



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

CERTIFICATION TEST REPORT

FOR

GNSS RECEIVER SYSTEM

MODEL NUMBER: GRS-1

**FCC ID: LCB-080501
IC: 6050B-080501**

REPORT NUMBER: 08J11925-1

ISSUE DATE: SEPTEMBER 30, 2008

Prepared for
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NVLAP LAB CODE 200065-0

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--	09/30/08	Initial Issue	T. Chan

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1. ATTESTATION OF TEST RESULTS

COMPANY NAME: TOPCON POSITIONING SYSTEMS, INC.
7400 NATIONAL DRIVE
LIVERMORE, CA, 94551, USA

EUT DESCRIPTION: GNSS RECEIVER SYSTEM

MODEL: GRS-1

SERIAL NUMBER: 0031(CONDUCTED UNIT) AND 006 (RADIATED UNIT)

DATE TESTED: JULY 23 to SEPTEMBER 25, 2008

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, Inc. (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 CCS based on interpretations and/or observations of test results. 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 CCS and all revisions are duly noted in the revisions section. Any alteration of this document not carried out by CCS will constitute fraud and shall nullify the document. No part of this report may be used to claim product certification, approval, or endorsement by NVLAP, NIST, or any government agency.

Approved & Released For CCS By:

Tested By:



THU CHAN
EMC SUPERVISOR
COMPLIANCE CERTIFICATION SERVICES

VIEN TRAN
EMC ENGINEER
COMPLIANCE CERTIFICATION SERVICES

2. TEST METHODOLOGY

The tests documented in this report were performed in accordance with ANSI C63.4-2003, 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.

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. MEASUREMENT UNCERTAINTY

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

PARAMETER	UNCERTAINTY
Power Line Conducted Emission	+/- 2.3 dB
Radiated Emission	+/- 3.4 dB

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

5. EQUIPMENT UNDER TEST

5.1. DESCRIPTION OF EUT

The EUT is GPS Receiver System with Bluetooth.

The radio module is manufactured by Taiyo Yuden Co., Ltd.

5.2. MAXIMUM OUTPUT POWER

The transmitter has a maximum peak conducted output power as follows:

Frequency Range (MHz)	Mode	Output Power (dBm)	Output Power (mW)
2402 - 2480	Basic GFSK	0.32	1.08
2402 - 2480	Enhanced 8PSK	2.20	1.66

5.3. DESCRIPTION OF AVAILABLE ANTENNAS

The radio utilizes a Chip antenna, with a maximum gain of 2.0 dBi.

5.4. SOFTWARE AND FIRMWARE

The EUT driver software installed in the laptop during testing was Test Tool ver 1.22

The test utility software used during testing was Bluetest.exe

5.5. WORST-CASE CONFIGURATION AND MODE

The worst-case channel is determined as the channel with the highest output power.

The EUT is a portable device; therefore X, Y and Z positions have been investigated. The worst case is to evaluate at Y positions.

5.6. DESCRIPTION OF TEST SETUP

SUPPORT EQUIPMENT

PERIPHERAL SUPPORT EQUIPMENT LIST				
Description	Manufacturer	Model	Serial Number	FCC ID
Laptop	IBM	Thinkpad T61	L3-A1589	DoC
AC Adapter	Lenovo	92P1160	11S92P1160Z1ZBGH74LH2	N/A
AC adapter	Topcon	A20A1-12MI	N/A	N/A

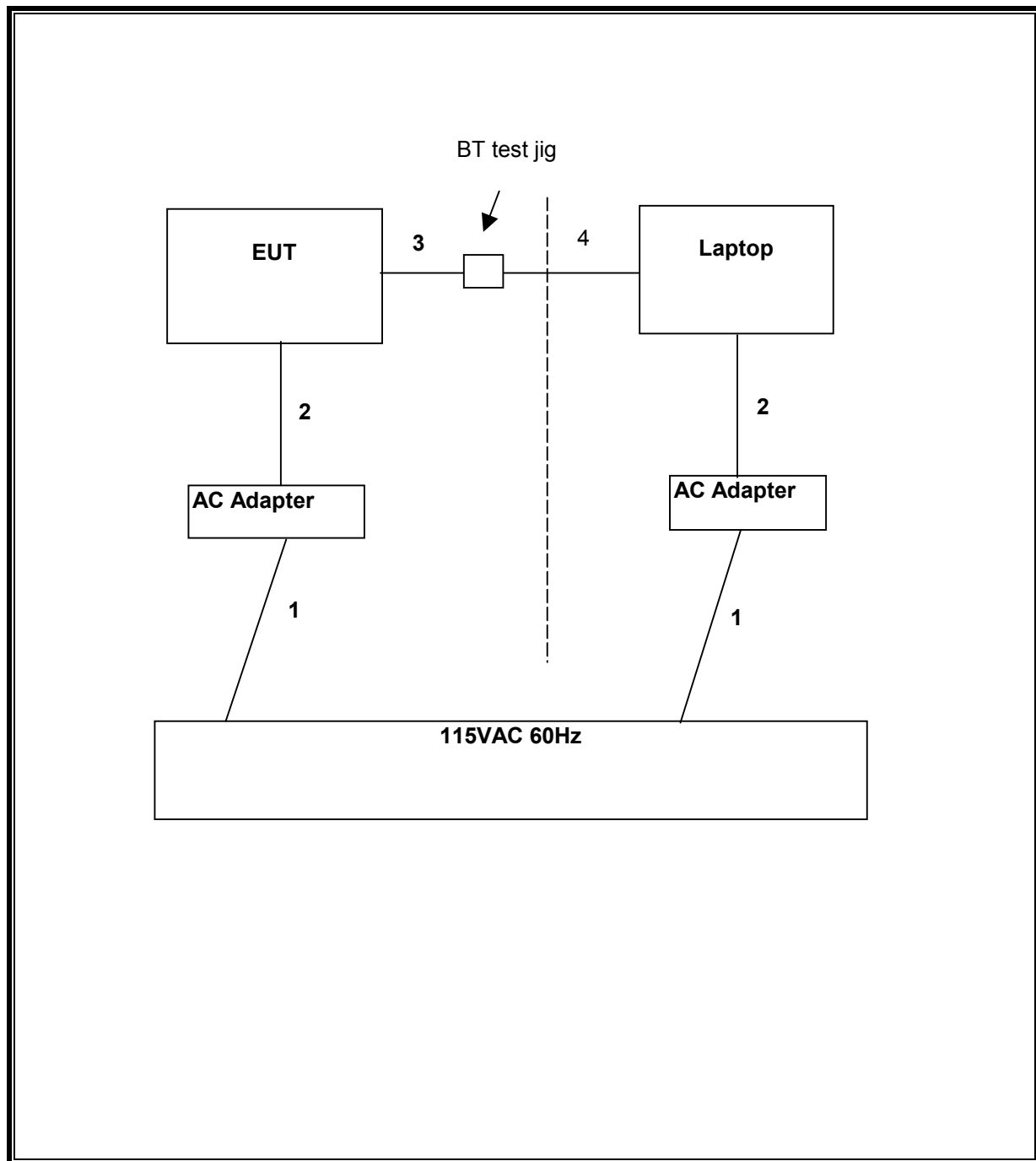
I/O CABLES

I/O CABLE LIST						
Cable No.	Port	# of Identical Ports	Connector Type	Cable Type	Cable Length	Remarks
1	AC	2	US 115V	Un-shielded	2m	NA
2	DC	2	DC	Un-shielded	2m	NA
3	3-pins	1	BT Jig card	Un-shielded	1m	NA
4	USB	1	RS232 to USB	Un-shielded	1m	NA

TEST SETUP

The EUT is connected to a laptop computer via test JIG and RS232 to USB connector 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 Due
EMI Receiver, 2.9 GHz	Agilent / HP	8542E	C00957	09/19/09
RF Filter Section, 2.9 GHz	Agilent / HP	85420E	C00958	09/19/09
Preamplifier, 1300 MHz	Agilent / HP	8447D	C00885	03/31/09
Antenna, Bilog, 2 GHz	Sunol Sciences	JB1	C01011	09/28/08
Antenna, Horn, 18 GHz	EMCO	3115	C00945	04/22/09
Preamplifier, 26.5 GHz	Agilent / HP	8449B	C01063	09/27/08
Spectrum Analyzer, 44 GHz	Agilent / HP	E4446A	C01069	10/08/09
EMI Test Receiver, 30 MHz	R & S	ESHS 20	N02396	08/06/09
LISN, 30 MHz	FCC	LISN-50/250-25-2	N02625	10/25/08
Peak Power Meter	Agilent / HP	E4416A	C00963	12/04/09
Peak / Average Power Sensor	Agilent / HP	E9327A	C00964	12/07/09
Reject Filter, 2.4-2.5 GHz	Micro-Tronics	BRM50702	N02685	CNR

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.

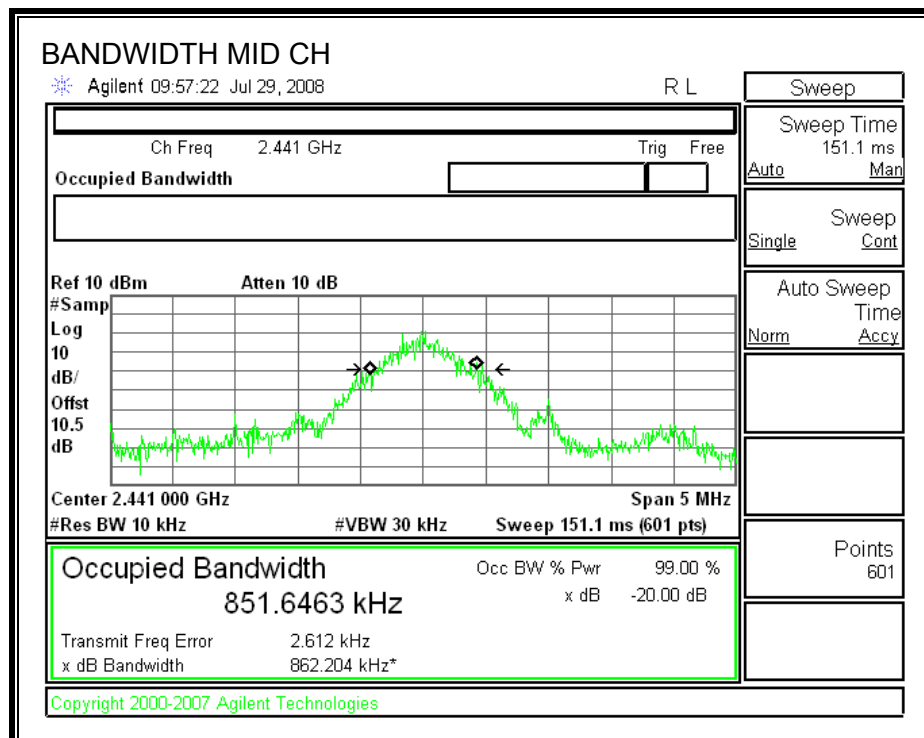
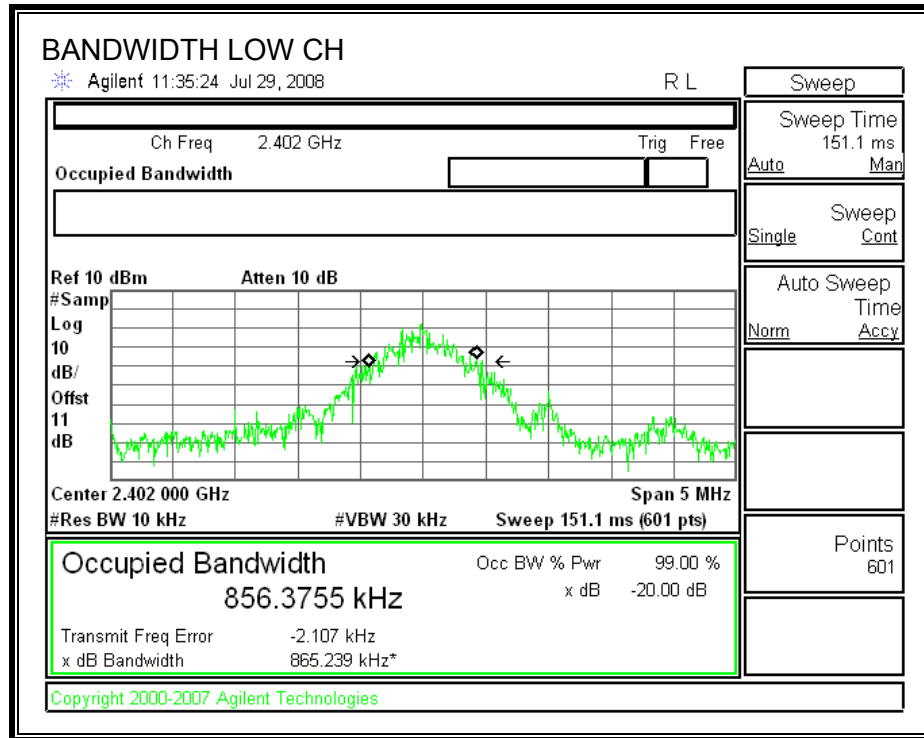
TEST PROCEDURE

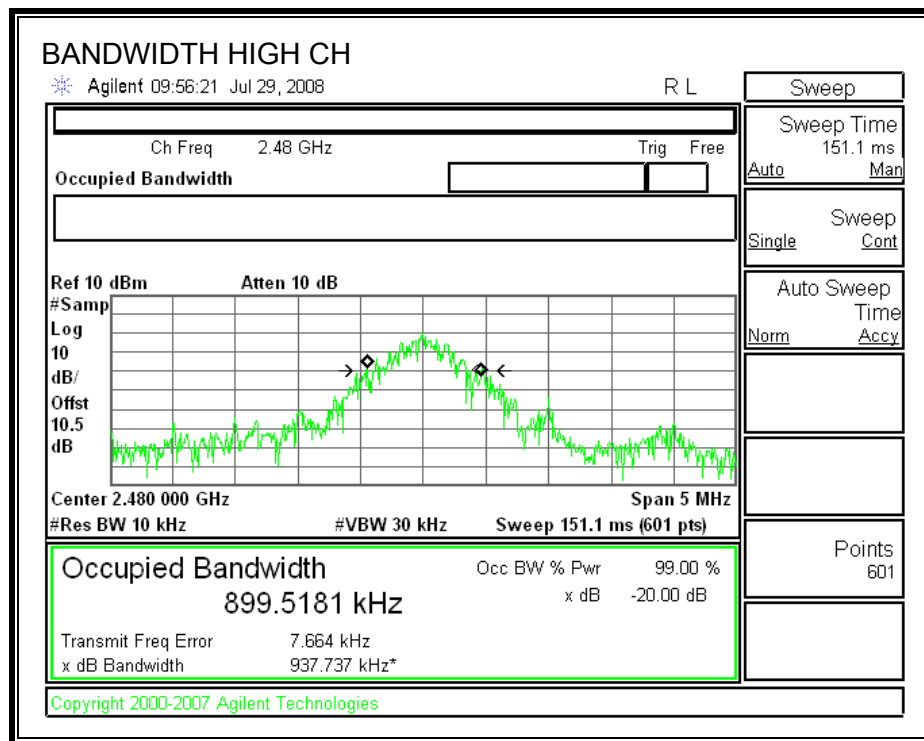
The transmitter output is connected to a spectrum analyzer. The RBW is set to $\geq 1\%$ of the 20 dB bandwidth. The VBW is set to $\geq$ RBW. The sweep time is coupled.

RESULTS

Channel	Frequency (MHz)	20 dB Bandwidth (kHz)	99% Bandwidth (kHz)
Low	2402	865.239	856.3755
Middle	2441	862.204	851.6463
High	2480	937.737	899.5181

20 dB AND 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.

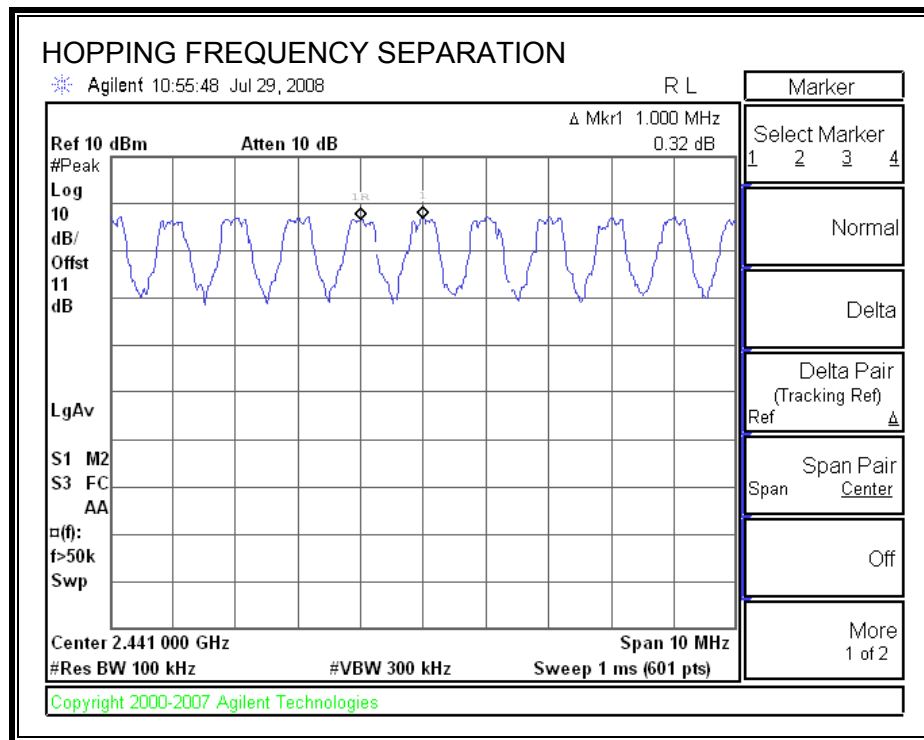
Alternatively, frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than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

TEST PROCEDURE

The transmitter output is connected to a spectrum analyzer. The RBW is set to 100 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.

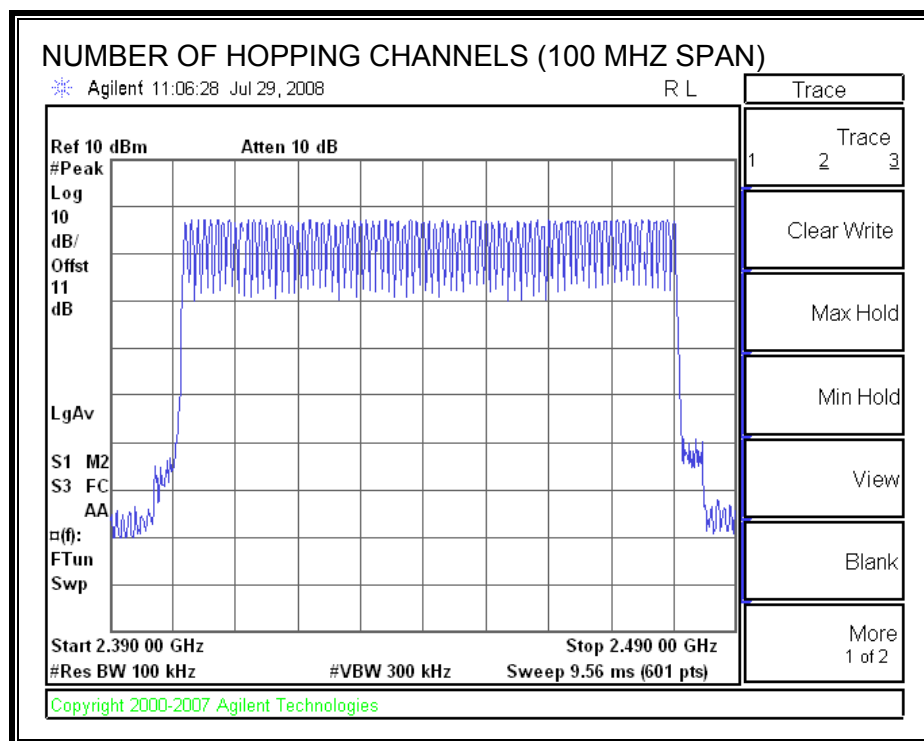
TEST PROCEDURE

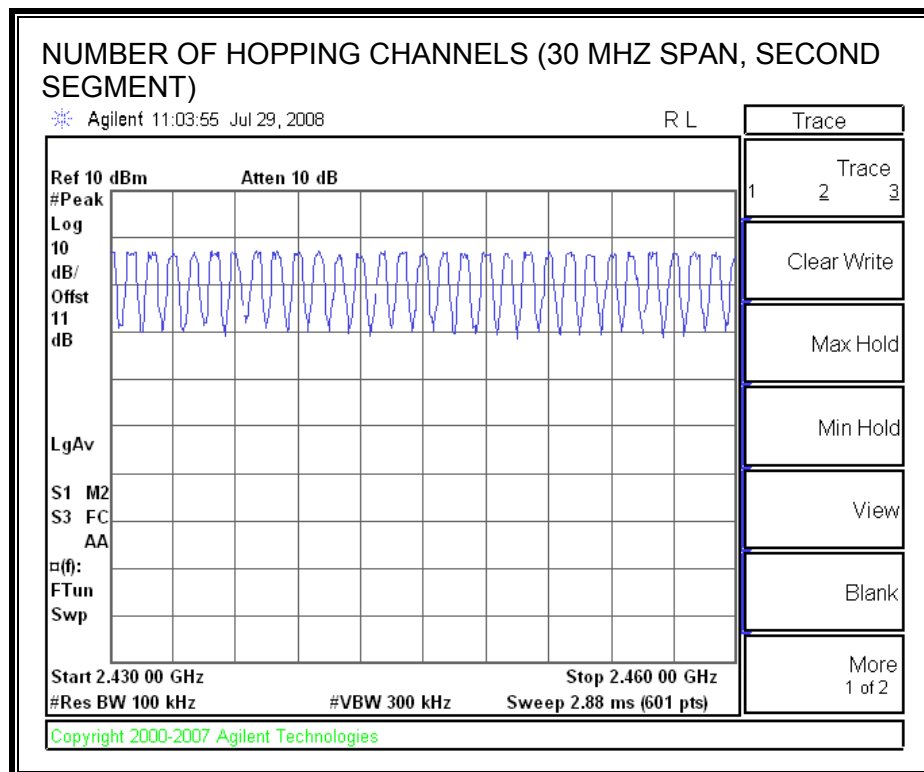
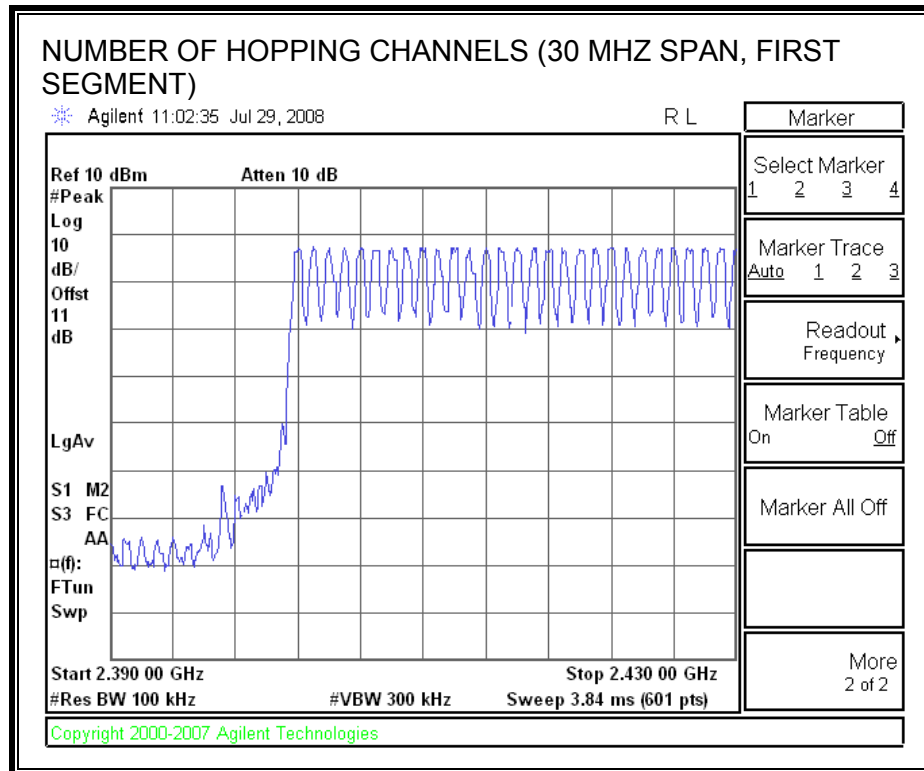
The transmitter output is connected to a spectrum analyzer. The span is set to cover the entire authorized band, in either a single sweep or in multiple contiguous sweeps. The RBW is set to a maximum of 1 % of the span. The analyzer is set to Max Hold.

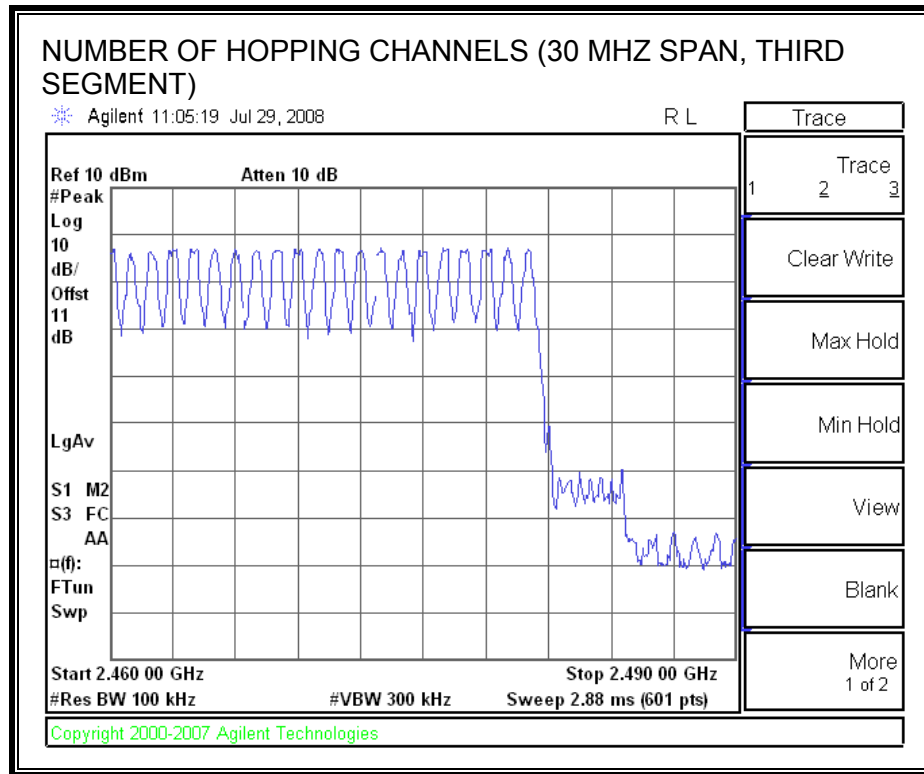
RESULTS

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.

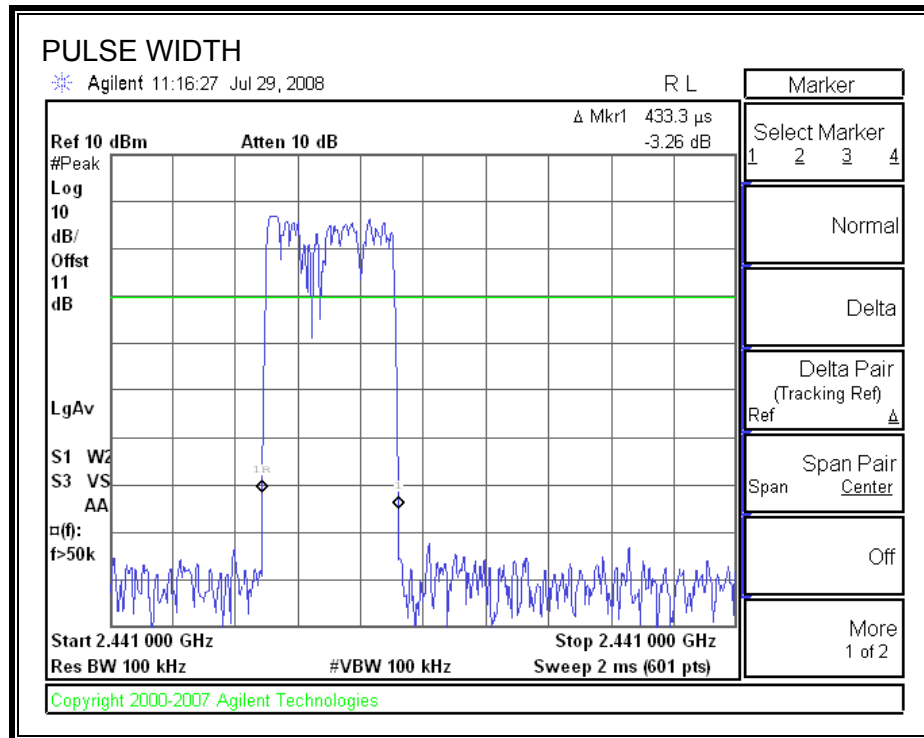
The average time of occupancy in the specified 31.6 second period (79 channels * 0.4 s) is equal to $10 * (\# \text{ of pulses in } 3.16 \text{ s}) * \text{pulse width}$.

RESULTS

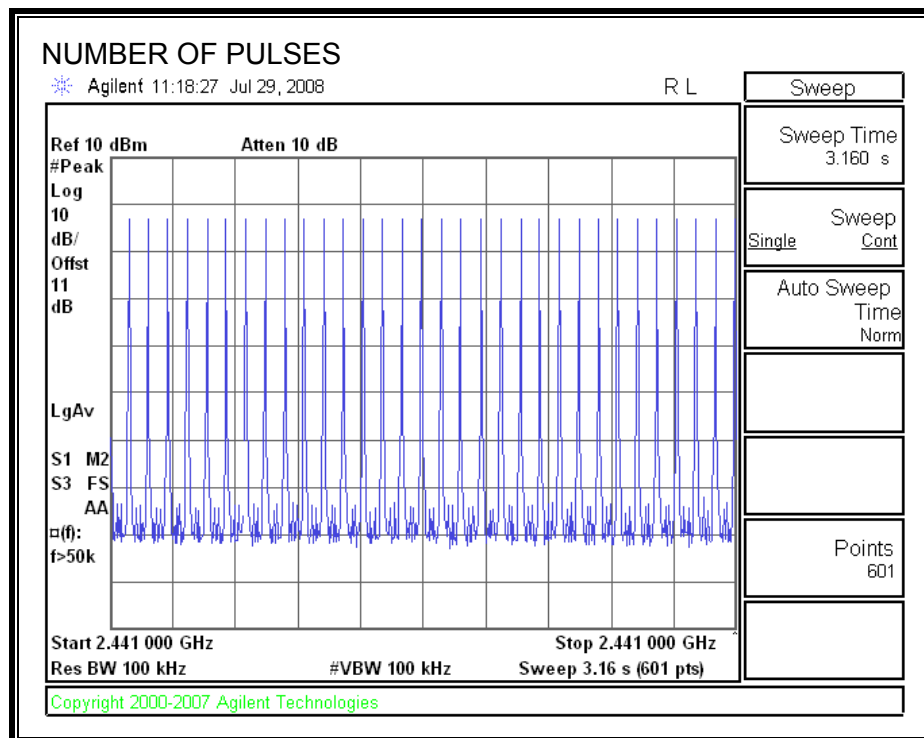
DH Packet	Pulse Width (msec)	Number of Pulses in 3.16 seconds	Average Time of (sec)	Limit (sec)	Margin (sec)
DH1	0.4333	32	0.139	0.4	0.261
DH3	1.692	16	0.271	0.4	0.129
DH5	2.97	11	0.327	0.4	0.073

DH1

PULSE WIDTH

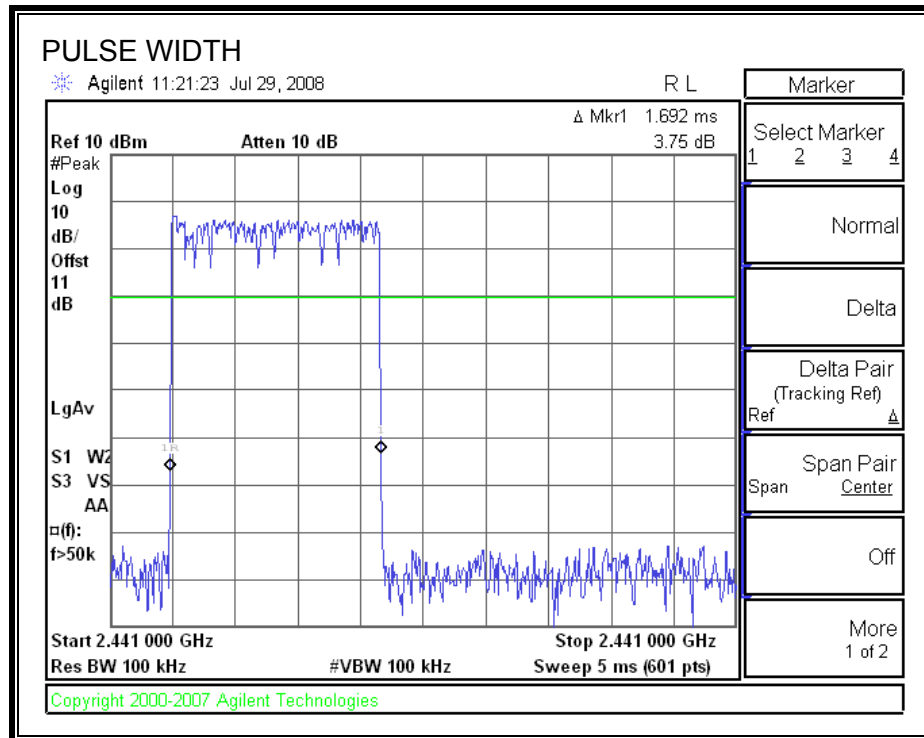


NUMBER OF PULSES IN 3.16 SECOND OBSERVATION PERIOD

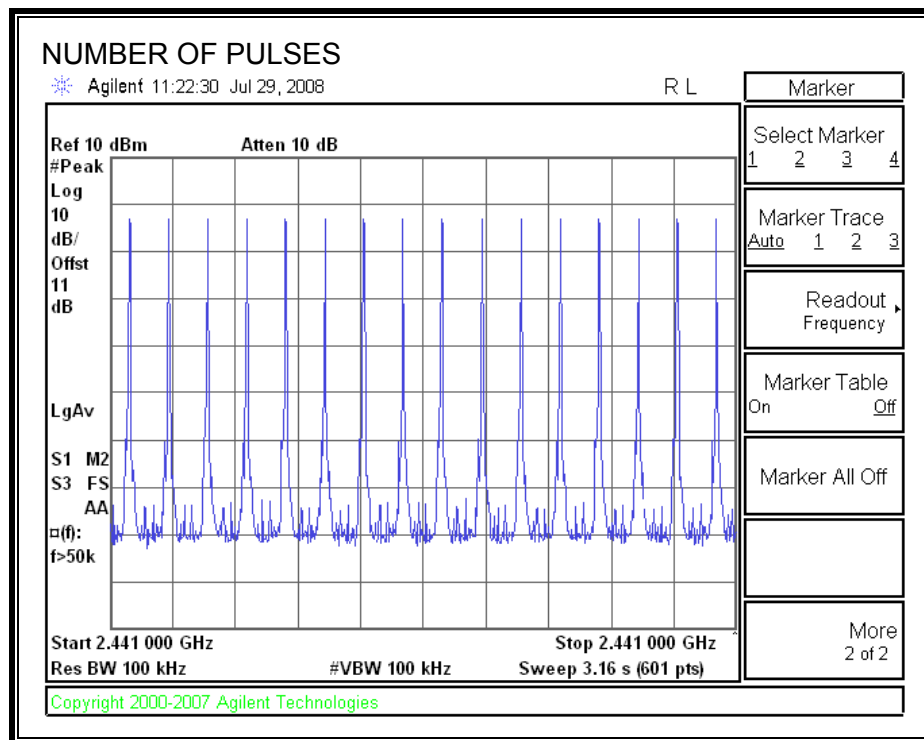


DH3

PULSE WIDTH

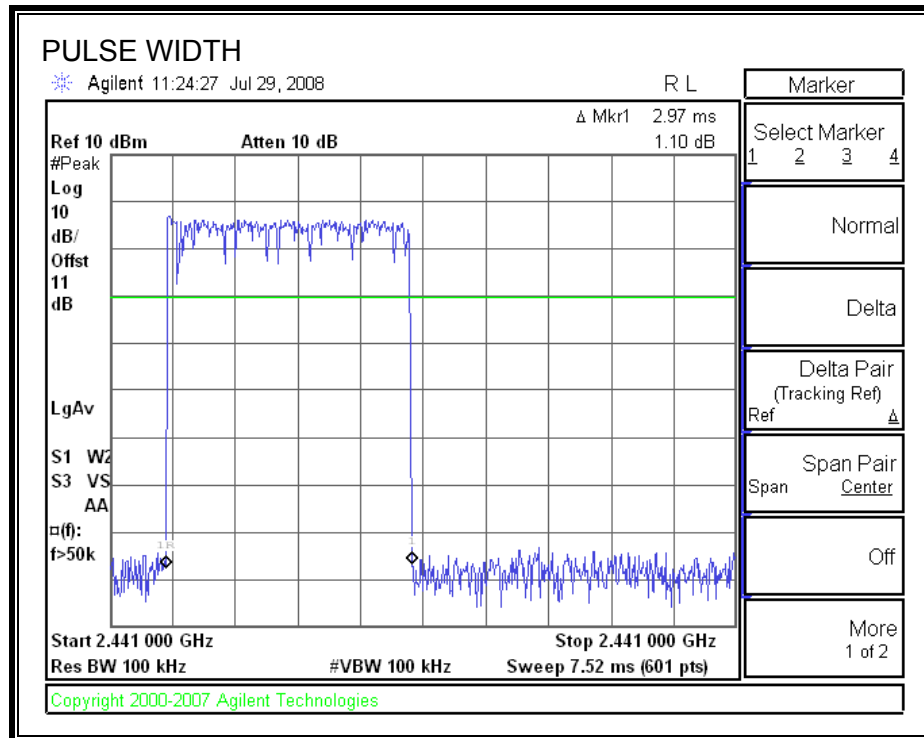


NUMBER OF PULSES IN 3.16 SECOND OBSERVATION PERIOD

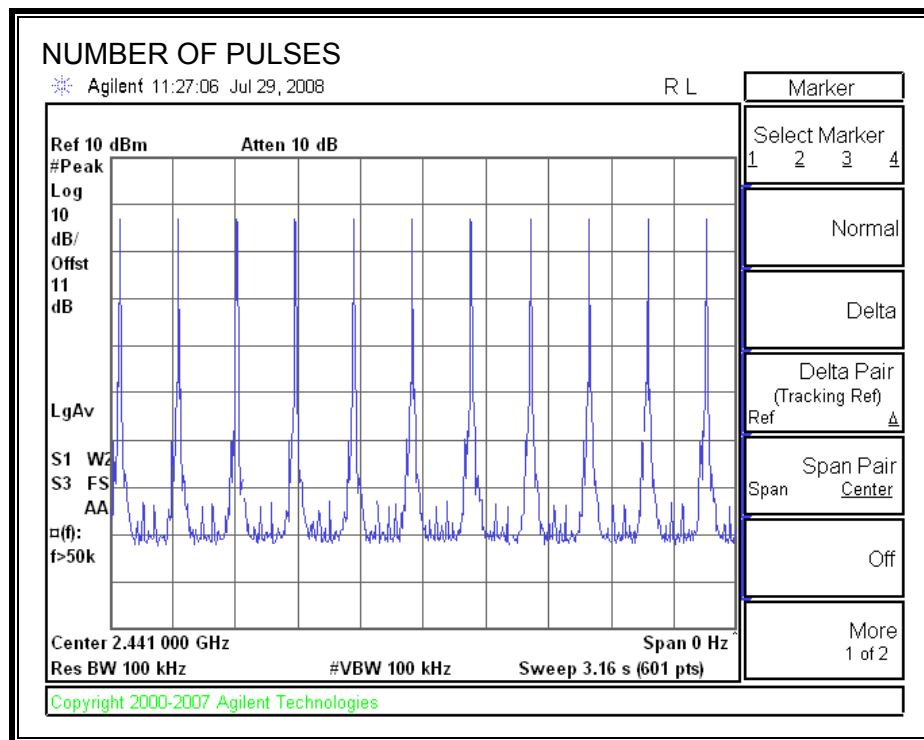


DH5

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.

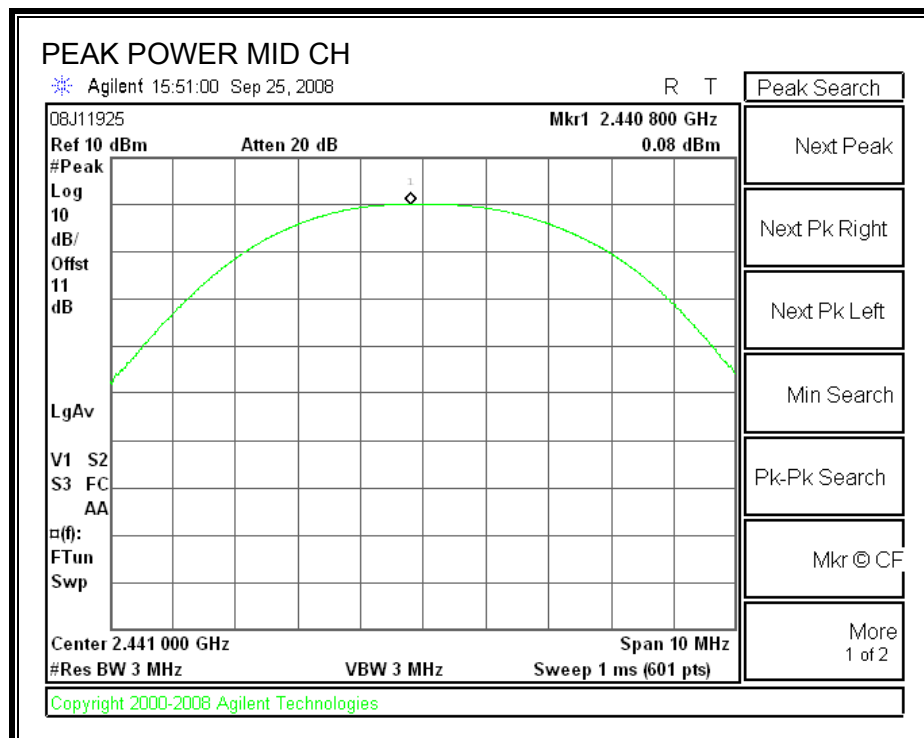
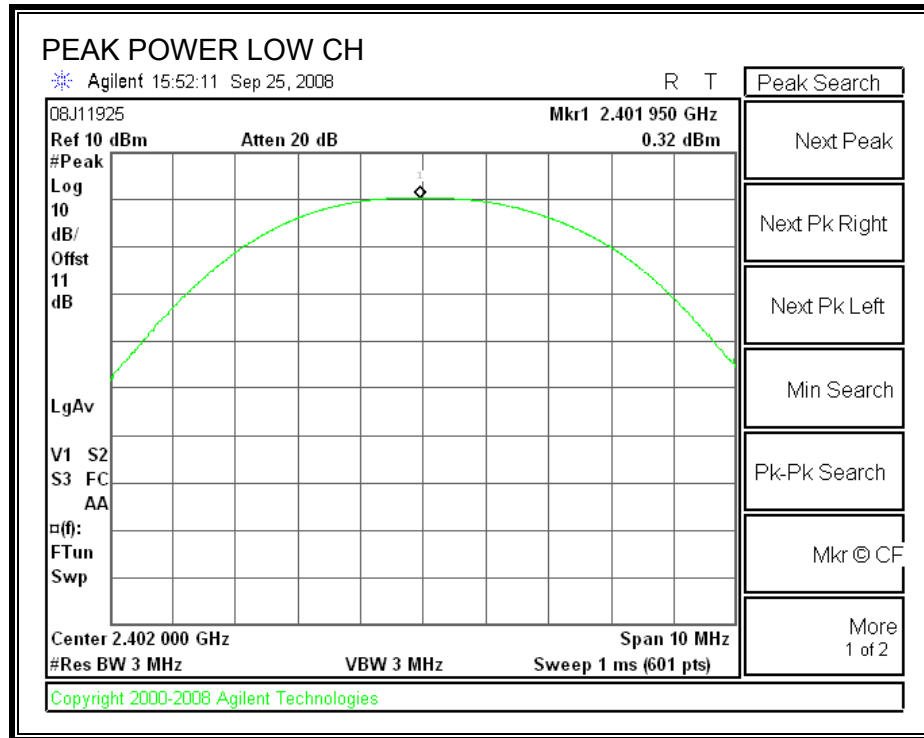
TEST PROCEDURE

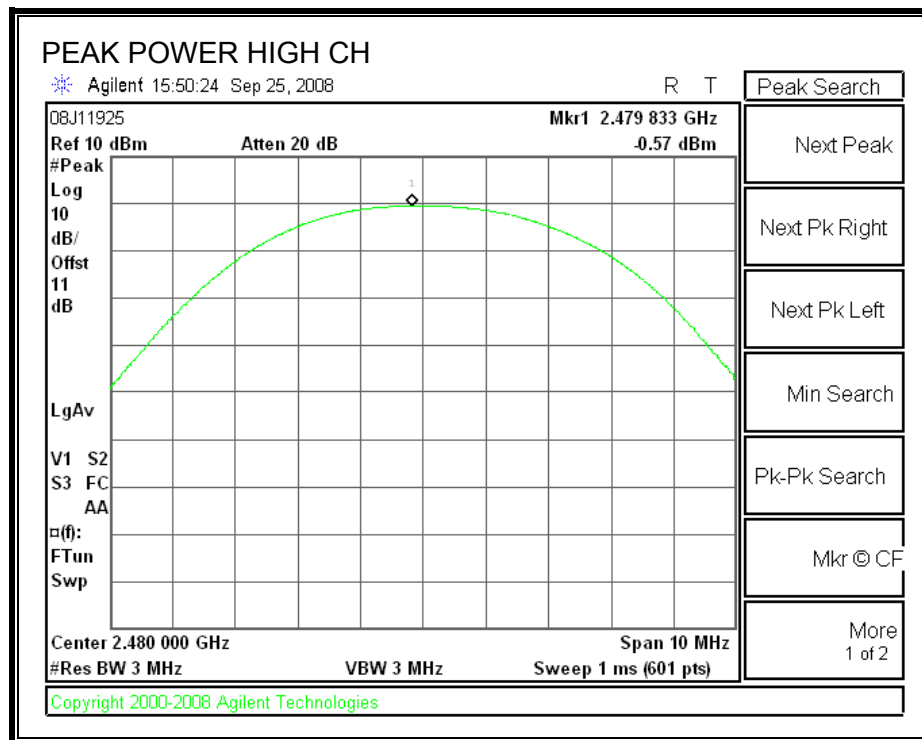
The transmitter output is connected to a spectrum analyzer the analyzer bandwidth is set to a value greater than the 20 dB bandwidth of the EUT.

RESULTS

Channel	Frequency (MHz)	Output Power (dBm)	Limit (dBm)	Margin (dB)
Low	2402	0.32	30	-29.68
Middle	2441	0.08	30	-29.92
High	2480	-0.57	30	-30.57

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 1dB 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	-0.03
Middle	2441	-0.30
High	2480	-0.93

7.1.7. CONDUCTED SPURIOUS EMISSIONS

LIMITS

FCC §15.247 (d)

IC RSS-210 A8.5

Limit = -20 dBc

TEST PROCEDURE

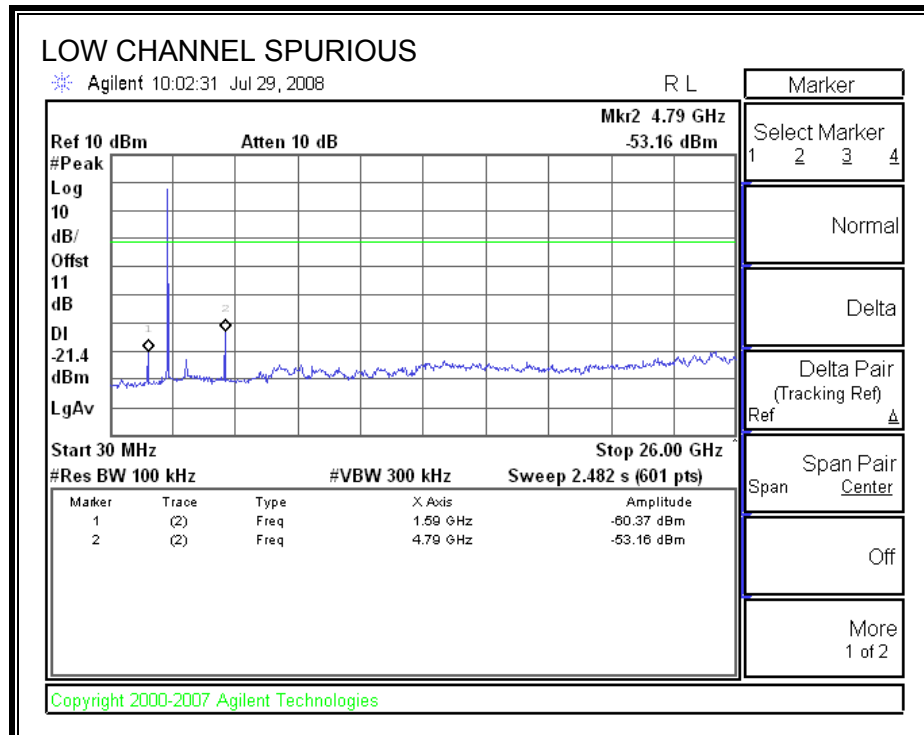
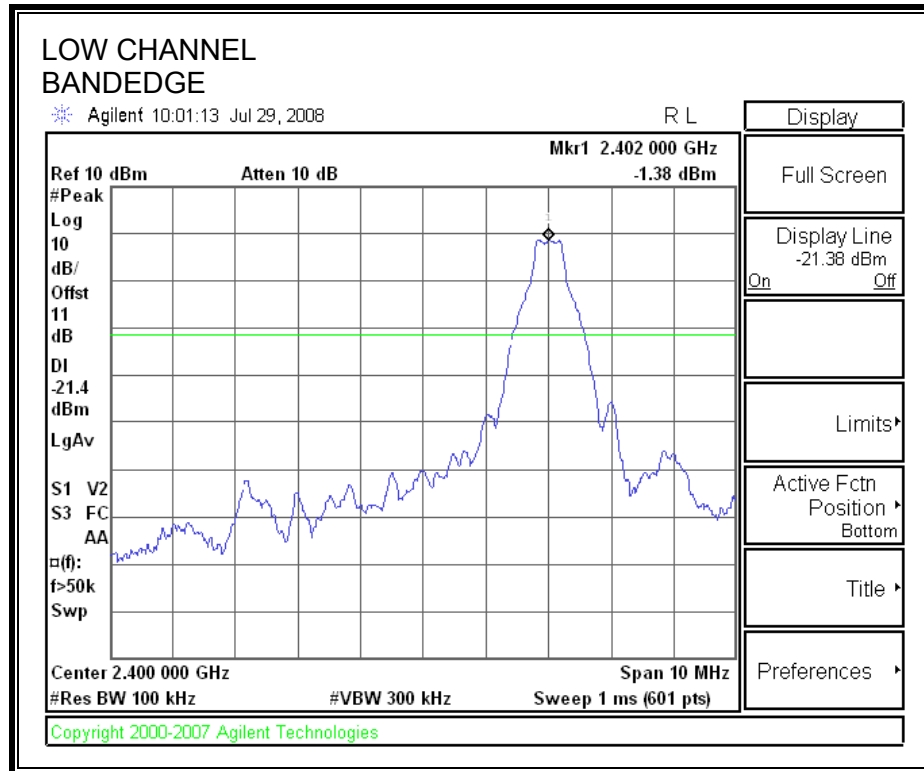
The transmitter output is connected to a spectrum analyzer. The resolution bandwidth is set to 100 kHz. The video bandwidth is set to 300 kHz.

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

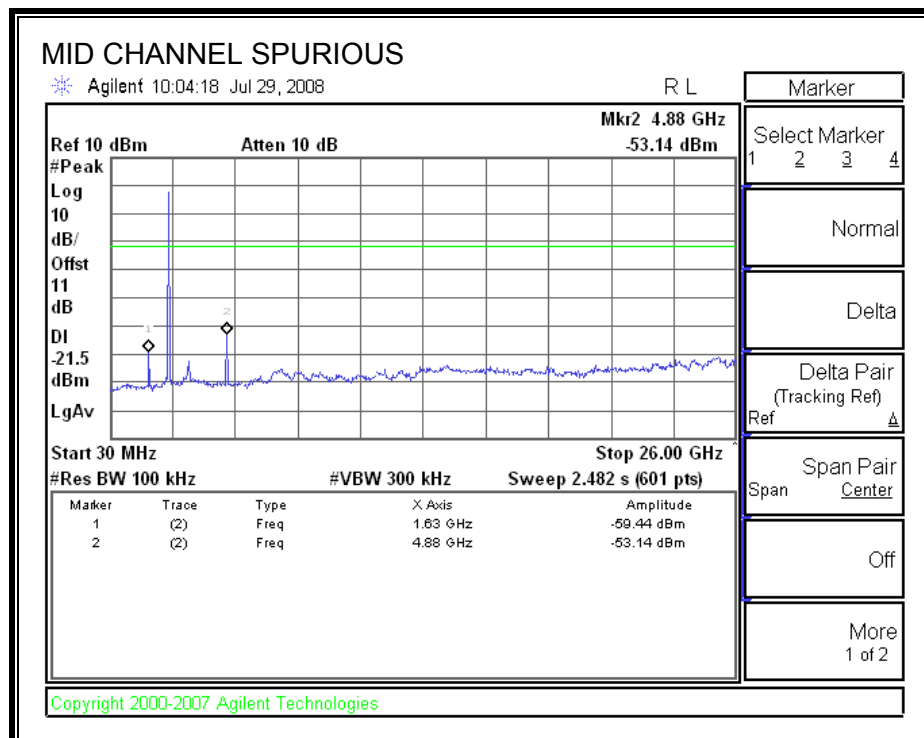
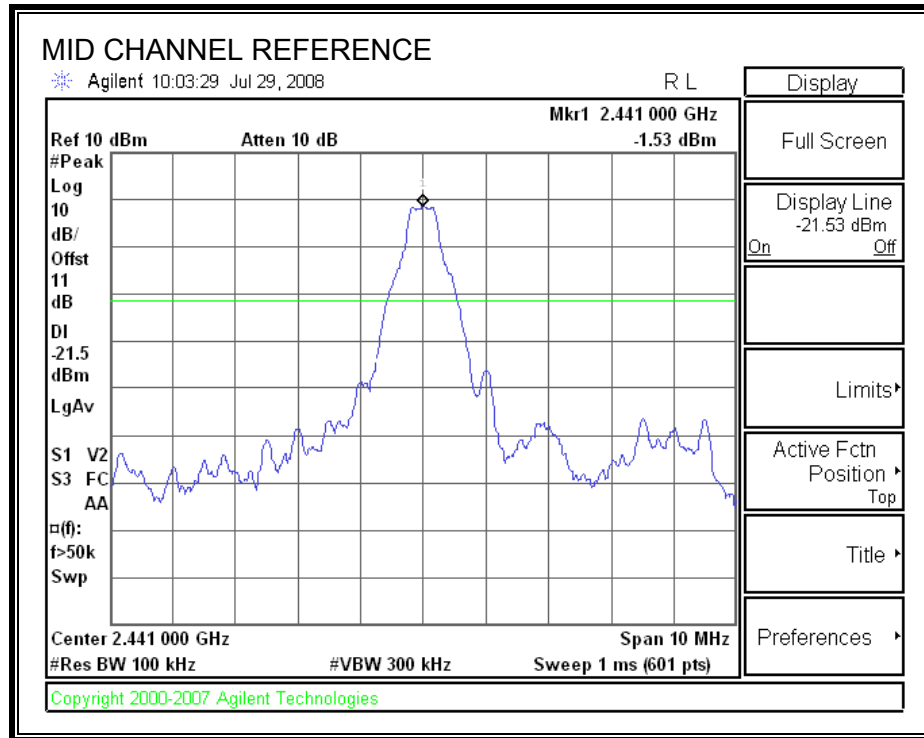
The bandedges at 2.4 and 2.4835 GHz are investigated with the transmitter set to the normal hopping mode.

RESULTS

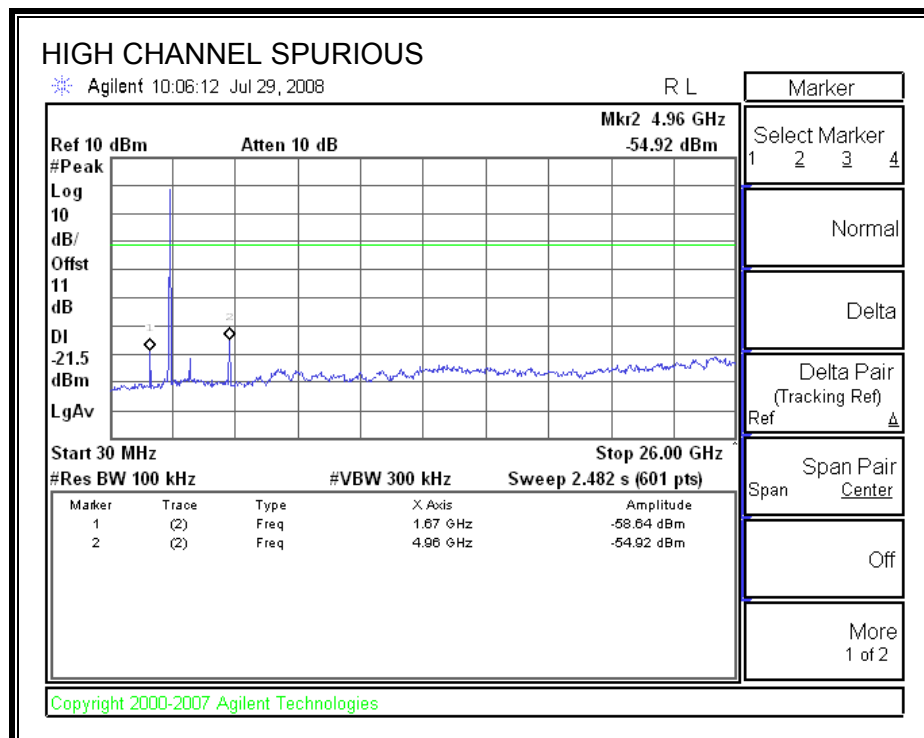
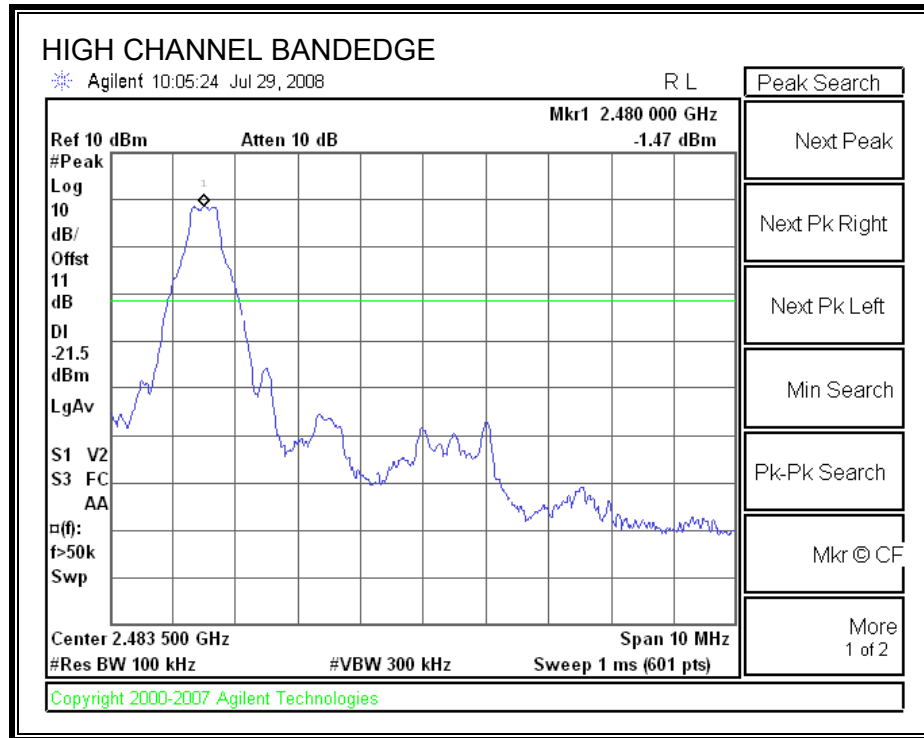
SPURIOUS EMISSIONS, LOW CHANNEL



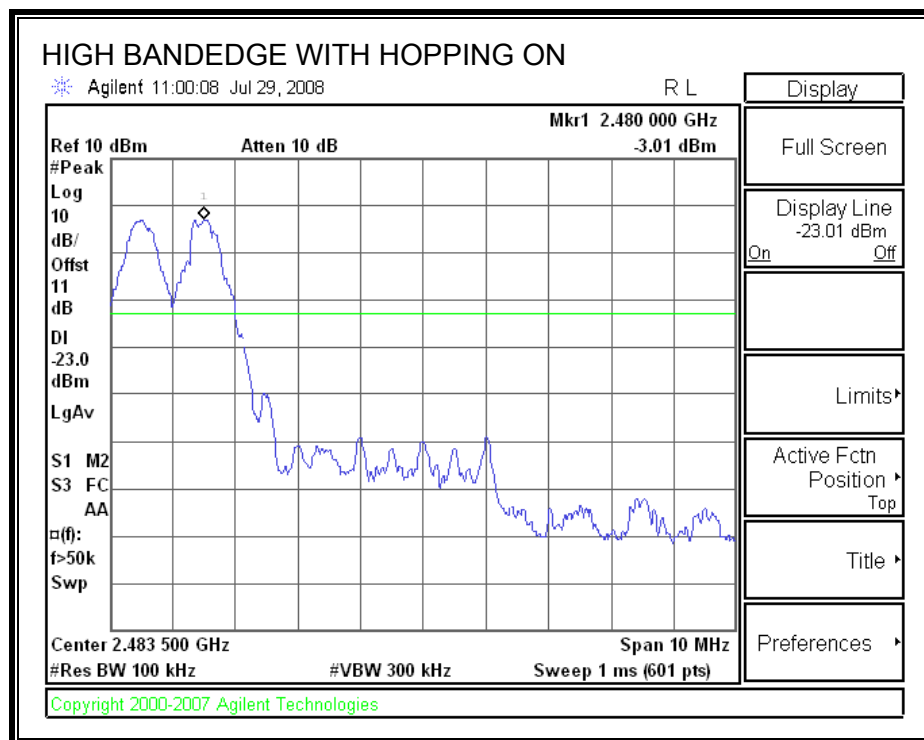
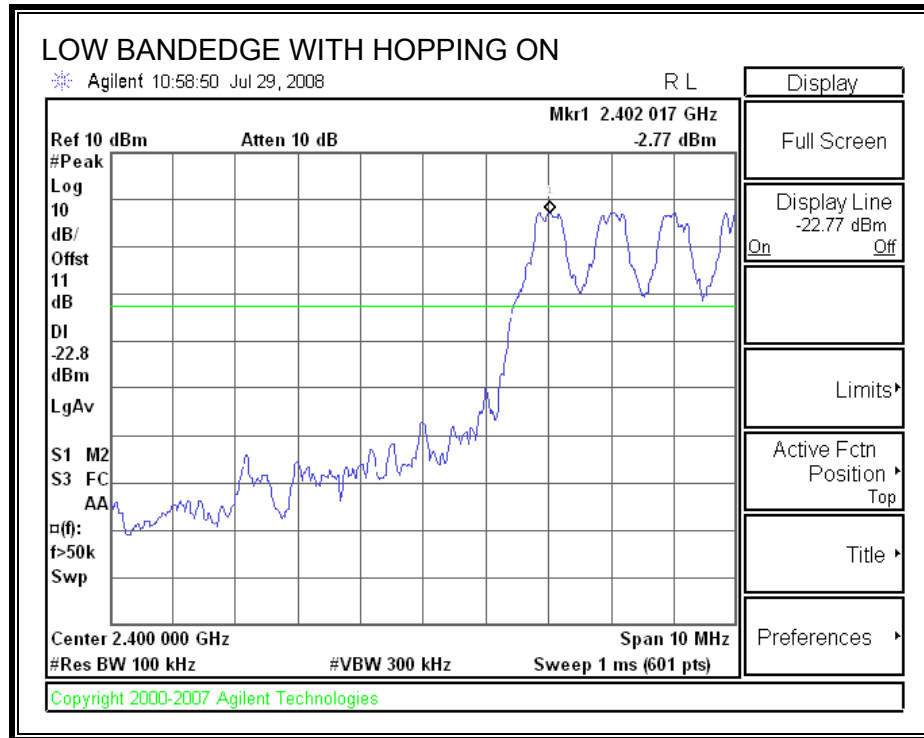
SPURIOUS EMISSIONS, MID CHANNEL



SPURIOUS EMISSIONS, HIGH CHANNEL



SPURIOUS BANDEDGE EMISSIONS WITH HOPPING ON



7.2. ENHANCED DATA RATE 8PSK MODULATION

7.2.1. 20 dB AND 99% BANDWIDTH

LIMIT

None; for reporting purposes only.

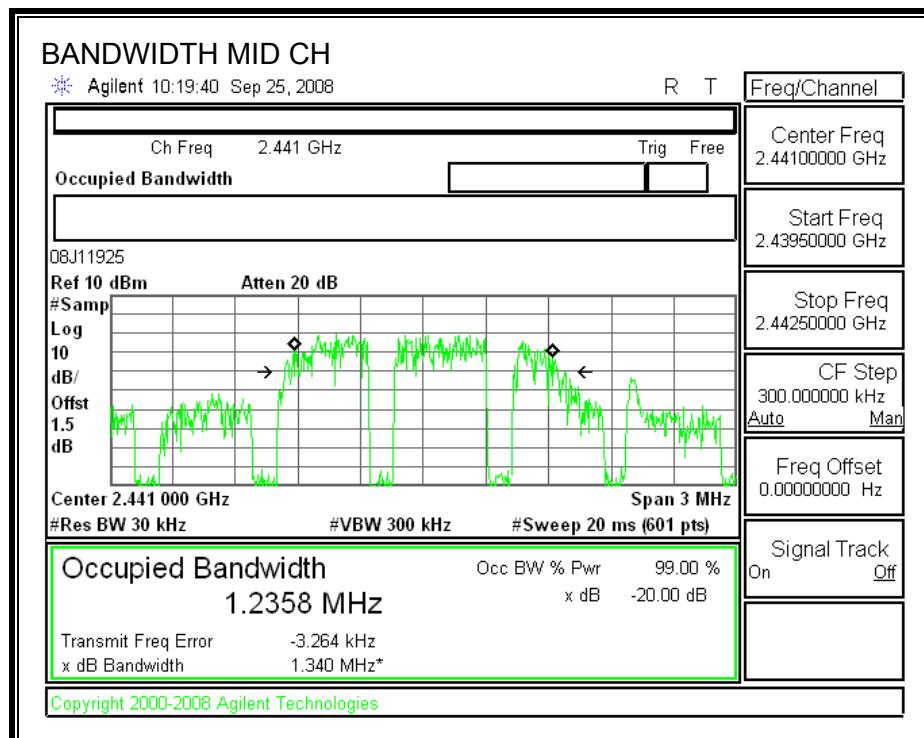
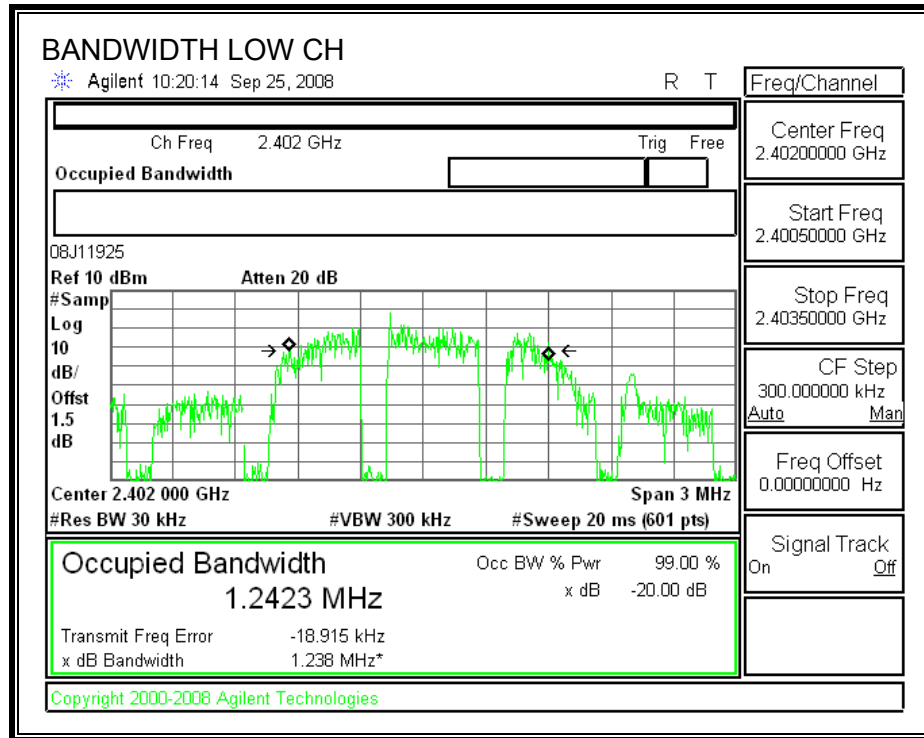
TEST PROCEDURE

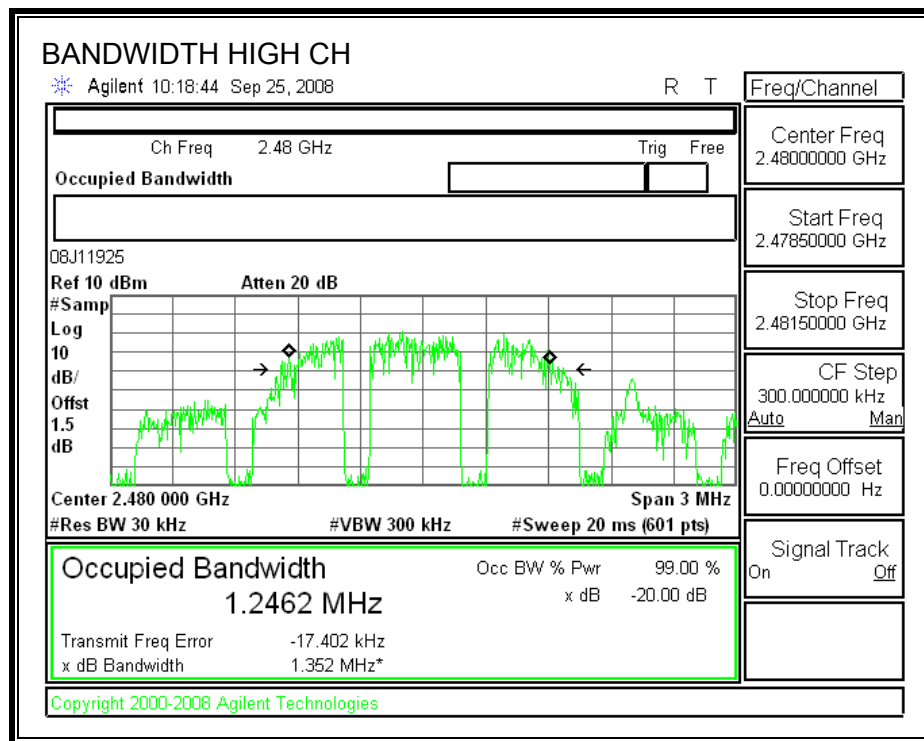
The transmitter output is connected to a spectrum analyzer. The RBW is set to $\geq 1\%$ of the 20 dB bandwidth. The VBW is set to $\geq$ RBW. The sweep time is coupled.

RESULTS

Channel	Frequency (MHz)	20 dB Bandwidth (kHz)	99% Bandwidth (kHz)
Low	2402	1238	1242.3
Middle	2441	1340	1235.8
High	2480	1362	1246.2

20 dB AND 99% BANDWIDTH





7.2.2. 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.

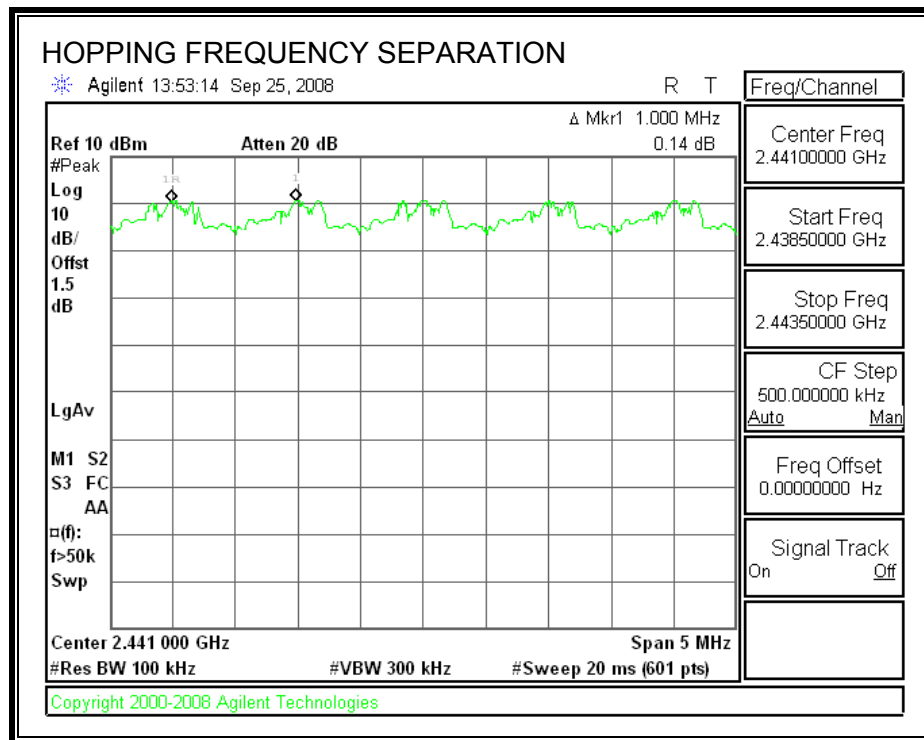
Alternatively, frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than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

TEST PROCEDURE

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

RESULTS

HOPPING FREQUENCY SEPARATION



7.2.3. 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.

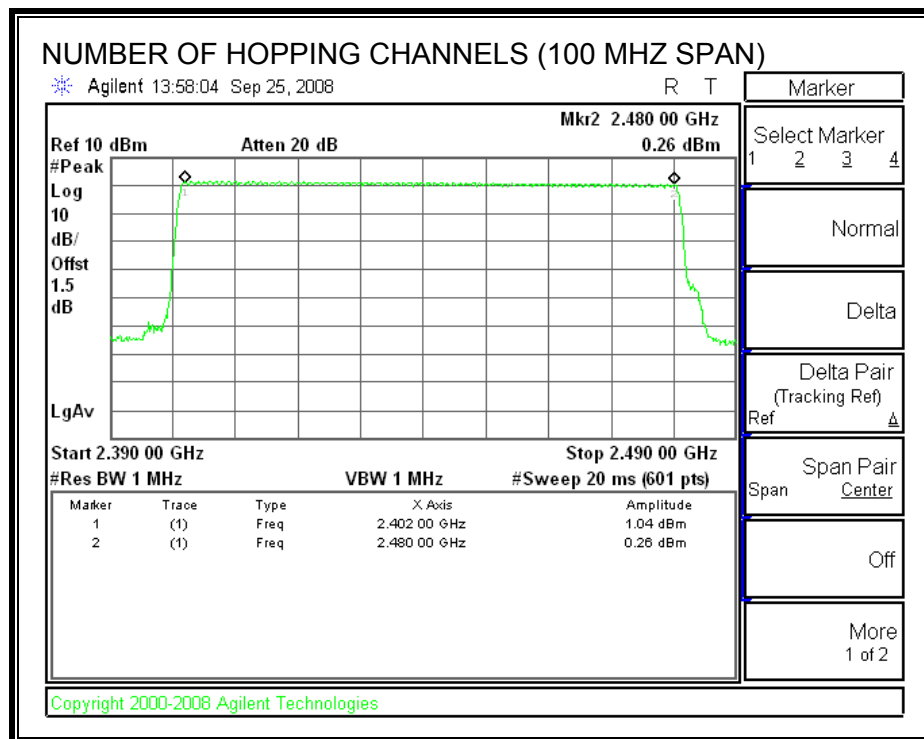
TEST PROCEDURE

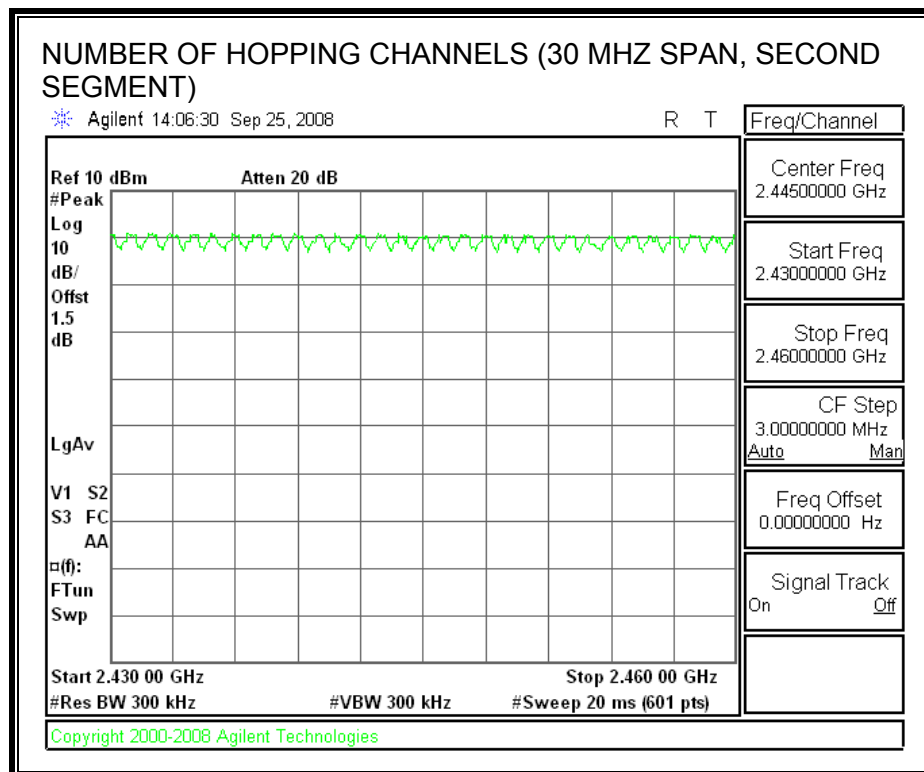
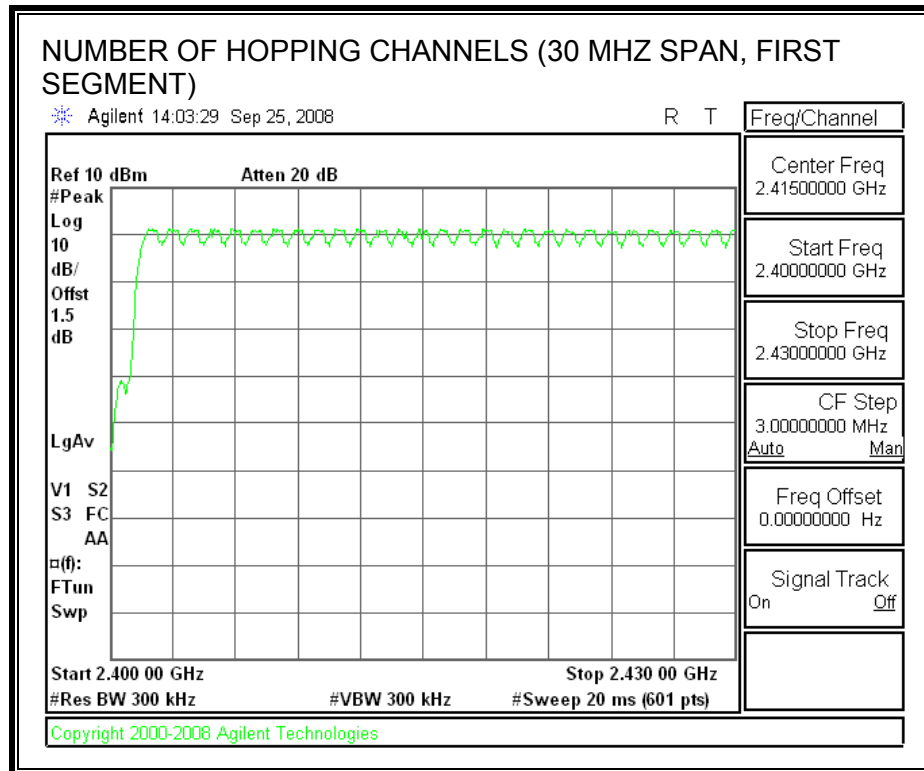
The transmitter output is connected to a spectrum analyzer. The span is set to cover the entire authorized band, in either a single sweep or in multiple contiguous sweeps. The RBW is set to a maximum of 1 % of the span. The analyzer is set to Max Hold.

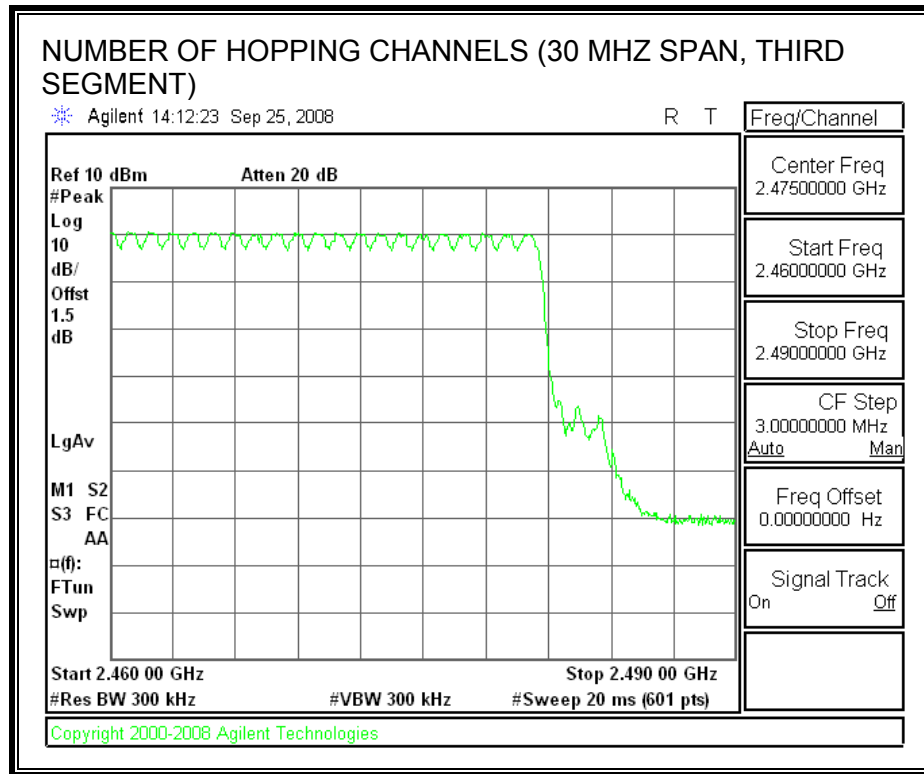
RESULTS

79 Channels observed.

NUMBER OF HOPPING CHANNELS







7.2.4. 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.

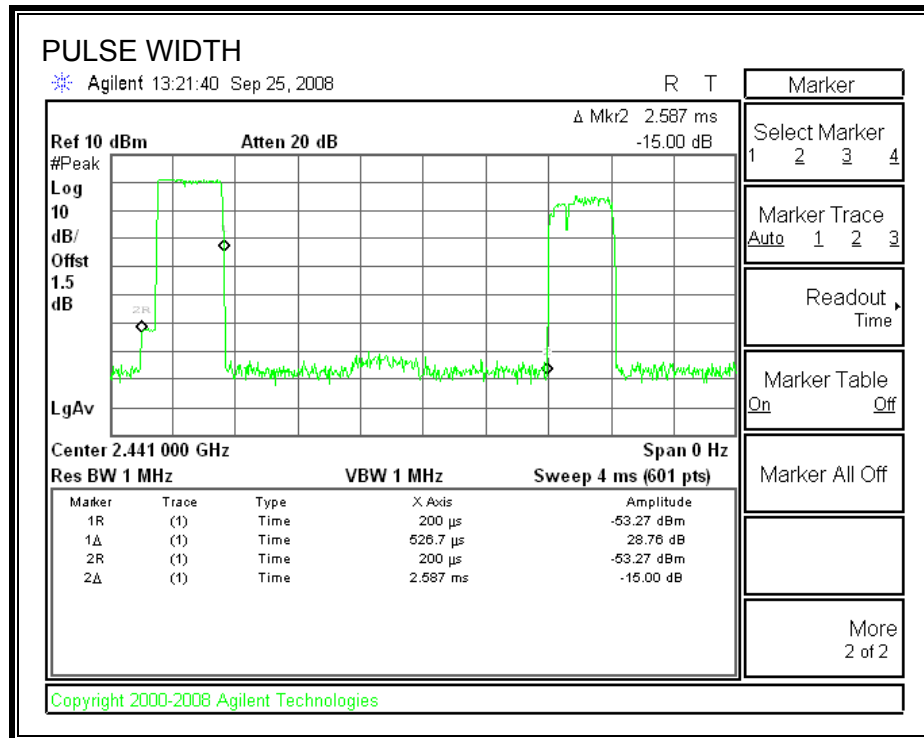
The average time of occupancy in the specified 31.6 second period (79 channels * 0.4 s) is equal to $10 * (\# \text{ of pulses in } 3.16 \text{ s}) * \text{pulse width}$.

RESULTS

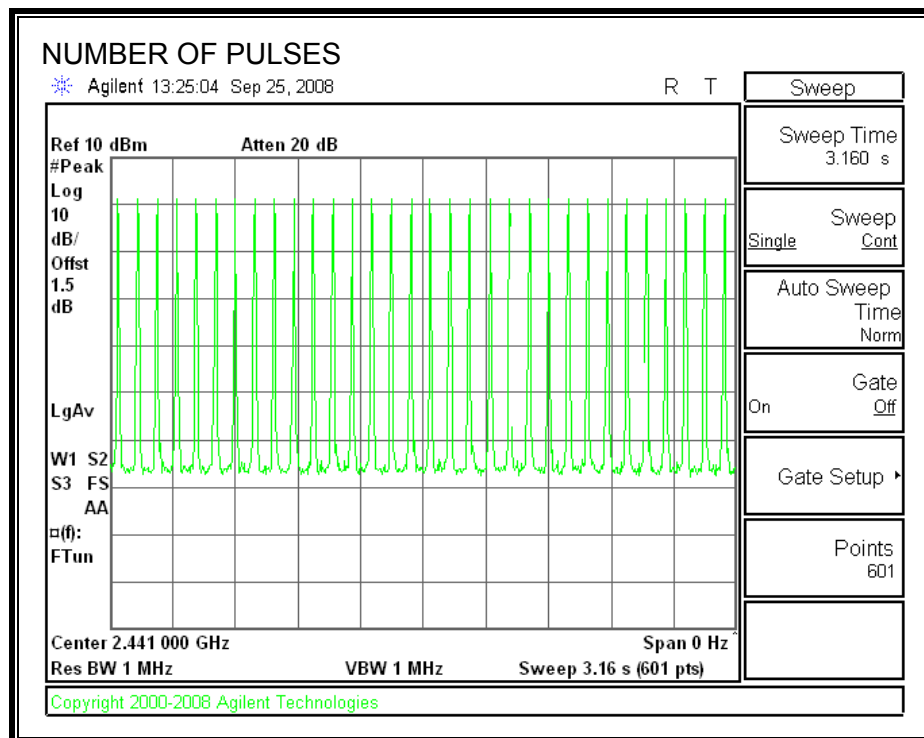
DH Packet	Pulse Width (msec)	Number of Pulses in 3.16 seconds	Average Time of (sec)	Limit (sec)	Margin (sec)
DH1	0.5267	32	0.169	0.4	0.231
DH3	1.783	16	0.285	0.4	0.115
DH5	3.033	11	0.334	0.4	0.066

DH1

PULSE WIDTH

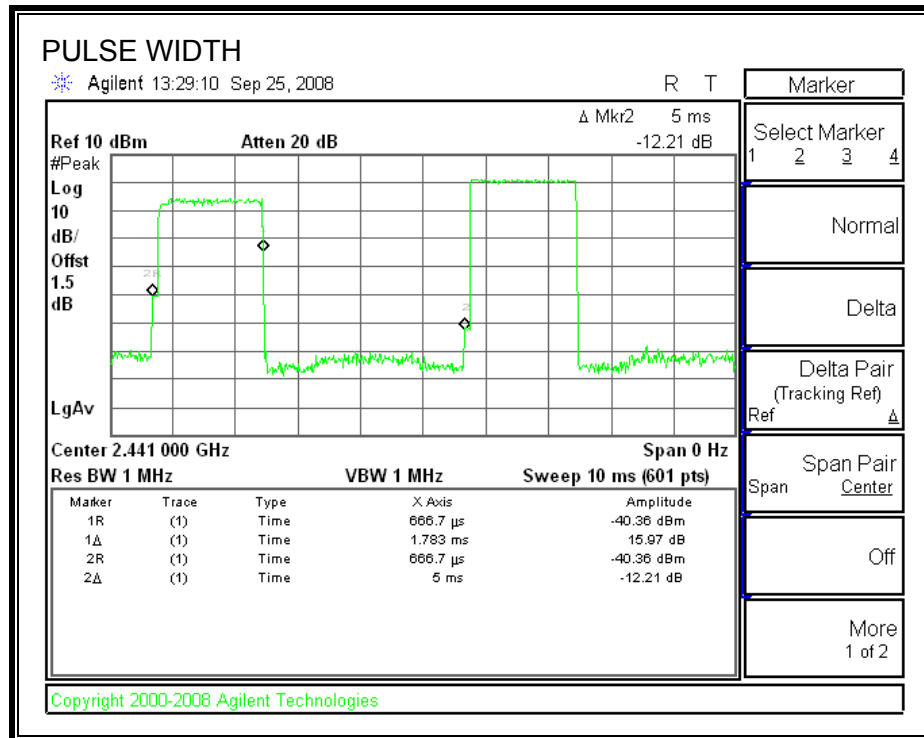


NUMBER OF PULSES IN 3.16 SECOND OBSERVATION PERIOD

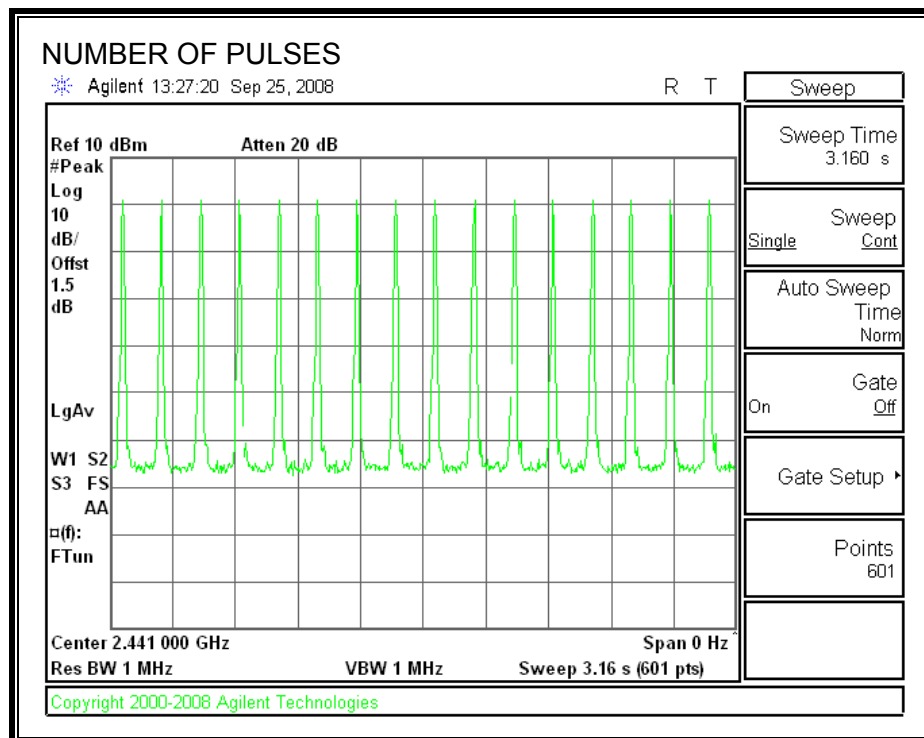


DH3

PULSE WIDTH

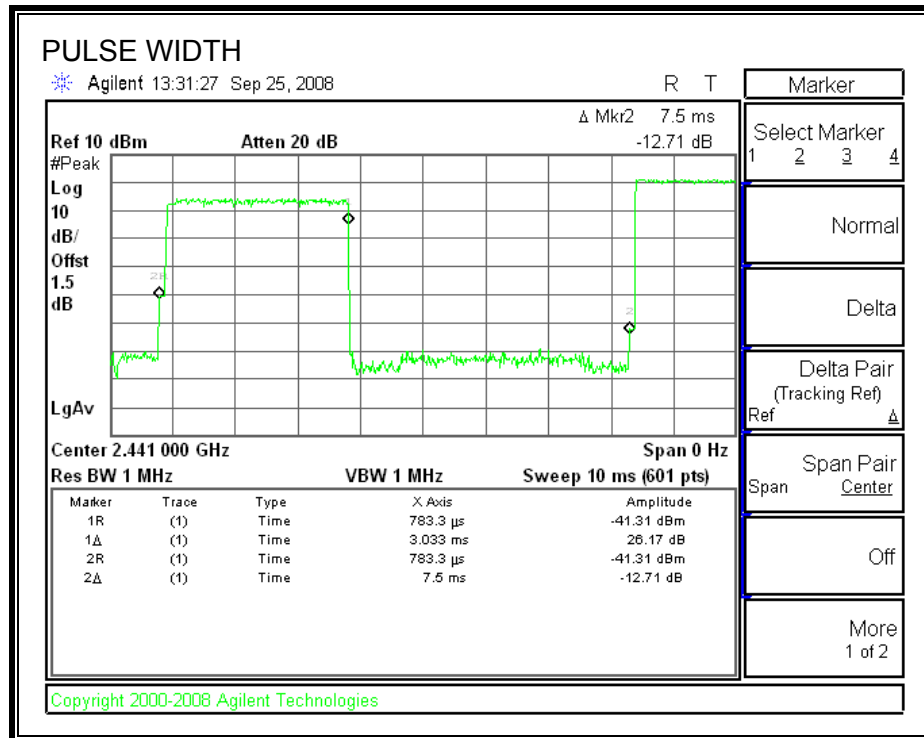


NUMBER OF PULSES IN 3.16 SECOND OBSERVATION PERIOD

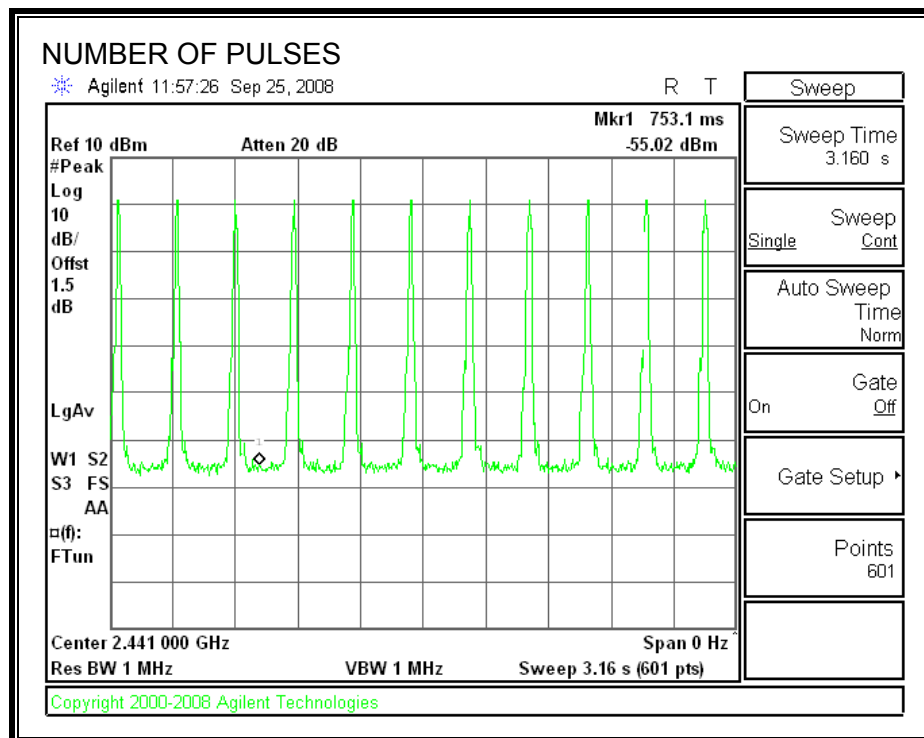


DH5

PULSE WIDTH



NUMBER OF PULSES IN 3.16 SECOND OBSERVATION PERIOD



7.2.5. 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. 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.

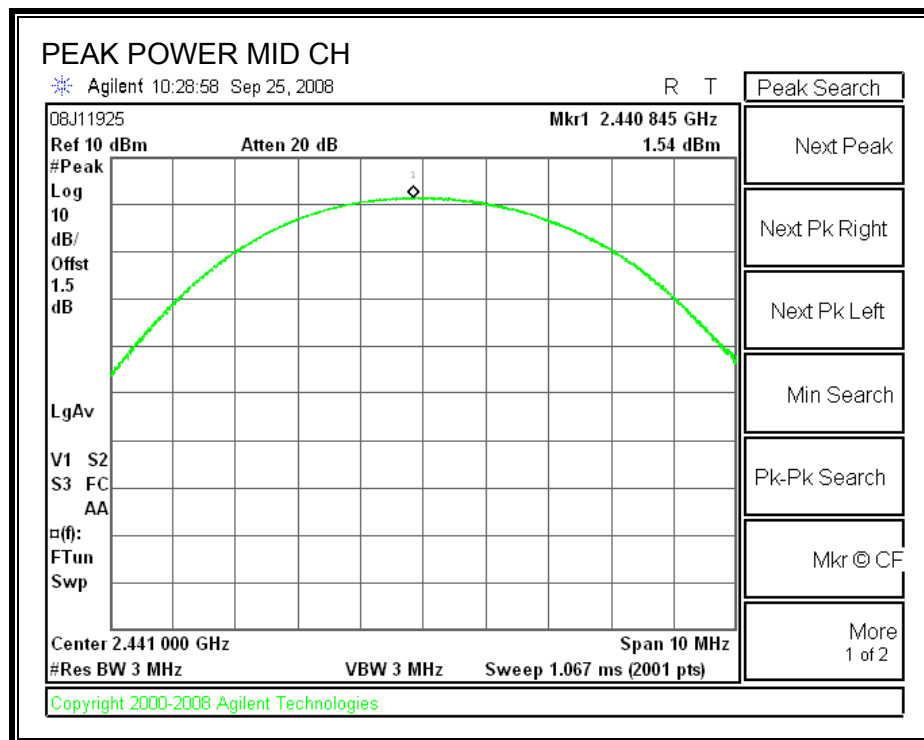
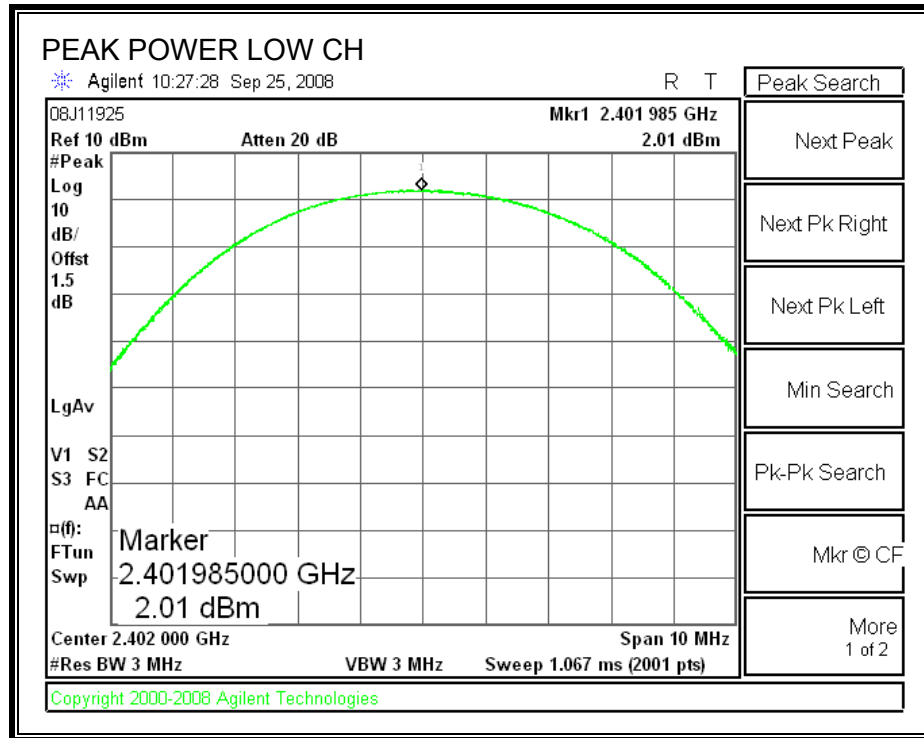
TEST PROCEDURE

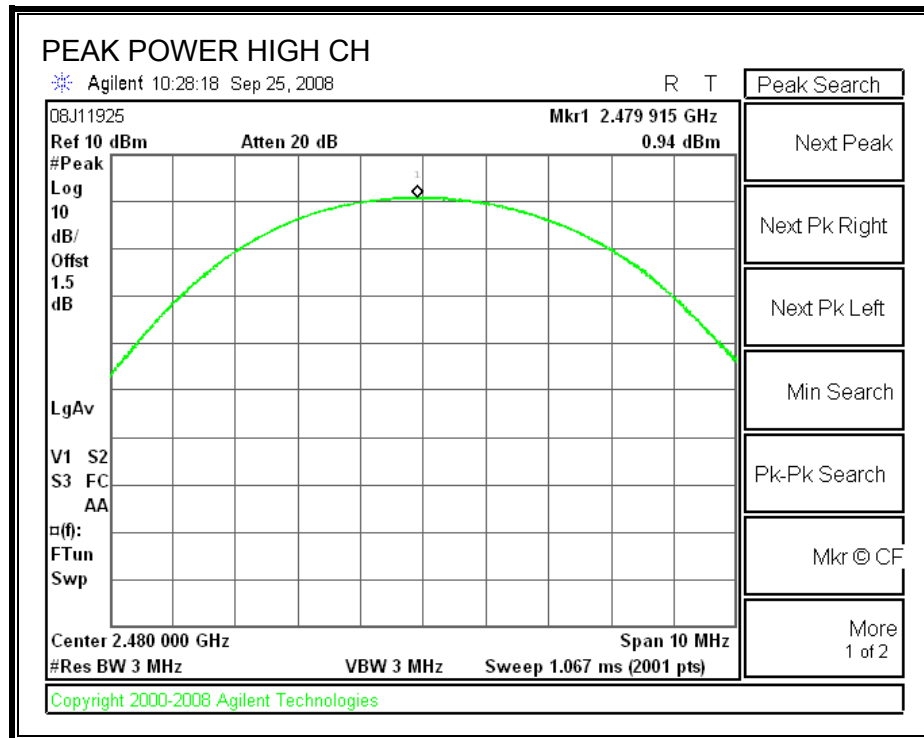
The transmitter output is connected to a spectrum analyzer the analyzer bandwidth is set to a value greater than the 20 dB bandwidth of the EUT.

RESULTS

Channel	Frequency (MHz)	Output Power (dBm)	Limit (dBm)	Margin (dB)
Low	2402	2.02	21	-18.95
Middle	2441	1.54	21	-19.43
High	2480	0.94	21	-20.03

OUTPUT POWER





7.2.6. AVERAGE POWER

LIMIT

None; for reporting purposes only.

TEST PROCEDURE

The transmitter output is connected to a power meter.

RESULTS

The cable assembly insertion loss of 1.5 dB (including 0 dB pad and 1.5dB 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	-0.18
Middle	2441	-0.32
High	2480	-0.91

7.2.7. CONDUCTED SPURIOUS EMISSIONS

LIMITS

FCC §15.247 (d)

IC RSS-210 A8.5

Limit = -20 dBc

TEST PROCEDURE

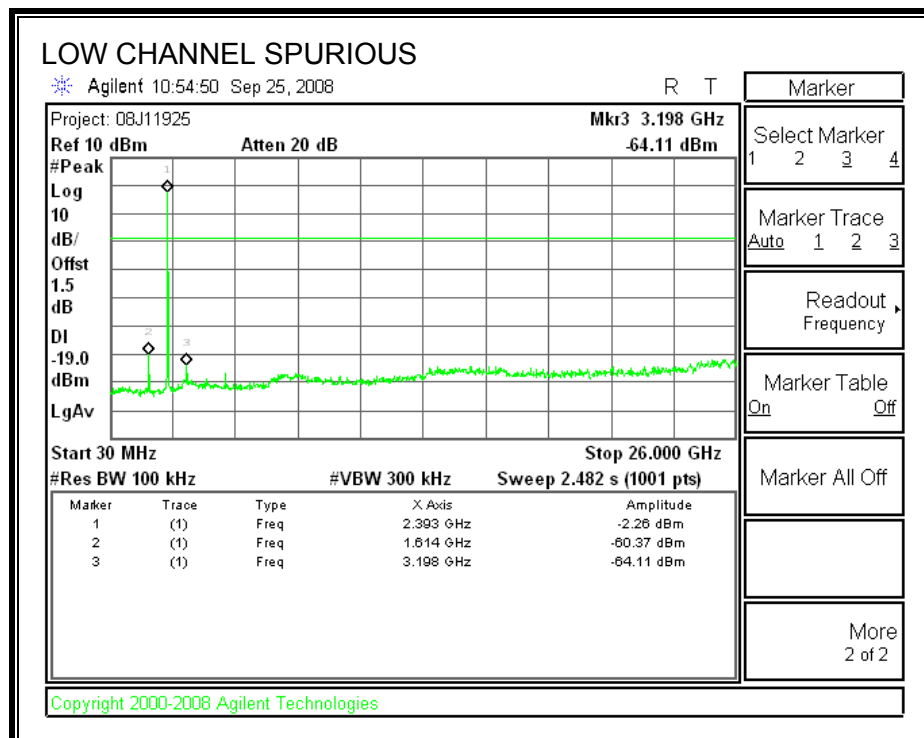
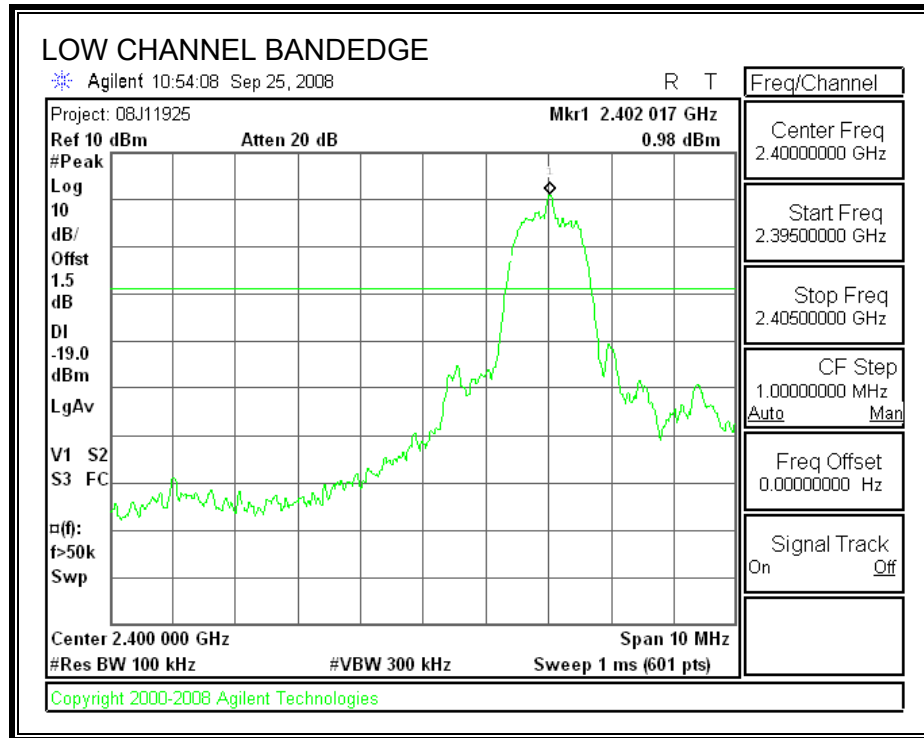
The transmitter output is connected to a spectrum analyzer. The resolution bandwidth is set to 100 kHz. The video bandwidth is set to 300 kHz.

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

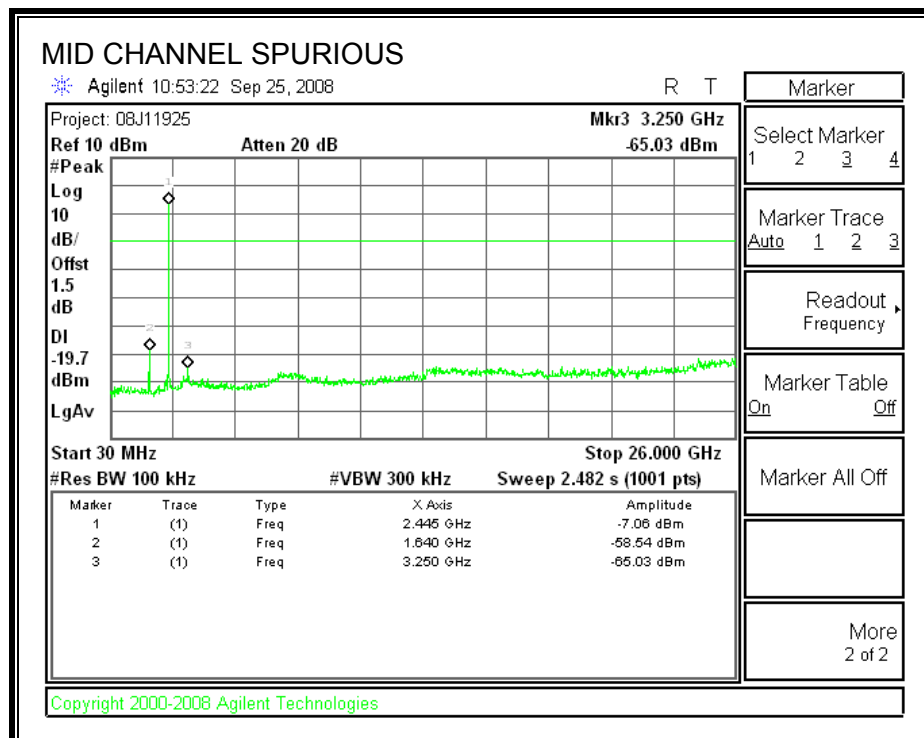
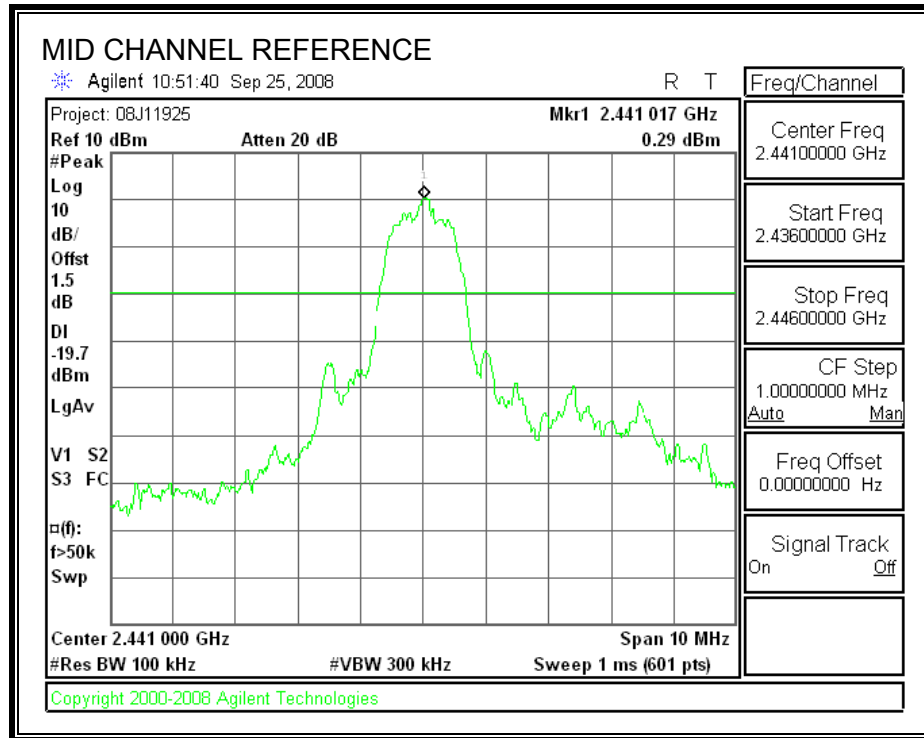
The bandedges at 2.4 and 2.4835 GHz are investigated with the transmitter set to the normal hopping mode.

RESULTS

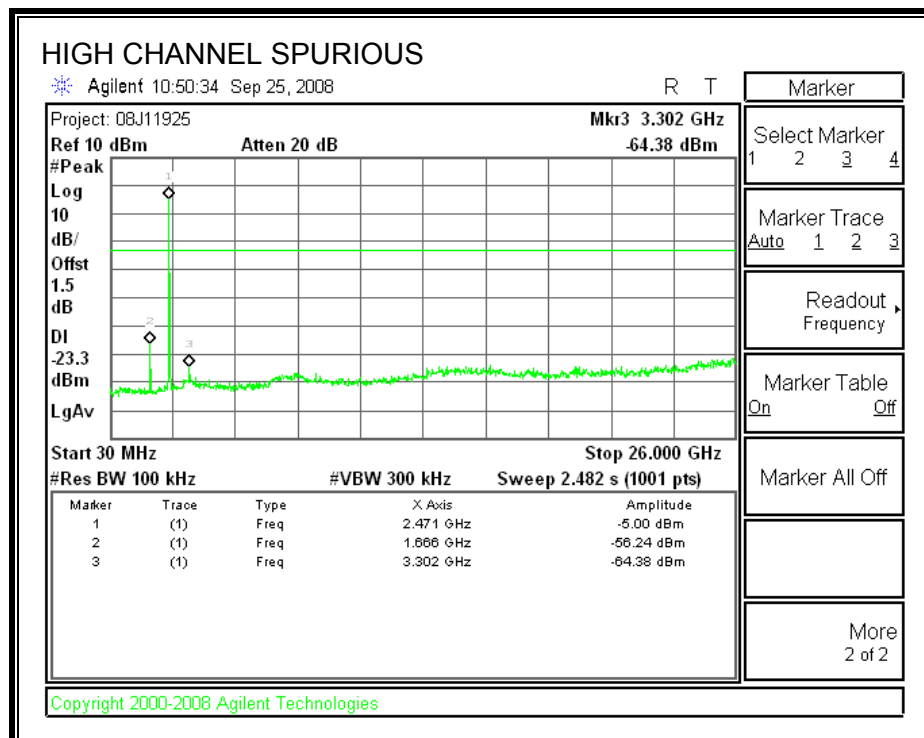
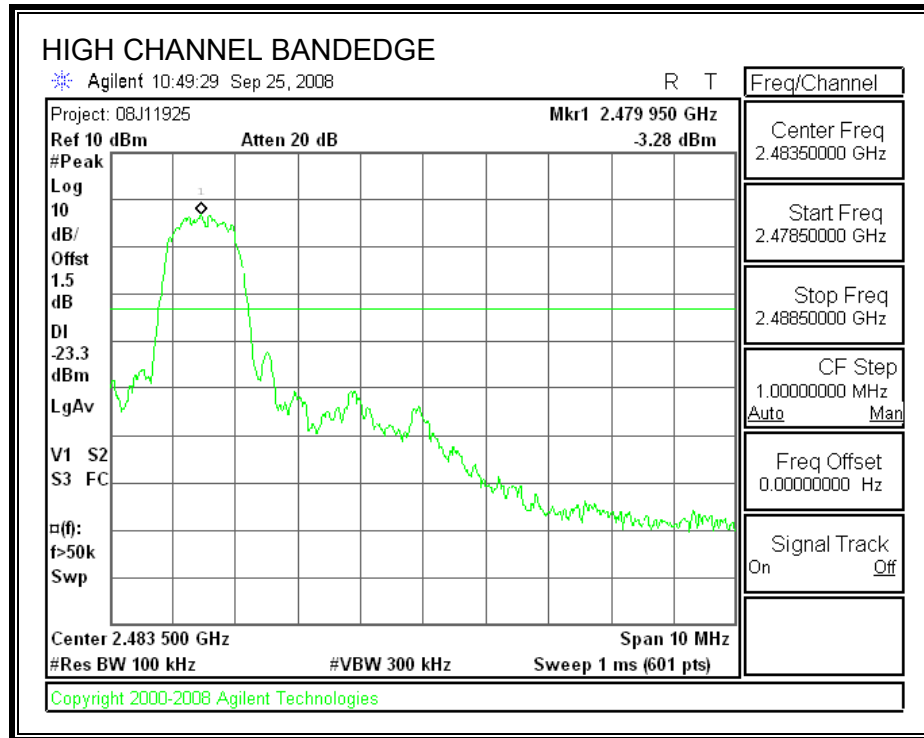
SPURIOUS EMISSIONS, LOW CHANNEL



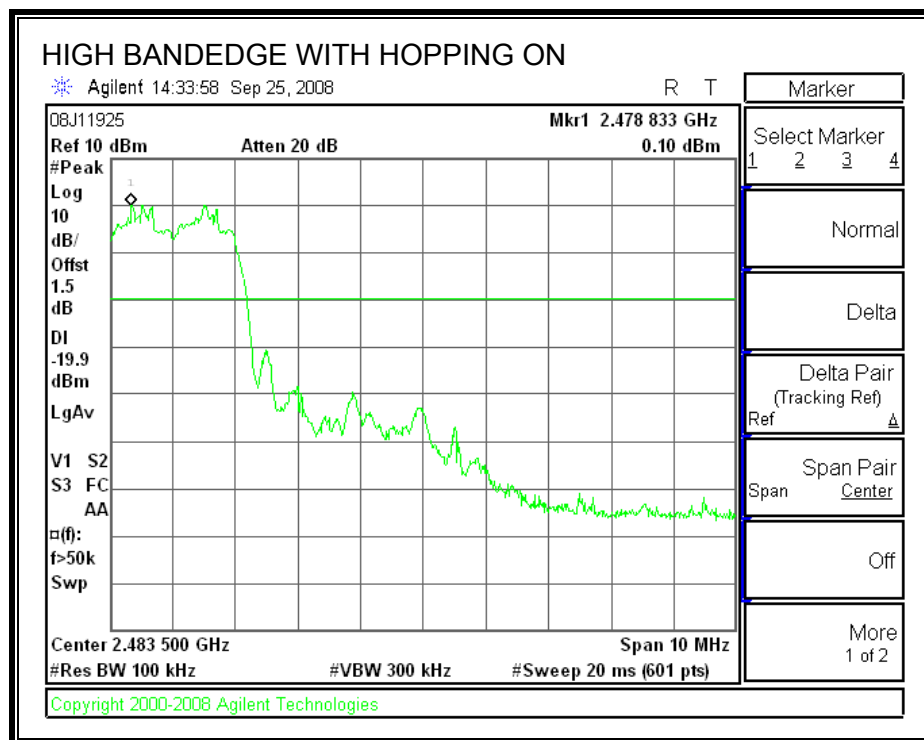
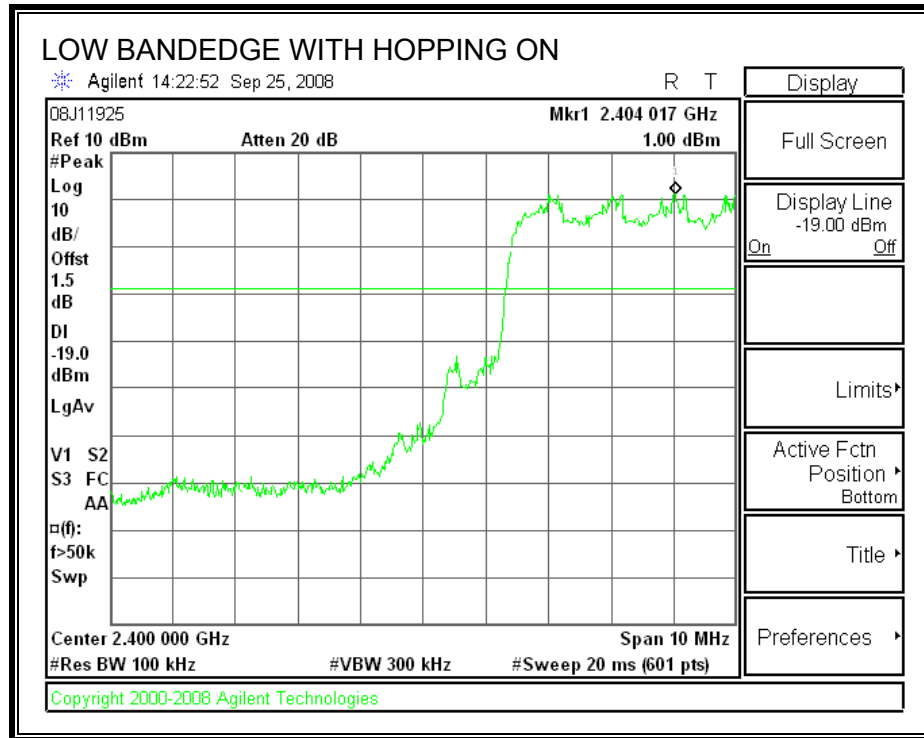
SPURIOUS EMISSIONS, MID CHANNEL



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.

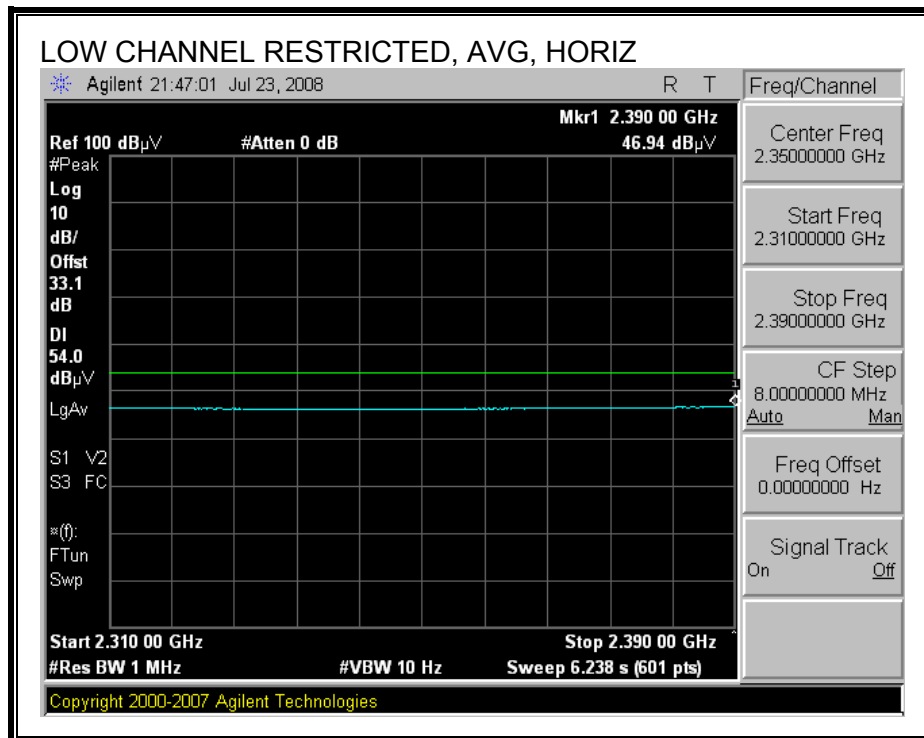
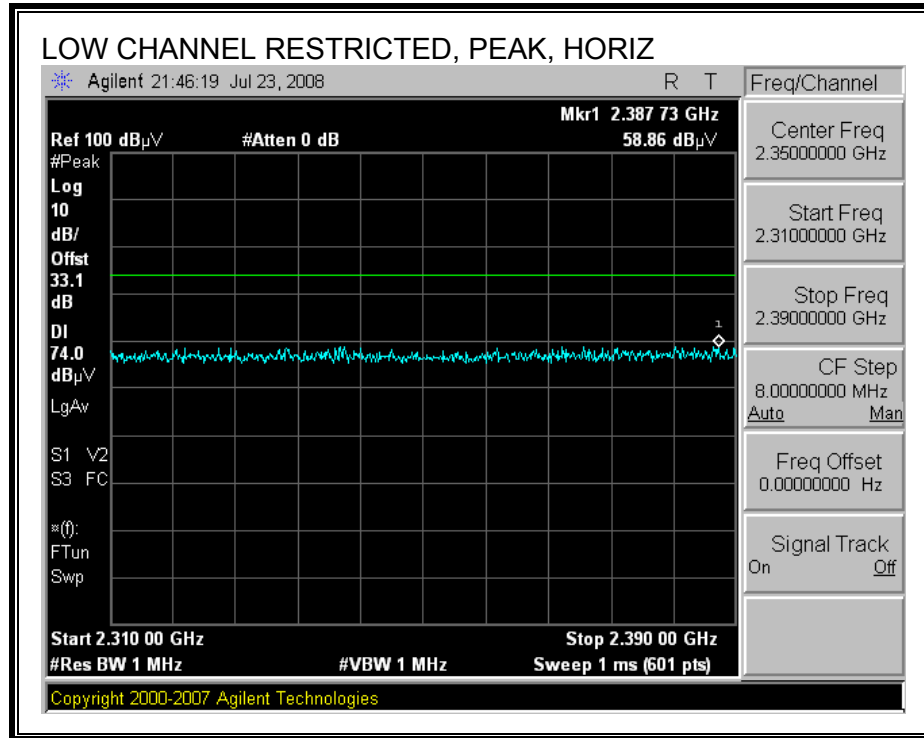
The spectrum from 30 MHz to 26 GHz is investigated with the transmitter set to the lowest, middle, and highest channels in the 2.4 GHz band.

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.

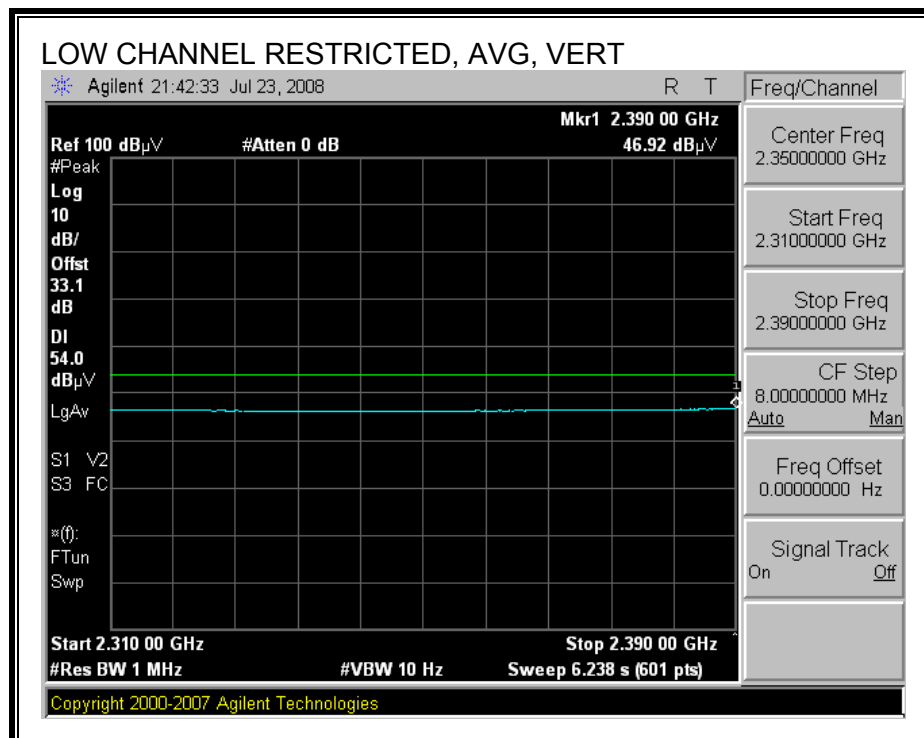
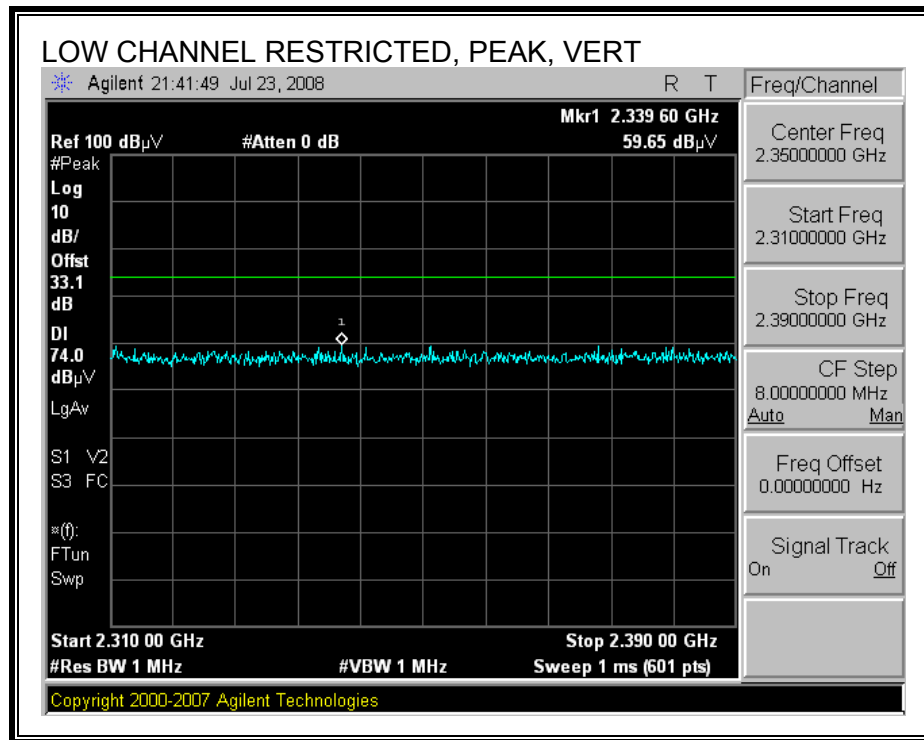
8.2. TRANSMITTER ABOVE 1 GHz

8.2.1. BASIC DATA RATE GFSK MODULATION

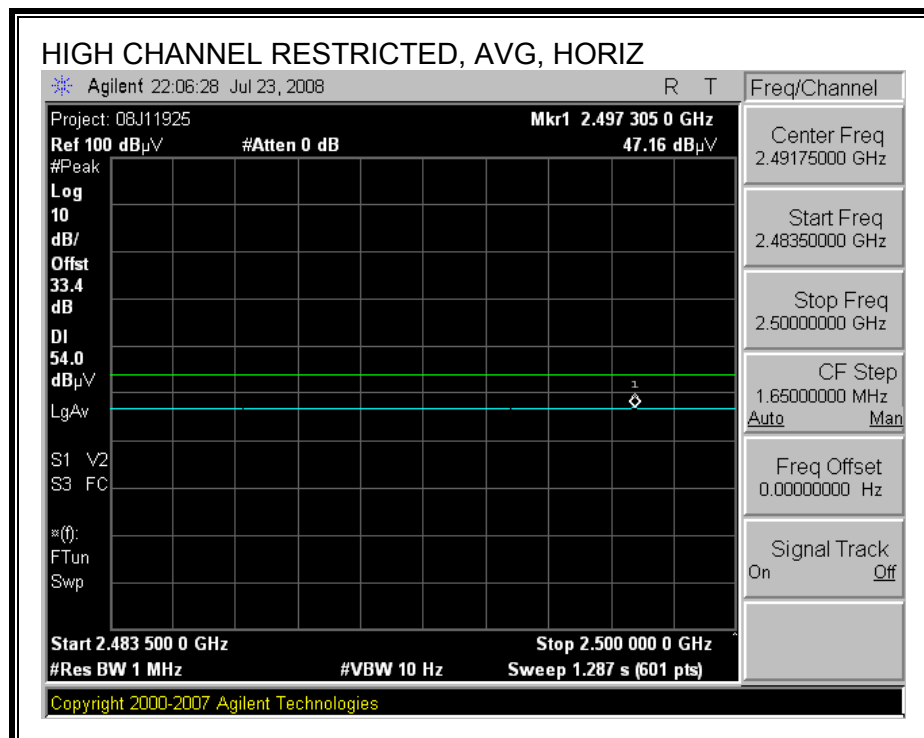
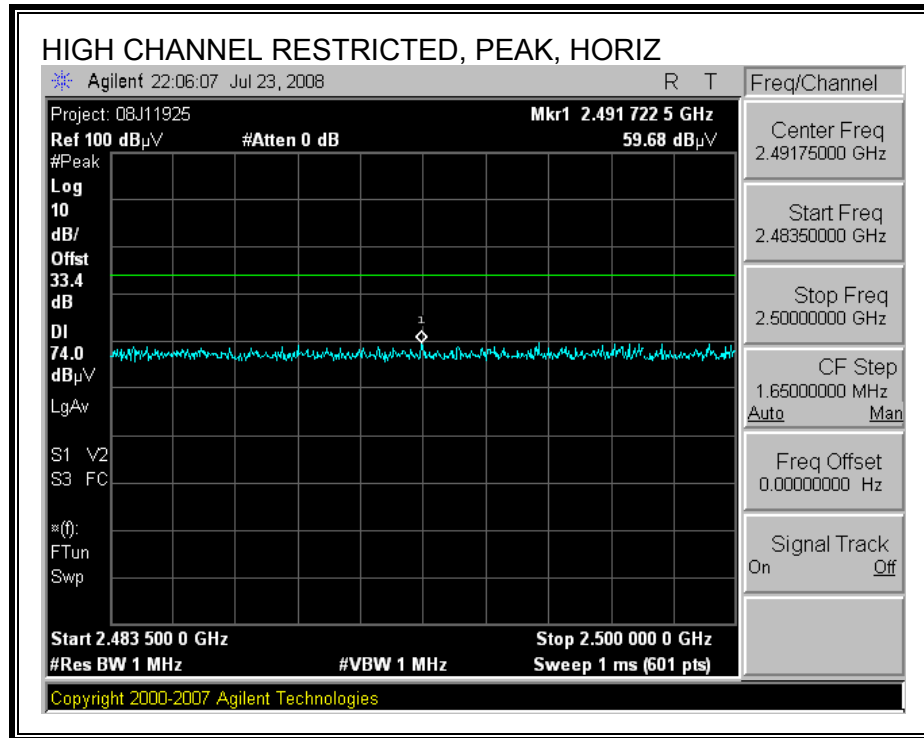
RESTRICTED BANDEDGE (LOW CHANNEL, HORIZONTAL)



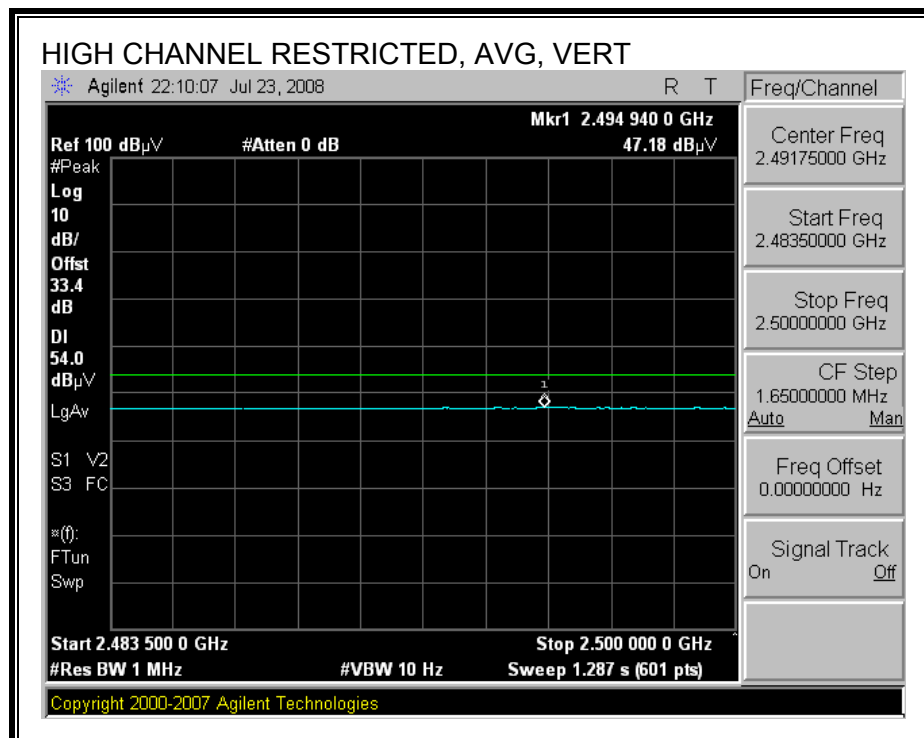
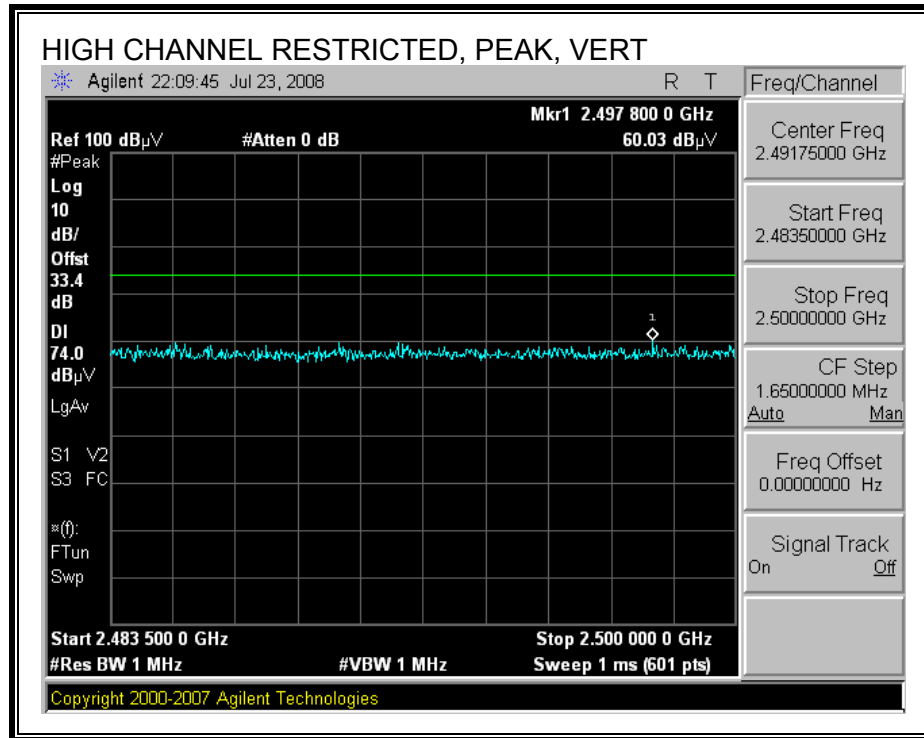
RESTRICTED BANDEDGE (LOW CHANNEL, VERTICAL)



RESTRICTED BANDEDGE (HIGH CHANNEL, HORIZONTAL)



RESTRICTED BANDEDGE (HIGH CHANNEL, VERTICAL)

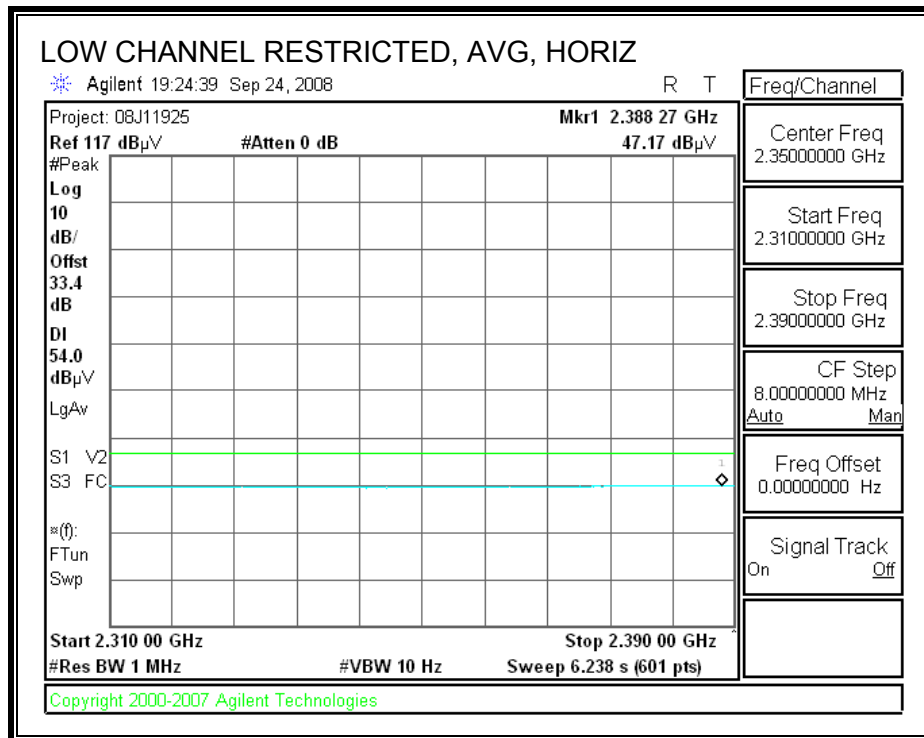
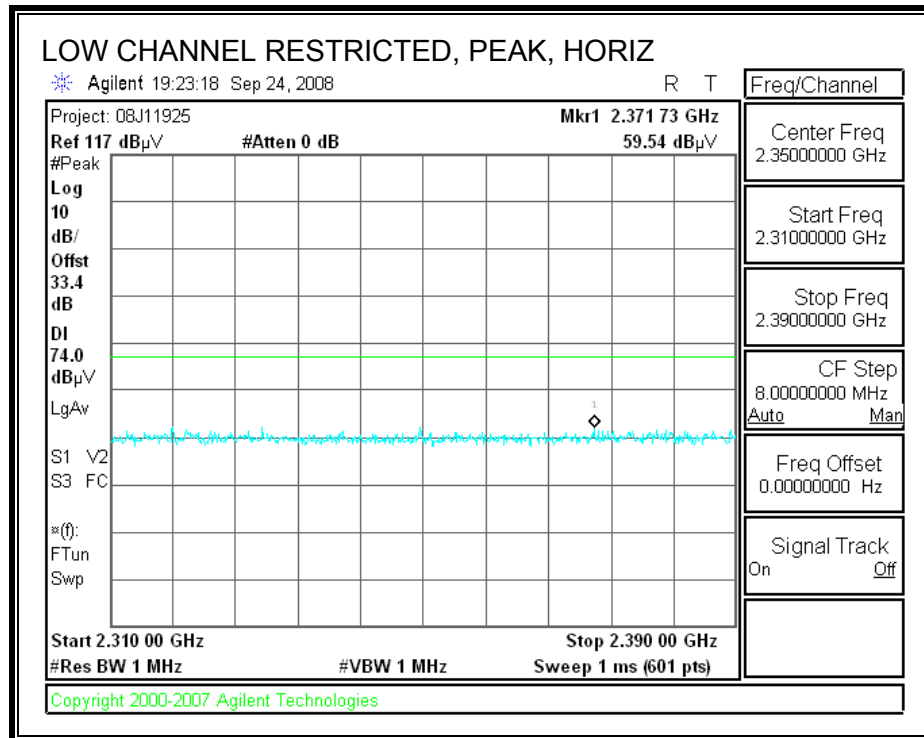


HARMONICS AND SPURIOUS EMISSIONS

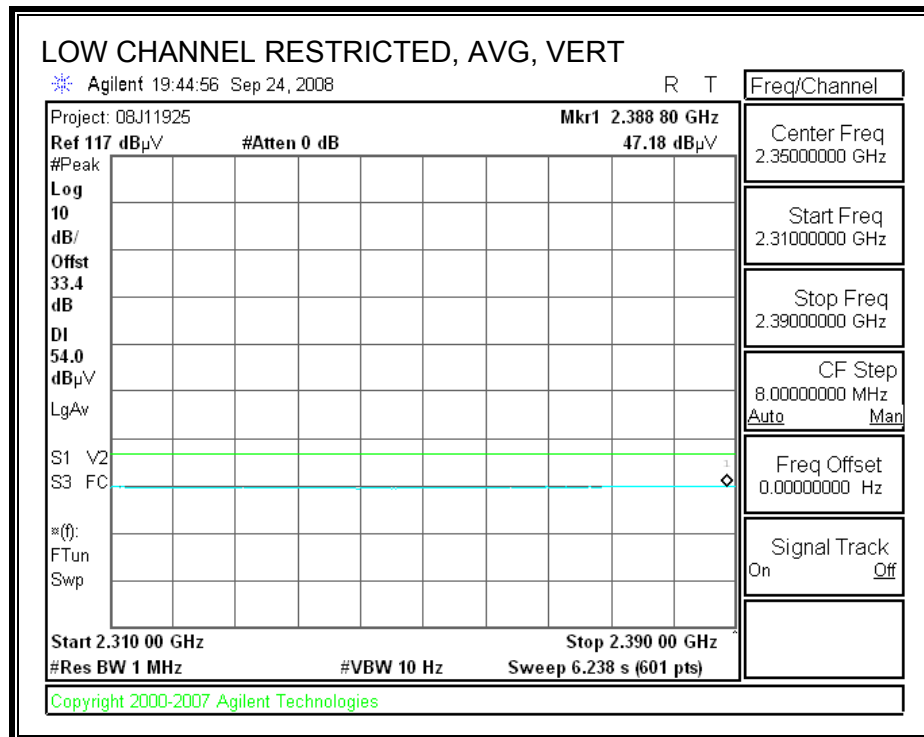
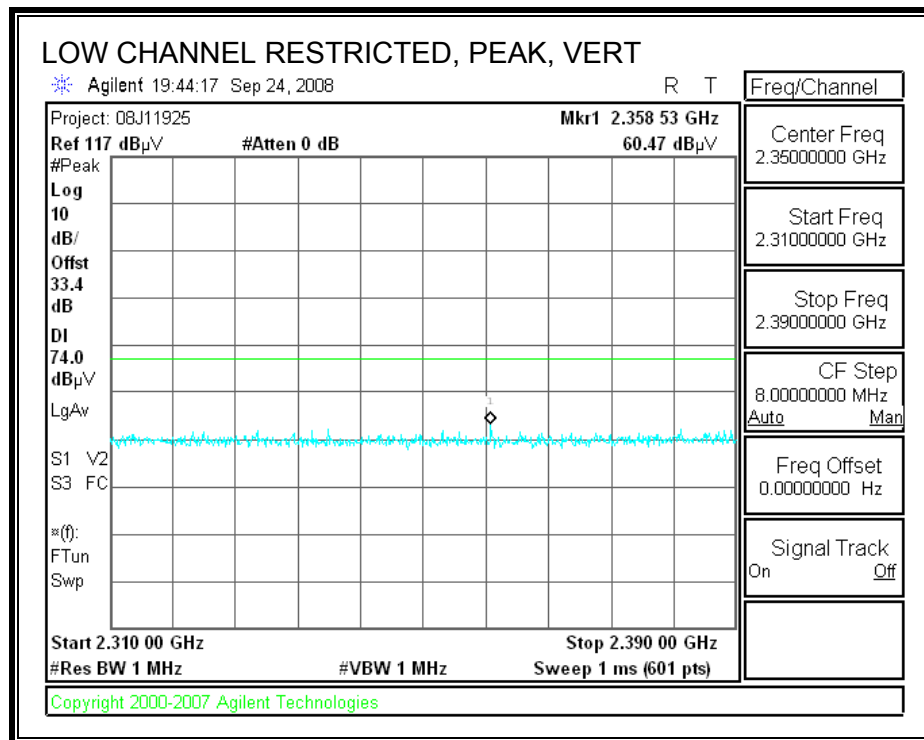
High Frequency Measurement																
Compliance Certification Services, Fremont 5m Chamber																
Company:		TOPCON														
Project #:		08J11925														
Date:		7/23/2008														
Test Engineer:		Can Ming Chung														
Configuration:		EUT with Laptop														
Mode:		Tx Mode GFSK, Y axis														
Test Equipment:																
Horn 1-18GHz			Pre-amplifier 1-26GHz			Pre-amplifier 26-40GHz			Horn > 18GHz			Limit				
T73; S/N: 6717 @3m			T145 Agilent 3008A005t									FCC 15.209				
Hi Frequency Cables																
2 foot cable			3 foot cable			12 foot cable			HPF			Reject Filter			Peak Measurements RBW=VBW=1MHz Average Measurements RBW=1MHz ; VBW=10Hz	
						B-5m Chamber						R_001				
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)	
Low Ch. 2402MHz																
4804	3.0	47.8	32.4	33.7	7.1	-34.8	0.0	0.0	53.7	38.4	74	54	-20.3	-15.6	V	
4804	3.0	48.2	32.9	33.7	7.1	-34.8	0.0	0.0	54.2	38.9	74	54	-19.8	-15.1	H	
Mid Ch. 2441MHz																
4882	3.0	48.4	32.9	33.8	7.2	-34.9	0.0	0.0	54.5	39.0	74	54	-19.5	-15.0	V	
4882	3.0	50.4	33.5	33.8	7.2	-34.9	0.0	0.0	56.5	39.6	74	54	-17.5	-14.4	H	
High Ch. 2480MHz																
4960	3.0	50.0	32.3	33.9	7.2	-34.9	0.0	0.0	56.2	38.5	74	54	-17.8	-15.5	V	
4960	3.0	51.6	33.2	33.9	7.2	-34.9	0.0	0.0	57.8	39.5	74	54	-16.2	-14.5	H	
Rev. 4.12.7																
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									

8.2.2. ENHANCED DATA RATE 8PSK MODULATION

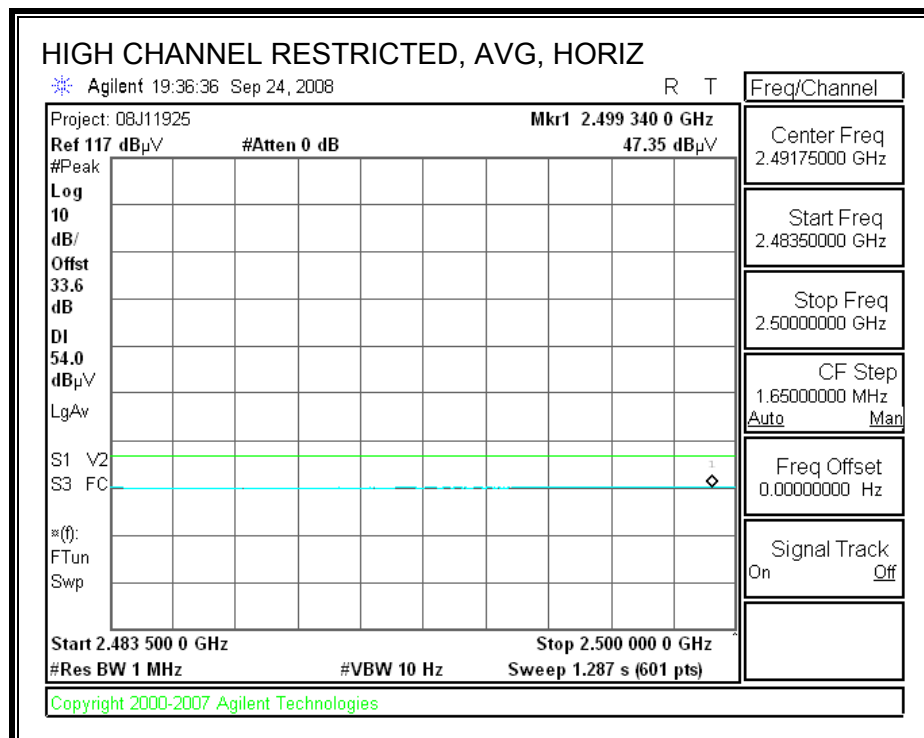
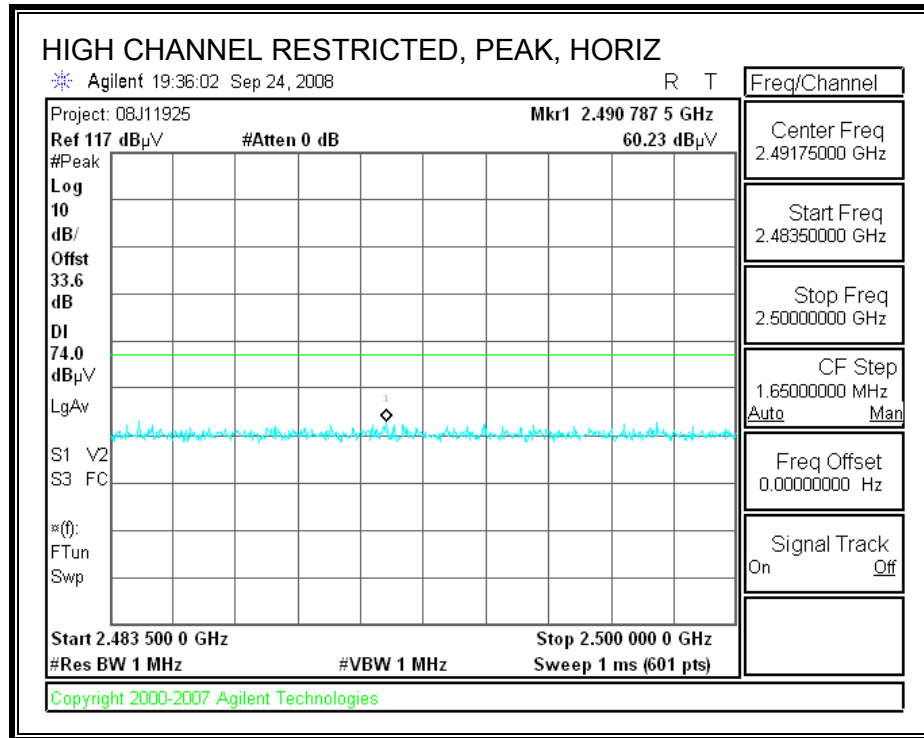
RESTRICTED BANDEDGE (LOW CHANNEL, HORIZONTAL)



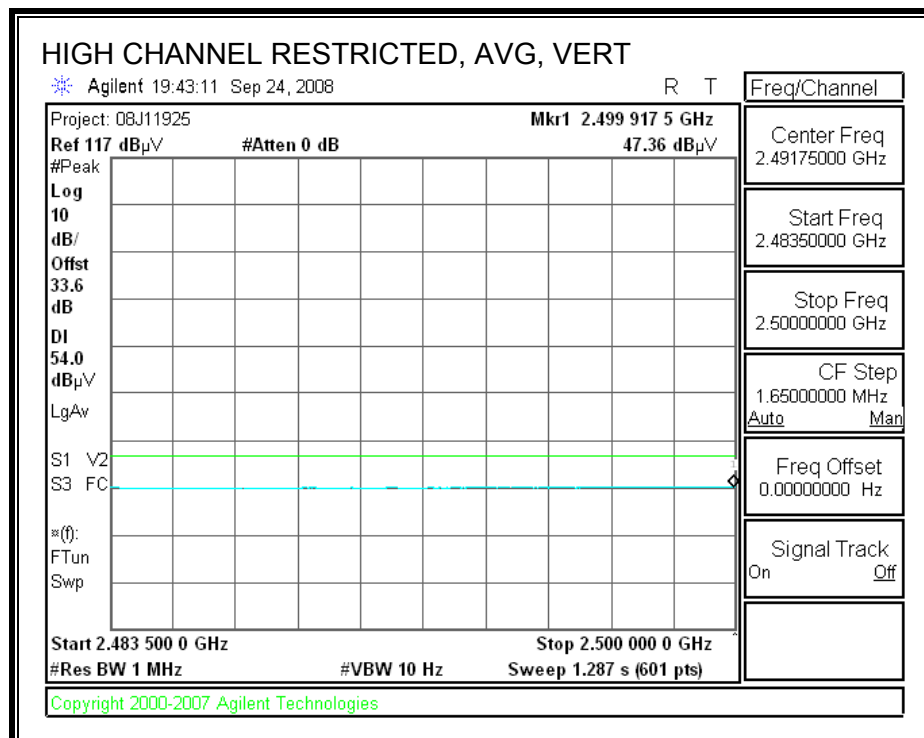
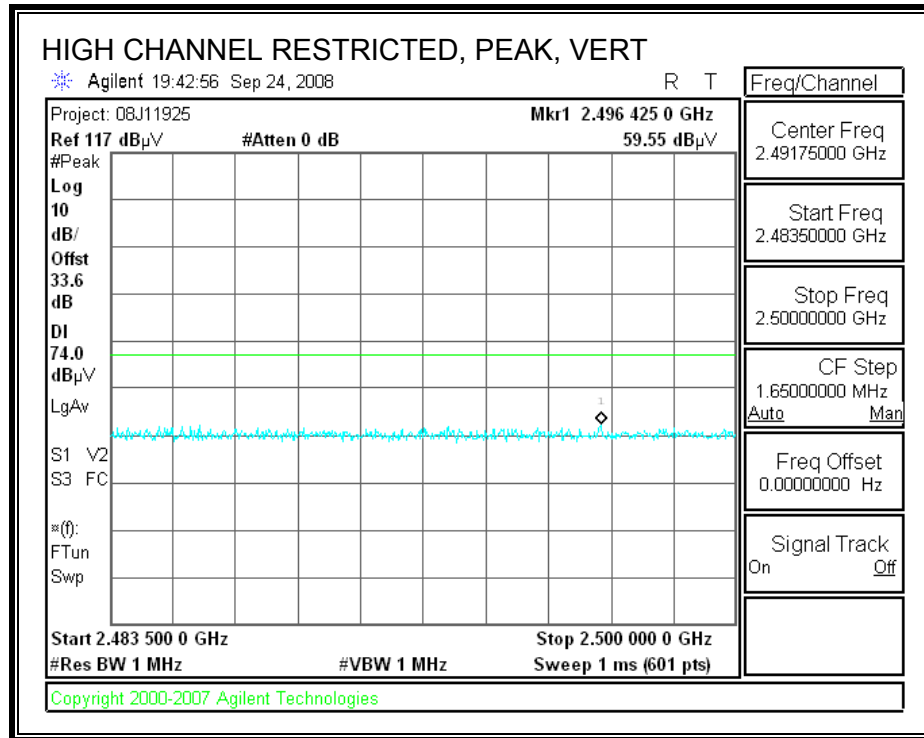
RESTRICTED BANDEDGE (LOW CHANNEL, VERTICAL)



RESTRICTED BANDEDGE (HIGH CHANNEL, HORIZONTAL)



RESTRICTED BANDEDGE (HIGH CHANNEL, VERTICAL)



HARMONICS AND SPURIOUS EMISSIONS

High Frequency Measurement															
Compliance Certification Services, Fremont 5m Chamber															
Company:		TOPCON													
Project #:		08J11925													
Date:		9/24/2008													
Test Engineer:		Vien Tran													
Configuration:		EUT with Laptop													
Mode:		Tx 8DPSK													
Test Equipment:															
Horn 1-18GHz		Pre-amplifier 1-26GHz		Pre-amplifier 26-40GHz		Horn > 18GHz		Limit							
T73; S/N: 6717 @3m		T145 Agilent 3008A005						FCC 15.209							
Hi Frequency Cables															
2 foot cable		3 foot cable		12 foot cable		HPF		Reject Filter		Peak Measurements RBW=VBW=1MHz Average Measurements RBW=1MHz ; VBW=10Hz					
				B-5m Chamber				R_001							
f GHz	Dist (m)	Read Pk dBuV	Read Avg. dBuV	AF dB/m	CL dB	Amp dB	D Corr dB	Filt dB	Peak dBuV/m	Avg dBuV/m	Pk Lim dBuV/m	Avg Lim dBuV/m	Pk Mar dB	Avg Mar dB	Notes (V/H)
Low Ch. 2402MHz															
1.603	3.0	50.0	47.0	27.3	4.0	-35.7	0.0	0.0	45.6	42.6	74	54	-28.4	-11.4	V, Spur
4.804	3.0	48.3	37.8	33.7	7.1	-34.8	0.0	0.0	54.3	43.8	74	54	-19.7	-10.2	V
1.603	3.0	50.9	47.3	27.3	4.0	-35.7	0.0	0.0	46.5	42.9	74	54	-27.5	-11.1	H, Spur
4.804	3.0	47.1	36.0	33.7	7.1	-34.8	0.0	0.0	53.1	42.0	74	54	-20.9	-12.0	H
Mid Ch. 2441MHz															
1.628	3.0	50.2	47.0	27.4	4.0	-35.7	0.0	0.0	46.0	42.8	74	54	-28.0	-11.2	V, Spur
4.882	3.0	45.9	32.7	33.8	7.2	-34.9	0.0	0.0	52.0	38.8	74	54	-22.0	-15.2	V
1.628	3.0	51.6	47.5	27.4	4.0	-35.7	0.0	0.0	47.4	43.3	74	54	-26.6	-10.7	H, Spur
4.882	3.0	44.2	31.1	33.8	7.2	-34.9	0.0	0.0	50.3	37.2	74	54	-23.7	-16.8	H
High Ch. 2480MHz															
1.653	3.0	53.2	49.8	27.5	4.1	-35.7	0.0	0.0	49.1	45.7	74	54	-24.9	-8.3	V, Spur
4.960	3.0	43.4	30.6	33.9	7.2	-34.9	0.0	0.0	49.7	36.8	74	54	-24.3	-17.2	V
1.653	3.0	54.6	51.8	27.5	4.1	-35.7	0.0	0.0	50.5	47.6	74	54	-23.5	-6.4	H, Spur
4.960	3.0	42.3	29.8	33.9	7.2	-34.9	0.0	0.0	48.6	36.1	74	54	-25.4	-17.9	H
f Measurement Frequency Dist Distance to Antenna Read Analyzer Reading AF Antenna Factor CL Cable Loss Amp Preamp Gain D Corr Distance Correct to 3 meters Avg Average Field Strength @ 3 m Peak Calculated Peak Field Strength HPF High Pass Filter Avg Lim Average Field Strength Limit Pk Lim Peak Field Strength Limit Avg Mar Margin vs. Average Limit Pk Mar Margin vs. Peak Limit															

8.3. RECEIVER ABOVE 1 GHz – WORST CASE

High Frequency Measurement															
Compliance Certification Services, Fremont 5m Chamber															
Company:		TOPCON													
Project #:		08J11925													
Date:		9/24/2008													
Test Engineer:		Vien Tran													
Configuration:		EUT with Laptop													
Mode:		Rx Worst-case													
Test Equipment:															
Horn 1-18GHz			Pre-amplifier 1-26GHz			Pre-amplifier 26-40GHz			Horn > 18GHz			Limit			
T73; S/N: 6717 @3m			T145 Agilent 3008A0050									RX RSS 210			
Hi Frequency Cables															
2 foot cable			3 foot cable			12 foot cable			HPF			Reject Filter			
						B-5m Chamber									
Peak Measurements RBW=VBW=1MHz Average Measurements RBW=1MHz ; VBW=10Hz															
f	Dist	Read Pk	Read Avg	AF	CL	Amp	D Corr	Filt	Peak	Avg	Pk Lim	Avg Lim	Pk Mar	Avg Mar	Notes
GHz	(m)	dBuV	dBuV	dB/m	dB	dB	dB	dB	dBuV/m	dBuV/m	dBuV/m	dBuV/m	dB	dB	(V/H)
1.627	3.0	49.4	45.7	27.4	4.0	-35.7	0.0	0.0	45.2	41.5	74	54	-28.8	-12.5	H
2.440	3.0	48.1	43.5	29.4	5.1	-35.1	0.0	0.0	47.5	42.9	74	54	-26.5	-11.1	H
1.627	3.0	47.8	42.2	27.4	4.0	-35.7	0.0	0.0	43.6	38.0	74	54	-30.4	-16.0	V
2.440	3.0	46.4	41.0	29.4	5.1	-35.1	0.0	0.0	45.8	40.4	74	54	-28.2	-13.6	V
Rev. 4.12.7															
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

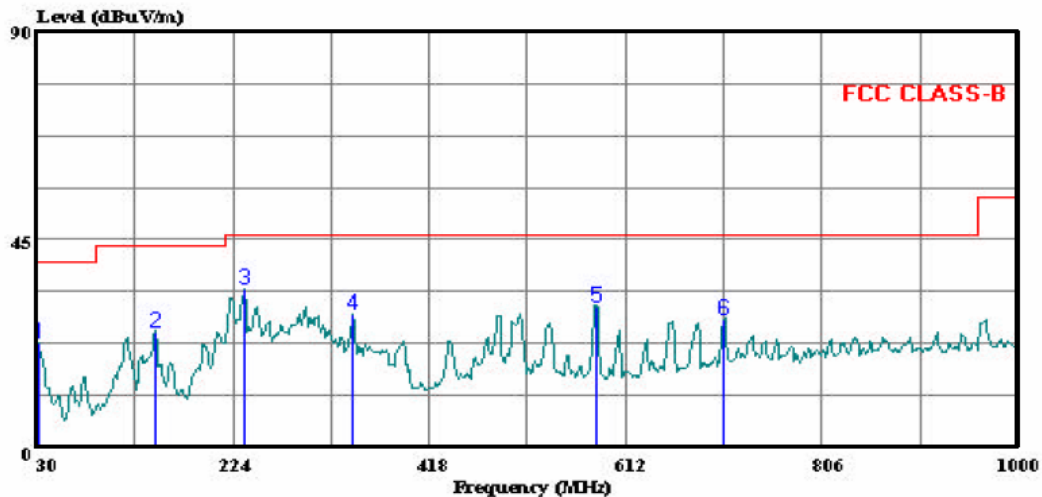
SPURIOUS EMISSIONS 30 TO 1000 MHz (WORST-CASE CONFIGURATION, HORIZONTAL)

HORIZONTAL PLOT



Compliance Certification Services
47173 Benicia Street
Fremont, CA 94538
Tel: (510) 771-1000
Fax: (510) 661-0888

Data#: 6 File#: 08J11925.EMI Date: 07-23-2008 Time: 22:26:39



Trace: 5

Ref Trace:

Condition: FCC CLASS-B VERTICAL
Test Operator:: Can Ming Chung
Project #: 08J11925
Company: Topcon
Configuration:: EUT with lSupport Equipment
Mode : TX bluetooth Mid Ch
Target: FCC Class-B

Page: 1

	Freq	Read	Level	Limit	Over	
	MHz	Level	Factor	Line	Limit	Remark
	MHz	dBuV	dB	dBuV/m	dBuV/m	dB
1	31.940	36.03	-13.33	22.70	40.00	-17.30 Peak
2	147.370	43.20	-18.09	25.11	43.50	-18.39 Peak
3	235.640	51.78	-17.68	34.10	46.00	-11.90 Peak
4	342.340	43.13	-14.33	28.80	46.00	-17.20 Peak
5	583.870	39.30	-8.73	30.58	46.00	-15.42 Peak
6	709.000	33.91	-6.15	27.76	46.00	-18.24 Peak

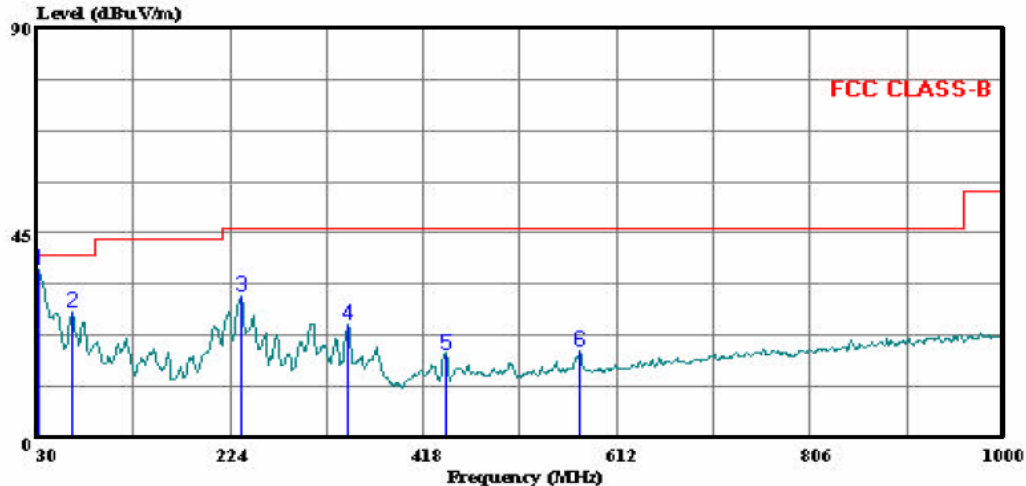
SPURIOUS EMISSIONS 30 TO 1000 MHz (WORST-CASE CONFIGURATION, VERTICAL)

VERTICAL PLOT



Compliance Certification Services
47173 Benicia Street
Fremont, CA 94538
Tel: (510) 771-1000
Fax: (510) 661-0888

Data#: 4 File#: 08J11925.EMI Date: 07-23-2008 Time: 22:16:30



Trace: 3

Ref Trace:

Condition: FCC CLASS-B VERTICAL
Test Operator:: Can Ming Chung
Project #: 08J11925
Company: Topcon
Configuration:: EUT with lSupport Equipment
Mode : TX bluetooth Mid Ch
Target: FCC Class-B

		Read		Limit	Over	
	Freq	Level	Factor	Level	Line	Limit Remark
	MHz	dBuV	dB	dBuV/m	dBuV/m	dB
1	31.940	50.33	-13.33	37.00	40.00	-3.00 Peak
2	65.890	51.37	-23.70	27.67	40.00	-12.33 Peak
3	235.640	49.01	-17.68	31.33	46.00	-14.67 Peak
4	342.340	39.36	-14.33	25.03	46.00	-20.97 Peak
5	440.310	29.99	-11.50	18.48	46.00	-27.52 Peak
6	575.140	27.77	-8.81	18.96	46.00	-27.04 Peak

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

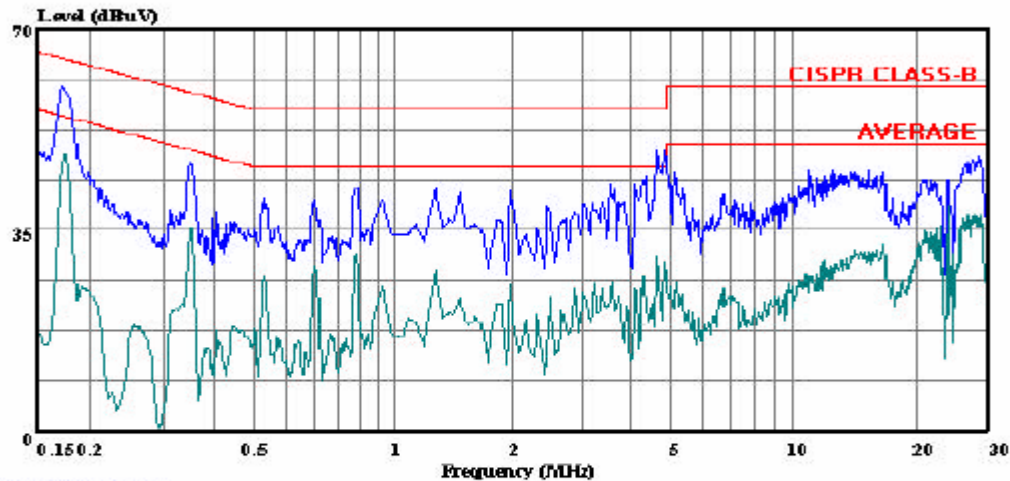
CONDUCTED EMISSIONS DATA (115VAC 60Hz)									
Freq.	Reading			Closs	Limit	EN B	Margin		Remark
(MHz)	PK (dBuV)	QP (dBuV)	AV (dBuV)	(dB)	QP	AV	QP (dB)	AV (dB)	L1 / L2
0.17	59.73	--	48.25	0.00	64.77	54.77	-5.04	-6.52	L1
0.35	46.71	--	35.33	0.00	58.96	48.96	-12.25	-13.63	L1
28.30	47.93	--	40.29	0.00	60.00	50.00	-12.07	-9.71	L1
0.17	58.97	--	48.27	0.00	64.86	54.86	-5.89	-6.59	L2
4.72	50.23	--	32.90	0.00	56.00	46.00	-5.77	-13.10	L2
27.42	47.78	--	40.34	0.00	60.00	50.00	-12.22	-9.66	L2
6 Worst Data									

LINE 1 RESULTS



Compliance Certification Services
47173 Benicia Street
Fremont, CA 94538
Tel: (510) 771-1000
Fax: (510) 661-0888

Data#: 7 File#: 08J11925.EMI Date: 07-30-2008 Time: 16:59:35



(Line Conduction)

Trace: 5

Ref Trace:

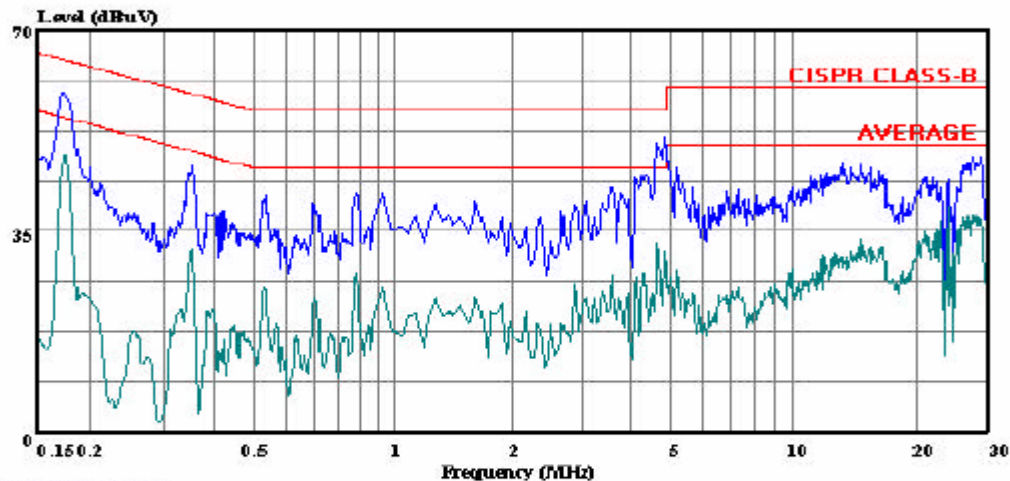
Condition: CISPR CLASS-B
Test Operator:: Chin Pang
Project #: 08J11925
Company: Topcon
Configuration: BUT only
Mode: TX
Target: FCC Class B
Voltage: 115VAC / 50 Hz
: L1: Peak (Blue), Average (Green)

LINE 2 RESULTS



Compliance Certification Services
47173 Benicia Street
Fremont, CA 94538
Tel: (510) 771-1000
Fax: (510) 661-0888

Data#: 14 File#: 08J11925.EMI Date: 07-30-2008 Time: 17:04:10



(Line Conduction)

Trace: 12

Ref Trace:

Condition: CISPR CLASS-B
Test Operator:: Chin Pang
Project #: : 08J11925
Company: : Topcon
Configuration: BUT Only
Mode: : TX
Target: : FCC Class B
Voltage: : 115VAC / 50 Hz
: L2: Peak (Blue), Average (Green)

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 × 10 ⁻⁴ <i>f</i> ^{0.5}	6.67 × 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).

CALCULATIONS

Given

$$E = \sqrt{(30 * P * G) / d}$$

and

$$S = E^2 / 3770$$

where

E = Field Strength in Volts/meter

P = Power in Watts

G = Numeric antenna gain

d = Distance in meters

S = Power Density in milliwatts/square centimeter

Combining equations, rearranging the terms to express the distance as a function of the remaining variables, changing to units of Power to mW and Distance to cm, and substituting the logarithmic form of power and gain yields:

$$d = 0.282 * 10^{((P + G) / 20)} / \sqrt{S}$$

where

d = MPE distance in cm

P = Power in dBm

G = Antenna Gain in dBi

S = Power Density Limit in mW/cm²

Rearranging terms to calculate the power density at a specific distance yields

$$S = 0.0795 * 10^{((P + G) / 10)} / (d^2)$$

The power density in units of mW/cm² is converted to units of W/m² by multiplying by a factor of 10.

LIMITS

From FCC §1.1310 Table 1 (B), the maximum value of $S = 1.0 \text{ mW/cm}^2$

From IC Safety Code 6, Section 2.2 Table 5 Column 4, $S = 10 \text{ W/m}^2$

RESULTS

Mode	Band	MPE Distance (cm)	Output Power (dBm)	Antenna Gain (dBi)	FCC Power Density (mW/cm ²)	IC Power Density (W/m ²)
Bluetooth	2.4 GHz	20.0	2.02	2.00	0.0005	0.005

11. CO-LOCATED MAXIMUM PERMISSIBLE EXPOSURE

LIMITS

Per OTE Bulletin 65, for frequency bands with the same MPE limits, the Power Densities produced by each transmitter are summed. The summation must be under the limit for the band.

Per OTE Bulletin 65, for frequency bands with different limits the Power Densities are calculated separately for each band, divided by the limit for the band and the results are then summed. The summation must be less than 1.

RESULTS

Mode	MPE Distance (cm)	Output Power (dBm)	Antenna Gain (dBi)	FCC Power Density (mW/cm ²)	FCC Limit (mW/cm ²)	IC Power Density (mW/cm ²)	IC Limit (mW/cm ²)
Bluetooth	20.0	2.20	2.00	0.00	1.00	0.01	10.00
850 MHz Cell	20.0	31.40	-8.34	0.04	1.00	0.40	10.00
Colocated				0.04	1.00	0.41	10.00