



FCC 47 CFR PART 15 SUBPART C

CERTIFICATION TEST REPORT

FOR

**HOME AUTOMATION GATEWAY PRODUCT: 802.11a/b/g/n 2x2 MIMO,
BLUETOOTH, BLUETOOTH LOW ENERGY, ZigBee and Z-WAVE**

MODEL NUMBER: ID:087

FCC ID: DKNCS08

REPORT NUMBER: R10526502-RF3A

ISSUE DATE: 2015-05-27

Prepared for
**ECHOSTAR TECHNOLOGIES LLC
90 INVERNESS CIRCLE EAST
ENGLEWOOD
CO, 80112, USA**

Prepared by
**UL LLC
12 LABORATORY DR.
RESEARCH TRIANGLE PARK, NC 27709 USA
TEL: (919) 549-1400**



NVLAP LAB CODE 200246-0

Revision History

Rev.	Issue Date	Revisions	Revised By
--	2015-05-27	Initial Issue	Jeff Moser

TABLE OF CONTENTS

1. ATTESTATION OF TEST RESULTS	5
2. TEST METHODOLOGY	6
3. FACILITIES AND ACCREDITATION	6
4. CALIBRATION AND UNCERTAINTY	6
4.1. MEASURING INSTRUMENT CALIBRATION	6
4.2. SAMPLE CALCULATION	6
4.3. MEASUREMENT UNCERTAINTY	7
5. EQUIPMENT UNDER TEST	8
5.1. DESCRIPTION OF EUT	8
5.2. MAXIMUM OUTPUT POWER.....	8
5.3. DESCRIPTION OF AVAILABLE ANTENNAS	9
5.4. SOFTWARE AND FIRMWARE.....	10
5.5. WORST-CASE CONFIGURATION AND MODE	10
5.6. DESCRIPTION OF TEST SETUP.....	11
6. TEST AND MEASUREMENT EQUIPMENT	13
7. ON TIME AND DUTY CYCLE.....	15
7.1. ON TIME AND DUTY CYCLE RESULTS.....	15
7.2. DUTY CYCLE PLOTS	16
8. ANTENNA PORT TEST RESULTS.....	18
8.1. BASIC DATA RATE GFSK MODULATION.....	18
8.1.1. 20 dB AND 99% BANDWIDTH	18
8.1.2. HOPPING FREQUENCY SEPARATION	23
8.1.3. NUMBER OF HOPPING CHANNELS.....	25
8.1.4. AVERAGE TIME OF OCCUPANCY	30
8.1.5. OUTPUT POWER	37
8.1.6. AVERAGE POWER	41
8.1.7. CONDUCTED SPURIOUS EMISSIONS.....	42
8.2. ENHANCED DATA RATE DQPSK MODULATION.....	51
8.2.1. 20 dB BANDWIDTH.....	51
8.2.2. AVERAGE TIME OF OCCUPANCY	54
8.2.3. OUTPUT POWER	61
8.2.4. AVERAGE POWER	65
8.3. ENHANCED DATA RATE 8DPSK MODULATION.....	66
8.3.1. 20 dB AND 99% BANDWIDTH	66
8.3.2. HOPPING FREQUENCY SEPARATION	71
8.3.3. NUMBER OF HOPPING CHANNELS.....	73
8.3.4. AVERAGE TIME OF OCCUPANCY	78

8.3.5.	OUTPUT POWER	85
8.3.6.	AVERAGE POWER	89
8.3.7.	CONDUCTED SPURIOUS EMISSIONS	90
9.	RADIATED TEST RESULTS.....	98
9.1.	LIMITS AND PROCEDURE	98
9.2.	TRANSMITTER ABOVE 1 GHz	99
9.2.1.	BASIC DATA RATE GFSK MODULATION	99
9.2.2.	ENHANCED DATA RATE 8DPSK MODULATION	106
9.3.	WORST-CASE BELOW 1 GHz.....	113
9.4.	WORST-CASE 18-26GHz	114
10.	AC POWER LINE CONDUCTED EMISSIONS	115
11.	SETUP PHOTOS	118

1. ATTESTATION OF TEST RESULTS

COMPANY NAME: ECHOSTAR TECHNOLOGIES LLC
90 INVERNESS CIRCLE EAST
ENGLEWOOD CO, 80112, USA

EUT DESCRIPTION: HOME AUTOMATION GATEWAY PRODUCT

MODEL: ID: 087

SERIAL NUMBER: FCC1, FCC9 (RE06039Z00418L)

DATE TESTED: February 18, 2015 – April 30, 2015

APPLICABLE STANDARDS	
STANDARD	TEST RESULTS
CFR 47 Part 15 Subpart C	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, any agency of the Federal Government, or any agency of any government.

Approved & Released
For UL LLC By:



Mike Ferrer
EMC Program Manager
UL – Consumer Technology Division

Prepared By:



Jeff Moser
EMC Program Manager
UL – Consumer Technology Division

2. TEST METHODOLOGY

The tests documented in this report were performed in accordance with ANSI C63.10-2009, FCC CFR 47 Part 2, FCC CFR 47 Part 15 and DA 00-705 Rel. March 30, 2000.

Note – Radiated testing above 1GHz was performed on a 1.5m table height, per ANSI C63.10: 2013. All other testing was performed per ANSI C63.10: 2009.

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.

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

UL LLC (RTP) is accredited by NVLAP, Laboratory Code 200246-0. The full scope of accreditation can be viewed at <http://ts.nist.gov/standards/scopes/2002460.htm>.

4. CALIBRATION AND UNCERTAINTY

4.1. MEASURING INSTRUMENT CALIBRATION

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

4.2. SAMPLE CALCULATION

Where relevant, the following sample calculation is provided:

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

4.3. MEASUREMENT UNCERTAINTY

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

Test	Uncertainty
Conducted Emissions (0.150-30MHz)	+/- 2.37 dB
Total RF power, conducted	+/- 0.45 dB
RF power density, conducted	+/- 1.5 dB
Spurious emissions, conducted	+/- 1.46 dB
Radiated Emissions (30-1000 MHz)	+/- 6.04 dB (3m)
Radiated Emissions (1-6 GHz)	+/- 5.96 dB
Radiated Emissions (6-18 GHz)	+/- 6.10 dB
Radiated Emissions (18-26 GHz)	+/- 6.81 dB

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

5. EQUIPMENT UNDER TEST

5.1. DESCRIPTION OF EUT

The EUT, EchoStar's ID:087 Home Automation Gateway Product, is a controller with a portfolio of connected devices offered as part of connected home services which allows the user to manage their home automation connected devices on the TV and their connected mobile hand held devices.

The EUT contains an 802.11a/b/g/n (n - 20MHz/40MHz) 2x2 MIMO transceiver, along with Bluetooth, Bluetooth Low Energy, ZigBee and Z-Wave (908 MHz and 916 MHz) transceivers.

The Bluetooth 2.4GHz radio in the ID:087 is derived from the MediaTek MT7632U chipset.

The EUT does not support Adaptive Frequency Hopping (AFH) mode.

This report covers the Bluetooth radio. Other reports were issued to cover the other radio technologies:

- R10526502-RF1: 802.11 b/g/n 2.4 GHz
- R10526502-RF2: 802.11 a/n 5 GHz
- R10526502-RF4: Bluetooth Low Energy
- R10526502-RF5: ZigBee
- R10526502-RF6: Z-Wave

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	8.15	6.53
2402 - 2480	DQPSK	7.46	5.57
2402 - 2480	Enhanced 8DPSK	7.50	5.62

5.3. DESCRIPTION OF AVAILABLE ANTENNAS

The Bluetooth antenna is a trace antenna on the PCB. The trace antenna has a gain of 3dBi.

The 802.11a/b/g/n 2.4/5GHz radio uses two Airgain, model N2420DS series antennas.

WLAN Antenna 0 has a gain of 3.1dBi in the 2.4GHz band and 2.5dBi in the 5GHz band.

WLAN Antenna 1 has a gain of 3.1dBi in the 2.4GHz band and 2.5dBi in the 5GHz band.

Antenna 0 is J21 u.fl on the PCB and has a short cable, Antenna 1 is J20 u.fl on the PCB and has a longer cable.

The Zigbee antenna is a trace antenna on the PCB. The trace antenna has a gain of 3dBi.

The Z-wave antenna is a trace antenna on the PCB. The trace antenna has a gain of 1.6dBi.

5.4. SOFTWARE AND FIRMWARE

The firmware in all units was: Linux kernel version 3.1.10

The driver for Bluetooth: HCI Control 1.0

The driver SW for Zigbee: Nodetest version 1.0

The driver for Z-wave: ZWave test ZM5304

The driver for Wi-Fi: Linux MT7662 0.0.00

The test utility SW: Python Test Scripts rev. 1.0

5.5. WORST-CASE CONFIGURATION AND MODE

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

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

The device is a table-top device and was positioned as such during radiated and line-conducted testing.

5.6. DESCRIPTION OF TEST SETUP

SUPPORT EQUIPMENT

Support Equipment List				
Description	Manufacturer	Model	Serial Number	FCC ID
EUT AC adapter	LITEON	PB-1180-2ES1	ETC1444046079	-
Laptop PC	HP	EliteBook 8470p	CNU342CL9Z	-
Laptop PC AC adapter	HP	677774-001	WCNXA0C3U5IA7F	

I/O CABLES

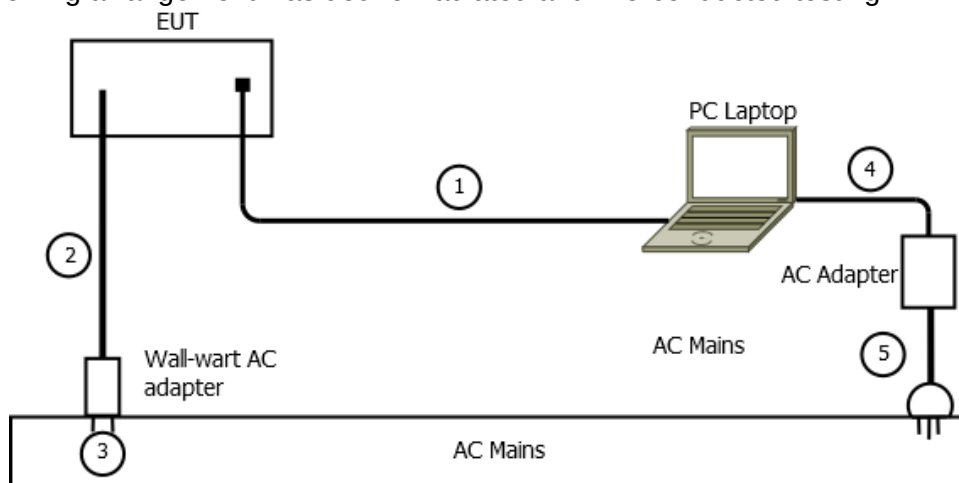
I/O Cable List						
Cable No	Port	# of identical ports	Connector Type	Cable Type	Cable Length (m)	Remarks
1	Ethernet	1	RJ45	CAT5UTP	15	Connection between laptop PC and EUT used to control the transmitter function of the EUT.
2	DC (12V)	1	2C DC	Unshielded	1.8	Wall-wart AC adapter DC output to EUT. Non-detachable.
3	AC	1	2C AC	N/A	0	Wall-wart AC adapter's AC input.
4	DC	1	2C DC	Unshielded	1.8	Laptop AC adapter output to laptop PC. Non-detachable
5	AC	1	3C AC	Unshielded	1.8	Laptop PC power adapter AC input. Detachable.

TEST SETUP

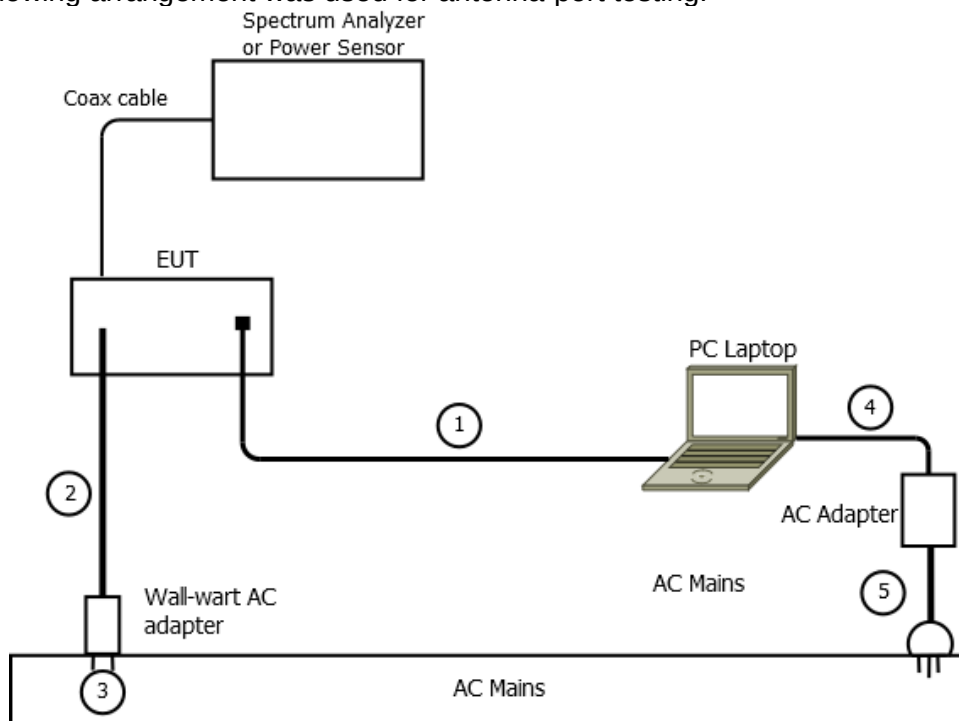
The EUT was configured as a table-top device connected to a located laptop PC over an Ethernet cable. This Ethernet connection was used to control the transmitter function of the EUT.

SETUP DIAGRAM FOR TESTS

The following arrangement was used for radiated and line-conducted testing.



The following arrangement was used for antenna-port testing.



6. TEST AND MEASUREMENT EQUIPMENT

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

Radiated Disturbance Emissions (E-field) – Chamber C

Equip. ID	Description	Manufacturer	Model Number	Last Cal.	Next Cal.
AT0066	Hybrid Broadband Antenna	Sunol Sciences Corp.	JB1	2014-07-10	2015-07-31
AT0062 (Testing after 02/28/2015)	Double-Ridged Waveguide Horn Antenna, 1 to 18 GHz	ETS Lindgren	3117	2014-07-22	2015-07-31
AT0067 (Testing before 03/01/2015)	Double-Ridged Waveguide Horn Antenna, 1 to 18 GHz	ETS Lindgren	3117	2014-02-19	2015-02-28
AT0063	Horn Antenna, 18-26.5GHz	ARA	MWH-1826/B	2014-07-23	2015-07-31
SAC_G (Hybrid)	Gain-Loss string for Hybrid antenna at 3m	Various	Various	2015-02-01	2016-02-29
SAC_G (3117)	Gain-Loss string for 3117 antenna at 3m	Various	Various	2015-02-01	2016-02-29
SAC_G (MWH-1826/B)	Gain-Loss string for MWH-1826/B antenna at 3m	Various	Various	2015-01-26	2016-01-31
SA0018	Spectrum Analyzer	Agilent	N9030A	2014-06-26	2015-06-30
SOFTEMI	EMI Software	UL	Version 9.5	NA	NA
HPF009	1GHz High-pass Filter	Micro-Tronics	HPM17672	2015-01-28	2016-01-31
HI0069	Temp/Humid/Pressure Meter	Cole-Parmer	99760-00	2014-06-27	2015-06-27

Wireless Conducted Measurement Equipment

Equipment ID	Description	Manufacturer	Model Number	Last Cal.	Next Cal.
	Common Equipment				
SA0020	Spectrum Analyzer, 3Hz-44GHz	Agilent Technologies	E4446	2015-02-26	2016-02-29
PAR0037	Power Meter, 100kHz to 110 GHz	HP	437B	2015-01-19	2016-01-31
MM0143	Digital Multimeter	Fluke	175	2014-09-04	2016-09-30
HI0069	Temp/Humid/Pressure Meter	Cole-Parmer	99760-00	2014-06-27	2015-06-27

Power-line Conducted Disturbance Emissions - Voltage

Equipment ID	Description	Manufacturer	Model Number	Last Cal.	Next Cal.
SA0021	EMI Test Receiver 9kHz-3.6GHz	Rohde & Schwarz	ESR3	2014-05-26	2015-05-31
ATA509	Coaxial cable, 20 ft., BNC - male to BNC-male	UL	RG-223	2014-09-15	2015-07-31
HI0041	Temp/Humid/Pressure Meter	Cole-Parmer	99760-00	2015-03-23	2016-03-31
SOFTEMI	EMI Software	UL	Version 9.5	NA	NA
ATA508	Transient Limiter, 0.009 to 100 MHz	Electro-Metrics	EM 7600	2014-09-03	2015-09-30
LISN002 (EUT)	LISN, 50-ohm/50-uH, 2-conductor, 25A	Fischer Custom Com.	FCC-LISN-50-25-2-01-550V	2014-09-04	2015-09-30
LISN003 (AUX)	LISN, 50-ohm/50-uH, 2-conductor, 25A	Fischer Custom Com.	FCC-LISN-50-25-2-01-550V	2014-09-04	2015-09-30

7. ON TIME AND DUTY CYCLE

LIMITS

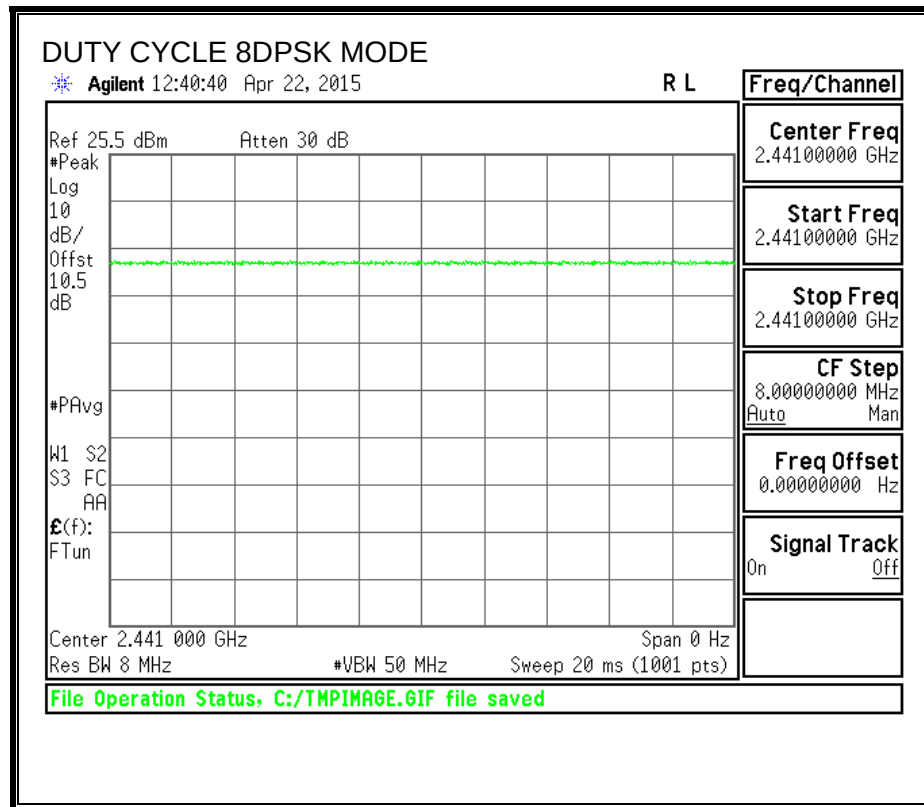
None; for reporting purposes only.

PROCEDURE

KDB 558074 Zero-Span Spectrum Analyzer Method.

7.1. 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)
2.4 GHz band (Hopping OFF)						
Bluetooth GFSK	100.000	100.000	1.000	100.00%	0.00	0.010
Bluetooth 8PSK	100.000	100.000	1.000	100.00%	0.00	0.010



8. ANTENNA PORT TEST RESULTS

8.1. BASIC DATA RATE GFSK MODULATION

8.1.1. 20 dB AND 99% BANDWIDTH

LIMIT

None; for reporting purposes only.

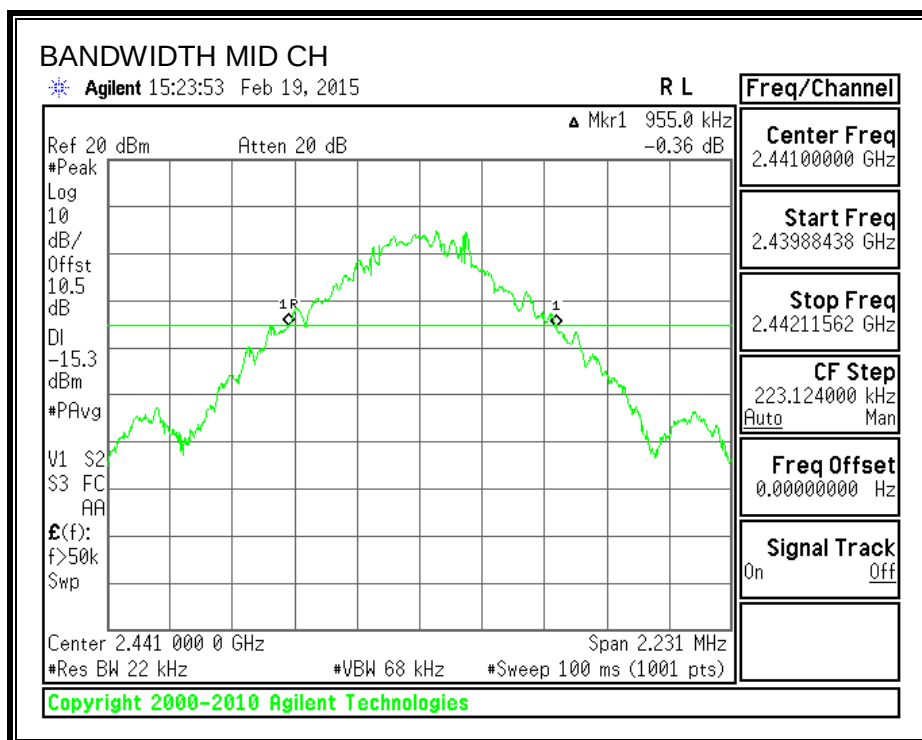
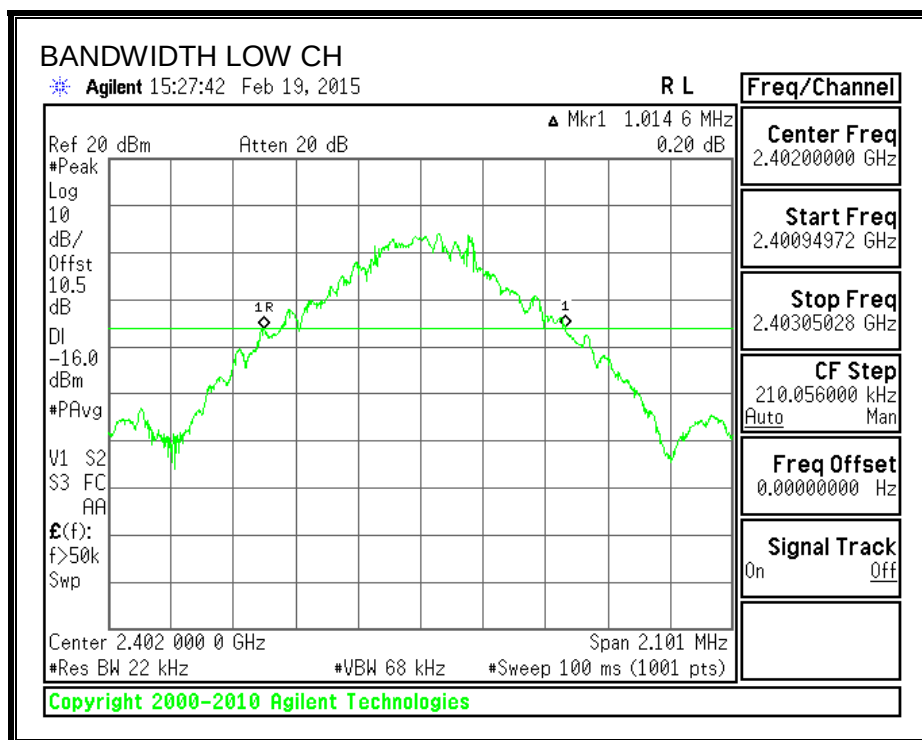
TEST PROCEDURE

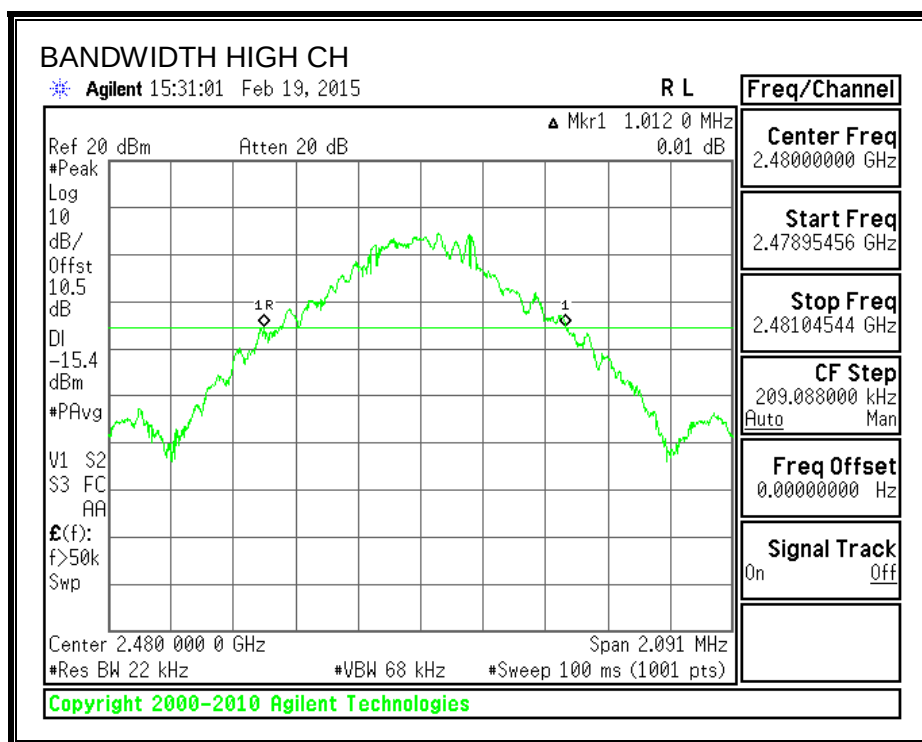
The transmitter output is connected to a spectrum analyzer. The RBW is set to $\geq 1\%$ of the 20 dB bandwidth. The VBW is set to $\geq$ RBW. The sweep time is coupled.

RESULTS - GFSK

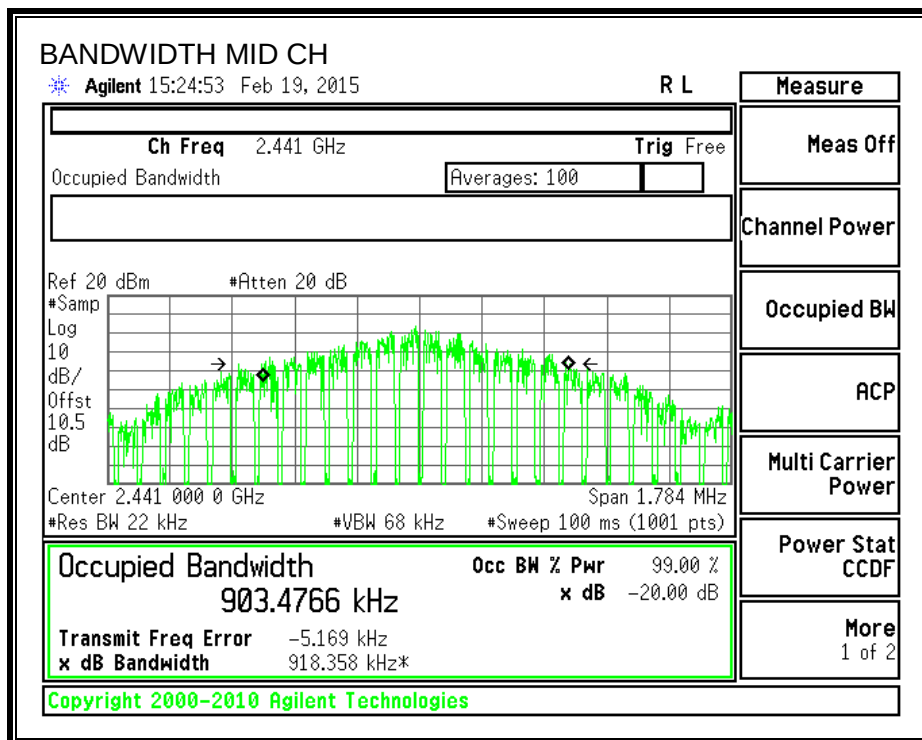
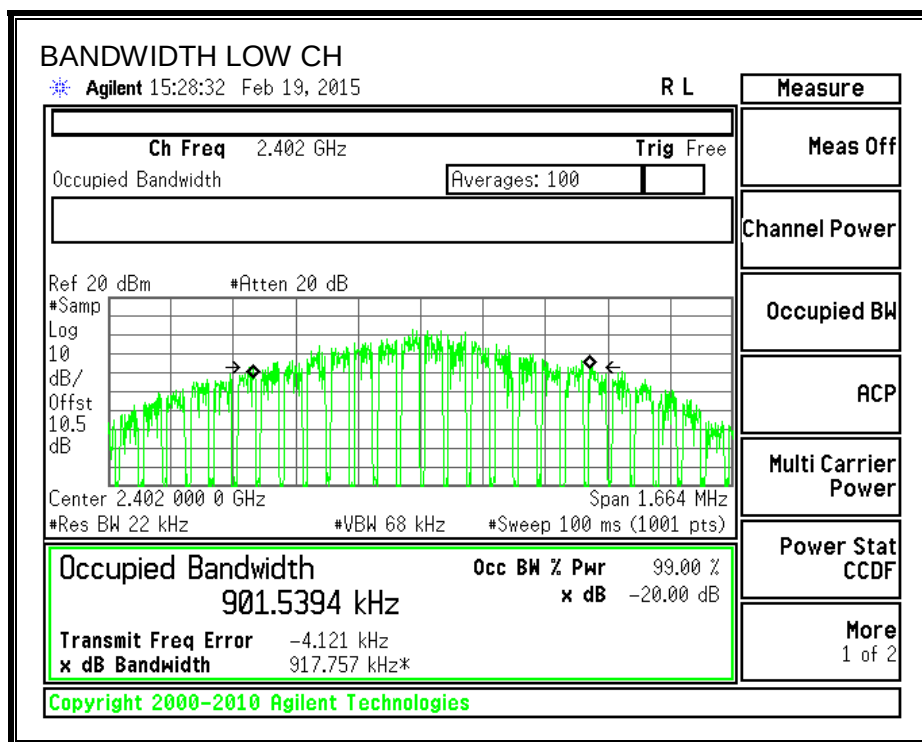
Channel	Frequency (MHz)	20 dB Bandwidth (kHz)	99% Bandwidth (kHz)
Low	2402	1014.6	901.5394
Middle	2441	955.0	903.4766
High	2480	1012.0	896.9605

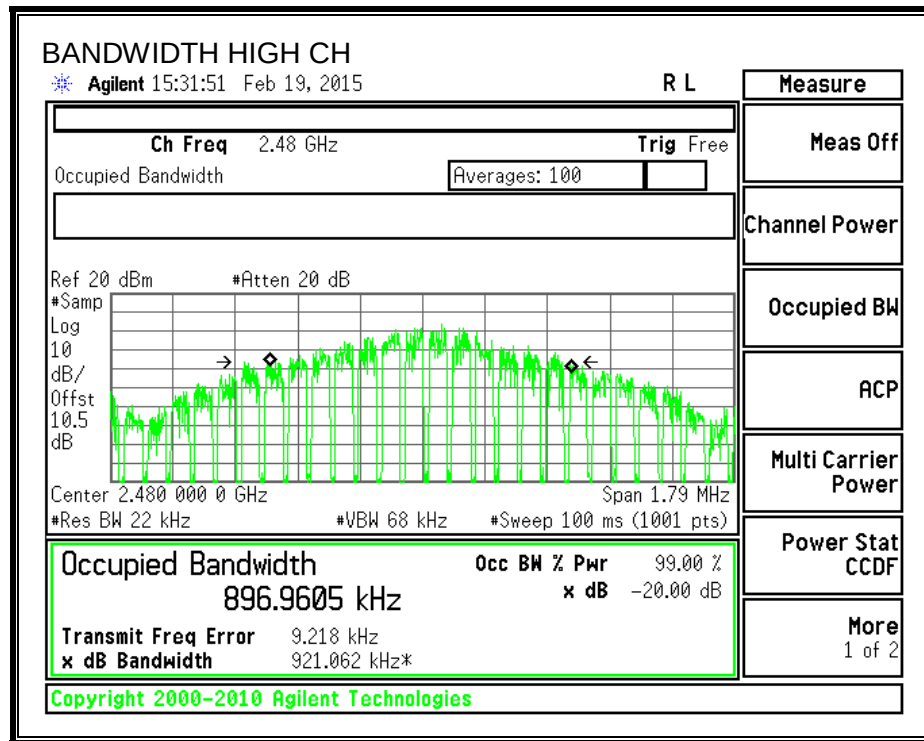
20 dB BANDWIDTH





99% BANDWIDTH





8.1.2. HOPPING FREQUENCY SEPARATION

LIMIT

FCC §15.247 (a) (1)

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.

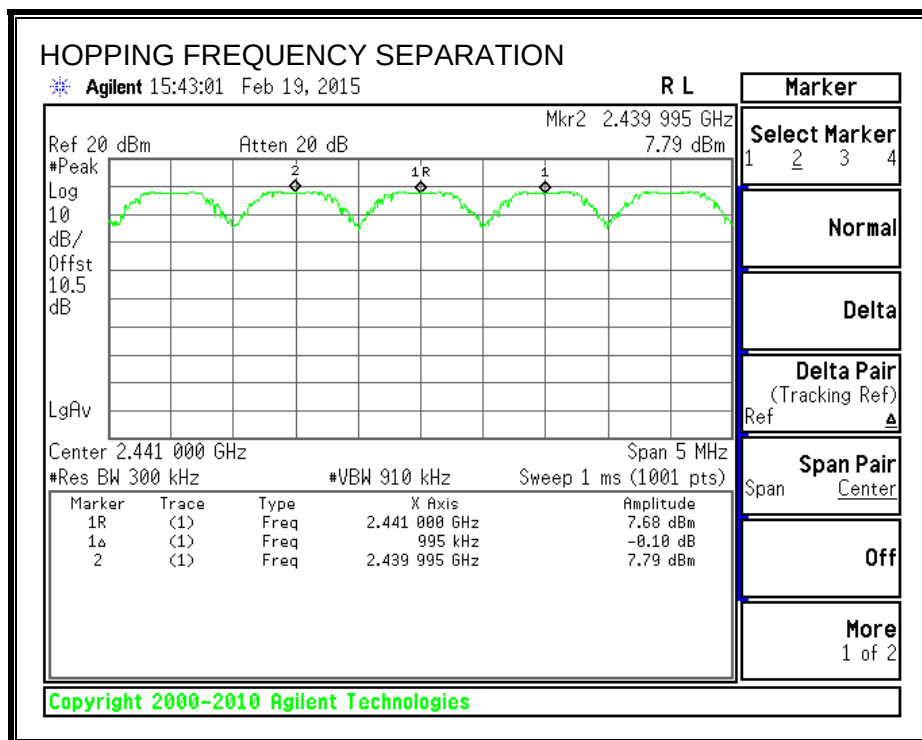
TEST PROCEDURE

The transmitter output is connected to a spectrum analyzer. The RBW is set to $\geq$ span and the VBW is set to $\geq$ RBW. The sweep time is coupled.

RESULTS - GFSK

GFSK mode has a hopping channel carrier frequencies separated by 995 kHz which is greater than the 20 dB BW.

HOPPING FREQUENCY SEPARATION



Note – The 20 dB BW for 2441 MHz is 955 kHz.

8.1.3. NUMBER OF HOPPING CHANNELS

LIMIT

FCC §15.247 (a) (1) (iii)

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

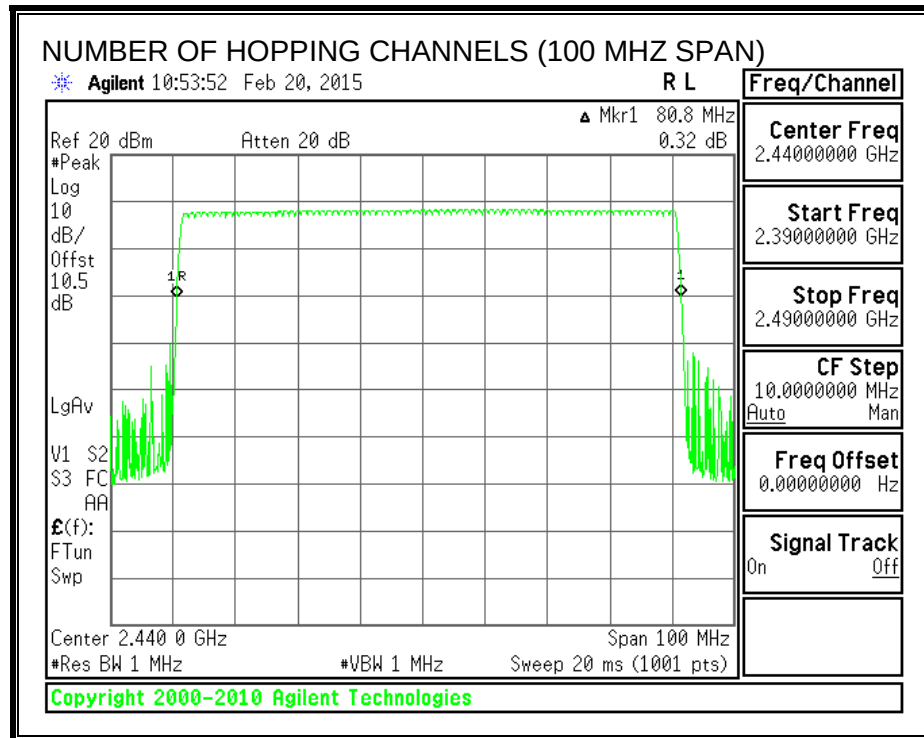
TEST PROCEDURE

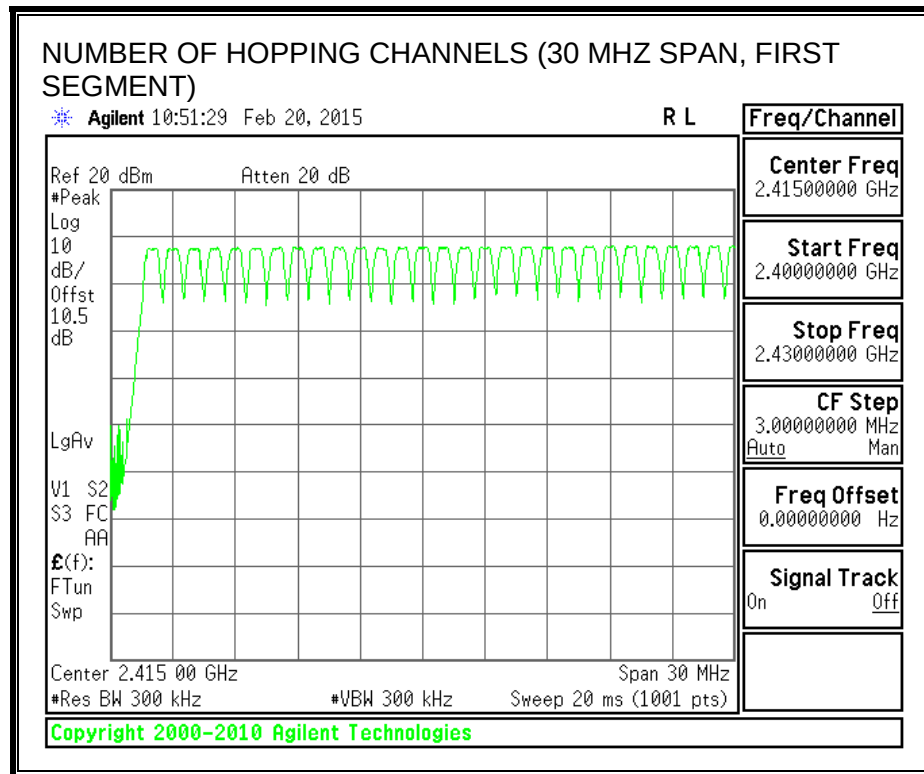
The transmitter output is connected to a spectrum analyzer. The span is set to cover the entire authorized band, in either a single sweep or in multiple contiguous sweeps. The RBW is set to a maximum of 1 % of the span. The analyzer is set to Max Hold.

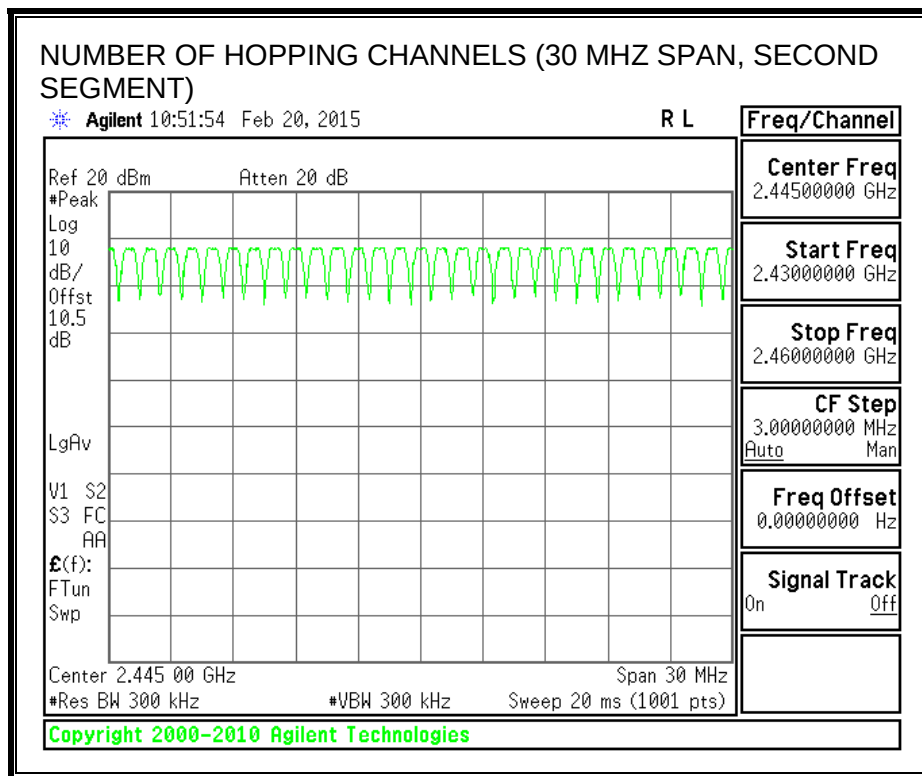
RESULTS - GFSK

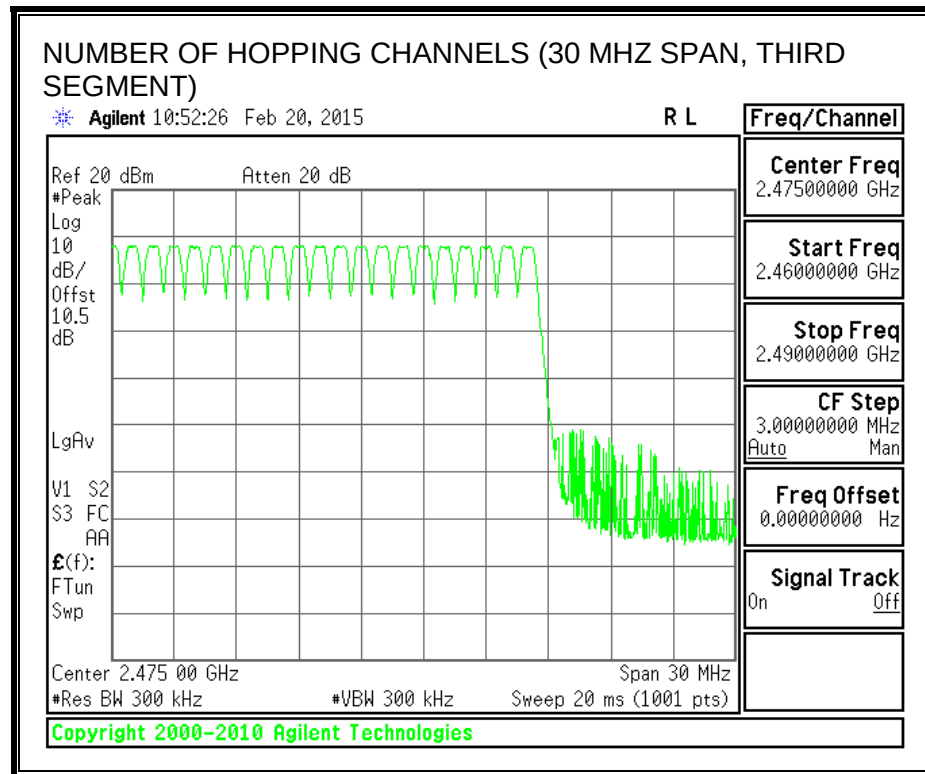
Normal Mode: 79 Channels observed.

NUMBER OF HOPPING CHANNELS









8.1.4. AVERAGE TIME OF OCCUPANCY

LIMIT

FCC §15.247 (a) (1) (iii)

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

TEST PROCEDURE

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

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

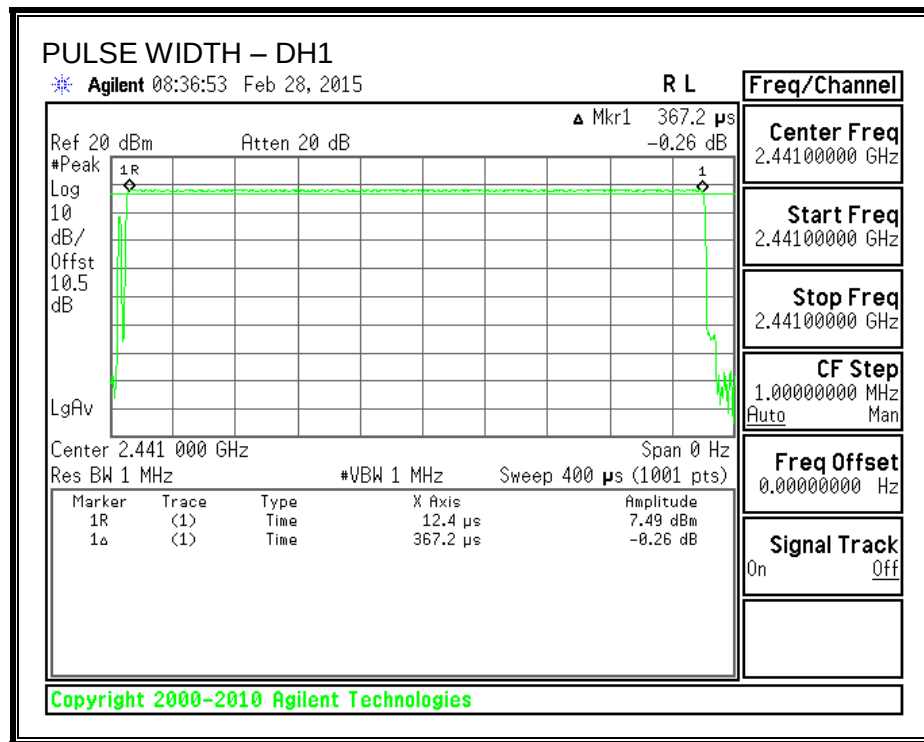
For AFH mode, the average time of occupancy in the specified 8 second period (20 channels * 0.4 seconds) is equal to $10 * (\# \text{ of pulses in } 0.8 \text{ s}) * \text{pulse width}$.

RESULTS – GFSK

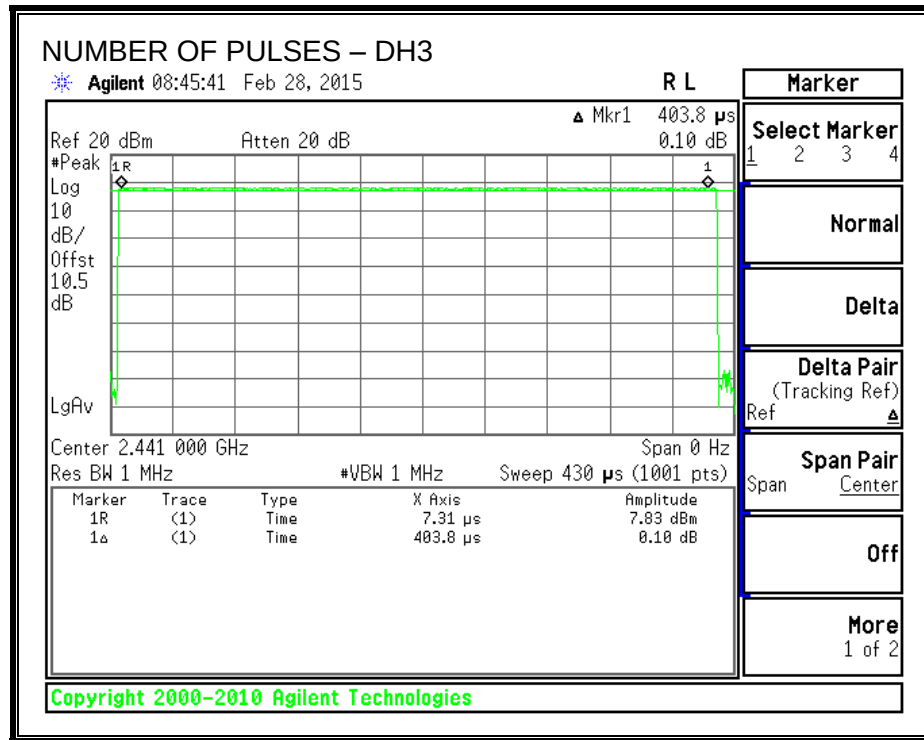
Time Of Occupancy = $10 * xx \text{ pulses} * yy \text{ msec} = zz \text{ msec}$

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	0.3672	32	0.118	0.4	-0.282
DH3	0.40377	16	0.065	0.4	-0.335
DH5	2.868	7	0.201	0.4	-0.199

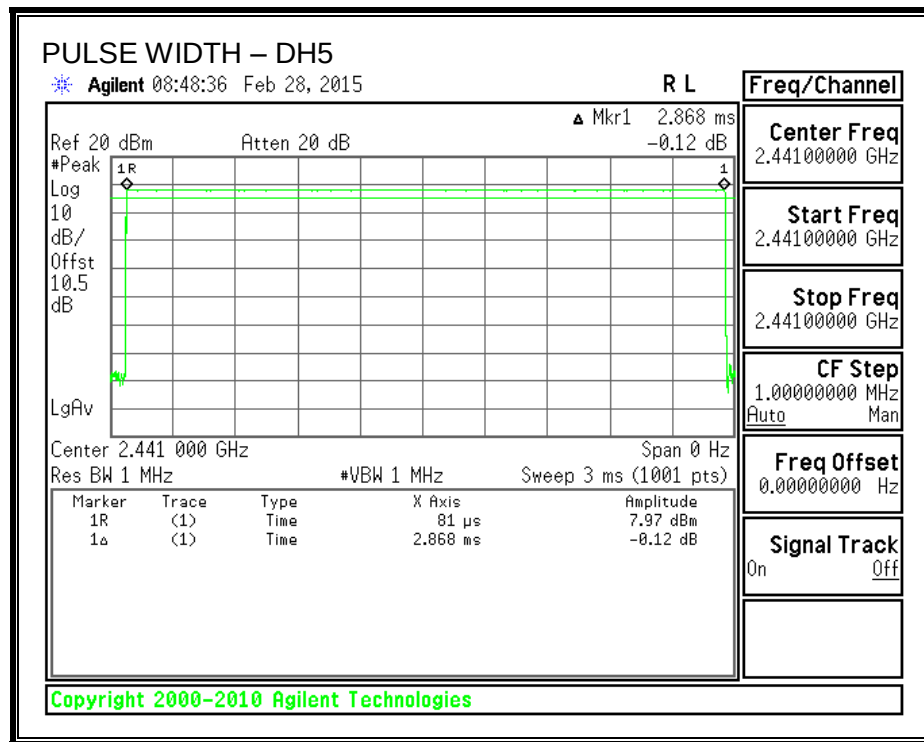
PULSE WIDTH - DH1



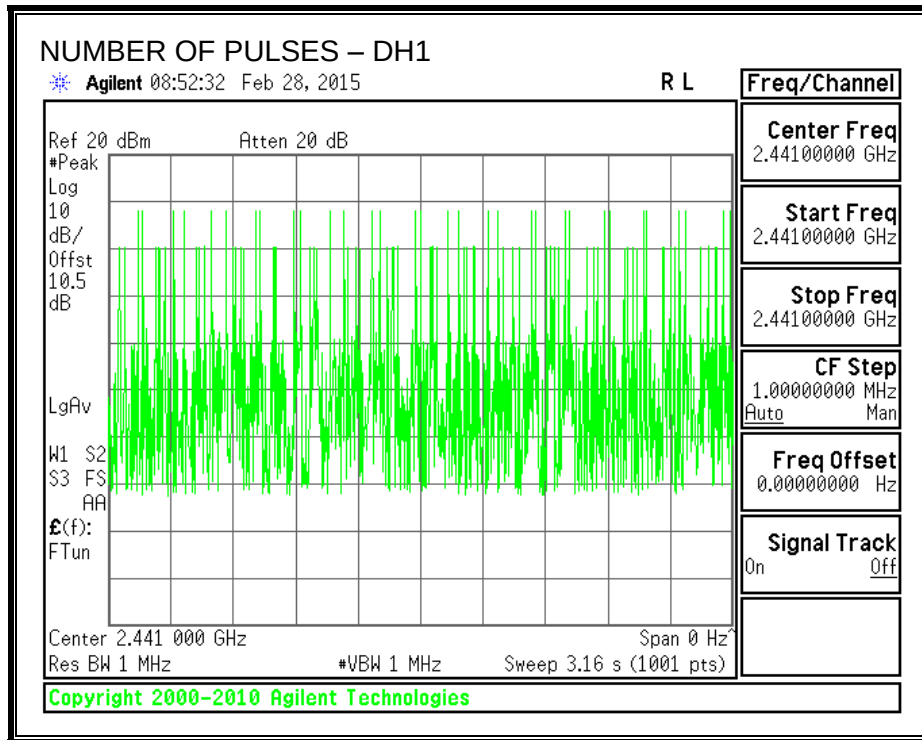
PULSE WIDTH – DH3



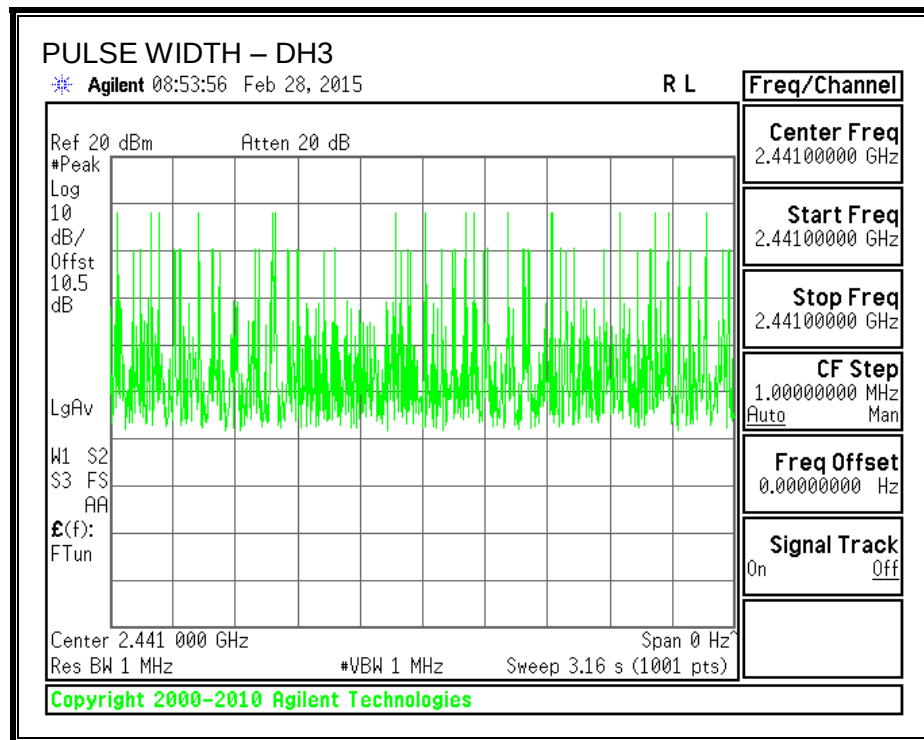
PULSE WIDTH – DH5



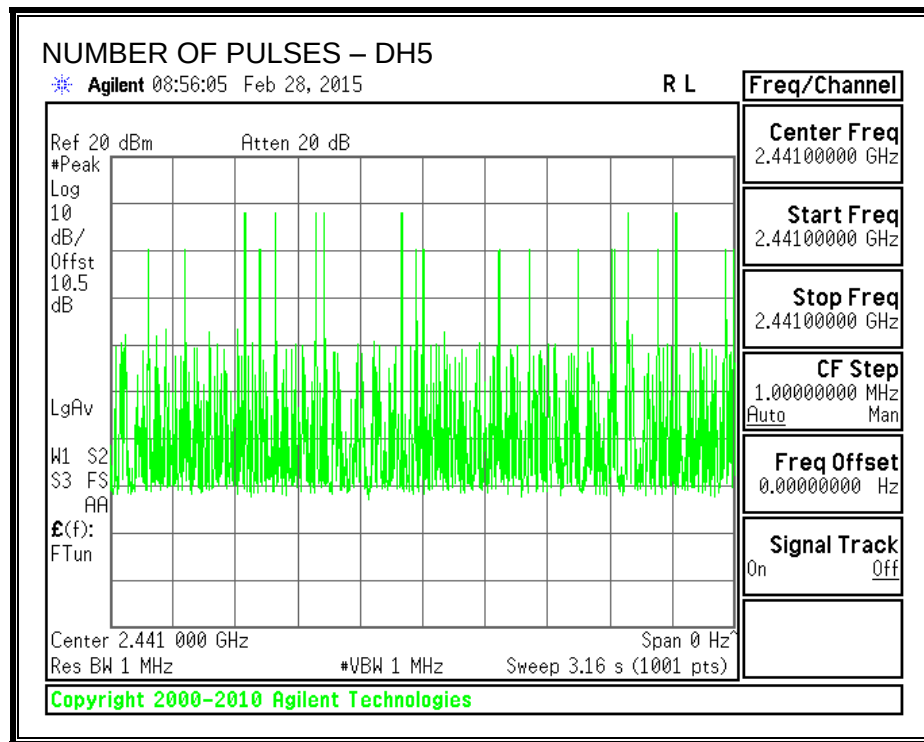
NUMBER OF PULSES IN 3.16 SECOND OBSERVATION PERIOD – DH1



NUMBER OF PULSES IN 3.16 SECOND OBSERVATION PERIOD – DH3



NUMBER OF PULSES IN 3.16 SECOND OBSERVATION PERIOD – DH5



8.1.5. 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.

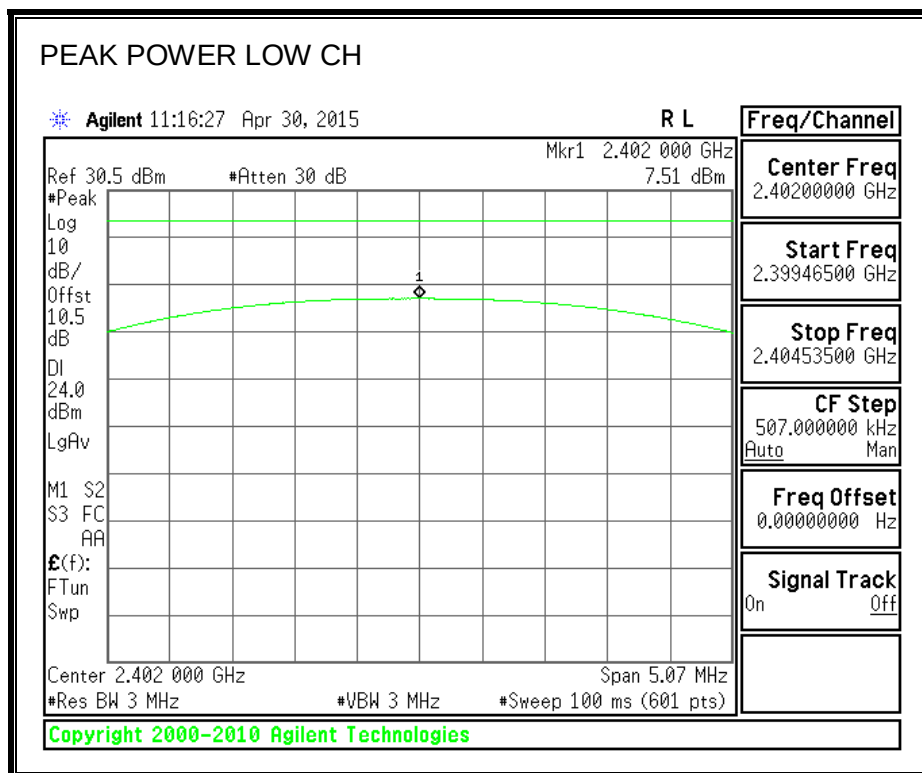
TEST PROCEDURE

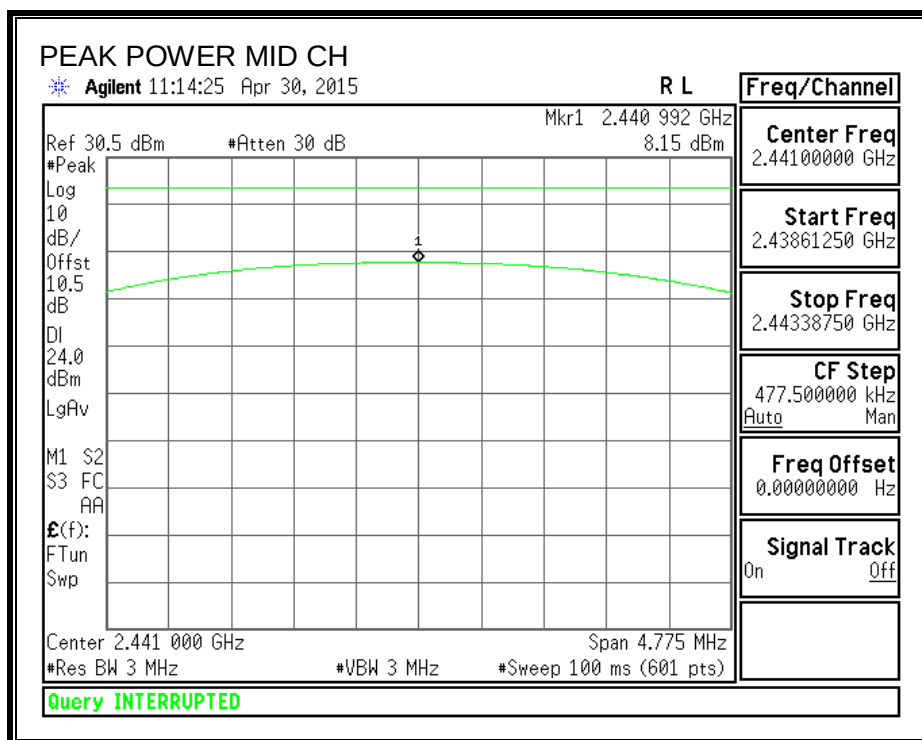
The transmitter output is connected to a spectrum analyzer the analyzer bandwidth is set to a value greater than the 20 dB bandwidth of the EUT.

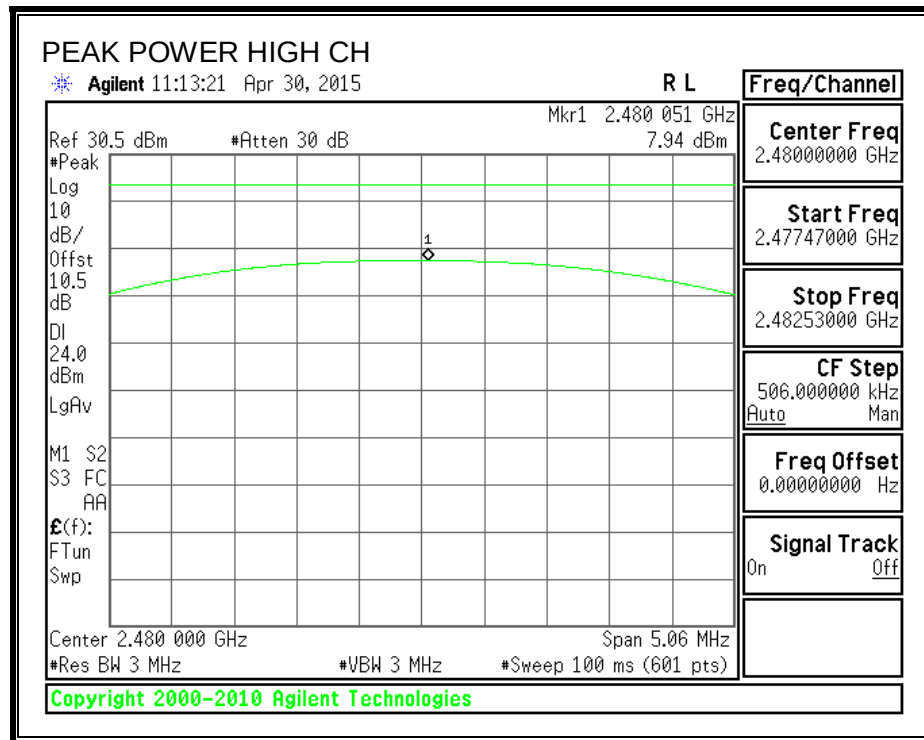
RESULTS – GFSK

Channel	Frequency (MHz)	Output Power (dBm)	Directional Gain (dBi)	Limit (dBm)	Margin (dB)
Low	2402	7.51	3.00	30	-22.49
Middle	2441	8.15	3.00	30	-21.85
High	2480	7.94	3.00	30	-22.06

OUTPUT POWER







8.1.6. AVERAGE POWER

LIMIT

None; for reporting purposes only.

TEST PROCEDURE

The transmitter output is connected to a power meter.

RESULTS - GFSK

The cable assembly insertion loss of 10.54 dB (including 10 dB pad and 0.54 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	6.10
Middle	2441	6.64
High	2480	6.50

8.1.7. 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)).

TEST PROCEDURE

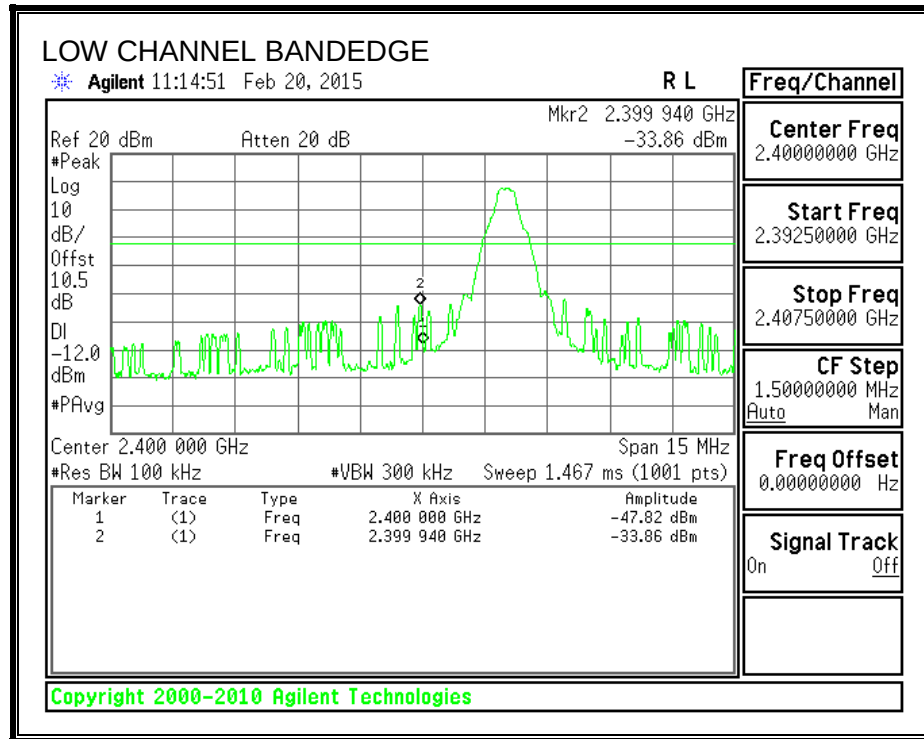
The transmitter output is connected to a spectrum analyzer. The resolution bandwidth is set to 100 kHz. The video bandwidth is set to 300 kHz.

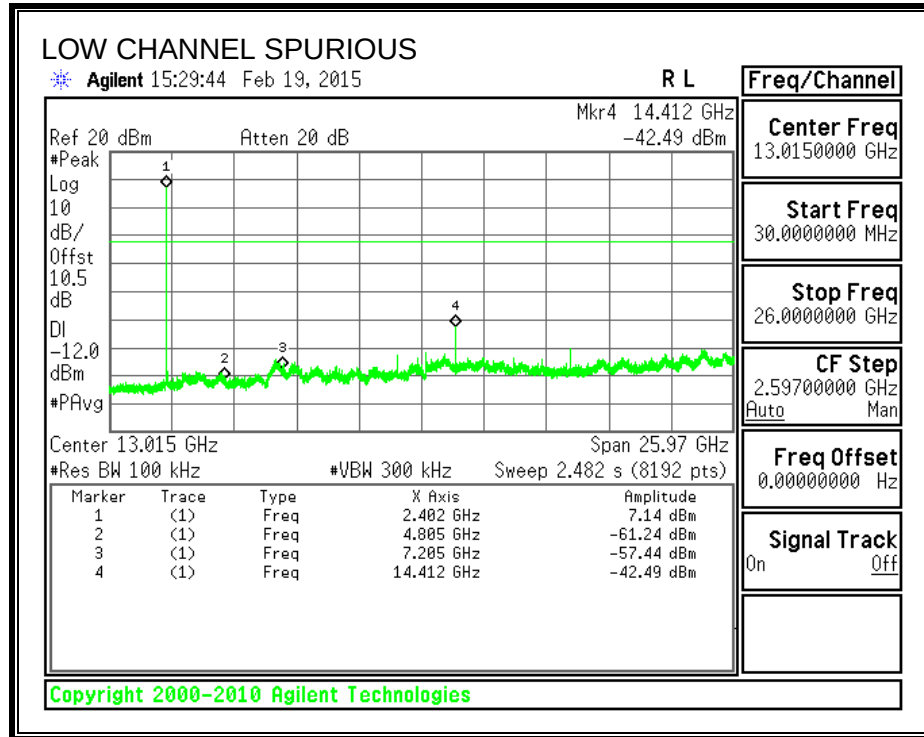
The spectrum from 30 MHz to 26 GHz is investigated with the transmitter set to the lowest, middle, and highest channels.

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

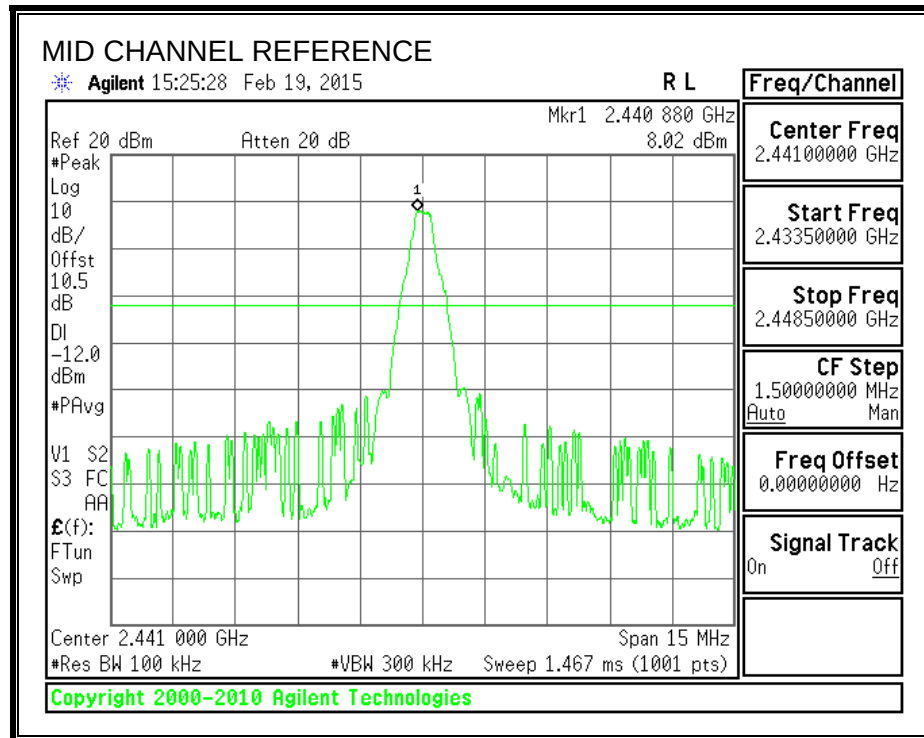
RESULTS - GFSK

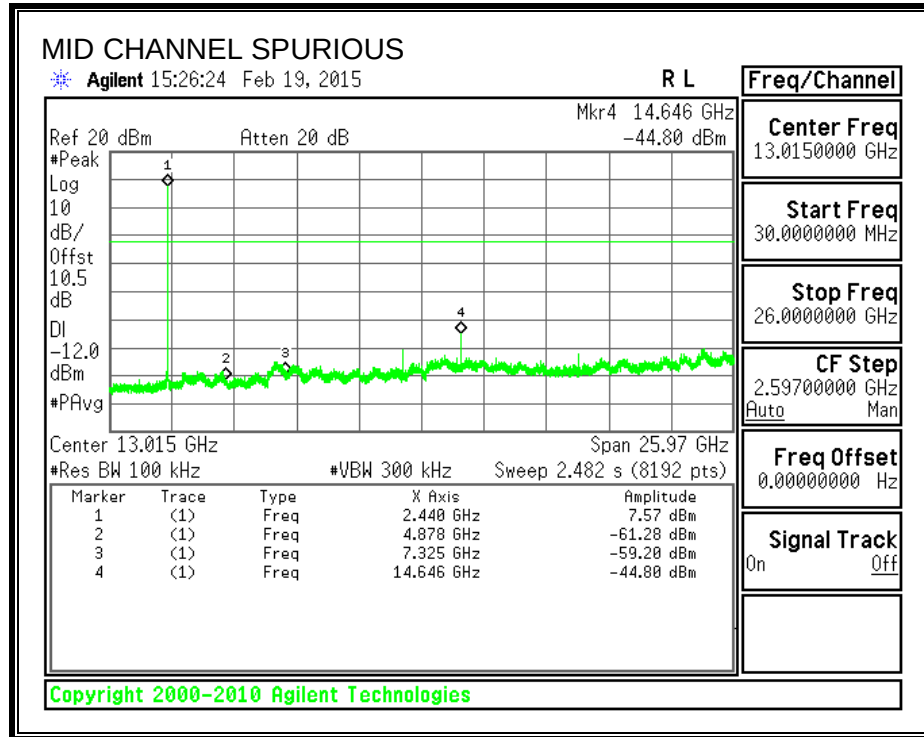
SPURIOUS EMISSIONS, LOW CHANNEL



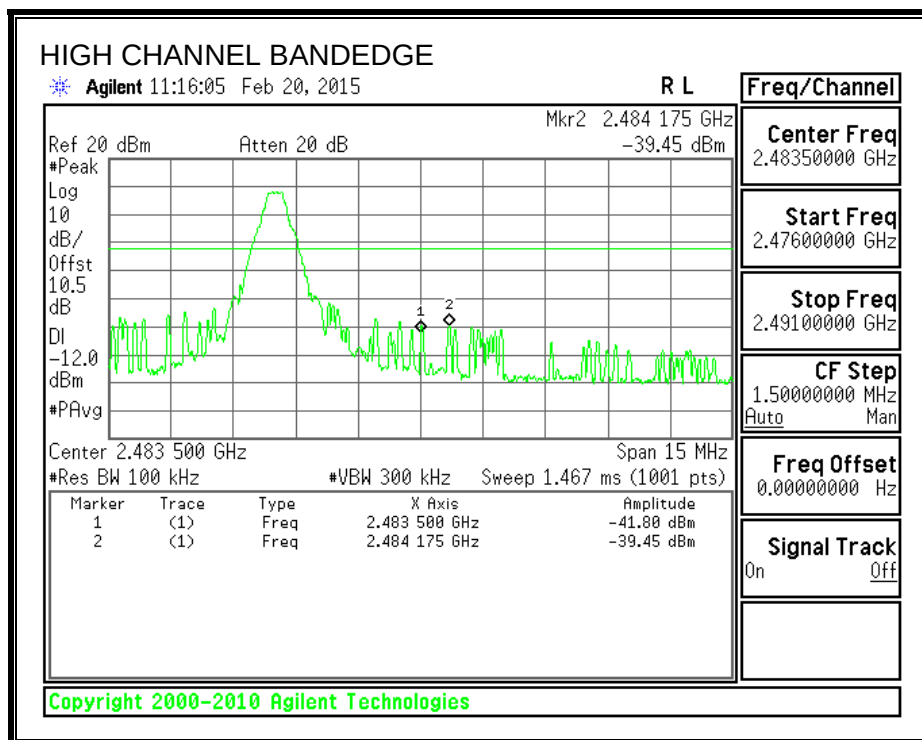


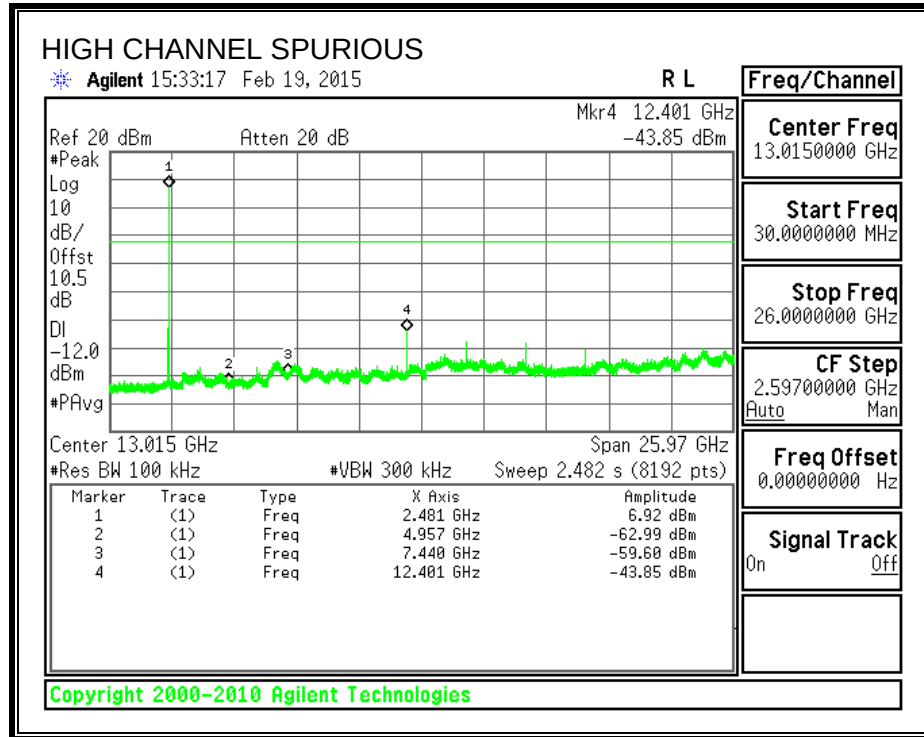
SPURIOUS EMISSIONS, MID CHANNEL



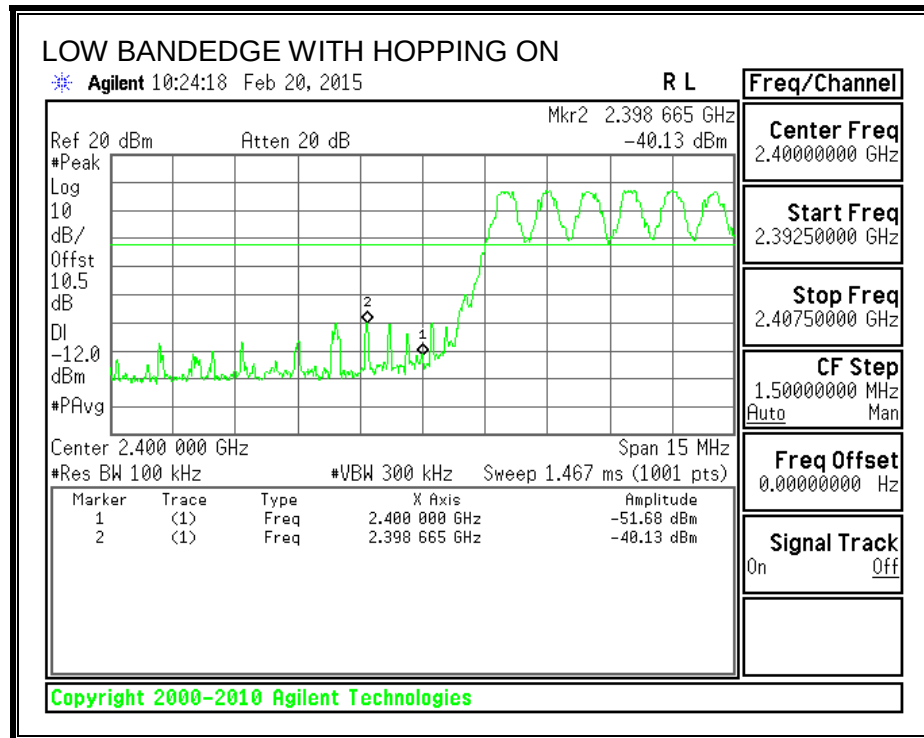


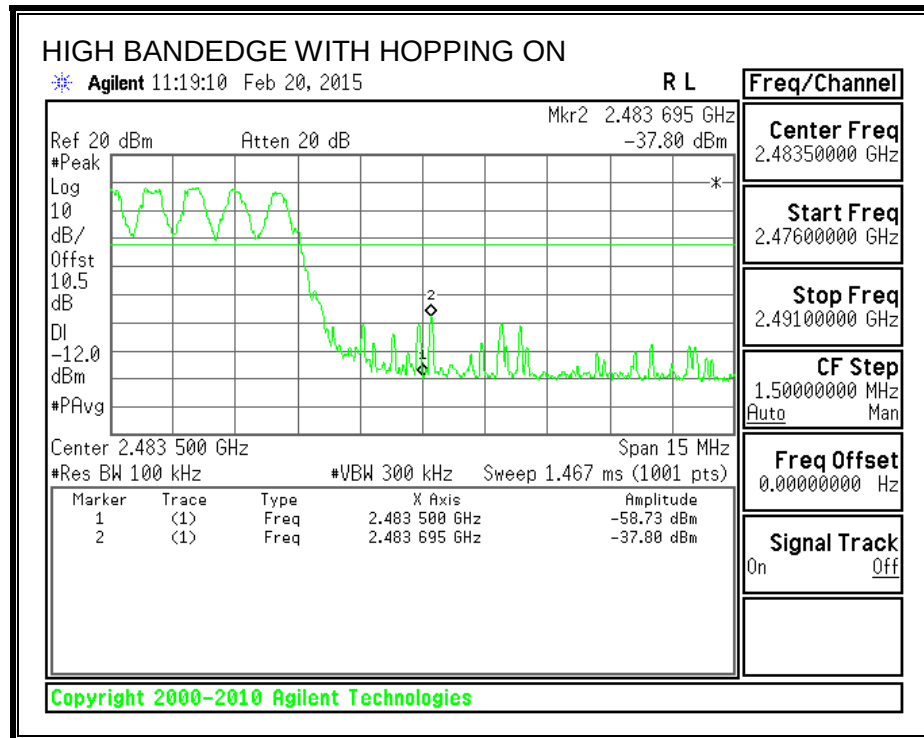
SPURIOUS EMISSIONS, HIGH CHANNEL





SPURIOUS BANDEDGE EMISSIONS WITH HOPPING ON





8.2. ENHANCED DATA RATE DQPSK MODULATION

8.2.1. 20 dB BANDWIDTH

LIMIT

None; for reporting purposes only.

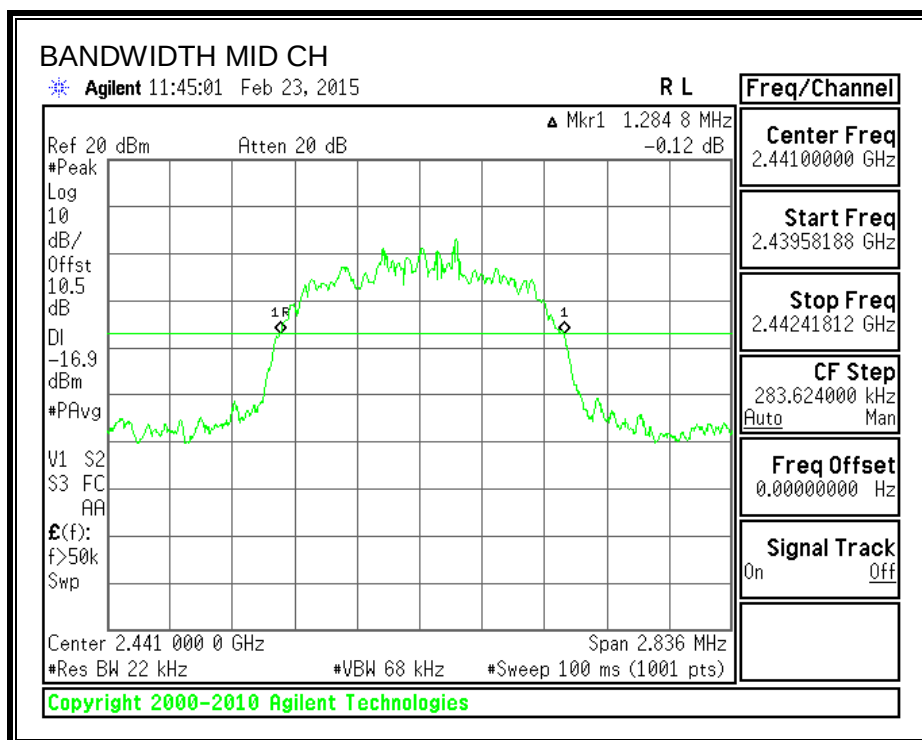
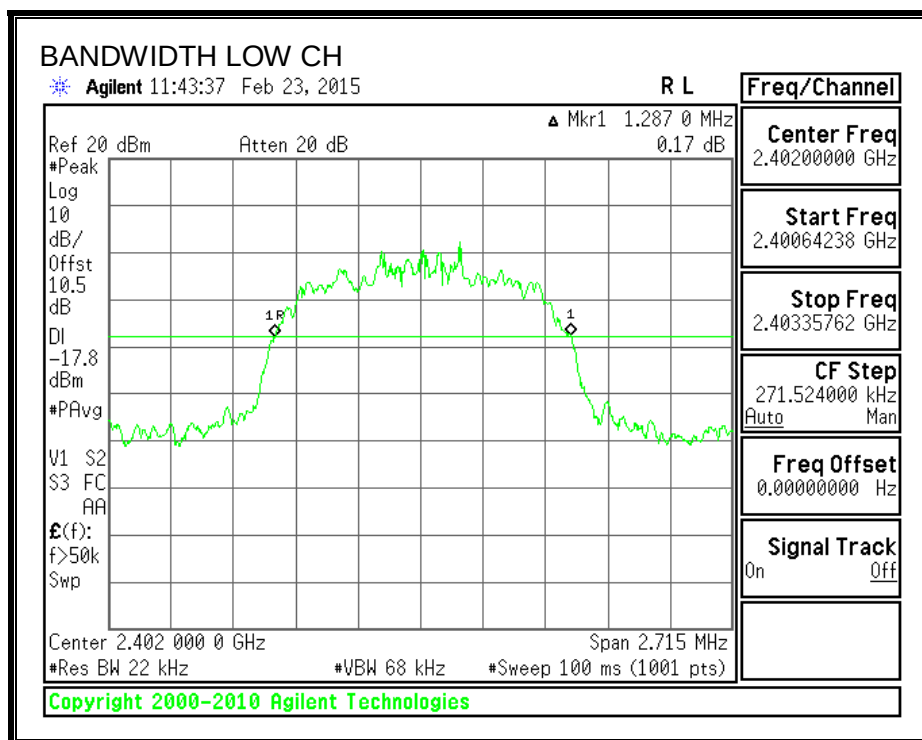
TEST PROCEDURE

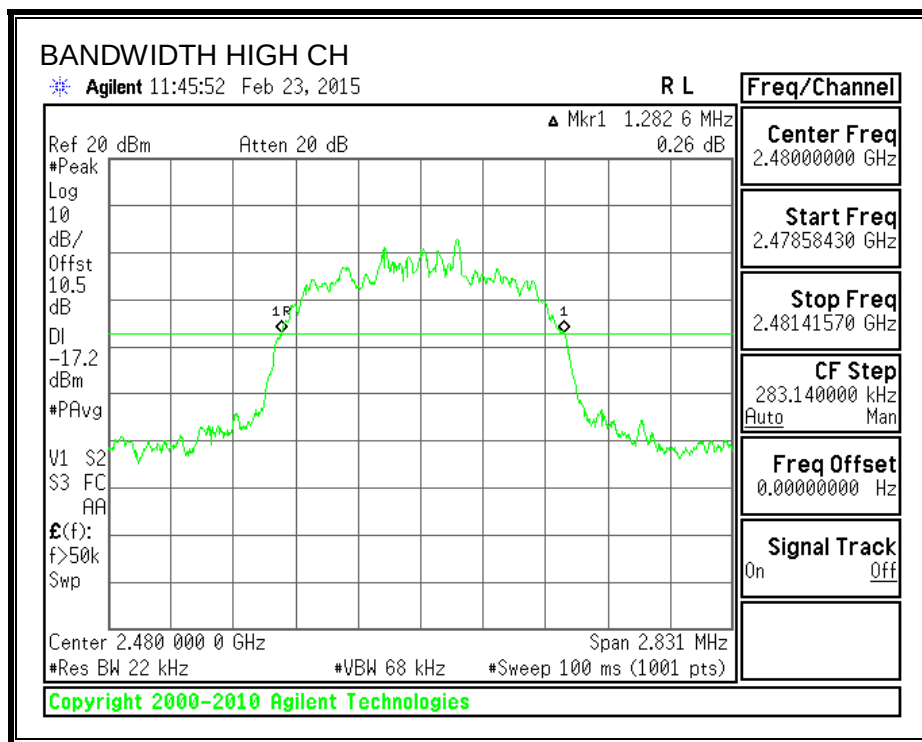
The transmitter output is connected to a spectrum analyzer. The RBW is set to $\geq 1\%$ of the 20 dB bandwidth. The VBW is set to $\geq$ RBW. The sweep time is coupled.

RESULTS - DQPSK

Channel	Frequency (MHz)	20 dB Bandwidth (kHz)
Low	2402	1287.0
Middle	2441	1284.8
High	2480	1282.6

20 dB BANDWIDTH





8.2.2. AVERAGE TIME OF OCCUPANCY

LIMIT

FCC §15.247 (a) (1) (iii)

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

TEST PROCEDURE

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

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

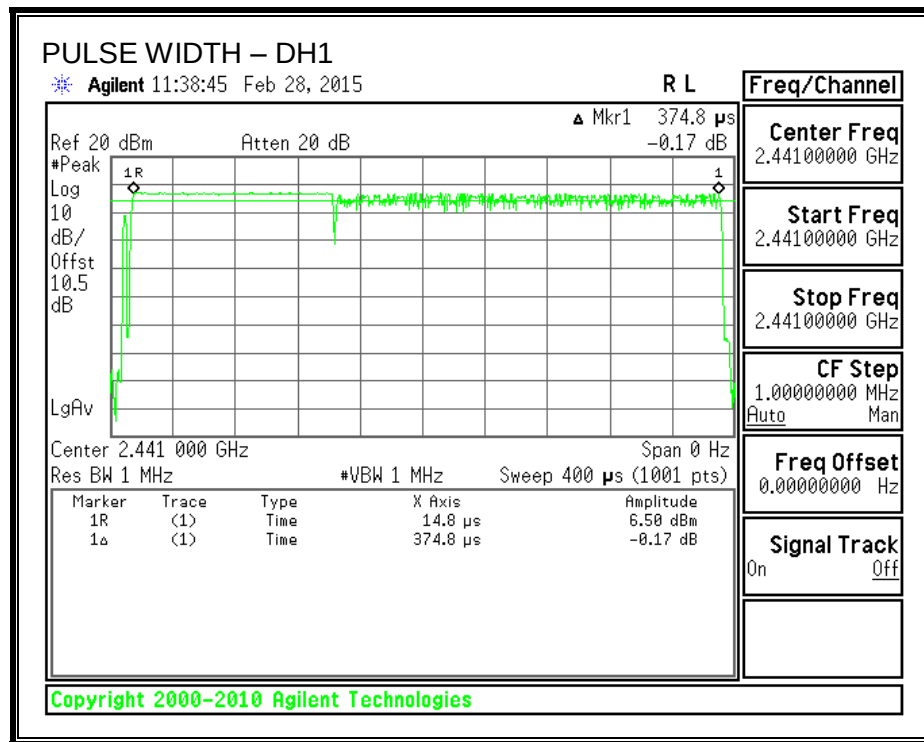
RESULTS - DQPSK

Time Of Occupancy = $10 * xx \text{ pulses} * yy \text{ msec} = zz \text{ msec}$

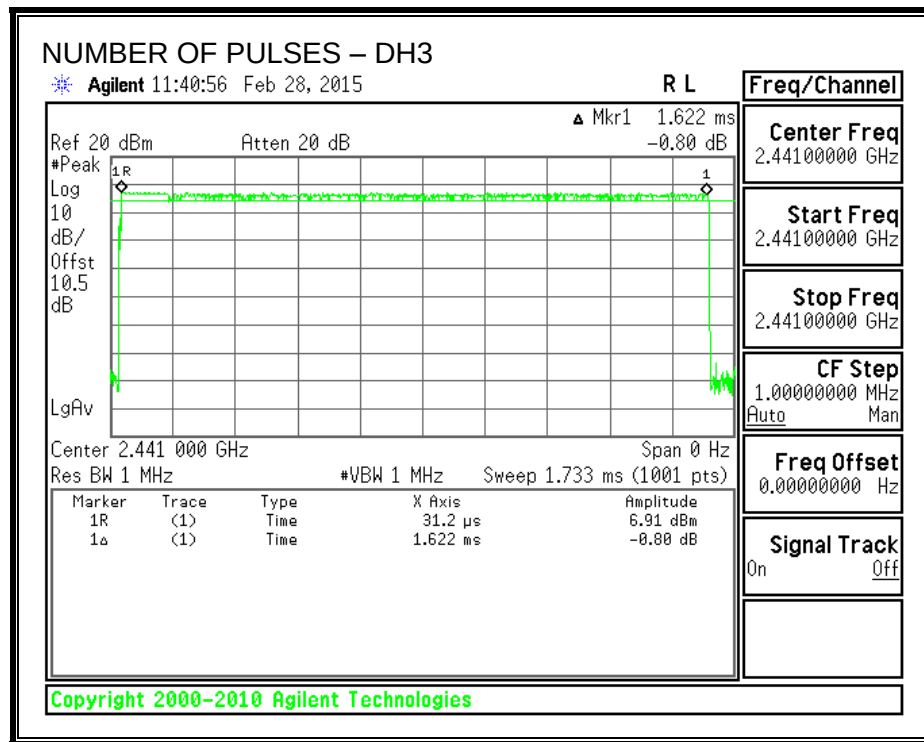
DQPSK Mode

DH Packet	Pulse Width (msec)	Number of Pulses in 3.16 seconds	Average Time of (sec)	Limit (sec)	Margin (sec)
DH1	0.3748	32	0.120	0.4	-0.280
DH3	1.6224	17	0.276	0.4	-0.124
DH5	2.86427	12	0.344	0.4	-0.056

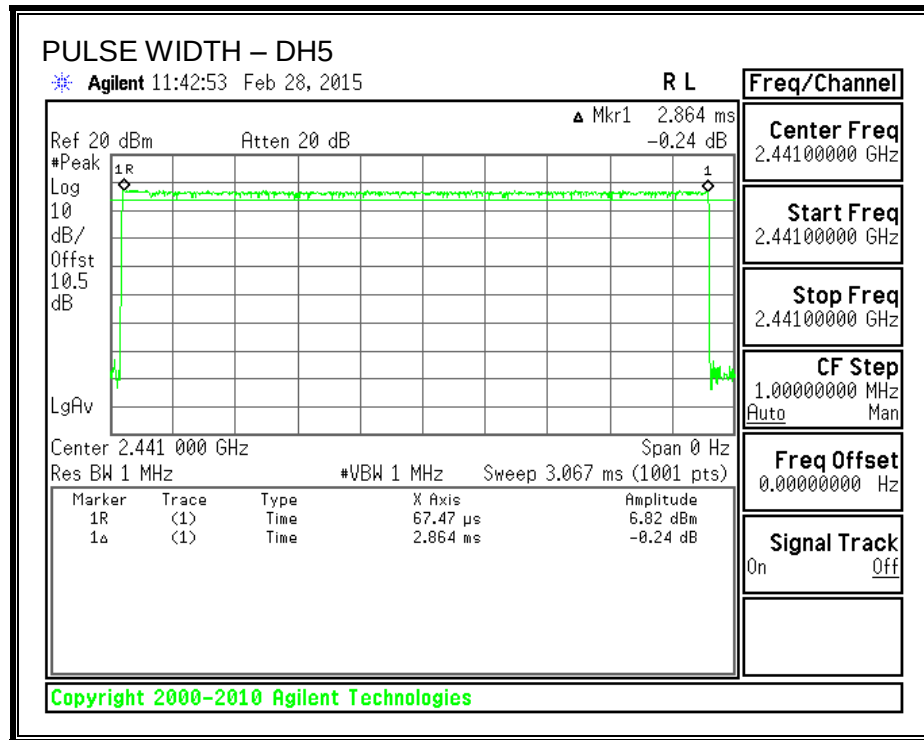
PULSE WIDTH - DH1



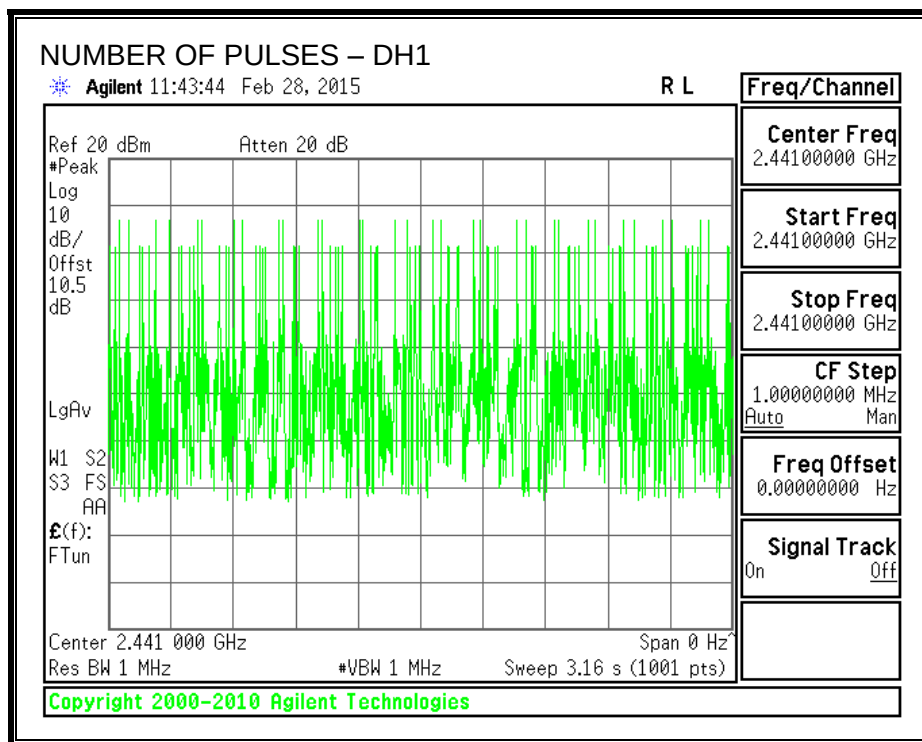
PULSE WIDTH – DH3



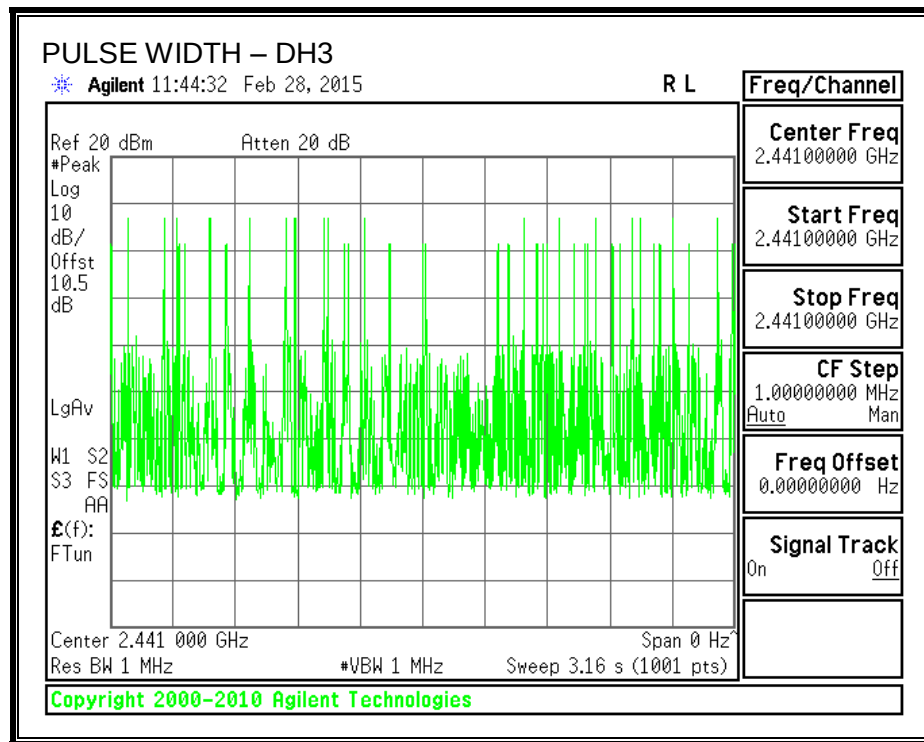
PULSE WIDTH – DH5



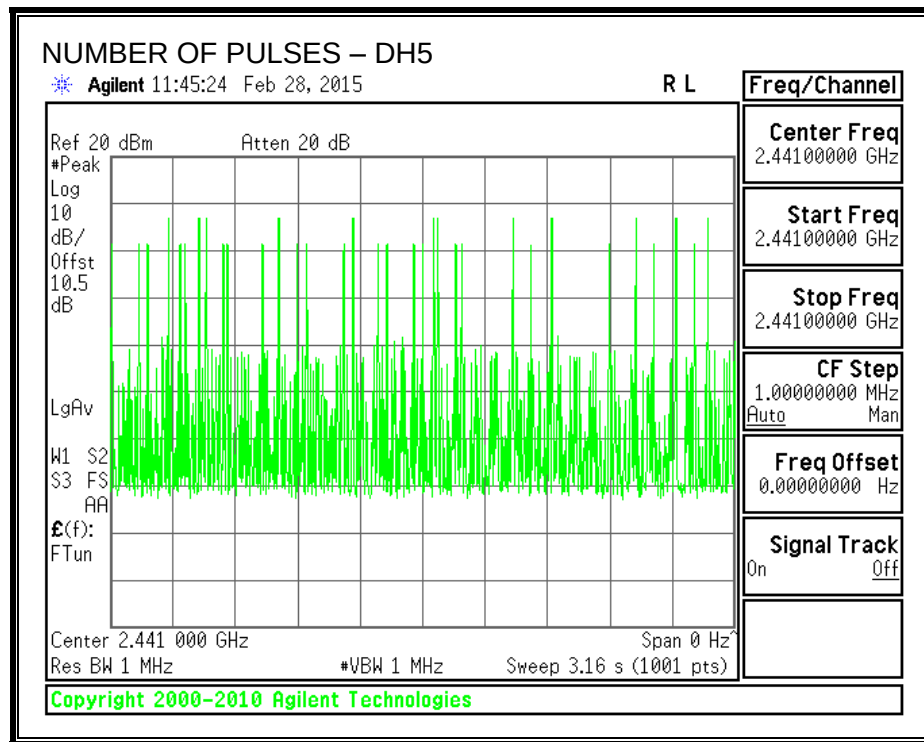
NUMBER OF PULSES IN 3.16 SECOND OBSERVATION PERIOD – DH1



NUMBER OF PULSES IN 3.16 SECOND OBSERVATION PERIOD – DH3



NUMBER OF PULSES IN 3.16 SECOND OBSERVATION PERIOD – DH5



8.2.3. 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.

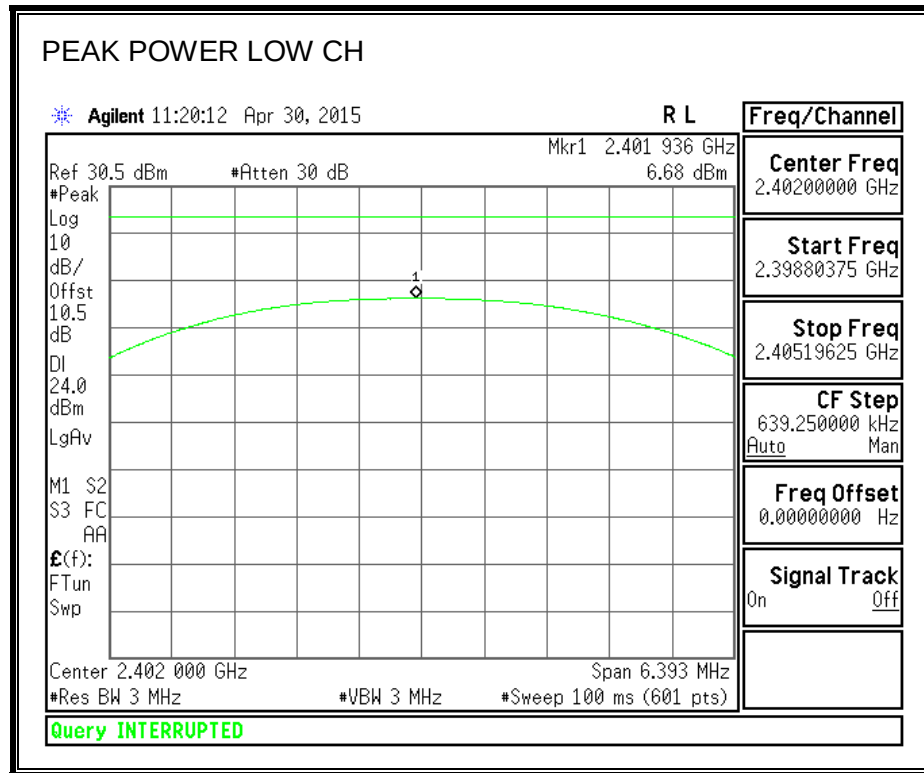
TEST PROCEDURE

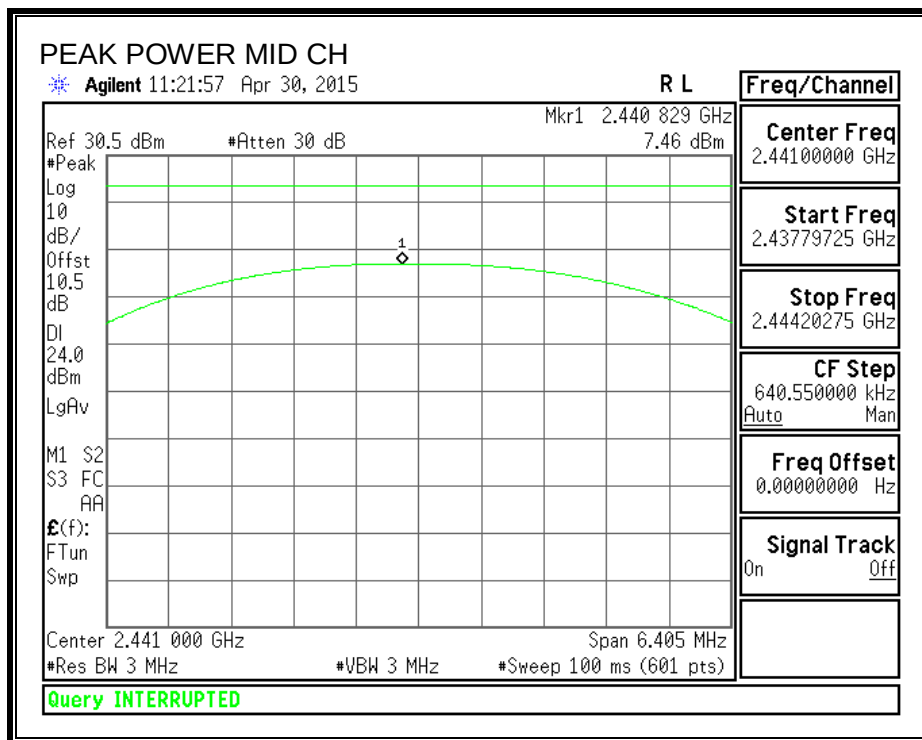
The transmitter output is connected to a spectrum analyzer the analyzer bandwidth is set to a value greater than the 20 dB bandwidth of the EUT.

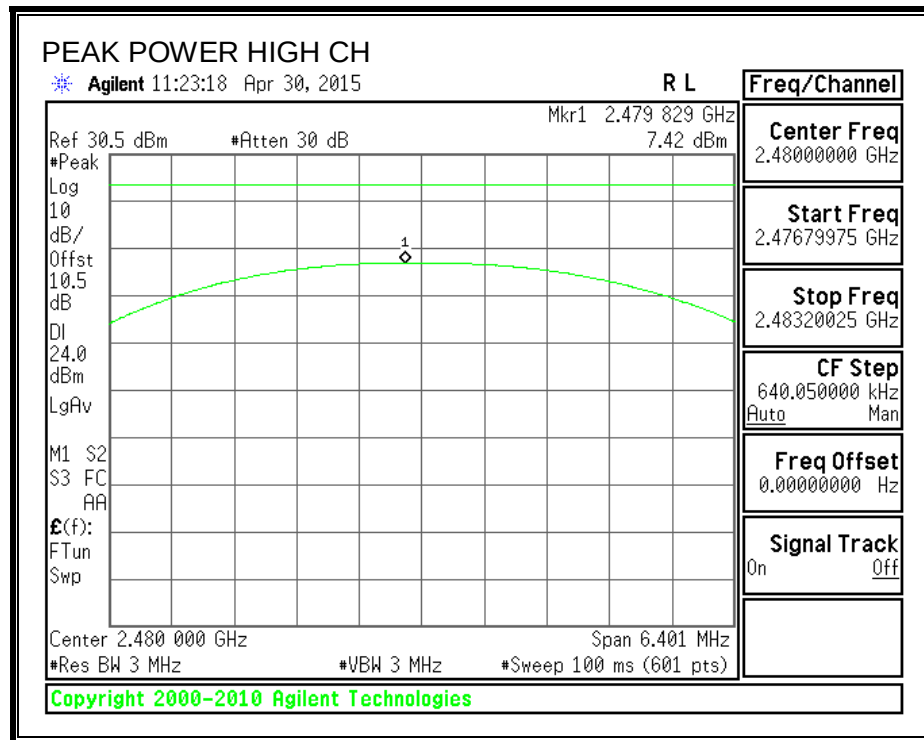
RESULTS - DQPSK

Channel	Frequency (MHz)	Output Power (dBm)	Directional Gain (dBi)	Limit (dBm)	Margin (dB)
Low	2402	6.68	3.00	30	-23.32
Middle	2441	7.46	3.00	30	-22.54
High	2480	7.42	3.00	30	-22.58

OUTPUT POWER







8.2.4. AVERAGE POWER

LIMIT

None; for reporting purposes only.

TEST PROCEDURE

The transmitter output is connected to a power meter.

RESULTS - DQPSK

The cable assembly insertion loss of 10.54 dB (including 10 dB pad and 0.54 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	5.11
Middle	2441	5.80
High	2480	5.40

8.3. ENHANCED DATA RATE 8DPSK MODULATION

8.3.1. 20 dB AND 99% BANDWIDTH

LIMIT

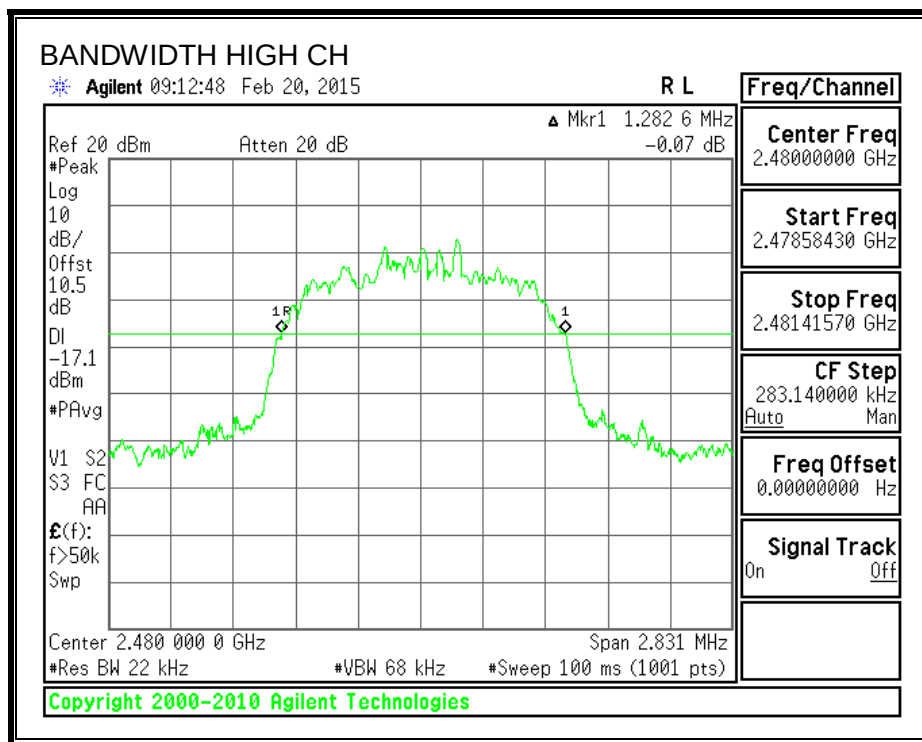
None; for reporting purposes only.

TEST PROCEDURE

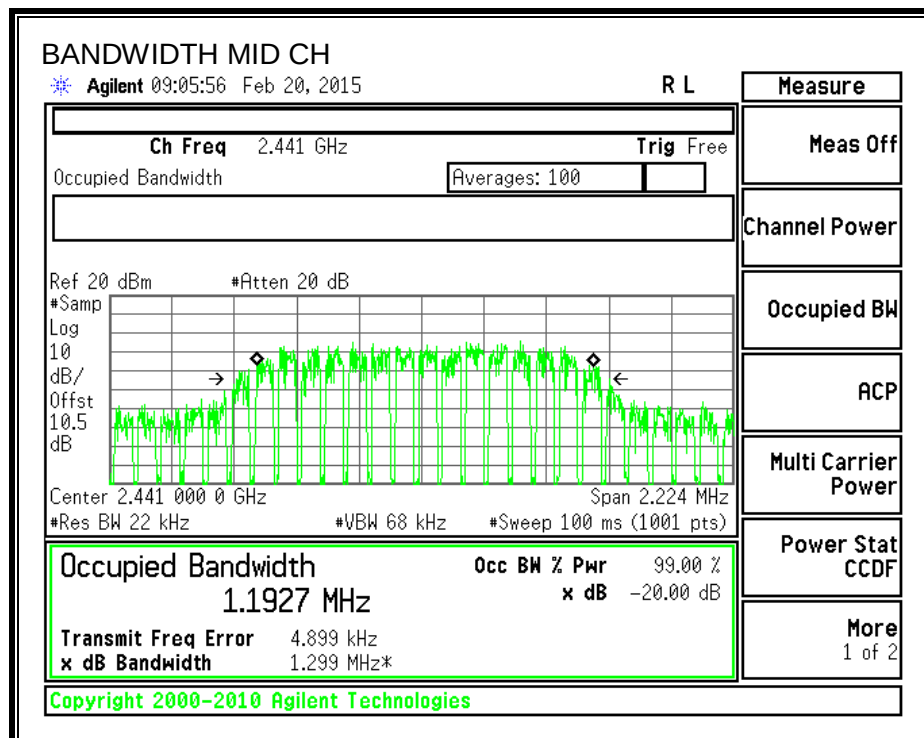
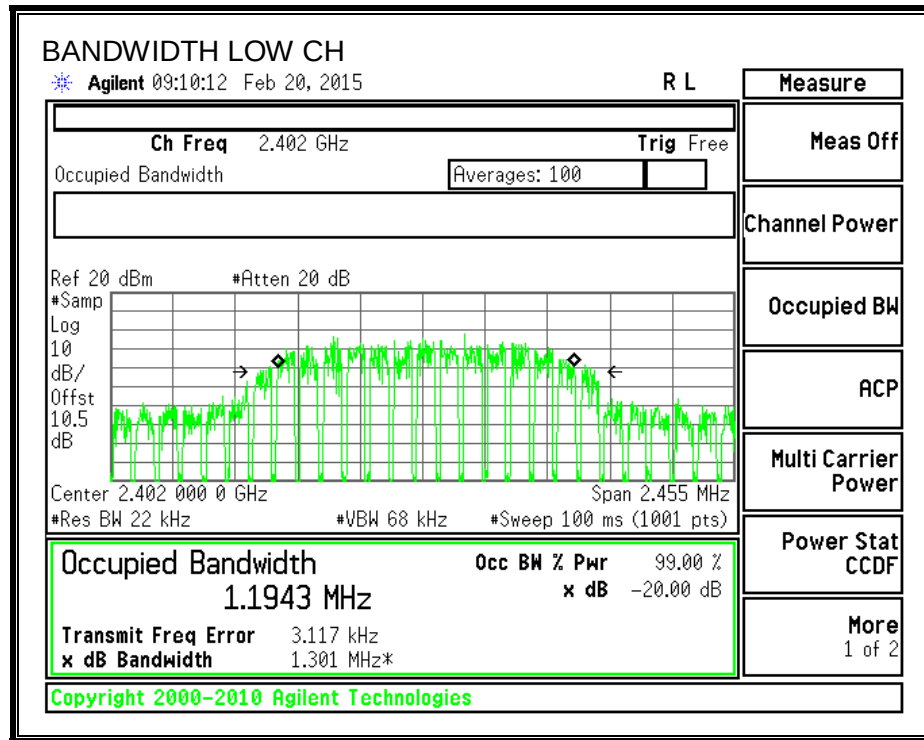
The transmitter output is connected to a spectrum analyzer. The RBW is set to $\geq 1\%$ of the 20 dB bandwidth. The VBW is set to $\geq$ RBW. The sweep time is coupled.

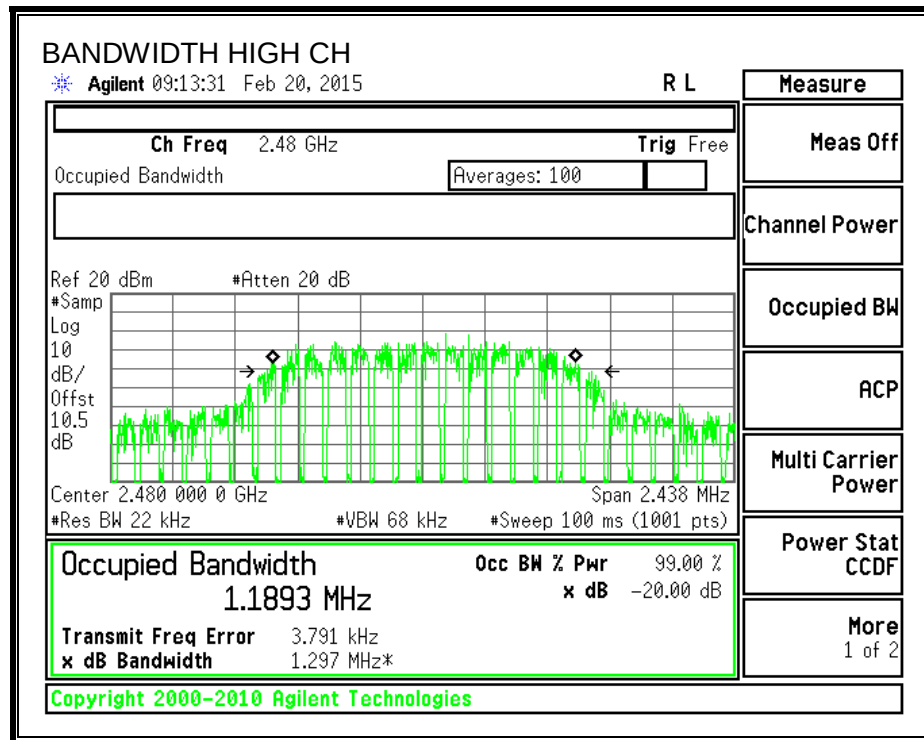
RESULTS – 8DPSK

Channel	Frequency (MHz)	20 dB Bandwidth (kHz)	99% Bandwidth (kHz)
Low	2402	1298.6	1194.3
Middle	2441	1294.6	1192.7
High	2480	1282.6	1189.3



99% BANDWIDTH





8.3.2. HOPPING FREQUENCY SEPARATION

LIMIT

FCC §15.247 (a) (1)

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.

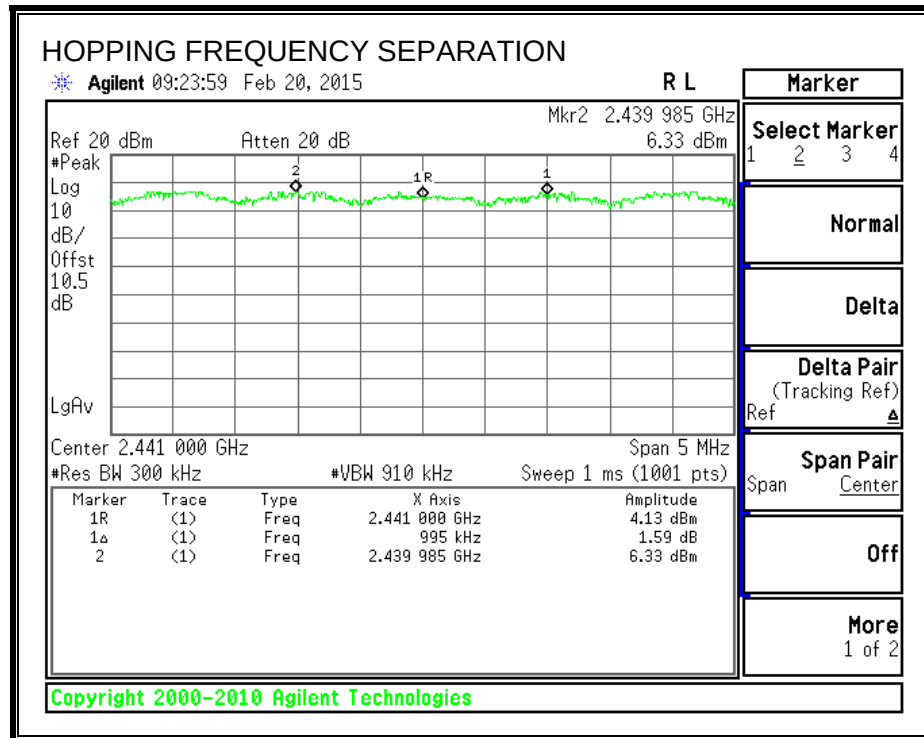
TEST PROCEDURE

The transmitter output is connected to a spectrum analyzer. The RBW is set to $\geq$ span and the VBW is set to $\geq$ RBW. The sweep time is coupled.

RESULTS – 8DPSK

Note – The EUT's Channel separation (995 kHz) is less than the 20 dB bandwidth (1.299 MHz). However, the EUT's power is less than 125 mW and the channel separation is allowed to be 2/3's the 20 dB BW or 866 kHz.

HOPPING FREQUENCY SEPARATION



Note – The EUT’s Channel separation (995 kHz) is less than the 20 dB bandwidth (1.299 MHz). However, the EUT’s power is less than 125 mW or 20 dBm (Power approx. 8 dBm). Therefore, the channel separation is allowed to be greater than 2/3’s the 20 dB BW or 866 kHz.

8.3.3. NUMBER OF HOPPING CHANNELS

LIMIT

FCC §15.247 (a) (1) (iii)

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

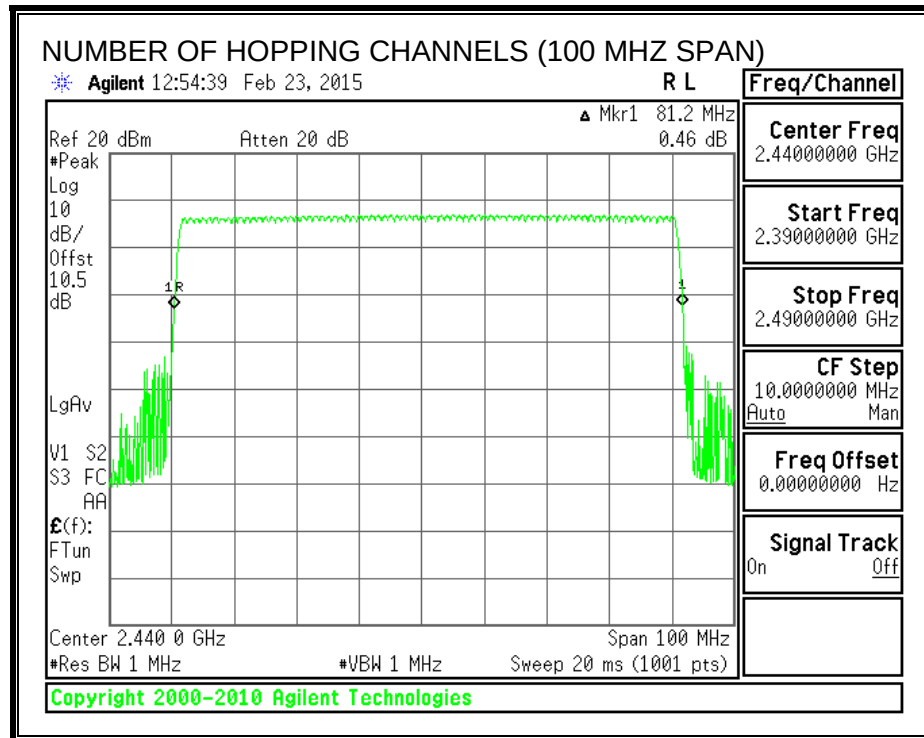
TEST PROCEDURE

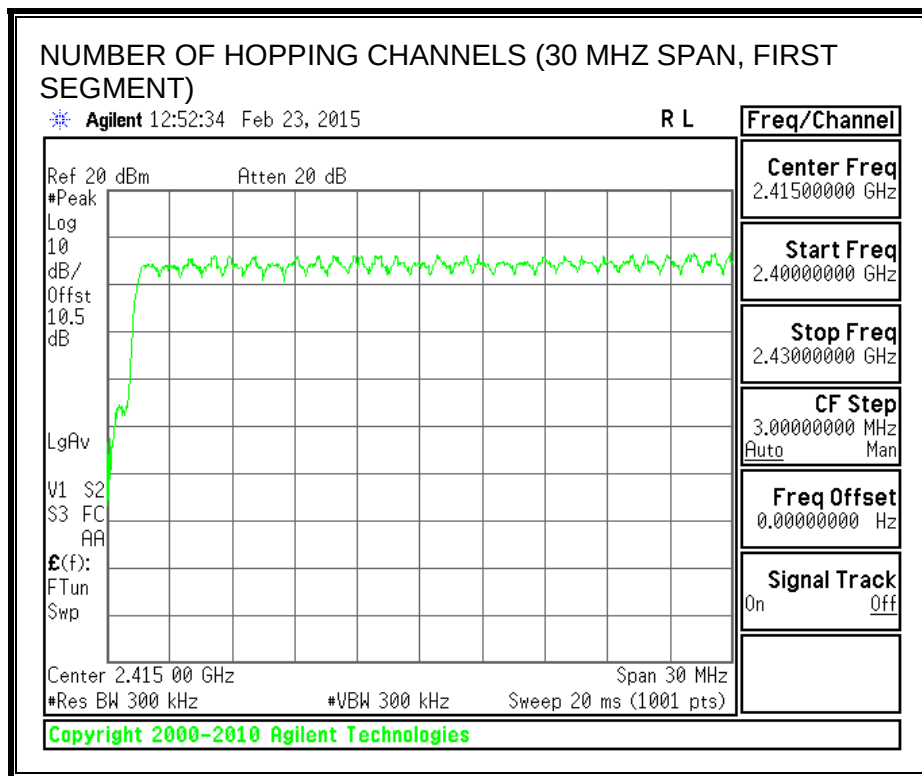
The transmitter output is connected to a spectrum analyzer. The span is set to cover the entire authorized band, in either a single sweep or in multiple contiguous sweeps. The RBW is set to a maximum of 1 % of the span. The analyzer is set to Max Hold.

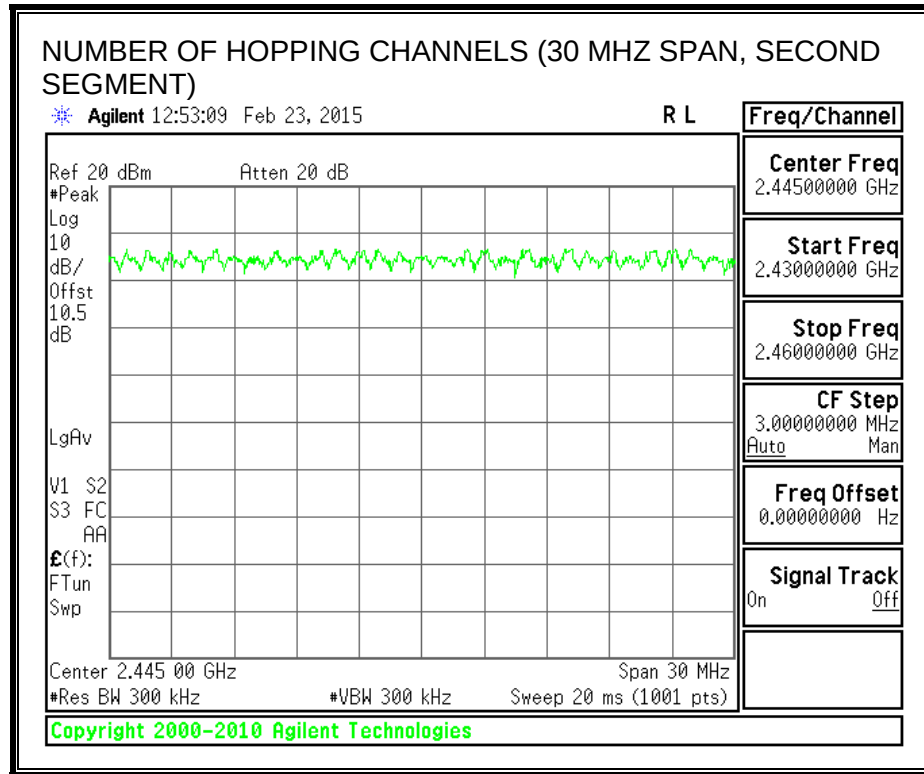
RESULTS – 8DPSK

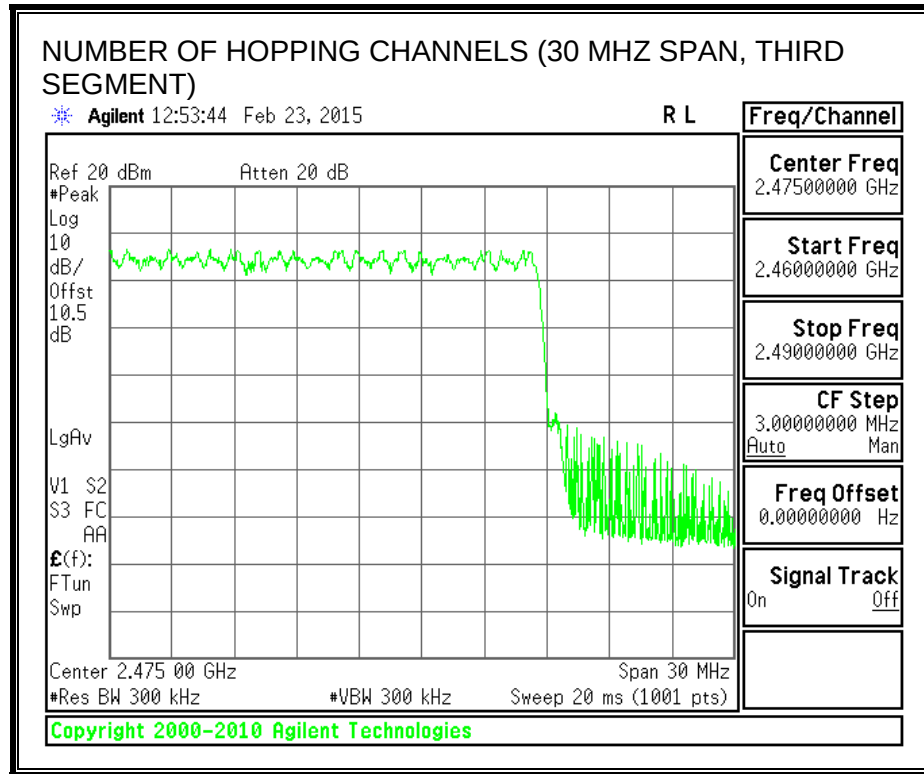
Normal Mode: 79 Channels observed.

NUMBER OF HOPPING CHANNELS









8.3.4. AVERAGE TIME OF OCCUPANCY

LIMIT

FCC §15.247 (a) (1) (iii)

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

TEST PROCEDURE

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

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

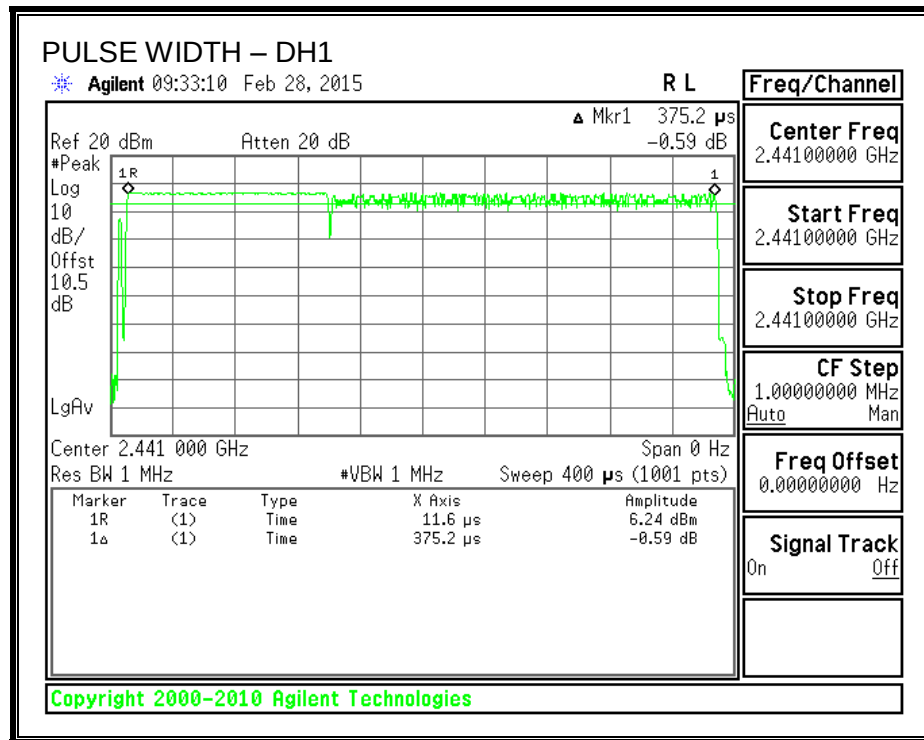
RESULTS – 8DPSK

Time Of Occupancy = $10 * xx \text{ pulses} * yy \text{ msec} = zz \text{ msec}$

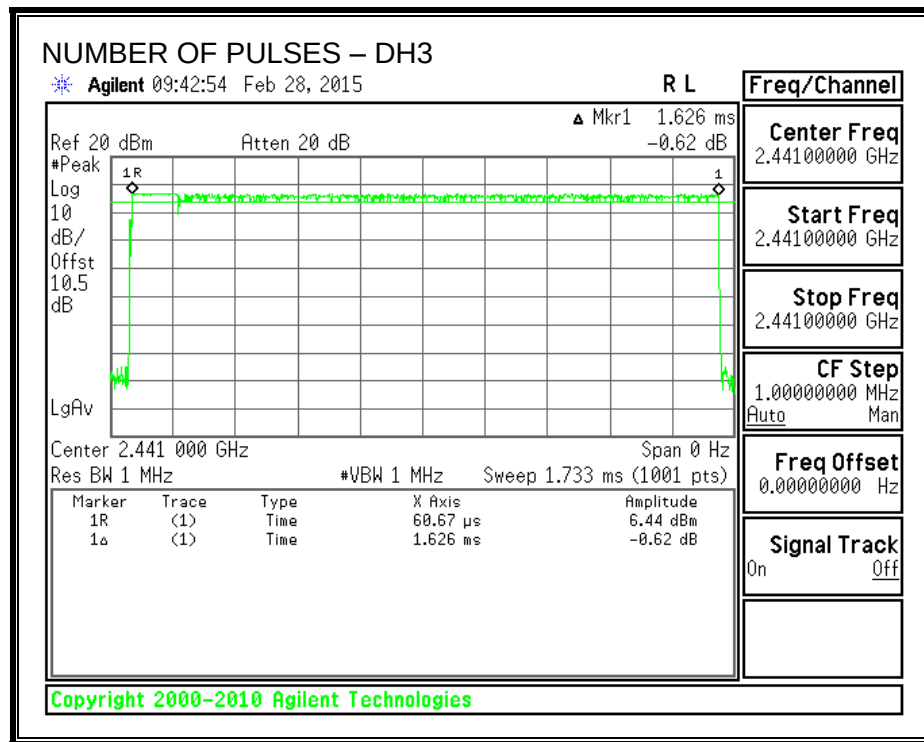
8PSK (EDR) Mode

DH Packet	Pulse Width (msec)	Number of Pulses in 3.16 seconds	Average Time of (sec)	Limit (sec)	Margin (sec)
DH1	0.3752	32	0.120	0.4	-0.280
DH3	1.62587	15	0.244	0.4	-0.156
DH5	2.874	11	0.316	0.4	-0.084

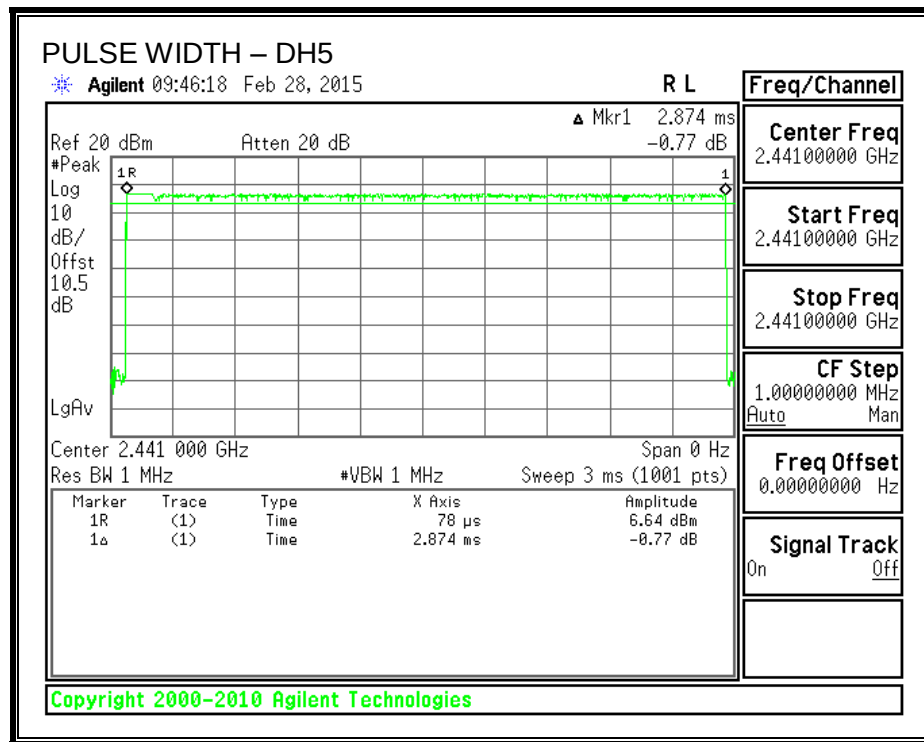
PULSE WIDTH - DH1



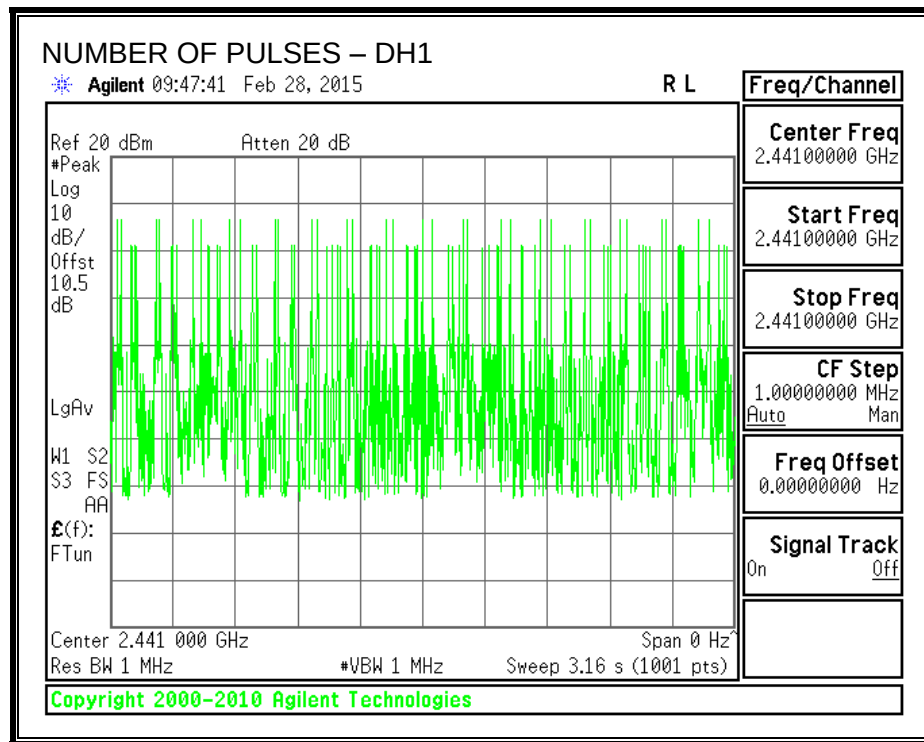
PULSE WIDTH – DH3



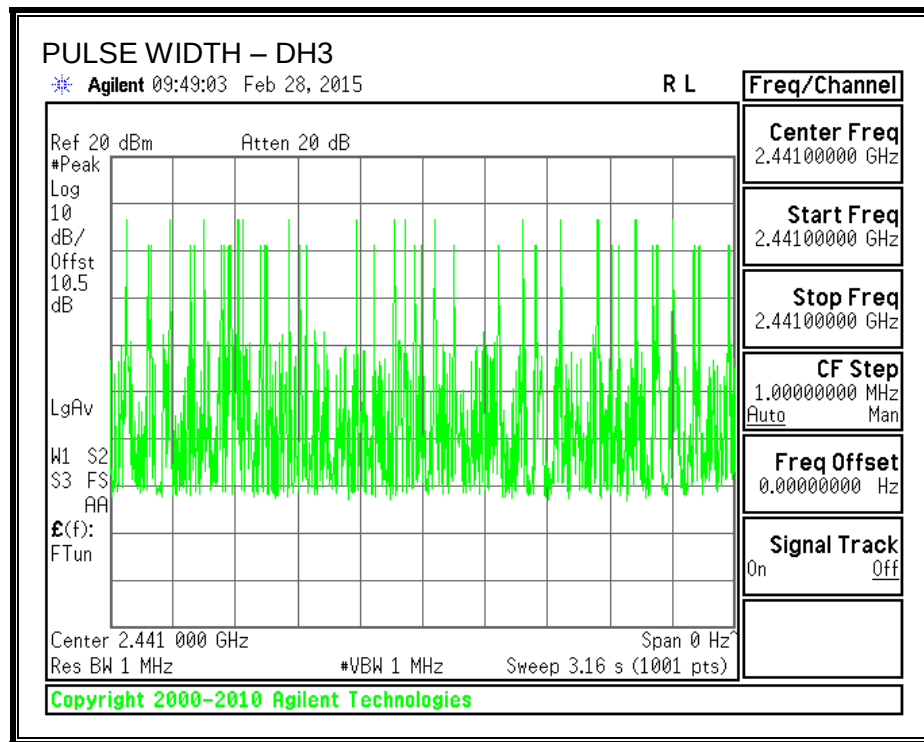
PULSE WIDTH – DH5



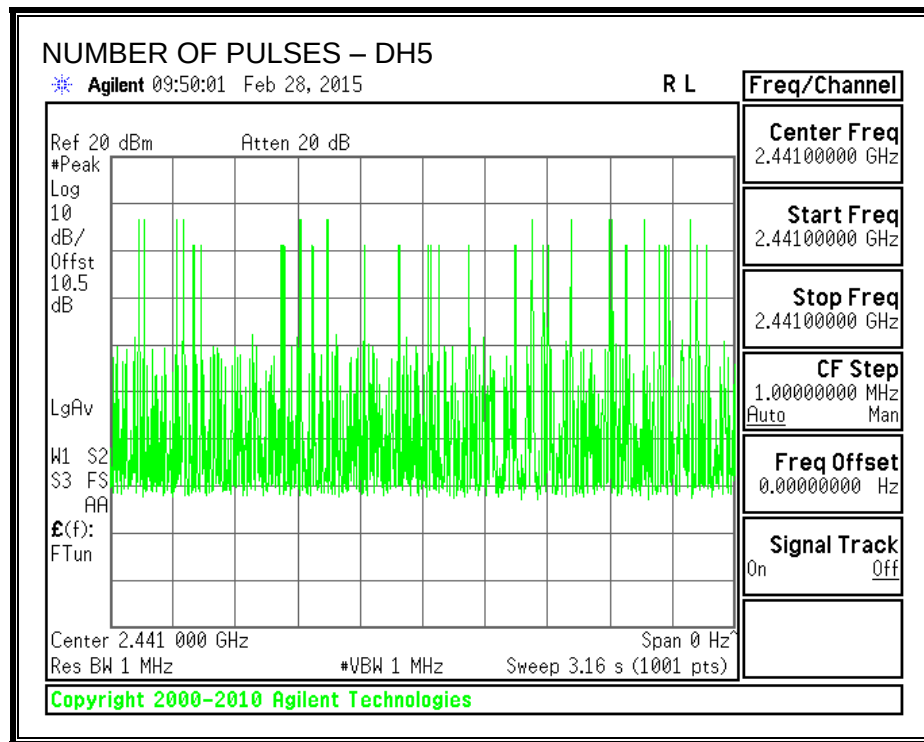
NUMBER OF PULSES IN 3.16 SECOND OBSERVATION PERIOD – DH1



NUMBER OF PULSES IN 3.16 SECOND OBSERVATION PERIOD – DH3



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.

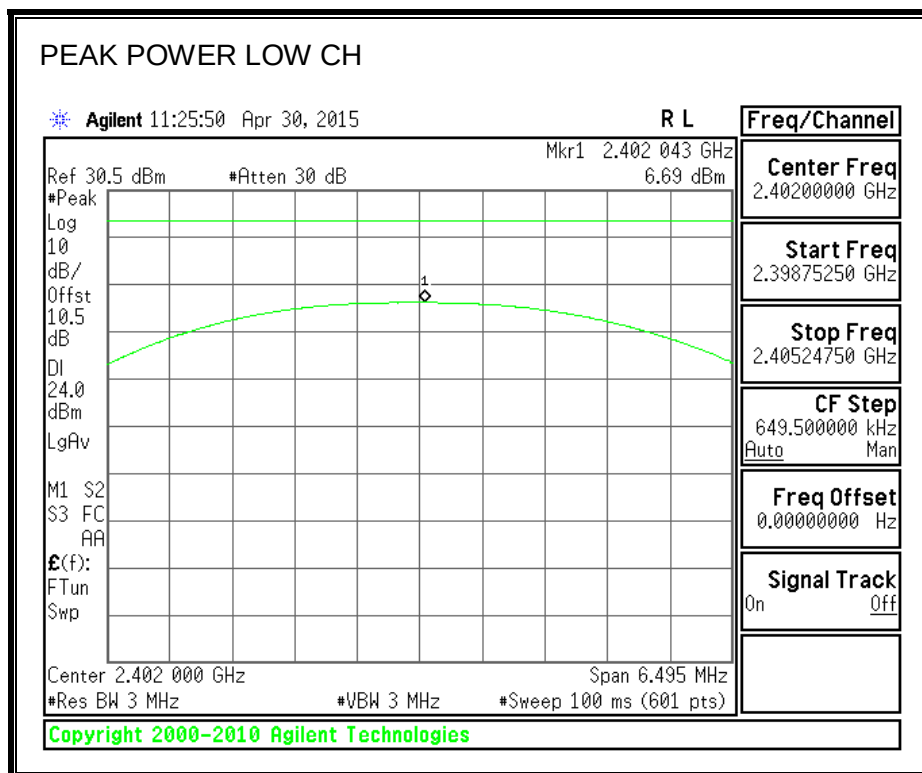
TEST PROCEDURE

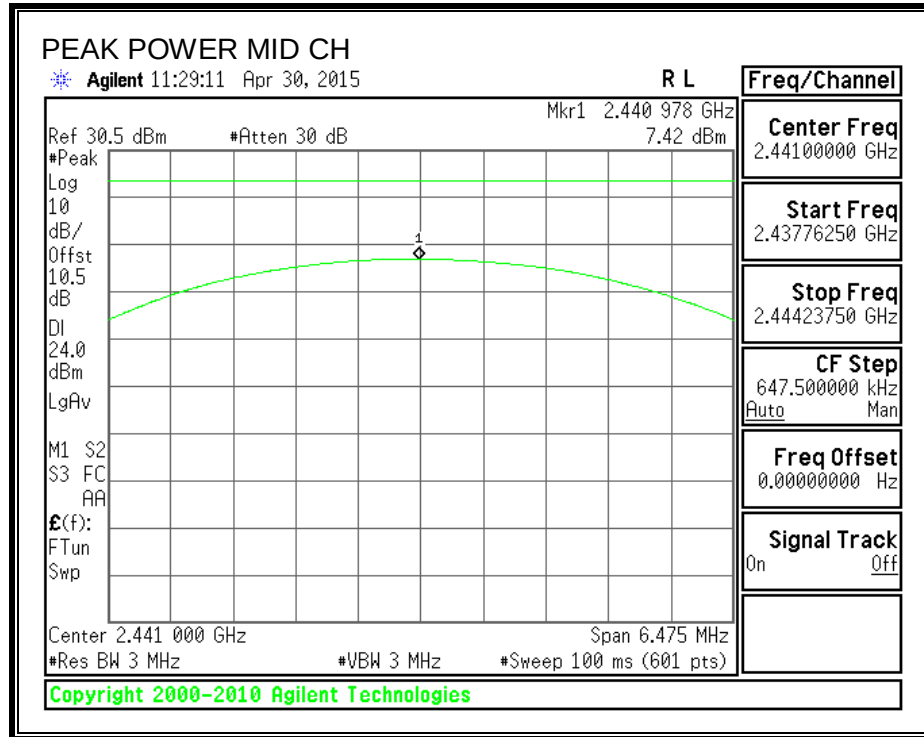
The transmitter output is connected to a spectrum analyzer the analyzer bandwidth is set to a value greater than the 20 dB bandwidth of the EUT.

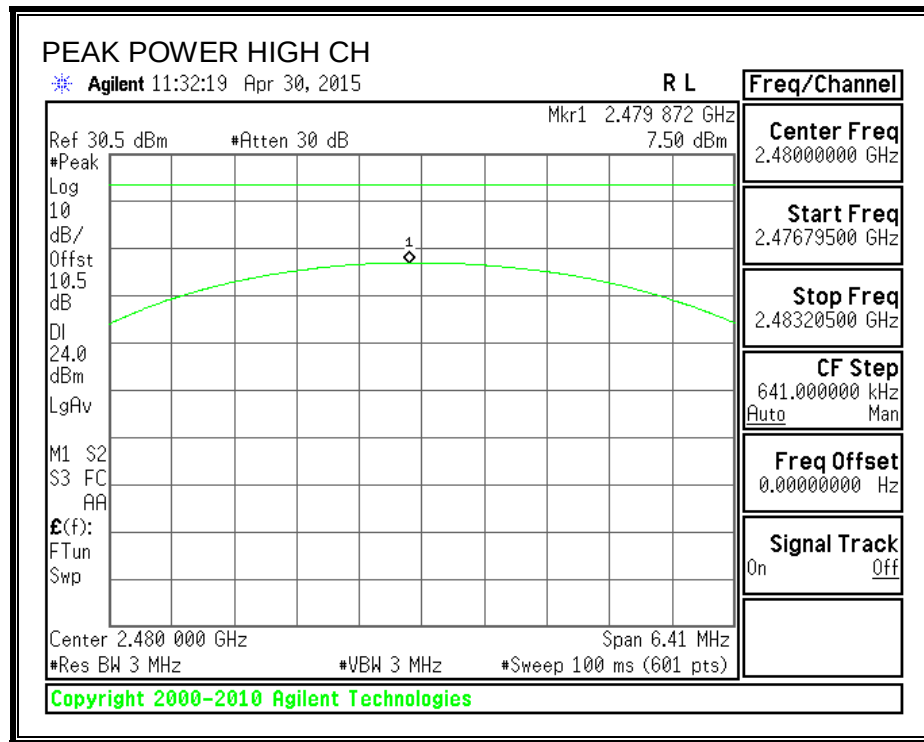
RESULTS – 8DPSK

Channel	Frequency (MHz)	Output Power (dBm)	Directional Gain (dBi)	Limit (dBm)	Margin (dB)
Low	2402	6.69	3.00	30	-23.31
Middle	2441	7.42	3.00	30	-22.58
High	2480	7.50	3.00	30	-22.50

OUTPUT POWER







8.3.6. AVERAGE POWER

LIMIT

None; for reporting purposes only.

TEST PROCEDURE

The transmitter output is connected to a power meter.

RESULTS – 8DPSK

The cable assembly insertion loss of 10.54 dB (including 10 dB pad and 0.54 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	5.38
Middle	2441	6.06
High	2480	5.87

8.3.7. CONDUCTED SPURIOUS EMISSIONS

LIMITS

FCC §15.247 (d)

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

TEST PROCEDURE

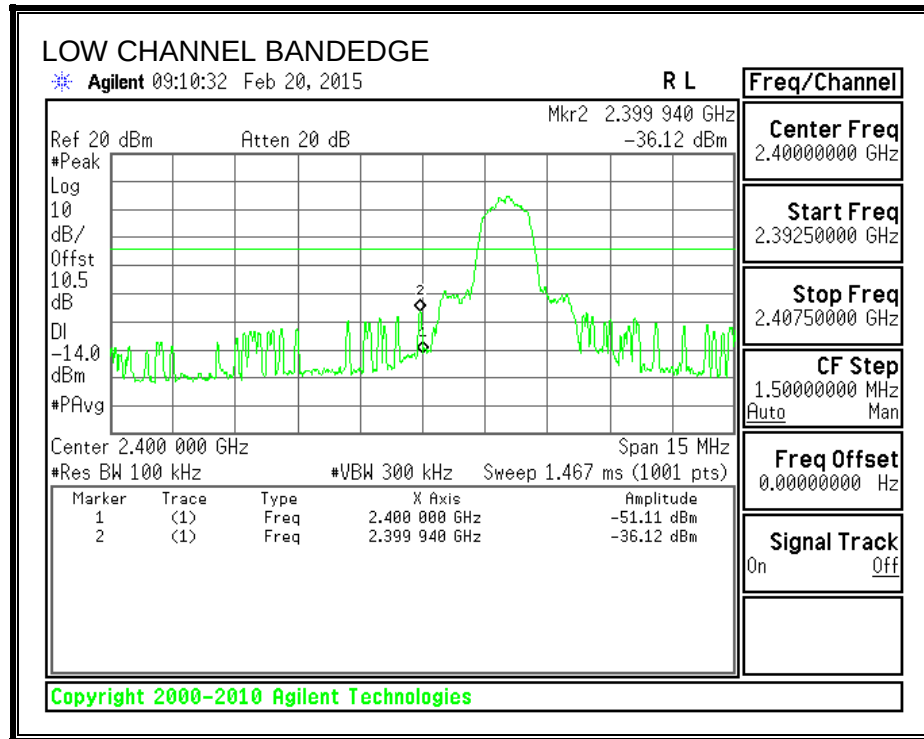
The transmitter output is connected to a spectrum analyzer. The resolution bandwidth is set to 100 kHz. The video bandwidth is set to 300 kHz.

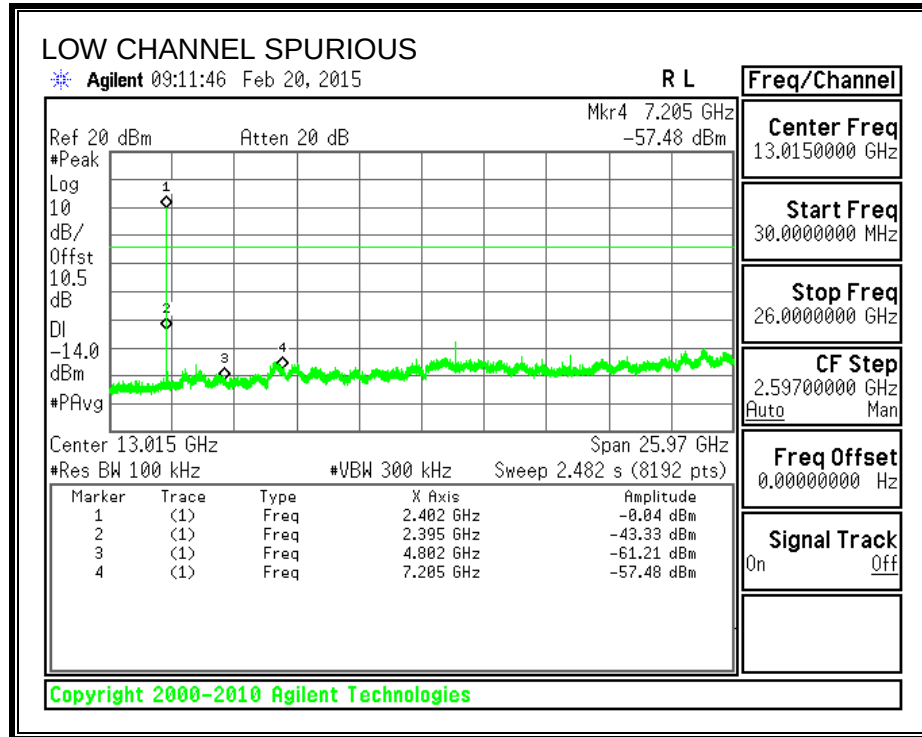
The spectrum from 30 MHz to 26 GHz is investigated with the transmitter set to the lowest, middle, and highest channels.

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

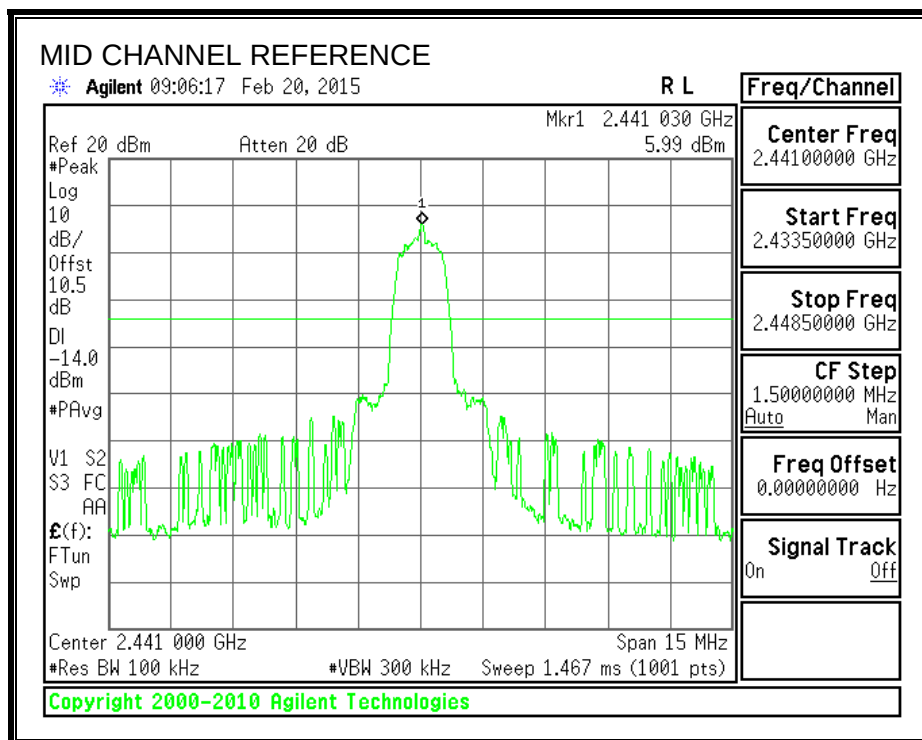
RESULTS – 8DPSK

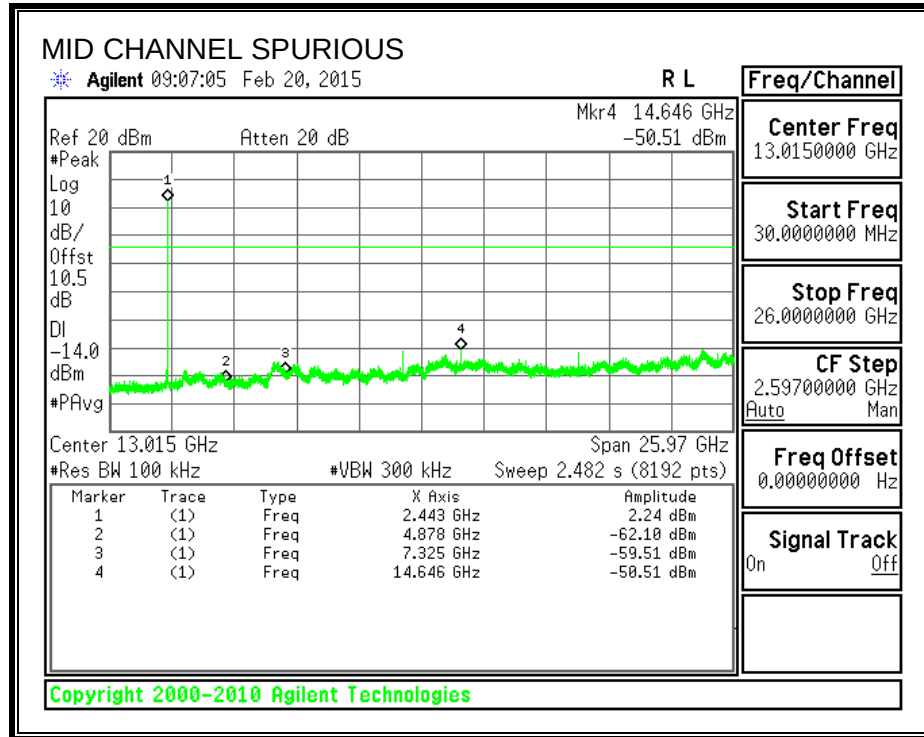
SPURIOUS EMISSIONS, LOW CHANNEL



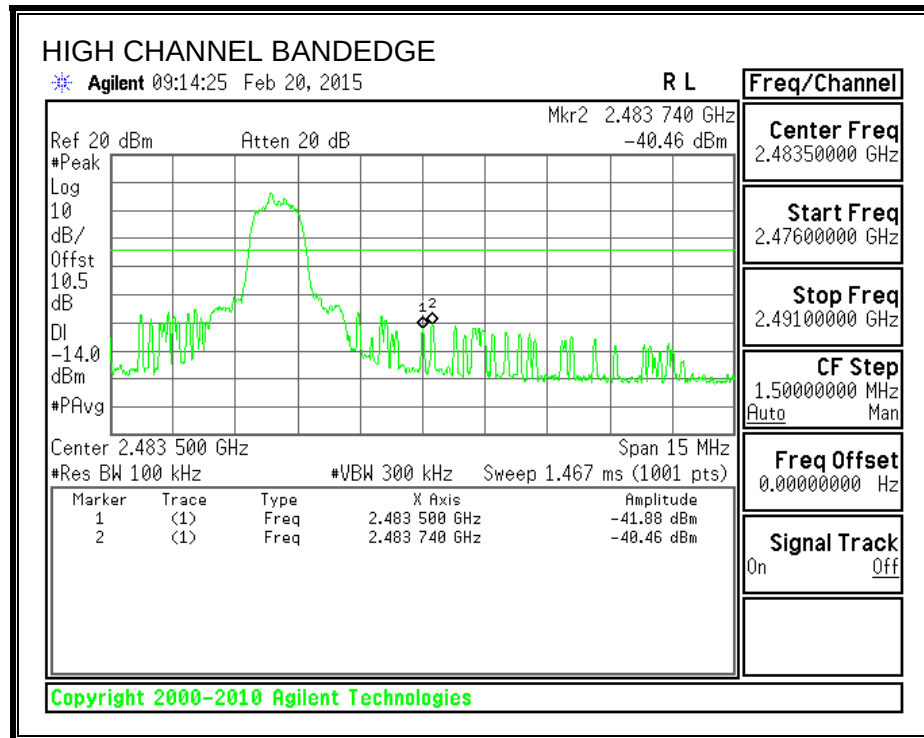


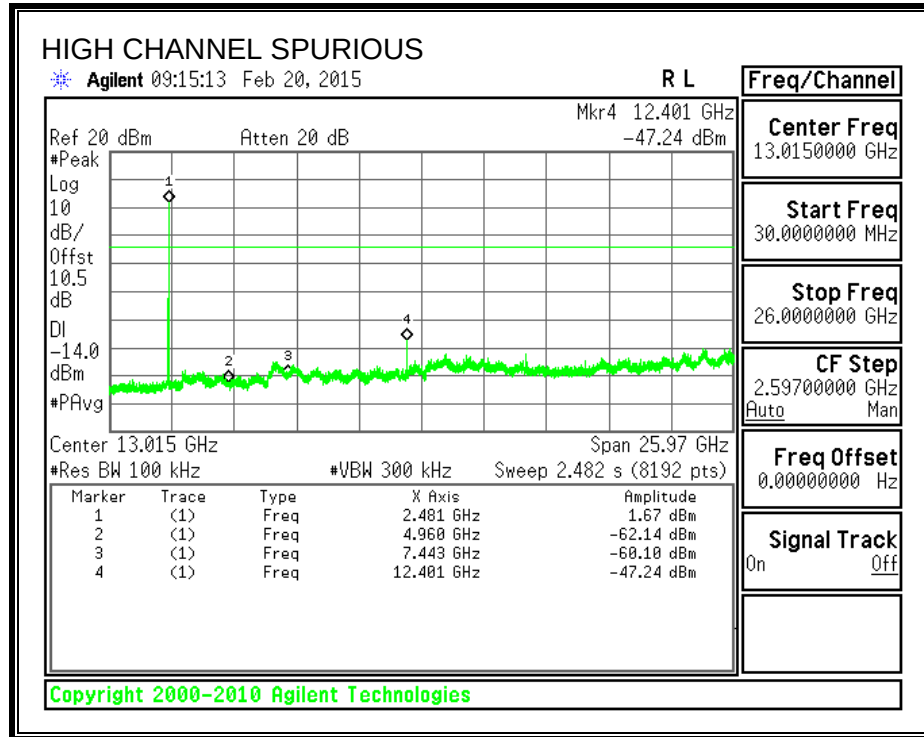
SPURIOUS EMISSIONS, MID CHANNEL



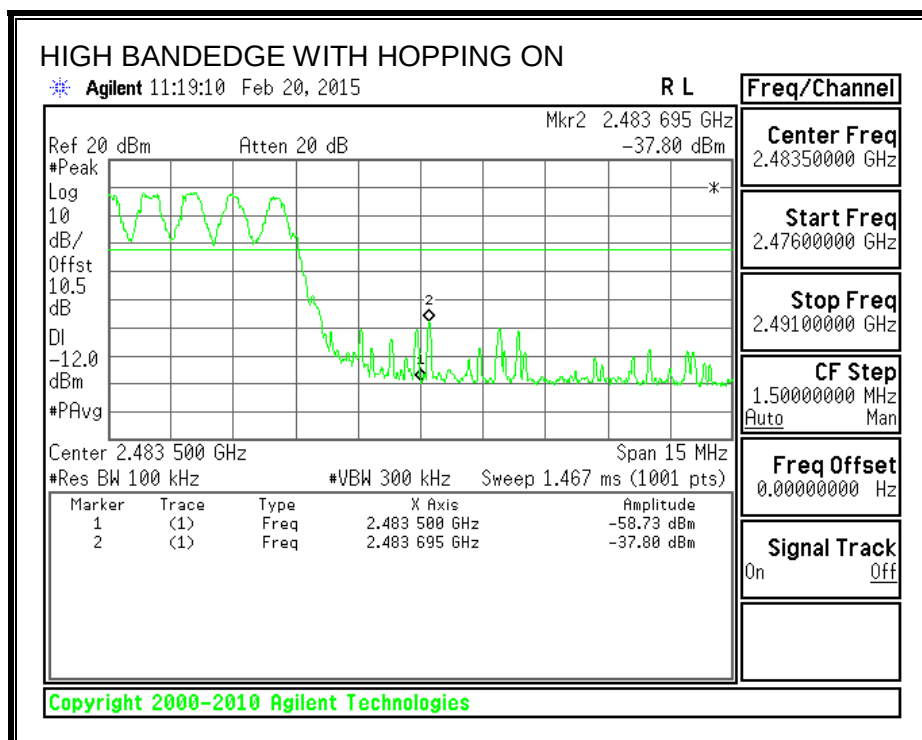
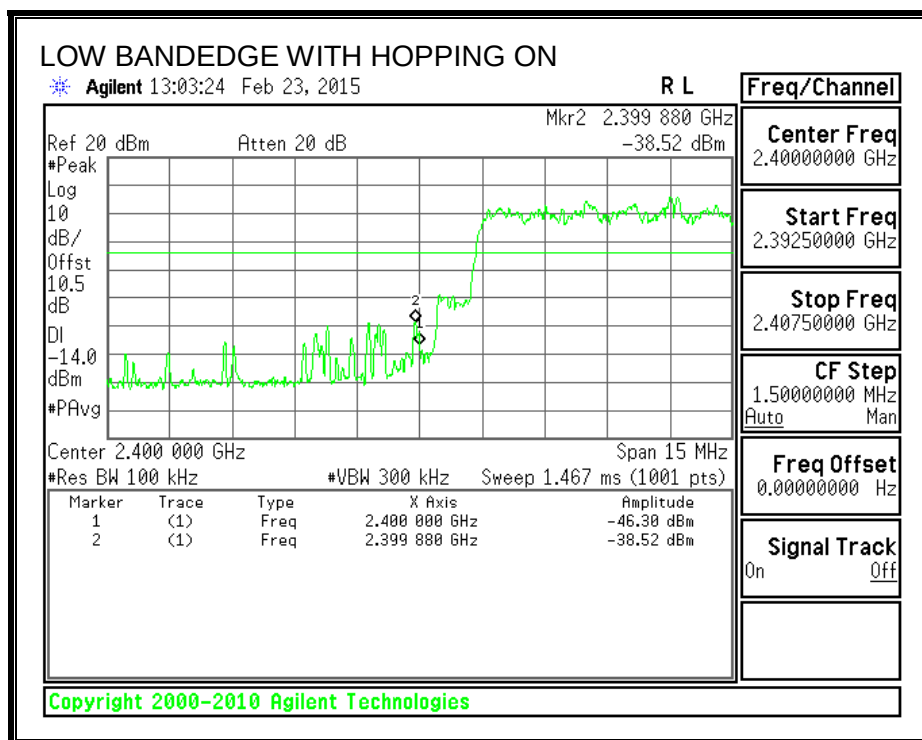


SPURIOUS EMISSIONS, HIGH CHANNEL





SPURIOUS BANDEDGE EMISSIONS WITH HOPPING ON



9. RADIATED TEST RESULTS

9.1. LIMITS AND PROCEDURE

LIMITS

FCC §15.205 and §15.209

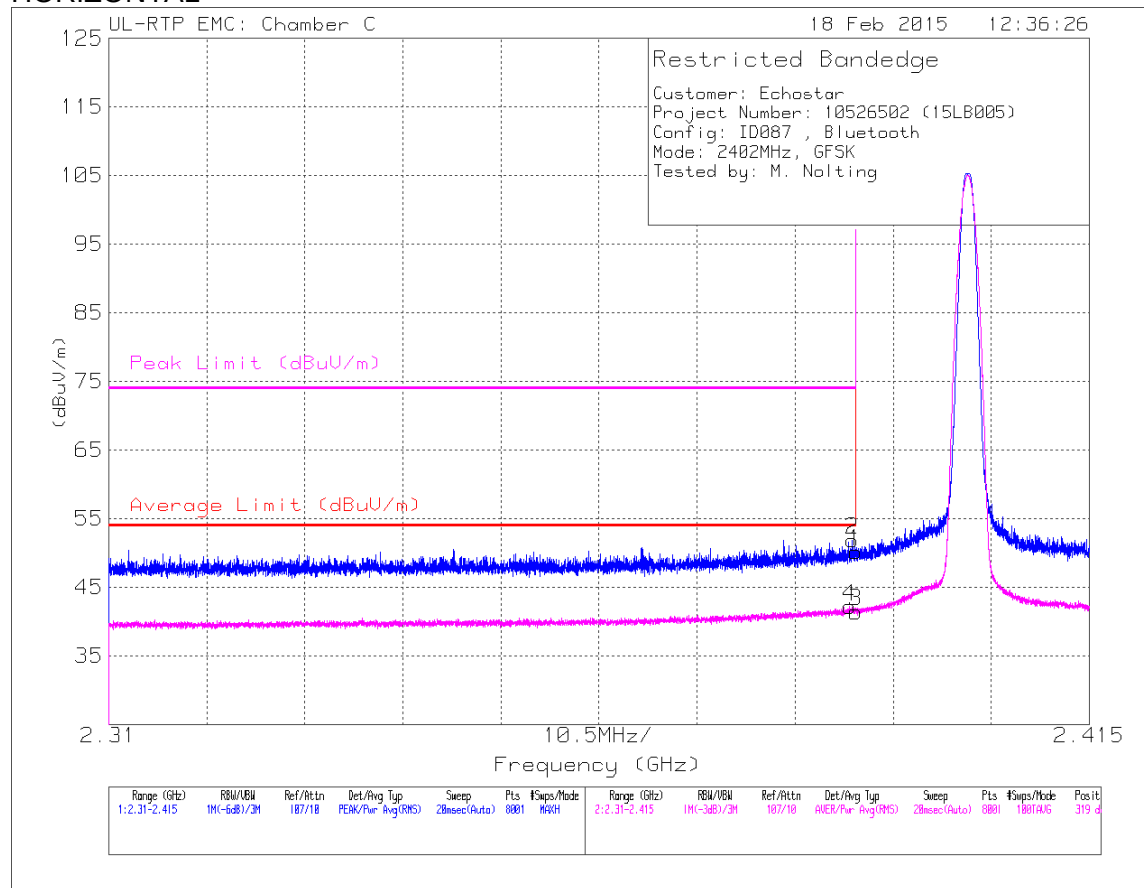
Frequency Range (MHz)	Field Strength Limit (uV/m) at 3 m	Field Strength Limit (dBuV/m) at 3 m
30 - 88	100	40
88 - 216	150	43.5
216 - 960	200	46
Above 960	500	54

9.2. TRANSMITTER ABOVE 1 GHz

9.2.1. BASIC DATA RATE GFSK MODULATION

RESTRICTED BANDEGE (LOW CHANNEL)

HORIZONTAL



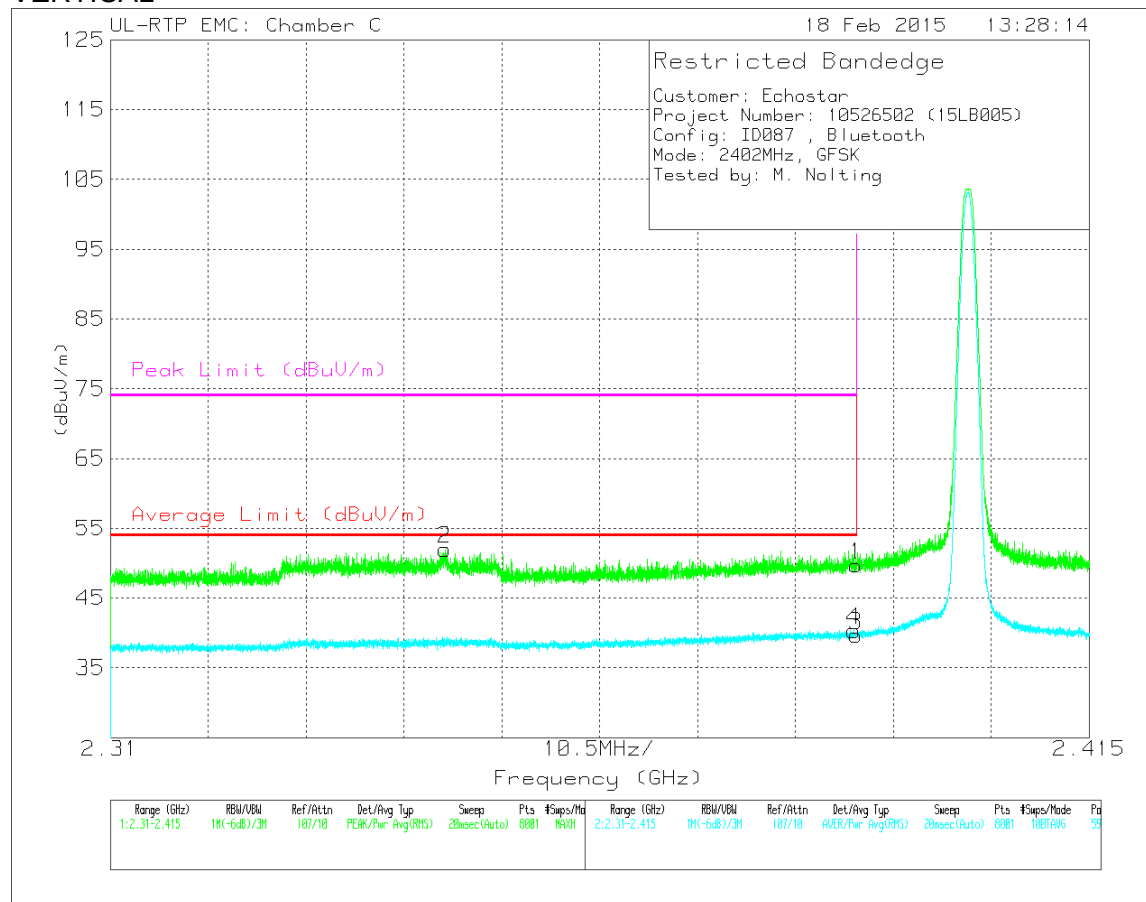
Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AT0067 (dB/m)	Amp/Cbl/ Fltr/Pad	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.39	44.6	Pk	32.3	-26.7	50.2	-	-	74	-23.8	319	133	H
2	* 2.39	46.3	Pk	32.3	-26.7	51.9	-	-	74	-22.1	319	133	H
3	* 2.39	35.86	RMS	32.3	-26.7	41.46	54	-12.54	-	-	319	133	H
4	* 2.389	36.59	RMS	32.3	-26.7	42.19	54	-11.81	-	-	319	133	H

* - indicates frequency in CFR15.205/IC7.2.2 Restricted Band

Pk - Peak detector

RMS - RMS detection

VERTICAL



Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AT0067 (dB/m)	Amp/Cbl/ Ftr/Pad	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	44.12	Pk	32.3	-26.7	49.72	-	-	74	-24.28	59	292	V
2	* 2.346	46.68	Pk	32.1	-26.8	51.98	-	-	74	-22.02	59	292	V
3	* 2.39	34.06	RMS	32.3	-26.7	39.66	54	-14.34	-	-	59	292	V
4	* 2.39	34.74	RMS	32.3	-26.7	40.34	54	-13.66	-	-	59	292	V

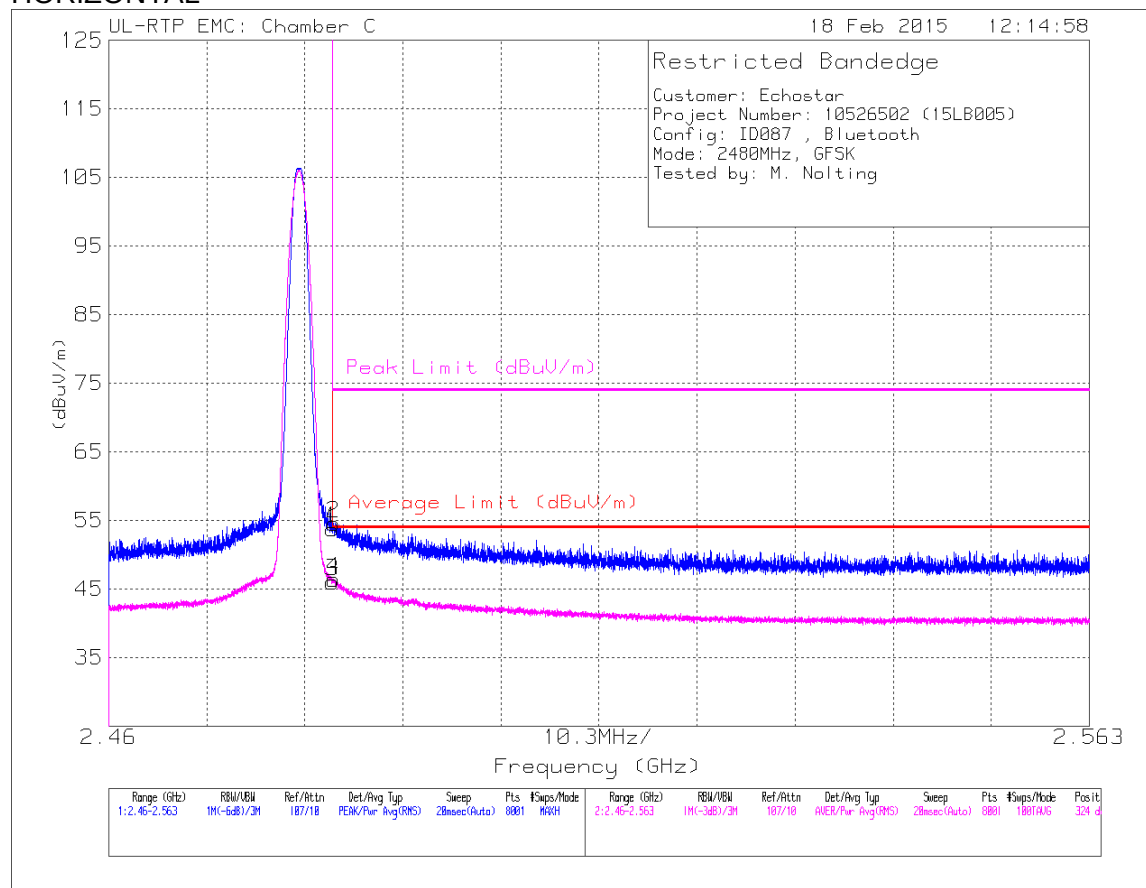
* - indicates frequency in CFR15.205/IC7.2.2 Restricted Band

Pk - Peak detector

RMS - RMS detection

RESTRICTED BANDEDGE (HIGH CHANNEL)

HORIZONTAL



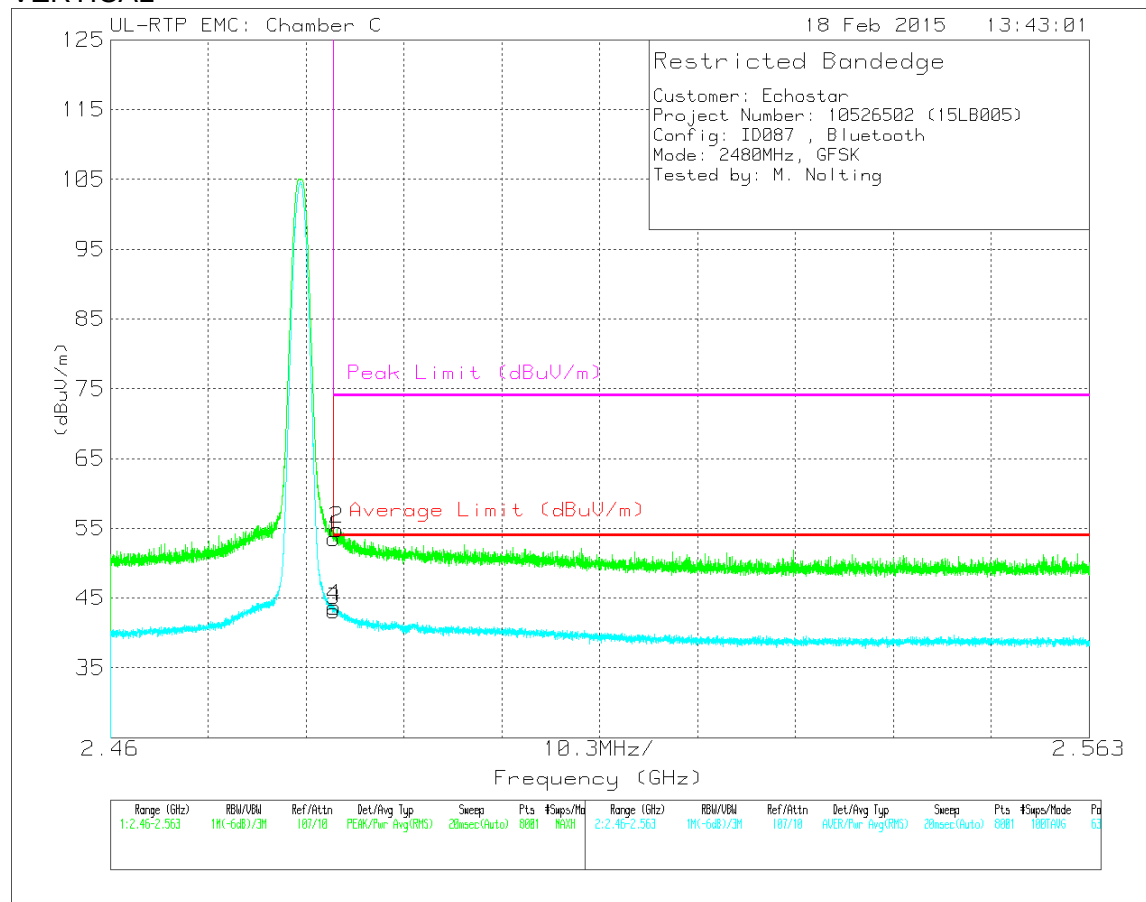
Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AT0067 (dB/m)	Amp/Cbl/ Ftr/Pad	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.484	47.65	Pk	32.6	-26.5	53.75	-	-	74	-20.25	324	128	H
2	* 2.484	48.47	Pk	32.6	-26.5	54.57	-	-	74	-19.43	324	128	H
3	* 2.484	39.95	RMS	32.6	-26.5	46.05	54	-7.95	-	-	324	128	H
4	* 2.484	40.32	RMS	32.6	-26.5	46.42	54	-7.58	-	-	324	128	H

* - indicates frequency in CFR15.205/IC7.2.2 Restricted Band

Pk - Peak detector

RMS - RMS detection

VERTICAL



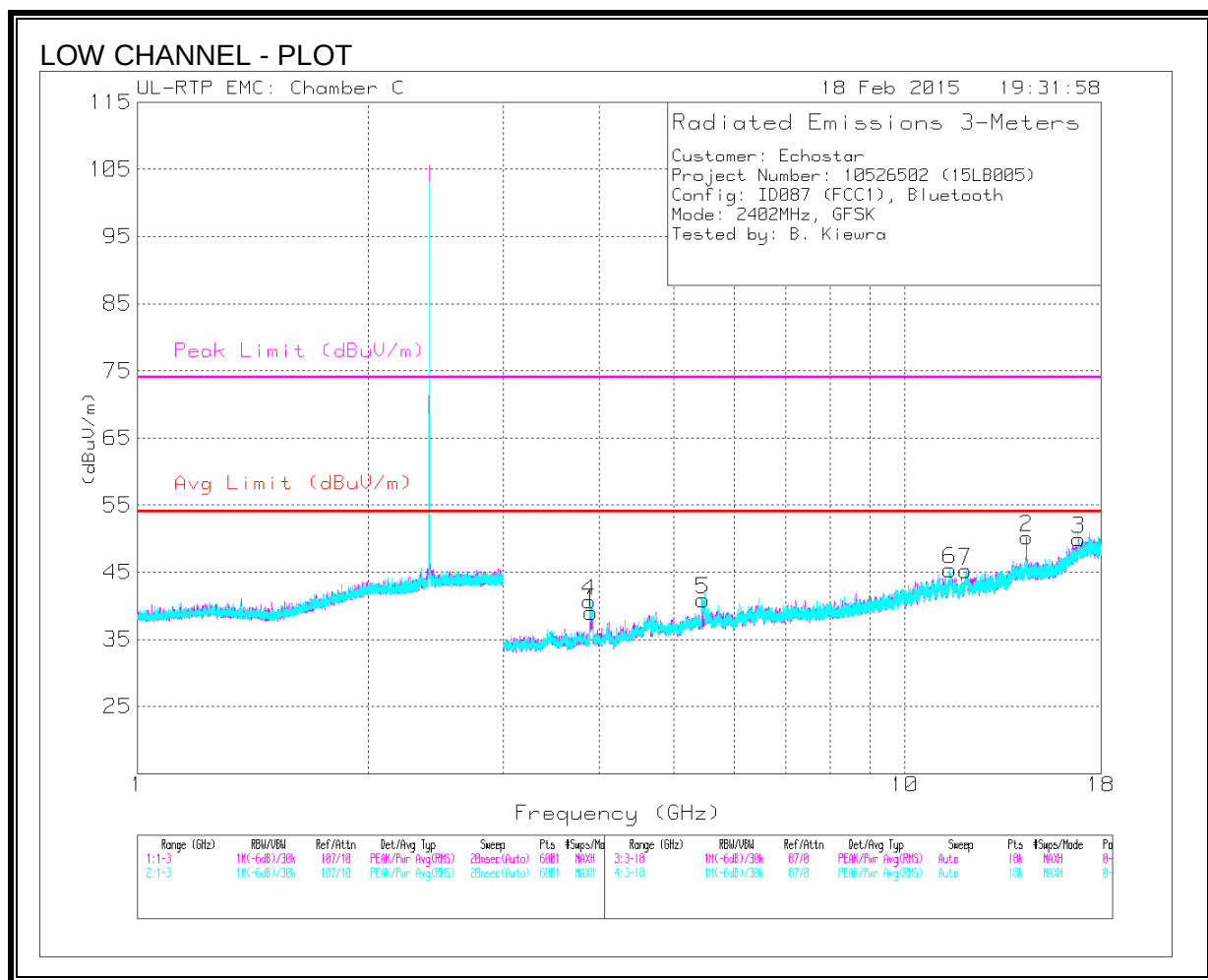
Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AT0067 (dB/m)	Amp/Cbl/ Ftr/Pad	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.484	47.44	Pk	32.6	-26.5	53.54	-	-	74	-20.46	63	347	V
2	* 2.484	48.75	Pk	32.6	-26.5	54.85	-	-	74	-19.15	63	347	V
3	* 2.484	37.11	RMS	32.6	-26.5	43.21	54	-10.79	-	-	63	347	V
4	* 2.484	37.6	RMS	32.6	-26.5	43.7	54	-10.3	-	-	63	347	V

* - indicates frequency in CFR15.205/IC7.2.2 Restricted Band

Pk - Peak detector

RMS - RMS detection

HARMONICS AND SPURIOUS EMISSIONS



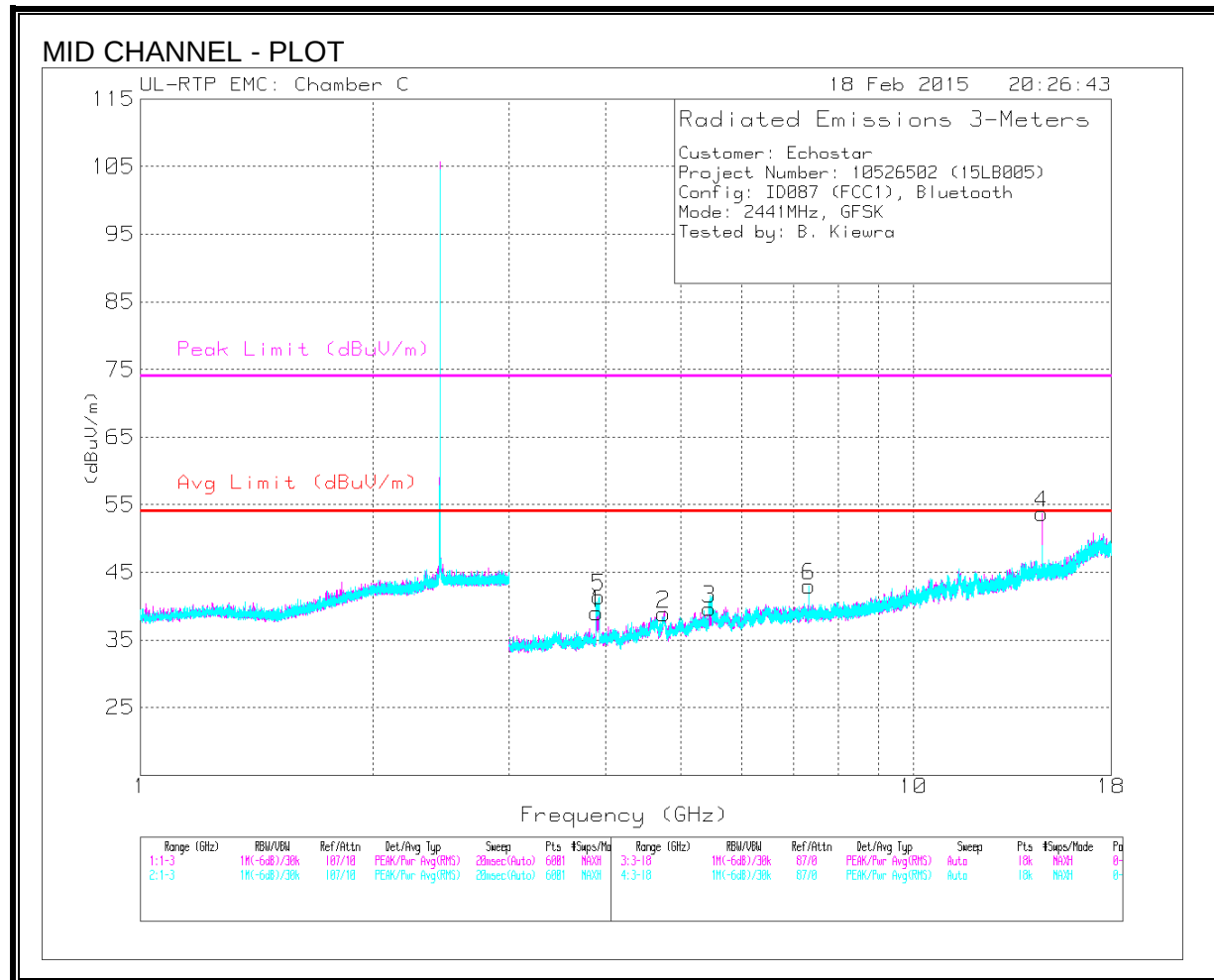
Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AT0067 (dB/m)	Amp/Cbl/ Fltr/Pad	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 3.891	51.62	PK2	33.7	-34.5	50.82	-	-	74	-23.18	136	371	H
	* 3.89	46.19	MAv1	33.7	-34.5	45.39	54	-8.61	-	-	136	371	H
4	* 3.883	50.87	PK2	33.7	-34.5	50.07	-	-	74	-23.93	66	294	V
	* 3.89	45.49	MAv1	33.7	-34.5	44.69	54	-9.31	-	-	66	294	V
5	* 5.451	46.76	PK2	35.8	-32	50.56	-	-	74	-23.44	79	372	V
	* 5.457	41.33	MAv1	35.8	-31.9	45.23	54	-8.77	-	-	79	372	V
6	* 11.448	37.53	PK2	39.1	-23.9	52.73	-	-	74	-21.27	298	384	V
	* 11.448	32.98	MAv1	39.1	-23.9	48.18	54	-5.82	-	-	298	384	V
7	* 11.998	38.92	PK2	39.3	-25.1	53.12	-	-	74	-20.88	82	106	V
	* 12	33.76	MAv1	39.3	-25.1	47.96	54	-6.04	-	-	82	106	V
2	14.412	32.89	Pk	39.8	-22.5	50.19	-	-	74	-23.81	0-360	250	H
3	16.828	28.64	Pk	42.2	-20.9	49.94	-	-	74	-24.06	0-360	250	H

* - indicates frequency in CFR15.205/IC7.2.2 Restricted Band

Pk - Peak detector

PK2 - KDB558074 Method: Maximum Peak

MAv1 - KDB558074 Option 1 Maximum RMS Average



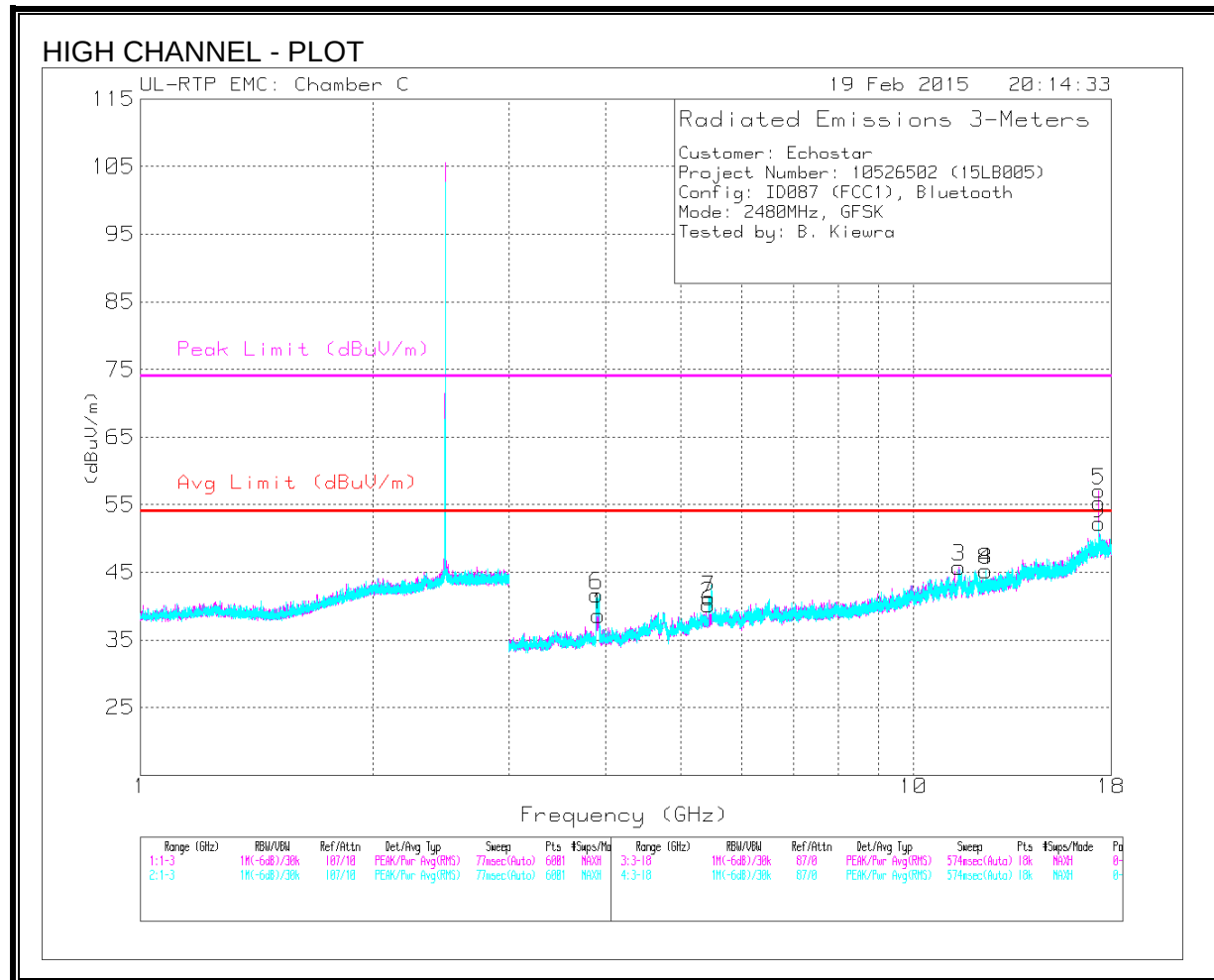
Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AT0067 (dB/m)	Amp/Cbl/ Fltr/Pad	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 3.89	51.84	PK2	33.7	-34.5	51.04	-	-	74	-22.96	136	371	H
	* 3.89	45.91	MAv1	33.7	-34.5	45.11	54	-8.89	-	-	136	371	H
2	* 4.753	45.21	PK2	35.3	-33.4	47.11	-	-	74	-26.89	127	306	H
	* 4.752	40.2	MAv1	35.3	-33.4	42.1	54	-11.9	-	-	127	306	H
3	* 5.446	44.72	PK2	35.8	-32	48.52	-	-	74	-25.48	110	368	H
	* 5.439	38.61	MAv1	35.8	-31.9	42.51	54	-11.49	-	-	110	368	H
5	* 3.89	51.06	PK2	33.7	-34.5	50.26	-	-	74	-23.74	70	297	V
	* 3.896	41.47	MAv1	33.7	-34.4	40.77	54	-13.23	-	-	70	297	V
6	* 7.323	43.74	PK2	36.2	-29.1	50.84	-	-	74	-23.16	297	242	V
	* 7.323	39.74	MAv1	36.2	-29.1	46.84	54	-7.16	-	-	297	242	V
4	14.646	37.02	PK	39.9	-23.2	53.72	-	-	74	-20.28	0-360	250	H

* - indicates frequency in CFR15.205/IC7.2.2 Restricted Band

Pk - Peak detector

PK2 - KDB558074 Method: Maximum Peak

MAv1 - KDB558074 Option 1 Maximum RMS Average



Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AT0067 (dB/m)	Amp/Cbl/ Fltr/Pad	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 3.889	51.41	PK2	33.7	-34.5	50.61	-	-	74	-23.39	130	370	H
	* 3.889	46.14	MAV1	33.7	-34.5	45.34	54	-8.66	-	-	130	370	H
2	* 5.449	44.14	PK2	35.8	-32	47.94	-	-	74	-26.06	119	251	H
	* 5.457	38.65	MAV1	35.8	-31.9	42.55	54	-11.45	-	-	119	251	H
3	* 11.447	37.74	PK2	39.1	-23.9	52.94	-	-	74	-21.06	294	382	H
	* 11.449	30.79	MAV1	39.1	-23.9	45.99	54	-8.01	-	-	294	382	H
4	* 12.4	40.92	PK2	39.3	-26	54.22	-	-	74	-19.78	217	248	H
	* 12.4	35.92	MAV1	39.3	-26	49.22	54	-4.78	-	-	217	248	H
6	* 3.889	52.05	PK2	33.7	-34.5	51.25	-	-	74	-22.75	76	264	V
	* 3.889	47.1	MAV1	33.7	-34.5	46.3	54	-7.7	-	-	76	264	V
7	* 5.447	47.07	PK2	35.8	-32	50.87	-	-	74	-23.13	77	232	V
	* 5.46	41.61	MAV1	35.8	-31.9	45.51	54	-8.49	-	-	77	232	V
8	* 12.4	41.42	PK2	39.3	-26	54.72	-	-	74	-19.28	44	203	V
	* 12.4	37.3	MAV1	39.3	-26	50.6	54	-3.4	-	-	44	203	V
5	17.36	35.07	Pk	42.2	-20.2	57.07	-	-	74	-16.93	0-360	250	H
9	17.36	30.24	Pk	42.2	-20.2	52.24	-	-	74	-21.76	0-360	250	V

* - indicates frequency in CFR15.205/IC7.2.2 Restricted Band

Pk - Peak detector

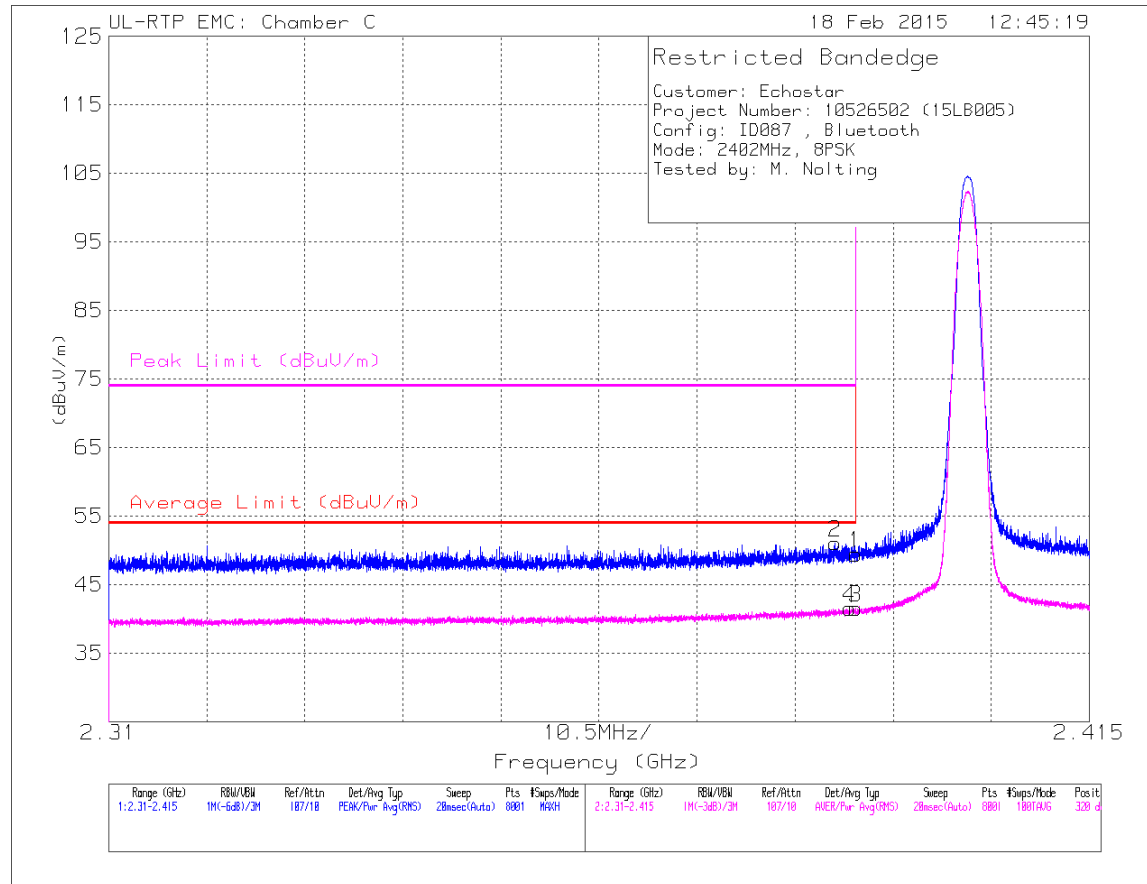
PK2 - KDB558074 Method: Maximum Peak

MAV1 - KDB558074 Option 1 Maximum RMS Average

9.2.2. ENHANCED DATA RATE 8DPSK MODULATION

RESTRICTED BANDEDGE (LOW CHANNEL)

HORIZONTAL



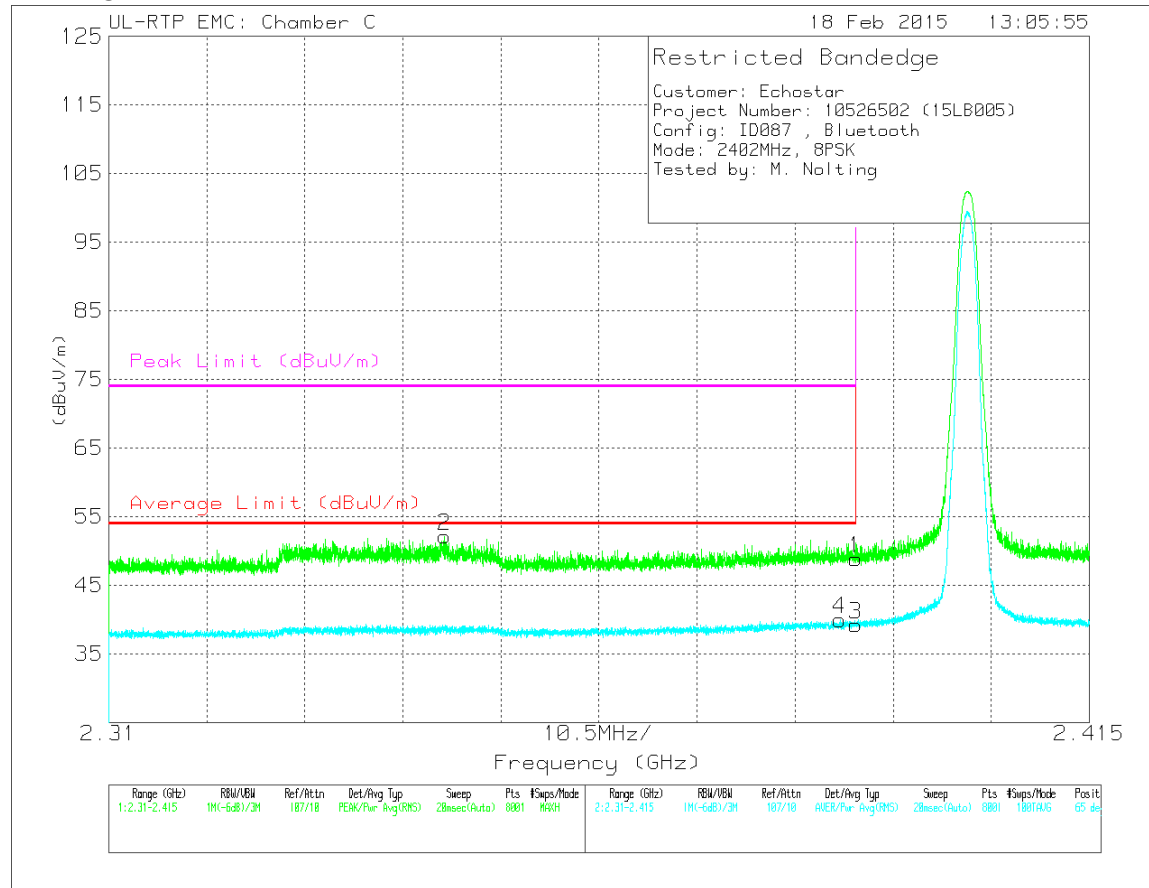
Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AT0067 (dB/m)	Amp/Cbl/ Fltr/Pad	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
2	* 2.388	45.52	Pk	32.3	-26.7	51.12	-	-	74	-22.88	320	136	H
4	* 2.389	35.96	RMS	32.3	-26.7	41.56	54	-12.44	-	-	320	136	H
1	* 2.39	43.87	Pk	32.3	-26.7	49.47	-	-	74	-24.53	320	136	H
3	* 2.39	35.99	RMS	32.3	-26.7	41.59	54	-12.41	-	-	320	136	H

* - indicates frequency in CFR15.205/IC7.2.2 Restricted Band

Pk - Peak detector

RMS - RMS detection

VERTICAL



Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AT0067 (dB/m)	Amp/Cbl/ Fitr/Pad	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	43.3	Pk	32.3	-26.7	48.9	-	-	74	-25.1	65	284	V
2	* 2.346	46.87	Pk	32.1	-26.8	52.17	-	-	74	-21.83	65	284	V
3	* 2.39	33.64	RMS	32.3	-26.7	39.24	54	-14.76	-	-	65	284	V
4	* 2.388	34.4	RMS	32.3	-26.7	40	54	-14	-	-	65	284	V

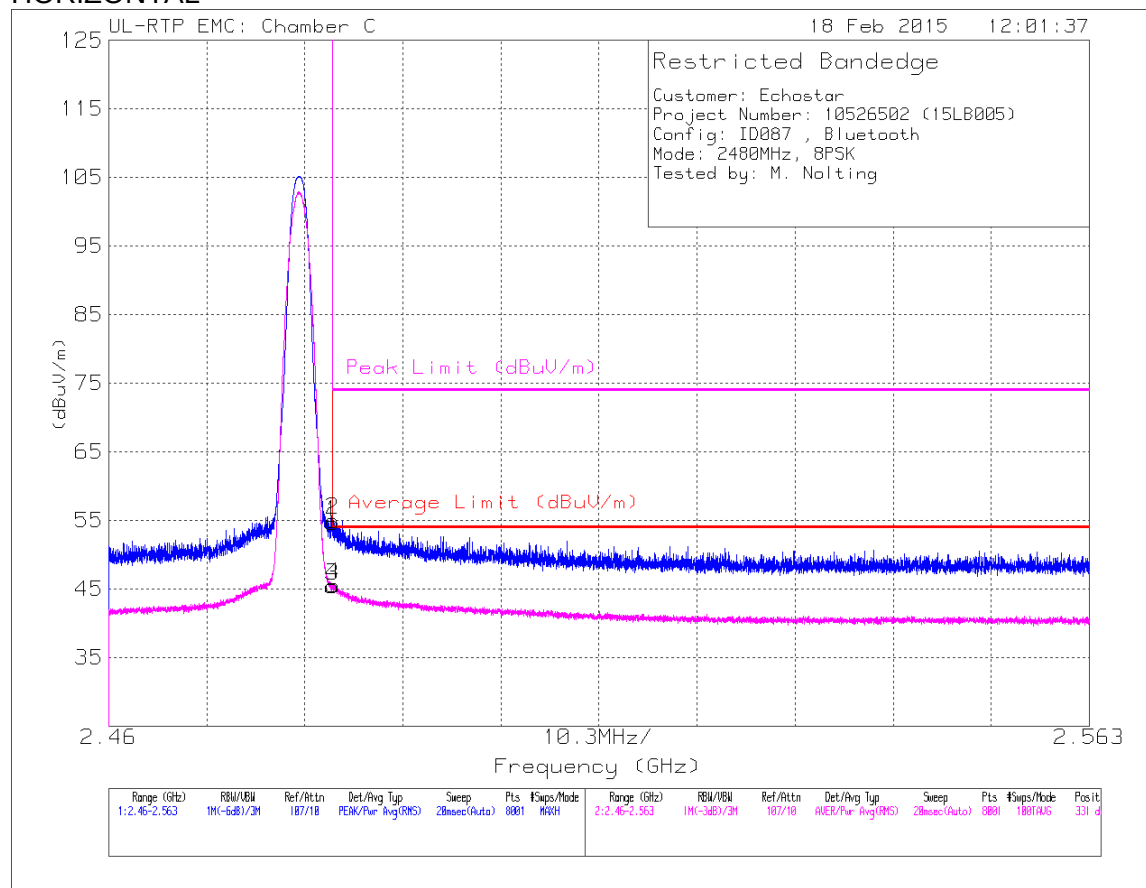
* - indicates frequency in CFR15.205/IC7.2.2 Restricted Band

Pk - Peak detector

RMS - RMS detection

RESTRICTED BANDEDGE (HIGH CHANNEL)

HORIZONTAL



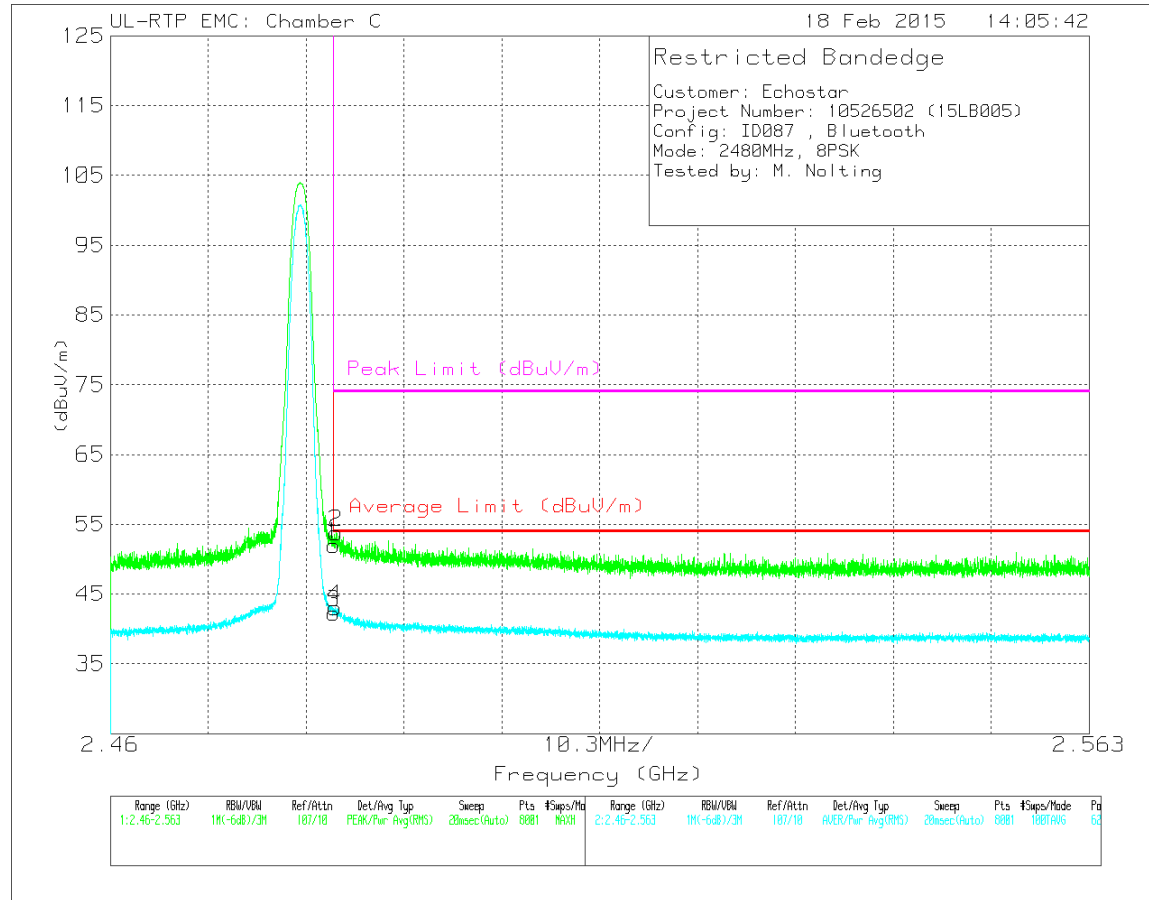
Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AT0067 (dB/m)	Amp/Cbl/ Ftr/Pad	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.484	48.55	Pk	32.6	-26.5	54.65	-	-	74	-19.35	331	128	H
2	* 2.484	48.92	Pk	32.6	-26.5	55.02	-	-	74	-18.98	331	128	H
3	* 2.484	39.32	RMS	32.6	-26.5	45.42	54	-8.58	-	-	331	128	H
4	* 2.484	39.45	RMS	32.6	-26.5	45.55	54	-8.45	-	-	331	128	H

* - indicates frequency in CFR15.205/IC7.2.2 Restricted Band

Pk - Peak detector

RMS - RMS detection

VERTICAL



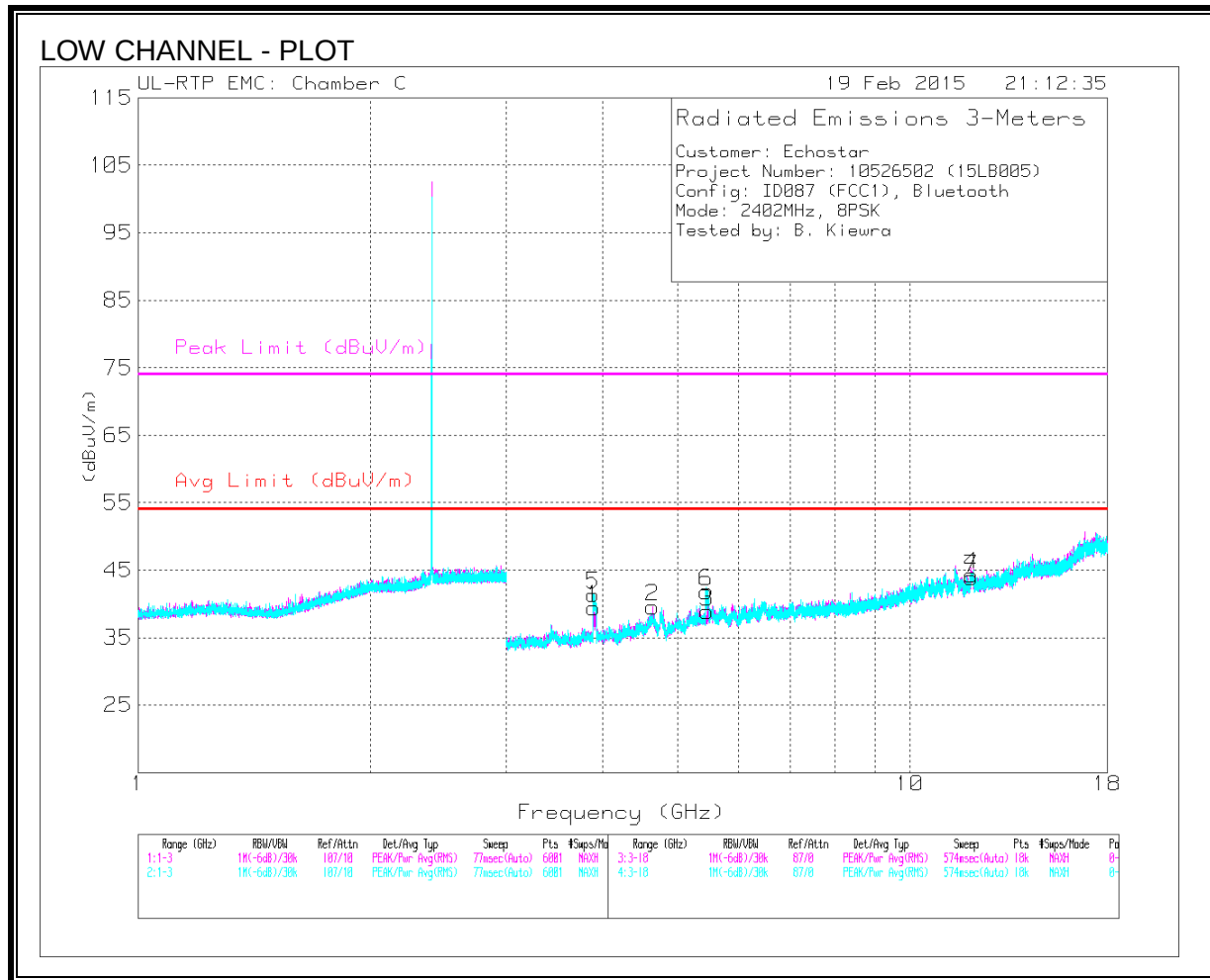
Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AT0067 (dB/m)	Amp/Cbl/ Ftr/Pad	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.484	45.89	Pk	32.6	-26.5	51.99	-	-	74	-22.01	62	346	V
2	* 2.484	47.72	Pk	32.6	-26.5	53.82	-	-	74	-20.18	62	346	V
3	* 2.484	36.19	RMS	32.6	-26.5	42.29	54	-11.71	-	-	62	346	V
4	* 2.484	36.95	RMS	32.6	-26.5	43.05	54	-10.95	-	-	62	346	V

* - indicates frequency in CFR15.205/IC7.2.2 Restricted Band

Pk - Peak detector

RMS - RMS detection

HARMONICS AND SPURIOUS EMISSIONS



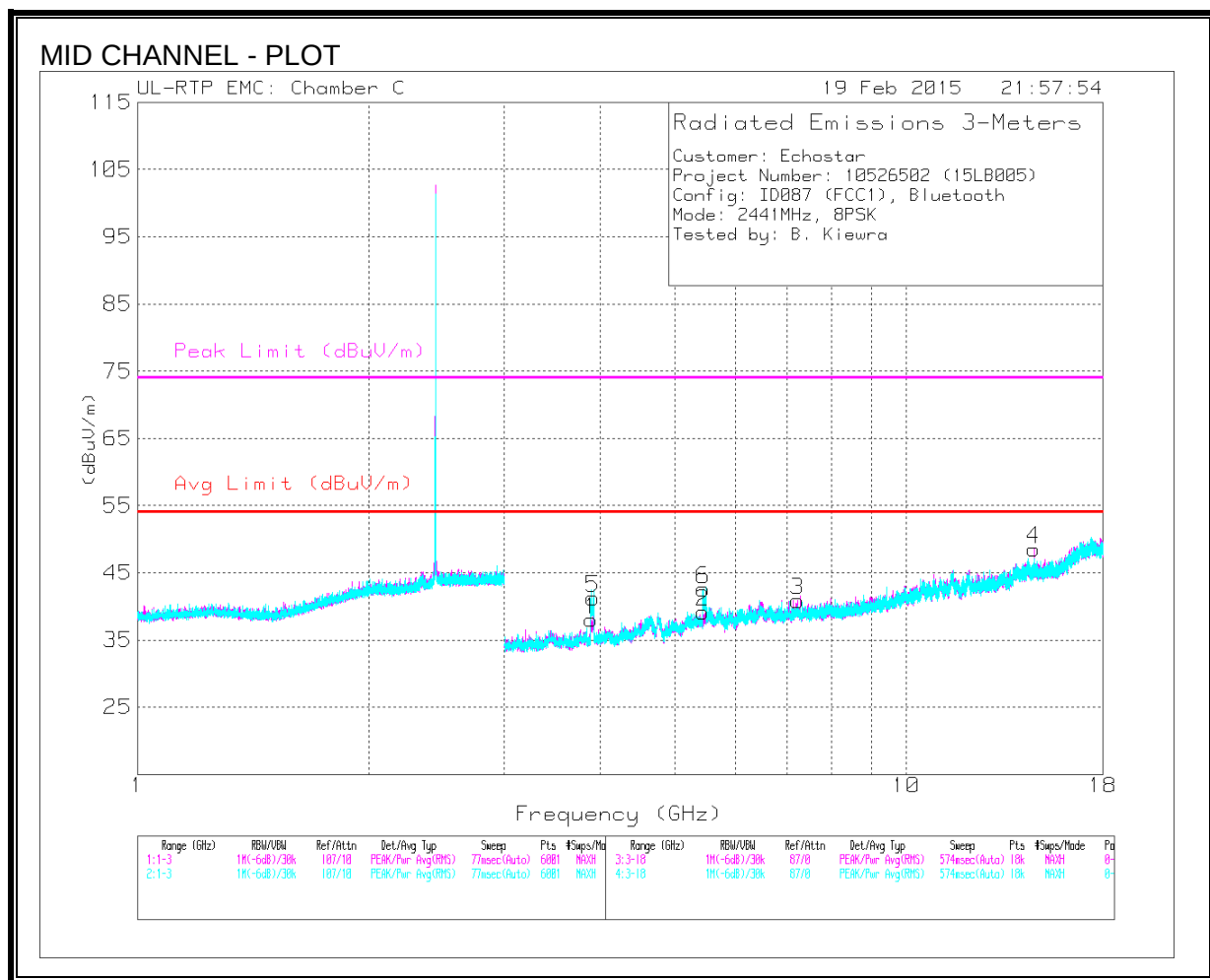
Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AT0067 (dB/m)	Amp/Cbl/ Fltr/Pad	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 3.889	52.77	PK2	33.7	-34.5	51.97	-	-	74	-22.03	136	370	H
	* 3.889	46.11	MAv1	33.7	-34.5	45.31	54	-8.69	-	-	136	370	H
2	* 4.641	44.63	PK2	35.1	-32.4	47.33	-	-	74	-26.67	32	301	H
	* 4.641	39.48	MAv1	35.1	-32.4	42.18	54	-11.82	-	-	32	301	H
3	* 5.451	42.92	PK2	35.8	-32	46.72	-	-	74	-27.28	75	369	H
	* 5.458	38.21	MAv1	35.8	-31.9	42.11	54	-11.89	-	-	75	369	H
4	* 12.01	38.96	PK2	39.3	-25	53.26	-	-	74	-20.74	53	300	H
	* 12.01	33.73	MAv1	39.3	-25	48.03	54	-5.97	-	-	53	300	H
5	* 3.889	52.14	PK2	33.7	-34.5	51.34	-	-	74	-22.66	72	287	V
	* 3.889	47.27	MAv1	33.7	-34.5	46.47	54	-7.53	-	-	72	287	V
6	* 5.445	48.06	PK2	35.8	-31.9	51.96	-	-	74	-22.04	79	372	V
	* 5.457	37.9	MAv1	35.8	-31.9	41.8	54	-12.2	-	-	79	372	V
7	* 12.009	38.3	PK2	39.3	-25	52.6	-	-	74	-21.4	319	128	V
	* 12.01	33.76	MAv1	39.3	-25	48.06	54	-5.94	-	-	319	128	V

* - indicates frequency in CFR15.205/IC7.2.2 Restricted Band

Pk - Peak detector

PK2 - KDB558074 Method: Maximum Peak

MAv1 - KDB558074 Option 1 Maximum RMS Average



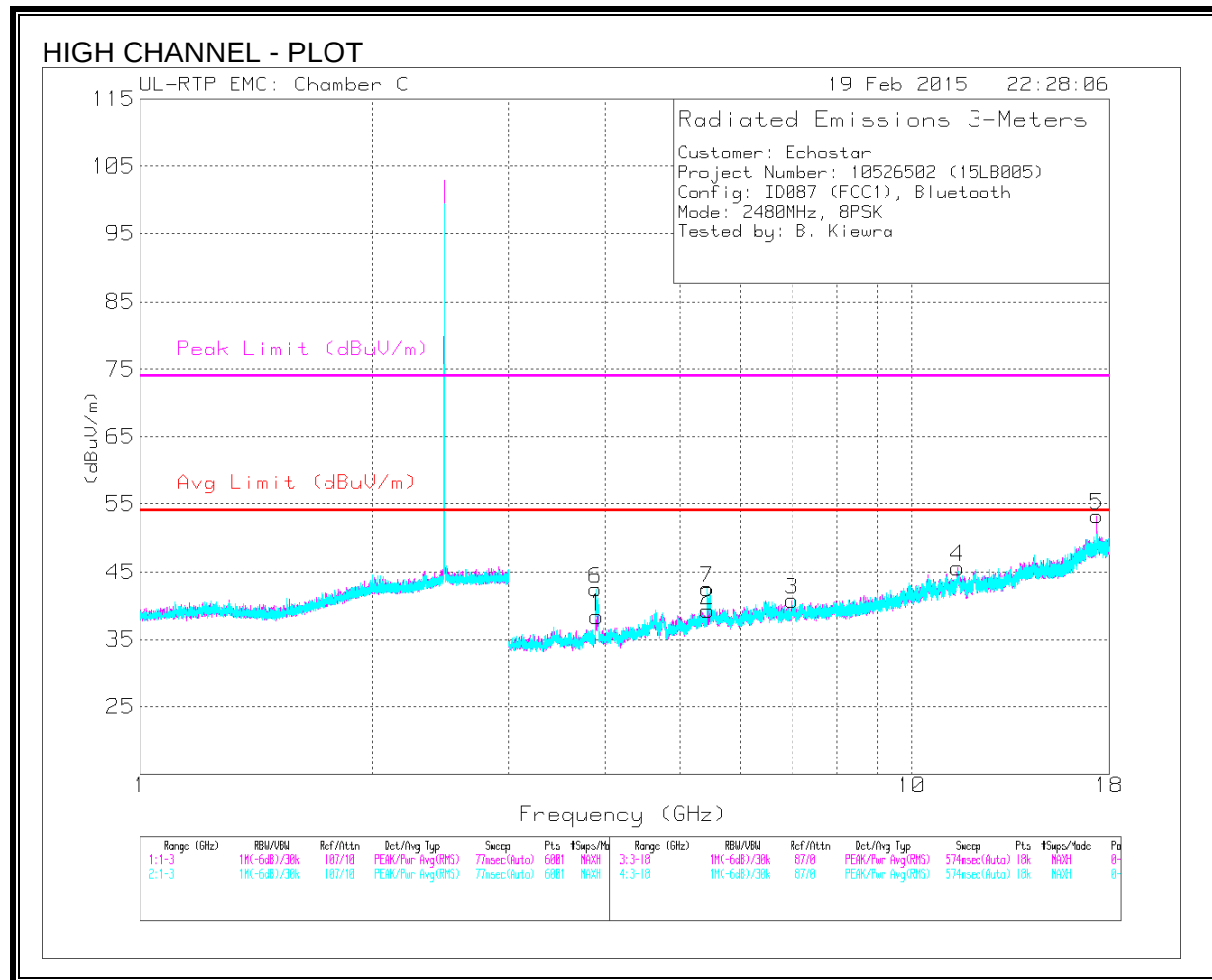
Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AT0067 (dB/m)	Amp/Cbl/Fltr/Pad	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 3.889	51.72	PK2	33.7	-34.5	50.92	-	-	74	-23.08	134	368	H
	* 3.889	46.7	MAv1	33.7	-34.5	45.9	54	-8.1	-	-	134	368	H
2	* 5.445	45.37	PK2	35.8	-31.9	49.27	-	-	74	-24.73	115	365	H
	* 5.454	36.55	MAv1	35.8	-32	40.35	54	-13.65	-	-	115	365	H
5	* 3.889	51.93	PK2	33.7	-34.5	51.13	-	-	74	-22.87	62	258	V
	* 3.889	46.23	MAv1	33.7	-34.5	45.43	54	-8.57	-	-	62	258	V
6	* 5.454	46.15	PK2	35.8	-32	49.95	-	-	74	-24.05	317	279	V
	* 5.448	40.65	MAv1	35.8	-32	44.45	54	-9.55	-	-	317	279	V
3	7.221	33.38	Pk	36.3	-28.8	40.88	-	-	74	-33.12	0-360	250	H
4	14.646	31.8	Pk	39.9	-23.2	48.5	-	-	74	-25.5	0-360	151	H

* - indicates frequency in CFR15.205/IC7.2.2 Restricted Band

Pk - Peak detector

PK2 - KDB558074 Method: Maximum Peak

MAv1 - KDB558074 Option 1 Maximum RMS Average



Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AT0067 (dB/m)	Amp/Cbl/Filtr/Pad	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 3.889	51.39	PK2	33.7	-34.5	50.59	-	-	74	-23.41	130	368	H
	* 3.889	46.23	MAv1	33.7	-34.5	45.43	54	-8.57	-	-	130	368	H
2	* 5.458	44.29	PK2	35.8	-31.9	48.19	-	-	74	-25.81	118	251	H
	* 5.448	35.95	MAv1	35.8	-32	39.75	54	-14.25	-	-	118	251	H
4	* 11.446	37.42	PK2	39.1	-23.9	52.62	-	-	74	-21.38	117	240	H
	* 11.447	33.12	MAv1	39.1	-23.9	48.32	54	-5.68	-	-	117	240	H
6	* 3.889	50.7	PK2	33.7	-34.5	49.9	-	-	74	-24.1	77	177	V
	* 3.889	45.54	MAv1	33.7	-34.5	44.74	54	-9.26	-	-	77	177	V
7	* 5.456	47.24	PK2	35.8	-31.9	51.14	-	-	74	-22.86	90	284	V
	* 5.454	41.73	MAv1	35.8	-32	45.53	54	-8.47	-	-	90	284	V
3	6.993	33.55	Pk	36	-28.8	40.75	-	-	74	-33.25	0-360	250	H
5	17.36	31.24	Pk	42.2	-20.2	53.24	-	-	74	-20.76	0-360	250	H

* - indicates frequency in CFR15.205/IC7.2.2 Restricted Band

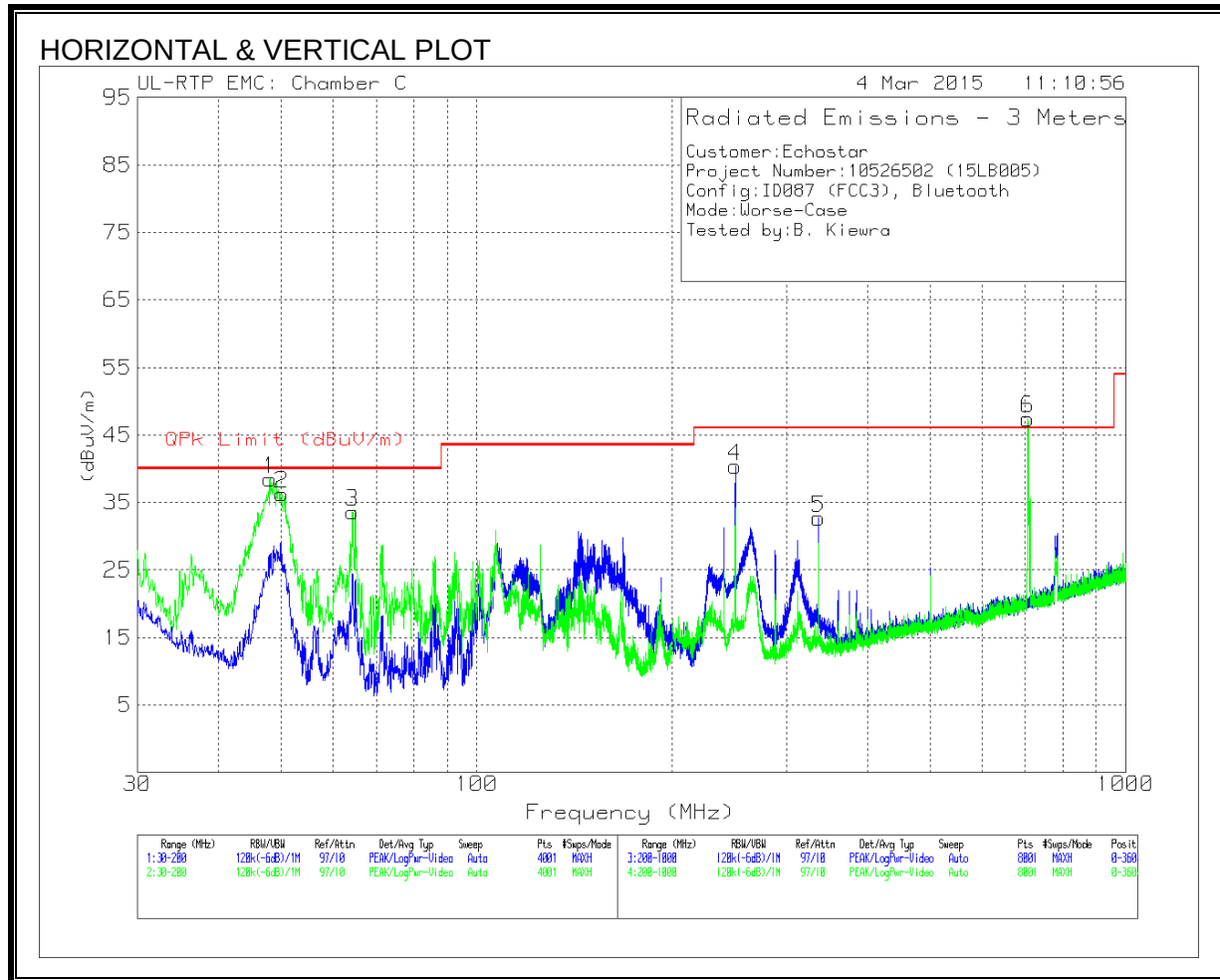
Pk - Peak detector

PK2 - KDB558074 Method: Maximum Peak

MAv1 - KDB558074 Option 1 Maximum RMS Average

9.3. WORST-CASE BELOW 1 GHz

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



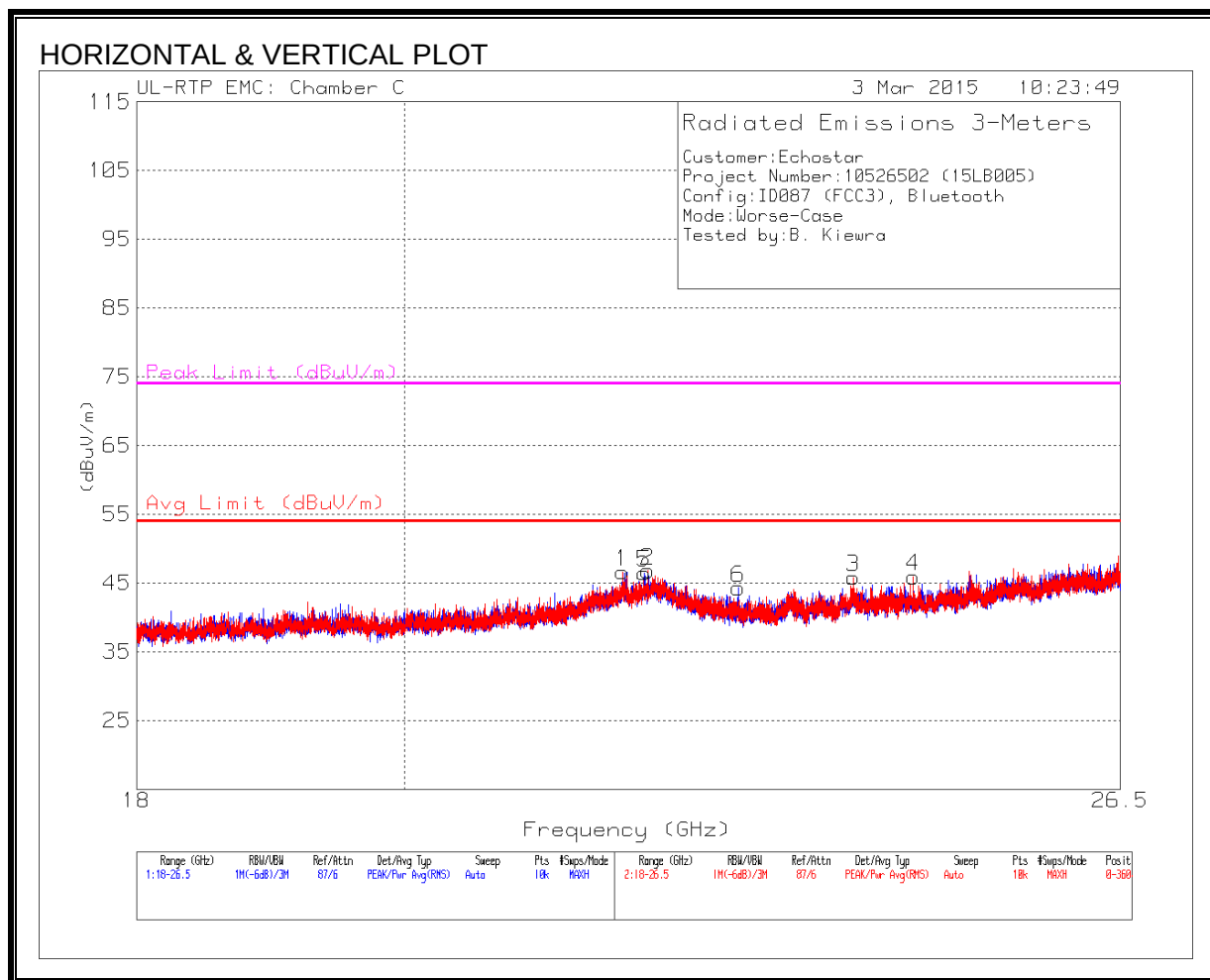
Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	AT0066 (dB/m)	Amp/Cbl (dB)	Corrected Reading (dBuV/m)	QPk Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
4	* 250.008	58.93	Qp	11.5	-30	40.43	46.02	-5.59	261	114	H
1	48.472	58.8	Qp	8.5	-31.4	35.9	40	-4.1	54	104	V
2	49.3025	56.56	Qp	8.1	-31.4	33.26	40	-6.74	108	104	V
3	64.3825	56.56	Pk	8.2	-31.2	33.56	40	-6.44	0-360	100	V
5	336.3	48.5	Pk	13.9	-29.7	32.7	46.02	-13.32	0-360	100	H
6	705.432	23.56	Qp	20.3	-28.7	15.16	46.02	-30.86	329	344	V

* - indicates frequency in CFR15.205/IC7.2.2 Restricted Band

Pk - Peak detector

9.4. WORST-CASE 18-26GHz

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



Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AT0063 (dB/m)	Amp/Cbl (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
6	* 22.804	41.7	Pk	33.9	-31.3	44.3	54	-9.7	74	-29.7	0-360	151	H
3	* 23.861	42.75	Pk	33.7	-30.6	45.85	54	-8.15	74	-28.15	0-360	151	V
1	21.789	42.12	Pk	36.4	-31.9	46.62	-	-	-	-	0-360	250	V
5	21.976	41.78	Pk	36.9	-32.2	46.48	-	-	-	-	0-360	250	H
2	22.006	42.11	Pk	36.9	-32.2	46.81	-	-	-	-	0-360	151	V
4	24.43	42.43	Pk	33.6	-30.1	45.93	-	-	-	-	0-360	151	V

* - indicates frequency in CFR15.205/IC7.2.2 Restricted Band

Pk - Peak detector

10. AC POWER LINE CONDUCTED EMISSIONS

LIMITS

FCC §15.207 (a)

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

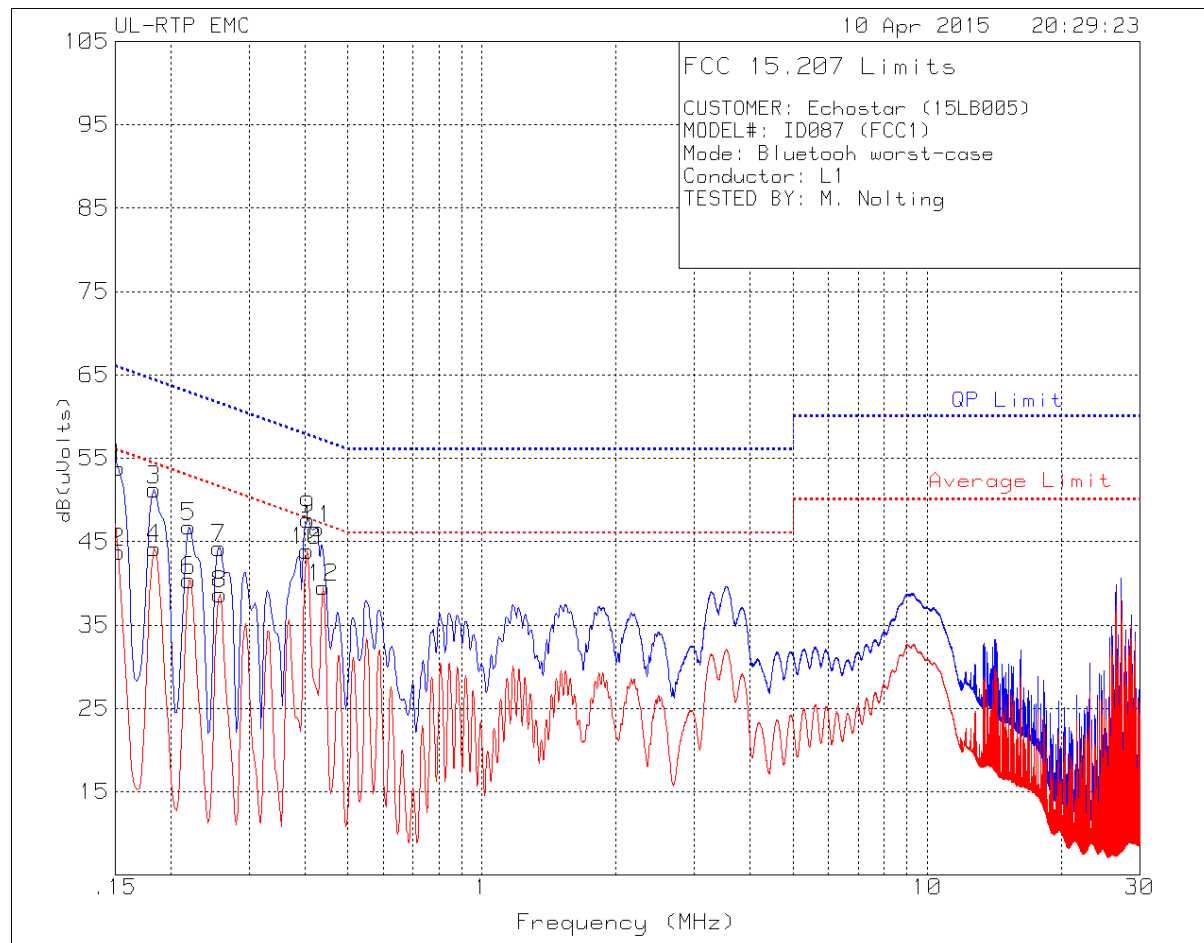
* Decreases with the logarithm of the frequency.

TEST PROCEDURE

Consistent with ANSI C63.4 and ANSI C63.10.

RESULTS

LINE 1 RESULTS

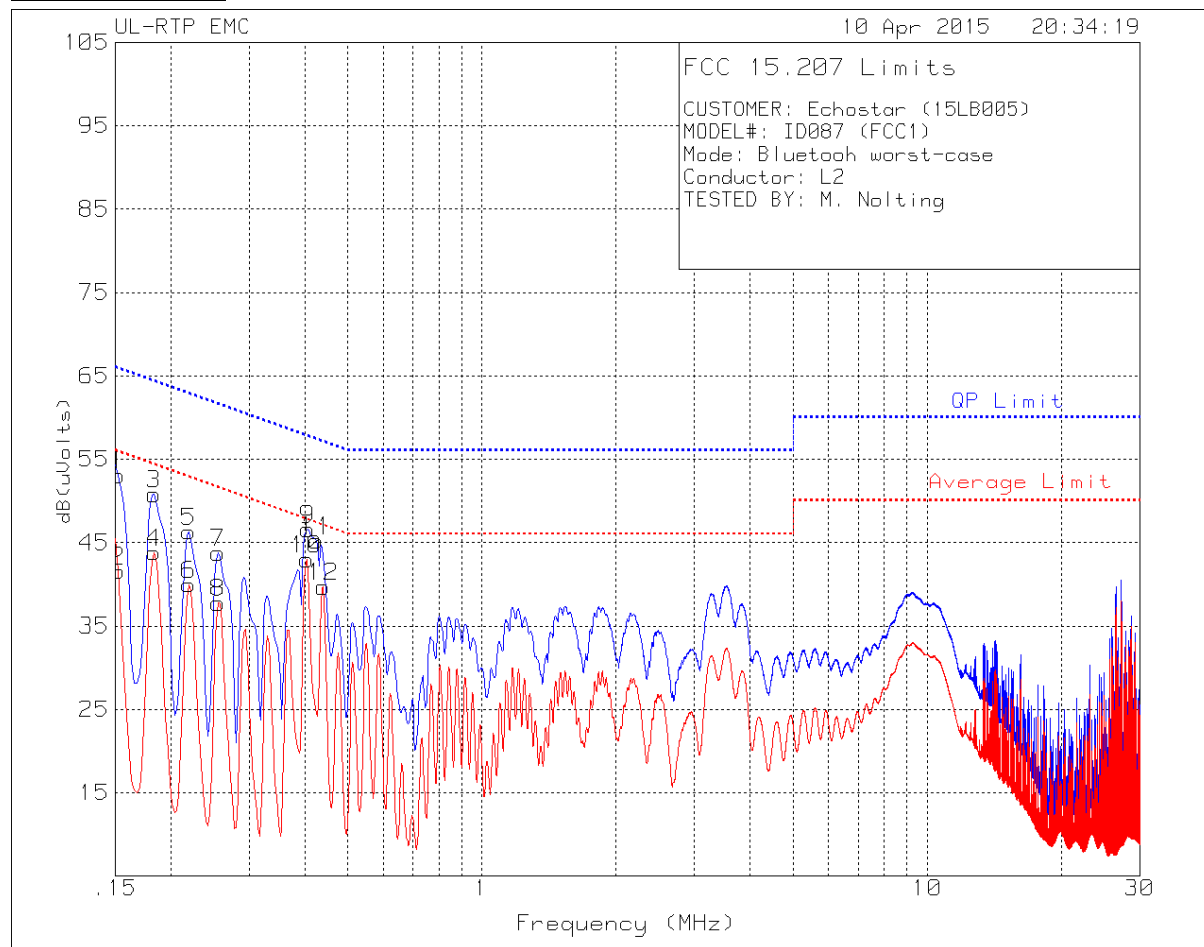


Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	LISN (dB)	Limiter & Cable (dB)	Corrected Reading (dBuV)	QP Limit	QP Margin (dB)	Average Limit	Average Margin (dB)
1	.15225	44.02	Qp	.4	9.4	53.82	65.88	-12.06	-	-
2	.15225	33.95	Ca	.4	9.4	43.75	-	-	55.88	-12.13
3	.18375	41.53	Qp	.3	9.4	51.23	64.31	-13.08	-	-
4	.18375	34.49	Ca	.3	9.4	44.19	-	-	54.31	-10.12
5	.21975	37.19	Qp	.2	9.4	46.79	62.83	-16.04	-	-
6	.21975	30.74	Ca	.2	9.4	40.34	-	-	52.83	-12.49
7	.25688	34.64	Qp	.2	9.4	44.24	61.53	-17.29	-	-
8	.258	29.1	Ca	.2	9.4	38.7	-	-	51.5	-12.8
10	.40425	34.41	Ca	.1	9.4	43.91	-	-	47.77	-3.86
9	.4065	38.13	Qp	.1	9.4	47.63	57.72	-10.09	-	-
11	.42675	37.04	Qp	.1	9.4	46.54	57.32	-10.78	-	-
12	.44025	30.01	Ca	.1	9.4	39.51	-	-	47.06	-7.55

Qp - Quasi-Peak detector

Ca - CISPR average detection

LINE 2 RESULTS



Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	LISN (dB)	Limiter & Cable (dB)	Corrected Reading (dBuV)	QP Limit	QP Margin (dB)	Average Limit	Average Margin (dB)
1	.15225	43.27	Qp	.4	9.4	53.07	65.88	-12.81	-	-
2	.15225	31.78	Ca	.4	9.4	41.58	-	-	55.88	-14.3
3	.18375	41.11	Qp	.3	9.4	50.81	64.31	-13.5	-	-
4	.18375	34.12	Ca	.3	9.4	43.82	-	-	54.31	-10.49
5	.21975	36.72	Qp	.2	9.4	46.32	62.83	-16.51	-	-
6	.21975	30.38	Ca	.2	9.4	39.98	-	-	52.83	-12.85
7	.25575	34.19	Qp	.2	9.4	43.79	61.57	-17.78	-	-
8	.25575	28.19	Ca	.2	9.4	37.79	-	-	51.57	-13.78
10	.40425	33.51	Ca	.1	9.4	43.01	-	-	47.77	-4.76
9	.4065	37.09	Qp	.1	9.4	46.59	57.72	-11.13	-	-
11	.4245	35.72	Qp	.1	9.4	45.22	57.36	-12.14	-	-
12	.44025	30.2	Ca	.1	9.4	39.7	-	-	47.06	-7.36

Qp - Quasi-Peak detector

Ca - CISPR average detection