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

CERTIFICATION TEST REPORT

FOR

MOBILE FAP 60, 10-PRINT FINGERPRINT CAPTURE DEVICE

MODEL: NOMAD 60 WIRELESS READER

FCC ID: Q9Y7680
IC: 7944B-7680

REPORT NUMBER: R12204358-E3

ISSUE DATE: 2018-07-11

Prepared for
CROSS MATCH TECHNOLOGIES INC.
3950 RCA BOULEVARD, SUITE 5001
PALM BEACH GARDENS, FL 33410, USA

Prepared by
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NVLAP TESTING

NVLAP Lab code: 200246-0

Revision History

Ver.	Issue Date	Revisions	Revised By
1	2018-07-11	Initial Issue	Niklas Haydon

TABLE OF CONTENTS

1. ATTESTATION OF TEST RESULTS

COMPANY NAME: Cross Match Technologies, Inc.
3950 RCA Blvd, Suite 5001
Palm Beach Gardens, FL 33410, USA

EUT DESCRIPTION: Mobile FAP 60, 10-print fingerprint capture device

MODEL: Nomad 60 Wireless Reader

SERIAL NUMBER: ENB008, ENB013

DATE TESTED: 2018-05-03 to 2018-06-12

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

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:

Bob Delisi
Principal Engineer
UL – Consumer Technology Division

Prepared By:

Niklas Haydon
Project Engineering Handler
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

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 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	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. DESCRIPTION OF EUT

The EUT is a portable wireless biometric identification device that contains 802.11 a/ac/b/g/n and Bluetooth radios.

5.2. MODIFICATIONS

Modifications were made to address compliance issues with 30 to 1000 MHz worst case radiated emissions testing in R12204358-E2. However, AC power line conducted emissions and 30 to 1000 MHz worst case radiated emissions testing were performed after the modifications listed below were made:

A shield was added over microcontroller, associated memory and power supplies. A bypass capacitor was added to USB flex assembly near USB connector. A TDK ZCAT 1730-0730 ferrite was added to USB-C-to-USB-C cable (refer to set up photos section).

5.3. 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	1.70	1.48
2402 - 2480	DQPSK	0.75	1.19
2402 - 2480	Enhanced 8PSK	1.12	1.29

5.4. DESCRIPTION OF AVAILABLE ANTENNAS

The radio utilizes an SMD monopole antenna, with a maximum gain of 3.5 dBi.

5.5. SOFTWARE AND FIRMWARE

The firmware installed in the EUT was MfgTools-Nomad4_WIFI_Nightly_Image_04_02_2018.eng.

The EUT driver installed in the host support equipment was Nomad60 version 1.0.0.0.

The test utility software used during testing was QCA Radio Control Toolkit (QRCT) version 3.0.156.0.

5.6. WORST-CASE CONFIGURATION AND MODE

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

DQPSK is represented by 8DPSK in some cases and DH5 testing represents DH1 and DH3.

5.7. DESCRIPTION OF TEST SETUP

SUPPORT EQUIPMENT

Support Equipment List			
Description	**Manufacturer**	**Model**	**Serial Number**
Laptop	HP	ProBook 4540s	CM000447
AC Adapter Type-C	PHIHONG	AQ15A-050A	P170900909A1

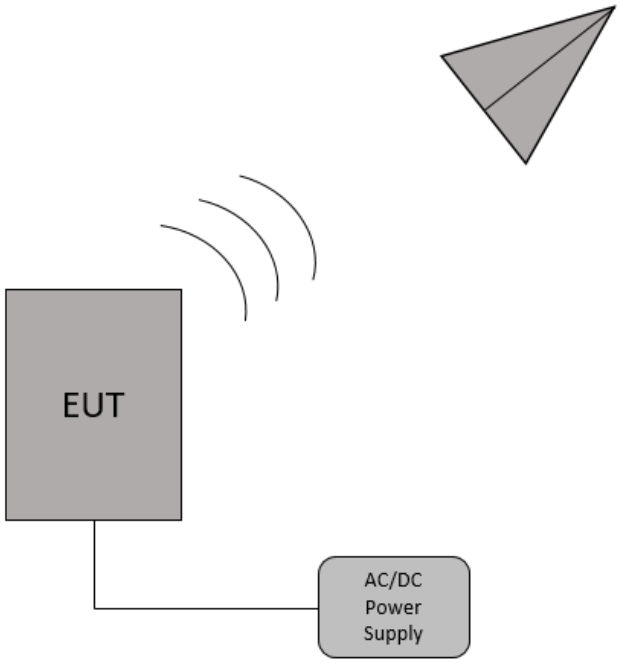
I/O CABLES

I/O Cable List						
Cable No.	**Port**	**# of Identical Ports**	**Connector Type**	**Cable Type**	**Cable Length (m)**	**Remarks**
1	USB-C	1	24-pin USB-C	USB-C	<3m	None

TEST SETUP

The EUT was installed in a typical configuration. The customer provided test software to exercise the EUTs during test. Refer to the following diagram.

SETUP DIAGRAM FOR TESTS



Note: Conducted setups were the same, except spectrum analyzer was connected directly to the antenna port.

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.
	30-1000 MHz				
AT0073	Hybrid Broadband Antenna	Sunol Sciences Corp.	JB3	2017-07-18	2018-07-31
	1-18 GHz				
AT0072	Double-Ridged Waveguide Horn Antenna, 1 to 18 GHz	ETS Lindgren	3117	2018-04-30	2019-04-30
	Gain-Loss Chains				
N-SAC02	Gain-loss string: 30-1000MHz	Various	Various	2017-06-11	2018-06-11
N-SAC03	Gain-loss string: 1-18GHz	Various	Various	2018-03-23	2019-03-23
	Receiver & Software				
SA0027	Spectrum Analyzer	Agilent	N9030A	2018-04-04	2019-04-04
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 - Radiated Disturbance Emissions Test Equipment (Morrisville - South Chamber)

Equip. ID	Description	Manufacturer	Model Number	Last Cal.	Next Cal.
	18-40 GHz				
AT0076	Horn Antenna, 18-26.5GHz	ARA	MWH-1826/B	2017-10-10	2018-10-10
	Gain-Loss Chains				
S-SAC04	Gain-loss string: 18-40GHz	Various	Various	2018-04-02	2019-04-02
	Receiver & Software				
SA0026	Spectrum Analyzer	Agilent	N9030A	2018-03-20	2019-03-20
	Additional Equipment used				
s/n 161024887	Environmental Meter	Fisher Scientific	15-077-963	2016-12-23	2018-12-23

Test Equipment Used – Conducted Emissions Test Equipment (Morrisville – CON2)

Equip. ID	Description	Manufacturer	Model Number	Last Cal.	Next Cal.
SA0020	Spectrum Analyser	Agilent	E4446A	2017-11-06	2018-11-06
PWM001	Power Meter	Keysight	N1911A	2017-07-17	2018-07-17
PWS001	Power Sensor	Keysight	N1921A	2017-12-18	2018-12-18
SN 161016511	Environmental Meter	Fisher Scientific	15-077-963	2016-12-21	2018-12-21

Test Equipment Used - Line-Conducted Emissions – Voltage (Morrisville – Conducted 1)

Equipment ID	Description	Manufacturer	Model Number	Last Cal.	Next Cal.
CBL076	Coax cable, RG223, N-male to BNC-male, 20-ft.	Pasternack	PE3476-240	2017-06-12	2018-06-12
s/n 160938893	Environmental Meter	Fisher Scientific	14-650-118	2016-11-02	2018-11-02
LISN003	LISN, 50-ohm/50-uH, 2-conductor, 25A	Fischer Custom Com.	FCC-LISN-50-25-2-01-550V	2017-08-22	2018-08-22
PRE0101521 (75141)	EMI Test Receiver 9kHz-7GHz	Rohde & Schwarz	ESCI 7	2017-08-23	2018-08-23
TL001	Transient Limiter, 0.009-30MHz	Com-Power	LIT-930A	2017-06-12	2018-06-12
PS215	AC Power Source	Elgar	CW2501M (s/n 1523A02397)	NA	NA
SOFTEMI	EMI Software	UL	Version 9.5	NA	NA

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, 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. ON TIME AND DUTY CYCLE

LIMITS

None; for reporting purposes only.

PROCEDURE

KDB 558074 Zero-Span Spectrum Analyzer Method.

8.1. ON TIME AND DUTY CYCLE RESULTS

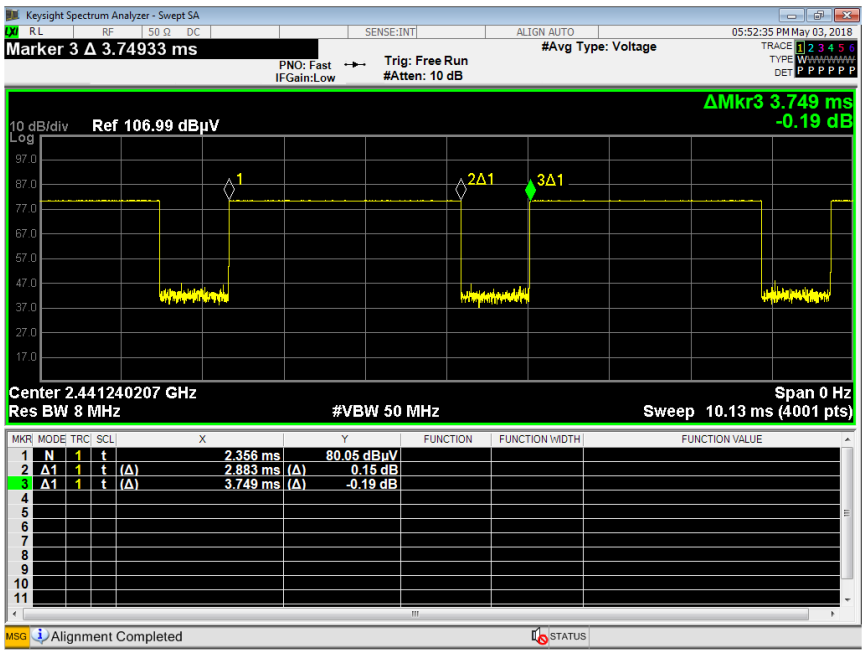
Mode	ON Time B (msec)	Period (msec)	Duty Cycle x (linear)	Duty Cycle (%)	Duty Cycle Correction Factor (dB)	1/B Minimum VBW (kHz)
Bluetooth GFSK	2.883	3.749	0.769	76.90%	2.28	0.347
Bluetooth QPSK	2.883	3.749	0.769	76.90%	2.28	0.347
Bluetooth 8PSK	2.868	3.739	0.767	76.71%	2.30	0.349

TEST INFORMATION

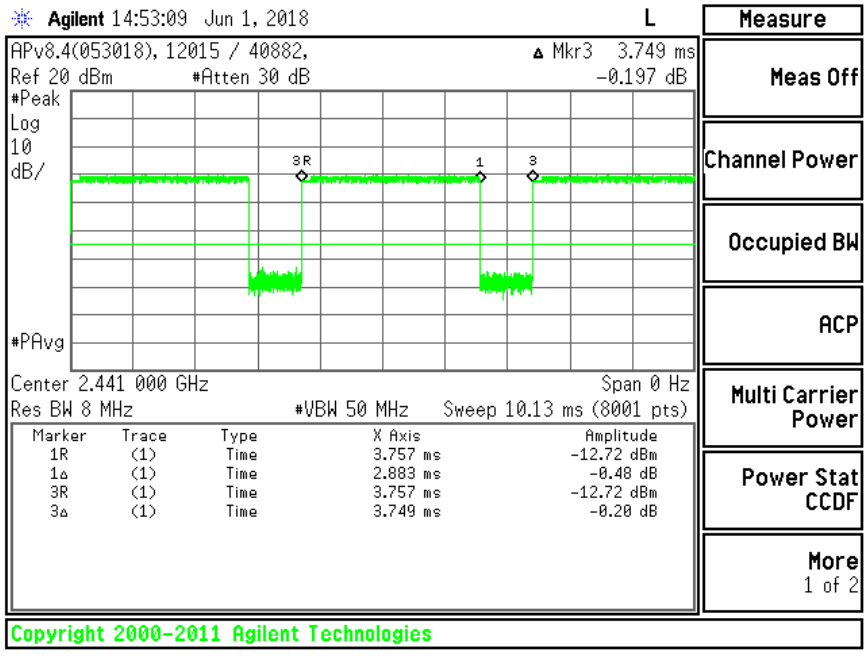
Test Date: 05-03-2018
Tested By: 46726

8.2. DUTY CYCLE PLOTS

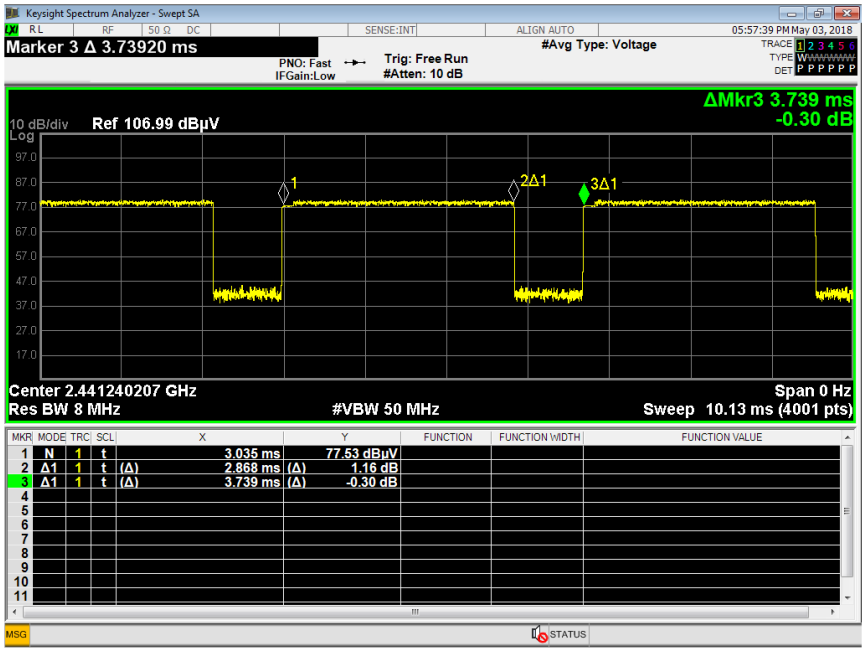
DUTY CYCLE GFSK MODE



DUTY CYCLE QPSK MODE



DUTY CYCLE 8PSK MODE



8.3. BASIC DATA RATE GFSK MODULATION

8.3.1. 20 dB AND 99% BANDWIDTH

LIMIT

None; for reporting purposes only.
Test per ANSI C63.10 Sections 6.9.2 and 6.9.3 and RSS-Gen 6.6.

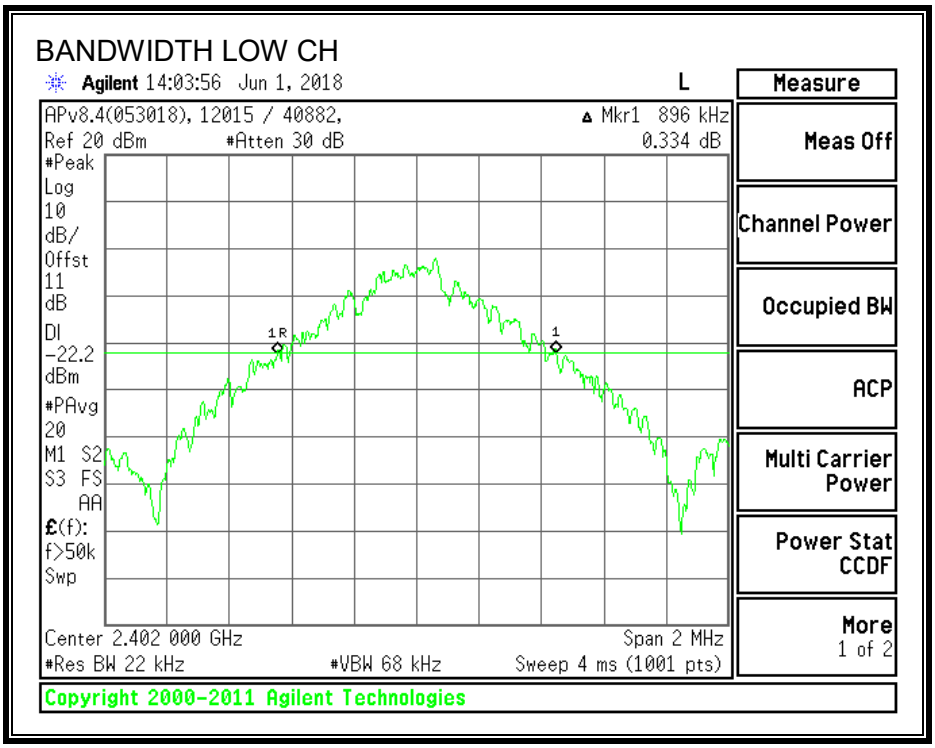
TEST PROCEDURE

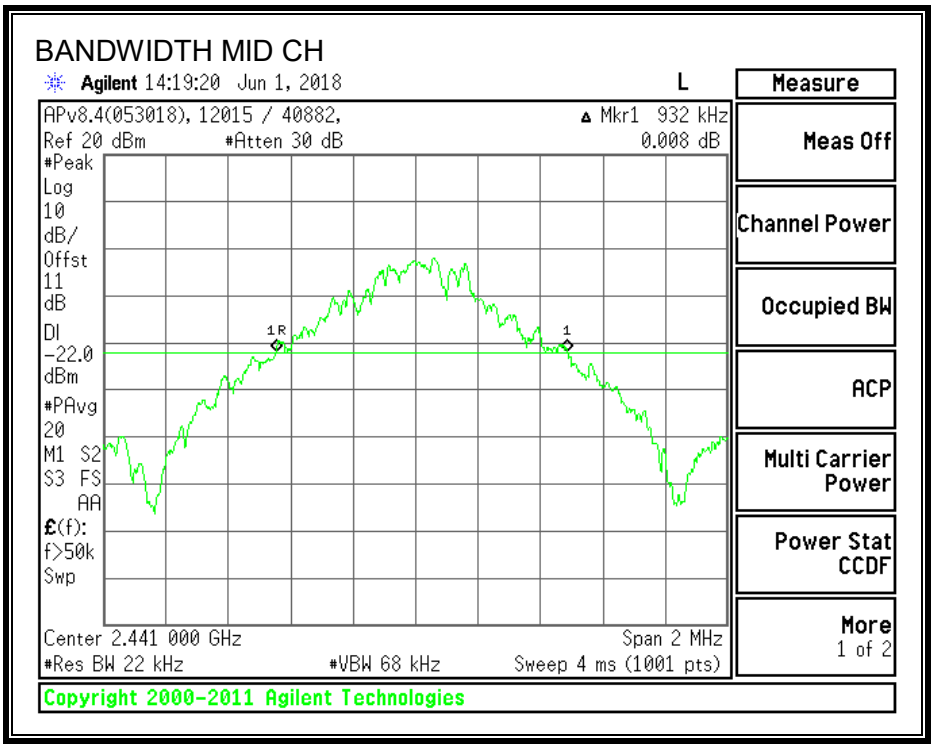
The transmitter output is connected to a spectrum analyzer. The RBW is set to 1%-5% of the 20 dB bandwidth and 99% Occupied Bandwidth. The VBW is set to ≥ RBW. The sweep time is coupled.

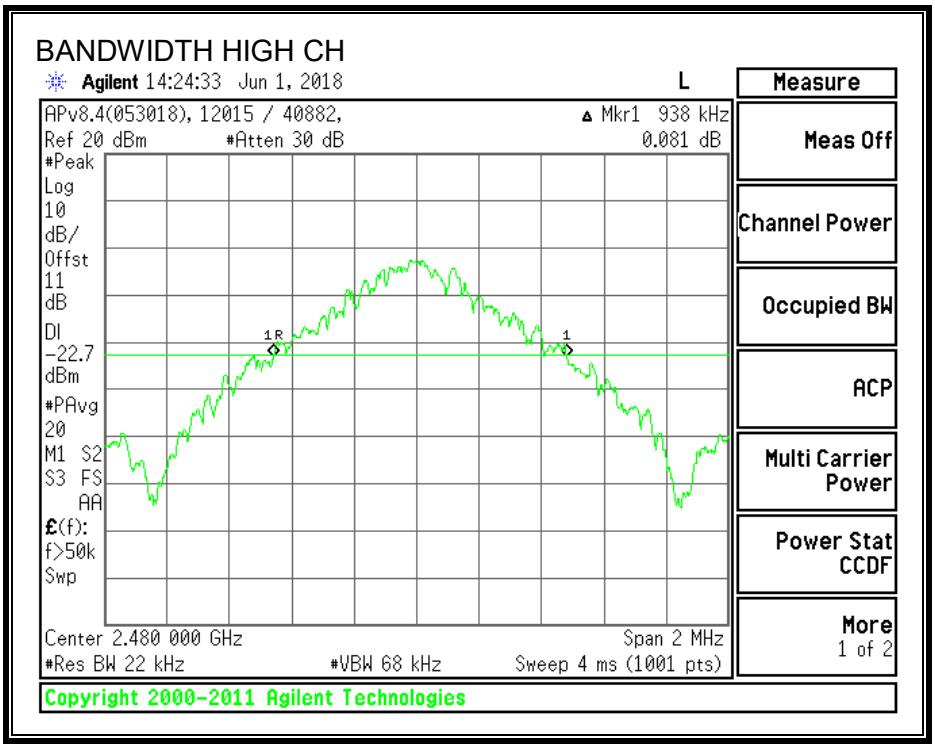
RESULTS

Channel	Frequency (MHz)	20 dB Bandwidth (kHz)	99% Bandwidth (kHz)
Low	2402	896	911.2631
Middle	2441	932	915.3149
High	2480	938	895.7677

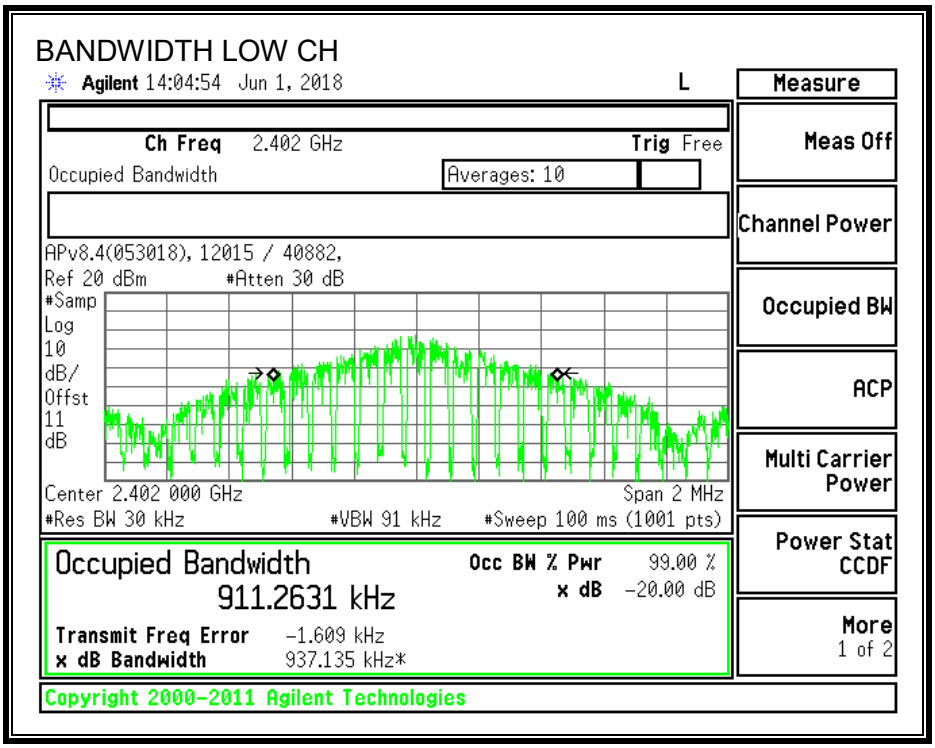
20 dB BANDWIDTH

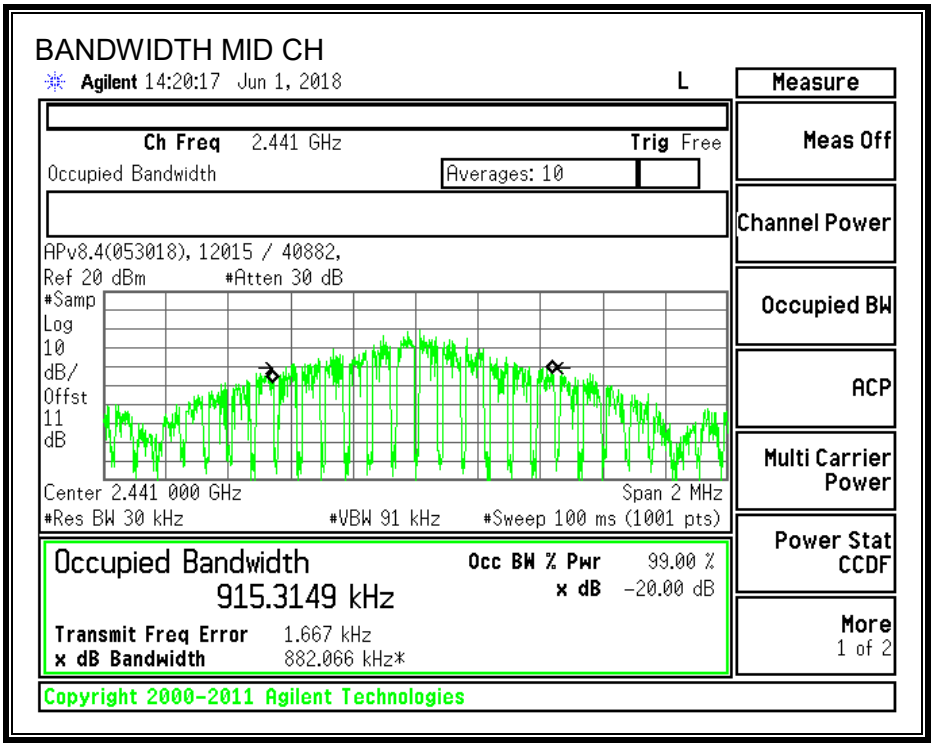


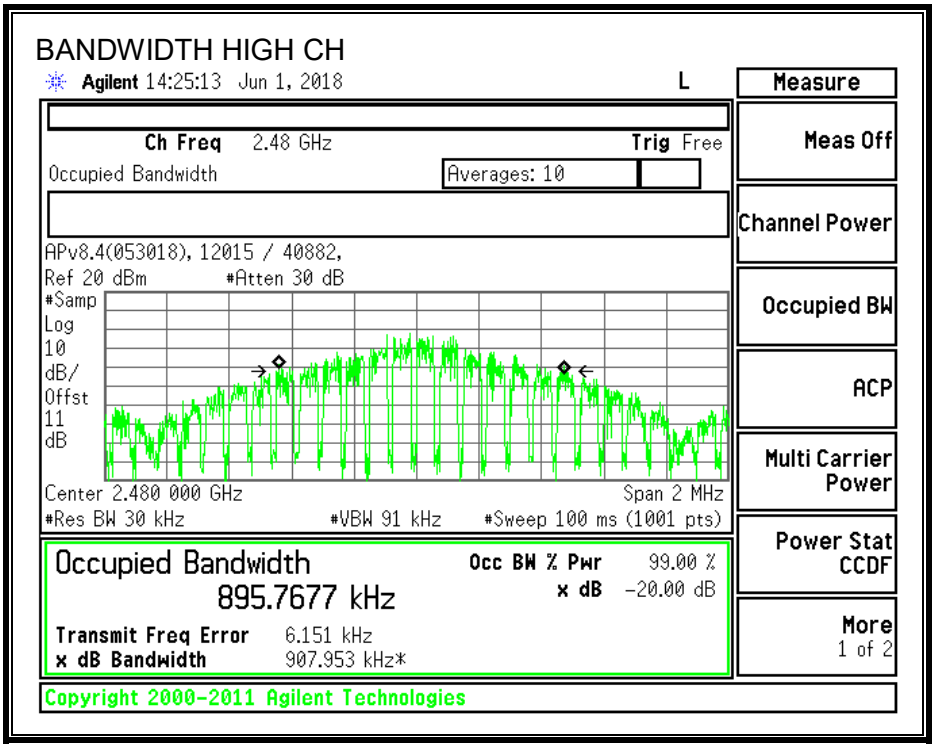




99% BANDWIDTH







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.

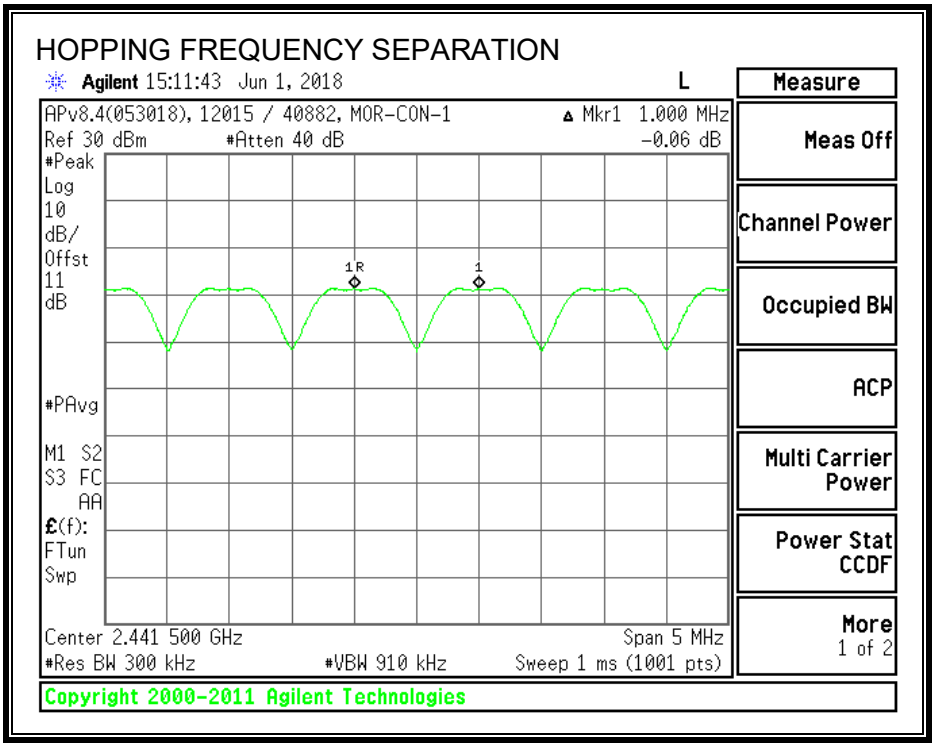
Alternatively, frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than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

RESULTS

HOPPING FREQUENCY SEPARATION



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

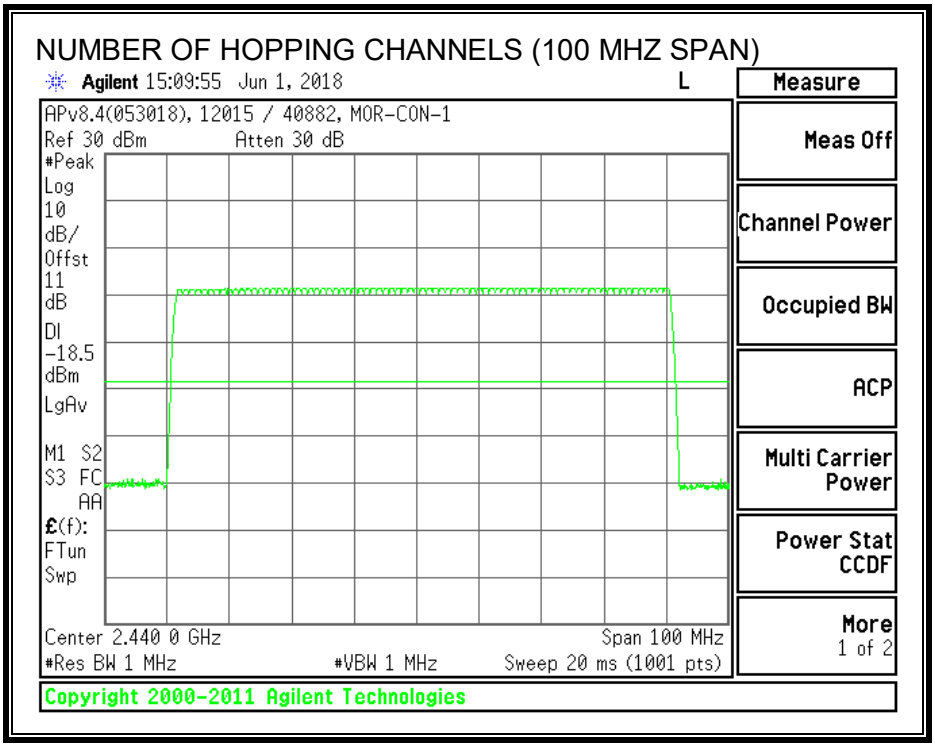
The transmitter output is connected to a spectrum analyzer. The span is set to cover the entire authorized band, in either a single sweep or in multiple contiguous sweeps for visibility of the entire span. Then, smaller spans are set to more clearly identify the channels. The RBW is set to 30% of the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

RESULTS

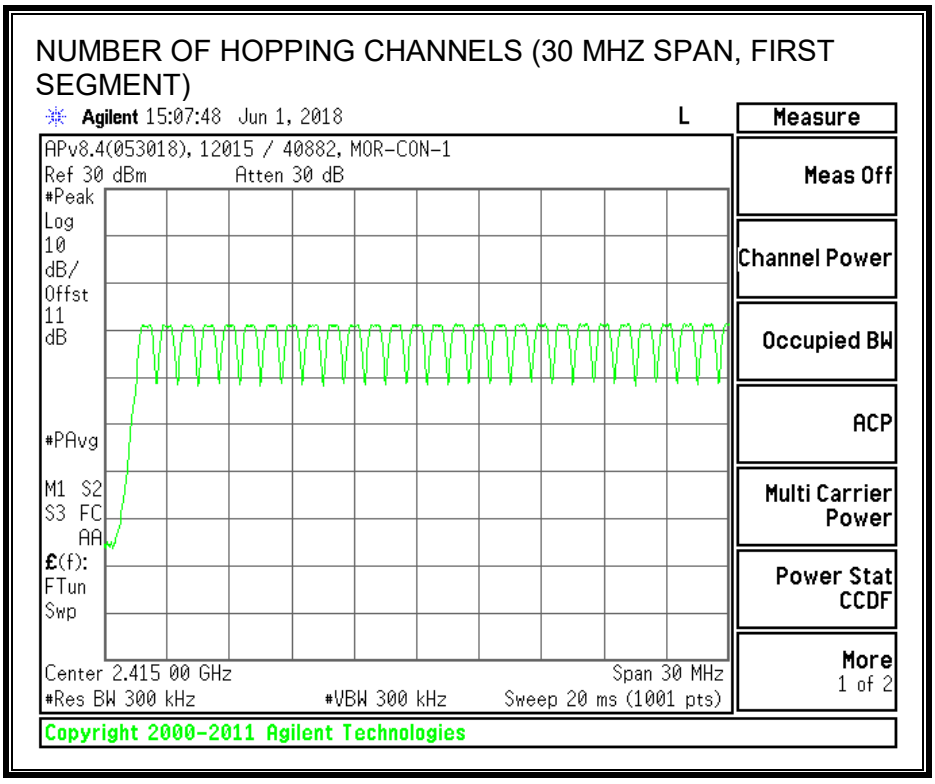
Normal Mode: 79 Channels observed.
AFH Mode: 15 Channels declared.

NUMBER OF HOPPING CHANNELS

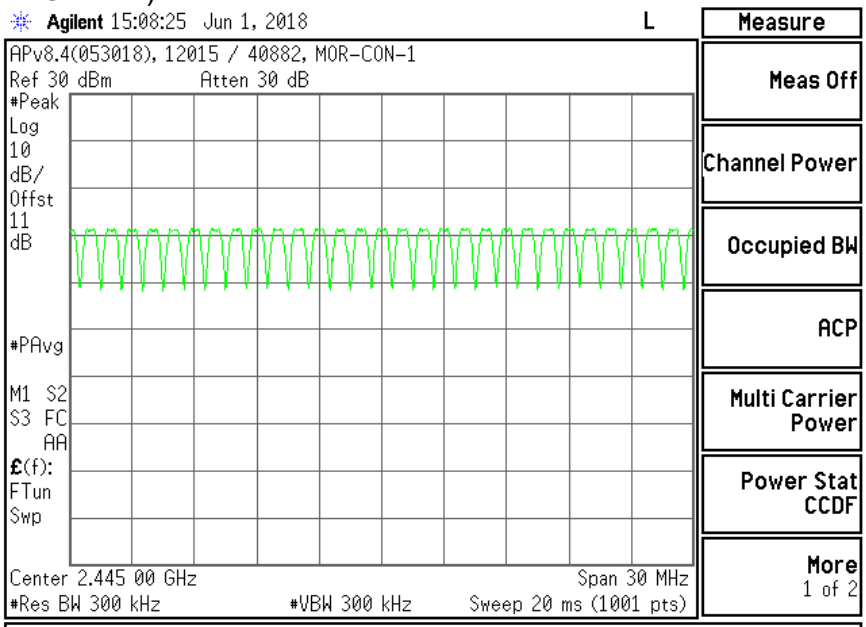
NUMBER OF HOPPING CHANNELS (100 MHZ SPAN)



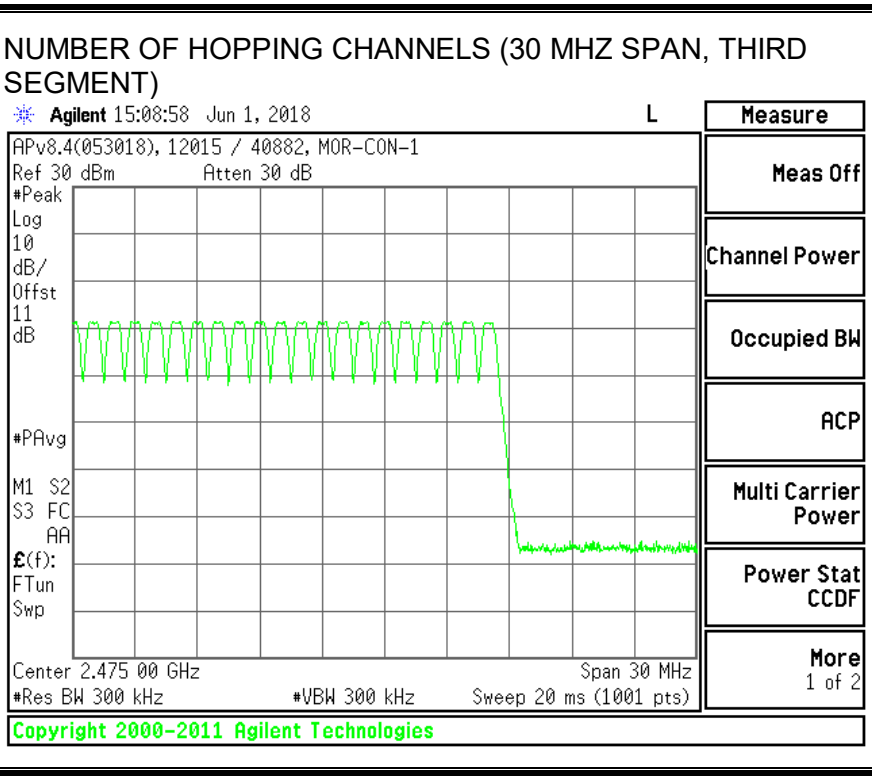
NUMBER OF HOPPING CHANNELS (30 MHZ SPAN, FIRST SEGMENT)



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.

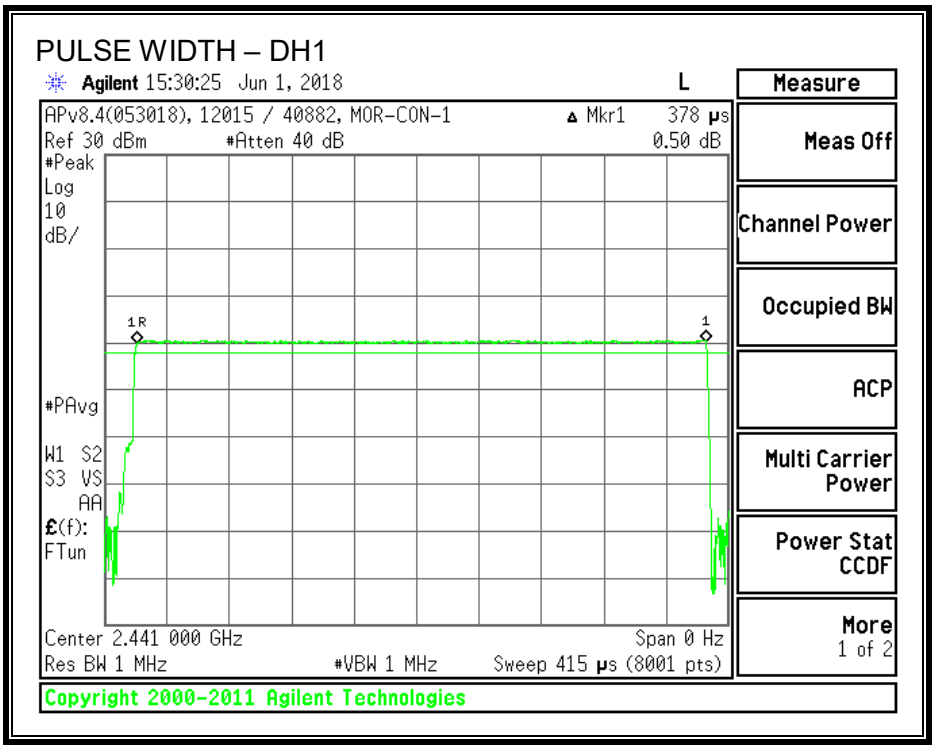
The average time of occupancy in the specified 31.6 second period (79 channels * 0.4 s) is equal to 10 * (# of pulses in 3.16 s) * pulse width.

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.

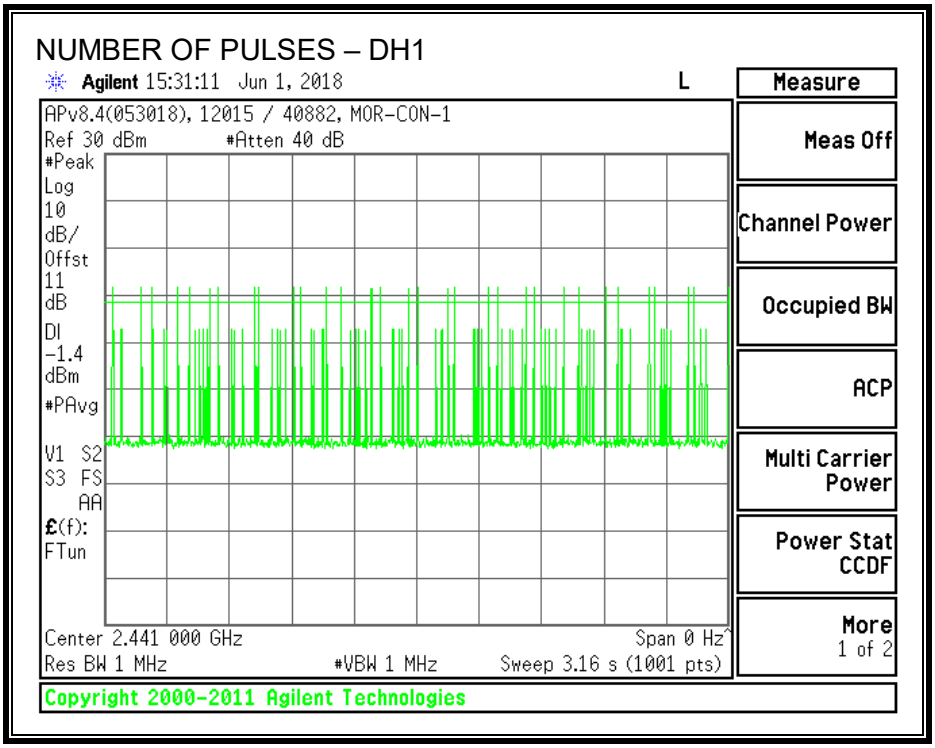
RESULTS

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	0.378	32	0.121	0.4	-0.279
DH3	1.634	15	0.245	0.4	-0.155
DH5	2.881	13	0.375	0.4	-0.025
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	0.378	8	0.030	0.4	-0.370
DH3	1.634	3.75	0.061	0.4	-0.339
DH5	2.881	3.25	0.094	0.4	-0.306

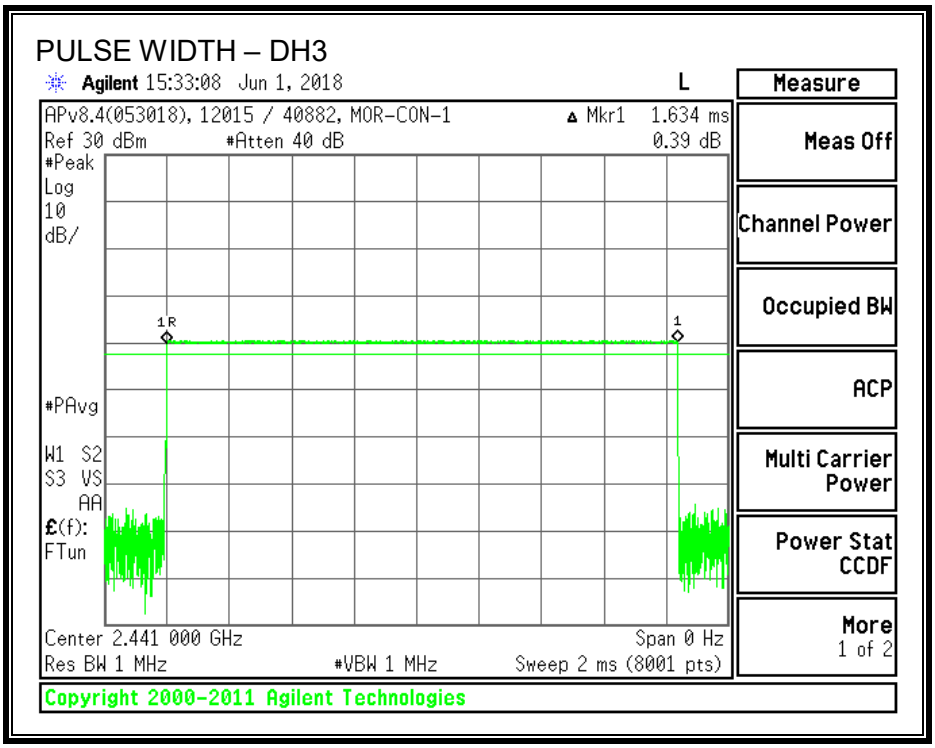
PULSE WIDTH - DH1



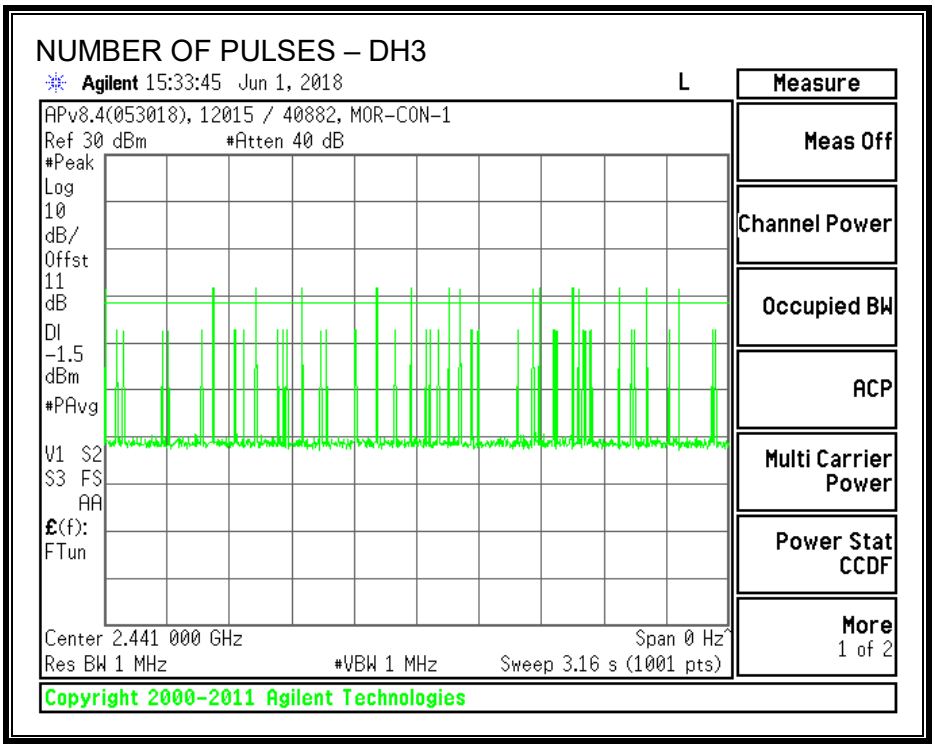
NUMBER OF PULSES IN 3.16 SECOND OBSERVATION PERIOD – DH1



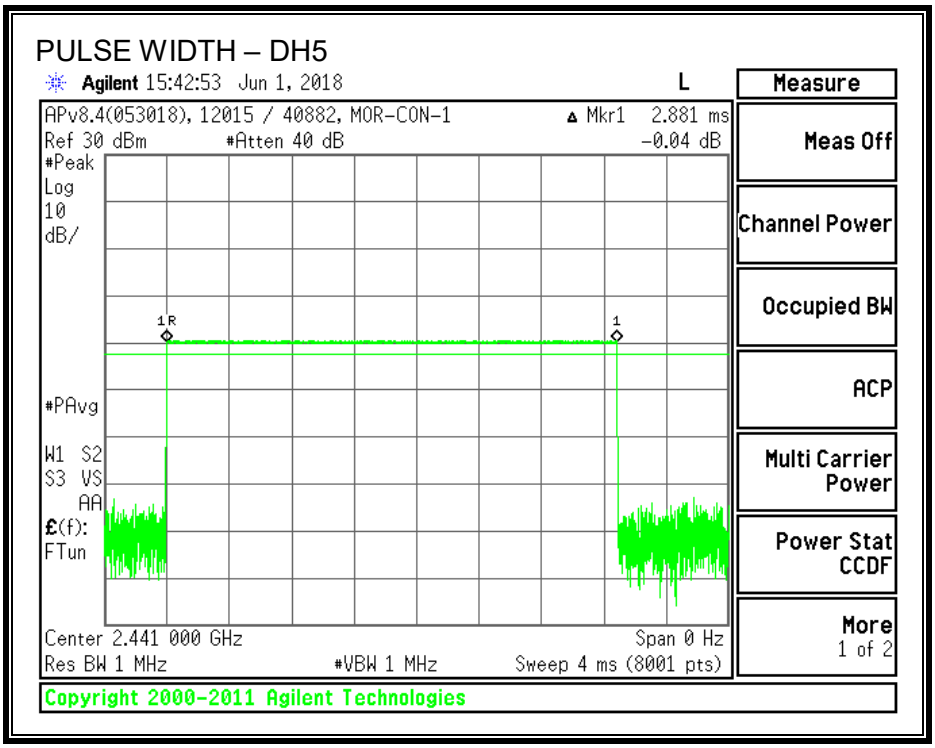
PULSE WIDTH – DH3



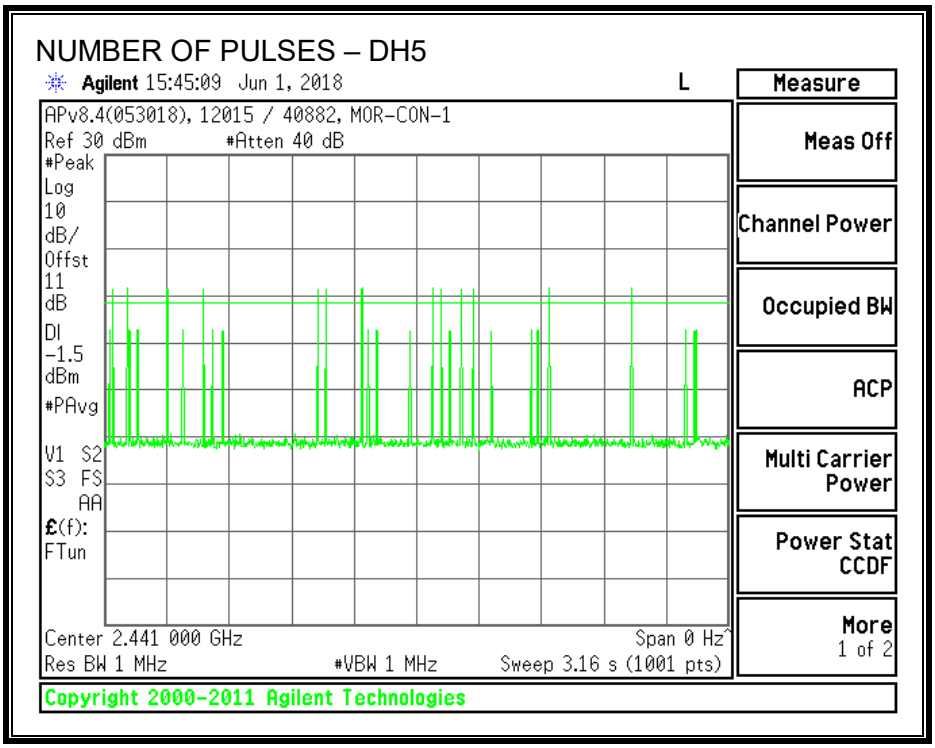
NUMBER OF PULSES IN 3.16 SECOND OBSERVATION PERIOD – DH3



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 power meter.

RESULTS

Channel	Frequency (MHz)	Output Power (dBm)	Directional Gain (dBi)	Limit (dBm)	Margin (dB)
Low	2402	1.41	3.50	21	-19.59
Middle	2441	1.67	3.50	21	-19.33
High	2480	1.70	3.50	21	-19.30

8.3.6. 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

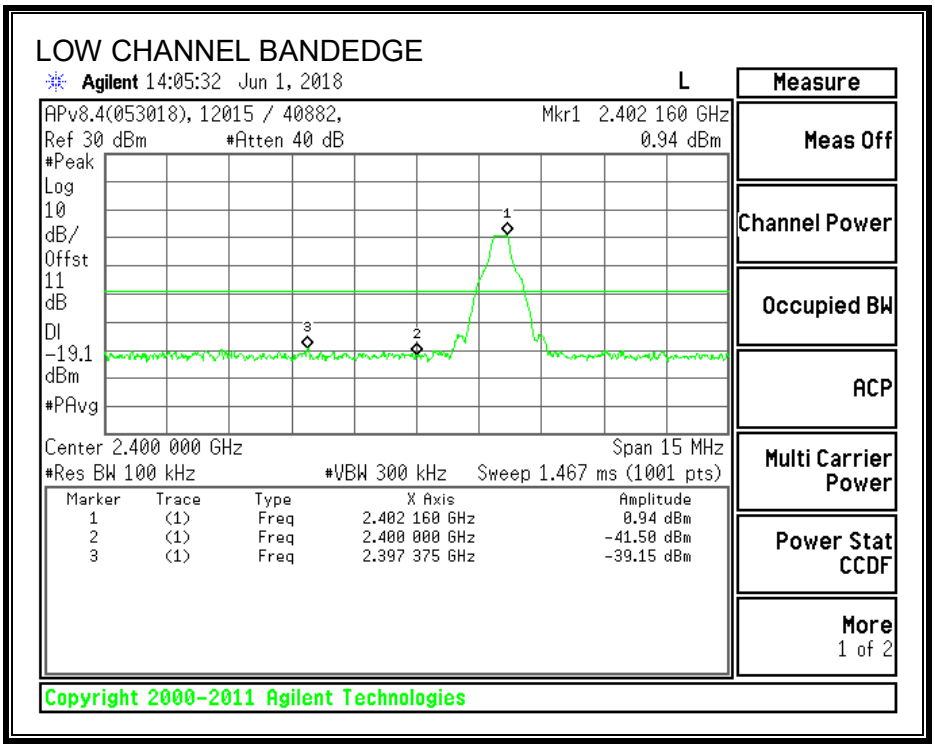
The transmitter output is connected to a spectrum analyzer. The resolution bandwidth is set to 100 kHz. The video bandwidth is set to 300 kHz.

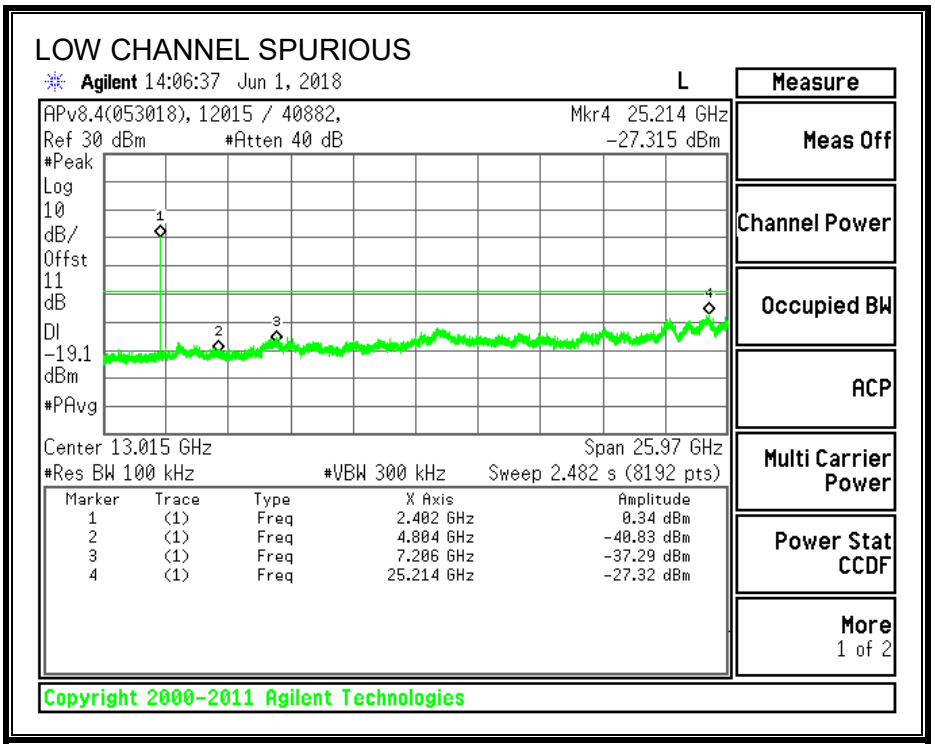
The spectrum from 30 MHz to 26 GHz is investigated with the transmitter set to the lowest, middle, and highest channels.

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

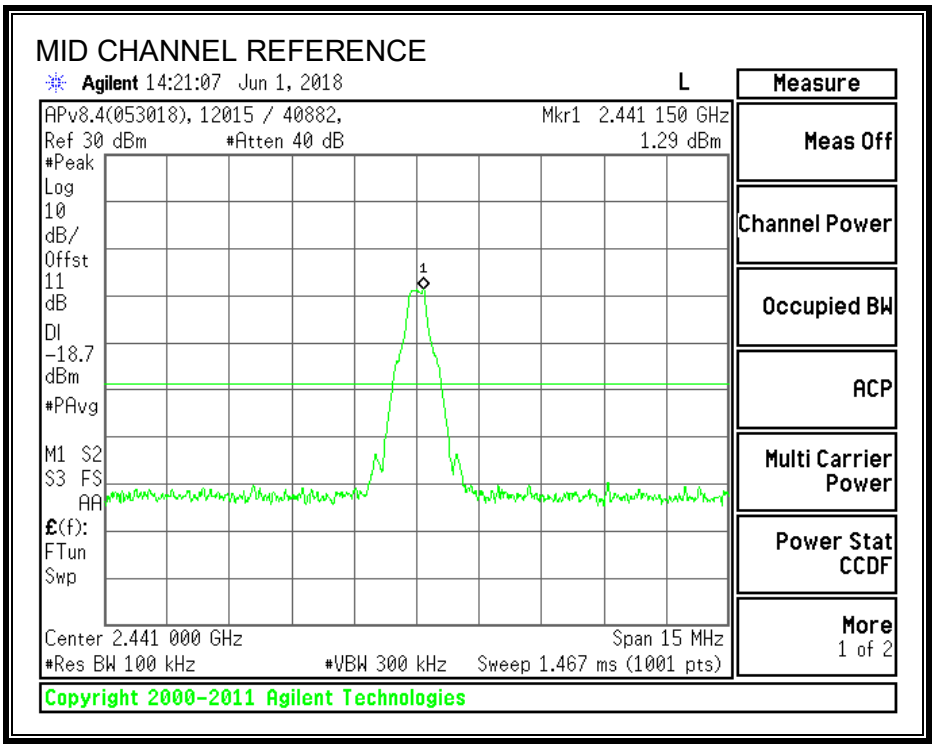
RESULTS

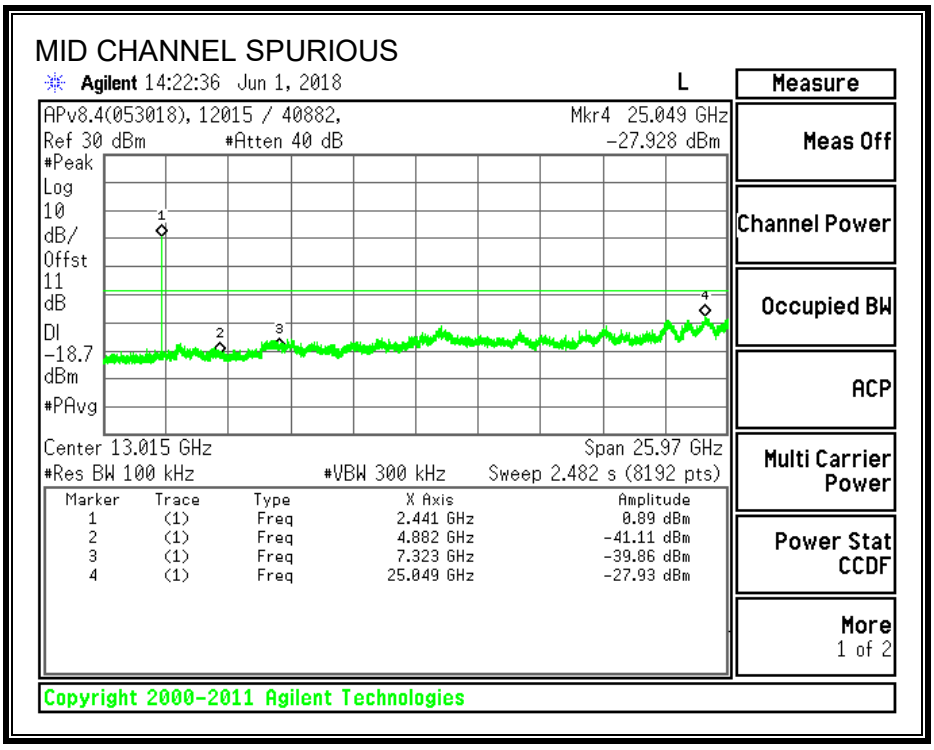
SPURIOUS EMISSIONS, LOW CHANNEL



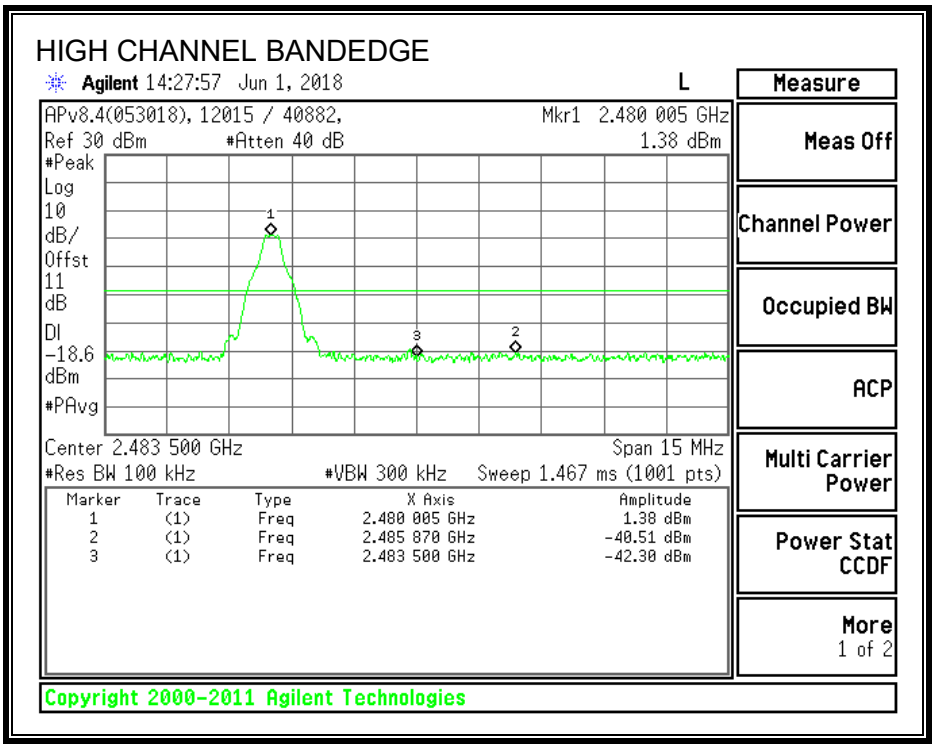


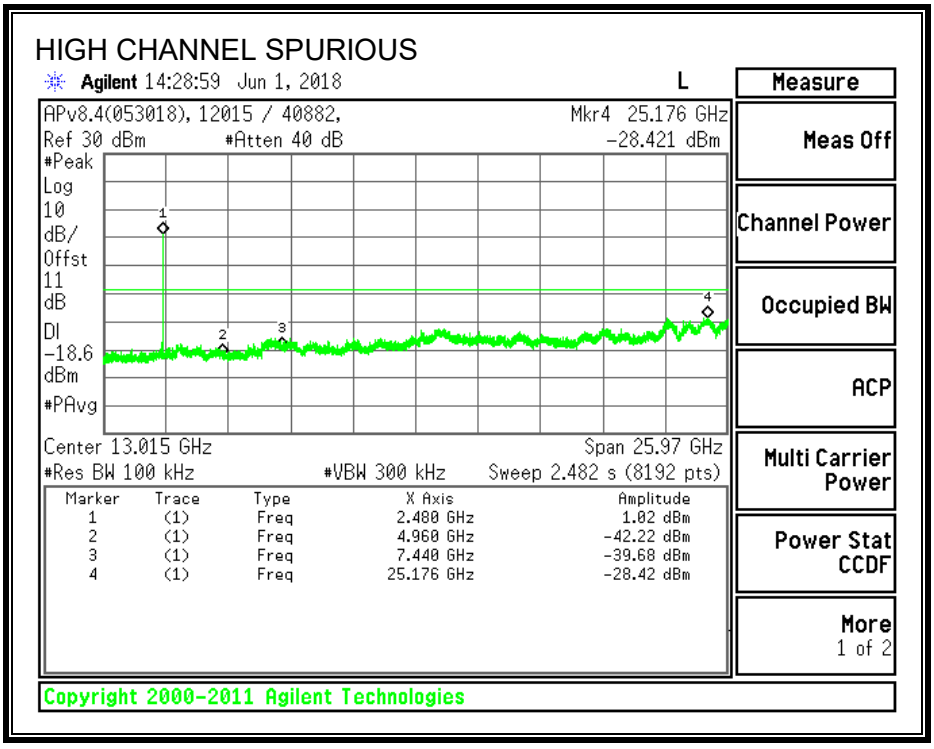
SPURIOUS EMISSIONS, MID CHANNEL





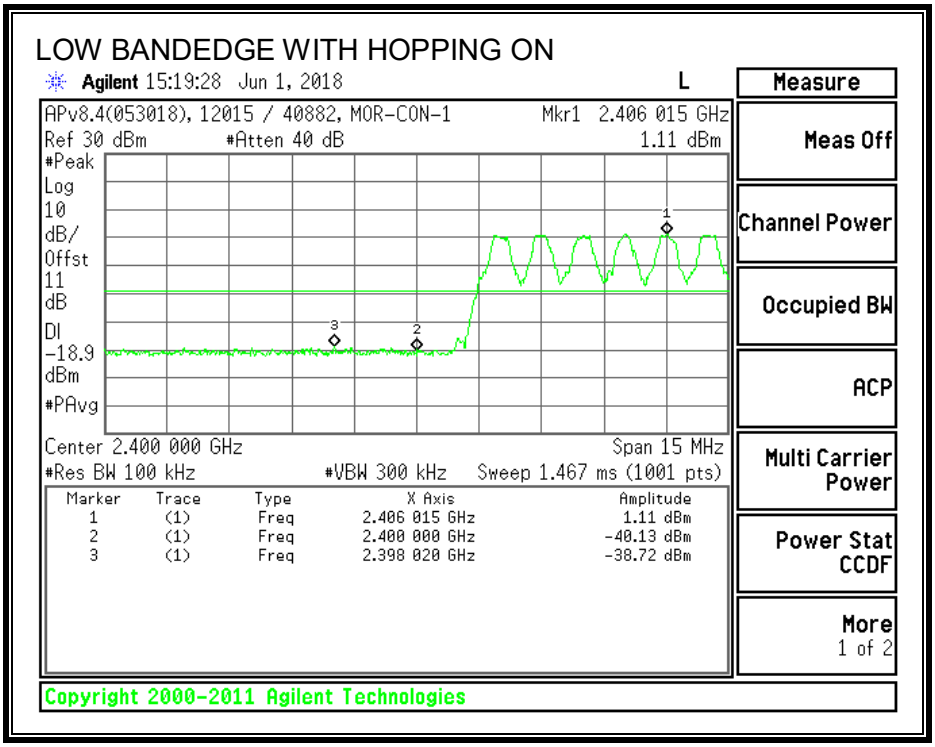
SPURIOUS EMISSIONS, HIGH CHANNEL



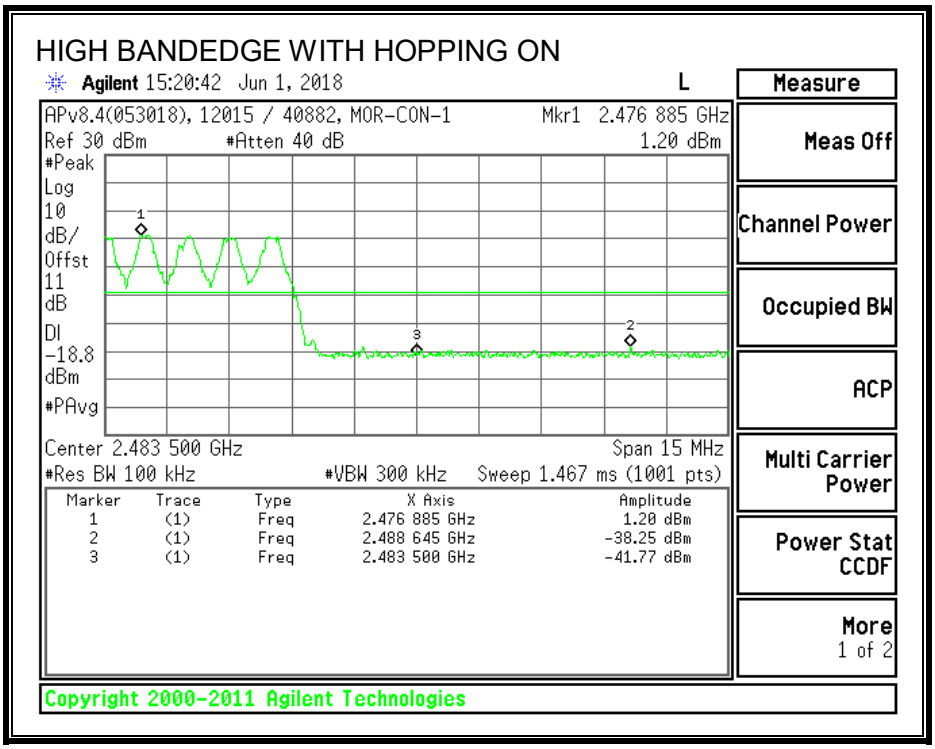


SPURIOUS BANDEDGE EMISSIONS WITH HOPPING ON

LOW BANDEDGE WITH HOPPING ON



HIGH BANDEDGE WITH HOPPING ON



8.4. ENHANCED DATA RATE QPSK MODULATION

8.4.1. 20 dB AND 99% BANDWIDTH

LIMIT

None; for reporting purposes only.
Test per ANSI C63.10 Sections 6.9.2 and 6.9.3 and RSS-Gen 6.6.

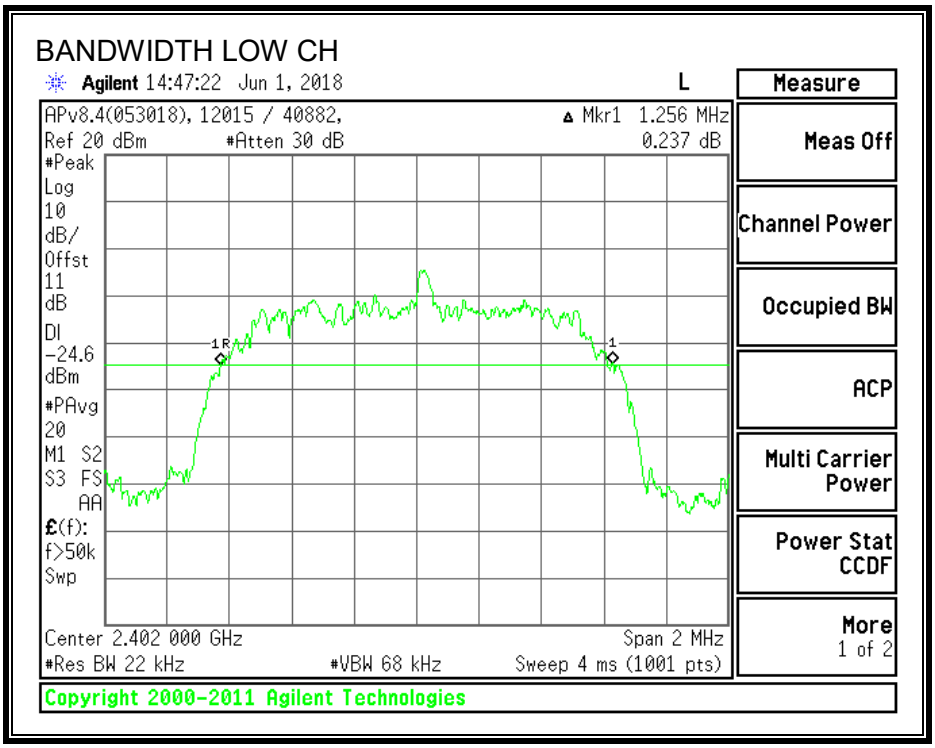
TEST PROCEDURE

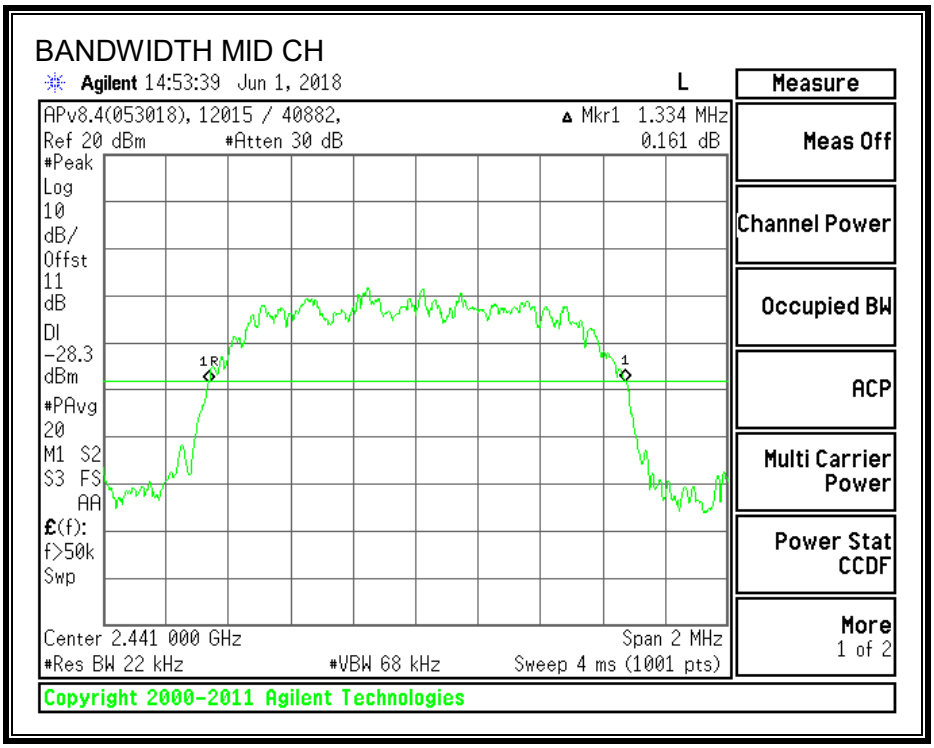
The transmitter output is connected to a spectrum analyzer. The RBW is set to 1%-5% of the 20 dB bandwidth and 99% Occupied Bandwidth. The VBW is set to ≥ RBW. The sweep time is coupled.

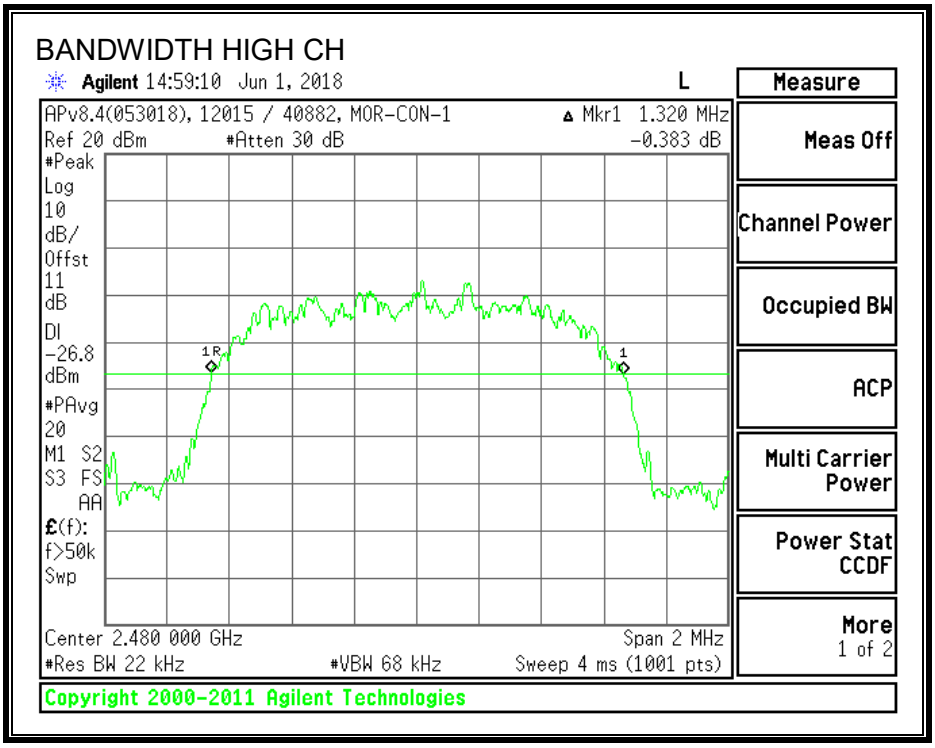
RESULTS

Channel	Frequency (MHz)	20 dB Bandwidth (kHz)	99% Bandwidth (kHz)
Low	2402	1256	1179.9
Middle	2441	1334	1181.8
High	2480	1320	1188.5

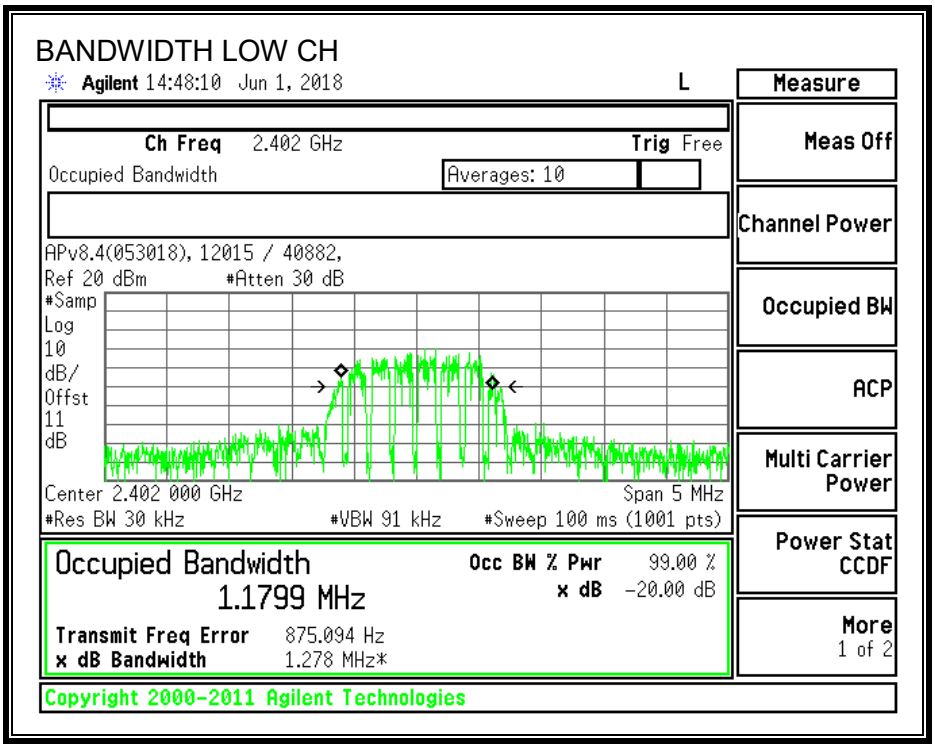
20 dB BANDWIDTH

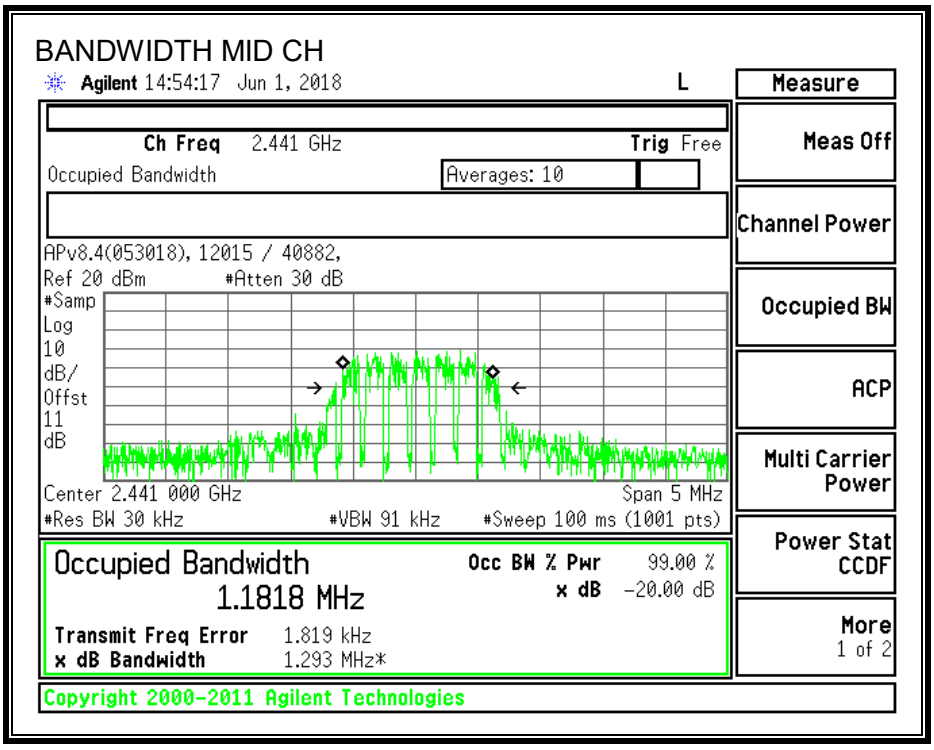


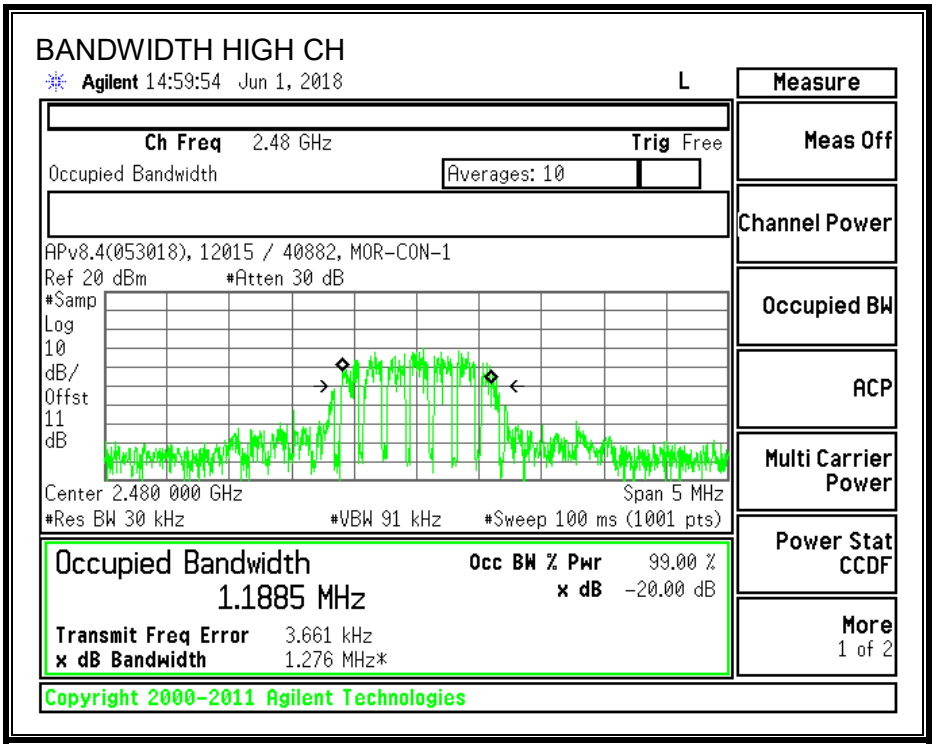




99% BANDWIDTH







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.

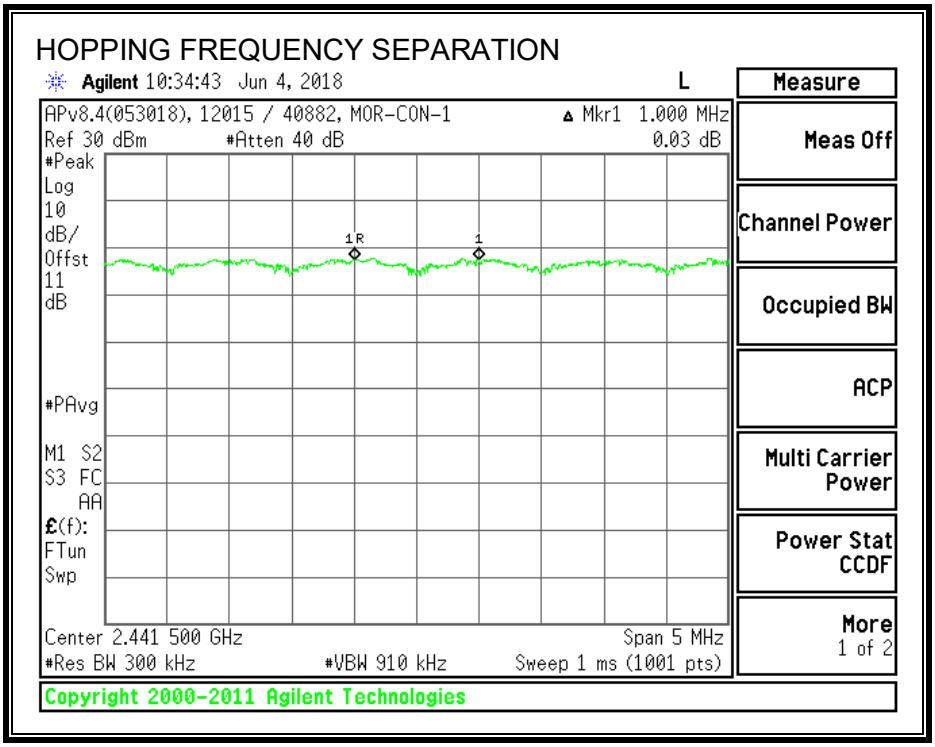
Alternatively, frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than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

RESULTS

HOPPING FREQUENCY SEPARATION



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

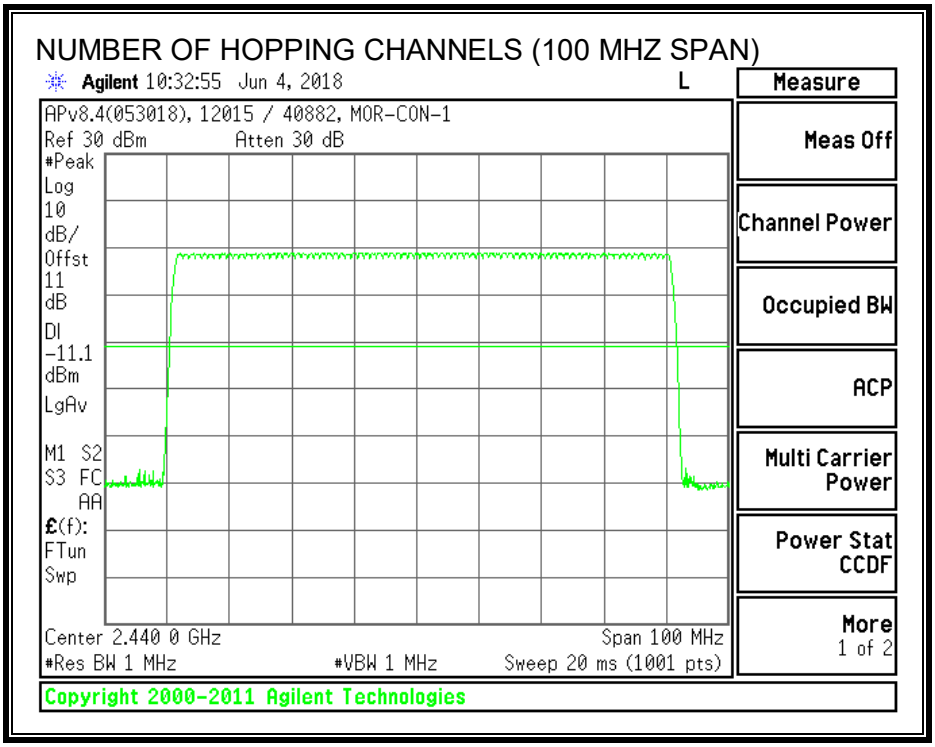
The transmitter output is connected to a spectrum analyzer. The span is set to cover the entire authorized band, in either a single sweep or in multiple contiguous sweeps for visibility of the entire span. Then, smaller spans are set to more clearly identify the channels. The RBW is set to 30% of the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

RESULTS

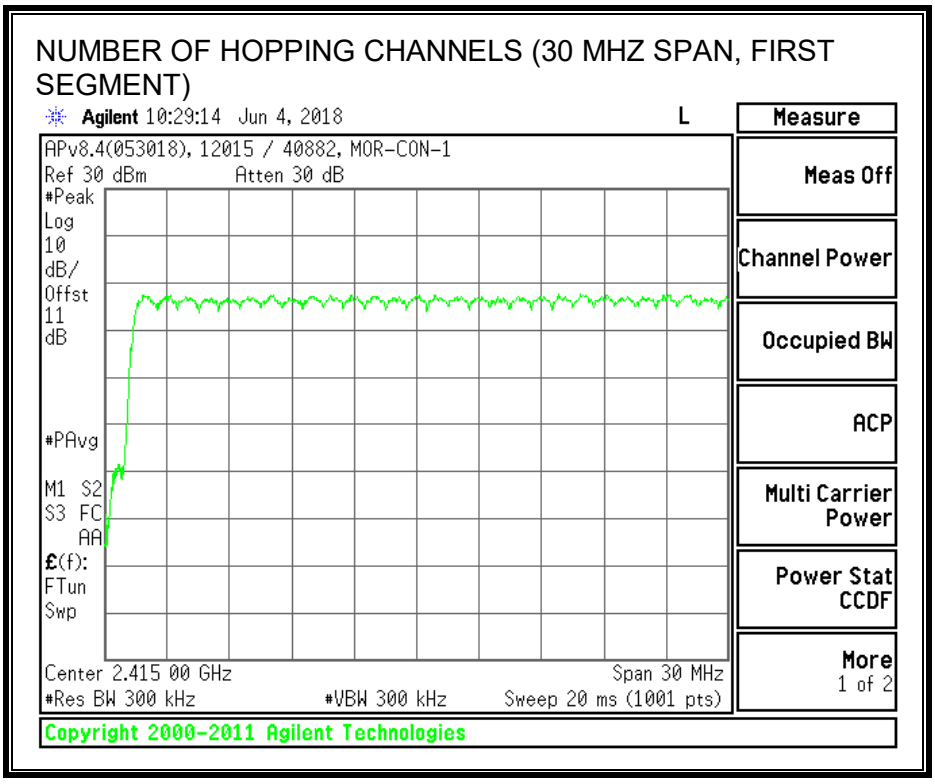
Normal Mode: 79 Channels observed.
AFH Mode: 15 Channels declared.

NUMBER OF HOPPING CHANNELS

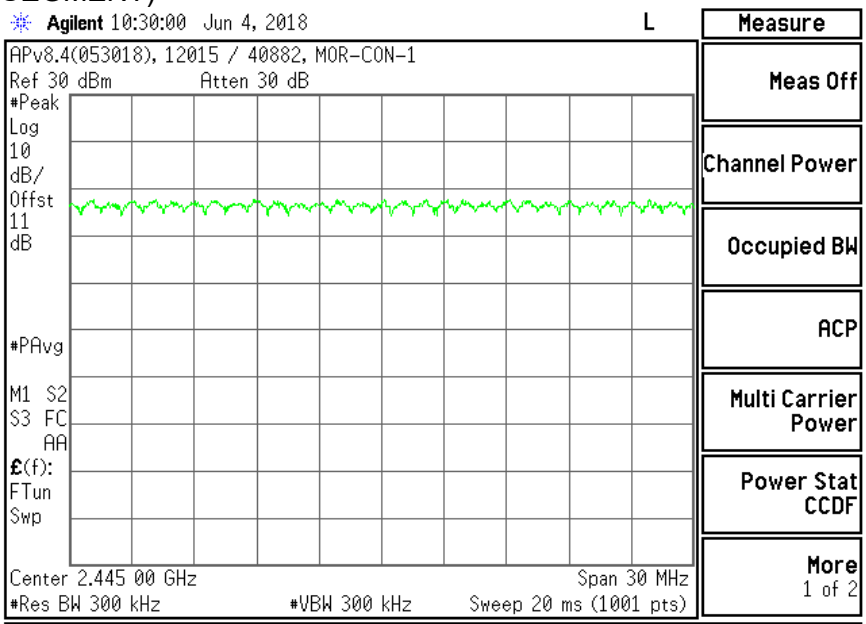
NUMBER OF HOPPING CHANNELS (100 MHZ SPAN)



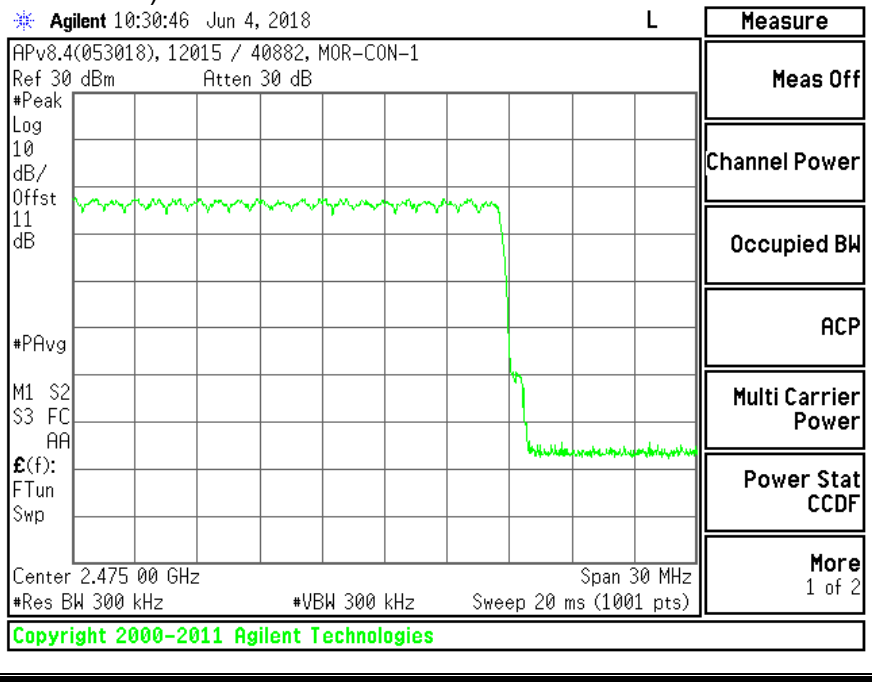
NUMBER OF HOPPING CHANNELS (30 MHZ SPAN, FIRST SEGMENT)



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.

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.

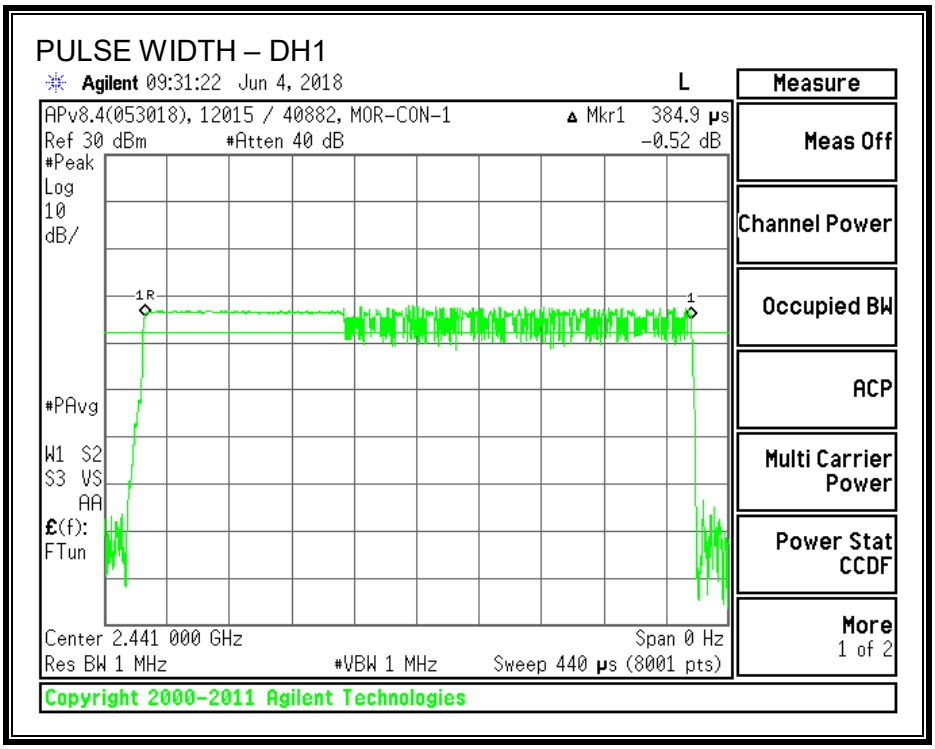
RESULTS

DQPSK Mode

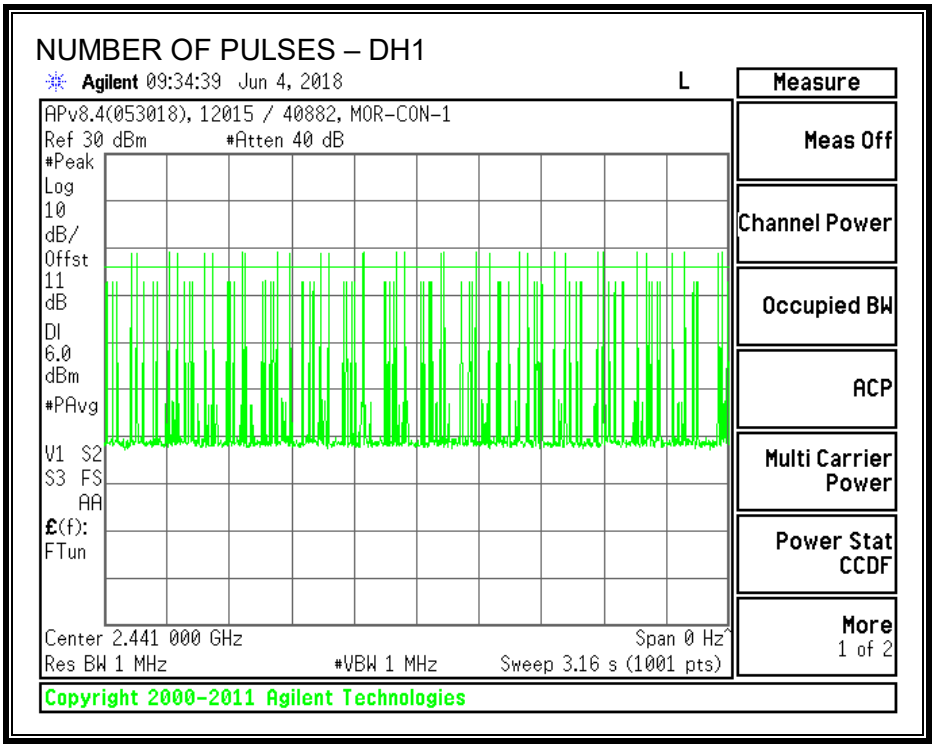
DH Packet	Pulse Width (msec)	Number of Pulses in 3.16 seconds	Average Time of (sec)	Limit (sec)	Margin (sec)
DH1	0.3849	31	0.119	0.4	-0.281
DH3	1.637	15	0.246	0.4	-0.154
DH5	2.883	11	0.317	0.4	-0.083

Note: for AFH (QPSK) 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 demonstrates compliance with channel occupancy when AFH is employed.

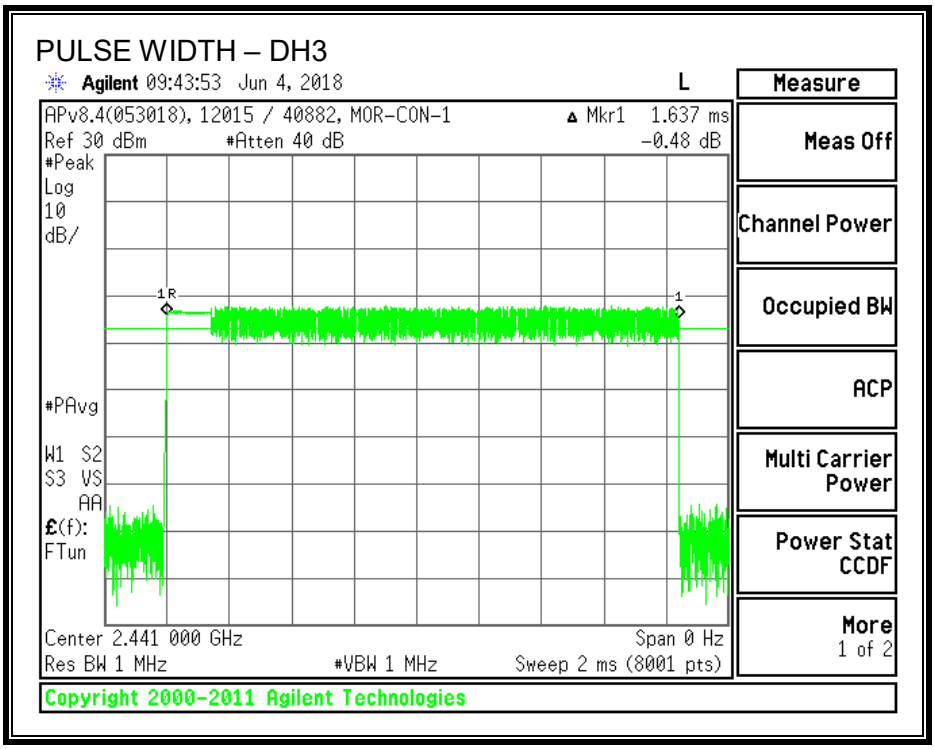
PULSE WIDTH - DH1



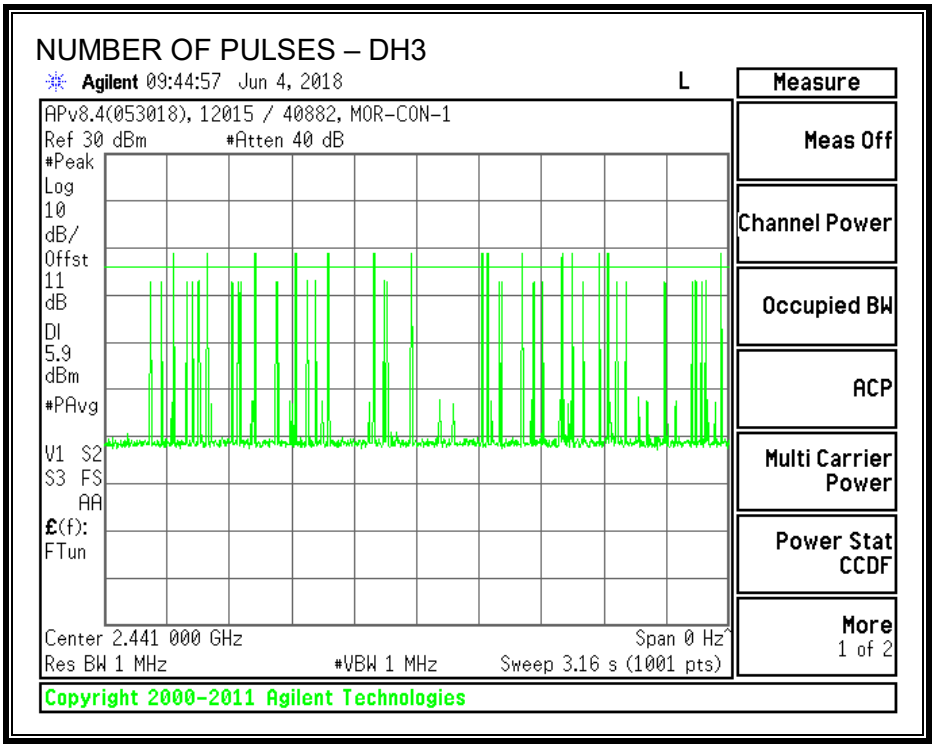
NUMBER OF PULSES IN 3.16 SECOND OBSERVATION PERIOD – DH1



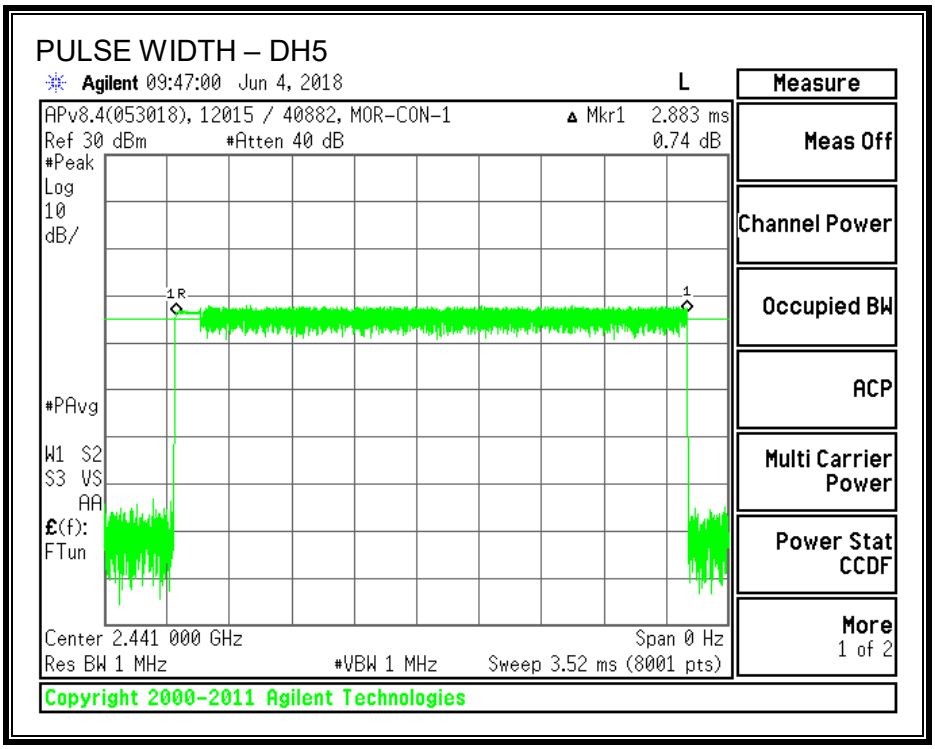
PULSE WIDTH – DH3



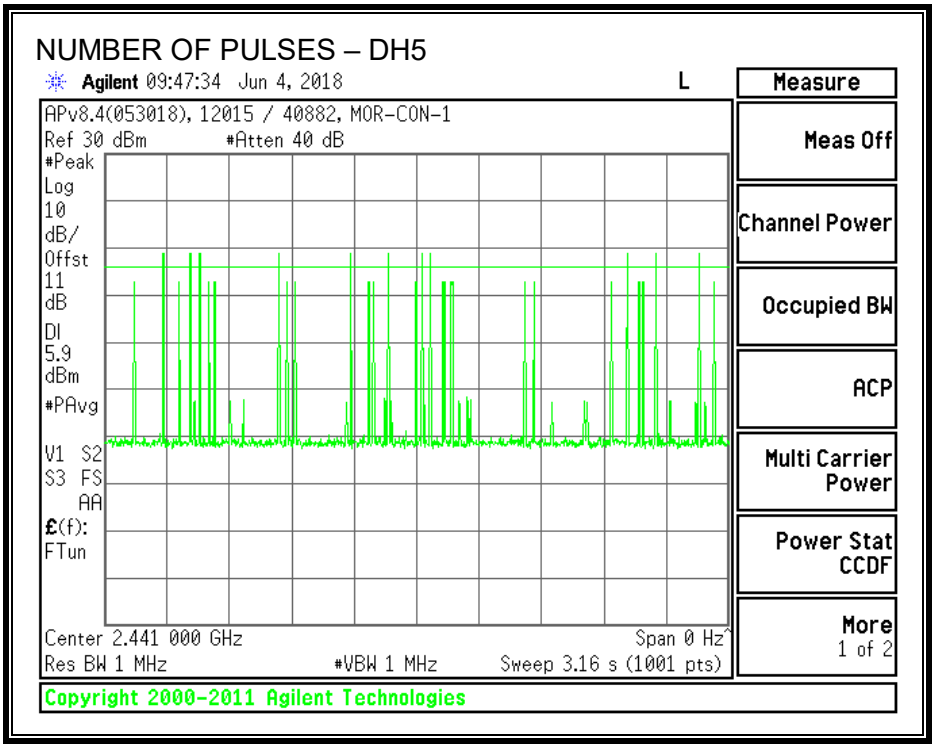
NUMBER OF PULSES IN 3.16 SECOND OBSERVATION PERIOD – DH3



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 power meter.

RESULTS

Channel	Frequency (MHz)	Output Power (dBm)	Directional Gain (dBi)	Limit (dBm)	Margin (dB)
Low	2402	0.25	3.50	21	-20.75
Middle	2441	0.69	3.50	21	-20.31
High	2480	0.75	3.50	21	-20.25

8.4.6. 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

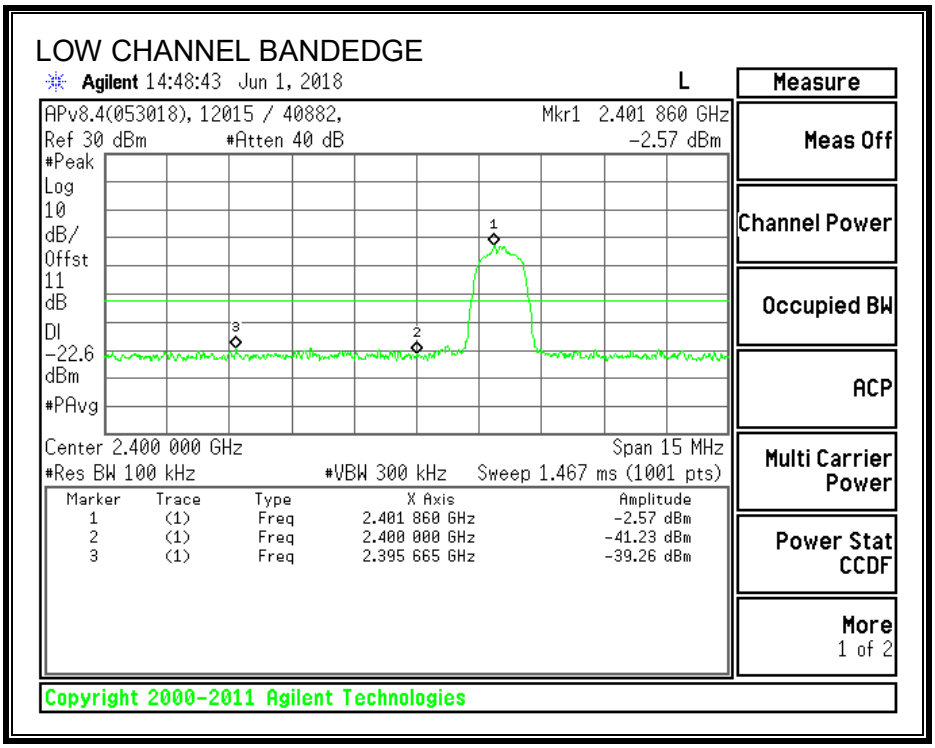
The transmitter output is connected to a spectrum analyzer. The resolution bandwidth is set to 100 kHz. The video bandwidth is set to 300 kHz.

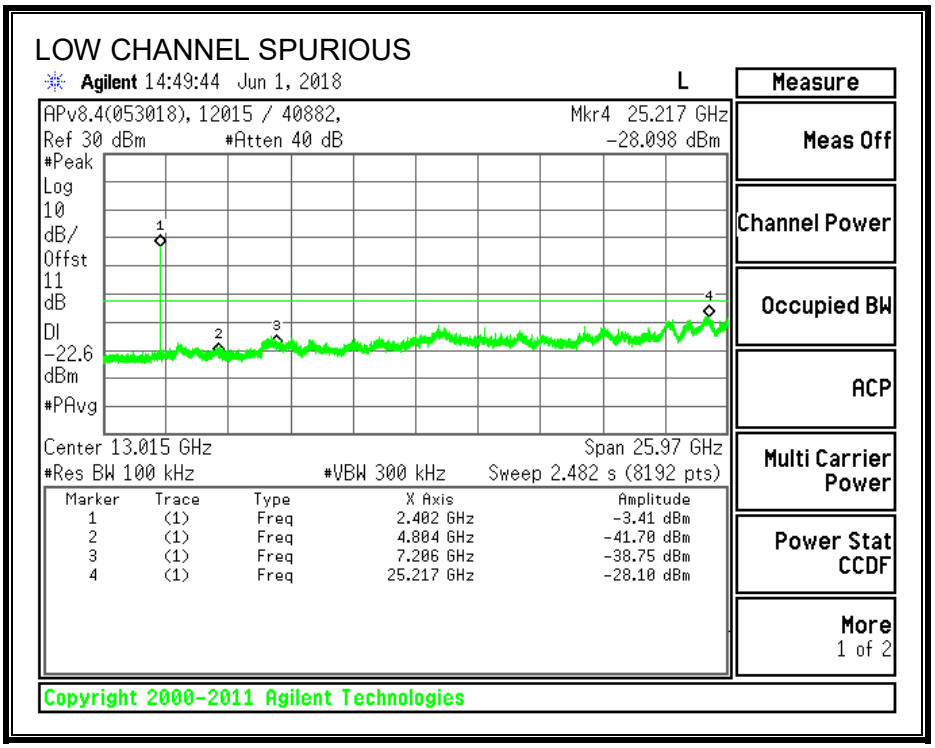
The spectrum from 30 MHz to 26 GHz is investigated with the transmitter set to the lowest, middle, and highest channels.

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

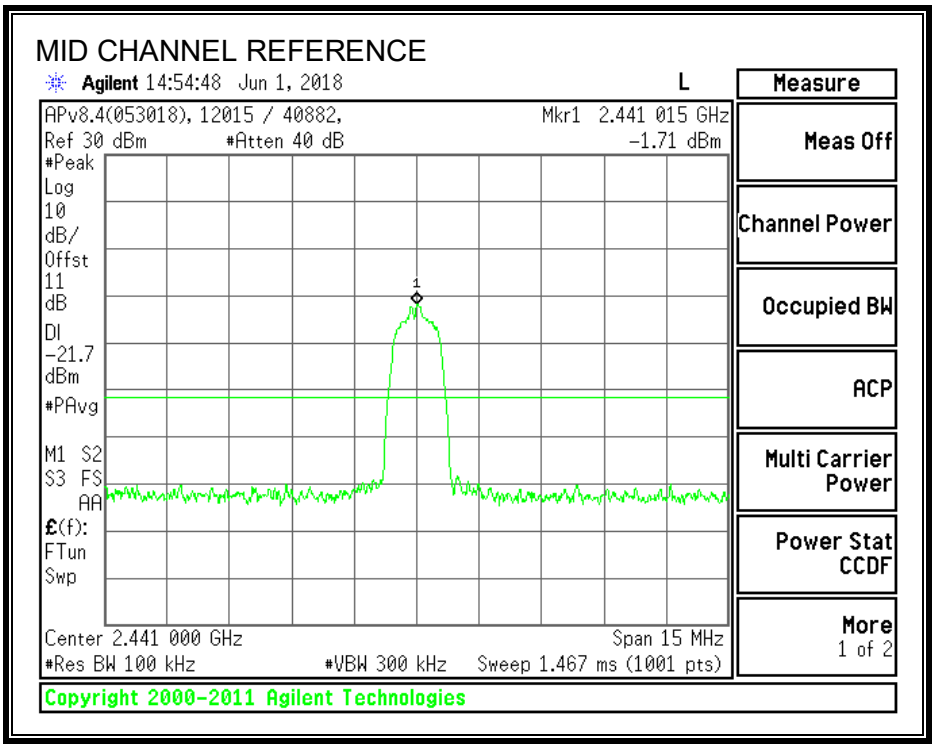
RESULTS

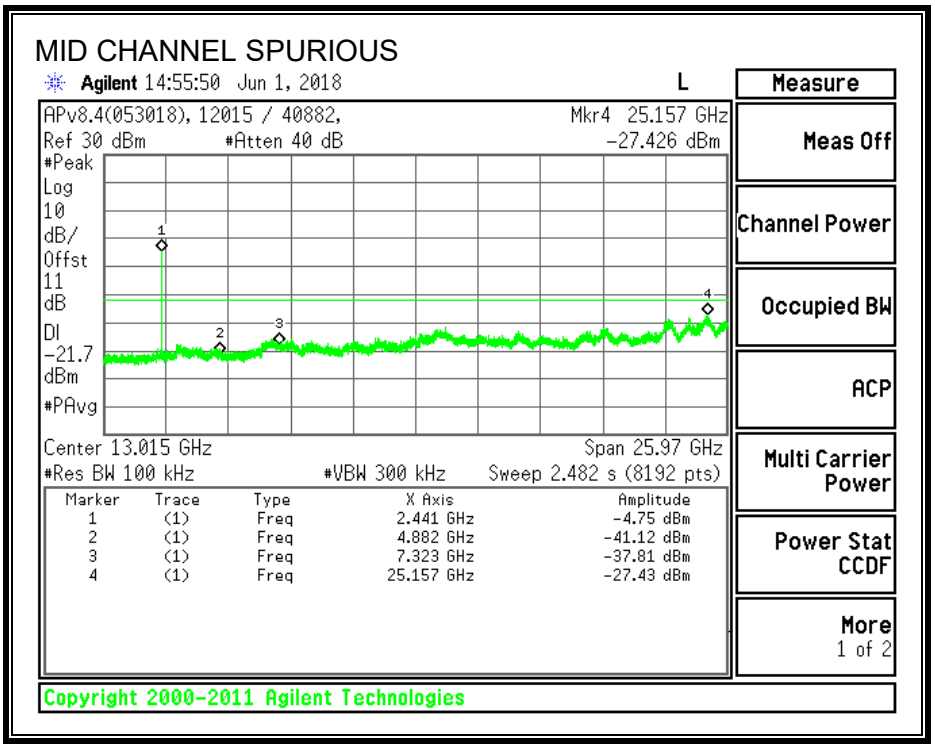
SPURIOUS EMISSIONS, LOW CHANNEL



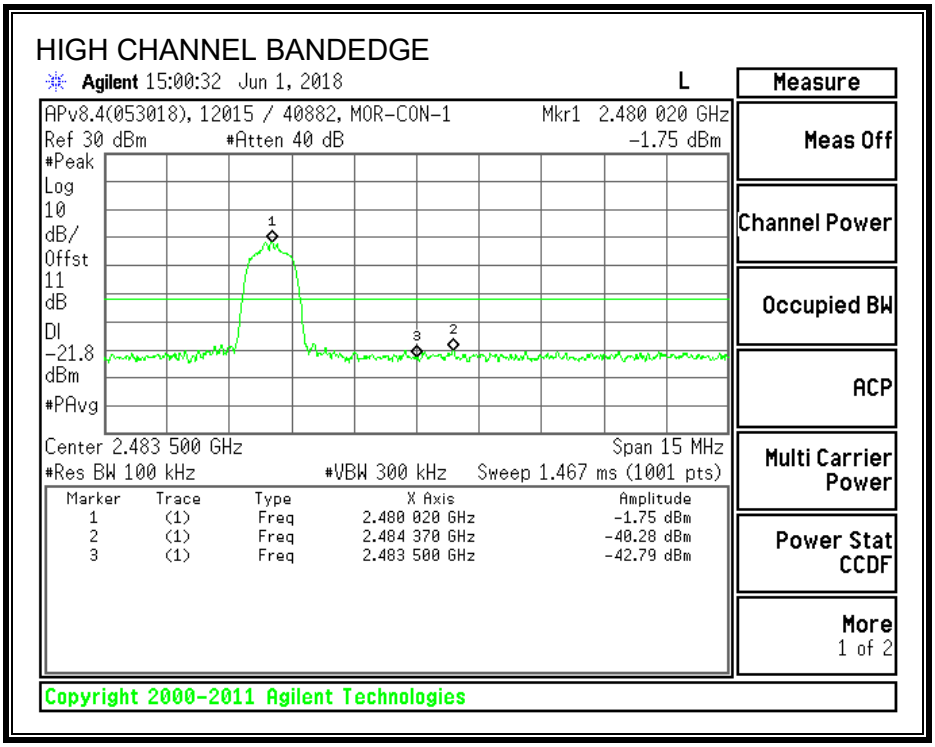


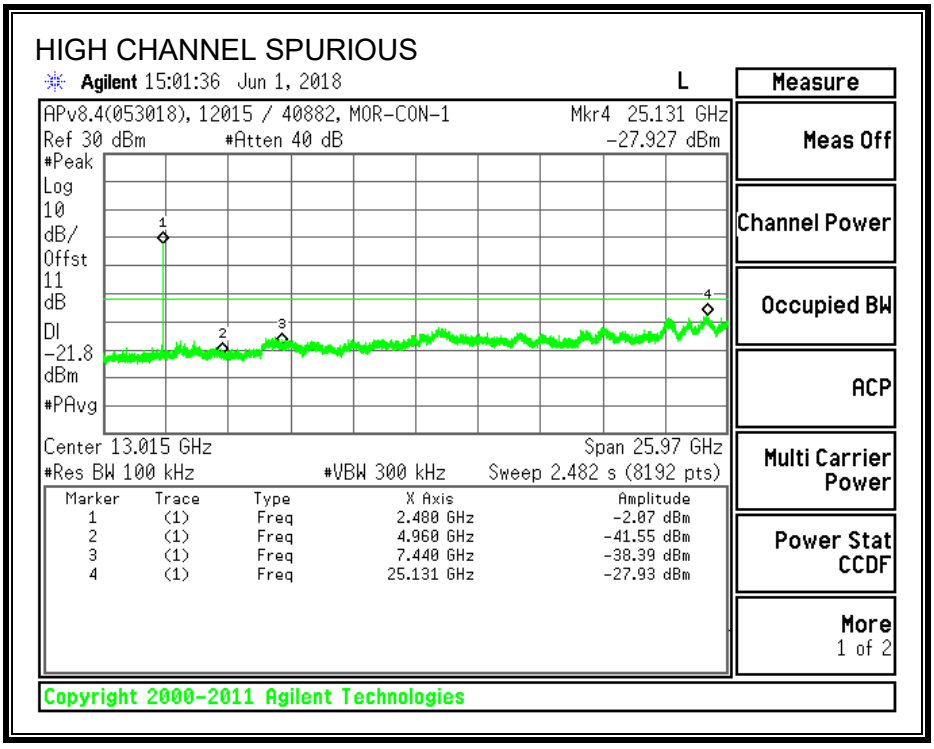
SPURIOUS EMISSIONS, MID CHANNEL





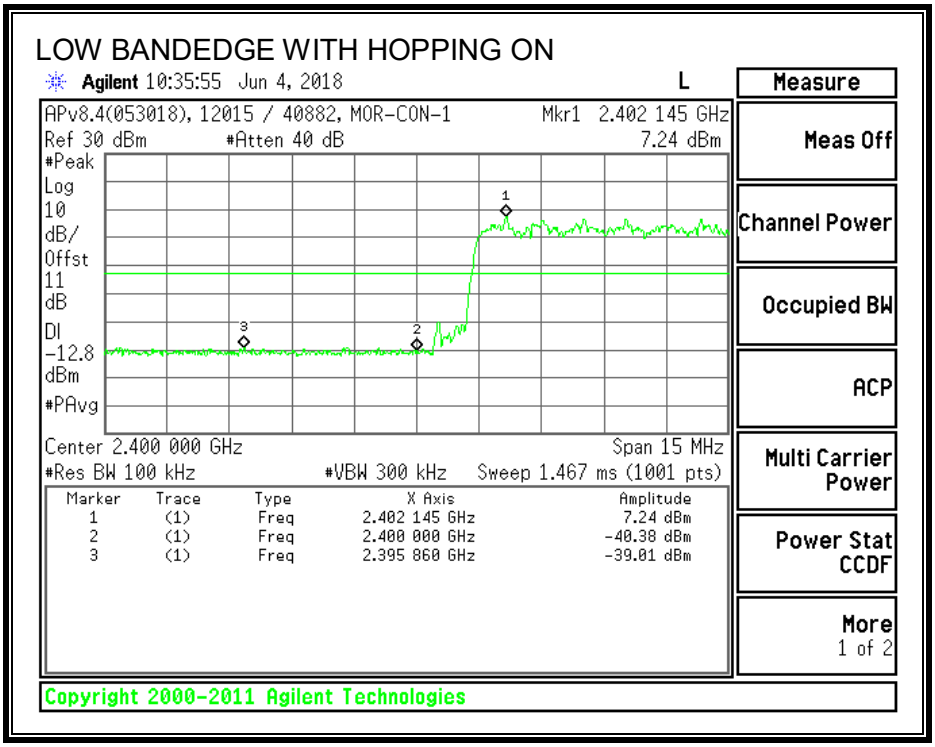
SPURIOUS EMISSIONS, HIGH CHANNEL



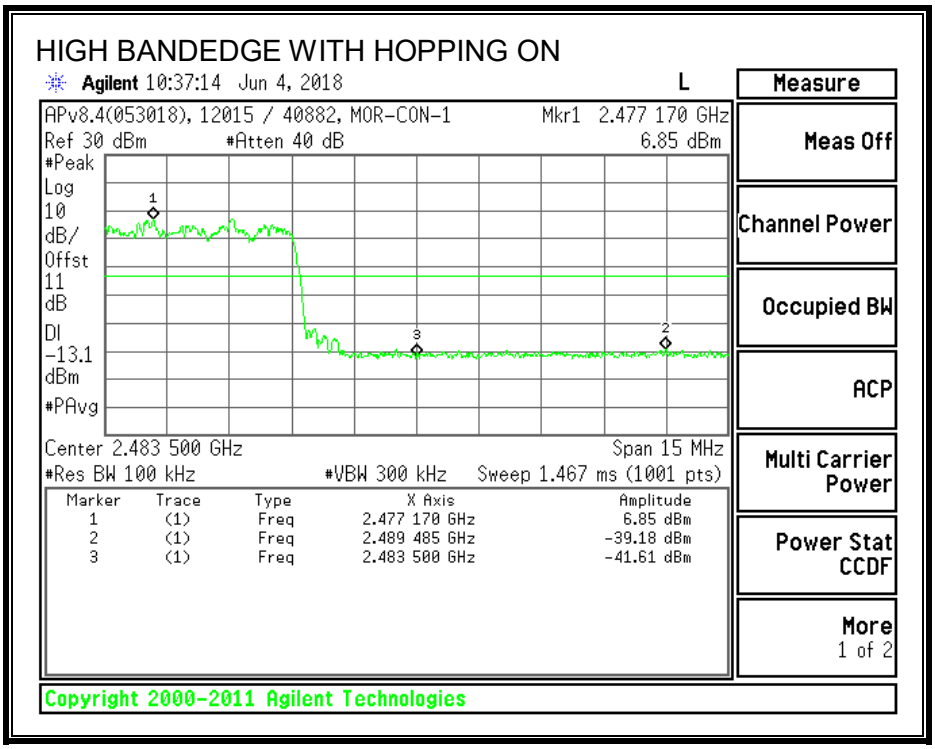


SPURIOUS BANDEDGE EMISSIONS WITH HOPPING ON

LOW BANDEDGE WITH HOPPING ON



HIGH BANDEDGE WITH HOPPING ON



8.5. ENHANCED DATA RATE 8PSK MODULATION

8.5.1. 20 dB AND 99% BANDWIDTH

LIMIT

None; for reporting purposes only.
Test per ANSI C63.10 Sections 6.9.2 and 6.9.3 and RSS-Gen 6.6.

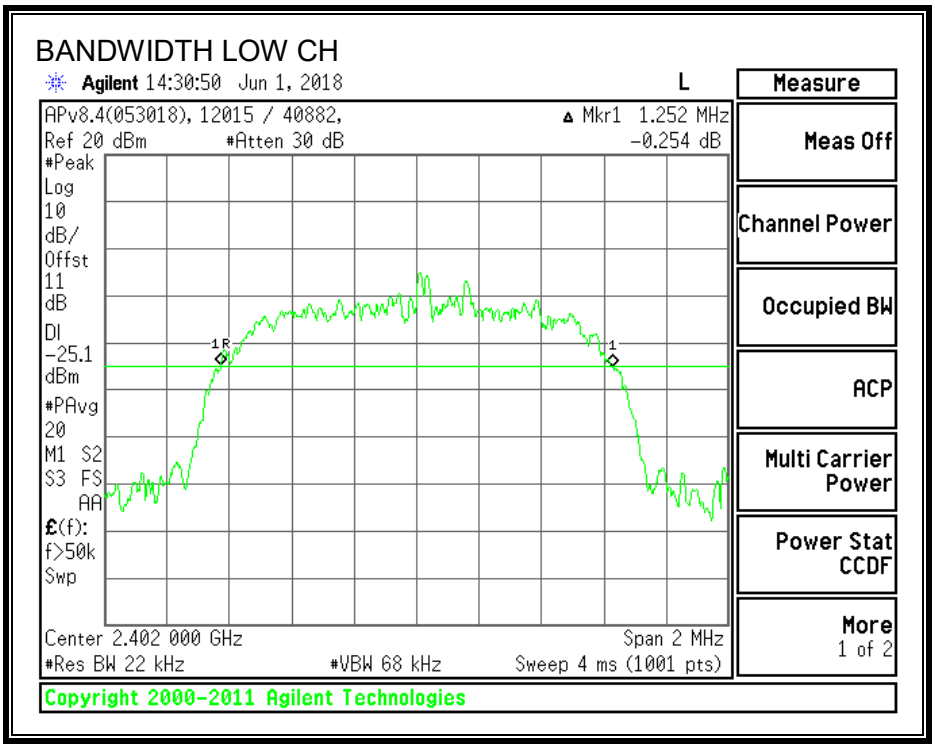
TEST PROCEDURE

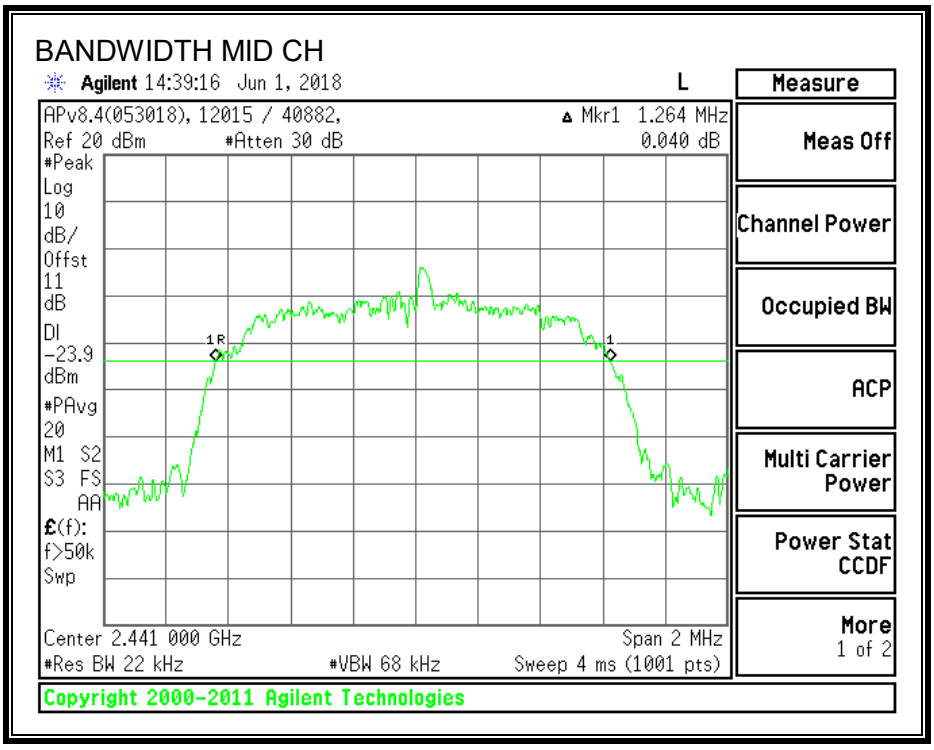
The transmitter output is connected to a spectrum analyzer. The RBW is set to 1%-5% of the 20 dB bandwidth and 99% Occupied Bandwidth. The VBW is set to ≥ RBW. The sweep time is coupled.

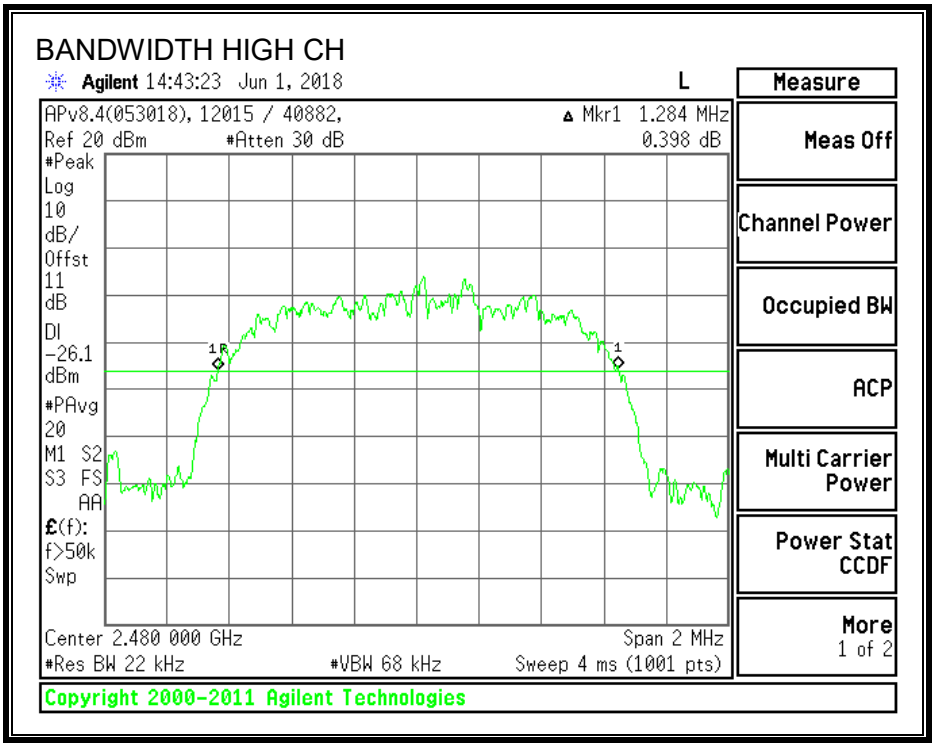
RESULTS

Channel	Frequency (MHz)	20 dB Bandwidth (kHz)	99% Bandwidth (kHz)
Low	2402	1252	1185.7
Middle	2441	1264	1185.5
High	2480	1284	1180

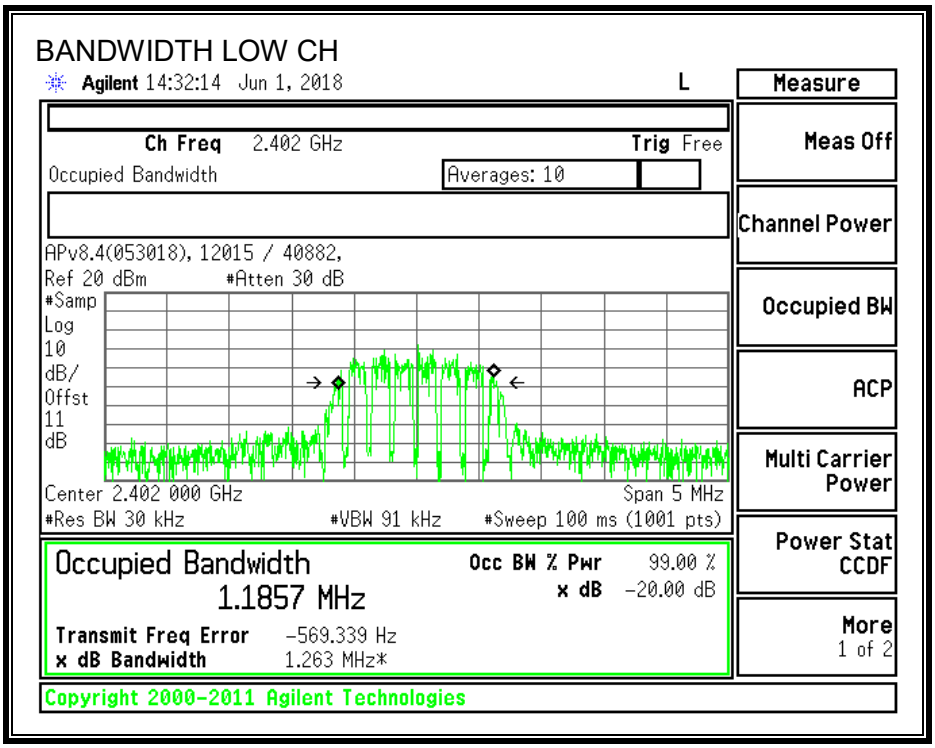
20 dB BANDWIDTH

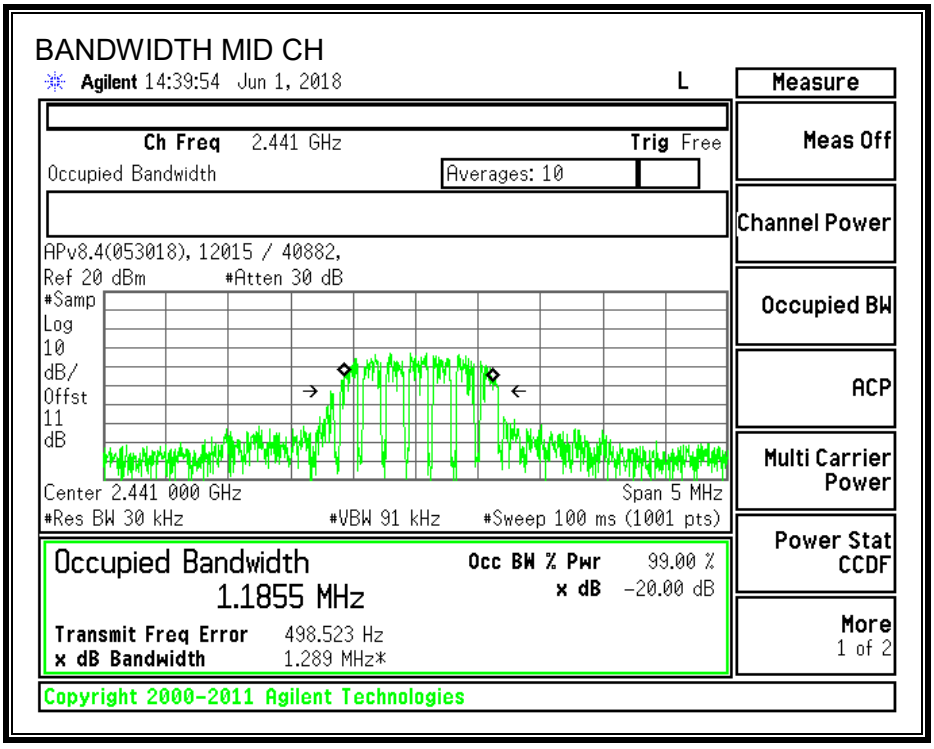


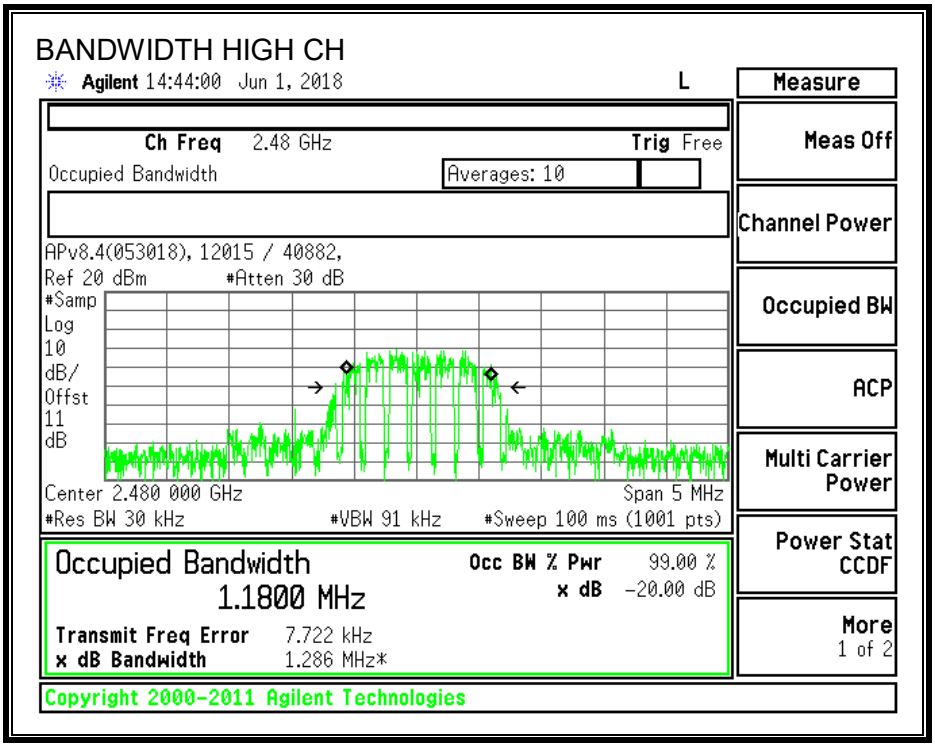




99% BANDWIDTH







8.5.2. 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.

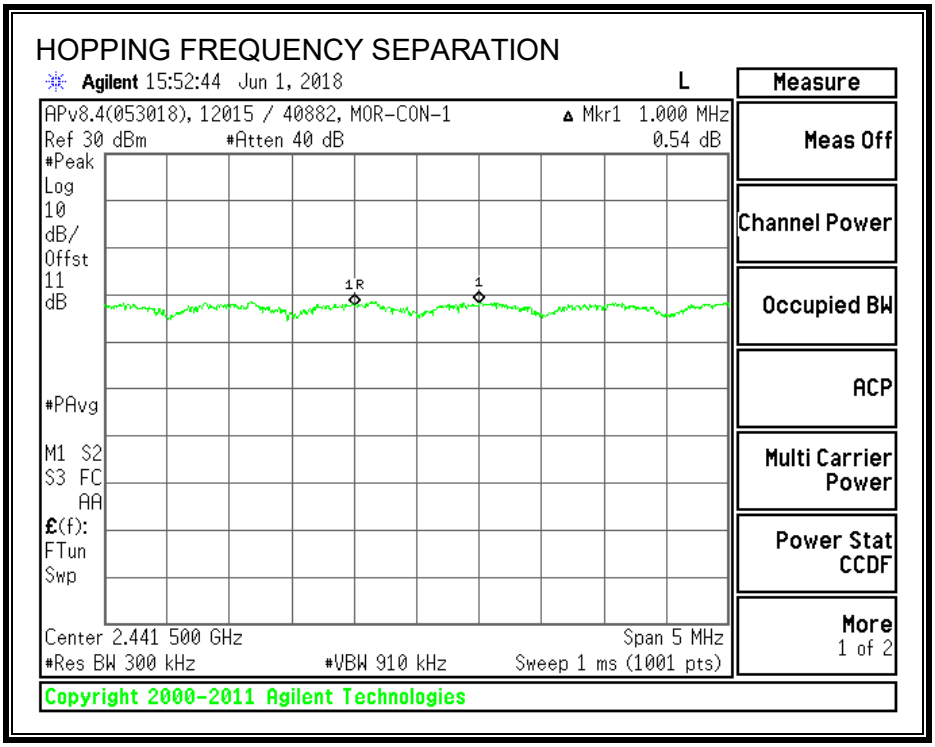
Alternatively, frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than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



8.5.3. 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

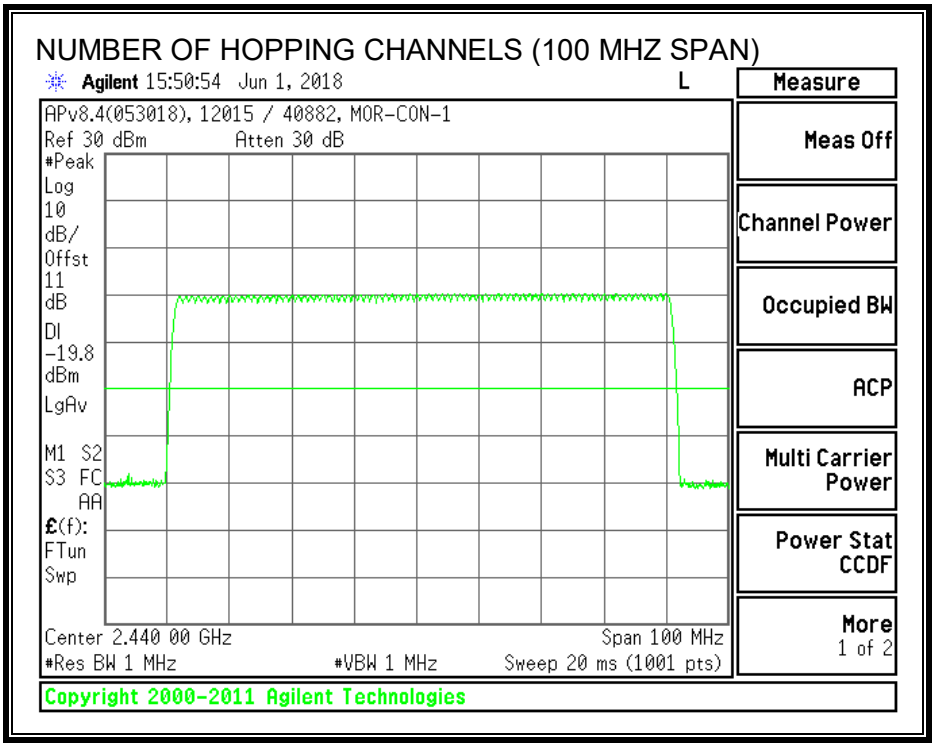
The transmitter output is connected to a spectrum analyzer. The span is set to cover the entire authorized band, in either a single sweep or in multiple contiguous sweeps for visibility of the entire span. Then, smaller spans are set to more clearly identify the channels. The RBW is set to 30% of the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

RESULTS

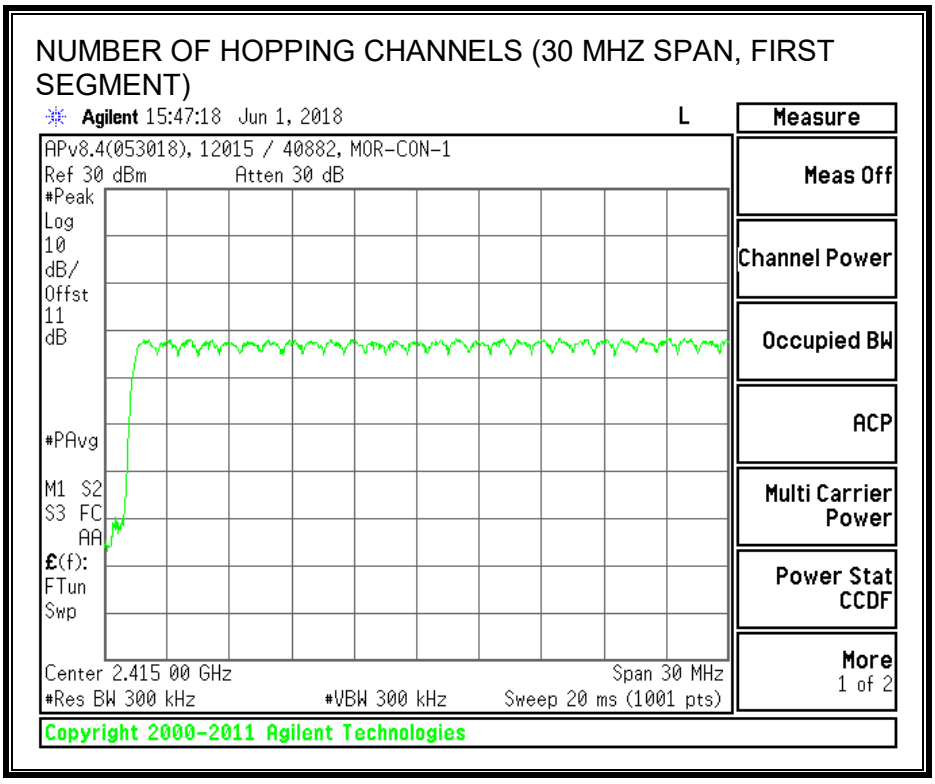
Normal Mode: 79 Channels observed.
AFH Mode: 15 Channels declared.

NUMBER OF HOPPING CHANNELS

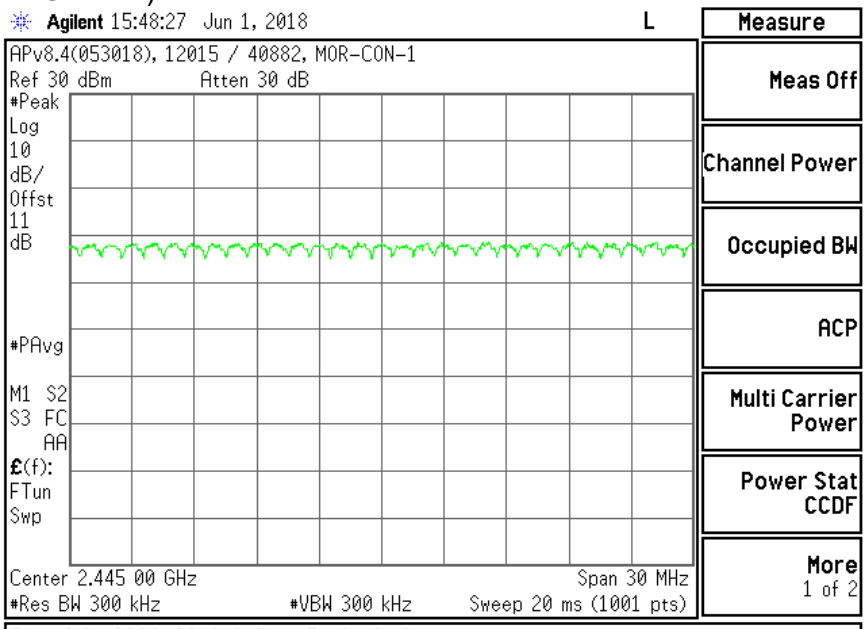
NUMBER OF HOPPING CHANNELS (100 MHZ SPAN)



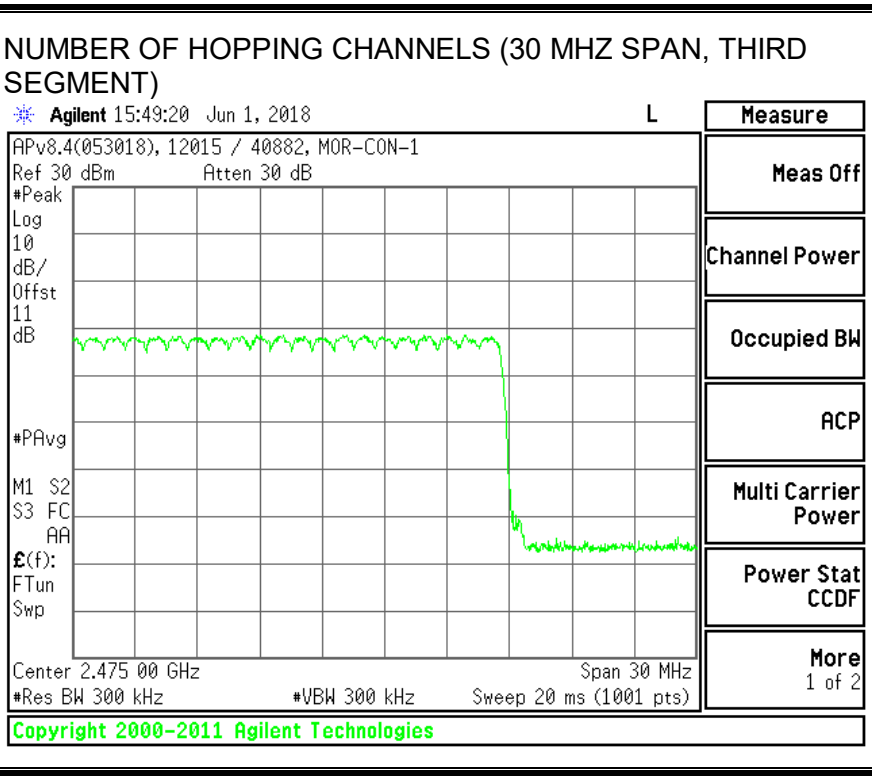
NUMBER OF HOPPING CHANNELS (30 MHZ SPAN, FIRST SEGMENT)



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



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



8.5.4. 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.

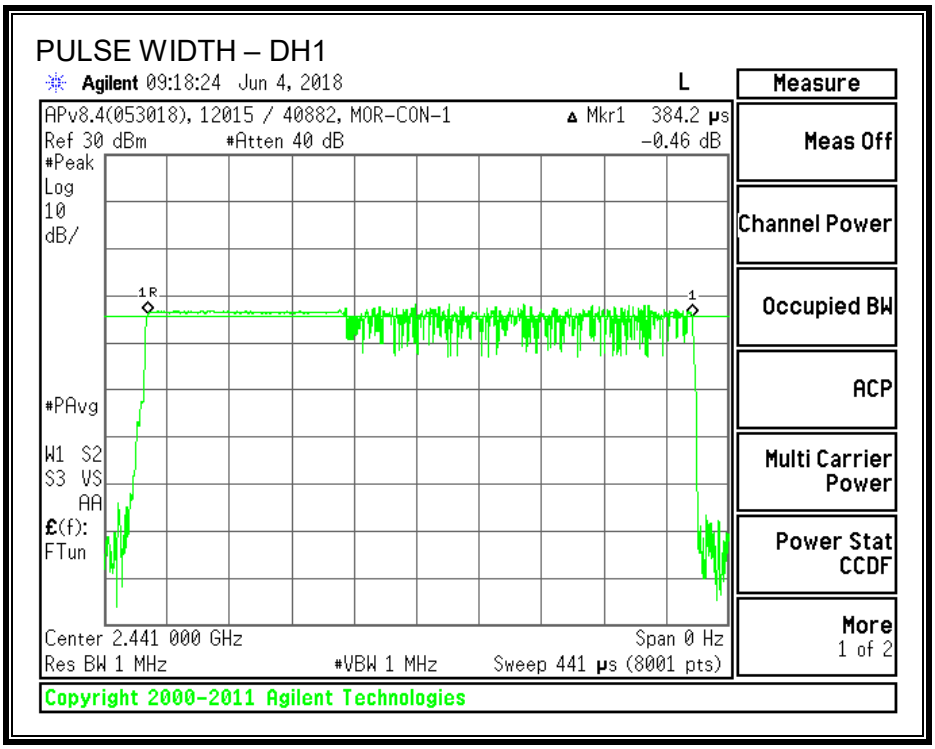
RESULTS

8PSK (EDR) Mode

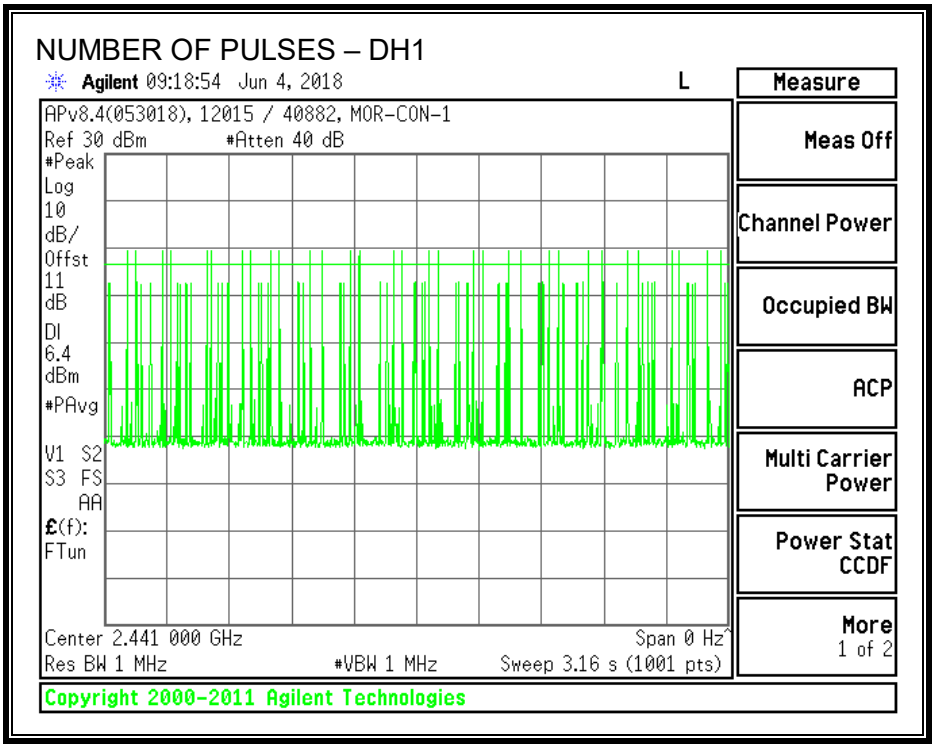
DH Packet	Pulse Width (msec)	Number of Pulses in 3.16 seconds	Average Time of (sec)	Limit (sec)	Margin (sec)
DH1	0.3842	32	0.123	0.4	-0.277
DH3	1.634	17	0.278	0.4	-0.122
DH5	2.884	13	0.375	0.4	-0.025

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 demonstrates compliance with channel occupancy when AFH is employed.

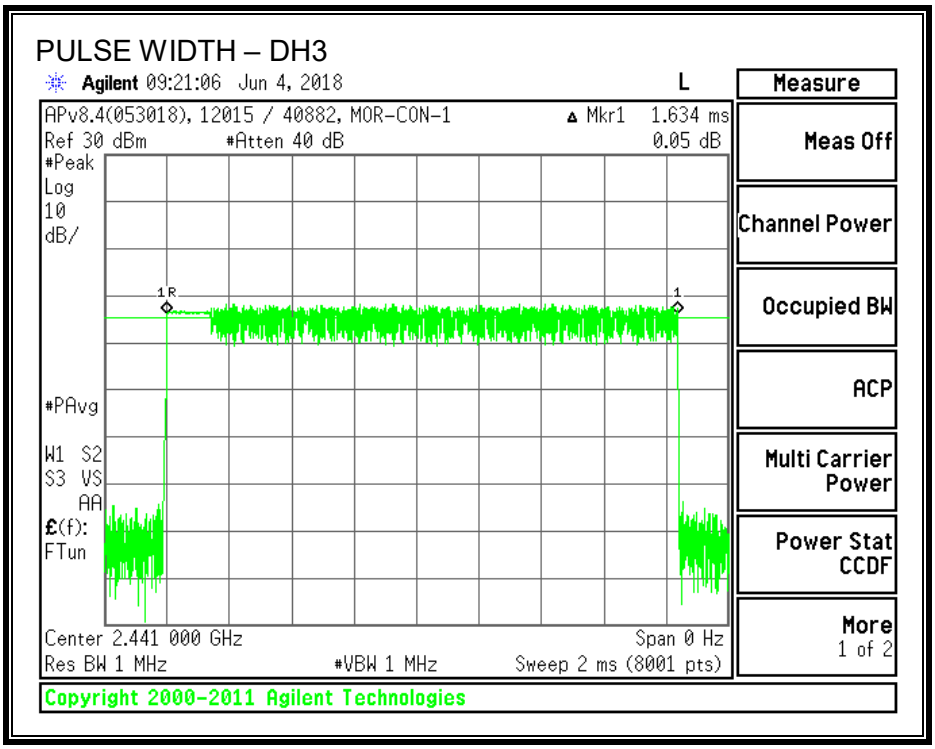
PULSE WIDTH - DH1



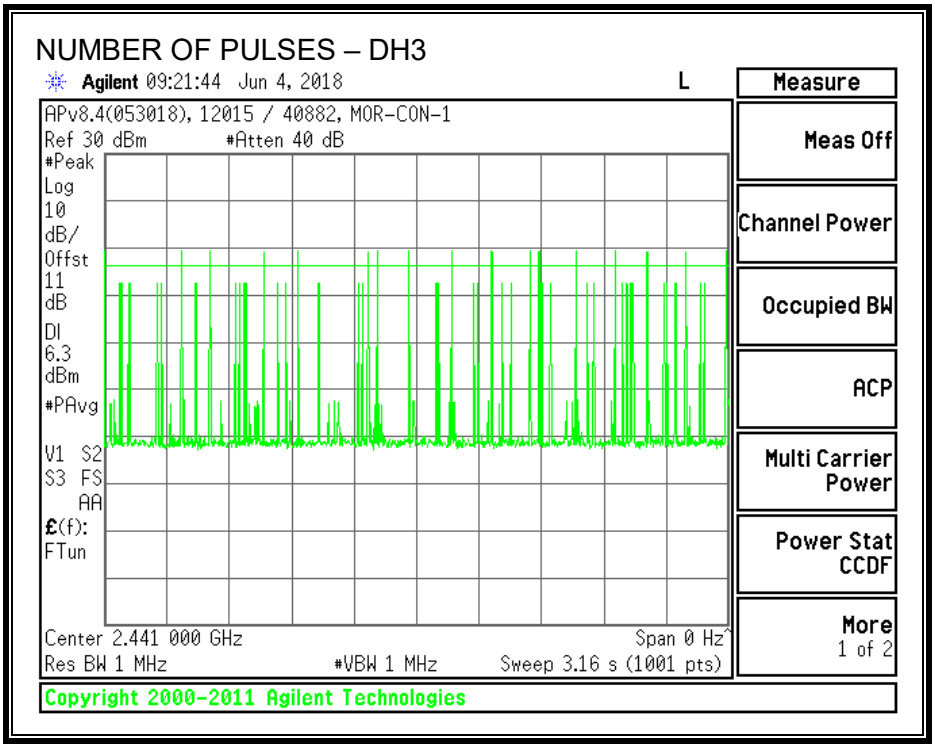
NUMBER OF PULSES IN 3.16 SECOND OBSERVATION PERIOD – DH1



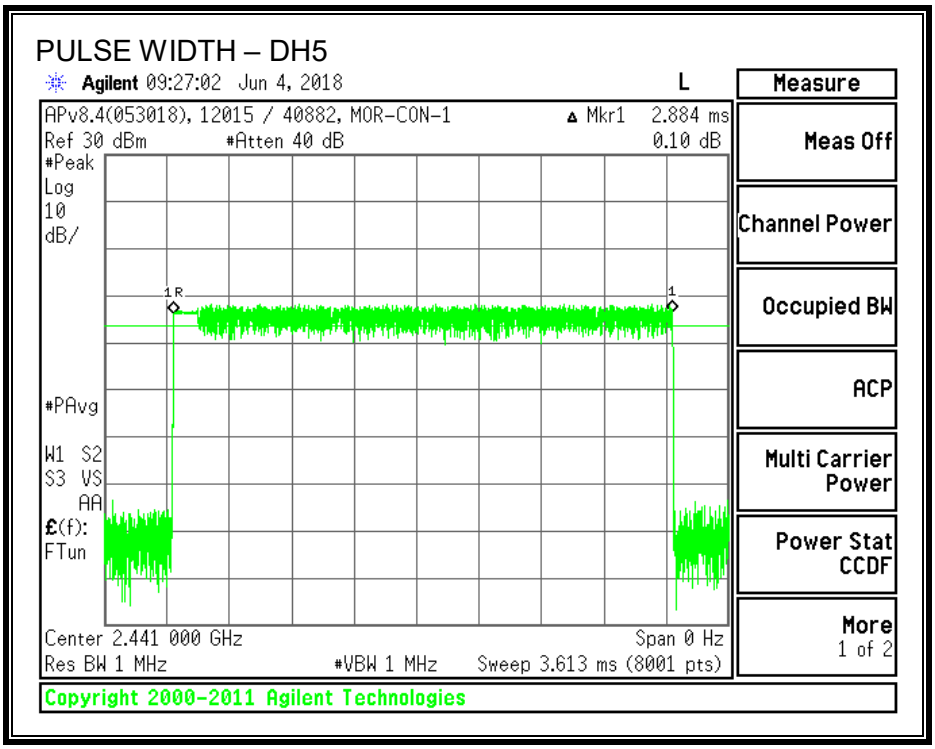
PULSE WIDTH – DH3



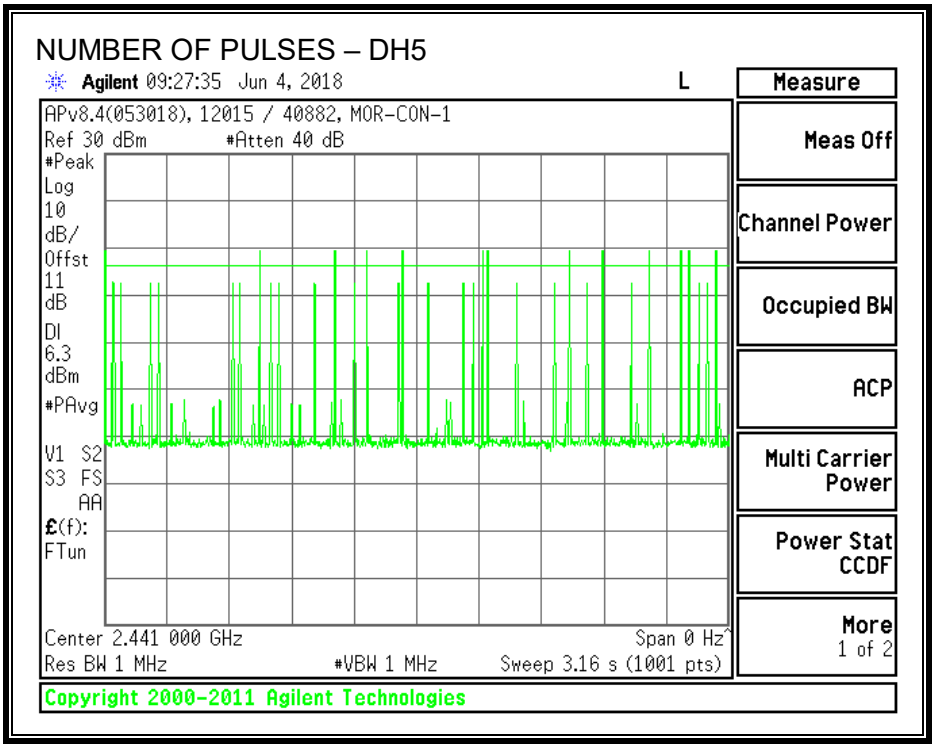
NUMBER OF PULSES IN 3.16 SECOND OBSERVATION PERIOD – DH3



PULSE WIDTH – DH5



NUMBER OF PULSES IN 3.16 SECOND OBSERVATION PERIOD – DH5



8.5.5. 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 power meter.

RESULTS

Channel	Frequency (MHz)	Output Power (dBm)	Directional Gain (dBi)	Limit (dBm)	Margin (dB)
Low	2402	0.68	3.50	21	-20.32
Middle	2441	1.05	3.50	21	-19.95
High	2480	1.12	3.50	21	-19.88

8.5.6. 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

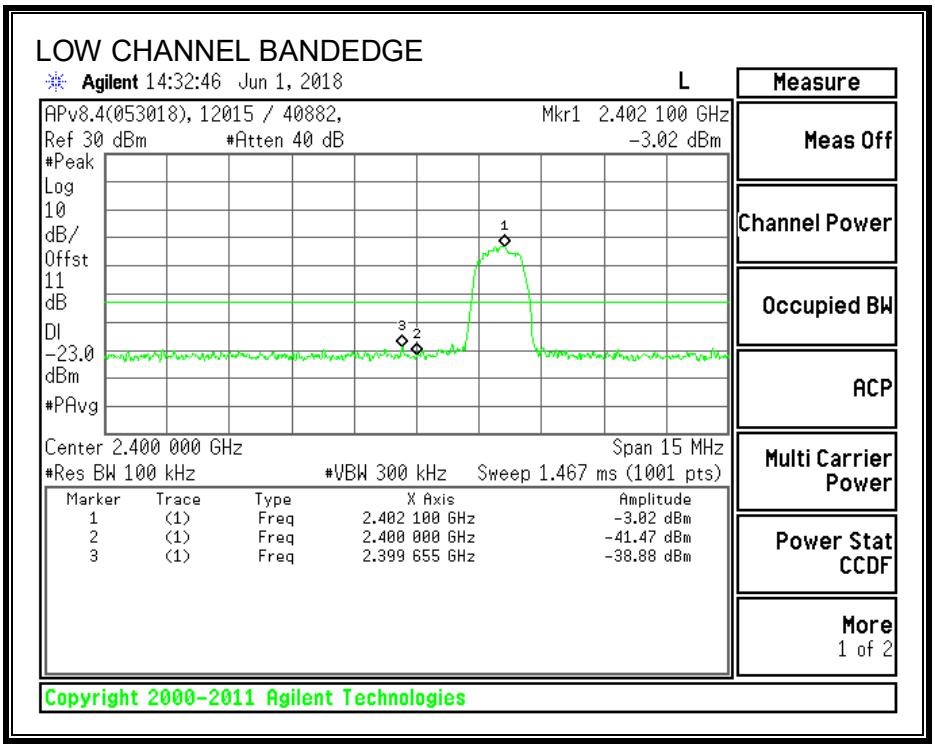
The transmitter output is connected to a spectrum analyzer. The resolution bandwidth is set to 100 kHz. The video bandwidth is set to 300 kHz.

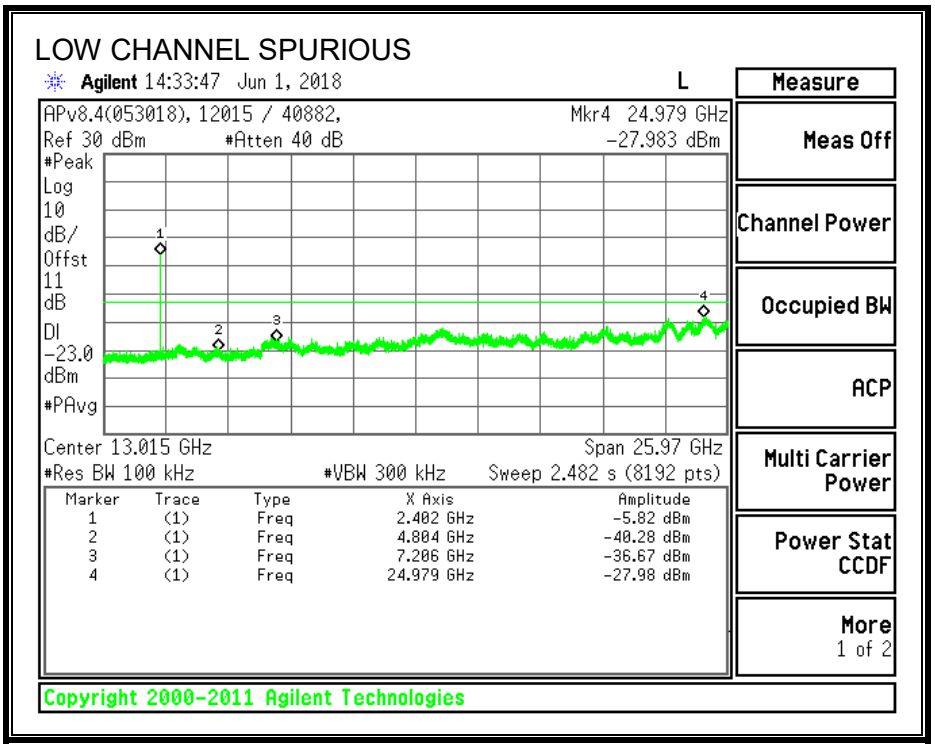
The spectrum from 30 MHz to 26 GHz is investigated with the transmitter set to the lowest, middle, and highest channels.

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

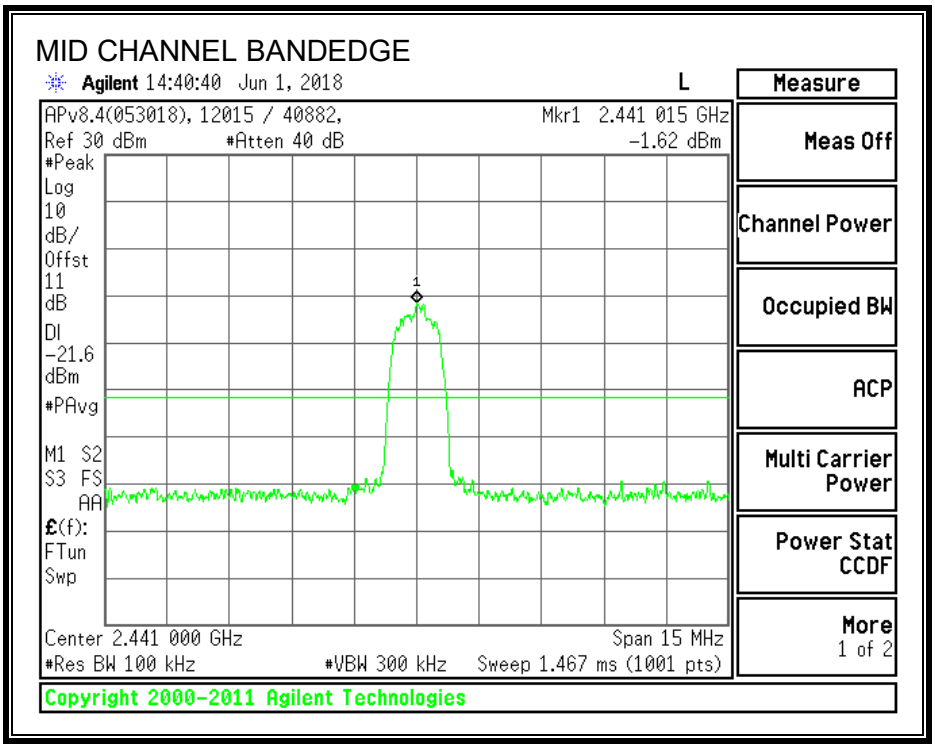
RESULTS

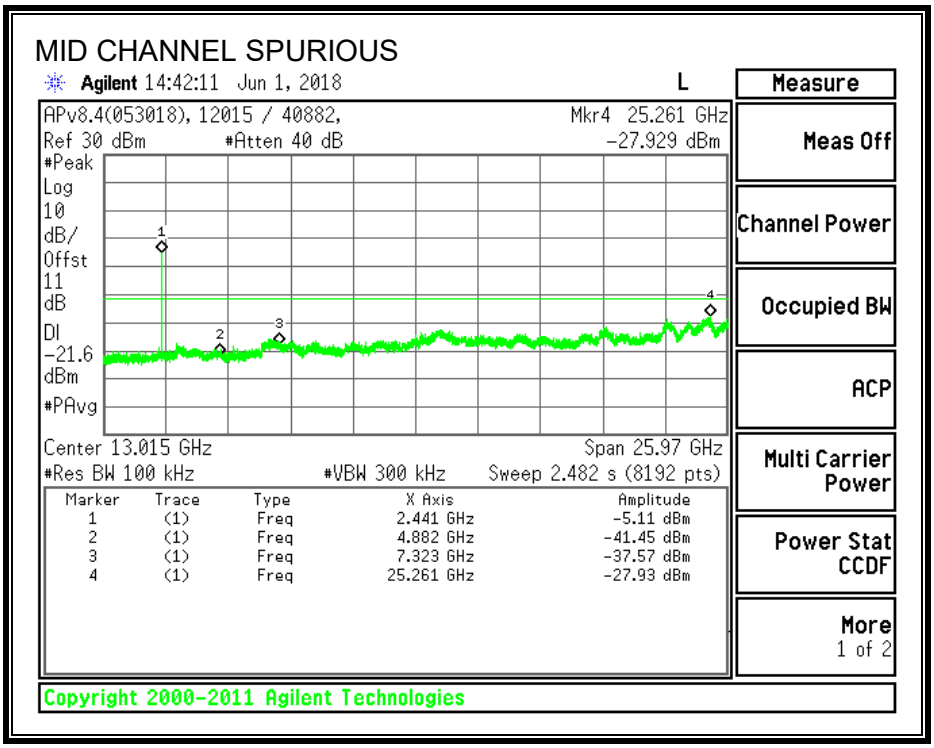
SPURIOUS EMISSIONS, LOW CHANNEL



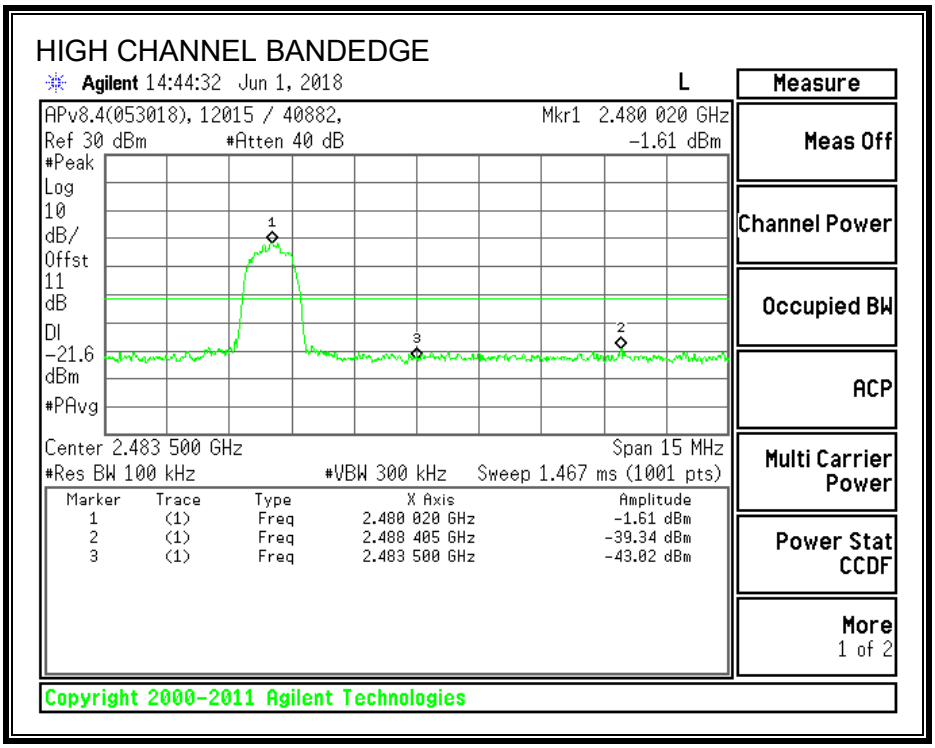


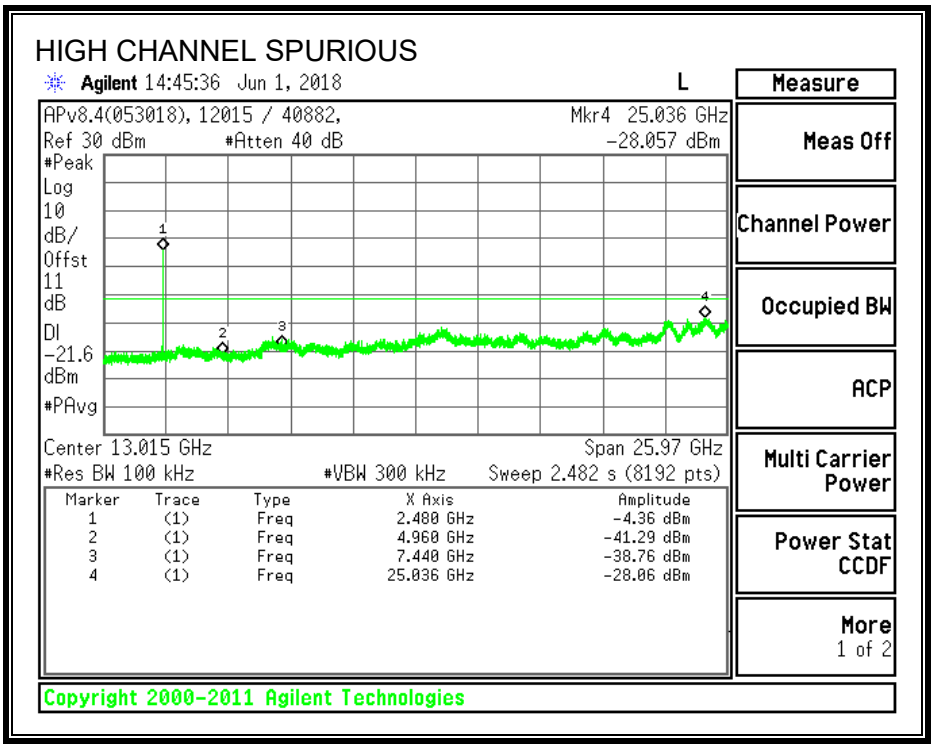
SPURIOUS EMISSIONS, MID CHANNEL





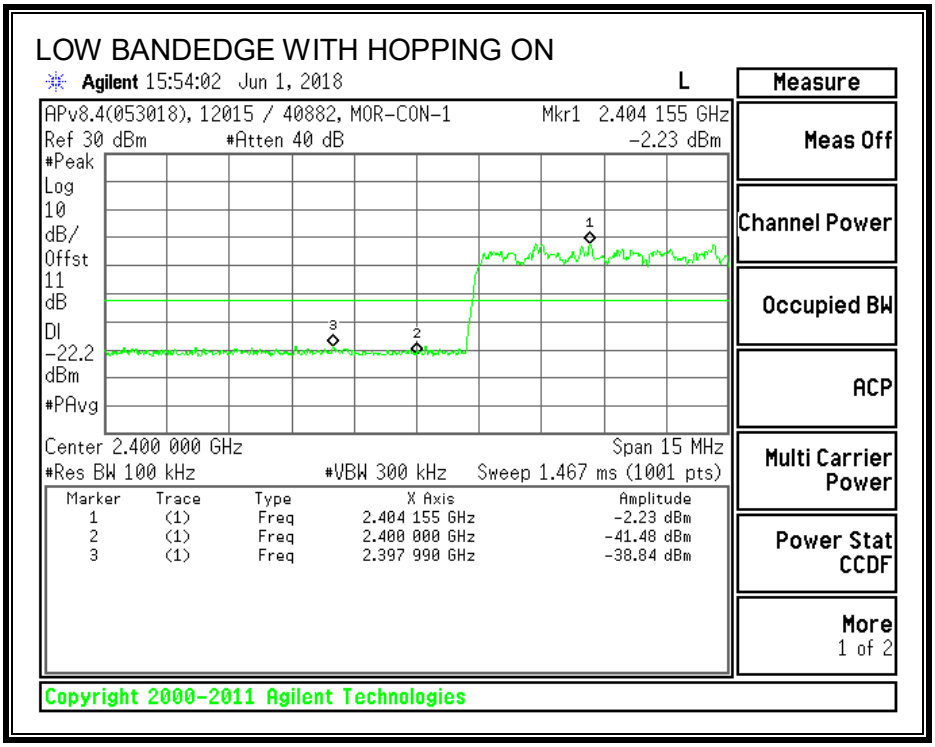
SPURIOUS EMISSIONS, HIGH CHANNEL



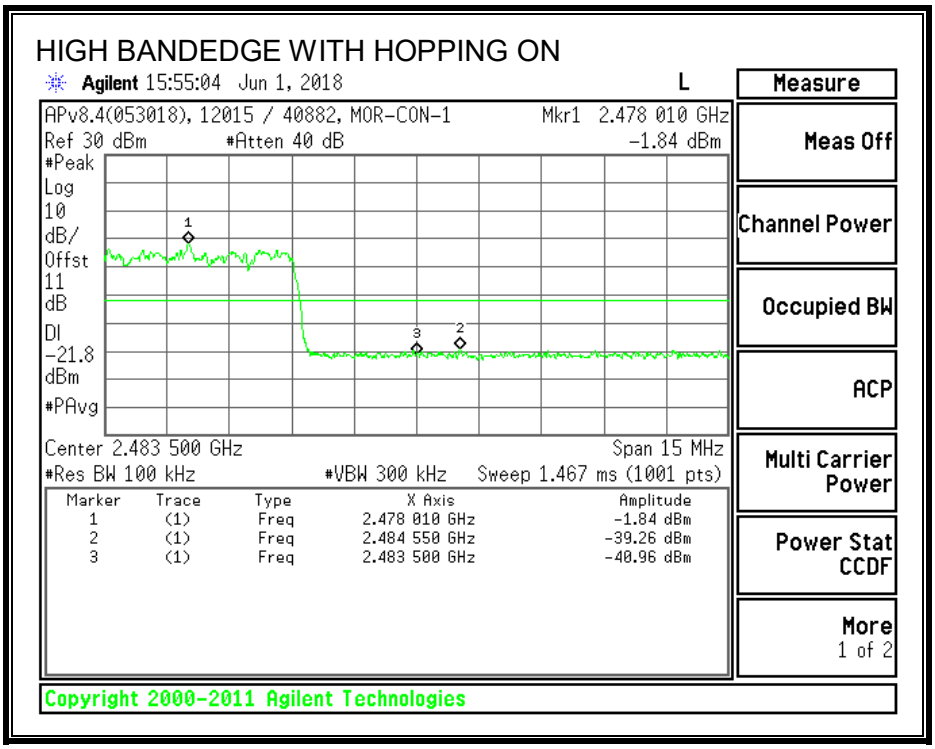


SPURIOUS BANDEDGE EMISSIONS WITH HOPPING ON

LOW BANDEDGE WITH HOPPING ON



HIGH BANDEDGE WITH HOPPING ON



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.

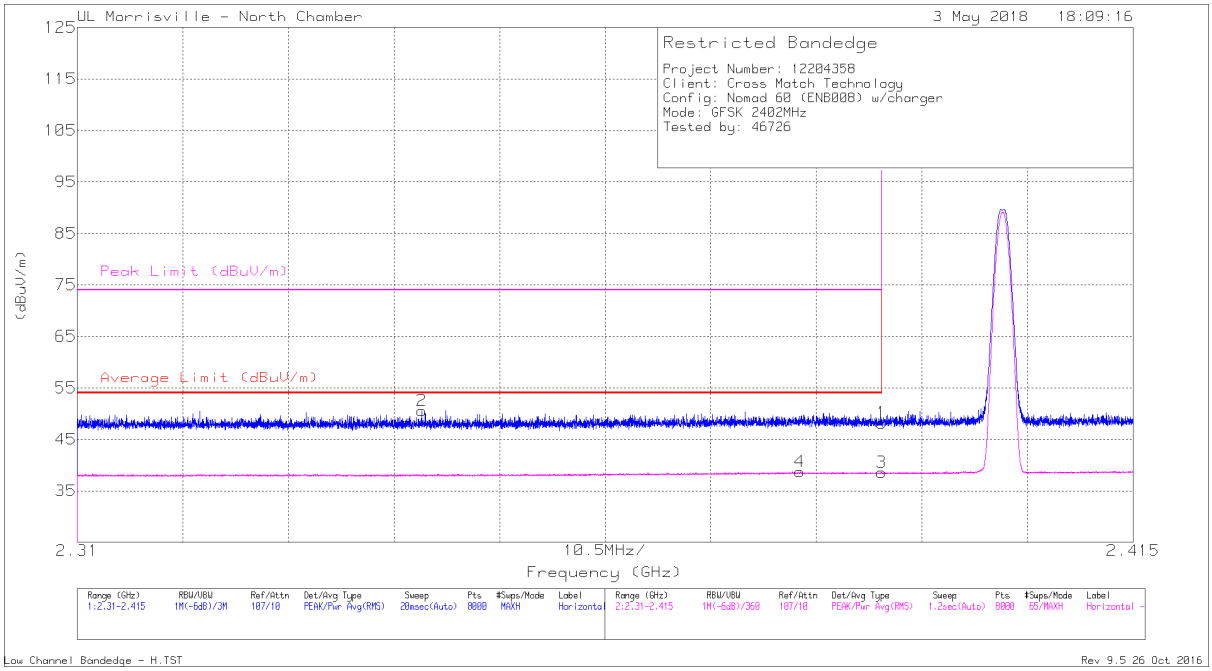
The spectrum from 1 to 18 GHz is investigated with the transmitter set to the lowest, middle, and highest channels in each applicable band. For 9kHz to 1000 MHz and 18 to 26 GHz investigation, the worst-case channel was selected.

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

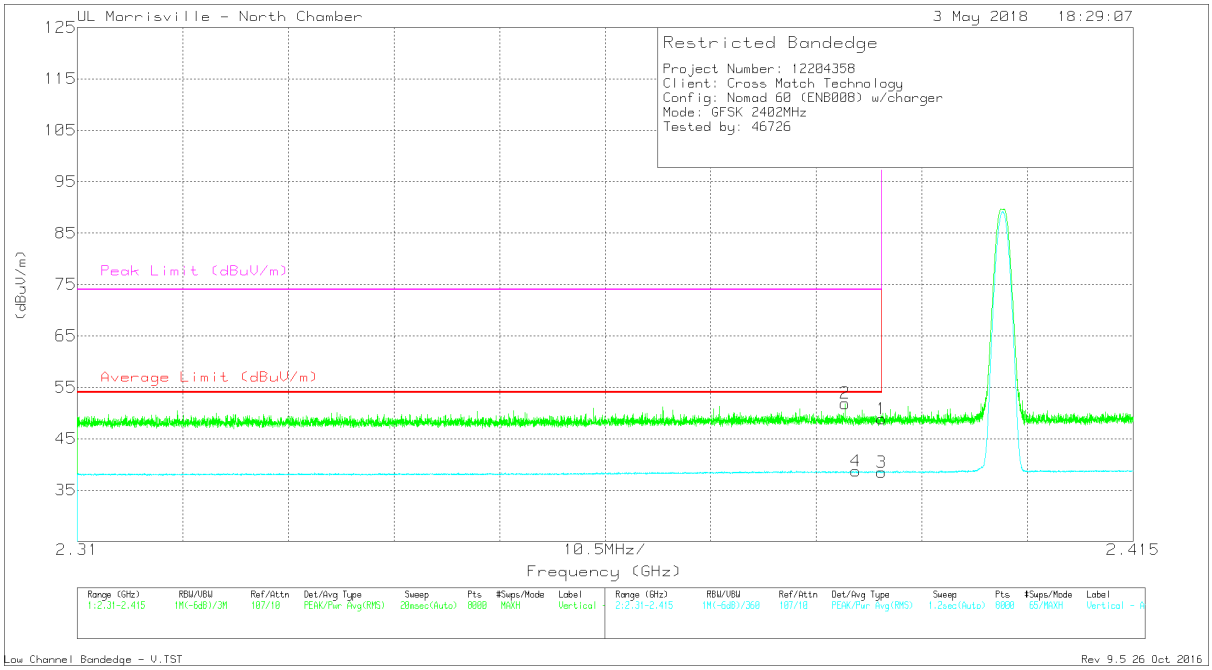
RESTRICTED BANDEDGE (LOW CHANNEL, HORIZONTAL)



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	40.86	Pk	32	-24.7	48.16	-	-	74	-25.84	7	251	H
2	* 2.344	43.66	Pk	31.7	-24.8	50.56	-	-	74	-23.44	7	251	H
3	* 2.39	31.3	V1TR	32	-24.7	38.6	54	-15.4	-	-	7	251	H
4	* 2.382	31.42	V1TR	32	-24.7	38.72	54	-15.28	-	-	7	251	H

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

RESTRICTED BANDEDGE (LOW CHANNEL, VERTICAL)



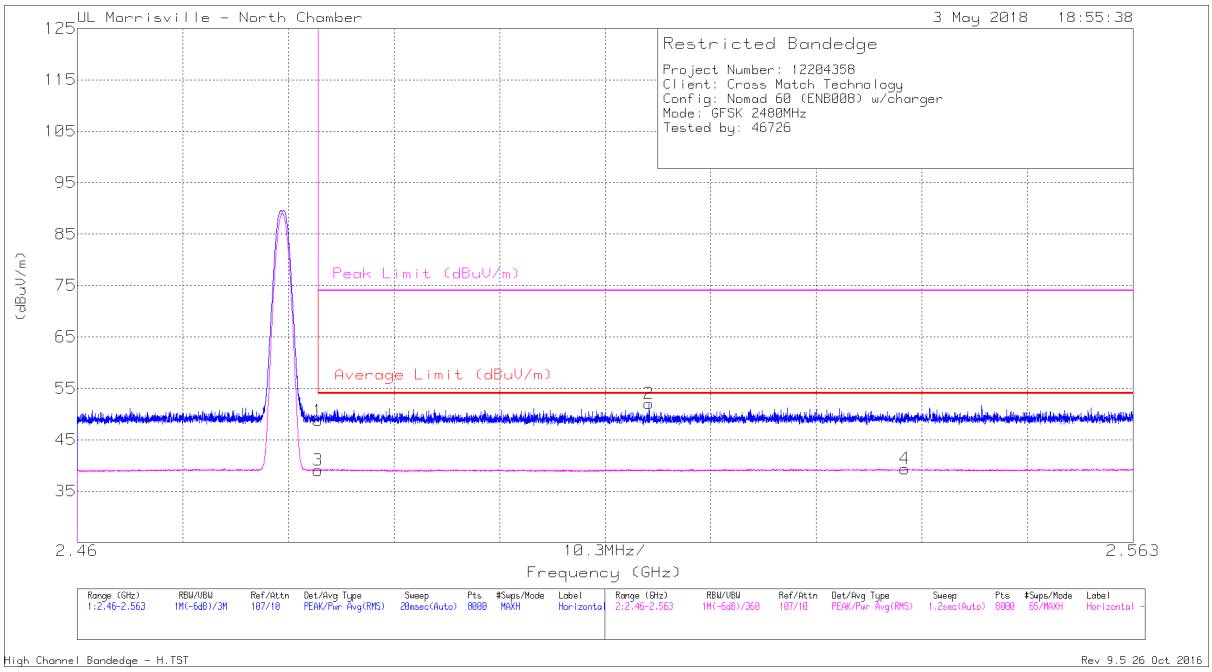
Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AT0072 AF (dB/m)	Amp/Cbl/Fltr/Pad (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
2	* 2.386	44.56	Pk	32	-24.7	51.86	-	-	74	-22.14	116	161	V
4	* 2.387	31.43	V1TR	32	-24.7	38.73	54	-15.27	-	-	116	161	V
1	* 2.39	41.54	Pk	32	-24.7	48.84	-	-	74	-25.16	116	161	V
3	* 2.39	31.16	V1TR	32	-24.7	38.46	54	-15.54	-	-	116	161	V

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

Pk - Peak detector

V1TR - U-NII: VB=1/Ton, RMS Average where: Ton is packet duration

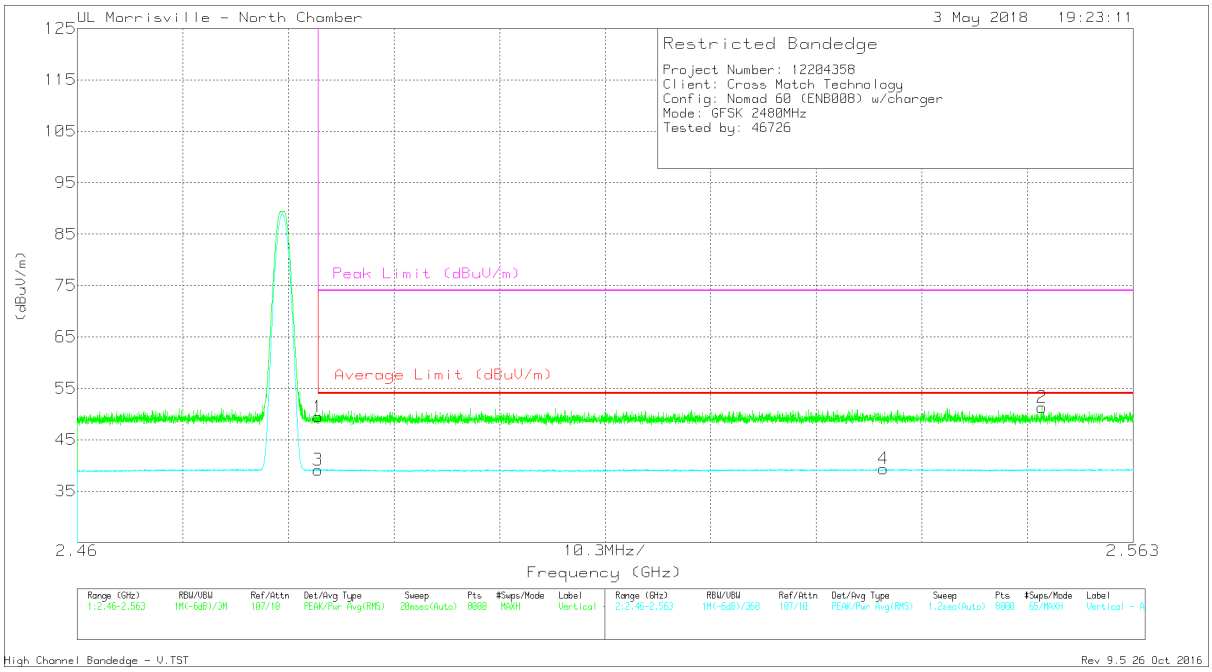
RESTRICTED BANDEDGE (HIGH CHANNEL, HORIZONTAL)



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	* 2.484	40.81	Pk	32.4	-24.5	48.71	-	-	74	-25.29	65	265	H
3	* 2.484	31.15	V1TR	32.4	-24.5	39.05	54	-14.95	-	-	65	265	H
2	2.516	44.21	Pk	32.3	-24.5	52.01	-	-	74	-21.99	65	265	H
4	2.541	31.45	V1TR	32.4	-24.5	39.35	54	-14.65	-	-	65	265	H

* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band
** - indicates frequency in Taiwan NCC LP0002 Restricted Band
Pk - Peak detector
V1TR - U-NII: VB=1/Ton, RMS Average where: Ton is packet duration

RESTRICTED BANDEDGE (HIGH CHANNEL, VERTICAL)

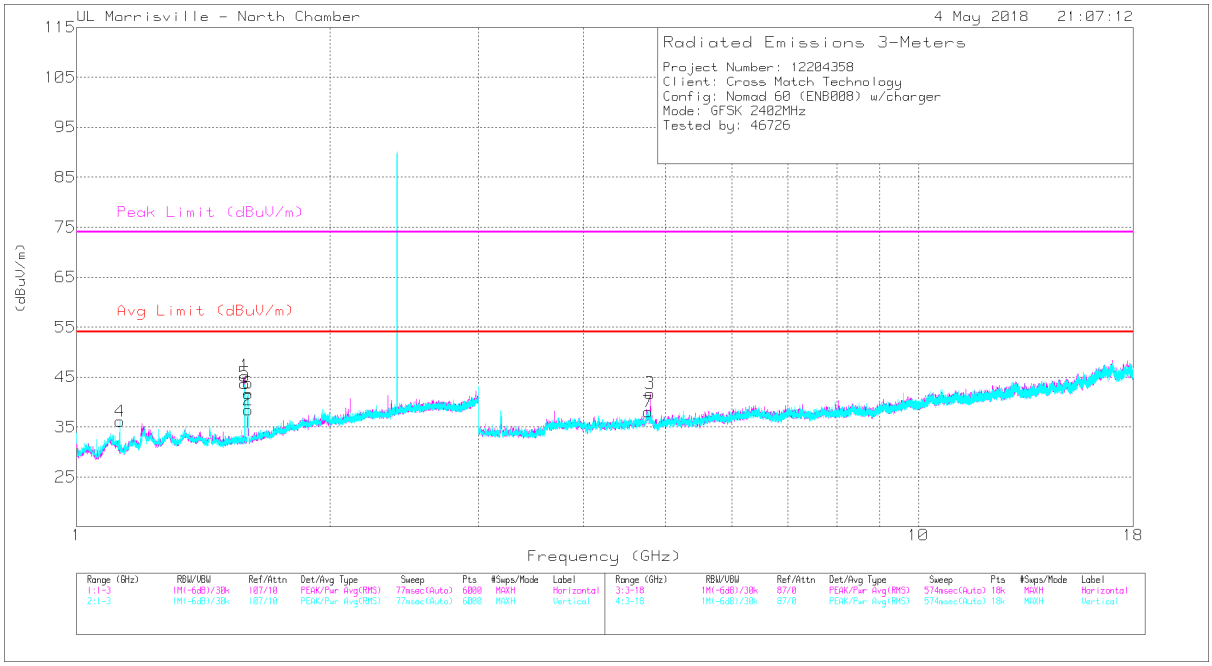


Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AT0072 AF (dB/m)	Amp/Cbl/Fltr/Pad (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.484	41.57	Pk	32.4	-24.5	49.47	-	-	74	-24.53	345	143	V
3	* 2.484	31.23	V1TR	32.4	-24.5	39.13	54	-14.87	-	-	345	143	V
4	2.539	31.45	V1TR	32.4	-24.5	39.35	54	-14.65	-	-	345	143	V
2	2.554	43.42	Pk	32.4	-24.5	51.32	-	-	74	-22.68	345	143	V

* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band
** - indicates frequency in Taiwan NCC LP0002 Restricted Band
Pk - Peak detector
V1TR - U-NII: VB=1/Ton, RMS Average where: Ton is packet duration

HARMONICS AND SPURIOUS EMISSIONS

Low Channel



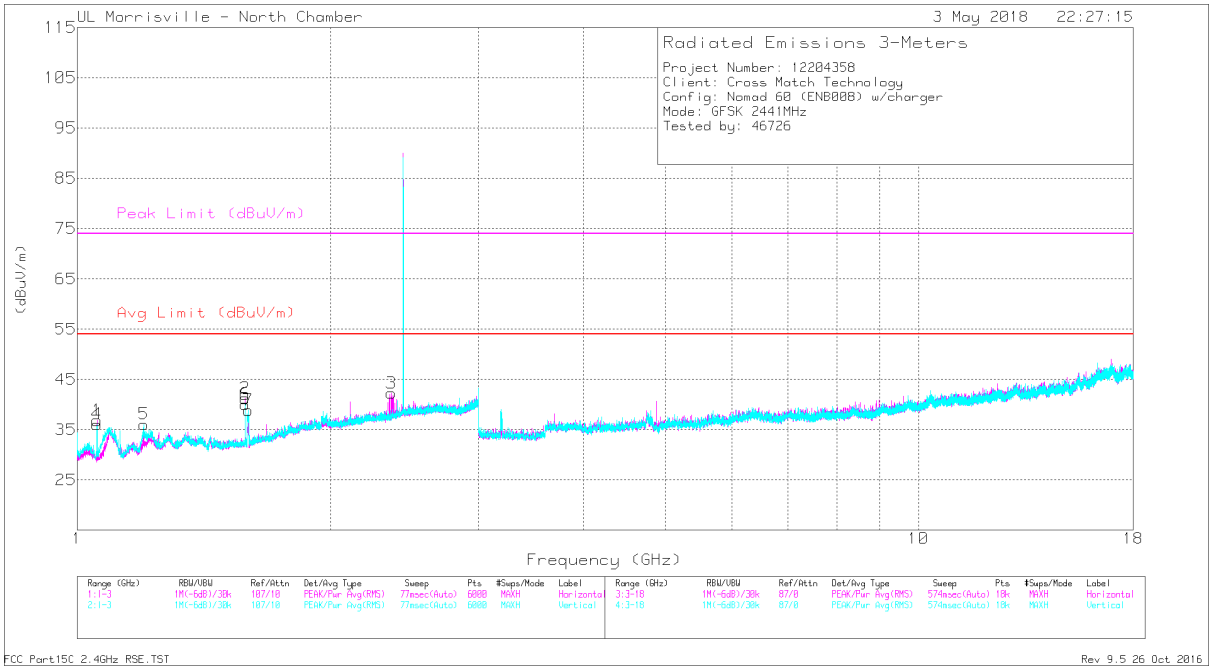
Markers	Frequency (GHz)	Meter Reading (dBuV)	Det	AT0072 AF (dB/m)	Amp/Cbl/Fltr/Pad (dB)	DC Corr (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 1.584	44.97	PK-U	27.8	-24.7	0	48.07	-	-	74	-25.93	36	160	H
	* 1.584	40.36	V1TR	27.8	-24.7	1.14	44.6	54	-9.4	-	-	36	160	H
2	* 1.599	42.3	PK-U	27.9	-24.6	0	45.6	-	-	74	-28.4	173	198	H
	* 1.599	29.88	V1TR	27.9	-24.6	1.14	34.32	54	-19.68	-	-	173	198	H
3	* 4.804	45.77	PK-U	34.1	-31.8	0	48.07	-	-	74	-25.93	356	131	H
	* 4.804	38.03	V1TR	34.1	-31.8	1.14	41.47	54	-12.53	-	-	356	131	H
4	* 1.125	41.12	PK-U	27.9	-26.7	0	42.32	-	-	74	-31.68	360	192	V
	* 1.125	33	V1TR	27.9	-26.7	1.14	35.34	54	-18.66	-	-	360	192	V
5	* 1.584	44.71	PK-U	27.8	-24.7	0	47.81	-	-	74	-26.19	23	252	V
	* 1.584	38.69	V1TR	27.8	-24.7	1.14	42.93	54	-11.07	-	-	23	252	V
6	* 1.599	44.21	PK-U	27.9	-24.6	0	47.51	-	-	74	-26.49	156	229	V
	* 1.599	32.68	V1TR	27.9	-24.6	1.14	37.12	54	-16.88	-	-	156	229	V
7	* 4.778	42.64	PK-U	34.1	-31.9	0	44.84	-	-	74	-29.16	282	111	V
	* 4.778	30.73	V1TR	34.1	-31.9	1.14	34.07	54	-19.93	-	-	282	111	V

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

PK-U - U-NII: Maximum Peak

V1TR - U-NII: VB=1/Ton, RMS Average where: Ton is packet duration

Mid Channel



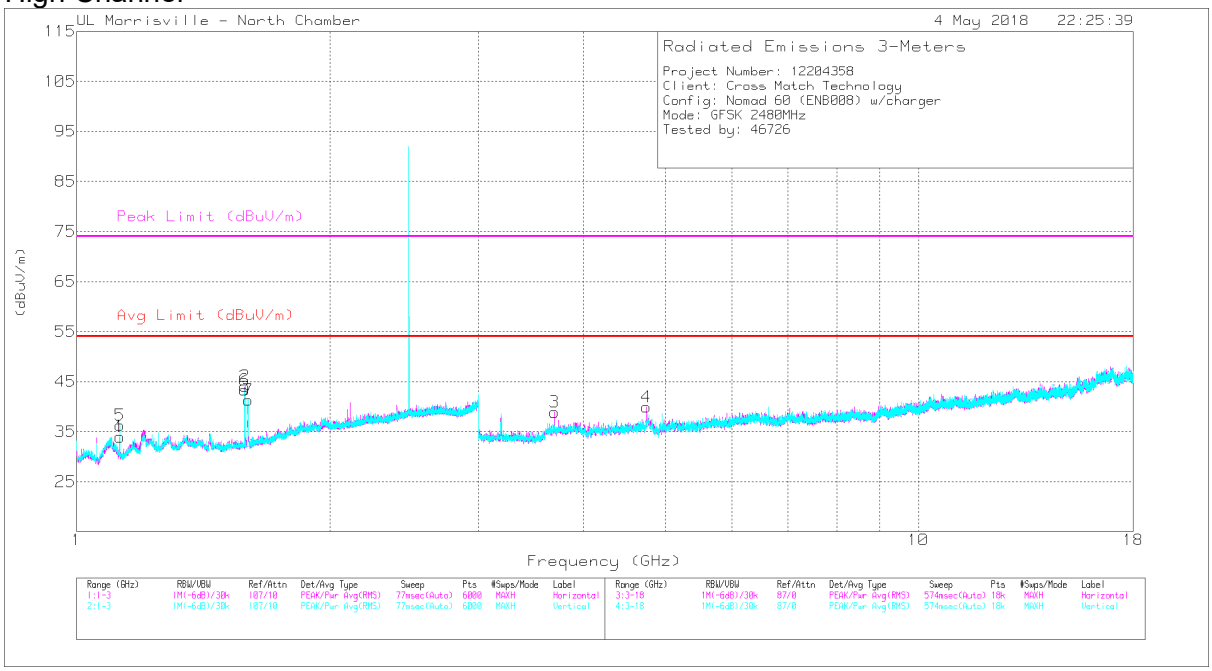
Markers	Frequency (GHz)	Meter Reading (dBuV)	Det	AT0072 AF (dB/m)	Amp/Cbl/Fltr/Pad (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 1.056	42.05	PK-U	27.1	-27.2	41.95	-	-	74	-32.05	24	102	H
	* 1.056	33.49	V1TR	27.1	-27.2	33.39	54	-20.61	-	-	24	102	H
4	* 1.584	41.79	PK-U	27.8	-24.7	44.89	-	-	74	-29.11	179	253	H
	* 1.584	34.64	V1TR	27.8	-24.7	37.74	54	-16.26	-	-	179	253	H
5	* 2.364	37.47	PK-U	31.8	-24.5	44.77	-	-	74	-29.23	170	178	H
	* 2.364	25.29	V1TR	31.8	-24.5	32.59	54	-21.41	-	-	170	178	H
2	* 1.056	42.56	PK-U	27.1	-27.2	42.46	-	-	74	-31.54	56	138	V
	* 1.056	35.12	V1TR	27.1	-27.2	35.02	54	-18.98	-	-	56	138	V
6	* 1.2	41.65	PK-U	28.7	-26.2	44.15	-	-	74	-29.85	96	106	V
	* 1.2	29.78	V1TR	28.7	-26.2	32.28	54	-21.72	-	-	96	106	V
7	* 1.584	43.05	PK-U	27.8	-24.7	46.15	-	-	74	-27.85	170	166	V
	* 1.584	36.11	V1TR	27.8	-24.7	39.21	54	-14.79	-	-	170	166	V
3	* 1.6	41.92	PK-U	27.9	-24.6	45.22	-	-	74	-28.78	153	146	V
	* 1.599	29.73	V1TR	27.9	-24.6	33.03	54	-20.97	-	-	153	146	V

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

PK-U - U-NII: Maximum Peak

V1TR - U-NII: VB=1/Ton, RMS Average where: Ton is packet duration

High Channel



Markers	Frequency (GHz)	Meter Reading (dBuV)	Det	AT0072 AF (dB/m)	Amp/Cbl/Fltr/Pad (dB)	DC Corr (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 1.125	39.96	PK-U	27.9	-26.7	0	41.16	-	-	74	-32.84	196	113	H
	* 1.125	31.07	V1TR	27.9	-26.7	1.14	33.41	54	-20.59	-	-	196	113	H
2	* 1.584	44.29	PK-U	27.8	-24.7	0	47.39	-	-	74	-26.61	29	160	H
	* 1.584	38.45	V1TR	27.8	-24.7	1.14	42.69	54	-11.31	-	-	29	160	H
3	* 3.696	45.4	PK-U	33.2	-32.3	0	46.3	-	-	74	-27.7	20	251	H
	* 3.696	36.02	V1TR	33.2	-32.3	1.14	38.06	54	-15.94	-	-	20	251	H
4	* 4.752	44.65	PK-U	34.1	-32.3	0	46.45	-	-	74	-27.55	83	161	H
	* 4.752	33.59	V1TR	34.1	-32.3	1.14	36.53	54	-17.47	-	-	83	161	H
5	* 1.125	40.66	PK-U	27.9	-26.7	0	41.86	-	-	74	-32.14	3	202	V
	* 1.125	32.63	V1TR	27.9	-26.7	1.14	34.97	54	-19.03	-	-	3	202	V
6	* 1.584	44.87	PK-U	27.8	-24.7	0	47.97	-	-	74	-26.03	27	248	V
	* 1.584	39.09	V1TR	27.8	-24.7	1.14	43.33	54	-10.67	-	-	27	248	V
7	* 1.599	44.15	PK-U	27.9	-24.6	0	47.45	-	-	74	-26.55	160	251	V
	* 1.599	32.06	V1TR	27.9	-24.6	1.14	36.5	54	-17.5	-	-	160	251	V

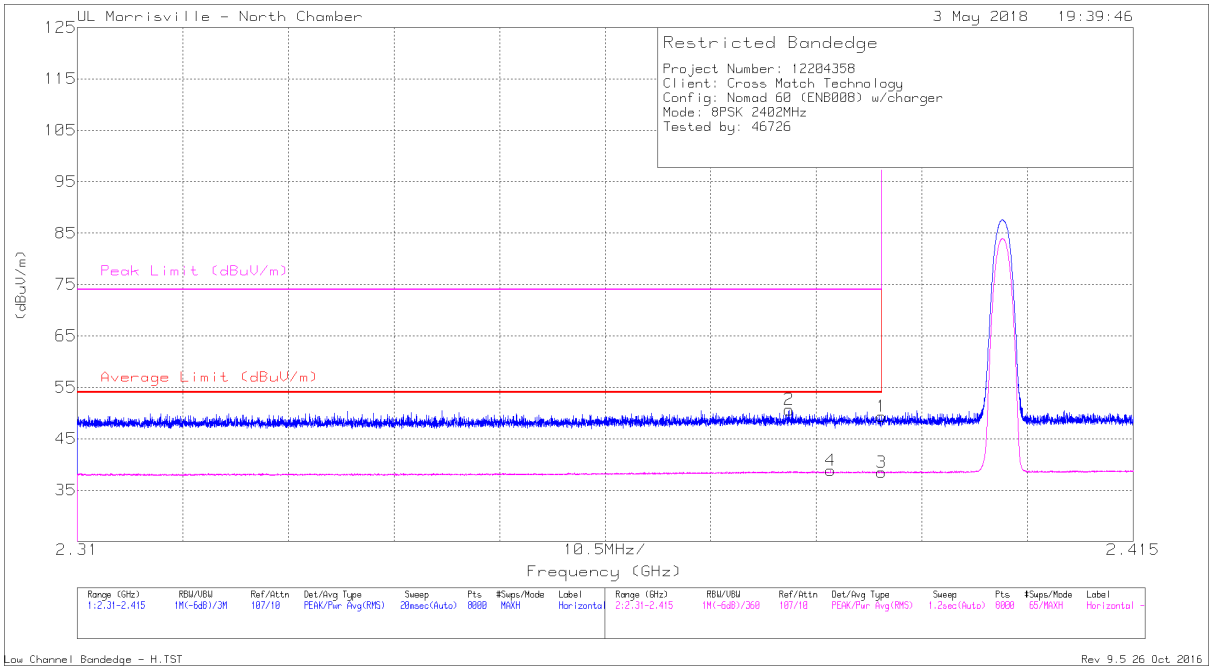
* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band

PK-U - U-NII: Maximum Peak

V1TR - U-NII: VB=1/Ton, RMS Average where: Ton is packet duration

9.2.2. ENHANCED DATA RATE 8PSK MODULATION

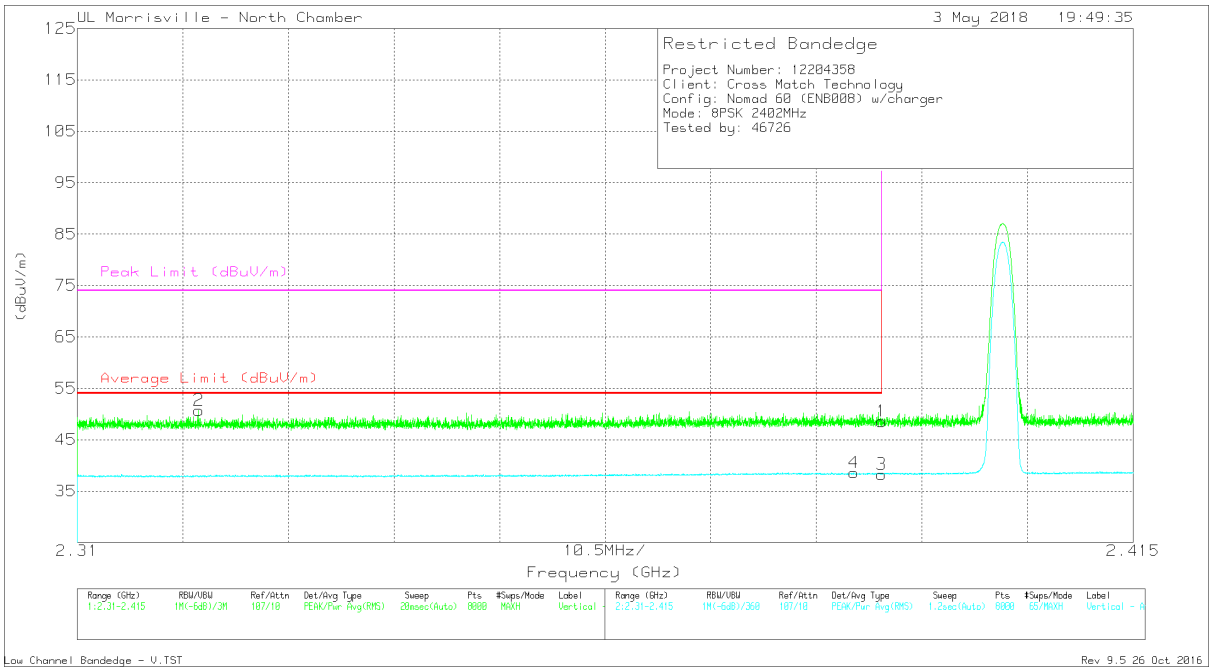
RESTRICTED BANDEDGE (LOW CHANNEL, HORIZONTAL)



Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	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
2	* 2.381	43.34	Pk	32	-24.7	50.64	-	-	74	-23.36	11	254	H
4	* 2.385	31.51	V1TR	32	-24.7	38.81	54	-15.19	-	-	11	254	H
1	* 2.39	42.04	Pk	32	-24.7	49.34	-	-	74	-24.66	11	254	H
3	* 2.39	31.16	V1TR	32	-24.7	38.46	54	-15.54	-	-	11	254	H

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

RESTRICTED BANDEDGE (LOW CHANNEL, VERTICAL)



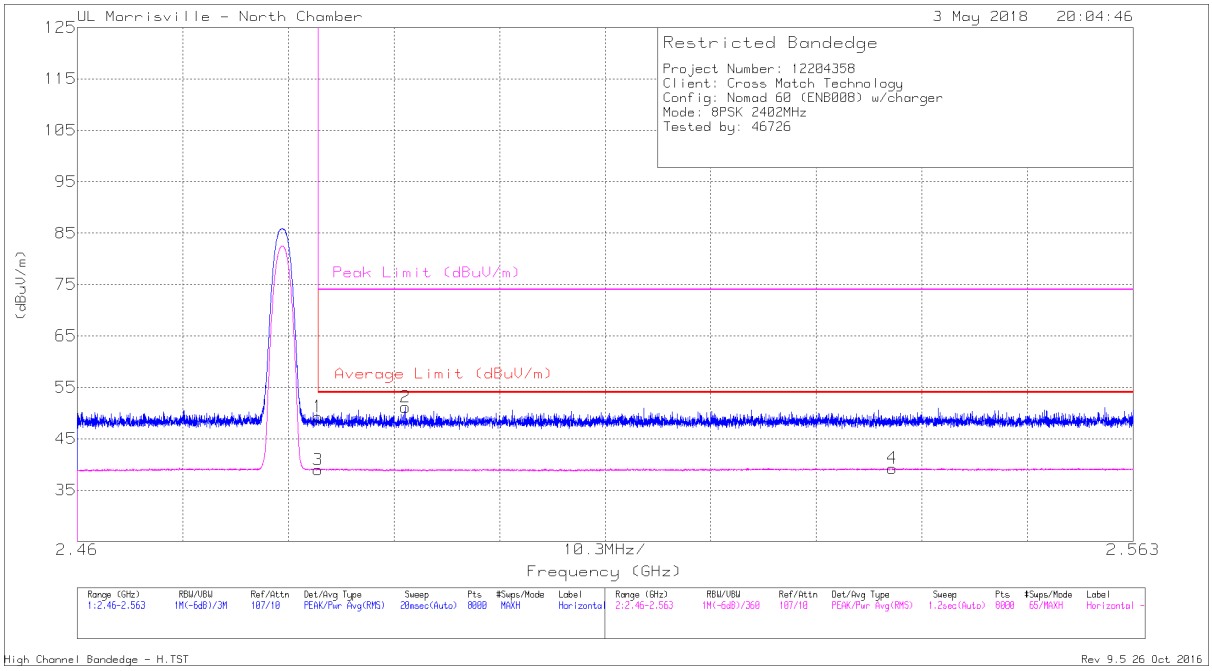
Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AT0072 AF (dB/m)	Amp/Cbl/Fltr/Pad (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
2	* 2.322	43.91	Pk	31.7	-24.9	50.71	-	-	74	-23.29	106	136	V
4	* 2.387	31.27	V1TR	32	-24.7	38.57	54	-15.43	-	-	106	136	V
1	* 2.39	41.27	Pk	32	-24.7	48.57	-	-	74	-25.43	106	136	V
3	* 2.39	30.96	V1TR	32	-24.7	38.26	54	-15.74	-	-	106	136	V

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

Pk - Peak detector

V1TR - U-NII: VB=1/Ton, RMS Average where: Ton is packet duration

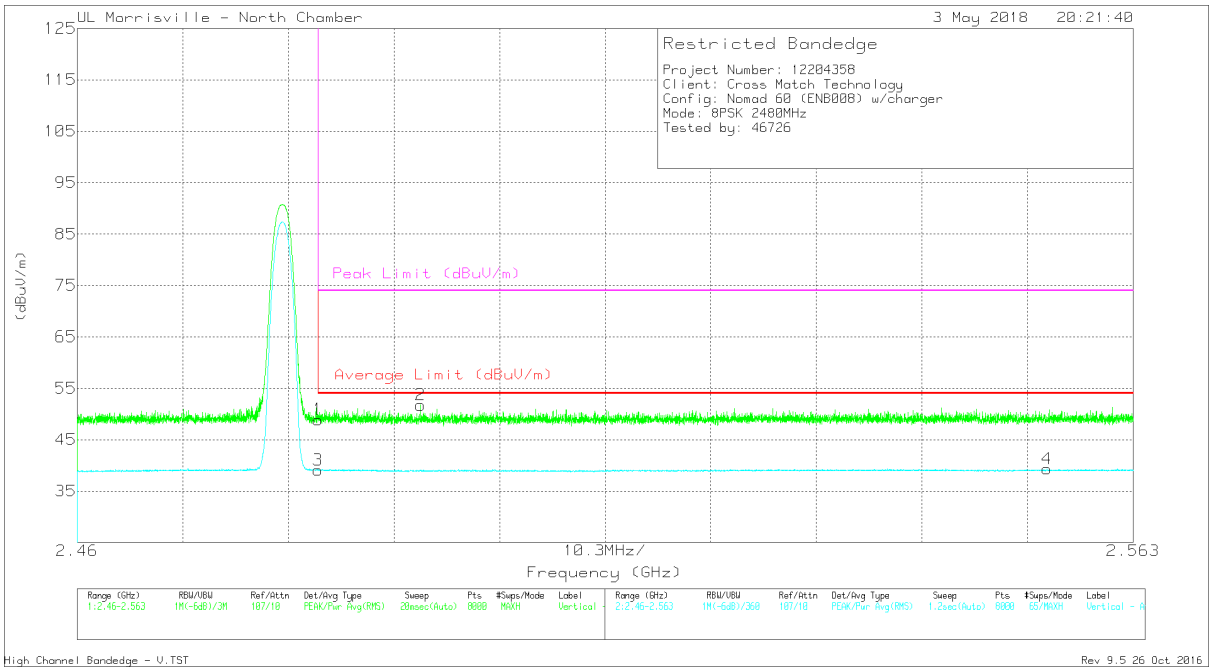
RESTRICTED BANDEDGE (HIGH CHANNEL, HORIZONTAL)



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	* 2.484	41.36	Pk	32.4	-24.5	49.26	-	-	74	-24.74	176	138	H
3	* 2.484	31.04	V1TR	32.4	-24.5	38.94	54	-15.06	-	-	176	138	H
2	* 2.492	43.34	Pk	32.3	-24.5	51.14	-	-	74	-22.86	176	138	H
4	2.54	31.36	V1TR	32.4	-24.5	39.26	54	-14.74	-	-	176	138	H

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

RESTRICTED BANDEDGE (HIGH CHANNEL, VERTICAL)

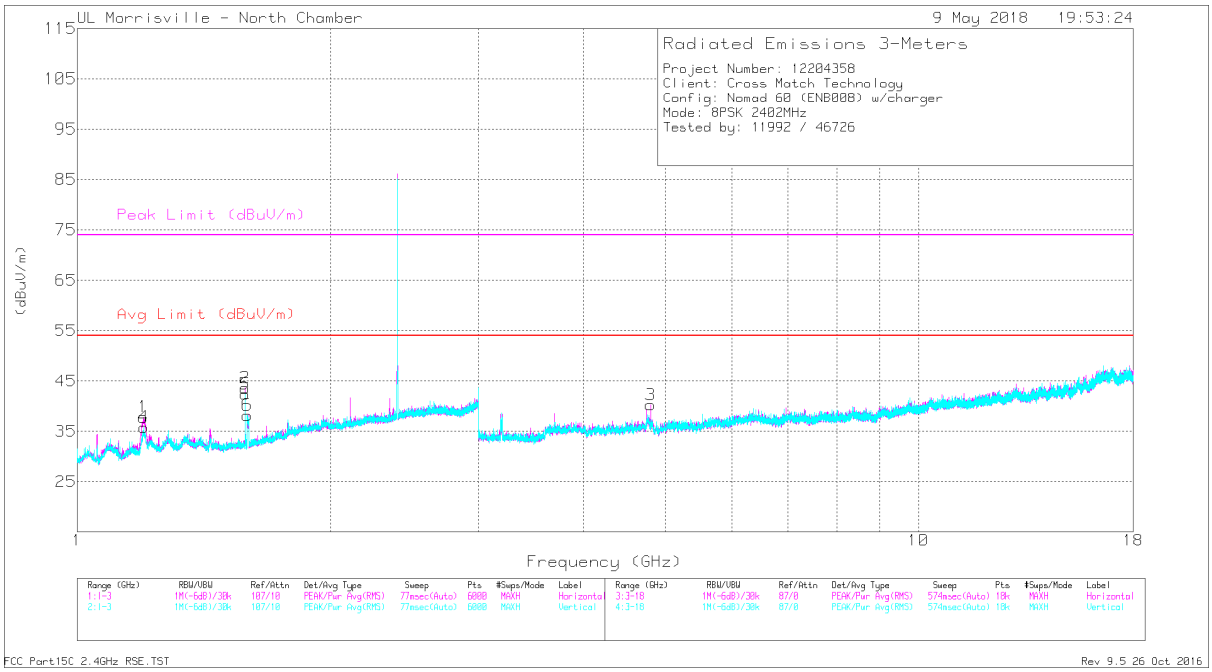


Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AT0072 AF (dB/m)	Amp/Cbl/Fltr/Pad (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.484	41	Pk	32.4	-24.5	48.9	-	-	74	-25.1	108	138	V
3	* 2.484	31.18	V1TR	32.4	-24.5	39.08	54	-14.92	-	-	108	138	V
2	* 2.493	43.95	Pk	32.3	-24.5	51.75	-	-	74	-22.25	108	138	V
4	2.555	31.44	V1TR	32.4	-24.5	39.34	54	-14.66	-	-	108	138	V

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

HARMONICS AND SPURIOUS EMISSIONS

Low Channel



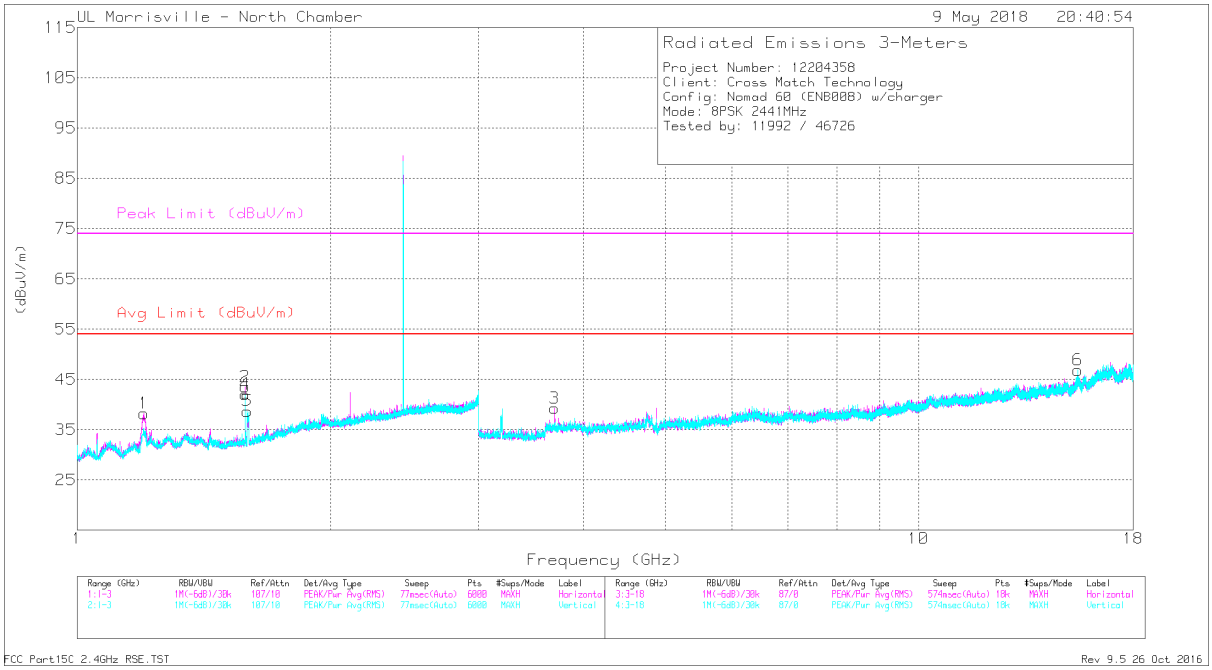
Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AT0072 AF (dB/m)	Amp/Cbl/Fltr/Pad (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 1.2	43.76	PK-U	28.7	-26.2	46.26	-	-	74	-27.74	58	140	H
	* 1.2	32.09	V1TR	28.7	-26.2	34.59	54	-19.41	-	-	58	140	H
2	* 1.584	42.96	PK-U	27.8	-24.7	46.06	-	-	74	-27.94	91	295	H
	* 1.584	36.58	V1TR	27.8	-24.7	39.68	54	-14.32	-	-	91	295	H
3	* 4.804	46.15	PK-U	34.1	-31.8	48.45	-	-	74	-25.55	2	110	H
	* 4.804	36.76	V1TR	34.1	-31.8	39.06	54	-14.94	-	-	2	110	H
4	* 1.202	40.24	PK-U	28.6	-26.2	42.64	-	-	74	-31.36	12	112	V
	* 1.2	28.22	V1TR	28.7	-26.2	30.72	54	-23.28	-	-	12	112	V
5	* 1.584	43.21	PK-U	27.8	-24.7	46.31	-	-	74	-27.69	49	152	V
	* 1.584	37.39	V1TR	27.8	-24.7	40.49	54	-13.51	-	-	49	152	V
6	* 1.595	42.24	PK-U	27.9	-24.6	45.54	-	-	74	-28.46	163	256	V
	* 1.593	30.57	V1TR	27.9	-24.7	33.77	54	-20.23	-	-	163	256	V

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

PK-U - U-NII: Maximum Peak

V1TR - U-NII: VB=1/Ton, RMS Average where: Ton is packet duration

Mid Channel



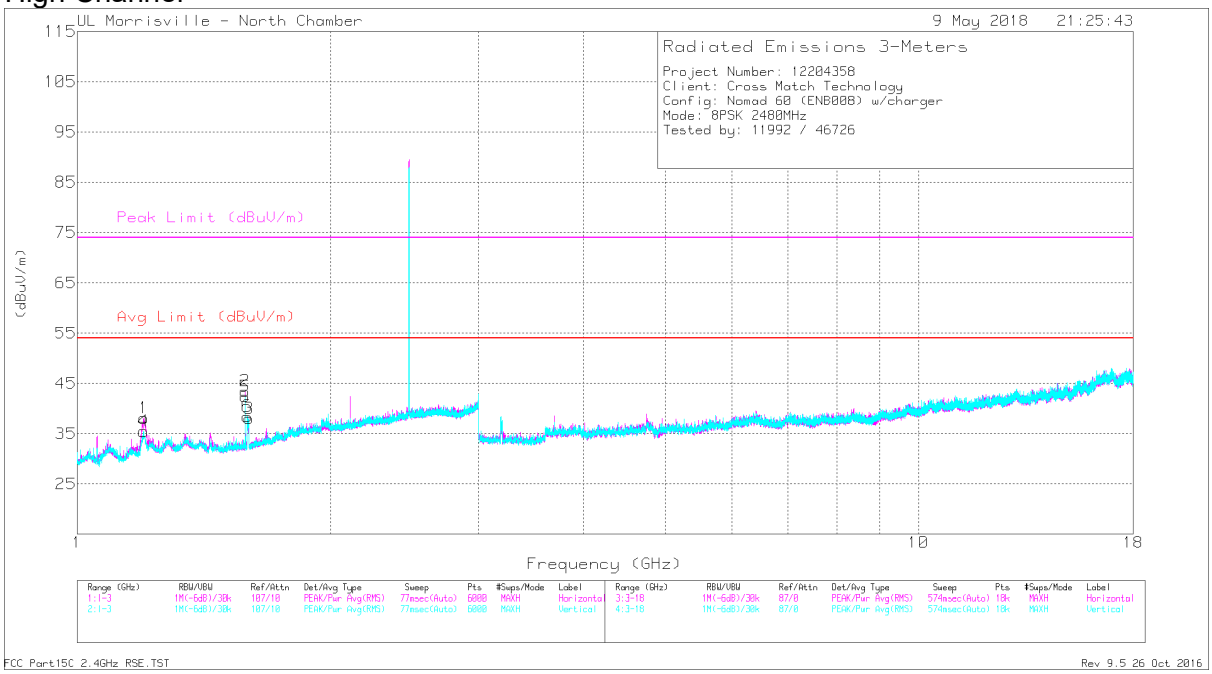
Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AT0072 AF (dB/m)	Amp/Cbl/Fltr/Pad (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 1.201	44.16	PK-U	28.6	-26.2	46.56	-	-	74	-27.44	66	137	H
	* 1.2	32.73	V1TR	28.7	-26.2	35.23	54	-18.77	-	-	66	137	H
2	* 1.584	45.02	PK-U	27.8	-24.7	48.12	-	-	74	-25.88	99	182	H
	* 1.584	39.47	V1TR	27.8	-24.7	42.57	54	-11.43	-	-	99	182	H
3	* 3.696	45.3	PK-U	33.2	-32.3	46.2	-	-	74	-27.8	81	236	H
	* 3.696	35.8	V1TR	33.2	-32.3	36.7	54	-17.3	-	-	81	236	H
4	* 1.584	43.07	PK-U	27.8	-24.7	46.17	-	-	74	-27.83	54	151	V
	* 1.584	37.11	V1TR	27.8	-24.7	40.21	54	-13.79	-	-	54	151	V
5	* 1.593	42.08	PK-U	27.9	-24.7	45.28	-	-	74	-28.72	167	205	V
	* 1.593	30.48	V1TR	27.9	-24.7	33.68	54	-20.32	-	-	167	205	V
6	* 15.474	35.43	PK-U	40.2	-24.2	51.43	-	-	74	-22.57	267	148	V
	* 15.472	24.28	V1TR	40.2	-24.2	40.28	54	-13.72	-	-	267	148	V

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

PK-U - U-NII: Maximum Peak

V1TR - U-NII: VB=1/Ton, RMS Average where: Ton is packet duration

High Channel



Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AT0072 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	* 1.2	44.94	PK-U	28.7	-26.2	47.44	-	-	74	-26.56	71	296	H
	* 1.2	31.87	V1TR	28.7	-26.2	34.37	54	-19.63	-	-	71	296	H
2	* 1.584	44.83	PK-U	27.8	-24.7	47.93	-	-	74	-26.07	101	180	H
	* 1.584	39.58	V1TR	27.8	-24.7	42.68	54	-11.32	-	-	101	180	H
3	* 1.599	40.97	PK-U	27.9	-24.6	44.27	-	-	74	-29.73	33	194	H
	* 1.598	28.8	V1TR	27.9	-24.6	32.1	54	-21.9	-	-	33	194	H
4	* 1.2	40.53	PK-U	28.7	-26.2	43.03	-	-	74	-30.97	10	103	V
	* 1.2	28.26	V1TR	28.7	-26.2	30.76	54	-23.24	-	-	10	103	V
5	* 1.584	43.11	PK-U	27.8	-24.7	46.21	-	-	74	-27.79	40	152	V
	* 1.584	37.36	V1TR	27.8	-24.7	40.46	54	-13.54	-	-	40	152	V
6	* 1.595	41.87	PK-U	27.9	-24.6	45.17	-	-	74	-28.83	153	239	V
	* 1.595	29.76	V1TR	27.9	-24.6	33.06	54	-20.94	-	-	153	239	V

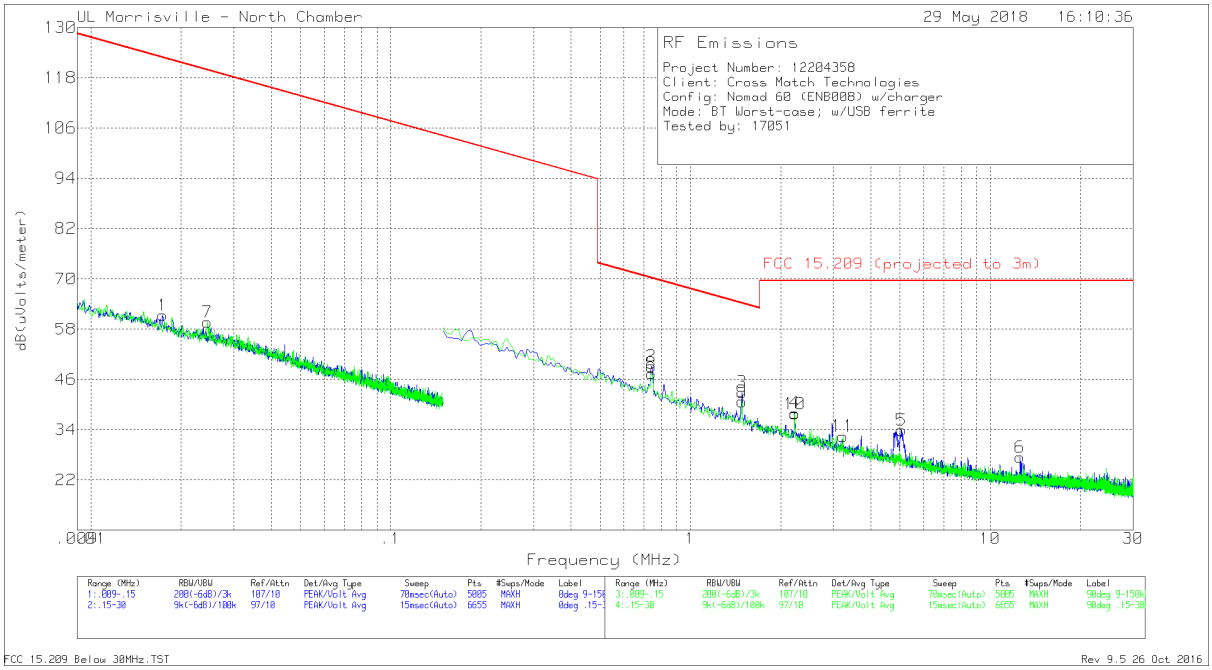
* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band
PK-U - U-NII: Maximum Peak
V1TR - U-NII: VB=1/Ton, RMS Average where: Ton is packet duration

9.3. RADIATED WORST-CASE

SPURIOUS EMISSIONS 9kHz to 30MHz (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).

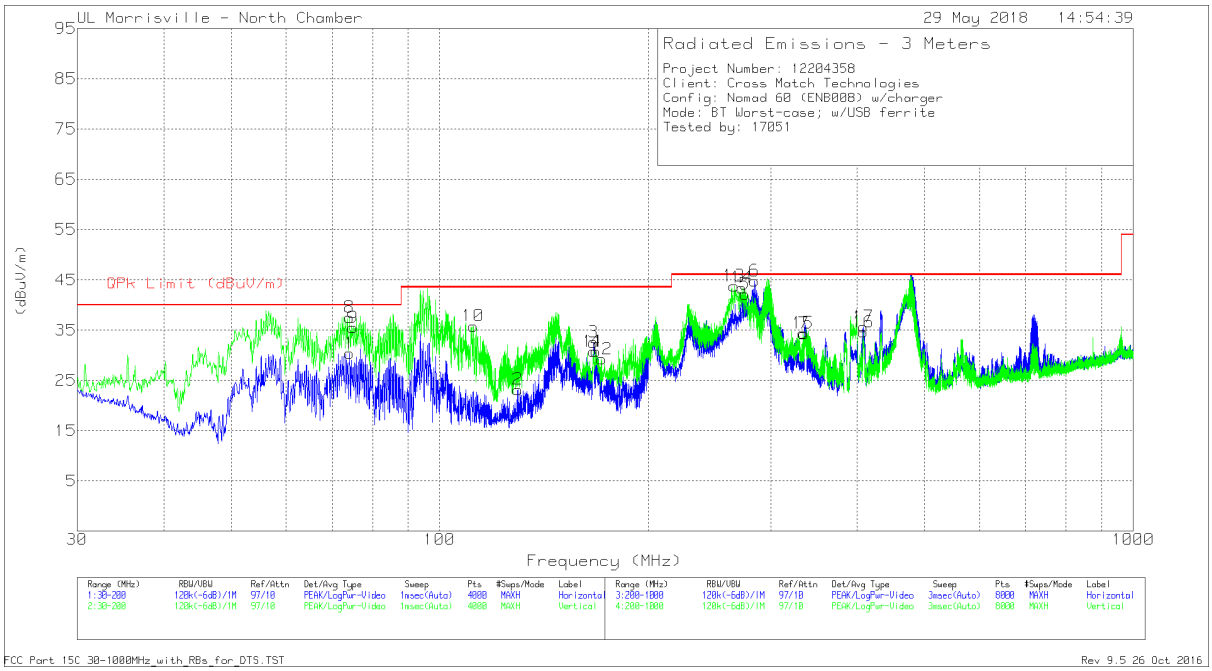
Although these tests were performed at a test site other than an open area test site, adequate comparison measurements were confirmed against an open area test site. Therefore sufficient tests were made to demonstrate that the alternative site produces results that correlate with the ones of tests made 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)
The following is for loop antenna @ 0 degrees.									
1	.01734	45.59	Pk	15.6	.1	61.29	122.82	-61.53	0-360
2	.74215	37.53	Pk	11.5	.1	49.13	70.19	-21.06	0-360
3	1.48683	31.22	Pk	11.5	.2	42.92	64.16	-21.24	0-360
4	2.22702	26.2	Pk	11.6	.2	38	69.54	-31.54	0-360
5	5.05768	21.96	Pk	11.5	.4	33.86	69.54	-35.68	0-360
6	12.58968	16.26	Pk	10.6	.6	27.46	69.54	-42.08	0-360
The following is for loop antenna @ 90 degrees.									
7	.02448	45.45	Pk	14.1	.1	59.65	119.83	-60.18	0-360
8	.74215	35.82	Pk	11.5	.1	47.42	70.19	-22.77	0-360
9	1.48683	29.03	Pk	11.5	.2	40.73	64.16	-23.43	0-360
10	2.22702	25.98	Pk	11.6	.2	37.78	69.54	-31.76	0-360
11	3.2274	20.43	Pk	11.7	.3	32.43	69.54	-37.11	0-360

Pk - Peak detector

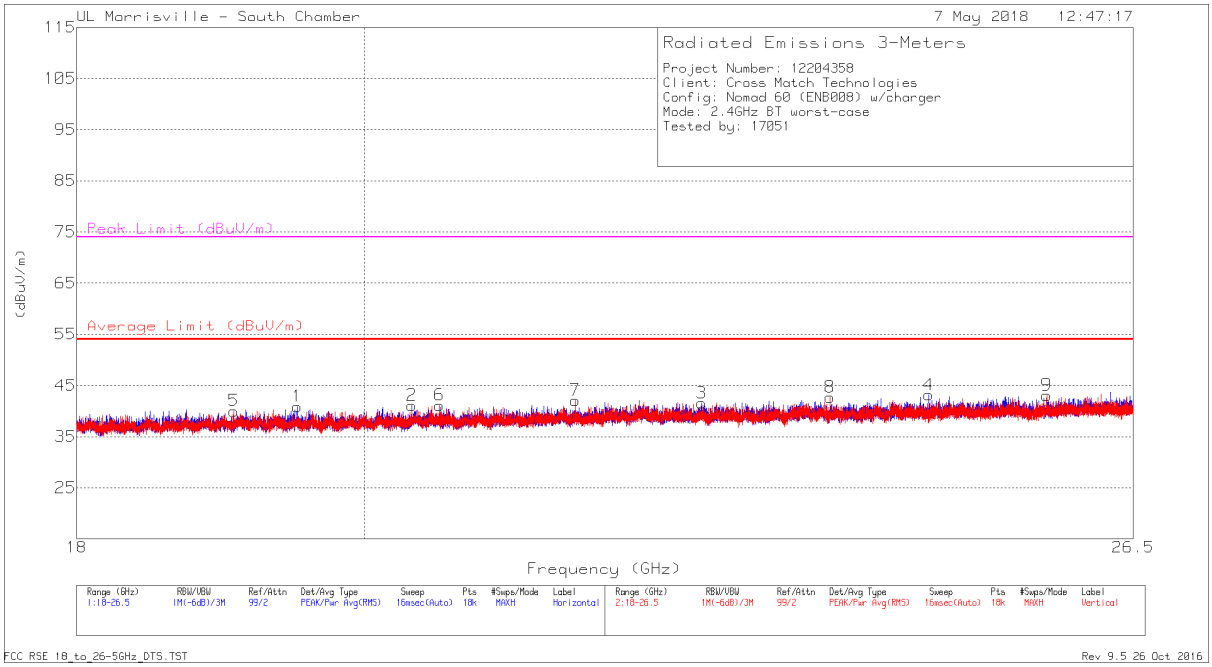
SPURIOUS EMISSIONS 30 TO 1000 MHz (WORST-CASE CONFIGURATION)



Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	AT0073 (dB/m)	Amp/Cbl (dB)	Corrected Reading (dBuV/m)	QPk Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 74.1264	48.39	Pk	13.2	-31.2	30.39	40	-9.61	0-360	100	H
2	* 129.6033	34.81	Pk	19	-30.6	23.21	43.52	-20.31	0-360	100	H
5	* 275.3794	50.43	Qp	18.8	-29.5	39.73	46.02	-6.29	220	102	H
6	* 284.7803	51.33	Qp	18.8	-29.5	40.63	46.02	-5.39	227	100	H
7	* 335.1176	44.13	Pk	19.5	-29.3	34.33	46.02	-11.69	0-360	102	H
3	* 166.7579	45.69	Pk	17.2	-30.3	32.59	43.52	-10.93	0-360	199	H
4	* 168.1182	43.95	Pk	17.1	-30.3	30.75	43.52	-12.77	0-360	199	H
17	* 408.3271	43.16	Pk	21.3	-28.8	35.66	46.02	-10.36	0-360	199	H
8	* 73.884	52.91	Qp	13.2	-31.2	34.91	40	-5.09	295	100	V
9	* 75.2	52.05	Qp	13.1	-31.2	33.95	40	-6.05	293	101	V
10	* 111.7487	48.53	Pk	18.1	-30.8	35.83	43.52	-7.69	0-360	102	V
11	* 166.7579	43.85	Pk	17.2	-30.3	30.75	43.52	-12.77	0-360	102	V
12	* 171.2641	42.88	Pk	16.8	-30.4	29.28	43.52	-14.24	0-360	102	V
13	* 265.962	52.36	Qp	18.4	-29.7	41.06	46.02	-4.96	195	100	V
14	* 272.6994	51.91	Qp	18.7	-29.6	41.01	46.02	-5.01	191	100	V
15	* 333.9174	44.21	Pk	19.5	-29.3	34.41	46.02	-11.61	0-360	102	V
16	* 408.3271	42.11	Pk	21.3	-28.8	34.61	46.02	-11.41	0-360	102	V

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

SPURIOUS EMISSIONS 18 to 26.5GHz (WORST-CASE CONFIGURATION)



Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AT0076 AF (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
5	* 19.064	47.24	Pk	32.6	-39.8	40.04	54	-13.96	74	-33.96	0-360	151	V
1	* 19.513	47.8	Pk	32.7	-39.6	40.9	54	-13.1	74	-33.1	0-360	149	H
2	* 20.351	47.32	Pk	33.1	-39.3	41.12	54	-12.88	74	-32.88	0-360	299	H
6	* 20.558	47.04	Pk	33.1	-39	41.14	54	-12.86	74	-32.86	0-360	101	V
3	* 22.629	46.59	Pk	33.7	-38.7	41.59	54	-12.41	74	-32.41	0-360	102	H
8	* 23.717	47.02	Pk	34	-38.3	42.72	54	-11.28	74	-31.28	0-360	151	V
7	21.605	47.72	Pk	33.4	-39	42.12	-	-	74	-31.88	0-360	101	V
4	24.591	46.54	Pk	34.3	-37.7	43.14	-	-	74	-30.86	0-360	102	H
9	25.674	45.8	Pk	34.3	-37	43.1	-	-	74	-30.9	0-360	201	V

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

10. AC POWER LINE CONDUCTED EMISSIONS

LIMITS

FCC §15.207 (a)

RSS-Gen 8.8

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

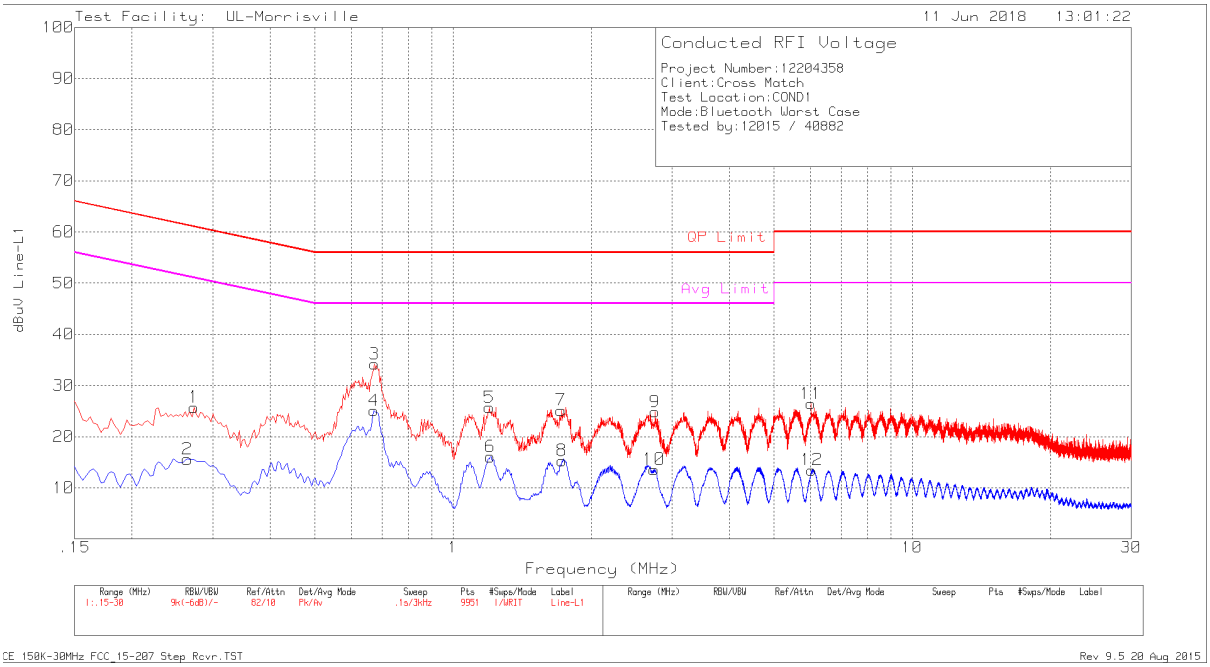
The EUT is placed on a non-conducting table 40 cm from the vertical ground plane and 80 cm above the horizontal ground plane. The EUT is configured in accordance with ANSI C63.10.

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 lines.

RESULTS

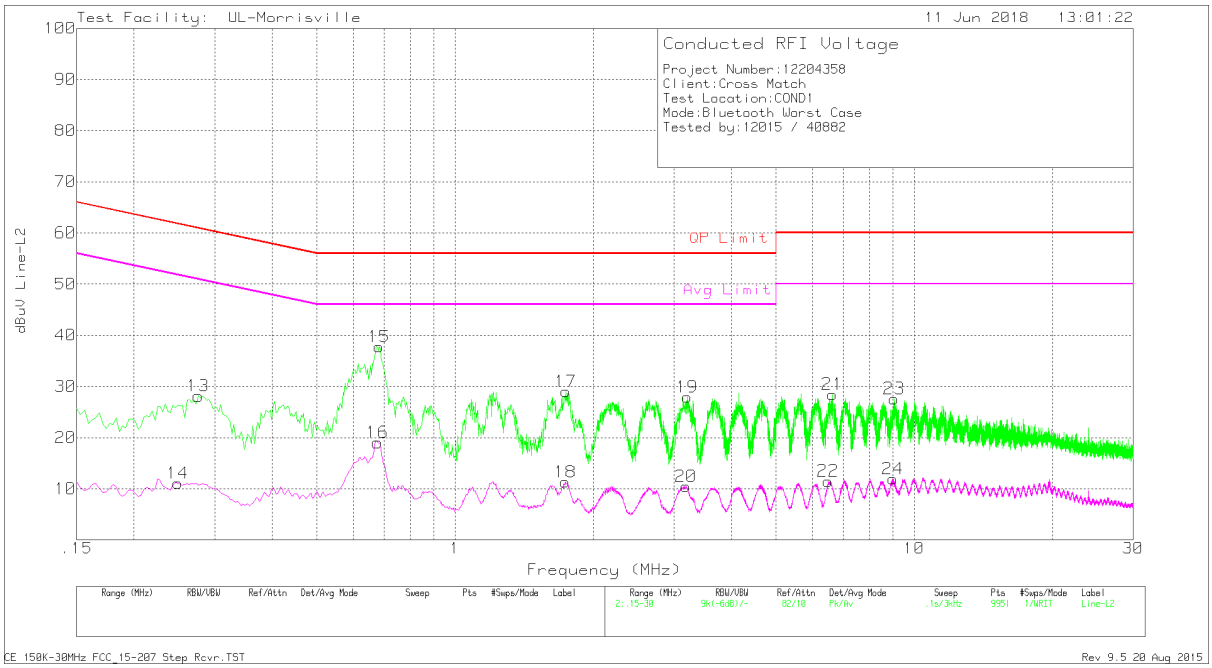
LINE 1 RESULTS



Range 1: Line-L1 .15 - 30MHz										
Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	LISN VCF (dB)	Cbl/Limiter (dB)	Corrected Reading dBuV	QP Limit	Margin (dB)	Avg Limit	Margin (dB)
1	.273	15.75	Pk	.1	9.9	25.75	61.03	-35.28	-	-
2	.264	5.58	Av	.1	9.9	15.58	-	-	51.3	-35.72
3	.675	24.32	Pk	0	9.9	34.22	56	-21.78	-	-
4	.672	15.18	Av	0	9.9	25.08	-	-	46	-20.92
5	1.2	15.67	Pk	0	10	25.67	56	-30.33	-	-
6	1.206	6.07	Av	0	10	16.07	-	-	46	-29.93
7	1.719	15.16	Pk	0	10	25.16	56	-30.84	-	-
8	1.728	5.31	Av	0	10	15.31	-	-	46	-30.69
9	2.754	14.87	Pk	0	10	24.87	56	-31.13	-	-
10	2.742	3.59	Av	0	10	13.59	-	-	46	-32.41
11	6.021	16.35	Pk	.1	10	26.45	60	-33.55	-	-
12	6.048	3.38	Av	.1	10	13.48	-	-	50	-36.52

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	QP Limit	Margin (dB)	Avg Limit	Margin (dB)
13	.276	18.12	Pk	.1	9.9	28.12	60.94	-32.82	-	-
14	.249	1.11	Av	.1	9.9	11.11	-	-	51.79	-40.68
15	.684	27.87	Pk	0	9.9	37.77	56	-18.23	-	-
16	.678	9.13	Av	0	9.9	19.03	-	-	46	-26.97
17	1.743	19.05	Pk	0	10	29.05	56	-26.95	-	-
18	1.74	1.3	Av	0	10	11.3	-	-	46	-34.7
19	3.204	17.91	Pk	0	10	27.91	56	-28.09	-	-
20	3.183	.44	Av	0	10	10.44	-	-	46	-35.56
21	6.645	18.36	Pk	.1	10	28.46	60	-31.54	-	-
22	6.501	1.41	Av	.1	10	11.51	-	-	50	-38.49
23	9.042	17.49	Pk	.1	10	27.59	60	-32.41	-	-
24	8.991	1.83	Av	.1	10	11.93	-	-	50	-38.07

Pk - Peak detector
Av - Average detection