



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

**CERTIFICATION TEST REPORT**

**FOR**

**RADIO HOLDER**

**MODEL NUMBER: RH-1/U**

**FCC ID: LCB-080521  
IC: 6050B-080521**

**REPORT NUMBER: 08J11939-1**

**ISSUE DATE: SEPTEMBER 30, 2008**

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**NVLAP LAB CODE 200065-0**

Revision History

<u>Rev.</u>	<u>Issue Date</u>	<u>Revisions</u>	<u>Revised By</u>
--	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:** RADIO HOLDER

**MODEL:** RH-1/U

**SERIAL NUMBER:** N/A

**DATE TESTED:** JULY 20 to SEPTEMBER 26, 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 equipped with UHF and Bluetooth transceivers. The Bluetooth transceiver operates at the frequency of 2402-2480MHz.

The radio module is manufactured by TAIYO YUDEN.

### 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	0.14	1.03
2402 - 2480	Enhanced 8PSK	1.98	1.58

### 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 firmware installed in the EUT during testing was BTTestTool, rev. 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 evaluated at Y positions.

## 5.6. DESCRIPTION OF TEST SETUP

### SUPPORT EQUIPMENT

PERIPHERAL SUPPORT EQUIPMENT LIST				
Description	Manufacturer	Model	Serial Number	FCC ID
Laptop	HP	Presario F700	CNF7458G3Q	DoC
AC Adapter	HP	PPP009H	F3-07091411250E	N/A
AC Adapter	Topcon	LE-0309ADAP12V300	N/A	N/A

### I/O CABLES

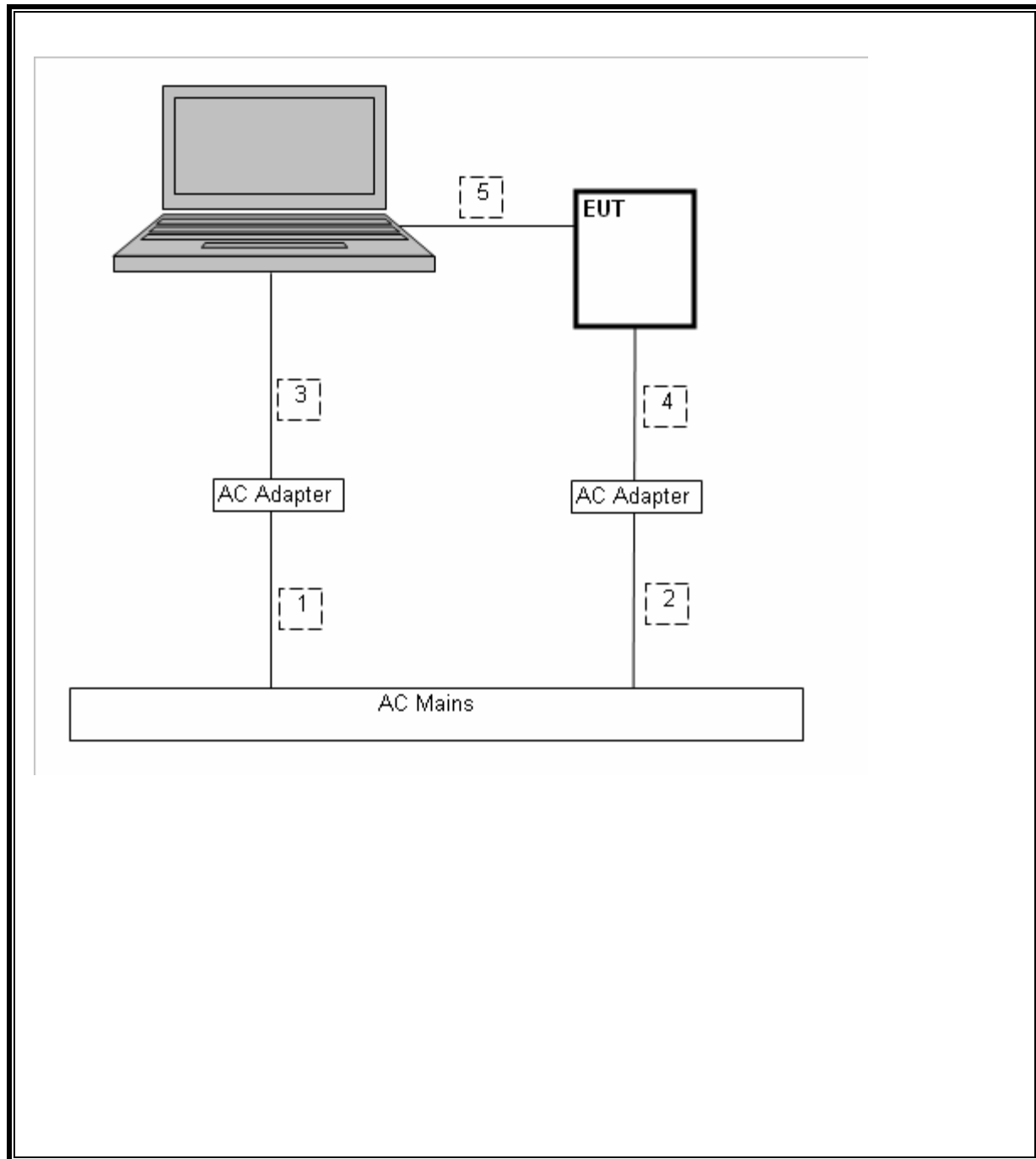
I/O CABLE LIST						
Cable No.	Port	# of Identical Ports	Connector Type	Cable Type	Cable Length	Remarks
1	AC	1	US115	Shielded	1.8m	Laptop
2	AC	1	US115	Un-shielded	1.8m	EUT
3	D C	1	DC	Un-shielded	1.5m	Laptop
4	D C	1	DC	Un-shielded	1m	Ferrite at EUT end
5	Serial	1	DB9	Shielded	2m	USB - Serial adapter

### TEST SETUP

The EUT is connected to a laptop computer via a test JIG and USB to Serial adapter cable during test. 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	06/12/09
RF Filter Section, 2.9 GHz	Agilent / HP	85420E	C00958	06/12/09
Preamplifier, 1300 MHz	Agilent / HP	8447D	C00885	05/09/09
LISN, 30 MHz	FCC	LISN-50/250-25-2	N02625	10/25/08
LISN, 10 kHz ~ 30 MHz	Solar	8012-50-R-24-BNC	N02481	10/25/08
EMI Test Receiver, 30 MHz	R & S	ESHS 20	N02396	01/27/09
Spectrum Analyzer, 44 GHz	Agilent / HP	E4446A	C01012	08/07/08
Antenna, Horn, 18 GHz	ETS	3117	C01006	04/15/09
Preamplifier, 26.5 GHz	Agilent / HP	8449B	C01052	08/03/08
Antenna, Bilog, 2 GHz	Sunol Sciences	JB1	C01011	10/13/08
Peak Power Meter	Agilent / HP	E4416A	C00963	12/02/08
Peak / Average Power Sensor	Agilent	E9327A	C00964	12/02/08
2.4 GHz High Pass Filter	Micro Tronics	BRC13192	N02683	N/A

## 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.

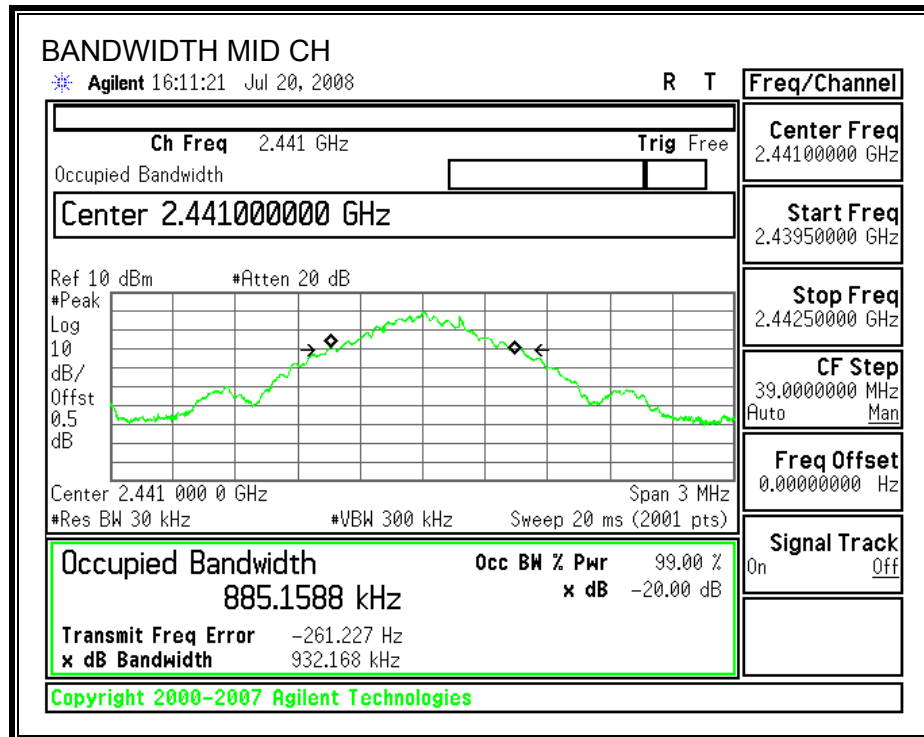
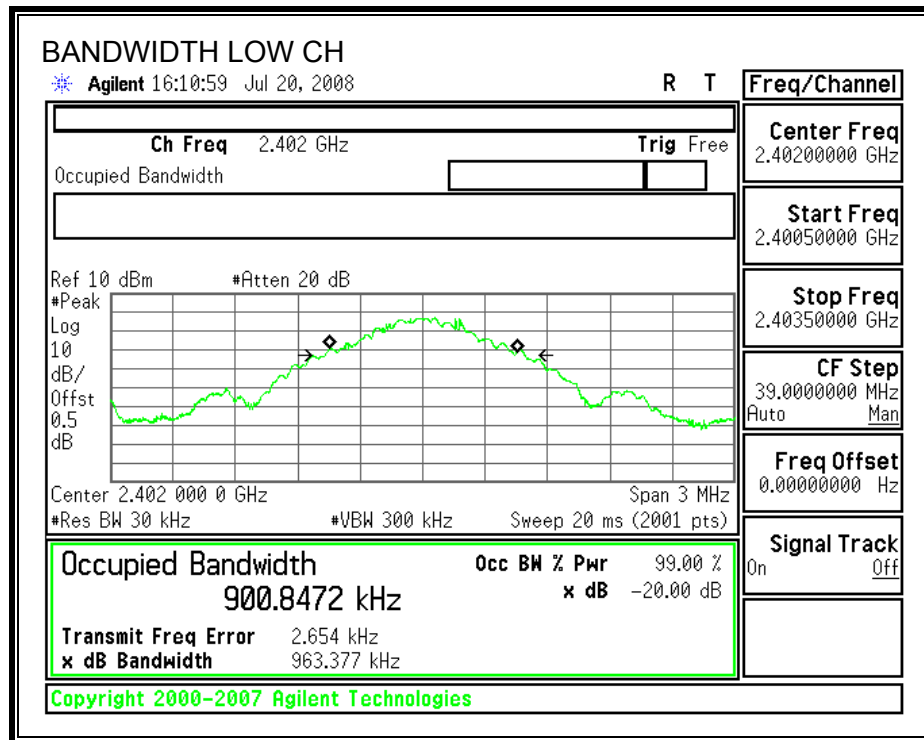
##### TEST PROCEDURE

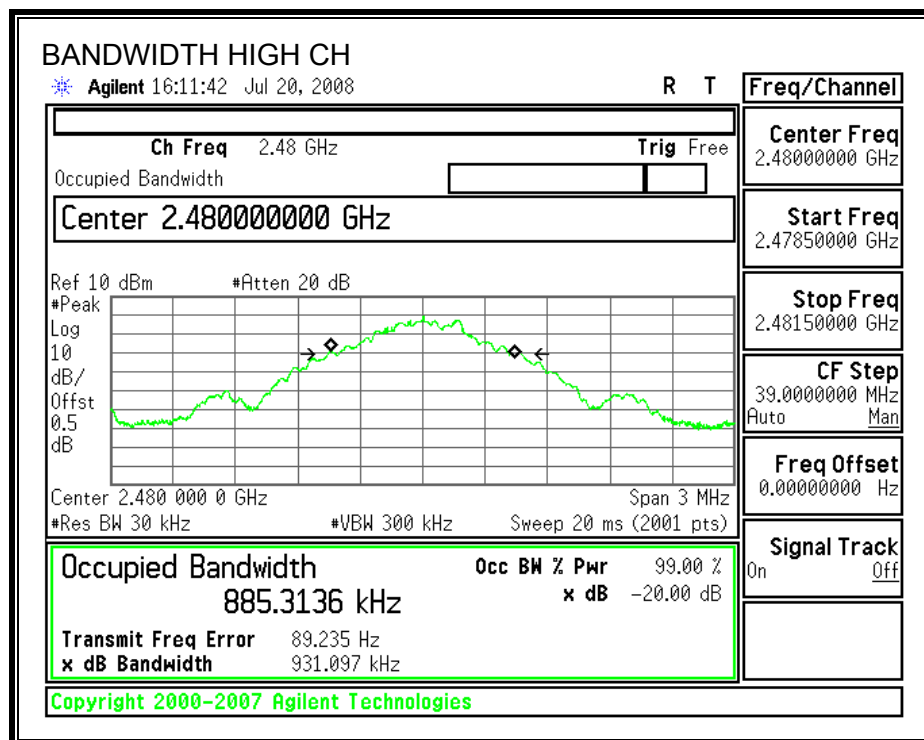
The transmitter output is connected to a spectrum analyzer. The RBW is set to  $\geq 1\%$  of the 20 dB bandwidth. The VBW is set to  $\geq$  RBW. The sweep time is coupled.

##### RESULTS

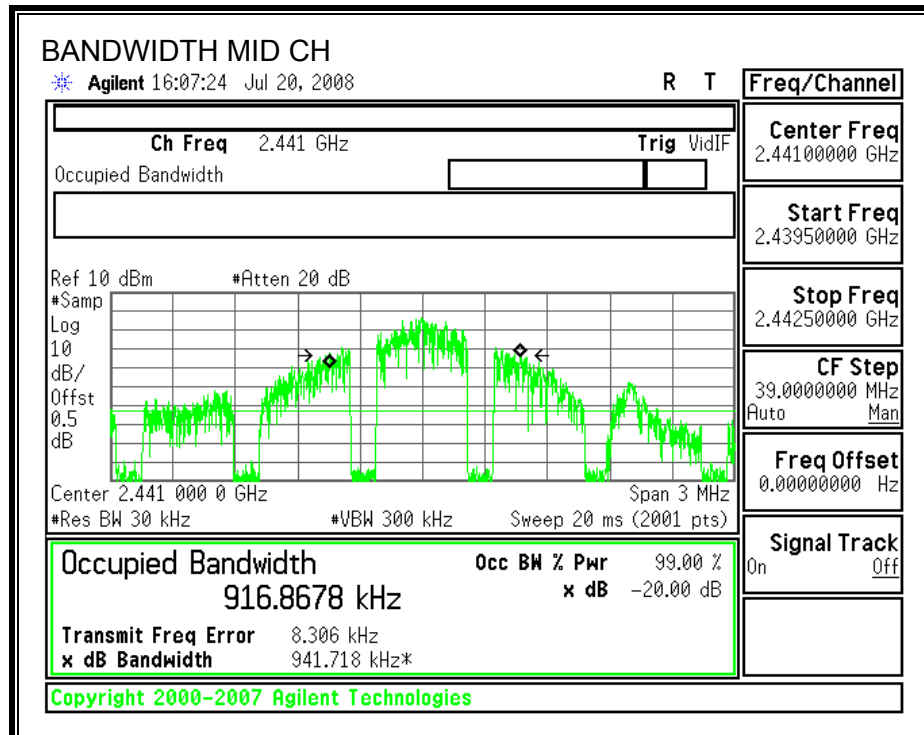
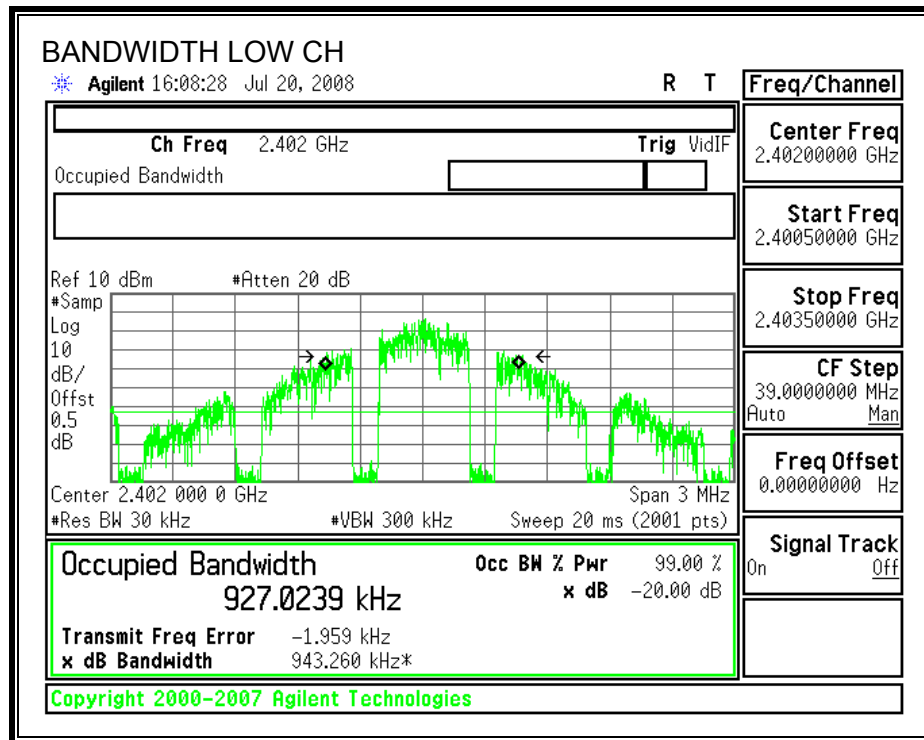
Channel	Frequency (MHz)	20 dB Bandwidth (kHz)	99% Bandwidth (kHz)
Low	2402	963.377	927.0239
Middle	2441	932.168	916.8678
High	2480	931.097	928.7699

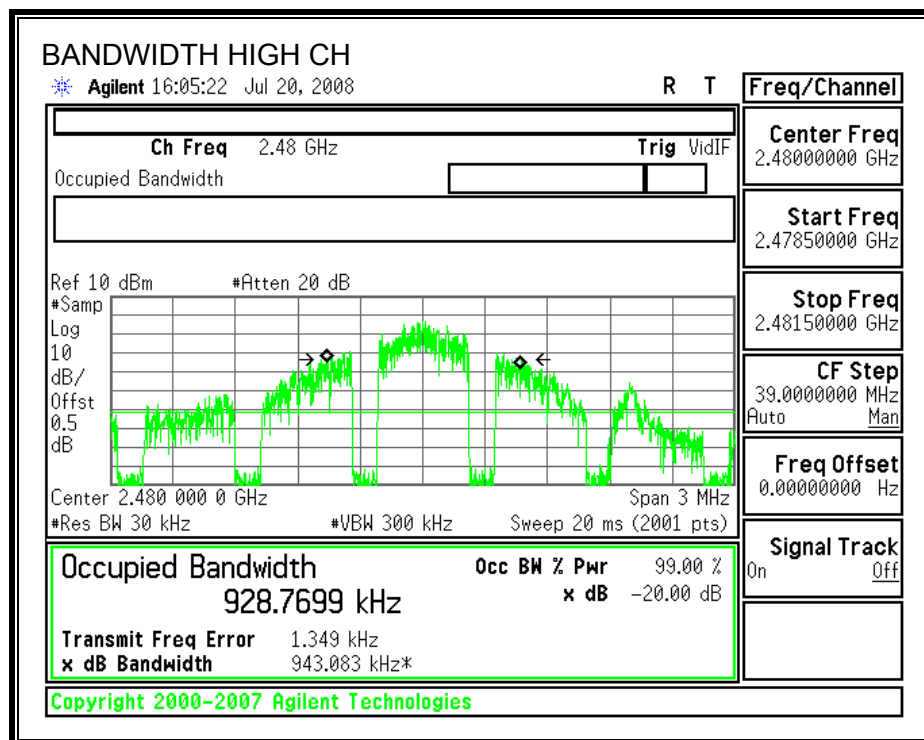
## 20 dB BANDWIDTH





**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.

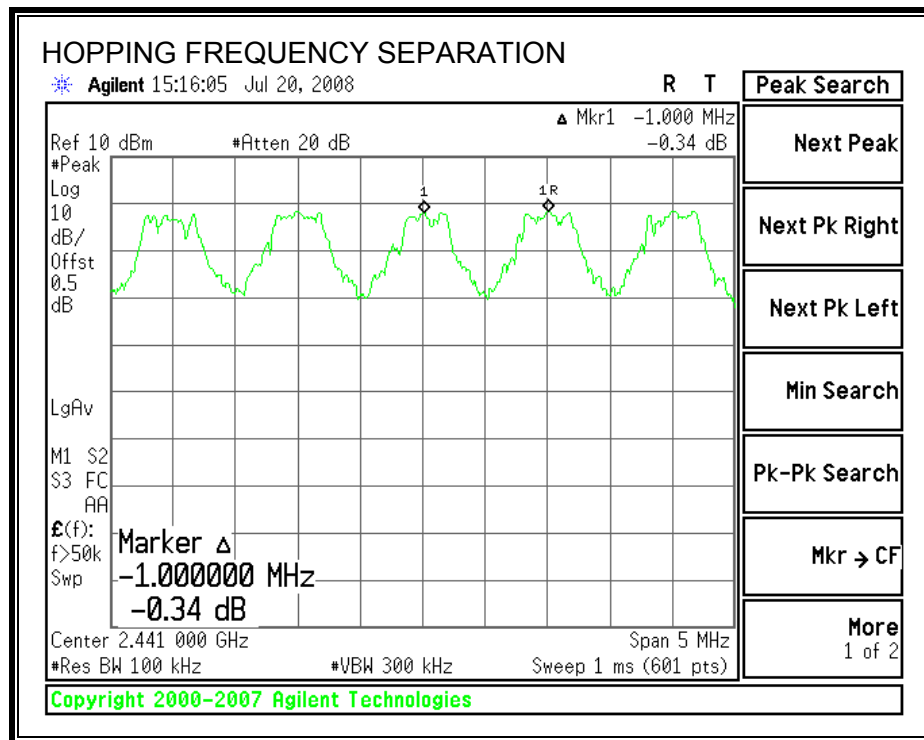
Alternatively, frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than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

### TEST PROCEDURE

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

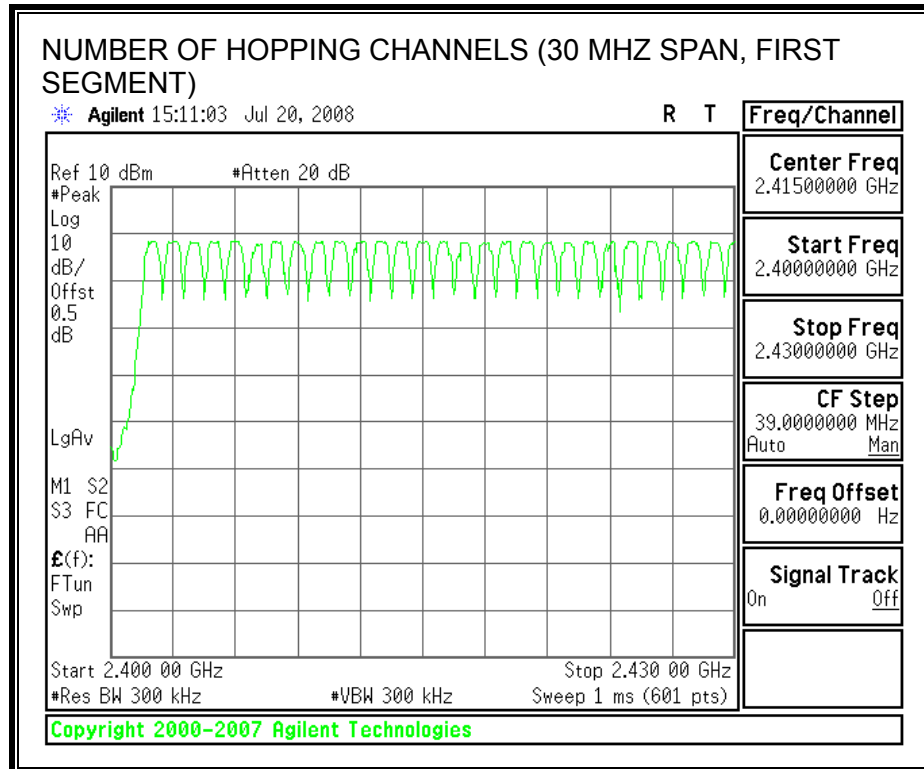
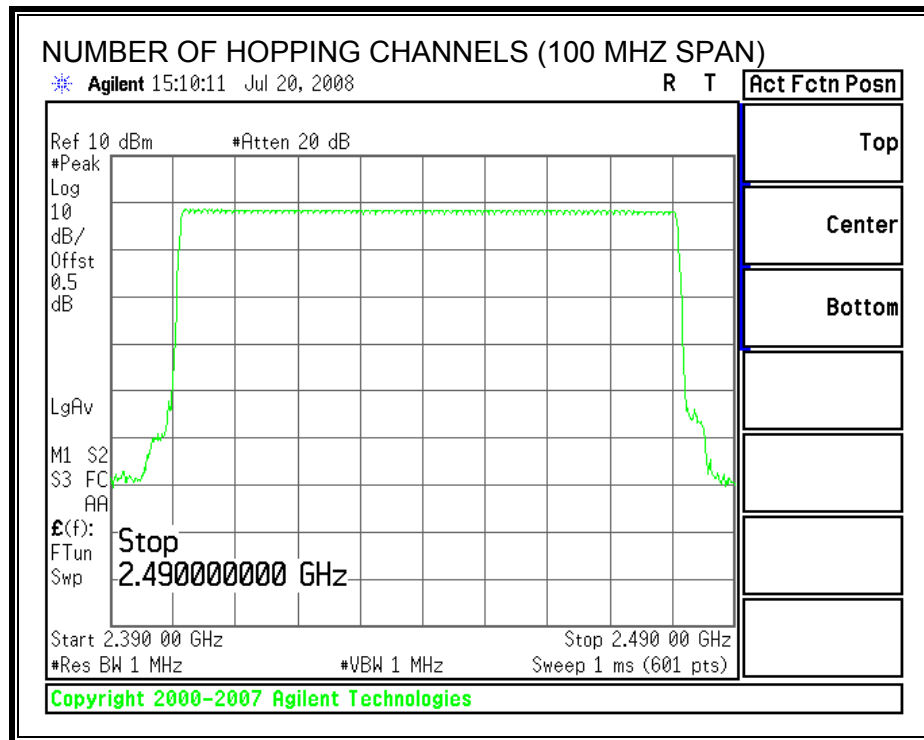
#### **TEST PROCEDURE**

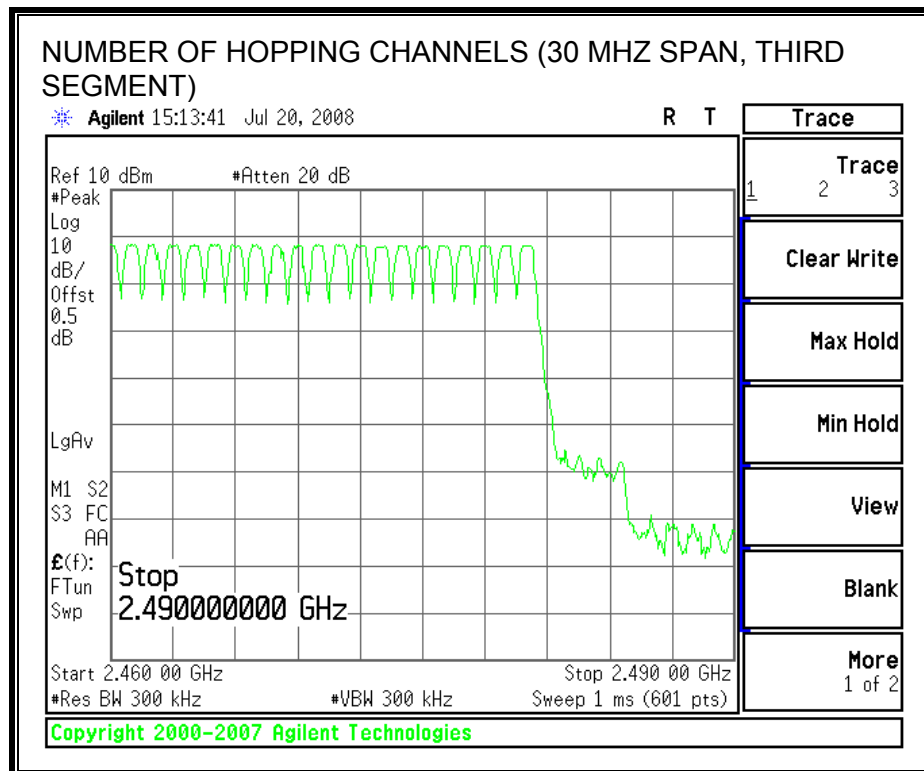
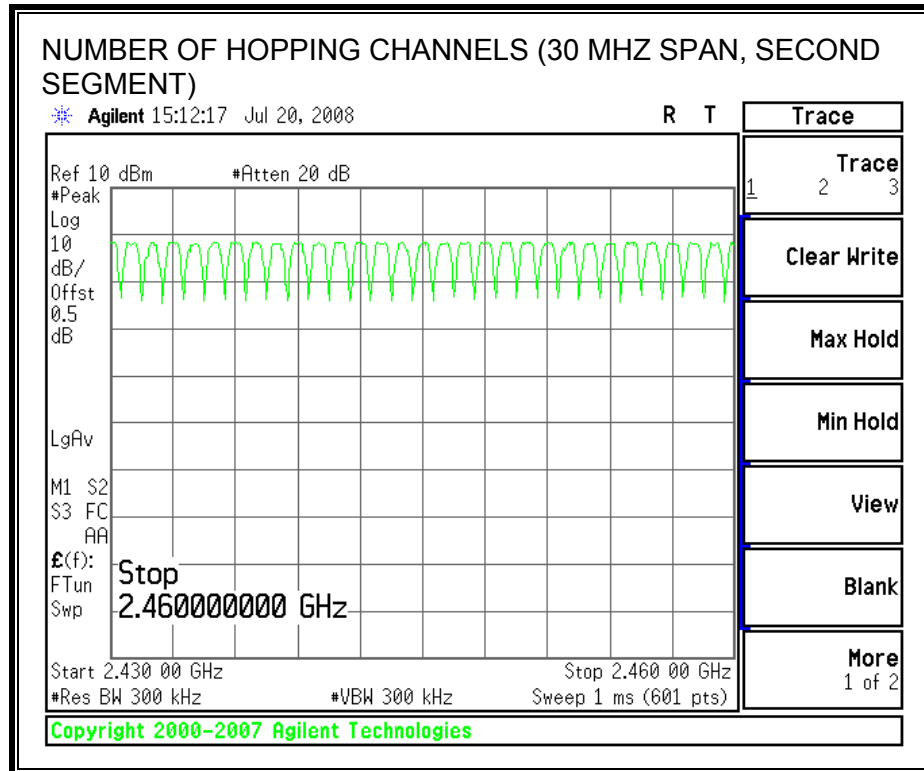
The transmitter output is connected to a spectrum analyzer. The span is set to cover the entire authorized band, in either a single sweep or in multiple contiguous sweeps. The RBW is set to a maximum of 1 % of the span. The analyzer is set to Max Hold.

#### **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.

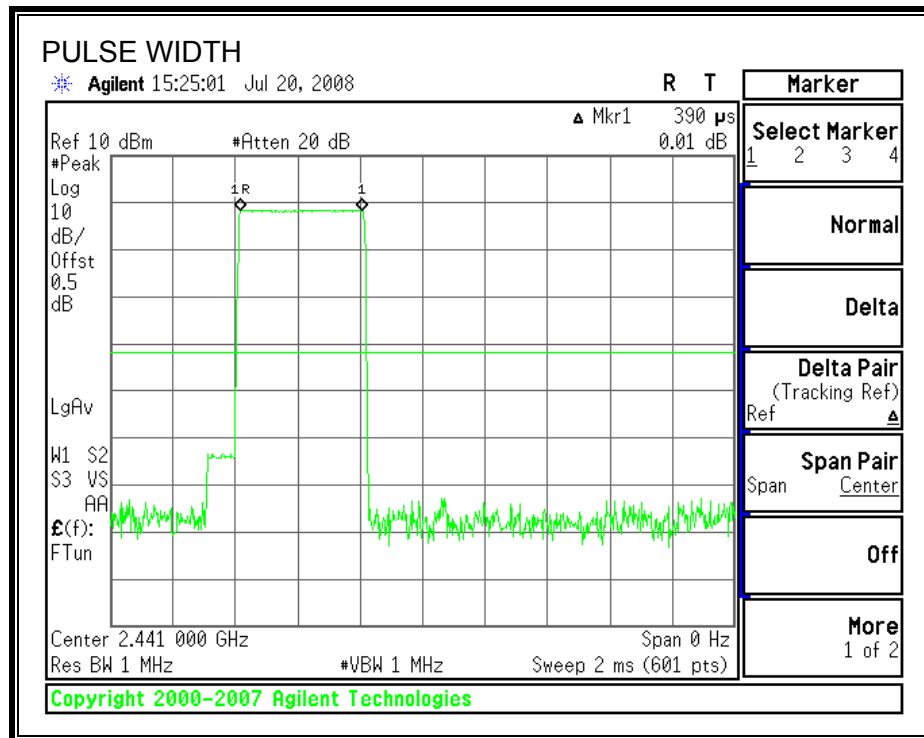
The average time of occupancy in the specified 31.6 second period (79 channels \* 0.4 s) is equal to  $10 * (\# \text{ of pulses in } 3.16 \text{ s}) * \text{pulse width}$ .

##### RESULTS

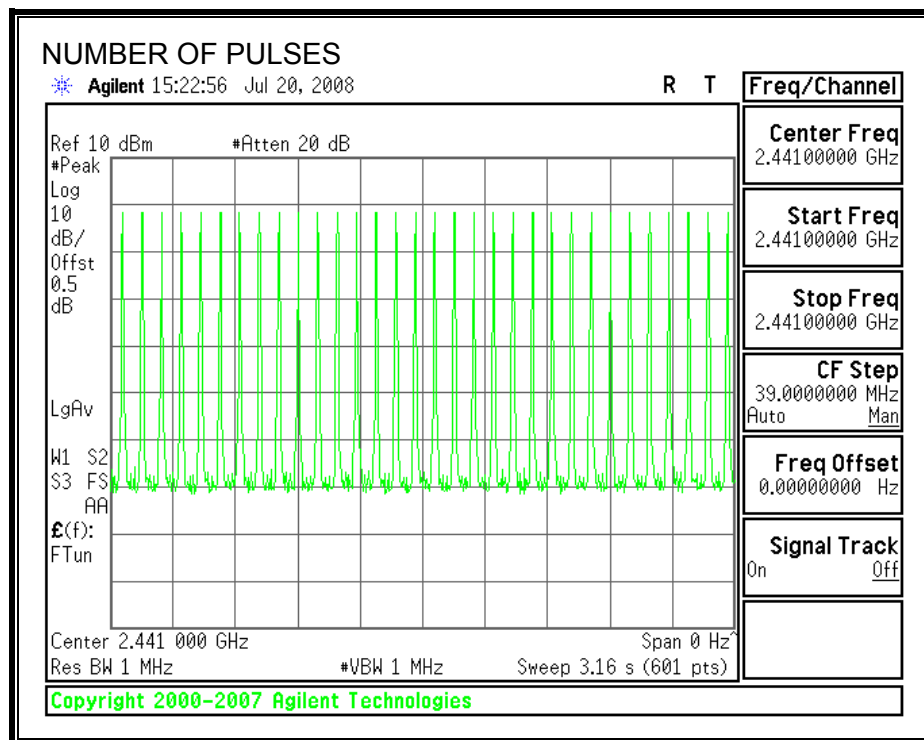
DH Packet	Pulse Width (msec)	Number of Pulses in 3.16 seconds	Average Time of (sec)	Limit (sec)	Margin (sec)
DH1	0.39	32	0.125	0.4	0.275
DH3	1.65	16	0.264	0.4	0.136
DH5	2.895	10	0.290	0.4	0.111

# DH1

## PULSE WIDTH

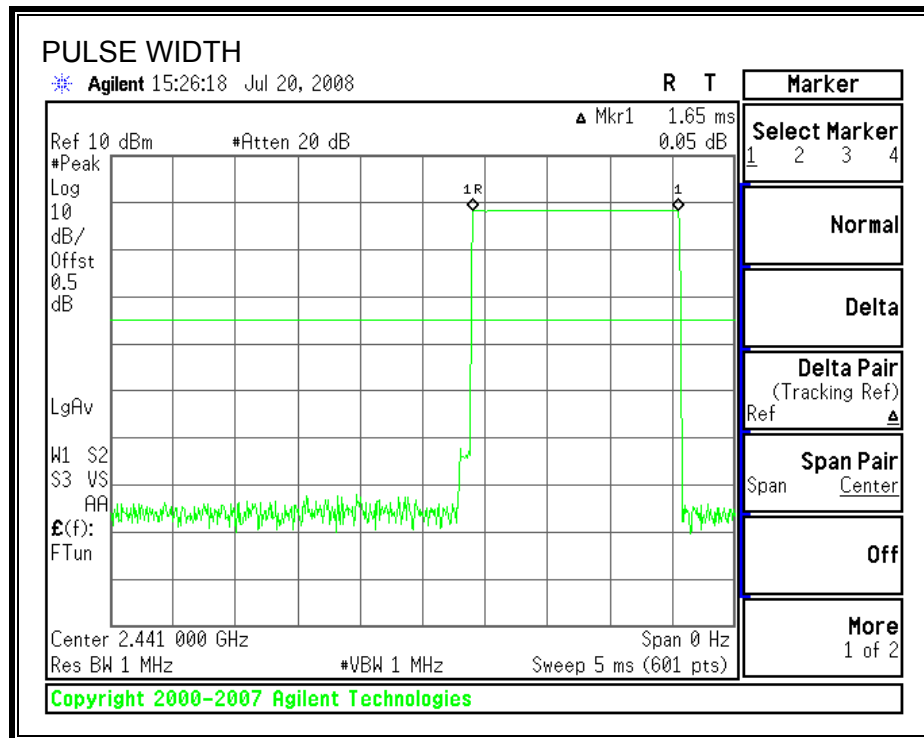


## NUMBER OF PULSES IN 3.16 SECOND OBSERVATION PERIOD

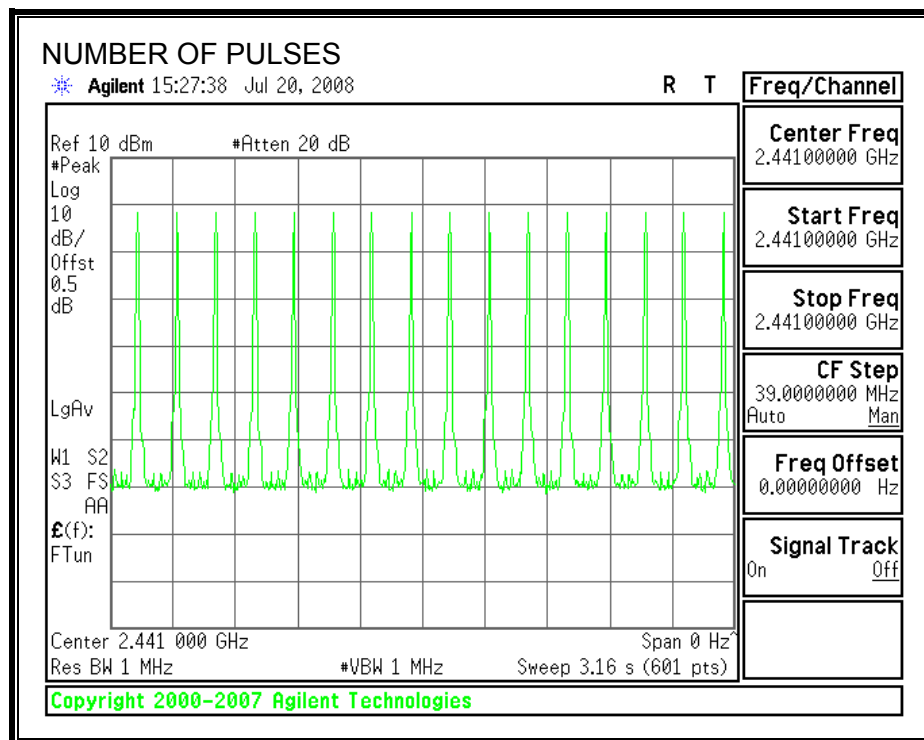


### DH3

#### PULSE WIDTH

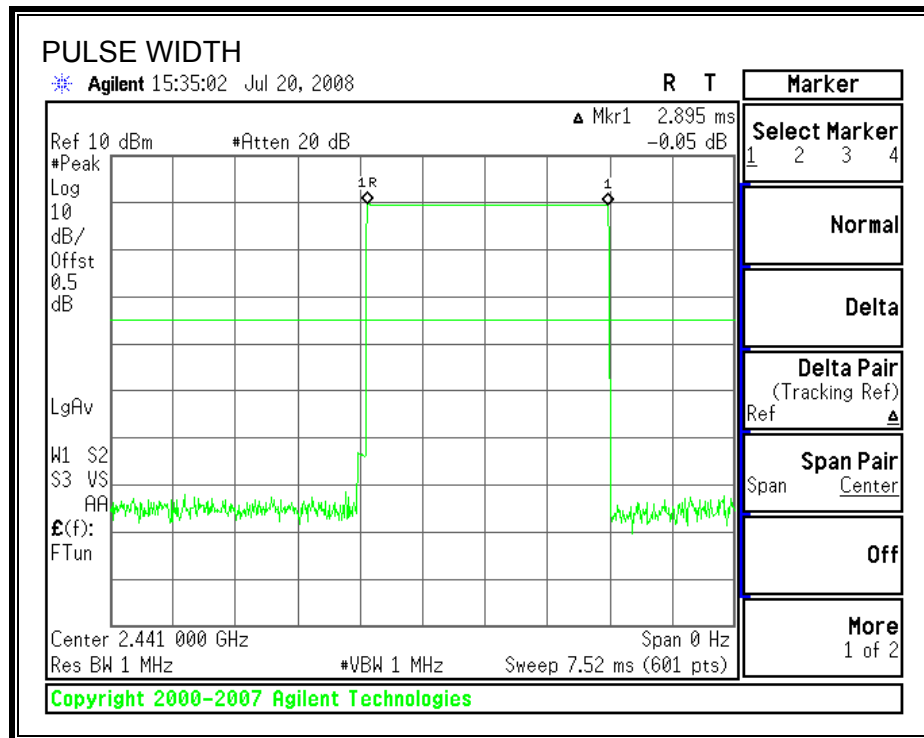


#### NUMBER OF PULSES IN 3.16 SECOND OBSERVATION PERIOD

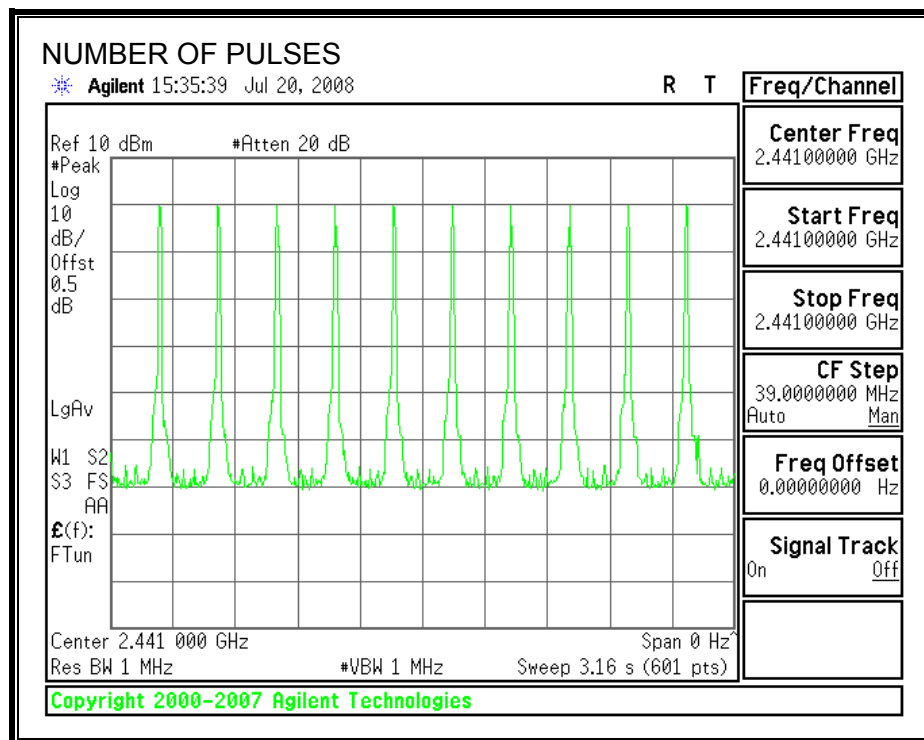


## DH5

### 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

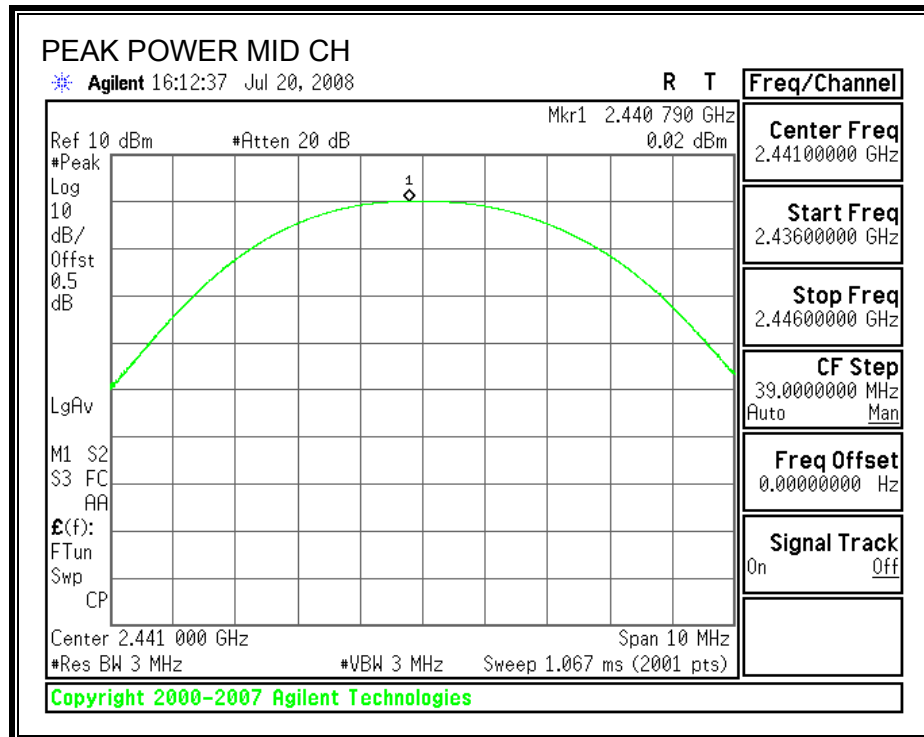
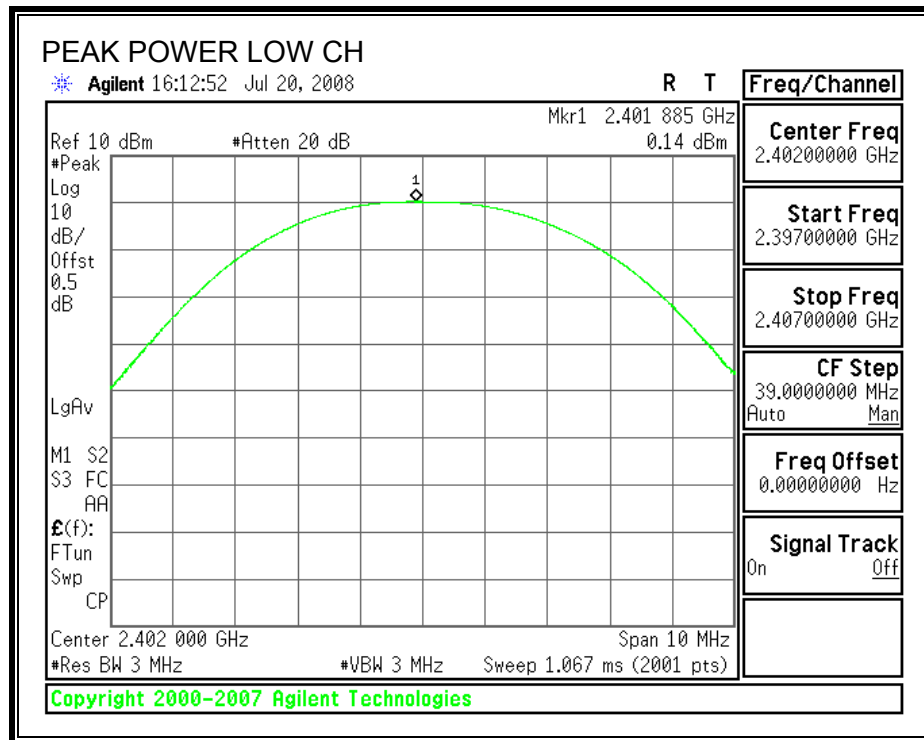
The transmitter output is connected to a spectrum analyzer the analyzer bandwidth is set to a value greater than the 20 dB bandwidth of the EUT.

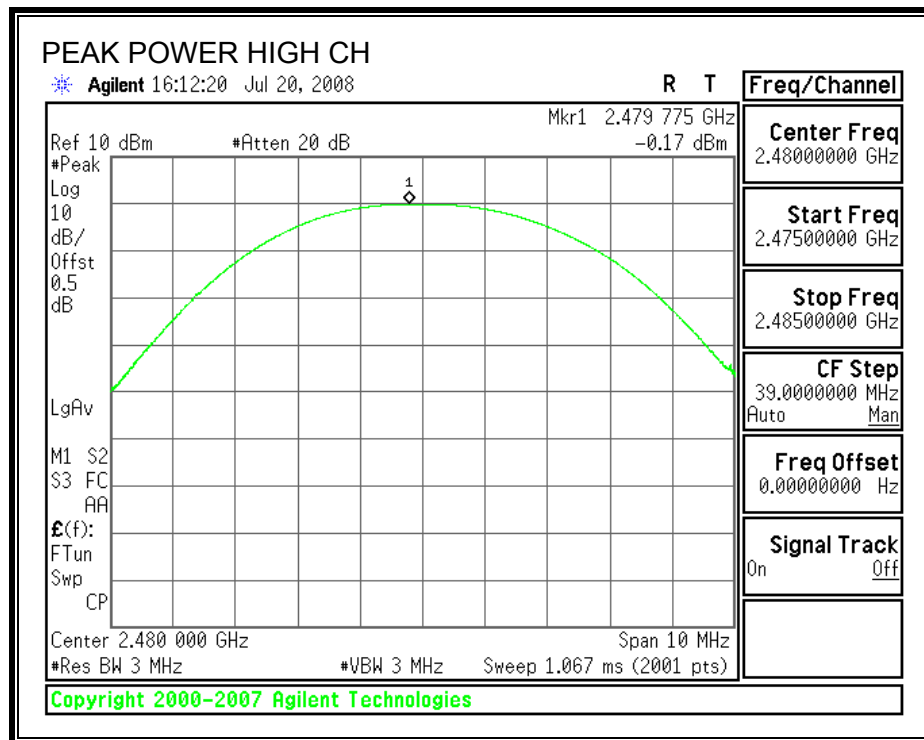
#### RESULTS

Channel	Frequency (MHz)	Output Power (dBm)	Limit (dBm)	Margin (dB)
Low	2402	0.14	30	-29.86
Middle	2441	0.02	30	-29.98
High	2480	-0.17	30	-30.17



## 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 0.5 dB (including 0 dB pad and 0.5 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	-0.14
Middle	2441	-0.28
High	2480	-0.61

### **7.1.7. CONDUCTED SPURIOUS EMISSIONS**

#### **LIMITS**

FCC §15.247 (d)

IC RSS-210 A8.5

Limit = -20 dBc

#### **TEST PROCEDURE**

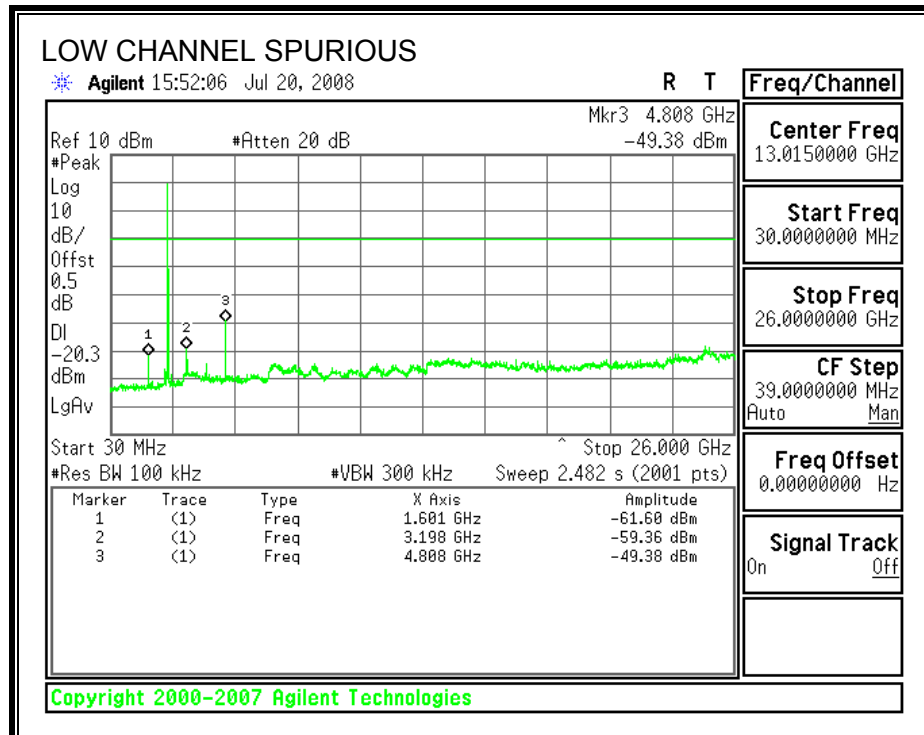
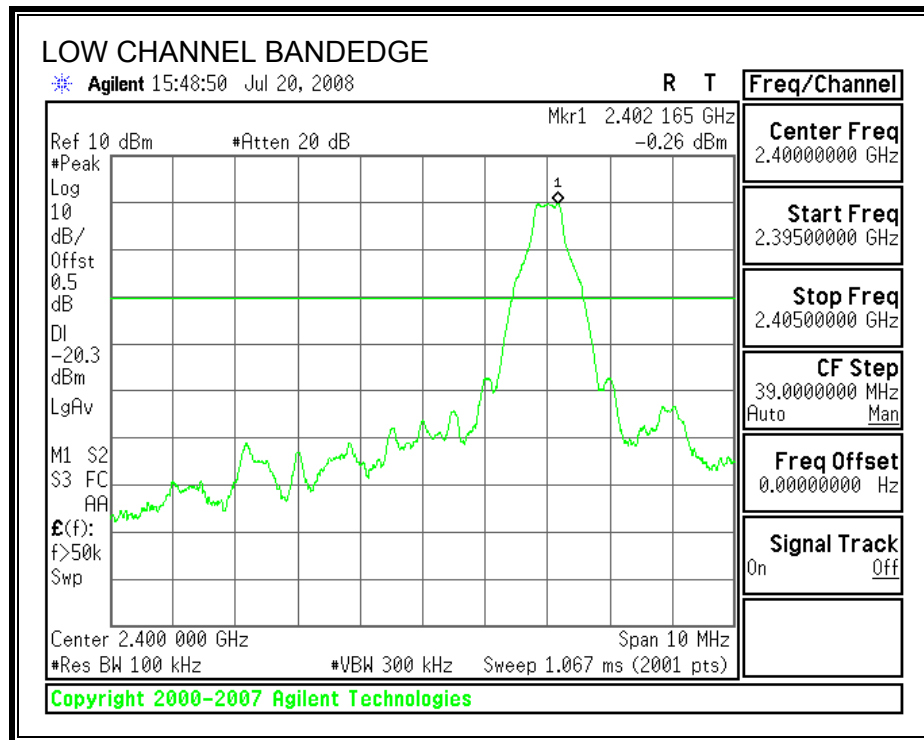
The transmitter output is connected to a spectrum analyzer. The resolution bandwidth is set to 100 kHz. The video bandwidth is set to 300 kHz.

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

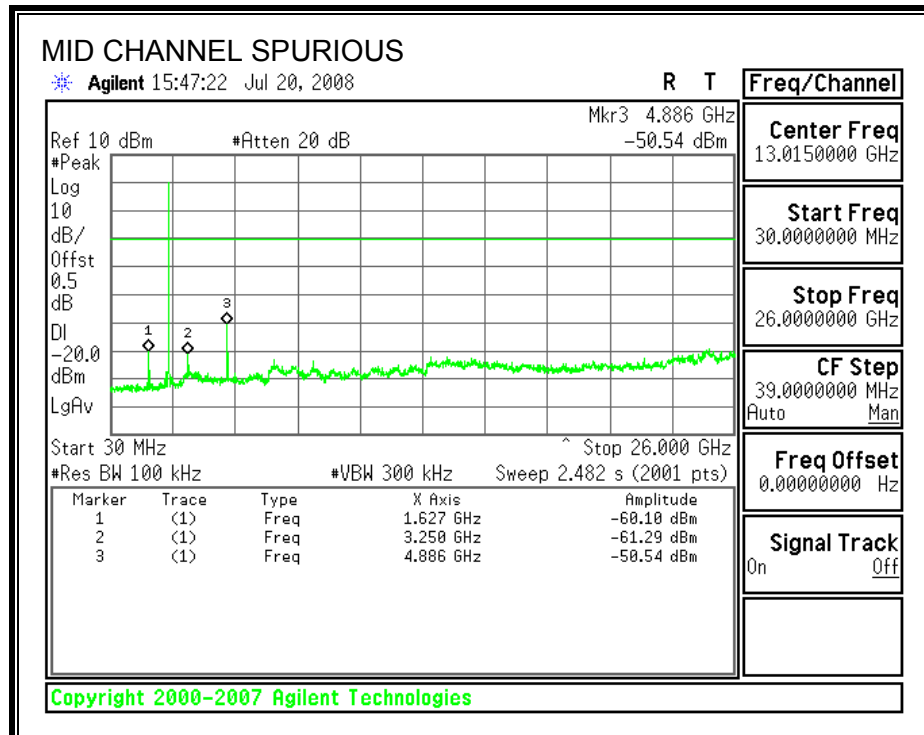
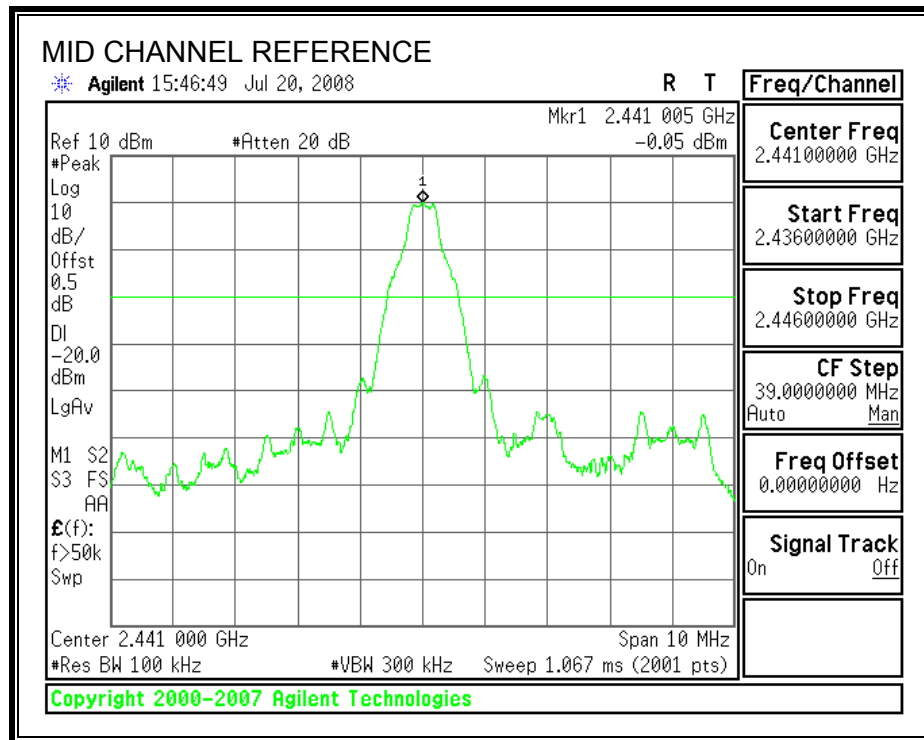
The bandedges at 2.4 and 2.4835 GHz are investigated with the transmitter set to the normal hopping mode.

#### **RESULTS**

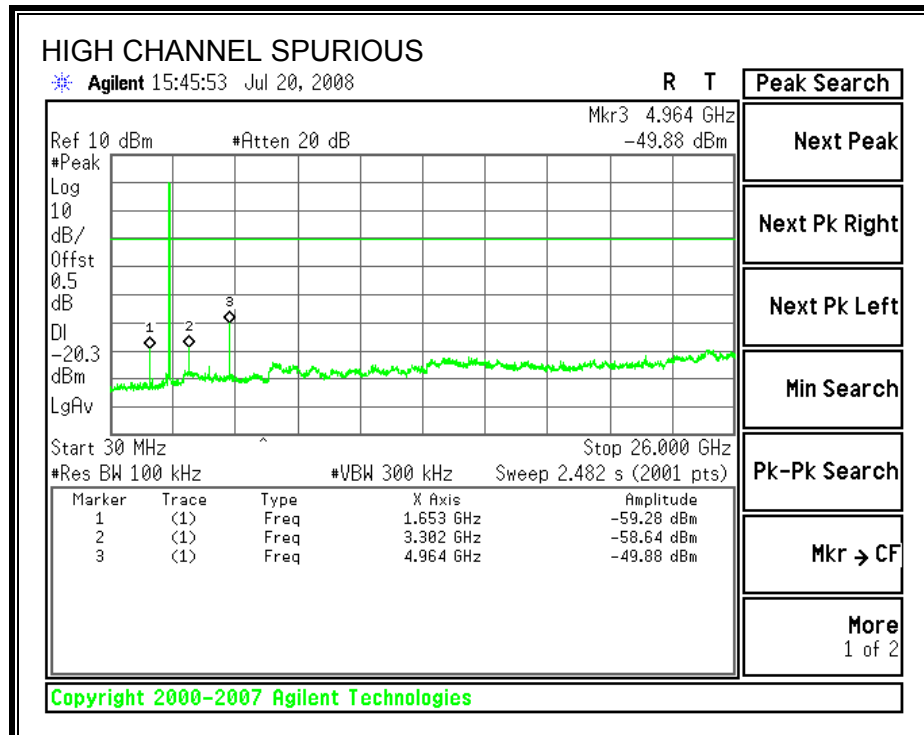
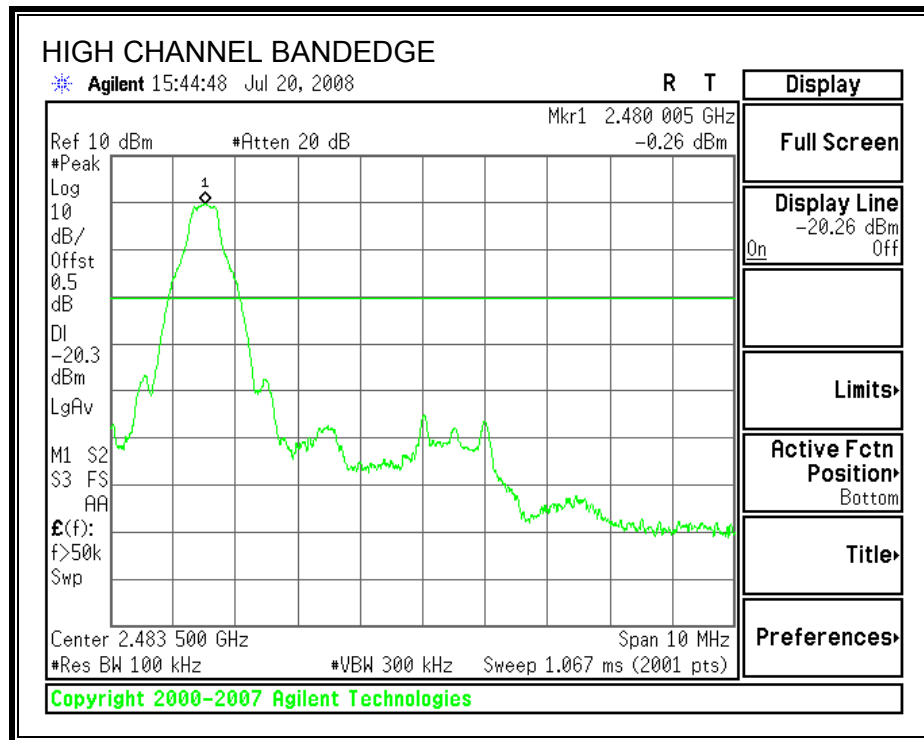
# **SPURIOUS EMISSIONS, LOW CHANNEL**



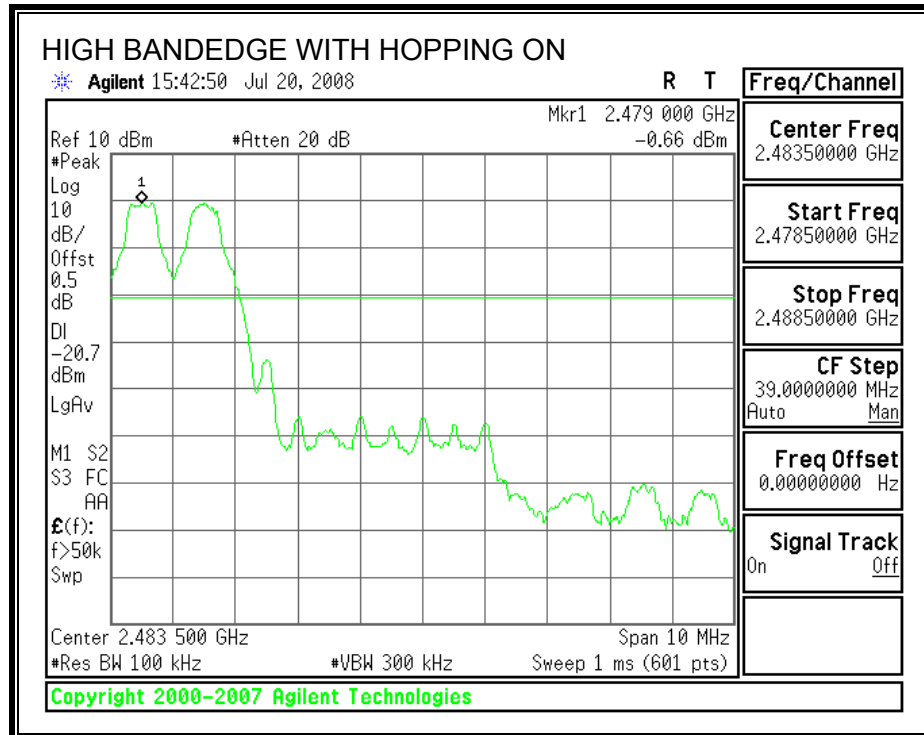
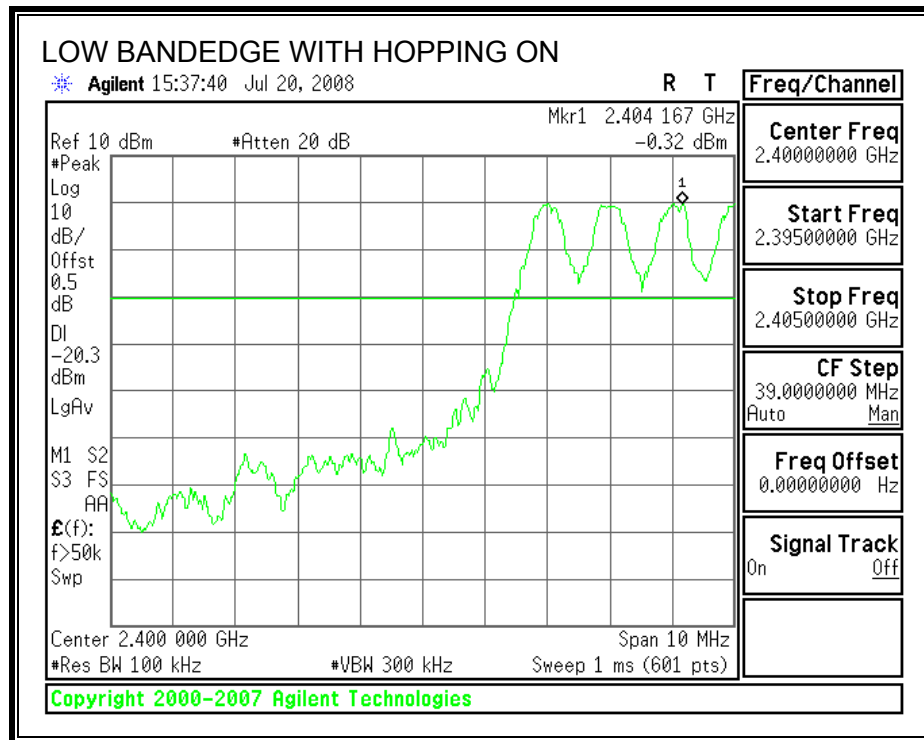
# **SPURIOUS EMISSIONS, MID CHANNEL**



# **SPURIOUS EMISSIONS, HIGH CHANNEL**



# **SPURIOUS BANEDGE 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.

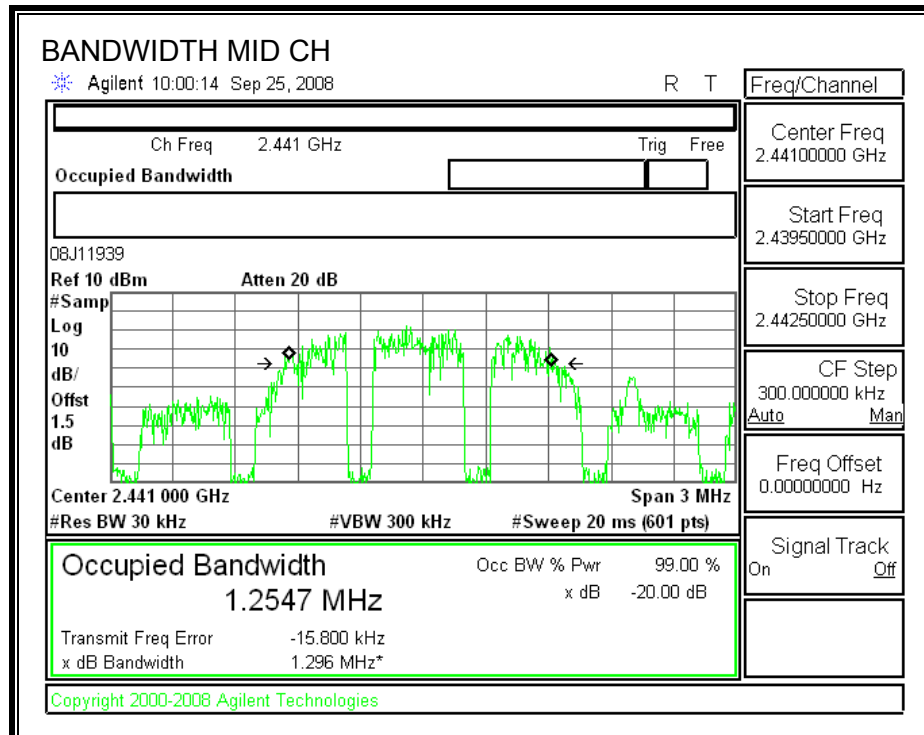
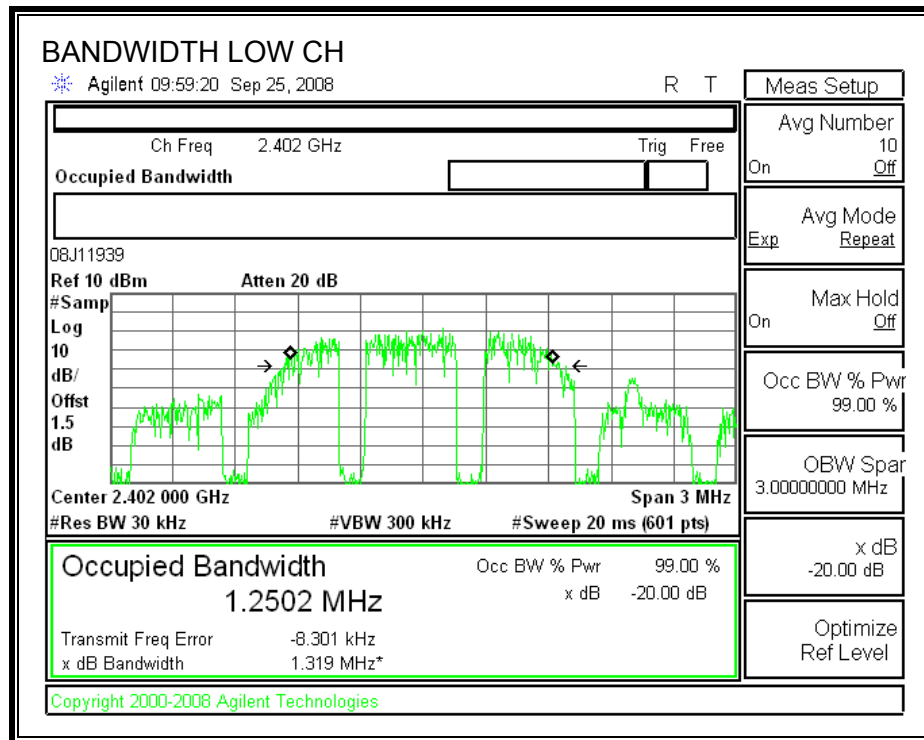
#### TEST PROCEDURE

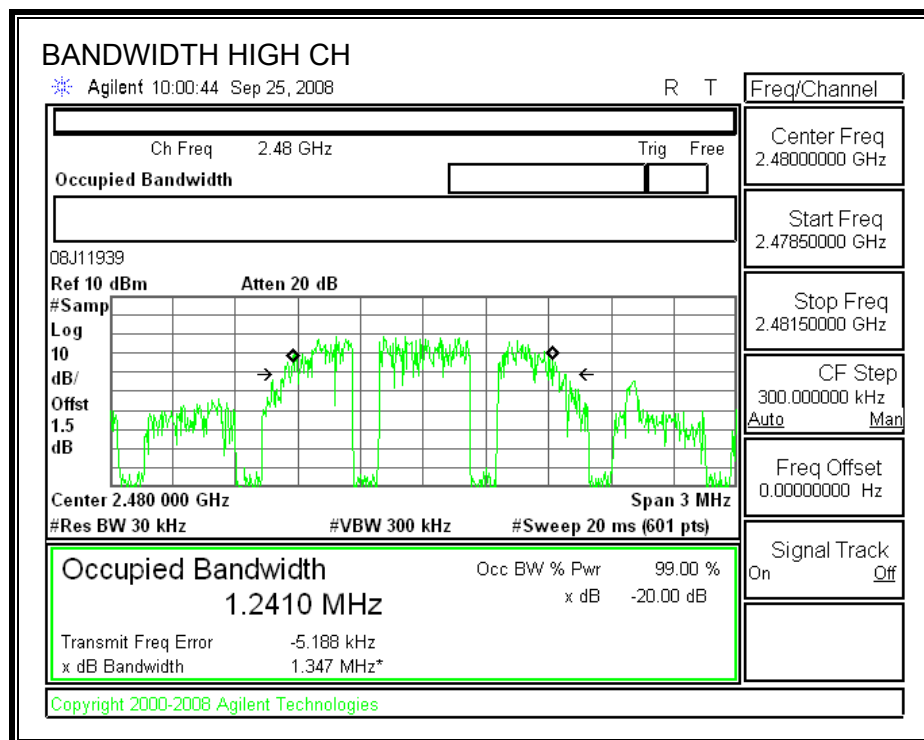
The transmitter output is connected to a spectrum analyzer. The RBW is set to  $\geq 1\%$  of the 20 dB bandwidth. The VBW is set to  $\geq$  RBW. The sweep time is coupled.

#### RESULTS

Channel	Frequency (MHz)	20 dB Bandwidth (kHz)	99% Bandwidth (kHz)
Low	2402	1319.0	1250.2
Middle	2441	1296.0	1254.7
High	2480	1347.0	1241.0

**20 dB & 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.

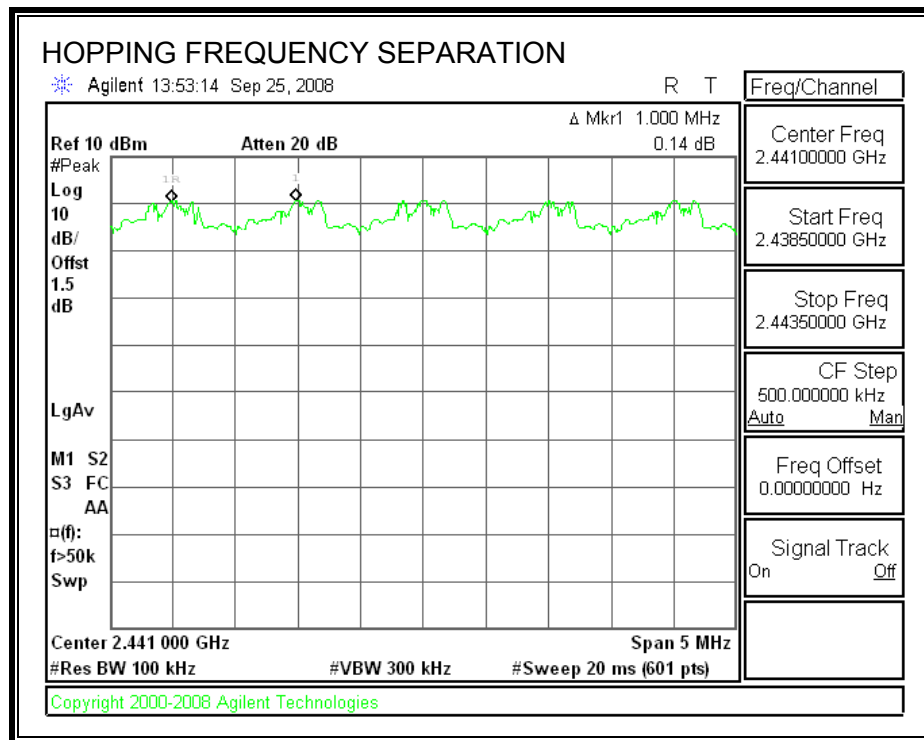
Alternatively, frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than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

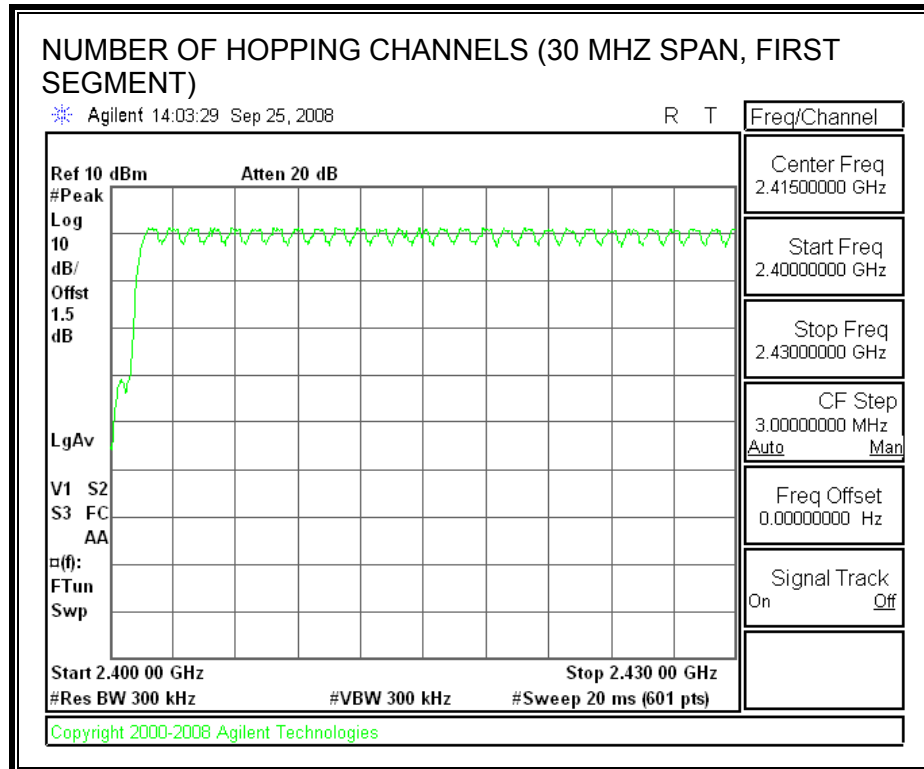
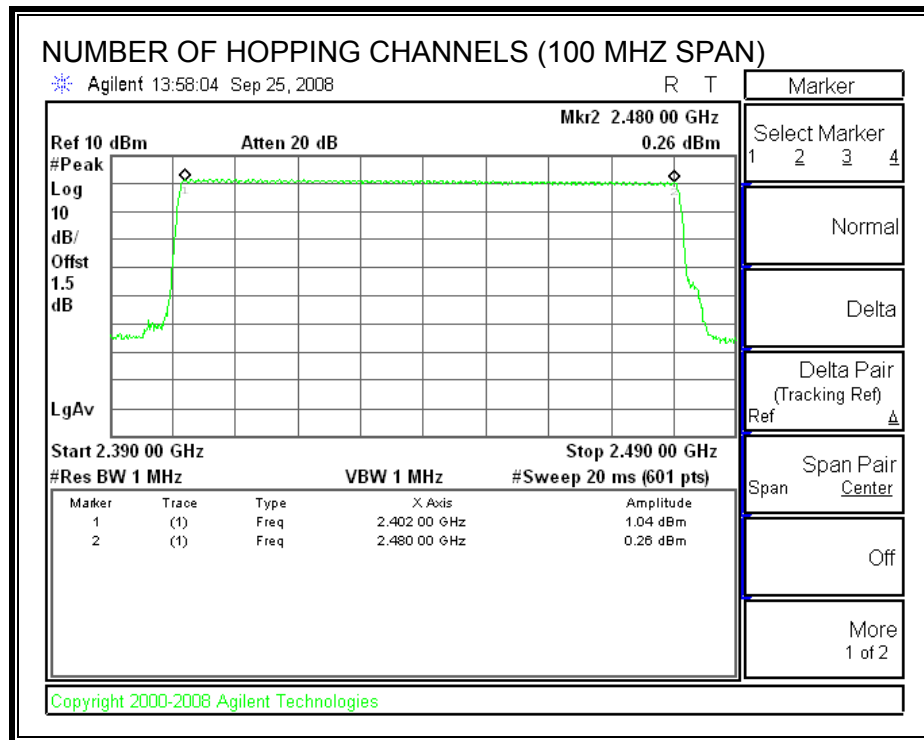
#### **TEST PROCEDURE**

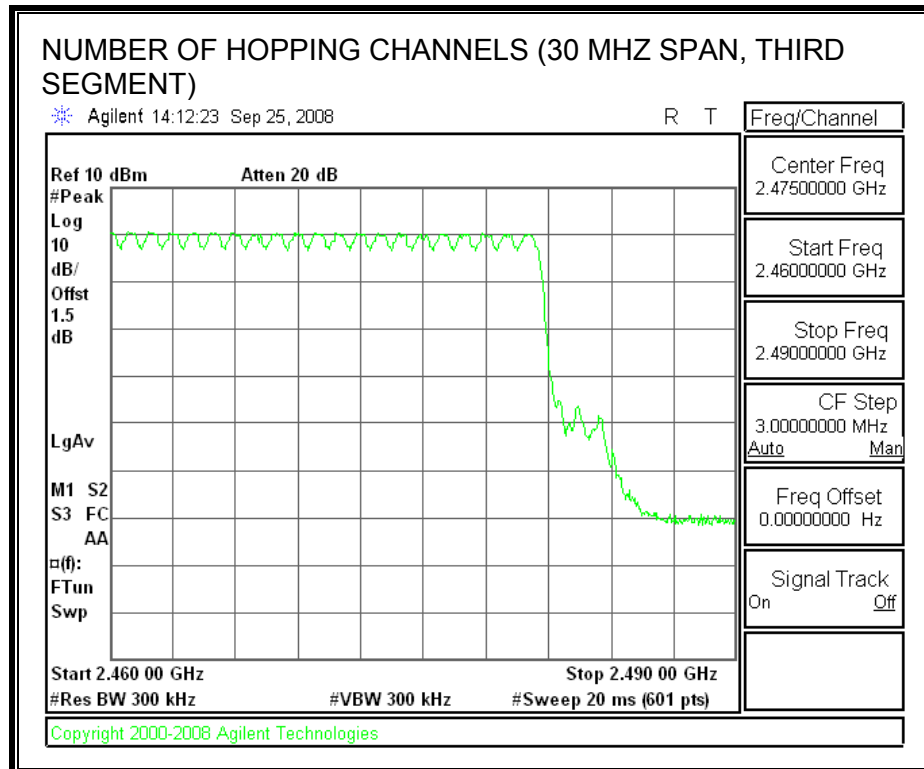
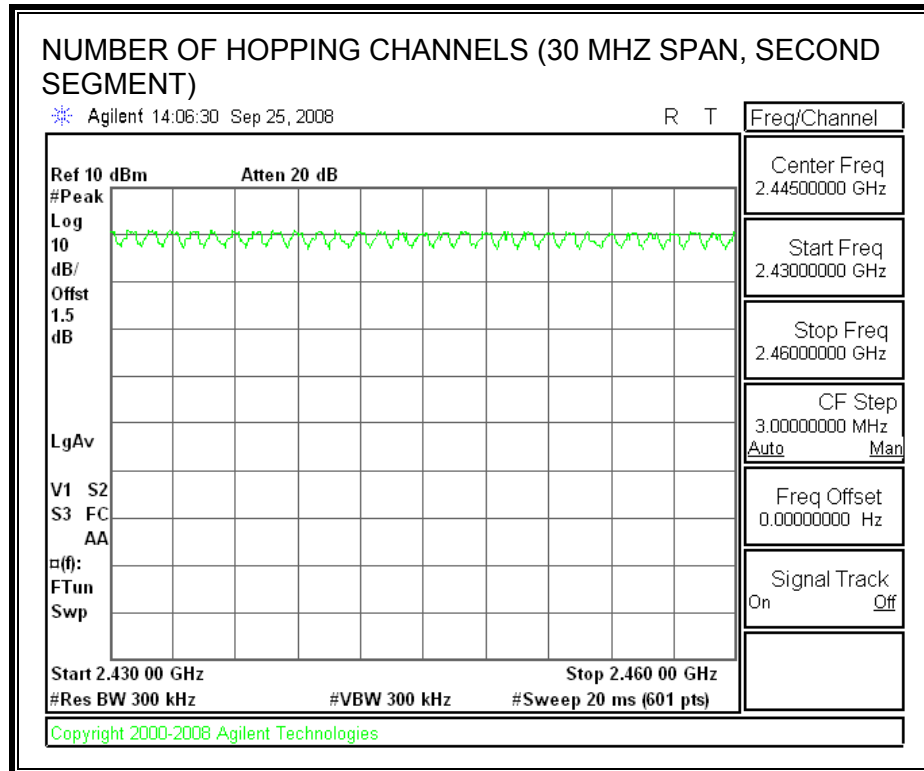
The transmitter output is connected to a spectrum analyzer. The span is set to cover the entire authorized band, in either a single sweep or in multiple contiguous sweeps. The RBW is set to a maximum of 1 % of the span. The analyzer is set to Max Hold.

#### **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  $10 * (\# \text{ of pulses in } 3.16 \text{ s}) * \text{pulse width}$ .

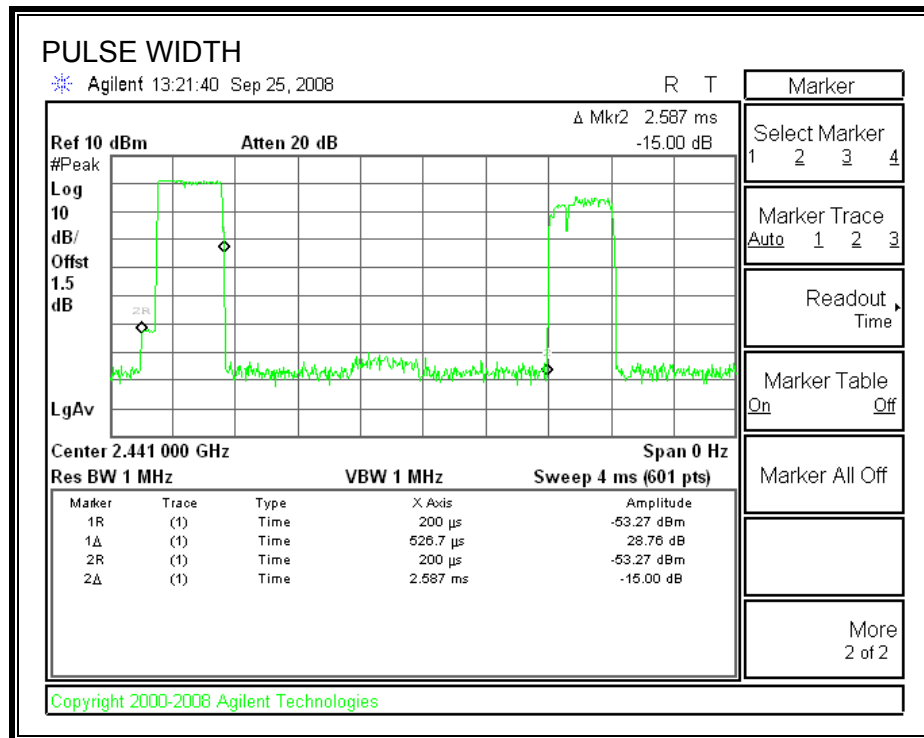
### RESULTS

DH Packet	Pulse Width (msec)	Number of Pulses in 3.16 seconds	Average Time of (sec)	Limit (sec)	Margin (sec)
DH1	0.527	32	0.169	0.4	0.231
DH3	1.73	16	0.277	0.4	0.123
DH5	3.033	11	0.334	0.4	0.066

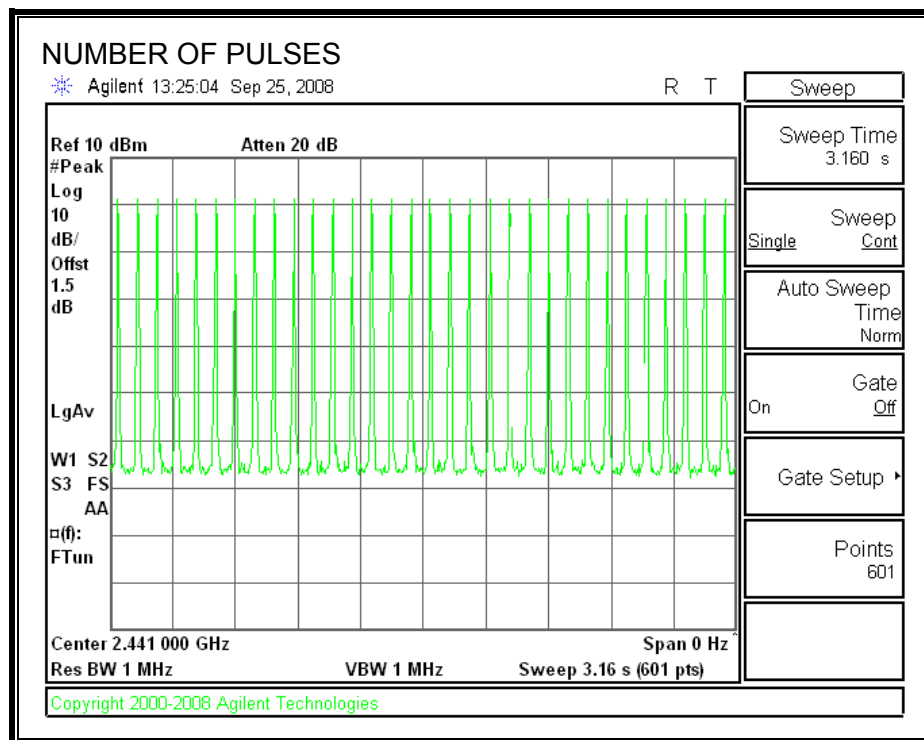


DH1

**PULSE WIDTH**

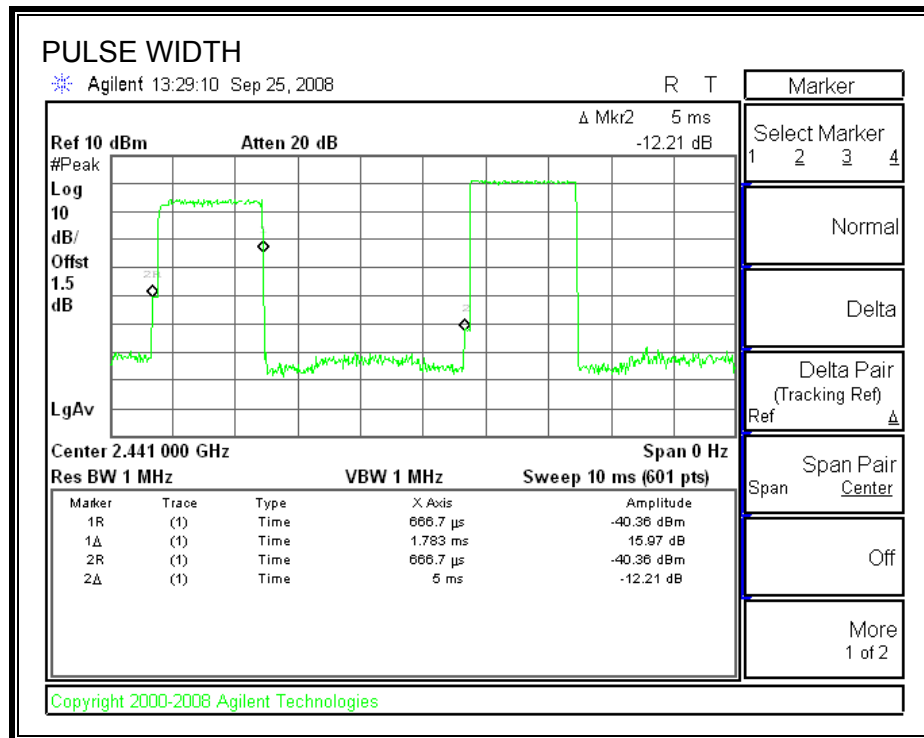


**NUMBER OF PULSES IN 3.16 SECOND OBSERVATION PERIOD**

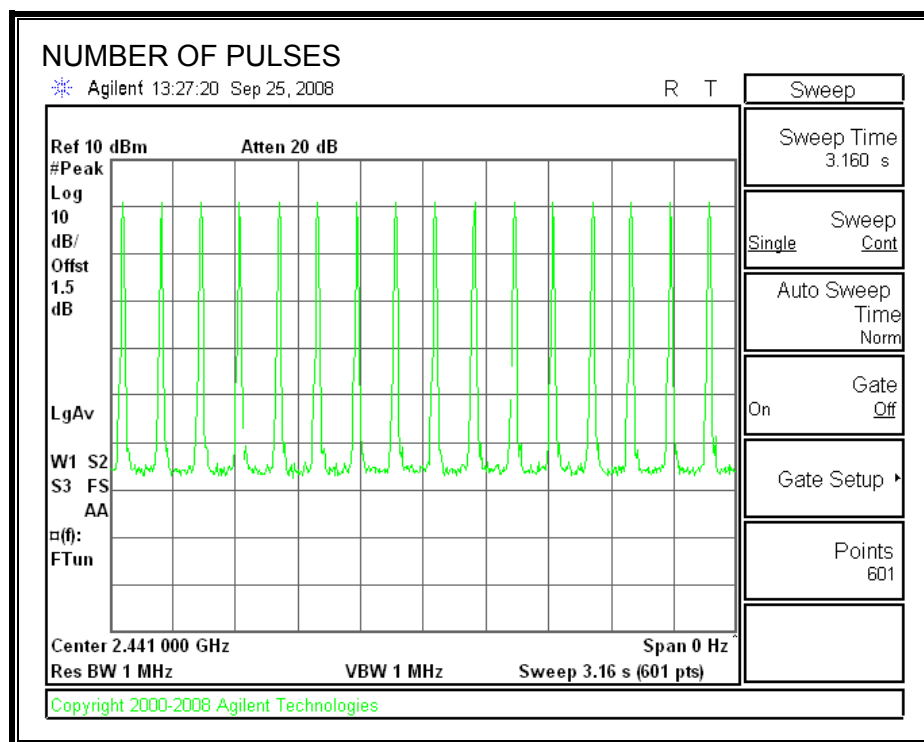


'DH3

### PULSE WIDTH

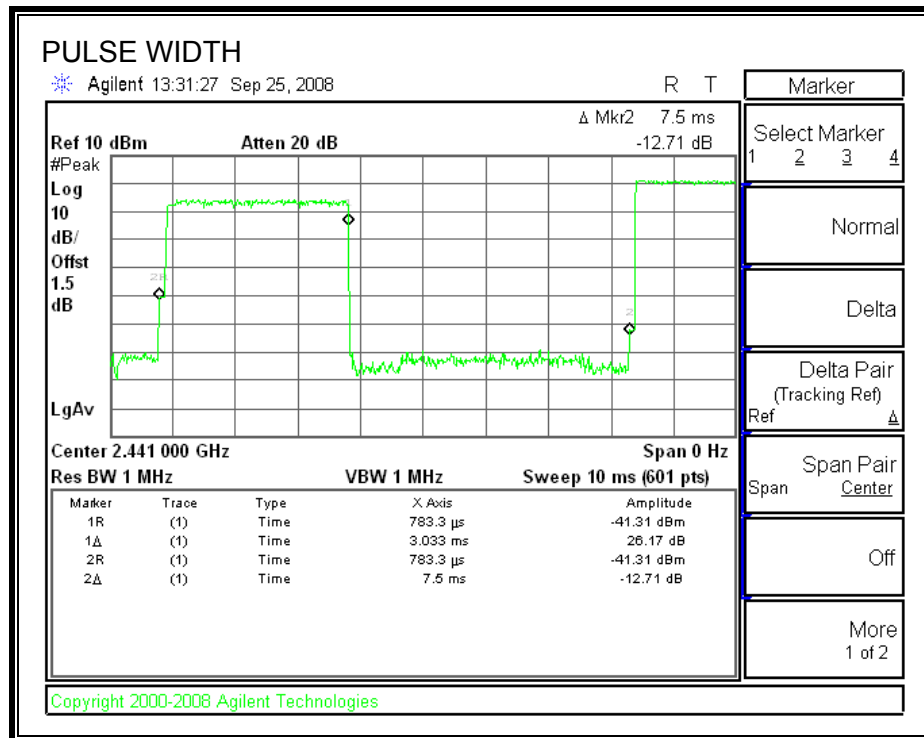


### NUMBER OF PULSES IN 3.16 SECOND OBSERVATION PERIOD

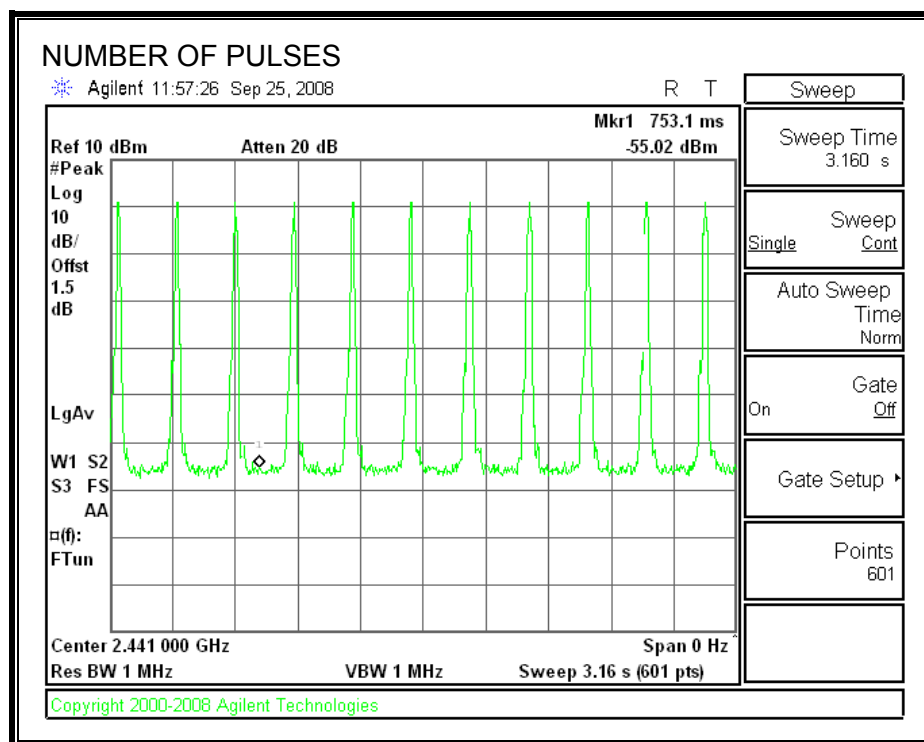


DH5

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

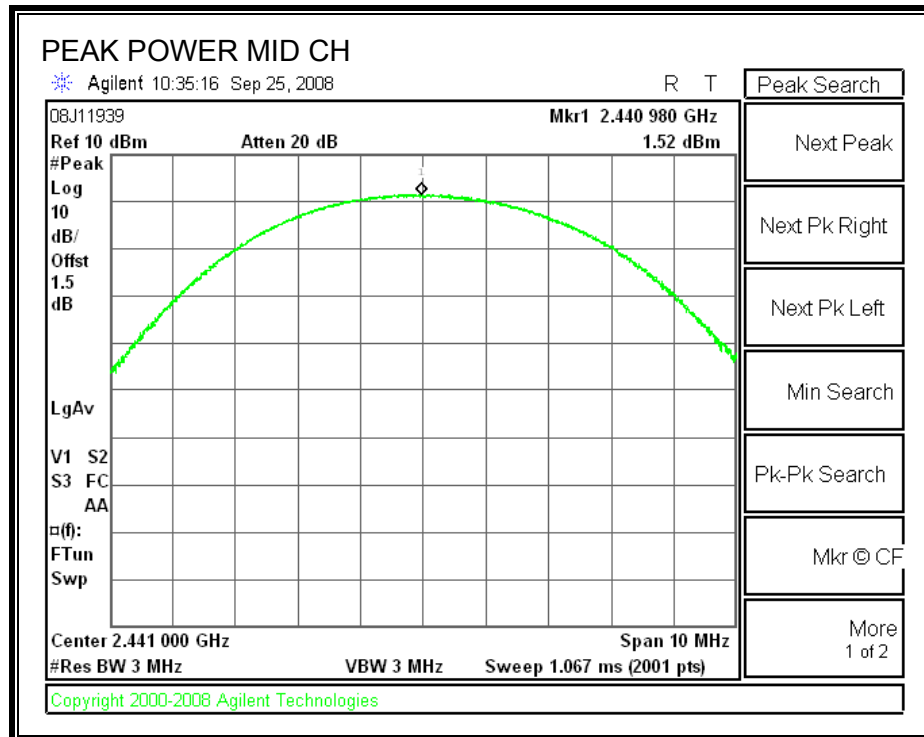
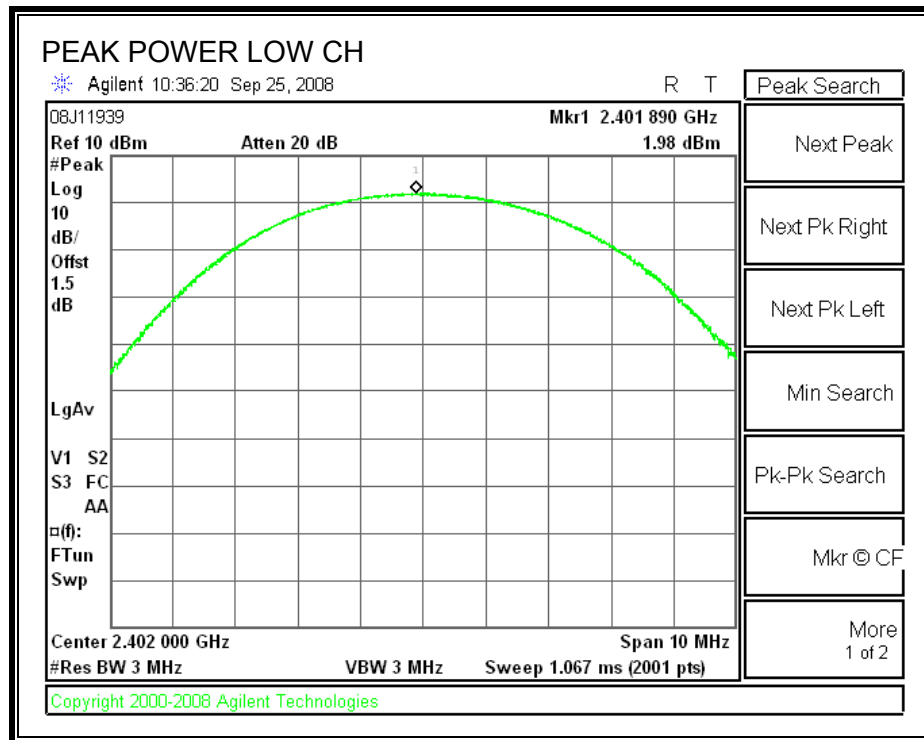
### TEST PROCEDURE

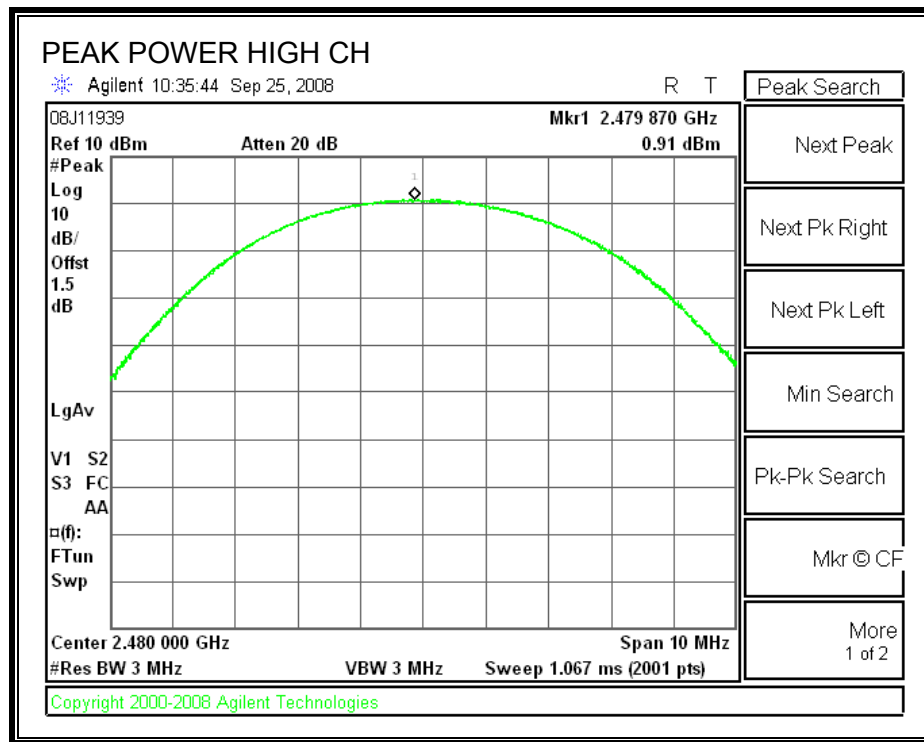
The transmitter output is connected to a spectrum analyzer the analyzer bandwidth is set to a value greater than the 20 dB bandwidth of the EUT.

### RESULTS

Channel	Frequency (MHz)	Output Power (dBm)	Limit (dBm)	Margin (dB)
Low	2402	1.98	21	-18.99
Middle	2441	1.52	21	-19.45
High	2480	0.91	21	-20.06

## 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 1.5 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	-0.22
Middle	2441	-0.38
High	2480	-0.90

## **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.

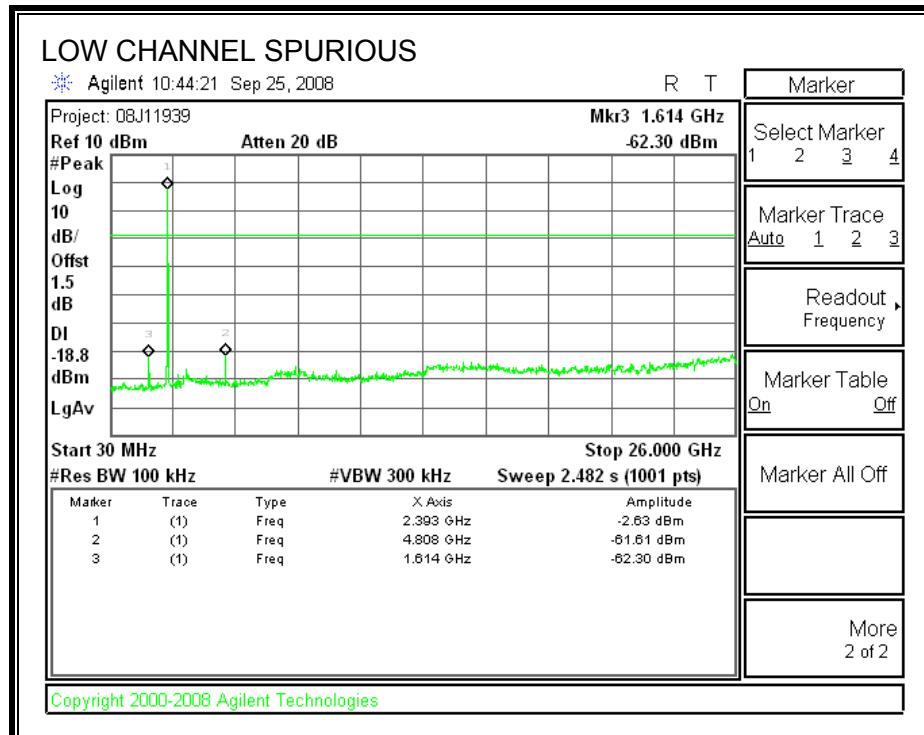
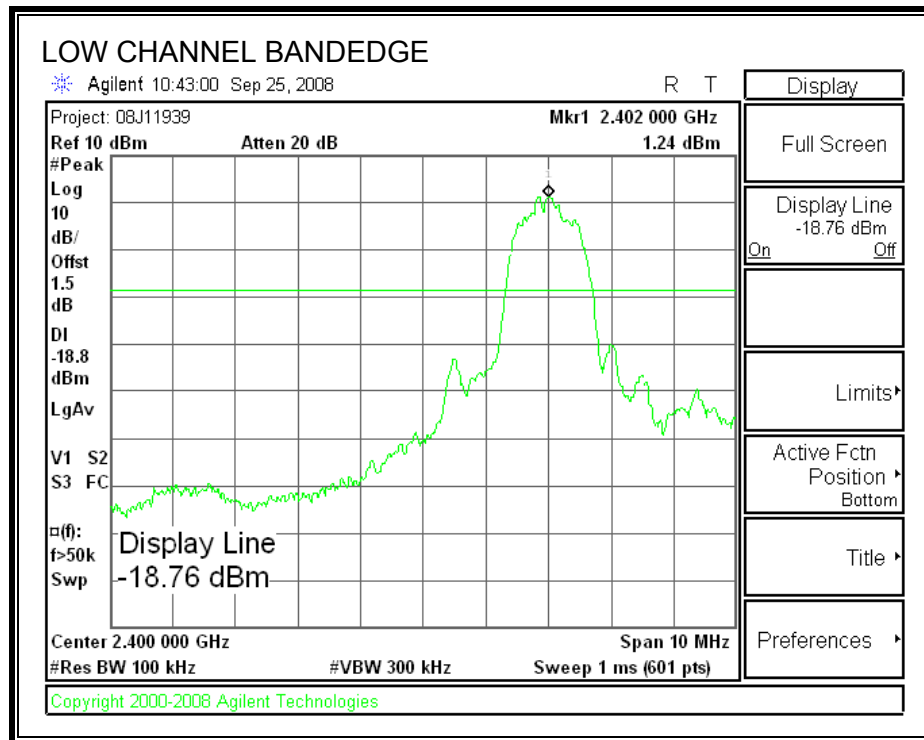
The spectrum from 30 MHz to 26 GHz is investigated with the transmitter set to the lowest, middle, and highest channels.

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

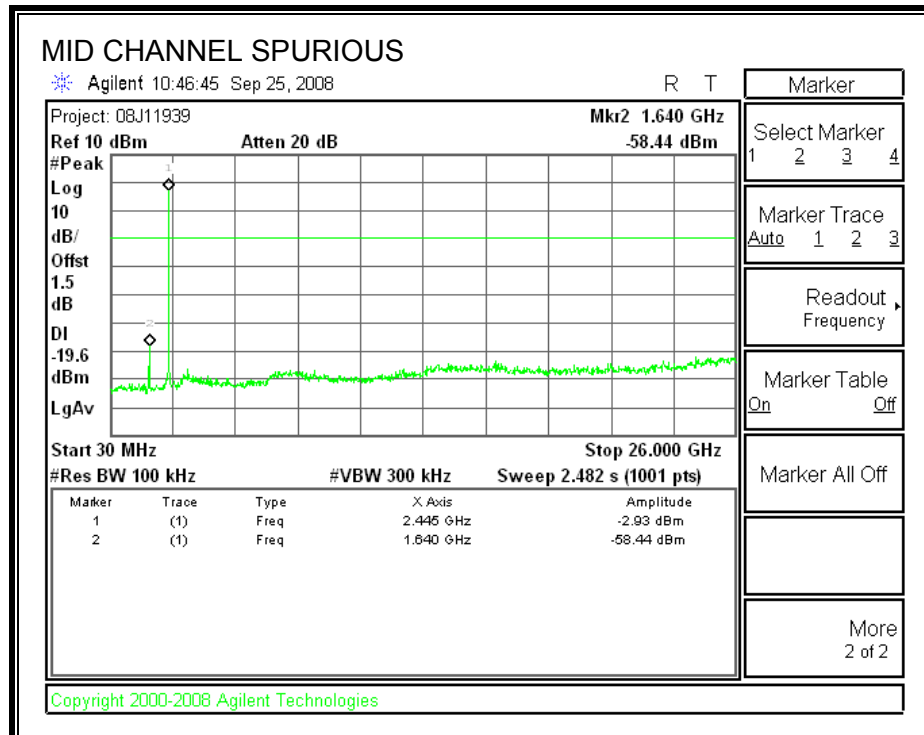
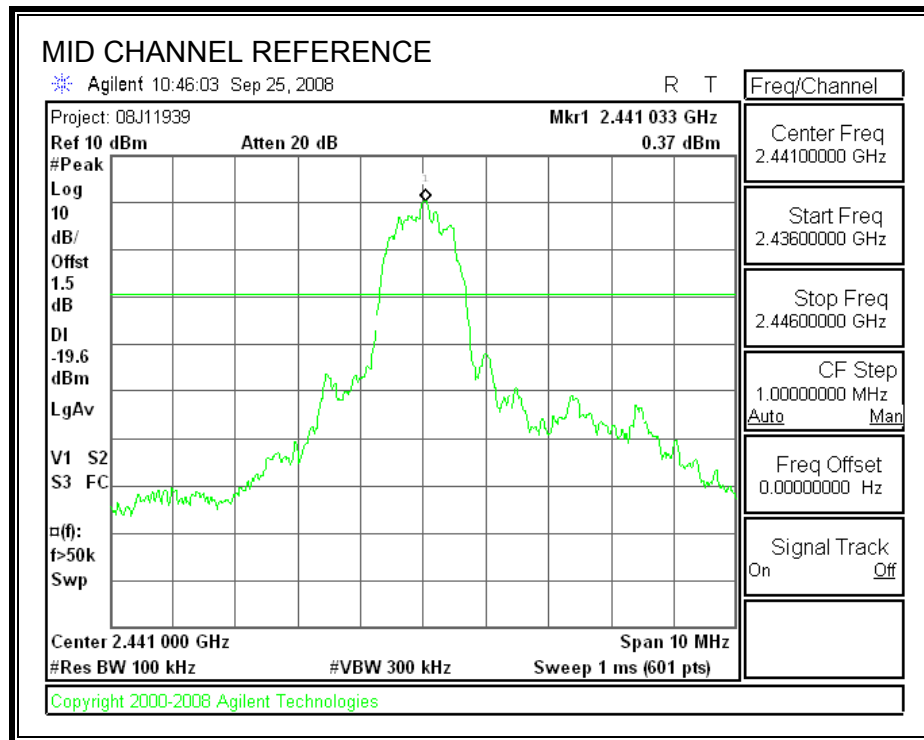
### **RESULTS**



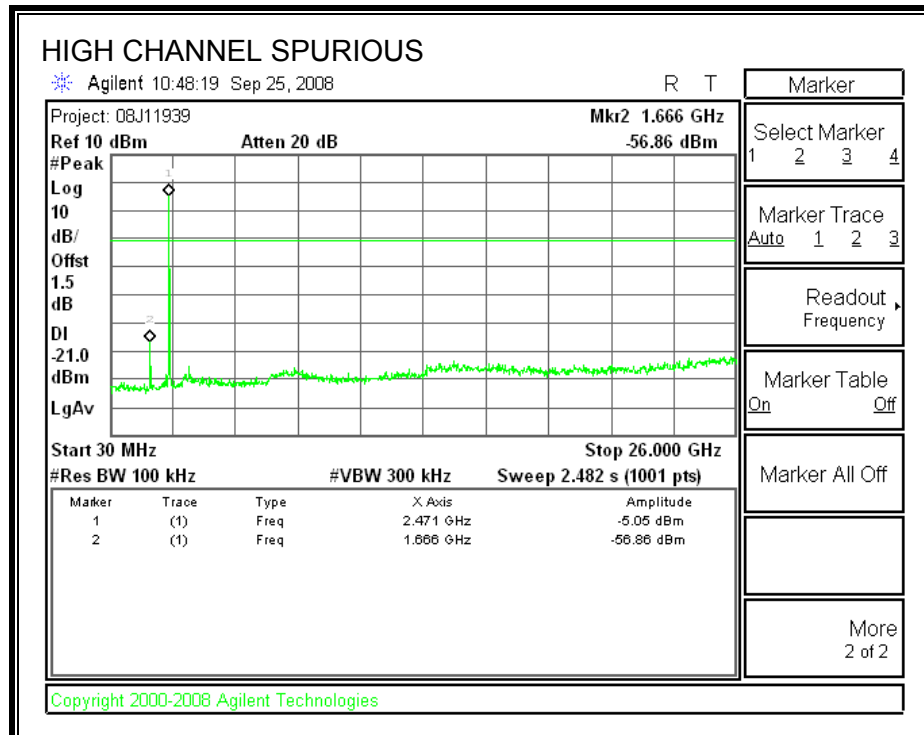
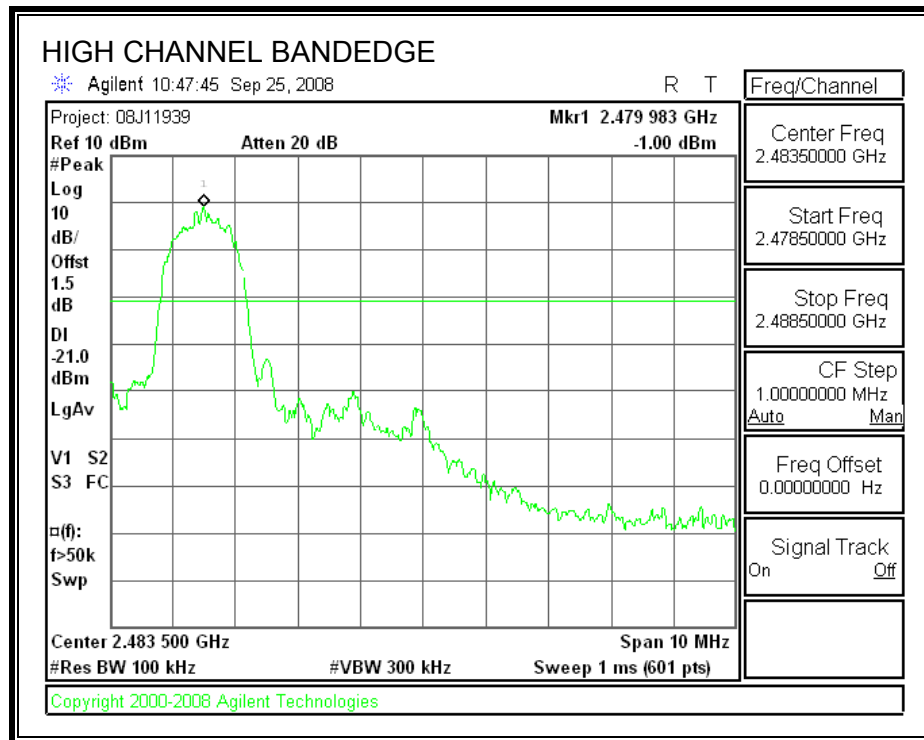
# **SPURIOUS EMISSIONS, LOW CHANNEL**



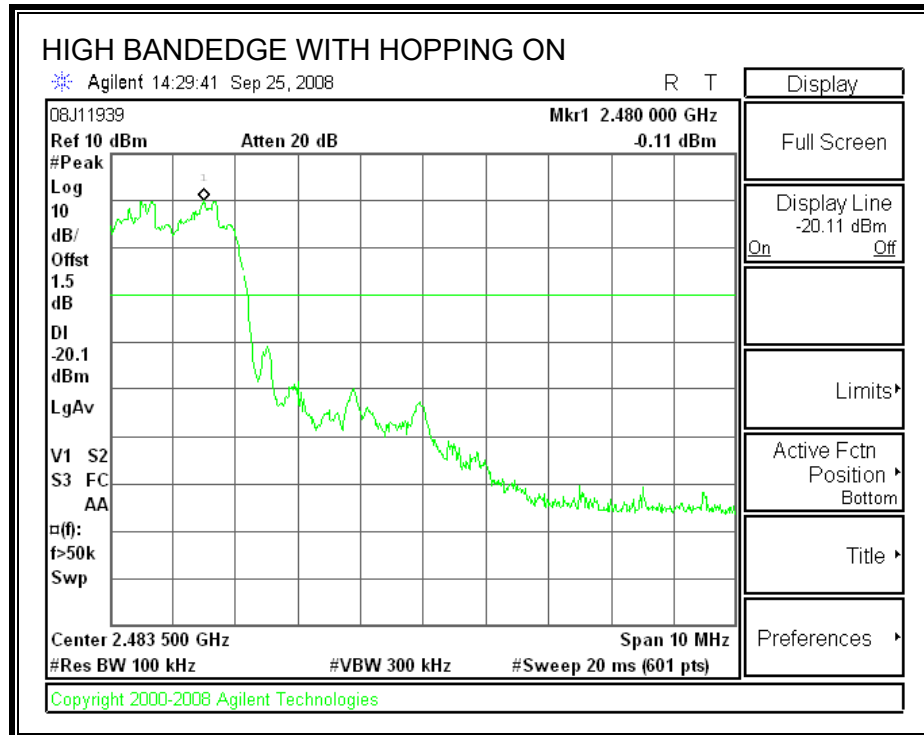
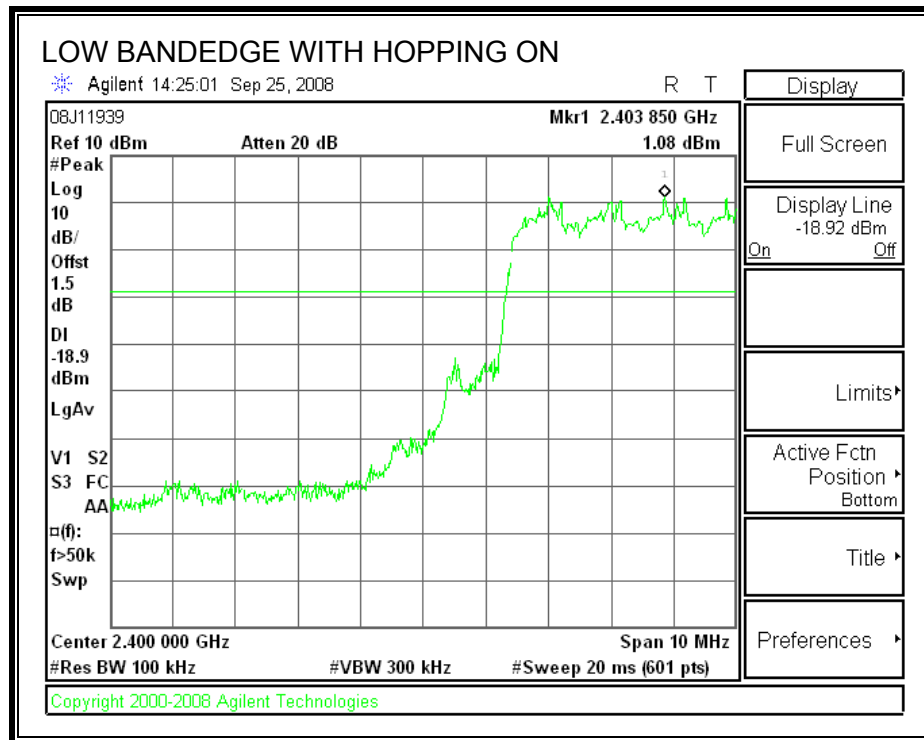
# **SPURIOUS EMISSIONS, MID CHANNEL**



# **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.

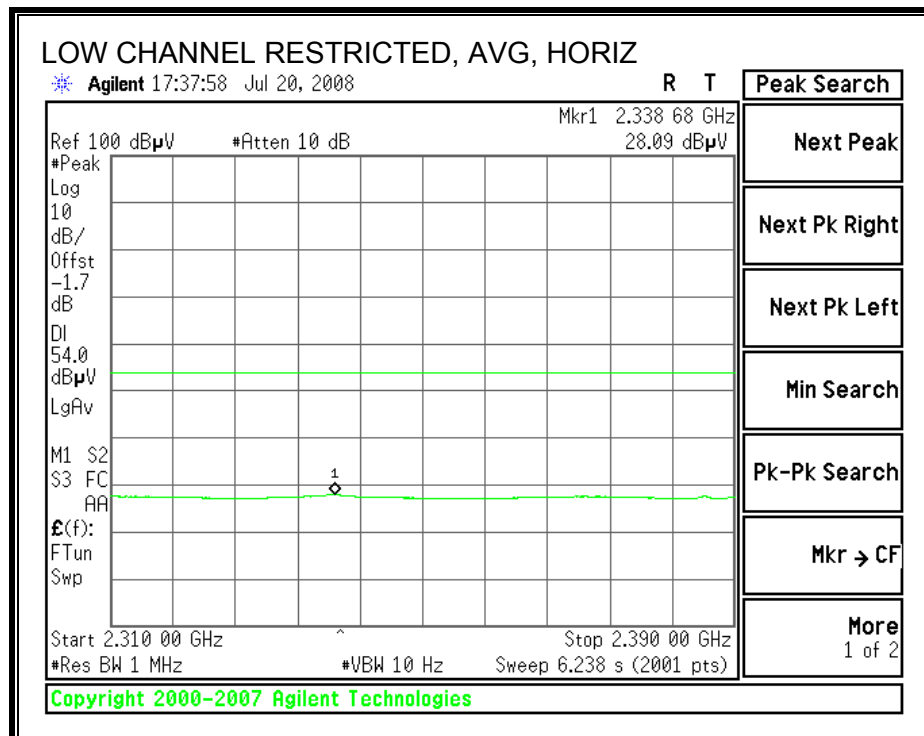
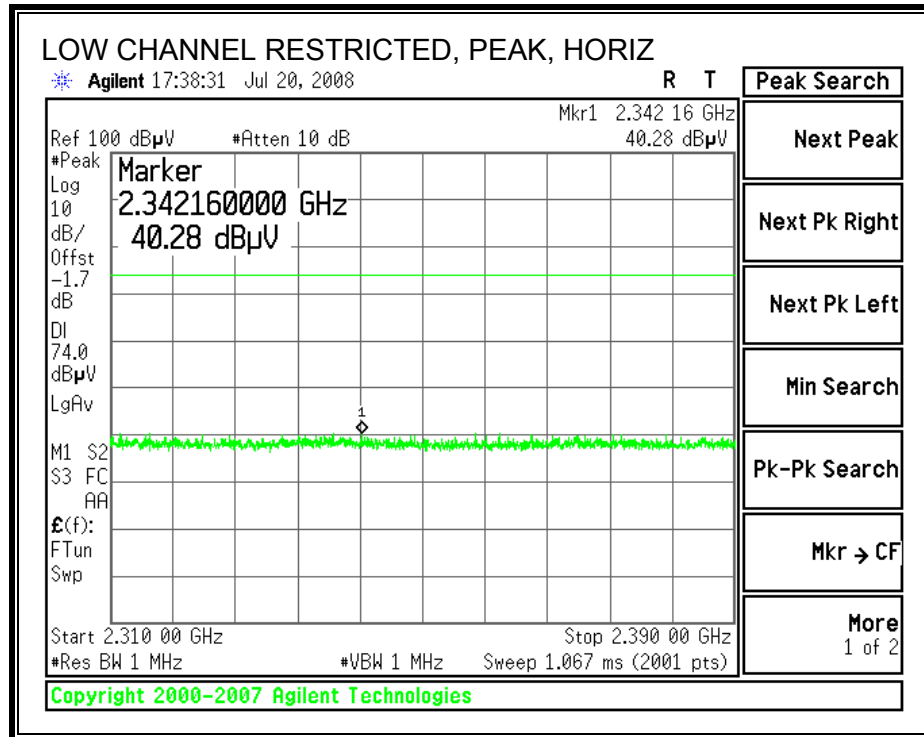
The spectrum from 30 MHz to 26 GHz is investigated with the transmitter set to the lowest, middle, and highest channels in the 2.4 GHz band.

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

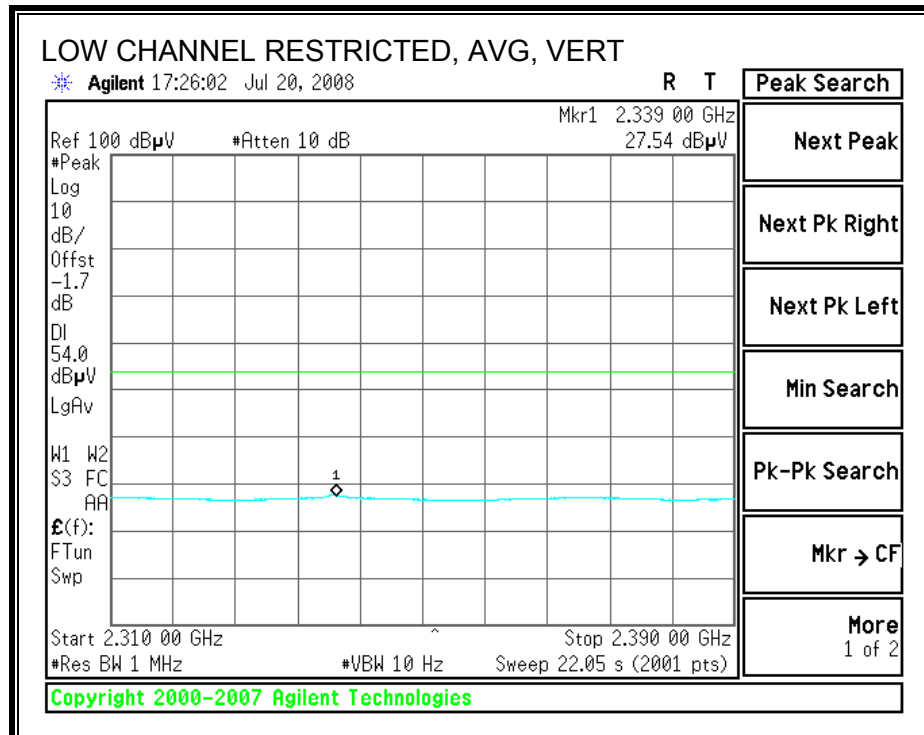
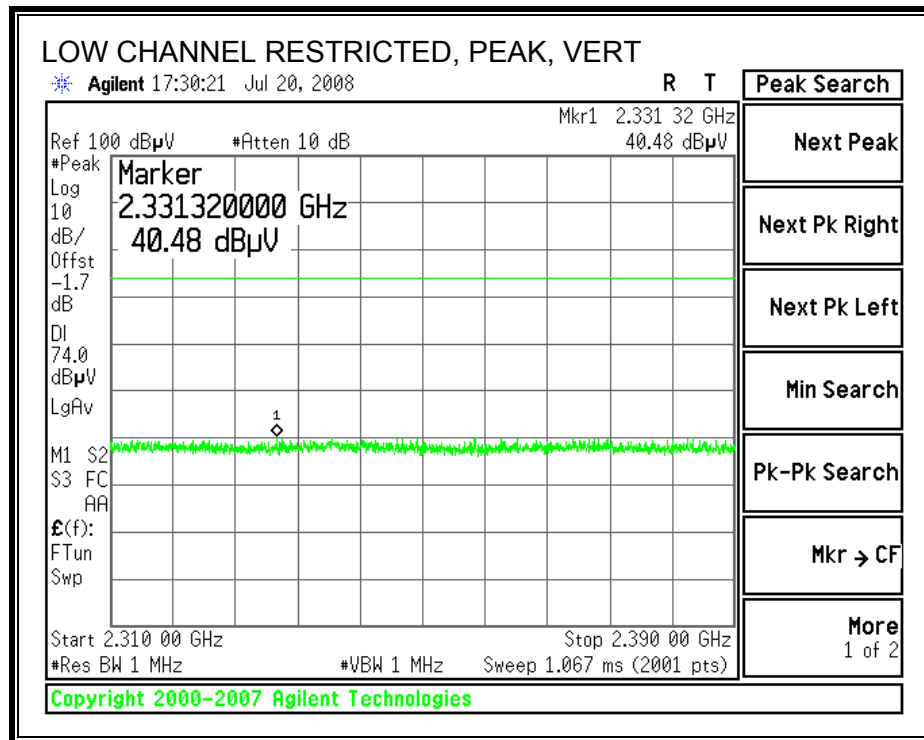
### 8.2.1. BASIC DATA RATE GFSK MODULATION

#### RESTRICTED BANDEDGE (LOW CHANNEL, HORIZONTAL)



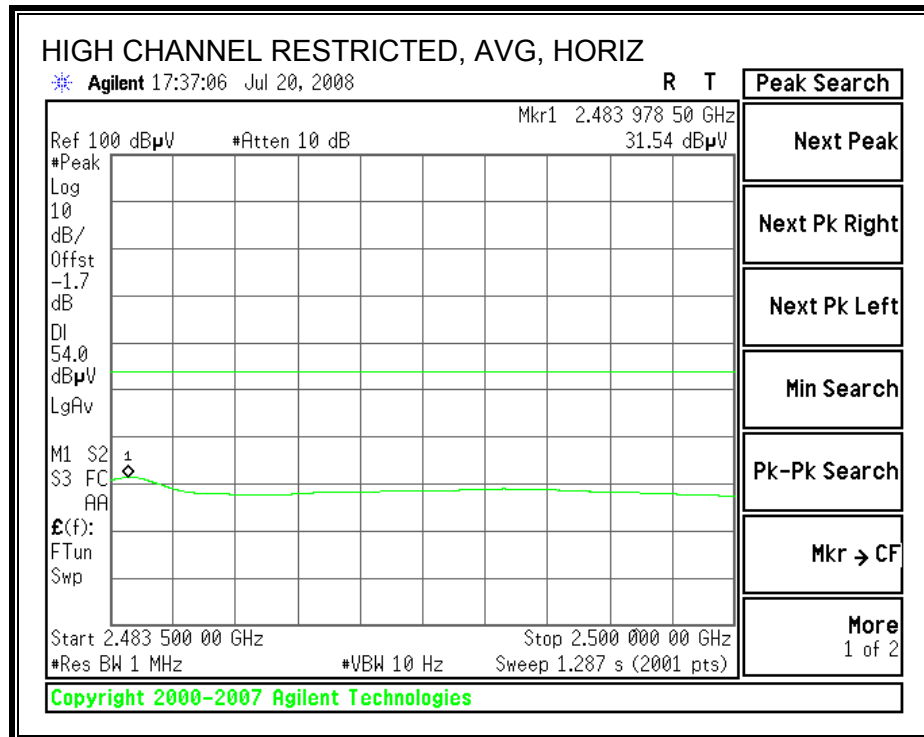
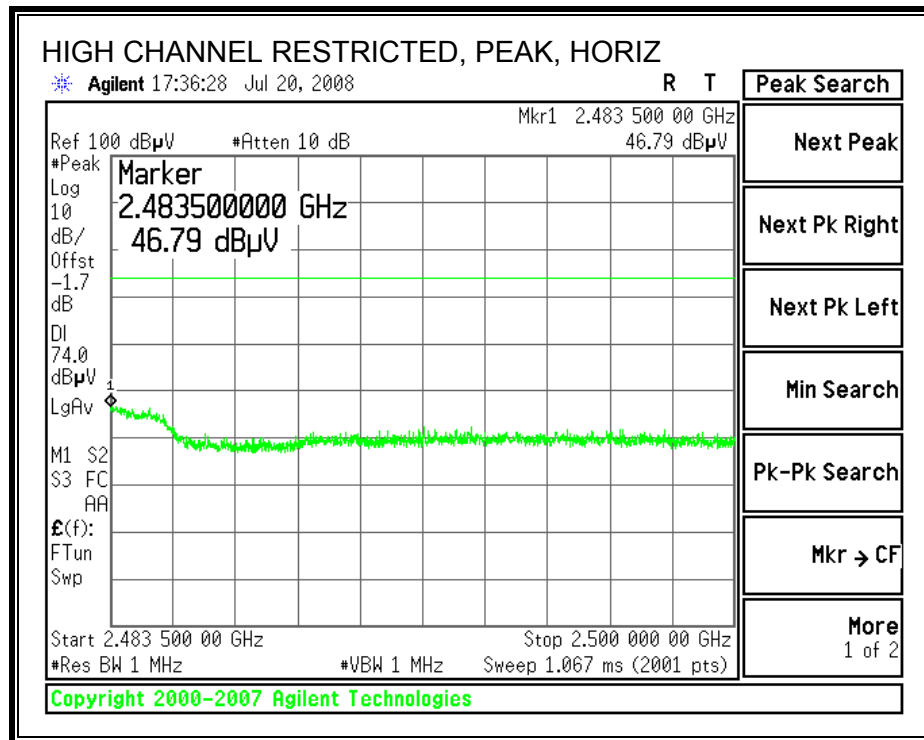


**RESTRICTED BANDEDGE (LOW CHANNEL, VERTICAL)**

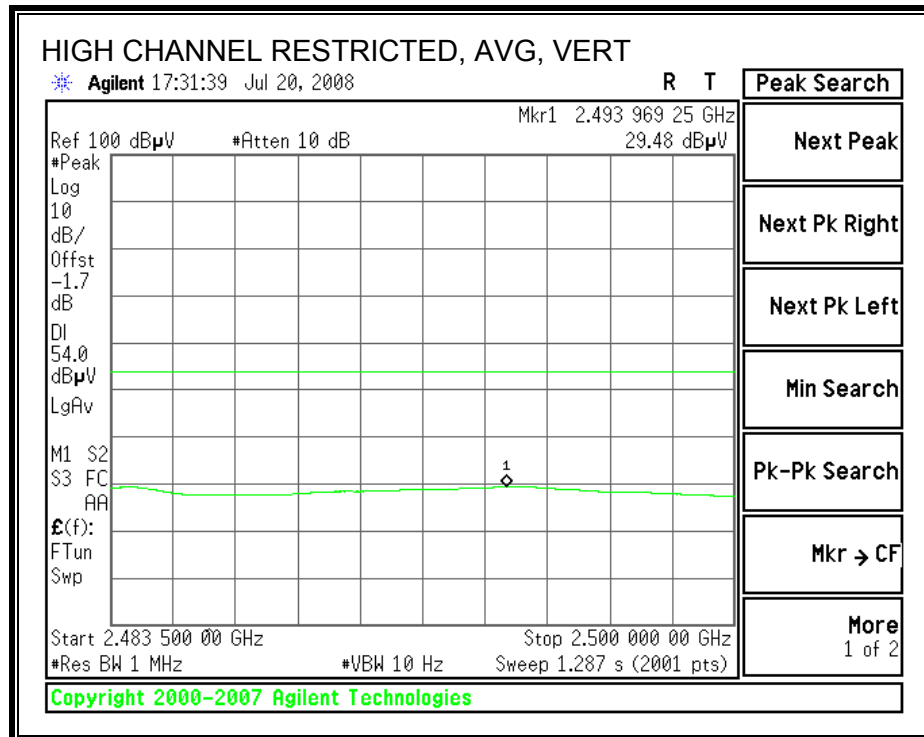
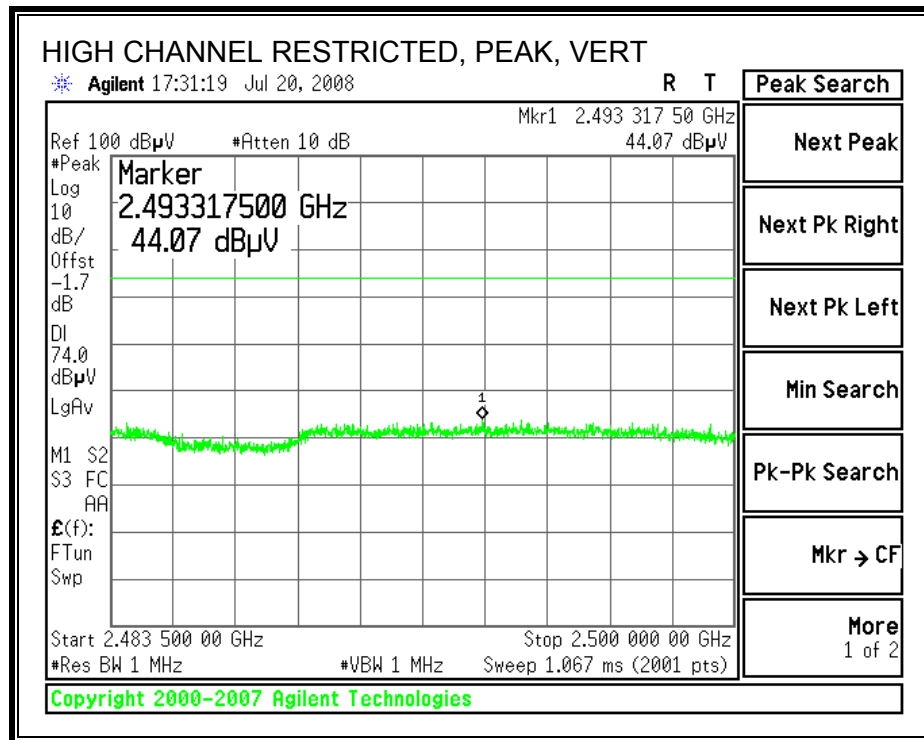




**RESTRICTED BANDEDGE (HIGH CHANNEL, HORIZONTAL)**



**RESTRICTED BANDEDGE (HIGH CHANNEL, VERTICAL)**

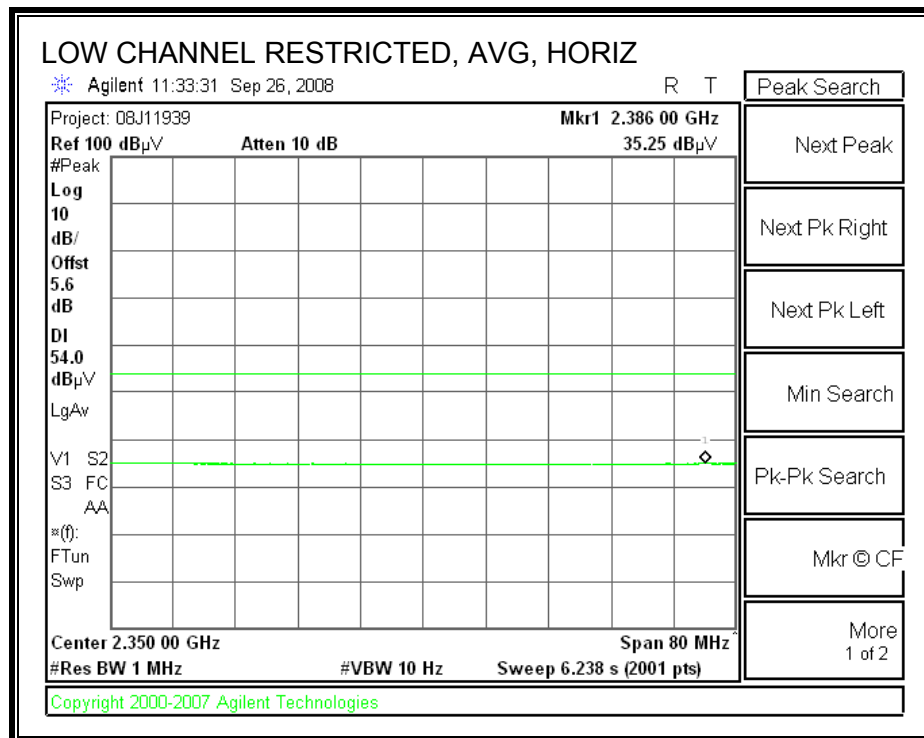
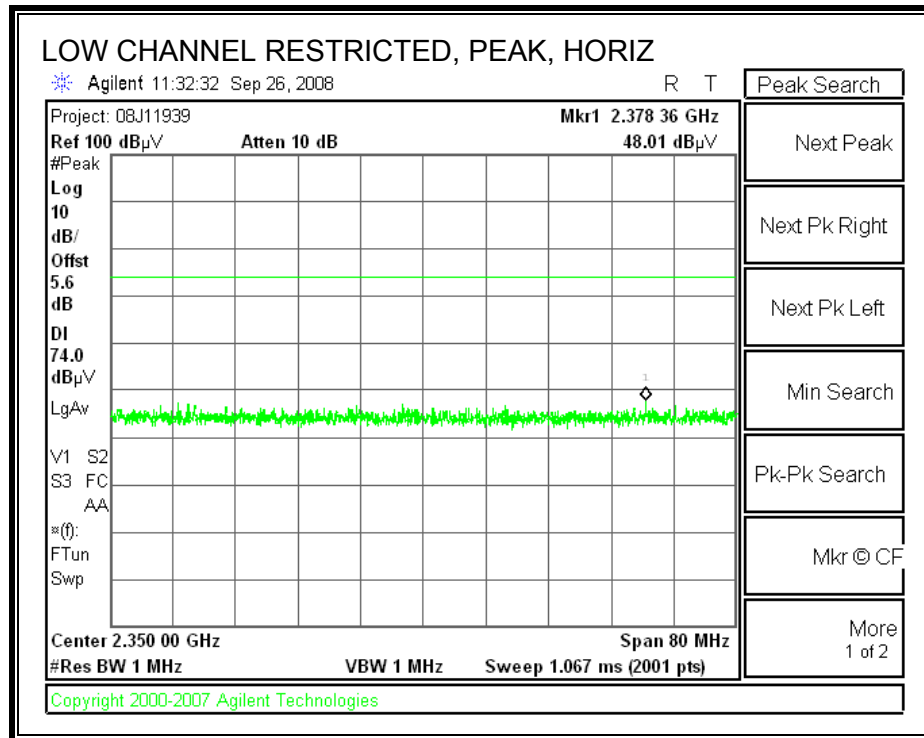


# HARMONICS AND SPURIOUS EMISSIONS

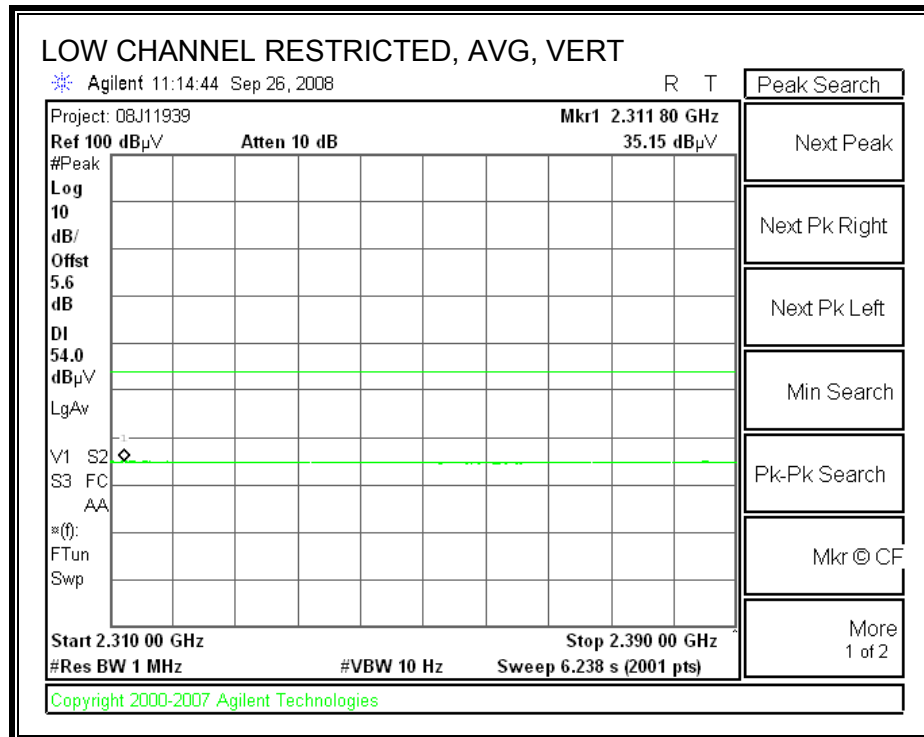
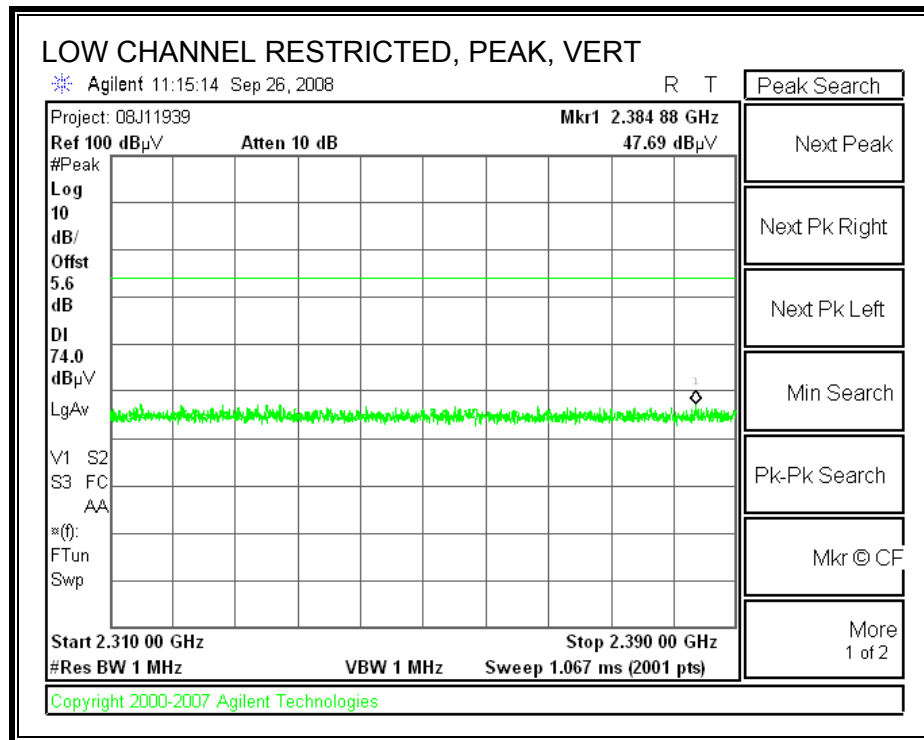
High Frequency Measurement																
Compliance Certification Services, Fremont 5m Chamber																
Company:		TOPCON														
Project #:		08J11939														
Date:		7/20/2008														
Test Engineer:		Devin Chang														
Configuration:		EUT only														
Mode:		Tx Mode, Y asix														
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 15.205				
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	Fltr dB	Peak dBuV/m	Avg dBuV/m	Pk Lim dBuV/m	Avg Lim dBuV/m	Pk Mar dB	Avg Mar dB	Notes (V/H)	
<b>Low Ch. 2402MHz</b>																
4.804	3.0	44.1	30.9	33.3	7.1	-34.8	0.0	0.0	49.6	36.4	74	54	-24.4	-17.6	V	
4.804	3.0	42.2	30.8	33.3	7.1	-34.8	0.0	0.0	47.7	36.4	74	54	-26.3	-17.6	H	
<b>Mid Ch. 2441MHz</b>																
4.882	3.0	44.9	30.7	33.4	7.2	-34.9	0.0	0.0	50.5	36.4	74	54	-23.5	-17.6	V	
4.882	3.0	44.2	31.3	33.4	7.2	-34.9	0.0	0.0	49.9	36.9	74	54	-24.1	-17.1	H	
<b>High Ch. 2480MHz</b>																
4.960	3.0	43.8	29.3	33.4	7.2	-34.9	0.0	0.0	49.6	35.1	74	54	-24.4	-18.9	V	
4.960	3.0	41.3	28.7	33.4	7.2	-34.9	0.0	0.0	47.0	34.5	74	54	-27.0	-19.5	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

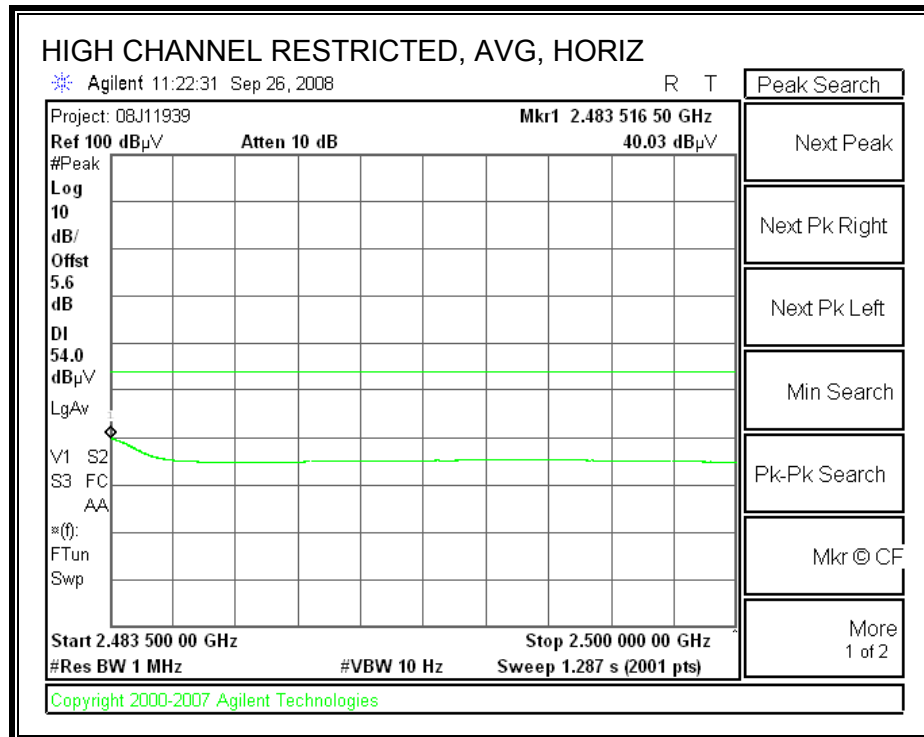
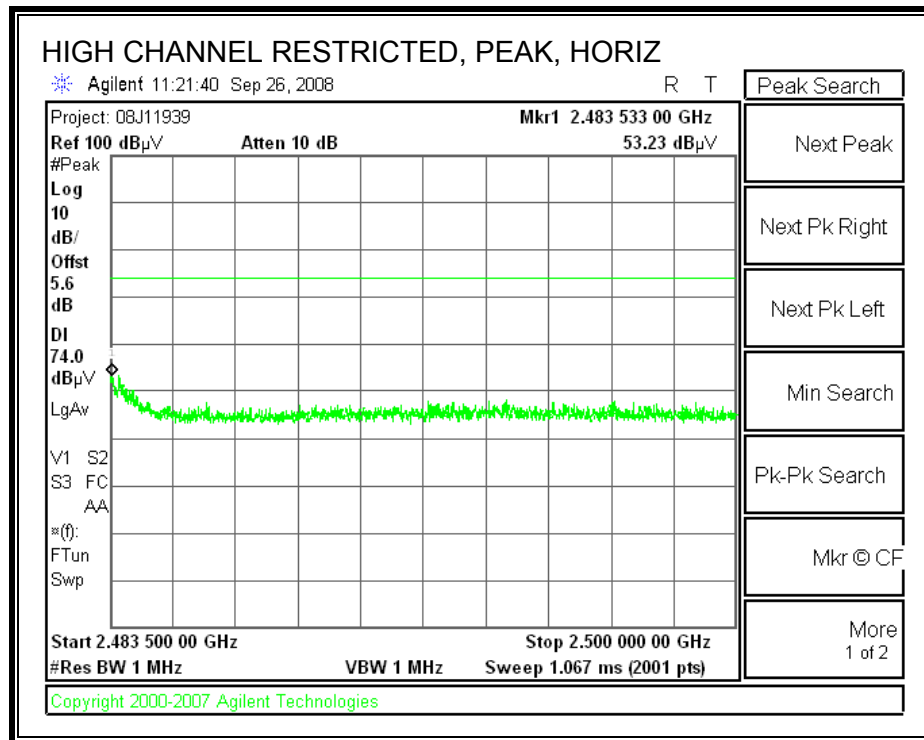
### RESTRICTED BANDEDGE (LOW CHANNEL, HORIZONTAL)



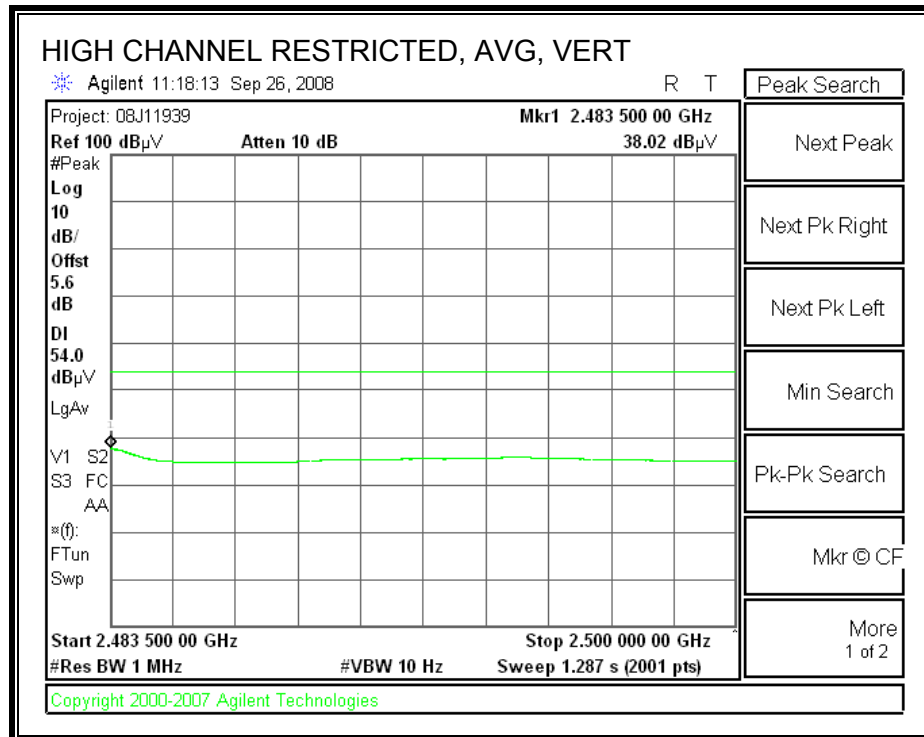
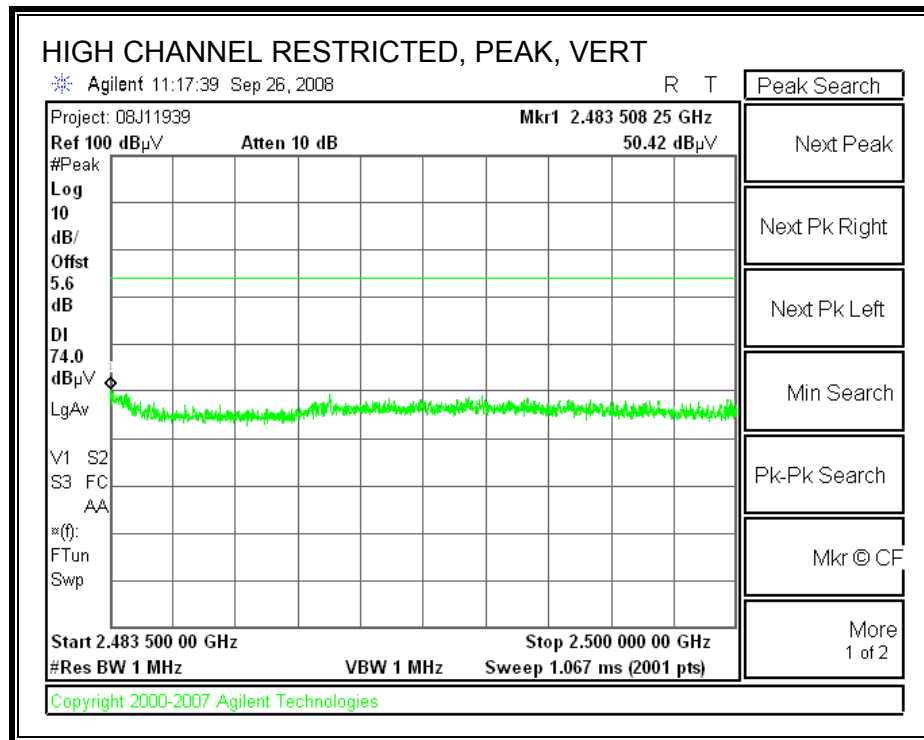
**RESTRICTED BANDEDGE (LOW CHANNEL, VERTICAL)**



**RESTRICTED BANDEDGE (HIGH CHANNEL, HORIZONTAL)**



**RESTRICTED BANDEDGE (HIGH CHANNEL, VERTICAL)**



## HARMONICS AND SPURIOUS EMISSIONS

<b>High Frequency Measurement</b> Compliance Certification Services, Fremont 5m Chamber															
Company:		TOPCON													
Project #:		08J11939													
Date:		9/26/2008													
Test Engineer:		Vien Tran													
Configuration:		EUT only													
Mode:		Tx 8PSK Mode													
<b>Test Equipment:</b>															
Horn 1-18GHz			Pre-amplifier 1-26GHz			Pre-amplifier 26-40GHz			Horn > 18GHz			Limit			
T73; S/N: 6717 @3m			T144 Miteq 3008A00931									FCC 15.205			
<b>Hi Frequency Cables</b>															
2 foot cable			3 foot cable			12 foot cable			HPF			Reject Filter			
						A-5m Chamber						R_001			
<div style="display: flex; justify-content: space-between;"> <div> <b>Peak Measurements</b>            RBW=VBW=1MHz  <b>Average Measurements</b>            RBW=1MHz ; VBW=10Hz         </div> </div>															
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)
<b>Low Ch. 2402MHz</b>															
4.804	3.0	43.2	31.3	33.3	6.9	-36.5	0.0	0.0	46.9	35.0	74	54	-27.1	-19.0	V
4.804	3.0	42.1	30.6	33.3	6.9	-36.5	0.0	0.0	45.8	34.3	74	54	-28.2	-19.7	H
<b>Mid Ch. 2441MHz</b>															
4.882	3.0	44.1	31.8	33.4	6.9	-36.5	0.0	0.0	47.9	35.6	74	54	-26.1	-18.4	V
4.882	3.0	43.3	30.9	33.4	6.9	-36.5	0.0	0.0	47.1	34.7	74	54	-26.9	-19.3	H
<b>High Ch. 2480MHz</b>															
4.960	3.0	43.3	30.2	33.4	7.0	-36.5	0.0	0.0	47.3	34.2	74	54	-26.7	-19.8	V
4.960	3.0	41.0	29.6	33.4	7.0	-36.5	0.0	0.0	45.0	33.6	74	54	-29.0	-20.4	H
Rev. 412.7															
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											

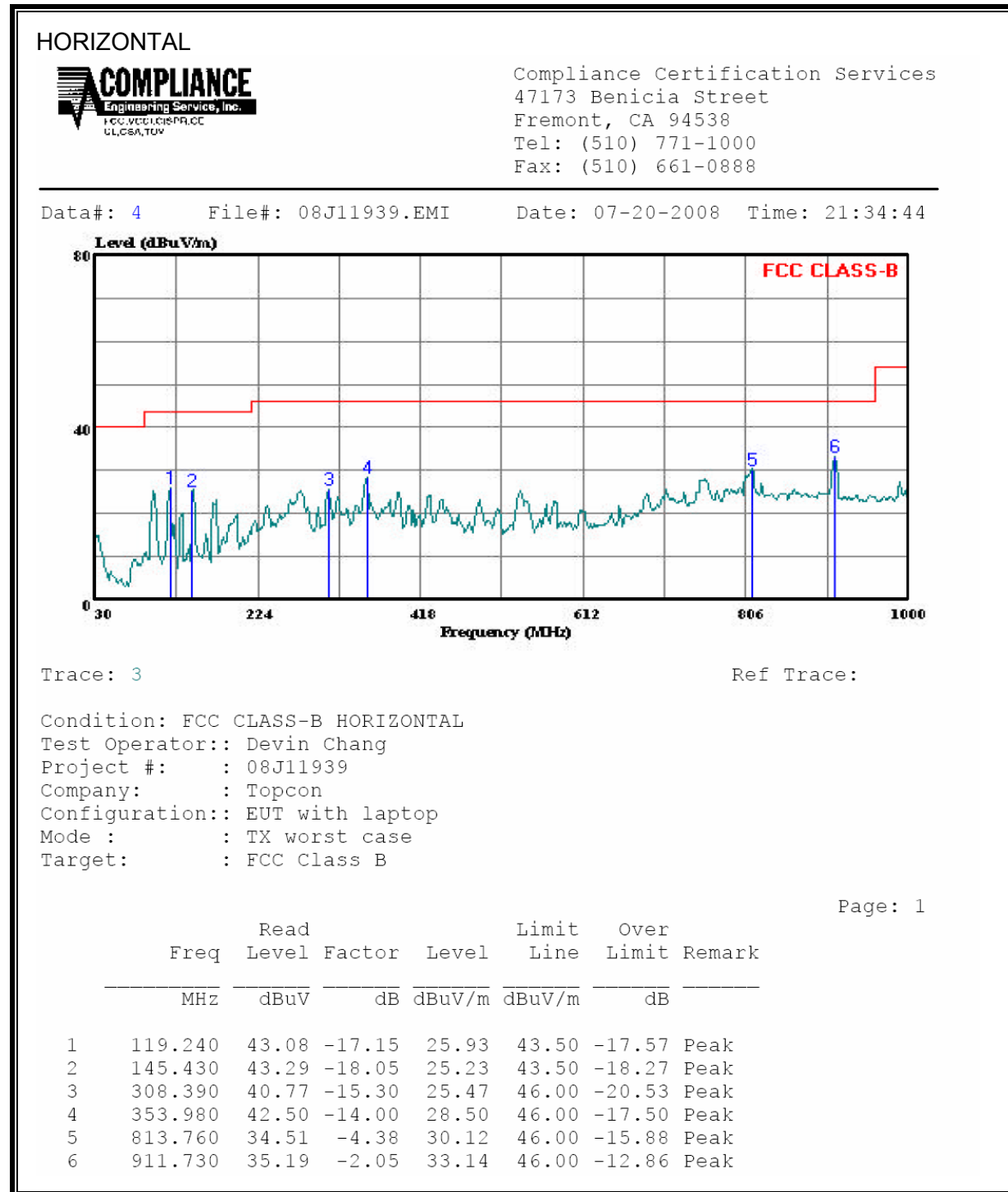


### 8.3. RECEIVER ABOVE 1 GHz – Worst-case

<b>High Frequency Measurement</b> Compliance Certification Services, Fremont 5m Chamber																	
Company:		TOPCON															
Project #:		08J11939															
Date:		7/20/2008															
Test Engineer:		Devin Chang															
Configuration:		EUT only															
Mode:		Rx Mode, Worst case															
<b>Test Equipment:</b>																	
Horn 1-18GHz				Pre-amplifier 1-26GHz				Pre-amplifier 26-40GHz				Horn > 18GHz				Limit	
T73; S/N: 6717 @3m				T145 Agilent 3008A0051												FCC 15.209	
<div style="display: flex; justify-content: space-between;"> <div style="width: 60%;"> <div style="padding: 2px; text-align: center;">Hi Frequency Cables</div> <div style="display: flex; justify-content: space-around;"> <div style="padding: 2px; text-align: center;">2 foot cable</div> <div style="padding: 2px; text-align: center;">3 foot cable</div> <div style="padding: 2px; text-align: center;">12 foot cable</div> </div> <div style="display: flex; justify-content: space-around;"> <div style="padding: 2px; text-align: center;">B-5m Chamber</div> </div> </div> <div style="width: 35%;"> <div style="display: flex; justify-content: space-around;"> <div style="padding: 2px; text-align: center;">HPF</div> <div style="padding: 2px; text-align: center;">Reject Filter</div> </div> <div style="padding: 2px; text-align: center;">R_001</div> </div> </div>																	
<div style="display: flex; justify-content: space-between;"> <div style="width: 60%;"> <div style="padding: 2px; text-align: center;">Peak Measurements</div> <div style="padding: 2px; text-align: center;">RBW=VBW=1MHz</div> </div> <div style="width: 35%;"> <div style="padding: 2px; text-align: center;">Average Measurements</div> <div style="padding: 2px; text-align: center;">RBW=1MHz ; VBW=10Hz</div> </div> </div>																	
f GHz	Dist (m)	Read Pk dBuV	Read Avg. dBuV	AF dB/m	CL dB	Amp dB	D Corr dB	Fltr dB	Peak dBuV/m	Avg dBuV/m	Pk Lim dBuV/m	Avg Lim dBuV/m	Pk Mar dB	Avg Mar dB	Notes (V/H)		
<b>Low Ch. 2402MHz</b>																	
1.206	3.0	50.2	38.2	24.5	3.5	-36.0	0.0	0.0	42.2	30.2	74	54	-31.8	-23.8	V		
1.627	3.0	55.7	48.7	26.1	4.0	-35.7	0.0	0.0	50.1	43.2	74	54	-23.9	-10.8	V		
3.314	3.0	49.9	37.8	30.8	5.8	-35.1	0.0	0.0	51.5	39.3	74	54	-22.5	-14.7	V		
1.206	3.0	47.2	35.8	24.5	3.5	-36.0	0.0	0.0	39.2	27.8	74	54	-34.8	-26.2	H		
1.626	3.0	56.6	48.3	26.1	4.0	-35.7	0.0	0.0	51.0	42.7	74	54	-23.0	-11.3	H		
3.314	3.0	43.9	33.9	30.8	5.8	-35.1	0.0	0.0	45.4	35.4	74	54	-28.6	-18.6	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										

## 8.4. WORST-CASE BELOW 1 GHz

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



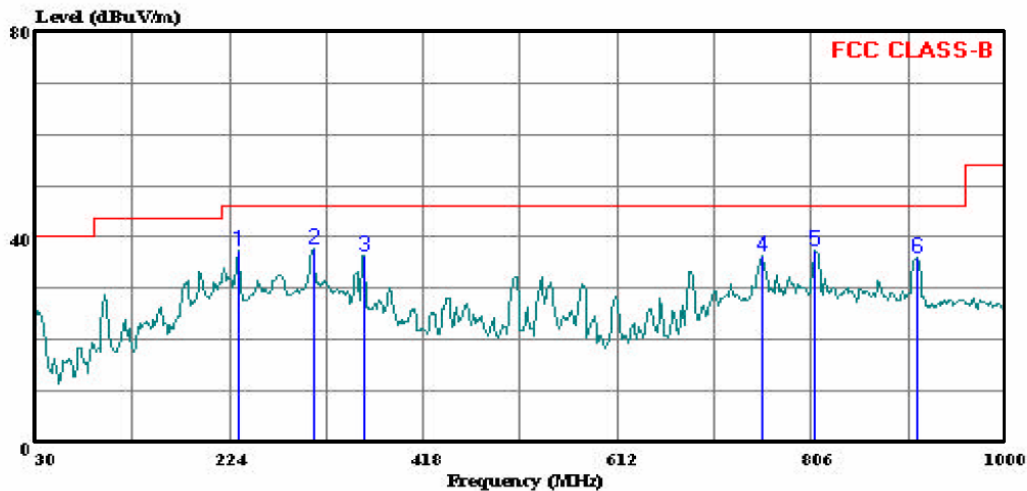
**SPURIOUS EMISSIONS 30 TO 1000 MHz (WORST-CASE CONFIGURATION, VERTICAL)**

VERTICAL



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

Data#: 2 File#: 08J11939.EMI Date: 07-20-2008 Time: 21:18:59



Trace: 1

Ref Trace:

Condition: FCC CLASS-B VERTICAL  
Test Operator:: Devin Chang  
Project #: 08J11939  
Company: Topcon  
Configuration: EUT with laptop  
Mode: TX worst case  
Target: FCC Class B

Page: 1

	Freq	Read	Factor	Level	Limit	Over	
	MHz	dBuV	dB	dBuV/m	dBuV/m	dB	Remark
1	232.730	54.95	-17.62	37.33	46.00	-8.67	Peak
2	308.390	53.19	-15.30	37.89	46.00	-8.11	Peak
3	358.830	50.14	-13.83	36.31	46.00	-9.69	Peak
4	756.530	41.66	-5.36	36.30	46.00	-9.70	Peak
5	809.880	41.80	-4.45	37.35	46.00	-8.65	Peak
6	911.730	37.93	-2.05	35.88	46.00	-10.12	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 <sup>*</sup>	56 to 46 <sup>*</sup>
0.5-5	56	46
5-30	60	50

<sup>\*</sup> 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**

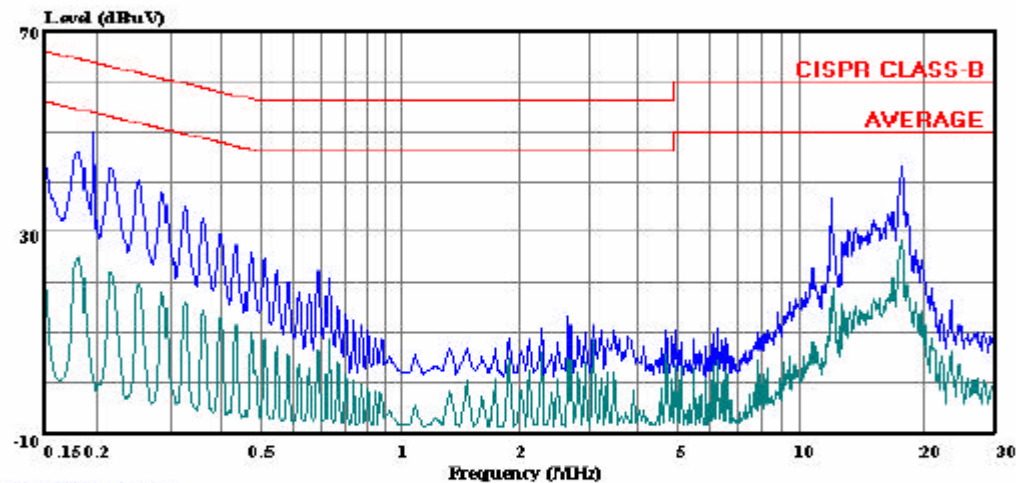
CONDUCTED EMISSIONS DATA (115VAC 60Hz)									
Freq.	Reading			Closs	Limit	EN B	Margin		Remark
(MHz)	PK (dBuV)	QP (dBuV)	AV (dBuV)	(dB)	QP	AV	QP (dB)	AV (dB)	L1 / L2
0.20	50.07	--	24.67	0.00	63.82	53.82	-13.75	-29.15	L1
0.25	39.97	--	21.95	0.00	61.72	51.72	-21.75	-29.77	L1
17.75	43.00	--	27.16	0.00	60.00	50.00	-17.00	-22.84	L1
0.18	45.96	--	25.13	0.00	64.44	54.44	-18.48	-29.31	L2
0.22	42.47	--	22.29	0.00	62.86	52.86	-20.39	-30.57	L2
17.66	41.78	--	29.60	0.00	60.00	50.00	-18.22	-20.40	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#: 21 File#: 08J11939.EMI Date: 07-28-2008 Time: 11:59:59



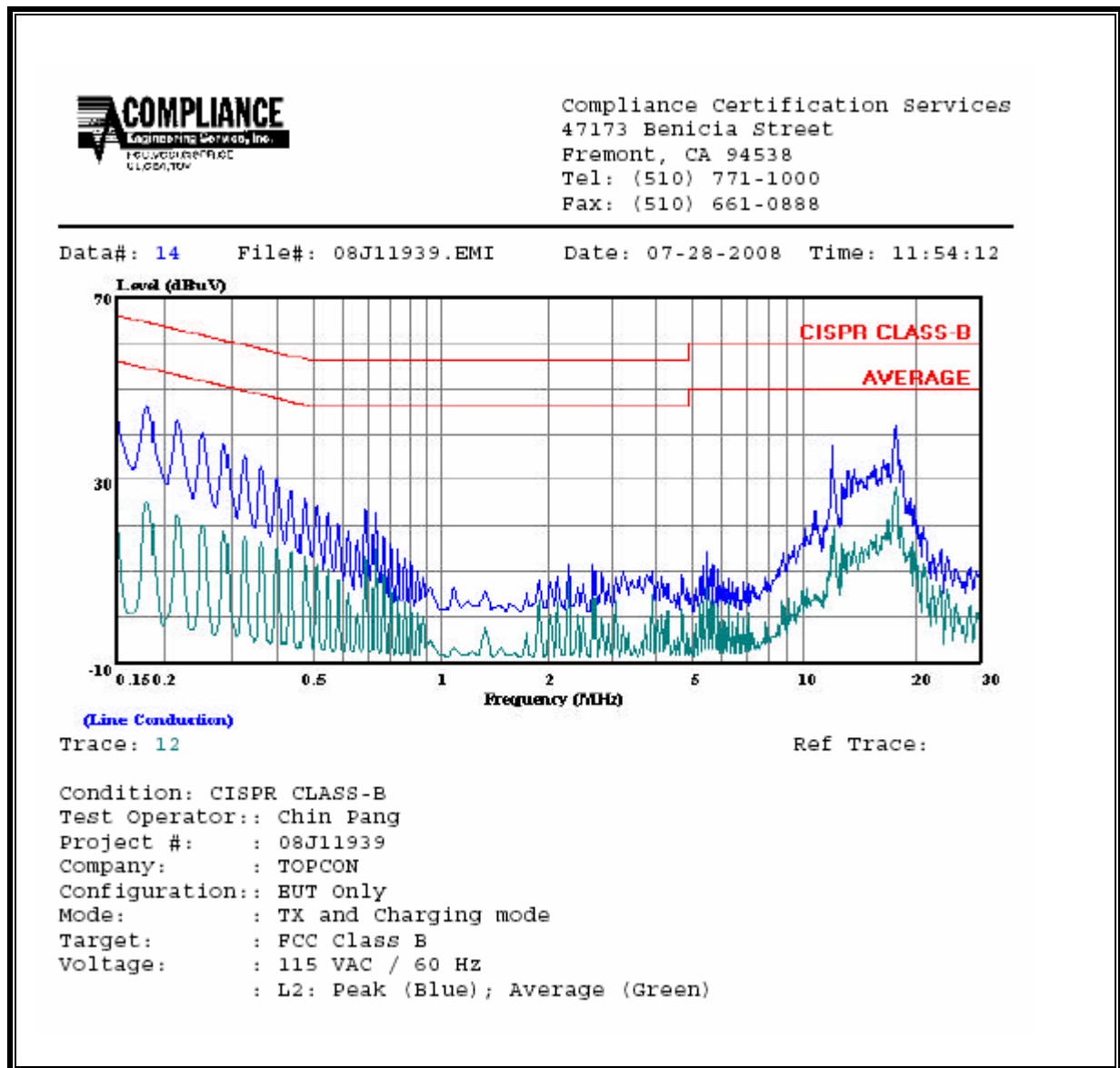
(Line Conduction)

Trace: 19

Ref Trace:

Condition: CISPR CLASS-B  
Test Operator:: Chin Pang  
Project #: 08J11939  
Company: TOPCON  
Configuration: BUT Only  
Mode: TX  
Target: FCC Class B  
Voltage: 115 VAC / 60 Hz  
: L1: Peak (Blue); Average (Green)

## 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 <sup>2</sup> )	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 <sup>2</sup> )	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 <sup>2</sup> )	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 <sup>2</sup> )	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 <sup>2</sup> )	5 Averaging Time (min)
0.003–1	280	2.19		6
1–10	280/ $f$	2.19/ $f$		6
10–30	28	2.19/ $f$		6
30–300	28	0.073	2*	6
300–1 500	1.585 $f^{0.5}$	0.0042 $f^{0.5}$	$f/150$	6
1 500–15 000	61.4	0.163	10	6
15 000–150 000	61.4	0.163	10	616 000 / $f^{1.2}$
150 000–300 000	0.158 $f^{0.5}$	4.21 x 10 <sup>-4</sup> $f^{0.5}$	6.67 x 10 <sup>-5</sup> $f$	616 000 / $f^{1.2}$

\* 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/m<sup>2</sup> is equivalent to 1 mW/cm<sup>2</sup>.
  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/cm<sup>2</sup>

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/cm<sup>2</sup> is converted to units of W/m<sup>2</sup> by multiplying by a factor of 10.

## **LIMITS**

From FCC §1.1310 Table 1 (B), the maximum value of S = 1.0 mW/cm<sup>2</sup>

From IC Safety Code 6, Section 2.2 Table 5 Column 4, S = 10 W/m<sup>2</sup>

## **RESULTS**

Mode	Band	MPE Distance (cm)	Output Power (dBm)	Antenna Gain (dBi)	FCC Power Density (mW/cm <sup>2</sup> )	IC Power Density (W/m <sup>2</sup> )
Bluetooth	2.4 GHz	20.0	1.98	2.00	0.0005	0.0050