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

CERTIFICATION TEST REPORT

FOR

BLUETOOTH AND LORA CELLPHONE CONNECTION ASSISTANT

MODEL NUMBER: BT 007

FCC ID: 2AJY7007
IC: 22043-007

REPORT NUMBER: R11576797-E1

ISSUE DATE: MARCH 21, 2017

Prepared for
BEARTOOTH RADIO, INC.
45 DISCOVERY DRIVE
BOZEMAN, MT 59718 USA

Prepared by
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NVLAP TESTING

NVLAP LAB CODE 200246-0

Revision History

Ver.	Issue Date	Revisions	Revised By
1	03/21/2017	Initial Issue	Brian Kiewra

TABLE OF CONTENTS

1. ATTESTATION OF TEST RESULTS

COMPANY NAME: Beartooth Radio, Inc.
45 Discovery Drive
Bozeman, MT, 59718 USA

EUT DESCRIPTION: Bluetooth and LoRa Cellphone Connection Assistant

MODEL: BT 007

SERIAL NUMBER: BT007170400006-00019

DATE TESTED: 2017-02-21 to 2017-02-28

APPLICABLE STANDARDS	
STANDARD	**TEST RESULTS**
CFR 47 Part 15 Subpart C	Pass
INDUSTRY CANADA (ISED CANADA) RSS-247 Issue 2	Pass
INDUSTRY CANADA (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
EMC Program Manager
UL – Consumer Technology Division

Prepared By:

Brian T. Kiewra
EMC Engineer
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, and 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 Suite B, Perimeter Park Drive, Morrisville, NC 27560.

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 (ISED) 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
RF output power, conducted	±0.45 dB
Power Spectral Density, conducted	±1.50 dB
Unwanted Emissions, conducted	±2.94 dB
All emissions, radiated	±5.36 dB
Conducted Emissions (0.150 – 30MHz)	±3.65 dB
Temperature	±0.07 °C
Humidity	±2.26 %
DC and Low Frequency Voltages	±1.27 %

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

5. EQUIPMENT UNDER TEST

5.1. DESCRIPTION OF EUT

The EUT is a Bluetooth and LoRa cellphone connection assistant.

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	0.97	1.25
2402 - 2480	DQPSK	2.66	1.85
2402 - 2480	Enhanced 8PSK	3.25	2.11

5.3. DESCRIPTION OF AVAILABLE ANTENNAS

The radio utilizes an antenna with a maximum gain of +0.1dBi.

5.4. SOFTWARE AND FIRMWARE

The firmware installed in the EUT during testing was mk1_fcc_test, rev. 1.0.1.

5.5. WORST-CASE CONFIGURATION AND MODE

All testing was performed in all modes except as noted below:

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

Below 1 GHz Radiated emissions and power line conducted emissions were performed with the EUT set to transmit at the channel with the highest output power as the worst-case scenario.

For both Conducted and Radiated Emissions, Enhanced Data rate modes, 8DPSK is considered equivalent to DQPSK or worst-case. Therefore, all tests were performed in 8DPSK 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
Power Supply	Motorola	SSW-2680US SPN5864A	15005-CD-0817337	NA

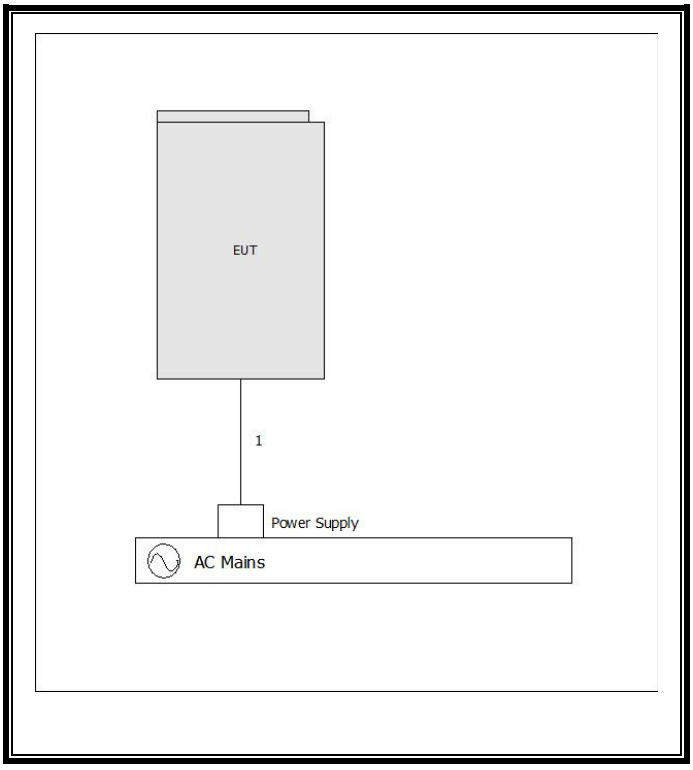
I/O CABLES

I/O Cable List						
Cable No.	Port	# of Identical Ports	Connector Type	Cable Type	Cable Length (m)	Remarks
1	USB	1	µUSB	USB	<3m	NA

TEST SETUP

The EUT is installed in as a standalone device.

SETUP DIAGRAM FOR TESTS



6. TEST AND MEASUREMENT EQUIPMENT

The following test and measurement equipment was utilized for the tests documented in this report:
Radiated Equipment Used For Testing

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
	30-1000 MHz				
AT0073	Hybrid Broadband Antenna	Sunol Sciences Corp.	JB3	2016-06-27	2017-06-30
	1-18 GHz				
AT0072	Double-Ridged Waveguide Horn Antenna, 1 to 18 GHz	ETS Lindgren	3117	2016-03-07	2017-03-31
	18-40 GHz				
AT0076	Horn Antenna, 18-26.5GHz	ARA	MWH-1826/B	2016-09-06	2017-09-06
	Gain-Loss Chains				
N-SAC01	Gain-loss string: 0.009-30MHz	Various	Various	2016-10-04	2017-10-04
N-SAC02	Gain-loss string: 30-1000MHz	Various	Various	2016-06-26	2017-06-30
N-SAC03	Gain-loss string: 1-18GHz	Various	Various	2016-08-28	2017-08-28
N-SAC04	Gain-loss string: 18-40GHz	Various	Various	2016-04-27	2017-04-30
	Receiver & Software				
SA0026	Spectrum Analyzer	Agilent	N9030A	2017-02-17	2018-07-28
SA0026 (18-40GHz RSE)	Spectrum Analyzer	Agilent	N9030A	2017-02-17	2018-07-28
SOFTEMI	EMI Software	UL	Version 9.5	NA	NA
	Additional Equipment used				
	Bluetooth Tester	Rohde & Schwarz	CBT	N/A	N/A

Note – The CBT was used to control Bluetooth modes of operation (Channel, Modulation, Packet Size), but was not used to control the transmit power of the device.

Antenna Port Conducted Equipment Used For Testing

Equipment ID	Description	Manufacturer	Model Number	Last Cal.	Next Cal.
	Conducted Room 1				
72822 (SA0019)	Spectrum Analyzer	Agilent Technologies	E4446A	2016-08-25	2017-08-25
PWM003	RF Power Meter	Keysight Technologies	N1911A	2016-06-21	2017-06-21
PWS003	Peak and Avg Power Sensor, 50MHz to 6GHz	Keysight Technologies	E9323A	2016-06-21	2017-06-21
MM0168	True RMS Multimeter	Agilent	U1232A	2016-10-07	2017-10-31
	Additional Equipment used				
-	Directional Coupler	Mini-Circuits	ZUDC10-183	N/A	N/A
-	Bluetooth Tester	Rohde & Schwarz	CBT	N/A	N/A

Note – The CBT was used to control Bluetooth modes of operation (Channel, Modulation, Packet Size), but was not used to control the transmit power of the device.

Line Conducted Equipment Used For Testing

Equipment ID	Description	Manufacturer	Model Number	Last Cal.	Next Cal.
CBL077	Coax cable, RG223, N-male to BNC-male, 20-ft.	Pasternack	PE3476-240	2016-06-15	2017-06-30
LISN003	LISN, 50-ohm/50-uH, 2-conductor, 25A	Fischer Custom Com.	FCC-LISN-50-25-2-01-550V	2016-08-24	2017-08-24
PRE0101521 (75141)	EMI Test Receiver 9kHz-7GHz	Rohde & Schwarz	ESCI 7	2016-08-23	2017-08-23
TL001	Transient Limiter, 0.009-30MHz	Com-Power	LIT-930A	2016-06-09	2017-06-30
PS215	AC Power Source	Elgar	CW2501M (s/n 1523A02397)	NA	NA
SOFTEMI	EMI Software	UL	Version 9.5	NA	NA
	Miscellaneous (if needed)				
MM0168	True RMS Multimeter	Agilent	U1232A	2016-10-07	2017-10-31
CDECABLE001	ANSI C63.4 1m extension cable.	UL	Per Annex B of ANSI C63.4	2016-06-04	2017-06-30
-	Bluetooth Tester	Rohde & Schwarz	CBT	N/A	N/A

Note – The CBT was used to control Bluetooth modes of operation (Channel, Modulation, Packet Size), but was not used to control the transmit power of the device.

7. ANTENNA PORT TEST RESULTS

7.1. ON TIME AND DUTY CYCLE

LIMITS

None; for reporting purposes only.

PROCEDURE

KDB 558074 Zero-Span Spectrum Analyzer Method.

ON TIME AND DUTY CYCLE RESULTS

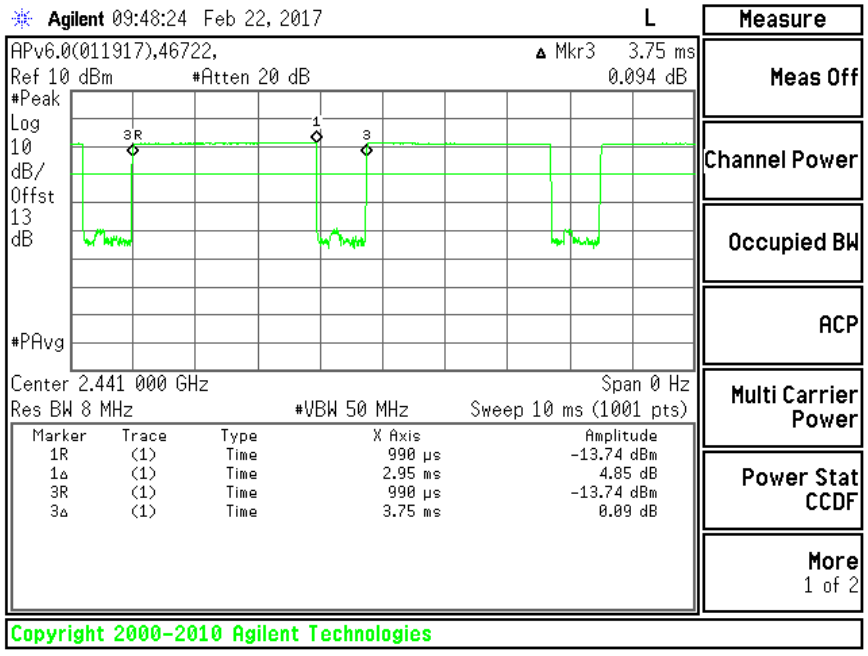
Mode	ON Time B (msec)	Period (msec)	Duty Cycle x (linear)	Duty Cycle (%)	Duty Cycle Correction Factor (dB)	1/B Minimum VBW (kHz)
2.4 GHz band (Hopping OFF)						
Bluetooth GFSK	2.950	3.750	0.787	78.67%	1.04	0.339
Bluetooth 8PSK	2.940	3.750	0.784	78.40%	1.06	0.340

TEST INFORMATION
Date: 2017-02-22
Project No: 11576797
Tester: John Manser

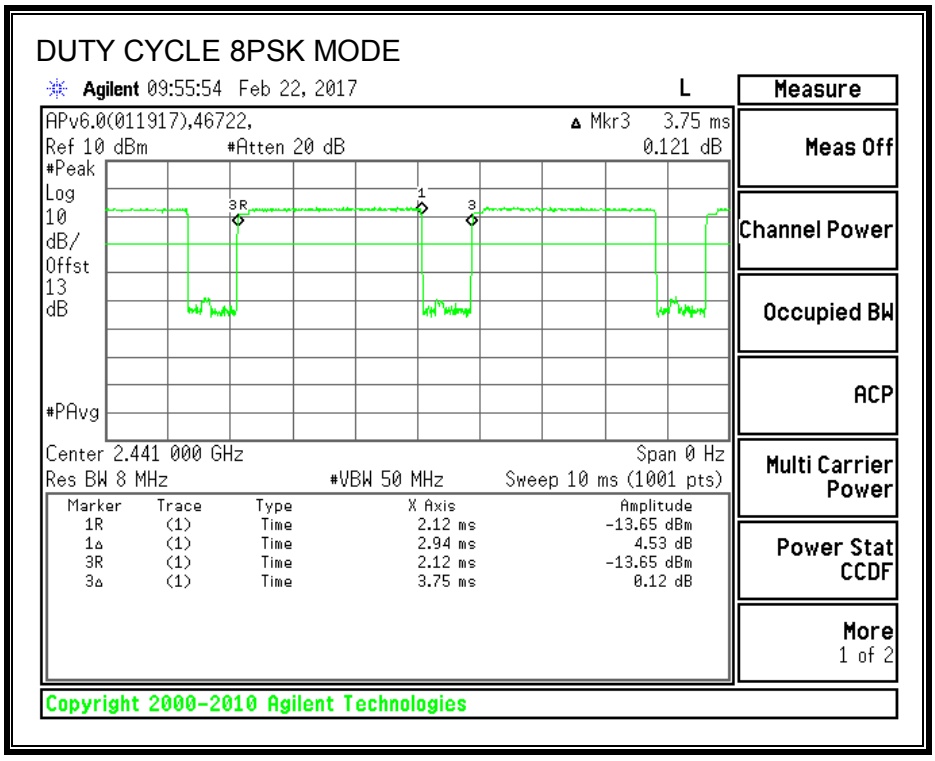
DUTY CYCLE PLOTS

HOPPING OFF

DUTY CYCLE GFSK MODE



DUTY CYCLE 8PSK MODE



7.2. BASIC DATA RATE GFSK MODULATION

7.2.1. 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.

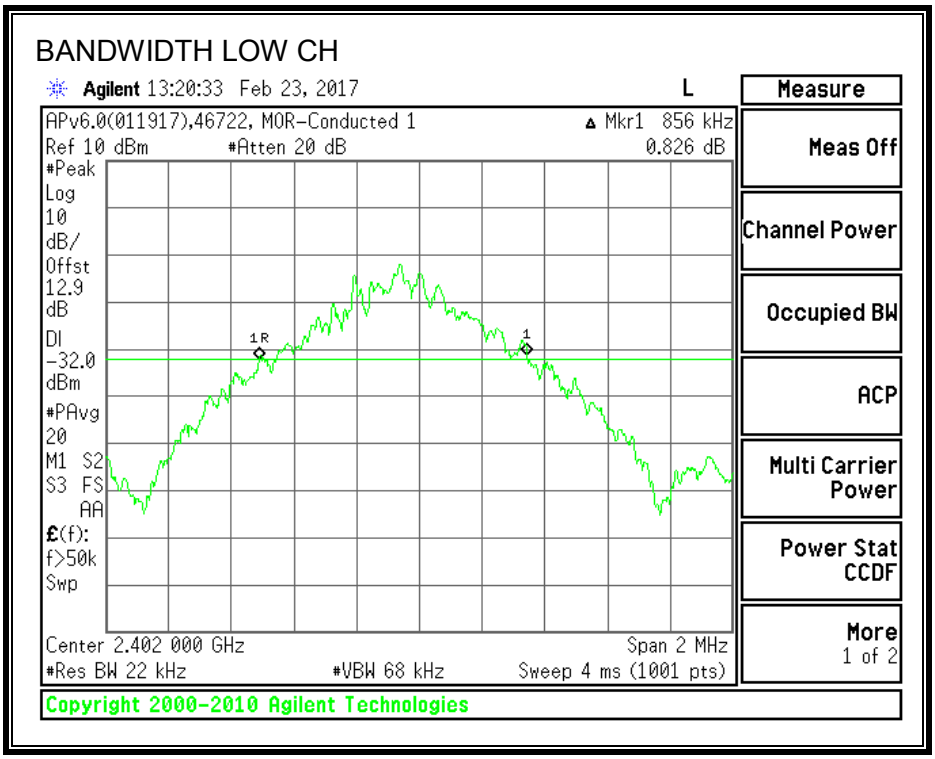
TEST PROCEDURE

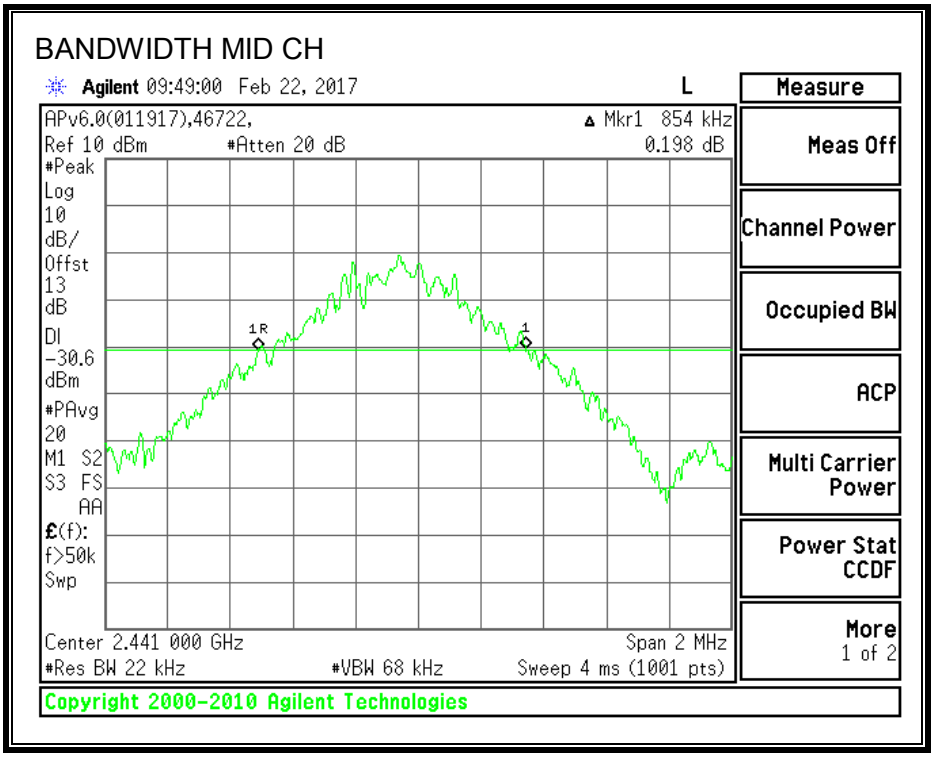
The transmitter output is connected to a spectrum analyzer. The RBW is set to 1-5% of the 20 dB bandwidth and 99% Occupied Bandwidth. The VBW is set to ≥ RBW. The sweep time is coupled.

RESULTS

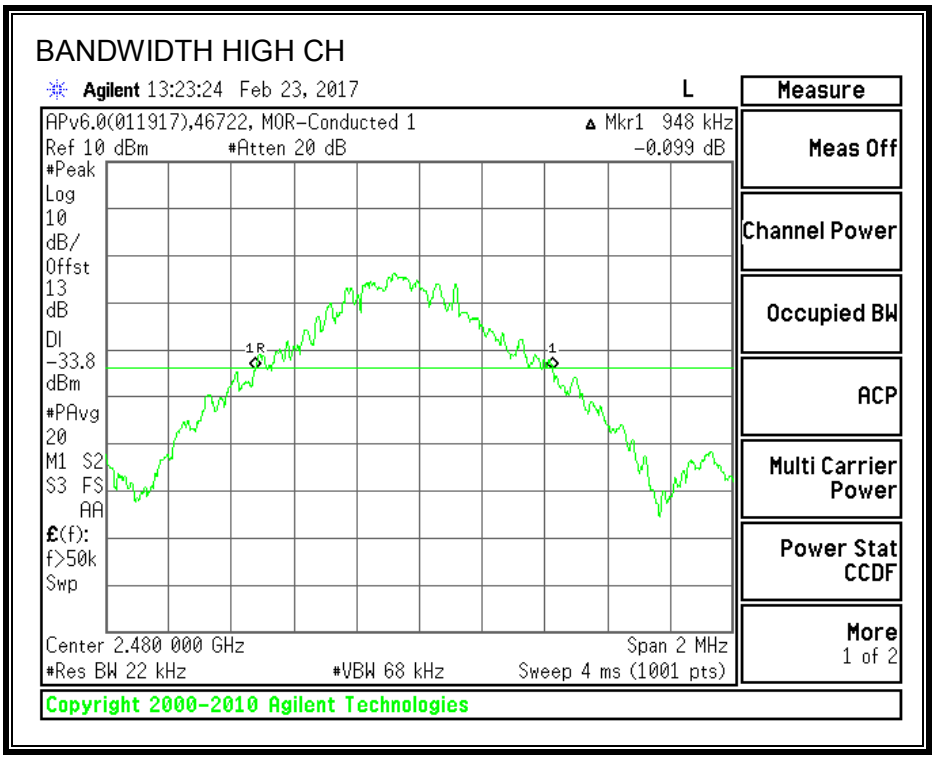
Channel	Frequency (MHz)	20 dB Bandwidth (kHz)	99% Bandwidth (kHz)
Low	2402	856	880.3669
Middle	2441	854	884.2437
High	2480	948	882.3831

20 dB BANDWIDTH

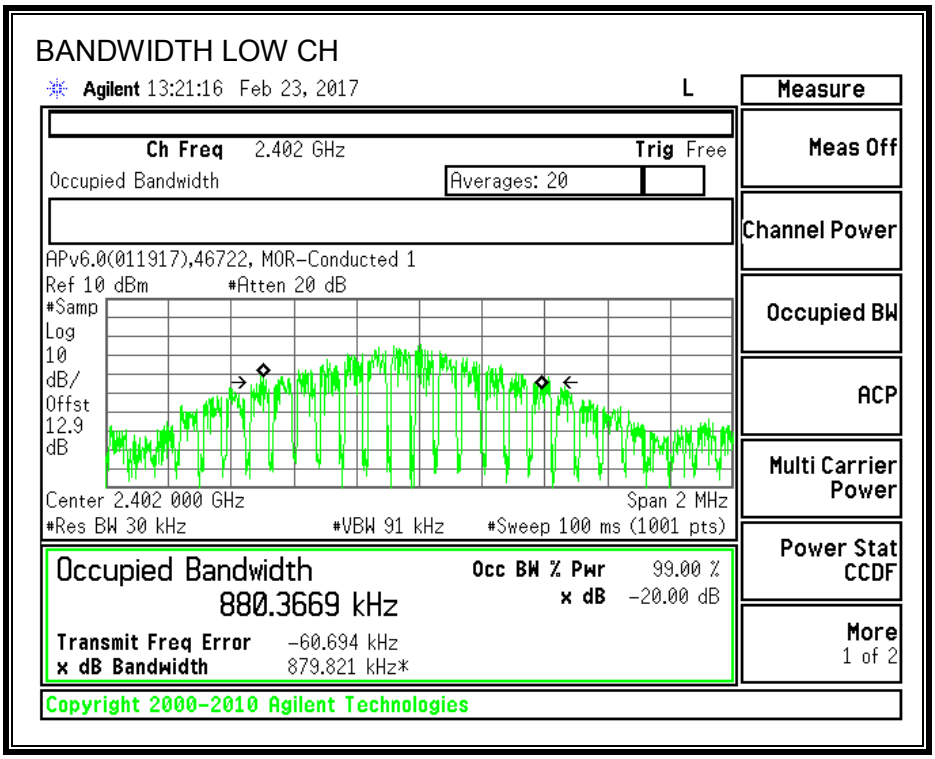


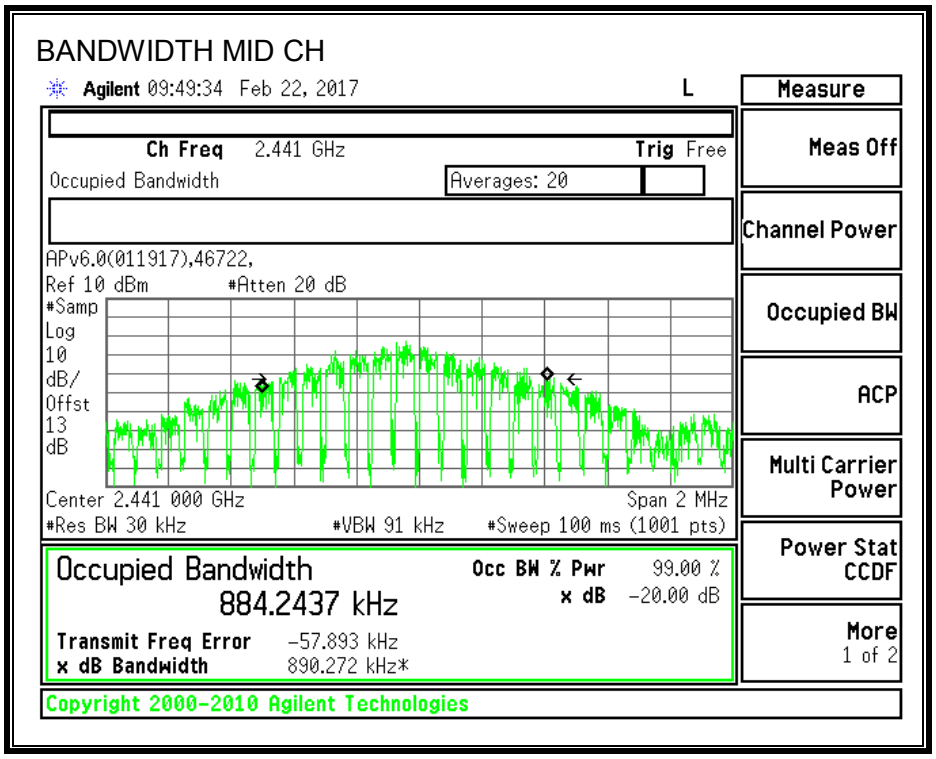


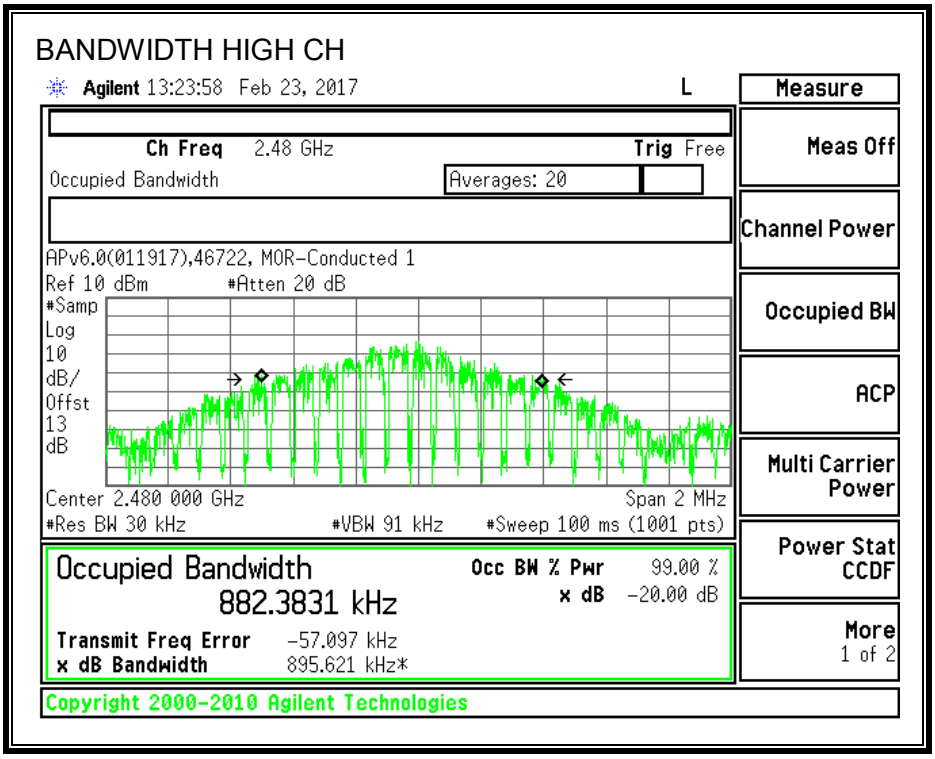
BANDWIDTH HIGH CH



99% BANDWIDTH







TEST INFORMATION

Date: 2017-02-22 and 2017-02-23

Project No: 11576797

Tester: John Manser

7.2.2. HOPPING FREQUENCY SEPARATION

LIMIT

FCC §15.247 (a) (1)

IC RSS-247 5.1 (2)

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

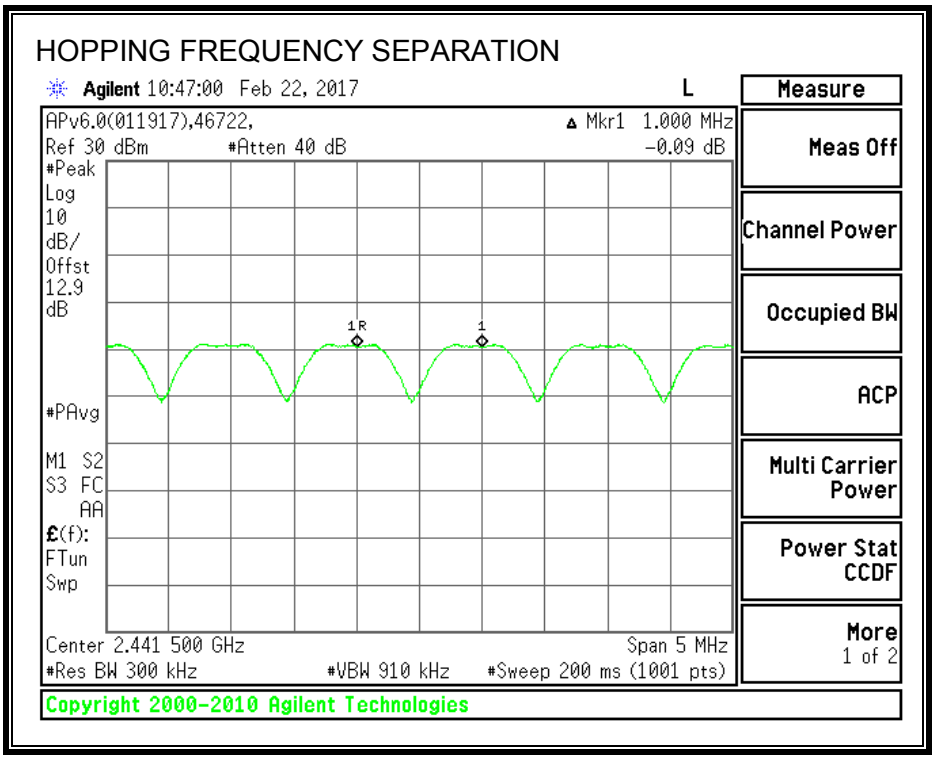
Alternatively, frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than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

TEST PROCEDURE

The transmitter output is connected to a spectrum analyzer. The RBW is set to 30% of channel spacing and the VBW is set such that VBW ≥ RBW. The sweep time is auto.

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	0.854	-0.146

TEST INFORMATION

Date: 2017-02-22

Project No: 11576797

Tester: John Manser

7.2.3. NUMBER OF HOPPING CHANNELS

LIMIT

FCC §15.247 (a) (1) (iii)

IC RSS-247 5.1 (4)

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

TEST PROCEDURE

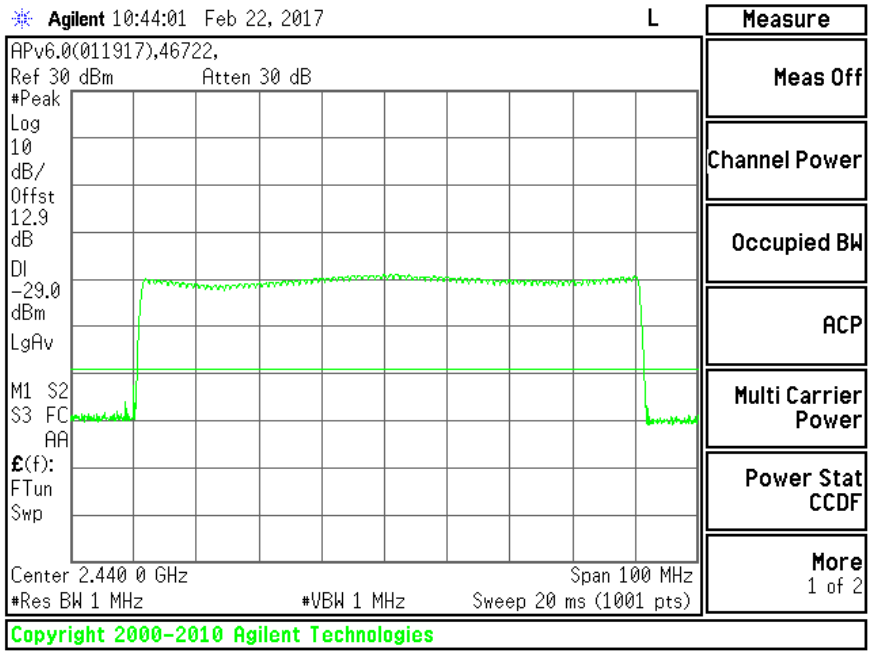
The transmitter output is connected to a spectrum analyzer. The span is set to cover the entire authorized band, in either a single sweep or in multiple contiguous sweeps for visibility of the entire span. Then, smaller spans are set to more clearly identify the channels. The RBW is set to 30% of the channel spacing (approx. 300 kHz). The analyzer is set to Max Hold.

RESULTS

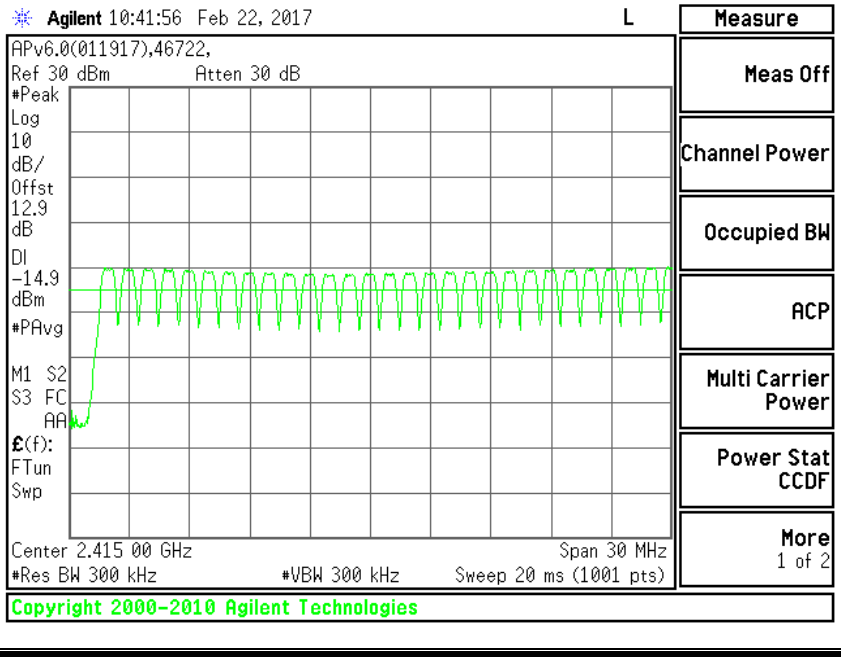
Normal Mode: 79 Channels observed.

NUMBER OF HOPPING CHANNELS

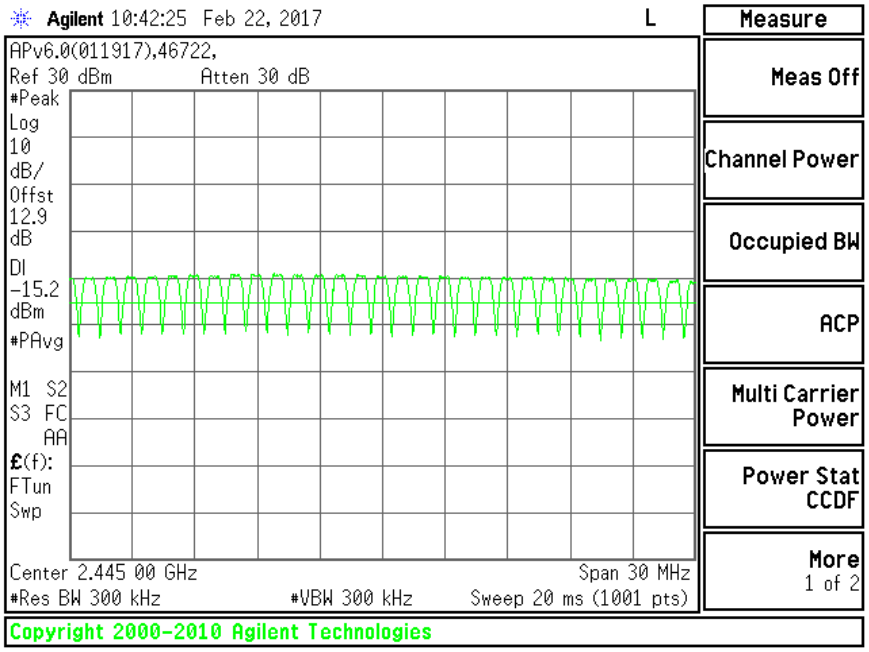
NUMBER OF HOPPING CHANNELS (100 MHZ SPAN)



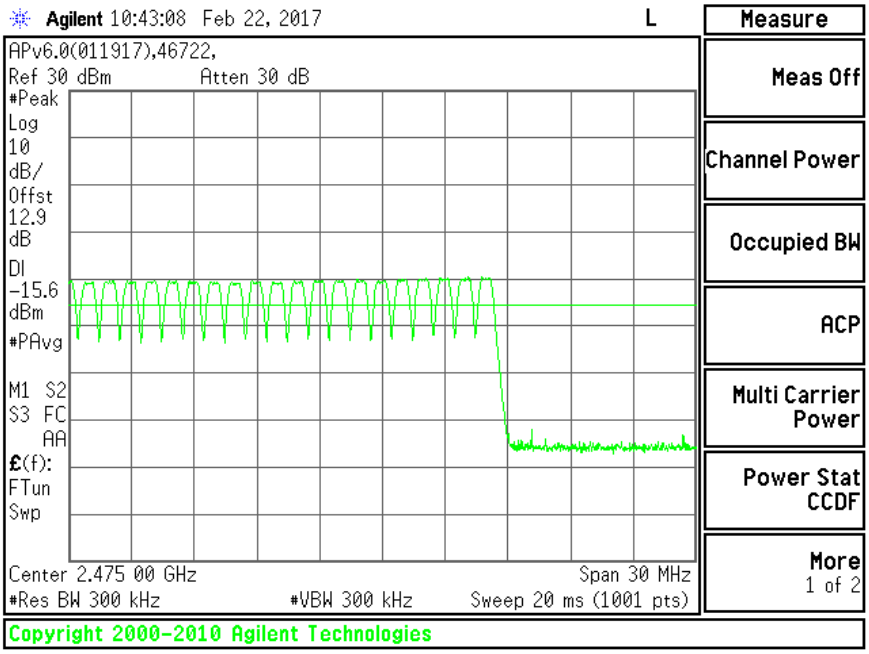
NUMBER OF HOPPING CHANNELS (30 MHZ SPAN, FIRST SEGMENT)



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



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



TEST INFORMATION
Date: 2017-02-22
Project No: 11576797
Tester: John Manser

7.2.4. AVERAGE TIME OF OCCUPANCY

LIMIT

FCC §15.247 (a) (1) (iii)
IC RSS-247 5.1 (4)

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

TEST PROCEDURE

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

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

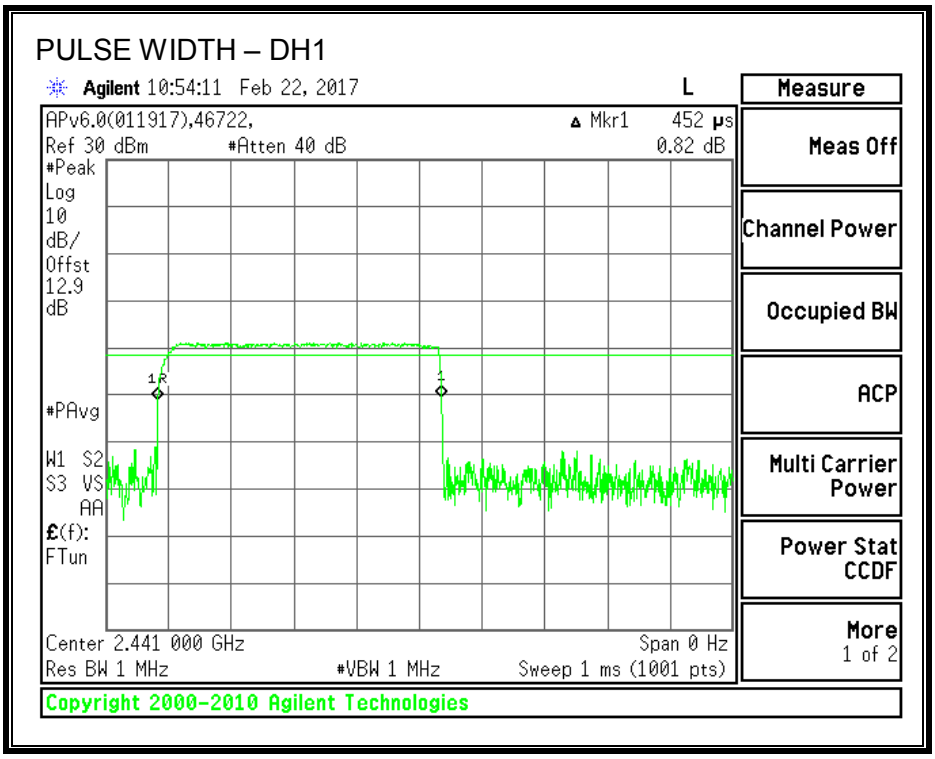
For AFH mode, the average time of occupancy in the specified 8 second period (20 channels * 0.4 seconds) is equal to 10 * (# of pulses in 0.8 s) * pulse width.

RESULTS

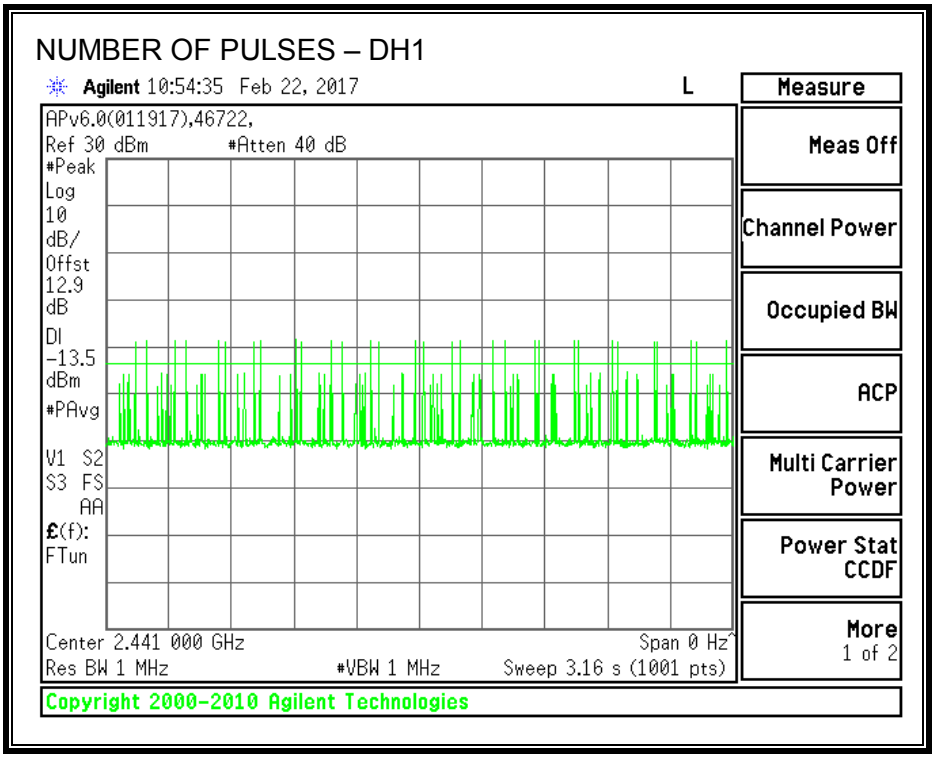
DH Packet	Pulse Width (msec)	Number of Pulses in 3.16 seconds	Average Time of Occupancy (sec)	Limit (sec)	Margin (sec)
GFSK Normal Mode					
DH1	0.452	31	0.140	0.4	-0.260
DH3	1.708	16	0.273	0.4	-0.127
DH5	2.948	12	0.354	0.4	-0.046
DH Packet	Pulse Width (msec)	Number of Pulses in 0.8 seconds	Average Time of Occupancy (sec)	Limit (sec)	Margin (sec)
GFSK AFH Mode					
DH1	0.452	7.75	0.035	0.4	-0.365
DH3	1.708	4	0.068	0.4	-0.332
DH5	2.948	3	0.088	0.4	-0.312

TEST INFORMATION
Date: 2017-02-22
Project No: 11576797
Tester: John Manser

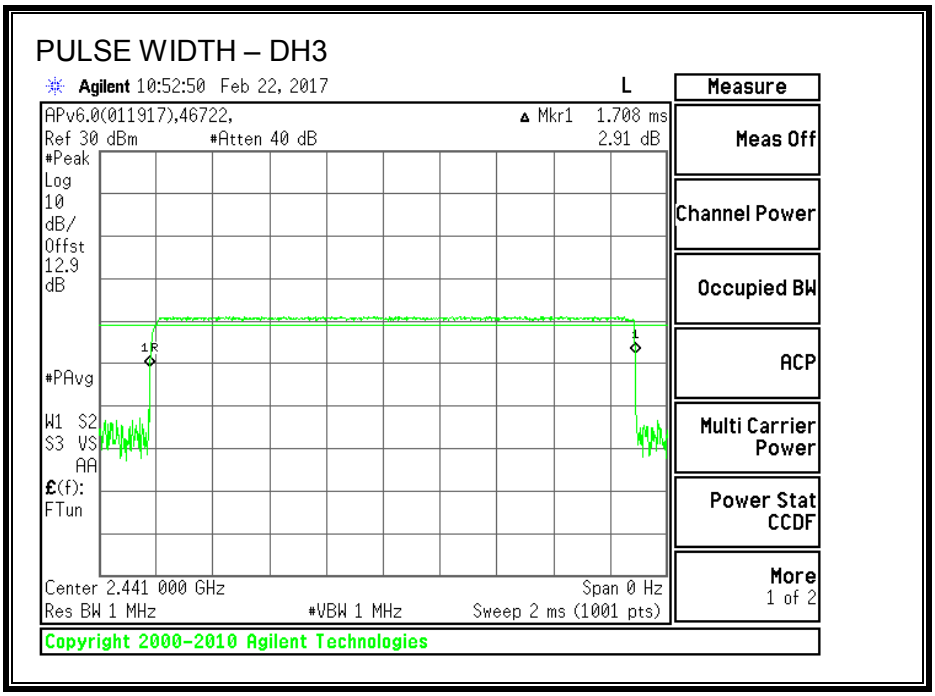
PULSE WIDTH - DH1



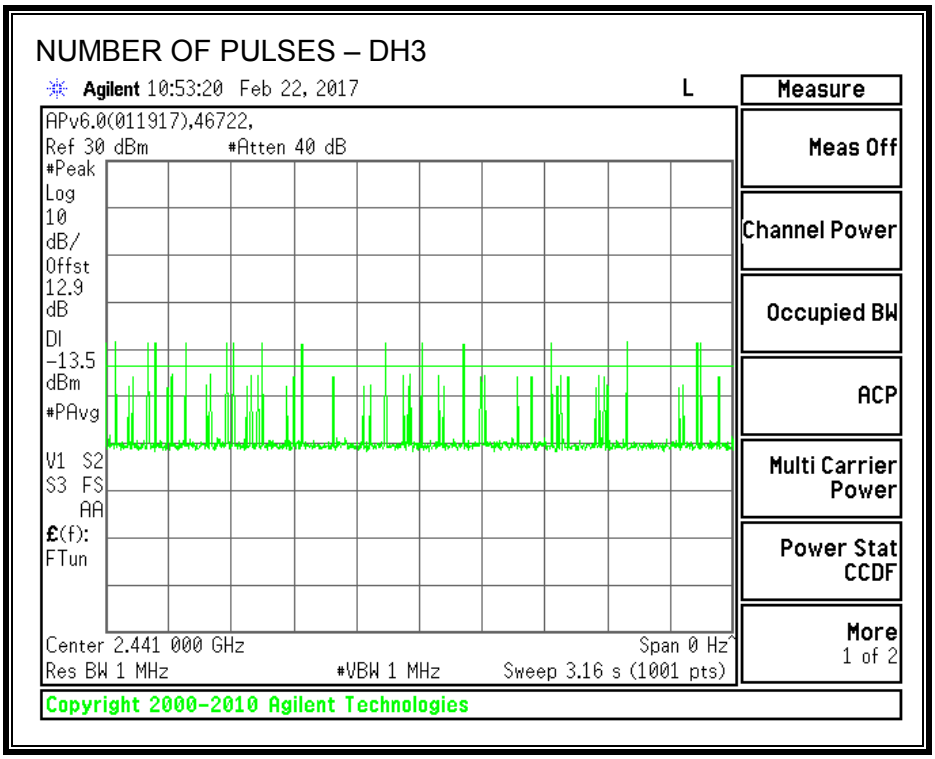
NUMBER OF PULSES IN 3.16 SECOND OBSERVATION PERIOD – DH1



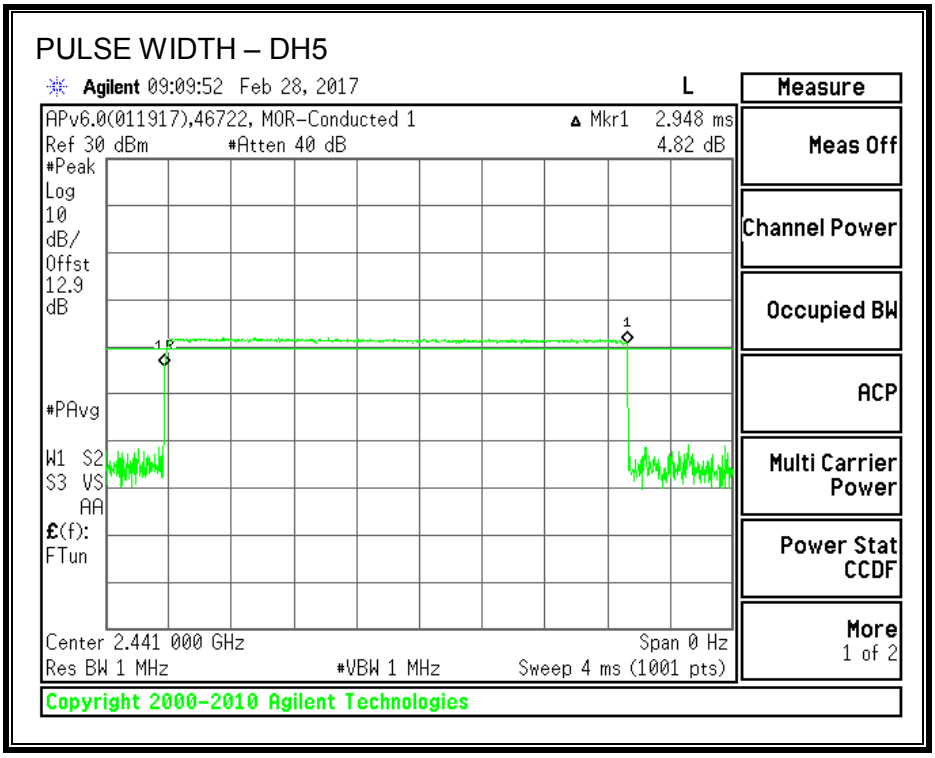
PULSE WIDTH – DH3



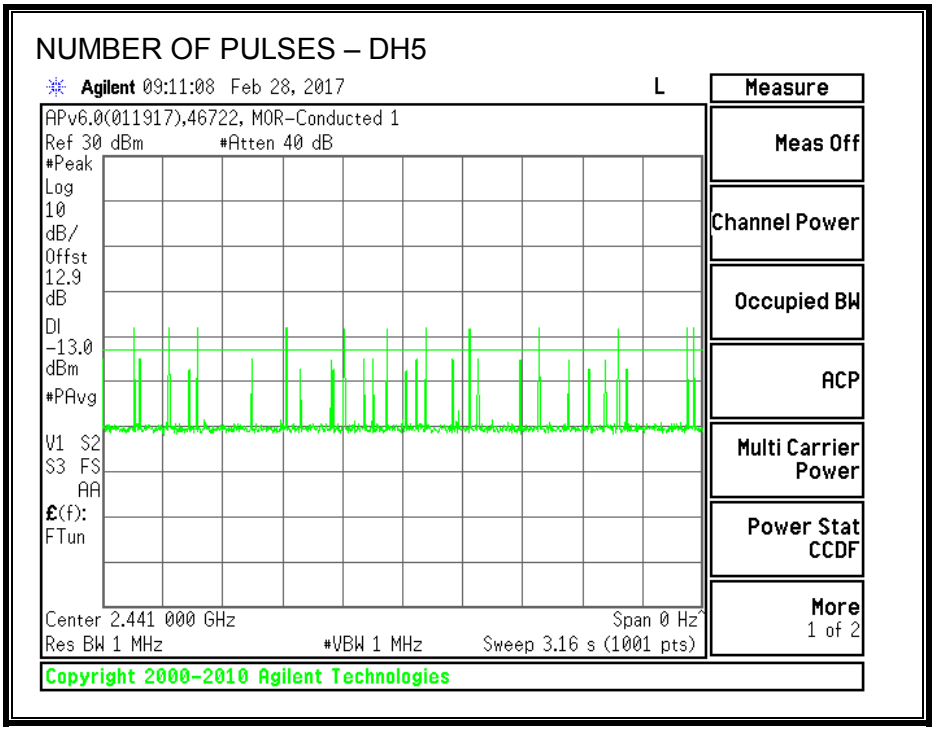
NUMBER OF PULSES IN 3.16 SECOND OBSERVATION PERIOD – DH3



PULSE WIDTH – DH5



NUMBER OF PULSES IN 3.16 SECOND OBSERVATION PERIOD – DH5



7.2.5. 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 (2)

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 power meter.

RESULTS

For 75 or more hopping channels

Channel	Frequency (MHz)	Output Power (dBm)	Directional Gain (dBi)	Limit (dBm)	Margin (dB)
Low	2402	0.05	0.10	30	-29.95
Middle	2441	0.97	0.10	30	-29.03
High	2480	0.65	0.10	30	-29.35

TEST INFORMATION
Date: 2017-02-21
Project No: 11576797
Tester: John Manser

7.2.6. AVERAGE POWER

LIMIT

None; for reporting purposes only.

TEST PROCEDURE

The transmitter output is connected to a power meter.

RESULTS

The cable assembly insertion loss of 12.7 dB for Low Channel and 12.8 dB for the Mid and High Channels (including 12.4 dB or 12.5 dB for the directional coupler and 0.3 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	-0.85
Middle	2441	0.63
High	2480	0.33

TEST INFORMATION
Date: 2017-02-21
Project No: 11576797
Tester: John Manser

7.2.7. 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.

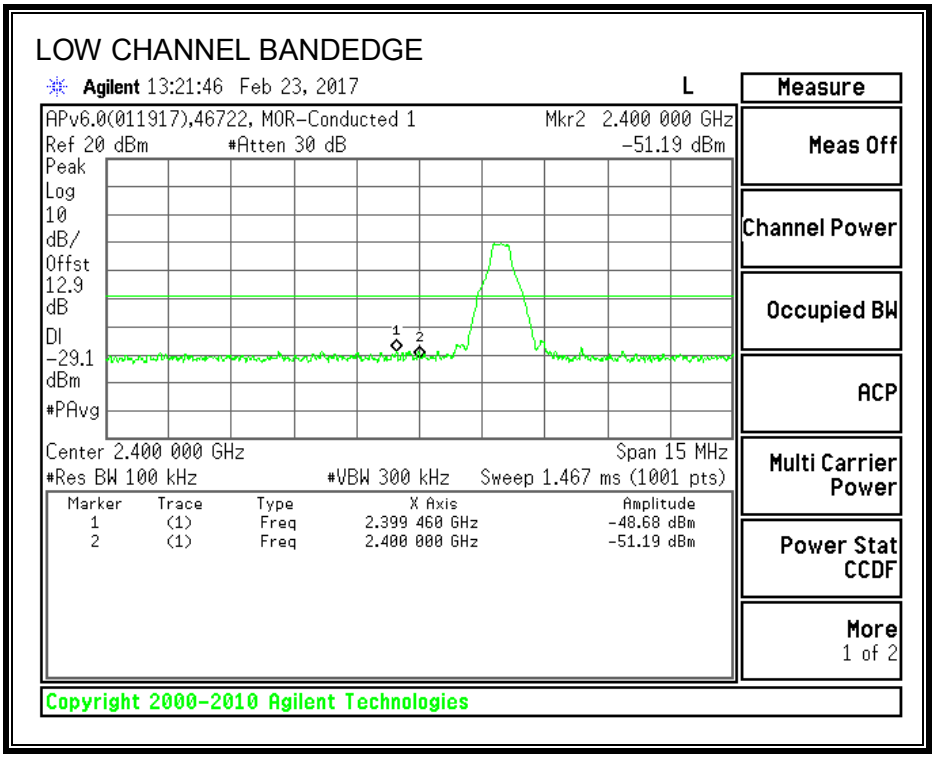
The spectrum from 30 MHz to 26 GHz is investigated with the transmitter set to the lowest, middle, and highest channels.

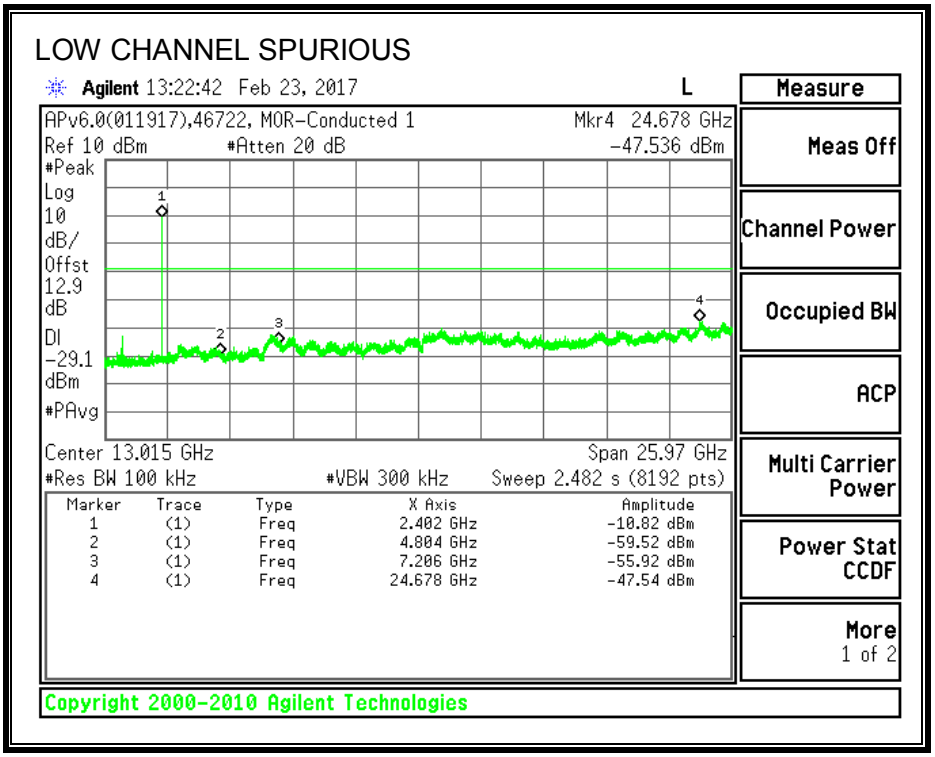
The bandedges at 2.4 and 2.4835 GHz are investigated with the transmitter set to the normal hopping mode.

TEST INFORMATION
Date: 2017-02-22 and 2017-02-23
Project No: 11576797
Tester: John Manser

RESULTS

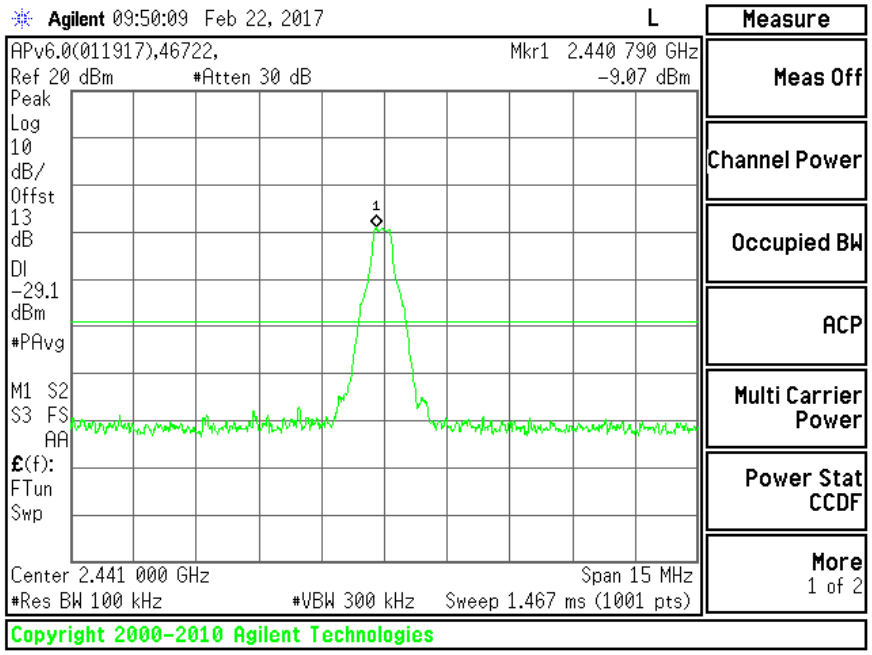
SPURIOUS EMISSIONS, LOW CHANNEL



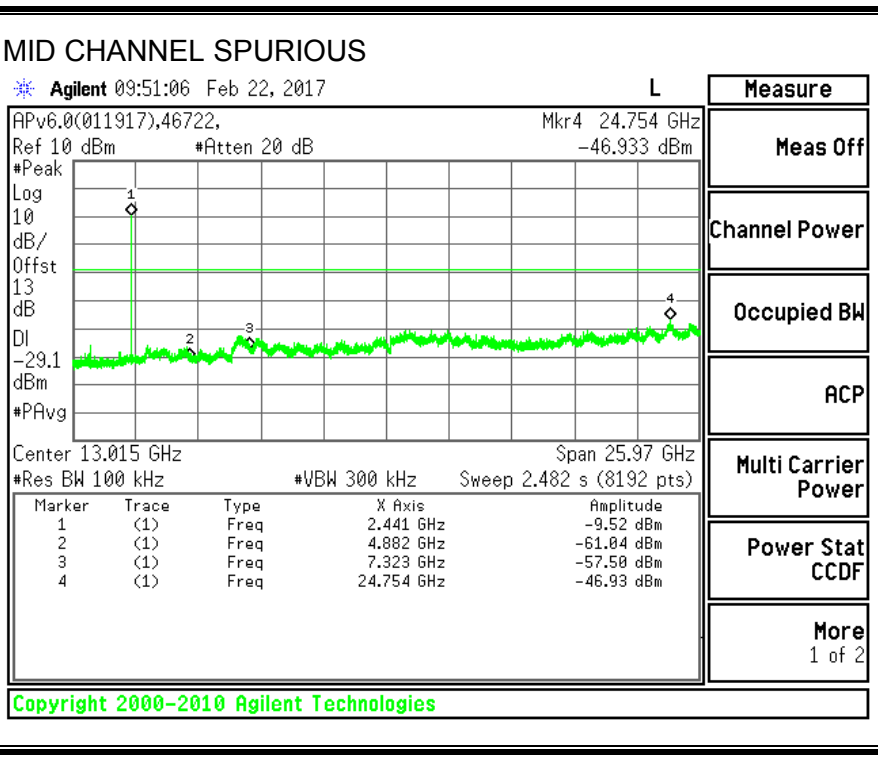


SPURIOUS EMISSIONS, MID CHANNEL

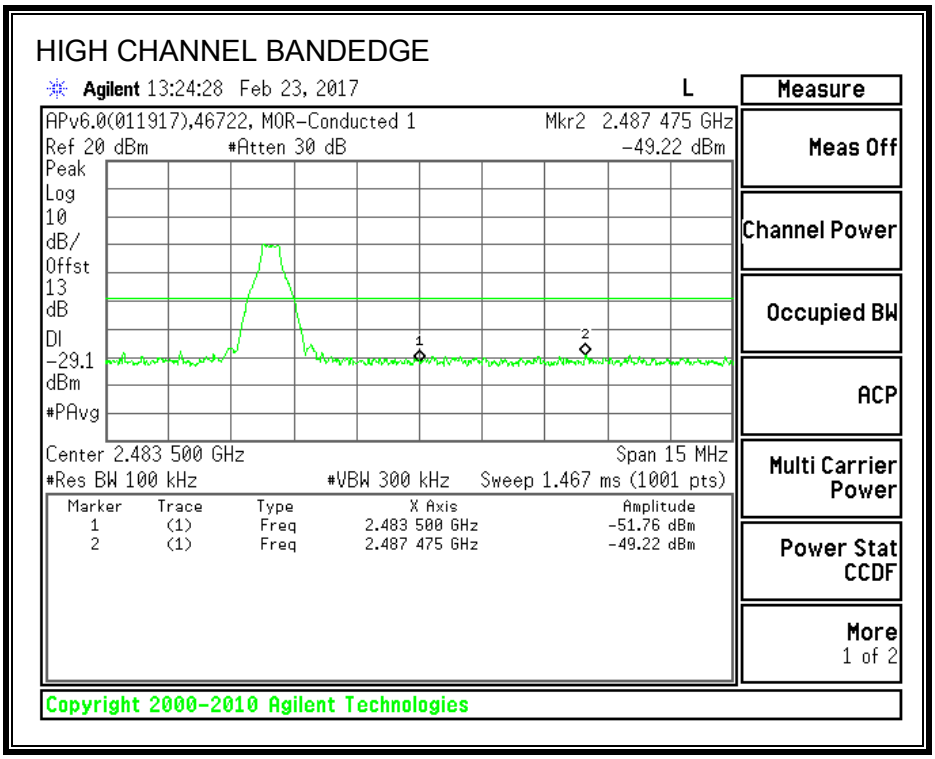
MID CHANNEL REFERENCE

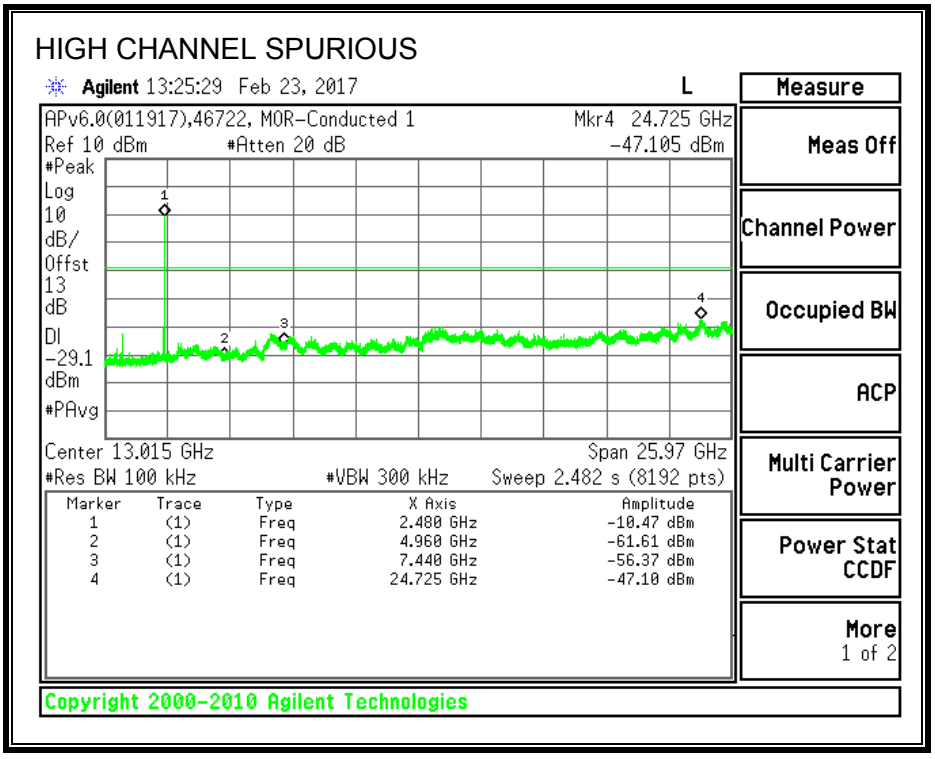


MID CHANNEL SPURIOUS



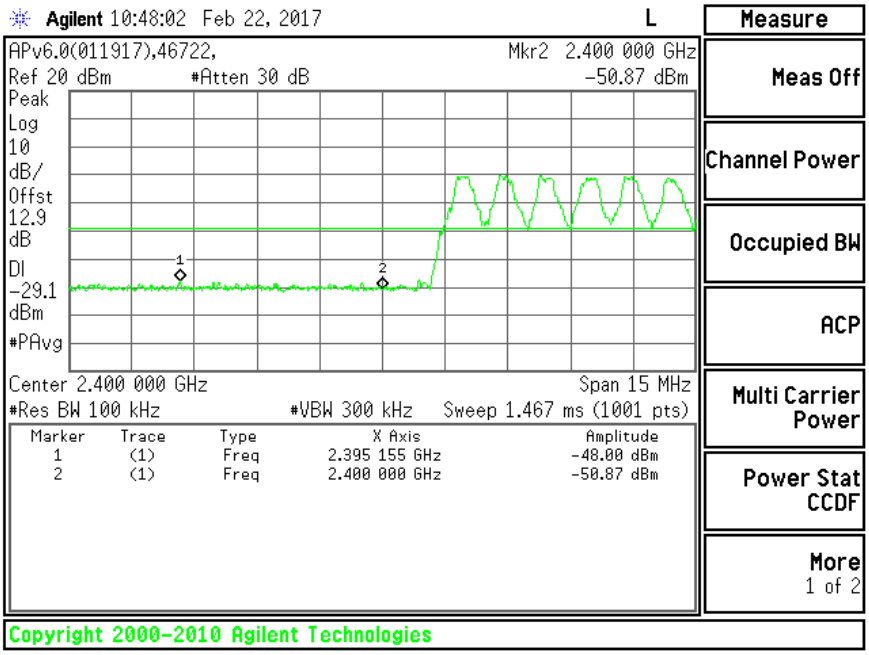
SPURIOUS EMISSIONS, HIGH CHANNEL



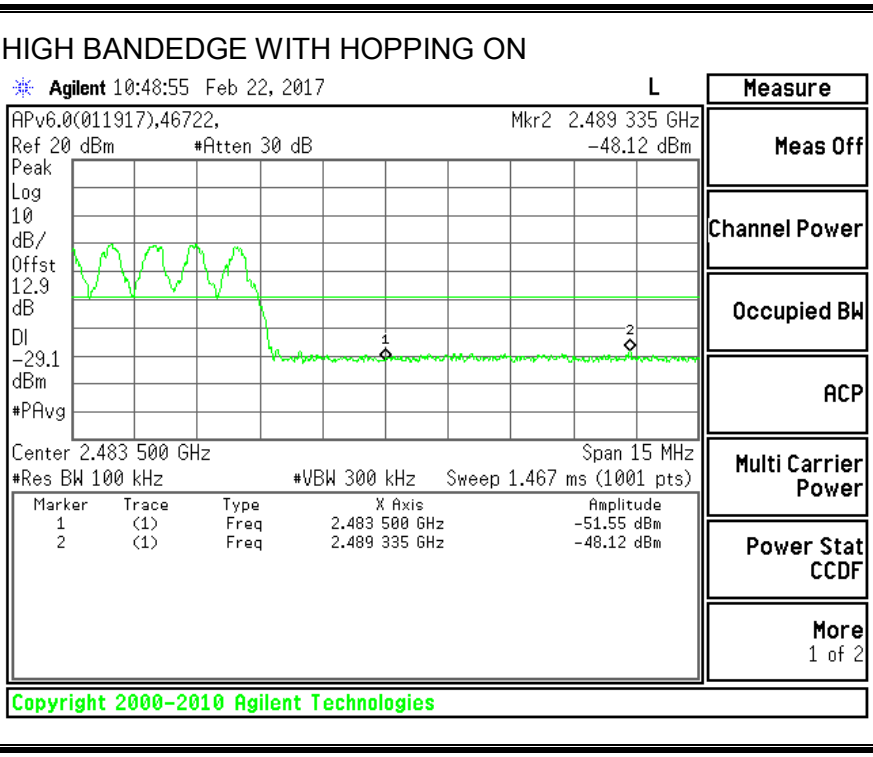


SPURIOUS BANDEDGE EMISSIONS WITH HOPPING ON

LOW BANDEDGE WITH HOPPING ON



HIGH BANDEDGE WITH HOPPING ON



7.3. ENHANCED DATA RATE QPSK MODULATION

7.3.1. AVERAGE TIME OF OCCUPANCY

LIMIT

FCC §15.247 (a) (1) (iii)

IC RSS-247 5.1 (4)

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

TEST PROCEDURE

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

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

RESULTS

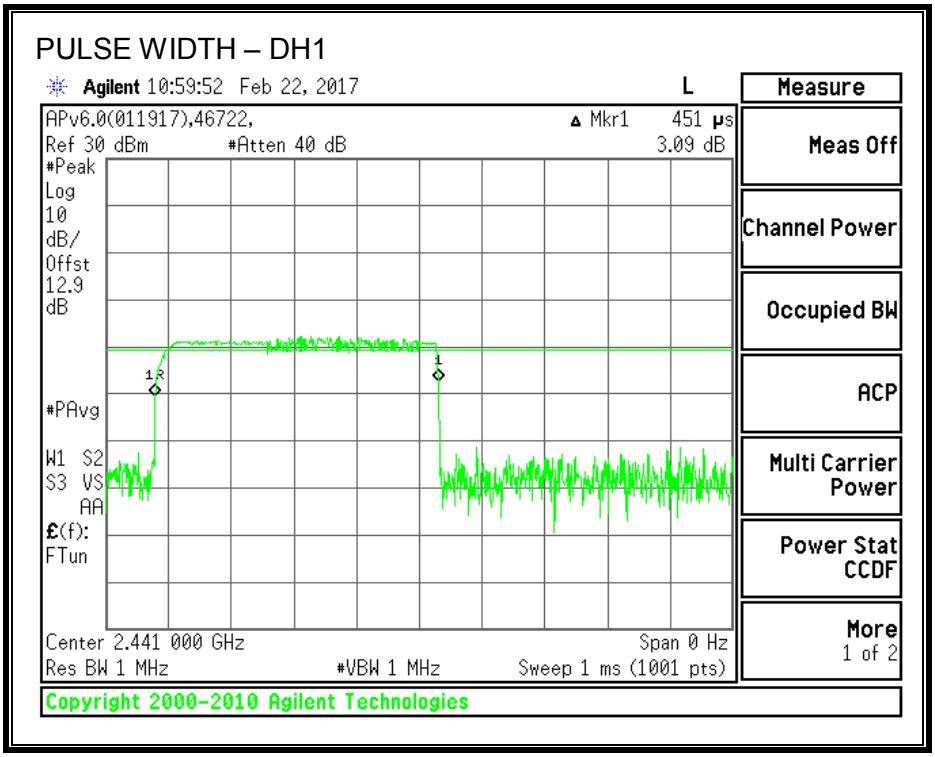
Time Of Occupancy = 10 * xx pulses * yy msec = zz msec

DQPSK Mode

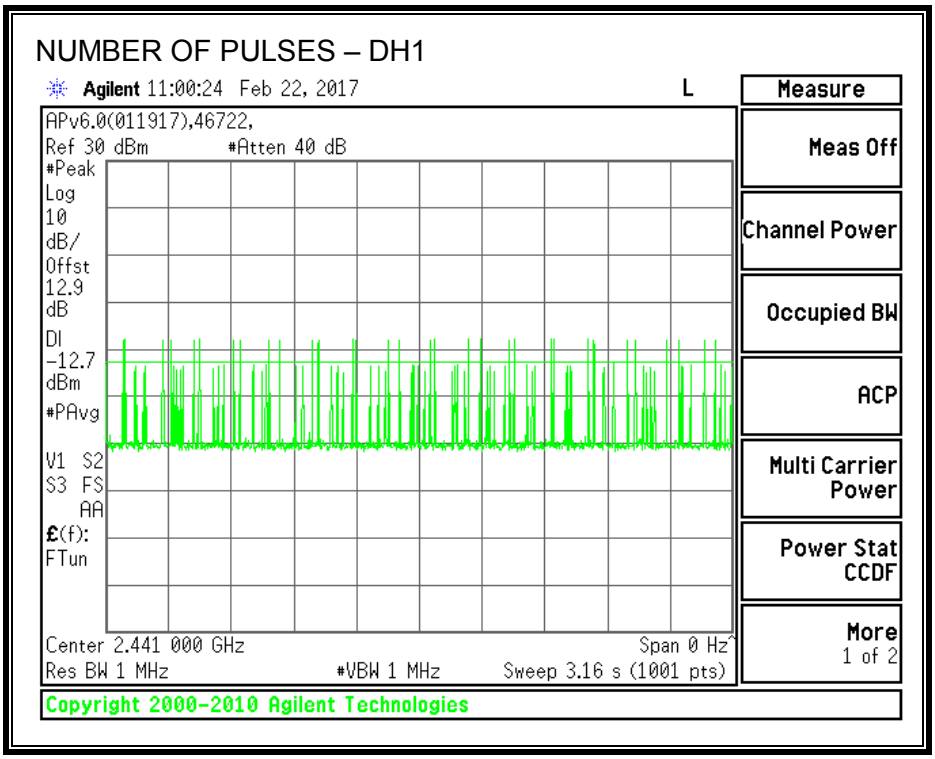
DH Packet	Pulse Width (msec)	Number of Pulses in 3.16 seconds	Average Time of (sec)	Limit (sec)	Margin (sec)
2DH1	0.451	32	0.144	0.4	-0.256
2DH3	1.704	20	0.341	0.4	-0.059
2DH5	2.952	12	0.354	0.4	-0.046

TEST INFORMATION
Date: 2017-02-22
Project No: 11576797
Tester: John Manser

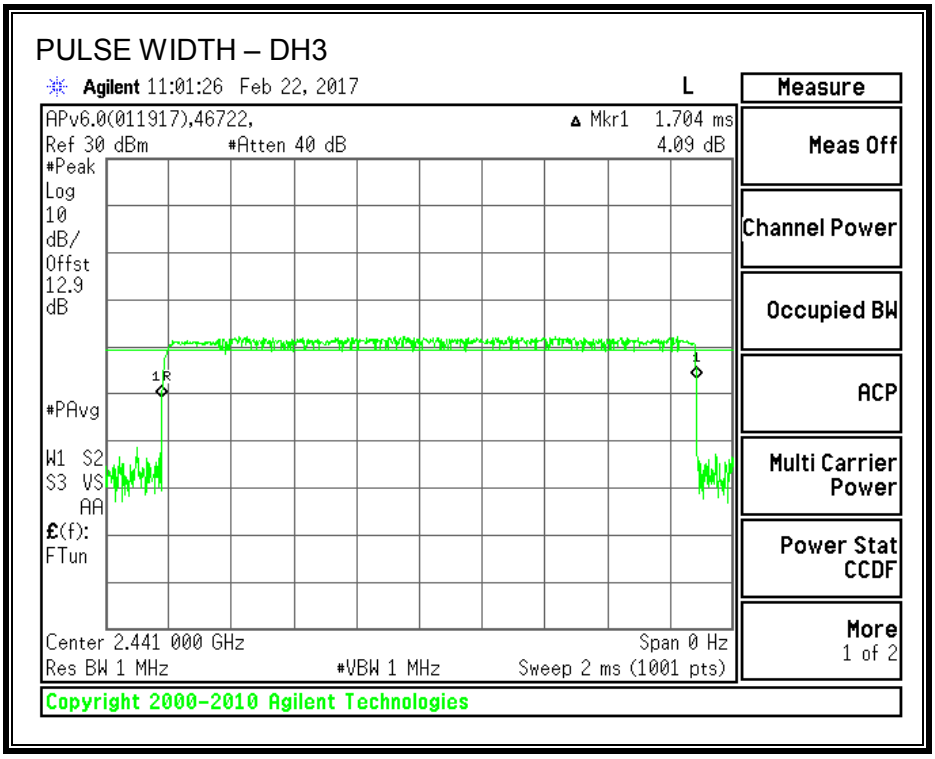
PULSE WIDTH - DH1



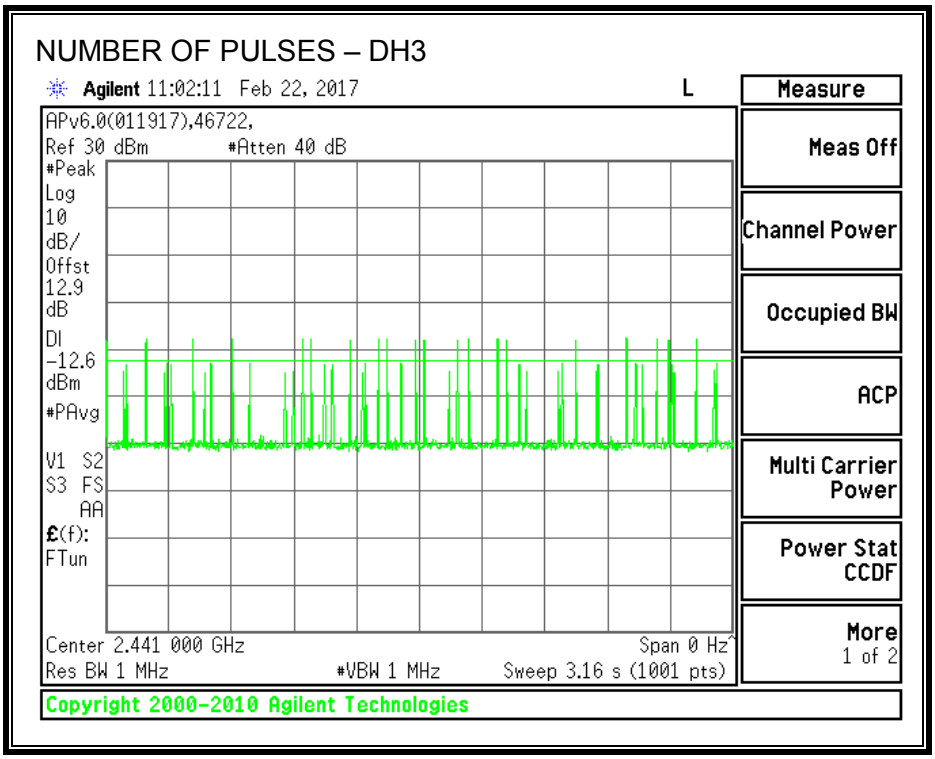
NUMBER OF PULSES IN 3.16 SECOND OBSERVATION PERIOD – DH1



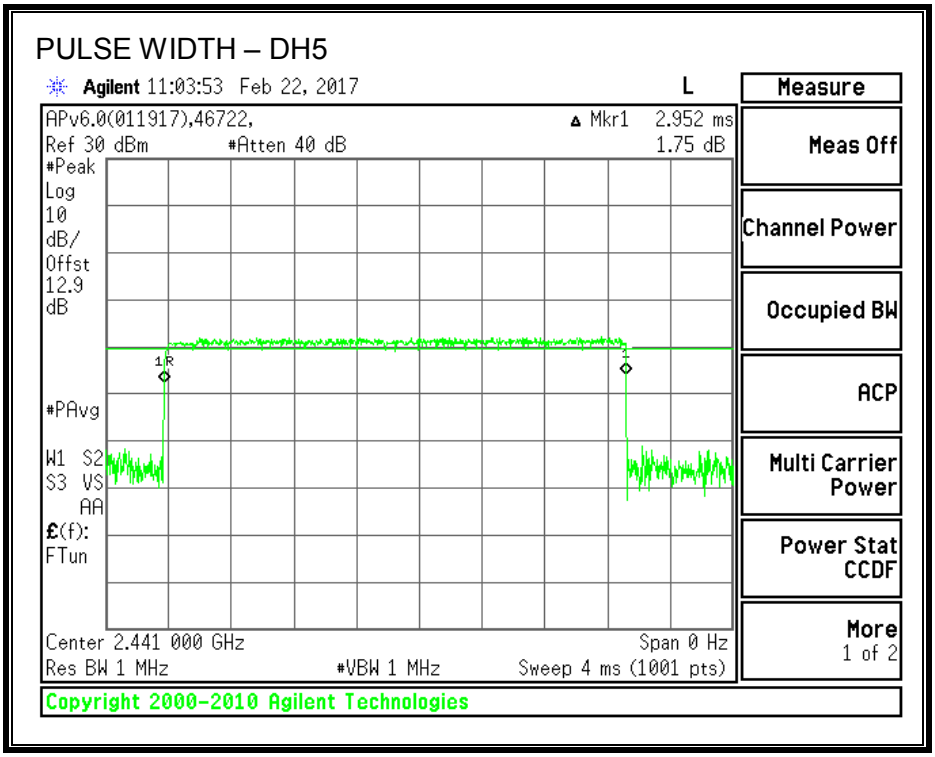
PULSE WIDTH – DH3



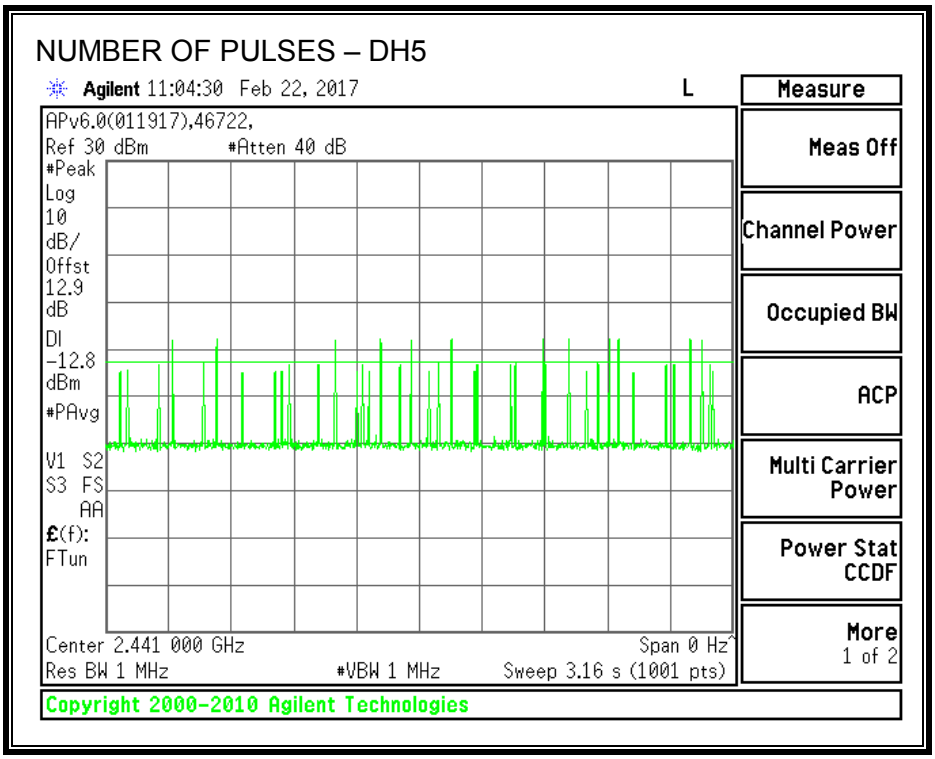
NUMBER OF PULSES IN 3.16 SECOND OBSERVATION PERIOD – DH3



PULSE WIDTH – DH5



NUMBER OF PULSES IN 3.16 SECOND OBSERVATION PERIOD – DH5



7.3.2. 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 (2)

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 power meter.

RESULTS

Channel	Frequency (MHz)	Output Power (dBm)	Directional Gain (dBi)	Limit (dBm)	Margin (dB)
Low	2402	1.76	0.10	21	-19.24
Middle	2441	2.66	0.10	21	-18.34
High	2480	2.33	0.10	21	-18.67

TEST INFORMATION
Date: 2017-02-21
Project No: 11576797
Tester: John Manser

7.3.3. 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 12.7 dB for Low Channel and 12.8 dB for the Mid and High Channels (including 12.4 dB or 12.5 dB for the directional coupler and 0.3 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	-0.81
Middle	2441	-0.76
High	2480	-0.76

TEST INFORMATION
Date: 2017-02-21
Project No: 11576797
Tester: John Manser

7.4. ENHANCED DATA RATE 8PSK MODULATION

7.4.1. 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

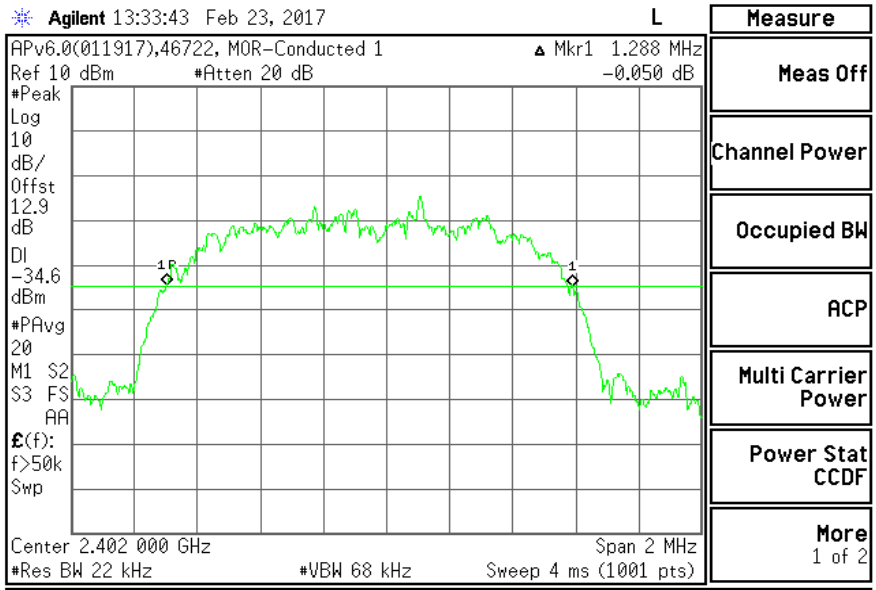
The transmitter output is connected to a spectrum analyzer. The RBW is set to 1-5% of the 20 dB bandwidth and 99% Occupied Bandwidth. The VBW is set to ≥ RBW. The sweep time is coupled.

RESULTS

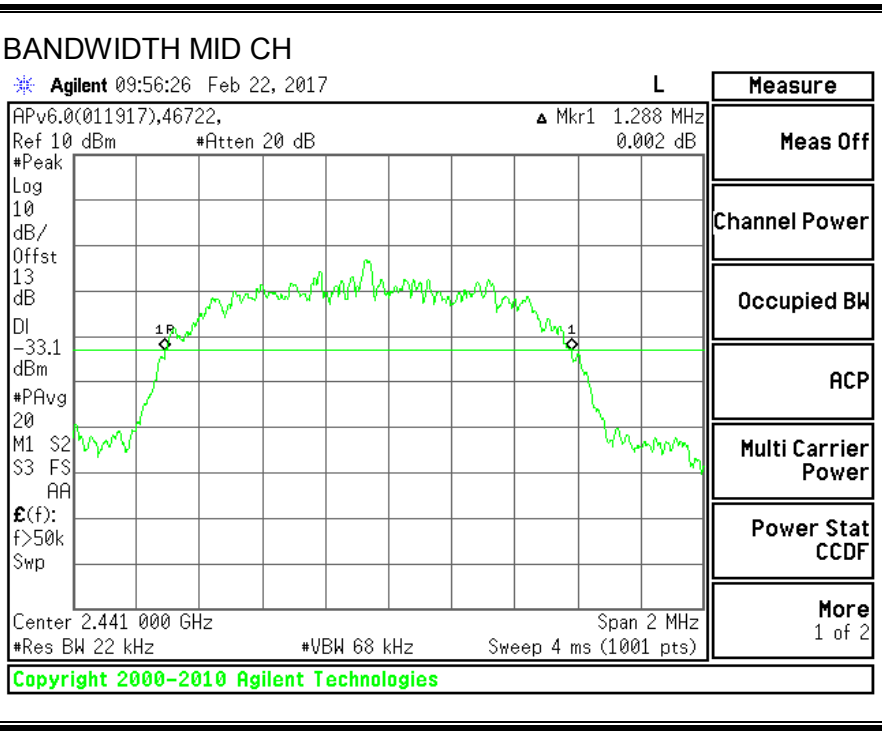
Channel	Frequency (MHz)	20 dB Bandwidth (kHz)	99% Bandwidth (kHz)
Low	2402	1288	1190.1
Middle	2441	1288	1197.5
High	2480	1322	1192.8

20 dB BANDWIDTH

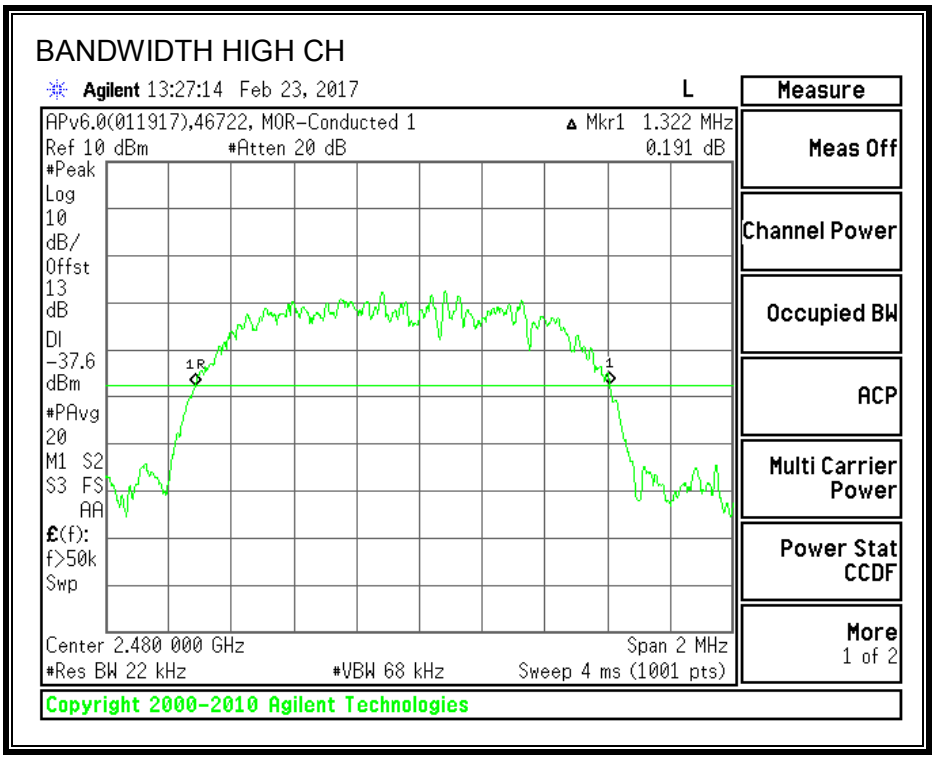
BANDWIDTH LOW CH



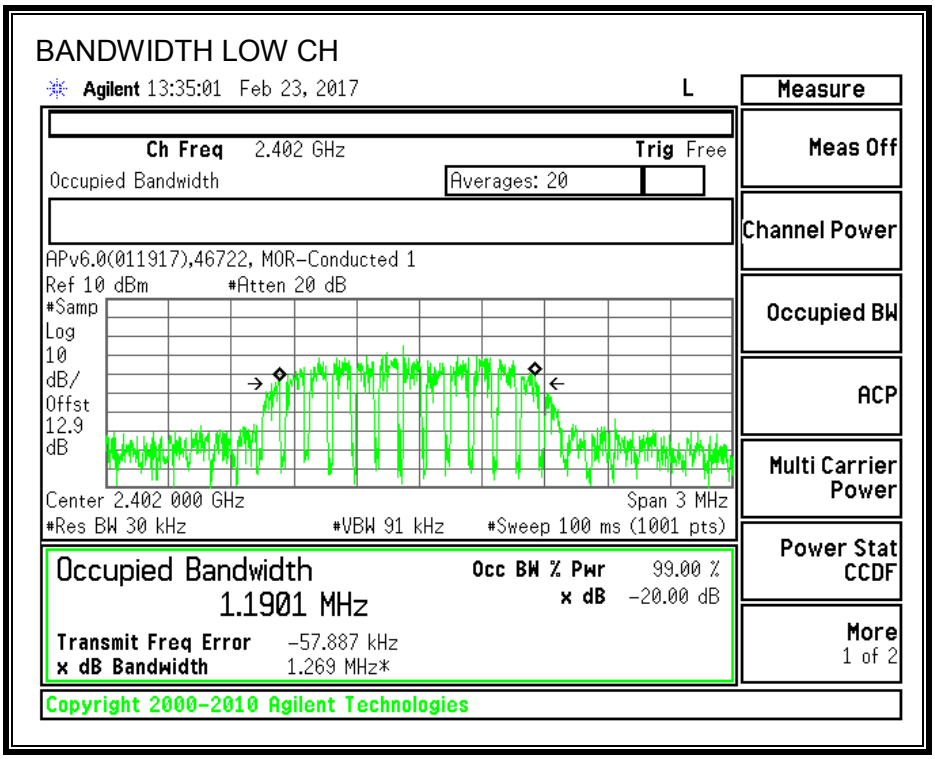
BANDWIDTH MID CH

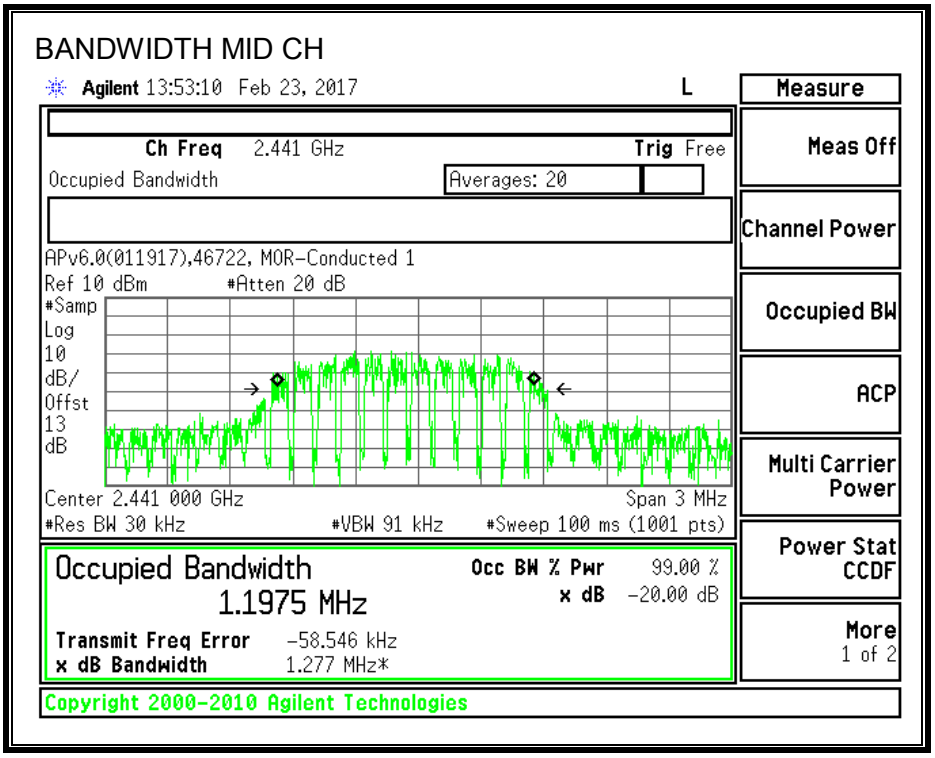


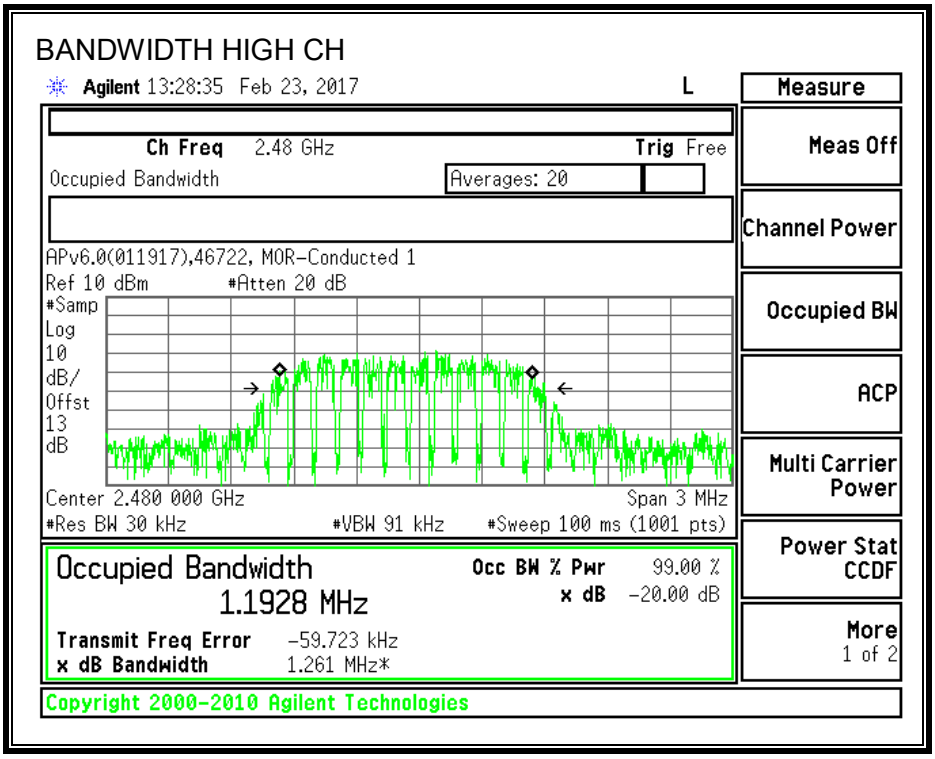
BANDWIDTH HIGH CH



99% BANDWIDTH







TEST INFORMATION

Date: 2017-02-22 and 2017-02-23

Project No: 11576797

Tester: John Manser

7.4.2. HOPPING FREQUENCY SEPARATION

LIMIT

FCC §15.247 (a) (1)

IC RSS-247 5.1 (2)

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

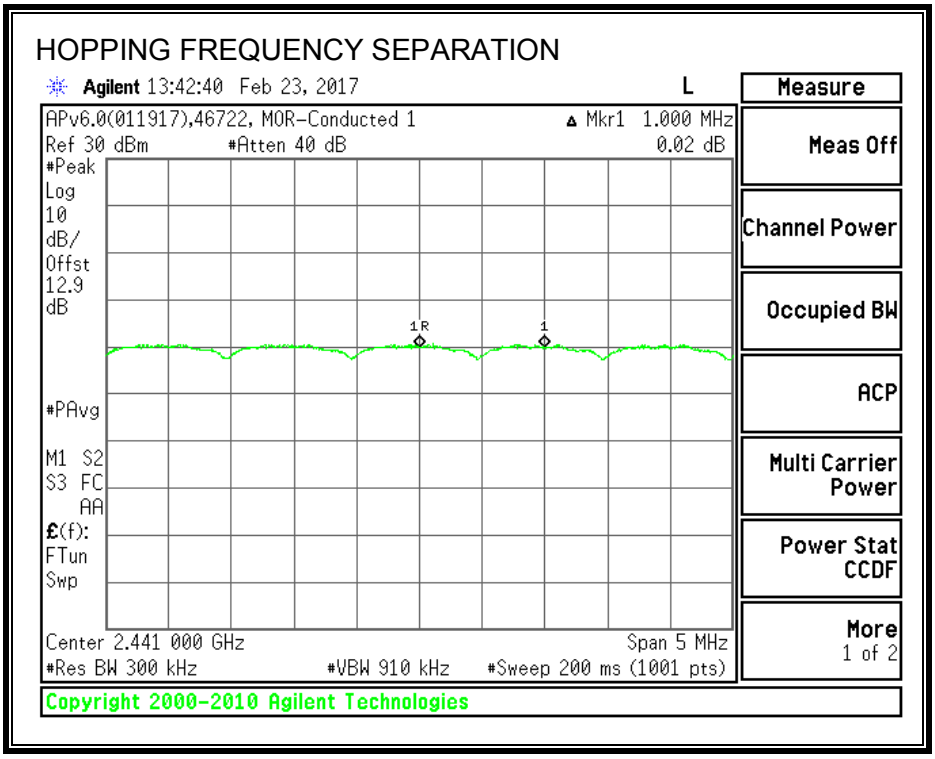
Alternatively, frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than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

TEST PROCEDURE

The transmitter output is connected to a spectrum analyzer. The RBW is set to 300 kHz and the VBW is set to 3x RBW. The sweep time is coupled.

RESULTS

HOPPING FREQUENCY SEPARATION



Ch. A (MHz)	Ch. B (MHz)	Ch. 1 to Ch. 2 Sep. (MHz)	Max. two-thirds 20 dB BW (MHz)	Margin (MHz)
2441	2442	1.000	0.859	-0.141

TEST INFORMATION

Date: 2017-02-23
Project No: 11576797
Tester: John Manser

7.4.3. NUMBER OF HOPPING CHANNELS

LIMIT

FCC §15.247 (a) (1) (iii)

IC RSS-247 5.1 (4)

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

TEST PROCEDURE

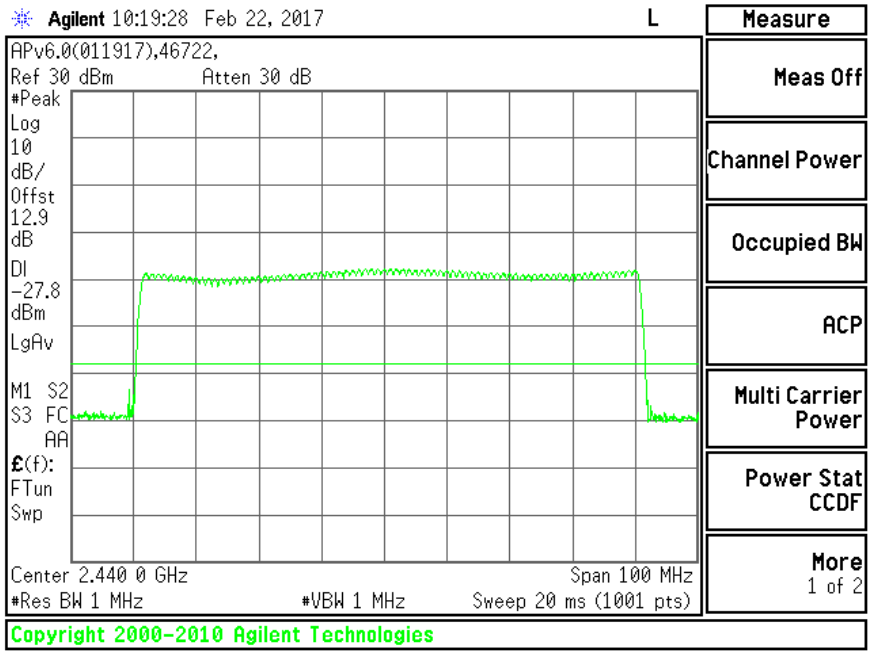
The transmitter output is connected to a spectrum analyzer. The span is set to cover the entire authorized band, in either a single sweep or in multiple contiguous sweeps for visibility of the entire span. Then, smaller spans are set to more clearly identify the channels. The RBW is set to 30% of the channel spacing (approx. 300 kHz). The analyzer is set to Max Hold.

RESULTS

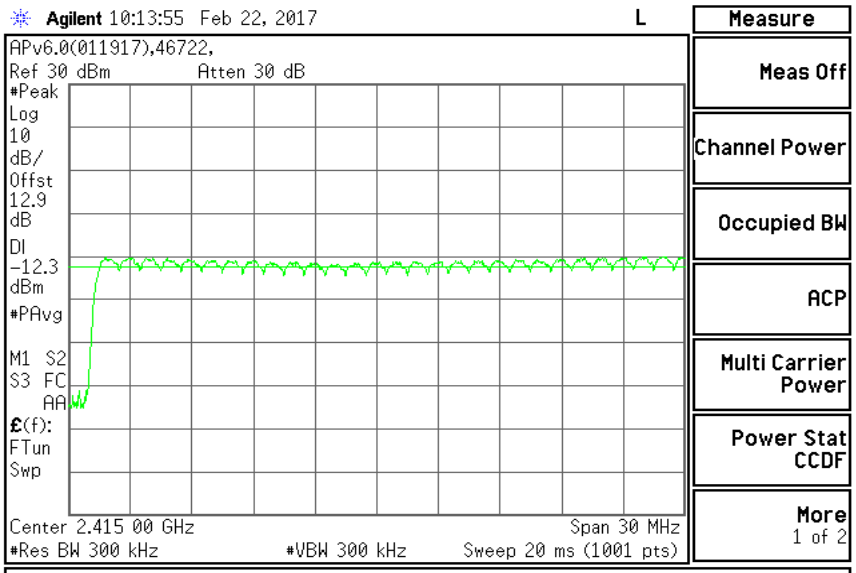
Normal Mode: 79 Channels observed.

NUMBER OF HOPPING CHANNELS

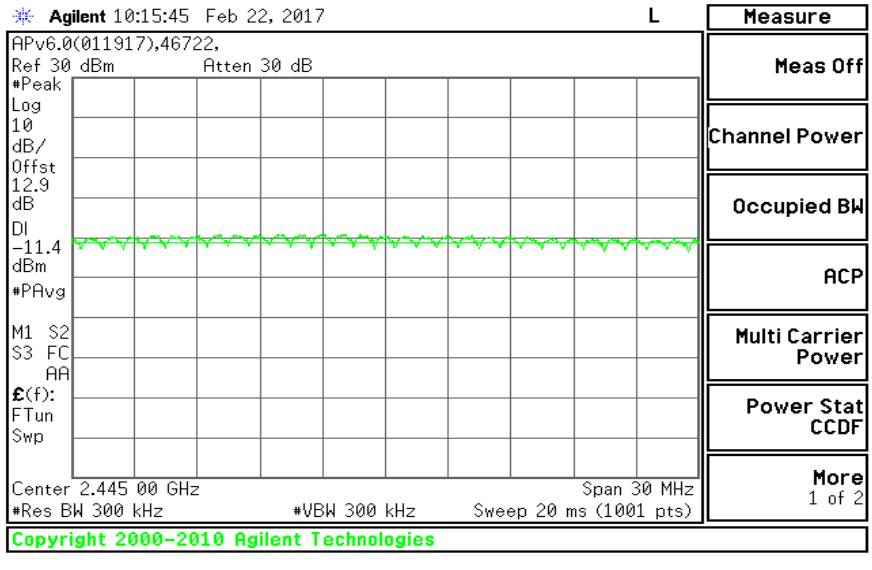
NUMBER OF HOPPING CHANNELS (100 MHZ SPAN)



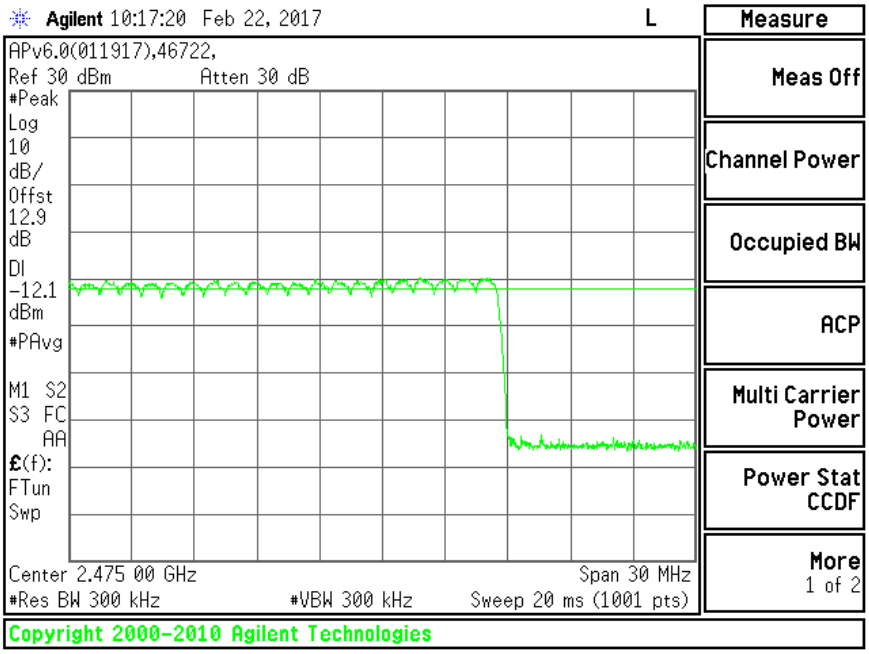
NUMBER OF HOPPING CHANNELS (30 MHZ SPAN, FIRST SEGMENT)



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



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



TEST INFORMATION
Date: 2017-02-22
Project No: 11576797
Tester: John Manser

7.4.4. AVERAGE TIME OF OCCUPANCY

LIMIT

FCC §15.247 (a) (1) (iii)
IC RSS-247 5.1 (4)

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

TEST PROCEDURE

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

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

RESULTS

Time Of Occupancy = 10 * xx pulses * yy msec = zz msec

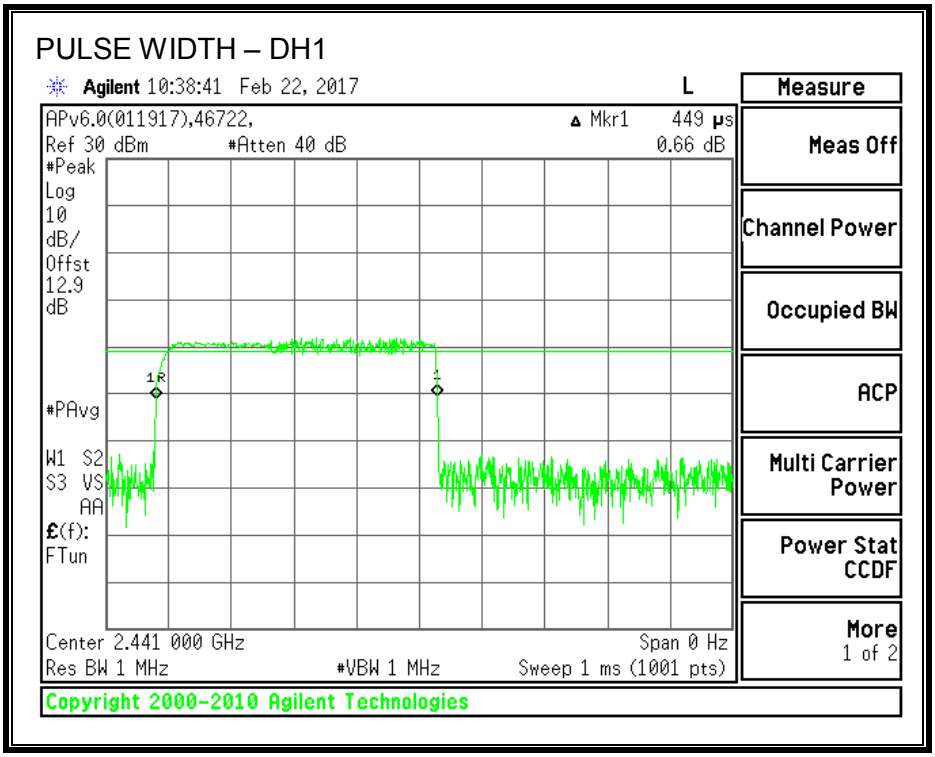
8PSK (EDR) Mode

DH Packet	Pulse Width (msec)	Number of Pulses in 3.16 seconds	Average Time of (sec)	Limit (sec)	Margin (sec)
3DH1	0.449	31	0.139	0.4	-0.261
3DH3	1.70	15	0.255	0.4	-0.145
3DH5	2.948	13	0.383	0.4	-0.017

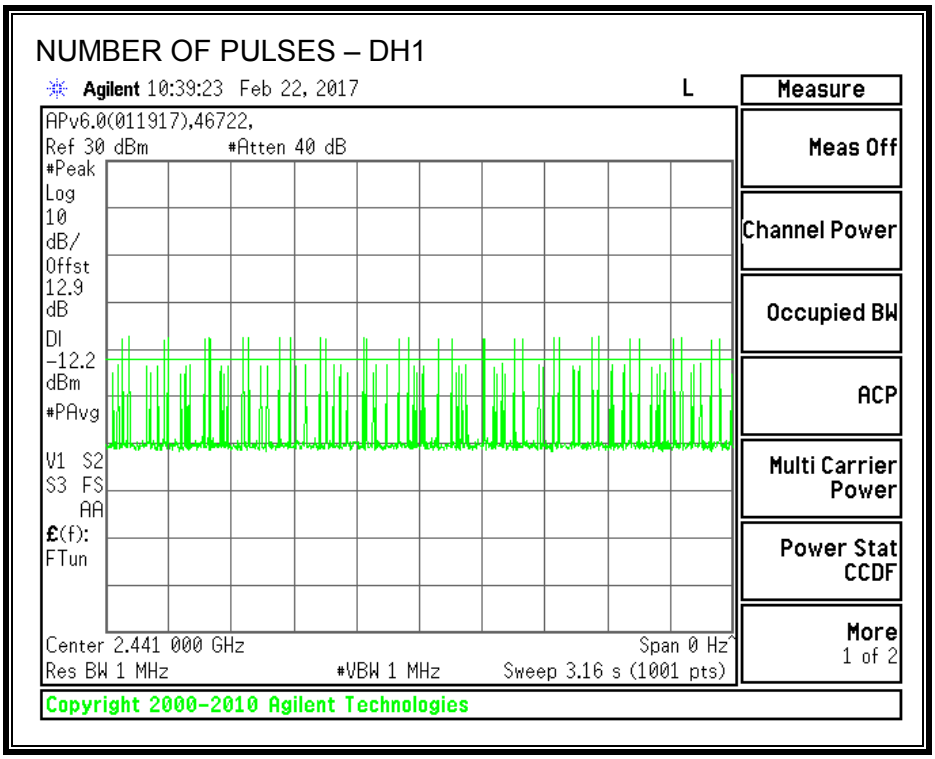
Note: for AFH (8PSK) mode, please refer to the results of AFH (GFSK) mode; the channel selection and hopping rate are the same for both EDR and Basic Rate operation, data for Basic Rate on page 24 demonstrates compliance with channel occupancy when AFH is employed.

TEST INFORMATION
Date: 2017-02-22
Project No: 11576797
Tester: John Manser

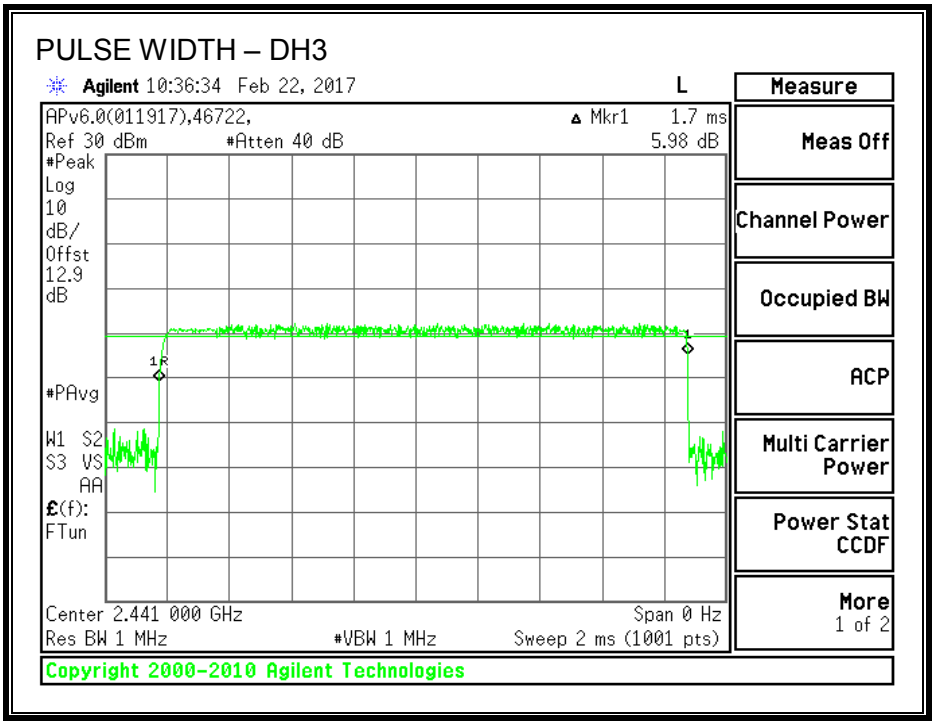
PULSE WIDTH - DH1



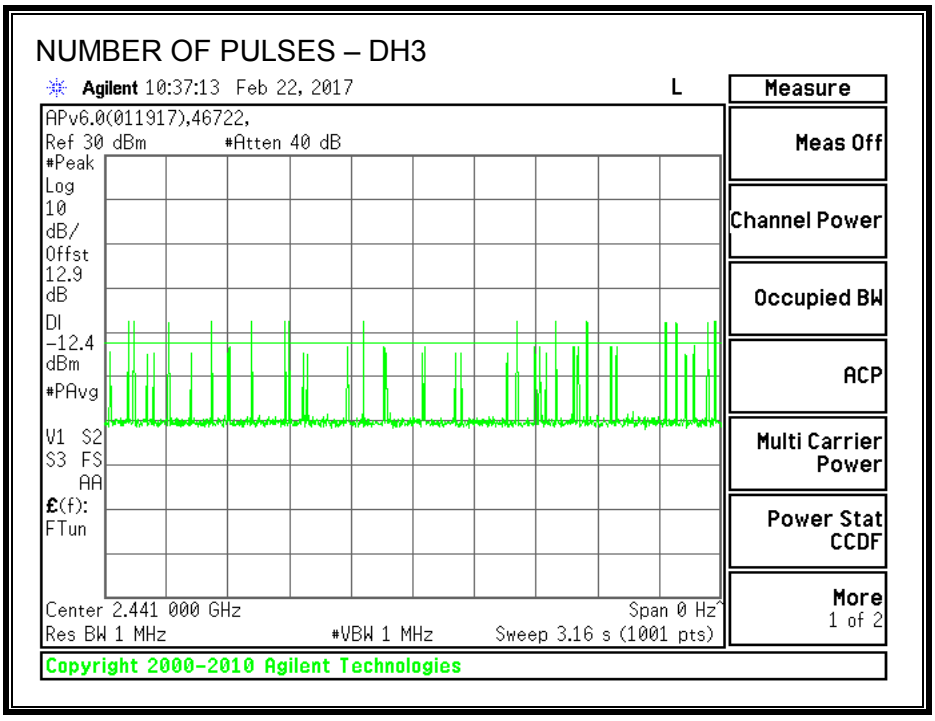
NUMBER OF PULSES IN 3.16 SECOND OBSERVATION PERIOD – DH1



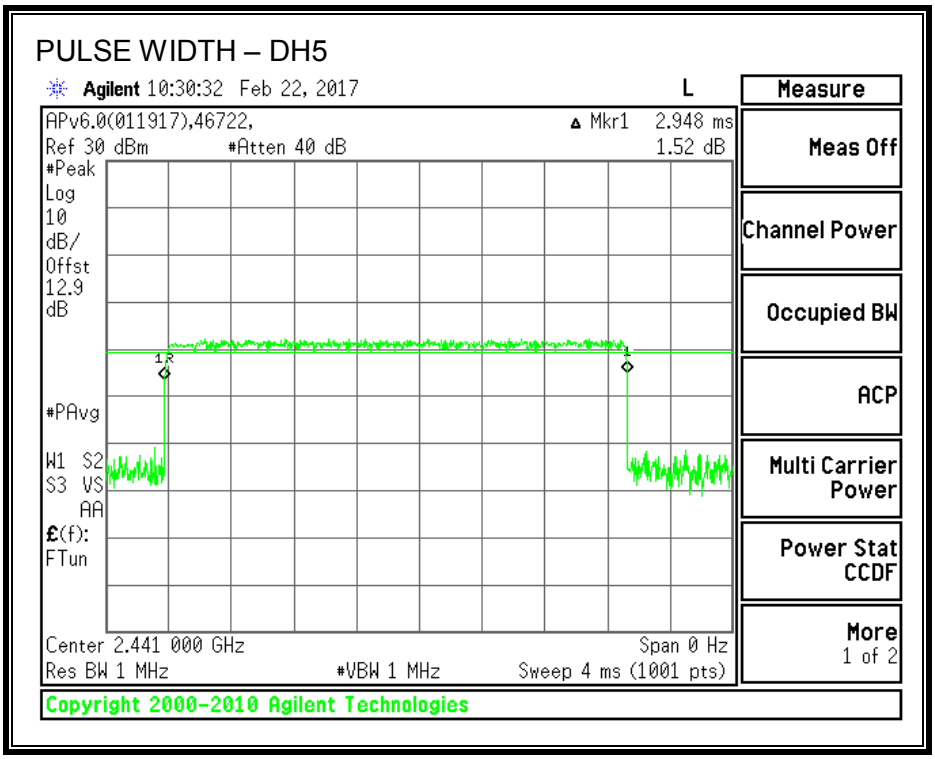
PULSE WIDTH – DH3



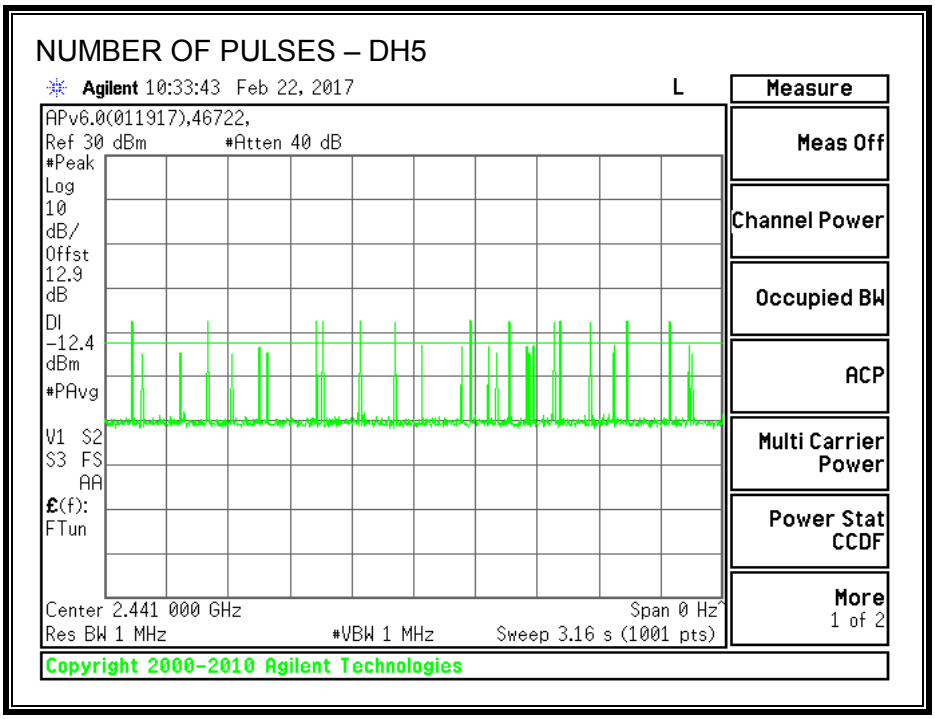
NUMBER OF PULSES IN 3.16 SECOND OBSERVATION PERIOD – DH3



PULSE WIDTH – DH5



NUMBER OF PULSES IN 3.16 SECOND OBSERVATION PERIOD – DH5



7.4.5. 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-210 Clause A8.4 (2)

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 power meter.

RESULTS

Channel	Frequency (MHz)	Output Power (dBm)	Directional Gain (dBi)	Limit (dBm)	Margin (dB)
Low	2402	2.34	0.10	21	-18.66
Middle	2441	3.25	0.10	21	-17.75
High	2480	2.86	0.10	21	-18.14

TEST INFORMATION
Date: 2017-02-21
Project No: 11576797
Tester: John Manser

7.4.6. 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 12.9 dB for Low Channel and 13dB for the Mid and High Channels (including 12.4 or 12.5 dB for the directional coupler and 0.3 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	-0.80
Middle	2441	-0.72
High	2480	-0.91

TEST INFORMATION
Date: 2017-02-21
Project No: 11576797
Tester: John Manser

7.4.7. 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.

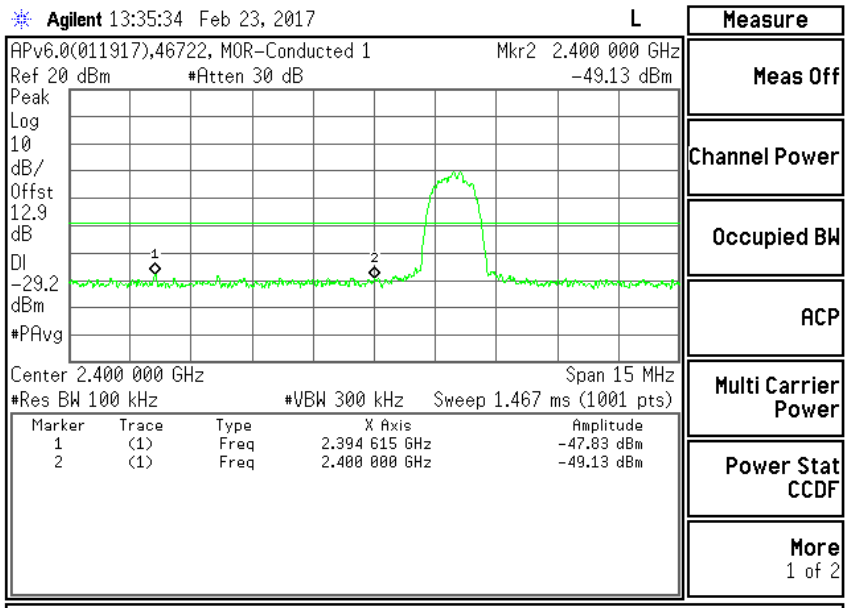
The bandedges at 2.4 and 2.4835 GHz are investigated with the transmitter set to the normal hopping mode.

TEST INFORMATION
Date: 2017-02-22 and 2017-02-23
Project No: 11576797
Tester: John Manser

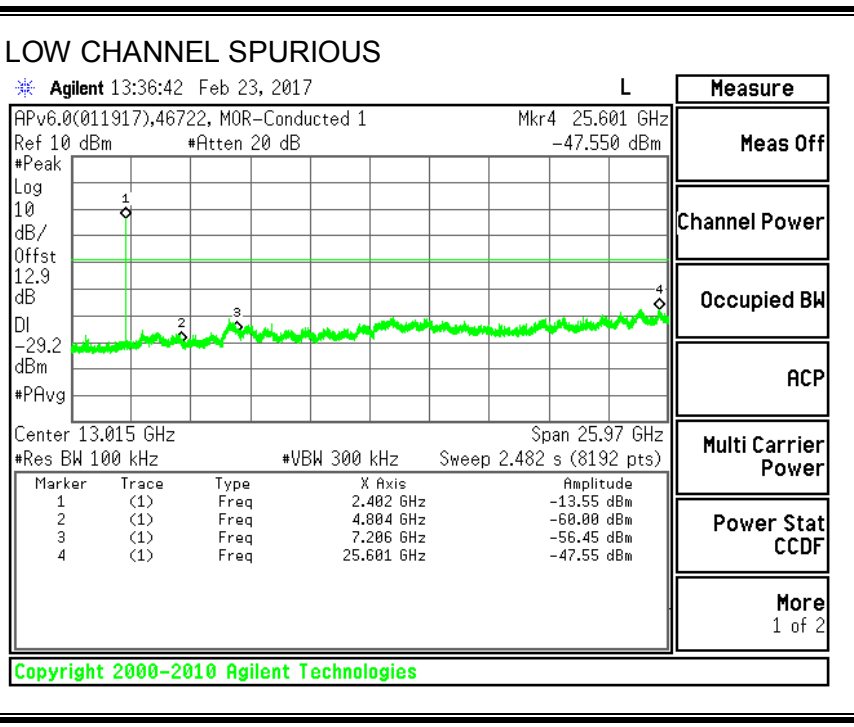
RESULTS

SPURIOUS EMISSIONS, LOW CHANNEL

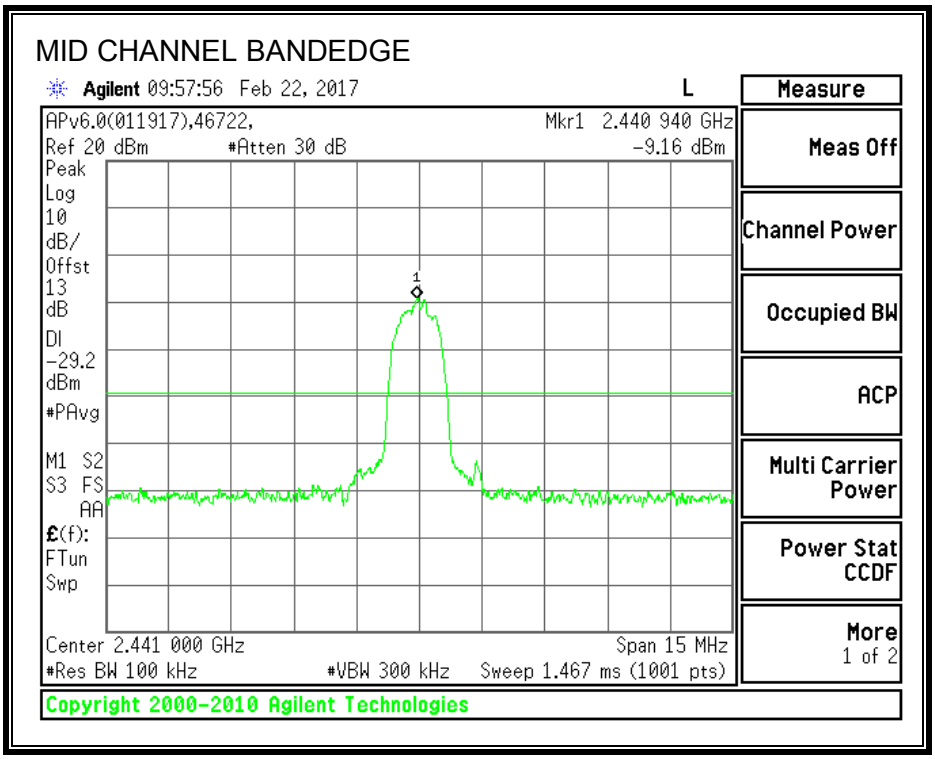
LOW CHANNEL BANDEDGE

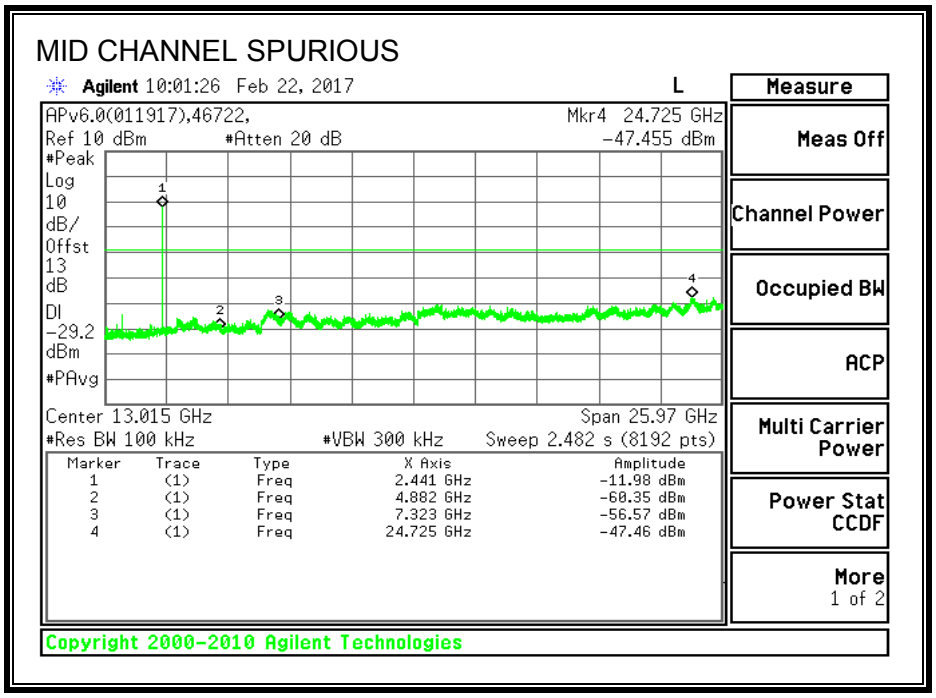


LOW CHANNEL SPURIOUS

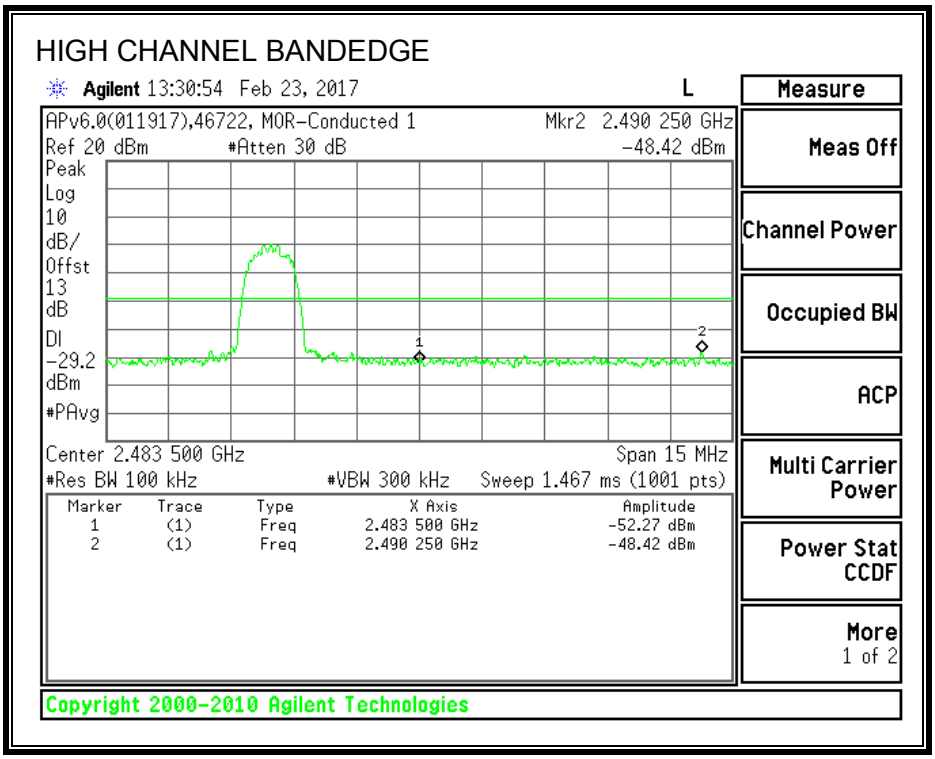


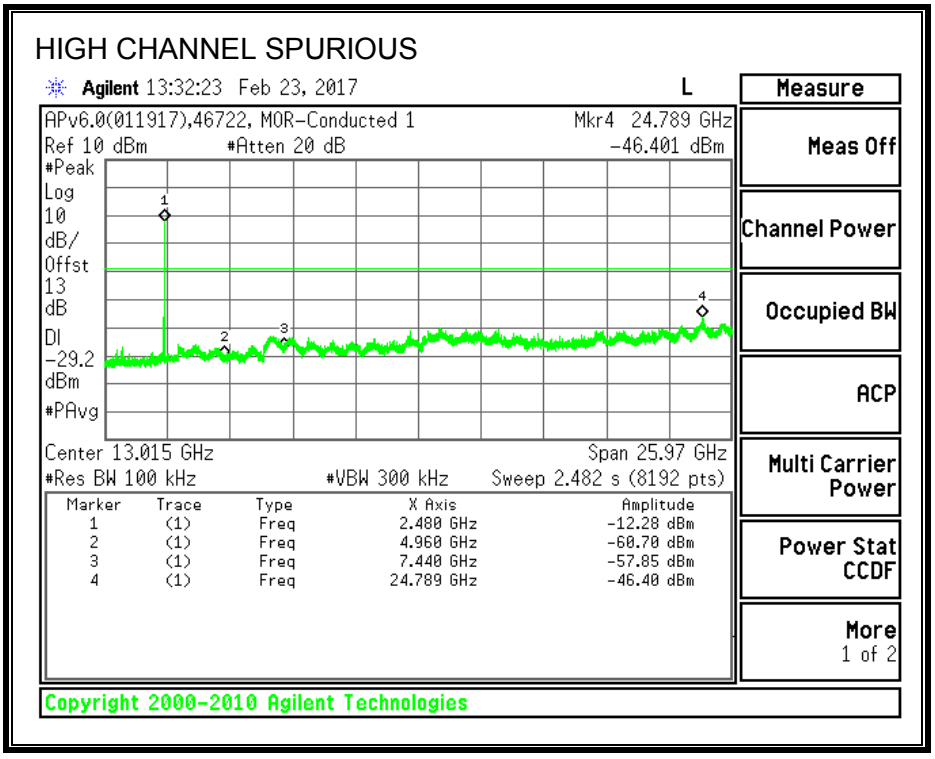
SPURIOUS EMISSIONS, MID CHANNEL





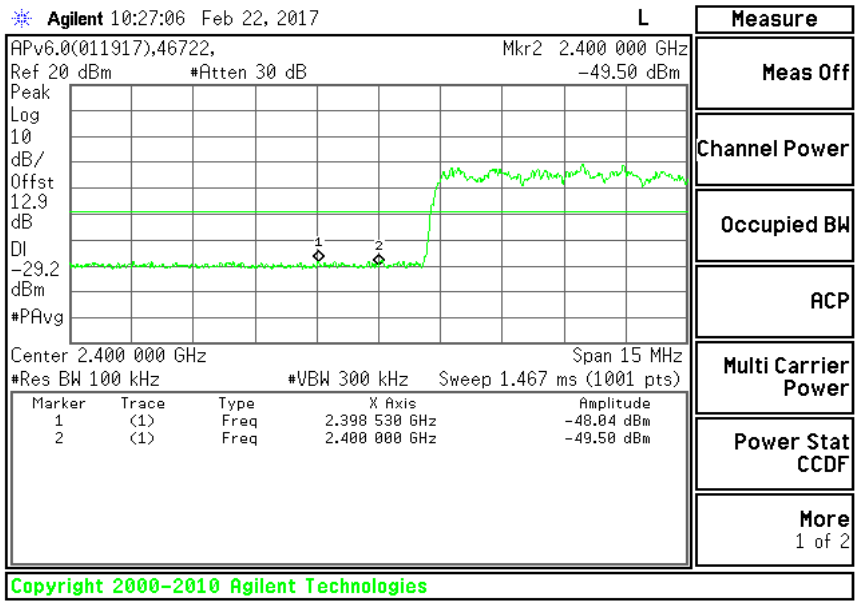
SPURIOUS EMISSIONS, HIGH CHANNEL



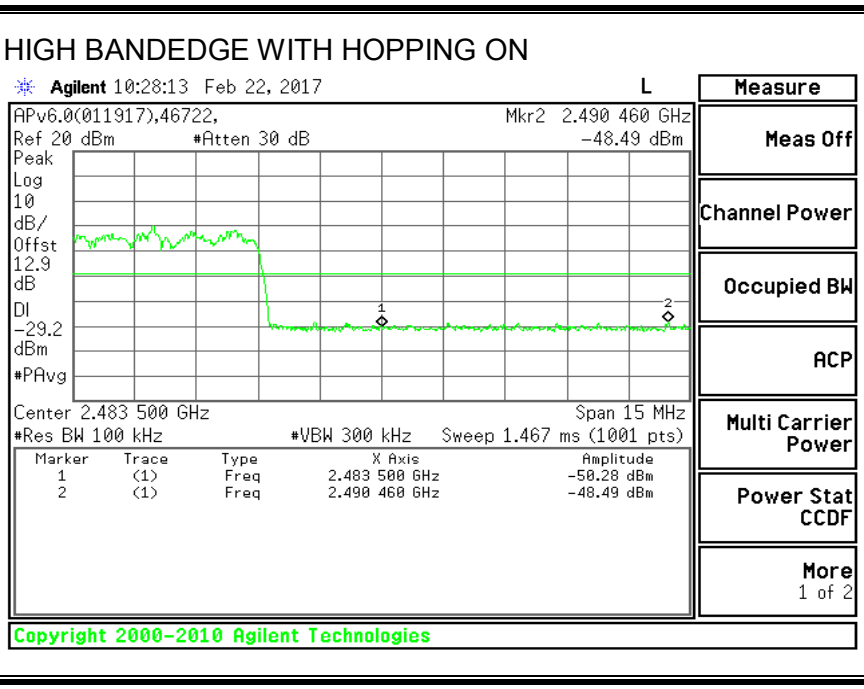


SPURIOUS BANDEDGE EMISSIONS WITH HOPPING ON

LOW BANDEDGE WITH HOPPING ON



HIGH BANDEDGE WITH HOPPING ON



8. RADIATED TEST RESULTS

8.1. LIMITS AND PROCEDURE

LIMITS

FCC §15.205, §15.209 and §15.247 (d)

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.

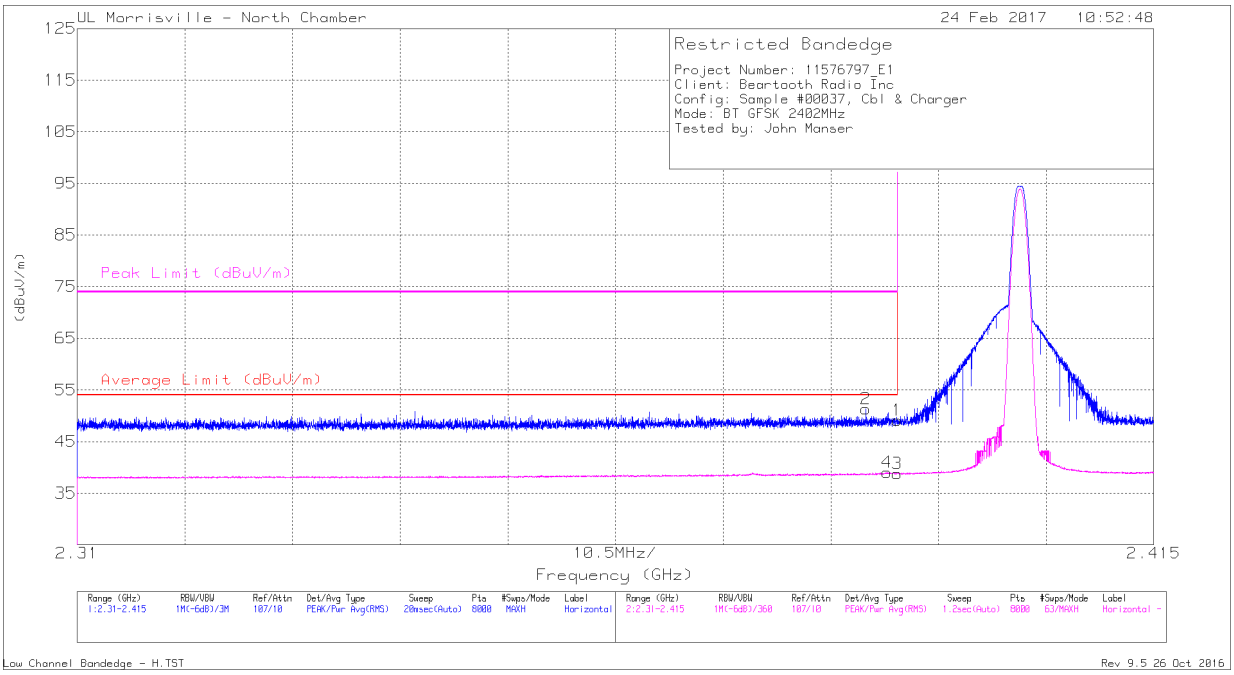
The spectrum from 9 kHz to 26 GHz is investigated. From 1-18GHz the transmitter set to the lowest, middle, and highest channels in each applicable band. For below 1GHz and above 18GHz the worst-case channel was selected.

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.

8.2. TRANSMITTER ABOVE 1 GHz

8.2.1. BASIC DATA RATE GFSK MODULATION

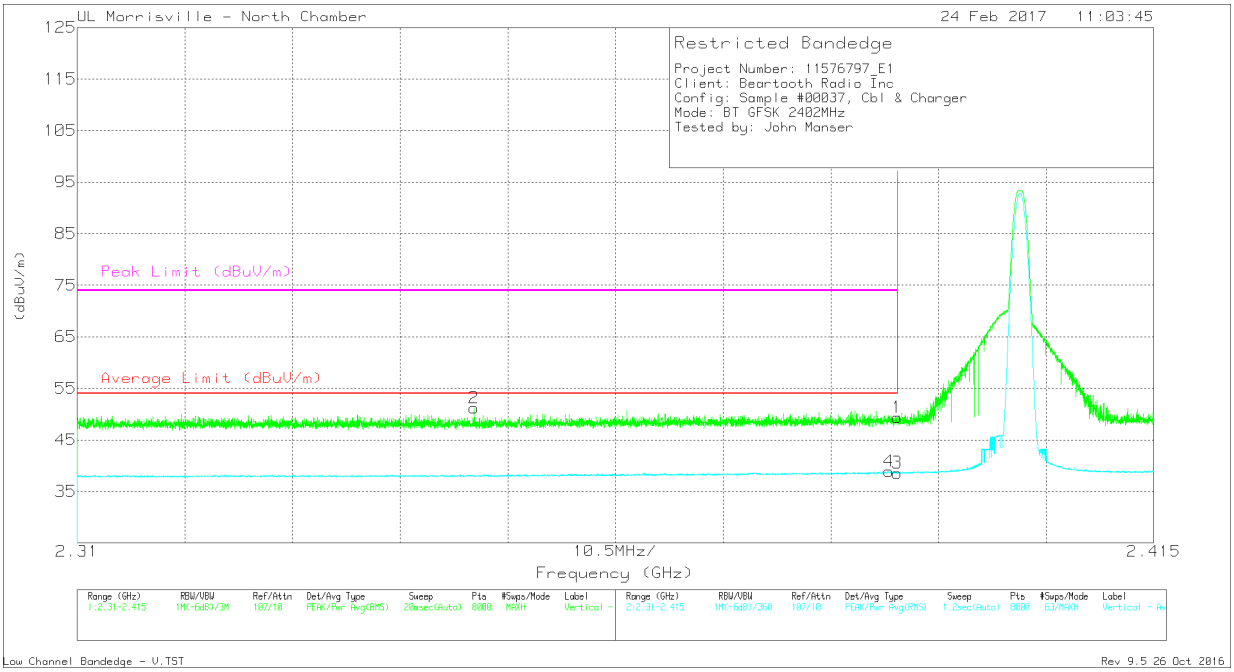
RESTRICTED BANDEDGE (LOW CHANNEL, HORIZONTAL)



Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF AT0072 (dB/m)	Amp/Cbl/ Fltr/Pad (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.39	41.49	Pk	32.1	-24.5	49.09	-	-	74	-24.91	94	126	H
2	* 2.387	43.7	Pk	32.1	-24.5	51.3	-	-	74	-22.7	94	126	H
3	* 2.39	31.21	V1TR	32.1	-24.5	38.81	54	-15.19	-	-	94	126	H
4	* 2.389	31.41	V1TR	32.1	-24.5	39.01	54	-14.99	-	-	94	126	H

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

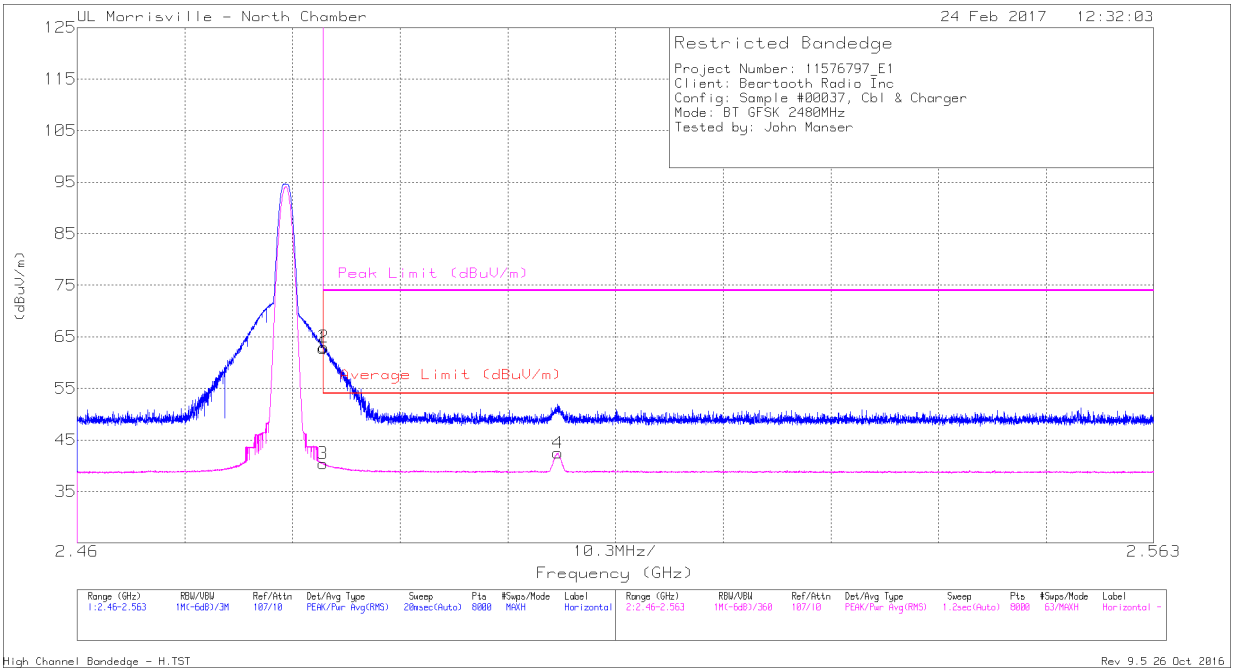
RESTRICTED BANDEDGE (LOW CHANNEL, VERTICAL)



Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF AT0072 (dB/m)	Amp/Cbl/ Fltr/Pad (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.39	41.72	Pk	32.1	-24.5	49.32	-	-	74	-24.68	188	119	V
2	* 2.349	44.08	Pk	31.7	-24.6	51.18	-	-	74	-22.82	188	119	V
3	* 2.39	31	V1TR	32.1	-24.5	38.6	54	-15.4	-	-	188	119	V
4	* 2.389	31.31	V1TR	32.1	-24.5	38.91	54	-15.09	-	-	188	119	V

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

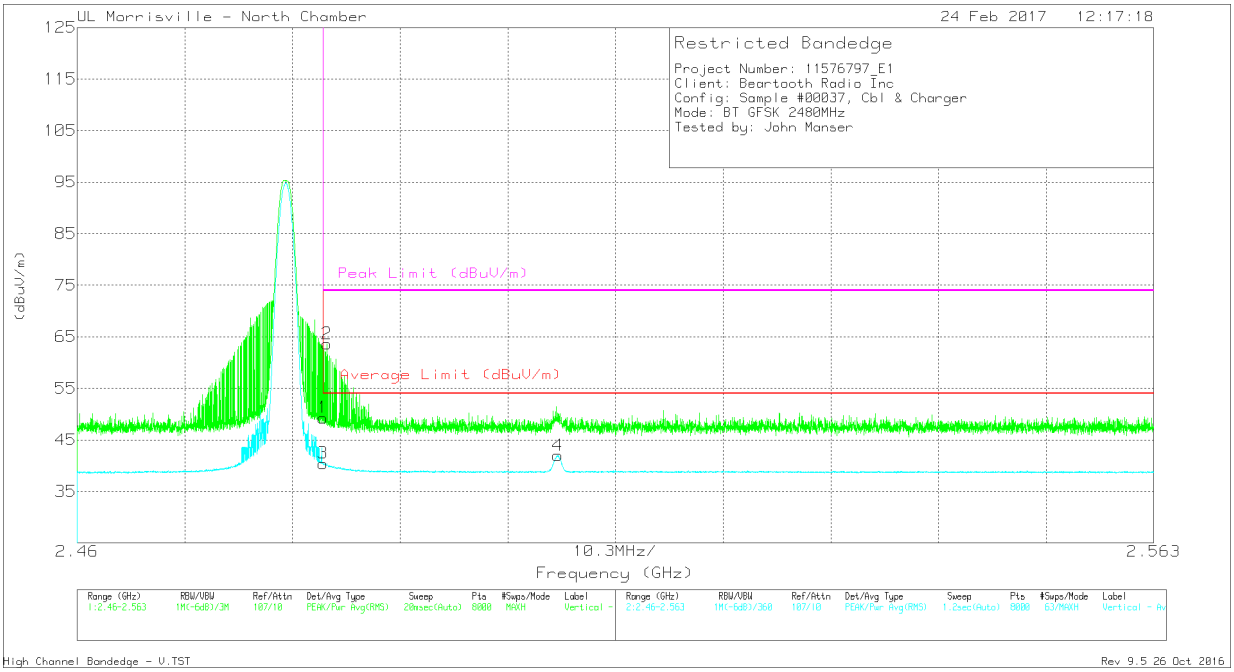
RESTRICTED BANDEDGE (HIGH CHANNEL, HORIZONTAL)



Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF AT0072 (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	54.8	Pk	32.3	-24.3	62.8	-	-	74	-11.2	14	116	H
2	* 2.484	55.04	Pk	32.3	-24.3	63.04	-	-	74	-10.96	14	116	H
3	* 2.484	32.42	V1TR	32.3	-24.3	40.42	54	-13.58	-	-	14	116	H
4	2.506	34.46	V1TR	32.3	-24.3	42.46	54	-11.54	-	-	14	116	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)

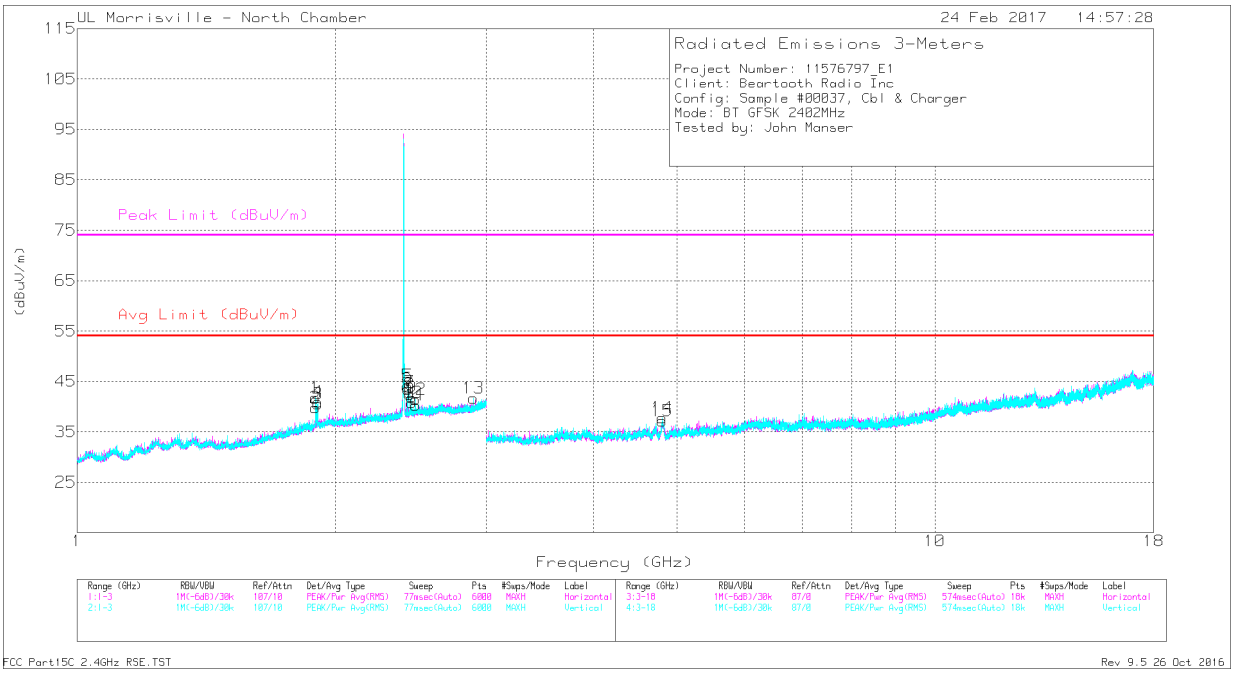


Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF AT0072 (dB/m)	Amp/Cbl/ Fltr/Pad (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.484	41.3	Pk	32.3	-24.3	49.3	-	-	74	-24.7	68	107	V
2	* 2.484	55.65	Pk	32.3	-24.3	63.65	-	-	74	-10.35	68	107	V
3	* 2.484	32.45	V1TR	32.3	-24.3	40.45	54	-13.55	-	-	68	107	V
4	2.506	33.98	V1TR	32.3	-24.3	41.98	54	-12.02	-	-	68	107	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

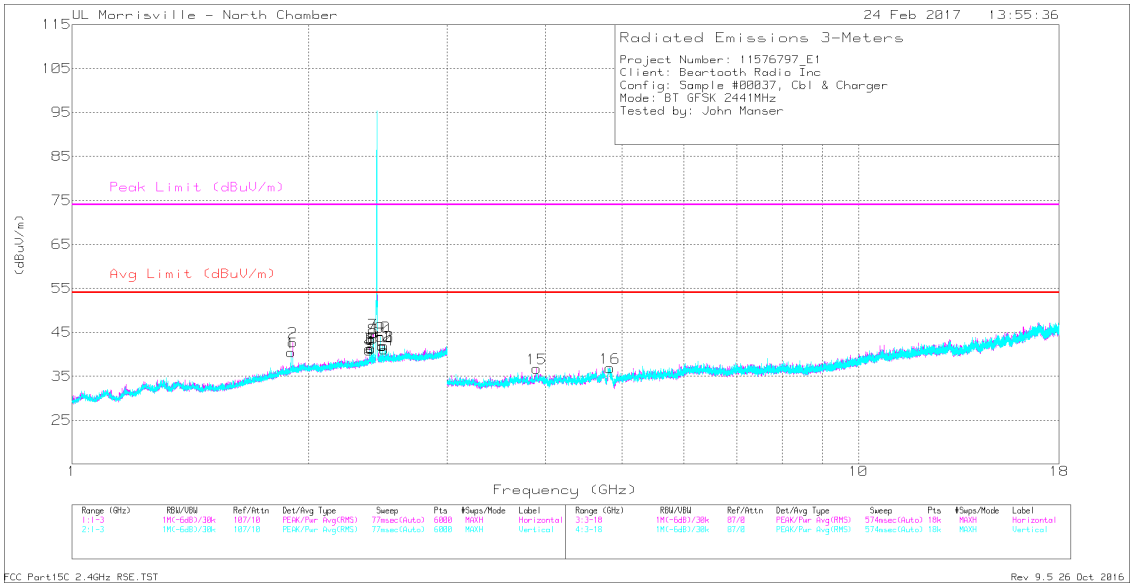
LOW CHANNEL 1-18GHz



Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF AT0072 (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
15	* 4.811	41.07	PK-U	34	-31.7	43.37	-	-	74	-30.63	4	272	H
	* 4.81	30.24	V1TR	34	-31.7	32.54	54	-21.46	-	-	4	272	H
13	* 2.896	37.15	PK-U	32.4	-23.6	45.95	-	-	74	-28.05	301	144	V
	* 2.896	25.52	V1TR	32.4	-23.6	34.32	54	-19.68	-	-	301	144	V
14	* 4.806	41.23	PK-U	34	-31.7	43.53	-	-	74	-30.47	27	322	V
	* 4.807	29.97	V1TR	34	-31.7	32.27	54	-21.73	-	-	27	322	V
2	1.896	33.1	Pk	31.1	-24.4	39.8	-	-	-	-	0-360	199	H
3	1.909	33.83	Pk	31.2	-24.5	40.53	-	-	-	-	0-360	199	H
6	2.428	35.83	Pk	32.2	-24.5	43.53	-	-	-	-	0-360	102	H
7	2.441	35.16	Pk	32.2	-24.5	42.86	-	-	-	-	0-360	199	H
10	2.454	33.04	Pk	32.2	-24.4	40.84	-	-	-	-	0-360	102	H
11	2.48	32.38	Pk	32.3	-24.4	40.28	-	-	-	-	0-360	102	H
1	1.896	35.07	Pk	31.1	-24.4	41.77	-	-	-	-	0-360	199	V
4	1.909	34.23	Pk	31.2	-24.5	40.93	-	-	-	-	0-360	102	V
5	2.428	36.43	Pk	32.2	-24.5	44.13	-	-	-	-	0-360	102	V
8	2.441	34.71	Pk	32.2	-24.5	42.41	-	-	-	-	0-360	199	V
9	2.454	34	Pk	32.2	-24.4	41.8	-	-	-	-	0-360	102	V
12	2.48	33.5	Pk	32.3	-24.4	41.4	-	-	-	-	0-360	102	V

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

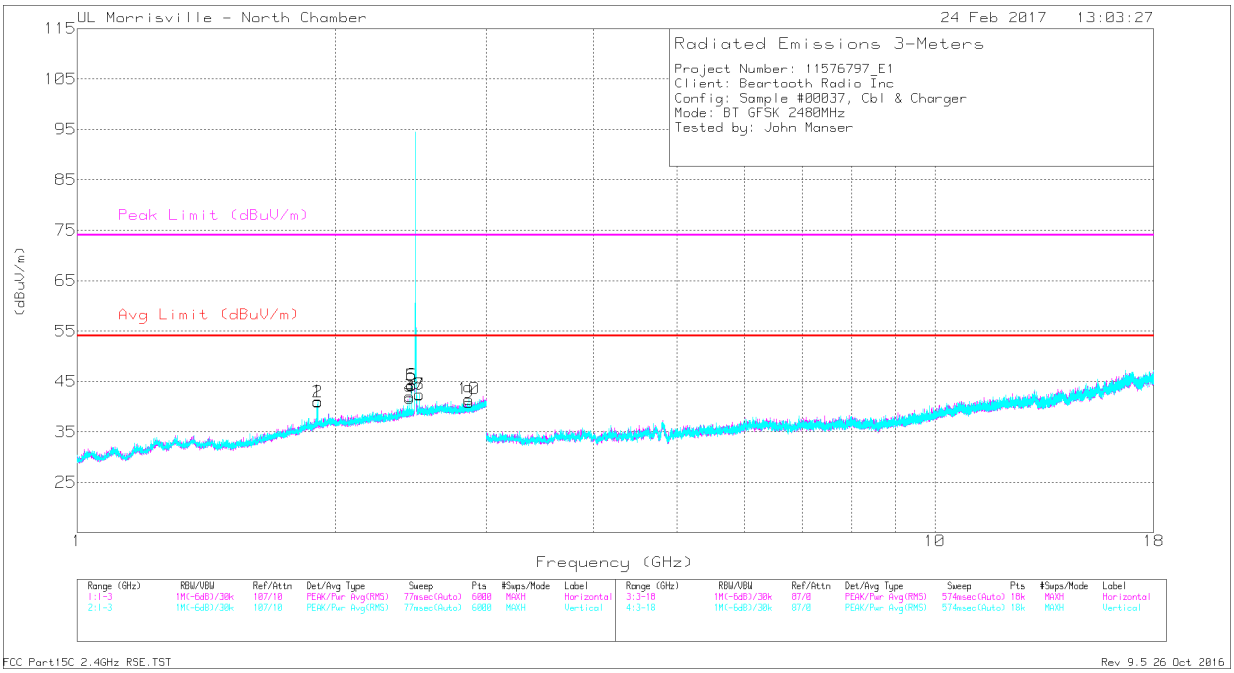
MID CHANNEL 1-18GHz



Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF AT0072 (dB/m)	Amp/Cbl/ Fltr/Pad (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
3	* 2.389	38.56	PK-U	32.1	-24.5	46.16	-	-	74	-27.84	97	126	H
	* 2.389	30.26	V1TR	32.1	-24.5	37.86	54	-16.14	-	-	97	126	H
14	* 2.493	38.86	PK-U	32.3	-24.4	46.76	-	-	74	-27.24	19	137	H
	* 2.493	29.39	V1TR	32.3	-24.4	37.29	54	-16.71	-	-	19	137	H
4	* 2.389	38.45	PK-U	32.1	-24.5	46.05	-	-	74	-27.95	186	118	V
	* 2.389	28.79	V1TR	32.1	-24.5	36.39	54	-17.61	-	-	186	118	V
13	* 2.493	39.19	PK-U	32.3	-24.4	47.09	-	-	74	-26.91	186	102	V
	* 2.493	29.23	V1TR	32.3	-24.4	37.13	54	-16.87	-	-	186	102	V
15	* 3.898	40.41	PK-U	33.5	-31.9	42.01	-	-	74	-31.99	265	312	H
	* 3.898	28.84	V1TR	33.5	-31.9	30.44	54	-23.56	-	-	265	312	H
16	* 4.83	41.25	PK-U	34.1	-31.6	43.75	-	-	74	-30.25	73	400	V
	* 4.828	28.93	V1TR	34.1	-31.5	31.53	54	-22.47	-	-	73	400	V
2	1.907	36.03	Pk	31.2	-24.5	42.73	-	-	-	-	0-360	199	H
6	2.402	33.54	Pk	32.2	-24.5	41.24	-	-	-	-	0-360	102	H
7	2.415	36.98	Pk	32.2	-24.5	44.68	-	-	-	-	0-360	102	H
10	2.467	36.12	Pk	32.3	-24.4	44.02	-	-	-	-	0-360	102	H
11	2.48	34.06	Pk	32.3	-24.4	41.96	-	-	-	-	0-360	102	H
1	1.897	33.71	Pk	31.1	-24.4	40.41	-	-	-	-	0-360	99	V
5	2.402	33.76	Pk	32.2	-24.5	41.46	-	-	-	-	0-360	99	V
8	2.415	35.88	Pk	32.2	-24.5	43.58	-	-	-	-	0-360	99	V
9	2.467	36.01	Pk	32.3	-24.4	43.91	-	-	-	-	0-360	99	V
12	2.48	33.97	Pk	32.3	-24.4	41.87	-	-	-	-	0-360	99	V

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

HIGH CHANNEL 1-18GHz

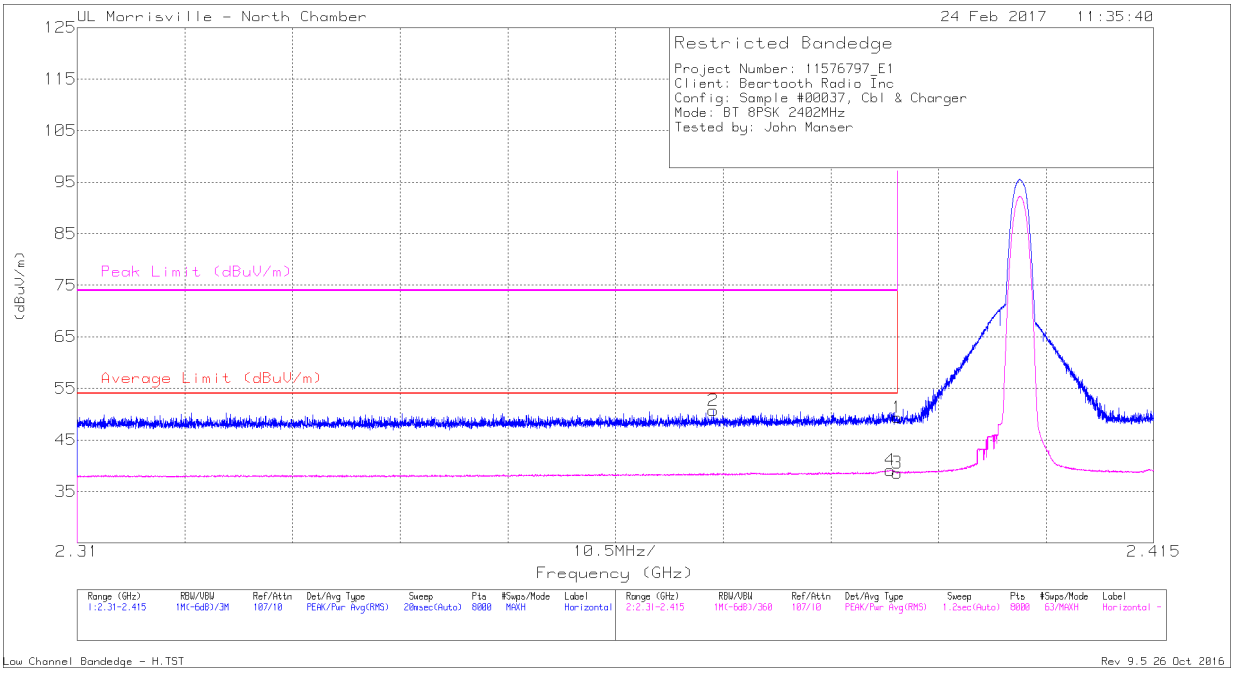


Marker	Freq (GHz)	Meter Reading (dBuV)	Det	AF AT0072 (dB/m)	Amp/Cbl /Fltr/Pad (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
9	* 2.86	36.87	PK-U	32.5	-23.7	45.67	-	-	74	-28.33	217	183	H
	* 2.86	25.46	V1TR	32.5	-23.7	34.26	54	-19.74	-	-	217	183	H
10	* 2.861	37.02	PK-U	32.5	-23.7	45.82	-	-	74	-28.18	83	156	V
	* 2.862	25.56	V1TR	32.5	-23.7	34.36	54	-19.64	-	-	83	156	V
2	1.908	34.26	Pk	31.2	-24.5	40.96	-	-	-	-	0-360	101	H
3	2.441	34.37	Pk	32.2	-24.5	42.07	-	-	-	-	0-360	101	H
6	2.454	36.55	Pk	32.2	-24.4	44.35	-	-	-	-	0-360	101	H
7	2.506	34.52	Pk	32.3	-24.4	42.42	-	-	-	-	0-360	101	H
1	1.907	34.34	Pk	31.2	-24.5	41.04	-	-	-	-	0-360	199	V
4	2.441	34.04	Pk	32.2	-24.5	41.74	-	-	-	-	0-360	99	V
5	2.454	36.36	Pk	32.2	-24.4	44.16	-	-	-	-	0-360	99	V
8	2.506	34.49	Pk	32.3	-24.4	42.39	-	-	-	-	0-360	99	V

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

8.2.2. ENHANCED DATA RATE 8PSK MODULATION

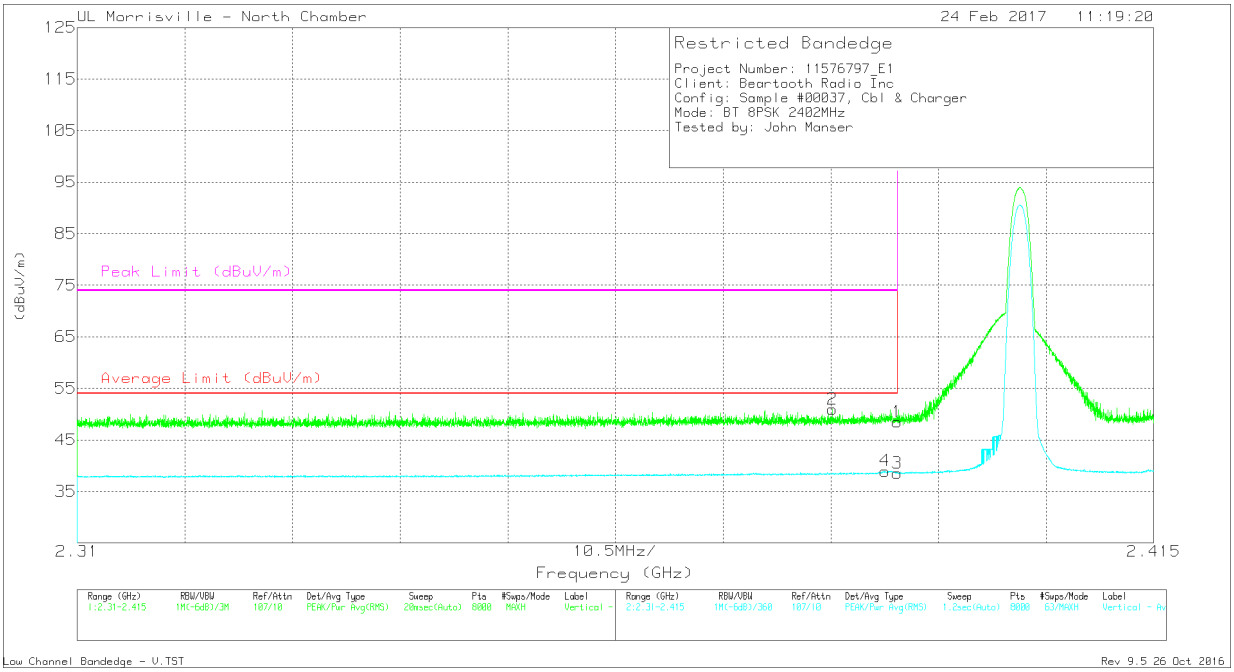
RESTRICTED BANDEDGE (LOW CHANNEL, HORIZONTAL)



Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF AT0072 (dB/m)	Amp/Cbl/ Fltr/Pad (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.39	41.73	Pk	32.1	-24.5	49.33	-	-	74	-24.67	99	125	H
2	* 2.372	43.34	Pk	31.9	-24.5	50.74	-	-	74	-23.26	99	125	H
3	* 2.39	30.98	V1TR	32.1	-24.5	38.58	54	-15.42	-	-	99	125	H
4	* 2.389	31.51	V1TR	32.1	-24.5	39.11	54	-14.89	-	-	99	125	H

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

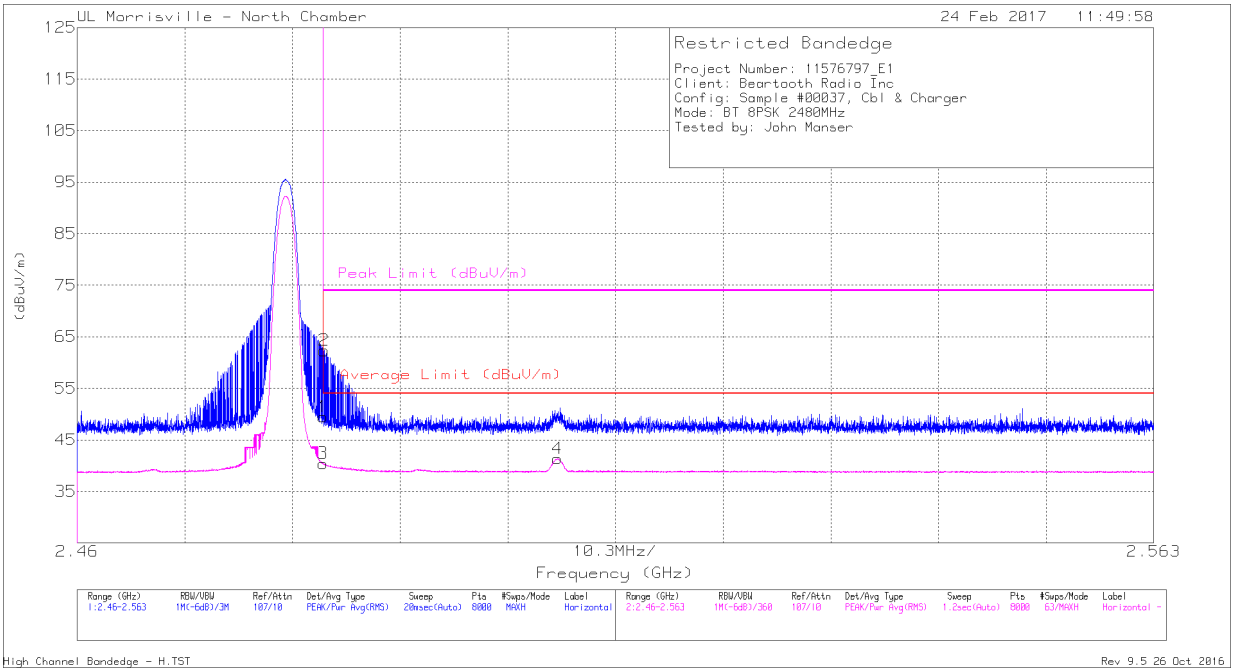
RESTRICTED BANDEDGE (LOW CHANNEL, VERTICAL)



Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF AT0072 (dB/m)	Amp/Cbl/ Fltr/Pad (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.39	40.87	Pk	32.1	-24.5	48.47	-	-	74	-25.53	190	120	V
2	* 2.384	43.37	Pk	32.1	-24.5	50.97	-	-	74	-23.03	190	120	V
3	* 2.39	30.95	V1TR	32.1	-24.5	38.55	54	-15.45	-	-	190	120	V
4	* 2.389	31.37	V1TR	32.1	-24.5	38.97	54	-15.03	-	-	190	120	V

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

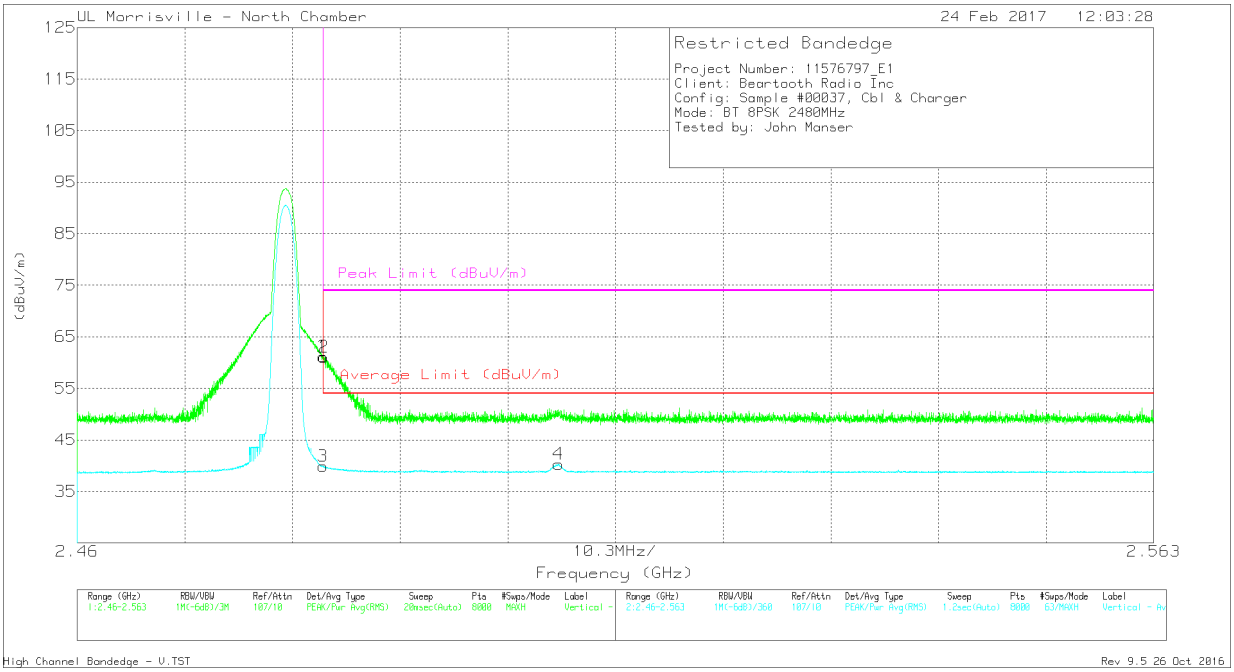
RESTRICTED BANDEDGE (HIGH CHANNEL, HORIZONTAL)



Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF AT0072 (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	41.51	Pk	32.3	-24.3	49.51	-	-	74	-24.49	15	117	H
2	* 2.484	54.34	Pk	32.3	-24.3	62.34	-	-	74	-11.66	15	117	H
3	* 2.484	32.43	V1TR	32.3	-24.3	40.43	54	-13.57	-	-	15	117	H
4	2.506	33.36	V1TR	32.3	-24.3	41.36	54	-12.64	-	-	15	117	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)

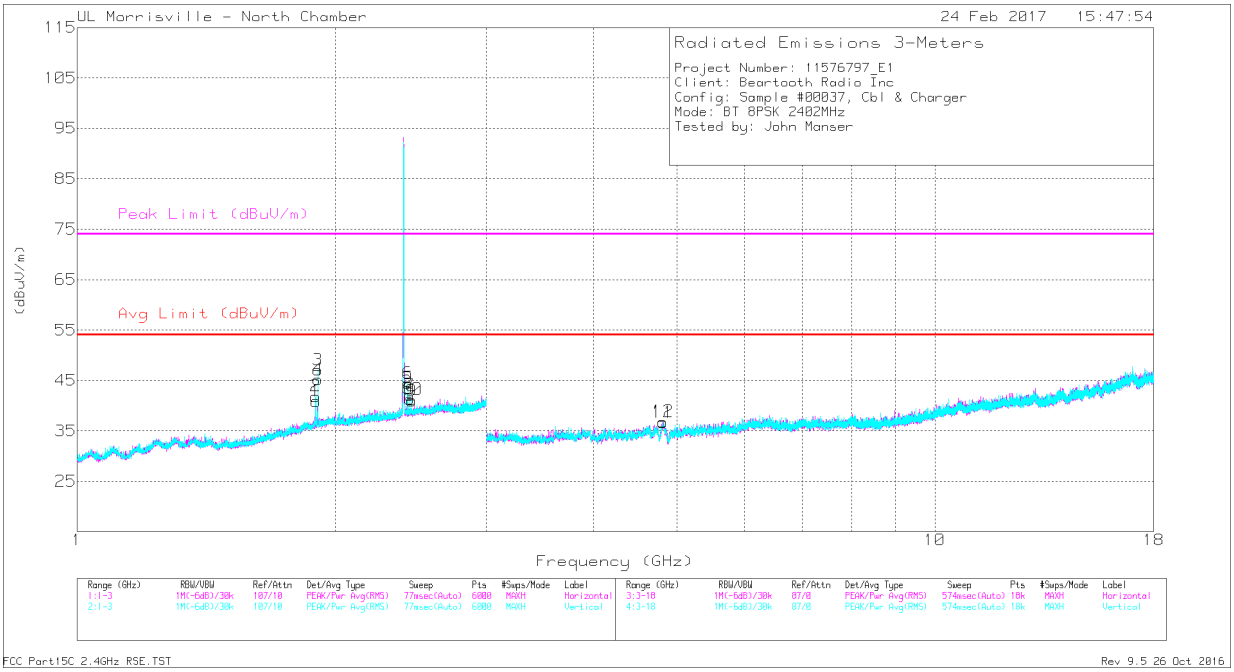


Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF AT0072 (dB/m)	Amp/Cbl/ Fltr/Pad (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.484	53.12	Pk	32.3	-24.3	61.12	-	-	74	-12.88	260	111	V
2	* 2.484	53.07	Pk	32.3	-24.3	61.07	-	-	74	-12.93	260	111	V
3	* 2.484	31.92	V1TR	32.3	-24.3	39.92	54	-14.08	-	-	260	111	V
4	2.506	32.32	V1TR	32.3	-24.3	40.32	54	-13.68	-	-	260	111	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

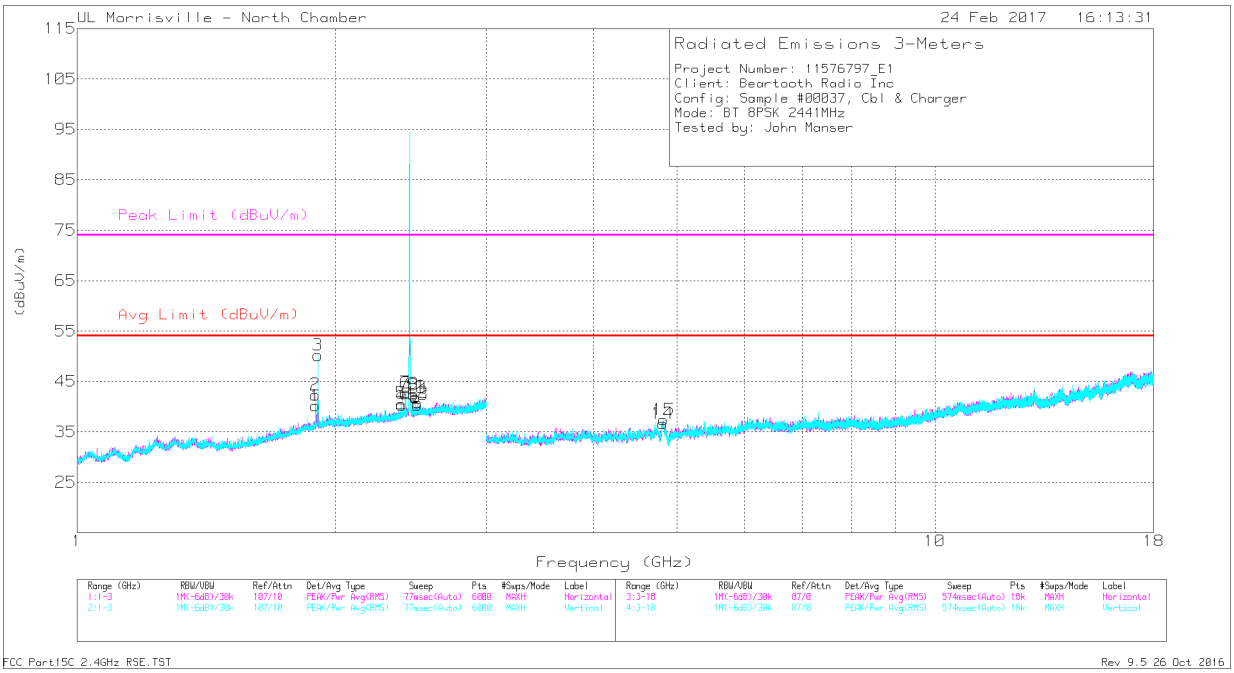
LOW CHANNEL 1-18GHz



Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF AT0072 (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
11	* 4.815	41.05	PK-U	34.1	-31.6	43.55	-	-	74	-30.45	244	193	H
	* 4.815	29.59	V1TR	34.1	-31.6	32.09	54	-21.91	-	-	244	193	H
12	* 4.817	40.46	PK-U	34.1	-31.6	42.96	-	-	74	-31.04	255	203	V
	* 4.817	29.58	V1TR	34.1	-31.6	32.08	54	-21.92	-	-	255	203	V
1	1.898	34.18	Pk	31.1	-24.4	40.88	-	-	-	-	0-360	103	H
4	1.908	38.51	Pk	31.2	-24.5	45.21	-	-	-	-	0-360	103	H
5	2.428	35.82	Pk	32.2	-24.5	43.52	-	-	-	-	0-360	103	H
8	2.441	33.59	Pk	32.2	-24.5	41.29	-	-	-	-	0-360	103	H
9	2.454	33.13	Pk	32.2	-24.4	40.93	-	-	-	-	0-360	103	H
2	1.897	35.18	Pk	31.1	-24.4	41.88	-	-	-	-	0-360	199	V
3	1.909	40.37	Pk	31.2	-24.5	47.07	-	-	-	-	0-360	199	V
6	2.428	36.72	Pk	32.2	-24.5	44.42	-	-	-	-	0-360	99	V
7	2.441	34.39	Pk	32.2	-24.5	42.09	-	-	-	-	0-360	99	V
10	2.454	33.42	Pk	32.2	-24.4	41.22	-	-	-	-	0-360	99	V

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

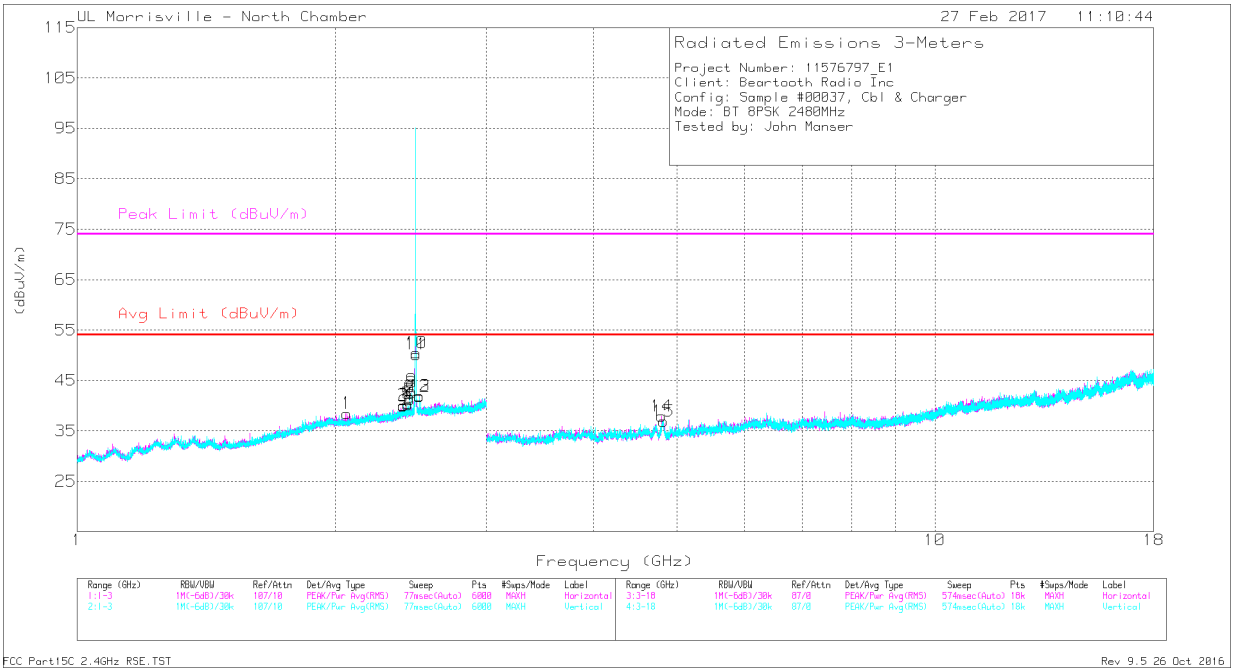
MID CHANNEL 1-18GHz



Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF AT0072 (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
5	* 2.389	40.12	PK-U	32.1	-24.5	47.72	-	-	74	-26.28	98	106	H
	* 2.389	29.35	V1TR	32.1	-24.5	36.95	54	-17.05	-	-	98	106	H
13	* 2.493	38.38	PK-U	32.3	-24.4	46.28	-	-	74	-27.72	189	110	H
	* 2.493	28.75	V1TR	32.3	-24.4	36.65	54	-17.35	-	-	189	110	H
14	* 4.814	41.27	PK-U	34	-31.6	43.67	-	-	74	-30.33	51	334	H
	* 4.814	29.81	V1TR	34	-31.6	32.21	54	-21.79	-	-	51	334	H
4	* 2.389	38.88	PK-U	32.1	-24.5	46.48	-	-	74	-27.52	223	107	V
	* 2.389	28.6	V1TR	32.1	-24.5	36.2	54	-17.8	-	-	223	107	V
12	* 2.493	38.52	PK-U	32.3	-24.4	46.42	-	-	74	-27.58	71	124	V
	* 2.493	28.9	V1TR	32.3	-24.4	36.8	54	-17.2	-	-	71	124	V
15	* 4.829	40.11	PK-U	34.1	-31.6	42.61	-	-	74	-31.39	252	171	V
	* 4.827	28.7	V1TR	34.1	-31.5	31.3	54	-22.7	-	-	252	171	V
1	1.896	33.51	Pk	31.1	-24.4	40.21	-	-	-	-	0-360	102	H
6	2.415	34.93	Pk	32.2	-24.5	42.63	-	-	-	-	0-360	102	H
9	2.467	34.66	Pk	32.3	-24.4	42.56	-	-	-	-	0-360	102	H
10	2.479	33.97	Pk	32.3	-24.4	41.87	-	-	-	-	0-360	102	H
2	1.896	35.67	Pk	31.1	-24.4	42.37	-	-	-	-	0-360	102	V
3	1.909	43.49	Pk	31.2	-24.5	50.19	-	-	-	-	0-360	200	V
7	2.415	35.15	Pk	32.2	-24.5	42.85	-	-	-	-	0-360	102	V
8	2.467	34.4	Pk	32.3	-24.4	42.3	-	-	-	-	0-360	102	V
11	2.48	34.08	Pk	32.3	-24.4	41.98	-	-	-	-	0-360	102	V

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

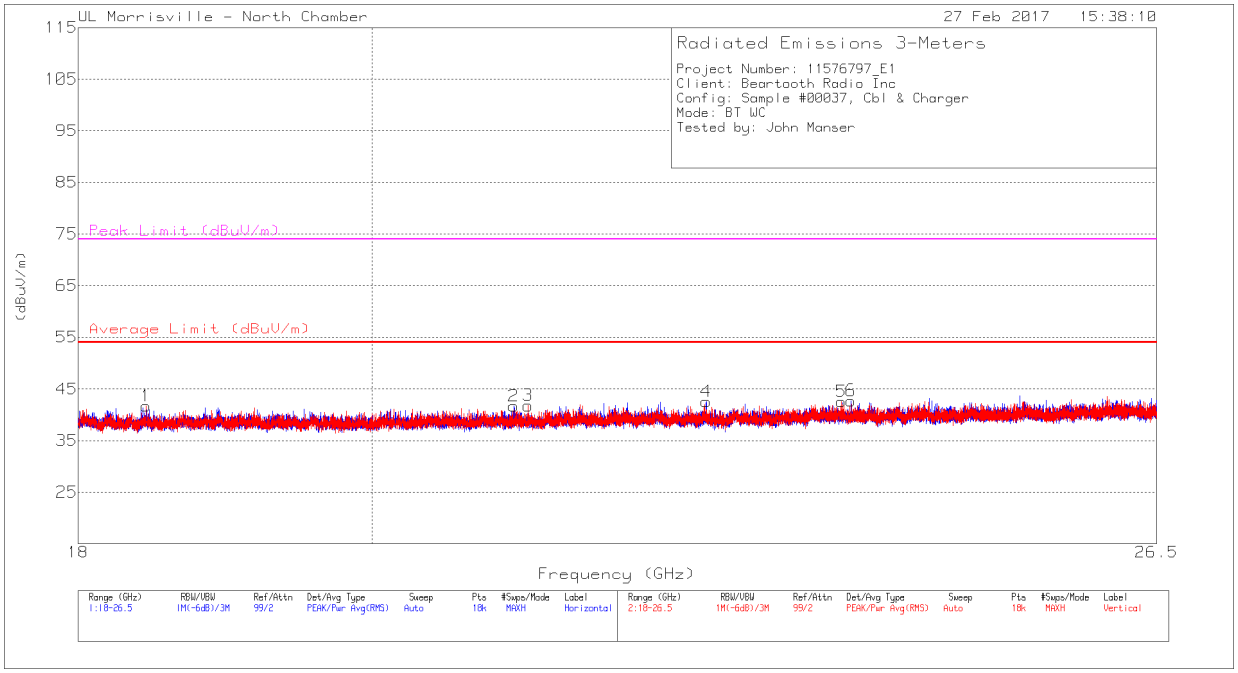
HIGH CHANNEL 1-18GHz



Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF AT0072 (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
10	* 2.484	54.63	PK-U	32.3	-24.4	62.53	-	-	74	-11.47	6	120	H
	* 2.484	32.15	V1TR	32.3	-24.4	40.05	54	-13.95	-	-	6	120	H
14	* 4.801	40.88	PK-U	34	-31.8	43.08	-	-	74	-30.92	335	155	H
	* 4.804	29.72	V1TR	34	-31.7	32.02	54	-21.98	-	-	335	155	H
11	* 2.484	54.42	PK-U	32.3	-24.4	62.32	-	-	74	-11.68	94	148	V
	* 2.484	32.17	V1TR	32.3	-24.4	40.07	54	-13.93	-	-	94	148	V
15	* 4.825	40.29	PK-U	34.1	-31.5	42.89	-	-	74	-31.11	81	266	V
	* 4.827	29.24	V1TR	34.1	-31.5	31.84	54	-22.16	-	-	81	266	V
1	2.062	31.88	Pk	31.1	-24.5	38.48	-	-	-	-	0-360	198	H
3	2.402	32.27	Pk	32.2	-24.5	39.97	-	-	-	-	0-360	102	H
4	2.428	32.53	Pk	32.2	-24.5	40.23	-	-	-	-	0-360	102	H
7	2.441	33.39	Pk	32.2	-24.4	41.19	-	-	-	-	0-360	198	H
9	2.454	35.21	Pk	32.2	-24.4	43.01	-	-	-	-	0-360	102	H
13	2.506	34	Pk	32.3	-24.4	41.9	-	-	-	-	0-360	102	H
2	2.402	32.41	Pk	32.2	-24.5	40.11	-	-	-	-	0-360	199	V
5	2.428	32.7	Pk	32.2	-24.5	40.4	-	-	-	-	0-360	102	V
6	2.441	34.06	Pk	32.2	-24.5	41.76	-	-	-	-	0-360	102	V
8	2.454	34.75	Pk	32.2	-24.4	42.55	-	-	-	-	0-360	102	V
12	2.506	33.88	Pk	32.3	-24.4	41.78	-	-	-	-	0-360	102	V

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

8.2.1. WORST-CASE ABOVE 18GHz



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
* 21.041	49	PK-U	33.2	-40.8	41.4	54	-12.6	74	-32.6	73	331	H
* 22.547	48.83	PK-U	33.5	-40.2	42.13	54	-11.87	74	-31.87	33	100	H
* 23.748	48.21	PK-U	33.9	-39.9	42.21	54	-11.79	74	-31.79	340	348	H
* 18.443	48.47	PK-U	32.7	-40.1	41.07	54	-12.93	74	-32.93	100	173	V
* 21.149	50.21	PK-U	33	-40.7	42.51	54	-11.49	74	-31.49	334	221	V
* 23.668	48.64	PK-U	33.8	-39.7	42.74	54	-11.26	74	-31.26	166	357	V

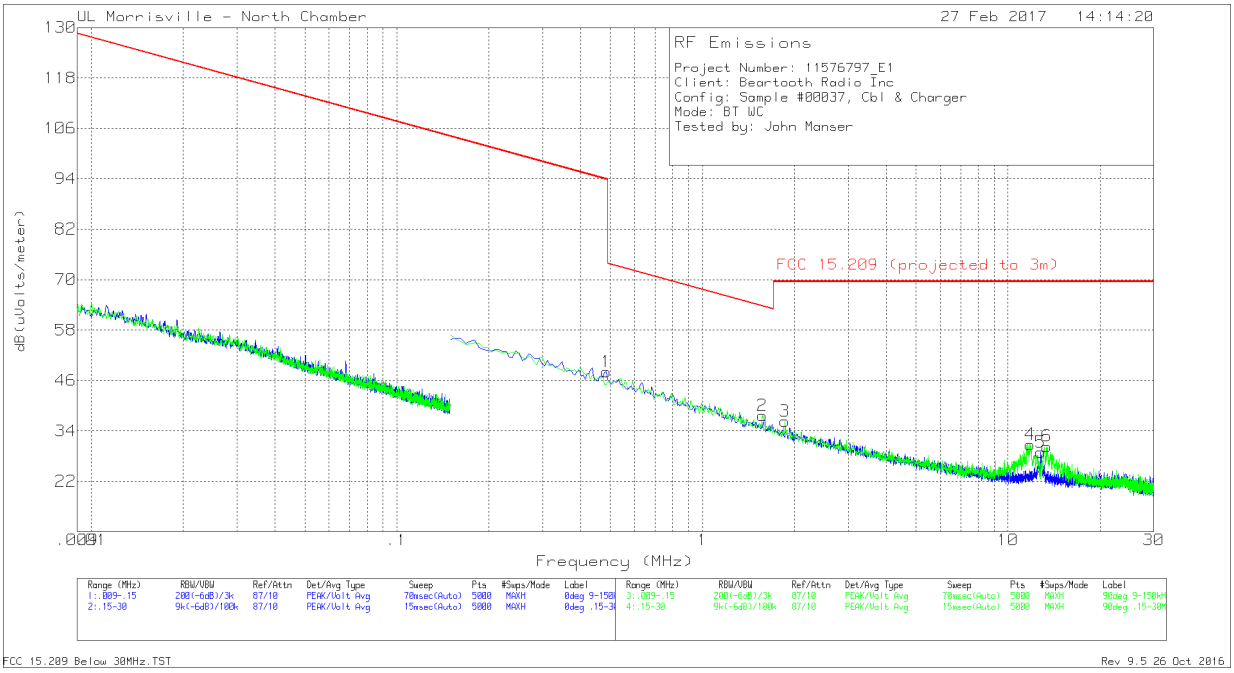
* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band
PK-U: Maximum Peak
V1TR: VB=1/Ton, where: Ton is packet duration

8.3. WORST-CASE BELOW 1 GHz

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).

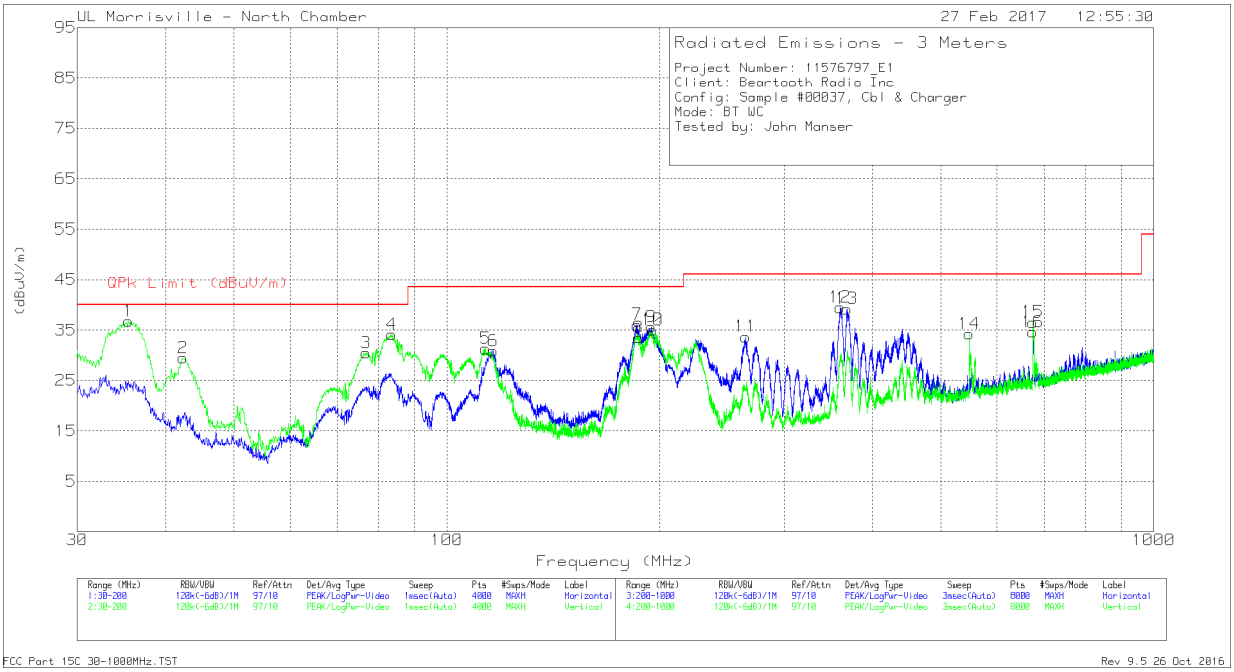
Although these tests were performed at a test site other than an open area test site, adequate comparison measurements were confirmed against an open area test site. Therefore sufficient tests were made to demonstrate that the alternative site produces results that correlate with the ones of tests made in an open field based on KDB 937606.



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	.48438	37.11	Pk	10.8	.1	48.01	93.9	-45.89	0-360
2	1.5711	26.47	Pk	11	.2	37.67	63.68	-26.01	0-360
3	1.86368	25.05	Pk	11	.2	36.25	69.54	-33.29	0-360
4	11.80539	19.67	Pk	10.5	.6	30.77	69.54	-38.77	0-360
5	12.77269	17.87	Pk	10.4	.6	28.87	69.54	-40.67	0-360
6	13.4295	19.34	Pk	10.4	.6	30.34	69.54	-39.2	0-360

Pk - Peak detector

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



Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	AT0073 AF (dB/m)	Amp/Cbl (dB)	Corrected Reading (dBuV/m)	QPk Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
6	* 116.410	39.51	Qp	17.8	-30.8	26.51	43.52	-17.01	285	309	H
11	* 264.587	41.04	Qp	17.5	-29.7	28.84	46.02	-17.18	333	107	H
5	* 113.351	40.99	Qp	17.5	-30.8	27.69	43.52	-15.83	100	102	V
7	185.9303	50.46	Pk	15.8	-30.2	36.06	43.52	-7.46	0-360	98	H
9	194.5601	48.95	Pk	16.8	-30.1	35.65	43.52	-7.87	0-360	98	H
12	359.7208	48.98	Pk	19.6	-29.1	39.48	46.02	-6.54	0-360	102	H
13	368.0218	48.52	Pk	19.8	-29.1	39.22	46.02	-6.8	0-360	102	H
16	674.3617	38.09	Pk	24.3	-27.8	34.59	46.02	-11.43	0-360	399	H
1	35.486	43.25	Qp	21.9	-31.7	33.45	40	-6.55	49	105	V
2	42.3282	44.3	Pk	16.8	-31.6	29.5	40	-10.5	0-360	102	V
3	76.8896	49.59	Pk	12.2	-31.3	30.49	40	-9.51	0-360	102	V
4	83.5433	49.87	Qp	11.7	-31.1	30.47	40	-9.53	126	110	V
8	186.7806	47.91	Pk	15.8	-30.2	33.51	43.52	-10.01	0-360	102	V
10	195.3253	48.24	Pk	17	-30.2	35.04	43.52	-8.48	0-360	102	V
14	548.3453	39.75	Pk	22.8	-28.3	34.25	46.02	-11.77	0-360	102	V
15	674.3117	40.07	Pk	24.3	-27.8	36.57	46.02	-9.45	0-360	199	V

* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band
Pk - Peak detector
Qp - Quasi-Peak detector

9. AC POWER LINE CONDUCTED EMISSIONS

LIMITS

FCC §15.207 (a)

RSS-Gen 7.2.2

Frequency of Emission (MHz)	Conducted Limit (dBuV)	
	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

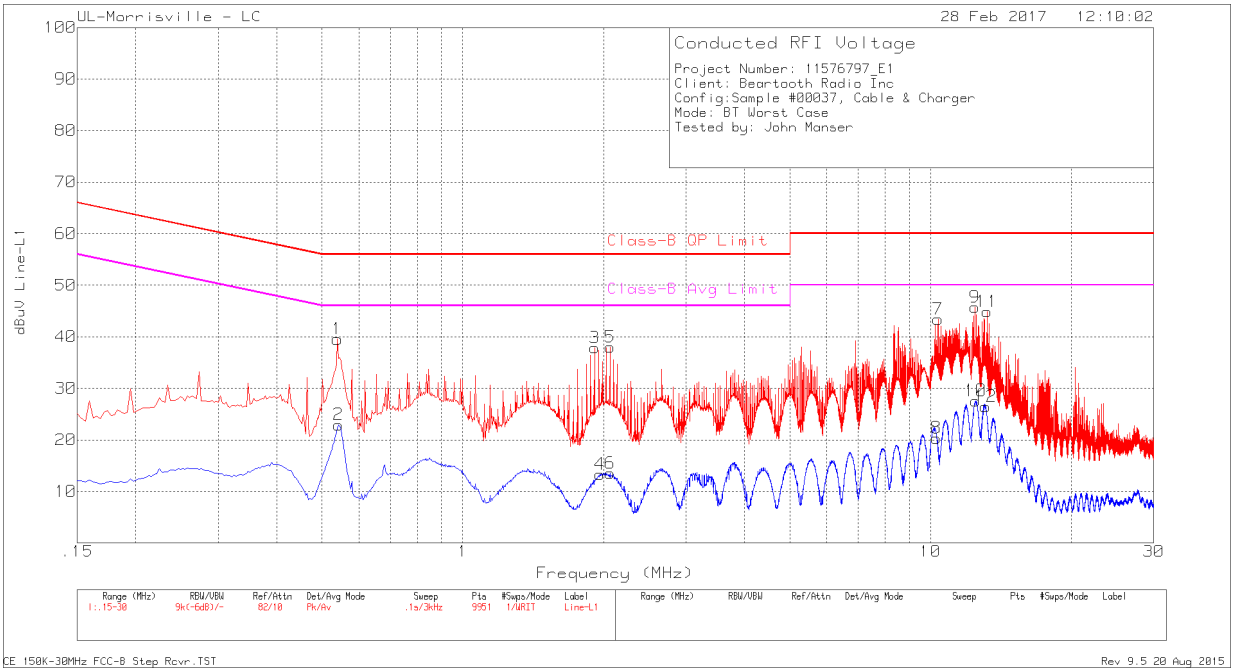
The EUT is placed on a non-conducting table 40 cm from the vertical ground plane and 80 cm above the horizontal ground plane. The EUT is configured in accordance with ANSI C63.10.

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

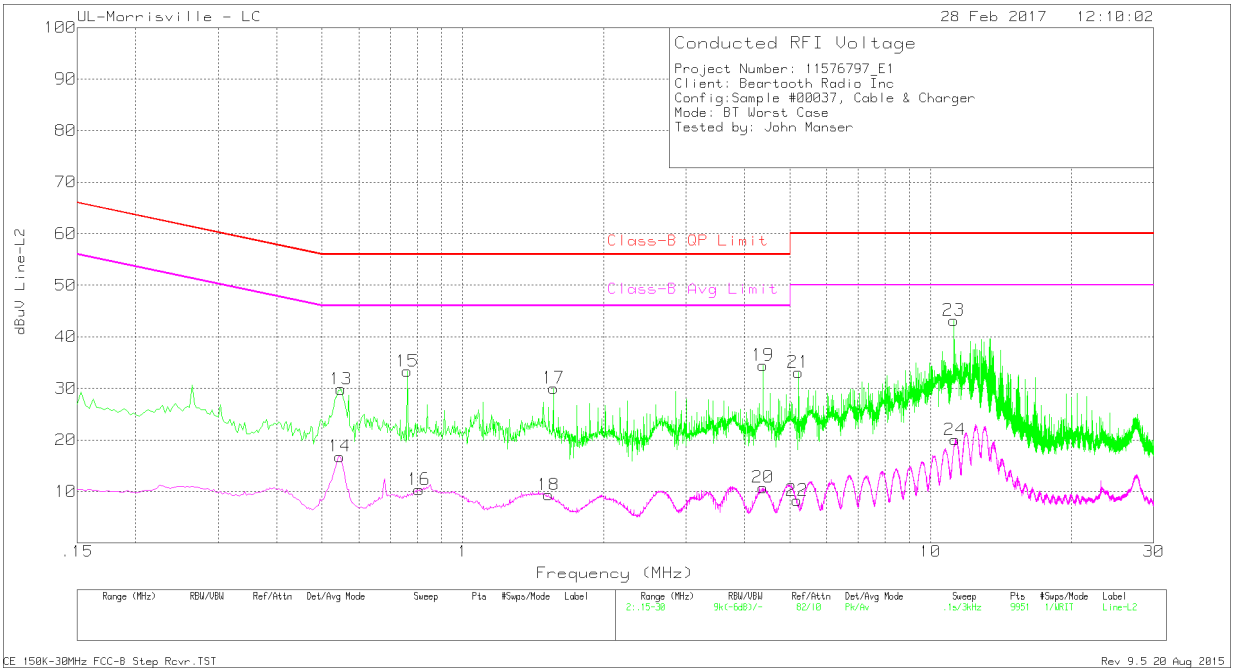
LINE 1 RESULTS



Range 1: Line-L1 .15 - 30MHz										
Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	LISN VCF (dB)	Cbl/Limiter (dB)	Corrected Reading dBuV	Class-B QP Limit	Margin (dB)	Class-B Avg Limit	Margin (dB)
1	.54	29.55	Pk	0	10	39.55	56	-16.45	-	-
2	.543	12.95	Av	0	10	22.95	-	-	46	-23.05
3	1.914	27.75	Pk	0	10.1	37.85	56	-18.15	-	-
4	1.965	3.23	Av	0	10.1	13.33	-	-	46	-32.67
5	2.064	27.9	Pk	0	10.1	38	56	-18	-	-
6	2.064	3.42	Av	0	10.1	13.52	-	-	46	-32.48
7	10.377	33	Pk	.1	10.3	43.4	60	-16.6	-	-
8	10.308	9.95	Av	.1	10.3	20.35	-	-	50	-29.65
9	12.447	35.22	Pk	.1	10.4	45.72	60	-14.28	-	-
10	12.492	17.09	Av	.1	10.4	27.59	-	-	50	-22.41
11	13.206	34.37	Pk	.1	10.4	44.87	60	-15.13	-	-
12	13.11	15.98	Av	.1	10.4	26.48	-	-	50	-23.52

Pk - Peak detector
Av - Average detection

LINE 2 RESULTS



Range 2: Line-L2 .15 - 30MHz										
Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	LISN VCF (dB)	Cbl/Limiter (dB)	Corrected Reading dBuV	Class-B QP Limit	Margin (dB)	Class-B Avg Limit	Margin (dB)
13	.549	19.84	Pk	0	10	29.84	56	-26.16	-	-
14	.546	6.8	Av	0	10	16.8	-	-	46	-29.2
15	.762	23.3	Pk	0	10	33.3	56	-22.7	-	-
16	.807	.38	Av	0	10	10.38	-	-	46	-35.62
17	1.563	20.07	Pk	0	10	30.07	56	-25.93	-	-
18	1.527	-.64	Av	0	10	9.36	-	-	46	-36.64
19	4.383	24.39	Pk	0	10.1	34.49	56	-21.51	-	-
20	4.383	.68	Av	0	10.1	10.78	-	-	46	-35.22
21	5.223	22.83	Pk	.1	10.2	33.13	60	-26.87	-	-
22	5.187	-2.01	Av	.1	10.2	8.29	-	-	50	-41.71
23	11.217	32.82	Pk	.1	10.3	43.22	60	-16.78	-	-
24	11.292	9.65	Av	.1	10.3	20.05	-	-	50	-29.95

Pk - Peak detector

Av - Average detection