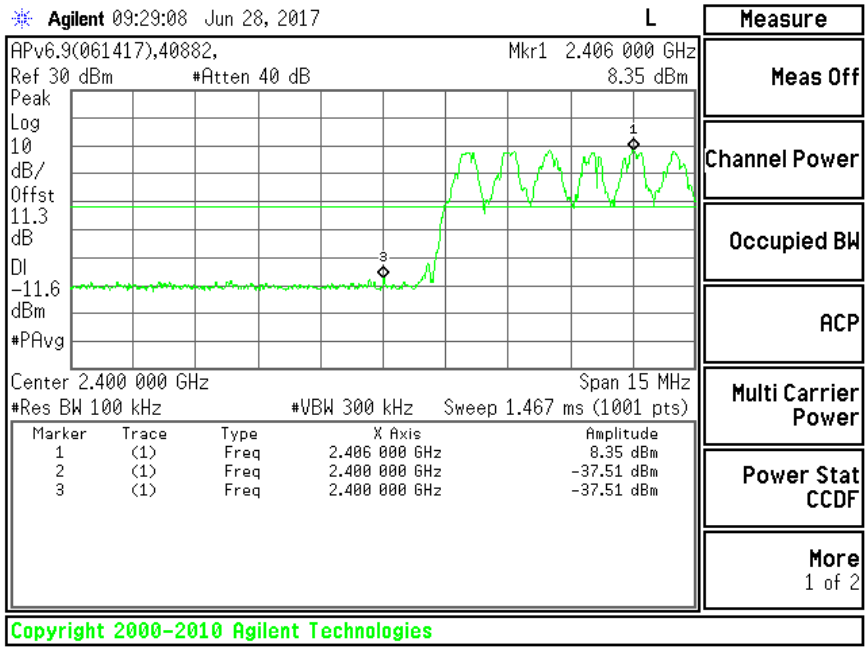
SPURIOUS EMISSIONS, HIGH CHANNEL



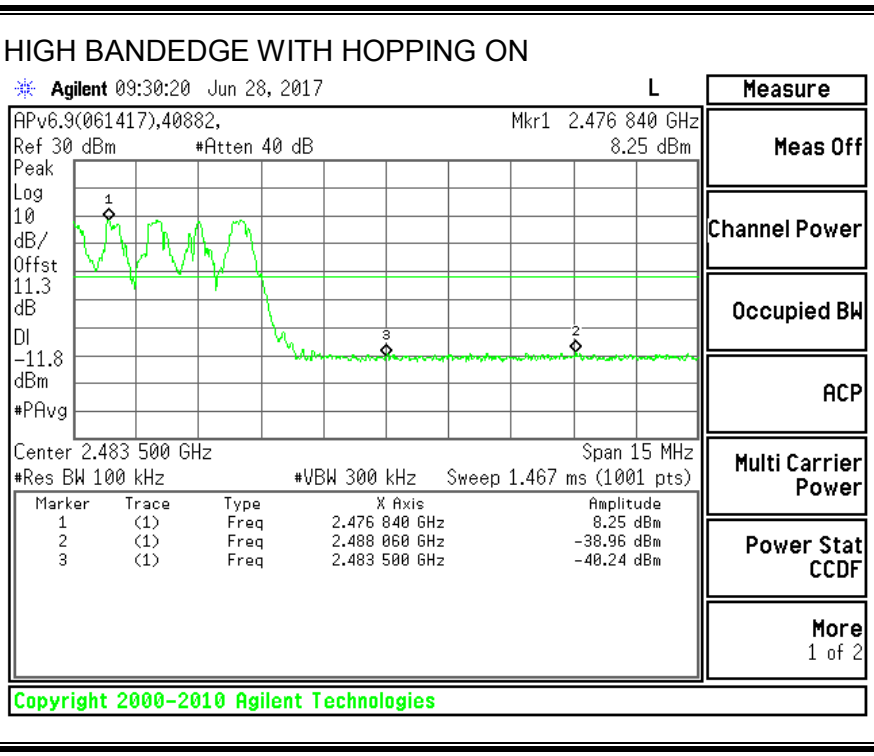


SPURIOUS BANDEDGE EMISSIONS WITH HOPPING ON

LOW BANDEDGE WITH HOPPING ON



HIGH BANDEDGE WITH HOPPING ON



8.3. ENHANCED DATA RATE QPSK MODULATION

8.3.1. 20 dB AND 99% BANDWIDTH

LIMIT

None; for reporting purposes only. Test per FCC §15.247(a)(1); IC RSS-247 5.1 (1), RSS-Gen 6.6.

TEST PROCEDURE

The transmitter output is connected to a spectrum analyzer. The RBW is set to 1-5% of the 20 dB bandwidth and 99% Occupied Bandwidth. The VBW is set to ≥ RBW. The sweep time is coupled.

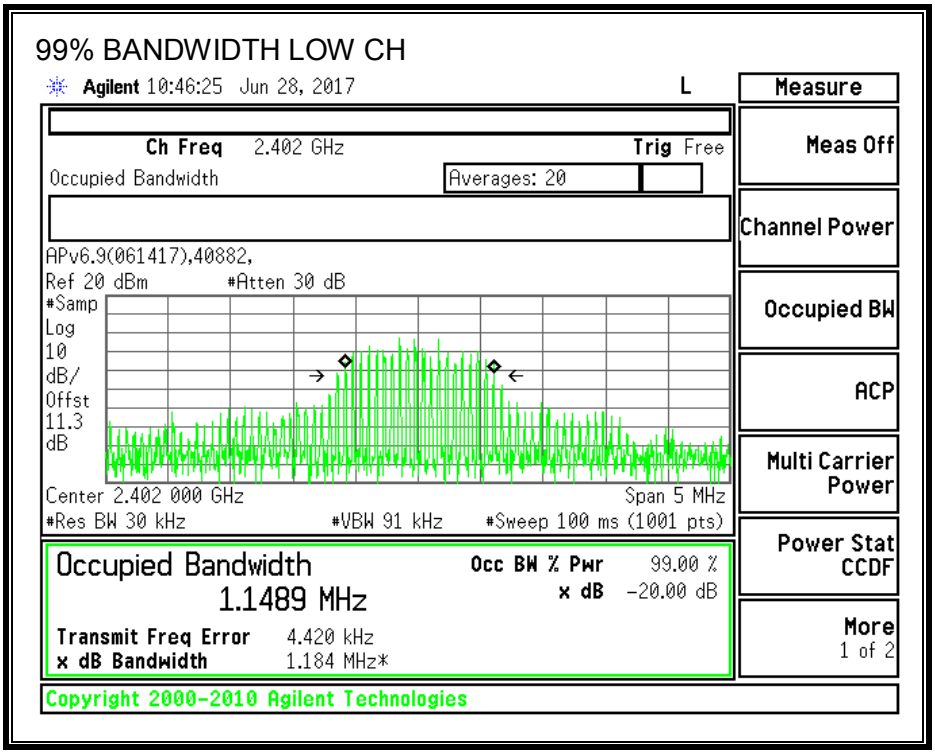
RESULTS

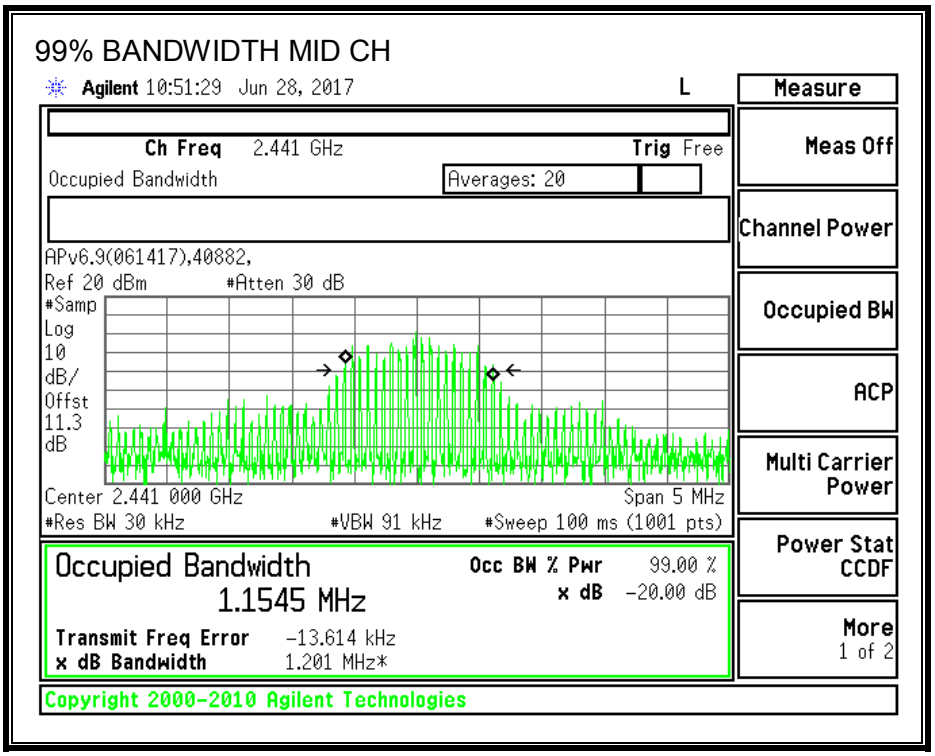
Channel	Frequency (MHz)	20 dB Bandwidth (kHz)	99% Bandwidth (kHz)
Low	2402	1248	1149
Middle	2441	1230	1155
High	2480	1224	1155

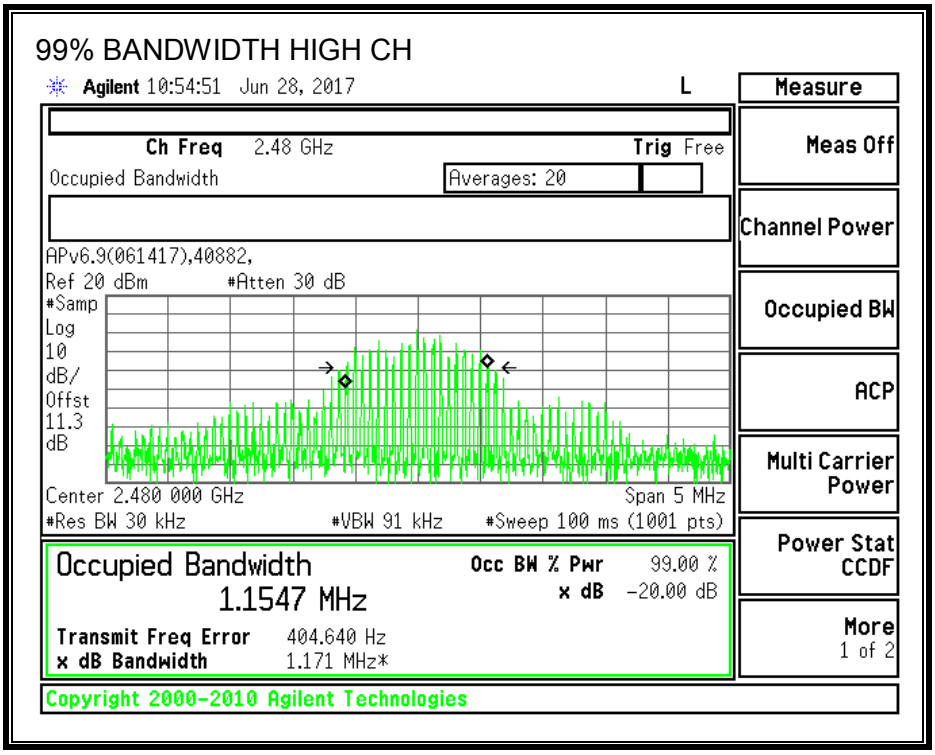
TEST INFORMATION

Date: 2017-06-28
Tester: Jeffrey Cabrera

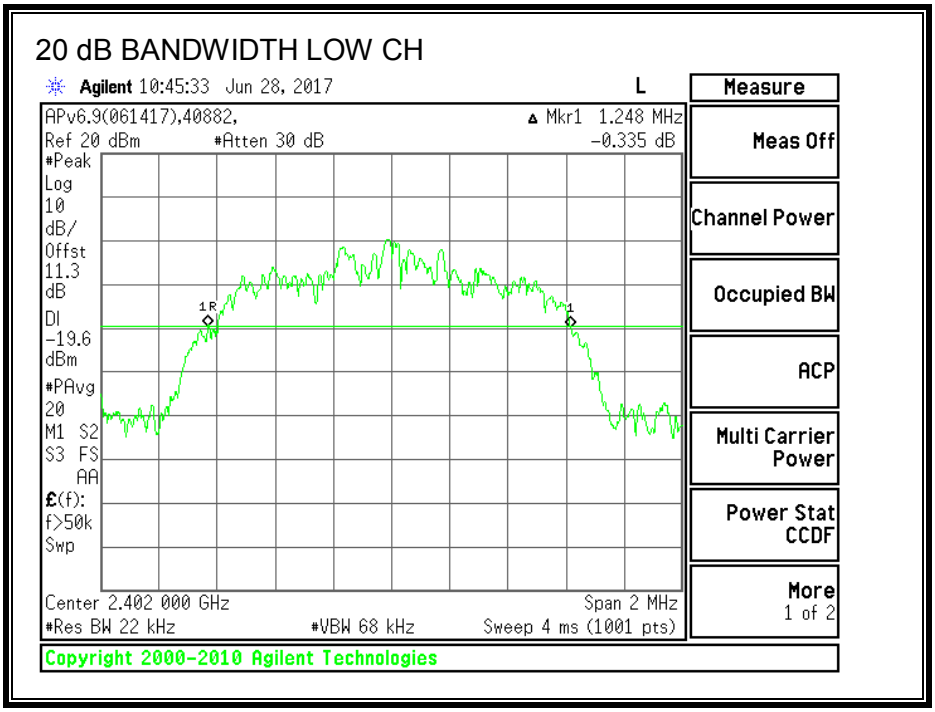
99% BANDWIDTH



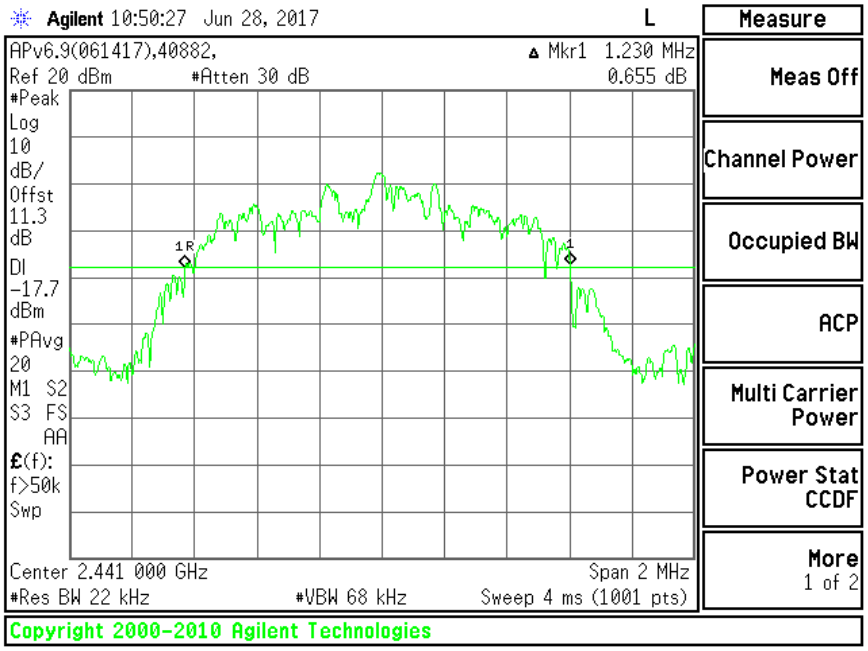




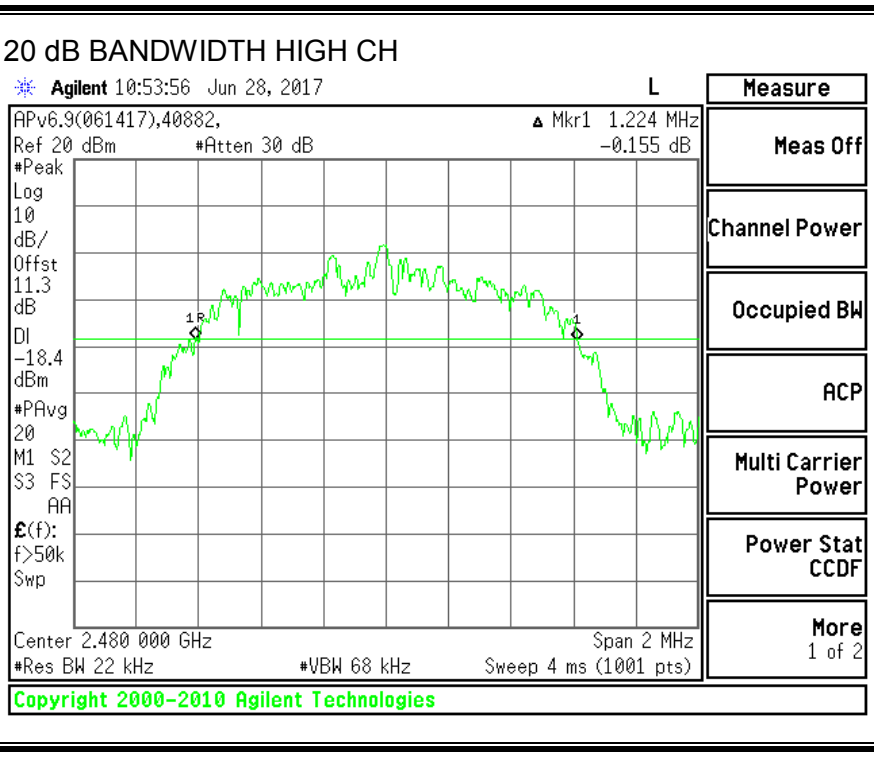
20 dB BANDWIDTH



20 dB BANDWIDTH MID CH



20 dB BANDWIDTH HIGH CH



8.3.2. HOPPING FREQUENCY SEPARATION

LIMIT

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 hoping channel, whichever is greater.

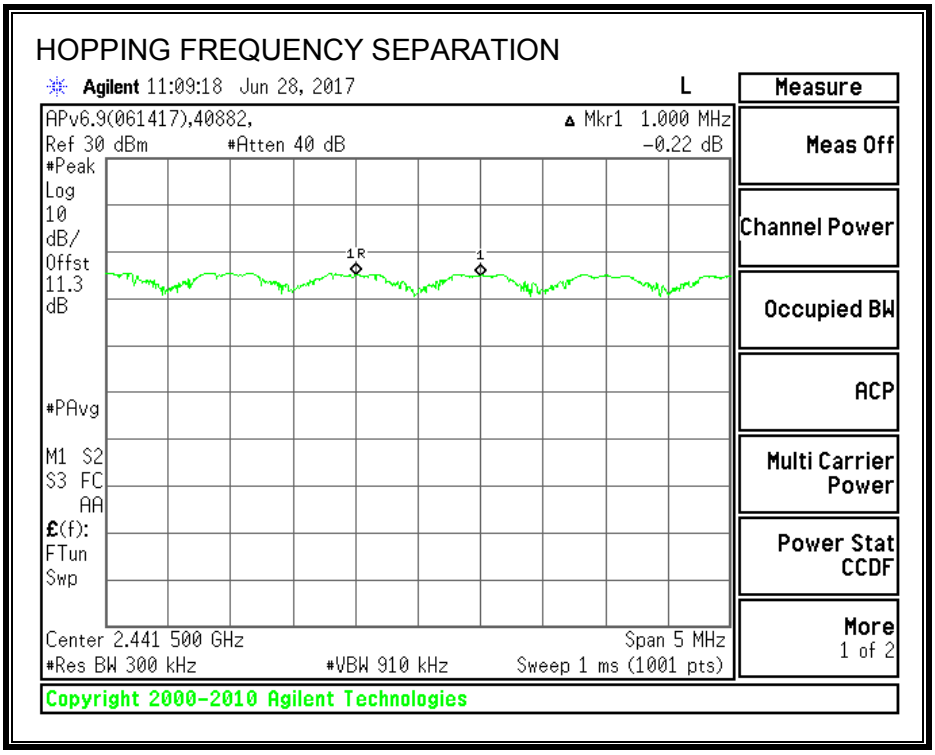
Alternatively, frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 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 300 kHz. The sweep time is coupled.

RESULTS

HOPPING FREQUENCY SEPARATION



Ch. A (MHz)	Ch. B (MHz)	Ch. 1 to Ch. 2 Sep. (MHz)	Max. 20 dB BW (MHz)	2/3 20 dB BW (MHz)	Margin (MHz)
2441	2442	1.000	1.248	0.832	-0.168

Note – The channel hopping separation of 1MHz is less than the 20 dB bandwidth (approx. 1.25 MHz). However, the output power is less than 125 mW and the channel separation is greater than 2/3 the 20 dB bandwidth (approx. 832 kHz).

TEST INFORMATION

Date: 2017-06-28

Tester: Jeffrey Cabrera

8.3.3. NUMBER OF HOPPING CHANNELS

LIMIT

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.

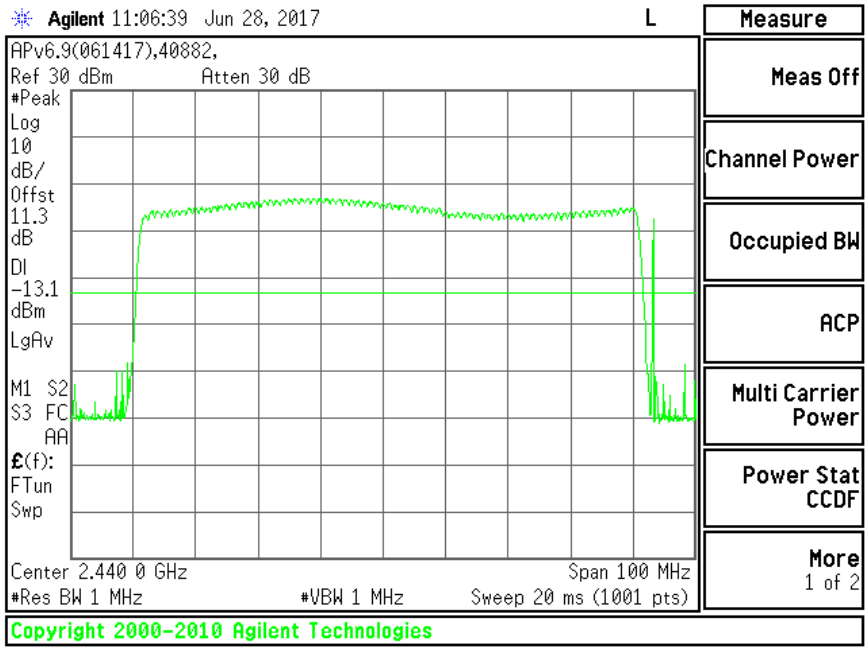
RESULTS

Normal Mode: 79 Channels observed.
AFH Mode: 20 Channels minimum declared.

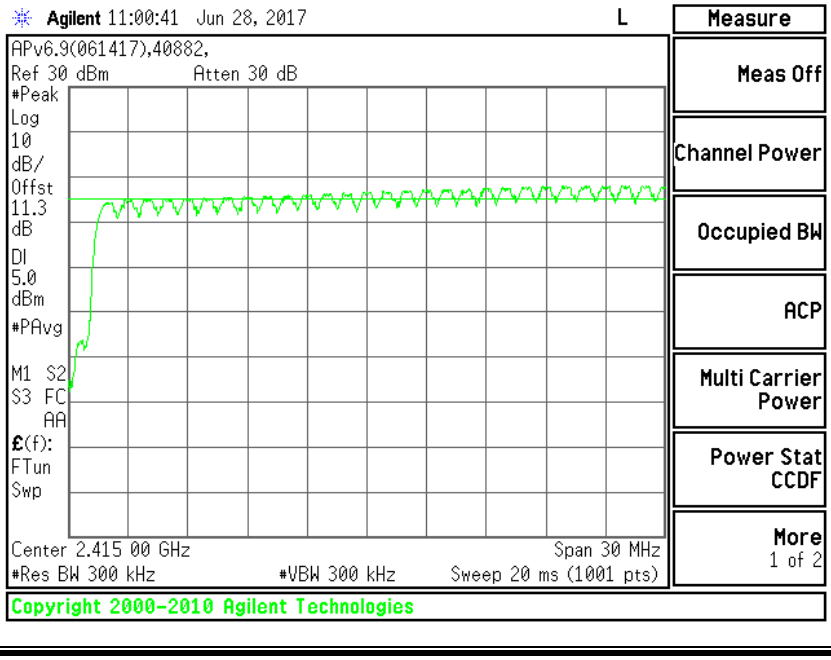
TEST INFORMATION
Date: 2017-06-28
Tester: Jeffrey Cabrera

NUMBER OF HOPPING CHANNELS

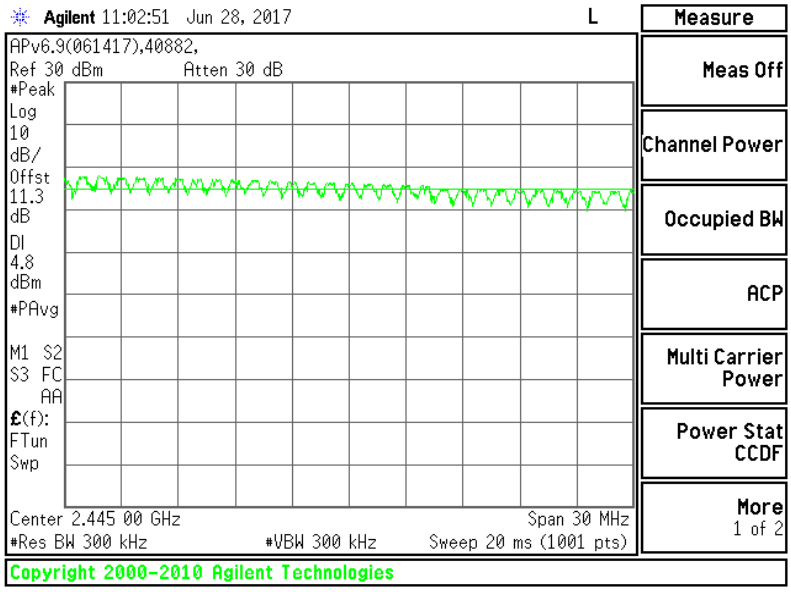
NUMBER OF HOPPING CHANNELS (100 MHZ SPAN)



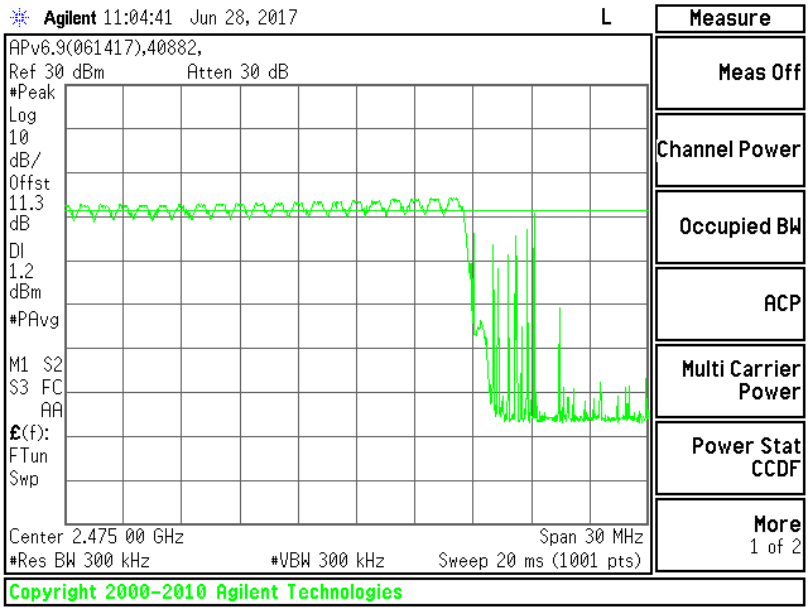
NUMBER OF HOPPING CHANNELS (30 MHZ SPAN, FIRST SEGMENT)



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



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



8.3.4. AVERAGE TIME OF OCCUPANCY

LIMIT

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 * (# of pulses in 3.16 s) * pulse width.

RESULTS

DQPSK Mode

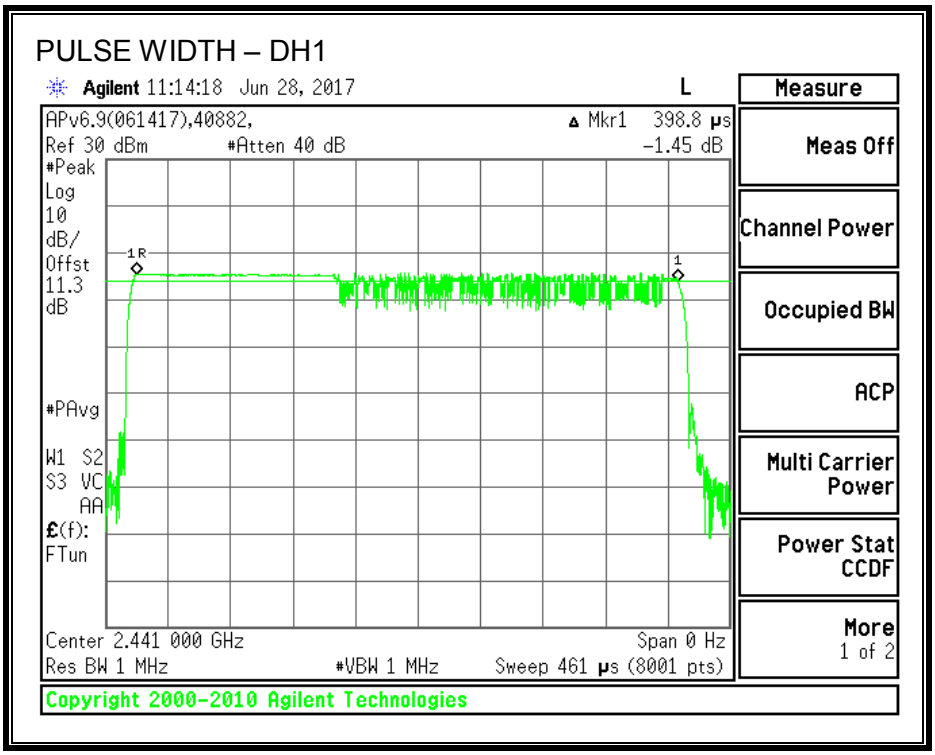
DH Packet	Pulse Width (msec)	Number of Pulses in 3.16 seconds	Average Time of (sec)	Limit (sec)	Margin (sec)
DH1	0.399	32	0.128	0.4	-0.272
DH3	1.65	17	0.281	0.4	-0.120
DH5	2.908	10	0.291	0.4	-0.109

Note: for AFH (DQPSK) mode, please refer to the results of AFH (GFSK) mode; the channel selection and hopping rate are the same for both EDR and Basic Rate operation, data for Basic Rate on page 25 demonstrates compliance with channel occupancy when AFH is employed.

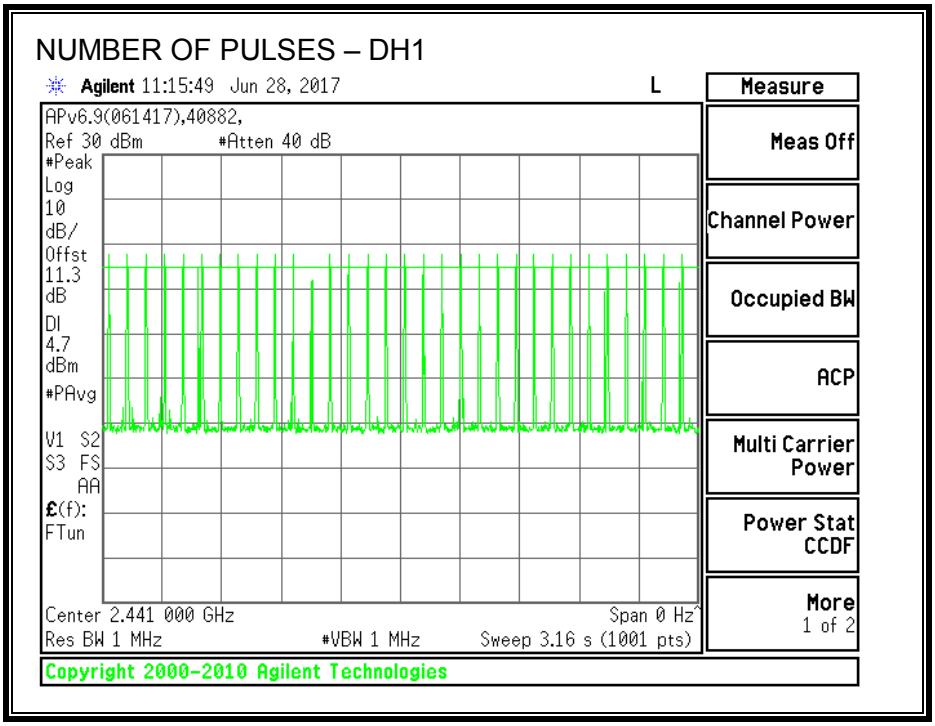
TEST INFORMATION

Date: 2017-06-28
Tester: Jeffrey Cabrera

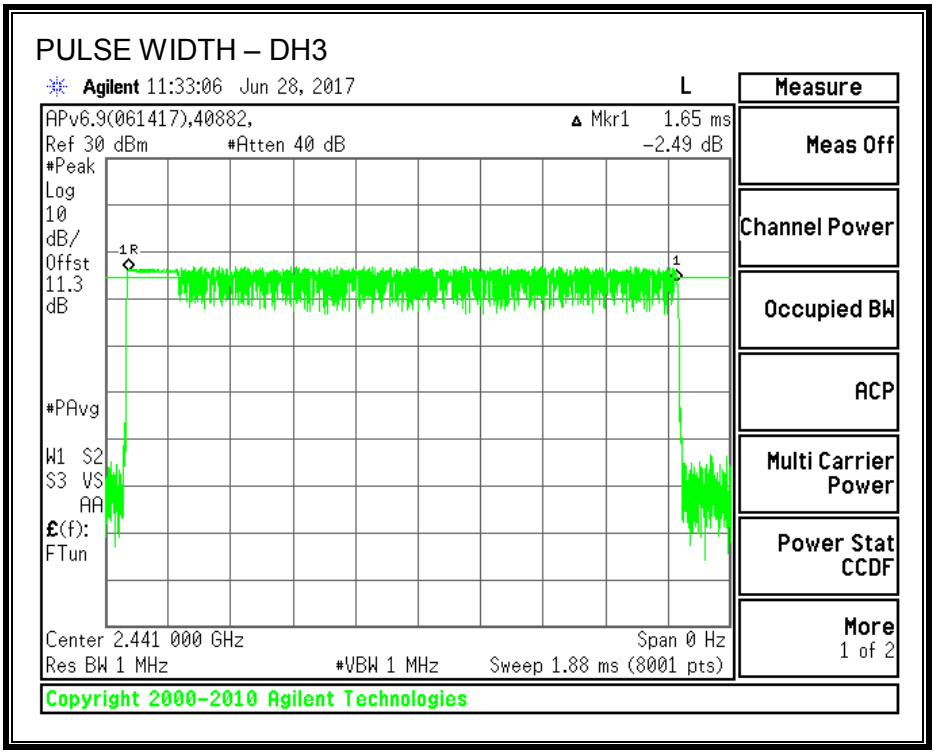
PULSE WIDTH - DH1



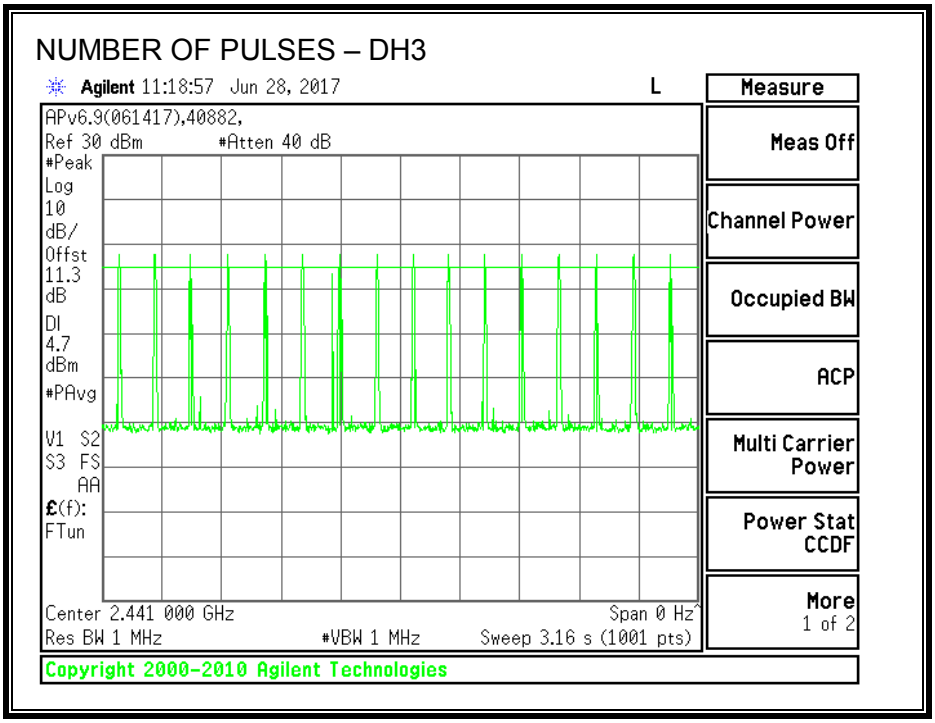
NUMBER OF PULSES IN 3.16 SECOND OBSERVATION PERIOD – DH1



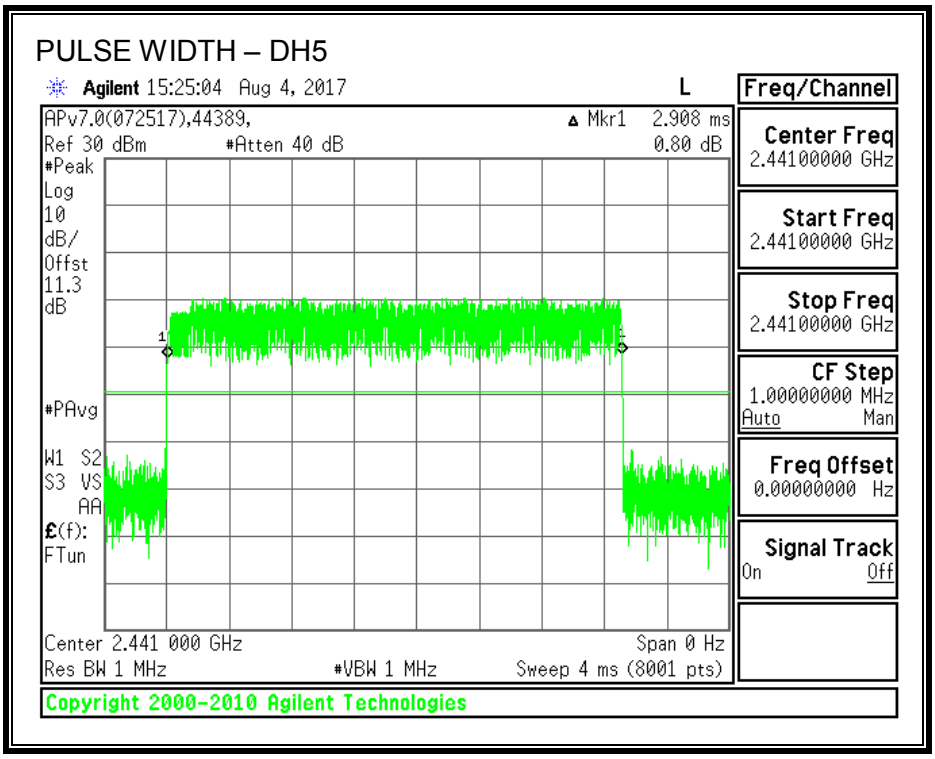
PULSE WIDTH – DH3



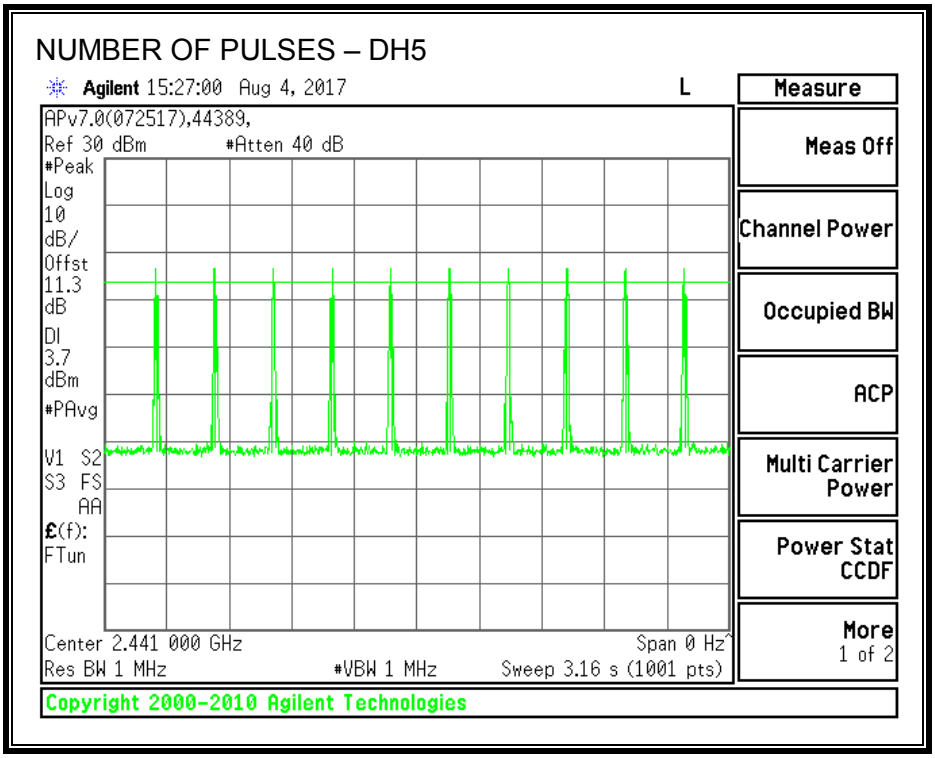
NUMBER OF PULSES IN 3.16 SECOND OBSERVATION PERIOD – DH3



PULSE WIDTH – DH5



NUMBER OF PULSES IN 3.16 SECOND OBSERVATION PERIOD – DH5



8.3.5. OUTPUT POWER

LIMIT

§15.247 (b) (1)

For frequency hopping systems operating in the 2400-2483.5 MHz band employing at least 75 non-overlapping hopping channels, and all frequency hopping systems in the 5725-5850 MHz band: 1 watt. For all other frequency hopping systems in the 2400-2483.5 MHz band: 0.125 watts.

RSS-247 5.4 (b)

For frequency hopping systems operating in the band 2400-2483.5 MHz and employing at least 75 hopping channels, the maximum peak conducted output power shall not exceed 1 W; for all other frequency hopping systems in the band, the maximum peak conducted output power shall not exceed 0.125 W.

TEST PROCEDURE

The transmitter output is connected to a spectrum analyzer the analyzer bandwidth is set to a value greater than the 20 dB bandwidth of the EUT.

RESULTS

Channel	Frequency (MHz)	Output Power (dBm)	Directional Gain (dBi)	Limit (dBm)	Margin (dB)
Low	2402	6.23	2.90	21	-14.77
Middle	2441	8.49	2.90	21	-12.51
High	2480	7.63	2.90	21	-13.37

TEST INFORMATION

Date: 2017-07-05
Tester: Jeffrey Cabrera

8.3.6. 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 11.31 dB (including 10 dB pad and 1.31 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	3.89
Middle	2441	6.33
High	2480	5.01

TEST INFORMATION

Date: 2017-07-05
Tester: Jeffrey Cabrera

8.3.7. CONDUCTED SPURIOUS EMISSIONS

LIMITS

FCC §15.247 (d)
In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

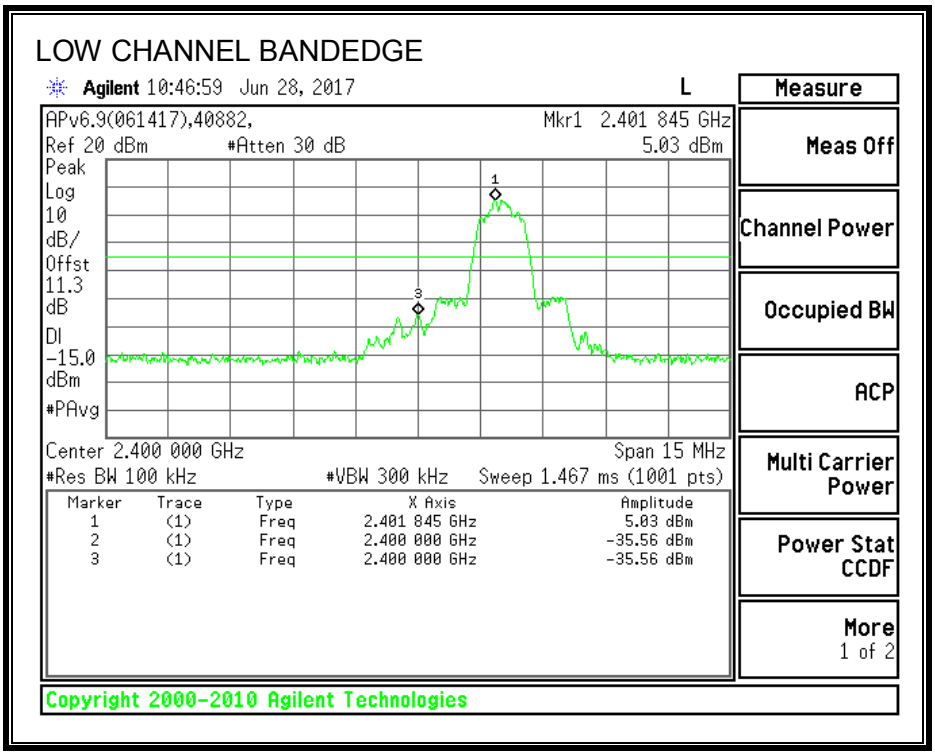
IC RSS-247 5.5
In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating, the RF power that is produced shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided that the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of root-mean-square averaging over a time interval, as permitted under Section A8.4 (4), the attenuation required shall be 30 dB instead of 20 dB. Attenuation below the general field strength limits specified in RSS-Gen is not required.

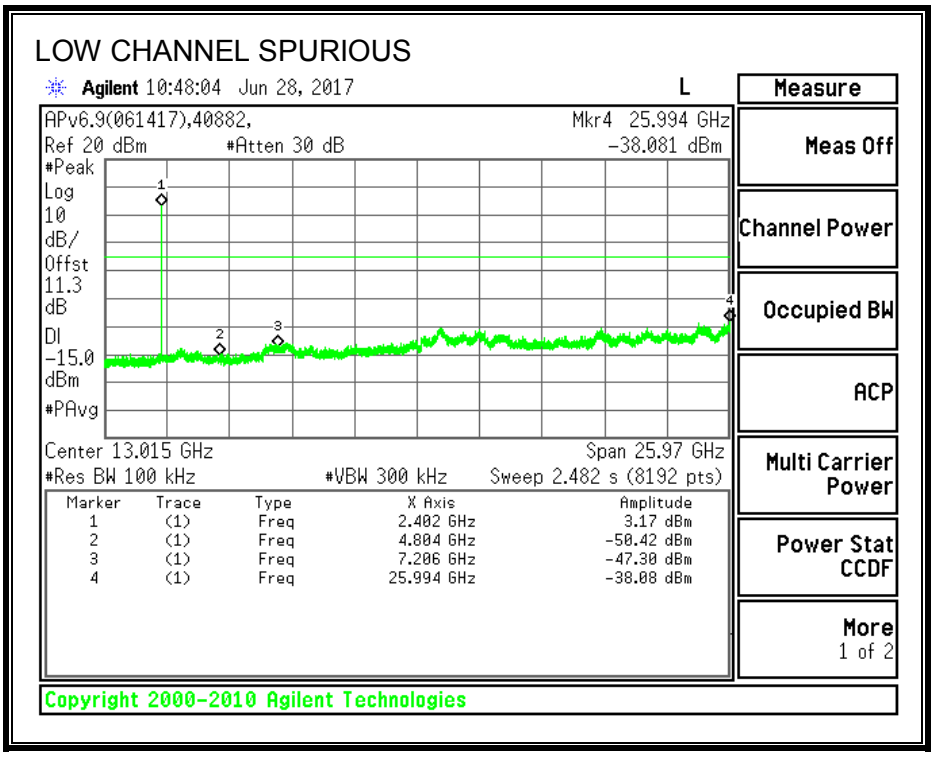
TEST PROCEDURE

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.

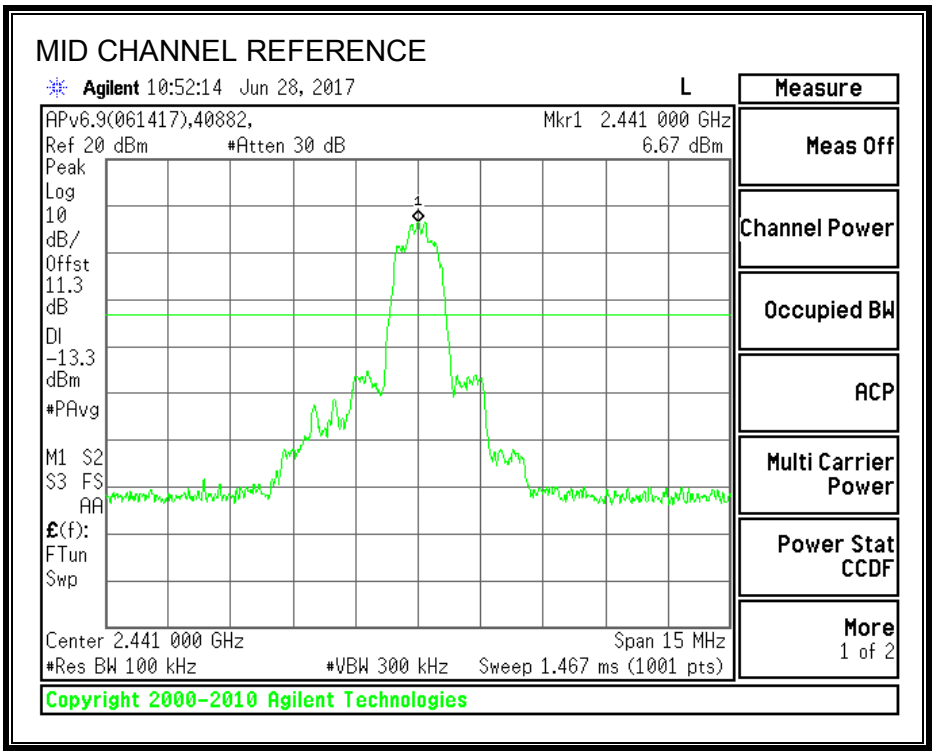
TEST INFORMATION
Date: 2017-06-28
Tester: Jeffrey Cabrera

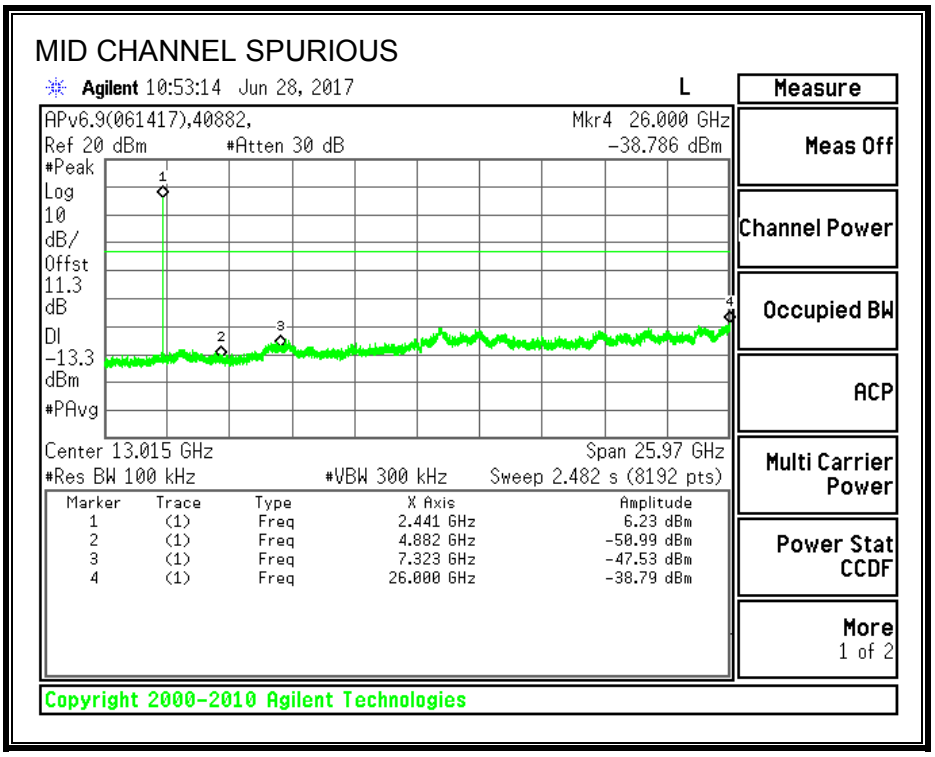
SPURIOUS EMISSIONS, LOW CHANNEL



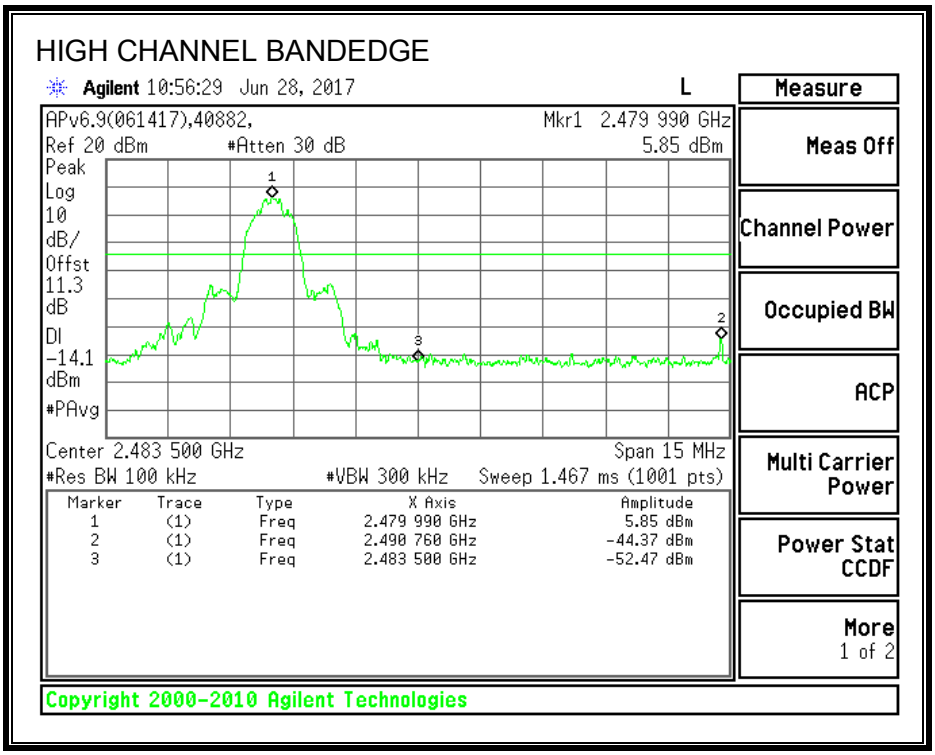


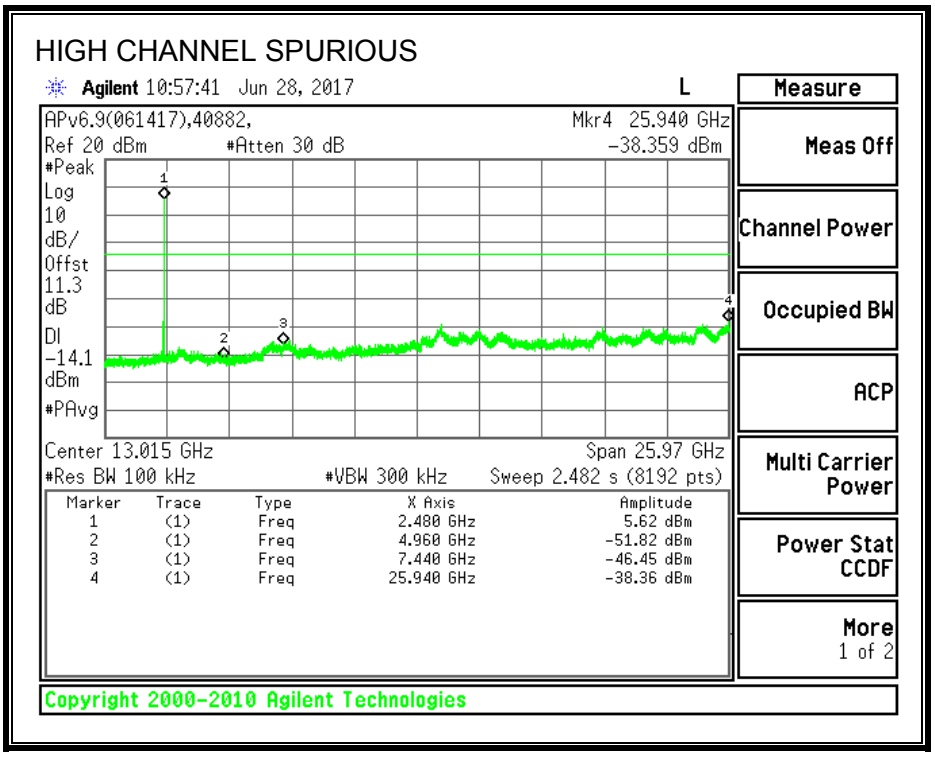
SPURIOUS EMISSIONS, MID CHANNEL





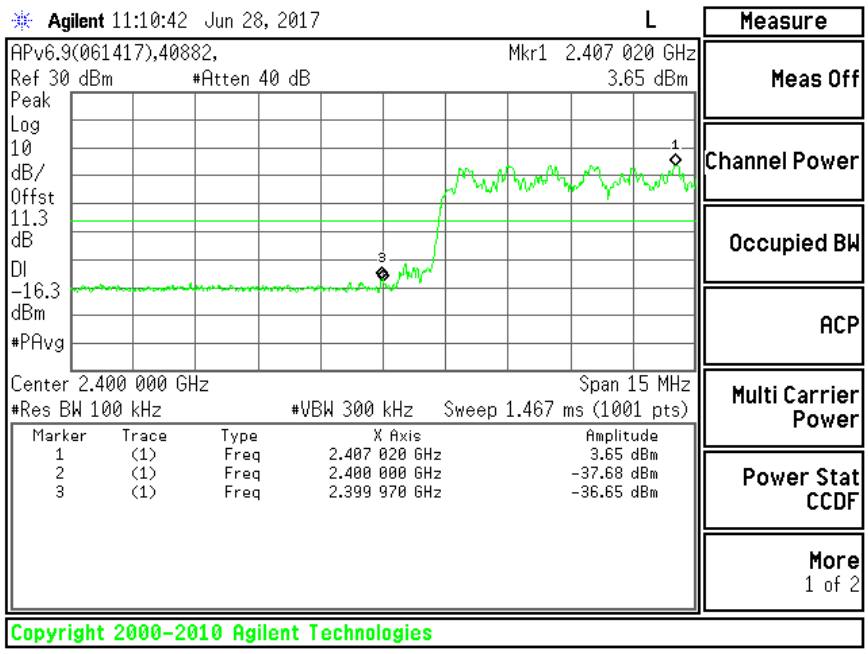
SPURIOUS EMISSIONS, HIGH CHANNEL



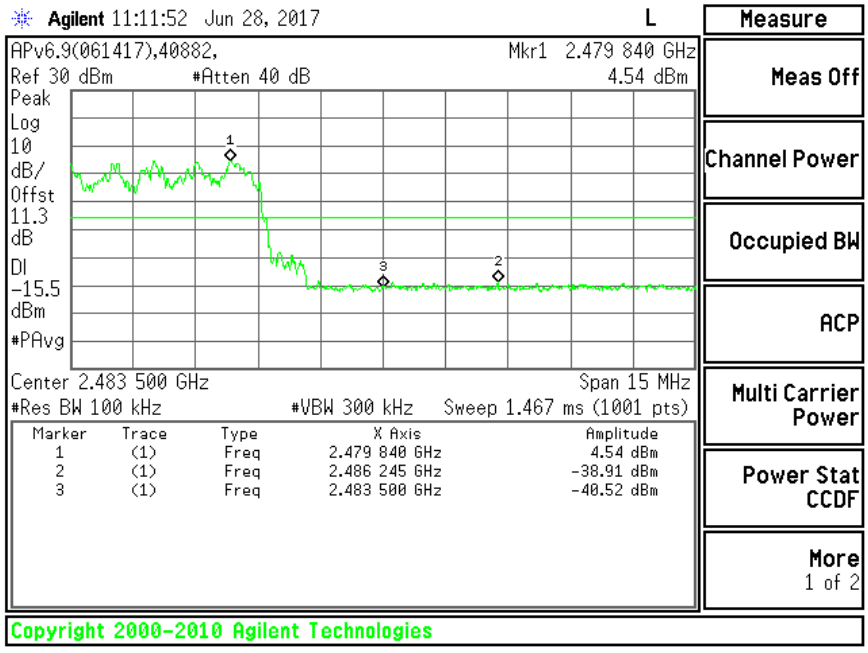


SPURIOUS BANDEDGE EMISSIONS WITH HOPPING ON

LOW BANDEDGE WITH HOPPING ON



HIGH BANDEDGE WITH HOPPING ON



8.4. ENHANCED DATA RATE 8PSK MODULATION

8.4.1. 20 dB AND 99% BANDWIDTH

LIMIT

None; for reporting purposes only. Test per FCC §15.247(a)(1); IC RSS-247 5.1 (1), RSS-Gen 6.6.

TEST PROCEDURE

The transmitter output is connected to a spectrum analyzer. The RBW is set to 1-5% of the 20 dB bandwidth and 99% Occupied Bandwidth. The VBW is set to ≥ RBW. The sweep time is coupled.

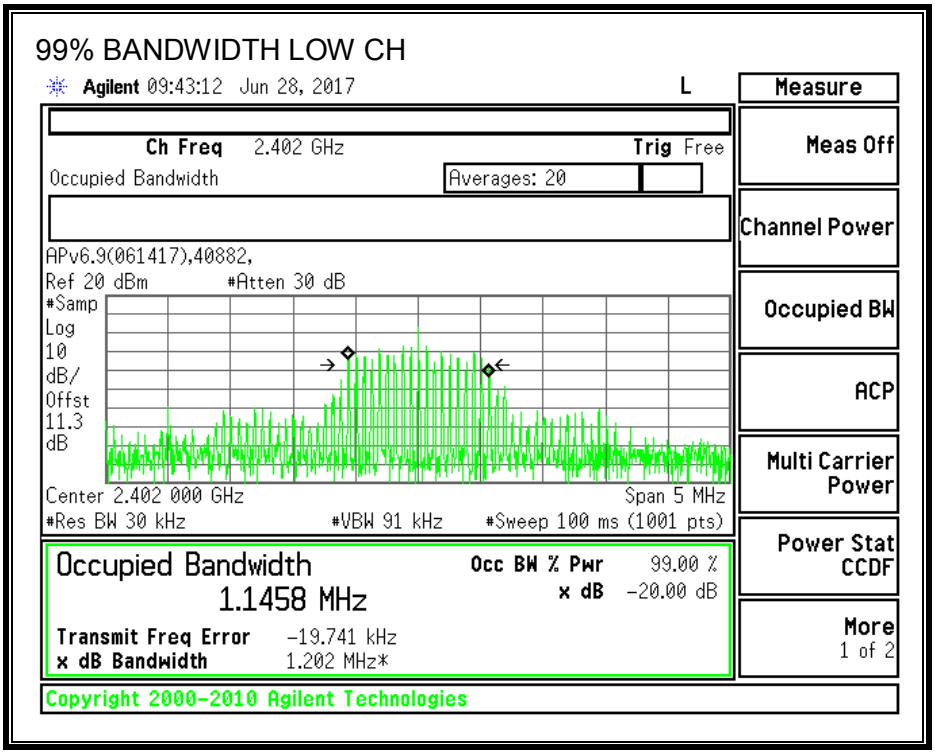
RESULTS

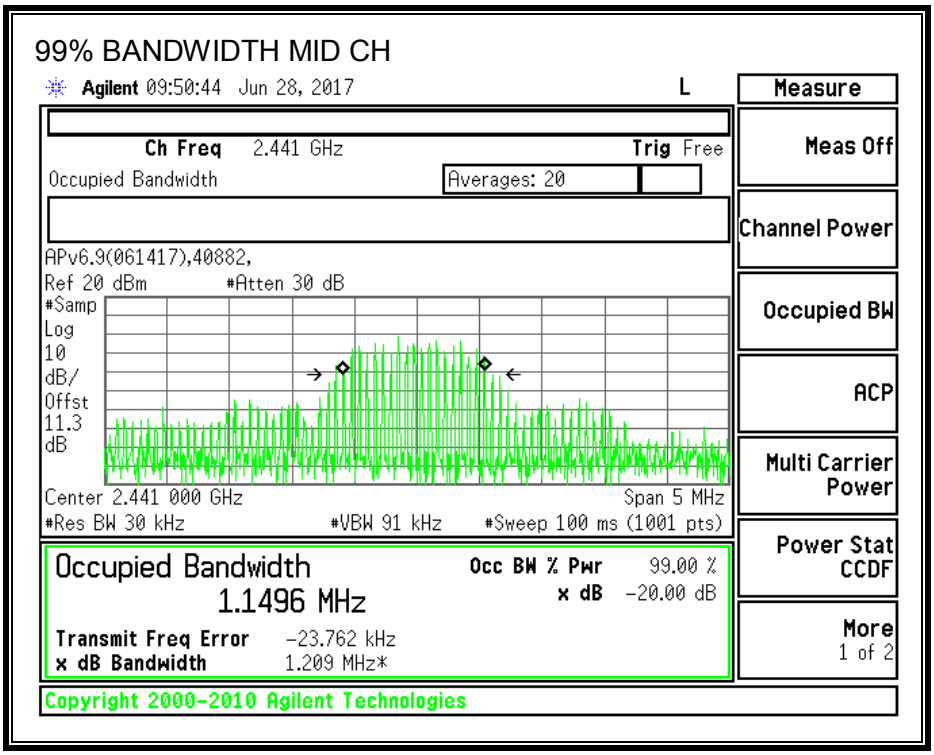
Channel	Frequency (MHz)	20 dB Bandwidth (kHz)	99% Bandwidth (kHz)
Low	2402	1206	1146
Middle	2441	1194	1150
High	2480	1176	1140

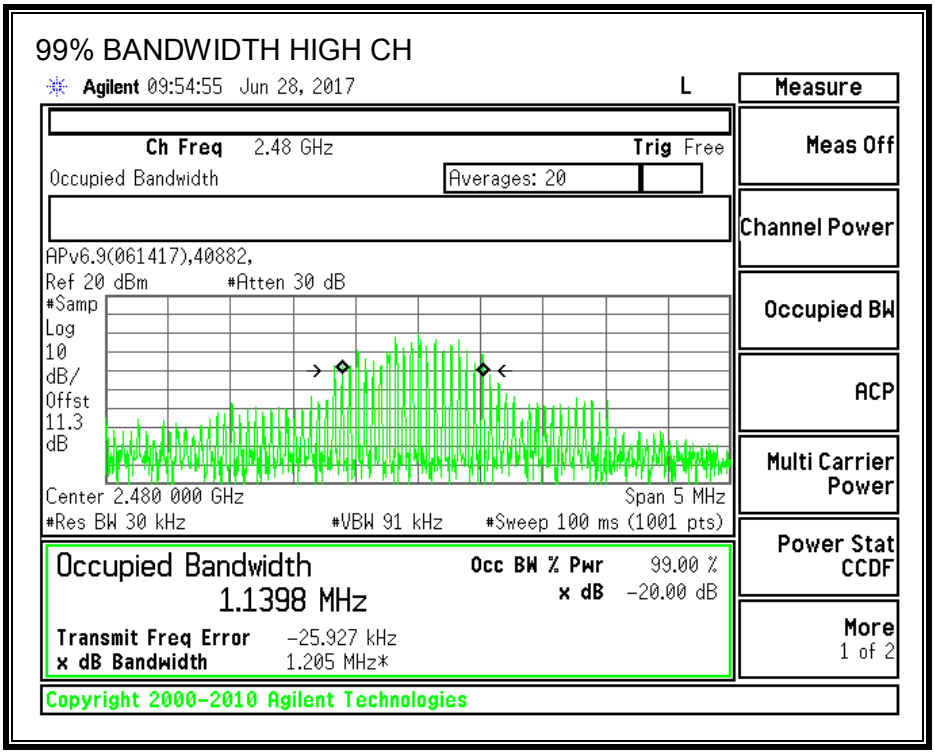
TEST INFORMATION

Date: 2017-06-28
Tester: Jeffrey Cabrera

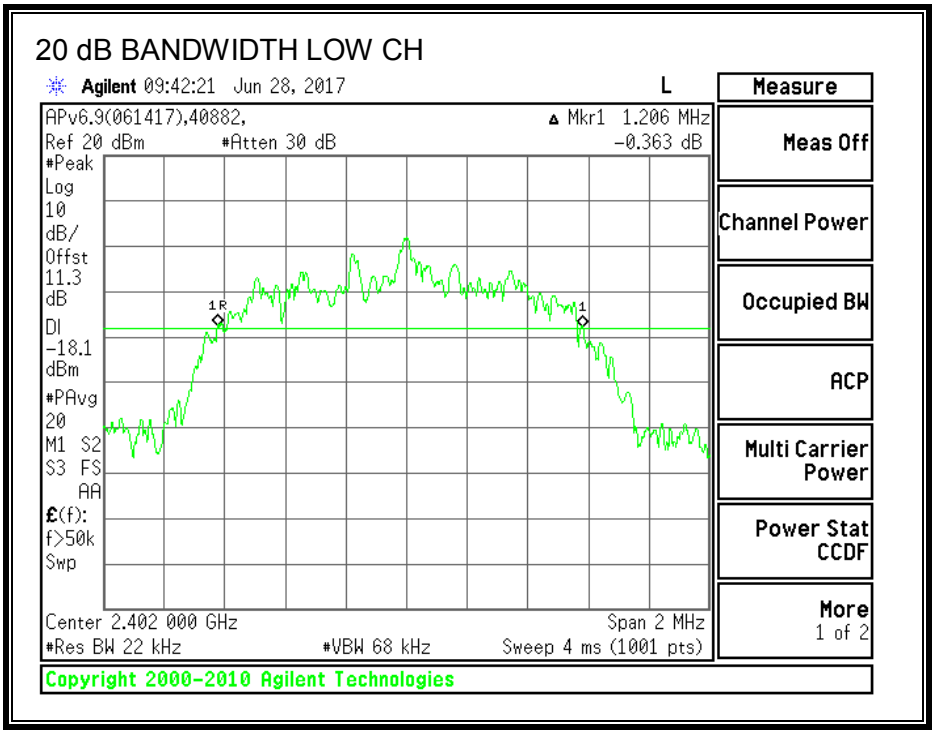
99% BANDWIDTH



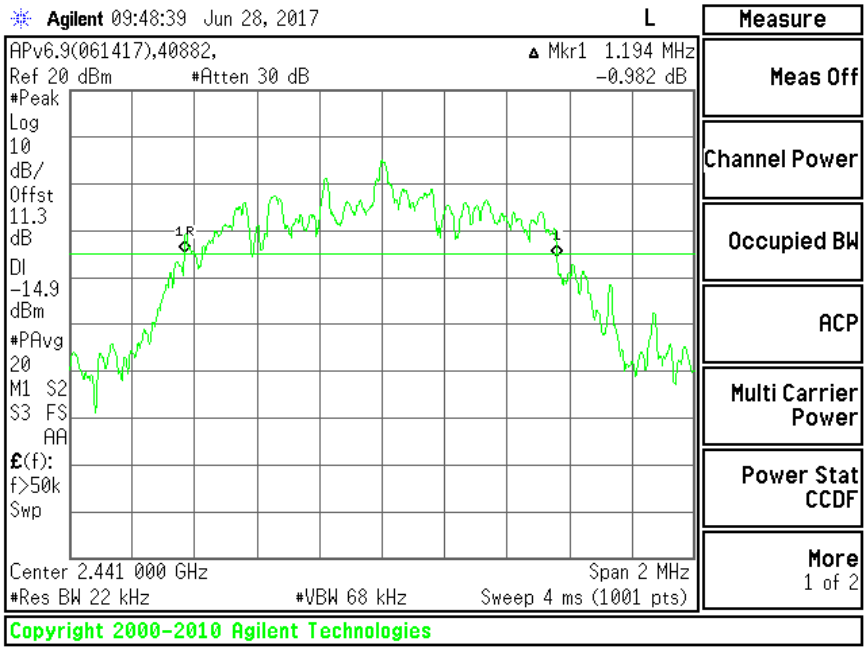




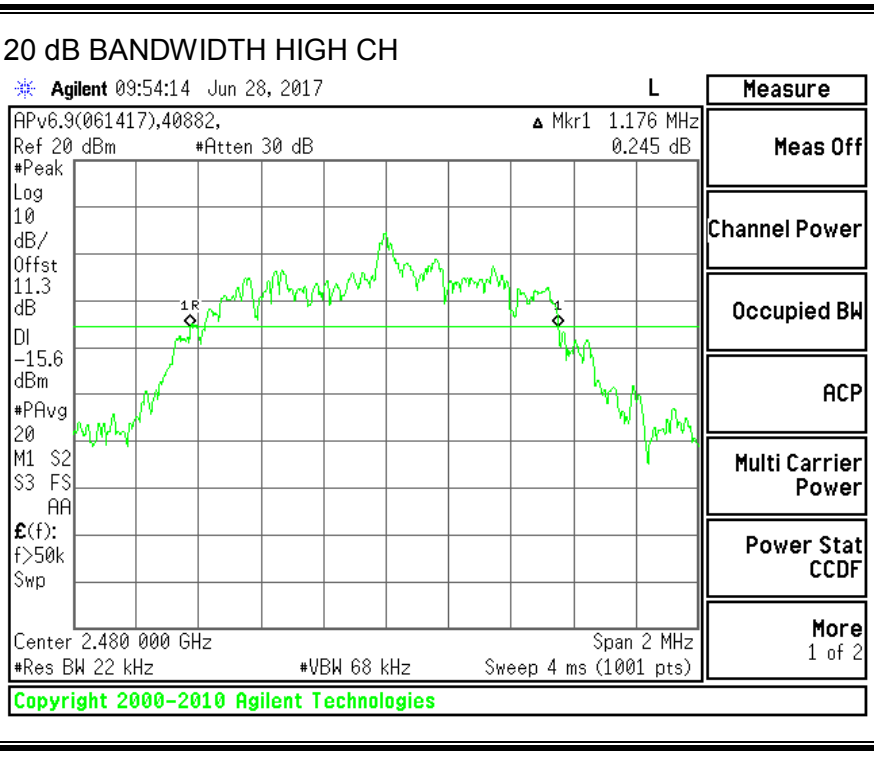
20 dB BANDWIDTH



20 dB BANDWIDTH MID CH



20 dB BANDWIDTH HIGH CH



8.4.2. HOPPING FREQUENCY SEPARATION

LIMIT

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 hoping channel, whichever is greater.

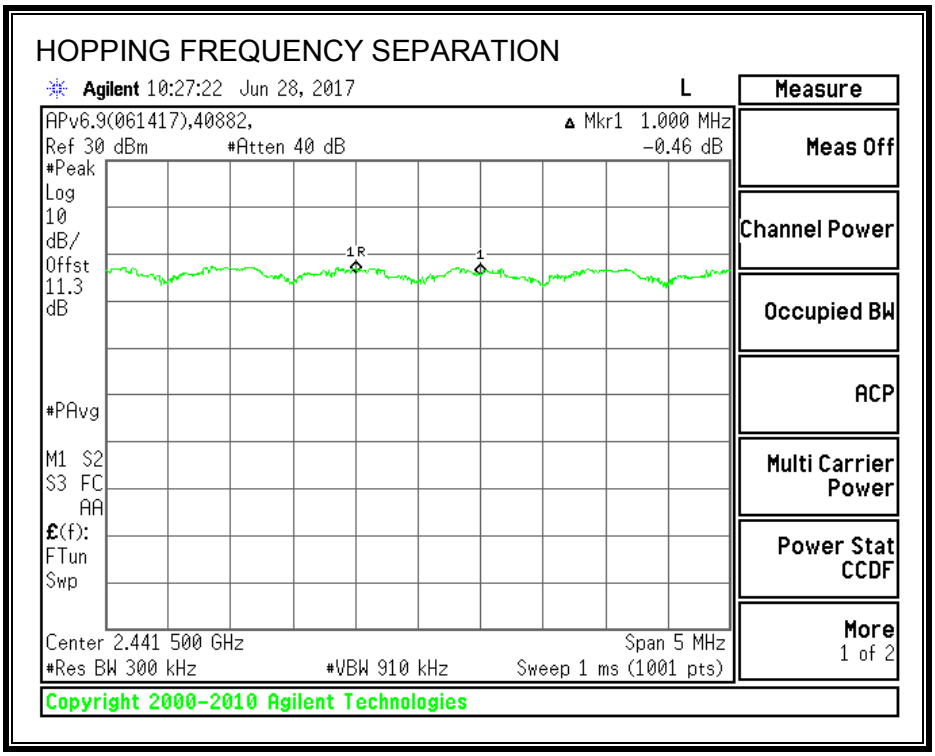
Alternatively, frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 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 300 kHz. The sweep time is coupled.

RESULTS

HOPPING FREQUENCY SEPARATION



Ch. A (MHz)	Ch. B (MHz)	Ch. 1 to Ch. 2 Sep. (MHz)	Max. 20 dB BW (MHz)	2/3 20 dB BW (MHz)	Margin (MHz)
2441	2442	1.000	1.206	0.804	-0.196

Note – The channel hopping separation of 1MHz is less than the 20 dB bandwidth (approx. 1.2 MHz). However, the output power is less than 125 mW and the channel separation is greater than 2/3 the 20 dB bandwidth (approx. 800 kHz)

TEST INFORMATION

Date: 2017-06-28

Tester: Jeffrey Cabrera

8.4.3. NUMBER OF HOPPING CHANNELS

LIMIT

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 for visibility of the entire span. Then, smaller spans are set to more clearly identify the channels. The RBW is set to 30% of the channel spacing (approx. 300 kHz). The analyzer is set to Max Hold.

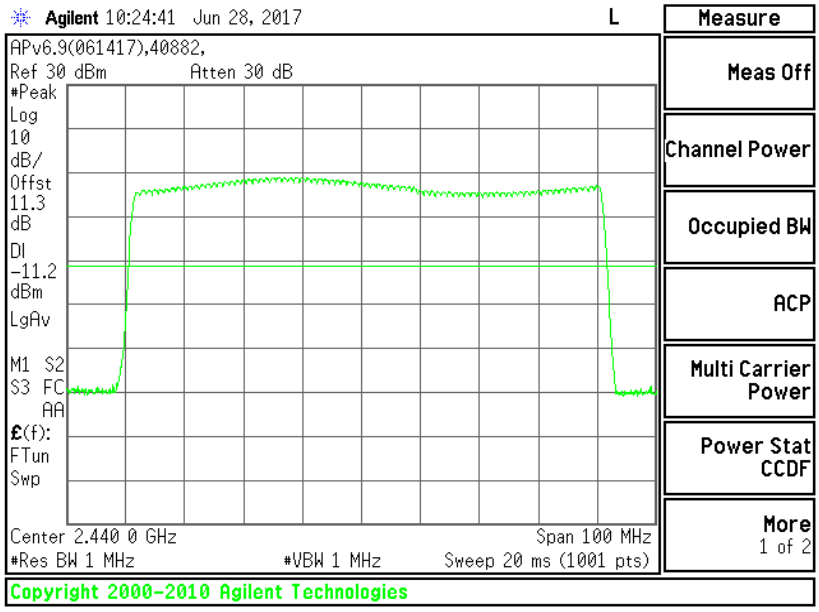
RESULTS

Normal Mode: 79 Channels observed.
AFH Mode: 20 Channels minimum declared.

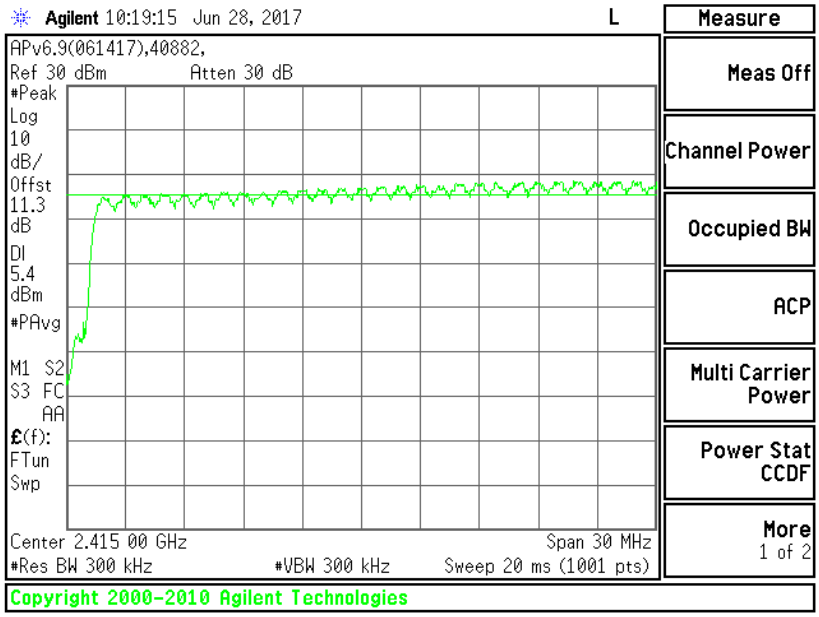
TEST INFORMATION
Date: 2017-06-28
Tester: Jeffrey Cabrera

NUMBER OF HOPPING CHANNELS

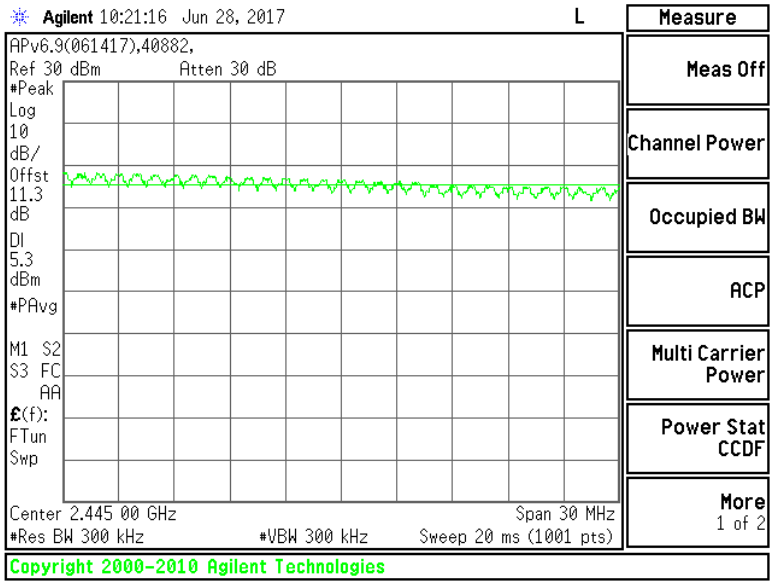
NUMBER OF HOPPING CHANNELS (100 MHZ SPAN)



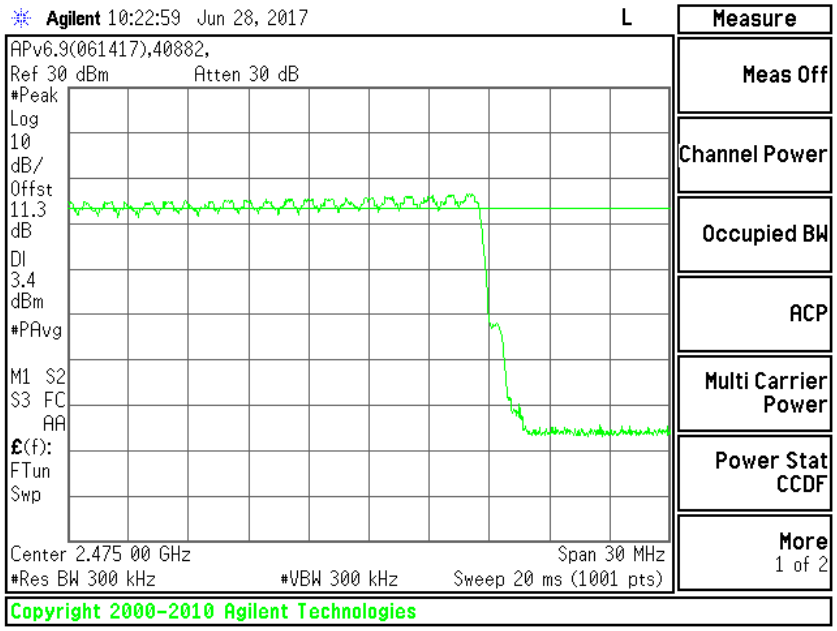
NUMBER OF HOPPING CHANNELS (30 MHZ SPAN, FIRST SEGMENT)



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



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



8.4.4. AVERAGE TIME OF OCCUPANCY

LIMIT

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 * (# of pulses in 3.16 s) * pulse width.

RESULTS

8PSK (EDR) Mode

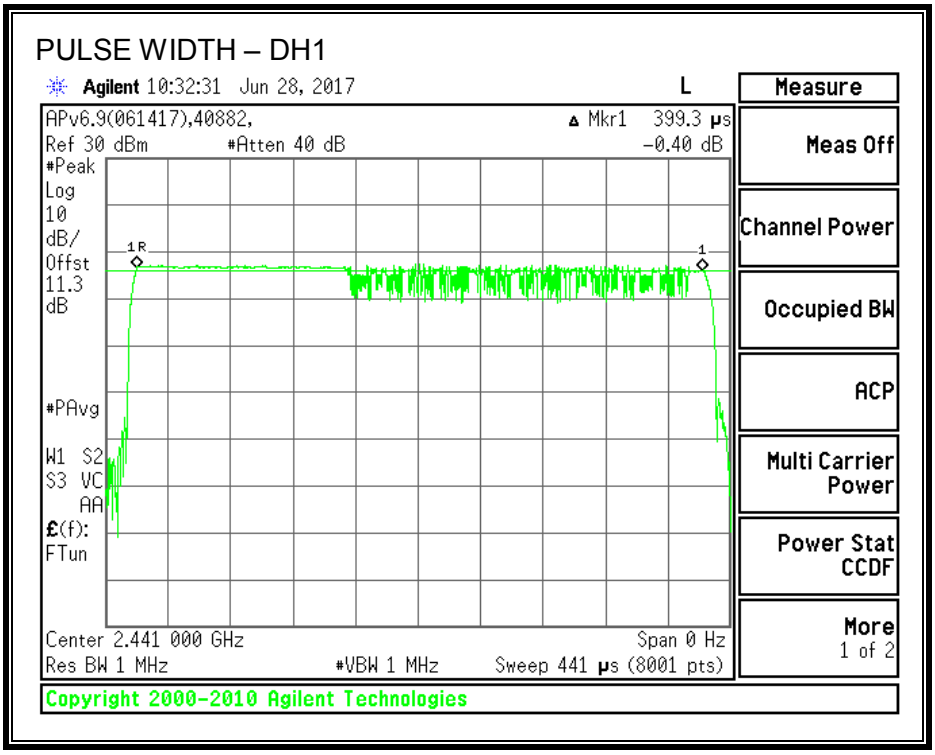
DH Packet	Pulse Width (msec)	Number of Pulses in 3.16 seconds	Average Time of (sec)	Limit (sec)	Margin (sec)
DH1	0.399	32	0.128	0.4	-0.272
DH3	1.649	16	0.264	0.4	-0.136
DH5	2.898	11	0.319	0.4	-0.081

Note: for AFH (8PSK) mode, please refer to the results of AFH (GFSK) mode; the channel selection and hopping rate are the same for both EDR and Basic Rate operation, data for Basic Rate on page 25 demonstrates compliance with channel occupancy when AFH is employed.

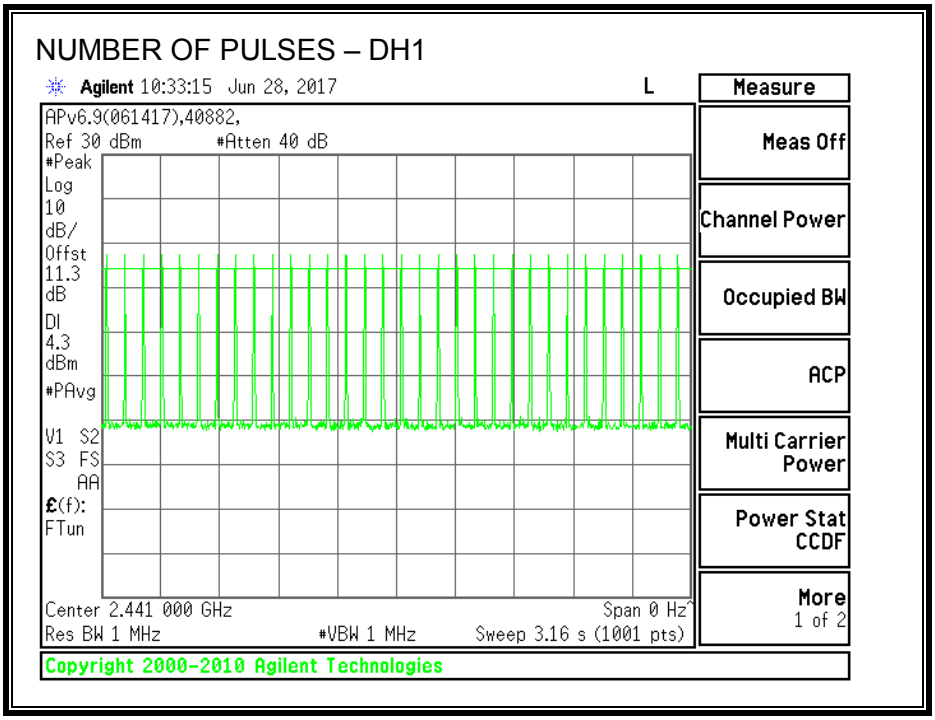
TEST INFORMATION

Date: 2017-06-28
Tester: Jeffrey Cabrera

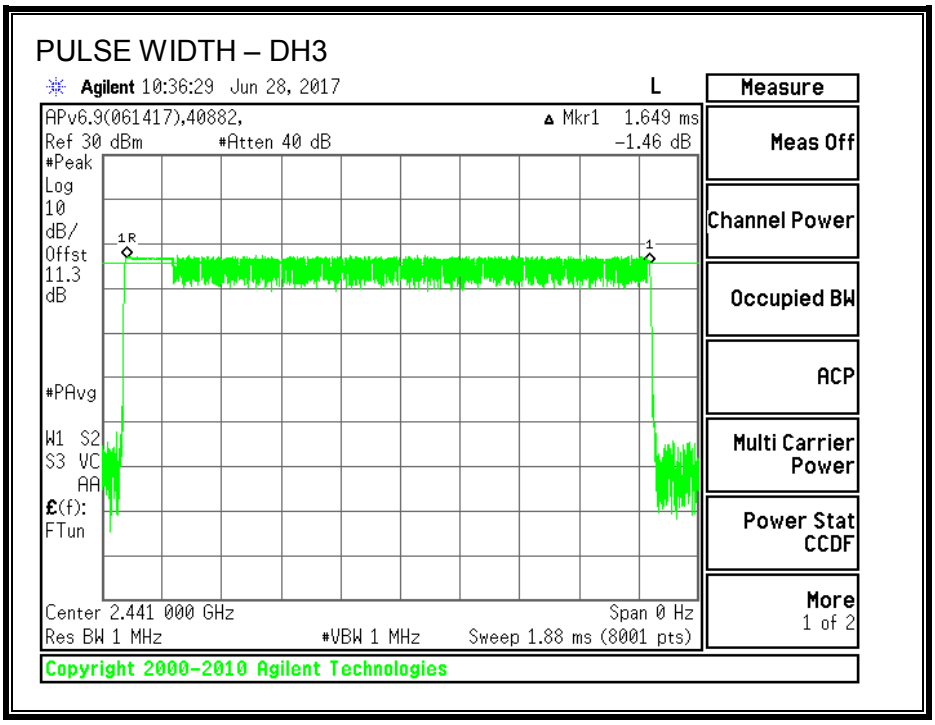
PULSE WIDTH - DH1



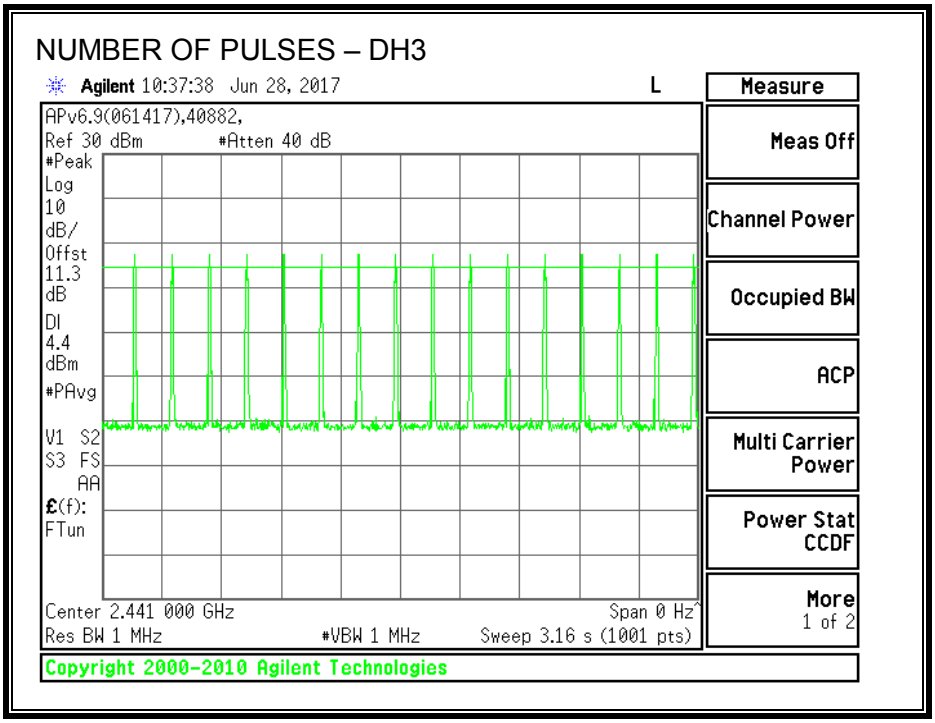
NUMBER OF PULSES IN 3.16 SECOND OBSERVATION PERIOD – DH1



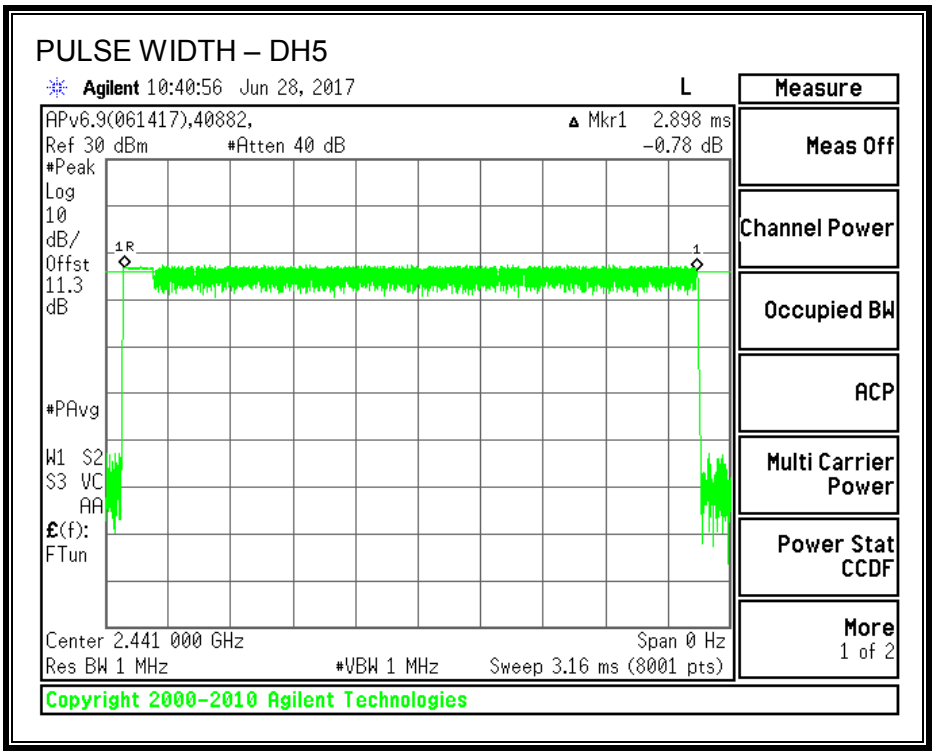
PULSE WIDTH – DH3



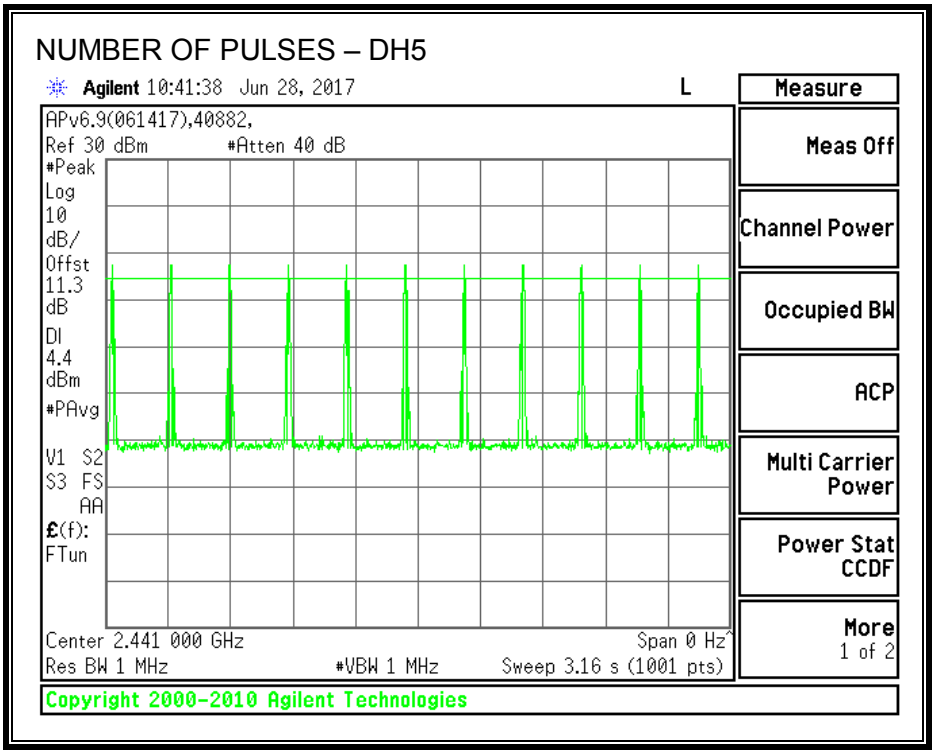
NUMBER OF PULSES IN 3.16 SECOND OBSERVATION PERIOD – DH3



PULSE WIDTH – DH5



NUMBER OF PULSES IN 3.16 SECOND OBSERVATION PERIOD – DH5



8.4.5. OUTPUT POWER

LIMIT

§15.247 (b) (1)

For frequency hopping systems operating in the 2400-2483.5 MHz band employing at least 75 non-overlapping hopping channels, and all frequency hopping systems in the 5725-5850 MHz band: 1 watt. For all other frequency hopping systems in the 2400-2483.5 MHz band: 0.125 watts.

RSS-247 5.4 (b)

For frequency hopping systems operating in the band 2400-2483.5 MHz and employing at least 75 hopping channels, the maximum peak conducted output power shall not exceed 1 W; for all other frequency hopping systems in the band, the maximum peak conducted output power shall not exceed 0.125 W.

TEST PROCEDURE

The transmitter output is connected to a spectrum analyzer the analyzer bandwidth is set to a value greater than the 20 dB bandwidth of the EUT.

RESULTS

Channel	Frequency (MHz)	Output Power (dBm)	Directional Gain (dBi)	Limit (dBm)	Margin (dB)
Low	2402	6.56	2.90	21	-14.44
Middle	2441	8.79	2.90	21	-12.21
High	2480	7.87	2.90	21	-13.13

TEST INFORMATION

Date: 2017-07-05
Tester: Jeffrey Cabrera

8.4.6. 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 11.31 dB (including 10 dB pad and 1.31 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	4.31
Middle	2441	4.36
High	2480	5.50

TEST INFORMATION
Date: 2017-07-05
Tester: Jeffrey Cabrera

8.4.7. CONDUCTED SPURIOUS EMISSIONS

LIMITS

FCC §15.247 (d)
In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

IC RSS-210 A8.5
In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating, the RF power that is produced shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided that the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of root-mean-square averaging over a time interval, as permitted under Section A8.4 (4), the attenuation required shall be 30 dB instead of 20 dB. Attenuation below the general field strength limits specified in RSS-Gen is not required.

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.

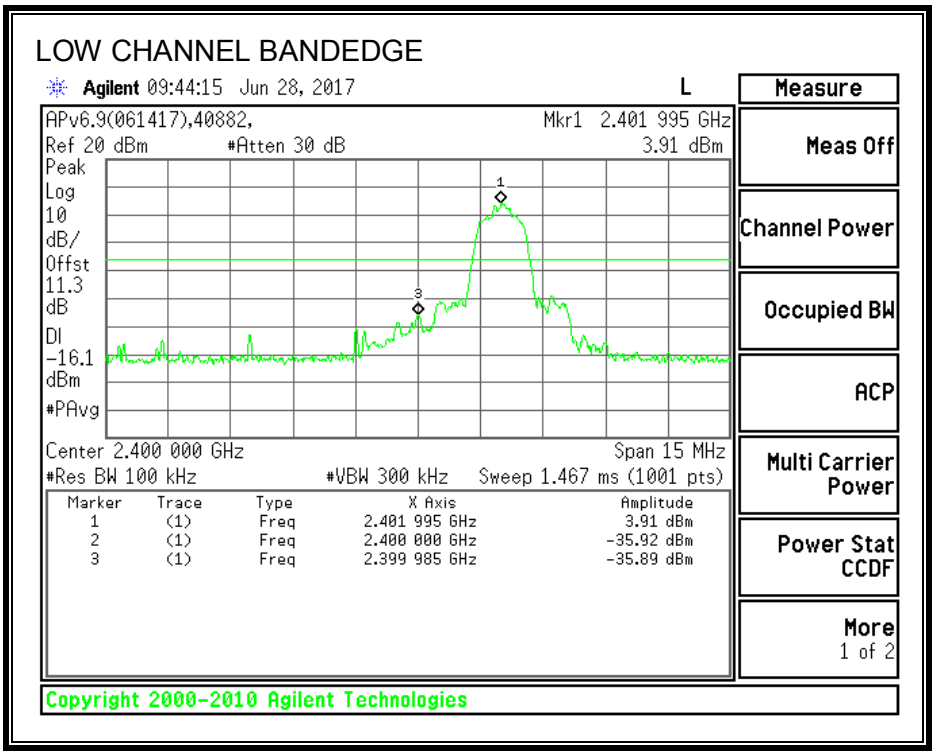
The spectrum from 30 MHz to 26 GHz is investigated with the transmitter set to the lowest, middle, and highest channels.

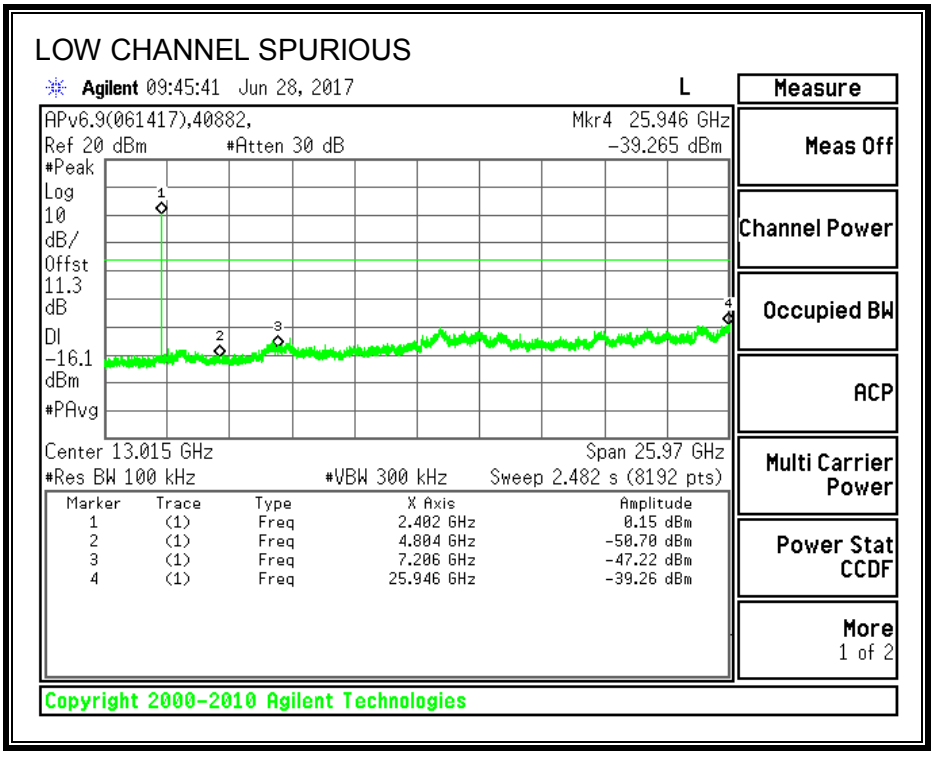
The bandedges at 2.4 and 2.4835 GHz are investigated with the transmitter set to the normal hopping mode.

TEST INFORMATION

Date: 2017-06-28
Tester: Jeffrey Cabrera

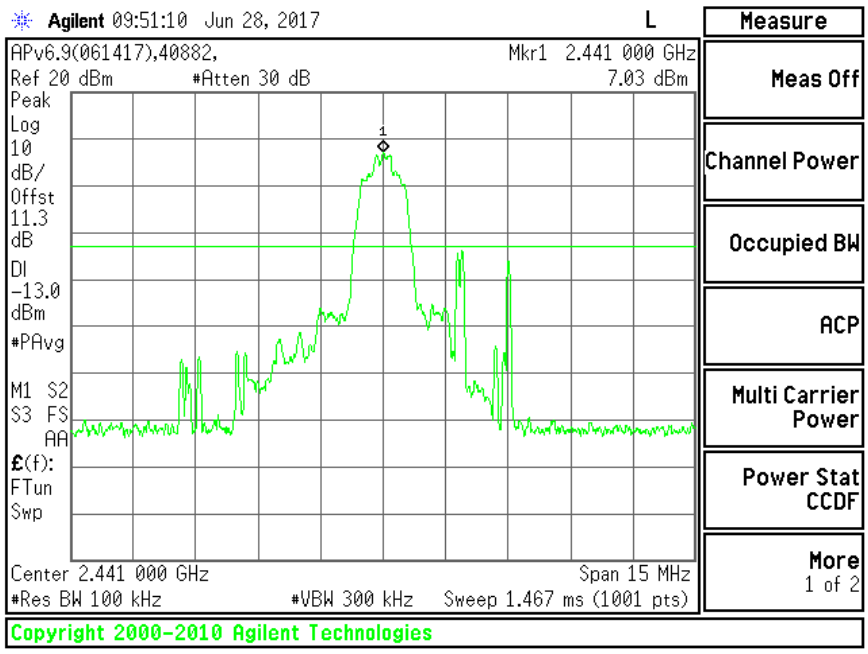
SPURIOUS EMISSIONS, LOW CHANNEL



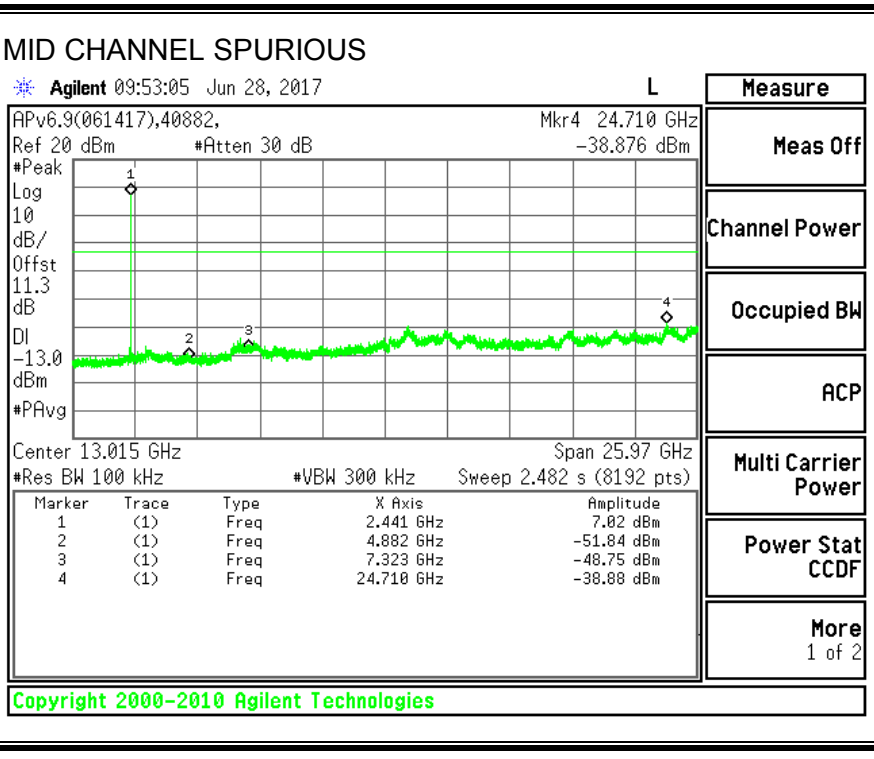


SPURIOUS EMISSIONS, MID CHANNEL

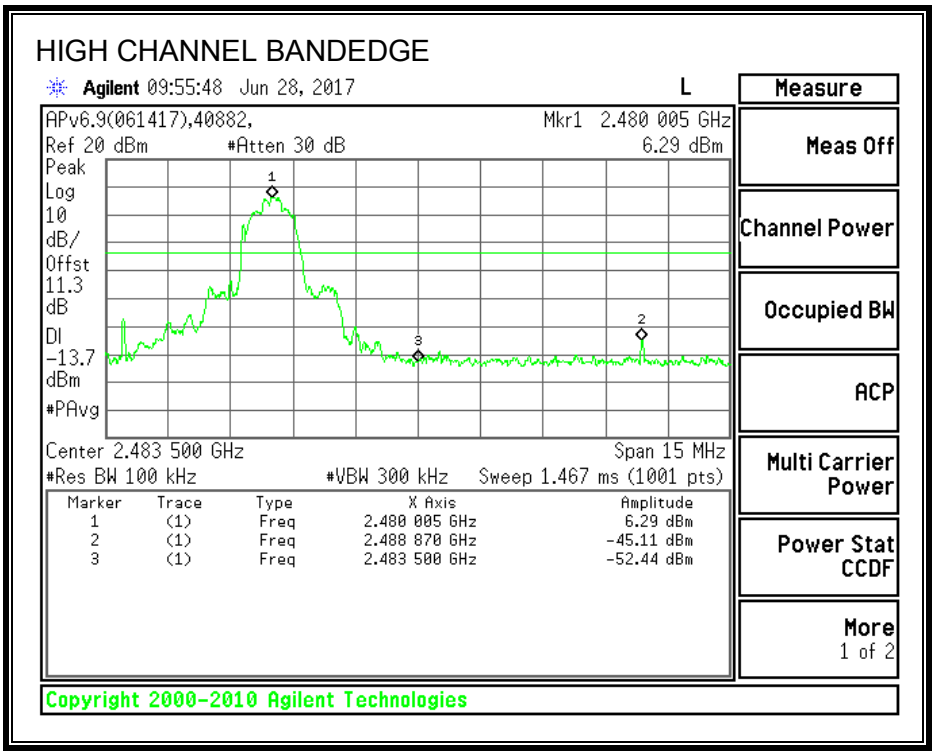
MID CHANNEL REFERENCE

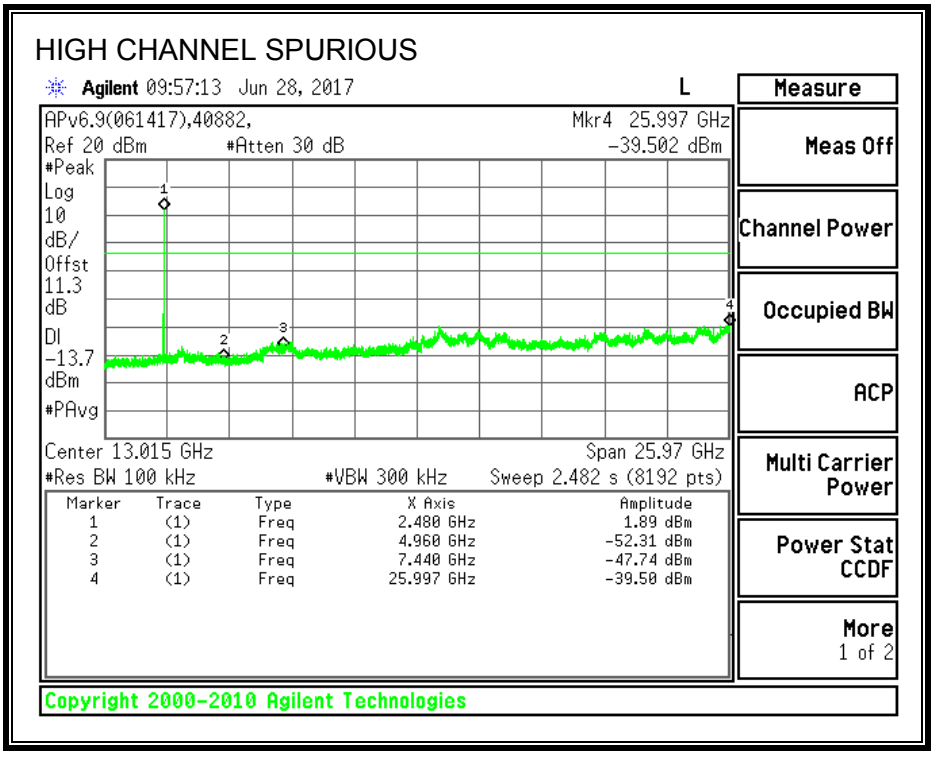


MID CHANNEL SPURIOUS



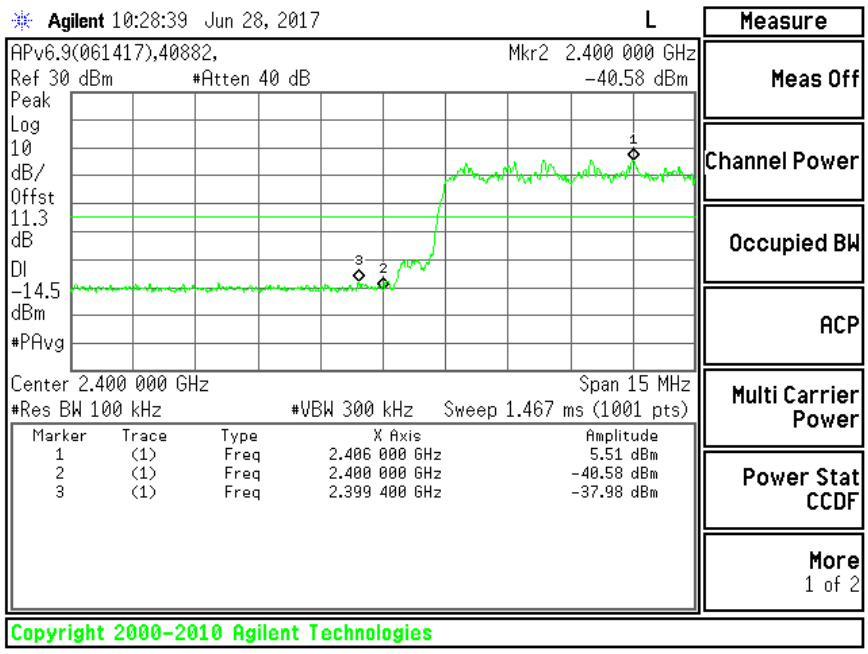
SPURIOUS EMISSIONS, HIGH CHANNEL



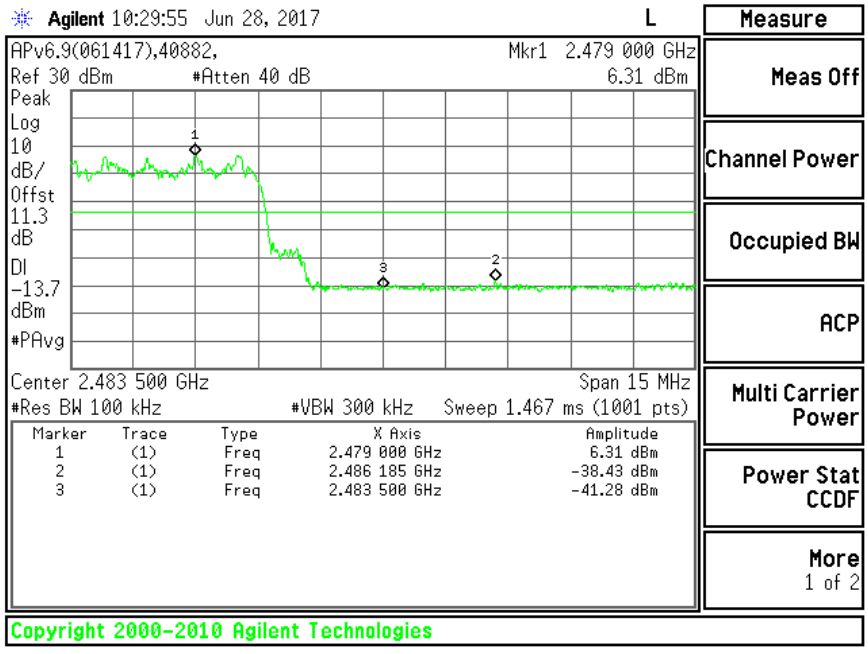


SPURIOUS BANDEDGE EMISSIONS WITH HOPPING ON

LOW BANDEDGE WITH HOPPING ON



HIGH BANDEDGE WITH HOPPING ON



9. RADIATED TEST RESULTS

9.1. LIMITS AND PROCEDURE

LIMITS

FCC §15.205 and §15.209
IC RSS-GEN Clause 8.9 (Transmitter)

Frequency Range (MHz)	Field Strength Limit (uV/m) at 3 m	Field Strength Limit (dBuV/m) at 3 m
0.009-0.490	2400/F(kHz) @ 300 m	-
0.490-1.705	24000/F(kHz) @ 30 m	-
1.705 - 30	30 @ 30m	-
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 below 1GHz measurements and 1.5 m above the ground plane for above 1GHz measurements. The antenna to EUT distance is 3 meters.

For measurements below 1 GHz the resolution bandwidth is set to 120 kHz for peak detection measurements or 120 kHz for quasi-peak detection measurements for the 30-1000 MHz range, 9 kHz for peak detection measurements or 9 kHz for quasi-peak detection measurements for the 0.15-30 MHz range and 200 Hz for peak detection measurements or 200 Hz for quasi-peak detection measurements for the 9 to 150 kHz range. Peak detection is used unless otherwise noted as quasi-peak.

For peak measurements above 1 GHz, the resolution bandwidth is set to 1 MHz and the video bandwidth is set to 3 MHz. For average measurements above 1GHz, the resolution bandwidth and video bandwidth are set as described in ANSI C63.10:2013 for the applicable measurement. The particular averaging method used for this test program was by measuring using a Peak detector with the resolution bandwidth set to 1MHz and a reduced video bandwidth, based on $1/T_{on}$ where T_{on} is the transmit on time.

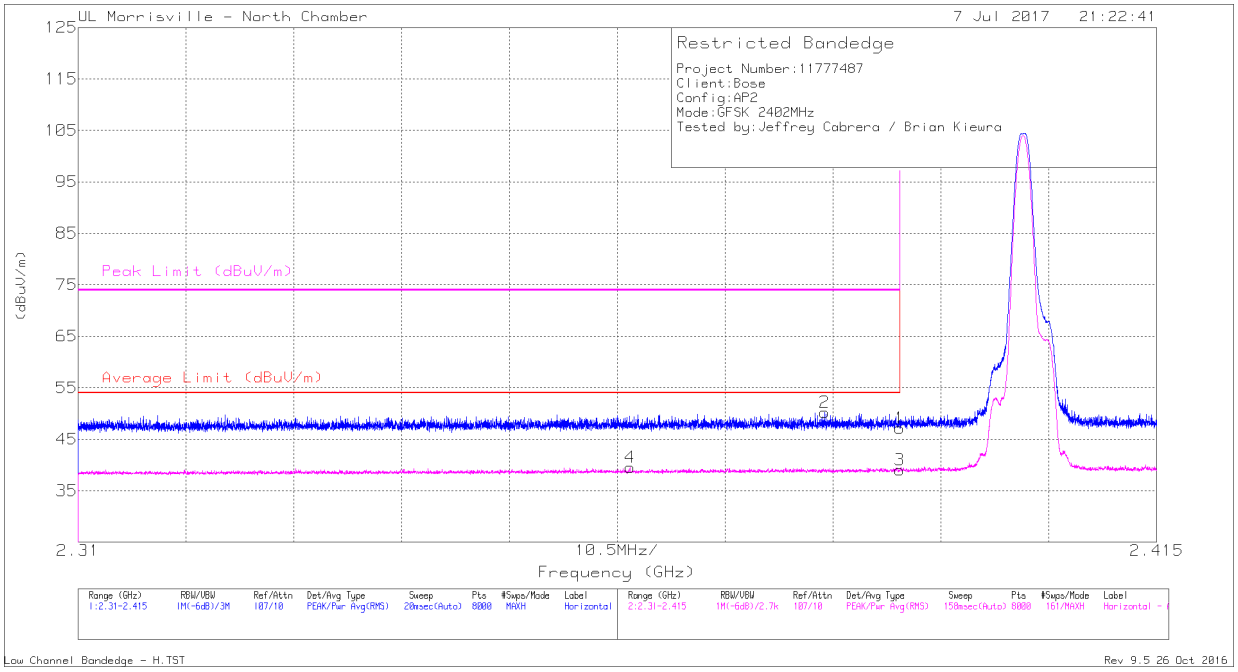
The spectrum from 1 to 18 GHz is investigated with the transmitter set to the lowest, middle, and highest channels in each applicable band. For 9kHz to 1000 MHz and 18 to 26 GHz investigation, the worst-case channel was selected.

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.

9.2. TRANSMITTER ABOVE 1 GHz

9.2.1. BASIC DATA RATE GFSK MODULATION

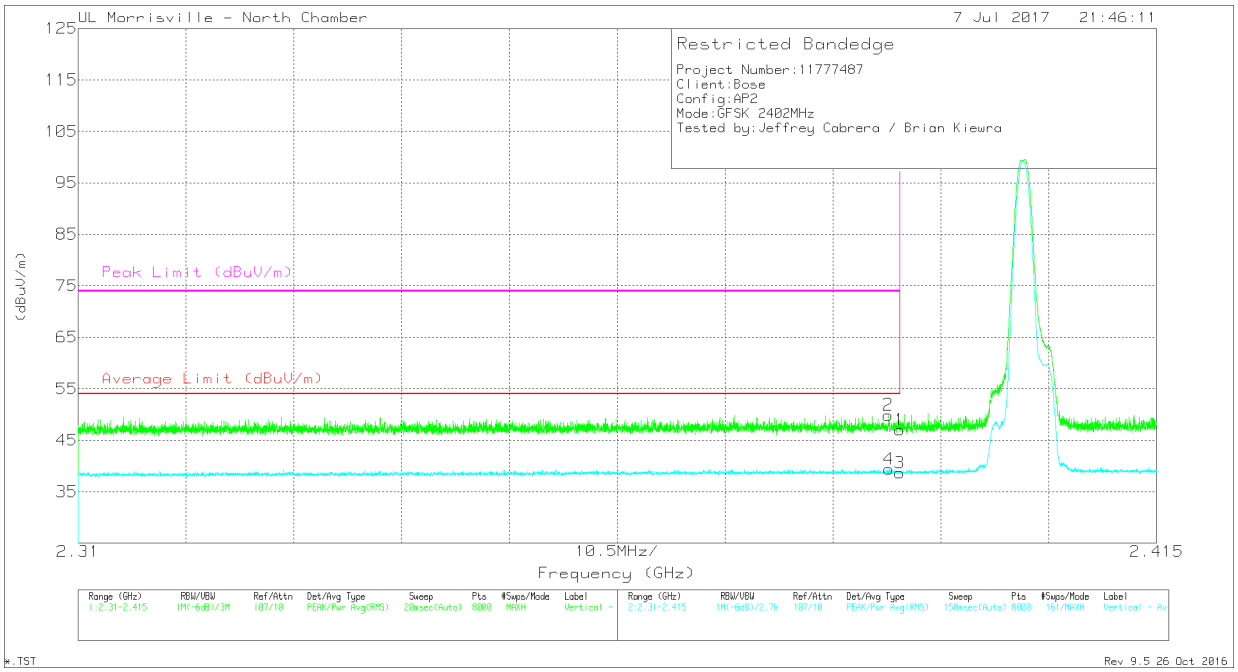
RESTRICTED BANDEDGE (LOW CHANNEL, HORIZONTAL)



Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AT0072 AF (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	39.82	Pk	31.8	-24.5	47.12	-	-	74	-26.88	163	249	H
2	* 2.383	42.94	Pk	31.8	-24.5	50.24	-	-	74	-23.76	163	249	H
3	* 2.39	31.74	V1TR	31.8	-24.5	39.04	54	-14.96	-	-	163	249	H
4	* 2.364	32.34	V1TR	31.7	-24.5	39.54	54	-14.46	-	-	163	249	H

* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band
Pk - Peak detector
V1TR: VB=1/Ton, where: Ton is packet duration

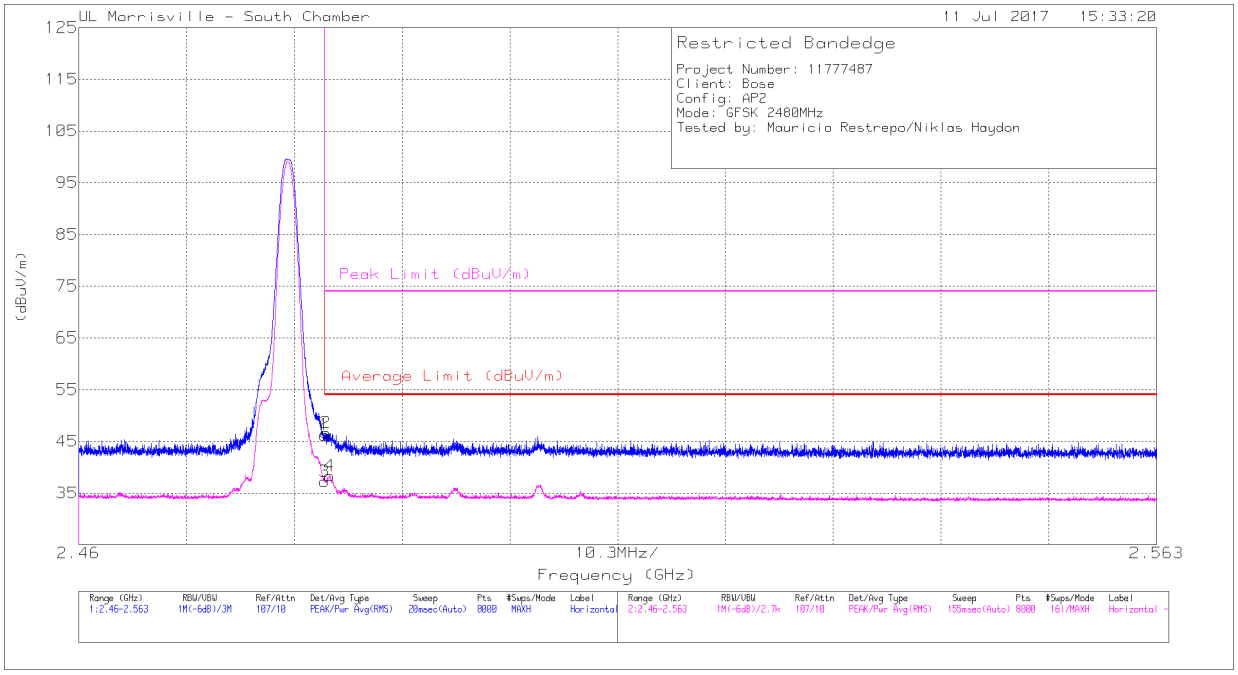
RESTRICTED BANDEDGE (LOW CHANNEL, VERTICAL)



Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AT0072 AF (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	39.69	Pk	31.8	-24.5	46.99	-	-	74	-27.01	287	399	V
2	* 2.389	42.59	Pk	31.8	-24.5	49.89	-	-	74	-24.11	287	399	V
3	* 2.39	31.33	V1TR	31.8	-24.5	38.63	54	-15.37	-	-	287	399	V
4	* 2.389	32.08	V1TR	31.8	-24.5	39.38	54	-14.62	-	-	287	399	V

* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band
Pk - Peak detector
V1TR: VB=1/Ton, where: Ton is packet duration

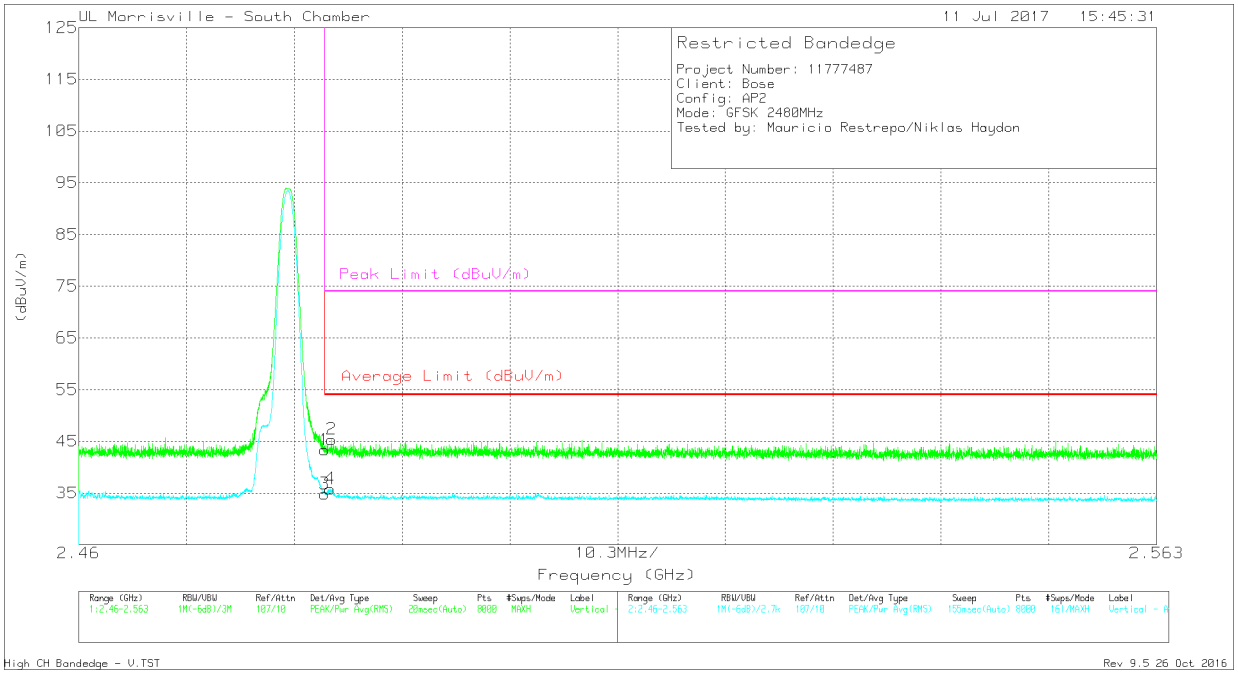
RESTRICTED BANDEDGE (HIGH CHANNEL, HORIZONTAL)



Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AT0069 AF (dB/m)	Amp/Cbl/Fltr/Pad (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.484	38.45	Pk	32.4	-24.6	46.25	-	-	74	-27.75	56	284	H
2	* 2.484	38.87	Pk	32.4	-24.6	46.67	-	-	74	-27.33	56	284	H
3	* 2.484	29.43	V1TR	32.4	-24.6	37.23	54	-16.77	-	-	56	284	H
4	* 2.484	30.53	V1TR	32.4	-24.6	38.33	54	-15.67	-	-	56	284	H

* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band
Pk - Peak detector
V1TR: VB=1/Ton, where: Ton is packet duration

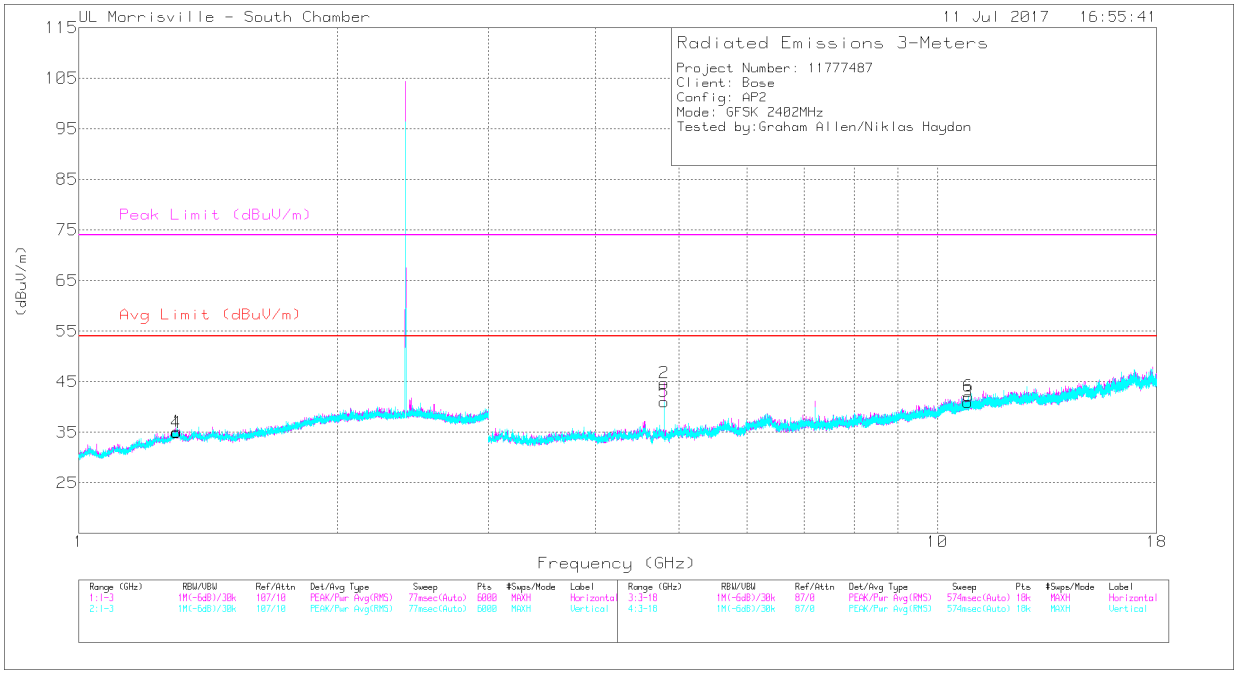
RESTRICTED BANDEDGE (HIGH CHANNEL, VERTICAL)



Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AT0069 AF (dB/m)	Amp/Cbl/Fltr/Pad (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.484	35.55	Pk	32.4	-24.6	43.35	-	-	74	-30.65	74	316	V
2	* 2.484	37.58	Pk	32.4	-24.6	45.38	-	-	74	-28.62	74	316	V
3	* 2.484	27.04	V1TR	32.4	-24.6	34.84	54	-19.16	-	-	74	316	V
4	* 2.484	28.02	V1TR	32.4	-24.6	35.82	54	-18.18	-	-	74	316	V

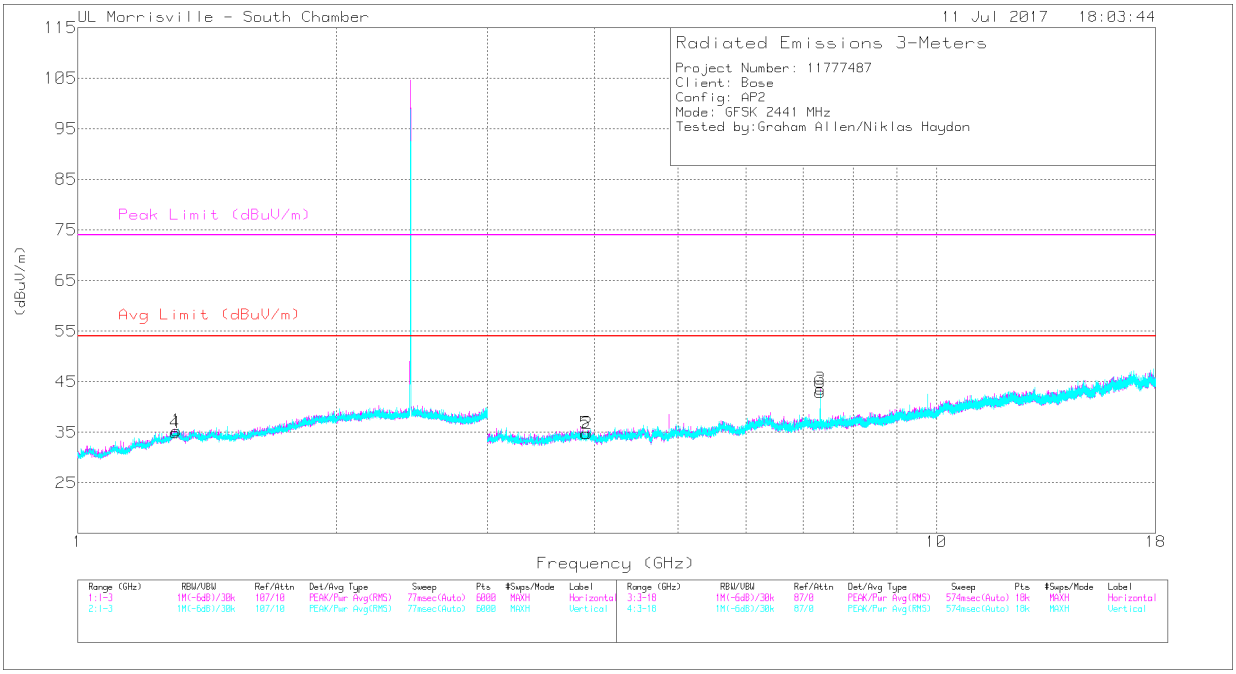
* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band
Pk - Peak detector
V1TR: VB=1/Ton, where: Ton is packet duration

HARMONICS AND SPURIOUS EMISSIONS



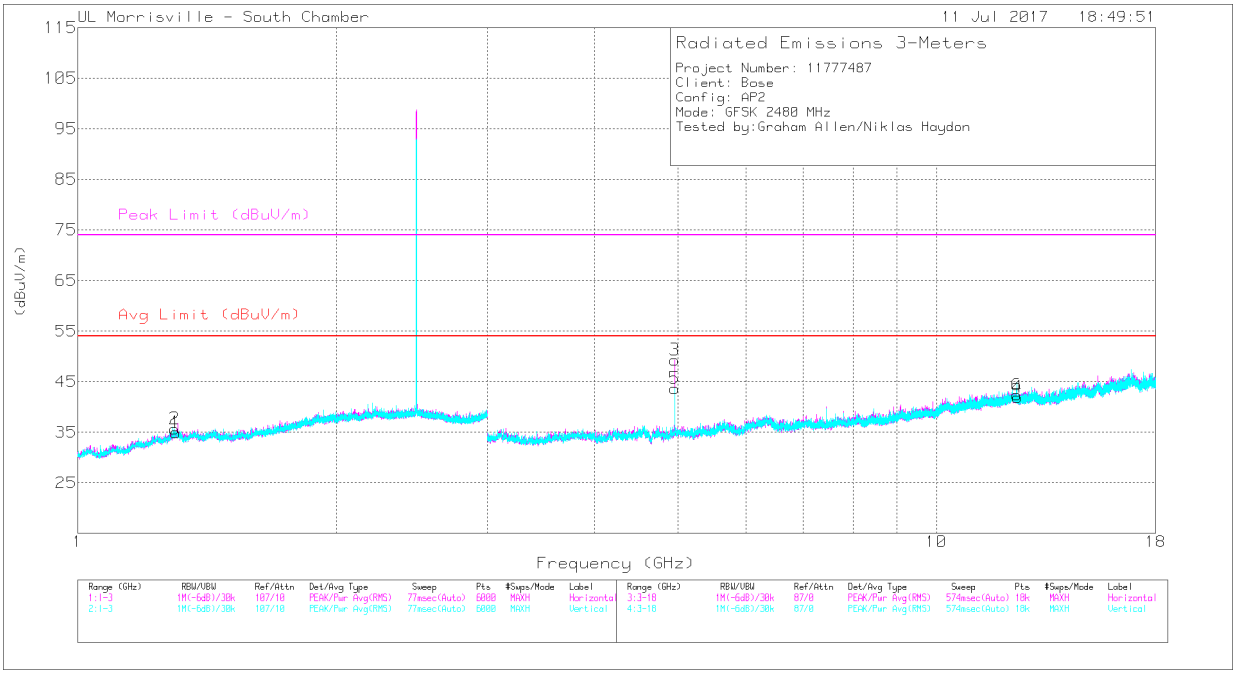
Markers	Frequency (GHz)	Meter Reading (dBuV)	Det	AT0069 AF (dB/m)	Amp/Cbl/Fltr/Pad (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 1.301	35.82	PK-U	29.2	-23.2	41.82	-	-	74	-32.18	192	392	H
	* 1.302	25.38	V1TR	29.2	-23.1	31.48	54	-22.52	-	-	192	392	H
4	* 1.296	36.74	PK-U	29.1	-23.2	42.64	-	-	74	-31.36	231	230	V
	* 1.296	25.3	V1TR	29.1	-23.2	31.2	54	-22.8	-	-	231	230	V
2	* 4.804	47.27	PK-U	34	-31.1	50.17	-	-	74	-23.83	54	105	H
	* 4.804	42.46	V1TR	34	-31.1	45.36	54	-8.64	-	-	54	105	H
3	* 10.844	34.57	PK-U	37.9	-25	47.47	-	-	74	-26.53	174	322	H
	* 10.843	24.57	V1TR	37.9	-25	37.47	54	-16.53	-	-	174	322	H
5	* 4.804	45.39	PK-U	34	-31.1	48.29	-	-	74	-25.71	200	103	V
	* 4.804	39.37	V1TR	34	-31.1	42.27	54	-11.73	-	-	200	103	V
6	* 10.876	35.85	PK-U	37.9	-25	48.75	-	-	74	-25.25	37	286	V
	* 10.877	25.06	V1TR	37.9	-25	37.96	54	-16.04	-	-	37	286	V

* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band
PK-U: Maximum Peak
V1TR: VB=1/Ton, where: Ton is packet duration



Markers	Frequency (GHz)	Meter Reading (dBuV)	Det	AT0069 AF (dB/m)	Amp/Cbl/Fltr/Pad (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 1.304	36.19	PK-U	29.1	-23.1	42.19	-	-	74	-31.81	189	223	H
	* 1.303	25.5	V1TR	29.2	-23.1	31.6	54	-22.4	-	-	189	223	H
2	* 3.921	40.99	PK-U	33.3	-32.1	42.19	-	-	74	-31.81	290	113	H
	* 3.92	29.82	V1TR	33.3	-32.1	31.02	54	-22.98	-	-	290	113	H
3	* 7.323	41.39	PK-U	35.5	-27.9	48.99	-	-	74	-25.01	300	111	H
	* 7.323	34.58	V1TR	35.5	-27.9	42.18	54	-11.82	-	-	300	111	H
4	* 1.3	35.85	PK-U	29.2	-23.2	41.85	-	-	74	-32.15	111	390	V
	* 1.299	25.33	V1TR	29.2	-23.2	31.33	54	-22.67	-	-	111	390	V
5	* 3.904	40.16	PK-U	33.3	-32.2	41.26	-	-	74	-32.74	332	140	V
	* 3.903	29.71	V1TR	33.3	-32.2	30.81	54	-23.19	-	-	332	140	V
6	* 7.323	41	PK-U	35.5	-27.9	48.6	-	-	74	-25.4	195	110	V
	* 7.323	34.21	V1TR	35.5	-27.9	41.81	54	-12.19	-	-	195	110	V

* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band
PK-U: Maximum Peak
V1TR: VB=1/Ton, where: Ton is packet duration

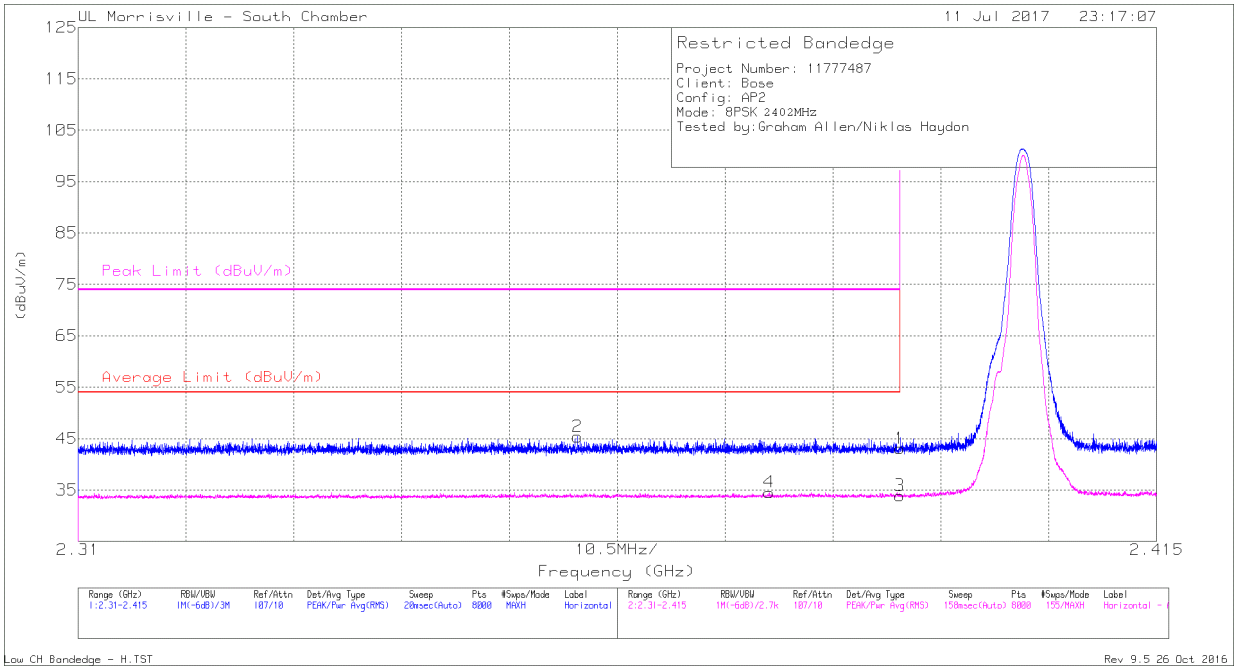


Markers	Frequency (GHz)	Meter Reading (dBuV)	Det	AT0069 AF (dB/m)	Amp/Cbl/Fltr/Pad (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
2	* 1.3	36.3	PK-U	29.2	-23.2	42.3	-	-	74	-31.7	76	377	H
	* 1.301	25.46	V1TR	29.2	-23.2	31.46	54	-22.54	-	-	76	377	H
6	* 4.96	48.56	PK-U	34	-31.3	51.26	-	-	74	-22.74	339	105	H
	* 4.96	44.44	V1TR	34	-31.3	47.14	54	-6.86	-	-	339	105	H
4	* 12.428	34.41	PK-U	38.9	-24.6	48.71	-	-	74	-25.29	40	366	H
	* 12.428	24.19	V1TR	38.9	-24.6	38.49	54	-15.51	-	-	40	366	H
1	* 1.298	35.62	PK-U	29.2	-23.2	41.62	-	-	74	-32.38	194	273	V
	* 1.297	25.55	V1TR	29.2	-23.2	31.55	54	-22.45	-	-	194	273	V
3	* 4.96	45.59	PK-U	34	-31.3	48.29	-	-	74	-25.71	234	109	V
	* 4.96	40.41	V1TR	34	-31.3	43.11	54	-10.89	-	-	234	109	V
5	* 12.41	34.5	PK-U	38.9	-24.6	48.8	-	-	74	-25.2	330	215	V
	* 12.41	24.24	V1TR	38.9	-24.6	38.54	54	-15.46	-	-	330	215	V

* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band
PK-U: Maximum Peak
V1TR: VB=1/Ton, where: Ton is packet duration

9.2.2. ENHANCED DATA RATE 8PSK MODULATION

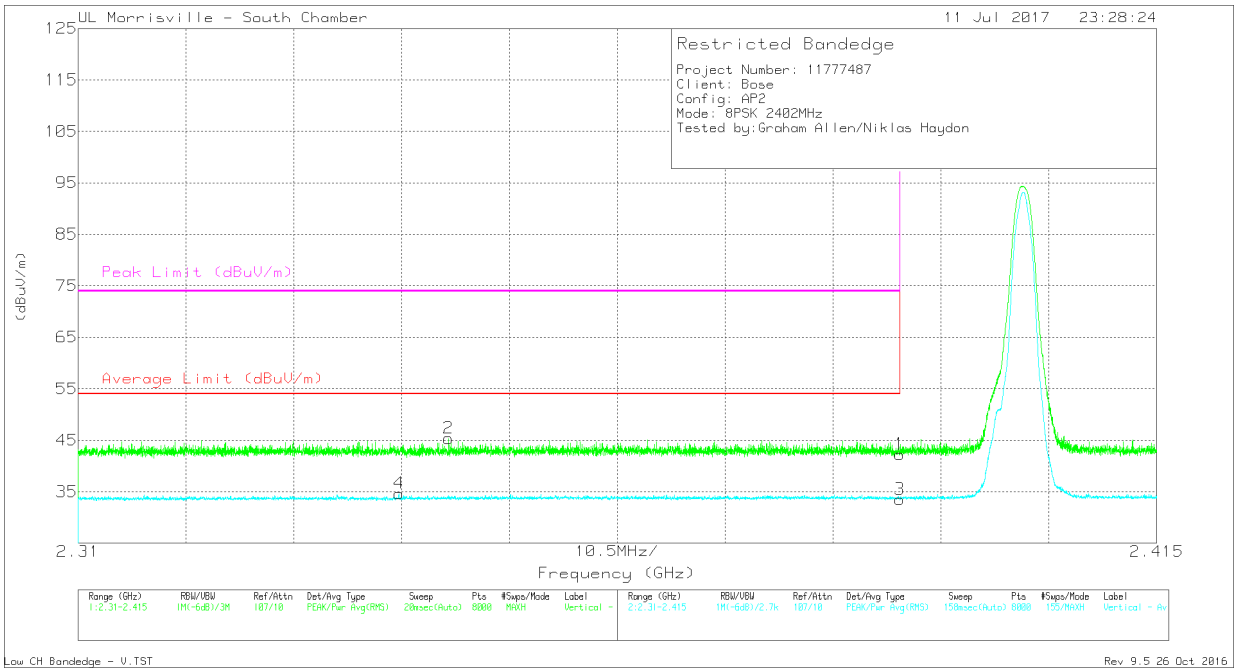
RESTRICTED BANDEDGE (LOW CHANNEL, HORIZONTAL)



Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AT0069 AF (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	35.27	Pk	31.9	-24.1	43.07	-	-	74	-30.93	54	187	H
2	* 2.359	37.38	Pk	31.8	-23.8	45.38	-	-	74	-28.62	54	187	H
3	* 2.39	26.11	V1TR	31.9	-24.1	33.91	54	-20.09	-	-	54	187	H
4	* 2.377	26.65	V1TR	31.9	-24	34.55	54	-19.45	-	-	54	187	H

* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band
Pk - Peak detector
V1TR: VB=1/Ton, where: Ton is packet duration

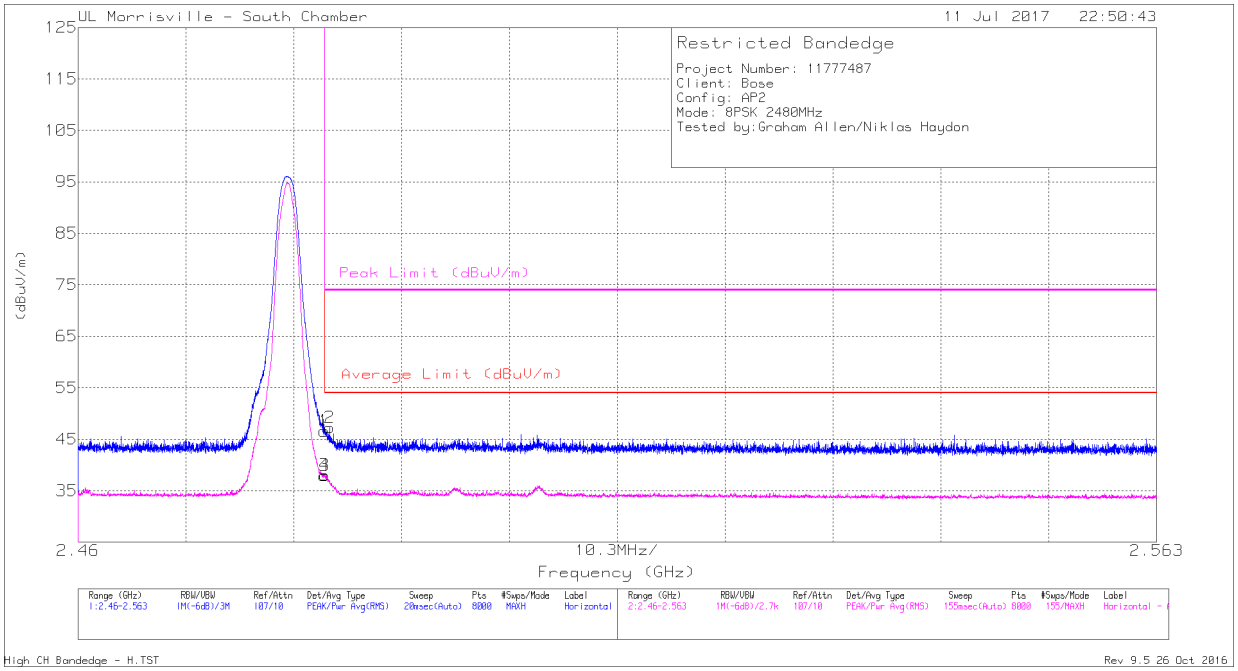
RESTRICTED BANDEDGE (LOW CHANNEL, VERTICAL)



Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AT0069 AF (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	34.48	Pk	31.9	-24.1	42.28	-	-	74	-31.72	140	290	V
2	* 2.346	37.47	Pk	31.7	-23.8	45.37	-	-	74	-28.63	140	290	V
3	* 2.39	25.74	V1TR	31.9	-24.1	33.54	54	-20.46	-	-	140	290	V
4	* 2.341	26.87	V1TR	31.7	-23.9	34.67	54	-19.33	-	-	140	290	V

* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band
Pk - Peak detector
V1TR: VB=1/Ton, where: Ton is packet duration

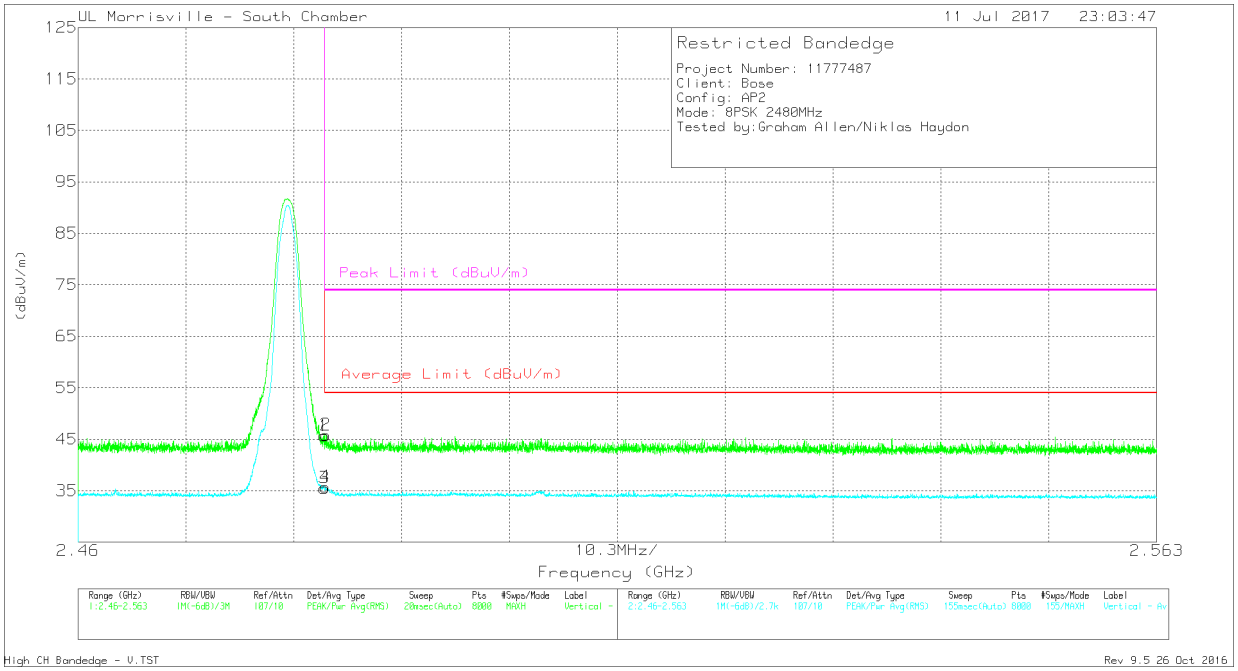
RESTRICTED BANDEDGE (HIGH CHANNEL, HORIZONTAL)



Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AT0069 AF (dB/m)	Amp/Cbl/Fltr/Pad (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.484	38.81	Pk	32.4	-24.6	46.61	-	-	74	-27.39	51	332	H
2	* 2.484	39.46	Pk	32.4	-24.6	47.26	-	-	74	-26.74	51	332	H
3	* 2.484	30.18	V1TR	32.4	-24.6	37.98	54	-16.02	-	-	51	332	H
4	* 2.484	30.26	V1TR	32.4	-24.6	38.06	54	-15.94	-	-	51	332	H

* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band
Pk - Peak detector
V1TR: VB=1/Ton, where: Ton is packet duration

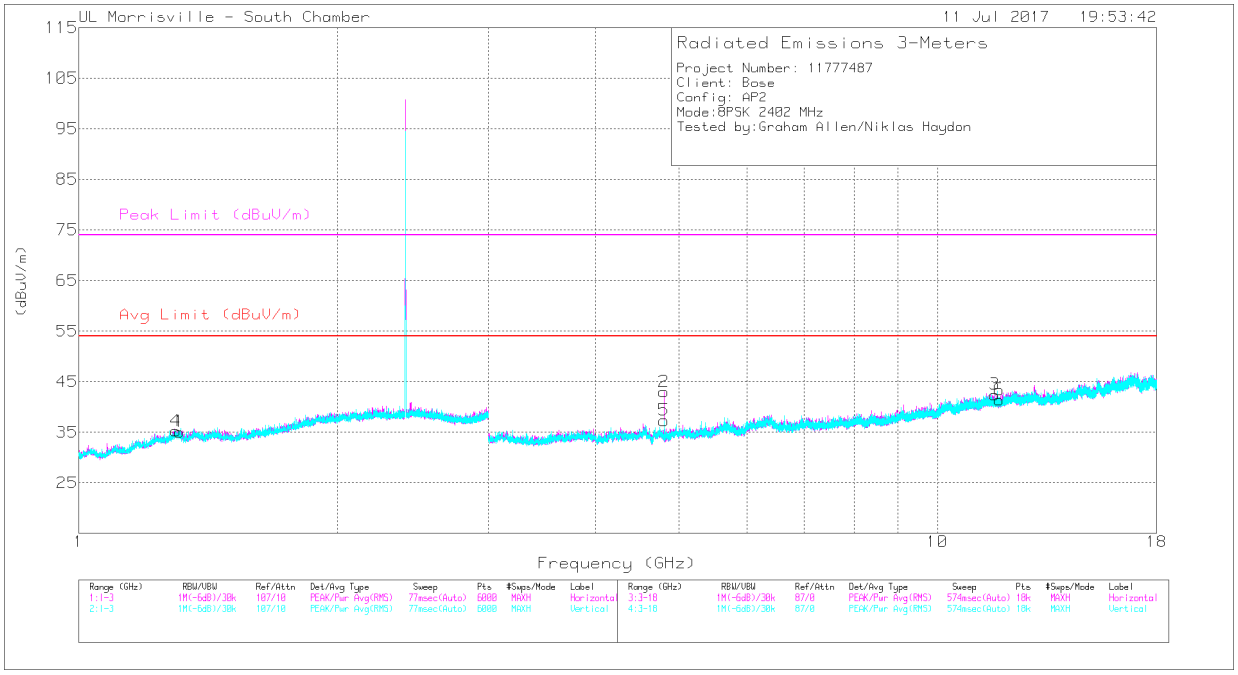
RESTRICTED BANDEDGE (HIGH CHANNEL, VERTICAL)



Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AT0069 AF (dB/m)	Amp/Cbl/Fltr/Pad (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.484	37.86	Pk	32.4	-24.6	45.66	-	-	74	-28.34	166	266	V
2	* 2.484	38.05	Pk	32.4	-24.6	45.85	-	-	74	-28.15	166	266	V
3	* 2.484	27.73	V1TR	32.4	-24.6	35.53	54	-18.47	-	-	166	266	V
4	* 2.484	27.95	V1TR	32.4	-24.6	35.75	54	-18.25	-	-	166	266	V

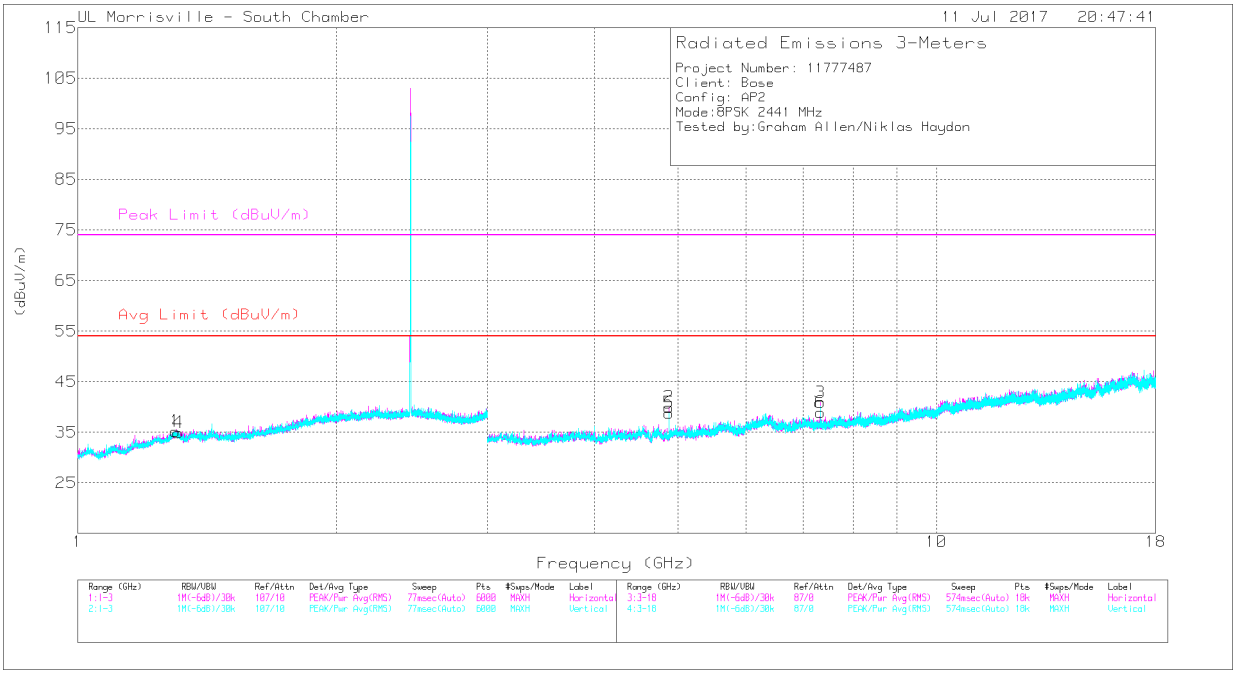
* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band
Pk - Peak detector
V1TR: VB=1/Ton, where: Ton is packet duration

HARMONICS AND SPURIOUS EMISSIONS



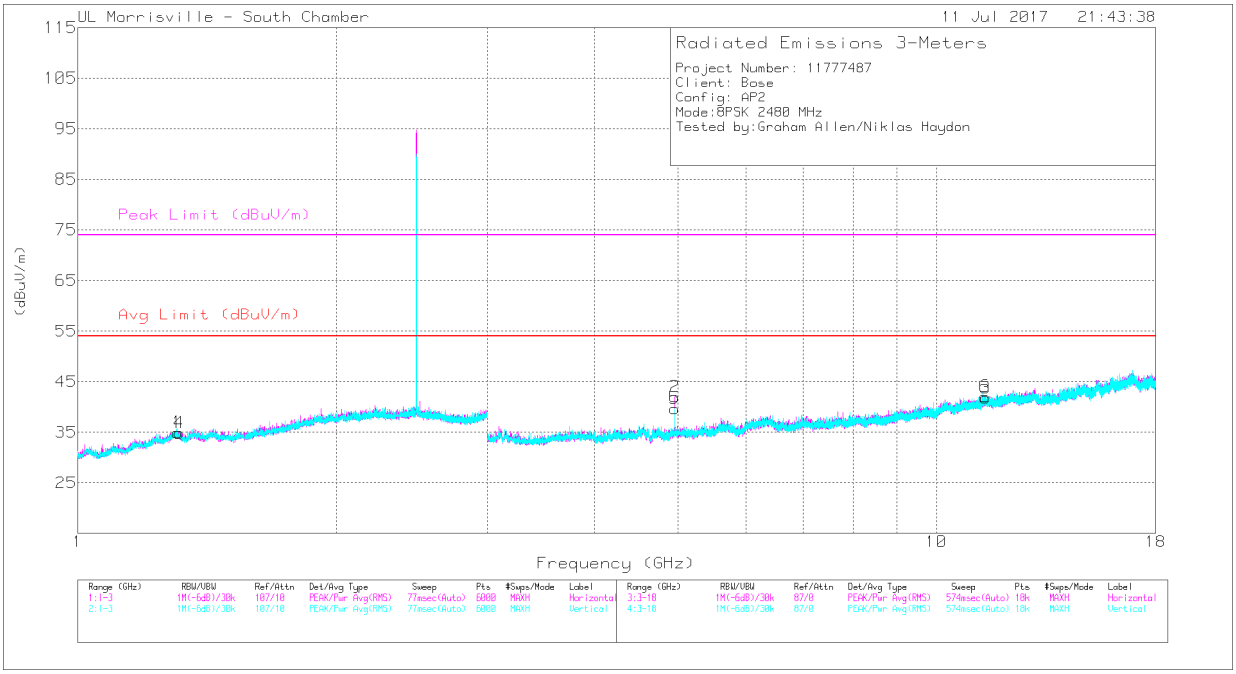
Markers	Frequency (GHz)	Meter Reading (dBuV)	Det	AT0069 AF (dB/m)	Amp/Cbl/Fltr/Pad (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 1.311	35.54	PK-U	29.1	-23.1	41.54	-	-	74	-32.46	348	212	H
	* 1.311	25.16	V1TR	29.1	-23.1	31.16	54	-22.84	-	-	348	212	H
2	* 4.804	44.99	PK-U	34	-31.1	47.89	-	-	74	-26.11	47	105	H
	* 4.804	39.34	V1TR	34	-31.1	42.24	54	-11.76	-	-	47	105	H
3	* 11.657	35.11	PK-U	38.4	-24.8	48.71	-	-	74	-25.29	51	399	H
	* 11.657	24.45	V1TR	38.4	-24.8	38.05	54	-15.95	-	-	51	399	H
4	* 1.297	35.87	PK-U	29.2	-23.2	41.87	-	-	74	-32.13	250	375	V
	* 1.297	25.27	V1TR	29.1	-23.2	31.17	54	-22.83	-	-	250	375	V
5	* 4.804	42.59	PK-U	34	-31.1	45.49	-	-	74	-28.51	214	104	V
	* 4.804	35.22	V1TR	34	-31.1	38.12	54	-15.88	-	-	214	104	V
6	* 11.797	35.02	PK-U	38.6	-24.6	49.02	-	-	74	-24.98	134	347	V
	* 11.797	23.97	V1TR	38.6	-24.6	37.97	54	-16.03	-	-	134	347	V

* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band
PK-U: Maximum Peak
V1TR: VB=1/Ton, where: Ton is packet duration



Markers	Frequency (GHz)	Meter Reading (dBuV)	Det	AT0069 AF (dB/m)	Amp/Cbl/Fltr/Pad (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 1.301	36.18	PK-U	29.2	-23.2	42.18	-	-	74	-31.82	58	117	H
	* 1.301	25.78	V1TR	29.2	-23.2	31.78	54	-22.22	-	-	58	117	H
2	* 4.882	43.2	PK-U	34	-31	46.2	-	-	74	-27.8	338	108	H
	* 4.882	36.36	V1TR	34	-31	39.36	54	-14.64	-	-	338	108	H
3	* 7.323	40.08	PK-U	35.5	-27.9	47.68	-	-	74	-26.32	303	107	H
	* 7.323	31.9	V1TR	35.5	-27.9	39.5	54	-14.5	-	-	303	107	H
4	* 1.31	35.73	PK-U	29.1	-23.1	41.73	-	-	74	-32.27	184	285	V
	* 1.309	25.24	V1TR	29.1	-23.1	31.24	54	-22.76	-	-	184	285	V
5	* 4.882	41.92	PK-U	34	-31	44.92	-	-	74	-29.08	221	106	V
	* 4.882	33.53	V1TR	34	-31	36.53	54	-17.47	-	-	221	106	V
6	* 7.323	39.06	PK-U	35.5	-27.9	46.66	-	-	74	-27.34	186	112	V
	* 7.323	29.93	V1TR	35.5	-27.9	37.53	54	-16.47	-	-	186	112	V

* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band
PK-U: Maximum Peak
V1TR: VB=1/Ton, where: Ton is packet duration



Markers	Frequency (GHz)	Meter Reading (dBuV)	Det	AT0069 AF (dB/m)	Amp/Cbl/Fltr/Pad (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 1.306	35.9	PK-U	29.1	-23.1	41.9	-	-	74	-32.1	167	317	H
	* 1.306	25.33	V1TR	29.1	-23.1	31.33	54	-22.67	-	-	167	317	H
2	* 4.96	46.06	PK-U	34	-31.3	48.76	-	-	74	-25.24	335	127	H
	* 4.96	39.82	V1TR	34	-31.3	42.52	54	-11.48	-	-	335	127	H
3	* 11.41	34.74	PK-U	38.2	-24.1	48.84	-	-	74	-25.16	212	153	H
	* 11.41	24.09	V1TR	38.2	-24.1	38.19	54	-15.81	-	-	212	153	H
4	* 1.311	36.32	PK-U	29.1	-23.1	42.32	-	-	74	-31.68	83	160	V
	* 1.311	25.16	V1TR	29.1	-23.1	31.16	54	-22.84	-	-	83	160	V
5	* 4.96	43.36	PK-U	34	-31.3	46.06	-	-	74	-27.94	223	104	V
	* 4.96	36.53	V1TR	34	-31.3	39.23	54	-14.77	-	-	223	104	V
6	* 11.397	34.34	PK-U	38.1	-23.9	48.54	-	-	74	-25.46	90	130	V
	* 11.397	23.92	V1TR	38.1	-23.9	38.12	54	-15.88	-	-	90	130	V

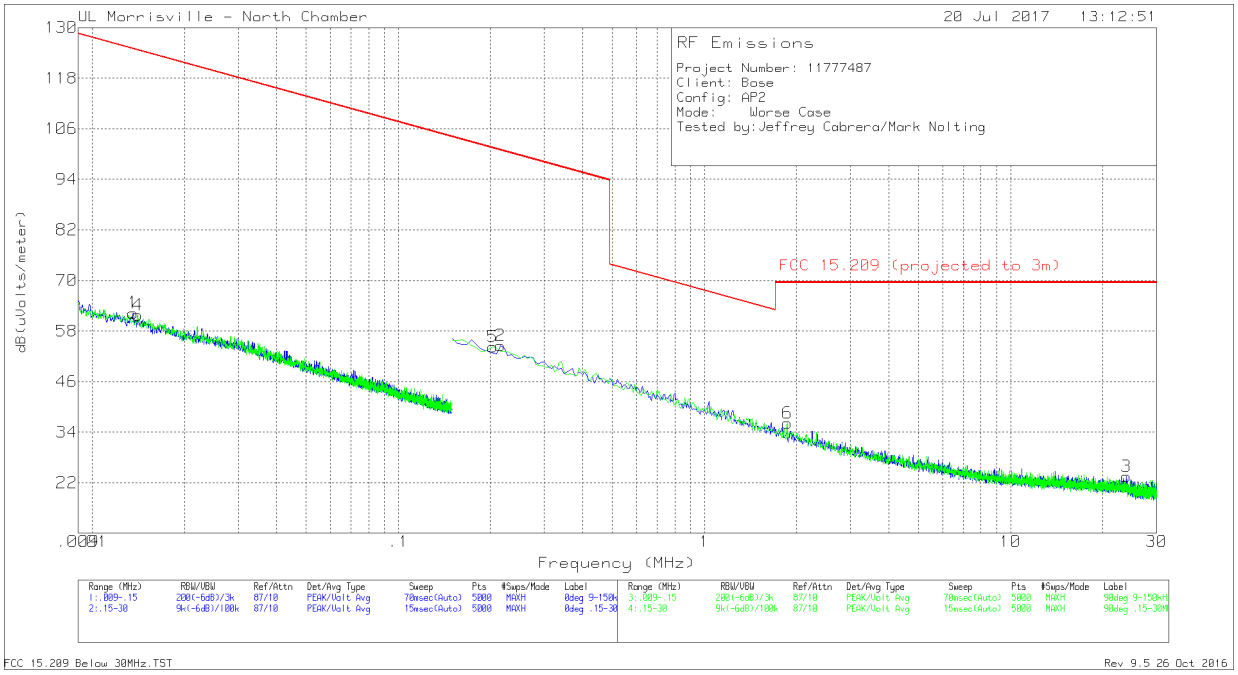
* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band
PK-U: Maximum Peak
V1TR: VB=1/Ton, where: Ton is packet duration

9.3. WORST-CASE

SPURIOUS EMISSIONS 9 kHz TO 30 MHz (WORST-CASE CONFIGURATION)

Note: All measurements were made at a test distance of 3 m. The limits in the plots and tabular data are the FCC/IC limits extrapolated from the specification distance (300 m from 9-490 kHz and 30 m from 490 kHz – 30 MHz) to the measurement distance to clearly show the relative levels of fundamental and spurious emissions and demonstrate compliance with the requirement that the level of any spurious emissions be below the level of the intentionally transmitted signal. The extrapolation factor for the limits were 40*Log (specification distance / test distance).

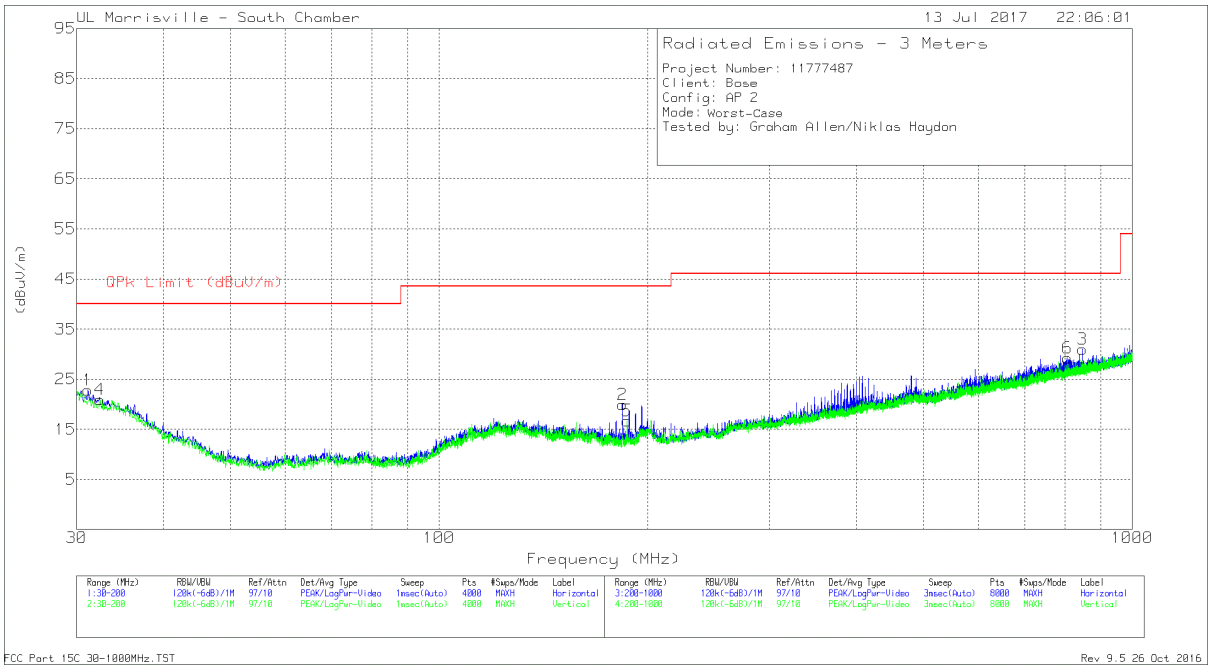
Although these tests were performed at a test site other than an open area test site, adequate comparison measurements were confirmed against an open area test site. Therefore sufficient tests were made to demonstrate that the alternative site produces results that correlate with the ones of tests made in an open field based on KDB 414788.



Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	AT0079 AF (dB/m)	Cbl (dB)	Corrected Reading dB(uVolts/meter)	FCC 15.209 (projected to 3m)	Margin (dB)	Azimuth (Degs)
1	.01359	45.39	Pk	16.8	.1	62.29	124.94	-62.65	0-360
4	.01407	45.08	Pk	16.6	.1	61.78	124.64	-62.86	0-360
5	.20374	43.43	Pk	10.7	.1	54.23	101.42	-47.19	0-360
2	.21568	43.76	Pk	10.7	.1	54.56	100.93	-46.37	0-360
6	1.86368	24.9	Pk	11	.2	36.1	69.54	-33.44	0-360
3	23.92652	13.45	Pk	9.2	.8	23.45	69.54	-46.09	0-360

Pk - Peak detector

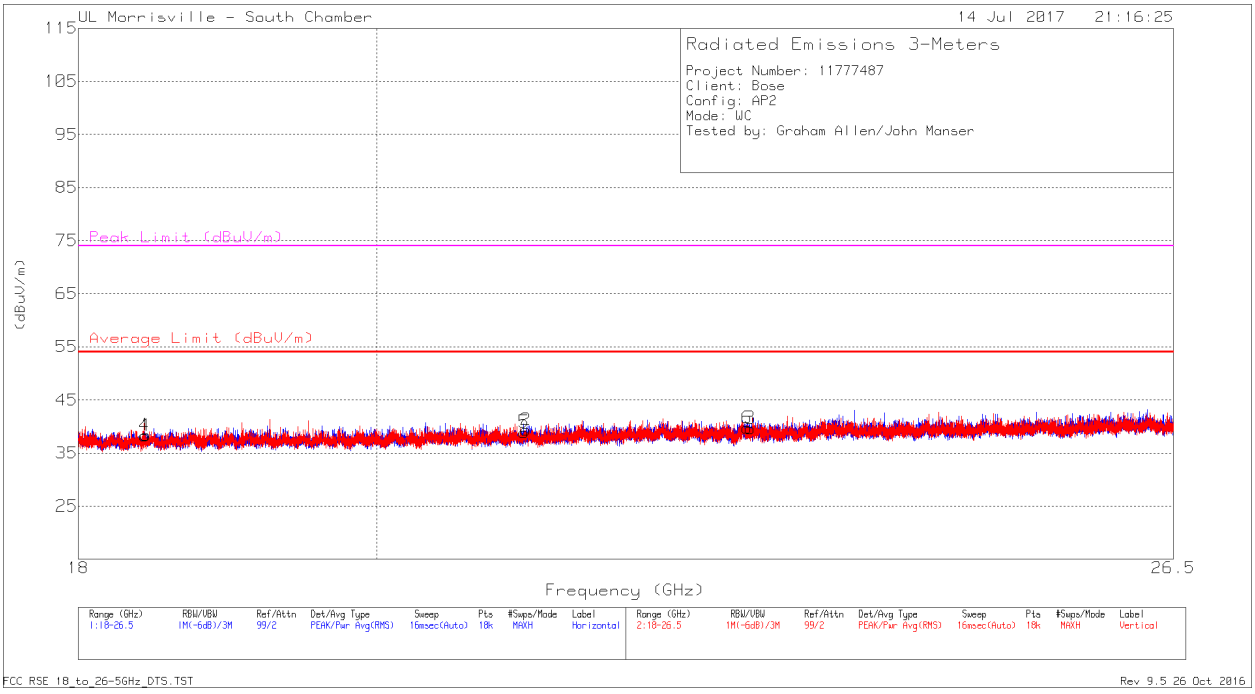
SPURIOUS EMISSIONS 30 TO 1000 MHz (WORST-CASE CONFIGURATION)



Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	AT0074 AF (dB/m)	Cbl/Amp (dB)	Corrected Reading (dBuV/m)	QPk Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	31.1478	29.19	Pk	25.4	-31.8	22.79	40	-17.21	0-360	399	H
2	184.0174	34.63	Pk	15.7	-30.4	19.93	43.52	-23.59	0-360	198	H
3	847.1841	31.99	Pk	26.6	-27.6	30.99	46.02	-15.03	0-360	298	H
4	32.4231	28.2	Pk	24.4	-31.7	20.9	40	-19.1	0-360	102	V
5	186.7806	31.2	Pk	15.8	-30.3	16.7	43.52	-26.82	0-360	102	V
6	806.7789	30.93	Pk	26.2	-27.9	29.23	46.02	-16.79	0-360	199	V

Pk - Peak detector

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



Markers	Frequency (GHz)	Meter Reading (dBuV)	Det	AF AT0076 (dB/m)	Amp/Cbl (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 18.434	47.81	PK-U	32.7	-40.3	40.21	54	-13.79	74	-33.79	305	292	H
2	* 21.085	47.37	PK-U	33.2	-39.7	40.87	54	-13.13	74	-33.13	0	300	H
3	* 22.818	47.42	PK-U	33.7	-39.2	41.92	54	-12.08	74	-32.08	249	241	H
4	* 18.425	47.5	PK-U	32.7	-40.3	39.9	54	-14.1	74	-34.1	255	323	V
5	* 21.069	47.49	PK-U	33.2	-39.7	40.99	54	-13.01	74	-33.01	221	278	V
6	* 22.794	48.31	PK-U	33.7	-39.2	42.81	54	-11.19	74	-31.19	298	125	V

* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band
PK-U: Maximum Peak