# FCC CFR47 PART 15 SUBPART C
# INDUSTRY CANADA RSS-210 ISSUE 7
# CERTIFICATION TEST REPORT

**FOR**

**802.11g WIRELESS LAN + BLUETOOTH PCI-E MINI CARD**

**MODEL NUMBER: BCM94312HMGB**

**FCC ID: QDS-BRCM1044**
**IC: 4324A-BRCM1044**

**REPORT NUMBER: 09U12439-2**

**ISSUE DATE: MARCH 24, 2009**

*Prepared for*

**BROADCOM CORPORATION**
**190 MATHILDA PLACE**
**SUNNYVALE, CA 94086, U.S.A.**

*Prepared by*
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NVLAP LAB CODE 200065-0

Revision History

| Rev. | Issue Date | Revisions | Revised By |
|---|---|---|---|
| --- | 03/24/09 | Initial Issue | T. Chan |

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# 1. ATTESTATION OF TEST RESULTS

**COMPANY NAME:** BROADCOM CORPORATION
190 MATHILDA PLACE
SUNNYVALE, CA 94086, U.S.A

**EUT DESCRIPTION:** 802.11g WIRELESS LAN + BLUETOOTH PCI-E MINI CARD

**MODEL:** BCM94312HMGB

**SERIAL NUMBER:** 10

**DATE TESTED:** MARCH 14-18, 2009

| 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:

THU CHAN
EMC MANAGER
COMPLIANCE CERTIFICATION SERVICES

Tested By:

CHIN PANG
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 an 802.11g Wireless LAN + Bluetooth PCI-E Mini Card and manufactured by Broadcom Corporation. Model number is BCM94312HMGB.

## 5.2. MAXIMUM OUTPUT POWER

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

| Frequency Range (MHz) | Mode | Output Power (dBm) (dBm) | Output Power (mW) |
|---|---|---|---|
| 2402 - 2480 | Basic GFSK | 4.34 | 2.72 |
| 2402 - 2480 | Enhanced 8PSK | 7.02 | 5.04 |

## 5.3. DESCRIPTION OF AVAILABLE ANTENNAS

The radio utilizes an 802.11bg WLAN and Bluetooth antennas, with a maximum gain of 3.9dBi.

## 5.4. SOFTWARE AND FIRMWARE

The EUT driver software installed in the host support equipment during testing was Broadcom BCM2070 Bluetooth 2.1 + EDR USB device, ver 5.5.0.4100.

The test utility software used during testing was Blue Tool Blue Tool, ver 1.1.2.7.

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## 5.5. WORST-CASE CONFIGURATION AND MODE

The worst-case data rate for each mode is determined to be as follows, based on preliminary tests of the chipset utilized in this radio.

All final tests in the GFSK mode were made at 1 Mb/s.

All final tests in the 8PSK mode were made at 3 Mb/s.

For radiated emissions below 1 GHz the worst-case configuration is determined to be the mode and channel with the highest output power.

## 5.6. DESCRIPTION OF TEST SETUP

**SUPPORT EQUIPMENT**

| PERIPHERAL SUPPORT EQUIPMENT LIST | | | | |
|---|---|---|---|---|
| Description | Manufacturer | Model | Serial Number | FCC ID |
| Laptop | Dell | Inspirom 630m | 454779 | DoC |
| AC Adapter | Dell | LA65NS0-00 | CN-ODF263-71615-6CG-F8C9 | DoC |

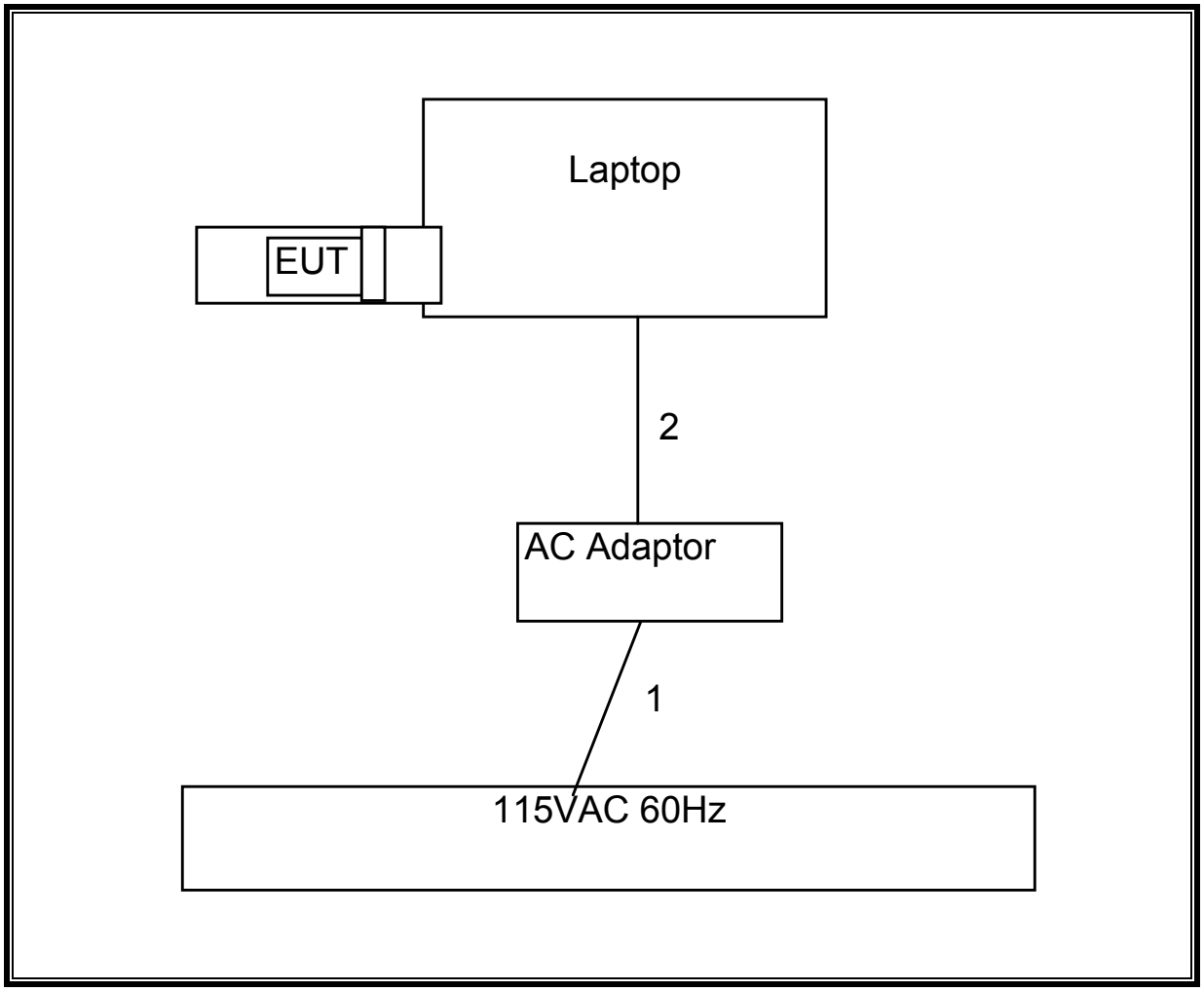
**I/O CABLES**

| I/O CABLE LIST | | | | | | |
|---|---|---|---|---|---|---|
| Cable No. | Port | # of Identical Ports | Connector Type | Cable Type | Cable Length | Remarks |
| 1 | AC | 1 | AC | Unshielded | 2m | N/A |
| 2 | DC | 1 | DC | Unshielded | 1m | Ferrite on laptop's end |

**TEST SETUP**

The EUT is connected to a host laptop computer via an extended card during the 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** |
| Temperature / Humidity Chamber | Thermotron | SE 600-10-10 | C00930 | 04/16/09 |
| Spectrum Analyzer, 26.5 GHz | Agilent / HP | E4407B | C01098 | 11/01/09 |
| Power Meter | Agilent / HP | 437B | N02778 | 10/18/09 |
| Power Senser | Agilent / HP | 8481A | N02784 | 10/22/09 |
| Preamplifier, 26.5 GHz | Agilent / HP | 8449B | C01052 | 08/03/09 |
| Antenna, Horn, 18 GHz | EMCO | 3115 | C00872 | 04/15/09 |
| Preamplifier, 1300 MHz | Agilent / HP | 8447D | C00885 | 05/09/09 |
| Antenna, Bilog, 2 GHz | Sunol Sciences | JB1 | C01011 | 09/28/09 |
| Spectrum Analyzer, 44 GHz | Agilent / HP | E4446A | C01012 | 08/07/09 |
| Reject Filter, 2.4-2.5 GHz | Micro-Tronics | BRC13192 | N02683 | CNR |

# 7. ANTENNA PORT TEST RESULTS

## 7.1.1. 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 hoping channel, whichever is greater.

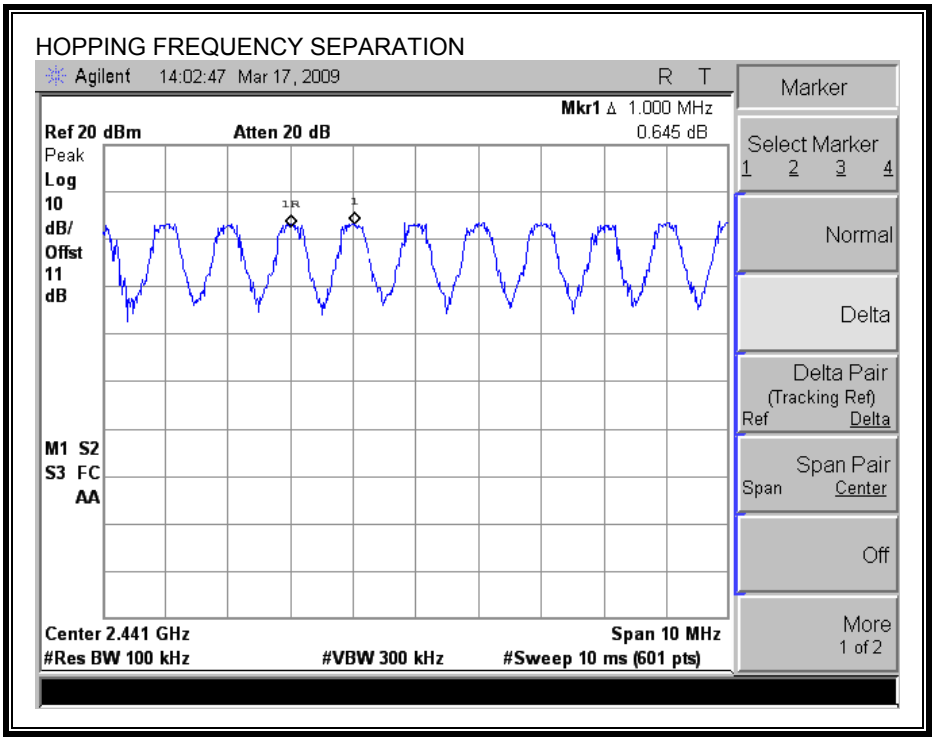
Alternatively, frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than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

**TEST PROCEDURE**

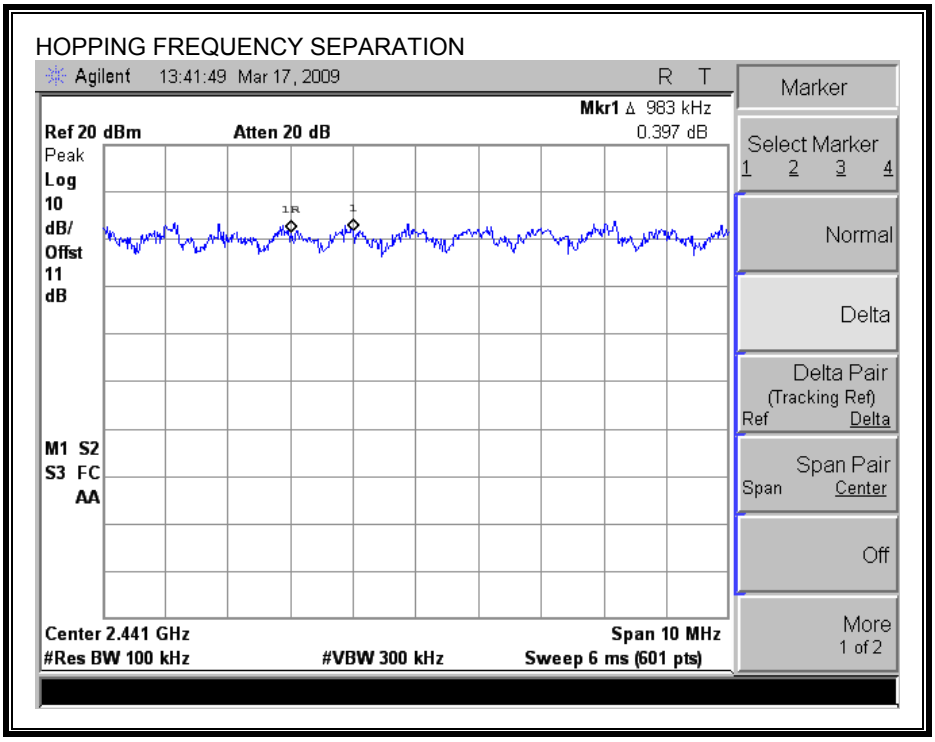
The transmitter output is connected to a spectrum analyzer. The RBW is set to 100 kHz and the VBW is set to 100 kHz. The sweep time is coupled.

**RESULTS**

## HOPPING FREQUENCY SEPARATION – GFSK MODE




## HOPPING FREQUENCY SEPARATION – 8PSK MODE



## 7.1.2. 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**

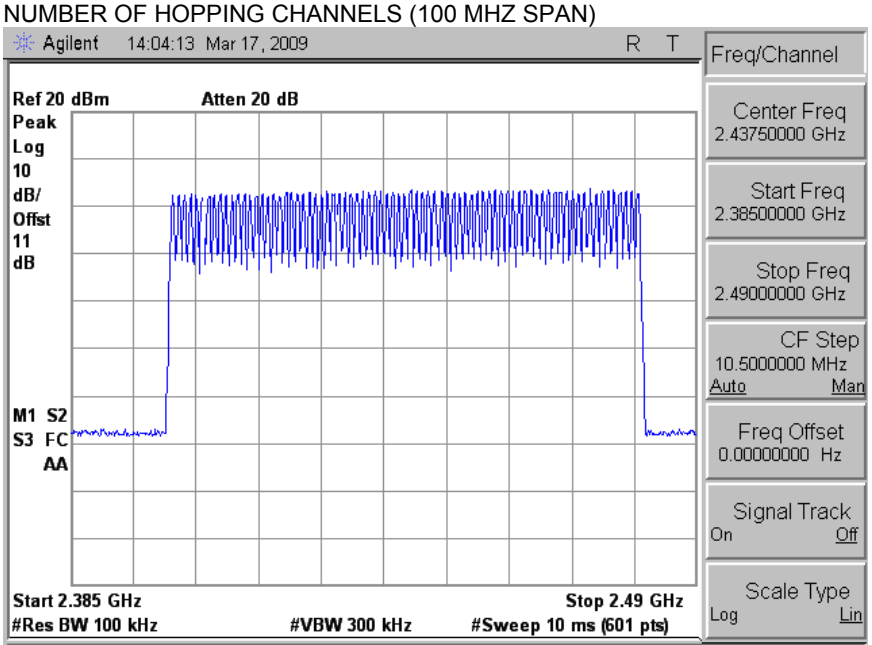
The transmitter output is connected to a spectrum analyzer. The span is set to cover the entire authorized band, in either a single sweep or in multiple contiguous sweeps. The RBW is set to a maximum of 1 % of the span. The analyzer is set to Max Hold.

**RESULTS**

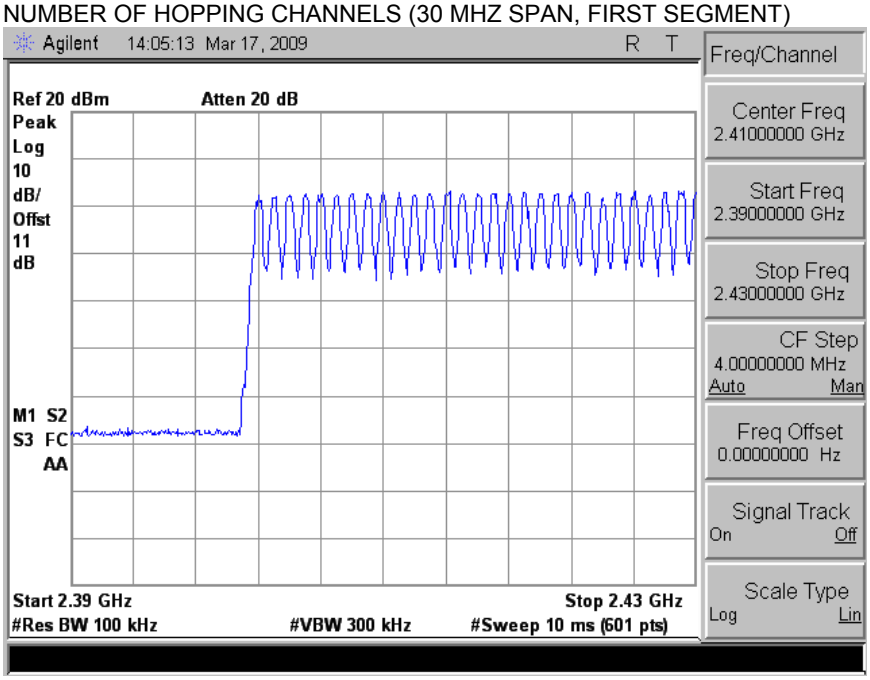
79 Channels observed.

## NUMBER OF HOPPING CHANNELS – GFSK MODE

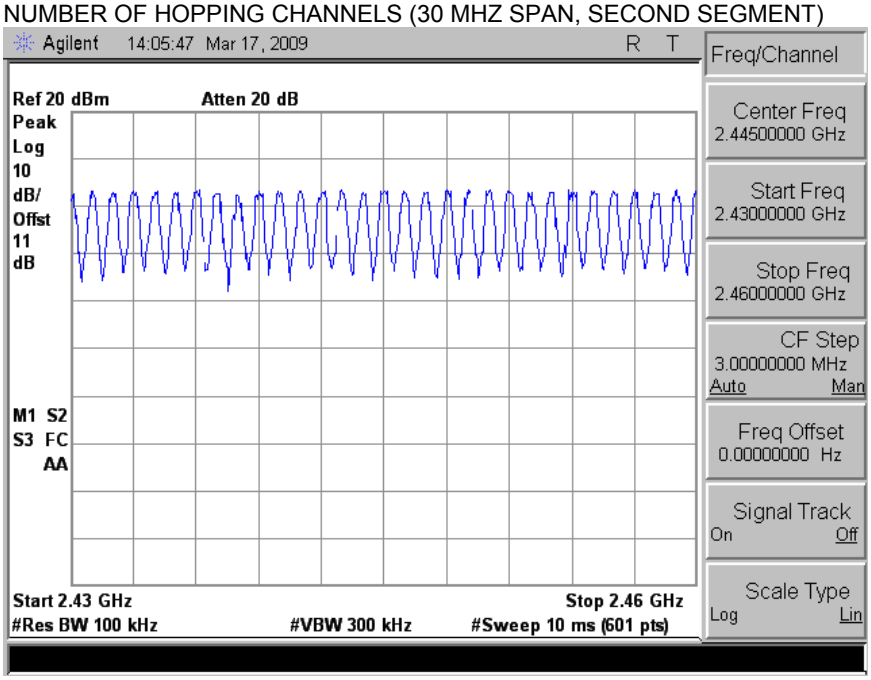
NUMBER OF HOPPING CHANNELS (100 MHZ SPAN)



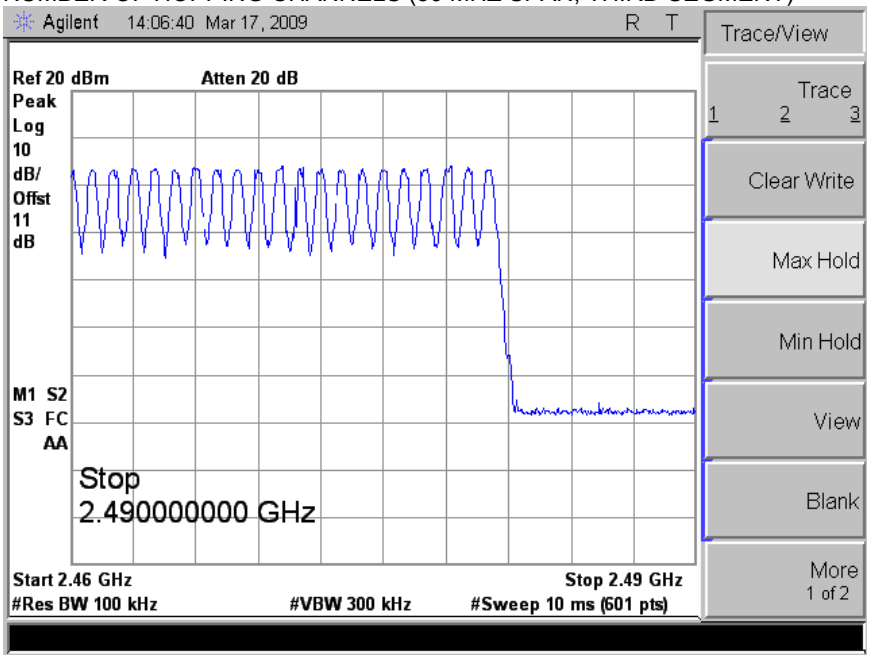

NUMBER OF HOPPING CHANNELS (30 MHZ SPAN, FIRST SEGMENT)



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

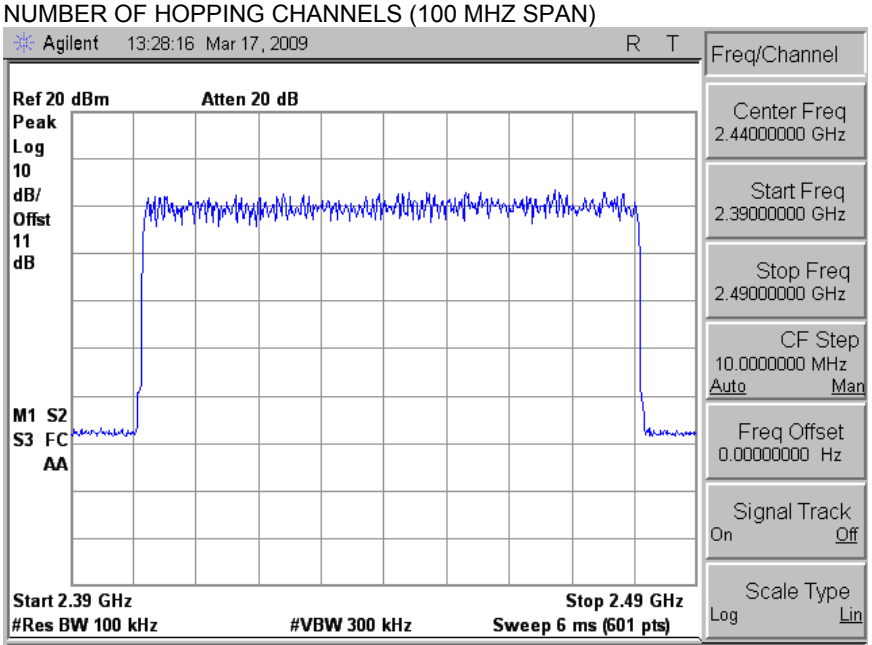



NUMBER OF HOPPING CHANNELS (30 MHZ SPAN, THIRD SEGMENT)

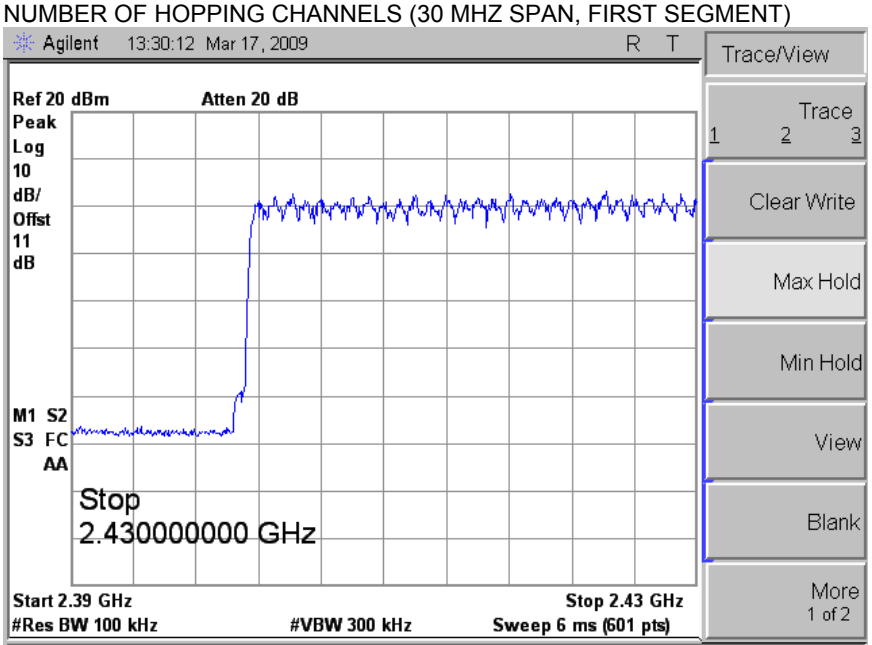


## NUMBER OF HOPPING CHANNELS – 8PSK MODE

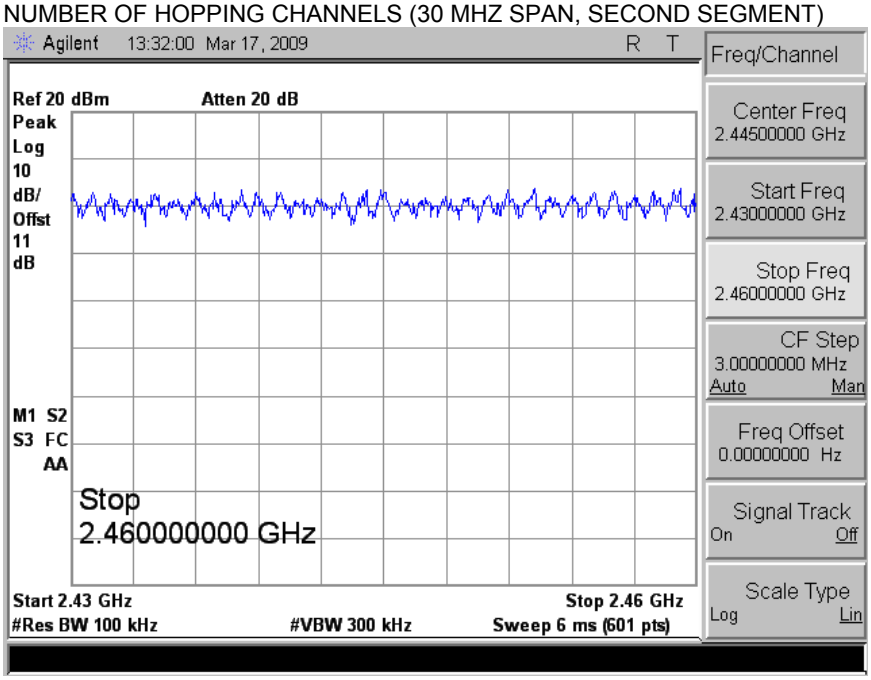
NUMBER OF HOPPING CHANNELS (100 MHZ SPAN)



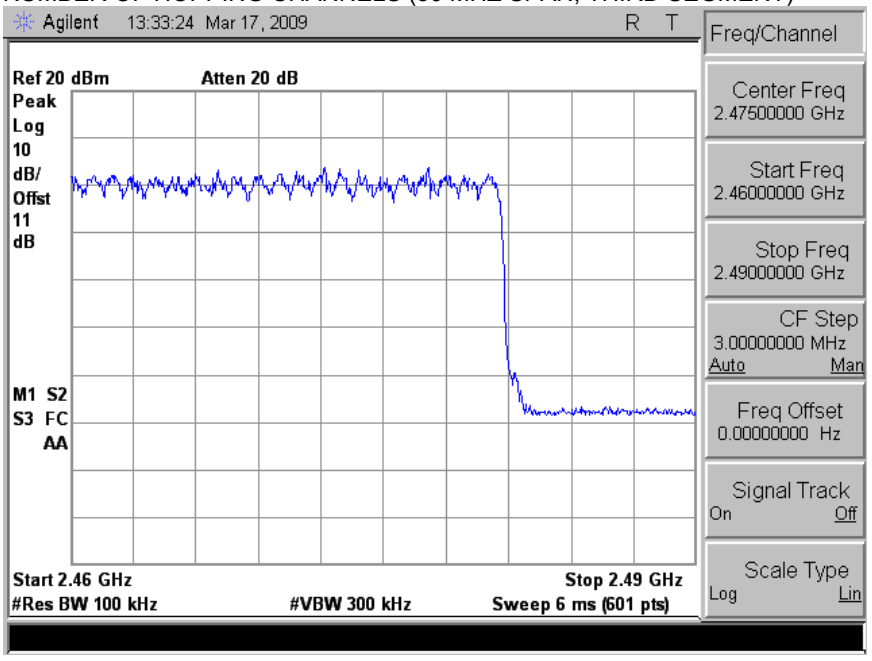

NUMBER OF HOPPING CHANNELS (30 MHZ SPAN, FIRST SEGMENT)



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




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



## 7.1.3. 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 * (# of pulses in 3.16 s) * pulse width.

**RESULTS**

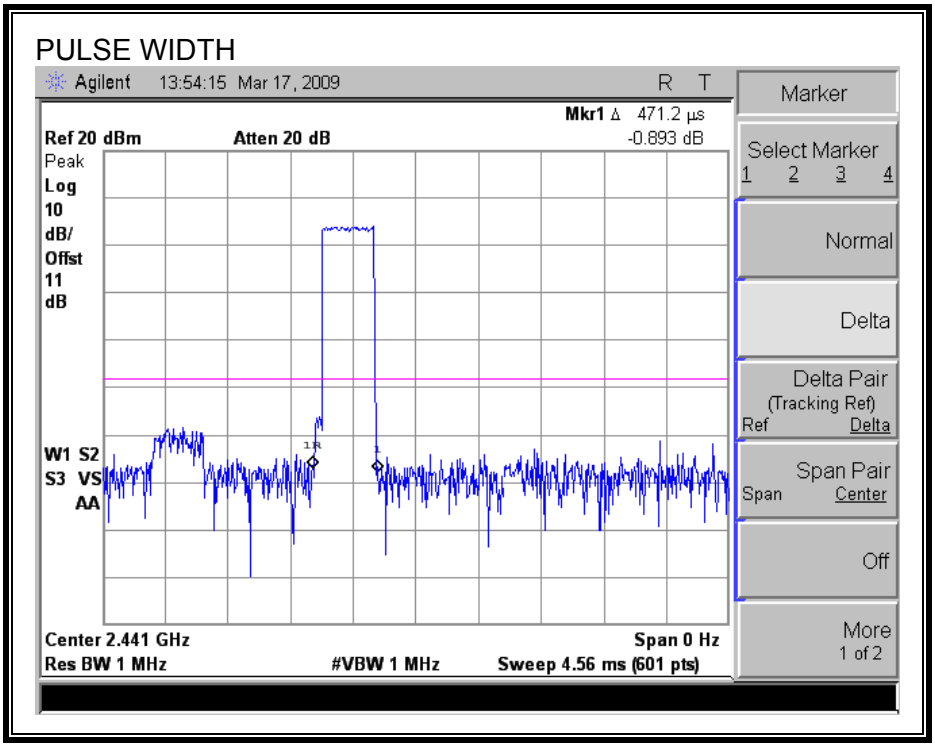
GFSK Mode

| DH Packet | Pulse Width (msec) | Number of Pulses in 3.16 seconds | Average Time of (sec) | Limit (sec) | Margin (sec) |
|---|---|---|---|---|---|
| DH1 | 0.471 | 32 | 0.151 | 0.4 | 0.249 |
| DH3 | 1.750 | 13 | 0.228 | 0.4 | 0.173 |
| DH5 | 2.983 | 10 | 0.298 | 0.4 | 0.102 |

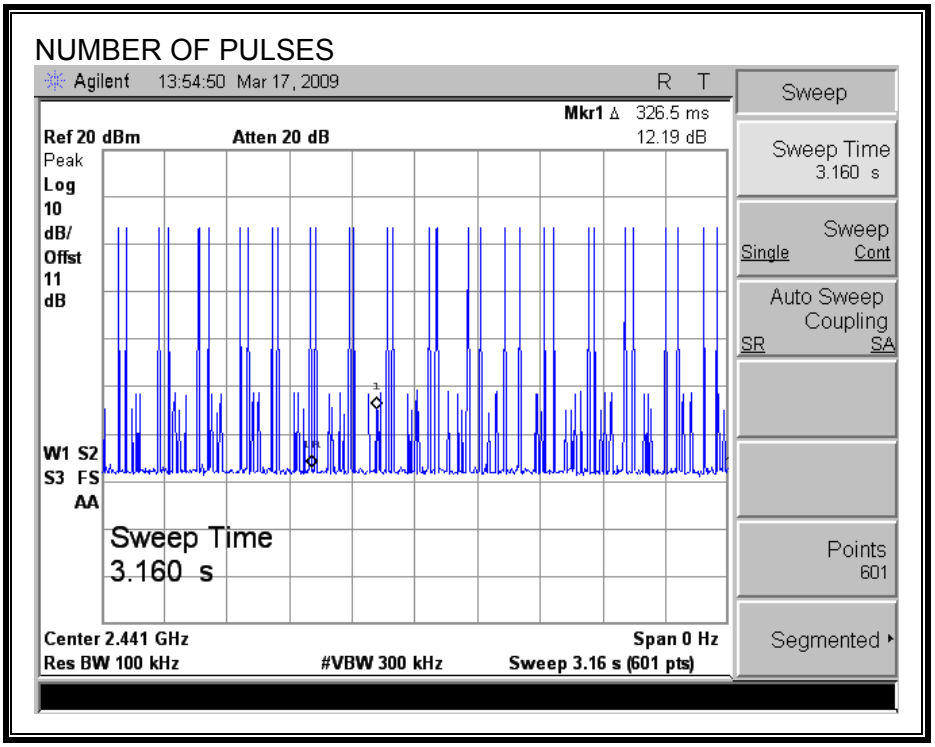
8PSK Mode

| DH Packet | Pulse Width (msec) | Number of Pulses in 3.16 seconds | Average Time of Occupancy (sec) | Limit (sec) | Margin (sec) |
|---|---|---|---|---|---|
| DH1 | 0.475 | 32 | 0.152 | 0.4 | 0.248 |
| DH3 | 1.738 | 14 | 0.243 | 0.4 | 0.157 |
| DH5 | 2.967 | 11 | 0.326 | 0.4 | 0.074 |

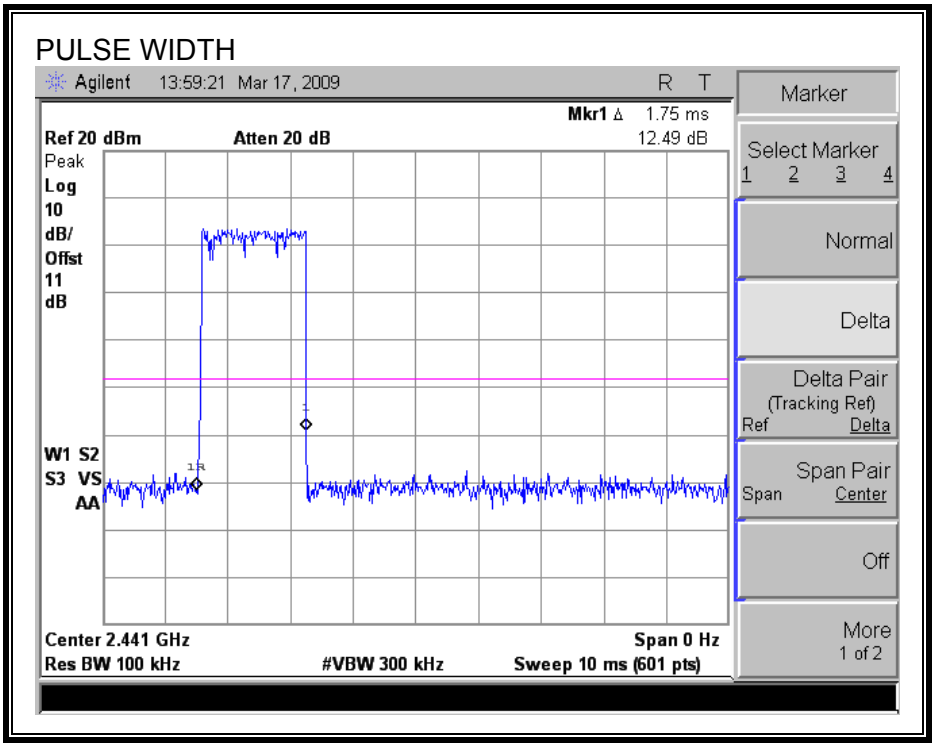
**GFSK MODE - FREQUENCY PACKET DH1**



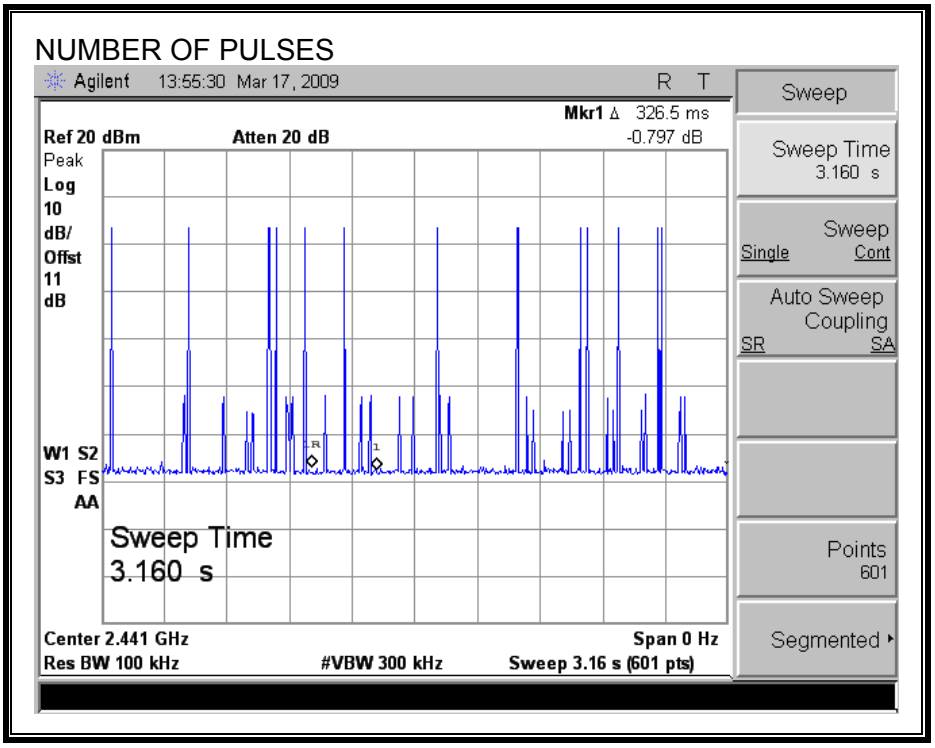

**NUMBER OF PULSES IN 3.16 SECOND OBSERVATION PERIOD**



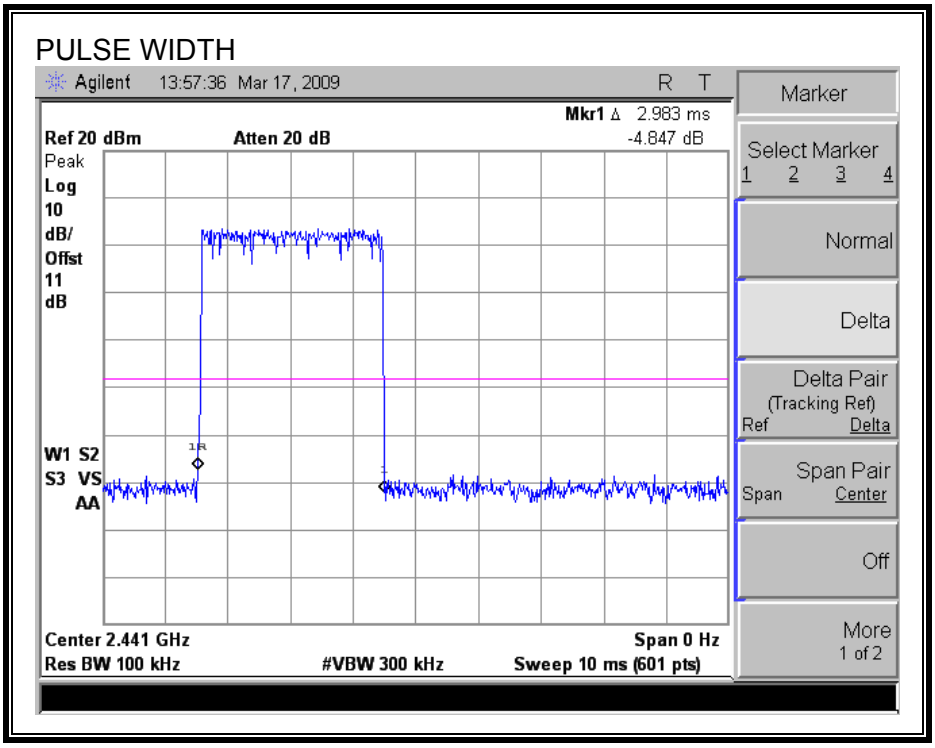
**FREQUENCY PACKET DH3**



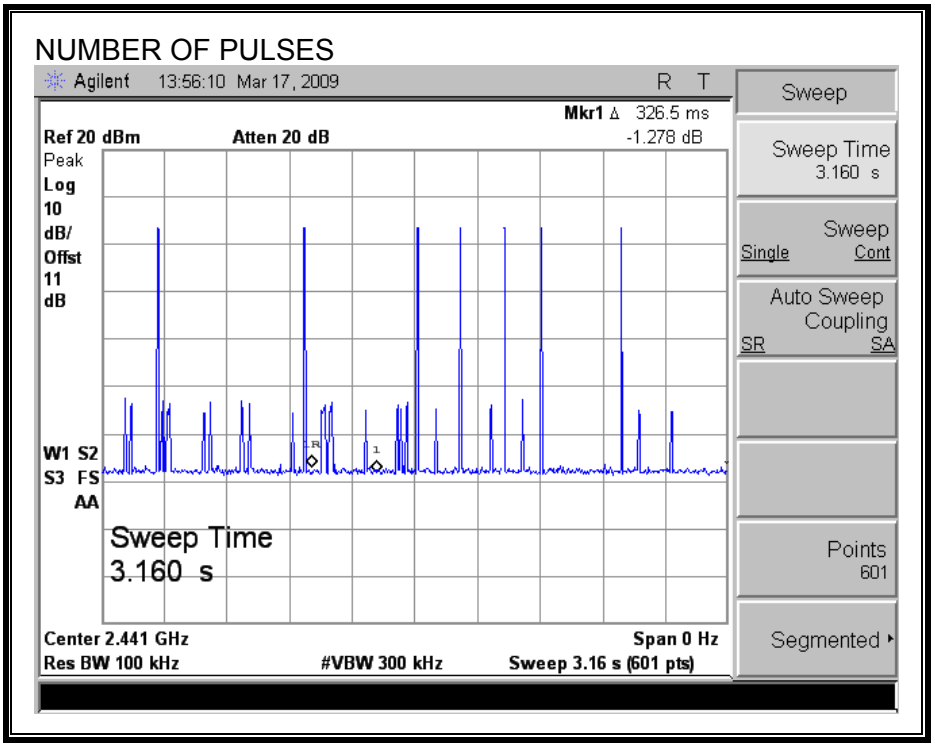

**NUMBER OF PULSES IN 3.16 SECOND OBSERVATION PERIOD**



**FREQUENCY PACKET DH5**

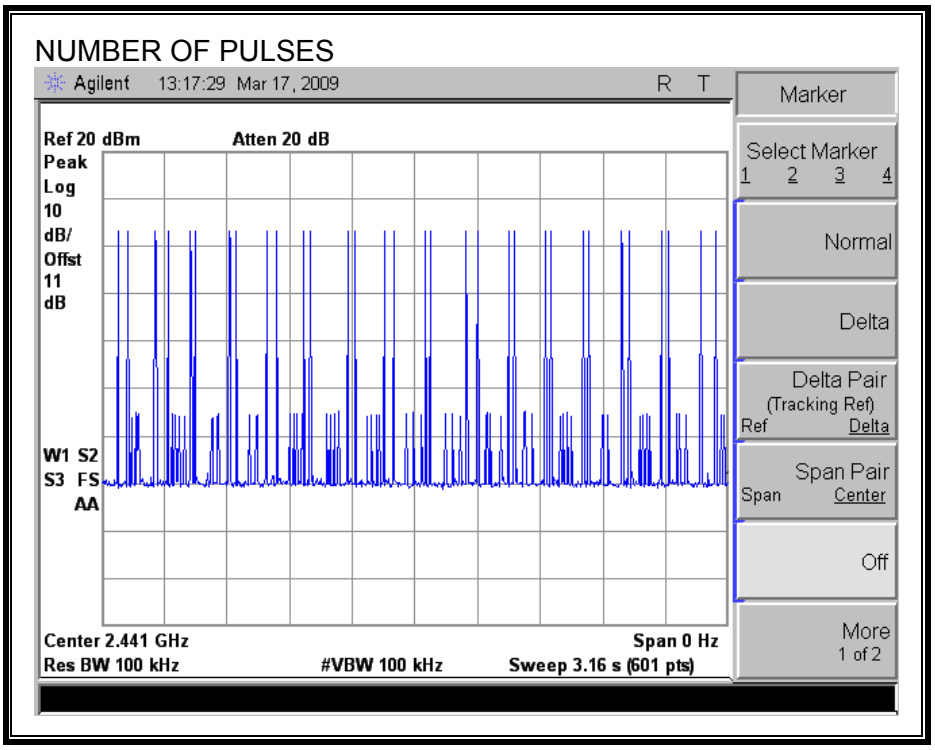



**NUMBER OF PULSES IN 3.16 SECOND OBSERVATION PERIOD**

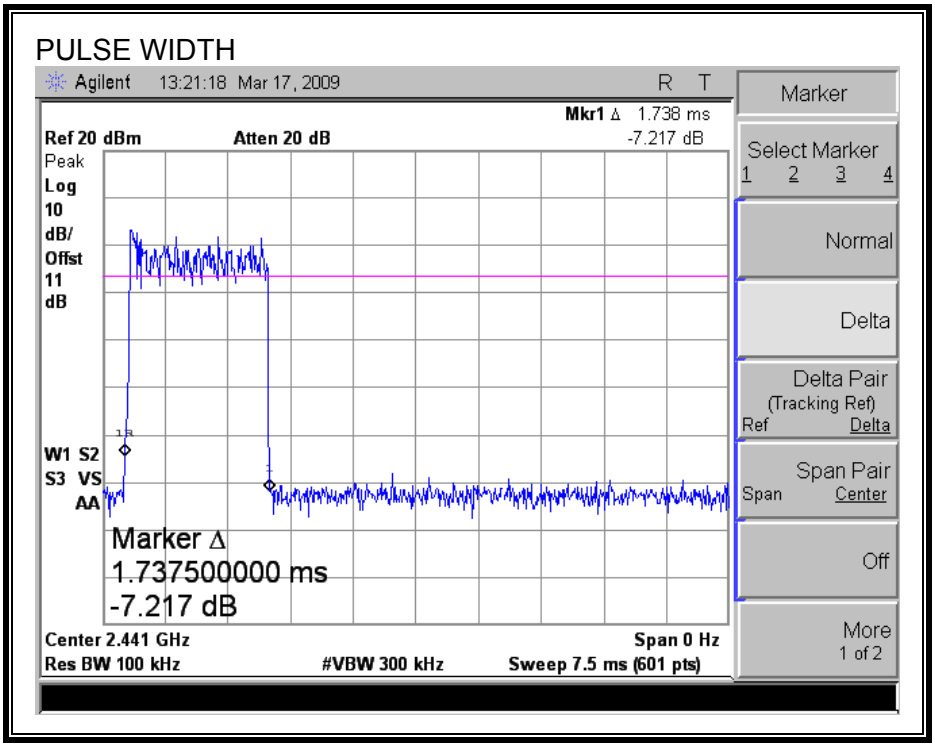


**8PSK MODE - FREQUENCY PACKET DH1**

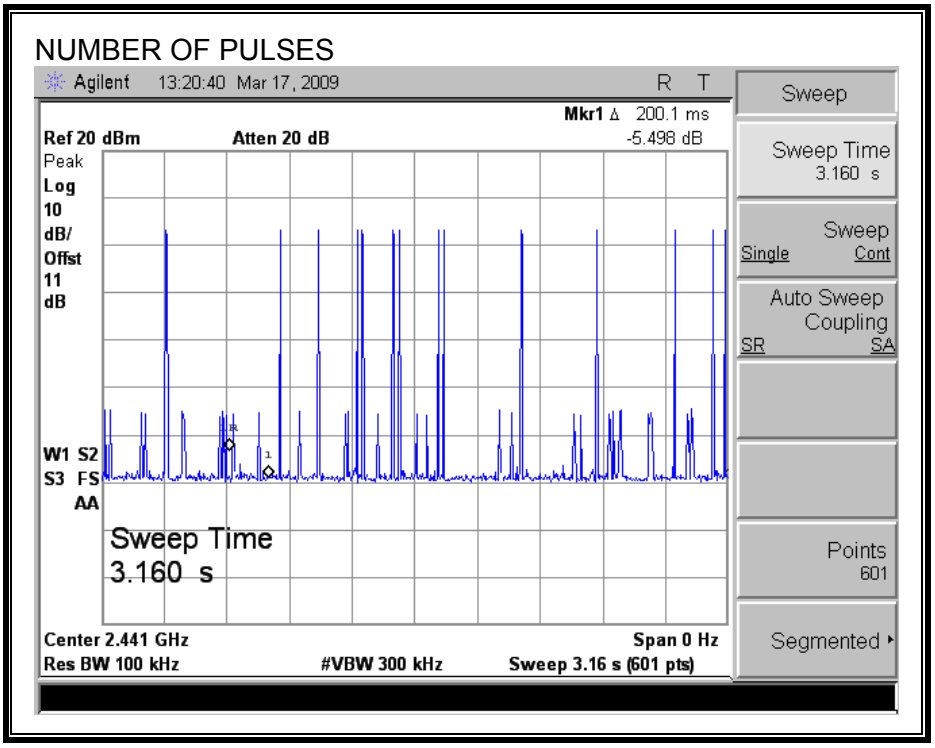

**NUMBER OF PULSES IN 3.16 SECOND OBSERVATION PERIOD**



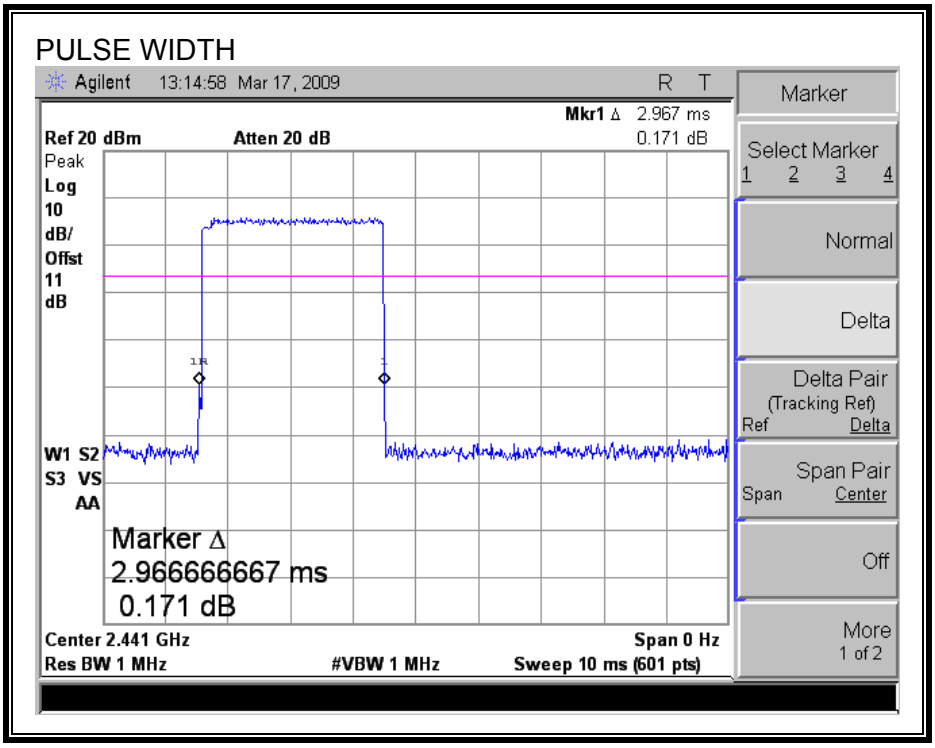
**FREQUENCY PACKET DH3**



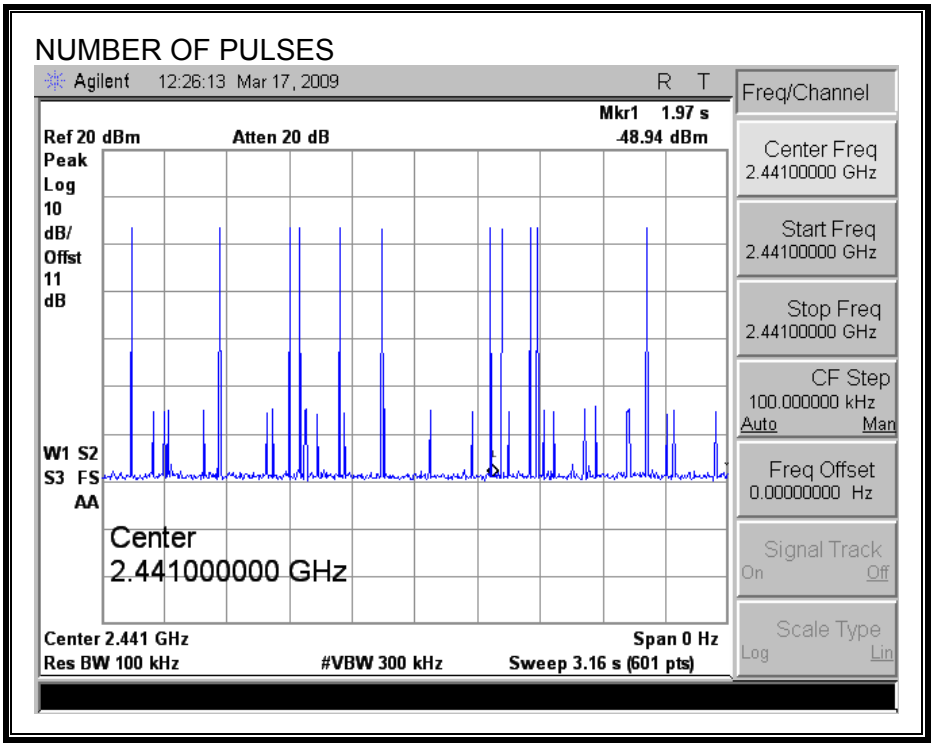

**NUMBER OF PULSES IN 3.16 SECOND OBSERVATION PERIOD**



**FREQUENCY PACKET DH5**




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



## 7.1.4. 20 dB AND 99% BANDWIDTH

**LIMIT**

None; for reporting purposes only.

**TEST PROCEDURE**

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

**RESULTS**

GFSK MODE

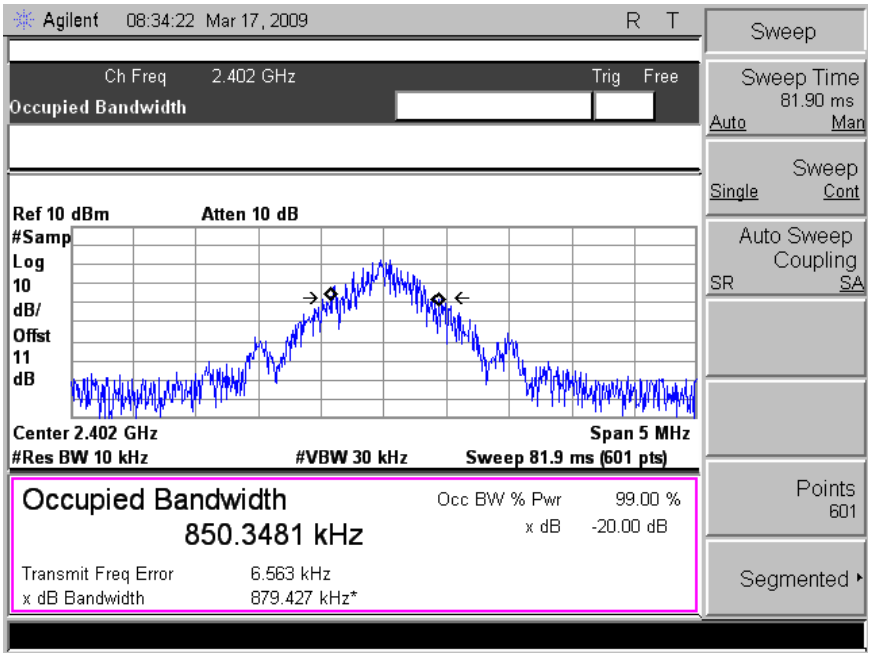
| Channel | Frequency (MHz) | 20 dB Bandwidth (kHz) | 99% Bandwidth (kHz) |
|---|---|---|---|
| 0 | 2402 | 879.427 | 850.3481 |
| 39 | 2441 | 877.662 | 848.7849 |
| 78 | 2480 | 888.765 | 852.1427 |

8PSK MODE

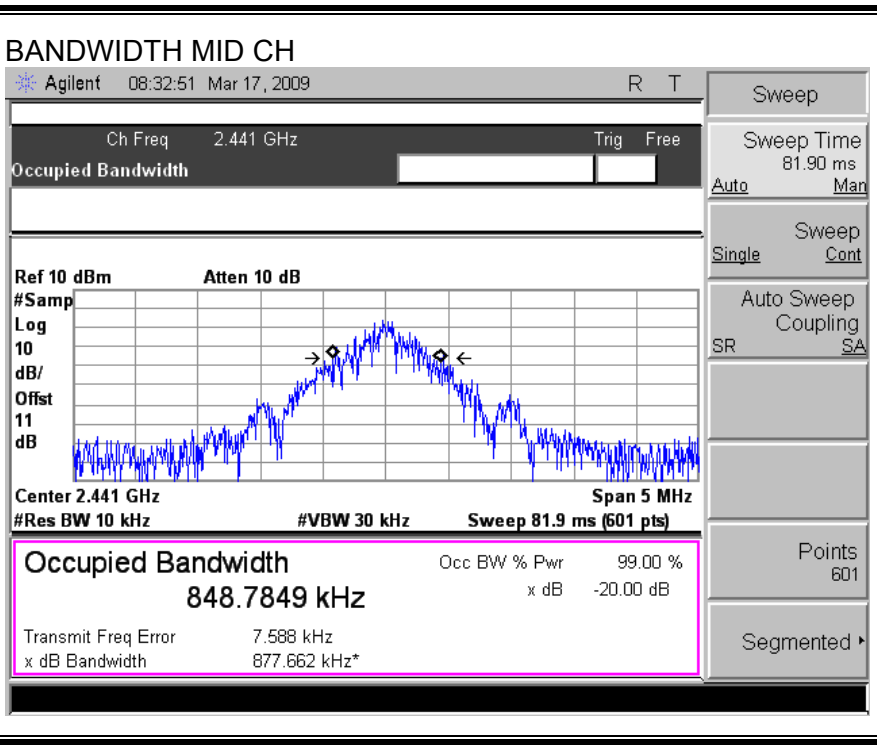
| Channel | Frequency (MHz) | 20 dB Bandwidth (MHz) | 99% Bandwidth (MHz) |
|---|---|---|---|
| 0 | 2402 | 1.284 | 1.1436 |
| 39 | 2441 | 1.332 | 1.2442 |
| 78 | 2480 | 1.296 | 1.1854 |

**GFSK MODE**
**99% AND 20 dB BANDWIDTH**

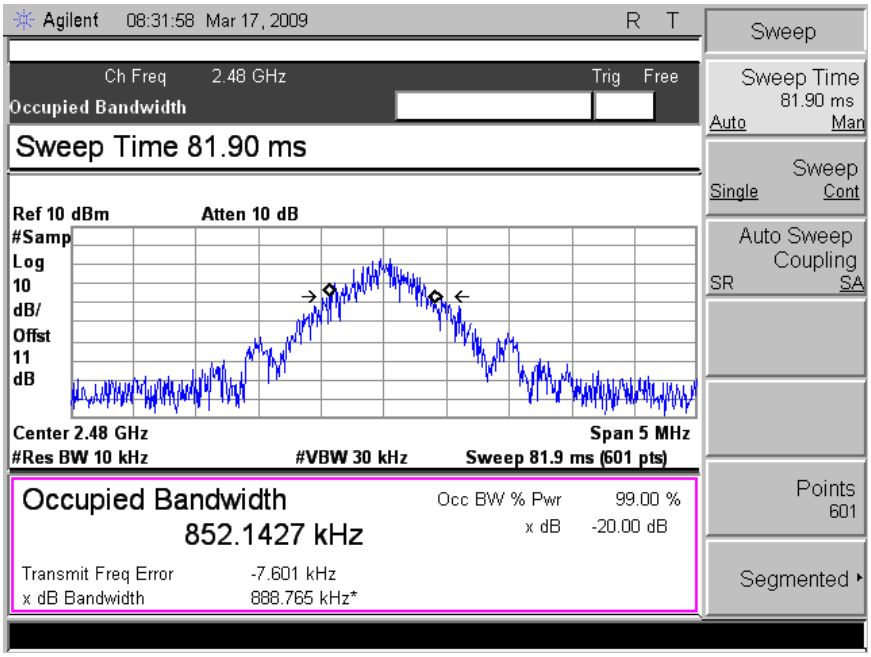
BANDWIDTH LOW CH




BANDWIDTH MID CH

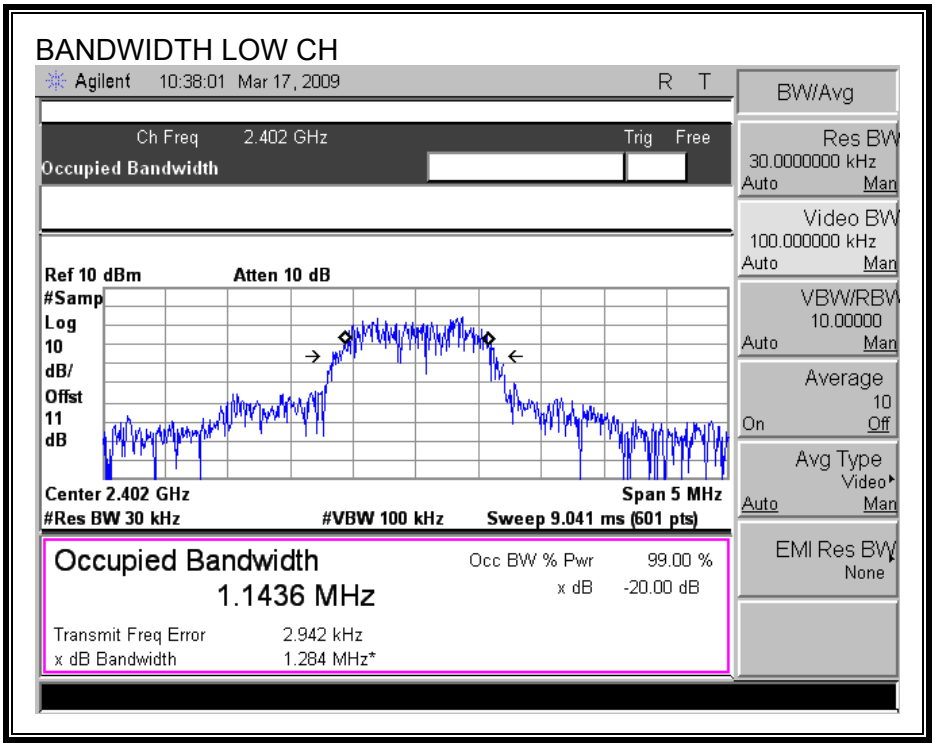


BANDWIDTH HIGH CH

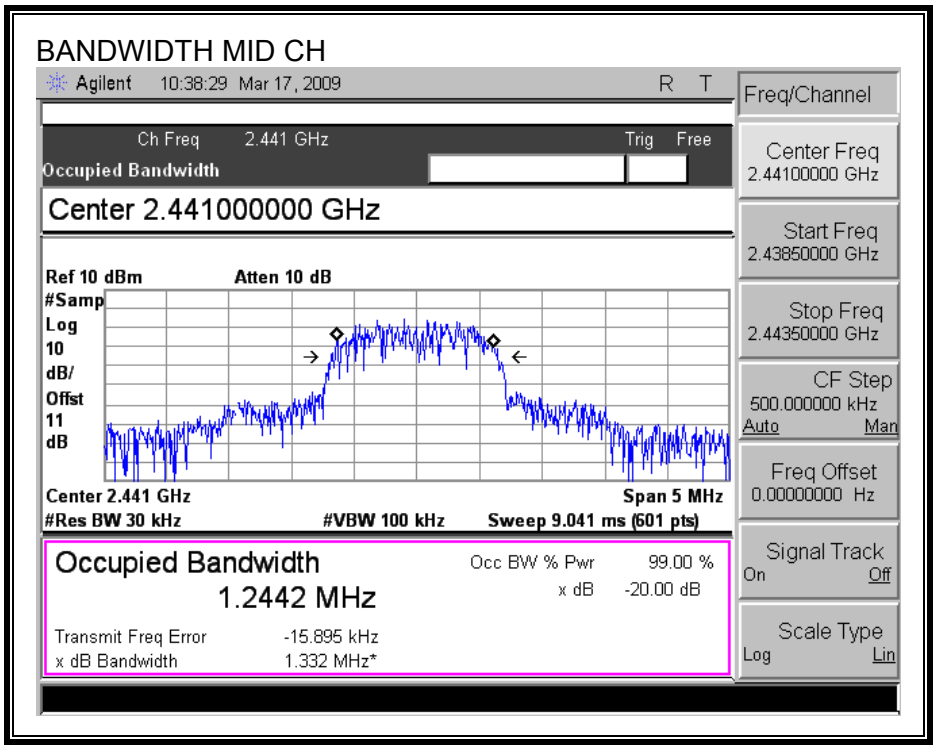


**8PSK**
**99% AND 20 dB BANDWIDTH**

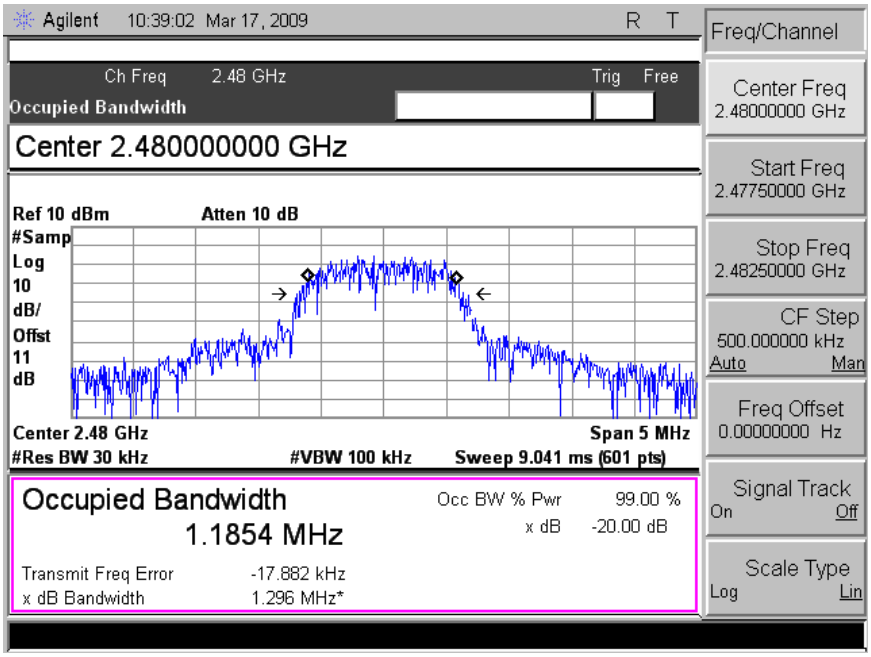
BANDWIDTH LOW CH




BANDWIDTH MID CH



BANDWIDTH HIGH CH



## 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**

GFSK MODE

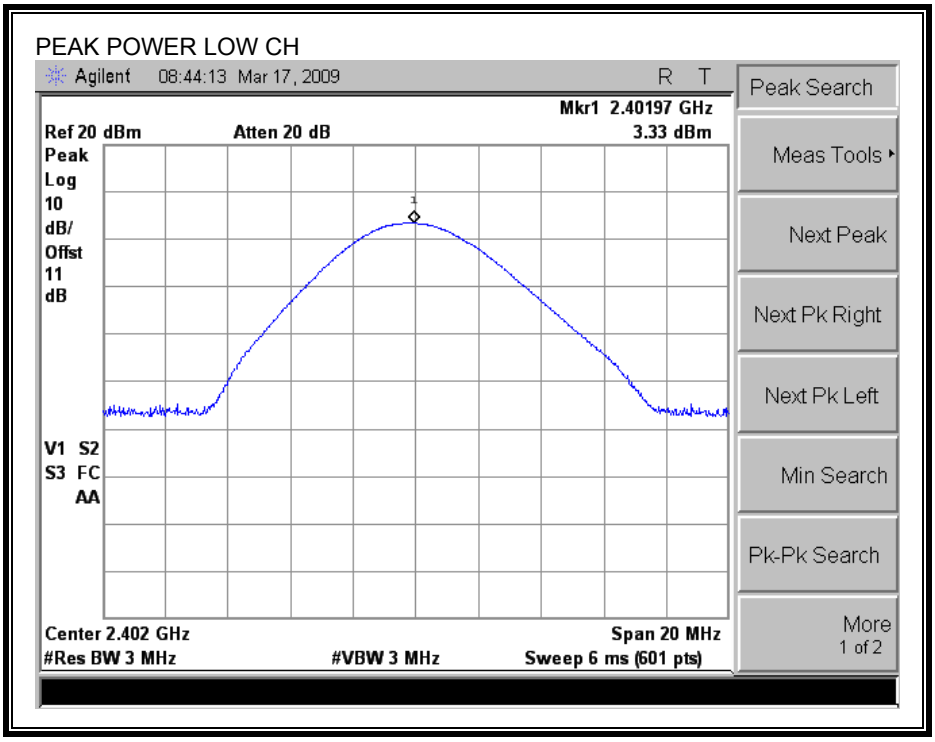
| Channel | Frequency (MHz) | Output Power (dBm) | Limit (dBm) | Margin (dB) |
|---|---|---|---|---|
| 0 | 2402 | 3.33 | 30 | -26.67 |
| 39 | 2441 | 4.09 | 30 | -25.91 |
| 78 | 2480 | 4.34 | 30 | -25.66 |

8PSK MODE

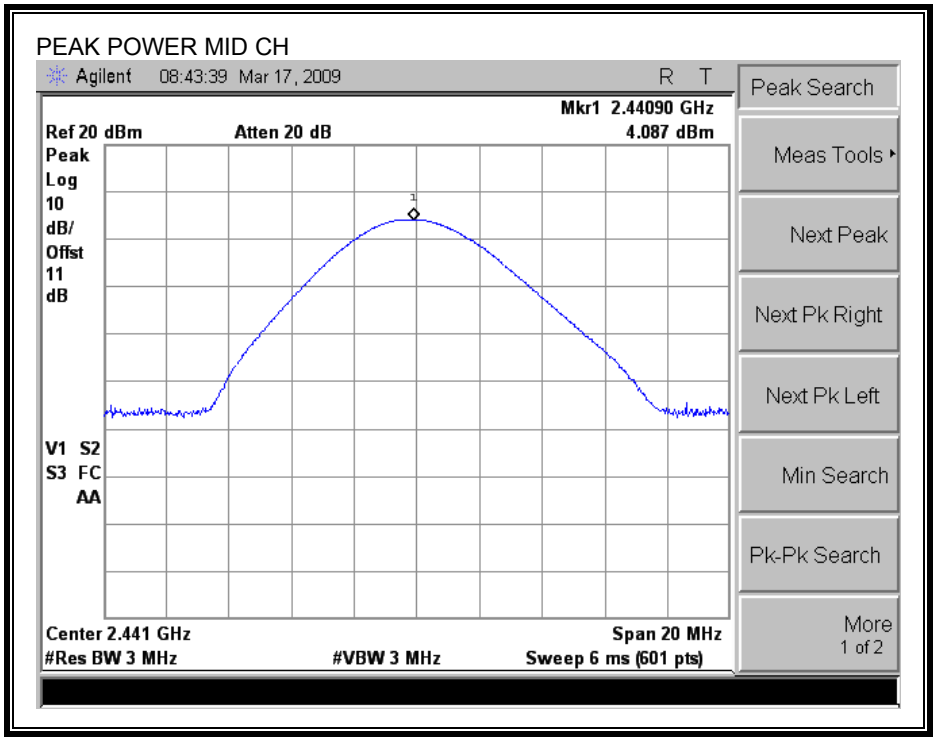
| Channel | Frequency (MHz) | Output Power (dBm) | Limit (dBm) | Margin (dB) |
|---|---|---|---|---|
| 0 | 2402 | 6.10 | 30 | -23.90 |
| 39 | 2441 | 6.77 | 30 | -23.23 |
| 78 | 2480 | 7.02 | 30 | -22.98 |

**OUTPUT POWER - GFSK**

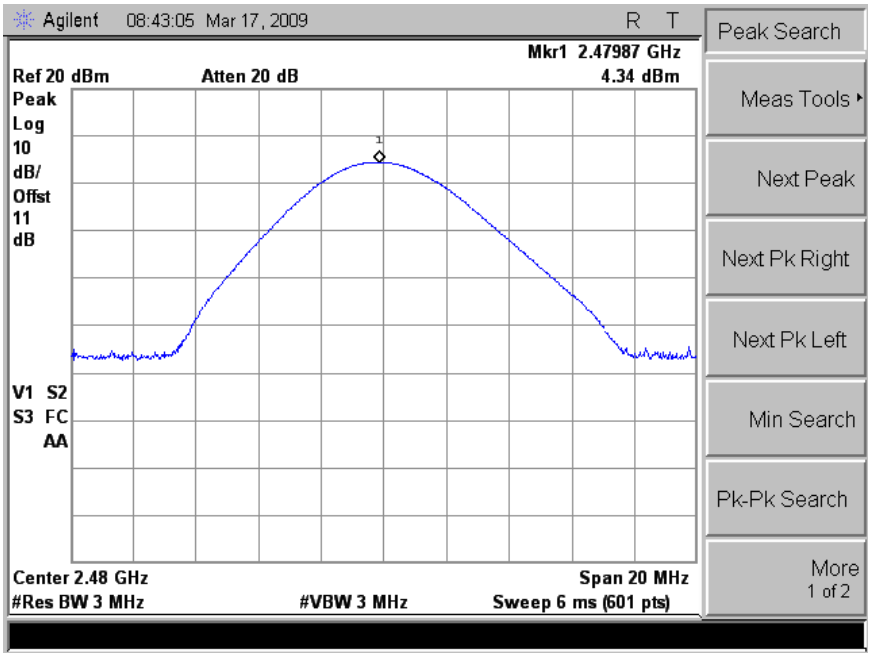
PEAK POWER LOW CH




PEAK POWER MID CH

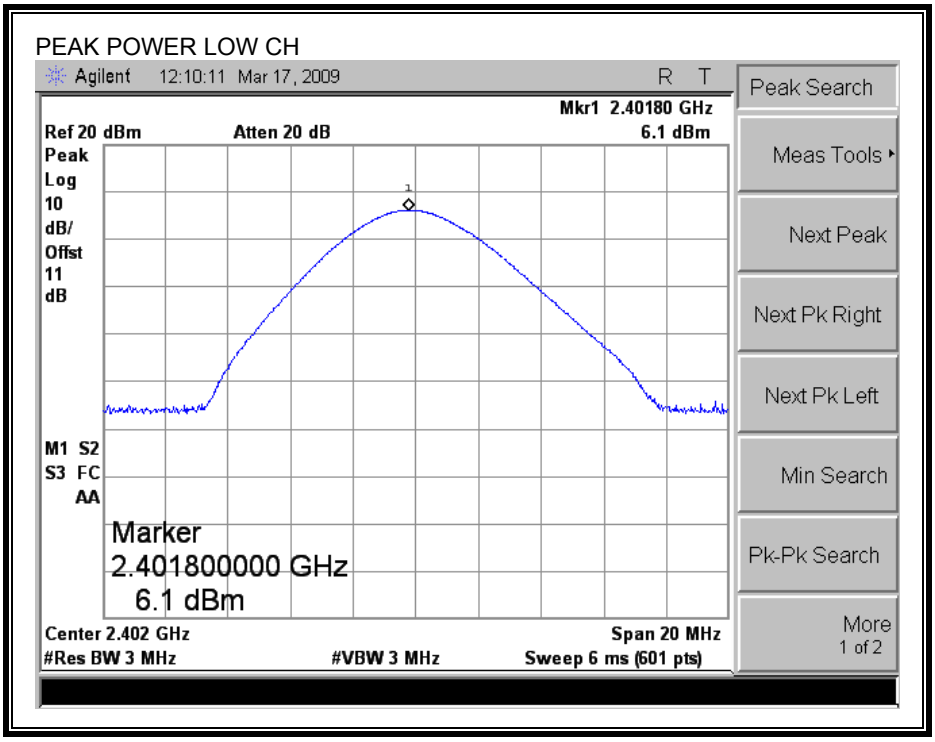


PEAK POWER HIGH CH

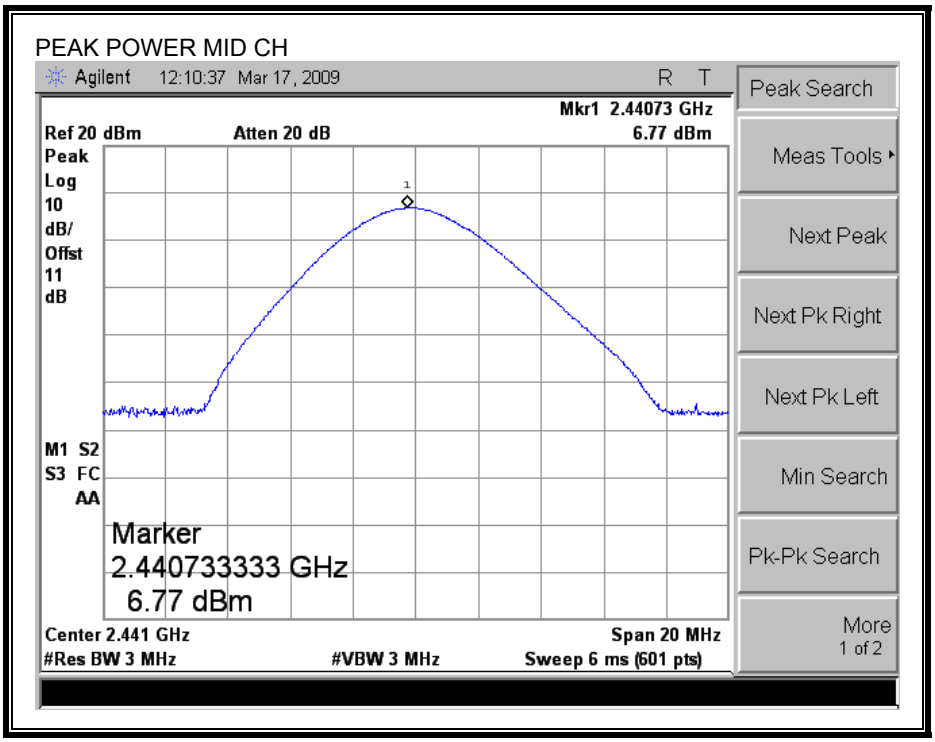


**OUTPUT POWER – 8PSK**

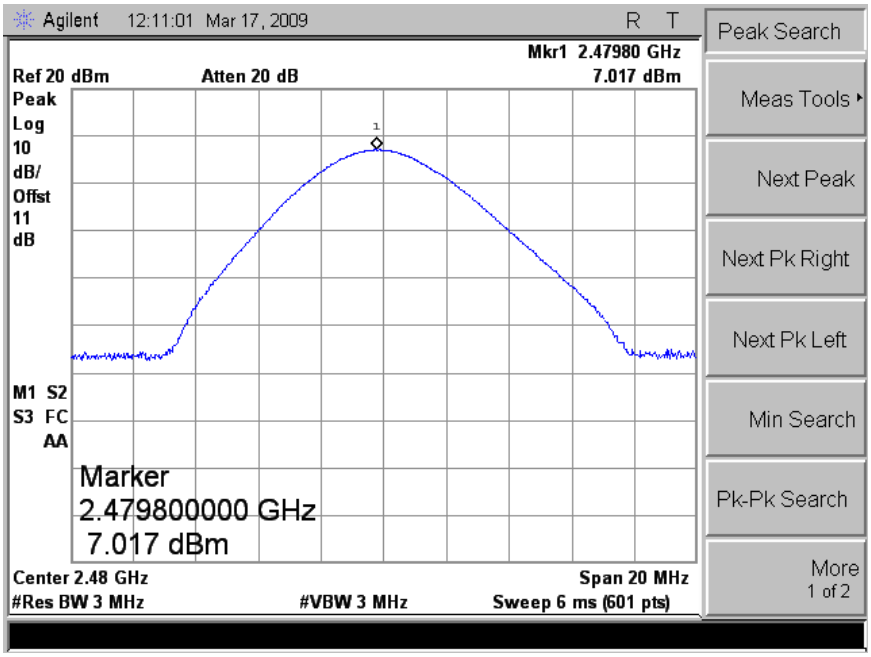
PEAK POWER LOW CH




PEAK POWER MID CH



PEAK POWER HIGH CH



## 7.1.6. 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.

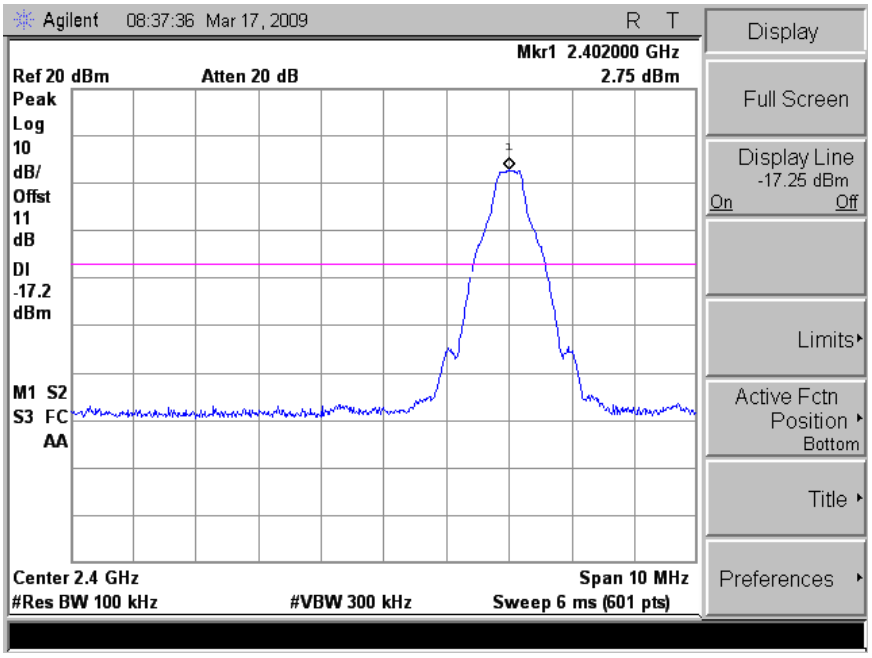
The spectrum from 30 MHz to 26 GHz is investigated with the transmitter set to the lowest, middle, and highest channels.

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

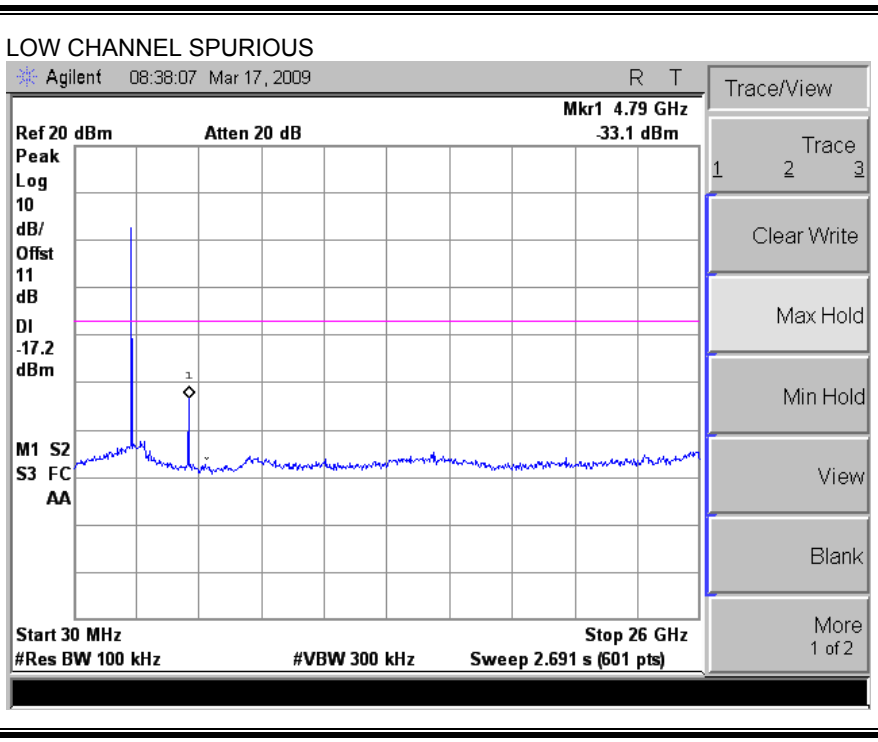
**RESULTS**

**SPURIOUS EMISSIONS, LOW CHANNEL – GFSK MODE**

LOW CHANNEL BANDEDGE

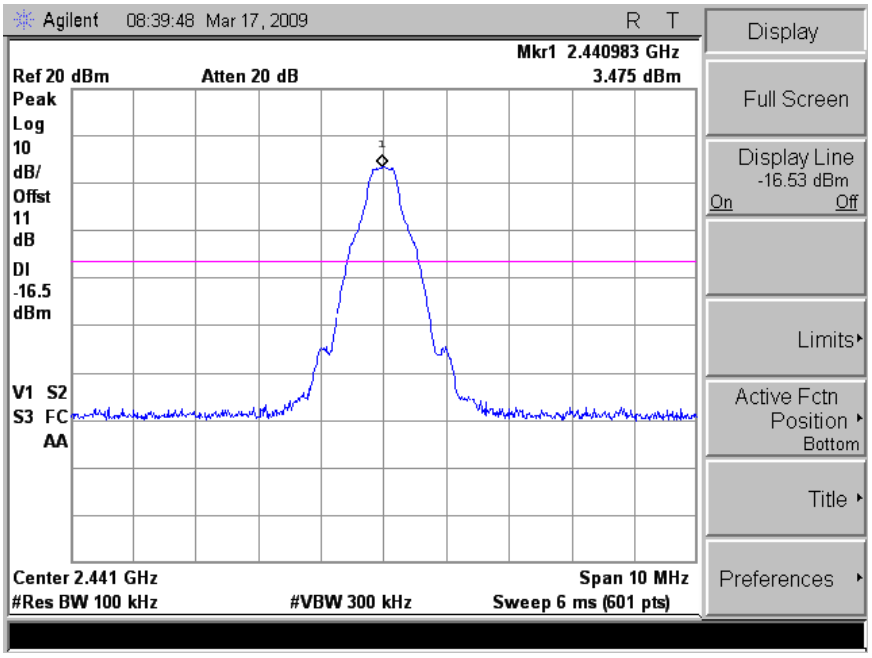



LOW CHANNEL SPURIOUS

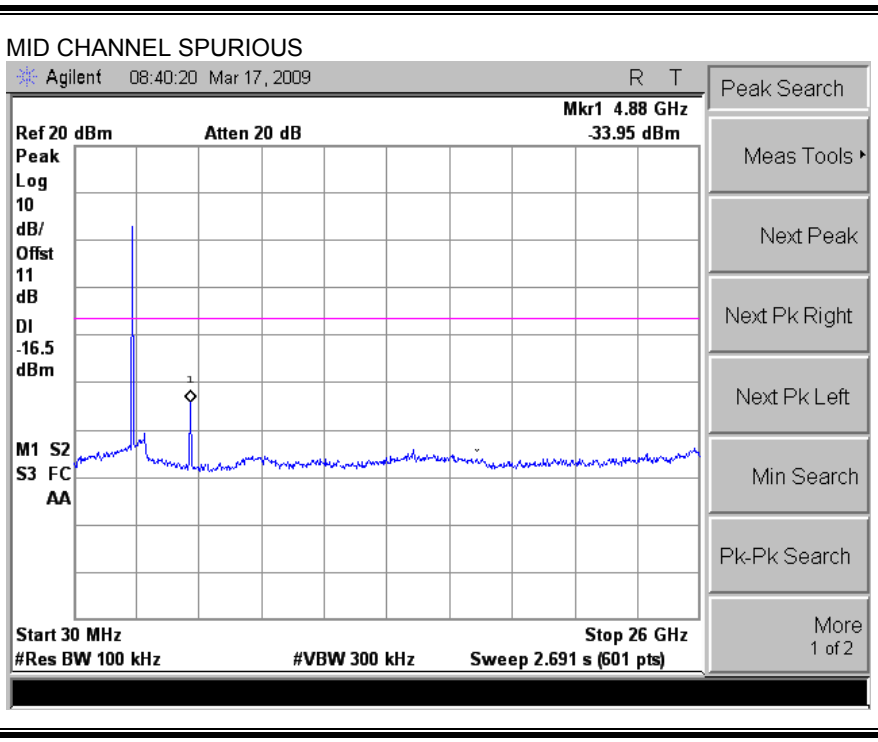


**SPURIOUS EMISSIONS, MID CHANNEL – GFSK MODE**

MID CHANNEL REFERENCE

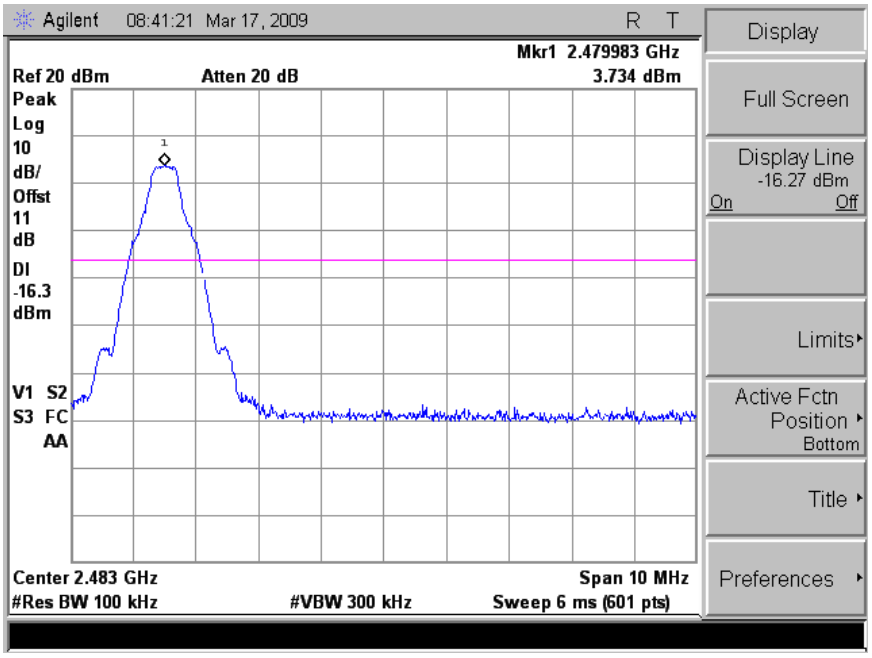



MID CHANNEL SPURIOUS

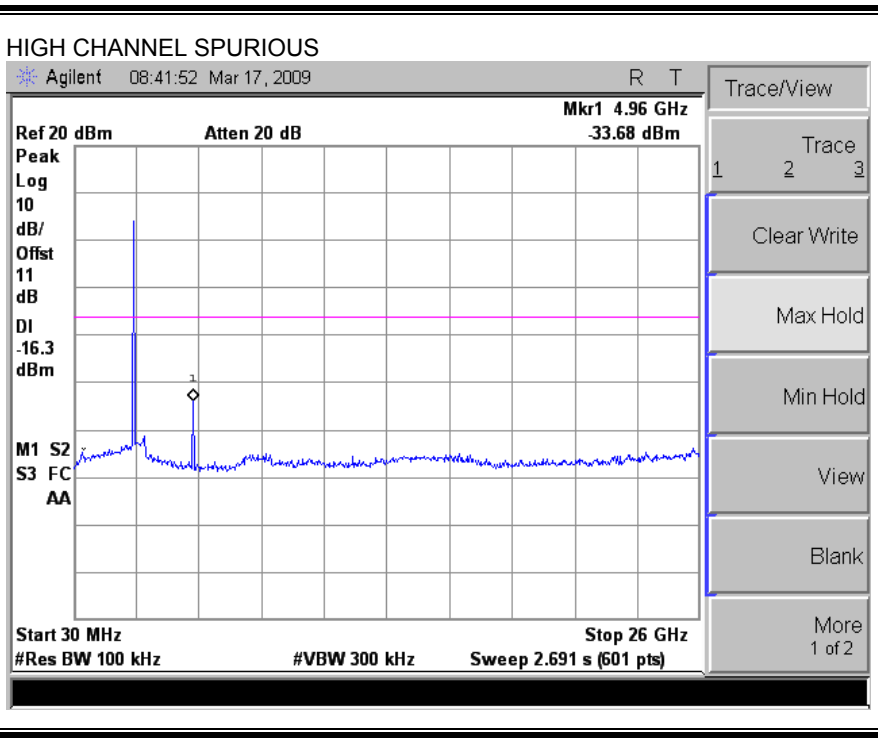


**SPURIOUS EMISSIONS, HIGH CHANNEL – GFSK MODE**

HIGH CHANNEL BANDEDGE

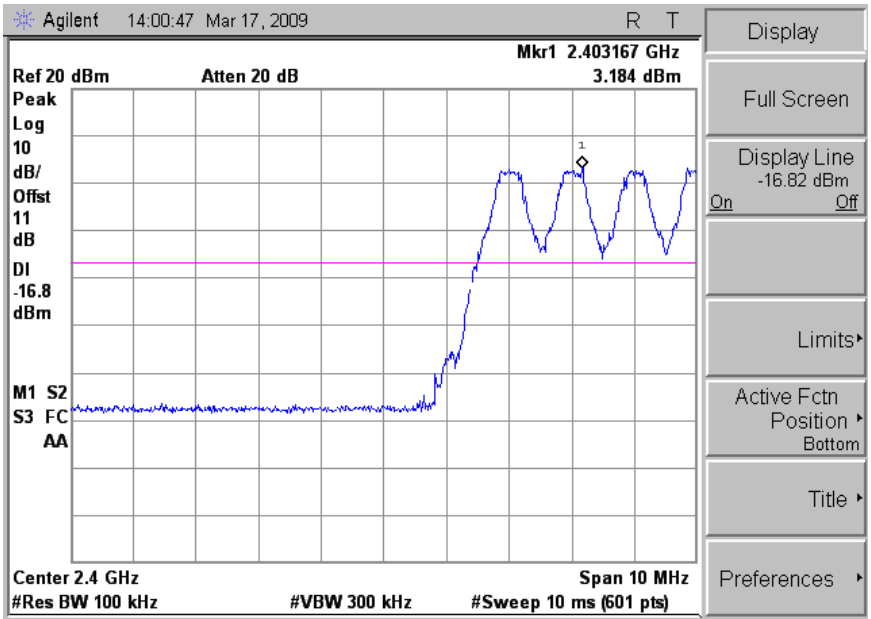



HIGH CHANNEL SPURIOUS

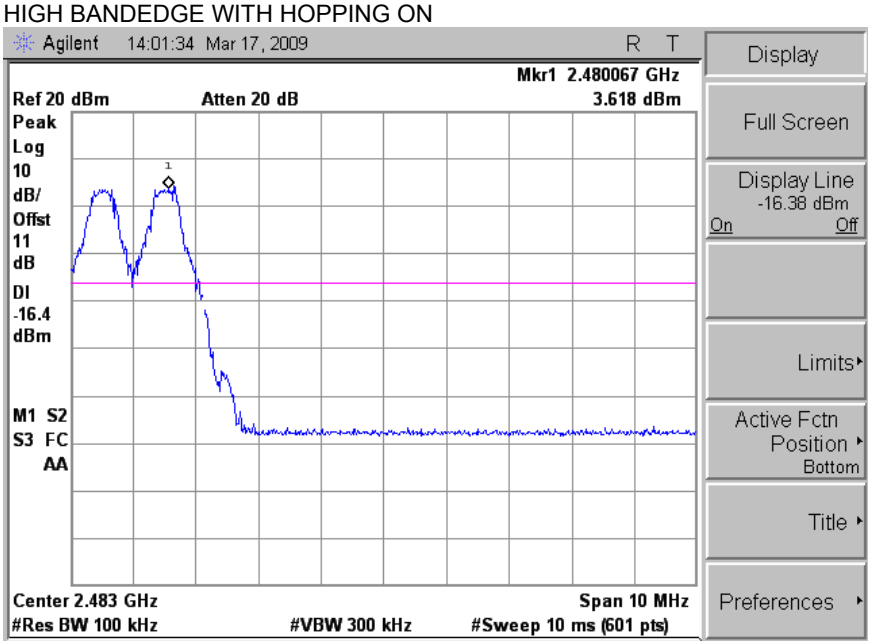


**SPURIOUS BANDEDGE EMISSIONS WITH HOPPING ON – GFSK MODE**

LOW BANDEDGE WITH HOPPING ON

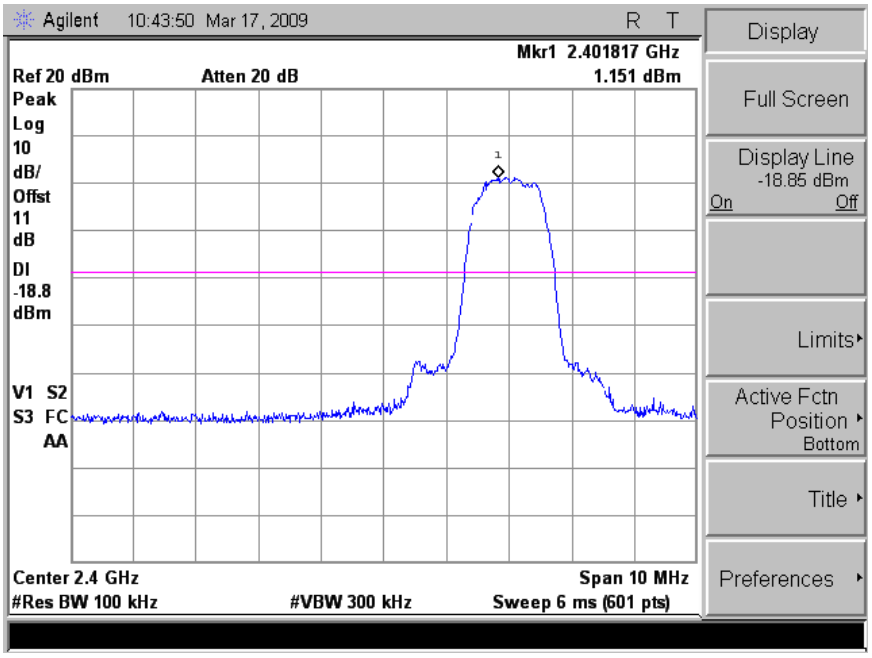



HIGH BANDEDGE WITH HOPPING ON

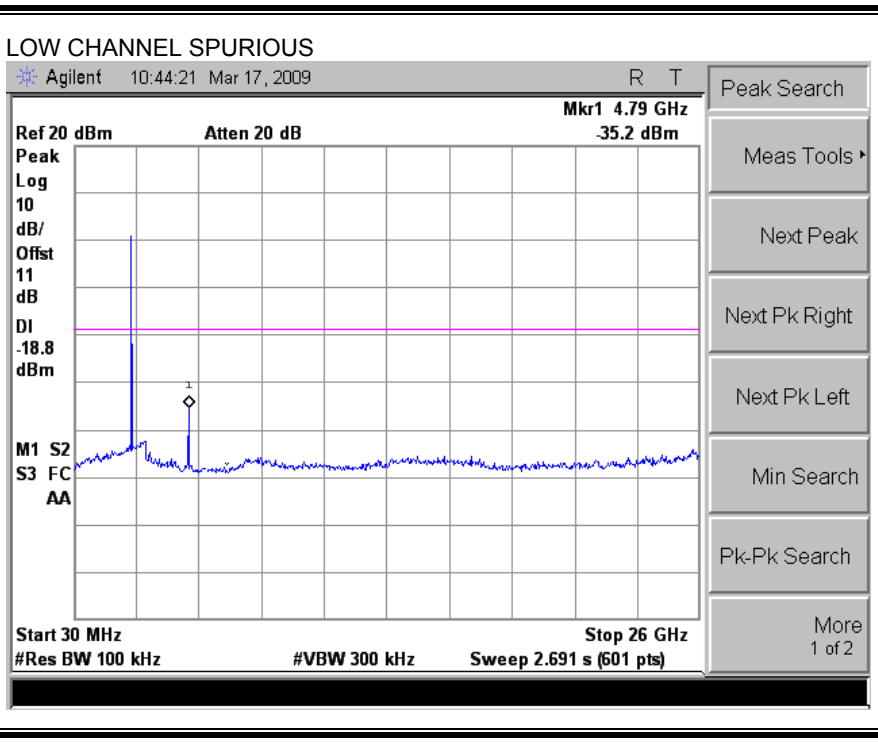


**SPURIOUS EMISSIONS, LOW CHANNEL – 8PSK MODE**

LOW CHANNEL BANDEDGE

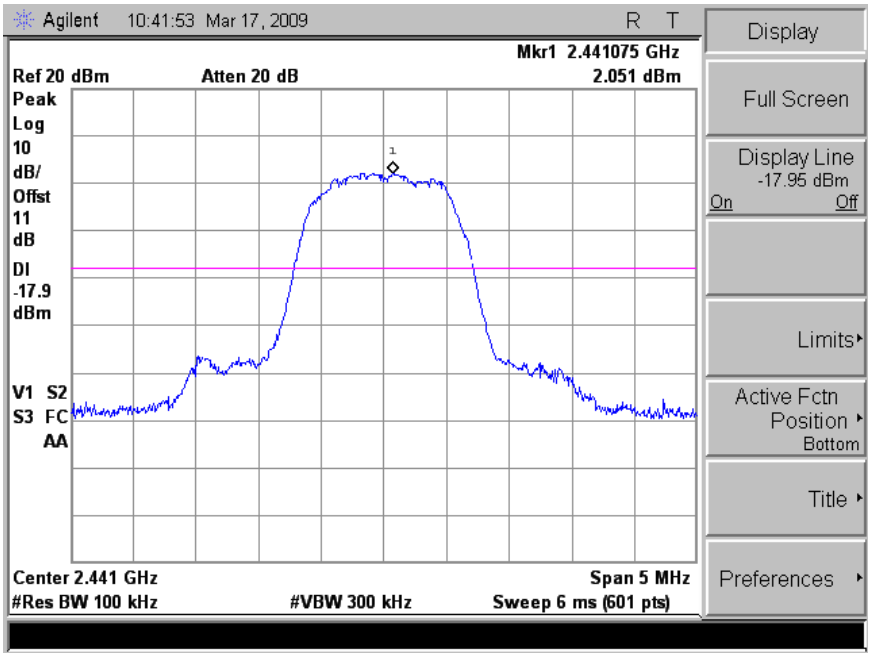



LOW CHANNEL SPURIOUS

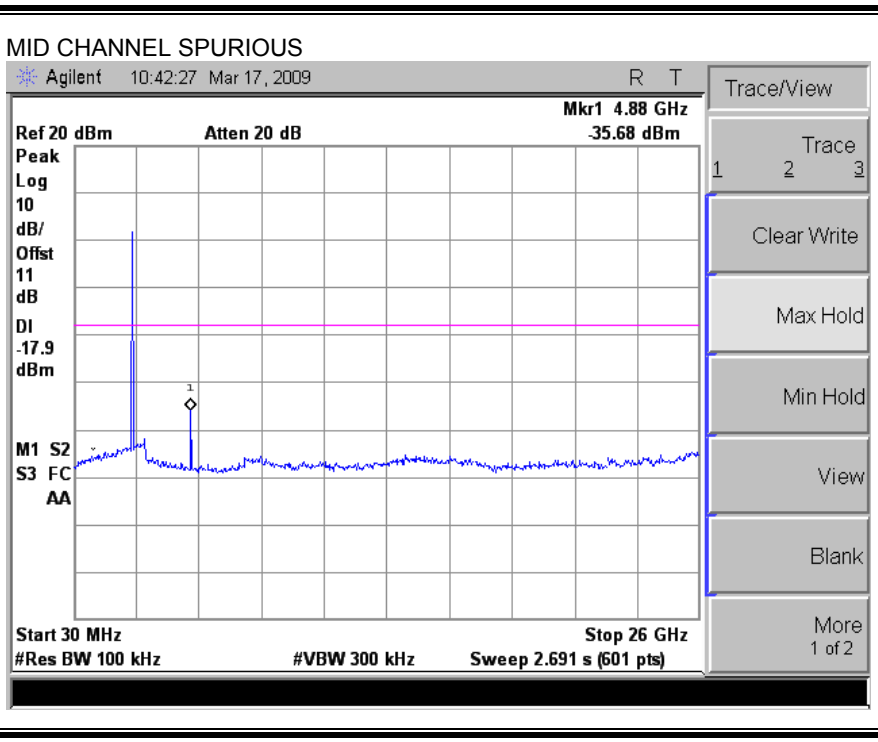


**SPURIOUS EMISSIONS, MID CHANNEL – 8PSK MODE**

MID CHANNEL REFERENCE

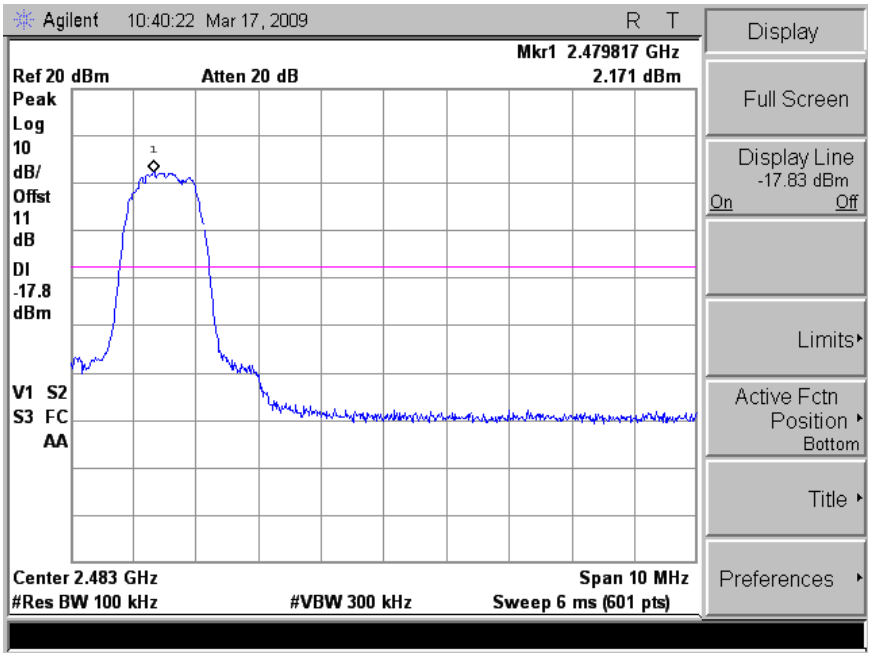



MID CHANNEL SPURIOUS

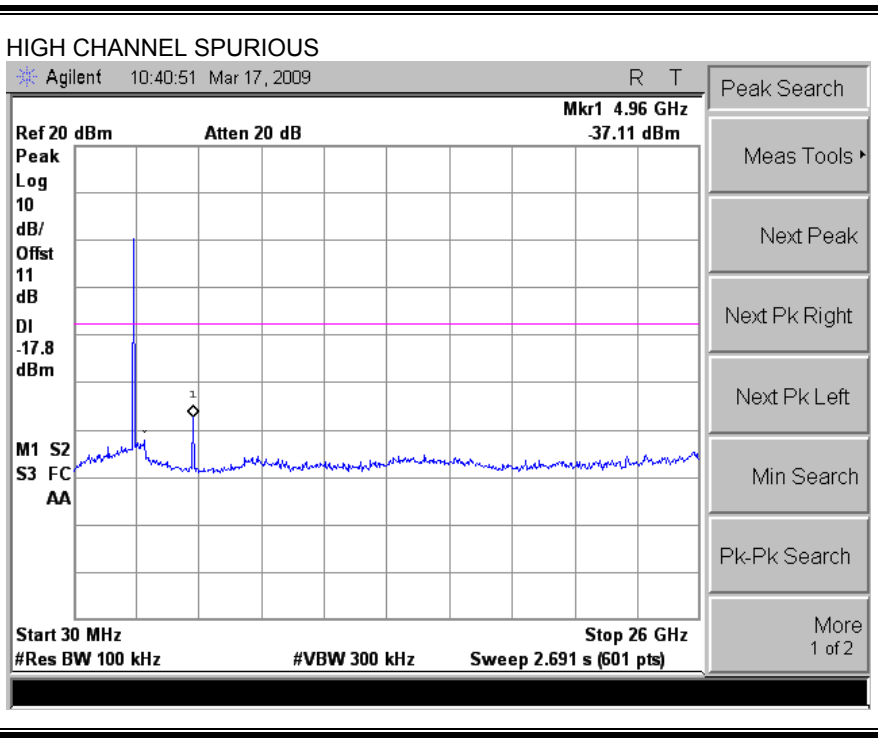


## SPURIOUS EMISSIONS, HIGH CHANNEL – 8PSK MODE

HIGH CHANNEL BANDEDGE

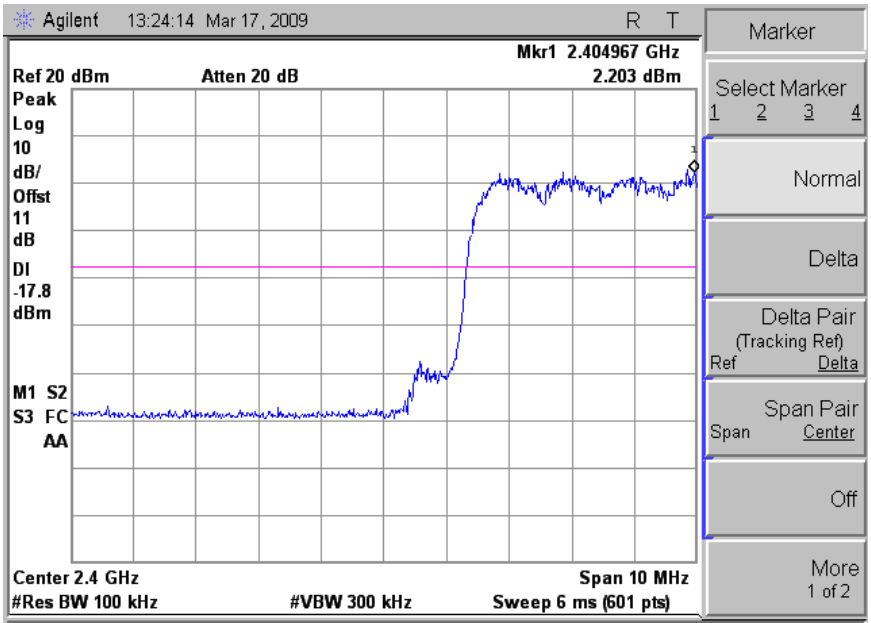



HIGH CHANNEL SPURIOUS

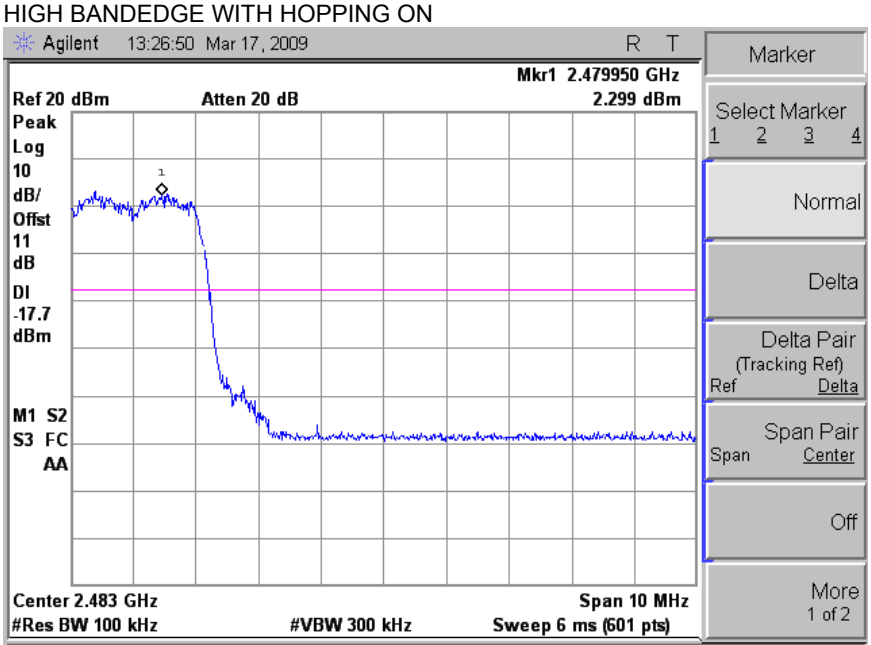


**SPURIOUS BANDEDGE EMISSIONS WITH HOPPING ON – 8PSK MODE**

LOW BANDEDGE WITH HOPPING ON




HIGH BANDEDGE WITH HOPPING ON



# 8. RADIATED TEST RESULTS

**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.

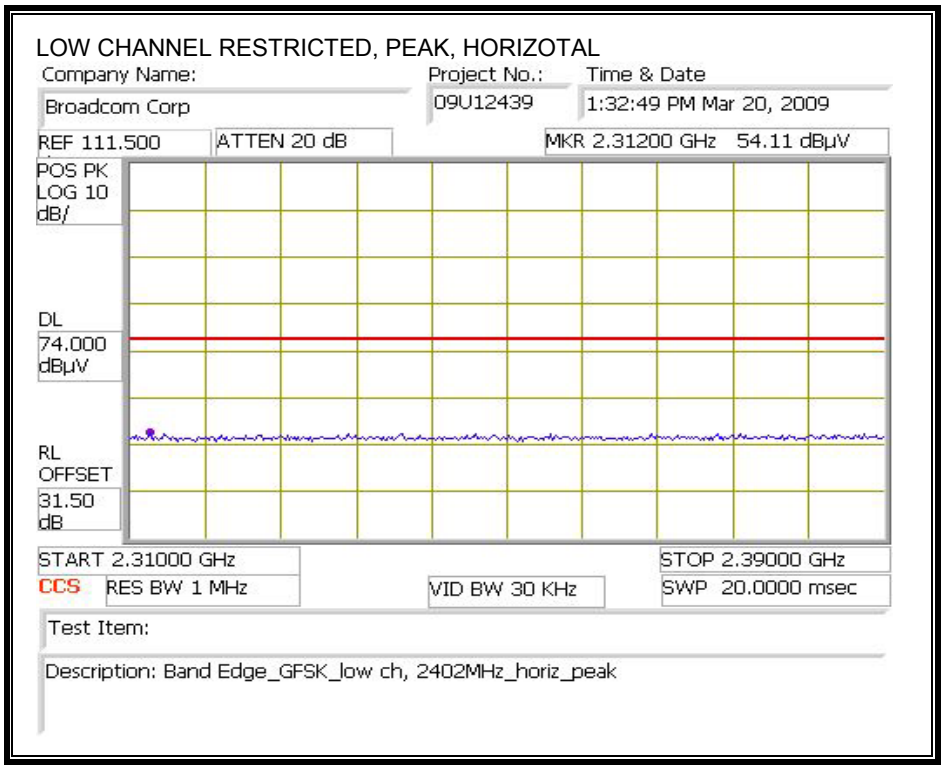
The spectrum from 30 MHz to 26 GHz is investigated with the transmitter set to the lowest, middle, and highest channels in the 2.4 GHz band.

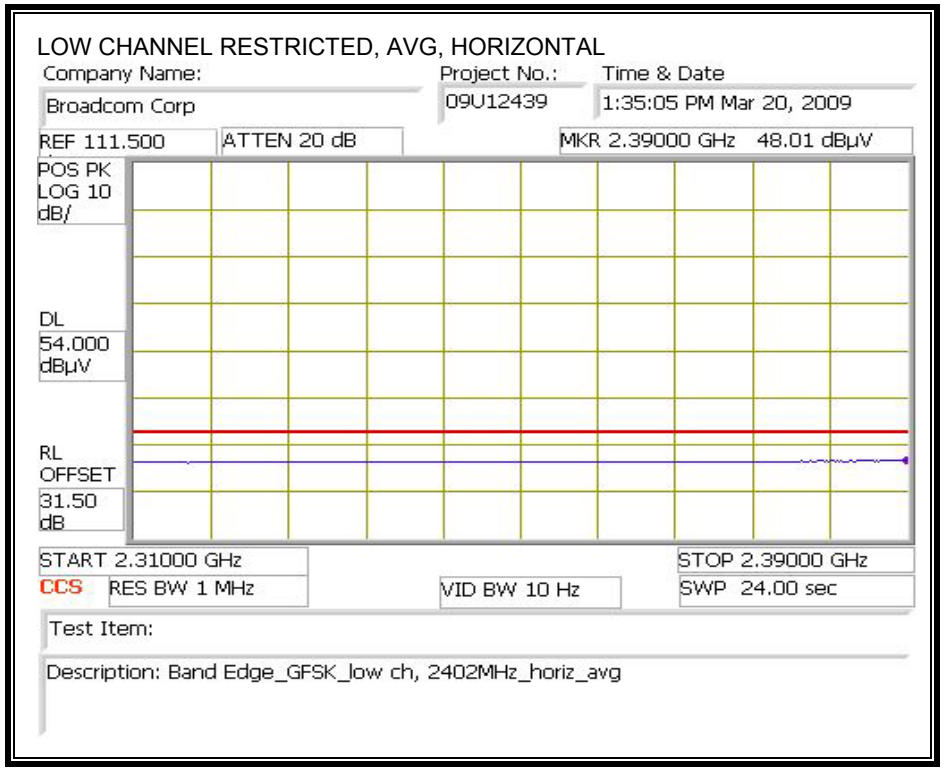
The frequency range of interest is monitored at a fixed antenna height and EUT azimuth. The EUT is rotated through 360 degrees to maximize emissions received. The antenna is scanned from 1 to 4 meters above the ground plane to further maximize the emission. Measurements are made with the antenna polarized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

# 8.1. TRANSMITTER ABOVE 1 GHz

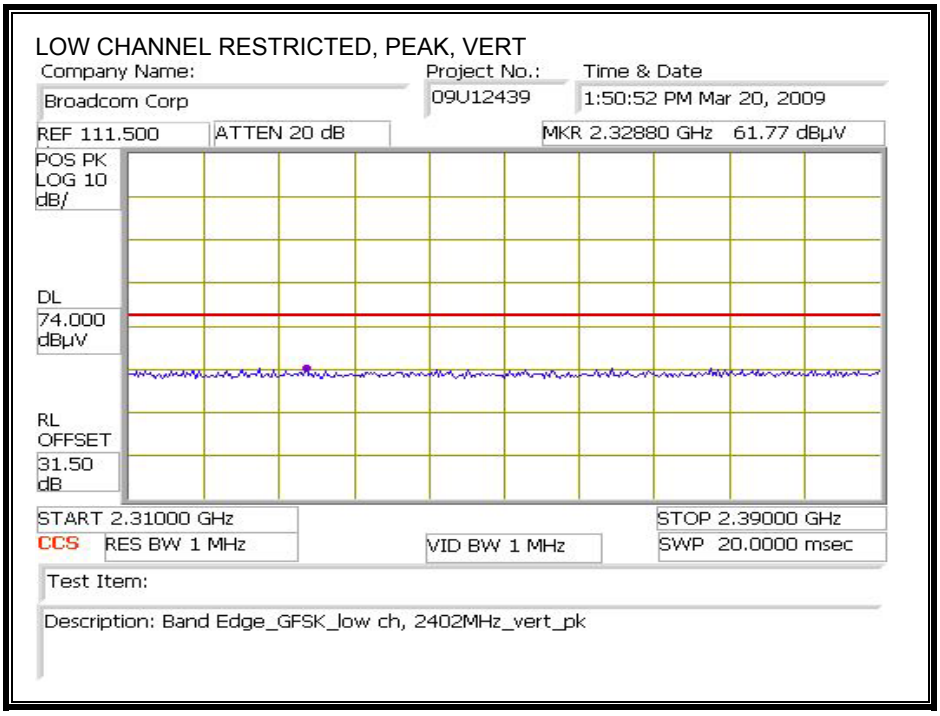
## 8.1.1. GFSK MODE

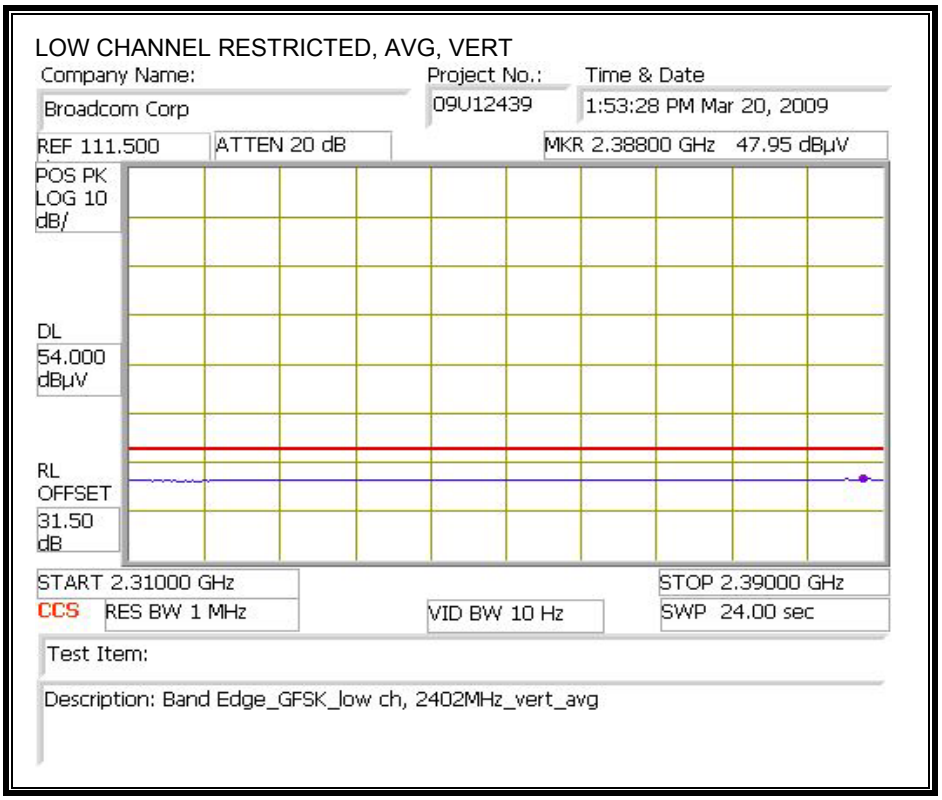
**RESTRICTED BANDEDGE (LOW CHANNEL, HORIZONTAL)**



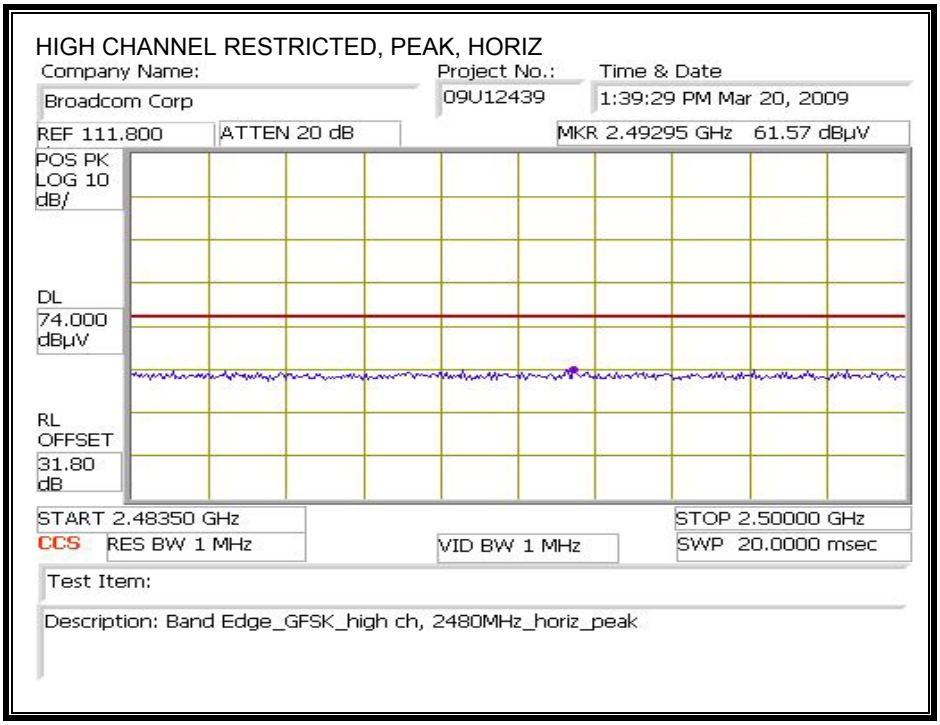



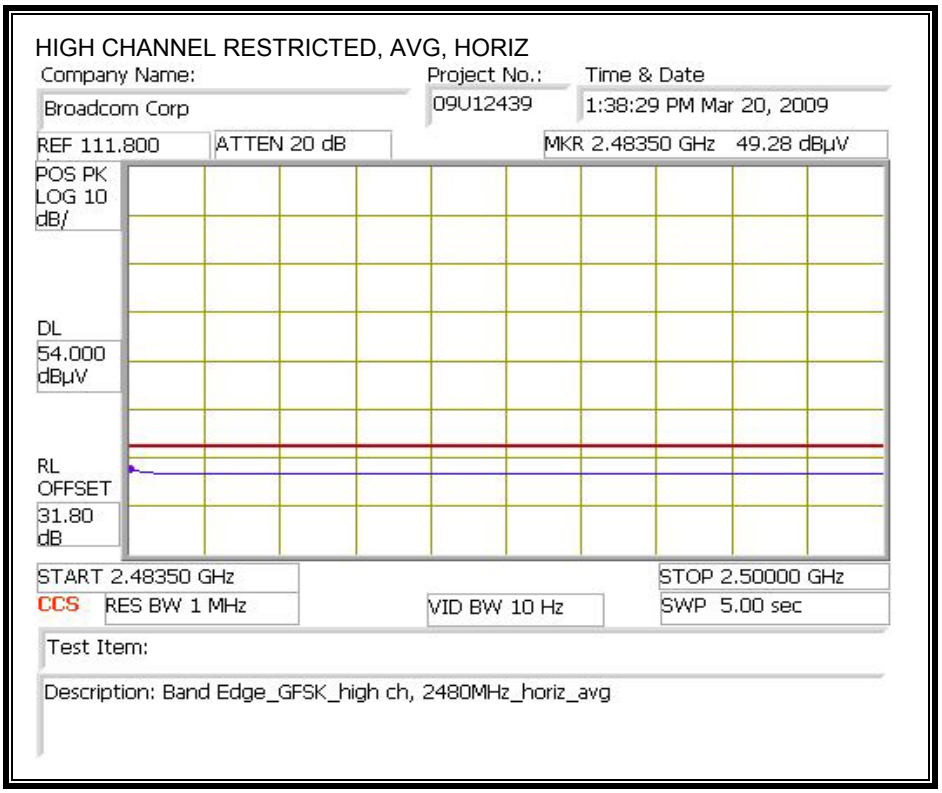
RESTRICTED BANDEDGE (LOW CHANNEL, VERTICAL)



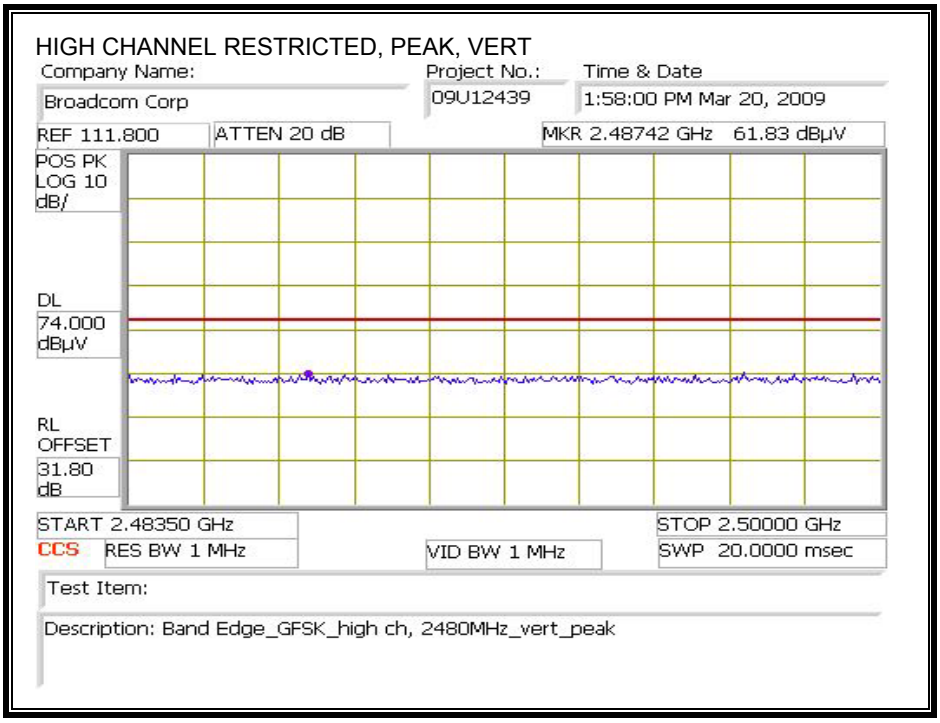



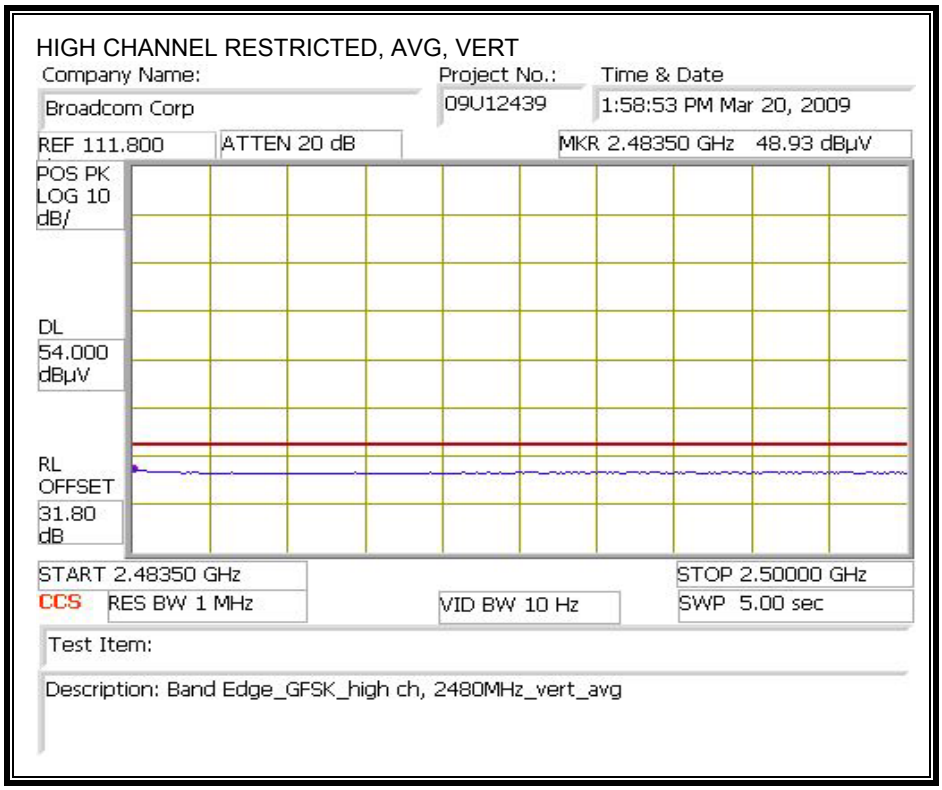
RESTRICTED BANDEDGE (HIGH CHANNEL, HORIZONTAL)



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



## HARMONICS AND SPURIOUS EMISSIONS – GFSK MODE

High Frequency Measurement
Compliance Certification Services, Fremont 5m Chamber

Company: Broadcom
Project #: 09U12439
Date: 3/13/09
Test Engineer: Chin Pang
Configuration: EUT/Antenna
Mode: TX, Bluetooth GFSK

Duty Cycle Correction Factor = 20log ((2.983ms x 3) / 100) = -20.96dB

Test Equipment:

| Horn 1-18GHz | Pre-amplifer 1-26GHz | Pre-amplifer 26-40GHz | Horn > 18GHz | Limit |
|---|---|---|---|---|
| T60; S/N: 2238 @3m | T34 HP 8449B | | | FCC 15.205 |

Hi Frequency Cables

| 3' cable 22807700 | 12' cable 22807600 | 20' cable 22807500 | HPF | Reject Filter |
|---|---|---|---|---|
| 3' cable 22807700 | 12' cable 22807600 | 20' cable 22807500 | | R_001 |

Peak Measurements
RBW=VBW=1MHz
Average Measurements
RBW=1MHz ; VBW=10Hz

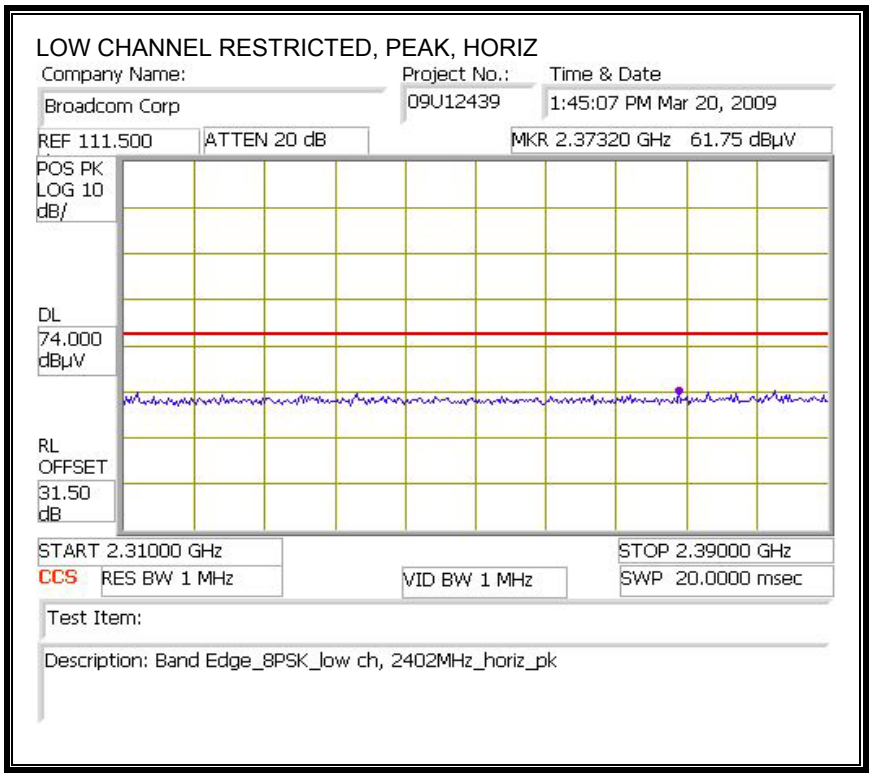
| f GHz | Dist (m) | Read Pk dBuV | Read Avg. dBuV | AF dB/m | CL dB | Amp dB | D Corr dB | Fltr dB | Peak dBuV/m | Avg dBuV/m | Pk Lim dBuV/m | Avg Lim dBuV/m | Pk Mar dB | Avg Mar dB | Notes (V/H) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Low Ch, 2402MHz** | | | | | | | | | | | | | | | |
| 4.804 | 3.0 | 60.3 | 40.3 | 32.7 | 5.8 | -34.8 | 0.0 | 0.0 | 63.9 | 43.9 | 74 | 54 | -10.1 | -10.1 | H |
| 4.804 | 3.0 | 59.9 | 39.9 | 32.7 | 5.8 | -34.8 | 0.0 | 0.0 | 63.5 | 43.5 | 74 | 54 | -10.5 | -10.5 | V |
| | | | | | | | | | | | | | | | |
| **Mid Ch, 2441MHz** | | | | | | | | | | | | | | | |
| 4.882 | 3.0 | 59.7 | 39.7 | 32.7 | 5.8 | -34.8 | 0.0 | 0.0 | 63.4 | 43.4 | 74 | 54 | -10.6 | -10.6 | H |
| 7.323 | 3.0 | 43.1 | 23.1 | 35.5 | 7.3 | -34.1 | 0.0 | 0.0 | 51.8 | 31.8 | 74 | 54 | -22.2 | -22.2 | H |
| 4.882 | 3.0 | 59.0 | 39.0 | 32.7 | 5.8 | -34.8 | 0.0 | 0.0 | 62.7 | 42.7 | 74 | 54 | -11.3 | -11.3 | V |
| 7.323 | 3.0 | 43.5 | 23.5 | 35.5 | 7.3 | -34.1 | 0.0 | 0.0 | 52.2 | 32.2 | 74 | 54 | -21.8 | -21.8 | V |
| | | | | | | | | | | | | | | | |
| **High Ch, 2480MHz** | | | | | | | | | | | | | | | |
| 4.960 | 3.0 | 61.0 | 41.0 | 32.8 | 5.9 | -34.8 | 0.0 | 0.0 | 64.9 | 44.9 | 74 | 54 | -9.1 | -9.1 | H |
| 7.440 | 3.0 | 39.9 | 19.9 | 35.6 | 7.3 | -34.1 | 0.0 | 0.0 | 48.8 | 28.8 | 74 | 54 | -25.2 | -25.2 | H |
| 4.960 | 3.0 | 58.0 | 38.0 | 32.8 | 5.9 | -34.8 | 0.0 | 0.0 | 61.9 | 41.9 | 74 | 54 | -12.1 | -12.1 | V |
| 7.440 | 3.0 | 38.5 | 18.5 | 35.6 | 7.3 | -34.1 | 0.0 | 0.0 | 47.4 | 27.4 | 74 | 54 | -26.6 | -26.6 | V |

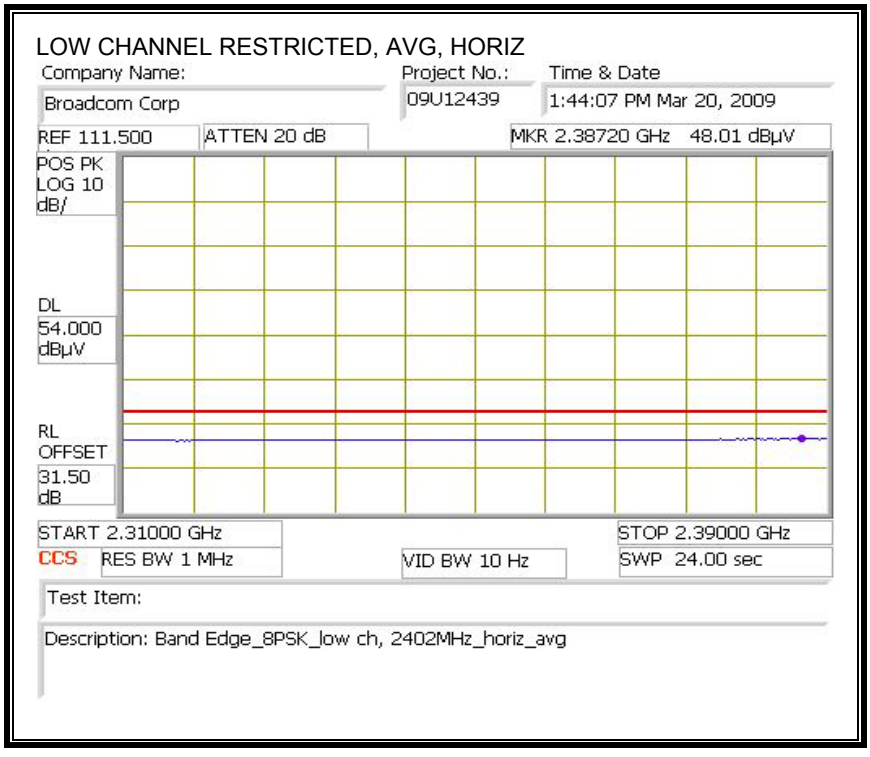
Rev. 11.10.08
**Note: No other emissions were detected above the system noise floor.**

| | | | | | |
|---|---|---|---|---|---|
| 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 | | |

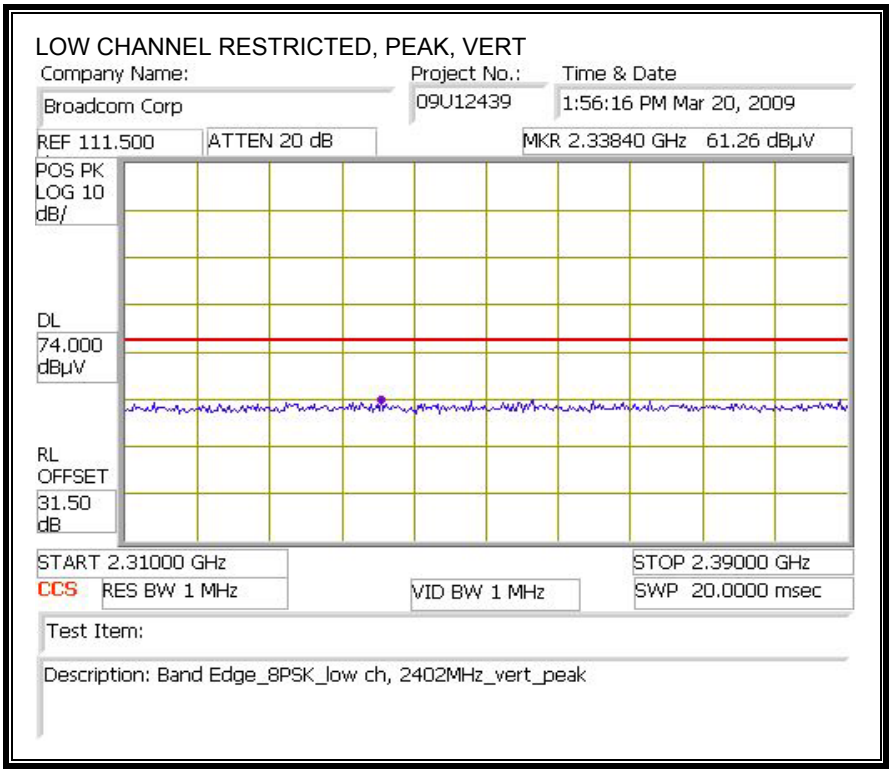
## 8.1.2. 8PSK MODULATION

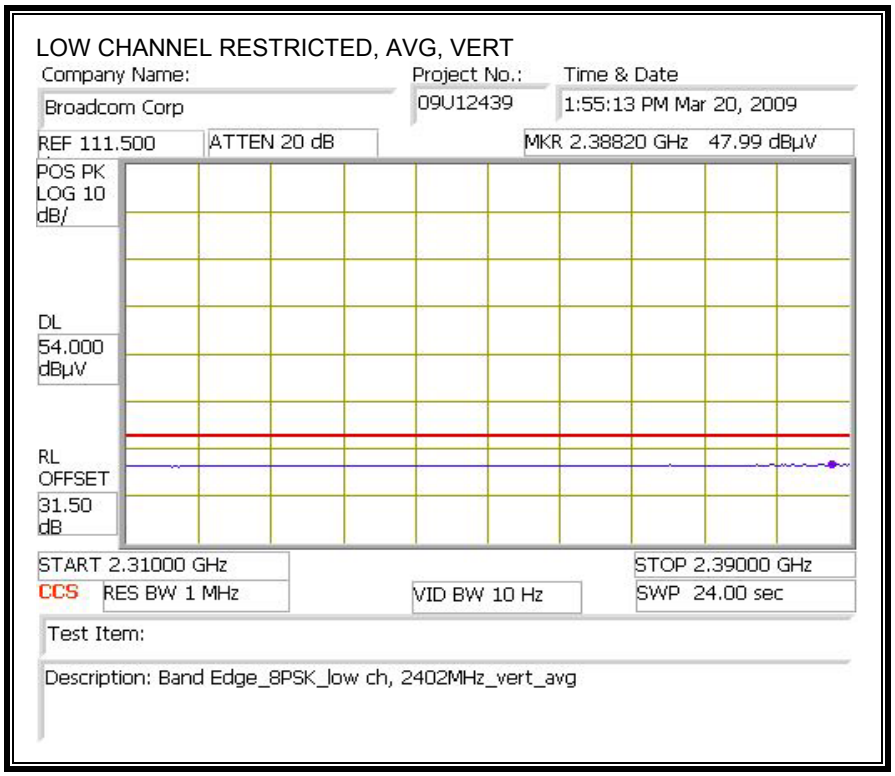
**RESTRICTED BANDEDGE (LOW CHANNEL, HORIZONTAL)**



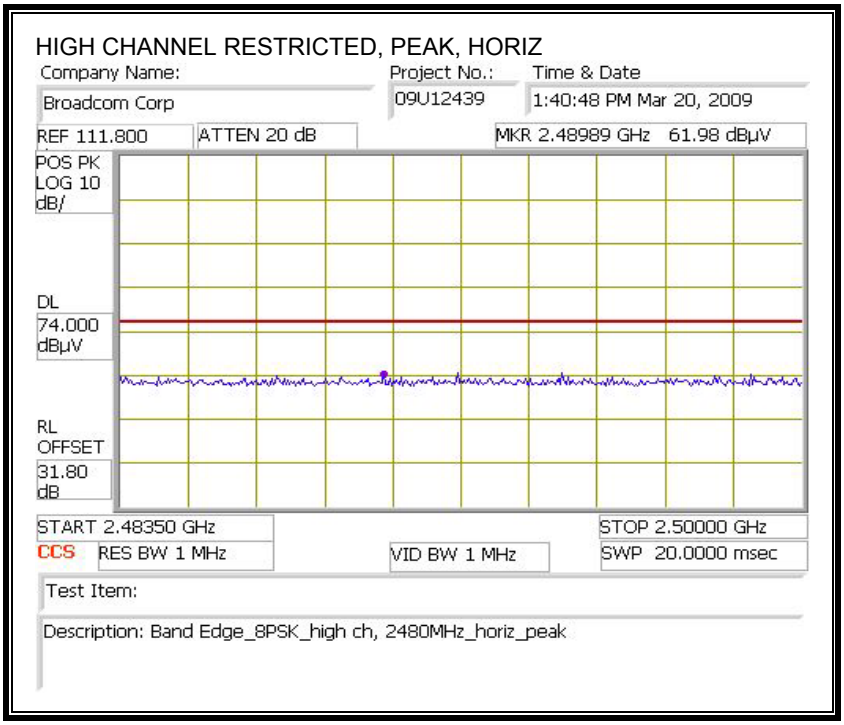



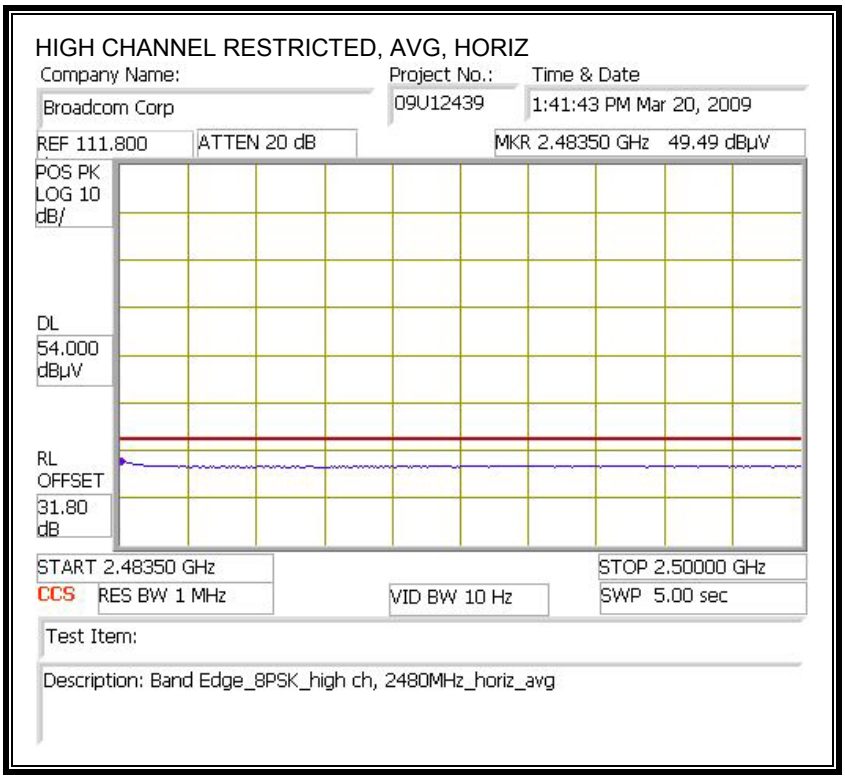
**RESTRICTED BANDEDGE (LOW CHANNEL, VERTICAL)**



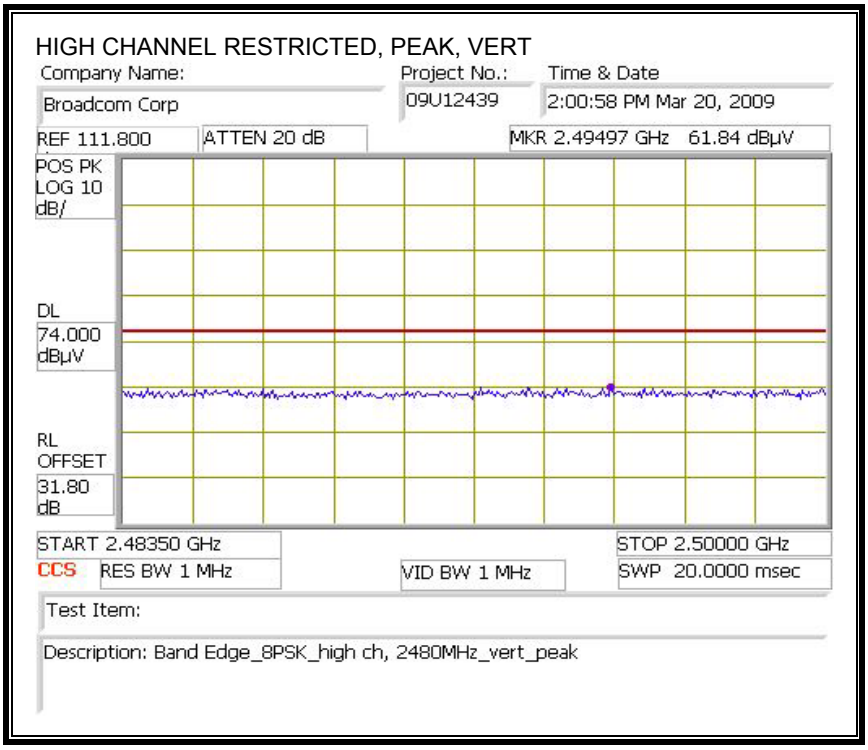



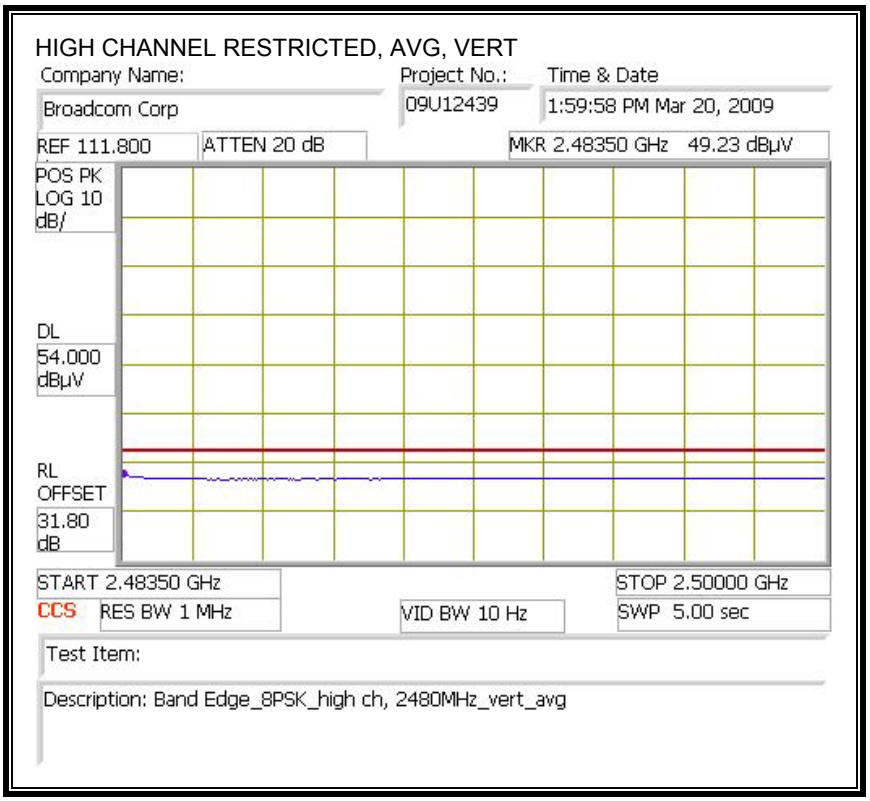
**RESTRICTED BANDEDGE (HIGH CHANNEL, HORIZONTAL)**



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



## HARMONICS AND SPURIOUS EMISSIONS – 8PSK MODE

High Frequency Measurement
Compliance Certification Services, Fremont 5m Chamber

Company: Broadcom
Project #: 09U12439
Date: 3/13/09
Test Engineer: Chin Pang
Configuration: EUT/Antenna
Mode: TX, Bluetooth 8PSK

Duty Cycle Correction Factor = 20log ((2.967ms x 3) / 100) = -21.01dB

Test Equipment:

| Horn 1-18GHz | Pre-amplifer 1-26GHz | Pre-amplifer 26-40GHz | Horn > 18GHz | Limit |
|---|---|---|---|---|
| T60; S/N: 2238 @3m | T34 HP 8449B | | | FCC 15.205 |

Hi Frequency Cables

| 3' cable 22807700 | 12' cable 22807600 | 20' cable 22807500 | HPF | Reject Filter |
|---|---|---|---|---|
| 3' cable 22807700 | 12' cable 22807600 | 20' cable 22807500 | | R_001 |

Peak Measurements
RBW=VBW=1MHz
Average Measurements
RBW=1MHz ; VBW=10Hz

| 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) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Low Ch, 2402MHz** | | | | | | | | | | | | | | | |
| 4.804 | 3.0 | 61.8 | 41.8 | 32.7 | 5.8 | -34.8 | 0.0 | 0.0 | 65.4 | 45.4 | 74 | 54 | -8.6 | -8.6 | H |
| 4.804 | 3.0 | 61.5 | 41.5 | 32.7 | 5.8 | -34.8 | 0.0 | 0.0 | 65.1 | 45.1 | 74 | 54 | -8.9 | -8.9 | V |
| | | | | | | | | | | | | | | | |
| **Mid Ch, 2441MHz** | | | | | | | | | | | | | | | |
| 4.882 | 3.0 | 60.0 | 40.0 | 32.7 | 5.8 | -34.8 | 0.0 | 0.0 | 63.7 | 43.7 | 74 | 54 | -10.3 | -10.3 | H |
| 7.323 | 3.0 | 44.0 | 24.0 | 35.5 | 7.3 | -34.1 | 0.0 | 0.0 | 52.7 | 32.7 | 74 | 54 | -21.3 | -21.3 | H |
| 4.882 | 3.0 | 58.2 | 38.2 | 32.7 | 5.8 | -34.8 | 0.0 | 0.0 | 61.9 | 41.9 | 74 | 54 | -12.1 | -12.1 | V |
| 7.323 | 3.0 | 41.5 | 21.5 | 35.5 | 7.3 | -34.1 | 0.0 | 0.0 | 50.2 | 30.2 | 74 | 54 | -23.8 | -23.8 | V |
| | | | | | | | | | | | | | | | |
| **High Ch, 2480MHz** | | | | | | | | | | | | | | | |
| 4.960 | 3.0 | 62.9 | 42.9 | 32.8 | 5.9 | -34.8 | 0.0 | 0.0 | 66.8 | 46.8 | 74 | 54 | -7.2 | -7.2 | H |
| 7.440 | 3.0 | 42.0 | 22.0 | 35.6 | 7.3 | -34.1 | 0.0 | 0.0 | 50.9 | 30.9 | 74 | 54 | -23.1 | -23.1 | H |
| 4.960 | 3.0 | 59.9 | 39.9 | 32.8 | 5.9 | -34.8 | 0.0 | 0.0 | 63.8 | 43.8 | 74 | 54 | -10.2 | -10.2 | V |
| 7.440 | 3.0 | 42.0 | 22.0 | 35.6 | 7.3 | -34.1 | 0.0 | 0.0 | 50.9 | 30.9 | 74 | 54 | -23.1 | -23.1 | V |

Rev. 11.10.08
**Note: No other emissions were detected above the system noise floor.**

| | | | | | |
|---|---|---|---|---|---|
| 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. RECEIVER ABOVE 1 GHz

High Frequency Measurement
Compliance Certification Services, Fremont 5m Chamber

Company: Broadcom
Project #: 09U12439
Date: 3/13/09
Test Engineer: Chin Pang
Configuration: EUT/Antenna
Mode: RX, Bluetooth ( Worse Case )

Test Equipment:

| Horn 1-18GHz | Pre-amplifer 1-26GHz | Pre-amplifer 26-40GHz | Horn > 18GHz | Limit |
|---|---|---|---|---|
| T60; S/N: 2238 @3m | T34 HP 8449B | | | FCC 15.209 |

Hi Frequency Cables

| 3' cable 22807700 | 12' cable 22807600 | 20' cable 22807500 | HPF | Reject Filter |
|---|---|---|---|---|
| 3' cable 22807700 | 12' cable 22807600 | 20' cable 22807500 | | |

Peak Measurements
RBW=VBW=1MHz
Average Measurements
RBW=1MHz ; VBW=10Hz

| 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) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Mid Ch, 2441MHz | | | | | | | | | | | | | | | |
| 1.000 | 3.0 | 61.4 | 45.0 | 24.5 | 2.4 | -38.3 | 0.0 | 0.0 | 50.0 | 33.6 | 74 | 54 | -24.0 | -20.4 | H |
| 1.600 | 3.0 | 57.6 | 35.0 | 26.5 | 3.0 | -37.4 | 0.0 | 0.0 | 49.7 | 27.1 | 74 | 54 | -24.3 | -26.9 | H |
| 2.490 | 3.0 | 52.0 | 32.0 | 28.3 | 3.9 | -36.3 | 0.0 | 0.0 | 47.9 | 27.9 | 74 | 54 | -26.1 | -26.1 | H |
| 1.000 | 3.0 | 61.0 | 42.6 | 24.5 | 2.4 | -38.3 | 0.0 | 0.0 | 49.6 | 31.2 | 74 | 54 | -24.4 | -22.8 | V |
| 1.600 | 3.0 | 56.0 | 35.3 | 26.5 | 3.0 | -37.4 | 0.0 | 0.0 | 48.1 | 27.4 | 74 | 54 | -25.9 | -26.6 | V |
| 2.490 | 3.0 | 50.6 | 32.0 | 28.3 | 3.9 | -36.3 | 0.0 | 0.0 | 46.5 | 27.9 | 74 | 54 | -27.5 | -26.1 | V |

Rev. 11.10.08
**Note: No other emissions were detected above the system noise floor.**

| | | | | | |
|---|---|---|---|---|---|
| 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. WORST-CASE BELOW 1 GHz

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

**30-1000MHz Frequency Measurement**
**Compliance Certification Services, Fremont 5m Chamber**

**Test Engr: Chin Pang**
**Date: 3/13/2009**
**Project #: 09U12439**
**Company: Broadcom**
**EUT Description: 802.11g wireless Lan+Bluetooth PCI-E half mini card**
**EUT M/N: BCM94312HMGB**
**Test Target: FCC Class B**
**Mode Oper:TX, BT**

| | | | |
|---|---|---|---|
| f | Measurement Frequency | Amp | Preamp Gain |
| Dist | Distance to Antenna | D Corr | Distance Correct to 3 meters |
| Read | Analyzer Reading | Filter | Filter Insert Loss |
| AF | Antenna Factor | Corr. | Calculated Field Strength |
| CL | Cable Loss | Limit | Field Strength Limit |

Margin Margin vs. Limit

| f MHz | Dist (m) | Read dBuV | AF dB/m | CL dB | Amp dB | D Corr dB | Filter dB | Corr. dBuV/m | Limit dBuV/m | Margin dB | Ant. Pol. V/H | Det. P/A/QP | Notes |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HORIZONTAL | | | | | | | | | | | | | |
| 202.927 | 3.0 | 44.6 | 11.9 | 1.2 | 27.4 | 0.0 | 0.0 | 30.3 | 43.5 | -13.2 | H | P | |
| 240.009 | 3.0 | 45.8 | 11.8 | 1.3 | 27.4 | 0.0 | 0.0 | 31.5 | 46.0 | -14.5 | H | P | |
| 624.024 | 3.0 | 39.7 | 18.6 | 2.2 | 28.6 | 0.0 | 0.0 | 32.0 | 46.0 | -14.0 | H | P | |
| 744.149 | 3.0 | 41.3 | 19.8 | 2.5 | 28.4 | 0.0 | 0.0 | 35.2 | 46.0 | -10.8 | H | P | |
| 816.032 | 3.0 | 45.2 | 21.1 | 2.6 | 28.1 | 0.0 | 0.0 | 40.7 | 46.0 | -5.3 | H | P | |
| VERTICAL | | | | | | | | | | | | | |
| 35.160 | 3.0 | 39.8 | 17.4 | 0.5 | 28.4 | 0.0 | 0.0 | 29.3 | 40.0 | -10.7 | V | P | |
| 143.885 | 3.0 | 42.9 | 12.9 | 1.0 | 27.9 | 0.0 | 0.0 | 29.0 | 43.5 | -14.5 | V | P | |
| 212.528 | 3.0 | 43.6 | 11.9 | 1.2 | 27.4 | 0.0 | 0.0 | 29.3 | 43.5 | -14.2 | V | P | |
| 676.467 | 3.0 | 40.9 | 18.8 | 2.4 | 28.5 | 0.0 | 0.0 | 33.5 | 46.0 | -12.5 | V | P | |
| 815.912 | 3.0 | 43.3 | 21.1 | 2.6 | 28.1 | 0.0 | 0.0 | 38.8 | 46.0 | -7.2 | V | P | |

**Rev. 1.27.09**

# 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**

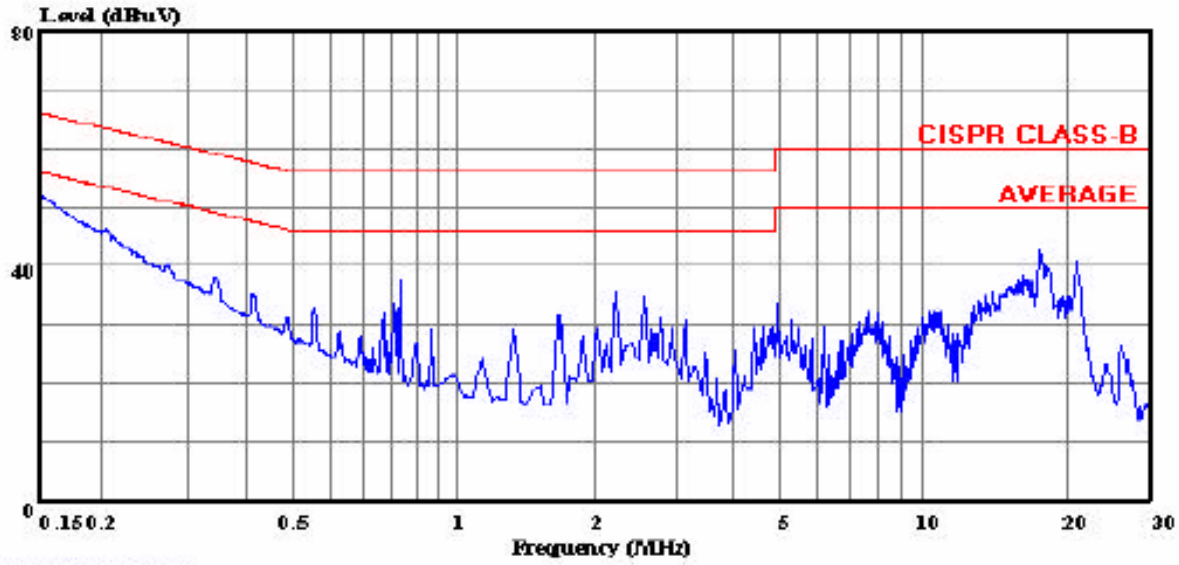
CONDUCTED EMISSIONS DATA (115VAC 60Hz)

| Freq. | Reading | | | Closs | Limit | FCC_B | Margin | | Remark |
|---|---|---|---|---|---|---|---|---|---|
| (MHz) | PK (dBuV) | QP (dBuV) | AV (dBuV) | (dB) | QP | AV | QP (dB) | AV (dB) | L1 / L2 |
| 0.15 | 52.10 | -- | -- | 0.00 | 66.00 | 56.00 | -13.90 | -3.90 | L1 |
| 0.83 | 37.65 | -- | -- | 0.00 | 56.00 | 46.00 | -18.35 | -8.35 | L1 |
| 17.57 | 42.52 | -- | -- | 0.00 | 60.00 | 50.00 | -17.48 | -7.48 | L1 |
| 0.15 | 49.54 | -- | -- | 0.00 | 66.00 | 56.00 | -16.46 | -6.46 | L2 |
| 0.56 | 40.18 | -- | -- | 0.00 | 56.00 | 46.00 | -15.82 | -5.82 | L2 |
| 20.92 | 39.75 | -- | -- | 0.00 | 60.00 | 50.00 | -20.25 | -10.25 | 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#: 08U11678 LC.EMI Date: 03-31-2008 Time: 08:48:59




(Line Conduction)

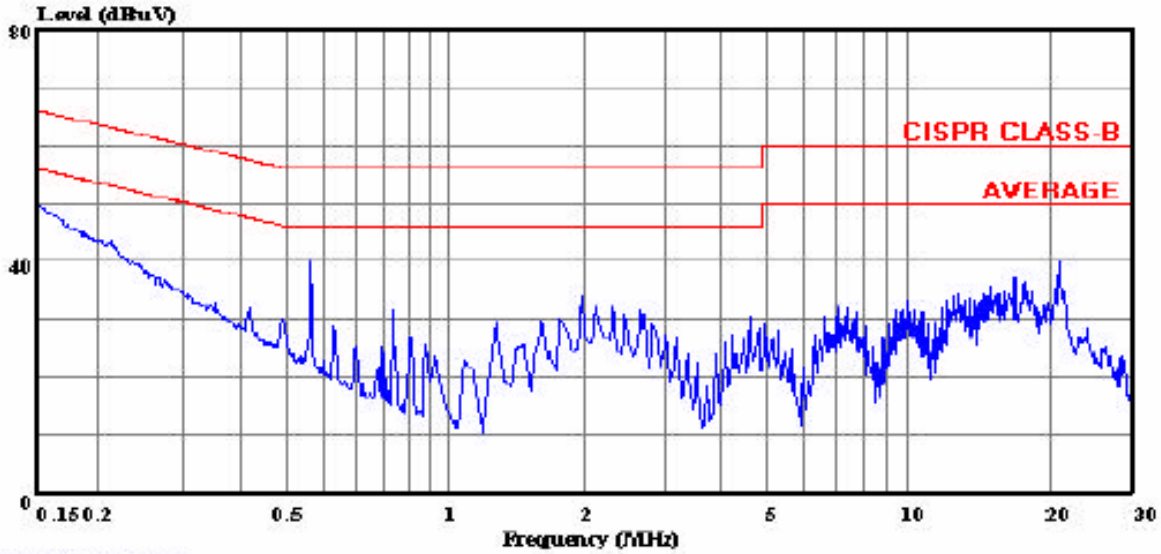
Trace: Ref Trace:

Condition: CISPR CLASS-B
Test Operator:: Vien Tran
Project #: : 08U11678
Company: : Broadcom
Configuration:: EUT & Support Equiptments
Mode: : Normal
Target: : FCC Class B
Voltage: : 115VAC / 60Hz
: Line 1: Peak (Blue)

**LINE 2 RESULTS**

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

Data#: 23 File#: 08U11678 LC.EMI Date: 03-31-2008 Time: 09:23:26




(Line Conduction)

Trace: Ref Trace:

Condition: CISPR CLASS-B
Test Operator:: Vien Tran
Project #: : 08U11678
Company: : Broadcom
Configuration:: EUT & Support Equiptments
Mode: : Normal
Target: : FCC Class B
Voltage: : 115VAC / 60Hz
: Line 2: Peak (Blue)

# 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 | $280/f$ | $2.19/f$ | | 6 |
| 10–30 | 28 | $2.19/f$ | | 6 |
| 30–300 | 28 | 0.073 | 2* | 6 |
| 300–1 500 | $1.585f^{0.5}$ | $0.0042f^{0.5}$ | $f/150$ | 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 | $0.158f^{0.5}$ | $4.21 \times 10^{-4}f^{0.5}$ | $6.67 \times 10^{-5}f$ | $616\,000/f^{1.2}$ |

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

**Notes:** 1. Frequency, $f$, is in MHz.
2. A power density of 10 $W/m^2$ is equivalent to 1 $mW/cm^2$.
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^2

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^2 is converted to units of W/m^2 by multiplying by a factor of 10.

**LIMITS**

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

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

**RESULTS**

(MPE distance equals 20 cm)

| Mode | Band | MPE Distance (cm) | Output Power (dBm) | Antenna Gain (dBi) | FCC Power Density (mW/cm^2) | IC Power Density (W/m^2) |
|---|---|---|---|---|---|---|
| GFSK | 2.4 GHz | 20.0 | 4.34 | -1.71 | 0.0004 | 0.00 |
| 8PSK | 2.4 GHz | 20.0 | 7.02 | -1.71 | 0.0007 | 0.01 |