



**FCC CFR47 PART 15 SUBPART C
INDUSTRY CANADA RSS-210 ISSUE 7**

CERTIFICATION TEST REPORT

FOR

BLUETOOTH INTERFACE BOARD FOR PRINTER

MODEL NUMBER: M224B

**FCC ID: BKMFBM224B
IC: 1052C-M224B**

REPORT NUMBER: 10J13472-1, Revision A

ISSUE DATE: NOVEMBER 23, 2010

Prepared for
**SEIKO EPSON CORPORATION
80 Harashinden Hirooka
Shiojiri, Nagano, 399-0785, JAPAN**

Prepared by
**COMPLIANCE CERTIFICATION SERVICES (UL CCS)
47173 BENICIA STREET
FREMONT, CA 94538, U.S.A.
TEL: (510) 771-1000
FAX: (510) 661-0888**



NVLAP LAB CODE 200065-0

Revision History

<u>Rev.</u>	<u>Issue Date</u>	<u>Revisions</u>	<u>Revised By</u>
--	11/16/10	Initial Issue	F. Ibrahim
A	11/23/10	Updated Test Equipment Cal & Due Date	T. Chan

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.....	6
5. EQUIPMENT UNDER TEST.....	7
5.1. DESCRIPTION OF EUT.....	7
5.2. MAXIMUM OUTPUT POWER.....	7
5.3. DESCRIPTION OF AVAILABLE ANTENNAS.....	7
5.4. SOFTWARE AND FIRMWARE.....	7
5.5. WORST-CASE CONFIGURATION AND MODE.....	7
5.6. DESCRIPTION OF TEST SETUP.....	8
6. TEST AND MEASUREMENT EQUIPMENT.....	10
7. ANTENNA PORT TEST RESULTS.....	11
7.1. BASIC DATA RATE GFSK MODULATION.....	11
7.1.1. 20 dB AND 99% BANDWIDTH.....	11
7.1.2. HOPPING FREQUENCY SEPARATION.....	18
7.1.3. NUMBER OF HOPPING CHANNELS.....	20
7.1.4. AVERAGE TIME OF OCCUPANCY.....	25
7.1.5. OUTPUT POWER.....	32
7.1.6. AVERAGE POWER.....	36
7.1.7. CONDUCTED SPURIOUS EMISSIONS.....	37
7.2. DQPSK MODULATION.....	46
7.2.1. OUTPUT POWER.....	46
7.2.2. AVERAGE POWER.....	50
7.3. ENHANCED DATA RATE 8PSK MODULATION.....	51
7.3.1. 20 dB AND 99% BANDWIDTH.....	51
7.3.2. HOPPING FREQUENCY SEPARATION.....	58
7.3.3. NUMBER OF HOPPING CHANNELS.....	60
7.3.4. AVERAGE TIME OF OCCUPANCY.....	65
7.3.5. OUTPUT POWER.....	72
7.3.6. AVERAGE POWER.....	76
7.3.7. CONDUCTED SPURIOUS EMISSIONS.....	77
8. RADIATED TEST RESULTS.....	86
8.1. LIMITS AND PROCEDURE.....	86

8.2.	TRANSMITTER ABOVE 1 GHz.....	87
8.2.1.	BASIC DATA RATE GFSK MODULATION.....	87
8.2.2.	ENHANCED DATA RATE 8PSK MODULATION.....	96
8.3.	RECEIVER ABOVE 1 GHz.....	105
8.4.	WORST-CASE BELOW 1 GHz.....	106
9.	AC POWER LINE CONDUCTED EMISSIONS.....	109
10.	MAXIMUM PERMISSIBLE EXPOSURE.....	113
11.	SETUP PHOTOS.....	117

1. ATTESTATION OF TEST RESULTS

COMPANY NAME: SEIKO EPSON CORPORATION
80 Harashinden Hirooka
Shiojiri, Nagano, 399-0785, JAPAN

EUT DESCRIPTION: Bluetooth Interface board for printer

MODEL: M224B

SERIAL NUMBER: 2135402-00

DATE TESTED: October 25 - 28, 2010

APPLICABLE STANDARDS	
STANDARD	TEST RESULTS
CFR 47 Part 15 Subpart C	Pass
INDUSTRY CANADA RSS-210 Issue 7 Annex 8	Pass
INDUSTRY CANADA RSS-GEN Issue 2	Pass

Compliance Certification Services (UL CCS) 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 CCS 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 CCS and all revisions are duly noted in the revisions section. Any alteration of this document not carried out by UL CCS 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 CCS By:



FRANK IBRAHIM
EMC SUPERVISOR
UL CCS

Tested By:



WILLIAM ZHUANG
EMC ENGINEER
UL CCS

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, RSS-GEN Issue 2, and RSS-210 Issue 7.

3. FACILITIES AND ACCREDITATION

The test sites and measurement facilities used to collect data are located at 47173 Benicia Street, Fremont, California, USA.

UL CCS is accredited by NVLAP, Laboratory Code 200065-0. The full scope of accreditation can be viewed at <http://www.ccsemc.com>.

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:

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

4.3. MEASUREMENT UNCERTAINTY

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

PARAMETER	UNCERTAINTY
Conducted Disturbance, 0.15 to 30 MHz	3.52 dB
Radiated Disturbance, 30 to 1000 MHz	4.94 dB

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

5. EQUIPMENT UNDER TEST

5.1. DESCRIPTION OF EUT

The EUT is a Bluetooth Interface board for printer.

The radio module is manufactured by SMK Corporation.

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	4.23	2.65
2402 - 2480	DQPSK	1.93	1.56
2402 - 2480	Enhanced 8PSK	2.27	1.69

5.3. DESCRIPTION OF AVAILABLE ANTENNAS

The radio utilizes a chip antenna, with a maximum gain of 2 dBi.

5.4. SOFTWARE AND FIRMWARE

The test utility software used during testing was RF Test Tool for Bluetooth Device Ver1.2.2.

5.5. WORST-CASE CONFIGURATION AND MODE

The worst-case channel is determined as the channel with the highest output power. Radiated Emissions below 1 GHz and Power Line Conducted Emissions were performed with EUT set to transmit at the channel with highest output power.

The fundamental of the EUT was measured in three orthogonal orientations to determine worst-case orientation, and it was found that orientation Y is worst-case; therefore all other final radiated measurements were performed with EUT set in Y orientation.

5.6. DESCRIPTION OF TEST SETUP

SUPPORT EQUIPMENT

PERIPHERAL SUPPORT EQUIPMENT LIST				
Description	Manufacturer	Model	Serial Number	FCC ID
Laptop PC	HP	Compaq 6710b	CNU80800TB	DoC
AC Adaptor	HP	PPP014L-SA	7Z14002209	DoC
Extend Card	SMK	BE005	N/A	DoC
DC Power Supply	HP	6296A	2410A-05117	DoC

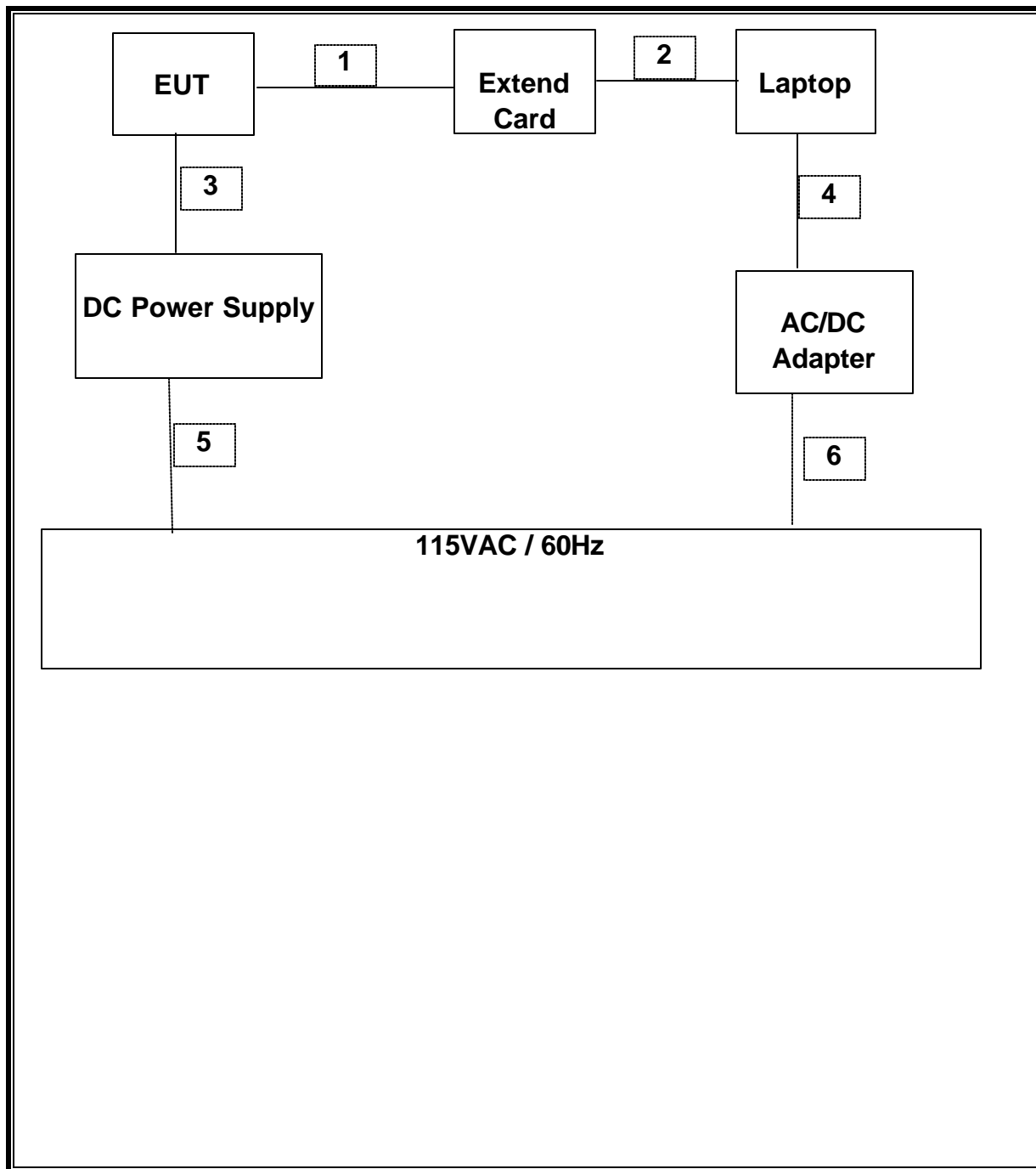
I/O CABLES

I/O CABLE LIST						
Cable No.	Port	# of Identical Ports	Connector Type	Cable Type	Cable Length	Remarks
1	21 Pin	1	Flat	Flat	0.2m	
2	Serial	1	USB	Unshielded	1m	
3	DC	2	DC	Unshielded	1.7m	
4	DC	2	DC	Unshielded	1.7m	
5	AC	1	AC	Unshielded	1m	
6	AC	1	AC	Unshielded	1m	

TEST SETUP

The EUT is connected to a host laptop computer during the tests. Test software exercised the radio card.

SETUP DIAGRAM FOR TESTS



6. TEST AND MEASUREMENT EQUIPMENT

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

TEST EQUIPMENT LIST					
Description	Manufacturer	Model	Asset	Cal Date	Cal Due
Peak Power Meter	Agilent / HP	E4416A	C00963	02/14/10	12/02/10
Spectrum Analyzer, 44 GHz	Agilent / HP	E4446A	C00996	04/29/10	10/29/11
Horn Antenna	EMCO	3115	C00872	04/15/10	04/15/11
Preamplifier, 26.5 GHz	Agilent / HP	8449B	C00749	08/03/10	09/27/11
Preamplifier, 1300 MHz	Agilent / HP	8447D	C00558	03/31/10	03/31/11
Antenna, Bilog,	ARA	LPB-25201	N02872	09/28/10	09/28/11

7. ANTENNA PORT TEST RESULTS

7.1. BASIC DATA RATE GFSK MODULATION

7.1.1. 20 dB AND 99% BANDWIDTH

LIMIT

None; for reporting purposes only.

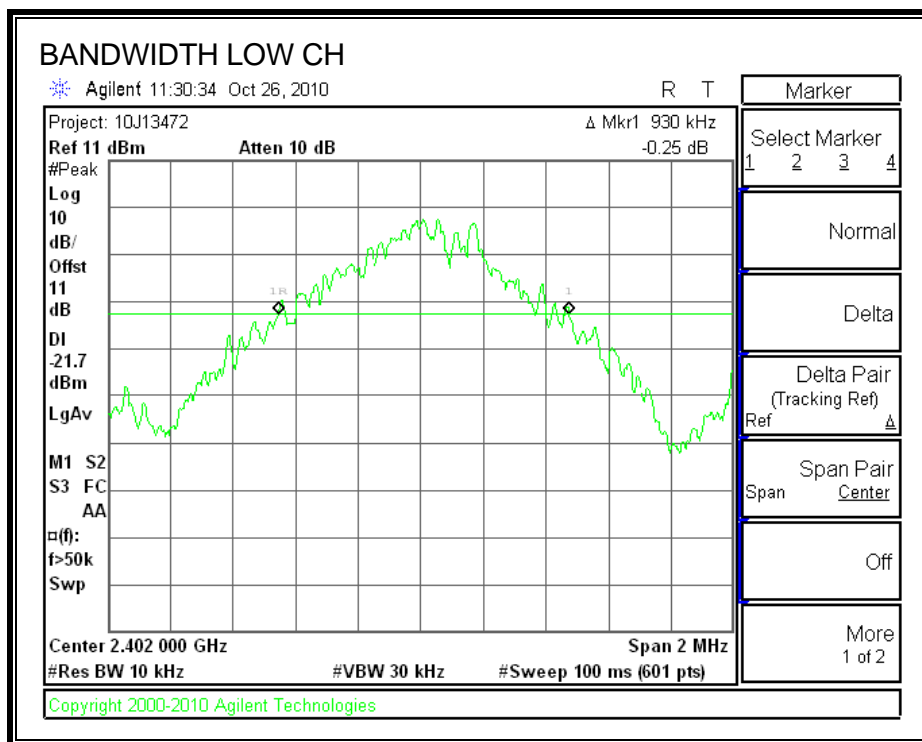
TEST PROCEDURE

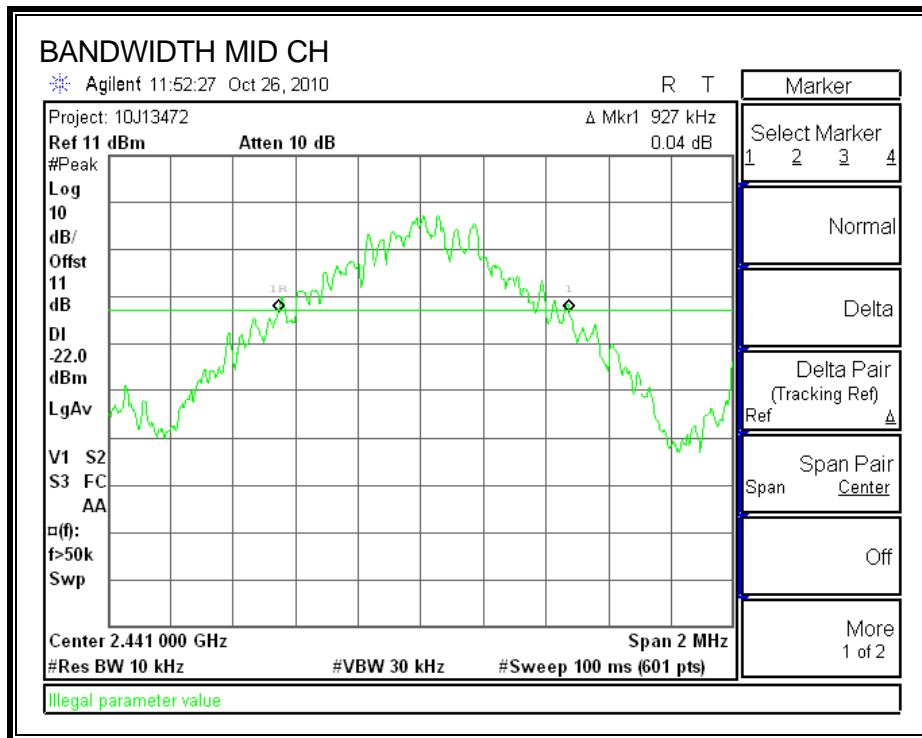
The transmitter output is connected to a spectrum analyzer. The RBW is set to = 1% of the 20 dB bandwidth. The VBW is set to = RBW. The sweep time is coupled.

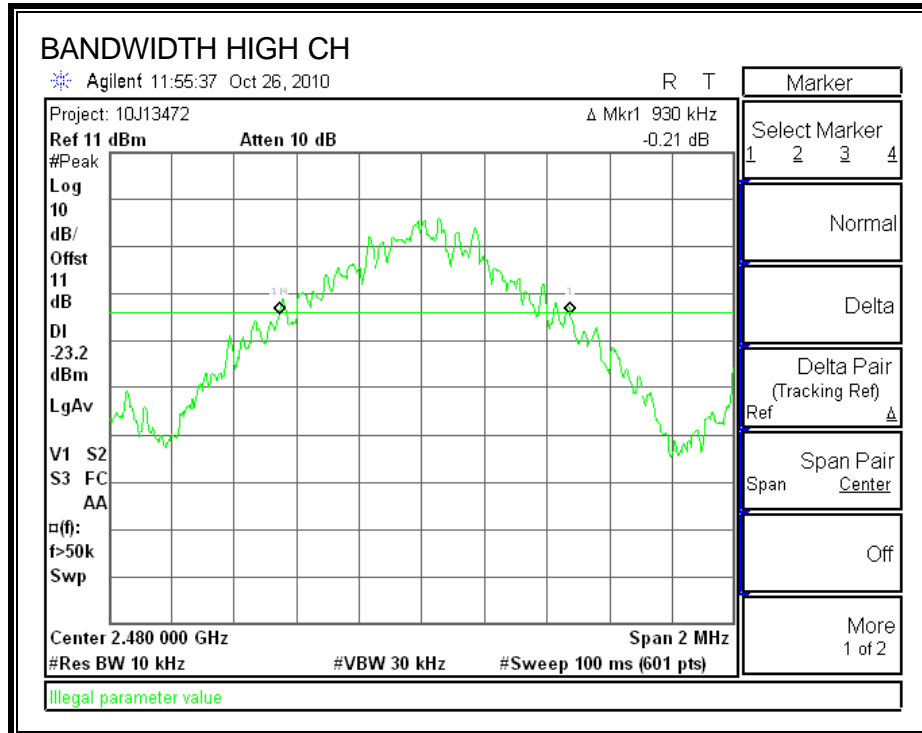
RESULTS

Channel	Frequency (MHz)	20 dB Bandwidth (kHz)	99% Bandwidth (kHz)
Low	2402	930	904.2557
Middle	2441	927	905.7801
High	2480	930	893.7268

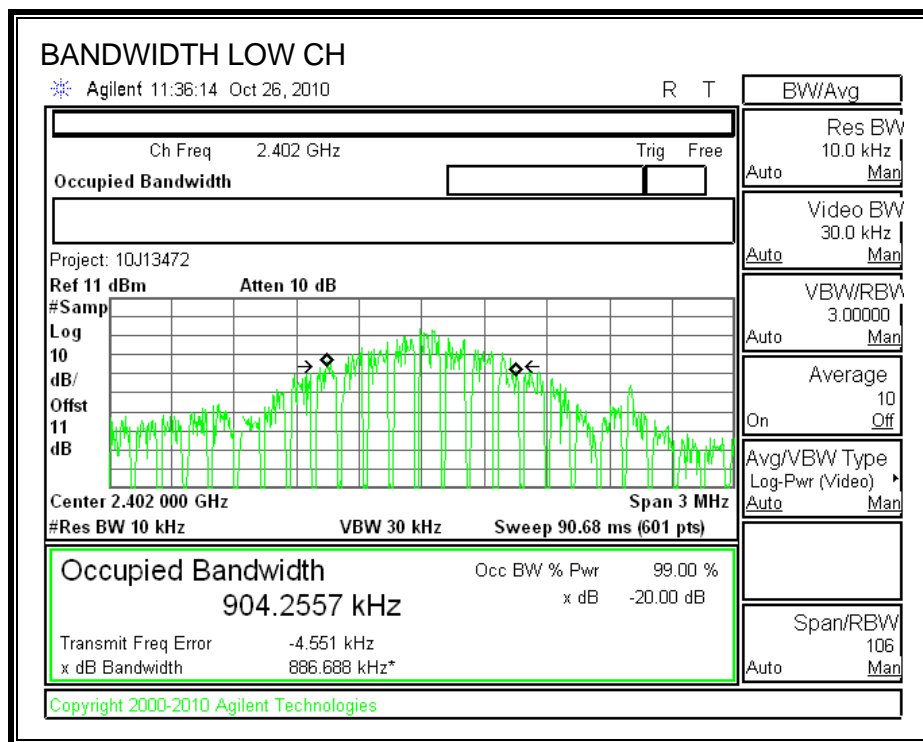
20 dB BANDWIDTH

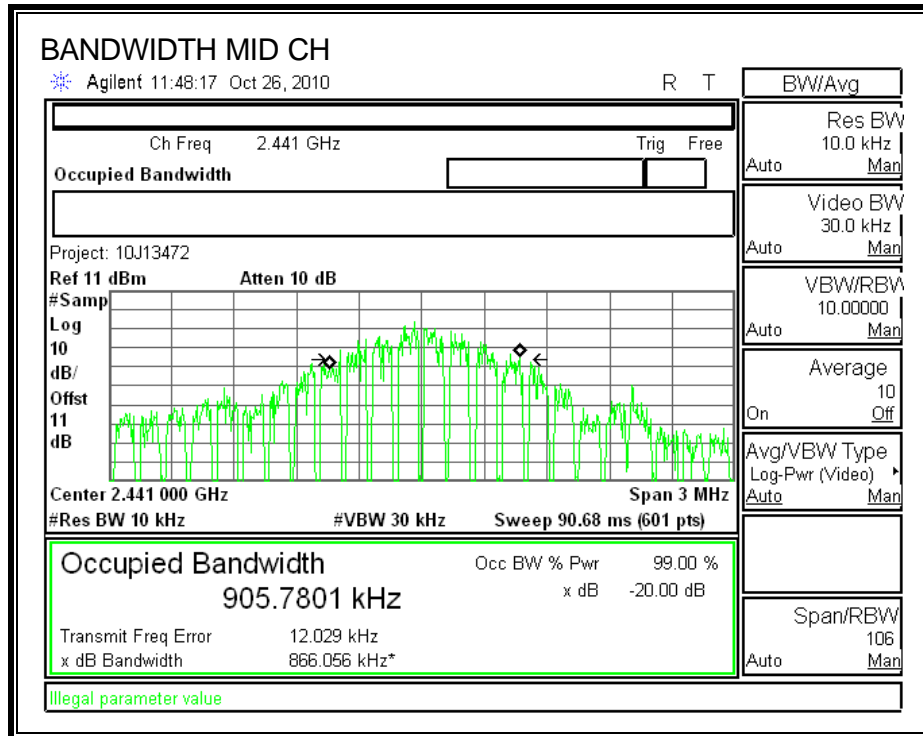


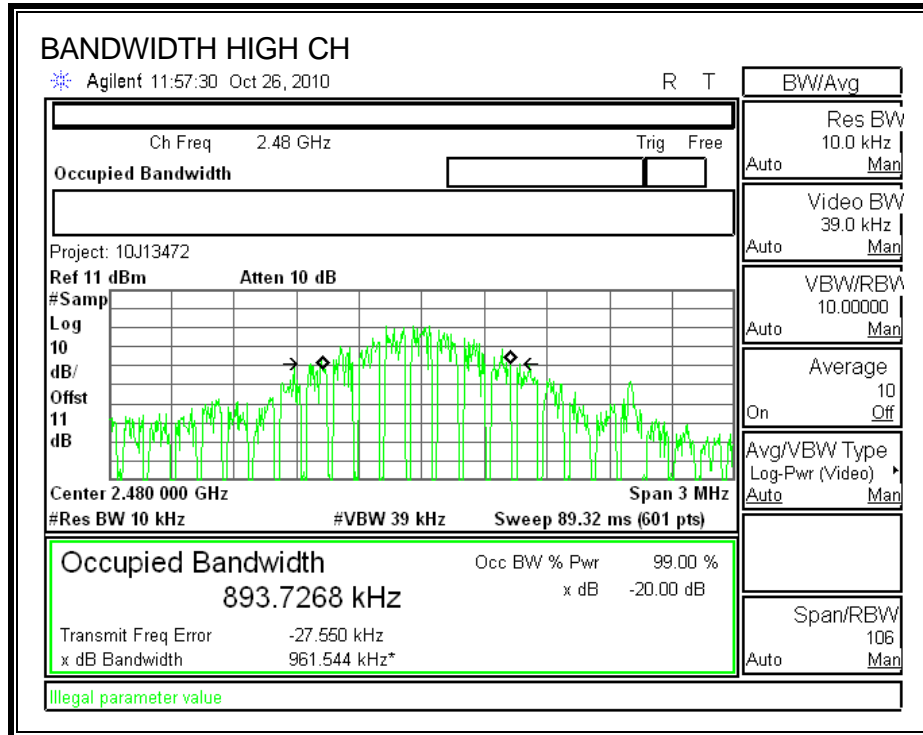




99% BANDWIDTH







7.1.2. HOPPING FREQUENCY SEPARATION

LIMIT

FCC §15.247 (a) (1)

IC RSS-210 A8.1 (b)

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

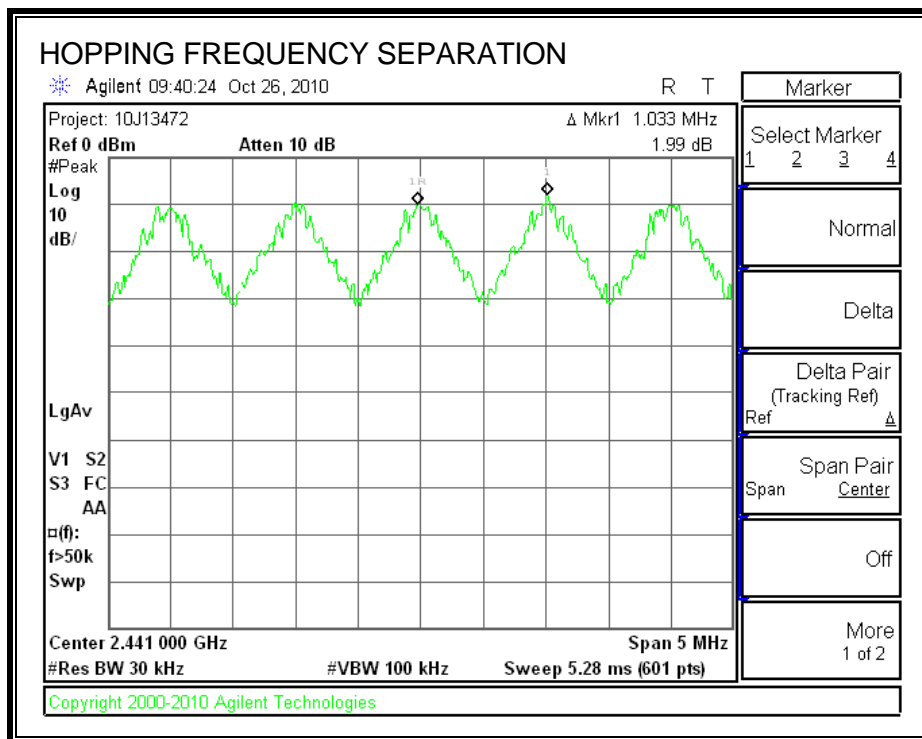
Alternatively, frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than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

TEST PROCEDURE

The transmitter output is connected to a spectrum analyzer. The RBW is set to 30 kHz and the VBW is set to 100 kHz. The sweep time is coupled.

RESULTS

HOPPING FREQUENCY SEPARATION



7.1.3. NUMBER OF HOPPING CHANNELS

LIMIT

FCC §15.247 (a) (1) (iii)

IC RSS-210 A8.1 (d)

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

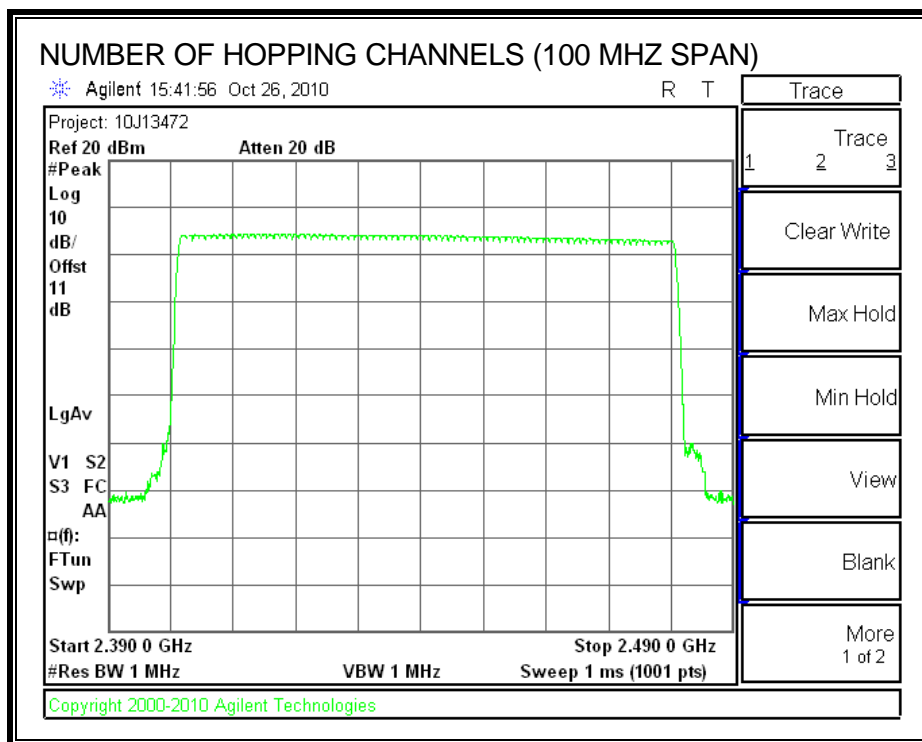
TEST PROCEDURE

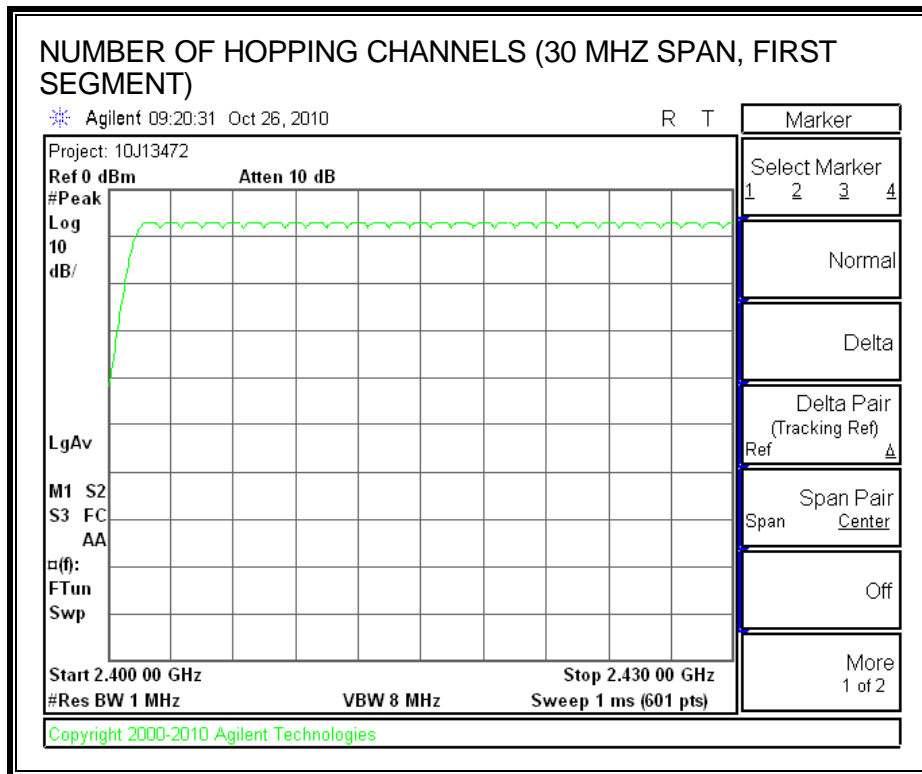
The transmitter output is connected to a spectrum analyzer. The span is set to cover the entire authorized band, in either a single sweep or in multiple contiguous sweeps. The RBW is set to 1MHz, VBW is set to a value greater than or equal to RBW. The analyzer is set to Max Hold.

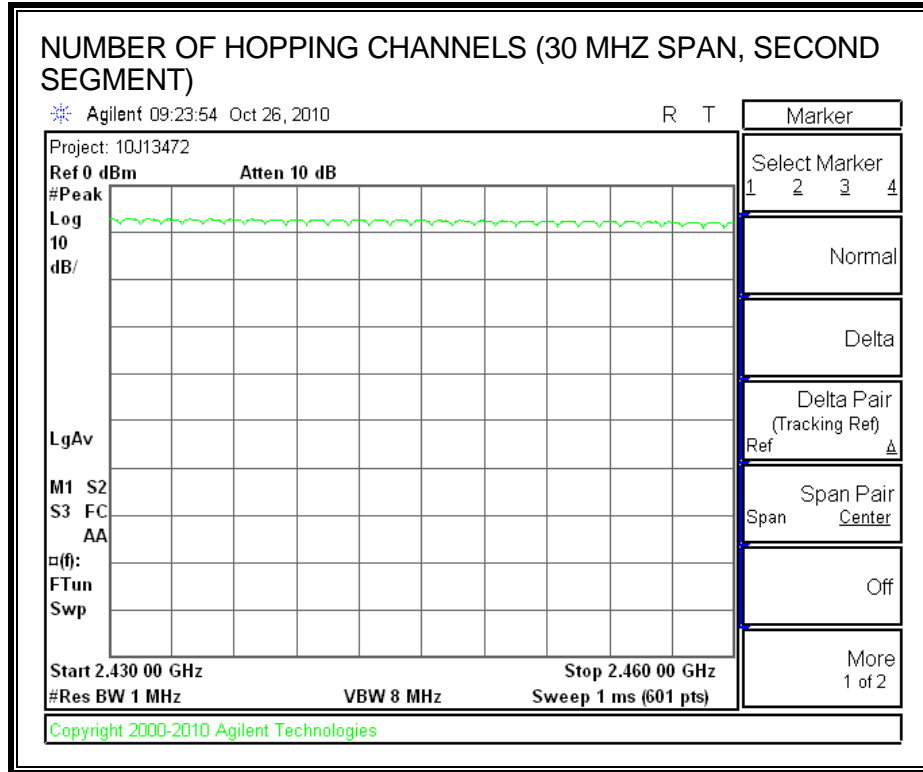
RESULTS

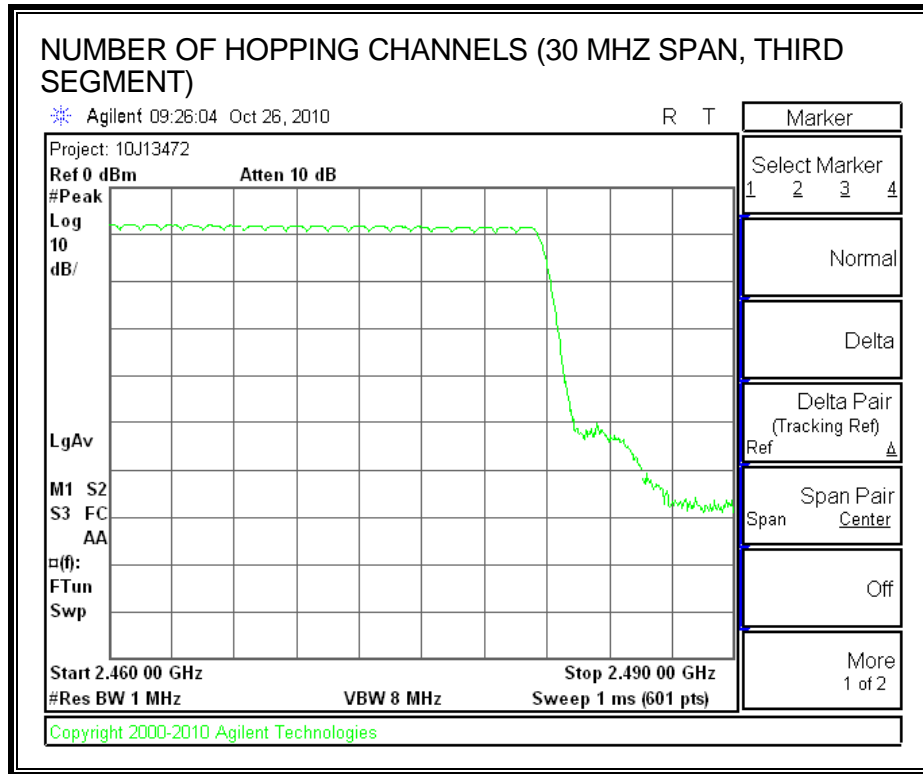
79 Channels observed.

NUMBER OF HOPPING CHANNELS









7.1.4. AVERAGE TIME OF OCCUPANCY

LIMIT

FCC §15.247 (a) (1) (iii)

IC RSS-210 A8.1 (d)

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

TEST PROCEDURE

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

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

RESULTS

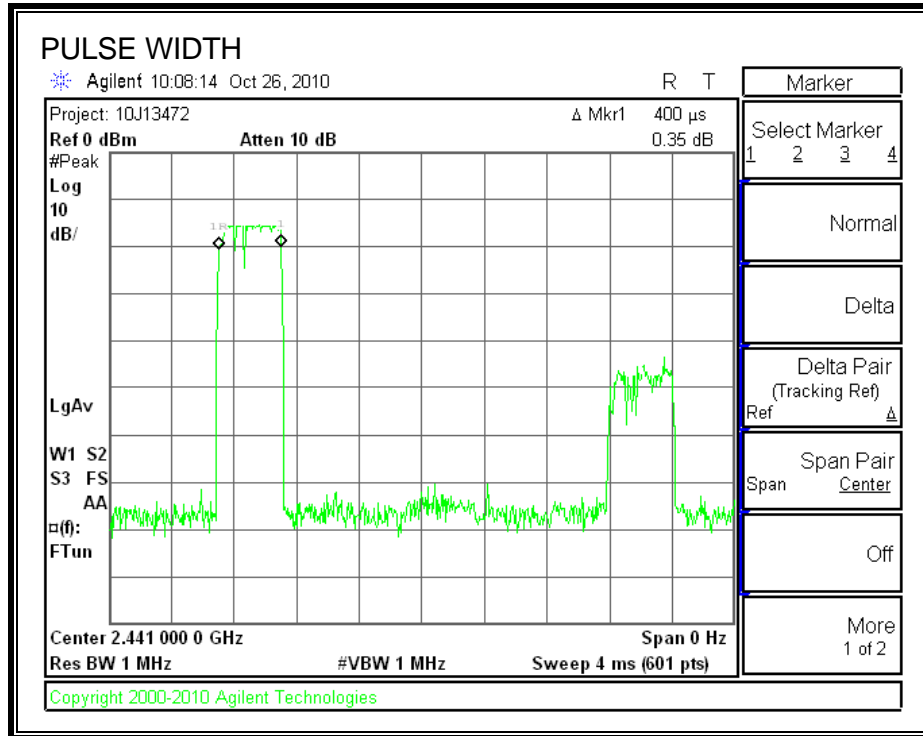
Time Of Occupancy = $10 * xx \text{ pulses} * yy \text{ msec} = zz \text{ msec}$

GFSK Mode

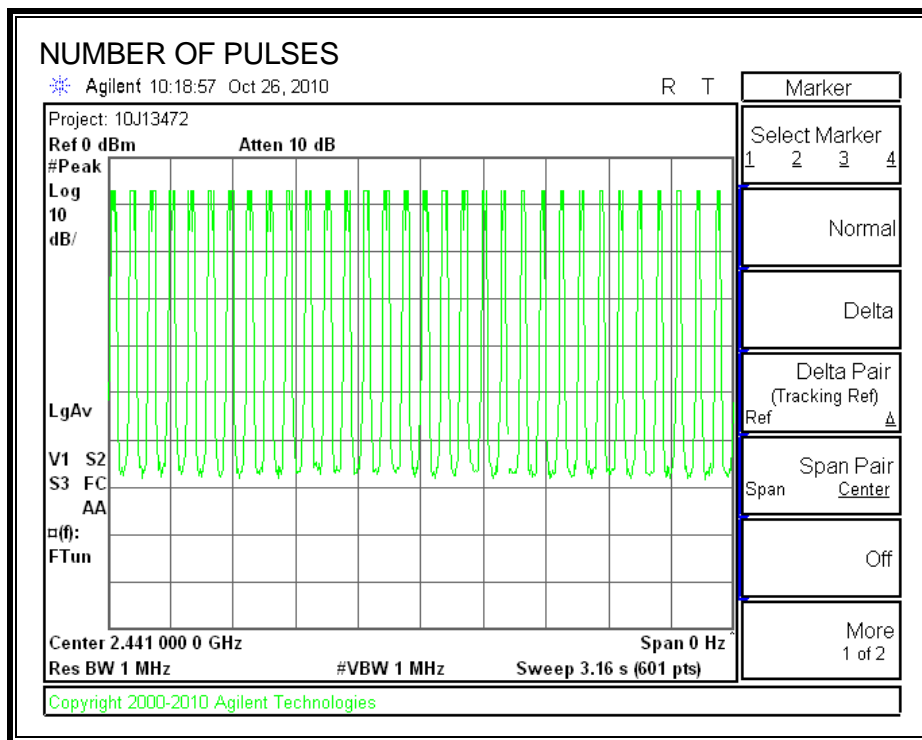
DH Packet	Pulse Width (msec)	Number of Pulses in 3.16 seconds	Average Time of (sec)	Limit (sec)	Margin (sec)
DH1	0.4	32	0.128	0.4	0.272
DH3	1.629	16	0.261	0.4	0.139
DH5	2.875	11	0.316	0.4	0.084

DH1 Packet

PULSE WIDTH

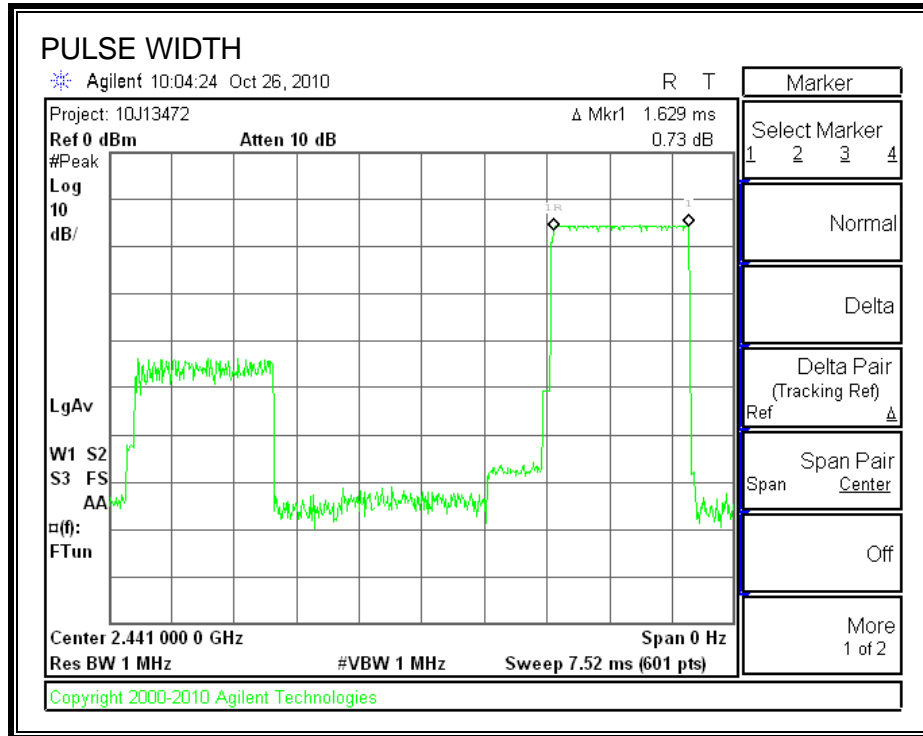


NUMBER OF PULSES IN 3.16 SECOND OBSERVATION PERIOD

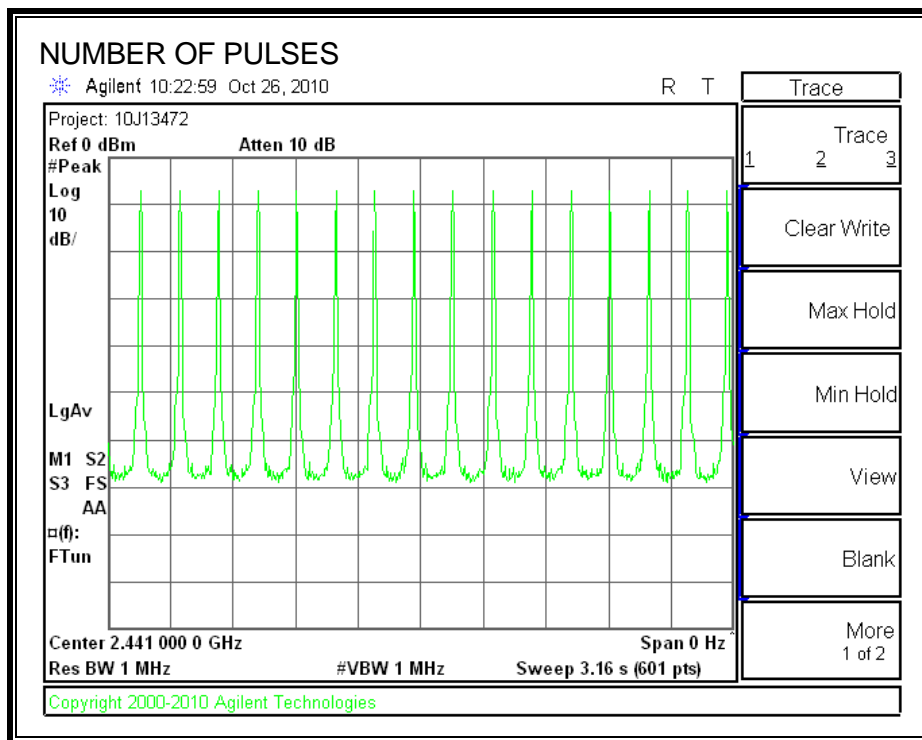


DH3 Packet

PULSE WIDTH

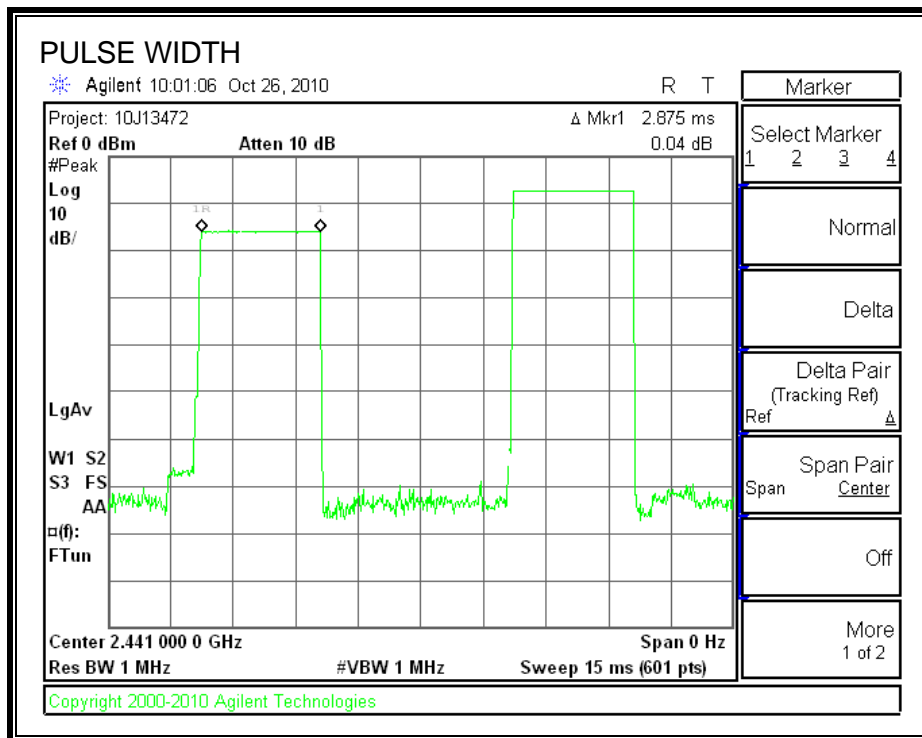


NUMBER OF PULSES IN 3.16 SECOND OBSERVATION PERIOD

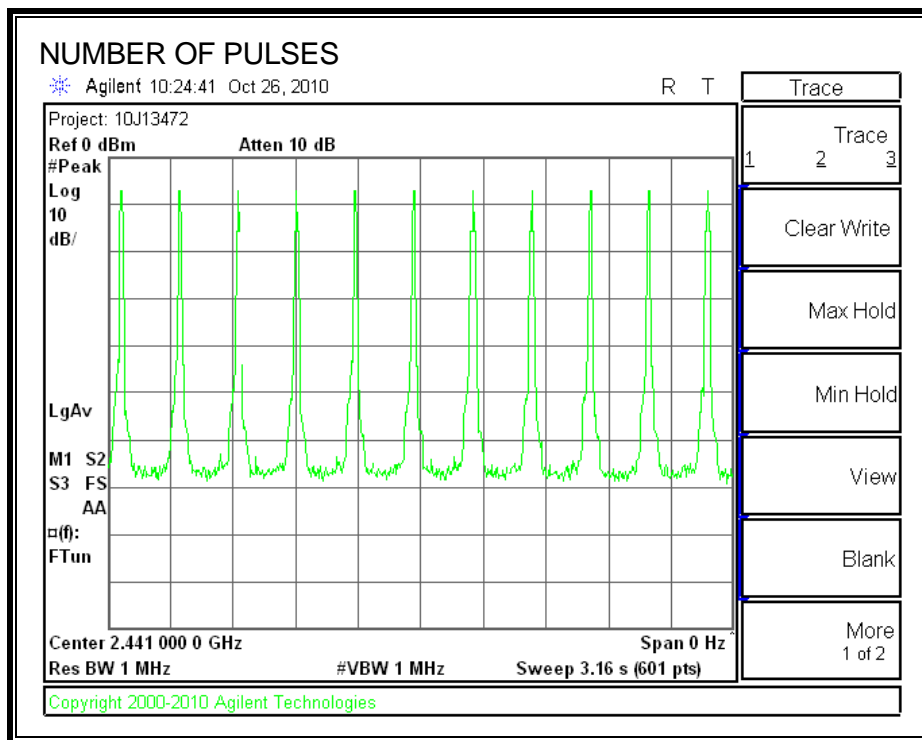


DH5 Packet

PULSE WIDTH



NUMBER OF PULSES IN 3.16 SECOND OBSERVATION PERIOD



7.1.5. OUTPUT POWER

LIMIT

§15.247 (b) (1)

RSS-210 Issue 7 Clause A8.4

The maximum antenna gain is less than 6 dBi, therefore the limit is 30 dBm.

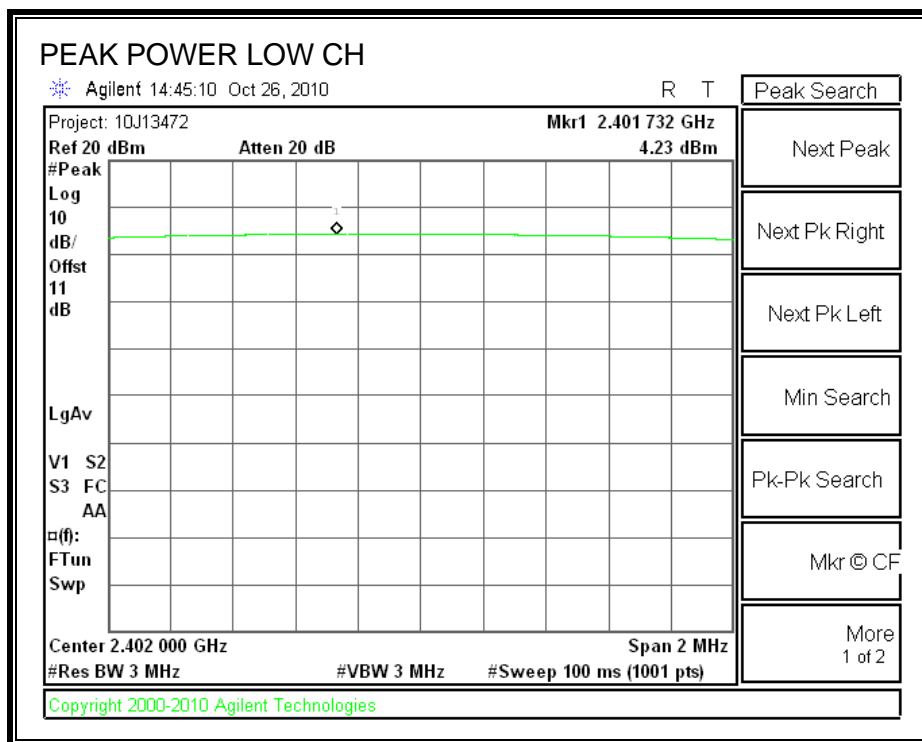
TEST PROCEDURE

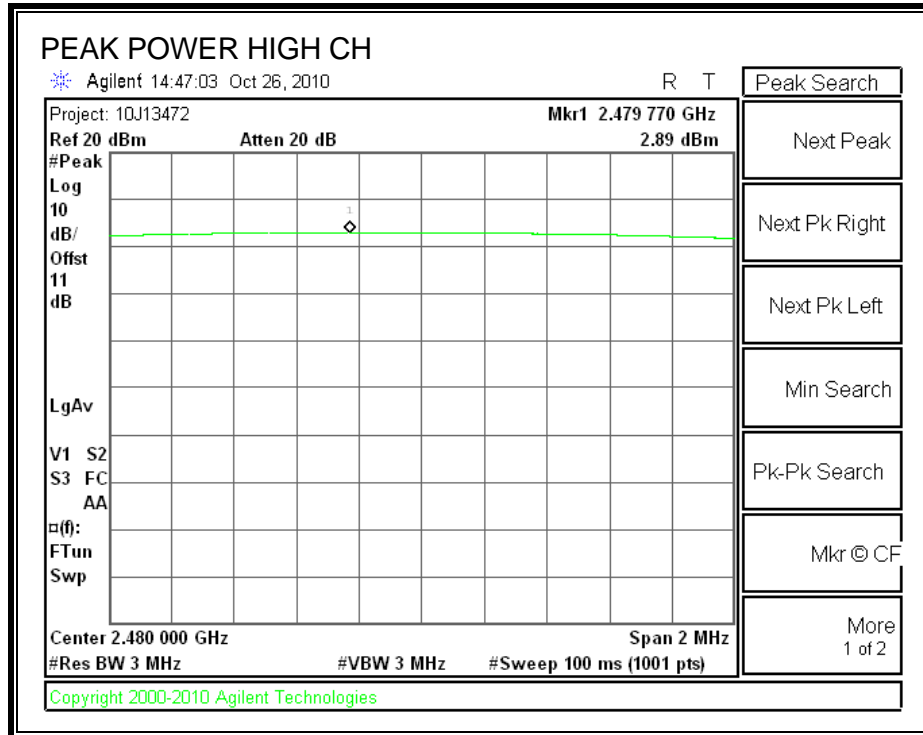
The transmitter output is connected to a spectrum analyzer the analyzer bandwidth is set to a value greater than the 20 dB bandwidth of the EUT.

RESULTS

Channel	Frequency (MHz)	Output Power (dBm)	Limit (dBm)	Margin (dB)
Low	2402	4.23	30	-25.77
Middle	2441	4.01	30	-25.99
High	2480	2.89	30	-27.11

OUTPUT POWER





7.1.6. AVERAGE POWER

LIMIT

None; for reporting purposes only.

TEST PROCEDURE

The transmitter output is connected to a power meter.

RESULTS

The cable assembly insertion loss of 11 dB (including 10 dB pad and 1 dB cable) was entered as an offset in the power meter to allow for direct reading of power.

Channel	Frequency (MHz)	Average Power (dBm)
Low	2402	2.60
Middle	2441	2.44
High	2480	1.41

7.1.7. CONDUCTED SPURIOUS EMISSIONS

LIMITS

FCC §15.247 (d)

IC RSS-210 A8.5

Limit = -20 dBc

TEST PROCEDURE

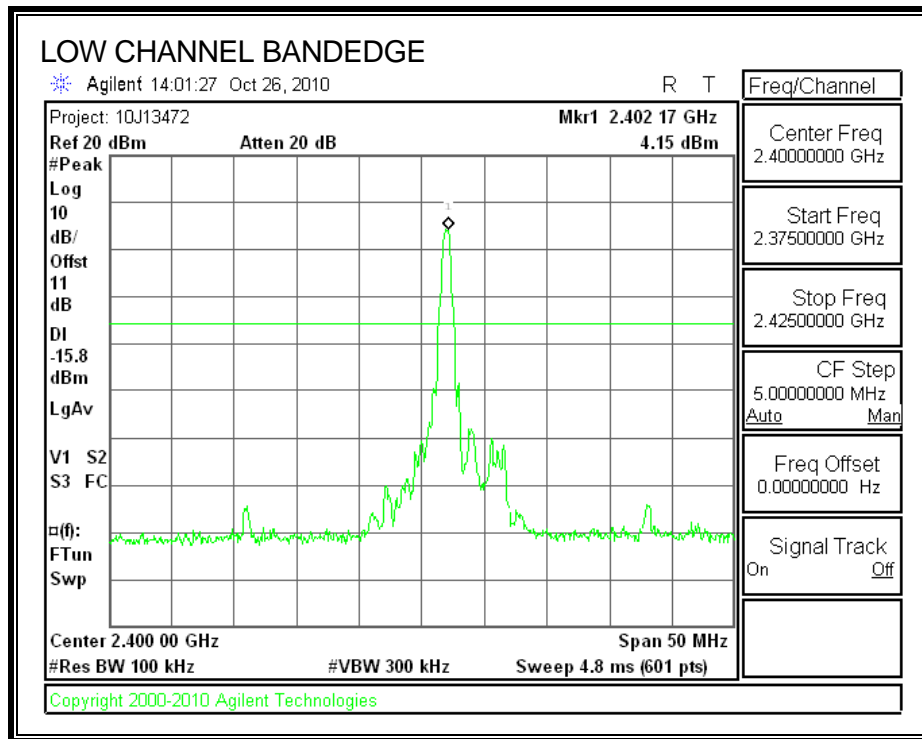
The transmitter output is connected to a spectrum analyzer. The resolution bandwidth is set to 100 kHz. The video bandwidth is set to 300 kHz.

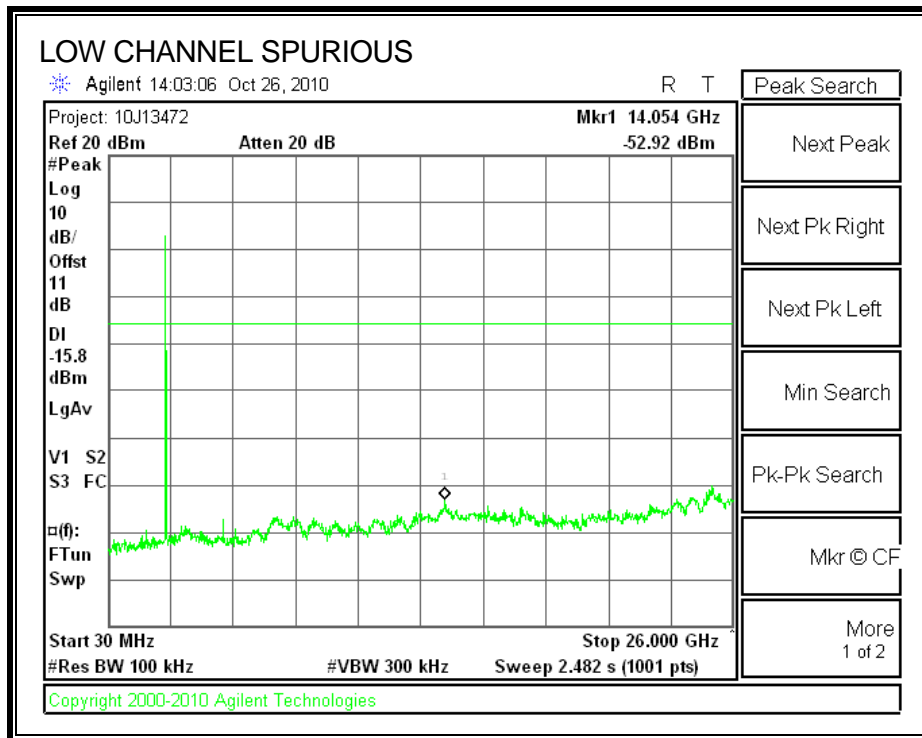
The spectrum from 30 MHz to 26 GHz is investigated with the transmitter set to the lowest, middle, and highest channels.

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

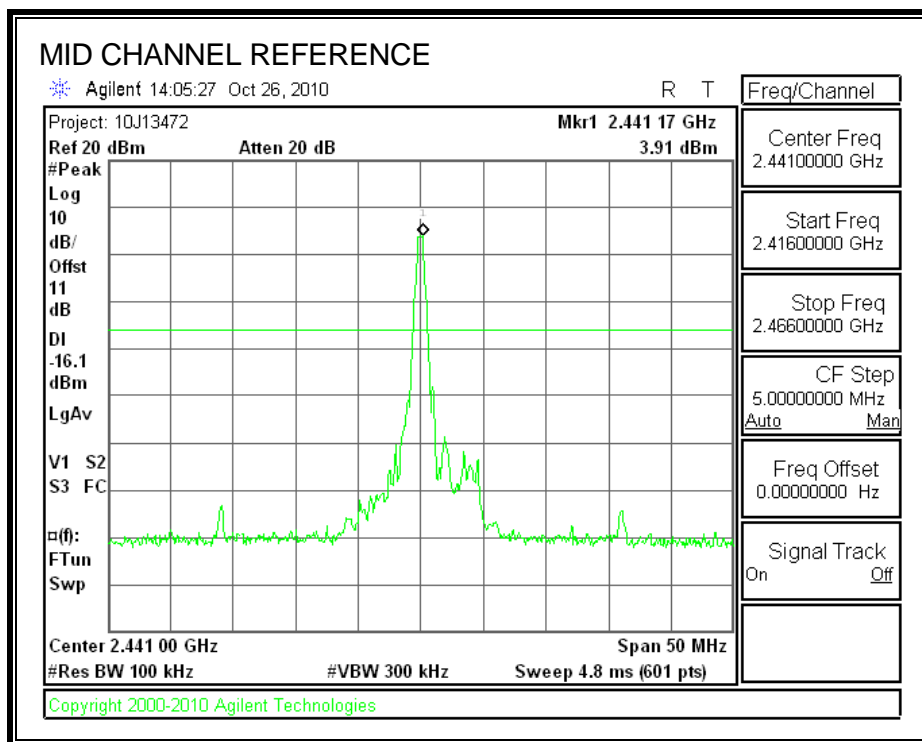
RESULTS

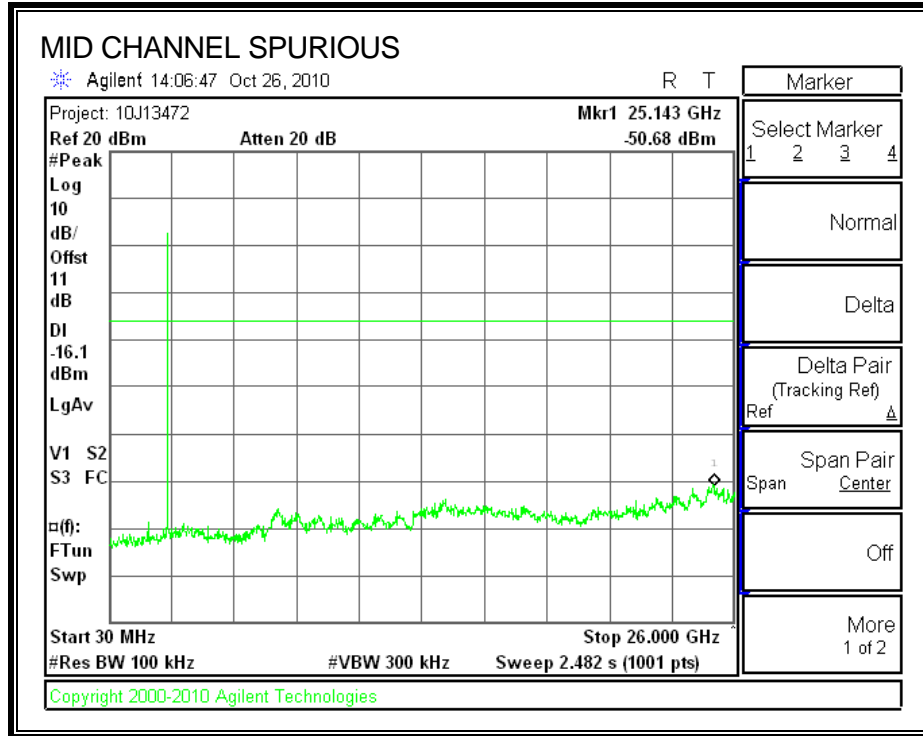
SPURIOUS EMISSIONS, LOW CHANNEL



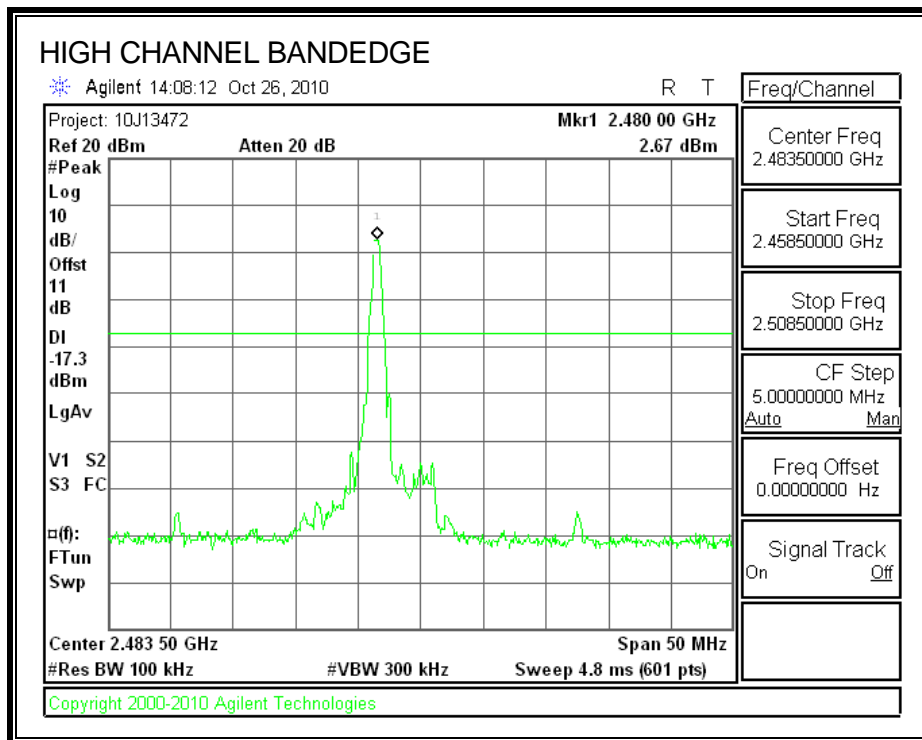


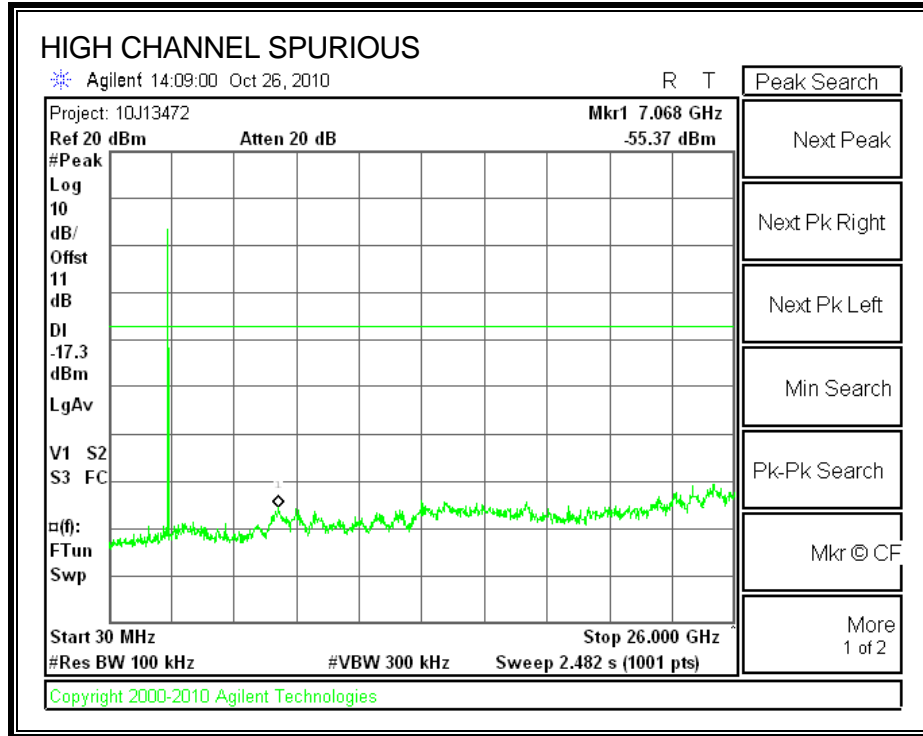
SPURIOUS EMISSIONS, MID CHANNEL



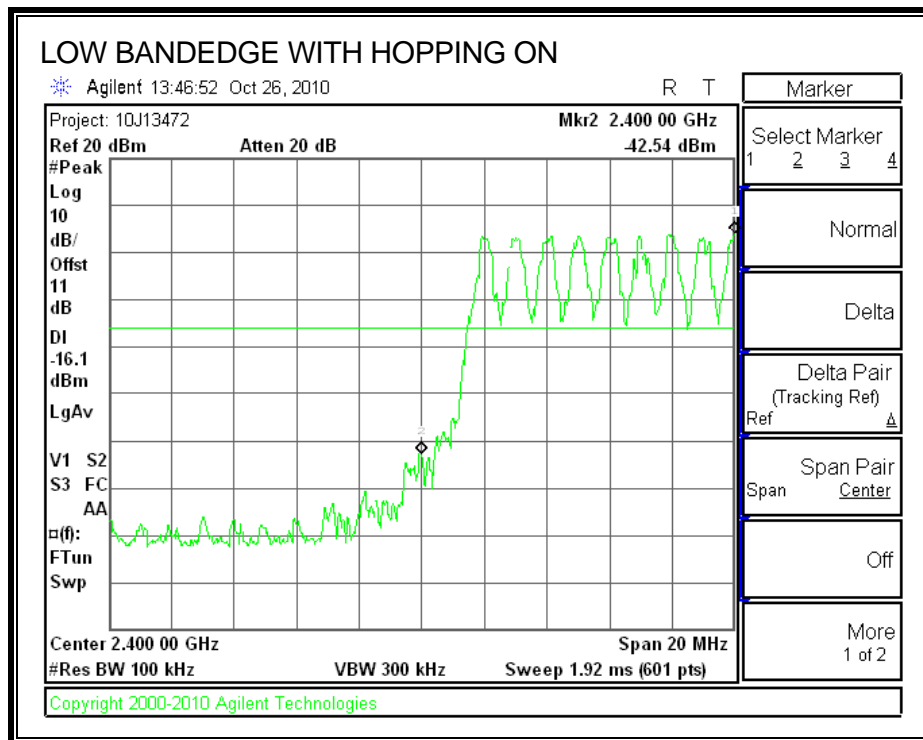


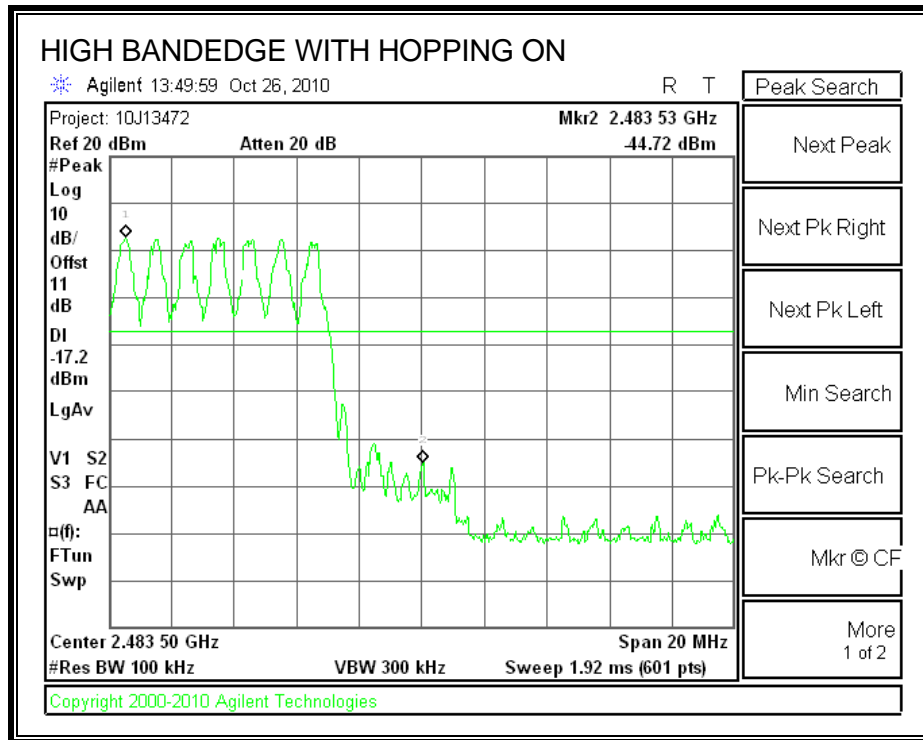
SPURIOUS EMISSIONS, HIGH CHANNEL





SPURIOUS BANDEDGE EMISSIONS WITH HOPPING ON





7.2. DQPSK MODULATION

7.2.1. OUTPUT POWER

LIMIT

§15.247 (b) (1)

RSS-210 Issue 7 Clause A8.4

The maximum antenna gain is less than 6 dBi, therefore the limit is 30 dBm.

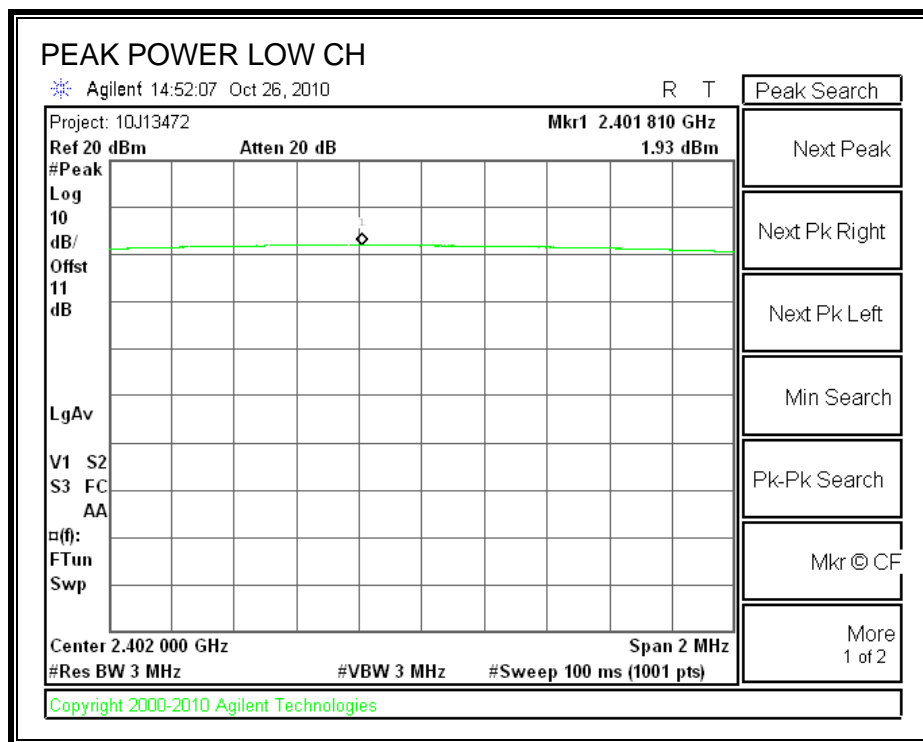
TEST PROCEDURE

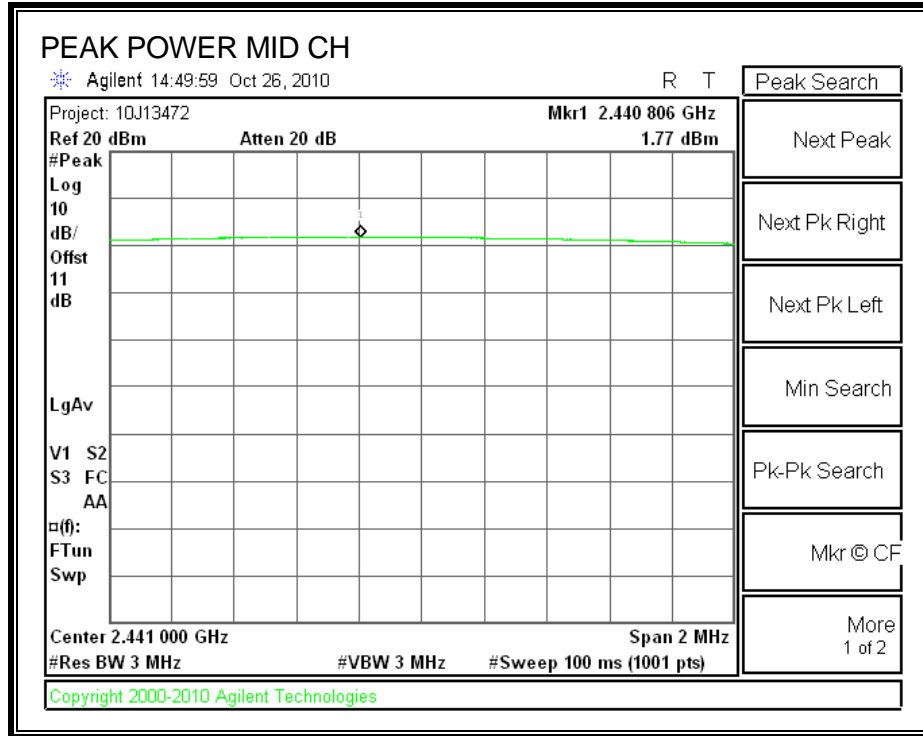
The transmitter output is connected to a spectrum analyzer the analyzer bandwidth is set to a value greater than the 20 dB bandwidth of the EUT.

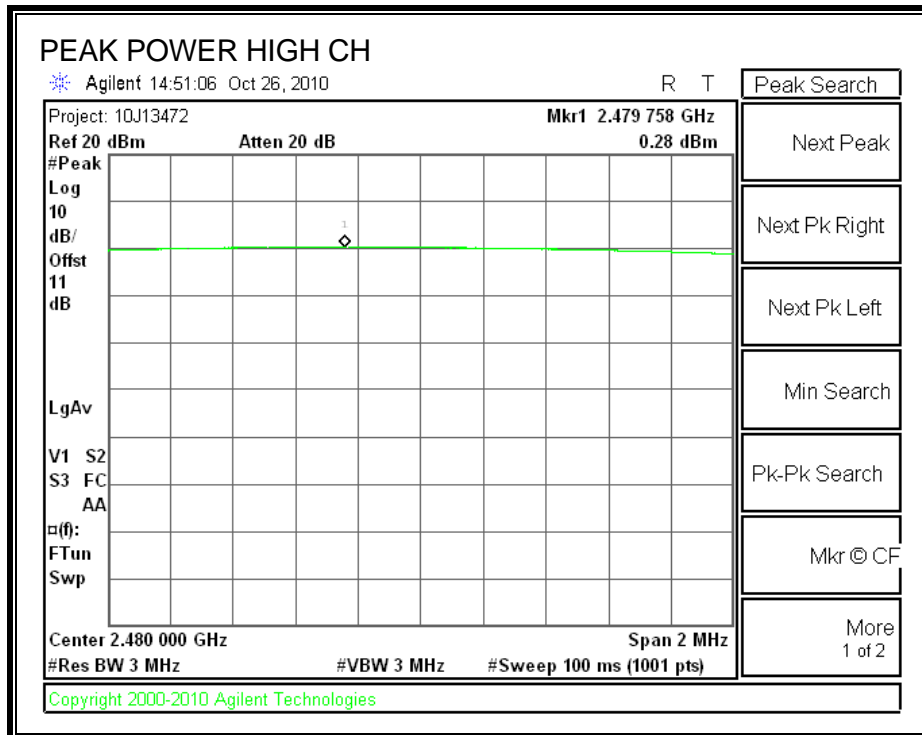
RESULTS

Channel	Frequency (MHz)	Output Power (dBm)	Limit (dBm)	Margin (dB)
Low	2402	1.93	30	-28.07
Middle	2441	1.77	30	-28.23
High	2480	0.28	30	-29.72

OUTPUT POWER







7.2.2. AVERAGE POWER

LIMIT

None; for reporting purposes only.

TEST PROCEDURE

The transmitter output is connected to a power meter.

RESULTS

The cable assembly insertion loss of 11 dB (including 10 dB pad and 1 dB cable) was entered as an offset in the power meter to allow for direct reading of power.

Channel	Frequency (MHz)	Average Power (dBm)
Low	2402	0.36
Middle	2441	-0.14
High	2480	-1.16

7.3. ENHANCED DATA RATE 8PSK MODULATION

7.3.1. 20 dB AND 99% BANDWIDTH

LIMIT

None; for reporting purposes only.

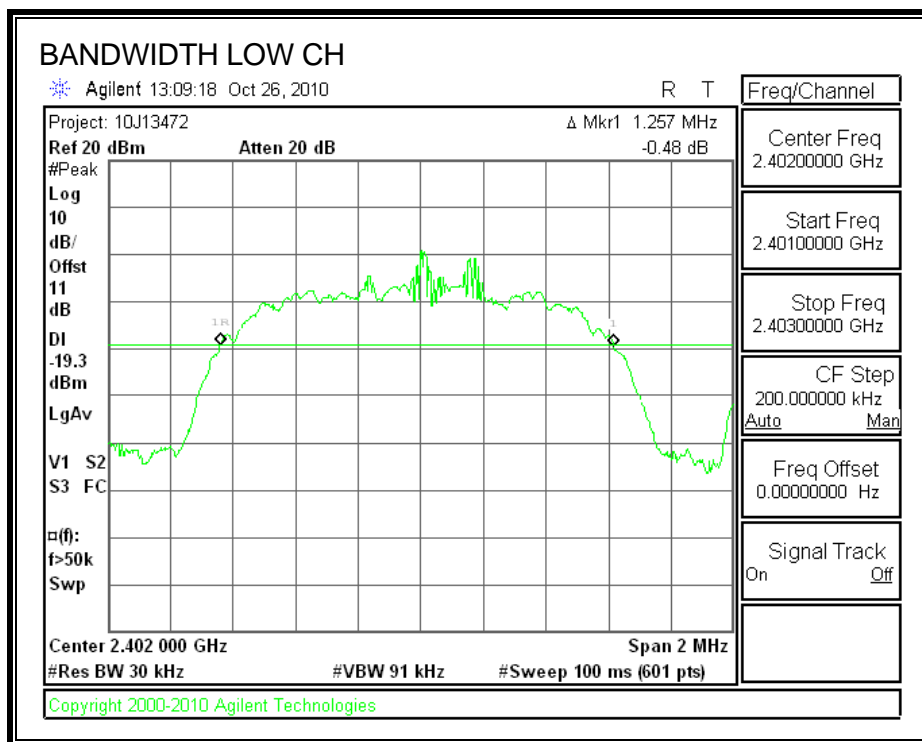
TEST PROCEDURE

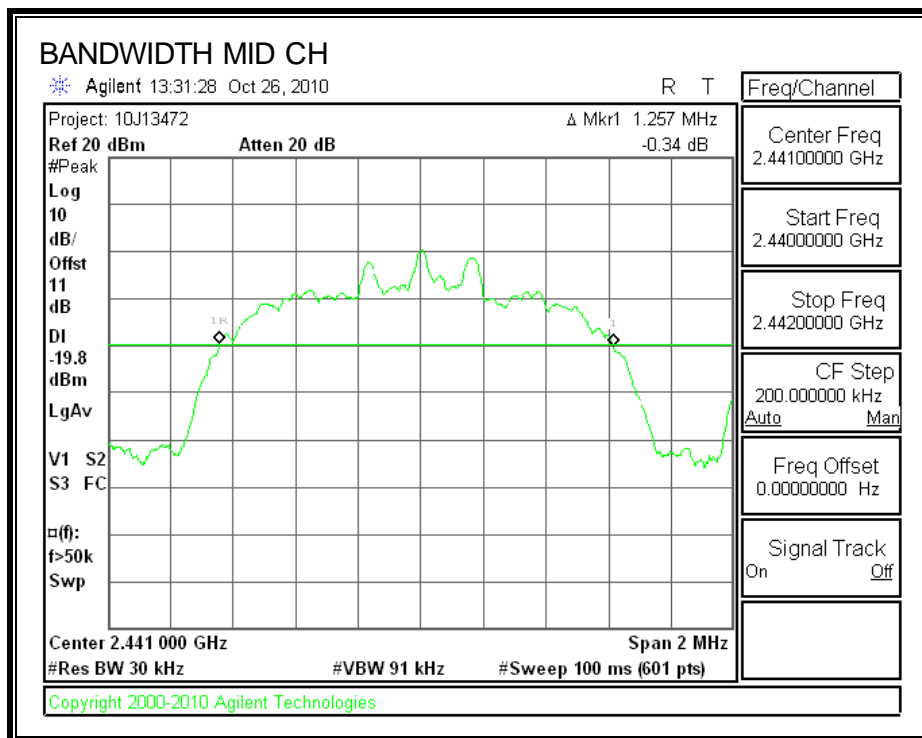
The transmitter output is connected to a spectrum analyzer. The RBW is set to = 1% of the 20 dB bandwidth. The VBW is set to = RBW. The sweep time is coupled.

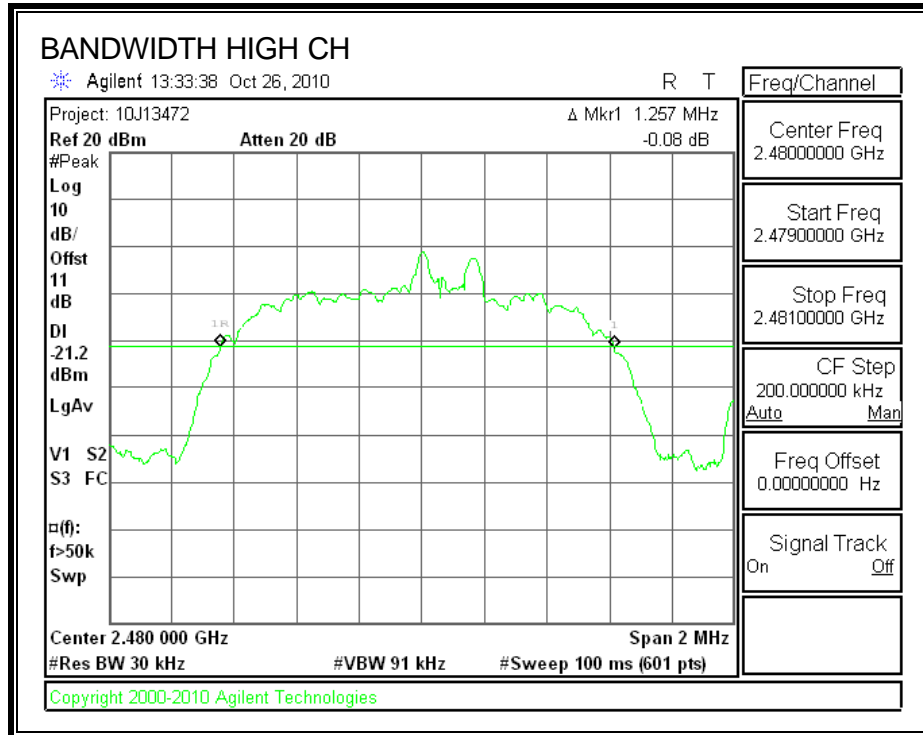
RESULTS

Channel	Frequency (MHz)	20 dB Bandwidth (kHz)	99% Bandwidth (kHz)
Low	2402	1257	1124.8
Middle	2441	1257	1230.6
High	2480	1257	1215.4

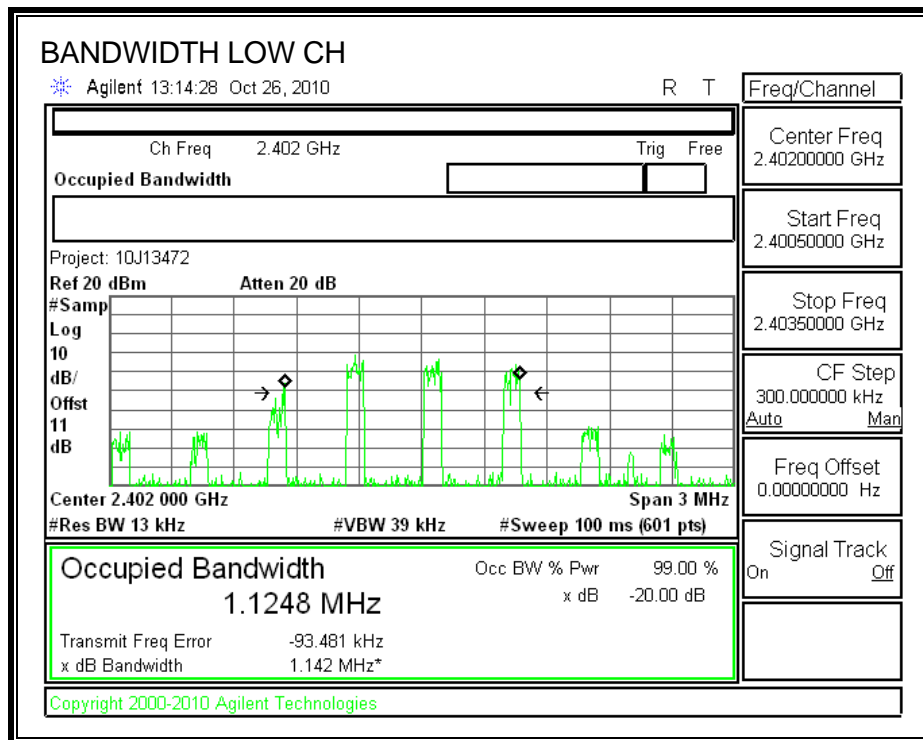
20 dB BANDWIDTH

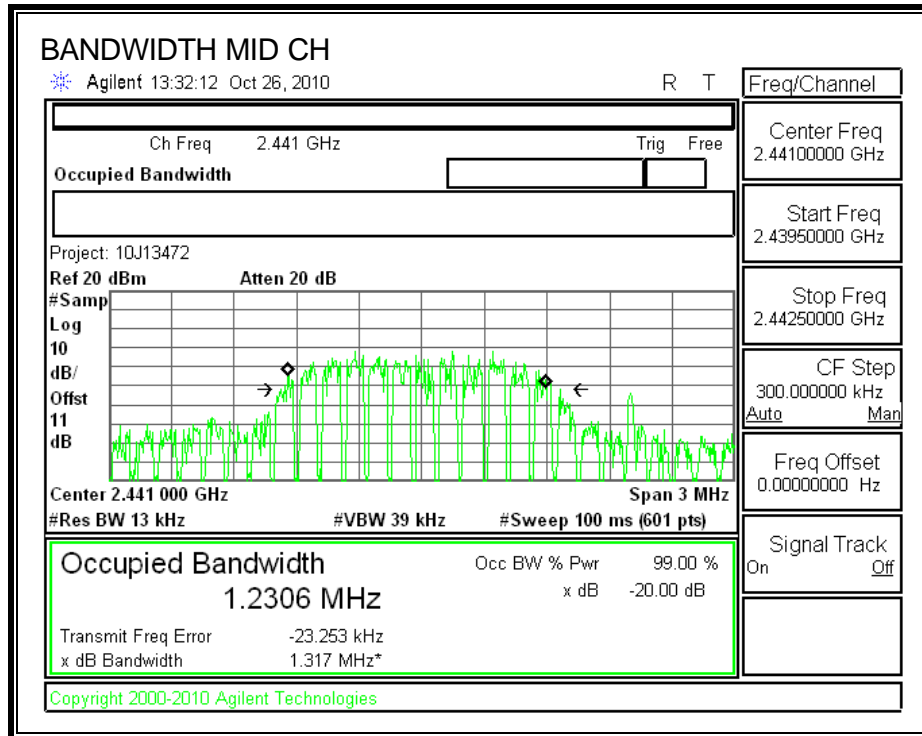


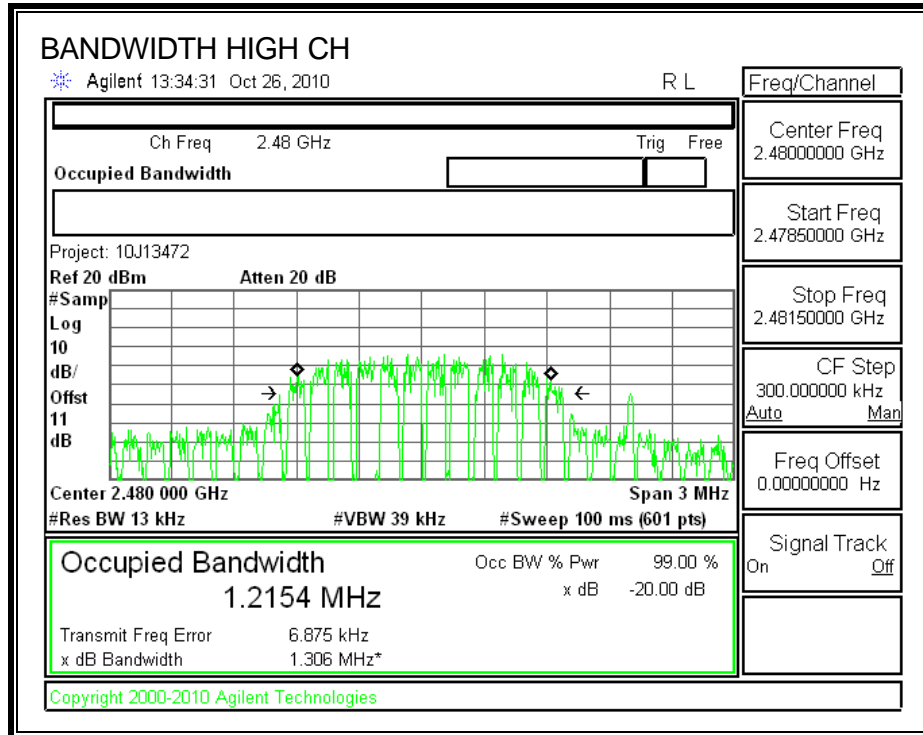




99% BANDWIDTH







7.3.2. HOPPING FREQUENCY SEPARATION

LIMIT

FCC §15.247 (a) (1)

IC RSS-210 A8.1 (b)

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

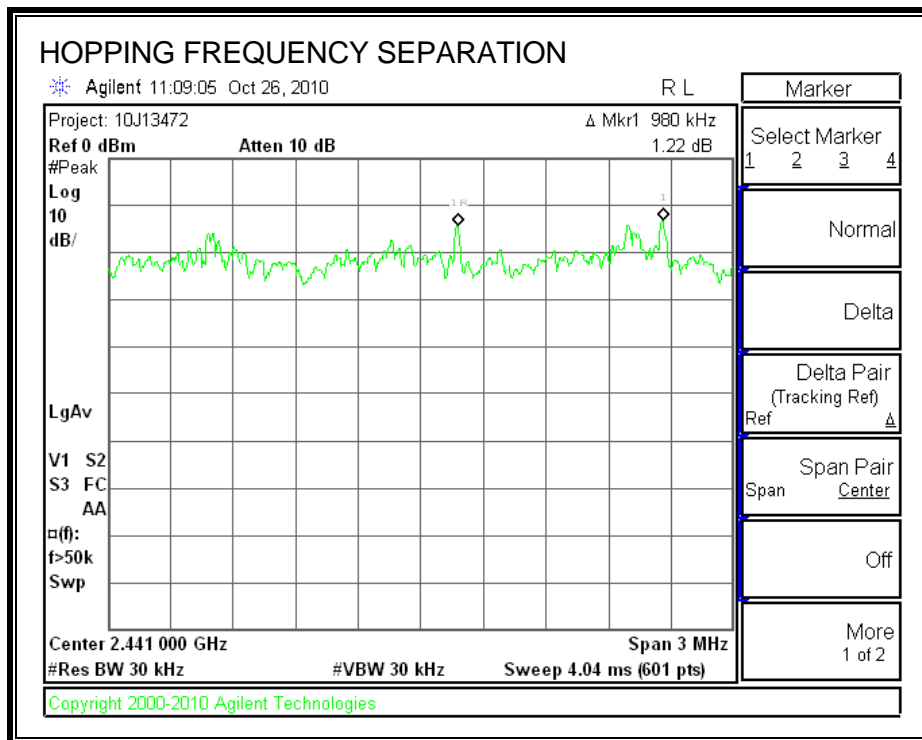
Alternatively, frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than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

TEST PROCEDURE

The transmitter output is connected to a spectrum analyzer. The RBW is set to 30 kHz and the VBW is set to 30 kHz. The sweep time is coupled.

RESULTS

HOPPING FREQUENCY SEPARATION



7.3.3. NUMBER OF HOPPING CHANNELS

LIMIT

FCC §15.247 (a) (1) (iii)

IC RSS-210 A8.1 (d)

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

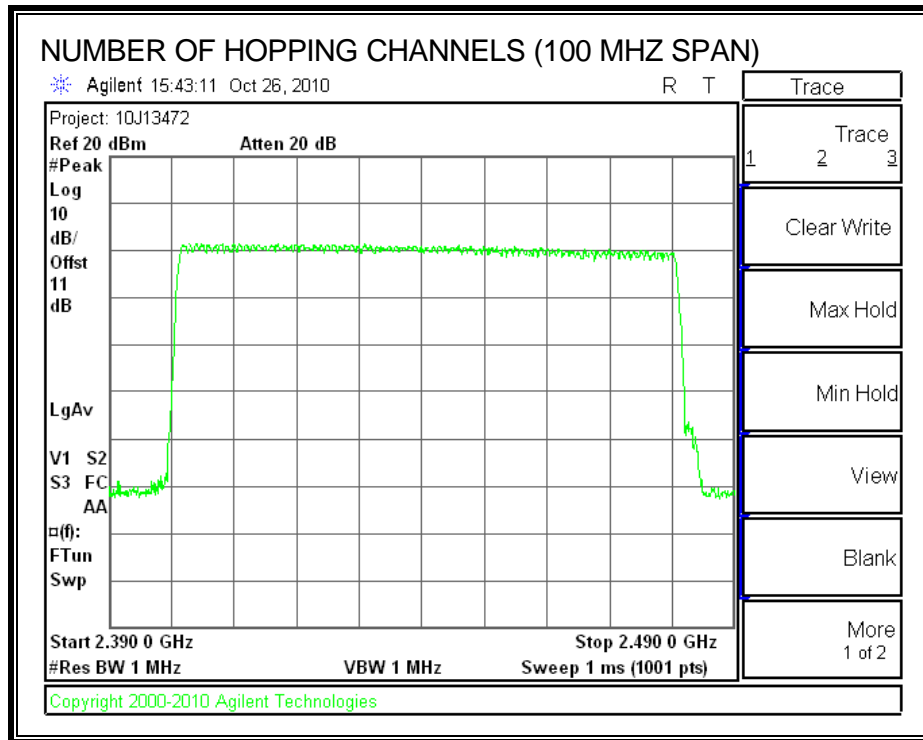
TEST PROCEDURE

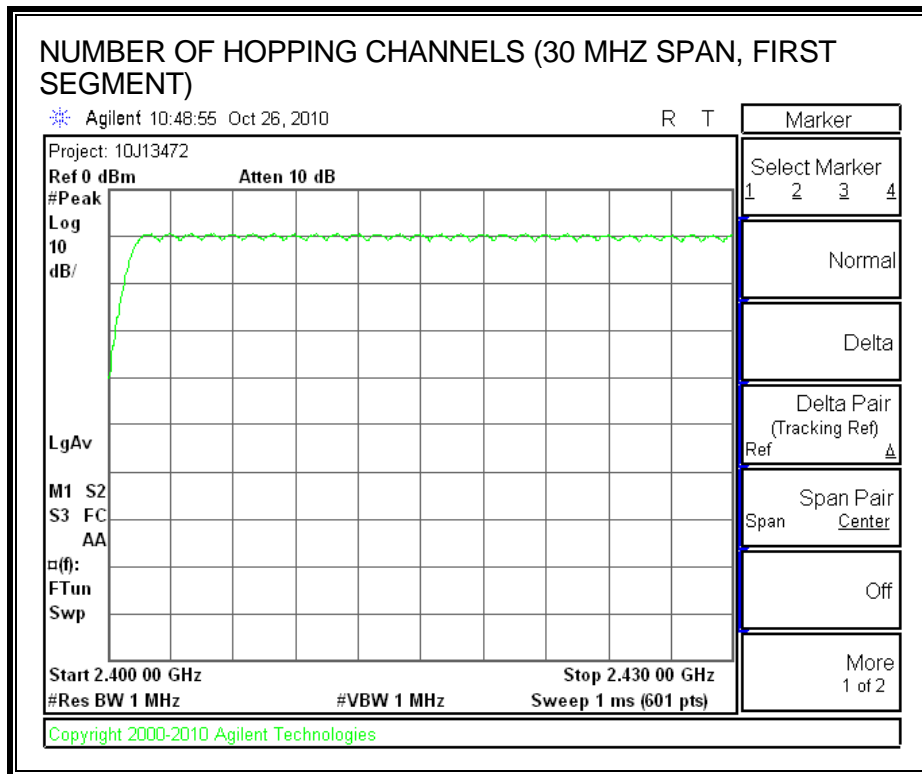
The transmitter output is connected to a spectrum analyzer. The span is set to cover the entire authorized band, in either a single sweep or in multiple contiguous sweeps. The RBW is set to a 1 MHz, VBW is set to a value greater than or equal to RBW. The analyzer is set to Max Hold.

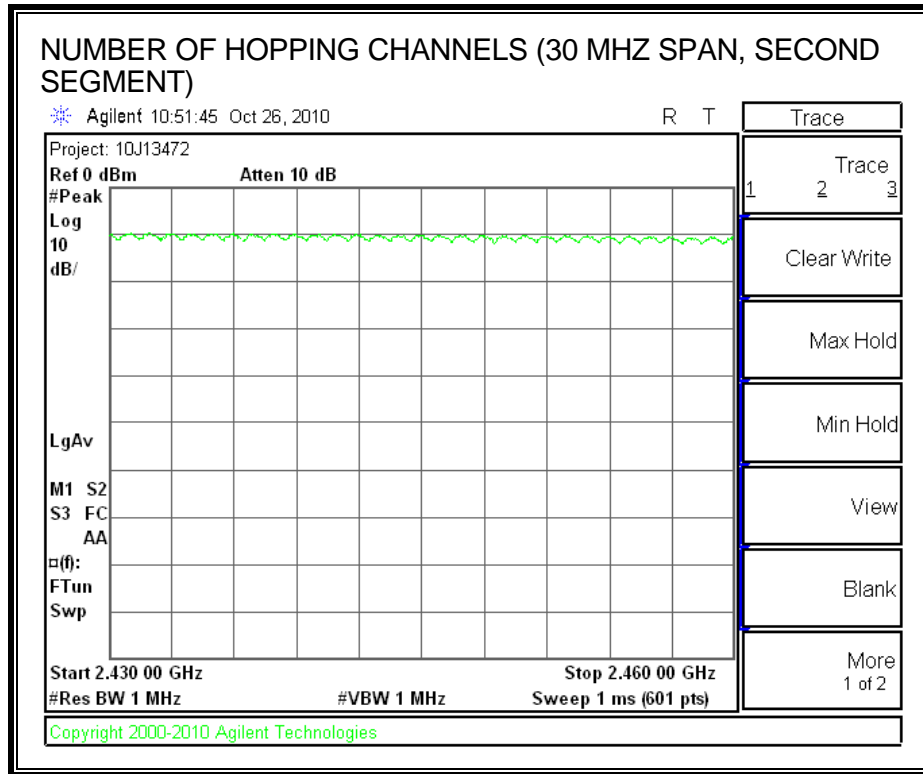
RESULTS

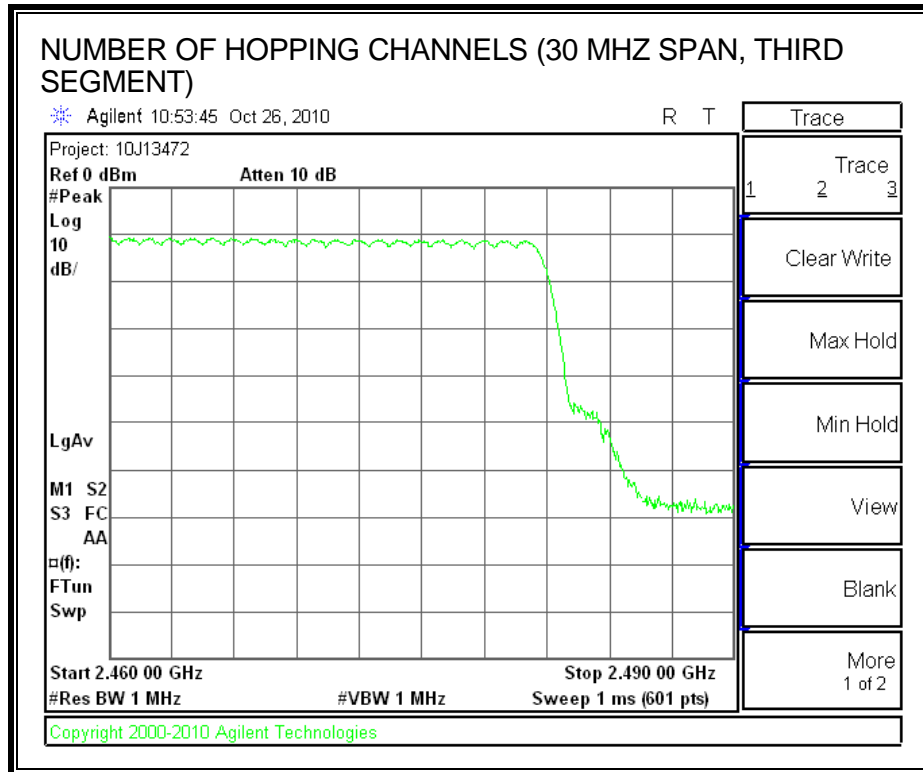
79 Channels observed.

NUMBER OF HOPPING CHANNELS









7.3.4. AVERAGE TIME OF OCCUPANCY

LIMIT

FCC §15.247 (a) (1) (iii)

IC RSS-210 A8.1 (d)

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

TEST PROCEDURE

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

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

RESULTS

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

8PSK Mode

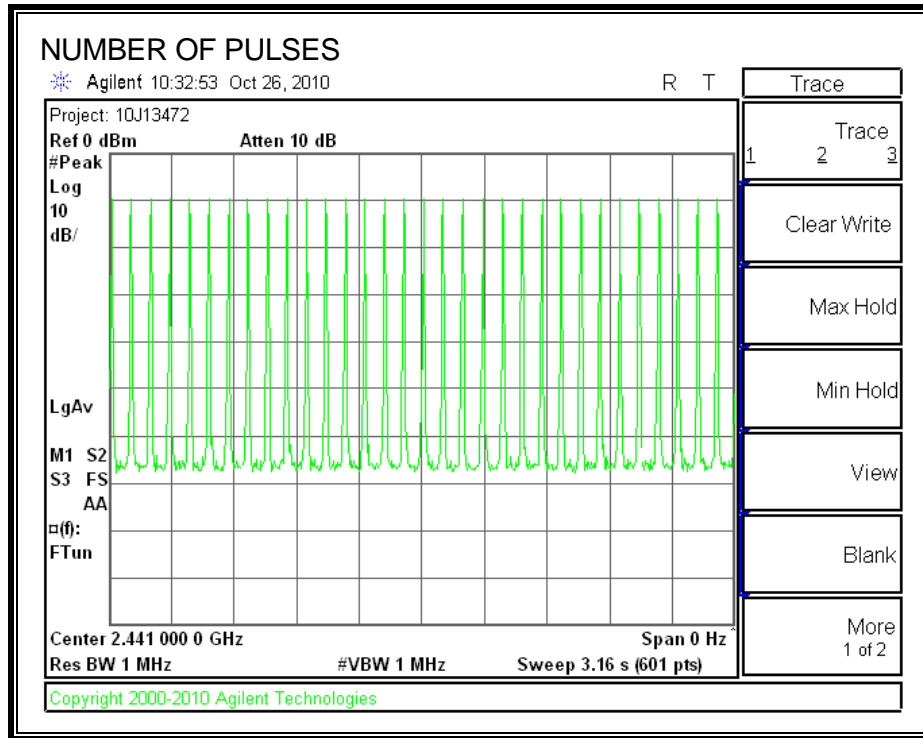
DH Packet	Pulse Width (msec)	Number of Pulses in 3.16 seconds	Average Time of Occupan cy (sec)	Limit (sec)	Margin (sec)
DH1	0.4067	32	0.130	0.4	0.270
DH3	1.654	16	0.265	0.4	0.135
DH5	2.875	11	0.316	0.4	0.084

DH1 Packet

PULSE WIDTH

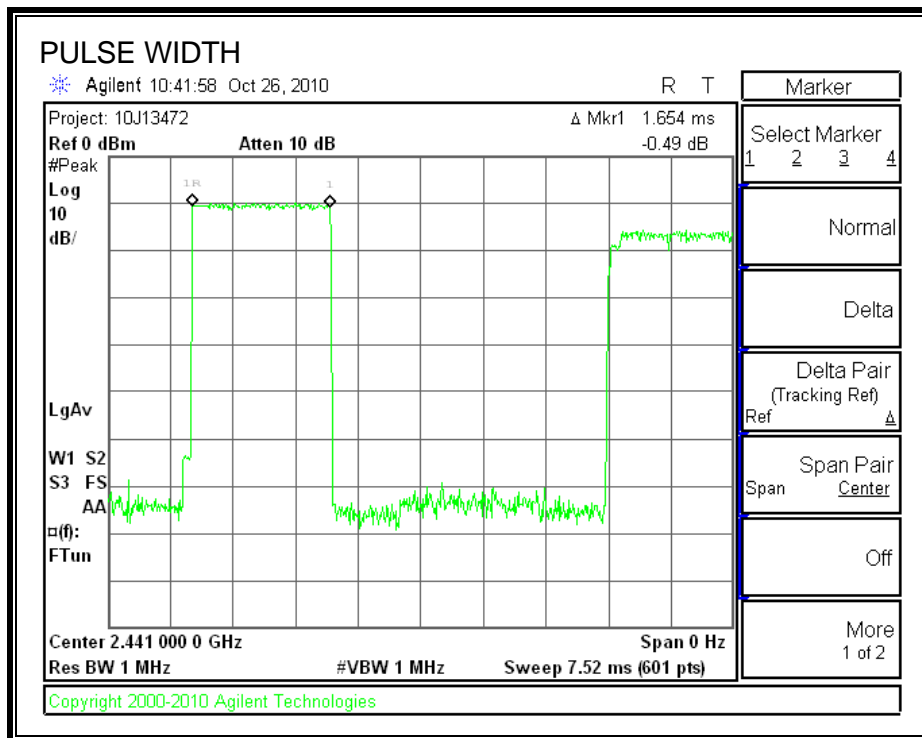


NUMBER OF PULSES IN 3.16 SECOND OBSERVATION PERIOD

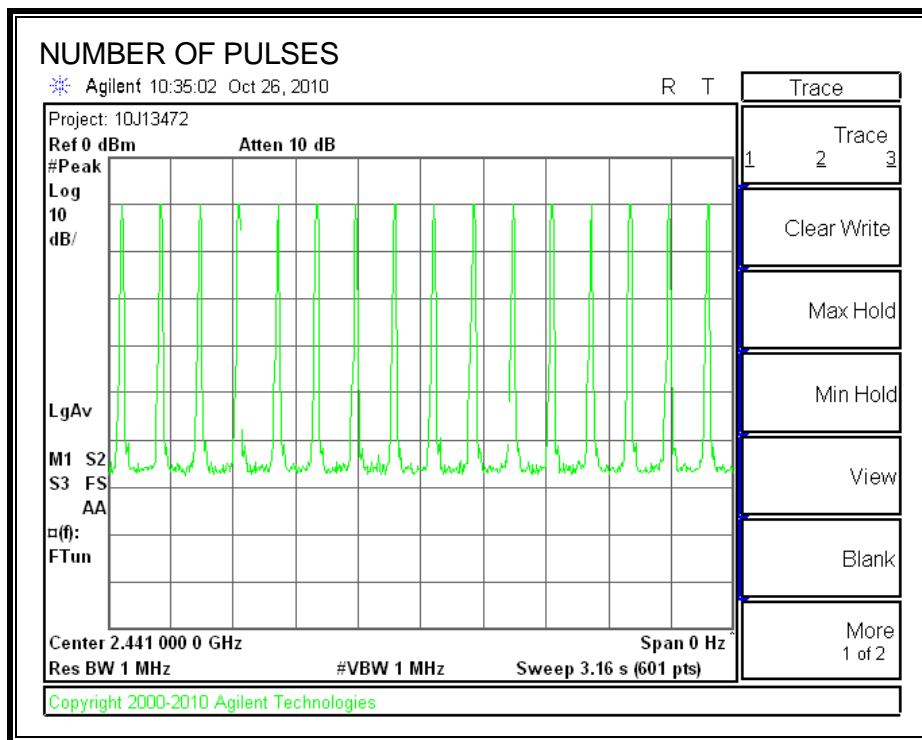


DH3 Packet

PULSE WIDTH

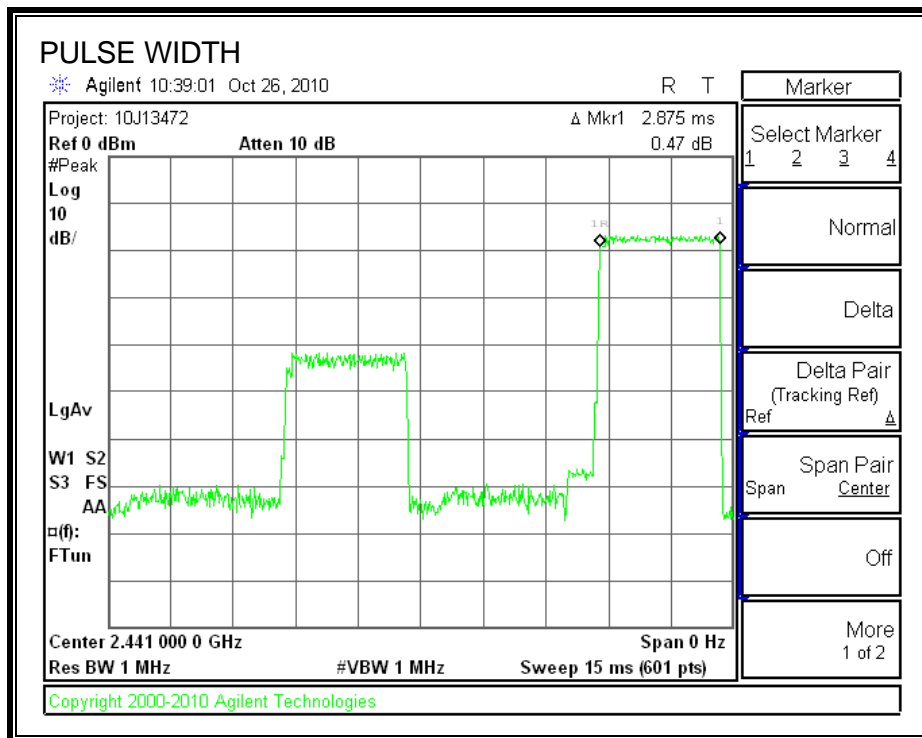


NUMBER OF PULSES IN 3.16 SECOND OBSERVATION PERIOD

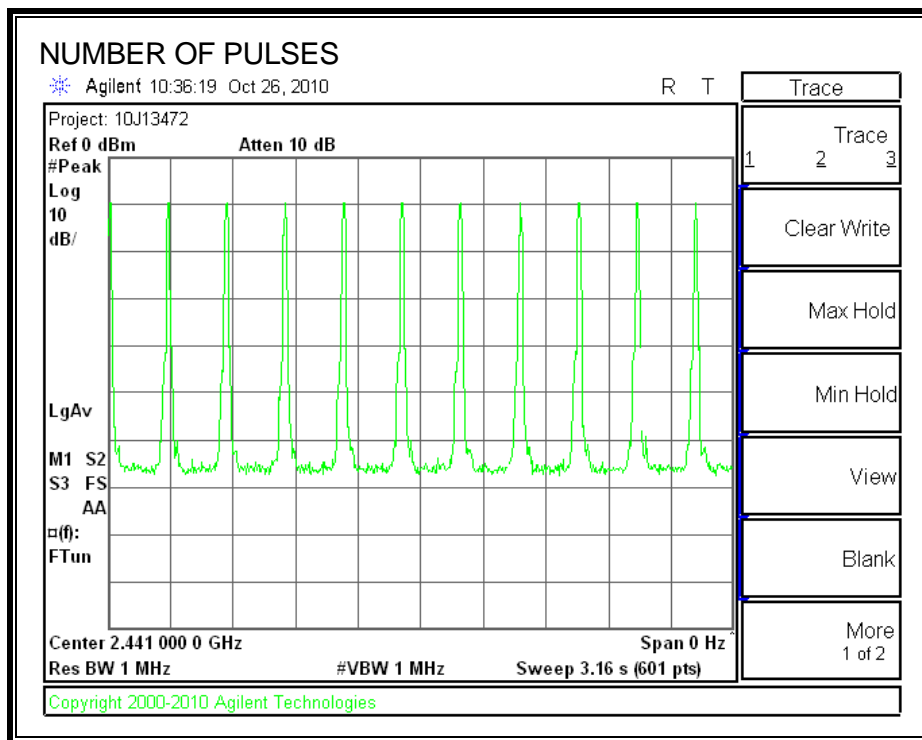


DH5 Packet

PULSE WIDTH



NUMBER OF PULSES IN 3.16 SECOND OBSERVATION PERIOD



7.3.5. OUTPUT POWER

LIMIT

§15.247 (b) (1)

RSS-210 Issue 7 Clause A8.4

The maximum antenna gain is less than 6 dBi, therefore the limit is 30 dBm.

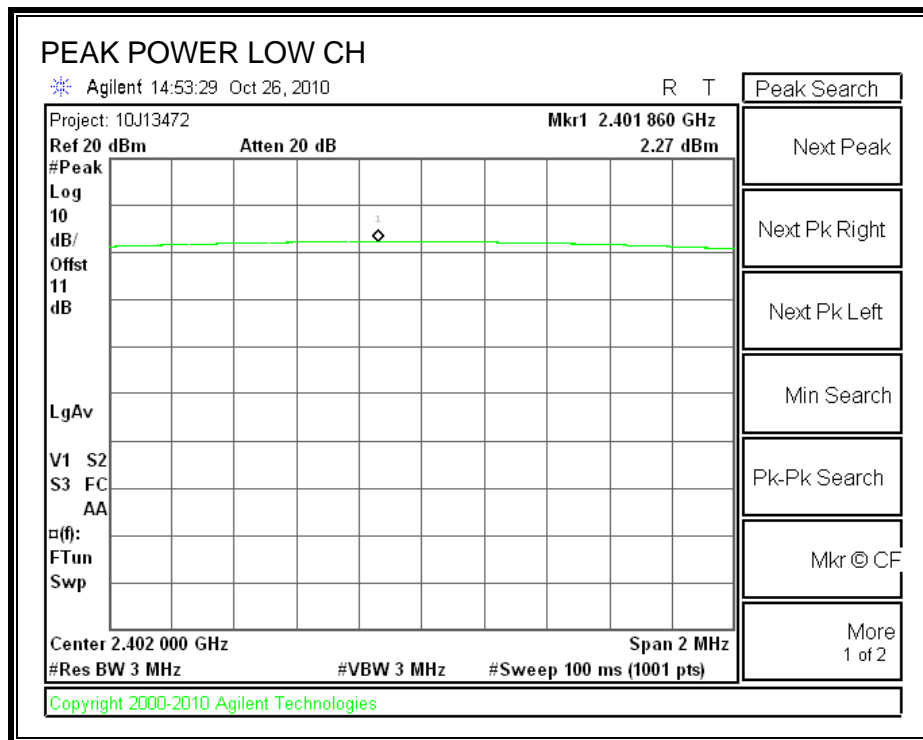
TEST PROCEDURE

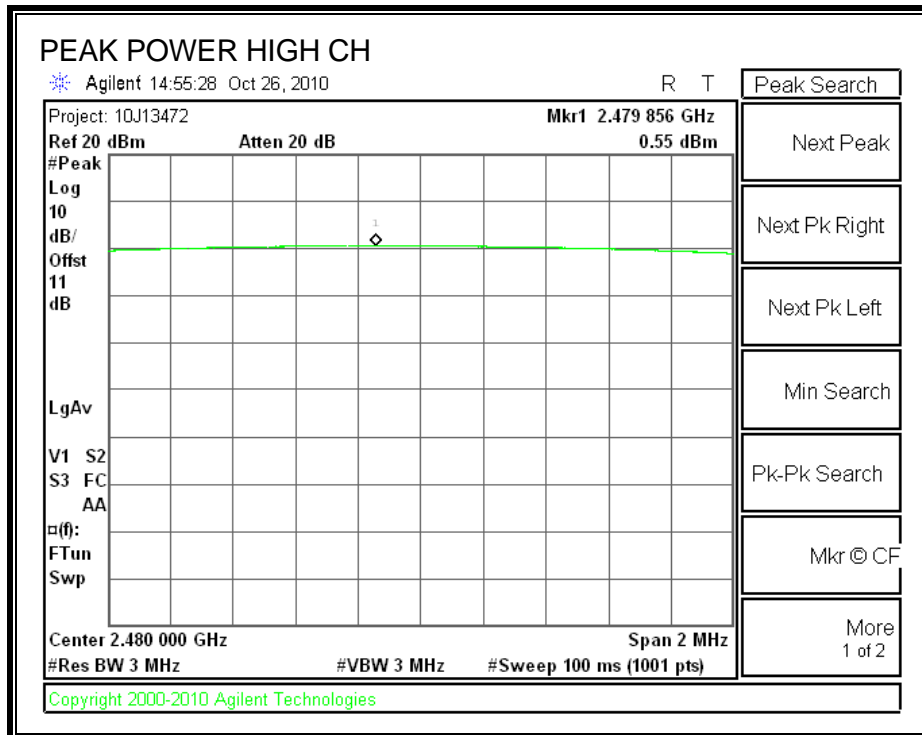
The transmitter output is connected to a spectrum analyzer the analyzer bandwidth is set to a value greater than the 20 dB bandwidth of the EUT.

RESULTS

Channel	Frequency (MHz)	Output Power (dBm)	Limit (dBm)	Margin (dB)
Low	2402	2.27	30	-27.73
Middle	2441	1.90	30	-28.10
High	2480	0.55	30	-29.45

OUTPUT POWER





7.3.6. AVERAGE POWER

LIMIT

None; for reporting purposes only.

TEST PROCEDURE

The transmitter output is connected to a power meter.

RESULTS

The cable assembly insertion loss of 11 dB (including 10 dB pad and 1 dB cable) was entered as an offset in the power meter to allow for direct reading of power.

Channel	Frequency (MHz)	Average Power (dBm)
Low	2402	0.62
Middle	2441	-0.24
High	2480	-1.98

7.3.7. CONDUCTED SPURIOUS EMISSIONS

LIMITS

FCC §15.247 (d)

IC RSS-210 A8.5

Limit = -20 dBc

TEST PROCEDURE

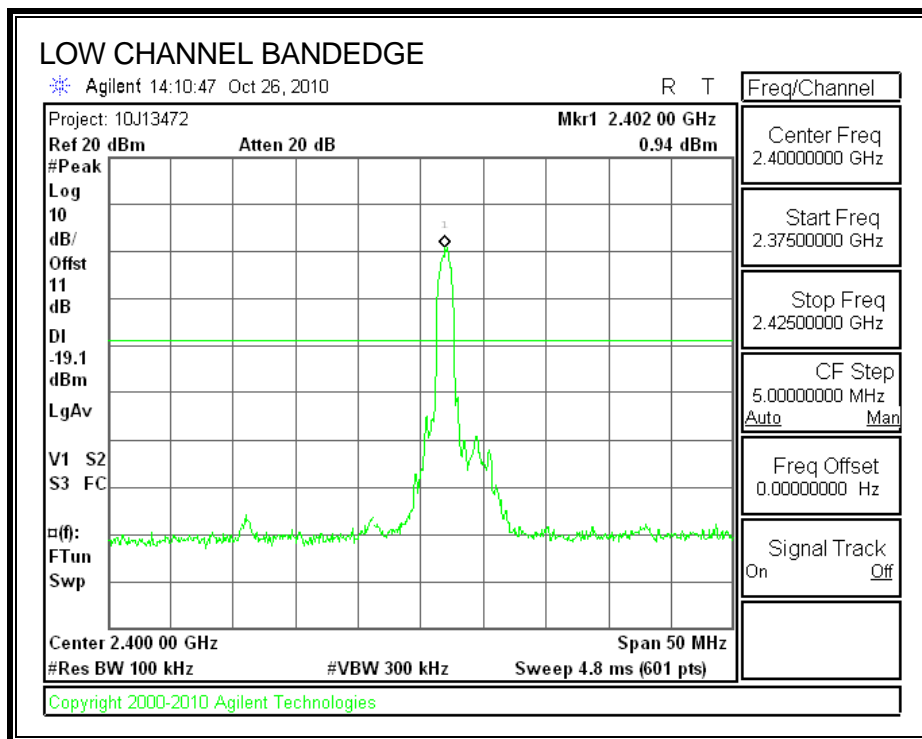
The transmitter output is connected to a spectrum analyzer. The resolution bandwidth is set to 100 kHz. The video bandwidth is set to 300 kHz.

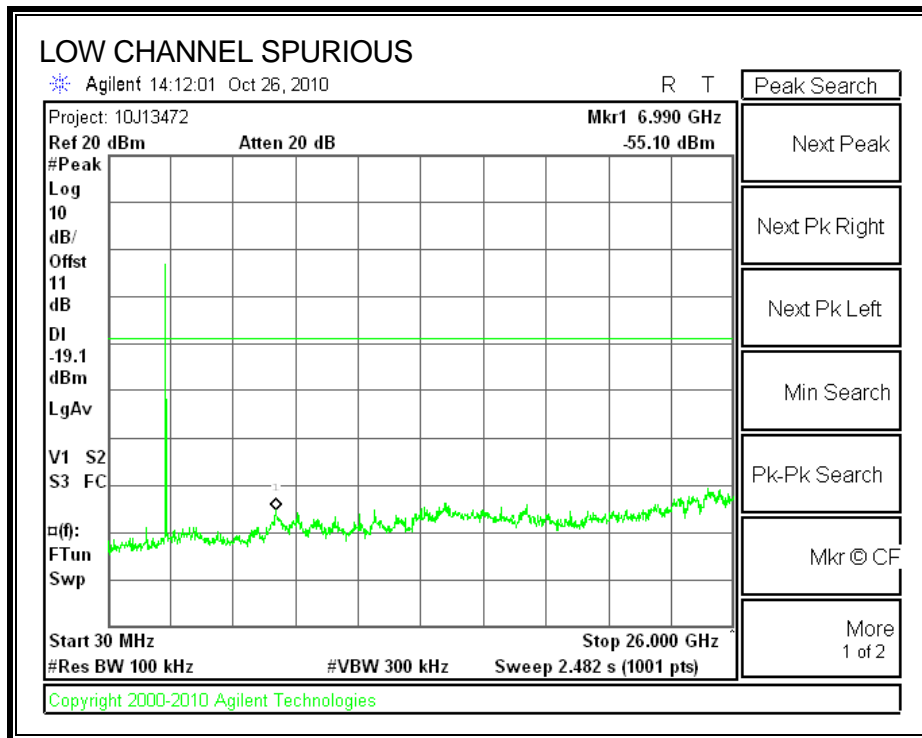
The spectrum from 30 MHz to 26 GHz is investigated with the transmitter set to the lowest, middle, and highest channels.

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

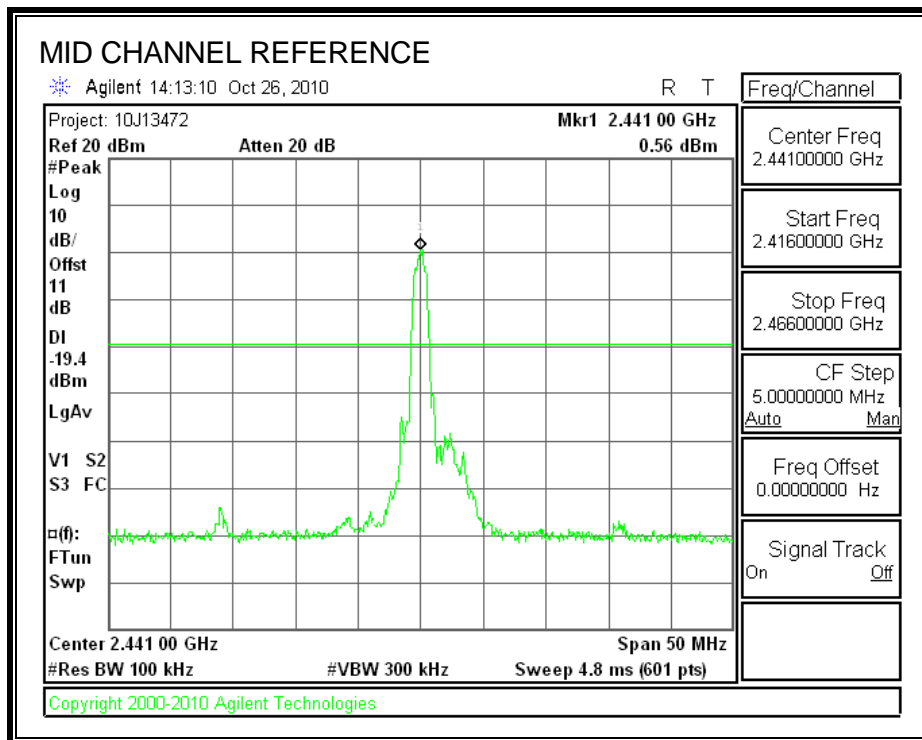
RESULTS

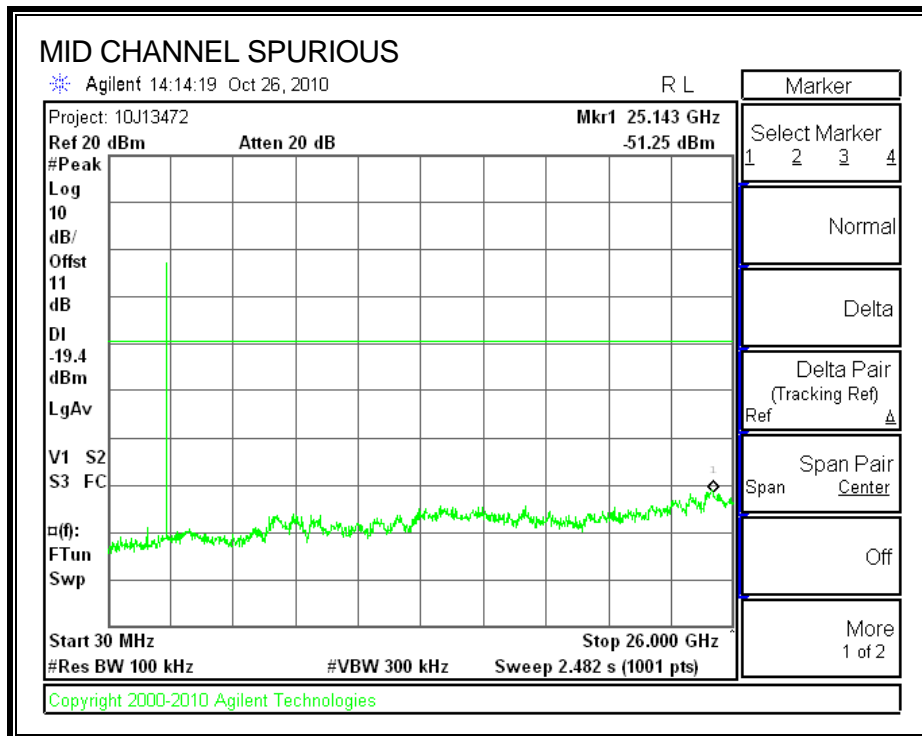
SPURIOUS EMISSIONS, LOW CHANNEL



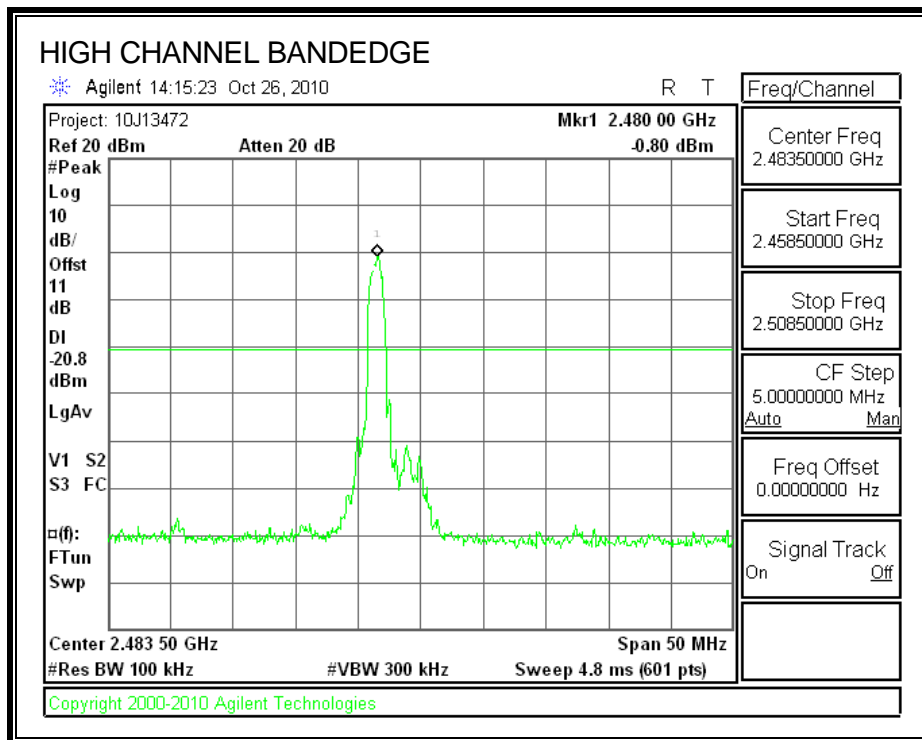


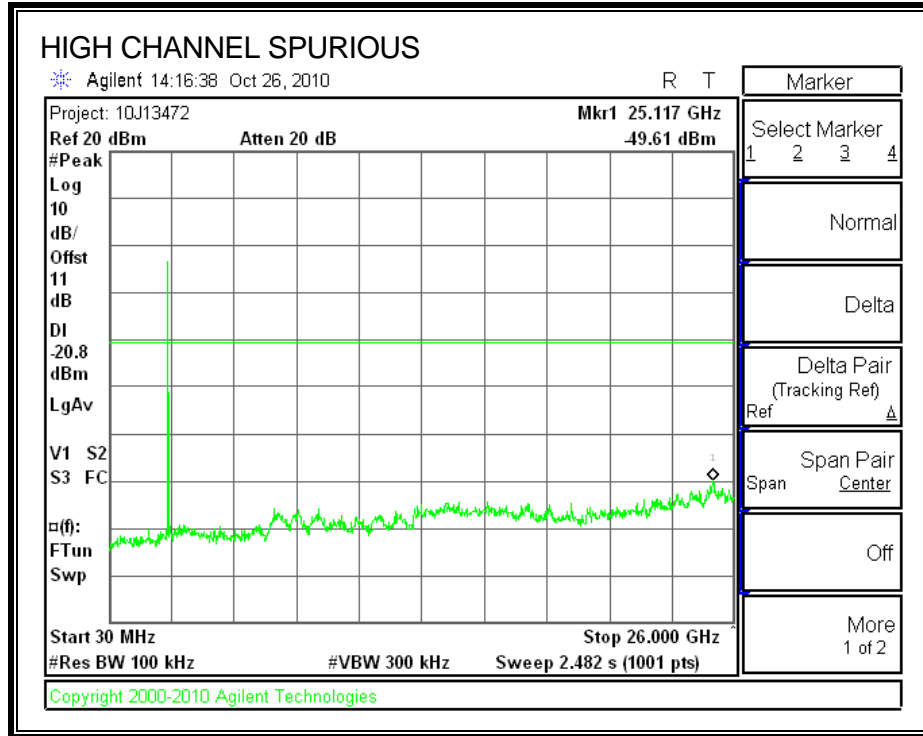
SPURIOUS EMISSIONS, MID CHANNEL



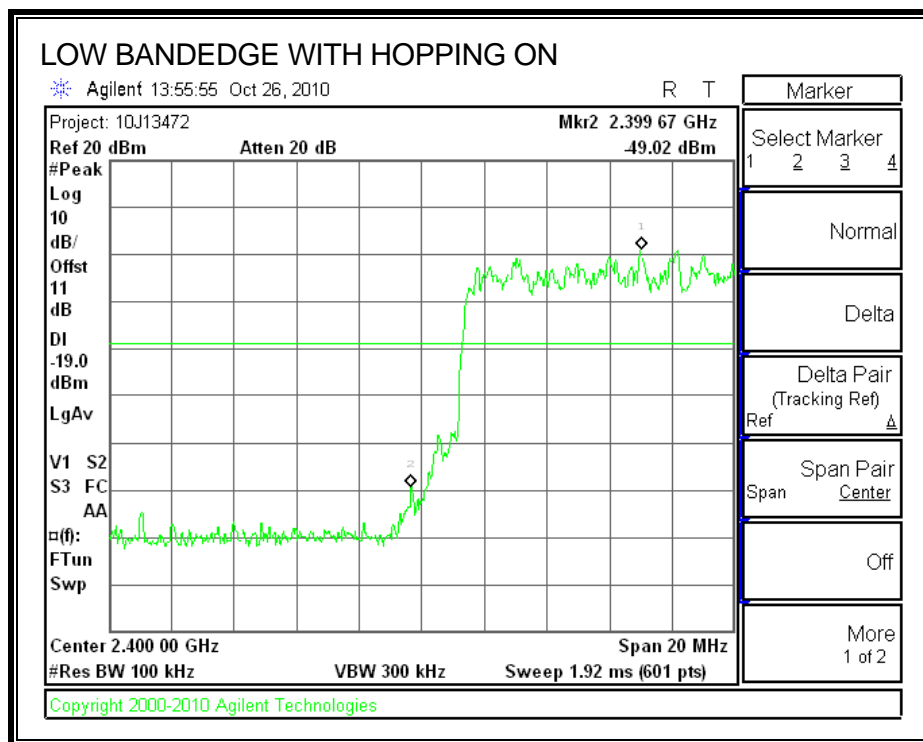


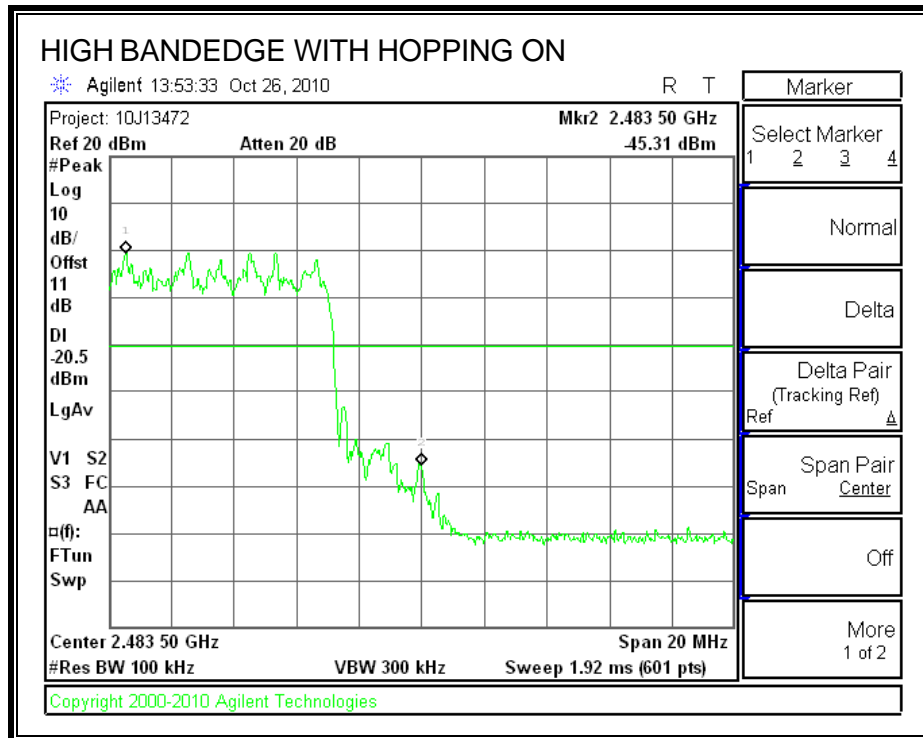
SPURIOUS EMISSIONS, HIGH CHANNEL





SPURIOUS BANDEDGE EMISSIONS WITH HOPPING ON





8. RADIATED TEST RESULTS

8.1. LIMITS AND PROCEDURE

LIMITS

FCC §15.205 and §15.209

IC RSS-210 Clause 2.6 (Transmitter)

IC RSS-GEN Clause 6 (Receiver)

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

TEST PROCEDURE

The EUT is placed on a non-conducting table 80 cm above the ground plane. The antenna to EUT distance is 3 meters. The EUT is configured in accordance with ANSI C63.4. The EUT is set to transmit in a continuous mode.

For measurements below 1 GHz the resolution bandwidth is set to 100 kHz for peak detection measurements or 120 kHz for quasi-peak detection measurements. Peak detection is used unless otherwise noted as quasi-peak.

For measurements above 1 GHz the resolution bandwidth is set to 1 MHz, then the video bandwidth is set to 1 MHz for peak measurements and 10 Hz for average measurements.

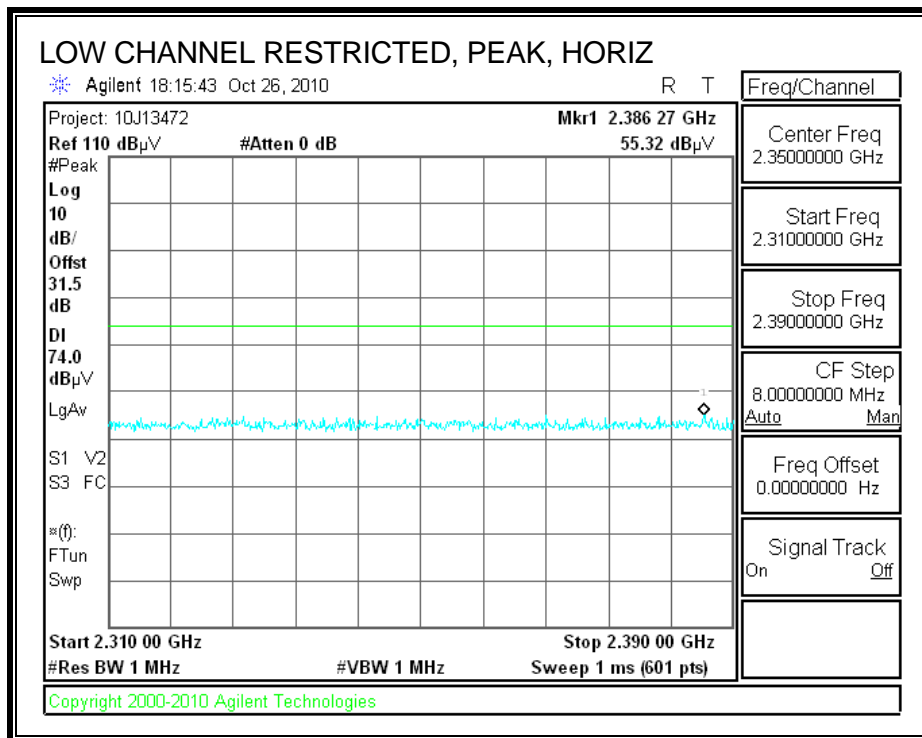
The spectrum from 30 MHz to 26 GHz is investigated with the transmitter set to the lowest, middle, and highest channels in the 2.4 GHz band.

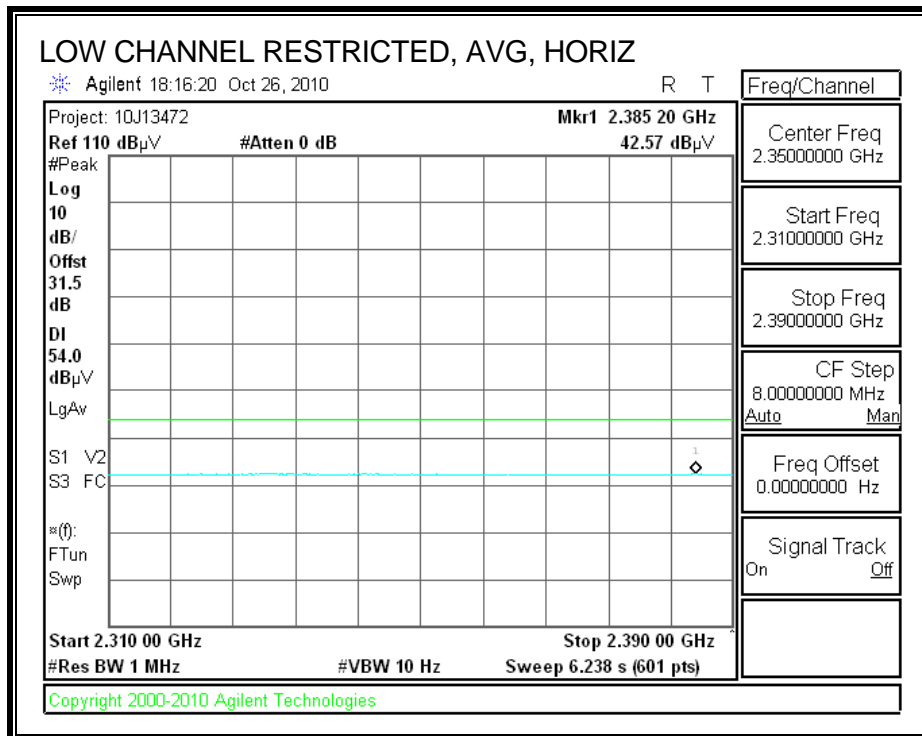
The frequency range of interest is monitored at a fixed antenna height and EUT azimuth. The EUT is rotated through 360 degrees to maximize emissions received. The antenna is scanned from 1 to 4 meters above the ground plane to further maximize the emission. Measurements are made with the antenna polarized in both the vertical and the horizontal positions.

8.2. TRANSMITTER ABOVE 1 GHz

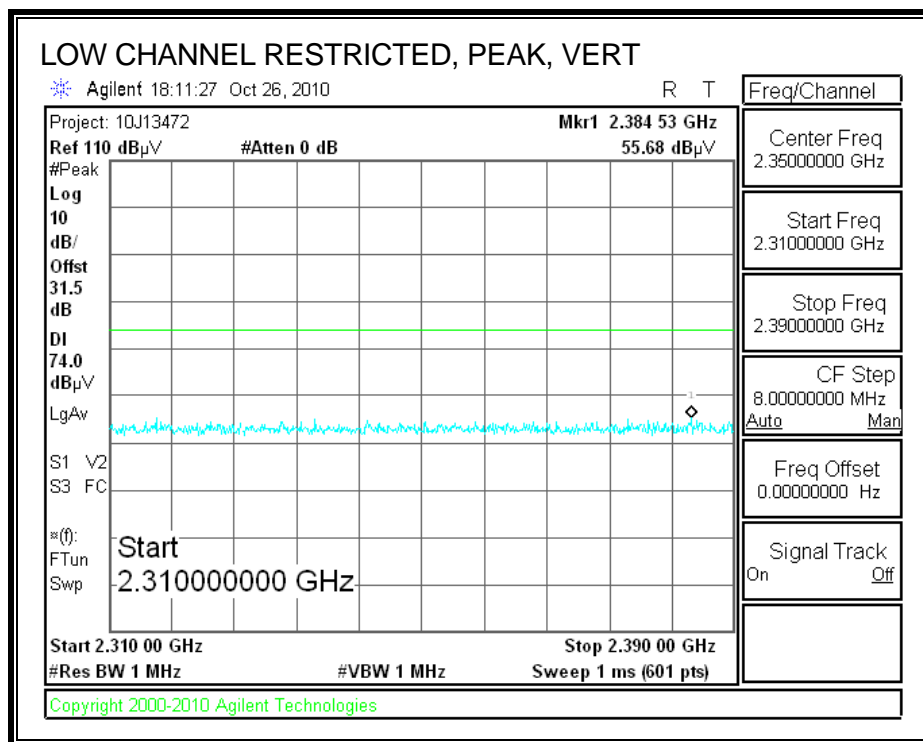
8.2.1. BASIC DATA RATE GFSK MODULATION

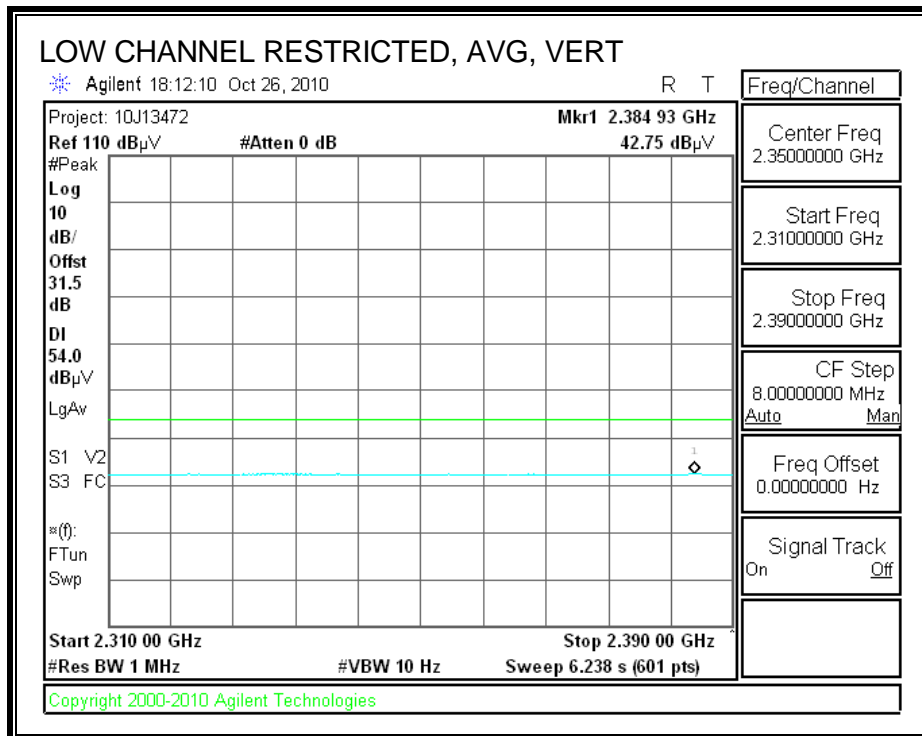
RESTRICTED BANDEDGE (LOW CHANNEL, HORIZONTAL)



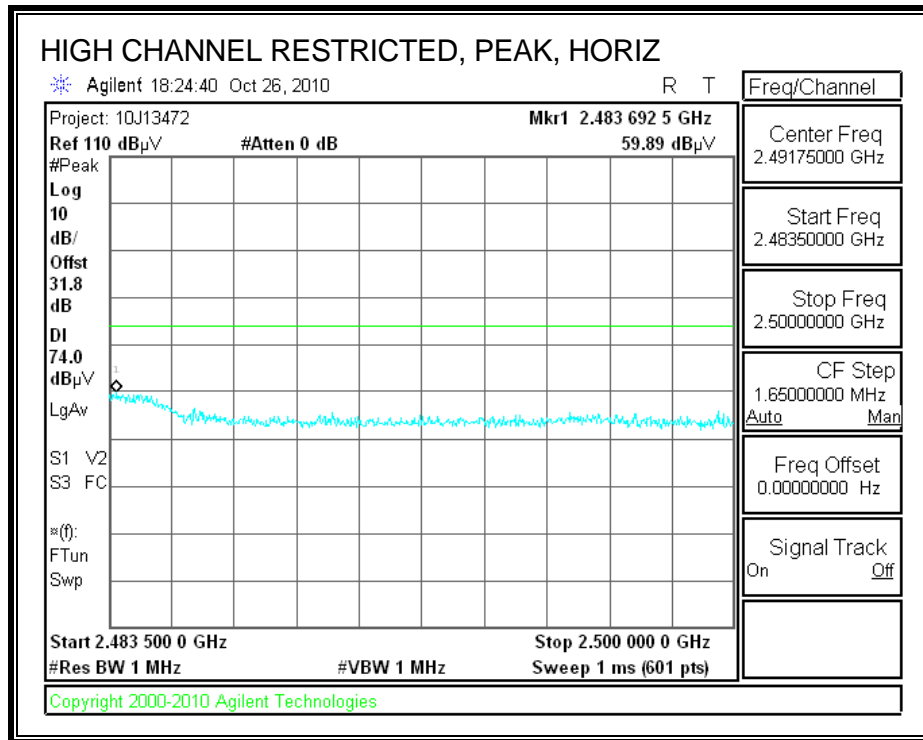


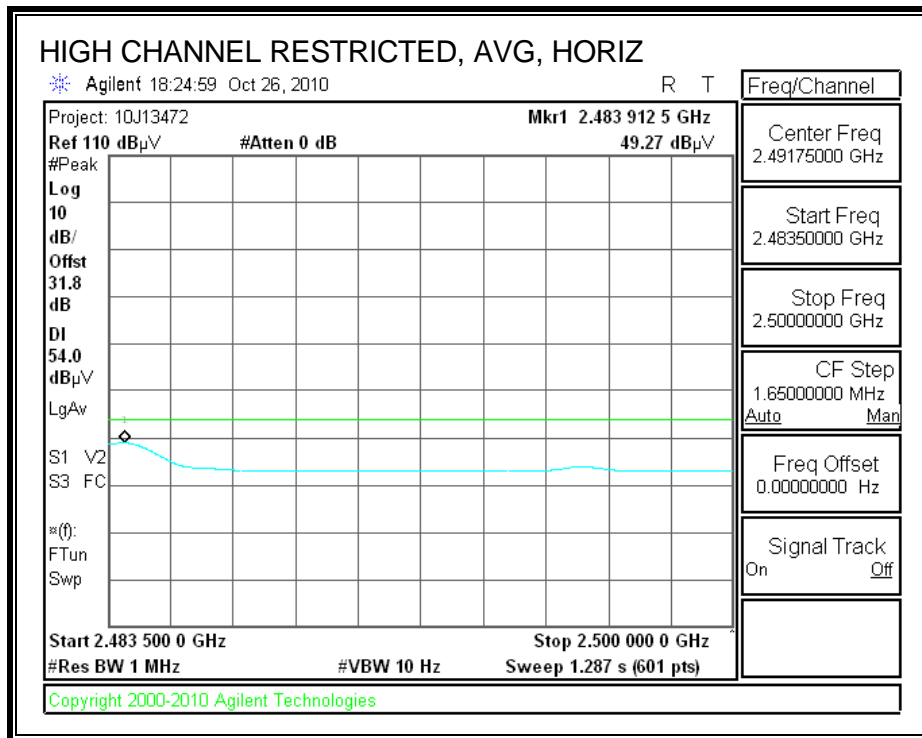
RESTRICTED BANDEDGE (LOW CHANNEL, VERTICAL)



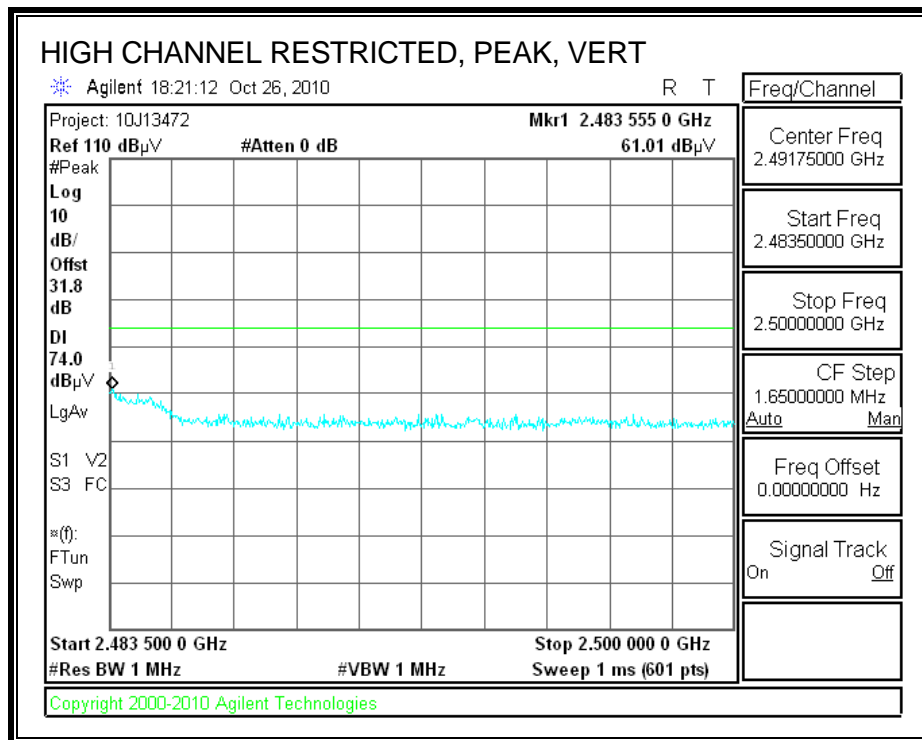


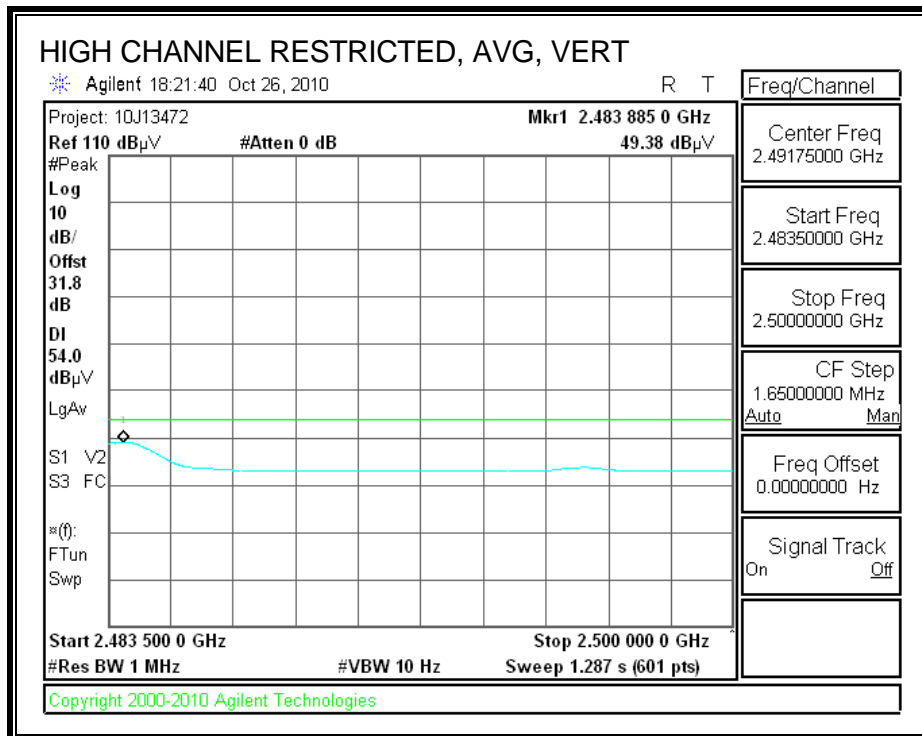
RESTRICTED BANEDGE (HIGH CHANNEL, HORIZONTAL)





RESTRICTED BANDEDGE (HIGH CHANNEL, VERTICAL)





HARMONICS AND SPURIOUS EMISSIONS

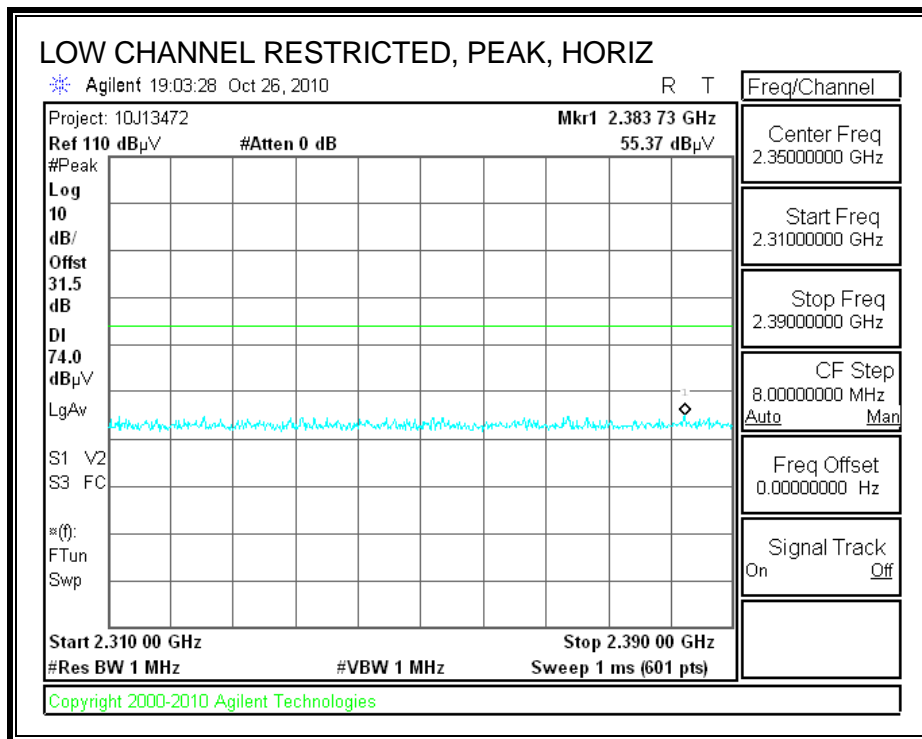
High Frequency Measurement															
Compliance Certification Services, Fremont 5m Chamber															
Test Engr:		William Zhuang													
Date:		10/26/10													
Project #:		10J13472													
Company:		SMK													
Test Target:		FCC 15.205													
Mode Oper:		Tx On, GFSK Modulation													
f	Dist	Read	AF	CL	Amp	D Corr	Fltr	Corr.	Limit	Margin	Ant. Pol.	Det.	Ant.High	Table Angle	Notes
GHz	(m)	dBuV	dB/m	dB	dB	dB	dB	dB	dBuV/m	dBuV/m	dB	V/H	P/A/QP	cm	Degree
Low Ch. 2402 MHz															
4.804	3.0	55.7	32.7	5.8	-34.8	0.0	0.0	59.4	74.0	-14.7	V	P	97.0	130.0	
4.804	3.0	34.6	32.7	5.8	-34.8	0.0	0.0	38.2	54.0	-15.8	V	A	97.0	130.0	
4.804	3.0	45.1	32.7	5.8	-34.8	0.0	0.0	48.7	74.0	-25.3	H	P	100.0	149.0	
4.804	3.0	30.0	32.7	5.8	-34.8	0.0	0.0	33.6	54.0	-20.4	H	A	100.0	149.0	
Mid Ch. 2441 MHz															
4.882	3.0	54.7	32.7	5.8	-34.8	0.0	0.0	58.4	74.0	-15.6	V	P	104.0	134.0	
4.882	3.0	39.3	32.7	5.8	-34.8	0.0	0.0	43.0	54.0	-11.0	V	A	104.0	134.0	
4.882	3.0	56.1	32.7	5.8	-34.8	0.0	0.0	59.8	74.0	-14.2	H	P	116.0	161.0	
4.882	3.0	40.1	32.7	5.8	-34.8	0.0	0.0	43.8	54.0	-10.2	H	A	116.0	161.0	
High Ch. 2480 MHz															
4.960	3.0	55.2	32.8	5.9	-34.8	0.0	0.0	59.1	74.0	-14.9	V	P	98.0	290.0	
4.960	3.0	41.2	32.8	5.9	-34.8	0.0	0.0	45.1	54.0	-8.9	V	A	98.0	290.0	
4.960	3.0	58.8	32.8	5.9	-34.8	0.0	0.0	62.6	74.0	-11.4	H	P	112.0	86.0	
4.960	3.0	43.7	32.8	5.9	-34.8	0.0	0.0	47.6	54.0	-6.4	H	A	112.0	86.0	

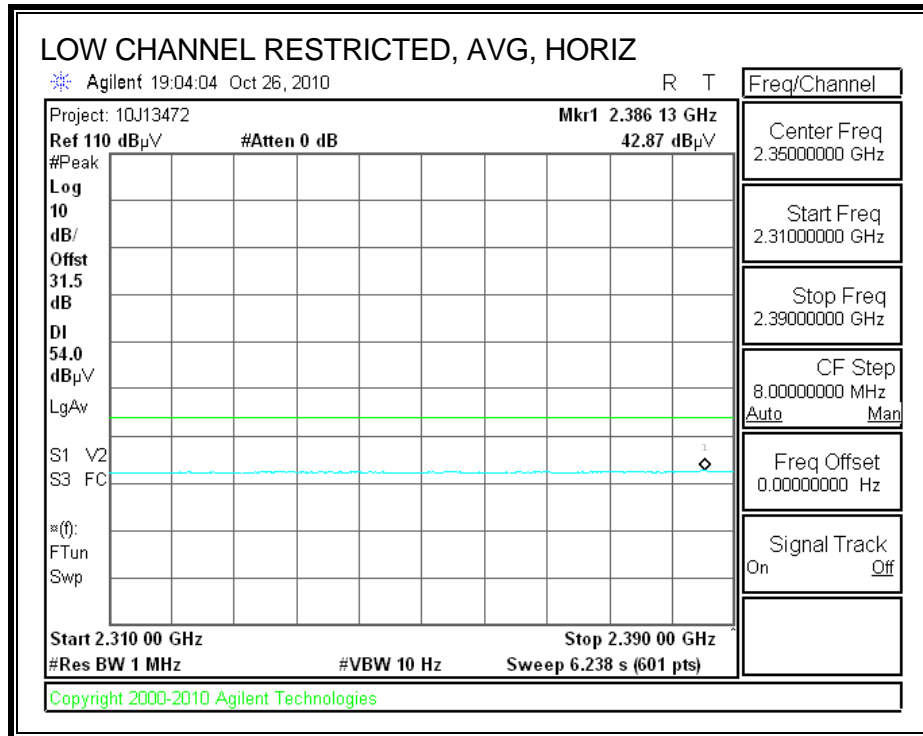
Rev. 4.1.2.7

Note: No other emissions were detected above the system noise floor.

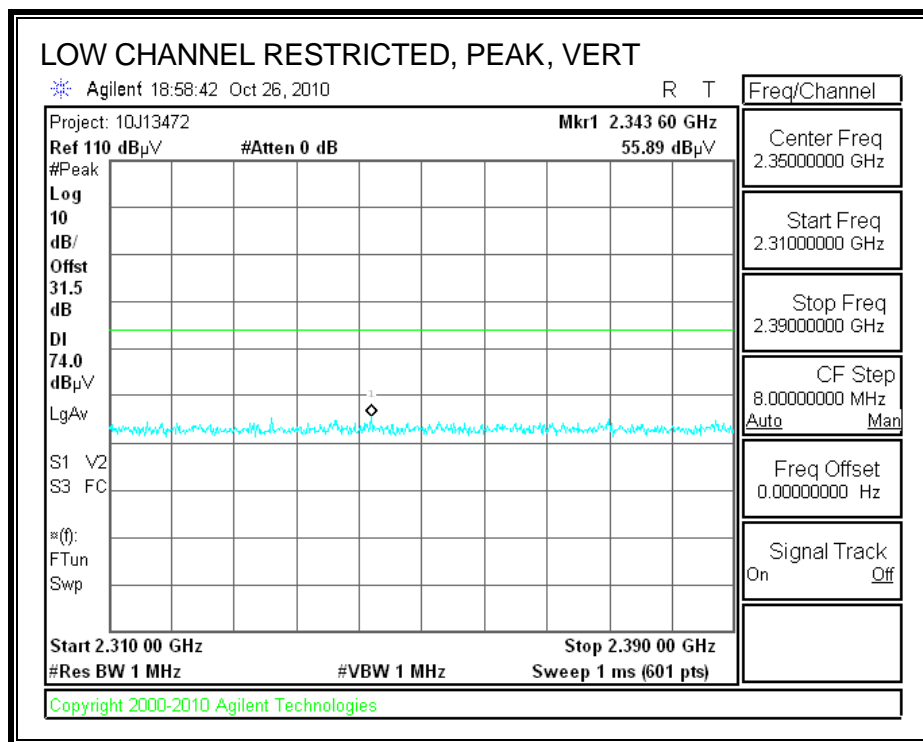
8.2.2. ENHANCED DATA RATE 8PSK MODULATION

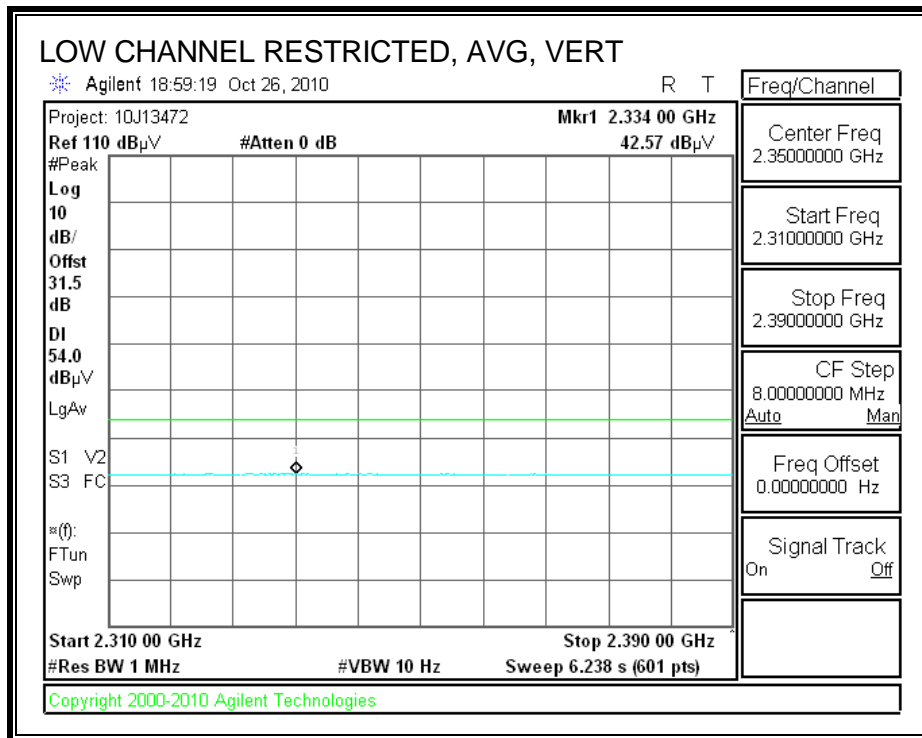
RESTRICTED BANDEDGE (LOW CHANNEL, HORIZONTAL)



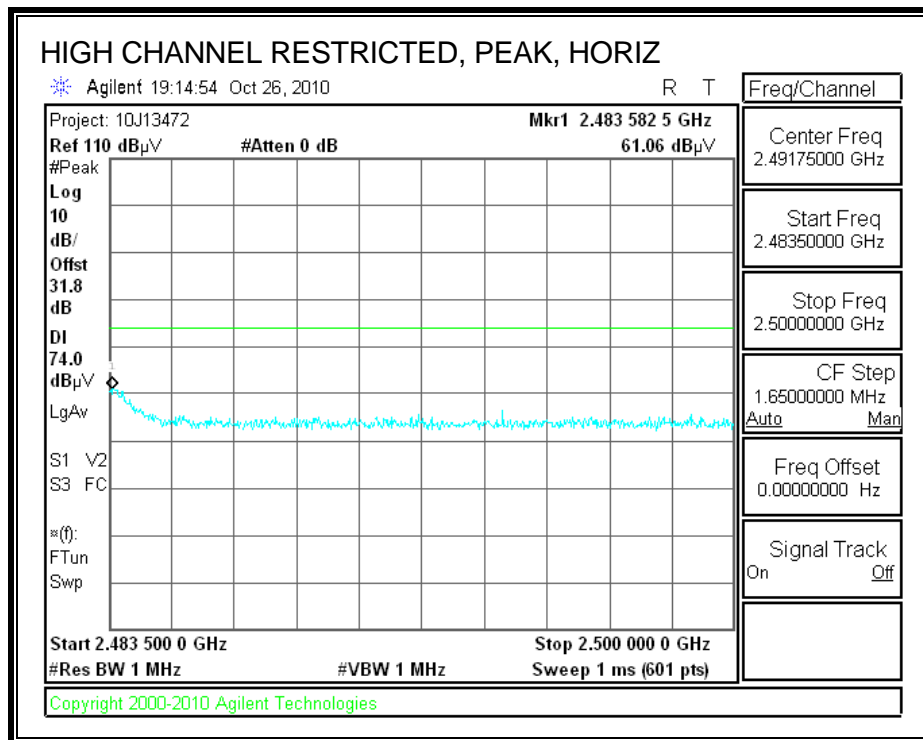


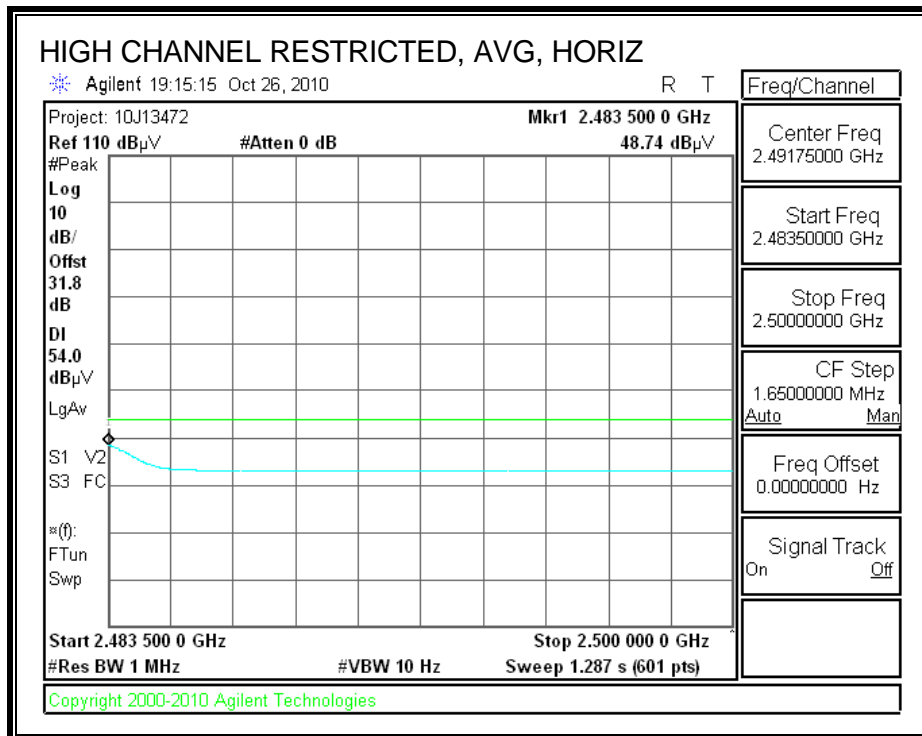
RESTRICTED BANDEDGE (LOW CHANNEL, VERTICAL)



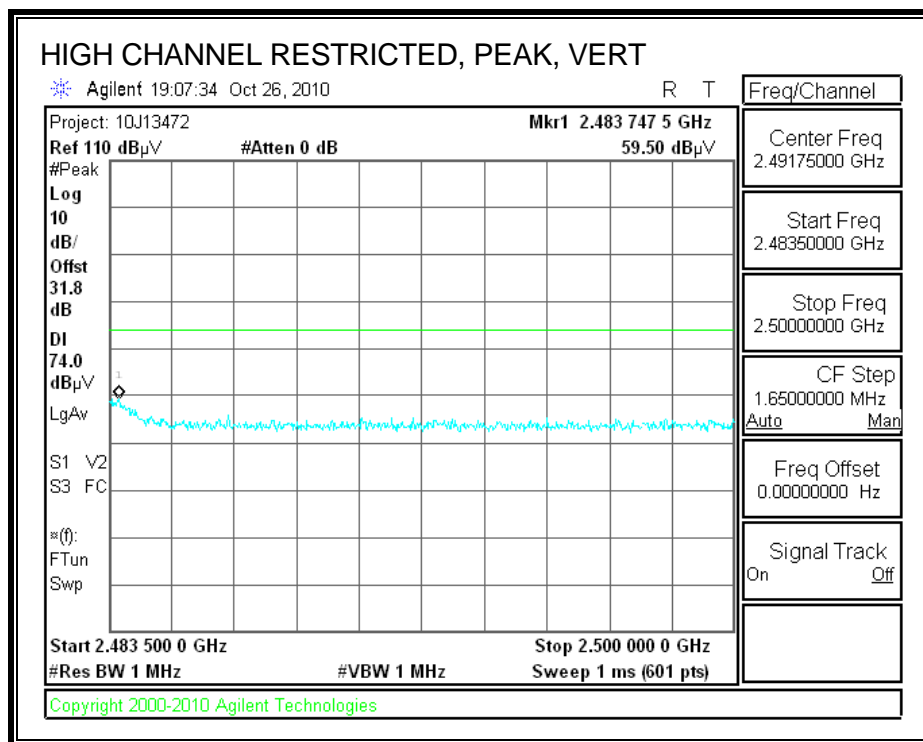


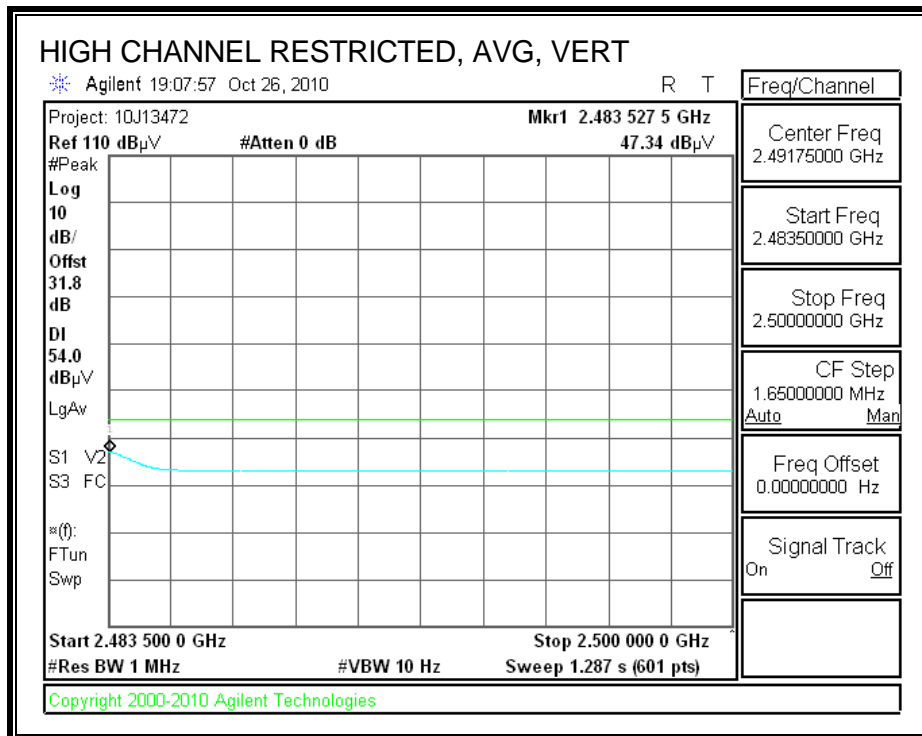
RESTRICTED BANDEDGE (HIGH CHANNEL, HORIZONTAL)





RESTRICTED BANDEDGE (HIGH CHANNEL, VERTICAL)





HARMONICS AND SPURIOUS EMISSIONS

High Frequency Measurement															
Compliance Certification Services, Fremont 5m Chamber															
Test Engr:		William Zhuang													
Date:		10/26/10													
Project #:		10J13472													
Company:		SMK													
Test Target:		FCC 15.205													
Mode Oper:		Tx On, 8PSK Modulation													
f	Dist	Read	AF	CL	Amp	D Corr	Fltr	Corr.	Limit	Margin	Ant. Pol.	Det.	Ant.High	Table Angle	Notes
GHz	(m)	dBuV	dB/m	dB	dB	dB	dB	dB	dBuV/m	dBuV/m	dB	V/H	P/A/QP	cm	Degree
Low Ch. 2402 MHz															
4.804	3.0	48.9	32.7	5.8	-34.8	0.0	0.0	52.5	74.0	-21.5	V	P	98.0	131.0	
4.804	3.0	29.7	32.7	5.8	-34.8	0.0	0.0	33.3	54.0	-20.7	V	A	98.0	131.0	
4.804	3.0	47.5	32.7	5.8	-34.8	0.0	0.0	51.1	74.0	-22.9	H	P	106.0	75.0	
4.804	3.0	28.6	32.7	5.8	-34.8	0.0	0.0	32.2	54.0	-21.8	H	A	106.0	75.0	
Mid Ch. 2441 MHz															
4.882	3.0	48.2	32.7	5.8	-34.8	0.0	0.0	51.9	74.0	-22.1	V	P	105.0	130.0	
4.882	3.0	29.0	32.7	5.8	-34.8	0.0	0.0	32.7	54.0	-21.3	V	A	105.0	130.0	
4.882	3.0	46.4	32.7	5.8	-34.8	0.0	0.0	50.1	74.0	-23.9	H	P	98.0	147.0	
4.882	3.0	27.9	32.7	5.8	-34.8	0.0	0.0	31.6	54.0	-22.4	H	A	98.0	147.0	
High Ch. 2480 MHz															
4.960	3.0	48.2	32.8	5.9	-34.8	0.0	0.0	52.1	74.0	-21.9	V	P	98.0	82.0	
4.960	3.0	28.8	32.8	5.9	-34.8	0.0	0.0	32.7	54.0	-21.3	V	A	98.0	82.0	
4.960	3.0	51.3	32.8	5.9	-34.8	0.0	0.0	55.1	74.0	-18.9	H	P	111.0	80.0	
4.960	3.0	30.8	32.8	5.9	-34.8	0.0	0.0	34.7	54.0	-19.3	H	A	111.0	80.0	
Rev. 4.1.2.7															
Note: No other emissions were detected above the system noise floor.															

8.3. RECEIVER ABOVE 1 GHz

High Frequency Measurement
 Compliance Certification Services, Fremont 5m Chamber

Company: SMK
 Project #: 10J13472
 Date: 10/28/2010
 Test Engineer: William Zhuang
 Configuration: EUT with Extend Card, Laptop and DC Power supply
 Mode: Rx On

Test Equipment:

Horn 1-18GHz	Pre-amplifer 1-26GHz	Pre-amplifer 26-40GHz	Horn > 18GHz	Limit
T60; S/N: 2238 @3m	T34 HP 8449B			RX RSS 210

Hi Frequency Cables

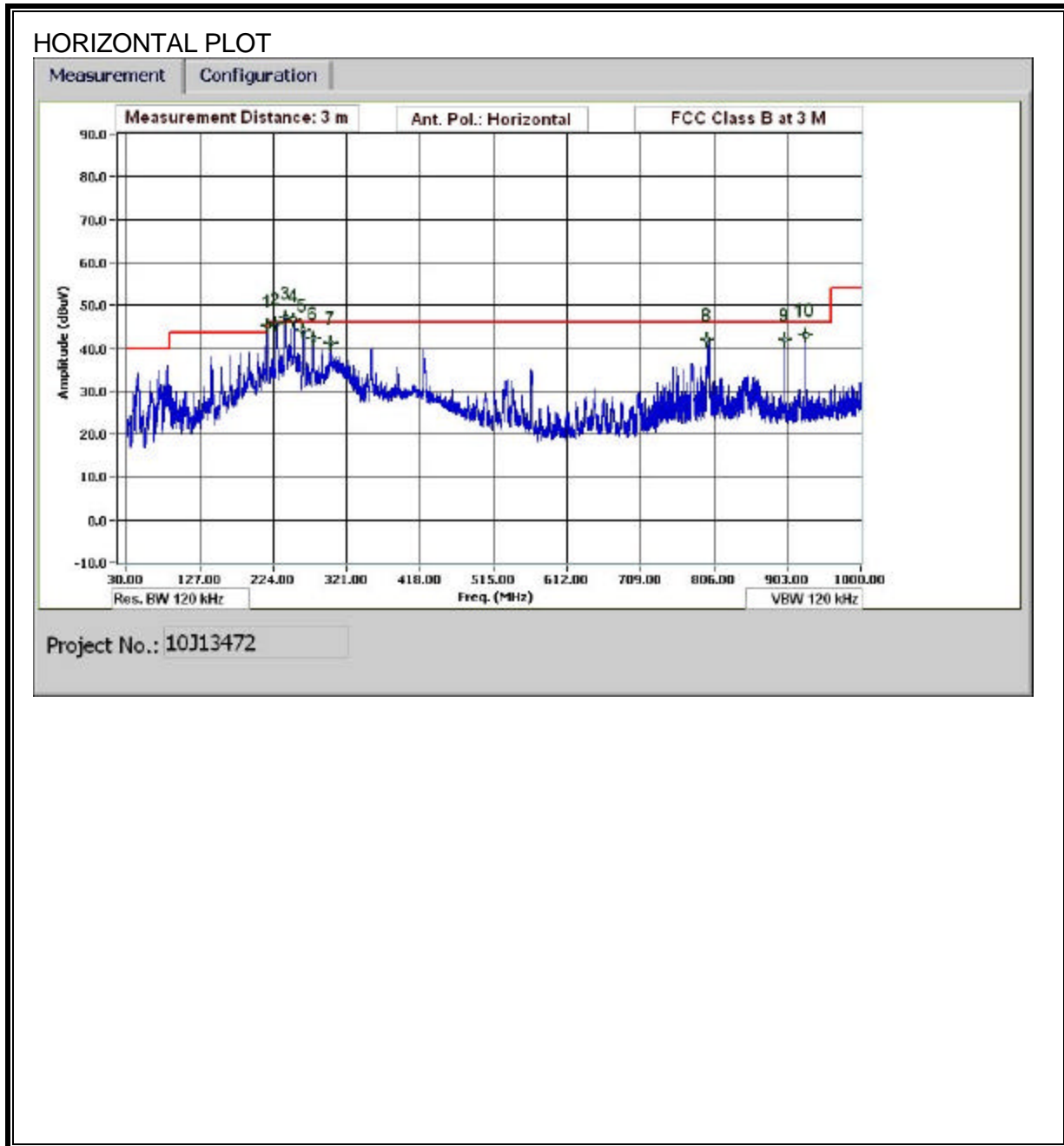
3' cable 22807700	12' cable 22807600	20' cable 22807500	HPF	Reject Filter	<u>Peak Measurements</u> RBW=VBW=1MHz <u>Average Measurements</u> RBW=1MHz, VBW=10Hz
3' cable 22807700	12' cable 22807600	20' cable 22807500			

f GHz	Dist (m)	Read Pk dBuV	Read Avg dBuV	AF dB/m	CL dB	Amp dB	D Corr dB	Ftr dB	Peak dBuV/m	Avg dBuV/m	Pk Lim dBuV/m	Avg Lim dBuV/m	Pk Mar dB	Avg Mar dB	Notes (V/H)
1.065	3.0	59.7	38.9	24.7	2.4	-38.2	0.0	0.0	48.6	27.8	74	54	-25.4	-26.2	V
1.328	3.0	64.6	39.1	25.6	2.7	-37.8	0.0	0.0	55.1	29.6	74	54	-18.9	-24.4	V
1.458	3.0	56.2	54.5	26.0	2.9	-37.6	0.0	0.0	47.5	45.8	74	54	-26.5	-8.2	V
1.597	3.0	56.2	40.3	26.5	3.0	-37.4	0.0	0.0	48.3	32.3	74	54	-25.7	-21.7	V
1.062	3.0	64.6	43.0	24.7	2.4	-38.2	0.0	0.0	53.5	32.0	74	54	-20.5	-22.0	H
1.330	3.0	58.0	36.7	25.6	2.7	-37.8	0.0	0.0	48.5	27.2	74	54	-25.5	-26.8	H
1.458	3.0	52.2	48.3	26.0	2.9	-37.6	0.0	0.0	43.4	39.5	74	54	-30.6	-14.5	H
1.600	3.0	51.2	45.5	26.5	3.0	-37.4	0.0	0.0	43.3	37.5	74	54	-30.7	-16.5	H

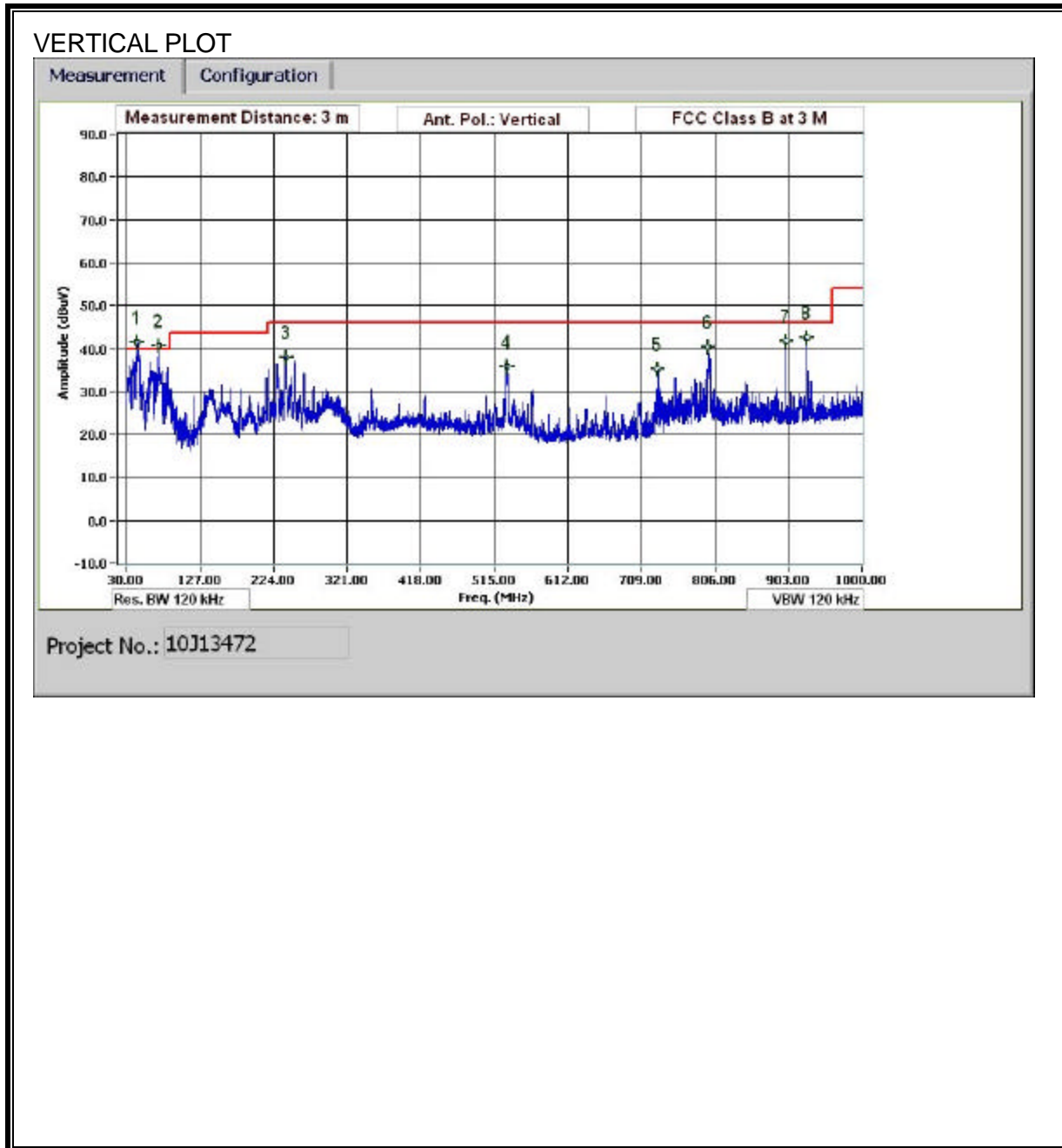
f	Measurement Frequency	Amp	Preamp Gain	Avg Lim	Average Field Strength Limit
Dist	Distance to Antenna	D Corr	Distance Correct to 3 meters	Pk Lim	Peak Field Strength Limit
Read	Analyzer Reading	Avg	Average Field Strength @ 3 m	Avg Mar	Margin vs. Average Limit
AF	Antenna Factor	Peak	Calculated Peak Field Strength	Pk Mar	Margin vs. Peak Limit
CL	Cable Loss	HPF	High Pass Filter		

8.4. WORST-CASE BELOW 1 GHz

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



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



HORIZONTAL AND VERTICAL DATA

HORIZONTAL AND VERTICAL DATA															
30-1000MHz Frequency Measurement															
Compliance Certification Services, Fremont 5m Chamber															
Test Engr:		William Zhuang													
Date:		10/28/10													
Project #:		10J13472													
Company:		SMK													
Test Target:		FCC Class B													
Mode Oper:		Tx On, worst case													
f	Measurement Frequency	Amp	Preamp Gain	Margin	Margin vs. Limit										
Dist	Distance to Antenna	D Corr	Distance Correct to 3 meters												
Read	Analyzer Reading	Filter	Filter Insert Loss												
AF	Antenna Factor	Corr.	Calculated Field Strength												
CL	Cable Loss	Limit	Field Strength Limit												
f MHz	Dist (m)	Read dBuV	AF dB/m	CL dB	Amp dB	D Corr dB	Pad dB	Corr. dBuV/m	Limit dBuV/m	Margin dB	Ant. Pol. V/H	Det. P/A/QP	Ant. High cm	Table Angle Degree	Notes
44.161	3.0	54.4	12.0	0.6	28.4	0.0	0.0	38.7	40.0	-1.3	V	QP	100.0	313.0	
72.002	3.0	57.1	8.2	0.7	28.3	0.0	0.0	37.7	40.0	-2.3	V	QP	100.0	313.0	
240.129	3.0	52.2	11.8	1.3	27.4	0.0	0.0	37.9	46.0	-8.1	V	P	100.0	0 - 360	
531.021	3.0	45.1	17.3	2.0	28.6	0.0	0.0	35.9	46.0	-10.1	V	P	100.0	0 - 360	
730.709	3.0	41.8	19.5	2.4	28.4	0.0	0.0	35.3	46.0	-10.7	V	P	100.0	0 - 360	
797.312	3.0	45.3	20.8	2.5	28.2	0.0	0.0	40.4	46.0	-5.6	V	P	100.0	0 - 360	
900.036	3.0	44.8	22.1	2.7	27.9	0.0	0.0	41.7	46.0	-4.3	V	P	100.0	0 - 360	
927.517	3.0	45.2	22.3	2.8	27.8	0.0	0.0	42.5	46.0	-3.5	V	P	100.0	0 - 360	
215.888	3.0	56.8	11.9	1.2	27.4	0.0	0.0	42.3	43.5	-1.2	H	QP	130.0	320.0	
227.768	3.0	60.0	11.9	1.3	27.4	0.0	0.0	45.7	46.0	-0.3	H	P	100.0	0 - 360	
240.009	3.0	58.6	11.8	1.3	27.4	0.0	0.0	44.3	46.0	-1.7	H	QP	130.0	320.0	
251.889	3.0	58.0	11.8	1.3	27.4	0.0	0.0	43.8	46.0	-2.2	H	QP	130.0	320.0	
263.89	3.0	57.9	12.3	1.4	27.4	0.0	0.0	44.1	46.0	-1.9	H	P	100.0	0 - 360	
276.85	3.0	55.7	12.7	1.4	27.4	0.0	0.0	42.4	46.0	-3.6	H	P	100.0	0 - 360	
300.251	3.0	53.7	13.5	1.5	27.4	0.0	0.0	41.3	46.0	-4.7	H	P	100.0	0 - 360	
797.432	3.0	46.7	20.8	2.5	28.2	0.0	0.0	41.9	46.0	-4.1	H	P	100.0	0 - 360	
900.036	3.0	45.1	22.1	2.7	27.9	0.0	0.0	42.0	46.0	-4.0	H	P	100.0	0 - 360	
927.517	3.0	45.8	22.3	2.8	27.8	0.0	0.0	43.0	46.0	-3.0	H	P	100.0	0 - 360	

Rev. 1.27.09
 Note: No other emissions were detected above the system noise floor.

9. AC POWER LINE CONDUCTED EMISSIONS

LIMITS

FCC §15.207 (a)

RSS-Gen 7.2.2

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

*Decreases with the logarithm of the frequency.

TEST PROCEDURE

The EUT is placed on a non-conducting table 40 cm from the vertical ground plane and 80 cm above the horizontal ground plane. The EUT is configured in accordance with ANSI C63.4.

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

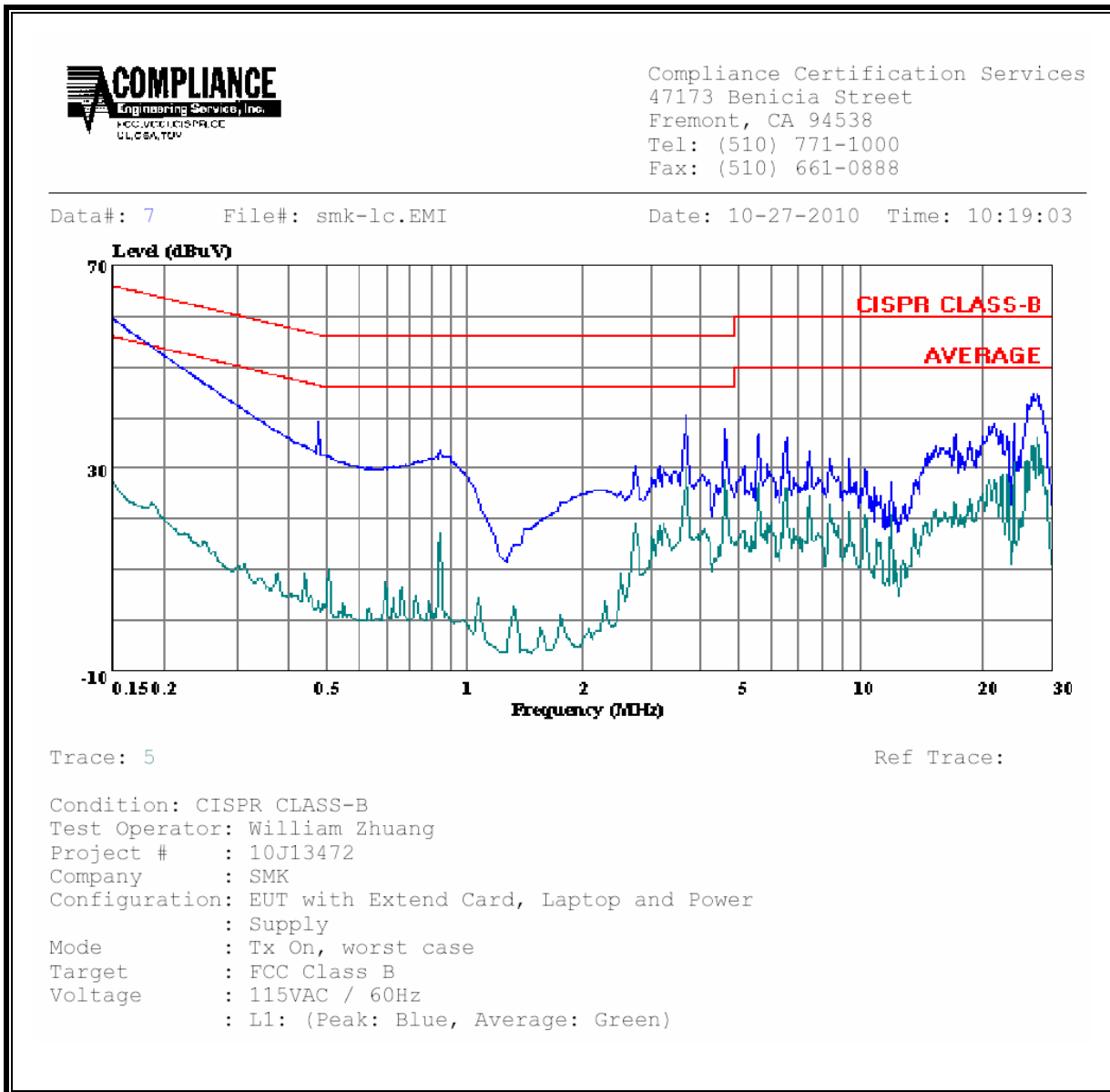
Line conducted data is recorded for both NEUTRAL and HOT lines.

RESULTS

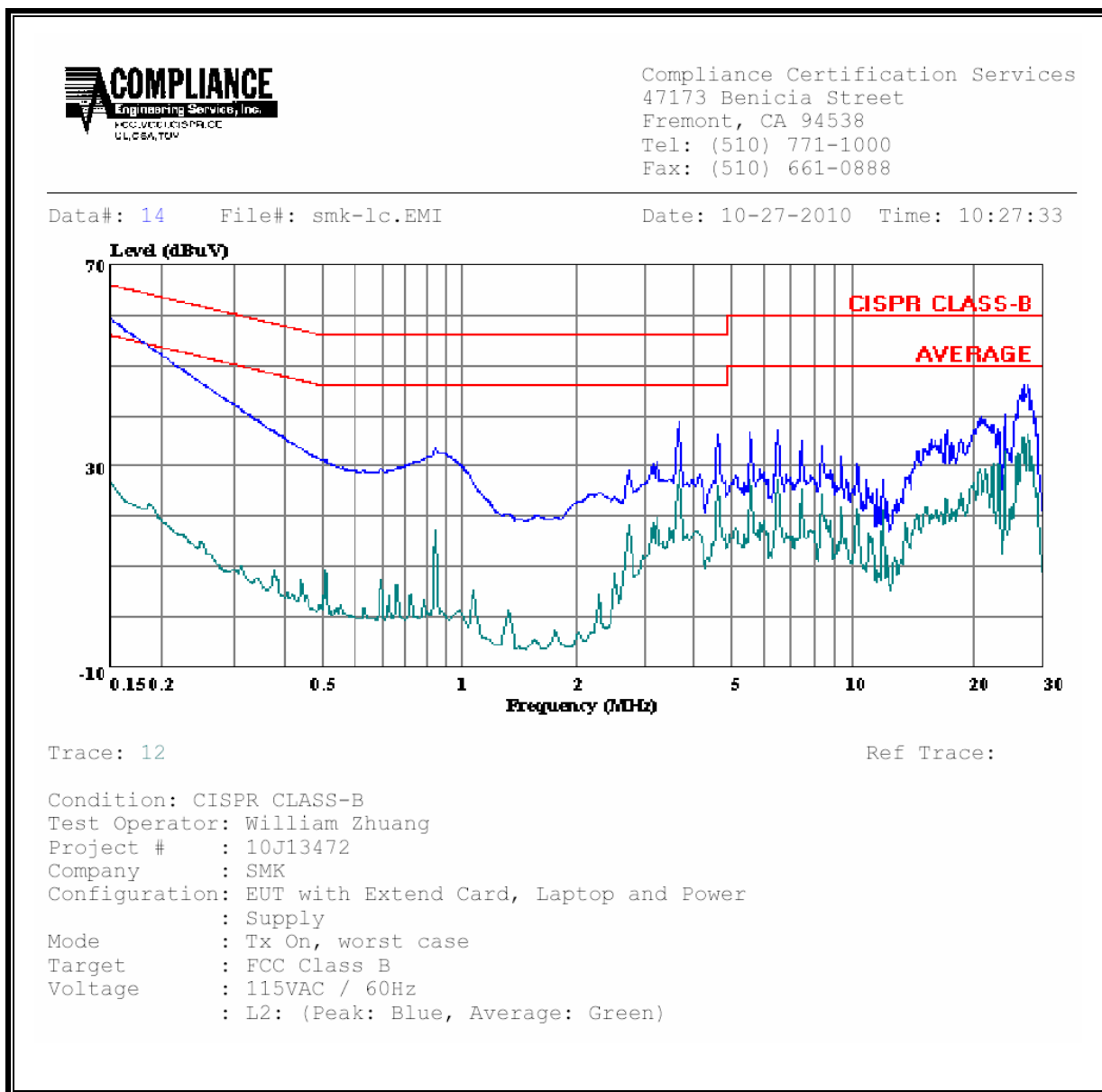
6 WORST EMISSIONS

CONDUCTED EMISSIONS DATA										
Freq. (MHz)	Reading			Class (dB)	Limit QP	FCC B		Margin		Remark L1 / L2
	PK (dBuV)	QP (dBuV)	AV (dBuV)			AV	QP (dB)	AV (dB)		
0.15	59.59	--	27.32	0.00	66.00	56.00	-6.41	-28.68	L1	
3.80	40.46	--	29.79	0.00	56.00	46.00	-15.54	-16.21	L1	
27.42	44.81	--	35.96	0.00	60.00	50.00	-15.19	-14.04	L1	
0.15	58.95	--	26.75	0.00	65.89	55.89	-6.94	-29.14	L2	
3.80	38.98	--	29.06	0.00	56.00	46.00	-17.02	-16.94	L2	
27.42	46.01	--	36.56	0.00	60.00	50.00	-13.99	-13.44	L2	
6 Worst Data										

LINE 1 RESULTS



LINE 2 RESULTS



10. MAXIMUM PERMISSIBLE EXPOSURE

FCC RULES

§1.1310 The criteria listed in Table 1 shall be used to evaluate the environmental impact of human exposure to radio-frequency (RF) radiation as specified in §1.1307(b), except in the case of portable devices which shall be evaluated according to the provisions of §2.1093 of this chapter.

TABLE 1—LIMITS FOR MAXIMUM PERMISSIBLE EXPOSURE (MPE)

Frequency range (MHz)	Electric field strength (V/m)	Magnetic field strength (A/m)	Power density (mW/cm ²)	Averaging time (minutes)
(A) Limits for Occupational/Controlled Exposures				
0.3–3.0	614	1.63	*(100)	6
3.0–30	1842/f	4.89/f	*(900/f ²)	6
30–300	61.4	0.163	1.0	6
300–1500 .....	.....	.....	f/300	6
1500–100,000 .....	.....	.....	5	6
(B) Limits for General Population/Uncontrolled Exposure				
0.3–1.34	614	1.63	*(100)	30
1.34–30	824/f	2.19/f	*(180/f ²)	30

TABLE 1—LIMITS FOR MAXIMUM PERMISSIBLE EXPOSURE (MPE)—Continued

Frequency range (MHz)	Electric field strength (V/m)	Magnetic field strength (A/m)	Power density (mW/cm ²)	Averaging time (minutes)
30–300	27.5	0.073	0.2	30
300–1500 .....	.....	.....	f/1500	30
1500–100,000 .....	.....	.....	1.0	30

f = frequency in MHz

* = Plane-wave equivalent power density

NOTE 1 TO TABLE 1: Occupational/controlled limits apply in situations in which persons are exposed as a consequence of their employment provided those persons are fully aware of the potential for exposure and can exercise control over their exposure. Limits for occupational/controlled exposure also apply in situations when an individual is transient through a location where occupational/controlled limits apply provided he or she is made aware of the potential for exposure.

NOTE 2 TO TABLE 1: General population/uncontrolled exposures apply in situations in which the general public may be exposed, or in which persons that are exposed as a consequence of their employment may not be fully aware of the potential for exposure or can not exercise control over their exposure.

IC RULES

IC Safety Code 6, Section 2.2.1 (a) A person other than an RF and microwave exposed worker shall not be exposed to electromagnetic radiation in a frequency band listed in Column 1 of Table 5, if the field strength exceeds the value given in Column 2 or 3 of Table 5, when averaged spatially and over time, or if the power density exceeds the value given in Column 4 of Table 5, when averaged spatially and over time.

**Table 5
 Exposure Limits for Persons Not Classed As RF and Microwave Exposed Workers (Including the General Public)**

1 Frequency (MHz)	2 Electric Field Strength; rms (V/m)	3 Magnetic Field Strength; rms (A/m)	4 Power Density (W/m ²)	5 Averaging Time (min)
0.003–1	280	2.19		6
1–10	280/ <i>f</i>	2.19/ <i>f</i>		6
10–30	28	2.19/ <i>f</i>		6
30–300	28	0.073	2*	6
300–1 500	1.585 <i>f</i> ^{0.5}	0.0042 <i>f</i> ^{0.5}	<i>f</i> /150	6
1 500–15 000	61.4	0.163	10	6
15 000–150 000	61.4	0.163	10	616 000 / <i>f</i> ^{1.2}
150 000–300 000	0.158 <i>f</i> ^{0.5}	4.21 x 10 ⁻⁴ <i>f</i> ^{0.5}	6.67 x 10 ⁻⁵ <i>f</i>	616 000 / <i>f</i> ^{1.2}

* Power density limit is applicable at frequencies greater than 100 MHz.

- Notes:**
1. Frequency, *f*, is in MHz.
 2. A power density of 10 W/m² is equivalent to 1 mW/cm².
 3. A magnetic field strength of 1 A/m corresponds to 1.257 microtesla (μT) or 12.57 milligauss (mG).

EQUATIONS

Power density is given by:

$$S = \text{EIRP} / (4 * \text{Pi} * \text{D}^2)$$

where

S = Power density in W/m²
EIRP = Equivalent Isotropic Radiated Power in W
D = Separation distance in m

Power density in units of W/m² is converted to units of mWc/m² by dividing by 10.

Distance is given by:

$$D = \text{SQRT} (\text{EIRP} / (4 * \text{Pi} * S))$$

where

D = Separation distance in m
EIRP = Equivalent Isotropic Radiated Power in W
S = Power density in W/m²

For multiple colocated transmitters operating simultaneously in frequency bands where the limit is identical, the total power density is calculated using the total EIRP obtained by summing the Power * Gain product (in linear units) of each transmitter.

$$\text{Total EIRP} = (P1 * G1) + (P2 * G2) + \dots + (Pn * Gn)$$

where

Px = Power of transmitter x
Gx = Numeric gain of antenna x

In the table(s) below, Power and Gain are entered in units of dBm and dBi respectively and conversions to linear forms are used for the calculations.

LIMITS

From FCC §1.1310 Table 1 (B), the maximum value of S = 1.0 mW/cm²

From IC Safety Code 6, Section 2.2 Table 5 Column 4, S = 10 W/m²

RESULTS

Band	Mode	Separation Distance (m)	Output Power (dBm)	Antenna Gain (dBi)	IC Power Density (W/m ²)	FCC Power Density (mW/cm ²)
2.4 GHz	Bluetooth	0.20	4.23	2.00	0.01	0.001